Review of Water Quality and Impact to Wetlands of Proposed Development in Spruce Creek, Florida

Report on Phase 1 of Scope of Work

June 2020

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BACKGROUND

SaveSpruceCreek (SSC), in consultation with Sweetwater Coalition of Volusia County and Public Trust Environmental Legal Institute of Florida Inc., is undertaking a comprehensive environmental study of areas of concern in Volusia County, primarily Spruce Creek and Tomoka River, both important Florida waterways. SSC has retained Coastal Risk Consulting to assist this study with an initial focus on a region of Spruce Creek near Port Orange and New Smyrna, where a potential highway interchange and other projects are being proposed.

- Spruce Creek forms in wetlands west of New Smyrna Beach and flows north, then turns east and discharges to the Intracoastal Waterway (ICWW).
- Spruce Creek is approximately 20.1 miles long and is a second-order stream that is tidally influenced in its lower reaches
- Spruce Creek consists of two Waterbody Identification Unit segments, WBIDs 2674 and 2674A, as shown in Figure 1. The combined drainage area of WBIDs 2674 (17.67 square miles) and 2674A (13.10 square miles) is 30.77 square miles.

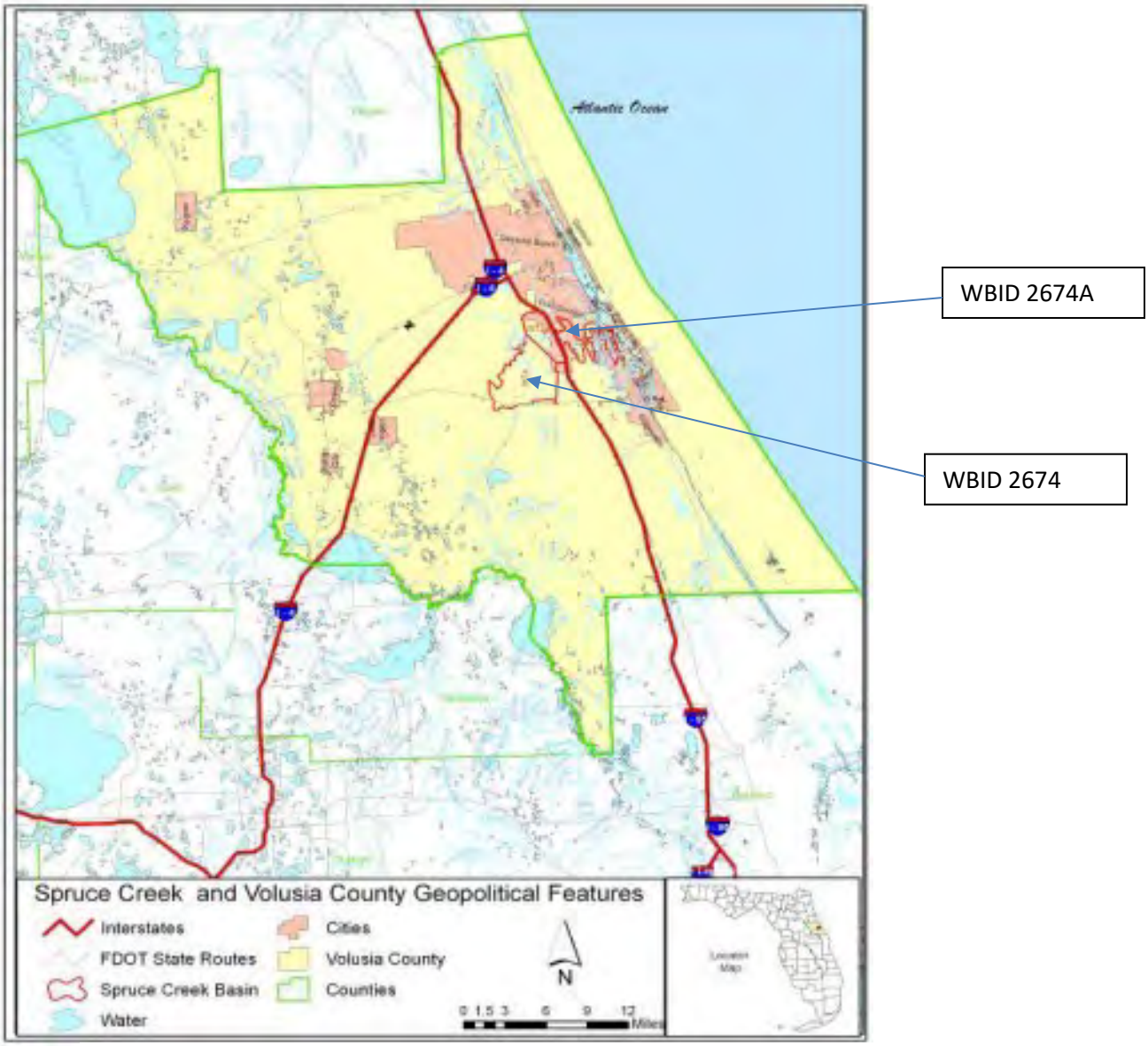


Figure 1: Location of Spruce Creek in Volusia County, Florida

Source: Final TMDL Report, 2008

- Spruce Creek is a Class III fresh waterbody per the Environmental Protection Agency (EPA) and Florida Department of Environmental Protection (DEP) classification guidelines.
- Designated uses for this class are recreation, propagation, and the maintenance of a healthy, well-balanced population of fish andwildlife

SCOPE OF WORK

The Scope of Work for a preliminary assessment of the impact of the proposed development, per Phase 1 of the signed proposal dated 01.15.2020, is as follows:

A) Review existing water quality data collected by the County, including salinity, nitrates, and other components. Provide a summary of the findings and an analysis of how increased high-density development in the watershed is likely to impact these parameters.

B) Review the TMDL (Total Maximum Daily Load) study done in 2008 and provide a discussion of whether and how development in the last ten years and development in the watershed may further impair Spruce Creek.

C) Analyze the current extent of wetlands in the area and how it will be infringed upon by the following proposed developments:

- Doris Leeper Spruce Creek Preserve land corridor purchase
- 1-95 Interchange at Pioneer Trail in New Smyrna and residential/commercial projects adjacent to the Interchange;
- commercial/residential projects in the Farmton mitigation bank; and
- the extension of South Williamson Blvd. from Port Orange to Farmton;

D) Areas for Further Analysis: Determine, jointly with SSC, a plan for Phase 2 - further detailed analysis of the impact on affected wetlands and the related economic Impact of construction.

FINDINGS AND RESULTS OF PRELIMINARY ASSESSMENT

(Key Findings are highlighted. Please see end of this report for Summary of Findings and Areas for Further Analysis)

A. Review of existing water quality data and impairment levels

We reviewed data in available TMDL reports, the TMDL report on the 2008 study and other documents provided by SSC. ***We observed there was limited information available up to 2014 and, no evidence of any water quality studies in Spruce Creek after 2014. Some readings for dissolved oxygen content and nutrients are available up to 2016.*** In addition, we also reviewed information on water quality on the websites of St. Johns River Water Management District and DEP. We focused on data derived from 5 basin stations relating to impairment of water quality from (1) Fecal Coliform, (2) Dissolved oxygen, and (3) nutrients (phosphorus and nitrogen). The locations of these 5 stations are given in Table 1.

Table 1: Locations of water sampling basin stations in Spruce Creek

Station ID	Station Name	Latitude	Longitude
SC01	VC-071 Spruce Creek, from W. side of center bridge on U.S. 1	29.5.11.	80.58.10.
SC02	VC-072 Spruce Cr, from dock at Riverwood, W. of SCL Railroad	29.4.48.	80.59.9.
SC04	VC-073 Spruce Cr from W. side of Moody Bridge on Airport Rd.	29.5.26.	81.1.37.
SC05	VC-074 Spruce Creek, from dock at Gamble Place	29.5.22.	81.2.40.
SC06	Spruce Creek from park dock - just S of Gamble property	29.5.16	81.2.34.

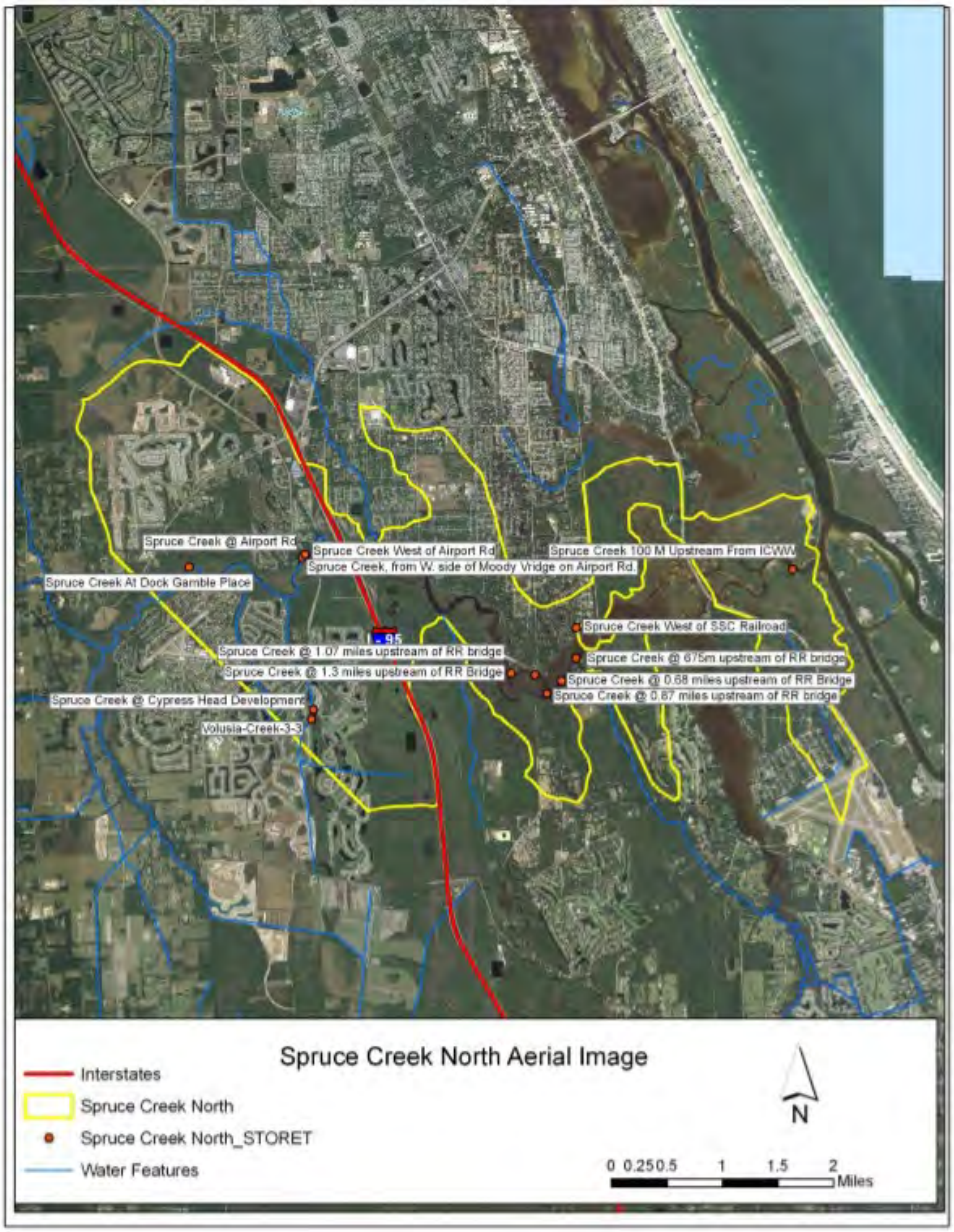


Figure 2: Historical sampling sites in Spruce Creek

1. Fecal Coliform

The Class III criteria for water quality impairment states that monthly averages shall be expressed as a geometric mean based on a minimum of 10 samples taken over a 30-day period. Fecal Coliform count in excess of 400 colonies (CFU) per 100 milliliters (ml) indicates impairment. ***Our review indicated that there was insufficient data (fewer than 10 samples in any given month) available to evaluate the geometric mean criterion for fecal coliform bacteria.***

Recent data (up to 2014) indicate that fecal coliform counts have been under the maximum value of 400 CFU/100 ml, indicating that the water samples met Class III criteria at that time. Given the long-term record of readings intermittently above 400 CFU/100 ml (see graphs below) and the continually increasing presence of non- point sources, **more recent data needs to be acquired to determine the degree of impairment**.

Data on fecal coliform from the different basin stations in Spruce Creek from 1999 to 2014 was analyzed in the form of graphs for each station as shown below. The red line denotes the standard of 400 CFU per 100 ml.

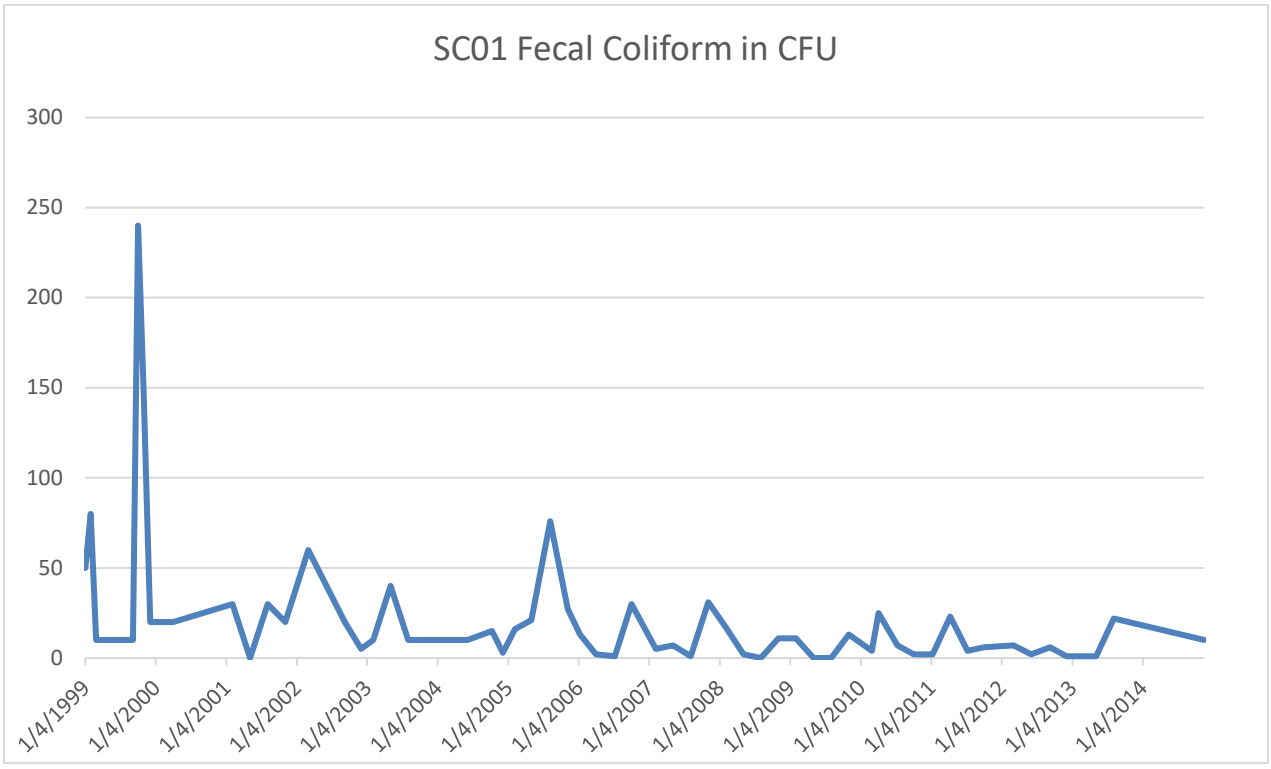


Figure 3: SC01 Fecal Coliform

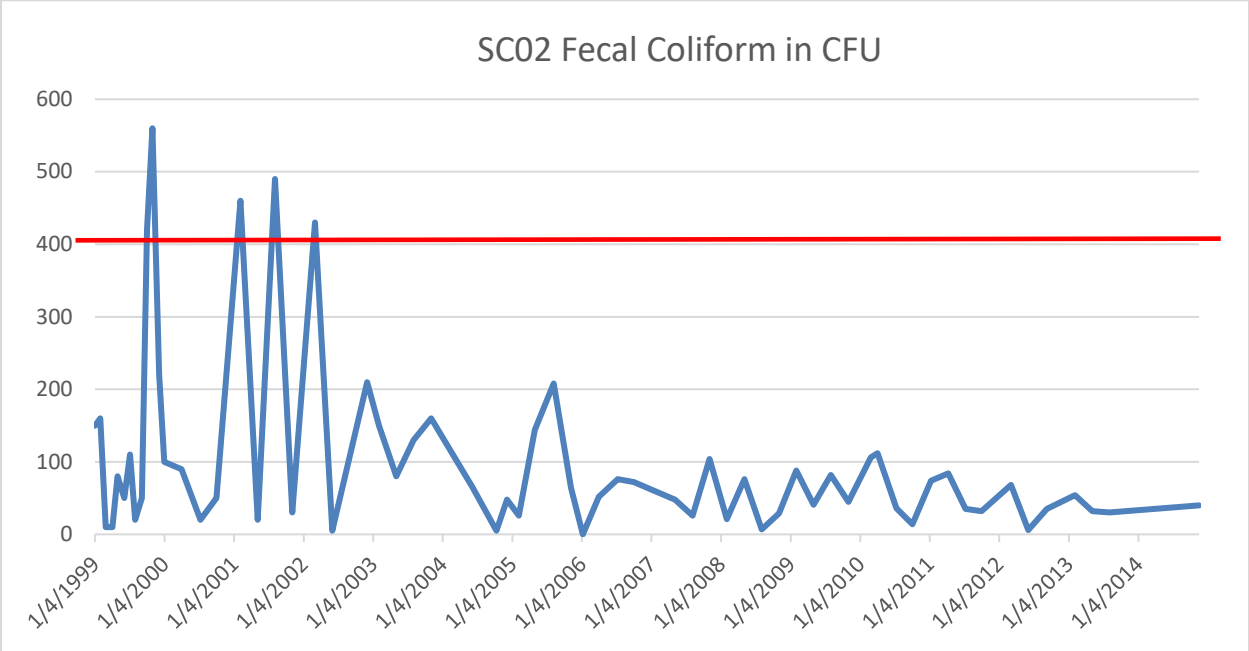


Figure 4: SC02 Fecal Coliform

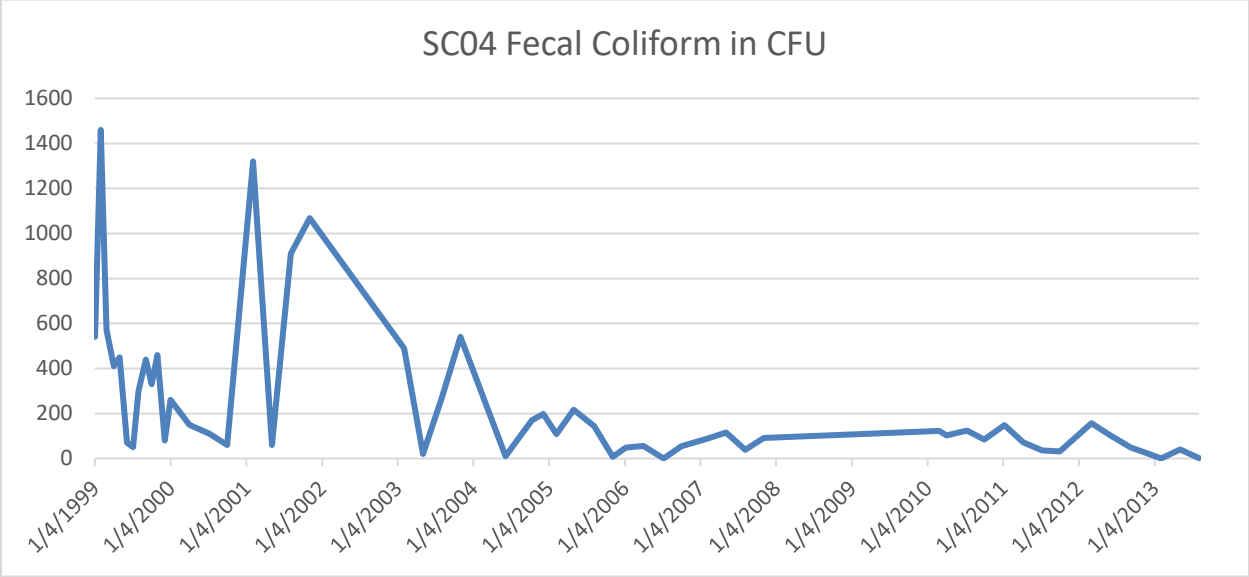


Figure 5: SC04 Fecal Coliform

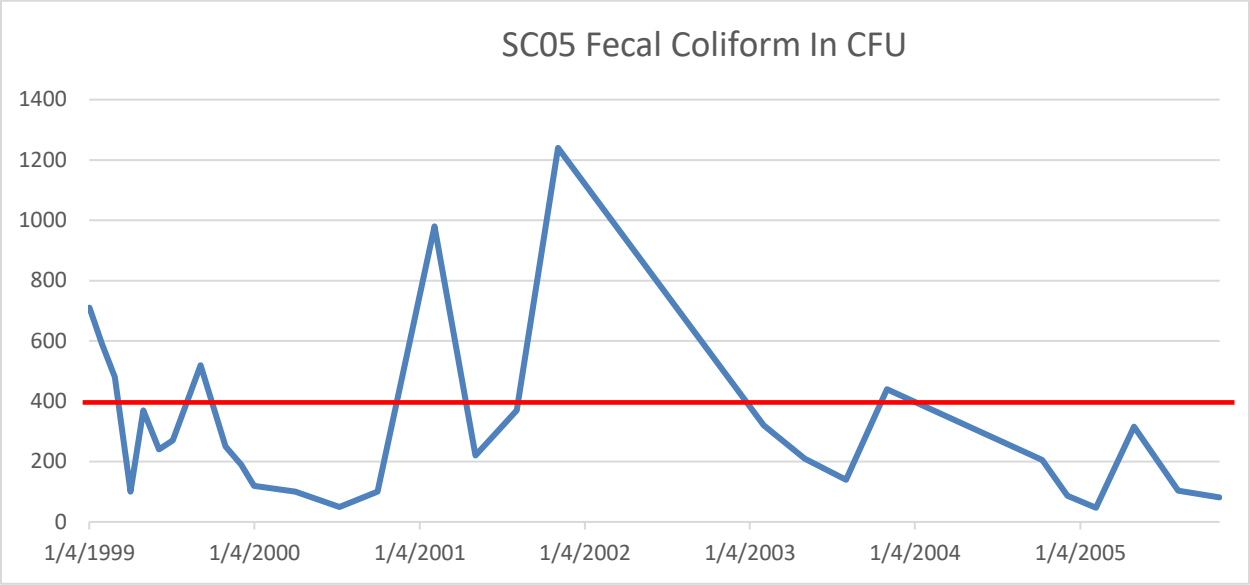


Figure 6: SC05 Fecal Coliform

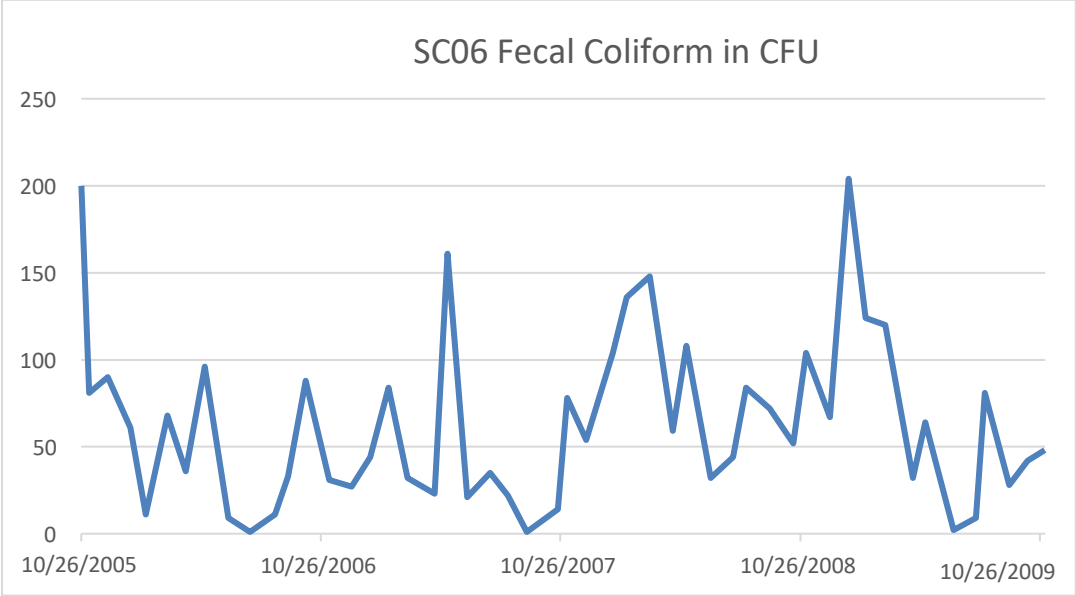


Figure 7: SC06 Fecal Coliform

2. Dissolved Oxygen

According to EPA's Class III guidelines for Florida waters, the 7-day average Dissolved Oxygen (DO) saturation should be not less than **51% or about 4 milligrams per liter (mg/l)** in 85°F temperature. However, related data is only available for one or two days a month. ***It was, therefore, not possible to get an average 7-day value. Only three stations have recorded samples after 2008.*** DO values in stations SC02 and SC04 are available until 2016 and appear to be above the minimum of 4 mg/l. DO values for SC05 have been below 0.5 mg/l in observations recorded from 1999 to 2006 and DO values for SC06 between 2005-2010 have generally been under 4 mg/l.

Data on dissolved oxygen and nutrients from the different basin stations in Spruce Creek from 1999 to 2014 was analyzed in the form of graphs for each station as shown below. The red line denotes the standard of 400 CFU per 100 ml.

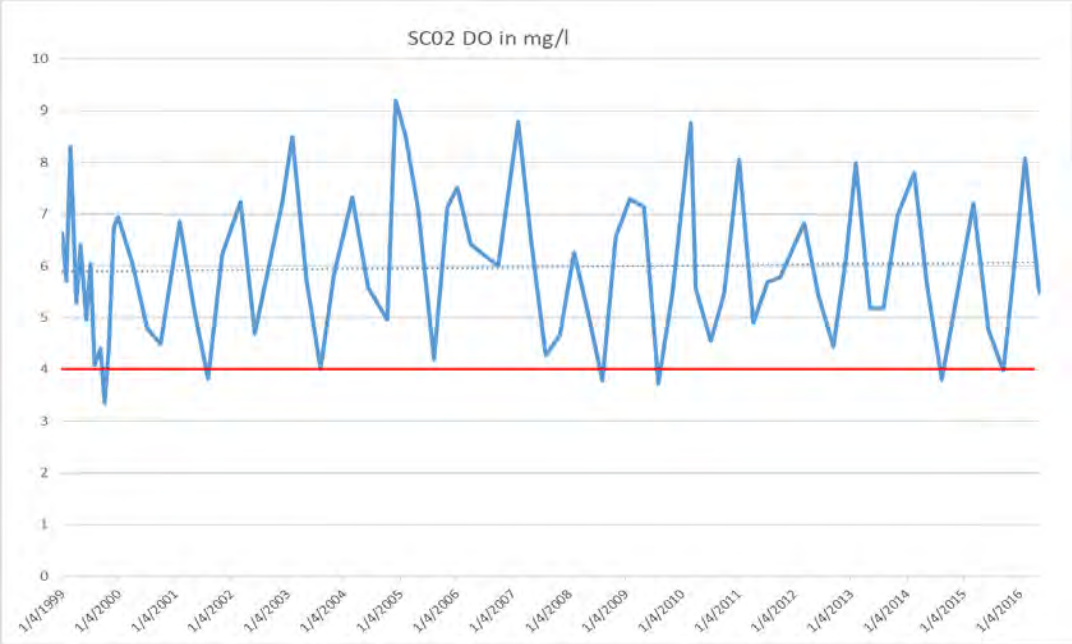


Figure 8: SC02 DO

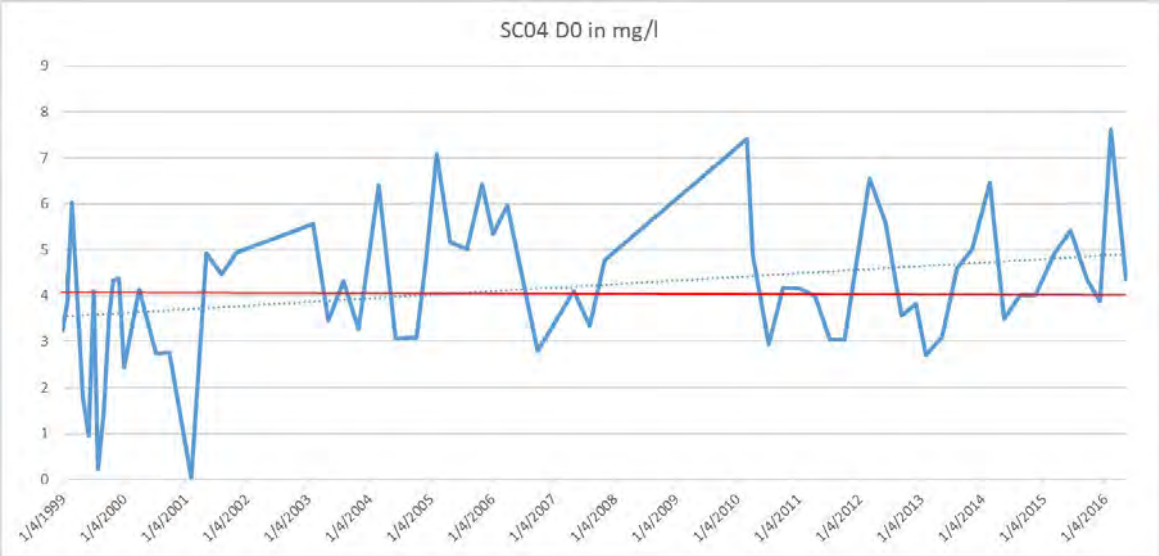


Figure 9: SC04 DO

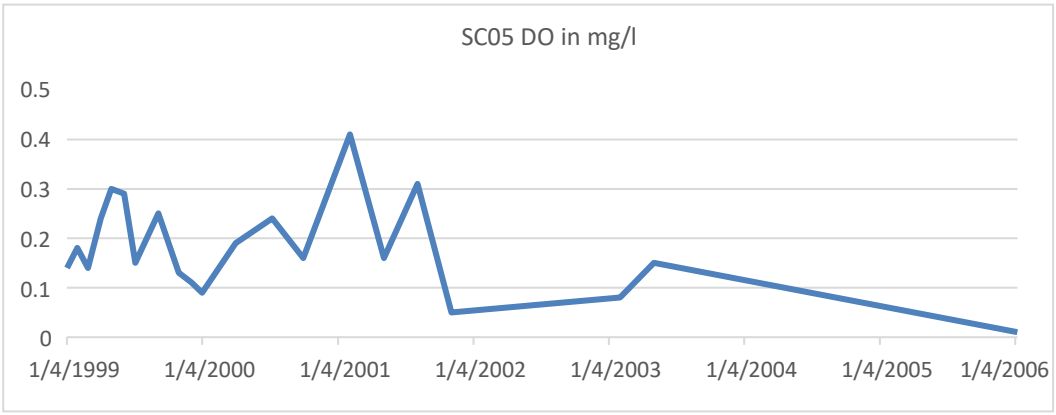


Figure 10: SC05 DO

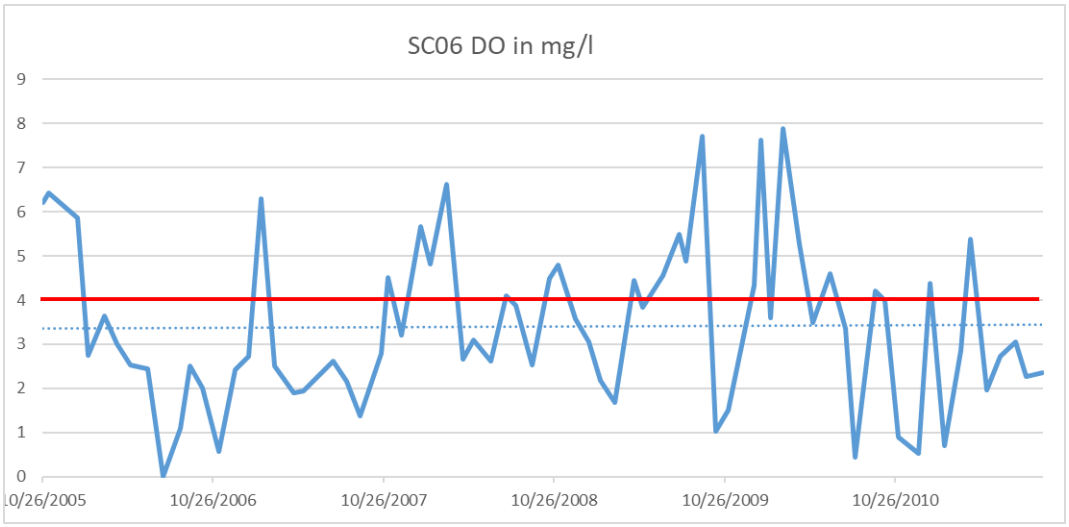


Figure 11: SC06 DO

3. Phosphorus

Per Florida Administrative Code 62-302.531, given the availability of site-specific TMDL nutrient criterion for Phosphorus, Total P values for Class I-IV waters should not be more than 0.16 mg/l. However, as seen in the data from the graphs below, all stations except SC01 show values higher than 0.1mg/l after 2008. In case of SC02 and SC04, while values are higher than 0.1mg/l, the trend shows a decrease in P from 2008 to 2016. In case of SC06, between 2008-2010, the P value trend line is above 0.1 mg/l. The red line denotes the standard of 0.1 mg/l.

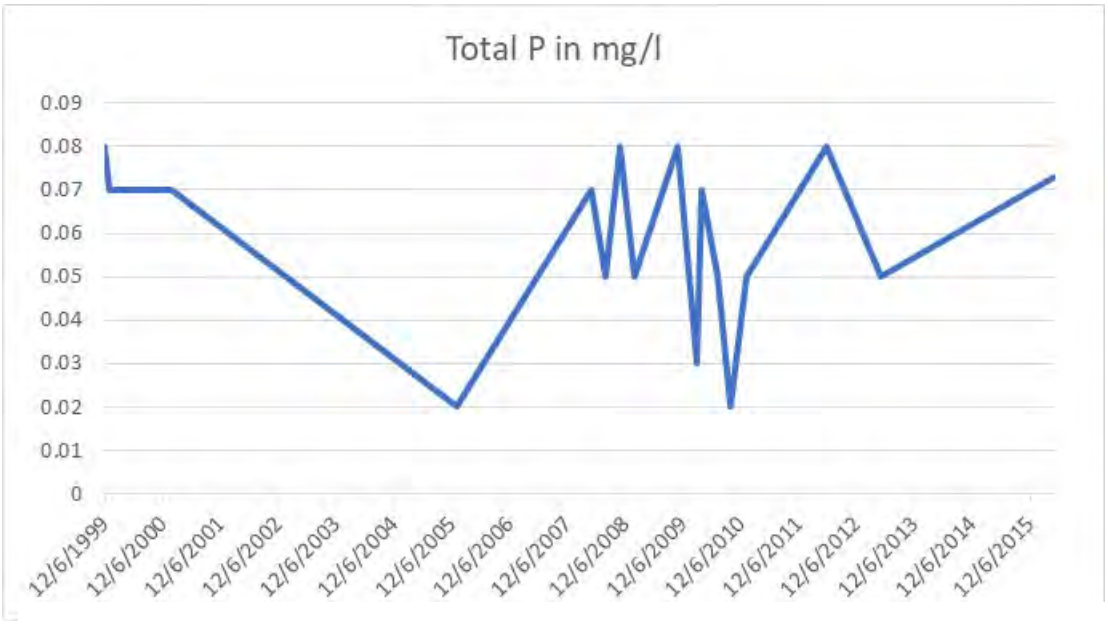


Figure 12: SC01 P

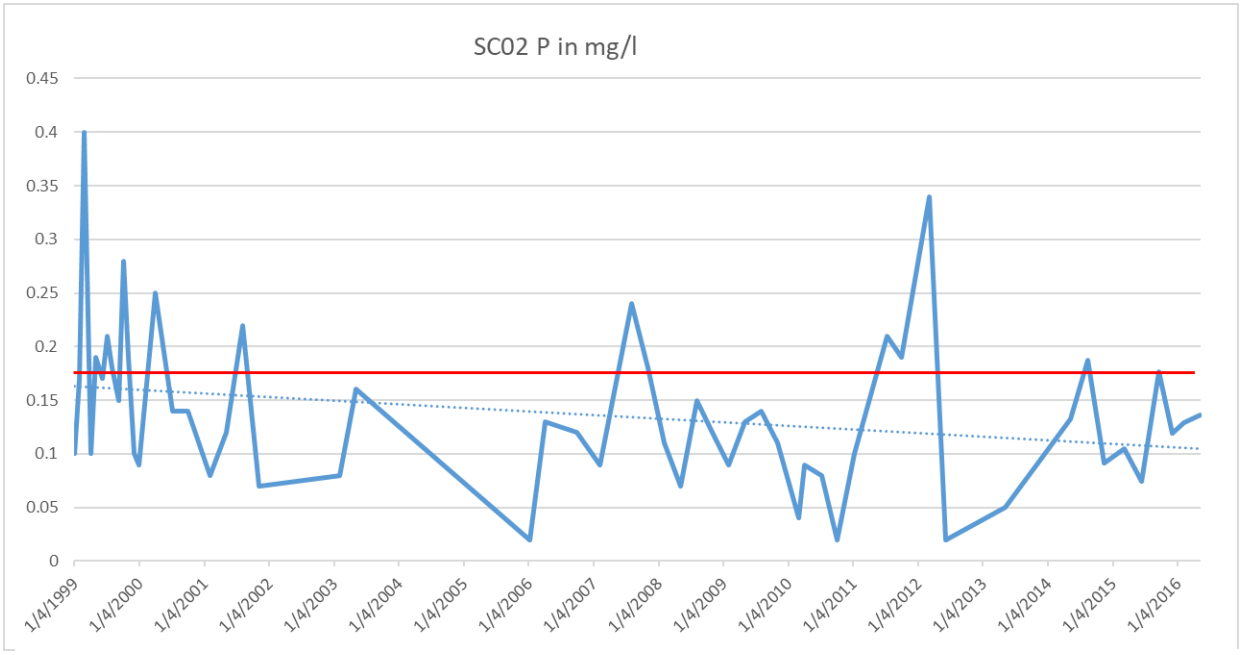


Figure 13: SC02 P

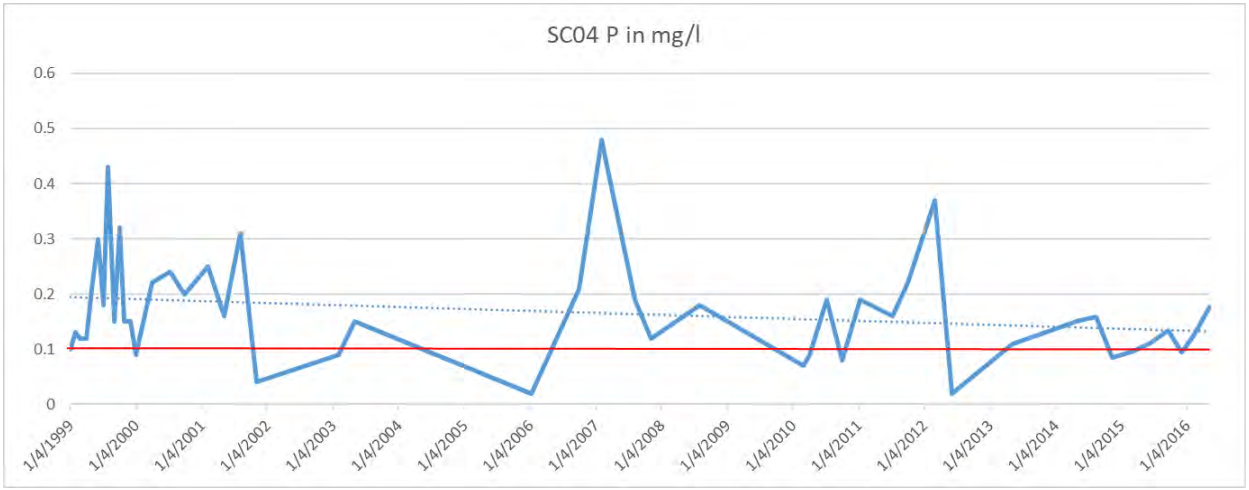


Figure 14: SC04 P

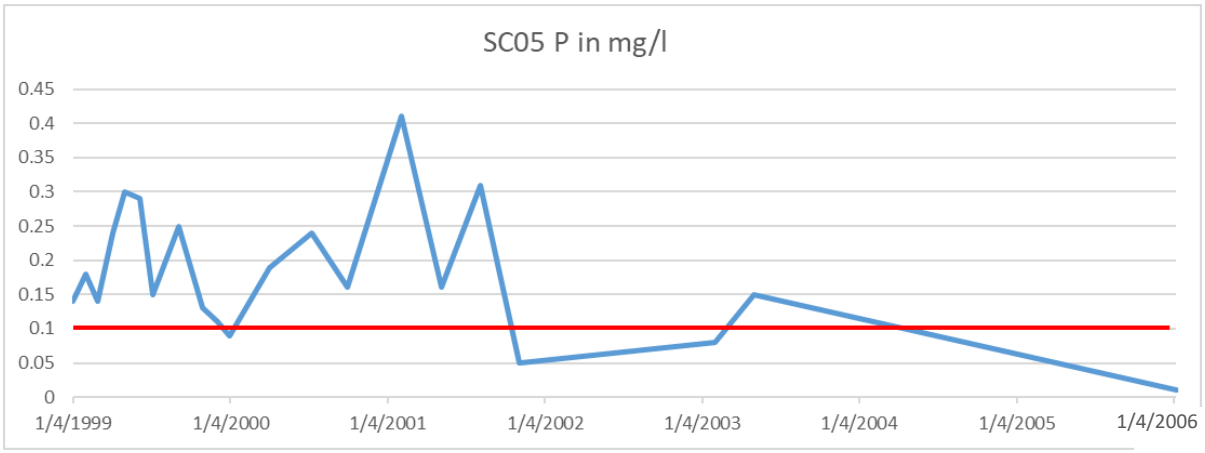


Figure 15: SC05 P

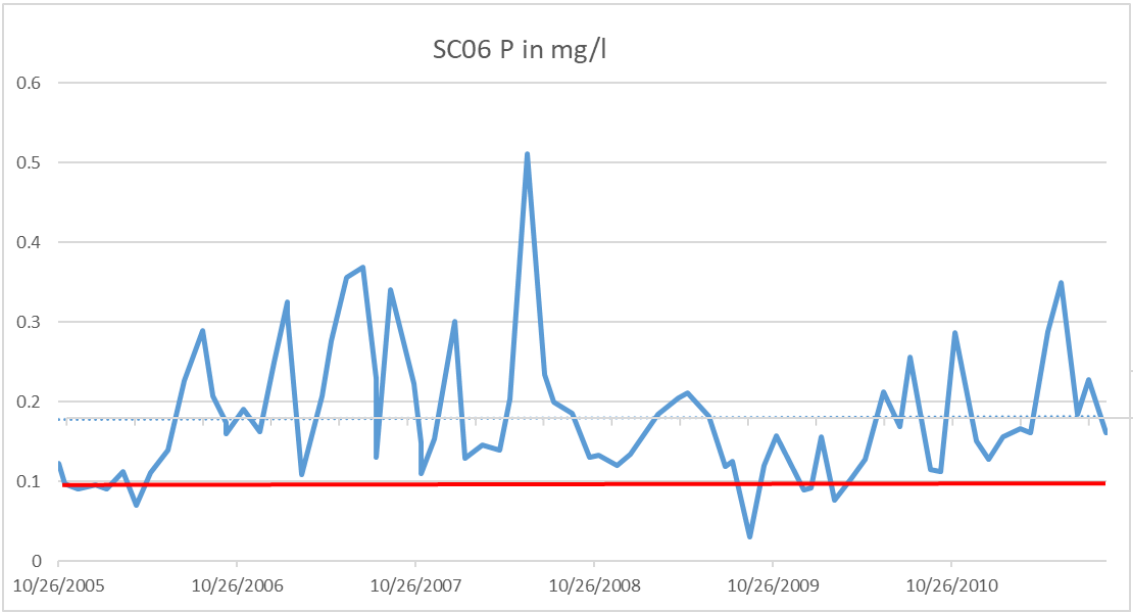


Figure 16: SC06 P

4. Nitrogen

The data available for Nitrogen contents at the Basin Stations, expressed in milligrams per liter, are presented in the graphs below. However, there is no numerically interpreted direct criterion for nitrogen in EPA or DEP guidelines. Nitrogen, like Phosphorus, is considered a nutrient and the nutrient criterion is based on the annual mean chlorophyll levels.

- A Water Body is considered as impaired for nutrients if the annual mean "chlorophyll a" for any year is greater than 11 µg/l (micrograms per liter) or, if data indicate annual mean chlorophyll values have increased by more than 50% over historical values for at least two consecutive years (Table 4 below).

(See Section B below: nutrient criterion in Rule 62-302 and recent revisions to surface water criteria**)**

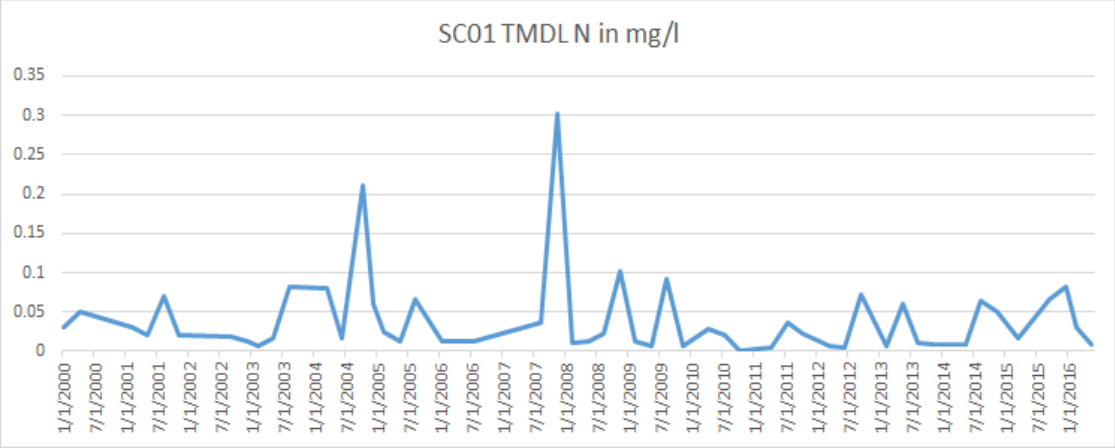


Figure 17: SC01 Total N in mg/l (excluding abnormal 1/4/1999 reading)

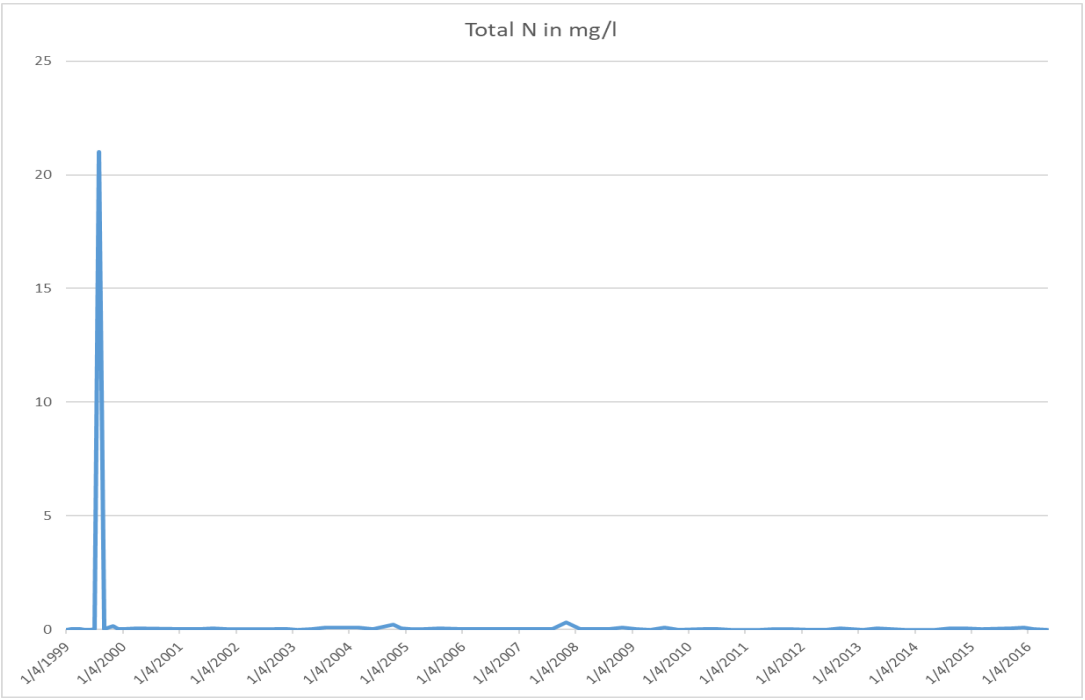


Figure 18: SC01 Total N in mg/l (including abnormal 1/4/1999 reading)

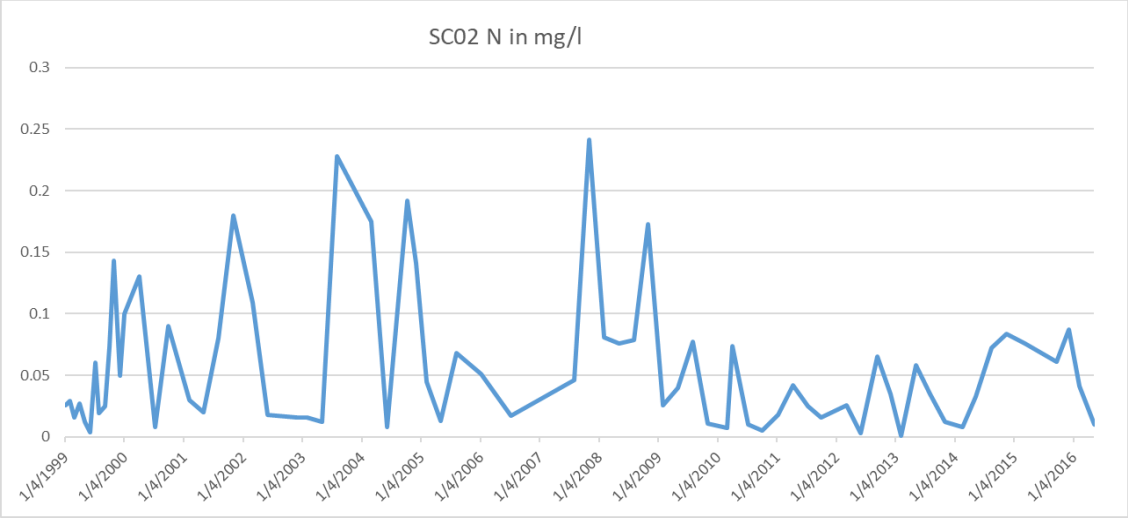


Figure 19: SC02 N

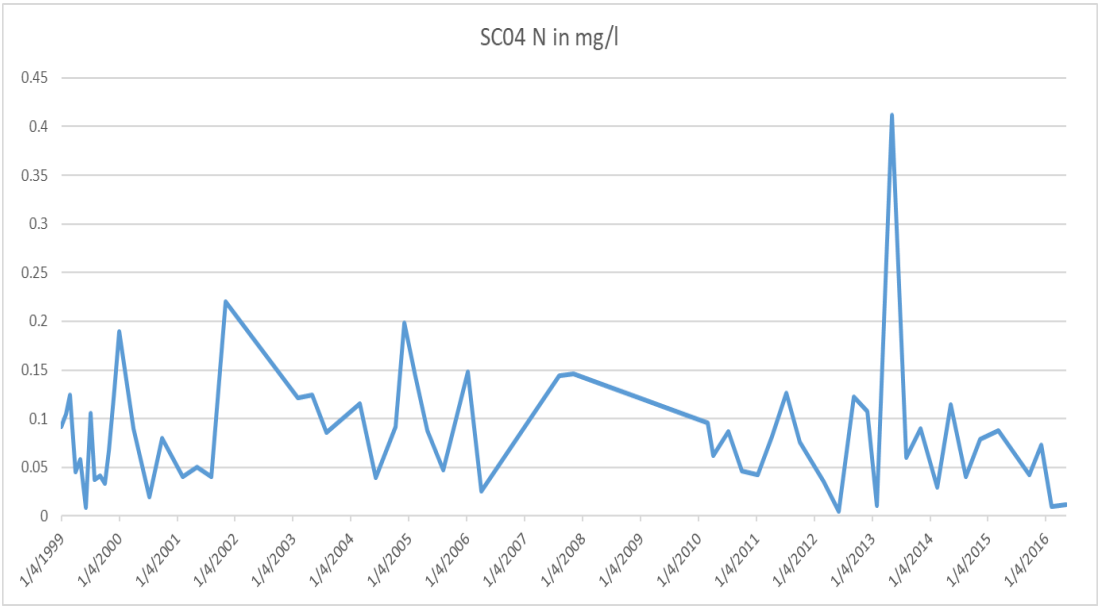


Figure 20: SC04 N

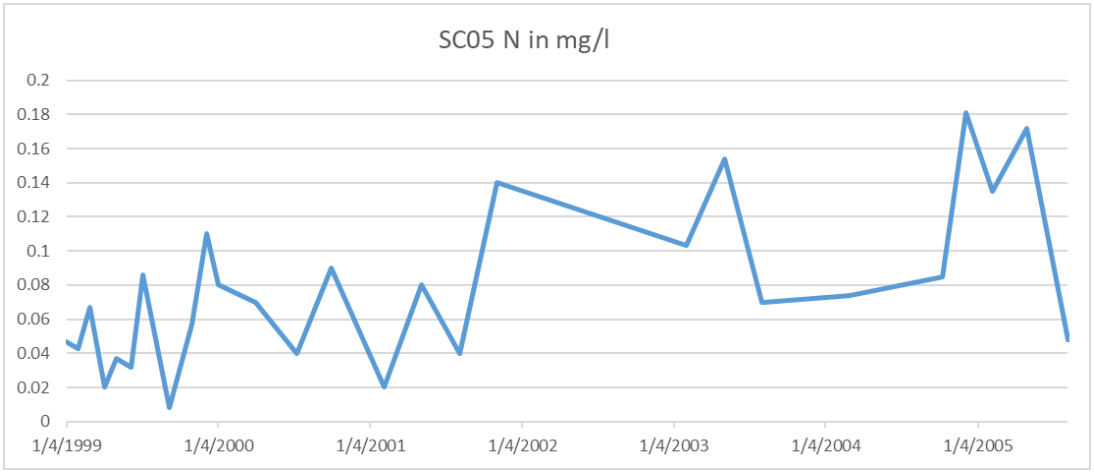


Figure 21: SC05 N

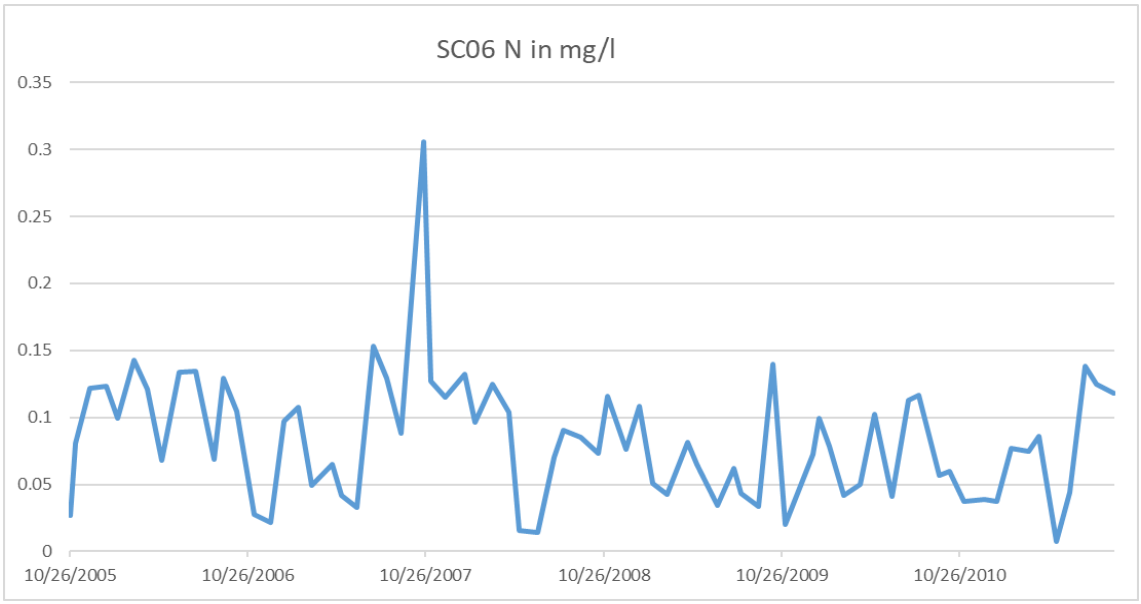
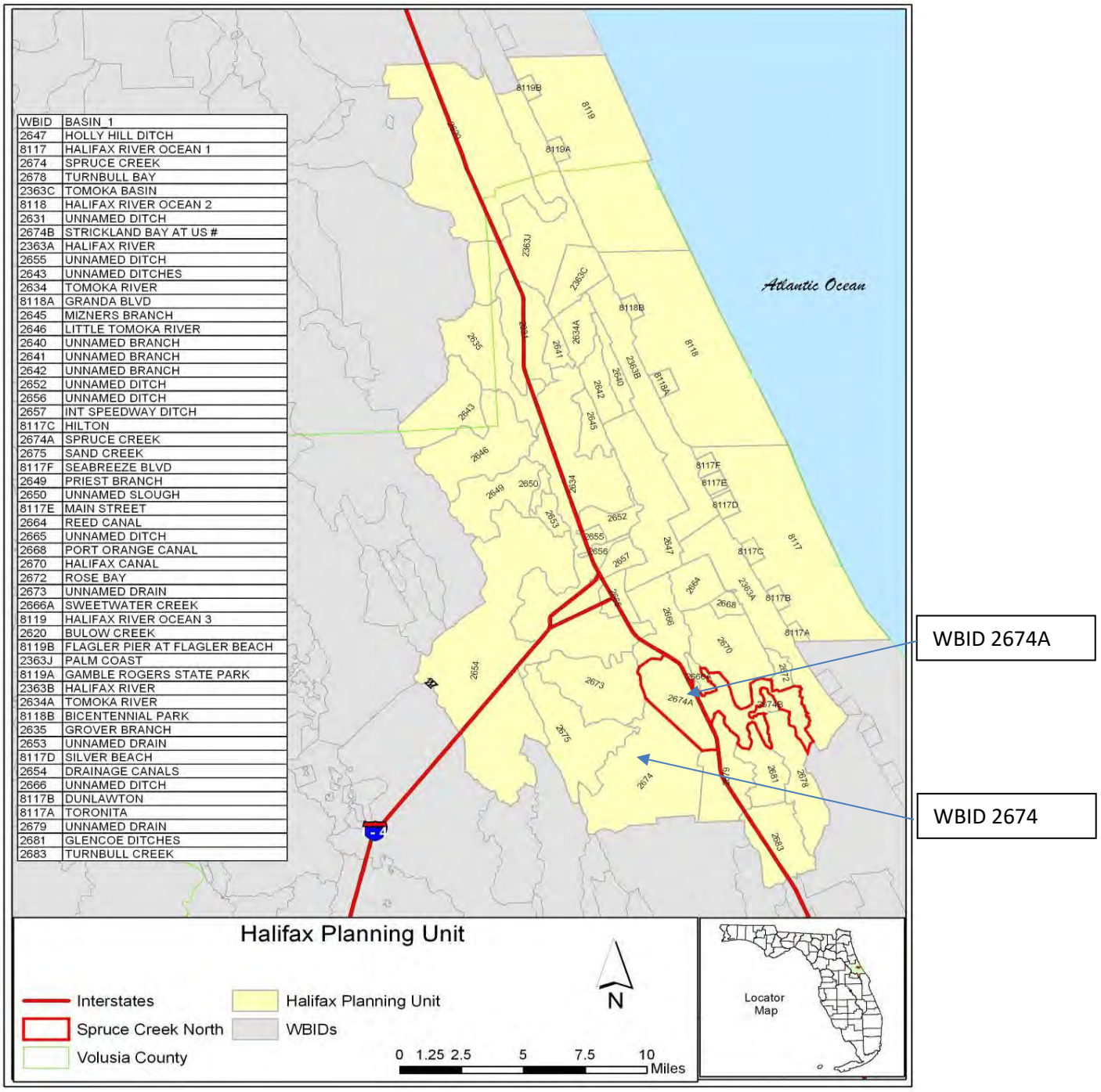


Figure 22: SC06 N

B. Review of TMDL Study conducted in 2008

As shown in Figure 1 above, Spruce Creek consists of two segments, WBID 2674 and WBID 2674A. The TMDL Study of 2008 addresses the DO and nutrient impairments in WBID 2674A. For assessment purposes DEP has divided the Upper East Coast Basin into water assessment polygons with a unique waterbody identification (WBID) number for each watershed or stream reach. Spruce Creek is part of the Halifax River Planning Unit. Planning Units are groups of smaller watersheds (WBIDs) that are part of a larger basin unit, in this case the Upper East Coast Basin. The Halifax River Planning Unit consists of 53 WBIDs. Figure 23 below shows the locations of these WBIDs.



WBID	BASIN_1
2647	HOLLY HILL DITCH
8117	HALIFAX RIVER OCEAN 1
2674	SPRUCE CREEK
2678	TURNBULL BAY
2363C	TOMOKA BASIN
8118	HALIFAX RIVER OCEAN 2
2631	UNNAMED DITCH
2674B	STRICKLAND BAY AT US #
2363A	HALIFAX RIVER
2655	UNNAMED DITCH
2643	UNNAMED DITCHES
2634	TOMOKA RIVER
8118A	GRANDA BLVD
2645	MIZNERS BRANCH
2646	LITTLE TOMOKA RIVER
2640	UNNAMED BRANCH
2641	UNNAMED BRANCH
2642	UNNAMED BRANCH
2652	UNNAMED DITCH
2656	UNNAMED DITCH
2657	INT SPEEDWAY DITCH
8117C	HILTON
2674A	SPRUCE CREEK
2675	SAND CREEK
8117F	SEABREEZE BLVD
2649	PRIEST BRANCH
2650	UNNAMED SLOUGH
8117E	MAIN STREET
2664	REED CANAL
2665	UNNAMED DITCH
2668	PORT ORANGE CANAL
2670	HALIFAX CANAL
2672	ROSE BAY
2673	UNNAMED DRAIN
2666A	SWEETWATER CREEK
8119	HALIFAX RIVER OCEAN 3
2620	BULOW CREEK
8119B	FLAGLER PIER AT FLAGLER BEACH
2363J	PALM COAST
8119A	GAMBLE ROGERS STATE PARK
2363B	HALIFAX RIVER
2634A	TOMOKA RIVER
8118B	BICENTENNIAL PARK
2635	GROVER BRANCH
2653	UNNAMED DRAIN
8117D	SILVER BEACH
2654	DRAINAGE CANALS
2666	UNNAMED DITCH
8117B	DUNLAWTON
8117A	TORONITA
2679	UNNAMED DRAIN
2681	GLENCOE DITCHES
2683	TURNBULL CREEK

Figure 23: WBIDs in Halifax River Planning Unit

TMDL Components for Spruce Creek:

- A TMDL is expressed as the sum of all point source loads (Wasteload Allocations, or WLAs), nonpoint source loads (Load Allocations, or LAs), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality.
- The objective of the TMDL Study was to provide a basis for allocating acceptable loads among all known pollutant sources in a watershed so that appropriate control measures can be implemented, and water quality standards achieved.
- **In our opinion, the process of completing the TMDL analysis in this study was thorough and efficient. However, the follow up necessary to reduce the observed impairment in the form of a basin management plan has not been implemented to date.**

A summary of the Study's major findings is given below:

Health of Spruce Creek Watershed:

- The report states that ***"The creek was verified as impaired for fecal coliform" and "The creek was verified as impaired for both DO [dissolved oxygen] and nutrients."*** (Final TMDL Report, 2008)
- Both waterbody identification units, WBID 2674 and WBID 2674A, were confirmed to be impaired. This TMDL establishes the allowable loadings to Spruce Creek that would restore the waterbody, so that it meets its applicable water quality criteria for both DO and nutrients. ***The proposed extension of South Williamson Boulevard passes right through Spruce Creek WBID 2674A, and, thus, should comply with the goals of these findings.*** (Final TMDL Report, 2008).

In our opinion, given the already impaired status of Spruce Creek, it is likely that the proposed extension would result in further deterioration of water quality because of runoffs from the highway.

- The TMDL report concluded that "A fecal coliform reduction of 53% is required" and "A TP [total phosphorous] reduction of 27% and a 25% reduction in BOD [biological oxygen demand] are required." (Final TMDL Report, 2008)

Historical water quality of Spruce Creek:

Summary of Fecal Coliform data for Spruce Creek:

- The Florida Department of Environmental Protection (DEP) used the IWR (Identification of Impaired Surface Water Rule) to assess water quality impairments in Spruce Creek and has verified the creek is impaired for fecal coliform based on data in the Department's IWR database.
- As shown in Table 2, there is a 20.8 percent overall exceedance rate for fecal coliform in Spruce Creek during the verified period. Exceedances occurred in February, April, July, and November and in all seasons.
- When aggregating data by season, the lowest percentage of exceedances occurred in the summer, the highest in Fall. (Final TMDL Report, 2008).

Table 2: Summary of Fecal Coliform Data by month for the verified period of January 1, 1999 - June 30, 2006

Month	N	Minimum	Maximum	Median	Mean	No. of Exceedances	% Exceedance	Mean Precipitation
January	0	ND	ND	ND	ND	ND	ND	2.51
February	5	230	410	350	324	1	20.00%	2.89
March	0	ND	ND	ND	ND	ND	ND	3.61
April	4	210	450	275	302.5	1	25.00%	2.35
May	0	ND	ND	ND	ND	ND	ND	2.86
June	0	ND	ND	ND	ND	ND	ND	6.15
July	5	220	1,600	360	569	1	20.00%	5.65
August	0	ND	ND	ND	ND	ND	ND	6.48
September	5	100	360	200	195.6	0	0.00%	6.92
October	0	ND	ND	ND	ND	ND	ND	4.9
November	5	83	710	240	316	2	40.00%	2.66
December	0	ND	ND	ND	ND	ND	ND	2.48

ND – No data.
Coliform counts are #/100mL.
Exceedances represent values above 400 counts/100mL
All the observations are from 2005 only.
Mean precipitation is for Daytona Beach International Airport in inches.

Fecal Coliform Criteria

Numerical criteria for bacterial quality are expressed in terms of fecal coliform bacteria concentrations. The water quality criteria for protection of Class III waters, as established by Rule 62-302, F.A.C., states the following:

Fecal Coliform Bacteria: The most probable number (MPN) or membrane filter (MF) counts per 100 ml of fecal coliform bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day.

- The criteria states that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. However, there were insufficient data (fewer than 10 samples in any month) available to evaluate the geometric mean criterion for fecal coliform bacteria. Therefore, the criterion selected for the TMDL was not to exceed 400 counts/100mL. (Final TMDL Report, 2008).
- A fecal coliform reduction of 53 percent is required from nonpoint sources. It should be noted that the load allocation includes loading from stormwater discharges that are not part of the NPDES Stormwater Program.

Summary of Dissolved Oxygen and Nutrients for Spruce Creek:

- The Florida Department of Environmental Protection (DEP) used the IWR to assess water quality impairments in Spruce Creek and has verified that the creek is impaired for DO and nutrients, based on data in the Department's IWR database. (Final TMDL Report, 2008)
- As shown in Table 3, there is a 23.4 percent overall exceedance rate for DO in Spruce Creek during the verified period. Exceedances occur in all seasons and in all months except March. During the verified period, samples ranged from 0.01 to 9.20 milligrams per liter (mg/L). As DO solubility is influenced by both salinity and water temperature, ranges in DO saturation were also evaluated. (Final TMDL Report, 2008)

Table 3: Summary of DO data by Month for the verified period (January 1, 1999- June 30, 2006)

Month	N	Minimum	Maximum	Median	Mean	No. of Exceedances	% Exceedance	Mean Precipitation
January	11	2.43	8.72	6.64	5.70	4	36.36%	2.51
February	21	0.01	8.97	5.73	5.75	3	14.29%	2.89
March	12	1.83	9.2	7.13	6.78	1	8.33%	3.61
April	15	4.13	7.72	6.38	6.03	0	0.00%	2.35
May	15	0.53	7.18	4.92	4.19	6	40.00%	2.86
June	17	0.95	7.1	3.76	4.11	9	52.94%	6.15
July	7	0.79	6.03	4.10	3.96	2	28.57%	5.65
August	24	0.22	6.93	4.33	4.45	3	12.50%	6.48
September	7	0.28	6.69	4.40	3.85	3	42.86%	6.92
October	11	2.77	6.17	3.54	4.06	6	54.55%	4.9
November	16	2.64	7.4	5.74	5.51	2	12.50%	2.66
December	15	3.51	9.2	6.42	6.21	1	6.67%	2.48

DO units are mg/L.
Mean precipitation is for Daytona Beach International Airport, in inches.

Source: Final TMDL Report: Spruce Creek, WBID 2674A, Upper East Coast Basin, Dissolved Oxygen and Nutrients

DO saturation ranged from 0.1 to 120.9 percent, with fewer than 10 percent of the saturation values greater than 100 percent. (***Oxygen saturation*** *is calculated as the percentage of dissolved O_2 concentration relative to that when completely saturated at the temperature of the measurement depth. In a stable body of water with no stratification,* ***dissolved oxygen will remain at 100% air saturation***.) Fewer than 10 percent of the DO saturation values were less than 34 percent. When aggregating data by season, the lowest percentage of exceedances occurred in the winter and the highest in spring. (Final TMDL Report, 2008)

Chlorophyll:

A summary of the annual average corrected chlorophyll a (chla) concentrations based on the IWR is shown in Table 4. During the verified period, the 11 micrograms per liter (µg/L) threshold was exceeded in 2003. In 2002, 2004, and 2006, there was insufficient data to calculate an annual average.

Table 4: Chlorophyll concentrations in Spruce Creek 1999 - 2006

Year	Mean	Exceedance
1999	5.30	no
2000	3.82	no
2001	5.96	no
2002		
2003	12.05	yes
2004		
2005	2.95	no
2006		

Corrected chla units are ug/L.
Historical threshold is 5.60 µg/L based on the 1991–1995 period.

Source: Final TMDL Report: Spruce Creek, WBID 2674A, Upper East Coast Basin, Dissolved Oxygen and Nutrients

Dissolved Oxygen Criterion

Numeric criteria for DO are expressed in terms of minimum and daily average concentrations. The water quality criterion for the protection of Class III marine waters, as established by Rule 62-302, F.A.C., states that **Dissolved Oxygen Criteria s**hall not average less than 5.0 in a 24-hour period and shall never be less than 4.0. Normal daily and seasonal fluctuations above these levels shall be maintained.

Nutrient Criterion:

The nutrient criterion in Rule 62-302, F.A.C., is expressed as a narrative: In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna [Note: For Class III waters in the Everglades Protection Area, this criterion has been numerically interpreted for phosphorus in Section 62-302.531, F.A.C.].

To assess whether this narrative criterion is being exceeded, the IWR provides thresholds for nutrient impairment in estuaries based on annual average chla levels. The following language is found in Rule 62-303, F.A.C. 62-303.353:

- "Nutrients in Estuaries and Open Coastal Waters. Estuaries, estuary segments, or open coastal waters shall be included on the planning list for nutrients if their annual mean chlorophyll a for any year is greater than 11 µg/l or if data indicate annual mean chlorophyll a values have increased by more than 50% over historical values for at least two consecutive years."

- ***"The Department finds that excessive nutrients (total nitrogen and total phosphorus) constitute one of the most severe water quality problems facing the State.*** It shall be the Department's policy to limit the introduction of man-induced nutrients into waters of the State. Particular consideration shall be given to the protection from further nutrient enrichment of waters which are presently high in nutrient concentrations or sensitive to further nutrient concentrations and sensitive to further nutrient loadings. Also, particular consideration shall be given to the protection from nutrient enrichment of those waters presently containing very low nutrient concentrations: **less than 0.3 milligrams per liter total nitrogen or less than 0.04 milligrams per liter total phosphorus."**
  Source: https://www.epa.gov/sites/production/files/2014-12/documents/fl_section62-302.pdf

Potential Sources of Nutrients in the Spruce Creek Watershed:

Point sources:

- No NPDES (National Pollutant Discharge Elimination System) wastewater facilities located in the watershed;
- State-permitted industrial facility along with partial coverage of septic tanks;
- Septic Tanks: Based on the 2000 Census figure of 211,938 housing units and the Florida Department of Health (FDOH) estimate of 96,633 permitted septic tanks in Volusia County, approximately 45 percent of households in the county are using septic tanks.

Land Uses and Non-Point sources:

- Potential non-point sources include loadings from surface runoff, ground water inflow, leakage from collection systems, and septic tanks;
- Leaking or Overflowing Wastewater Collection Systems;
- Septic tanks/ Wastewater Collection Systems / Urban Areas;
- Upstream Drainage Area of Spruce Creek (in particular, Nitrogen and Phosphorus).

Approximately 3,050 households in the watershed are connected to the city of Port Orange wastewater facility. Using 2.34 people per home and a 70-gallon/per person/per- day discharge, a daily flow of approximately 1.89 x 105 L is transported through the collection system.

All the above pollutants (Fecal Coliform, Dissolved Oxygen and Nutrients) are likely to have increased with population growth and urbanization in the region over the past 2 decades (Figures 24, 25).

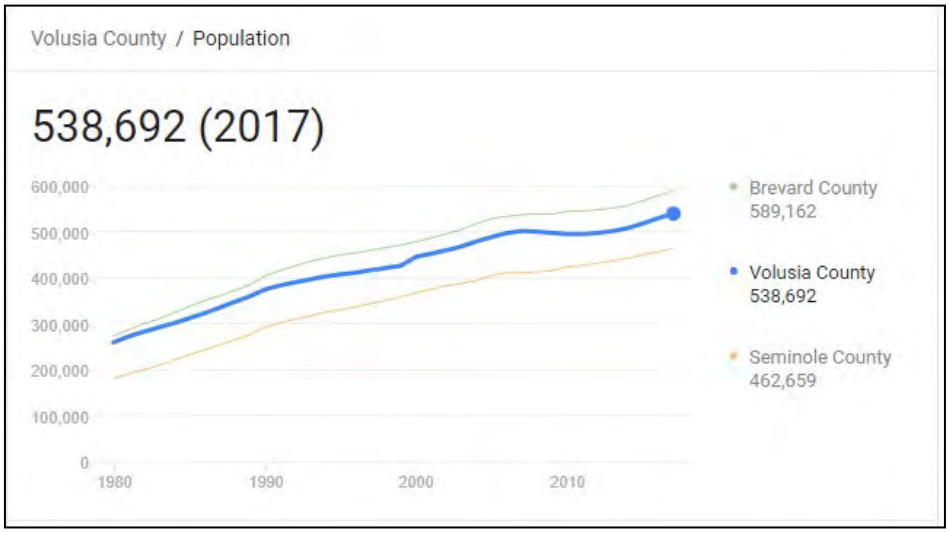


Figure 24: Population increases in Brevard, Volusia and Seminole Counties

Source: US Census Bureau

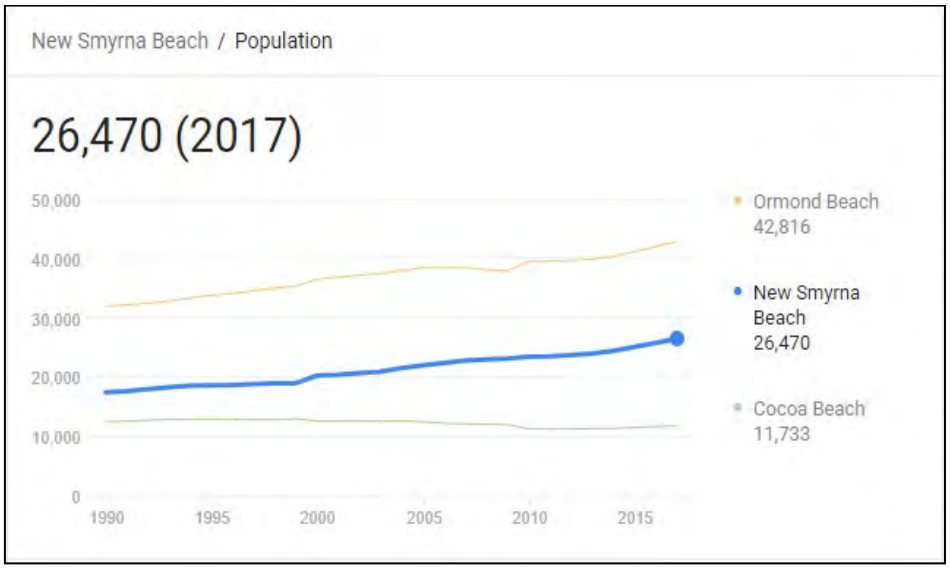


Figure 25: Population growth in New Smyrna Beach

Population projections suggest that an additional 13,933 additional dwelling units will be needed in unincorporated Volusia County to meet the rise in population by the year 2025 (The Volusia County Comprehensive Plan, 2019).

Basin Management Action Plan (BMAP):

- Spruce Creek is an "impaired waterbody" according to the FDEP. "The creek was verified as impaired for fecal coliform" and for "both DO and nutrients." [Final TMDL report, 2008]
- The TMDL concluded that "A fecal coliform reduction of 53% is required" and "A TP [total phosphorous] reduction of 27% and a 25% reduction in BOD [biological oxygen demand] are required."
- Following the adoption of the 2008 TMDL Study report by DEP, the next step in the TMDL process

is to develop an implementation plan for the TMDL, referred to as the BMAP.

- ***Though the recommended TMDLs for Spruce Creek were adopted by DEP, there is no adapted or pending basin management action plan as of date.*** See Figures 26 & 27 below that show the status of BMAPs in Spruce Creek and other watersheds in the vicinity.

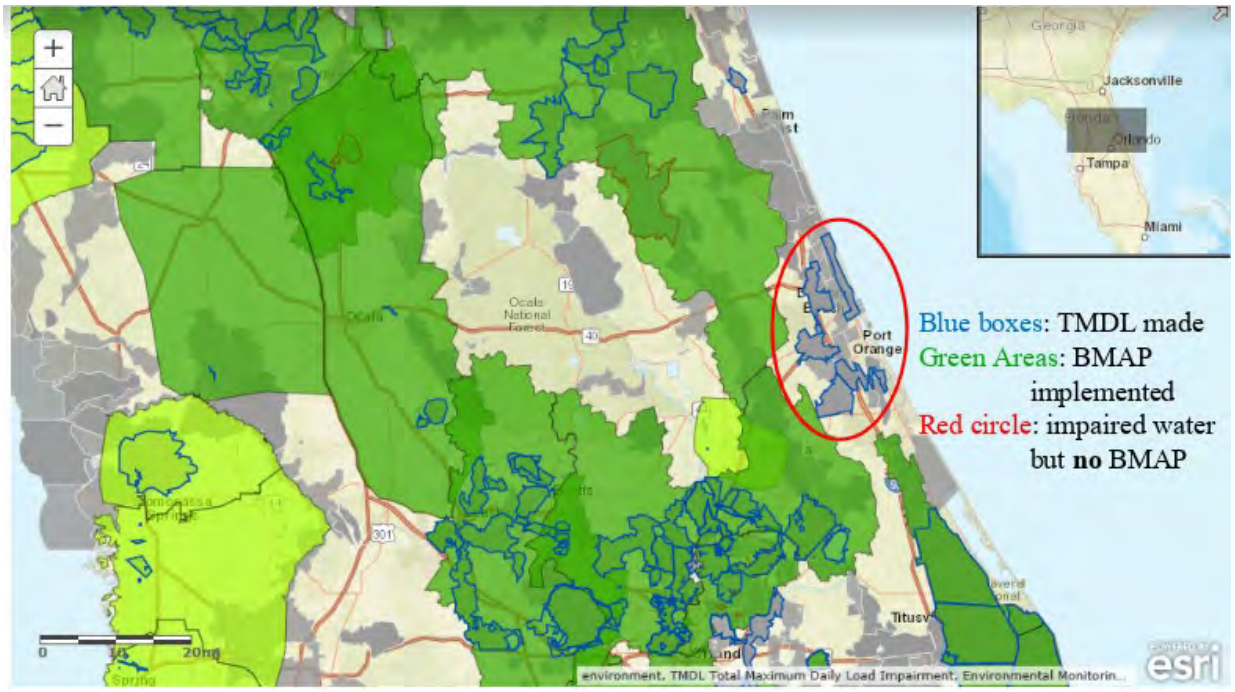


Figure 26: Status of TMDLs and BMAPs for watersheds in Upper East Coast Basin

Source: Florida Department of Environment Protection BMAPs Interactive Maps

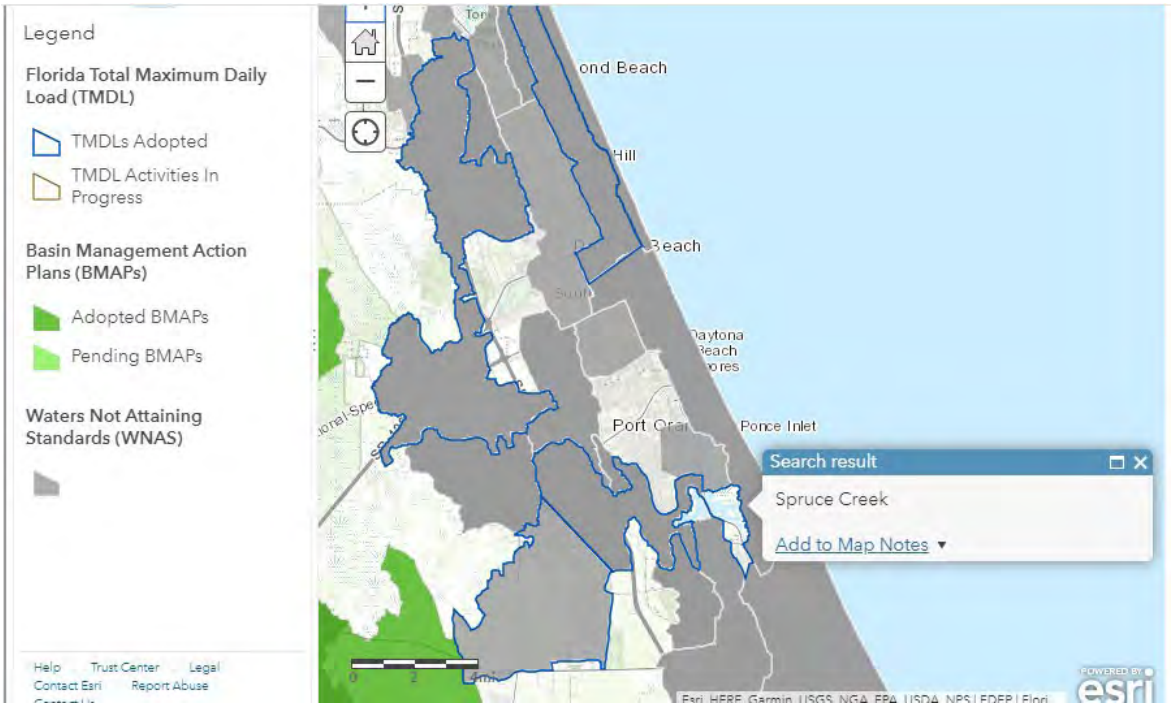


Figure 27: Status of TMDLs and BMAPs in Halifax River Planning Unit

C. Possible impacts on Spruce Creek wetlands by proposed developments

Figure 28: Spruce Creek's beautiful ecosystem is home to diverse flora and fauna

In the previous section we reviewed the characteristics of the water systems of the area. Our findings emphasized the fragility of the Spruce Creek River System, an area of special natural beauty. In this section, we review the extent of wetlands and general land use of the area; and provide a preliminary analysis of the current and future impact of proposed development projects on this environment. In addition to development projects, there is also the less obvious, but real growth in the population of the area, as indicated in Figures 24 & 25 above, that cause further stresses on the natural environment.

Typically, the impact of these developments is reviewed on a case by case basis as they are proposed analyzed and frequently approved. ***However, the combined impact of all proposed projects in the area is likely to have a larger impact than the sum of impacts of individual projects, especially on the most vulnerable areas of the wetlands and the Farmington Mitigation Bank,*** a large area of supposedly reserved land for environmental conservation.

Also, it is normal under the review process to take current and past conditions as the baseline for the environmental assessment. However, in the Spruce Creek River Basin, water conditions are changing and will change in the future. The most important and predictable of these changes are the steady rise in sea level and increasing impact of storm surge on the lower reaches of the stream, as well as the additional impact of the more intense precipitation (heavy rainfall) accompanying a warmer atmosphere. ***These impacts need more detailed analysis at a later stage.*** This review looks at the current and threatened changes in land use and first-level impacts of the proposed development projects.

Current and future land use in the area

The Spruce Creek Watershed is an area that is facing increased development pressures. According to Table 5 and Figure 31 below, urban and built-up areas already represent 38.4 percent of the area, medium-density residential represent 14.8 percent, followed by forest 22.2 percent, and wetlands only 21.3 percent. **Source:** Final TMDL Report, 2008

Table 5: Land Use in Spruce Creek

Level 3 Land Use Code	Attribute	Acres	% of Total
1200	Residential, medium density–2-5 dwelling units/acre	1,174.93	14.73
4110	Pine flatwoods	786.93	9.87
4340	Upland mixed coniferous/hardwood	782.61	9.81
6420	Saltwater marshes	752.96	9.44
1100	Residential, low density–less than 2 dwelling units/acre	593.39	7.44
1300	Residential, high density–6 or more dwelling units/acre	398.58	5.00
6170	Mixed wetland hardwoods	384.12	4.82
5300	Reservoirs–pits, retention ponds, dams	251.94	3.16
1820	Golf courses	233.09	2.92
1180	Rural residential	227	2.85
2130	Woodland pastures	187.42	2.35
6300	Wetland forested mixed	176.85	2.22
8140	Roads and highways (divided 4-lanes with medians)	174.32	2.19
1290	Medium density under construction	170.21	2.13
2110	Improved pastures (monoculture, planted forage crops)	167.94	2.11
6120	Mangrove swamps	151.72	1.90
3200	Shrub and brushland (wax myrtle or saw palmetto, occasionally scrub)	126.83	1.59
5100	Streams and waterways	123.03	1.54
1400	Commercial and services	109.41	1.37
3300	Mixed upland nonforested	106.02	1.33
3100	Herbaceous upland nonforested	91.91	1.15
8110	Airports	86.42	1.08
6460	Mixed scrub-shrub wetland	85.51	1.07
6210	Cypress	70.64	0.89
4200	Upland hardwood forests	69.52	0.87
1700	Institutional	57.13	0.72
4130	Sand pine	53.55	0.67
4410	Coniferous pine	52.89	0.66
2510	Horse farms	48.97	0.61
1390	High density under construction	40.1	0.50
1190	Low density under construction	30.79	0.39
6410	Freshwater marshes	30.16	0.38
4430	Forest regeneration	25.28	0.32
1900	Open land	22.73	0.28
1850	Parks and zoos	19.87	0.25
6250	Hydric pine flatwoods	19.59	0.25
5200	Lakes	18.06	0.23
6440	Emergent aquatic vegetation	13.98	0.18
7430	Spoil areas	12.03	0.15
2430	Ornamentals	9.63	0.12
6180	Cabbage palm hammock	7.62	0.10
1860	Community recreational facilities	7.52	0.09
8330	Water supply plants	4.81	0.06
5400	Bays and estuaries	4.62	0.06
8310	Electrical power facilities	4.57	0.06
6430	Wet prairies	3.38	0.04
8370	Surface water collection basins	3.29	0.04
4400	Tree plantations	2.32	0.03
	TOTAL:	**7,976.19**	**100.00%**

Future Land Use

Since 2008, considerable additional development of building and infrastructure has taken place in the County and further development is planned per Figures 29 and 30 below from the Volusia County Comprehensive Plan.

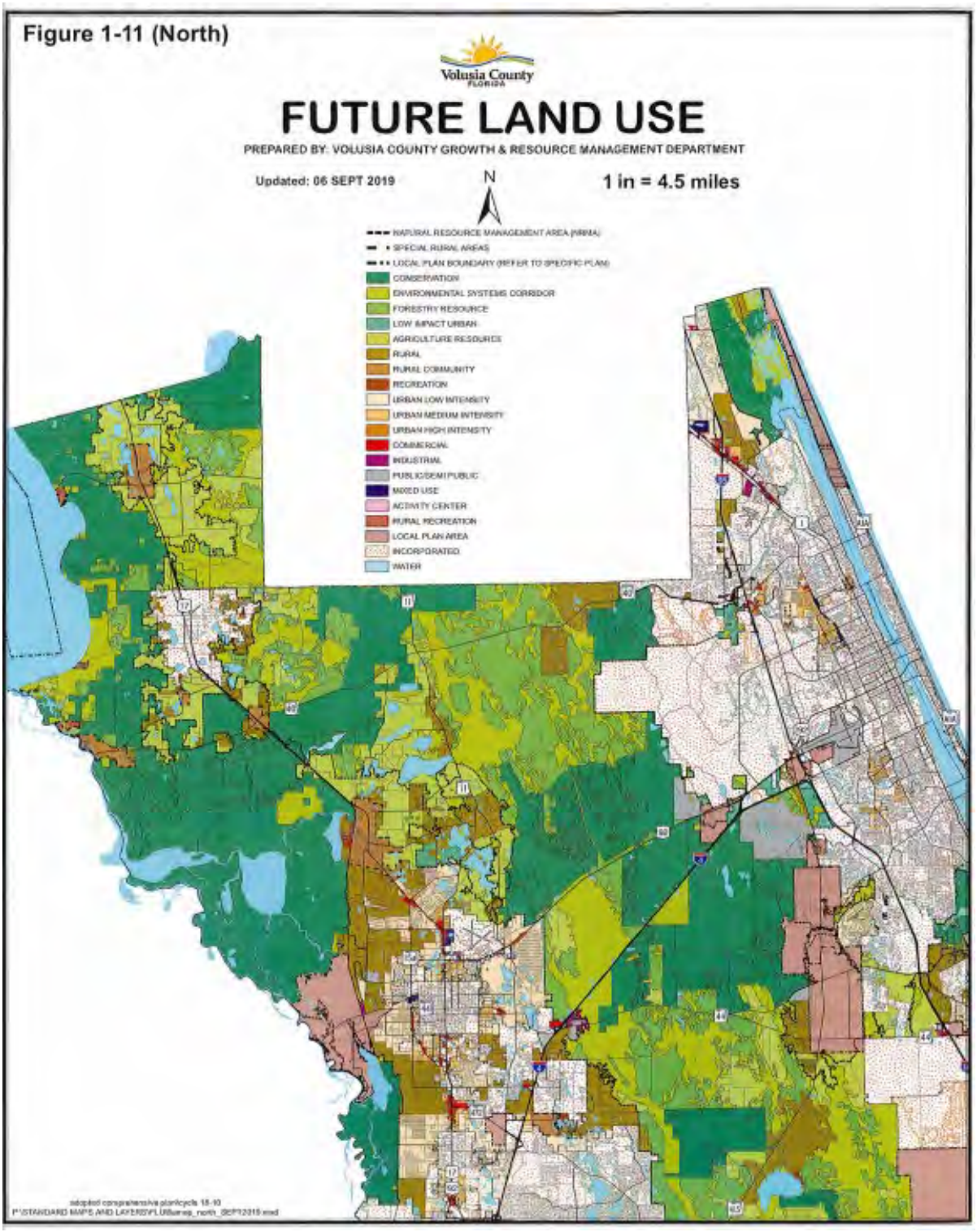


Figure 29: Projected Future Land Use in North Volusia County

Source: The Volusia County Comprehensive Plan, 2019

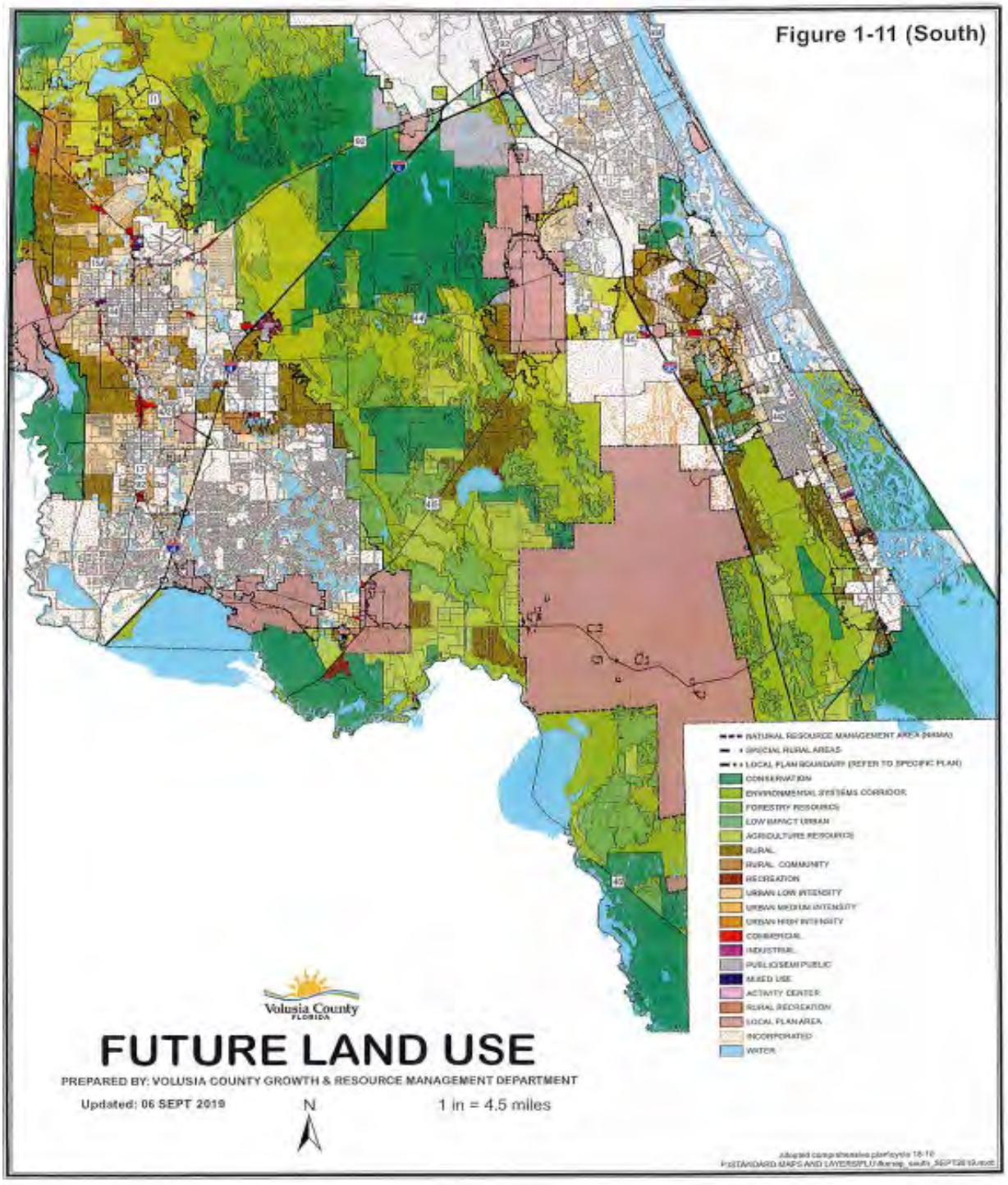


Figure 30: Projected Future Land Use in South Volusia County

Source: The Volusia County Comprehensive Plan, 2019

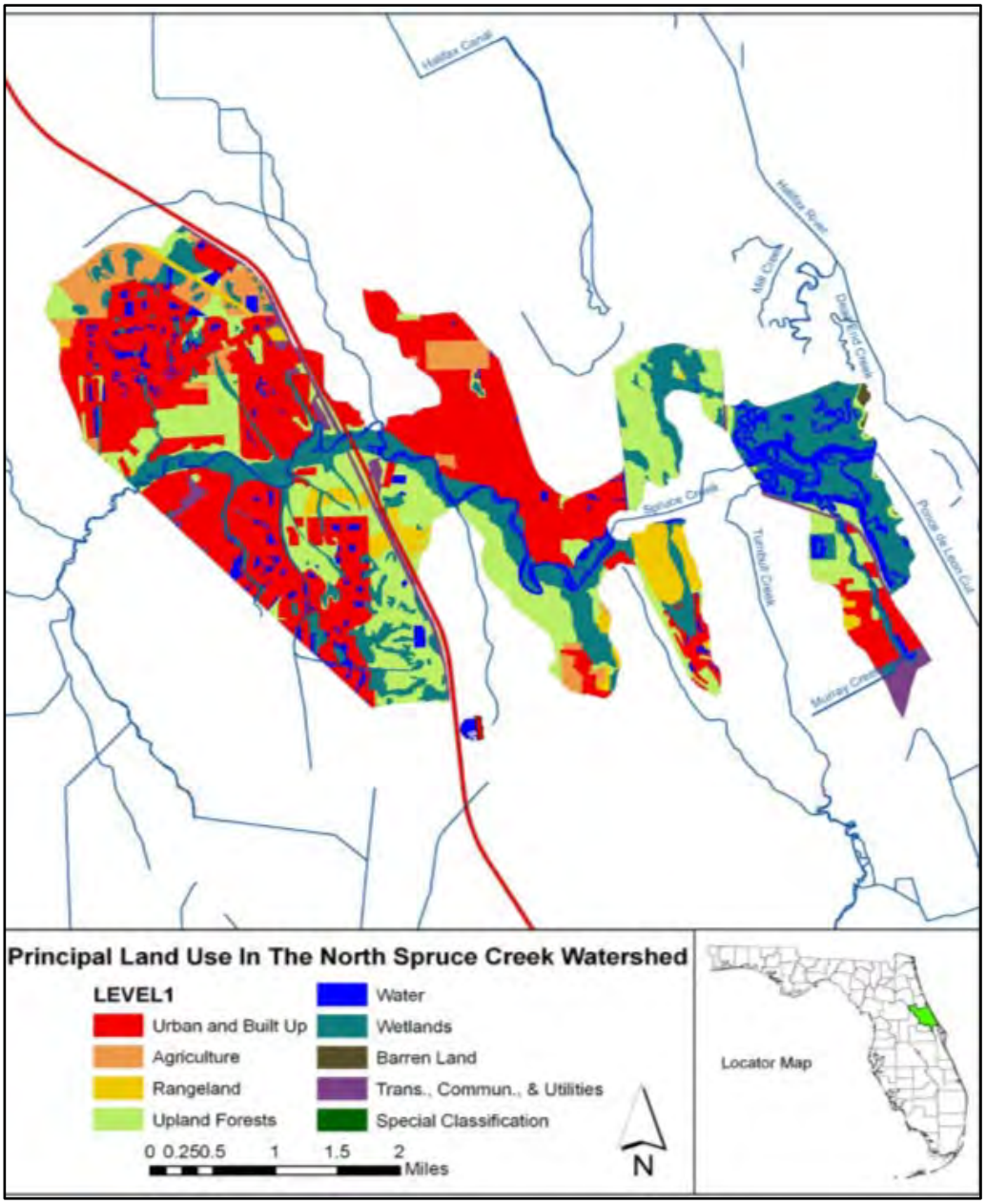


Figure 31: Historical Land Use in Spruce Creek WBID 2674A watershed

Source: Final TMDL Report, 2008

Summary of Land Use and Extent of Wetlands

The 2008 maps above show several categories of wetland in the Spruce Creek basin as follows:

Upstream Segment (2674)

Wetland Forest - 651 acres (5.8%)
Mixed scrub wetland - 388 acres (3.4%)
Wet prairies - 80 acres (0.7%)
Freshwater marsh - (21 acres (0.2%)

Downstream (2764A)

Salt water marsh - (9.4%)

Wetland Bush - (4.8 %)
Mixed wet forest - (2.2%)
Mangrove - (2%)
Freshwater marsh - (0.4%)

The maps indicate that just 10 percent of the upland basin and about 19 percent of the lower basin is wetland, but the maps show that wetland is located in strategic areas, alongside the creek and in the lower reaches susceptible to environmental and climate threats. Reduction of acreage or threats to these wetlands would likely have far reaching impacts on the whole basin and its environment. The 2019 maps show updated land use and projections for the future. ***Recent changes as well as future projections need further analysis and may be reviewed in Phase 2 of our study.***

Impact of Proposed Development Projects:

SSC identified 4 proposed development projects for review in this preliminary assessment, for an evaluation of the current ecological properties of the specific areas and how each would be affected by additional building and transportation infrastructure. ***It should be noted again that these impacts would be further exacerbated by flooding risks from future Sea Level Rise, Storm Surge and Heavy Rainfall flooding. A detailed analysis of flooding risks at the individual parcel level can be conducted in Phase 2 of our study.:***

1) Doris Leeper Spruce Creek Preserve land corridor purchase;

1A. Highlights of the Preserve

- Doris Leeper Spruce Creek Preserve (DLSCP) consists of 1,932 acres of state-owned land within the Preserve in Volusia County, lying in Sections 22, 23, 25, 28, 29, 33, 34, 35, 36, and 38, Township 16 South, Range 33 East. (DLSCP Management Plan, 2010).
- Other adjacent, non-state-owned conservation lands increase the total area to 2,477 acres. DLSCP is approximately 8 miles southeast of Daytona Beach and 43 miles northeast of Orlando.
- The property lies within three (3) local jurisdictions that include the City of Port Orange, the City of New Smyrna Beach, and Volusia County.
- DLSCP is bordered on the north by Spruce Creek and Rose Bay, on the west by public lands along Interstate 95 on the south by developed and undeveloped private residential lands, and on the east by US Hwy 1, although some parcels do occur east of US 1.

1B. Impact of proposed project

- If permits are granted for pending development projects sought in the Preserve, there would be a significant adverse impact to plant and animal life in the area (Figure 28 above).
- A multitude of natural communities, including some that are imperiled, populate the preserve, including salt marsh, maritime hammock, scrubby flatwoods, bottomland forest, scrub and wet flatwoods. **(Spruce Creek Management Plan)**
- These many natural communities provide habitat for a great variety of plant and animal species, many of which are listed species, and include: Cooper's Hawk, Tricolored Heron, Giant Leather Fern, Florida Manatee, Florida Beargrass, Florida Scrub Jay and Roseate Spoonbill. **(Spruce Creek Management Plan)**
- Creating a wildlife corridor across I-95 using an undeveloped land adjacent to Spruce Creek will connect the isolated eastern coastal park with protected lands in the center of the State.

- Wildlife corridors are a practice in habitat conservation, allowing connections or reconnections between habitats, combating habitat fragmentation to facilitate animal/species connectivity.
- Connectivity is a key component of conserving biodiversity for several reasons. Connected populations generally have a higher likelihood of surviving. Connectivity between populations also provide greater flexibility for a species to respond to changing environmental conditions, such as climate change, compared to isolated populations in habitat patches. ("Safe Passages" book).
- Wildlife crossing structures (underpass and overpass) improve traffic safety across roads. They assist in avoiding collisions between vehicles and animals, which in addition to killing or injuring wildlife may cause injury to humans and property damage. (Handbook of road ecology).
- The connectivity between wildlife populations on opposite sides of the road allows animals to access resources and mates and facilitates gene flow, thereby improving the viability of wildlife populations. (Handbook of road ecology).
- Wetlands aid in wildlife habitat, flood control, and water quality. Wetlands also allow species possibly facing extinction an environment in which to flourish.

2) I -95 Interchange at Pioneer Trail

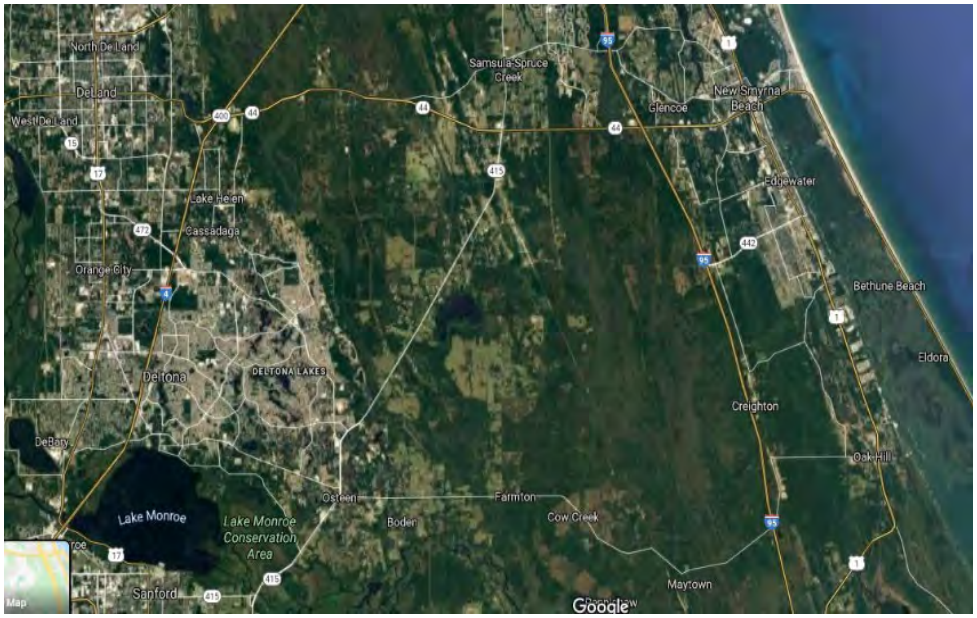


Figure 32: Area of proposed I-95 Interchange at Pioneer Trail

2A. Highlights of the Area around the Interchange

- Figure 32 shows the area on which the interchange is being proposed. It is land that is critical to the health and well-being of the State-owned, Doris Leeper Spruce Creek Preserve (DLSCP) and Spruce Creek itself, an Outstanding Florida Waterbody (OFW).
- Part of the land where this construction is potentially slated to occur is on land that has been desired, at least at one time, to be purchased for conservation by State and/or local government agencies. (FDOT Pioneer commentary).
- This land was and likely still is rated very highly in terms of land acquisition value, both for the need to preserve filtration lands within the Spruce Creek water basin (as not much remains in an

undeveloped state), and for the need and desire to expand the boundaries of the DLSCP. (FDOT Pioneer commentary).

2B. Impact of proposed development

- Leaving land undeveloped allows for more plant and animal species, including endangered and/or threatened species like the scrub jay and gopher tortoise, to have habitat to survive. (FDOT Pioneer commentary).
- Wetlands provide important ecological services that contribute to watershed functions, most notably in pollutant removal, flood attenuation, groundwater recharge and discharge, shoreline protection, and wildlife habitat.
- The benefit of wetland ecological services generally increases as total wetland cover increases in a watershed. When wetlands are lost or degraded by land development, these services must often be replaced by costly water treatment and flood control infrastructure.

3) The Farmton Mitigation Bank Development and new Community Development District (CDD) establishment

3A. Highlights of the Farmton Mitigation Bank

- Farmton Mitigation Bank was permitted by the St. Johns River Water Management District (SJRWMD) and U.S. Army Corps of Engineers (USACE) in April 2000, as a 24,000+ acre mitigation bank, located within a large tract (approximately 57,000 acres) owned by Miami Corporation, making it the largest permitted wetland mitigation bank in the United States.
- It is located at three sites (North, South, and West) in Volusia and Brevard Counties (Figure 34). The North site covers 16,289 acres and includes Crane Swamp and a portion of the headwaters of Spruce Creek. The South site covers 4052 acres at Buck Lake. The West site covers 3,581 acres that include Cow Creek and Deep Creek.
- The natural communities that occur on the Farmton Mitigation Bank site include a variety of high quality forested and herbaceous wetland and upland habitats (Table 6 and Figure 33).
- They include cypress swamp, freshwater marsh, scrub/shrub wetlands, mixed forested wetlands, cypress/pine swamp, wetland coniferous forest, wetland hardwood forest, and uplands primarily comprised of pine flatwoods and slash pine plantation, and to a lesser degree, temperate upland hardwood hammock.
- The mitigation bank lands are hydrologically interconnected and drain to Spruce Creek in the Halifax River watershed, and in the St. Johns River watershed, through Deep Creek and Buck Lake.
- Typically, mitigation banks include wetlands and streams while conservation banks include habitats of endangered species.
- The impact of increasing industrialization and urbanization on natural habitats, streams, and wetlands is inevitable. Mitigation banks provide an opportunity to at least partially offset this impact.
- On the other hand, a mitigation bank is more efficient in that it ensures that a vast consolidated piece of land is recovered or conserved to offset the adverse impact of developers on a lot of small sites.

- Although this system has some limitations such as the lack of robust environmental assessment techniques to correctly assess the ecological loss in economic or monetary terms, and the poor quality of such artificially developed wetlands in terms of floral and faunal diversity in some cases, it still has a lot of advantages that outweigh these disadvantages.

*Table 6: Natural Communities present on the Farmton Mitigation Bank**

Ecological Community (FNAI 2010)	Total Acreage	North Bank Acreage	West Bank Acreage	South Bank Acreage
Wetland Communities				
Basin Swamp	10,206	9,776	332	198
Bottomland Forest	2,109	156	1,193	760
Wet Flatwoods	909	761	-	148
Basin Marsh	2,276	1,267	109	900
Wet Prairie (Shrub)	491	-	6	485
Salt Marsh	21	-	-	21
Marsh Lake	216	-	-	216
Total Wetlands	***16,228***	***11,960***	***1,640***	***2,728***
Upland Communities				
Mesic Flatwoods	6,895	3,933	1,312	1,650
Mesic Hammock	442	37	390	15
Sandhill	27	27	-	-
Upland Hardwood Forest	251	10	241	-
Total Uplands	***7,615***	***4,007***	***1,943***	***1,665***
Total Acreage	***23,843***	***15,967***	***3,583***	***4,393***

**The acreages provided in this table do not match the acreages used for the mitigation assessment areas and credit calculations, since those areas are based on mitigation activities not reflected here.*

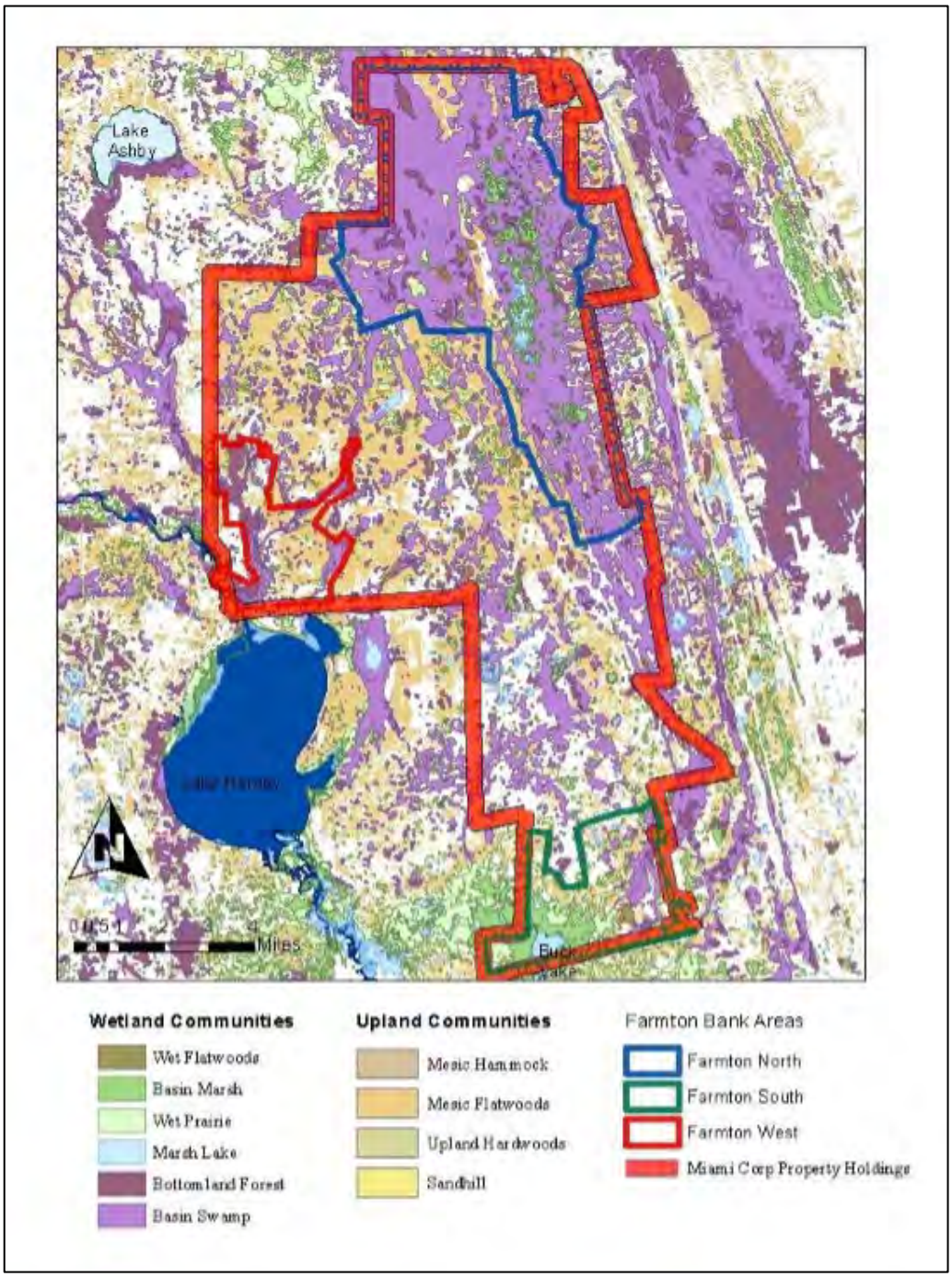


Figure 33: Natural Communities in the Farmton Mitigation Bank

Source: Endangered Species Act (ESA) Farmton Mitigation Bank Final Report (2012)

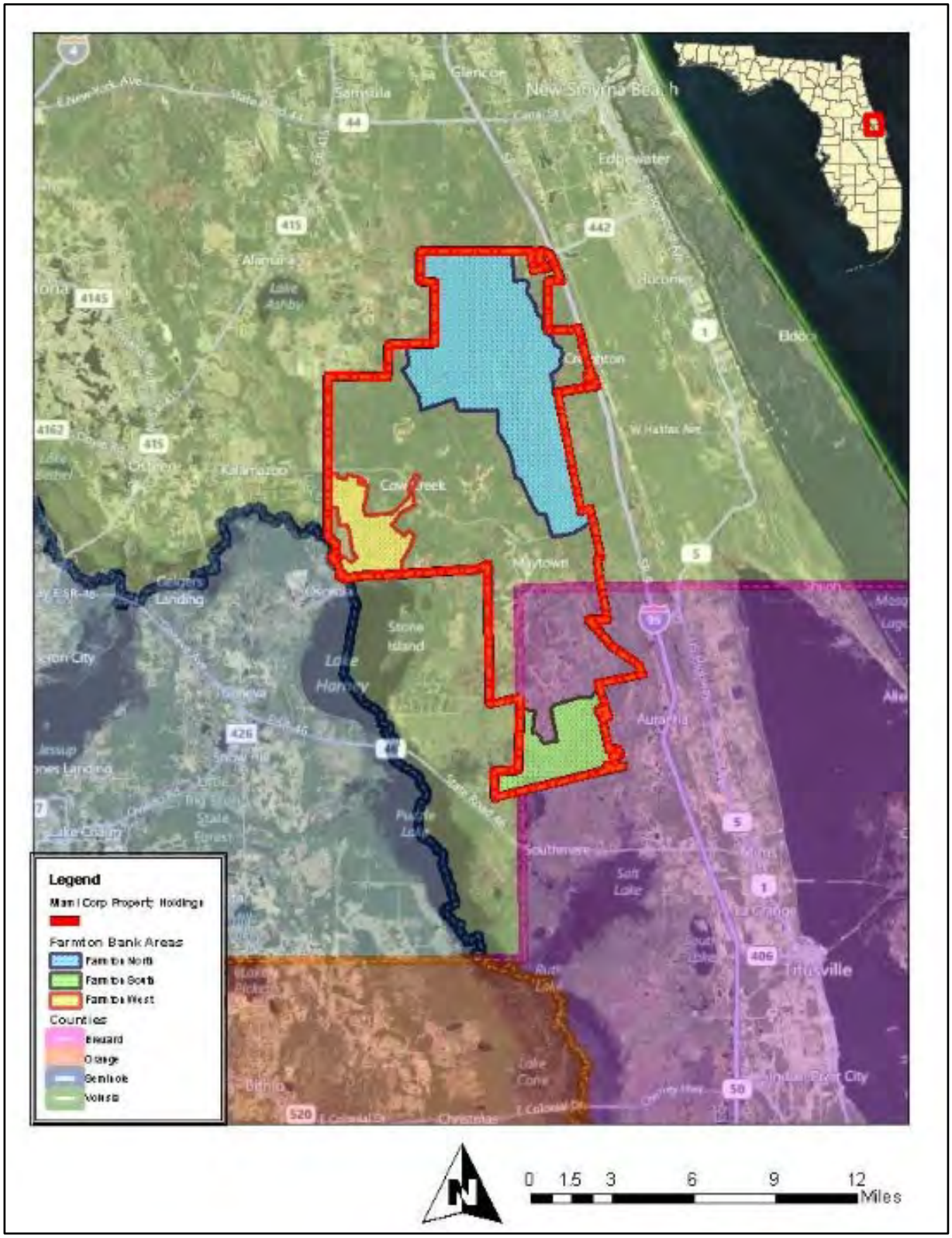


Figure 34: Farmton Mitigation Bank Location Map

Source: ESA Farmton Mitigation Bank Final Report (2012)

3B. Impact of proposed development on the Farmton Mitigation Bank

- Mitigation banking is a way to offset the ecological loss of a development project by compensating for the preservation and restoration of a different area. However,
- Miami Corporation, a privately owned investment company that has owned a majority of the Farmton tract since 1920 (https://www.farmtontreefarm.com/about.html), has applied to the US Army Corps of Engineers and SJWMD to remove 1,116.35 state mitigation bank acres and 374.77 federal mitigation bank acres to build a new city.
- As land steward for the Farmton Tract, Miami Corporation's traditional focus has been on sustainable agriculture, water resource management, responsible development and long-term conservation to balance environmental values and economic forces.
- This proposed development may cause adverse effects to the hydrological connectivity, surface water flows, and watershed integrity, as well as wildlife and habitat in the Farmton Mitigation Bank, primarily arising from:
    - Disruption of hydrologic connectivity of the mitigation bank lands, degradation of the regional watersheds and sensitive wetland habitats due to roadway expansions, water withdrawals, and installation of wastewater utilities.
    - Disruption to wildlife movement and migration due to a significant reduction and narrowing in FDEP Priority 1 Greenways corridors with critical linkages, and loss of Florida Fish & Wildlife Conservation Commission (FFWCC) Strategic Habitat Conservation Area lands.
    - Displacement of wildlife and disruption of foraging, nesting, and other critical life cycle activities due to encroachment by development areas and incompatible land uses within open space and Green Key areas. Areas outside the (Sustainable Development Areas) SDAs, surrounding (Resource Based Open Space) RBOSs, and transportation corridors, have been designated by the Farmton Local Plan as GreenKey areas.

4) Extension of Williamson Blvd through New Smyrna Beach and Edgewater

- The proposed highway from the current junction of South Williamson Blvd and Pioneer Trail will cut right through the heart of Spruce Creek's lower segment (WBID 2674A) and down to Farmton wetland mitigation bank and headwaters of Spruce Creek.
- This development would potentially cause further deterioration in water quality and habitats of endangered species in Spruce Creek.
- There is also the likelihood of increased wildlife mortality due to vehicular collisions. With the planned road expansion to Williamson Boulevard, Maytown Road, and other connector roads, there is the strong likelihood of increased mortality to terrestrial wildlife species.
- The Final TMDL report of 2008 indicated that any development in this area should be accompanied by a plan to restore the already impaired water body to acceptable levels of fecal coliform, dissolved oxygen and nutrients. A detailed study together with traffic and road construction experts would be required to determine if such restoration is feasible given the environmental impact of the proposed highway.

SUMMARY OF FINDINGS

A) Analysis of Water Quality –

Sufficient readings are not available from recent samples to make a definitive determination of the water quality in Spruce Creek. While the few samples taken from 2009 to 2016 to test for fecal coliform, DO and nutrients indicated that, in most cases, the sample results met required levels, these are not considered reliable particularly in view of the significantly impaired status of Spruce Creek water quality established after exhaustive analysis by Florida DEP in the 2008 TMDL study.

B) Results of 2008 TMDL Study –

The study concluded that water quality in Spruce Creek was significantly impaired and established allowable maximum loadings of pollutants to restore the water body to comply with applicable criteria of the EPA and DEP. The study stated that any development project undertaken in the area should comply with the water quality goals of the study. The study also recommended establishing a Basin Management Action Plan for implementation of the TMDL objectives of the study. To date, no such plan has been prepared. However, a draft Management Plan for the Doris Leeper Spruce Creek Preserve was prepared in 2011. ***The extent to which this plan addresses the requirements of the 2008 TMDL Study can be reviewed in Phase 2 of our assignment.***

C) Impact of proposed developments on Spruce Creek Wetlands –

Our Preliminary Assessment indicates that all four of the proposed development projects described above would have a detrimental impact on the water quality, watershed integrity and possibilities for maintenance of current ecosystems in the area. The magnitude and rate of such deterioration can be dimensioned after further detailed analysis.

D) AREAS FOR FURTHER ANALYSIS

- Detailed review of Land Use patterns and maps to determine extent of environmental and natural habitat degradation in Spruce Creek over the past 15-20 years
- Detailed review of future projections of sea level rise, storm surge, heavy rainfall as well as climate change impacts of increasing extreme heat events and rainfall intensity for the region and their impact, taken together with continued urban development on Spruce Creek and Tomoka River Basins.

Reference:

TMDL Final Report, 2008: Fecal Coliform TMDL for Spruce Creek, WBID 2674
TMDL Final Report, 2008: Dissolved Oxygen and Nutrient TMDL for Spruce Creek, WBID 2674A
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