2.1

TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Nutrients

In

Wekiva Springs (WBID 2956C), Rock Springs Run (WBID 2967), and Volusia Blue Spring (WBID 28933)

Middle St. Johns River Basin, Florida

Prepared by:

US EPA Region 4
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EPA
United States
Environmental Protection
Agency

Region 4
serving the southeast

Under the authority of Section 303(d) of the Clean Water Act, 33 U.S. Code §1251 et.seq., as amended by the Water Quality Act of 1987 (PL 100-4), the U.S Environmental Protection Agency is hereby establishing Total Maximum Daily Loads (TMDLs) for nutrients in Wekiva Springs, Rock Springs Run, and Volusia Blue Spring in the Middle St. Johns River Basin. Subsequent actions must be consistent with this TMDL.

Gail Mitchell for

James D. Giattina, Director
Water Management Division

12/21/05

Date

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LIST OF ABBREVIATIONS

BMP	Best Management Practices
BPJ	Best Professional Judgment
CFS	Cubic Feet per Second
DMR	Discharge Monitoring Report
D.O.	Dissolved Oxygen
EPA	Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FGS	Florida Geological Survey
HUC	Hydrologic Unit Code
IWR	Impaired Waters Rule
LA	Load Allocation
Mg/L	Milligrams per liter
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
N	Nitrogen
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
NO_3NO_2	Nitrate – Nitrite Concentration
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
µg/L	Micrograms per liter
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WBID	Water Body Identification
WLA	Waste Load Allocation
WMP	Water Management Plan

SUMMARY SHEET
Total Maximum Daily Load (TMDL)

1. **303(d) Listed Waterbody Information**
   State: Florida
   Basin: Middle St. Johns River

Impaired Waterbodies for TMDLs (1998 303(d) List):

WBID	Segment Name	County	Constituent
2956C	Wekiva Springs	Orange	Nutrients
2967	Rock Springs Run	Orange	Nutrients
28933	Volusia Blue Spring	Volusia	Nutrients

1. **TMDL Endpoint (i.e., Target):**
   The State of Florida has narrative criteria for nutrients requiring 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. The target for these TMDLs is controlling nitrate concentrations to levels observed in least disturbed springs discharging from the Floridan Aquifer System. Using a reference spring approach, the median nitrate concentration in an unimpacted spring is about 0.11 mg/L.

2. **TMDL Approach**
   A reference spring approach is used to define biological and water quality conditions in ecologically healthy springs. A percent reduction was calculated based on existing conditions and the target. Existing conditions were estimated as the 90th percentile concentration of available data.

3. **TMDL Allocation:**

Stream Name / WBID	Parameter	WLA		LA	TMDL
		Continuous (MPN/day)[5]	MS4 (reduction)		
Wekiva Springs/ WBID 2956C)	Nutrients	N/A	N/A	95% reduction	95% reduction
Rock Springs Run	Nutrients	N/A	N/A	95% reduction	95% reduction
Volusia Blue Spring	Nutrients	N/A	N/A	91% reduction	91% reduction

Note: TMDL incorporates an implicit Margin of Safety

5. **Endangered Species (yes or blank):** Yes

6. **EPA Lead on TMDL (EPA or blank):** EPA

7. **TMDL Considers Point Source, Nonpoint Source, or both:** Nonpoint Source

8. **Major NPDES Discharges to surface waters in East Cedar River watershed:** None

TOTAL MAXIMUM DAILY LOAD (TMDL)
NUTRIENTS IN SELECT SPRINGS IN THE MIDDLE ST. JOHNS RIVER BASIN

1. INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The TMDL for Wekiva Springs (WBID 2956C), Rock Springs Run (WBID 2967), and Volusia Blue Spring (WBID 28933) is being established pursuant to EPA commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998). There are many "Blue Springs" in Florida. Florida Department of Environment (FDEP) scientists have adopted the convention of referring to these springs with the county name placed before the name "Blue Spring". Thus, Blue Spring in Volusia County becomes Volusia Blue Spring.

FDEP developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The state's 52 basins are divided into 5 groups. Water quality is assessed in each group on a rotating five-year cycle. The springs in the Middle St. Johns River basin are in the group 3 basin and were first assessed in 2002 with plans to revisit water management issues in 2007. FDEP established five water management districts (WMD) responsible for managing ground and surface water supplies in the counties encompassing the districts. The springs in this report are managed through the St. Johns Water Management District (SJRWMD).

For the purpose of planning and management, the WMDs divided the district into planning units defined as either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. Wekiva Springs and Rock Springs Run are in the Wekiva River Planning Unit, and Volusia Blue Spring is in the Lake Woodruff Planning Unit. These planning units contain smaller, hydrological based units called drainage basins, which are further divided into "water segments"; each assigned a unique Waterbody IDentificaton (WBID) number. A water segment usually contains only one unique waterbody type (stream, lake, cannel, etc.).

2. PROBLEM DEFINITION

Florida's 1998 Section 303(d) list identified Wekiva Springs (WBID 2956C), Rock Springs Run (WBID 2967), and Volusia Blue Spring (WBID 28933) in the Middle St. Johns River basin as impaired for nutrients. Wekiva Springs and Rock Springs Run are located in Orange County (see Figure 1). Elevated nitrate levels are identified as the leading cause of nutrient impairment in Florida

springs.

FDEP has narrative criteria for nutrients requiring 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. Although spring water originates as groundwater, chemical and biological constituents that enter the aquifer through recharge processes may affect the water quality, flora and fauna of springs and spring runs.

A reference spring approach is used to establish a nutrient target necessary to support ecologically healthy conditions in impaired springs. Appropriate reference springs were selected based on FDEP's Springs Initiative Monitoring Program. In this program, FDEP conducts biological and water quality monitoring at springs throughout the state. Data from these efforts are used for documenting conditions within springs for making resource protection decisions. Juniper Springs is located in the St. Johns Water Management District and was identified through the Springs Initiative program as "a system [that] can continue to be used to help define biological and water quality expectations from least disturbed springs in Florida" (FDEP, 2004).

Nitrate data collected in the impaired springs is often analyzed and reported as nitrate-nitrite (NO_3NO_2 as N) or separately as nitrate (NO_3) nitrite (NO_2). Nitrites are not considered to have an adverse affect on water quality as the nitrite concentrations in the springs are often below detection limits (see data in Appendix A). The Springs Initiative Monitoring Program reports nitrate concentrations as nitrate-nitrite. The FDEP IWR database reports nitrate and nitrite separately and in some instances as nitrate-nitrite. Because nitrites have a negligible impact on the overall nitrate-nitrite concentration, it is reasonable to consider the majority of the nitrate-nitrite concentrations are in the form of nitrates.

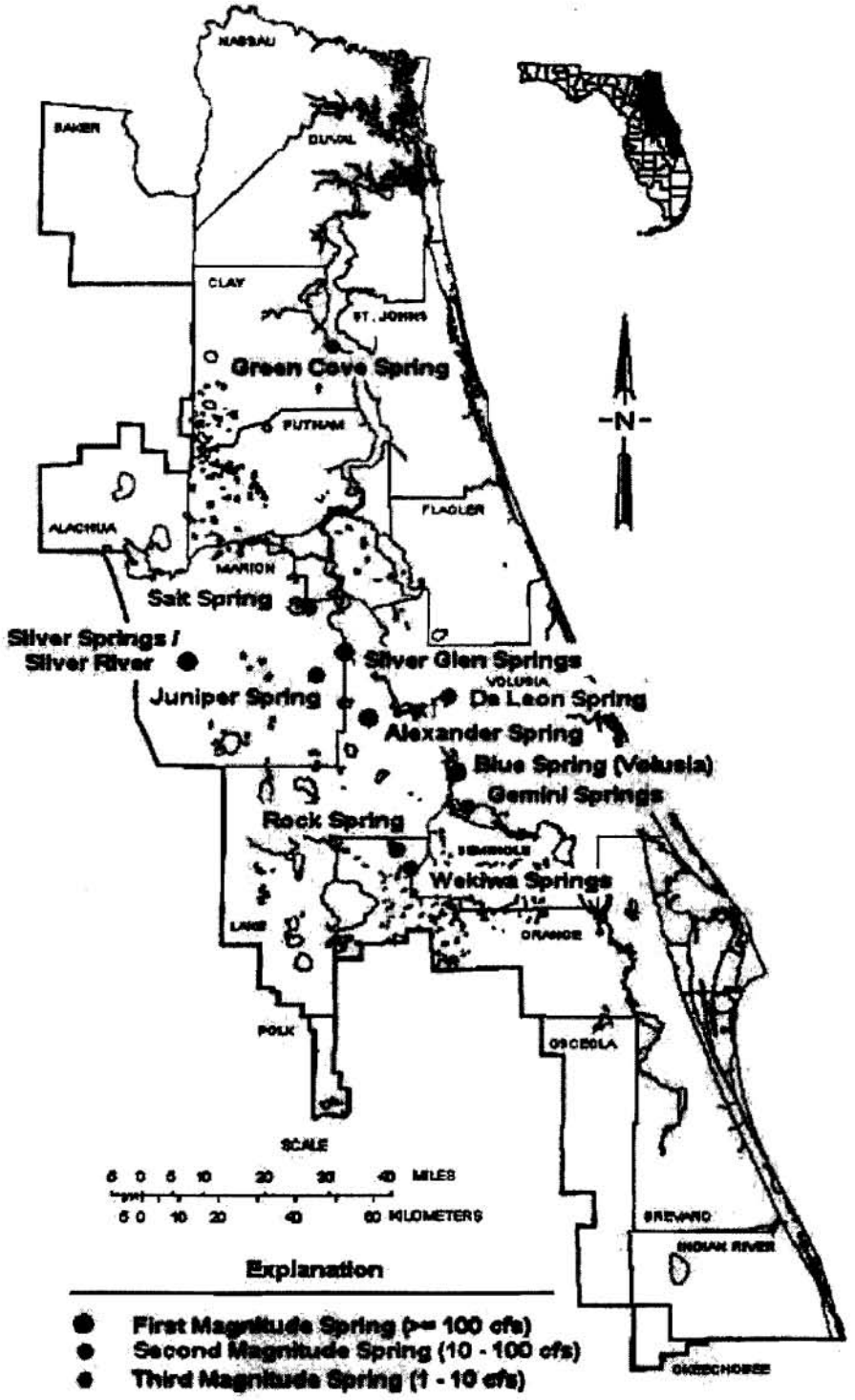


Figure 1. Location of Springs in Middle St. Johns River basin

3. WATERSHED DESCRIPTION

Springs in Florida are important as a source of surface water, habitat for aquatic life, and recreation. There are over 30 springs in the Middle St. Johns River basin. Springs occur at places where the potentiometric surface of the Floridan Aquifer is above the land surface and confining beds above the aquifer have been breached. The recharge area of the spring is defined as the springshed. Springs are classified by magnitude, or volume, of their flow or discharge. There are eight different classifications of springs (FGS, 2002). A Magnitude 1 spring has a discharge in excess of 100 cubic feet per second (cfs) whereas a Magnitude 8 spring has a discharge of less than one pint per minute. The following descriptions of the springs are from the *Middle St. Johns Basin Status Report* (FDEP, 2003) and the Florida Geological Survey (FGS) report entitled *Springs of Florida* (FGS, 2004). These documents should be consulted for additional details.

Wekiva Springs (WBID 2956C)

Wekiva Springs is located within Wekiva Springs State Park, approximately 4 miles northeast of the town on Apopka. Wekiva Springs State Park is heavily used for swimming, canoeing and camping. The spring pool is roughly circular and measures 105 ft in diameter. The primary vent is in the southeast portion of the pool and is a 35 ft long fissure in the limestone. The water of Wekiva Springs is clear bluish green. The boil over the vent is voluminous. Wekiva Springs is a Magnitude 2 spring having an annual mean discharge of about 74 cfs. Wekiva Springs discharges to Wekiva River, which in turn discharges into the St. Johns River north of Lake Monroe. Landuse use in the WBID is predominately forest and wetland (see Table 1). The drainage area shown in this table does not represent the springshed.

The nitrate-nitrite concentrations measured in Wekiva Springs is higher than those found in over 90 percent of Florida streams (FDEP, 2003). Overall habitat assessment scores for the spring are in the optimal range (i.e., > 120) indicating the benthic invertebrate community was not limited by habitat availability or quality. The stream condition index (SCI) for Wekiva Springs is in the "good" range. Diatoms with some blue-green taxa dominate the periphyton community in Wekiva Springs. The particular taxa found were indicative of eutrophic conditions, which was not surprising given the continued nutrient enrichment in Wekiva Springs.

Rock Springs Run (WBID 2967)

Rock Springs Run is located inside Kelly Park in Orange County, Florida. Rock Springs Run is the discharge stream for Rock Springs, which flows into the Wekiva River. Rock Springs emerges from a horizontal cave at the base of a 20 ft high vertical lirnestone and sand bluff. The spring originates from the Floridan Aquifer and is classified as a Magnitude 2 spring with annual mean discharge of about 64 cfs. The water from Rock Springs is clear and bluish. The cave and immediate vicinity of the springhead are closed to public use, but the rest of the run serves as a swimming, snorkeling and tubing hotspot. The spring is bordered on all sides by high, rolling sand hills that are owned and maintained as a county park. Landuse use in the WBID is predominately forest and wetland, with urban development accounting for 12 percent of the landuse in 2000 (see Table 1).

The nitrate-nitrite concentrations measured in Rock Springs Run are higher than those found in 95 percent of Florida streams. Overall habitat assessment scores for the spring are in the optimal range (i.e., > 120) indicating the benthic invertebrate community was not limited by habitat availability or quality. The SCI score for the spring is in the "good" range. Diatoms with some blue-

green taxa dominate the periphyton community in Rock Springs. The particular taxa found were indicative of eutrophic conditions, which was not surprising given the continued nutrient enrichment in Rock Springs.

Volusia Blue Spring (WBID 28933)

Volusia Blue Spring is 6 miles southwest of Deland in Volusia County, Florida. The spring is located inside Blue Spring State Park. Access to the springhead is by an elevated wooden boardwalk along the east bank of the spring run. The bottom of the spring is limestone and sand. The spring water is clear and blue with a greenish tinge. Algae are ubiquitous in the spring and its run. The spring run discharges directly to the St. Johns River through dense hardwood and palm forest. The spring and its run provide essential habitat for the endangered West Indian Manatee population of the St. Johns River and for two species of aquatic snails (Blue Spring Silt Snail) found nowhere else in the world. The spring originates from the Floridan Aquifer and is classified as a Magnitude 1 spring with annual mean discharge of about 162 cfs. The spring is considered an excellent place for nature study, swimming, scuba diving, and canoeing. Landuse use in the WBID is predominately forest and wetland (see Table 1).

The nitrate-nitrite concentrations measured in Volusia Blue Spring are higher than those found in 90 percent of Florida streams. Elevated nitrate-nitrite levels are related to nitrogen loading in the recharge basin. Overall habitat assessment scores for the spring are in the sub-optimal range due to lack of substrate availability/diversity. The SCI score for the spring is in the "poor" range. Diatoms with some blue-green taxa dominate the periphyton community in Volusia Blue Spring. The particular taxa found were indicative of eutrophic conditions, which was not surprising given the continued nutrient enrichment in Rock Springs.

Juniper Springs (WBID 2905A, reference conditions)

Juniper Springs is located in the Ocala National Forest in Marion County, Florida. Monitoring efforts at Juniper Springs are conducted through the St. Johns River Water Management District. Juniper Creek, which flows from Juniper Springs to Lake George, is a popular canoeing creek known for its aesthetic qualities. Juniper Springs has a generally shallow pool with multiple vents. The spring originates from the Floridan Aquifer and is classified as a Magnitude 2 spring with annual mean discharge of about 12 cfs. The bottom of the spring consists of sand and limestone with patches of native aquatic grasses. The spring water is clear and pale blue. Overall algal presence is relatively sparse. All land adjacent to the spring pool is landscaped and developed into a recreational area. Landuse in the WBID is predominately wetlands (see Table 1).

The nitrate-nitrite concentrations measured in Juniper Springs are lower than average for Florida streams and much lower than most Florida springs. Overall habitat assessment scores for the spring are in the "excellent" range. The SCI score for the spring is in the "optimal" range. The periphyton community was dominated by Diatoms with some blue-green and green algal taxa. This spring system is considered by FDEP to represent "least disturbed" conditions for springs in Florida.

4. WATER QUALITY STANDARD AND TARGET IDENTIFICATION

Wekiva Springs, Rock Springs Run, and Volusia Blue Spring are designated as Class III waters. The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Class III waters are further categorized based on fresh

or marine waters. Springs are considered freshwater systems. The water quality criteria for protection of Class III waters are established by the State of Florida in the Florida Administrative Code (F.A.C.), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative or more stringent criteria are specified in F.A.C. Section 62-302.530. In addition, unless otherwise stated, all criteria express the maximum not to be exceeded at any time. The specific criteria addressed in this document are as follows:

Nutrients (Class III Waters)

The State of Florida has narrative criteria for nutrients requiring 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.

Target Identification

A reference stream approach is used to establish ecological conditions supporting a balance in natural populations of aquatic flora or fauna. Juniper Springs was selected as an appropriate reference condition as the spring is ecologically healthy, discharges from the Floridan Aquifer, and has similar utilization features (i.e., swimming, canoeing and kayaking) as the impaired springs. Juniper Springs is not impaired for nutrients and has similar land cover distribution as the impaired springs.

Elevated nitrate-nitrite levels in the impaired streams are considered the main stressors associated with a relatively low quality algal community (FDEP, 2004). Controlling nitrate-nitrite should address the nutrient impairment. Nitrate-nitrite concentrations measured in Juniper Springs between 1991 and 2004 range between 0.072 and 0.581 mg/L (see Appendix A). The 90^{th} percentile concentration of the measured values is about 0.11 mg/L and is selected as the nutrient target as this is the statistic used to define existing conditions in the impaired streams. Historic levels of nitrate-nitrite measured in the impaired springs are within the range of levels measured in Juniper Creek (see
Table 3).

Table 1 Landuse Distribution

Description	Wekiva Springs (WBID 2956C)		Rock Springs Run (WBID 2967)		Volusia Blue Spring (WBID 28933)		Juniper Springs (WBID 2905A)	
	Area	Percentage	Area	Percentage	Area	Percentage	Area	Percentage
Residential	0	0	2485	11.7	0	0	0	0
Commercial, Industrial, & Public	0	0	325	1.5	0	0	0	0
Agriculture	0	0	3782	17.9	0	0	0	0
Rangeland	0	0	2244	10.6	0	0	0	0
Forest	0.89	4.9	5690	26.9	18	96.3	1	6
Water	1.11	6.1	165	0.8	0	0	0	0
Wetlands	16	89.0	6254	29.5	1	3.7	17	94
Barren & Extractive	0	0	186	0.9	0	0	0	0
Transportation & Utilities	0	0	47	0.2	0	0	0	0
Total	18	100	21,177	100	19	100	18	100

5. WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

FDEP maintains ambient monitoring stations throughout the basin. All data collected at monitoring stations within the impaired WBIDs and reference stream are used in the analysis. Table 2 provides a list of the monitoring stations used in the development of the TMDL. Data collected during the Group 3 listing cycle (i.e., January 1997 through December 2003) and recent data collected as part of the Springs Initiative Monitoring Program are considered in the data assessment.

Table 3 provides a statistical summary of available nutrient data collected at the stations identified in Table 2. The data summarized in
Table 3 is from FDEP's Impaired Waters Rule (IWR) database and the Springs Initiative Monitoring Program. The U.S. Geological Survey (USGS) has been monitoring water quality in Florida springs as early as the 1930's. A summary of water quality data available from the USGS not in the IWR database is provided in Table 4. The USGS data collected in Rock Springs is from the spring vent and may not be a complete characterization of water quality in the spring run.

Chlorophyll-a concentrations above 20 μg/L are often used as an indicator of nutrient problems in a stream. In the impaired springs, chlorophyll-a levels are well below this threshold value. Total phosphorus and Total Kjeldahl nitrogen (TKN) concentrations during most sampling events were relatively average for most Florida streams. Nitrate-Nitrite concentrations in all impaired springs were higher than the concentrations found in 90 percent of Florida streams. In general, nitrate concentrations in excess of 1 mg/L cause a significant shift in the balance of spring ecologic communities, leading to intensified degradation of the biological system (SJRWMD, 2002). The trend in nitrate-nitrite levels in the impaired springs over time is shown in Figures 2 through 4. Conductivity is considered one of the most important variables regulating the changes of algal species composition in aquatic ecosystems (Stevenson, 2004). Springs with high conductivity often have thicker algal mats and a higher percentage of the spring bottom covered by macroalgae.

The USGS has monitored the geochemistry of the Floridan Aquifer system using data collected from both wells and springs (Sprinkle, 1989). In this report, nitrogen and phosphorus concentrations in groundwater are summarized by statistical quartiles. The 75th percentile concentration of nitrate and nitrate-nitrite in water samples collected in the Upper Floridan Aquifer is about 0.02 and 0.08 mg/L, respectively. Results of statistical analysis indicate an observed trend of increasing nitrate concentrations in the groundwater in unconfined recharge areas of the Upper Floridan aquifer, probably a result of increased development.

Table 2. Monitoring Stations used in the Development of Nutrient TMDLs

Wekiva Springs (WBID 2956C)	21FLORANBW82	4/1/1996 – 12/1/1998	12
	SPRINGS006 (Springs Initiative Monitoring Program)	10/16/2000 – 11/9/2004	7
	21FLGW 11403	5/7/2002 – 10/17/2002	2
Rock Springs Run (WBID 2967)	Springs Initiative Monitoring Program (STORET ID not known)	4/17/2002 – 11/9/2004	6
	21FLCEN 20010342	1/11/1999 – 10/22/2002	6

	21FLGW 11395	5/7/2002	1
	21FLORANBWA	1/31/1991 – 10/19/1992	8
	21FLSJWM73483	10/2/2002 – 4/6/2003	8
Volusia Blue Spring (WBID 28933)	SPRINGS005 (Springs Initiative Monitoring Program)	10/17/2000 – 4/20/2004	8
	112WRD 02235500	6/16/1998 – 9/24/2002	20
	21FLCEN 20010364	3/18/2002 – 10/22/2002	5
	21FLGW 9673	10/24/2001 – 4/8/2003	7
	21FLCEN 20010365	3/18/2002 – 10/22/2002	7
Juniper Springs	Springs Initiative Monitoring Program (STORET ID not known)	4/9/2002 – 5/4/2004	5

Table 3. Summary of Nutrient Monitoring Data

Wekiva Springs (2956C)	Chlorophyll–a (µg/L)	12	1.000	3.500	1.700	2.35
	Ammonia (mg/L)	21	0.010	0.220	0.028	0.041
	Nitrate-Nitrite (mg/L)	9	0.290	1.500	1.049	1.41
	TKN (mg/L)	22	0.063	2.500	0.499	1.09
	Total Phosphorus (mg/L)	22	0.012	0.160	0.099	0.147
	Dissolved Oxygen (mg/L)	22	0.330	7.170	3.955	7.17
	Conductivity(umhos/cm)	22	136	1023	321.5	349
Rock Springs Run (2967)	Chlorophyll–a (µg/L)	29	1.000	6.800	1.953	4.05
	Ammonia (mg/L)	47	0.010	0.424	0.045	0.1
	Nitrate-Nitrite (mg/L)	29	0.044	1.700	1.037	1.52
	TKN (mg/L)	52	0.060	3.500	0.599	1.28
	Total Phosphorus (mg/L)	50	0.010	0.477	0.103	0.17
	Dissolved Oxygen (mg/L)	55	1.020	8.700	5.291	7.49
	Conductivity(umhos/cm)	50	26	420	248	281
Volusia Blue Springs (28933)	Chlorophyll–a (µg/L)	1	2.8			
	Ammonia (mg/L)	41	0.010	0.180	0.051	0.12
	Nitrate-Nitrite (mg/L)	47	0.100	0.900	0.518	0.784
	TKN (mg/L)	46	0.060	0.430	0.201	0.25
	Total Phosphorus (mg/L)	46	0.020	0.840	0.085	0.0805
	Dissolved Oxygen (mg/L)	42	0.280	6.700	1.410	2.87
	Conductivity(umhos/cm)	8	138	2019	1075	1799
Juniper Springs	Chlorophyll–a (µg/L)	Not available				
	Ammonia (mg/L)	5	0.01	0.01	0.01	0.01
	Nitrate-Nitrite (mg/L)	22	0.066	0.581	0.104	0.11
	TKN (mg/L)	5	0.06	0.071	0.062	0.066

	Total Phosphorus (mg/L)	7	0.029	0.056	0.037	0.051
	Dissolved Oxygen (mg/L)	7	6	9.72	7.52	8.93
	Conductivity(umhos/cm)	28	106	144	119	128

Table 4. Historic Nutrient Levels in Impaired Springs (USGS data)

Wekiva Springs (USGS02234600)	Ammonia (mg/L)	1	0.02				9/2/1977
	Nitrate (mg/L)	12	0.1	6.0	2.017	4.35	1/11/1961 – 11/8/1971
	Nitrite (mg/L)	6	0.01	0.06	0.027	0.055	6/3/1969 – 11/8/1971
	Total Phosphorus (mg/L)	6	0.1	0.12	0.11	0.115	4/11/1972 – 5/22/2001
	Dissolved Oxygen (mg/L)	9	0.1	1.6	0.656	1.52	4/21/1969 – 9/17/2001
Rock Springs (USGS2334610)	Ammonia (mg/L)	2	0.01	0.03	0.02	0.028	5/6/1971 – 8/16/1999
	Nitrate (mg/L)	19	0.1	6.3	2.505	4.96	4/26/1956 – 11/8/1971
	Nitrite (mg/L)	5	0.01	0.02	0.012	0.016	11/17/1969 – 11/8/1971
	Total Phosphorus (mg/L)	1	0.08				8/16/1999
	Dissolved Oxygen (mg/L)	8	0.2	4	1.975	3.16	4/21/1969 – 2/27/2001
Volusia Blue Springs (USGS02235500)	Ammonia (mg/L)	14	0.06	0.14	0.099	0.12	5/2/1972 – 4/8/2004
	Nitrate (mg/L)	8	0.2	3.9	1.163	2.08	11/1/1960 – 9/16/1971
	Nitrite (mg/L)	3	0.01	0.02	0.017	0.02	5/23/1970 – 4/26/1971
	Total Phosphorus (mg/L)	42	0.01	0.14	0.068	0.09	5/2/1972 – 7/29/2004
	Dissolved Oxygen (mg/L)	20	0.2	3.2	1.435	2.33	5/9/1967 – 7/29/2004
Juniper Springs (USGS02236130)	Ammonia (mg/L)	Not Measured					

	Nitrate (mg/L)	3	0.02	0.07	0.037	0.06	6/16/1960 – 4/28/1972
	Nitrite (mg/L)	1	0.006				4/28/1972
	Total Phosphorus (mg/L)	Not Measured					
	Dissolved Oxygen (mg/L)	9	6	7.4	6.578	7.08	11/3/1908 – 2/27/2001

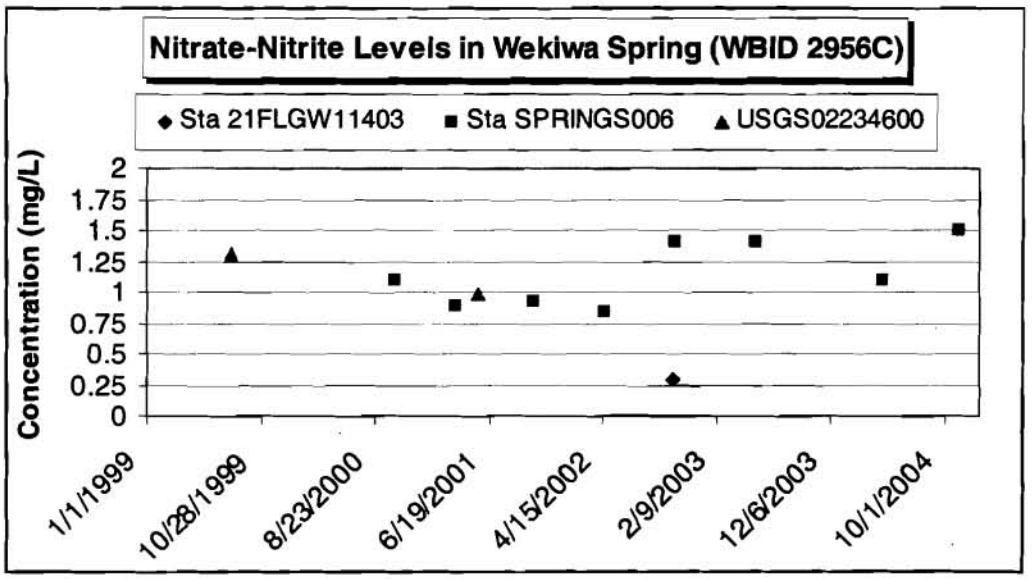
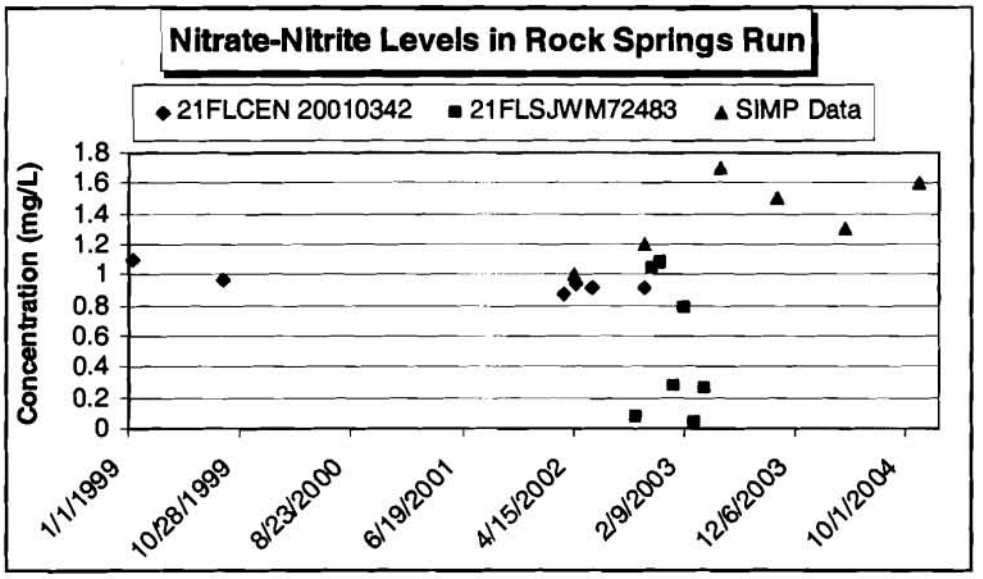


Figure 2. Nitrate-Nitrite levels in Wekiva Springs



Note: SIMP data is collected as part of Springs Initiative Monitoring Program

Figure 3. Nitrate-Nitrite levels in Rock Springs Run

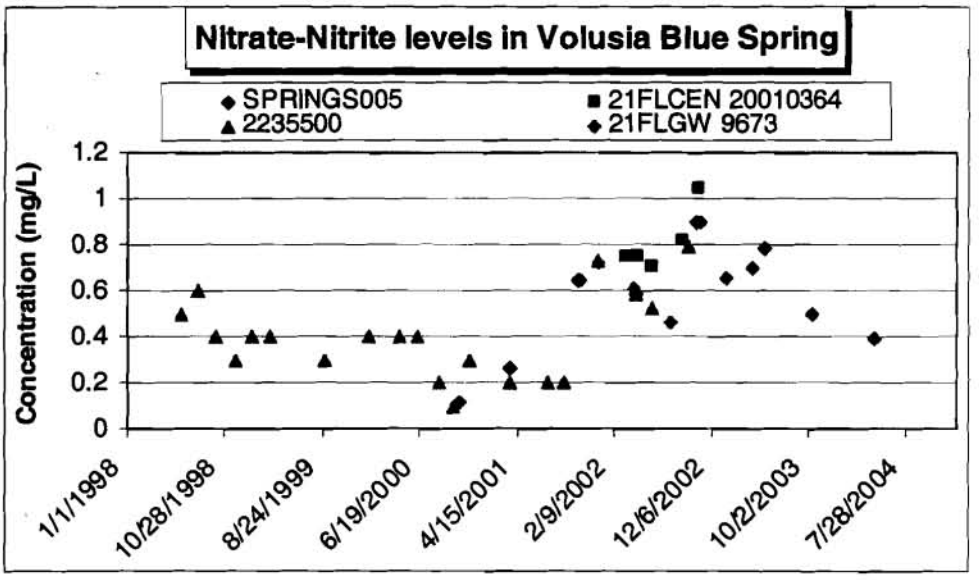


Figure 4. Nitrate-Nitrite levels in Volusia Blue Springs

6. SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of nutrients in the springshed, and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or non-point sources.

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. Industrial NPDES permitted facilities discharging treated effluent or stormwater (i.e., Phase I or II MS4 discharges) are considered primary point sources of nutrients.

Non-point sources of pollution are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of nutrients on land surfaces and wash off as a result of storm events. The major issues impacting the health of springs include population growth, urban sprawl, and the growing demand for groundwater, and introduction of fertilizers, pesticides, and other pollutants to the springshed.

6.1 Point Sources

There are no point sources discharging directly into the impaired WBIDs. In addition, none of the springs are within a Municipal Separate Storm Sewer Systems (MS4s) jurisdiction. Currently, large and medium MS4s serving populations greater than 100,000 people are required to obtain a NPDES storm water permit. In March 2003, small MS4s serving urbanized areas will be required to obtain a permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile.

6.2 Non-point Sources

The spring recharge basin consists of all areas where water can be shown to contribute to the groundwater flow system that discharges from the impaired spring. Chemical and biological constituents that enter the aquifer through recharge processes may affect the water quality, flora and fauna of springs and spring runs. As water quality in the Floridan aquifer has declined, the flora and fauna associated with the springs have been negatively affected. Changes in water quality are a direct result of Florida's increased population and changed landuse patterns.

Elevated nitrates have been identified by FDEP as a problem in springs (FGS, 2004). Nitrates found in spring water originate from fertilizers, septic tanks, and animal waste that enter the aquifer in the spring recharge area. Nitrate encourages algal and invasive aquatic plant growth, which leads to eutrophication of the spring and spring run. Nitrite is less of a problem in springs, and can originate from sewage and other organic waste products.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as outlined in Chapter 403 Florida Statutes (F.S.), was established as a technology-based program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C.

Florida's stormwater program is unique in having a performance standard for older stormwater systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older stormwater management systems shall be reduced as needed to

restore or maintain the beneficial uses of water" (Section 62-4-.432 (5) (c), F.A.C.).

Nonstructural and structural BMPs are an integral part of the State's stormwater programs. Nonstructural BMPs, often referred to as "source controls", are those that can be used to prevent the generation of nonpoint source pollutants or to limit their transport off-site. Typical nonstructural BMPs include public education, land use management, preservation of wetlands and floodplains, and minimizing impervious surfaces. Technology-based structural BMPs are used to mitigate the increased stormwater peak discharge rate, volume, and pollutant loadings that accompany urbanization.

7. ANALYTICAL APPROACH

The approach for calculating the nutrient TMDLs are based on a reference stream approach. Nitrate has been identified as the nutrient having the greatest negative impact on water quality. By reducing nitrate concentrations in the impaired springs to levels observed in a non-impaired spring, water quality standards should be achieved. The TMDL is expressed as a percent reduction necessary to reduce nitrate concentrations to levels measured in unimpaired streams of comparable land use and size. The reduction needed to meet the target concentration is calculated based on the 90th percentile of all measured nitrate concentrations in the impaired springs. The 90th percentile concentration implies 90 percent of the measured values are lower than this concentration or 10 percent are higher. The 90th percentile concentration represents existing conditions. The percent reduction required to meet the nitrate target is based on the following equation:

Percent Reduction (%) = (existing concentration – target) / existing concentration * 100 (equation 1)

8. DEVELOPMENT OF TOTAL MAXIMUM DAILY LOADS

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measure. The nutrient TMDLs for Wekiva Springs, Rock Springs Run, and Volusia Blue Spring is expressed in terms of a percent reduction. A WLA for nutrients is not applicable as there are no facilities discharging in the irnpaired WBIDs.

8.1 Critical Conditions

Critical conditions were addressed in the TMDL by using all data collected in the WBID in the analysis. The critical condition for nutrients is typically occurs between April and August when excessive algal growth can lead to imbalances in the algal community structure (dominance by only a few species) and impacts to the food web (undesirable prey for zooplankton and fish species). Controlling nitrates in the springshed should result in reduced algal growth, which will be critical to achieving water quality standards for nutrients.

8.2 Existing Conditions

Existing conditions are based on the 90th percentile concentration of nitrates measured in the impaired springs. As shown in
Table 3, the 90th percentile nitrate-nitrite concentrations in Wekiva Springs, Rock Springs Run, and Volusia Blue Spring is 1.41, 1.52, and 0.784 mg/L, respectively.

8.3 Margin of Safety

There are two methods for incorporating a MOS in the analysis: a) implicitly incorporate the MOS using conservative assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. An implicit MOS was used in the analysis as a conservative nitrate level was selected as the target.

8.4 Determination of TMDL, LA and WLA

The TMDL components are expressed as percent reduction required for meeting the nitrate target of 0.11 mg/L. By achieving the reduction in the sources contributing nitrates, nutrient levels in the springs and spring runs should be reduced to levels necessary for attainment of the designated use. TMDL components for the impaired springs are summarized in Table 5. Although the reductions proposed in Table 5 are high, much of the reductions may have been achieved through the efforts of the Florida Springs Task Force as evident by declines in current nitrate levels (see Appendix A).

Table 5. Summary of TMDL Components

Wekiva Springs (WBID 2956C)	Nitrate	N/A	N/A	92% reduction	92% reduction
Rock Springs Run (WBID 2967)	Nitrate	N/A	N/A	93% reduction	93% reduction
Volusia Blue Springs (WBID 28933)	Nitrate	N/A	N/A	86% reduction	86% reduction

8.4.1. Waste Load Allocations

There are no NPDES facilities discharging to the WBIDs of concern. Any future facility permitted to discharge nutrients in the impaired WBIDs will be required to meet end-of-pipe limits that do not

cause or contribute to nutrient impairment in the spring. Future urban development in the WBIDs that qualify the municipalities as an MS4 entity will be required to meet the nitrate reductions proposed in this TMDL.

8.4.2. Load Allocations

The primary modes of transport of nitrates to the spring and spring runs is through groundwater recharge processes and surface water runoff. The load allocations for the impaired springs are expressed as a percent reduction in nitrate necessary to achieve narrative nutrient water quality standards. By reducing nitrate concentrations in the springshed, the growth of invasive plant species should be reduced, resulting in an improvement to the flora and fauna of the springs and spring runs.

8.5 Seasonal Variation

Seasonal variation was incorporated in the analysis by using the entire period of record of data collected in the WBID. The critical condition for nutrients is typically occurs between April and August when excessive algal growth can lead to imbalances in the algal community structure. In general, the highest nitrate measurements occurred during this time period (see Appendix A).

9. RECOMMENDATIONS

Controlling nitrate sources in the recharge areas of the springs should be the focus of implementing this TMDL. Through the Spring Task Force, FDEP has developed outreach strategies aimed at educating the public on threats affecting springs. Details of these strategies can be found at: www.dep.state.flu.us/springs/protection/.

FDEP employs the Basin Management Action Plan (B-MAP) as the mechanism for developing strategies to accomplish the necessary load reductions. Components of a B-MAP are:

- Allocations among stakeholders
- Listing of specific activities to achieve reductions
- Project initiation and completion timeliness
- Identification of funding opportunities
- Agreements
- Local ordinances
- Local water quality standards and permits
- Follow-up monitoring

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APPENDIX A WATER QUALITY DATA

Table A- 1. Guide to Water Quality Remark Codes (Rcode column in data tables)

Remark Code	Definition
A	Value reported is mean of two or more samples
E	Extra sample taken in compositing process
I	The value reported is less than the practical quantification limit and greater than or equal to the method detection limit.
J	Estimated, Value shown is not a result of analytical measurement.
K	Off-scale low. Actual value not known, but known to be less than value shown
U	Material was analyzed for but not detected. Value stored is the limit of detection.
<	NAWQA – actual value is known to be less than the value shown
Z	Too many colonies were present to count (TNTC), the numeric value represents the filtration volume

Table A- 2. Select nutrient data collected in Wekiva Springs (WBID 2956C)

Parameter	Station	Date	Time	Concentration	Rcode
Chlorophyll-a (µg/L)	21FLORANBW82	2/23/1994	1200	1	&
		5/31/1994	1138	1	&
		8/23/1994	1210	1	&
		11/1/1994	1200	1.1	
		2/14/1995	1351	2.9	
		8/22/1995	1143	1.4	
		11/29/1995	1135	2.4	
		1/11/1996	1155	1	
		4/9/1996	1245	1	&
		7/8/1996	1215	1.7	
		10/8/1996	1230	2.4	
		2/25/1997	1130	3.5	
Ammonia (mg/L)	21FLGW 11403	10/17/2002	1039	0.012	I
	21FLORANBW82	4/9/1996	1245	0.01	K
		7/8/1996	1220	0.01	K
		9/29/1996	805	0.01	K
		10/8/1996	1230	0.03	
		2/25/1997	1130	0.01	
		8/22/1997	2500	0.02	
		10/29/1997	2500	0.22	
		3/24/1998	2500	0.05	
		6/23/1998	2500	0.01	K
		6/24/1998	2500	0.01	K
		9/29/1998	2500	0.01	K

Parameter	Station	Date	Time	Concentration	Rcode
		12/1/1998	2500	0.01	K
	Springs006	10/16/2000		0.015	I
		3/21/2001		0.031	
		10/16/2001		0.022	
		4/17/2002		0.015	I
		10/22/2002		0.041	
		5/20/2003		0.016	I
		4/20/2004		0.01	U
		11/9/2004		0.031	I
	USGS 2234600	9/2/1977	16:40	0.02	
		8/10/1999	15:00	0.03	
		5/22/2001	10:00	0.03	
Nitrite (mg/L)	21FLORANBW82	4/9/1996	1245	0.007	
		7/8/1996	1220	0.01	
		9/29/1996	805	0.005	K
		10/8/1996	1230	0.005	K
		2/25/1997	1130	0.006	
		8/22/1997	2500	0.005	K
		10/29/1997	2500	0.012	
Nitrite (mg/L)	21FLORANBW82	3/24/1998	2500	0.005	K
		6/23/1998	2500	0.005	K
		6/24/1998	2500	0.007	
		9/29/1998	2500	0.005	K
		12/1/1998	2500	0.005	K
	USGS 2234600	6/13/1969	11:15	0.01	
		11/17/1969	12:10	0.01	
		5/15/1970	10:30	0.05	
		9/21/1970	12:50	0.01	
		5/6/1971	9:40	0.06	
		11/8/1971	12:30	0.02	
Nitrate (mg/L)	21FLORANBW82	4/9/1996	1245	1.338	
		7/8/1996	1220	1.77	
		9/29/1996	805	0.01	K
		10/8/1996	1230	1.6	
		2/25/1997	1130	1.24	
		8/22/1997	2500	0.24	
		10/29/1997	2500	0.39	
		3/24/1998	2500	0.17	
		6/23/1998	2500	0.01	K
		6/24/1998	2500	0.01	K
		9/29/1998	2500	0.01	K
		12/1/1998	2500	0.01	K
	USGS 2234600	6/13/1969	11:15	0.01	
		11/17/1969	12:10	0.01	

Parameter	Station	Date	Time	Concentration	Rcode
		5/15/1970	10:30	0.05	
		9/21/1970	12:50	0.01	
		5/6/1971	9:40	0.06	
		11/8/1971	12:30	0.02	
Nitrate-Nitrite (mg/L)	21FLGW 11403	10/17/2002	1039	0.29	
	Springs006	10/16/2000		1.1	
		3/21/2001		0.89	
		10/16/2001		0.92	
		4/17/2002		0.84	J
		10/22/2002		1.4	
		5/20/2003		1.4	
		4/20/2004		1.1	
		11/9/2004		1.5	
	USGS 2234600	9/2/1977	16:40	0.63	
		8/10/1999	15:00	1.3	
		5/22/2001	10:00	0.98	
Total Phosphorus (mg/L)	21FLGW 11403	5/7/2002	1516	0.16	J
		10/17/2002	1039	0.12	
	21FLORANBW82	4/9/1996	1245	0.12	
		7/8/1996	1220	0.12	
		9/29/1996	805	0.15	
		10/8/1996	1230	0.114	
		2/25/1997	1130	0.106	
		8/22/1997	2500	0.048	
		10/29/1997	2500	0.077	
		3/24/1998	2500	0.065	
		6/23/1998	2500	0.024	
		6/24/1998	2500	0.034	
		9/29/1998	2500	0.012	
		12/1/1998	2500	0.014	
	USGS2234600	4/11/1972		0.1	
		9/2/1977		0.11	
		8/10/1999		0.12	
		5/22/2001		0.11	
	Springs006	10/16/2000		0.12	
		3/21/2001		0.11	
		10/16/2001		0.14	J
		4/17/2002		0.11	
		10/22/2002		0.13	J
		5/20/2003		0.13	
		4/20/2004		0.15	

Parameter	Station	Date	Time	Concentration	Rcode
		11/9/2004		0.13	
Total Kjeldahl Nitrogen (mg/L)	21FLGW 11403	5/7/2002	1516	0.063	I
		10/17/2002	1039	0.12	I
	21FLORANBW82	4/9/1996	1245	0.2	
		7/8/1996	1220	0.2	
		9/29/1996	805	1.1	
		10/8/1996	1230	0.2	
		2/25/1997	1130	0.2	K
		8/22/1997	2500	0.6	
		10/29/1997	2500	0.9	
		3/24/1998	2500	0.9	
		6/23/1998	2500	1	
		6/24/1998	2500	2.5	
		9/29/1998	2500	1.3	
		12/1/1998	2500	0.7	
	Springs006	10/16/2000		0.1	I
		3/21/2001		0.084	I
		10/16/2001		0.12	I
Total Kjeldahl Nitrogen (mg/L)	Springs006	4/17/2002		0.1	I
		10/22/2002		0.151	
		5/20/2003		0.191	
		4/20/2004		0.067	I
		11/9/2004		0.19	I

Table A- 3. Select nutrient data collected in Rock Springs Run (WBID 2967)

Parameter	Station	Date	Time	Concentration	Rcode
Chlorophyll-a (μg/L)	21FLCEN 20010342	4/23/2002	1255	1.4	
	21FLORANBWA	1/14/1996	920	1.1	
		4/12/1996	930	1	&
		7/11/1996	855	2.1	
		10/11/1996	930	3	
		2/28/1997	950	4.5	
Ammonia (mg/L)	21FLCEN 20010342	1/11/1999		0.0121	
		9/13/1999		0.01331	
		3/18/2002	1250	0.0242	I
		4/23/2002	1252	0.03146	J
		6/4/2002	1304	0.01452	I
		9/3/2002	1210	0.4235	
		10/22/2002	1359	0.0363	
	21FLGW 11395	5/7/2002	1131	0.01	U

Parameter	Station	Date	Time	Concentration	Rcode
	21FLORANBWA	1/14/1996	920	0.136	
		4/12/1996	930	0.01	K
		7/11/1996	855	0.01	K
		10/11/1996	930	0.04	
		2/28/1997	950	0.01	K
		8/22/1997	2500	0.01	K
		10/29/1997	2500	0.01	K
		3/24/1998	2500	0.01	K
		6/23/1998	2500	0.02	
		9/29/1998	2500	0.01	
		12/1/1998	2500	0.14	
		10/2/2002	1300	0.25	
		1/12/2003	820	0.044	
		2/8/2003	915	0.013	I
		3/10/2003	1130	0.043	
		4/6/2003	850	0.028	I
	Springs Initiative Program (sample ID not known	4/17/2002		0.01	U
		10/22/2002		0.018	I
		5/20/2003		0.011	I
		10/16/2003		0.01	U
Ammonia (mg/L)	Springs Initiative Program (sample ID not known)	4/20/2004		0.01	U
		11/9/2004		0.01	U
Nitrite (mg/L)	21FLORANBWA	1/14/1996	920	0.005	
		4/12/1996	930	0.013	
		7/11/1996	855	0.008	
		10/11/1996	930	0.005	K
		2/28/1997	950	0.005	K
		8/22/1997	2500	0.005	
		10/29/1997	2500	0.005	K
		3/24/1998	2500	0.005	K
		6/23/1998	2500	0.005	K
		9/29/1998	2500	0.006	
		12/1/1998	2500	0.005	K
	USGS2234610	11/17/1969	11:30	0.01	
		5/16/1970	12:00	0.02	
		9/21/1970	9:35	0.01	
		5/6/1971	11:50	0.01	
		11/8/1971	11:25	0.01	
Nitrate (mg/L)	21FLORANBWA	1/14/1996	920	0.93	
		4/12/1996	930	1.12	
		7/11/1996	855	1.39	
		10/11/1996	930	1.25	
		2/28/1997	950	1.05	
		8/22/1997	2500	0.01	K
		10/29/1997	2500	0.01	K
		3/24/1998	2500	0.01	K

Parameter	Station	Date	Time	Concentration	Rcode
		6/23/1998	2500	0.01	
		9/29/1998	2500	0.01	K
		12/1/1998	2500	0.01	K
	USGS2234610	4/26/1956	16:00	0.1	
		10/17/1960	15:40	1.2	
		1/11/1961		2.7	
		5/25/1961	15:55	1	
		5/6/1962		0.5	
		10/11/1968	10:45	0.2	
		10/28/1968	12:10	2.6	
		12/9/1968	12:30	2.7	
		1/27/1969	12:10	0.2	
		3/10/1969	11:45	2.1	
		4/21/1969	11:21	3.1	
		6/13/1969	10:20	2.9	
		8/11/1969	11:30	3.1	
		9/29/1969	11:55	3.7	
		11/17/1969	11:30	5.2	
		5/16/1970	12:00	6.3	
		9/21/1970	9:35	0.4	
Nitrate (mg/L)	USGS2234610	5/6/1971	11:50	4.9	
		11/8/1971	11:25	4.7	
Nitrate-Nitrite (mg/L)	21FLCEN 20010342	1/11/1999		1.1	
		9/13/1999		0.96	
		3/18/2002	1250	0.88	
		4/23/2002	1252	0.94	
		6/4/2002	1304	0.91	
		10/22/2002	1359	0.91	
	21FLGW 11395	5/7/2002	1131	1.3	
	21FLSJWM73483	10/2/2002	1300	0.084	
		11/14/2002	1210	1.04	
		12/5/2002	1355	1.07	
		12/5/2002	1400	1.08	
		1/12/2003	820	0.276	
		2/8/2003	915	0.786	
		3/10/2003	1130	0.044	
		4/6/2003	850	0.261	
	Springs Initiative Program (sample ID not known)	4/17/2002		1	J
		10/22/2002		1.2	
		5/20/2003		1.7	
		10/16/2003		1.5	
		4/20/2004		1.3	
		11/9/2004		1.6	
Total	21FLCEN 20010342	3/18/2002	1250	0.086	A
		4/23/2002	1252	0.097	

Parameter	Station	Date	Time	Concentration	Rcode
Phosphorus (mg/L)		6/4/2002	1304	0.092	
		9/3/2002	1210	0.28	
		10/22/2002	1359	0.1	J
	21FLGW 11395	5/7/2002	1131	0.082	
	21FLORANBWA	1/14/1996	920	0.088	
		4/12/1996	930	0.086	
		7/11/1996	855	0.098	
		10/11/1996	930	0.087	
		2/28/1997	950	0.093	
		8/22/1997	2500	0.034	
		10/29/1997	2500	0.01	
		3/24/1998	2500	0.021	
		6/23/1998	2500	0.023	
		9/29/1998	2500	0.016	
		12/1/1998	2500	0.015	
	21FLSJWM73483	10/2/2002	1300	0.169	
		11/14/2002	1210	0.183	
		12/5/2002	1355	0.085	
Total Phosphorus (mg/L)	21FLSJWM73483	12/5/2002	1400	0.098	
		1/12/2003	820	0.042	
		2/8/2003	915	0.068	
		3/10/2003	1130	0.113	
		4/6/2003	850	0.118	
	Springs Initiative Program (sample ID not known)	4/17/2002		0.098	A
		10/22/2002		0.096	J
		5/20/2003		0.11	
		10/16/2003		0.099	
		4/20/2004		0.11	
		11/9/2004		0.084	A
Total Kjeldahl Nitrogen (mg/L)	21FLCEN 20010342	1/11/1999		0.15	
		9/13/1999		0.17	
		3/18/2002	1250	0.19	I
		4/23/2002	1252	0.19	I
		6/4/2002	1304	0.16	I
		9/3/2002	1210	3.5	
		10/22/2002	1359	0.92	J
	21FLGW 11395	5/7/2002	1131	0.06	U
	21FLORANBWA	1/14/1996	920	0.3	
		4/12/1996	930	0.4	
		7/11/1996	855	0.3	
		10/11/1996	930	0.5	
		2/28/1997	950	0.2	
		8/22/1997	2500	1.4	
		10/29/1997	2500	0.8	

Parameter	Station	Date	Time	Concentration	Rcode
		3/24/1998	2500	1	
		6/23/1998	2500	0.8	
		9/29/1998	2500	0.5	
		12/1/1998	2500	0.8	
		10/2/2002	1300	2.76	
		11/14/2002	1210	0.76	
		12/5/2002	1355	0.54	
		12/5/2002	1400	0.63	
		1/12/2003	820	1.24	
		2/8/2003	915	0.526	
		3/10/2003	1130	1.4	
		4/6/2003	850	1.27	
	Springs Initiative Program (sample ID not known)	4/17/2002		0.06	U
		10/22/2002		0.23	
		5/20/2003		0.06	U
		10/16/2003		0.096	I
		4/20/2004		0.06	U
		11/9/2004		0.06	U

Table A- 4. Select nutrient data collected in Volusia Blue Spring (WBID 28933)

Parameter	Station	Date	Time	Concentration	Rcode
Chlorophyll-a (μg/L)	21FLCEN 20010365	3/18/2002	1110	2.8	
Ammonia (mg/L)	21FLCEN 20010364	3/18/2002	1037	0.03025	
		4/23/2002	1017	0.0242	
		6/4/2002	1008	0.01331	
		9/3/2002	956	0.01573	
	21FLCEN 20010365	3/18/2002	1105	0.03146	
		4/23/2002	1040	0.02662	
		10/22/2002	1042	0.01331	
	21FLGW 9673	10/24/2001	1030	0.03267	
		12/18/2001	1433	0.01	U
		4/8/2002	1100	0.021	
		7/31/2002	1235	0.048	
		10/29/2002	1030	0.01	U
		1/20/2003	1645	0.01	U
		4/8/2003	1511	0.013	
	112WRD 02235500	5/6/1976	11:00	0.08	
		5/25/1977	8:10	0.08	
		9/2/1977	10:45	0.11	
		5/30/1978	10:00	0.12	
		5/15/1979	10:40	0.09	
		4/21/1980	9:40	0.12	
		5/20/1981	12:15	0.11	

Parameter	Station	Date	Time	Concentration	Rcode
		2/5/1985	10:30	0.08	
		6/16/1998	11:38	0.03	
		8/7/1998	11:30	0.01	<
		9/28/1998	10:30	0.07	
		12/4/1998	10:08	0.08	
		1/22/1999	11:50	0.08	
		3/18/1999	14:30	0.08	
		9/1/1999	11:29	0.12	
		1/11/2000	13:00	0.06	
		4/18/2000	16:45	0.1	
		6/8/2000	11:30	0.06	
		8/15/2000	10:44	0.15	
		9/28/2000	10:30	0.12	
		11/16/2000	10:51	0.18	
		3/19/2001	12:50	0.12	
		7/17/2001	12:15	0.12	
		9/4/2001	13:25	0.12	
		12/18/2001	12:15	0.02	
		4/15/2002	14:03	0.03	
		6/5/2002	12:30	0.02	
		9/24/2002	13:30	0.01	<
		11/21/2002	11:55	0.01	
Ammonia (mg/L)	112WRD 02235500	3/13/2003	14:30	0.01	<
		5/8/2003	16:08	0.01	<
		8/18/2003	17:00	0.01	
		10/23/2003	13:12	0.03	
		2/12/2004	14:42	0.02	
		4/8/2004	15:00	0.06	
	SPRINGS005	10/17/2000		0.093	
		3/21/2001			
		10/16/2001		0.01	U
		4/17/2002		0.018	I
		10/21/2002		0.022	
		5/19/2003		0.01	U
		10/14/2003		0.01	U
		4/20/2004		0.041	
Nitrate-Nitrite (mg/L)	21FLGW 9673	10/24/01	1030	0.64	
		12/18/01	1433	0.72	
		4/8/02	1100	0.61	
		7/31/02	1235	0.46	
		10/29/02	1030	0.9	
		1/20/03	1645	0.65	
		4/8/03	1511	0.7	
	21FLCEN 20010364	3/18/02	1037	0.56	
		4/23/02	1017	0.57	
		6/4/02	1008	0.53	
		9/3/02	956	0.65	

Parameter	Station	Date	Time	Concentration	Rcode
		10/22/02	1027	0.85	
	21FLCEN 20010365	3/18/02	1105	0.57	
		4/23/02	1040	0.59	
		6/4/02	1025	0.55	
		9/3/02	1016	0.67	
		10/22/02	1042	0.85	
	112WRD 02235500	6/16/1998	1138	0.5	
		8/7/98	1130	0.6	
		9/28/98	1030	0.4	
		12/4/98	1008	0.3	
		1/22/99	1150	0.4	
		3/18/99	1430	0.4	
		9/1/99	1129	0.3	
		1/11/00	1300	0.4	
		4/18/00	1645	0.4	
		6/8/00	1130	0.4	
		8/15/00	1044	0.2	
		9/28/00	1030	0.1	
		11/16/00	1051	0.3	
		3/19/01	1250	0.2	
Nitrate-Nitrite (mg/L)	112WRD 02235500	7/17/01	1215	0.2	
		9/4/01	1325	0.2	
		12/18/01	1215	0.73	
		4/15/02	1403	0.58	
		6/5/02	1230	0.52	
		9/24/02	1330	0.79	
	SPRINGS005	10/17/2000		0.11	
		3/21/2001		0.264	
		10/16/2001		0.64	
		4/17/2002		0.58	J
		10/21/2002		0.9	
		5/19/2003		0.78	
		10/14/2003		0.5	
		4/20/2004		0.39	
Total Phosphorus (mg/L)	21FLGW 9673	10/24/01	1030	0.067	
		12/18/01	1433	0.079	
		4/8/02	1100	0.076	
		10/29/02	1030	0.067	
		1/20/03	1645	0.07	
		4/8/03	1511	0.067	
	21FLCEN 20010364	3/18/02	1037	0.068	
		4/23/02	1017	0.84	
		6/4/02	1008	0.077	
		9/3/02	956	0.074	
		10/22/02	1027	0.062	

Parameter	Station	Date	Time	Concentration	Rcode
	21FLCEN 20010365	3/18/02	1105	0.077	
		4/23/02	1040	0.081	
		6/4/02	1025	0.078	
		6/4/02	1023	0.075	
		9/3/02	1017	0.079	
		9/3/02	1016	0.079	
		10/22/02	1042	0.069	
	112WRD 02235500	6/16/98	1138	0.07	
		8/7/98	1130	0.04	
		9/28/98	1030	0.07	
		12/4/98	1008	0.07	
		1/22/99	1150	0.07	
		3/18/99	1430	0.09	
		9/1/99	1129	0.06	
		1/11/00	1300	0.04	
		4/18/00	1645	0.06	
		6/8/00	1130	0.06	
		8/15/00	1044	0.08	
		9/28/00	1030	0.08	
		11/16/00	1051	0.08	
Total Phosphorus (mg/L)	112WRD 02235500	3/19/01	1250	0.02	<
		7/17/01	1215	0.07	
		9/4/01	1325	0.05	
		12/18/01	1215	0.05	E
		4/15/02	1403	0.04	
		6/5/02	1230	0.06	
		9/24/02	1330	0.04	
	SPRINGS005	10/17/2000		0.093	
		3/21/2001		0.072	
		10/16/2001		0.069	J
		4/17/2002		0.072	
		10/21/2002		0.067	J
		5/19/2003		0.069	A
		10/14/2003		0.076	
		4/20/2004		0.098	
Total Kjeldahl Nitrogen (mg/L)	21FLGW 9673	10/24/01	1030	0.14	
		12/18/01	1433	0.19	
		4/8/02	1100	0.22	
		7/31/02	1235	0.25	
		10/29/02	1030	0.15	
		1/20/03	1645	0.16	
		4/8/03	1511	0.15	
	21FLCEN 20010364	3/18/02	1037	0.19	
		4/23/02	1017	0.18	
		6/4/02	1008	0.17	

Parameter	Station	Date	Time	Concentration	Rcode
		9/3/02	956	0.17	
		10/22/02	1027	0.19	
	21FLCEN 20010365	3/18/02	1105	0.22	
		4/23/02	1040	0.2	
		6/4/02	1023	0.17	
		9/3/02	1017	0.2	
		9/3/02	1016	0.17	
		10/22/02	1042	0.06	
	112WRD 02235500	6/16/98	1138	0.2	<
		8/7/98	1130	0.2	<
		9/28/98	1030	0.2	<
		12/4/98	1008	0.21	
		1/22/99	1150	0.2	<
		3/18/99	1430	0.2	<
		9/1/99	1129	0.2	<
		1/11/00	1300	0.2	<
		4/18/00	1645	0.2	<
		6/8/00	1130	0.2	<
		8/15/00	1044	0.31	
		9/28/00	1030	0.27	
Total Kjeldahl Nitrogen (mg/L)	112WRD 02235500	11/16/00	1051	0.2	<
		3/19/01	1250	0.43	
		7/17/01	1215	0.25	
		9/4/01	1325	0.2	<
		12/18/01	1215	0.2	<
		4/15/02	1403	0.2	<
		6/5/02	1230	0.2	<
		9/24/02	1330	0.2	<
	SPRINGS005	10/17/2000		0.3	
		3/21/2001		0.141	
		10/16/2001		0.14	I
		4/17/2002		0.25	
		10/21/2002		0.21	
		5/19/2003		0.13	I
		10/14/2003		0.24	
		4/20/2004		0.2	

Table A- 5. Select nutrient data collected in Juniper Springs (WBID 2905A)

Parameter	Station	Date	Time	Concentration	Rcode
Nitrate-Nitrite (mg/L)	21FLSJWMJUN	1/16/1996	1100	0.581	
		3/20/1996	1000	0.08	
		4/29/1996	1130	0.077	
		7/10/1996	1015	0.097	
	Springs Initiative Program (ID not known)	4/9/2002		0.072	
		4/15/2003		0.073	
		5/4/2004		0.077	
		10/14/2002		0.075	

Parameter	Station	Date	Time	Concentration	Rcode
		10/13/2003		0.075	
Total Phosphorus (mg/L)	21FLSJWMJUN	4/29/1996	1131	0.047	
	Springs Initiative Program (ID not known)	4/9/2002		0.036	I
		4/15/2003		0.029	
		5/4/2004		0.056	
		10/14/2002		0.029	I
		10/13/2003		0.035	I
Ammonia (mg/L)		4/9/2002		0.01	U
		4/15/2003		0.01	U
		5/4/2004		0.01	U
		10/14/2002		0.01	U
		10/13/2003		0.01	U
		4/9/2002		0.01	U
Total Kjeldahl Nitrogen (mg/L)		4/9/2002		0.06	U
		4/15/2003		0.06	U
		5/4/2004		0.06	U
		10/14/2002		0.071	I
		10/13/2003		0.06	U

~~EH 12/19~~

ROUTING AND TRANSMITTAL SLIP Date 12-13-05

TO: (Name, office symbol, room number, building, Agency/ Post)	Initials	Date
1. DAVIS	MD	12/13/05
2. Godfrey	Gmy	12/16
3. Bartlett	[illegible]	12/19
4. Mitchell		
5. GiattiNA	GM	12/20

	Action		File		Note and Return
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	As Requested		For Correction		Prepare Reply
	Circulate		For Your Information		See Me
	Comment		Investigate		Signature
	Coordination		Justify		

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5041-103

OPTIONAL FORM 41 (Rev. 1-94)
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Under the authority of Section 303(d) of the Clean Water Act, 33 U.S. Code §1251 et.seq., as amended by the Water Quality Act of 1987 (PL 100-4), the U.S Environmental Protection Agency is hereby establishing Total Maximum Daily Loads (TMDLs) for nutrients in Wekiva Springs, Rock Springs Run, and Volusia Blue Spring in the Middle St. Johns River Basin. Subsequent actions must be consistent with this TMDL.

Gail Mitchell — 12/20/05

James D. Giattina, Director
Water Management Division

Date

Concurrances:

J. Eason JE 12-13

M. Davis 12/15/05

A. Godfrey 12/16/05

A. Bartlett 12/19

G. Mitchell _____

J. Giattina _____