Summary of Outstanding Florida Springs Basin Management Action Plans – June 2018

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Background

The Florida Springs and Aquifer Protection Act (Chapter 373, Part VIII, Florida Statutes [F.S.]), provides for the protection and restoration of 30 Outstanding Florida Springs (OFS), which comprise 24 first magnitude springs, 6 additional named springs, and their associated spring runs. The Florida Department of Environmental Protection (FDEP) has assessed water quality in each OFS and determined that 24 of the 30 OFS are impaired for the nitrate form of nitrogen. Table 1 provides a list of all 30 OFS and indicates which are currently impaired by nitrate nitrogen concentrations above the state's Numeric Nutrient Criterion (NNC) for nitrate. Total Maximum Daily Loads (TMDLs) have been issued for all 24 of the impaired springs. The Springs Protection Act requires that FDEP adopt Basin Management Action Plans (BMAPs) for each of the impaired OFS by July 1, 2018. BMAPs describe the State's efforts to achieve water quality standards in impaired waters within a 20-year time frame.

Table 1. Outstanding Florida Springs.

PLANNING_UNIT	TITLE	IMPAIRED?
Withlacoochee River	Madison Blue Spring	Yes
Lake Woodruff Unit	Volusia Blue Spring	Yes
Homosassa River Planning Unit	Homosassa Spring Group	Yes
Lake Woodruff Unit	DeLeon Spring	Yes
Rainbow River	Rainbow Spring Group	Yes
Middle Suwannee	Falmouth Spring	Yes
Chipola River	Jackson Blue Spring	Yes
Lake George Unit	Silver Glen Springs	No
Wekiva River	Wekiwa Spring	Yes
Marshall Swamp Unit	Silver Springs	Yes
Lake Monroe Unit	Gemini Springs	Yes
Wakulla River	Wakulla Spring	Yes
Lower Suwannee	Fanning Springs	Yes
Middle Suwannee	Troy Spring	Yes
Aucilla River	Wacissa Spring Group	Yes
Crystal River / Kings Bay Planning Unit	Crystal River (Including Kings Bay Spring Group)	Yes
Middle Suwannee	Lafayette Blue Spring	Yes
Middle Suwannee	Peacock Springs	Yes
Santa Fe River	Devil's Ear Spring	Yes
Santa Fe River	Ichetucknee Spring Group	Yes
Santa Fe River	Poe Spring	No
Middle Coastal	Weeki Wachee Spring Group	Yes
Santa Fe River	Hornsby Spring	Yes
Santa Fe River	Treehouse Spring	No
Santa Fe River	Columbia Spring	No
Lower Suwannee	Manatee Spring	Yes
Alexander Springs Creek	Alexander Spring	No
St. Andrews Bay	Gainer Spring Group	No
Wekiva River	Rock Springs	Yes
Chassahowitzka Planning Unit	Chassahowitzka Spring Group	Yes

The purpose of this white paper is to provide a summary of the nitrate-nitrogen loading status of the impaired OFS and FDEP's water quality restoration goals listed in the impaired OFS BMAPs.

FDEP's Nitrogen Source Inventory Loading Tool (NSILT) was developed to provide quantitative estimates of nitrogen loading from all significant sources to the land surface and to the underlying groundwater. NSILT is based on best available science developed over the last two decades by researchers with the U.S. Geological Survey, water management district staff, FDEP staff, and university researchers. However, due to the complexity of factors governing nitrate leaching and attenuation at the land surface and in the aquifer, NSILT estimates are approximate. Due to the variability in methods and multiple draft and final NSILT Excel spreadsheets currently available, FSI used best professional judgement in completing the attached tables.

Findings

Table 2 provides a summary of FDEP estimated nitrogen loading rates by land use category in the springsheds of the 24 OFS that are the focus of restoration actions. The information in this table highlights the magnitude of the nitrogen pollution problem in Florida's springs and the Floridan Aquifer, water source for the springs and principal potable water supply for North and Central Florida.

- The contributing area for these 24 OFS is roughly 4.6 million acres. The total Springs Region of Florida has been previously estimated as about 17 million acres by the Florida Geological Survey. The 24 impaired OFS represent about 150 spring vents out of Florida's 1,090 recorded springs. Roughly 80% of those springs (more than 800) are estimated to be impaired by elevated nitrate concentrations.[1]
- The total load of nitrogen applied to the land surface affecting those 24 OFS is estimated by FDEP as 122 million pounds per year, for an average load over the 4.6 million springshed acres of about 27 pounds N per acre per year. About 5 pounds N per acre per year is largely of natural origin from atmospheric inputs, while the remainder (22 pounds N per acre per year or 80%) is largely anthropogenic.
- The major human sources of nitrogen to the land surface as estimated by FDEP average: farm fertilizer (9.5 lbs N/ac/yr), livestock wastes (8.6 lbs N/ac/yr), urban fertilizer (1.7 lbs N/ac/yr), septic systems (1.6 lbs N/ac/yr), and disposal of municipal wastewaters (0.4 lbs/ac/yr). For the 24 impaired OFS, agricultural practices contribute an estimated 82% of the anthropogenic nitrogen loading to the land surface, or about 83 million pounds each year.

Table 3 provides a summary of FDEP's NSILT analysis of the estimated sources of nitrogen reaching the groundwater in the Floridan Aquifer. The following observations are derived from those nitrogen loading estimates.

- Nitrogen loaded to the land surface receives significant attenuation as it leaches through soil and rock into the Floridan Aquifer. The overall average nitrogen attenuation averages 87% of the nitrogen loaded on the land surface. Atmospheric nitrogen contributions receive the greatest attenuation (91%) followed by livestock waste (89%). Septic tank effluents (59%) and municipal wastewater disposal (69%) receive the least amount of attenuation.

[1] R. Knight. 2015. Silenced Springs – Moving from Tragedy to Hope. FSI Publishing. High Springs, Florida.

- An estimated 20 million pounds of nitrogen reaches the Floridan Aquifer in the springsheds for these OFS. About one half of this nitrogen load is derived from synthetic nitrogen fertilizers. Agricultural inputs in these springsheds dominate the anthropogenic nitrogen loads to the aquifer and OFS at about 70%. Septic systems only contribute about 15% of the total nitrogen load to the groundwater feeding these OFS.

Table 4 summarizes the magnitude of the necessary recovery efforts outlined in the 13 OFS BMAPs currently under consideration for adoption by the Secretary of FEP. Several important observations are extracted from review of the estimates in this table.

- FDEP estimates that there are about 300,000 septic systems detrimentally affecting the groundwater feeding the OFS. At a conservative estimated cost of $15,000 each to upgrade to advanced nitrogen removal the estimated price tag for this 15% of the nitrogen load problem, is about $4.5 billion.
- While FDEP's NSILT estimates indicate about 20 million pounds of nitrogen are reaching the Florida Aquifer annually in the vicinity of these OFS, their OFS BMAPs only include plans to address 12.7 million pounds or about 63% of that total estimated load. These BMAPs ignore 37% of the actual nitrogen loads reaching the OFS.
- OFS nitrogen TMDLs range from 0.23 to 0.35 mg/L measured at the spring vents with required concentration and mass reductions from 20 to 91% and an overall average reduction of 68% of all nitrogen inputs.
- These TMDLs authorize a continuing nitrogen load of about 4.1 million pounds of nitrogen per year at the OFS. This allowed nitrogen loading rate is about 5 times higher than the natural (pre-development) nitrogen loading rate to the aquifer and springs.
- FDEP estimates that nitrogen loading to the groundwater will need to be reduced by about 8.6 million pounds per year over the next 20 years to achieve the legislatively-mandated OFS restoration goal. This goal does not account for inevitable increases in anthropogenic nitrogen loading to the OFS in the future.
- Based on the observed relationship between nitrogen loading to the land surface and attenuation of that nitrogen before it reaches the aquifer, FDEP's NSILT estimates that current nitrogen loading to the land surface will need to be reduced by about 79 million pounds per year to achieve the OFS TMDLs.

The FDEP estimates summarized in Tables 2 through 4 indicate that the task of achieving the nitrate nitrogen water quality TMDLs in the state's OFS is monumental. The draft OFS BMAPs minimize the magnitude and severity of the task by focusing on just the nitrogen loads to the aquifer and just for a relatively small group of affected springs. Hundreds of Florida's additional artesian springs not mentioned in the 2016 Springs Protection Act are also impaired due to nitrate pollution and are not included in these BMAPs. Also, even for the OFS mentioned in the Springs Protection Act about 37% of the nitrate load in those springsheds is ignored, leading to the continuing non-compliance of the nitrogen NNC for springs and diffuse groundwater discharges in those OFS groups.

The facts are that both urban and agricultural fertilizer use through the springs region will need to be reduced by an average of at least 68% to achieve the restoration goals mandated for these OFS. More than 150,000 existing septic tanks will also need to be converted to receive advanced nitrogen removal or will need to be connected to municipal wastewater treatment systems outfitted with advanced

nitrogen removal. Regional populations of livestock, including cattle, dairy cows, poultry, and horses will need to be reduced by a comparable percentage to achieve the springs NNC nitrate.

The first Florida spring nitrate TMDL was established for the springs along the Santa Fe and Suwannee Rivers in 2009. The resulting Santa Fe Springs BMAP was finalized in 2012 to implement that TMDL. The primary method for reducing nitrogen loading included in that first BMAP was the full implementation of agricultural Best Management Practices (BMPs). A spring Restoration Focus Area was established in a portion of the Santa Fe Springshed and in which agricultural BMPs were implemented. This Springs Focus Area was intensively monitored between 2012 and 2016 to evaluate progress with BMAP implementation. FDEP's 2016 Santa Fe Springs BMAP progress report concluded that even though most agricultural producers in the Santa Fe Springs Focus Area were enrolled in the BMP program, the main source of nitrate nitrogen in the groundwater in springs was still derived from fertilizer, and "no significant decreases in nitrate-N concentration were observed over the four-year period in the sampled springs or Santa Fe River sites".[2] Despite this negative finding from the Santa Fe BMAP effort, the new and updated OFS BMAPs largely rely on BMPs to solve intensive agriculture's nutrient pollution problem in springs.

Conclusions

Based on this review of the scope of the proposed Florida Department of Environmental Protection Outstanding Florida Springs Basin Management Action Plan effort, FSI concludes the following:

- The Florida springs nitrate issue is much greater than the Florida legislature and the public understands – based on the NSILT data summarized in Table 2, anthropogenic nitrogen loads to the land surface affecting groundwater at fewer than 20% of Florida's springs (about 150 out of 800 that are impaired by elevated nitrate nitrogen) are at least 100 million pounds per year. FSI estimates that total annual nitrogen loading from human sources to the land surface in Florida's Springs Region is about 340 million pounds per year.
- FDEP's estimated average anthropogenic nitrogen load to the land surface in the OFS BMAP area is about 20 pounds per acre per year. This existing nitrogen loading rate will need to be reduced by about 70% to achieve spring and spring run nitrate-nitrogen water quality goals.
- Considering Florida's Springs Region as a whole, the required reduction in anthropogenic nitrogen sources to the land surface is estimated as 230 million pounds per year. About half of this reduction needs to be achieved by reduced use of nitrogen fertilizer and the rest needs to be through improved nitrogen removal in septic systems, municipal wastewater systems, and reduced nitrogen loading from livestock waste management.
- Existing BMPs have been shown to be ineffective at measurably reducing nitrogen loads to the groundwater and springs. Advanced BMPs that include nitrogen reductions of 80% or more at the land surface are needed to achieve BMAP goals. At this time the only known agricultural Advanced BMP capable of achieving this goal is conversion from intensive row crop or confined animal agriculture to low-intensity managed forests.

[2] Four-Year Progress Report, January 2013–December 2016 - Implementation of Best Management Practices in the Santa Fe Restoration Focus Area: Nitrate-N Concentrations in Groundwater, Springs, and River Water. A Joint Document Prepared by the Division of Environmental Assessment and Restoration Florida Department of Environmental Protection, Tallahassee, Florida, and Office of Agricultural Water Policy Florida Department of Agriculture and Consumer Services, Tallahassee, Florida. June 2017.

- Over the past four years FDEP has dedicated tens of millions of dollars to connecting existing on-site wastewater treatment and disposal systems (OSTDS or septic systems) to municipal wastewater systems with advanced levels of nitrogen removal. At an average of more than $15,000 per septic system, these connections will be cost prohibitive and highly unpopular for the approximately one million septic systems in the Springs Region that need to be connected to achieve the springs nitrate NNC (approximately $15 billion). The futility of these efforts is further highlighted by the relatively small fraction of the nitrogen pollution problem (about 15% on average) that is actually due to septic systems.
- The 2016 Springs Protection Act mandate to require nitrogen-removing technology in all new septic systems on lots of less than one acre and located in an OFS Priority Focus Area will not solve the springs nitrogen-loading problem. The NSILT data analysis indicates that this required minimal area should be raised to at least 3 to 5 acres for all new septic systems to avoid increasing the unacceptable nitrate load to groundwater in the Florida Springs Region.
- It is unrealistic to believe that the 20-year OFS water quality restoration goal will be achieved by voluntary measures and with minimal public expenditure. Cost effective strategies to meet this goal need to be evaluated and included in the final OFS BMAPs. One cost effective approach to solving this problem is legislative enactment of a fee or tax on all nitrogen loads to the land surface and aquifer. This proposed Aquifer Protection Fee (APF) should include a fee on the nitrogen content of fertilizers as a measure to discourage their unnecessary use and to raise money to implement more costly measures like septic system conversions. Also, all septic system owners in the state should be charged an APF comparable to the cost of advanced nitrogen removal costs for customers of public wastewater facilities.

Solving the spring and aquifer pollution problem in Florida's Springs Region is achievable. But it will require the combined efforts of the legislature, state environmental agencies, and the general public. Understanding the simple fact that humans drink the same water that is harmful to the wildlife that live in the springs should be enough of an inducement to follow through with the inevitable need for significantly reducing society's nitrogen footprint on the aquifer.

*Table 2. Summary of Outstanding Florida Springs nitrogen loading rates **to the land surface** by source as estimated by the Florida Department of Environmental Protection and published in the 2018 OFS Basin Management Action Plans. Values in red font were estimated based on partial data.*

Total Nitrogen Load to **Land Surface** from Major Sources										
								Fertilizer		
Spring Group	Outstanding Florida Springs	Contributing Area (ac)	Total Load (lb/yr)	Atm. Deposition	WWTF	Septic Systems	Livestock	Urban	Farm	Fertilizer Total
Weeki Wachee	Weeki Wachee	159,622	5,119,987	1,144,933	66,995	639,916	1,108,001	991,667	1,168,475	2,160,142
Wakulla	Wakulla	847,930	6,222,759	2,118,364	162,938	1,356,862	747,248	498,694	1,236,317	1,735,011
Santa Fe	Devils Complex	228,663	7,874,698	1,297,554	13,994	145,166	1,989,668	147,407	4,280,909	4,428,316
Middle St. Johns	Volusia Blue	61,430	2,953,954	355,599	736,038	768,595	65,265	957,858	70,599	1,028,457
Silver	Silver	632,454	13,123,858	2,723,407	147,046	1,588,490	6,552,444	1,028,107	1,044,066	2,072,173
Rainbow	Rainbow	434,560	11,784,824	1,180,485	64,216	526,685	8,426,966	493,557	1,092,915	1,586,472
Chassahowitzka	Chassahowitzka	139,375	2,337,172	749,437	18,482	131,885	466,538	456,853	513,977	970,830
Homosassa	Homosassa	201,234	3,405,462	1,069,339	14,611	226,284	769,742	686,268	639,218	1,325,486
Jackson Blue	Jackson Blue	83,543	4,236,963	424,114	-	63,114	785,119	16,955	2,947,661	2,964,616
Santa Fe	Ichetucknee	245,414	6,443,886	1,597,780	139,654	285,627	2,078,852	423,991	1,917,982	2,341,973
Santa Fe	Hornsby	77,551	3,021,214	441,930	7,573	46,679	820,513	145,342	1,559,177	1,704,519
Crystal River	Kings Bay	163,801	2,934,502	938,620	37,197	577,022	419,406	541,816	420,441	962,257
Lower Suwannee	Fanning/Manatee	199,928	11,379,313	1,072,115	134,474	137,448	3,292,079	317,248	6,425,949	6,743,197
Middle Suwannee	Troy/Falm/LafBl/Peac	553,924	26,209,236	4,229,923	16,283	254,768	7,438,227	382,581	13,887,454	14,270,035
Withlacoochee	Madison Blue	84,788	2,909,439	480,325	-	37,799	411,092	30,684	1,949,539	1,980,223
Middle St. Johns	DeLeon	65,392	1,371,387	315,074	24,786	107,859	562,175	113,147	622,309	735,456
Middle St. Johns	Gemini	27,290	338,413	131,489	10,344	45,013	234,612	47,220	259,708	306,927
Middle St. Johns	Wekiwa/Rock	183,165	6,824,687	882,531	69,427	302,117	1,574,670	316,928	1,743,106	2,060,034
Wacissa	Wacissa	200,000	3,817,633	963,646	75,808	329,886	1,719,400	346,058	1,903,318	2,249,376
Totals		4,590,064	122,309,387	22,116,664	1,739,865	7,571,215	39,462,017	7,942,380	43,683,120	51,625,500

*Table 3. Summary of Outstanding Florida Springs nitrogen loading rates **to the Floridan Aquifer** by source as estimated by the Florida Department of Environmental Protection and published in the 2018 OFS Basin Management Action Plans. Values in red font were estimated based on partial data.*

Total Nitrogen Load to **Groundwater** from Major Sources										
								Fertilizer		
Spring Group	Outstanding Florida Springs	Contributing Area (ac)	Total Load (lb/yr)	Atm. Deposition	WWTF	Septic Systems	Livestock	Urban	Farm	Fertilizer Total
Weeki Wachee	Weeki Wachee	159,622	940,144	93,208	45,105	282,875	91,347	263,674	163,935	427,609
Wakulla	Wakulla	847,930	843,473	212,134	26,697	293,400	23,840	119,681	167,721	287,402
Santa Fe	Devils Complex	228,663	1,572,910	150,162	5,537	89,271	290,102	53,060	984,778	1,037,838
Middle St. Johns	Volusia Blue	61,430	514,094	25,872	64,171	278,365	4,131	131,260	10,295	141,555
Silver	Silver	632,454	1,661,273	167,042	73,447	628,466	458,007	128,434	179,683	308,117
Rainbow	Rainbow	434,560	1,328,073	91,226	23,102	251,823	639,170	81,938	240,814	322,752
Chassahowitzka	Chassahowitzka	139,375	380,463	61,346	10,111	58,357	40,811	118,997	90,841	209,838
Homosassa	Homosassa	201,234	582,175	83,152	5,662	96,116	136,978	152,423	107,844	260,267
Jackson Blue	Jackson Blue	83,543	717,766	33,203	-	12,618	51,152	2,777	618,016	620,793
Santa Fe	Ichetucknee	245,414	1,657,089	218,132	29,856	218,054	328,150	206,128	656,769	862,897
Santa Fe	Hornsby	77,551	503,624	40,123	5,470	59,198	62,198	43,973	292,662	336,635
Crystal River	Kings Bay	163,801	591,530	79,541	20,453	250,174	30,793	139,875	70,694	210,569
Lower Suwannee	Fanning/Manatee	199,928	2,332,702	95,500	50,173	61,822	884,287	84,575	1,156,345	1,240,920
Middle Suwannee	Troy/Falm/LafBl/Peac	553,924	4,274,798	362,637	5,472	108,122	1,290,525	96,898	2,411,144	2,508,042
Withlacoochee	Madison Blue	84,788	451,424	42,745	-	16,833	36,948	8,246	346,652	354,898
Middle St. Johns	DeLeon	65,392	205,708	12,199	778	28,800	17,264	39,084	107,583	146,667
Middle St. Johns	Gemini	27,290	50,762	2,511	1,687	21,633	58	24,289	584	24,873
Middle St. Johns	Wekiwa/Rock	183,165	1,023,703	61,328	168,770	296,984	8,318	342,454	145,849	488,303
Wacissa	Wacissa	200,000	572,645	101,093	2,567	22,280	99,370	4,138	343,197	347,335
Totals		4,590,064	20,204,356	1,933,154	539,058	3,075,191	4,493,449	2,041,904	8,095,406	10,137,310

Table 4. Summary of Outstanding Florida Springs water quality improvement goals as estimated by the Florida Department of Environmental Protection (FDEP) and published in the 2018 OFS Basin Management Action Plans. FDEP's estimated Load at each OFS is calculated by multiplying the average spring discharge times the average spring nitrate nitrogen concentration. FDEP required attenuation at spring is the difference between nitrogen load to groundwater minus nitrogen load at the spring. Estimated attenuation needed at land surface was calculated as the product of FDEP required attenuation at spring (%) and FDEP estimated total load to land surface. Values in red font were estimated based on partial data.

FDEP TMDL and BMAP Summary											
Spring Group	Outstanding Florida Springs	FDEP Contributing Area (ac)	FDEP Est. Total N Load to Land Surface (lb/yr)	FDEP Est. Total N Load to GW (lb/yr)	FDEP Est. Load at Spring (lb/yr)	FDEP TMDL (mg/L)	FDEP TMDL to GW (lb/yr)	FDEP Required Attenuation at Spring (lb/yr))	FDEP Required Attenuation at Spring (%)	Est. Attenuation Needed at Land Surface (lb/yr)	FDEP Est. # OSTDS
Weeki Wachee	Weeki Wachee	159,622	5,119,987	940,144	289,000	0.28	93,800	195,200	68%	3,458,206	
Wakulla	Wakulla	847,930	6,222,759	843,473	701,411	0.35	561,847	139,564	20%	1,238,180	12,000
Santa Fe	Devils Complex	228,663	7,874,698	1,572,910	1,899,233	0.35	664,731	1,234,502	65%	5,118,556	4,000
Middle St. Johns	Volusia Blue	61,430	2,953,954	514,094	162,550	0.35	100,897	61,653	38%	1,120,394	40,000
Silver	Silver	632,454	13,123,858	1,661,273	1,298,498	0.35	368,363	930,135	72%	9,400,831	66,517
Rainbow	Rainbow	434,560	11,784,824	1,328,073	2,198,348	0.35	414,741	1,783,607	81%	9,561,496	33,859
Chassahowitzka	Chassahowitzka	139,375	2,337,172	380,463	197,454	0.23	81,753	115,701	59%	1,369,499	4,000
Homosassa	Homosassa	201,234	3,405,462	582,175	245,580	0.23	88,448	157,132	64%	2,178,952	4,000
Jackson Blue	Jackson Blue	83,543	4,236,963	717,766	719,234	0.35	67,252	651,982	91%	3,840,786	3,000
Santa Fe	Ichetucknee	245,414	6,443,886	1,657,089	308,107	0.35	107,837	200,270	65%	4,188,535	11,000
Santa Fe	Hornsby	77,551	3,021,214	503,624	435,385	0.35	152,385	283,000	65%	1,963,787	2,000
Crystal River	Kings Bay	163,801	2,934,502	591,530	487,000	0.23	213,000	274,000	56%	1,651,034	28,000
Lower Suwannee	Fanning/Manatee	199,928	11,379,313	2,332,702	1,276,822	0.35	145,500	1,131,322	89%	10,082,586	5,000
Middle Suwannee	Troy/Falm/LafBl/Peac	553,924	26,209,236	4,274,798	1,489,907	0.35	693,663	796,244	53%	14,006,879	4,000
Withlacoochee	Madison Blue	84,788	2,909,439	451,424	361,000	0.35	79,300	281,700	78%	2,270,330	2,000
Middle St. Johns	DeLeon	65,392	1,371,387	205,708	31,852	0.35	14,657	17,195	54%	740,330	3,892
Middle St. Johns	Gemini	27,290	338,413	50,762	20,496	0.35	6,226	14,270	70%	235,615	2,334
Middle St. Johns	Wekiwa/Rock	183,165	6,824,687	1,023,703	275,065	0.286	65,637	209,428	76%	5,196,155	65,000
Wacissa	Wacissa	200,000	3,817,633	572,645	296,596	0.24	165,487	131,109	44%	1,687,569	1,678
Totals		4,590,064	122,309,387	20,204,356	12,693,538		4,085,524	8,608,014	68%	79,309,719	292,280