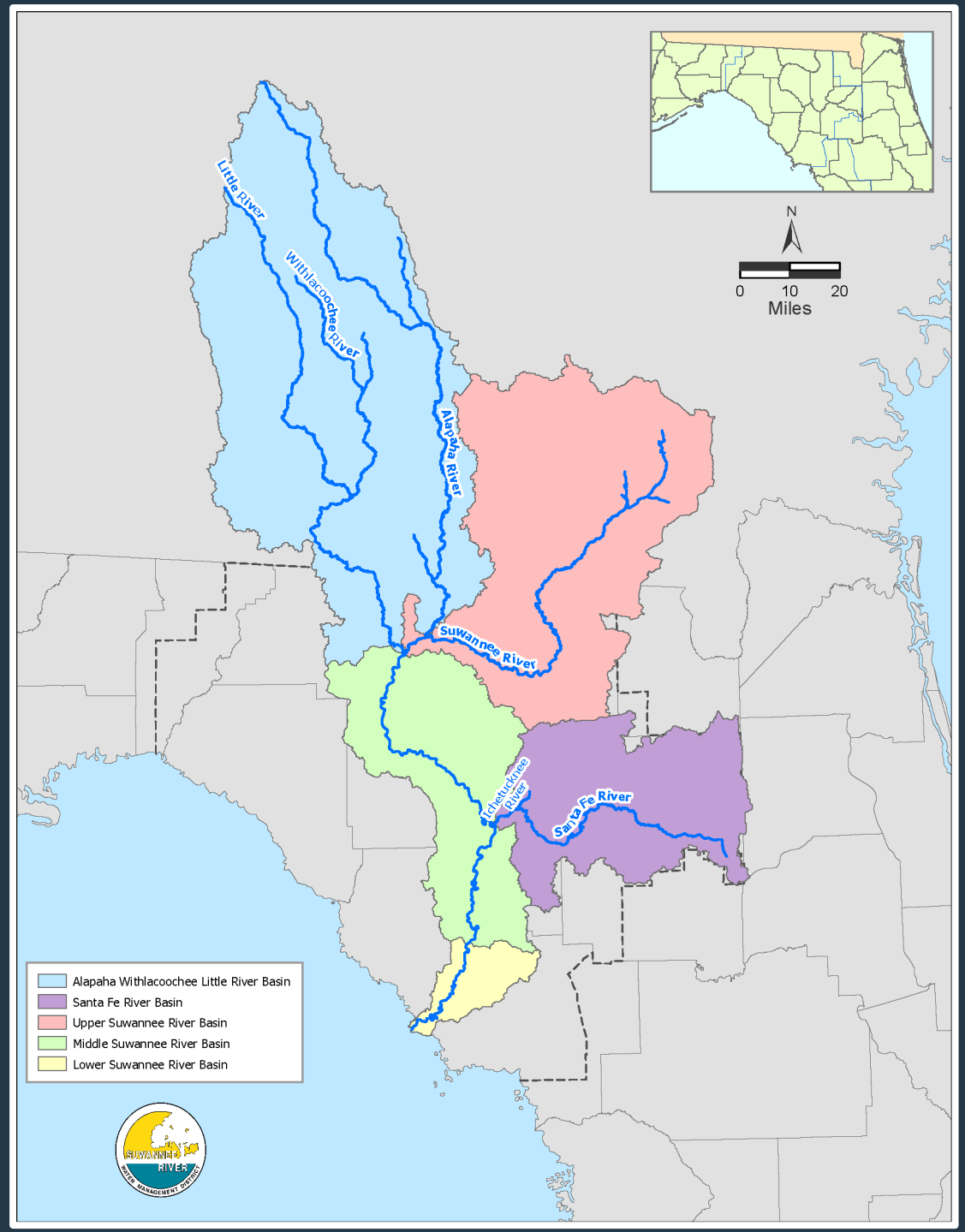
Upper and Middle Suwannee River Minimum Flows and Levels – Draft Results

Suwannee River Basin

- 9,950 square mile area
  - 57% in Georgia
  - 43% in Florida
- 246 river miles
  - Okefenokee Swamp to Gulf of Mexico
- Second largest river in Florida
- Outstanding Florida Water



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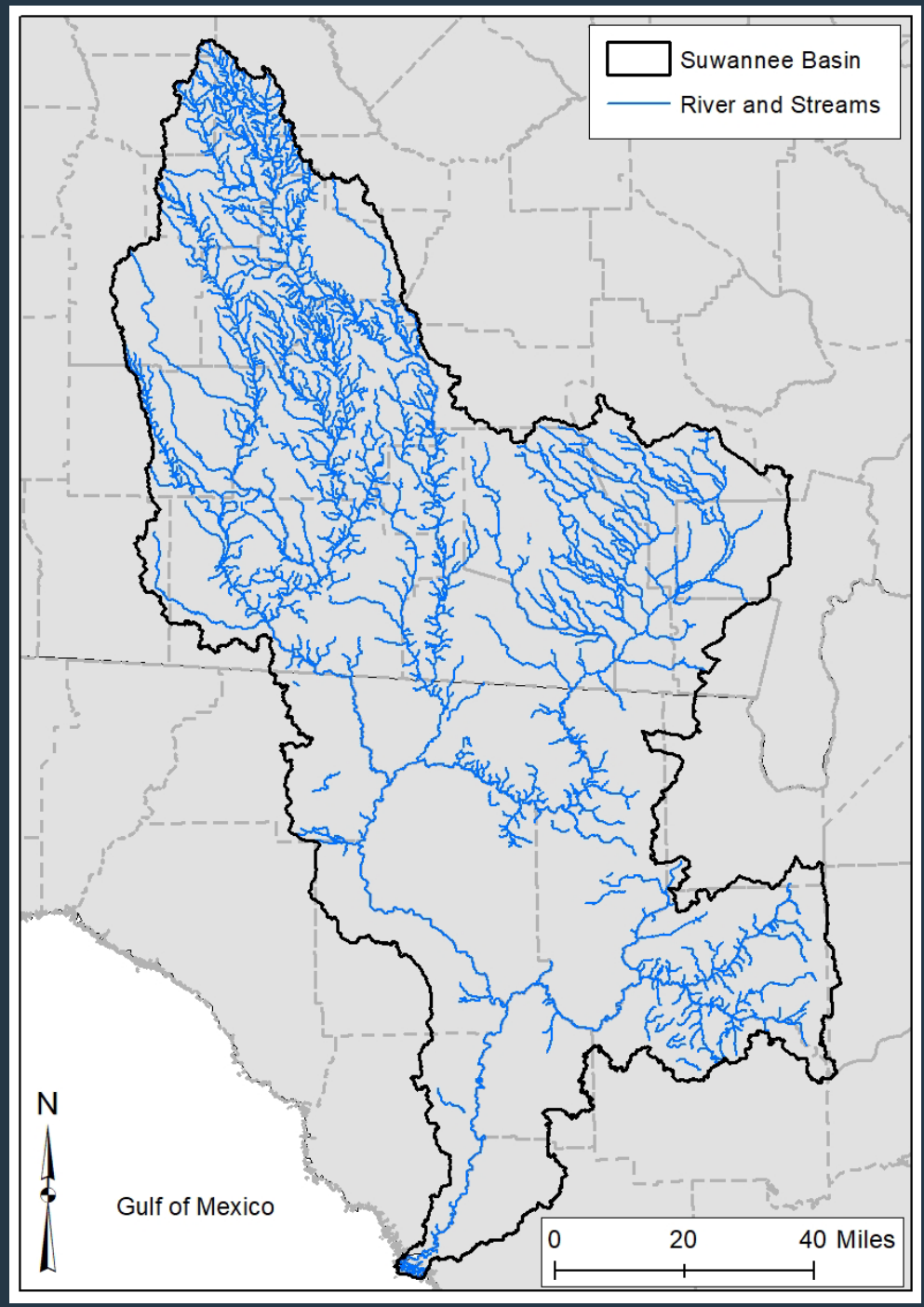

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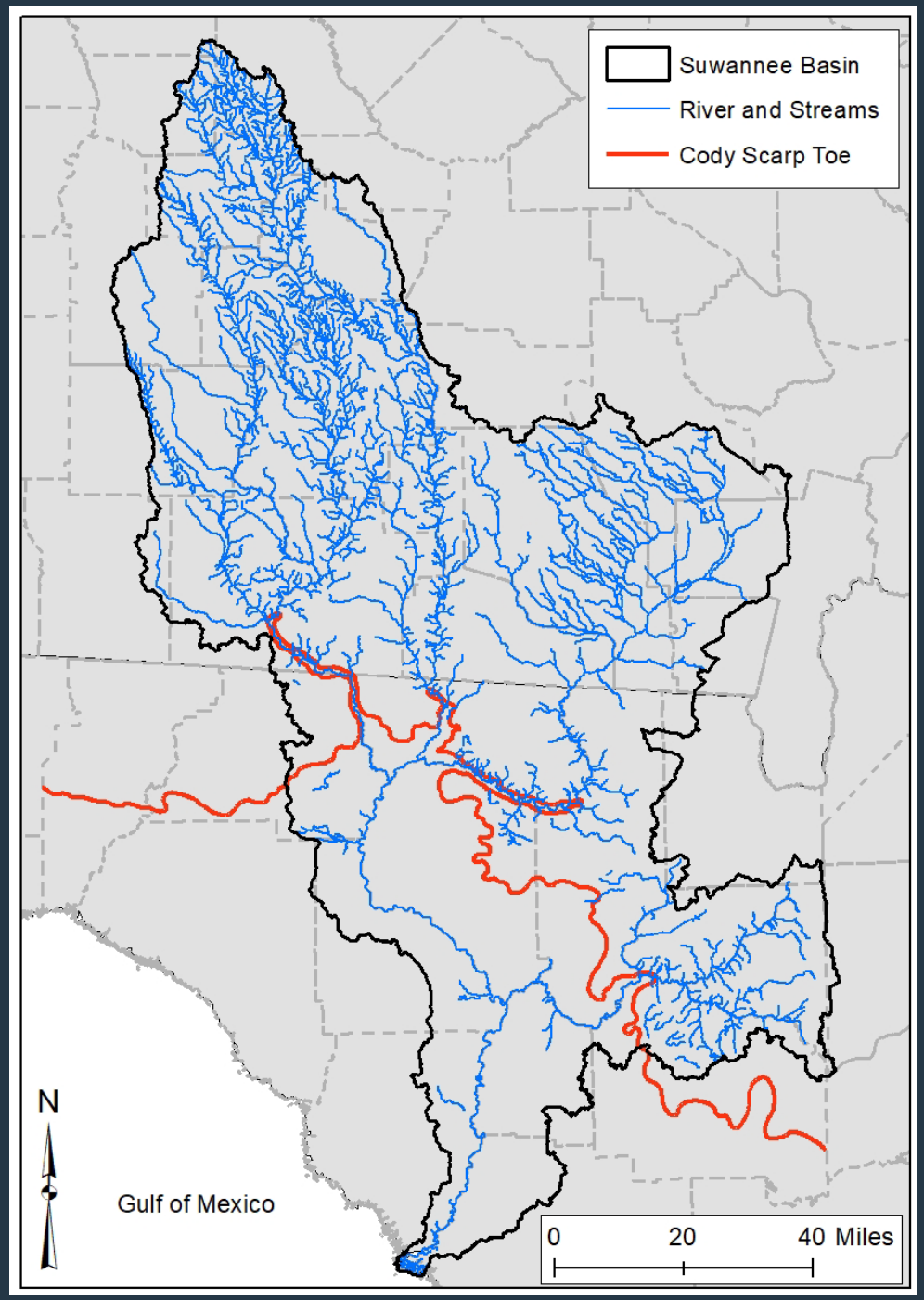

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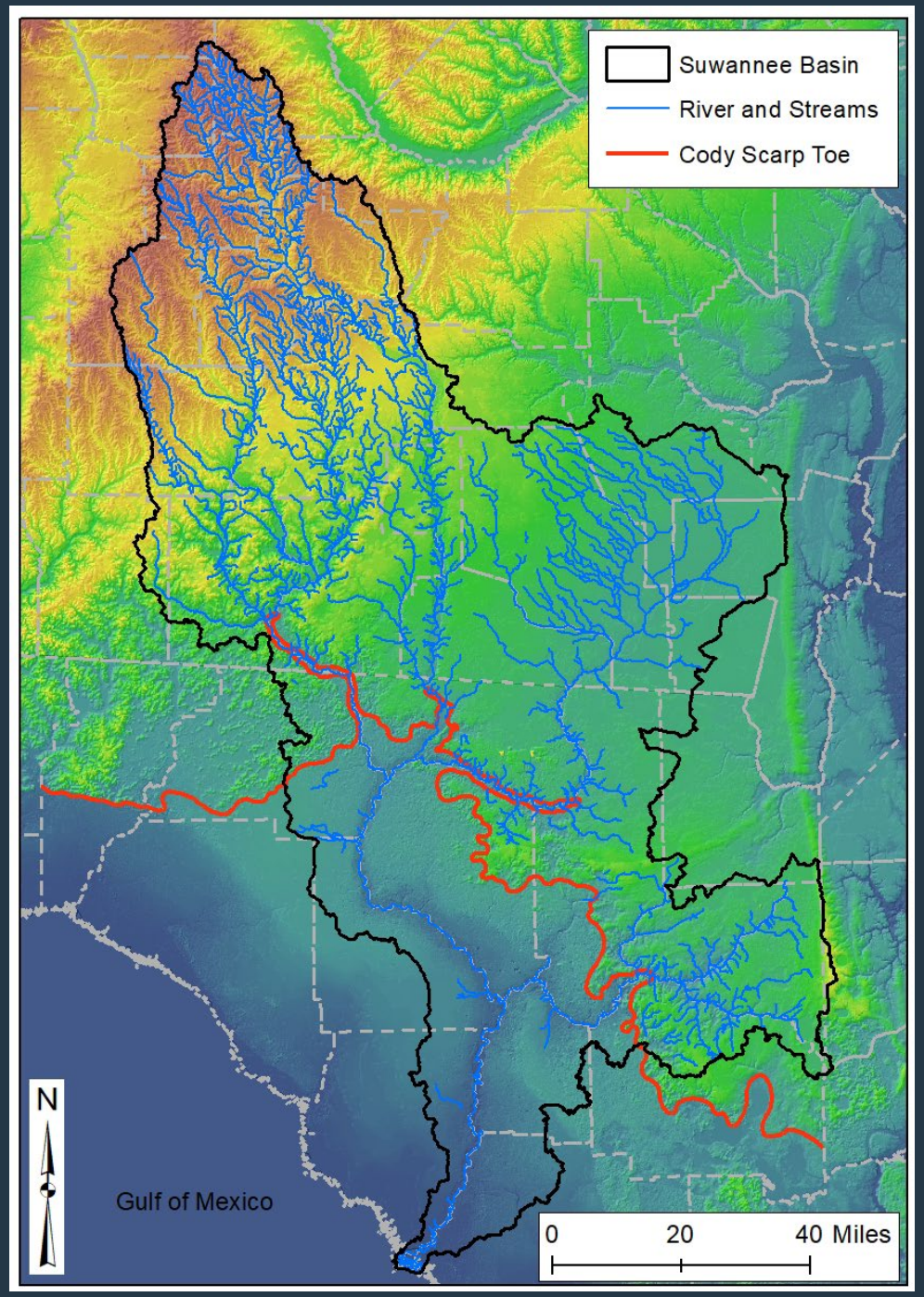

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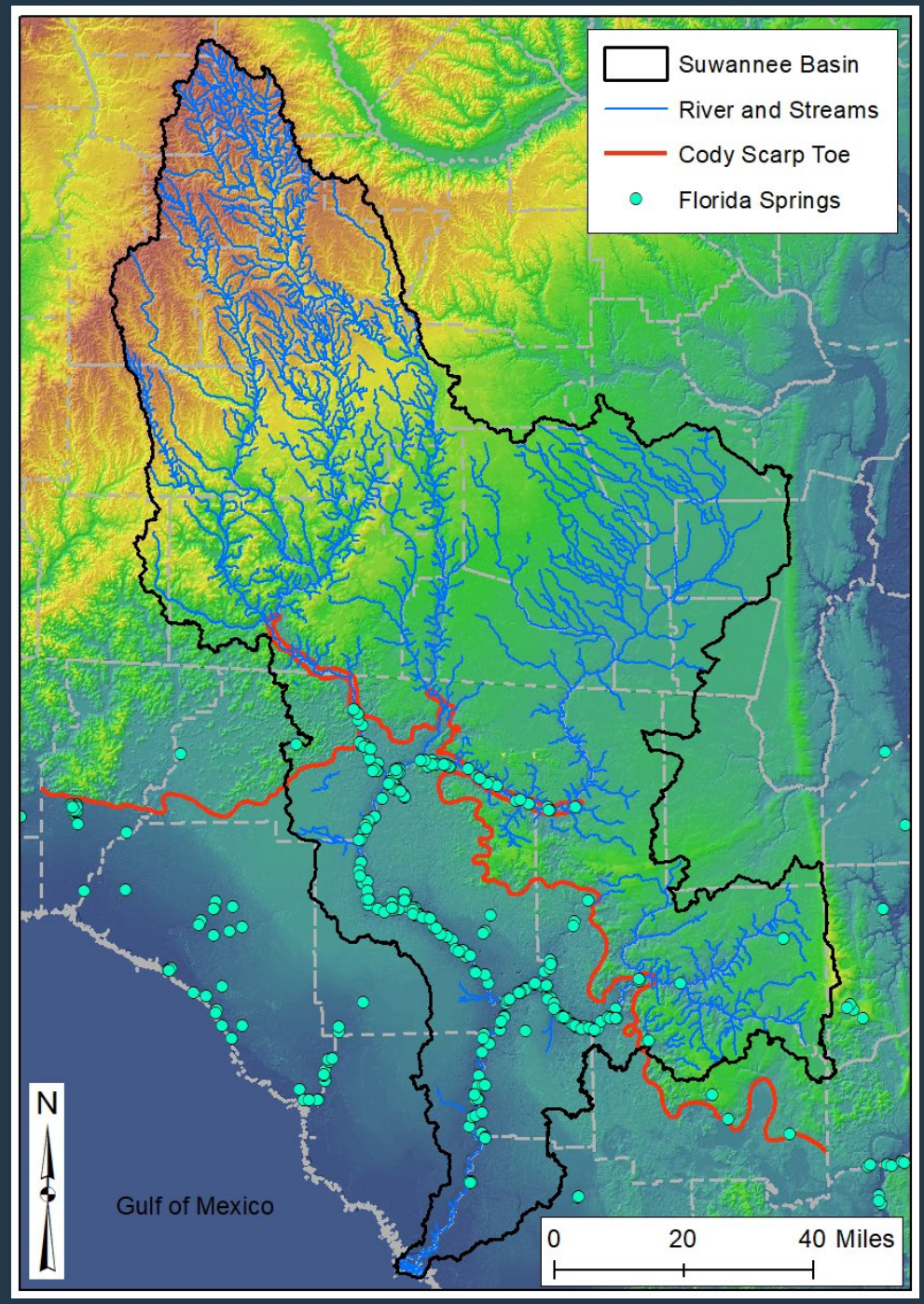
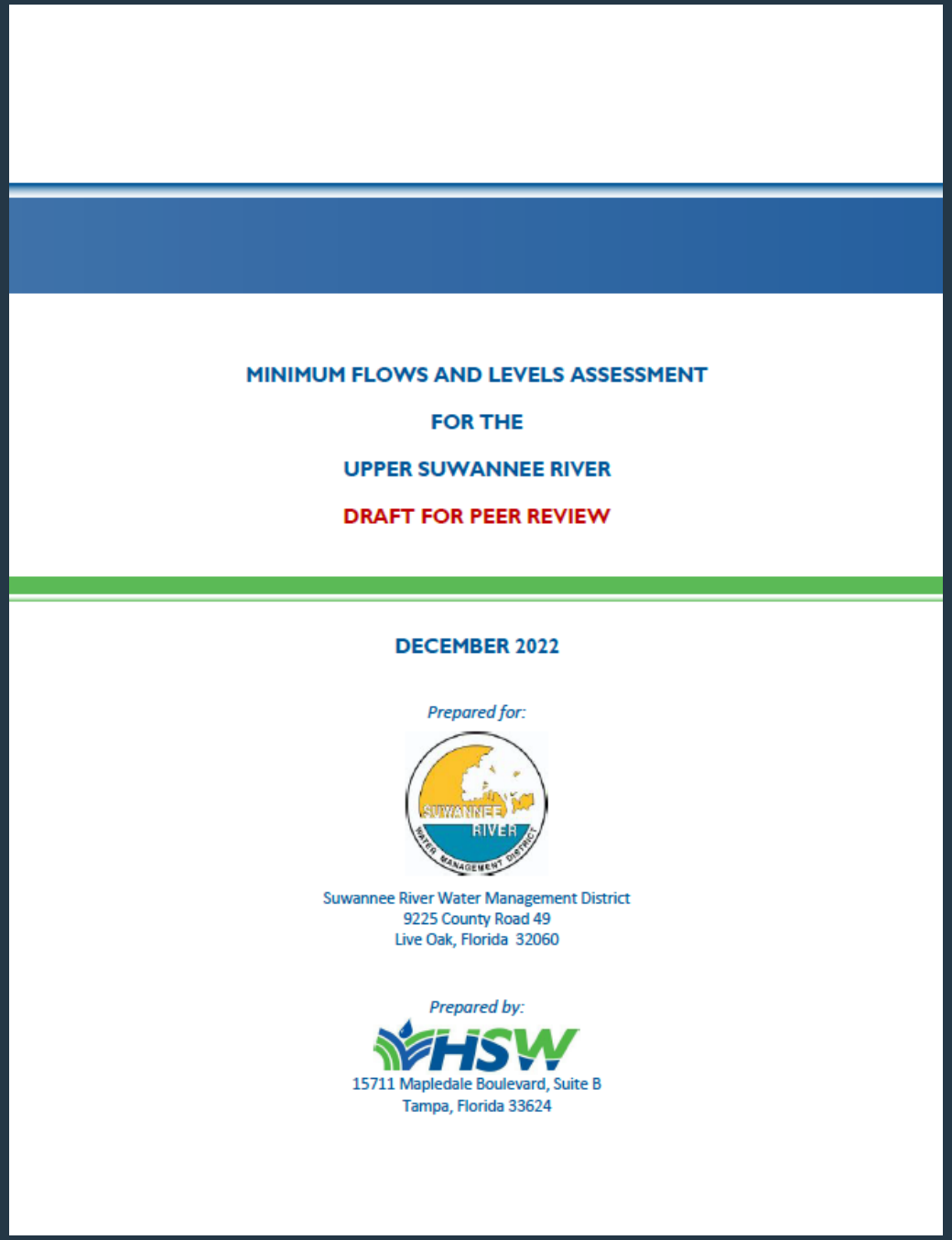


Upper Suwannee River MFL Report Sections

1) Introduction
2) Hydrology
3) Biology
4) Approach to Setting MFLs
5) Evaluation of Water Resource Values (WRVs)
6) River MFLs
7) References



MINIMUM FLOWS AND LEVELS ASSESSMENT

FOR THE

UPPER SUWANNEE RIVER

DRAFT FOR PEER REVIEW

DECEMBER 2022

Prepared for:

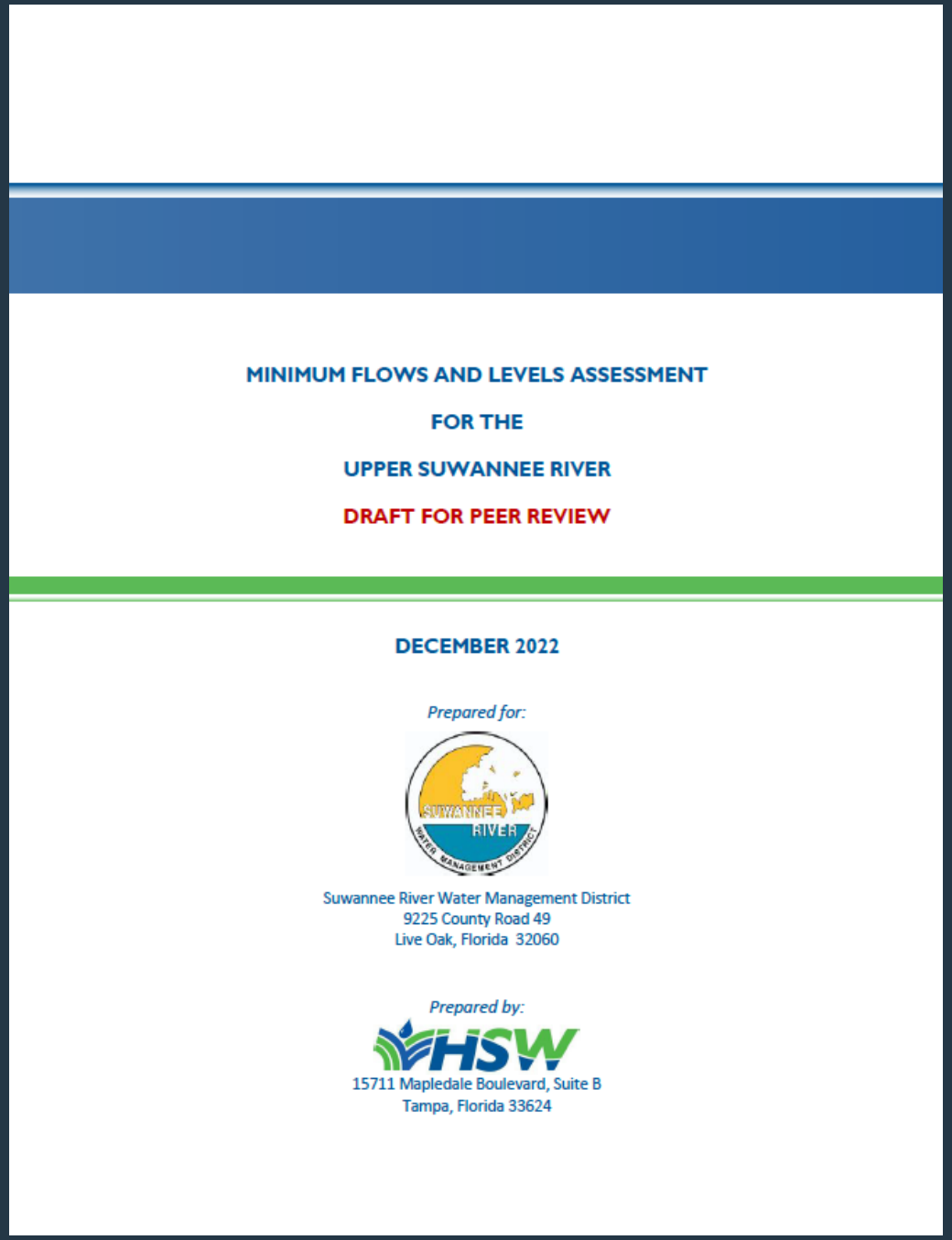
Suwannee River Water Management District
9225 County Road 49
Live Oak, Florida 32060

Prepared by:

HSW
15711 Mapledale Boulevard, Suite B
Tampa, Florida 33624

Upper Suwannee River MFL Report Appendices

A. Suwannee Springs Gage Extension
B. Water Use Hindcasting
C. Reference Timeframe (RTF) Flow Methodology
D. HEC-RAS Model
E. In-Stream Habitat (SEFA) Evaluation
F. Indicators of Hydrologic Alteration



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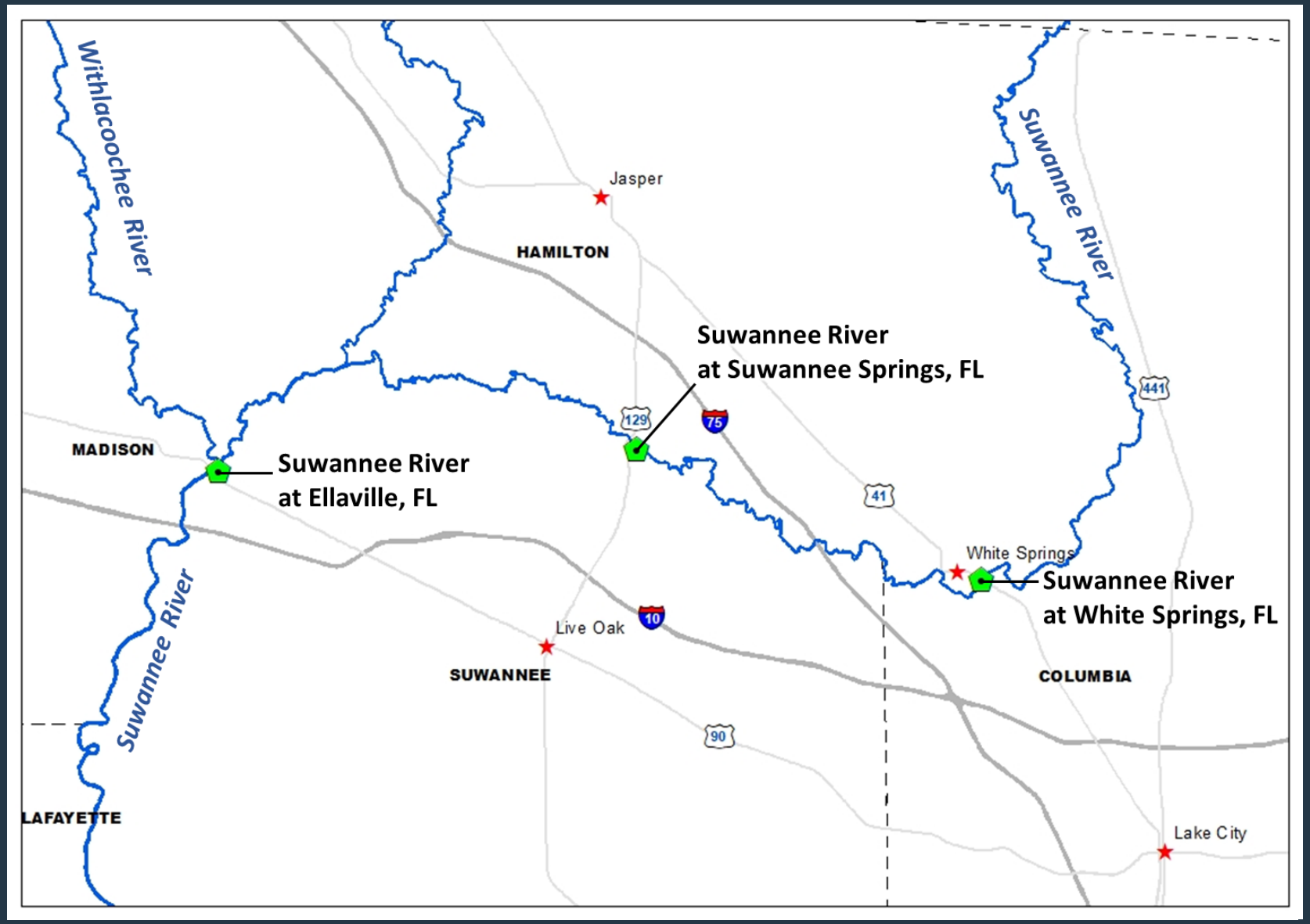
Upper Suwannee River

- FL/GA line to Ellaville
- 79 river miles
- 9 priority springs
- MFL compliance gages at White Springs and Suwannee Springs



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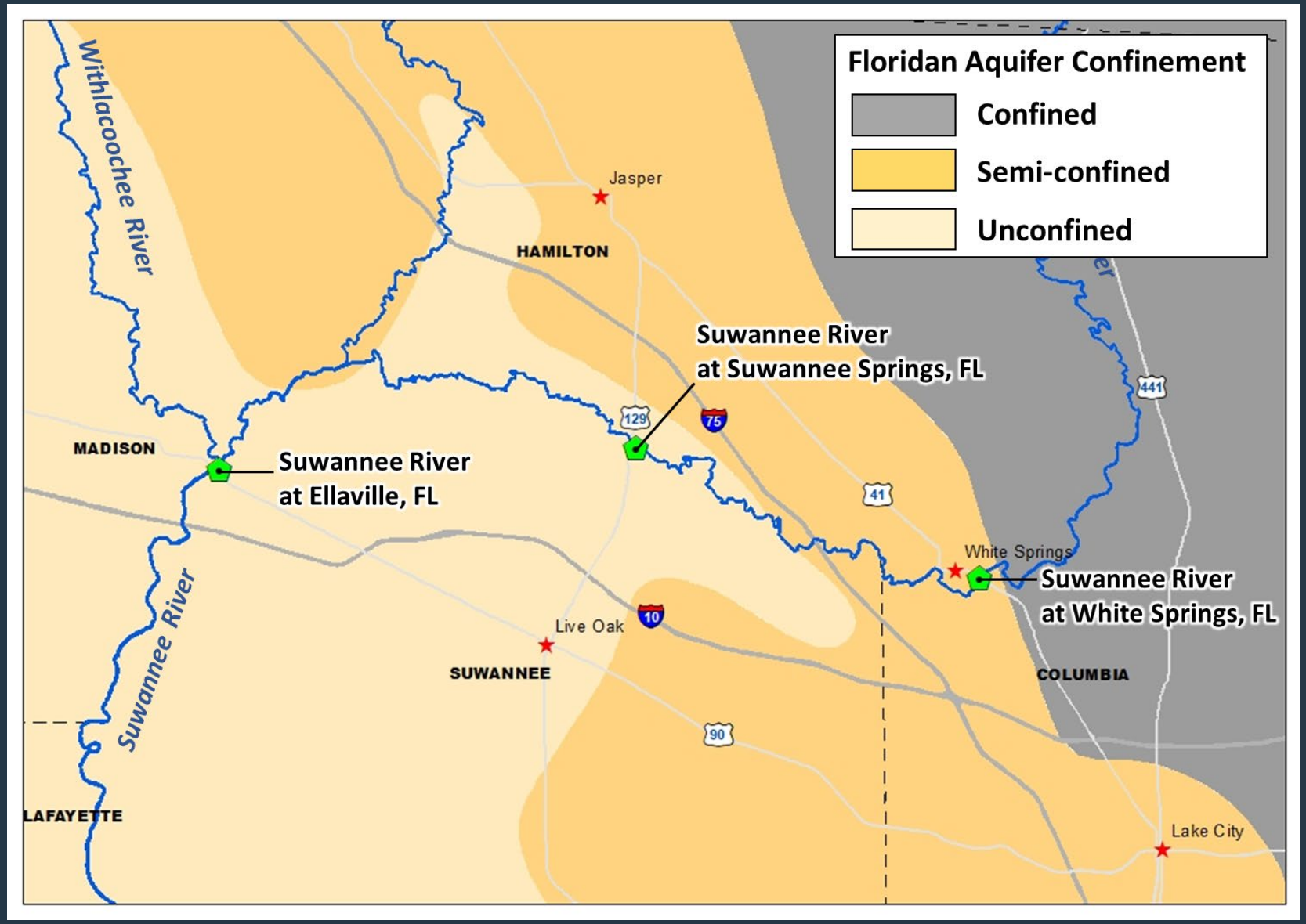

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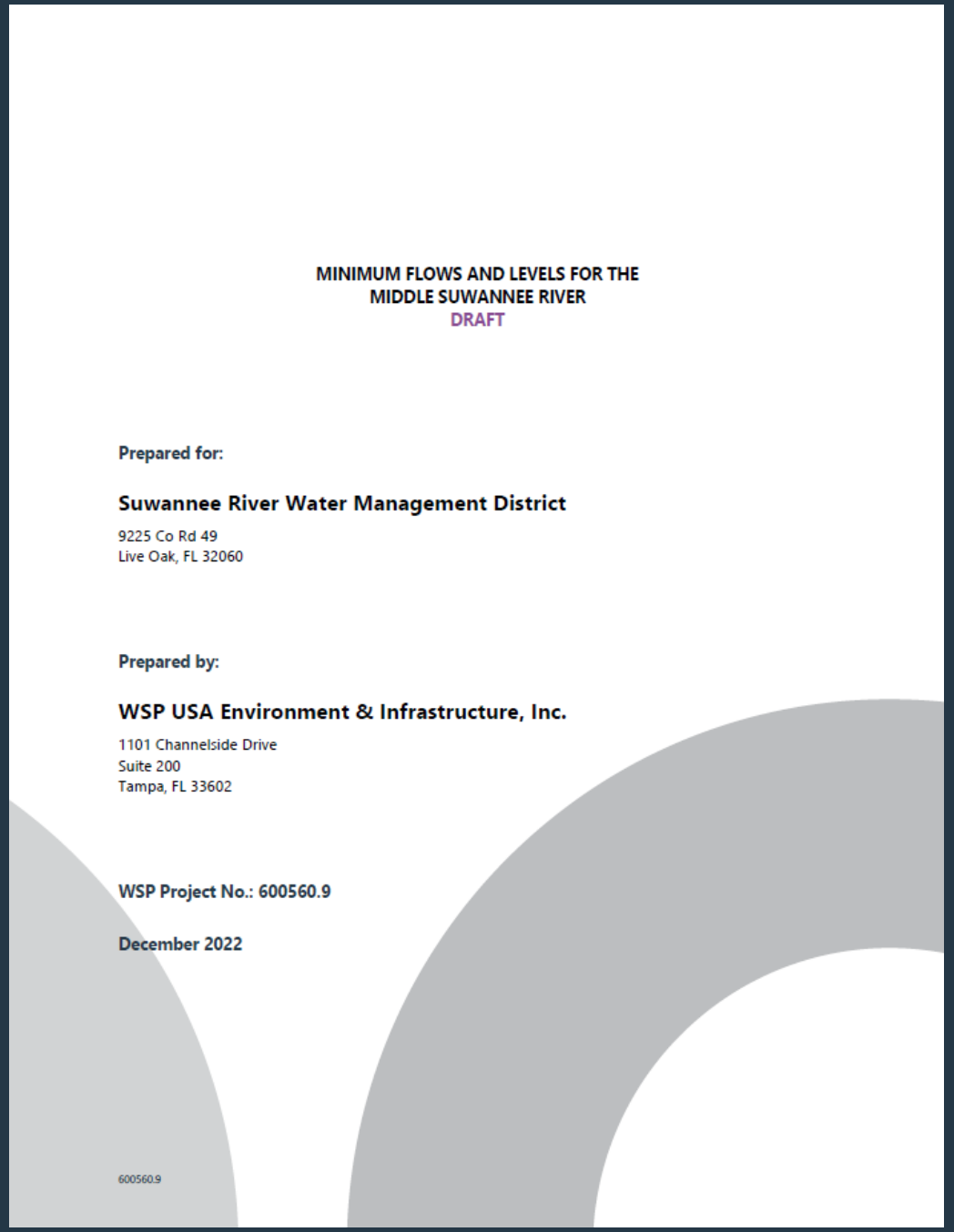
5) Evaluation of WRVs
6) River MFLs
7) References



MINIMUM FLOWS AND LEVELS FOR THE
MIDDLE SUWANNEE RIVER
DRAFT

Prepared for:

Suwannee River Water Management District

9225 Co Rd 49
Live Oak, FL 32060

Prepared by:

WSP USA Environment & Infrastructure, Inc.

1101 Channelside Drive
Suite 200
Tampa, FL 33602

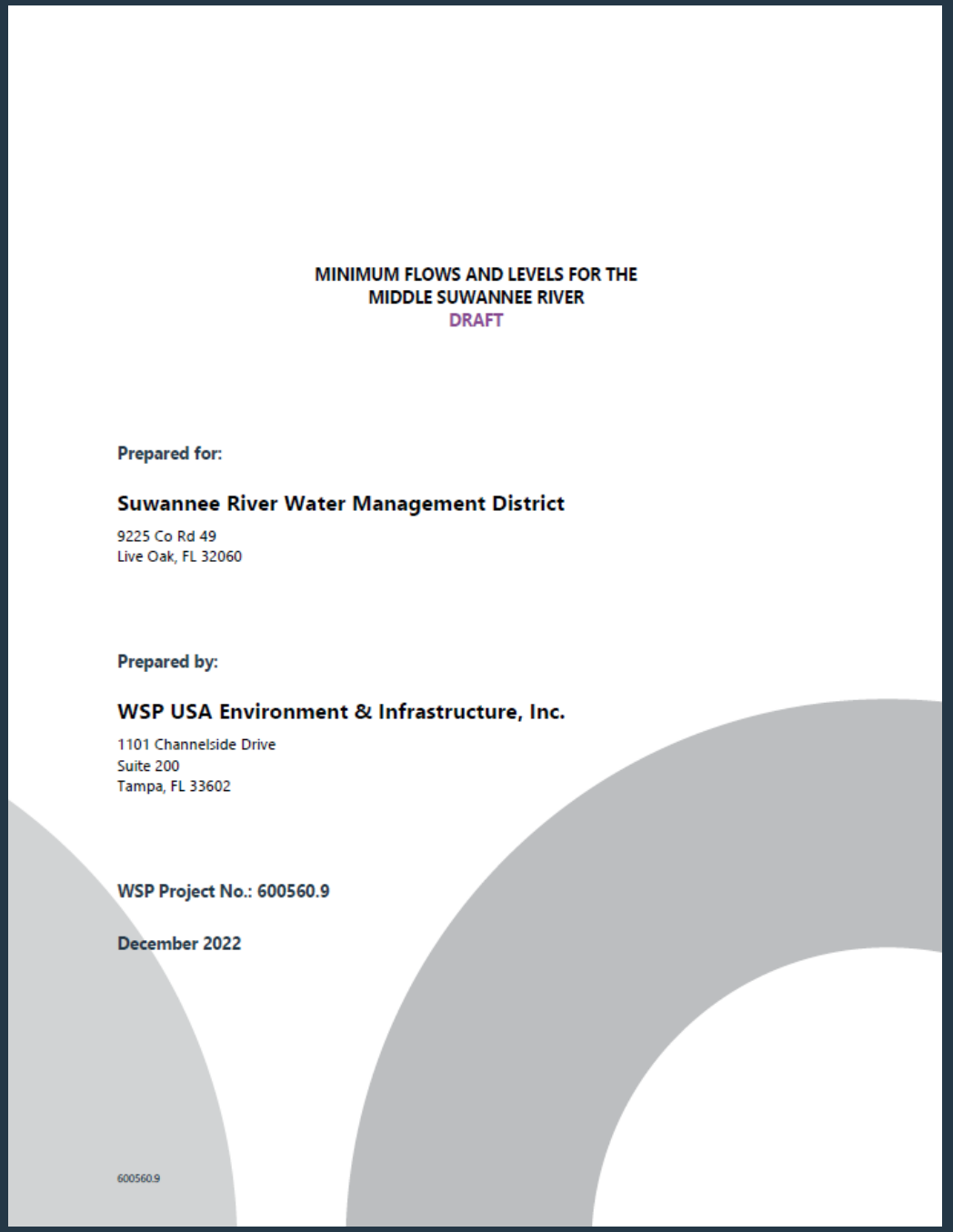
WSP Project No.: 600560.9

December 2022

600560.9

Middle Suwannee River MFL Report Appendices

I. Hydrologic Gap-Filling Memo
II. Baseflow Separation Analysis
III. Water Quality and Springs Evaluation
IV. Floodplain Biology Memo
V. Floodplain and Spring Data Collection
VI. Water Use Hindcasting
VII. RTF Flow Methodology
VIII. In-Stream Analyses Memo
IX. HEC-RAS Model
X. Available Flow and MFL Criteria



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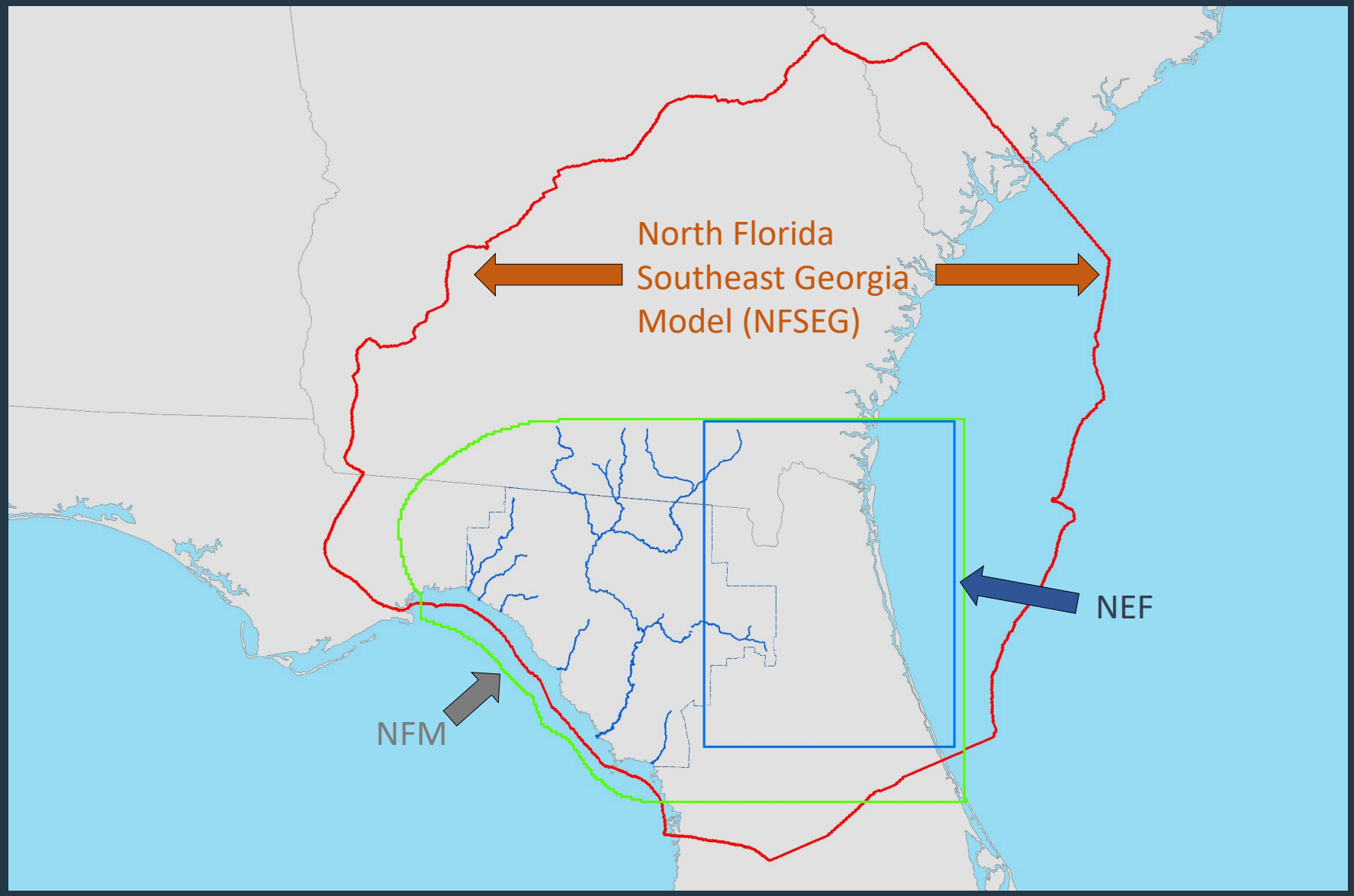
Middle Suwannee River

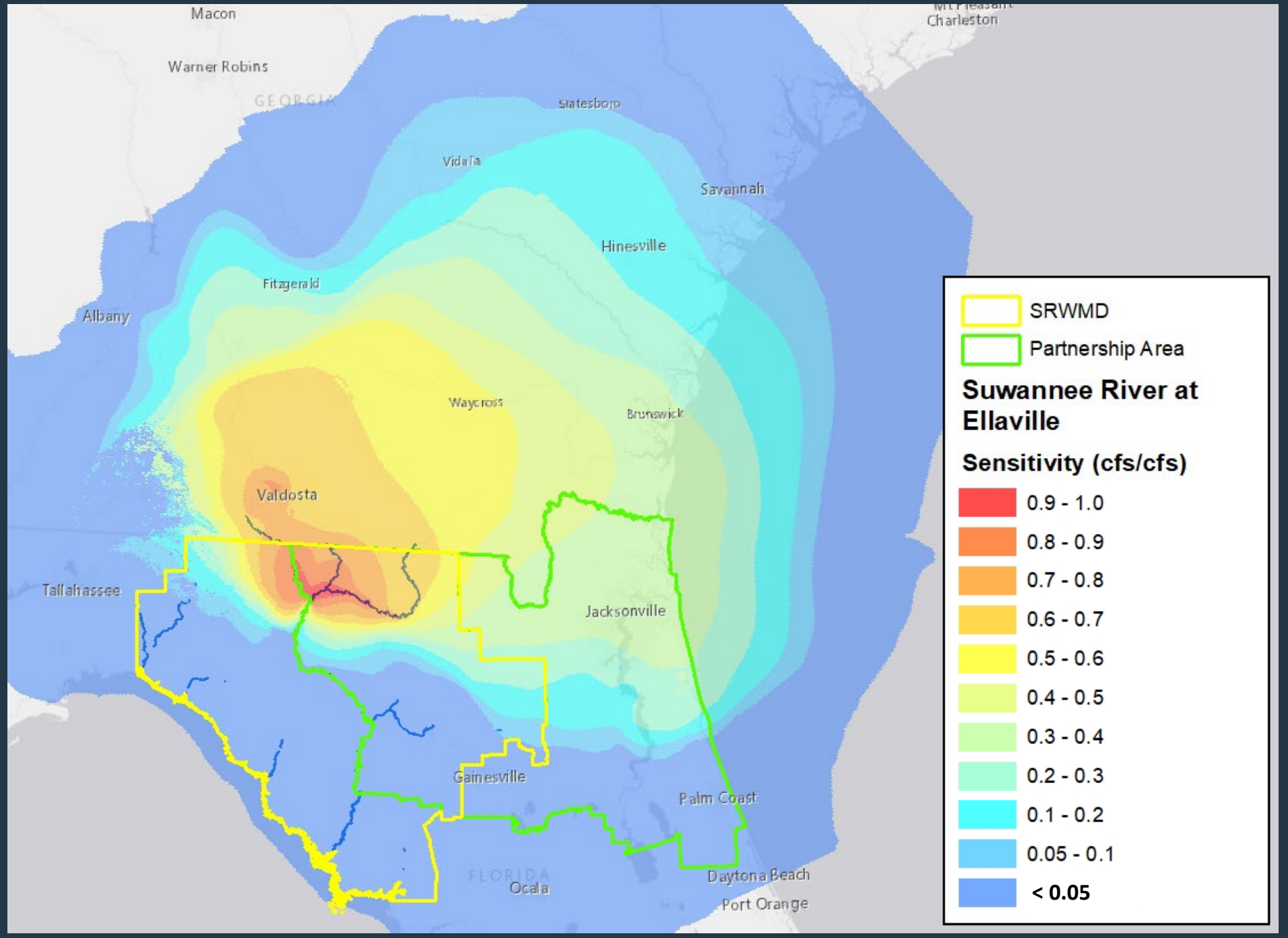
- Ellaville to Wilcox
- 92 river miles
- 24 priority springs including 4 Outstanding Florida Springs
- MFL compliance gages at Ellaville and Branford (red stars)

Regional Groundwater Modeling

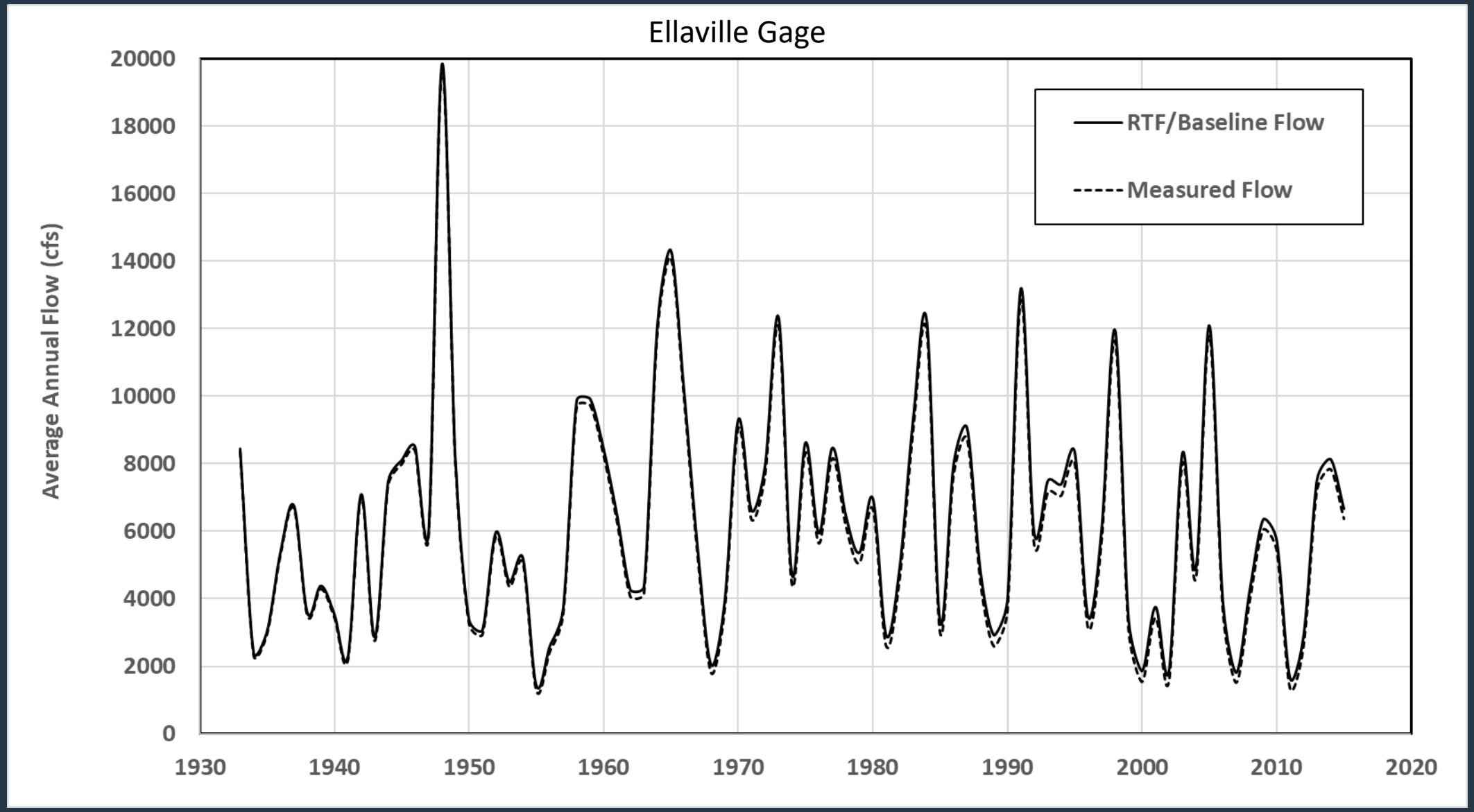


Sensitivity Map

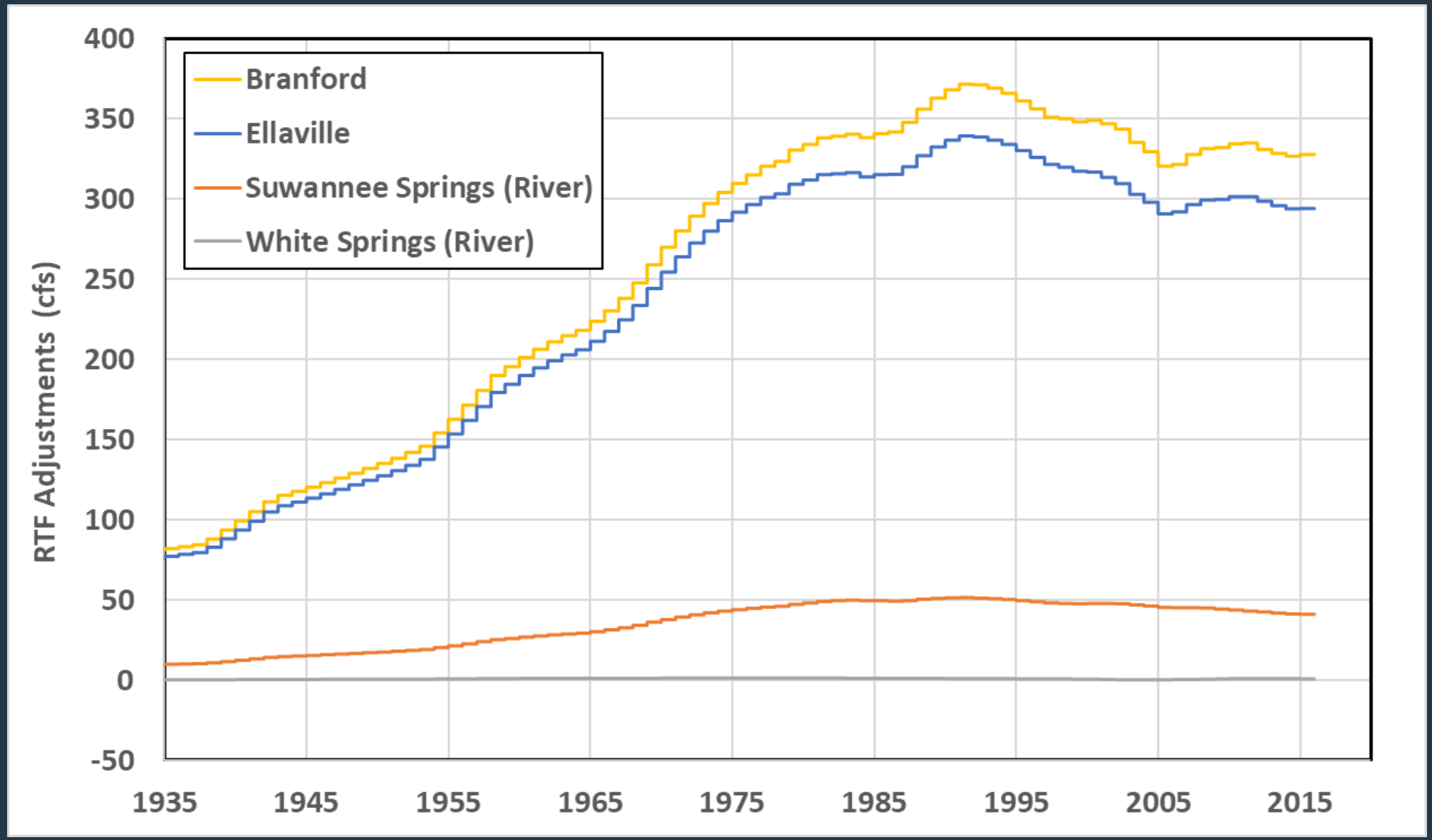
Suwannee River at Ellaville



Reference Timeframe (RTF) Adjustments



RTF Adjustments for River Gages



MFL Compliance Gages - Daily Flow Datasets

Site Name	USGS Site ID	Drainage Area (square miles)	Continuous Daily Period of Record	RTF-Adjusted Period of Record
Suwannee River at **White Springs**	02315500	2,430	2/1927 – current	WY1938 – WY2015
Suwannee River at **Suwannee Springs**	02315550	2,630	10/1974 – 9/1996 10/2011 – current	WY1938 – WY2015
Suwannee River at **Ellaville**	02319500	6,970	2/1927 – current	WY1933 – WY2015
Suwannee River at **Branford**	02320500	7,880	7/1931 – current	WY1933 – WY2015

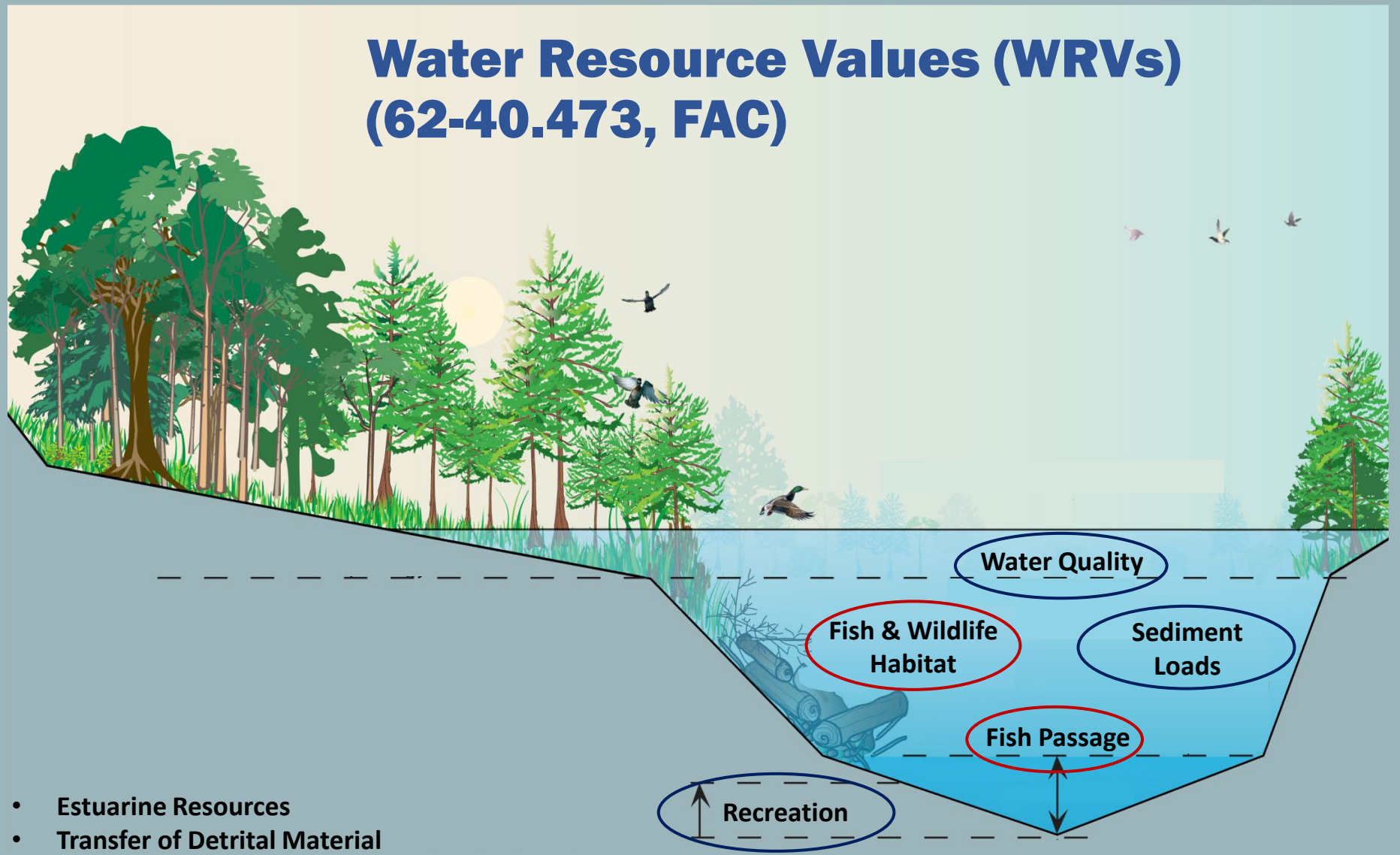
Minimum Flows and Levels (MFLs)

Section 373.042, F.S.

- The minimum flow (or level) for a given watercourse is the limit at which further withdrawals **would be significantly harmful** to the water resources or ecology of the area.

- The minimum flow and minimum water level shall be calculated by the department and the governing board using the **best information available**.

Water Resource Values (WRVs) (62-40.473, FAC)



- Estuarine Resources
- Transfer of Detrital Material
- Maintenance of Freshwater Storage and Supply
- Aesthetic and Scenic Attributes
- Filtration/Absorption of Nutrients and other Pollutants
- Navigation

- Boating
- Paddling

A conceptual illustration, not to scale

Upper and Middle Suwannee River MFLs WRV Metrics

- Recreation
  - Paddling/Boating
- Fish and Wildlife Habitat and Fish Passage
  - General fish and Gulf sturgeon passage
  - Gulf sturgeon spawning depth
  - In-stream habitat (SEFA analyses)
  - Floodplain habitats
- Sediment Loads
  - Bankfull and alluvial ridge crest conditions
- Water Quality
  - Gulf sturgeon spawning (conductivity)

Percent of Time/Area Method

Table 13. Change in flow (allowable withdrawal) resulting from a 15% decrease in the time flow is greater than the threshold condition for Floodplain Swamp inundation

Floodplain habitat metrics				Flow and time exceeded resulting from a 15% decrease in time exceeded			Decrease in flow and time exceeded		
Description	Flow	Time flow exceeded		Time flow exceeded		Flow	Time	Flow	
	(cfs)	%	Average days/year	%	Average days/year	cfs	Average days/year	cfs	%
Index[1]	A	B	C	D	E	F	G	H	I
Floodplain Swamp inundation	7,531	4.4	16	3.7	14	7,956	2	425	5.3

1. A=threshold stage (flow), B=% time threshold flow exceeded, C=B*365, D=B*0.85, E=C*0.85, F=flow associated with 15% reduction in exceedance time, G=E-C, H=F-A, I=100*(F-A)/F. Refer to Figure 57.

Percent of Time/Area Method

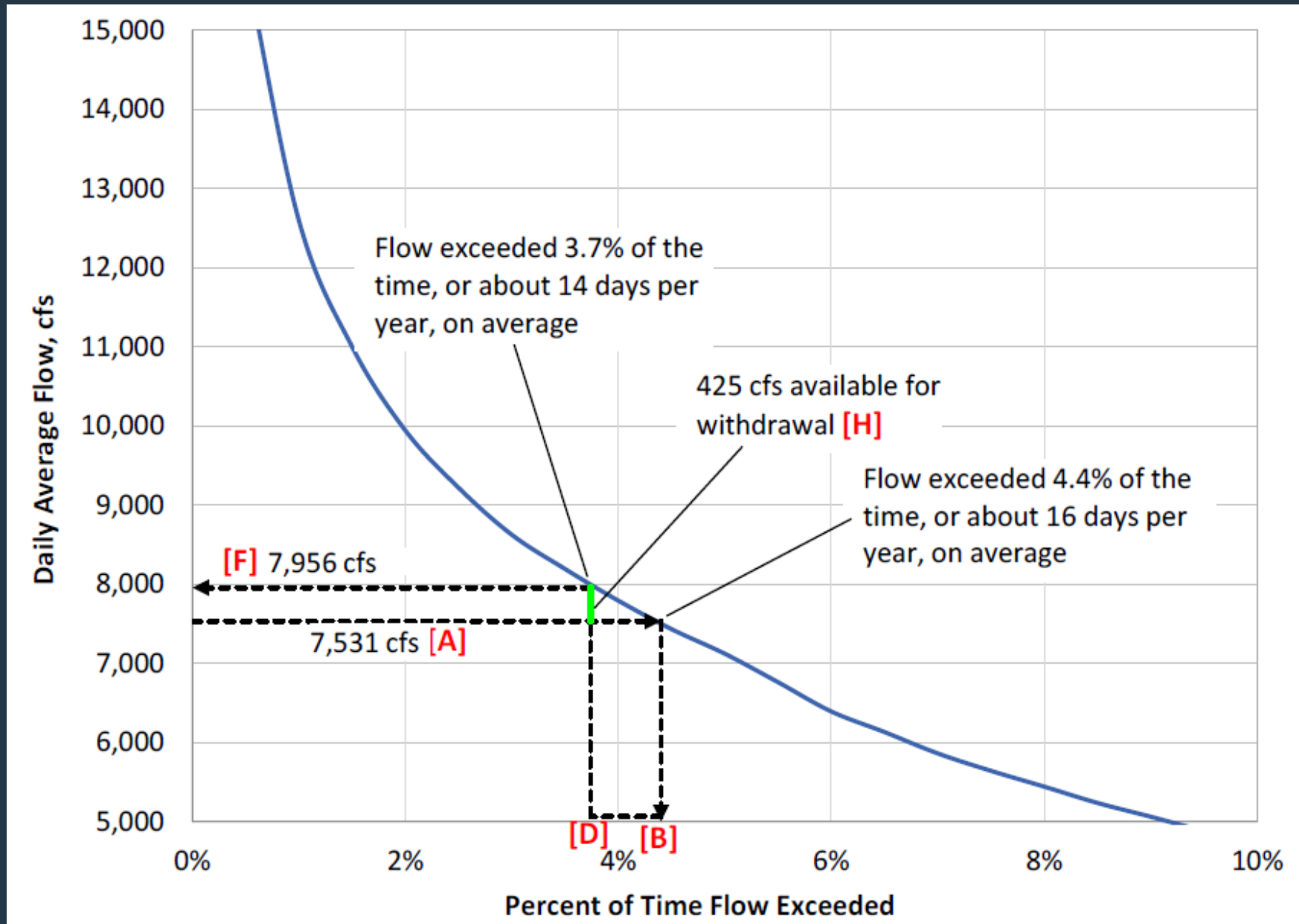
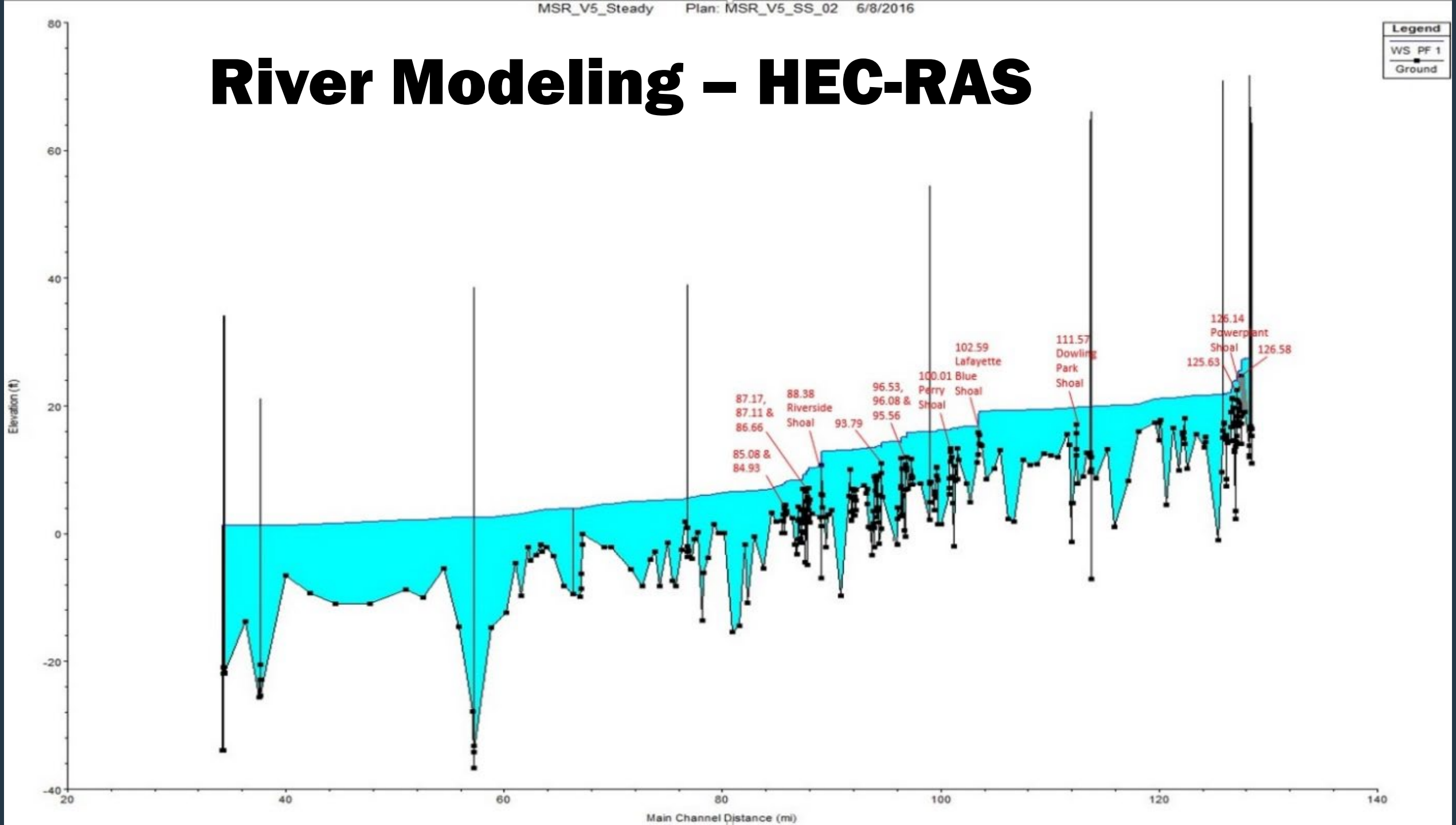


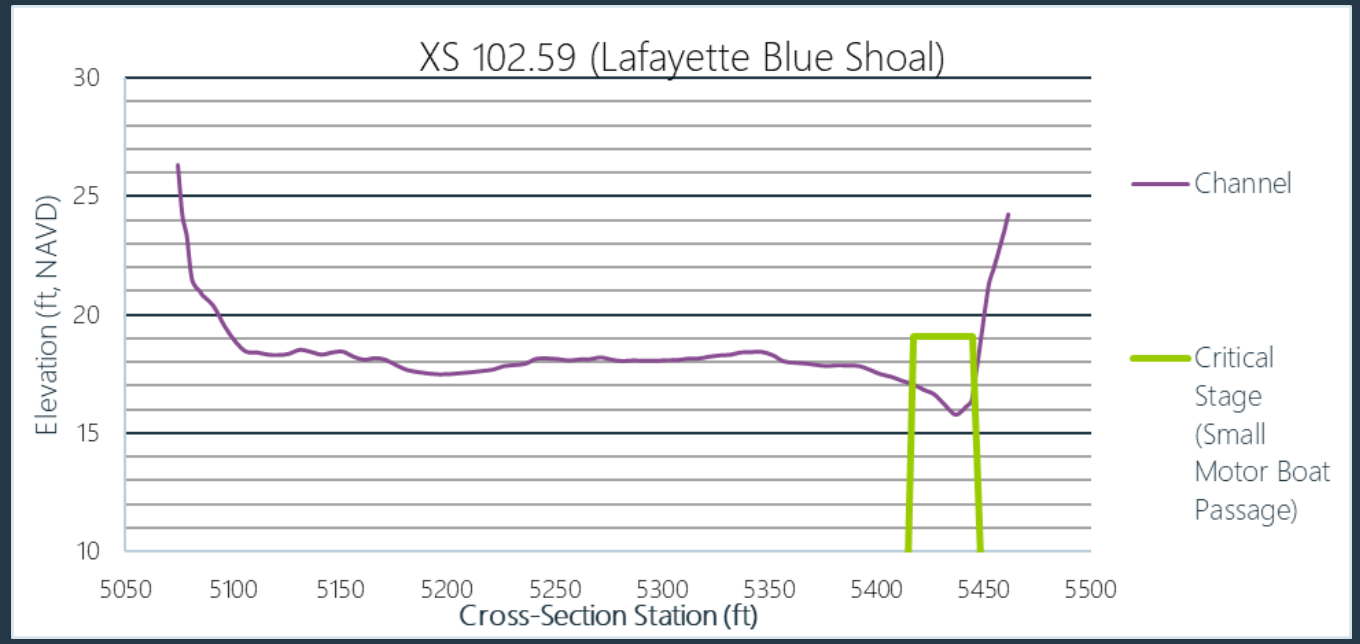
Figure 57. RTF (baseline) flow duration curve and exceedance frequencies associated with the USR Floodplain Swamp vegetation community

River Modeling – HEC-RAS



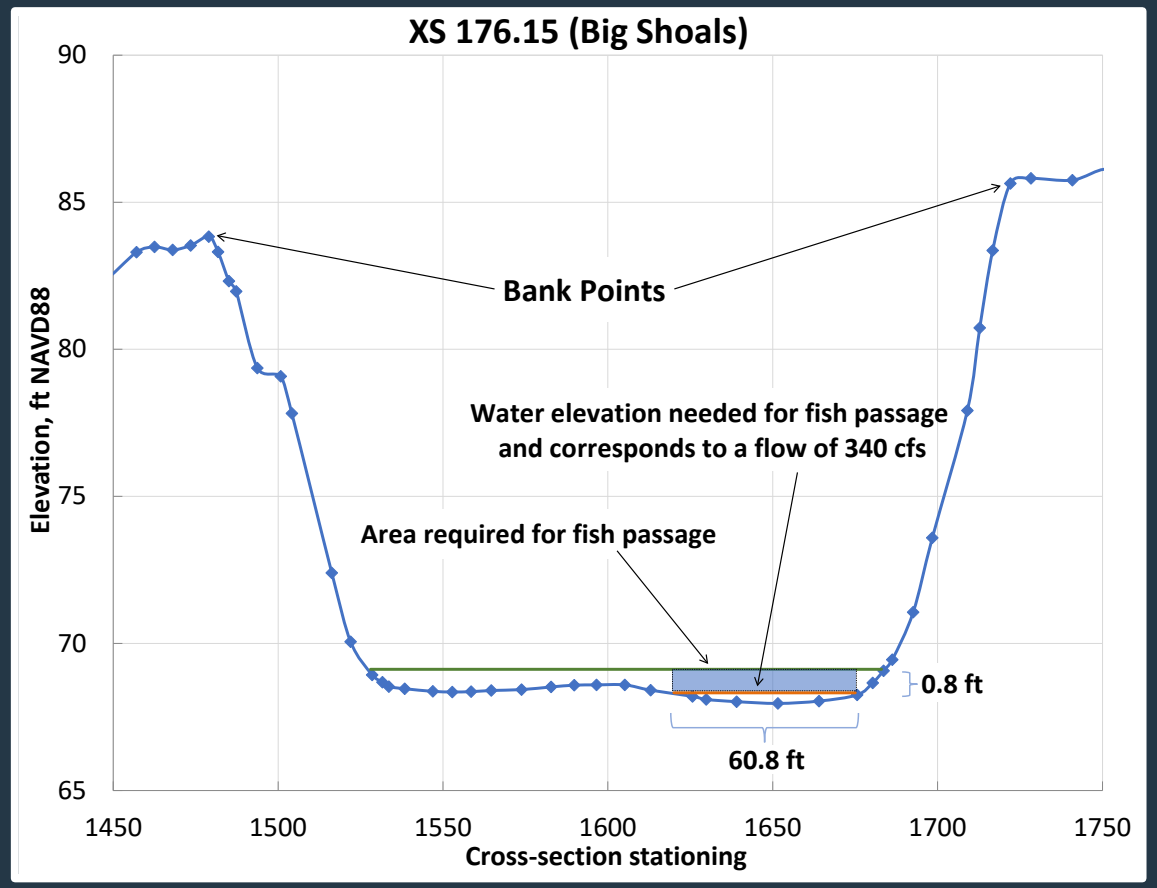
Recreation - Paddling/Boating

Upper Suwannee

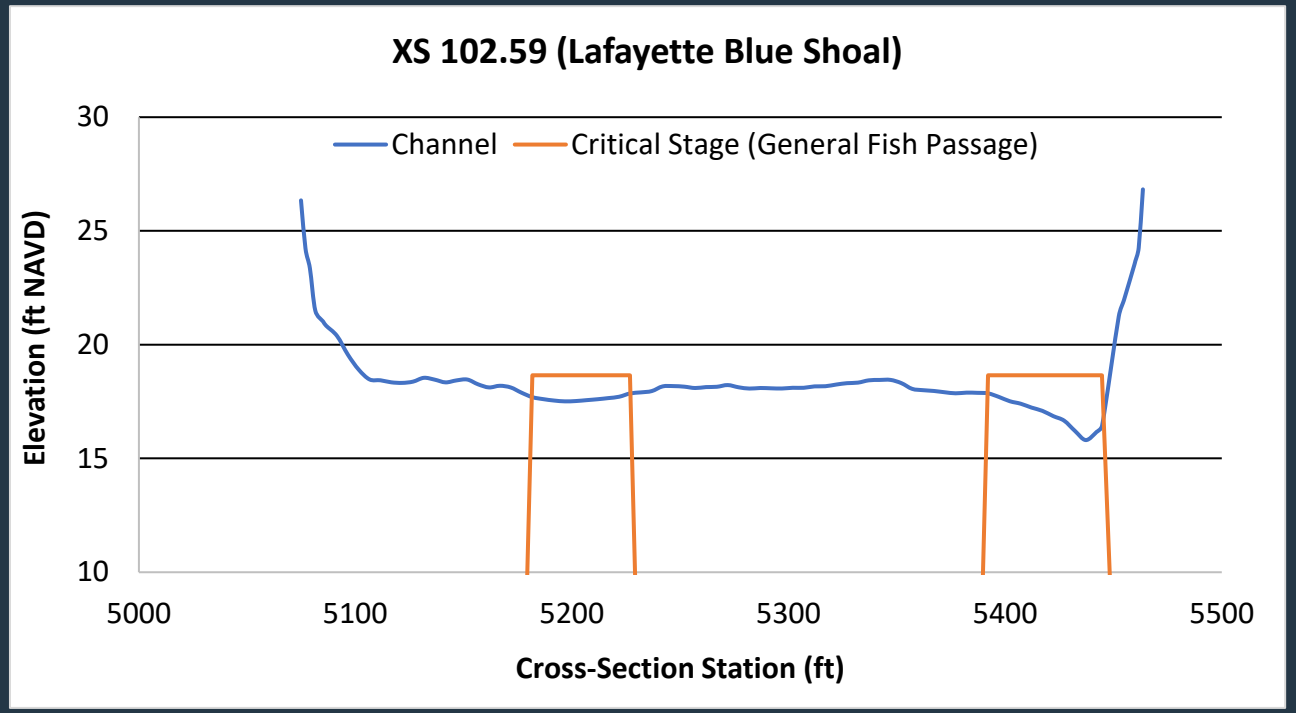


Middle Suwannee

Fish Passage General

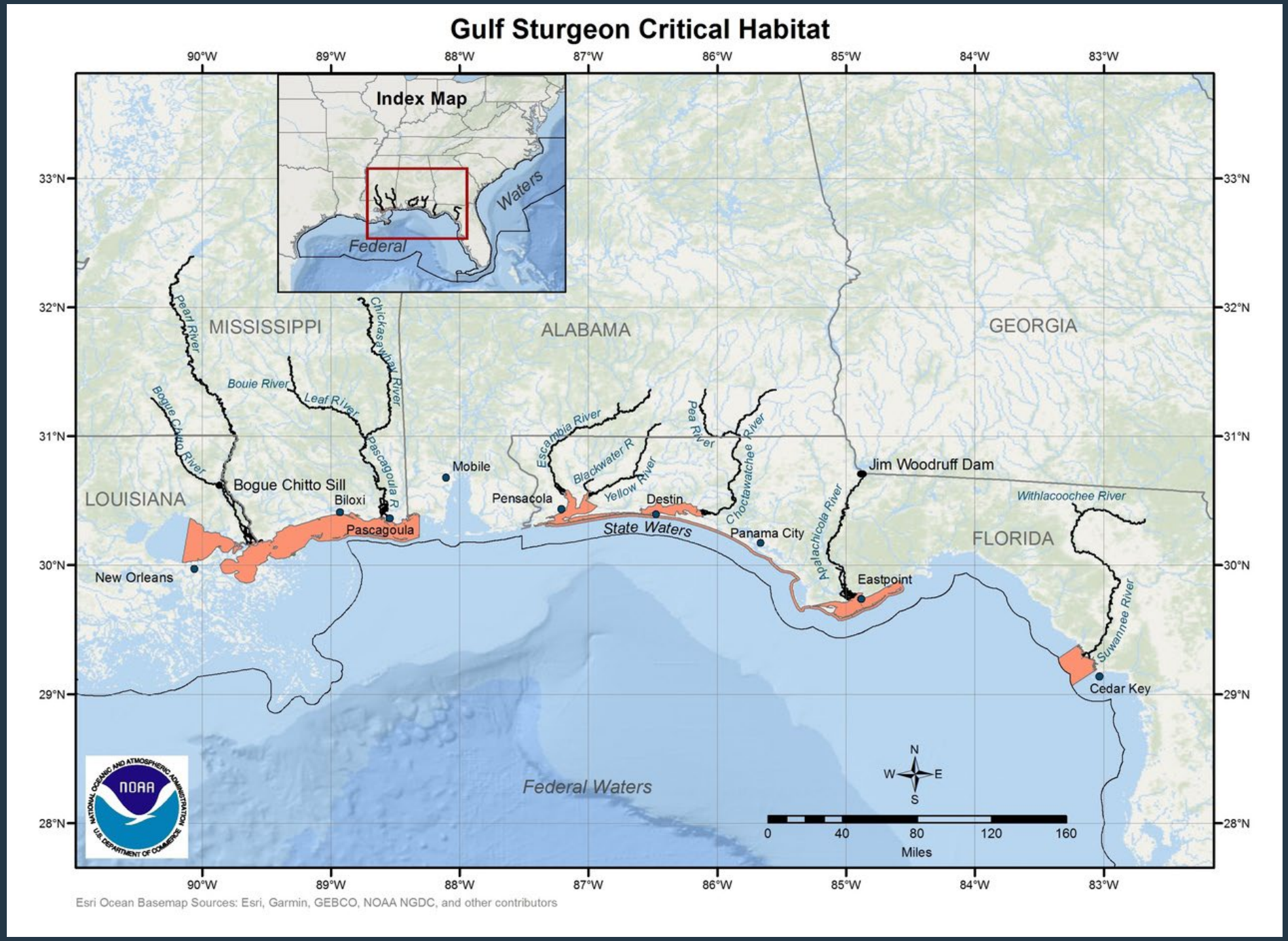


Upper Suwannee



Middle Suwannee

Gulf Sturgeon Analyses



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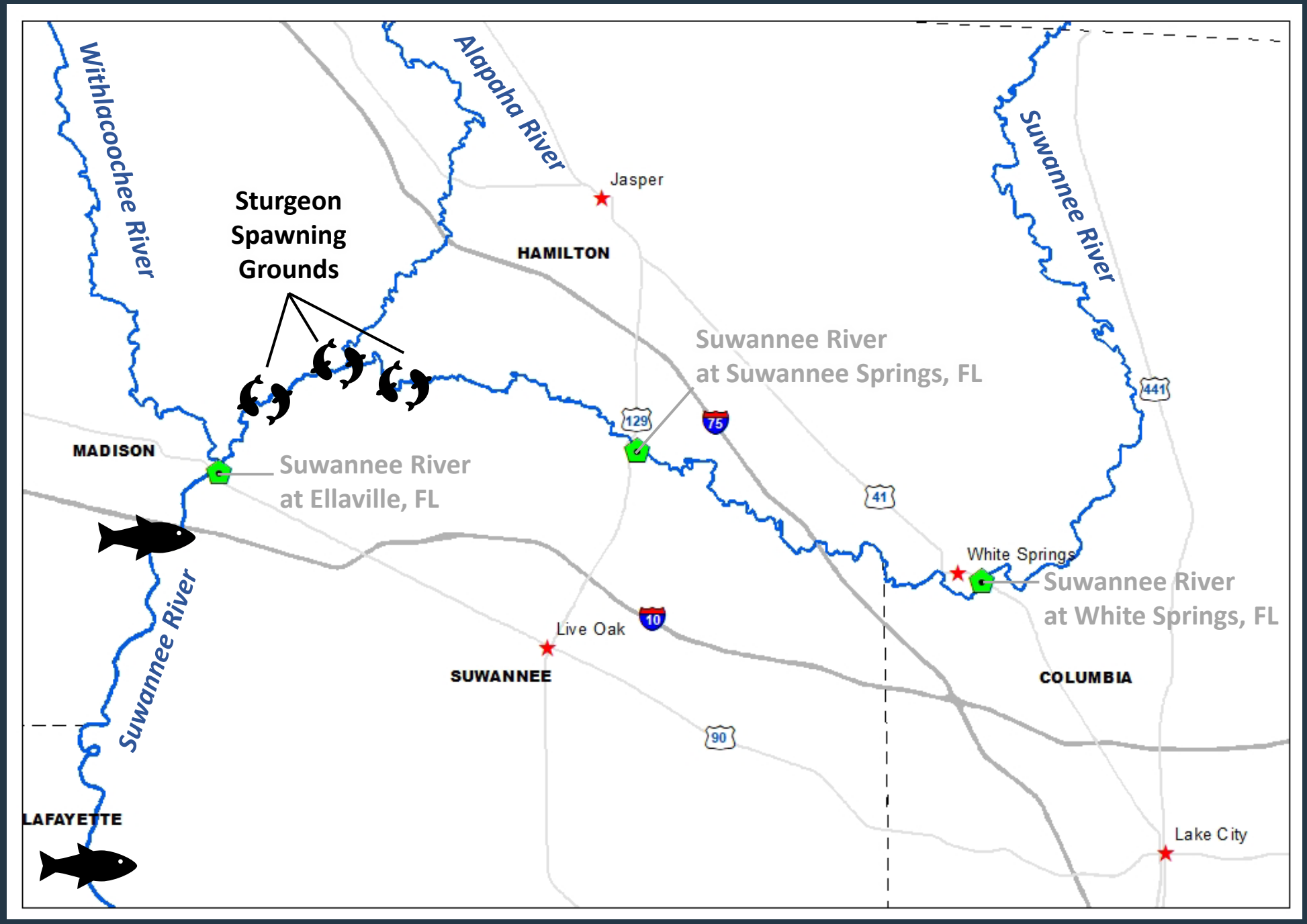
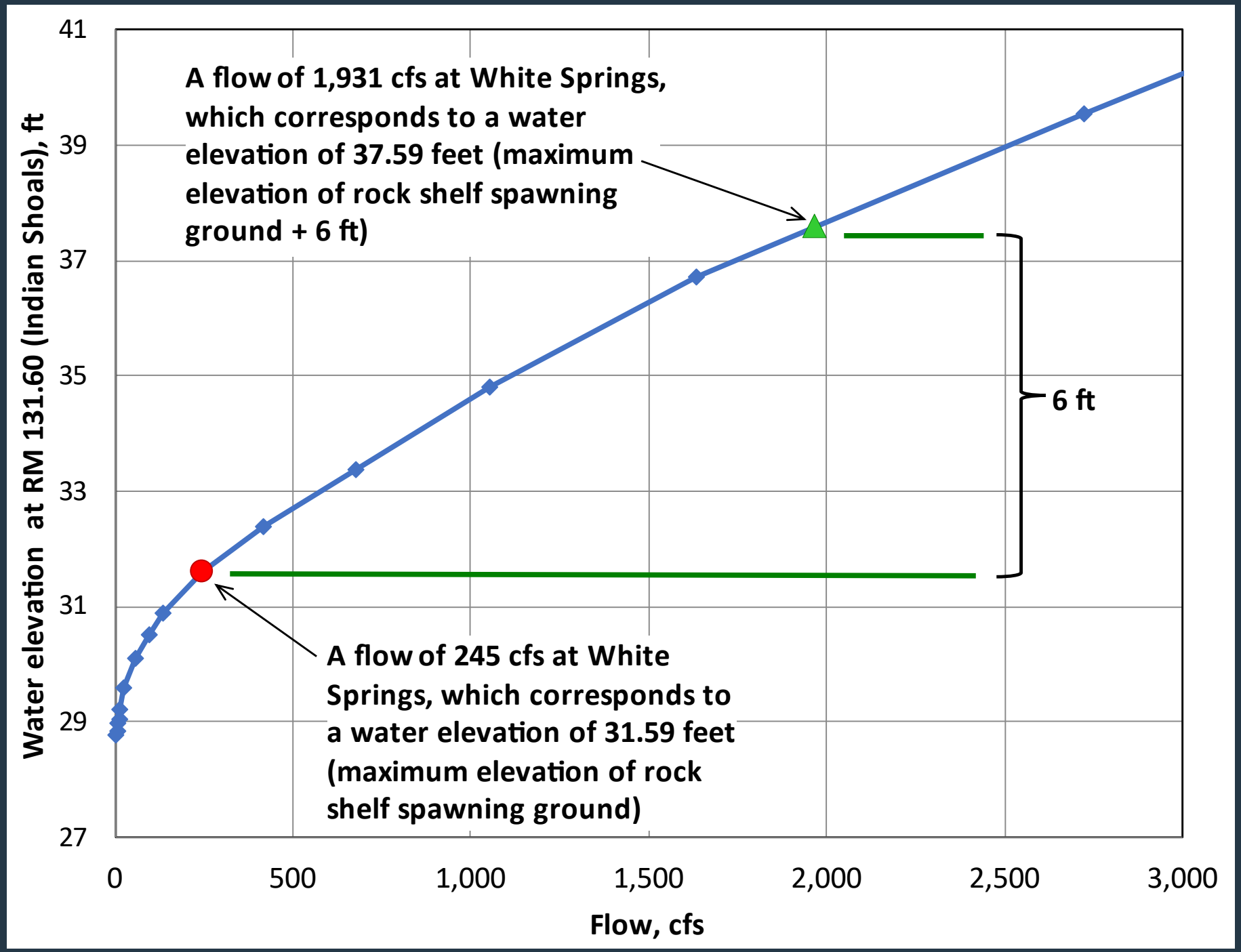


Gulf Sturgeon Spawning Depth

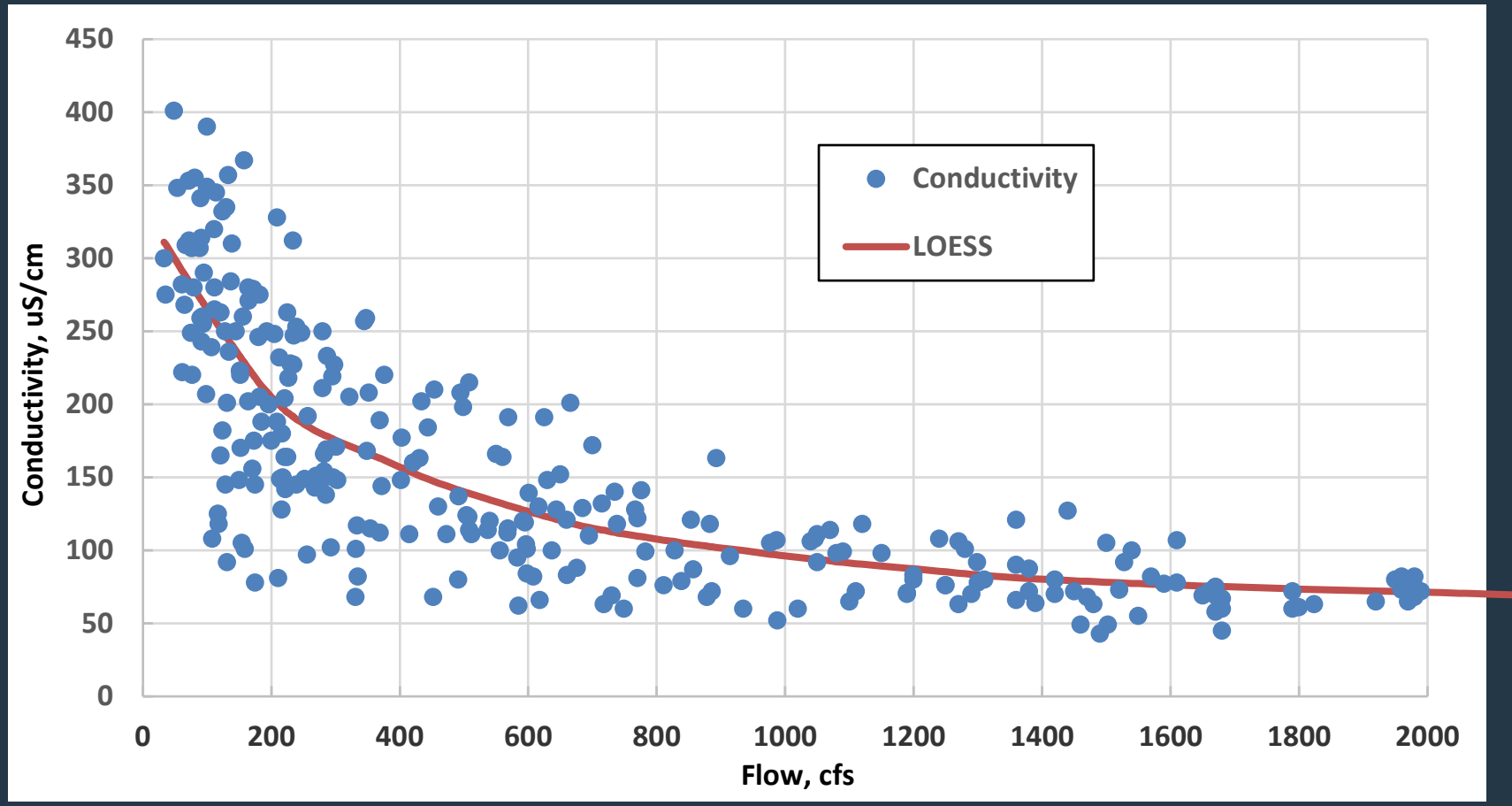


Gulf Sturgeon Spawning Water Quality

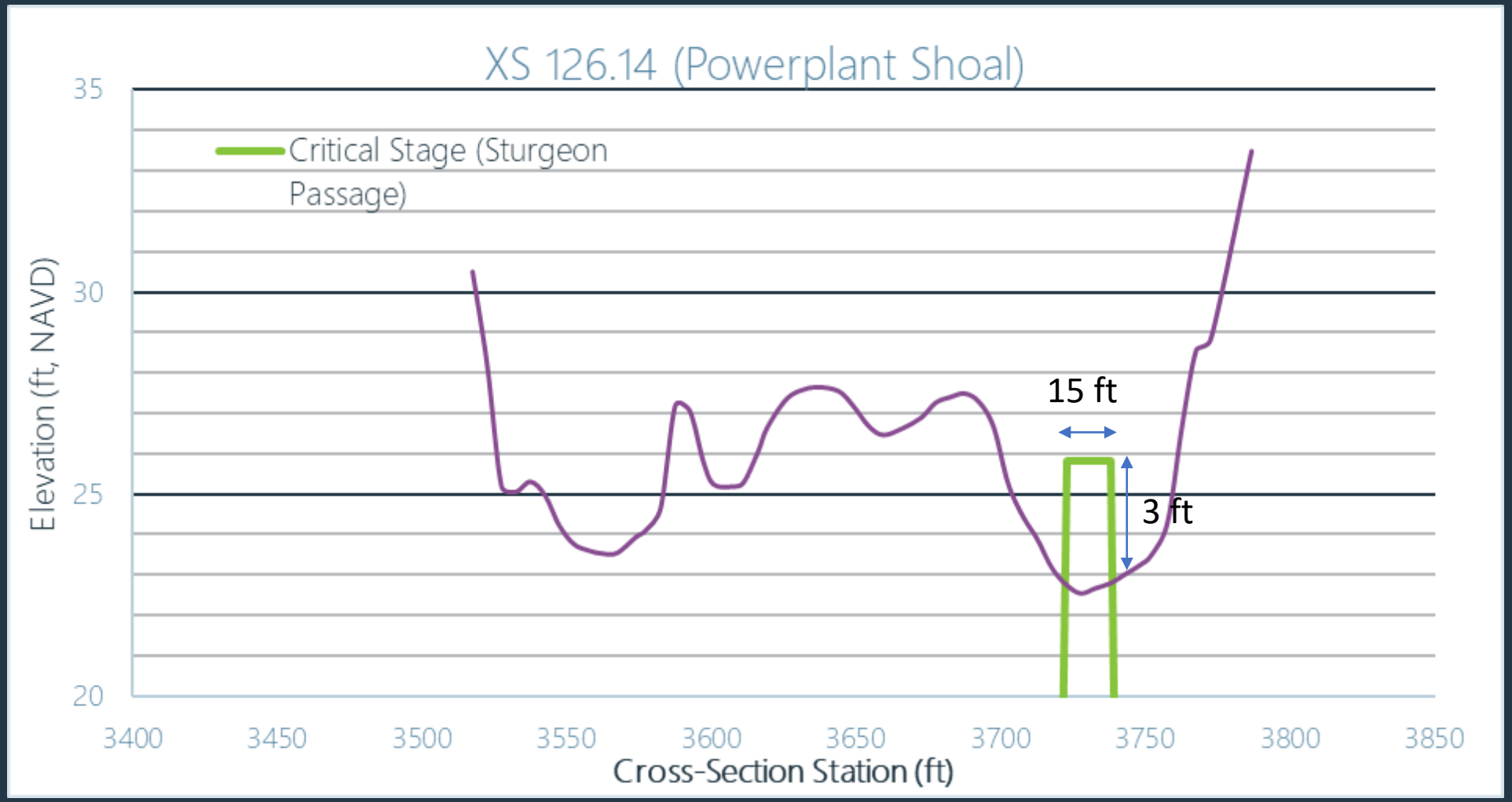
Table 18. Range in water quality for successful Gulf sturgeon spawning

Water quality characteristic	Range for successful Gulf sturgeon spawning	Limiting value for lowest flow	Limiting value for highest flow
Conductivity, umhos/cm	40 to 110	110	40
Calcium, mg/L	6 to 18	18	6.0
pH	7.0 to 7.5	7.5	7.0
Secchi depth, m	0.6 to 1.4	1.4	0.6

[Source: Clugston & Sulak, 1999]



Gulf Sturgeon Passage Depth

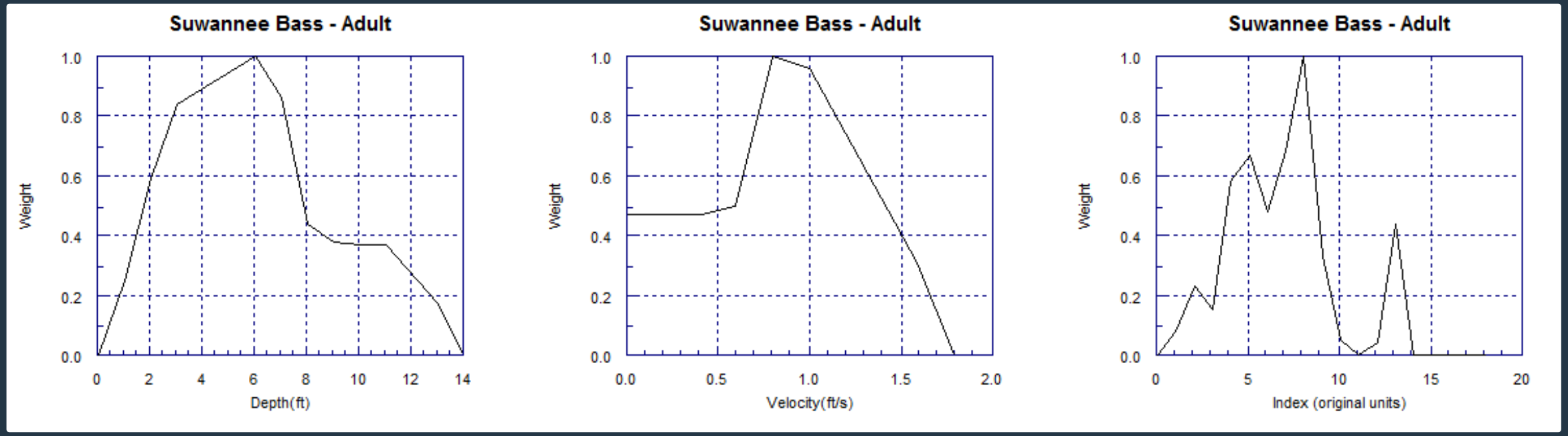


Instream Habitat Analyses

Species or Group	Life Stage
Suwannee Bass	Adult, Juvenile, Spawning
Redbreast Sunfish	Adult, Juvenile, Spawning, Fry
Habitat Guilds	Shallow/Slow, Shallow/Fast, Deep/Slow, Deep/Fast
Channel Catfish	Adult, Juvenile, Juvenile (spring, summer, fall), Spawning, Fry
Darters	Generic (adult), Blackbanded (adult)
Macroinvertebrates	Ephemeroptera, Plecoptera, Trichoptera, EPT Total, *Pseudocloeon ephippiatum* (nymph),
	Hydropsychidae Total, *Tvetenia vitracies* (larvae), Benthic Macroinvertebrates (low grad)
Largemouth Bass	Adult, Juvenile, Spawning, Fry
Bluegill	Adult, Juvenile, Spawning, Fry
Spotted Sunfish	Adult, Juvenile, Spawning, Fry
Cyprinidae	Adult
Gulf Sturgeon	Juvenile, Adult*
Metallic Shiner	Adult
Spotted Sucker	Juvenile, Adult

Instream Habitat Analyses

- Habitat Suitability
  - Depth
  - Velocity
  - Substrate Type



Habitat Suitability Curves

Instream Habitat Analyses

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Reference
Gulf sturgeon													Chapman & Carr, 1995; Sulak & Randal, 2009
Suwannee bass													Strong et al. 2010
Largemouth bass			X	X	X	X	X						Rogers & Allen 2010
Bluegill sunfish				X	X	X	X	X	X	X	X		Bass Fishing Florida 2021a
Channel catfish				X	X	X	X						Chapman 2018
Redbreast sunfish					X	X	X	X	X				Bass Fishing Florida, 2021b
Spotted sunfish			X	X	X	X	X	X	X	X			Hill & Cichra, 2005

X – fry months

Blue Shading – spawning months

Instream Habitat
Upper Suwannee

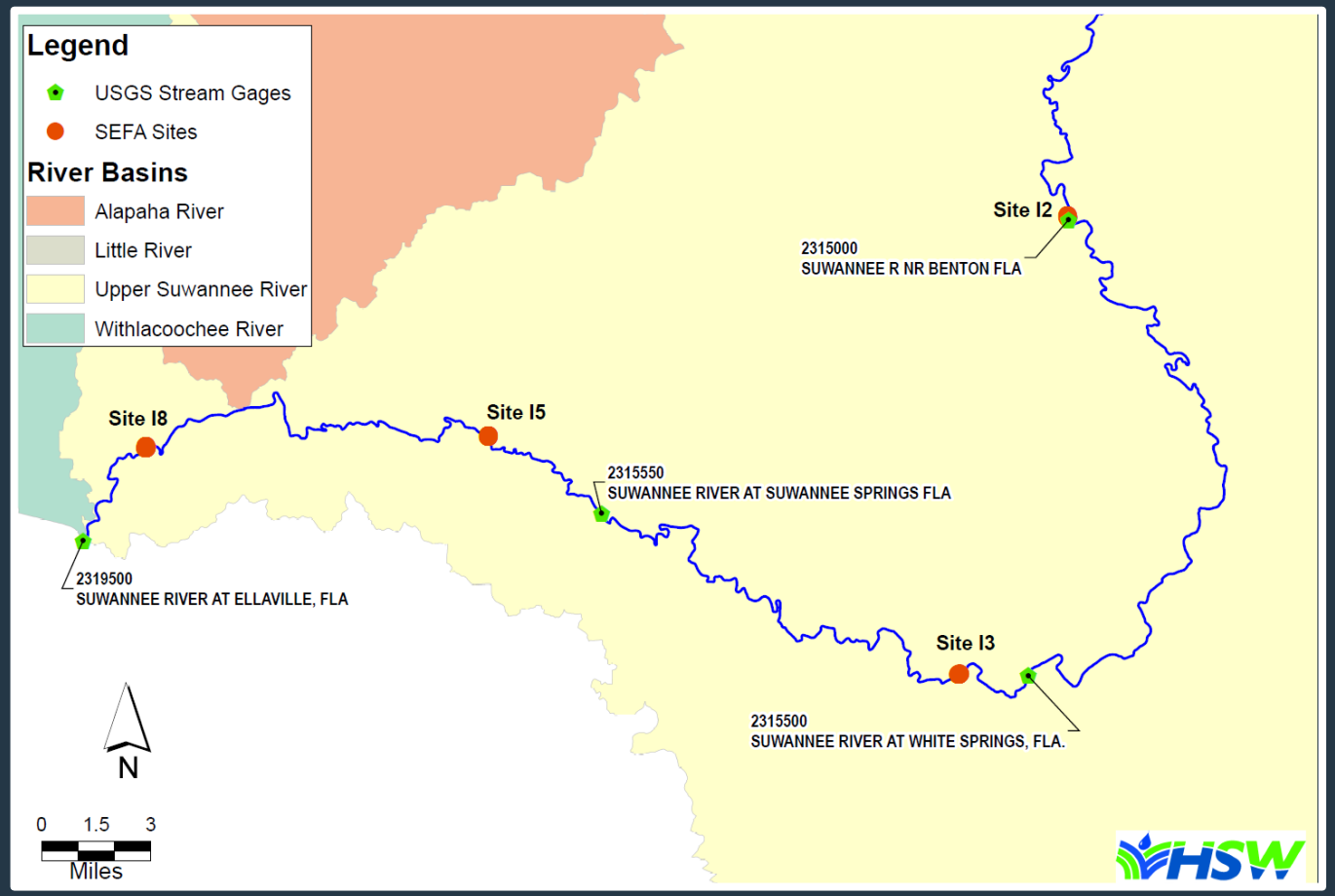
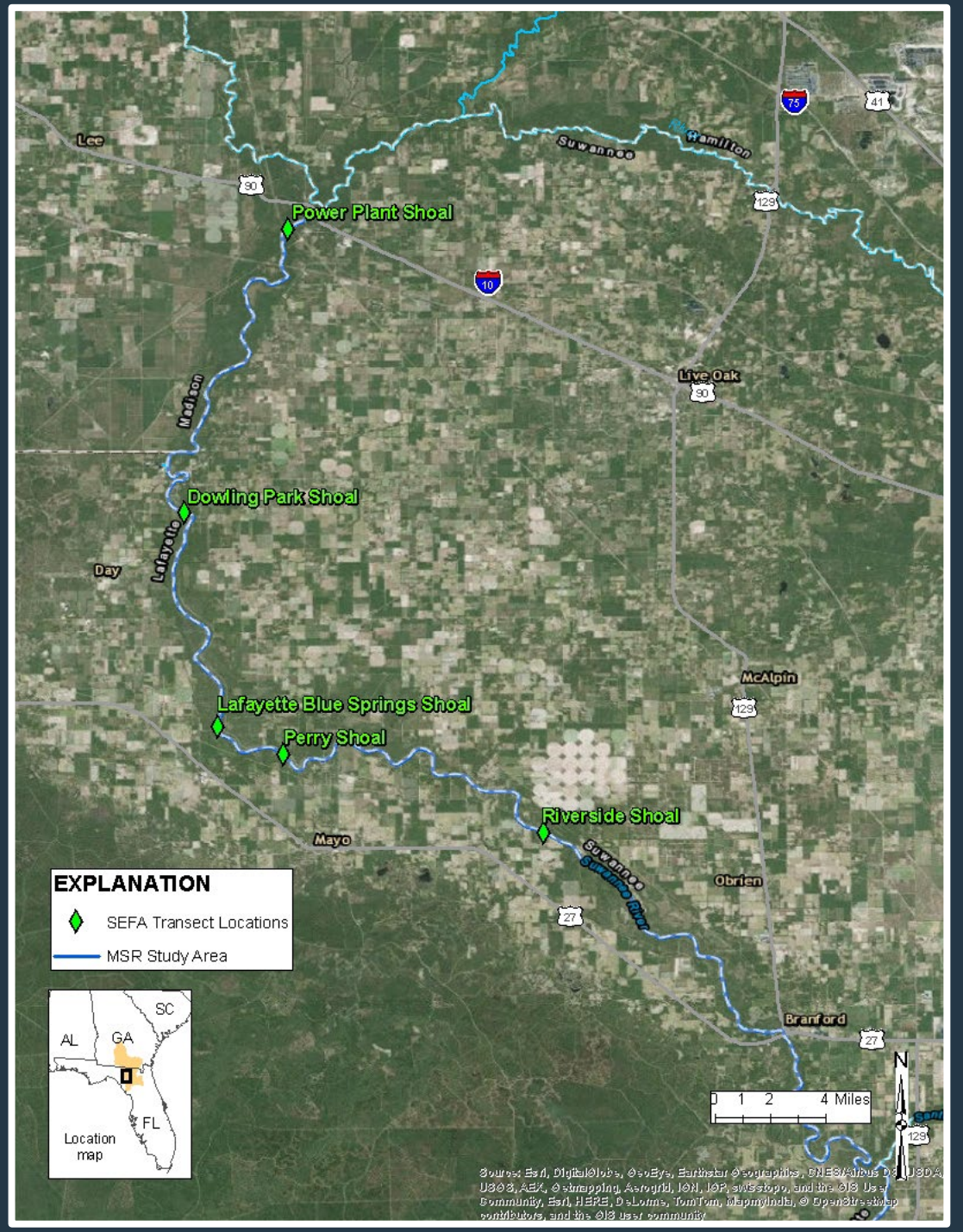


Table 17. Habitat suitability curves used in the MFL analysis

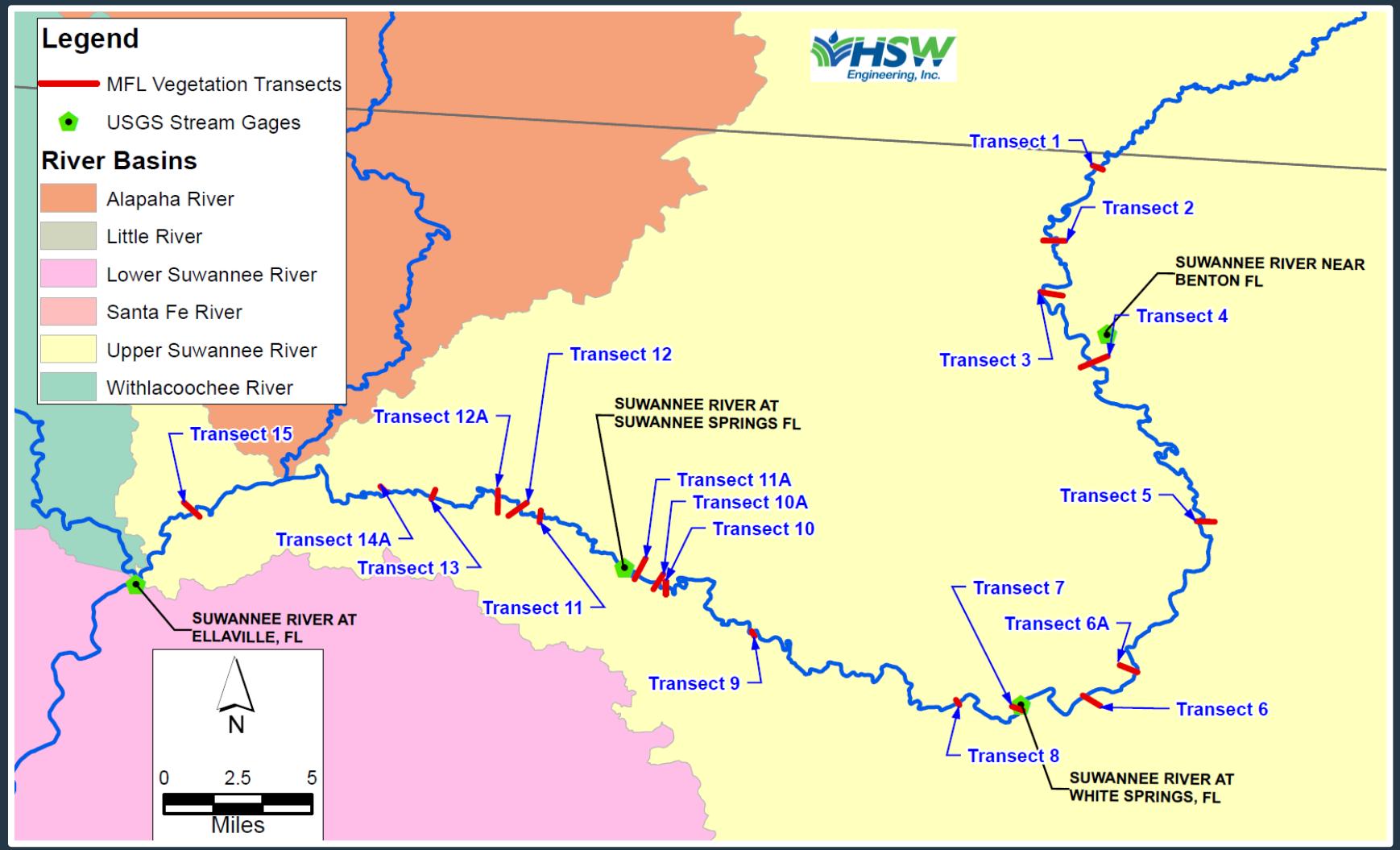
Species	Change in Flow (%)	Constant Change in Flow (cfs)	Months analyzed
White Springs gage			
Largemouth Bass – fry	8.1	111	March-July
Suwannee Bass - Spawning	7.2	114	March-June
Largemouth Bass – adult	11	130	Jan-Dec
Suwannee Springs gage			
Largemouth Bass – fry	7.8	126	March-July
Suwannee Bass - Spawning	6.9	129	March-June
Largemouth Bass – adult	10.2	143	Jan-Dec

Instream Habitat Middle Suwannee

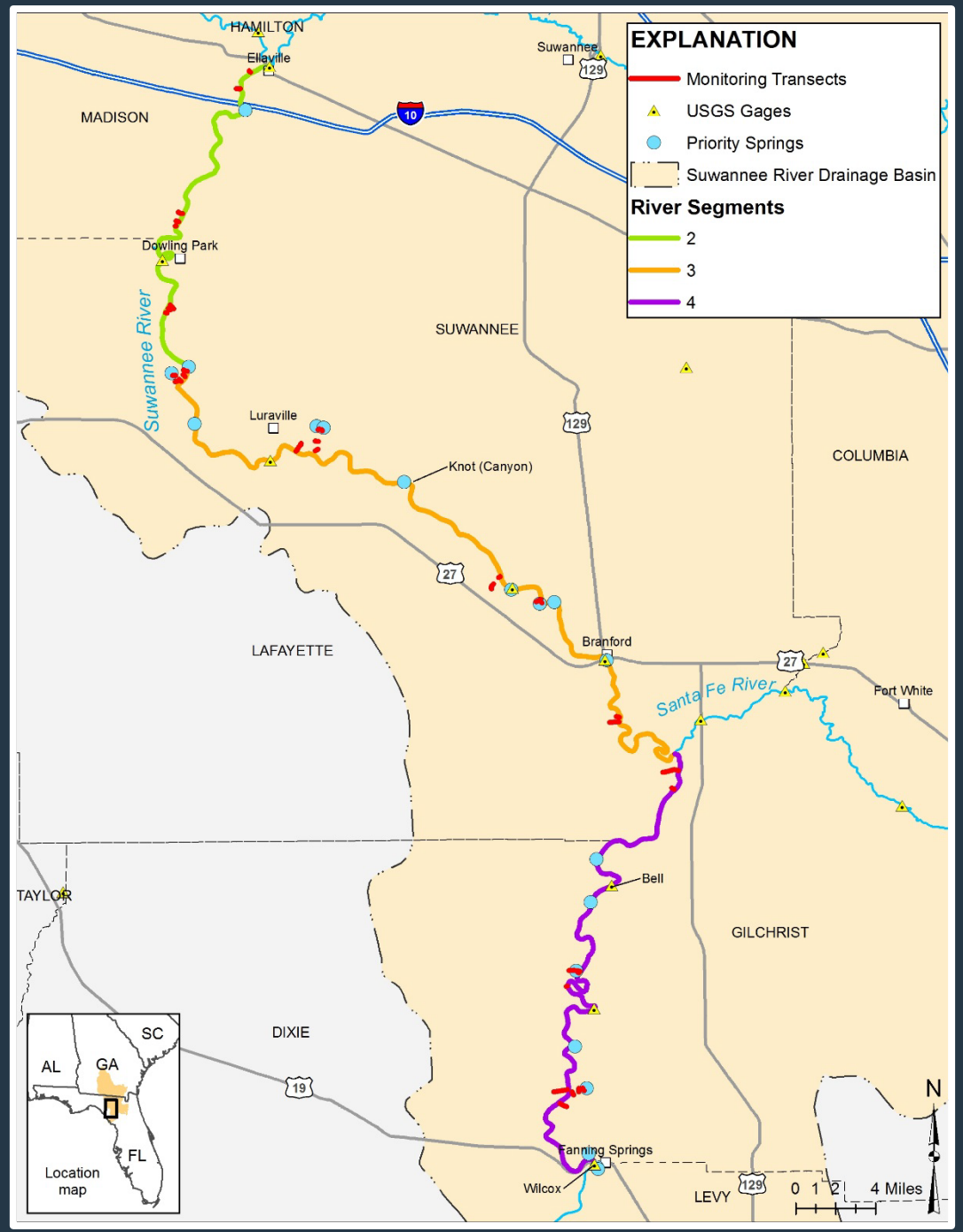
USGS Gage	Site	Species/Life Stage	Change in Flow (%)	Hydrologic Shift (cfs)
Ellaville	Power Plant	Habitat Guild Deep/Slow	**15.7**	**600**
		Largemouth Bass Adult	18.2	696
		Largemouth Bass Fry	18.9	722
		Bluegill Fry	23.9	914
	Dowling Park	Gulf Sturgeon Adult	18.9	722
Branford	Lafayette Blue	Largemouth Bass Fry	14.9	744
		Largemouth Bass Adult	16.0	799
		Gulf Sturgeon Adult	**18.9**	**944**
		Habitat Guild Deep/Slow	22.6	1129
	Perry	no limiting species		
	Riverside	Largemouth Bass Adult	20.7	1034
		Habitat Guild Deep/Slow	21.3	1064

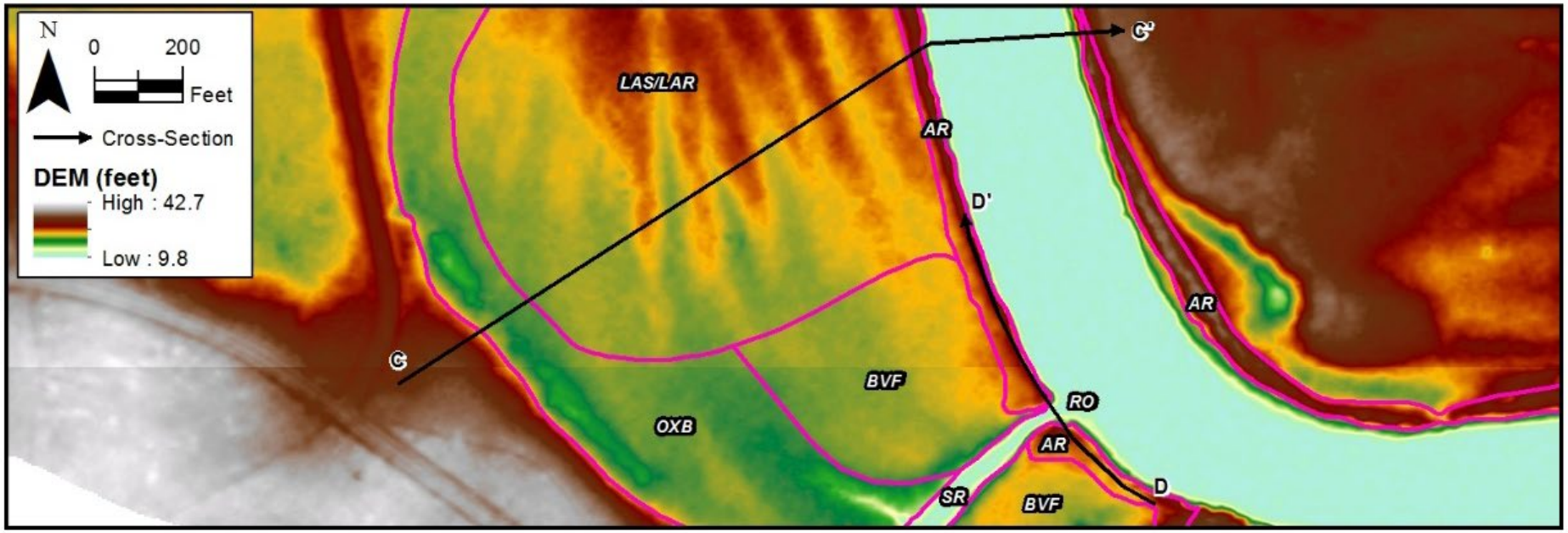


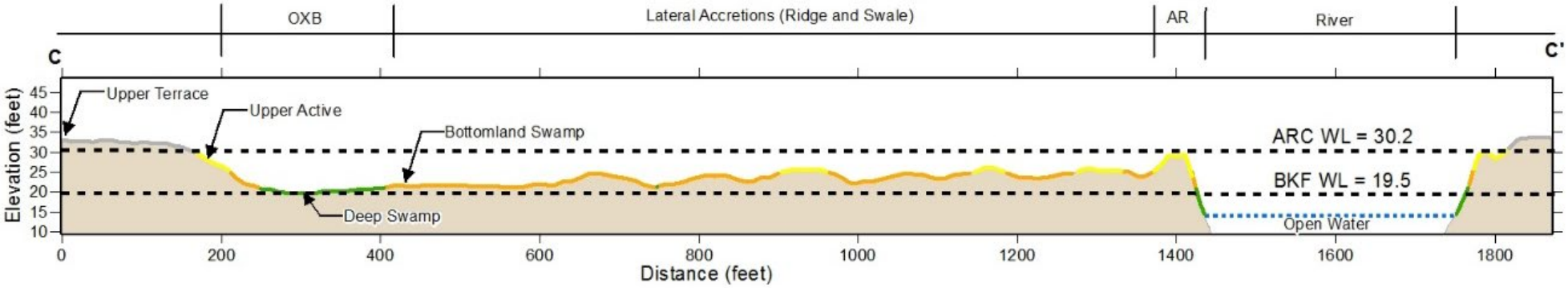
Floodplain Habitat
Upper Suwannee



Floodplain Habitat
Middle Suwannee



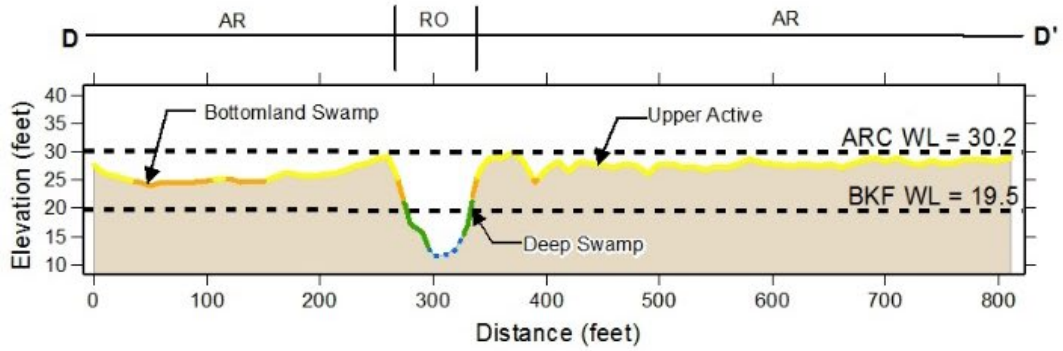




Community

- Upper Terrace
- Upper Active
- Bottomland Swamp
- Deep Swamp
- Open Water

Notes:
AR - Alluvial Ridge
BB - Bankfull Bench
BSD - Backswamp Depression
BVF - Base Valley Flat
LAS - Lateral Accretion Swale
LAR - Lateral Accretion Ridge
OXB - Oxbow
RO - Spring Outlet
SR - Spring Run



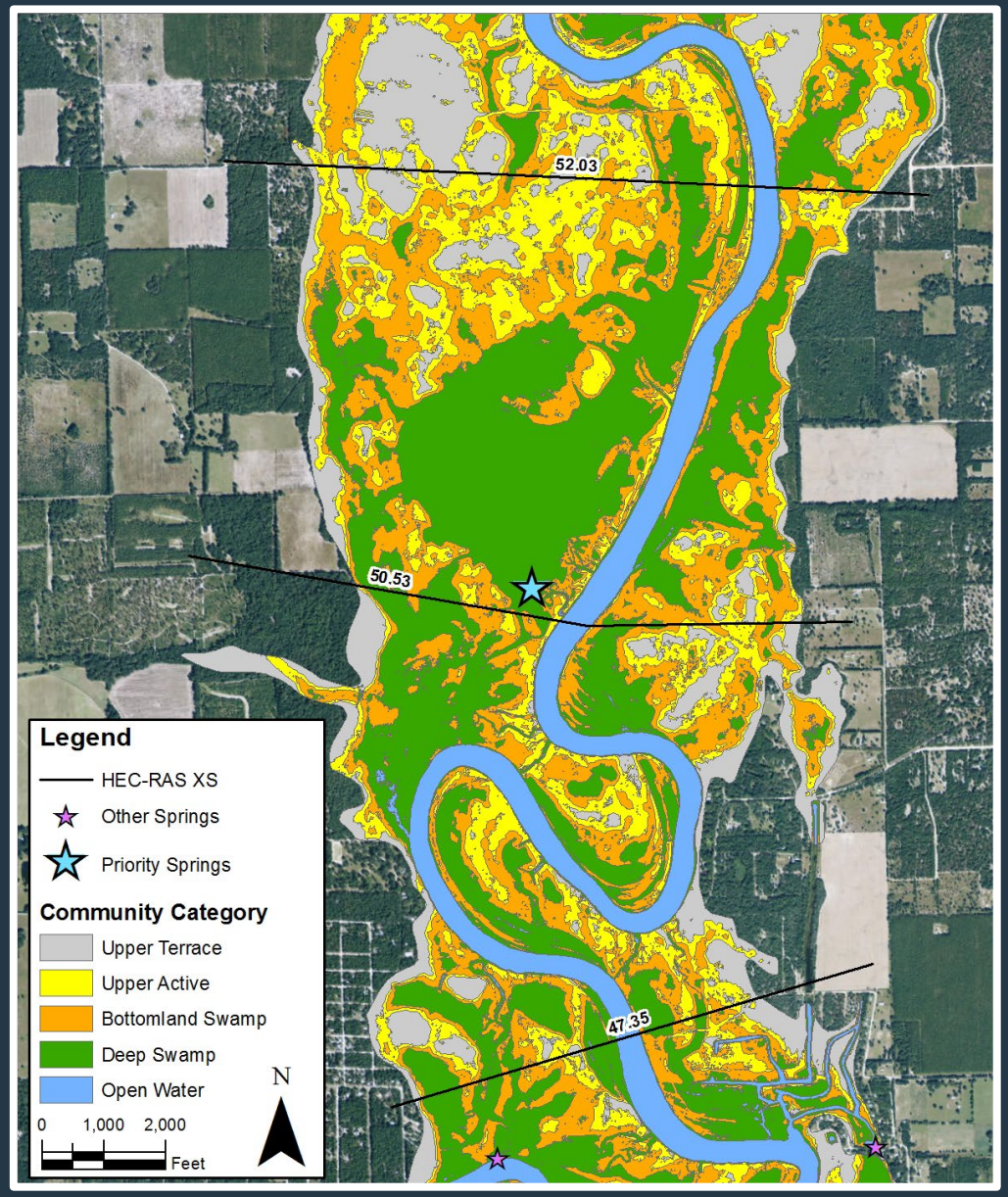
Floodplain Habitat
Middle Suwannee

Stage Necessary to Inundate Floodplain Surfaces

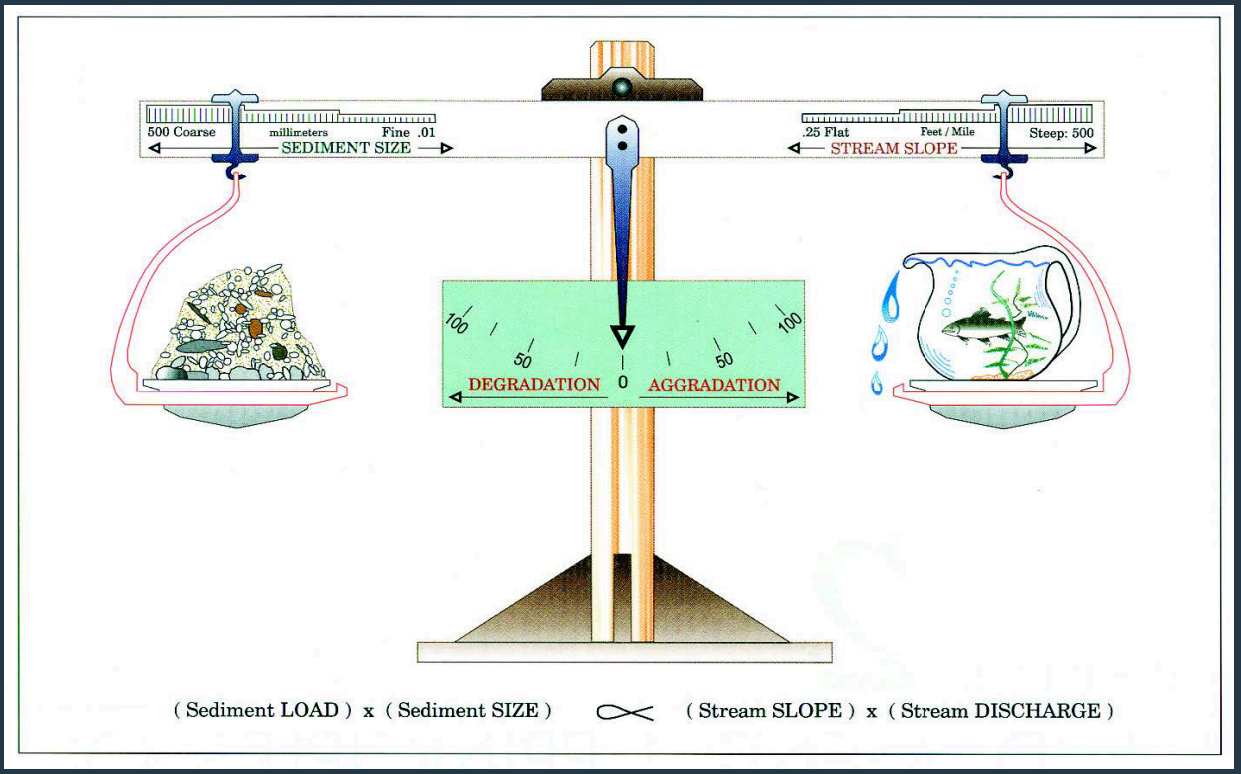
Gage	River-Mile	Stage (ft NAVD)			
		Bankfull	Deep Swamp	Bottomland Swamp	Alluvial Ridge
Ellaville	127.5	35.5	36.4	44.5	56.6
Luraville	98.1	25.0	26.7	31.6	39.1
Branford	76.1	18.1	19.5	23.1	28.0
Bell	56.5	12.5	13.1	16.2	19.2

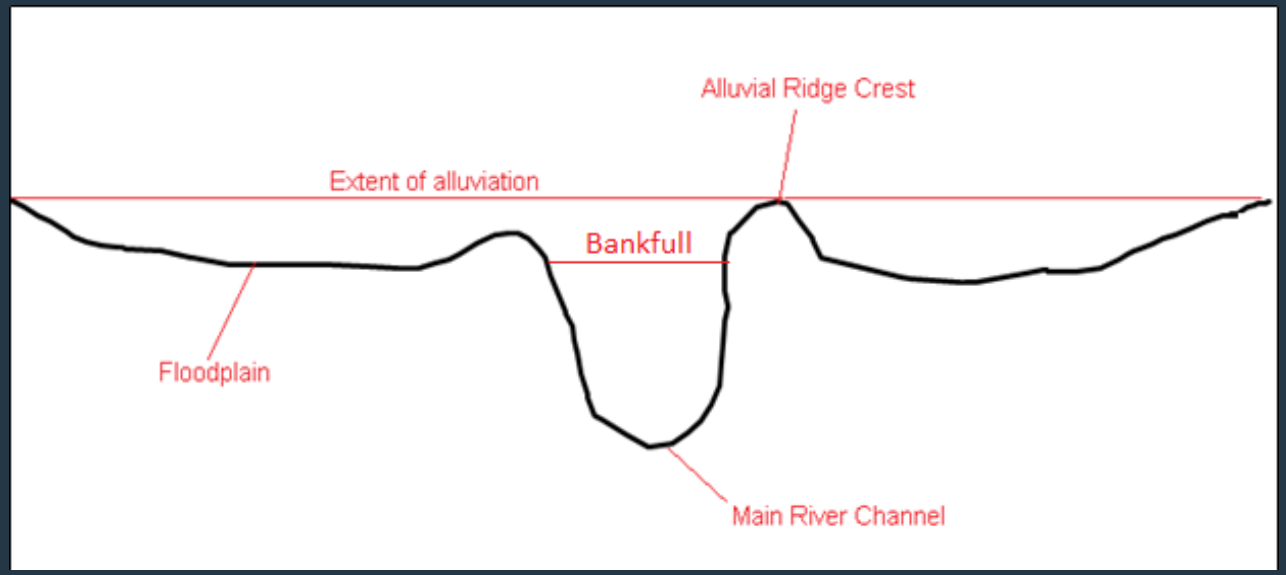
Flow Necessary to Inundate Floodplain Surfaces

Gage	River-Mile	Stage (ft NAVD)			
		Bankfull	Deep Swamp	Bottomland Swamp	Alluvial Ridge
Ellaville	127.5	8,282	9,028	17,776	34.623
Luraville	98.1	9,039	10,961	16,963	28,650
Branford	76.1	10,553	12,259	17,149	24,996
Bell	56.5	12,696	13,536	18,775	25,780



Sediment Loads
Bankfull Condition





White Springs River Gage Results

Resource Value and Indicator			WRV Assessment Method	Threshold Flow (cfs)	RTF Flow (cfs)	Hydrologic Shift (cfs)
Recreation In and On the Water	Paddling		Percent-of-time	172	323	151
	Boating		Percent-of-time	476	713	237
Fish and Wildlife Habitat and Fish Passage	Gulf sturgeon spawning passage	Feb-Apr	Percent-of-time	45	276	231
		Sep-Nov			128	**82.3** ← 12.2% allowable flow reduction at the median
	Gulf sturgeon spawning (6-ft depth)	Mar-Apr	Percent-of-time	1,931	2,571	640
		Sep-Oct			2,301	370
	General fish passage and instream habitat		Percent-of-time	352	569	217
			SEFA (Largemouth Bass fry)	565	676	111
	Floodplain habitat		Percent-of-time	7,531	7,956	425
			Percent-of-area	7,531	8,271	740
Sediment Loads	Bankfull condition		Percent-of-time	7,040	7,491	451
Water Quality	Gulf sturgeon spawning (conductivity)	Mar-Apr	Percent-of-time	566	1,051	485
		Sep-Oct			753	187

White Springs River Gage Results

Resource Value and Indicator			WRV Assessment Method	Threshold Flow (cfs)	RTF Flow (cfs)	Hydrologic Shift (cfs)
Recreation In and On the Water	Paddling		Percent-of-time	172	323	151
	Boating		Percent-of-time	476	713	237
Fish and Wildlife Habitat and Fish Passage	Gulf sturgeon spawning passage	Feb-Apr	Percent-of-time	45	276	231
		Sep-Nov			128	**82.3** ← 12.2% allowable flow reduction at the median
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Sediment Loads	Bankfull condition		Percent-of-time	7,040	7,491	451
Water Quality	Gulf sturgeon spawning (conductivity)	Mar-Apr	Percent-of-time	566	1,051	485
		Sep-Oct			753	187

Suwannee Springs River Gage Results

Resource Value and Indicator			WRV Assessment Method	Threshold Flow (cfs)	RTF Flow (cfs)	Hydrologic Shift (cfs)
Recreation In and On the Water	Paddling		Percent-of-time	306	488	182
	Boating		Percent-of-time	655	926	271
Fish and Wildlife Habitat and Fish Passage	Gulf sturgeon spawning passage	Feb-Apr	Percent-of-time	164	426	262
		Sep-Nov			260	**96.8** ← 11.0% allowable flow reduction at the median
	Gulf sturgeon spawning (6-ft depth)	Mar-Apr	Percent-of-time	2,251	2,910	659
		Sep-Oct			2,619	368
	General fish passage and instream habitat		Percent-of-time	520	758	238
			SEFA (Largemouth Bass fry)	754	880	126
	Floodplain habitat		Percent-of-time	7,641	8,087	446
			Percent-of-area	7,641	8,339	698
Sediment Loads	Bankfull condition		Percent-of-time	7,158	7,631	473
Water Quality	Gulf sturgeon spawning (conductivity)	Mar-Apr	Percent-of-time	767	1,329	562
		Sep-Oct			1,010	243

Suwannee Springs River Gage Results

Resource Value and Indicator			WRV Assessment Method	Threshold Flow (cfs)	RTF Flow (cfs)	Hydrologic Shift (cfs)
Recreation In and On the Water	Paddling		Percent-of-time	306	488	182
	Boating		Percent-of-time	655	926	271
Fish and Wildlife Habitat and Fish Passage	Gulf sturgeon spawning passage	Feb-Apr	Percent-of-time	164	426	262
		Sep-Nov			260	**96.8** ← 11.0% allowable flow reduction at the median
	Gulf sturgeon spawning (6-ft depth)	Mar-Apr	Percent-of-time	2,251	2,910	659
		Sep-Oct			2,619	368
	General fish passage and instream habitat		Percent-of-time	520	758	238
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			Percent-of-area	7,641	8,339	698
Sediment Loads	Bankfull condition		Percent-of-time	7,158	7,631	473
Water Quality	Gulf sturgeon spawning (conductivity)	Mar-Apr	Percent-of-time	767	1,329	562
		Sep-Oct			1,010	243

Ellaville River Gage Results

Resource Value and Indicator			WRV Assessment Method	Threshold Flow (cfs)	RTF Flow (cfs)	Hydrologic Shift (cfs)
Recreation In and On the Water	Boating		Percent-of-time	1,908	2,457	549
Fish and Wildlife Habitat and Fish Passage	Gulf sturgeon spawning passage	Feb-Apr	Percent-of-time	1,998	3,339	1,341
		Sep-Nov			2,344	**346** ← **9.1% allowable flow reduction at the median**
	General fish passage		Percent-of-time	1,045	1,840	795
	Fish passage in/out – Allen Mill Pond		Percent-of-time	3,079	3,746	667
	Fish passage in/out – Peacock Spring		Percent-of-time	7,453	8,474	1,021
	Instream habitat		SEFA (Deep/Slow Guild)	3,222	3,822	600
	Riparian bank habitat/open water		Percent-of-time	1,916	2,461	545
	Deep swamp floodplain habitat		Percent-of-time	9,028	10,171	1,143
	Bottomland swamp floodplain habitat		Percent-of-time	17,776	18,759	983
Sediment Loads	Bankfull condition		Percent-of-time	8,282	9,494	1,212
	Alluvial ridge crest condition		Percent-of-time	34,623	36,644	2,021

Ellaville River Gage Results

Resource Value and Indicator			WRV Assessment Method	Threshold Flow (cfs)	RTF Flow (cfs)	Hydrologic Shift (cfs)
Recreation In and On the Water	Boating		Percent-of-time	1,908	2,457	549
Fish and Wildlife Habitat and Fish Passage	Gulf sturgeon spawning passage	Feb-Apr	Percent-of-time	1,998	3,339	1,341
		Sep-Nov			2,344	**346** ← 9.1% allowable flow reduction at the median
	General fish passage		Percent-of-time	1,045	1,840	795
	Fish passage in/out – Allen Mill Pond		Percent-of-time	3,079	3,746	667
	Fish passage in/out – Peacock Spring		Percent-of-time	7,453	8,474	1,021
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	Deep swamp floodplain habitat		Percent-of-time	9,028	10,171	1,143
	Bottomland swamp floodplain habitat		Percent-of-time	17,776	18,759	983
Sediment Loads	Bankfull condition		Percent-of-time	8,282	9,494	1,212
	Alluvial ridge crest condition		Percent-of-time	34,623	36,644	2,021

Branford River Gage Results

Resource Value and Indicator			WRV Assessment Method	Threshold Flow (cfs)	RTF Flow (cfs)	Hydrologic Shift (cfs)
Recreation In and On the Water	Boating		Percent-of-time	1,778	2,738	960
Fish and Wildlife Habitat and Fish Passage	Gulf sturgeon spawning passage	Feb-Apr	Percent-of-time	3,044	4,381	1,337
		Sep-Nov			3,444	**400** ← 8.0% allowable flow reduction at the median
	General fish passage		Percent-of-time	2,042	2,898	856
	Instream habitat		SEFA (Gulf sturgeon adult)	4,049	4,993	944
	Riparian bank habitat/open water		Percent-of-time	5,485	6,331	846
	Deep swamp floodplain habitat		Percent-of-time	12,259	13,243	984
	Bottomland swamp floodplain habitat		Percent-of-time	17,149	18,328	1,179
Sediment Loads	Bankfull condition		Percent-of-time	10,553	11,671	1,212
	Alluvial ridge crest condition		Percent-of-time	24,996	26,026	1,030

Branford River Gage Results

Resource Value and Indicator			WRV Assessment Method	Threshold Flow (cfs)	RTF Flow (cfs)	Hydrologic Shift (cfs)
Recreation In and On the Water	Boating		Percent-of-time	1,778	2,738	960
Fish and Wildlife Habitat and Fish Passage	Gulf sturgeon spawning passage	Feb-Apr	Percent-of-time	3,044	4,381	1,337
		Sep-Nov			3,444	**400** ← 8.0% allowable flow reduction at the median
	General fish passage		Percent-of-time	2,042	2,898	856
	Instream habitat		SEFA (Gulf sturgeon adult)	4,049	4,993	944
	Riparian bank habitat/open water		Percent-of-time	5,485	6,331	846
	Deep swamp floodplain habitat		Percent-of-time	12,259	13,243	984
	Bottomland swamp floodplain habitat		Percent-of-time	17,149	18,328	1,179
Sediment Loads	Bankfull condition		Percent-of-time	10,553	11,671	1,212
	Alluvial ridge crest condition		Percent-of-time	24,996	26,026	1,030

Upper and Middle Suwannee River MFLs Summary

Upper Suwannee River

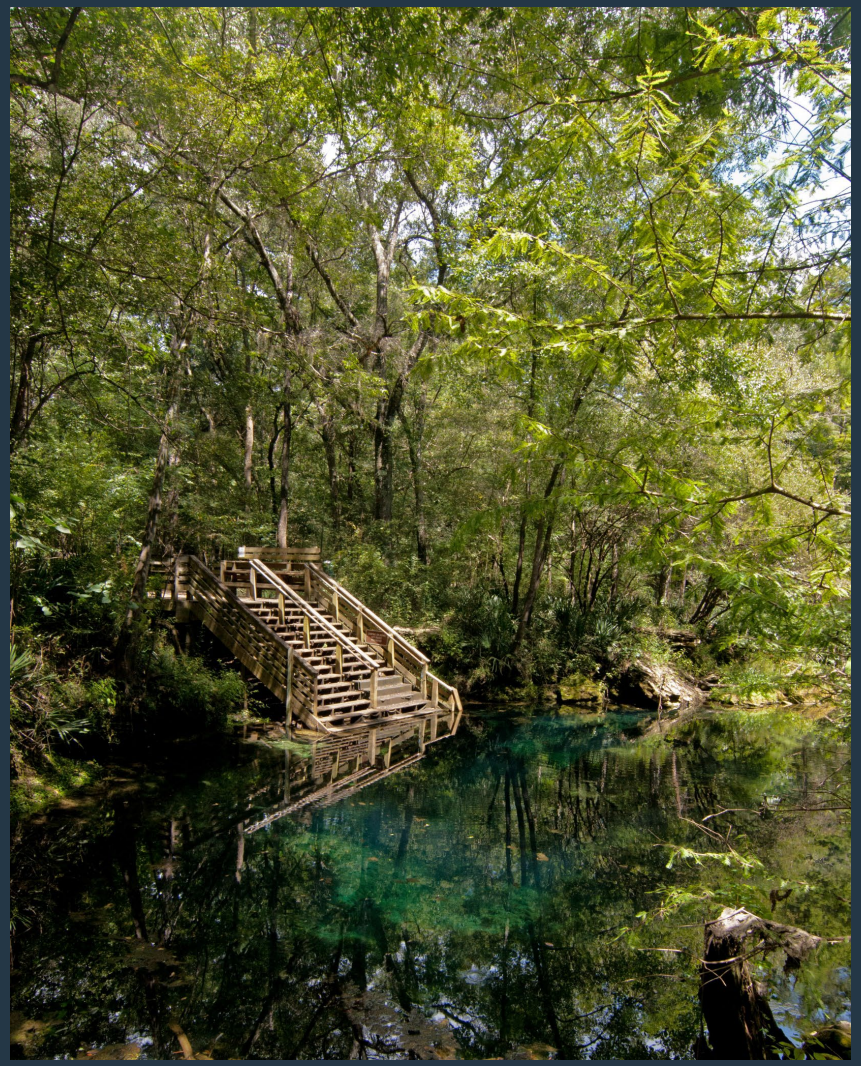
- White Springs gage: 594 cfs (12.2%) at the median
- Suwannee Springs gage: 783 cfs (11.0%) at the median

Middle Suwannee River

- Ellaville gage: 3,476 cfs (9.1%) at the median
- Branford gage: 4,593 cfs (8.0%) at the median

Springs-specific Metrics (Under Evaluation)

- River flood events (brown-outs)
- Water quality
- Macroalgae inhibition
- Bathing/swimming
- Channel morphology
- Downstream habitat support
- Manatee/snook thermal refuge



Peacock Springs