Wekiva River Basin

Draft Minimum Flows and Levels

Peer Review Kick-off Meeting

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1/23/2024

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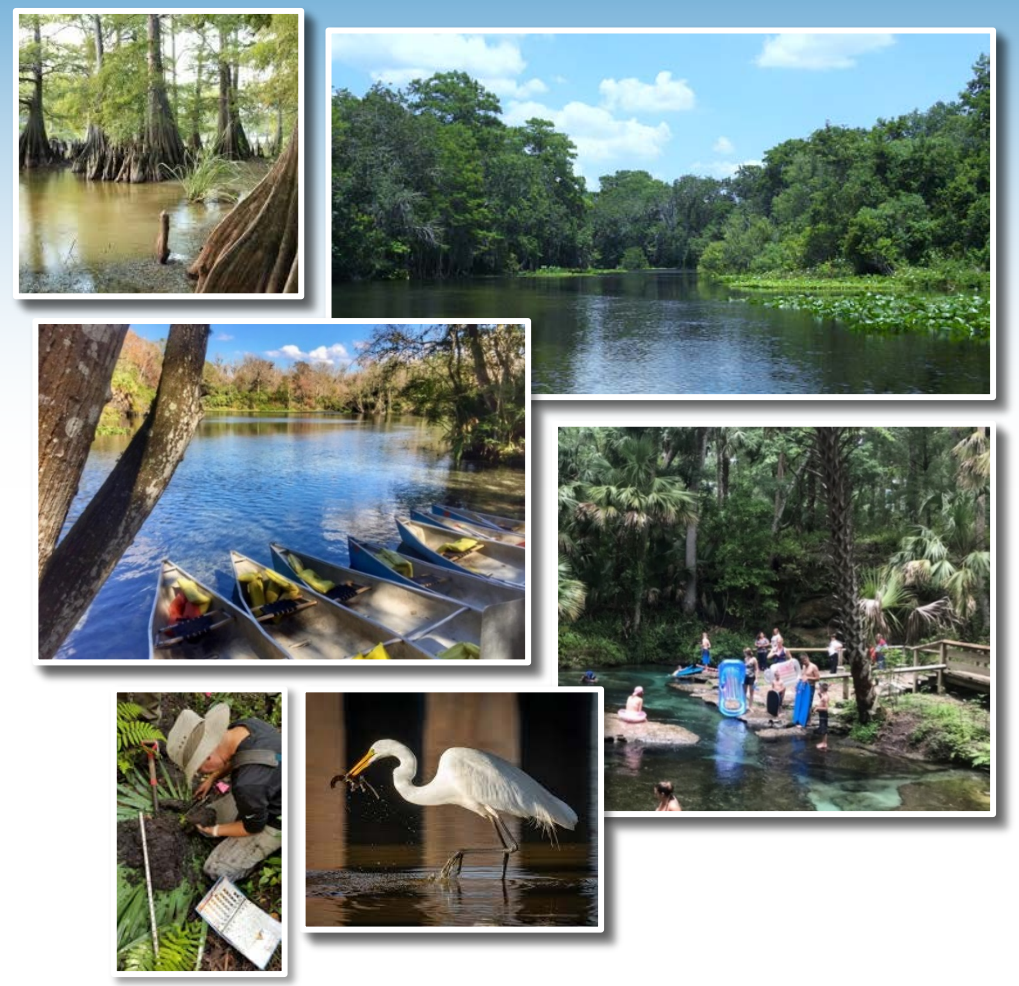
Water Management District

Agenda

- Overview of Peer Review, Wekiva Basin and MFLs Process
- Hydrological Analyses
- MFLs Determination and Assessment
- WRVs Assessment
- Recommended Minimum Flows
- Stakeholder questions
- Next Steps – Tentative Schedule
- Basin Tour



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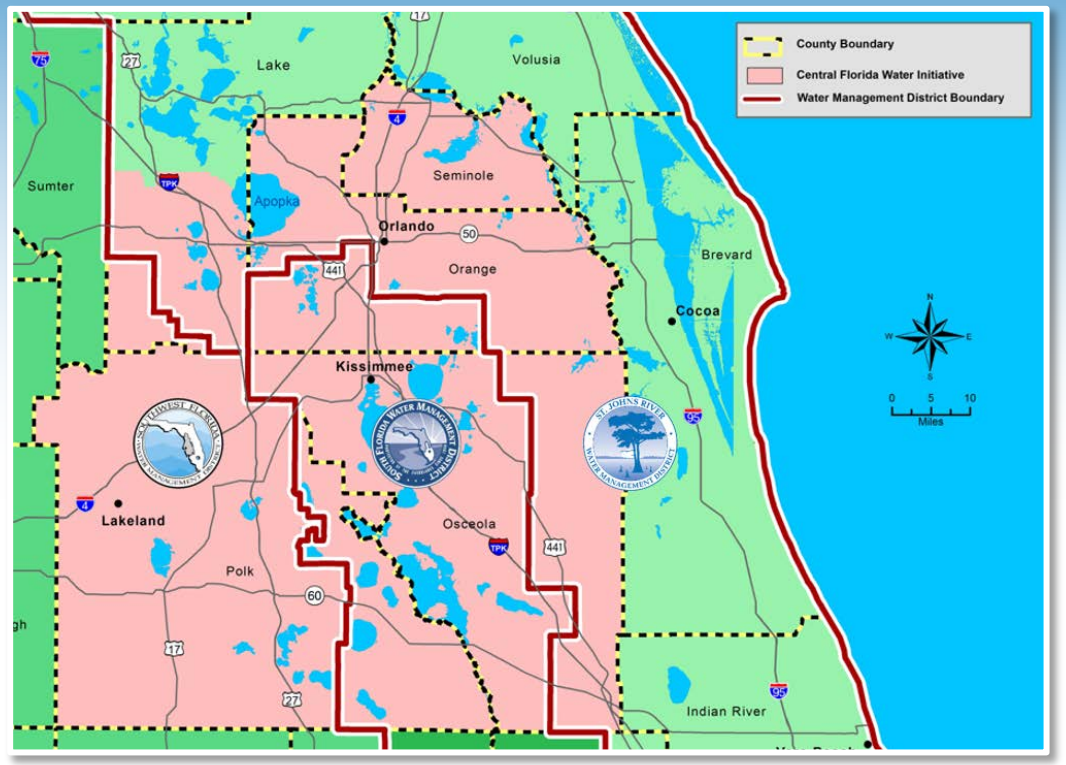
Peer Review Process

- Kick-off meeting – introduce MFLs and clarify scope
- Collaborative CFWI process that involves all interested stakeholders
- Peer reviewers can consider stakeholder input as part of their final comments / recommendations
- HSPF and HEC-RAS models peer reviewed by Dynamic Solutions and Intera
- MFLs peer reviewed by scientists and engineers at **BFA**



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Peer Review Process

Scope of Work

- Determine appropriateness of environmental criteria, hydrological analyses and recommended minimum flows;
- Determine validity and appropriateness of methods and procedures used for data analyses, assumptions used and conclusions drawn regarding the recommended minimum flows;
- Determine adequacy of data used to support conclusions and recommendations; and
- Identify and make recommendations regarding any deficiencies in development of the draft recommended minimum flows for the Wekiva River basin systems.

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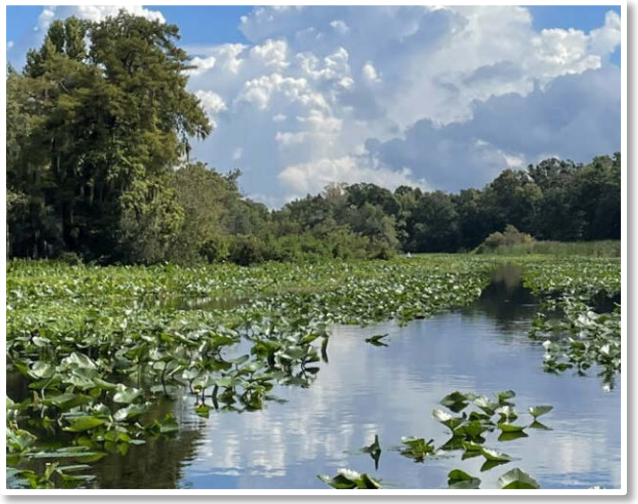
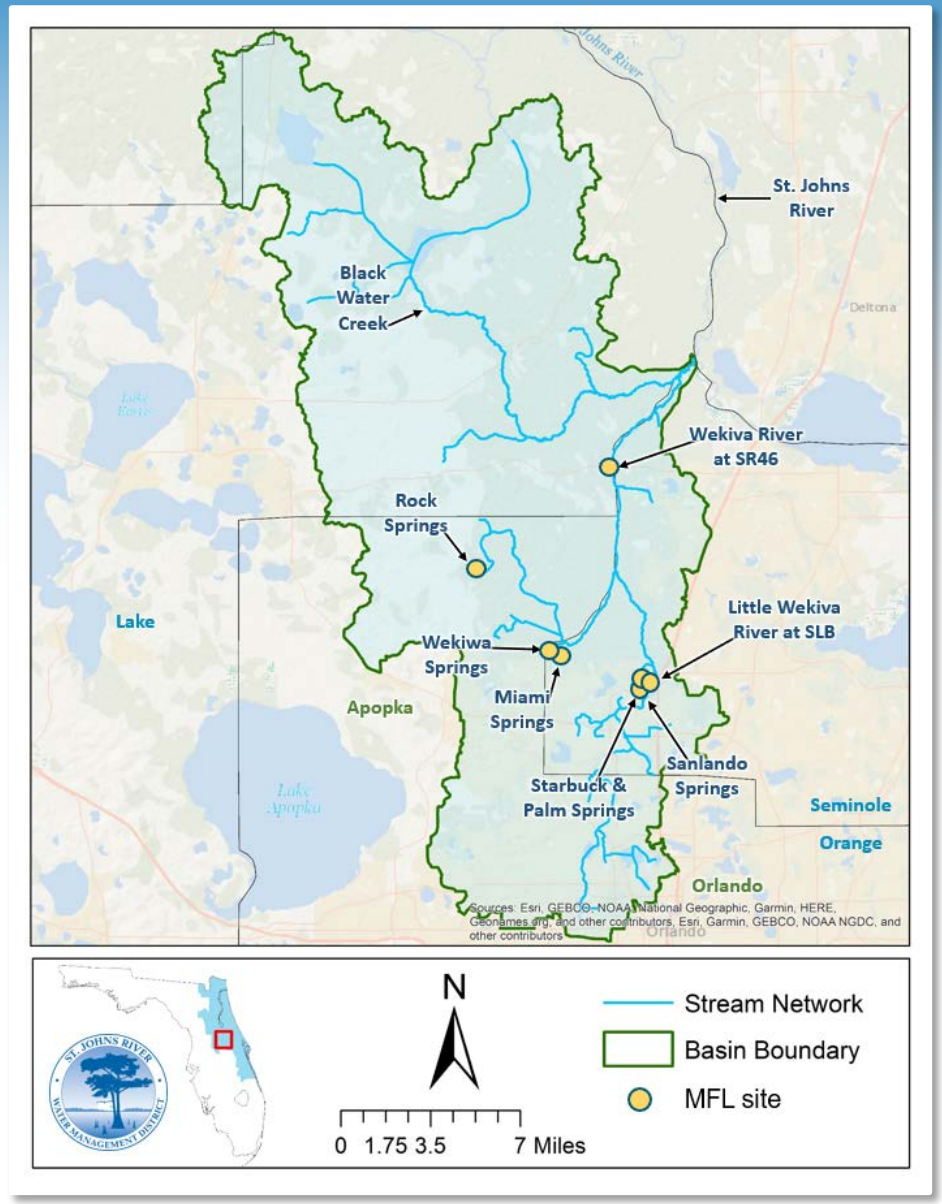
Wekiva River Basin

- Third largest tributary of the St. Johns River
- 376 sq. mile watershed
- 110 sq. miles of adjacent protected uplands
- River travels 15 miles changing from clear 2nd magnitude spring runs to blackwater river
- 34 named and innumerable unnamed springs (3rd, 4th and 5th magnitude)





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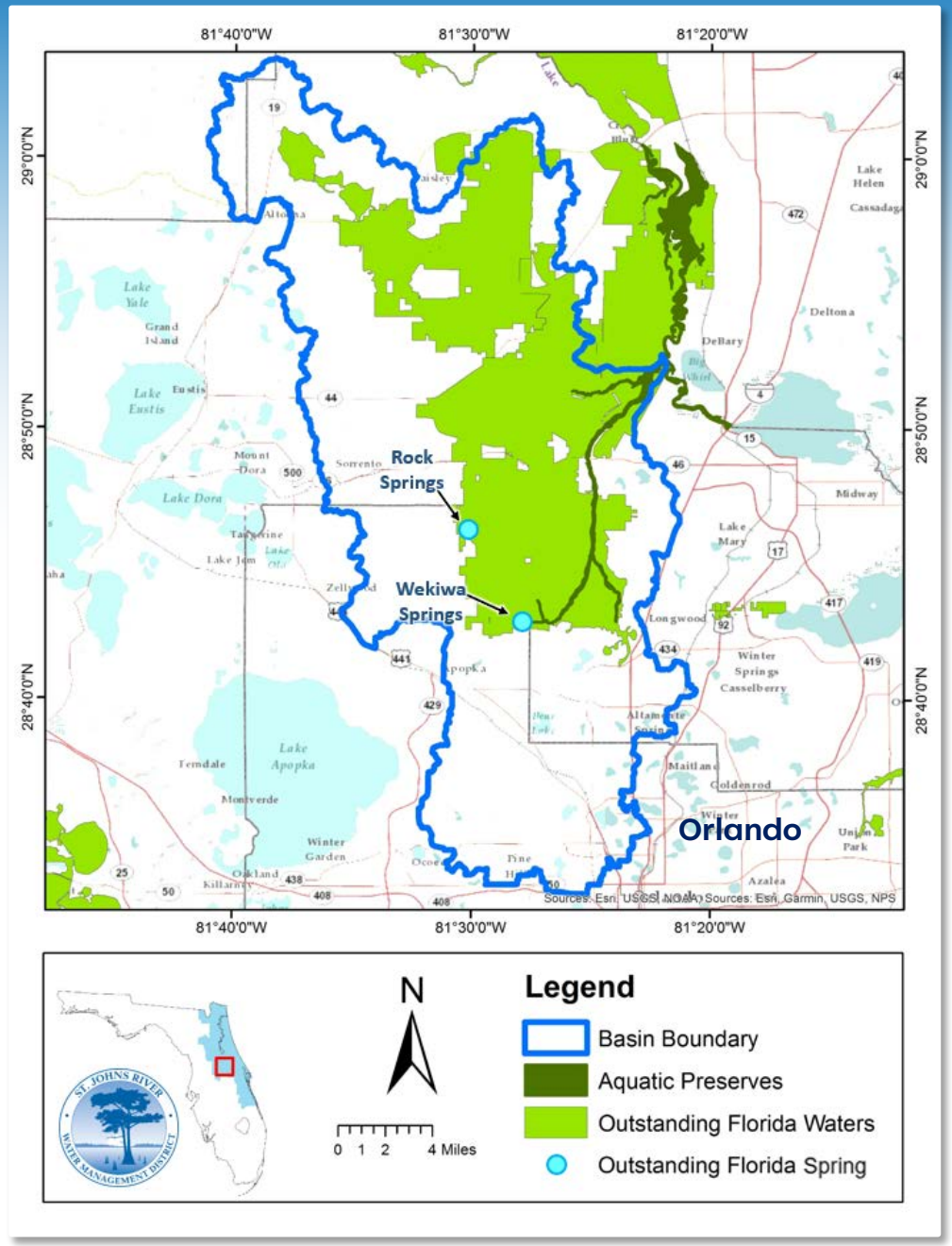
Designations and Protections

- **National Wild and Scenic River** for its "outstandingly remarkable" scenic and recreational attributes
- **Florida Scenic and Wild River**
- Large portions of the basin designated as **Outstanding Florida Waters**
- Majority of the mainstem of the Wekiva River and Little Wekiva River protected as **Florida Aquatic Preserves**
- Wekiwa Springs and Rock Springs, both second magnitude, designated as **Outstanding Florida Springs**
- Wekiva River is a **State Canoe Trail**



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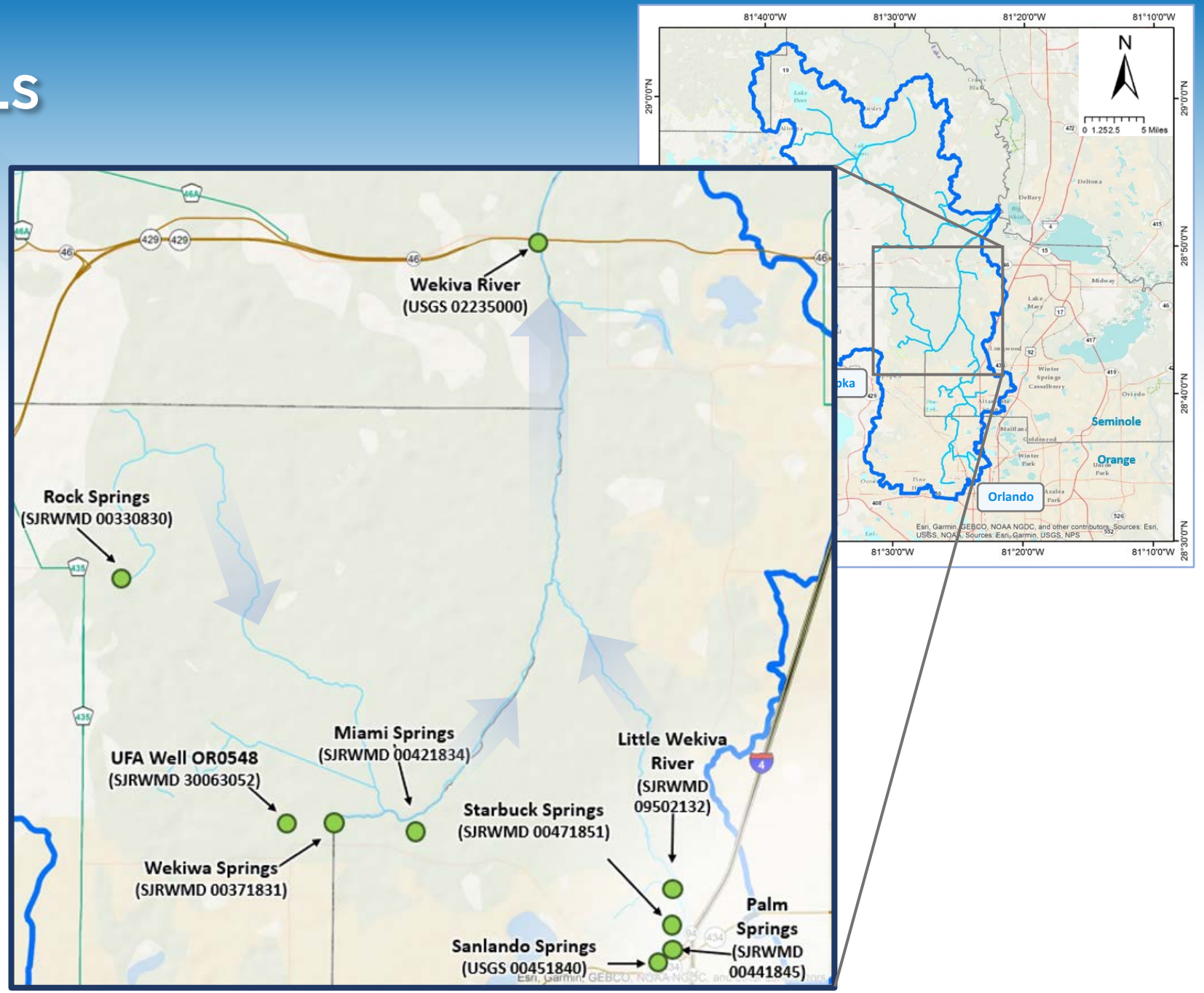
Wekiva Basin MFLs

- **MFLs adopted in 1992:**
  - Wekiva River at SR46
  - Wekiwa Springs (OFS)
  - Rock Springs (OFS)
  - Palm Springs
  - Sanlando Springs
  - Starbuck Springs
  - Miami Springs
- **Reevaluation**
  - All the above
- **New MFLs**
  - Little Wekiva River



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Why do we set MFLs?

Statutory Directive

Water management districts must establish MFLs that set…

"…the limit at which further withdrawals would be significantly harmful to the water resources or the ecology of the area."

Section 373.042(1), Florida Statutes (F.S.)

MFLs Process – Overview

MFLs Determination:

- Determine the most critical environmental features to protect and the minimum hydrologic regime required for their protection (MFLs condition)

MFLs Assessment:

- Determine the current impacted hydrologic regime (current-pumping condition)
- Compare the MFLs and current-pumping conditions to determine if water is available (freeboard)

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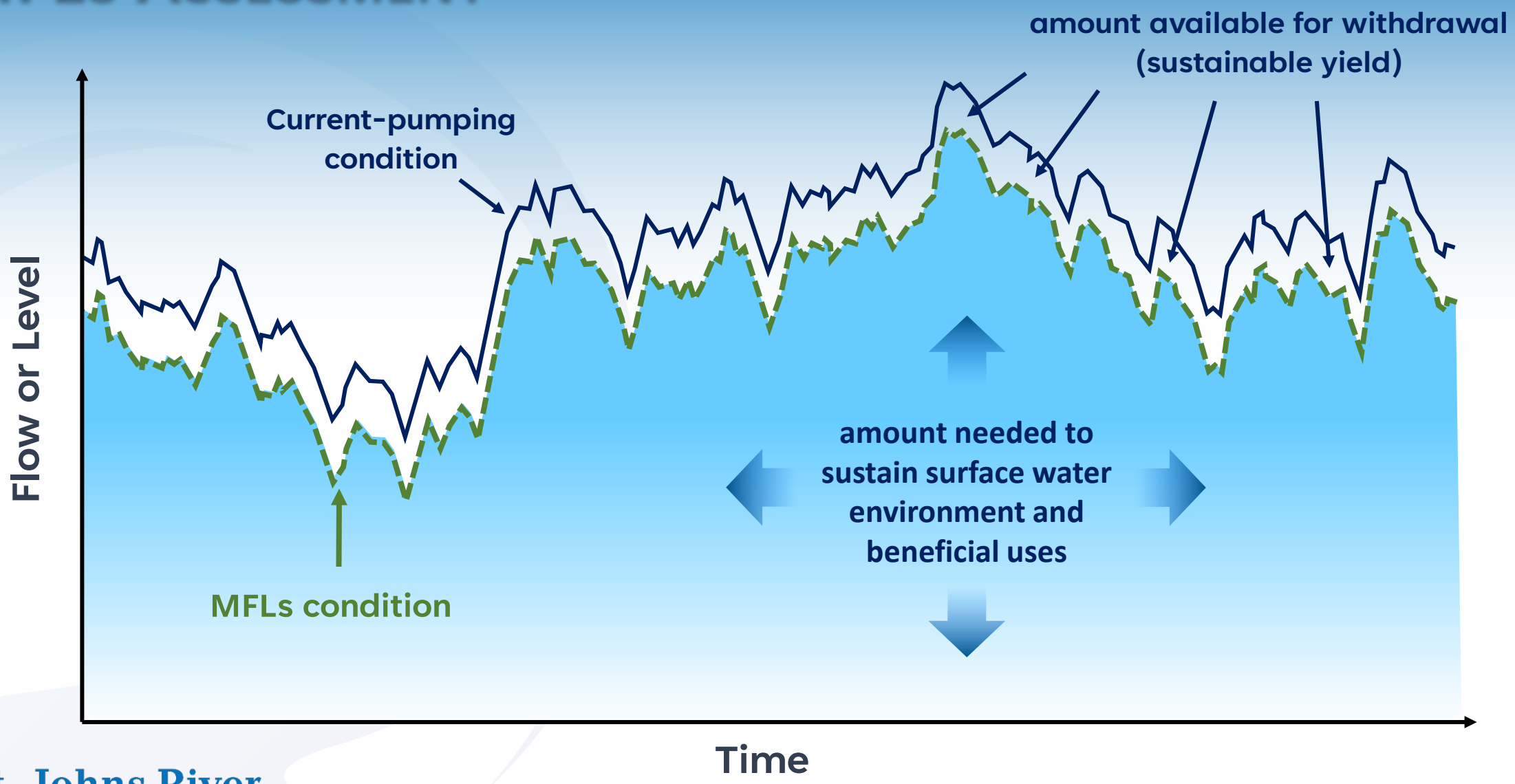
MFLs Assessment



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Field Data Collection

Transects

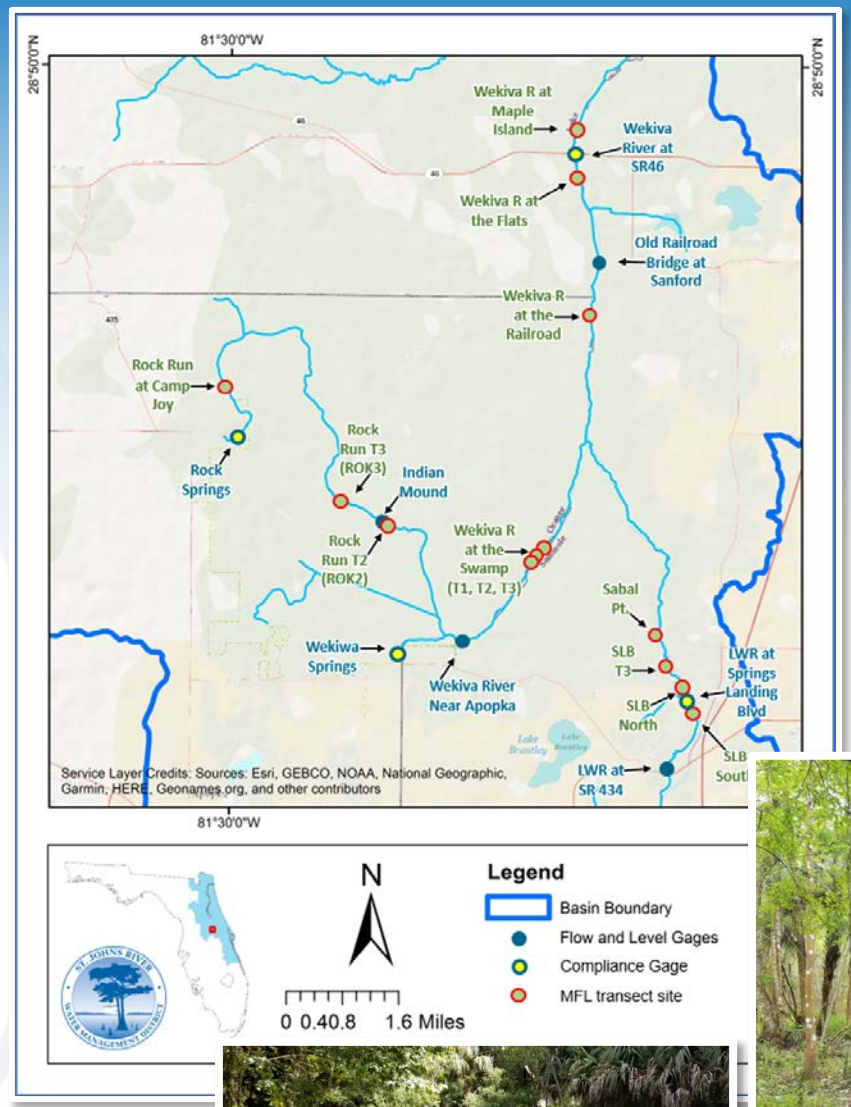
- 13 ecological transects
- 72 elevation cross-sections for surface water models

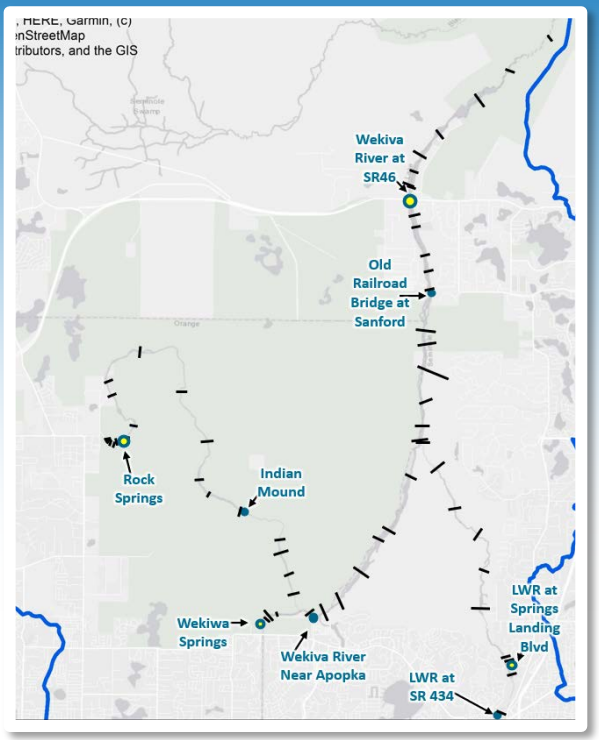
Vegetation and Soils

- Location and composition of wetland communities and soils

Elevation / Depths / Velocities

- Vegetation and soils elevations
- Key topography along transects
- Spring pool bathymetry
- Critical river cross-sections
- Spring pool bathymetry
- Boat ramp elevations
- Boat passage restrictions
- Fish and manatee passage depths
- Critical velocities for shad migration





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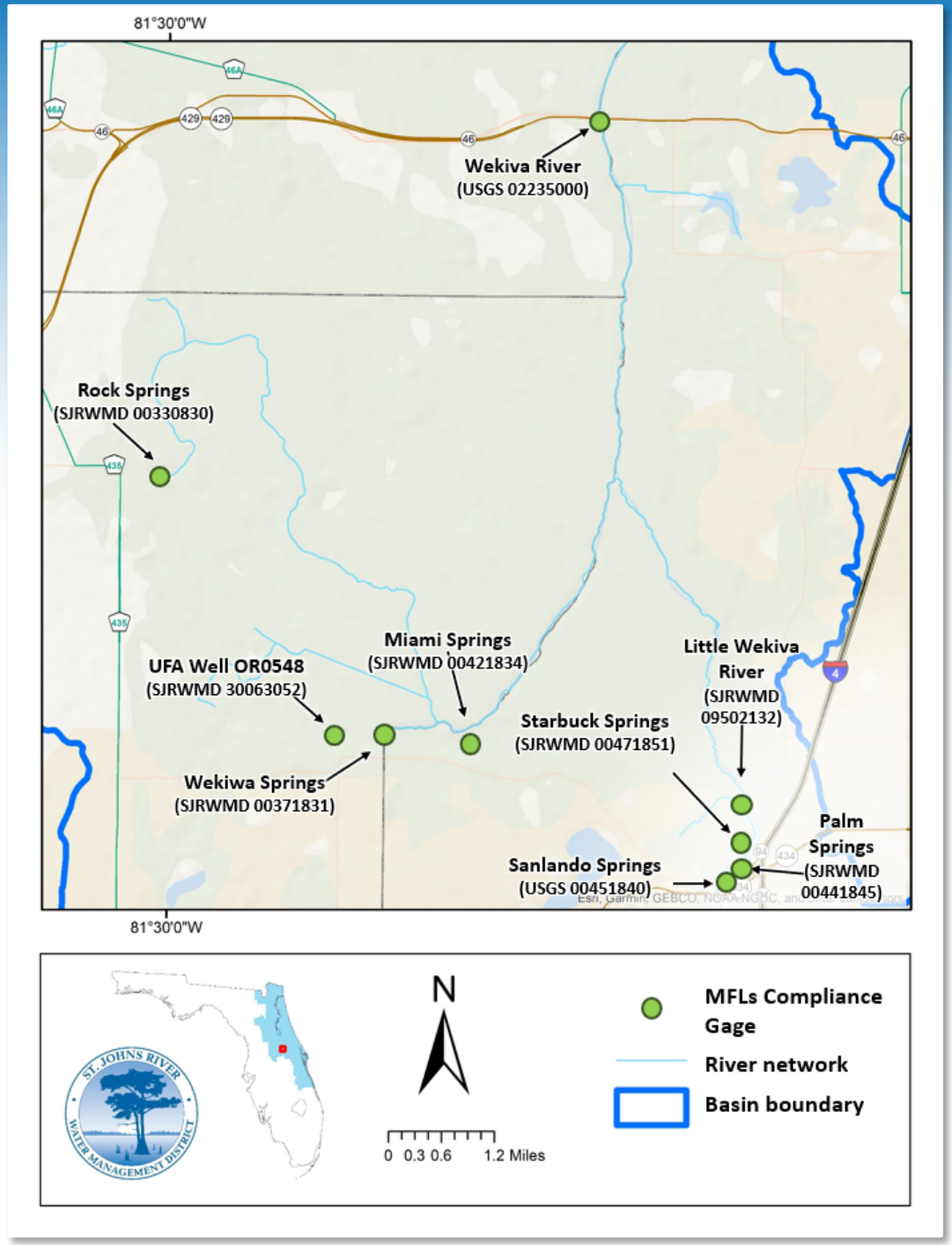
WL and Flow Monitoring Data

System	Agency	Station No.
Wekiva River at SR 46	USGS	02235000
Wekiwa Springs	SJRWMD / USGS	00371831
Miami Springs	SJRWMD	00421834
Rock Springs	SJRWMD	00330830
Little Wekiva River at SLB	SJRWMD	09502132
Palm Springs	SJRWMD	00441845
Sanlando Springs	USGS	00451840
Starbuck Springs	SJRWMD	00471851



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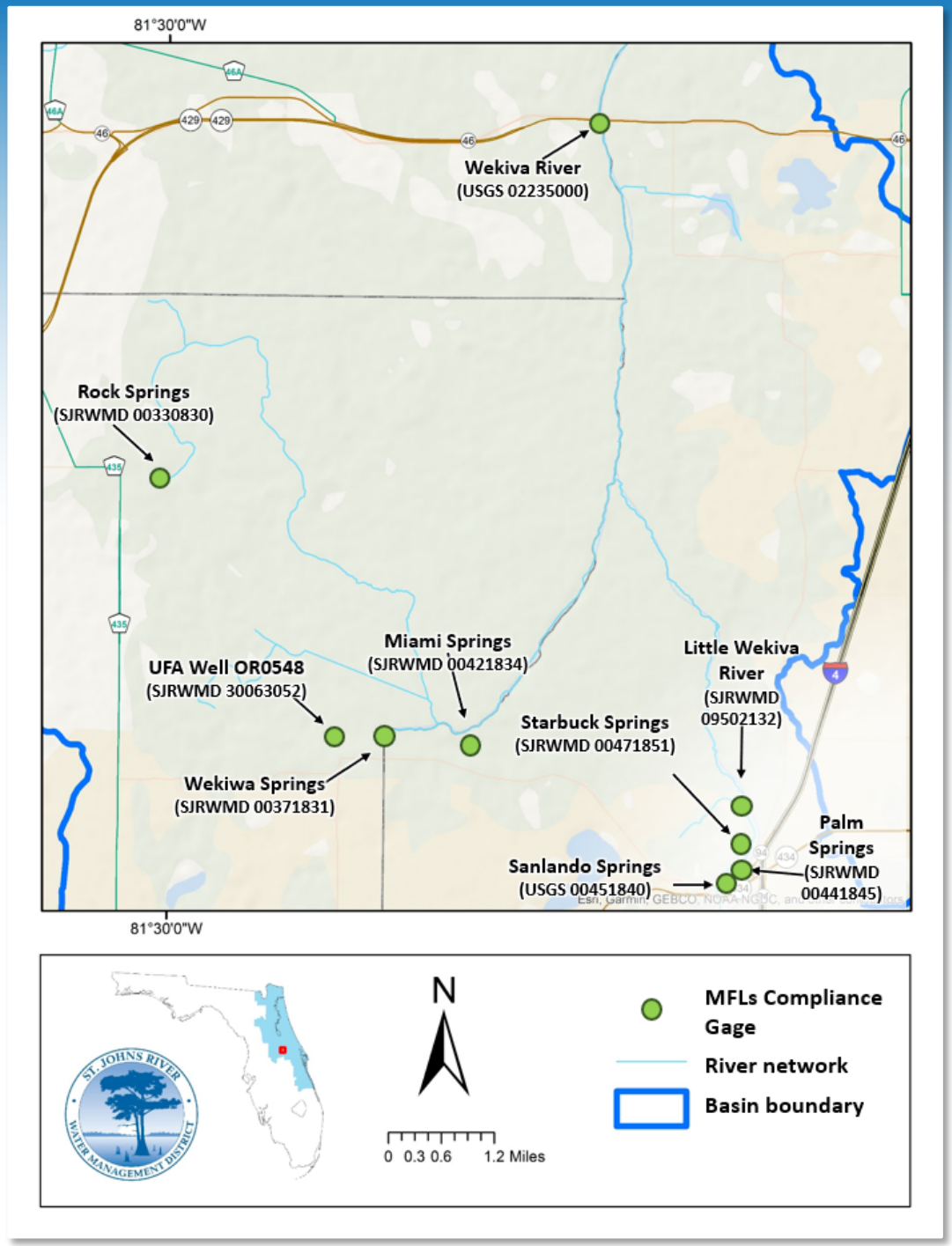
Hydrological Data

System	Flow Period of Record	WL Period of Record
Wekiva River at SR 46	1935 - Present	1935 - Present
Wekiwa Springs	1932 - Present	1984 - Present
Miami Springs	1945 - Present	1985 - Present
Rock Springs	1931 - Present	1959 - Present
Little Wekiva River at SLB	2002 – 2009; 2016 - Present	1995 – 2009; 2016 - Present
Palm Springs	1941 to Present	1985 - Present
Sanlando Springs	1941 to Present	1980 - Present
Starbuck Springs	1944 to Present	1986 - Present



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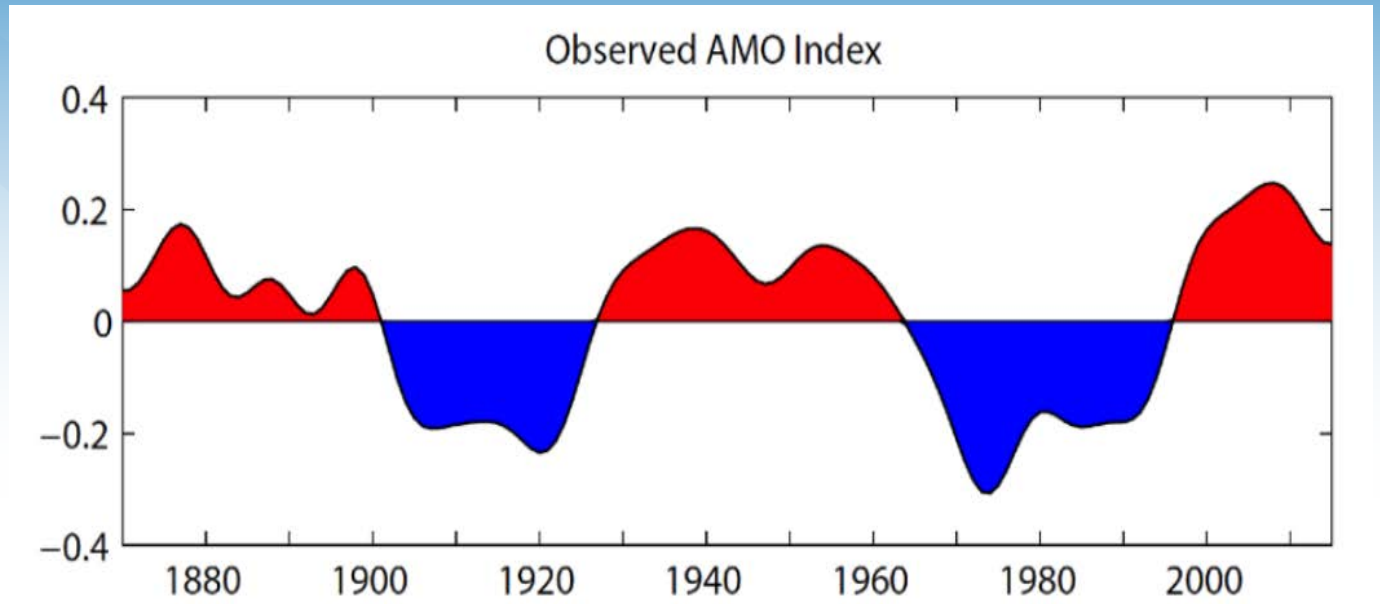
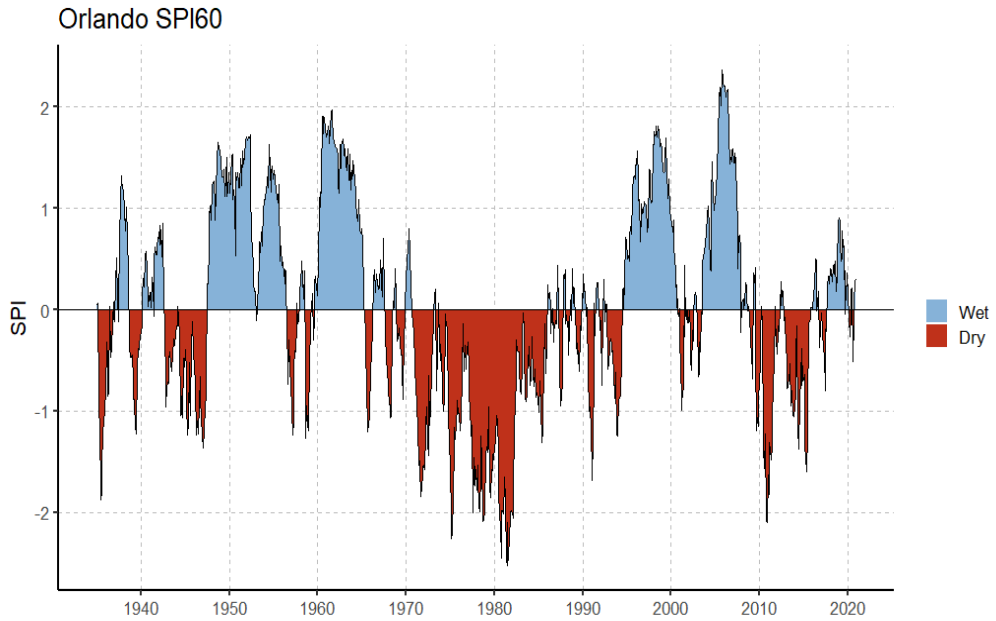
Hydrological Analysis

- Climatic cycles
  - AMO, ENSO, etc
- Spring Flows
- Long-term trends





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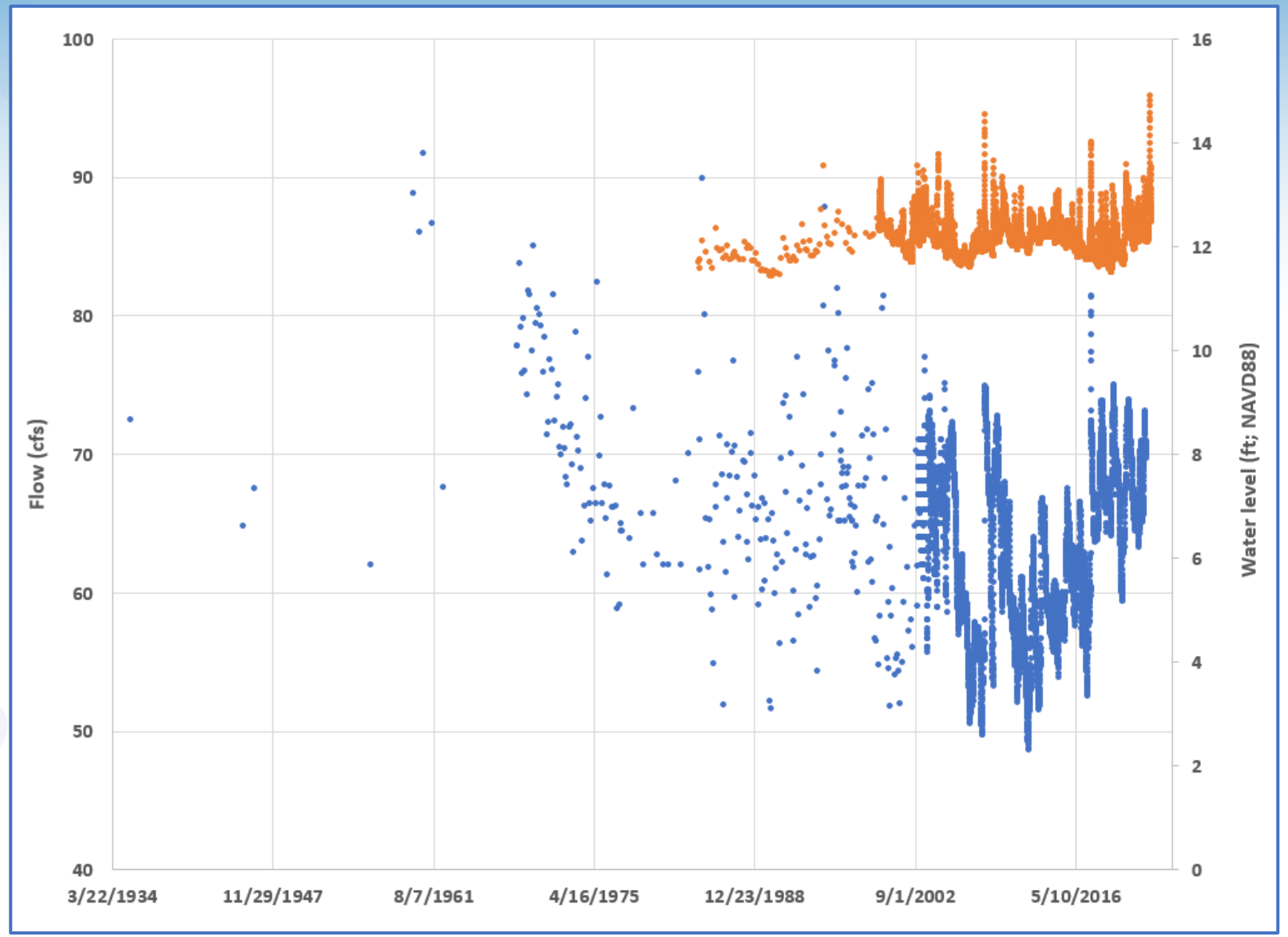
Wekiwa Springs Flows and Levels

	Flow (cfs)	Level (ft; NAVD88)
Range	48.6 - 91.7	9.9 – 14.9
Average	62.9	12.1
Median	63.0	12.1
2022 Avg	68.3	12.5



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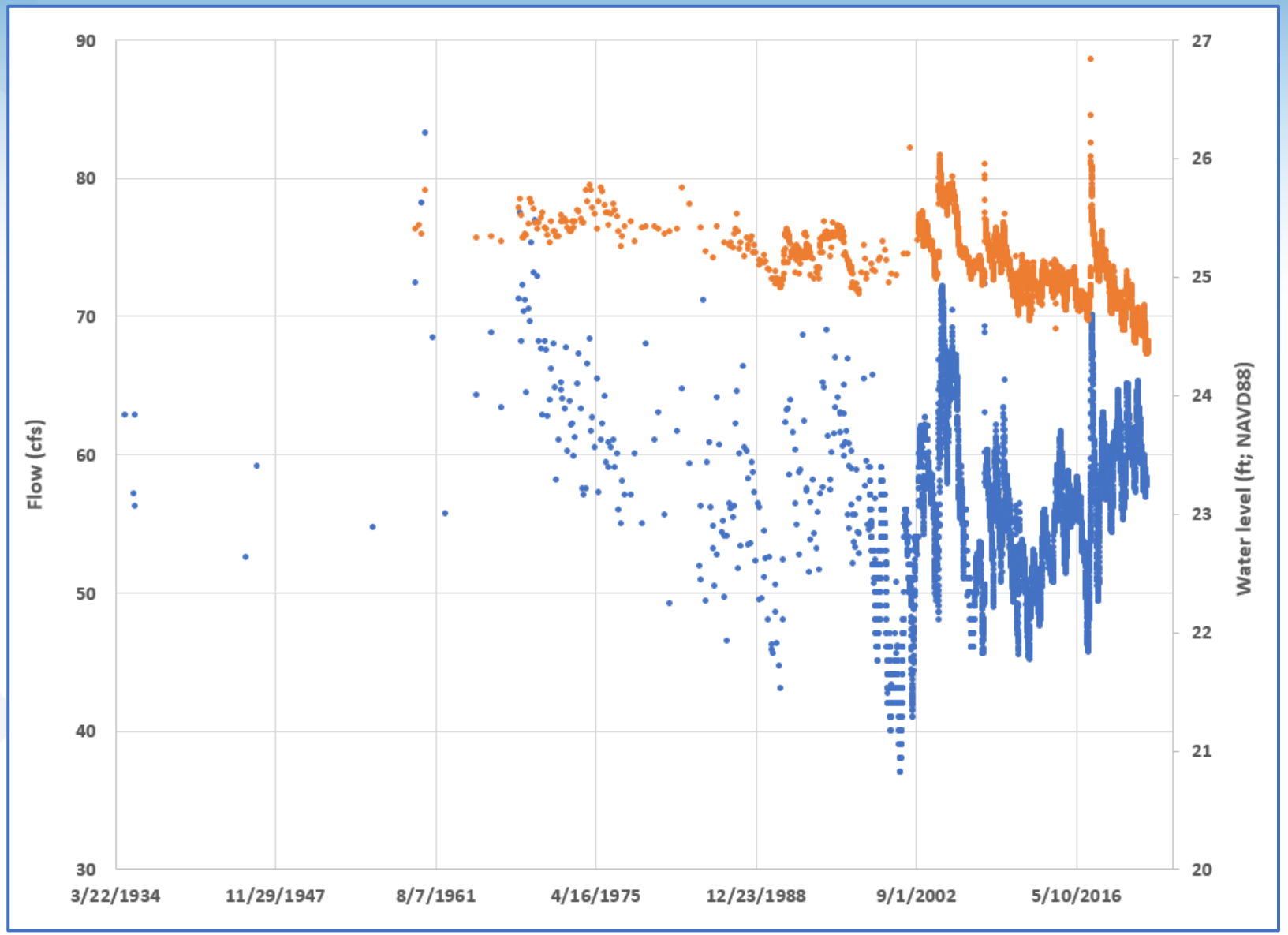
Rock Springs Flows and Levels

	Flow (cfs)	Level (ft; NAVD88)
Range	37.0 – 83.2	24.3 – 26.8
Average	55.8	25.1
Median	56.0	25.0
2022 Avg	60.2	24.6



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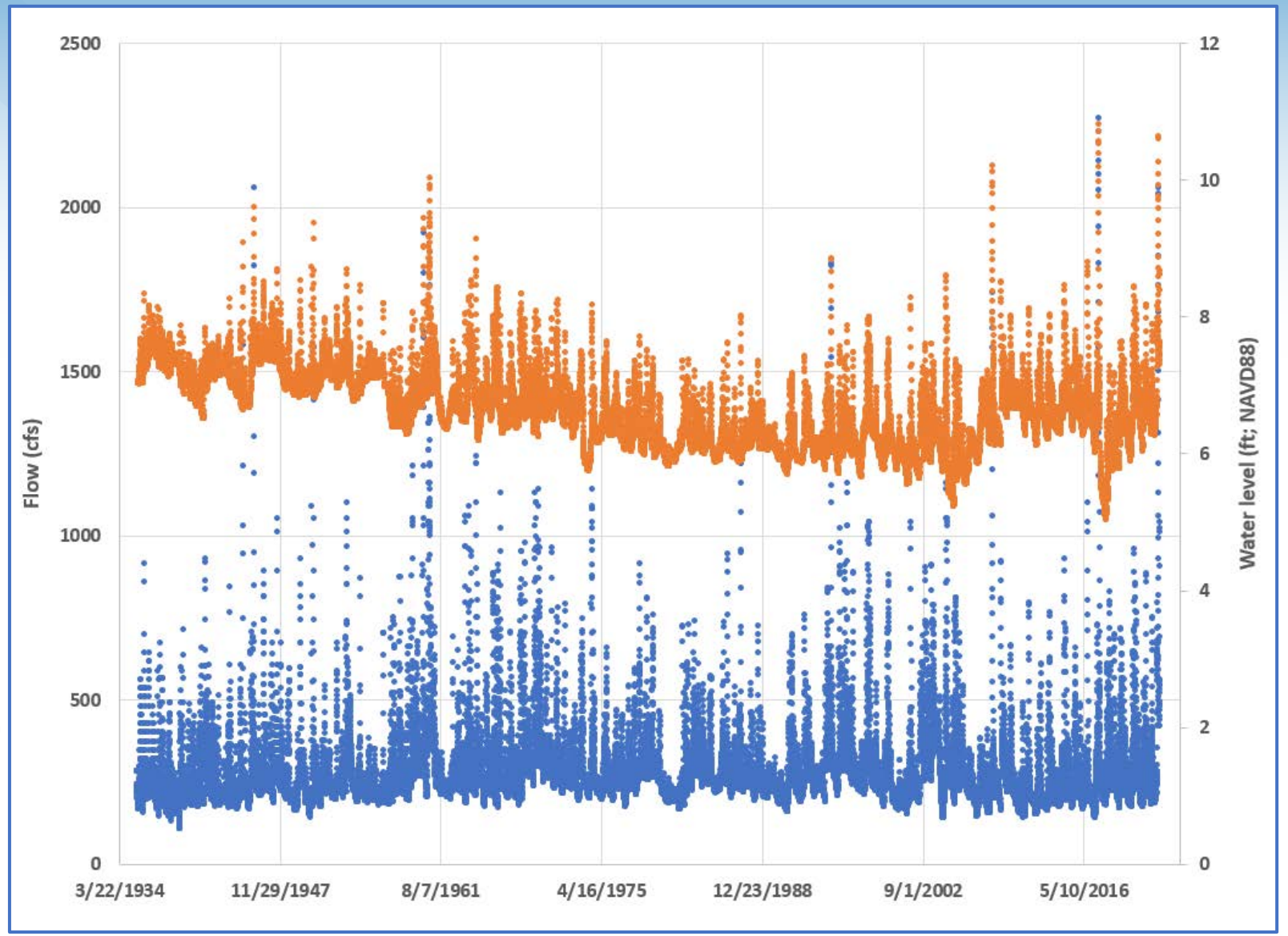
Wekiva River SR46 Flows and Levels

	Flow (cfs)	Level (ft; NAVD88)
Range	105 - 2,270	5.0 - 10.8
Average	287	6.6
Median	249	6.6
2022 Avg	385	7.0



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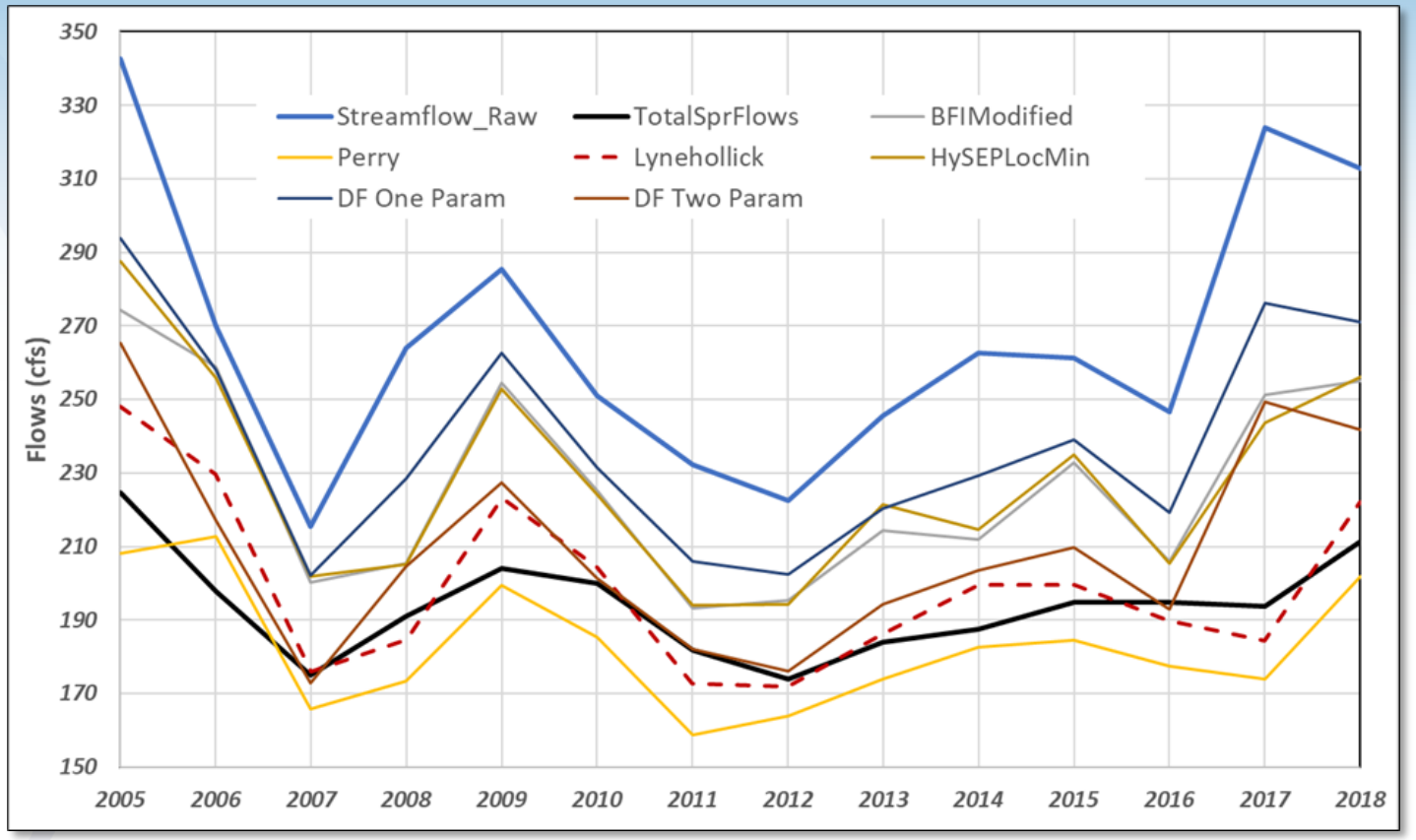
Wekiva River SR46 Baseflows

- Continuous long-term data
- Most of baseflow is spring flows
- Lyne-Hollick recursive digital filter (Lyne and Hollick 1979)



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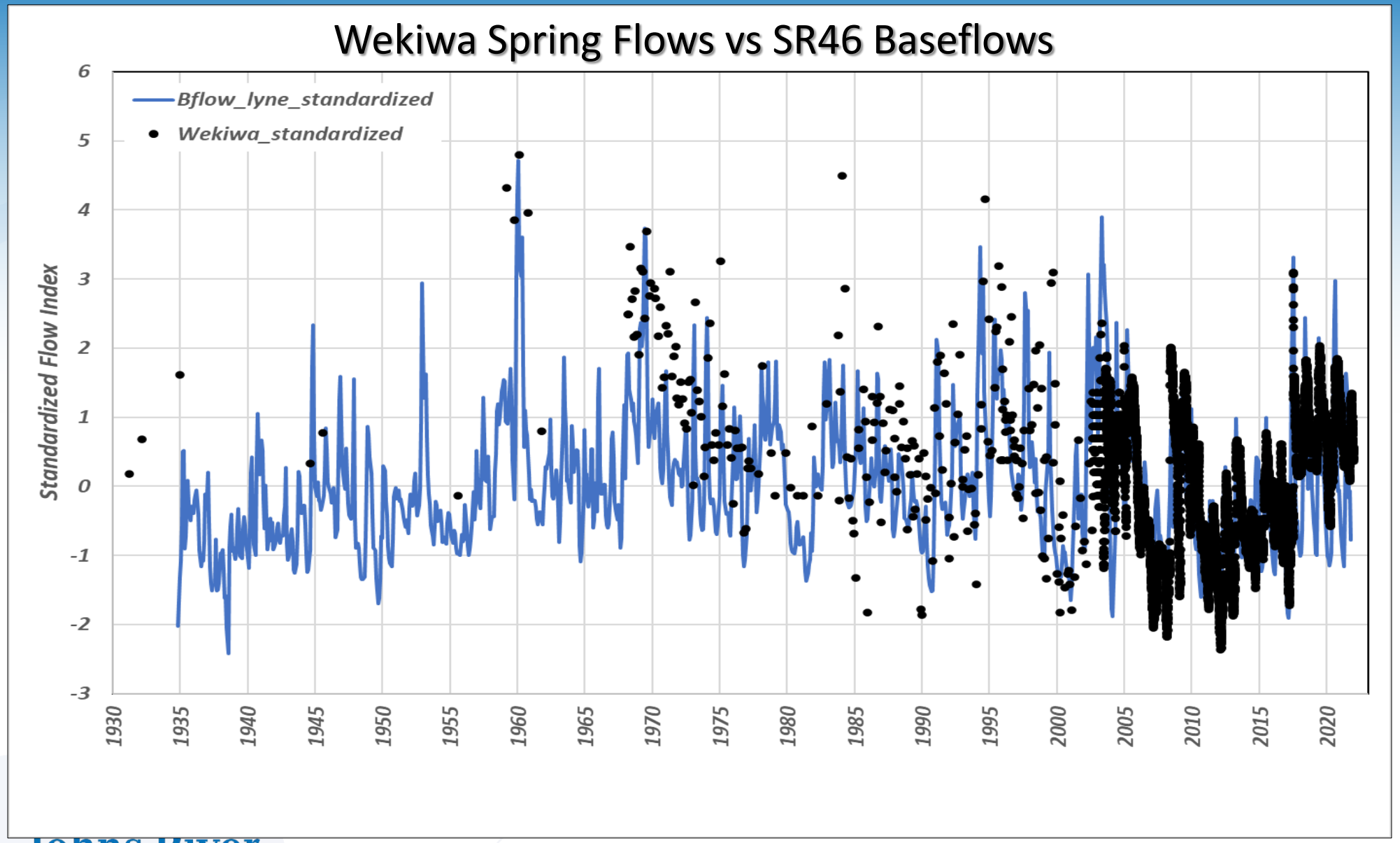
Wekiwa Spring Flows vs SR46 Baseflows



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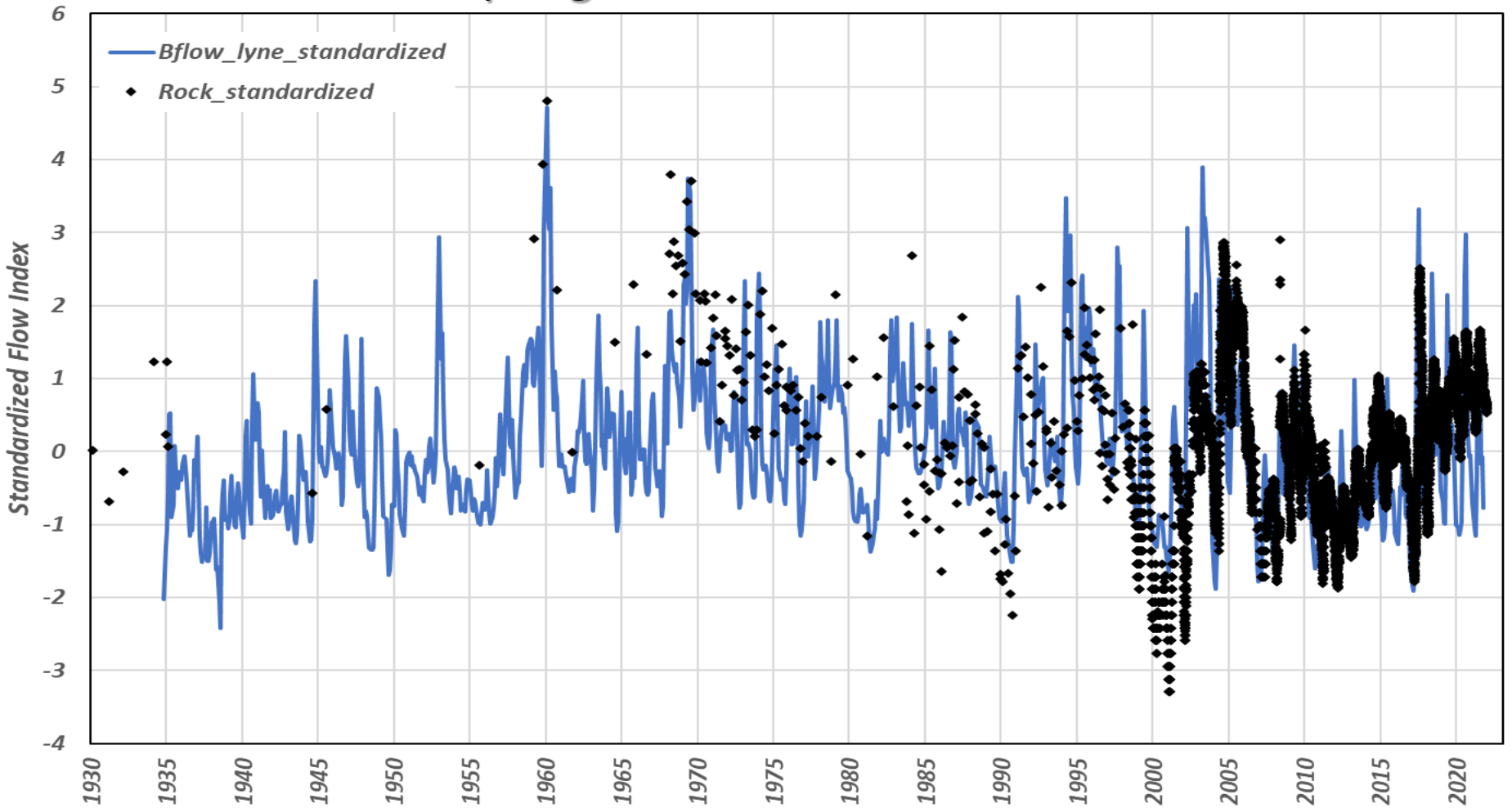
Rock Spring Flows vs SR46 Baseflows



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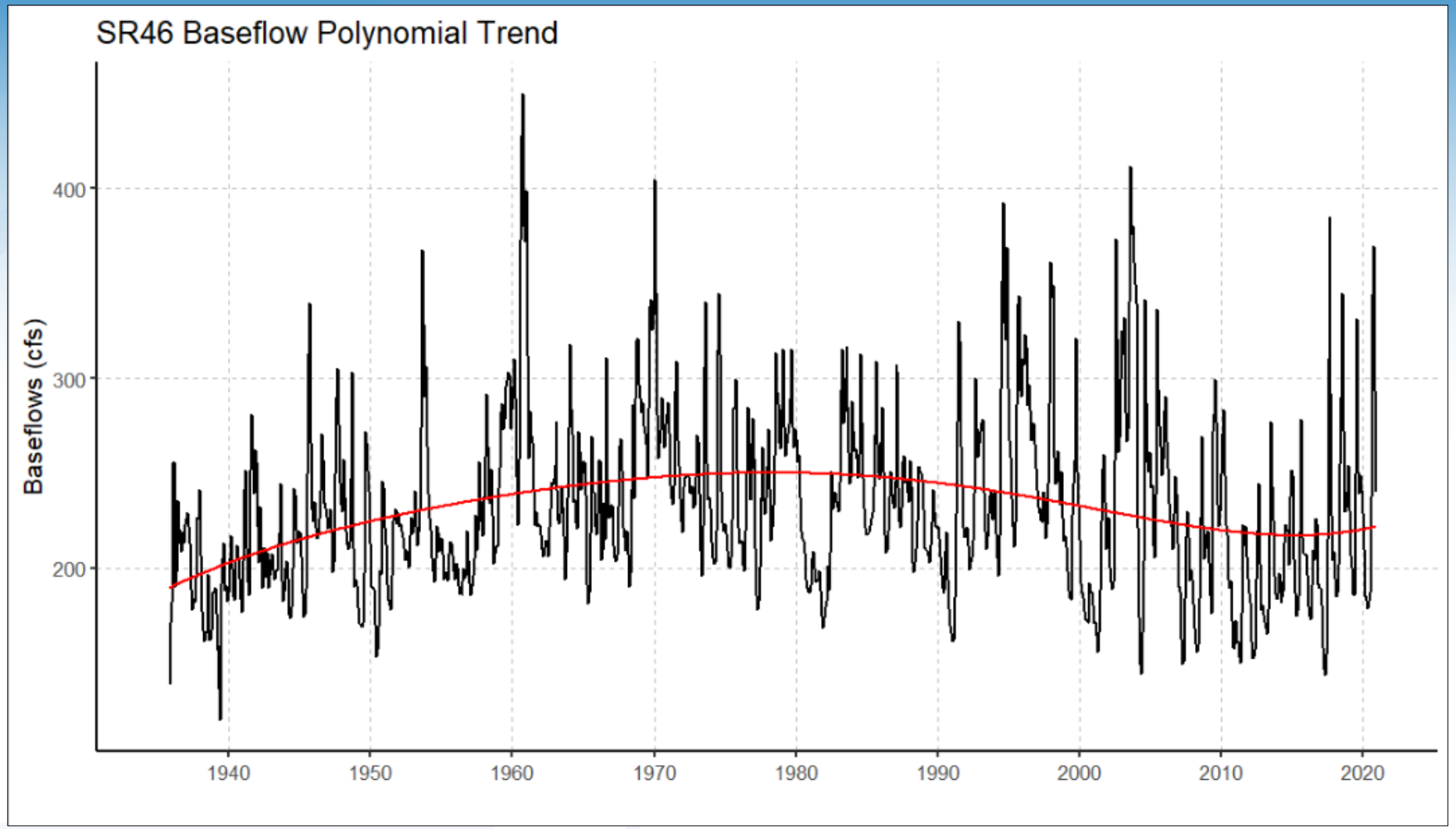

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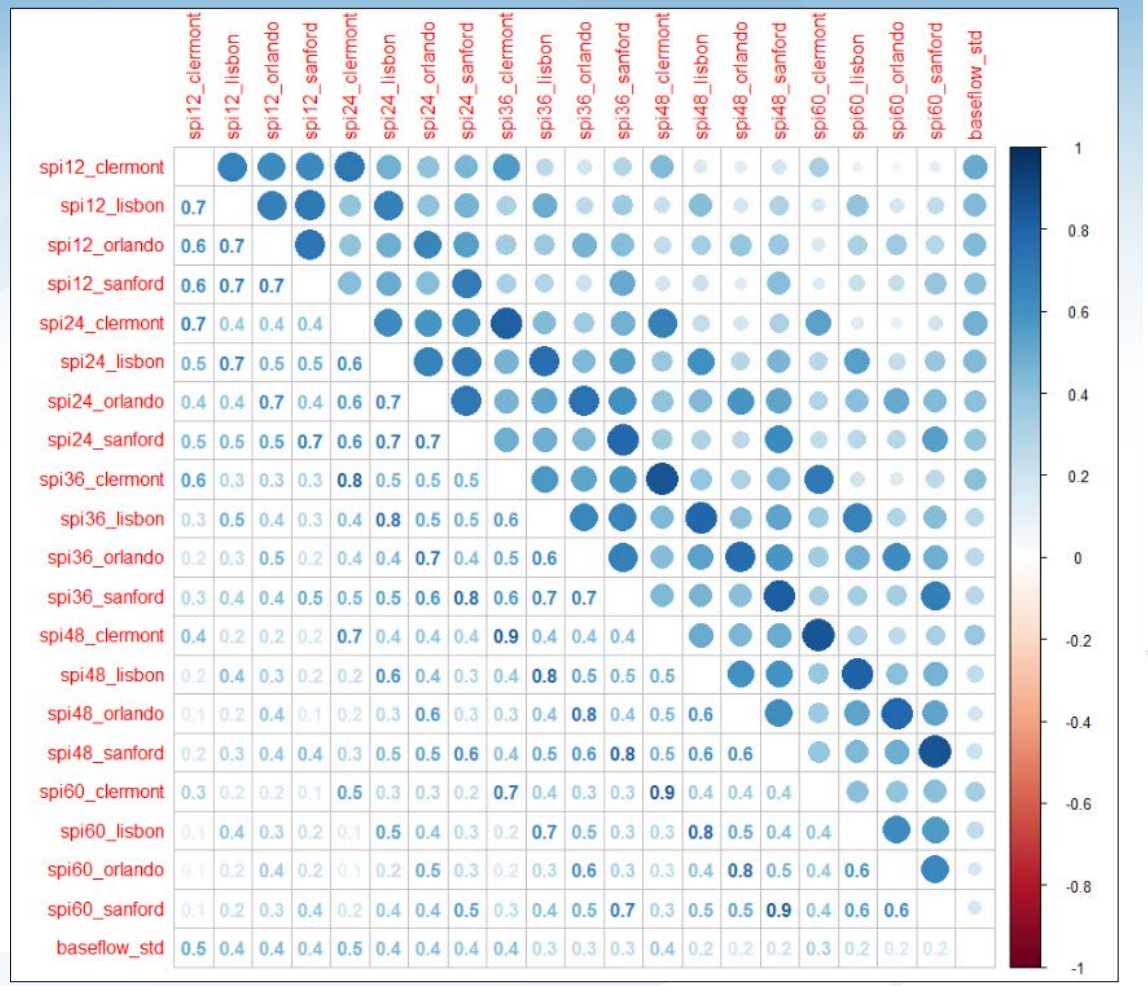
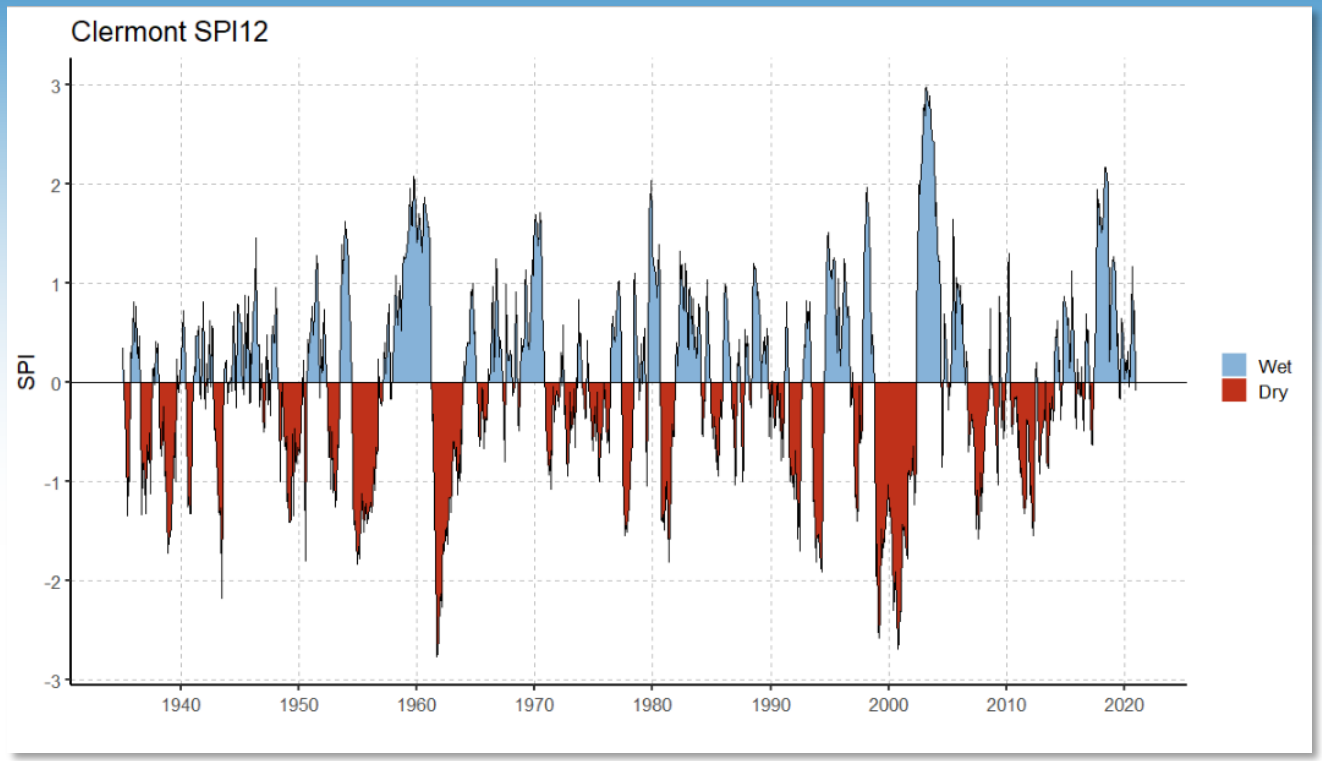
Rainfall Analysis





Standard Precipitation Index (SPI)

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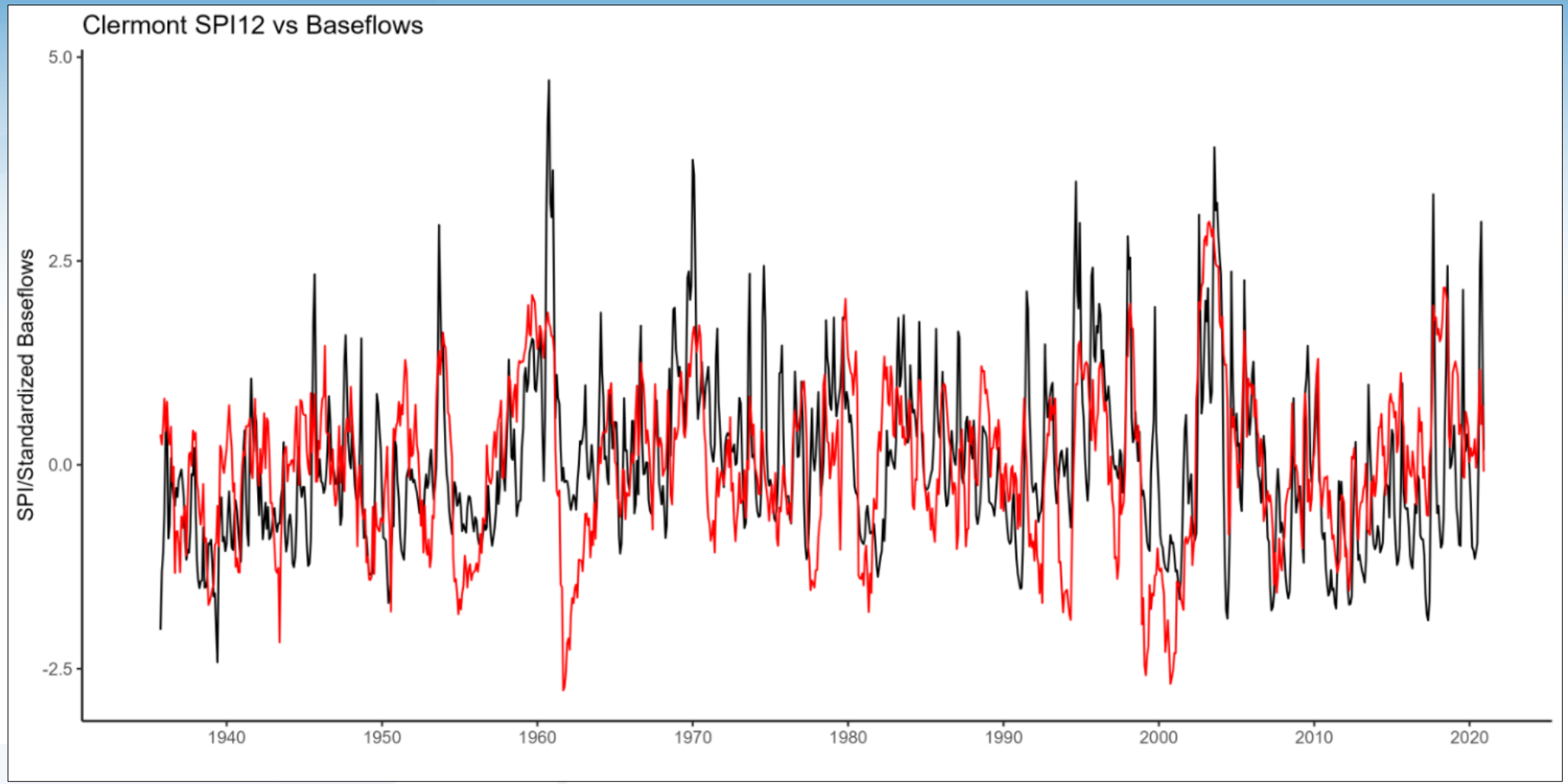
Rainfall vs SR46 Baseflows



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Conclusions

- Baseflow at SR 46 generally follows a similar trend to the 12-month SPI derived from the rainfall at Clermont
- There does not appear to be any significant long-term decline in flows since the 1930s and no obvious deviation between rainfall and baseflows trends
- Discerning any anthropogenic influences such as groundwater pumping impact on flows using the available data does not seem to be possible due to
  - insufficient long-term spring flows
  - uncertainties in baseflow estimation techniques and flow measurements
  - Influence of vegetation and sedimentation
- Numerical groundwater models such as the East-Central Florida Transient Expanded (ECFTX) remain the best available tool to estimate impact of groundwater pumping on spring flows.

Wekiva River Basin

MFLs Determination

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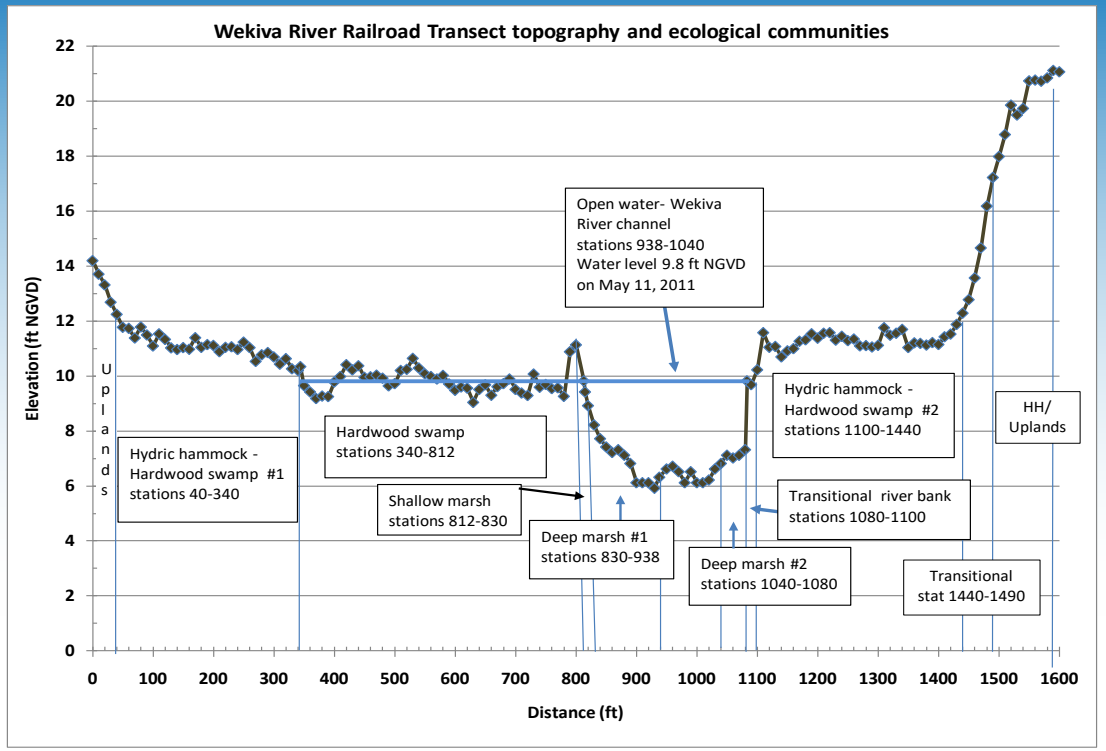
Minimum Frequent High

- **Magnitude: Mean elevation of hardwood swamp (HS) communities**
  - SR46: 6 transects
  - Wekiwa Springs: 3 transects
  - Rock Springs / Run: 3 transects
  - Little Wekiva River: 3 transects
- **Duration: 30-day exceedance**
- **Return Interval: SWIDS: Mean (+SE) FH RI:**
  - 4 Silver River floodplain HS transects
  - 3 St. Johns River HS transects
  - 4 Ocklawaha River HS transects near Conner gage
  - 3 Rainbow River HS transects



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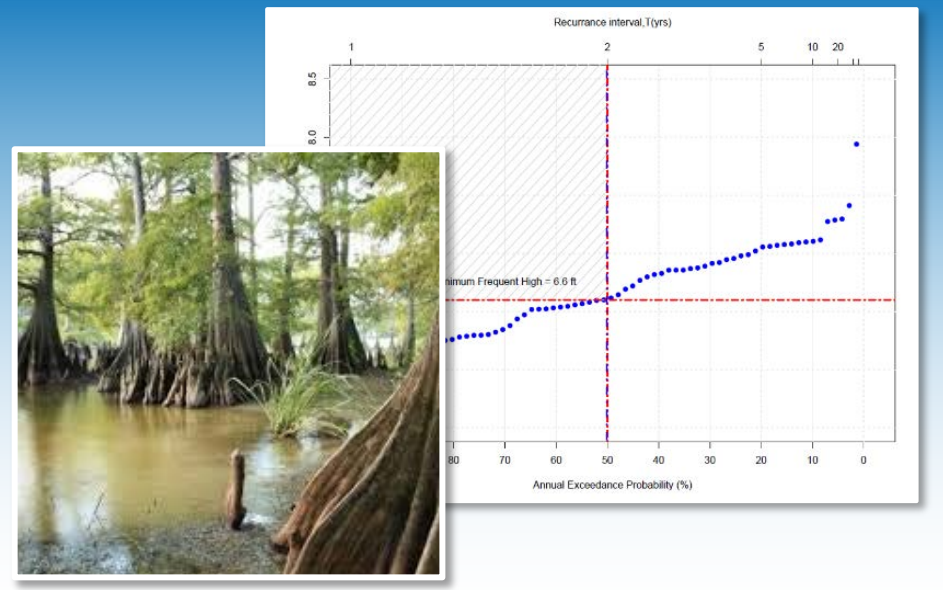
Minimum Frequent High

Wekiva River Basin System	Minimum Frequent High Components		
	Level (ft NAVD 88)	Duration (days)	Return Interval (years)
Wekiva River at SR 46	6.6	30	2.0
Wekiwa Springs	12.1	30	2.0
Rock Springs	25.0	30	2.0
Little Wekiva River at SLB	18.7	30	2.0



Florida River System	Return Interval (yr)
St. Johns River at Lake Monroe	1.6
St. Johns River at Pine Island	1.6
St. Johns River at Emmanuel Bend	2.0
Silver River	1.8
Rainbow River	2.7
Ocklawaha River	1.3
Average	**1.8**
Average + SE	2.0

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Minimum Average

- **Magnitude: Mean elevation of Histosol/Histic Epipedon (H/HE) minus 0.3 ft offset**
  - SR46: 4 transects
  - Wekiwa Springs: 1 transect
  - Rock Springs / Run: 3 transects
  - Little Wekiva River: 3 transects
- **Duration: 180-d average non-exceedance**
- **Return Interval: SWIDS: Mean (-SE) MA RI:**
  - 4 Silver River floodplain HS transects
  - 3 St. Johns River HS transects
  - 3 Rainbow River HS transects

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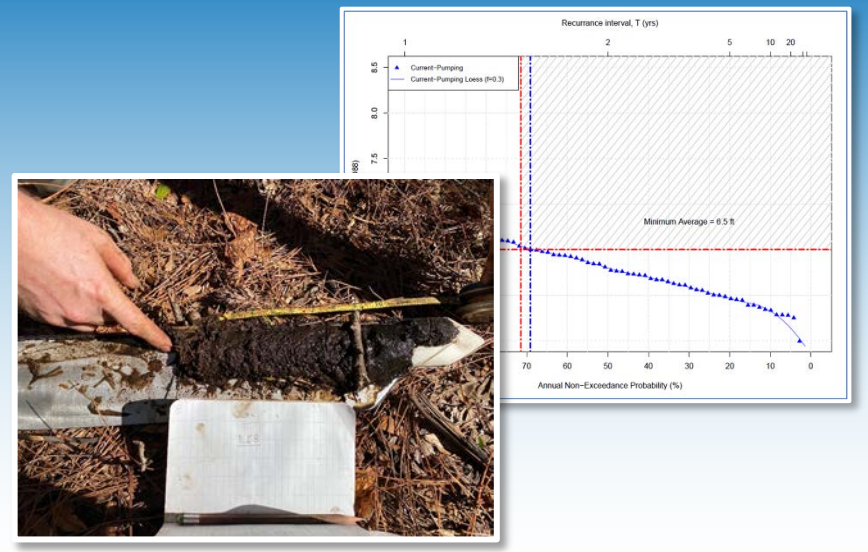
Minimum Average

Wekiva River Basin System	Minimum Average Components		
	Level (ft NAVD 88)	Duration (days)	Return Interval (years)
Wekiva River at SR 46	6.5	180	1.4
Wekiwa Springs	11.9	180	1.4
Rock Springs	24.7	180	1.4
Little Wekiva River at SLB	18.1	180	1.4



Florida River System	Return Interval (yr)
St. Johns River at Lake Monroe	1.0
St. Johns River at Pine Island	2.1
St. Johns River at Emmanuel Bend	2.2
Silver River	1.6
Rainbow River	1.6
Average	**1.7**
Average - SE	1.4

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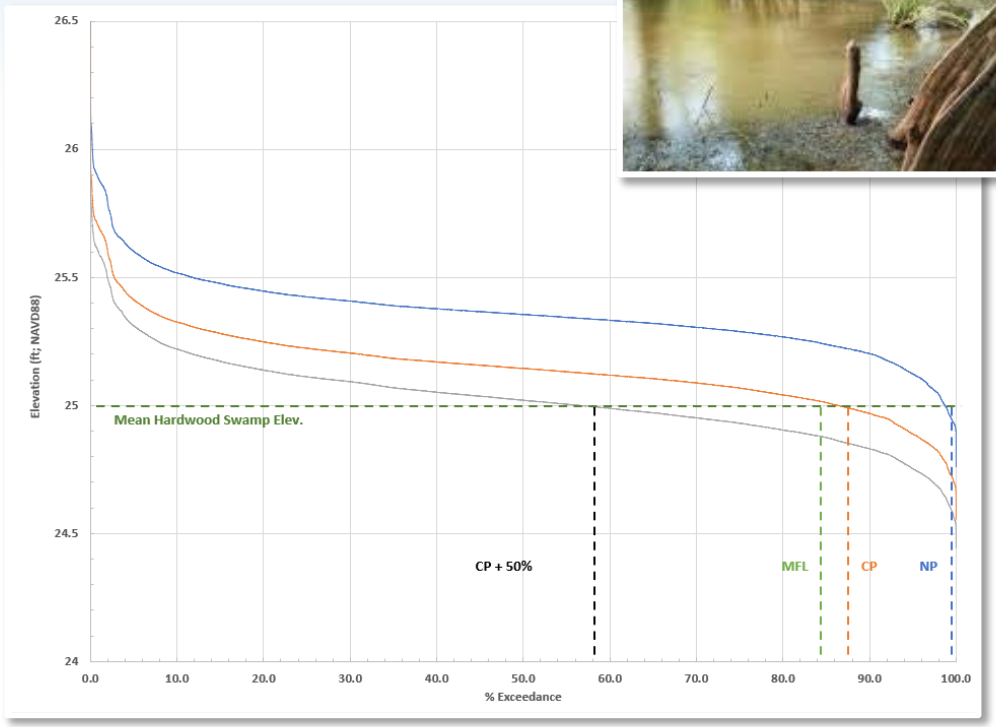
Floodplain Swamp Inundation Protection

- **Metric used for systems either:**
  - Not protected by Frequent High (i.e., very large freeboard); or
  - Where FH is not met under no-pumping
- **Floodplain inundation critical to protect**
  - Structure and function
  - Biogeochemistry
  - Spawning, forage, refuge for numerous species
- **Metric based on 15% reduction in NP condition inundation frequency of hardwood swamp communities**



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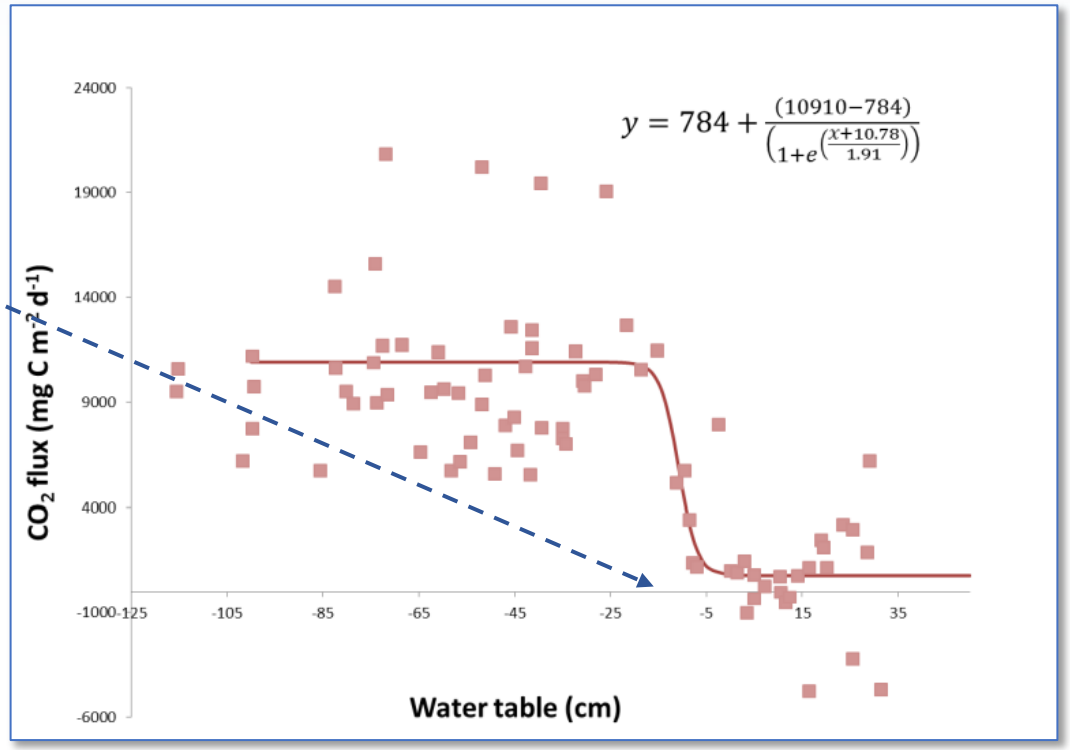
Organic Soils: Harmful Drying Event

- **Metric used for systems either:** Not protected by Minimum Average (i.e., very large freeboard); or Where MA is not met under no-pumping
- Based on research by and discussions with Todd Osborne (UF Biogeochem. Lab)
- **8-day drying event** (drying events ≥ 8 days lead to oxidation/subsidence)
- **Harmful Drying Event**:
  - *Elevation*: Mean H/HE - **0.3 ft**
  - *Duration*: 8 or more days
- **Metric**
  - total duration of harmful drying events
- **Threshold**
  - **15%** increase in total duration of **NP** harmful drying events



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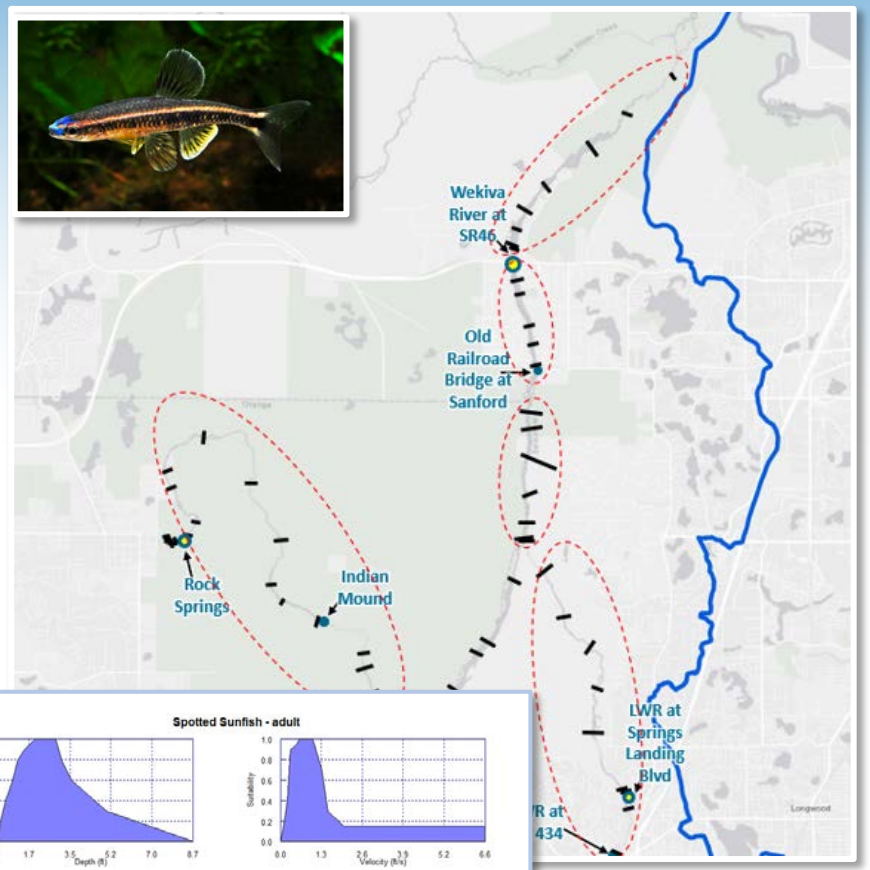
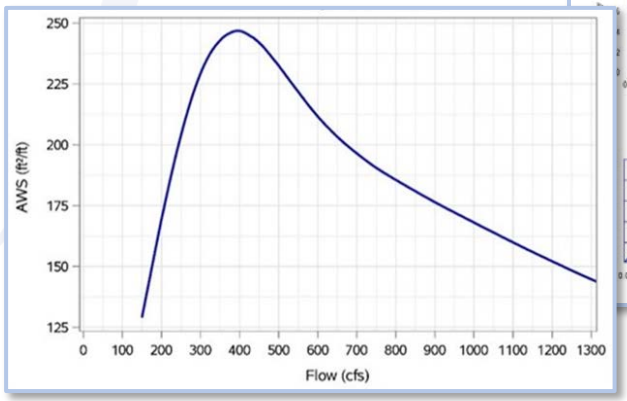
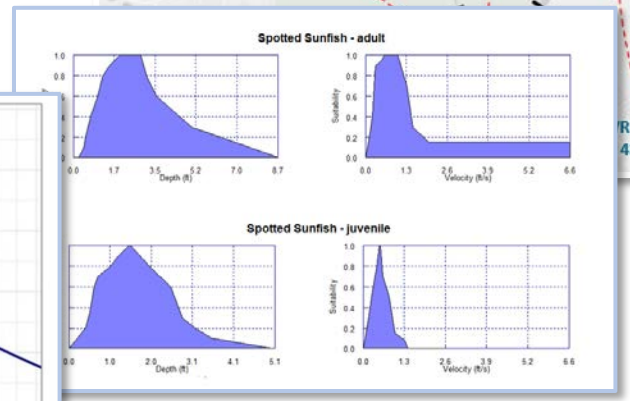
SEFA: System for Environmental Flow Analysis

- **Habitat suitability (AWS; ft²/ft) evaluated**
- **HEC-RAS output:** velocity distributions; stage/flow data at numerous cross sections
- **32** species, life-stages and functional groups
- For **6** areas within the Wekiva River basin
- Species-specific depth and velocity preferences
- Majority common, two are imperiled species
  - *e.g., bluenose shiner, American shad*







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Wekiva River Basin

MFLs Assessment

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MFLs Assessment

Dataset

Long-term water levels or flows

Pumping Impact Assessment

Determine the impact from pumping on levels and/or flows

Current-Pumping Condition Levels

Develop no-pumping and current-pumping condition levels/flows

Current Status of MFLs

Estimate freeboard or deficit in the levels/flows under current pumping condition to assess current status of MFLs

Future Status of MFLs

Estimate freeboard or deficit in the levels/flows under future pumping condition

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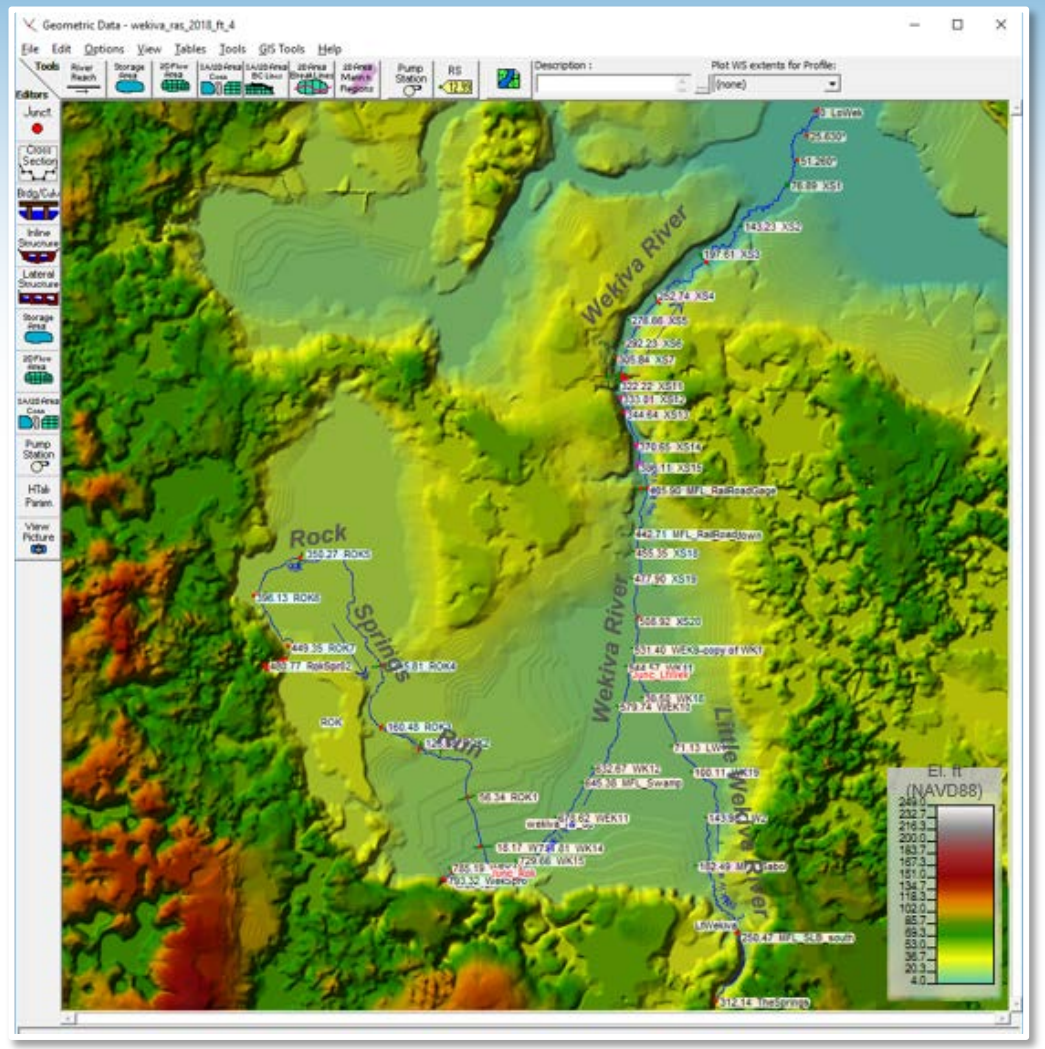
Hydrologic, Hydraulic and Groundwater Modeling

MFLs determinations and assessment depend on modeling

- Long-term Dynamic Modeling
  - Watershed Hydrology: **HSPF**
  - River Hydraulics: **HEC-RAS**
- Pumping impact estimate: **ECFTX v2 groundwater model**



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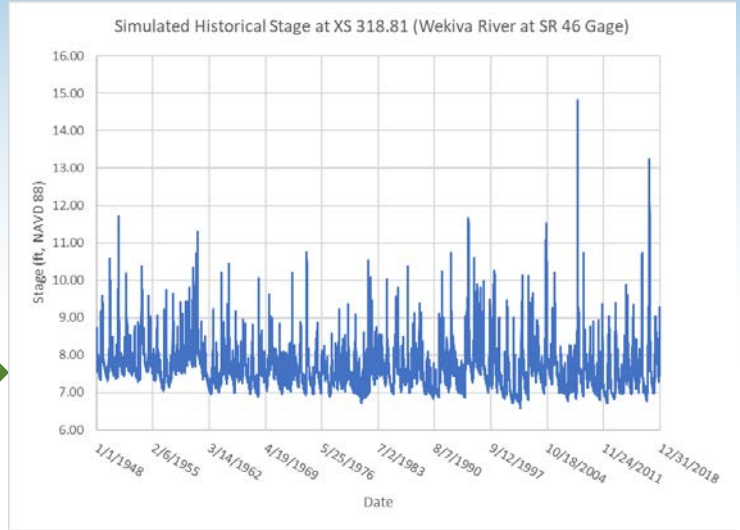
MODELING – HISTORICAL CONDITIONS

Basin Flows (Simulated by HSPF)

Spring Flows (Extended observed flows)

HEC-RAS (Unsteady dynamic model)



Daily Long-term river flows and stages (1948 – 2018)

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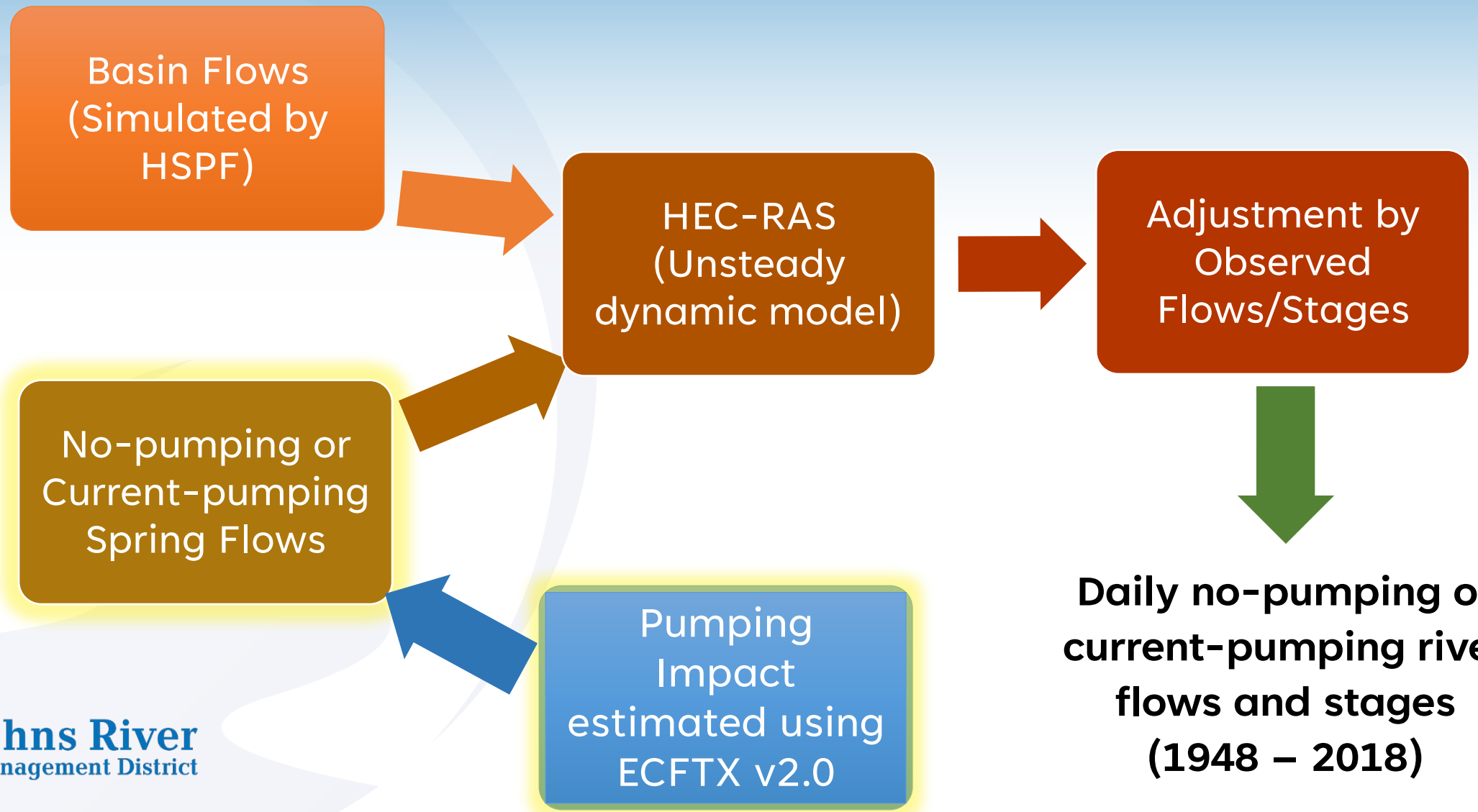
MODELING – NO-PUMPING AND CURRENT PUMPING



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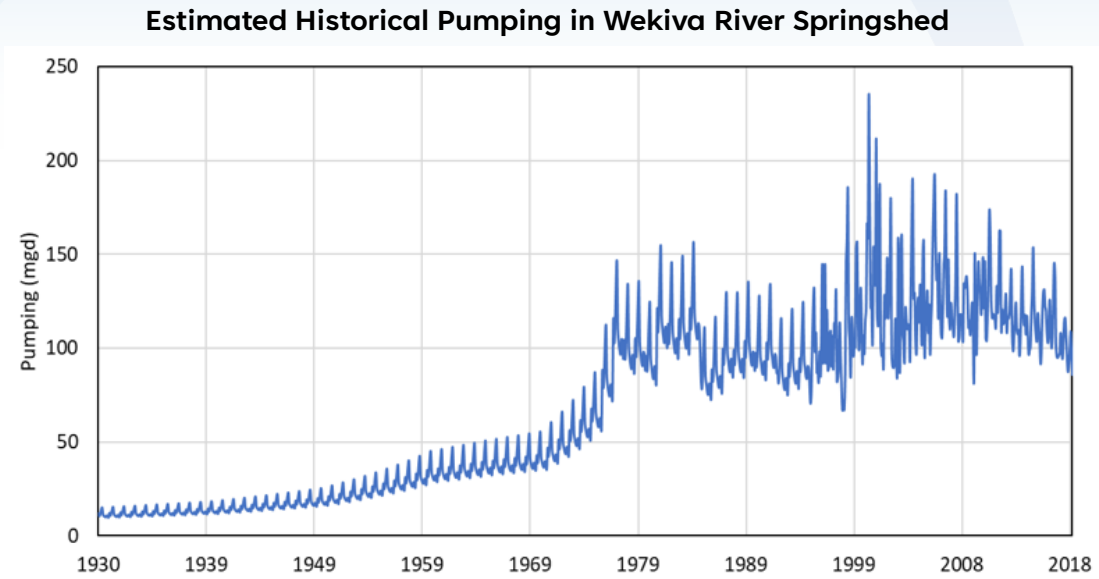
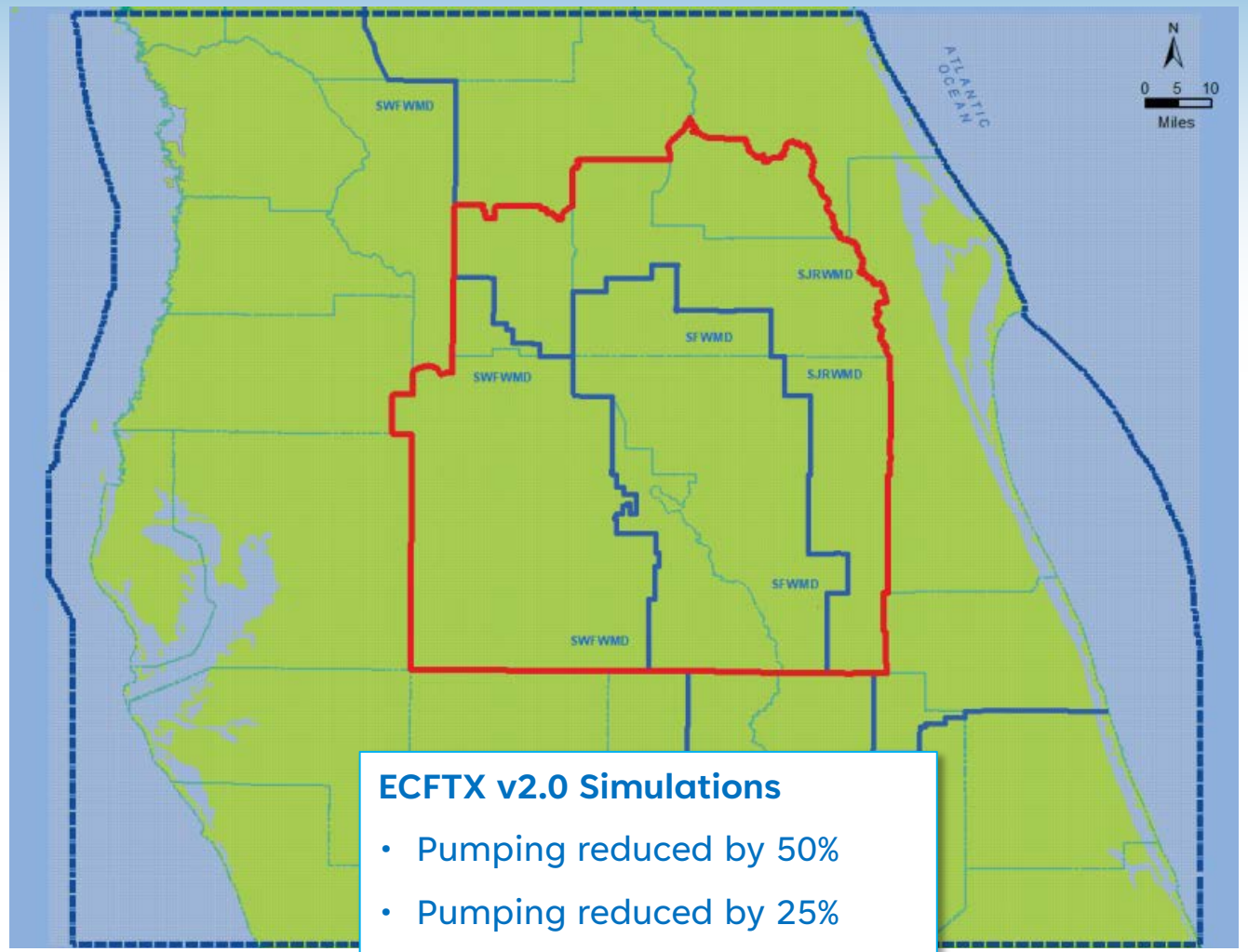
MFLs Assessment: Pumping Impact Assessment

- ECFTX v2.0
- Historical pumping



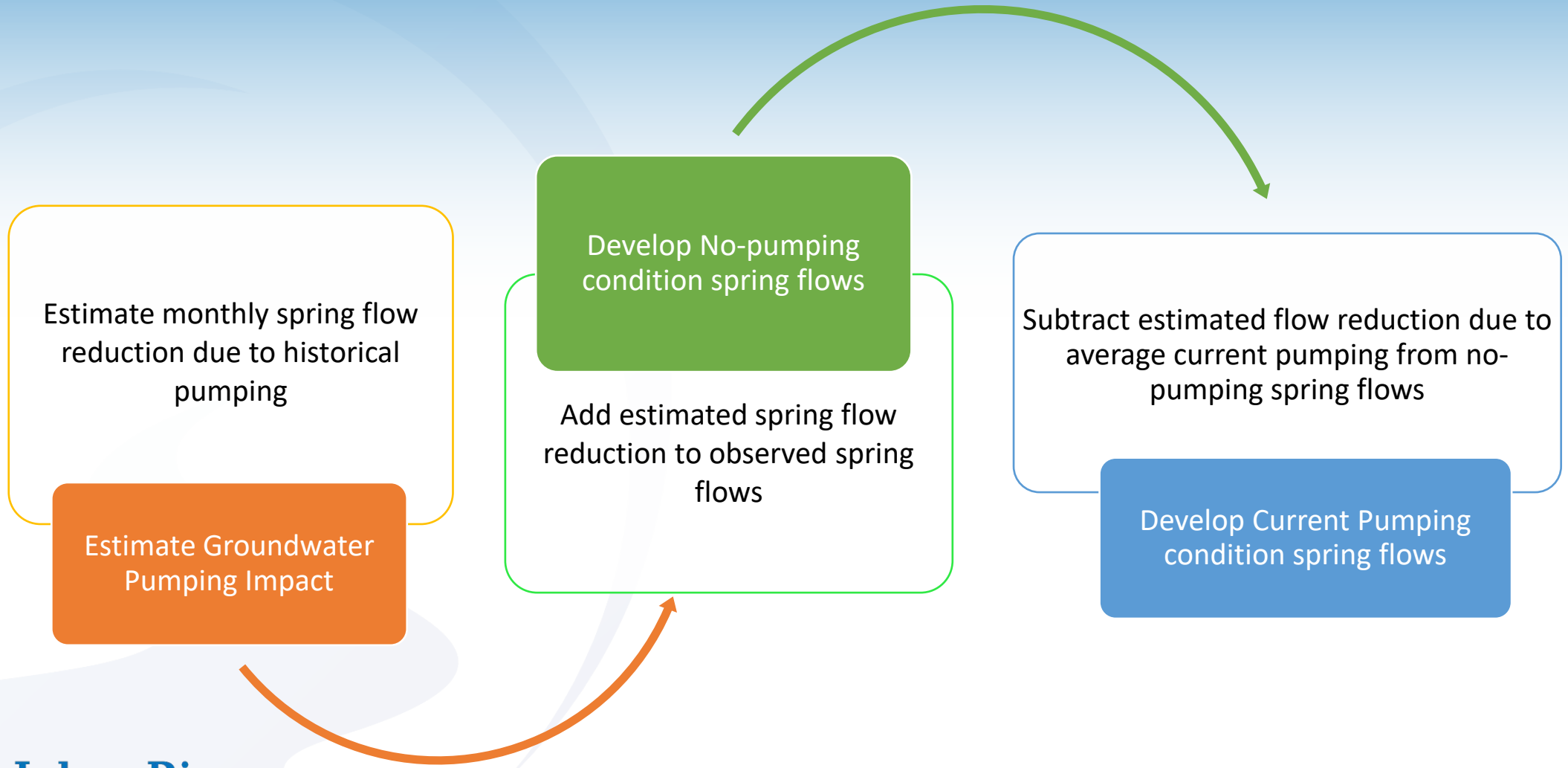


ECFTX v2.0 Simulations

- Pumping reduced by 50%
- Pumping reduced by 25%
- Calibration period condition
- Pumps off

St. Johns River Water Management District

MFLs Assessment: No- and Current-Pumping Data Development



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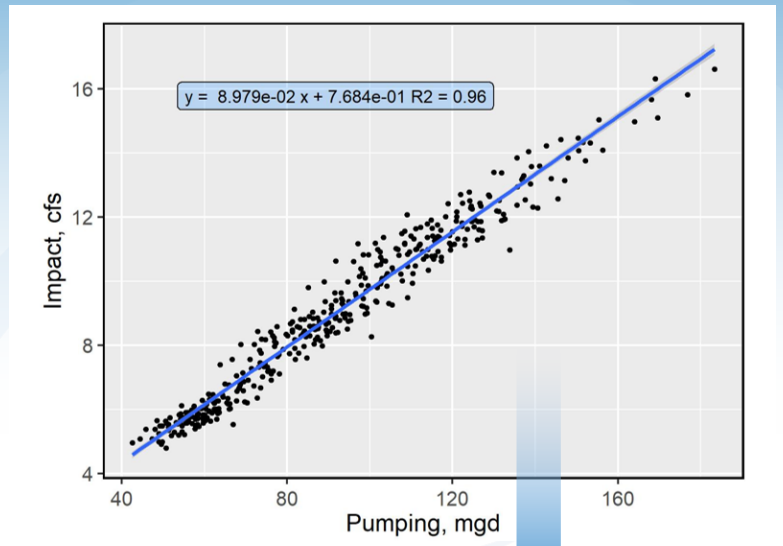
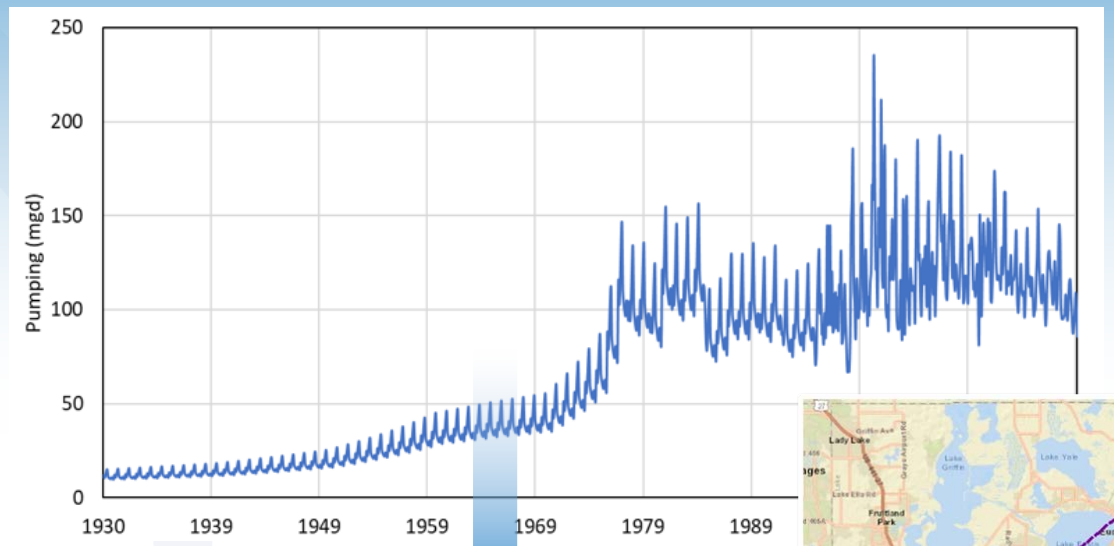
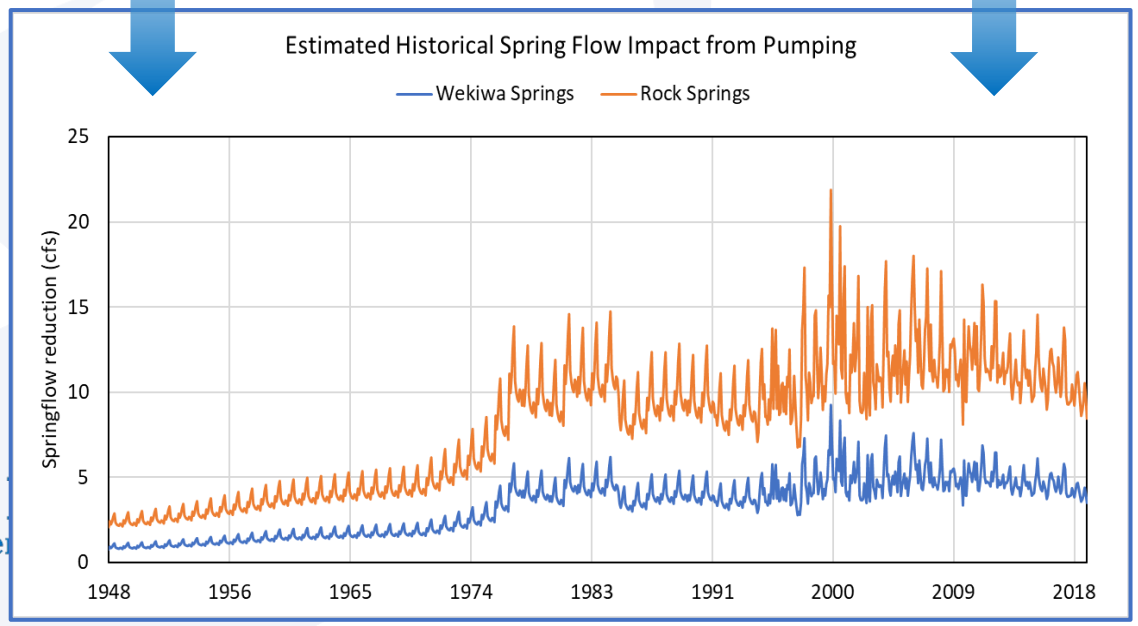
Groundwater Pumping Impact

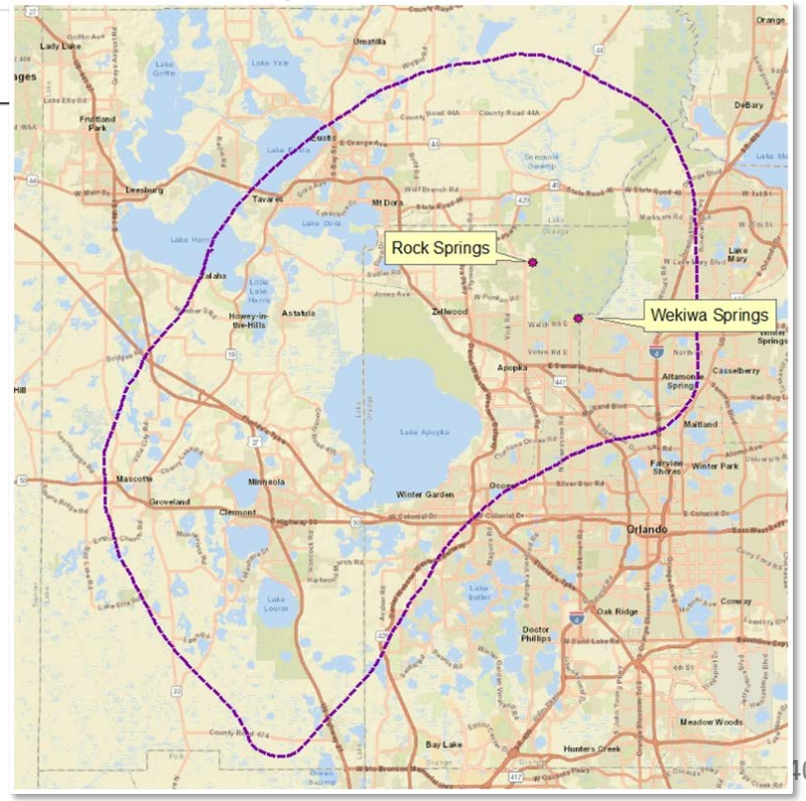
Flow Impact (cfs) at Rock Springs vs Pumping (mgd)



Estimated Historical Pumping in Wekiva River Springshed

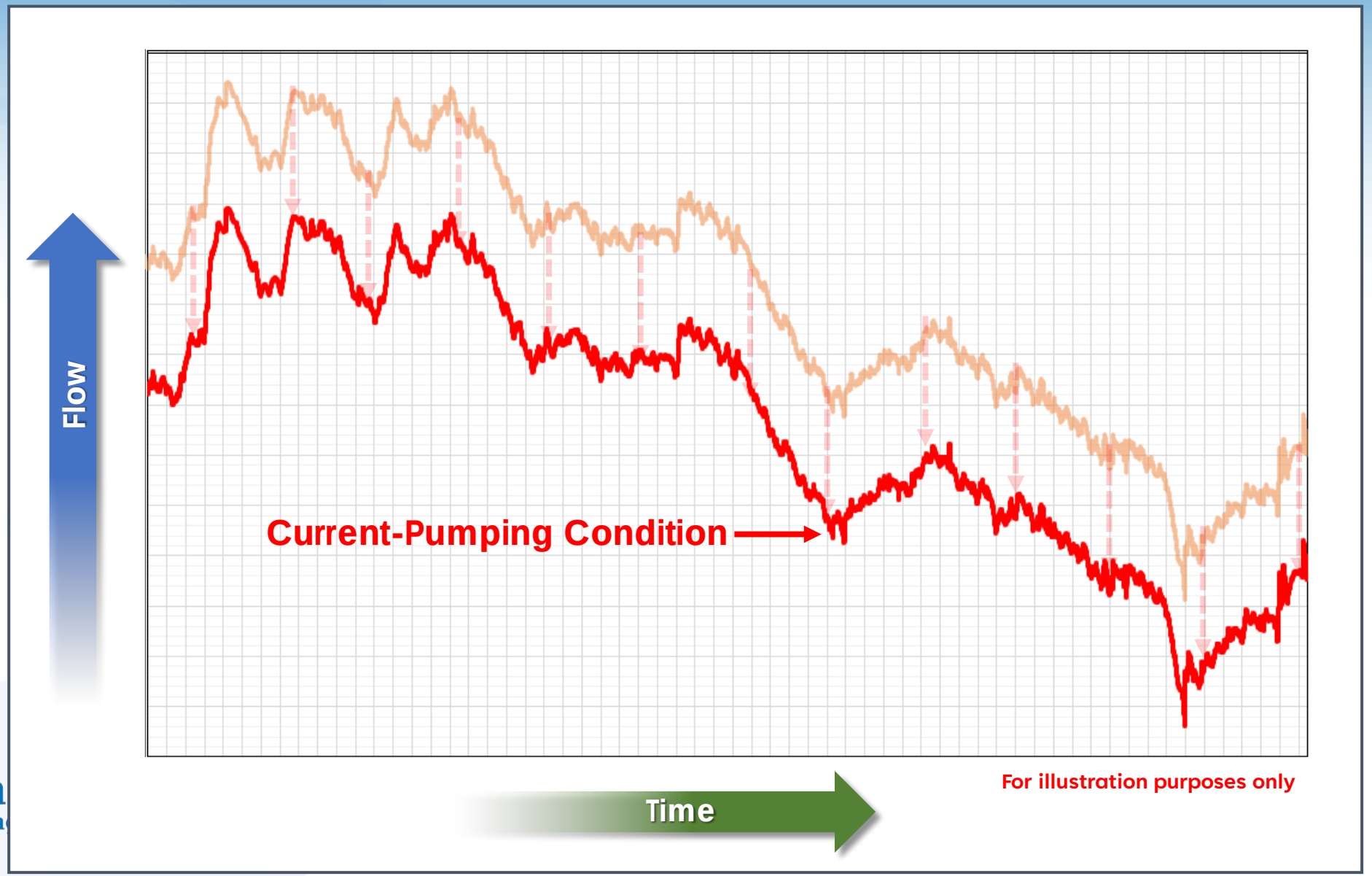






St. Johns River Water Management

No-Pumping and Current-Pumping Spring Flows



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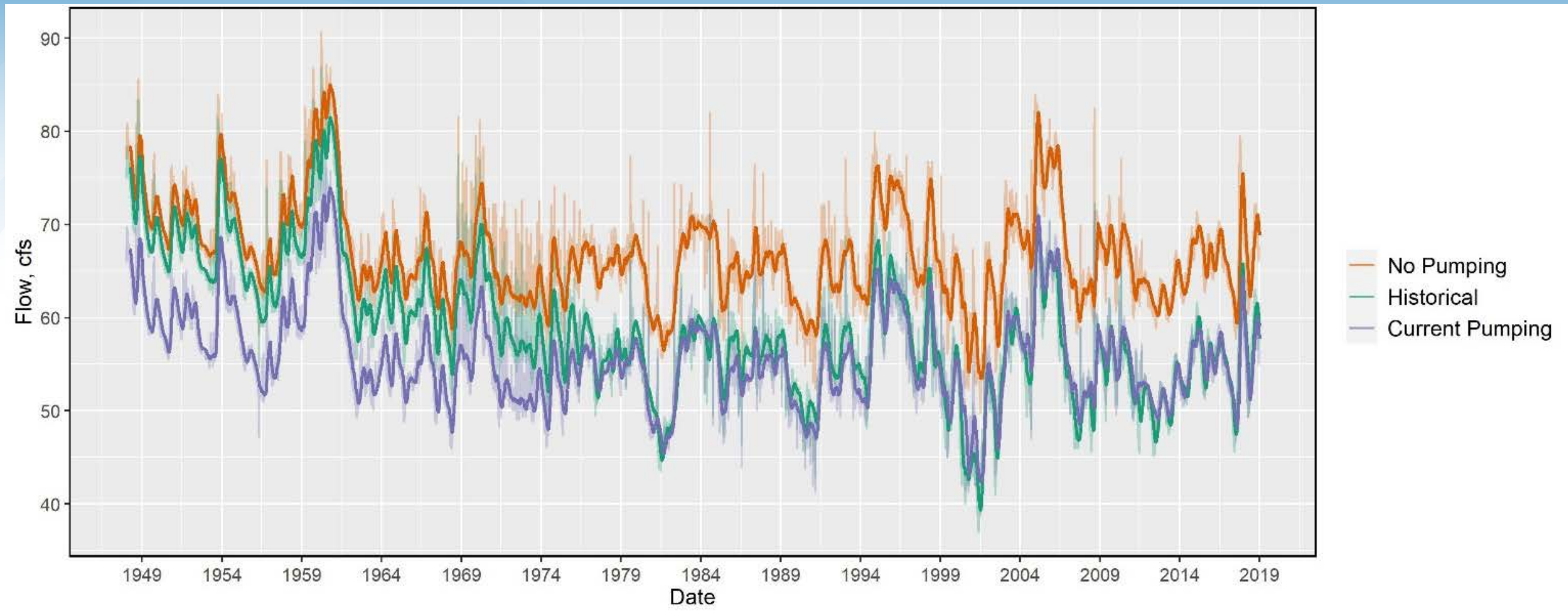
No-pumping and Current-pumping Spring Flows



Rock Springs

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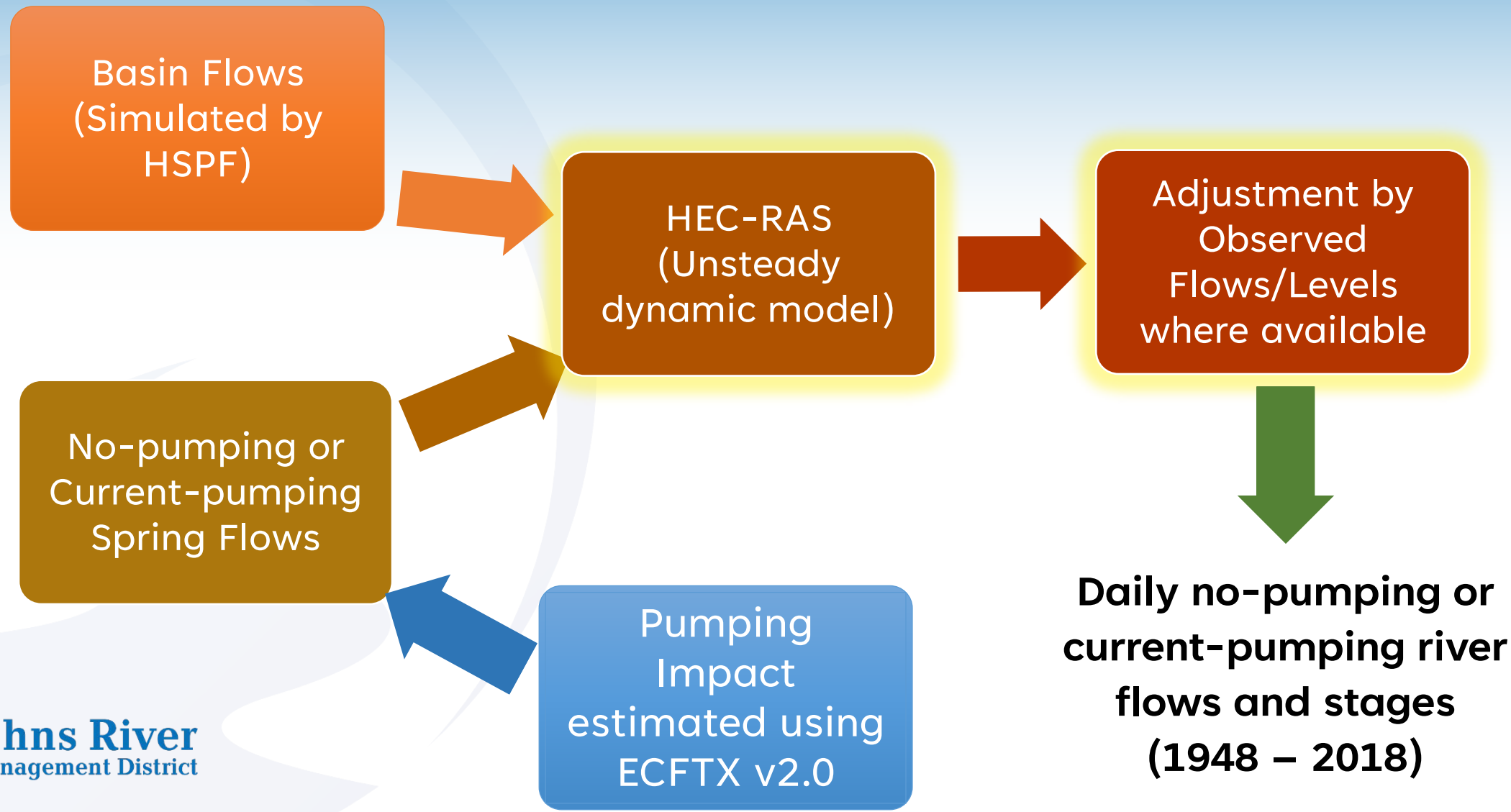
MODELING – NO-PUMPING AND CURRENT PUMPING



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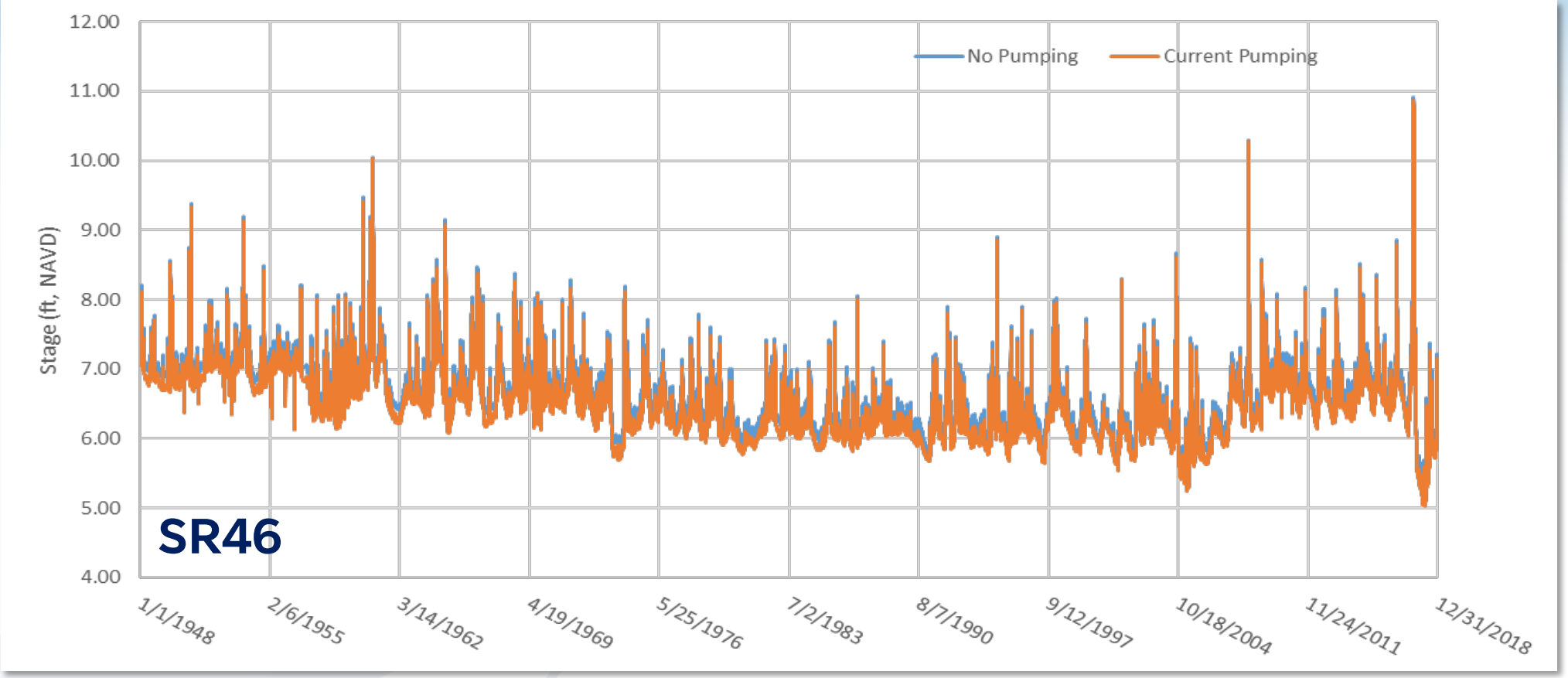
No-pumping and Current-pumping River Levels/Flows

Final NP flows/levels = Observed/estimated + (Simulated NP – Simulated Historical)

CP flows/levels = Final NP – (Simulated NP – Simulated CP)

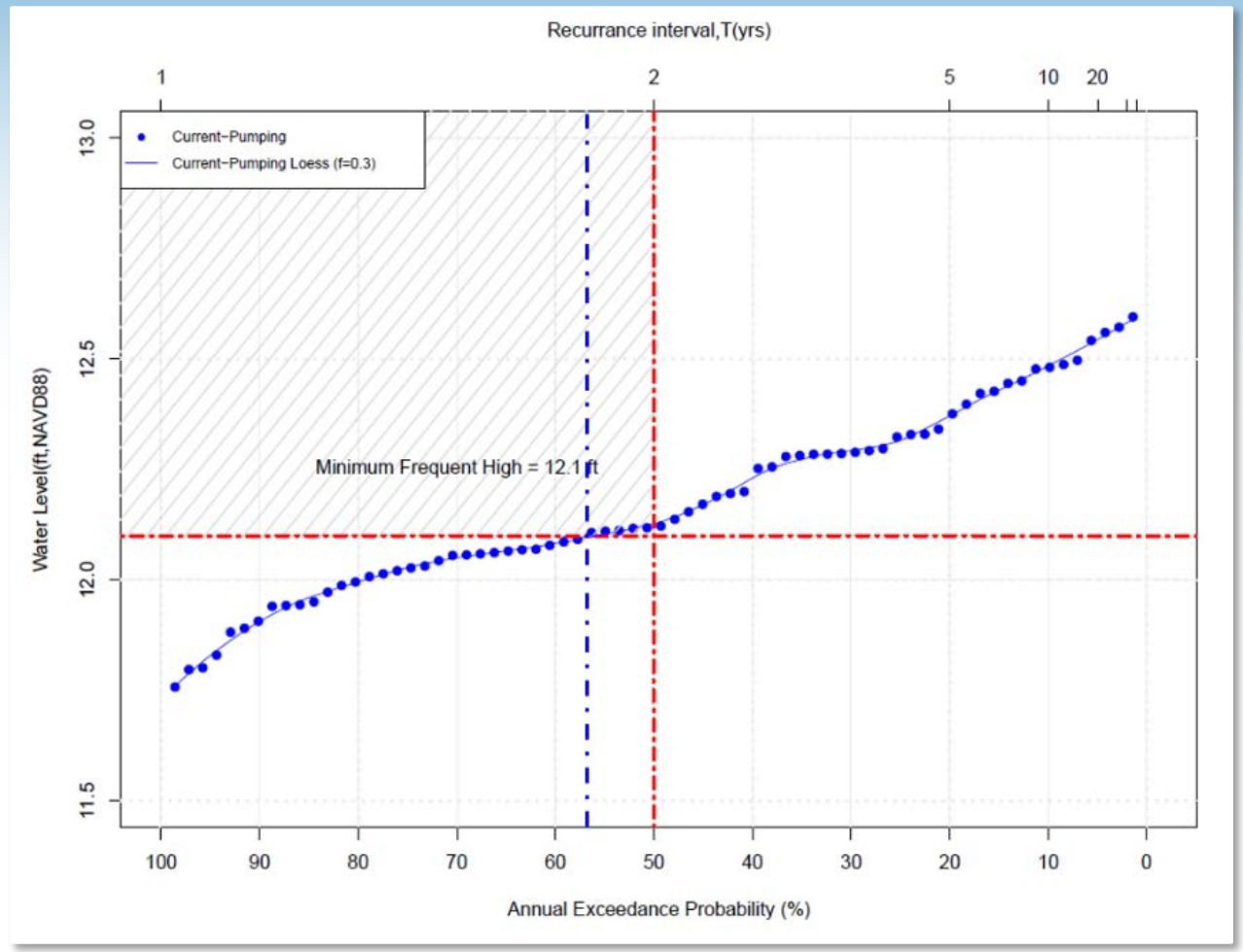


St. Johns River Water Management District

Event-Based Metric Assessment: Frequency Analysis

Frequency Analysis - Weibull Plot

- Determine flow event probabilities;
- Rank annual probability (current-pumping) data;
- Compare MFL frequency (RI) to current frequency;
- Iteratively reduce (if there is freeboard) or increase (if there is deficit) boundary condition (**spring flows**) in HEC-RAS model until MFL is just met;
- Use most constraining MFL for the freeboard/deficit = **MFLs Condition**



St. Johns River Water Management District

Minimum Frequent High

Wekiva R. at SR 46

- CP = MFL
- FB = 0 cfs

Wekiwa Springs

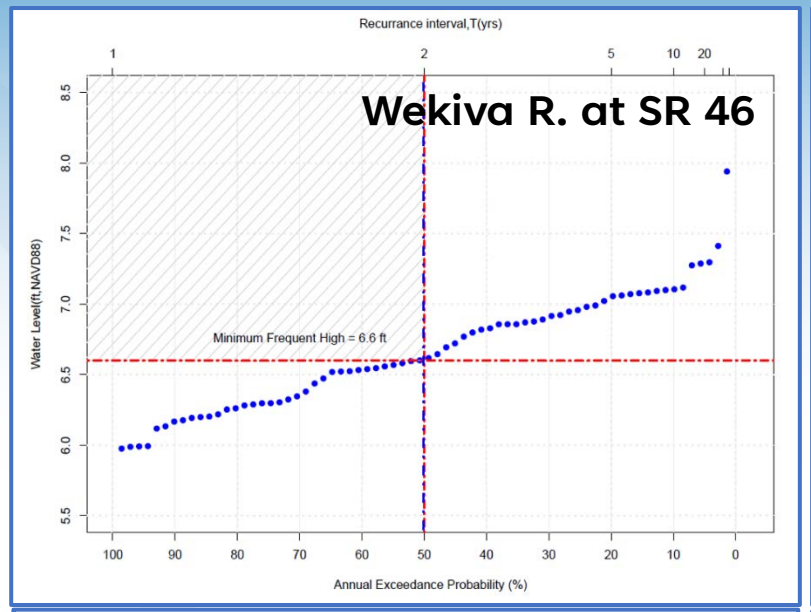
- CP level < 0.05 ft from MFL
- FB = 0 cfs

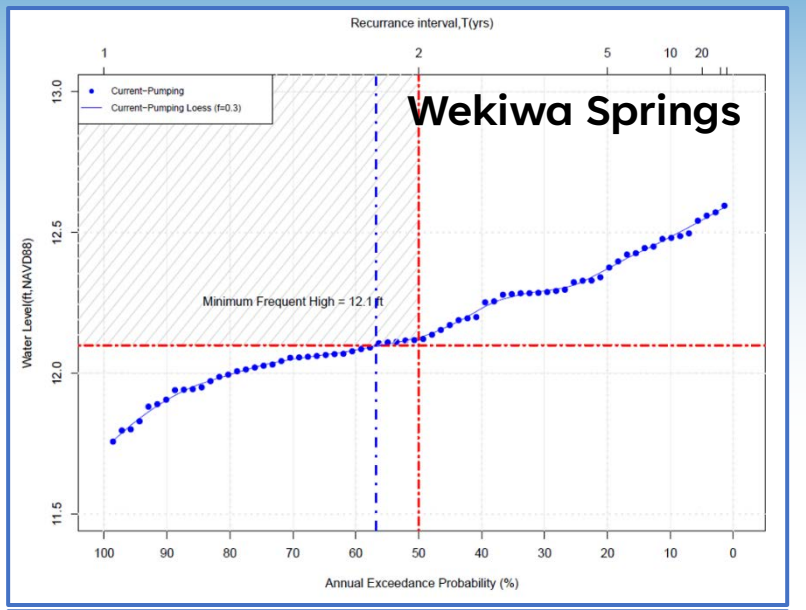
Rock Springs

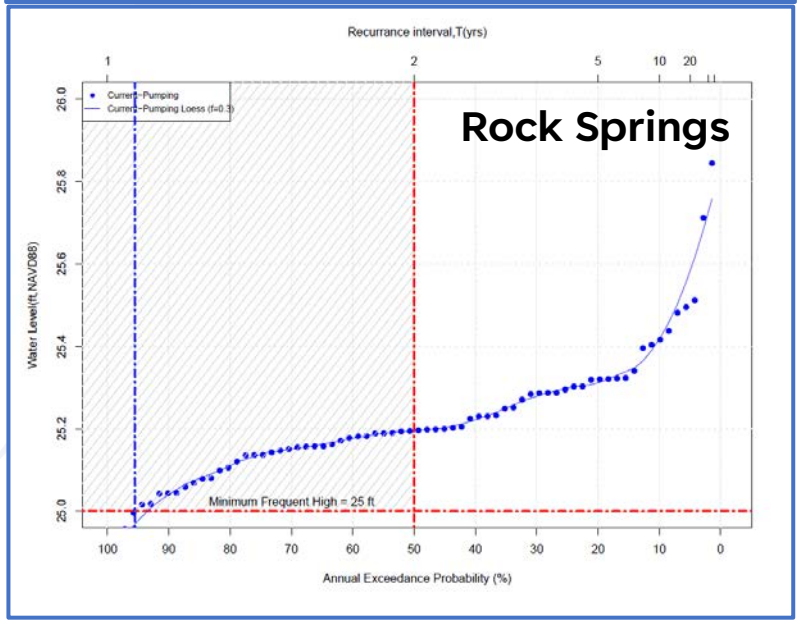
- FB ≥ 5.5 cfs (50% increase in CP impact)

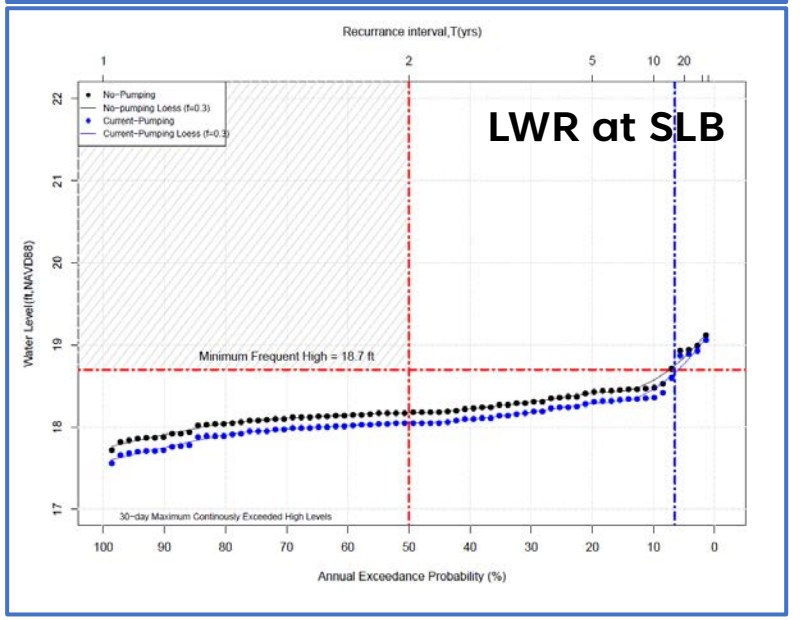
Little Wekiva R. at SLB

- Not meeting under No-pumping condition









St. Johns River Water Management District

Minimum Average

Wekiva R. at SR 46

- CP level < 0.05 ft from MFL
- UFA FB = 0 cfs

Wekiwa Springs

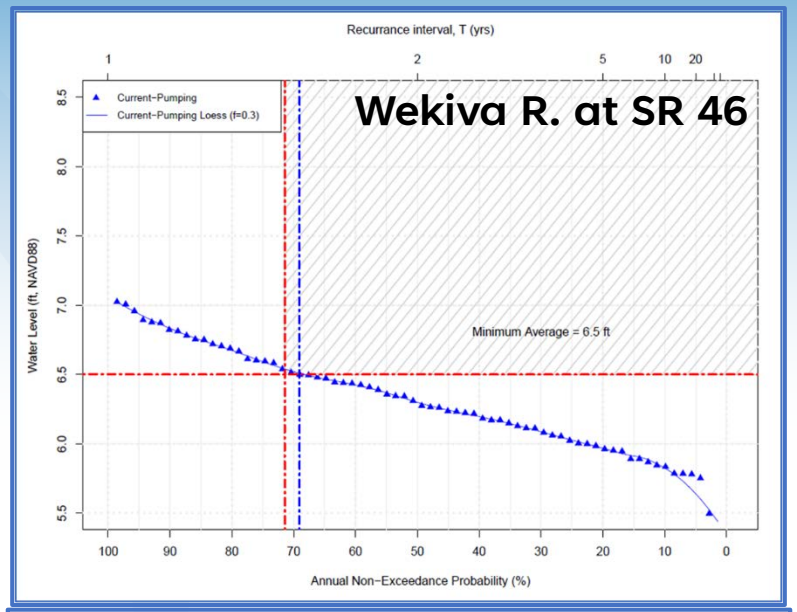
- UFA FB ≥ 2.3 cfs (50% increase in CP impact)

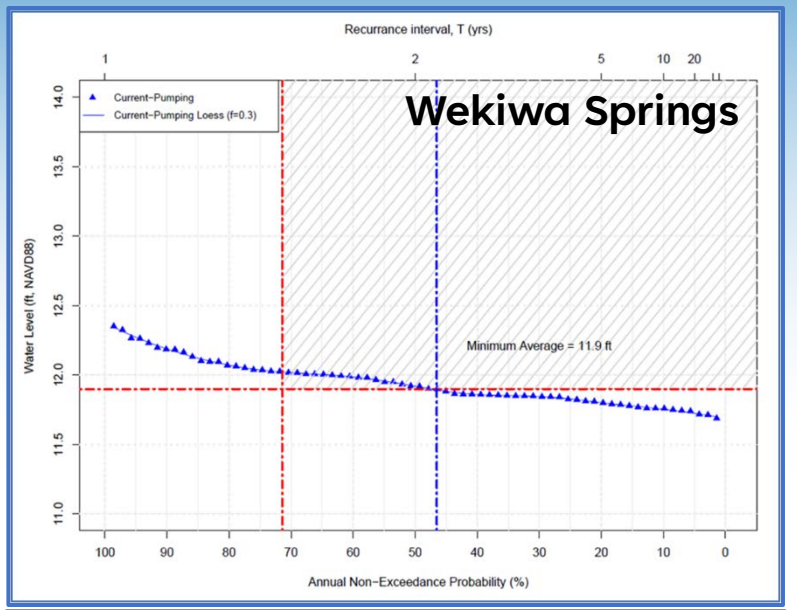
Rock Springs

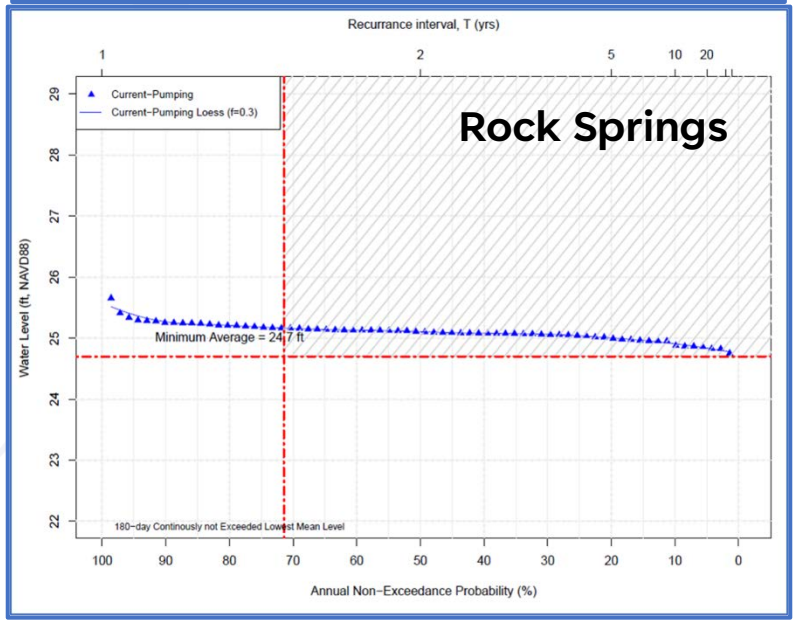
- FB ≥ 5.5 cfs (50% increase in CP impact)

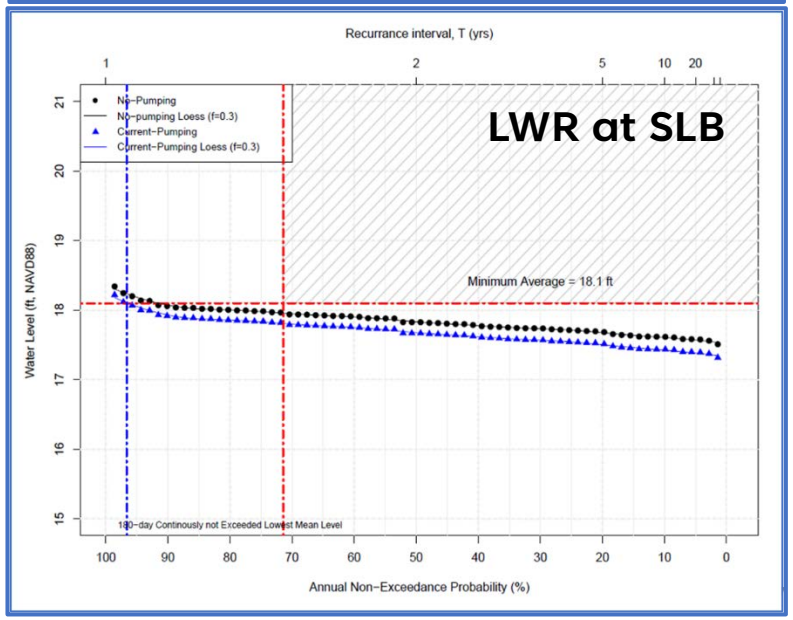
Little Wekiva R. at SLB

- Not meeting under No-pumping condition









St. Johns River Water Management District

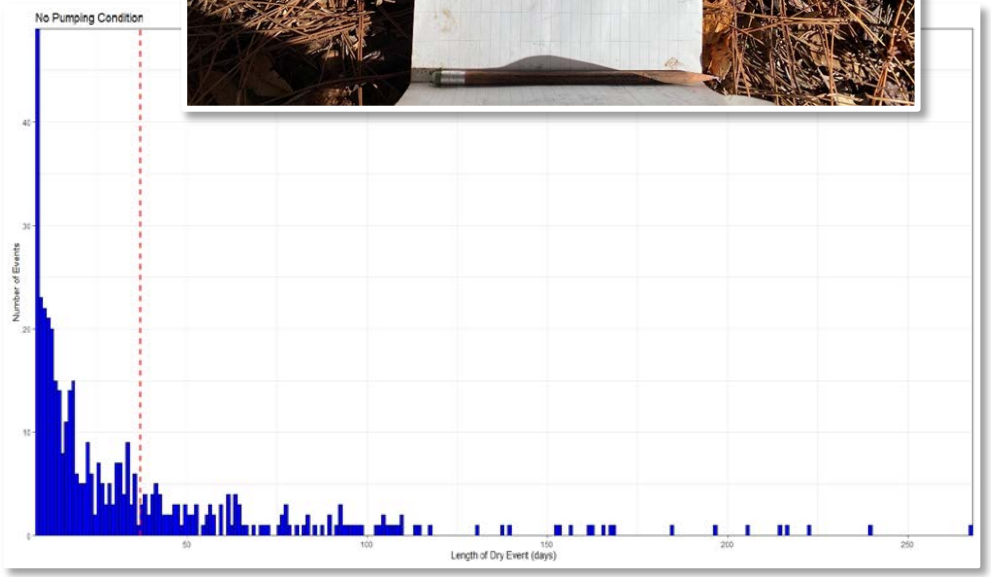
Floodplain Swamp Inundation Protection

Scenario	Little Wekiva River at SLB (exceedance %)	Rock Springs / Run (exceedance %)
No-pumping Condition (NP)	9.5	98.6
MFL (NP minus 15%)	8.1	83.8
Current-pumping Condition (CP)	8.4	85.1
Flow freeboard (% increase in impact from CP; cfs)	**(35%; 3.1 cfs)**	**(5%; 0.5 cfs)**

St. Johns River Water Management District

Organic Soils: Harmful Drying Event

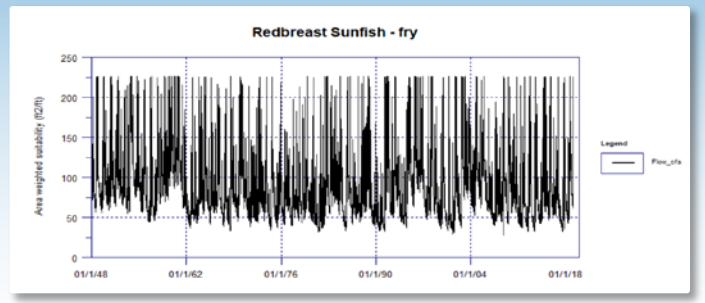
Scenario	Little Wekiva River at SLB (days)	Rock Springs / Run (days)
No-pumping Condition (NP)	16152	0
MFL (NP plus 15%)	18575 (NP + 15%)	-
Current-pumping Condition (CP)	18486 (NP + 13%)	39
Flow freeboard (% increase in impact from CP; cfs)	**(5%; 0.4 cfs)**	**(NA)**

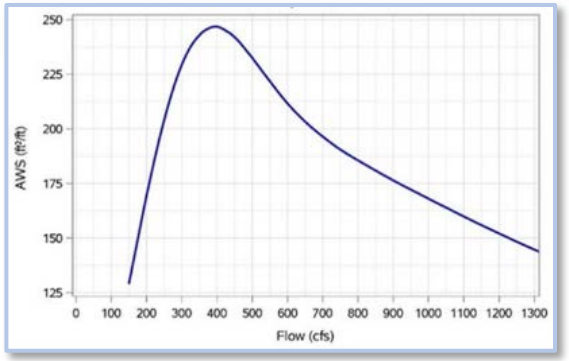


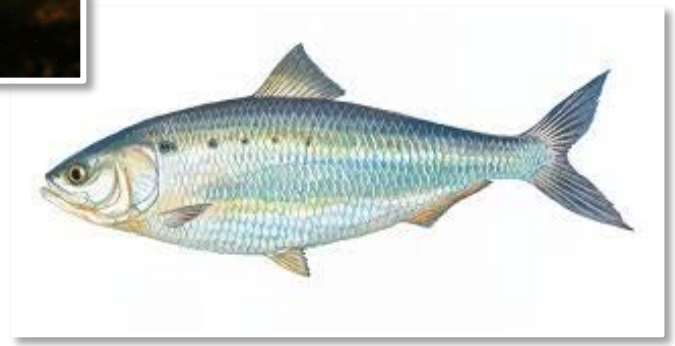
St. Johns River Water Management District

SEFA: System for Environmental Flow Analysis

- **Very small** reductions in habitat suitability (AWS; ft^2/ft) under CP
- Largest reduction = 10.5% for a ubiquitous generalist species (redbreast sunfish fry)
- AWS reduction **> 5% in only 7.8% of cases** (i.e., only 15 of the possible 192 cases)
- AWS reduction < 5% in 177 location/taxa combinations
  - for many it was much less than 5%
- Imperiled species:
  - Bluenose shiner (**0.6 – 3.3%** AWS reduction)
  - American shad (**1.9 – 6.9%** AWS reduction)







St. Johns River Water Management District

SEFA: Example Results: SJR in vicinity of SR46

Taxon / Life Stage / Guild	NP Condition Average AWS (ft^2/ft)	CP Condition Average AWS (ft^2/ft)	AWS % Reduction (NP - CP) / NP
American Shad	**245.8**	**240.2**	**2.3**
Bluenose Shiner	**142.4**	**140.9**	**1.1**
Blackbanded Darter Adult	276.8	275.6	0.4
Channel Catfish Fry	293	284.6	2.9
Channel Catfish Juvenile	138.4	136.9	1.1
Channel Catfish Juvenile Spring	141.6	135.6	4.2
Channel Catfish Juvenile Summer	154.9	153.5	0.9
Generic Darters adult	270.3	263.7	2.4
Habitat Guilds Deep Fast	164.5	153.5	6.7
Habitat Guilds Deep Slow	147	144	2
Largemouth Bass Adult	196	186.6	4.8
Largemouth Bass Juvenile	298.5	294.7	1.3
Redbreast Sunfish Adult	287.6	281	2.3
Redbreast Sunfish Fry	**99.3**	**88.9**	**10.5**
Redbreast Sunfish Juvenile	162.9	161.6	0.8
Spotted Sunfish Adult	296.8	294.6	0.7
Spotted Sunfish Fry	114.5	113.6	0.8
Spotted Sunfish Juvenile	205.3	201.5	1.9
Spotted Sunfish Spawning	152.4	148.8	2.4

St. Johns River Water Management District

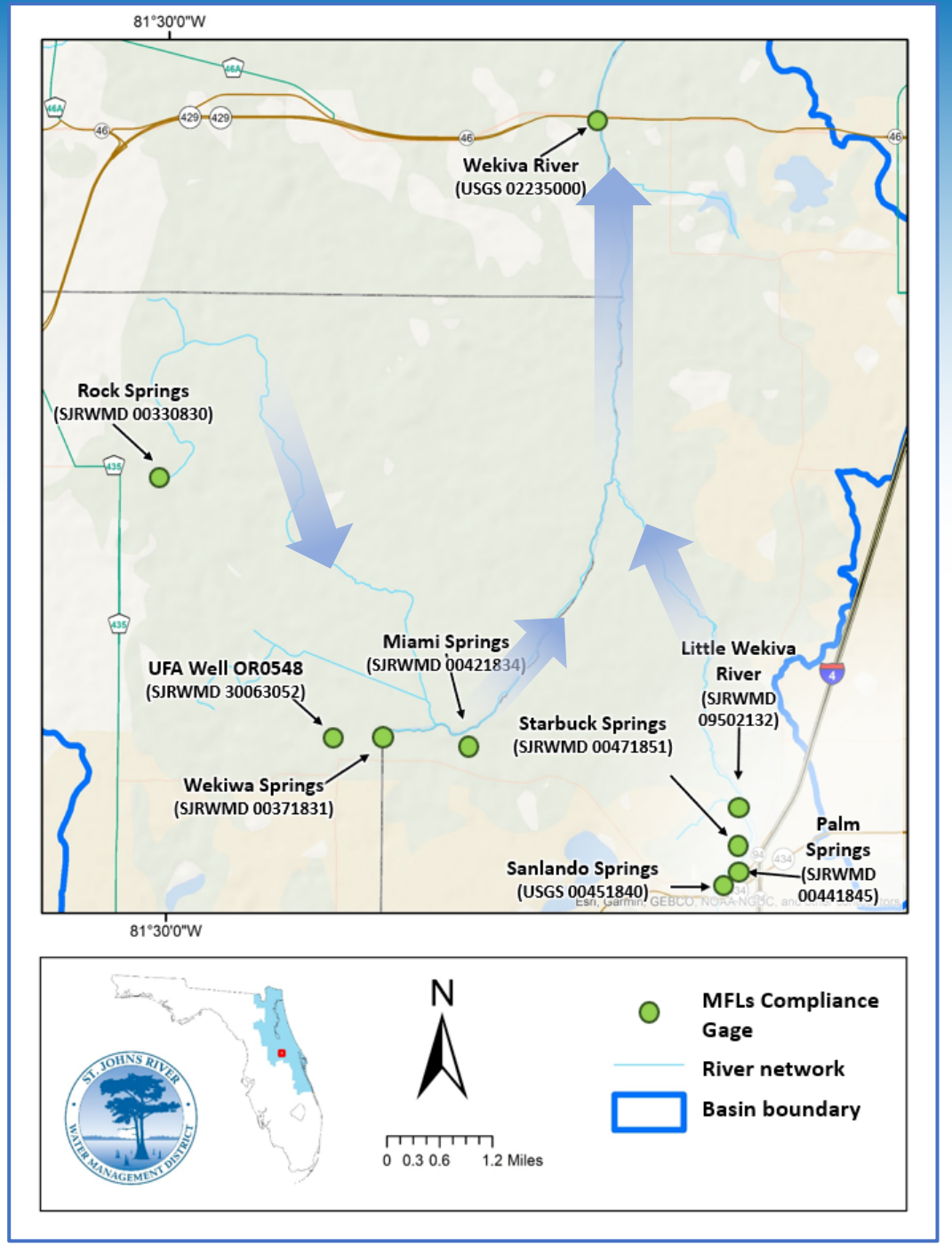
Flow Freeboard (cfs): Based on 2014-2018 Avg. Condition

Environmental Metric	River / Spring Flow Freeboard (cfs)			
	Wekiva River at SR 46	Wekiwa Springs	Rock Springs	Little Wekiva River at SLB
Minimum Frequent High	**0.0**	**0.0**	> 5.5	> 4.4
Minimum Average	**0.0**	> 2.3	> 5.5	NA
Organic Soils - Drying	NA	NA	NA	**0.4**
Floodplain Inundation	NA	NA	**0.5**	3.1
In-channel Fish Habitat (SEFA)	>0.0	>0.4	>0.5	>0.4

St. Johns River Water Management District

Basin-Wide Flow Freeboard

- **SJR recommends that impact be limited to the current-pumping condition for all water bodies in the Wekiva River basin**
  - Wekiva River at SR46 and Wekiwa Springs: **impact = current-pumping condition**
  - Any flow reduction > CP condition in upstream springs will decrease the flows at SR 46 resulting in violation of MFLs at that location.
  - MFL for Wekiva River at SR 46 is an indicator for conditions throughout the basin
    - based on transects that extend from upstream of the confluence of the LWR to downstream of SR 46



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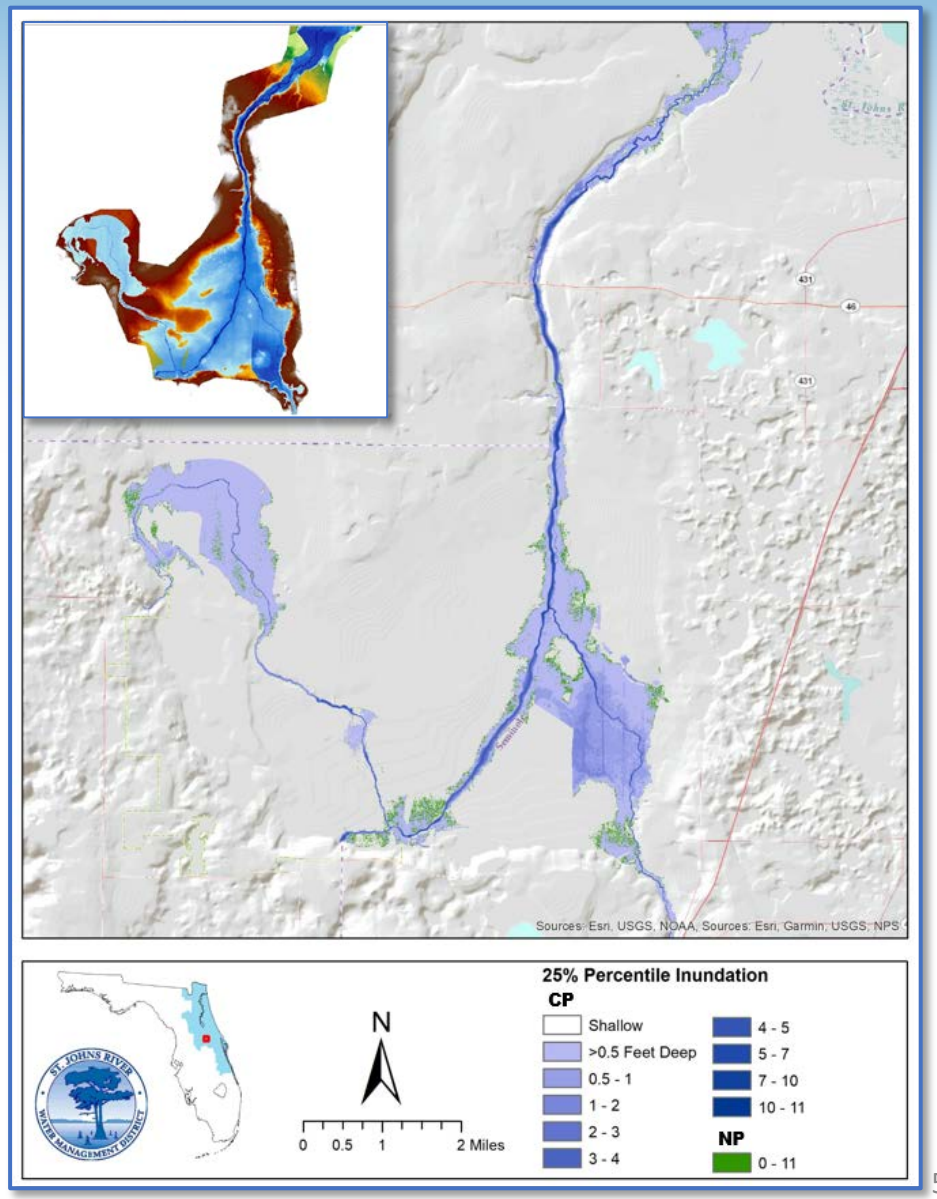
Basin-Wide Flow Freeboard = CP Condition

Basin-wide Wetland Inundation Analysis

- Spatial assessment to put MFLs condition in basin-wide context
- Cross-section data merged with LiDAR to create floodplain and channel terrain data
- HEC-RAS mapper used to export raster files (1-100th flow percentiles) representing basin area inundation
- For each percentile, under NP and CP conditions inundation polygon created and compared with mapped wetland area in ArcGIS
- No-pumping and Current-pumping wetland inundation compared for whole basin
- **Analysis indicates a moderate (15.6%) reduction in wetland inundation from NP to CP conditions.**
  - Similar to MFLs condition used for Rainbow River MFLs



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Basin-Wide Flow Freeboard = CP Condition

Other lines of evidence also support basin-wide MFLs condition equal to current-pumping condition

- Nature Conservancy's **Indicators of Hydrologic Alteration** (IHA) analysis
  - 62 ecologically relevant flow statistics evaluated to compare NP and CP conditions
  - Moderate (average = ~ 9%) change for many parameters
  - Several low flow parameters indicate greater change
  - Results indicate CP condition is not overly constraining; changes are starting to occur

IHA Statistics Group	Regime characteristics	Hydrological parameters
Group 1: Magnitude of monthly water conditions	Magnitude Timing	Mean value for each calendar month
Group 2: Magnitude and duration of annual extreme water conditions	Magnitude Duration	Annual minima 1-day means Annual maxima 1-day means Annual minima 3-day means Annual maxima 3-day means Annual minima 7-day means Annual maxima 7-day means Annual minima 30-day means Annual maxima 30-day means Annual minima 90-day means Annual maxima 90-day means
Group 3: Timing of Annual Extreme Water Conditions	Timing	Julian date of each annual 1-day maximum Julian date of each annual 1-day minimum
Group 4: Frequency and Duration of High/Low Pulses	Frequency Duration	No. of high pulses each year No. of low pulses each year Mean duration of high pulses within each year (days) Mean duration of low pulses within each year (days)
Group 5: Rate/Frequency of water condition changes	Rates of change Frequency	Means of all positive differences between consecutive daily values Means of all negative differences between consecutive daily values No. of rises No. of falls

from Richter et al., 1997

St. Johns River Water Management District

Wekiva River Basin

Water Resource Values (WRVs) Assessment

St. Johns River
Water Management District

Water Resource values (WRVs) Assessment

"...consideration shall be given to... non-consumptive uses, and environmental values..."

62-40.473, F.A.C.

- Recreation in and on the water
- Fish & wildlife habitats and the passage of fish
- Estuarine resources
- Transfer of detrital material
- Maintenance of freshwater storage & supply
- Aesthetic and scenic attributes
- Filtration / absorption of nutrients & pollutants
- Sediment loads
- Water quality
- Navigation

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WRVs Assessment: Recreation

Wekiva River, Wekiwa Springs and Rock Springs: extremely popular; high use

- *Example*: **Wekiwa Springs** in FY21-22:
  - > 400,000 visitors
  - > $50 Million economic impact (FDEP 2021)

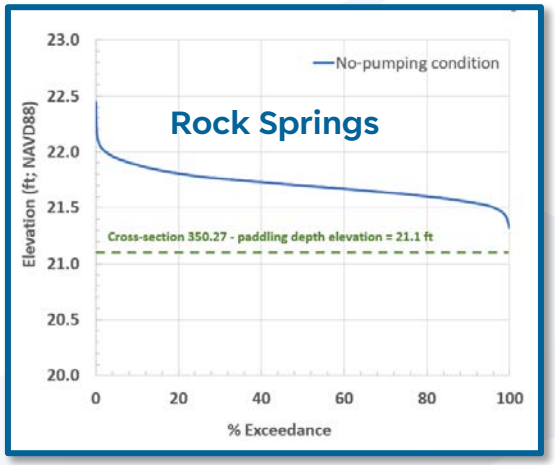
Numerous activities

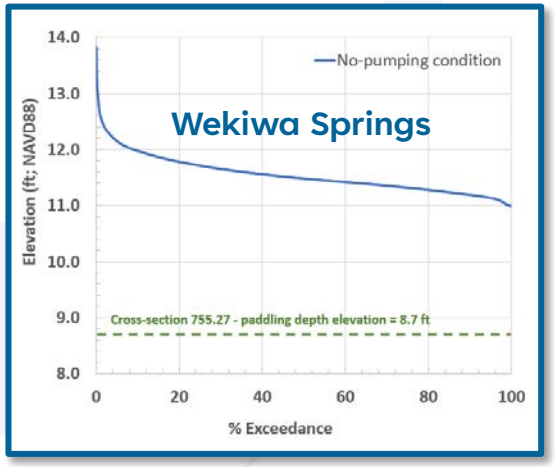
- swimming, wading
- scuba diving
- paddling (canoes, kayaks, paddle boards)
- use of motorboats
- fishing
- hiking, camping, horseback riding

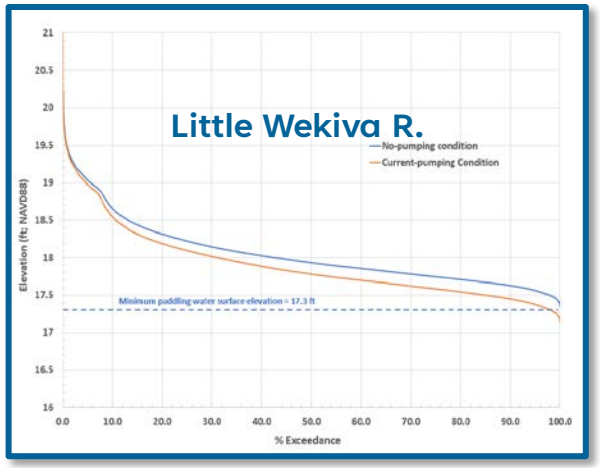
St. Johns River Water Management District

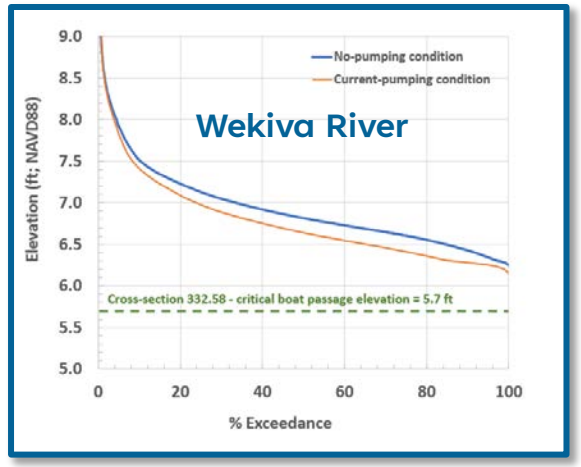
WRVs Assessment: Paddling depth

- **Depths sufficient for canoes, kayaks, paddle boards, etc.**
- **Metric: Elevation that provides:**
  - Minimum depth of 20 inches
  - Minimum width of 9 feet
- **Threshold:** 15% reduction in exceedance relative to the no-pumping condition
- **Results: Protected under Current-pumping (i.e., MFLs) condition** at all cross-sections









St. Johns River
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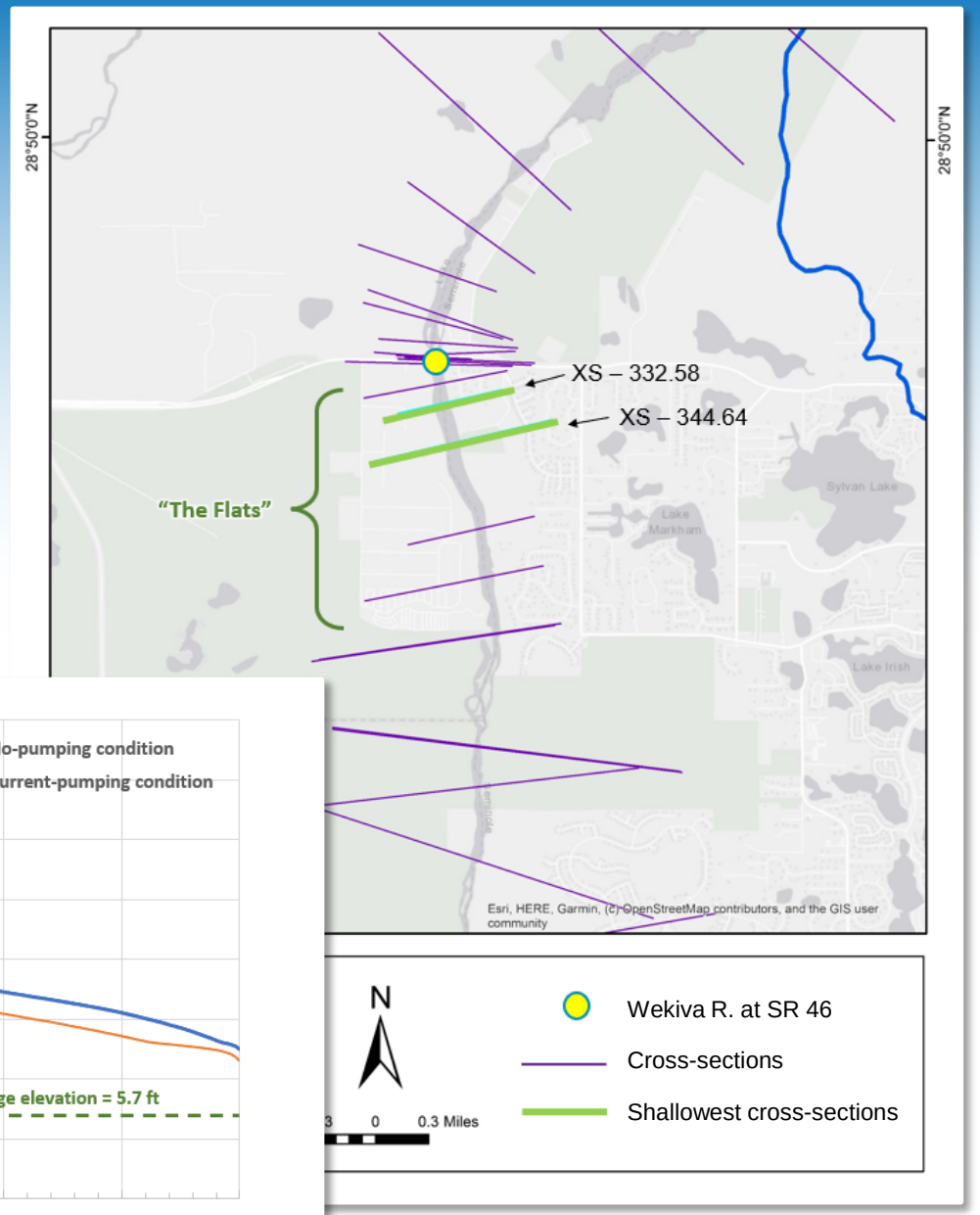
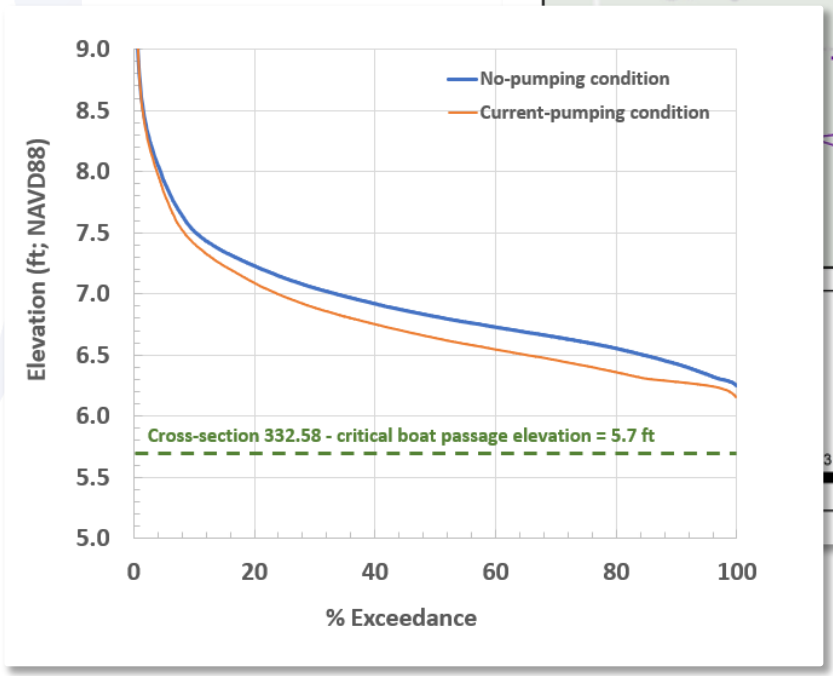
WRVs Assessment: Boat Passage

- **Depths and widths sufficient for small motorboats**
- **Location: Middle and Lower Wekiva River**
- **Metric: Elevation that provides:**
  - Minimum depth of 20 inches
  - Minimum width of 20 feet
- **Threshold:** 15% reduction in exceedance relative to the no-pumping condition
- **Results: Protected under Current-pumping (i.e., MFLs) condition** at the shallowest cross-section at "The Flats"





St. Johns River Water Management District

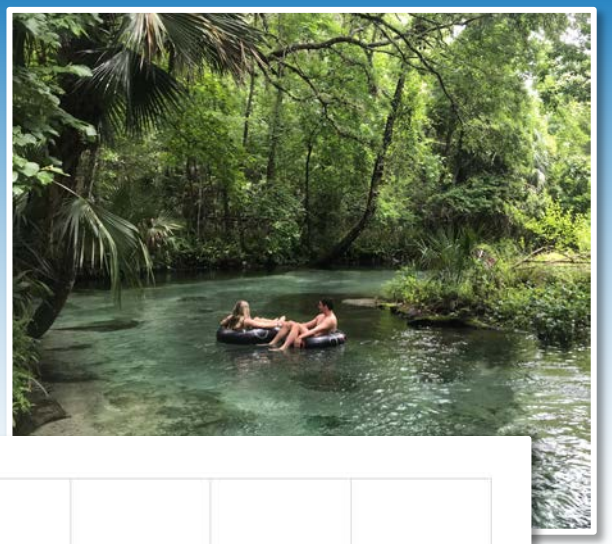
WRVs Assessment: Boat Ramp Usage

- **Depths and widths sufficient for small motorboats and canoe launching**
- **Metric: Elevation that provides:**
  - Minimum of 20 inches above minimum boat ramp depth
- **Threshold:** 15% reduction in exceedance relative to the no-pumping condition
- **Results: Protected under Current-pumping (i.e., MFLs) condition** at four highest-use public boat ramps

Boat Ramp	Critical elevation (ft; NAVD 88)	Exceedance (%)		
		NP Condition	MFLs Condition	CP Condition
Wekiva Island	10.9	98.6	83.8	**88.0**
Wekiva Falls	8.2	99.4	84.5	**91.6**
Wilson's Landing	7.1	100	85.0	**99.8**
Katie's Landing	5.1	99.5	84.6	**93.3**

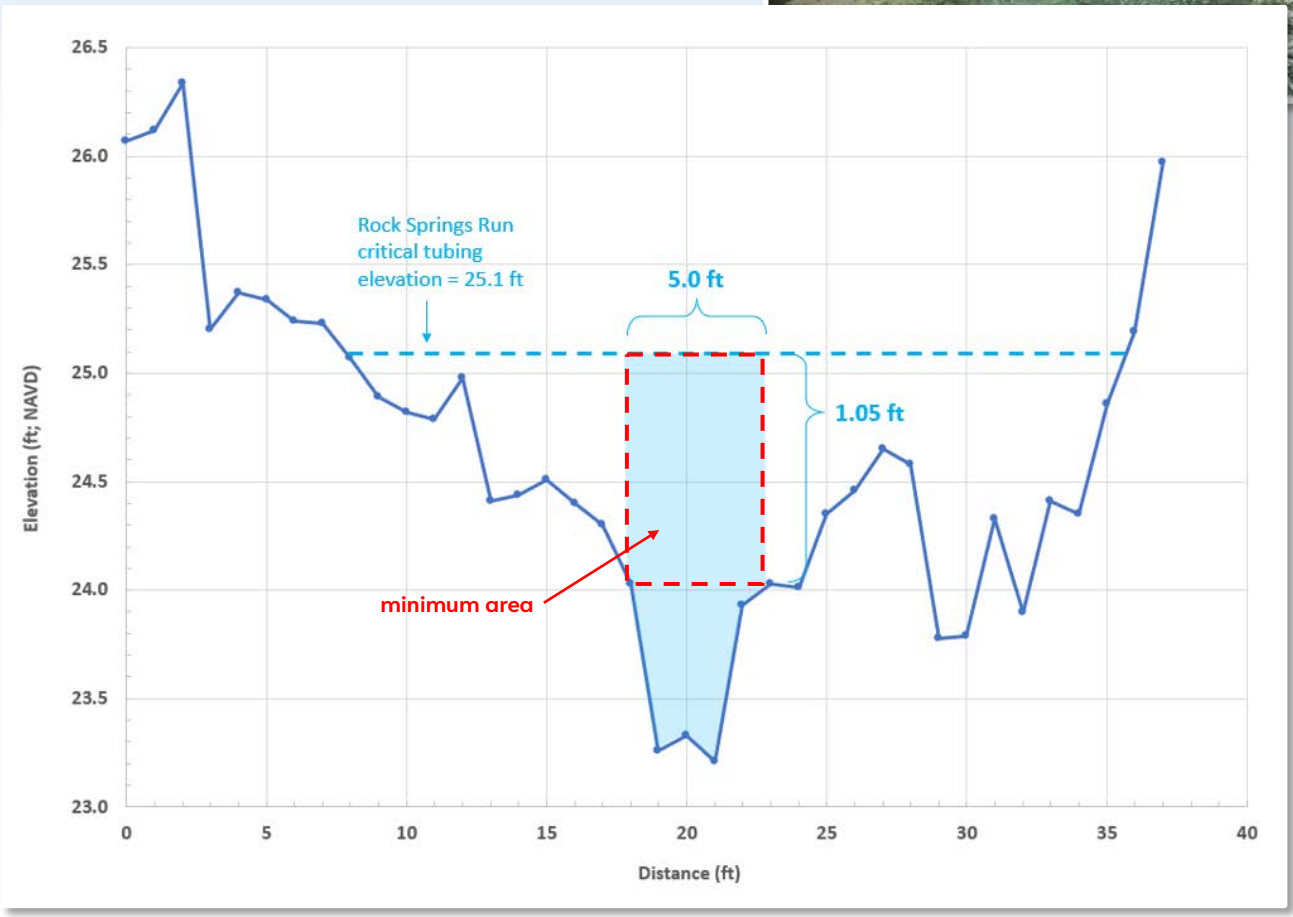
St. Johns River Water Management District

WRVs Assessment: Tubing Depth



- **Depths sufficient for tubing in Rock Springs Run**
- **Metric: Elevation that provides:**
  - Minimum depth of 1.05 ft across minimum of 5 ft width

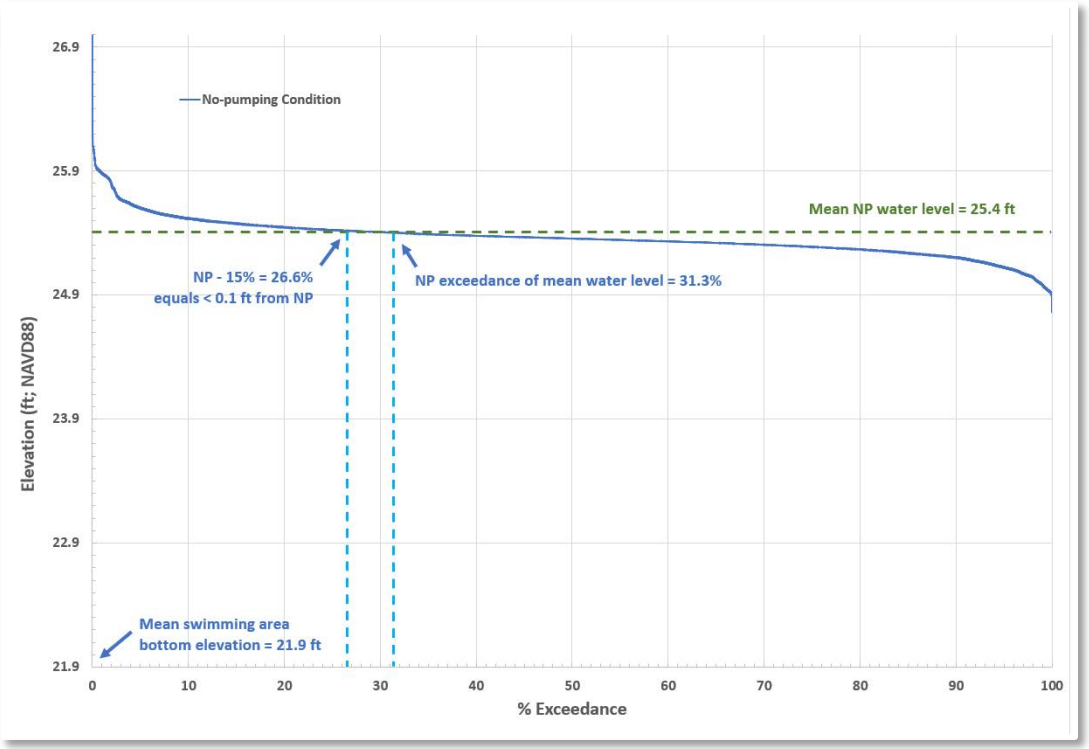
- **Threshold:** 15% reduction in exceedance relative to the no-pumping condition
- **Results: Protected under Current-pumping (i.e., MFLs) condition** at the shallowest cross-section (100% of the time)



St. Johns River Water Management District

WRVs Assessment: Swimming Depth

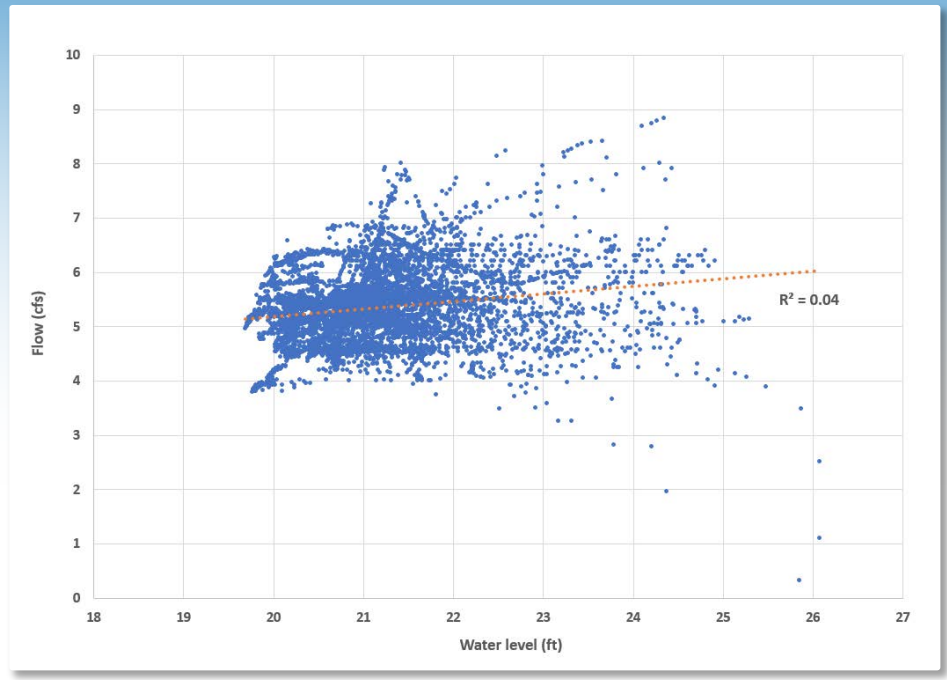
- **Depth sufficient for swimming in spring pools**
- **Locations:**
  - Kelly Park – Rock Springs swimming area
  - Wekiwa Springs State Park spring pool
- **Metric:** Average depth in spring pool
- **Threshold:** 15% reduction in no-pumping condition average pool depth
  - **Rock Springs: 3.0 ft (3.5 ft under NP)**
  - **Wekiwa Springs: 4.0 ft (4.7 ft under NP)**
- **Results:** Current-pumping (i.e., MFLs) condition **protected at both springs**
  - **Rock Springs: 3.2 ft (0.3 ft from NP)**
  - **Wekiwa Springs: 4.5 ft (0.2 ft from NP)**

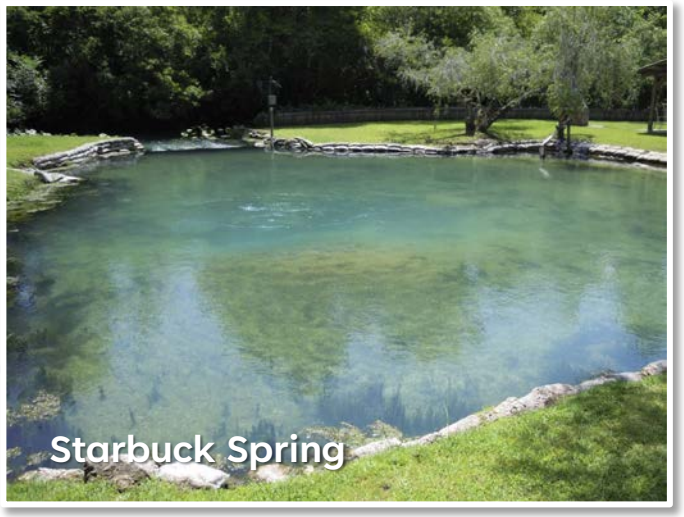


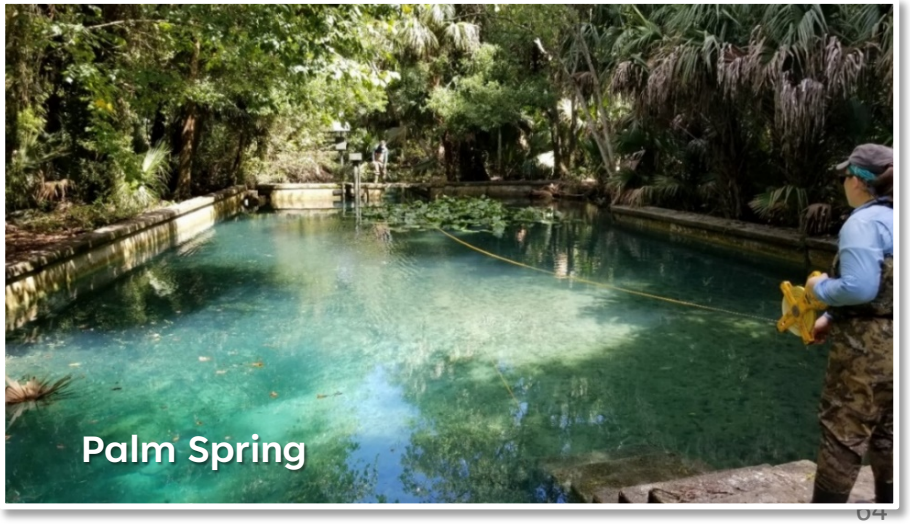
St. Johns River Water Management District

WRVs Assessment: Swimming Depth

- Surveyed and evaluated swimming depth metric at
  - **Sanlando Spring**
  - **Starbuck Spring**
  - **Palm Spring**
- **Very poor relationship between flow and level**
  - An elevation/depth metric would allow for a large reduction in flow; not appropriate as metric







WRVs Assessment: Fish and Wildlife Habitat and Passage of Fish

Metric	Environmental Values
FH, MA, Soils Drying, Floodplain Inundation	Wetland community composition and location; organic soils
SEFA	Habitat availability for fish community, including SSC
Basin-wide wetland inundation	Areal extent of wetland communities
Fish Passage	Sufficient depth and width for passage of large-bodied fish
Manatee Passage	Sufficient depth and width for passage of manatee
Shad spawning habitat	Available habitat (depths and velocities) at low flows

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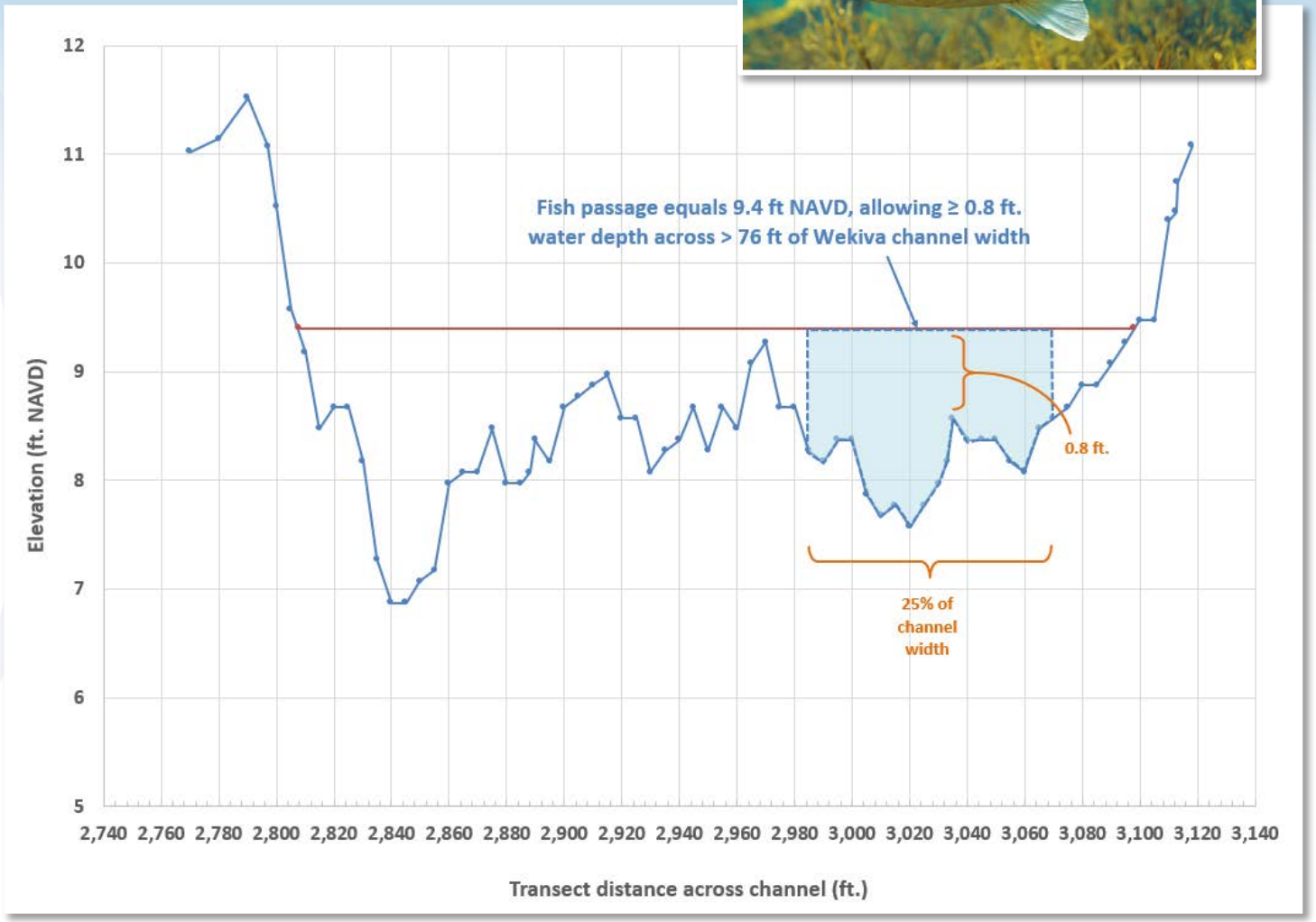
WRVs Assessment: Fish Passage

- **Depths and widths sufficient for passage of large fish (bass, gar, etc)**
- **Metric: Elevation that provides:**
  - Minimum depth of 0.8 ft across minimum of 25% of channel
- **Threshold:** 15% reduction in exceedance relative to the no-pumping condition
- **Results: Protected under Current-pumping (i.e., MFLs) condition** at all cross-sections in the HEC-RAS model



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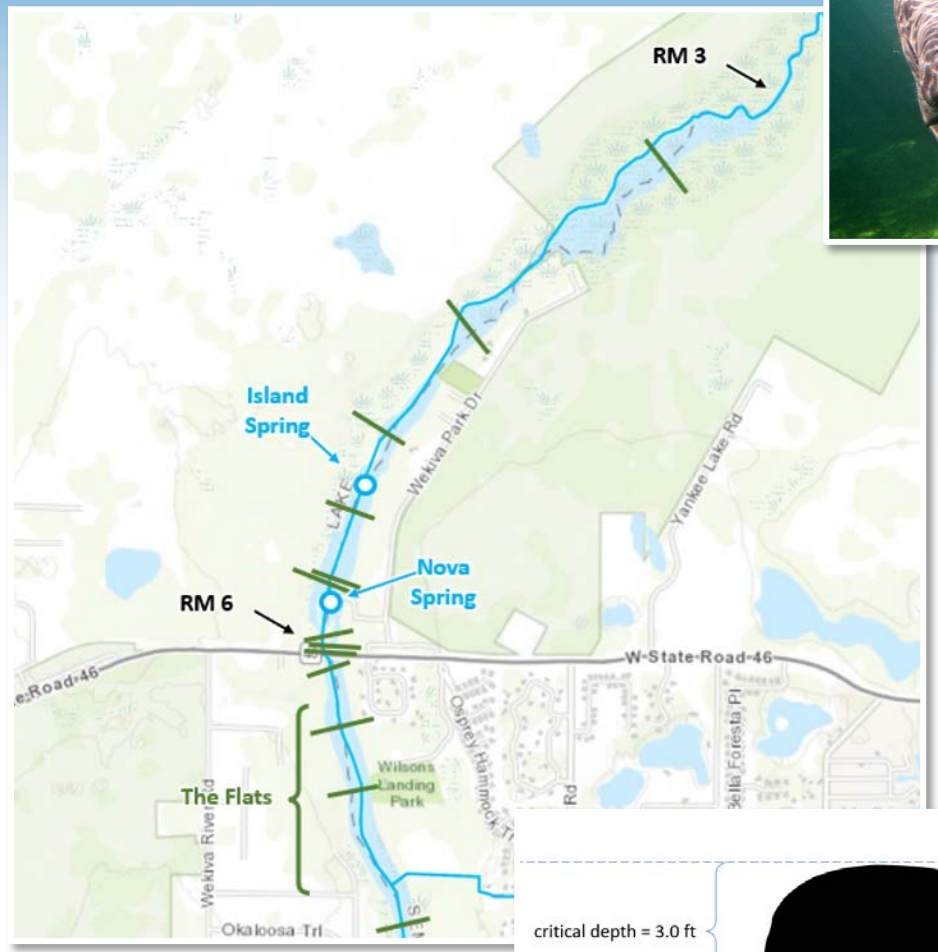
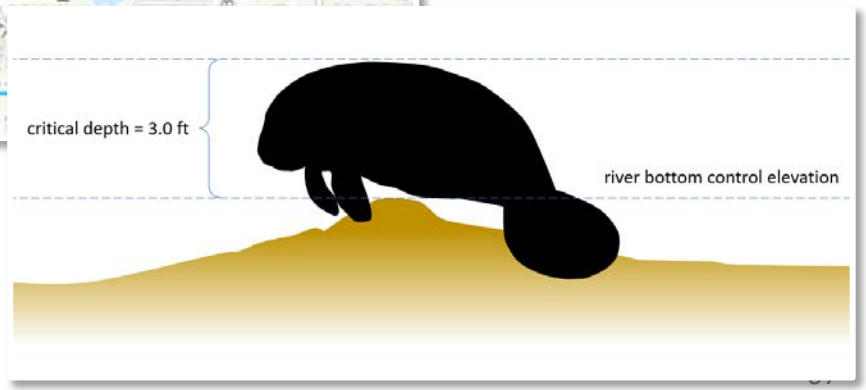
WRVs Assessment: Manatee Passage

- **Depths and widths sufficient for passage of manatee**
- **Location: downstream of "The Flats"**
- **Metric: Elevation that provides:**
  - Minimum depth of 3.0 ft at shallowest cross-sections
- **Threshold:** 15% reduction in exceedance relative to the no-pumping condition
- **Results: One of 12 cross-sections did not meet critical depth under NP or CP**
  - **no difference due to pumping**





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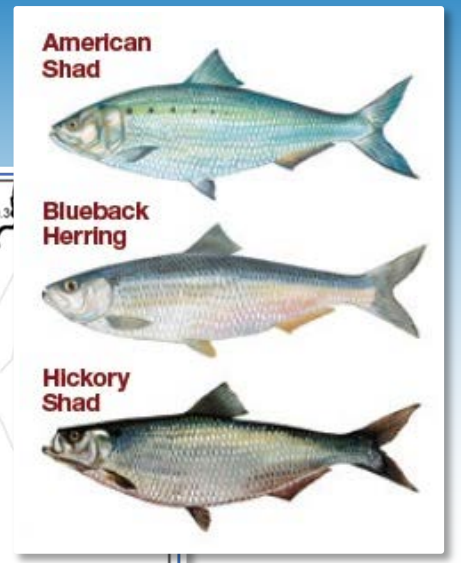
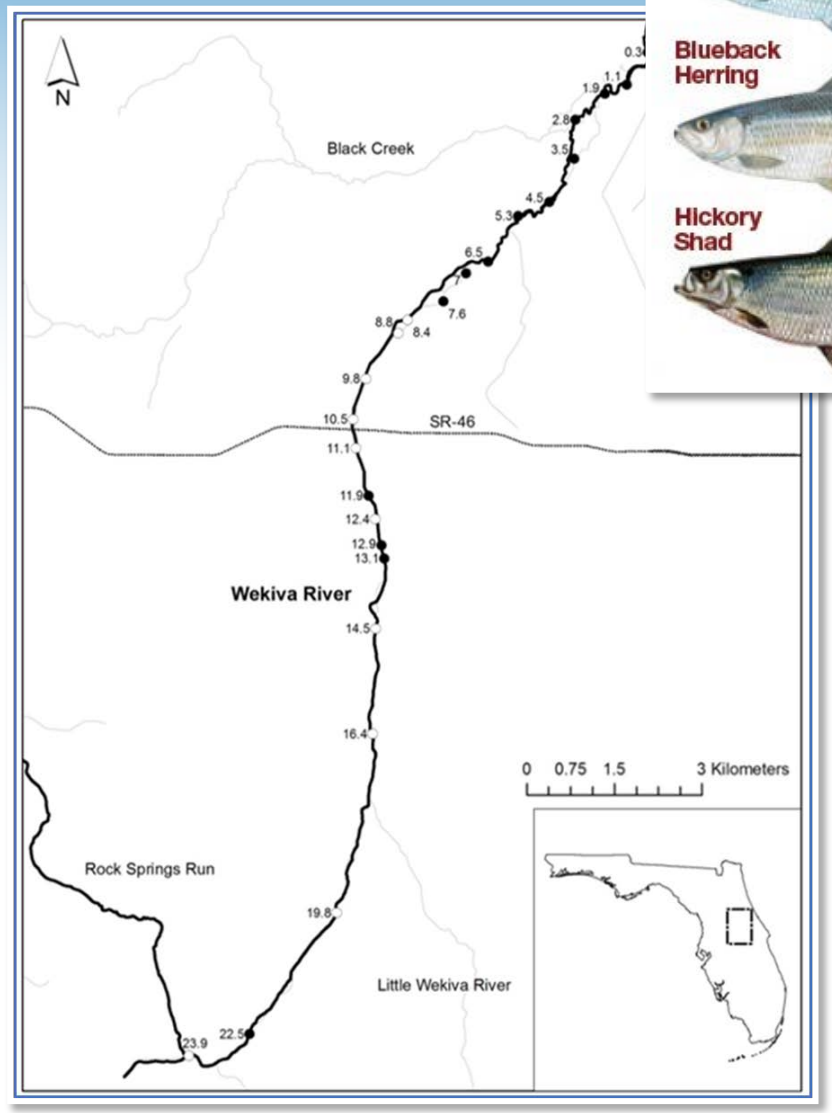
WRVs Assessment: Shad Spawning Habitat

- **Available spawning habitat (depths and velocities) at low flows**
- Three Alosid spp. ascend the Wekiva to spawn
- **Location:** 26 sites on Wekiva River, downstream of LWR confluence
- **Assessment:** *Mace and Miller (2019)* quantified depth, velocity during two very low flow events
  - P90: mean flow = 189 cfs
  - P97: mean flow = 173 cfs
- **Results:**
  - **22 sites** had surface water velocity (> 0.7 ft s-1) and water depths (> 1.5 ft) sufficient to provide suitable spawning for **American Shad**
  - **26 sites** had depth and velocity considered optimal for **blueback herring** and **hickory shad**





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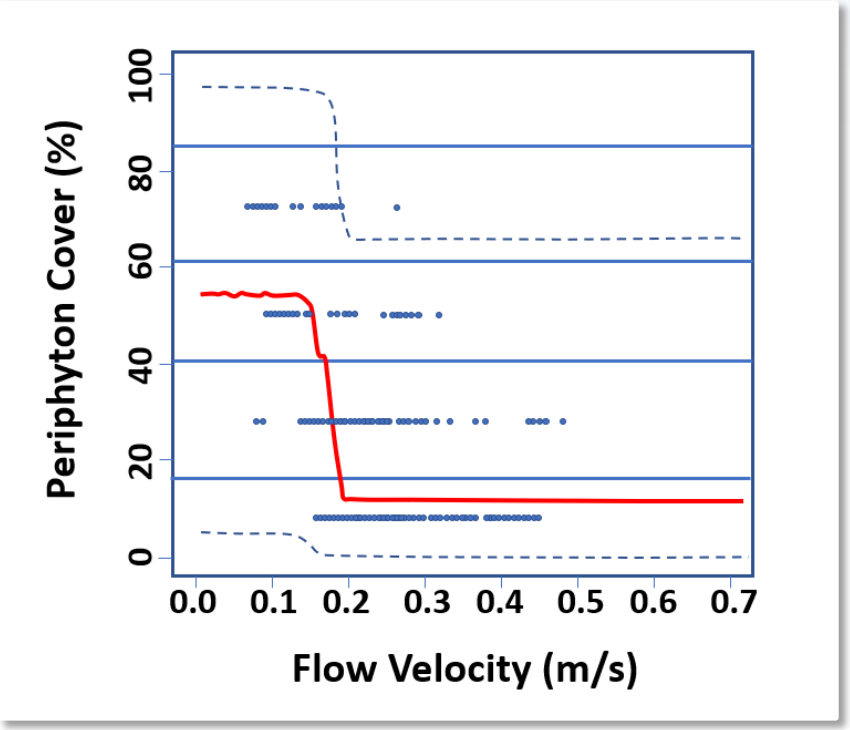
WRVs Assessment: Transfer of Detrital Material

- Positive relationship between flow and TOC (and by inference detritus)
- Protect flooding regime with FH, MA and other primary metrics

- **Algae Scour**
  - Protect velocities required for algal scour / sloughing
  - Critical scour velocity threshold = 0.22 m/s
    - Based on CRISPS and other Florida Studies
  - **Of 72** cross-sections evaluated throughout basin, **only 4** had NP velocities that exceeded threshold > 5% of the time
    - **At all 4, > 15% reduction at CP; but < 0.01 m/s reduction at all 4**
    - These only constitute about 17% of reach between confluence of LWR to the SJR



Adapted from Reaver et al. 2019

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WRVs Assessment: Sediment Transport

Metric / critical velocities:

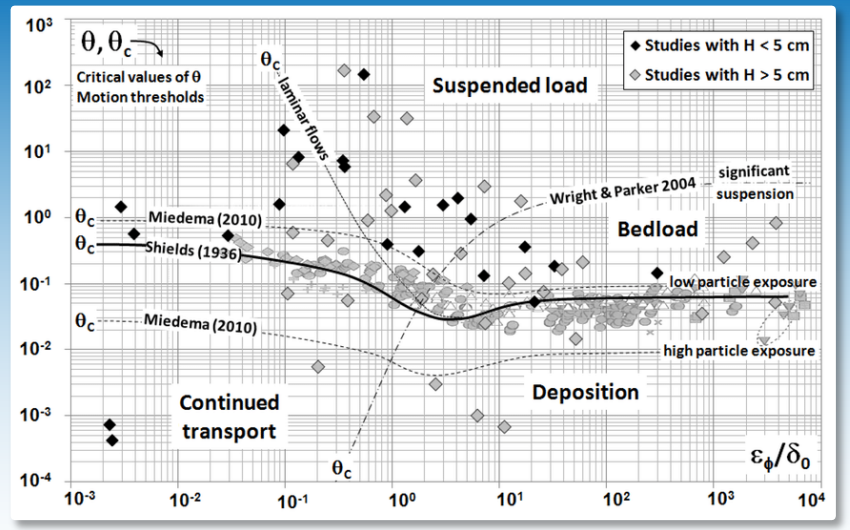
- Entrainment: 0.1 ft/sec
- Transport: 0.6 ft/sec

Impact Threshold:

- no more than a 15% reduction in exceedance of critical velocities relative to a no-pumping condition

Results: Wekiva River

- Under CP condition, entrainment velocity always exceeded at cross-sections where it was exceeded under the NP condition
- Sediment transport velocity reduced by small amount (0.03 to 0.05 ft/s) at four cross-sections that exceeded threshold for > than 5% of the time under the no-pumping condition



Cross-section ID	No-pumping condition velocity (ft/s)		Percent of time met or exceeded under NP (%)	Velocity reduction from NP to CP (%)	Velocity reduction from NP to CP (ft/s)
	Min	Max			
405.90	0.35	2.07	19.0	26.8	0.03
305.84	0.51	1.34	88.0	21.0	0.05
305.54	0.45	1.27	38.2	24.0	0.03
143.23	0.37	1.36	23.8	31.5	0.03

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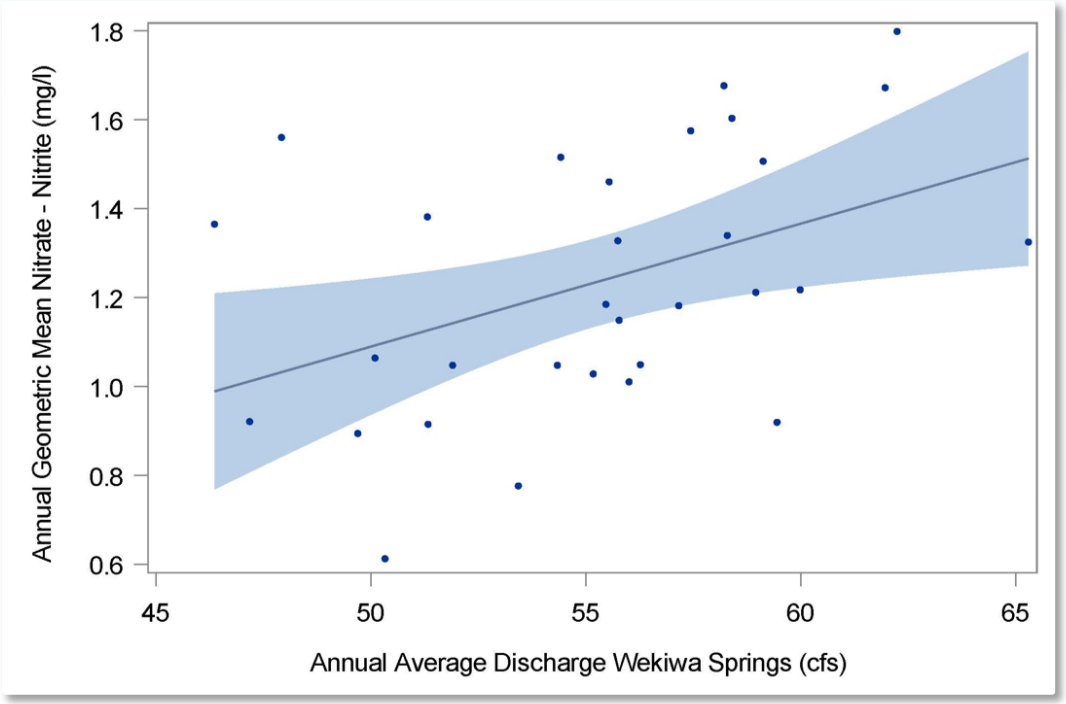
WRVs Assessment: Water Quality

A suite of WQ parameters were evaluated 1) with flow; and 2) over time:

- **Nutrients:** ammonium, nitrate-nitrite, total Kjeldahl nitrogen, total nitrogen, orthophosphate, and total phosphorus
- **Other:** TOC, chl *a*, conductivity, dO, oxygen %, TDS, TSS, alkalinity, turbidity, and color.

Results summary

- Positive relationship between nitrogen concentration and flow: **loading issue**
  - NO_x related to mass balance in the watershed; not flow related
- PO4: slight positive rel. with Q in springs; negative in rivers
- Non-nutrient parameters exhibited flat regression slopes and wide confidence intervals;
  - Most have very weak or non-existent relationship with flow



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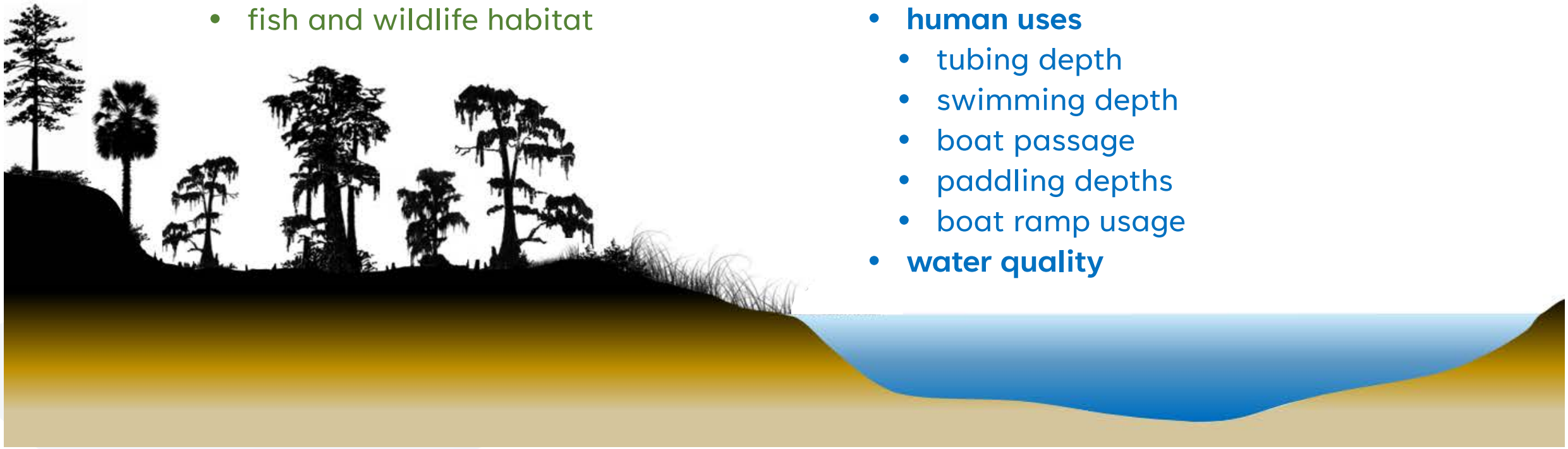
Environmental Functions and Values Evaluated

floodplain / basin

- **vegetation community composition / location**
- **deep organic soils maintenance**
- **wetland inundation / extent**
- **flooding functions / values:**
  - nutrient and carbon dynamics
  - fish and wildlife habitat

in-channel

- **fish habitat**
  - including imperiled species
- **fish and manatee passage**
- **critical velocities**
  - algal scour
  - sediment transport
- **human uses**
  - tubing depth
  - swimming depth
  - boat passage
  - paddling depths
  - boat ramp usage
- **water quality**



WRVs Assessment: Summary

WRV	Environmental Criteria Evaluated	Protected by the MFLs Condition?
Recreation in and on the water	Paddling depth; boat passage; boat ramp usage; tubing depth, swimming/wading depth	Yes
Fish and wildlife habitats and the passage of fish	FH, MA, drying metric, floodplain inundation metric, SEFA, fish passage, manatee passage, shad spawning habitat, basin-wide wetland inundation	Yes
Transfer of detrital material	Primary floodplain metrics; algal scour	Yes
Maintenance of freshwater storage and supply	Other WRVs protected by the MFLs condition, provide balance between consumptive and non-consumptive uses.	Yes
Aesthetic and scenic attributes	Protection of fish and wildlife, recreation and water quality metrics	Yes
Filtration, absorption of nutrients and pollutants	Primary floodplain metrics; GPP	Yes
Sediment loads	Sediment entrainment and transport velocities; relationship between TSS and flow	Yes
Water quality	Nutrients (NOx, TN and TP) and other parameters; comparisons with flow and temporal trends	Yes

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Recommended Minimum Flows

	Mean No-Pumping Condition Flow (cfs)	Recommended Minimum Mean Flow (cfs)	Adopted (Original) Minimum Mean Flow (cfs)
Rock Springs	66.9	**55.8**	**53.0**
Wekiwa Springs	69.0	**64.4**	**62.0**
Sanlando Springs	26.0	**21.0**	**15.0**
Starbuck Springs	15.0	**12.8**	**13.0**
Palm Springs	6.7	**5.6**	**7.0**
Miami Springs	6.4	**5.6**	**4.0**
Little Wekiva River at SLB	80.2	**71.3**	**NA***
Wekiva River at SR 46	304.5	**278.5**	**NA***

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Recommended MFLs allow an **8.5% reduction in mean flow for the Wekiva River at SR46**

- within the range (3.0 – 19.0%)
- similar to the average (7.6%)

...of allowable flow reduction of adopted MFLs for spring-fed rivers in Florida.

Spring-fed River Systems	Adopted MFLs allowable reduction to average flow (%)
Chassahowitzka River System	3.0
Homosassa River System	3.0
Rainbow River	5.0
Wacissa River	5.1
Ichetucknee River	5.8
Aucilla River	6.5
Silver River	6.5
Peace River at Zolfo Spring	8.0
Lower Santa Fe River	8.0
Weeki Wachee River System	10.0
Crystal River System and Kings Bay Springs	11.0
Lower Alafia River	19.0
Average	**7.6**

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MFLs Status

- MFLs Condition = 2014 – 2018 avg. impact condition
- Freeboard = 0 cfs at 2014 – 2018 avg.
- Water use has increased since 2014 – 2018 avg.
- Therefore, Wekiva River Basin systems are in Recovery
- Mitigate recovery deficit = demands in excess of 2014 – 2018 average condition

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ONGOING STATUS / ADAPTIVE MANAGEMENT

Monitoring

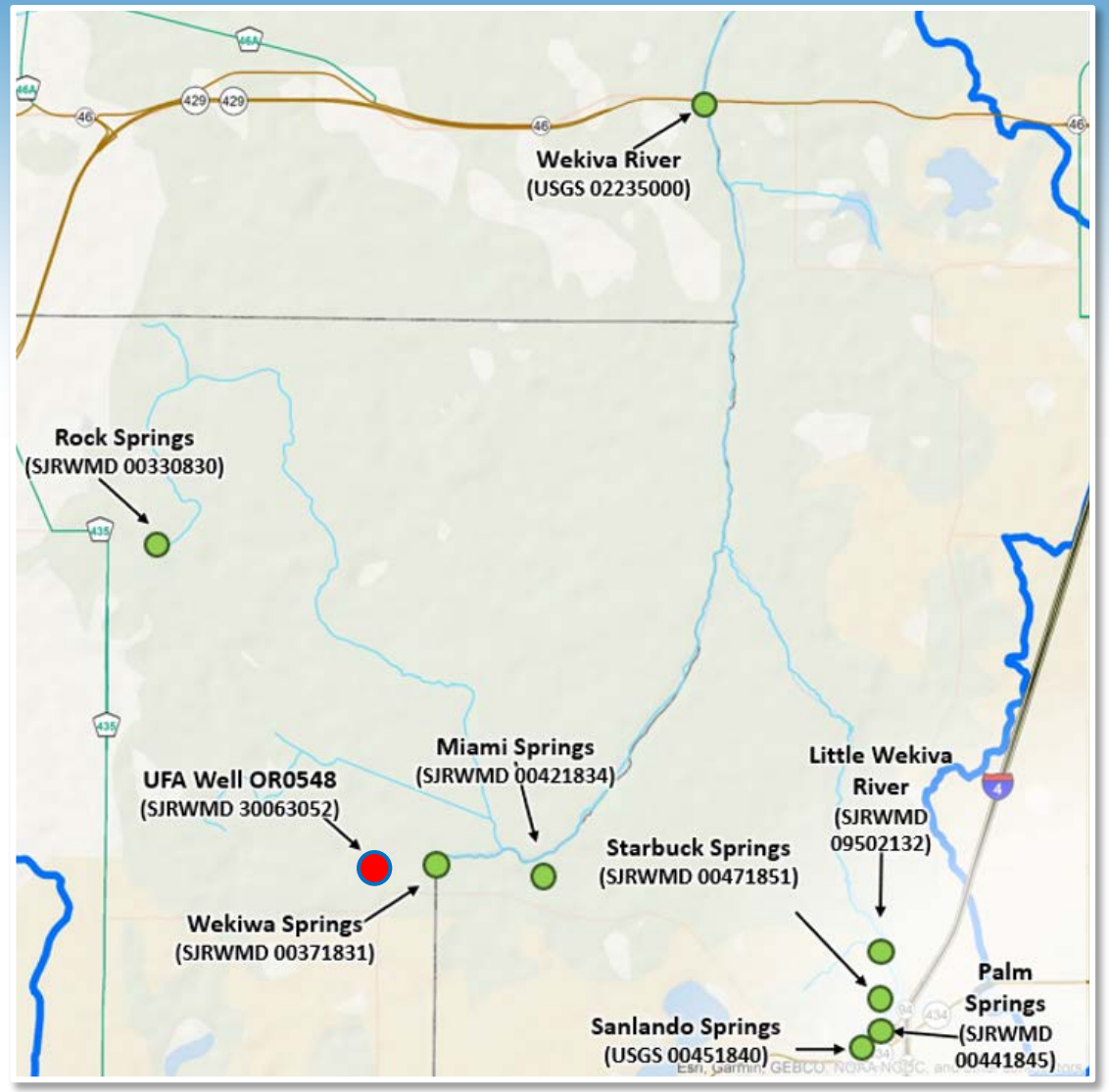
- Minimum mean flows
- Metrics upon which MFLs are based
- Groundwater level trends
- Relationship between OR0548 and spring flows

UFA well OR0548 (Wekiwa Springs State Park)

- OR0548 has generally same trend as springs

Adaptive Management

- If mean flows fall below minimum, a more detailed analysis will be triggered
- Rainfall and uncertainty analyses
- Determine if min flows not meeting is due to pumping



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Please also submit all questions and comments in writing to Andrew Sutherland at:

asutherl@sjrwmd.com

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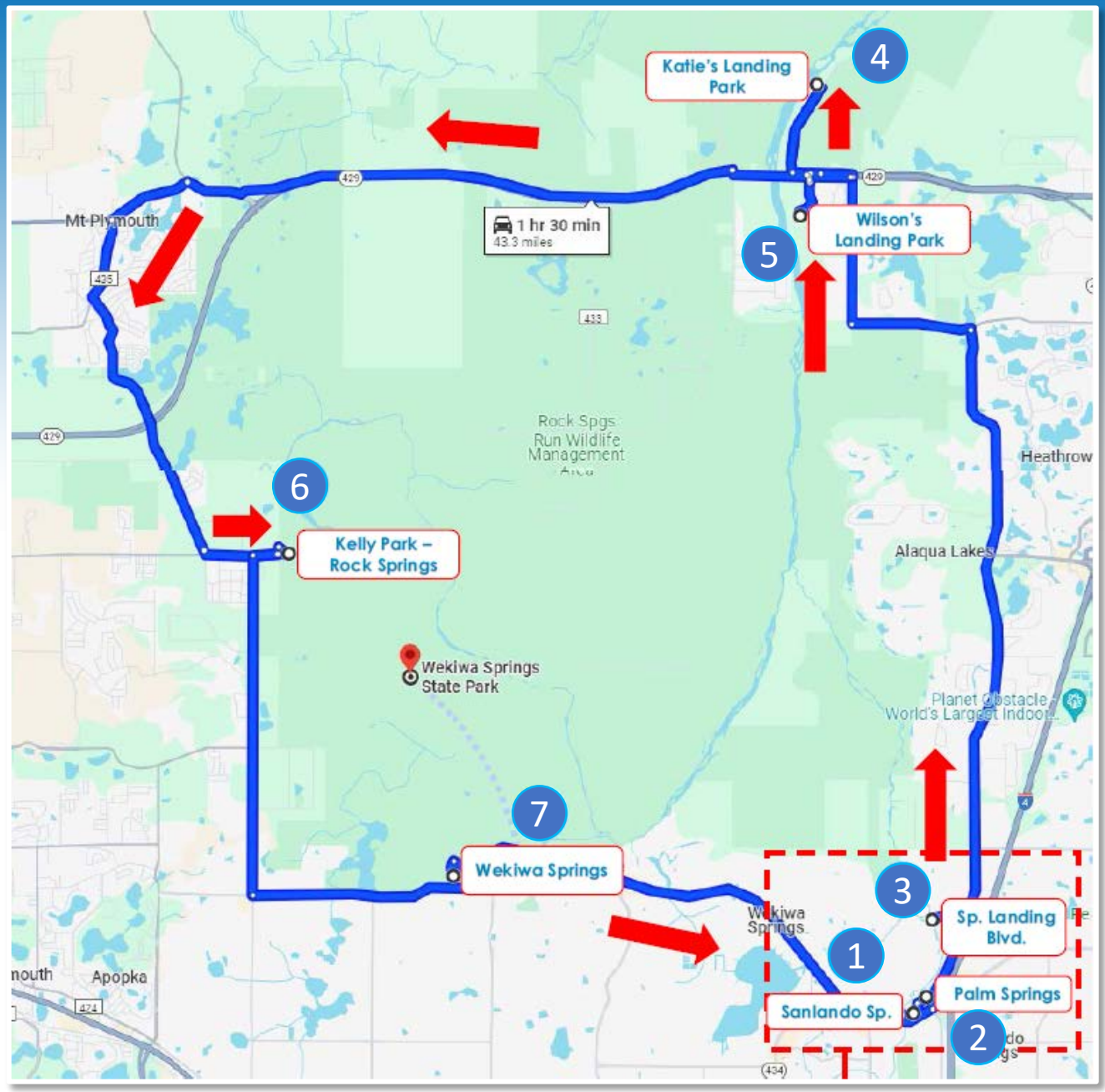
Peer Review Schedule and Next Steps

Task	Date
Kick-off Meeting	Jan. 23, 2024
BFA Presentation of Initial Findings – Public Workshop	Feb. 21, 2024
Draft Technical Memorandum	Mar. 12, 2024
Presentation of Draft TM – Public Teleconference	Mar. 13, 2024
Final Technical Memorandum	April 12, 2024
Stakeholder Meetings / Strategy Development	2024
Notice of Rule Development	Late 2024?

Wekiva River Basin
Site Tour

- 30 minutes for lunch
- Drive to “The Springs” neighborhood
  - NOTE: Tell Security Guard
    “I’m with the SJRWMD tour”
- Springs Landing Boulevard – Little Wekiva River
- Katie’s Landing
- Wilson’s Landing
- Kelly Park – Rock Springs
- Wekiwa Springs State Park



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For more information on the Wekiva River Basin MFLs go to:

https://www.sjrwmd.com/minimumflowsandlevels/wekiva-basin

...or email Andrew Sutherland at:

asutherl@sjrwmd.com

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