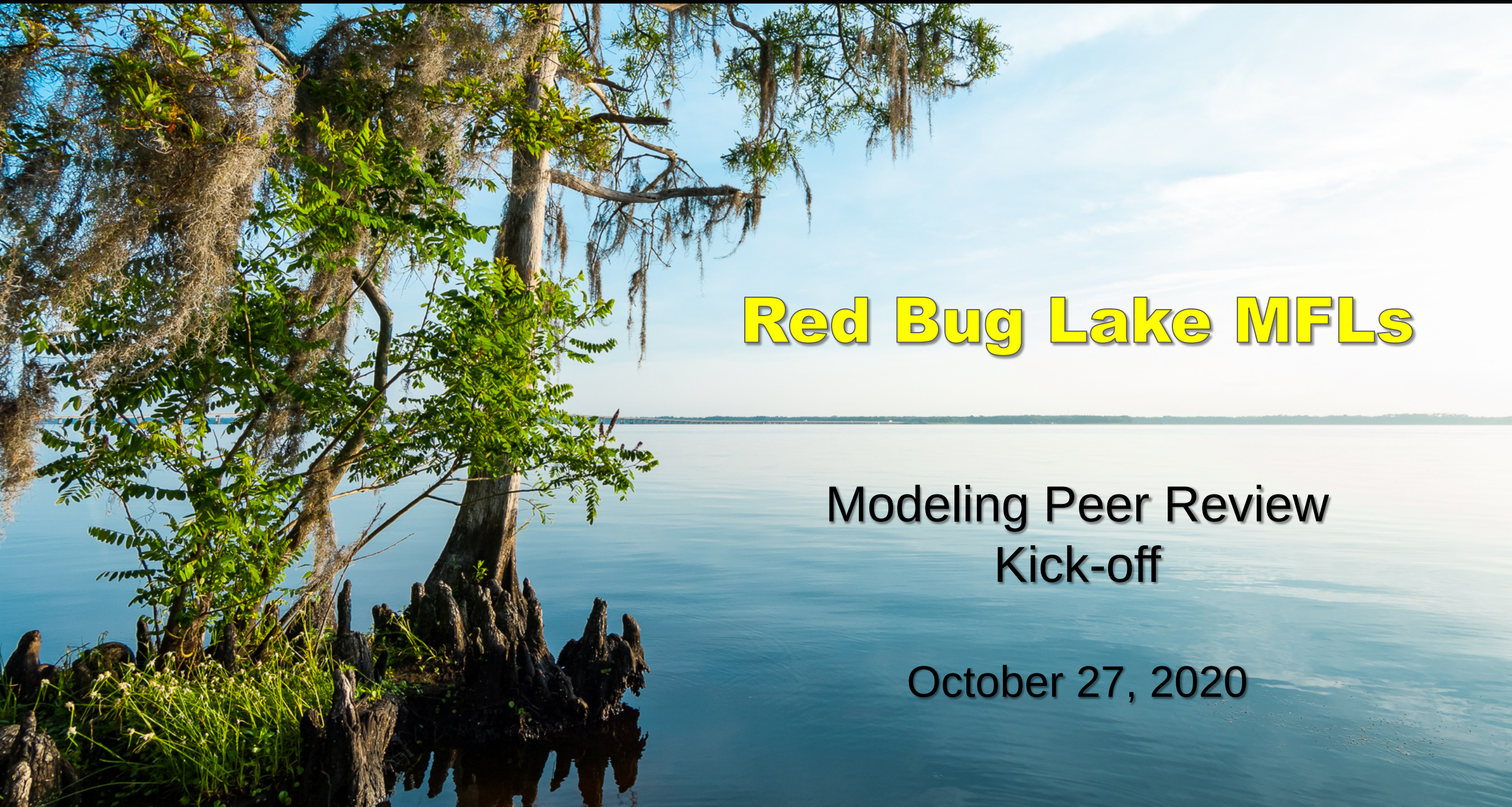


Red Bug Lake MFLs

Modeling Peer Review Kick-off

October 27, 2020

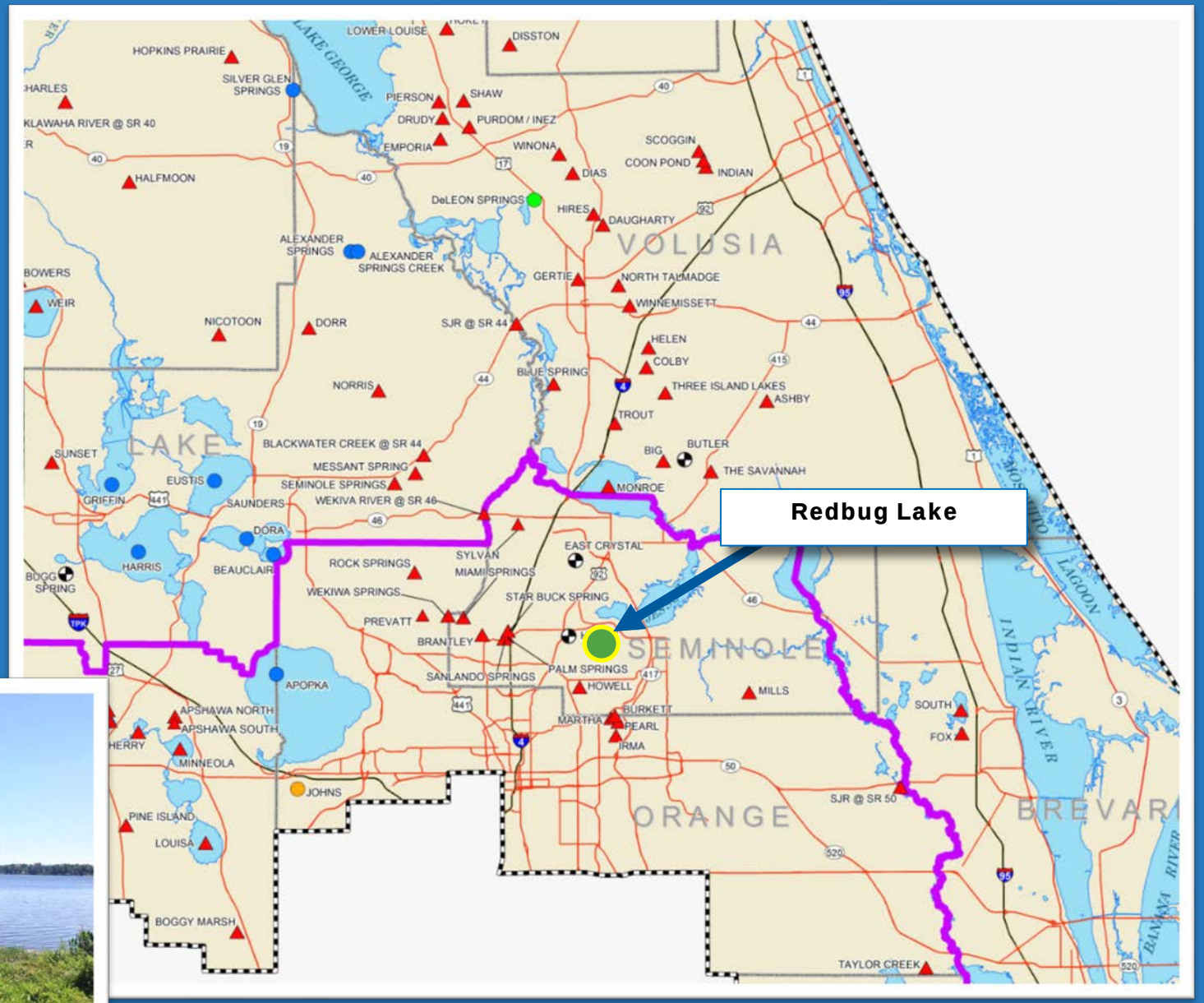
Agenda

- Introductions and meeting objectives
- Overview of Red Bug Lake MFLs
- Overview of HSPF model
- Stakeholder comments
- Meeting adjourn

Redbug Lake

Seminole County

- *Large, relatively intact wetlands*
- *Large county park*
- *Added to replace Lake Hodge*



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.)

Statutory Directive

"...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**

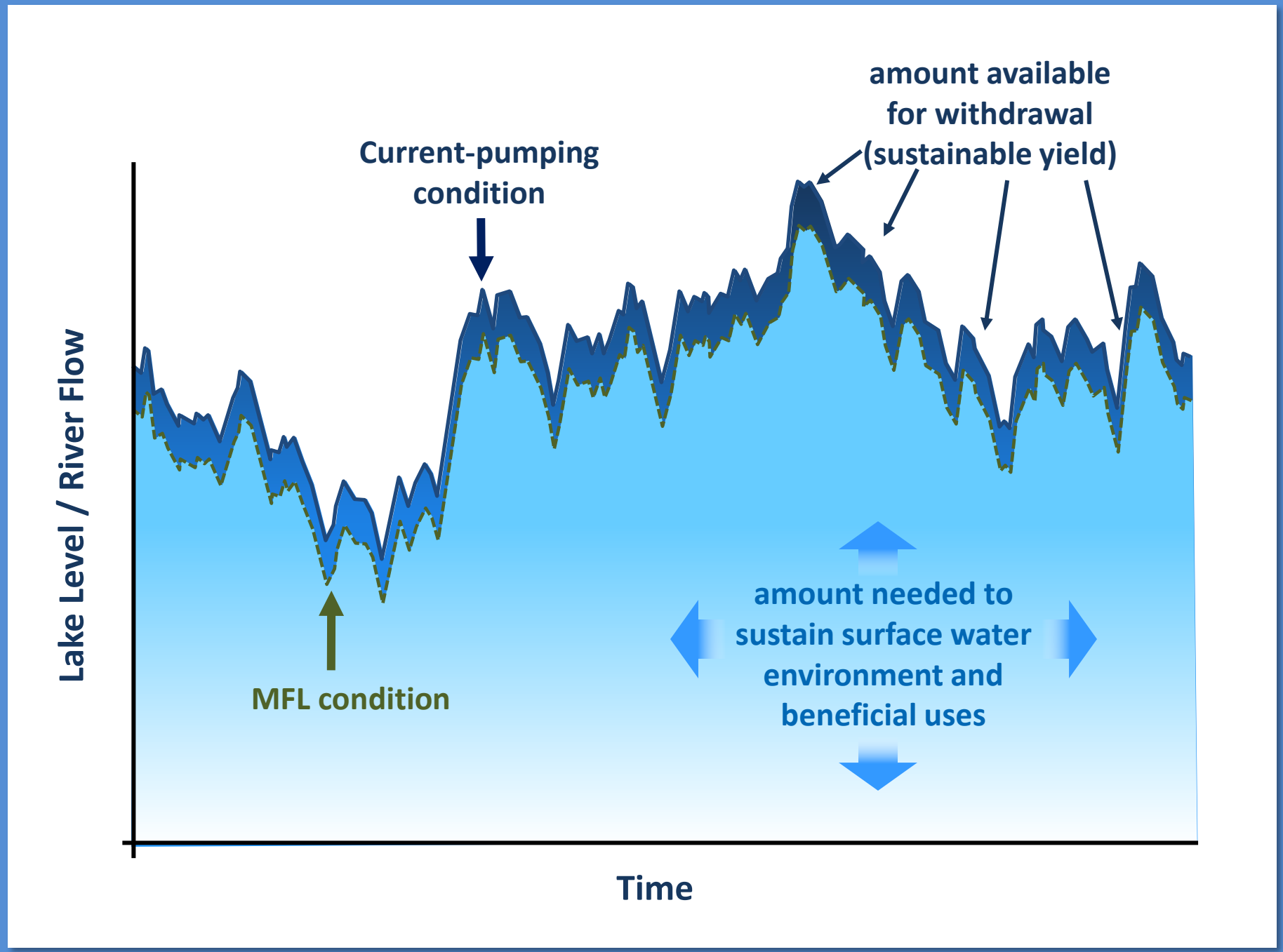
MFL Process Overview

MFLs Determination:

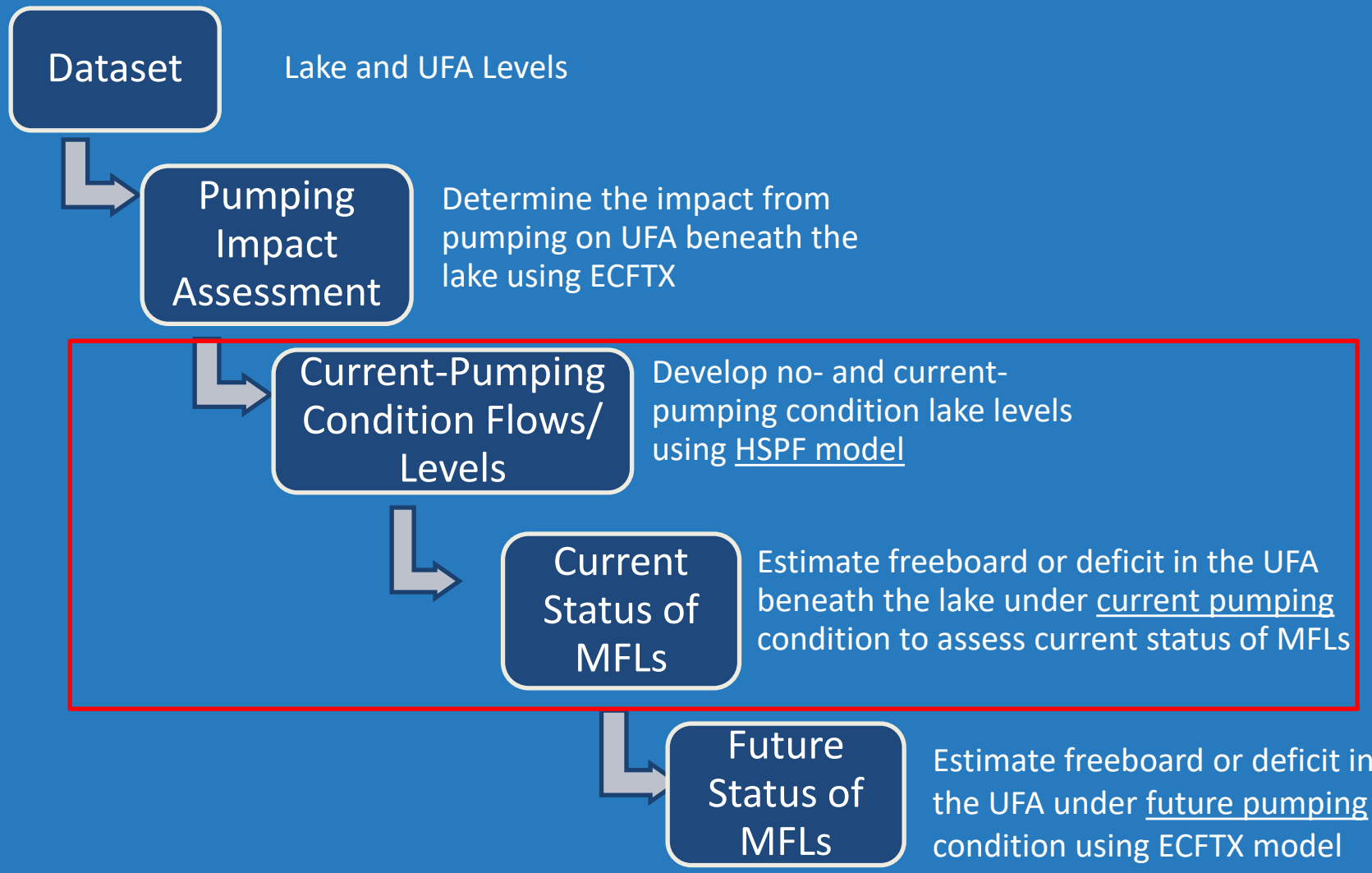
- Determine the most critical environmental features to protect and the minimum hydrologic regime required for their protection (MFLs condition)

MFLs Assessment:

- Determine the current impacted hydrologic regime (current-pumping condition)
  - Requires determination of no-pumping hydrologic regime, which represents historical no-pumping condition
- Compare the MFLs and current-pumping conditions to determine if water is available (freeboard)


amount available
for withdrawal
(sustainable yield)
Current-pumping
condition
Lake Level / River Flow
MFL condition
amount needed to
sustain surface water
environment and
beneficial uses
Time

Hydrological Analysis



Use of HSPF Model for MFLs

- **Simulation of interaction between the lake and the UFA**
- **Evaluation of the effect of pumping on critical lake levels needed for WRVs (fish and wildlife habitat, recreation, water quality, etc)**
- **Assessment of the current status of MFLs to estimate water availability or deficit**

Potential Model Simulations

- **Long-term simulations (50-60 years)**
- **Scenarios (by adjusting UFA boundary condition)**
  - **No-pumping condition simulations**
  - **Current-pumping condition simulations**

Peer Reviewer

- **Patrick Tara, PE (Intera, Inc)**

Red Bug Lake Hydrologic Modeling

Anne Elise Wester, PhD
SJRWMD

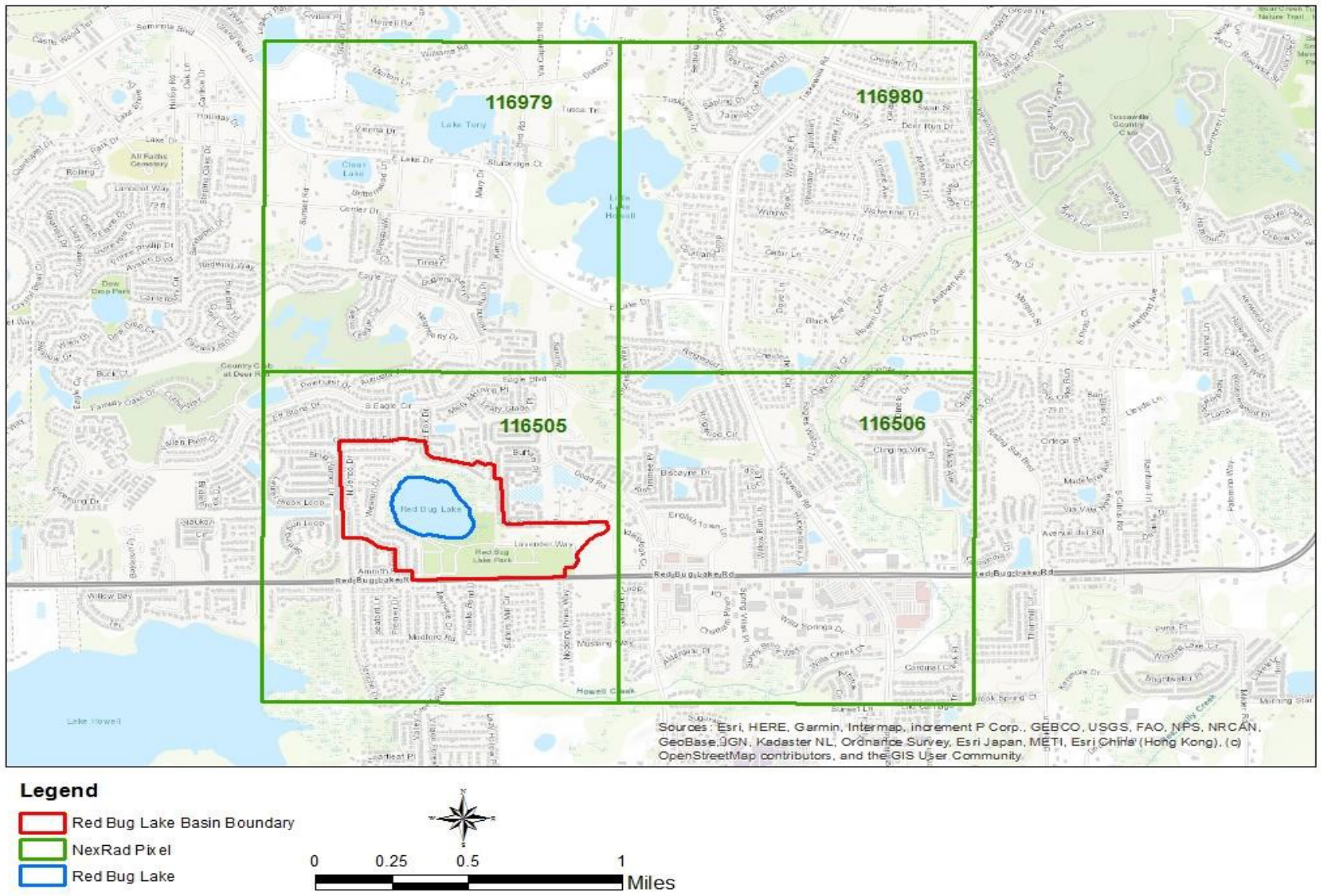
Contents

- Background on Red Bug Lake
- Hydrological Model (HSPF) development and calibration
- Sensitivity analysis
- Long-term simulation

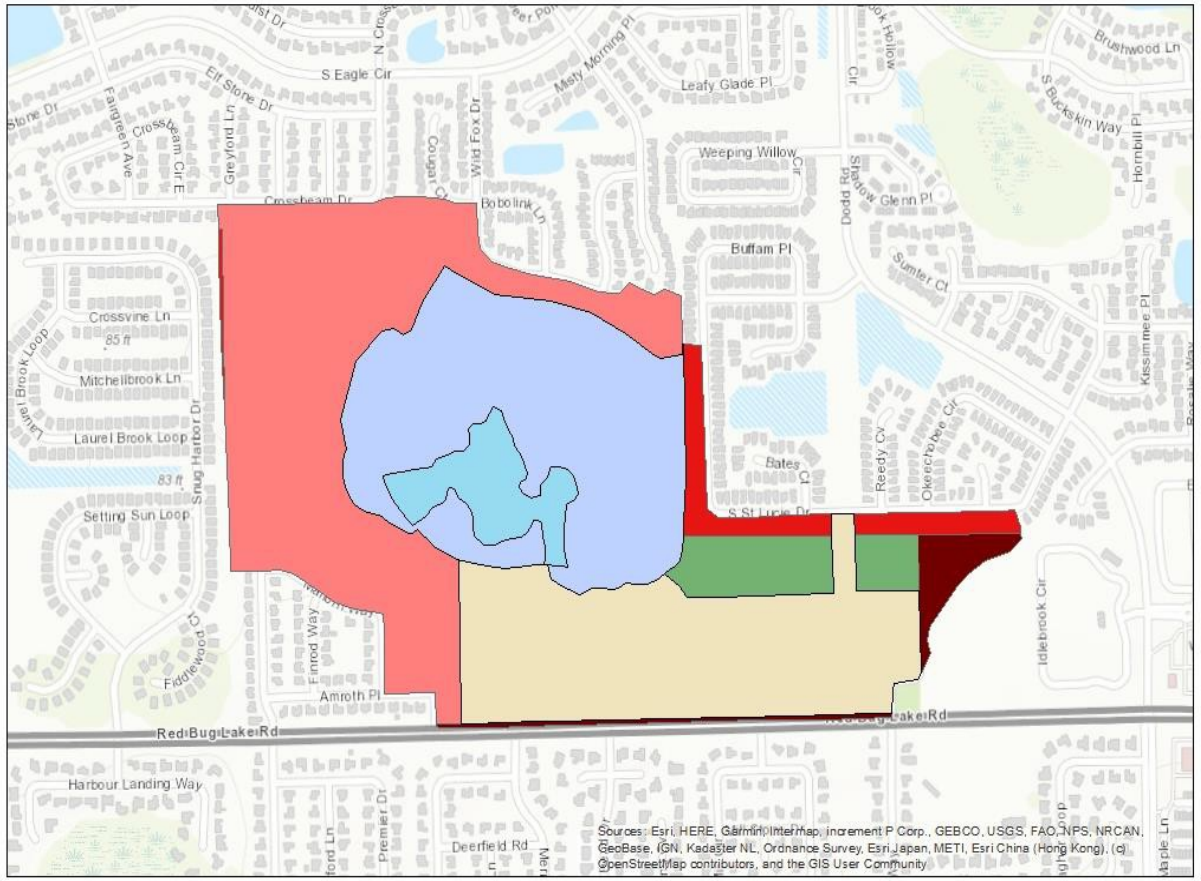
Red Bug Lake MFL

- **Model development by DSLLC**
  - **Review data provided by SJRWMD**
  - **Develop Red Bug Lake HSPF**
  - **Calibrate and validate model**
  - **Develop long-term simulations**

Drainage Basin



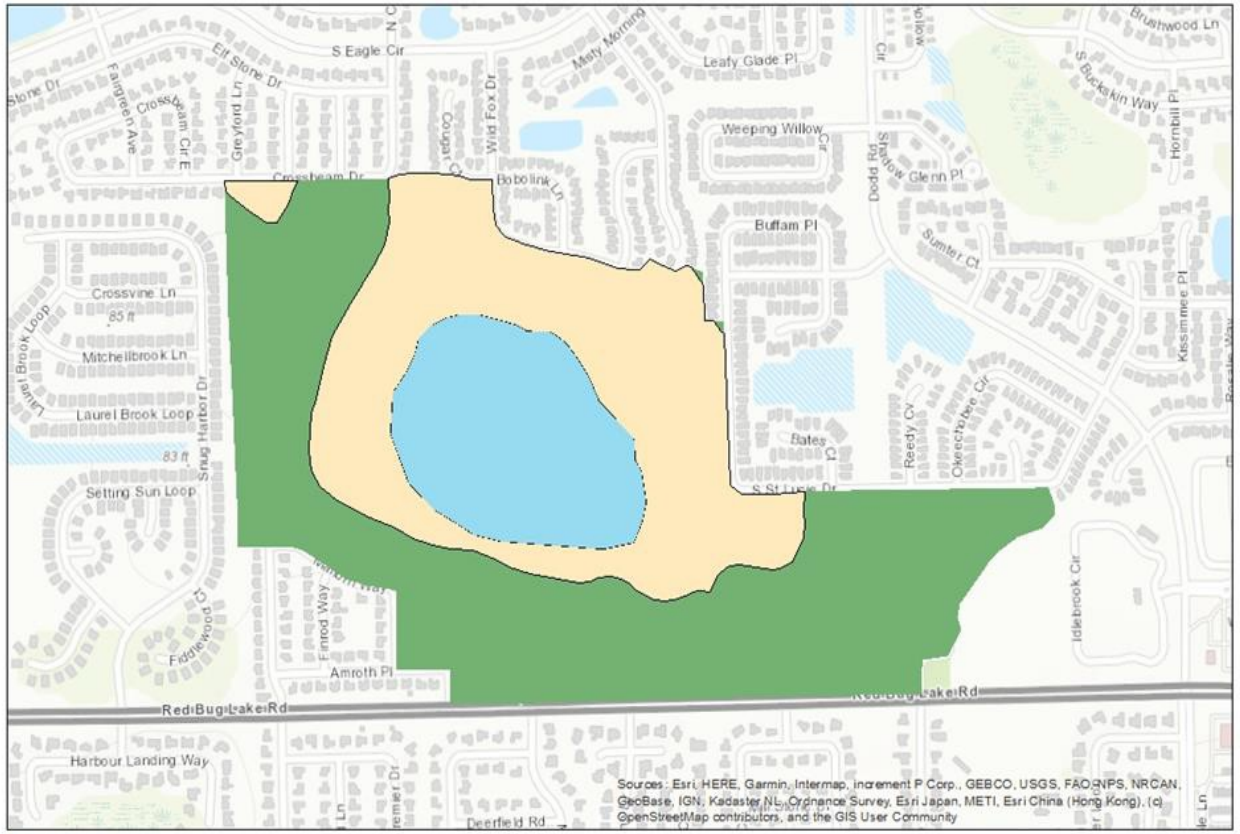
Land Use and Soil



Legend

- Commercial/Industrial
- Forest
- High density residential
- Medium density residential
- Open
- Water
- Wetland

0 0.05 0.1 0.2 Miles



Legend

Hydrologic Soil Group

- A
- A/D
- Water

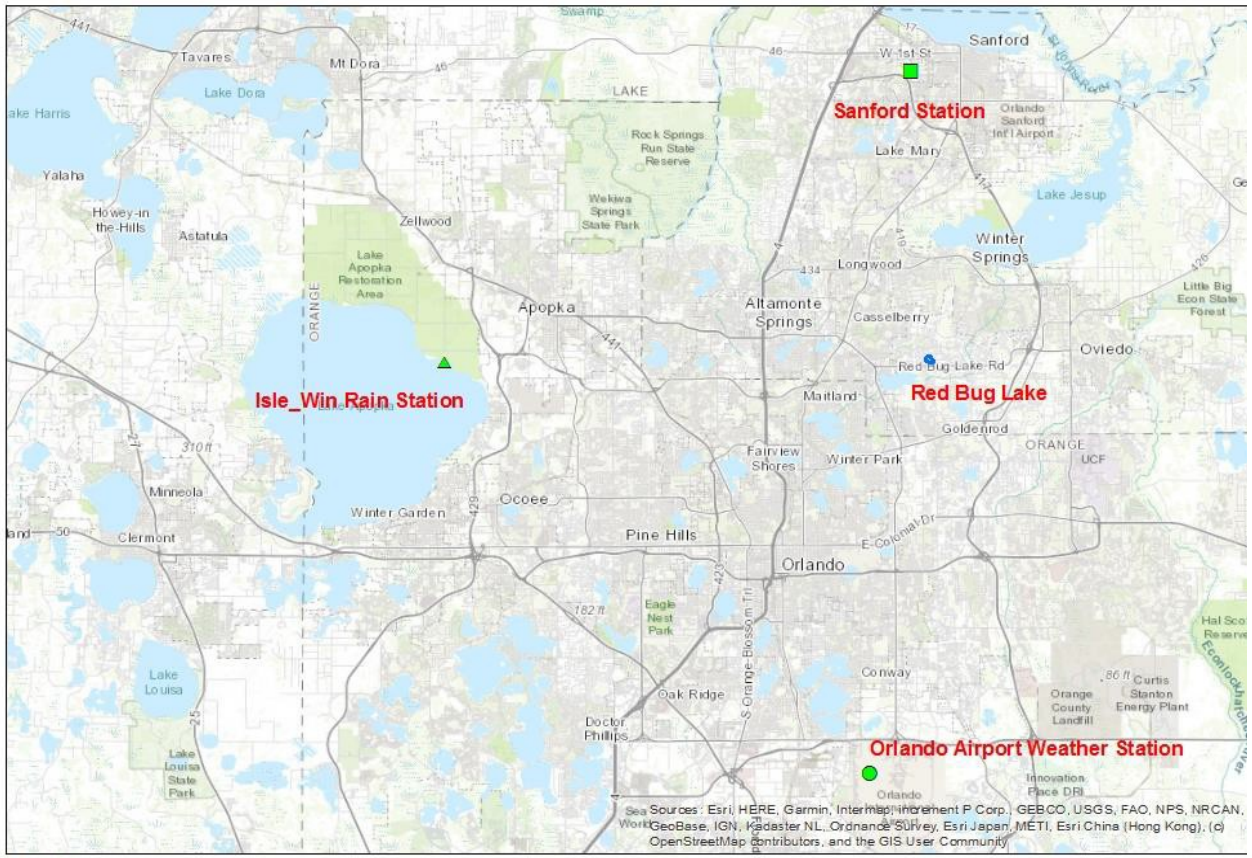
0 0.05 0.1 0.2 Miles

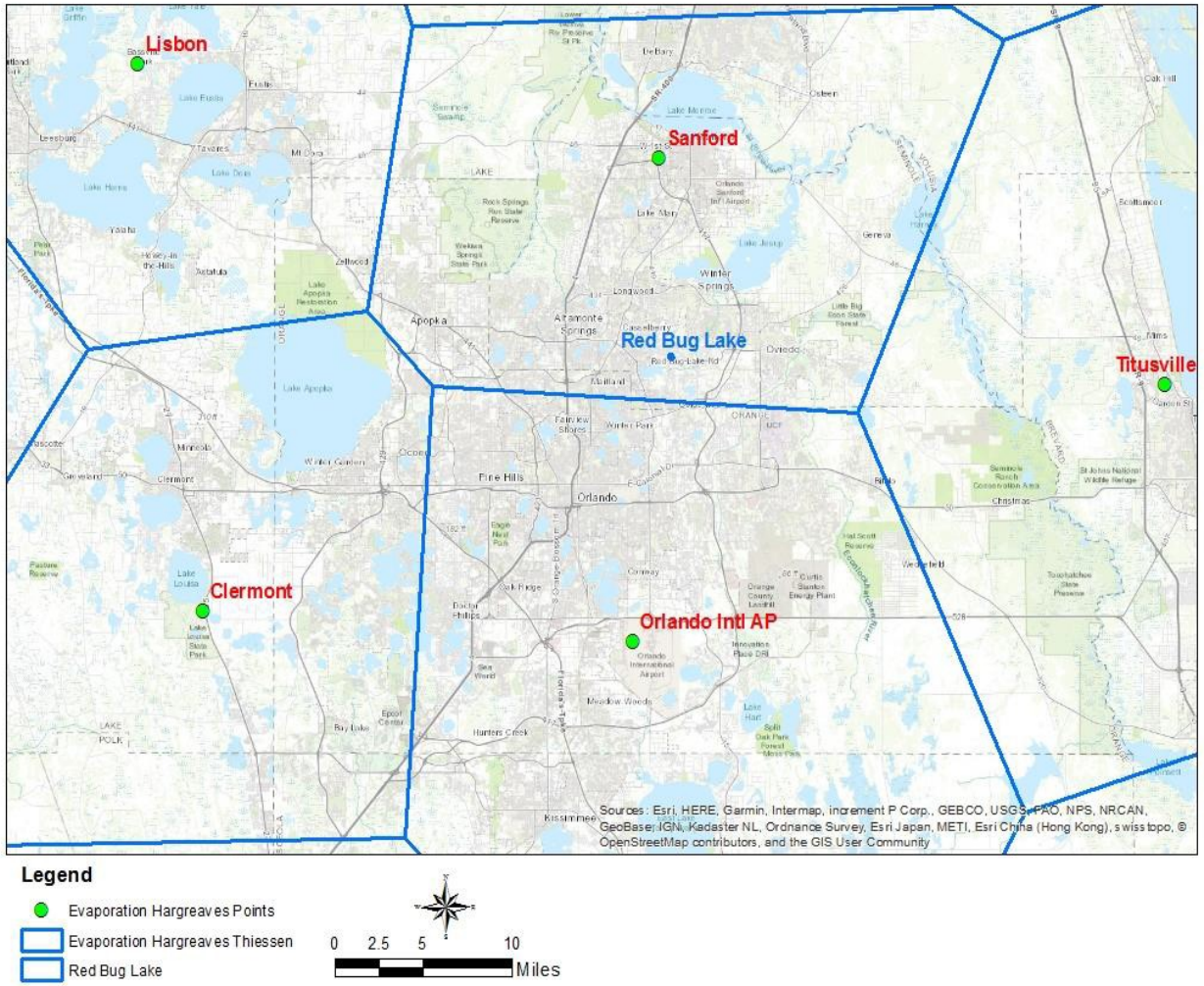
Bathymetry


Outflow structure
67.92 ft
68.92 ft
66.823
64.823
62.823
59.823
57.823
61.823
Legend
Additional Transects
SJRWMD Transect Lines
1 ft DEM Contour
1 ft Bathymetry Contour
DOQQ 2004
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
0
0.05
0.1
0.2
Miles

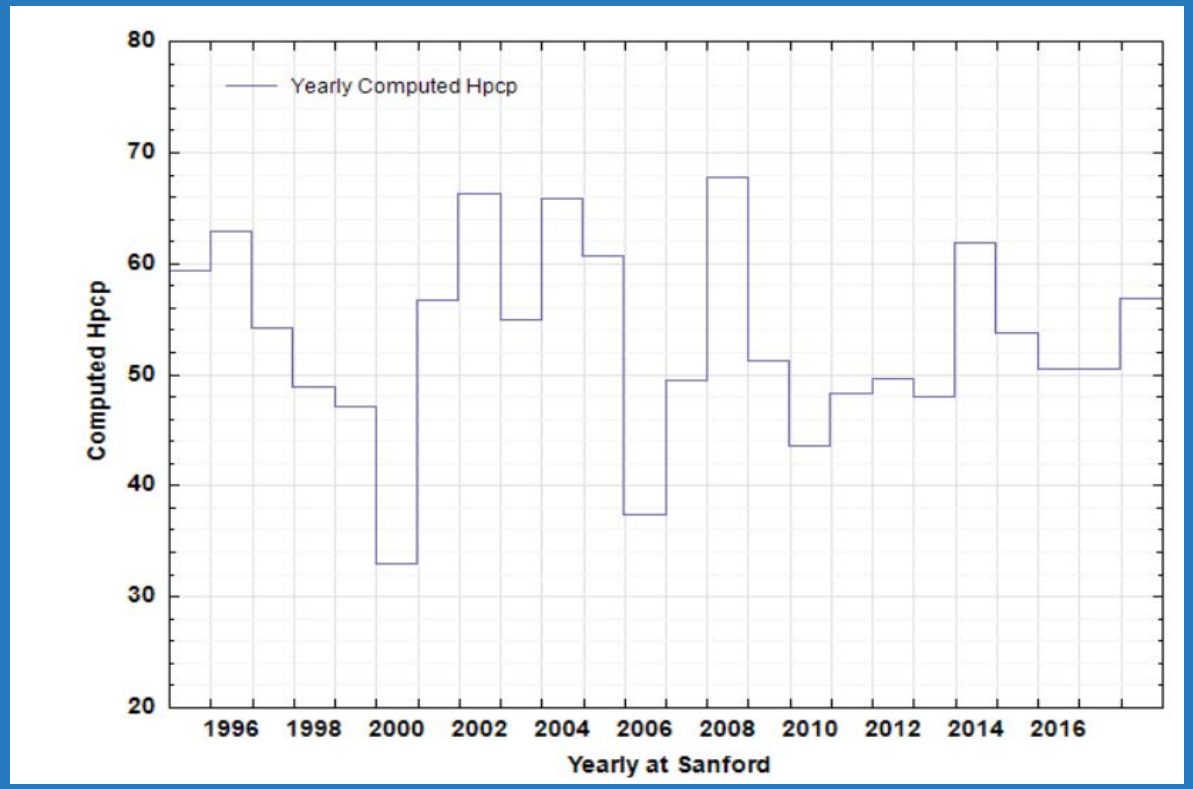

Outflow structure
68.92 ft
67.92 ft
66.823
64.823
62.823
59.823
57.823
61.823
Legend
1 ft DEM Contour
1 ft Bathymetry Contour
Depression
65.8 - 66.5
66.5 - 66.9
66.9 - 67.2
67.2 - 67.5
67.5009091 - 67.90006256
DOQQ 2004
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
0
0.05
0.1
0.2
Miles

Rainfall and PET stations

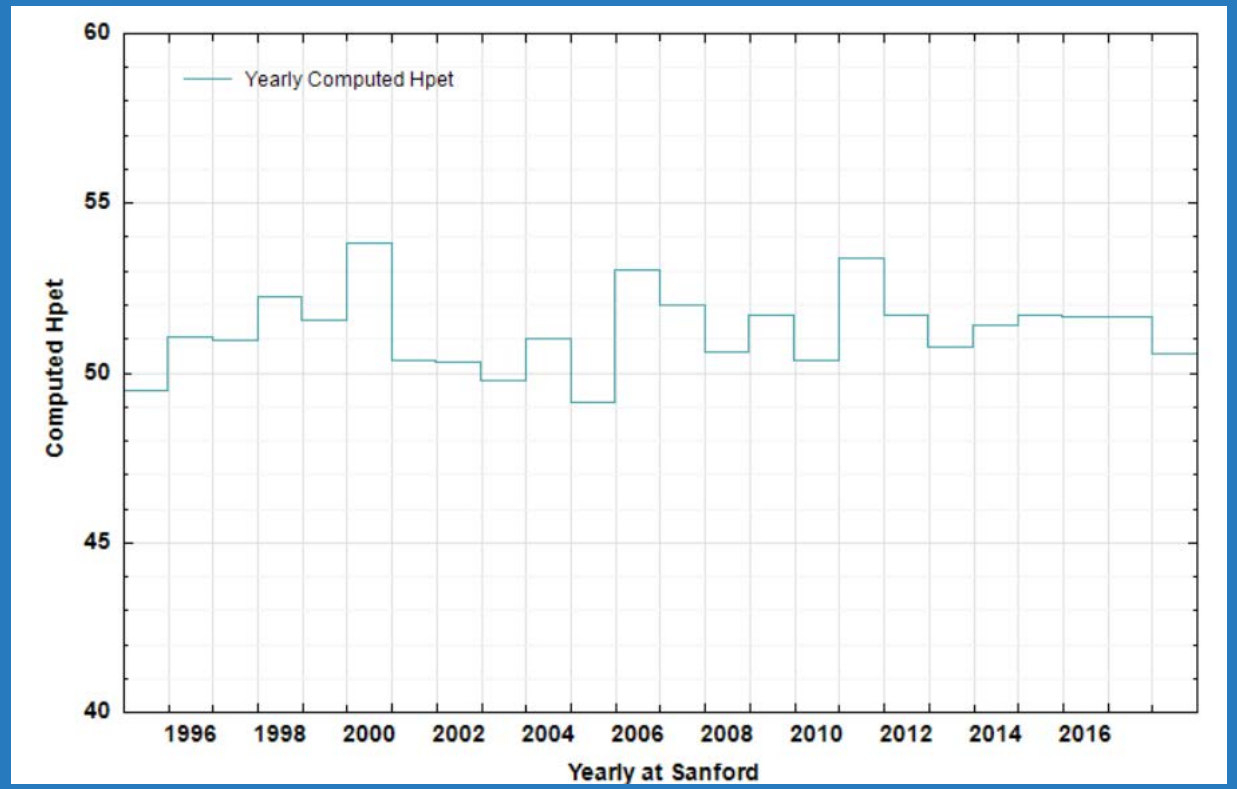




Rainfall and PET

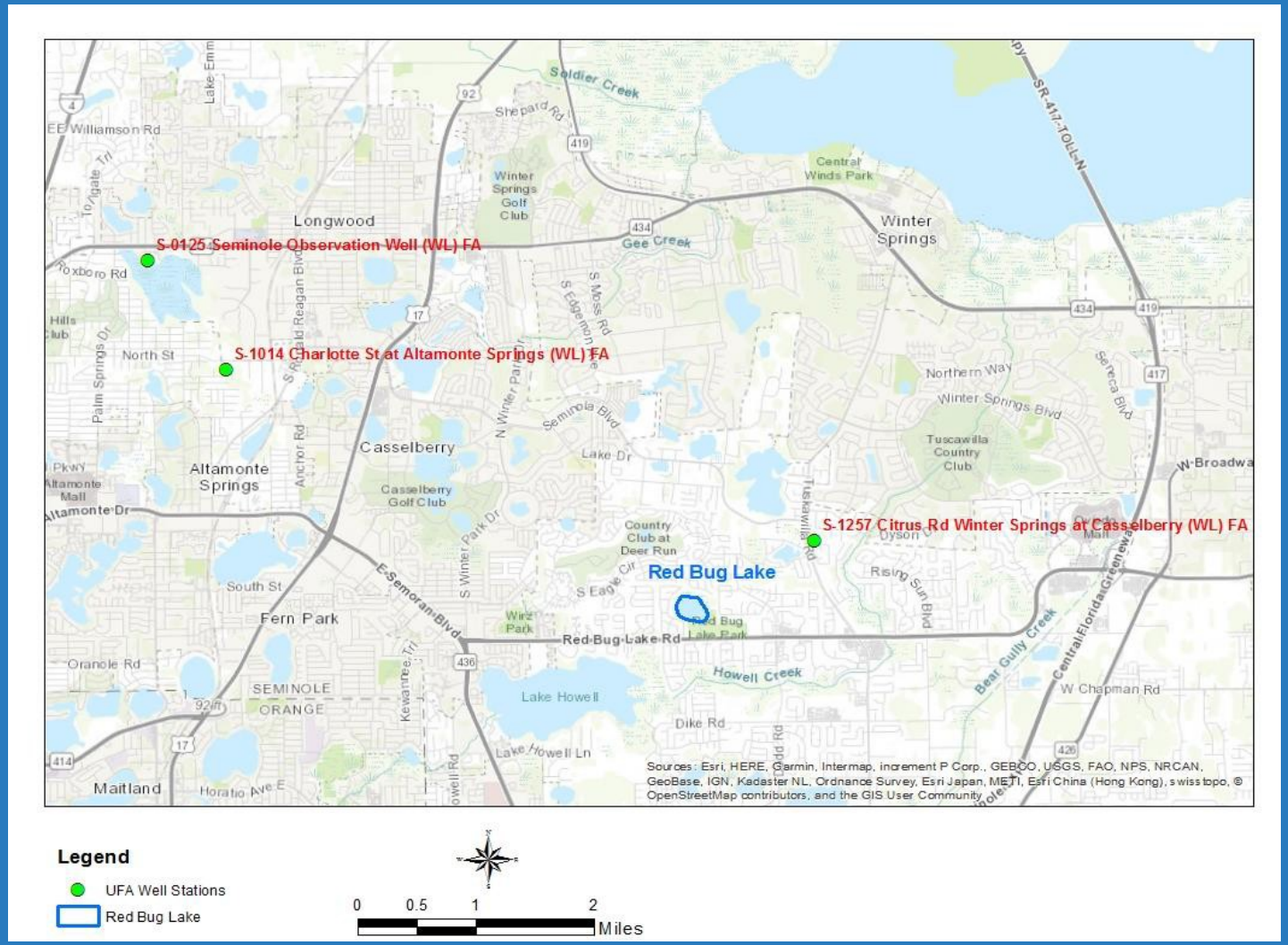


ANNUAL RAINFALL AT SANFORD (1995-2018)

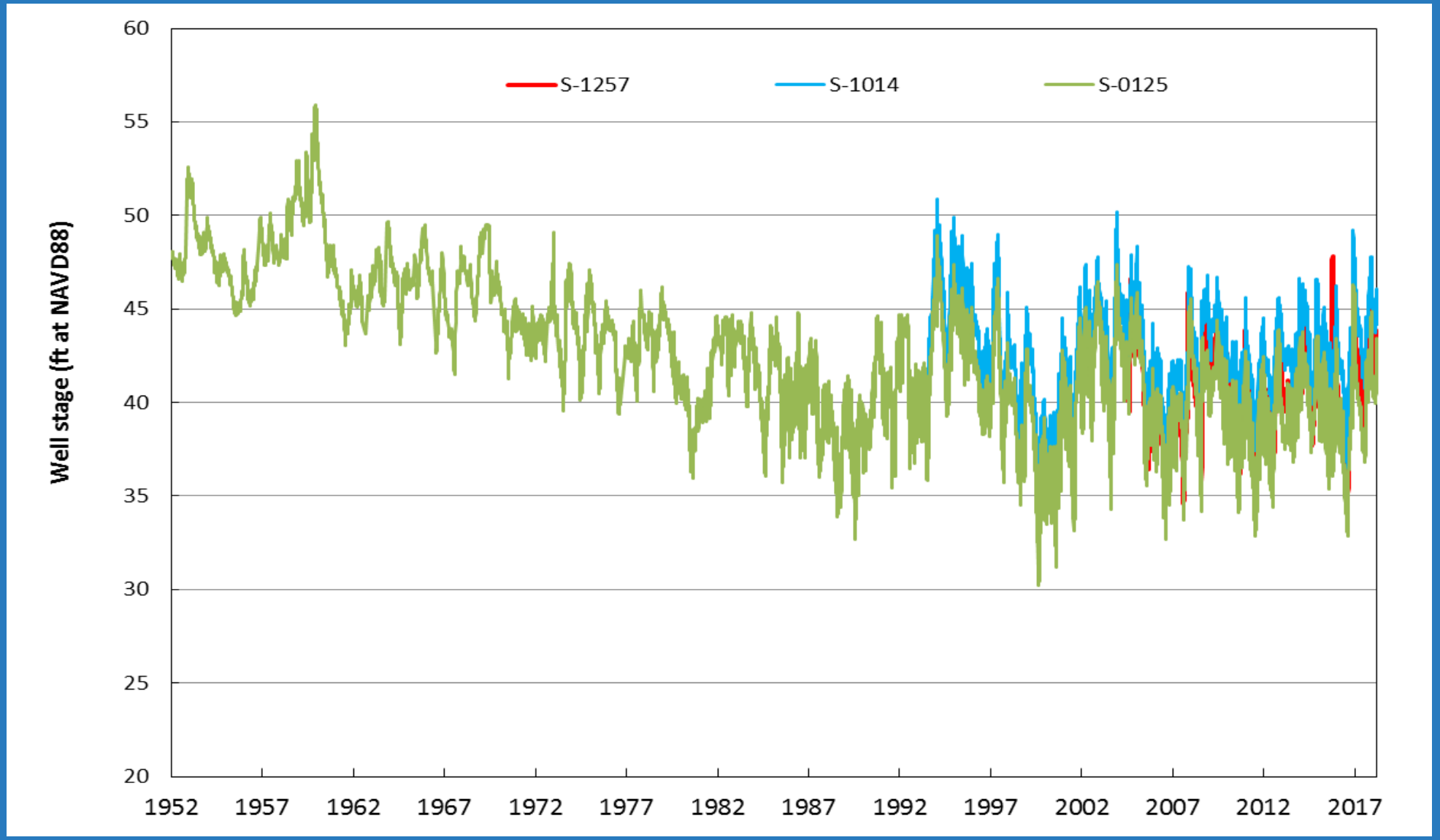


ANNUAL PET AT SANFORD STATION (1995-2018)

Location of UFA monitoring wells

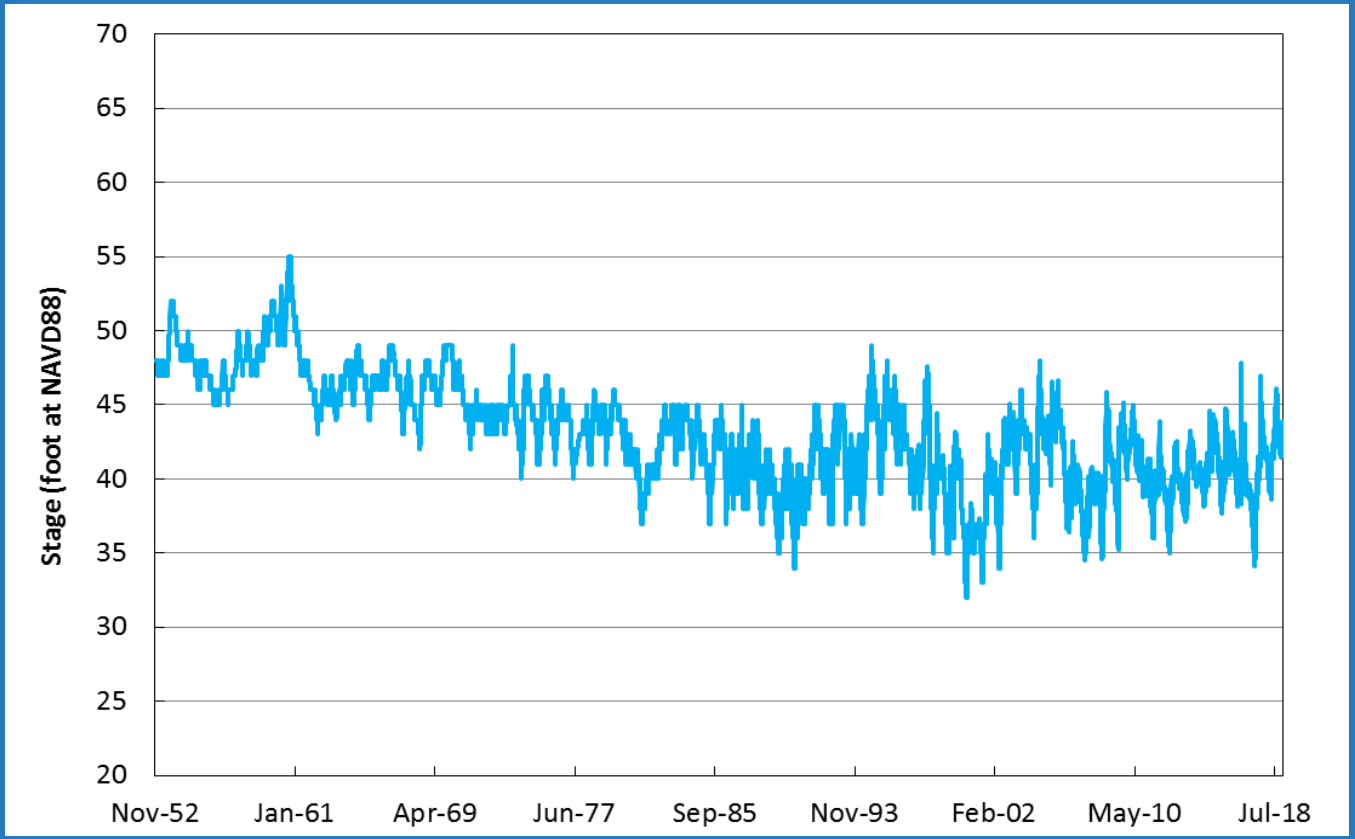


Groundwater



Extended UFA levels

Station Correlated with S-1257	Dates	Regression	R-squared
S-0125	2005-2018	Y=0.8204x+7.8459	0.801
S-1014	2005-2018	Y=1.0056x-2.2751	0.9775



Hydrological Model Setup

- HSPF
- 1 sub-basin
- Outflow structure
- Seepage between lake and UFA

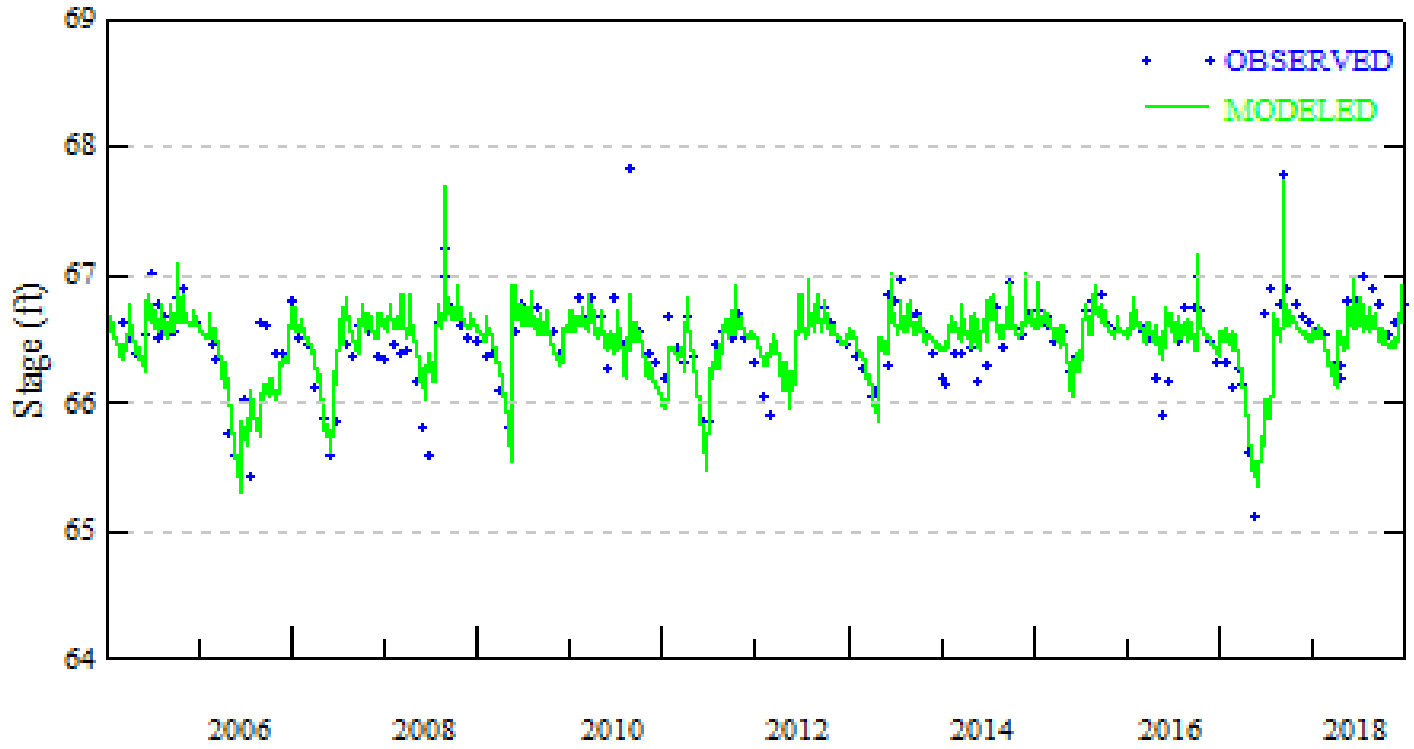
Hydrologic Model Calibration

- **Calibration Period**
  - **1/1/2005- 12/31/2018**
- **Validation Period**
  - **1/1/1995-12/31/2004**

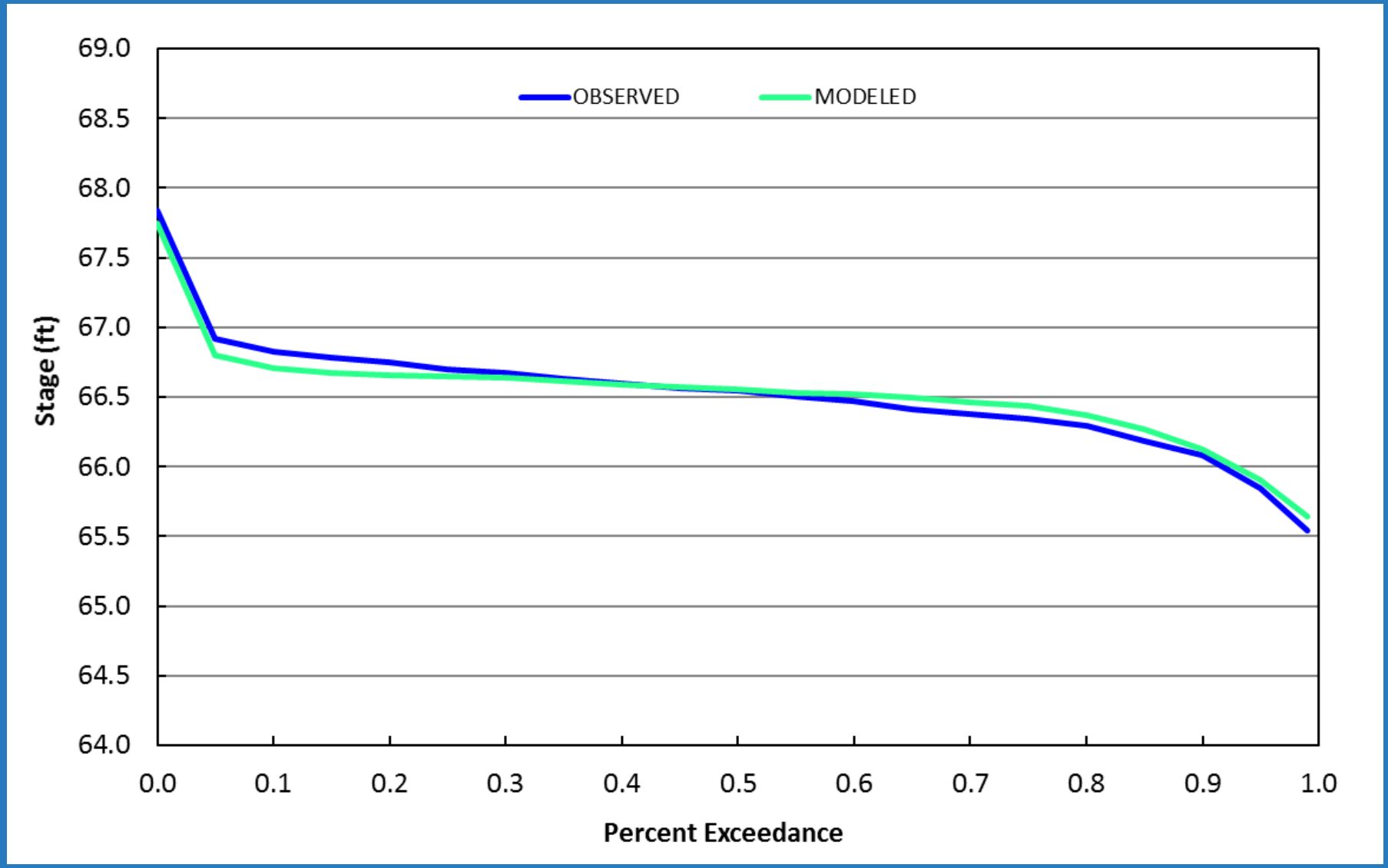
Outlet

- Lake stage <= 66.52 feet (NAVD88), there is no discharge.
- Lake stage >66.52 and < 66.72 feet, there is only discharge from these two inlets.
  - The discharge is calculated based on $Q = CLh^{3/2}$ with *C* value of 3.32 and length of 1.5 feet.
- Lake stage > = 66.72 feet, there is discharge from these two inlets plus the discharge from the overtopping walls.
  - The discharge from the overtopping wall is estimated based on $Q = CLh^{3/2}$ with *C* value of 2.34 and length of 10 feet, the perimeter of the edge wall.

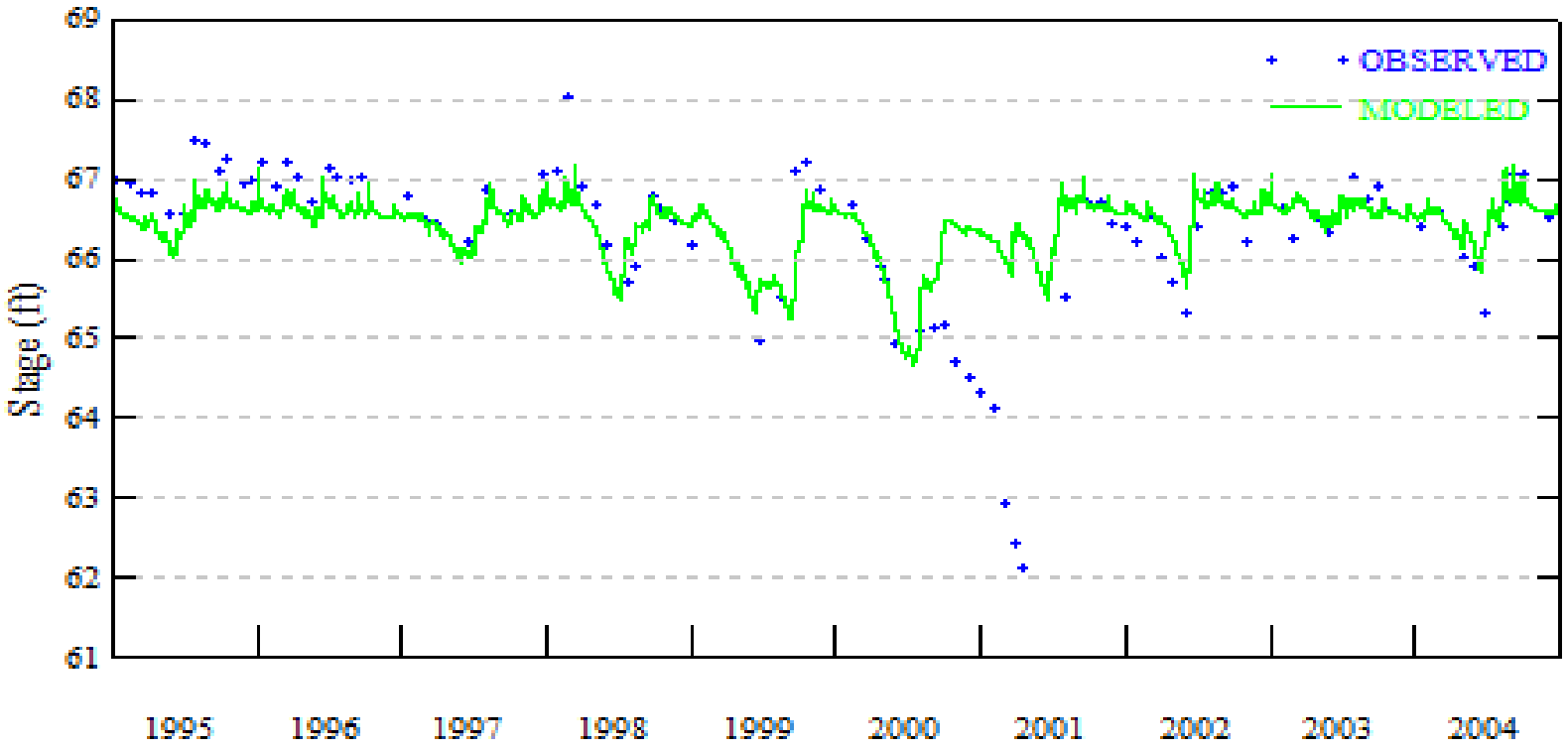
Calibration Results



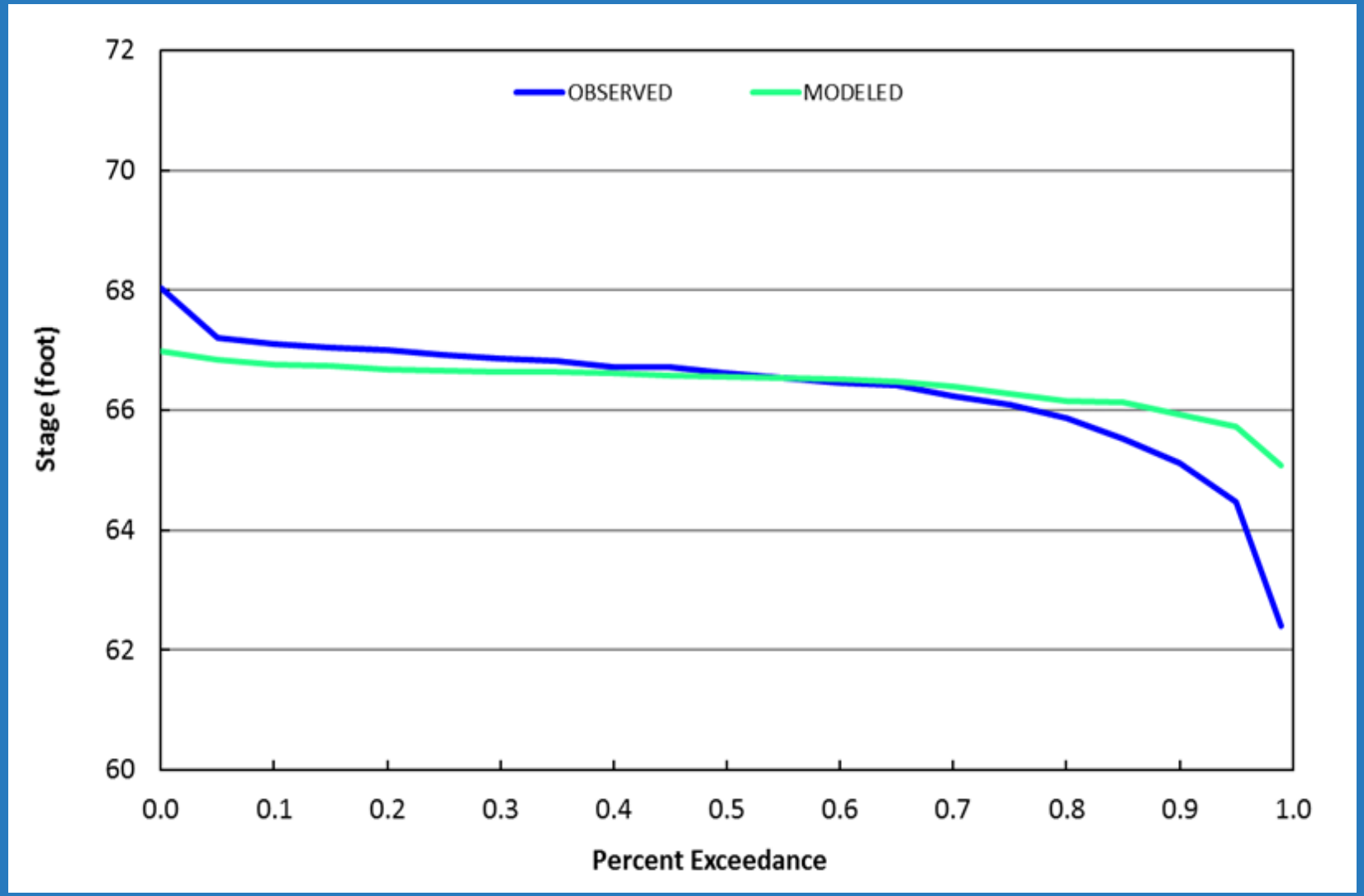
Calibration Results



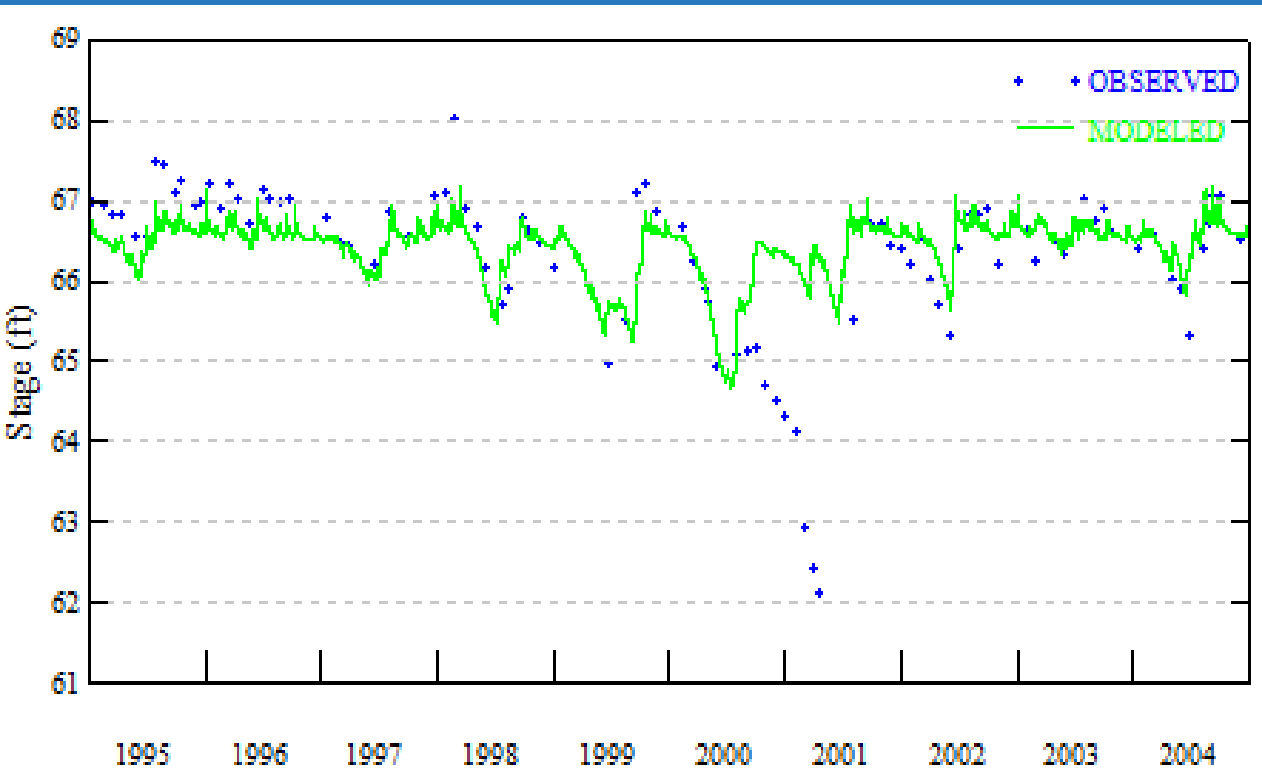
Validation Results



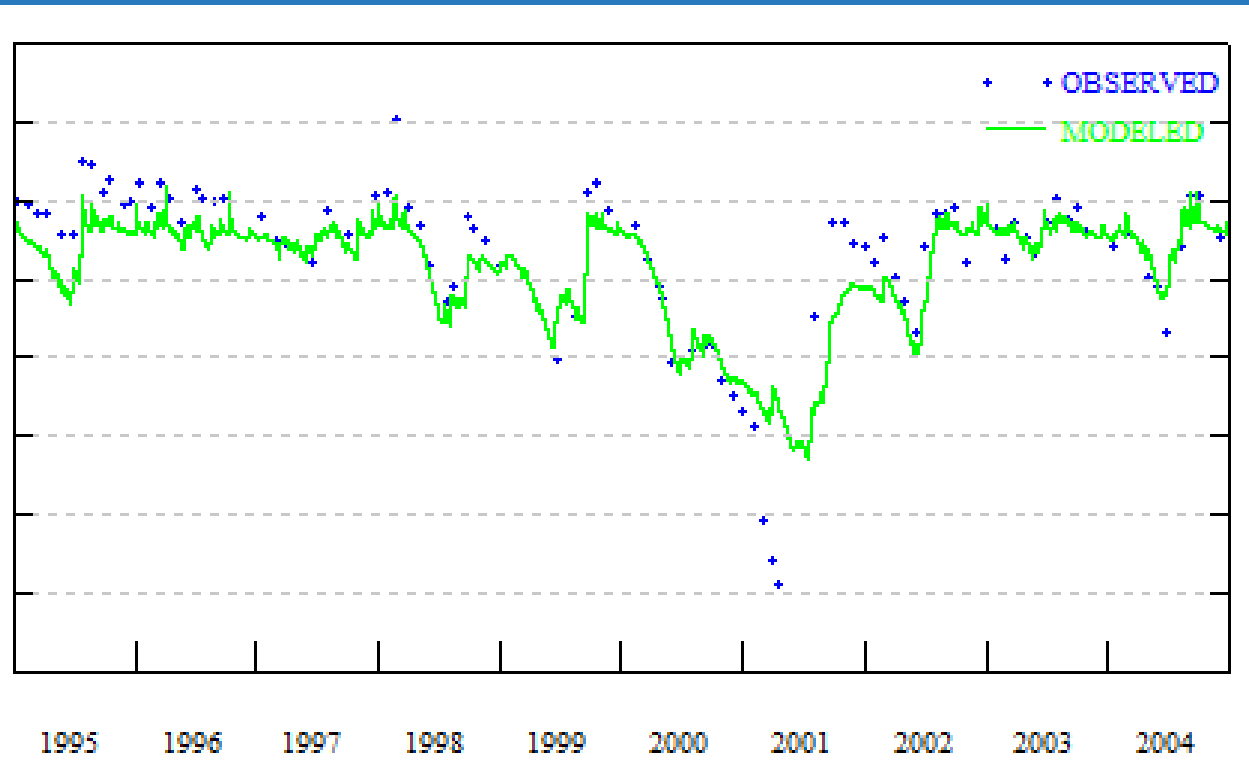
Validation Results



Validation using NEXRAD Rainfall



Stanford Station Rainfall

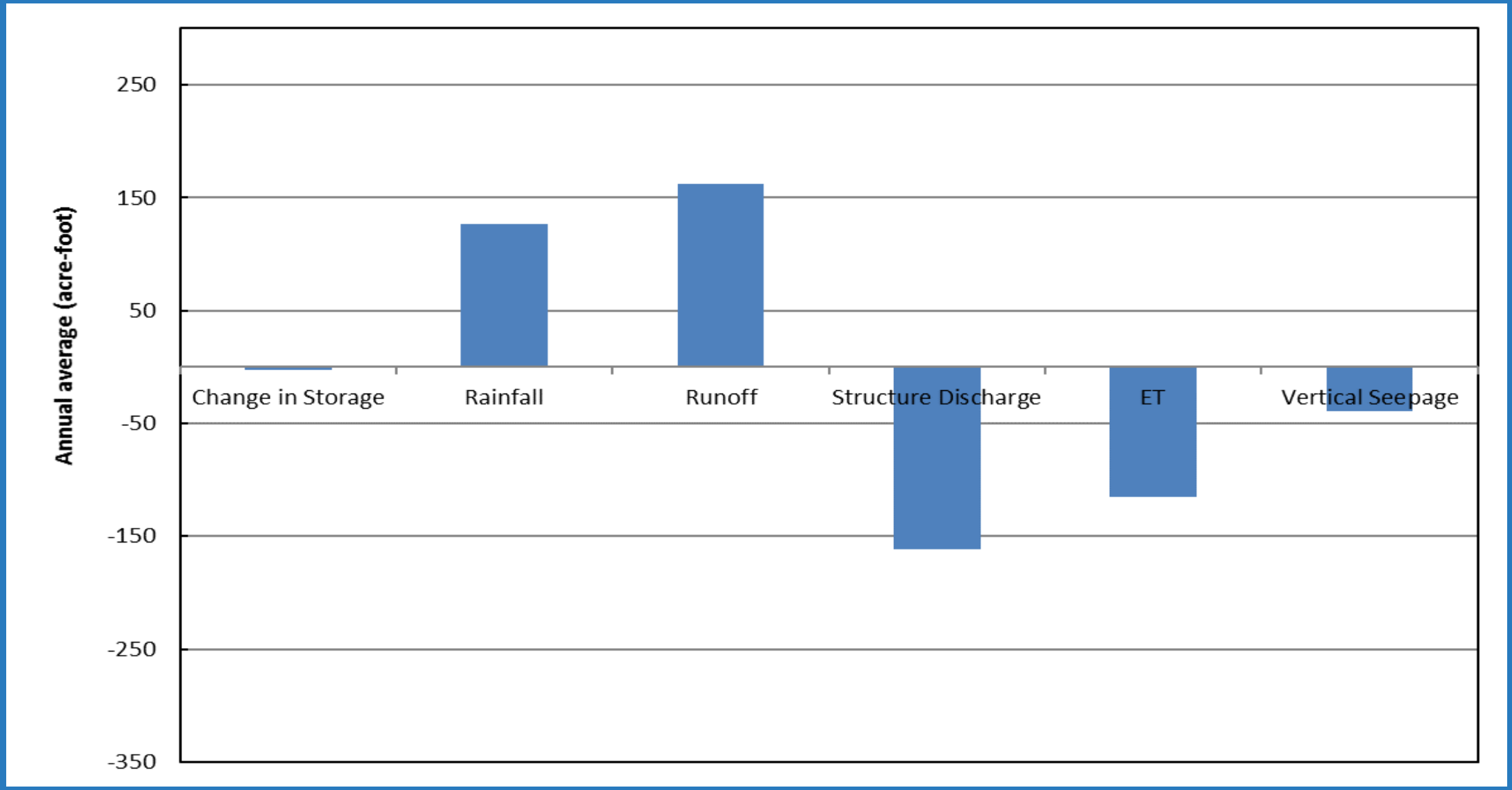


Nexrad Rainfall

Hydrologic Model Performance

	Sample size	Mean-Observed (ft)	Mean-Modeled (ft)	NSE Coeff.	RMSE (ft)	Percentage of modeled stages within ±1.0 feet of measured data
Calibration	177	66.49	66.50	0.58	0.23	100%
Calibration w/ Nexrad	177	66.49	66.54	0.69	0.2	98.3%
Verification	95	66.32	66.47	0.25	0.87	88.4%
Verification w/ Nexrad	95	66.32	66.17	0.72	0.53	93.7%

Water Balance 1995-2018



Sensitivity Analysis

Five HSPF parameters selected for the sensitivity analysis included:

- **DEEPFR - the fraction of groundwater inflow which will enter deep inactive groundwater,**
- **INFILT - an index to the infiltration capacity of the soil,**
- **K – the leakance value used to calculate vertical seepage flows to UFA,**
- **LZSN - the lower zone nominal storage, and**
- **LZETP - the lower zone ET parameter.**

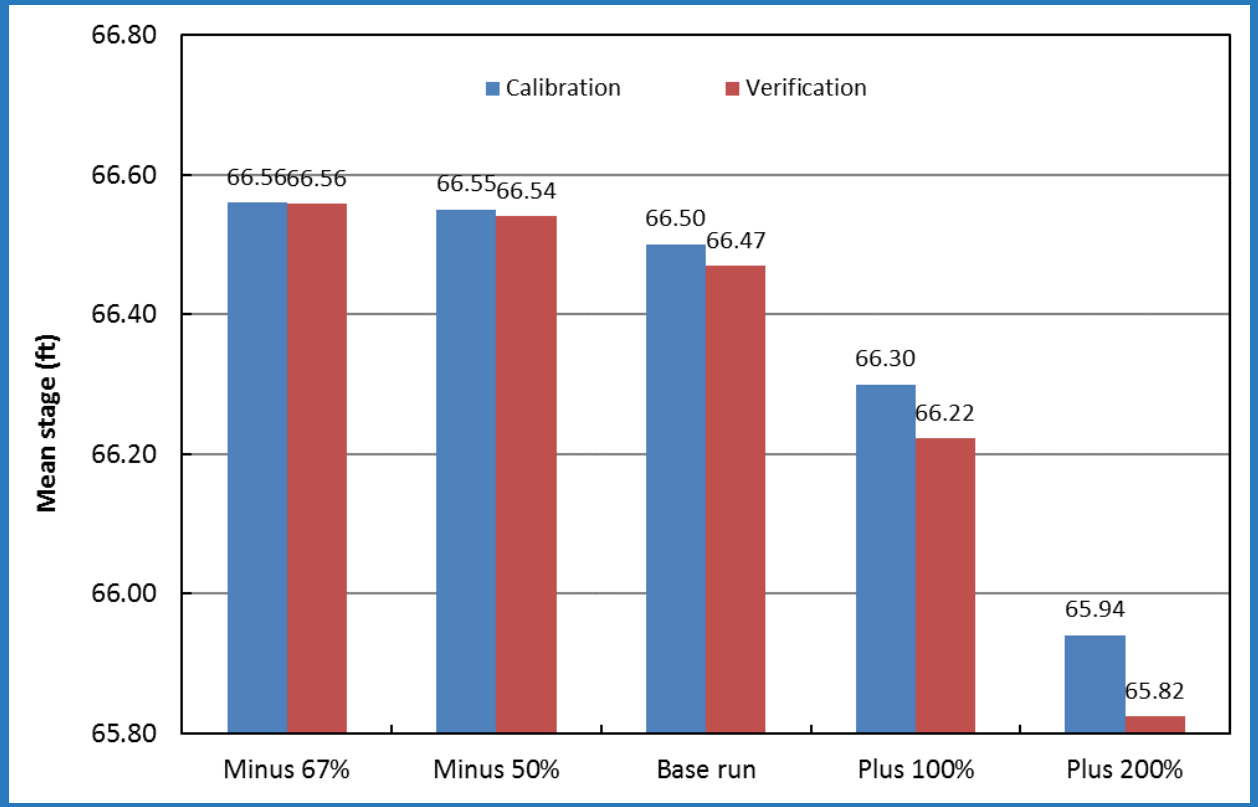
Four different perturbation levels for DEEPFR, INFILT, LZSN, and LZETP as follows:

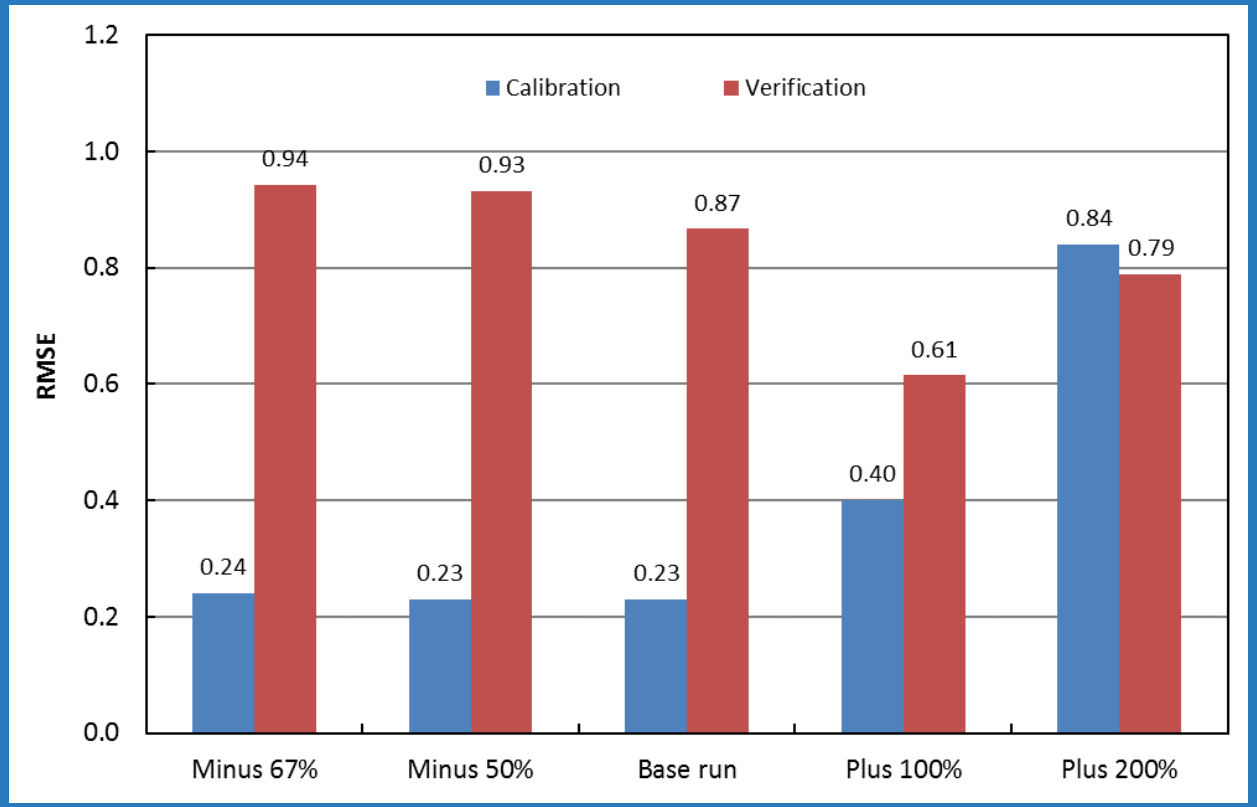
- Decreased by 50% (Minus 50%),
- Decreased by 25% (Minus 25%),
- Increased by 25% (Plus 25%), and
- Increased by 50% (Plus 50%).

The four different perturbation levels for leakance (**K**) were as follows:

- Decreased by 67% (Minus 67%),
- Decreased by 50% (Minus 50%),
- Increased by 100% (Plus 100%), and
- Increased by 200% (Plus 200%).

K-value


Calibration
Verification
Mean stage (ft)
66.80
66.60
66.40
66.20
66.00
65.80
66.56
66.56
66.55
66.54
66.50
66.47
66.30
66.22
65.94
65.82
Minus 67%
Minus 50%
Base run
Plus 100%
Plus 200%


Calibration
Verification
RMSE
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.24
0.94
0.23
0.93
0.23
0.87
0.40
0.61
0.84
0.79
Minus 67%
Minus 50%
Base run
Plus 100%
Plus 200%

Sensitivity Analysis Takeaways

- **Parameter of leakance K is the most sensitive parameter**
- **DEEPFR and LZETP are the parameters with medium sensitivity**
- **Parameters of INFILT and LZSN have the lowest sensitivity**

Long-term Simulation

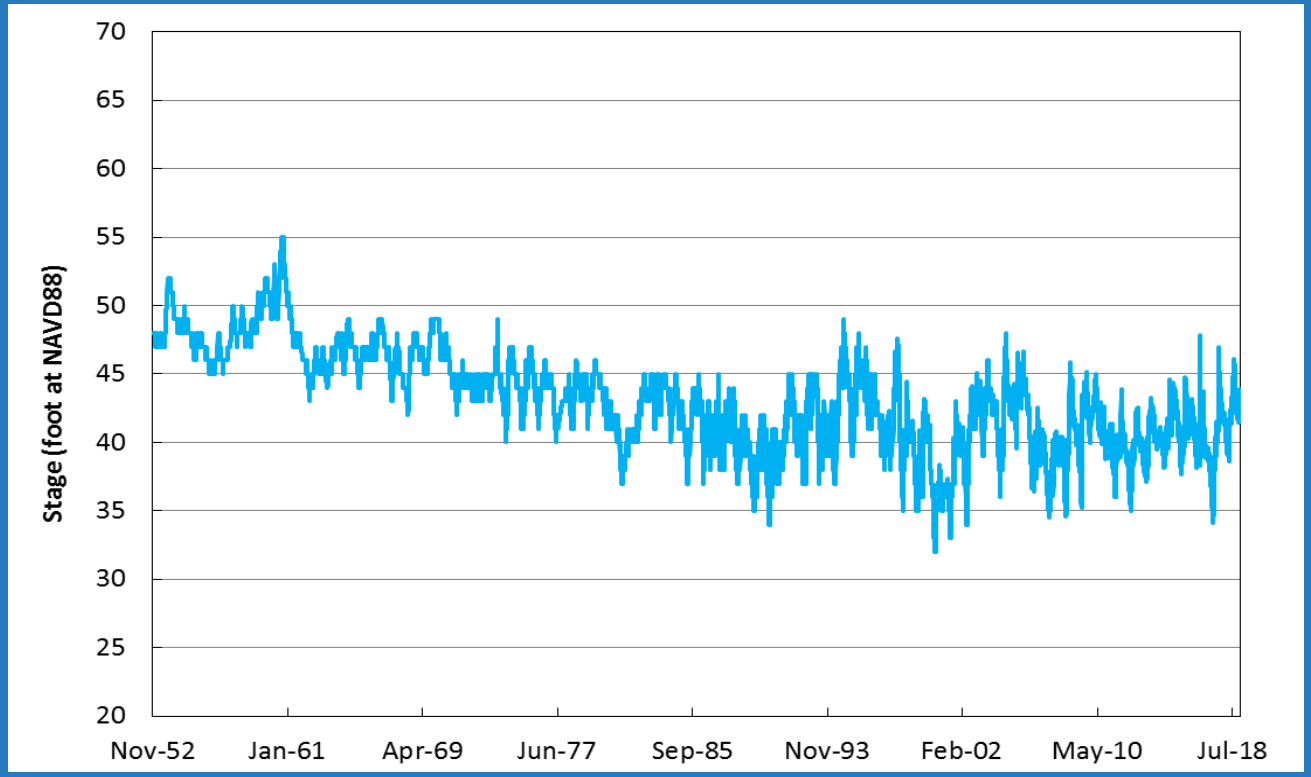
- **Calibrated model was run from November 12, 1952 to December 31, 2018**
  - **Extensions of hourly rainfall, PET, and daily UFA groundwater levels**
  - **All the hydrologic parameters were kept the same.**
  - **A composite rainfall dataset used Sanford Pre-1995 and Nexrad post-1995**

Groundwater Levels

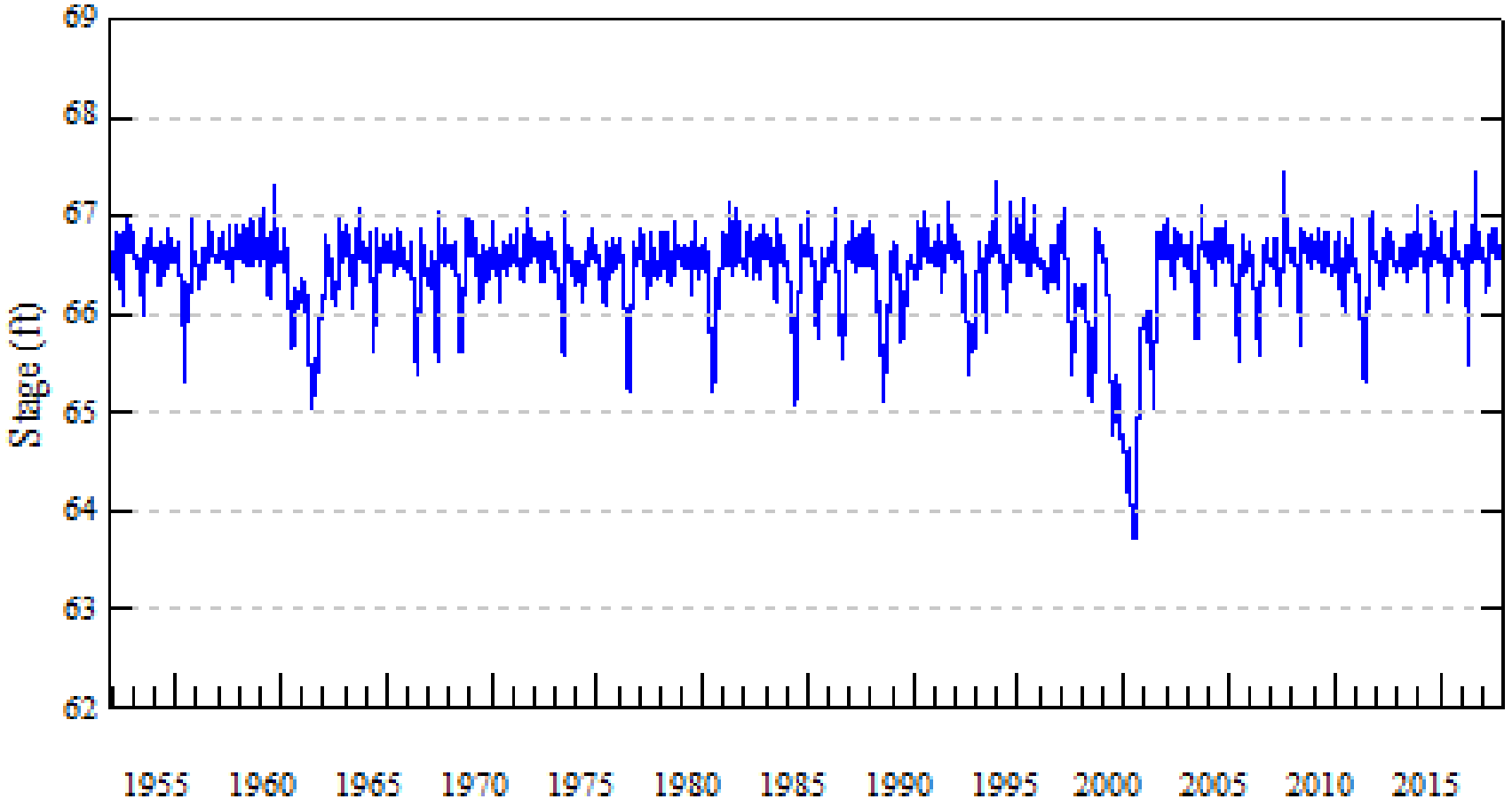
Station ID	Station Name	Latitude	Longitude	Date Start	Date End	Interval
09991414	S-1257 Citrus Rd Winter Springs at Casselberry (WL) FA	28.660	-81.274	2/9/2005	Present	Daily
22752271	S-1014 Charlotte St at Altamonte Springs (WL) FA	28.682	-81.356	5/13/1994	Present	Daily
09670943	S-0125 Seminole Observation Well (WL) FA	28.696	-81.367	11/12/1952	Present	Daily

S-1257 Elevation = 0.7398*(**S-1014** Elevation)^1.0672 (r^2=0.98)

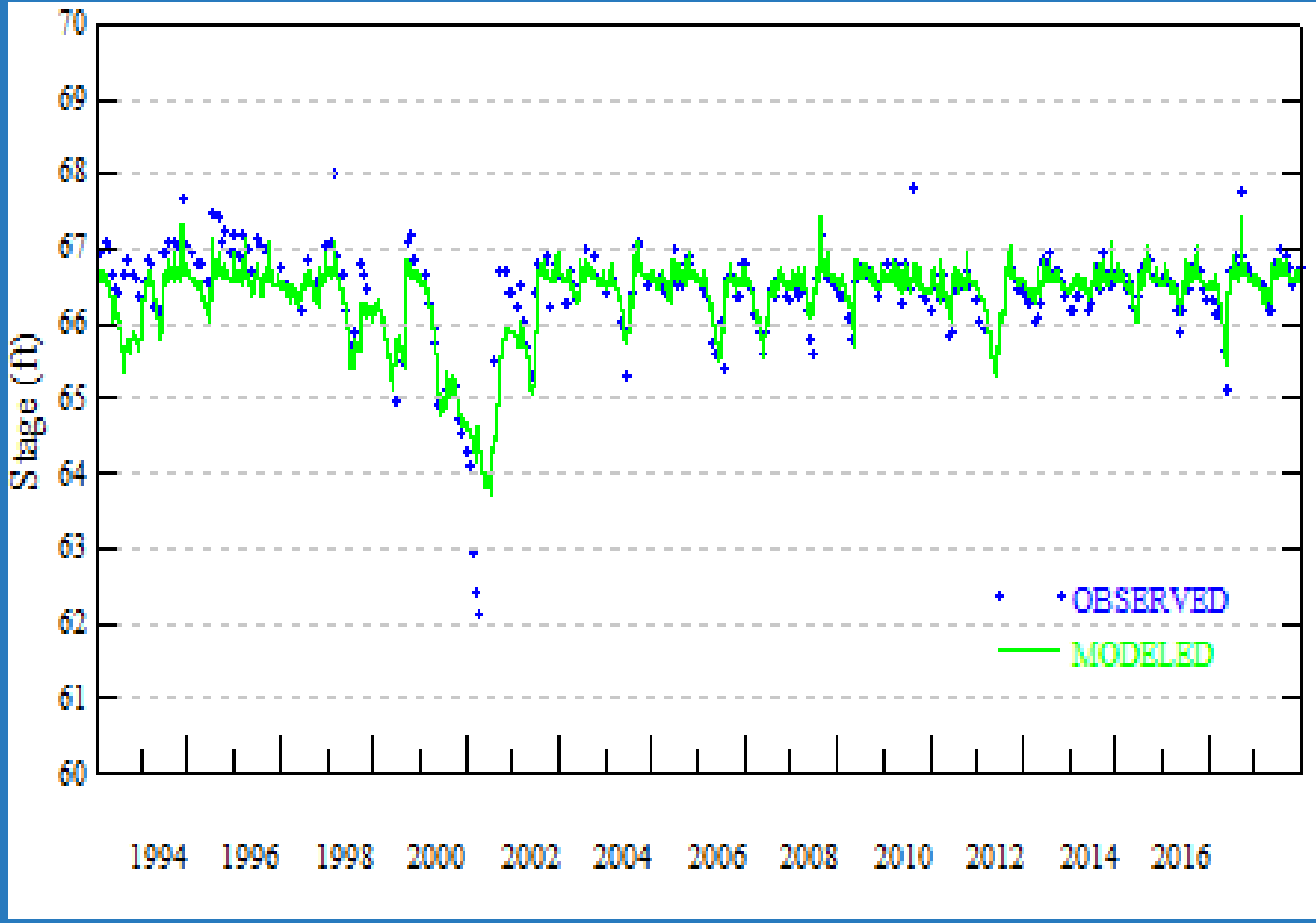
S-1257 Elevation = 1.4746*(**S-0125** Elevation)^0.8993 (r^2=0.80)

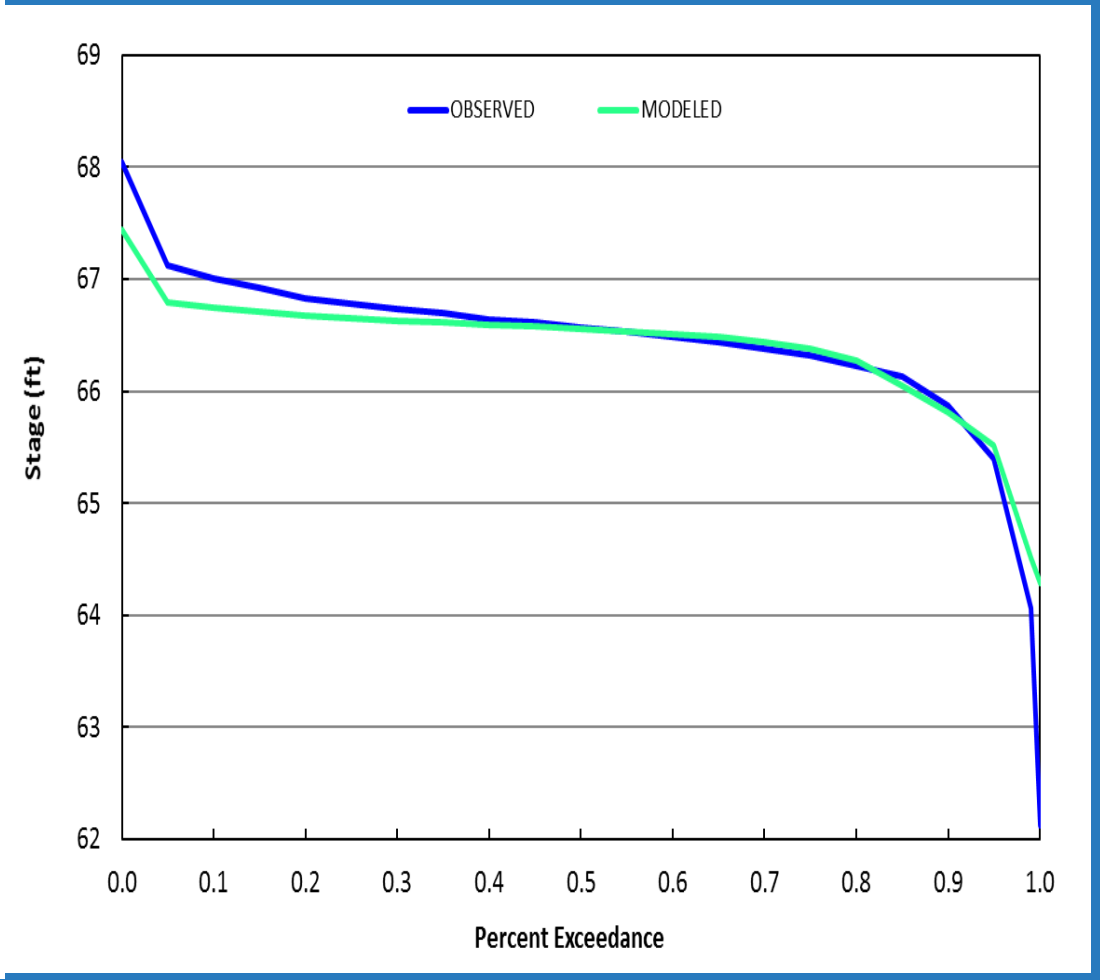


Long-term Results



Long-term Results compared with the available observed levels





Next Steps

• Fieldwork / env. analyses	Early 2021
• Long-term Sims / Assessment	Early 2021
• Draft MFLs Report	Summer / Fall 2021
• MFLs Report Peer Review	End of 2021
• Rulemaking	Early 2022

Thank you