WESTERN EVERGLADES RESTORATION PROJECT

PROJECT DELIVERY TEAM (PDT) MEETING

NOVEMBER 7, 2017

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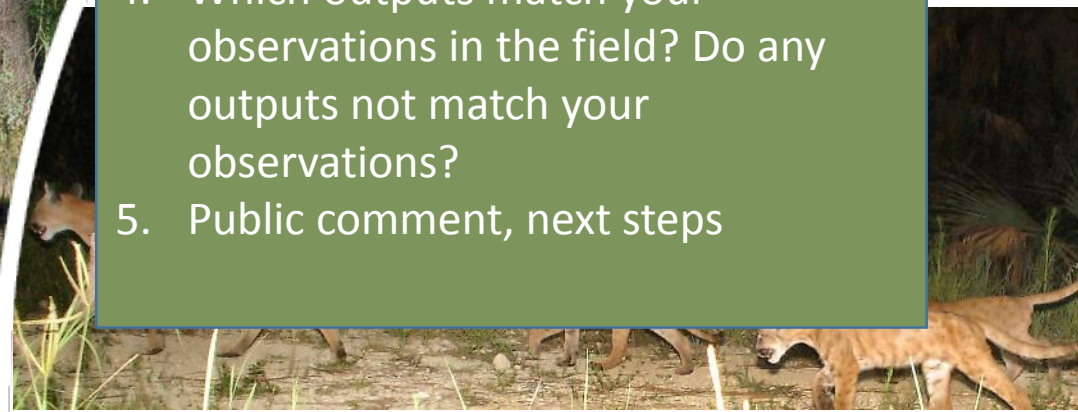
Today's agenda:

1. Quick subteam updates.
2. Break
3. Building on the modeling discussion from the June 2017 WERP workshop, our modelers will present ***preliminary*** outputs for our baseline scenario of existing conditions.
4. Which outputs match your observations in the field? Do any outputs not match your observations?
5. Public comment, next steps



Update from WERP Project Management





WERP Project Management

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Recent Accomplishments

Eco-PCX Review of Performance Measures:

- Good progress on review of the predictive performance measures (PMs) to be used to evaluate the alternative plans.

Modeling/Engineering:

- LiDAR data incorporated into the RSMGL
- Model calibration near completion

Adaptive management (AM) Plan

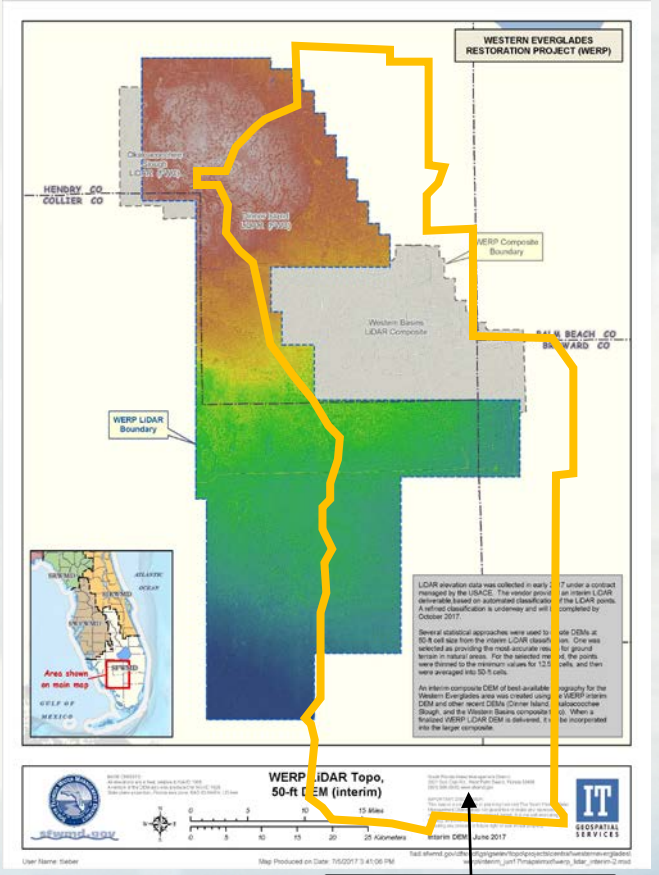
- Identified WQ uncertainties
- Draft management options initiated

Update from WERP Engineering/modeling Sub-team

Engineering/Modeling Sub-team

Progress:

- Calculated the conveyance of existing canals within the project area
- Incorporated new LiDAR data interim product and detailed ground survey for 11-mile Rd in the RSMGL model area. Details of the Loop Rd and Tamiami Trail as-built have also been incorporated into the model
- Completed Digital Elevation Model (DEM) request from the ECO sub-team
- Updated and performed preliminary testing in the performance measure scripts from RECOVER and CEPP
- Calibrated RSMGL for the above ground water levels
- Updated existing and future-without scenario modeling assumptions for consistency



WERP Boundary (approx.)

Engineering/Modeling Sub-team

What's Next? → Extensive Modeling to Determine Most Effective Aspects of the Alternatives

- Final LiDAR data deliverable from A/E: 17-November
- Continue RSMGL calibration of below-ground water levels
- Perform existing and future-without scenarios models runs: 15-December
- Continue to update and test restoration performance measure modeling scripts
- Calculate the conveyance capacity of proposed canals within the project area
- Models runs for the Alternatives Round 1 and 2
- Rough costs for features in Alternatives Round 1 and 2
- Continued coordination with the WERP sub-teams to refine the alternatives

Engineering/Modeling Sub-team
Summary of Path Forward

- Continue calibration and baseline modeling in 2017
- "Learning Round" (Round 1) quantitative modeling of the planning alternatives will begin in December 2017
- Discussion of Round 1 RSM Modeling: February 2018 PDT meeting
- Reconfigure the alternatives and reduce the number of alternatives, based on Learning Round results.
- Identify the Tentatively Selected Plan (TSP) by July 2018.
- Several analyses, reviews, and refinements follow the TSP, before identifying the Recommended Plan in 2019.

Update from WERP Water Quality Sub-team

Water Quality (WQ) Sub-team

Progress:

ADAPTIVE MANAGEMENT (AM) PLAN

- Identified WQ topics, called "Uncertainties," to address in the AM Plan
- Screened and Prioritized them
- Drafting management options to address them

What's Next?

- Draft write-ups of the management options (in 2017); when finished these will be part of the TSP (in 2018)
- Draft the WQ Monitoring Plan (in 2017); when finished this will be part of the TSP (in 2018)
- Use model results to refine the Monitoring & AM Plans (in 2018)

Update from WERP Plan Formulation Sub-team

Plan Formulation Sub-team

Progress:

- Further refinement of planning alternatives before quantitative modeling in early 2018
  - Incorporating Government to Government consultation input
  - Refinement using the published Conceptual Ecological Model
- Path forward for including Tribal requests for restoration measures on their lands
- Path forward for considering known archeological sites during screening
- Screening criteria based on federal “Principles and Guidelines”, to use after quantitative modeling Learning Round
- Coordinating closely with Atlanta and Headquarters reviewers on including water quality treatment
- Writing sections of the draft Project Implementation Report (PIR)

Plan Formulation Sub-team

What's Next When Learning Round of model results is available (early 2018)?

- **Performance of the alternatives, and components of the alternatives, will be evaluated. Continue adjustments to alternatives.**
  - **Are constraints violated? Are P&G screening criteria met?**
  - **Are other considerations included?**
  - **Level of performance toward the objectives, per the performance measures**
  - **Exercise screening, in addition to performance measures.**
  - **Do the alternative plans have sufficient WQ treatment? Are the treatment options realistic (e.g., sizes, locations)? Work in coordination with WQ subteam.**
- **Use results to propose "re-mixed" hybrid alternative(s) for next round of modeling.**
  - **This means: It is likely that our TSP will not look exactly like any one of the current alternatives.**
  - **The TSP is likely to be a hybrid of the best performing, cost-effective aspects of the alternatives.**
- **Once we have a TSP, we will still refine further after reviews, to "Recommended Plan".**

Update from WERP ECO Sub-Team

Eco Sub-team

Progress:

- **PROJECT PERFORMANCE MEASURES**
  - Required documentation submitted to USACE ECO-PCX on 31 August 2017. USACE ECO-PCX is required to review and approve project performance measures utilized for WERP and methodology to calculate Habitat Units.

- Initial Kick Off Meeting	5 October 2017
- Interim Review Teleconference	19 October 2017
- Complete Model Review	27 October 2017
- Comment Evaluations Complete	13 November 2017
- Comment Backcheck Complete	20 November 2017
- USACE ECO-PCX Recommendation	January 2018

- **ECOLOGICAL PLANNING TOOLS**
  - WERP will use ecological planning tools (Wading Birds, Apple Snail Model, Alligator, Small Fish etc.) funded by RECOVER and run by USGS to evaluate alternative effects. Coordination efforts between USGS and WERP modelers continue. Calls held monthly.
  - USGS received RSM Digital Elevation Model and is working collaboratively to test tools with WERP modelers.

What's Next?

- Review performance measure and ecological tool output as available for baselines and provide feedback.

Eco Sub-team

Progress:

- **ADAPTIVE MANAGEMENT PLAN**
  - Identified, screened and prioritized Uncertainties for WERP-specific and Adaptive Management relevant criteria
  - Reviewed Templates and Examples for the development of Management Strategies and Management Option Matrices (MOMs) for prioritized Uncertainties
  - Initiated the development of draft Management Strategies/ MOMs ("Strawman products") for inclusion within the AM Plan

What's Next?

- **AM Plan**
  - Continue to develop Strawman products and complete drafts of Management Strategies/ MOMs for presentation to the Team
  - Utilize modeling results to update focus of the AM Plan
- Draft Outline of Ecological Monitoring Plan

Baseline Modeling Update

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Presentation Goal and Objectives

Overall goal: Status report on model calibration

- Reintroduce the primary H&H regional modeling tool to be used in evaluating WERP alternatives
- Summarize the calibration approach being used in WERP modeling
- Provide an update of the calibration progress with reference to a calibration/validation effort completed in 2010 (referred to as CV_2010)
- Share knowledge & solicit feedback on calibration challenges and planned courses of action before production of base simulations

Presentation Overview

Topics to be presented:

- What is RSM?
- Description of RSMGL
- Calibration Approach
- Results
- Summary

What is RSM?

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- RSM = Regional Simulation Model
- Simulates all major water budget components

  (rainfall, evapotranspiration (ET), surface runoff, levee seepage, etc.)
- Developed with South Florida's unique hydrology in mind
- Has capability to handle water management operations
- Used as a regional and sub-regional scale hydrologic model
- Developed and maintained by the H&H Bureau at the South Florida Water Management District

What is RSM?

- Developed using object-oriented methods (C++)
- Can be used as a distributed- and/or lumped-parameter model
- Uses a triangular numerical mesh (distributed mode only)
- Simulates 1-D canal, 2-D overland & groundwater flows
- Uses the diffusive wave approximation of Saint-Venant's equations

Description of RSMGL

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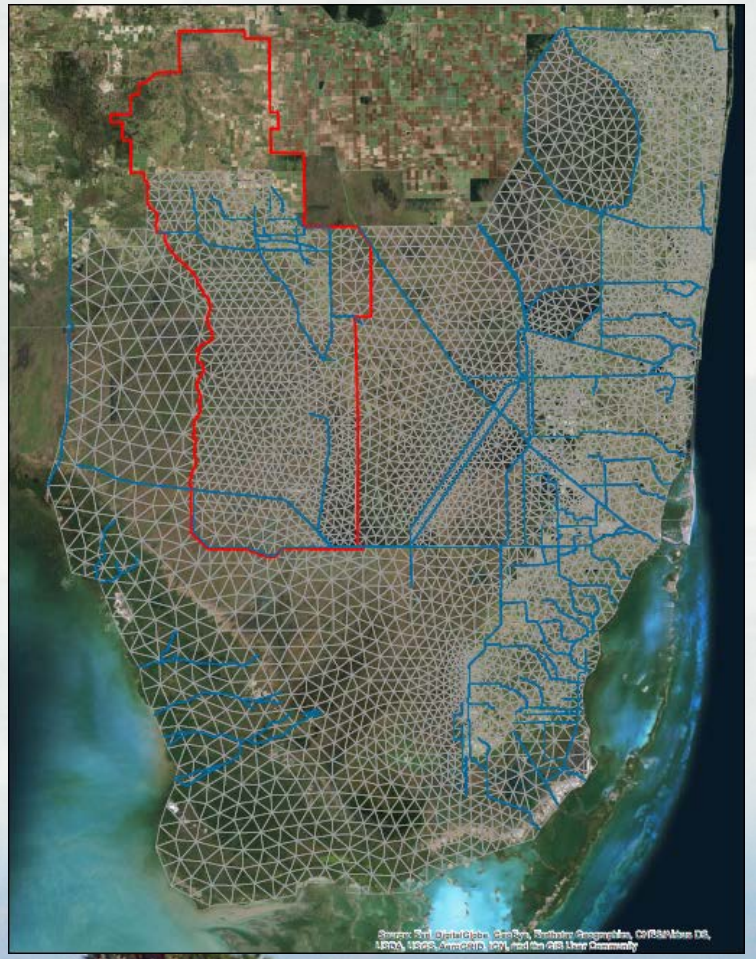
- RSMGL = Regional Simulation Model Glades-LECSA; an application of RSM in the remnant Everglades, Big Cypress National Preserve and most of the Lower East Coast Service Areas (LECSA)
- For WERP: RSMGL was recently expanded to include the Feeder Canal Basins; C-139 Annex, western Tamiami Canal and Loop Road.



WERP Project Area : ~1,204 sq. miles

RSMGL model extent : ~5,943 sq. miles

Model Domain and Primary Basins

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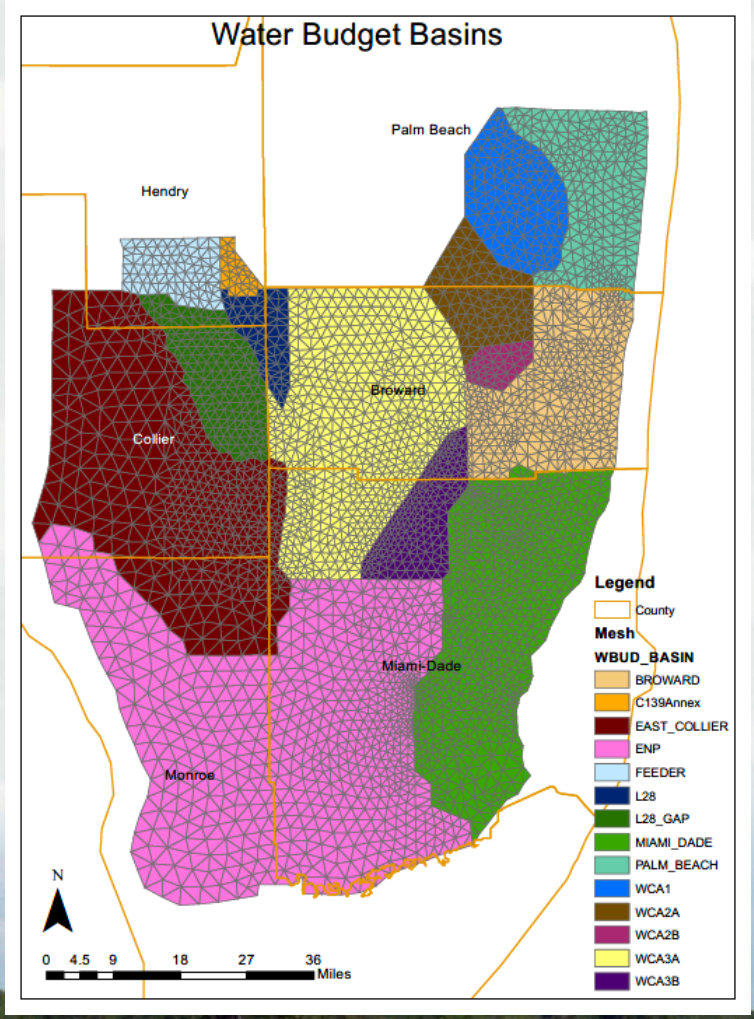
- 5,943 square miles
- 6 counties (some are only partially covered)
- 14 hydrologic basins:
  - Urban areas (majority of the Lower East Cost Service Area)
  - Natural areas (all Water Conservation areas, ENP, BCNP, L28 Triangle, Seminole and Miccosukee natural areas and C139 Annex)



Model Mesh with Project Boundary

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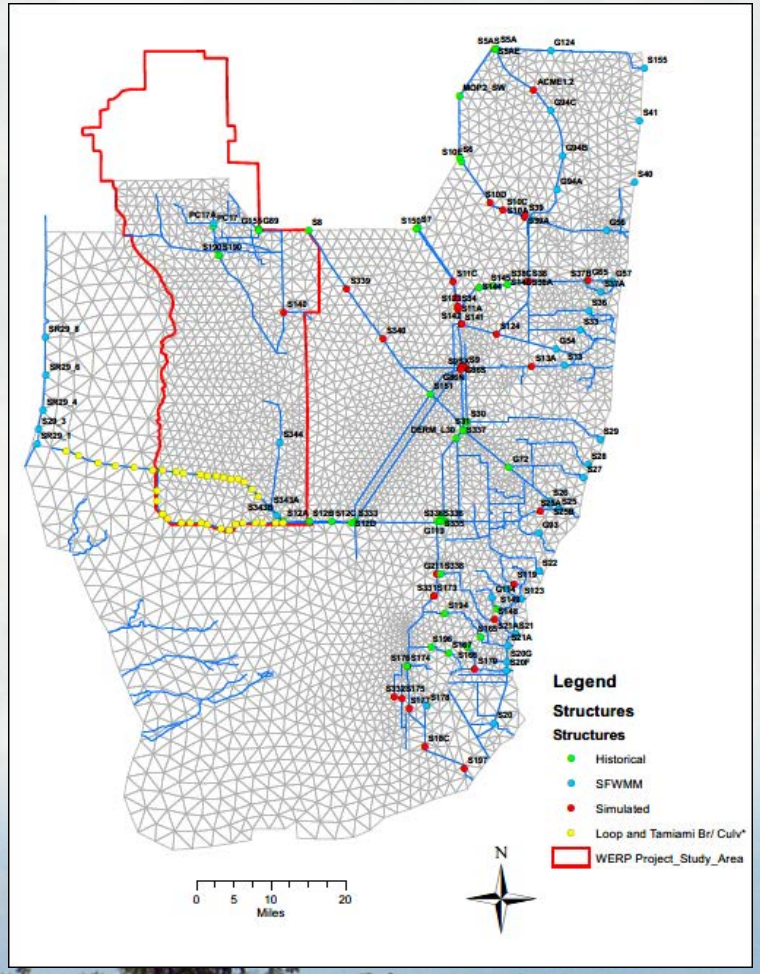
Entire Model Domain

- Area: 5,943 mi^2
- Number of cells: 6719
- Cell size range: 0.05 to 3.92 mi^2
- Mean & Std of cell sizes: 0.88 & 0.62 mi^2

Within Project Area

- Area: 934 mi^2
- Number of cells:
  - WERP: 1346
  - Pre-WERP: 504
- Cell size range: 0.18 to 1.73 mi^2
- Mean & std dev of cell sizes:
  - WERP: 0.69 & 0.21 mi^2
  - Pre-WERP: 1.69 & 0.83 mi^2



Rainfall and Reference Evapotranspiration (ET)

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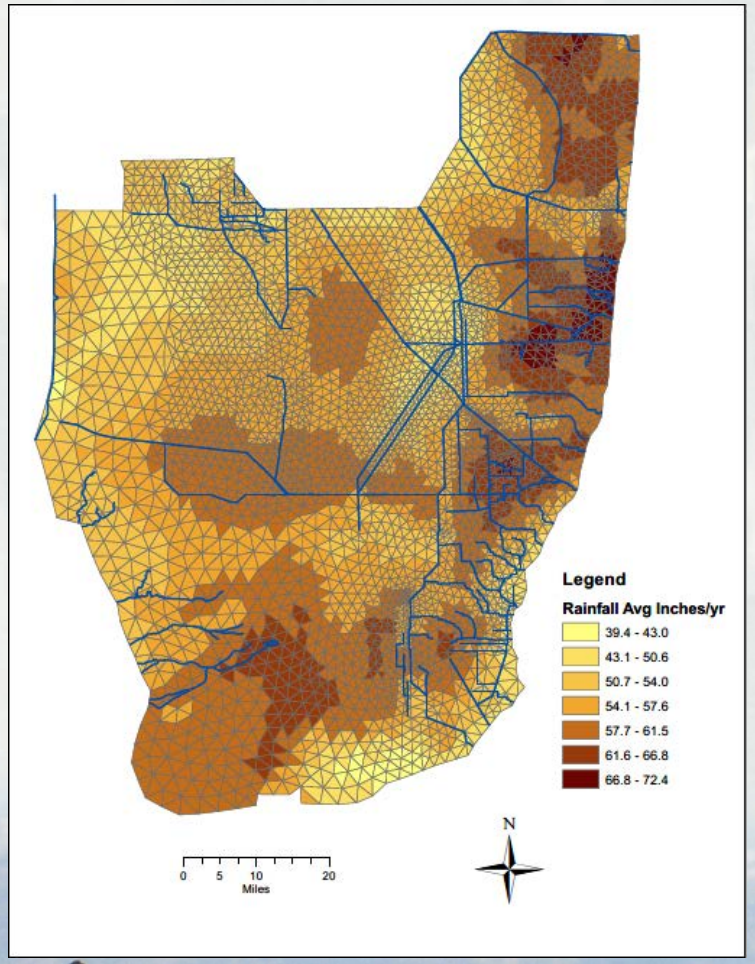

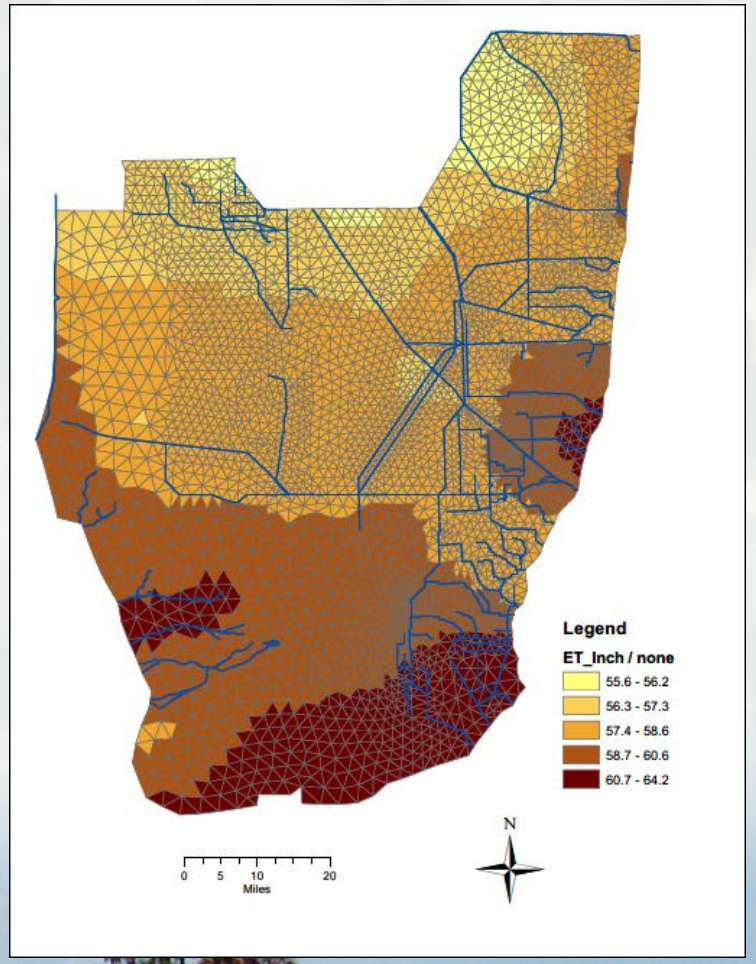

Model Topography

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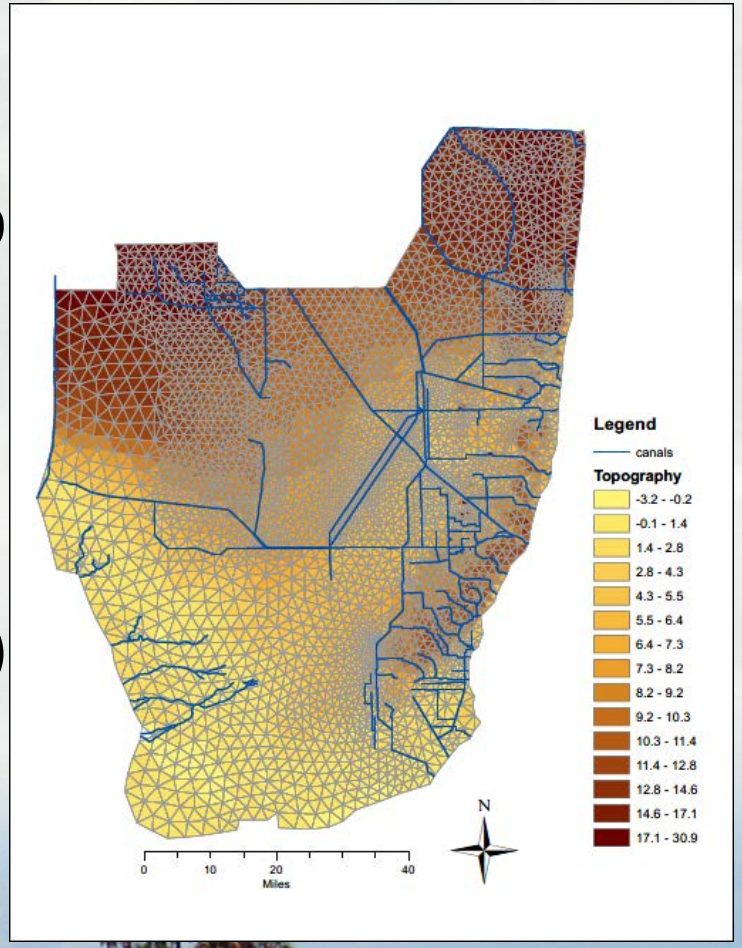
- Topo Value Range: -3.2 to 30.9 ft NGVD29
- Primary data sources:
  - USGS HAED accuracy of ≈ ± 0.5 ft
  - WERP LiDAR (≈ ± 0.33 ft)
  - C139 Annex LiDAR (≈ ± 0.18 ft)
  - Feeder Canal Basin (≈ ± 0.24 ft)
  - Seminole/BigCypress LiDAR (≈ ± 0.35 ft)



Model Topography

(WERP minus pre-WERP topography)

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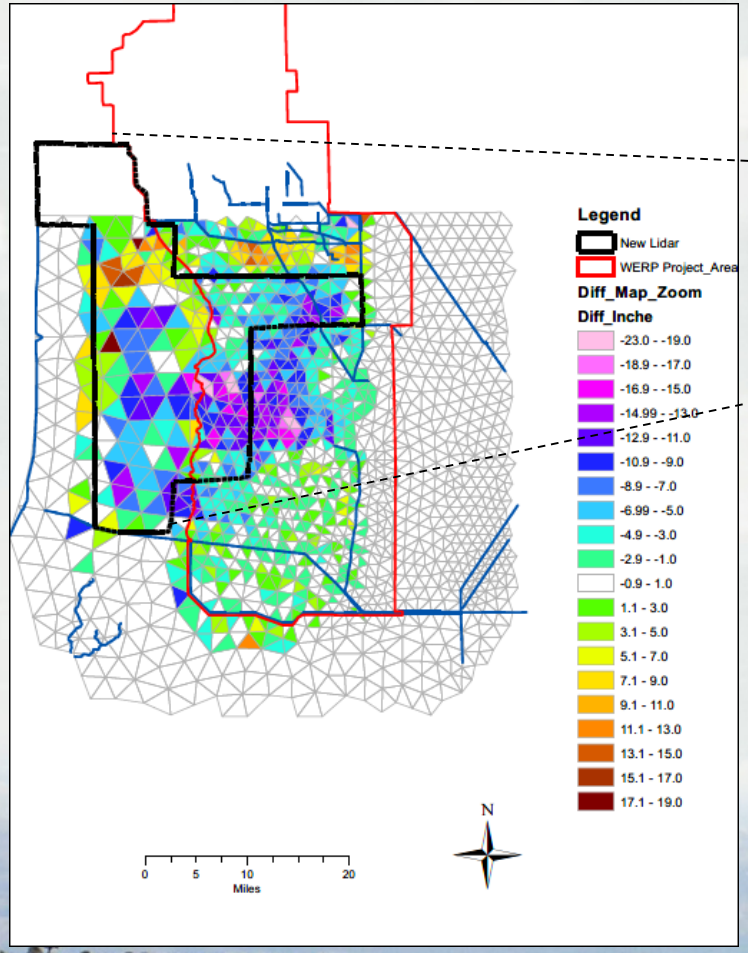

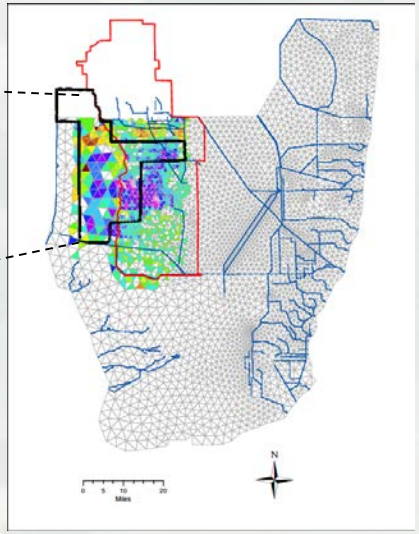

new LiDAR data extent relative to WERP project area

Landuse-Landcover Data

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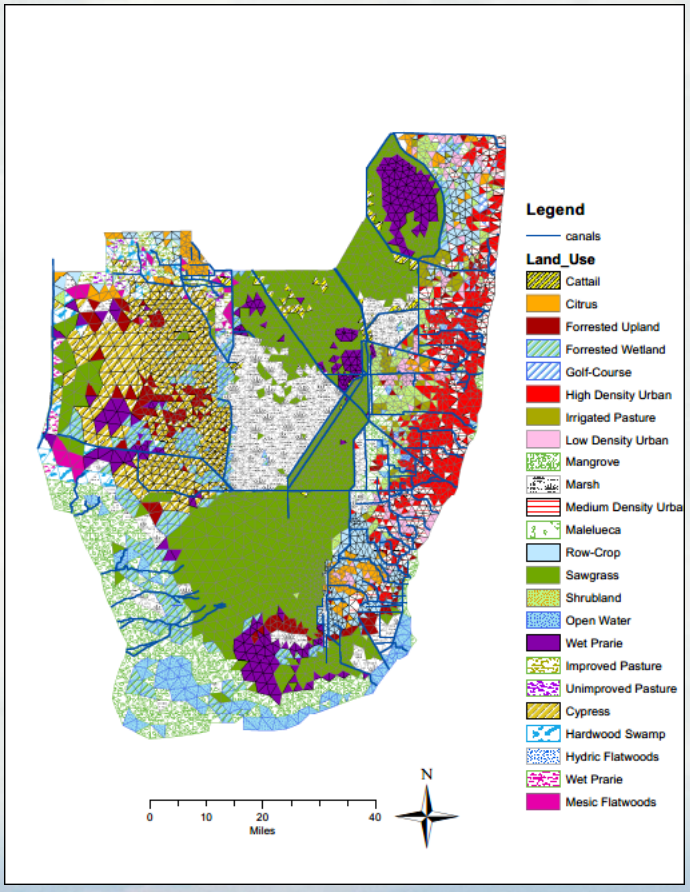
- 24 Landuse-Landcover (LULC) types
- Top 4 LULC types (25.9%)
  - Sawgrass (1,424 mi^2)
  - Cypress (617 mi^2)
  - Mangrove (521 mi^2)
  - Marsh (517 mi^2)
- Urban LULC classes (high, medium, and Low density) cover 5.94%
- Used for the calibration of surface roughness and ET parameter values



Landuse-Landcover Data
(WERP project area)

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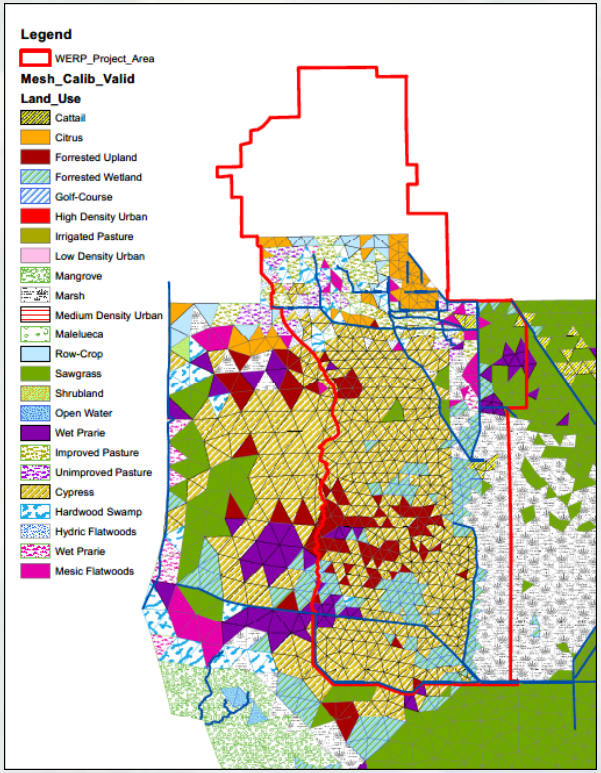
- 19 LULC types
- Top 4 LULC types (72.1%)
  - Cypress (410 mi^2)
  - Marsh (104 mi^2)
  - Forested Wetland (92 mi^2)
  - Forested Upland (59 mi^2)



Levee Seepage

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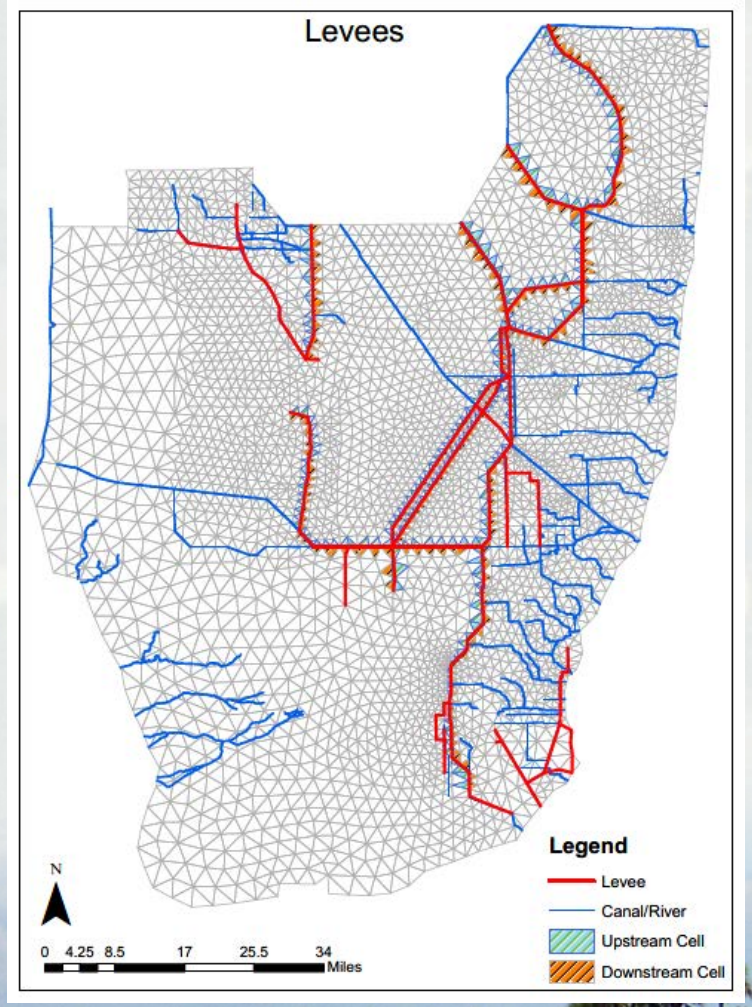

Canals and Structures

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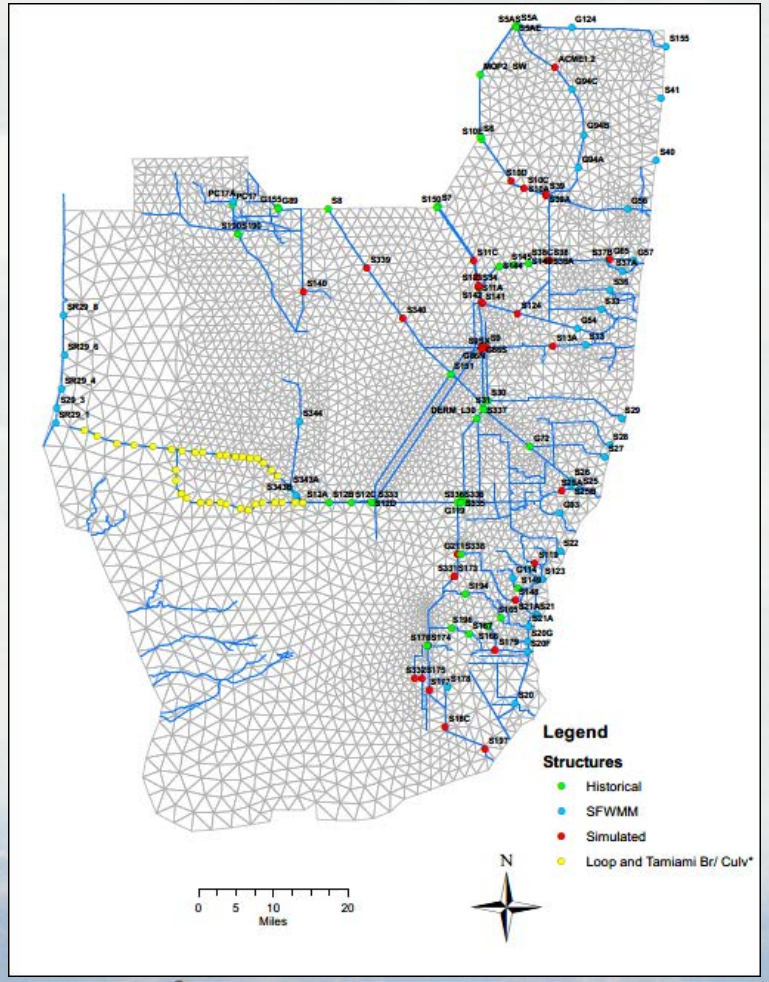

- Canals in RSMGL-WERP: 1,185 miles
- Additional canals for WERP (129 miles):
  - Northern WERP Area: 74 miles
  - Tamiami Trail & Loop Road:
    32 & 23 miles, respectively
- Additional structures for WERP:
  - 45 Tamiami Bridges
  - 95 Loop Road Culverts

Boundary Conditions

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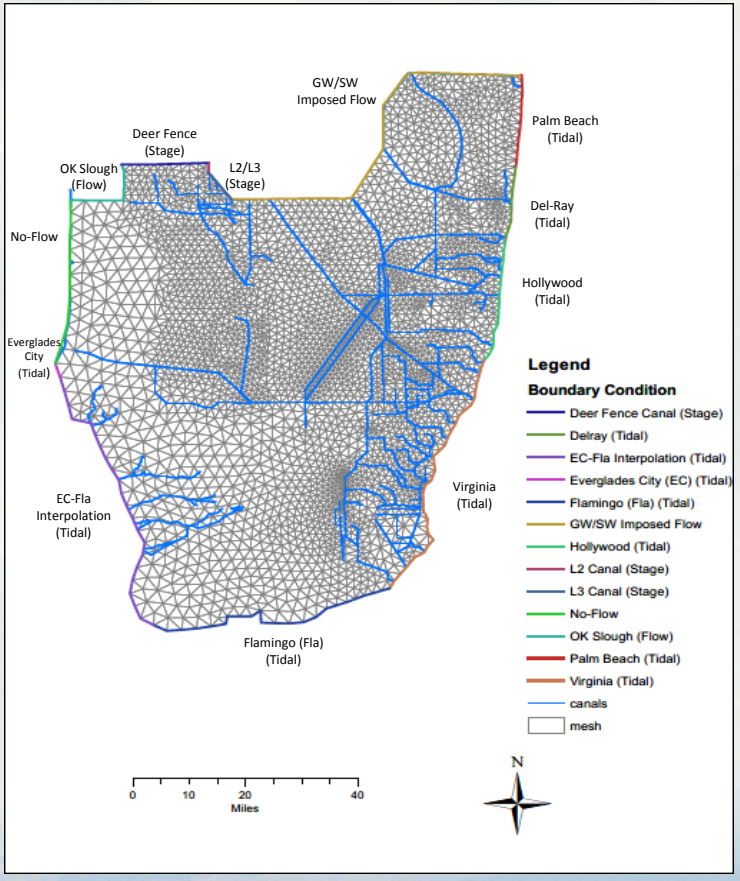
Additional boundary conditions included for WERP:

- Okaloacoochee flows
- Stage boundary conditions along Deer Fence Canal
- Stage boundary conditions along L2/L3 canal



Model Calibration Approach

RSMGL calibration:

- the process of improving RSMGL by matching model output data with observed data; data = water levels and flows
- used as a means of establishing confidence in the ability of the model to simulate or predict water levels and flows in the model domain
- a prerequisite to WERP baseline and alternative scenario simulations

Model Calibration Approach

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- Period of Record: Historical daily stage and flow data from 7/1/1995 to 12/31/2000 were used to run the calibration of the RSMGL; 1/1/2001 to 12/31/2005 were used to run the validation.
- Location: Historical time-series data from 36 gages were used as bases for the calibration of the Glades-LECSA model for WERP.
- Tool: The model was calibrated primarily using PEST (Doherty, 2004). PEST (**P**arameter **EST**imation) is a general-purpose model-independent nonlinear parameter estimation software package.
- Objective: The calibration objective function was to minimize the weighted sum of squares of the absolute bias calculated at each measuring site.
- Knobs: Selected model parameter values were adjusted (using PEST) until simulated and historical stages were in agreement, i.e., the calibration objective is satisfactorily met.
- Stopping criteria: Model calibration was considered as satisfactory when the absolute bias and RMSE values at all 36 gages were less than 1 and 2 feet, respectively.

Calibration Gages Maps

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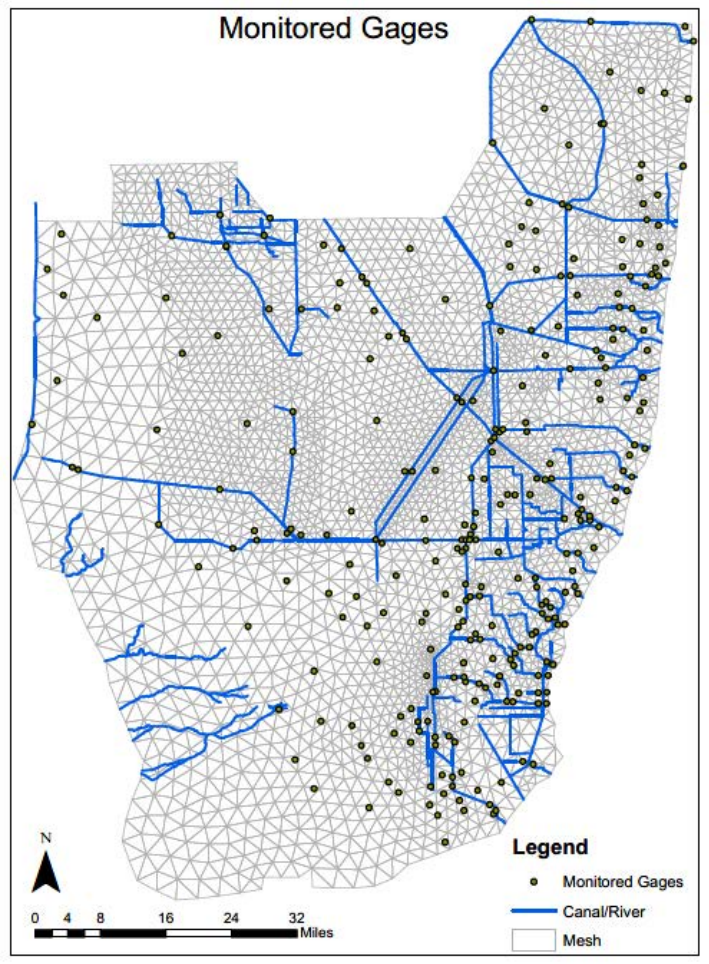

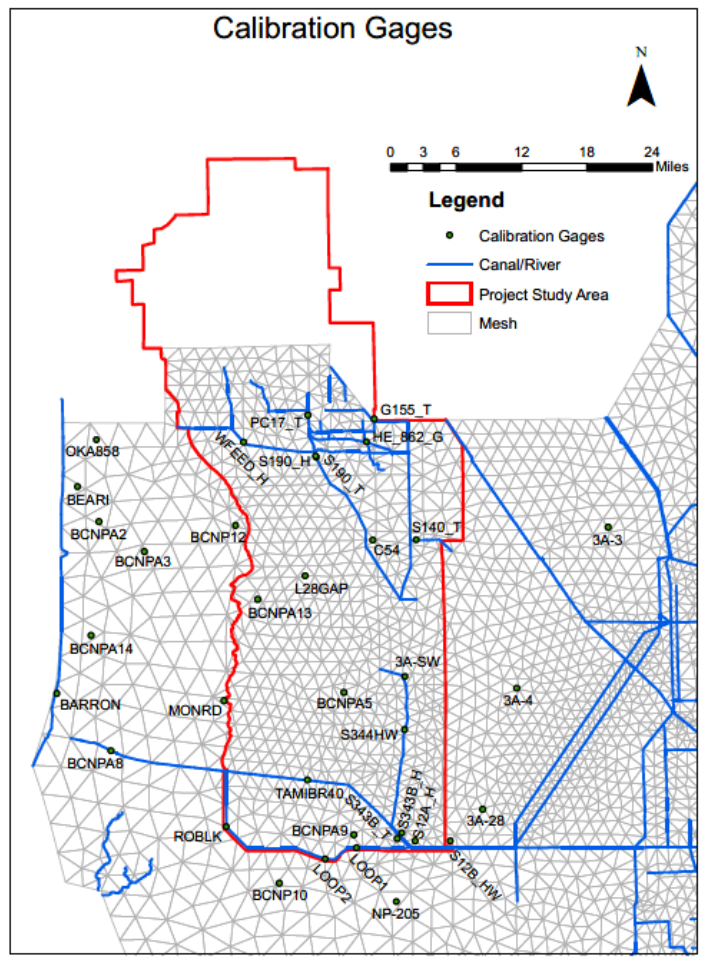

Calibration Objective Function

$$\Phi = w_1 \sum_{i=1}^{M} Bias_{i,allseason}^2 + w_2 \sum_{i=1}^{M} Bias_{i,dryseason}^2 + w_3 \sum_{i=1}^{M} Bias_{i,wetseason}^2$$

Φ = weighted sum of cumulative bias squared

M = total number of calibration gages;

w_1 = weight for all season

w_2 = weight for dry season

w_3 = weight for wet season

Bias values were computed on a daily basis and aggregated to a final representative value for each gage.

Model Calibration Parameters

- Aquifer saturated hydraulic conductivity values
- Canal leakance values
- Levee seepage coefficients
- Overland Manning's roughness coefficients
- Canal Manning's roughness coefficients
- General head boundary conductance values
- Evapotranspiration coefficients
- Evapotranspiration extinction depths
- SV converter parameter values
- WCD leakance value

Goodness-of-fit Statistical Estimators

$$Bias = \frac{\sum_{i=1}^{n} (\hat{x} - x_i)}{n}$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n} (\hat{x} - x_i)^2}{n - 1}}$$

n = total number of measured observations at a gaging station

Bias Calibration (WERP vs CV_2010)

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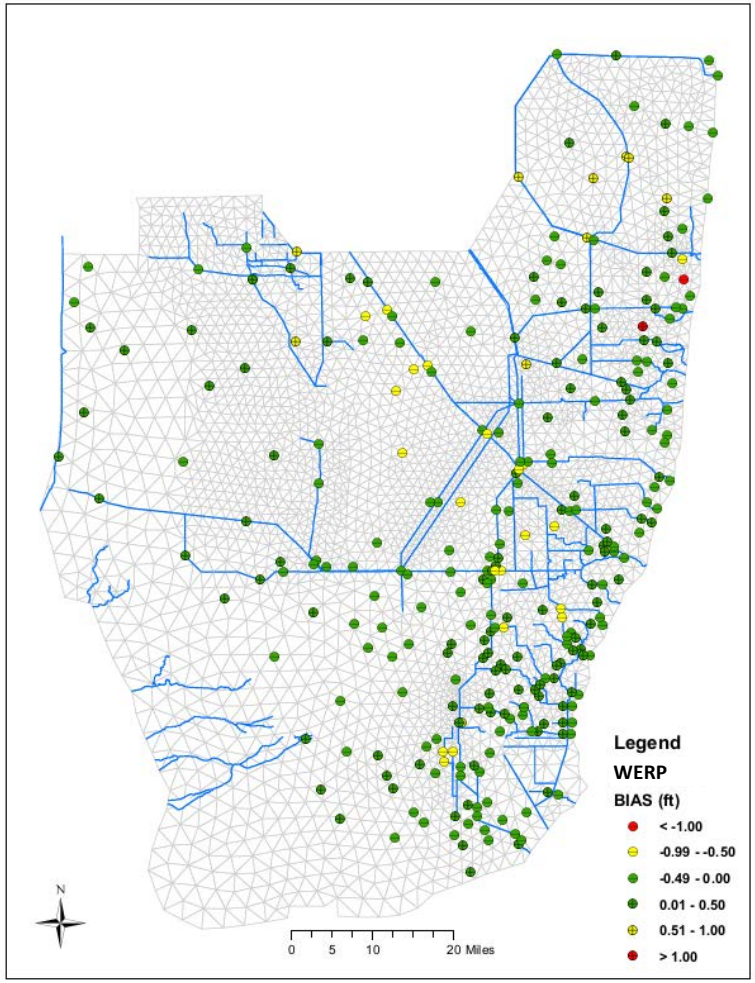

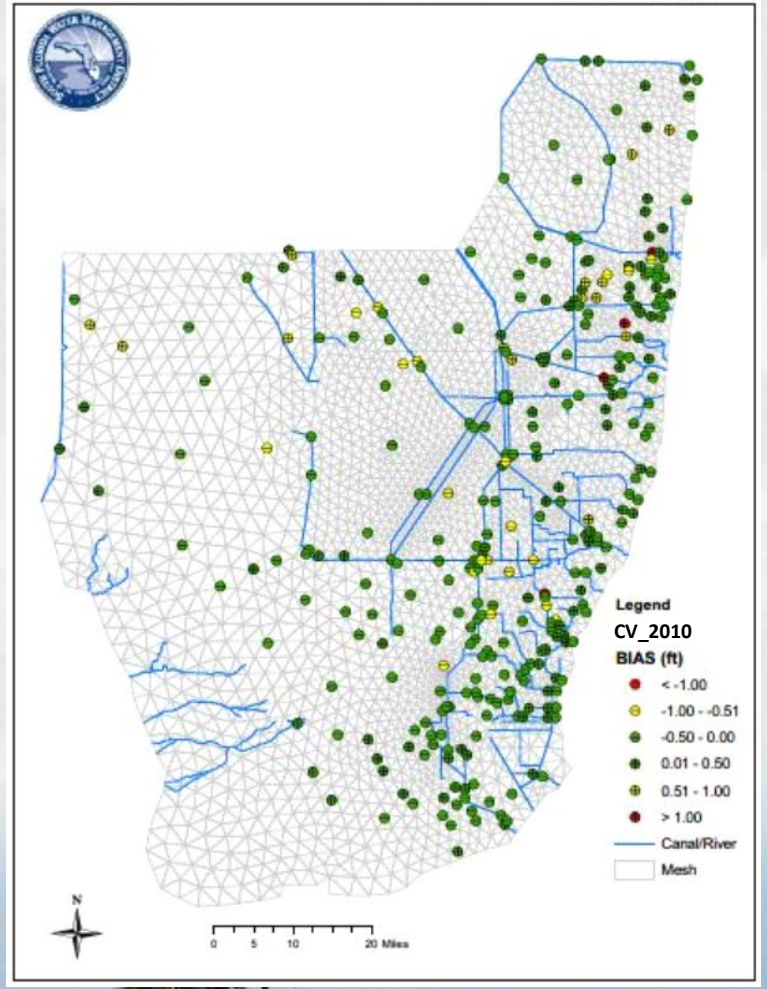

RMSE Calibration (WERP vs CV_2010)

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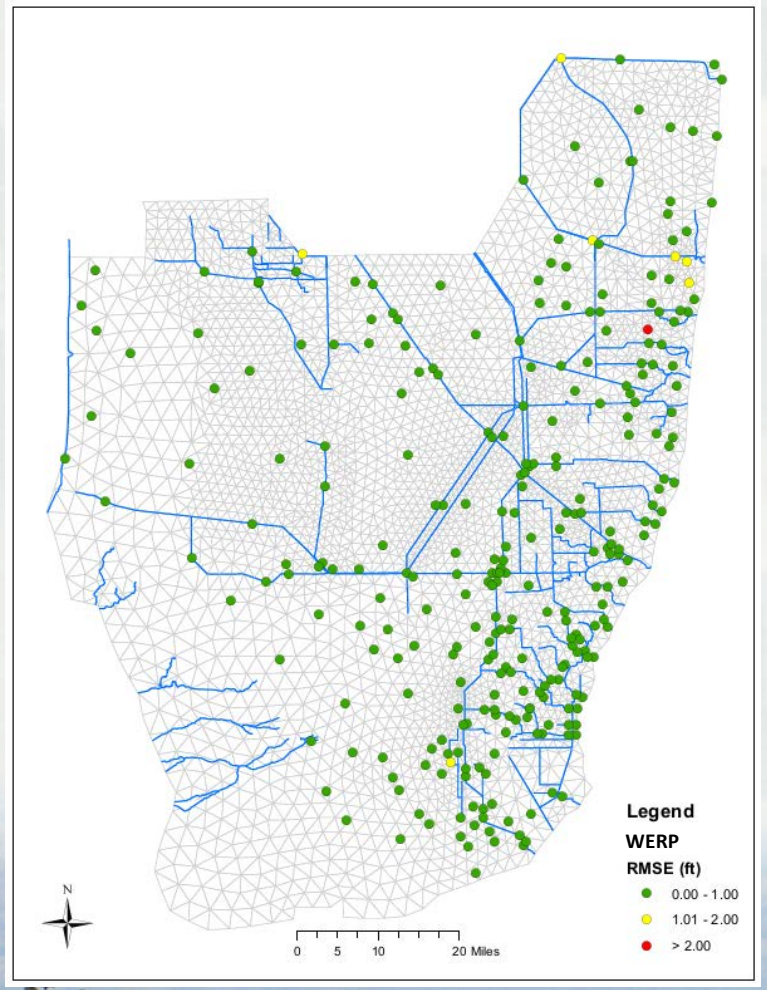

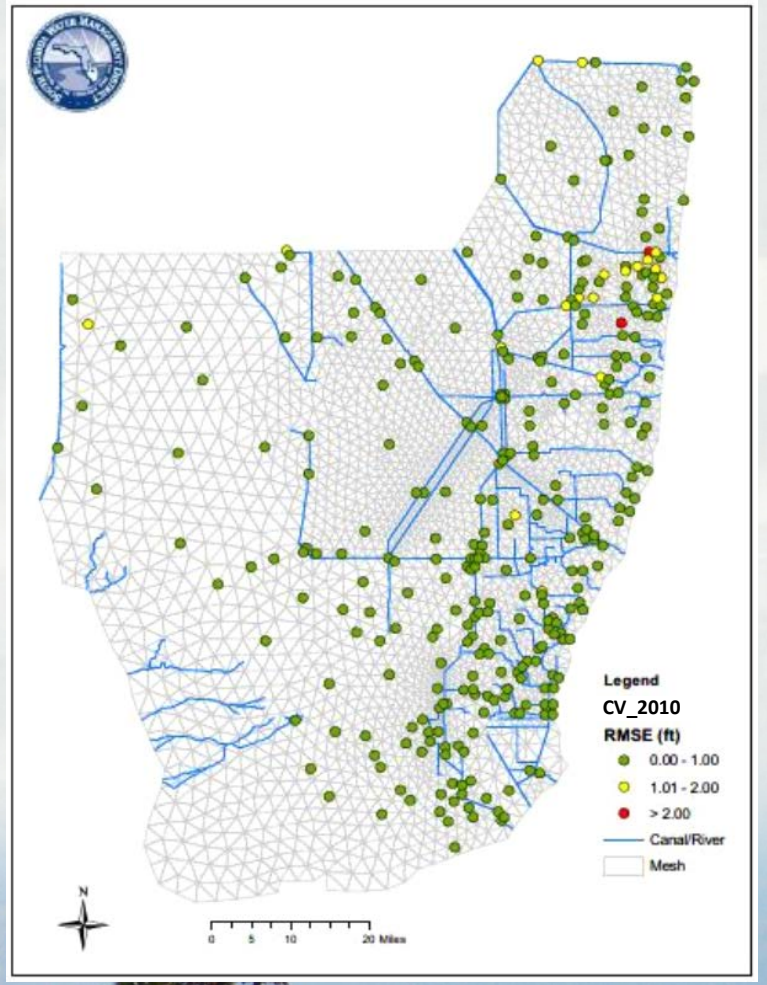

Calibration Gages Maps

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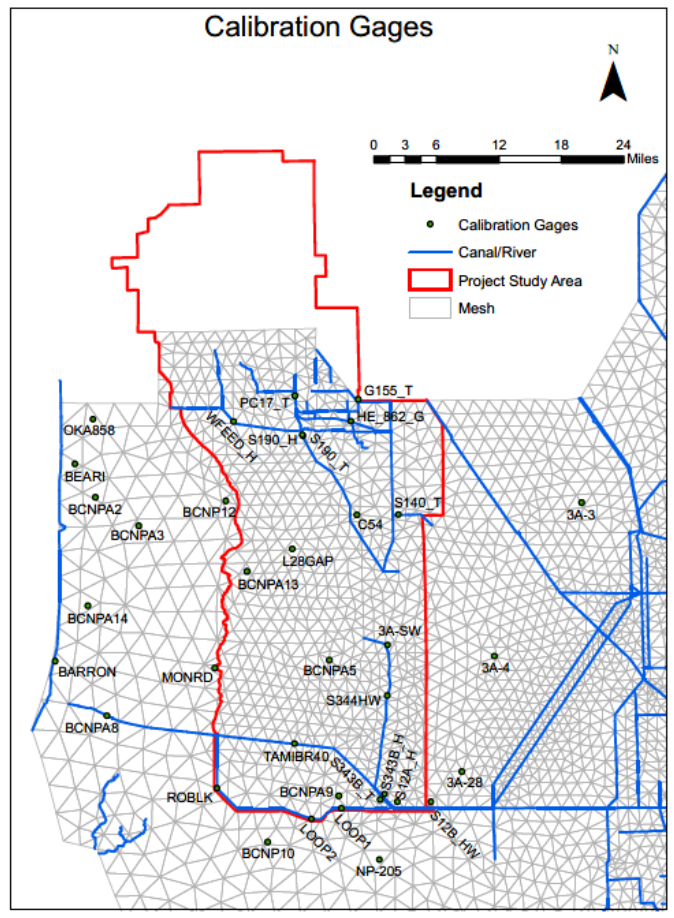

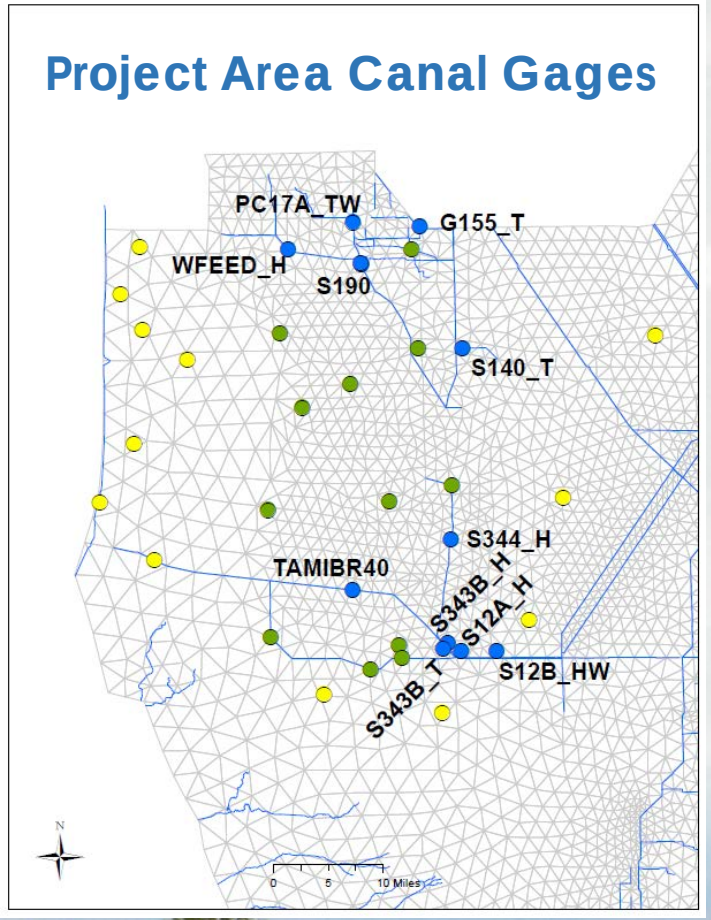

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Selected Calibration Plots

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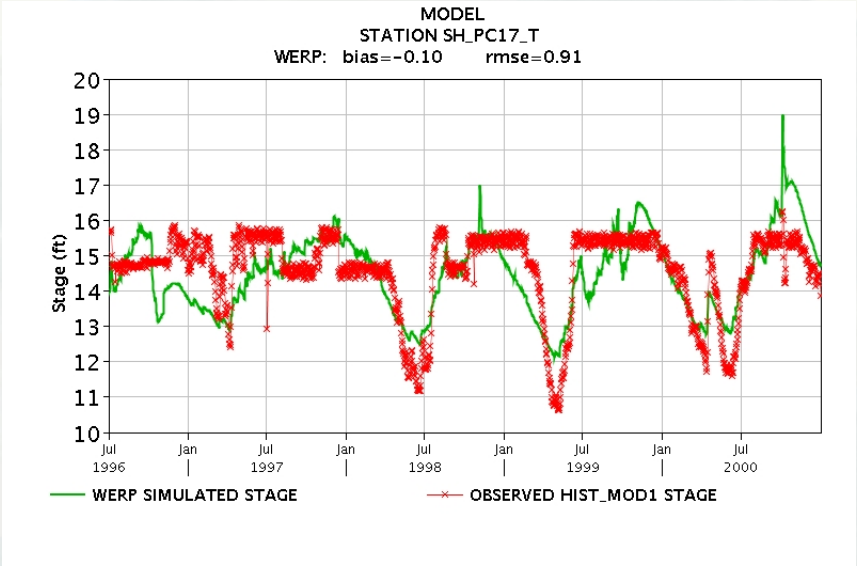

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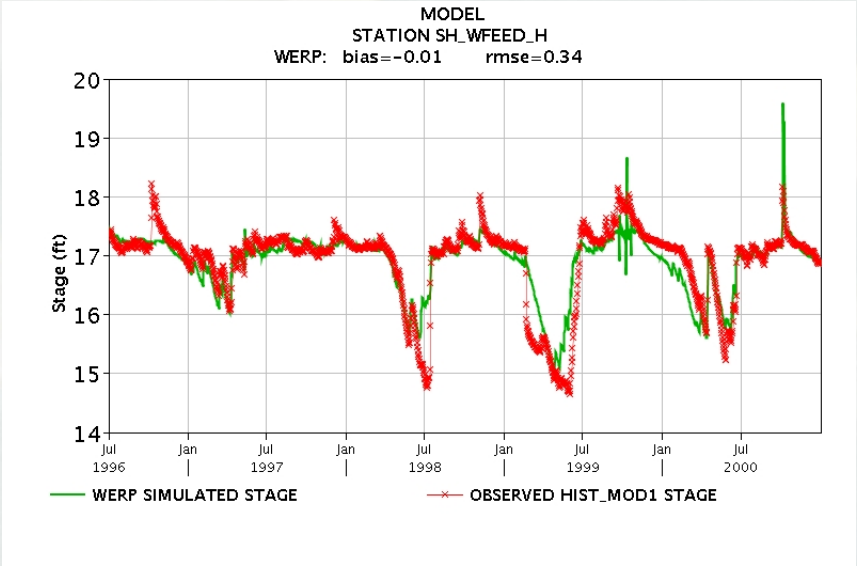

Selected Calibration Plots

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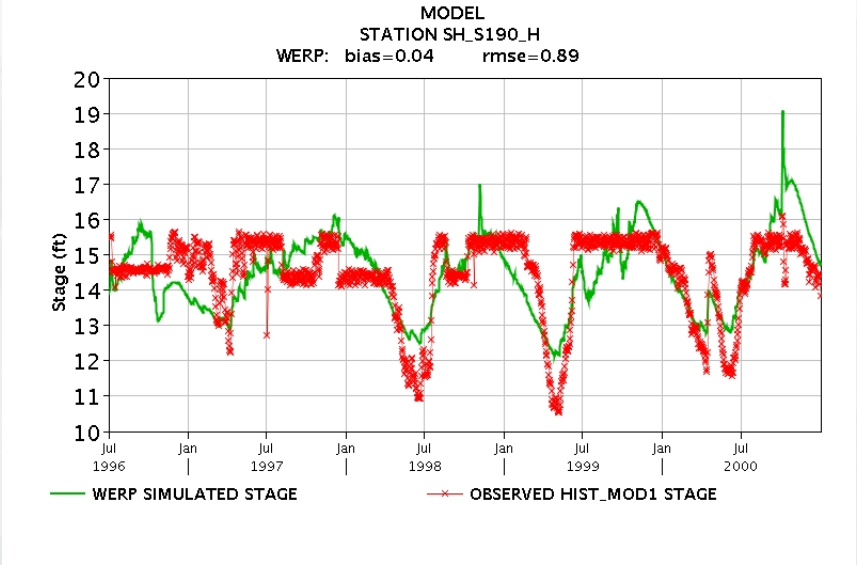

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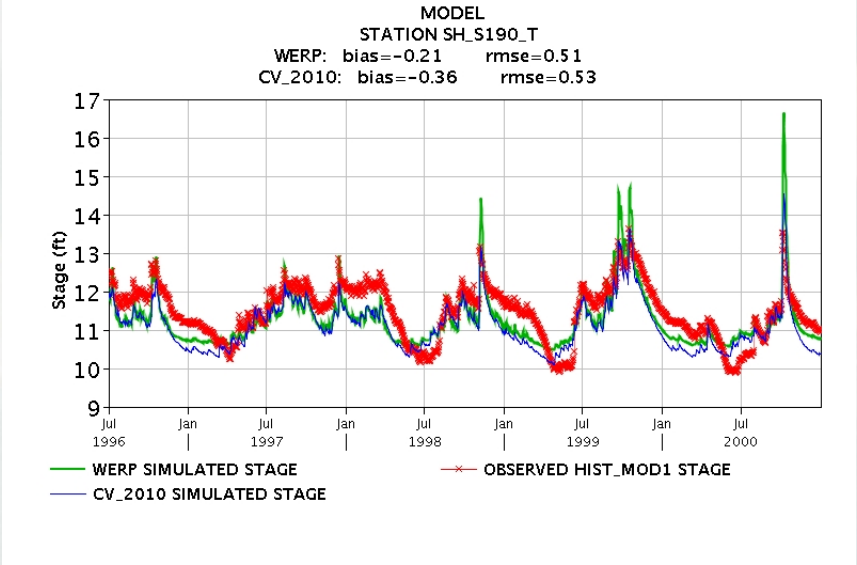

Selected Calibration Plots

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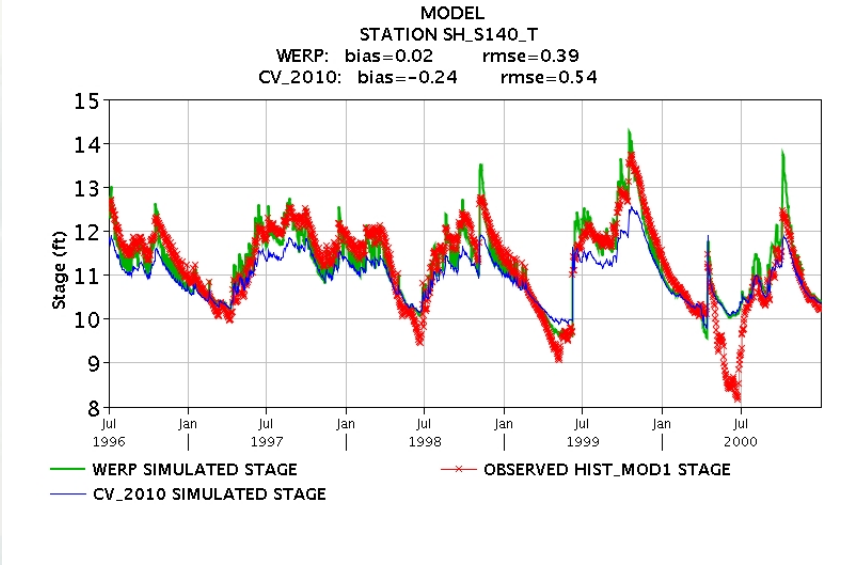

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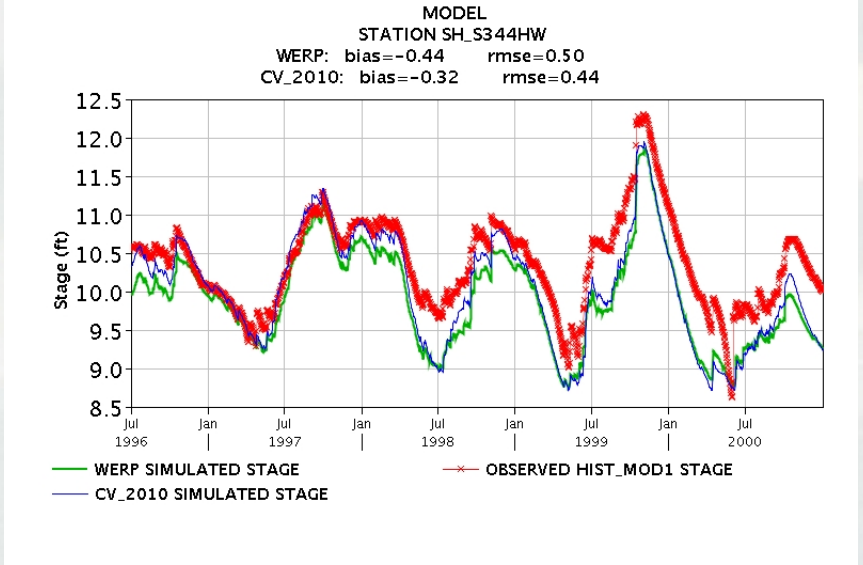

Selected Calibration Plots

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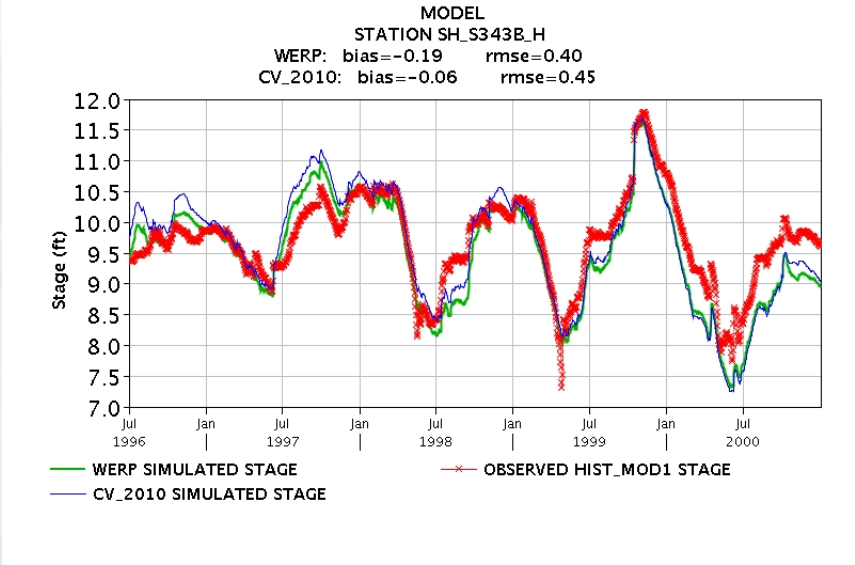

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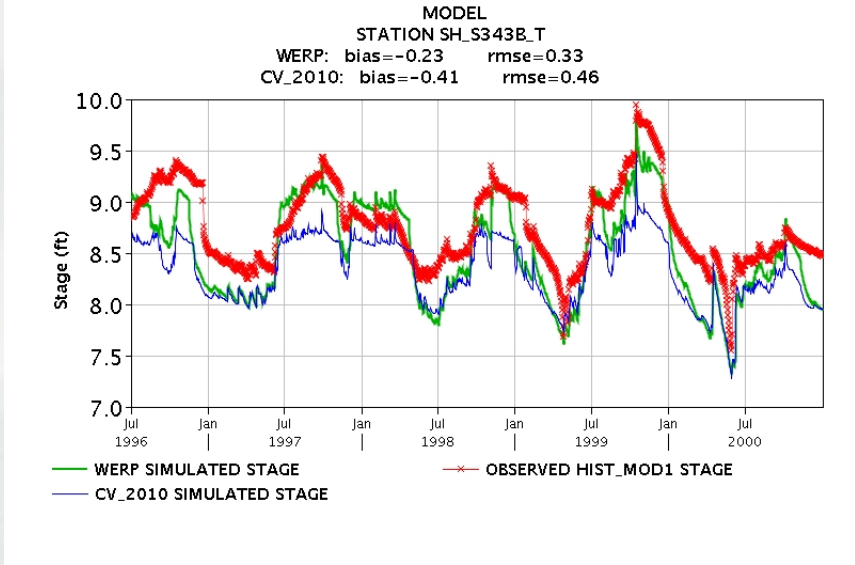

Selected Calibration Plots

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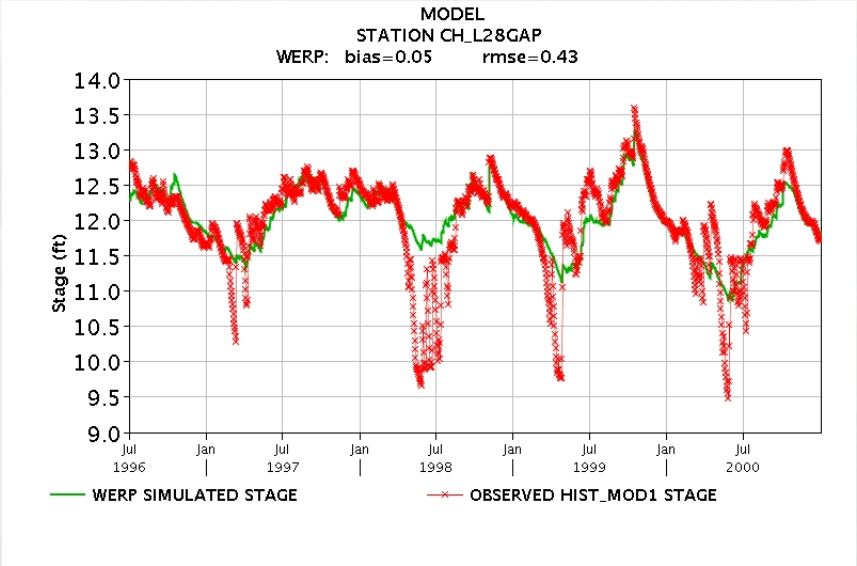

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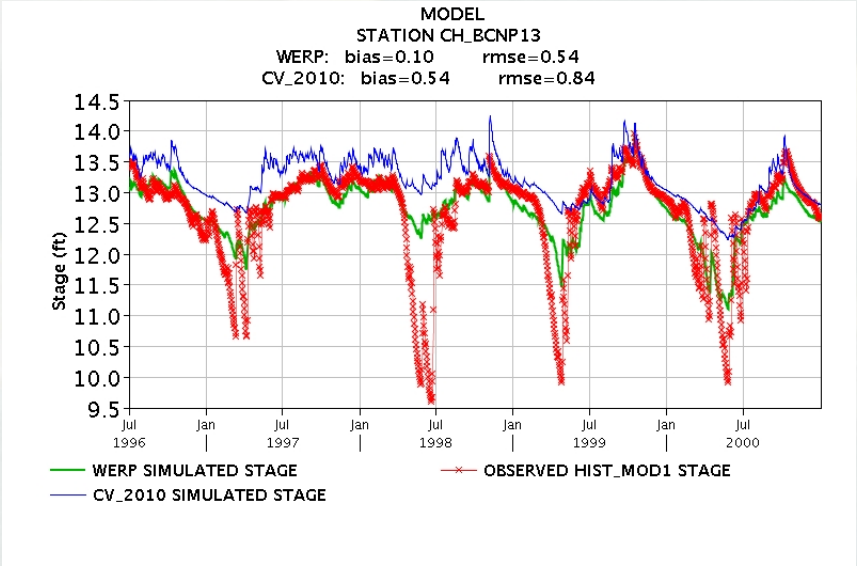
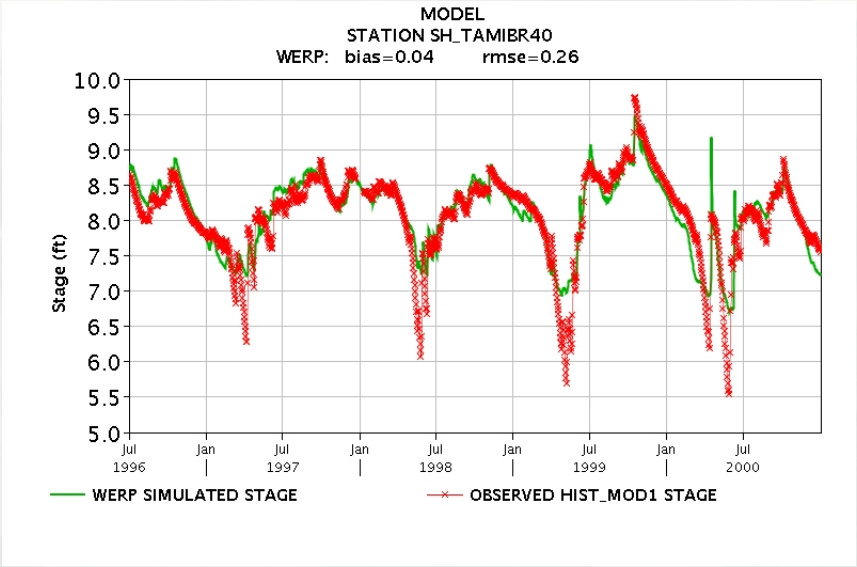


Selected Calibration Plots

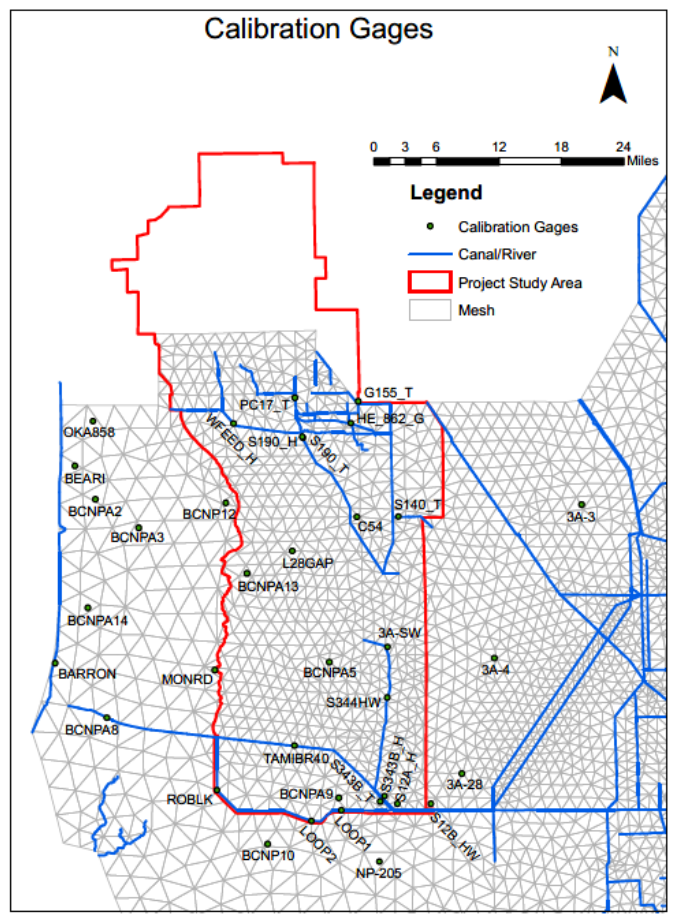
BUILDING STRONG

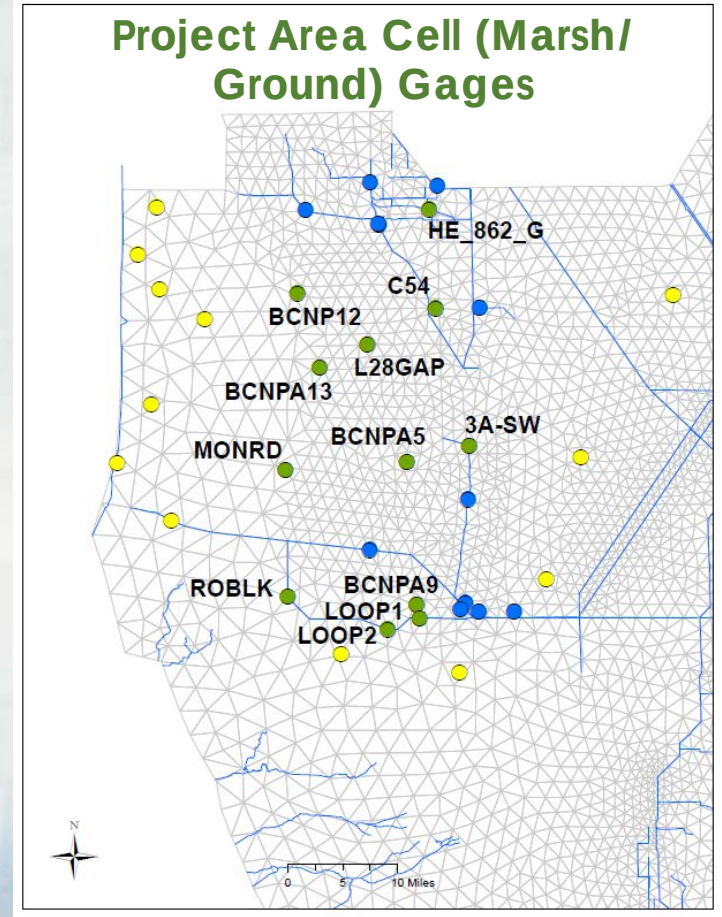
{TAMIBR40}



Calibration Gages Maps

BUILDING STRONG





Selected Calibration Plots

BUILDING STRONG

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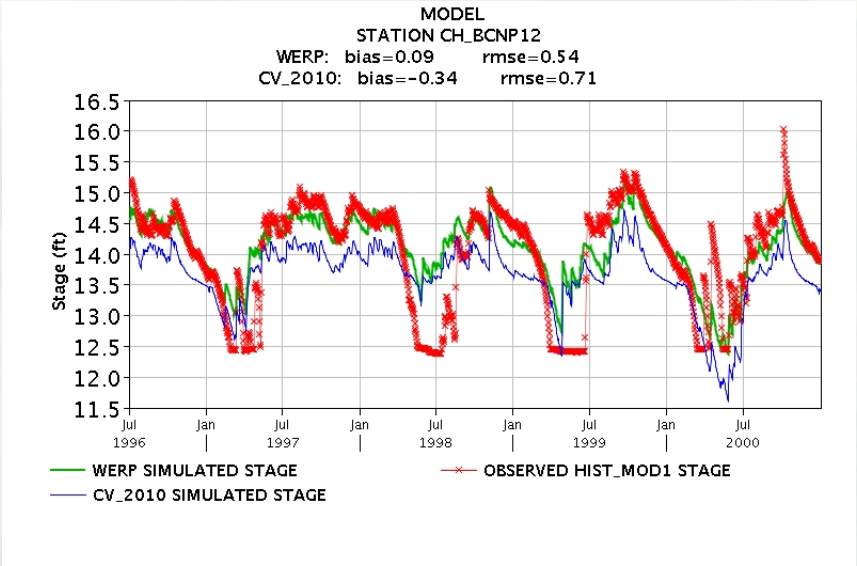

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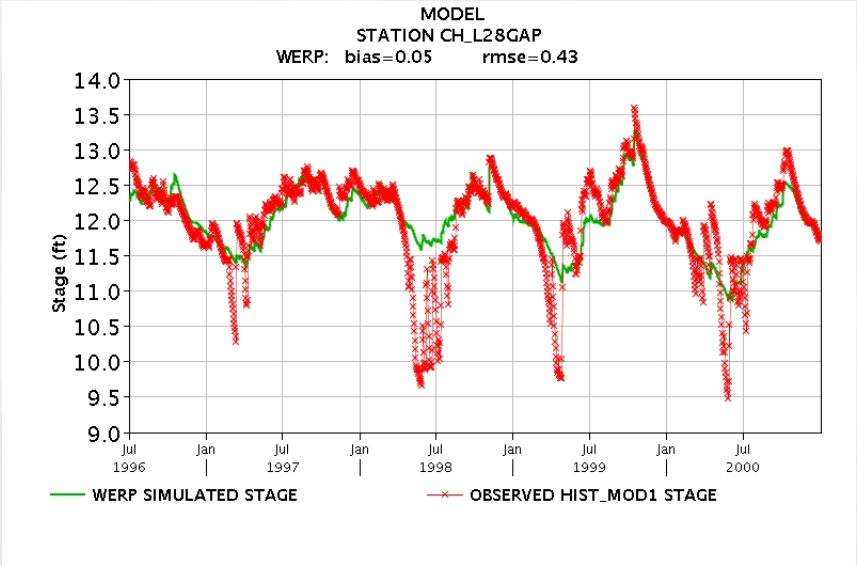

Selected Calibration Plots

BUILDING STRONG

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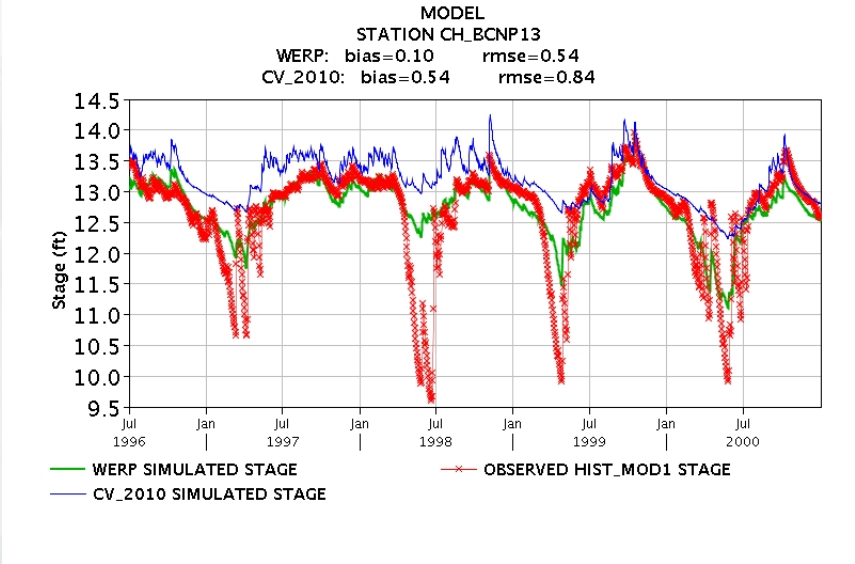

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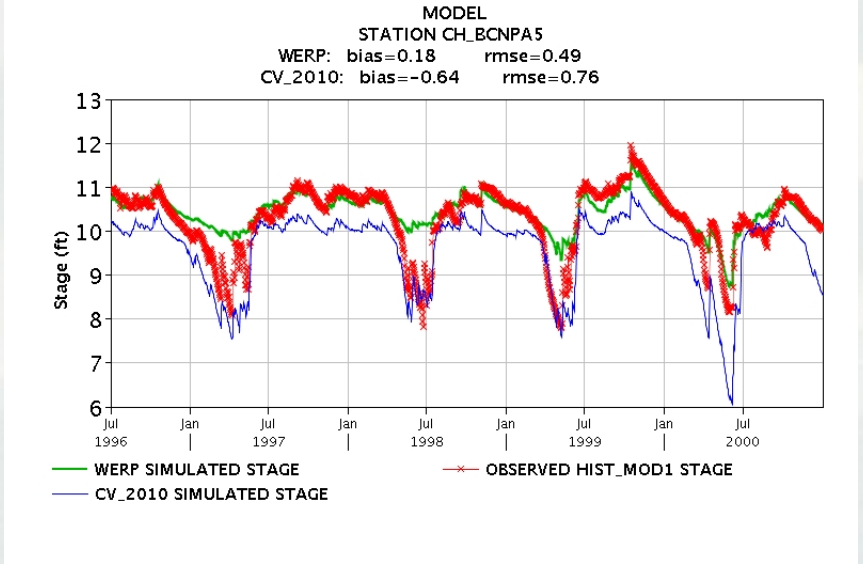
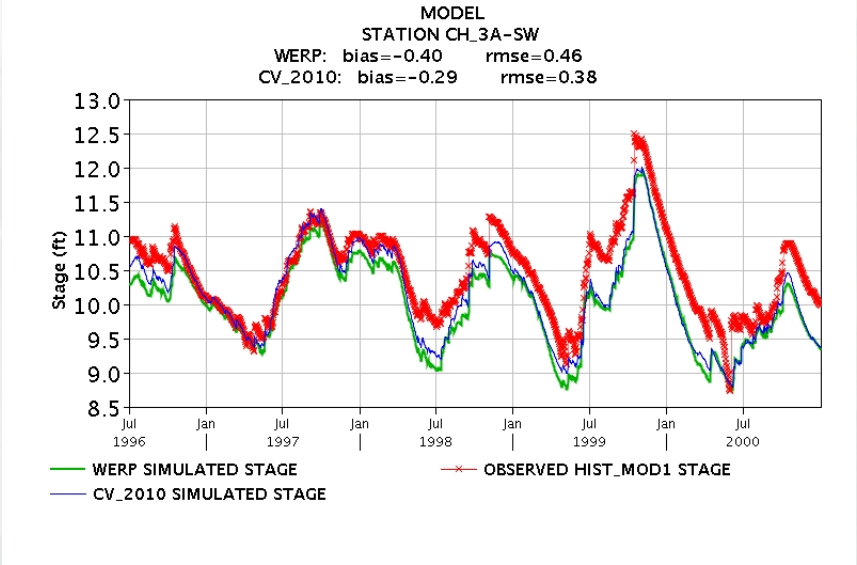


Selected Calibration Plots

BUILDING STRONG

{3A-SW}



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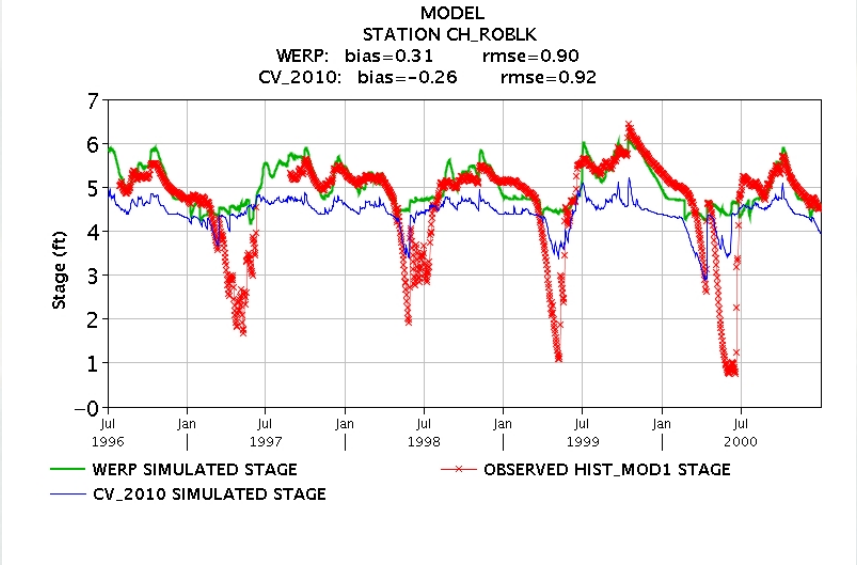

Selected Calibration Plots

BUILDING STRONG

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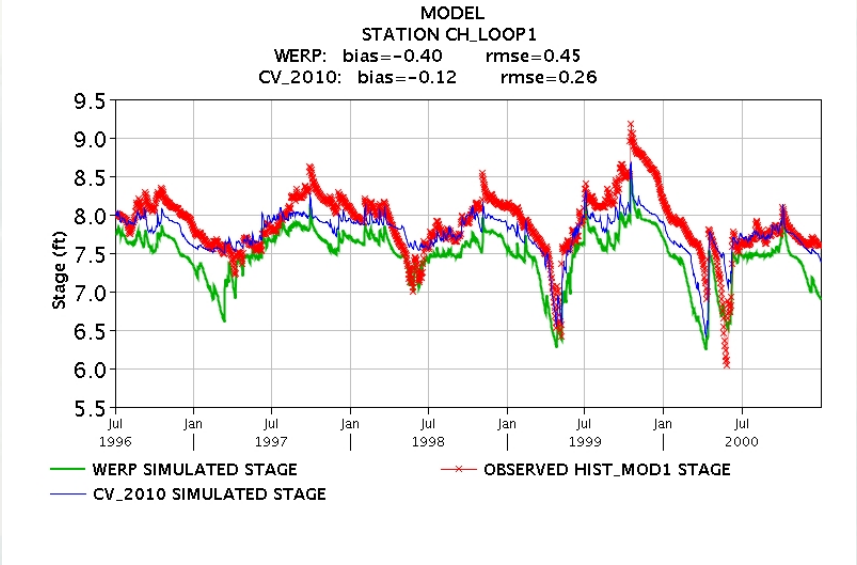

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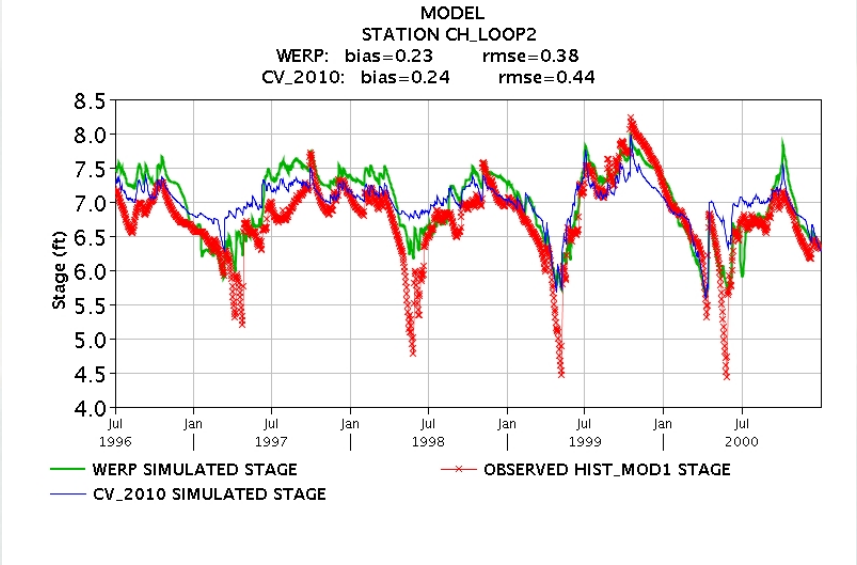
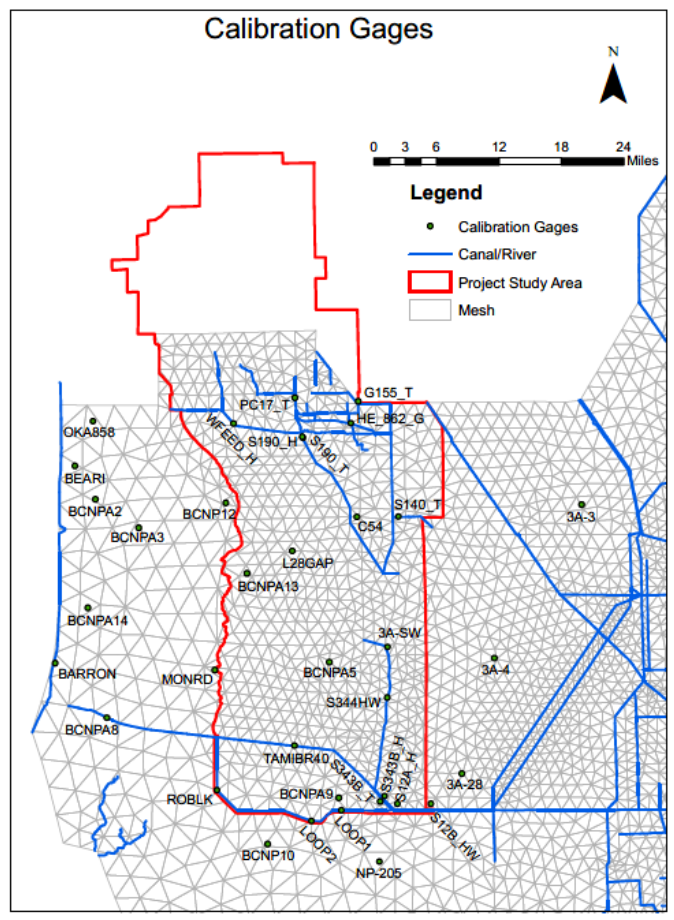
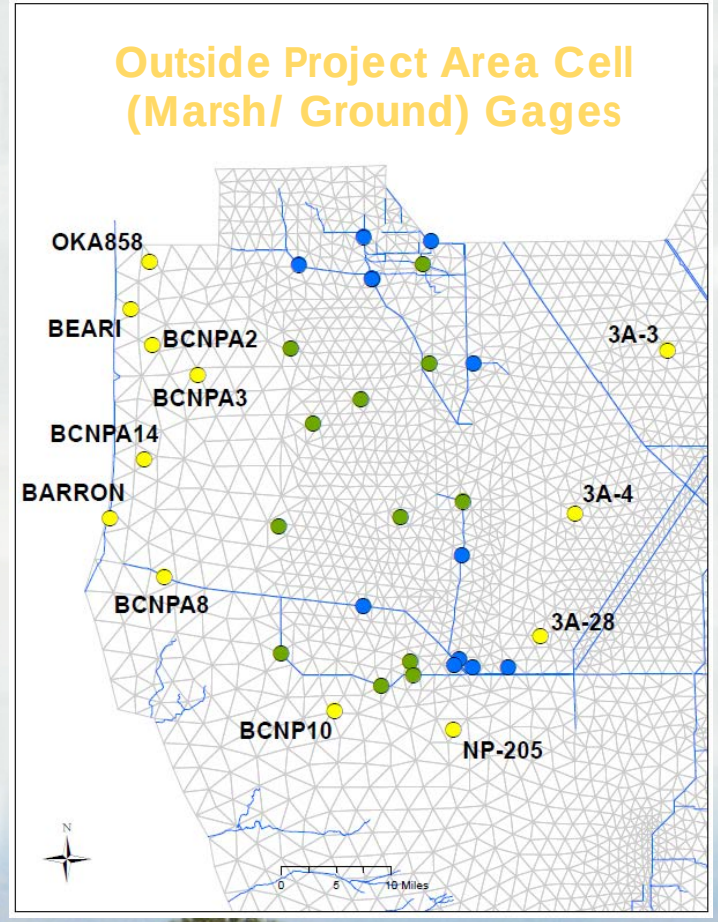


Calibration Gages Maps

BUILDING STRONG





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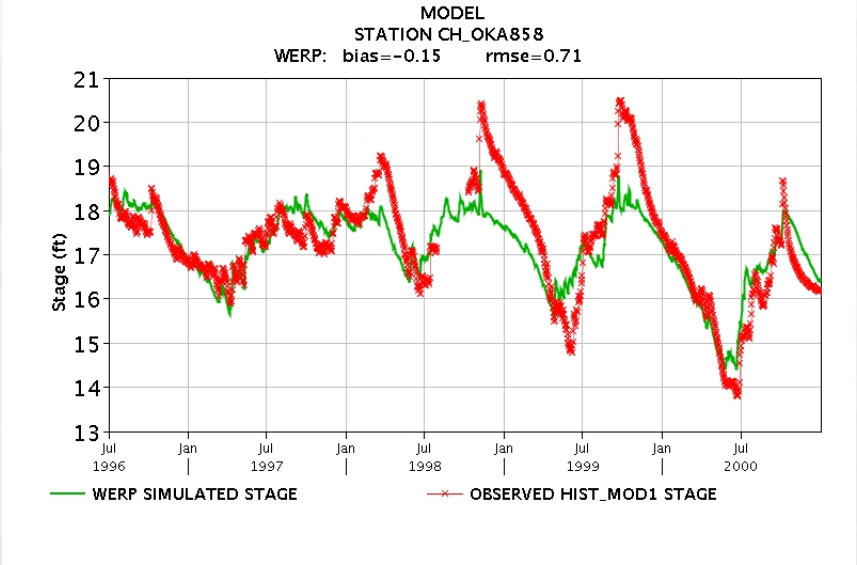
Selected Calibration Plots

BUILDING STRONG

{OKA858}



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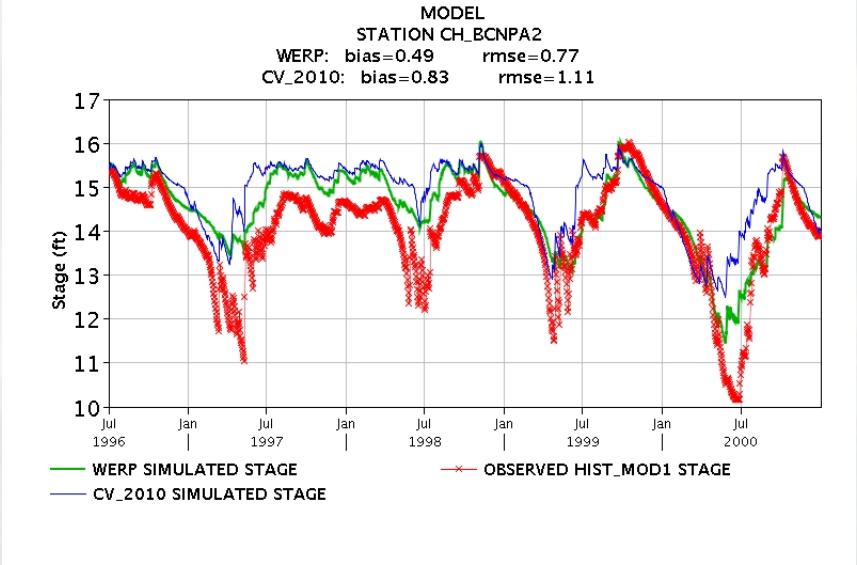
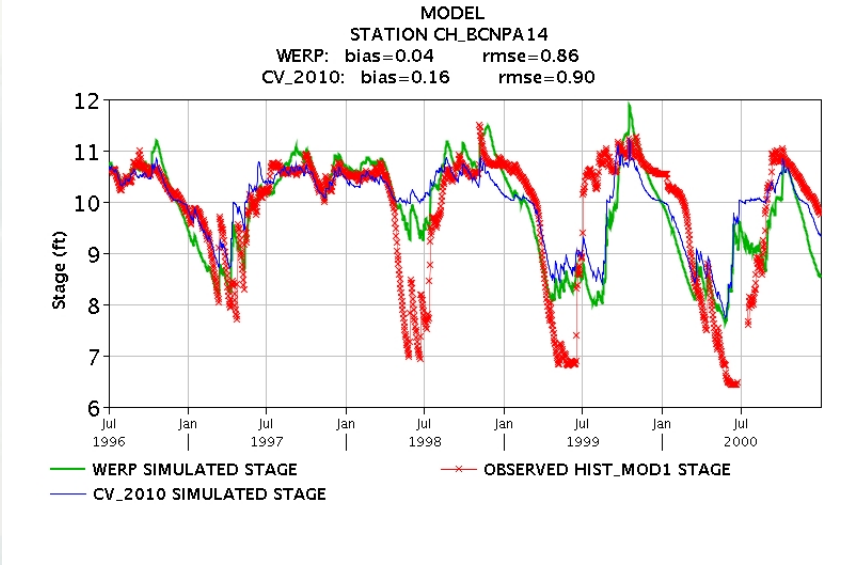


Selected Calibration Plots

BUILDING STRONG

{BCNPA14}



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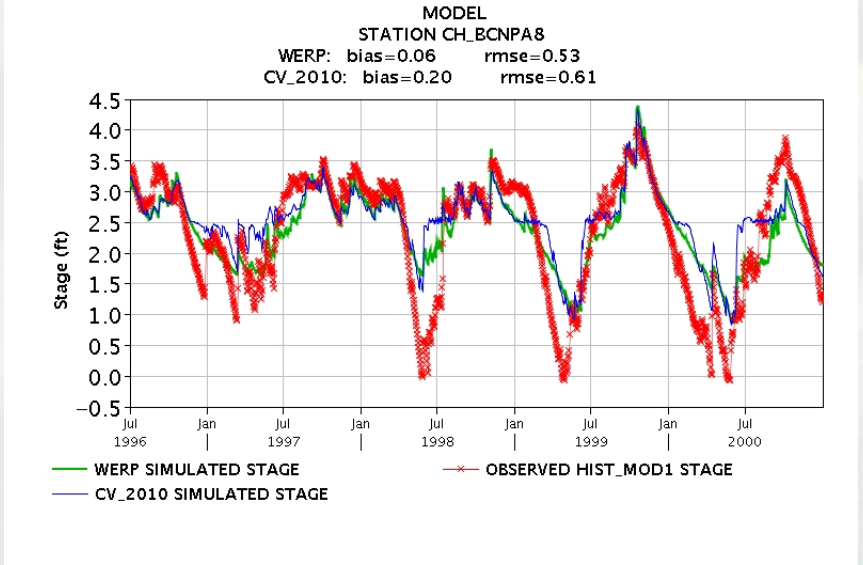

Selected Calibration Plots

BUILDING STRONG

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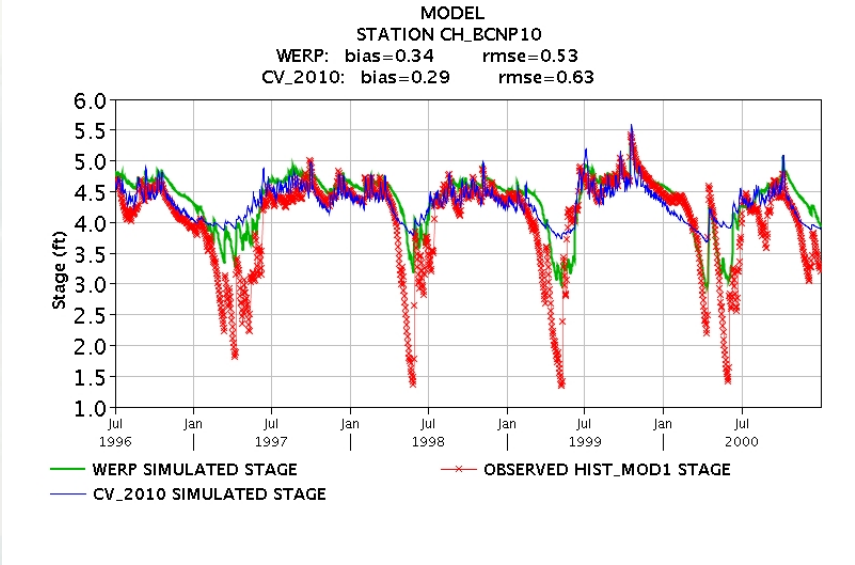

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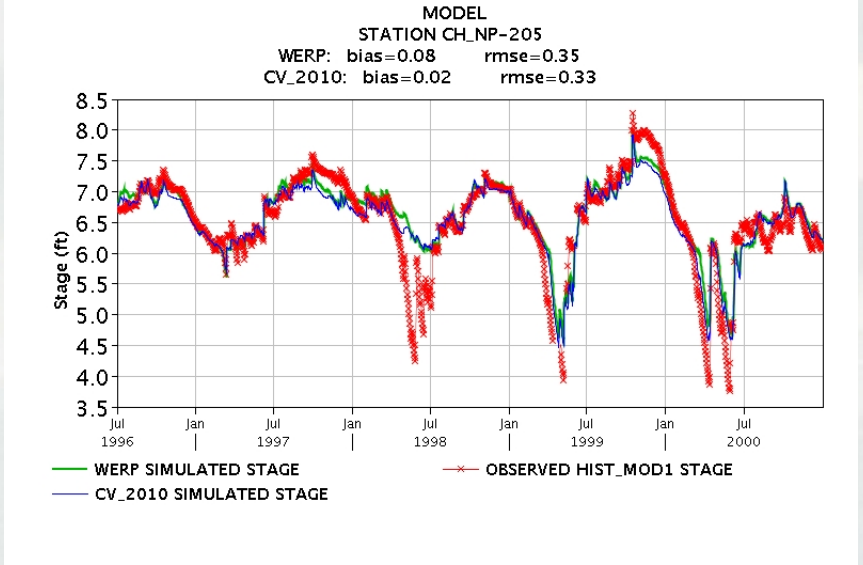
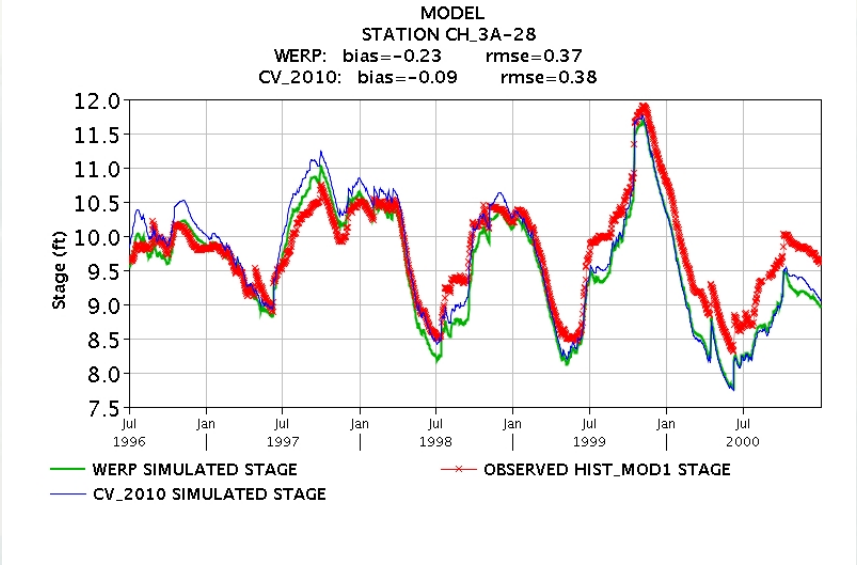


Selected Calibration Plots

BUILDING STRONG

{3A-28}



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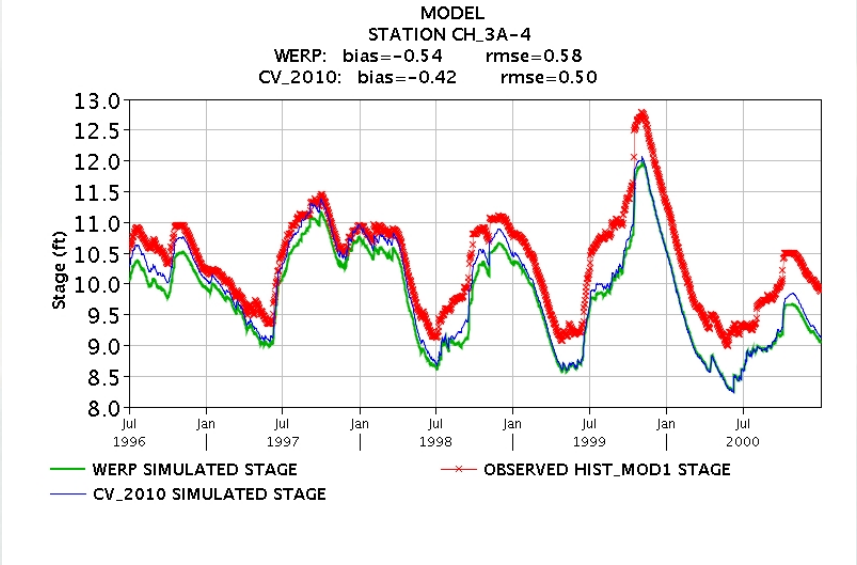
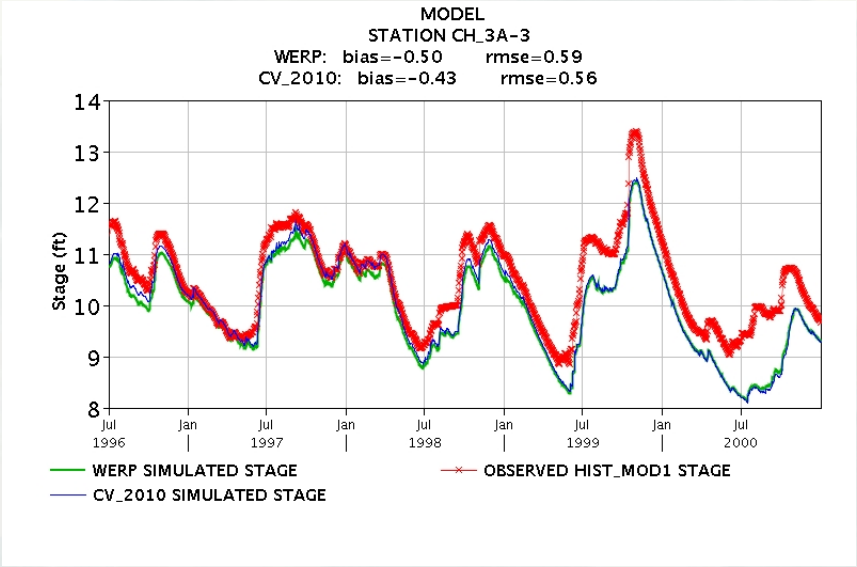


Selected Calibration Plots

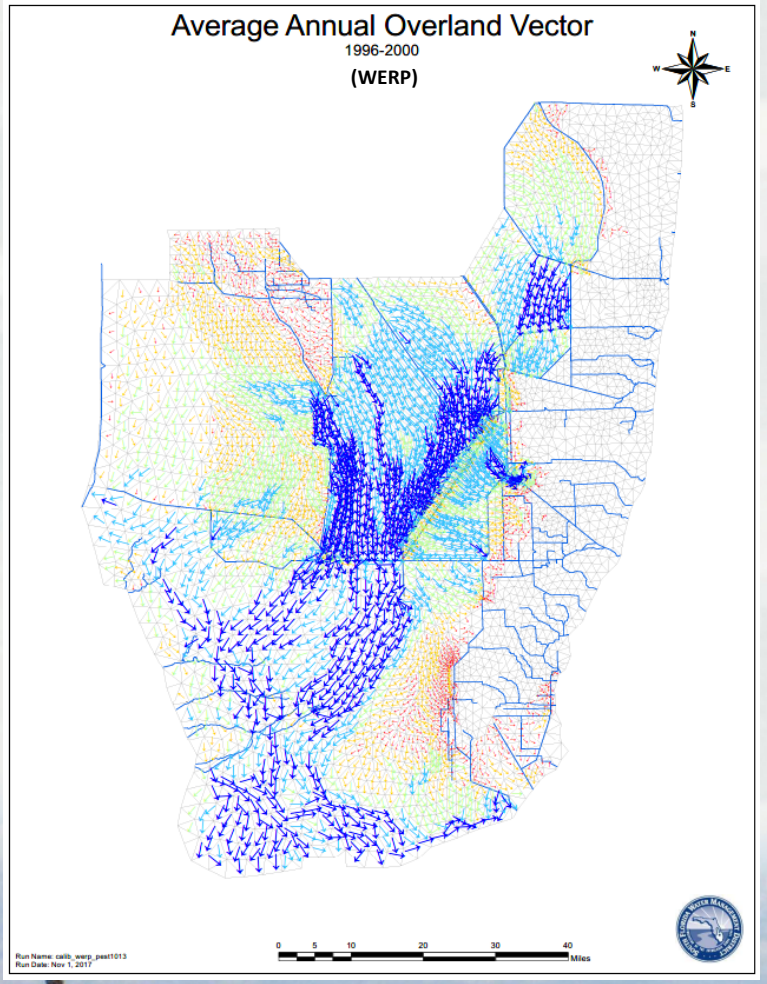
BUILDING STRONG

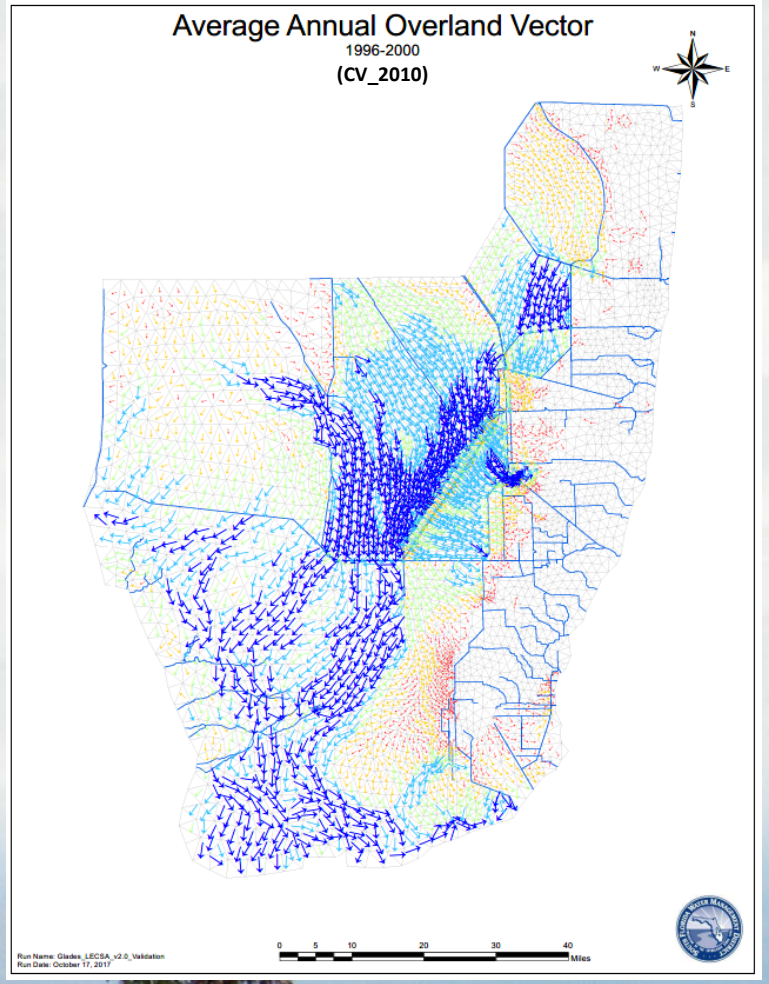
{3A-3}



Mean Annual Overland Flow for Calibration Period (1996-2000), WERP vs CV_2010

BUILDING STRONG





Summary

BUILDING STRONG

	Average (ft)		Standard Deviation (ft)	
	Calibration	Validation	Calibration	Validation
Abs. Bias (ft)	0.25	--	0.19	--
RMSE (ft)	0.58	--	0.22	--

Northern WERP RSM submodel

- North WERP RSM was created to focus on developed land in Region 2 where several management measures will be considered.
- North WERP RSM includes detailed agricultural land use.
- Calibrate to more recently reported water use, basin structure flows, and shallow groundwater stage.

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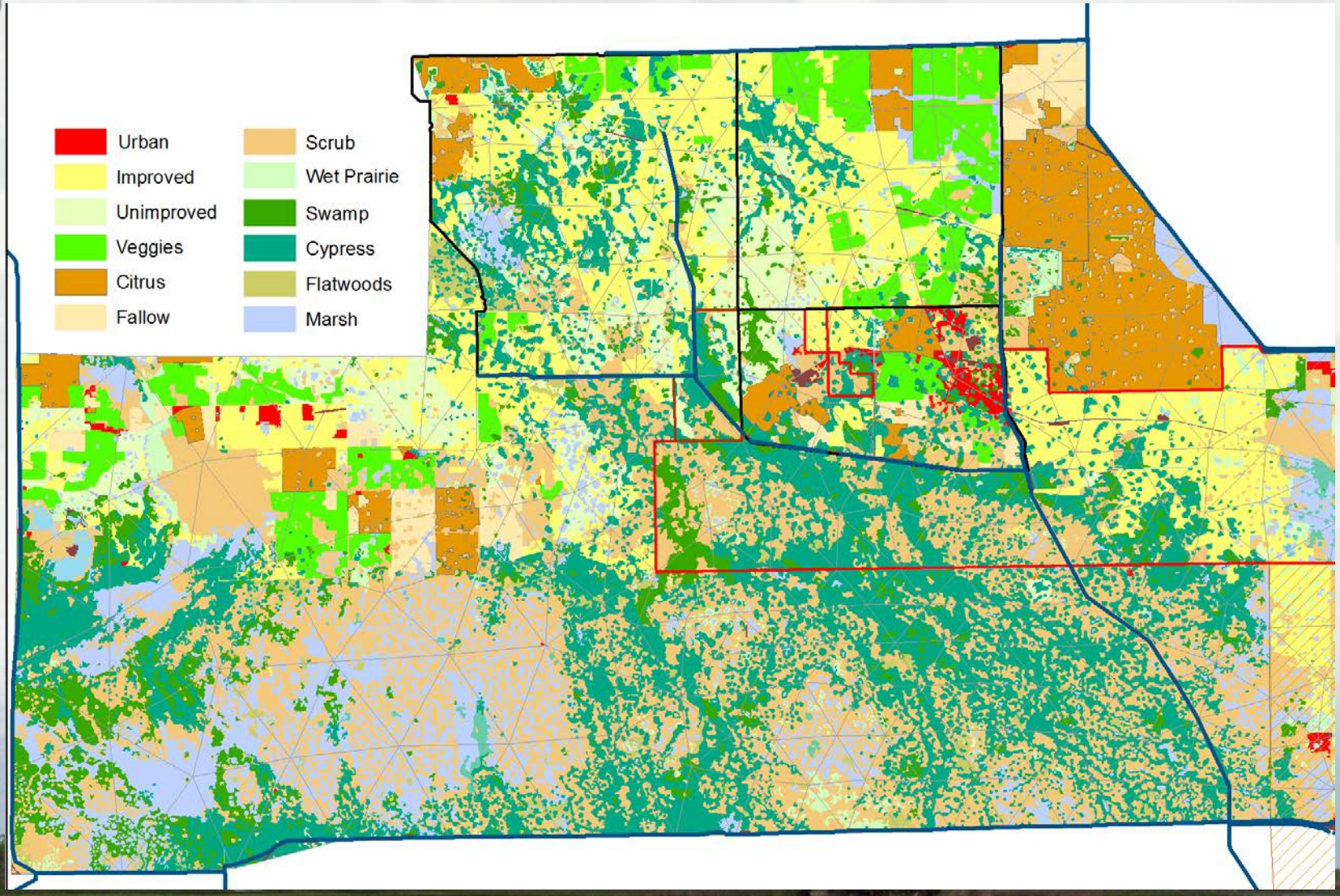
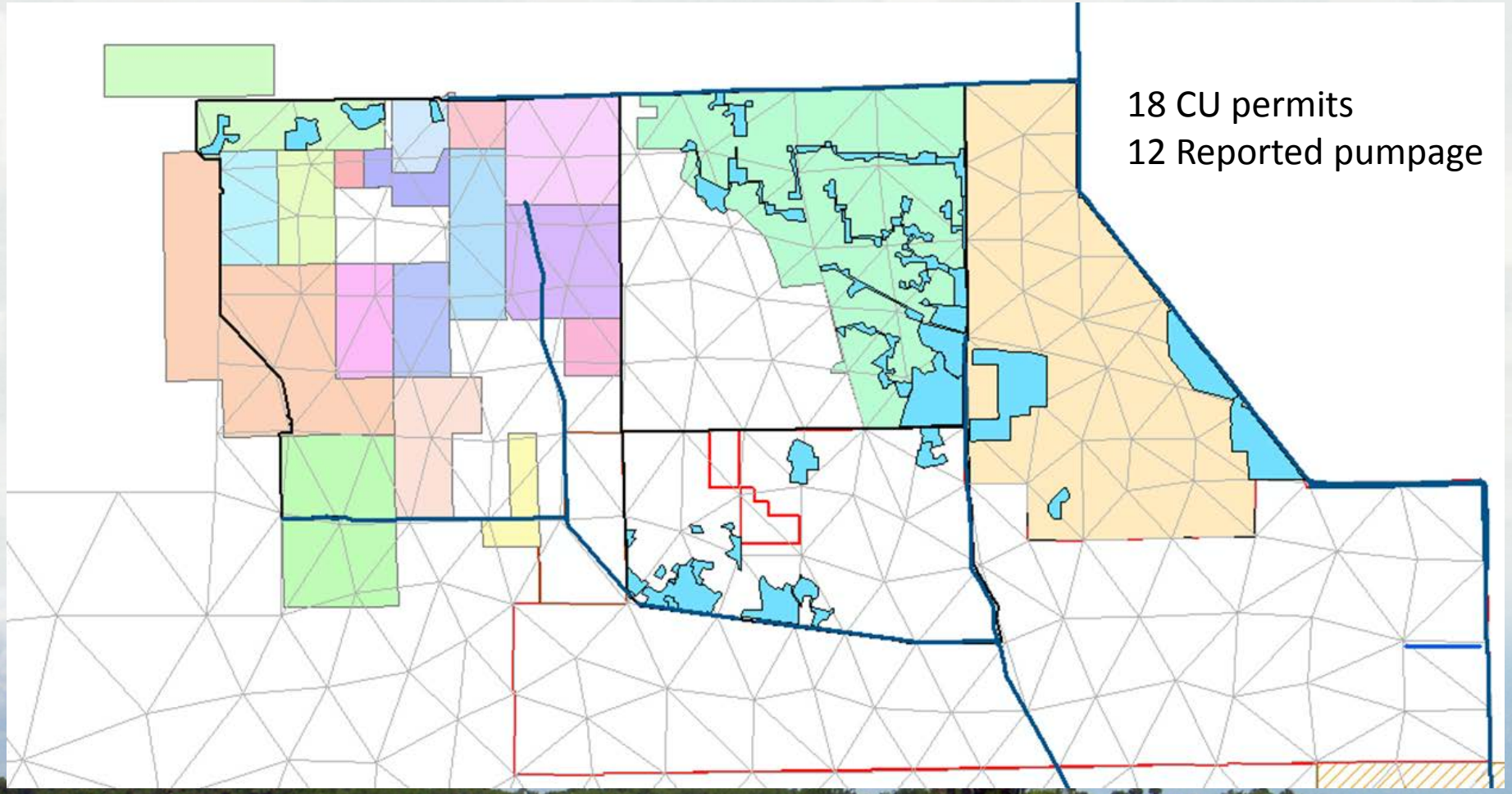
Predominant Landuse (2012)



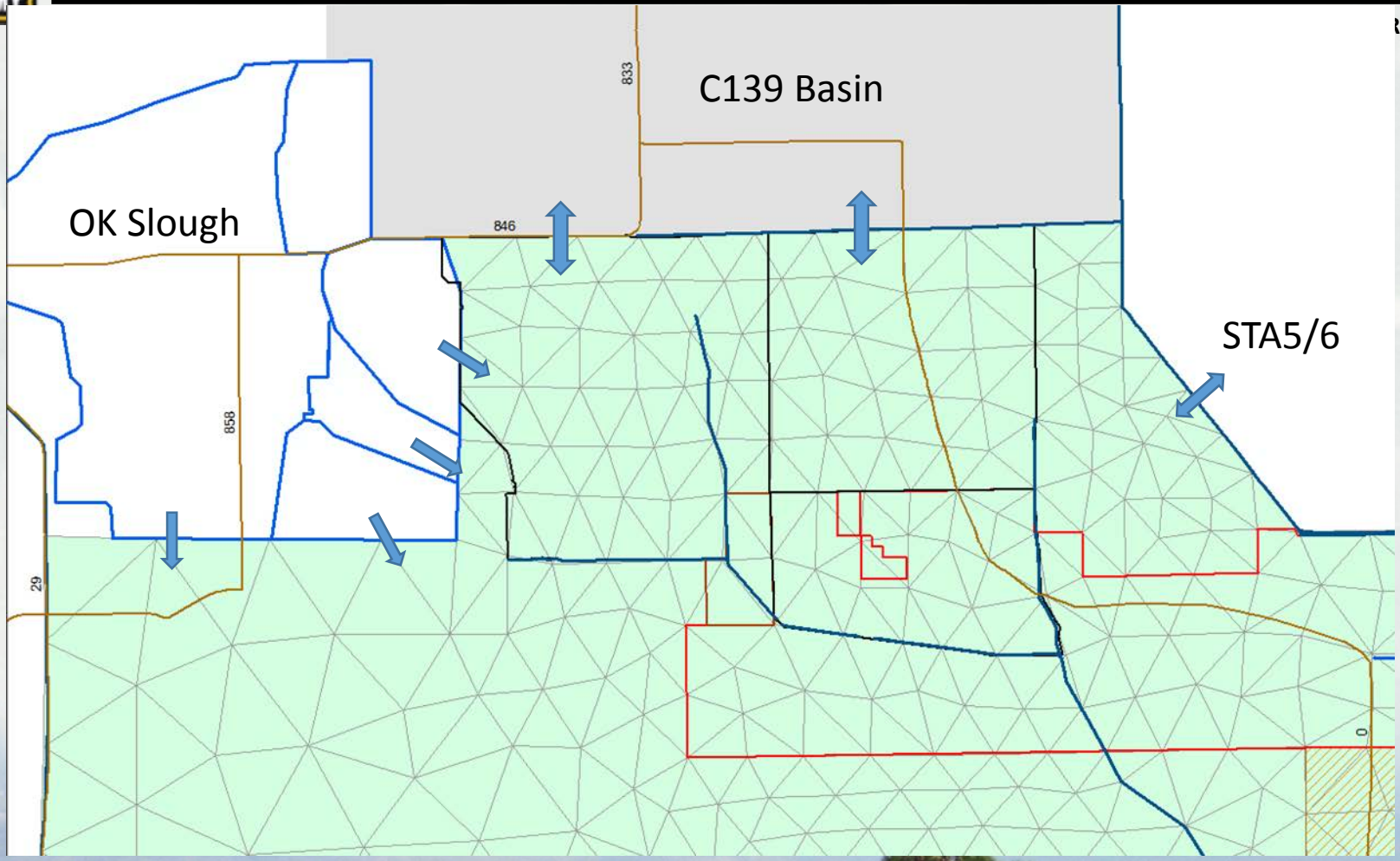
Water Users & Impoundments

BUILDING STRONG

Consumptive use permits and impoundments



Boundary Conditions

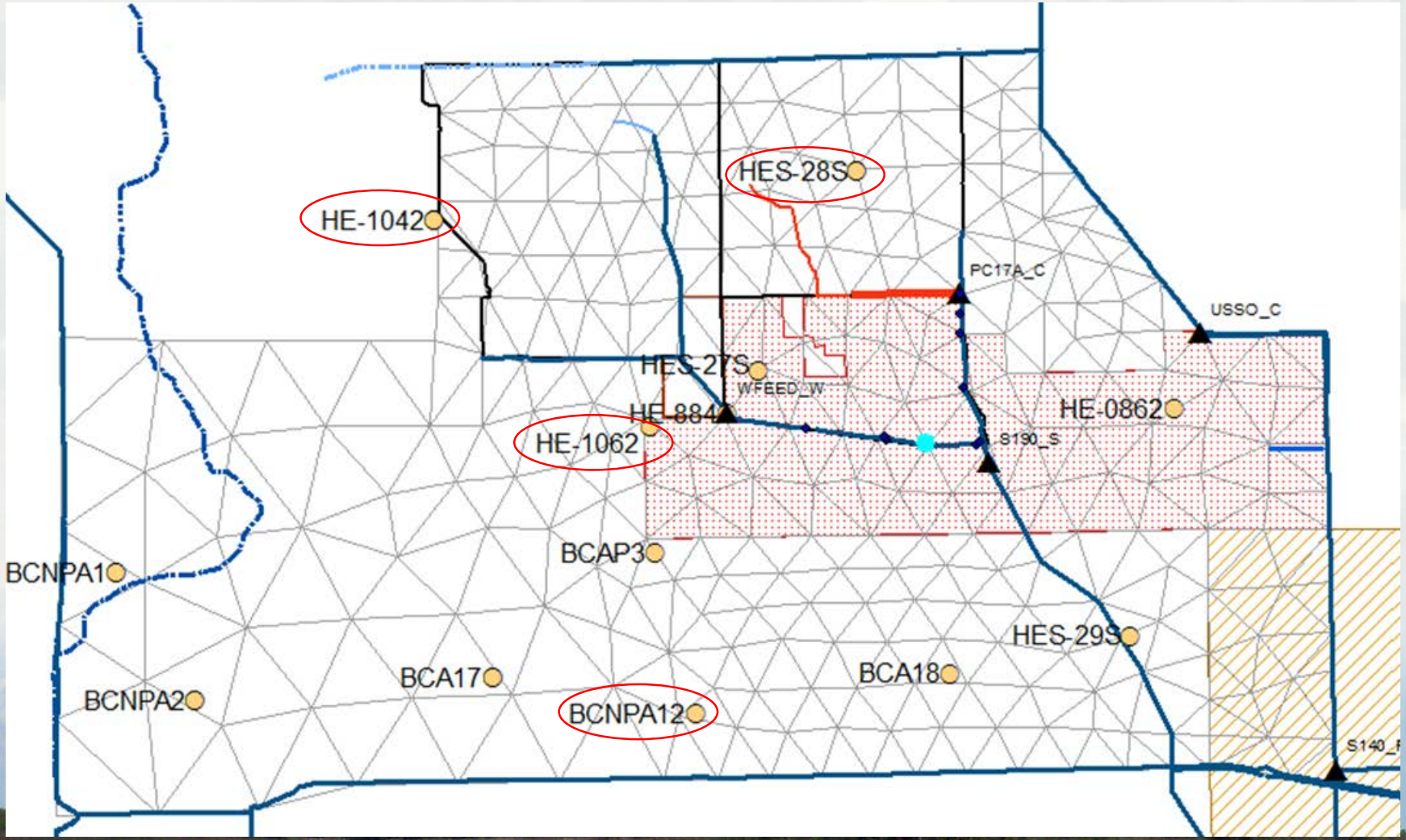


Calibration

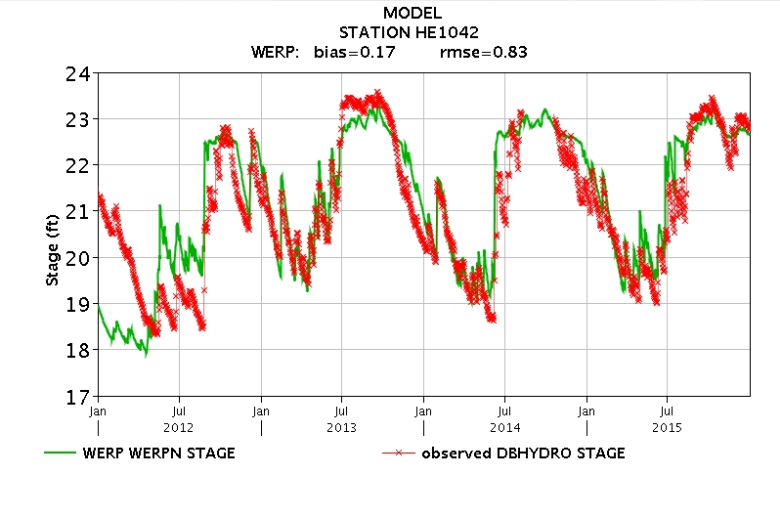
- Best available information.
  - Landuse, water use, hydrologic data
- Calibration period (2010-2016) depending on location
  - C139 Annex (2010-2015)
  - North Feeder Basin (2012-1016)
  - West Feeder Basin (2012-2015)
- Manual Calibration Approach
- Calibration objective: History matching at several locations
  - Canal and wetland Stage
  - Shallow groundwater
  - Agricultural water use
  - Historical patterns

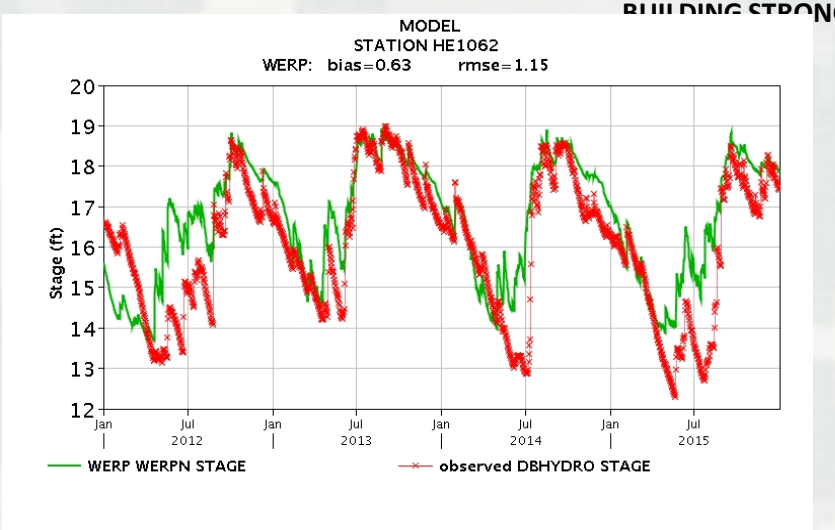
Calibration Gages

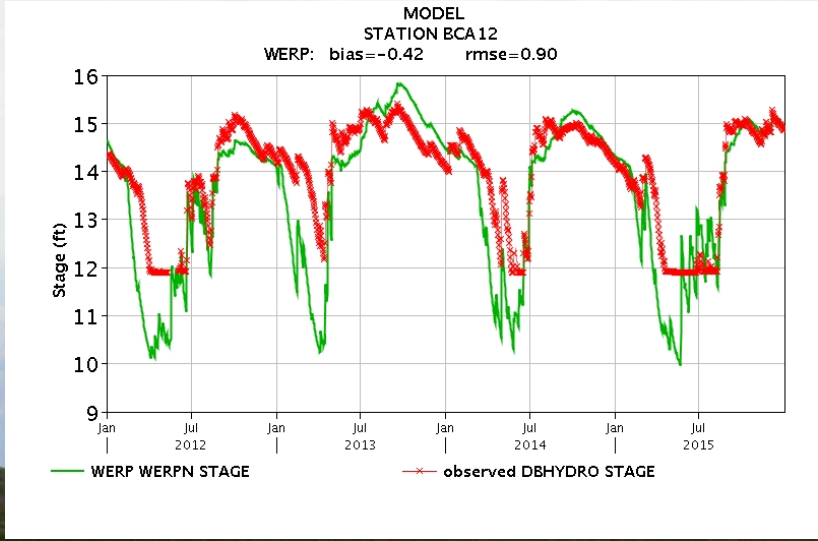
BUILDING STRONG

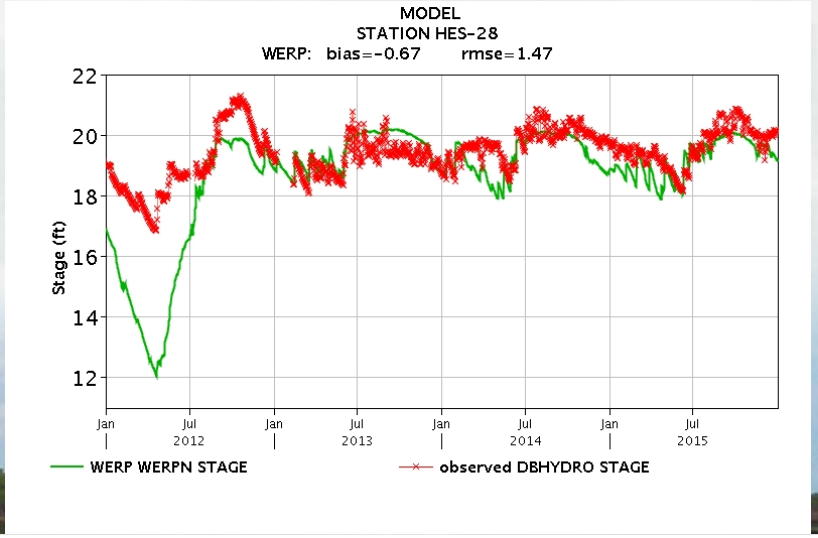


Interim Calibration





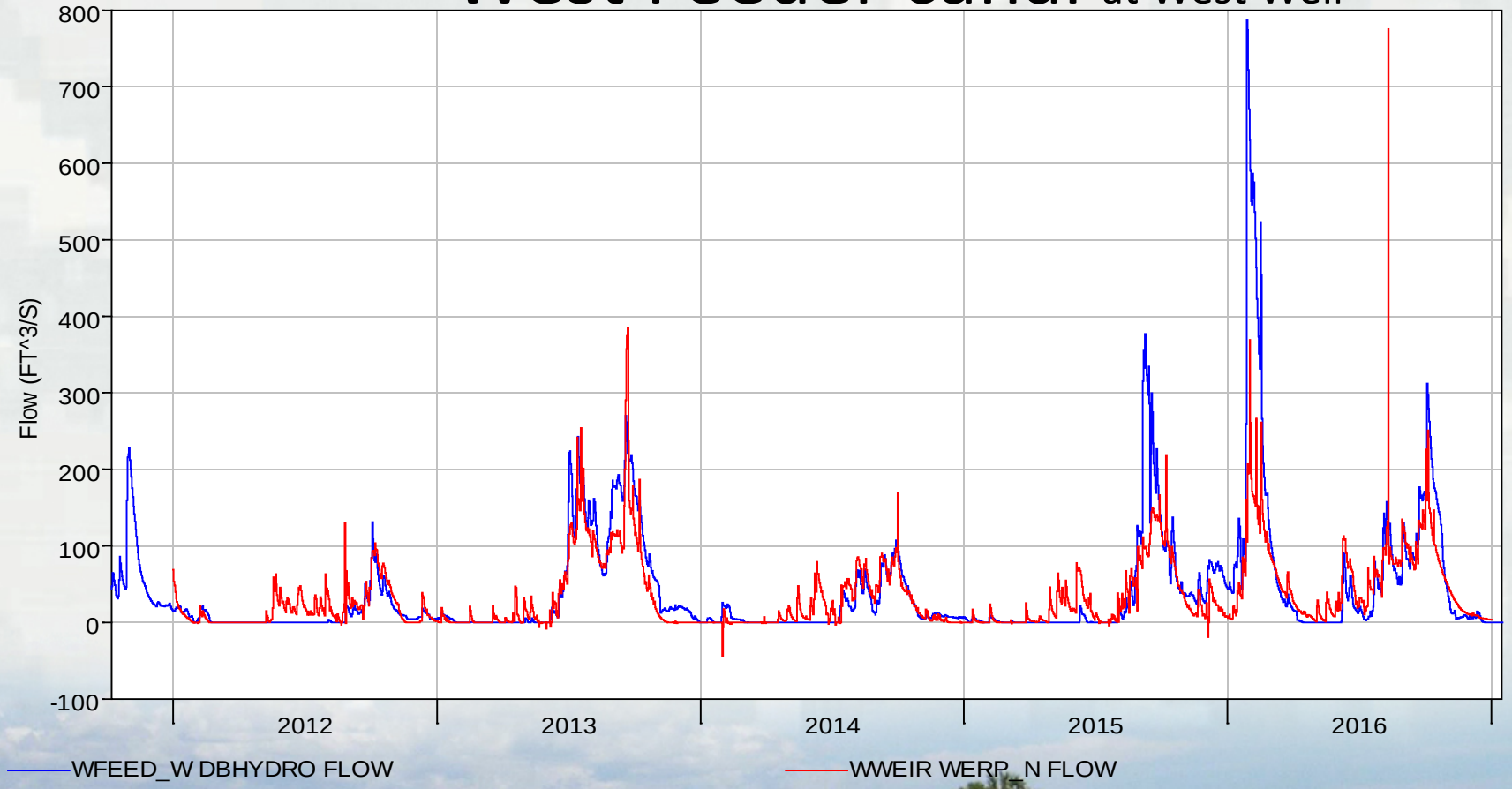




Interim Calibration

BUILDING STRONG

West Feeder canal at West Weir



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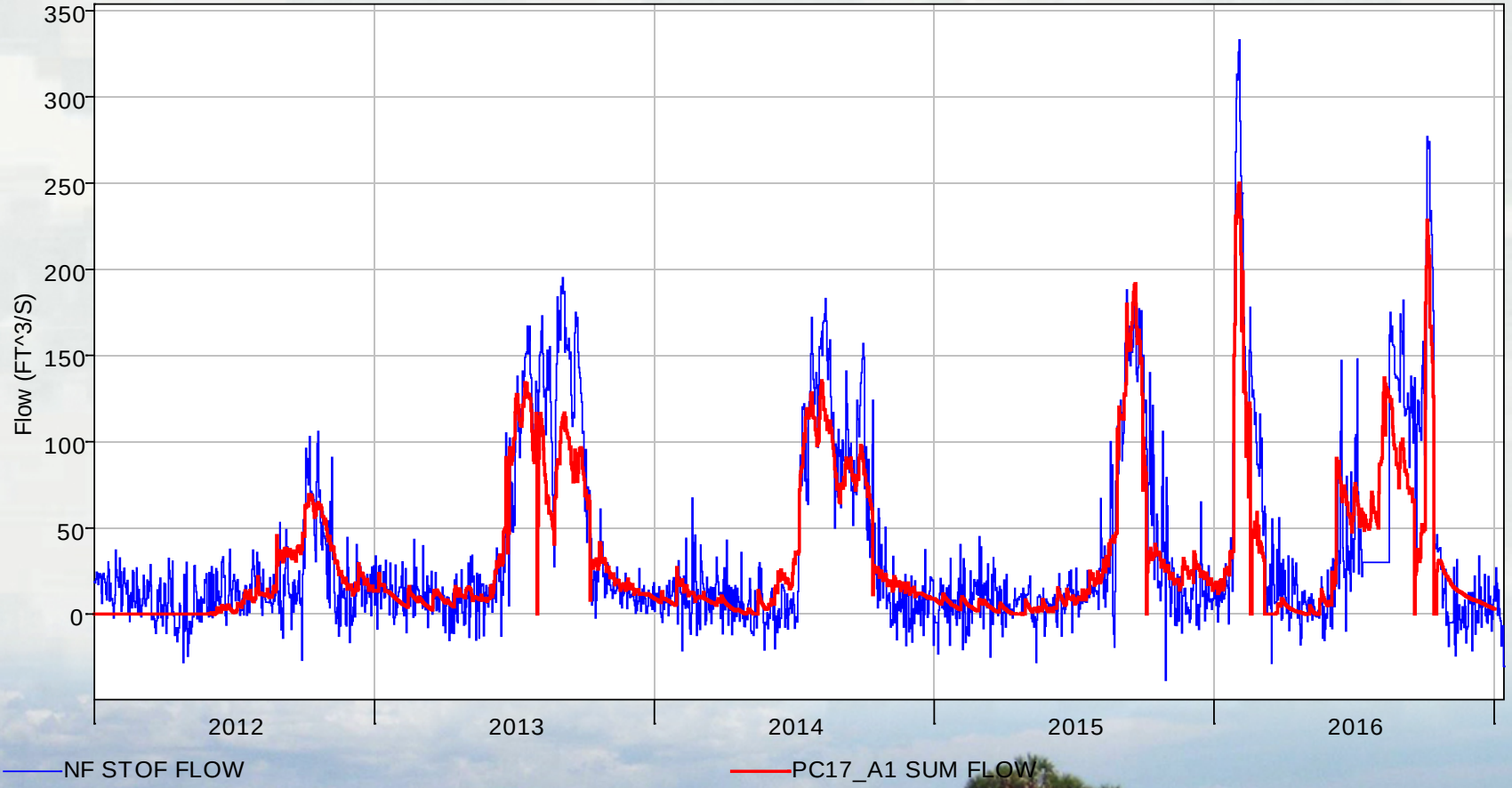
Interim Calibration

BUILDING STRONG

North Feeder Canal at USGS UVM



Summary & Next Steps

BUILDING STRONG

- Out of the 23 cell (marsh+gw) and 13 canal gages used in the calibration, all gages met the acceptability criteria for both bias (1 ft) and RMSE (2 ft).
- Above-ground water levels are simulated better than below-ground water levels.
- Efforts are in place to improve the matching of below-ground water levels and recession rates.
- Integrate more detailed modeling of northern WERP area with RSMGL.
- Prepare baseline RSMGL simulations by incorporating final parameter values from the calibration effort.

Public Comment

Next Steps & Wrap Up

Next PDT Meeting:

- December 19, 2017, 1:00 to 4:00 PM (to be confirmed)
- Meeting will be held via teleconference