



Photo credit: John Hannon, Reclamation

2024 CWEMF Annual Meeting: Session 7: CVP WTMP, Chapter 3

Presentation: What We Have Done

Moderator: Yung-Hsin Sun, Sunzi Consulting



Session 7: CVP WTMP, Chapter 3

3:30 Introduction
Moderator: Yung-Hsin Sun (Sunzi Consulting LLC)

3:40 Presentation: What We have Done

3:40 Design with Users and Durability in Mind

3:57 Enabling Platform with Capacity and Flexibility

4:14 Community Engagement and Institutional Knowledge Development

4:21 Peer Review and Rollout Preview

4:31 Q&A

4:40 Reclamation Panel Discussion with Q&A:
The End is the Beginning
5:15 Adjourn



Mike Deas, PhD, PE
Watercourse Engineering
(Consultant Team Lead)



John DeGeorge, PhD, PE
Resource Management Associates



Yung-Hsin Sun, PhD, PE, BC.WRE
Sunzi Consulting



Randi Field
Bureau of Reclamation, CVO
(Reclamation Project Lead)



All of You



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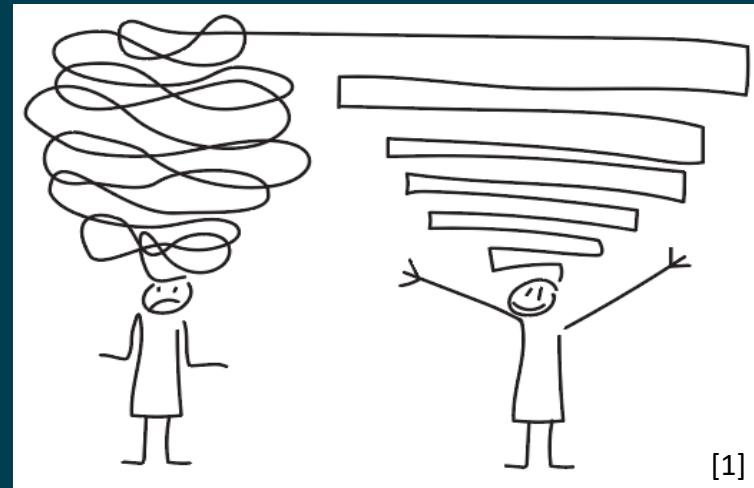


Mike Deas, PhD, PE
Watercourse Engineering
(Consultant Team Lead)



Typical Simulation Modeling Challenges

- Disparate data sources
 - Data acquisition
 - Data QA and metadata
 - Data storage and access
- Model input development
 - File construction
 - File/study management
 - Consistent boundary conditions
- Model and Model Simulation
 - Model management
 - Multiple model handshake
 - Unique features
 - Calibration/Recalibration
- Simulation types (e.g., Forecast, Hindcast, Operations, etc.)
- Post processing
 - Consistent tools
 - Adaptable repeatable reporting
- Model development documentation
- Transparency



Water Temperature Modeling Platform: Next Generation Tools

WTMP Items	Highlights of Unique Features
Data Management System	Improve flexibility for data access and quality of data
Model Domain	Consistent with operations that influence downstream water temperature
Model Framework	Addresses multi-model simulations/different spatial-temporal scales + uncertainty
Temperature Models	Representations capture reservoir stratification and cold-water pool dynamics and longitudinal river temperature gradients
Key Code Modifications	Enhanced modeling considerations for unique facility components
Communications/Transparency	Modeling Technical Committee and project documentation Planned model distribution (Web access/RISE)



WTMP Framework and Models

Framework: HEC-WAT

Hydrologic Engineering Center (HEC) Watershed Analysis Tool

Data Acquisition

Database

DMS

Automated data acquisition
QA procedures
Model-ready-data

Models

RES-SIM

HEC Reservoir System Simulation:
Reservoir (1-D vertical)
River reaches (1-D longitudinal)

CE-QUAL-W2

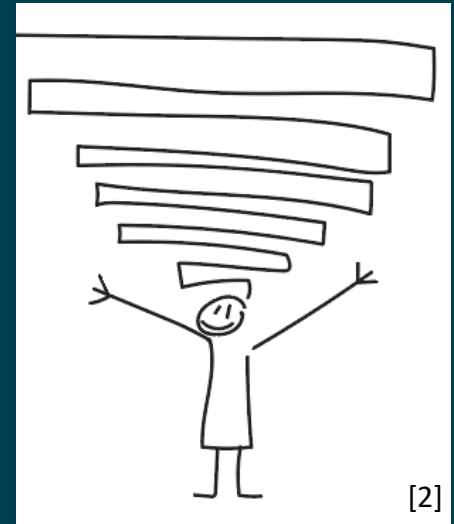
Reservoir (2-D vertical and longitudinal)

Automated Reporting
Data Drop



Outcomes

- Facilitate standard data management approaches
 - Automate repetitive modeling tasks
 - Standardized and automated reporting
 - Overall reduced modeling activities time
 - Facilitate training for new staff
-
- Enhanced efficiency, consistency, adaptability, and transparency to address current and future modeling activities to support temperature management actions



Outcomes

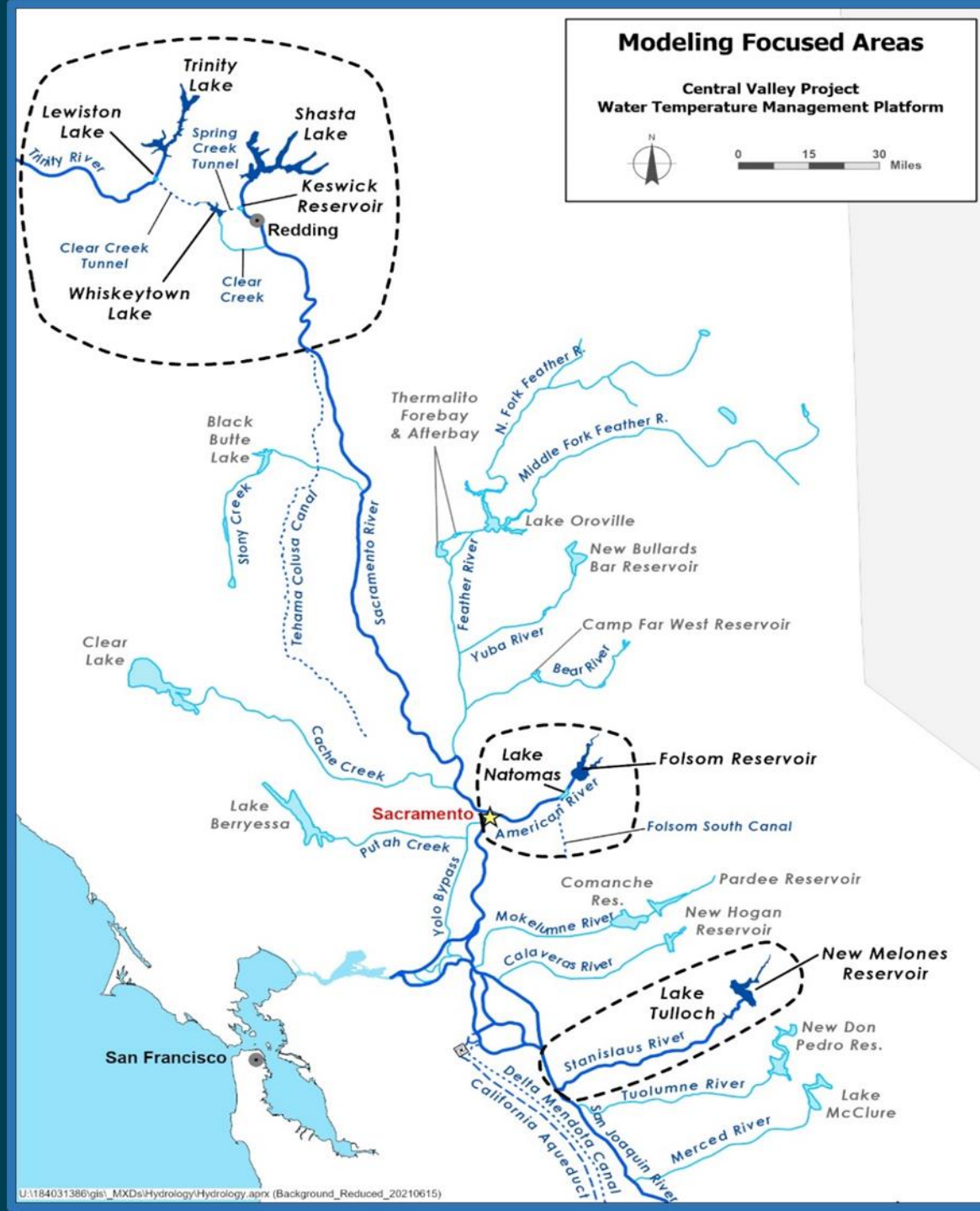
- Facilitate standard approaches for data management
- Automate repetitive modeling tasks
- Standardized and automated reporting
- Overall reduced time to carry out modeling activities
- Facilitate training for new staff

- Overall enhanced efficiency, consistency, adaptability, and transparency in modeling to support temperature management activities

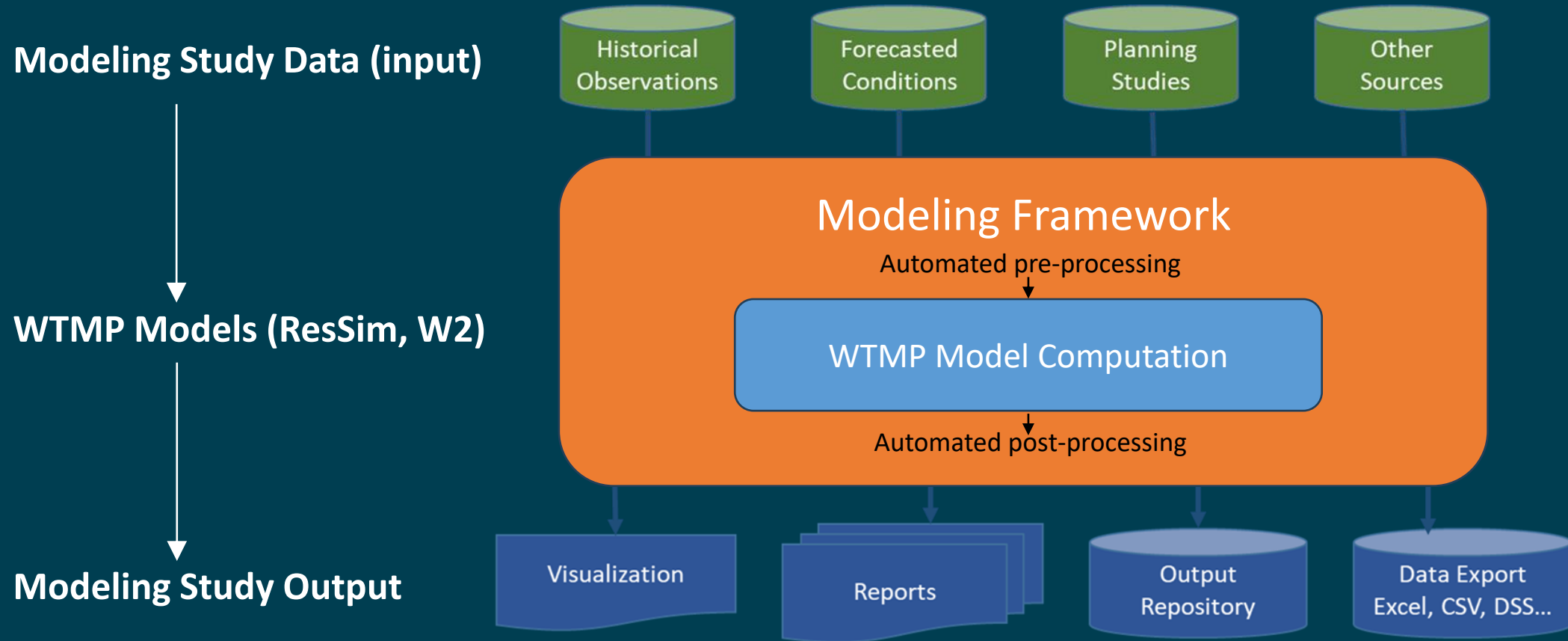


WTMP Domain

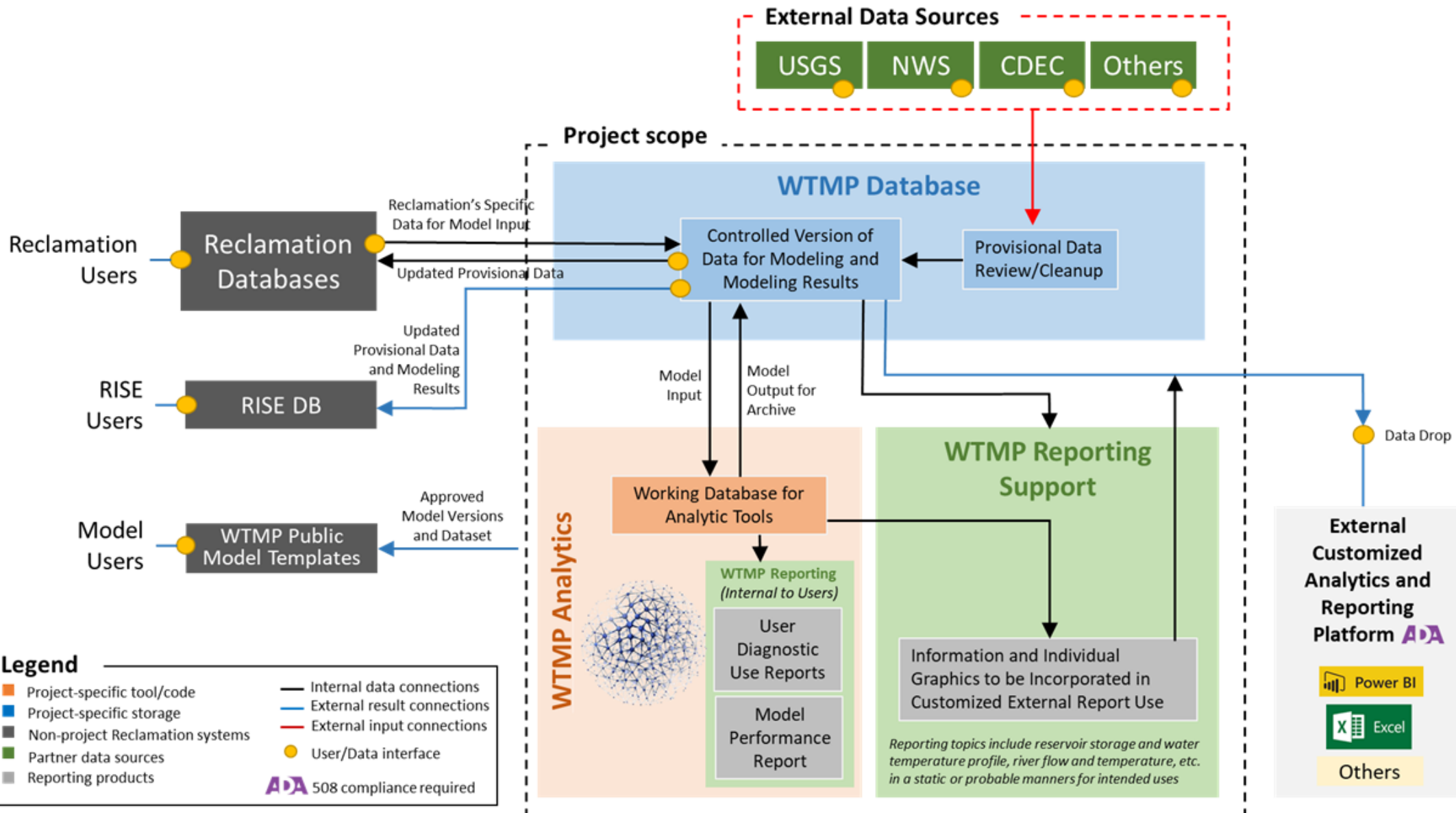
- Sacramento and Trinity Rivers
- American River
- Stanislaus River



WTMP Analytics Framework - Basics



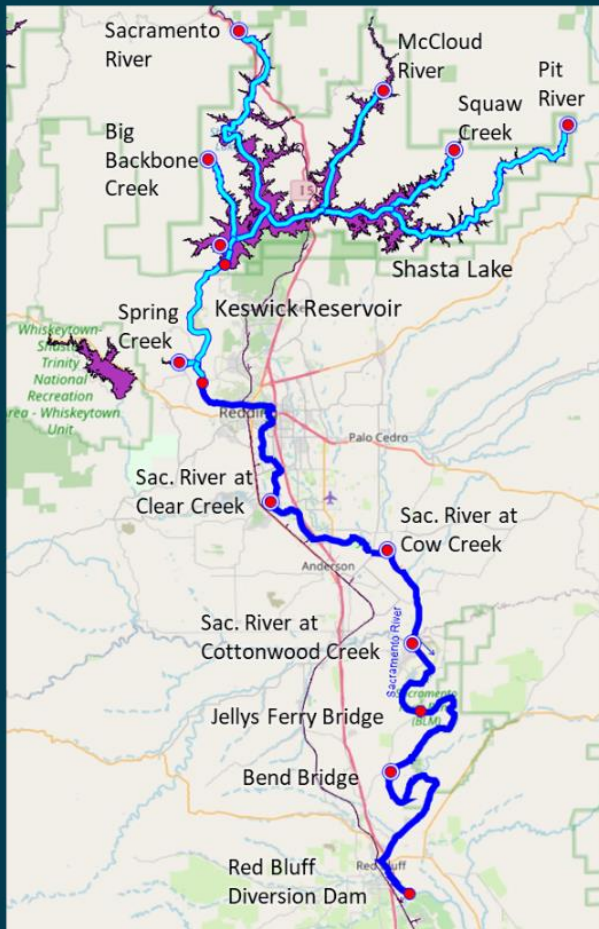
WTMP Analytics Framework - Details



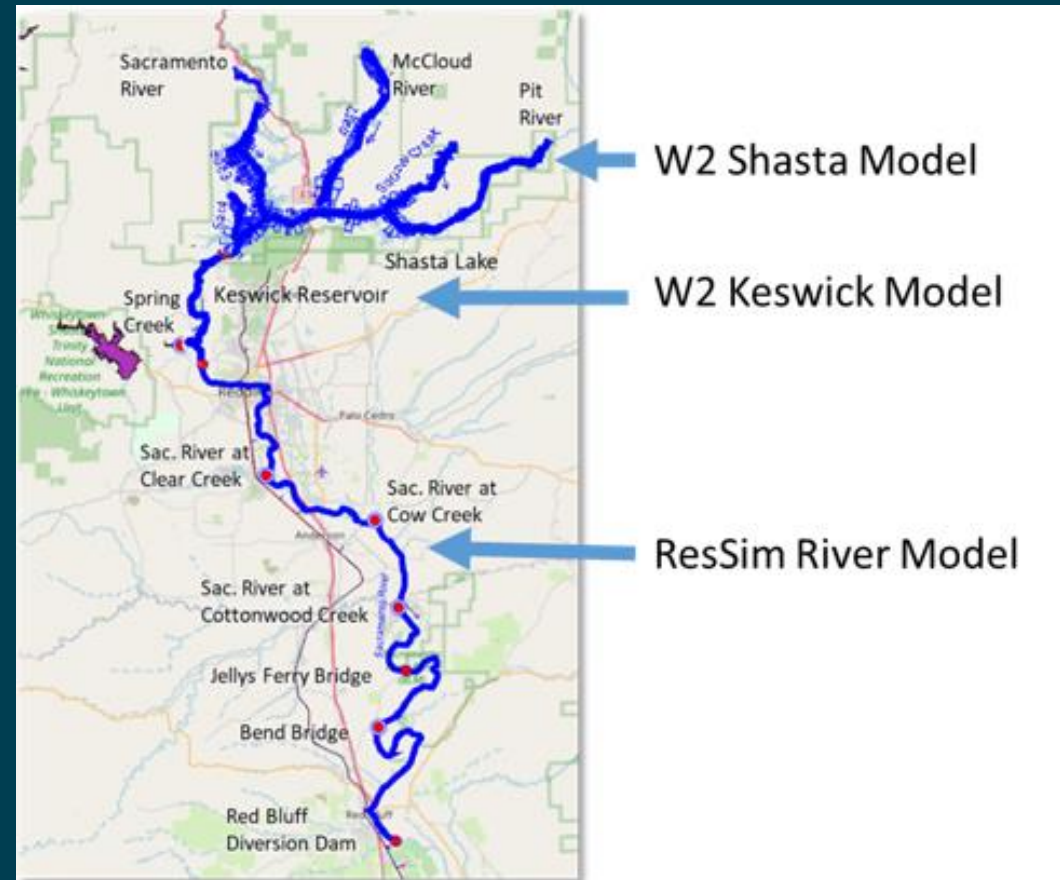
HEC-WAT Framework Using W2 and ResSim

- Shasta-Keswick-Upper Sacramento River

- ResSim Only



- Combined W2 and ResSim



Model Performance

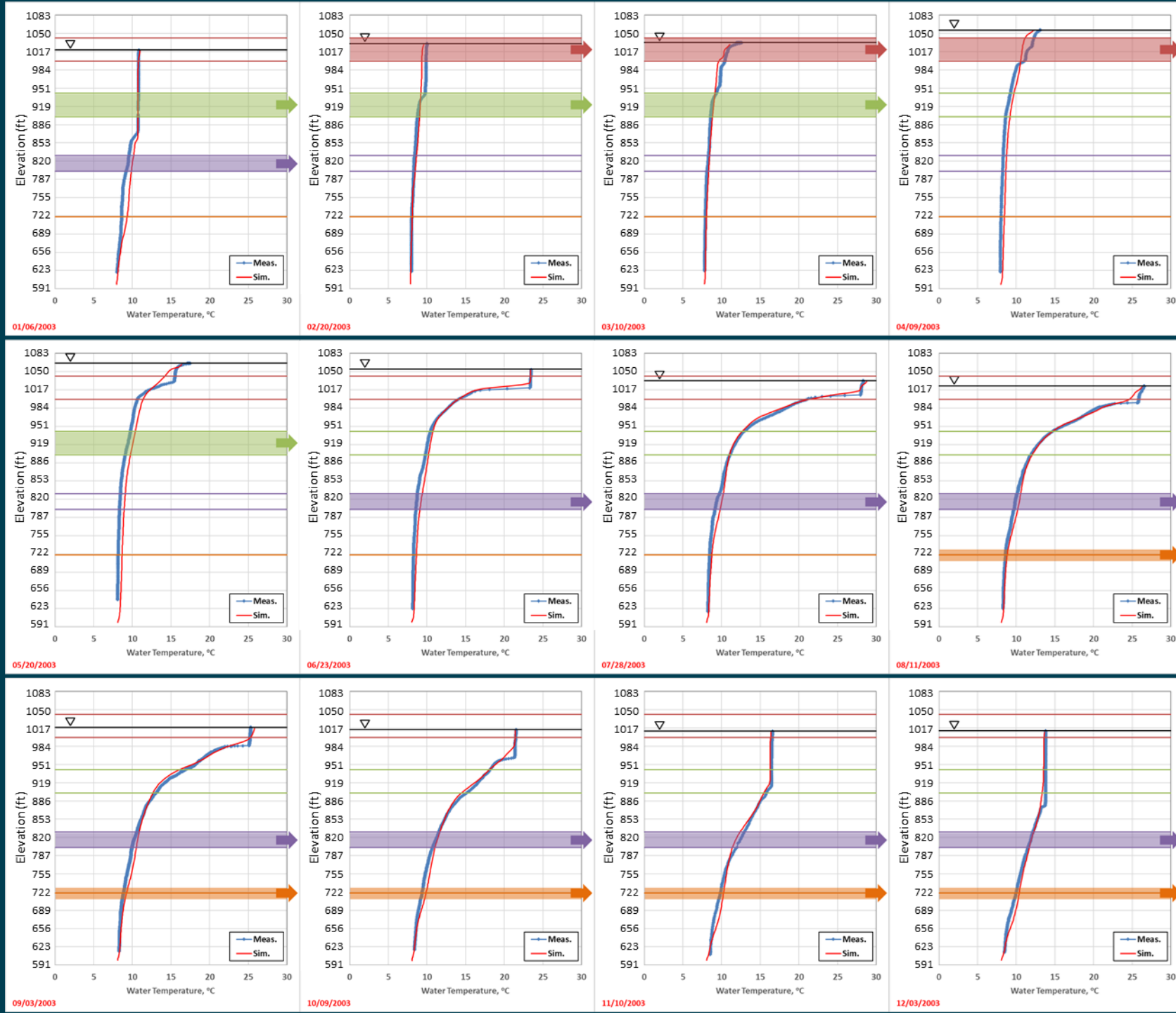
- CWEMF Protocols and Peer Review Support
- Extensive model testing and assessment
 - 2000-2021 (where data available)
 - Objective-driven model performance metrics
 - Calibration and validation metrics (statistical, graphical)
 - Temperature signatures of seasonally stratified reservoirs: profile and outflow temperatures
 - Temperature signatures of rivers and small reservoirs: time series
 - Sensitivity analysis
- Outcome:
Robust, durable tool

Parameter	Mean Bias	MAE	RMSE	NSE
Stage	±0.5 ft (0.15 m)	≤1.0 ft (0.3 m)	≤1.5 ft (0.45 m)	≥0.65
Flow	±150 cfs (4.2 cms)	≤300 cfs (8.4 cms)	≤500 cfs (14.2 cms)	≥0.65
Water Temperature	±1.3°F (0.75°C)	≤1.8°F (1.0°C)	≤2.7°F (1.5°C)	≥0.65



Sacramento River Basin - Shasta Lake

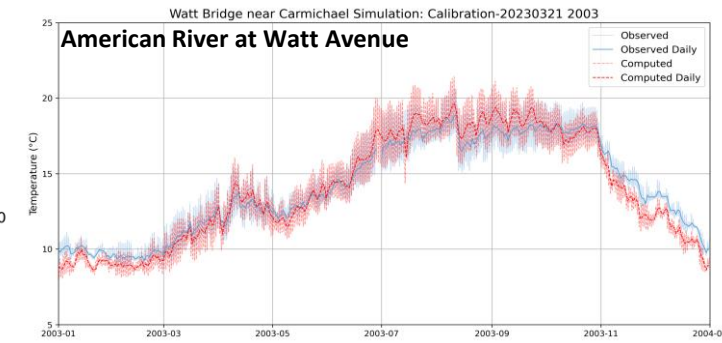
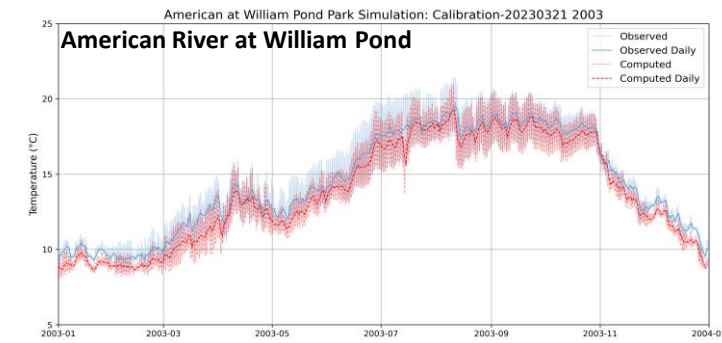
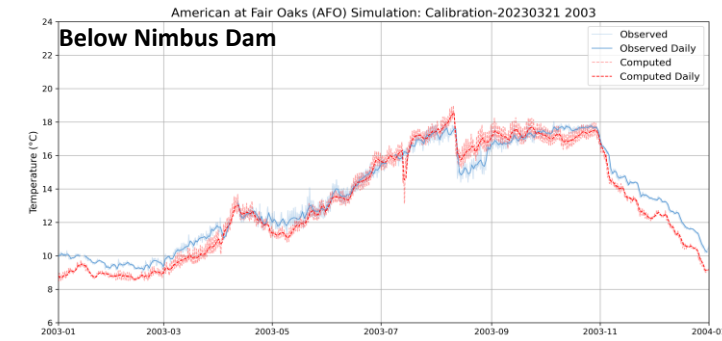
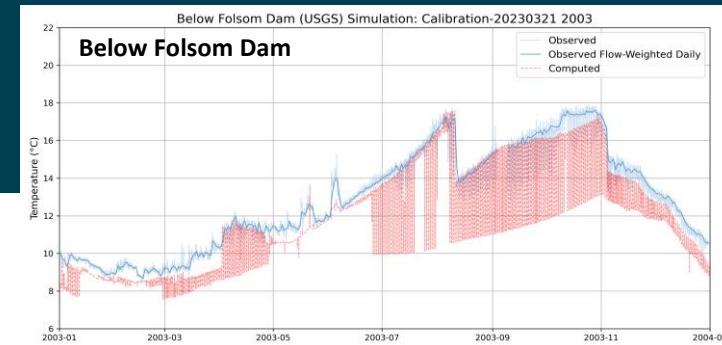
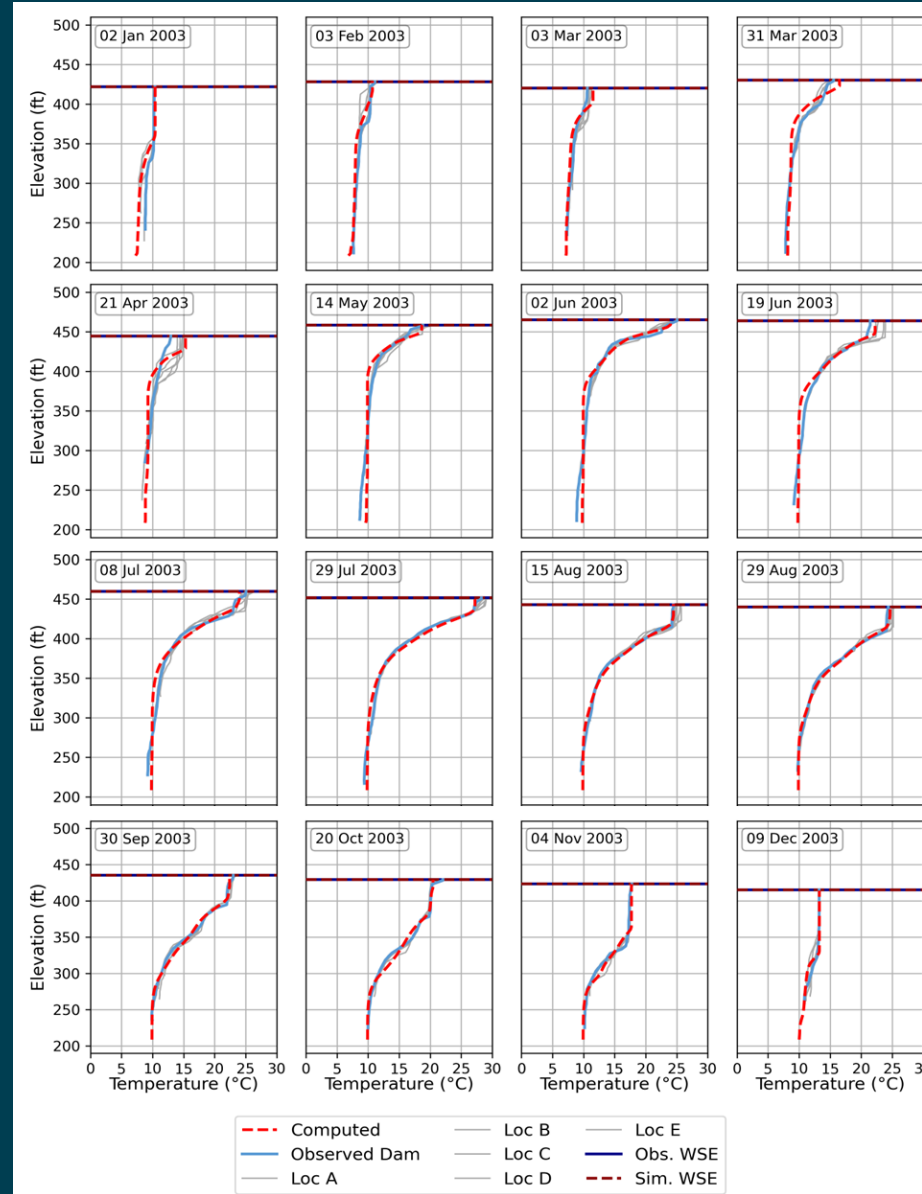
- CE-QUAL-W2
- Shasta Lake water temperature profile
- Active TCD gate settings
- 2003 Results



American River Basin

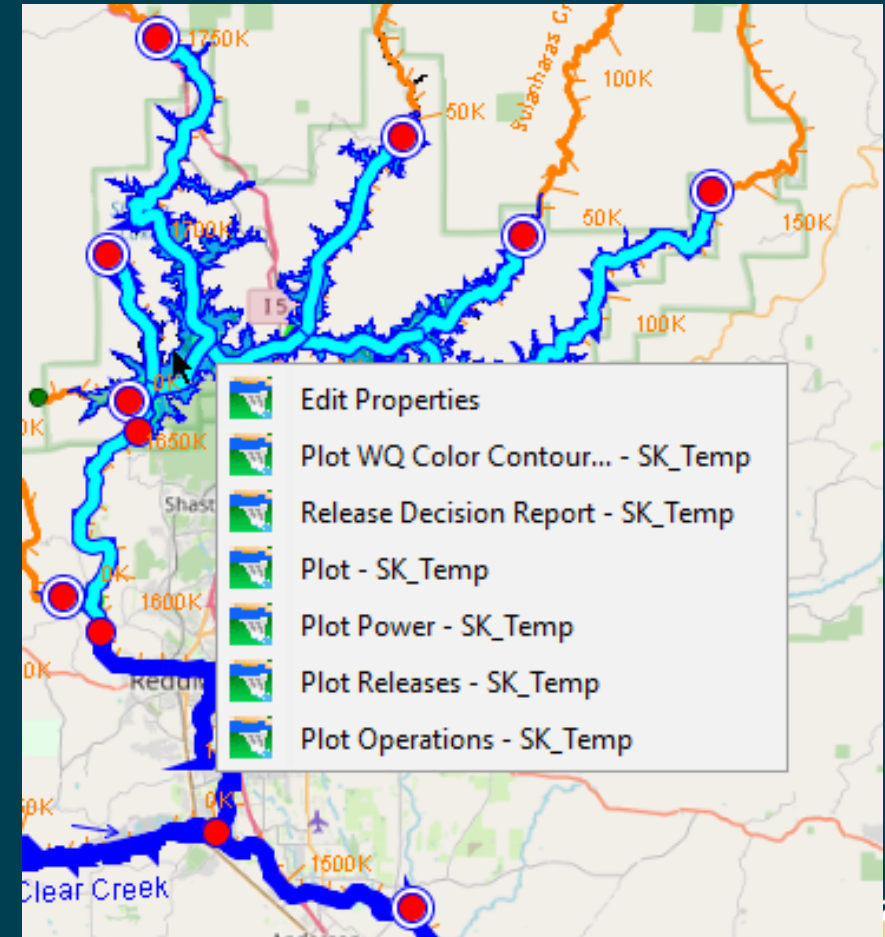
– American River

- HEC-ResSim
- Folsom Lake
 - Water temperature profile
 - Outflow temperature
- Nimbus Dam
- American River
 - At William Pond
 - At Watt Avenue
- 2003 results



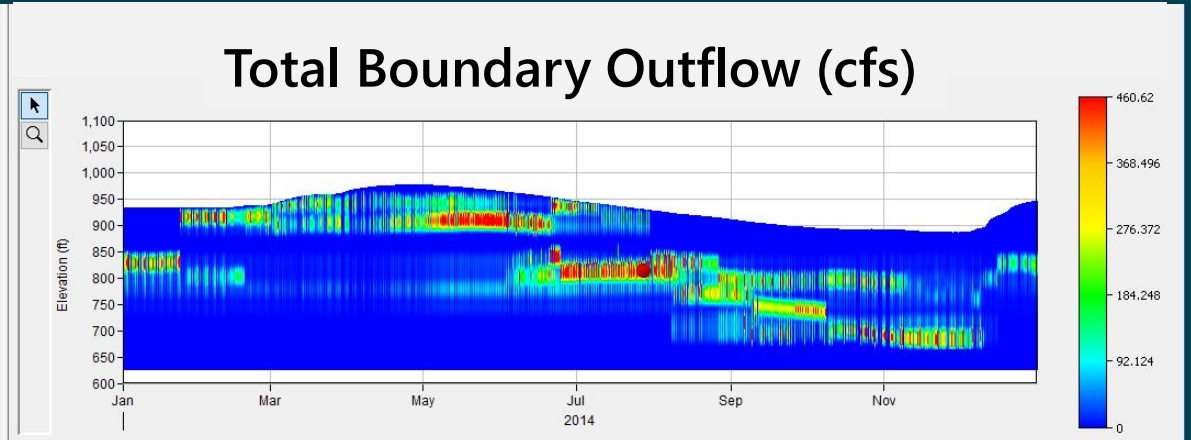
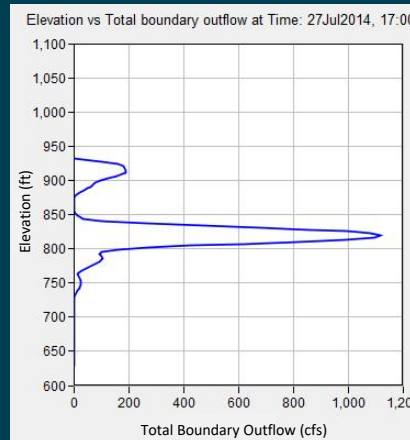
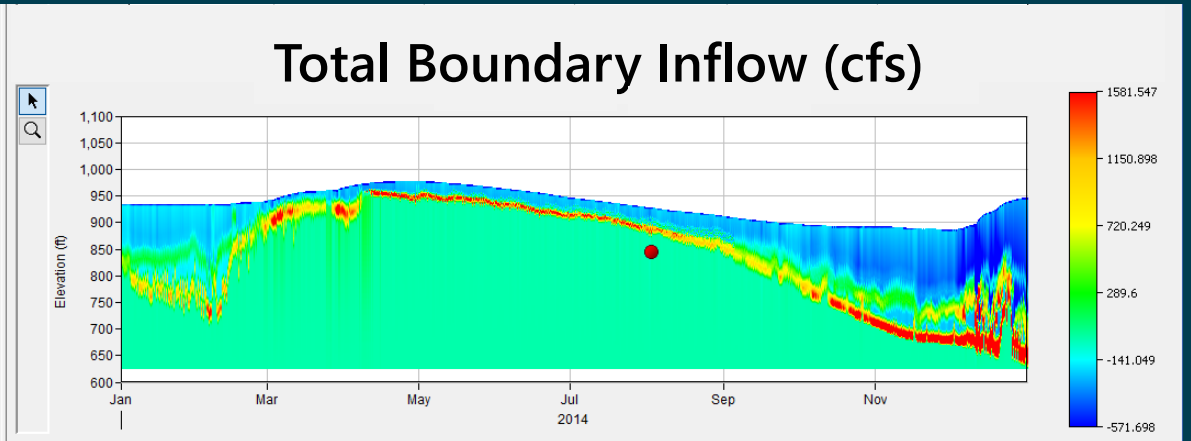
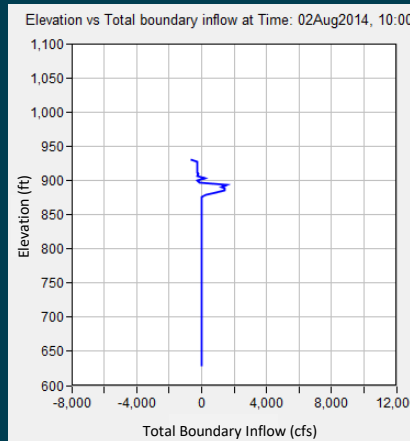
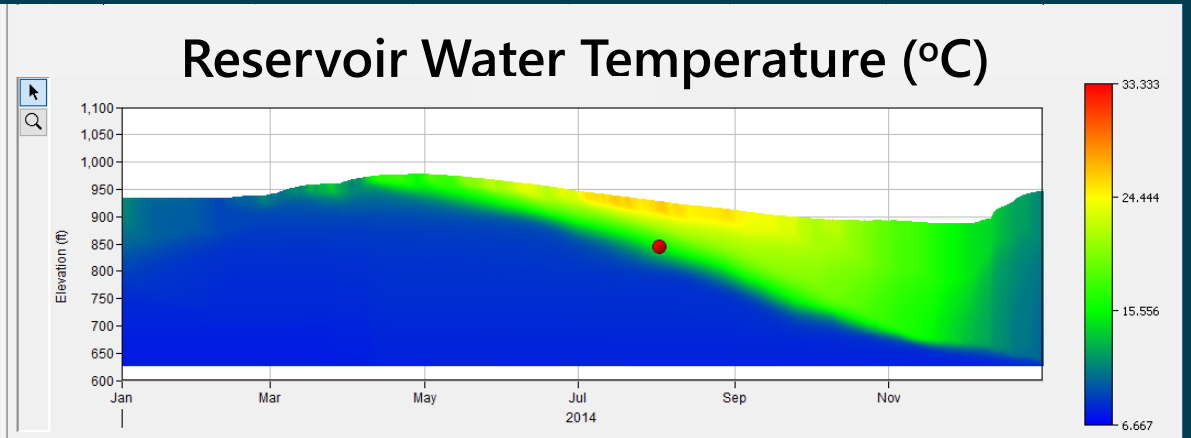
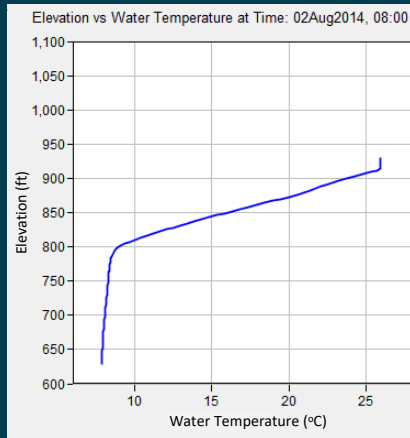
Graphical User Interface

- Display editors
- User interface system schematic-based elements (clickable)
- Plots
- Tables
- Extending tools to CE-QUAL-W2



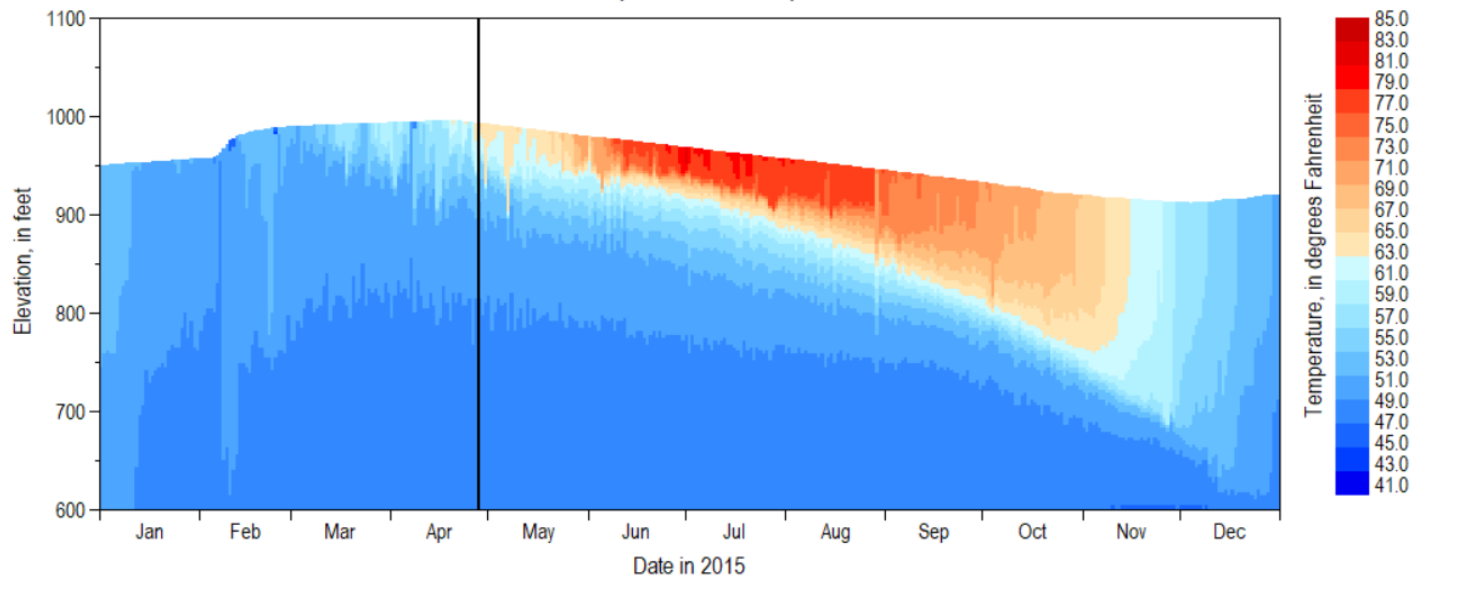
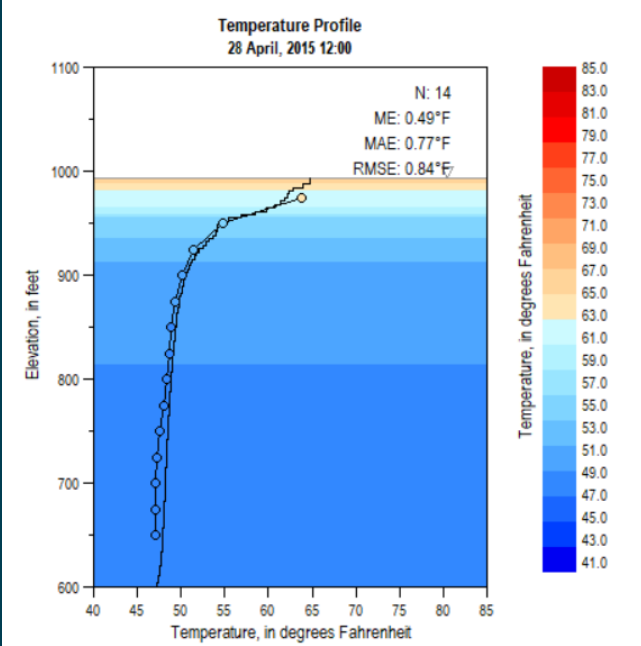
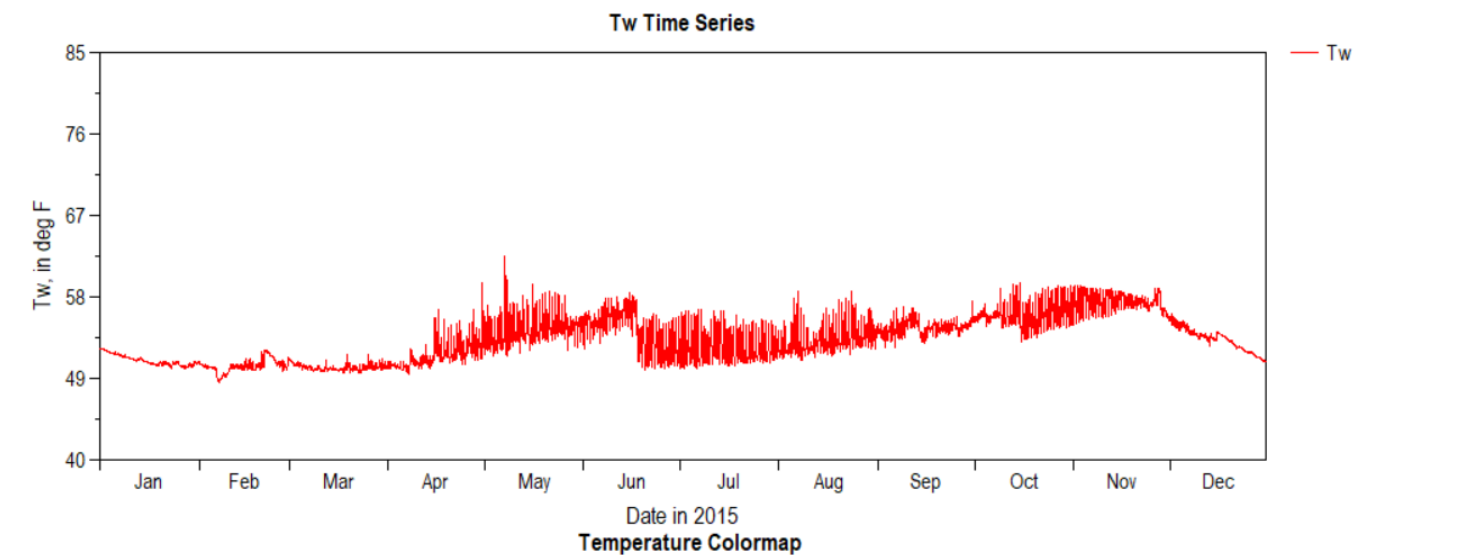
Contour Plots: Reservoirs (HEC-ResSim)

Shasta Lake



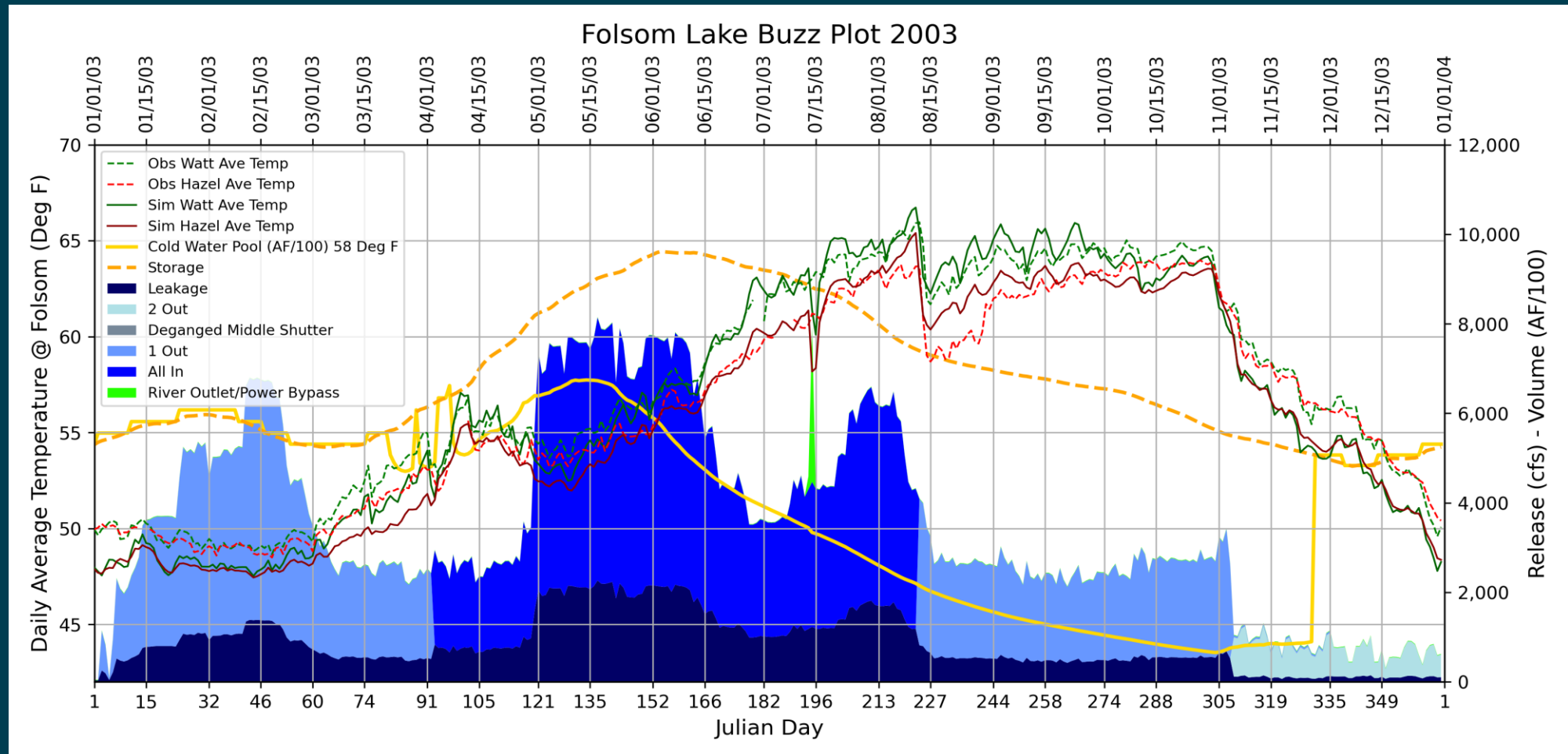
Contour Plots: Reservoirs (CE-QUAL-W2)

Shasta Lake



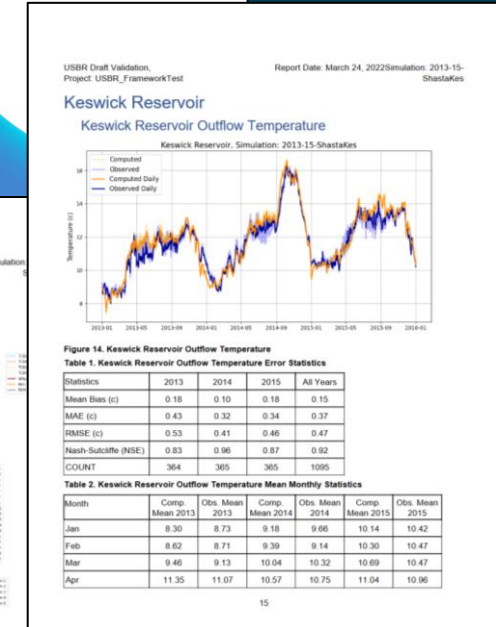
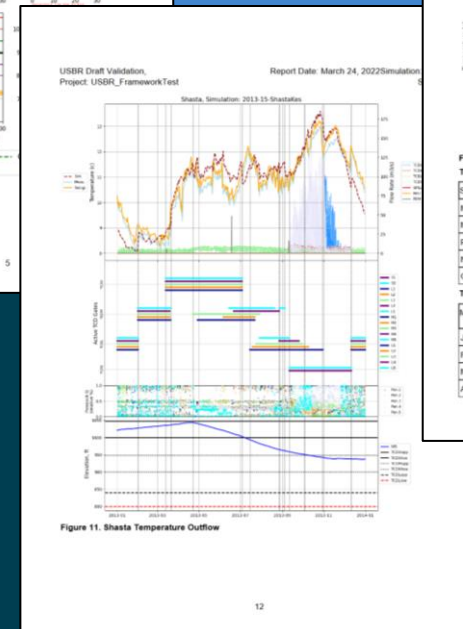
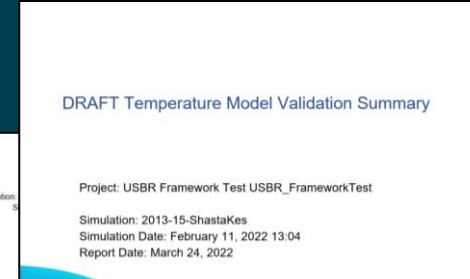
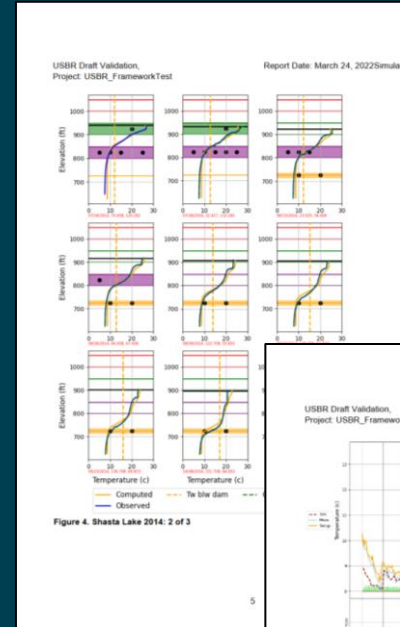
Customized Plots - American River

- Folsom 2003 results



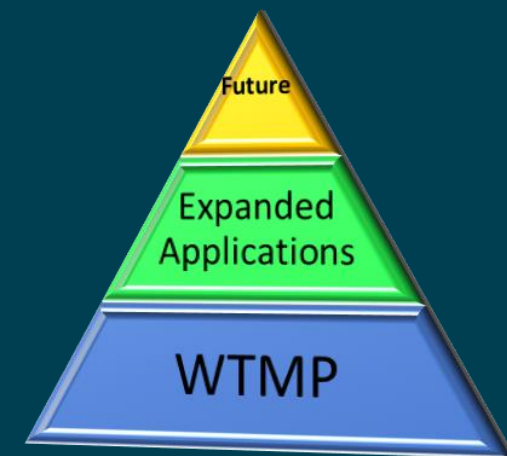
Automated Plotting and Tabulation of Results

- Rapid creation of key output tables and graphics to facilitate results review by modelers
- Calibration Reports
- Creation of tables and graphics that could be incorporated in other reporting and presentation products



The WTMP Looking Forward

- Continued refinement of WTMP project elements (multi-year project)
- Extending modeling workflow processes (e.g., LTO, automated recalibration, developing multi-scenarios studies)
- Ongoing training of Reclamation's diverse technical staff (CVO, BDO, TSC)
- Installation of the Data Management System and WTMP within Reclamation's internal network
- Develop data sharing protocols and processes via Reclamation Information Sharing Environment (RISE)^[3]
- WTMP framework provides foundational components and establishes processes/protocols that accommodates technological advancements that can be used repeatedly into the future



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WTMP Objectives

Enhance Efficiency, Consistency, Adaptability and Transparency

- Ease model application and output interpretation
 - Reduce requirement for training on file editing and information flow
 - Reduce the time it takes to carry out modeling activities
 - Facilitate standard approaches for data management and reporting
 - Automate repetitive modeling tasks
- Facilitate the use of multiple models individually or in a sequence
- Managing updates and addition of new features
- Reducing input error and errors in general!



Framework Functions for Team Members with Different Roles

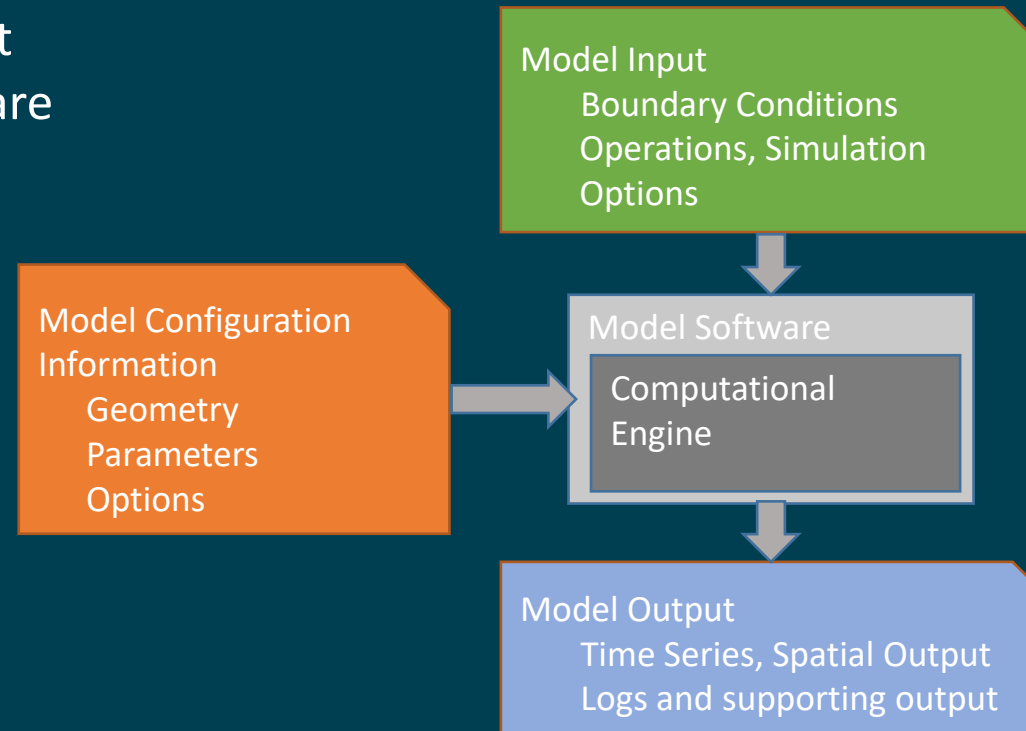
- **Model Operator:** Carries out modeling studies
- **Power User:** Configures automated processing for pre- and post-processing, designs reports, manages model linkages
- **Expert Modeler:** Responsible for configuration and calibration of a model for a particular system
- **Model Developer:** Responsible for the development and maintenance of a model's computational engine
- **IT Support:** Manages the IT infrastructure to facilitate team modeling and provide connectivity to web data sources



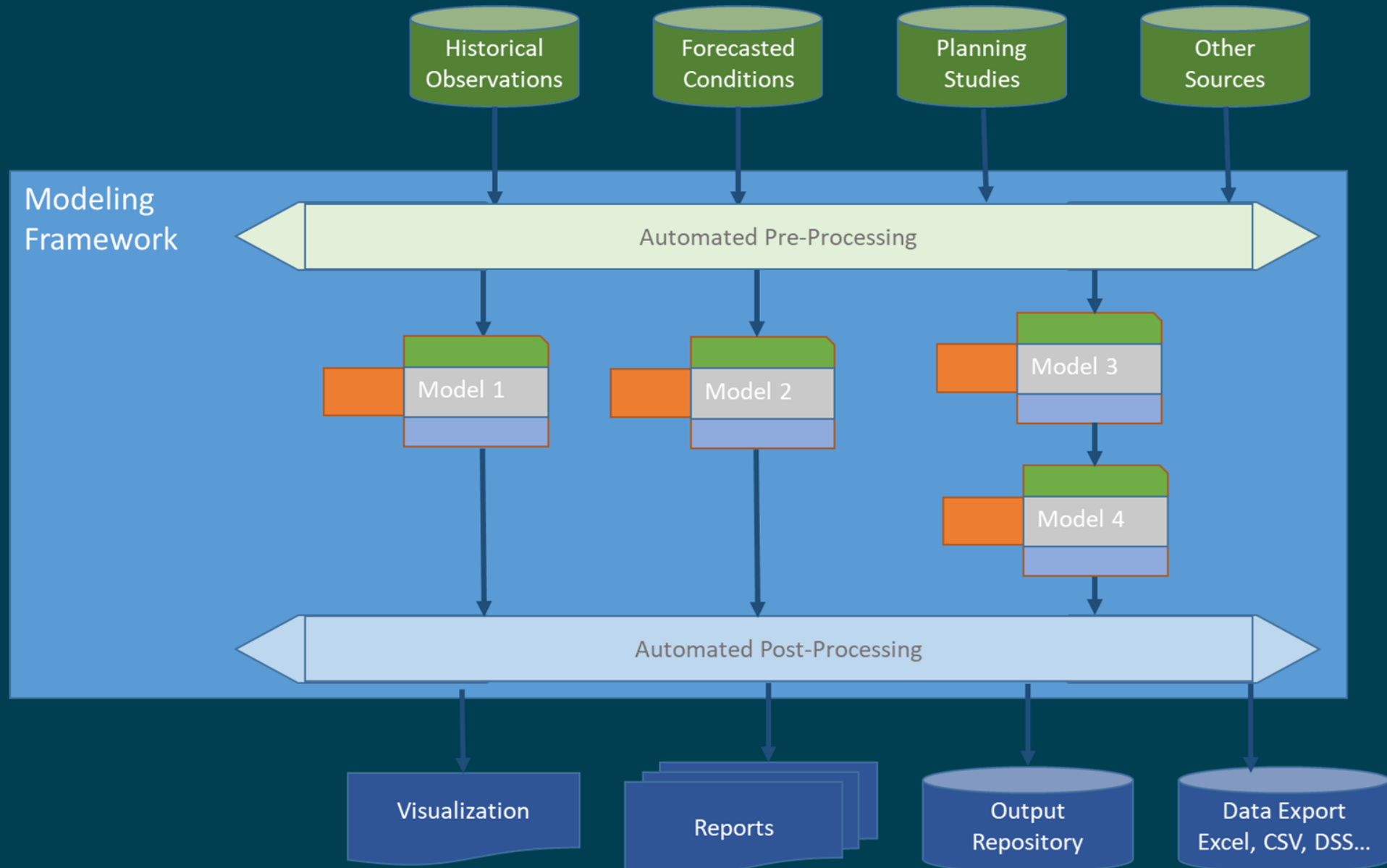
Model, Configuration, Input and Output

“Model Software” in this context refers to a computational software program, for example:

CE-QUAL-W2
HEC-5Q
HEC-ResSim
CALSIM II
DSM2
...



WTMP Analytics Framework



WTMP Modeling Framework User Interface

Menus and
Toolbar Buttons

Study Tree

Study Element
Details

The screenshot displays the WTMP Modeling Framework User Interface. The main window shows a map of the Sacramento-Trinity region with a blue line representing a simulation path. A 'WTMP Actions Window' is open, showing simulation details for 'Prescribed2014'. The window includes a table of simulations and buttons for 'Run Simulation', 'Create Report...', 'Save Results', and 'Delete Results'. A 'Study Tree' on the left lists various simulation elements. A 'Georeferenced Schematic' is overlaid on the map, showing a network of rivers and reservoirs. The interface also includes a menu bar, a toolbar, and a status bar at the bottom.

Simulation	Selected	Map	Report
ResSim Prescribed-Prescribed2014	<input checked="" type="checkbox"/>	Display In Map	View
W2 Shasta Prescribed-Prescribed2014	<input type="checkbox"/>	Display In Map	View

Legend:
■ Not Computed
■ Out of Date
■ Computed
■ Compute Error

WTMP Actions
Window

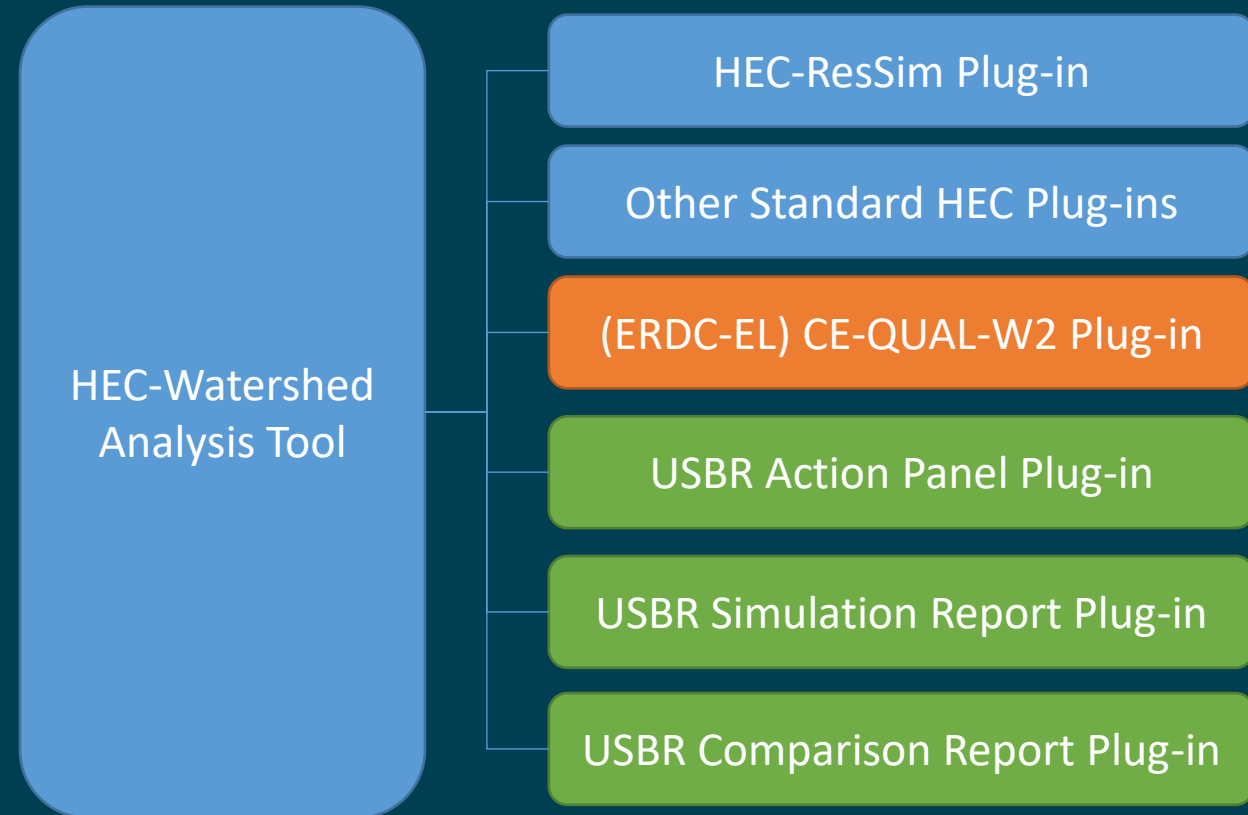
Georeferenced
Schematic



HEC-WAT and WTMP Software Plug-ins

- USBR WTMP Modeling Framework is based on the USACE Hydrologic Engineering Center's HEC-WAT product.
- HEC-WAT is designed to support customization through software plug-ins

<https://www.hec.usace.army.mil/software/hec-wat/>



Simulation Controls in the User Interface

The screenshot displays the 'WTMP Actions Window' with the 'Prescribed Conditions' tab selected. The 'Simulation Group' is set to 'Prescribed2014'. The 'Description' field is empty. The 'Analysis Period' is set to 2014, with a 'Start Time' of 1 January 2014, 00:00 and an 'End Time' of 31 December 2014, 24:00. The 'Simulations' table lists two simulations: 'ResSim Prescribed-Prescribed2014' (selected) and 'W2 Shasta Prescribed-Prescribed2014'. The 'Run Simulation' button is highlighted by a callout. The 'Create Report...' button is highlighted by a callout. The 'Save Results' and 'Delete Results' buttons are highlighted by a callout. A legend at the bottom indicates the status of simulations: Not Computed (blue), Out of Date (black), Computed (green), and Compute Error (red).

Simulation controls operate on the selected Simulations

Run the selected Simulation(s)

Bring up the Report Creation Dialog

Save or Delete reference results

Simulation	Selected	Map	Report
ResSim Prescribed-Prescribed2014	<input checked="" type="checkbox"/>	Display In Map	View
W2 Shasta Prescribed-Prescribed2014	<input type="checkbox"/>	Display In Map	View

■ Not Computed ■ Out of Date ■ Computed ■ Compute Error

Run Simulation Create Report... Save Results Delete Results



Forecast Modeling Overview

- Differences from Hindcast
 - Hindcast is about testing model performance once all boundary conditions are known
 - Forecast is about testing temperature management plans against possible future conditions
- Hydrologic Conditions from Operations Forecasts
- Meteorological Conditions from Historical Experience and/or Climate Forecasts
- Objective is to select the best seasonal temperature targets for management of cold water resources
- Consider a range of possible futures through ensemble simulation



Ensemble Simulation

- **Variability**
 - Future Hydrology and associated Reservoir Operations
 - Future Meteorology
 - Temperature Management Plan
- Hydrology + Operations and Meteorology combine to form a set of model Boundary Conditions
- A Boundary Condition Set combined with a Temperature Target Time Series and Initial Conditions provide the inputs required for a single simulation run
- Ensemble simulation can be used to explore the impact of the these forms of variability individually or together



WTMP Forecasting User Interface Concept

Tabs to choose between Prescribed (Hindcast) and Forecast Simulation

WTMP Actions Window

Simulation Group: F18-04-TTSP

Description:

Initial Conditions

Operations

Meteorology

Boundary Condition Sets

Temperature Target Sets

Shasta Lake

Keswick Reservoir

Trinity Lake

Lewiston Reservoir

Whiskeytown Lake

Get/Update Data

Review Data

Keep Simulation Group controls at the top of the screen

Side tabs to move between data preparation panels

Summarize the information collected for each primary data set

Provide visualization of data to facilitate QA

Buttons to trigger data import, processing, and review actions



Preparing Data for Forecast Simulation: Operations

Table shows list of imported operations

Data for operation highlighted in upper table

The screenshot shows the WTMP Actions Window with the 'Forecast Conditions' tab selected. The 'Operations' list in the 'Initial Conditions' section is highlighted, showing 'APR50_WY2018v' and 'APR90_WY2018v'. Below this is a table with columns for 'Operations', 'File Path', 'Description', and 'Forecast Date'. The 'APR50_WY2018v' row is highlighted. To the right, the 'Import Operations Data' dialog box is open, showing the 'Operations Name' as 'APR50-WY2018v', the 'Description' as 'April 2018 - 50 percentile CVOs Excel Sheet', and the 'Operations File' as 'amentoTrinity_working/forecast/CVP-ops/APR50_WY2018v.xls'. The 'Import...' button in the table is also highlighted.

Operations	File Path	Description	Forecast Date
APR50_WY2018v	forecast/CVP-ops/APR50_WY2018v.xls		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	View	Shasta														
2																
3			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar		Be
4	Trinity/Cla															Mc
5	Inflow		110	105	38	7	1	1	14	32	58	85	130	150		Su
6	Est.		5.1	6.7	7.7	9.8	8.7	6.8	3.2	1.5	1	1.7	1.5	2.3		Ja
7	Total		70.7	116	117.6	111.3	137.2	127.7	48.9	43.2	27	18.7	18.2	53.3		Fe
8	River		600	1498	783	450	857	870	373	300	300	300	300	300		M:
9	River		35.7	92.1	46.6	27.7	52.7	51.8	22.9	17.8	18.4	18.4	16.7	18.4		Ap
10	Carr PP		35	23.9	71	83.7	84.5	75.9	25.9	25.3	8.6	0.2	1.5	34.9		M:

Button to import CVO spreadsheets



Preparing Data for Forecast Simulation: Meteorology

Table shows list of imported operations

Met Data for highlighted set in upper table

The screenshot shows the WTMP Actions Window with the 'Forecast Conditions' tab selected. The 'Operations' table lists several sets, with 'APR50_WY2018v' highlighted. A red arrow points from this row to the 'Import...' button in the 'Met Forecast Name' table below. The 'Import Met Data' dialog box is open, showing the 'Meteorology Name' as 'Met', 'Description' as 'Historic year 2018', and 'Data Source' as 'Historic'. A table in the dialog shows the following data:

Select	Year	Spring Avg Air...	Summer Avg ...	Autumn Avg A...
<input type="checkbox"/>	2013	71.2	79.1	53.2
<input type="checkbox"/>	2014	70.7	80.8	56.4
<input type="checkbox"/>	2015	73.2	80.8	55.3
<input type="checkbox"/>	2016	71.4	80.7	52.9
<input type="checkbox"/>	2017	70.0	83.0	55.3
<input checked="" type="checkbox"/>	2018	70.3	80.5	56.2
<input type="checkbox"/>	2019	70.6	80.2	55.6

Below the dialog, the 'Met Forecast Name' table shows 'H-2017' with 'Historic' type. The 'Location' is 'Lewiston Res' and the 'Record' is 'Air Temperature'. A line graph shows the temperature data for 2017, with the y-axis labeled 'TEMP (C)' ranging from -10 to 50 and the x-axis showing months from Jan to Nov. A red arrow points from the 'Import...' button in the dialog to the graph.

Button to import Met Data



Preparing Data for Forecast Simulation: Boundary Conditions

Table shows list of
Boundary Condition
Sets

BC Data for
highlighted set in
upper table

The screenshot displays the WTMP Actions Window with the 'Forecast Conditions' tab selected. The 'Simulation Group' is 'F18-04-TTSP'. A table lists boundary condition sets with columns for 'Initial Co', 's', 'Meteorology', and 'Condition Sets'. The set 'APR50_WY2018v-H-2018' is highlighted in blue. A red arrow points from this row to a line graph showing temperature data for 'Shasta-Pit-In - TEMP-WATER' from April to October 2018. Another red arrow points from the 'Create B.C. Sets...' button to a 'Create Boundary Conditions' dialog box. This dialog box has two tables: 'Operations' with 'APR50_WY2018v' selected, and 'Meteorology' with 'H-2018' selected. A third red arrow points from the 'Create B.C. Sets...' button to the 'Create Boundary Conditions' dialog box.

Initial Co	s	Meteorology	Condition Sets
Keswick Reservoir (2018-04-15)	APR50_WY2018v	H-2017	APR50_WY2018v-H-2018
Whiskeytown Lake (2018-04-03)	APR90_WY2018v	H-2018	APR50_WY2018v-H-2014
Shasta Lake (2018-04-17)		H-2019	APR90_WY2018v-H-2018
Lewiston Reservoir (2012-04-25)		H-2014	APR90_WY2018v-H-2014
Trinity Lake (2018-04-04)			

Select	Operations	Select	Meteorology
<input checked="" type="checkbox"/>	APR50_WY2018v	<input type="checkbox"/>	H-2017
<input type="checkbox"/>	APR90_WY2018v	<input checked="" type="checkbox"/>	H-2018
		<input type="checkbox"/>	H-2019
		<input type="checkbox"/>	H-2014

Button to build
Boundary Condition
Sets



Preparing Data for Forecast Simulation: Temperature Targets

Table shows list of imported Temp Target Sets

Temp Target Set highlighted in upper table

The screenshot shows the WTMP Actions Window with the 'Forecast Conditions' tab selected. The 'Simulation Group' is 'F18-04-TTSP'. Below this, there are several tables for 'Initial Conditions', 'Operations', 'Meteorology', 'Boundary Condition Sets', and 'Temperature Target Sets'. The 'Temperature Target Sets' table is highlighted in blue. A red arrow points from this table to the 'Select Temperature Target Set' dialog box. The dialog box has 'Import Set From Existing' selected and 'forecast/CVP-ops/TTSP_weekly.dss' in the 'Select file' field. The 'Description' field is empty. Below these fields is a table with two columns: 'Temperature Target Set' and 'River Location'. The 'Temperature Target Set' column has four rows: 'SHASTA - TIER 1', 'SHASTA - TIER 2', 'SHASTA - TIER 3', and 'SHASTA - TIER 4'. The 'River Location' column has a dropdown menu with 'Above Clear Creek' selected. The 'SHASTA - TIER 1' row is checked. At the bottom of the dialog box are 'OK' and 'Cancel' buttons. A red arrow points from the 'Import/Create T.T. Set...' button in the main window to the 'OK' button in the dialog box.

Temperature Target Set	River Location
<input checked="" type="checkbox"/> SHASTA - TIER 1	Above Clear Creek
<input type="checkbox"/> SHASTA - TIER 2	
<input type="checkbox"/> SHASTA - TIER 3	
<input type="checkbox"/> SHASTA - TIER 4	

Temperature Target Set	Description	River Location	Import/Create T.T. Set...
SHASTA - TIER 5		Above Clear Creek	Import/Create T.T. Set...

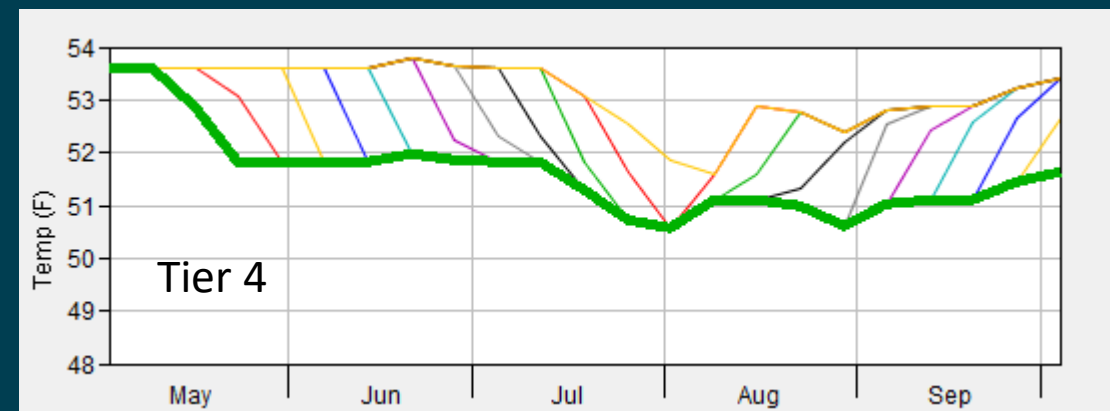
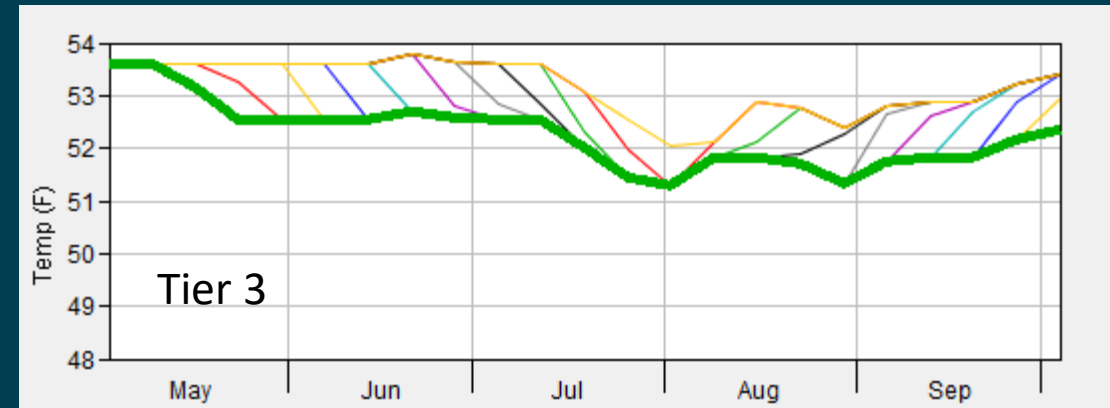
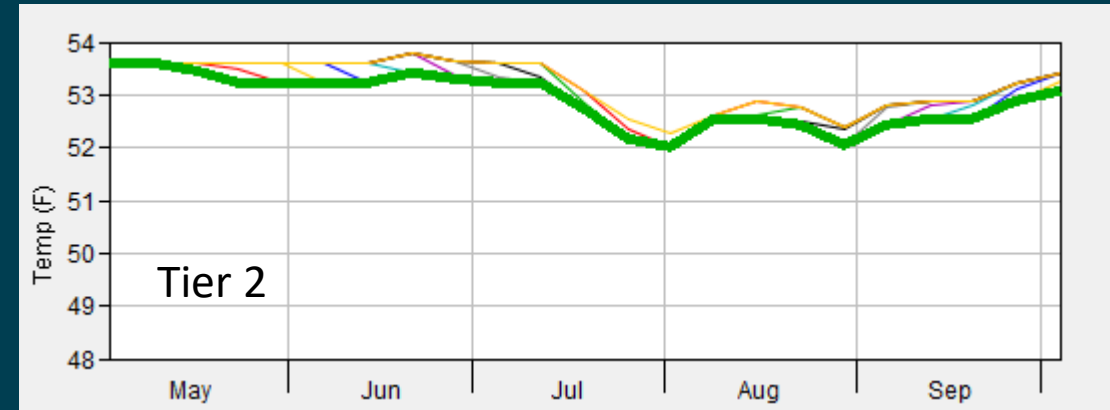
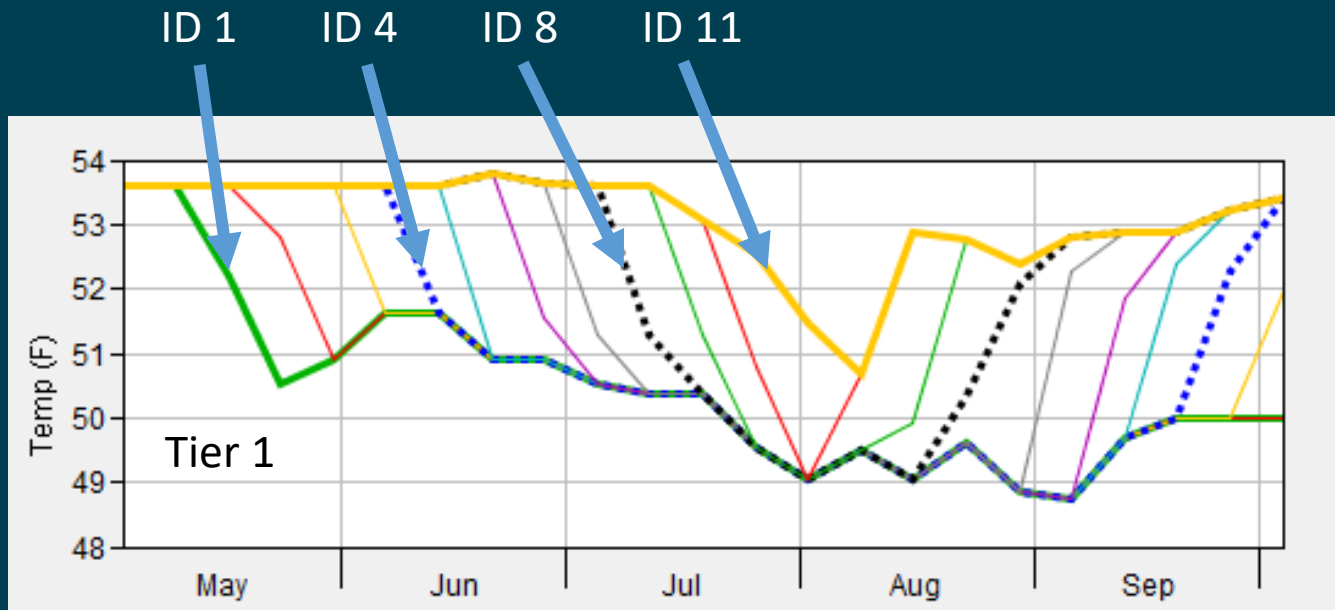
Date	1 (C)	2 (C)	3 (C)	4 (C)	5 (C)	6 (C)	7 (C)	8 (C)	9 (C)	10 (C)	11 (C)
2018-01-05											
2018-01-12											
2018-01-19											
2018-01-26											
2018-02-02											
2018-02-09		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
2018-02-16		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
2018-02-23		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
2018-03-02		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
2018-03-09		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
2018-03-16		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
2018-03-23		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
2018-03-30		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
2018-04-06		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0

Button to import Temperature Target Sets



Temperature Target Sets

TTSP Spreadsheet (Example)



Preparing Data for Forecast Simulation: Selecting Data for Simulation

List of Ensemble Sets ready to run

At least one Temp Target member must identified before row can be selected for simulation

The screenshot shows the WTMP Actions Window with the 'Forecast Conditions' tab selected. The 'Simulation Group' is 'F18-04-TTSP'. The 'Analysis Period' is '2018-04-TTSP', with a 'Start Time' of '2 April 2018, 00:00' and an 'End Time' of '31 October 2018, 24:00'. The 'Simulations' table lists three simulation entries: 'ResSim-F18-04-TTSP' (Selected), 'W2 Shasta-F18-04-TTSP', and 'W2 5-Res-F18-04-TTSP'. Below this, a detailed table for 'ResSim-F18-04-TTSP' shows four rows of data with columns for 'Selected to Run', 'Boundary Conditions', 'Temperature Target Set', 'Target Members To Run', and 'Target Members Previously Run'. The first row is selected, showing 'APR50_WY2018v-H-2018' for Boundary Conditions and 'SHASTA - TIER 5' for Temperature Target Set. An 'Edit Ensemble Set...' button is visible to the right of this table. A red arrow points from the text 'At least one Temp Target member must identified before row can be selected for simulation' to the 'SHASTA - TIER 5' cell in the first row. Another red arrow points from the text 'Button to edit the Ensemble Sets' to the 'Edit Ensemble Set...' button. An 'Edit Ensemble Set' dialog box is open in the top right, showing a list of 'Boundary Conditions' and 'Temperature Target Sets'. The 'SHASTA - TIER 5' target set is selected. The dialog also shows a list of 'Selected Ensemble Sets' including 'APR50_WY2018v-H-2014-SHASTA - TIER 5', 'APR50_WY2018v-H-2018-SHASTA - TIER 5', 'APR90_WY2018v-H-2014-SHASTA - TIER 5', and 'APR90_WY2018v-H-2018-SHASTA - TIER 5'. Buttons for 'Add EnsembleSet', 'Remove EnsembleSet', 'OK', and 'Cancel' are present.

Simulation	Selected	Map
ResSim-F18-04-TTSP	<input checked="" type="checkbox"/>	Display In Map View
W2 Shasta-F18-04-TTSP	<input type="checkbox"/>	Display In Map View
W2 5-Res-F18-04-TTSP	<input type="checkbox"/>	Display In Map View

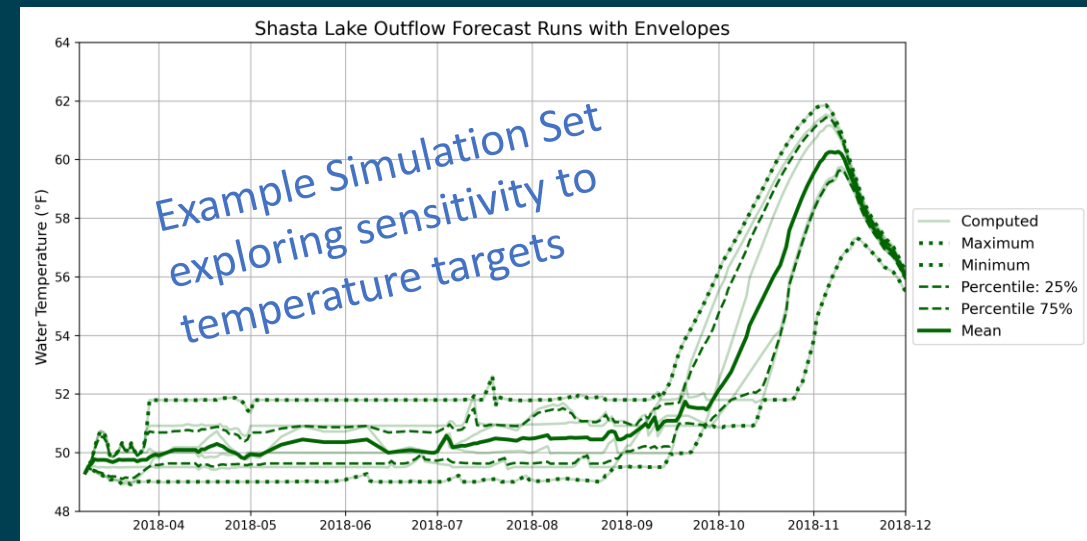
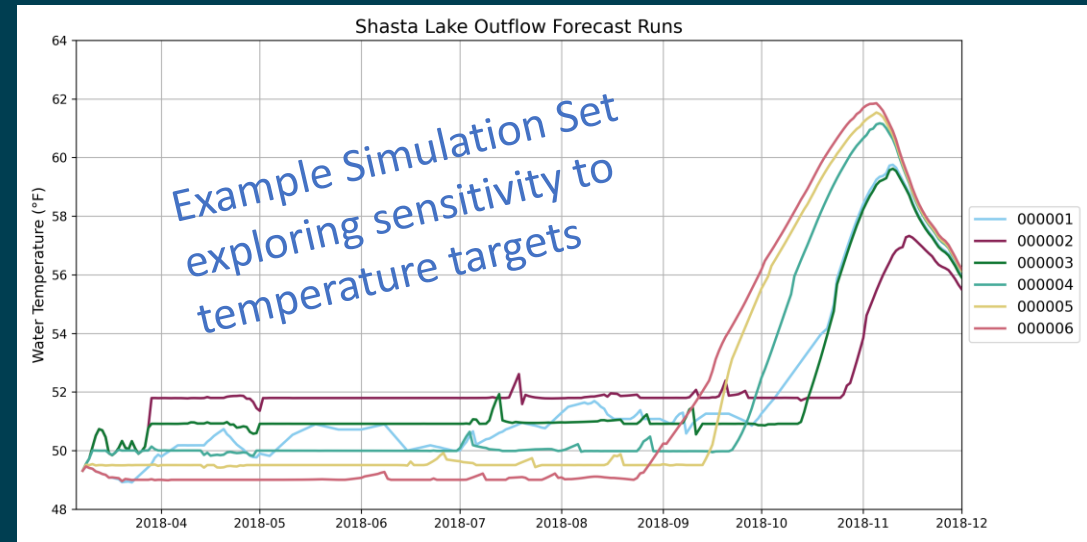
Selected to Run	Boundary Conditions	Temperature Target Set	Target Members To Run	Target Members Previously Run
<input checked="" type="checkbox"/>	APR50_WY2018v-H-2018	SHASTA - TIER 5	5	5
<input type="checkbox"/>	APR50_WY2018v-H-2014	SHASTA - TIER 5		
<input type="checkbox"/>	APR90_WY2018v-H-2018	SHASTA - TIER 5		
<input type="checkbox"/>	APR90_WY2018v-H-2014	SHASTA - TIER 5		

Button to edit the Ensemble Sets



Results Reporting

- Plotting Individual Ensemble Members
 - Demonstrates differences between specific simulations
 - Most useful for a small set of simulations
- Exceedance Plots
 - Demonstrates the distribution possible outcomes
 - Most useful for larger sets of simulations where each results is equally likely
- UI supports filtering results to examine sensitivity to specific inputs



Session 7: CVP WTMP, Chapter 3

3:30 Introduction
Moderator: Yung-Hsin Sun (Sunzi Consulting LLC)

3:40 **Presentation: What We have Done**

3:40 Design with Users and Durability in Mind

3:57 Enabling Platform with Capacity and Flexibility

4:14 **Community Engagement and Institutional Knowledge Development**

4:21 Peer Review and Rollout Preview

4:31 Q&A

4:40 Reclamation Panel Discussion with Q&A:
The End is the Beginning

5:15 Adjourn



Yung-Hsin Sun, PhD, PE, BC.WRE
Sunzi Consulting



Model Technical Committee

- The primary mechanism for Reclamation's engagement process in addition to project website, mailing list, etc. .
- A community approach for *collaborative model development*
 - Focusing on technical discussions to advance water temperature modeling tools and analytical methods,
 - Leveraging collective expertise for progressive review of model and platform development to improve overall outcomes, and
 - Maintaining an open and transparent environment for information sharing and cooperation.



Model Technical Committee

- 10 quarterly MTC meetings from 7/21 through 10/23
 - 3 hours in length
 - Materials and summary available on Reclamation's [project website](#)
- Participants:
 - Technical staff (especially modeling specialists) and managers from resource management agencies, federal/state/local agencies, organizations, consulting practitioners, and supporting staff of adjacent programs and processes.
 - Relative consistent participation throughout the 2.5-year process.



MTC Agenda Designed to Match Platform Development Progression

Topic	7/1/21	10/7/21	1/6/22	4/7/22	7/7/22	10/6/22	1/5/23	4/6/23	7/6/23	10/5/23
MTC Orientation	1/2/3	-	-	-	-	-				
Project Purposes, Goals, Anticipated Outcomes	1/2/3	3	-	-	-	-				
Modeling Framework Selection	1	2	3	-	-	-				
Water Temperature Model Selection	1	2	3	-	-	-				
Consistency between System Model and Detailed Models	-	1	2	3	-	-				
Common Model Preparation and Considerations	-	1	2/3	-	-	-				
Sacramento/Trinity River Water Temperature Model	-	-	1	2	2/3	3	-	-	-	-
American River Water Temperature Model	-	-	-	1	2	2/3	-	-	-	-
Stanislaus River Water Temperature Model	-	-	-	-	1	2	3	-	-	-
Modeling Framework Implementation	1	-	2	-	-	-	2/3	-	3	-
Mid-term Peer Review Outcomes	-	-	-	-	-	1/2/3	-	-	-	-
Phase II Activities (Introduction only)	-	-	-	-	1/2/3	-	-	-	-	-
Follow-up Model Discussions (as needed)							1	2	3	-
Characterization of Model Uncertainty							1	2	3	3
Communication of Model Uncertainty							1	1/2	2/3	3
Output and Visualization							-	1	2	3
Final Peer Review Outcomes							-	-	-	1/2/3
Celebration							-	-	-	1/2/3

Key: 1 – Introductory Presentation; 2 – Comments and Discussion; 3 – Closure Discussion.

Reclamation's Institutional Knowledge Development

- Reclamation will own and implement the WTMP.
- Develop and retain institutional knowledge is the key to success.
 - Integrated team structure
 - Develop solutions with active participation by Reclamation staff
 - Collaborative development with hand-on opportunities
 - Regular team meetings with paced incremental reviews to establish shared experience in problem solving
 - Milestone workshops with Reclamation for enhanced learning experience and on-boarding
 - Documentation, documentation, and documentation
- **Validation:** Reclamation team's stellar performance in the final peer review.



What is Next for Engagement and Institutional Knowledge Development

- *Stay on the path that works.*
- Maintain the same integrated team with Reclamation for continued fostering organization capacity growth and long-term implementation
- Maintain the same principles for engaging modeling community and interested parties (more in the rollout preview)
 - Engaging currently established technical groups for facilitated adoption
 - Forming a WTMP User Group



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Randi Field
Bureau of Reclamation, CVO
(Reclamation Project Lead)



WTMP Final Peer Review

- **What did the Review cover?**

- Tested the technical merits/methods of the model
- Model development process
- Evaluation of model performance
- Documentation and support material
- Application and adequacy of the models

- **What was Feedback?**

- Model elements were found to be appropriately represented and consistent with project objectives
- Extremely positive feedback and responses from the Peer Review Panel

- **What was the outcome?**

- Built confidence in technical adequacy for application
- WTMP performed documentation enhancements based on feedback
- Team transition to testing and facilitated adoption



Response to Peer Review Comments

- **Addressed comments in documentation:**
 - Polished diagrams, maps, and graphics
 - Enhanced text content including section overviews
 - Reformatted model performance to arrange results by year type
 - Identified specific ranges of meteorological conditions where were calibrated
 - Enhanced tables and plots of reservoirs including water year type classification, volumes, and min/max release



Quote from the Peer Review Final Report

"The WTMP Project Team has taken important and commendable steps to position the modeling framework along an adequate path. These steps include:

1. engagement with scientific community working on climate forecasts and downscaling,
2. engagement with stakeholders,
3. modeling's and data sharing,
4. sharing documentation on modeling approach and performance,
5. system monitoring,
6. hinder approach for continuing model performance evaluation, and
7. building the system framework to operate within a Monte Carlo framework."



WTMP Peer Review Panel: Features to Commend

Items externally perceived as laudable practice and a significant complement to CWEMF Modeling Guidelines:

- Model development transparency
- Open software/free
- Data management
- Data quality
- Data availability
- Stakeholder engagement through open science
- Model dissemination to build community capability in-house and within stakeholder communities



WTMP Peer Review Panel: Suggestions

Additional Areas of Future Work:

- Incorporate future 3-to-5-day meteorologic forecast uncertainties
- Continue investigating forecast uncertainty
- Explore Water Data Markup Language (WaterML)
- Investigate additional data gap filling methodologies
- Improve areas in the model where parameterization was applied
- Craft future work plan



Next Peer Review

Independent peer reviews complement Reclamation's commitment to quality and integrity of analytical tools to support Project operations:

- HEC-ResSim model independent scientific review
 - In the context of WTMP use
 - Water quality module for water temperature modeling applications
- Reclamation is partnering with USACE, Hydrologic Engineering Center
- Review host is the Delta Stewardship Council, Delta Science Program
- Tentative review date is January 2025



Rollout Update!

- Facilitated Adoption to begin in Spring 2025
- WTMP tools to be available for distribution in Fall 2025
- **Why the new approach?**
 - Logistical challenges - Institutional security requirements
 - Facilitated adoption – Expansion/more frequent interaction
 - Testing - Additional time to address project scope, data magnitude, and level of technical detail
 - Preparation – New media elements

Facilitated adoption including migration, onboarding, and education, aiming at empowering users with success from the beginning. More details to come.

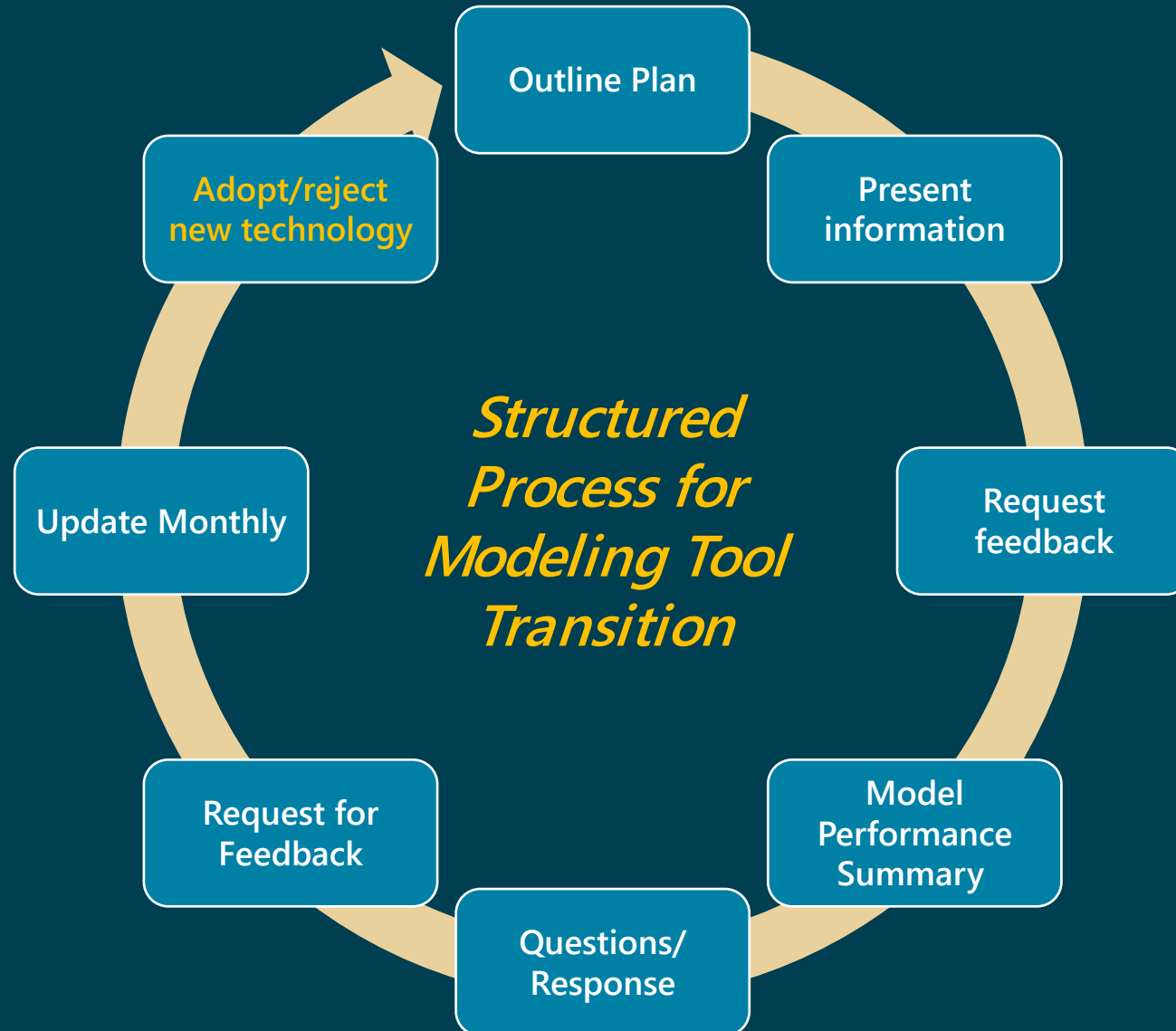


What will happen Spring 2025?

- Facilitated Adoption for the WTMP:
 - Opportunity to engage with WTMP teams/stakeholders
 - Initiate the setup of the Seasonal Temperature Management Plan
 - Present parallel performance comparisons of new and legacy tools
 - Offer consistent monthly updates May through October
 - Comprehensive seasonal hindcast evaluation complete late November/early December



What is Facilitated Adoption?



What are the benefits of Facilitated Adoption?

- **Gradual and stepwise introduction of:**
 - Tools
 - Inputs and Assumptions
 - Results
 - Analysis
 - Processes
- **Greater opportunities for community feedback:**
 - Information presentation - Graphic/tabular displays
 - Performance assessment
 - Workflow process testing

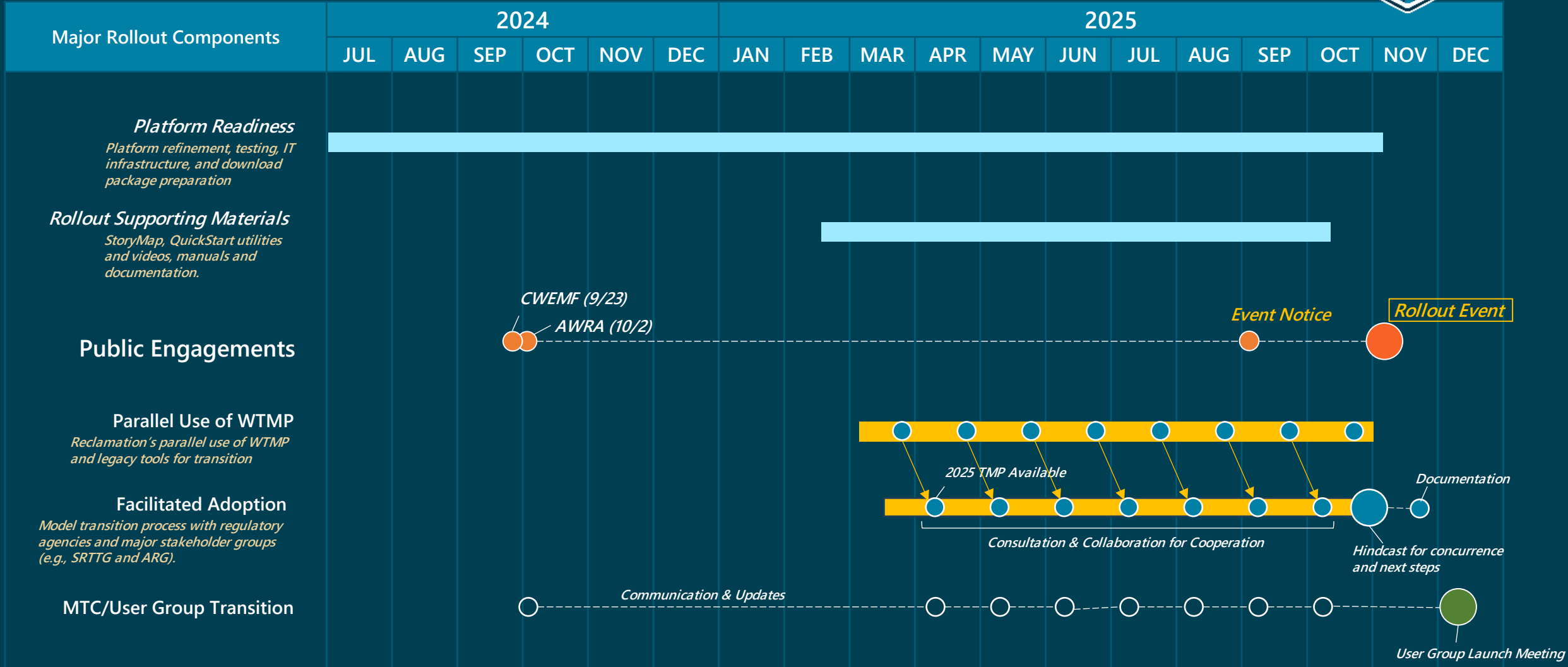


What to Expect at the Fall 2025 Rollout?

- A celebration event that you do not want to miss.
- **Access to the WTMP tool package with links for downloading:**
 - Model Documentation
 - Model Software Packages
 - RISE data
 - QuickStart Videos
 - WTMP StoryMap
- **Launch the Water Temperature Modeling User Group:**
 - Voluntary recruiting process and sign-up information
 - First meeting will follow approximately a month after the Rollout event



WTMP Rollout Schedule



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All of You





Photo credit: John Hannon, Reclamation

2024 CWEMF Annual Meeting: Session 7: CVP WTMP, Chapter 3

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