



Riverware Modeling in the Deschutes Basin: An Integrated Basin Scale Opportunity Assessment

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Introduction

- ▶ Objectives
- ▶ The approach
- ▶ Riverware modeling in the Deschutes River Basin, Oregon
- ▶ Visualization tool
- ▶ Next steps

Objectives of Opportunity Assessment

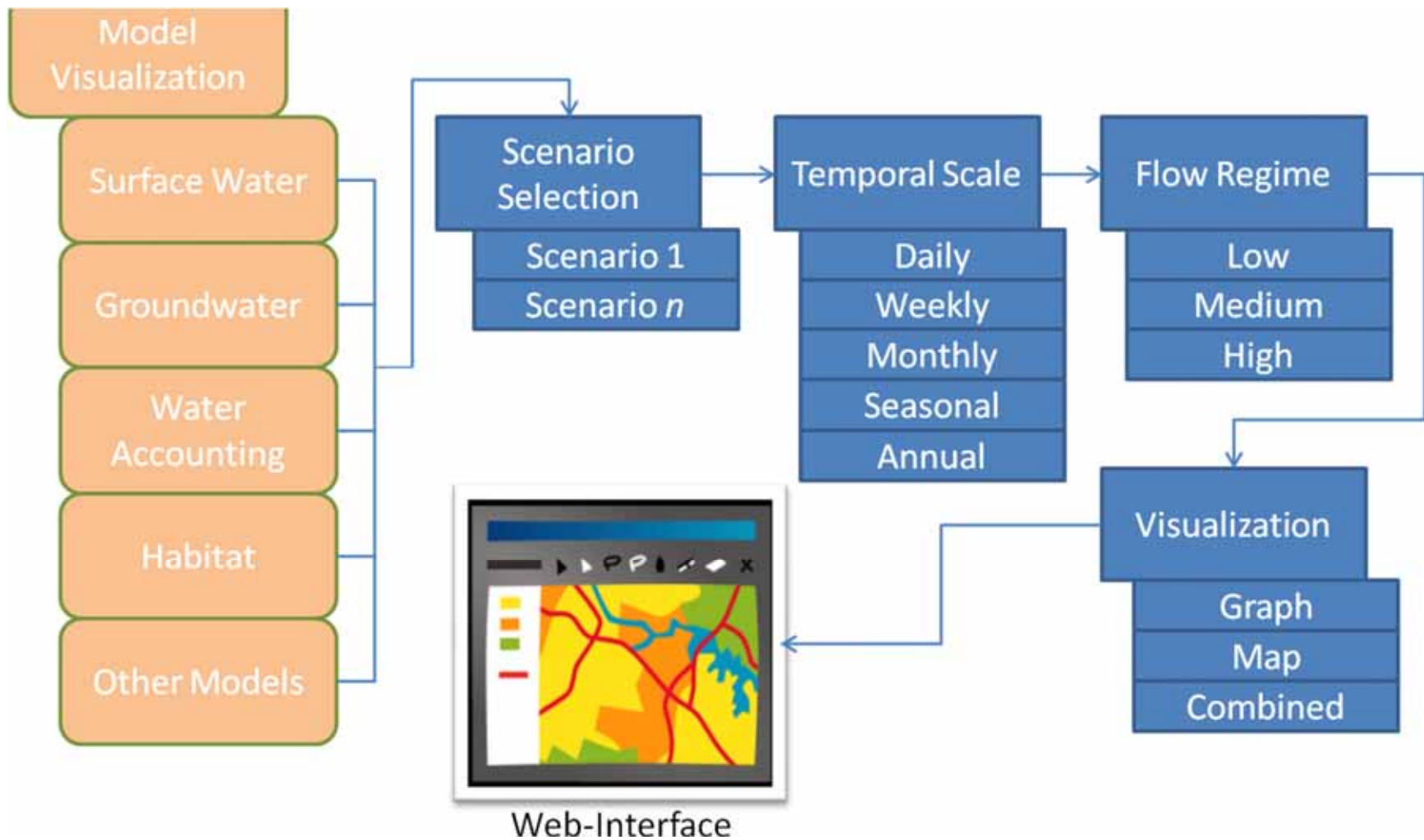
- ▶ To develop an approach for basin scaled identification and analysis of sustainable hydropower and environmental protection/restoration opportunities, while protecting other water users
 - Stakeholder engagement
 - System-scale analysis
 - To inform policy with the basin



The approach

- ▶ Generic approach – exportability
 - Leverage from existing tools
 - Using datasets consistently available throughout the US
- ▶ Customization
 - Stakeholders identified challenges
 - Based on hydro-climatological characteristics of the basin
- ▶ System-scale analysis:
 - Hydrology modeling
 - Water resource management
 - Development of scenarios for identifying opportunities or mitigating issues
- ▶ Visualization
 - Model outputs that feed into a decision support/data visualization system

The approach



Project Location

- ▶ The Upper Deschutes/Crooked River Basin located in Central Oregon
- ▶ 7 irrigation districts of which 90 % of water use is for Agriculture
- ▶ Major irrigation reservoirs in both sub basins
- ▶ Complex environmental and regulatory issues
- ▶ Multiple stakeholder groups engaged in environmental and water use planning
- ▶ Large potential for small hydropower opportunities



Basin Opportunities

- ▶ Hydropower
 - Adding turbines to existing dams without hydropower capability
 - In canal and conduit small hydropower
 - Flow shaping to firm power generation at Pelton-Round Butte facilities
- ▶ Environmental
 - Enhance flows below reservoirs
 - Habitat restoration and water quality improvements
 - Assist in environmental planning process through application of modeling tools and data aggregation

Basin Scale tasks



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- ▶ Model development
- ▶ Modeling scenarios
- ▶ Visualization

The Riverware Modeling

- ▶ Why Riverware?
 - Simulated hydropower on a daily time step
 - Incorporated water rights into water accounting
 - Integrates surface and groundwater hydrology
 - Tool used by many agencies within the basin

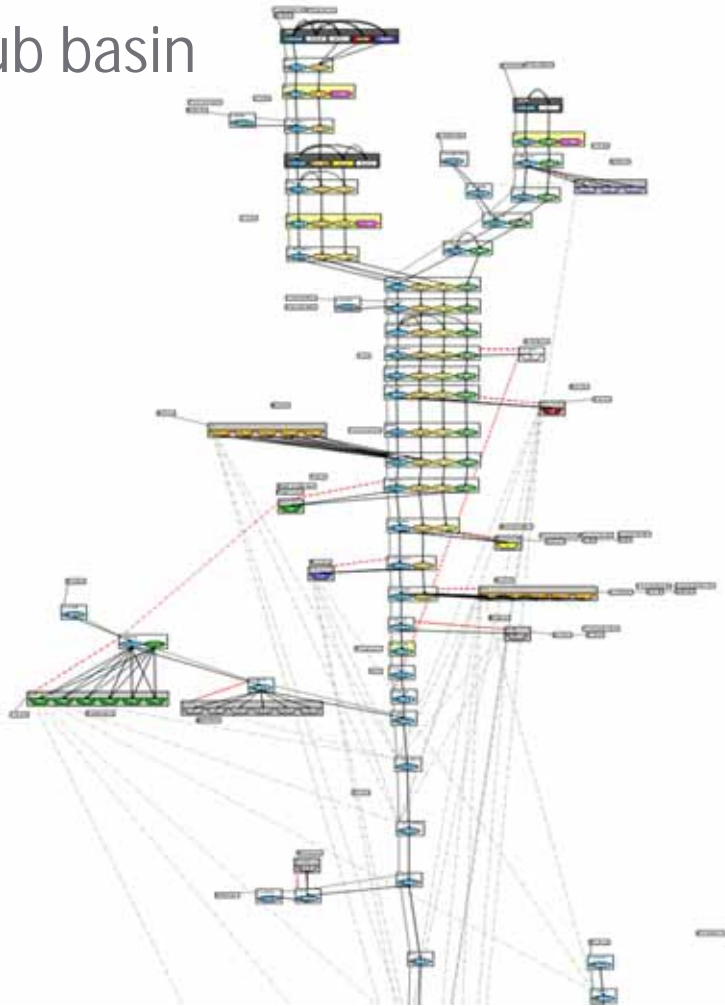
- ▶ Water resource modeling:
 - Existing MODSIM monthly set up for the basin
 - Monthly Surface and Groundwater flows

Riverware Modeling

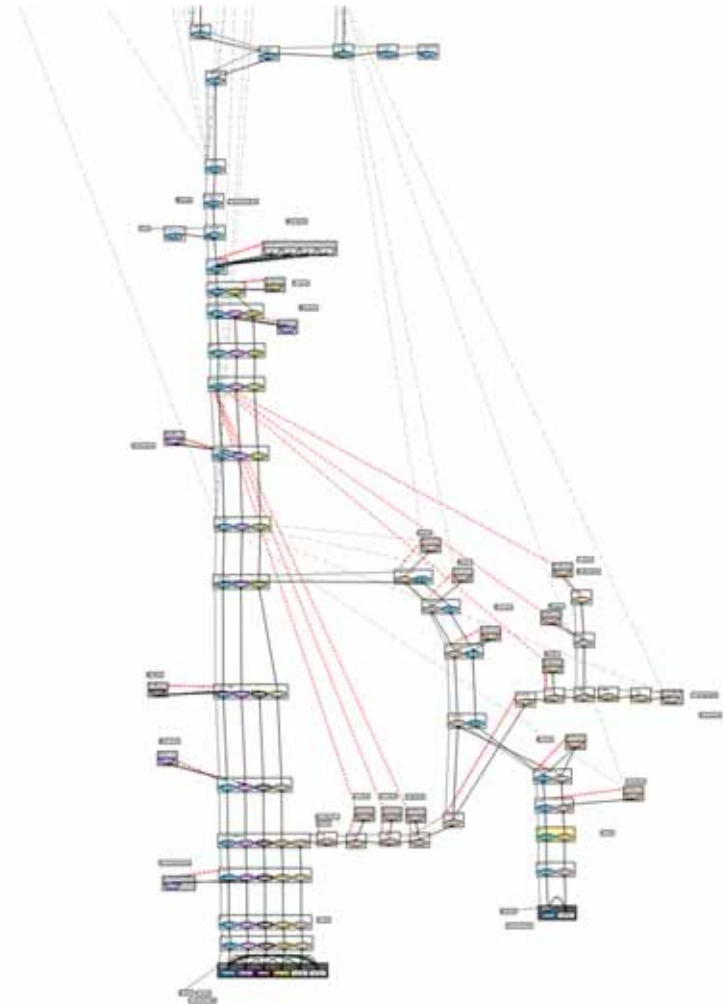
- ▶ 31 Diversions (water user objects)
 - 54 accounts
 - 36 Natural Flow
 - 18 Storage
- ▶ 5 Dams with Hydropower
- ▶ 8 inline Hydropower objects
- ▶ 3 pumping systems
- ▶ Over 20 groundwater return flow locations

Riverware Modeling

Deschutes
sub basin



Crooked
sub basin



Rule order

Accounts

- Initial Requests
- Flood Control
- Natural Flow
- Storage



Physical

- Outflows and Demands are set from accounts

Riverware Calibration

Storage

Reservoir	Observed vs. 2012 USBR MODSIM Simulated			Observed vs. Riverware Simulated Storage		
	Bias (acre -ft.)	MAE (acre-ft.)	R ²	Bias (acre -ft.)	MAE (acre-ft.)	R ²
Crane	506	5,155		2,485	5,885	
Crescent	788	6,193		-3,159	6,084	
Wickiup	-2,613	21,451		-22,823	25,448	
Prineville	-6,299	13,832		-157	17,258	
Ochoco	-2,931	6,586		3,475	5,739	

Discharge

Reservoir	Observed vs. 2012 USBR MODSIM Simulated			Observed vs. Riverware Simulated Discharge		
	Bias (cfs)	MAE (cfs)	R ²	Bias (cfs)	MAE (cfs)	R ²
Crane	0.89	60.34		5.57	70.24	
Crescent	1.23	22.17		0.93	22.03	
Wickiup	-0.03	111.70		34.71	209.34	
Prineville	-13.75	121.51		6.30	135.99	
Ochoco	10.81	43.32		-10.01	33.21	
BENO	-33.29	100.330		19.494	211.907	
DEBO	-407.722	474.897		-216.476	324.768	

- ▶ Scenarios were ran from 1928 to 2008 Natural Flow conditions

- ▶ Baseline (current Conditions)
- ▶ Deschutes River Integrated
 - Adding proposed hydropower facilities
 - Increasing Wickiup Reservoirs outflow
 - 25cfs (current minimum)
 - 100, 175, 250, and 350
 - Decreased water supply to major irrigators
 - ◆ 10 and 20% supply reduction

- ▶ Crooked River Integrated
 - Added proposed hydropower
 - No Environmental scenarios could be agreed on within the sub basin due to pending legislation

Visualization Tool

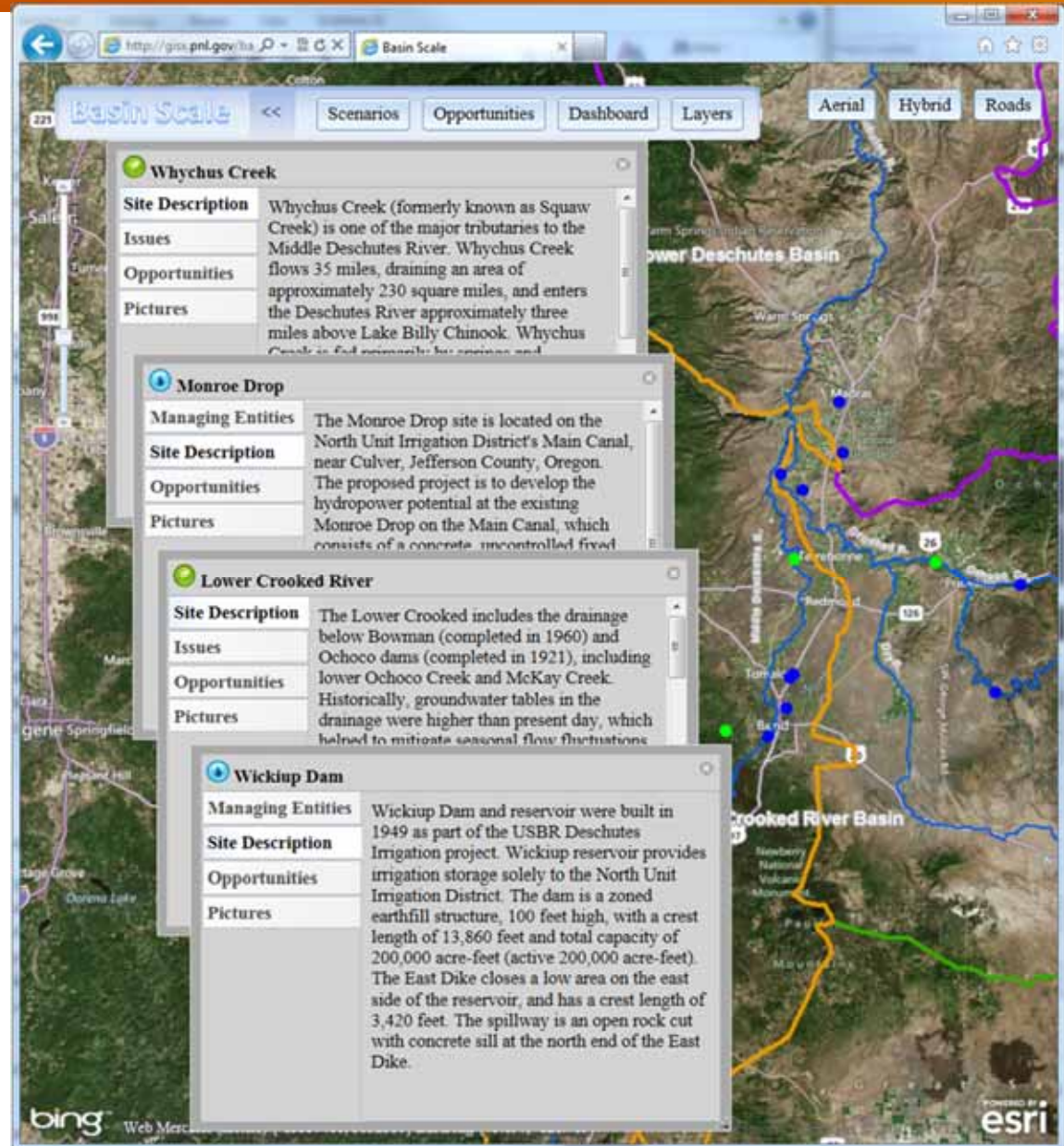
► Visualization tool has the following features presented on an online forum :

■ **Interactive basin map**

- Layers like roads, aerial and site photos, gage data

■ **Opportunity explorer**

- Detail site specific environmental and hydropower opportunities



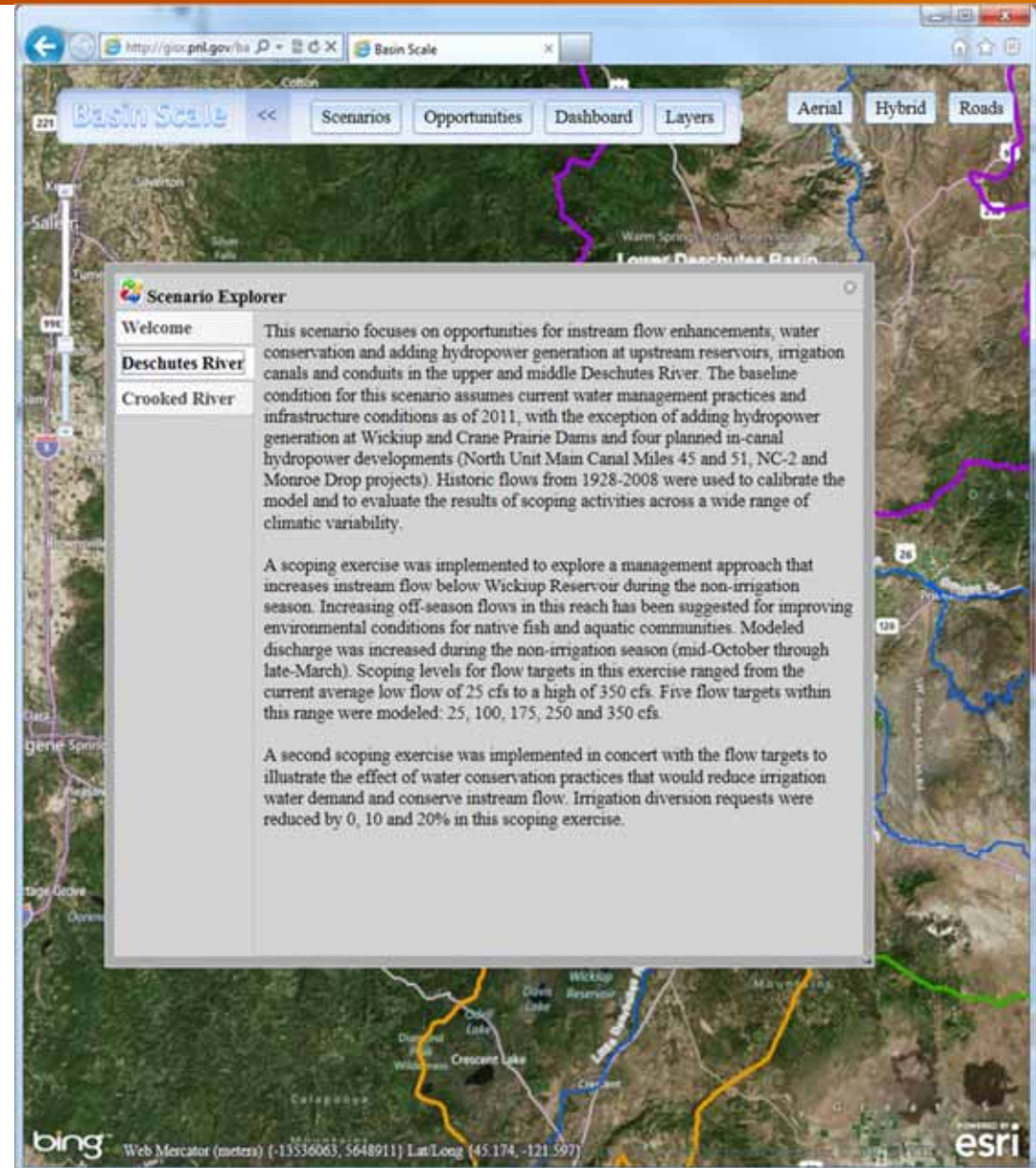
Visualization tool

► **Scenario explorer**

- Site specifically describes the modeling scenarios and leads the user through data of model results

► **Model Results Dashboard**

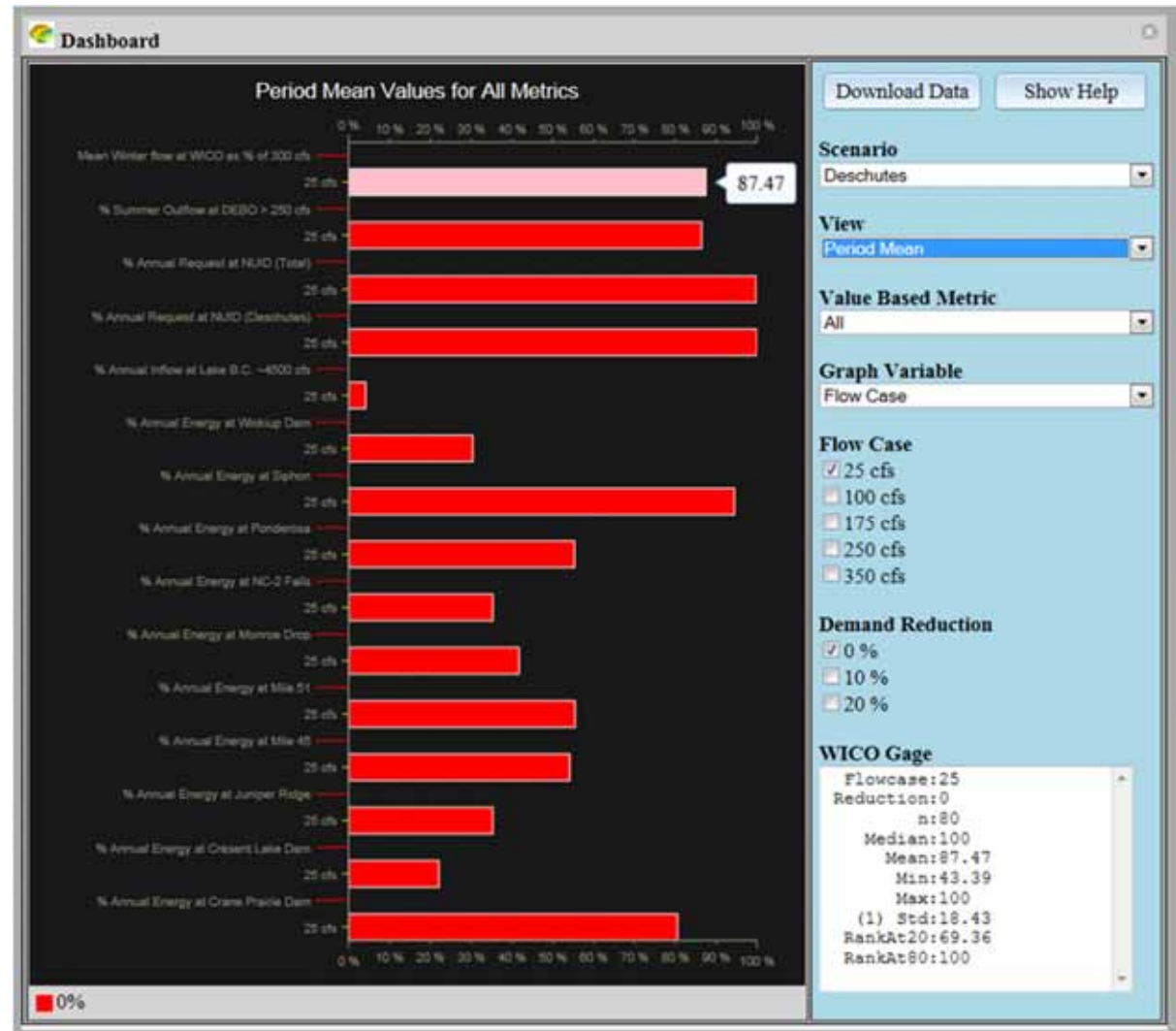
- Allows user to compare and contrast modeling scenarios



Visualization

► *Model Results Dashboard*

- Allows user to compare and contrast modeling scenarios using value based metrics as well as download modeling data results



Next Steps

- ▶ The model will be housed with the Bureau of Reclamation Pacific Northwest Region
- ▶ Provide continual guidance with the use of the model and continue to engage with stakeholders within the basin

QUESTIONS?

