# Modeling System Benefits in RiverWare

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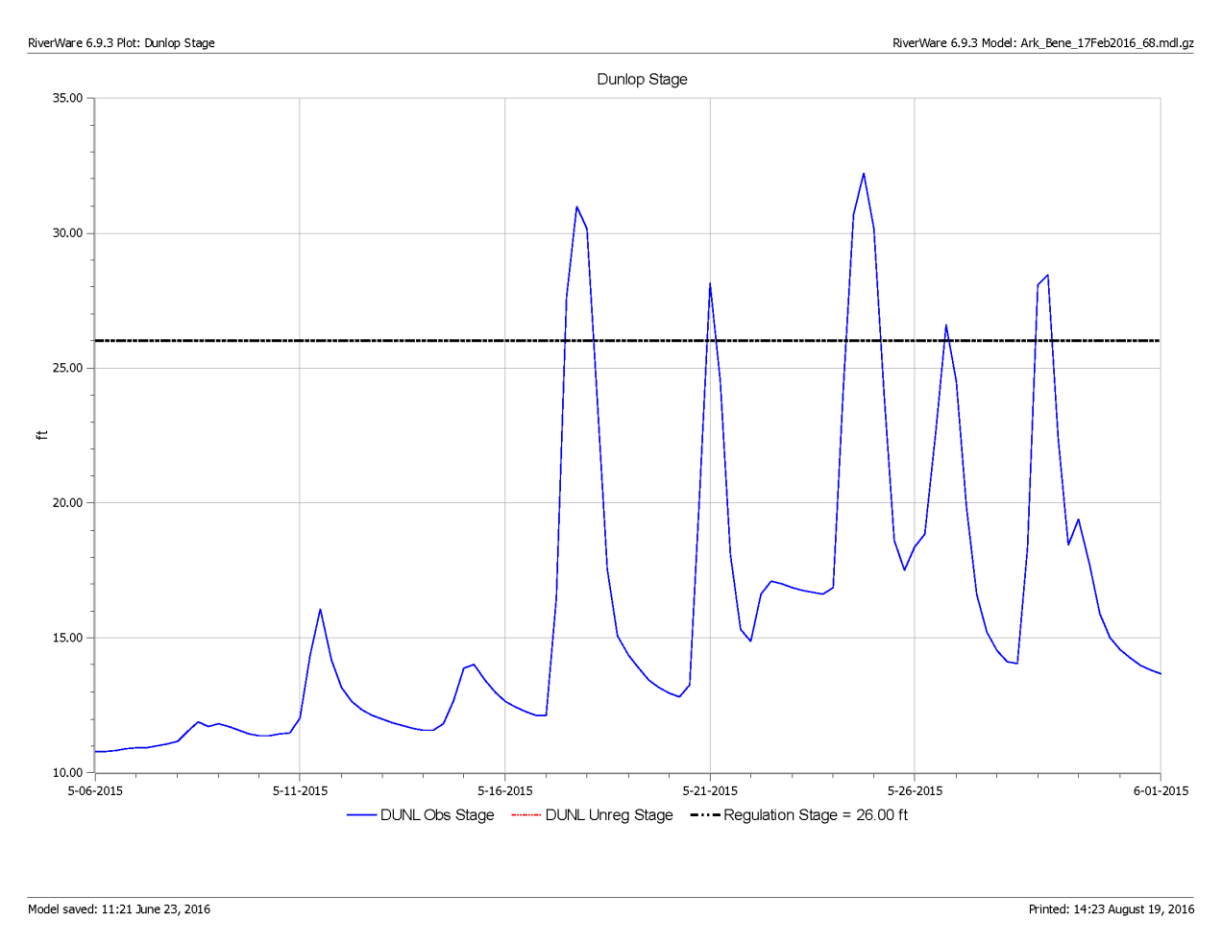
# Introduction

- Why have benefits models?
  - Need a way to quantify monetary savings or damage reduction due to the presence of projects.
  - Required to report project benefits to Congress annually.
- How do we derive these values?
  - Use observed stages that give us the controlled condition, and calculate stages that reflect an uncontrolled condition.
  - Compare these results and using damage curves we are able to calculate the $$$ saved by having the projects in place.

# Determining If Benefits Need To Be Calculated



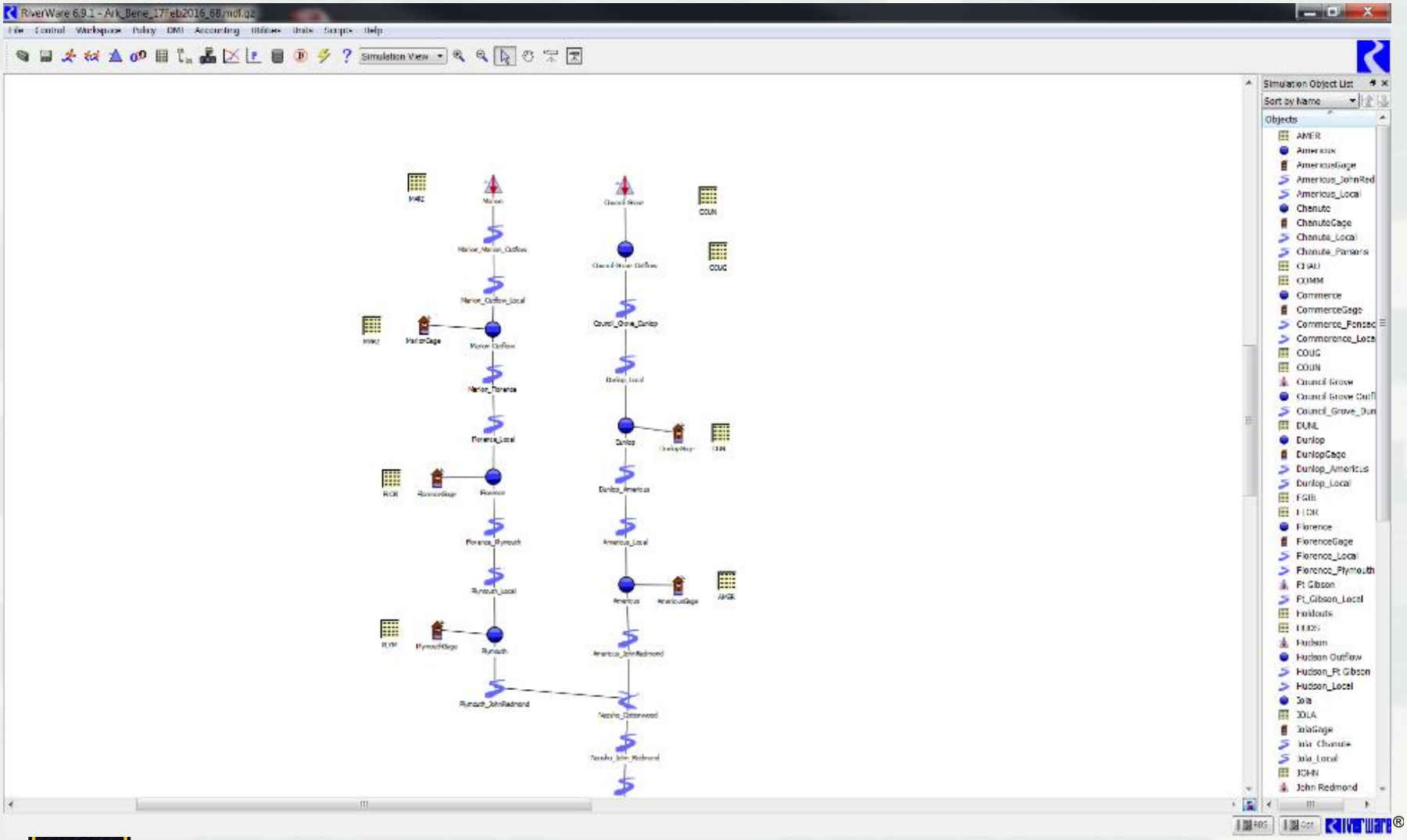
# Existing Tools and Methods

- Pre-Processing data from WCDS
  - Reservoir Inflow/Outflow/Elevation
  - Gage Flow/Stage
- Clean data using DSS
  - Fill missing data
  - Remove erroneous peaks
- Existing Tools
  - HEC-1
  - ViewGraph
  - DSS
  - Flow2Stage
  - DSSMATH/DSS Scrips

# Existing Methods

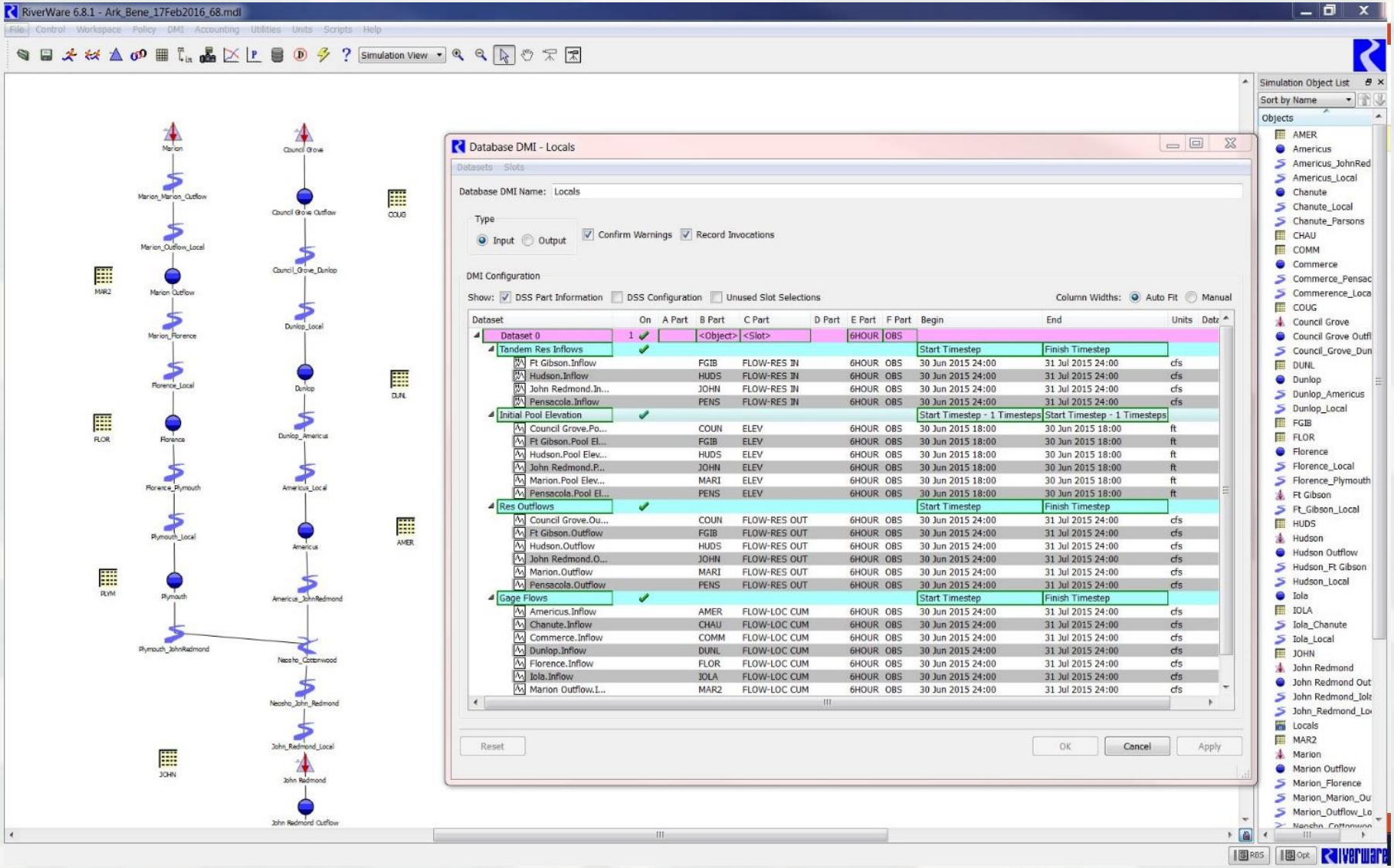
- Run HEC-1 benefits model
  - Convert to 6-Hour
  - Calculate Locals and Unregulated
- Clean Unregulated Data
  - Remove negative local flow values
- Convert to Unregulated Stage hydrographs
- Plot locations with Benefits
- Holdouts
- Holdout Distribution

# Model Interfaces



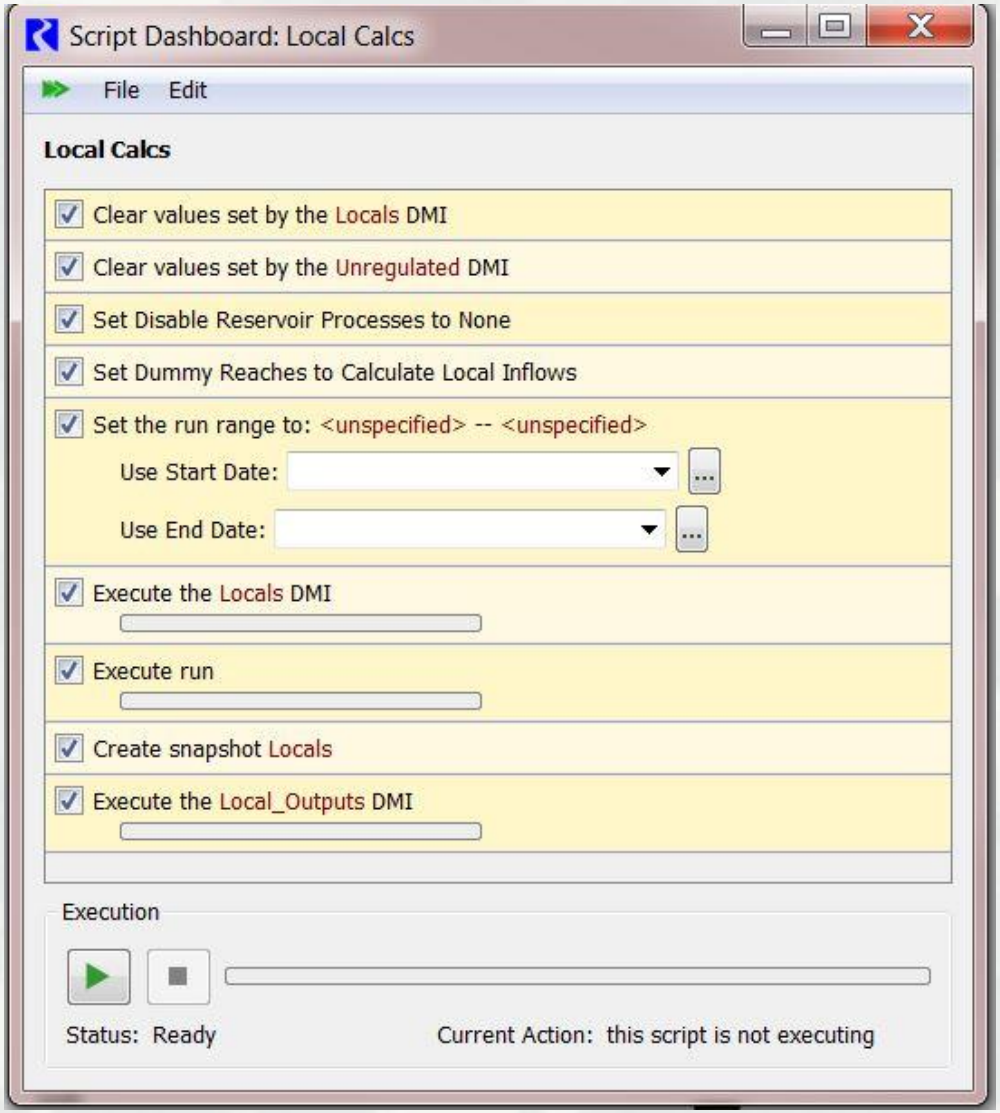
# RiverWare Approach

- Extract data from WCDS
  - Clean
  - Convert to Local
  - Convert to 6-Hour
- Use DMI to input data into RW
- Calculate Locals
- Export DMI to DSS
  - Remove Negative Locals
- Import Cleaned Locals
- Calculate Unregulated Flows
- Calculate Reservoir Holdouts


RiverWare 6.8.1 - Ark_Bene_17Feb2016_68.mdl
Database DMI - Locals
Database DMI Name: Locals
Simulation Object List
Sort by Name
Objects
Marion
Council Grove
Marion_Marion_Outflow
Council Grove Outflow
Marion_Outflow_Local
Council_Grove_Dunlop
Marion Outflow
Dunlop_Local
Marion_Florence
Dunlop
Florence_Local
Dunlop_Americus
Florence
Americus_Local
Florence_Plymouth
Americus
Plymouth_Local
Americus_JohnRedmond
Plymouth
Neosho_Cottonwood
Plymouth_JohnRedmond
Neosho_John_Redmond
John_Redmond_Local
John Redmond
John Redmond Outflow
COUG
MAR2
DUNL
FLOR
AMER
PLYM
JOHN

# Scripts

- Separate Scripts for calculating
  - Locals
  - Unregulated Conditions



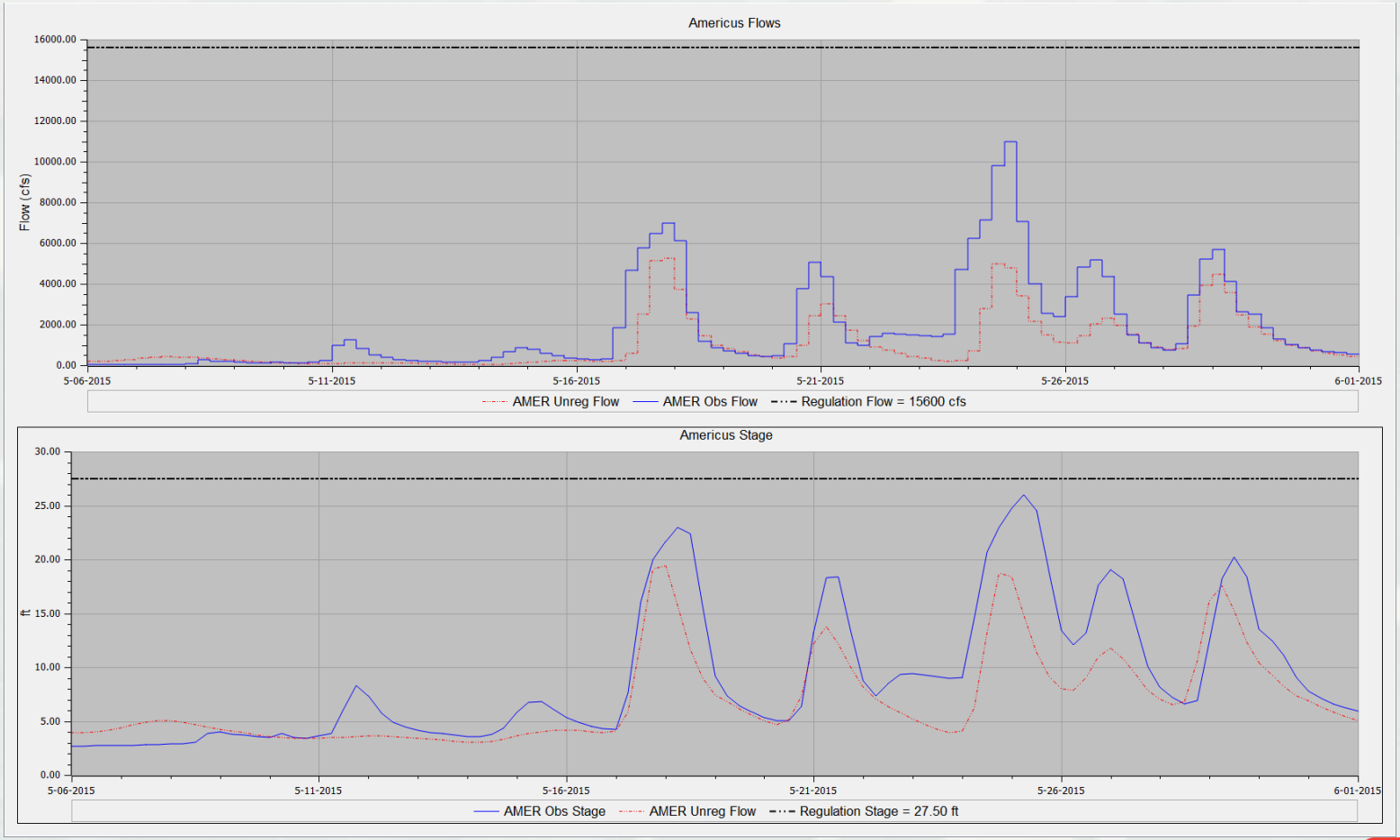
# RiverWare Methods

- Locals
  - ► Set Reservoir Methods to None
  - ► Use same Routing methods from HEC-1
    - Modified Puls
    - Muskingum
    - Lag
  - ► Create “Dummy” Reaches to calculate Locals
    - No Routing
    - Solve Local Inflow

# RiverWare Methods

- Unregulated Flows
  - Disable Reservoirs to Pass Inflow
  - Dummy Reaches to No Local Inflow, Solve Outflow

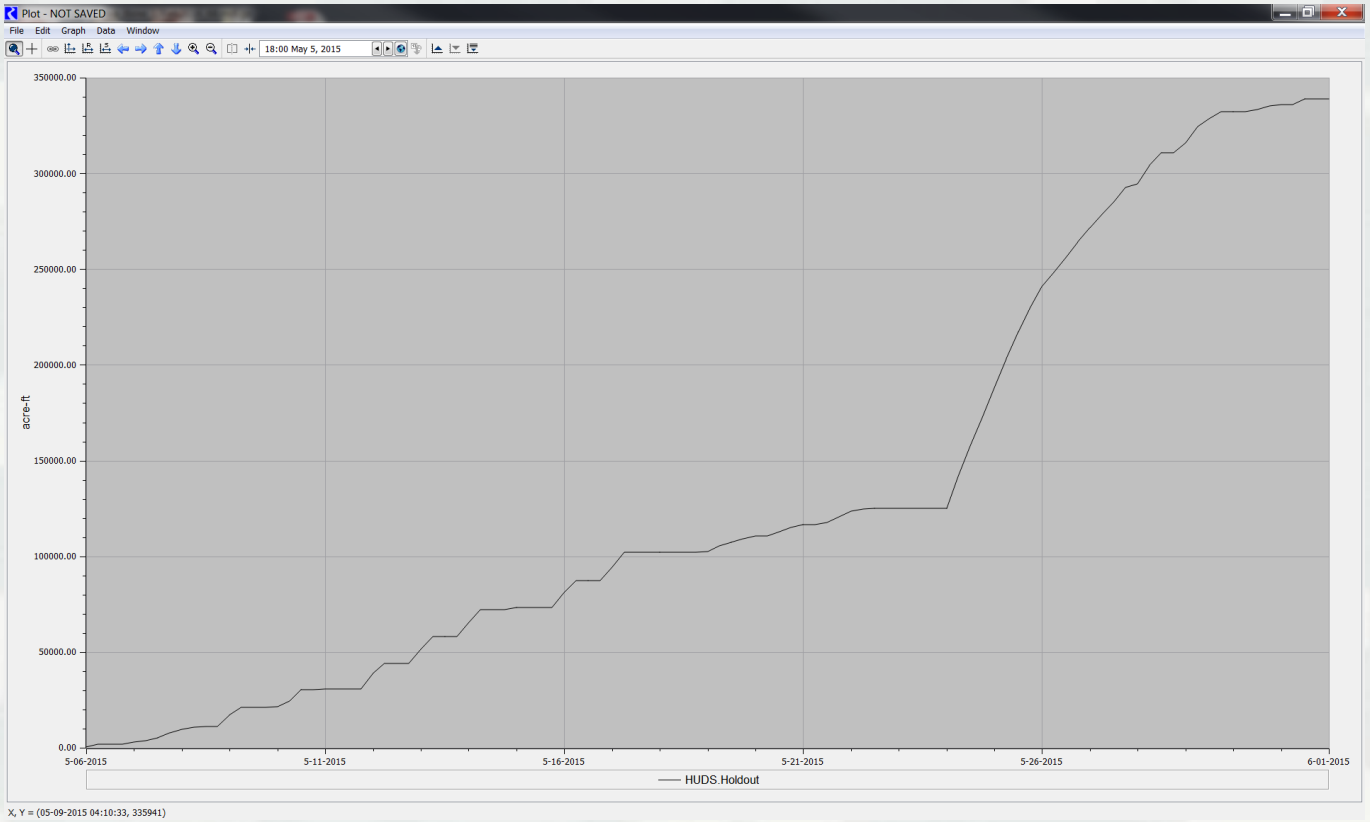
# RiverWare Unregulated Results

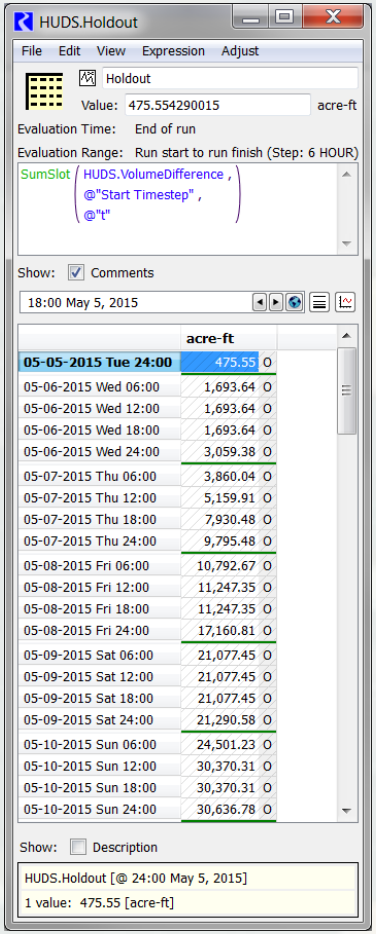


# Holdouts

- What was the volume of water maintained in reservoir during events?
- Calculated when Inflow > Outflow
  - ► Flow converted into Volume
  - ► Summed over entire modeled period
- When Inflow < Outflow
  - ► Holdout calculation set to zero
- Benefits distributed by percentage of total volume per basin.

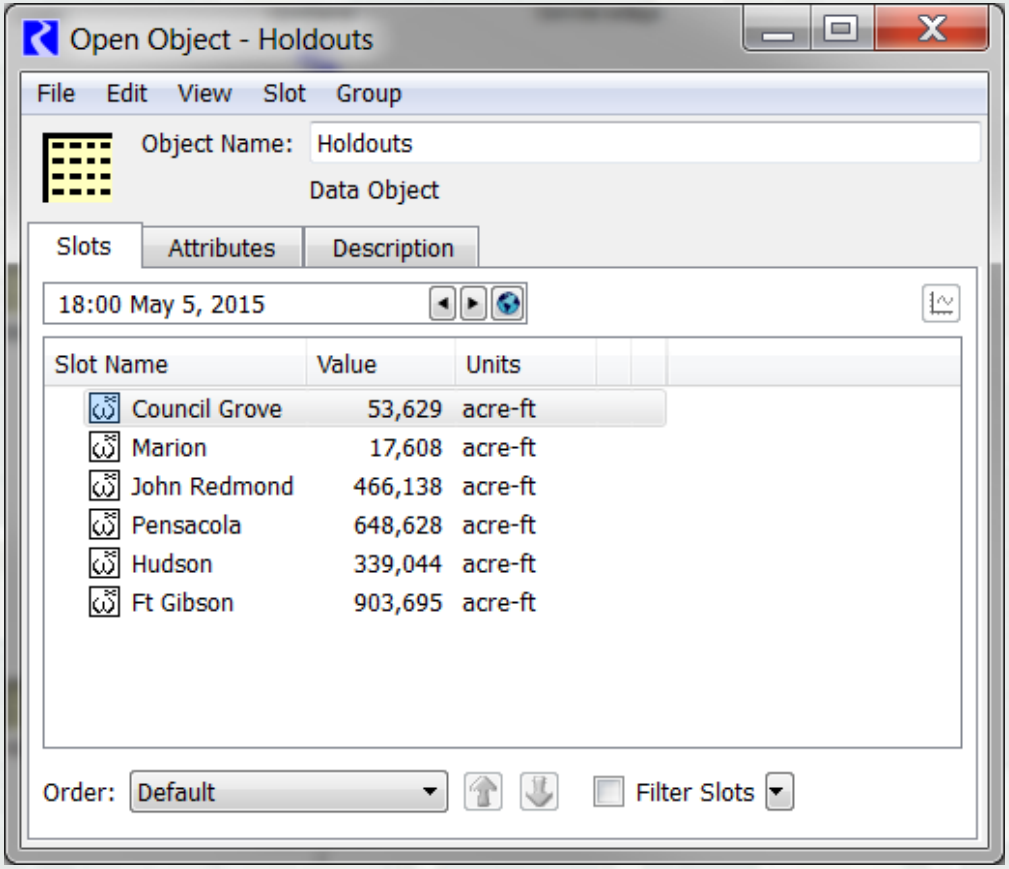
# May 2015 Holdouts for Hudson




| | acre-ft | |
|---|---|---|
| **05-05-2015 Tue 24:00** | 475.55 | O |
| 05-06-2015 Wed 06:00 | 1,693.64 | O |
| 05-06-2015 Wed 12:00 | 1,693.64 | O |
| 05-06-2015 Wed 18:00 | 1,693.64 | O |
| 05-06-2015 Wed 24:00 | 3,059.38 | O |
| 05-07-2015 Thu 06:00 | 3,860.04 | O |
| 05-07-2015 Thu 12:00 | 5,159.91 | O |
| 05-07-2015 Thu 18:00 | 7,930.48 | O |
| 05-07-2015 Thu 24:00 | 9,795.48 | O |
| 05-08-2015 Fri 06:00 | 10,792.67 | O |
| 05-08-2015 Fri 12:00 | 11,247.35 | O |
| 05-08-2015 Fri 18:00 | 11,247.35 | O |
| 05-08-2015 Fri 24:00 | 17,160.81 | O |
| 05-09-2015 Sat 06:00 | 21,077.45 | O |
| 05-09-2015 Sat 12:00 | 21,077.45 | O |
| 05-09-2015 Sat 18:00 | 21,077.45 | O |
| 05-09-2015 Sat 24:00 | 21,290.58 | O |
| 05-10-2015 Sun 06:00 | 24,501.23 | O |
| 05-10-2015 Sun 12:00 | 30,370.31 | O |
| 05-10-2015 Sun 18:00 | 30,370.31 | O |
| 05-10-2015 Sun 24:00 | 30,636.78 | O |

# May 2015 Holdouts for Neosho River



# Future Development

- Expansion from test Basin (Neosho River) to all current Benefits Models
- Automation of Stream Rating Curves
- Corps Water Management Systems (CWMS) Implementation
- Model Report