TAPER – A Water Management Tool for Flood Operations of the Arkansas River within Tulsa District

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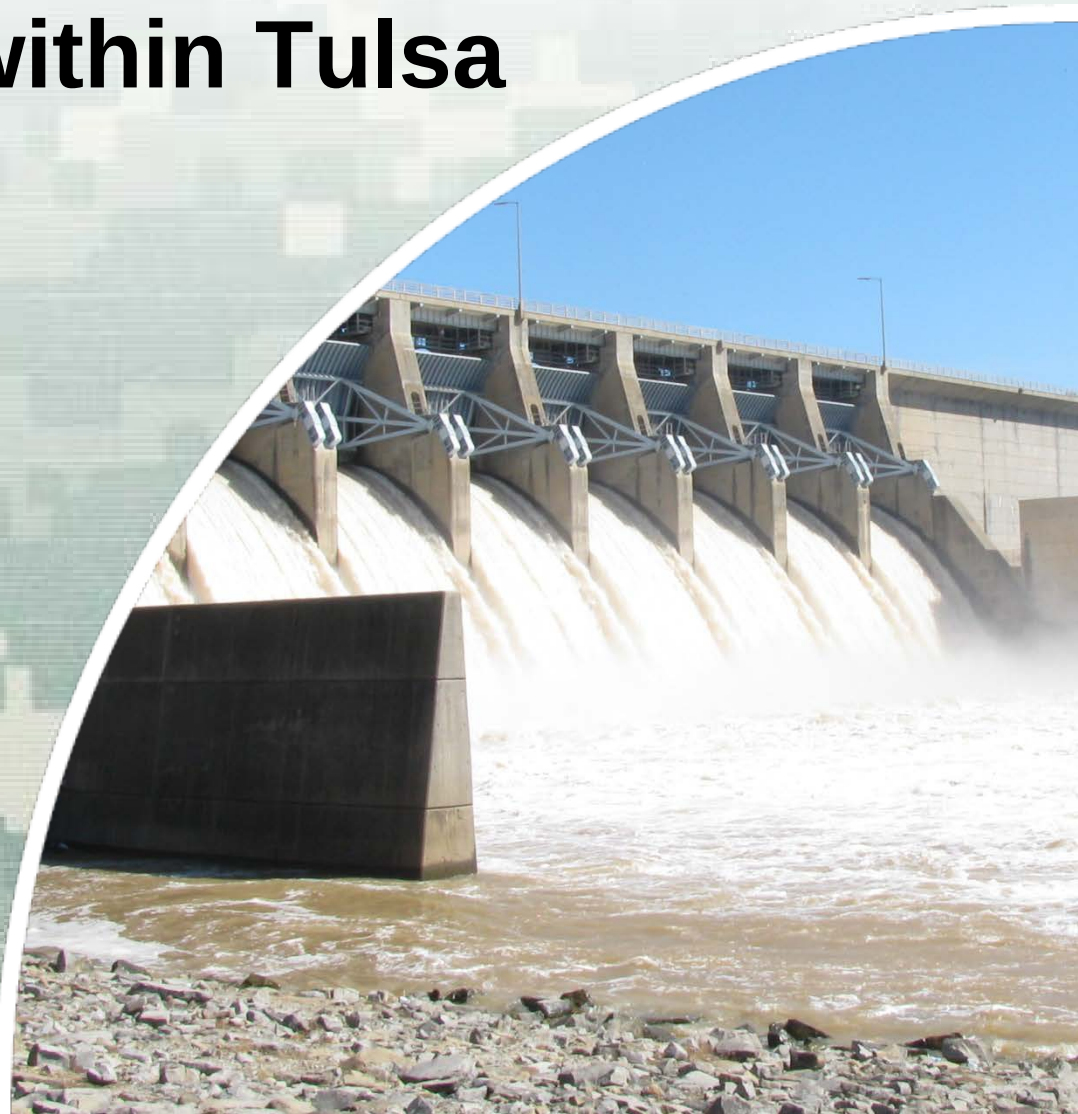
USACE, Tulsa District

RiverWare User's Group Meeting

Boulder, CO

February 3, 2015



US Army Corps of Engineers

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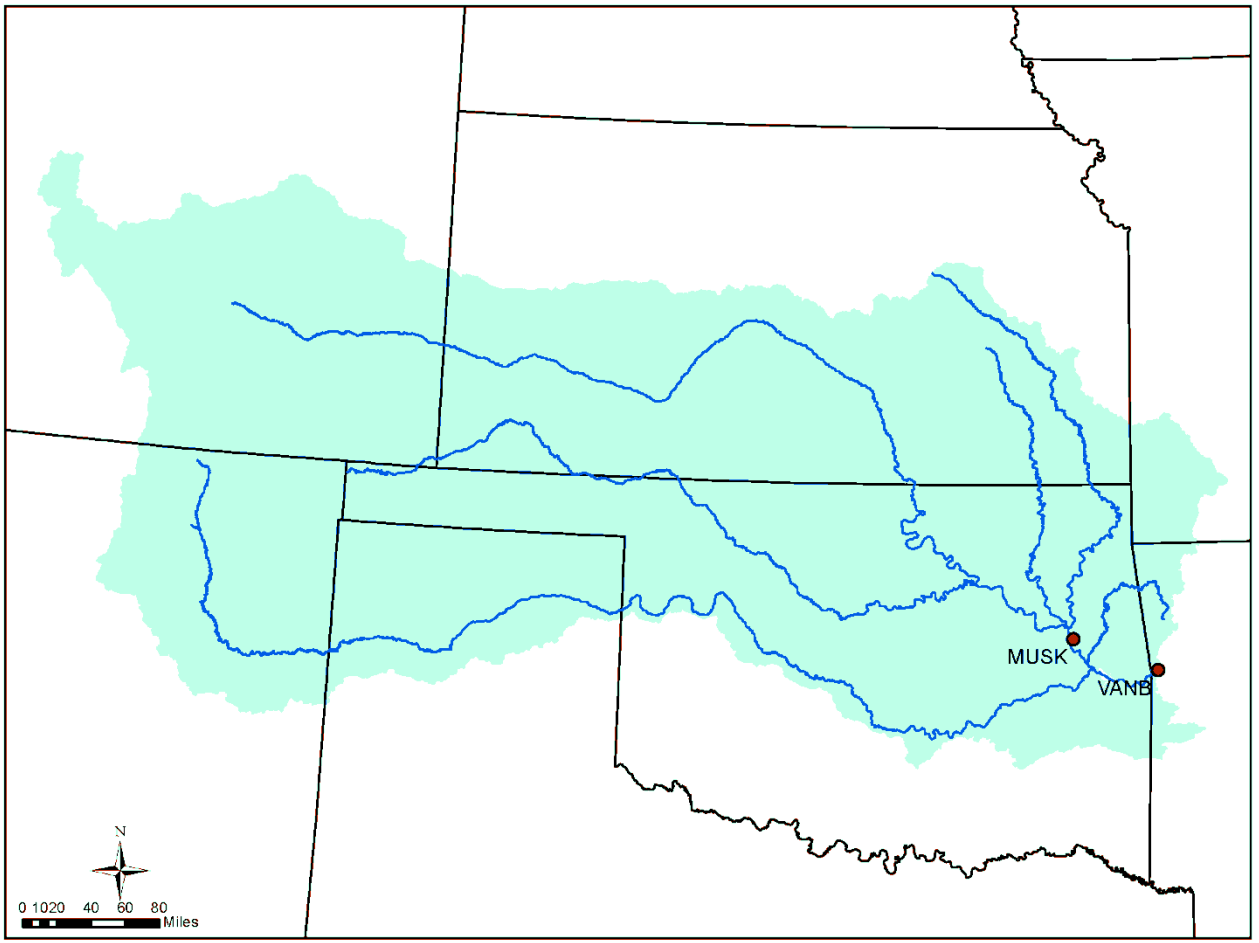
Introduction

- TAPER – Definition
- Arkansas River Watershed
- Goals
- Historic TAPER Program
- RiverWare
- Initial Conditions
- Rules
  - Surcharge
  - Regulation Discharge
  - Flood Control
- Results
- Conclusion

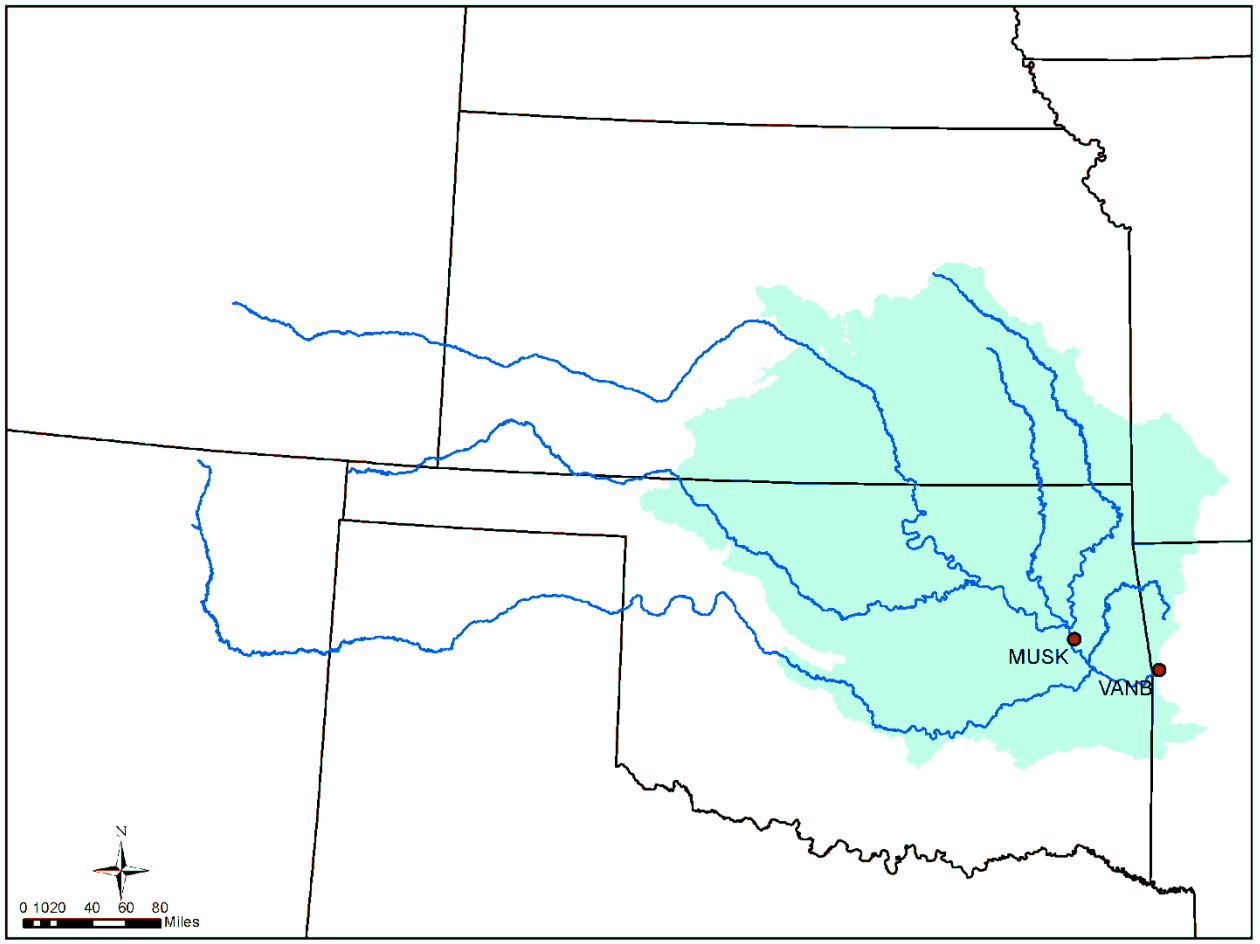
Location


Boulder, CO
Denver
Colorado
United States
Kansas
Missouri
Wichita
Van Buren, AR
Oklahoma City
Oklahoma
Amarillo
New Mexico

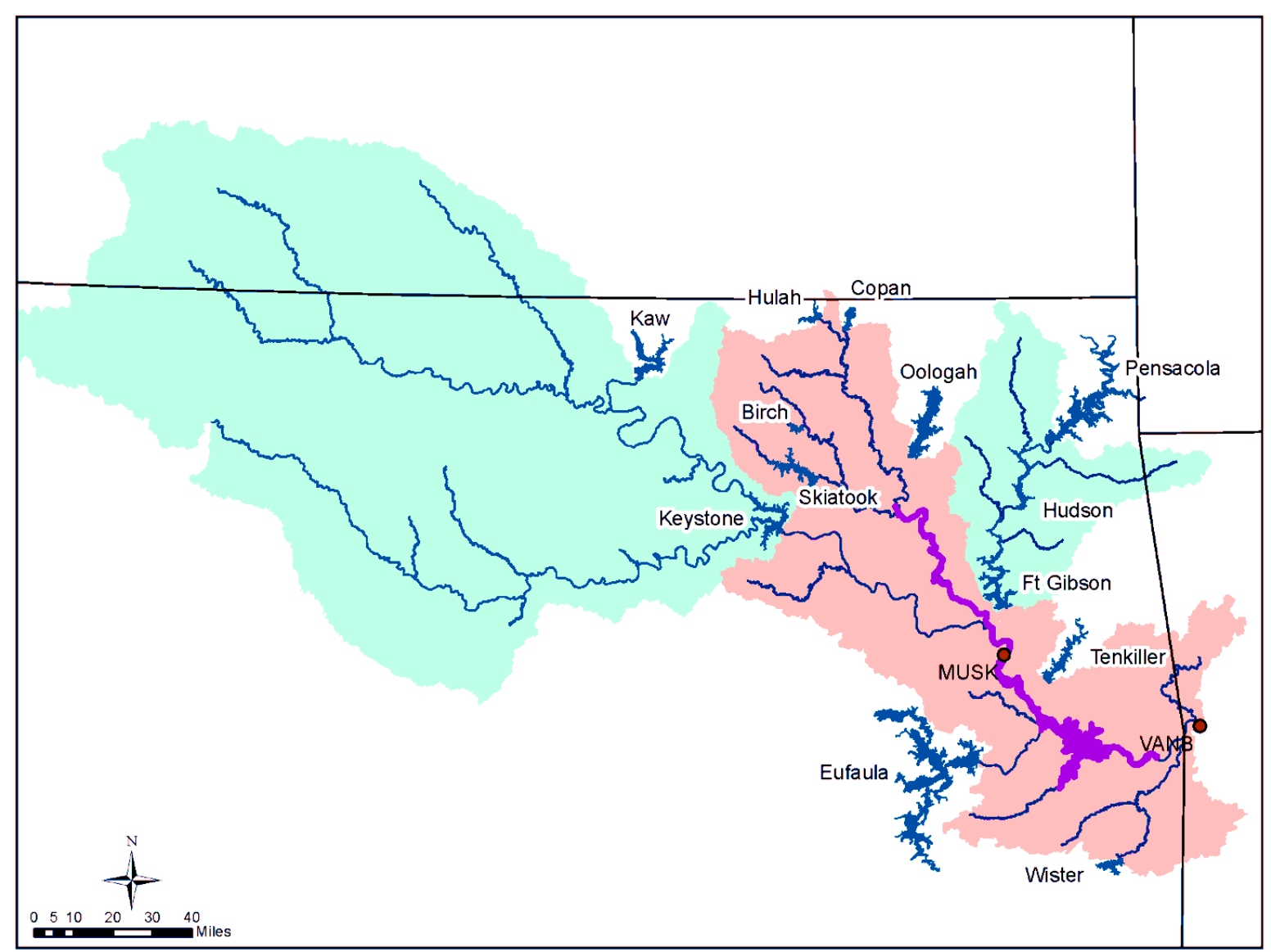
Arkansas River Drainage Area



Contributing Drainage Area



TAPER Projects

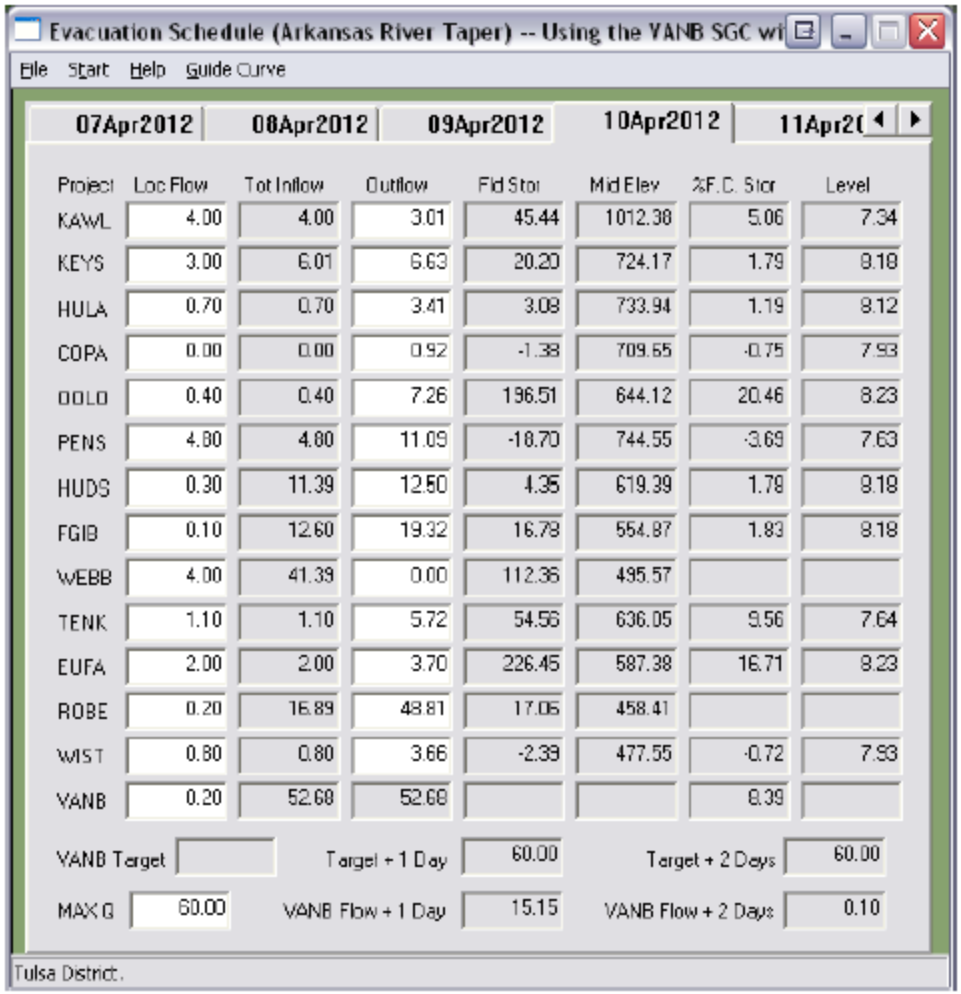


Goals

- Prevent flooding
- Evacuate flood pools according to approved Water Management Plan
- Maintain navigation operations

Water Management

- History of Development
  - ▶ TAPER
    - Daily average
      - ▷ Inflow
      - ▷ Release
      - ▷ Routing
  - ▶ Advantage
    - Quick
  - ▶ Disadvantage
    - Fluctuation of flows



RiverWare

- Developed by CADSWES (Colorado Center for Advanced Decision Support for Water and Environmental System)
- Reservoir and river modeling system
- Operational and decision support tool

CADSWES

Center for Advanced Decision Support for Water and Environmental Systems
UNIVERSITY OF COLORADO BOULDER

U.S.ARMY

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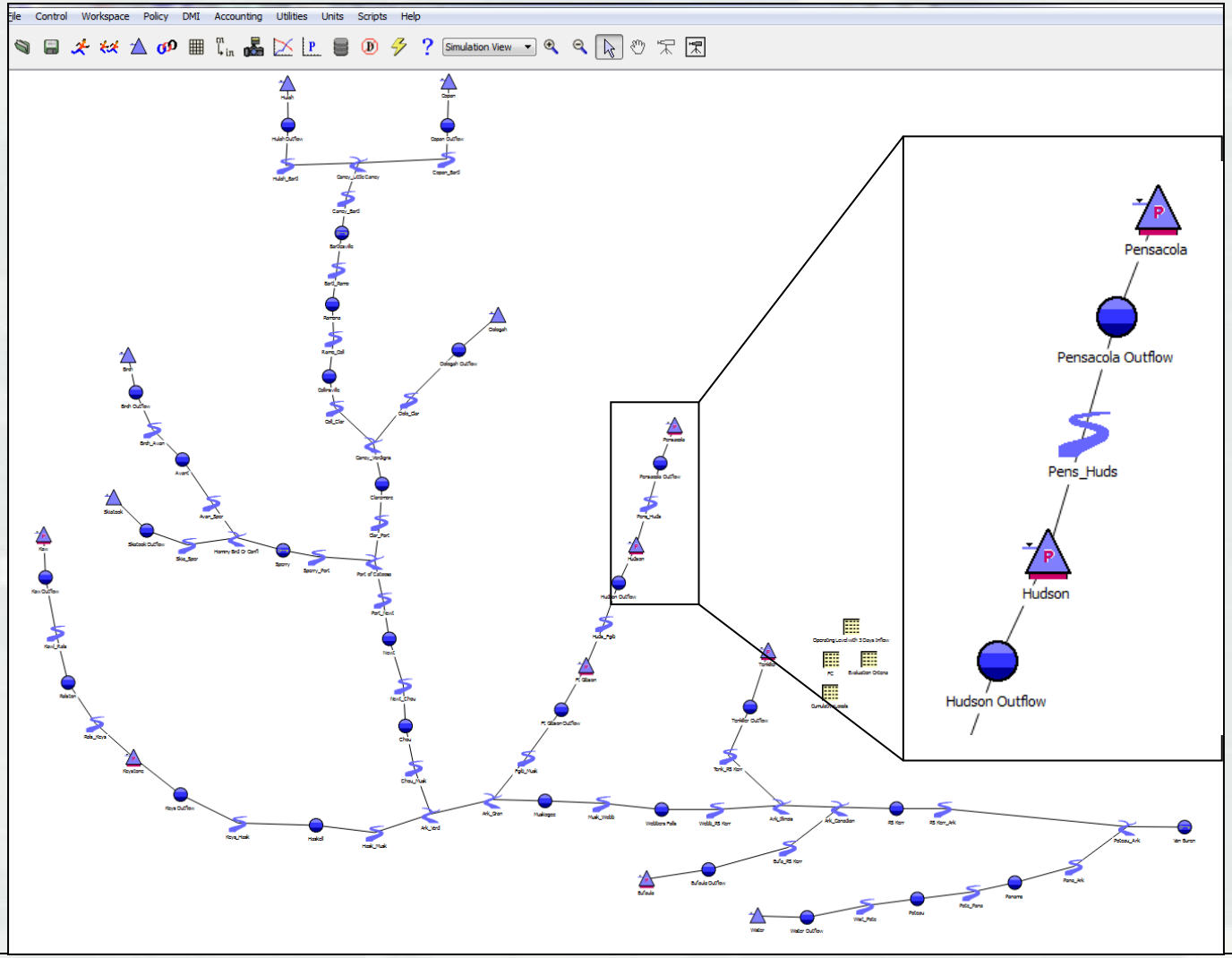
RiverWare


File Control Workspace Policy DMI Accounting Utilities Units Scripts Help
Simulation View
Pensacola
Pensacola Outflow
Pens_Huds
Hudson
Hudson Outflow

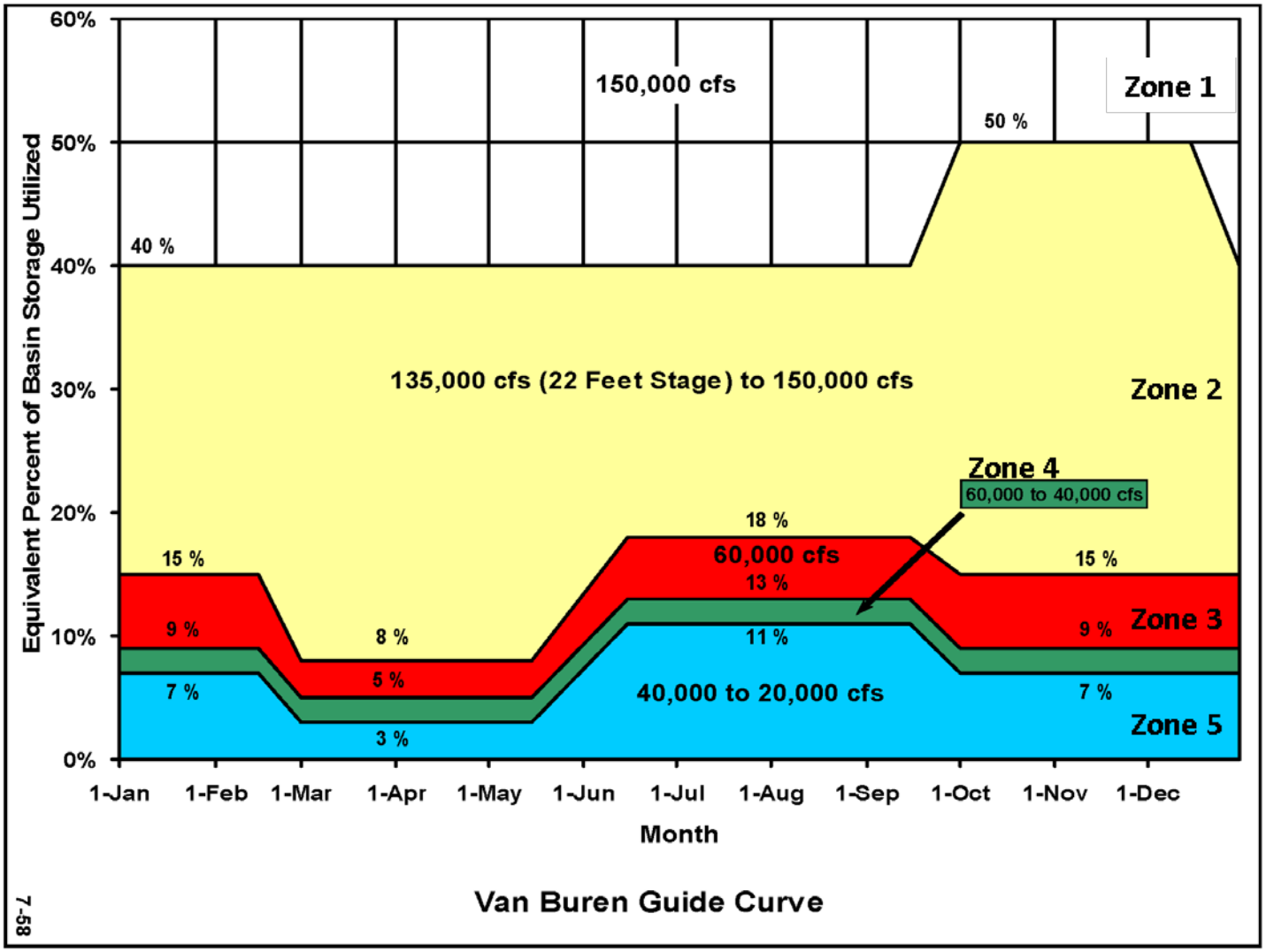
Initial Conditions

- WCDS data
  - 30 days pre-simulation release and locals
  - Initial Elevation
- Routed through system
- Forecast data (HEC-1) or water managers input
  - Reservoir inflows
  - Local runoff

Rules

- Surcharge
  - Determines if surcharge necessary and route
- Regulation Discharge
  - Empty space computed
  - Set target flows
- Flood Control
  - Set releases 13 reservoirs
  - Route to meet target flows

Seasonal Guide Curve



Equivalent Percent of Basin Storage Utilized

$$\frac{\sum_{@t} Project\ Storages + (\sum_{t}^{t+3} Project\ Inflows - \sum_{t}^{t+3} Project\ Releases)}{\sum_{@t} Project\ Flood\ Control\ Storage} * 100$$

$$\sum_{t}^{t+3} Project\ Releases \sim 180{,}000\ ac - ft$$

- Approximation for 1st run

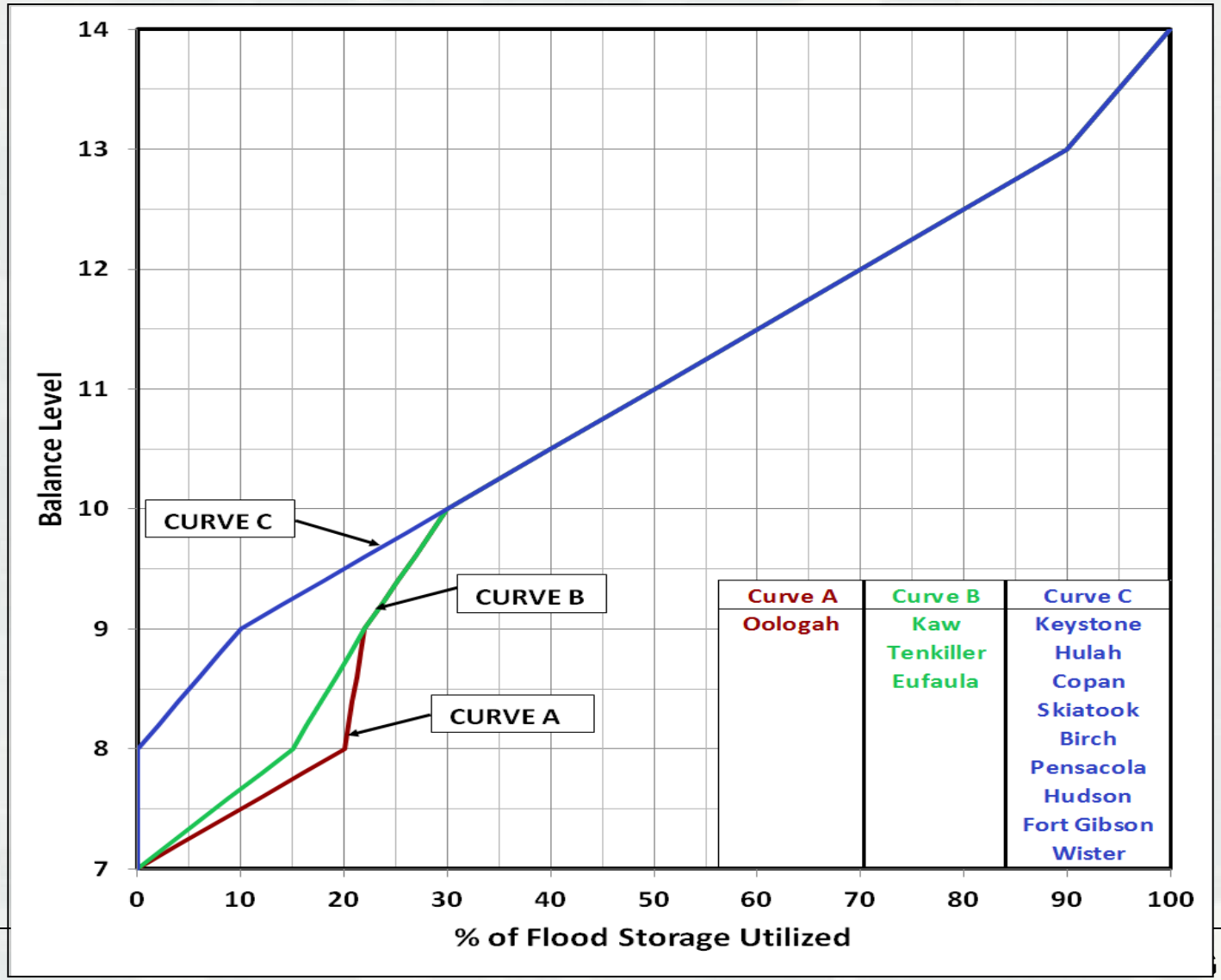
MRM Iterations

- 1st run
  - 3 Days of releases is approximately 180,000 ac-ft
  - Estimate of 3 days of releases for lower flows at VANB
- 2nd run
  - =3 Days of releases of projects
  - Set by previous run
  - Run through 3 iterations for solution

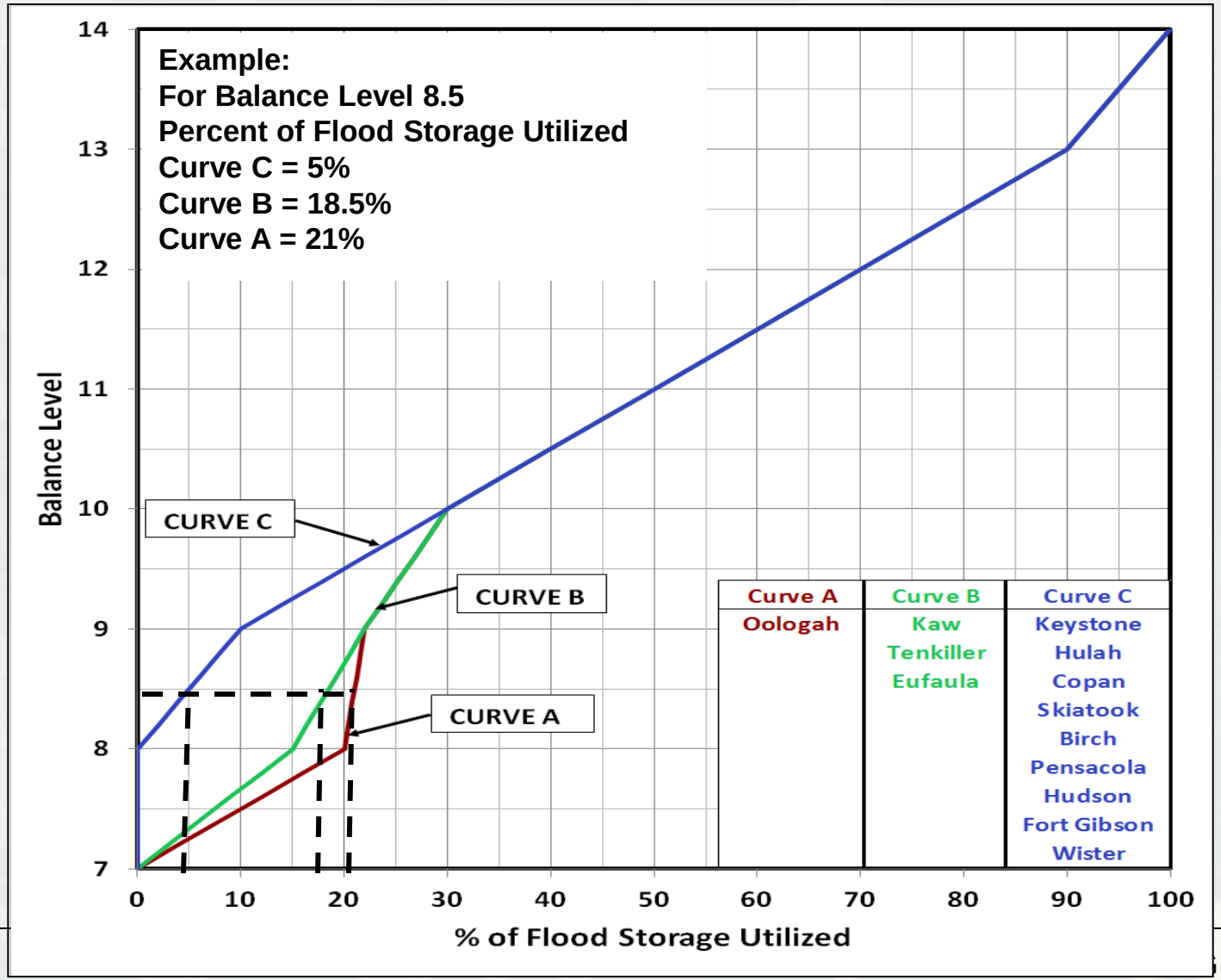
Rules

- Surcharge
  - Determines if surcharge necessary and route
- Regulation Discharge
  - Empty space computed
  - Set target flows
- Flood Control
  - Set releases 13 reservoirs
  - Route to meet target flows

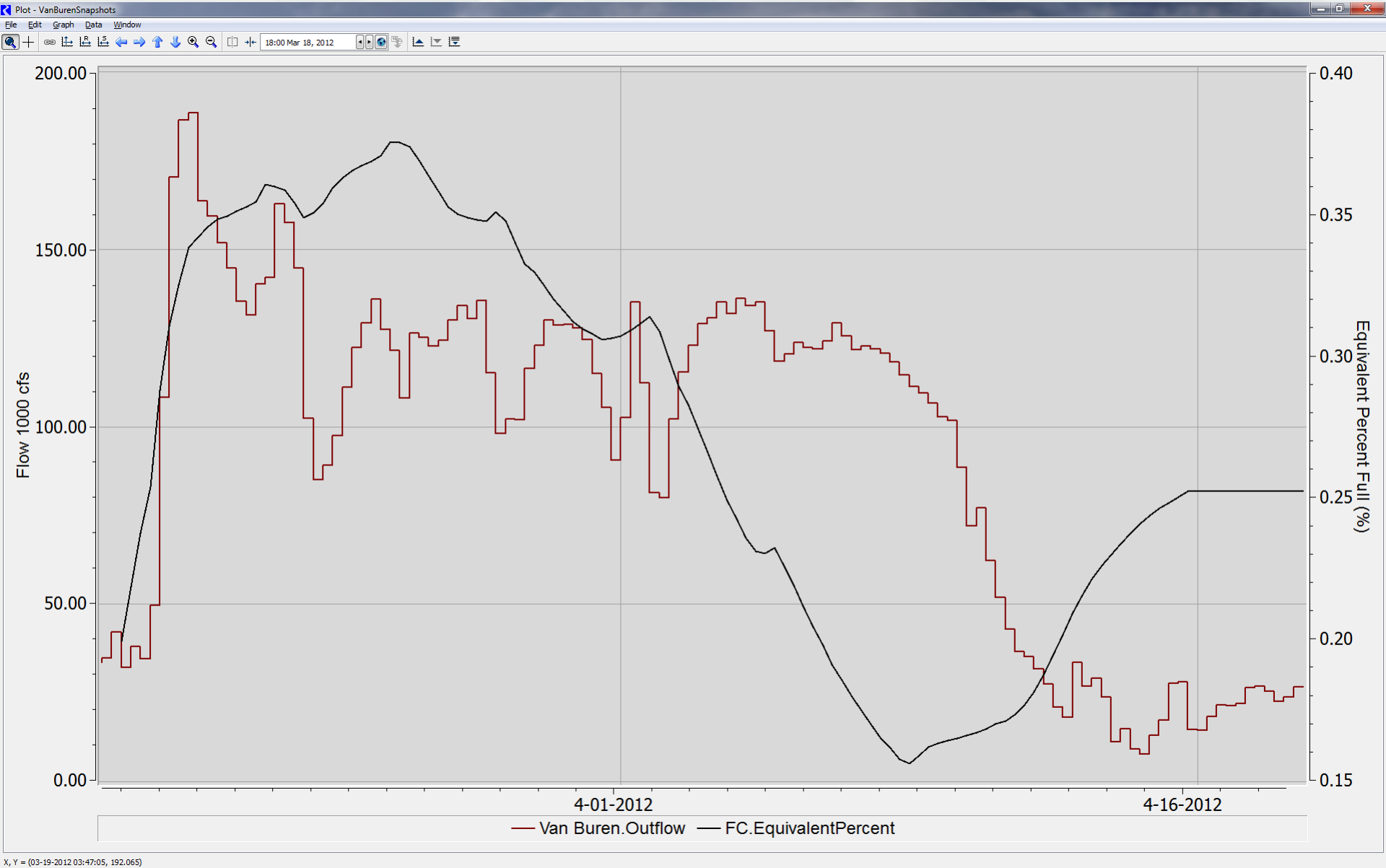
Reservoir Operation Curves A-C



Reservoir Operation Curves A-C



Results


Plot - VanBurenSnapshots
File Edit Graph Data Window
18:00 Mar 18, 2012
200.00
150.00
100.00
50.00
0.00
Flow 1000 cfs
0.40
0.35
0.30
0.25
0.20
0.15
Equivalent Percent Full (%)
4-01-2012
4-16-2012
Van Buren.Outflow
FC.EquivalentPercent
X, Y = (03-19-2012 03:47:05, 192.065)

Results

- System Control Table (SCT)
  - ▶ Summarizes 6-hr results with daily aggregate

SCT TAPER_Inflow_Outflow_Daily.sct (TAPER_Sep02_14_650_MRMconfiguration_August2013_no0routing.mdl.gz)

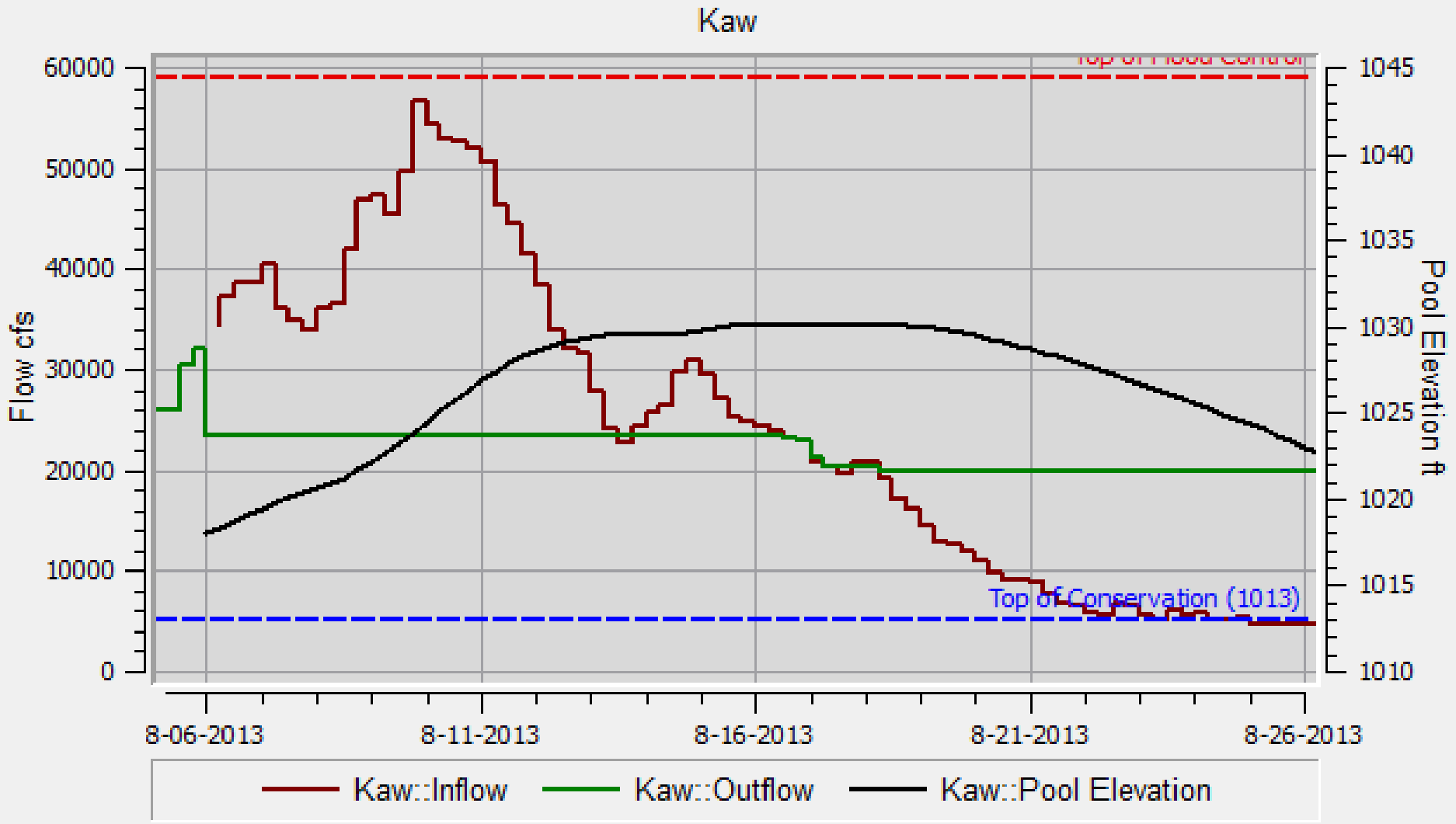
File Edit Slots Aggregation View Config DMI Run Diagnostics Go To

NaN 24:00 Aug 5, 2013

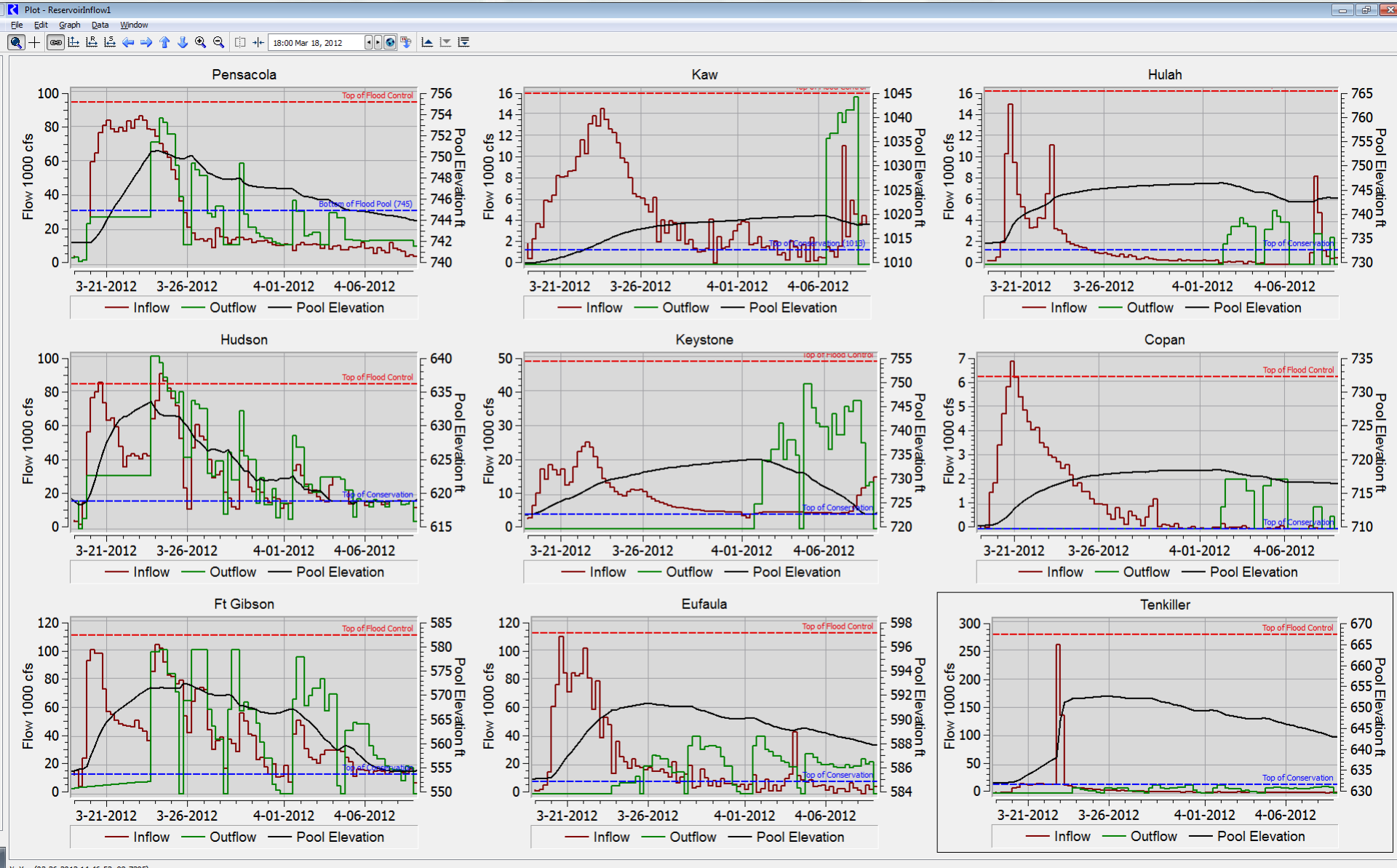
Series Slots | Edit Series Slot List | Scalar Slots | Other Slots | Object Grid

Slot Label	Units		8/6 24:00 Tue	8/7 24:00 Wed	8/8 24:00 Thu	8/9 24:00 Fri	8/10 24:00 Sat	8/11 24:00 Sun	8/12 24:00 Mon
HULA									
Hulah.Inflow Sum	cfs	Ave	946.62	1,269.76	12,205.95	11,586.05	4,425.80	1,890.51	4,808.37
Hulah.Outflow	cfs	Ave	85.12	0.00	0.00	0.00	1,853.20	5,000.00	4,328.43
Hulah.Operating Level	NONE	Last	9.02	9.07	9.56	10.02	10.12	10.00	10.02
Hulah.Pool Elevation	ft	Last	739.77	740.26	744.47	747.77	748.44	747.62	747.75
FC.HULA	NONE	Last	0.10	0.11	0.21	0.30	0.32	0.30	0.30
Operating Level with 3 Days Inflow.Hulah	NONE	Last	10.02	10.19	10.27	10.46	10.75	10.69	10.58
COPA									
Copan.Inflow Sum	cfs	Ave	176.99	587.99	2,260.17	4,566.27	3,385.07	1,677.80	1,943.57
Copan.Outflow	cfs	Ave	2.00	0.00	0.00	0.00	0.00	0.00	0.00
Copan.Operating Level	NONE	Last	8.37	8.43	8.67	9.08	9.27	9.36	9.46

Plots

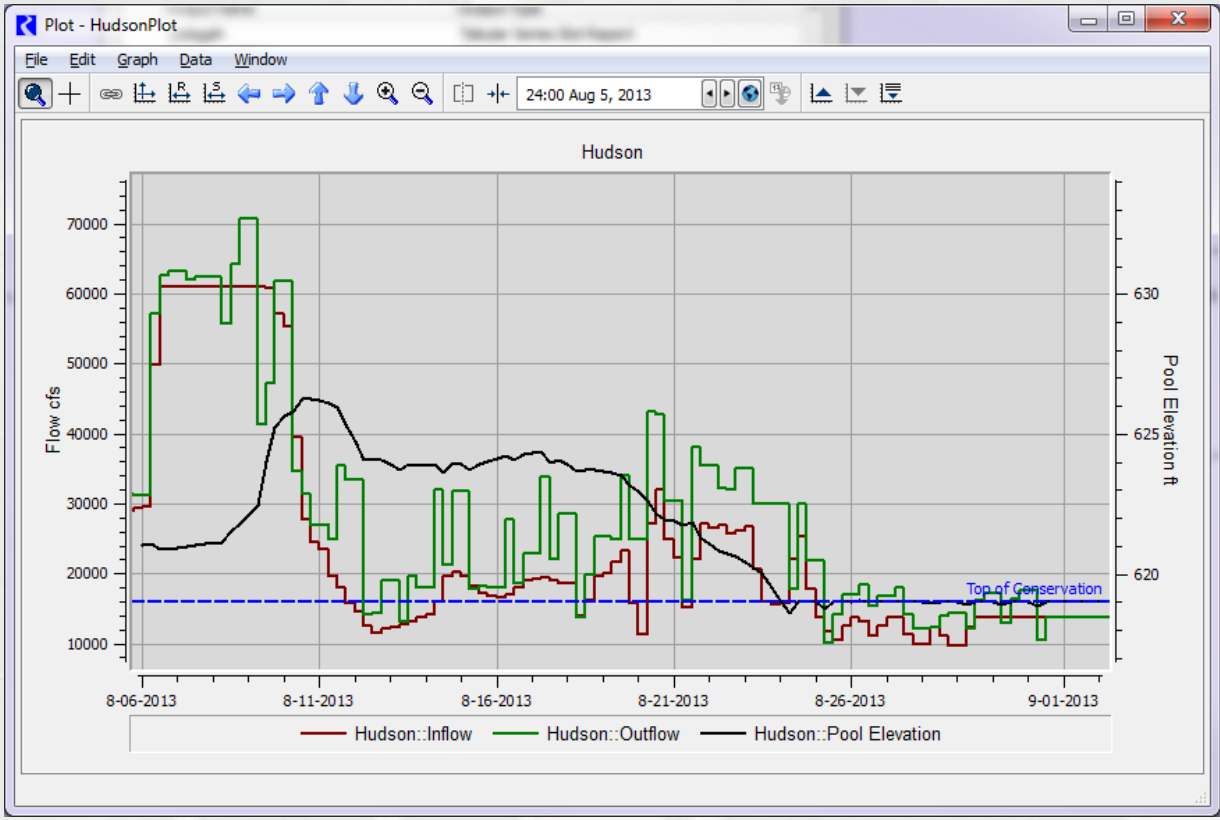

Kaw
Flow cfs
Pool Elevation ft
60000
50000
40000
30000
20000
10000
0
1045
1040
1035
1030
1025
1020
1015
1010
Top of Conservation (1013)
8-06-2013
8-11-2013
8-16-2013
8-21-2013
8-26-2013
Kaw::Inflow
Kaw::Outflow
Kaw::Pool Elevation

Grid Plots


Plot - ReservoirInflow1
File Edit Graph Data Window
18:00 Mar 18, 2012
Pensacola
Top of Flood Control
Bottom of Flood Pool (745)
Kaw
Top of Conservation (1013)
Hulah
Top of Conservation
Hudson
Top of Flood Control
Top of Conservation
Keystone
Top of Flood Control
Top of Conservation
Copan
Top of Flood Control
Top of Conservation
Ft Gibson
Top of Flood Control
Eufaula
Top of Flood Control
Top of Conservation
Tenkiller
Top of Flood Control
Top of Conservation
Flow 1000 cfs
Pool Elevation ft
3-21-2012
3-26-2012
4-01-2012
4-06-2012
Inflow
Outflow
Pool Elevation

Output

- Plots
- Tables
- Html
- Text files
- DSS files



Html

Tenkiller

	Inflow 1000 cfs	Outflow 1000 cfs	Elevation ft	VANB Outflow 1000 cfs	VANB Target 1000 cfs
03-18-2012 24:00	0.89	0.00	632.39	42.07	135.00
03-19-2012 06:00	0.43	0.00	632.41	32.22	135.00
03-19-2012 12:00	1.12	0.00	632.45	38.10	135.00
03-19-2012 18:00	0.88	0.00	632.48	34.54	135.00
03-19-2012 24:00	1.12	0.00	632.52	49.55	135.00
03-20-2012 06:00	8.83	0.00	632.84	108.22	135.00

Questions