INVESTIGATING CHANGES TO AN OPERATING PLAN USING BORG-RIVERWARE

RiverWare User Group Meeting

Jennifer Short PE, CFM
SWL – USACE
Date: 29 August 2023

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INTRODUCTION

Borg-RiverWare
White River System
Needs
Results
Path to get to this point

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BORG-RIVERWARE

- Borg MOEA – Borg Multiobjective Evolutionary Algorithm
  - Many-objectives – evaluate conflicting performance
  - Adaptive search to optimize problem
  - High-performance
- RiverWare – White River period of record daily model from 1940-2017
- Together

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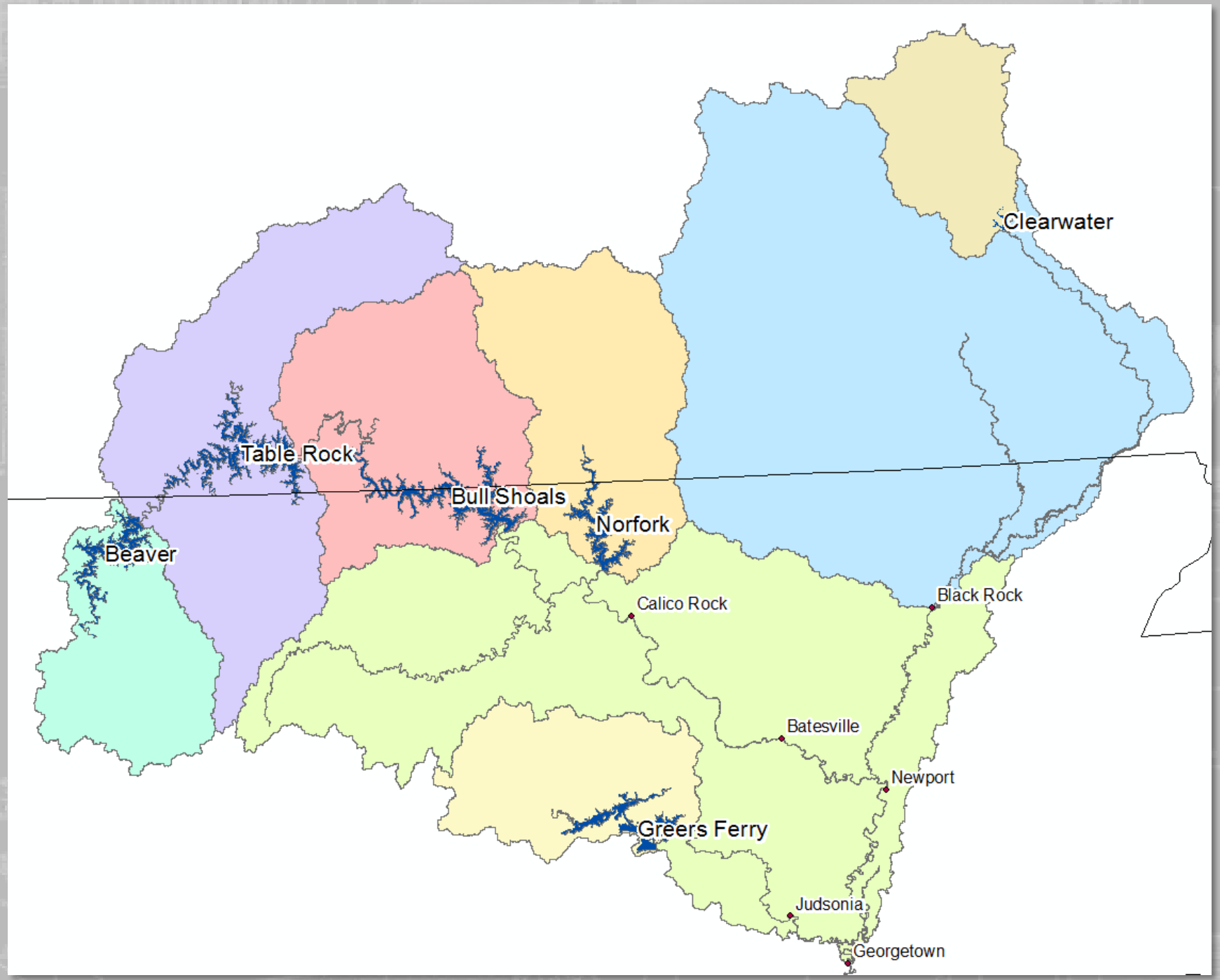
WHITE RIVER

5 Lakes on White River
1 Lake on Black River
4 Lakes regulate to Newport



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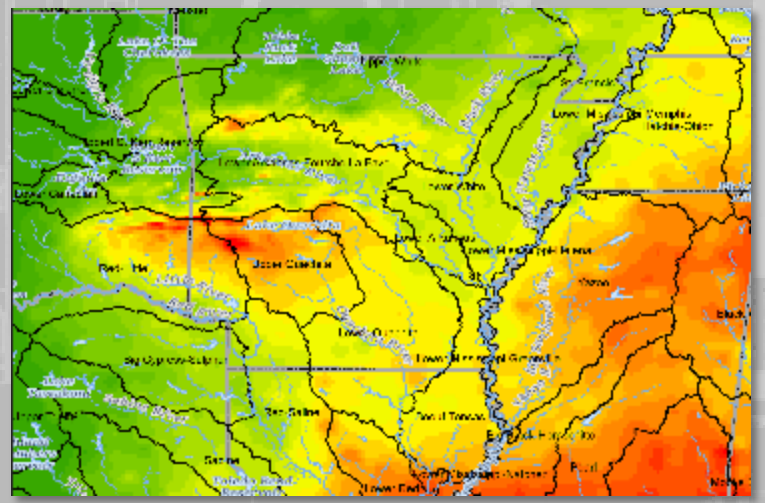
AUTHORIZED PURPOSES – SYSTEM BALANCES

- Flood Risk Management
  - Reduction in peak flows downstream
- Hydropower
  - Primarily marketed to rural electric cooperatives and municipal utilities
- Water Supply (BV, BS, NF, GF)
  - 14 water districts/users for municipal and industrial uses
- Minimum Flow (BS, NF)
  - Provides an increase in wetted perimeter of tailwaters of Bull Shoals and Norfork
- Recreation
  - Ancillary benefit. Marinas, resorts, in-lake users
- Fish and Wildlife
  - Dissolved oxygen and water temperature maintenance

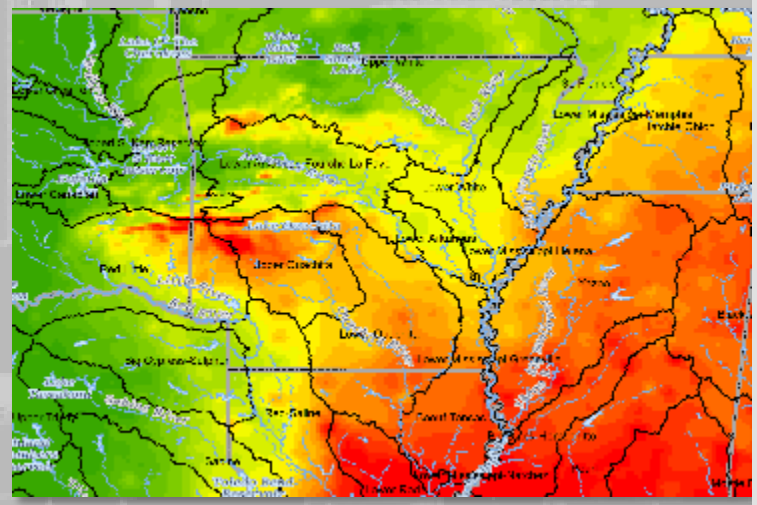
CHANGES IN WEATHER PATTERNS

The region is wetter in the last decade than most of the decades in living memory.

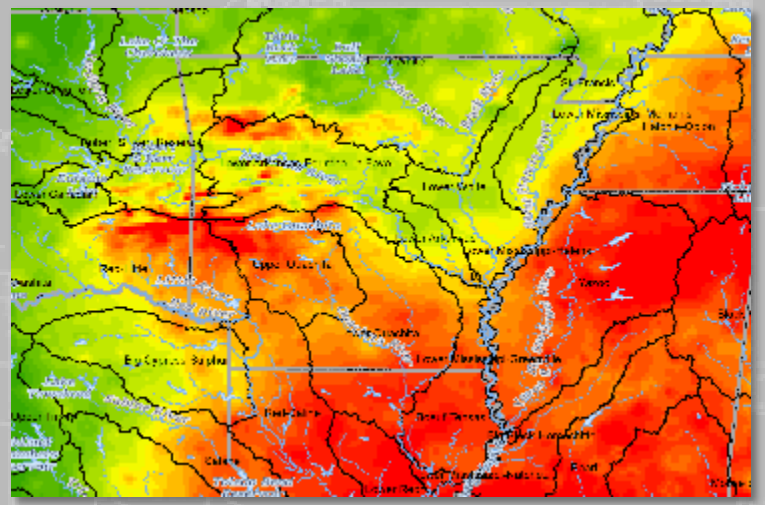
1959 - 1973



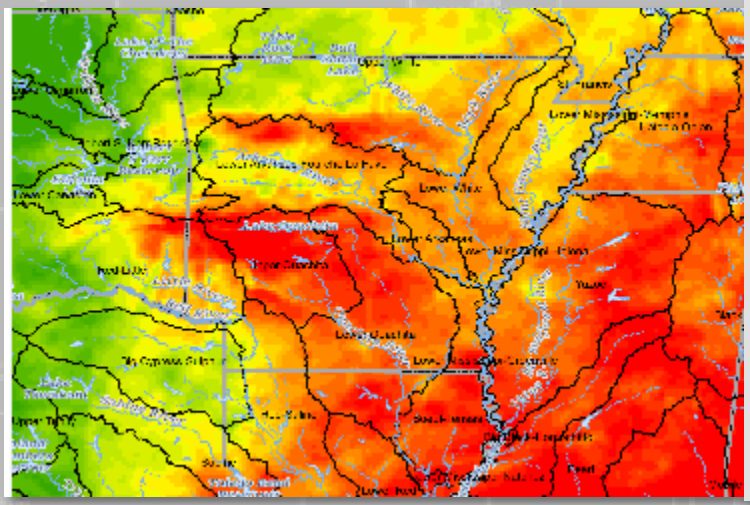
1974 - 1988

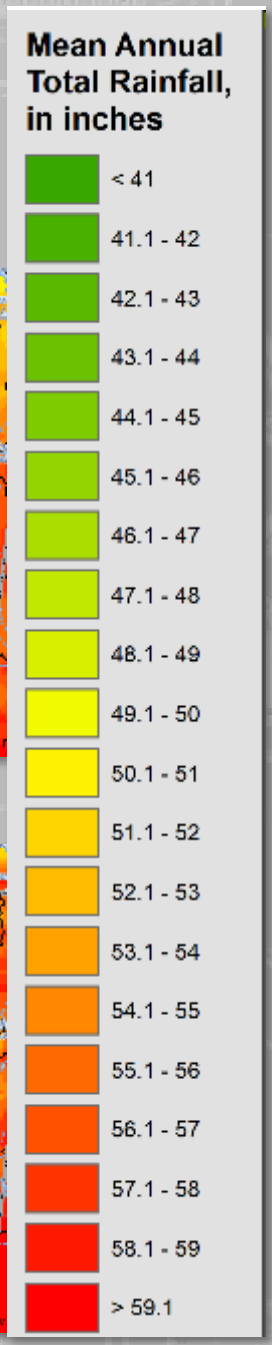


1989-2003



2004-2017





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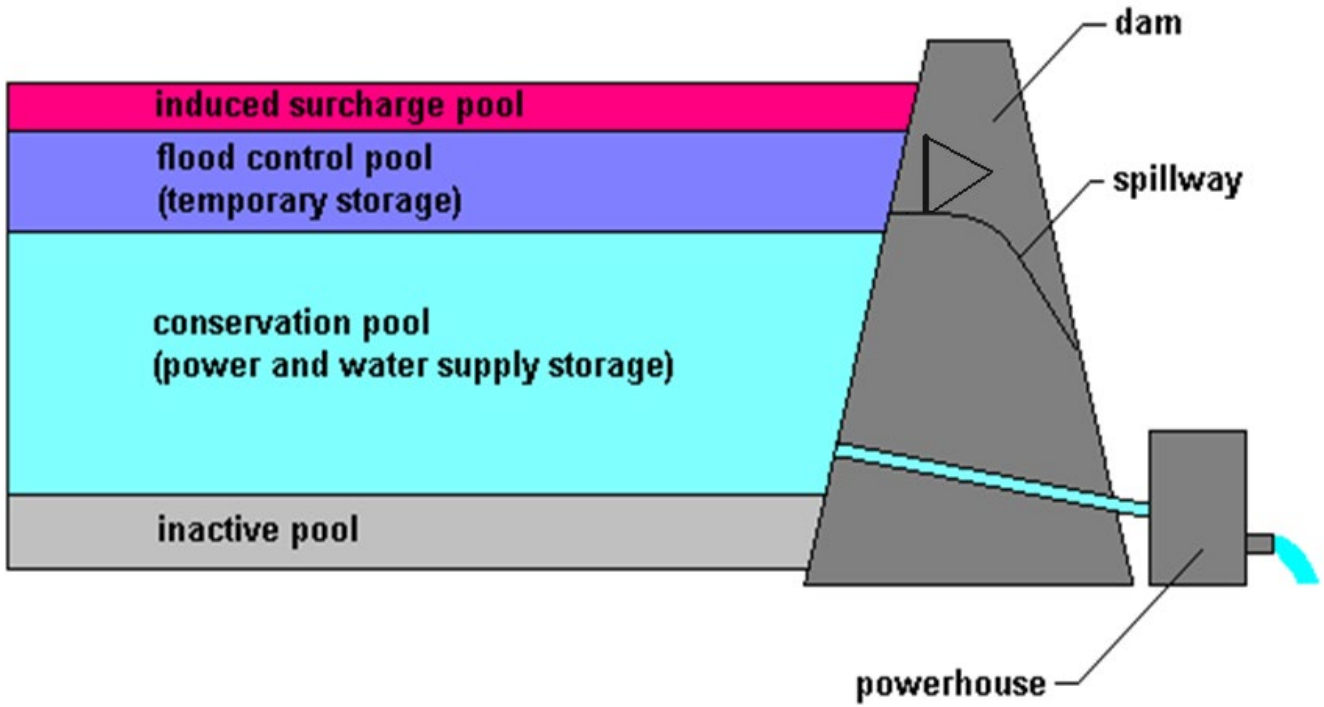
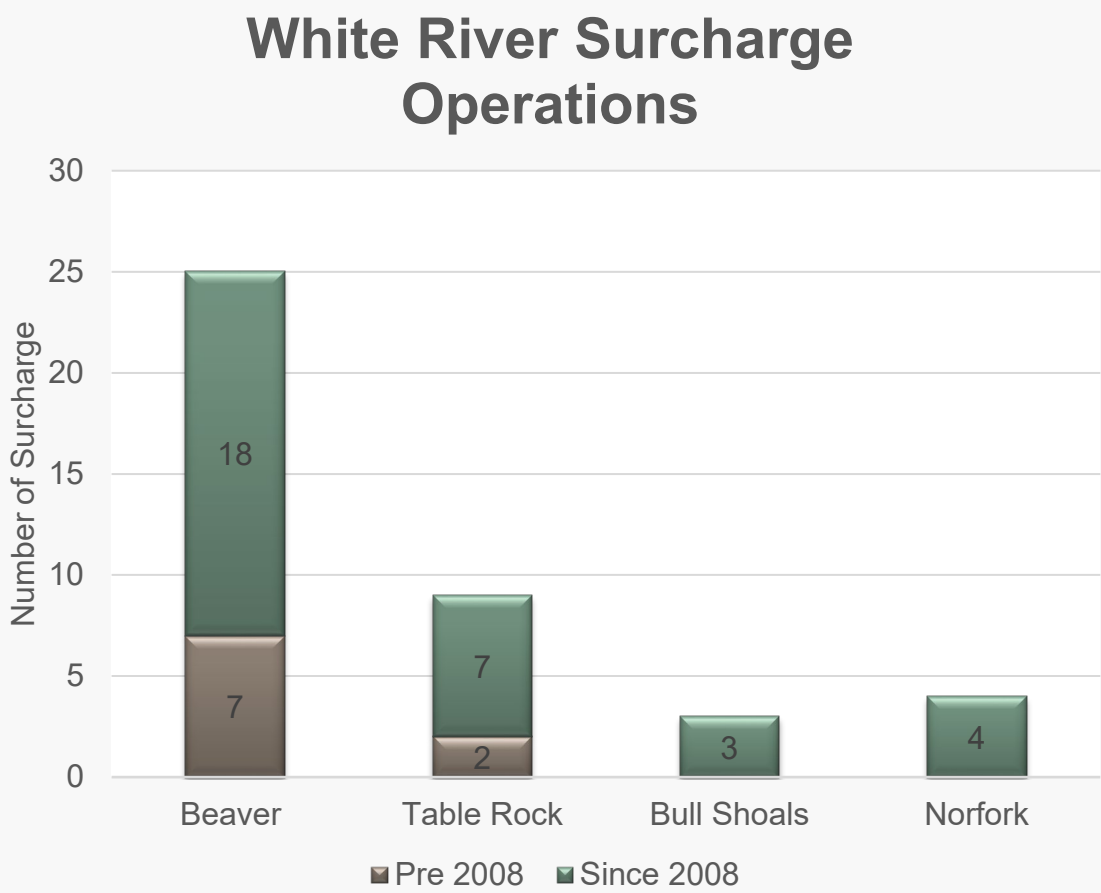
NEW CHALLENGES

- Since 2008, 12 of the 13 years have resulted in above average rainfall





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GOALS

Evaluate if there is a change in the operating plan that will reduce how often Beaver lake is high in the flood pool.

Change regulating stages at Newport and 2 flood rules at Beaver

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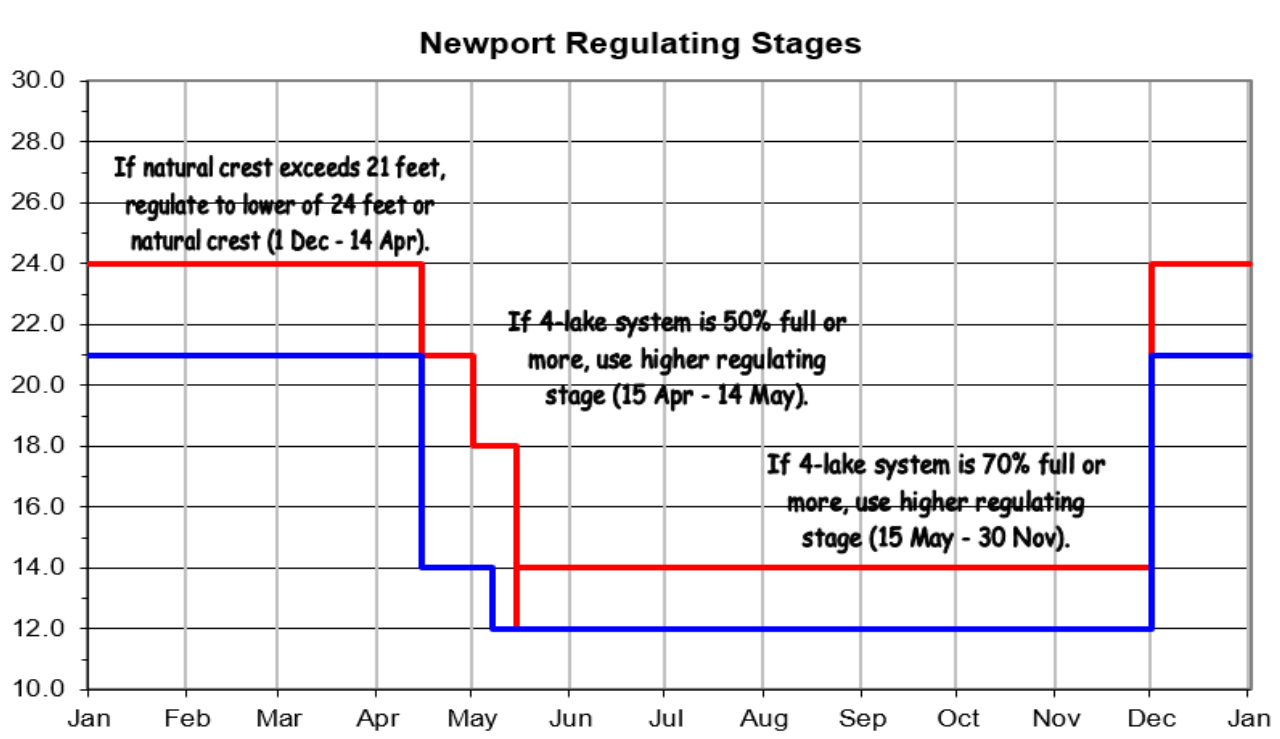

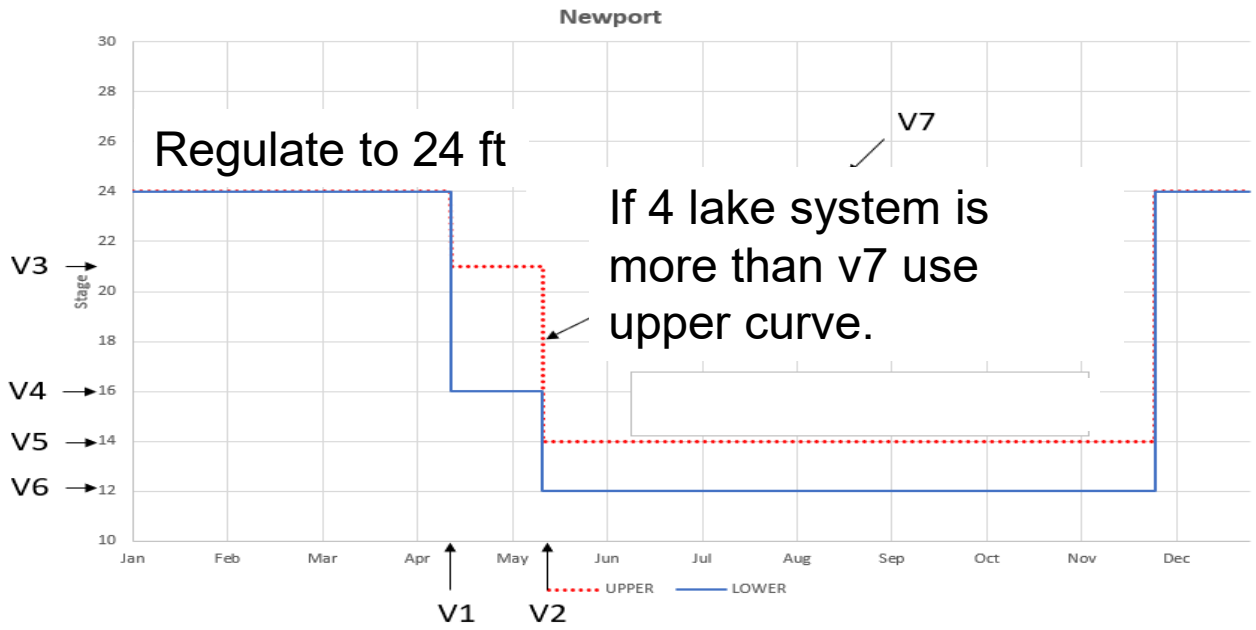

OBJECTIVES

Minimize/reduce
75% percentile annual max pool elevation for
– Beaver
– Table Rock
– Bull Shoals
– Norfork
50% quantile Annual Flow Duration Newport
Total Flow Over 12ft at Newport

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EPSILON

- Important
- Set to minimum change of interest as starting point for each objective
  (Borg-RiverWareUserGuide)
- Re-evaluate as needed

TotalNewportbase	TotalNewport12ft	TotalNewport24ft	TotalHighLakes	TotalHighNewport	Uncontrolled
108573780	109389550	144414592	109172089	112697231	169613024

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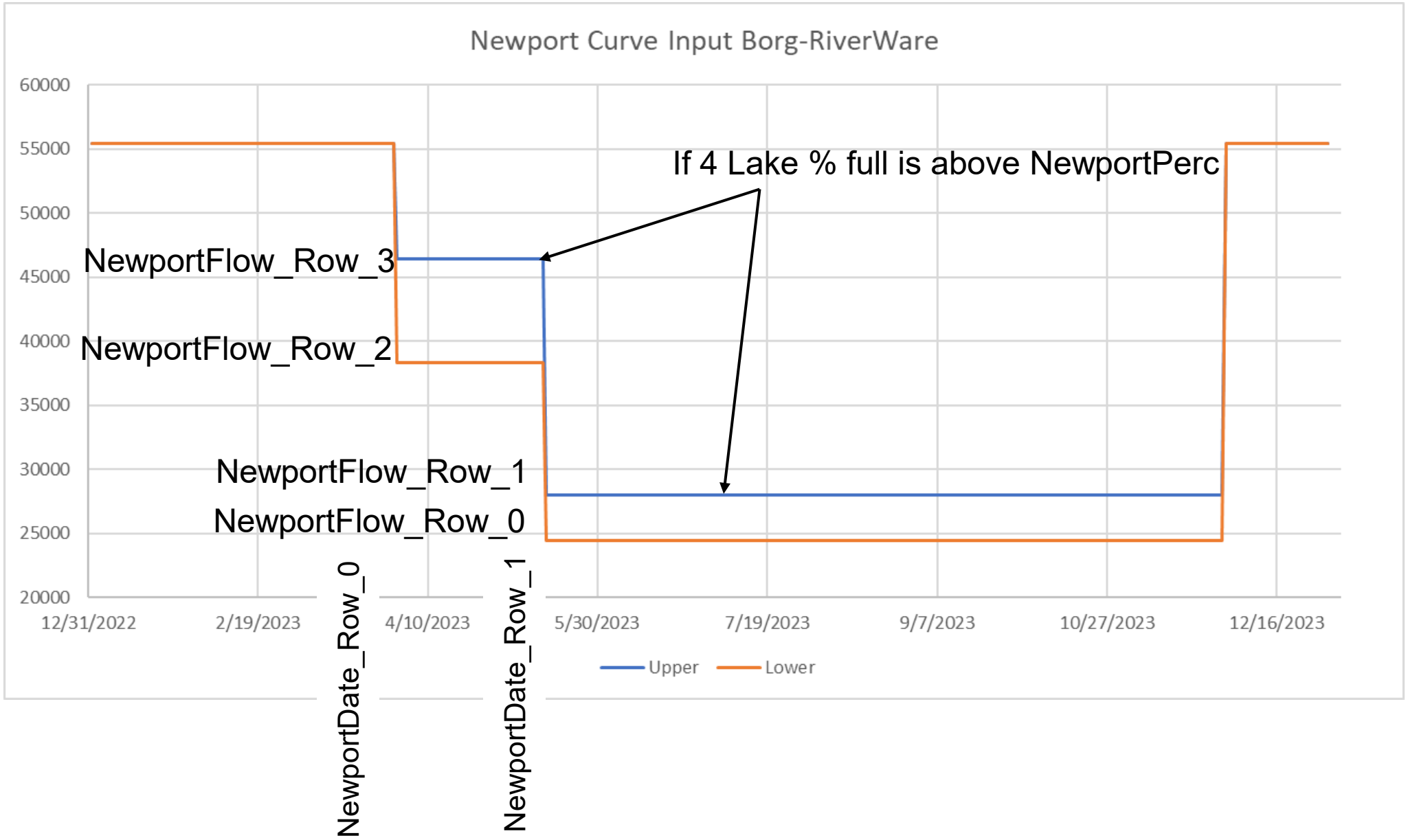
Newport Curve Input Borg-RiverWare
60000
55000
50000
45000
40000
35000
30000
25000
20000
12/31/2022
2/19/2023
4/10/2023
5/30/2023
7/19/2023
9/7/2023
10/27/2023
12/16/2023
Upper
Lower
If 4 Lake % full is above NewportPerc
NewportFlow_Row_3
NewportFlow_Row_2
NewportFlow_Row_1
NewportFlow_Row_0
NewportDate_Row_0
NewportDate_Row_1

BorgRiverWare.Int...

File Edit Row Column View Adjust

Intermediate Flows

Value:

	cfs
0	24,500.00
1	32,000.00
2	39,000.00
3	42,000.00

BorgRiverWare.Thr...

File Edit Row Column View Adjust

Threshold Dates

Value: 335 NONE

	Julian Dates NONE
0	105.00
1	121.00
2	335.00

Show Description

BorgRiverWar...

File Edit Row Column View

Threshold Percentages

Value:

	NONE
0	0.70

Show Description

Initialization Rules

Newport.Percent Full Regulation Table

Edit Row Column View Adjust

Percent Full Regulation Table

Value:

umn Entity: Discharge

	24,500.00 cfs --- decimal	24,500.00 cfs --- decimal	32,000.00 cfs --- decimal	32,000.00 cfs --- decimal	39,000.00 cfs --- decimal	39,000.00 cfs --- decimal	42,000.00 cfs --- decimal	42,000.00 cfs --- decimal	55,400.00 cfs --- decimal	55,400.00 cfs --- decimal
23:00:01 Apr 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00
0:00:01 Apr 15	0.00	0.00	0.00	0.00	0.00	0.70	0.70	2.00	2.00	2.00
23:00:01 Apr 30	0.00	0.00	0.00	0.00	0.00	0.70	0.70	2.00	2.00	2.00
0:00:01 May 1	0.00	0.70	0.70	2.00	2.00	2.00	2.00	2.00	2.00	2.00
23:00:01 Nov 30	0.00	0.70	0.70	2.00	2.00	2.00	2.00	2.00	2.00	2.00
0:00:01 Dec 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00

Show Description

1 Year Period (Base 1900)
Irregular Interval

Interpolate Lookup

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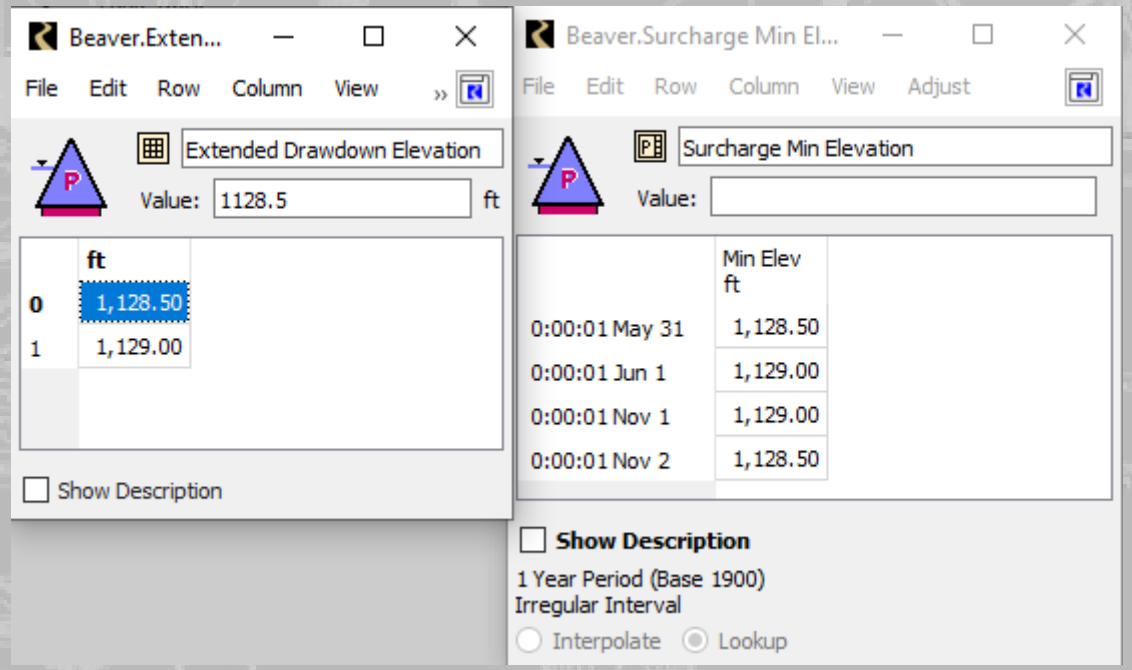
OTHER DECISION VARIABLES

MinFRMuli – minimum FIRM release multiplier (1-2)
BeaverDDElev Row 0-1 – Beaver drawdown elevation for
– Nov 2- May 31
– June 1- Nov 1



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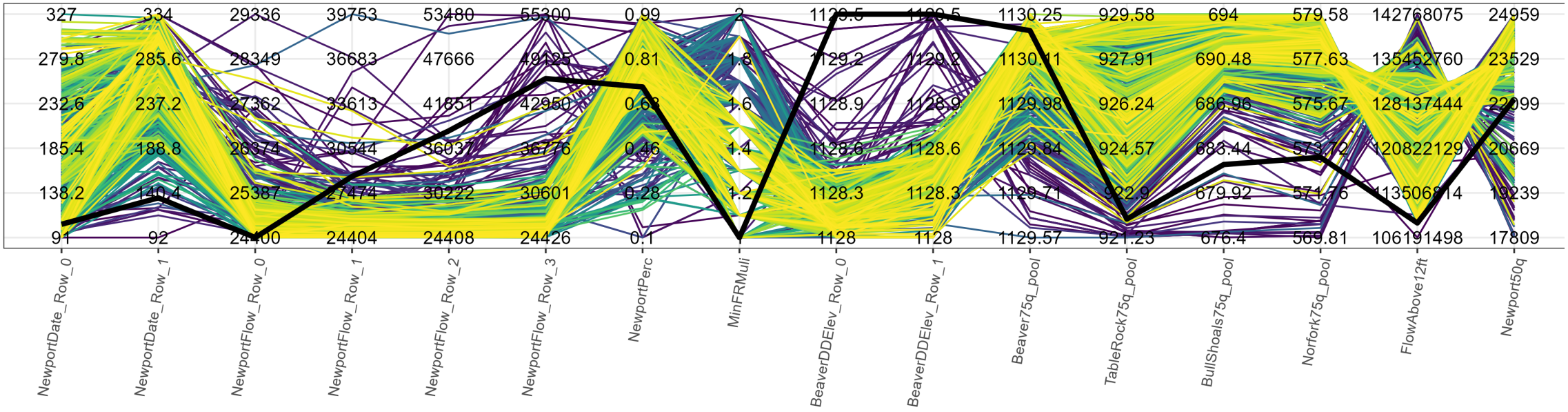
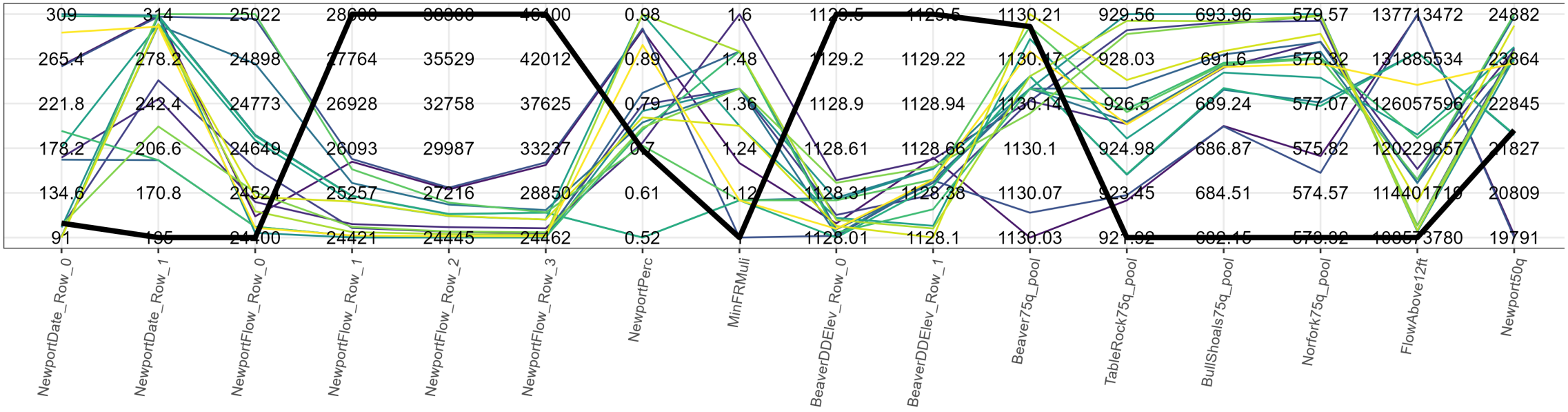
ALL VALUES (1000 RUNS)



Decision Variables

Objective Results

NONDOMINATED SOLUTIONS



Decision Variables

Objective Results

RECOMMENDED PATH

- Bring together
  - Expert on the system
  - Expert on Borg
  - Expert on RiverWare
- Plotting software

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THANK YOU

CADSWES
USACE Little Rock

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