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Managing Water in the West

Modeling to Support the Colorado River Basin Water Supply and Demand Study

RiverWare User Group Meeting
August 28, 2013

U.S. Department of the Interior
Bureau of Reclamation

Presentation Outline

- Basin Study Overview
- Study Manager
- Modeling ‘Dynamic’ Portfolios

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Colorado River Basin Water Supply and Demand Study

- **Study Objective**
  - Assess future water supply and demand imbalances over next 50 years
  - **D**evelop and evaluate opportunities for resolving imbalances
- Study **c**onducted by Reclamation and the Basin States in collaboration with stakeholders throughout the Basin
- A 3 year study that began in January 2010 and completed December 2012
- A planning study – did *not* result in any decisions, but provides the technical foundation for future activities

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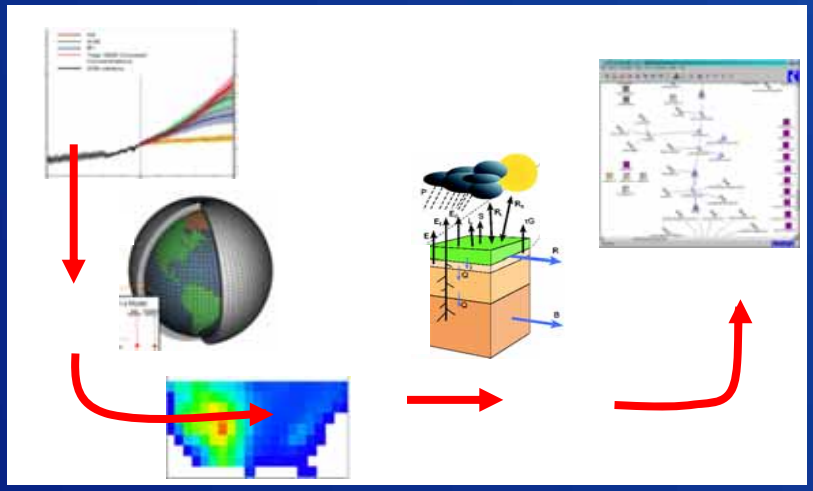
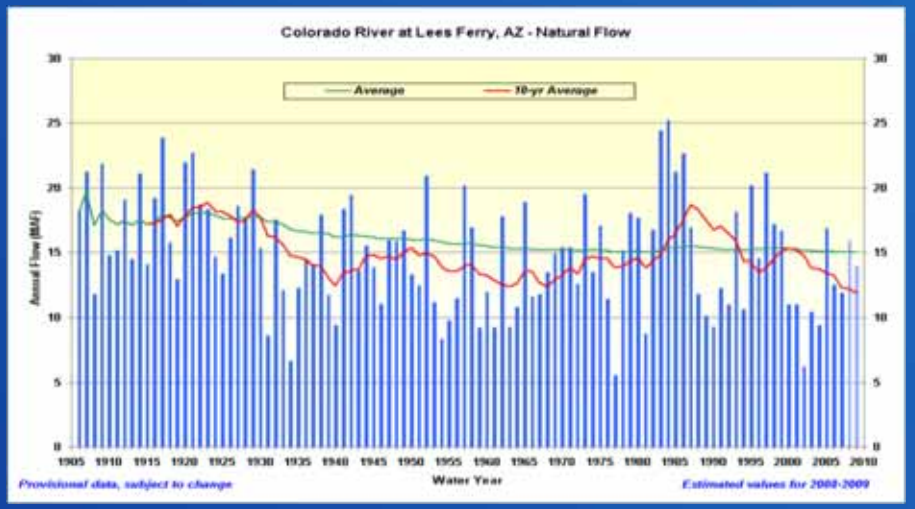
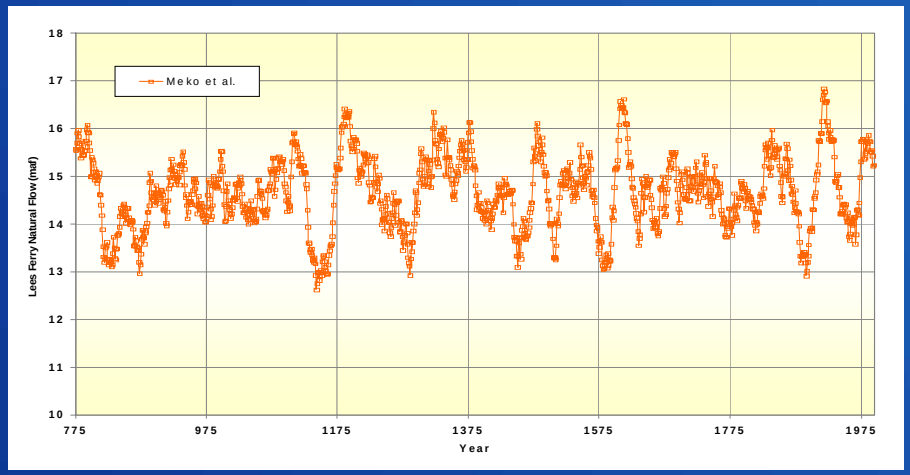
Water Supply Scenarios*

- Observed Resampled
- Paleo Resampled
- Paleo Conditioned
- Downscaled GCM Projected







* Multiple realizations for each scenario

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Water Demand Scenarios

- **Current Projected (A)**: growth, development patterns, and institutions continue along recent trends
- **Slow Growth (B):** low growth with emphasis on economic efficiency
- **Rapid Growth (C1 and C2):** economic resurgence (population and energy) and current preferences toward human and environmental values
  - C1 – slower technology adoption
  - C2 – rapid technology adoption
- **Enhanced Environment (D1 and D2):** expanded environmental awareness and stewardship with growing economy
  - D1 – with moderate population growth
  - D2 – with rapid population growth

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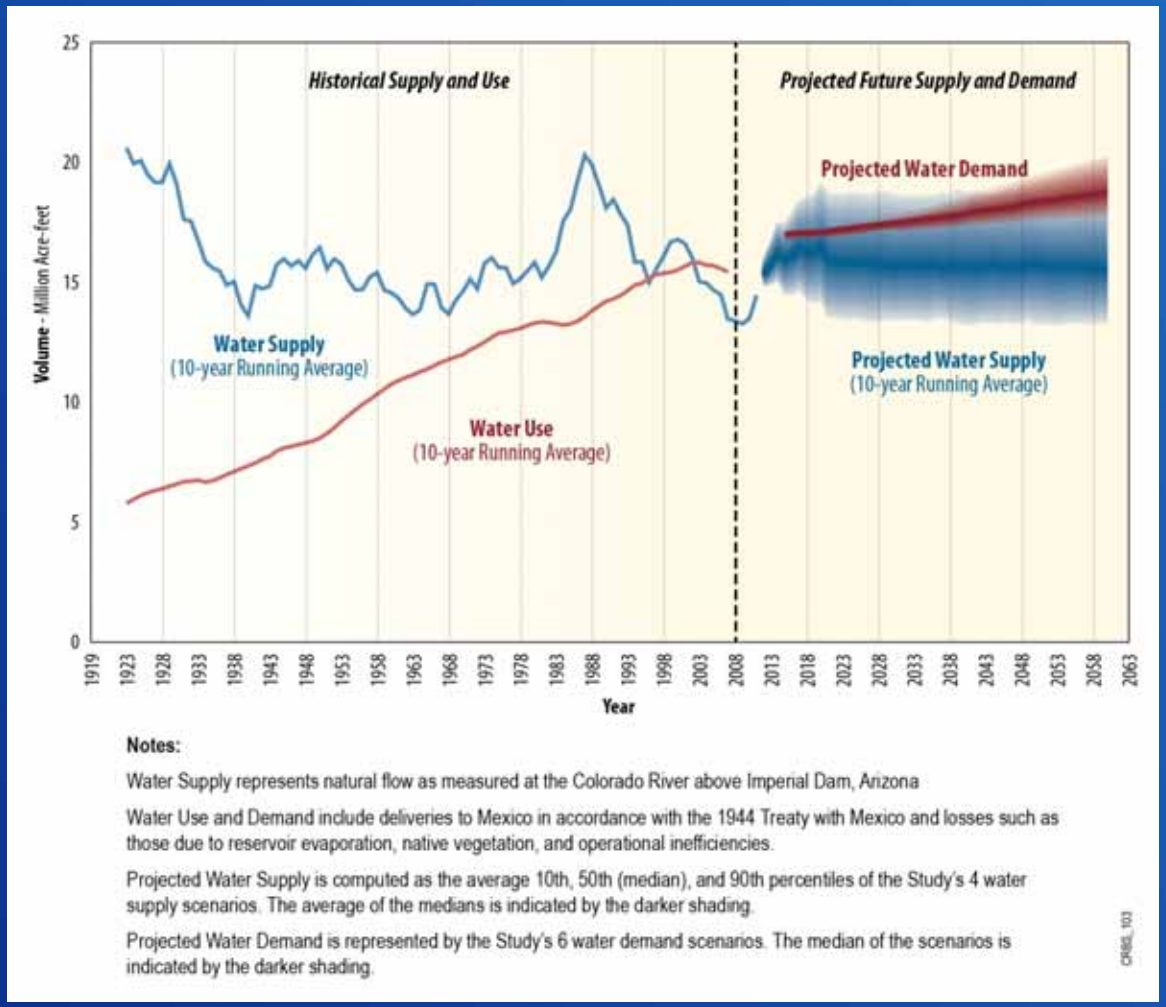
Projected Future Colorado River Basin Water Supply and Demand

- Average supply-demand imbalances by 2060 are approximately 3.2 million acre-feet
- This imbalance may be more or less depending on the nature of the particular supply and demand scenario
- Imbalances have occurred in the past and deliveries have been met due to reservoir storage



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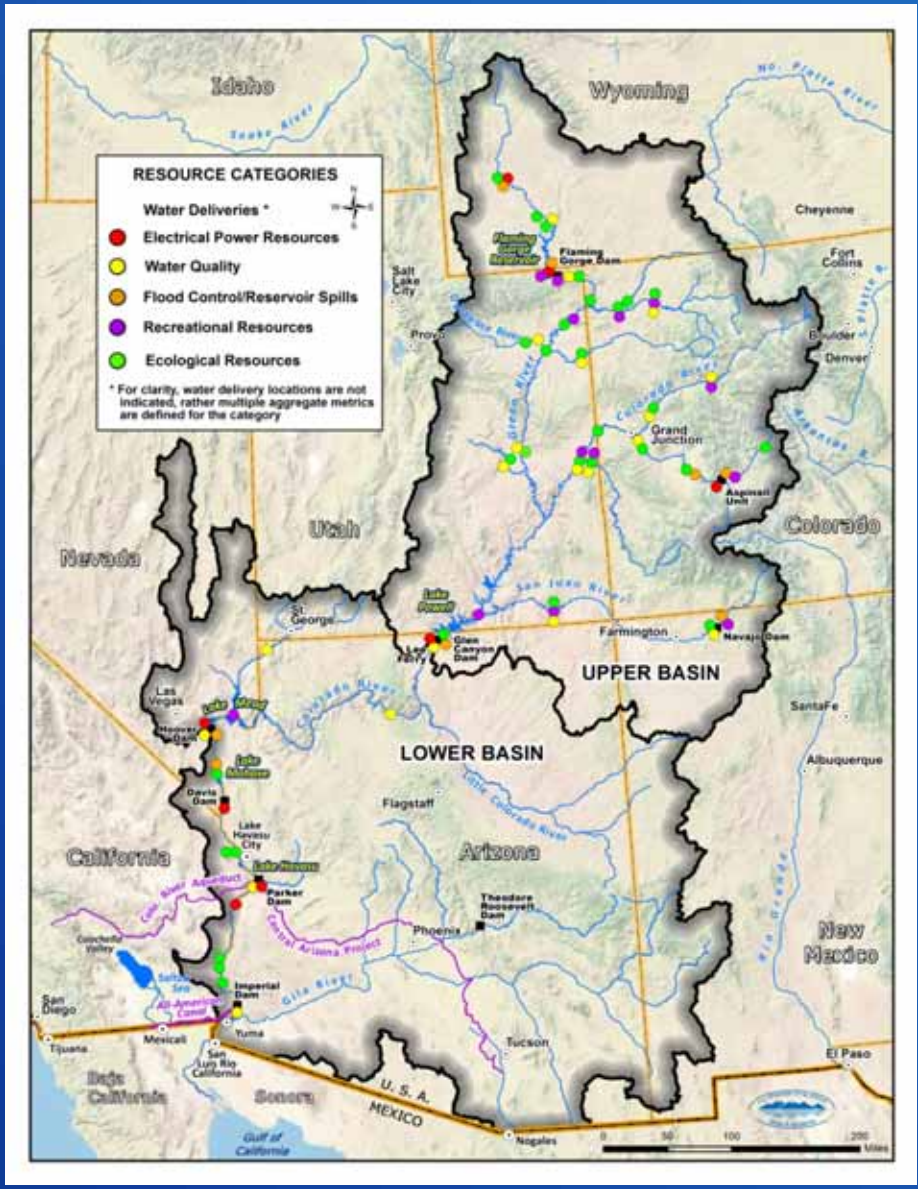
System Reliability Analysis

- Simulate the state of the system over the next 50 years for each scenario, with and without options and strategies
- Use metrics and vulnerabilities to quantify impacts to Basin resources
- **Resource Categories**
  - Water Deliveries
  - Electrical Power Resources
  - Water Quality
  - Flood Control
  - Recreational Resources
  - Ecological Resources



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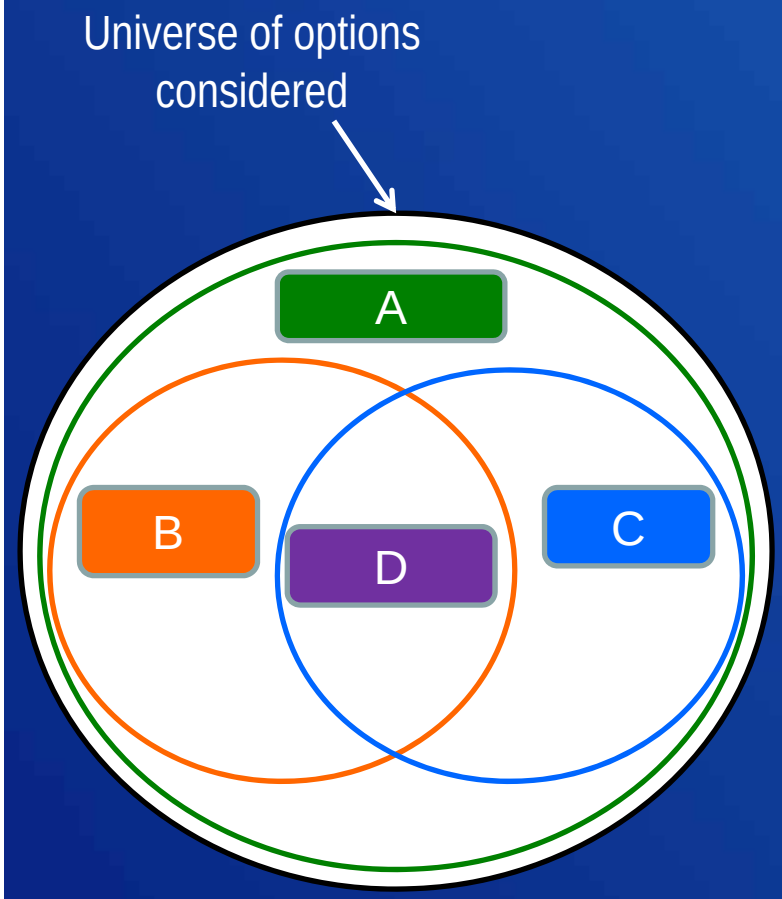
Summary of Portfolios



Option Selection
• Least restrictive resulting in a highly inclusive set of option preferences • Considers the largest set of options
• Low-risk strategy in the long-term with high reliability • High technical feasibility • Excludes options with high permitting, legal and policy risks
• Prioritizes options that have low environmental impacts and long-term flexibility • Excludes options with high permitting risk
• High technical feasibility and long-term reliability • Low energy intensity • Excludes options with high permitting, legal, and policy risk • Considers smallest set of options

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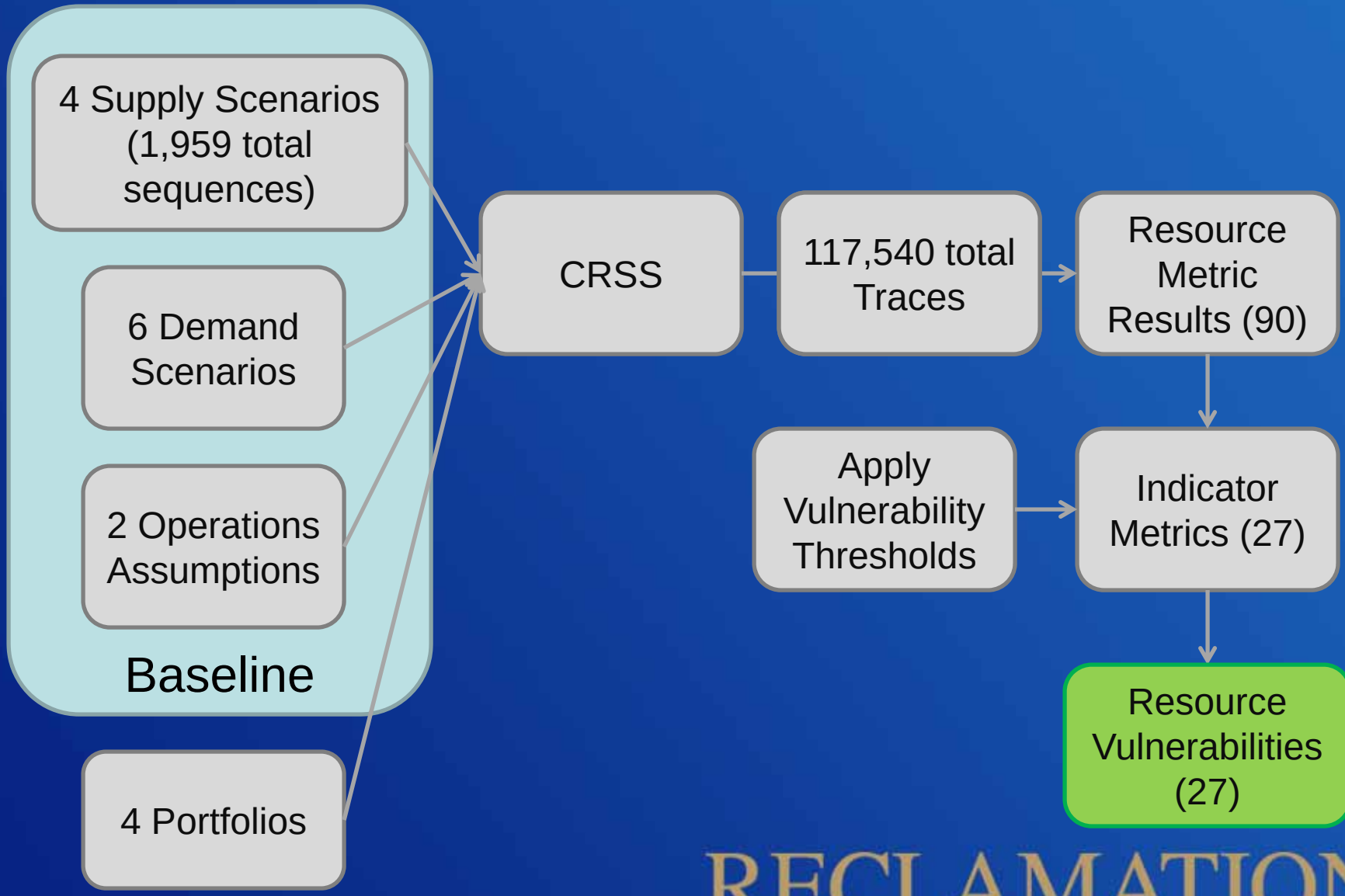
System Reliability Analysis Approach



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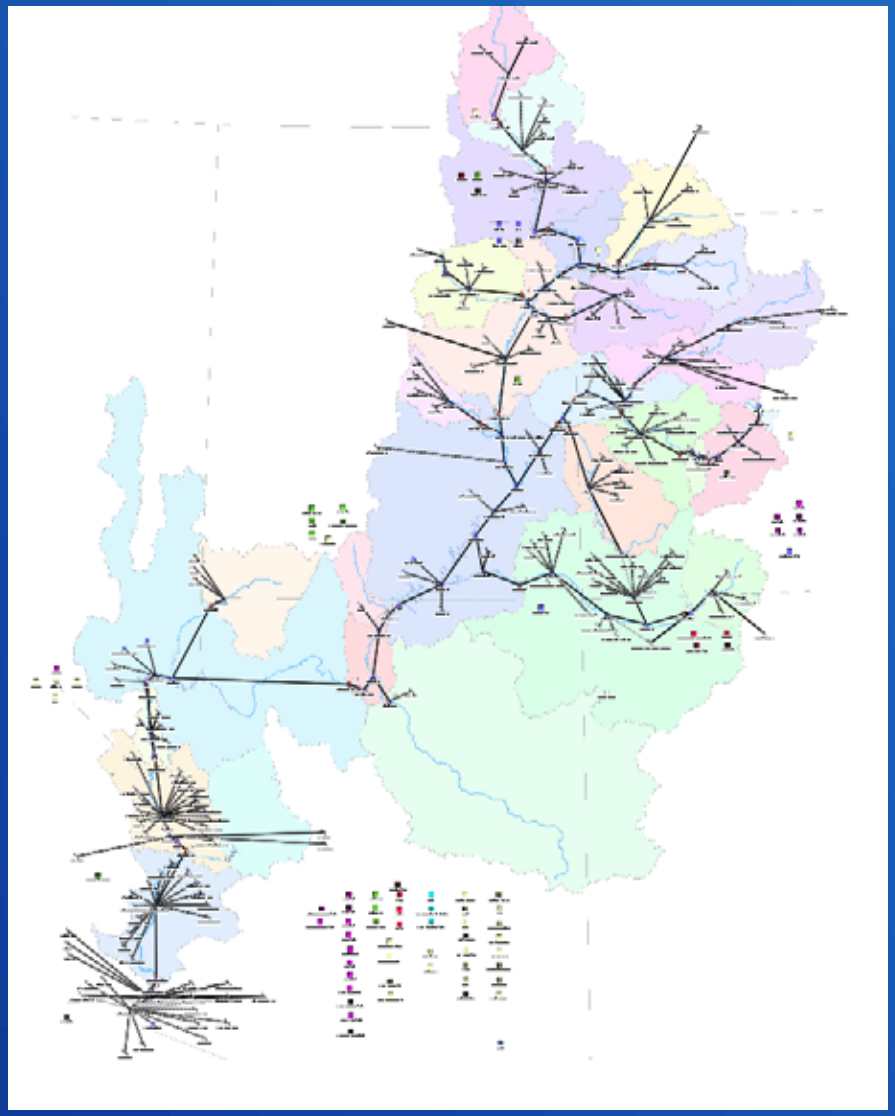
Colorado River Simulation System (CRSS)

- Reclamation's official Basin-wide long-term planning model
- Implemented in RiverWare™
- Simulates operations at 12 reservoirs and deliveries to over 500 individual 'water users' at a monthly time-step
- Model logic reflects reservoir operations
- Gives a range of potential future system conditions



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CRSS Enhancements

- Navajo ROD
- Flaming Gorge ROD
- State of Colorado water priorities
- Climate impacts on reservoir evaporation
- Demands modeling – data objects

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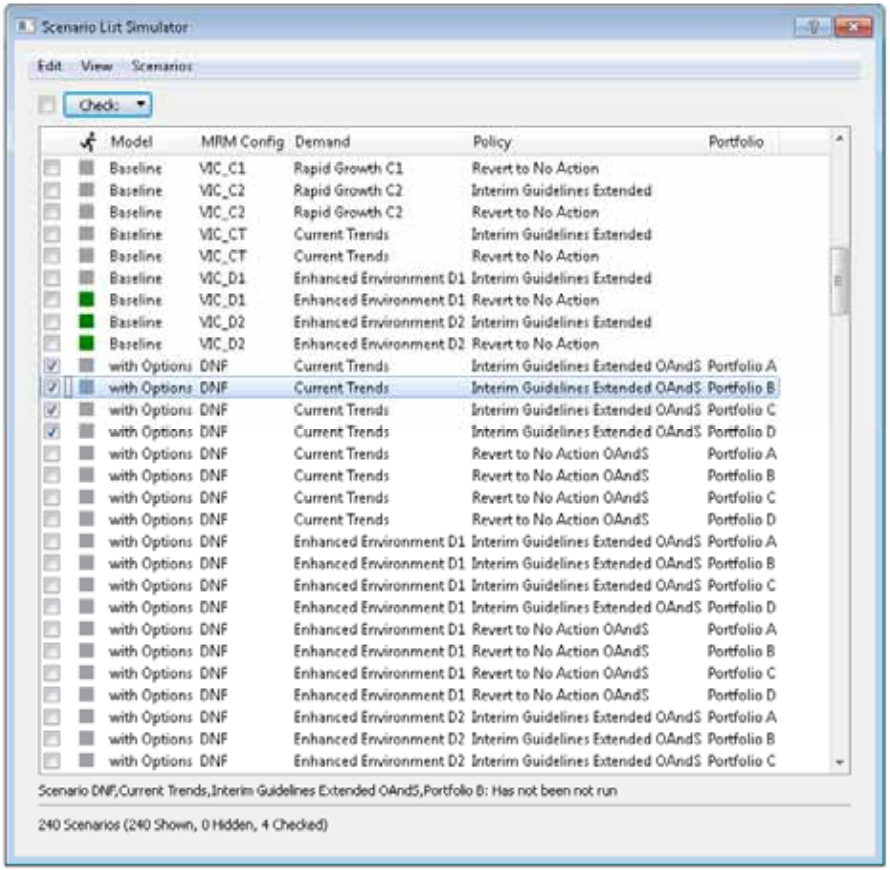
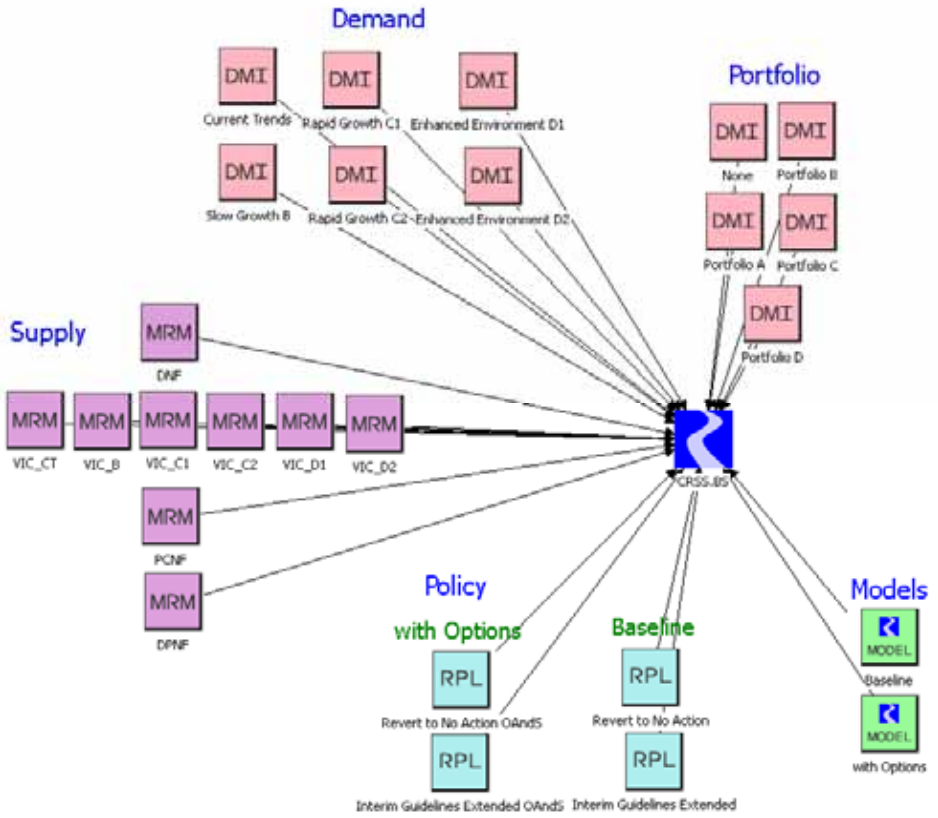
RiverWare™ Study Manager

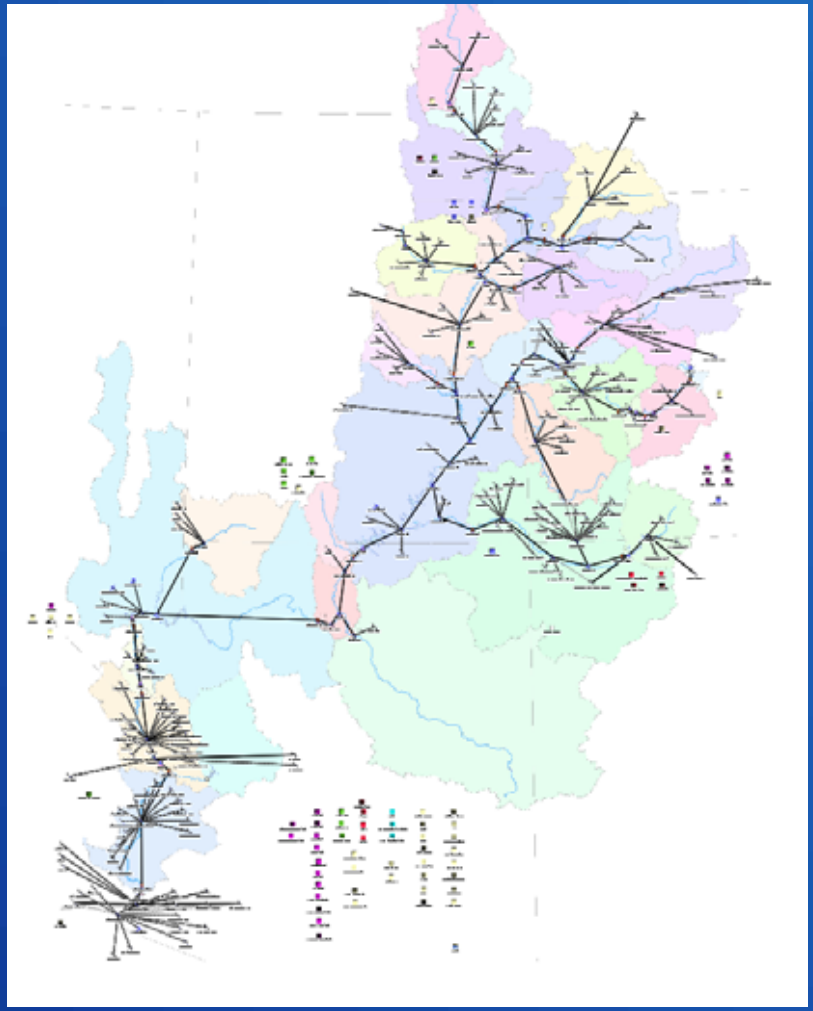
- Manage input and output for all 240 scenarios
- Automate simulation process





Approach to Implement and Analyze Portfolios

- Inputs to CRSS included option timing, yield, and cost
- Options were implemented, based on cost-effectiveness, when signposts indicated an approaching vulnerability
  - This dynamic approach avoids implementing options when not needed
  - Signposts were informed by vulnerable conditions (those conditions that frequently led to vulnerabilities)
- All portfolios were assessed across all future conditions



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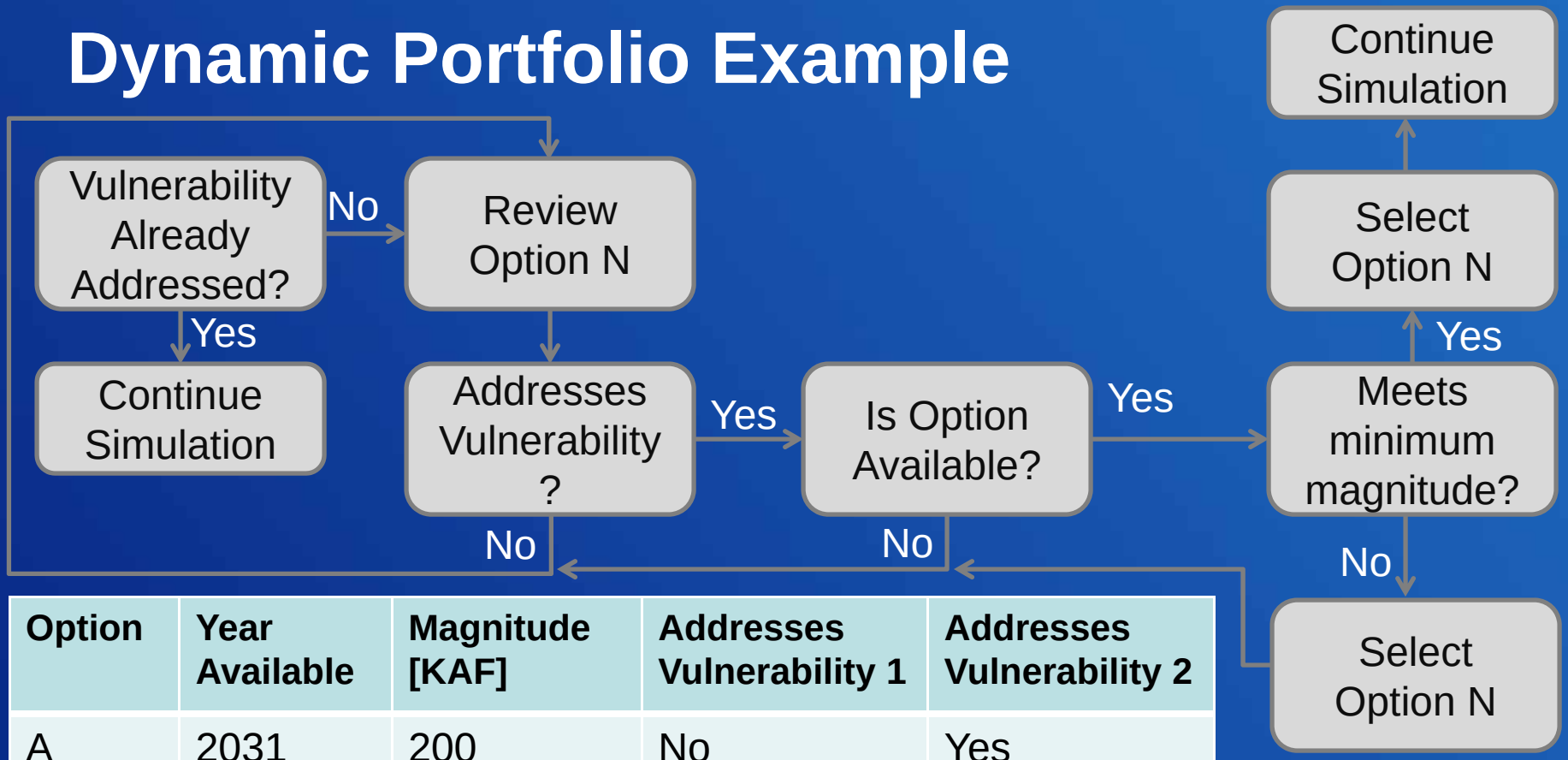
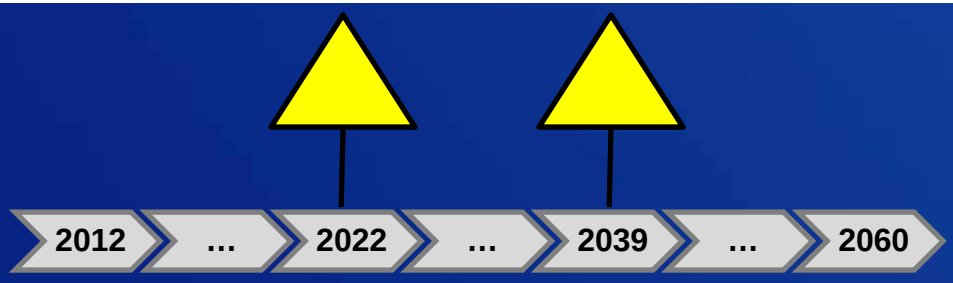
Dynamic Portfolio Example



Option	Year Available	Magnitude [KAF]	Addresses Vulnerability 1	Addresses Vulnerability 2
A	2031	200	No	Yes
B	2021	75	Yes	No
C	2045	150	Yes	Yes



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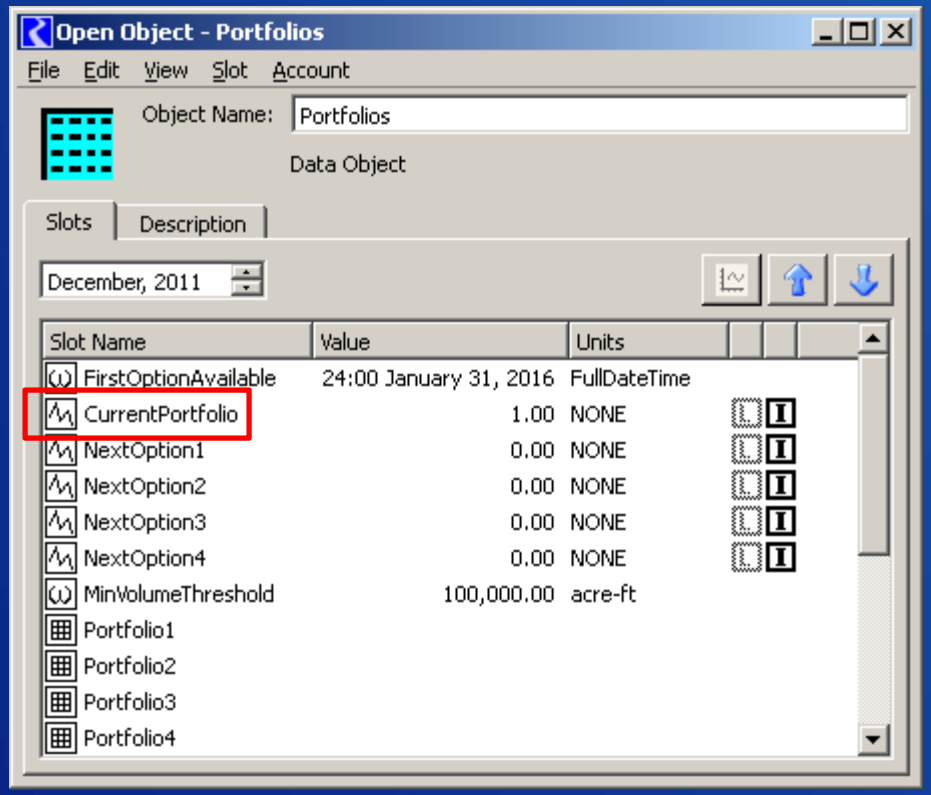
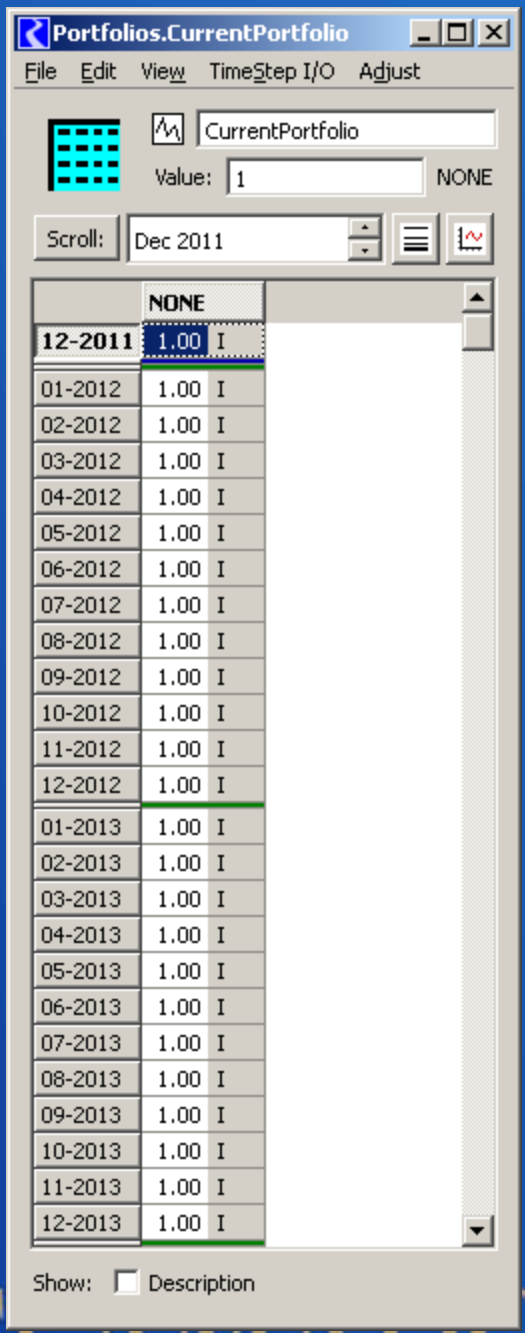
Dynamic Portfolios In CRSS





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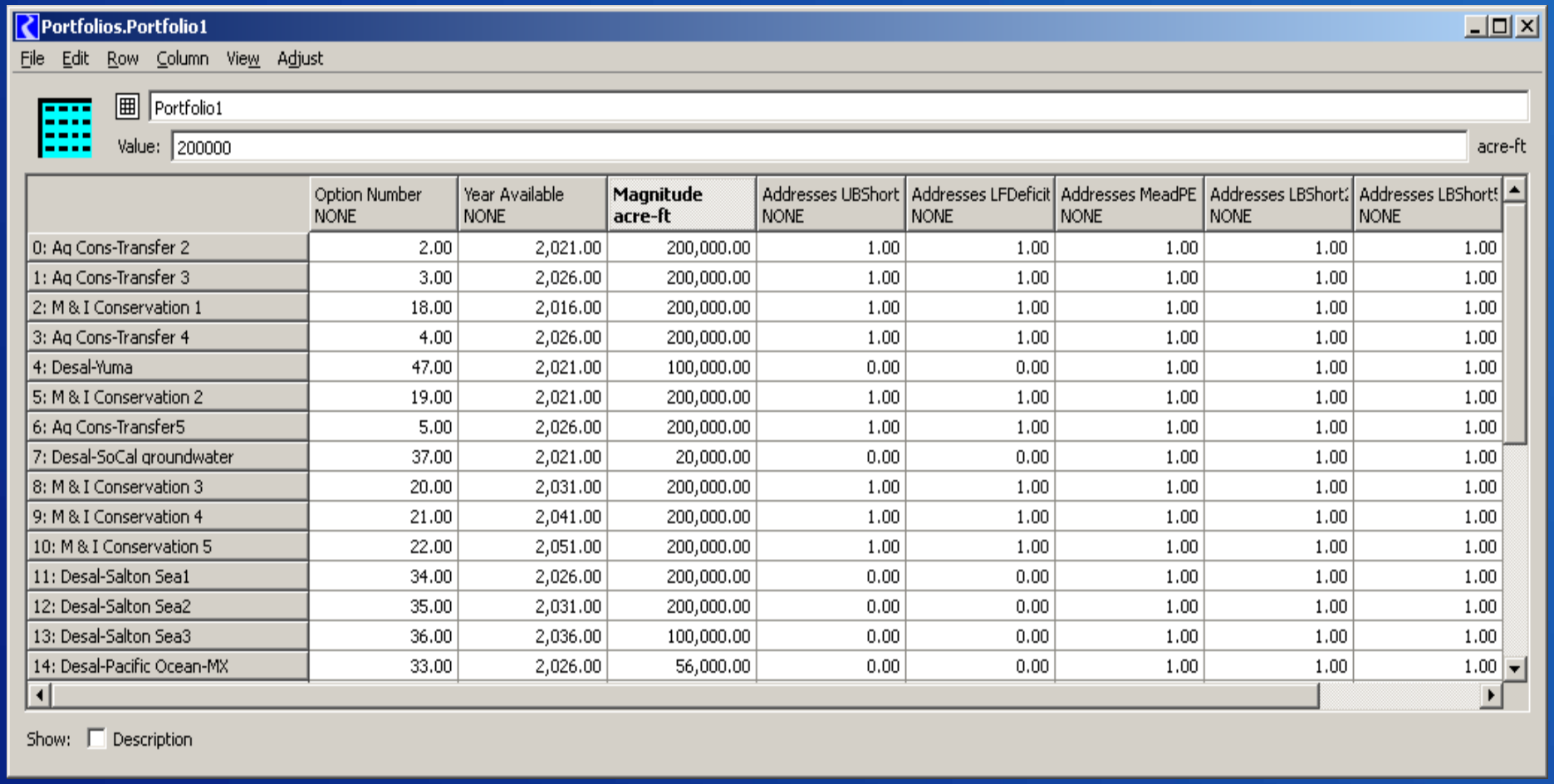
Dynamic Portfolios In CRSS



	Option Number NONE	Year Available NONE	**Magnitude acre-ft**	Addresses UBShort NONE	Addresses LFDeficit NONE	Addresses MeadPE NONE	Addresses LBShort2 NONE	Addresses LBShort5 NONE
0: Aq Cons-Transfer 2	2.00	2,021.00	200,000.00	1.00	1.00	1.00	1.00	1.00
1: Aq Cons-Transfer 3	3.00	2,026.00	200,000.00	1.00	1.00	1.00	1.00	1.00
2: M & I Conservation 1	18.00	2,016.00	200,000.00	1.00	1.00	1.00	1.00	1.00
3: Aq Cons-Transfer 4	4.00	2,026.00	200,000.00	1.00	1.00	1.00	1.00	1.00
4: Desal-Yuma	47.00	2,021.00	100,000.00	0.00	0.00	1.00	1.00	1.00
5: M & I Conservation 2	19.00	2,021.00	200,000.00	1.00	1.00	1.00	1.00	1.00
6: Aq Cons-Transfer5	5.00	2,026.00	200,000.00	1.00	1.00	1.00	1.00	1.00
7: Desal-SoCal groundwater	37.00	2,021.00	20,000.00	0.00	0.00	1.00	1.00	1.00
8: M & I Conservation 3	20.00	2,031.00	200,000.00	1.00	1.00	1.00	1.00	1.00
9: M & I Conservation 4	21.00	2,041.00	200,000.00	1.00	1.00	1.00	1.00	1.00
10: M & I Conservation 5	22.00	2,051.00	200,000.00	1.00	1.00	1.00	1.00	1.00
11: Desal-Salton Sea1	34.00	2,026.00	200,000.00	0.00	0.00	1.00	1.00	1.00
12: Desal-Salton Sea2	35.00	2,031.00	200,000.00	0.00	0.00	1.00	1.00	1.00
13: Desal-Salton Sea3	36.00	2,036.00	100,000.00	0.00	0.00	1.00	1.00	1.00
14: Desal-Pacific Ocean-MX	33.00	2,026.00	56,000.00	0.00	0.00	1.00	1.00	1.00

Show: Description

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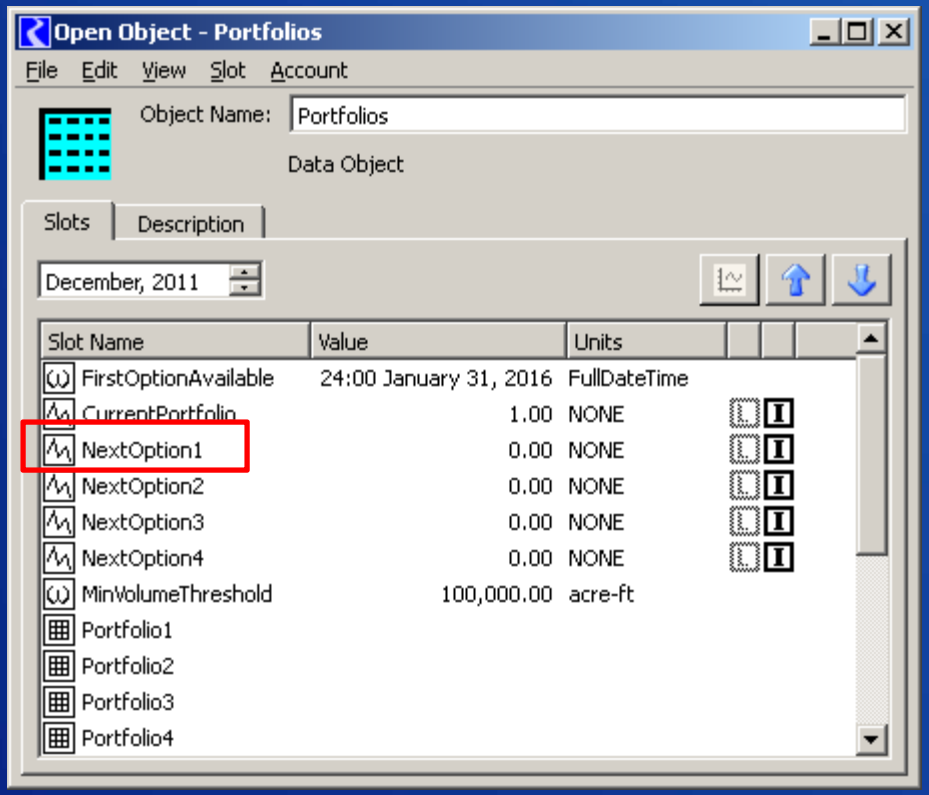
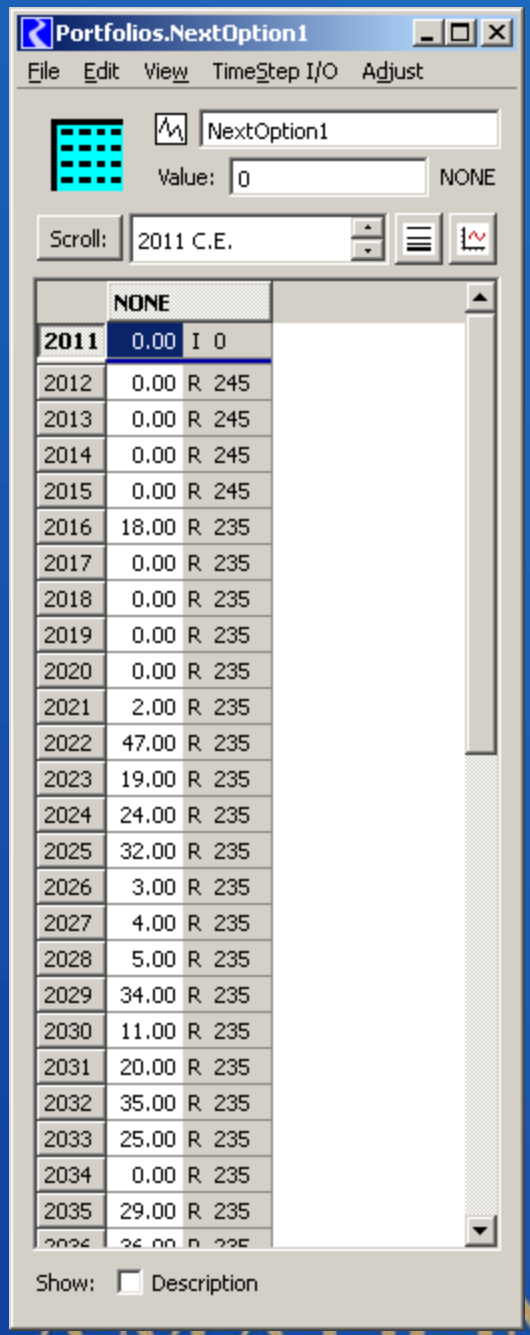
Dynamic Portfolios In CRSS





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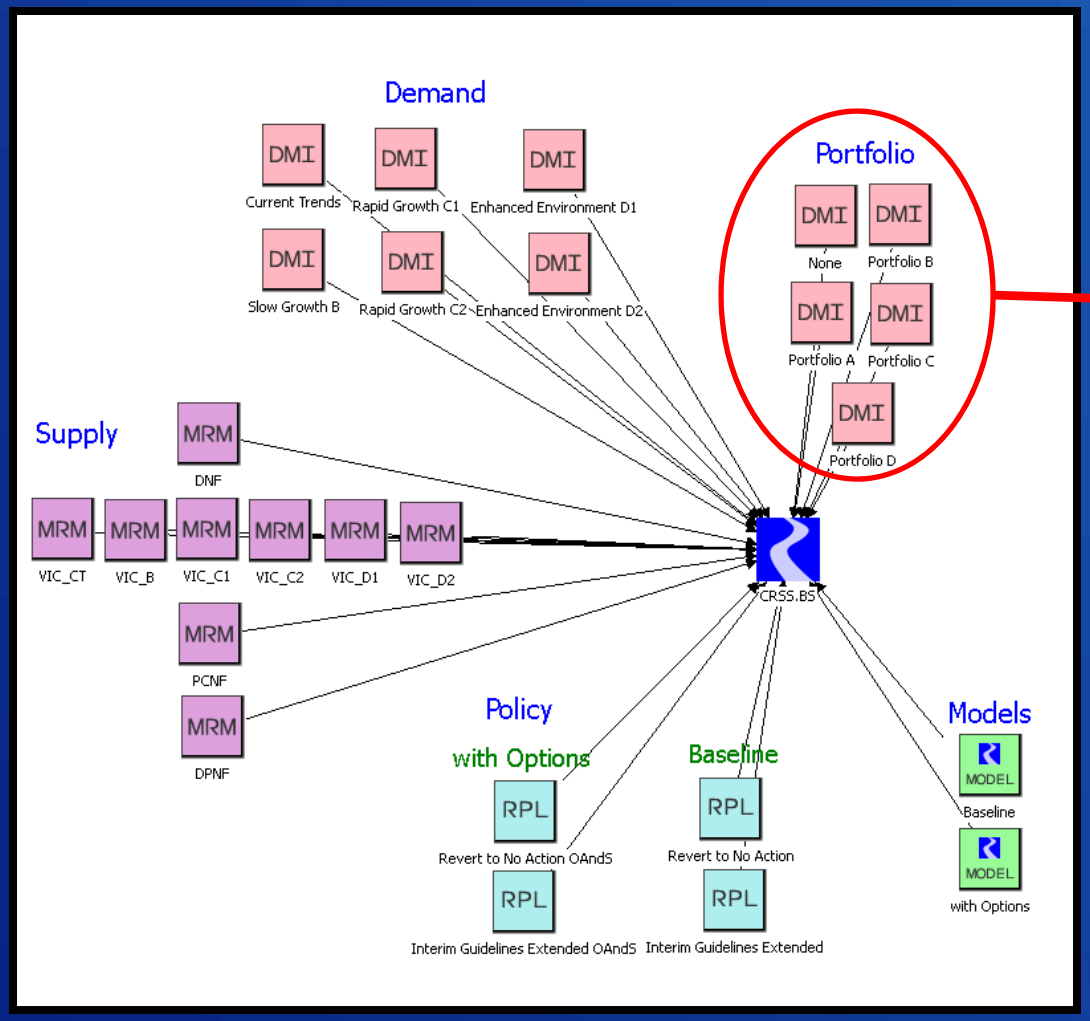
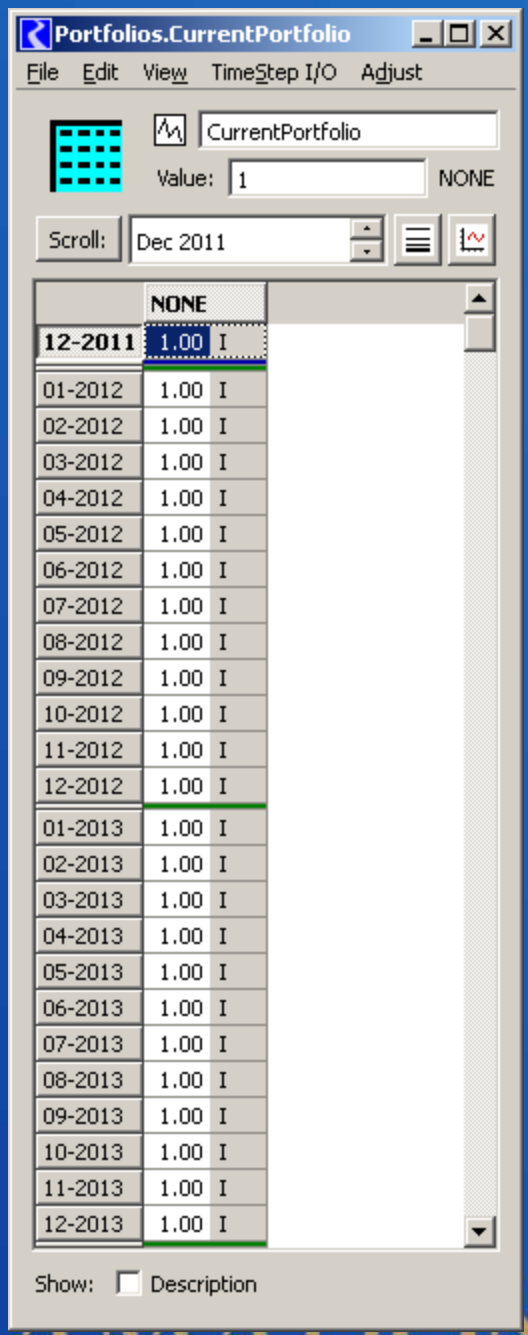
Dynamic Portfolios In CRSS: Study Manager





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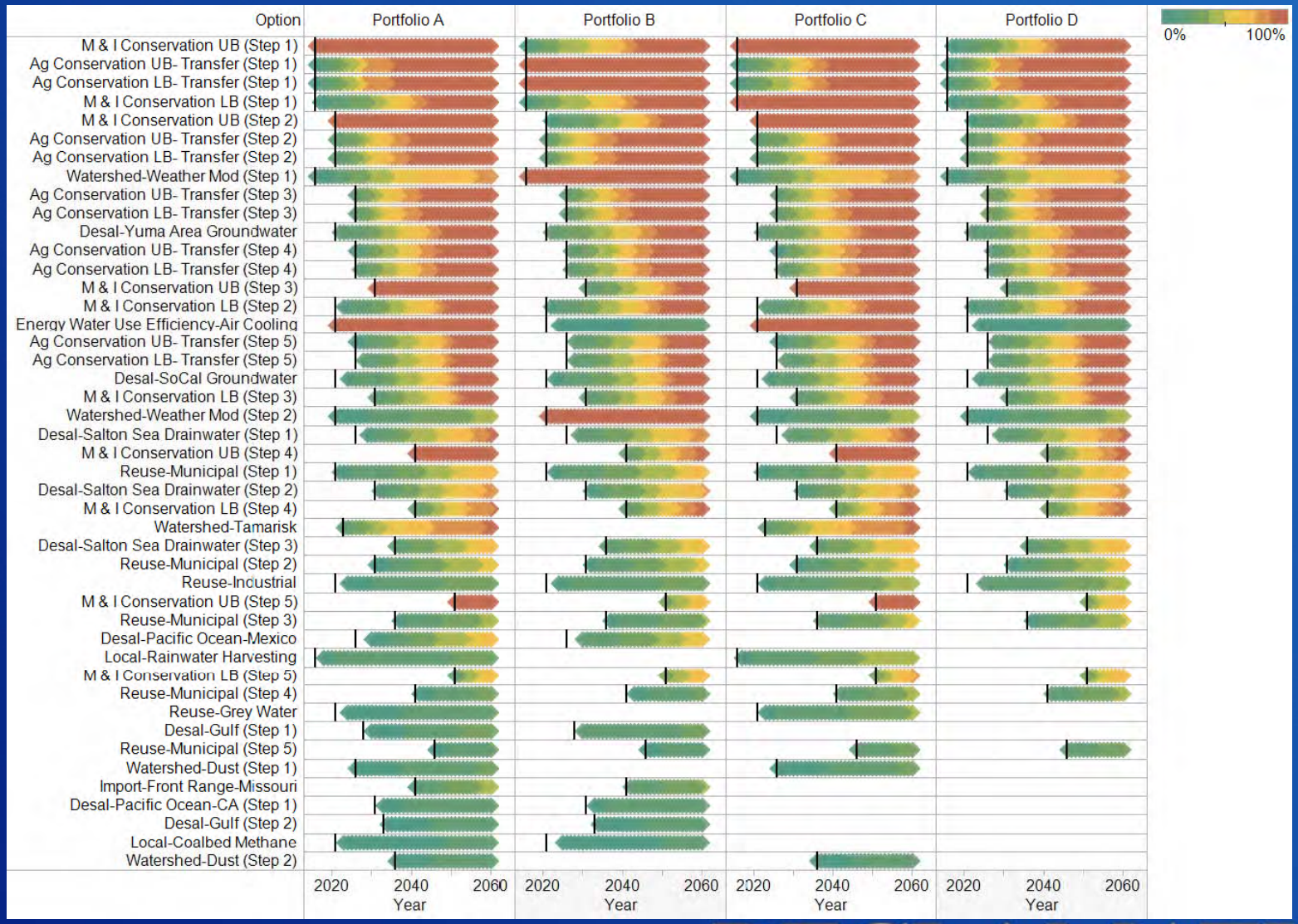
Frequency of Option Implementation



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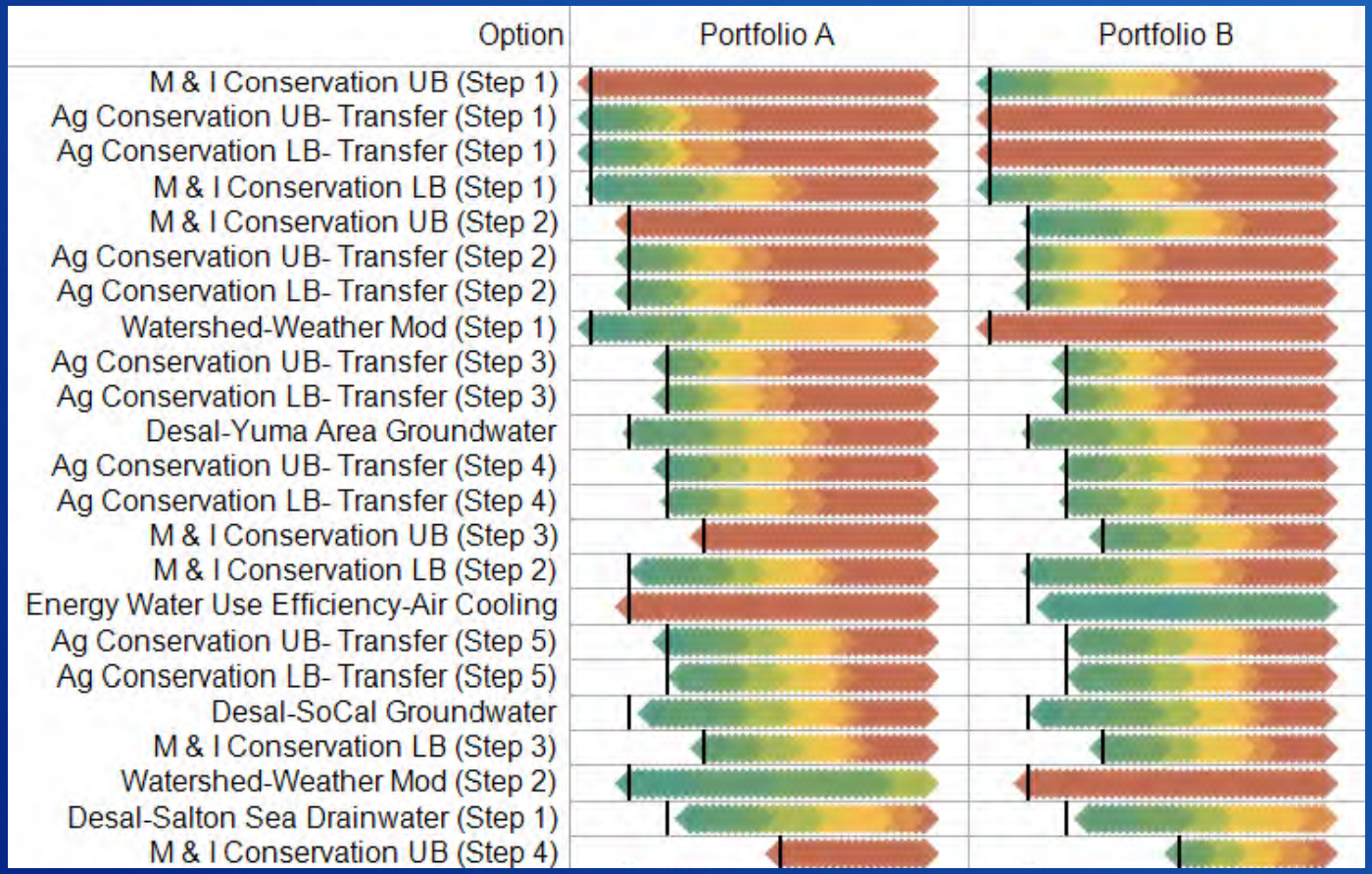

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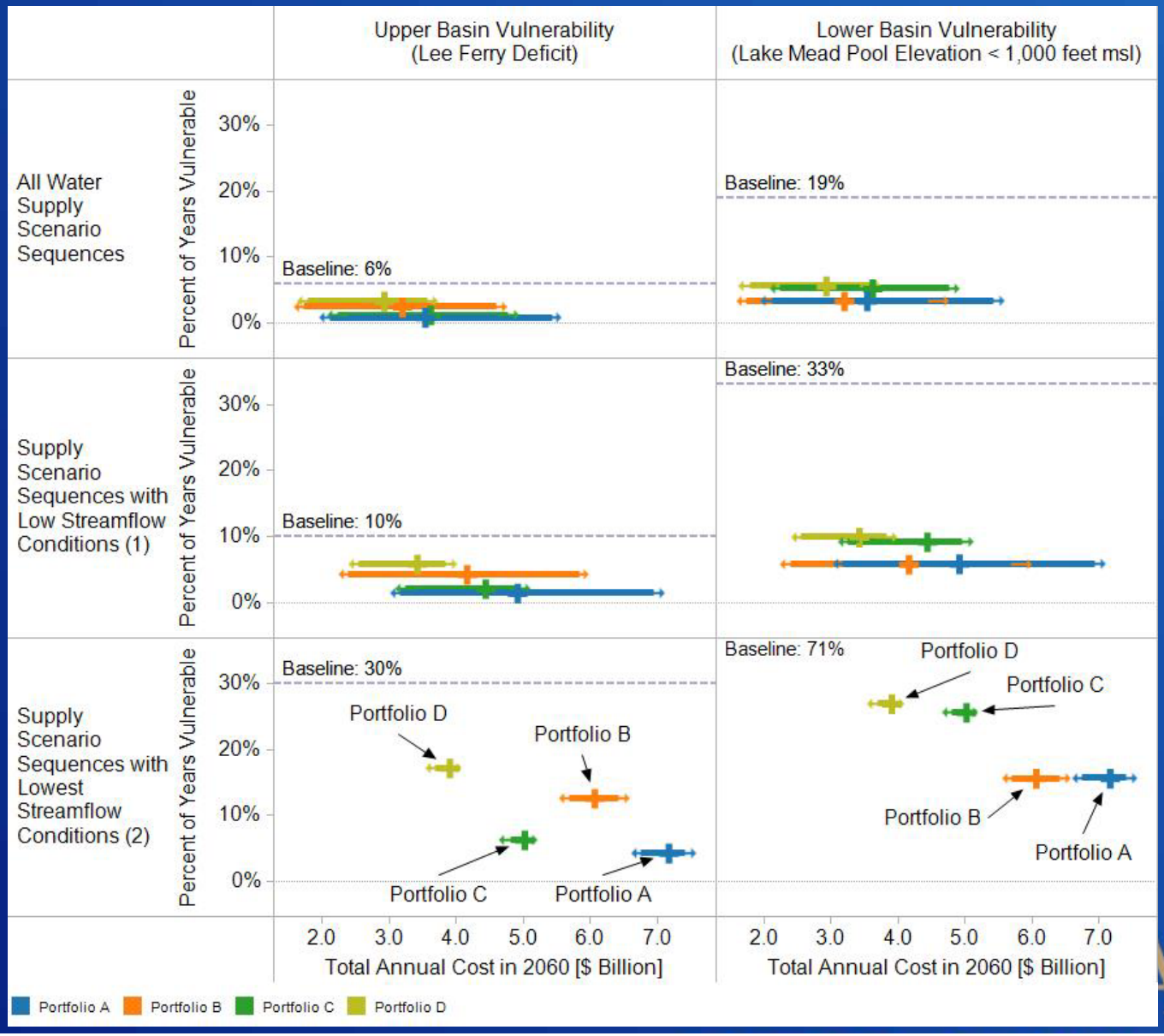
Comparing Portfolio Results
Percent years vulnerable vs. cost (2041-2060)



Colorado River Basin Water Supply and Demand Study

Study Contact Information

- Website: http://www.usbr.gov/lc/region/programs/crbstudy.html
- Email: ColoradoRiverBasinStudy@usbr.gov
- Telephone: 702-293-8500; Fax: 702-293-8418

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