

Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
February 20-21, 2013

Agenda Item

Colorado River Basin Water Supply and Demand Study

Time Allotted

45 minutes for presentation; 15 minutes for Q&A and Discussion

Action Requested

✓ Information item only.

Presenter

Carly Jerla, Water Resource Engineer, Bureau of Reclamation, Lower Colorado Region

Previous Action Taken

N/A

Relevant Science

N/A

Background Information

The Colorado River Basin Water Supply and Demand Study was authorized by Congress and jointly funded and prepared by the Bureau of Reclamation and the seven Colorado River Basin states and projects water supply and demand imbalances throughout the Colorado River Basin and adjacent areas over the next 50 years. The Colorado River Basin Water Supply and Demand Study, the first of its kind, also includes a wide array of adaptation and mitigation strategies proposed by stakeholders and the public to address the projected imbalances.

The average imbalance in future supply and demand is projected to be greater than 3.2 million acre-feet by 2060, according to the study. One acre-foot of water is approximately the amount of water used by a single household in a year. The study projects that the largest increase in demand will come from municipal and industrial users, owing to population growth. The Colorado River Basin currently provides water to some 40 million people, and the study estimates that this number could nearly double to approximately 76.5 million people by 2060, under a rapid growth scenario.

Authorized by the 2009 SECURE Water Act, the study analyzes future water supply and demand scenarios based on factors such as projected changes in climate and varying levels of growth in communities, agriculture and business in the seven Colorado River Basin states of Arizona, California, Colorado, New Mexico, Nevada, Utah, and Wyoming.

The study includes over 150 proposals from study participants, stakeholders and the public that represent a wide range of potential options to resolve supply and demand imbalances. Proposals include increasing water supply through reuse or desalinization methods, and reducing demand through increased conservation and efficiency efforts. The scope of the study does not include a decision as to how future imbalances should or will be addressed. Reclamation intends to work with

Colorado River Basin Water Supply and Demand Study, continued

stakeholders to explore in-basin strategies, rather than proposals - such as major trans-basin conveyance systems - that are not considered cost effective or practical.

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Managing Water in the West

Colorado River Basin Water Supply and Demand Study

Glen Canyon AMWG Meeting
Tempe, AZ
February 20, 2013



U.S. Department of the Interior
Bureau of Reclamation

Colorado River Basin Water Supply and Demand Study

Agenda

- Study Overview
- Overview of Final Study Report
- Next Steps
- Questions and Discussion



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Colorado River Basin Water Supply and Demand Study

- Study Objective
 - Assess future water supply and demand imbalances over the next 50 years
 - Develop and evaluate opportunities for resolving imbalances
- Study conducted by Reclamation and the Basin States, in collaboration with stakeholders throughout the Basin
- Began in January 2010 and completed in December 2012
- A planning study – does *not* result in any decisions, but will provide the technical foundation for future activities

Cost-Share Partners

Arizona Department of Water Resources

(California) Six Agency Committee

Colorado Water Conservation Board

New Mexico Interstate Stream Commission

Southern Nevada Water Authority

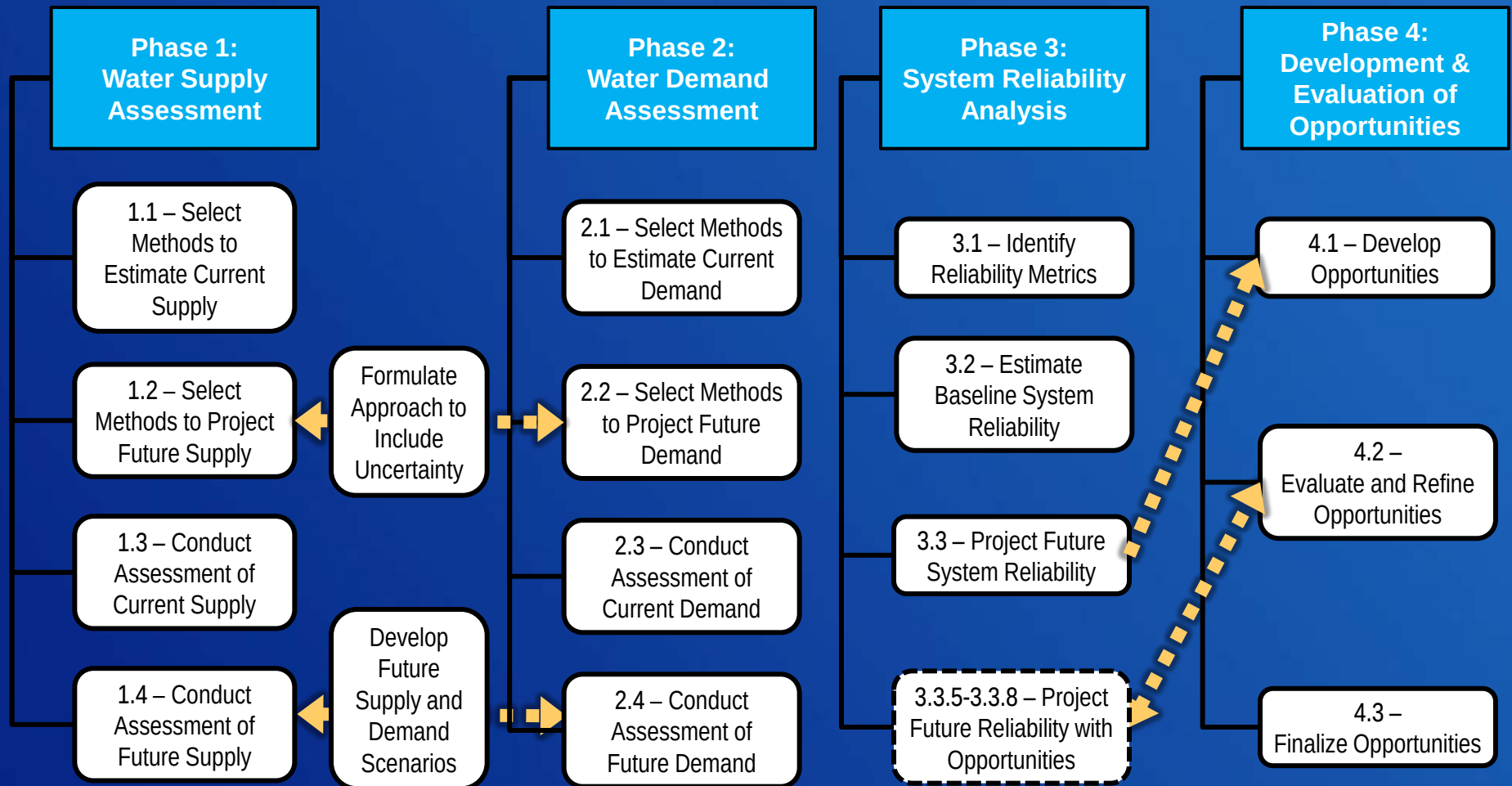
Utah Division of Water Resources

Wyoming State Engineer's Office

Reclamation's Upper and Lower Colorado Regions

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Study Phases and Tasks



Final Study Reports

- The final Study is a collection of reports available at:
<http://www.usbr.gov/lc/region/programs/crbstudy/report1.html>

Executive Summary

Study Report

Technical Report A – Scenario Development

Technical Report B – Water Supply Assessment

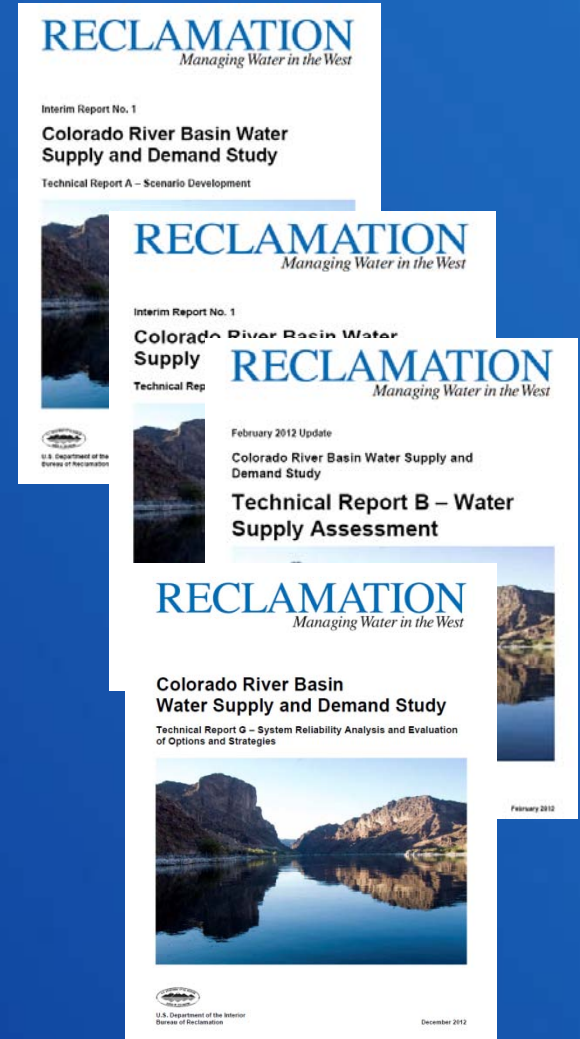
Technical Report C – Water Demand Assessment

Technical Report D – System Reliability Metrics

Technical Report E – Approach to Develop and Evaluate Opportunities to Balance Supply

Technical Report F – Development of Options and Strategies

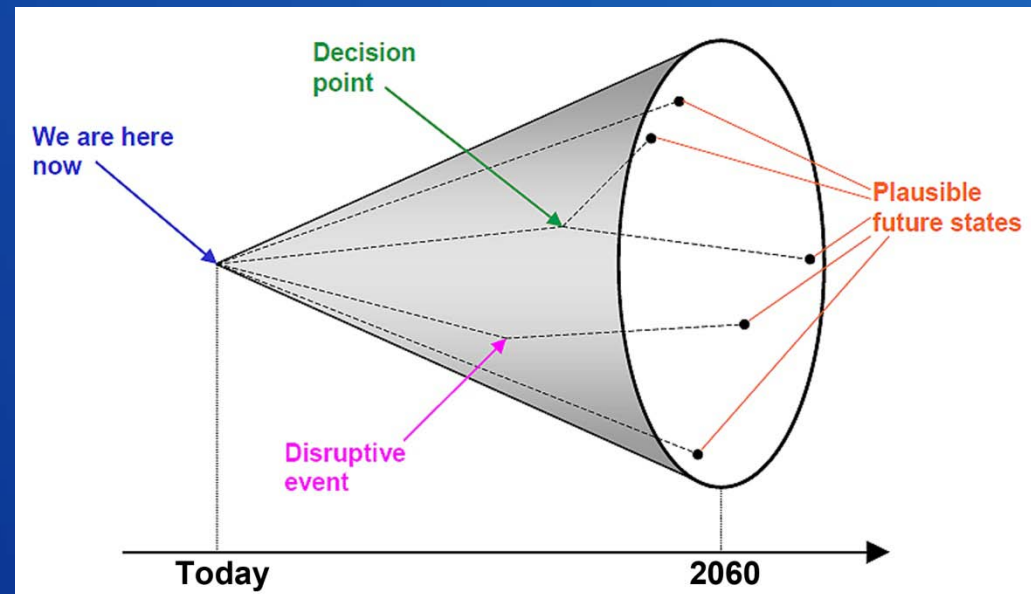
Technical Report G – System Reliability Analysis and Evaluation of Options and Strategies



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Scenario Planning: Addressing an Uncertain Future

- The path of major influences on the Colorado River system is uncertain and can not be represented by a single view
- An infinite number of plausible futures exist
- A manageable and informative number of scenarios are being developed to explore the broad range of futures

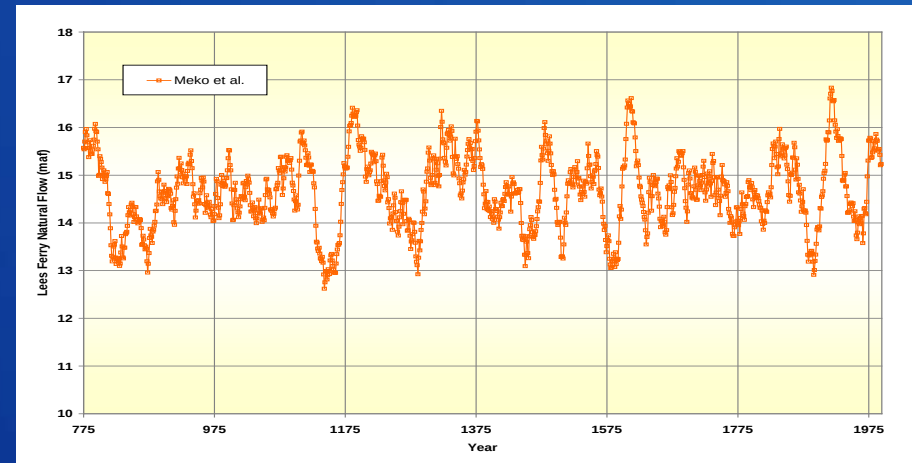
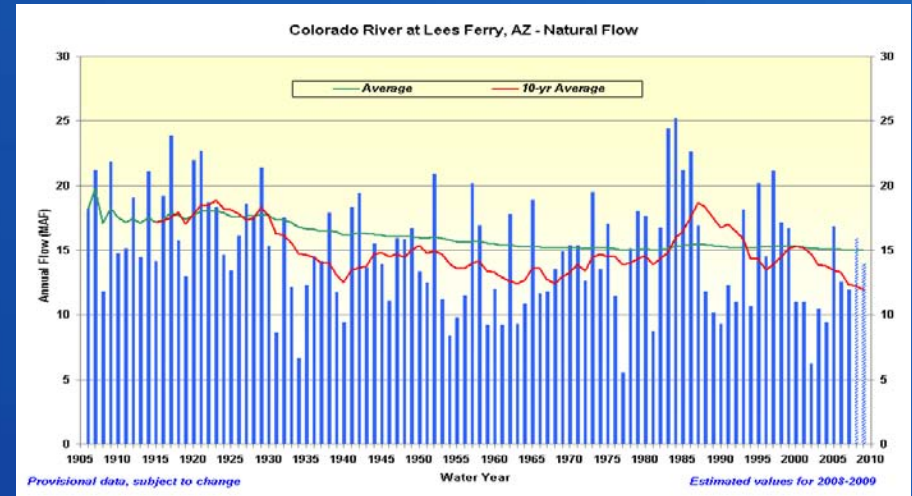
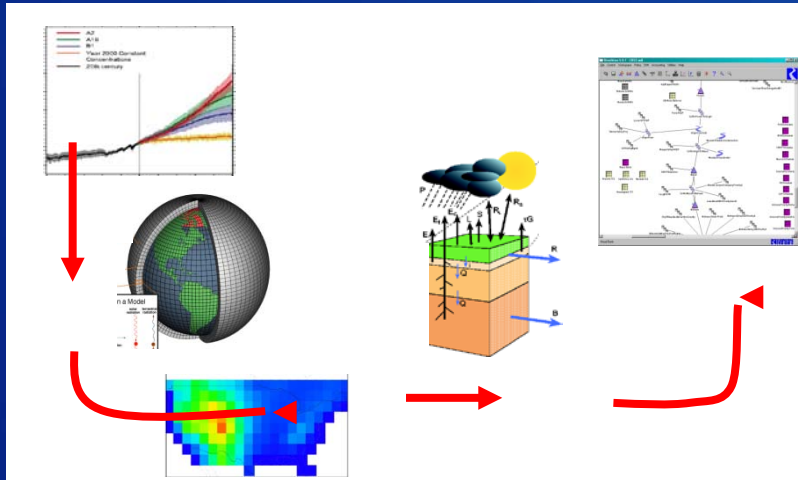


(adapted from Timpe and Scheepers, 2003)

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Water Supply Scenarios*

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

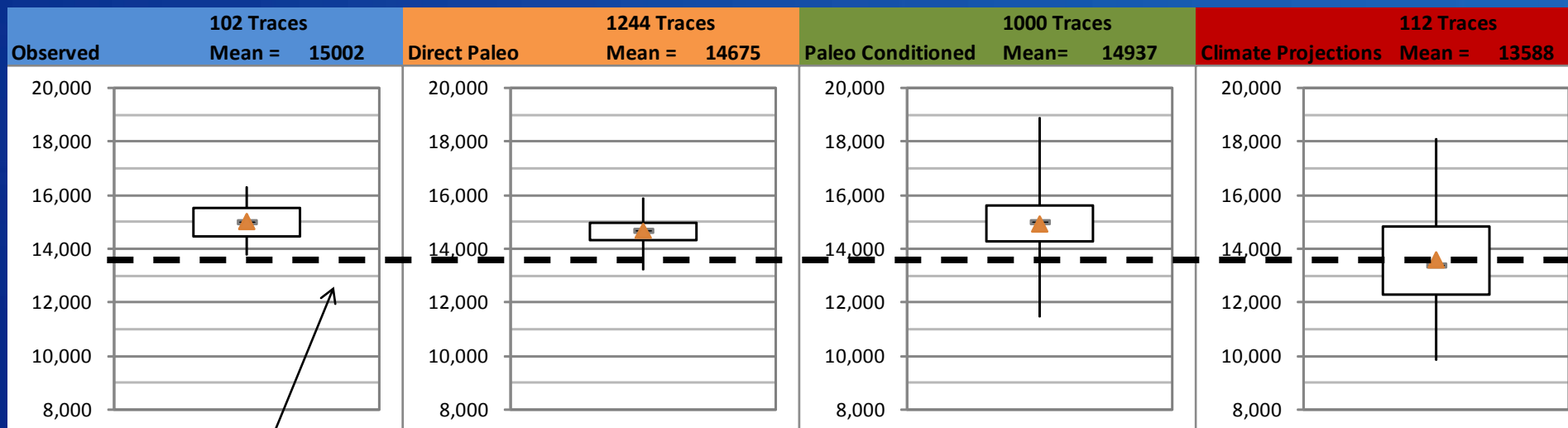


* Multiple sequences for each scenario

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Quantification of Water Supply Scenarios

Projections of 2011-2060 Average Natural Flow at Lees Ferry



1991 – 2010 average = 13.7 MAF

Box represents 25th – 75th percentile, whiskers represent min and max, and triangle represents mean of all traces

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Water Demand Scenarios

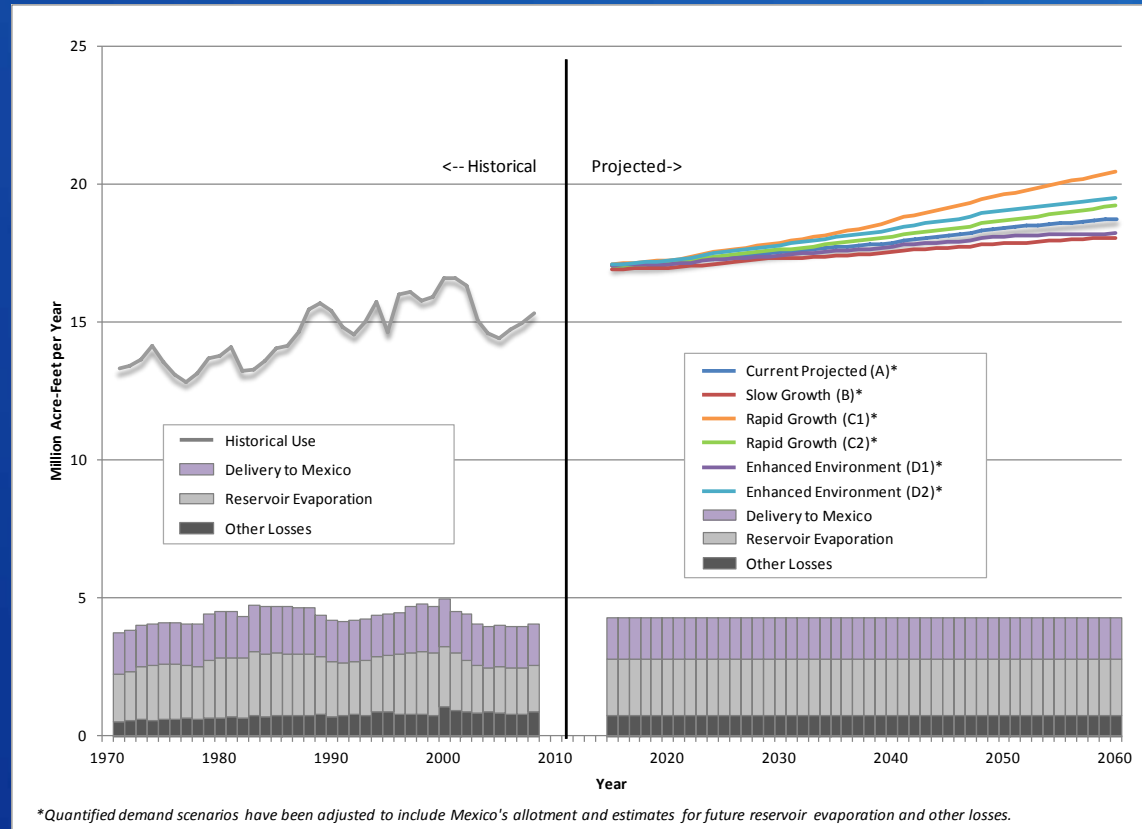
- **Current Projected (A):** growth, development patterns, and institutions continue along recent trends
- **Slow Growth (B):** low growth with emphasis on economic efficiency
- **Rapid Growth (C1 and C2):** economic resurgence (population and energy) and current preferences toward human and environmental 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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Water Demand Quantification Results

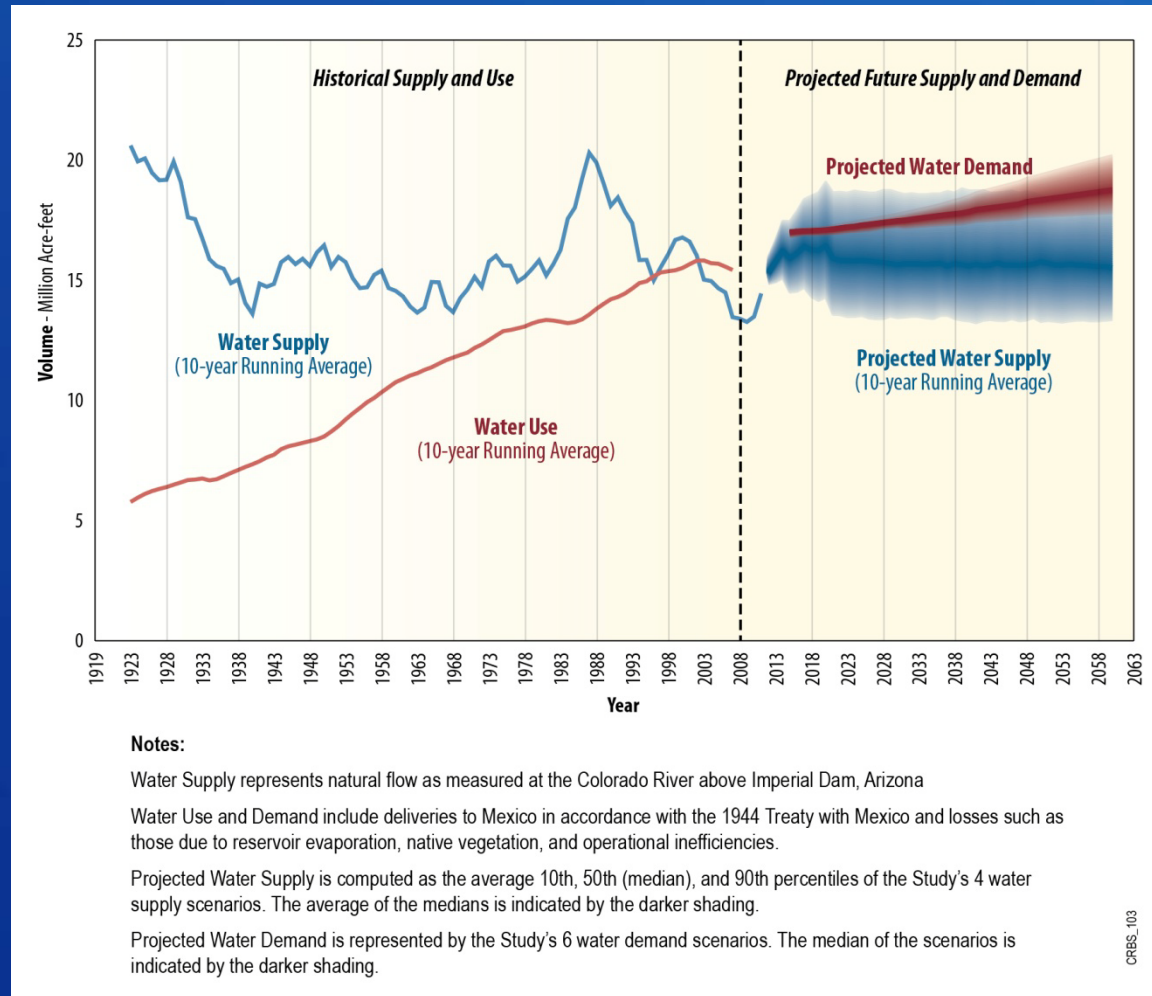
- Demand for consumptive uses ranges between 13.8 and 16.2 maf by 2060 (including Mexico and losses 18.1 and 20.4 maf by 2060)
- Approximately a 20% spread between the lowest (Slow Growth) and highest (Rapid Growth – C1) demand scenarios

Colorado River Basin Historical Use and Future Projected Demand



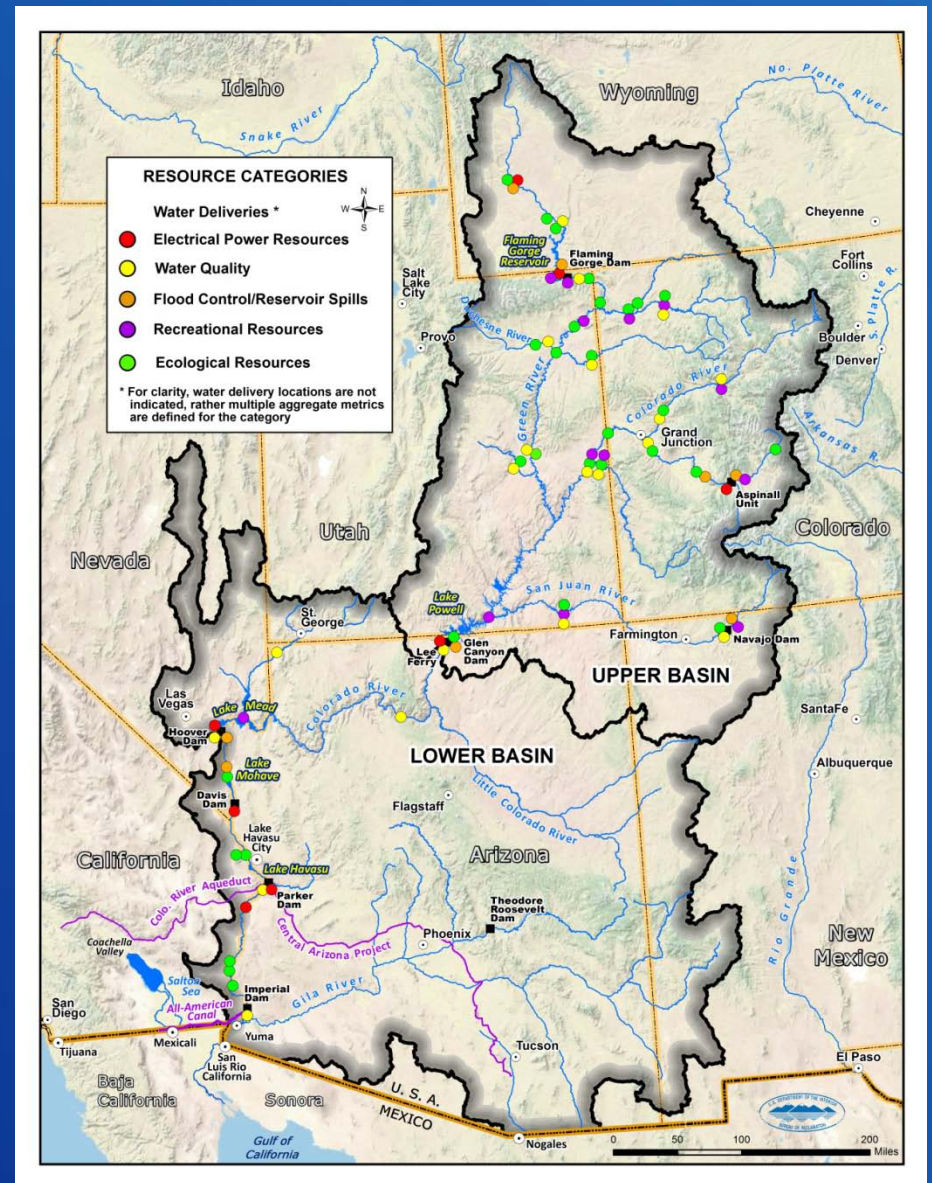
Projected Future Colorado River Basin Water Supply and Demand

- 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



System Reliability Analysis

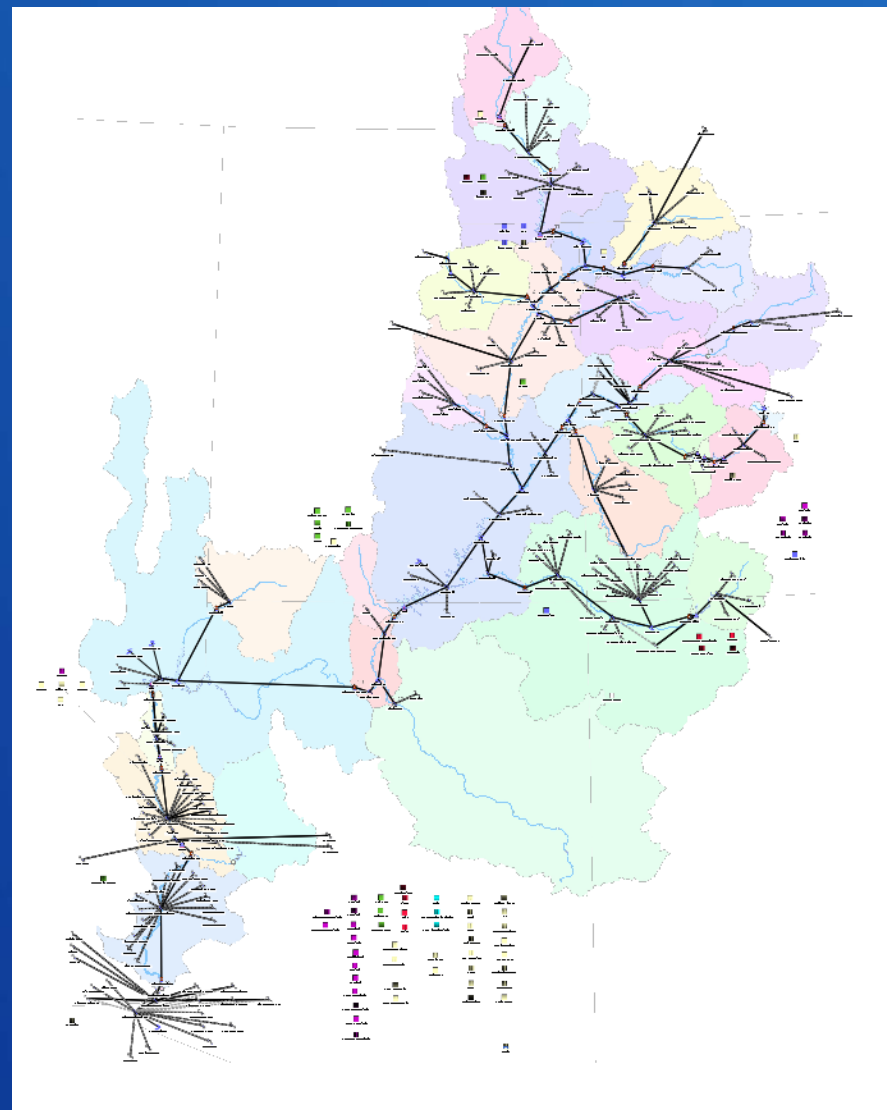
- Simulate the state of the system over the next 50 years for each scenario, with and without options and strategies
- Use metrics and vulnerabilities to quantify impacts to Basin resources
- **Resource Categories**
 - Water Deliveries
 - Electrical Power Resources
 - Water Quality
 - Flood Control
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



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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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System Reliability Analysis

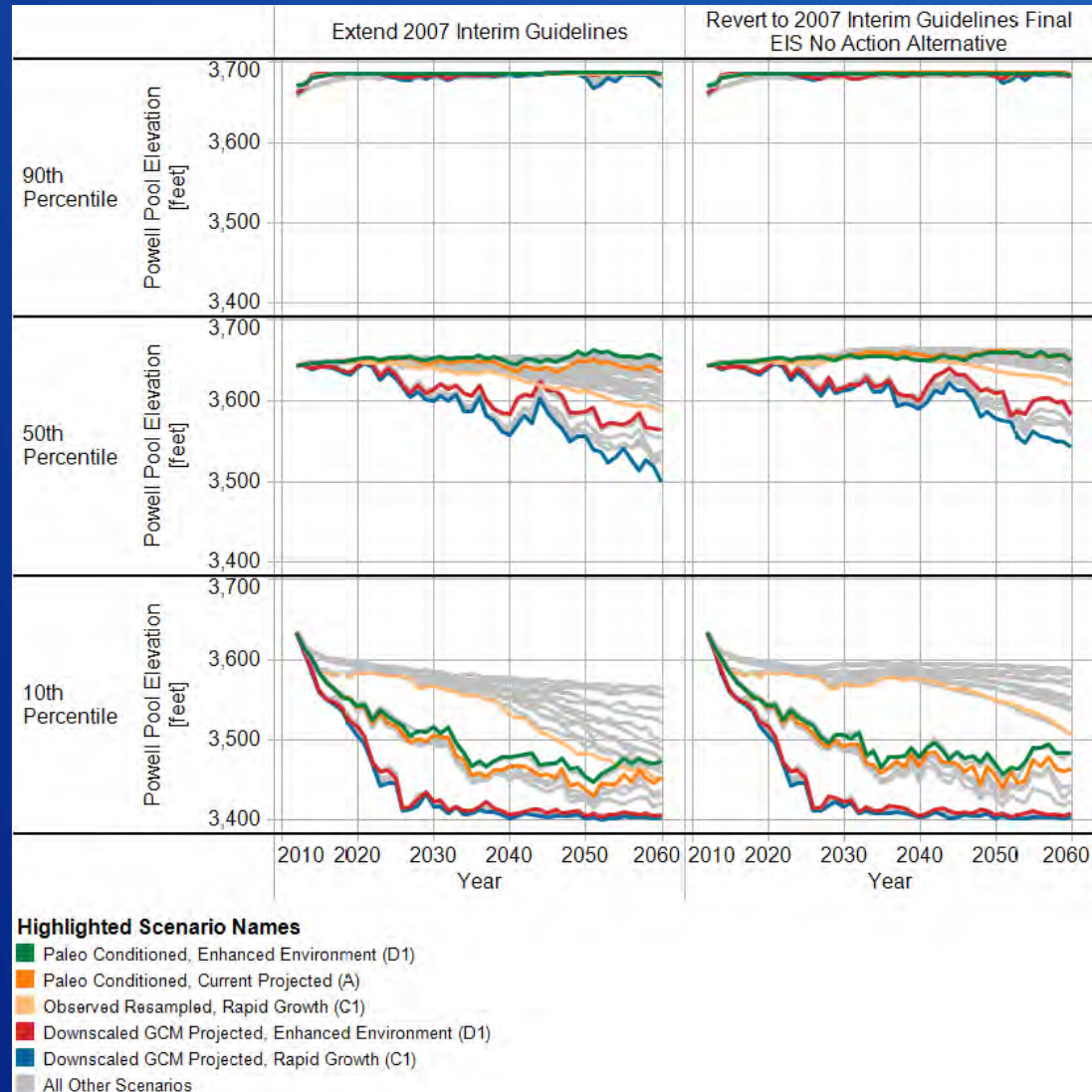
Key Modeling Assumptions

- All combinations ($6 \times 4 = 24$) of supply/demand are modeled both with and without options and strategies
- 2 assumptions for Powell and Mead operations from 2027 - 2060
 - Continuation of the 2007 Interim Guidelines (IG) and revert to Interim Guidelines EIS No Action Alternative
- Upper Basin Shortage
 - Shortages are primarily hydrologic
 - Import deficit water above Powell to ensure 75 MAF over 10 years arrives at Lee Ferry, AZ
 - Report as “Lee Ferry Deficit” and do not assign to any particular state or user
- Lower Basin Shortage
 - For shortages beyond the IG (or No Action), do not assign to any particular state or user
 - Assume Mexico shortage during IG (or No Action) is 16.67% of total Lower Basin shortage

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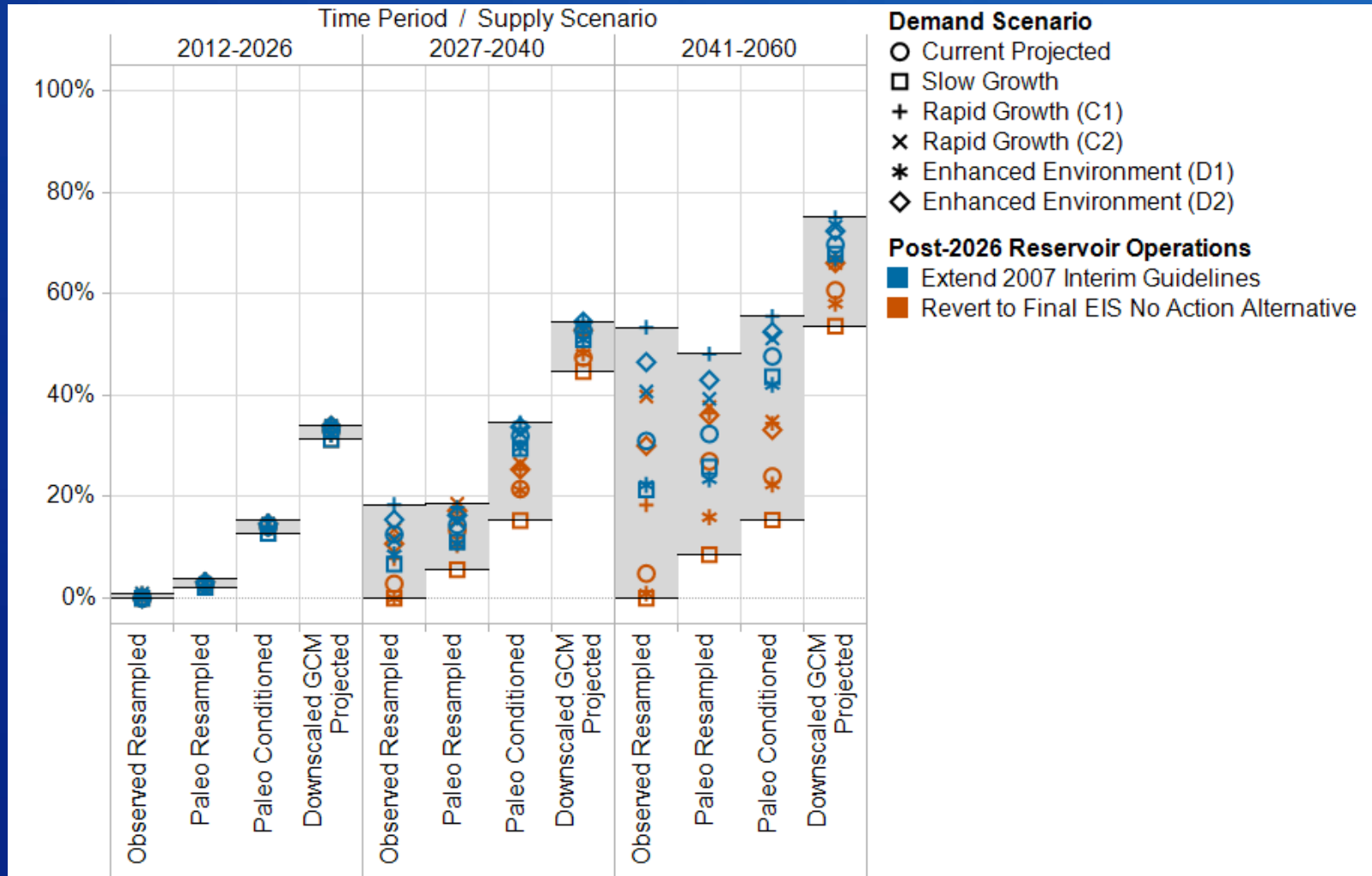
Lake Powell Pool Elevation

10th, 50th, 90th Percentiles by Scenario



Lake Mead Pool Elevation < 1,000 feet

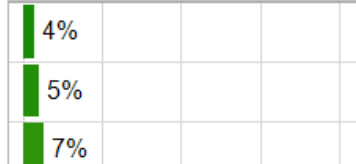
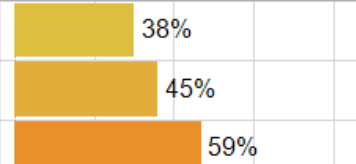
Percent of Traces Vulnerable



Time Period

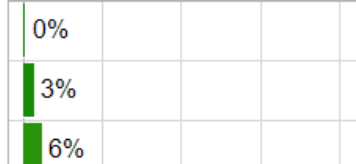
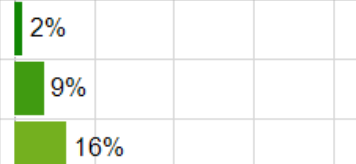
Upper Basin Shortage
(exceeds 25% of
requested depletion in any
one year)

2012-2026
2027-2040
2041-2060



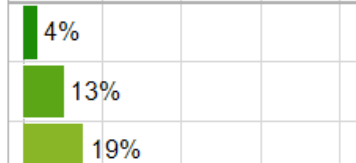
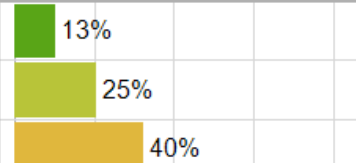
Lee Ferry Deficit
(exceeds zero in any one
year)

2012-2026
2027-2040
2041-2060



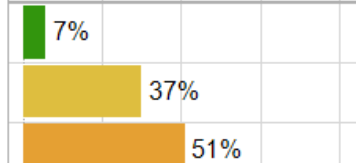
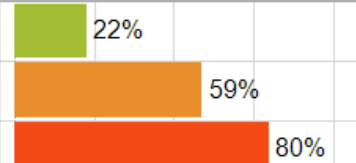
Lake Mead Pool Elevation
< 1,000 feet
(below 1,000 feet in any
one month)

2012-2026
2027-2040
2041-2060



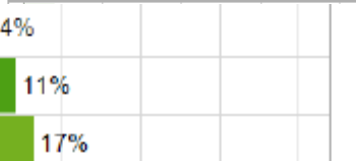
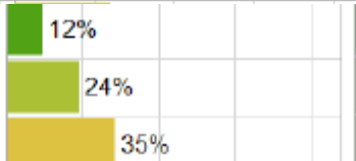
Lower Basin Shortage
(exceeds 1 maf over any
two year window)

2012-2026
2027-2040
2041-2060



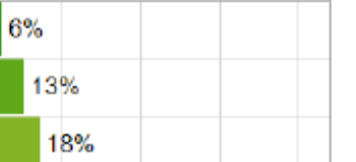
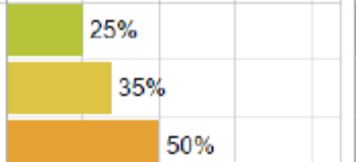
Lake Powell Pool Elevation
< 3,490 feet
(below power pool of 3,490
feet in any one month)

2012-2026
2027-2040
2041-2060



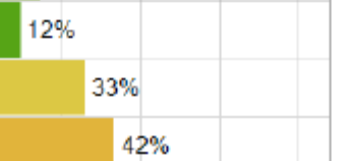
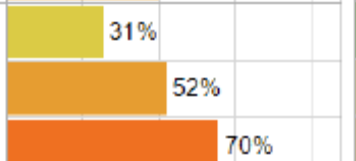
Upper Basin Electrical
Power Generated
(below 4,450 GWh per year
for more than three
consecutive years)

2012-2026
2027-2040
2041-2060



Lake Mead Pool Elevation
< 1,050 feet
(below 1,050 feet in any one
month of any year)

2012-2026
2027-2040
2041-2060



0% 25% 50% 75% 100%

Percent Traces Vulnerable

0% 25% 50% 75% 100%

Percent Years Vulnerable

Water Deliveries and Electrical Power Resources

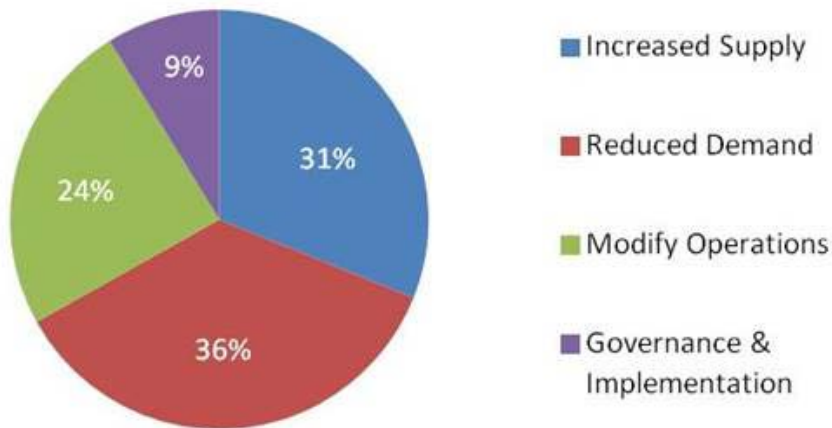
Percent of Traces and Years Vulnerable

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Summary of Options Submitted

- Over 150 options were submitted to the Study from Nov 2011 - Feb 2012
- All options received were included and are reflected in the Study

Distribution of Options Received



Increased Supply – reuse, importation, desalination, etc.

Reduced Demand – M&I and agricultural conservation, etc.

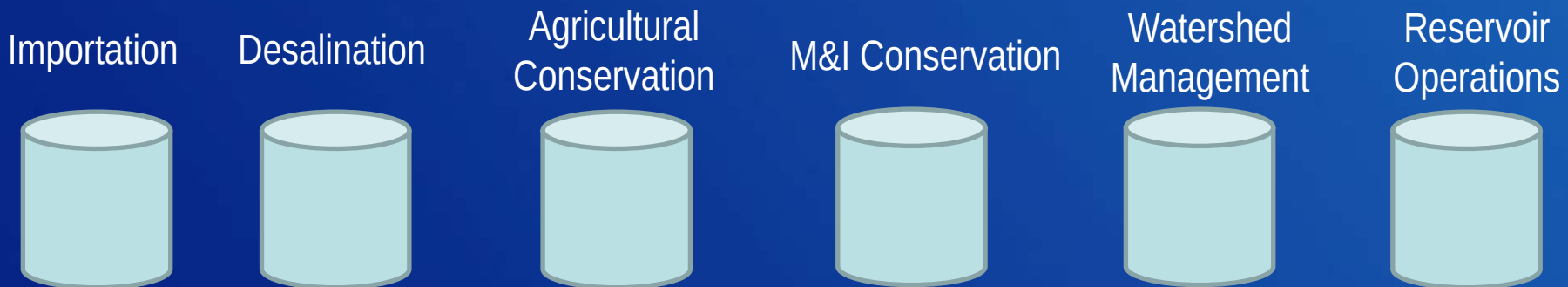
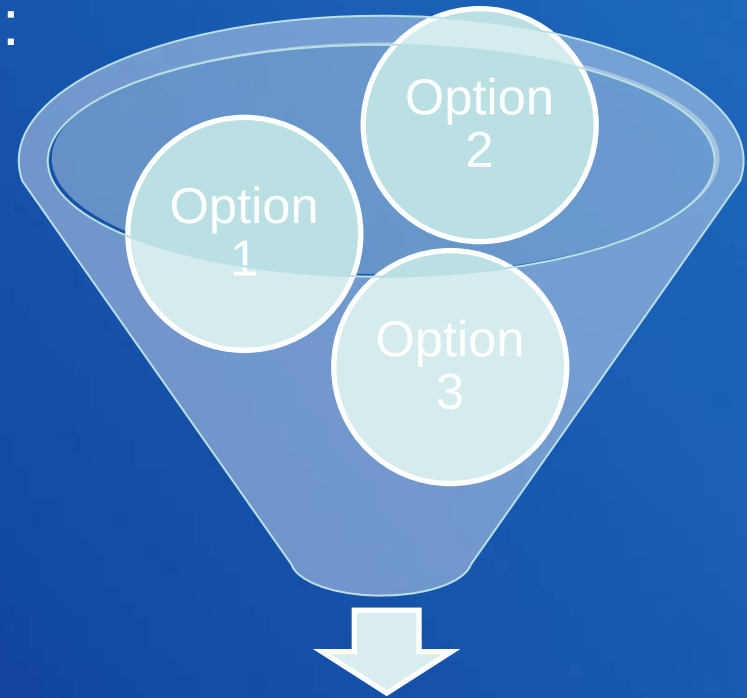
Modify Operations – transfers & exchanges, water banking, etc.

Governance & Implementation – stakeholder committees, population control, re-allocation, etc.

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Organizing and Characterizing Options

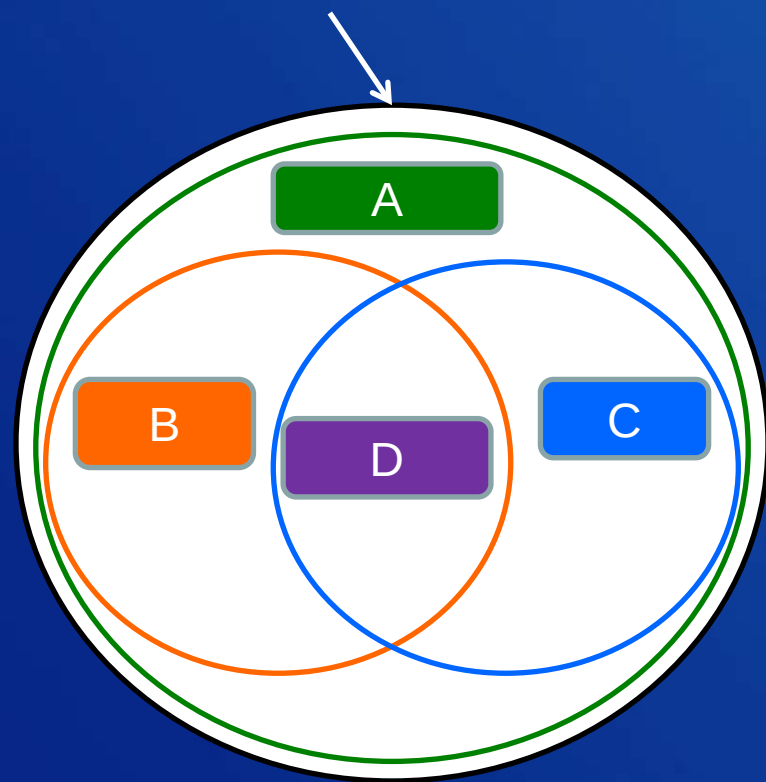
- Characterization Criteria includes:
 - Potential yield
 - Timing of implementation
 - Technical feasibility
 - Cost
 - Environmental impacts/permitting requirements
 - Legal/public policy
 - Risk/uncertainty



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Summary of Portfolios

Universe of options
considered



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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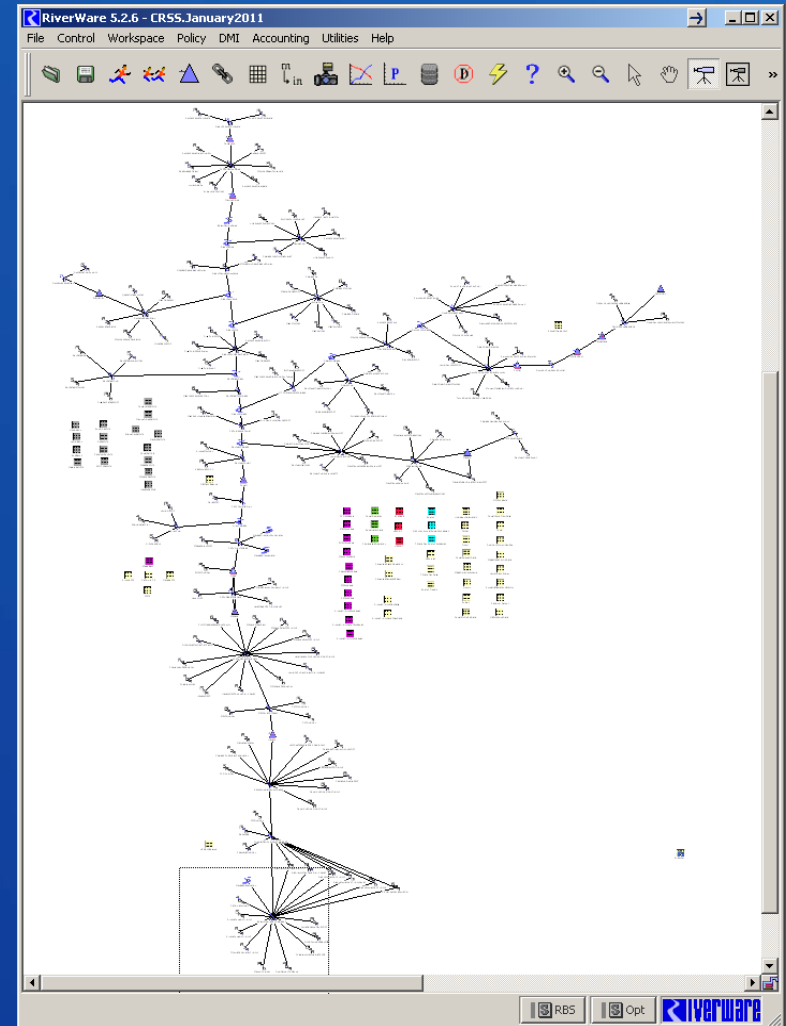
Summary of Option Inclusion Across Portfolios

Option Category	Option Group	Portfolios			
		Portfolio A	Portfolio B	Portfolio C	Portfolio D
Importation	Imports to the Colorado Front Range from the Missouri or Mississippi Rivers	X	X		
Desalination	Gulf of California	X	X		
	Pacific Ocean in California	X	X		
	Pacific Ocean in Mexico	X	X		
	Salton Sea Drainwater	X	X	X	X
	Groundwater in Southern California	X	X	X	X
	Groundwater in the Area near Yuma, Arizona	X	X	X	X
Reuse	Municipal Wastewater	X	X	X	X
	Grey Water	X		X	
	Industrial Wastewater	X	X	X	X
Local Supply	Treatment of Coal Bed Methane-Produced Water	X	X		
	Rainwater Harvesting	X		X	
Watershed Management	Dust Control	X		X	
	Tamarisk Control	X		X	
	Weather Modification	X	X	X	X
M&I Water Conservation	M&I Conservation	X	X	X	X
Agricultural Water Conservation	Agricultural Water Conservation with Transfers	X	X	X	X
Energy Water Use Efficiency	Power Plant Conversion to Air Cooling	X	X	X	X
Water Banking	Upper Basin Water Bank	X		X	

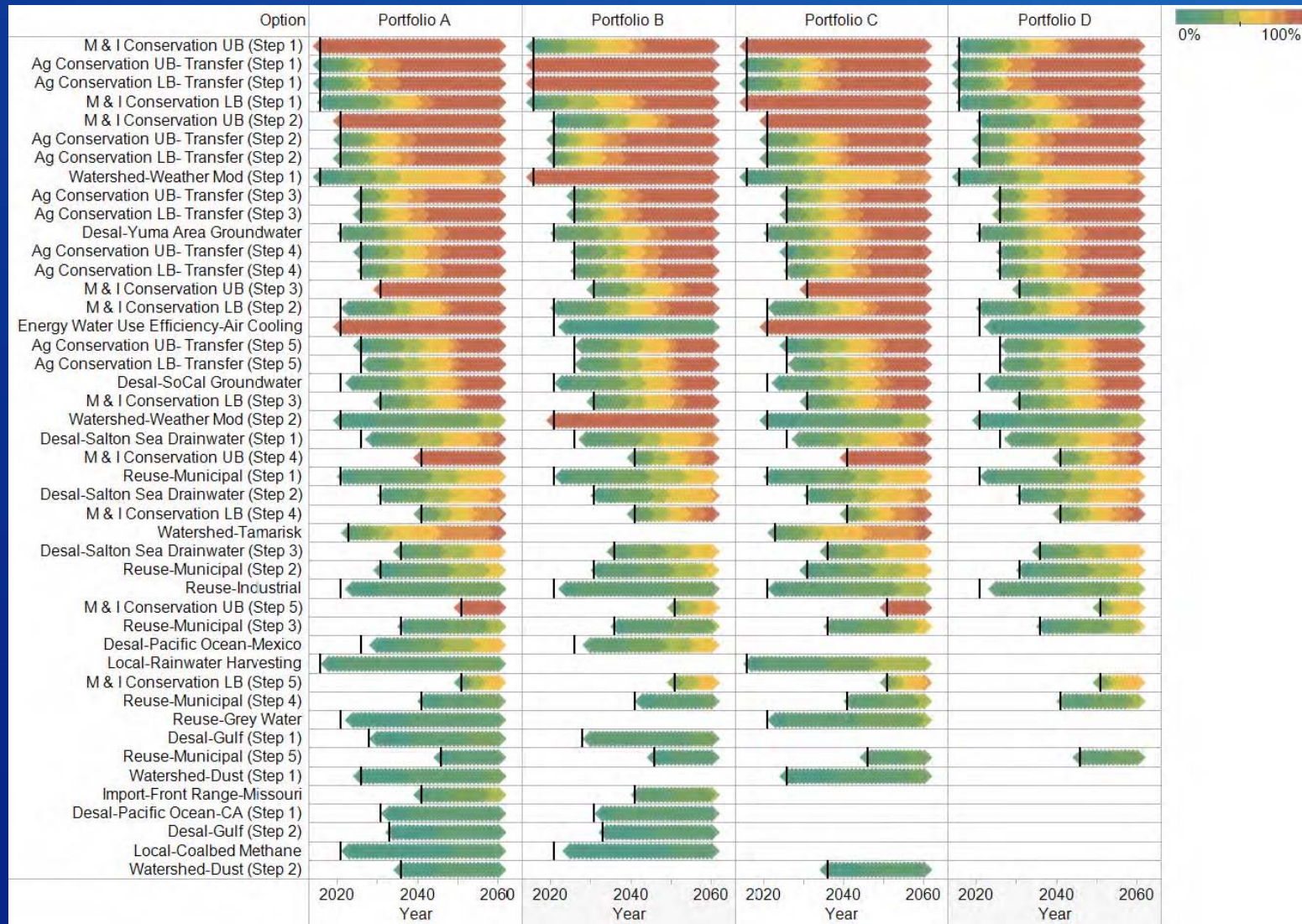
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Analyze Portfolios

- Assess performance for all future supply-demand combined scenarios
- Utilize a dynamic approach to avoid implementing options when not needed
- Summarize portfolio performance
 - Evaluation criteria
 - Metric performance



Frequency of Option Implementation

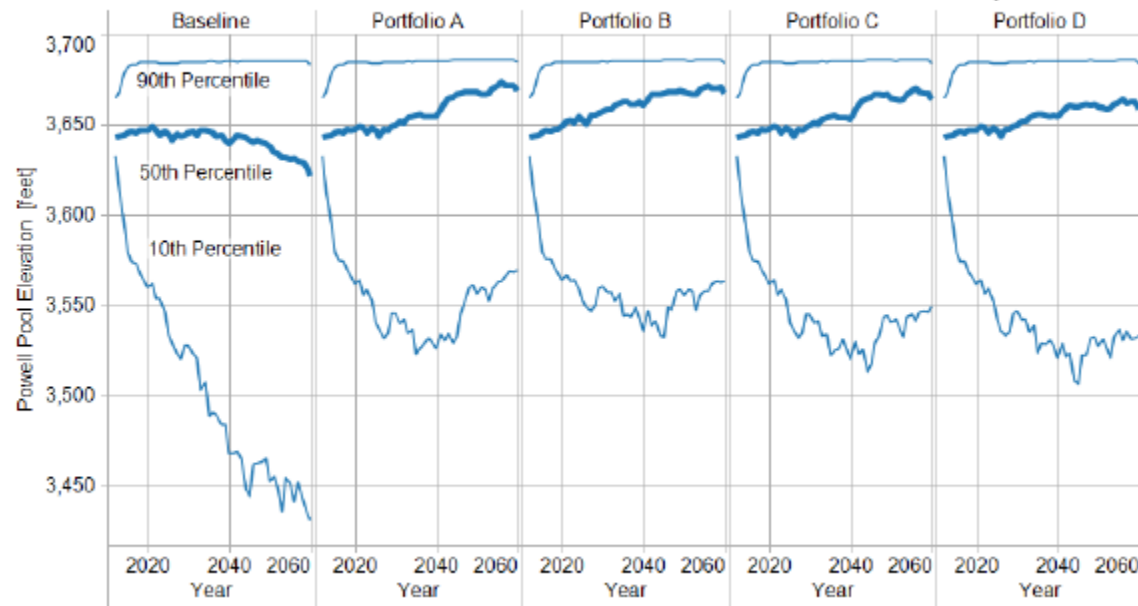


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Lake Powell Pool Elevation *10th, 50th, 90th Percentiles*

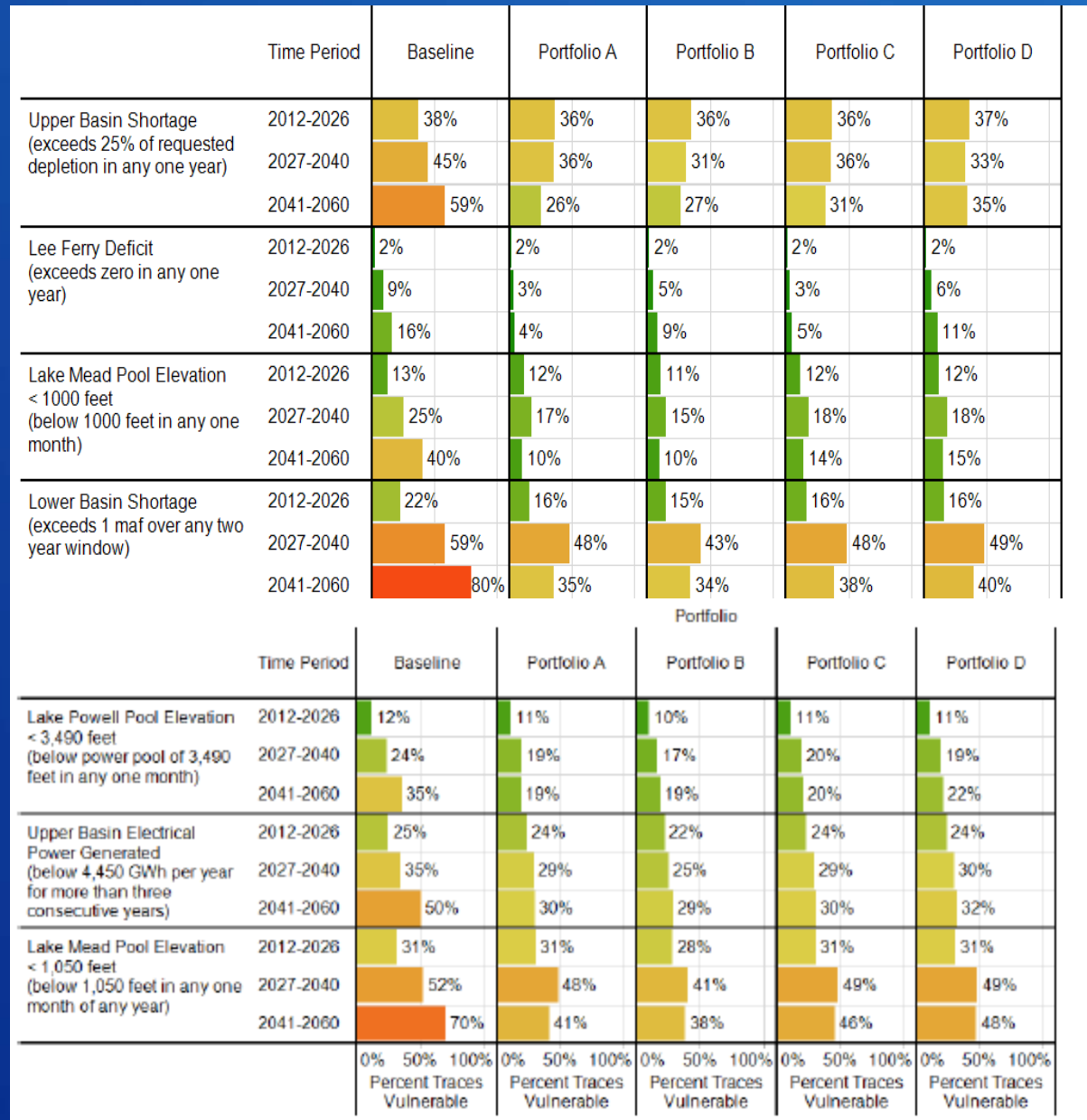
FIGURE G-22

10th, 50th, 90th Percentiles for Lake Powell End-of-December Pool Elevation for the Baseline and Four Dynamic Portfolios



Water Deliveries and Electrical Power Resources

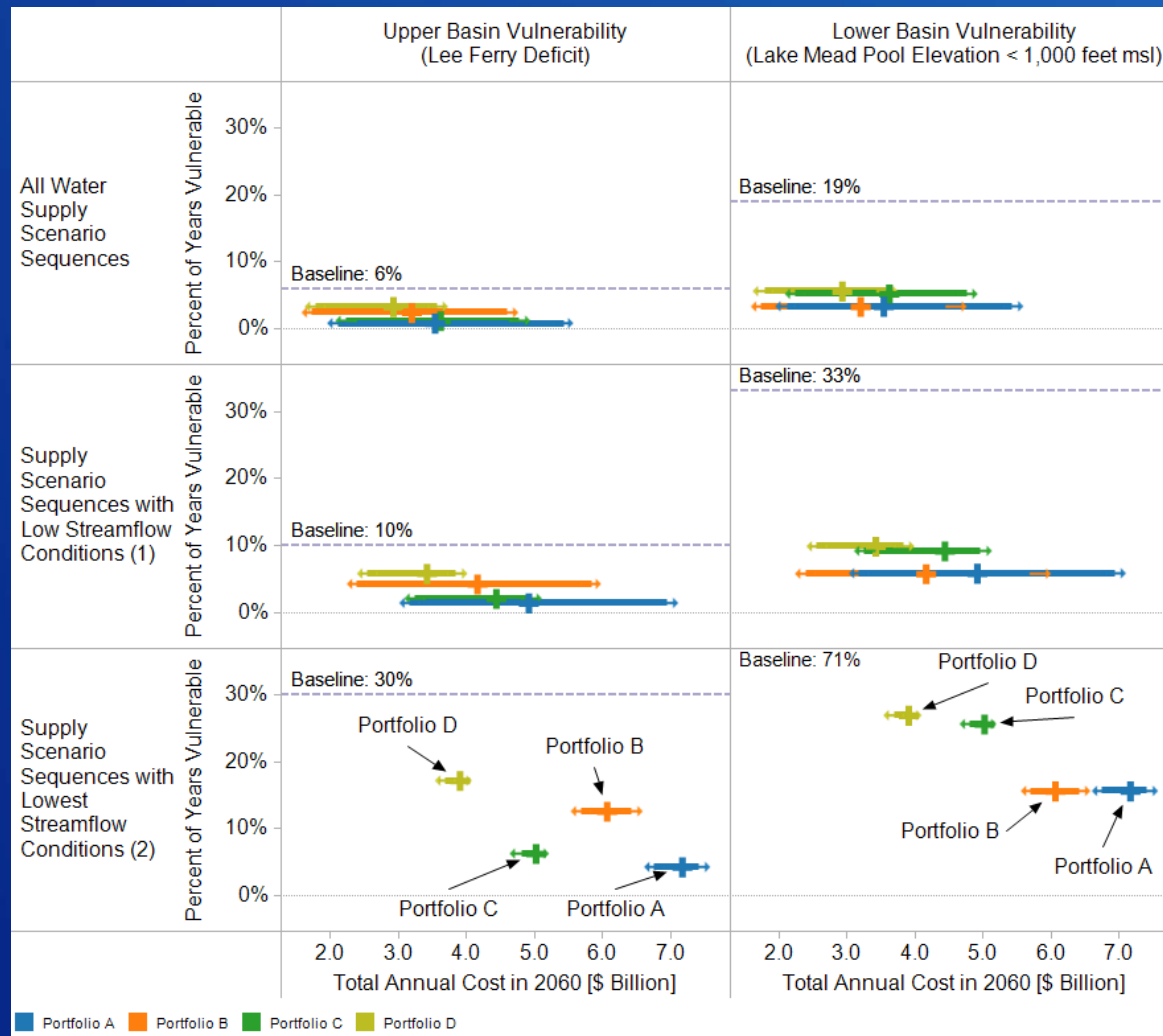
Percent of Traces Vulnerable



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Water Deliveries

Percent years vulnerable vs. cost (2041-2060)



Summary

- The system is vulnerable if we do nothing
- Doing something greatly reduces that vulnerability and makes us more resilient to adverse conditions but does not eliminate vulnerability
- In the near term, all portfolios show that conservation, transfers, and reuse are cost-effective ways to reduce vulnerability
- In the longer term, more tradeoffs emerge to achieve an acceptable level of risk in terms of options, cost, resources, and other implications.

Next Steps

- The Study lists 10 areas where next steps should be taken:
 - M&I and Agricultural Water Conservation and Reuse
 - Water Banks
 - Watershed Management
 - Augmentation
 - Water Transfers
 - Tribal Water
 - Environmental Flows
 - Data and Tool Development
 - Climate Science Research
 - Partnerships
- In early 2013, convened by Reclamation, a workshop will be held to initiate actions to implement next steps

Colorado River Basin Water Supply and Demand Study

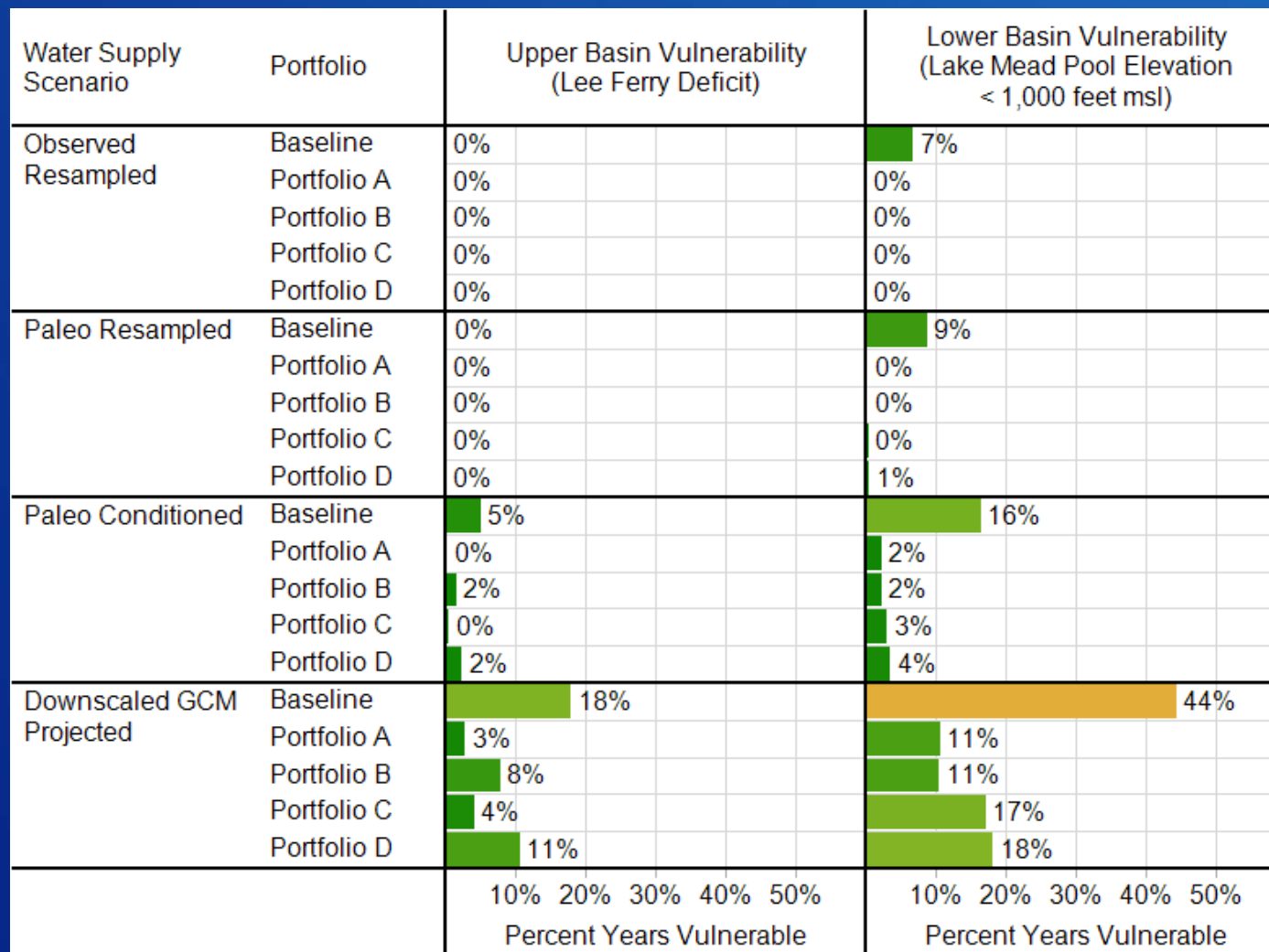
Study Contact Information

- 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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Portfolios Effectiveness at Reducing Vulnerability

Percent of Years Vulnerable from 2041 - 2060



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