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Managing Water in the West

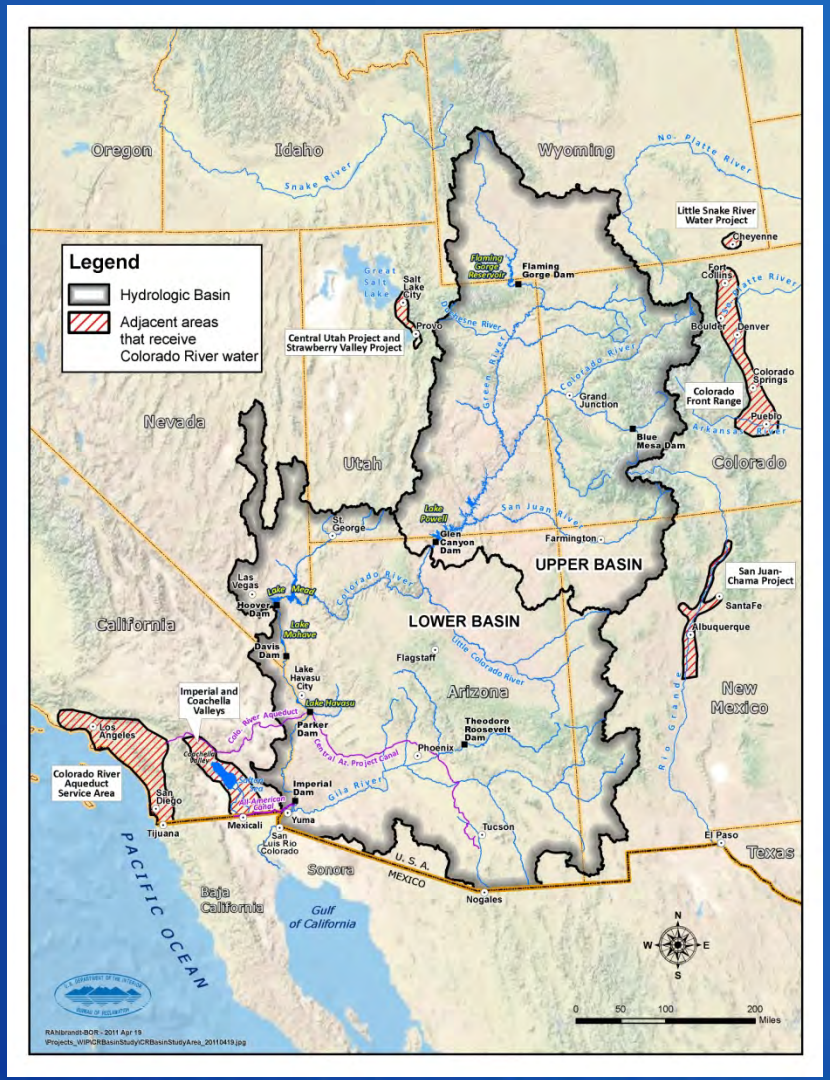
Colorado River Basin Water Supply and Demand Study

Public Outreach Meeting
July 17, 2012

U.S. Department of the Interior
Bureau of Reclamation

Colorado River Basin Water Supply and Demand Study

- Welcome and Introductions
- Study Overview
- Summary of Water Demand Scenario Quantification
- Summary of Options and Strategies to Resolve Imbalances
- Updated Schedule
- Questions and Discussion



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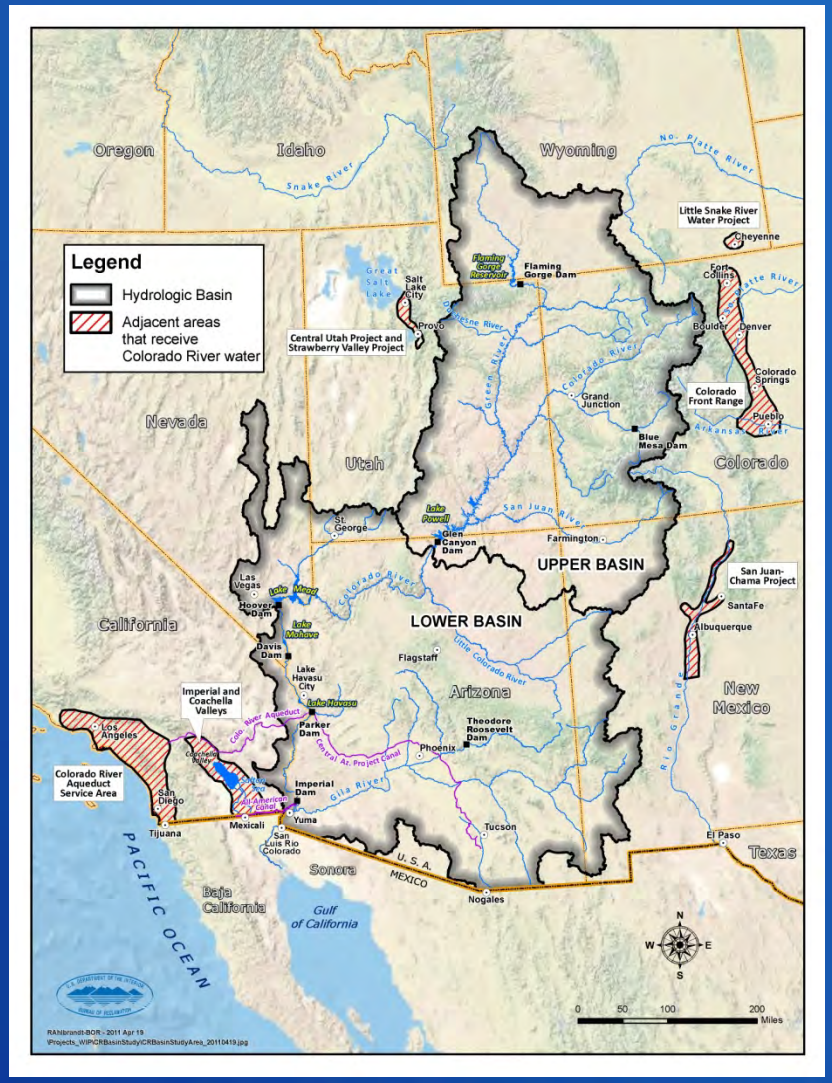
Colorado River Basin Water Supply and Demand Study

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



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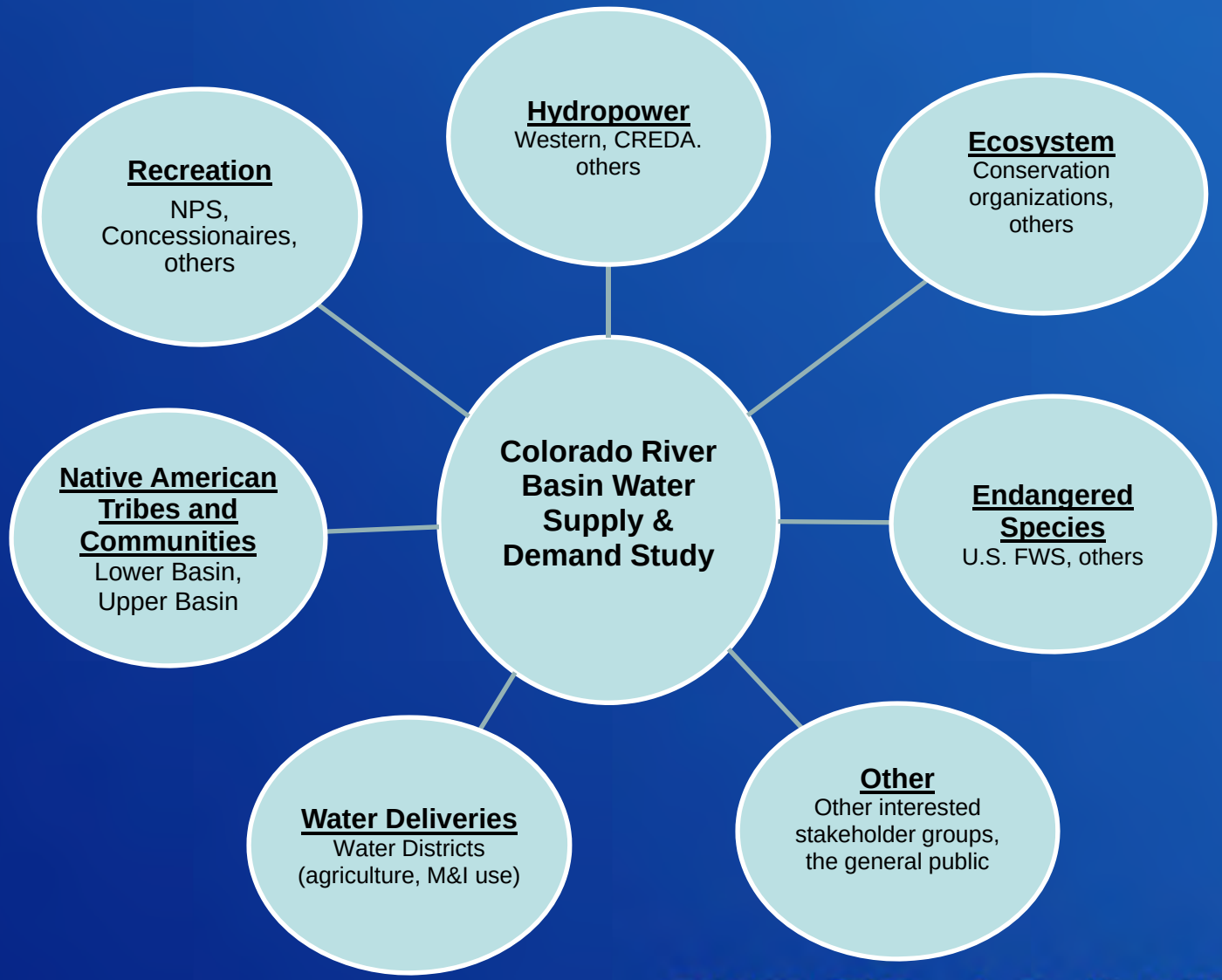
Study Outreach



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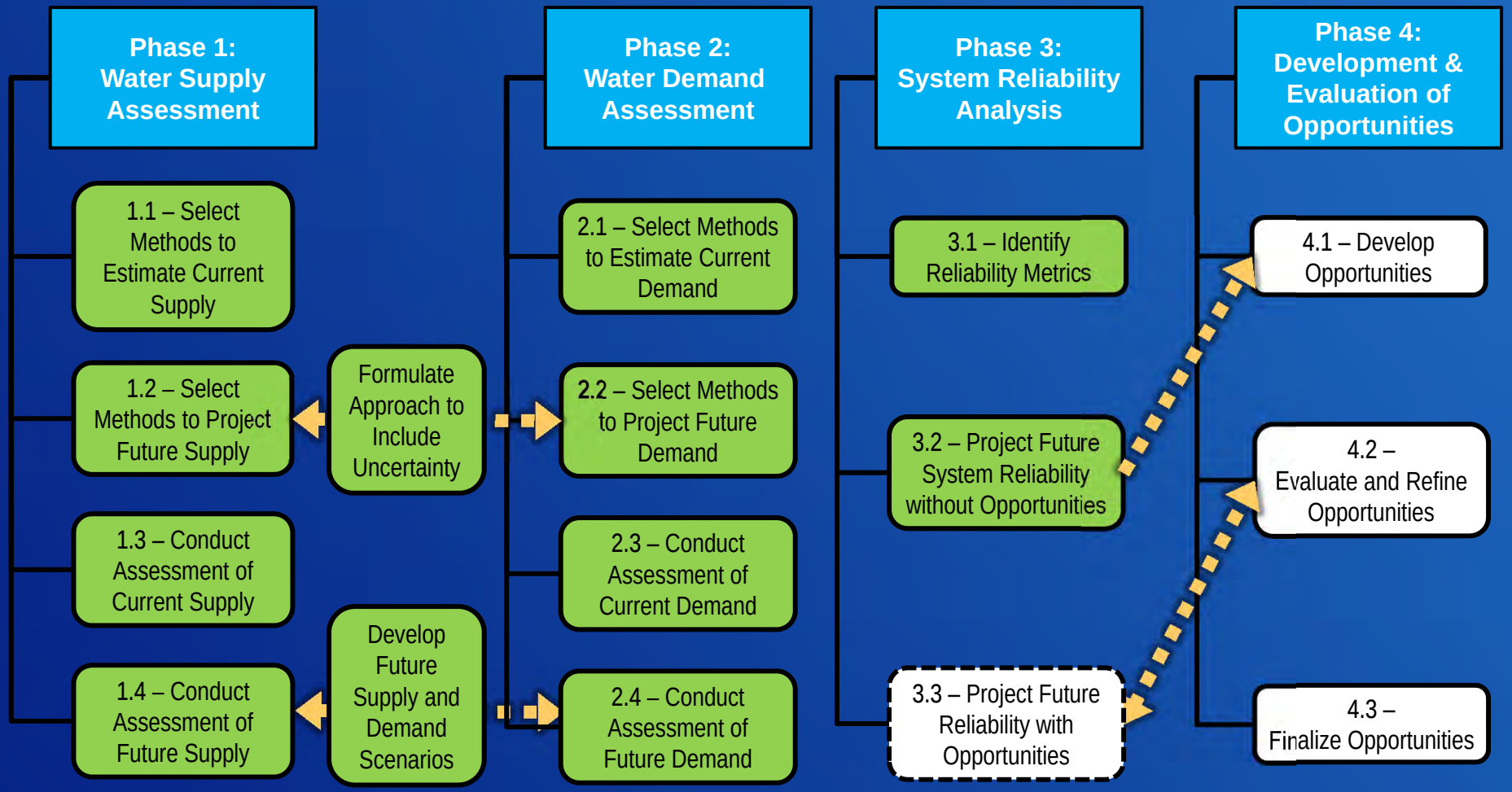
Study Phases and Tasks



Green denotes essentially complete

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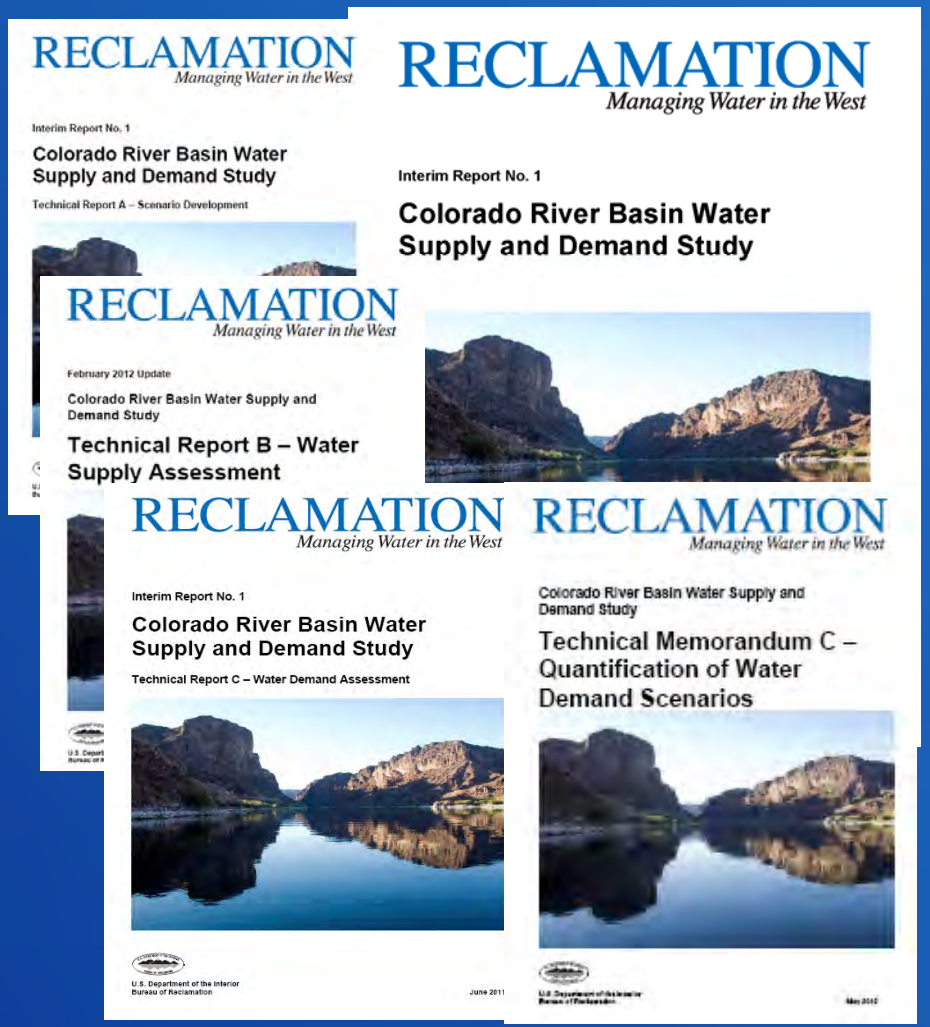
Study Reporting

June 2011	Interim Report No. 1
November 2011	Report to Solicit Input on Options and Strategies
February 2012	Technical Report B – Water Supply Assessment Technical Report D – System Reliability Metrics
April 2012	Options posted to Study website
May 2012	Technical Memo C – Quantification of Water Demand Scenarios
September 2012	Final Study Report



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Colorado River Basin Water Supply and Demand Study

Summary of Water Demand Scenario Quantification

Presenter: James Prairie

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Objective of the Water Demand Assessment

- The objective of the Water Demand Assessment is to assess the quantity and location of current and future water demands in the Study Area[1] to meet the needs of Basin resources
- Basin resources include: municipal and industrial (M&I) use, hydropower generation, recreation, and fish and wildlife habitat

[1]The Study Area is defined as the hydrologic boundaries of the Basin plus the adjacent areas of the Basin States that receive Colorado River water

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Water Demand Assessment Approach

- The Study has taken a scenario planning approach to quantify the range of uncertainty associated with future water demand (and supply) through 2060
- Demand scenarios were originally published in narrative or "storyline" format in *Technical Report C – Water Demand Assessment*
- Demand scenarios have been "quantified" (put numbers to) and were published in a technical memo released in May 2012

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Water Demand Scenarios

Storyline	Scenario	Theme
Current Projected	A	Continuation of growth, development patterns, and institutions follow long-term trends
Slow Growth	B	Slow growth with emphasis on economic efficiency
Rapid Growth	C1 and C2	Economic resurgence (population and energy) and current preferences toward human and environmental values
Enhanced Environment	D1 and D2	Expanded environmental awareness and stewardship with growing economy

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Representation of Water Demands

- The Colorado River supports many important resources
  - Some resources necessitate the “depletion” of the water from the system (e.g., water is used by irrigated agriculture to grow crops)
  - Other resources need the presence of water that does not deplete the system (e.g., flow requirements for native fish)
- A complete representation of all resource needs is required to assess system reliability
  - Withdrawals are represented by demand scenarios
  - Other resource needs are represented through system targets and constraints via system reliability metrics
  - These are described in Technical Report D – System Reliability Metrics
- The largest demands on the river system are for deliveries to agriculture, municipal, and industrial use

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Representation of Water Demands

- Demands presented across category by state and planning area within a state
- Tribal demands developed in coordination with tribes through one-on-one outreach
- Projections for deliveries to Mexico in accordance with the 1944 Treaty with Mexico
- Losses such as those due to reservoir evaporation and phreatophytes are not included in the demand scenarios and will be represented through the system reliability modeling

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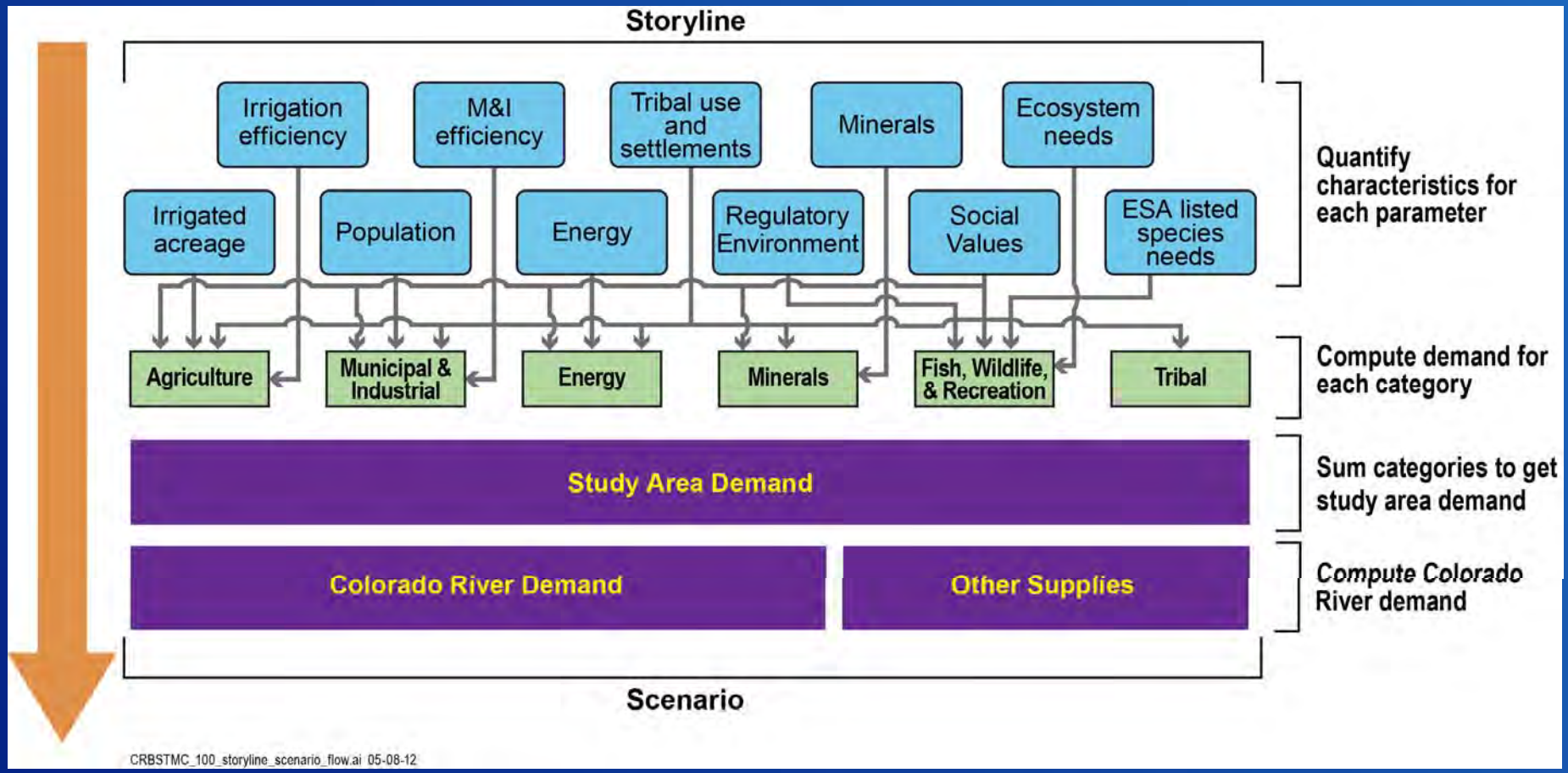
Approach to Quantifying Demand Scenarios



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Demand Categories

Demand Category	Definition
Agriculture	Water used to meet irrigation requirements of agricultural crops, maintain stock ponds, and sustain livestock
Municipal and Industrial	Water used to meet urban and rural population needs, and industrial needs within urban areas
Energy	Water used for energy services and development
Minerals	Water used for mineral extraction not related to energy services
Fish, Wildlife, Recreation	Water used to meet National Wildlife Refuge, National Recreation Area, state park, and off-stream wetland habitat needs
Tribal	Water used to meet tribal needs and settlement of tribal water rights claims

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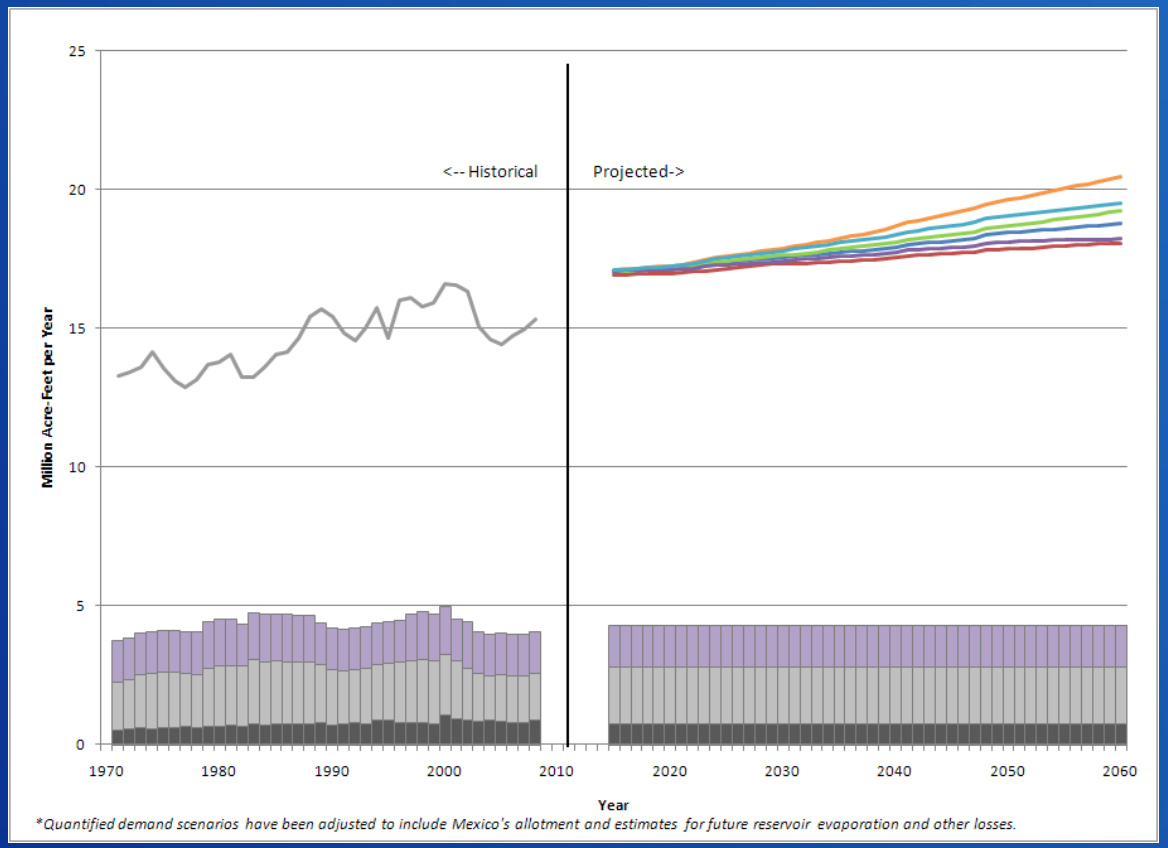
Water Demand Quantification Results

- Projected demands range 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



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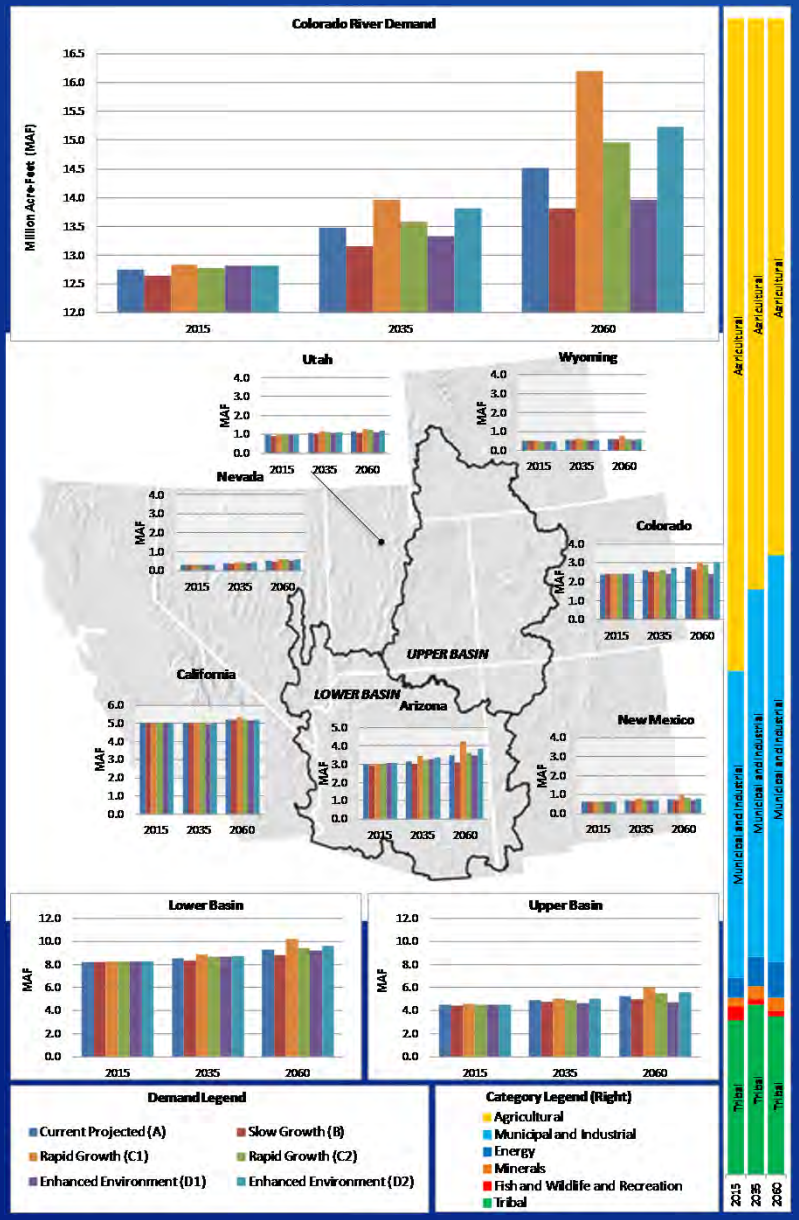
Water Demand Quantification Results



- Parameters driving demands include population, per capita water use, and irrigated acreage and are projected to change from 2015 to 2060:
  - Population increase from about 40 million people by 23% (49 million) to 91% (77 million)
  - Per capita water use decrease by 7% to 19%
  - Irrigated acreage decrease from about 5.5 million acres by 6% (5.2 million) to15% (4.6 million)

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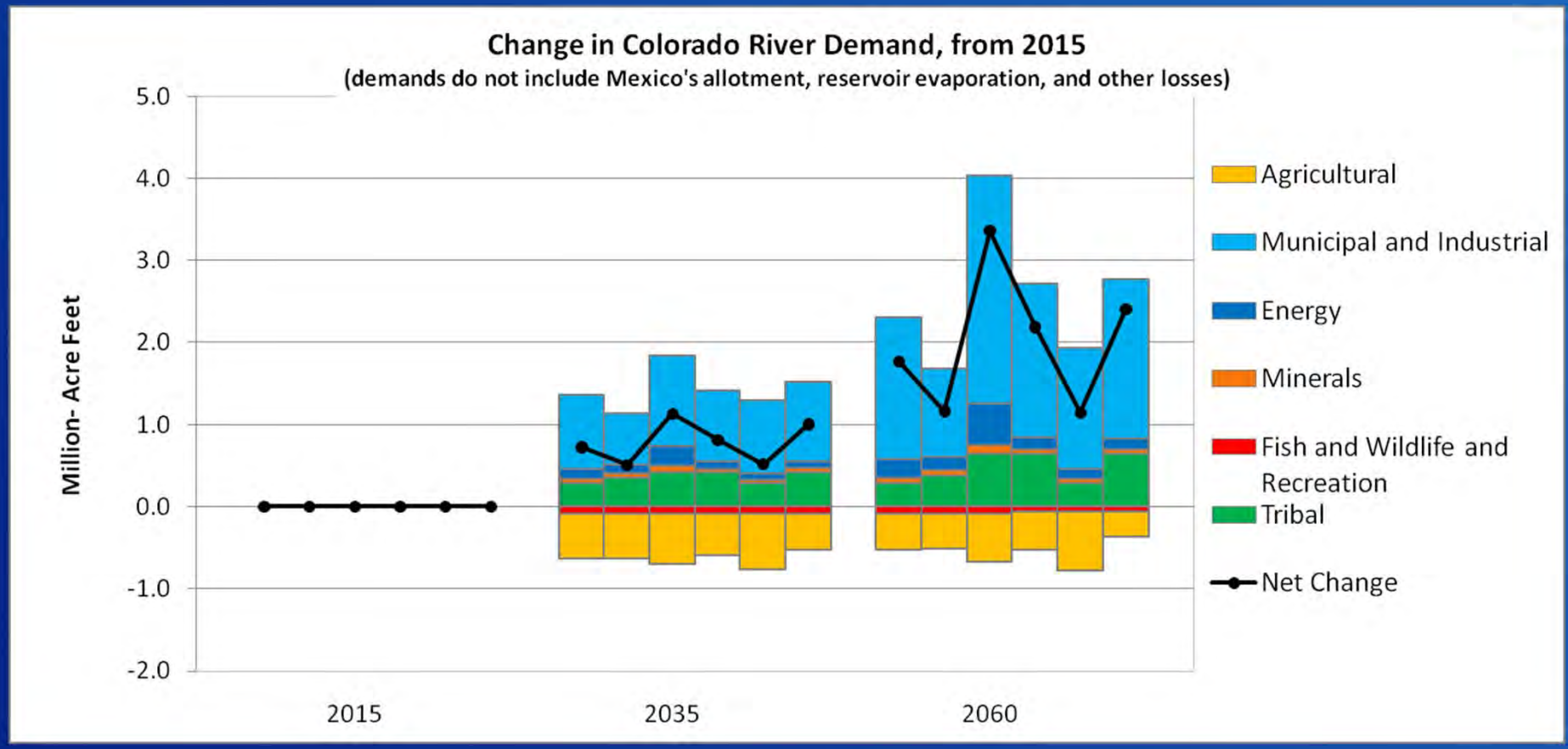
Projected Changes in Demand Categories



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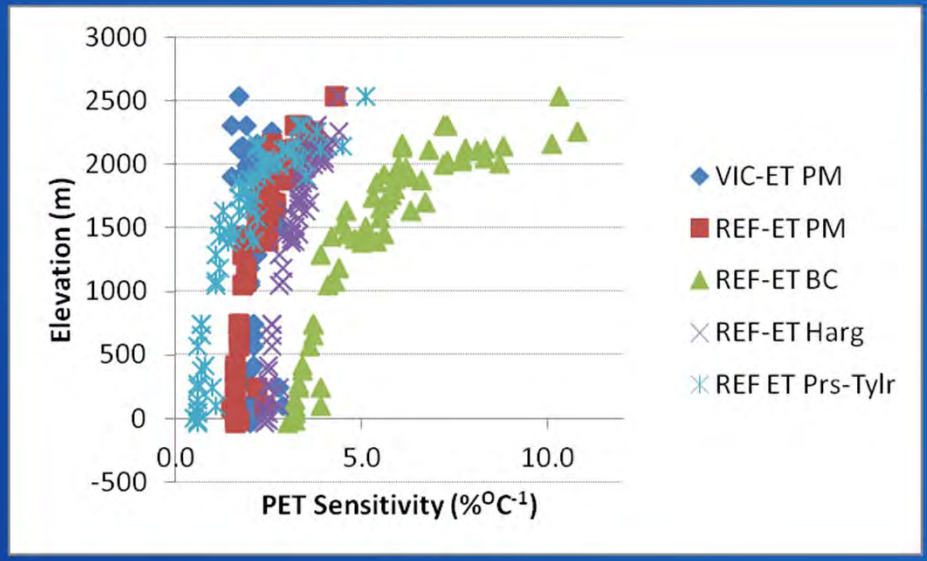
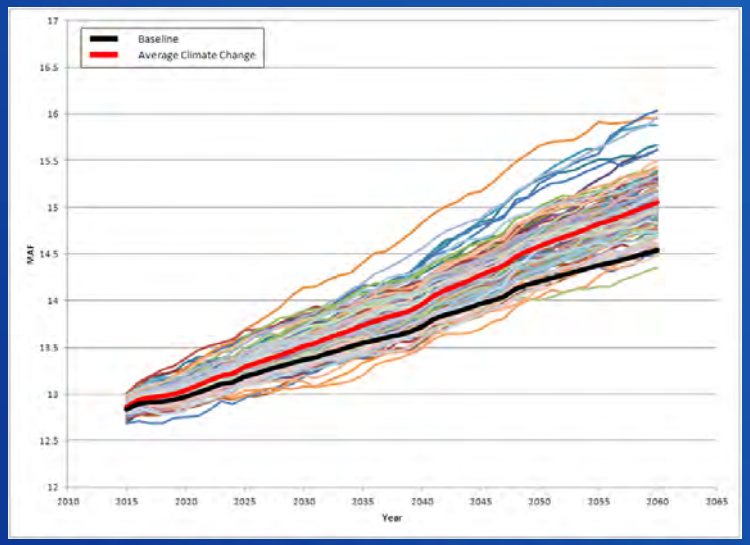
Climate Change Effects on Water Demand

- Potential ET is sensitive to warming with greater sensitivity at higher elevations
- Agricultural, outdoor M&I, phreatophyte, and reservoir evaporation demands are influenced
- Increase in demand:
  - ~250 kaf in 2015
  - ~800 kaf in 2060





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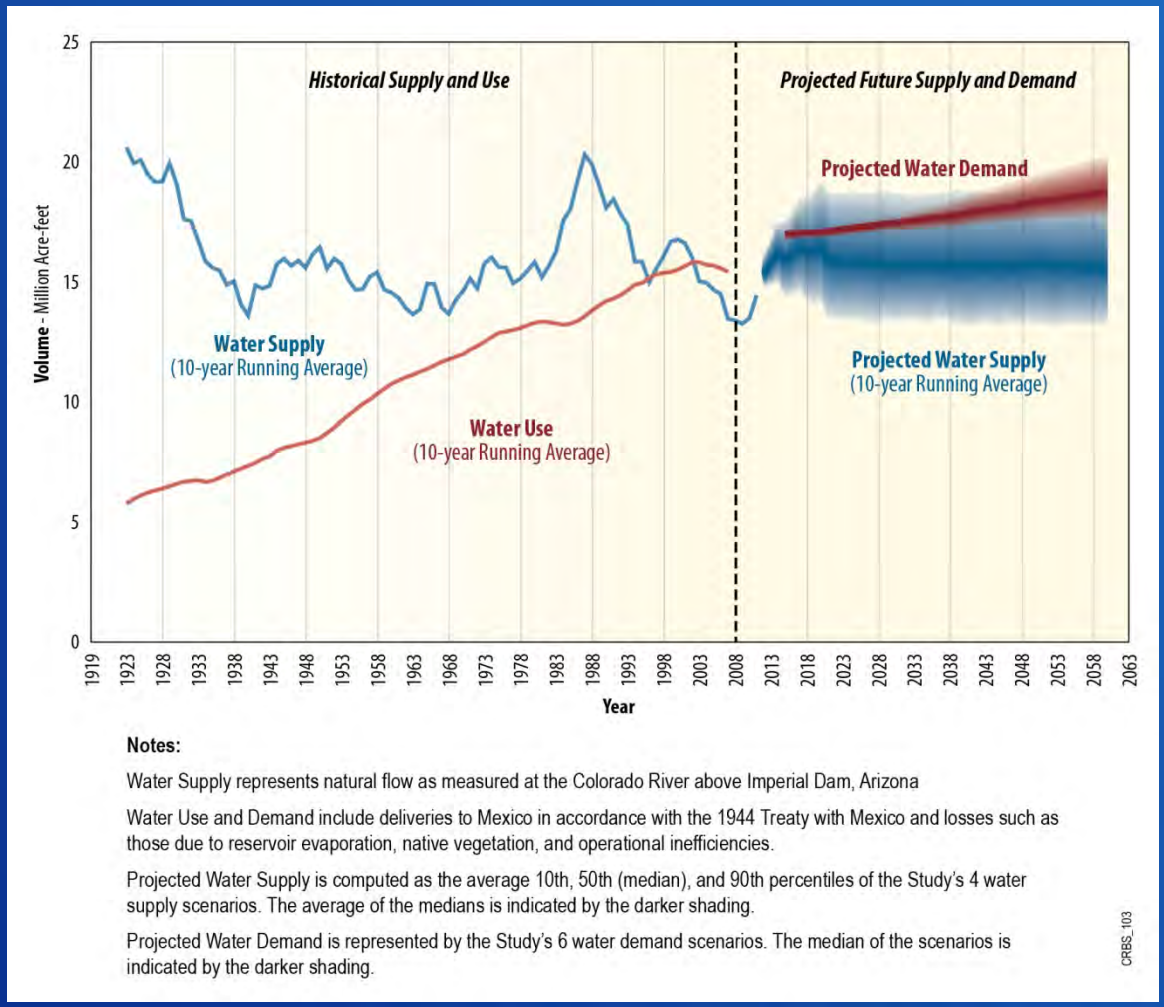
Projected Future Colorado River Basin Water Supply and Demand

- Average supply-demand imbalances by 2060 are approximately 3.5 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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Next Steps

- Combine demand scenarios with supply scenarios to project future reliability of the system to meet the needs of Basin resources
- Measure system reliability through system reliability metrics
- Assess effectiveness of various options and strategies across demand and supply scenarios combinations

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Colorado River Basin Water Supply and Demand Study

Summary of Options & Strategies to Resolve Imbalances

Presenter: Armin Munevar and David Groves

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Objective of the Options and Strategies Phase

- The objective of the Options and Strategies phase is to identify, describe, and evaluate options and strategies that can be implemented to address the imbalances between supplies and demands
- The Study is intended to explore a broad range of options and will not result in the selection of a particular proposed option or set of options

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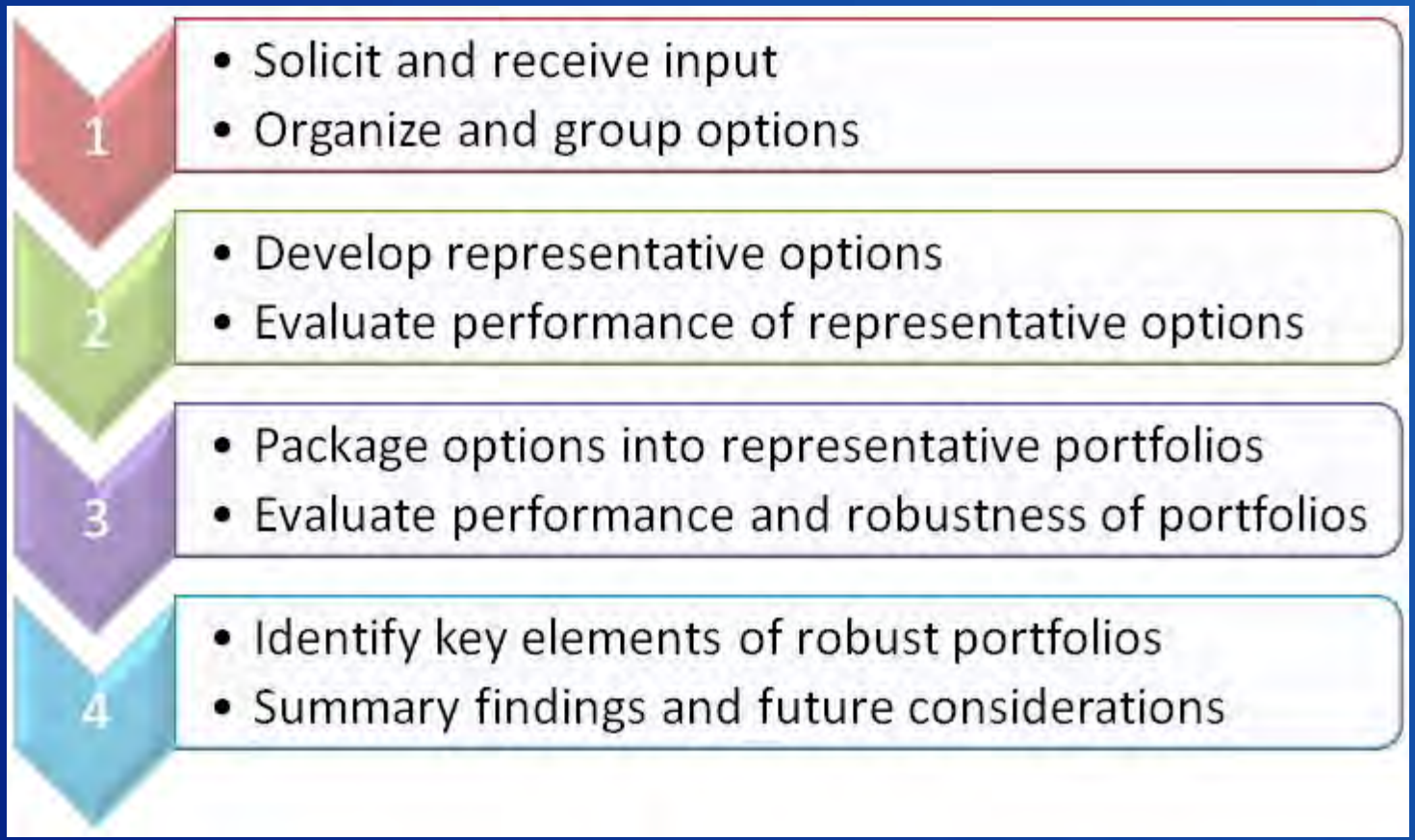
Approach for Developing & Evaluating Options & Strategies



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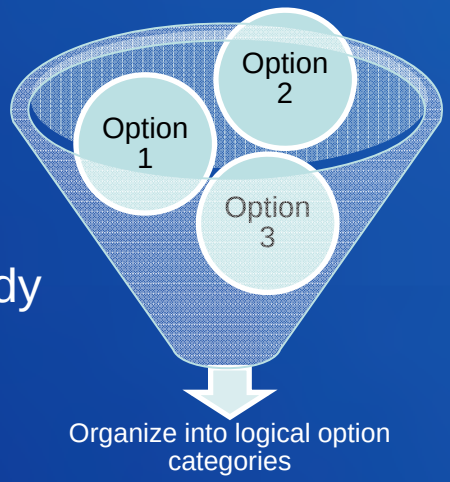
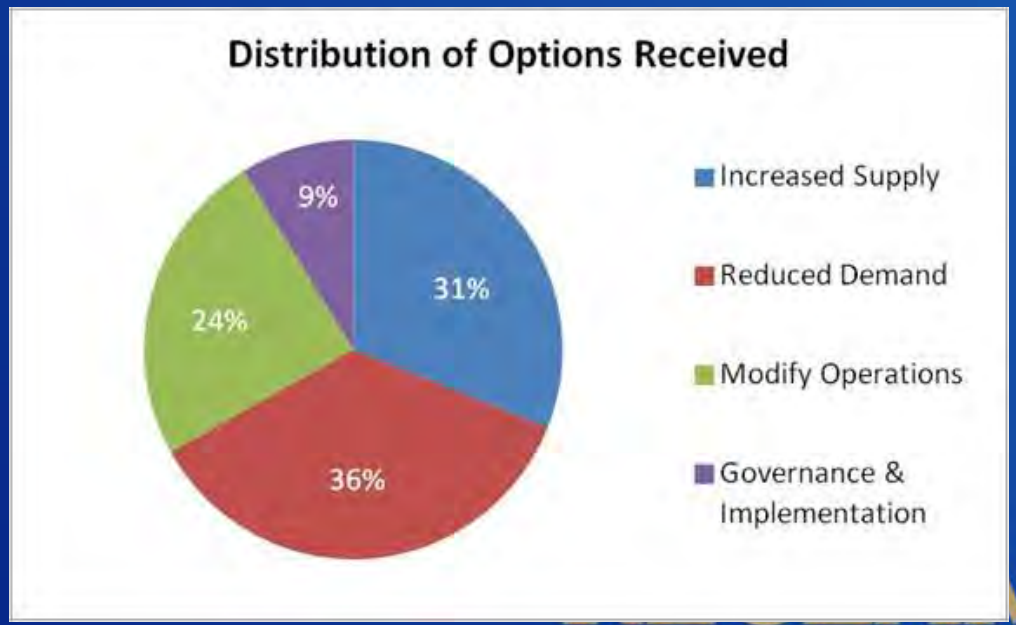
Organizing and Categorizing Options

- Over 150 options were submitted to the Study and have been posted to the Study website in their original form



- Options grouped into like categories

Increase Supply | Decrease Demand | Modify Operations | Governance & Implementation



Increase Supply Options

- **Importation**
  - River imports to Front Range
  - River imports to Green River
  - Ocean imports to southern California
- **Desalination**
  - Pacific Ocean
  - Gulf of California
  - Brackish groundwater
  - Yuma area
  - Salton Sea drainwater
- **Reuse**
  - Municipal wastewater
  - Graywater recycling
  - Industrial wastewater recycling
- **Local Supply**
  - Coalbed methane produced water
  - Non-tributary groundwater
  - Rainwater harvesting
- **Watershed Management**
  - Brush management
  - Forest management
  - Dust mitigation
  - Tamarisk control
  - Weather modification

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Reduce Demand Options

- **M&I Conservation**
  - Indoor residential
  - Outdoor residential
  - Commercial, industrial, and institutional
  - Parks and golf courses
- **Agricultural Water Conservation**
  - Conveyance system efficiency
  - On-farm irrigation efficiency
  - Improved irrigation management
  - Controlled environment agriculture
  - Reductions in consumptive use
- **Energy Water Use Efficiency**
  - Demand management at thermoelectric power plants
- **System Evaporation Reduction**
  - Covers for canals and lakes
  - System reoperation for preferential storage

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Modify Operations Options

- System Operation
  - Reservoir re-operation
  - Surface or groundwater storage
  - Hydropower optimization
- Water Banking
  - Upper Basin
  - Lower Basin
  - Individual state-based banks
- Transfers & Exchanges
  - Guided water markets
  - Agricultural-urban water transfers

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Governance and Implementation Options

- Governance, Implementation, Finance
  - Growth control, new governing processes, funding of basin-wide programs
- Data and Information
  - Additional and enhanced monitoring of both streamflow and Upper Basin water use
- Tribal Water Use and Transfers
  - Resolution of water claims, increased tribal water use, participation in water programs
- Others
  - Reallocation of state apportionments, prohibit new large-scale diversions, dedicate water to specific interests

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Option Characterization Approach

- Characterization done at an “appraisal” level
- Options characterized quantitatively or qualitatively
- Quantitative characterization entails
  - Evaluation of characterization criteria:
  - Assignment of A through E based on criteria assessment
- Qualitative characterization includes discussion of potential opportunities and constraints, including legal and regulatory constraints
  - Most Governance and Implementation options have been characterized qualitatively

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Option Characterization Criteria and Assumptions

Characterization Criteria Include:

- Potential yield
- Timing of implementation
- Technical feasibility and reliability
- Cost
- Energy source and needs
- Permitting requirements
- Legal/public policy
- Implementation risk/uncertainty

Overarching Assumptions

- Applied Basin-wide approach, where possible
- Considered ultimate and phased implementations
- Timing and permitting considered
- Costs include capital, O&M, and life-cycle costs ($/AF)
- Energy needs assessed (kWh/AF)
- Other impacts include qualitative assessment of impacts within and outside of basin

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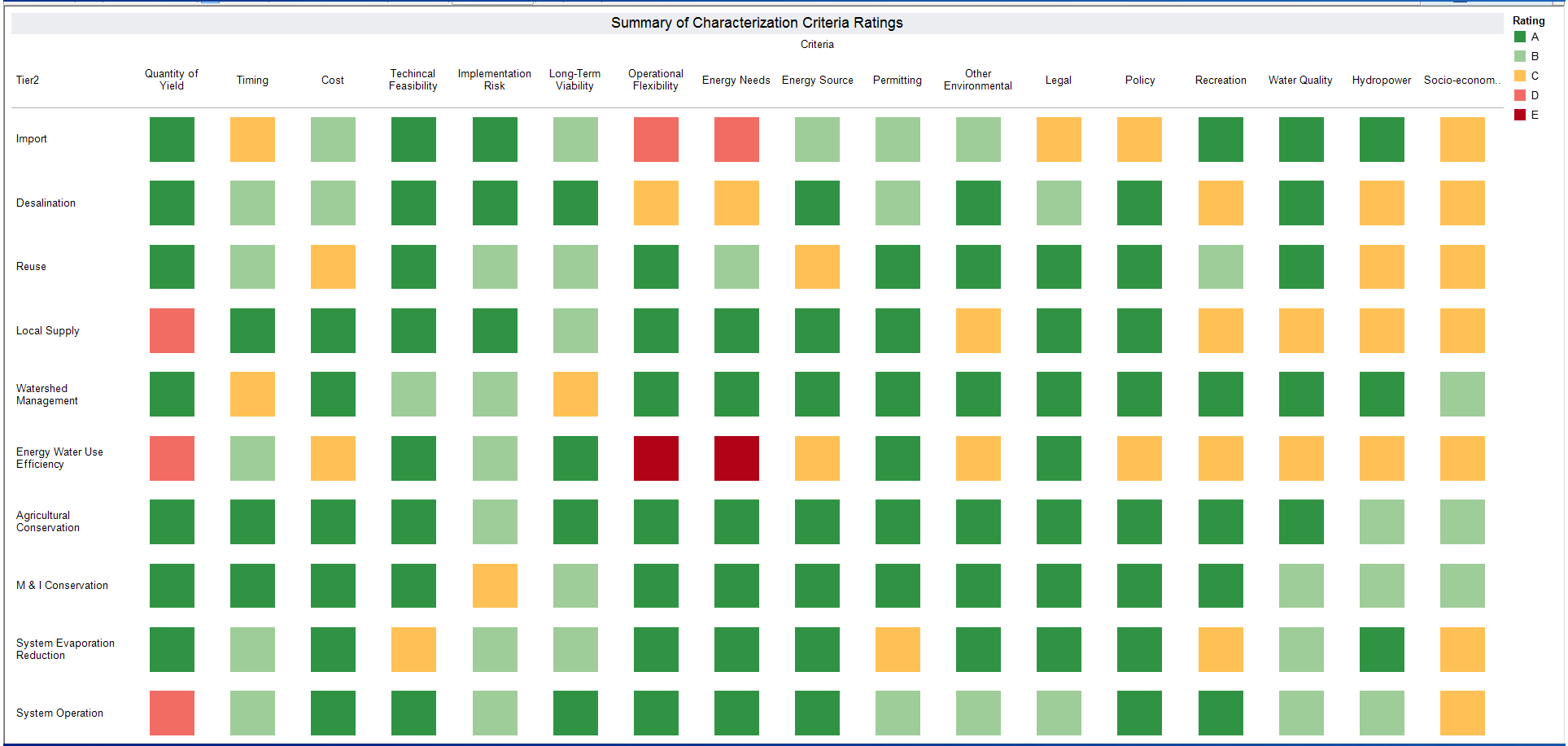
Example Characterization Results



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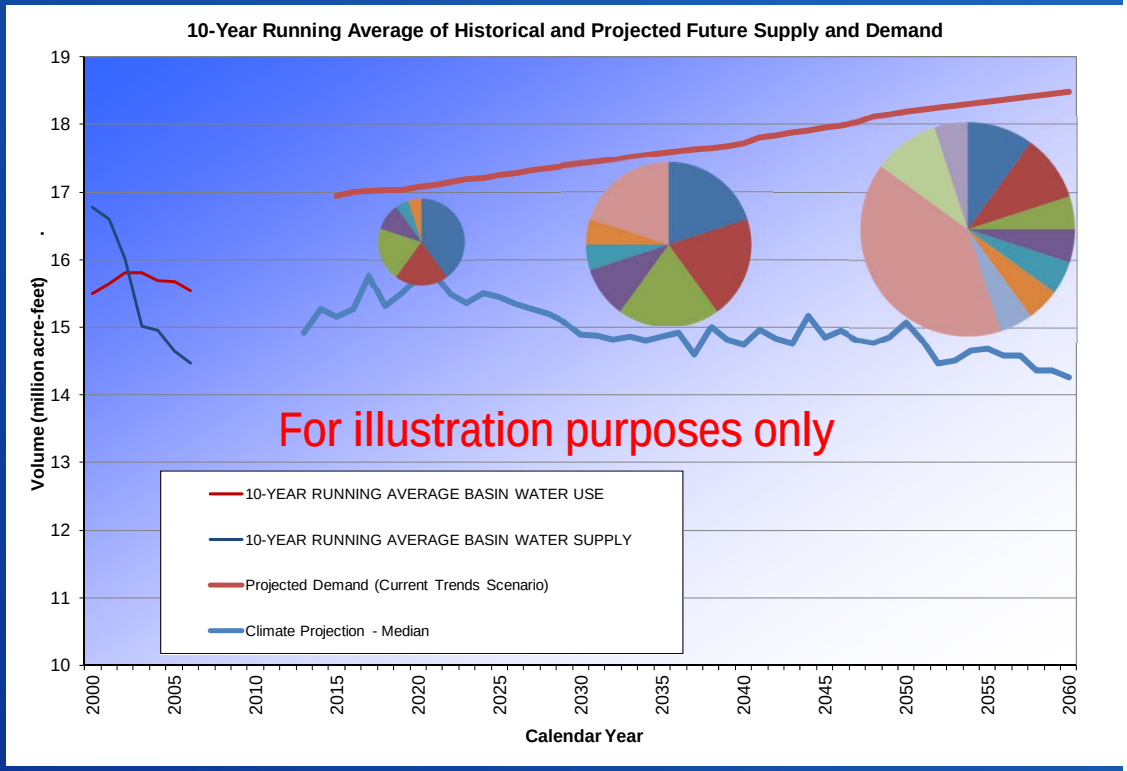
Portfolio Development

- "Portfolios", or unique combinations of options, implement a particular strategy
- Characterization criteria drive inclusion of options
- Performance of portfolios assessed for all future supply-demand combined scenarios



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A Portfolio Implements a Strategy by Defining the Order and Timing of Options

A) Which Options Are to Be Used?

List of options by priority:

- Ranked by cost-effectiveness
- Adjusted by option characteristics

B) What Conditions Trigger Options?

Implementation rules:

- External conditions that trigger option implementation

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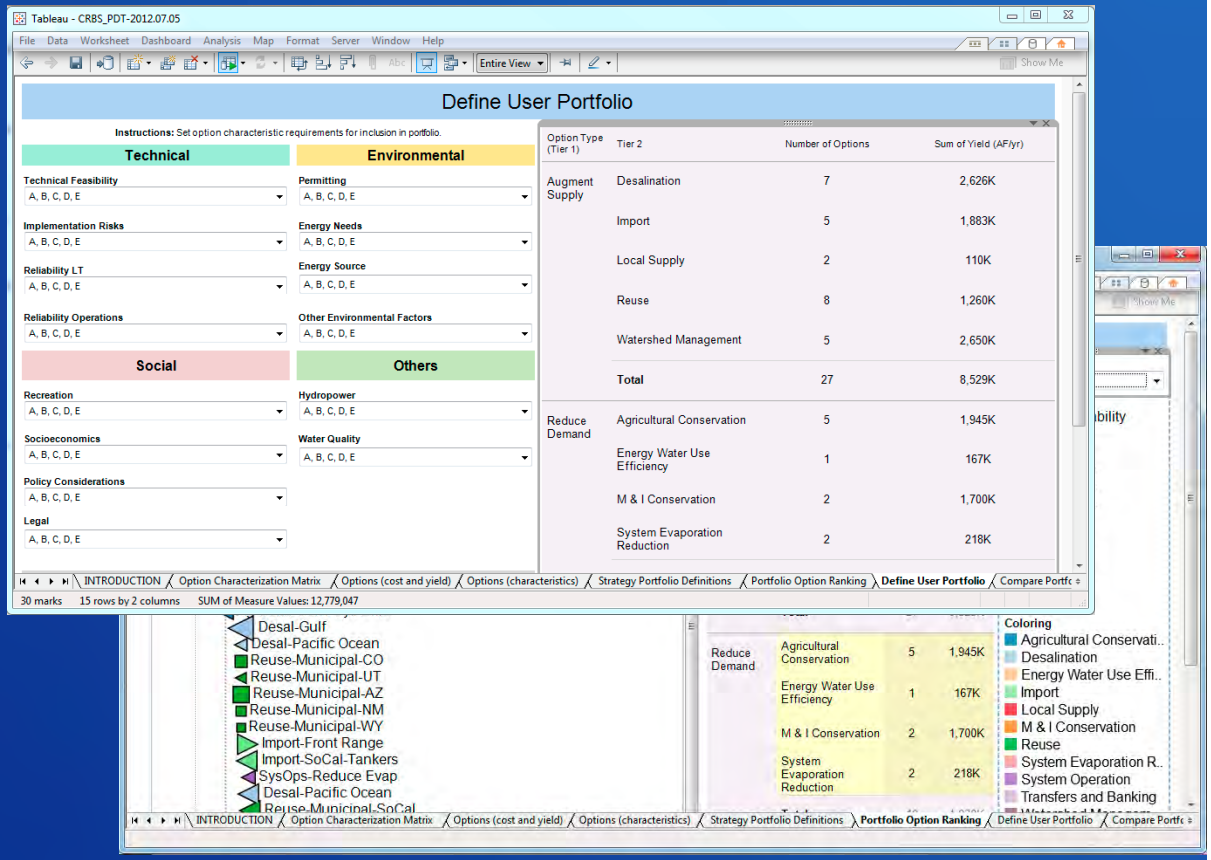
Portfolio Development Tool
Defines Portfolios Based on Strategy

- User:
  - Define characteristics of options to include
- Tool:
  - List of options that meet user-defined characteristics, prioritized by cost effectiveness and availability



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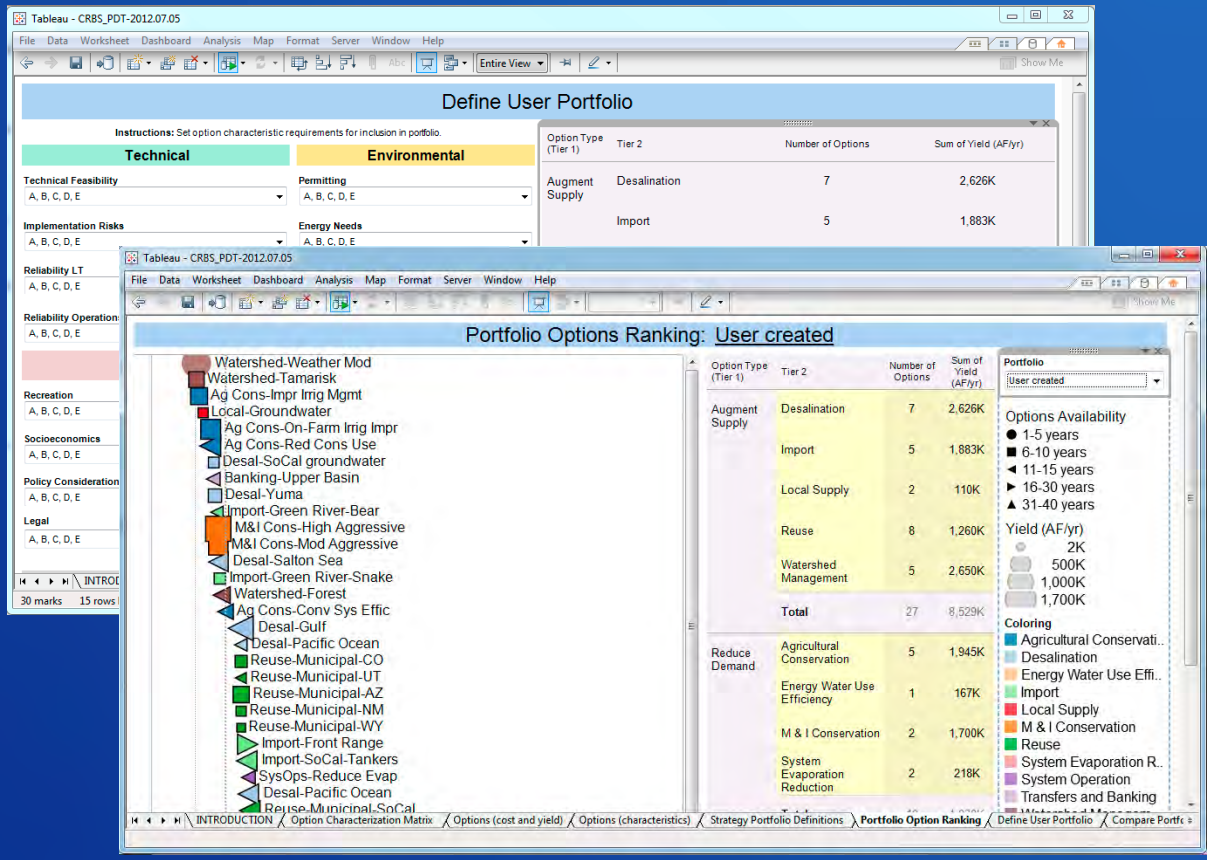

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Example Portfolio:
Most Cost Effective Options

Options to be Used	Conditions that Trigger Options
1. Agricultural conservation 2. Local supply 3. M&I conservation 4. Desalination 5. Imports 6. Reuse 7. Watershed management	Low Reliability – Low reservoir elevations – Upper Basin shortages – Lower Basin shortages

Portfolio options reflect location and amount of supply augmentation or demand reduction, based on submitted options.

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Portfolios To Be Evaluated Across Scenarios and Compared

- How do portfolios improve the system reliability across the scenarios?
- What options are required and under which scenarios?
- Which options are common across scenarios and portfolio types?
- How much would it cost to implement needed options?
- What are the key tradeoffs between portfolios?

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Colorado River Basin Water Supply and Demand Study

Updated Study Timeline & Questions

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Study Completion

May - June	• Complete characterization of submitted options
July	• Complete reliability analysis without and with operation and strategies
August	• Evaluate portfolios and summarize findings
September	• Publish final Study report

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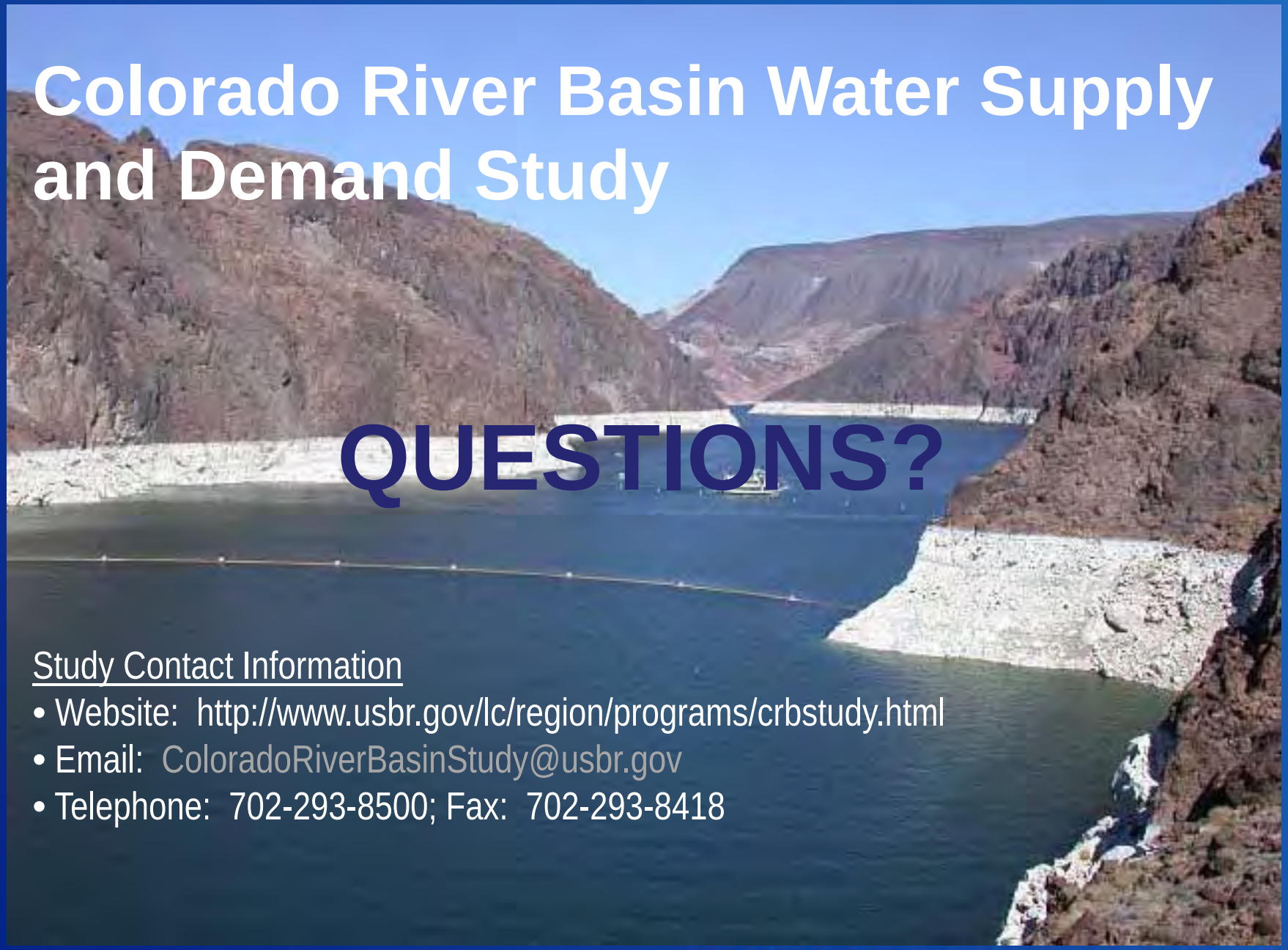

QUESTIONS?

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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