The Colorado River Basin Water Supply and Demand Study

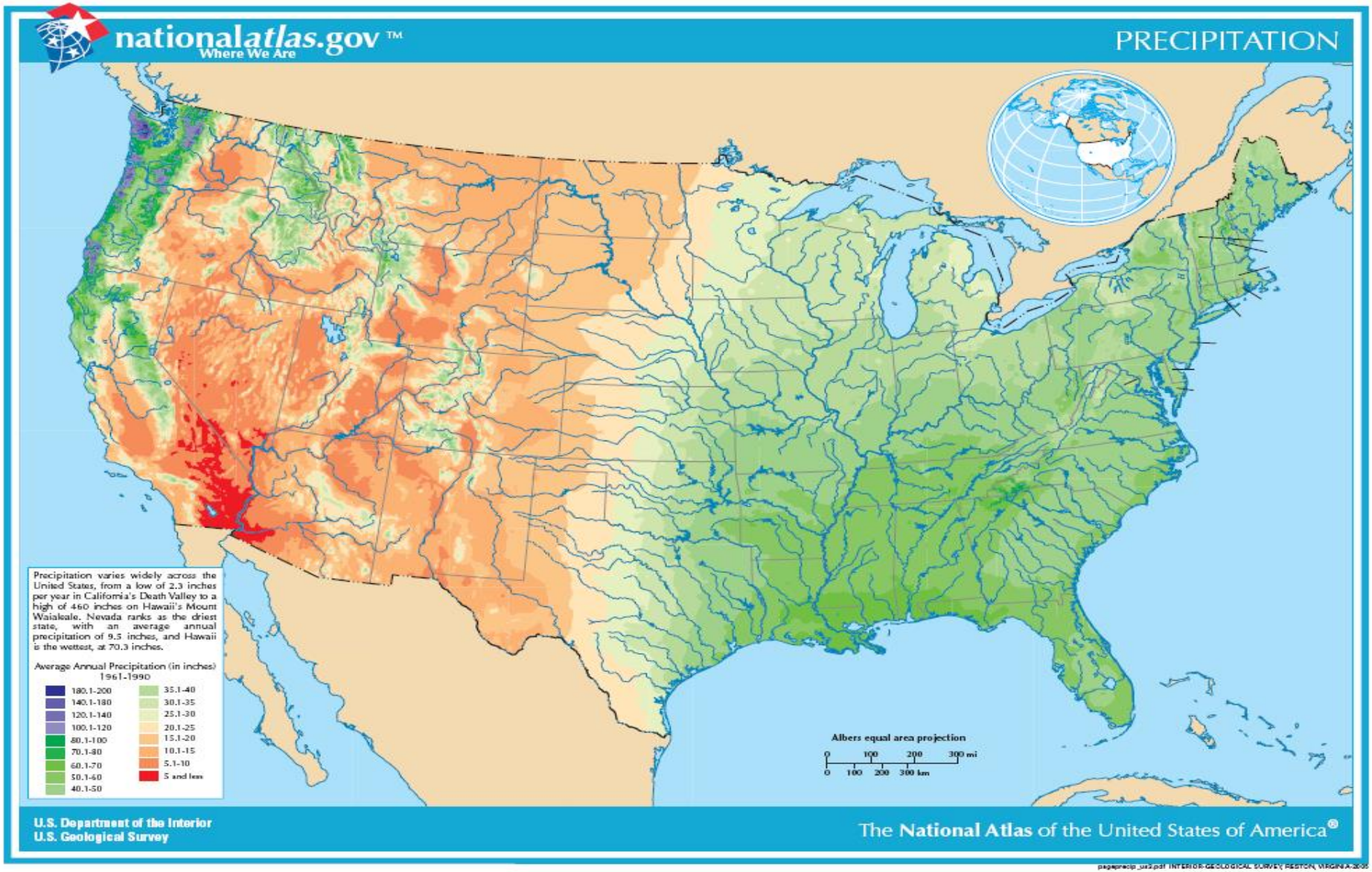
World Water Week Stockholm

2017 August 27 – September 1

Presentation Outline

- Bureau of Reclamation Overview
- Reclamation's Basin Study Program
- Colorado River Basin 101
- The Colorado River Basin Water Supply & Demand Study
- Moving Forward Effort
- Q & A

Annual Average Precipitation

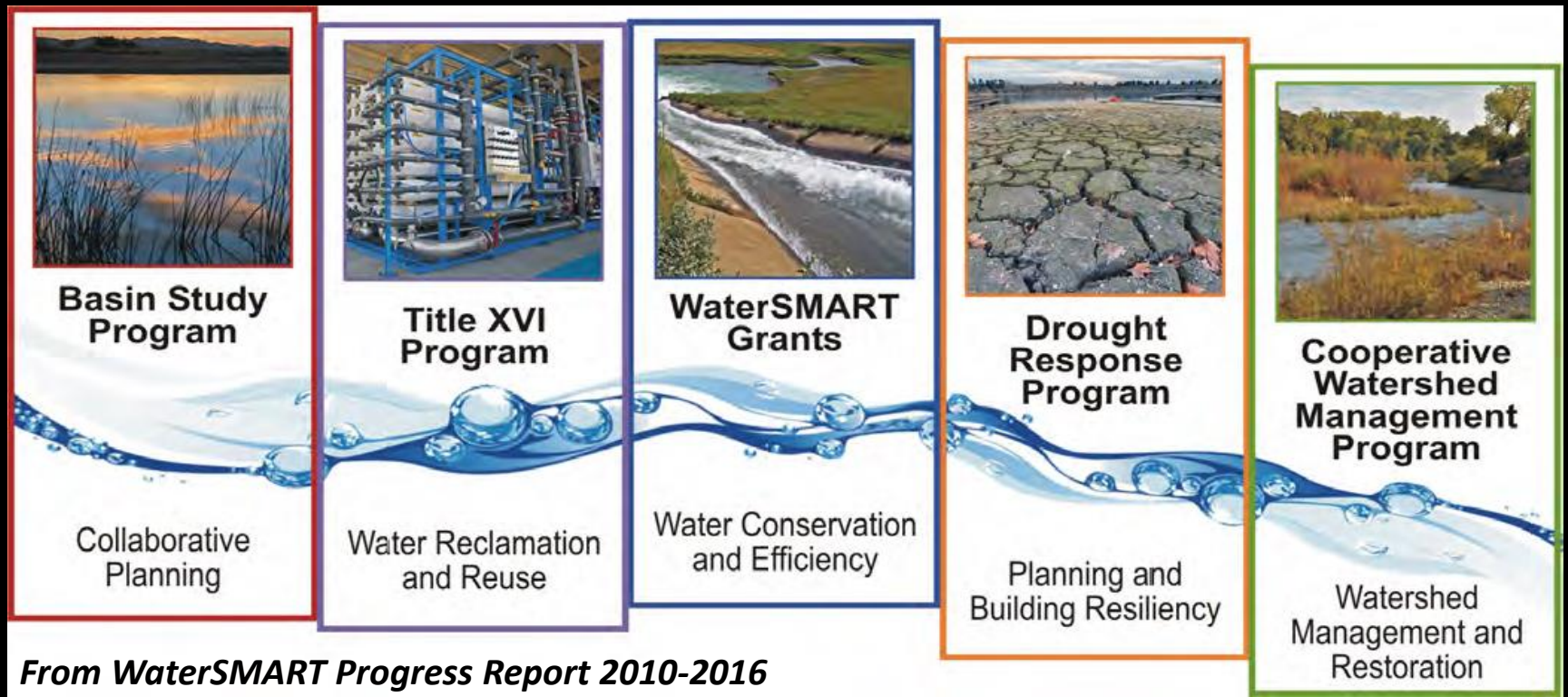


Bureau of Reclamation

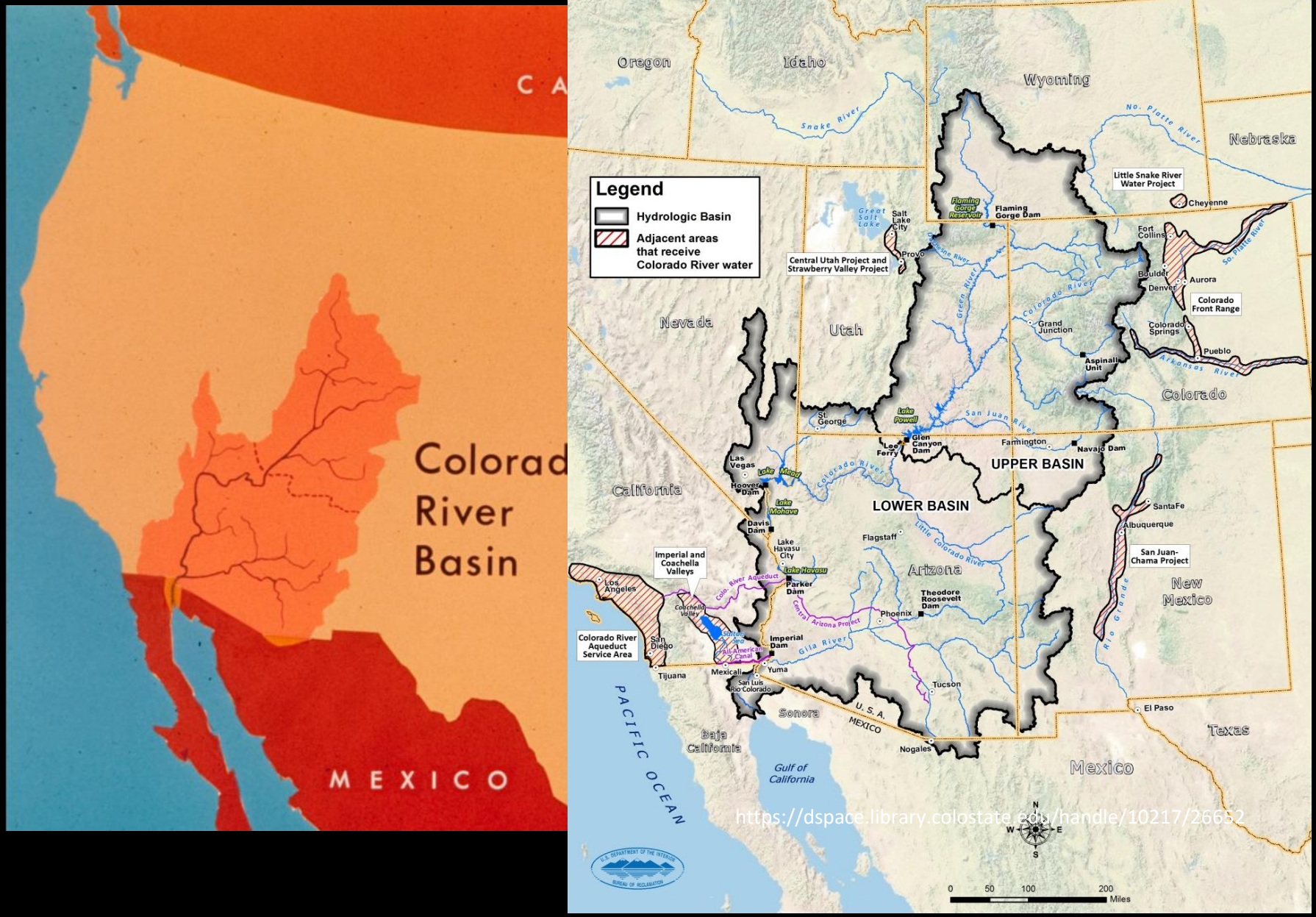
- U.S. Department of the Interior agency established in 1902 in the 17 western United States
- Largest wholesaler of water in U.S., providing water to over 31 million people
- Provide water to irrigate over 4 million hectares of farmland, producing 60% of the nation's vegetables
- Second largest producer of hydroelectric power in the U.S., with 58 powerplants producing 40 billion KWH
- Over 600 dams and reservoirs

WaterSMART: Sustain and Manage America's Resources for Tomorrow

- Provides opportunities to improve water management through collaboration and cooperation
- In 2009, as part of the implementation of the SECURE Water Act, Reclamation established the Basin Study Program as part of WaterSMART to provide support for collaborative climate adaptation planning.



From WaterSMART Progress Report 2010-2016


Colorad
River
Basin
MEXICO
Legend
Hydrologic Basin
Adjacent areas that receive Colorado River water
Oregon
Idaho
Wyoming
Nebraska
Nevada
Utah
Colorado
California
Arizona
New Mexico
Texas
Mexico
Snake River
No. Platte River
So. Platte River
Little Snake River Water Project
Flaming Gorge Reservoir
Flaming Gorge Dam
Cheyenne
Great Salt Lake
Salt Lake City
Provo
Central Utah Project and Strawberry Valley Project
Fort Collins
Boulder
Denver
Aurora
Colorado Front Range
Green River
Colorado River
Grand Junction
Colorado Springs
Pueblo
Aspinall Unit
Arkansas River
St. George
Lake Powell
San Juan River
Glen Canyon Dam
Lee Ferry
Farmington
Navajo Dam
UPPER BASIN
LOWER BASIN
Las Vegas
Lake Mead
Hoover Dam
Lake Mohave
Davis Dam
Lake Havasu City
Lake Havasu
Parker Dam
Flagstaff
Little Colorado River
SantaFe
Albuquerque
San Juan-Chama Project
Rio Grande
Imperial and Coachella Valleys
Los Angeles
Colo. River Aqueduct
Coachella Valley
Central Arizona Project
Theodore Roosevelt Dam
Phoenix
Colorado River Aqueduct Service Area
San Diego
Salton Sea
All American Canal
Imperial Dam
Gila River
Tijuana
Mexicali
Yuma
San Luis Rio Colorado
Tucson
El Paso
U. S. A.
MEXICO
Sonora
Baja California
Nogales
Gulf of California
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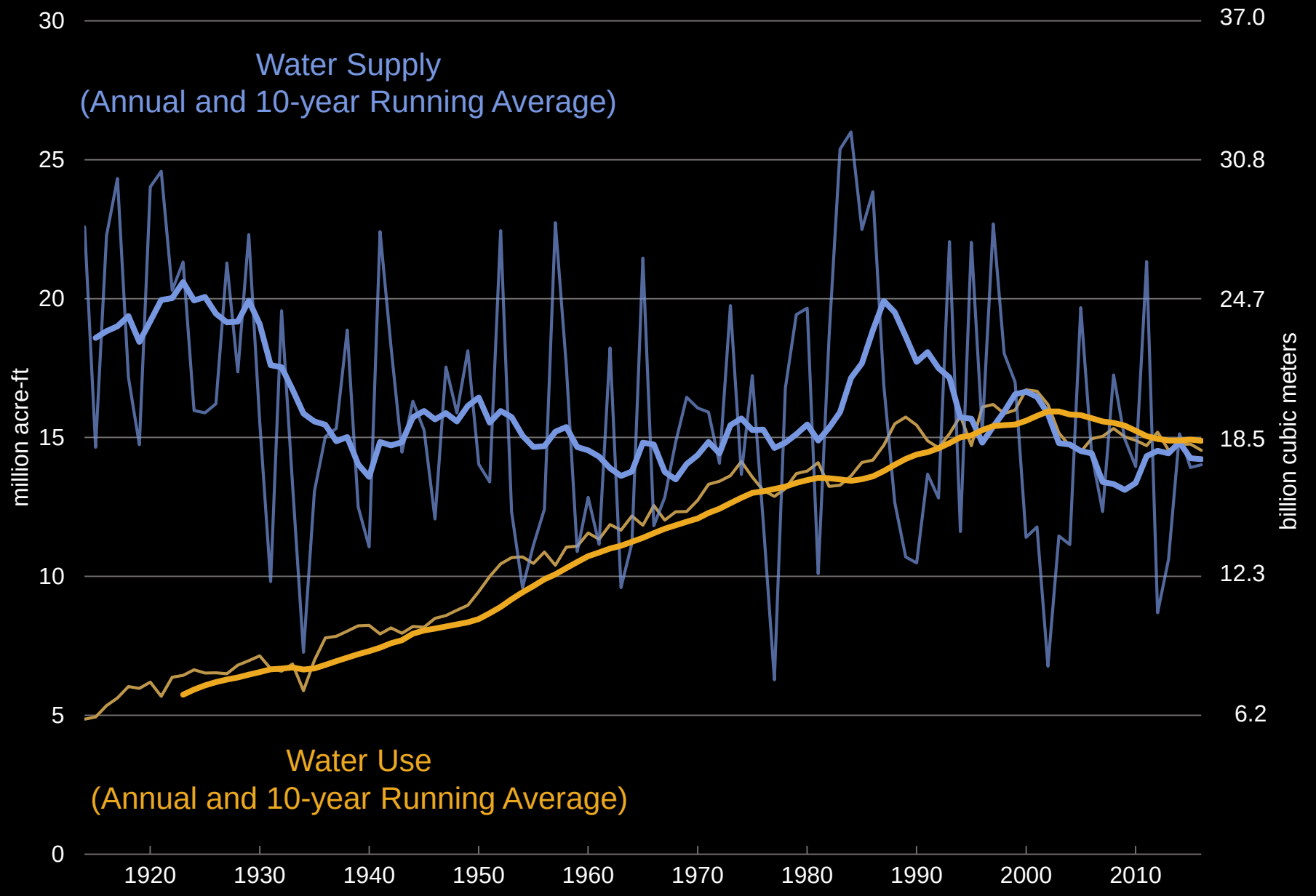
Colorado River System

- Drains 3,755 square kilometers in the western US
- Serves water needs of 40 million people
- Irrigates nearly 1.82 million hectares
- 10 major reservoirs, storage of over 72.8 BCM
- 4000 MW of generating capacity
- Long-term average annual inflow is 19.7 BCM
  - Ranging from 7.4 to 32.1 BCM
- Average annual consumptive use is 18.5 BCM

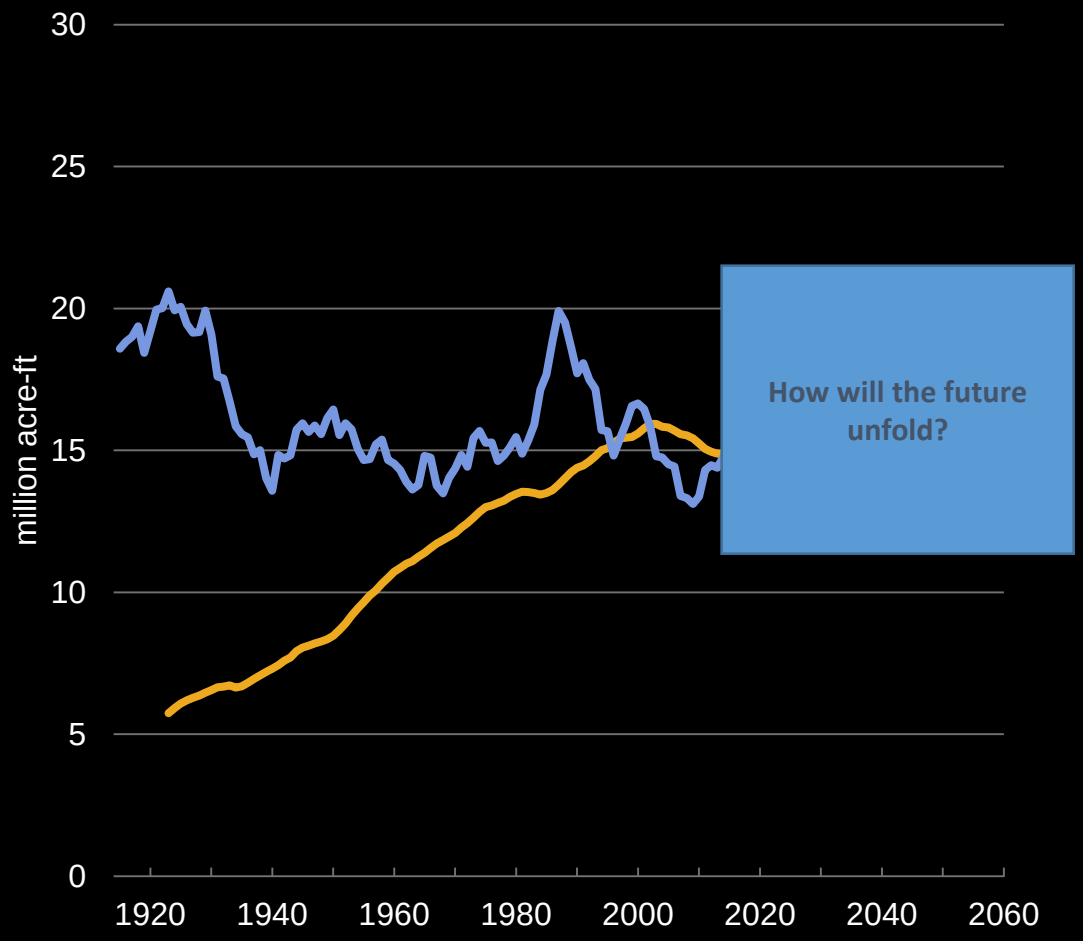
Lake Powell, formed by Glen Canyon Dam

Colorado River Basin Water Supply and Use

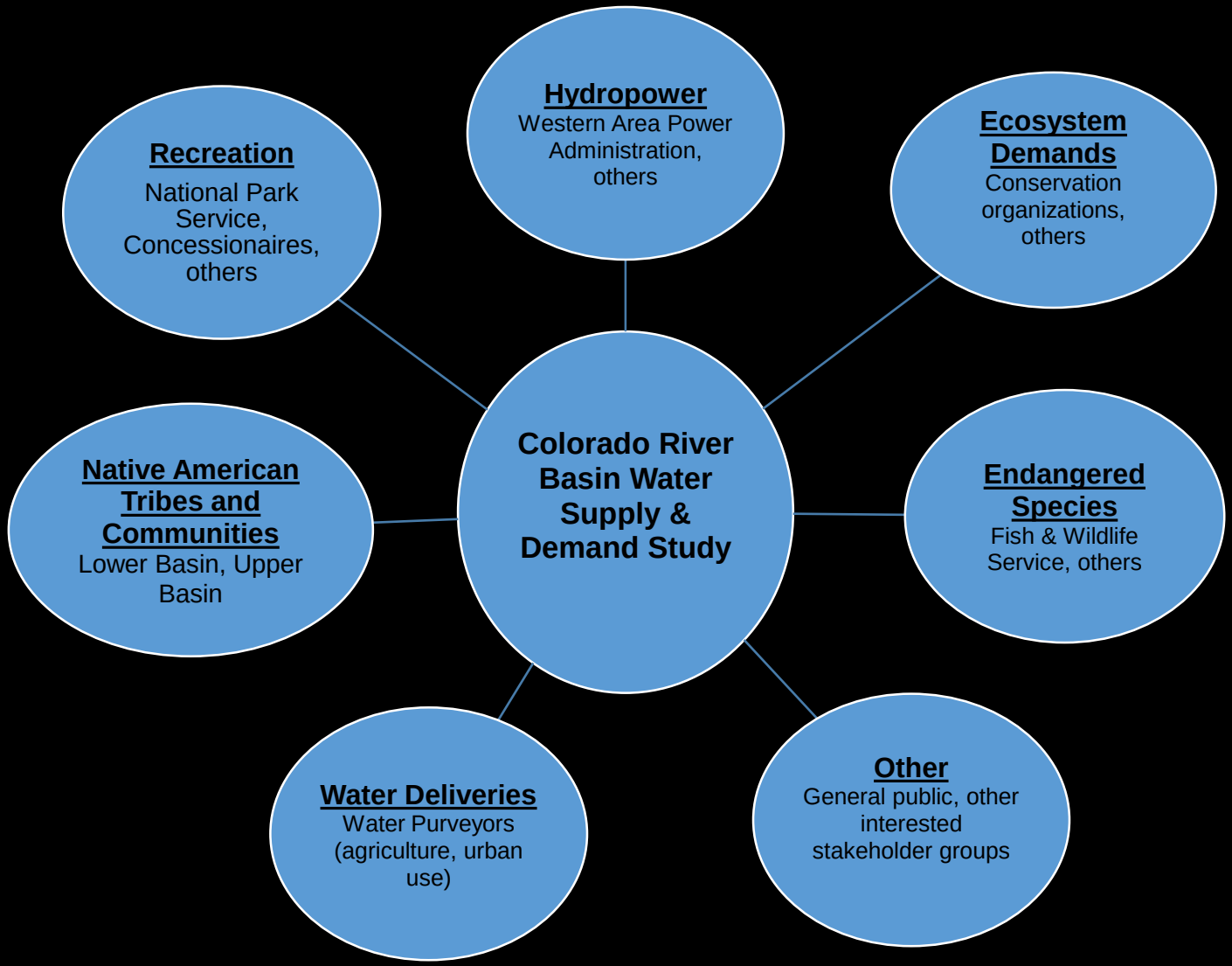


Colorado River Basin Water Supply and Demand Study (2012)

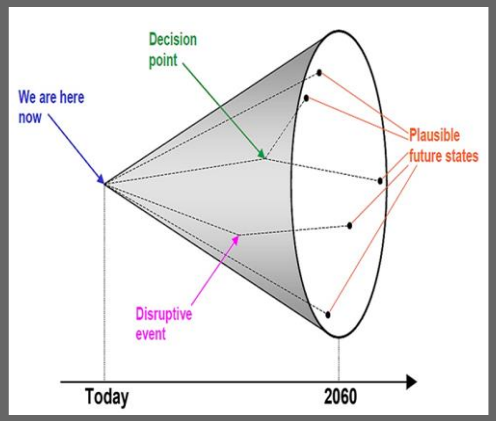
- Study Objective
  - Assess future water supply and demand imbalances over the next 50 years
  - Develop and evaluate opportunities for resolving imbalances
- Conducted by Reclamation and the 7 Colorado River Basin States, in collaboration with stakeholders throughout the Basin
- A planning study – did not result in any decisions but provides technical foundations for future activities



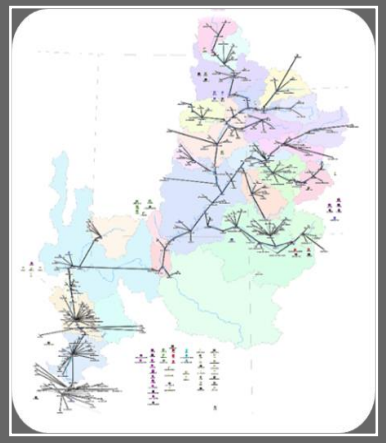
Stakeholder Collaboration



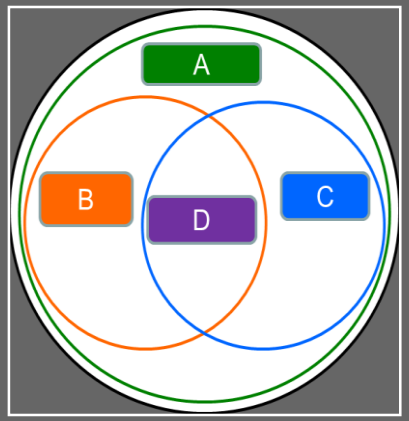
Study Approach



Phase 1 & 2: Water Supply and Demand Assessment



Phase 3: System Reliability Analysis



Phase 4: Development & Evaluation of Opportunities

Water Supply and Demand Assessment

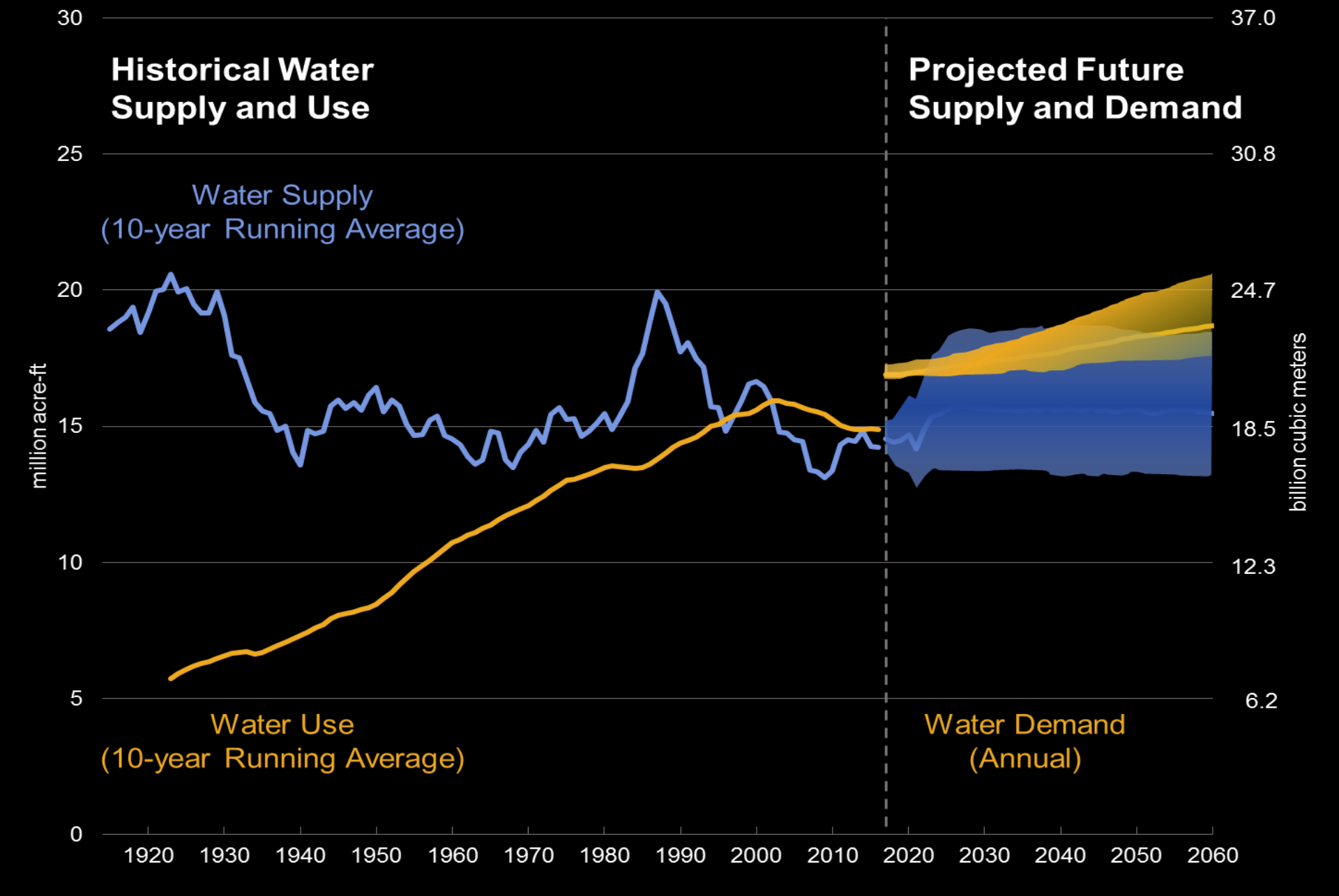
Water Supply Scenarios

- **Observed Resampled**
  - Future will be similar to past 100 years
- **Paleo Resampled**
  - Future represented by distant past (1,250 years)
- **Paleo Conditioned**
  - Blend paleo and observed records for view of future
- **Downscaled GCM Projected**
  - Future represented by ensemble of GCM projections

Water Demand Scenarios

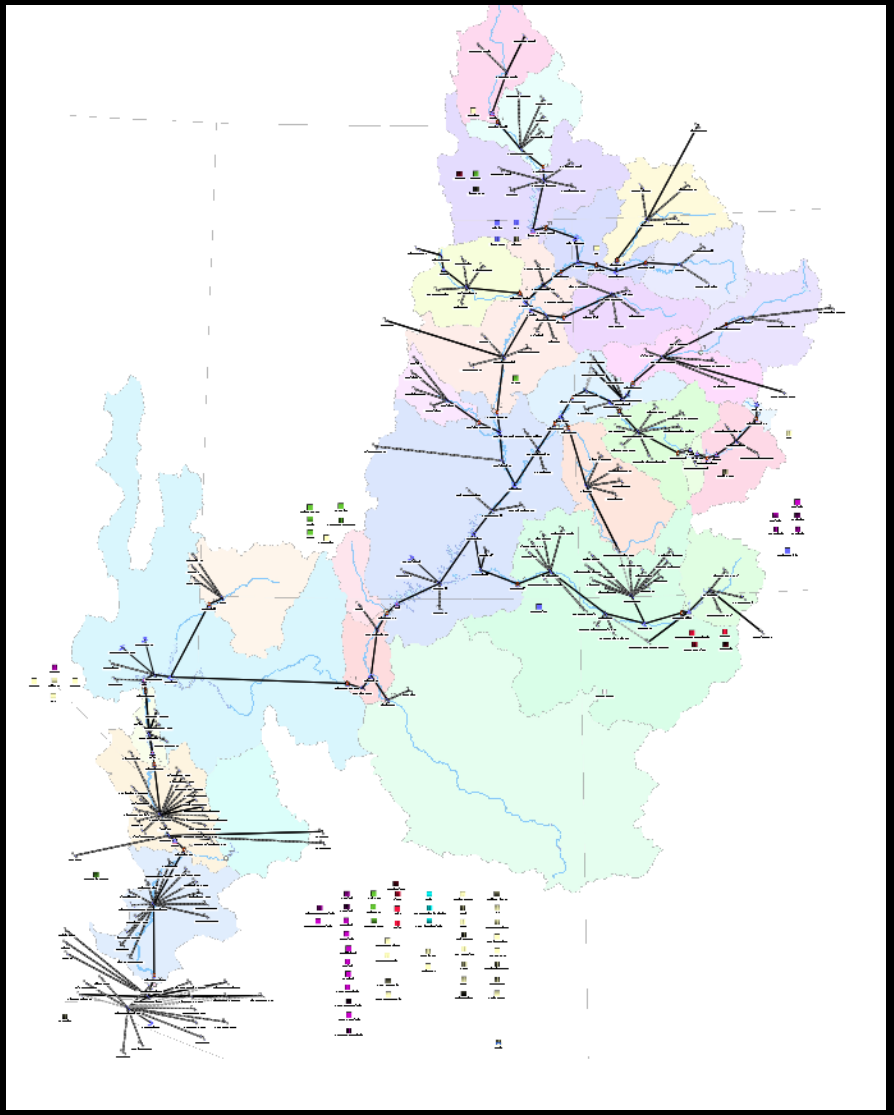
- **Current Trends**
  - Future continues along recent trends
- **Slow Growth**
  - Low growth with emphasis on economic efficiency
- **Rapid Growth** *(2 branches)*
  - Economic resurgence with varying technology adoption rates
- **Enhanced Environment** *(2 branches)*
  - Expanded environmental awareness with varying population growth

Colorado River Basin Water Supply, Use & Demand



System Reliability Analysis

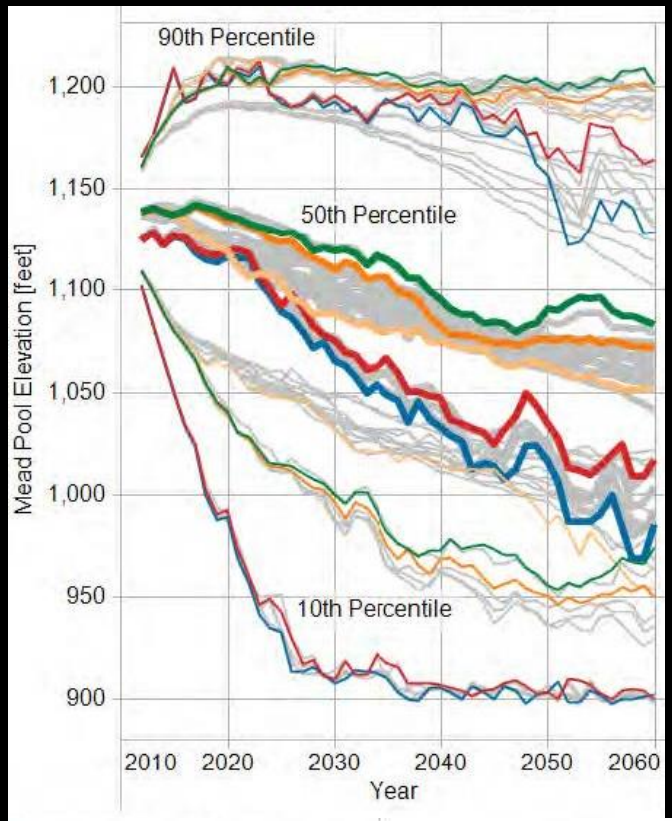
- Simulate the state of the system over the next 50 years for each scenario, with and without options and strategies
- Use metrics and vulnerabilities to quantify impacts to Basin resources
- **Resource Categories**
  - Water Deliveries
  - Electrical Power Resources
  - Water Quality
  - Flood Control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



Colorado River Simulation System (CRSS) in RiverWare™

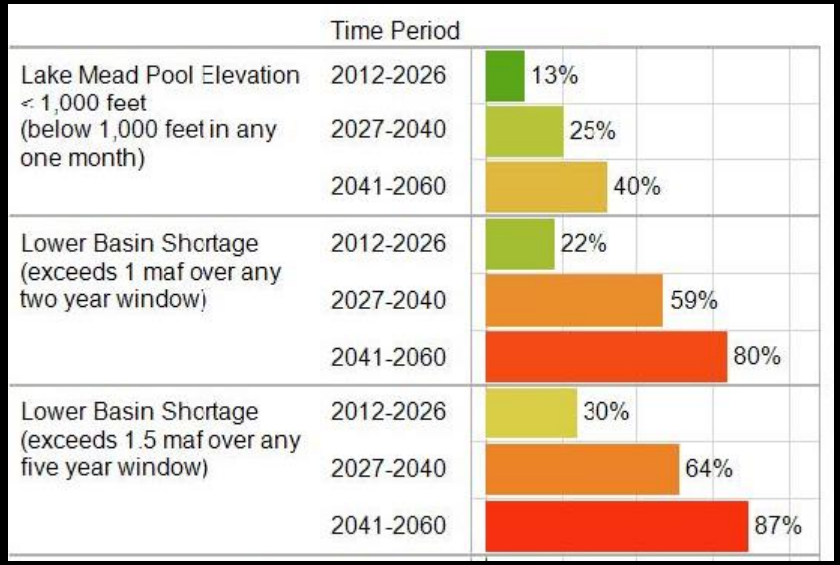
Example of Results

FIGURE G-6
10th, 50th, 90th Percentiles for Lake Mead End-of-December Pool Elevation



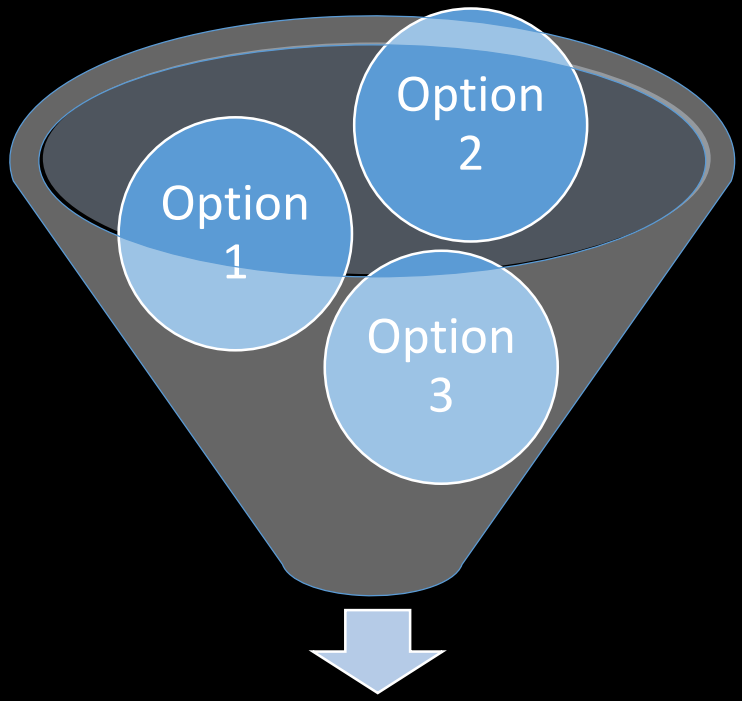
Highlighted Scenario Names
- Paleo Conditioned, Enhanced Environment (D1)
- Paleo Conditioned, Current Projected (A)
- Observed Resampled, Rapid Growth (C1)
- Downscaled GCM Projected, Enhanced Environ. (D1)
- Downscaled GCM Projected, Rapid Growth (C1)
- All Other Scenarios

FIGURE G-8
Summary of Vulnerability Without Options and Strategies for Water Delivery Metrics



Development & Evaluation of Opportunities

- Over 150 options submitted to the Study
- Options were evaluated based on:
  - Quantity of yield
  - Timing of implementation
  - Technical feasibility
  - Energy needs
  - Cost
  - Permitting
  - Legal and policy considerations
  - Implementation risk

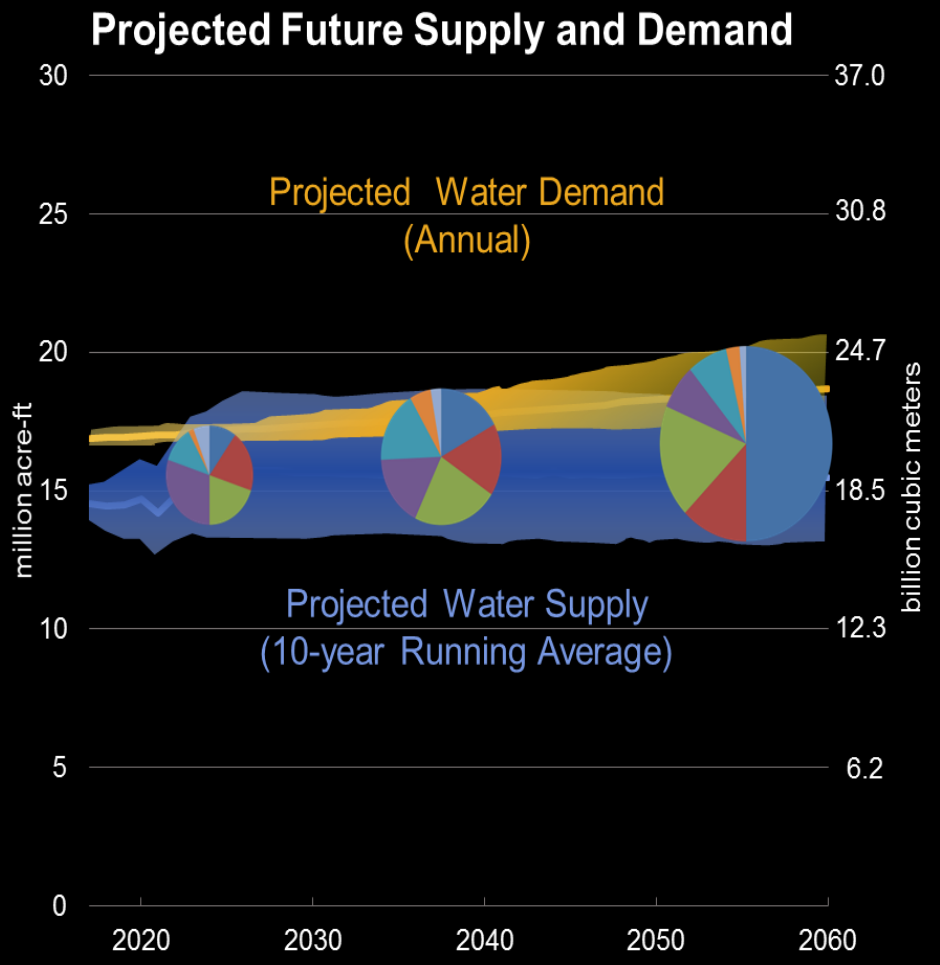


Importation | Desalination | Agricultural Conservation | M&I Conservation | Watershed Management | System Operations

Does not represent all option categories

Portfolio Development

- "Portfolios" are combinations of options that implement a particular strategy
- Strategy expressed through evaluation of option criteria which determines how options are combined
- **Portfolios**
  - A: "Inclusive"
  - B: "High Reliability"
  - C: "Environmentally Preferred"
  - D: "Selective"

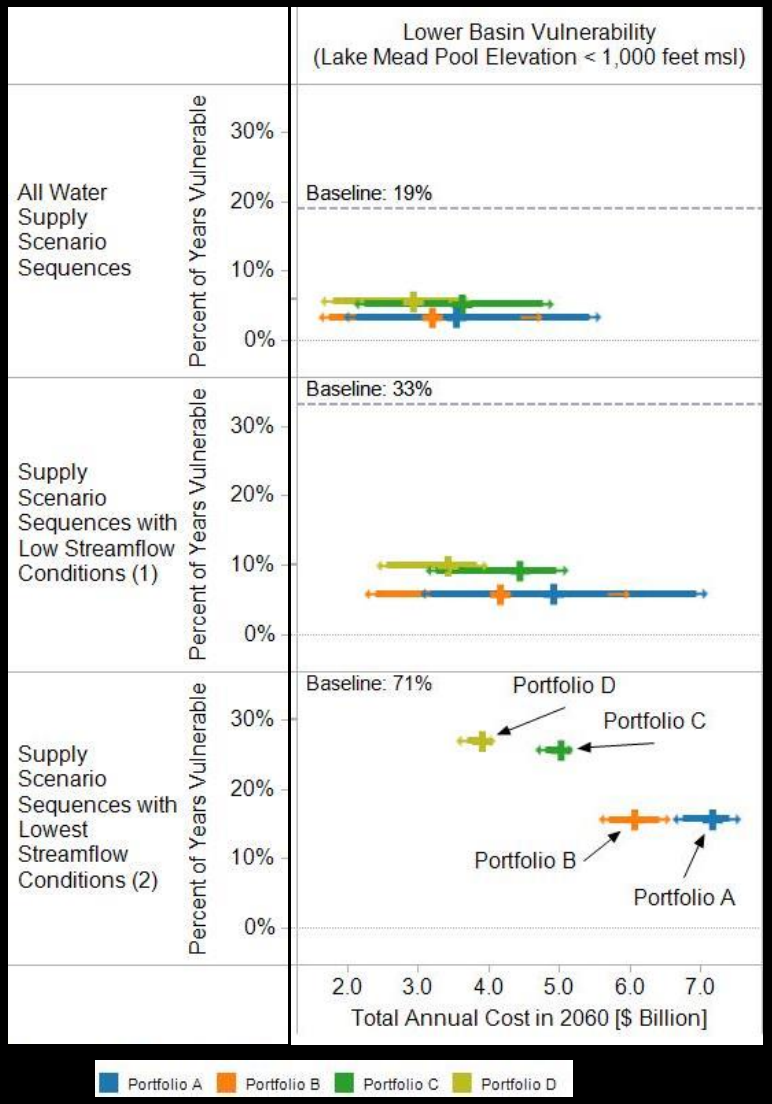


Portfolio Performance

FIGURE G-28
Percent of Vulnerable Traces for Each Water Delivery Indicator Metric

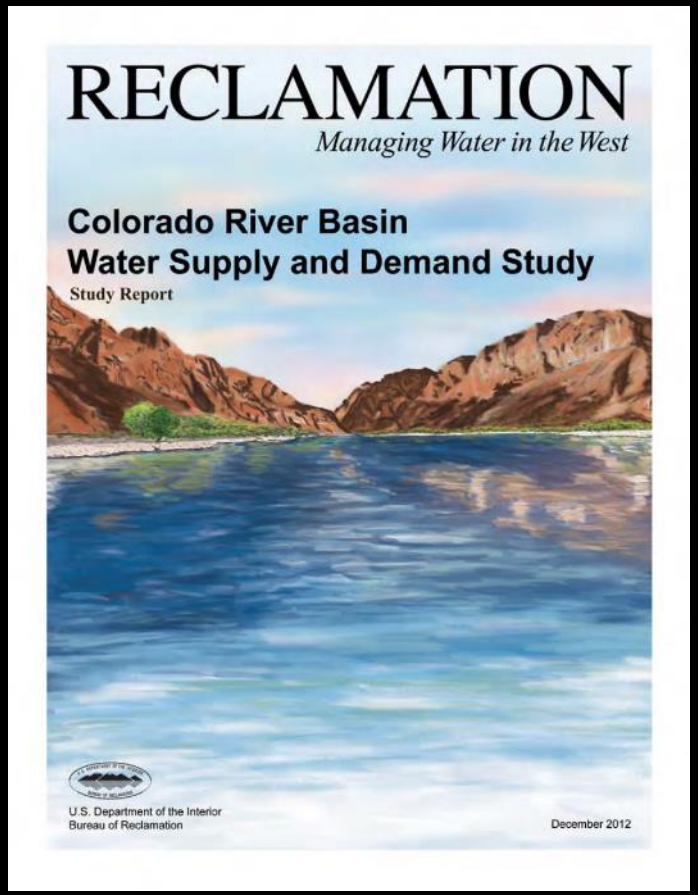
	Time Period	Baseline	Portfolio A	Portfolio B	Portfolio C	Portfolio D
Lake Mead Pool Elevation < 1000 feet (below 1000 feet in any one month)	2012-2026	13%	12%	11%	12%	12%
	2027-2040	25%	17%	15%	18%	18%
	2041-2060	40%	10%	10%	14%	15%
Lower Basin Shortage (exceeds 1 maf over any two year window)	2012-2026	22%	16%	15%	16%	16%
	2027-2040	59%	48%	43%	48%	49%
	2041-2060	80%	35%	34%	38%	40%
Lower Basin Shortage (exceeds 1.5 maf over any five year window)	2012-2026	30%	29%	27%	28%	29%
	2027-2040	64%	61%	54%	61%	61%
	2041-2060	87%	61%	58%	62%	66%

FIGURE G-52
Percent of Years Vulnerable from 2041-2060 and Range of Total Annual Cost in 2060



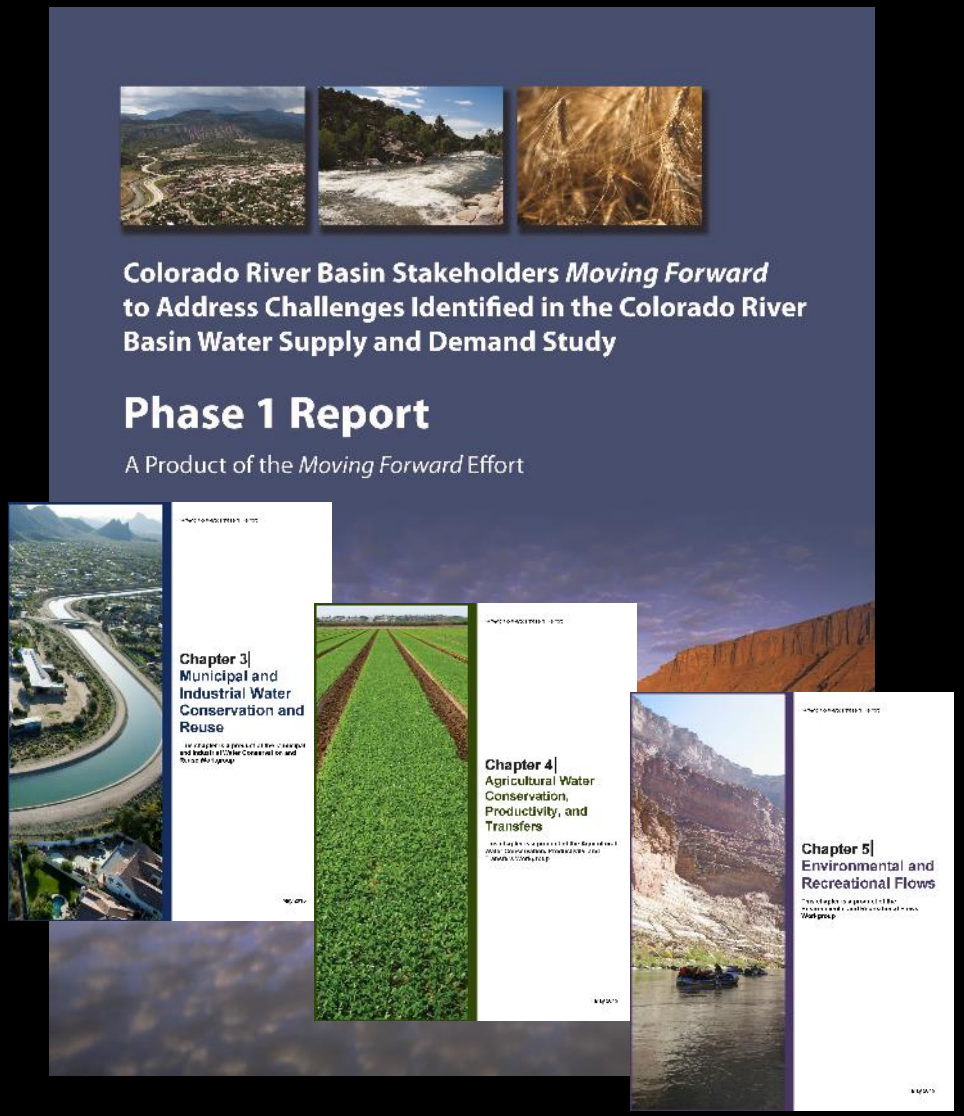
Future Considerations & Next Steps

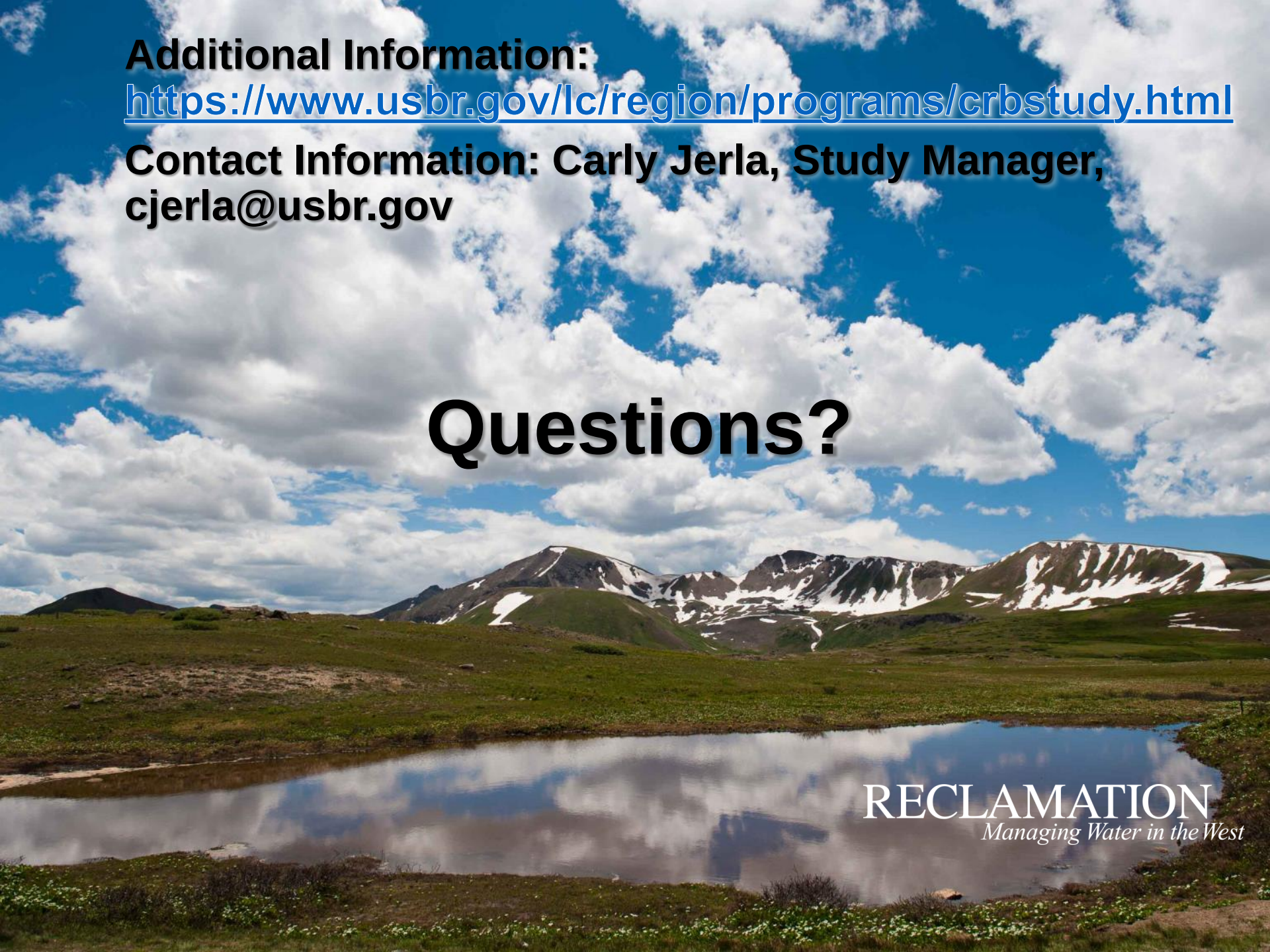
- The Study identified additional steps to be considered at appropriate levels (federal, state, local) in 10 areas:
  - M&I and Agricultural Water Conservation and Water Reuse
  - Water Banks
  - Watershed Management
  - Augmentation
  - Water Transfers
  - Tribal Water
  - Environmental Flows
  - Data and Tool Development
  - Climate Science Research
  - Partnerships



Moving Forward Effort (2015)

- Launched to move forward on Study recommendations
- Expands to an even broader stakeholder group with the necessary expertise to explore specific topics
  - Municipal & Industrial Conservation
  - Agricultural Conservation
  - Environmental & Recreational Flows
- Identified future actions with broad-based support to be taken to help resolve future water supply and demand imbalances




Additional Information:
https://www.usbr.gov/lc/region/programs/crbstudy.html
Contact Information: Carly Jerla, Study Manager, cjerla@usbr.gov
Questions?
RECLAMATION
Managing Water in the West