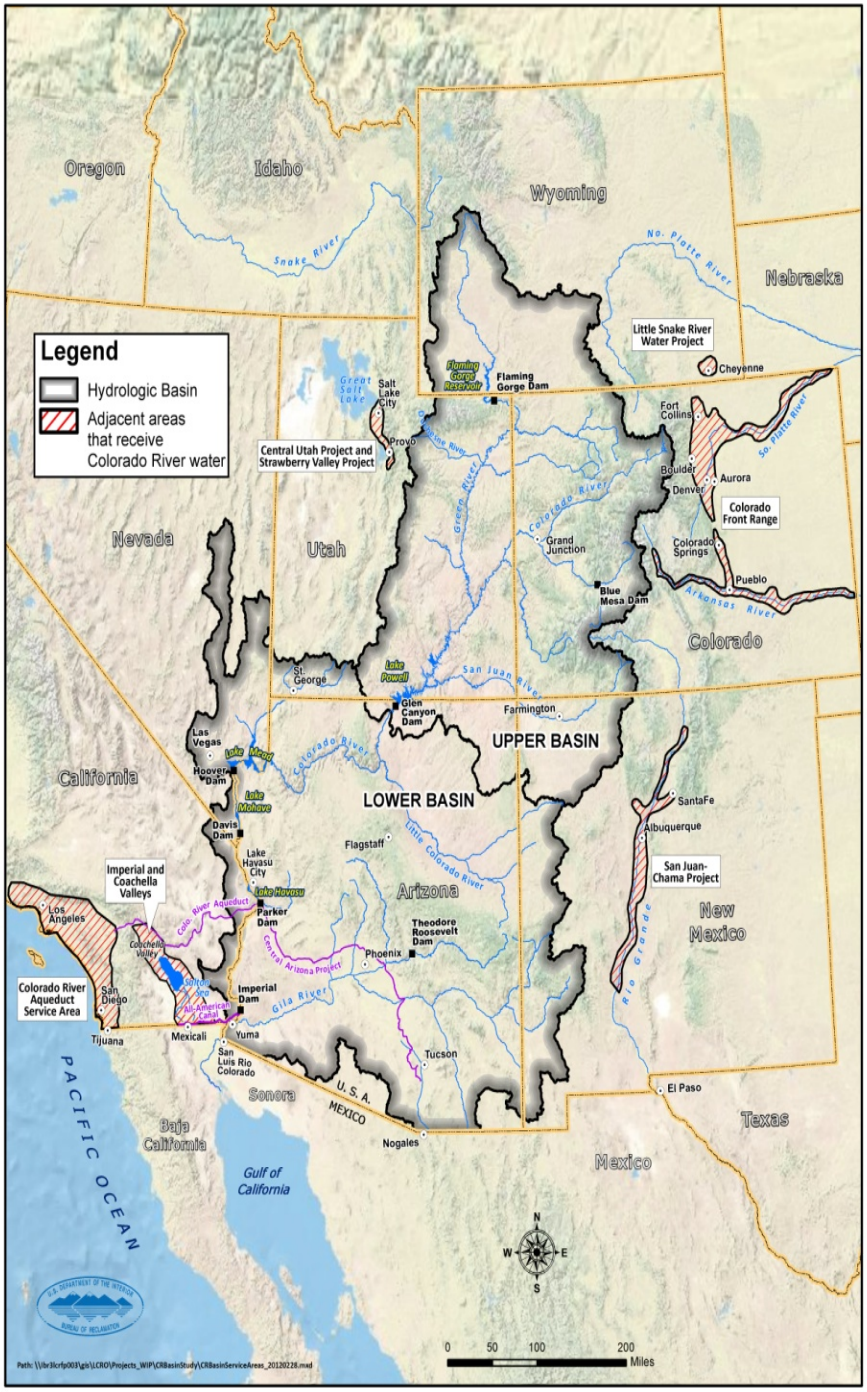


COLORADO WATER CONSERVATION BOARD · STATE OF COLORADO · 1876 · 1937

Colorado River Basin Study

Ted Kowalski

Southwestern Water Conservation District

31st Annual Water Seminar

April 5, 2013

Durango, Colorado

where in the WORLD

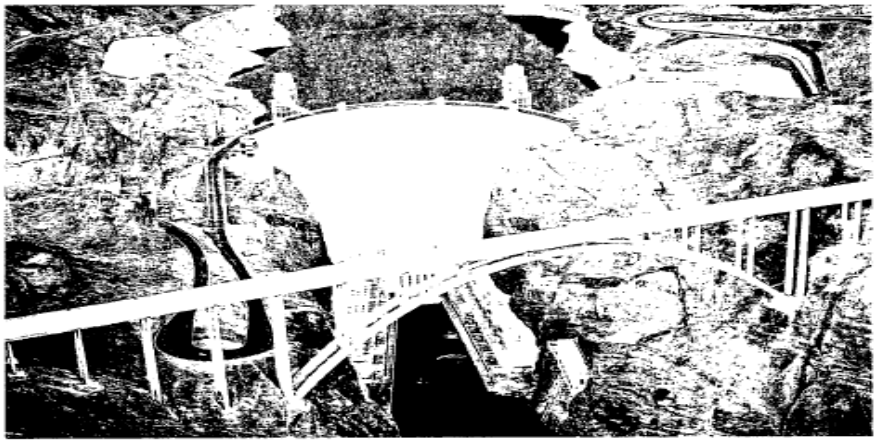
+2 ☆ Great job!

This case closes on:
FRI, Feb 15, 2013

The American Southwest needs more water. Should we bag Arctic icebergs and tow them south to melt? Or bring Alaskan river water in on huge tanker ships? Or divert river water from other areas of the U.S. through miles of pipes? These were some of the wackier ideas collected by the U.S. Bureau of Reclamation and seven states as they worked together on a 3-year study of future water needs.

As the Southwest has grown steadily in population, its demand for water has skyrocketed. But there are few sources. Today 40 million people in CO, NV, UT, WY, NM, AZ and CA all depend on water from *one* great river. This river has over 70% of its water taken out for irrigating crops. It is also used for drinking, hydroelectric power, and recreation. A decade of drought has not helped its flow, and the study predicted that climate change will reduce it by 9% more in the next 50 years. Western water managers, who must ensure their cities have enough water to grow, are worried about shortages.

Other ideas collected by the study include re-use of water, stronger conservation programs, "water banks", and the de-salting of ocean water. Let's hope they help keep this river, the "lifeblood of the American West", flowing.



The Hoover Dam was built to control the flow of this powerful river.

The river's end, in the Gulf of CA.

Thousands raft the river every year.

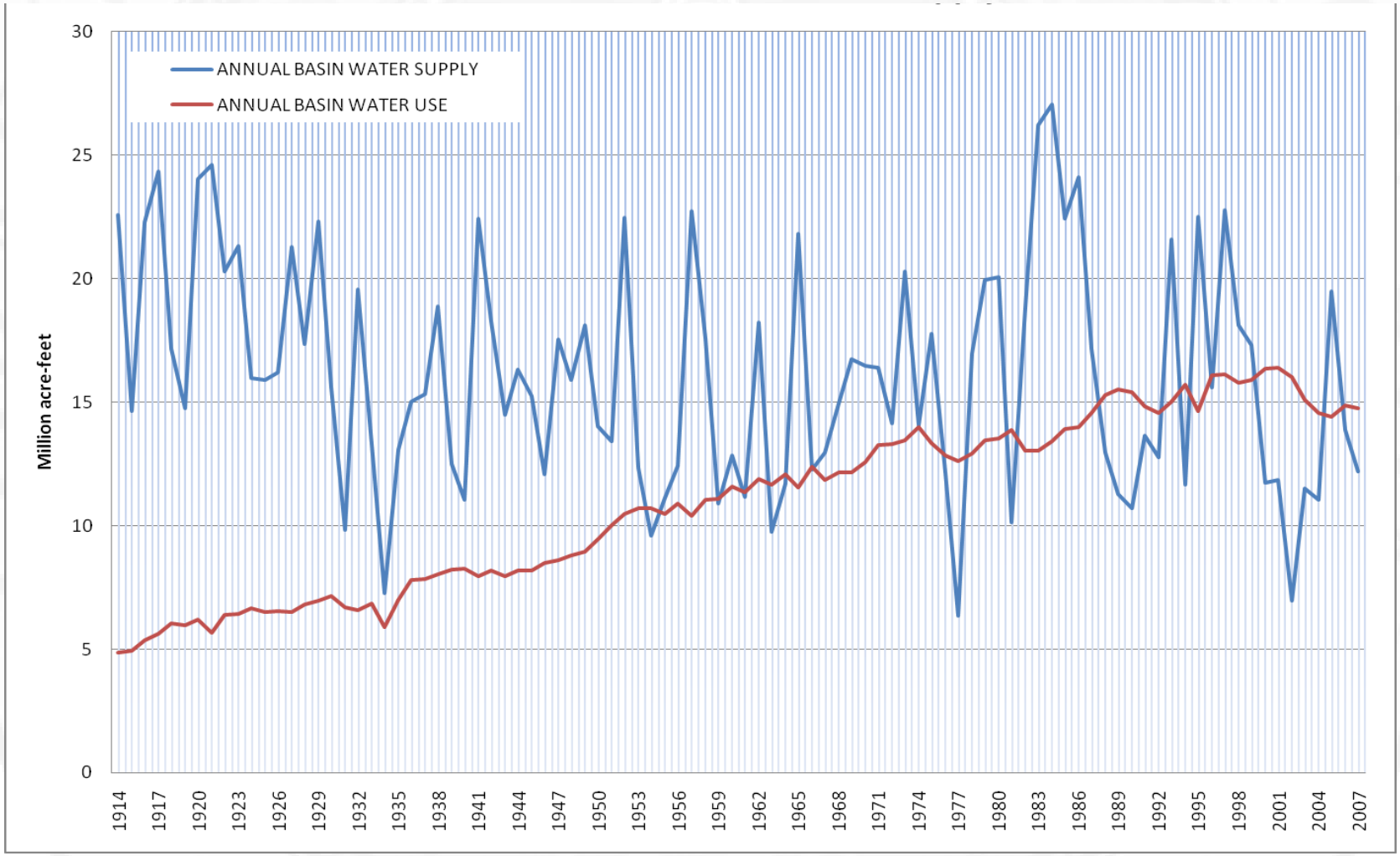
What is the name of this important river?

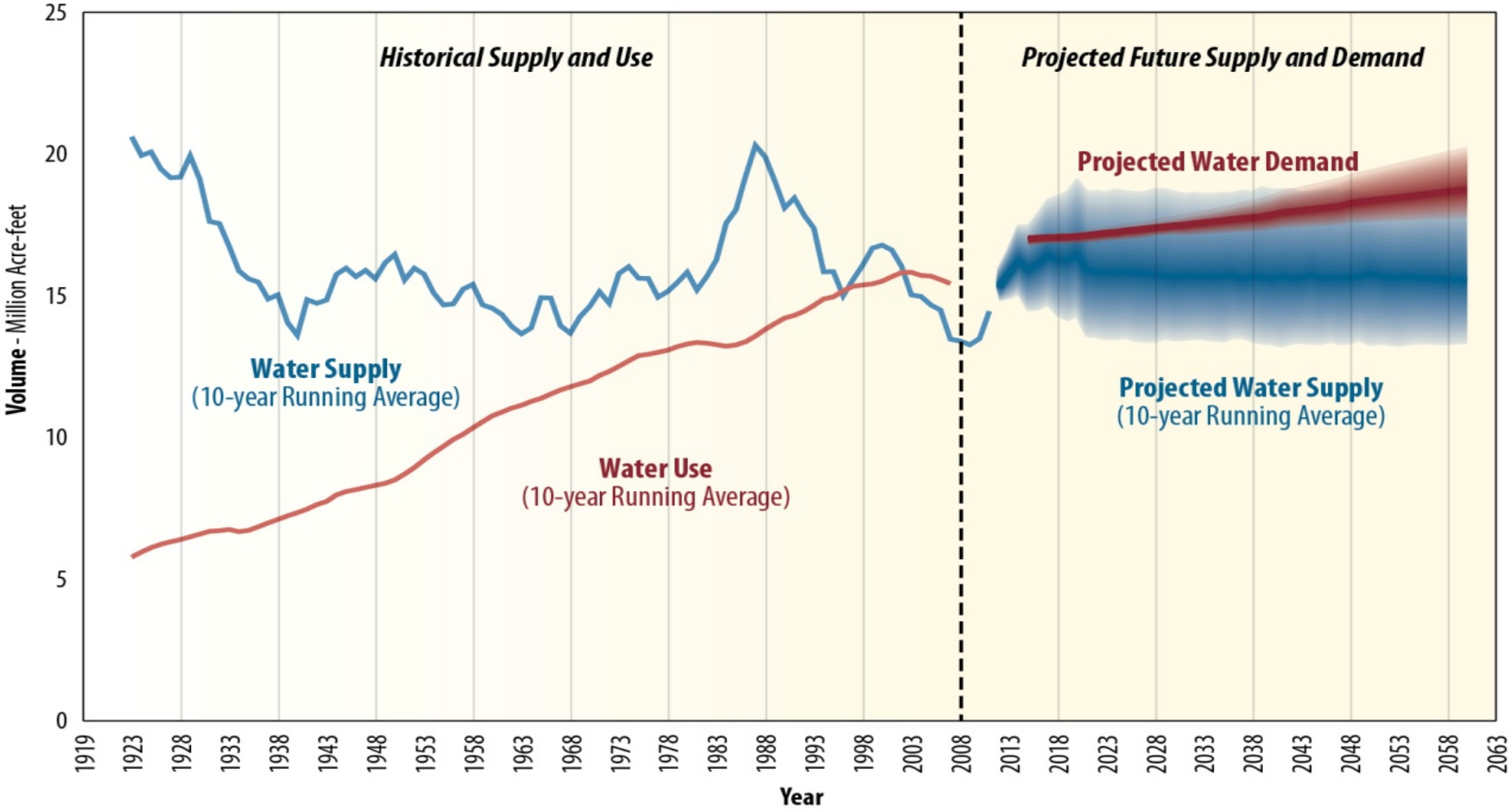
Answer: the Colorado River

Name: _____ *Class Code:* _____

Return your answer to your classroom collection folder!

Historic Colorado River Water Supply & Use (Annual)





Notes:

Water Supply represents natural flow as measured at the Colorado River above Imperial Dam, Arizona

Water Use and Demand include deliveries to Mexico in accordance with the 1944 Treaty with Mexico and losses such as those due to reservoir evaporation, native vegetation, and operational inefficiencies.

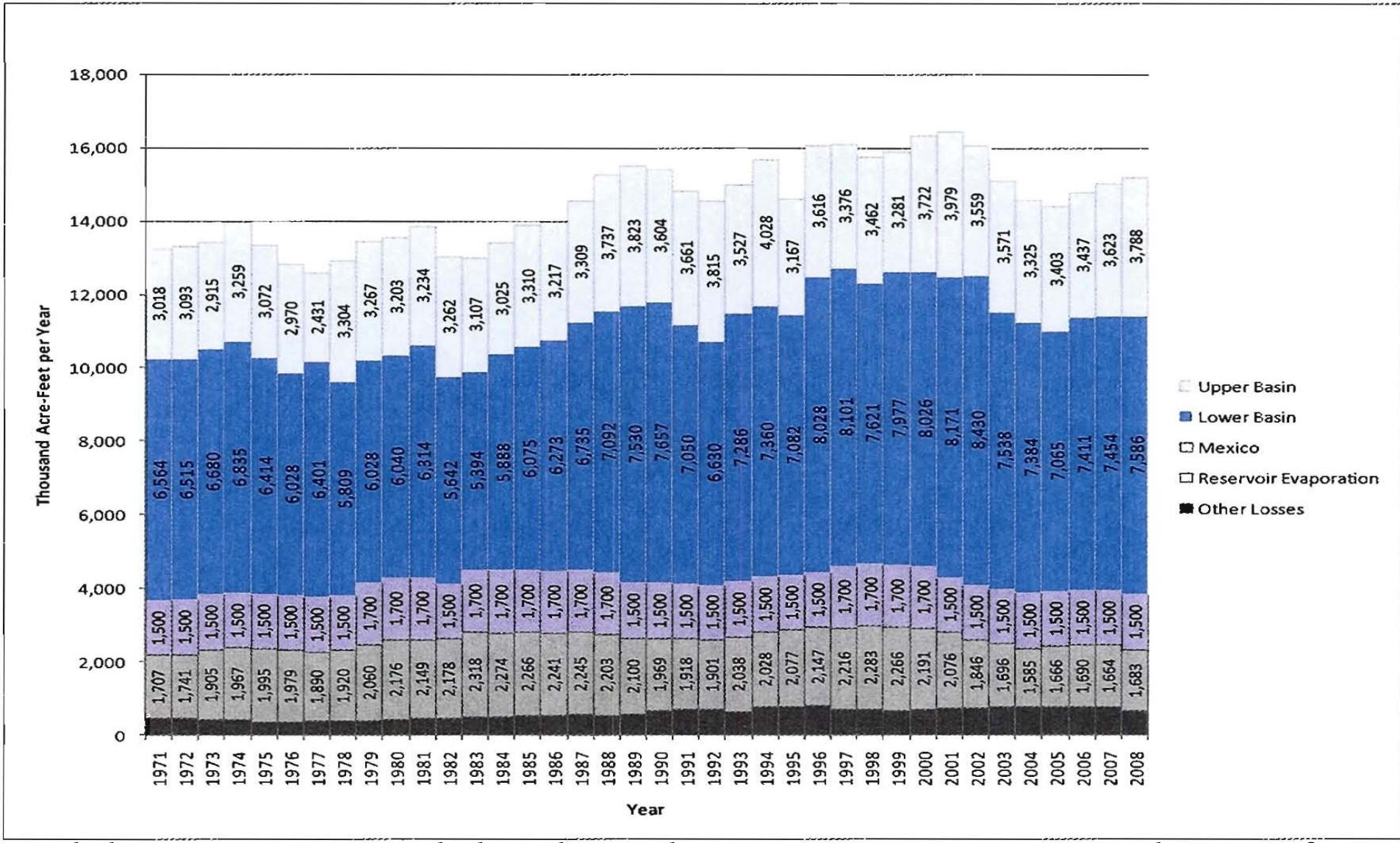
Projected Water Supply is computed as the average 10th, 50th (median), and 90th percentiles of the Study's 4 water supply scenarios. The average of the medians is indicated by the darker shading.

Projected Water Demand is represented by the Study's 6 water demand scenarios. The median of the scenarios is indicated by the darker shading.

CRBS_103

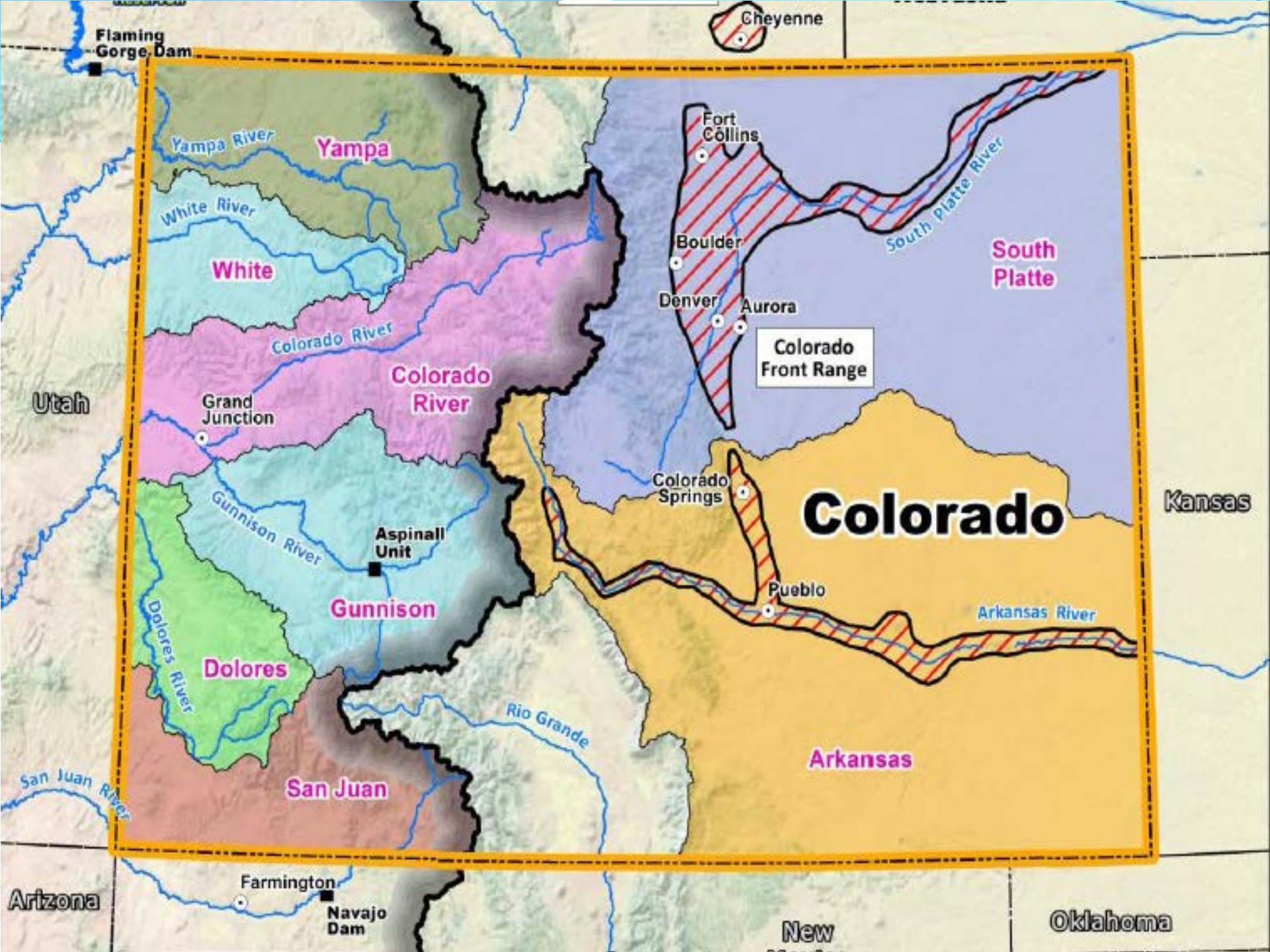
FIGURE C-6

Historical Colorado River Water Consumptive Use[1] by Basin[2], Delivery to Mexico, Reservoir Evaporation, and Other Losses[3], 1971-2008



Year	Upper Basin	Lower Basin	Mexico	Reservoir Evaporation	Other Losses
1971	3,018	6,564	1,500	1,707	
1972	3,093	6,515	1,500	1,741	
1973	2,915	6,680	1,500	1,905	
1974	3,259	6,835	1,500	1,967	
1975	3,072	6,414	1,500	1,995	
1976	2,970	6,028	1,500	1,979	
1977	2,431	6,401	1,500	1,890	
1978	3,304	5,809	1,500	1,920	
1979	3,267	6,028	1,700	2,060	
1980	3,203	6,040	1,700	2,176	
1981	3,234	6,314	1,700	2,149	
1982	3,262	5,642	1,500	2,178	
1983	3,107	5,394	1,700	2,318	
1984	3,025	5,888	1,700	2,274	
1985	3,310	6,075	1,700	2,266	
1986	3,217	6,273	1,700	2,241	
1987	3,309	6,735	1,700	2,245	
1988	3,737	7,092	1,700	2,203	
1989	3,823	7,530	1,500	2,100	
1990	3,604	7,657	1,500	1,969	
1991	3,661	7,050	1,500	1,918	
1992	3,815	6,630	1,500	1,901	
1993	3,527	7,286	1,500	2,038	
1994	4,028	7,360	1,500	2,028	
1995	3,167	7,082	1,500	2,077	
1996	3,616	8,028	1,500	2,147	
1997	3,376	8,101	1,700	2,216	
1998	3,462	7,621	1,700	2,283	
1999	3,281	7,977	1,700	2,266	
2000	3,722	8,026	1,700	2,191	
2001	3,979	8,171	1,500	2,076	
2002	3,559	8,430	1,500	1,846	
2003	3,571	7,538	1,500	1,696	
2004	3,325	7,384	1,500	1,585	
2005	3,403	7,065	1,500	1,666	
2006	3,437	7,411	1,500	1,690	
2007	3,623	7,454	1,500	1,664	
2008	3,788	7,586	1,500	1,683	

1.Excludng consumptive use in the lower basin tributaries. 2. Lower Basin Use great than 7.5 maf is due to surplus water supply conditions in the Lower Division States. 3. Phreatophyte and operational inefficiency losses.


Flaming Gorge Dam
Cheyenne
Yampa River
Yampa
White River
White
Colorado River
Colorado River
Grand Junction
Utah
Gunnison River
Aspinall Unit
Gunnison
Dolores River
Dolores
San Juan River
San Juan
Rio Grande
Arkansas
Fort Collins
South Platte River
South Platte
Boulder
Denver
Aurora
Colorado Front Range
Colorado Springs
Colorado
Pueblo
Arkansas River
Kansas
Farmington
Navajo Dam
Arizona
New
Oklahoma

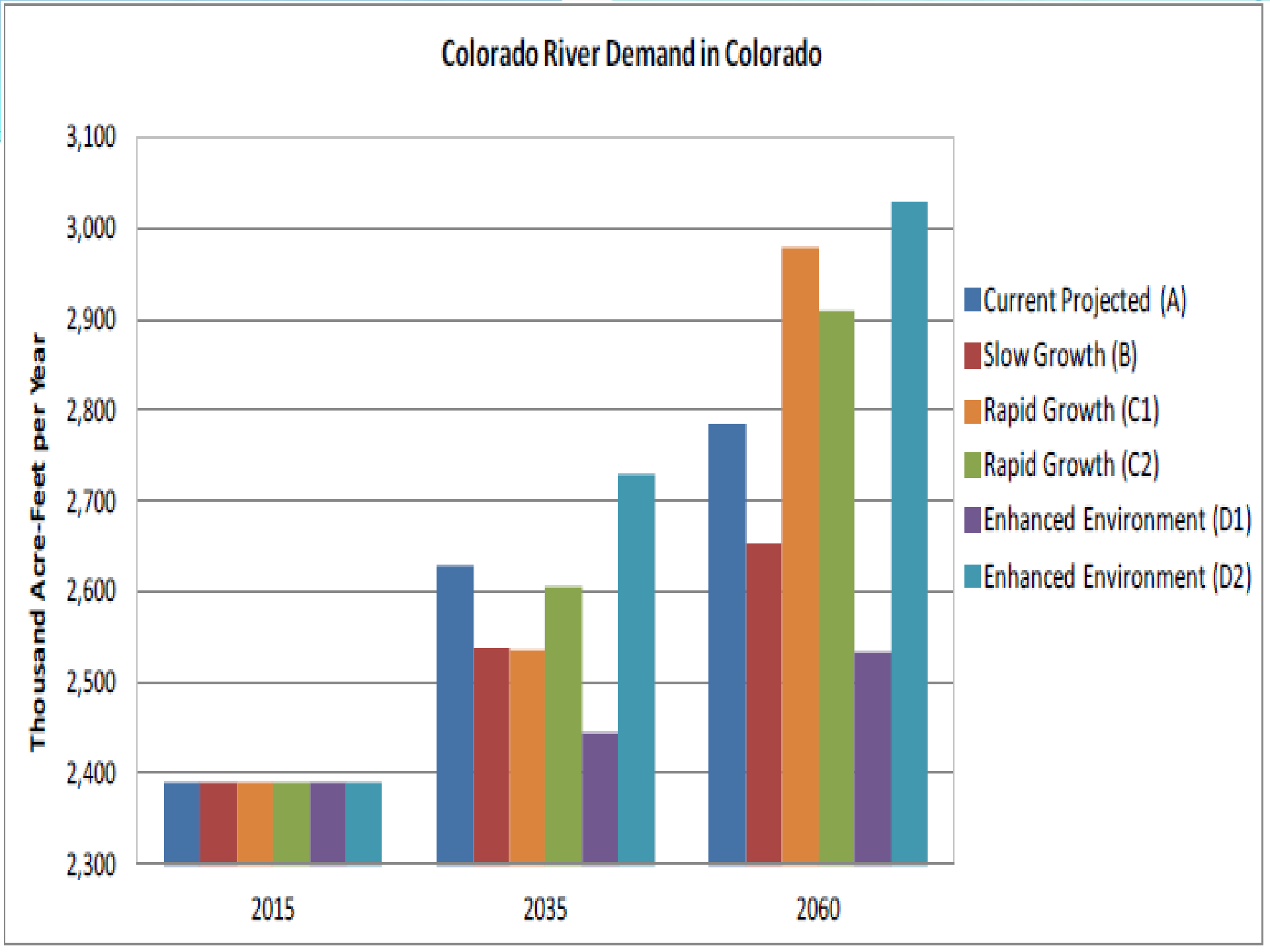
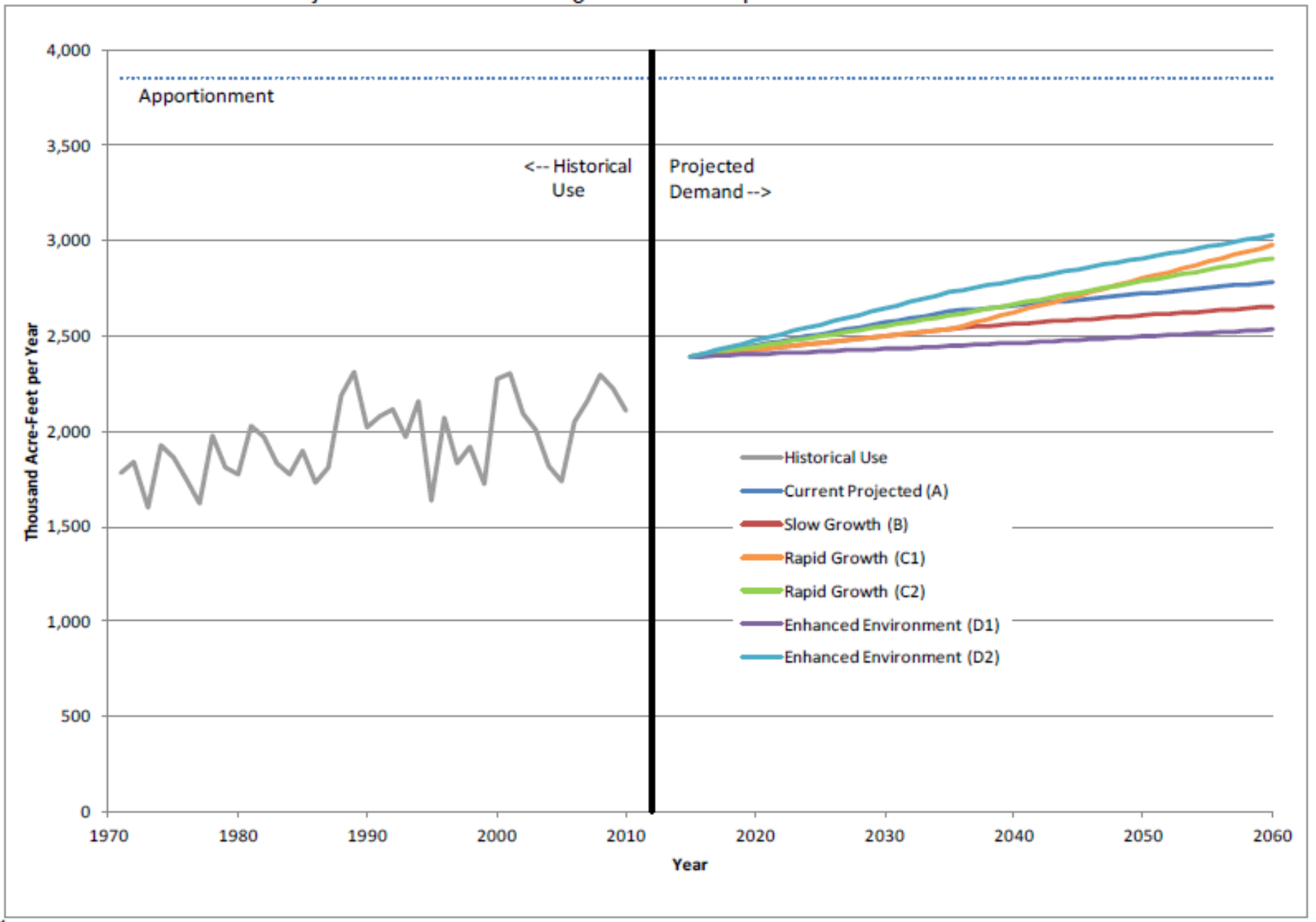

Colorado River Demand in Colorado
Thousand Acre-Feet per Year
3,100
3,000
2,900
2,800
2,700
2,600
2,500
2,400
2,300
2015
2035
2060
Current Projected (A)
Slow Growth (B)
Rapid Growth (C1)
Rapid Growth (C2)
Enhanced Environment (D1)
Enhanced Environment (D2)

FIGURE C2-3

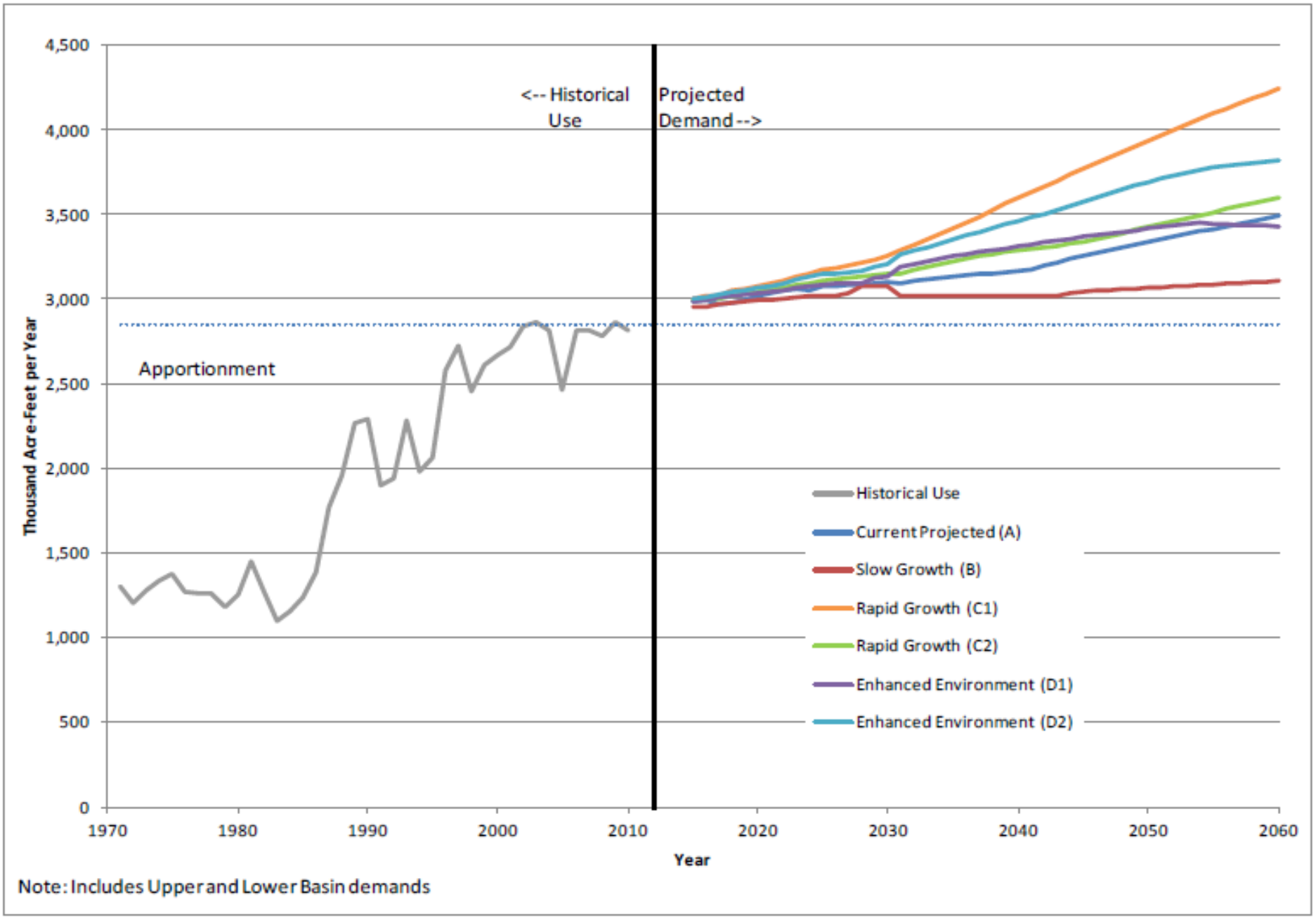
Historical Use and Future Projected Demand Excluding Reservoir Evaporation[1]



[1]Reservoir evaporation on the order of 430 thousand acre-feet is not included in this plot.

FIGURE C6-3

Historical Use and Future Projected Demand



Note: Includes Upper and Lower Basin demands

Law of the River Allocations

- **7.5 MAF to Upper Basin**
- **7.5 MAF to Lower Basin (4.4 CA; 2.8 AZ; 0.3 NV)**
- **1.0 MAF additional to Lower Basin**
- **<u>1.5 MAF to Mexico (in most years)</u>**

17.5 MAF in allocations

Current Use Estimates

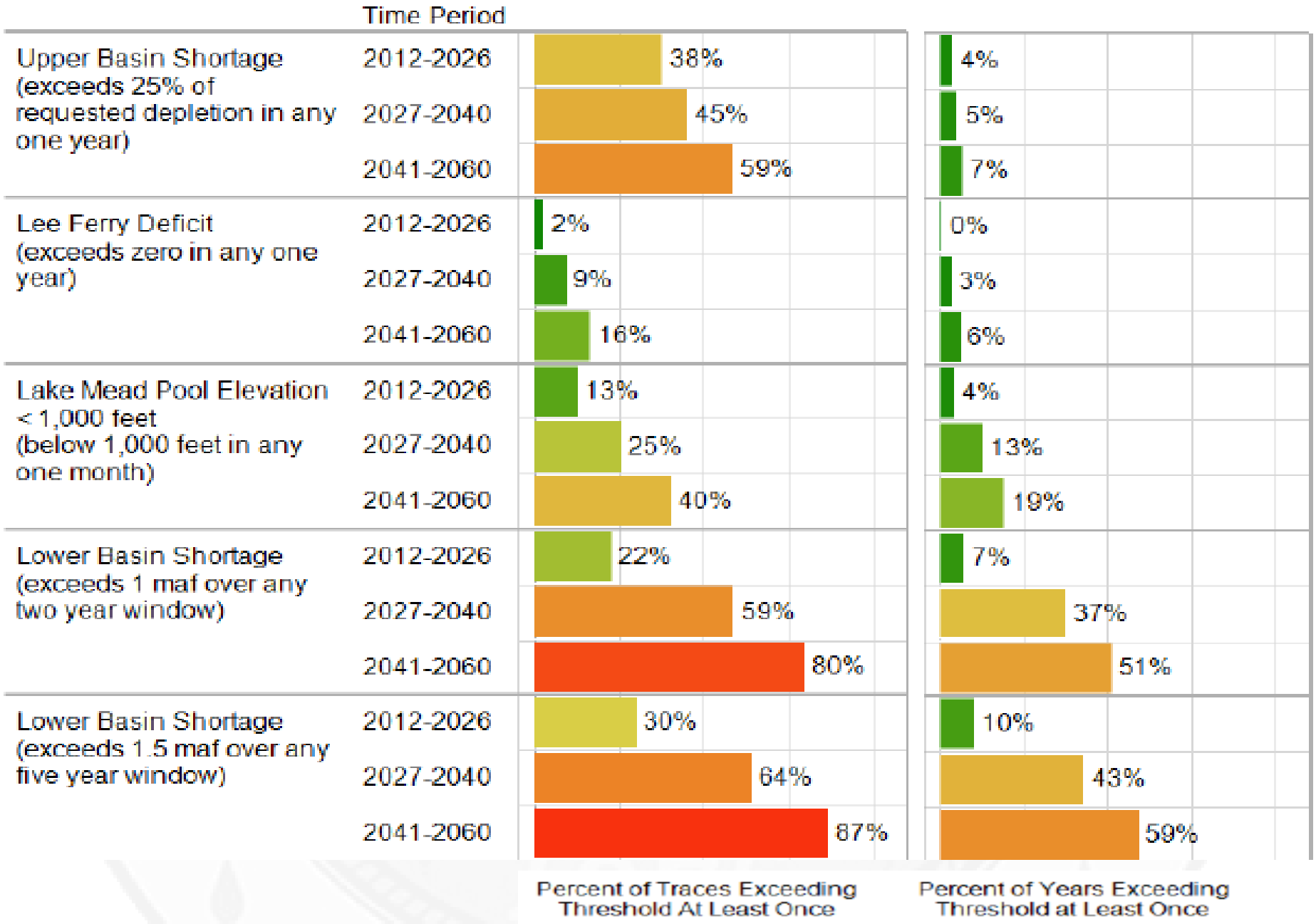
	MAF/ year
Upper Basin uses incl. reservoir evap.	4.0 - 4.5
Lower Basin mainstem uses	7.5 - 7.5
Lower Basin reservoir evap.	1.0 - 1.5
Lower Basin tributaries	2.0 - 2.5
Total Lower Basin	10.5 - 11.5
Subtotal	14.5 – 16.0
Add Mexico	1.5 1.5
TOTAL	16.0 – 17.5

Source-Dave Kanzer, CRWCD and summarized by REK before the CRBS

System Response Variables

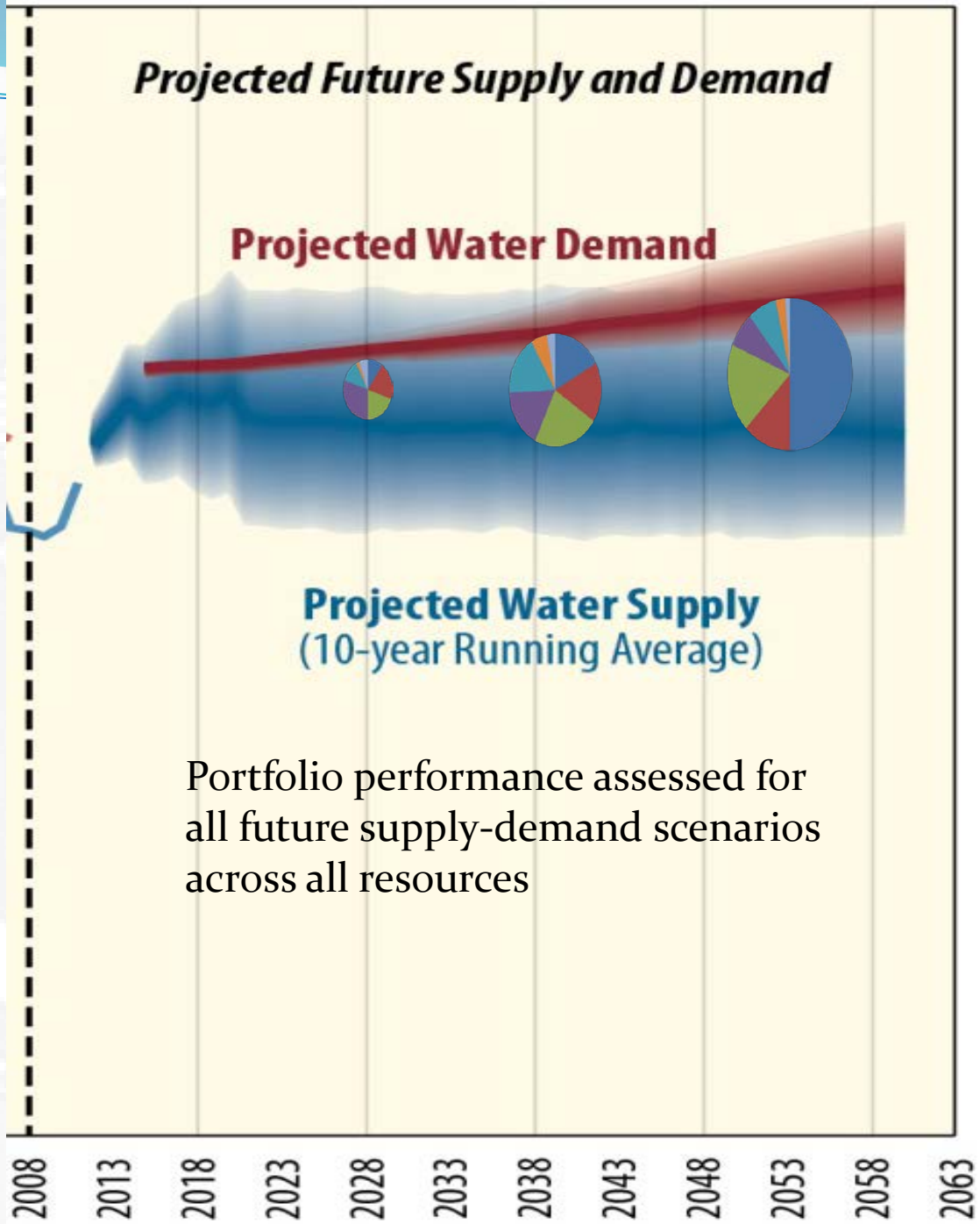
Powel Pool Elevation	Total Energy Production
Mead Pool Elevation	Total Storage Above Powell
Lower Basin Shortage	Flow of Green River at Green River, UT
Upper Basin Shortage	Flow of Colorado River near Cisco, UT
Powell Water Year Release	Flow of San Juan River near Bluff, UT
Lee Ferry Deficit	

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



Portfolio Development

- "Portfolios" are combinations of options that implement a particular strategy.
- Strategy expressed through characterization criteria which determines how options are combined. Infinite possibilities.
- Four Study portfolios are only illustrative



Portfolio performance assessed for all future supply-demand scenarios across all resources

FIGURE F-14

Ordered Options, Yield, Cost, and Timing Availability for Portfolio A

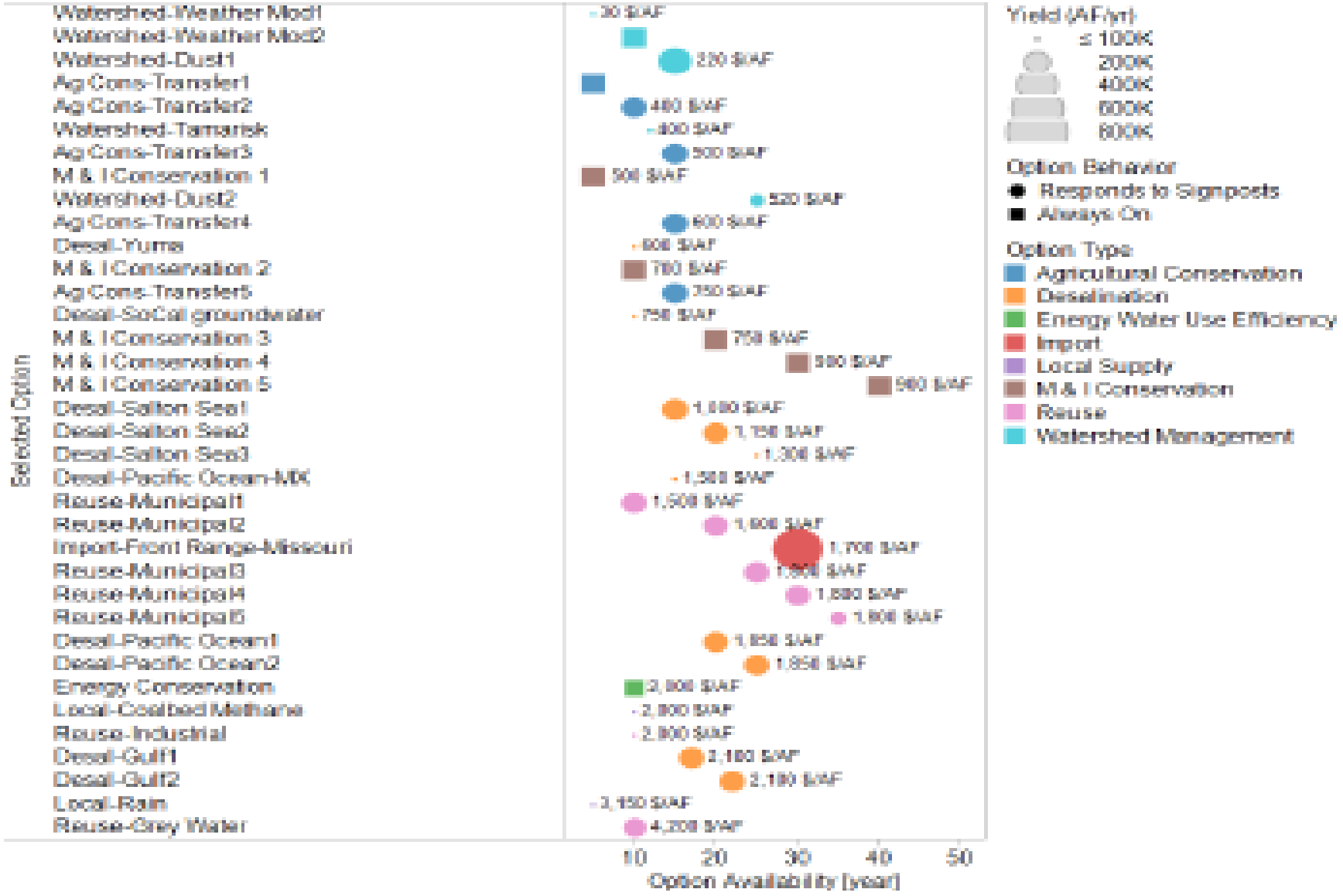
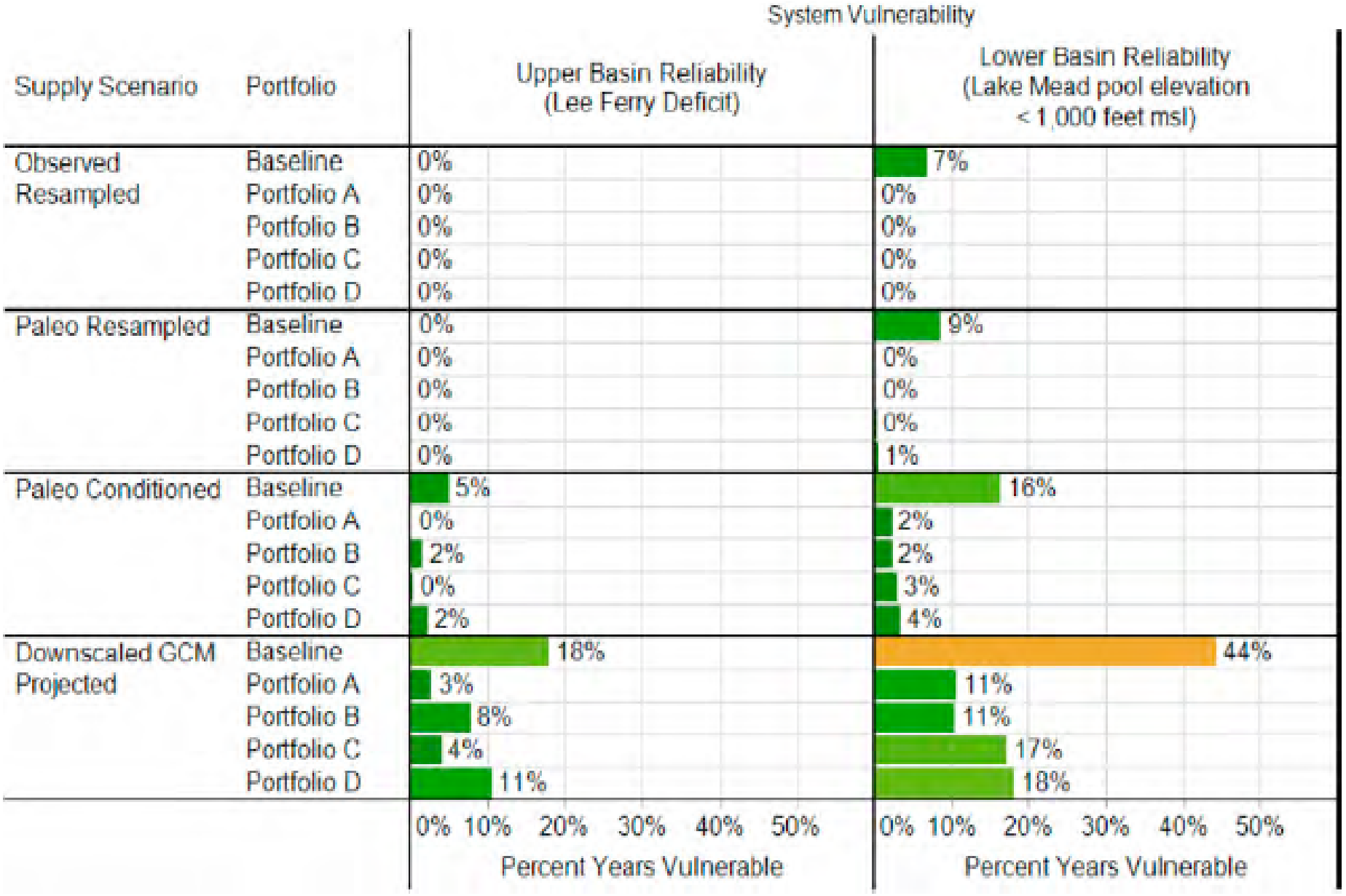


FIGURE G-44

Percent of Years Vulnerable for Upper Basin Reliability (left) and Lower Basin Reliability (right) in 2041–2060 with Portfolios Implemented, by Supply Scenario



Key Points

- Demands in the Upper Division States do not reach or exceed apportionments by 2060.
- Lower Division demands already exceed apportionments.
- Shortages in the Lower Basin are primarily due to high demands and overuse (evaporation, losses, tributaries).
- Shortages in the Upper Basin are primarily due to hydrologic shortages.

Key Points

- Using historical hydrology, there are only very small differences between the demand scenarios as to the likelilhood of a deficit at Lees Ferry (assuming 75/10). Mexican obligations? Tributaries?
- The average of the 112 Global Climate Models (GCMs) show 9% decrease in 2011-2060 average natural flow at Lees Ferry.
- "Signposts" of observable conditions can be used to identify the increased risk of a near-term Lee Ferry Deficit.

Next Steps

- Educational outreach.
- States are committed to supporting additional Climate Change research and model improvements.
- States are committed to working together on developing additional actions to take in the immediate future.
  - Augmentation feasibility
  - Water banking will continue to be explored
  - Working groups on Agriculture and M&I Conservation
  - Watershed options (weather modification, tamarisk)
- Explore Environmental and Recreational flow needs.
- Continue to work on an inclusive dialogue.

Celebrating 75 years

"to conserve, develop, protect, and manage Colorado's water for present and future generations."