

# RECLAMATION

*Managing Water in the West*

Interim Report No. 1

## Colorado River Basin Water Supply and Demand Study



U.S. Department of the Interior  
Bureau of Reclamation

June 2011

## **Mission Statements**

### **Protecting America's Great Outdoors and Powering Our Future**

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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## Colorado River Basin Water Supply and Demand Study

# Executive Summary

*Prepared by:*

**Colorado River Basin Water Supply and Demand Study  
Study Team**



**U. S. Department of the Interior  
Bureau of Reclamation**

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# Executive Summary

Spanning parts of the seven states of Arizona, California, Colorado, New Mexico, Nevada, Utah, and Wyoming (Basin States), the Colorado River Basin (Basin) is one of the most critical sources of water in the western United States (West). The Colorado River and its tributaries provide water to over 30 million people for municipal use, supply water used to irrigate nearly 4 million acres of land, and are also the lifeblood for at least 15 Native American tribes, 7 National Wildlife Refuges, 4 National Recreation Areas, and 11 National Parks. Hydropower facilities along the Colorado River provide more than 4,200 megawatts of generating capacity, helping meet the power needs of the West and offset use of fossil fuels. The Colorado River is vital to Mexico to meet both agricultural and municipal water needs. It is essential to understand that the natural water supply of the Basin is highly variable year to year. The ability to capture water Basin-wide during years in which supply is greater than demand has resulted in meeting most of the resource needs throughout the 20th-century, although localized shortages routinely occur, particularly in the headwaters areas during times of drought.

Throughout the 20th-century, the challenges and complexities of ensuring a sustainable water supply and meeting future demand in the over-allocated Colorado River system have been recognized. These challenges have been systematically documented in studies conducted by the Bureau of Reclamation and the Basin States over the past 60 years. Concerns regarding the reliability of the Colorado River system to meet the future needs of Basin resources<sup>1</sup> in the 21st-century are heightened, given the likelihood of increasing demand for water throughout the Basin, coupled with projections of reduced supply due to climate change.

Funded through the Basin Study Program under the Department of the Interior's WaterSMART Program, the Colorado River Basin Water Supply and Demand Study (Study) is being conducted by the Bureau of Reclamation's Upper Colorado and Lower Colorado Regions and agencies representing the Basin States. The purpose of the Study is to define current and future imbalances in water supply and demand in the Basin and the adjacent areas of the Basin States that receive Colorado River water over the next 50 years (through 2060), and to develop and evaluate adaptation and mitigation strategies to resolve those imbalances. The Study contains four major phases to accomplish this goal: Water Supply Assessment, Water Demand Assessment, System Reliability Analysis, and Development and Evaluation of Opportunities for Balancing Supply and Demand.

The Study is being conducted in collaboration with stakeholders throughout the Basin whose participation and input are critical to the Study's success. Interests are broad and include Native American tribes and communities, agricultural users, purveyors of municipal and industrial water, power users, and environmental groups. Through the Study's outreach efforts, many interested parties have been involved and others are encouraged to do so. A

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<sup>1</sup> Resources include water allocations and deliveries for municipal, industrial, and agricultural use; hydroelectric power generation; recreation; fish, wildlife, and their habitats (including candidate, threatened, and endangered species); water quality including salinity; flow and water-dependent ecological systems; and flood control.

variety of options for involvement exist and range from attending public meetings and informational webinars to participating directly in the development of work products through the Study's technical sub-teams. Additional information is provided on the Study website at: <http://www.usbr.gov/lc/region/programs/crbstudy.html>.

Due to the inherent complexities of the Study and the many diverse interests and perspectives throughout the Basin, a dynamic reporting approach reflecting continuous technical developments and the ongoing input of stakeholders has been adopted. This approach consists of the issuance of interim reports, which are “snapshots” of the Study's progress as of a particular date. Interim Report No. 1, which documents the Study progress through January 31, 2011, is the first interim report to be issued for the Study and is available for download from the Study website (provided above). Project participants and stakeholders are encouraged to review and comment on the information provided in this report. Written comments should be submitted within 30 days following its release and will be incorporated into subsequent interim reports, as appropriate. Instructions for submitting comments are provided on the Study website.

The status of the Study as of January 31, 2011 is presented in the following sections. Ongoing work from February 1, 2011 will be documented in the next interim report.

## **1.0 Scenario Development**

The amount of water available and changes in the demand for water throughout the Basin over the next 50 years are highly uncertain and dependent upon a number of factors. The potential impacts of future climate variability and climate change further contribute to these uncertainties. Nevertheless, projections of future supply and demand are needed to assess the future reliability of the Colorado River system to meet the needs of Basin resources and to identify options and strategies to mitigate future risks to those resources. These projections must be sufficiently broad to capture the plausible ranges of uncertainty in future water supply and demand. A scenario planning and development process has been used to guide the development of a broad range of future water supply and demand projections, resulting in four scenarios related to future water supply, and four scenarios related to future water demand. The extent to which these scenarios have been fully defined and quantified varies. Work is ongoing to complete this effort and will be included in subsequent interim reports.

## **2.0 Water Supply Assessment**

In 2004, Reclamation initiated a multi-faceted research and development program to investigate and implement a variety of methods for projecting plausible future inflow sequences for Colorado River planning studies. Based on this work and the information gathered in the scenario planning process, four water supply scenarios have been quantified and analyzed. These four scenarios are titled Observed Resampled, Paleo Resampled, Paleo Conditioned, and Downscaled Global Climate Model (GCM) Projected, and are based on information from three sources—the observed historical streamflow record, the paleo-reconstructed streamflow record, and projections of streamflow using future climate projections from GCMs.

Under the Downscaled GCM Projected scenario, the mean natural flow as measured at Lees Ferry over the next 50 years is projected to decrease by approximately 9 percent, along with a projected increase in both drought frequency and duration as compared to the observed historical streamflow record. Droughts lasting 5 or more years are projected to occur 40 percent of the time over the next 50 years. Projected changes in climate and hydrologic processes include continued warming across the Basin, a trend toward drying, although precipitation patterns continue to be spatially and temporally complex, and increases in evapotranspiration and decreases in snowpack, as more precipitation falls as rain rather than snow.

Although some minor methodological and reporting differences exist, the results presented in this report are consistent with Reclamation's report to Congress published in March 2011, in fulfillment of the requirements within Section (§) 9503 of the SECURE Water Act (enacted into law as part of the Omnibus Public Land Management Act of 2009, Public Law 111-11). That report<sup>2</sup> provides information on the future risks to water supply throughout the eight major Reclamation river basins, whereas this Study is focused on a more detailed, Basin-wide risk assessment with a focus on the development and evaluation of opportunities to mitigate and adapt to those risks.

A review of the data and tools used to quantify the Downscaled GCM Projected scenario is ongoing. As a result, the streamflow projections under this scenario may be updated and included in the next interim report.

### **3.0 Water Demand Assessment**

Historically, Reclamation has considered a single projection of future demands in long-term Basin planning studies based on data and information provided by the Basin States, Native American tribes and communities, federal agencies, and other water entitlement holders. The Study considers additional projections of demand, a significant and important advancement in long-term Basin planning. Through the scenario planning process, the most critical uncertainties affecting future demand were identified (e.g., changes in population and water use efficiency) and were combined into four scenarios, titled Current Trends, Economic Slowdown, Expansive Growth, and Enhanced Environment and Healthy Economy.

The Current Trends scenario is the first scenario that is being quantified and will be used as a starting point for quantifying the remaining scenarios. Although the Current Trends scenario is not a direct mathematical projection of historical data, it relies on knowledge of historical consumptive uses and losses, as well as planning data and expertise to estimate future trends in water demands. As such, historical consumptive uses and losses data were compiled and are presented in this report. From 1971-1999 (just prior to the start of the recent drought in 2000), consumptive uses and losses in the Basin have increased from approximately 13 million acre-feet (maf) to 16 maf per year, an increase of about 23 percent.

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<sup>2</sup> Available at: <http://www.usbr.gov/climate/SECURE/docs/SECUREWaterReport.pdf>.

## 4.0 System Reliability Metrics

System reliability metrics (metrics) are measures that indicate the ability of the Colorado River system to meet the needs of Basin resources under multiple future conditions. Metrics will be used to measure the potential impacts to Basin resources resulting from future supply and demand imbalances, and to measure the effectiveness of options and strategies to address those imbalances.

A process was developed for metric identification and used to craft a detailed set of metrics for the Basin resources. Based on the *Plan of Study* and working closely with stakeholders, resource categories were identified (Water Deliveries, Electrical Power Resources, Water Quality, Flood Control, Recreational Resources, and Ecological Resources), followed by identification of attributes of interest associated with each category (e.g., shoreline public use facilities is an attribute of interest under the Recreational Resources category). Metrics were defined for each attribute of interest, depending on the location of the attribute and the availability of data and/or tools.

In some cases, the spatial and temporal detail of the data and/or tools available will limit the ability to quantitatively assess the potential resource impacts. In these cases, impacts will either be assessed in a qualitative manner or, where time and resources permit, additional analysis may be performed to enable a quantitative assessment.

Metrics have been defined for each of the identified resource categories; however, additional metrics for the Ecological Resources category are currently under consideration. Refinement of the metrics will be documented in subsequent interim reports.

## 5.0 Next Steps

This Interim Report No. 1 documents the progress of the Study through January 31, 2011. Ongoing work from February 1, 2011 will be documented in the next interim report and will include:

- Completion of the quantification of the Downscaled GCM Projected scenario
- Quantification of the water demand scenarios, including the effects of climate change on demand
- Refinement of system reliability metrics
- Assessment of system reliability to determine the magnitude and location of future supply and demand imbalances and the impacts to Basin resources
- Initiation of the development and evaluation of opportunities for resolving supply and demand imbalances

An updated timeline for the Study, outlining the major activities through the end of the Study in July 2012, is provided in Table 1. As the Study progresses, opportunities for stakeholder participation will continue to be provided through a variety of outreach activities, particularly with respect to the development and evaluation of opportunities for resolving supply and demand imbalances.

**TABLE 1**  
Updated Study Timeline

<b>Timeframe</b>	<b>Activity</b>
February – August 2011	Quantify Demand Scenarios
July – September 2011	Perform Baseline System Reliability Analysis
September – December 2011	Develop Options and Strategies
October 2011	Publish Interim Report Number 2
November 2011 – February 2012	Perform System Reliability Analysis with Options and Strategies
March 2012	Publish Interim Report Number 3
April – May 2012	Finalize and Evaluate Options and Strategies
June 2012	Publish Draft Final Study Report for Comment
July 2012	Publish Final Study Report



# Disclaimer

The Colorado River Basin Water Supply and Demand Study (Study) is funded jointly by the Bureau of Reclamation (Reclamation) and the seven Colorado River Basin States (Basin States). The purpose of the Study is to analyze water supply and demand imbalances throughout the Colorado River Basin and those adjacent areas of the Basin States that receive Colorado River water through 2060; and develop, assess and evaluate options and strategies to address the current and projected imbalances.

Reclamation and the Basin States intend that this Study will promote and facilitate cooperation and communication throughout the Basin regarding the reliability of the system to continue to meet Basin needs and the strategies that may be considered to ensure that reliability. Reclamation and the Basin States recognize the Study will have to be constrained by funding, timing and technological and other limitations, which may present specific policy questions and issues, particularly related to modeling and interpretation of the provisions of the Law of the River during the course of the Study. In such cases, Reclamation and the Basin States will develop and incorporate assumptions to further complete the Study. Where possible, a range of assumptions will typically be used to identify the sensitivity of the results to those assumptions.

Nothing in the Study, however, is intended for use against any Basin State, the Federal government or the Upper Colorado River Commission in administrative, judicial or other proceedings to evidence legal interpretations of the law of the river. As such, assumptions contained in the Study or any reports generated during the Study do not, and shall not, represent a legal position or interpretation by the Basin States, Federal government or Upper Colorado River Commission as it relates to the law of the river. Furthermore, nothing in this Study is intended to, nor shall this Study be construed so as to, interpret, diminish or modify the rights of any Basin State, the Federal government, or the Upper Colorado River Commission under federal or state law or administrative rule, regulation or guideline, including without limitation the Colorado River Compact, (45 Stat. 1057), the Upper Colorado River Basin Compact (63 Stat. 31), the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, Treaty Between the United States of America and Mexico (Treaty Series 994, 59 Stat. 1219), the United States/Mexico agreement in Minute No. 242 of August 30, 1973, (Treaty Series 7708; 24 UST 1968) or Minute No. 314 of November 26, 2008, or Minute No. 318 of December 17, 2010, the Consolidated Decree entered by the Supreme Court of the United States in *Arizona v. California* (547 U.S. 150 (2006)), the Boulder Canyon Project Act (45 Stat. 1057), the Boulder Canyon Project Adjustment Act (54 Stat. 774; 43 U.S.C. 618a), the Colorado River Storage Project Act of 1956 (70 Stat. 105; 43 U.S.C. 620), the Colorado River Basin Project Act of 1968 (82 Stat. 885; 43 U.S.C. 1501), the Colorado River Basin Salinity Control Act (88 Stat. 266; 43 U.S.C. 1951), the Hoover Power Plant Act of 1984 (98 Stat. 1333), the Colorado River Floodway Protection Act (100 Stat. 1129; 43 U.S.C. 1600), or the Grand Canyon Protection Act of 1992 (Title XVIII of Public Law 102-575, 106 Stat. 4669). Reclamation and the Basin States continue to recognize the entitlement and right of each State under existing law to use and develop the water of the Colorado River system.<sup>3</sup>

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<sup>3</sup> Reclamation and the Basin States have exchanged letters and are in the process of amending the Contributors' funding agreement to, among other things, document and clarify the intent of the Parties consistent with the above disclaimer.