Overview of the Colorado River Basin Water Supply and Demand Study

Upper Colorado River Basin Water Conference
November 9, 2012
Colorado Mesa University, Grand Junction CO
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 November 2012
- A planning study – will not result in any decisions, but will provide the technical foundation for future activities
Study Phases and Tasks

**Phase 1: Water Supply Assessment**
1.1 – Select Methods to Estimate Current Supply
1.2 – Select Methods to Project Future Supply
1.3 – Conduct Assessment of Current Supply
1.4 – Conduct Assessment of Future Supply

**Phase 2: Water Demand Assessment**
2.1 – Select Methods to Estimate Current Demand
2.2 – Select Methods to Project Future Demand
2.3 – Conduct Assessment of Current Demand
2.4 – Conduct Assessment of Future Demand

**Phase 3: System Reliability Analysis**
3.1 – Identify Reliability Metrics
3.2 – Estimate Baseline System Reliability
3.3 – Project Future System Reliability
3.3.5-3.3.8 – Project Future Reliability with Opportunities

**Phase 4: Development & Evaluation of Opportunities**
4.1 – Develop Opportunities
4.2 – Evaluate and Refine Opportunities
4.3 – Finalize Opportunities

Formulate Approach to Include Uncertainty
Develop Future Supply and Demand Scenarios
<table>
<thead>
<tr>
<th>Date</th>
<th>Document Title</th>
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<tbody>
<tr>
<td>June 2011</td>
<td>Interim Report No. 1</td>
</tr>
<tr>
<td>November 2011</td>
<td>Report to Solicit Input on Options and Strategies</td>
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<tr>
<td>February 2012</td>
<td>Technical Report B – Water Supply Assessment</td>
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<td></td>
<td>Technical Report D – System Reliability Metrics</td>
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<td>April 2012</td>
<td>Options posted to Study website</td>
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<td>May 2012</td>
<td>Technical Memo C – Quantification of Water Demand Scenarios</td>
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<td>November 2012</td>
<td>Final Study Report</td>
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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)
Water Supply Scenarios

Observed Resampled:
- future hydrologic trends and variability will be similar to the past 100 years

Paleo Resampled:
- future hydrologic trends and variability are represented by the distant past (approximately 1250 years)

Paleo Conditioned:
- future hydrologic trends and variability are represented by a blend of the wet dry states of the paleo-climate record but magnitudes are more similar to the observed period

Downscaled GCM Projected:
- future climate will continue to warm with regional precipitation trends represented through an ensemble of future GCM projections

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
Quantification of Water Supply Scenarios

Projections of 2011-2060 Average Natural Flow at Lees Ferry

<table>
<thead>
<tr>
<th>Observed</th>
<th>102 Traces Mean = 15002</th>
<th>Direct Paleo Mean = 14675</th>
<th>Paleo Conditioned Mean = 14937</th>
<th>Climate Projections Mean = 13588</th>
</tr>
</thead>
</table>

1991 – 2010 average = 13.7 MAF

Box represents 25th – 75th percentile, whiskers represent min and max, and triangle represents mean of all traces
# Projections of Natural Flow at Lees Ferry

## Deficit and Surplus Statistics

*Computed over the 2011-2060 Period*

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Observed Resampled</th>
<th>Paleo Resampled</th>
<th>Paleo Conditioned</th>
<th>Downscaled GCM Projected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of Deficit(^1) lasting 5 years or longer</td>
<td>22%</td>
<td>30%</td>
<td>25%</td>
<td>48%</td>
</tr>
<tr>
<td>Frequency of Surplus(^1) lasting 5 years or longer</td>
<td>28%</td>
<td>15%</td>
<td>18%</td>
<td>&lt;1%</td>
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\(^1\)A deficit/surplus period occurs whenever the 2-year running mean is below/above the observed mean of 15.0 maf
Quantification of Water Demand Scenarios

• 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

*Quantified demand scenarios have been adjusted to include Mexico's allotment and estimates for future reservoir evaporation and other losses.
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) to 15% (4.6 million)
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.

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.
System Reliability Analysis

- Simulate the state of the system on a monthly time step over the next 50 years for each scenario, with and without options and strategies

- Metrics will be used to quantify impacts to Basin resources

- **Resource Categories**
  - Water Deliveries
  - Electrical Power Resources
  - Water Quality
  - Flood Control
  - Recreational Resources
  - Ecological Resources

  *For clarity, water delivery locations are not indicated (about 250 locations)*
Summary of Options Submitted

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

**Increased Supply** – importation, reuse, 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.
Organizing and Characterizing Options

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

- “Portfolios” are combinations of options that implement a particular strategy.

- Strategy expressed through characterization criteria which determines how options are combined.

- Four Study portfolios have been developed that have varying costs and yields and reflect different preferences towards reliability and environmental impacts.

Portfolio performance assessed for all future supply-demand scenarios across all resources.
Final Study Report

• The Final Study Report will be published in late November and will consist of:
  – Executive Summary
  – Study Report
  – Technical Report A: Scenario Development
  – Technical Report B: Water Supply Assessment
  – Technical Report C: Water Demand Assessment
  – Technical Report E: Approach to Develop and Evaluate Options and Strategies
  – Technical Report F: Options and Strategies
Colorado River Basin Water Supply and Demand Study

Study Contact Information
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