

RECLAMATION

Managing Water in the West

Colorado River Basin Water Supply and Demand Study

Public Meeting
Overview of Interim Report No. 1
June 14, 2011



U.S. Department of the Interior
Bureau of Reclamation

Colorado River Basin Water Supply and Demand Study

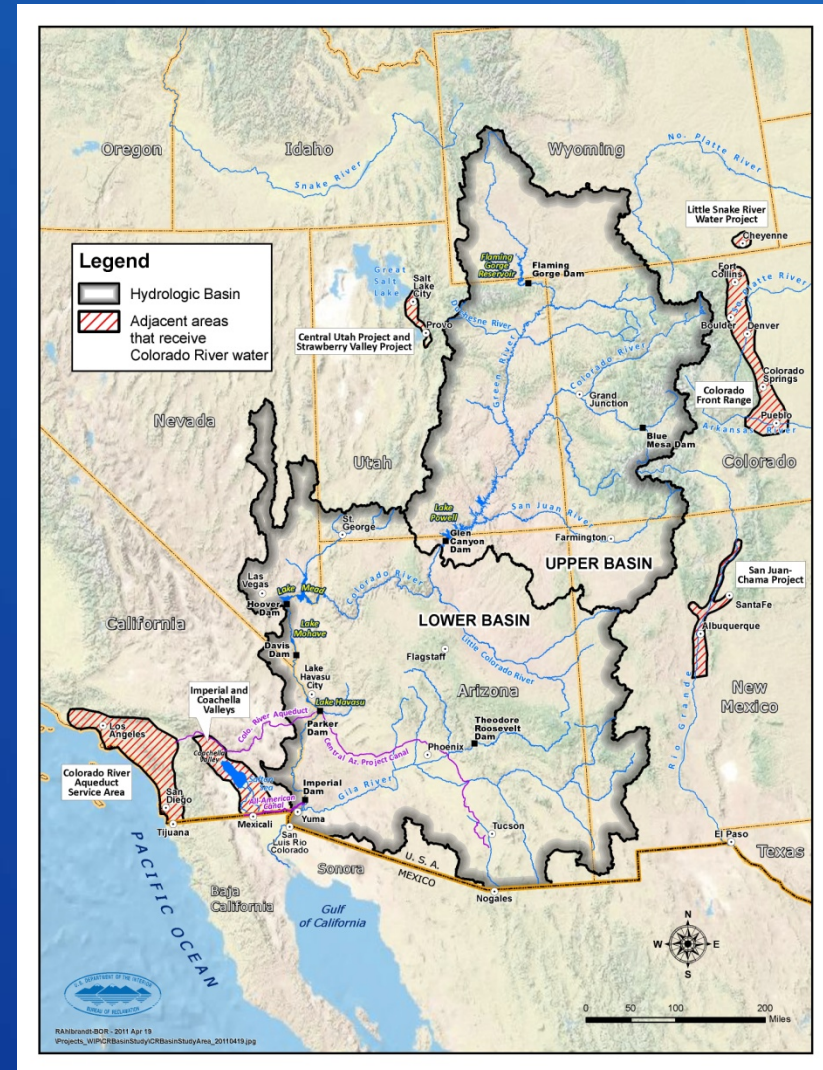
- Welcome and Introductions
- Study Overview and Status
- Overview of Interim Report No. 1
- Schedule
- Questions



RECLAMATION

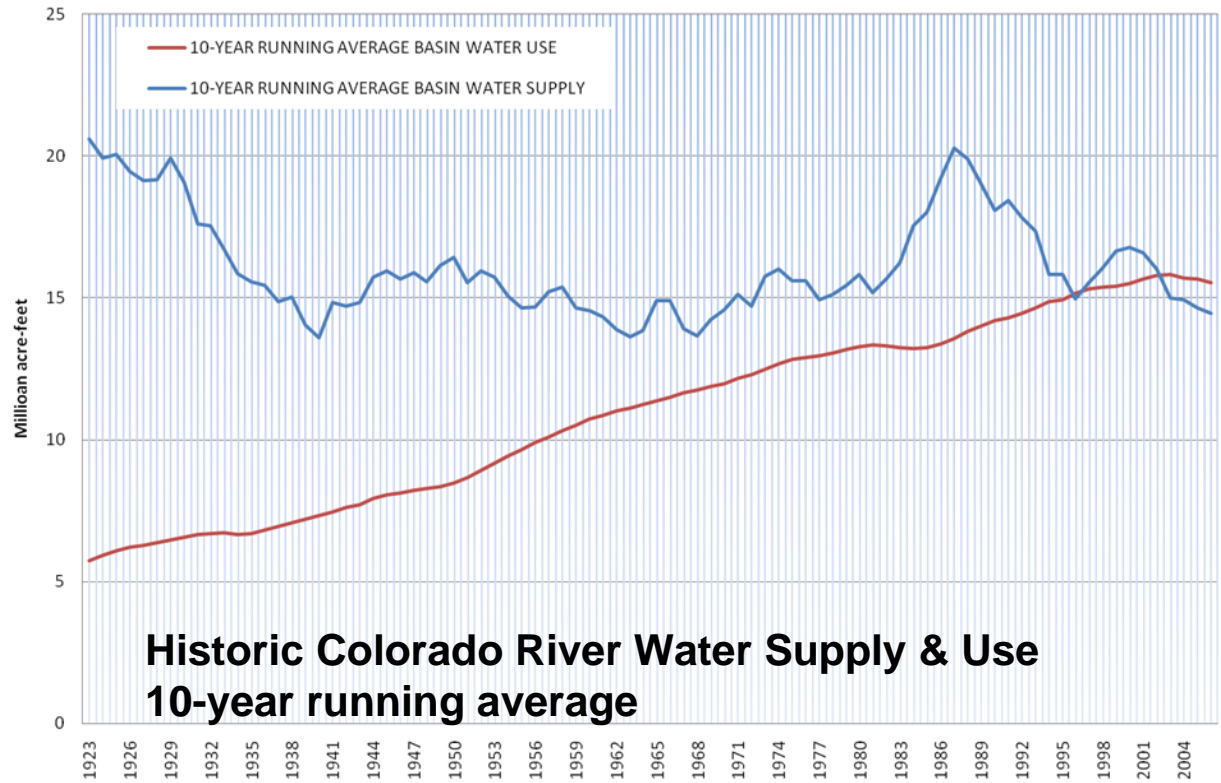
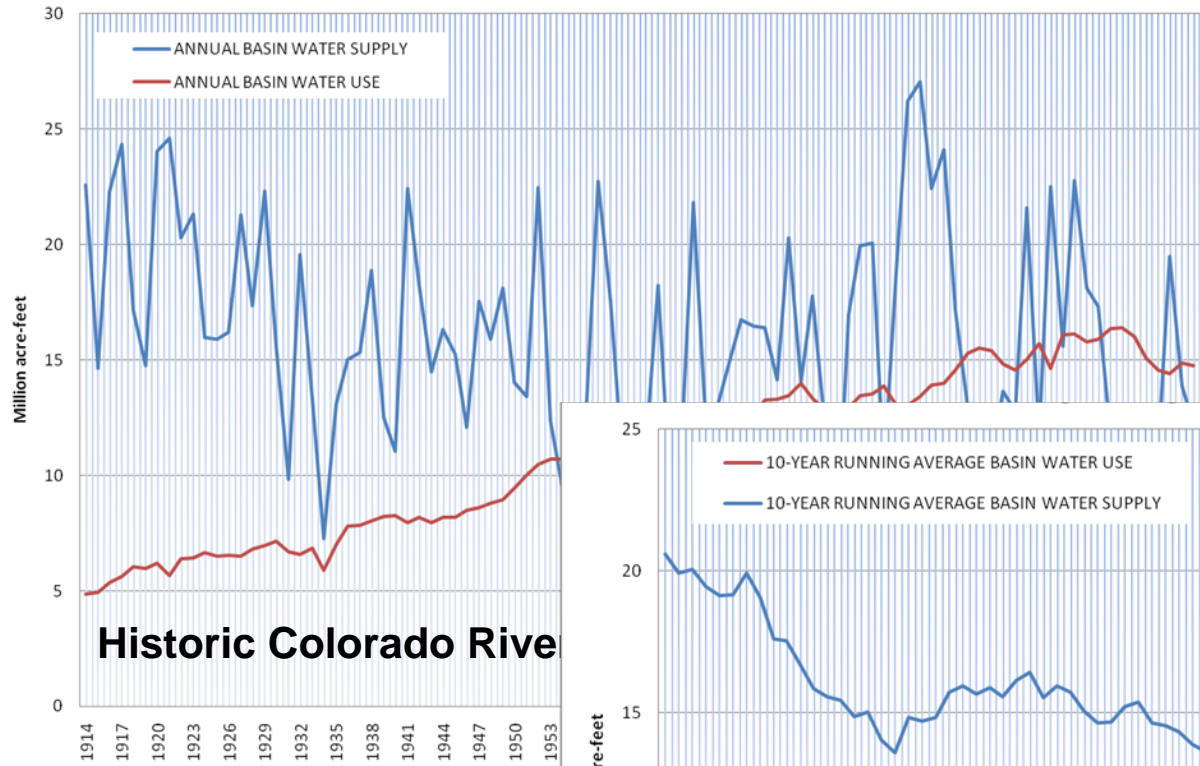
Colorado River Basin Water Supply and Demand Study

- Study Objective
 - Assess future water supply and demand imbalances and develop/evaluate opportunities for resolving imbalances
- Study being conducted by Reclamation and the Basin States, in collaboration with stakeholders throughout the Basin
- Study began in January 2010 and will be completed by July 2012
- Email:
ColoradoRiverBasinStudy@usbr.gov
- Website:
<http://www.usbr.gov/lc/region/programs/crbstudy.html>
- A planning study – will *not* result in any decisions

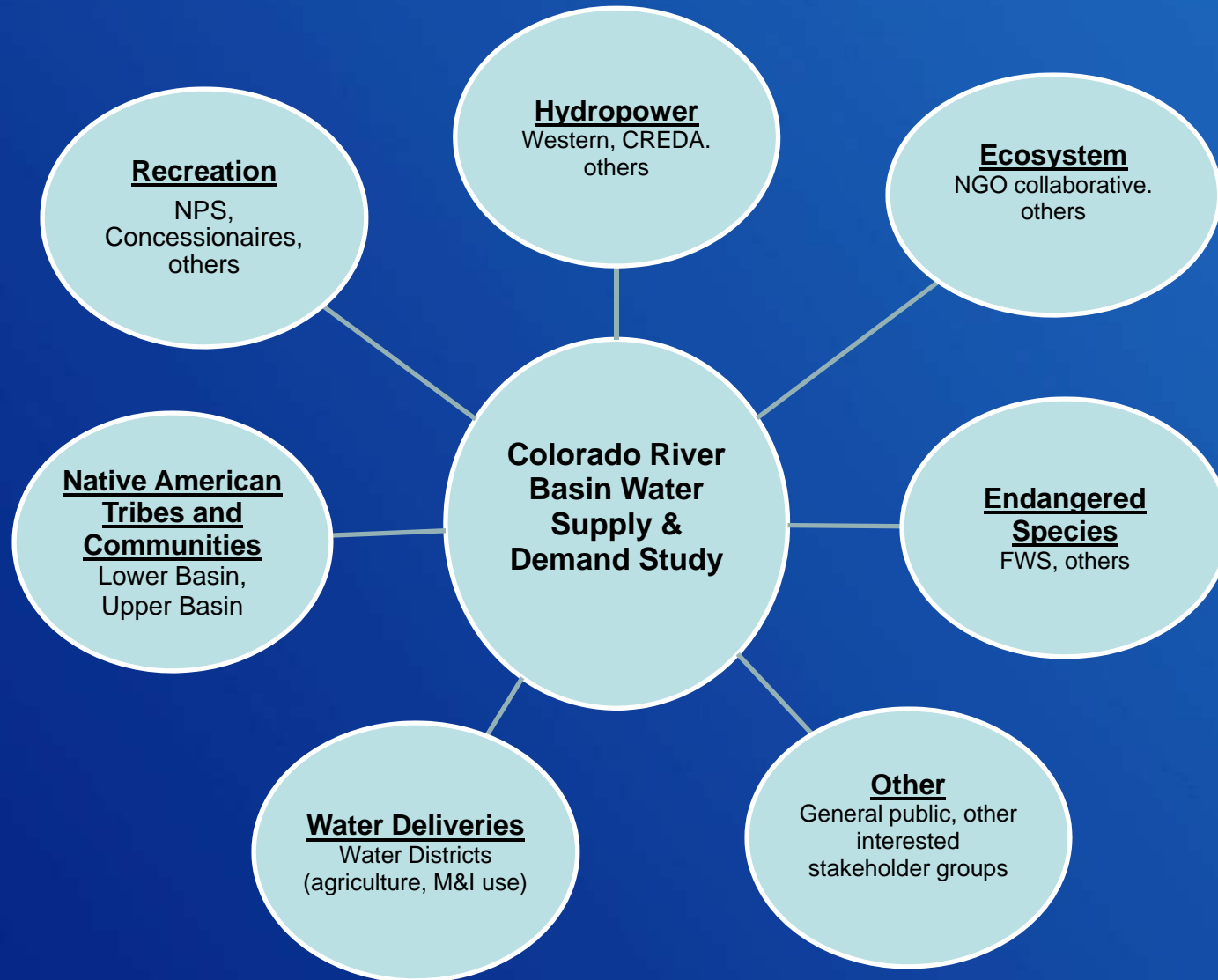


RECLAMATION

Colorado River Basin Water Supply and Demand Study



Study Outreach

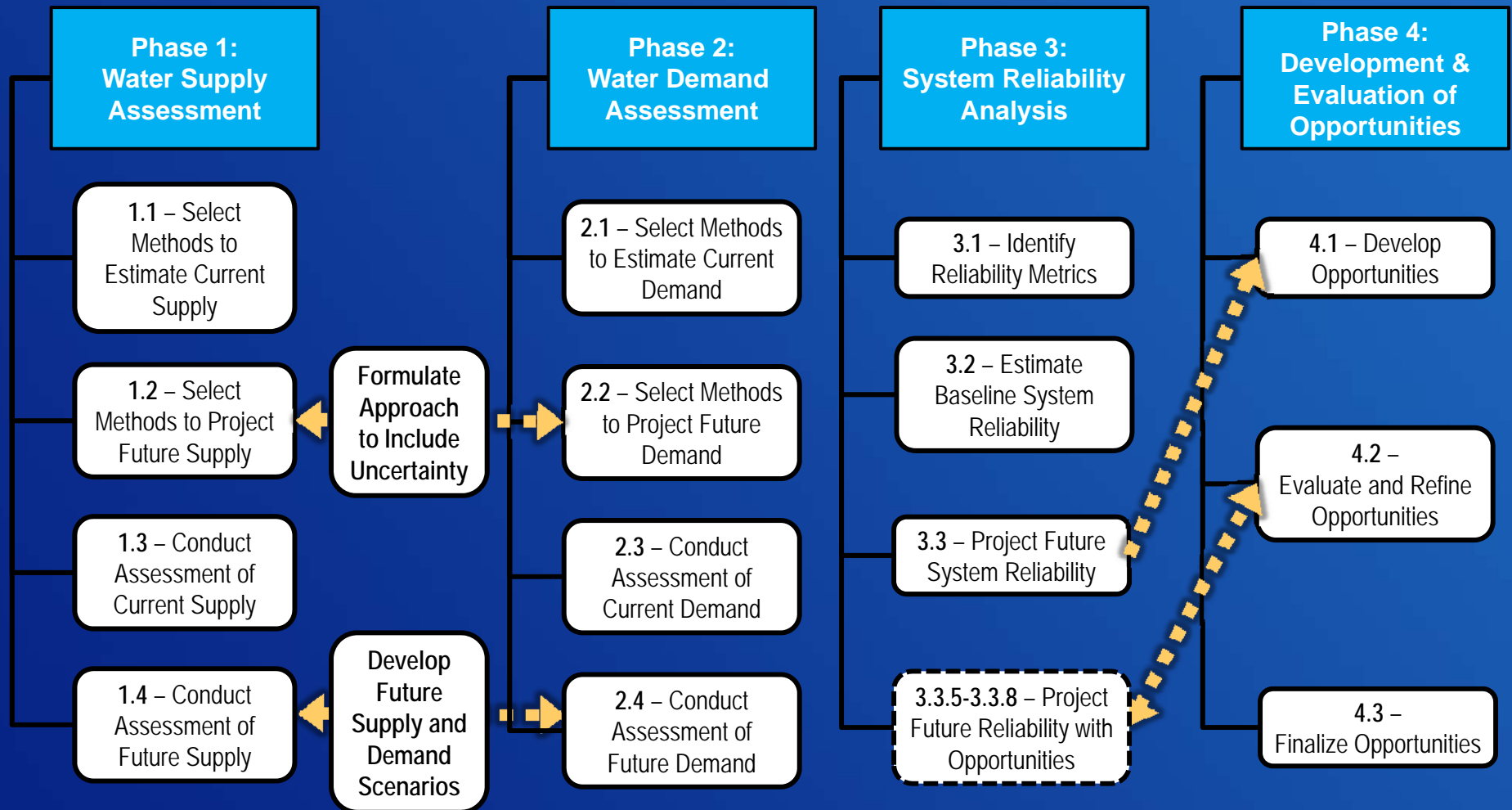


RECLAMATION

Options for Participation in the Study (not mutually exclusive)

- Project website, webinars, emails
- Review and comment on products
- Periodic updates (formal and/or informal)
- Establish points-of-contact with working groups (“Sub-Teams”)
- Participation in Sub-Teams
- Other

Study Phases and Tasks



Green denotes essentially complete

RECLAMATION

Interim Reports

- Facilitate the integration of continuous technical developments and the ongoing input of stakeholders
- Provide a comprehensive “snapshot” of the Study’s progress to date
- Are complete reports as of that date

Interim Report No. 1

- Interim Report No. 1 is a “snapshot” as of January 31, 2011 and is available at:
<http://www.usbr.gov/lc/region/programs/crbstudy/report1.html>
- Consists of:
 - Executive Summary
 - Status Report
 - Technical Report A – Scenario Development
 - Technical Report B – Water Supply Assessment
 - Technical Report C – Water Demand Assessment
 - Technical Report D – System Reliability Metrics

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

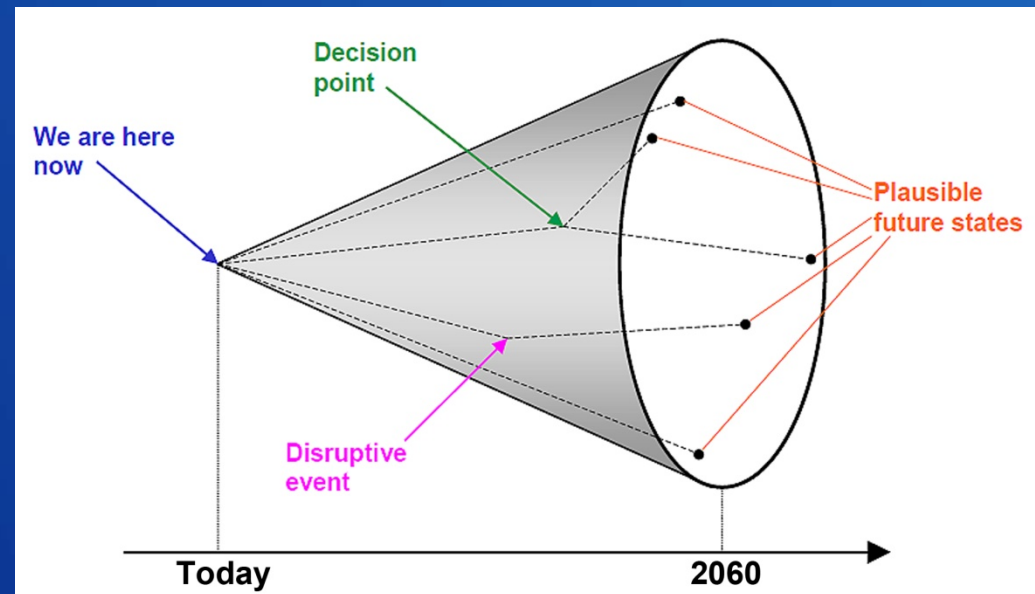
RECLAMATION

Comments

- Should be submitted by July 8, 2011
- May be submitted in the following ways:
 - Study website at:
<http://www.usbr.gov/lc/region/programs/crbstudy.html>
 - E-mail to: **ColoradoRiverBasinStudy@usbr.gov**
 - U.S. mail to:
U.S. Bureau of Reclamation
Attention Ms. Pam Adams, LC-2721
PO Box 61470
Boulder City NV 89006-1470
 - Fax to: **702-293-8418**
- Comments will be incorporated into subsequent interim reports as appropriate

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

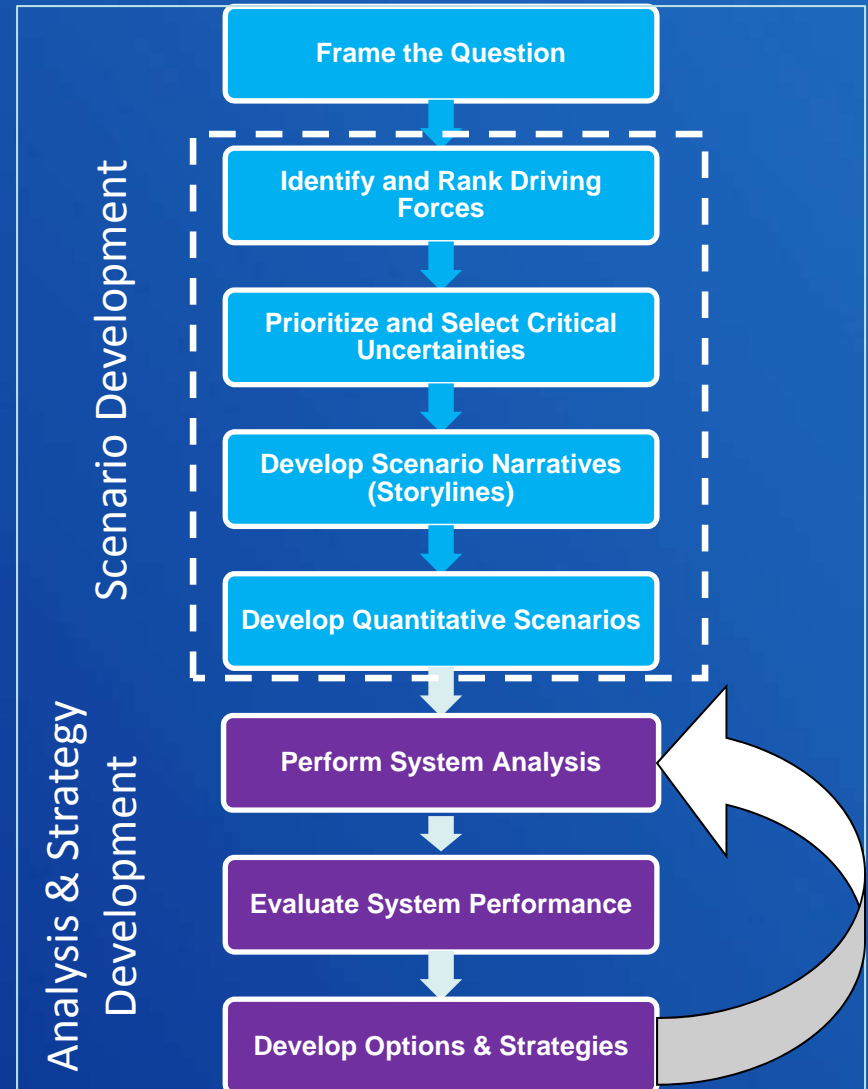


(adapted from Timpe and Scheepers, 2003)

RECLAMATION

Key Elements of Scenario Approach

- Frame the question
 - Focal question or key issue to be addressed in the Study
- Identify and rank driving forces
 - Major factors influencing future system reliability
- Prioritize and select critical uncertainties
 - Key driving forces that are highly important and highly uncertain
- Group key uncertainties and develop storylines
 - Narrative descriptions that weave the critical uncertainties into plausible future trajectories
- Develop scenarios
 - Specific, quantitative outcomes of the storylines



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 Global Climate Model (GCM) Projected:

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

Water Demand Scenarios *

Current Trends:

- growth, development patterns, and institutions continue along recent trends

Economic Slowdown:

- low growth with emphasis on economic efficiency

Expansive Growth:

- economic resurgence (population and energy) and current preferences toward human and environmental values *

Enhanced Environment and Healthy Economy:

- expanded environmental awareness and stewardship with growing economy*

* Additional “branches” possible depending upon assumed trajectory of specific socio-economic factors.

* Preliminary – Subject to change

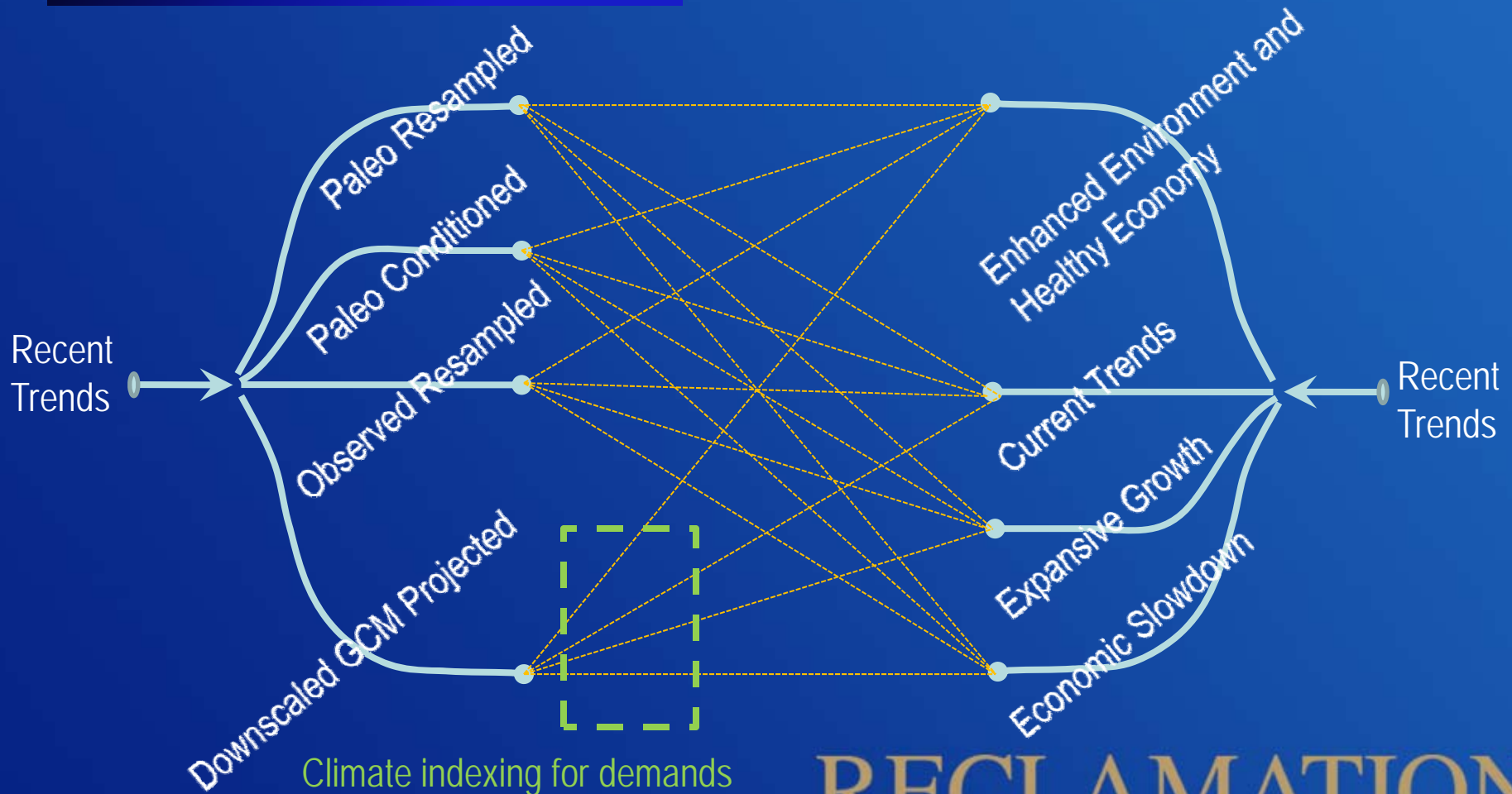
RECLAMATION

Integration of Supply and Demand Scenarios

Water Supply Scenarios

(multiple realizations for each scenario)

Water Demand Scenarios



RECLAMATION

Colorado River Basin Water Supply and Demand Study

Summary of Technical Report B

Water Supply Assessment



Presenter: Carly Jerla

RECLAMATION

Objective of the Water Supply Assessment

- The objective of the Water Supply Assessment is to assess the probable magnitude and variability of historical and future natural flow¹ in the Basin
- The assessment includes the potential effects of future climate variability and climate change

¹Natural flow represents the flow that would have occurred at a location had depletions and reservoir regulation not been present upstream of that location

Critical Uncertainties Affecting Water Supply Scenarios

Critical Uncertainty Identified in Survey	General Driving Force Category
Changes in streamflow variability and trends	Natural Systems
Changes in climate variability and trends	

Water Supply Scenarios *

- **Observed Resampled:** future hydrologic trends and variability are similar to the past approximately 100 years
- **Paleo Resampled:** future hydrologic trends and variability are represented by reconstructions of streamflow for a much longer period in the past (nearly 1,250 years) that show expanded variability
- **Paleo Conditioned:** future hydrologic trends and variability are represented by a blend of the wet-dry states of the longer paleo-reconstructed period (nearly 1,250 years), but magnitudes are more similar to the observed period (about 100 years)
- **Downscaled GCM Projected:** future climate will continue to warm with regional precipitation and temperature trends represented through an ensemble of future downscaled GCM projections

* Preliminary – Subject to change

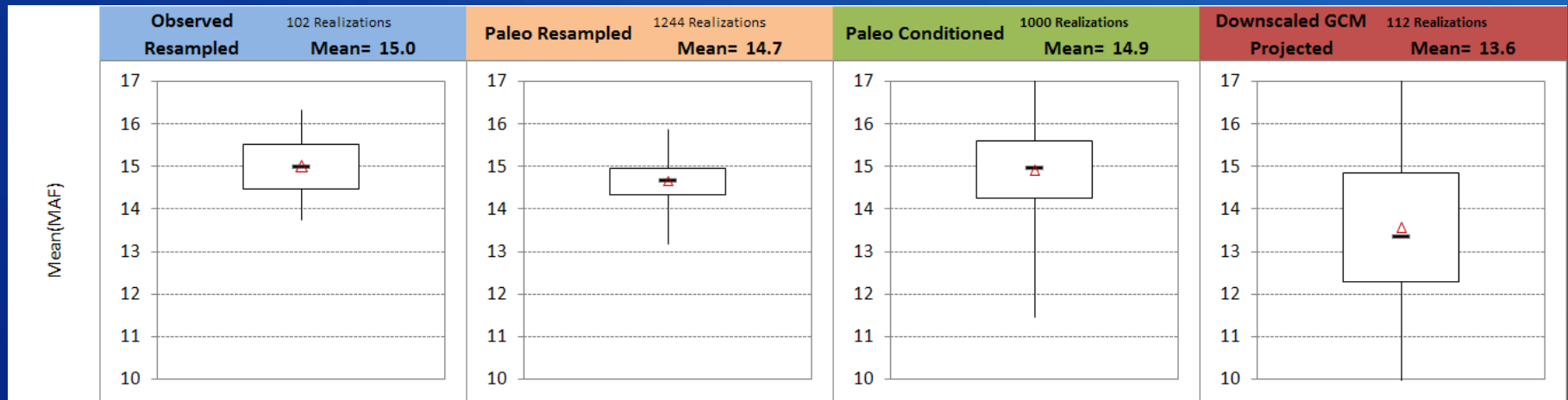
RECLAMATION

Projections of Natural Flow at Lees Ferry

Annual and Monthly Statistics

2011-2060 Period Mean Annual Flows

Box represents 25th – 75th percentile, whiskers represent min and max, and triangle represents mean of all realizations



- The peak natural flow under the Downscaled GCM Projected scenario occurs in May, one month earlier than the other scenarios
- This monthly peak is approximately 500 kaf less than under the other scenarios

RECLAMATION

Projections of Natural Flow at Lees Ferry

Deficit and Surplus Statistics

Computed over the 2011-2060 Period

Statistic	Observed Resampled	Paleo Resampled	Paleo Conditioned	Downscaled GCM Projected
Frequency of Deficit ¹ lasting 5 years or longer	22%	30%	25%	40%
Frequency of Surplus ¹ lasting 5 years or longer	28%	15%	18%	<1%

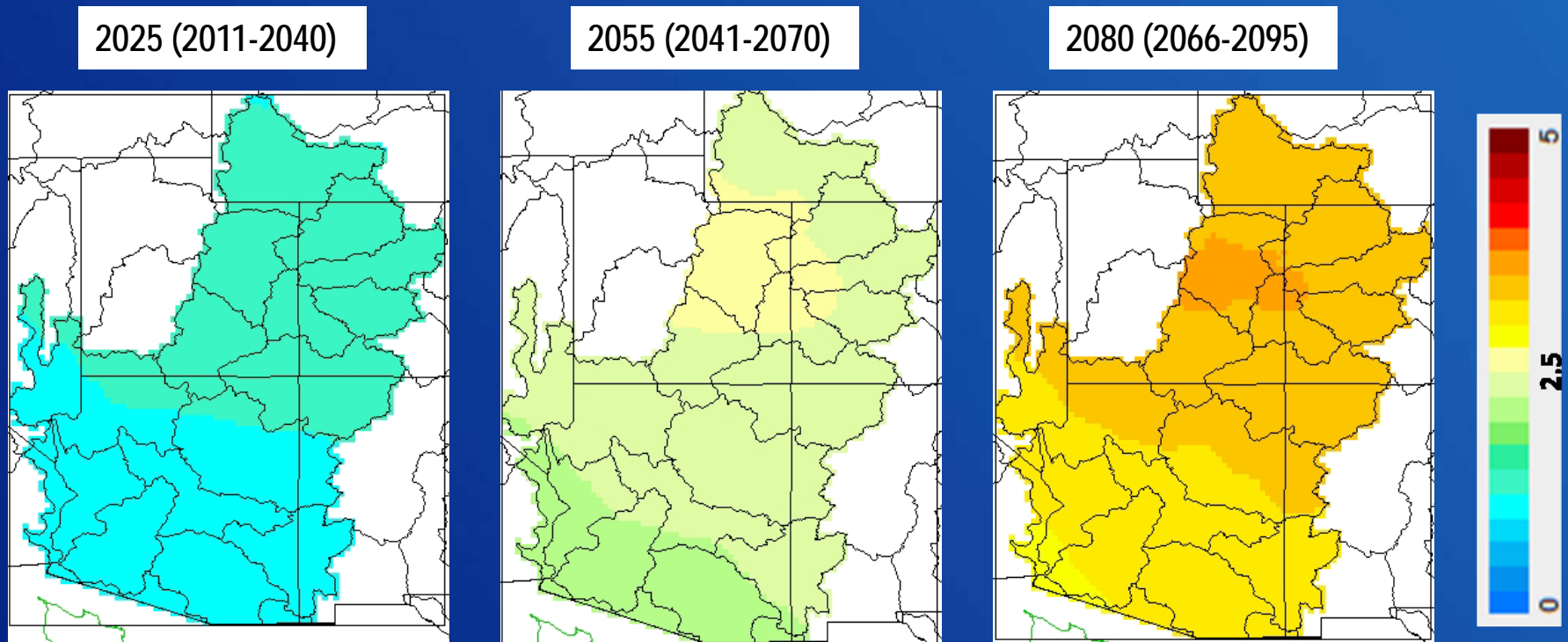
¹A deficit/surplus period occurs whenever the 2-year running mean is below/above the observed mean of 15.0 maf

RECLAMATION

Projected Changes in Temperature

Annual mean change under the Downscaled GCM Projected scenario

Change in degrees Celsius compared to 1971-2000 mean



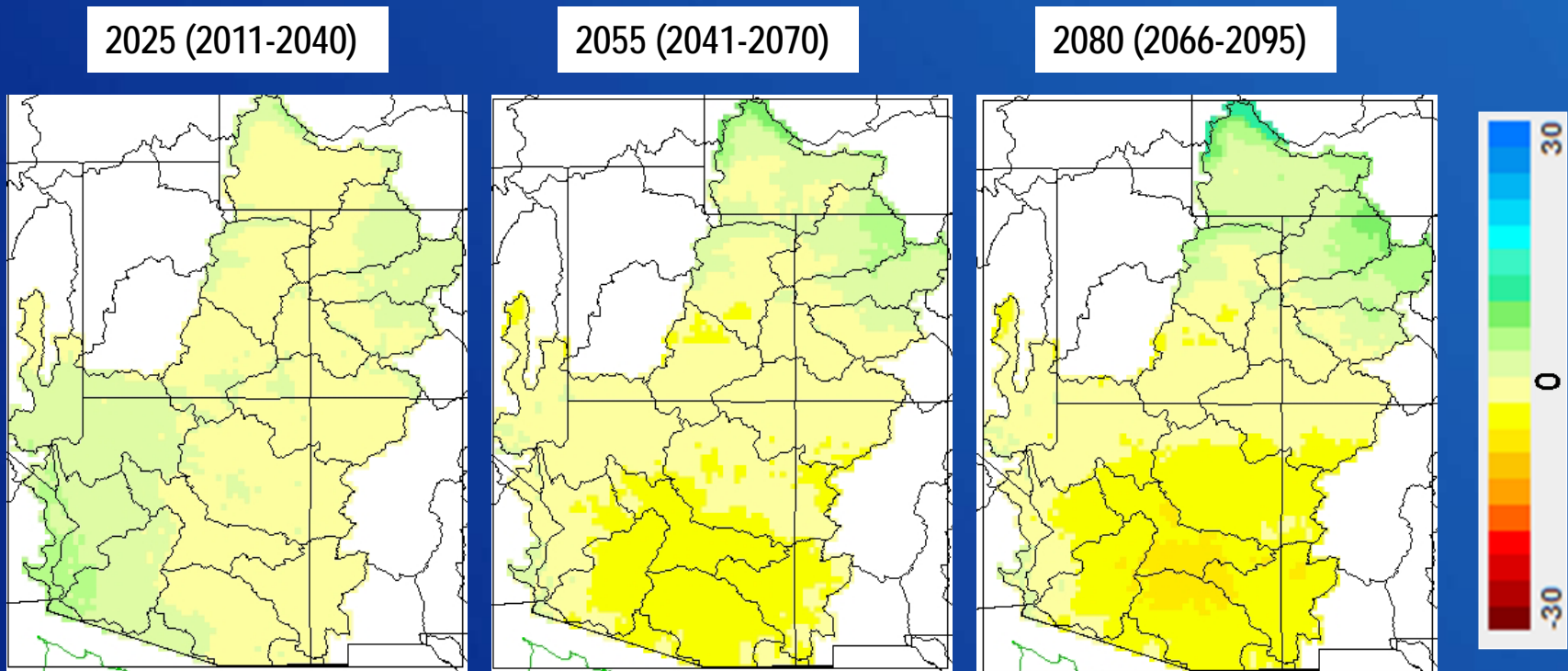
Warming is projected to increase across the Basin

RECLAMATION

Projected Changes in Precipitation

Annual mean change under the Downscaled GCM Projected scenario

Percent change compared to 1971-2000 mean



General trend towards drying is projected although precipitation increases higher elevations are projected

RECLAMATION

Projected Changes in Snowpack

Mean change in April SWE under the Downscaled GCM

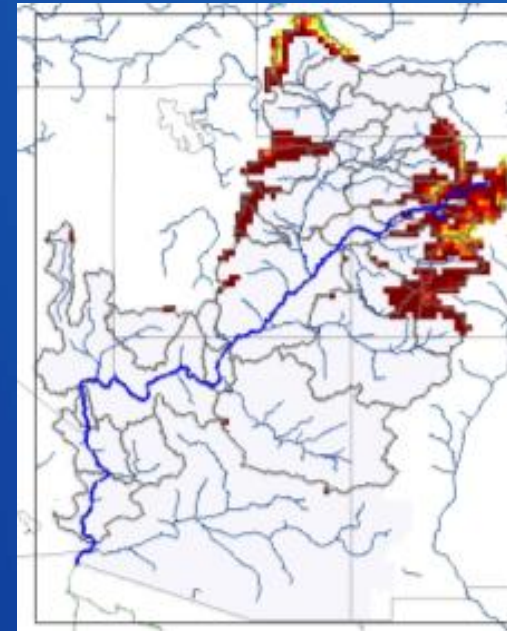
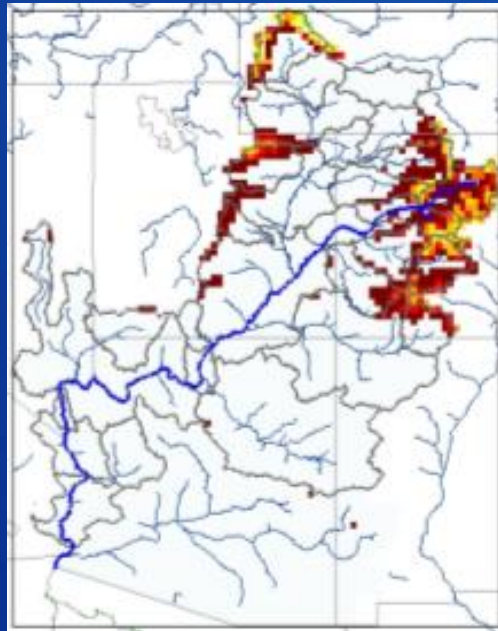
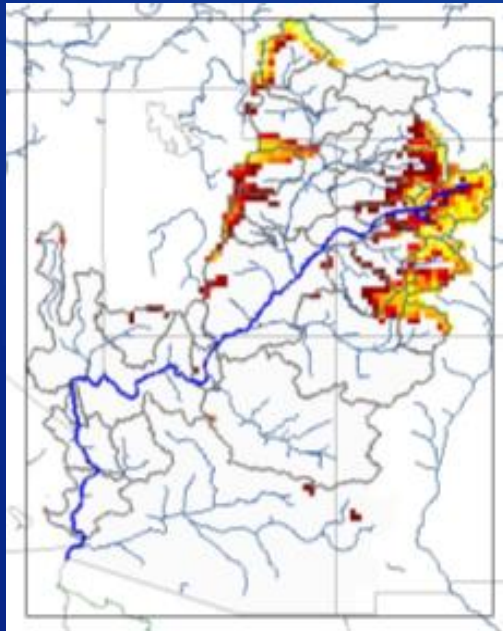
Projected scenario

Mean change in April SWE under the Downscaled GCM Projected scenario

2025 (2011-2040)

2055 (2041-2070)

2080 (2066-2095)



Snowpack is projected to decrease as more precipitation falls as rain and warmer temperatures cause an earlier melt

RECLAMATION

Next Steps

- Additional analysis and investigation of the Downscaled GCM Projected scenario is ongoing in two areas in particular
 - 1) Application of a secondary bias-correction to the natural flows generated by the hydrologic model
 - 2) Analysis of sequences that exhibit extremely high natural flows

Colorado River Basin Water Supply and Demand Study

Summary of Technical Report C

Water Demand Assessment



Presenter: Jim Prairie

RECLAMATION

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 Area¹ to meet the needs of Basin resources
- Basin resources include: municipal and industrial (M&I) use, hydropower generation, recreation, and fish and wildlife habitat

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

Critical Uncertainties Affecting Water Demand Scenarios

Critical Uncertainty Identified in Survey	General Driving Force Category
Changes in population and distribution	Demographics & Land Use
Changes in agricultural land use	
Changes in agricultural water use efficiency	Technology & Economics
Changes in municipal and industrial water use efficiency	
Changes in water needs for energy generation	
Changes in institutional and regulatory conditions	Social & Governance
Changes in flow-dependent ecosystem needs for Endangered Species Act-listed species	
Changes in other flow-dependent ecosystem needs	
Changes in social values affecting water use	
Changes in water availability due to tribal water use and settlement of tribal water rights claims	

Water Demand Scenarios *

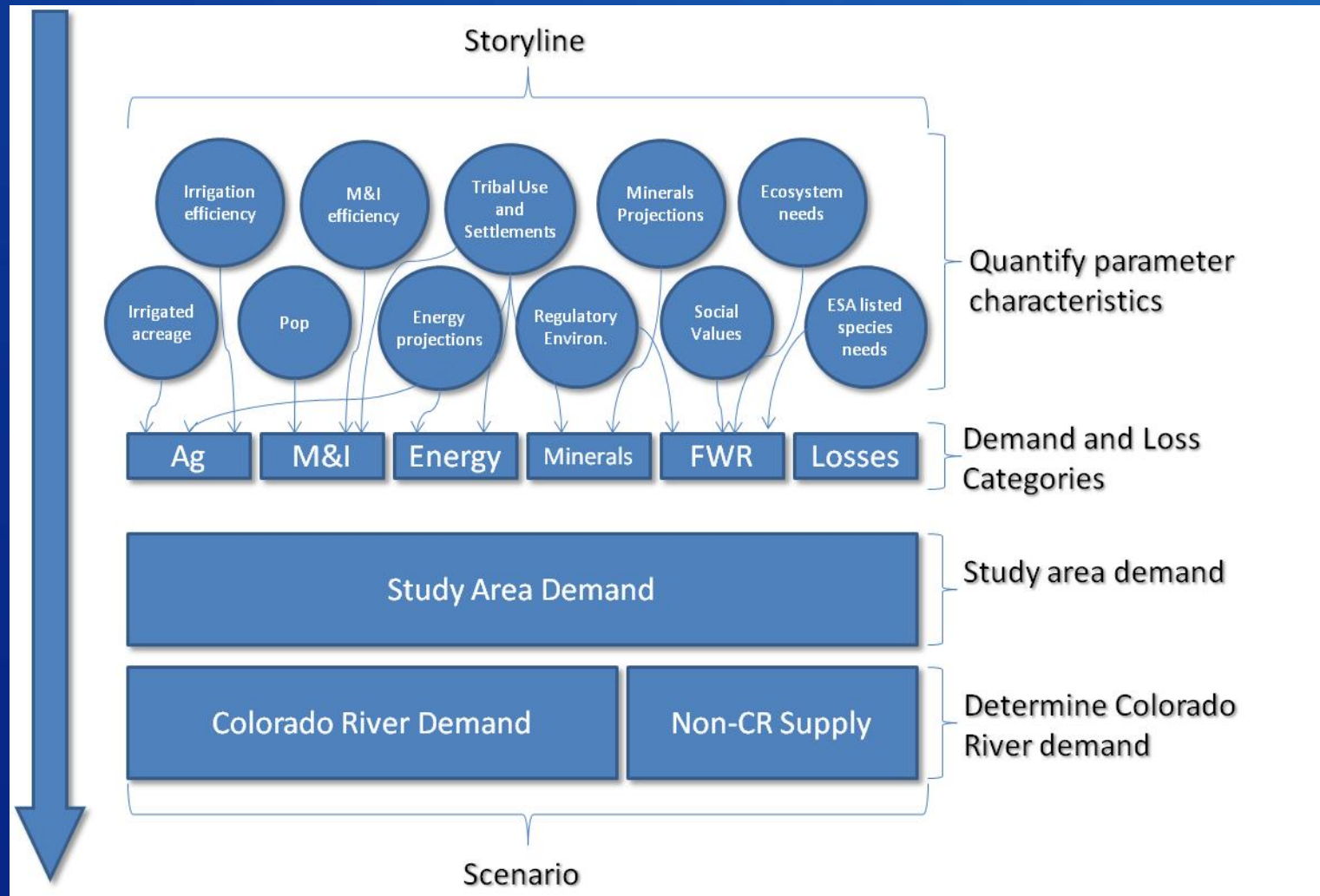
- **Current Trends:** growth, development patterns, and institutions continue along recent trends
- **Economic Slowdown:** low growth with emphasis on economic efficiency
- **Expansive Growth:** economic resurgence (population and energy) and current preferences toward human and environmental values **
- **Enhanced Environment and Healthy Economy:** expanded environmental awareness and stewardship with growing economy **

* Preliminary – Subject to change

** Additional “branches” possible depending upon assumed trajectory of specific socio-economic factors

RECLAMATION

Approach to Quantifying Demand Scenarios



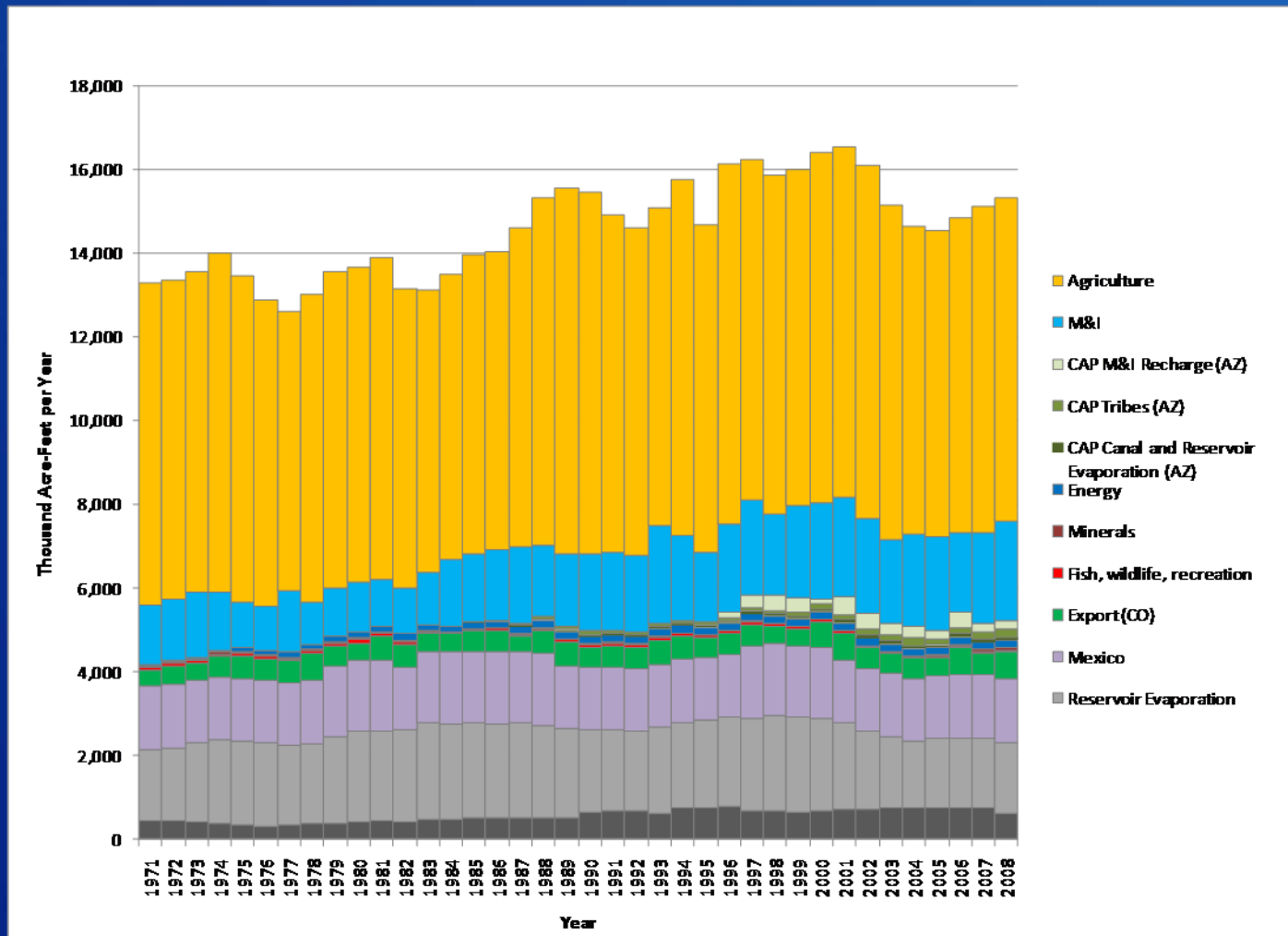
RECLAMATION

Current Trends Scenario

- Theme
 - Growth, development patterns, and institutions continue along recent trends
- Parameter Characteristics
 - Best estimate of population growth
 - Nominal increases in irrigated agricultural lands
 - Continued current trends in agricultural water use efficiency
 - M&I water use efficiency increases according to current policy and technology
 - Water needs for energy expand
 - No anticipated changes in regulations
 - No change in currently realized ESA-listed species needs
 - No change in current planning and/or projections associated with ecosystem needs or practices
 - Social values affecting water use are similar to recent past
 - Tribal water use continues as projected in settlements

RECLAMATION

Historical Colorado River Water Consumptive Use by Use Category



RECLAMATION

Next Steps

- Quantifying the scenarios will be primary focus of the coming months
- Scenario quantification will begin with the Current Trends scenario, followed by the quantification of the other scenarios (Economic Slowdown, Expansive Growth, and Enhanced Environment and Healthy Economy)

Colorado River Basin Water Supply and Demand Study

Summary of Technical Report D

System Reliability Metrics



Presenter: Carly Jerla

RECLAMATION

Objective of the System Reliability Metrics

- The objective of the System Reliability Metrics task is to develop a set of comprehensive metrics¹ to be used to measure the potential impacts to Basin resources from future supply and demand imbalances
- Metrics will also be used to measure the effectiveness of options and strategies to address supply and demand imbalances

¹Metrics are measures that indicate the ability of the Colorado River system to meet the needs of the Basin resources under multiple future conditions.

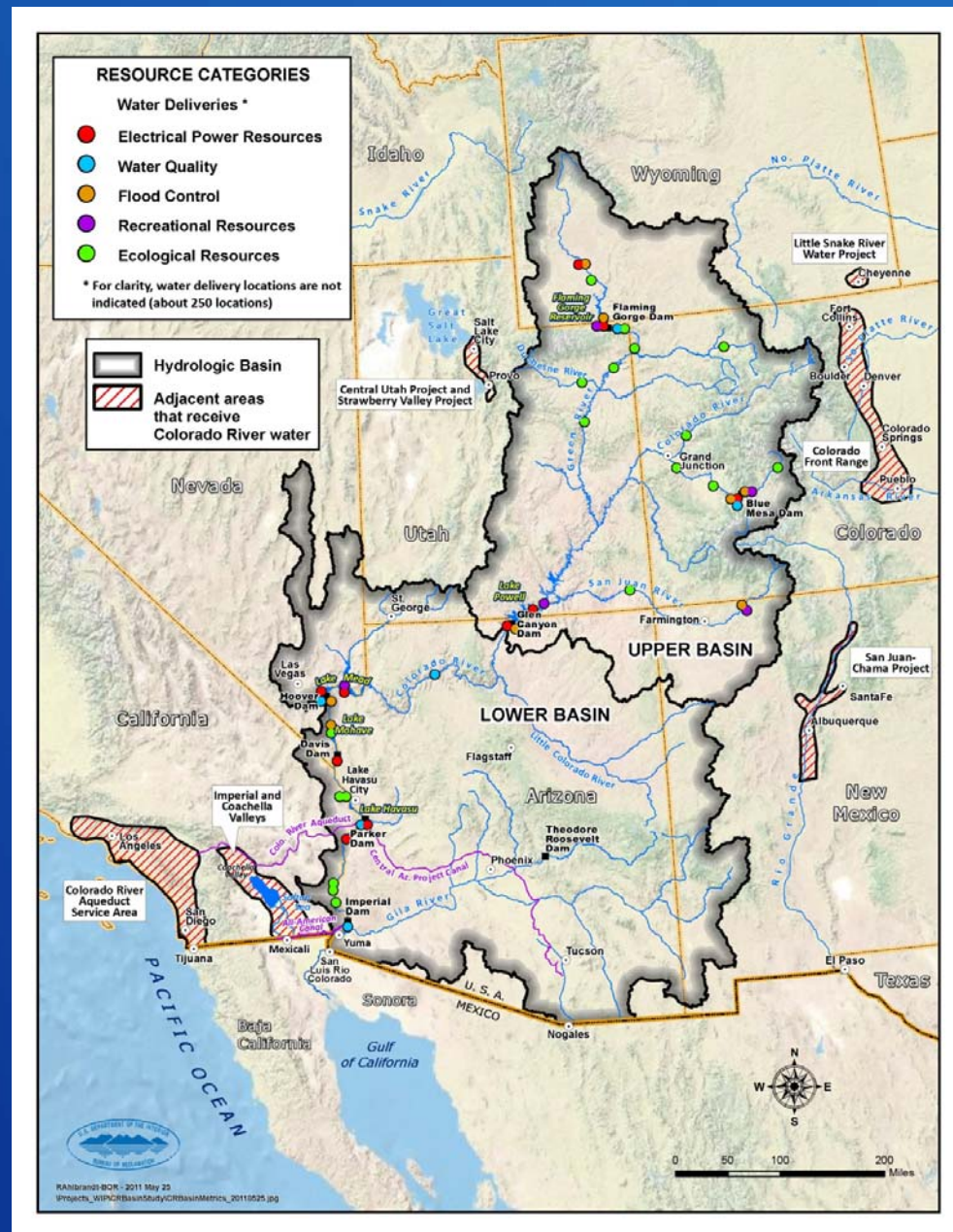
RECLAMATION

System Reliability Metrics

Resource Categories

- Water Deliveries
- Electrical Power Resources
- Water Quality
- Flood Control
- Recreational Resources
- Ecological Resources

Metrics can be measured quantitatively or qualitatively depending on the data and tools available



RECLAMATION

Next Steps

- Next steps include fully defining metrics that have been identified but have not yet been defined
 - In particular these include metrics related to the Ecological Resources category
- Adjustments to metrics will be made as some defined metrics may not prove to be informative or further analysis identifies the need for other metrics

Updated Study Timeline & Questions



Milestones & Updated Study Timeline

February – April 2011	Quantify Demand Scenarios
July – September 2011	Perform “Baseline” System Reliability Analysis
September – December 2011	Develop Options & Strategies
October 2011	Publish Interim Report No. 2
November 2011 – February 2012	Perform System Reliability Analysis with Options & Strategies
March 2012	Publish Interim Report No. 3
April – May 2012	Finalize & Evaluate Options & Strategies
June 2012	Publish Draft Final Study Report for Comment
July 2012	Publish Final Study Report

Colorado River Basin Water Supply and Demand Study

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

RECLAMATION