Natural Resources Law Center Summer Conference

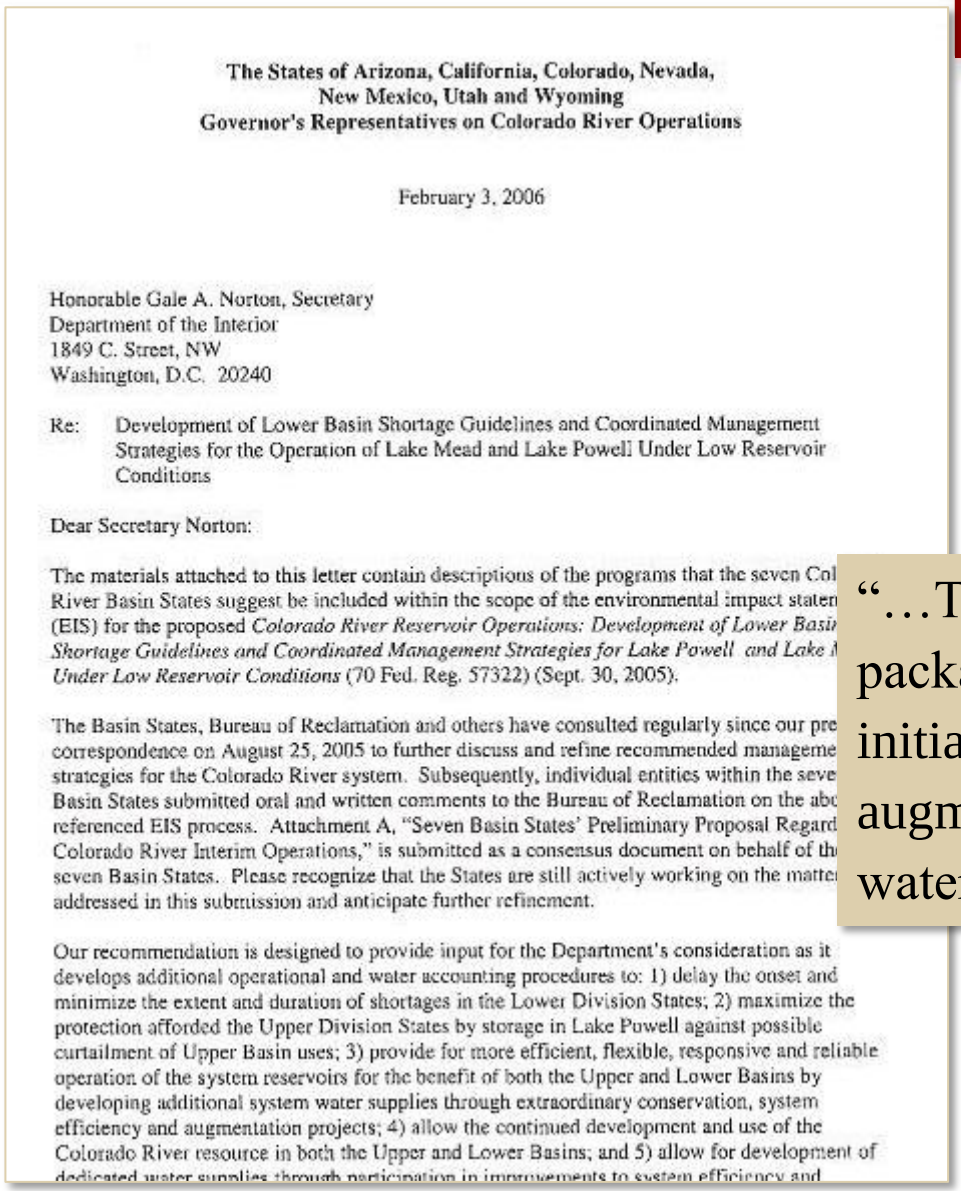
Long-Term Augmentation of the Water Supply of the Colorado River System

Helping to provide a clear vision of water augmentation in the Colorado River Basin

Colorado River Water Consultants
CH2MHILL · BLACK & VEATCH

June 10, 2011

The "Basin States Alternative"



The States of Arizona, California, Colorado, Nevada,
New Mexico, Utah and Wyoming
Governor's Representatives on Colorado River Operations

February 3, 2006

Honorable Gale A. Norton, Secretary
Department of the Interior
1849 C. Street, NW
Washington, D.C. 20240

Re: Development of Lower Basin Shortage Guidelines and Coordinated Management Strategies for the Operation of Lake Mead and Lake Powell Under Low Reservoir Conditions

Dear Secretary Norton:

The materials attached to this letter contain descriptions of the programs that the seven Col River Basin States suggest be included within the scope of the environmental impact staten (EIS) for the proposed *Colorado River Reservoir Operations: Development of Lower Basi Shortage Guidelines and Coordinated Management Strategies for Lake Powell and Lake M Under Low Reservoir Conditions* (70 Fed. Reg. 57322) (Sept. 30, 2005).

The Basin States, Bureau of Reclamation and others have consulted regularly since our pre correspondence on August 25, 2005 to further discuss and refine recommended manageme strategies for the Colorado River system. Subsequently, individual entities within the seve Basin States submitted oral and written comments to the Bureau of Reclamation on the abo referenced EIS process. Attachment A, "Seven Basin States' Preliminary Proposal Regard Colorado River Interim Operations," is submitted as a consensus document on behalf of th seven Basin States. Please recognize that the States are still actively working on the matte addressed in this submission and anticipate further refinement.

Our recommendation is designed to provide input for the Department's consideration as it develops additional operational and water accounting procedures to: 1) delay the onset and minimize the extent and duration of shortages in the Lower Division States; 2) maximize the protection afforded the Upper Division States by storage in Lake Powell against possible curtailment of Upper Basin uses; 3) provide for more efficient, flexible, responsive and reliable operation of the system reservoirs for the benefit of both the Upper and Lower Basins by developing additional system water supplies through extraordinary conservation, system efficiency and augmentation projects; 4) allow the continued development and use of the Colorado River resource in both the Upper and Lower Basins; and 5) allow for development of dedicated water supplies through participation in improvements to system efficiency and

"…The States will move forward with a package of other actions that include… initiation of a study for long-term augmentation of Colorado River System water supplies."

The Purpose of the Project

- Evaluate major options for augmenting the Colorado River supply:
  - Environmental
  - Costs
  - Overall feasibility
- Prepare summary report on result

> *"CRWC to provide the technical assessment of options …the States will provide legal, administrative, or institutional considerations."*

Exhibit A, Scope of Services,
Agreement to Provide Professional Services

Colorado River Basin

Meetings with states provided information on options

- Wyoming
- Colorado
- California
- Lower Colorado Region – Reclamation
- Nevada
- New Mexico
- Arizona
- Utah
- Upper Colorado Region – Reclamation

Twelve long-term augmentation concepts were initially identified and 'white papers' prepared

- Brackish water desalination
- Coalbed methane produced water
- Conjunctive use
- Ocean water desalination
- Power Plants - Reduction of consumptive use
- Reservoir evaporation control
- River basin imports
- Stormwater storage
- Vegetation management
- Water imports using ocean routes
- Water reuse
- Weather modification

Locations of augmentation options

ALTERNATIVE	Quantity Evaluated (AFY)	Cost $ / AF
Brackish Water Desalination	4,000 – 50,000	$700 – $2,000
Coalbed Methane Produced Water	3,000 – 20,000	$900 – $4,600
Conjunctive Use	8,000 – 40,000	$400 – $700
Ocean Water Desalination	20,000 – 100,000	$1,100 – $1,800
Power Plants - Reduce Consumptive Use	1,500 – 160,000	$1,000 – $4,000
Reservoir Evaporation Control	0 – 270,000	$500 – $2,000
River Basin Imports	30,000 – 700,000	Needs more refinement
Stormwater Storage	0 –100,000	$600 +
Vegetation Management	20,000 – 150,000 *	$30 – $100
Water Imports Using Ocean Routes	10,000 – 300,000	$1,400 – $4,000
Water Reuse	20,000 – 800,000	$900 – $1,700
Weather Modification	150,000 – 1,400,000	$20 – $30

* Lower Basin Only

Technical Memoranda drafted on six options designated by Technical Committee

- Brackish Water Desalination
- Conjunctive Use
- Ocean Water Desalination
- River Basin Imports
- Stormwater Storage (Painted Rock Reservoir)
- Vegetation Management

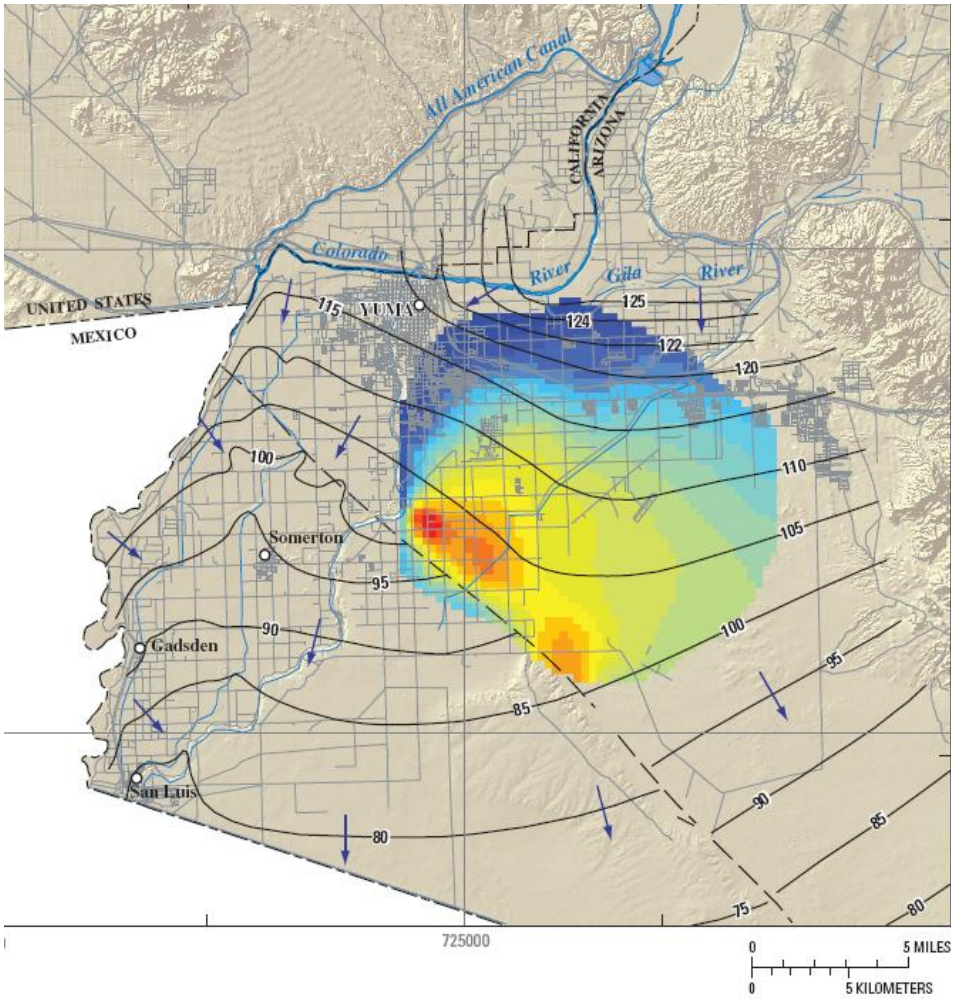
Assumptions used for costs of options

Discount Rate	5.0%
Inflation Rate	5.0%
Operations Labor Rate	$50/hour
Cost of Power	$0.08/kwh
Unit cost	= annual cost/annual yield ($/AF)
Annual cost	= amortized capital cost + O&M
Period of amortization	30 years

Brackish Water Desalting

Quantity Evaluated:
4,000 – 50,000 AFY
Cost: $700 – $2,000/AF

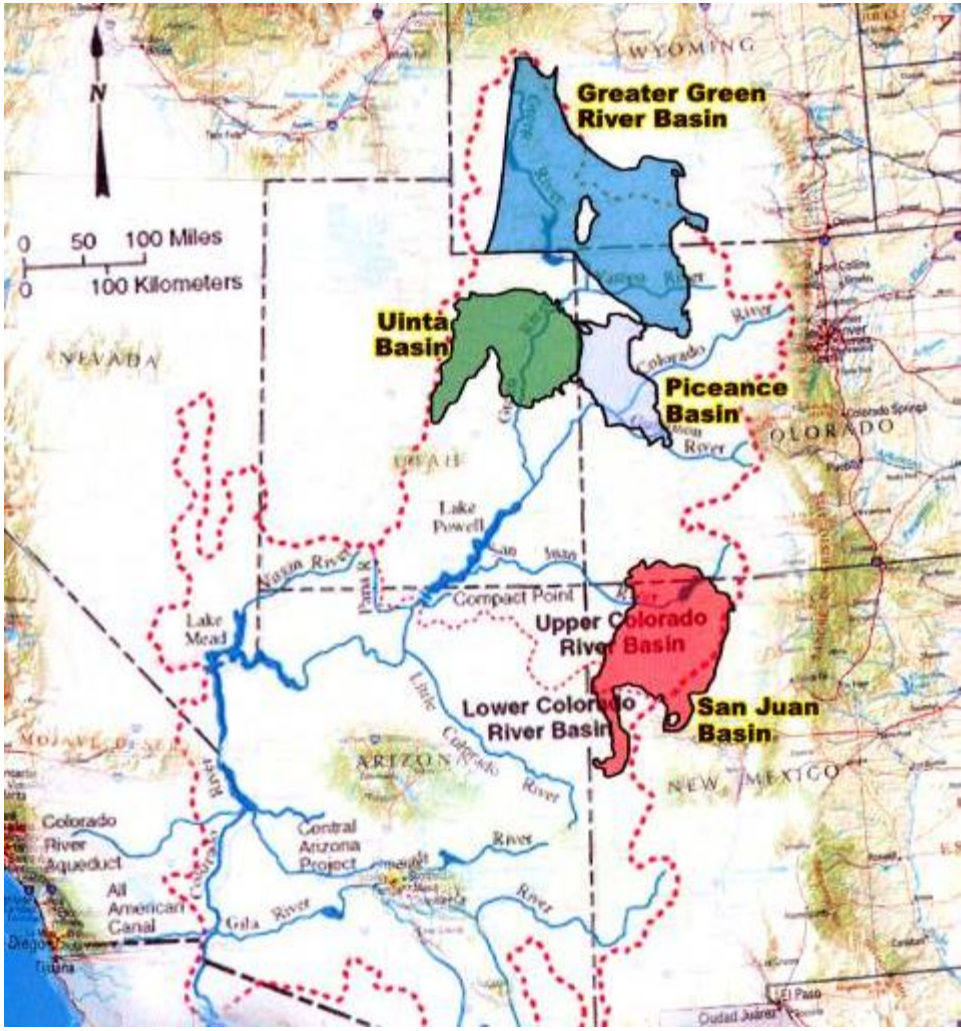
Yuma Desalter



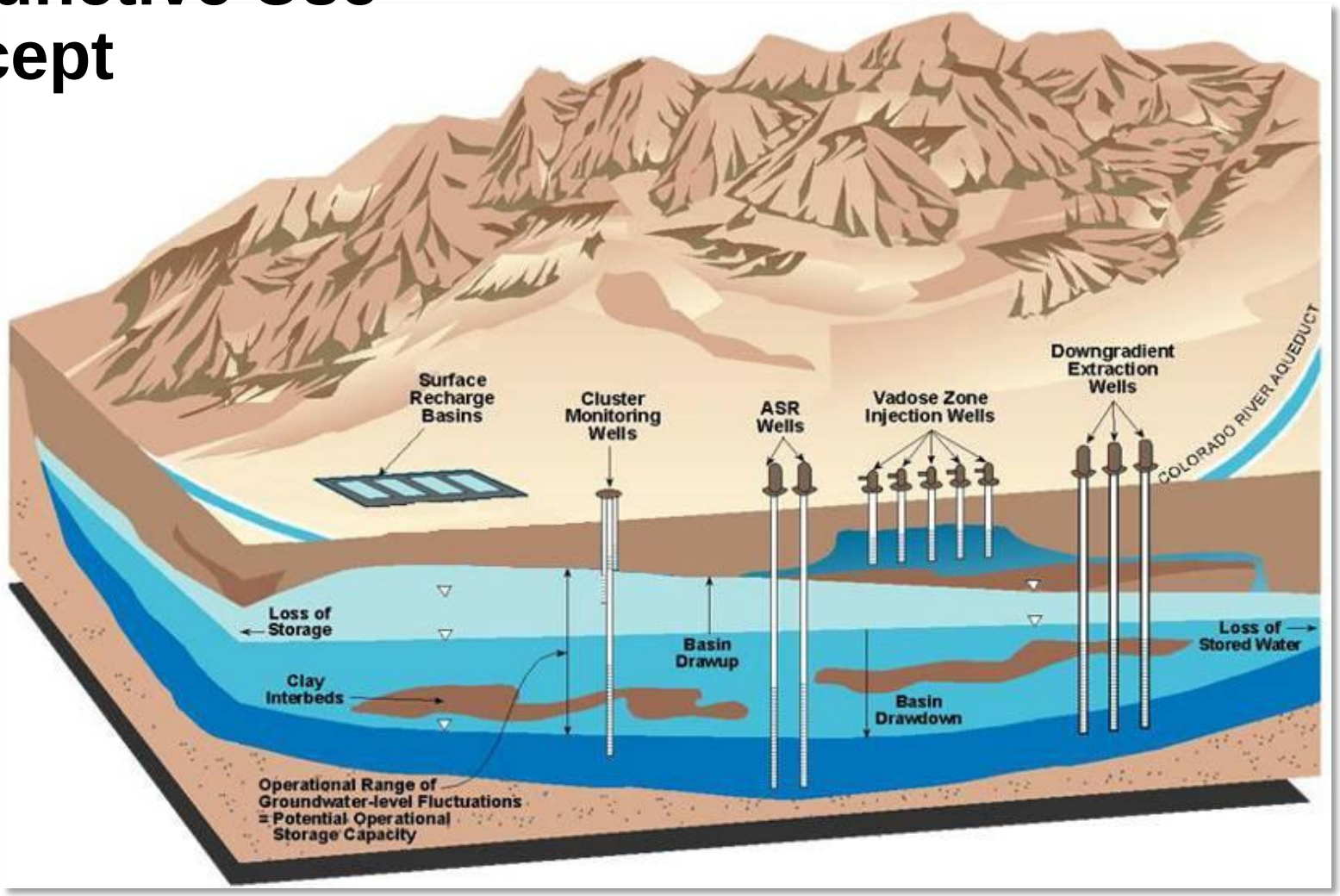
Coalbed Methane Produced Water

Quantity Evaluated :
3,000 – 20,000 AFY

Cost: $900 – $4,600/AF



Conjunctive Use Concept



Conjunctive Use Concept

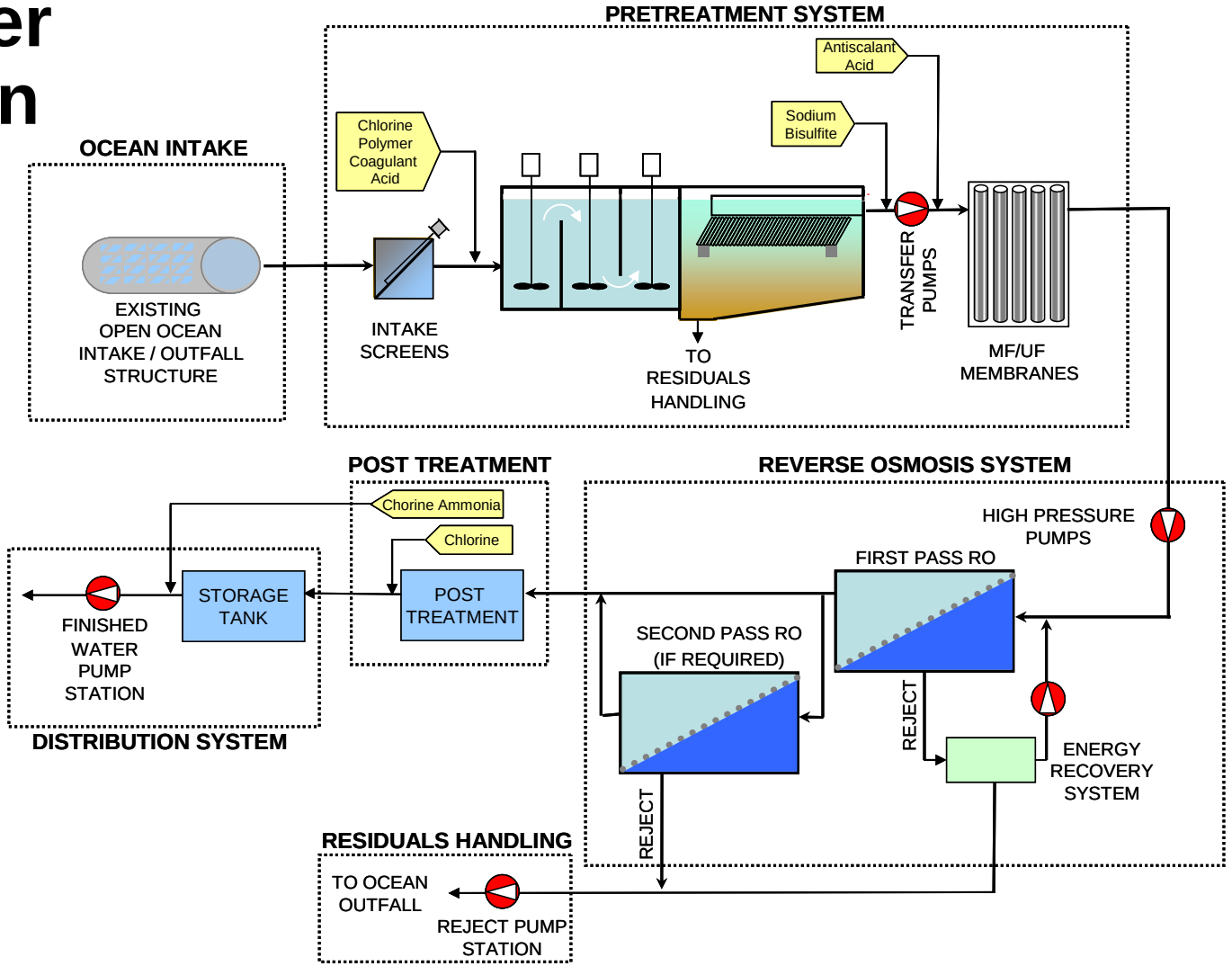
Quantity Evaluated :
8,000 – 40,000 AFY

Cost: $400 – $700/AF

Explanation

- Semitropic Water Storage District
- Chino Groundwater Basin
- Hayfield Groundwater Storage Project
- ***2*** Phoenix Active Management Area
- ***3*** Pinal Active Management Area
- ***4*** Tucson Active Management Area

Ocean Water Desalination Process



Ocean Water Desalination Concept

Quantity Evaluated:
20,000 – 100,000 AFY

Cost: $1,100 – $1,800/AF

- Desalt ocean water by reverse osmosis to drinking water standards and integrate into supply system

Power Plants – Reduction of Consumptive Use

Plant Name	Plant Capacity (MW)	Consumptive Use (AFY)	Water Source
Navajo	2,409	27,366	Lake Powell
Jim Bridger	2,312	25,266	Green River
Four Corners	2,270	22,515	San Juan River
San Juan	1,848	19,981	San Juan River
Hunter	1,441	18,968	Cottonwood Creek
Huntington	996	12,307	Huntington Creek
Bonanza	500	7,964	Green River
Reid Gardner	612	7,500	Muddy River
Naughton	707	6,081	Hams Fork River
Hayden	465	2,896	Yampa River
Carbon	189	2,679	Price River
Craig	1,339	2,534	Yampa River
South Point Energy Center	708	1,955	Colorado River
Desert Basin Power	646	1,810	Central Arizona Project Canal Water
Nucla	114	1,520	San Miguel River

Power Plants – Reduction of Consumptive Use

Quantity Evaluated:
Up to 160,000 AFY

Cost: $1,000 – $4,000/AF

Navajo Power Plant

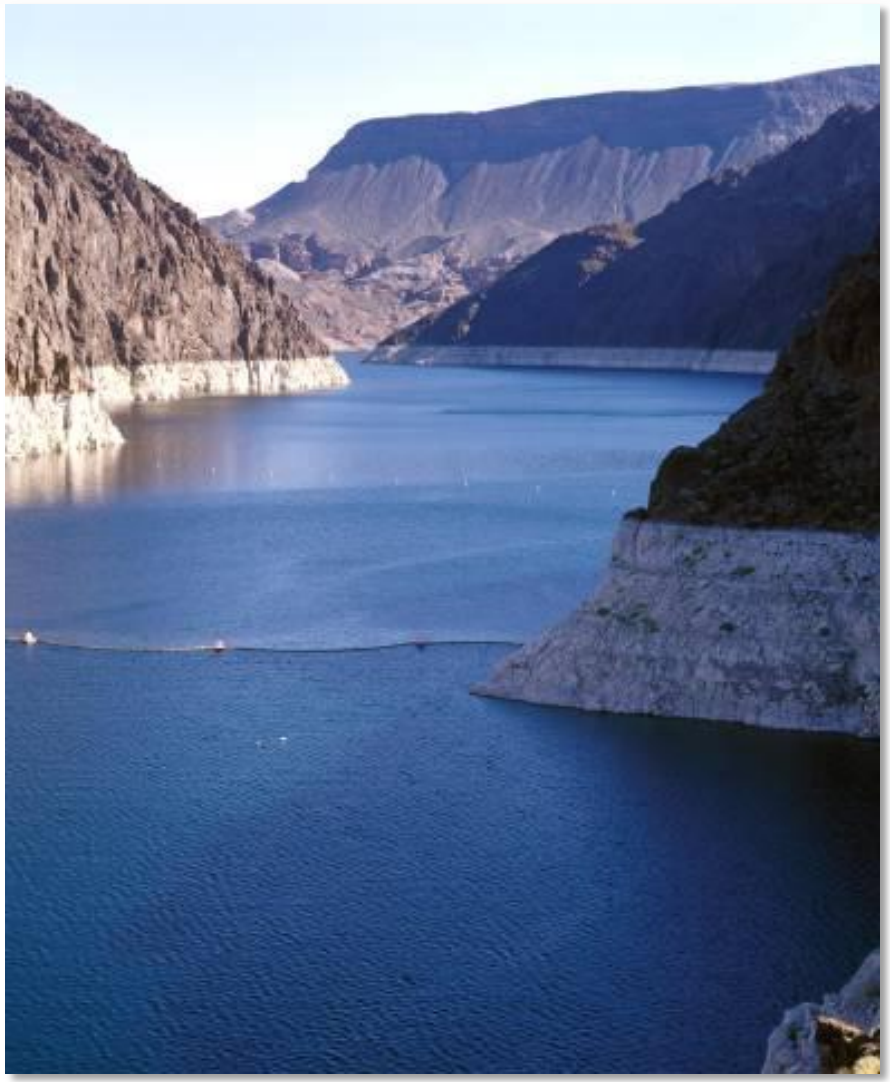
Reservoir Evaporation Control

Quantity Evaluated (chemical covers):
Up to 270,000 AFY
Quantity Evaluated (preferential storage):
Up to 90,000 AFY

Cost: $500 – $2,000/AF

Options

- Chemical covers
- Preferential upstream storage



Lake Mead, photo credit: Bureau of Reclamation

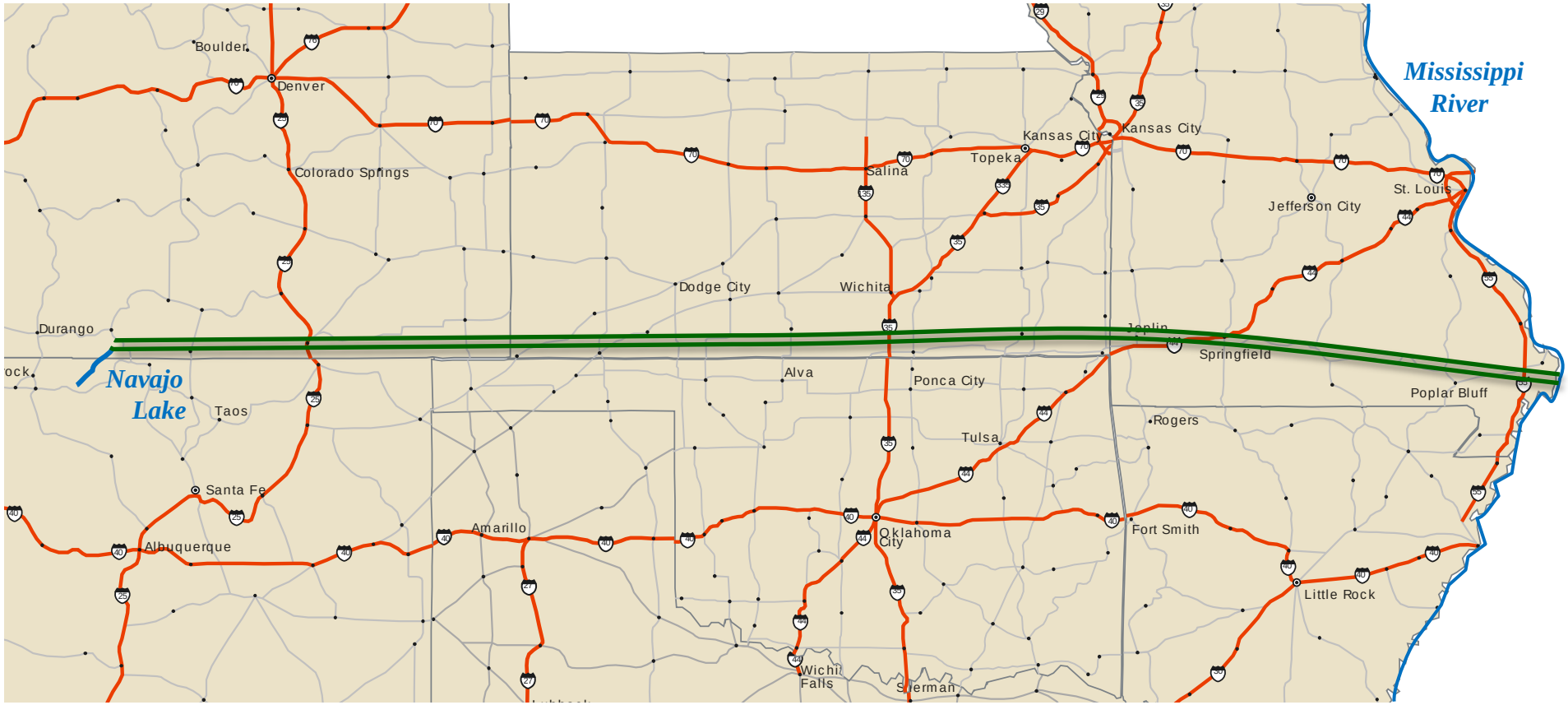
River Basin Imports

Quantity Evaluated:
30,000 - 700,000 AFY

Cost: Needs more refinement

Transbasin Imports
Mississippi River Diversion

Quantity: 675,000 AFY
Cost: $1,370 / AF



Stormwater Storage

Quantity Evaluated:
Up to 100,000 AFY
(but unreliable)

Cost: $600+/AF

Painted Rock Control Tower, photo credit: USACE

Vegetation Management Location 1: Lower Virgin River

Quantity Evaluated : 17,000 AFY

Cost: $100 /AF

Concept:

- Saltcedar removed by *spraying and burning*; ongoing revegetation and spraying as needed

Vegetation Management Location 2: Lower Colorado River

Quantity Evaluated : 154,000 AFY

Cost: $30 /AF

Concept:

- Saltcedar removed by *leaf beetles*; ongoing revegetation and spraying as needed

Water Imports Using Ocean Routes

Quantity Evaluated:
10,000 – 300,000 AFY

Cost: $1,400 – $4,000/AF

Options

- Undersea Aqueduct
- Tankers
- Towing Water Bags
- Towing Icebergs

Towing an iceberg

Water Reuse

Quantity Evaluated:
20,000 – 800,000 AFY

Cost: $900 – $1,700/AF

Concept

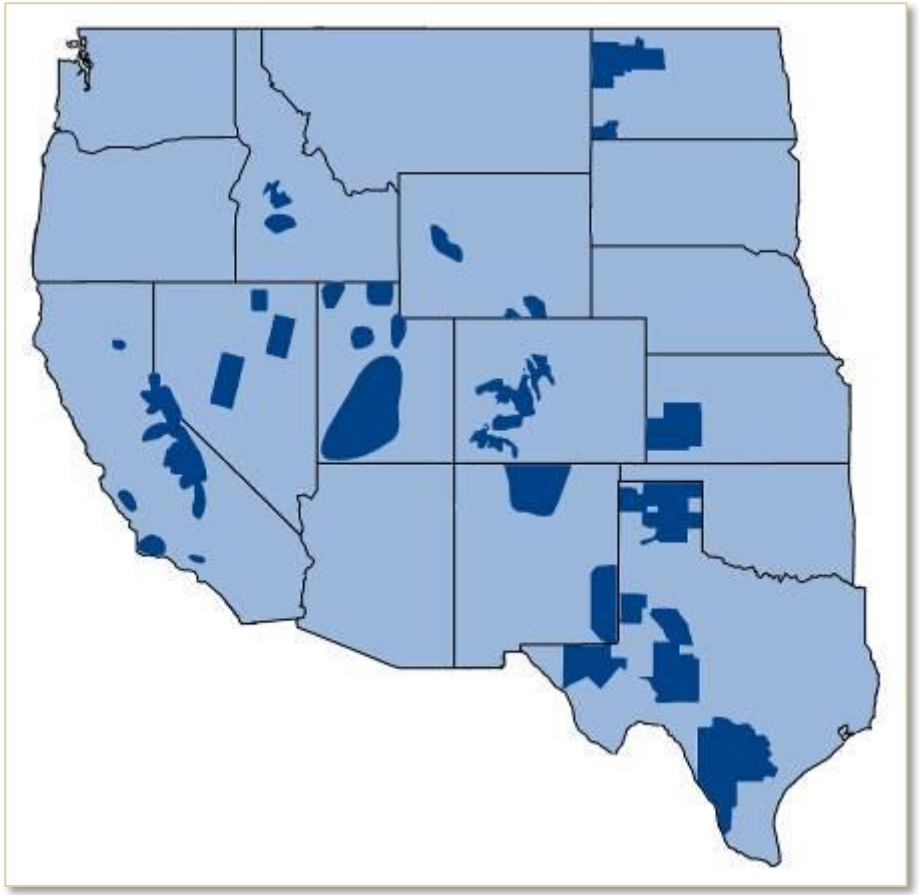
- Reuse Colorado River-derived wastewater in large urban areas

Irrigation using reclaimed water

Weather Modification

Quantity Evaluated:
150,000 – 1,400,000 AFY

Cost:
$20 – $30/AF



Weather Modification Programs in Western U.S

Augmentation Quantities and Costs

	Annual Yield Evaluated Acre-Feet per Year	Cost $ per Acre-Foot
Brackish Water Desalination	4,000 – 50,000	$700 - $2,000
Coalbed Methane Produced Water	3,000 – 20,000	$900 – $4,600
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**The States of Arizona, California, Colorado, Nevada,
New Mexico, Utah and Wyoming
Governors' Representatives on Colorado River Operations**

April 30, 2007

Honorable Dirk Kempthorne, Secretary
Department of the Interior
1849 C. Street, NW
Washington, D.C. 20240

Re: Basin States' Comments on *Draft Environmental Impact Statement, Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead*

Dear Secretary Kempthorne:

Thank you for the opportunity to comment on the *Draft Environmental Impact Stateme Colorado River Interim Guidelines for Lower Basin Shortages and Coordina Operations for Lake Powell and Lake Mead* (72 Fed. Reg. 9,026) (Feb. 28, 20 (hereinafter "DEIS"). The Basin States emphasize that the Basin States' Alternative b meets critical elements of the purpose and need statement articulated in the DEIS. It d so by giving water managers the certainty to engage in meaningful long-range planni while also promulgating programs to increase operational and resource managem flexibility on the River. This is particularly important given the impacts of the drou on the Colorado River system over the last seven years and the uncertain hydrology goi forward. Thus, the Basin States strongly encourage you to select the Basin Stat Alternative analyzed in the DEIS, together with the modifications outlined in this le and the included attachments ("Basin States' Proposal"), as the preferred alternative the Final Environmental Impact Statement ("FEIS") and the selected action in the Rec of Decision ("ROD").

Basin States' Proposal

The Basin States have made tremendous progress over the last two years in setting aside contentious issues and reaching agreements regarding operation of the Colorado River system reservoirs. Since the Basin States originally forwarded a Preliminary Proposal and draft Seven States' Agreement to your predecessor on February 3, 2006 ("Preliminary Proposal"), the Basin States have finalized a number of agreements and proposals. These documents, which are described in detail below, incorporate and give further definition to each of the elements of the Preliminary Proposal and the Basin

Importance of Augmentation Projects to the Basin

"Implementation of projects to augment the long-term supply of the Colorado River is of utmost importance not only to the Basin States and the millions of people who live here, but to the nation as a whole.."

Final Report

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