

**WRRC**  
WATER RESOURCES RESEARCH CENTER



COLLEGE OF  
AGRICULTURE  
& LIFE SCIENCES  

---

COOPERATIVE EXTENSION

# **Thirsty Rivers in Water-Scarce Regions: Experiences from the Colorado River**

Sharon B. Megdal, Ph.D.

[smegdal@email.arizona.edu](mailto:smegdal@email.arizona.edu) or [megdal.sharon@gmail.com](mailto:megdal.sharon@gmail.com)

Rehabilitation of the Lower Jordan River

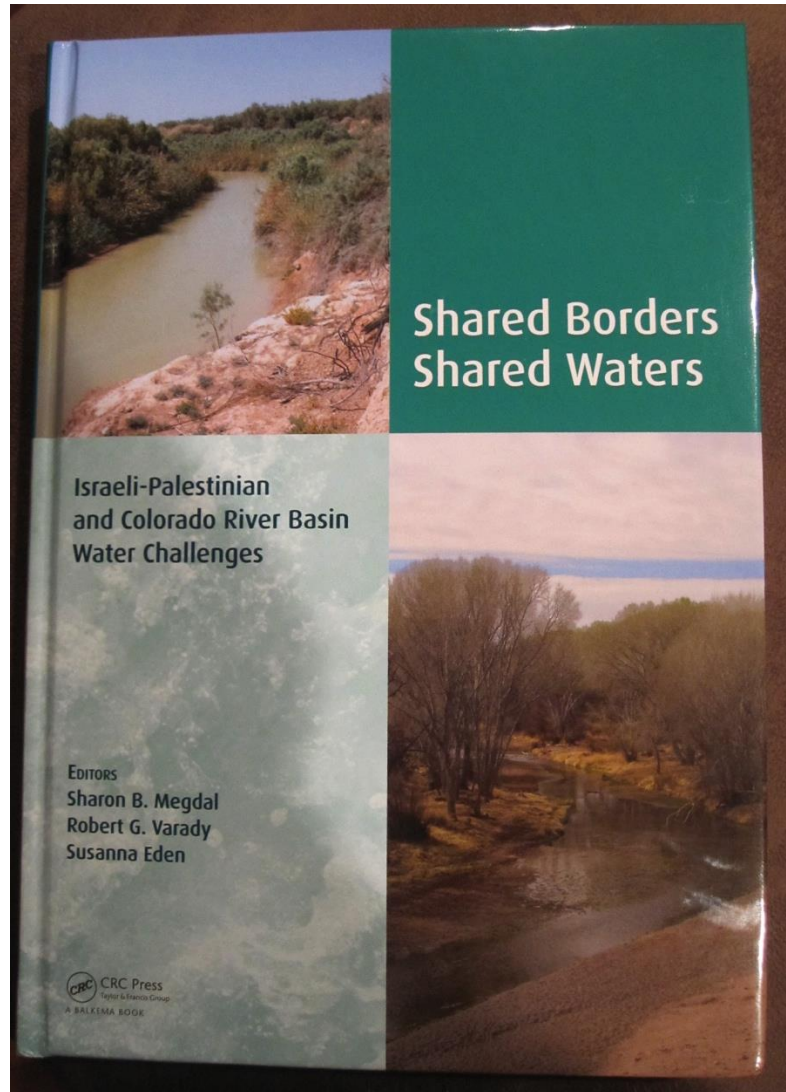
International Conference

21 October 2014



[wrrc.arizona.edu](http://wrrc.arizona.edu)

# A goal of this conference is to “provide a discussion platform to share our lessons and learn from the experiences of others”



Jordan River, [globalwater.jhu.edu/magazine/article/the\\_unholy\\_state\\_of\\_the\\_lower\\_jordan\\_river\\_a\\_call\\_for\\_action](http://globalwater.jhu.edu/magazine/article/the_unholy_state_of_the_lower_jordan_river_a_call_for_action)



San Pedro River, [forums.ghosttowns.com/showthread.php?18715-Contention-and-persidio-Santa-Cruz-De-Terrenate-Ari](http://forums.ghosttowns.com/showthread.php?18715-Contention-and-persidio-Santa-Cruz-De-Terrenate-Ari)

# Comparative analysis of water management and policy

ARTICLE IN PRESS

Journal of Arid Environments xxx (2014) 1–15

Contents lists available at [ScienceDirect](#)

Journal of Arid Environments

journal homepage: [www.elsevier.com/locate/jaridenv](http://www.elsevier.com/locate/jaridenv)



ELSEVIER

A tale of two rivers: Pathways for improving water management in the Jordan and Colorado River basins

Assaf Chen <sup>a,\*</sup>, Adam Abramson <sup>b</sup>, Nir Becker <sup>c</sup>, Sharon B. Megdal <sup>d</sup>

Water scarcity

Rivers are highly- or over-allocated and shared

Growing populations and economies; Significant agricultural activity

Environmental degradation

Climate “hot spots”

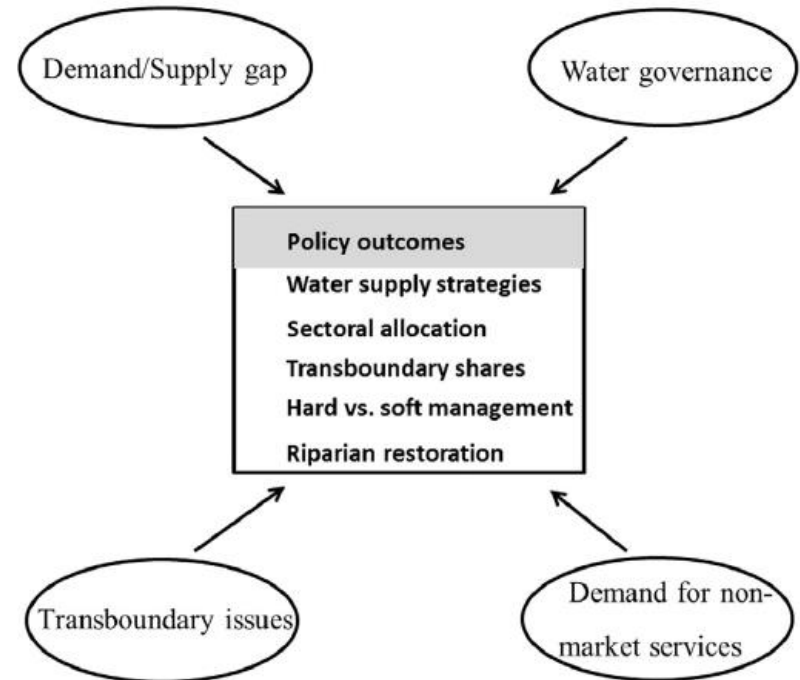


Fig. 3. Driving forces and their qualitative impact on policy outcomes.

# Innovative Grey Water System in Jordan



*Water* **2012**, 4, 580-596; doi:10.3390/w4030580

OPEN ACCESS

*water*

ISSN 2073-4441

www.mdpi.com/journal/water

*Article*

## Grey Water Reuse for Agricultural Purposes in the Jordan Valley: Household Survey Results in Deir Alla

Othman A. Al-Mashaqbeh <sup>1,\*</sup>, Ayoup M. Ghrair <sup>1</sup> and Sharon B. Megdal <sup>2</sup>

<sup>1</sup> Royal Scientific Society, Knowledge, Amman-al Jubaiha 11941, Jordan;  
E-Mail: [ayoup.ghrair@rss.jo](mailto:ayoup.ghrair@rss.jo)

## CLEAN

Soil Air Water

Ayoub M. Ghrair <sup>1</sup>  
Othman A. Al-Mashaqbeh <sup>1</sup>  
Sharon B. Megdal <sup>2</sup>

Research Article

## Performance of a Grey Water Pilot Plant Using a Multi-Layer Filter for Agricultural Purposes in the Jordan Valley

<sup>1</sup>Royal Scientific Society, Knowledge, Scientific Research Center, Amman-al Jubaiha, Jordan

<sup>2</sup>Water Resources Research Center

# Complex Water Management Issues, Challenges, and Solutions

- Growth and the need for additional supplies (competition)
- Drought/climate variability
- Water-energy Nexus
- Water quantity assessments
- Water quality
- Desalination
- Use of recycled water for potable and other water needs
- Access to and utilization of renewable supplies
- **Transboundary water issues**
- The surface water/groundwater interface
- **Riparian areas and other environmental considerations**
- Water rights settlements
- Conservation programs
- Water storage and recovery (water banking)
- Groundwater replenishment
- Water cost/pricing
- Water Planning

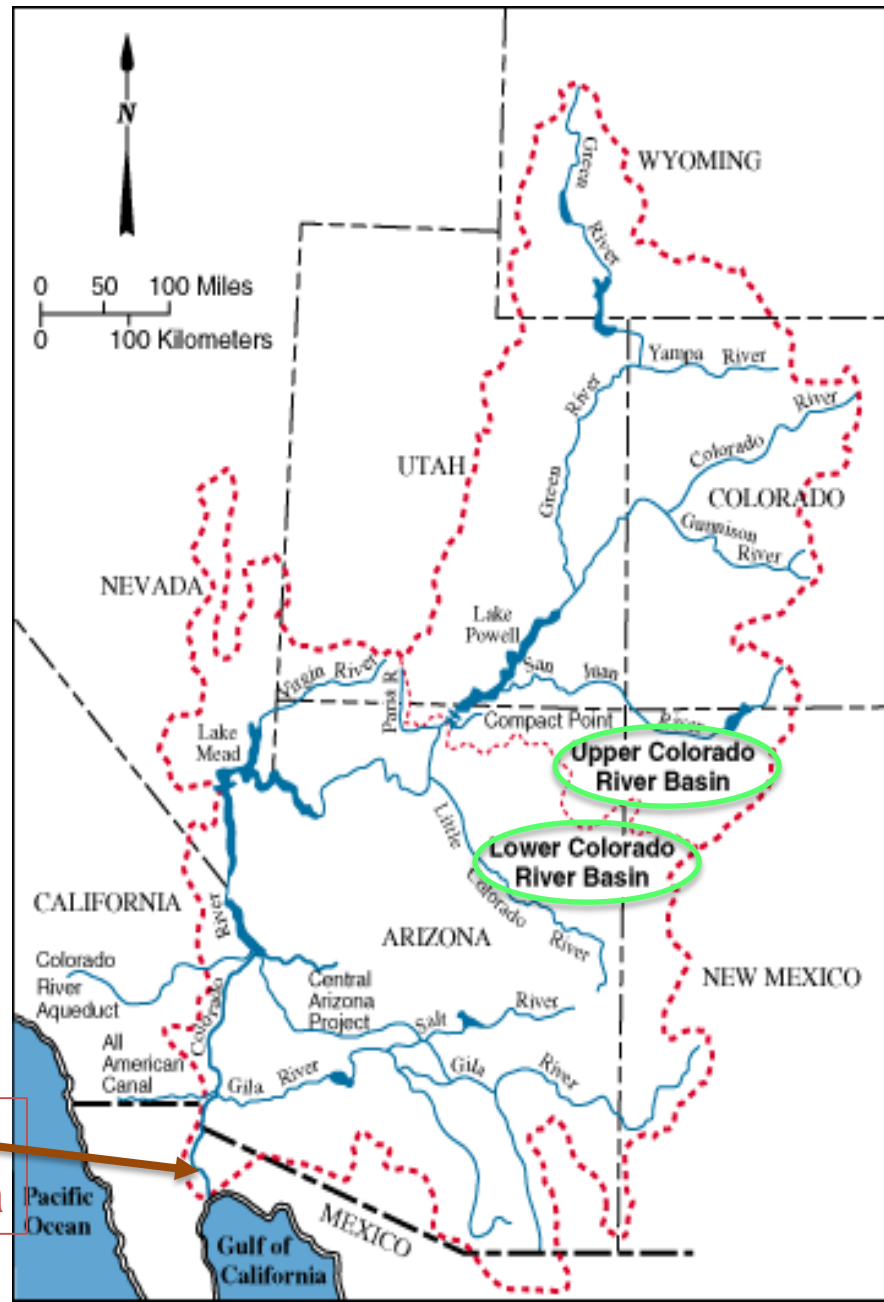
**Uncertainty!**



# Colorado River Basin (CRB)



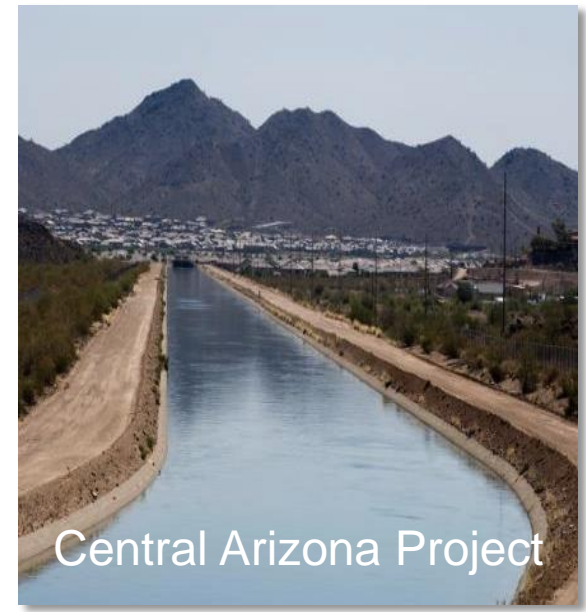
Water Allocations  
Upper Basin 9250 MCM  
Lower Basin 9250 MCM  
Mexico 1,850 MCM  
Evaporation  
Historical flows per  
Tree ring analysis  
~ 18,500 MCM  
=>Structural Deficit



Colorado River Delta



Hoover Dam on Colorado River between Arizona and Nevada



Central Arizona Project

## **Complex water management system**

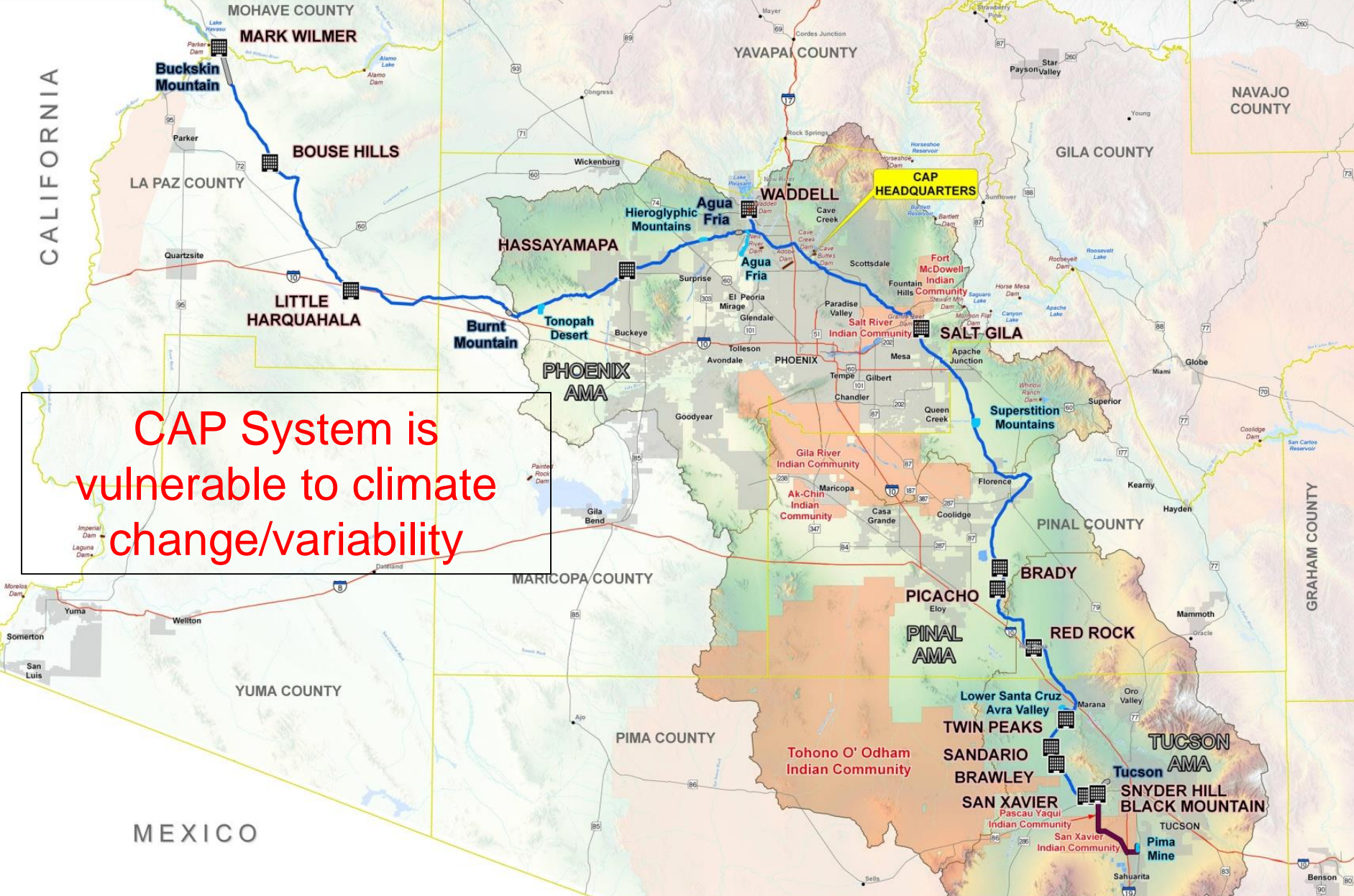


Colorado River through Grand Canyon



Central Arizona Project

CALIFORNIA



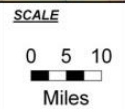
**CAP System is vulnerable to climate change/variability**

**CENTRAL ARIZONA PROJECT CANAL INFRASTRUCTURE**

**LEGEND**

GENERAL FEATURES	
•	Arizona Towns
▭	County Boundaries
—	Highways
▭	Incorporated Cities
—	Rivers
▭	Indian Communities
—	Dams
▭	Lakes

CANAL FEATURES	
▭	WADDLE Pumping Plants
▭	Tucson Tunnels
▭	Agua Fria Pipelines
▭	Agua Fria Recharge



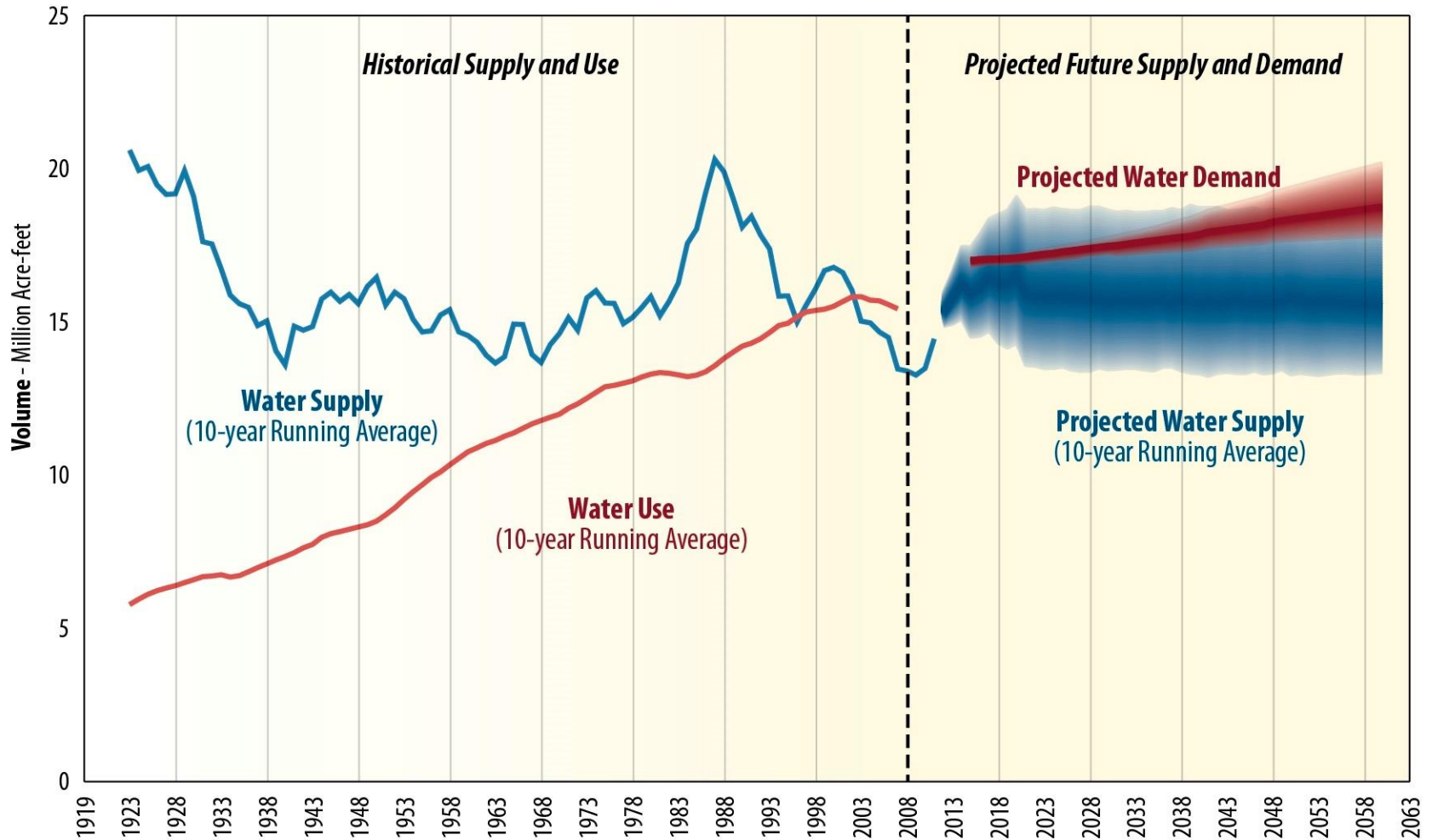
Date: JULY 2009  
 Location: X:\Maps\Canal\_Map\CAP\_Canal\_Simple  
 Projection: NAD 83 HARN, AZ State Plane, Central Zone, Intl. Feet

This map is not a legal document and is for informational purposes only. It does not constitute a contract. The user is responsible for verifying the accuracy of the data and for obtaining any necessary permits or clearances. The user is also responsible for obtaining any necessary insurance coverage. The user is also responsible for obtaining any necessary permits or clearances. The user is also responsible for obtaining any necessary insurance coverage. The user is also responsible for obtaining any necessary permits or clearances. The user is also responsible for obtaining any necessary insurance coverage.





# The supply-demand gap for the US portion of the Colorado River Basin



# Management of the Colorado River

- Within the U.S., the Secretary of the Department of Interior is the manager of the River
  - U.S. Bureau of Reclamation is the responsible agency with the Department
- Reclamation works with the seven U.S. states, each of which has authority for in-state water management
- The 1944 Water Treaty for the "Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande"
- International Boundary and Water Commission (IBWC) mission is to "provide binational solutions to issues that arise during the application of United States - Mexico treaties regarding boundary demarcation, national ownership of waters, sanitation, water quality, and flood control in the border region".
- <http://www.ibwc.gov/home.html>

# International Boundary and Water Commission (IBWC) and Minute 319

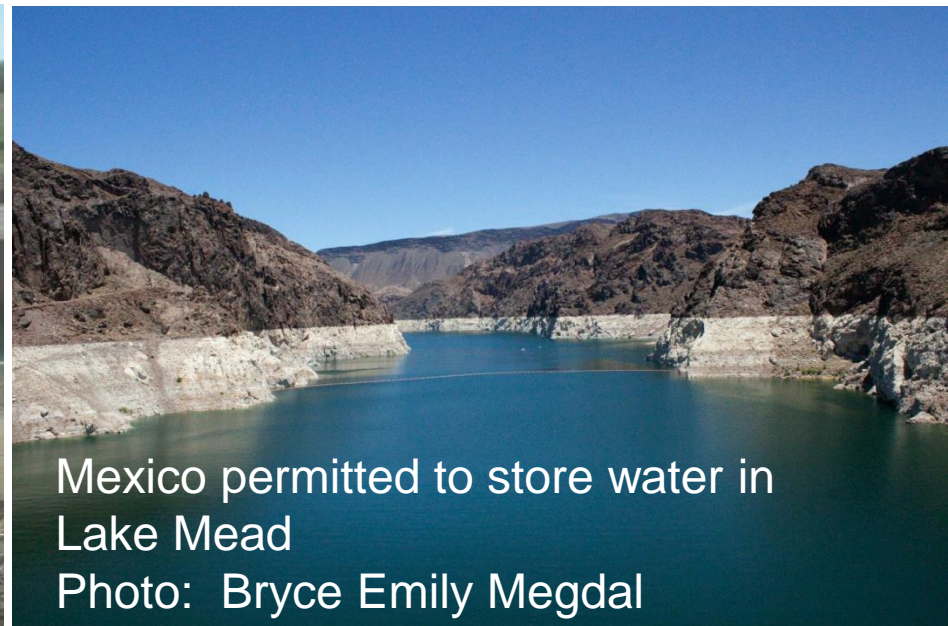
- One U.S. and one Mexican Commissioner
- Empowered to adopt “minutes” to the 1944 treaty
- Border water and wastewater issues flow through IBWC, regardless of the asymmetrical water governance frameworks of the two countries.
- IBWC established working groups, which gave NGOs a “seat at the discussion table”.
- Working with IBWC are the U.S. Bureau of Reclamation and CONAGUA as the lead federal water agencies, respectively
- **\*\*Minute 319\*\*** allowed for a Pulse Flow for restoration pilot program, sharing water surplus and shortage between U.S. and Mexico, allowing Mexico to store water in U.S. reservoirs, maintain salinity standards, and encourage binational water development and conservation projects.

# Related Minutes

- 2010: Minutes 316, 317, and 318 laid the foundation for Minute 319.
- Minute 318 granted Mexico storage rights in Lake Mead after the 2010 earthquake.
- New way of managing the Colorado River water sharing.



Earthquake in Mexico 4 April 2010  
Photo: Sorongran Institute



Mexico permitted to store water in  
Lake Mead  
Photo: Bryce Emily Megdal

## Minute 319

*“Interim International Cooperative Measures in the Colorado River Basin through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California”*

- **5 Year Interim Agreement**  
(thru December 31, 2017)
- **Comprised of 7 Sections :**
  - Extension of Minute 318
  - Surplus Sharing
  - Shortage Sharing
  - Intentionally Created Mexican Allocation (ICMA)
  - Salinity Management
  - Water for the Environment & ICMA to ICS Exchange
  - **International Projects**



**Minute No. 319 Signing Ceremony –  
November 20, 2012**

Slide courtesy of IBWC  
November 2013 Presentation

# Colorado River in Mexico

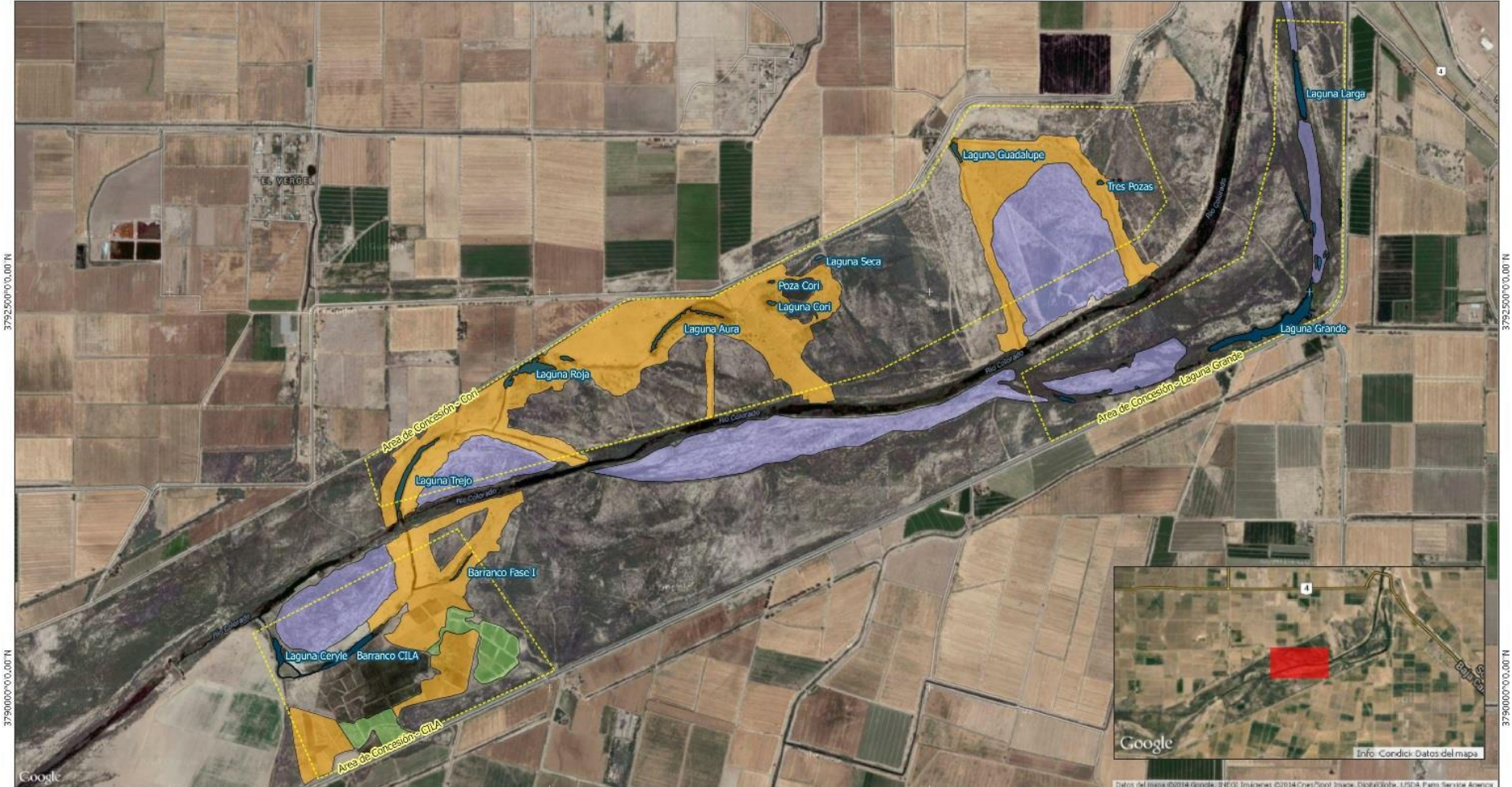


12814999°0'0.00"W

12812499°0'0.00"W

12809999°0'0.00"W

12807499°0'0.00"W



12814999°0'0.00"W

12812499°0'0.00"W

12809999°0'0.00"W

12807499°0'0.00"W

**ZONA DE RESTAURACIÓN LAGUNA GRANDE**  
 El mapa muestra la Zona de Restauración Laguna Grande y las Areas en Concesión de Zona Federal. Se presenta la ubicación de los polígonos de trabajo de las diferentes actividades como parte de Fase I y Fase II.  
 Área reforestada (Fase I - 2013): 13.3 hectáreas (32.9 acres)  
 Área desmontada (Fase II - 2014): 165.4 hectáreas (408.7 acres)  
 Área adicional (Próximas fases): 136.8 hectáreas (338 acres)  
 Total: 315.5 hectáreas (779.6 acres).

**SIMBOLOGÍA**

Zonas de restauración - 315.5 hectáreas (779.6 acres)

- Área reforestada Fase I (2013) - 13.3 hectáreas (32.9 acres)
- Área desmontada Fase II (2014) - 165.4 hectáreas (408.7 acres)
- Área adicional (próximas fases) - 136.8 hectáreas (338 acres)

Cuerpos de agua

- Laguna

Área de concesión de Zona Federal

Limite de Área de concesión

**DATOS CARTOGRAFICOS**

Proyección: Pseudo Mercator  
 Datum: WGS84  
 Fuente de mapa: Google Hybrid  
 Openlayer Map

0 200 400 600 800 m

**LOCALIZACIÓN**

Elaboro: Tomás E. Rivas Salcedo  
 Fecha: 13 Septiembre 2014  
 Clave de mapa: SI2014+MAP-0000

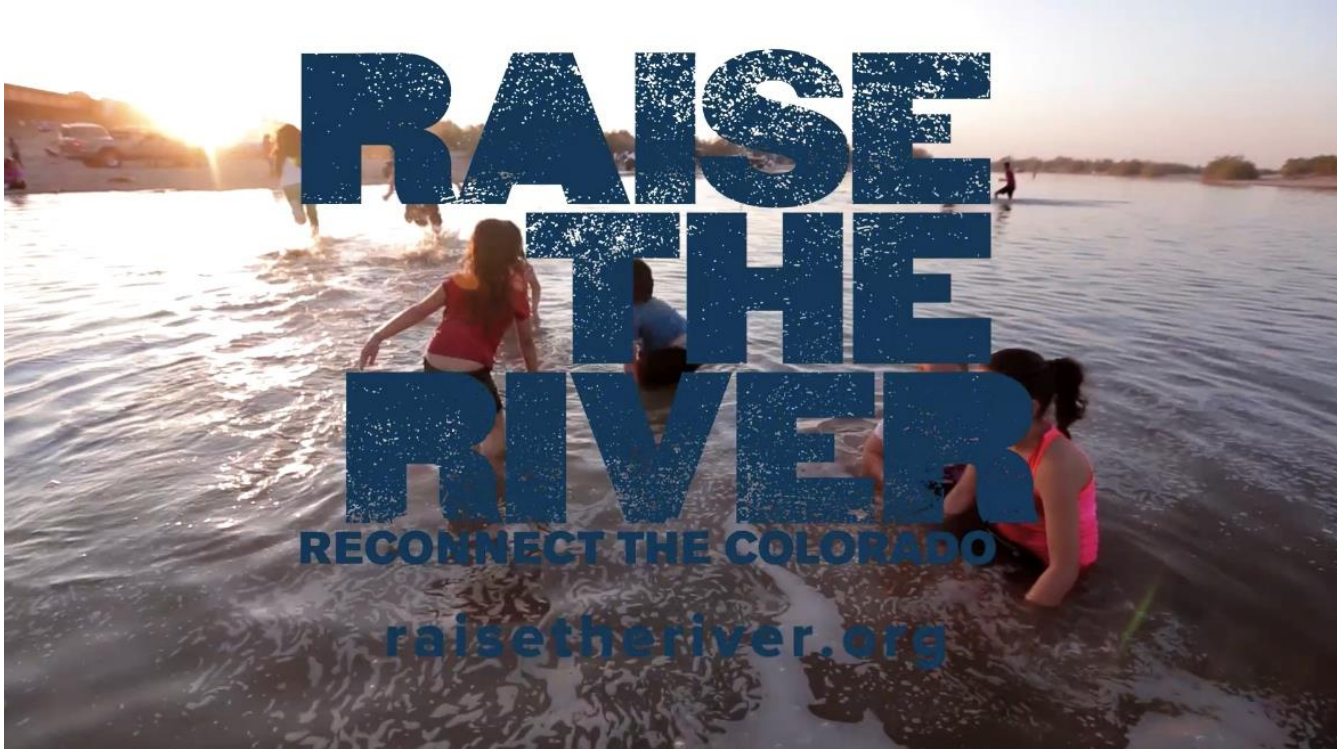
Laguna Grande Restoration Area: Green represents the reforested area during 2013 (33 acres); orange represents the cleared and leveled area during 2014 (409 acres); violet represents the additional acres that are expected to be restored in the next project phases (338 acres).

# 2014 Pulse Flow

- Occurred March 23rd – May 18th, 2014.
- Designed to mimic, at a reduced scale, spring floods that affected the Colorado River Delta for years. Cottonwoods and willows were producing seeds during that time, and those seeds need to land on wet ground to germinate and support restoration goals of the Pulse Flow.







Founding Members - Raise the River Coalition

**Environmental Defense Fund**  
**National Fish and Wildlife Foundation**  
**The Nature Conservancy**  
**Pronatura Noroeste**  
**Redford Center**  
**Sonoran Institute**

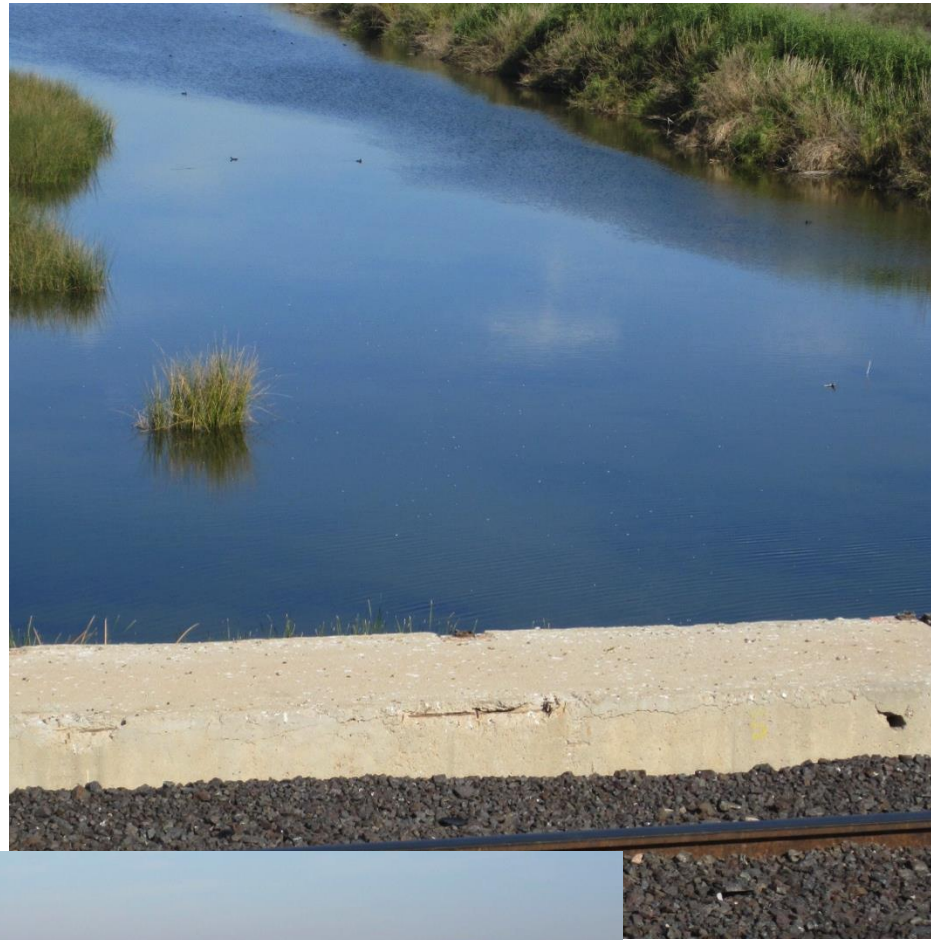
# **Renewal – A Reborn Colorado River Once Again Finds Her Path to the Sea**

<http://youtu.be/TODV7FW746s>





Pulse Flow (photo from movie)



“Normal”  
flow:  
agricultural  
runoff

# Water for the Pulse Flow

- Three equal water components totaling 195 MCM
  - 130 MCM were released in the Pulse Flow (65 MCM responsibility of each country)
  - The third 65 MCM is called base flow and is designed to support restoration projects in the Delta over the next four years. NGOs are responsible for obtaining this base flow.
- U.S. contributed \$21 million to Mexico for infrastructure and environmental projects in Mexico, including lining the Reforma canal in Mexico.

# Hydrologic and vegetative response monitored



CILA restoration site



Tamarisk returning in experimental plot

Willows sprouted during  
Pulse Flow



Photos courtesy of Nate Delano

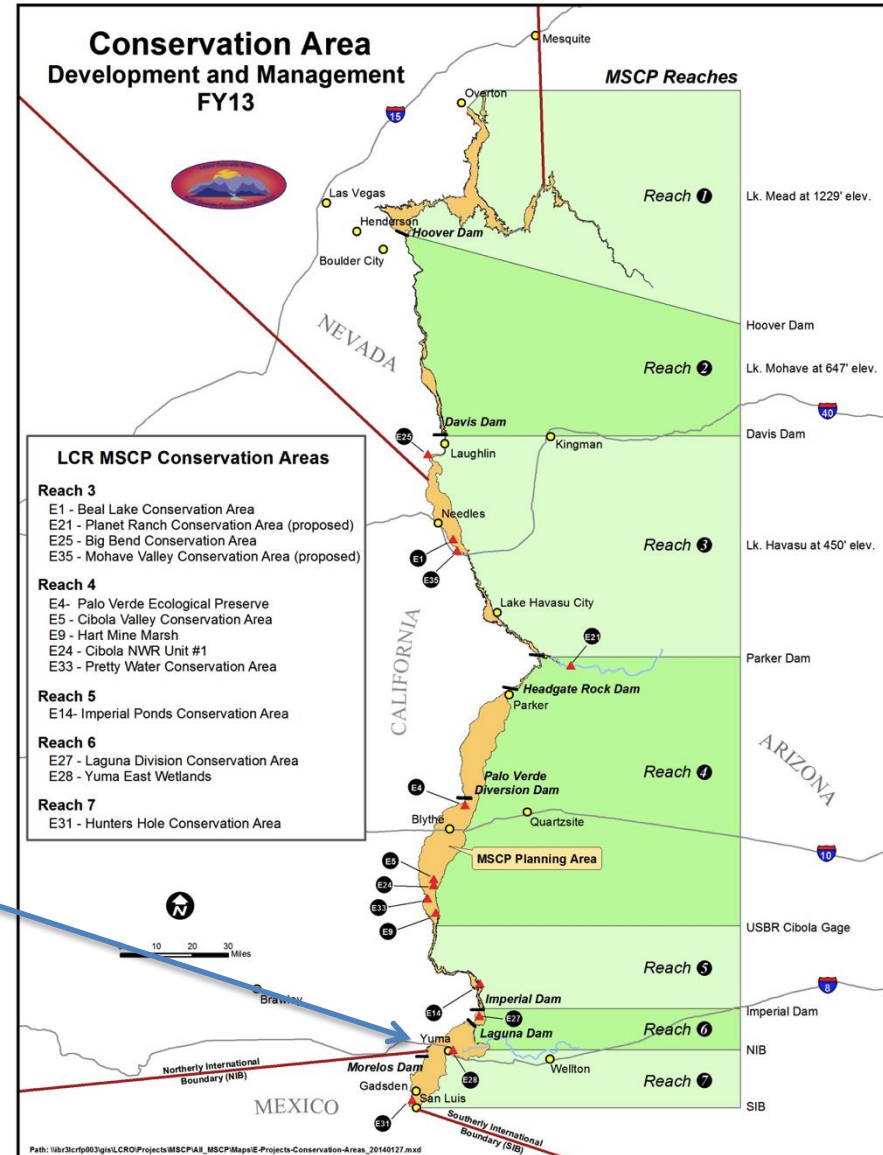
# Importance of drivers and enabling mechanisms

- IBWC Commissioner interaction, which is frequent, follows diplomatic protocols when official actions are contemplated.
- Groundwork for cooperation that included NGOs was established prior to the 2010 earthquake
- Earthquake led to new level of cooperation. Seven US states involved, too.
- Funding for NGO efforts has been a positive factor



# Another important restoration effort: U.S. Lower Colorado River Multispecies Conservation Program (MSCP)

- Involves the Lower Basin States and the U.S. Bureau of Reclamation
- Driver: Compliance with the federal Endangered Species Act (Sections 7 and 10)
- Reach 6
  - Laguna Division Restoration Area
  - Yuma East Wetlands



# **Selected Facts about the MSCP (Source: Central Arizona Project)**

- The 50-year Program (authorized through 2055) includes fifty-seven participating agencies, states, tribes and non-governmental organizations.
- 2015 marks the 10-year implementation anniversary.
- The total Program cost in 2003 dollars is \$626 million. Program costs are split 50/50 between the federal government and non-federal program parties. The non-federal cost-share is split between Arizona 25%, California 50% and Nevada 25%.
- The Program has established goals for the creation of habitats that meet the needs of covered species.
- The MSCP uses Adaptive Management to "learn by doing."
- Web site for more information: <http://www.lcrmscp.gov/>





Laguna Division Restoration Area



Yuma East Wetlands

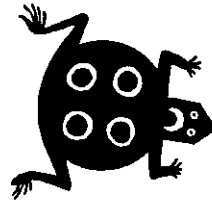


Photos  
taken 10  
October  
2014

# Another asset in MX of binational importance: Cienega de Santa Clara



**The frog does not drink up the pond in  
which he lives. – *American Indian  
(Lakota) Proverb***



**Thank you!  
Toda Raba  
Shukran**