COLLEGE OF AGRICULTURE & LIFE SCIENCES
COOPERATIVE EXTENSION

WATER RESOURCES RESEARCH CENTER

Groundwater Governance and Management

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AGI Critical Issues Forum: Addressing Changes in Regional Groundwater Resources: Lessons from the High Plains Aquifer
October 27, 2016

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GREATER DEPTH, BROADER PERSPECTIVE FOR A CLEAR WATER FUTURE

We tackle key water policy and management issues, empower informed decision-making, and enrich understanding through engagement, education, and applied research.

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What I work on

- Groundwater, groundwater, groundwater
  - National-scale surveys of governance and management
  - Groundwater recharge and banking
  - Transboundary aquifer assessment
- Colorado River Basin issues
- Characterization and evaluation of what we do and what we can do at multiple geographic scales
- Student and public education

Water policy reflects many determining factors

- Resource Availability
- Location of water demands and supplies
- Economics
- Historic and Current Legal/Institutional Framework
- The nature of involvement of multiple governmental and non-governmental entities, including the extent of centralized versus decentralized decision making
- Politics of Area
- Public values and socio-cultural factors
- Historical context
- Information
- Etc…

Importance of Context

Water cycle; Geographic context

CAST® Issue Paper Number 44 November 2009

Water, People, and the Future: Water Availability for Agriculture in the United States

Abstract

With a projected 25% and 50% increase in U.S. and world population, respectively, by the year 2050, substantial increases in freshwater use for food, fiber, and fuel production, as well as municipal and residential consumption, are inevitable. This increased water use will not come without consequences.

Already, the United States has experienced the mining of groundwater, resulting in declining water tables, increased costs of water withdrawal, and the deterioration of water quality. Long-term drought conditions have greatly decreased surface water flows. Climate change predictions include higher temperatures, decreases in snowpack, shifts in precipitation patterns, increases in evapotranspiration, and more frequent droughts. Not surprisingly, conflicts over water use are continually emerging.

As one of the largest users of water in the United States, agriculture will be impacted significantly by changes in water availability and cost. Approximately 40% of the water withdrawn from U.S. surface and groundwater sources is used for agricultural irrigation. Although the proportion of available freshwater used in agriculture varies widely among geographical areas, it is a major proportion of total water use in every area.

Increasing responsibilities are being placed on agricultural water users at a time when available water resources are decreasing. Additionally, increasing industrial and residential water use will continue to limit the water available to agriculture. Since agriculture faces a future with less water available, substantial efforts will be

In central Arizona, the Santa Rosa Canal provides Colorado River water for cotton, alfalfa, wheat, and other crops. (Photo courtesy of USDA Agricultural Research Service Image Gallery.)

This material is based upon work supported by the U.S. Department of Agriculture's (USDA) Cooperative State Research, Education, and Extension Service (CSREES) Grant No. 2009-38902-20041, Grant No. 2008-38902-19327, Grant No. 2007-31100-06019/Iowa State University (ISU) Project No. 413-40-02, and USDA's Agricultural Research Service (ARS) Agreement No. 59-0202-7-144. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of USDA, CSREES, ISU, or ARS.

Water Resource Sustainability in the High Plains Aquifer

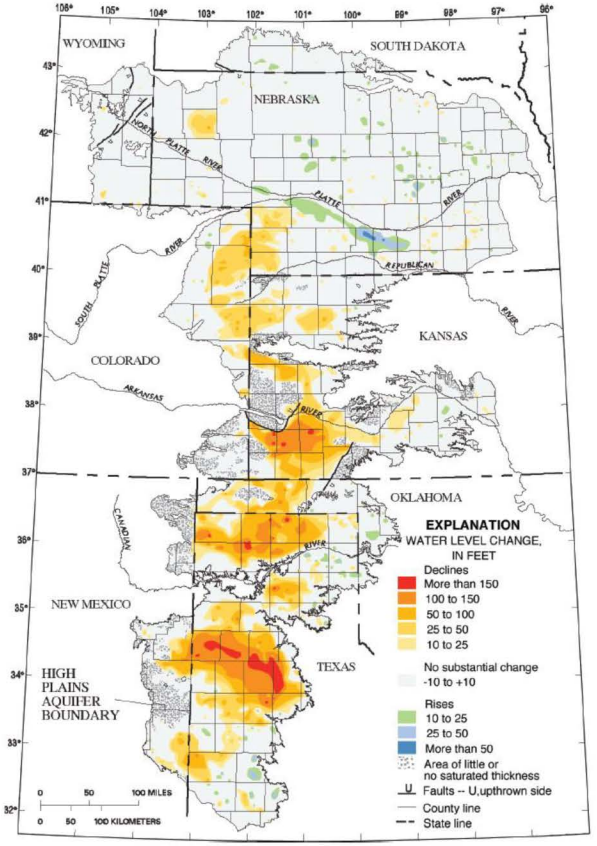


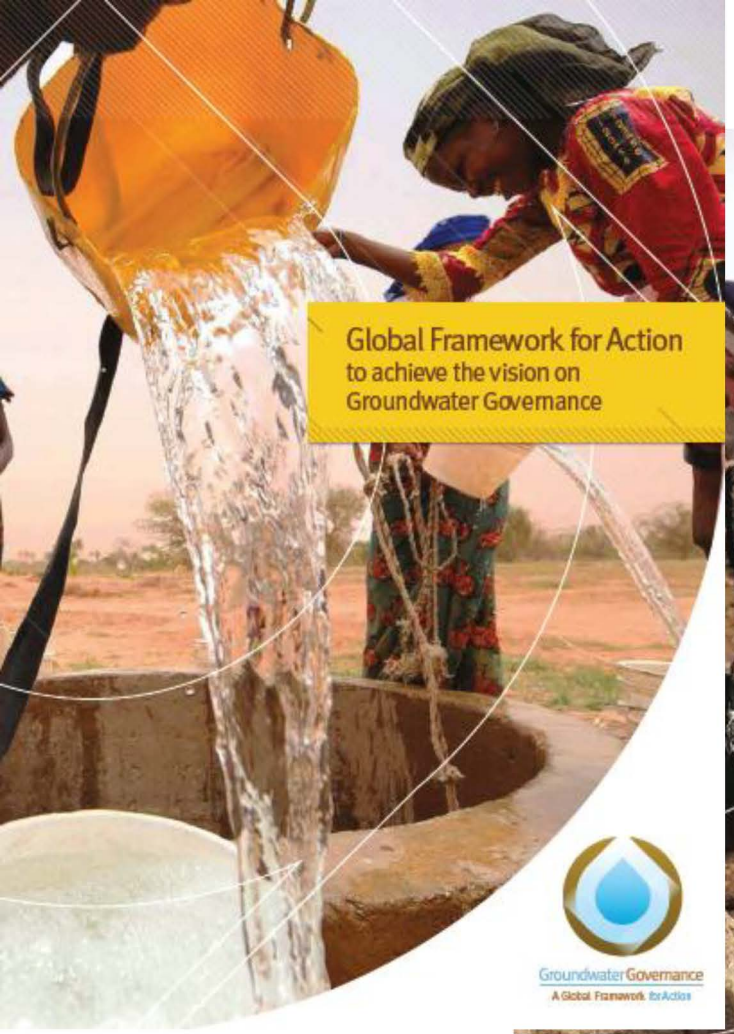
Figure 6. High Plains aquifer, predevelopment to 2005 (McGuire 2007).

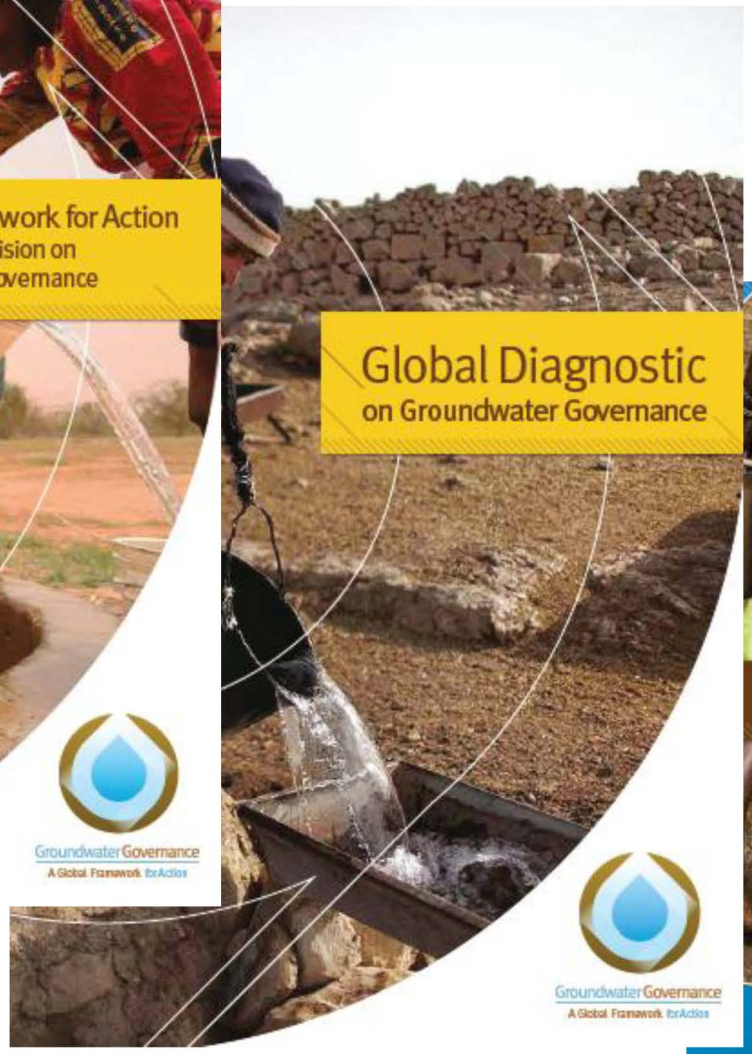
Predevelopment to 2005

High Plains

"Whereas deliberately bypassing the opportunity to divert overland runoff in Kansas' Wet Walnut Creek watershed or the Platte River basin might be expected to benefit particular ecological systems, in most other High Plains locations no utility would be gained from leaving water in the ground. Pumping the ground water has and will continue to create wealth—not only for individuals, local economies, and the states, but for the Nation."

www.groundwatergovernance.org

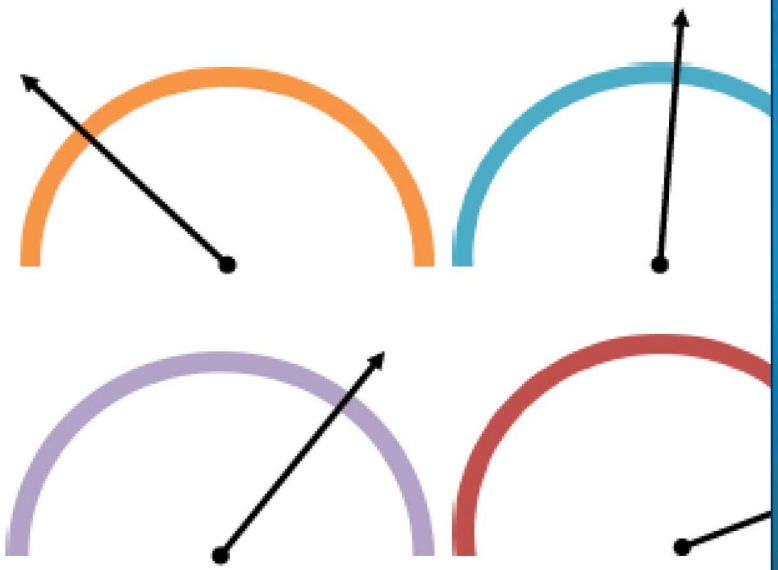




OECD Water Governance Initiativ

INVENTORY

OF WATER GOVERNAN INDICATORS AND MEASUREMENT FRAMEWORKS



Contact: Aziza.Akhmouch@oecd.org and Oriana.Romano@oecd.o
Last up-dated on 10 July 2015

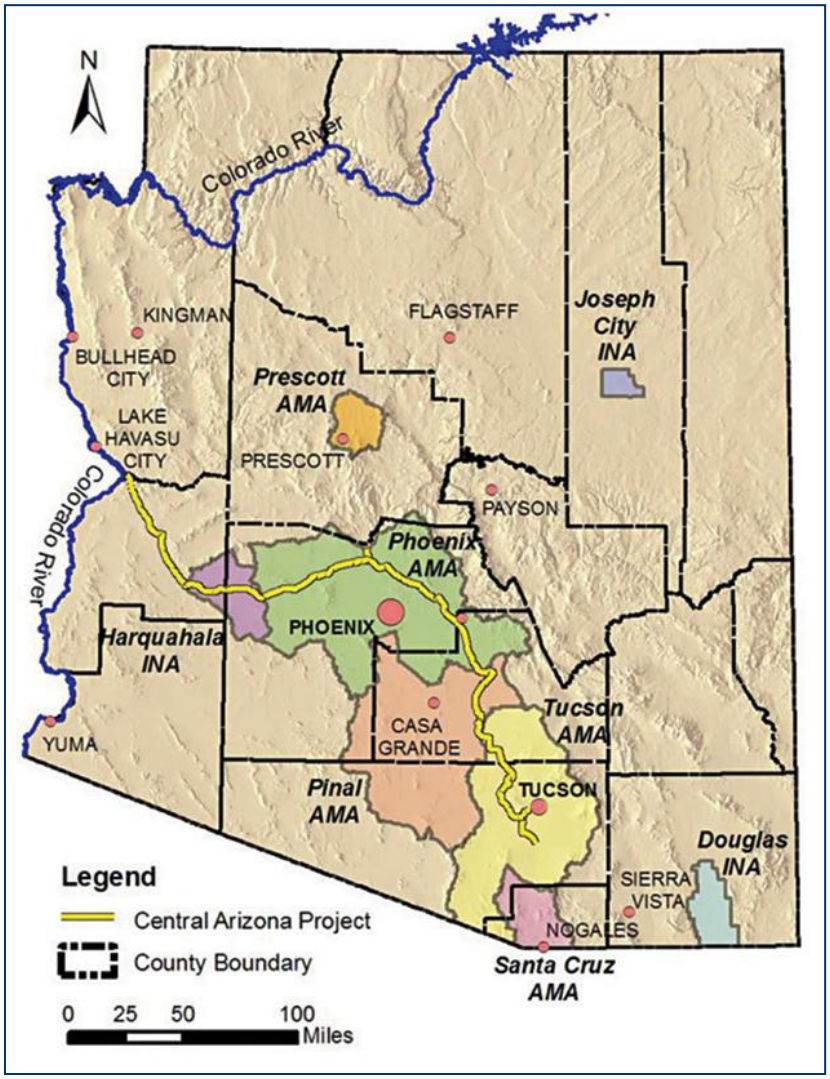
OECD Studies on Water

Stakeholder Engagement for Inclusive Water Governance

OECD

http://www.oecd.org/gov/regional-policy/water-governance-initiative.htm

Legal/Institutional/Governance Context: Cannot paint US with a single brushstroke



Groundwater governance – 2013 Initial Survey of States

Groundwater governance is the overarching framework of groundwater use laws, regulations, and customs, as well as the processes of engaging the public sector, the private sector, and civil society.

Groundwater

Issue Paper/

Groundwater Governance in the United States: Common Priorities and Challenges

by Sharon B. Megdal[1], Andrea K. Gerlak[2], Robert G. Varady[3], and Ling-Yee Huang[4]

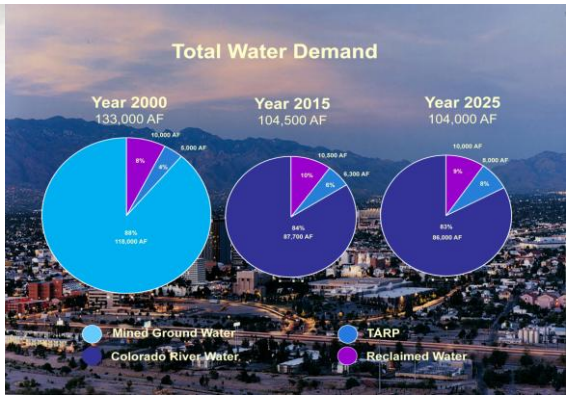
Governance vs. Management

Water management is *what* we *do*.

E.g., the actors operate wells, treat water for use/reuse, store water through managed aquifer recharge, conserve…

SHARON B. MEGDAL AND ALAN FORREST

How a Drought-Resilient Water Delivery System Rose Out of the Desert: The Case of Tucson Water



Water **2014**, *6*, 1500-1514; doi:10.3390/w6061500

OPEN ACCESS

water

ISSN 2073-4441

www.mdpi.com/journal/water

Article

Water Banks: Using Managed Aquifer Recharge to Meet Water Policy Objectives

Sharon B. Megdal [1,3,*], Peter Dillon [2] and Kenneth Seasholes [3]

Journal of Hydrology 521 (2015) 18–33

Contents lists available at ScienceDirect

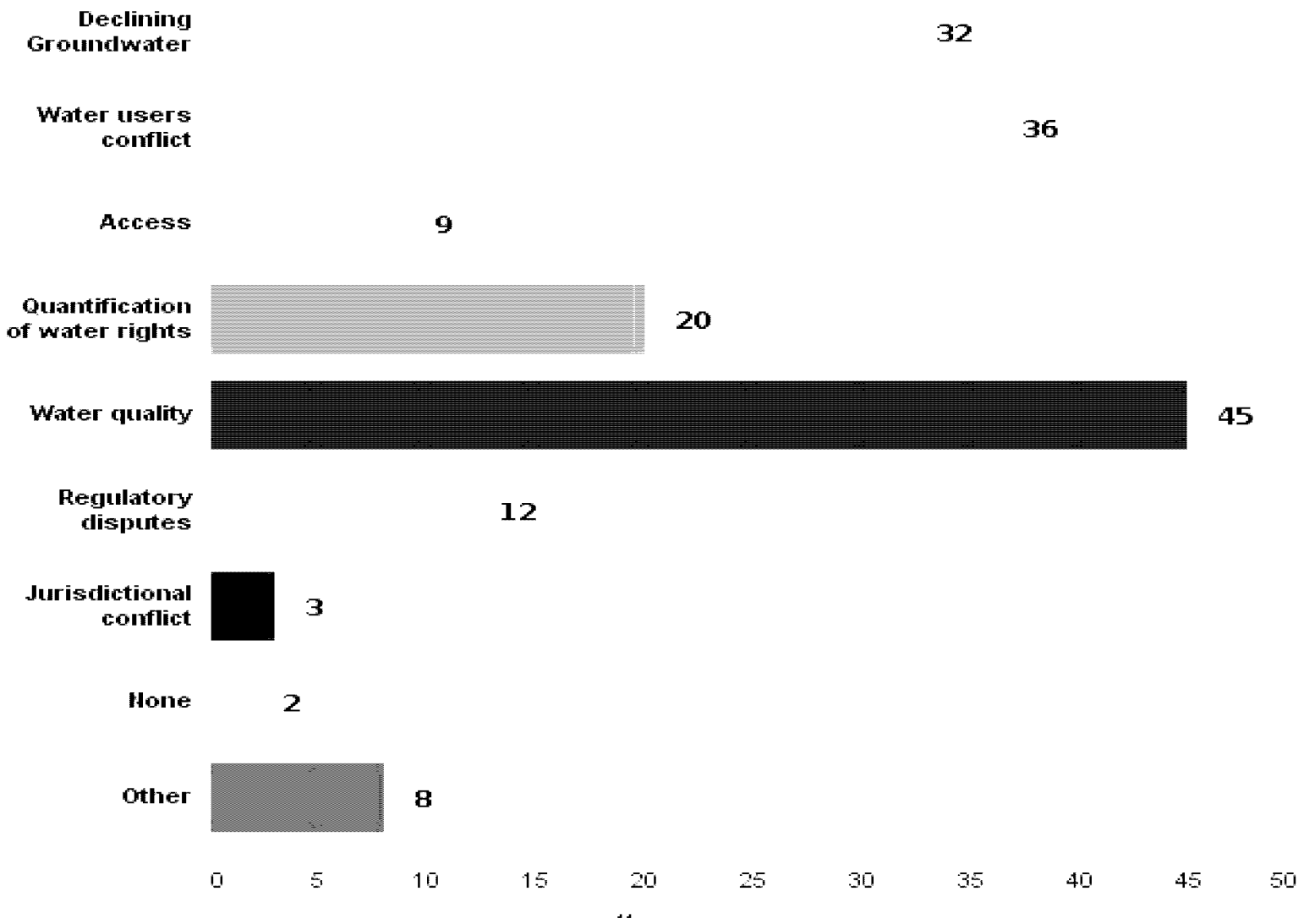
Journal of Hydrology

journal homepage: www.elsevier.com/locate/jhydrol

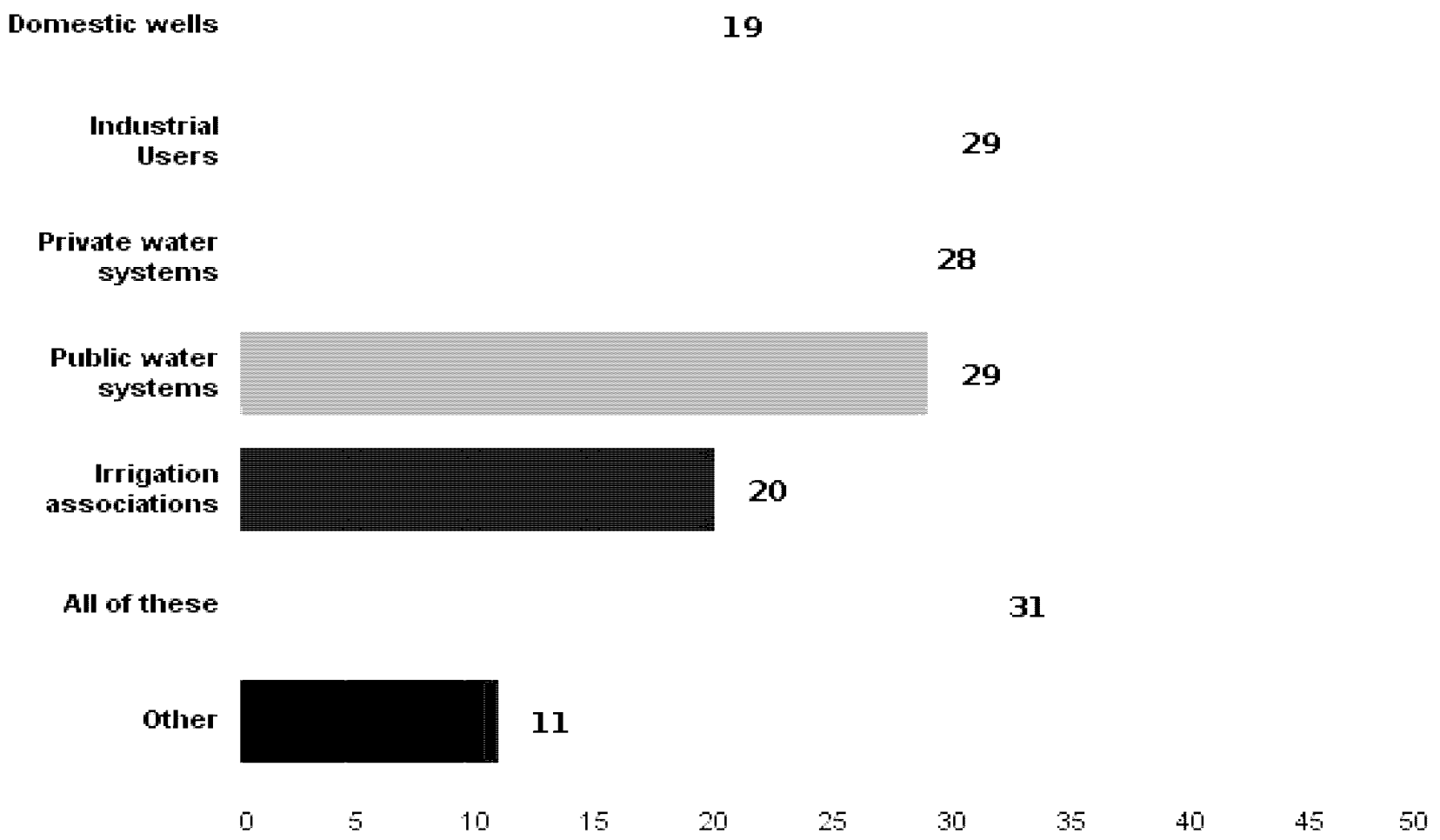
Climate change and water resources management in the Upper Santa Cruz River, Arizona

Eylon Shamir [a,*], Sharon B. Megdal [b], Carlos Carrillo [c], Christopher L. Castro [c], Hsin-I Chang [c], Karletta Chief [e], Frank E. Corkhill [d], Susanna Eden [b], Konstantine P. Georgakakos [a,f], Keith M. Nelson [d], Jacob Prietto [b]

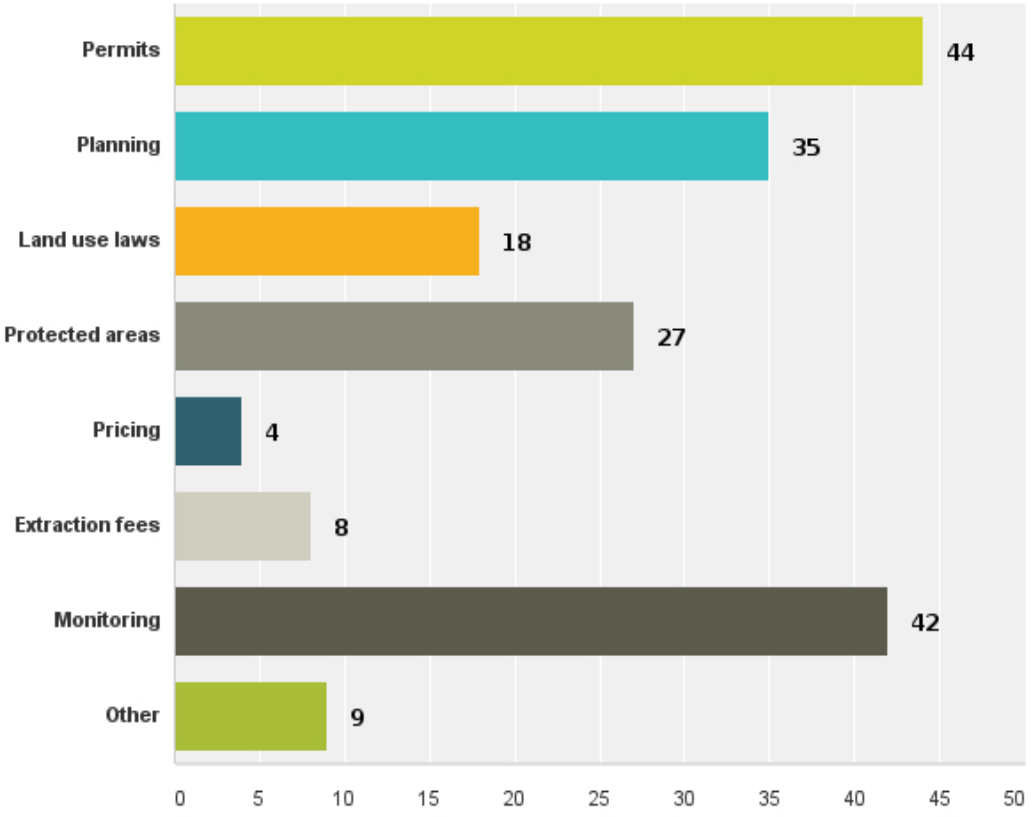
What are the state's groundwater governance priorities?



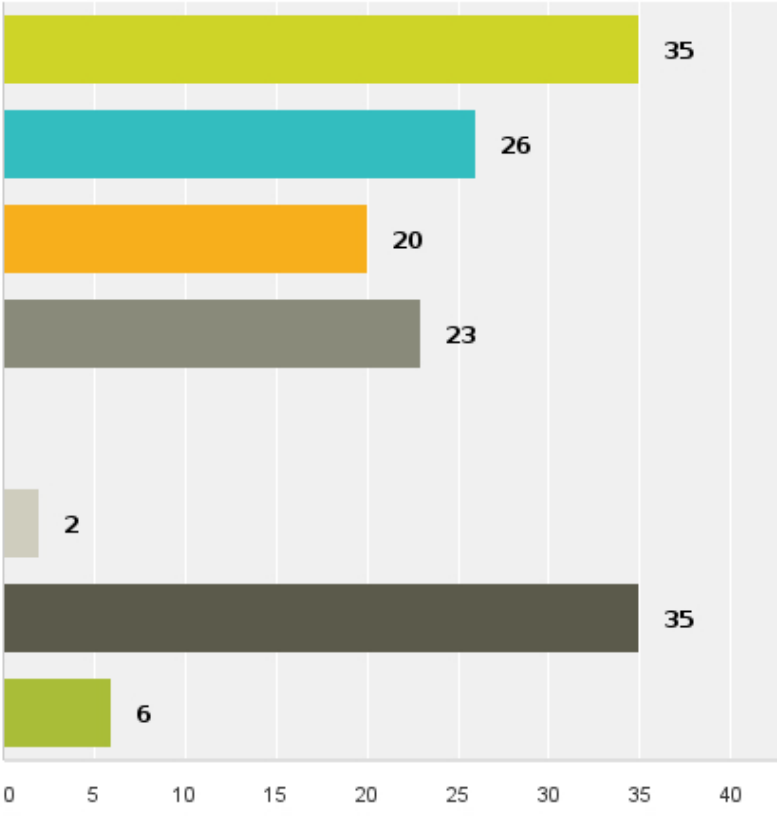
To which of the following user groups do groundwater regulations apply?



Q21 Which tools does the state use to manage groundwater use/quantity?

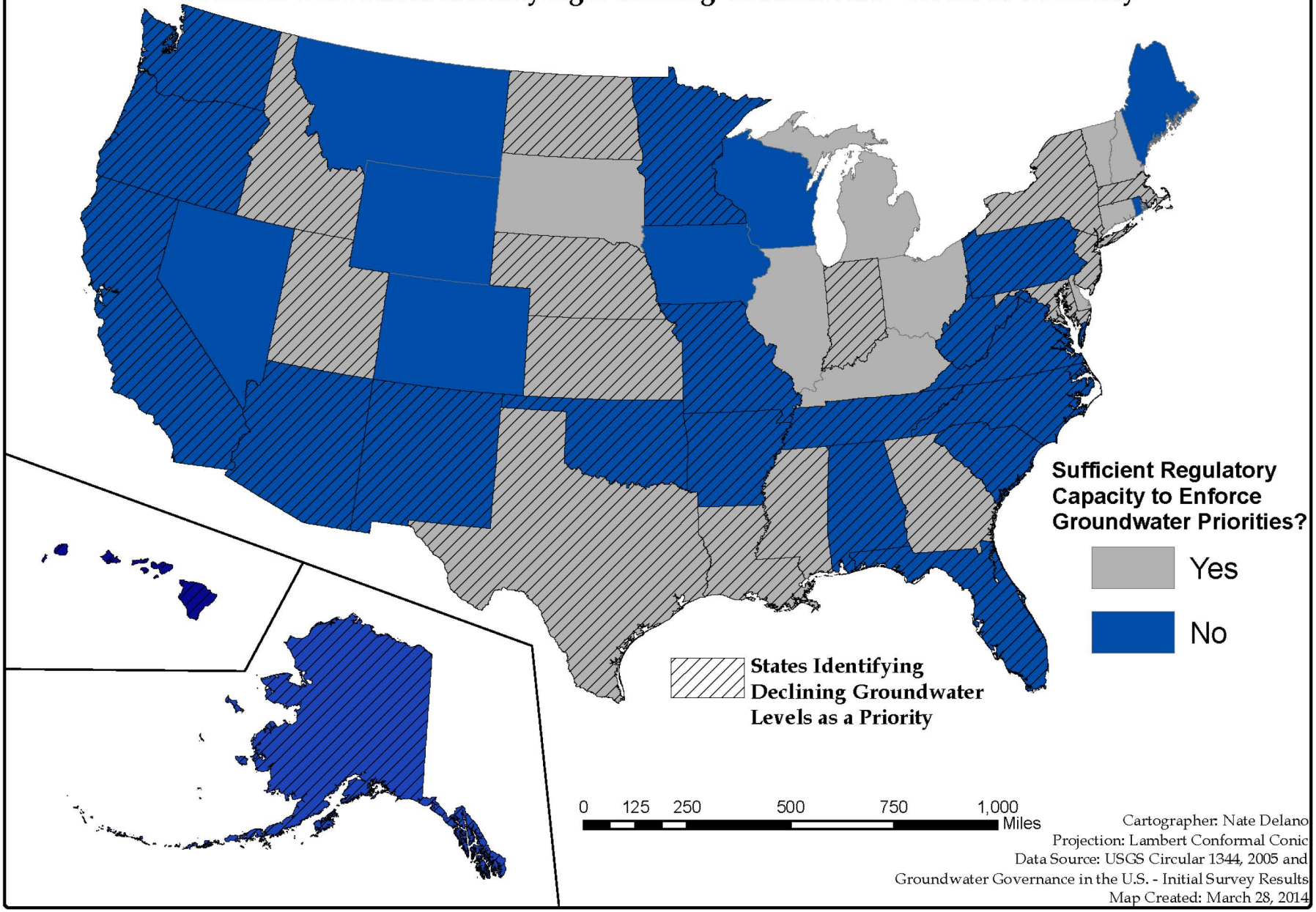


Q24 Which tools does the state use to manage groundwater quality?



States Lacking Sufficient Capacity to Enforce Groundwater Priorities

Overlaid with States Identifying Declining Groundwater Levels as a Priority



Cartographer: Nate Delano
Projection: Lambert Conformal Conic
Data Source: USGS Circular 1344, 2005 and Groundwater Governance in the U.S. - Initial Survey Results
Map Created: March 28, 2014

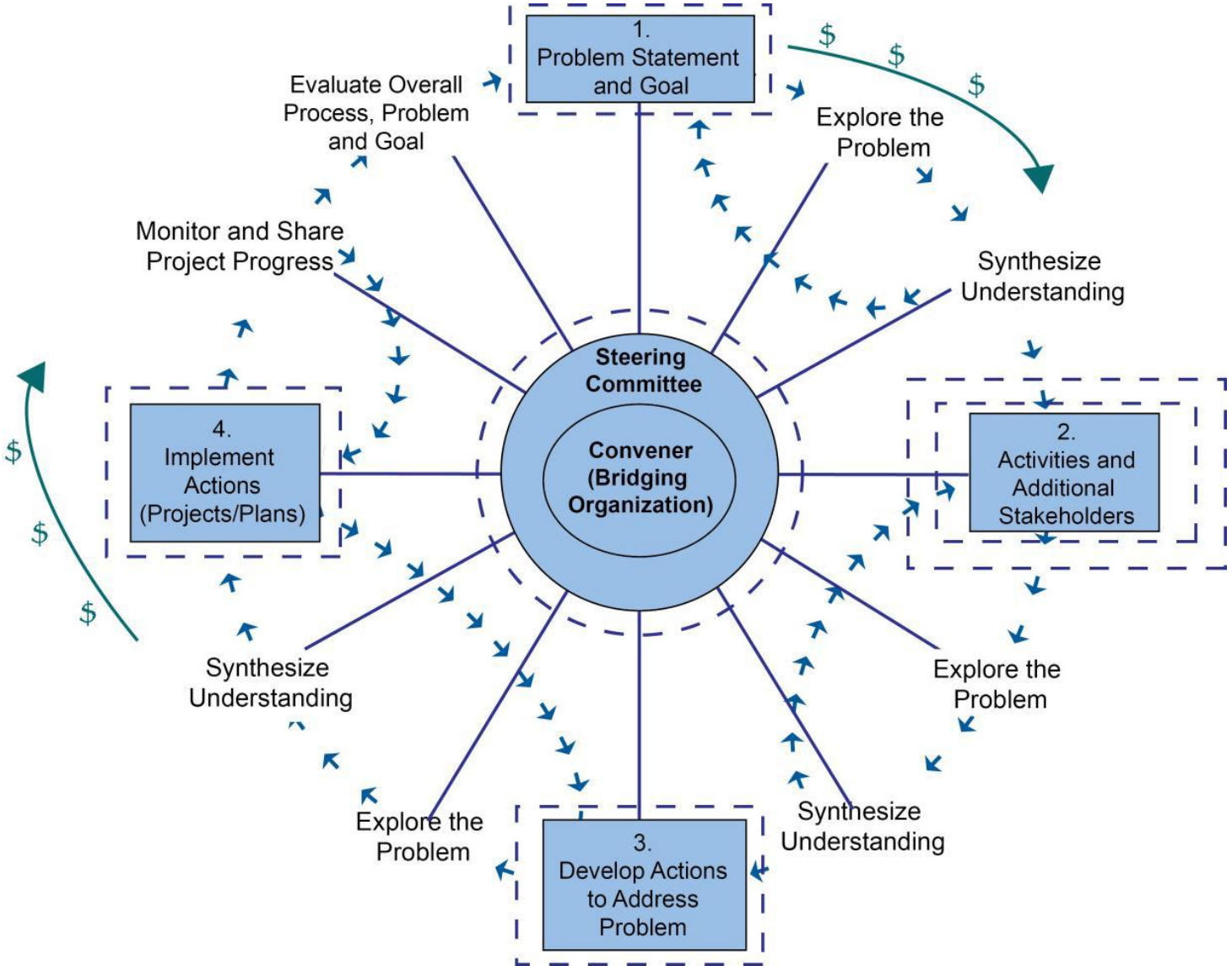
Within-state regional cooperation – three case studies from the Sunbelt

- Regional collaboration and innovation in the face of growing demands for water
  - Orange County Water District (CA) implementation of indirect potable reuse program
  - Central Florida Water Initiative
  - Prescott Valley, AZ implemented a first-ever auction of effluent recharge credits
- Drivers include existing and new legislation, along with litigation or the threat of litigation
- Stakeholder engagement is important, especially as options become more costly and complex

Water **2016**, *8*(4), 118; doi:10.3390/w8040118

Explore, Synthesize, and Repeat: Unraveling Complex Water Management Issues through the Stakeholder Engagement Wheel

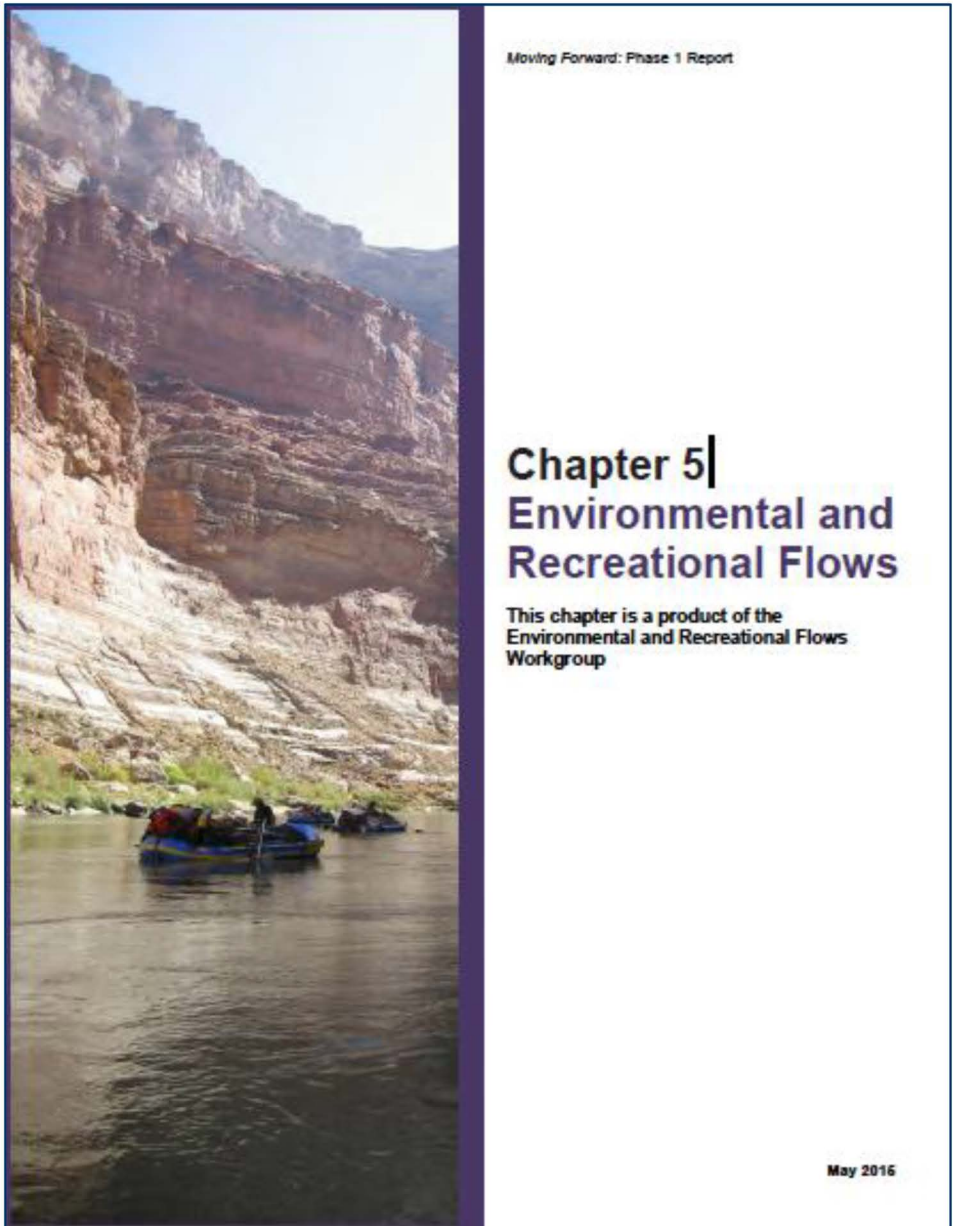
Kelly E. Mott Lacroix and Sharon B. Megdal



Searching for Solutions

- Considering the options and implementing some
  - Desalination
  - Reuse
  - Conservation and increased efficiencies
  - Water banking
  - Voluntary transactions
  - Rainwater harvesting; grey water systems
  - Water importation
  - Financing

Environmental Considerations

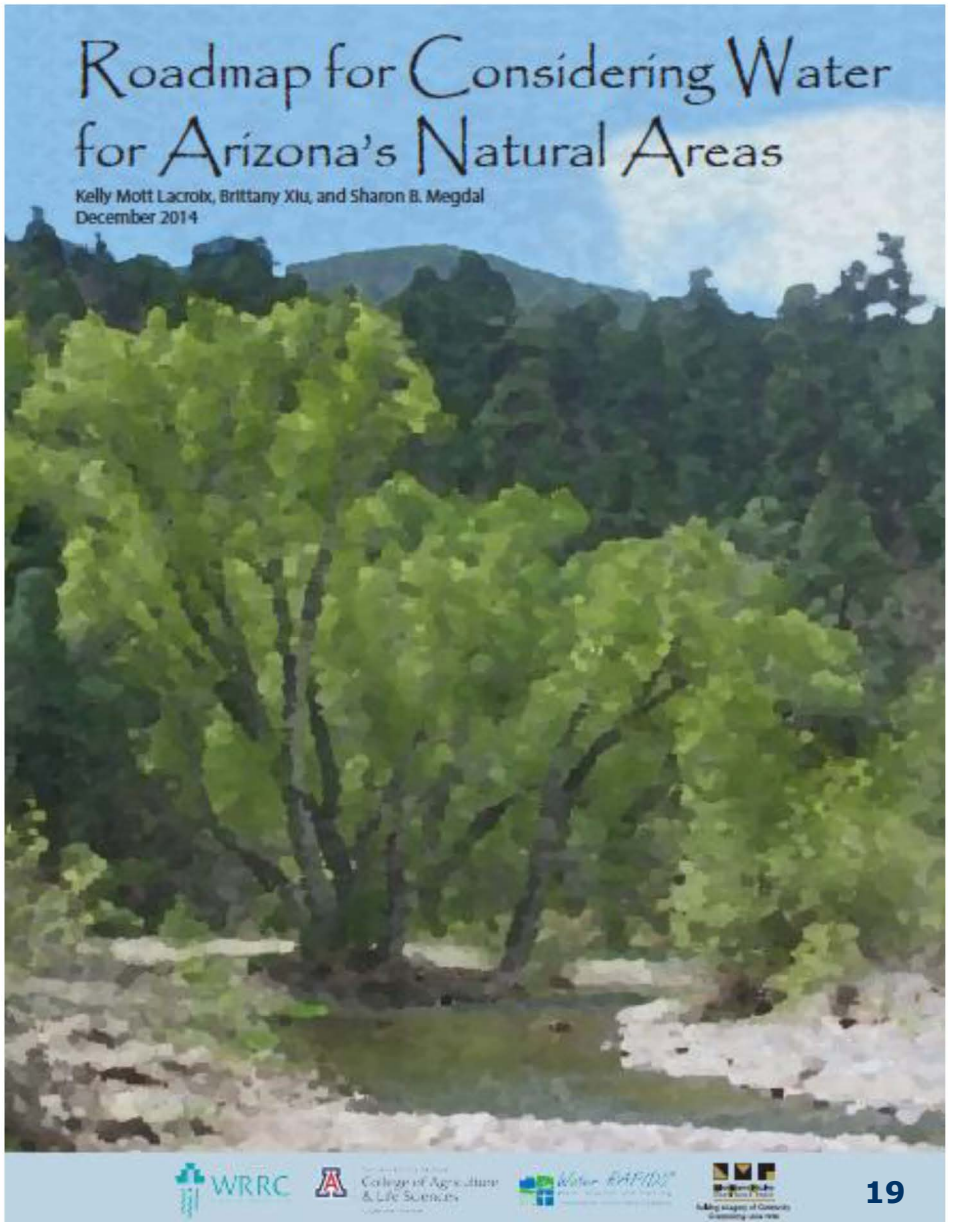


Moving Forward: Phase 1 Report

Chapter 5
Environmental and Recreational Flows

This chapter is a product of the Environmental and Recreational Flows Workgroup

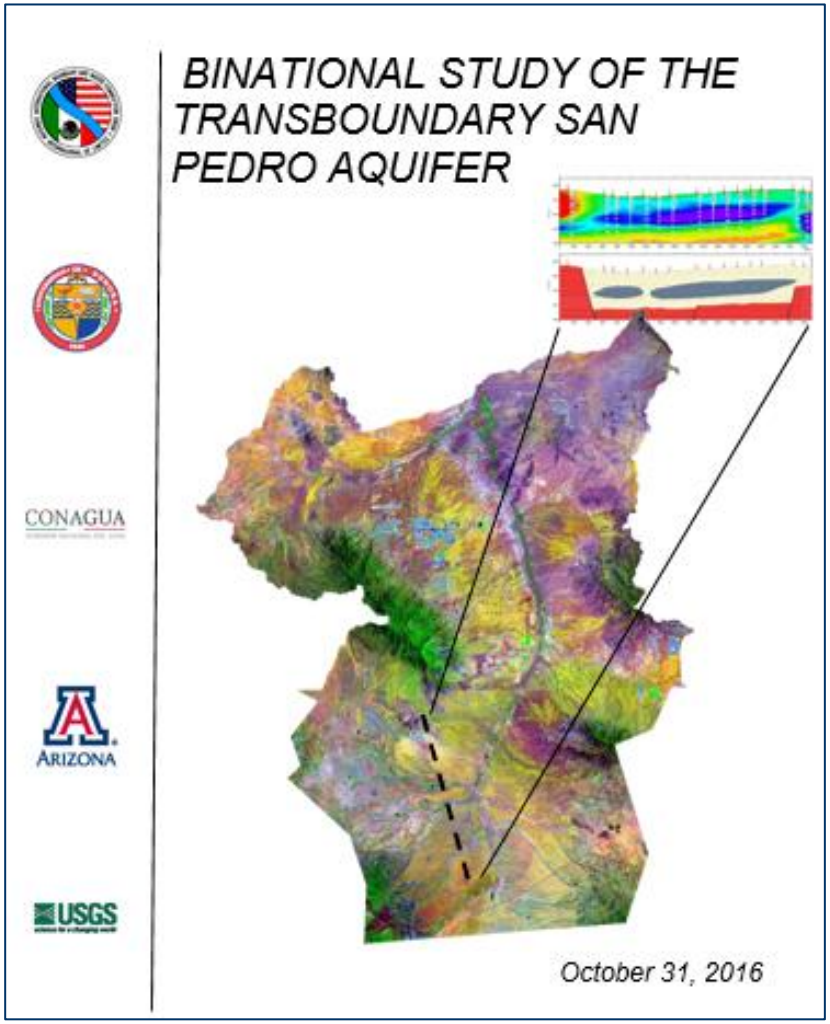
May 2016



Colorado River Basin

Transboundary aquifer assessment

http://wrrc.arizona.edu/TAAP



The Invisible Water

by Sharon B. Megdal

Water policy discussions around the globe are focusing on groundwater and how to improve its governance and management. Growing water demands and changing climate's influence on temperature and precipitation patterns have underscored the importance of groundwater – the invisible water.

Groundwater meets about 40 percent of Arizona's annual water uses. While the Colorado River, which also satisfies about 40 percent of Arizona's annual needs, is receiving a lot of attention, with the Central Arizona Project's "Protect Lake Mead" campaign and other efforts to raise awareness of work being done to forestall and maybe even avoid shortage, efforts to manage our groundwater resources wisely deserve at least equal attention. Those of us who work in the water sector in Arizona know how important groundwater is to communities and economic activities throughout the state. We regularly cite the centrality of Arizona's 1980 Groundwater Management Act, which implemented a strong regulatory framework for groundwater utilization in designated Active Management Areas. But because these provisions do not apply statewide, even here in Arizona, where groundwater management seems second nature, groundwater overdraft continues to be a challenge.

National and global attention is focusing on the importance of good groundwater governance and management. The www.groundwatergovernance.org site published a series of important documents as part of multi-year project to share information on good groundwater governance practices. The project's purpose was "to influence political decisions thanks to better awareness of the paramount importance of groundwater resources and their sustainable management in averting the impending water crisis". I had the pleasure to participate in the early phases of this effort.

Recently, I have been involved in two other collaborative efforts to improve groundwater governance and management. The Groundwater Visibility Initiative (GVI) represents a joint effort of two national organizations, the American Water Resources Association (AWRA) and the National Groundwater Association (NGWA). I was part of the small, dedicated group that planned the GVI workshop held in April 2016. One outcome is the recent article "Making Groundwater Visible", which appeared in the September 2016 issue of AWRA's publication, *IMPACT*. The article, which reports on the results of the workshop, points to how groundwater's physical invisibility has led to its omission from many water policy, governance, and management discussions. The key findings are summarized in the article as follows: (1) Governing and managing groundwater require working with people; (2) Data and information are key; (3) Some "secrets" remain; (4) We need to take care of what we have; (5) Effective groundwater management is critical to an integrated water management portfolio that is adaptive and resilient to drought and climate change; and (6) To be robust, policies of the agriculture, energy, environment, land-use planning, and urban development sectors must incorporate groundwater considerations.

The second effort emerged from the 9th International Symposium on Managed Aquifer Recharge (ISMAR9), which was held in Mexico City in June 2016. A working group formed to develop the document "Sustainable Groundwater Management Policy Directives", which was published in English and Spanish and has its own six summary points or directives. (I) Recognize aquifers and groundwater as critically important, finite, valuable and vulnerable resources. (II) Halt the chronic depletion of groundwater in aquifers on a global basis. (III) Aquifer systems are unique and need to be well understood, and groundwater should be invisible no more. (IV) Groundwater must be sustainably managed and protected within an integrated water resource framework. (V) Managed Aquifer Recharge should be greatly increased globally. (VI) Effective groundwater management requires collaboration, robust stakeholder participation, and community engagement.

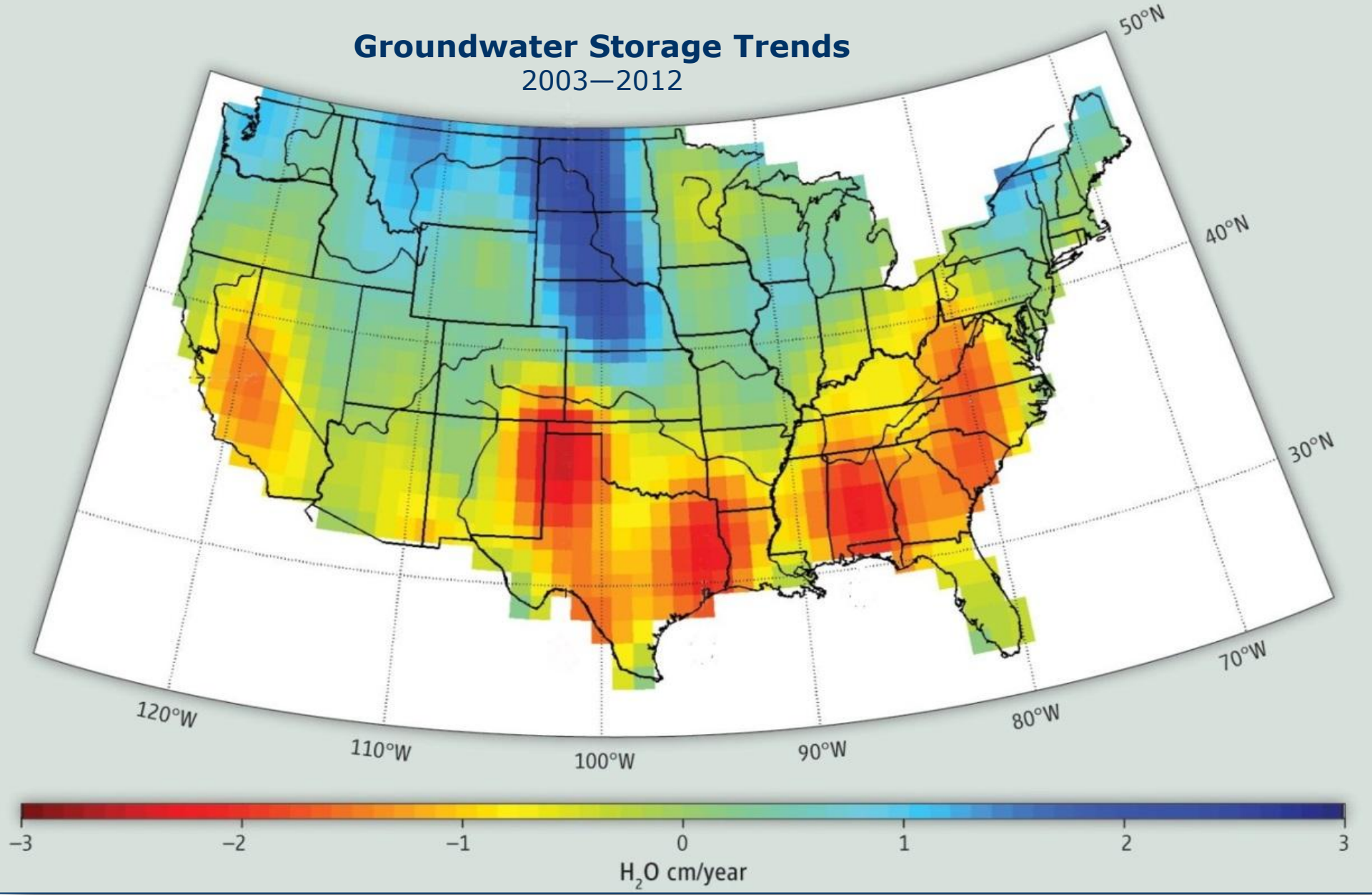
Engagement has been a key focal area in water governance efforts, such as the Water Governance Initiative by the Organisation for Economic Co-operation and Development, in which I participate. An overview of a substantive report on stakeholder engagement produced through this OECD initiative was published in a special issue of the journal Water: Water Governance, Stakeholder Engagement, and Sustainable Water Resources Management. WRRC colleague Susanna Eden and collaborator Eylon Shamir joined me in guest editing this collection of papers, which are all freely available online at // www.mdpi.com/journal/water/special_issues/water-gov. I encourage readers to take a look at this collection of papers, several of which relate to Arizona groundwater. "Modes and Approaches of Groundwater Governance: A Survey of Lessons Learned from Selected Cases across the Globe", by Varady et al. considers Arizona water banking as one of its case studies. Ballester and Mott Lacroix look at public participation in water planning in the Ebro River (Spain) and Tucson basins. Eden et al. report on the stakeholder participation component of a project that used hydrologic and climate modeling to help water users and managers understand how climate variability affects groundwater storage and recharge in the southern end of Santa Cruz Active Management Area. Mott Lacroix and Megdal's article on the "stakeholder engagement wheel" drew from multiple Arizona regions, and Chief et al. consider Arizona tribal nations' water use in their paper, "Engaging Southwestern Tribes in Sustainable Water Resources Topics and Management".

Finally, I would be remiss if I did not mention the important work on groundwater assessment being carried out along the US-Mexico border. The binational Transboundary Aquifer Assessment Program has produced a report on the San Pedro Aquifer in English and Spanish and is completing a similar report for the binational Santa Cruz Aquifer.

Groundwater is a critically important resource for Arizona and much of the world. People are coming together to emphasize the need to understand this resource and manage it better. At the University of Arizona Water Resources Research Center, we endeavor to contribute to efforts to share best practices for groundwater assessment, governance, and management. Please visit http://wrrc.arizona.edu/programs-research to find out more.

Groundwater Storage Trends

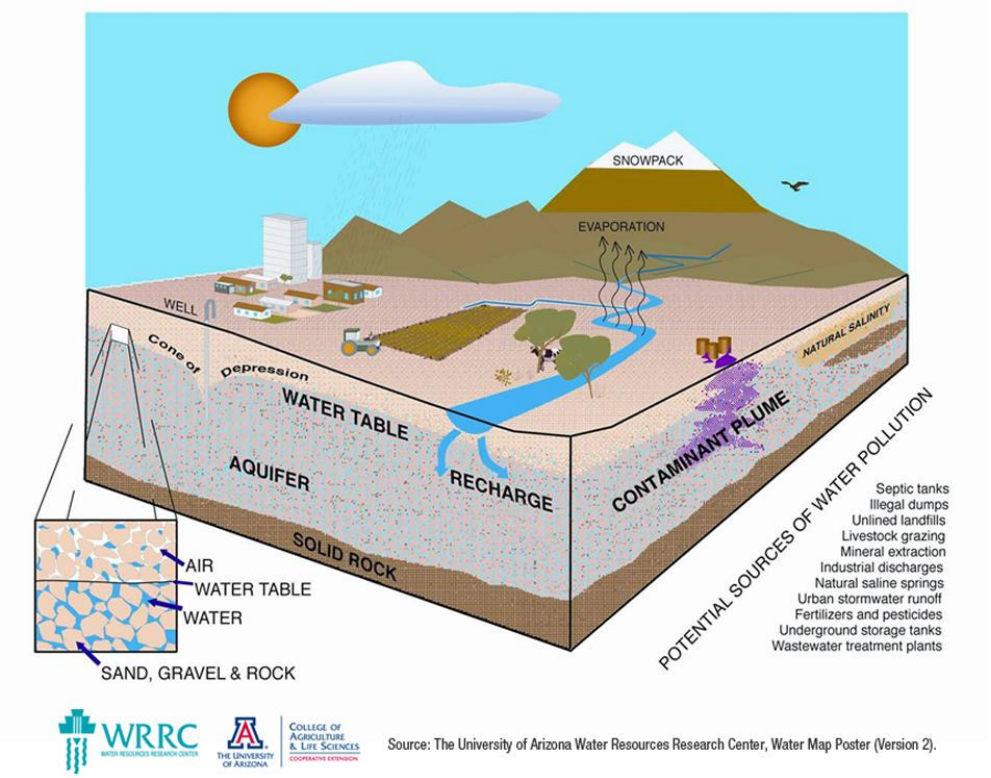
2003—2012



J. S. Famiglietti and M. Rodell, Water in the Balance, *Science,* 340, 1300 (2013)

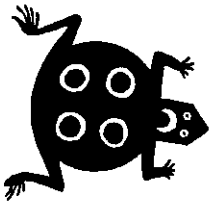
Some C's of Water Challenges and Solutions

- Competition for water resources
- Climate
- Lack of Certainty
- Community
- Collaboration
- Compromise
- Communication
- Cycle of water
- Context



Thank you!

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



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