

“Nature always wears the colors of the  
spirit”



arizona



# Our Mission

**To preserve plants, animals,  
and natural communities that  
represent the diversity of life  
on Earth  
by protecting the lands and  
waters they need to survive.**



# Our Story

We achieve **lasting results** by  
finding common ground with  
communities and partners.



Bella Vista  
Ranches/Water

Bureau of Land  
Management (BLM)

U.S. Geological  
Survey

Audubon Arizona

Arizona State Land  
Department

U.S.D.A. Agricultural  
Research Service

National Park Service

U.S. Forest Service

The Nature

## **Upper San Pedro Partnership**

To meet the long-term needs of the  
Sierra Vista Subwatershed by  
achieving sustainable yield of the  
regional aquifer by 2011



# National Defense Authorization Act for 2004–Section 321

“Restore and maintain the sustainable  
yield of the aquifer by 2011”

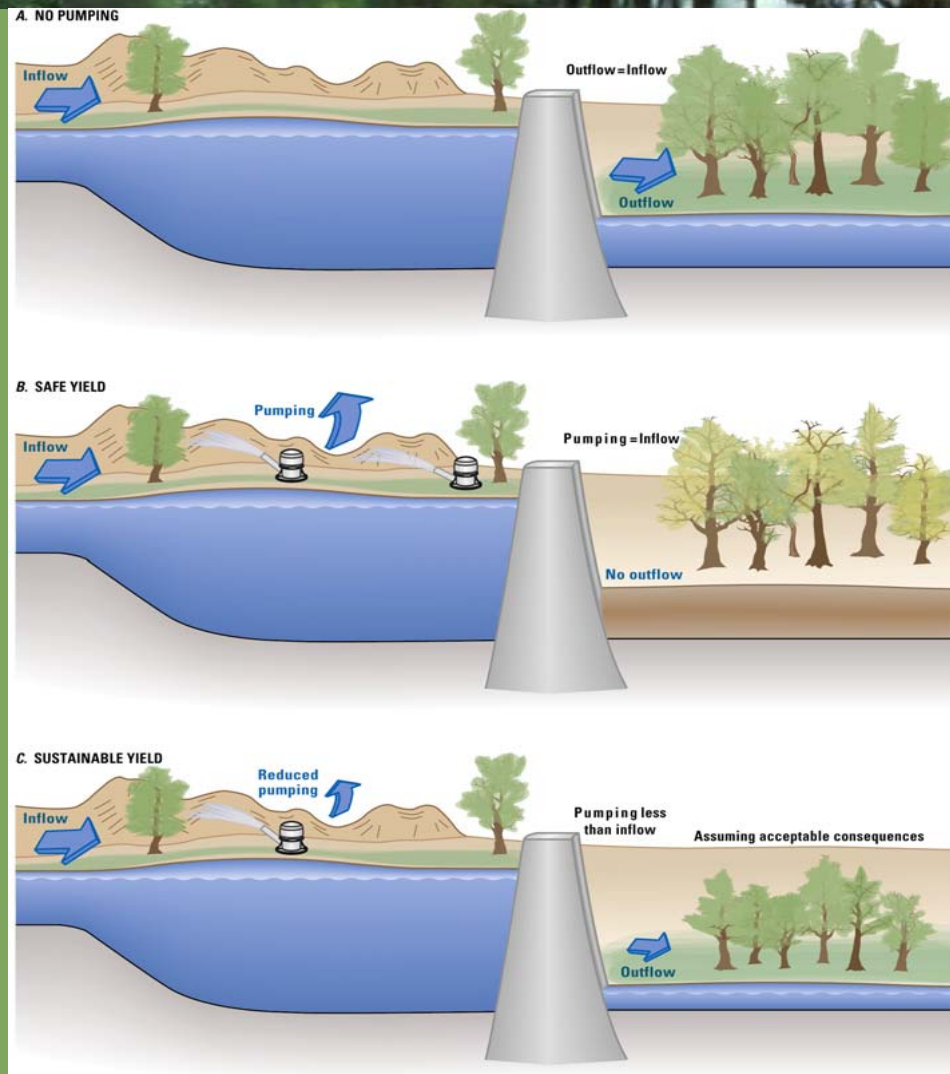
Recognizes the Partnership and the importance of  
collaborative water use management

Requires that measurable annual goals for reduction  
in overdraft are set

Establishes a mandate, but provides no funding to  
achieve it



...the development and use of groundwater in a manner that can be maintained for an indefinite time without causing environmental, economic, or social consequences...





# Criteria for Sustainable Yield

- Ground-water levels in alluvial aquifer maintained
- Stream base flow and flood flows maintained
- Accrete aquifer storage
- Riparian habitat and ecologic diversity maintained
- Water quality sustained
- Overall riparian condition maintained
- Springs in the SPRNCA continue to flow



# Upper San Pedro Partnership Approach: Adaptive Management

- Reduction of the annual water deficit by approximately two thirds
- Establishment of over 100 member agency projects





© Hal Malde

## 6 Water Management of the Regional Aquifer in the Sierra Vista Subwatershed, Arizona—2005 Report to Congress

**Table 2.** Planned annual yields and estimates of actual annual yields for 2002 through 2011 of measures planned by Partnership members to reduce aquifer overdraft

[Yields are in acre-feet/year; ---, indicates no yield in year. Numbers compiled in May – June, 2005. Conservation yields in each year are relative to a zero yield in the baseline year of 2002; Recharge yields are total values and are relative to a baseline of zero acre feet]

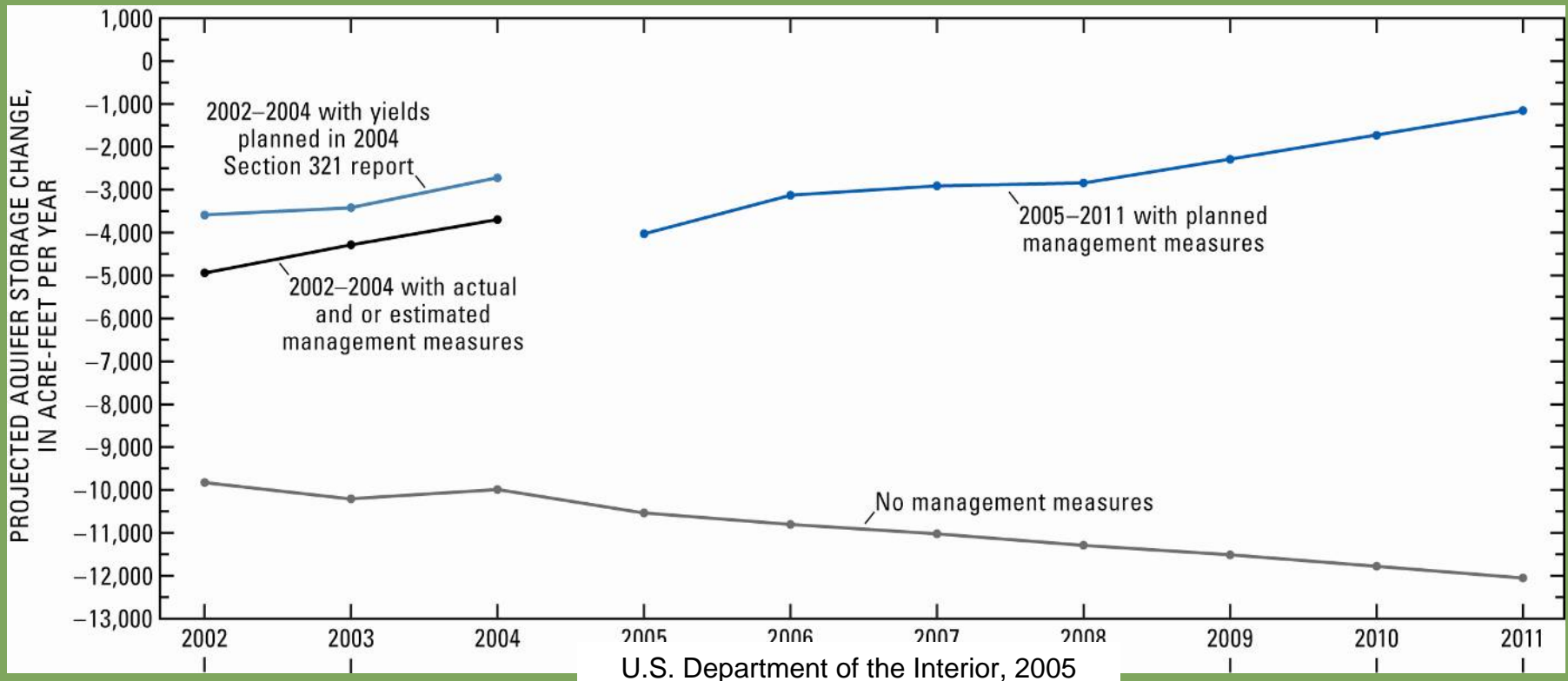
Description	Measure type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
		Yield Actual	Yield Actual	Yield Actual	Yield Planned	Yield Planned	Yield Planned	Yield Planned	Yield Planned	Yield Planned	Yield Planned
<b>Fort Huachuca</b>											
Conservation measures <sup>1</sup>	Conservation	---	-60	150	200	280	330	220	270	320	340
Reduced ground-water pumping through effluent reuse <sup>1</sup>	Conservation	---	-25	-90	54	54	54	54	54	54	54
Effluent recharge <sup>2</sup>	Recharge	190	290	440	610	575	540	505	470	435	435
Stormwater detention basins <sup>3</sup>	Recharge	60	30	25	370	370	370	370	430	490	580
<b>Cochise County</b>											
Conservation measures <sup>1</sup>	Conservation	---	---	10	60	110	170	220	270	320	380
<b>Sierra Vista</b>											
Conservation measures <sup>1</sup>	Conservation	---	50	100	290	290	300	300	310	310	320
Effluent recharge <sup>4</sup>	Recharge	930	1,750	1,870	1,970	2,090	2,150	2,220	2,280	2,350	2,420
Stormwater detention basins <sup>3</sup>	Recharge	140	180	290	150	150	180	180	180	180	180
<b>The Nature Conservancy and Fort Huachuca</b>											
Retirement of agricultural pumping <sup>5</sup>	Conservation	---	---	---	---	250	250	500	1,000	1,500	2,000
<b>Bisbee</b>											
Conservation measures <sup>1</sup>	Conservation	---	---	---	---	10	20	30	40	50	60
Reduced ground-water pumping through effluent reuse	Conservation	---	---	---	---	420	420	420	420	420	420
Effluent recharge	Recharge	---	---	---	---	170	180	180	180	190	190
<b>Huachuca City</b>											
Conservation measures <sup>1</sup>	Conservation	---	---	---	---	5	5	10	10	10	20
Effluent recharged at Fort Huachuca	Recharge	---	---	---	---	---	170	180	180	180	180
<b>Tombstone</b>											
Conservation measures <sup>1</sup>	Conservation	---	---	---	---	5	5	10	10	10	20
<b>Bureau of Land Management</b>											
Mesquite reduction <sup>7</sup> , and retirement of agricultural ground-water pumping <sup>8</sup>	Conservation	475	475	475	490	580	660	750	830	920	1,000
<b>Urban enhanced ephemeral-stream channel stormwater recharge</b>											
Increase in stormwater recharge in ephemeral channels by urbanization <sup>9</sup>	Recharge	3,100	3,100	3,100	2,300	2,300	2,300	2,300	2,300	2,300	2,300
<b>Total yields</b>											
Total yield <sup>10</sup>		4,900	5,800	6,400	6,500	7,700	8,100	8,400	9,200	10,000	11,000
Total yield projected in original 321 report <sup>10</sup>		6,400	6,800	7,700	8,300	9,100	10,500	11,200	12,300	13,100	13,900

See footnote 10 for details.

U.S. Department of the Interior, 2005



# Projected annual aquifer-storage change with/without management measures





# Adaptive Management

**Inventory/research** to develop conceptual and simulation models

**Modeling** provides guidance for development of long-term monitoring strategies and implementation of projects/policies

**Monitoring** evaluates effectiveness of project and policy implementation



# What about effects of climate?



# Loss of Flow at the Charleston Streamflow-Gaging Station

© Hal Malde

‘...on July 6, 2005, the USGS streamgauge at the Charleston bridge was documented to register no streamflow for the first time since 1913. Continuous flows were restored on July 17, 2005.’



-LA Times July 17<sup>th</sup>

"Doomed river"

-Phoenix New Times, August 8<sup>th</sup>

"CAP to Sierra Vista is Studied"

-Arizona Daily Star, July 23<sup>rd</sup>

"Arizona River Runs Dry"

-Arizona Republic, July 15



# WHY?

Loss of streamflow at Charleston in 2005 was likely caused by an interaction of several factors (human influences and climatic)



# Streamflow trends at Charleston

## -Summer baseflows:

Generally  $< 5$  cfs since the 1930's

Frequently  $< 1$  cfs in past decade

## -Winter baseflows:

Over past 70 years: 6 out of 10 lowest flows in last 10 years





# Climate: Timing of precipitation

- The start of the 2005 monsoon was the second latest on record (National Weather Service, Tucson).



# Climate: Floodflows are strongly linked to baseflows

Flood flows have a strong influence in maintaining baseflows throughout the year, through their ability to recharge the alluvial aquifer



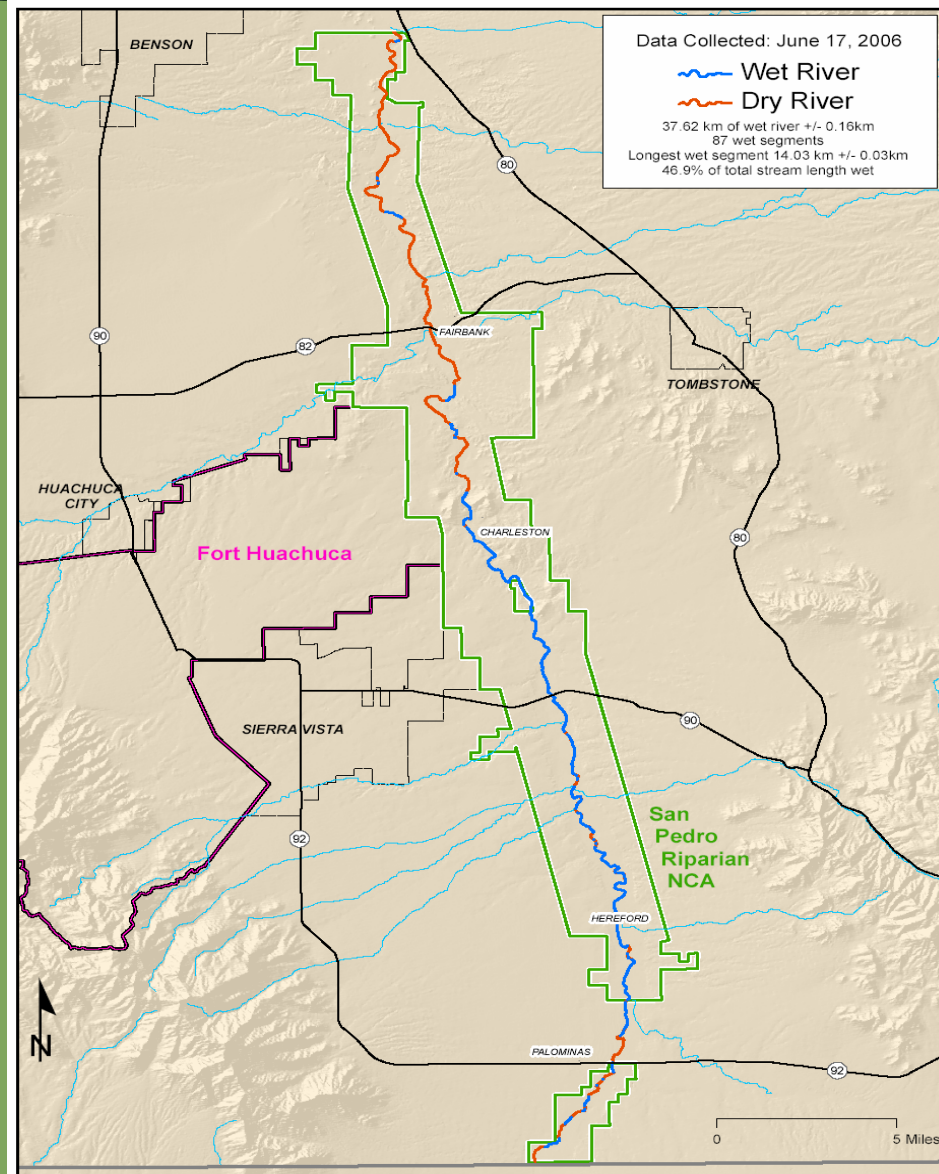
## Date    % length of river wet

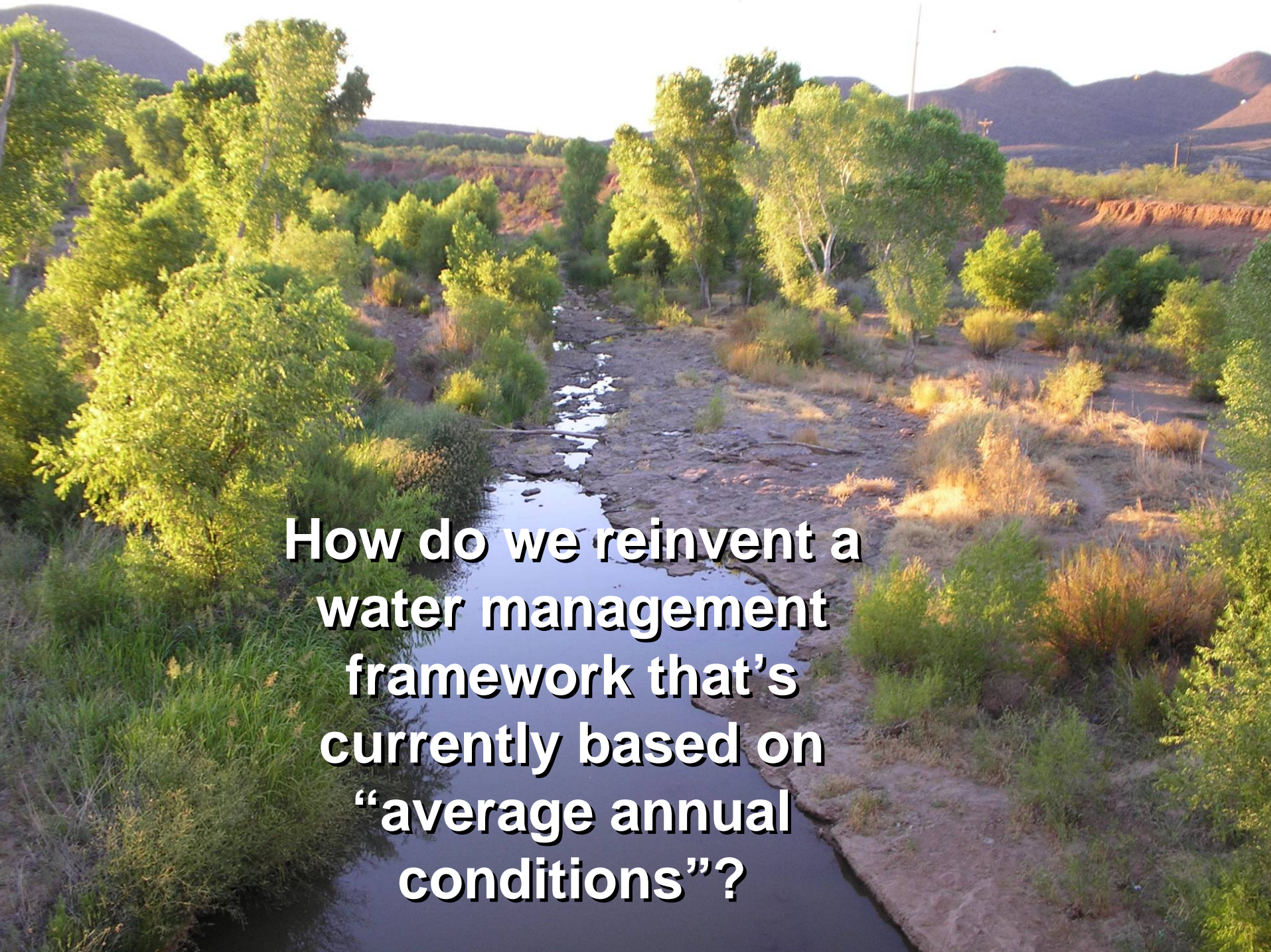
6/99                      52%

6/01                      76%

6/04                      46%

6/06                      47%



A landscape photograph showing a riverbed with sparse water, surrounded by green trees and dry brush in a semi-arid region. The riverbed is mostly dry with small pools of water. The surrounding area is filled with lush green trees and bushes, contrasting with the dry, cracked earth of the riverbed. In the background, there are rolling hills and mountains under a clear sky.

**How do we reinvent a  
water management  
framework that's  
currently based on  
“average annual  
conditions”?**



# Managing with Uncertainty and Variability

- Inter-annual climatic variability
- Decadal climatic variability
- Global climate change



Informed decision-making requires  
an even broader interdisciplinary  
approach...

