WHY PUMPING IN BIG CHINO VALLEY THREATENS THE VERDE RIVER

By

William Meyer and Edward W. Wolfe

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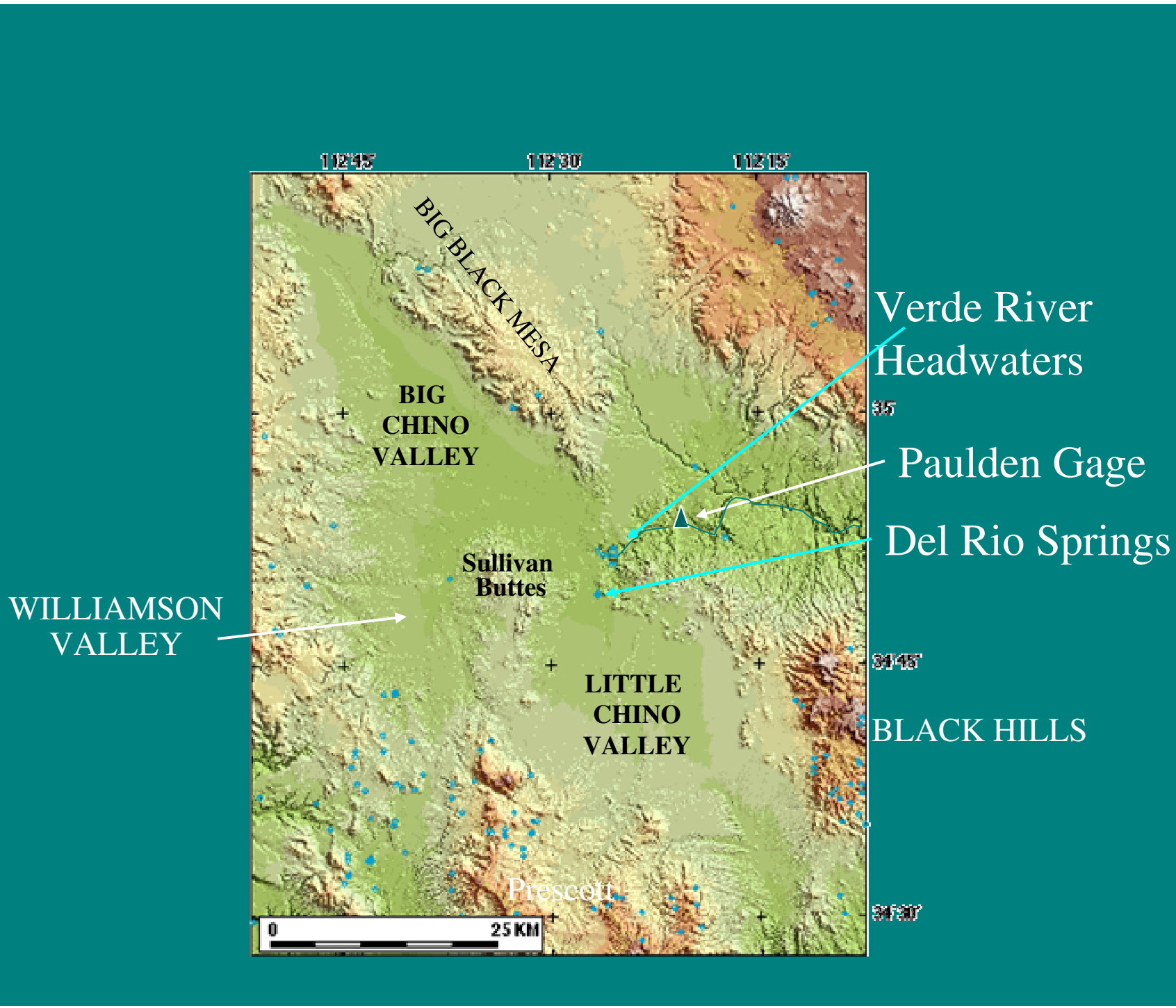

112°45'
112°30'
112°15'
BIG BLACK MESA
BIG CHINO VALLEY
Verde River Headwaters
35°
Paulden Gage
Del Rio Springs
Sullivan Buttes
WILLIAMSON VALLEY
34°45'
LITTLE CHINO VALLEY
BLACK HILLS
Prescott
34°30'
0
25 KM

Three independent studies by agencies of the Federal Government have concluded that ground water in the Big Chino Valley discharges to the Verde River.

A 1994 report by the U.S. Bureau of Reclamation concluded that "*the flows in the Verde River can be accounted for by the known recharge sources in the Big Chino Valley and from areal precipitation*".

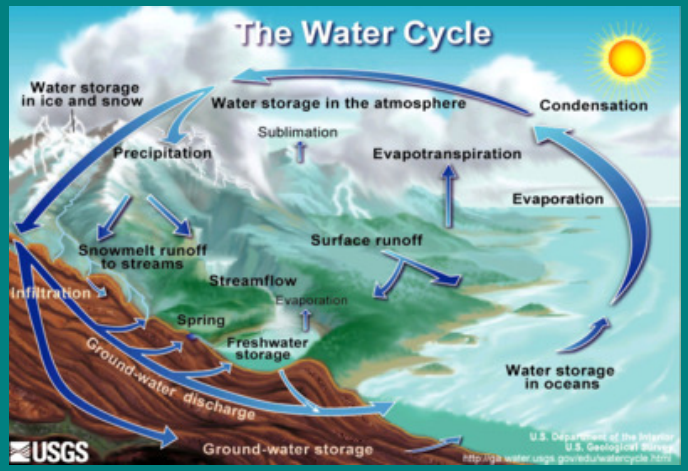
A 2005 study by the U.S. Geological Survey concluded that "*ground-water outflow from the Big Chino Valley occurs only as base flow in the Verde River*".

A second study by the U.S. Geological Survey in 2005 concluded that ground-water outflow from the Big Chino Valley contributes 80 to 86 percent of the base flow of the upper Verde River as measured at the Paulden streamgage.

In addition, the consultant hired by the Upper Verde River Watershed Protection Coalition to review the two USGS reports stated: *"…the basic finding that about 80 percent of the upper Verde River base flow is derived from Big Chino Valley is hydrologically sound, and has been generally believed by hydrologists since 1976".*

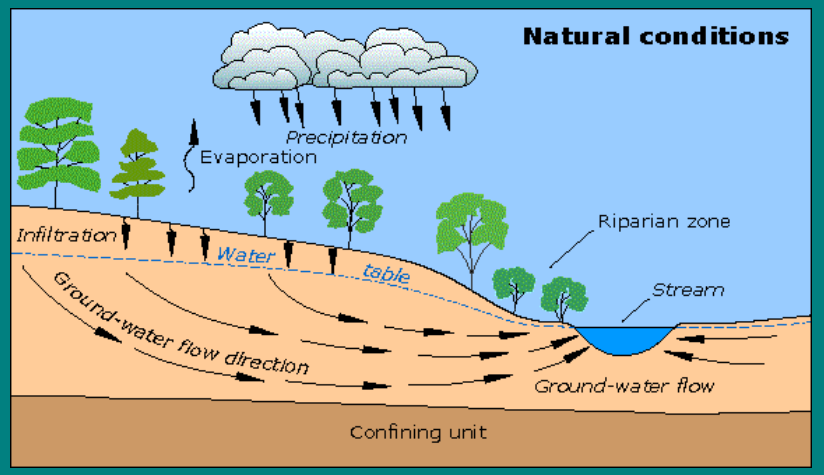
WHY PUMPING IN BIG CHINO VALLEY THREATENS THE VERDE RIVER

Ground water is constantly moving “downhill” due to the force of gravity



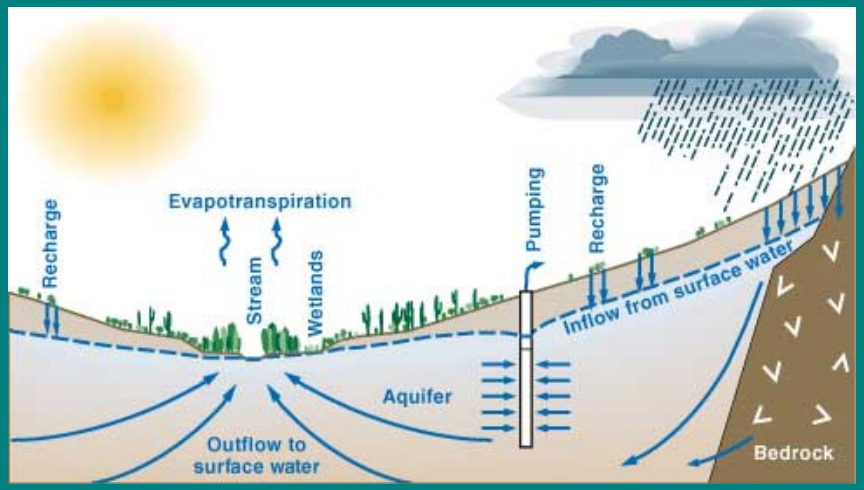
It ultimately moves to the lowest part of a ground-water basin where it discharges to:

- stream (s),
- springs,
- by evaporation, and/or
- evapotranspiration.



Ground Water Pumpage

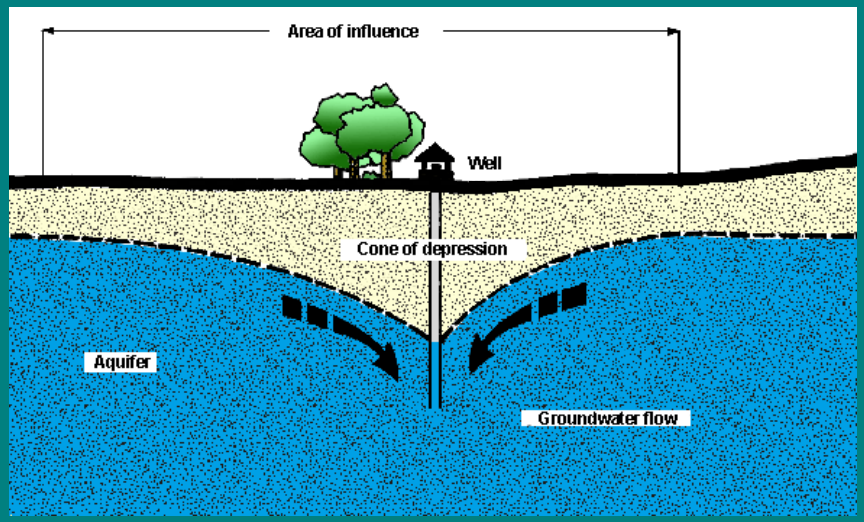
The introduction of wells introduces a new form of discharge.



Discharge of Ground Water by Wells

As stated by an established and field-proven principle in the science of ground water hydrology,
this discharge:

- Is balanced by a loss of water in the ground-water system equal to pumpage.
- The loss is initially from the aquifer and is expressed by declining water levels.



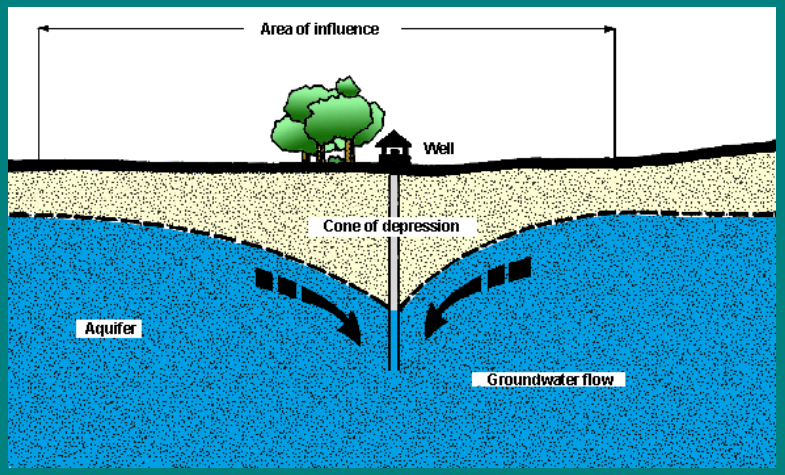
Because perpetual removal of water from storage is obviously not possible;

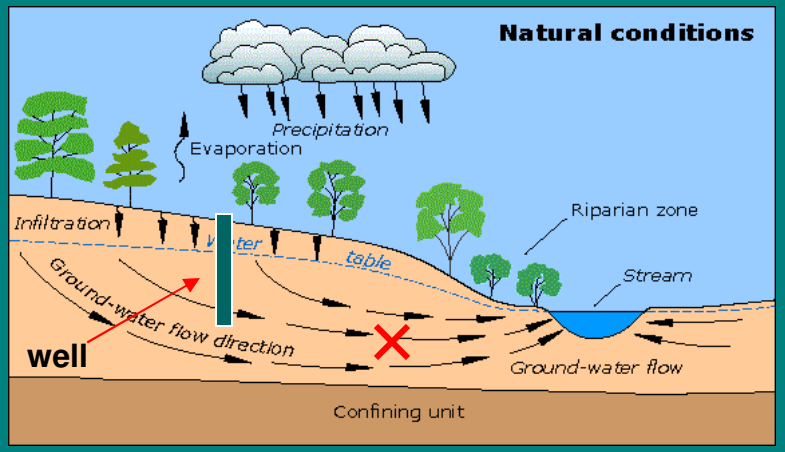
the principle further states that for pumpage to be sustainable, there must be:

1. **An increase in recharge equal to pumpage;**

1. **A decrease in natural discharge equal to pumpage;**

3. **A combination of 1 and 2**





Because (1) ground-water pumpage for the pipeline does not involve increased recharge and (2) discharge from the Big Chino Valley is to the Verde River:

- **The ground-water principle that pumpage is balanced by a loss of water means that ground-water withdrawal in the Big Chino Valley will result in a decrease in ground-water discharge from the valley to the river equal to or nearly equal to pumpage.**

- **The above conclusion is supported by the 1994 USBR report that stated "*the results of this investigation suggest that groundwater pumping in the upper Big Chino Valley would have an adverse effect on the flow and perhaps the biota of the Verde River*."**

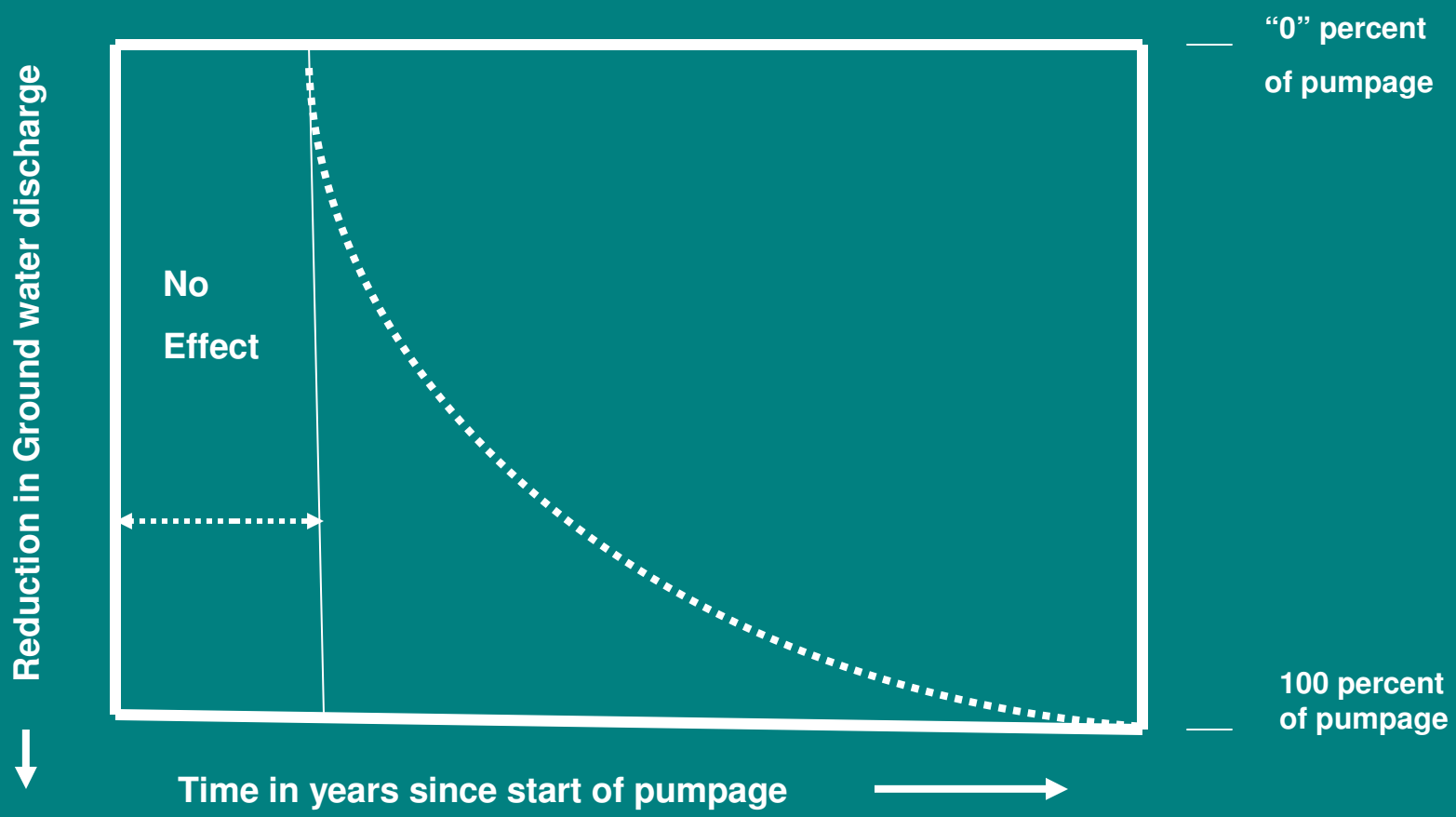
- **The decrease in discharge occurs regardless of where the wells are placed.**

- **Increasing the distance of the wells from the discharge area only increases the time required for the withdrawal to impact discharge.**

  It does not alter the ultimate magnitude of the impact.

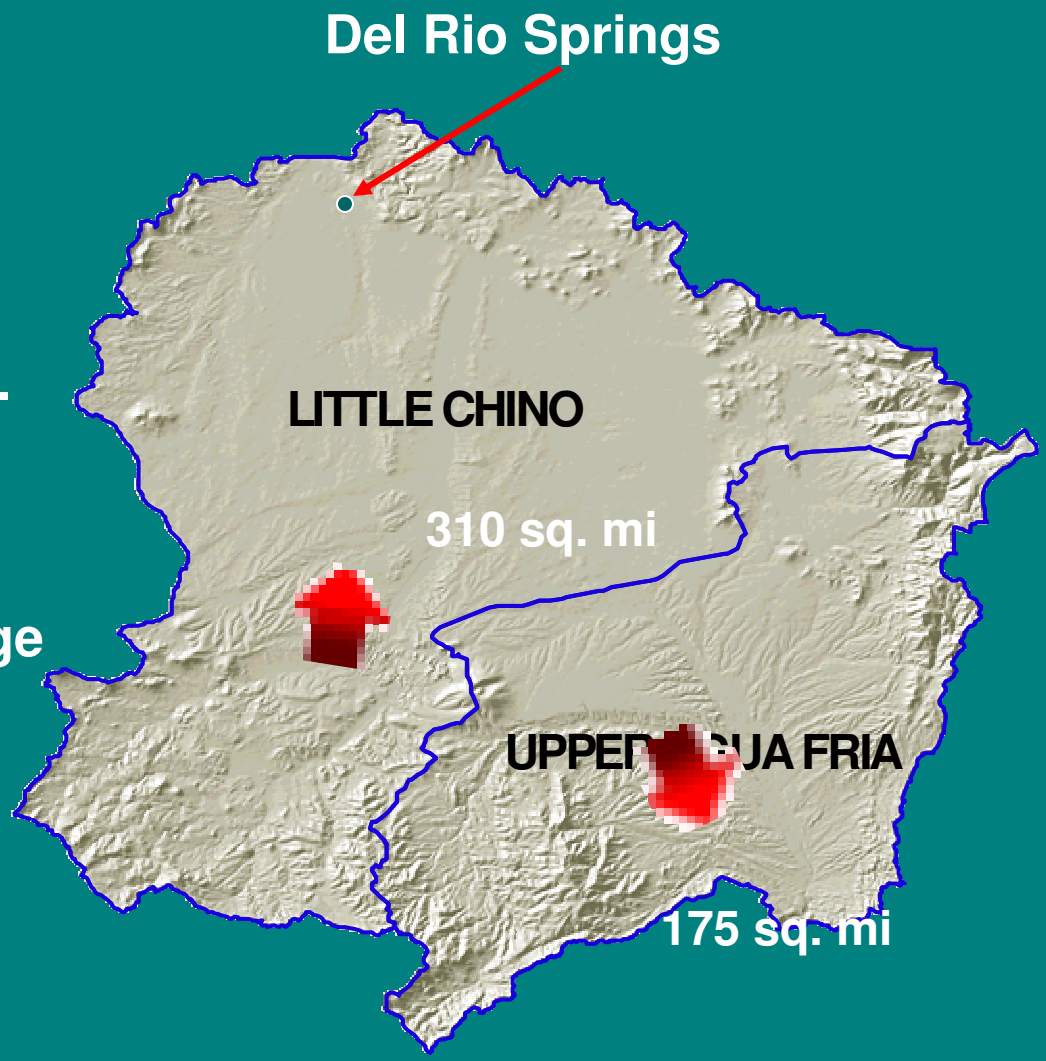
- **Some of the loss in discharge may occur by a reduction in evapotranspiration, but this loss would be expected to be minimal.**

Reduction in Ground-water Discharge to the Verde River from Pumpage in Big Chino Valley

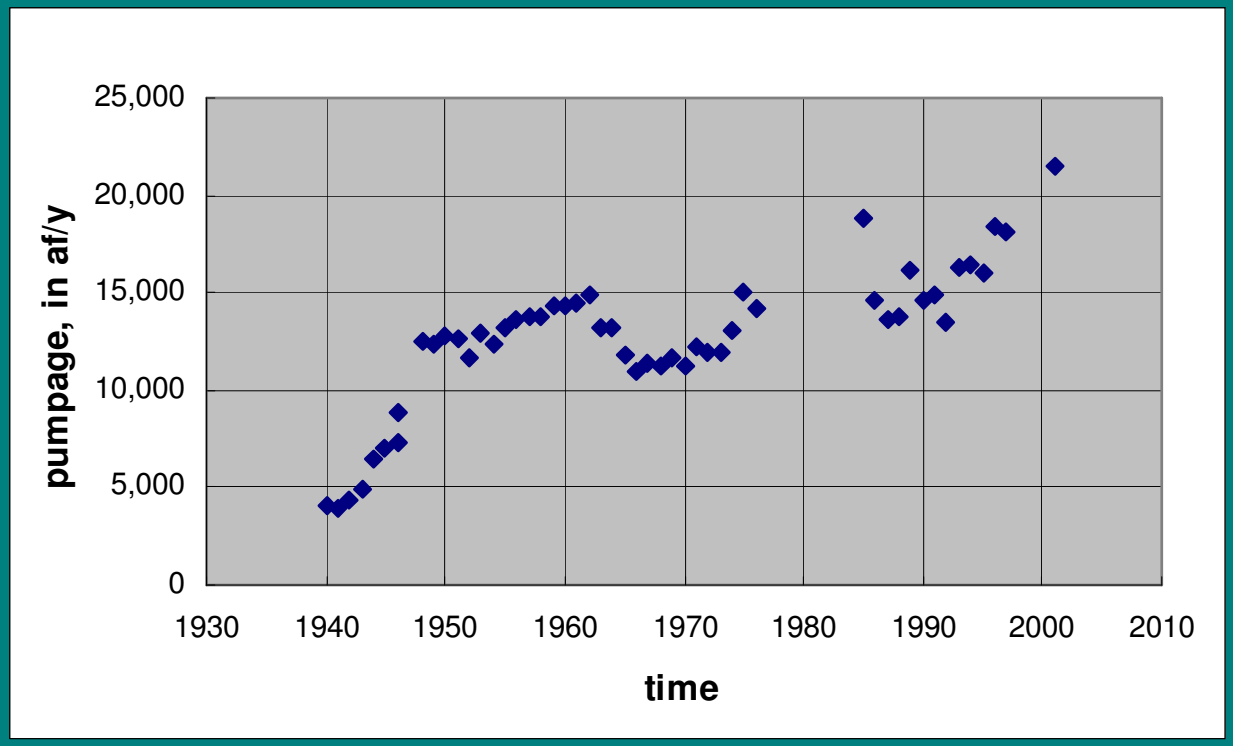


A NEXT-DOOR EXAMPLE OF THE LOSS OF NATURAL DISCHARGE AS A RESULT OF PUMPING.

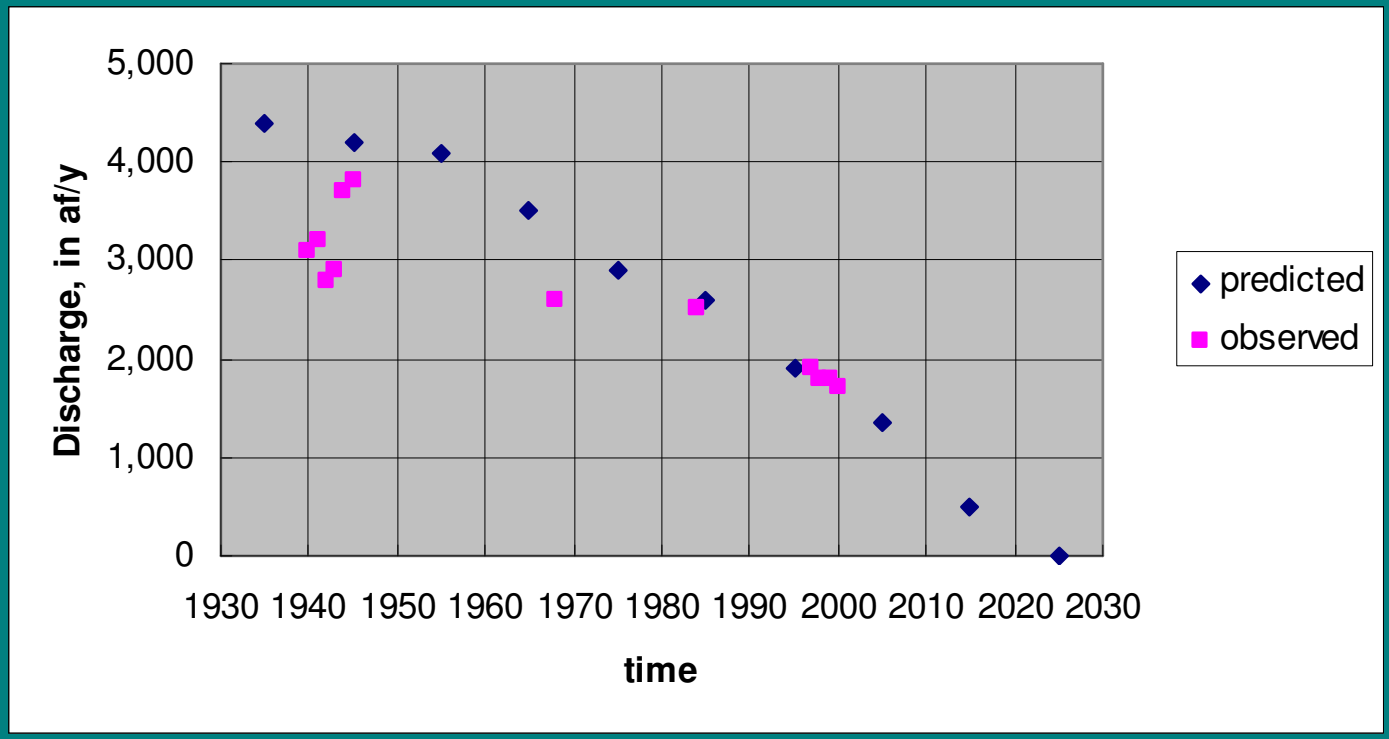
- Ground water moves northeasterly in the Little Chino sub-basin.
- Del Rio Springs is a major location of ground-water discharge from the sub-basin.



Ground-water Pumpage
Little Chino Valley 1940-1976. PAMA 1985-2001



Model Predicted and Observed Decline in Discharge from Del Rio Springs, 1935-2025 (modified from Nelson, 2002)



IS "*THE BIG CHINO WATER RANCH…ABOVE AND LARGELY DISCONNECTED FROM THE PRIMARY SOURCES OF GROUNDWATER THAT CONTRIBUTE TO OUTFLOW OF THE UPPER VERDE RIVER*"?

The USBR study concluded:

1) *"…the upper and lower parts of the Big Chino valley are not hydrologically isolated, but rather are in direct hydrologic connection"*

2) *" …the flows in the Verde River can be accounted for by the known recharge sources in the Big Chino Valley (Walnut and Partridge Creeks, and Williamson Valley Wash) and from areal precipitation"* .

The Bureau further stated that:

3) "*…the groundwater models indicate that the groundwater in the Big Chino Basin is hydrologically connected to the upper Verde River; …analysis of the results of the ground water models [imply] that there is no continuous impediment to the flow of water from the northern part of the valley to the upper Verde River*."

And:

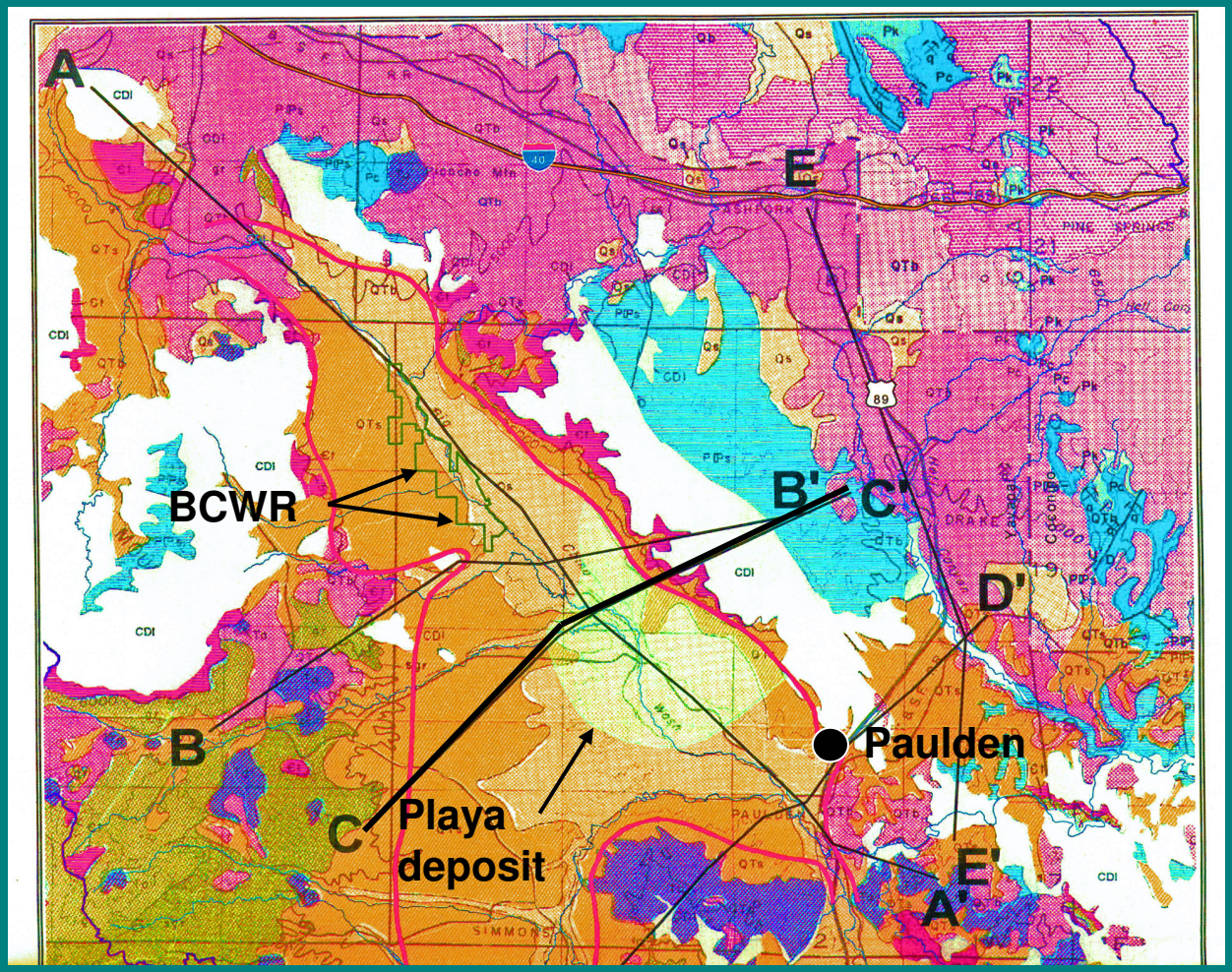
4) "*…the northern and southern parts of the Valley are hydrologically connected to the east, west, and beneath the semi-pervious material that has been referred to as the "clay barrier"*

- The 1994 Bureau study further demonstrated that the basin-fill and underlying limestone aquifer in the Big Chino Valley are hydrologically connected and that water moves vertically between them to discharge to the upper Verde River.

- Thus, pumpage in either aquifer will reduce flow in the Verde River by an amount equal to or nearly equal to pumpage.

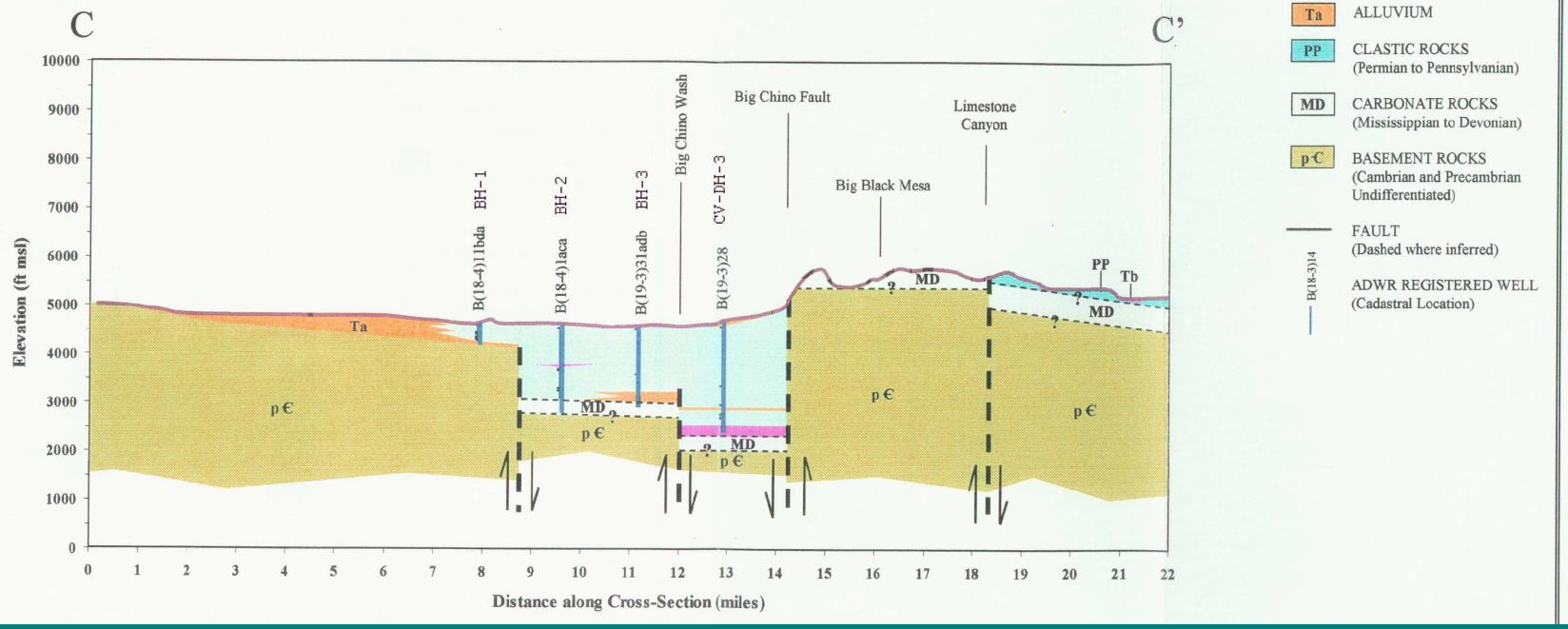
Geologic map of Big Chino Valley showing approximate location of playa deposit ("clay barrier") and cross section C-C'

The contention stems from the occurrence of a thick clay-rich deposit (playa deposit) within the southern half of the valley. All agree that the movement of ground water through such a clay-rich deposit is slow.



(From Southwest Ground-water Consultants, Inc., 2005, Big Chino Ranch Hydrology Study, Prepared for the City of Prescott)

Cross section C-C'

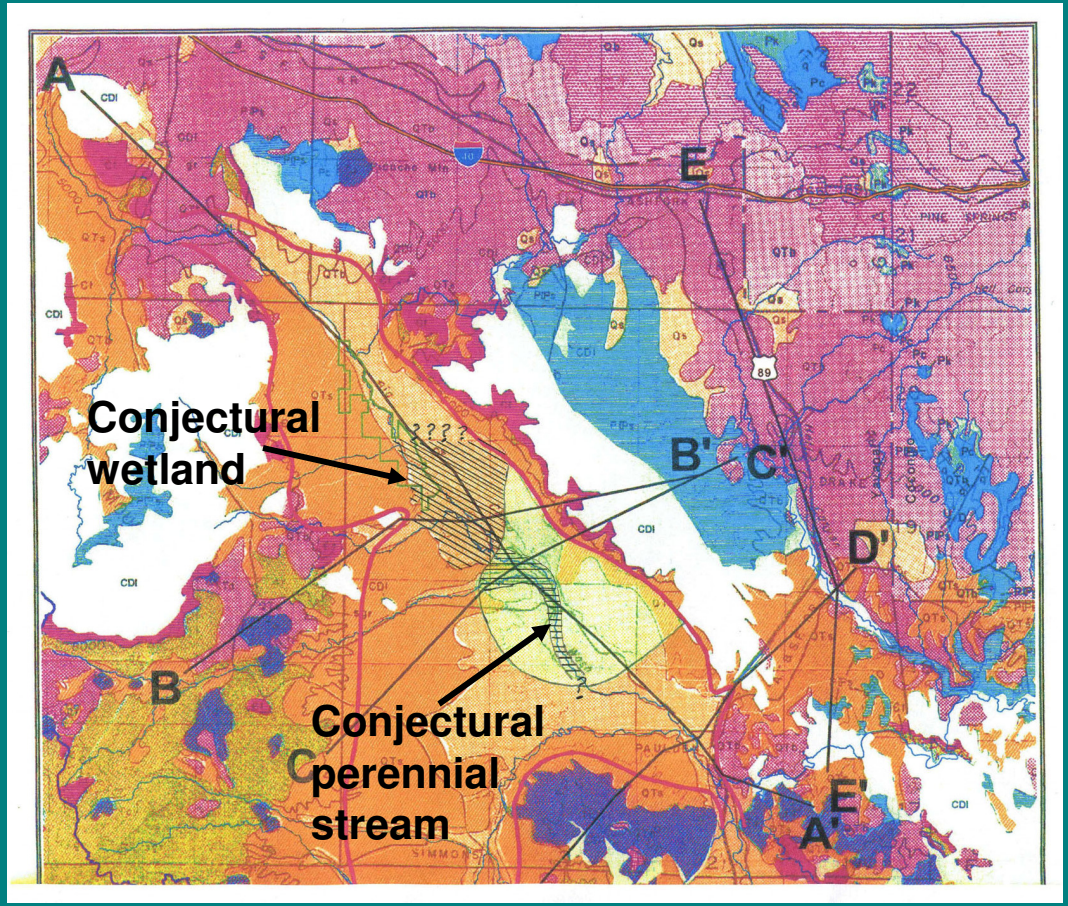


(From Southwest Ground-water Consultants, Inc., 2005, Big Chino Ranch Hydrology Study, Prepared for the City of Prescott)

Coarser-grained alluvial deposits within and beneath beneath the playa deposit as well as limestone beneath it provide pathways for less restricted down-valley ground-water movement.

WHAT IF GROUND WATER BENEATH THE UPPER VALLEY WERE DISCONNECTED FROM THE VERDE RIVER?

- **Ground-water levels would have risen to the surface behind the impediment, thereby creating an extensive wetland.**
- **The wetland would have existed for centuries if not millennia and would be marked by well developed, mature riparian vegetation.**
- **Big Chino Wash would be perennial across the "clay plug" and downstream from it until water was entirely lost by downward seepage.**
- **An extensive riparian area would also be expected to have existed along the perennial reach.**



- **SO -- The lack of evidence for the above further indicates that the "clay plug" does not block the down-valley movement of ground water.**

THE BOTTOM LINE

- Ground-water withdrawal in the Big Chino Valley will result in an eventual decrease in ground-water discharge to the Verde River equal to or nearly equal to pumpage.

- Increasing the distance of the wells from the discharge area only increases the time required for the withdrawal to impact discharge. It does not alter the ultimate magnitude of the impact on the river.

- The basin fill and underlying limestone aquifer are hydrologically connected and pumpage in either aquifer will impact the Verde River equally.