Texas Water Conservation Association
71st Annual Convention

Pecos/Devils River Watershed Projects

Part II

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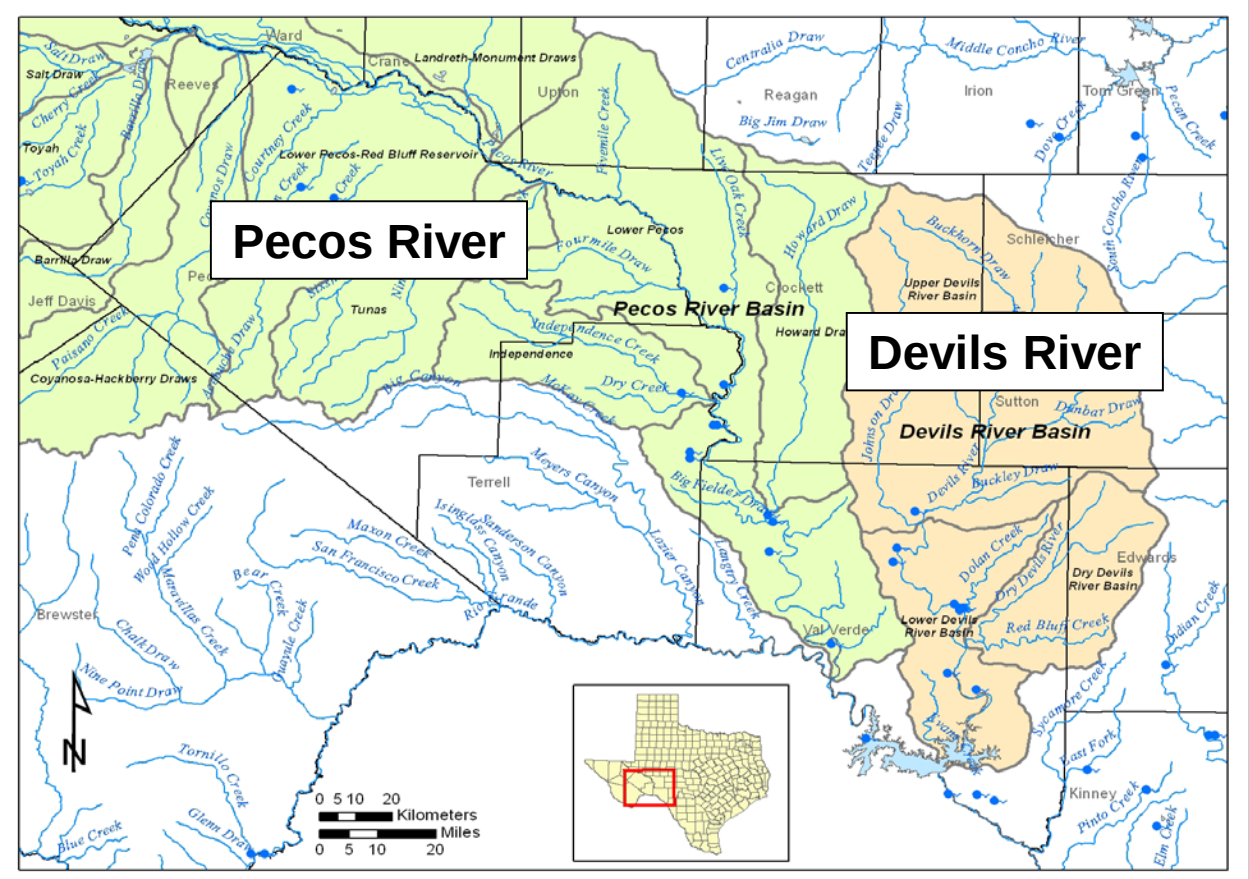
Southwest Research Institute®

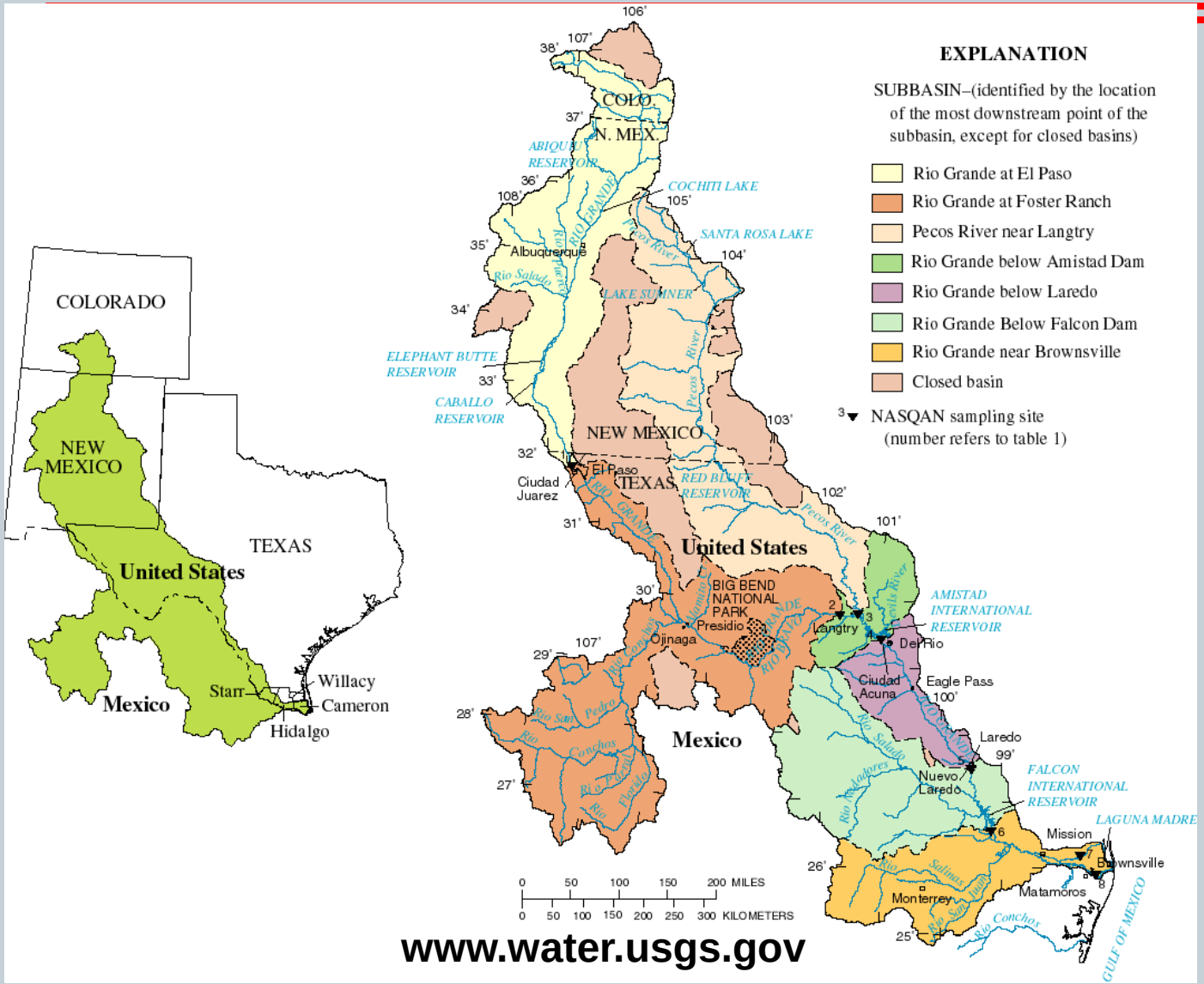
Presented on behalf of the Irrigation Panel

Why is Preserving and Protecting the Devils River and Lower Pecos River Important?



Need to put these two rivers in a broader geographical context

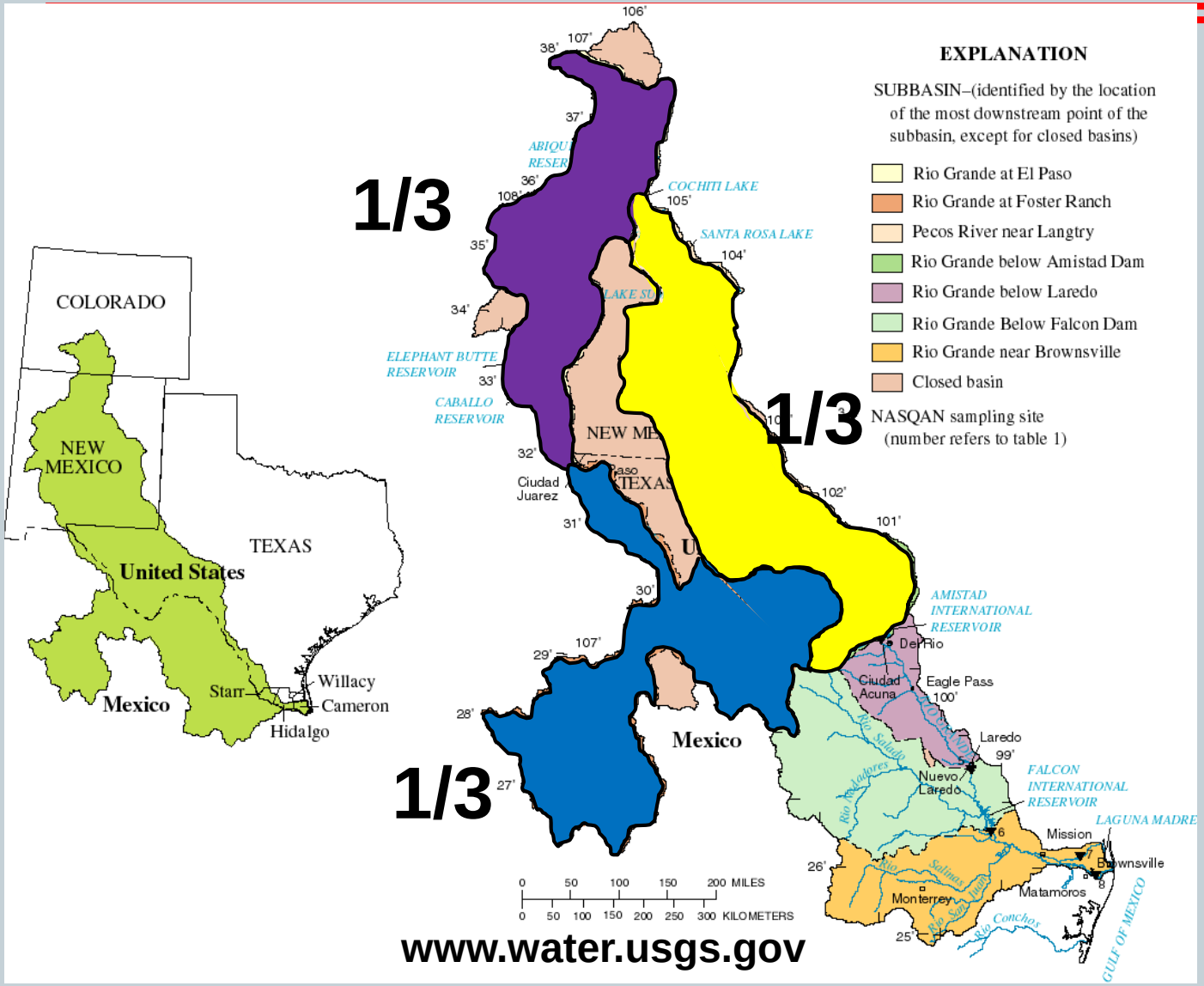
Rio Grande Watershed



www.water.usgs.gov

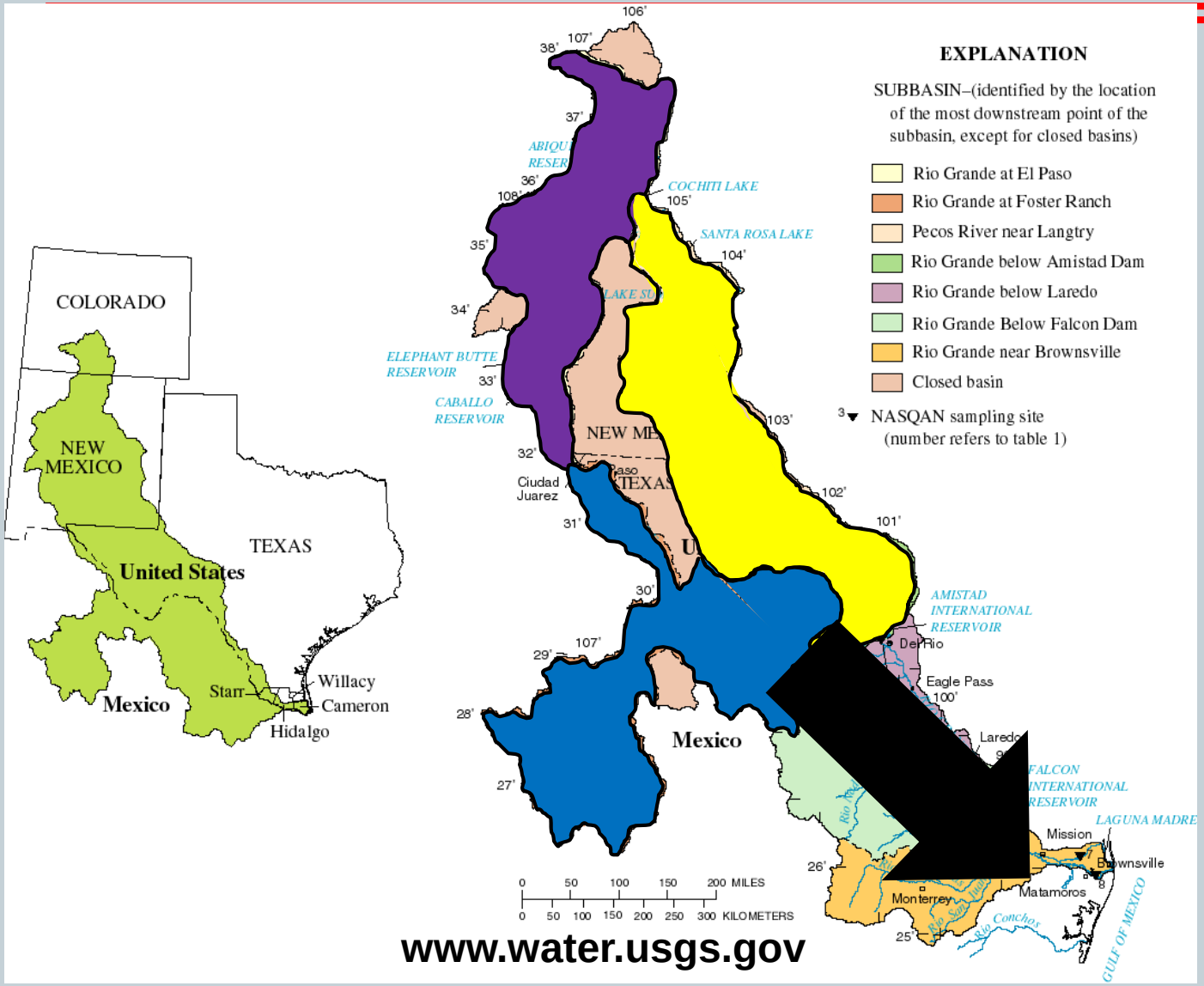
Pecos River and Devils River play an integral role in the water resources of the Rio Grande

Rio Grande Watershed



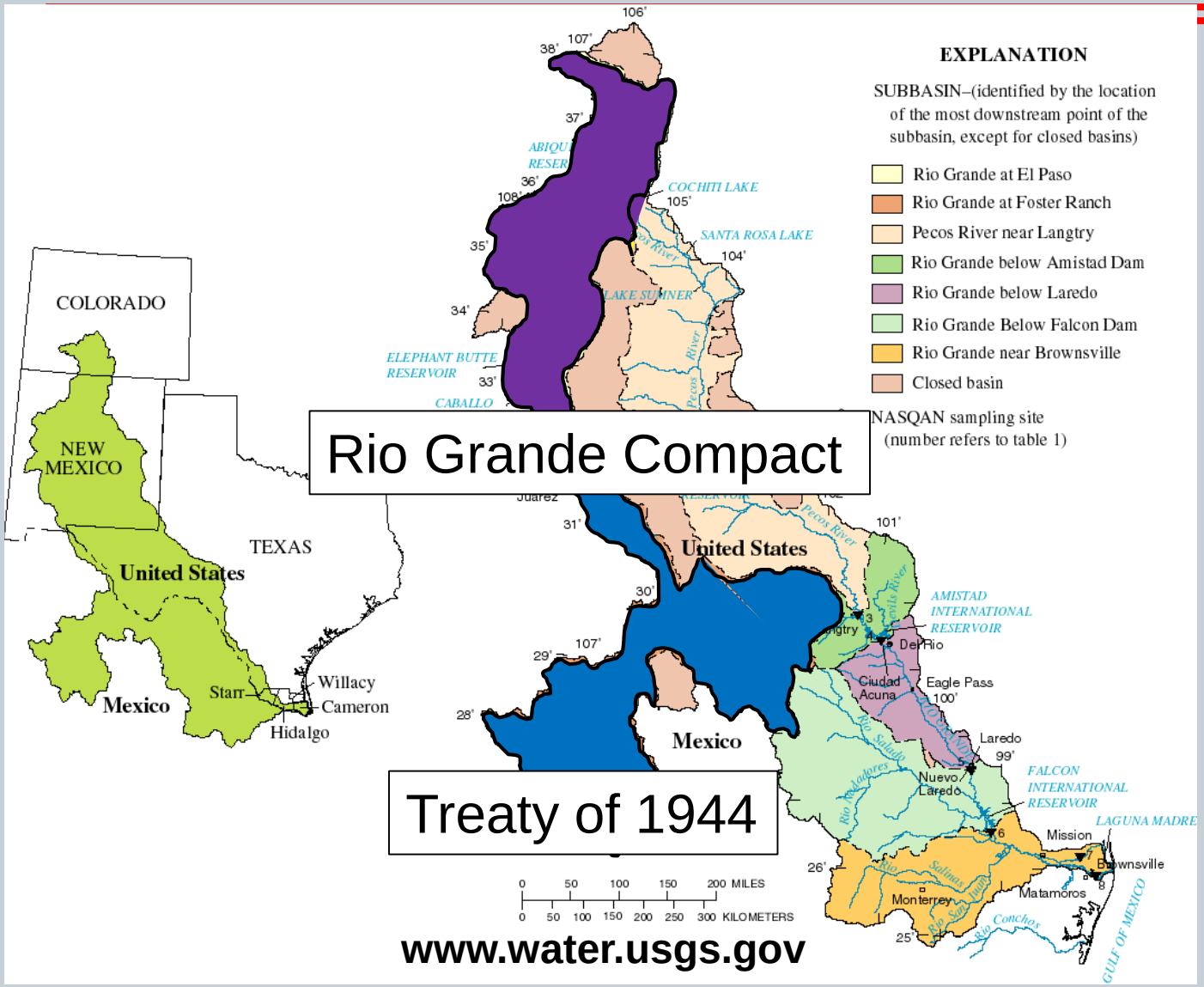
Of flow to the lower Rio Grande, 1/3 comes from NM and CO, 1/3 comes from Mexico and mid-Texas, and 1/3 comes from Val Verde County

Rio Grande Watershed



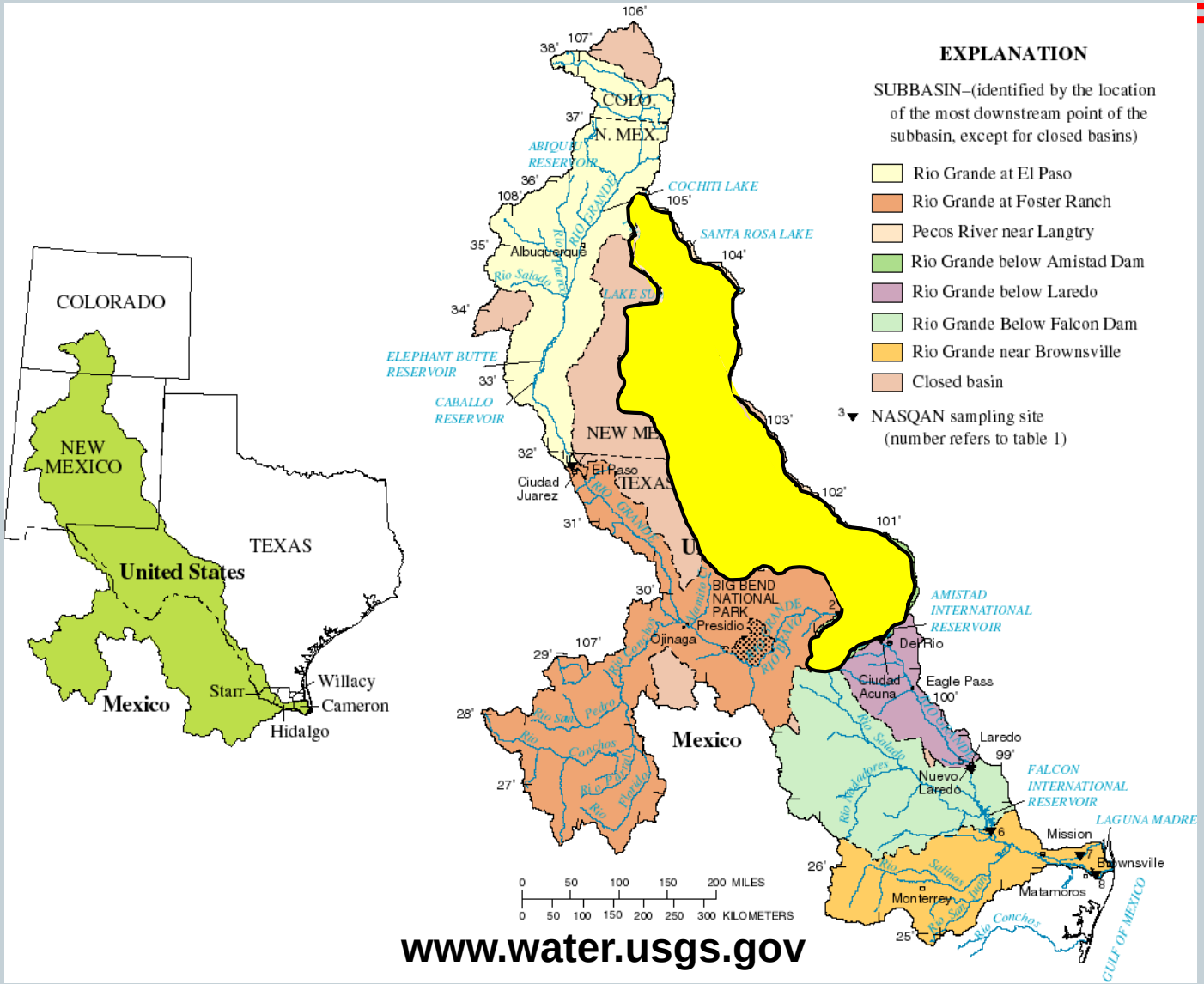
Knowing these relative contributions is key to understanding their combined impact on the lower Rio Grande

Rio Grande Watershed



There are agreements in place that dictate the terms of agreement for the 1/3 from NM and CO and the 1/3 from Mexico, although each has issues

Rio Grande Watershed



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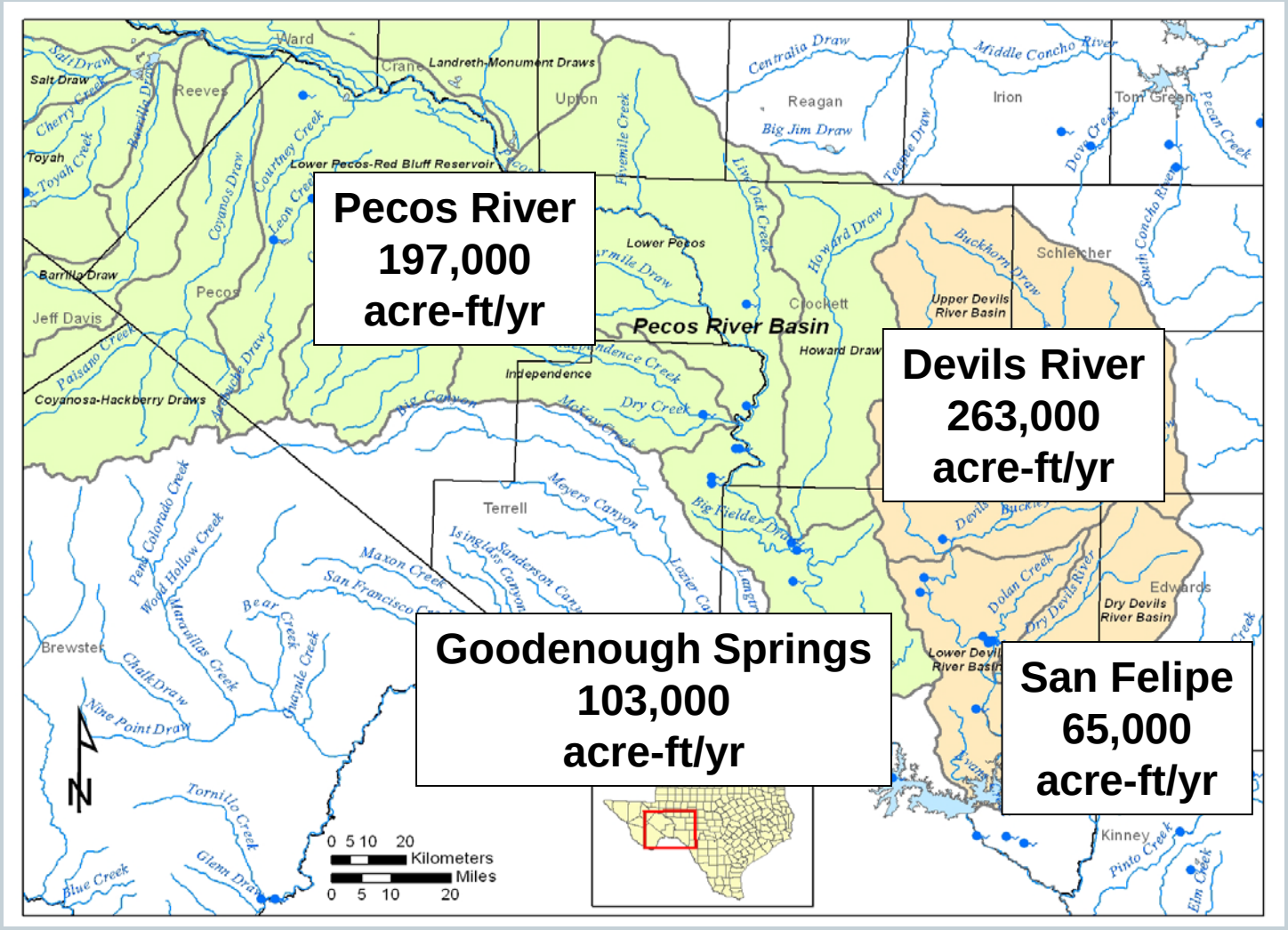
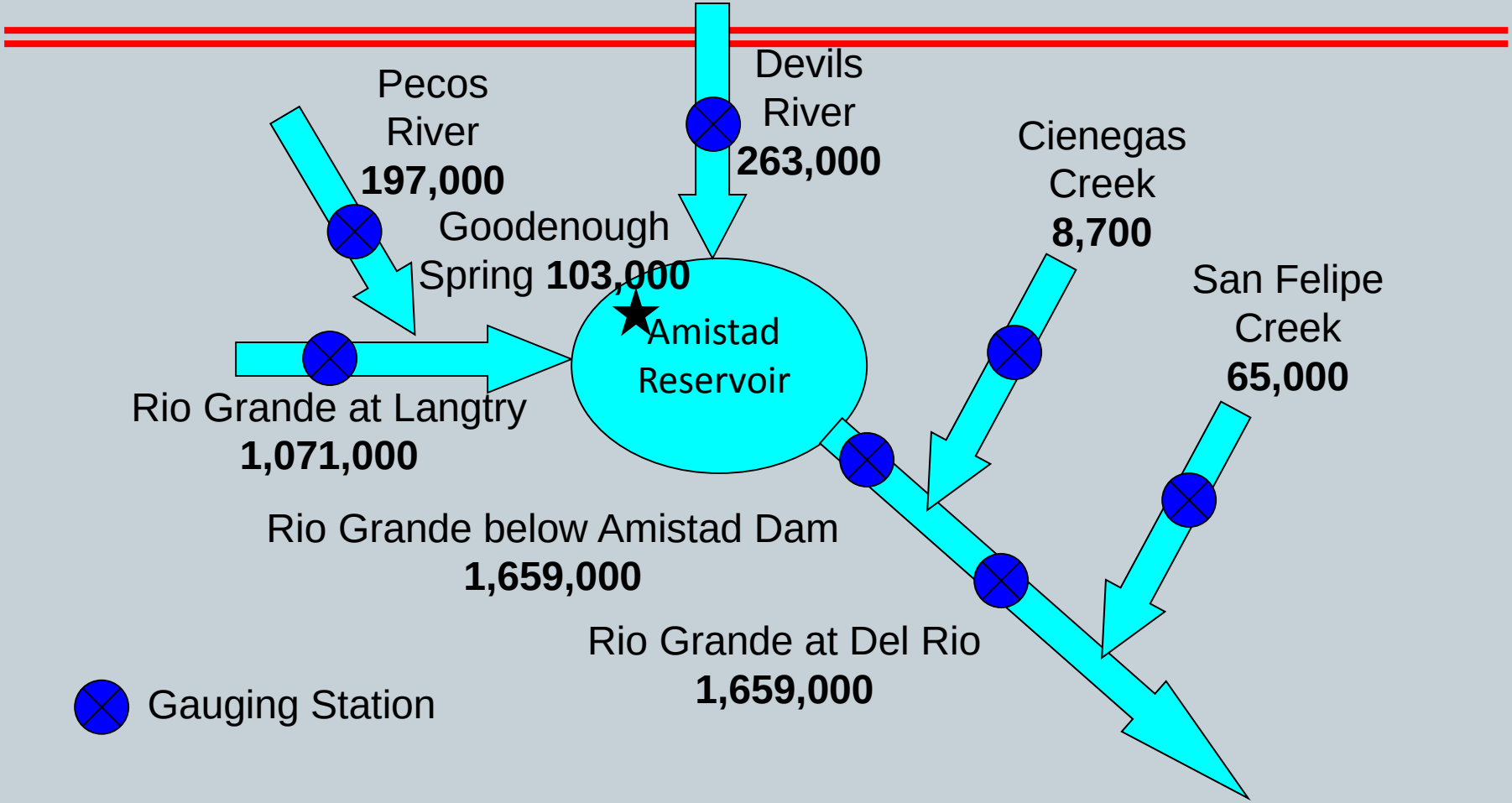
How the 1/3 from Val Verde County is managed is less settled…..

How Much Water Are We Talking About? Average Annual Flow by Each River/Spring

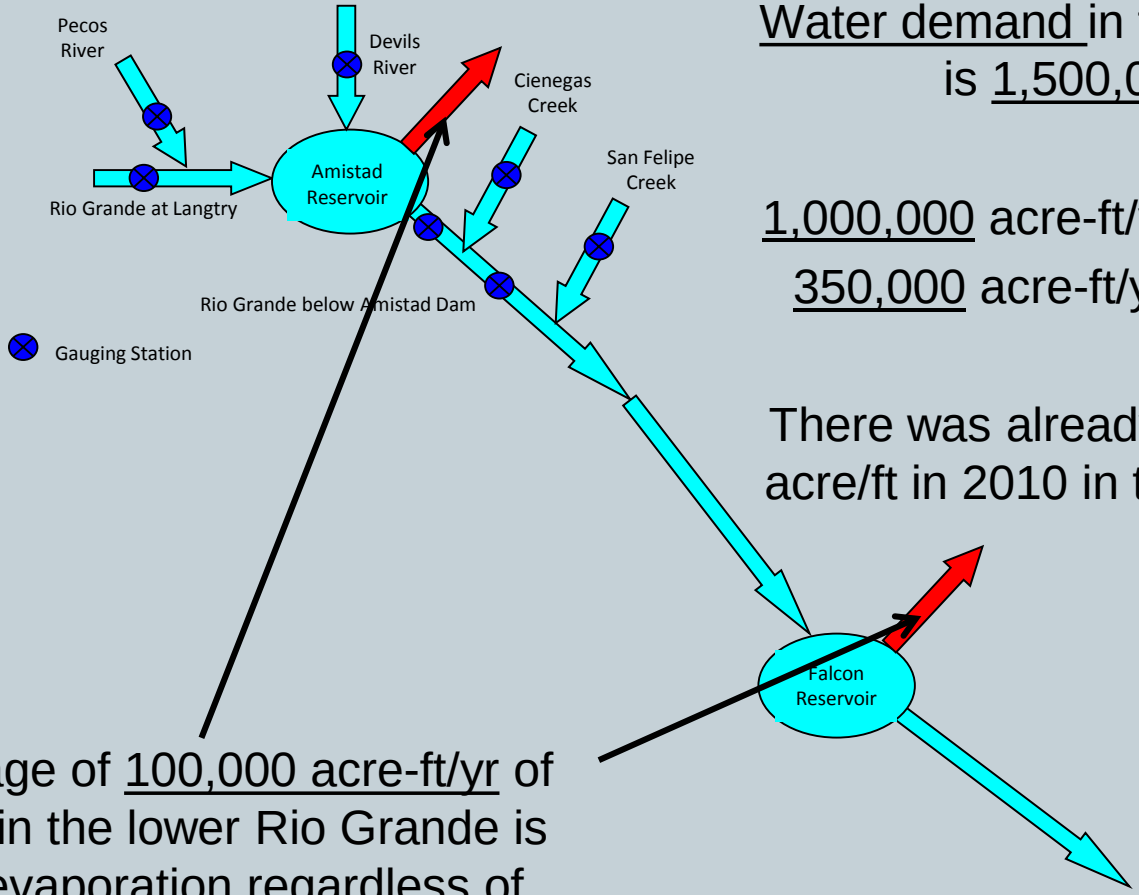


Rio Grande Water Budget in Val Verde County (acre-ft/yr)



In an average year, 1.07 million acre-ft flows into Val Verde County and 1.7 million acre-ft flows out of Val Verde County via the Rio Grande

Amistad and Falcon Reservoirs Lose 100,000 acre-ft to Evaporation Every Year



Water demand in the lower Rio Grande is 1,500,000 acre-ft/yr

1,000,000 acre-ft/yr from surface water

350,000 acre-ft/yr from groundwater

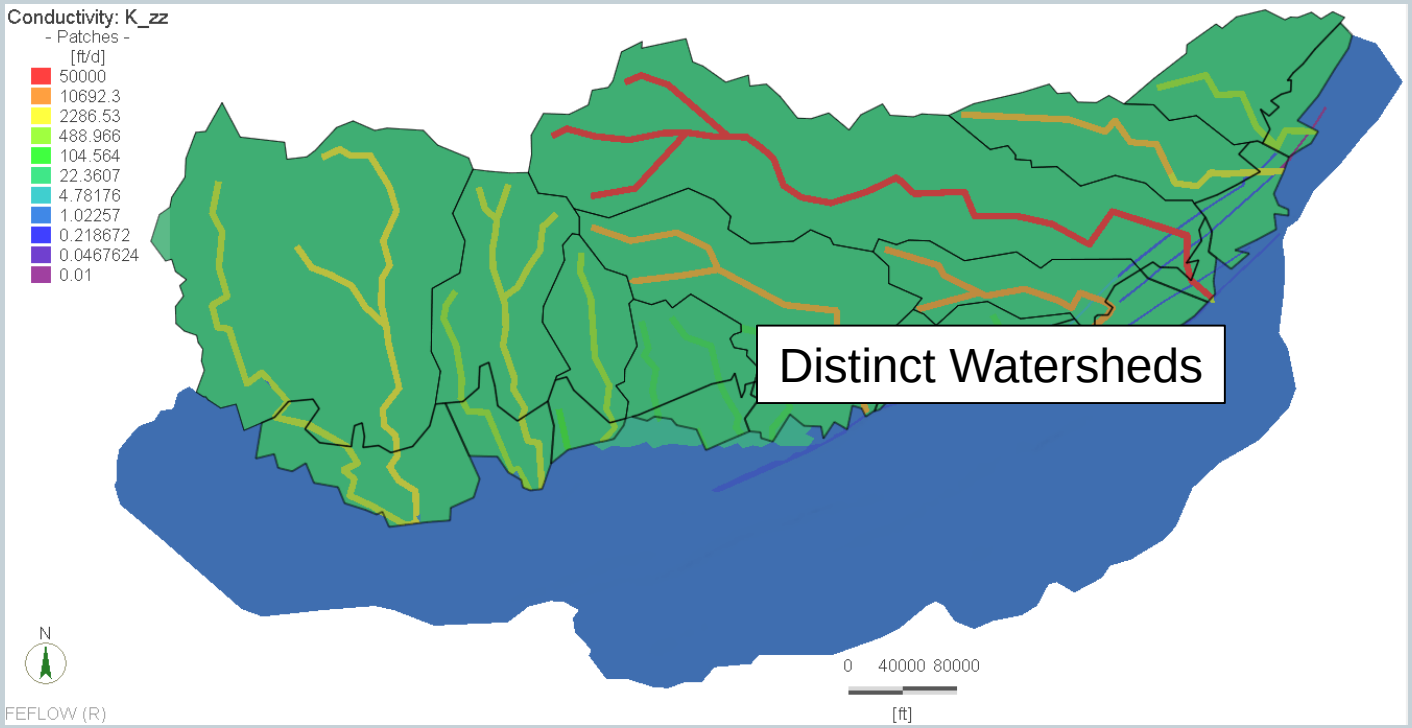
There was already a deficit of 150,000 acre/ft in 2010 in the lower Rio Grande

An average of 100,000 acre-ft/yr of the flow in the lower Rio Grande is lost to evaporation regardless of river flow management

* Lower Rio Grande Basin Study. Bureau of Reclamation & RGRWA

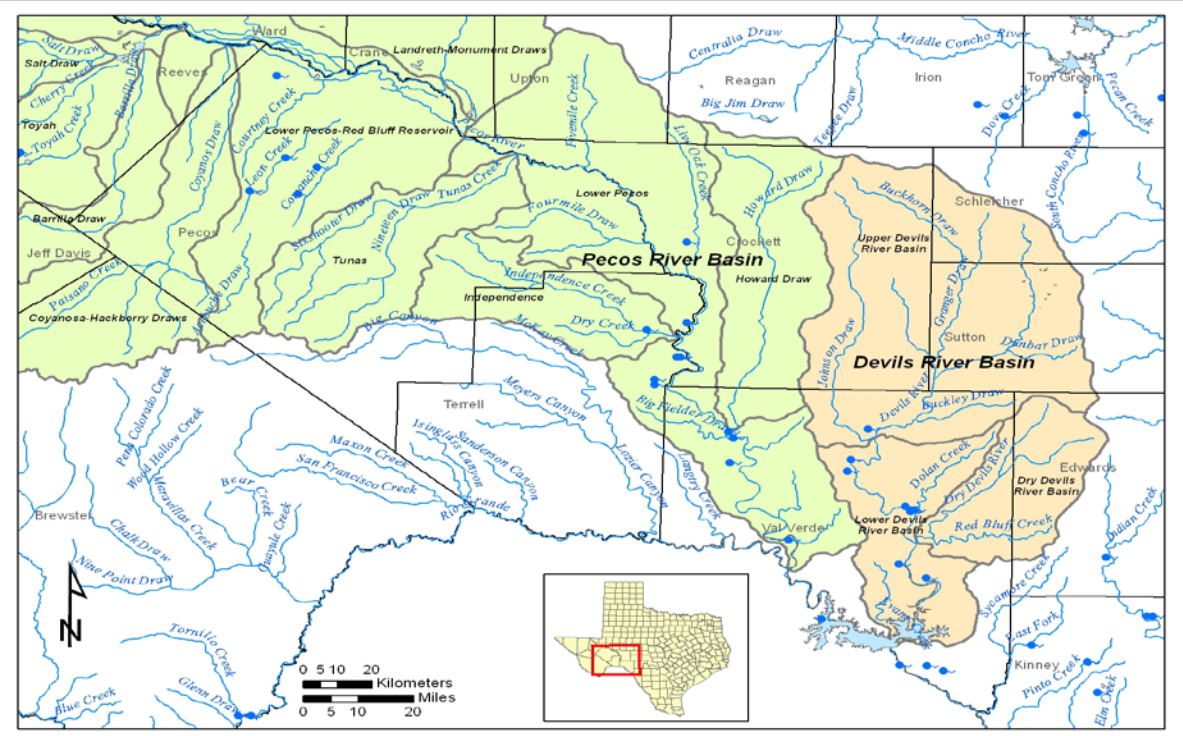
Studies are Underway to Better Characterize the Water Resources of the Lower Pecos River and Devils River Watersheds

Related Studies Suggest There Is Limited Groundwater Flow from Adjacent Watersheds



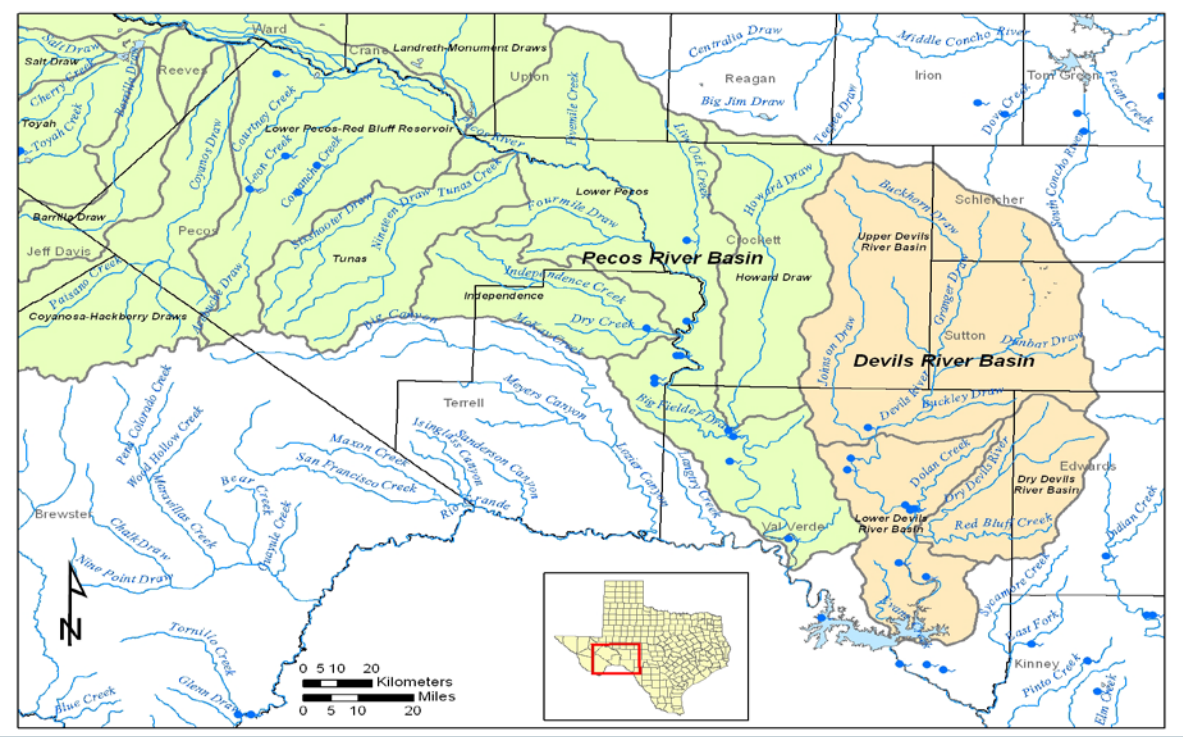
Related studies of the <u>Edwards Aquifer</u> suggest watersheds on the edge of the Edwards Plateau act separately and there is limited groundwater flow between adjacent watersheds

This suggests There Is Limited Groundwater Flow Between the Pecos, Devils, and Sycamore Watersheds



Water in each watershed will tend to stay in its watershed. It is unlikely that surface water or significant groundwater will flow from one watershed to an adjacent watershed, particularly where aquifers are shallow.

Lower Pecos River Watershed and Pecos River Watershed Should be Investigated Separately



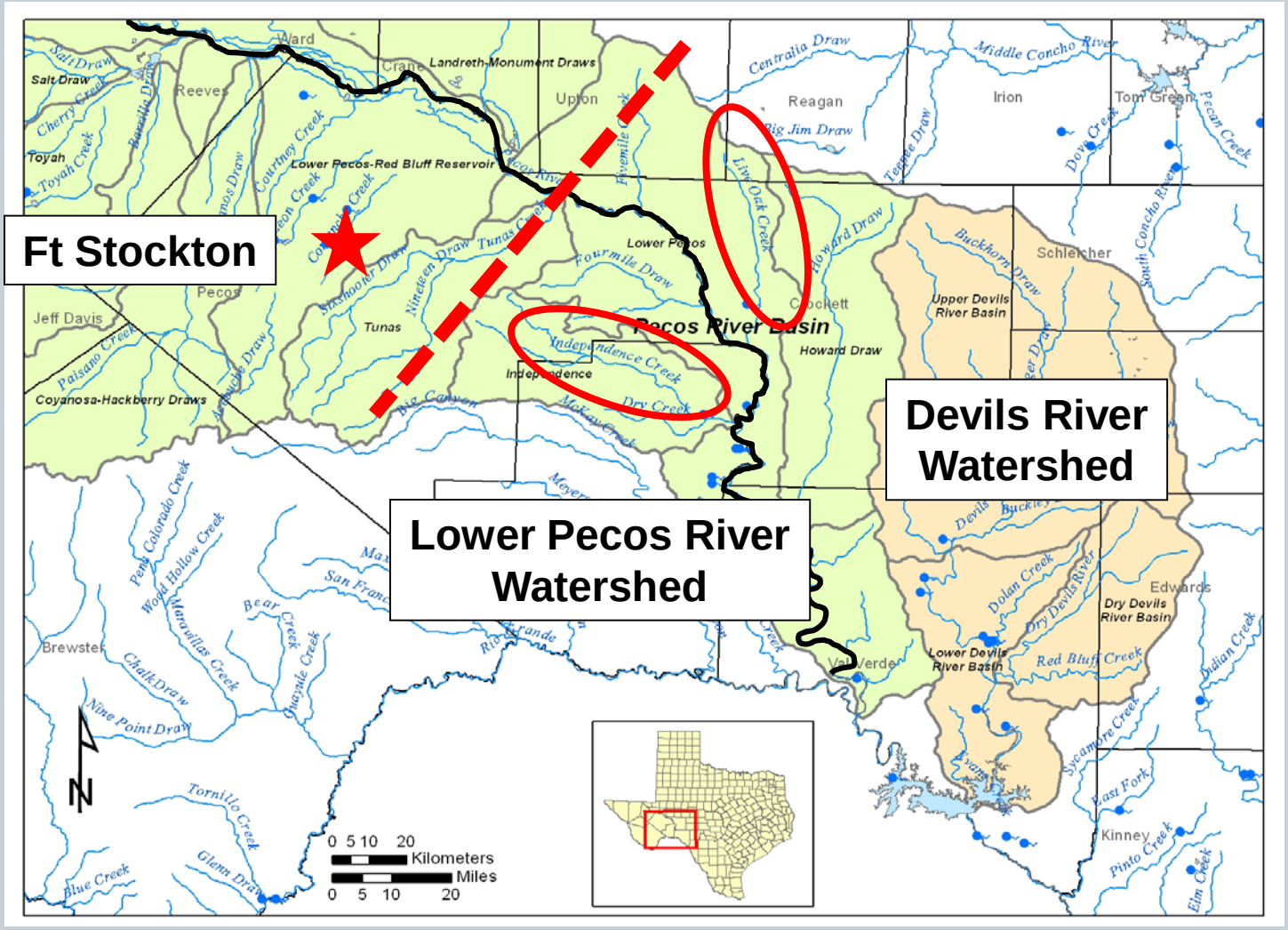
Pecos River Discharge

Pecos River discharge:
197,000 acre-ft/yr
for 1967 -2009….

….but **32,000 acre-ft/yr**
for the period 1961-1967
during heavy pumping and irrigation

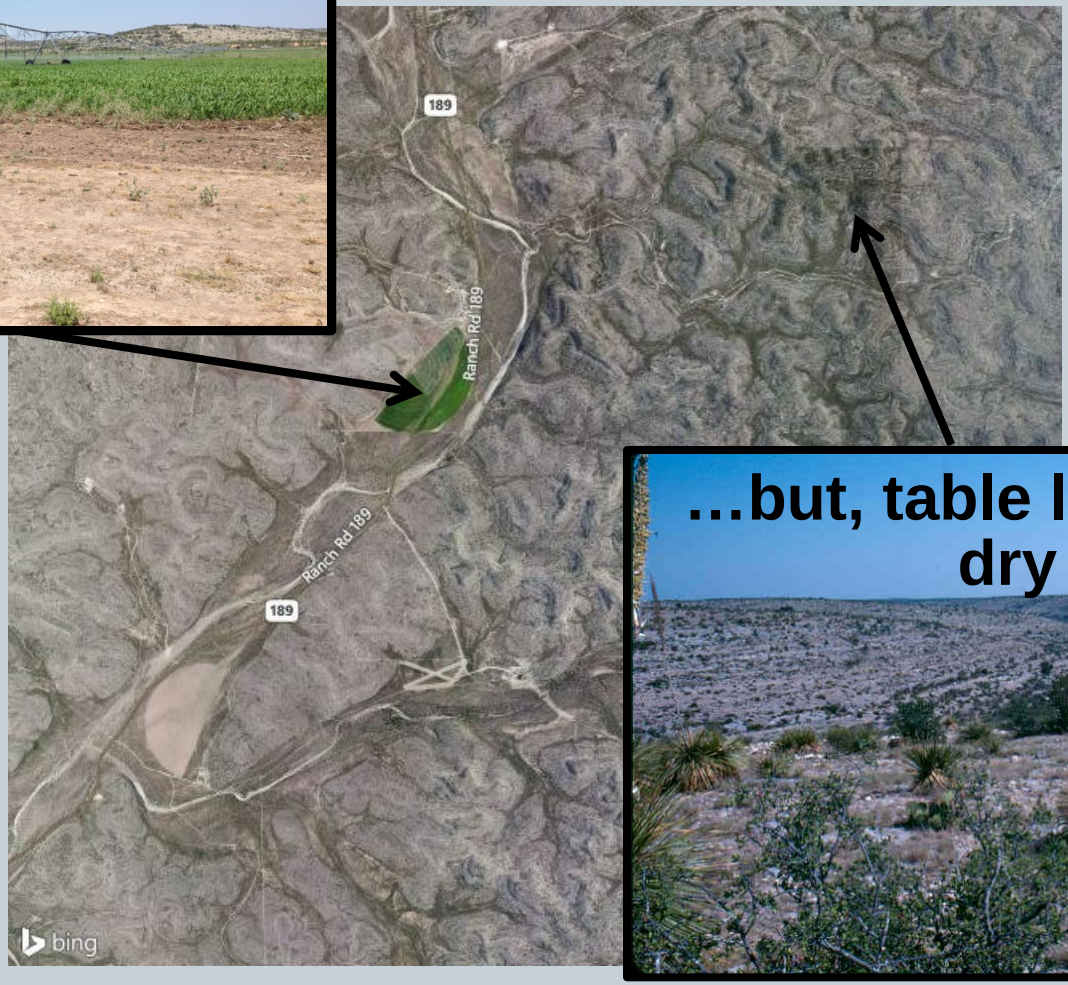
Comanche Springs started to decline in 1947 and ceased flowing in 1961

Lower Pecos River Watershed



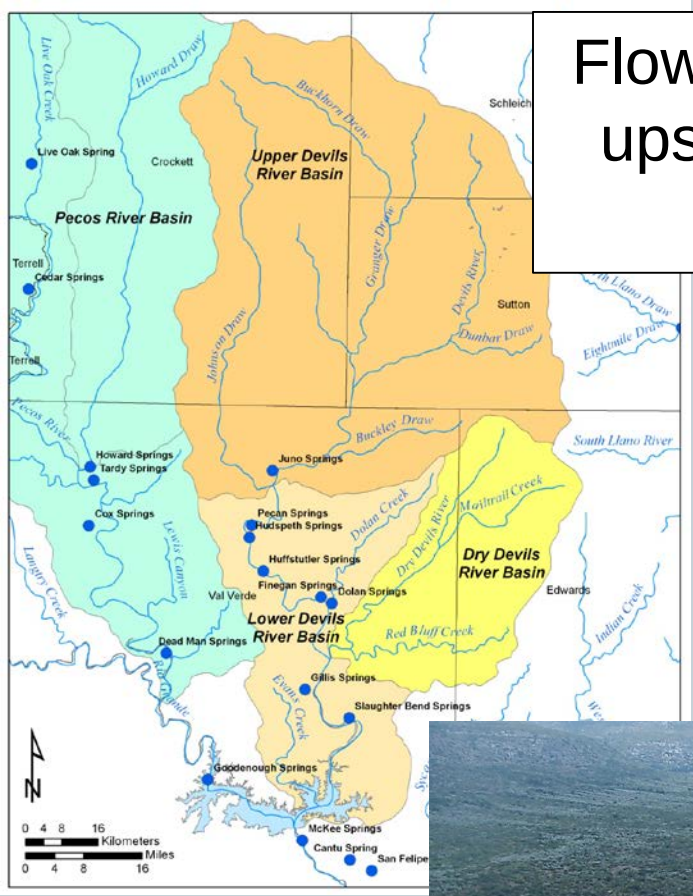
How is this much water conveyed through this desert landscape?

Consider the Presence of 1,000 gpm Wells Along Rivers in the Upper Devils River (Near Juno)

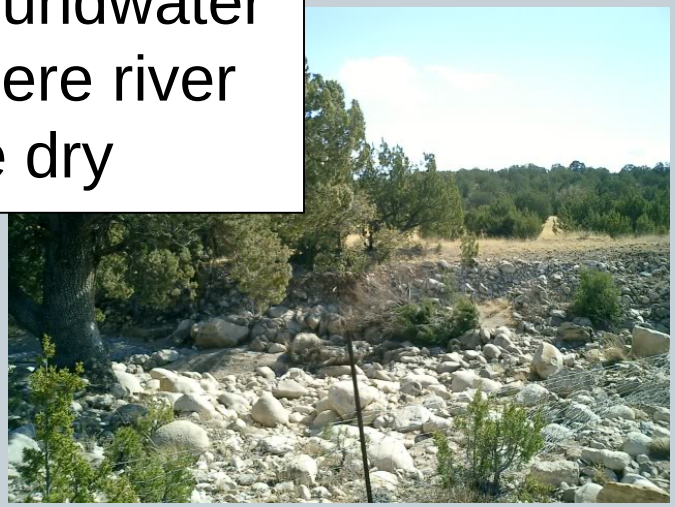


Where is this water coming from?

Water Is Conveyed as Groundwater Upstream and Surface Water Downstream



Flow is as groundwater upstream where river beds are dry

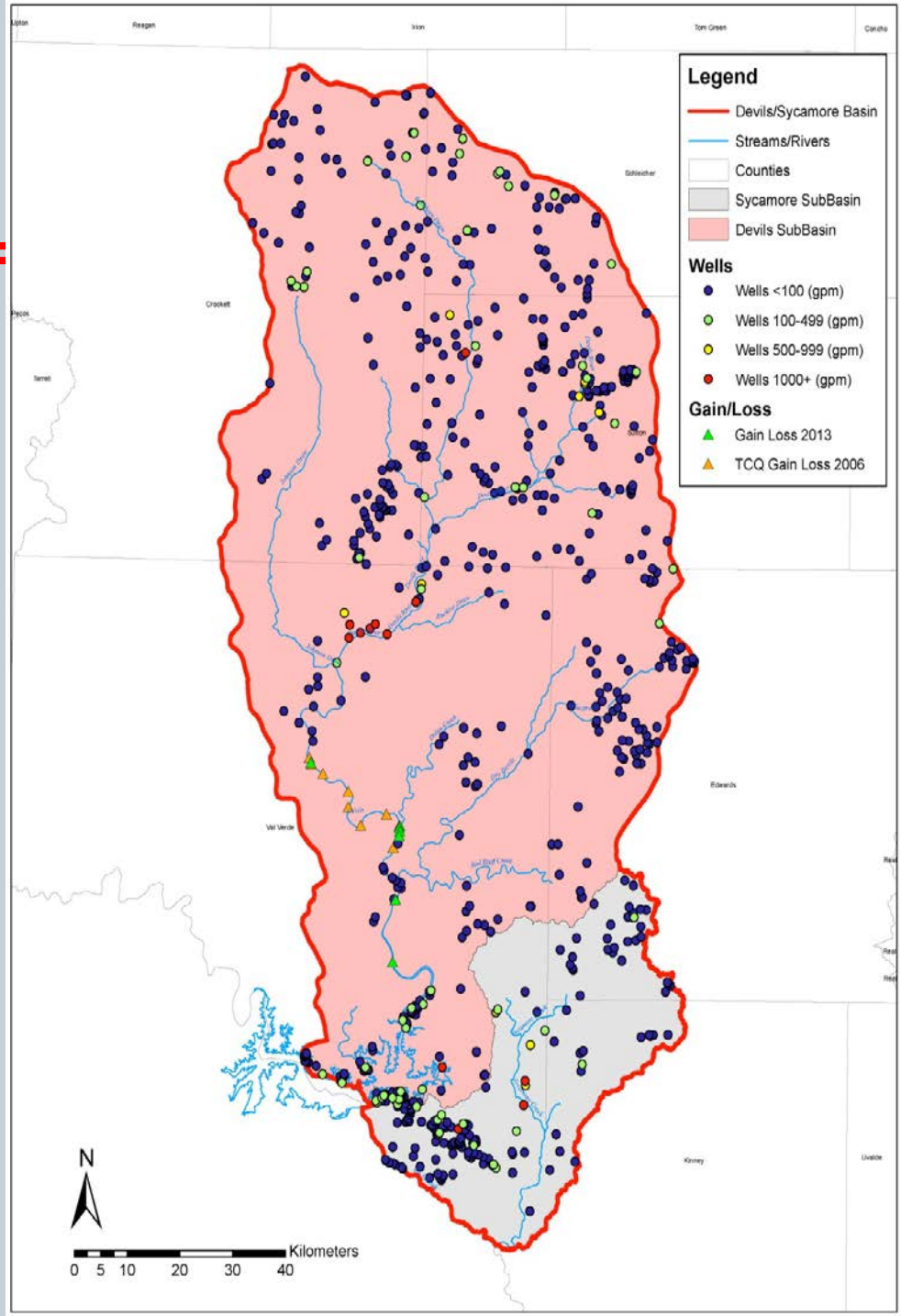


…and as surface water downstream

It is important to note that all high capacity wells in the Devils River watershed are located along major river channels

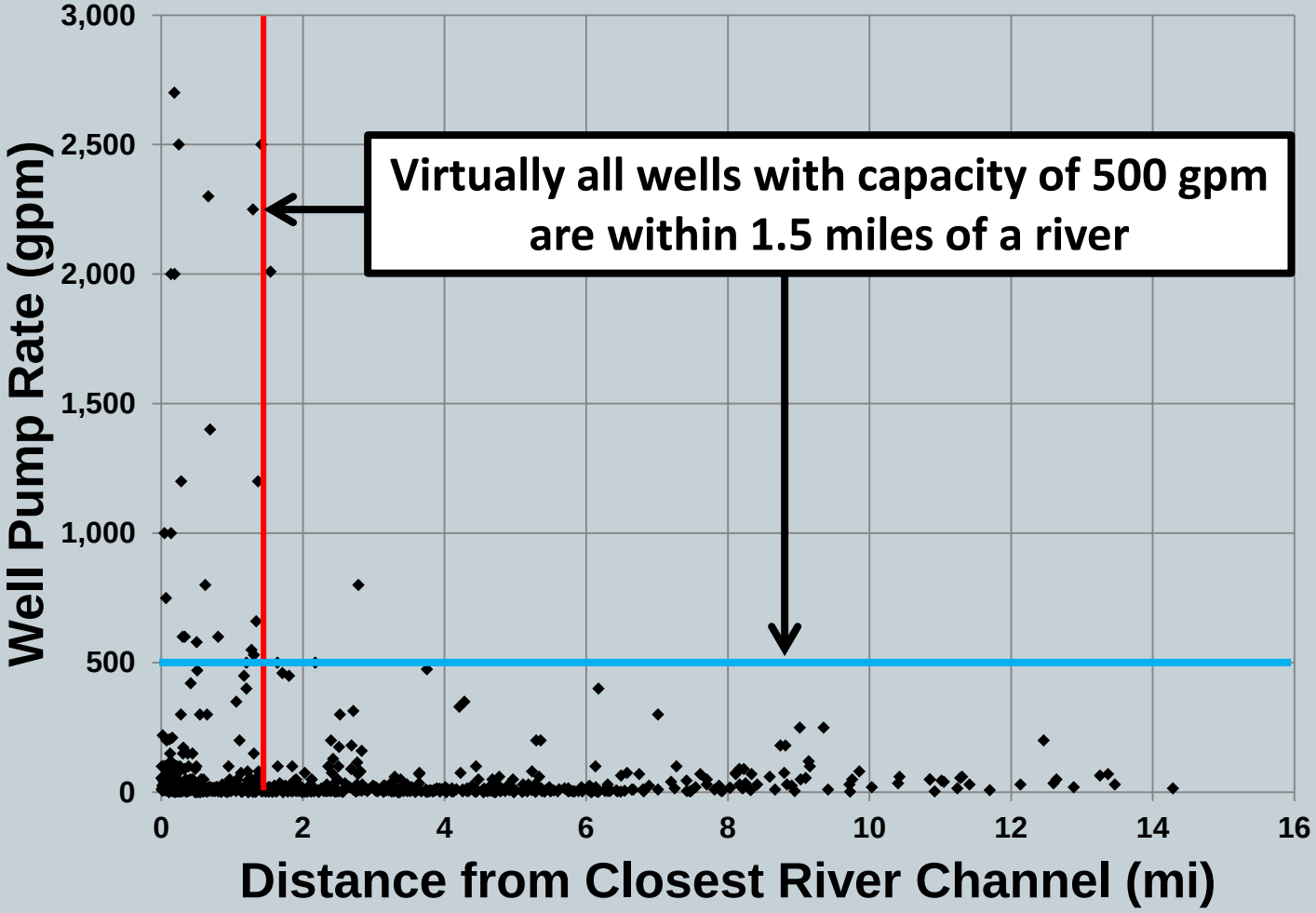
This observation is supported by a review of over 2,200 wells in the TWDB database

There are 752 wells with measured capacity in the TWDB database.
When plotted on a map of the Devils River watershed, it is apparent that high capacity water wells are only located near river channels



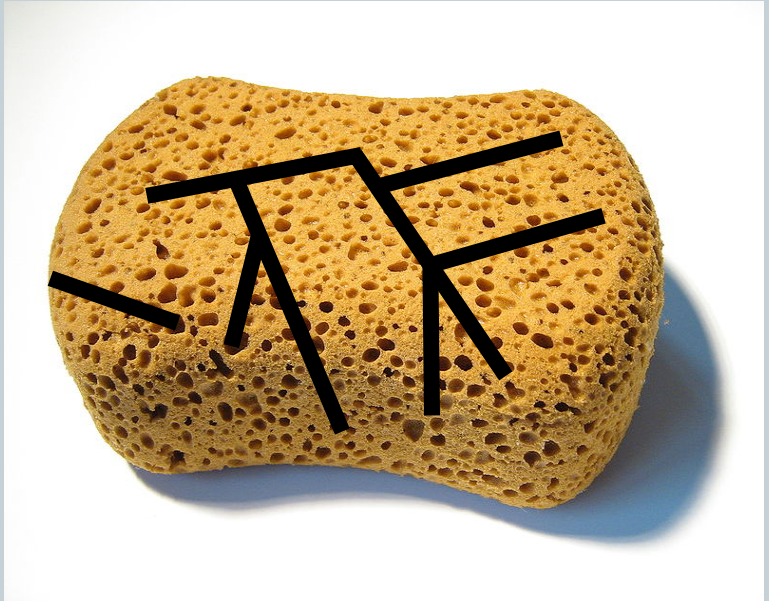
A Graph of These Data Support This Observation

Distance From River Channel Versus Well Capacity

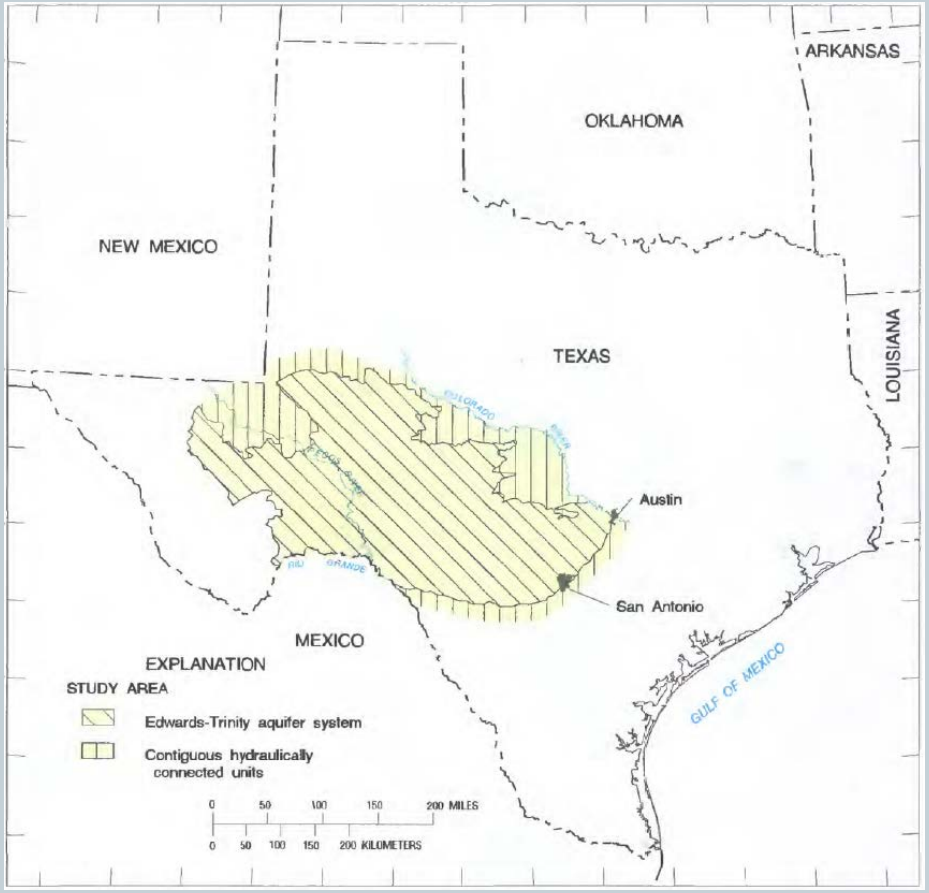


The well data suggest there are preferential flow paths in the subsurface located near rivers that carry significant water.

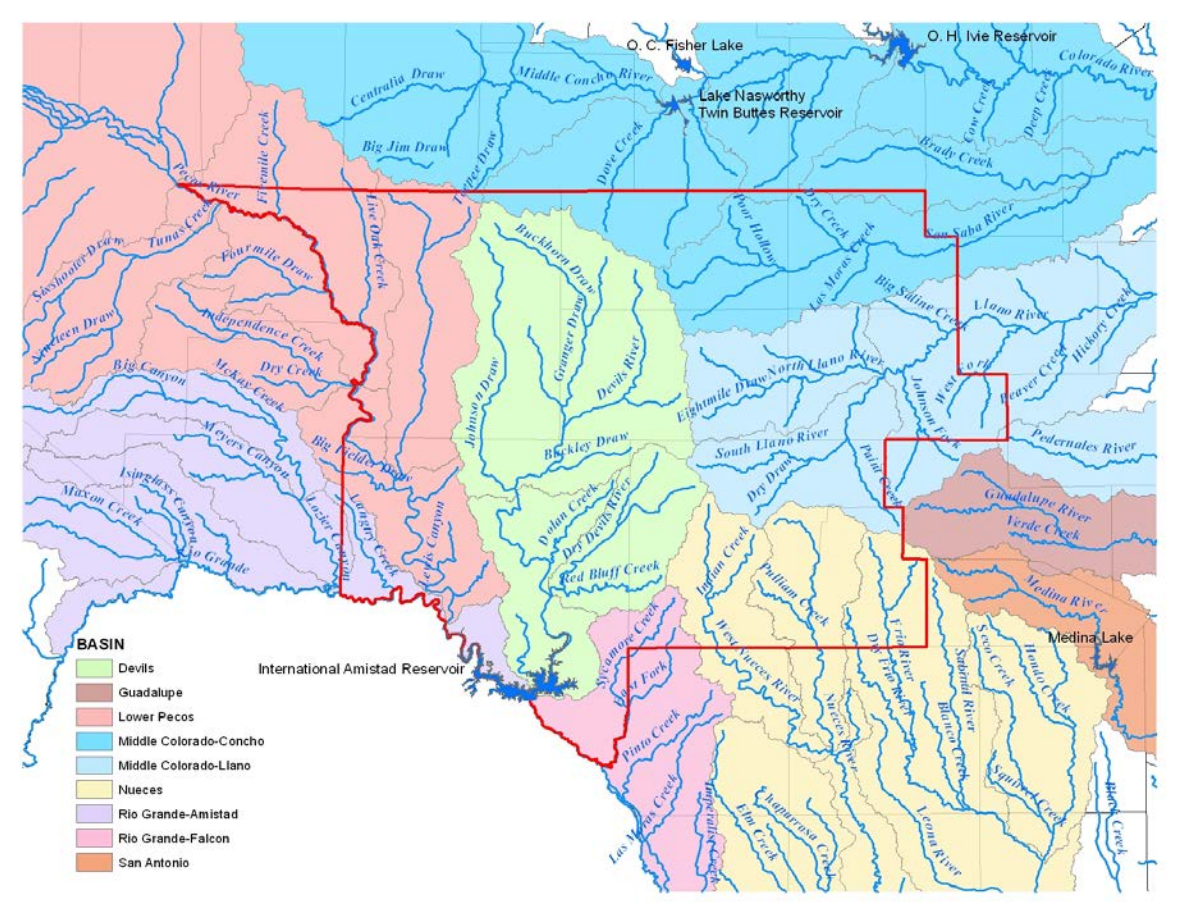
If we consider the Edwards-Trinity Aquifer a sponge, then these preferential flow paths can be thought of as pipes in the sponge



Step 1: The Edwards Plateau Was Formed by Sea Sediments that Solidified Then Lifted Over 10s of Millions of Years

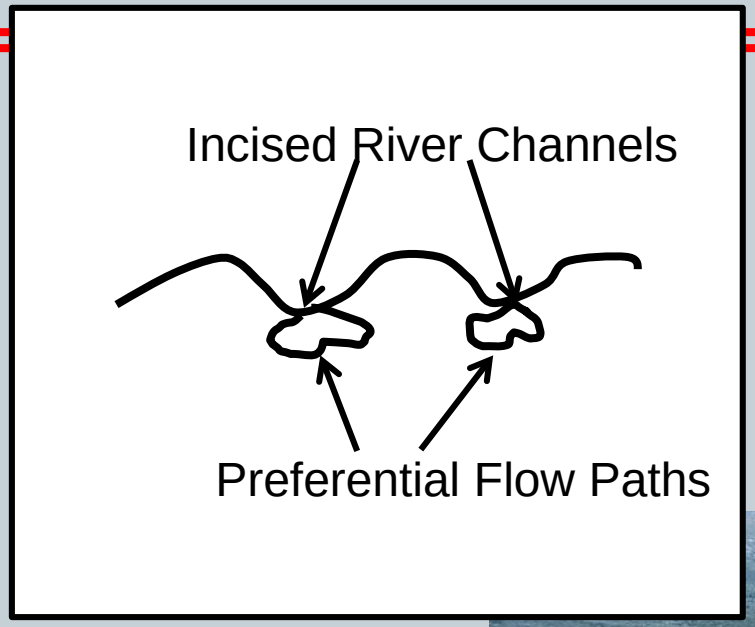


Step 2: River Basins Are Formed as the Edwards Plateau Is Uplifted and Rock Is Eroded



Once started, these river channels and basins probably retain the same alignment over millions of years

Step 3: Rain Water Is Focused into River Beds and Acts as a Mild Acid That Dissolves the Limestone



The preferential flow paths that are formed may be a "pipe", but it is more likely the flow paths are simply zones of enhanced permeability

Two Important Points:

1)These preferential flow paths are in **bed rock**, **not gravel beds**

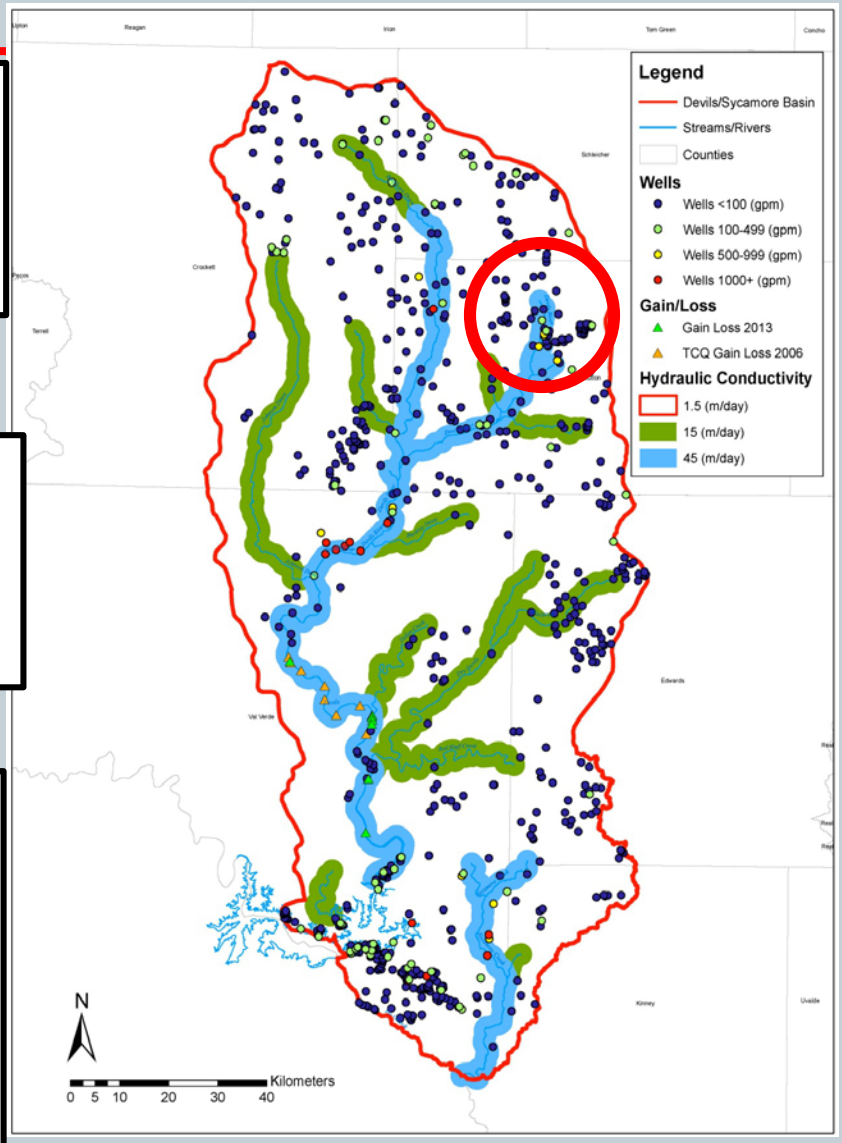
2) You **cannot assume** to have high capacity wells **everywhere** in Edwards-Trinity Aquifer just because you happen to have a high-capacity well that's **near a river channel**

Supporting Proof of Preferential Flow Channels in River Channels

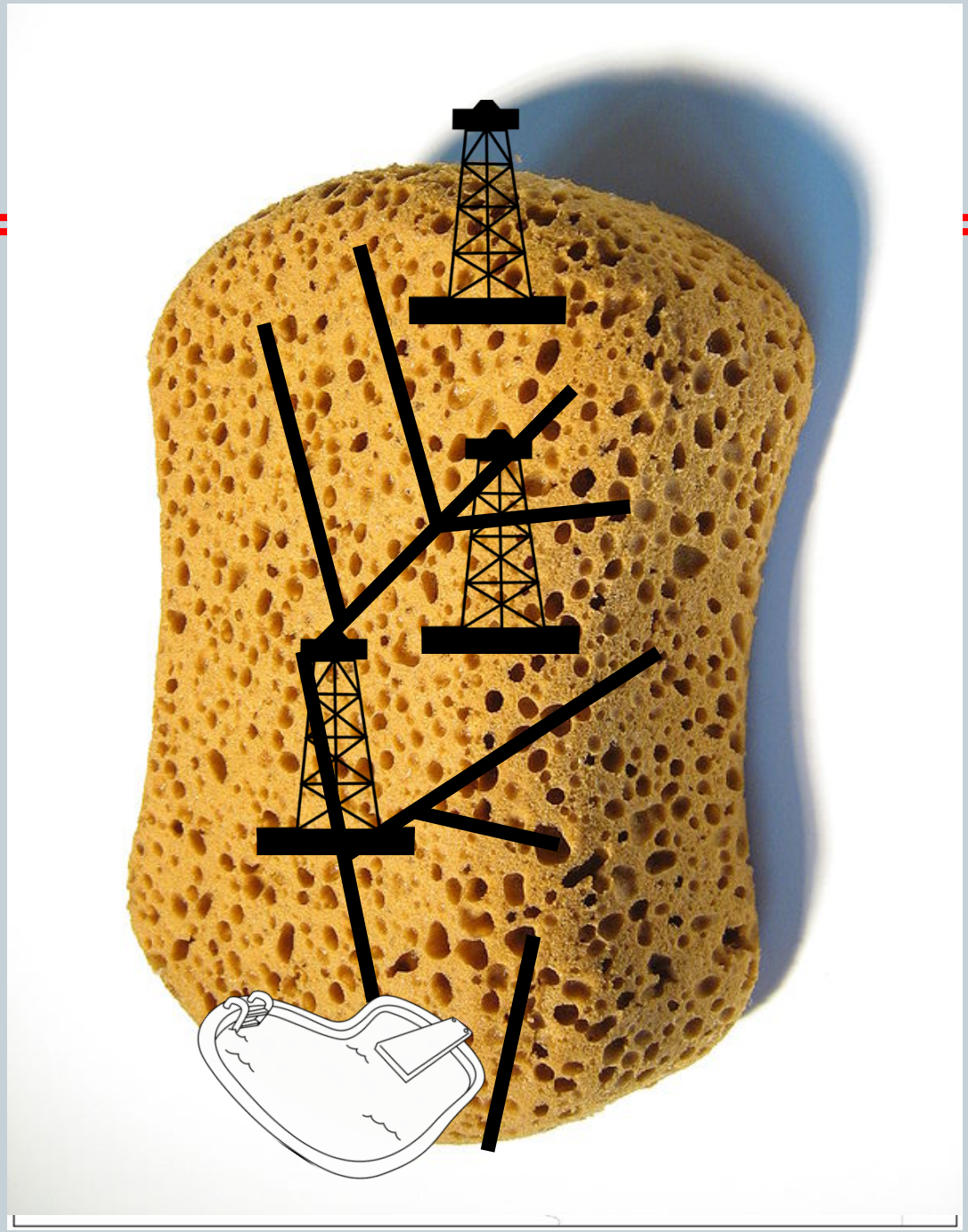
Dye tracer tests in Sonora confirm the presence of preferential flow in Devils River channel

Groundwater will flow at most a few 10s of feet/yr in a porous media aquifer such as the Carrizo-Wilcox

Preliminary results from the Sonora tracer test suggests groundwater travels a half to one mile a day in the “pipes” associated with Devils River



What is needed to build a model of the Devils River watershed?



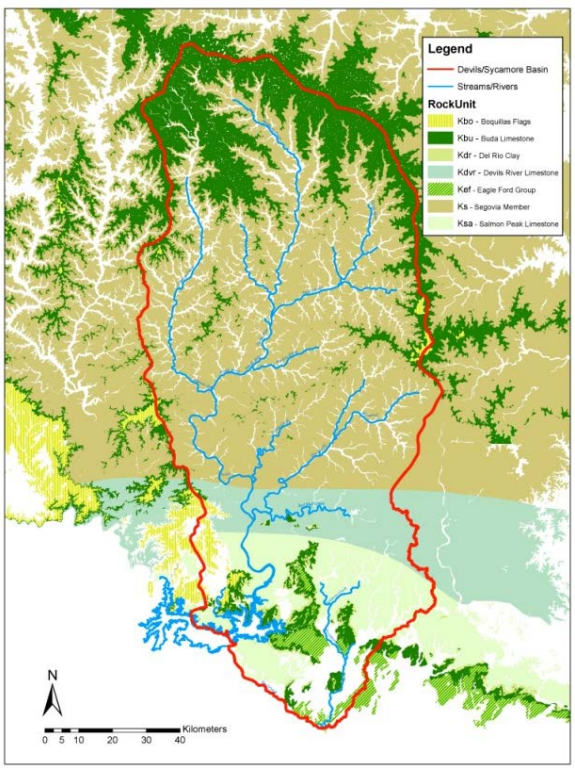
1) Need to model the entire watershed

2) Need to add pipes

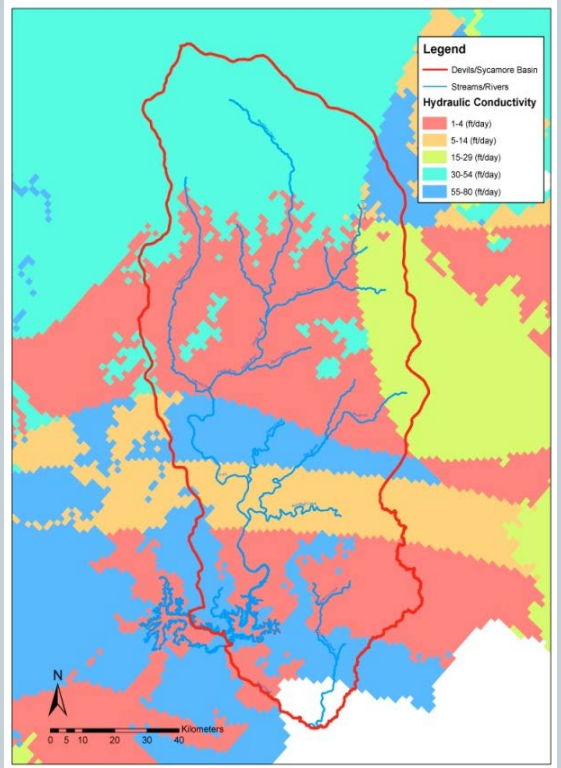
How is Groundwater Flow Characterized by the Texas Groundwater Development Board?

The Texas Water Development Board Model Appears To Be Based on the Mapped Geologic Formations

Mapped geology of Devils River watershed



TWDB model of Devils River watershed hydrogeology

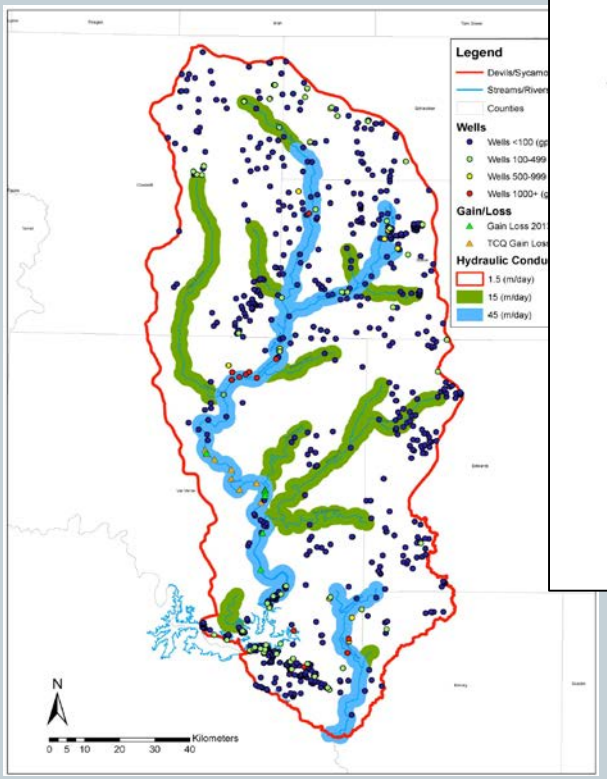


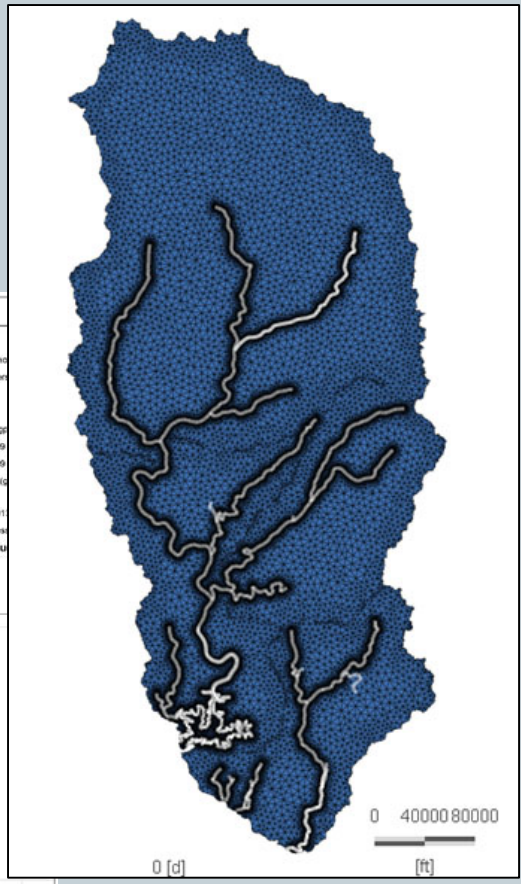
The Texas Water Development Board model units are represented as porous media (“sponges”) with no preferential flow paths

How Should the Devils River Watershed Be Modeled?

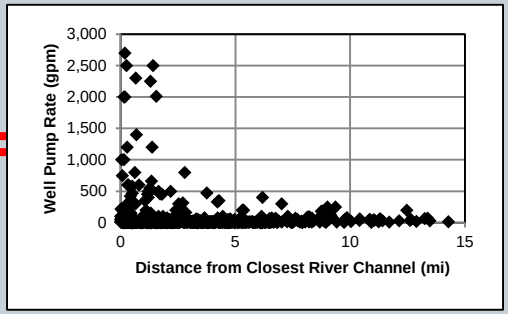
It is recommended the Devils River and Lower Pecos River watersheds be modeled as separate hydrologic entities with preferential flow paths (i.e., "pipes") embedded in porous media (i.e., "sponges")

Refined characterization Of Devils River watershed hydrogeology

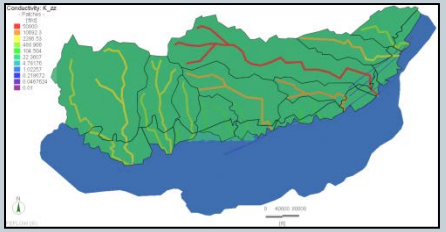




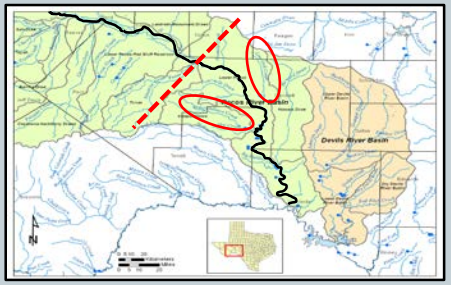
Summary



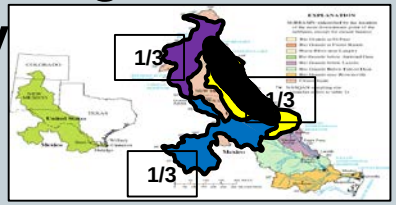
- High capacity water wells are only located near river channels
- There are preferential flow paths in the subsurface located near rivers that carry significant groundwater



- Related studies suggest there is limited groundwater flow from adjacent watersheds
- Lower Pecos River and Devils River watersheds should be modeled as separate hydrologic entities



- Lower Rio Grande is dependent on management of groundwater resources that supply Amistad Reservoir



Acknowledgements

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