



Aquifers of New Mexico

New Mexico Water Leaders Workshop

December 6-8, 2023

Las Cruces, NM

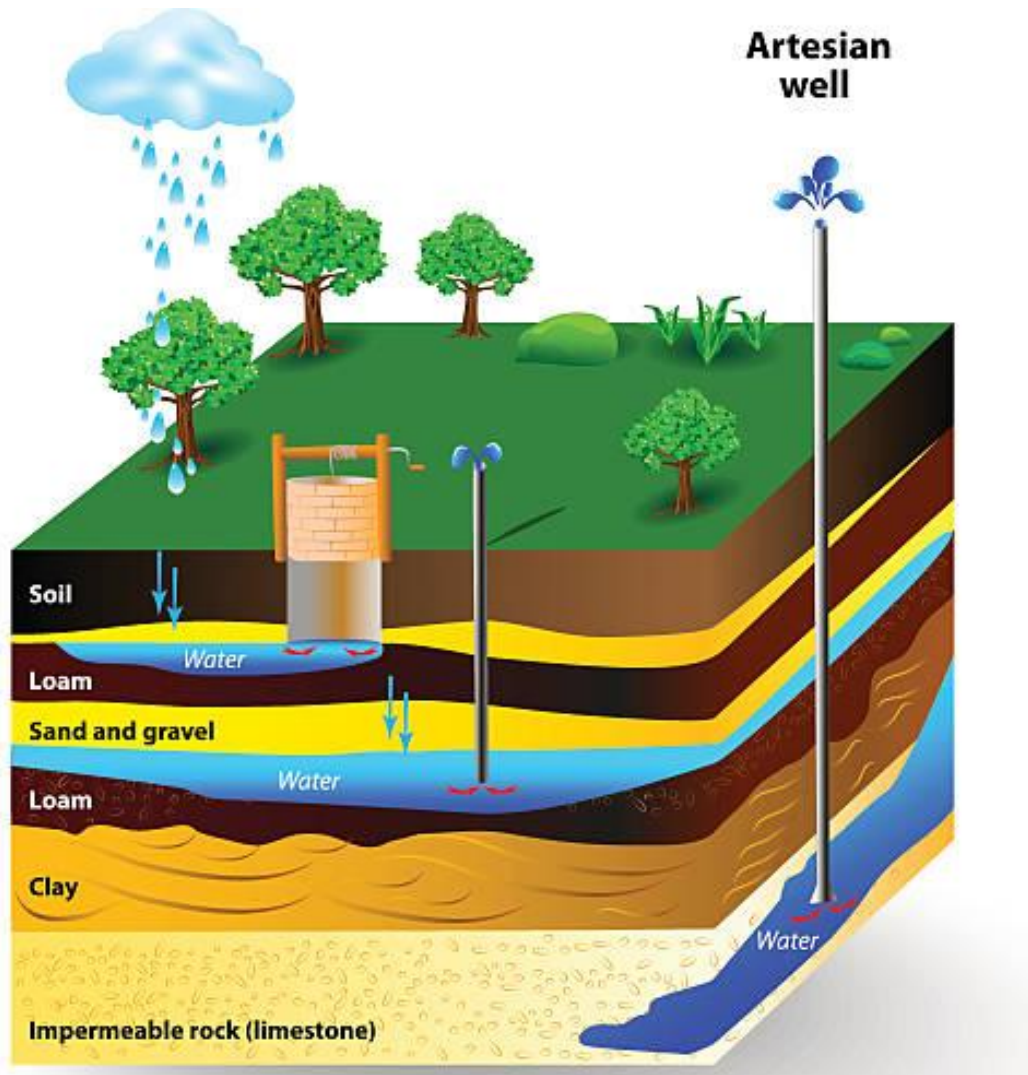
Katie Zemlick, Ph.D.

Hydrology Bureau Chief

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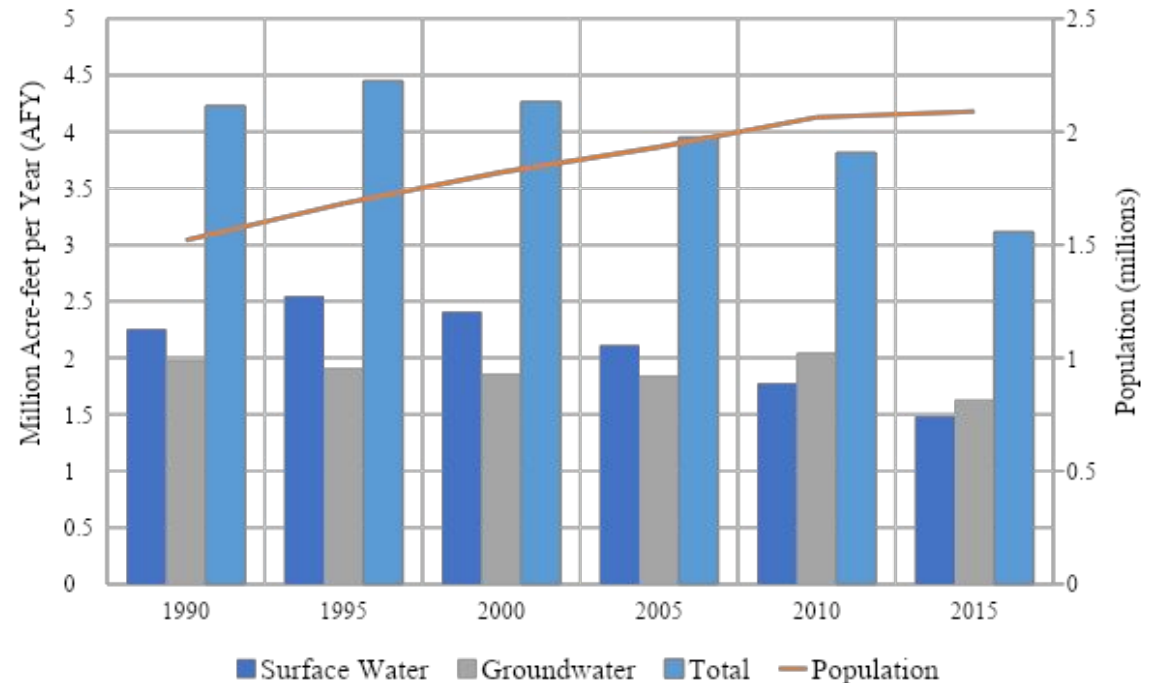
Katie.Zemlick@ose.nm.gov

What is an aquifer?



An **aquifer** is a *geologic formation*, a group of formations, or a part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs. The areal and vertical location of major aquifers is fundamental to the determination of groundwater availability for the Nation. (USGS, 2021)

New Mexico, 1990-2015



Principal aquifers and groundwater-level change in NM

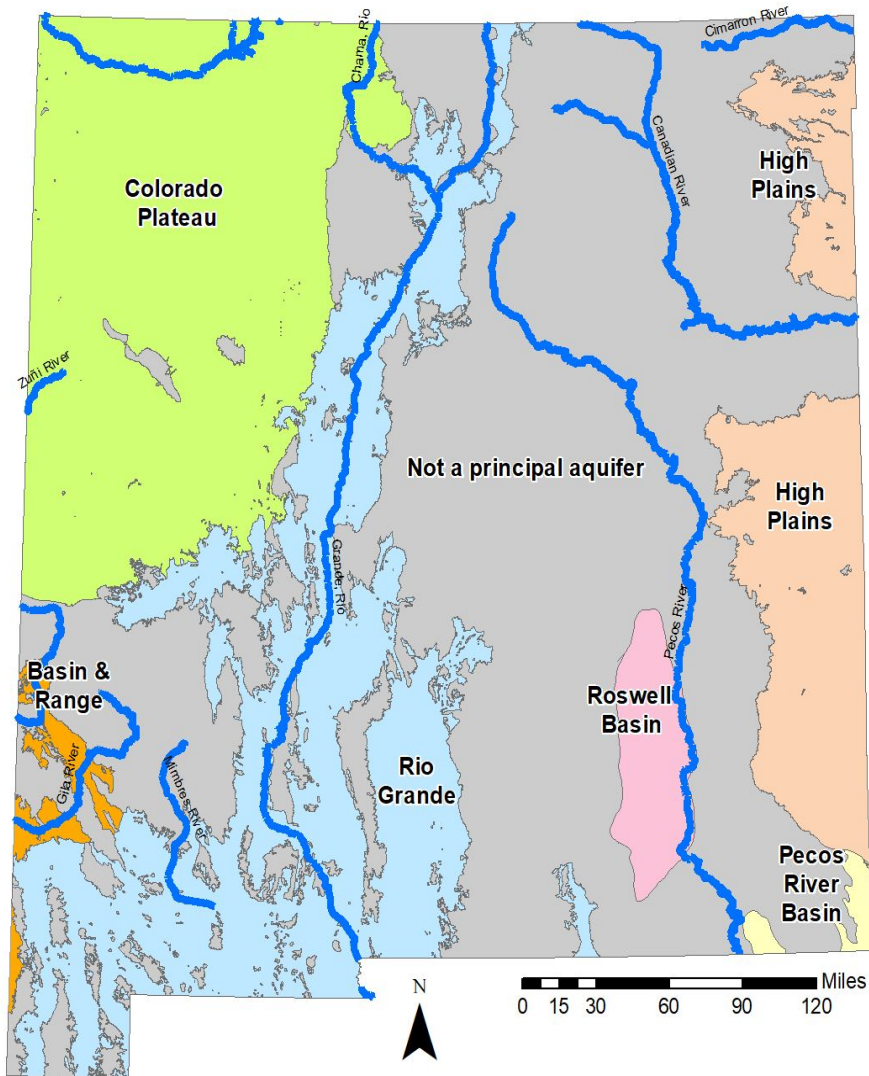
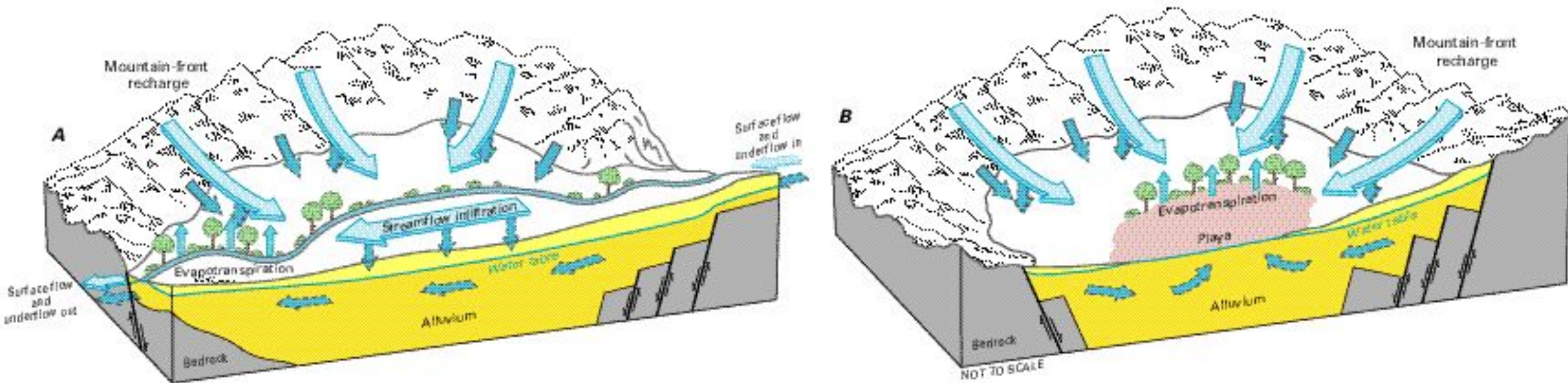


Table 15. Summary of statewide groundwater-level changes in New Mexico.

Aquifer	Number of wells used to calculate mean and median composite water-level changes	Composite water-level change (feet)		Time period
		Mean	Median	
Colorado Plateaus aquifers, Grants to Crownpoint area	10	-3.8	-35	1980-84 to 2015-19
High Plains aquifer, northeast New Mexico	11	-32	-40	1980-84 to 2015-19
High Plains aquifer, east-central New Mexico	53	-28	-24	1980-84 to 2015-19
High Plains aquifer, southeast New Mexico	88	-17	-17	1980-84 to 2015-19
Pecos River Basin alluvial aquifer	6	+0.72	-4.2	1980-84 to 2015-19
Rio Grande aquifer system, north-central New Mexico	15	-9.8	-18	1980-84 to 2015-19
Rio Grande aquifer system, central New Mexico	10	-2.9	-1.6	1985-89 to 2015-19
Rio Grande aquifer system, Albuquerque area, New Mexico	26	-1.0	+0.65	1985-89 to 2015-19
Rio Grande aquifer system, Plains of San Agustin, New Mexico	9	-1.2	-1.2	1990-94 to 2015-19
Rio Grande aquifer system, Rio Grande Valley, south-central New Mexico	34	-5.6	-9.3	1980-84 to 2015-19
Rio Grande aquifer system, mesa lands west and southwest of Las Cruces, New Mexico	11	+6.8	-4.5	1980-84 to 2015-19
Roswell Basin aquifer system, New Mexico	94	-1.3	-2.7	1980-84 to 2015-19

Map modified from Myers (2022) and table from Myers (2022), USGS OFR 2022-1008

Hydrologic Basins: Open vs. Closed






An **open basin (A)** is stream connected and discharge can occur through surface water interaction (through-flowing streams), groundwater underflow, and evapotranspiration.

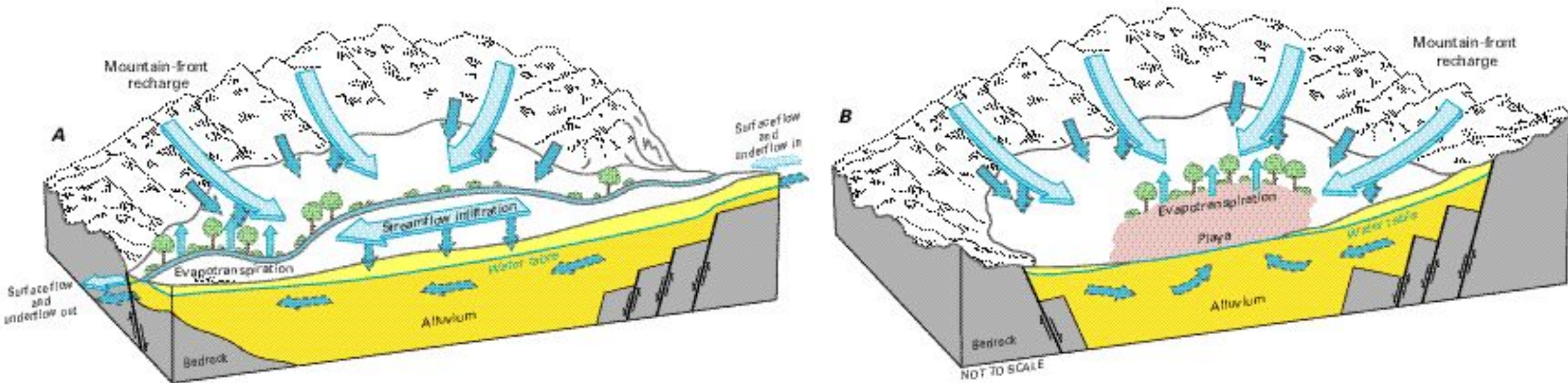
A **closed basin (B)** is not stream connected and discharge occurs primarily through evapotranspiration from plants and playas or lakes.

Modified from Anderson, T.W., Welder, G.E., Lesser, Gustavo, and Trujillo, A., 1988, Region 7, Central alluvial basins, in Back, William, Rosenshein, J.S., and Seaber, P.R., eds, Hydrology: Geological Society of America, The Geology of North America, v. O-2, p. 81-86.

EXPLANATION

-  Direction of surface-water movement
-  Direction of ground-water movement
-  Fault—Arrows show relative direction of movement

Hydrologic Basins: Open vs. Closed






In an **open basin** (A) recharge can occur due to infiltration of runoff, surface water interaction, and groundwater underflow.

In a **closed basin** (B) recharge occurs primarily through infiltration of runoff.

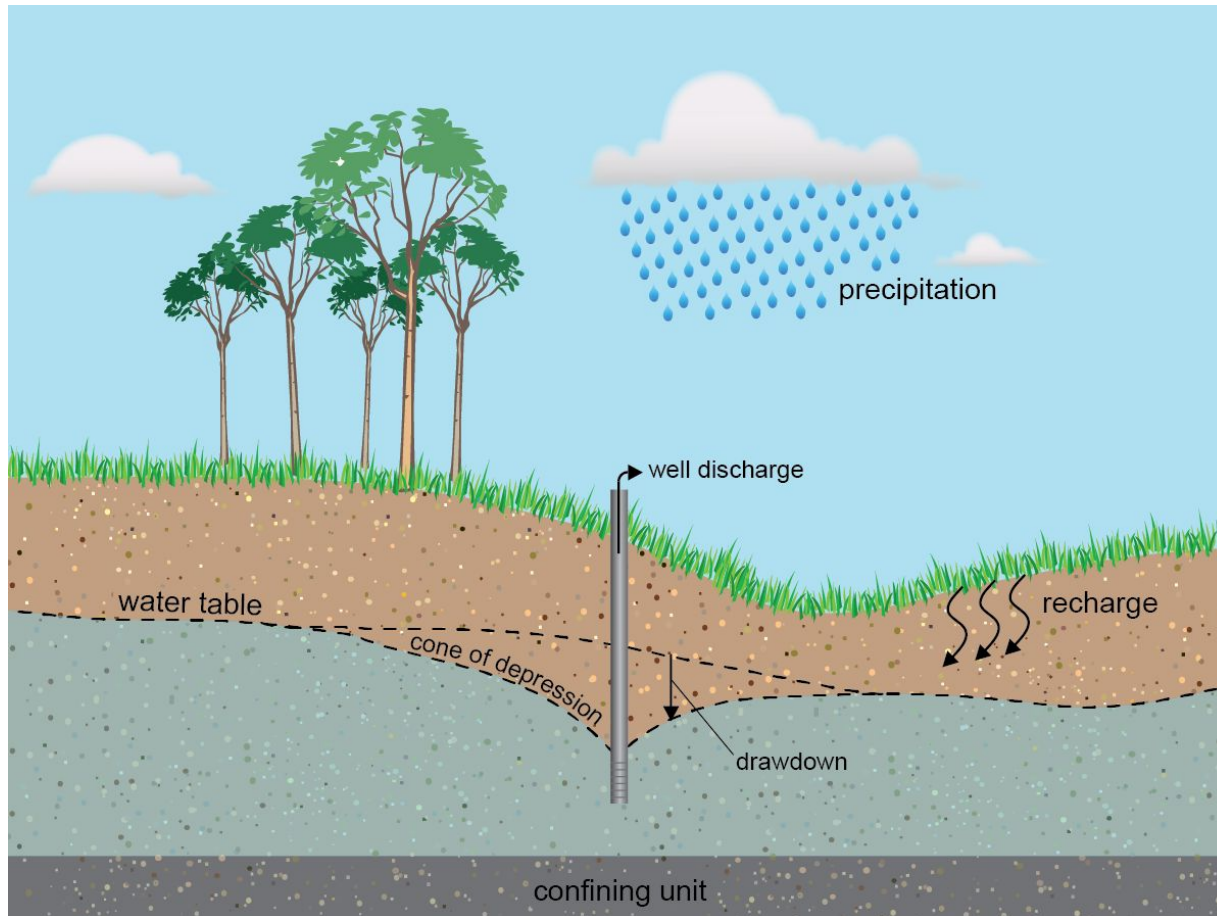
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EXPLANATION

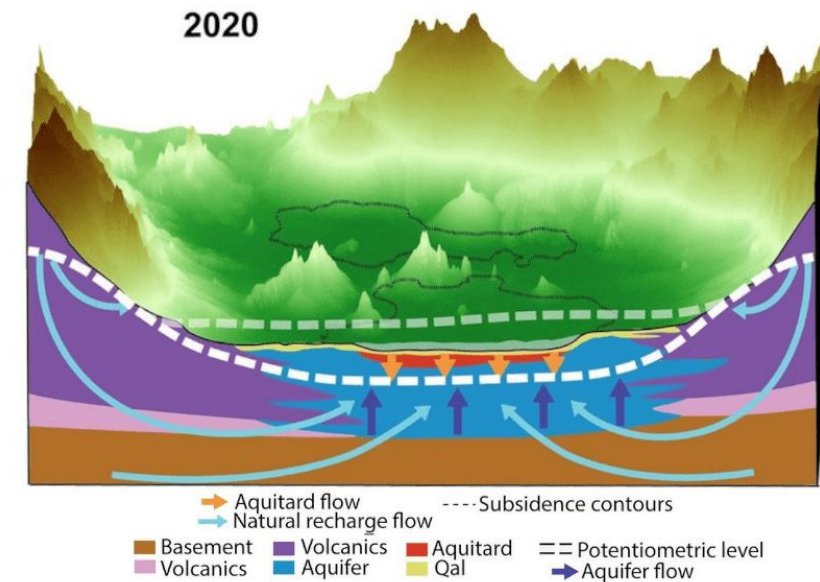
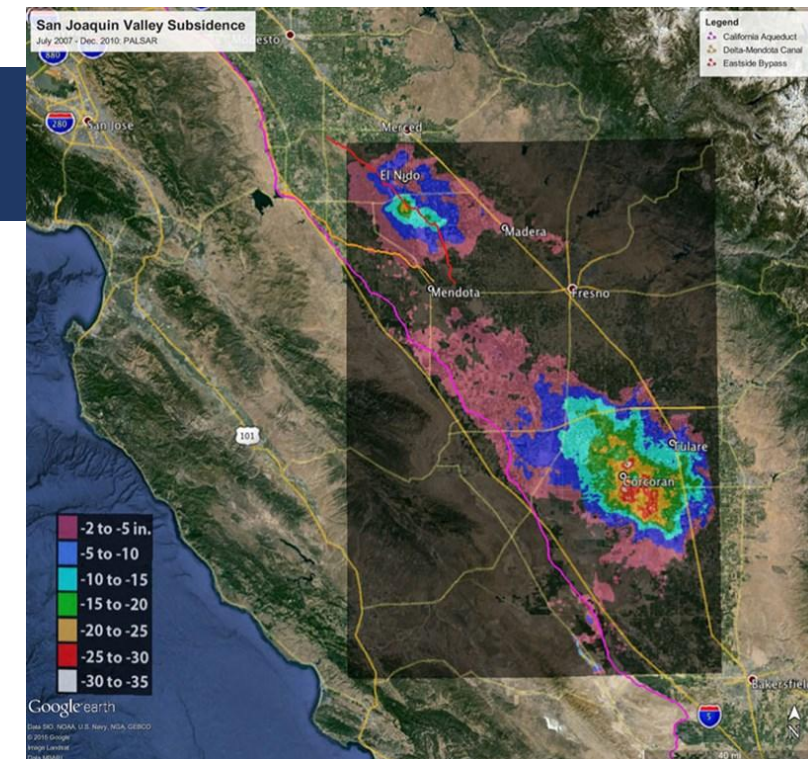
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Groundwater mining & aquifer overdraft

Groundwater Pumping >> Recharge - Evapotranspiration

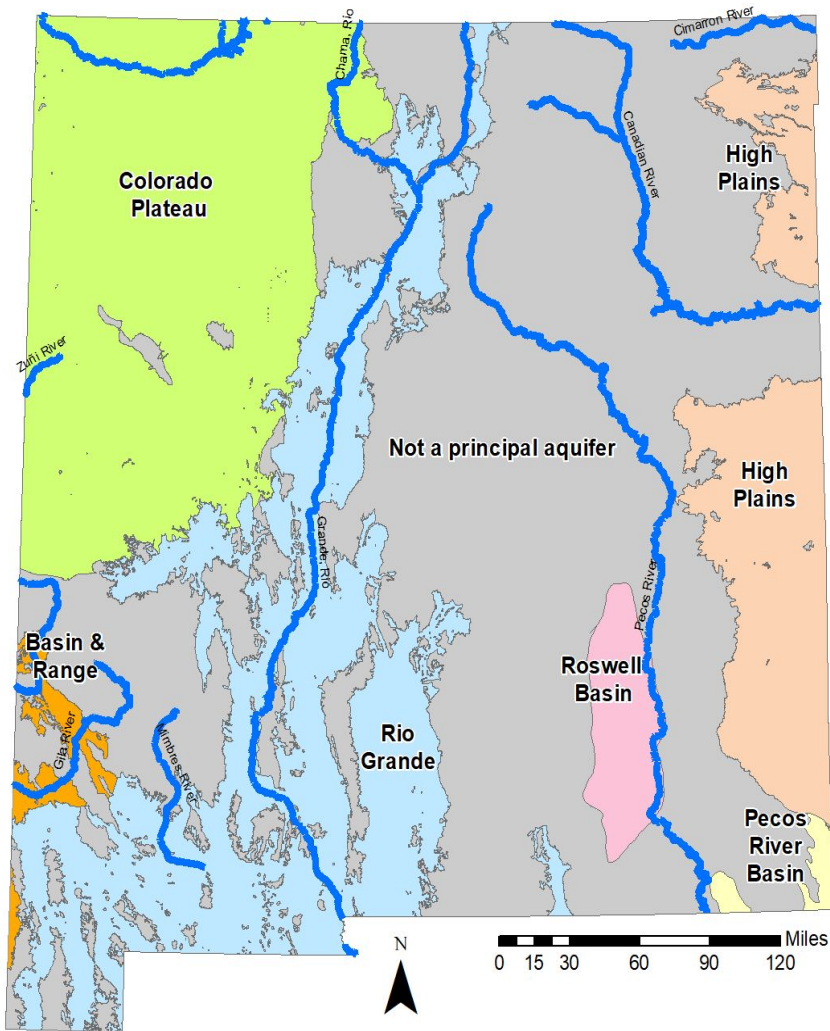


[https://www.usgs.gov/media/images/cone-depression-pumping-a-well-can-cause-water-level-lowering;](https://www.usgs.gov/media/images/cone-depression-pumping-a-well-can-cause-water-level-lowering)
<https://eos.org/research-spotlights/the-looming-crisis-of-sinking-ground-in-mexico-city>

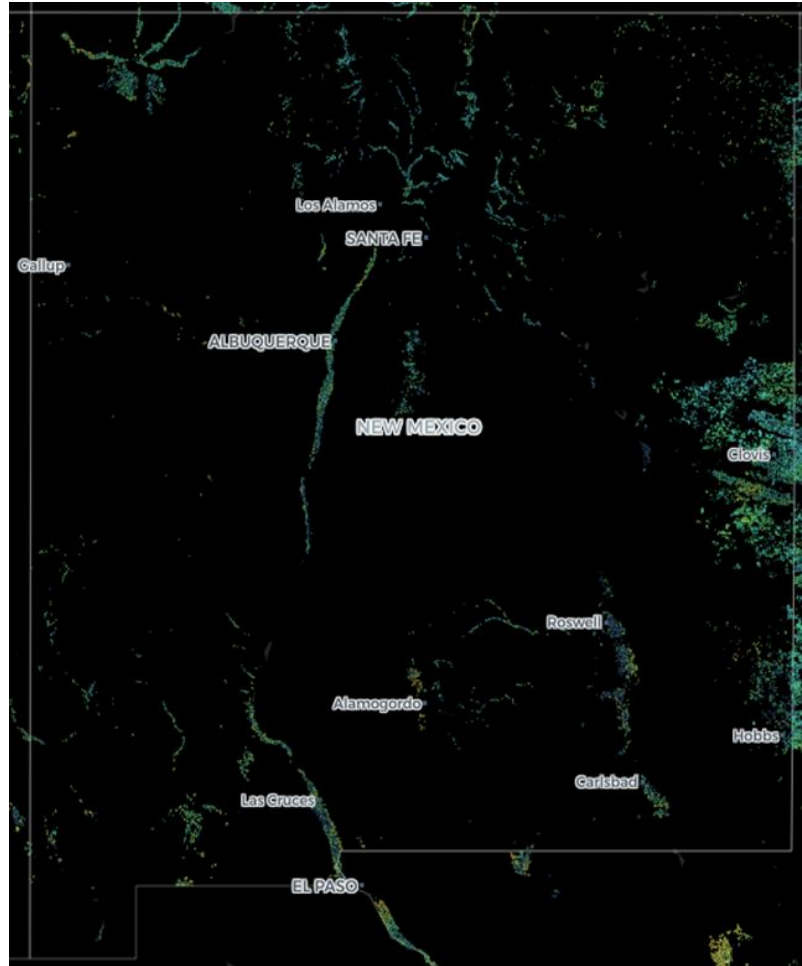


High Plains Aquifer

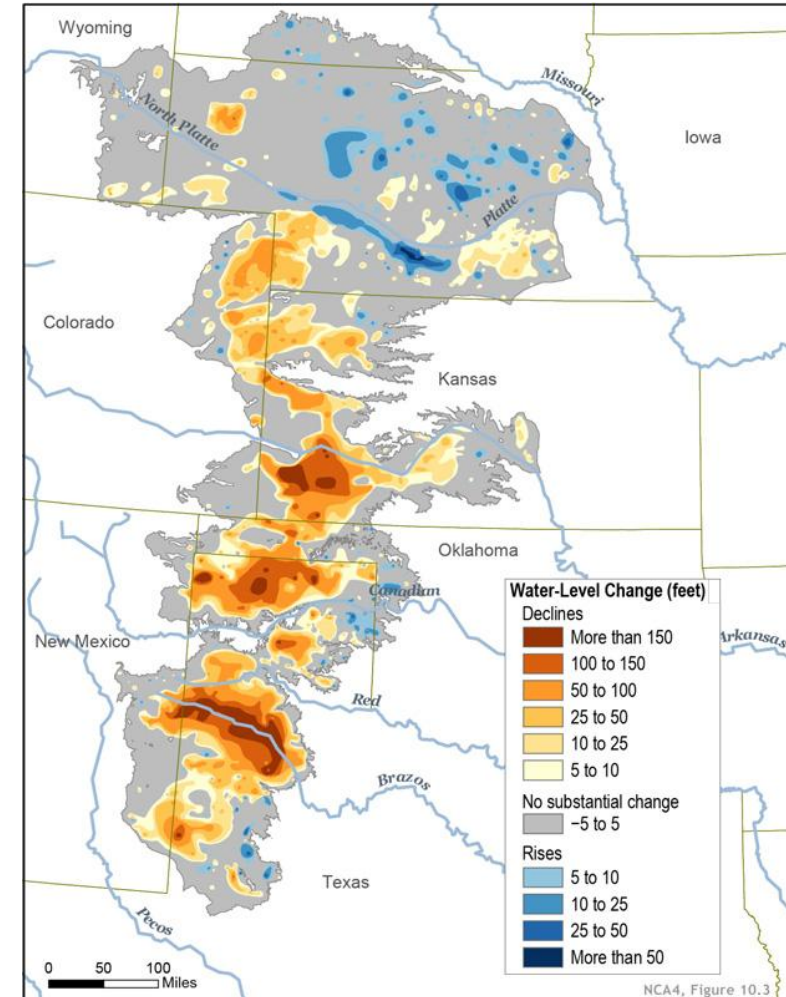
Principal Aquifers and Major Rivers



Evapotranspiration (ET) Rates

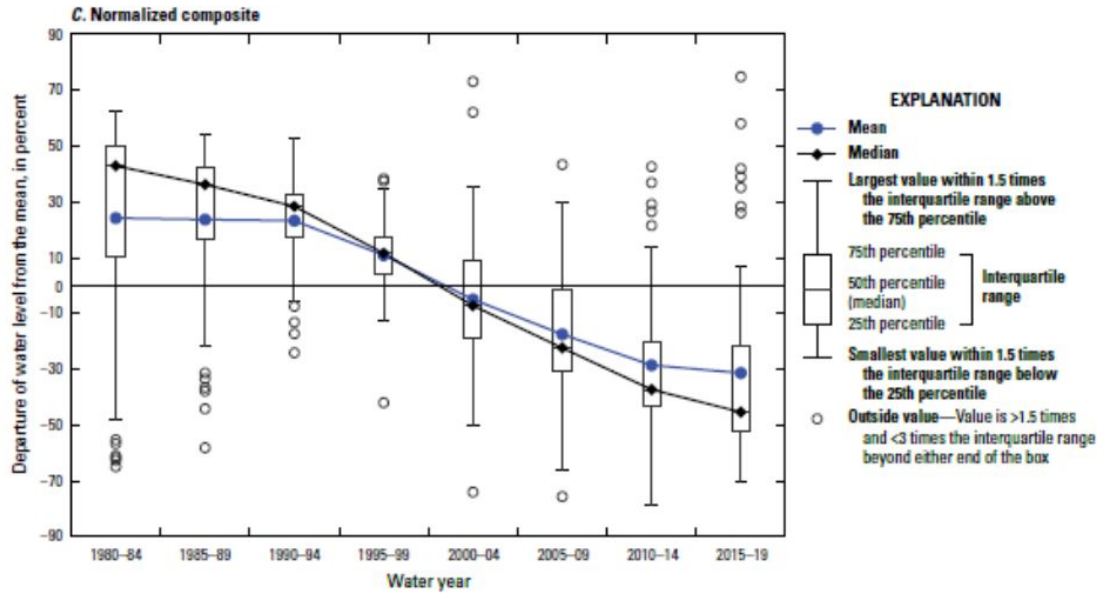


Groundwater declines pre-dev. - 2015

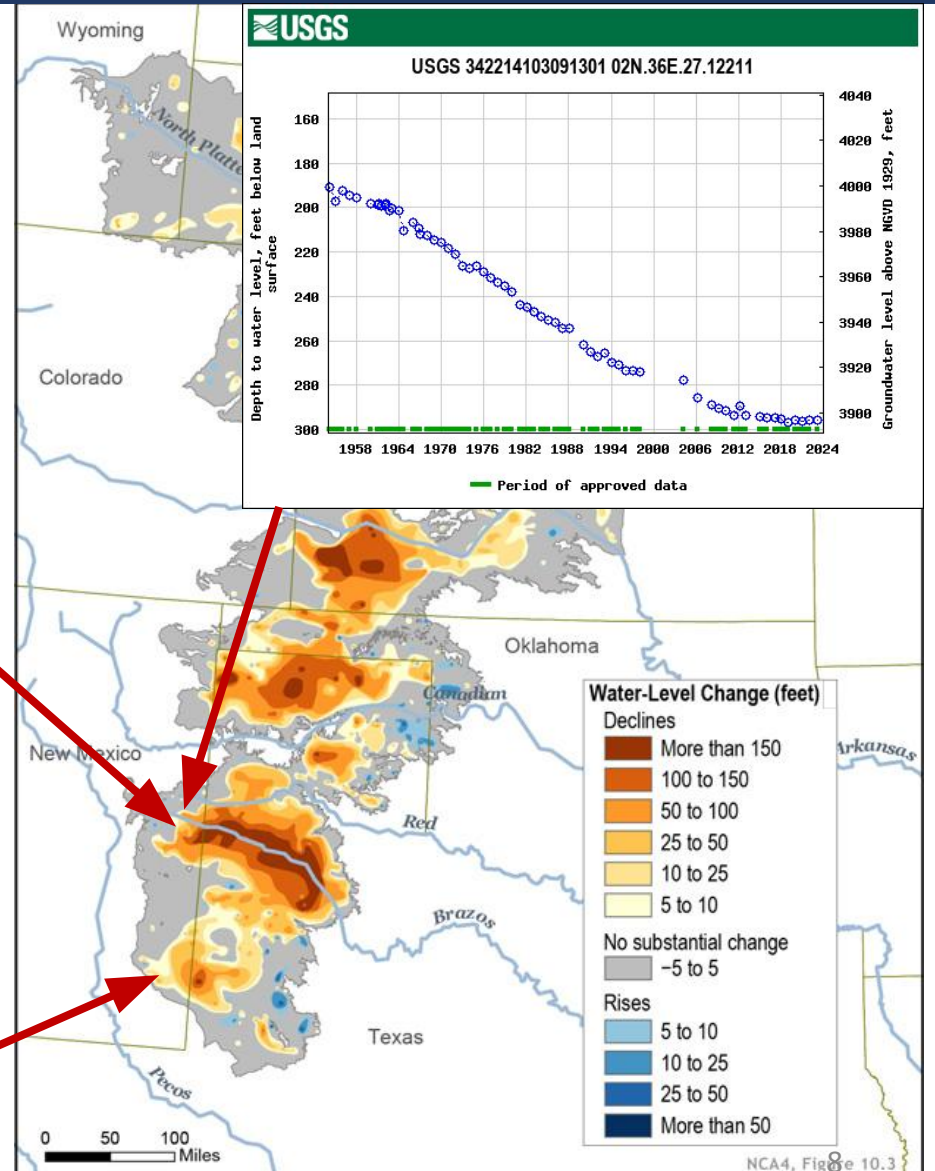
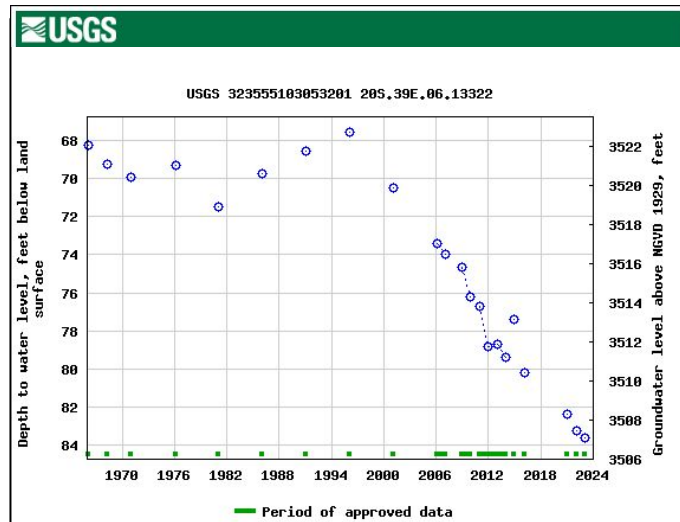


Left: Principal Aquifers (Myers, 2022) and Major Rivers in New Mexico; Middle: OPENET map of ET rates, Right: McGuire (2017) Water-level and recoverable water in storage changes, High Plains aquifer, predevelopment to 2015 and 2013–15: U.S. Geological Survey Scientific Investigations Report 2017–5040, 14 p., <https://doi.org/10.3133/sir20175040>

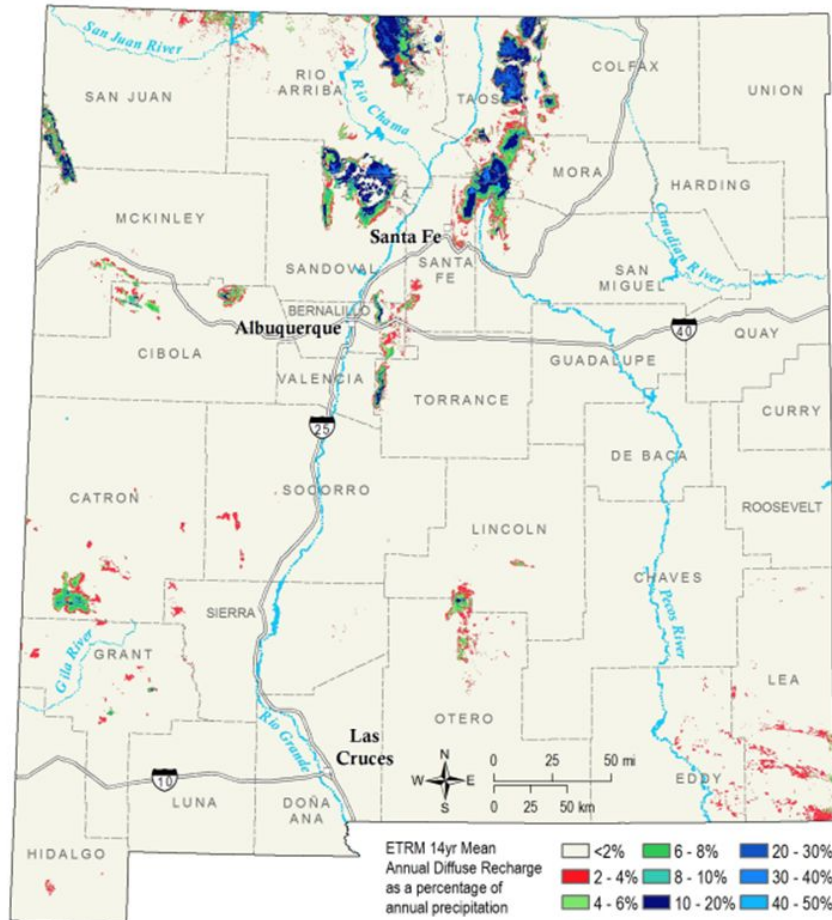
High Plains Aquifer



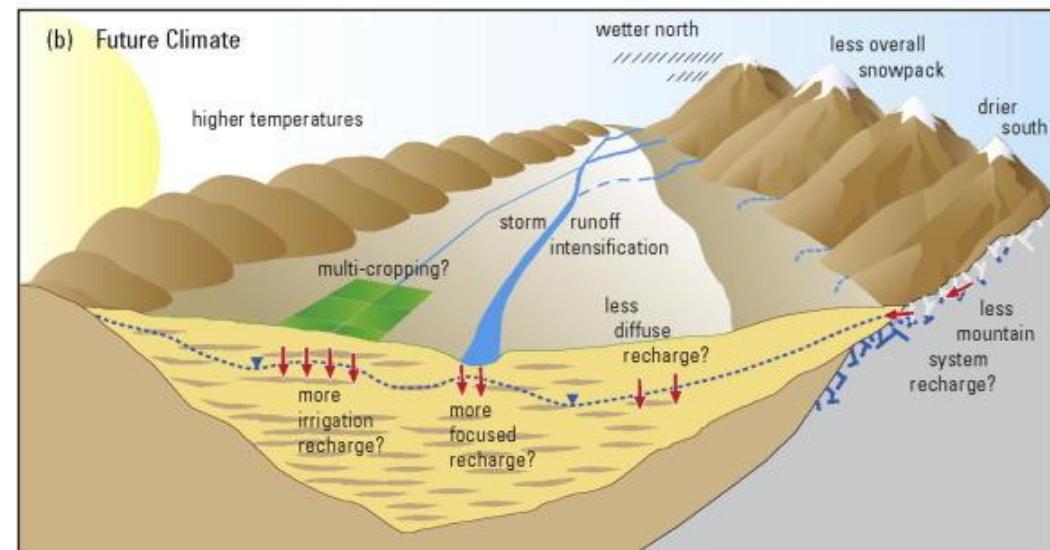
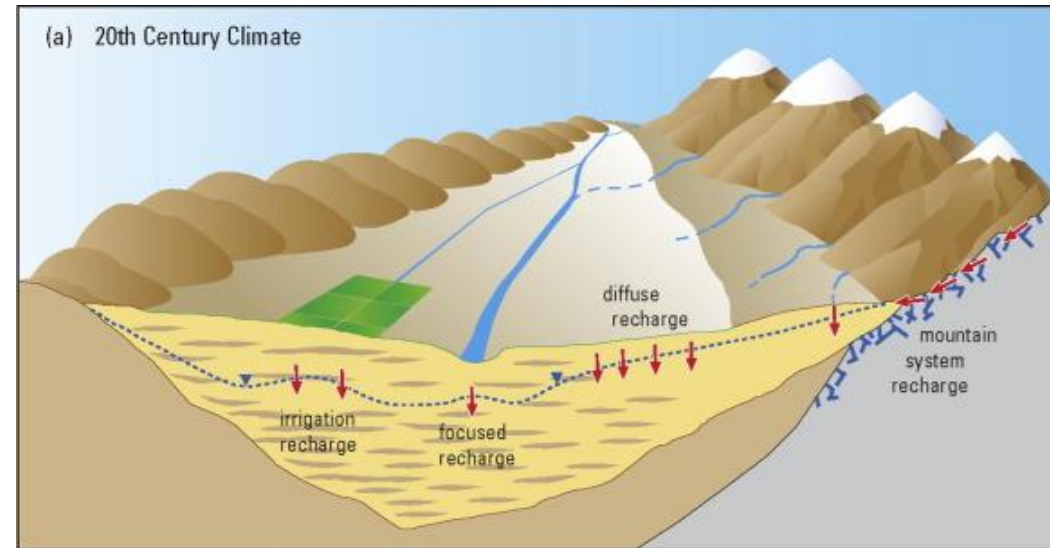
- First declared in the 1930s
- ~22% of irrigation water use
- High Plains Aquifer Closure in 2009
- No new appropriations
- Critical Management Areas (CMAs)



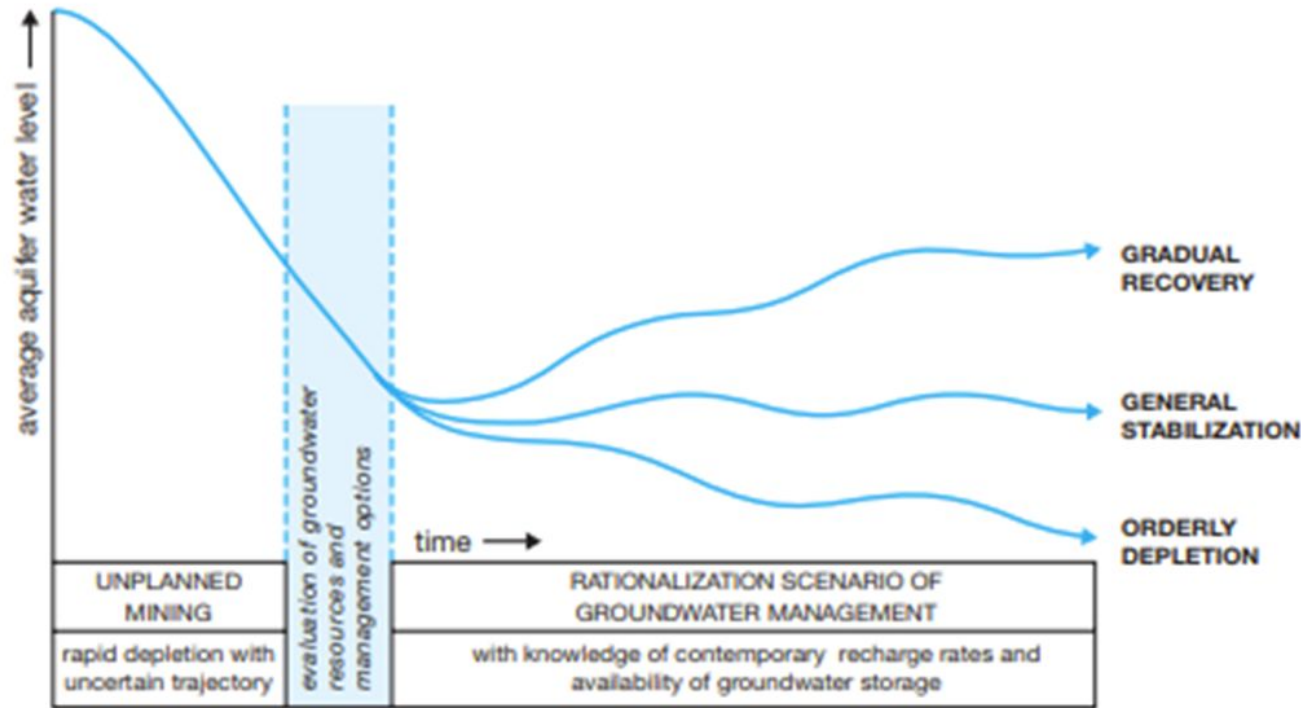
Aquifer recharge in a changing climate



The above map show modeled average annual diffuse recharge between 2001 and 2014. Little-to-no recharge occurs in much of the state. Most of the recharge occurs in the high mountains where precipitation rates are higher and average temperatures are lower.

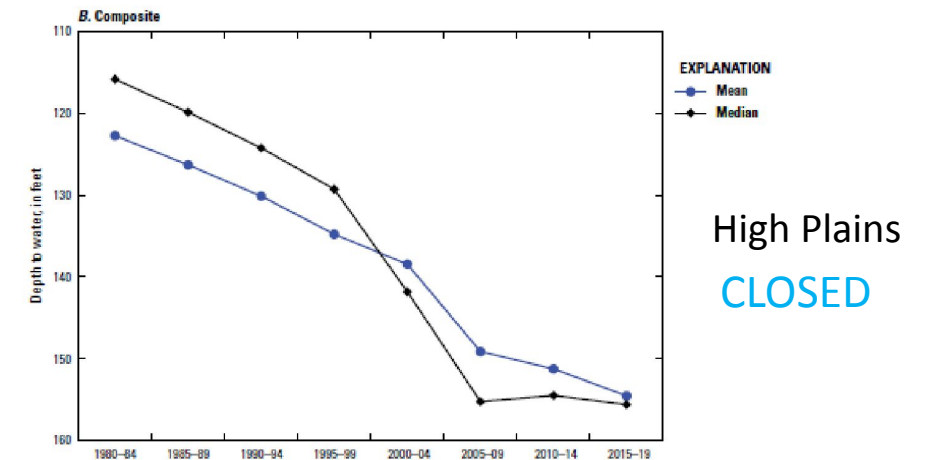
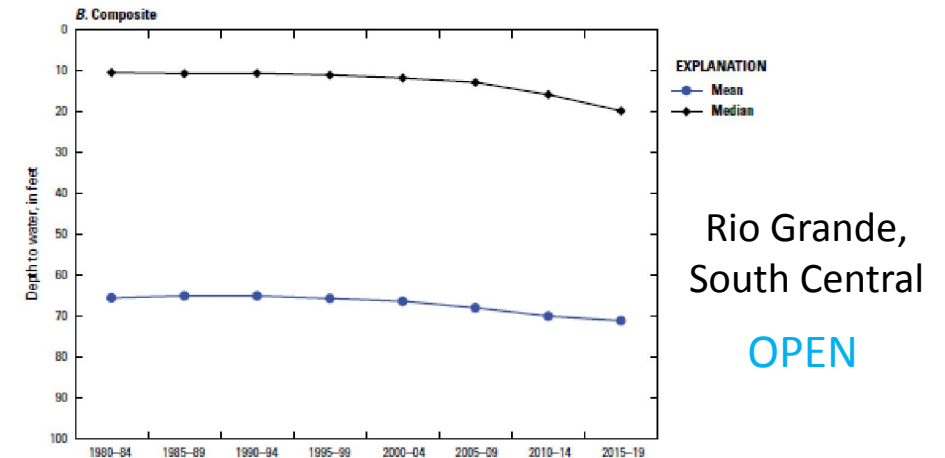
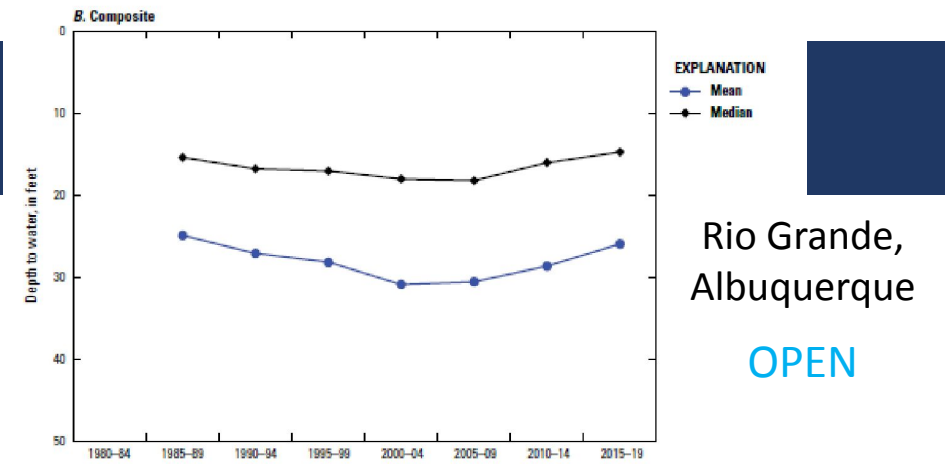


Water management in mined basins



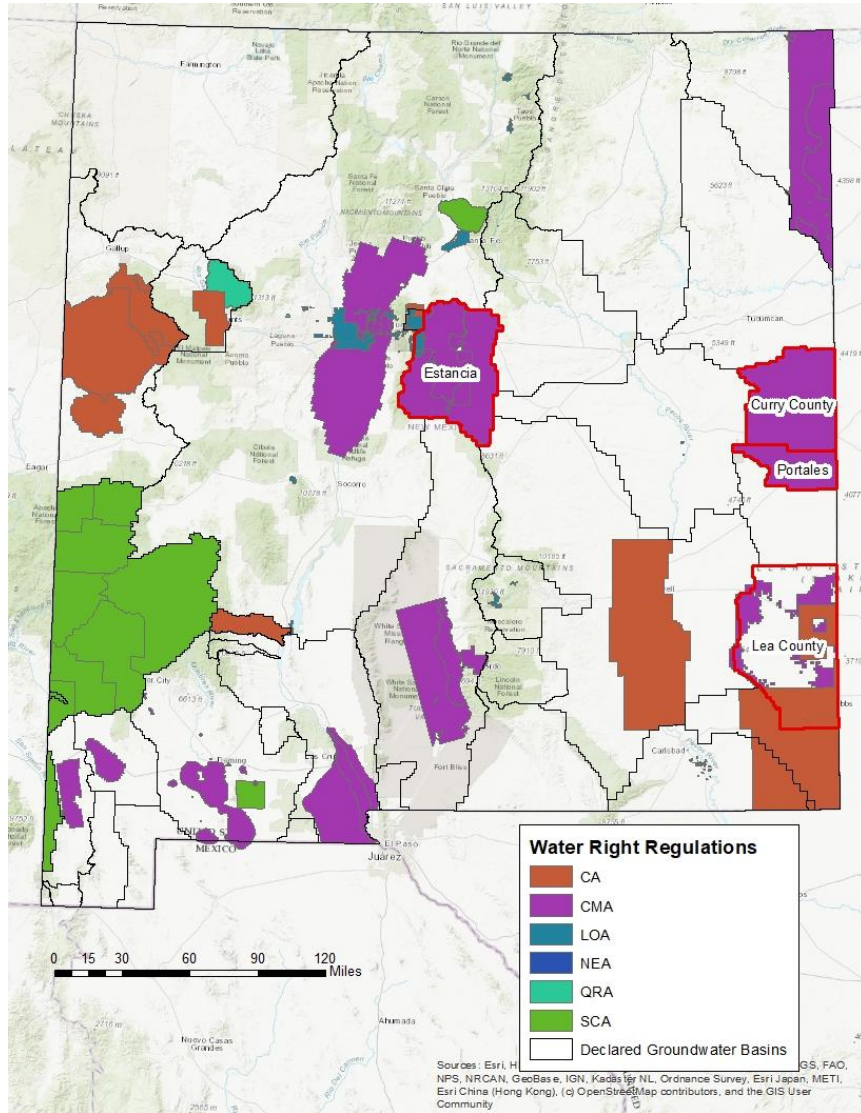
Targets for groundwater resource management in 'rationalization scenarios' for indiscriminate and excessive exploitation

(Left: <https://documents1.worldbank.org/curated/en/621881468137375750/pdf/301010PAPER0BN11.pdf>, Right: Myers (2022))

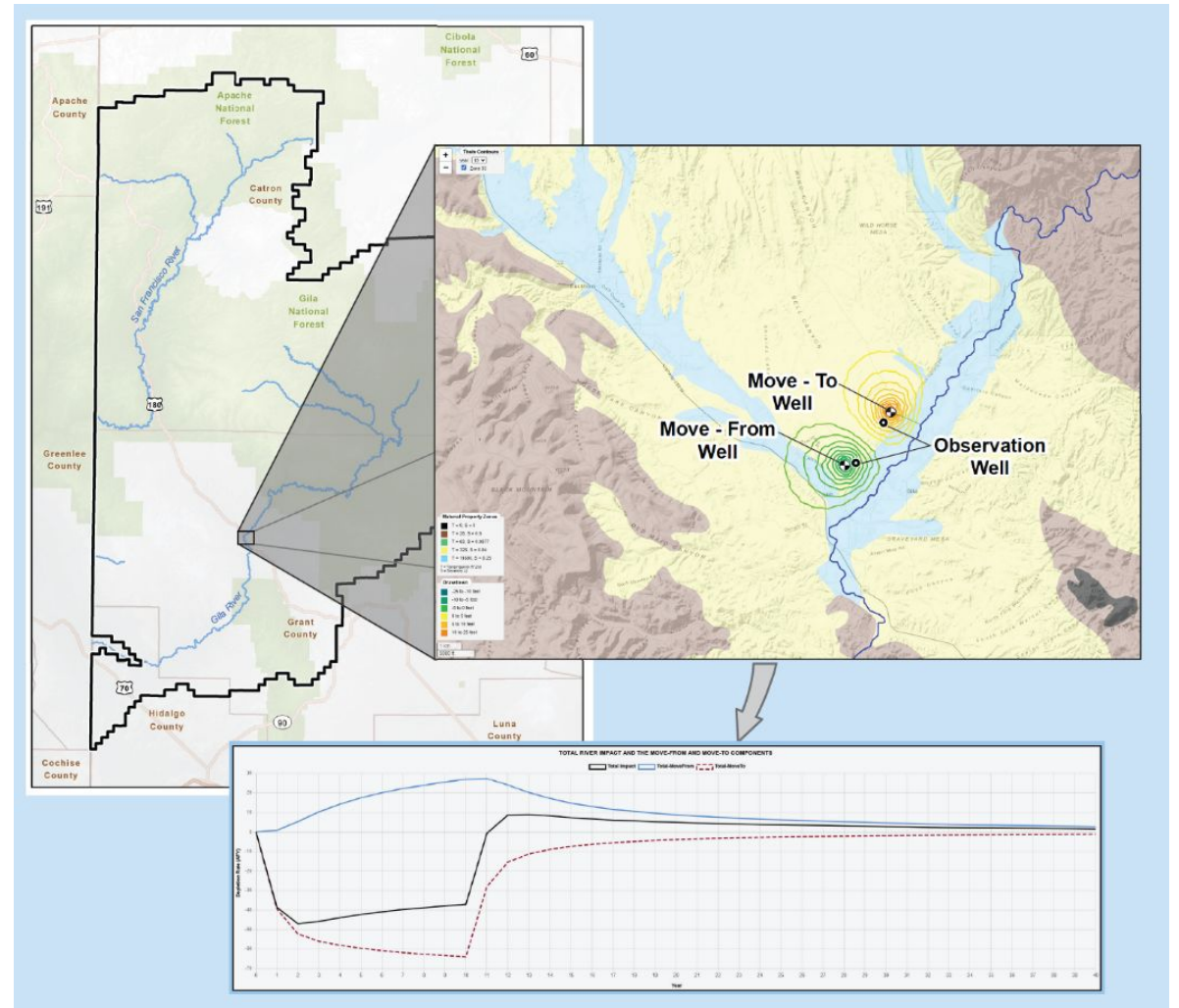


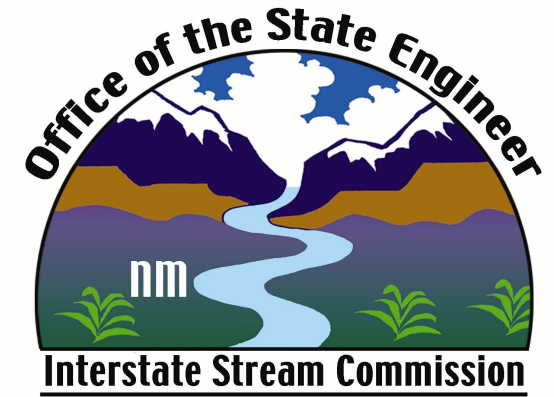
Modeling tools

Numerical Models



Analytical Models





Thank you

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