



Effects of drought on groundwater in Texas:

Water level and spring flow data analysis of current and historic drought conditions



Texas Groundwater Protection Committee Meeting
July 13, 2022



Causes and impacts of drought

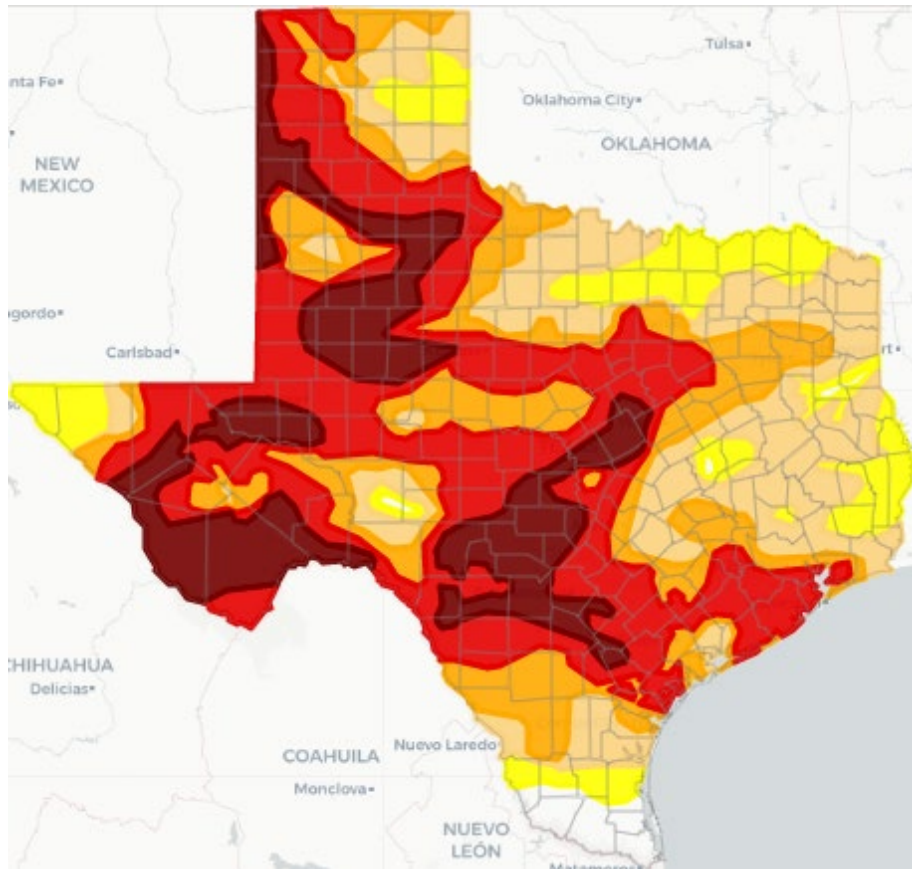
- El Niño-Southern Oscillation (ENSO) and La Niña
- Warmer temperatures → increased evaporation
- Variable precipitation → decreased recharge
- Dwindling surface water supplies
- More reliance on groundwater
- Declines in groundwater levels
- Stressed vegetation and crops



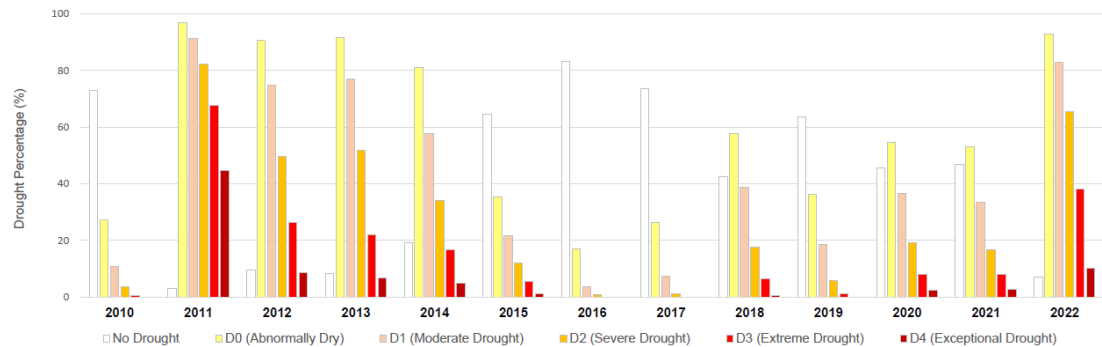
Previous droughts

- 1950 to 1957
 - Most significant drought recorded since 1895
 - 77 months
- 2010 to 2014
 - 2nd worst and longest statewide drought on record
 - 51 months
 - 2011 worst one-year drought on record
- Evidence of more severe megadroughts from tree-ring data
- Local scale droughts since 2014

Current drought



Annual Averages for State Wide Drought Conditions



Map Date: 2022-07-05

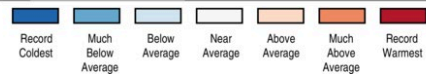
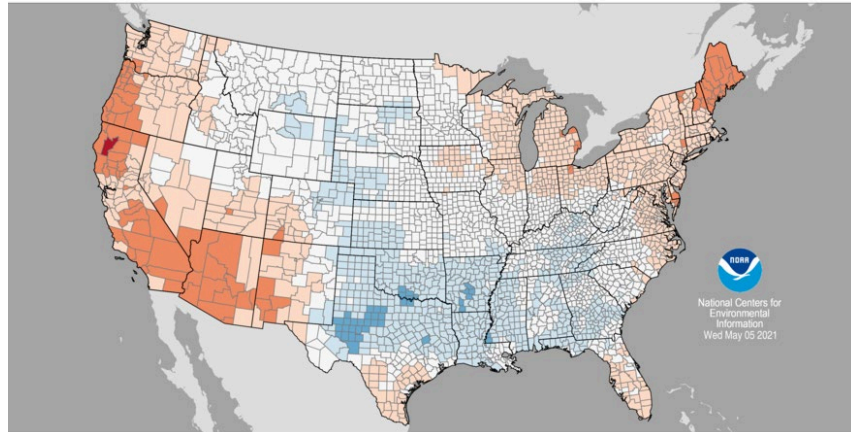
Texas

- None: 2.47%
- D0+: 97.53%
- D1+: 86.79%
- D2+: 66.05%
- D3+: 45.91%
- D4: 16.11%



County Average Temperature Ranks

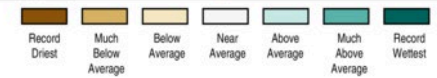
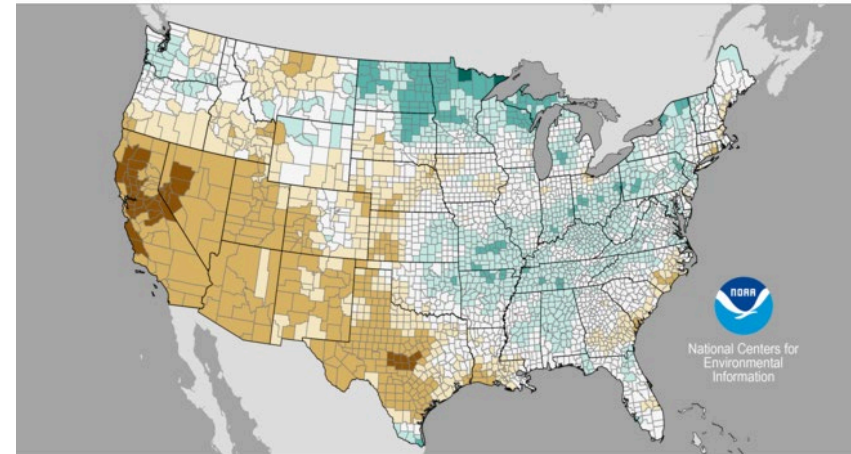
April 2021
Period: 1895-2021



National Centers for Environmental Information
Wed May 05 2021

County Precipitation Ranks

January-May 2022
Period: 1895-2022



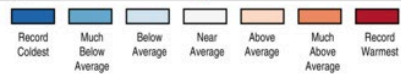
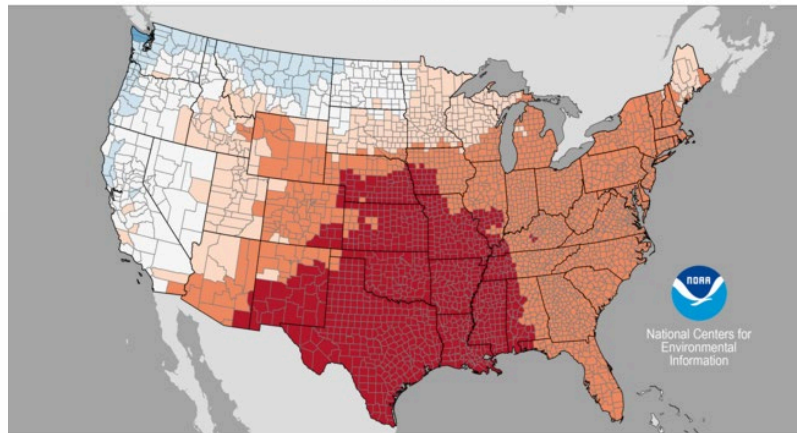
National Centers for Environmental Information

Tue Jun 07 2022

Data Source: nClimGrid

County Average Temperature Ranks

December 2021
Period: 1895-2021



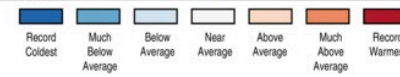
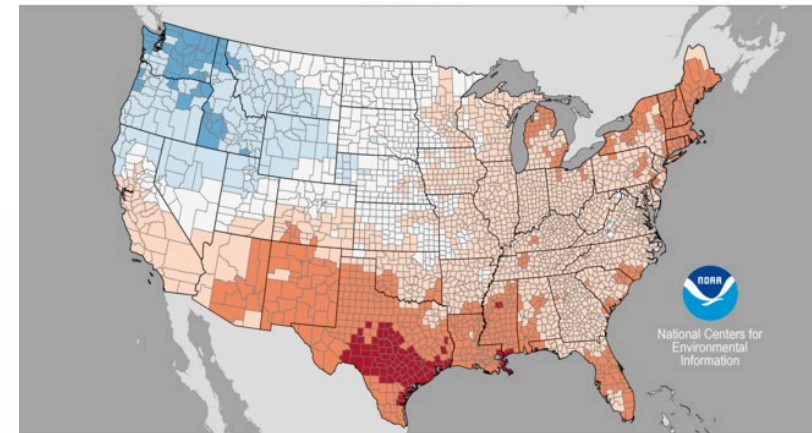
National Centers for Environmental Information

Sat Jan 08 2022

Data Source: nClimGrid

County Average Temperature Ranks

May 2022
Period: 1895-2022



National Centers for Environmental Information

Tue Jun 07 2022

Data Source: nClimGrid



Groundwater response to drought

Observations

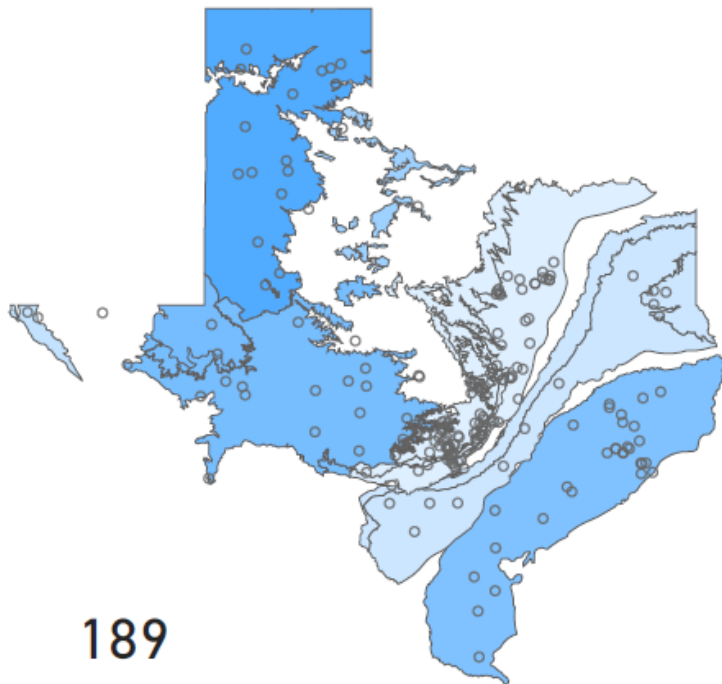
- Water level elevations
- Spring discharge
- Correlation with periods of dry conditions
- Impacts appear on variable timescales

Tools

- Drought indicator recorder wells and springs
- [TWDB monthly Texas Water Conditions Report](#)
- Average water level changes
- Hydrographs
- Well drilling counts



Annual Change by Aquifer



189

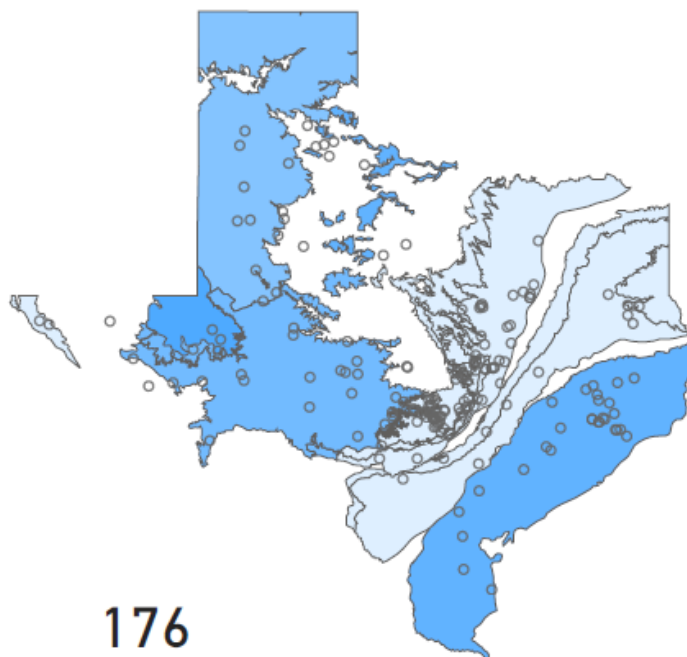
Reporting wells

06/30/2022

Reference Date

Data from [TWDB Groundwater Database](#). Difference in average monthly water levels for active recorder wells averaged by aquifer. Publishable results only. The number and locations of wells active over the relevant time periods are shown in each panel. Local groundwater conditions may vary from the average values indicated.

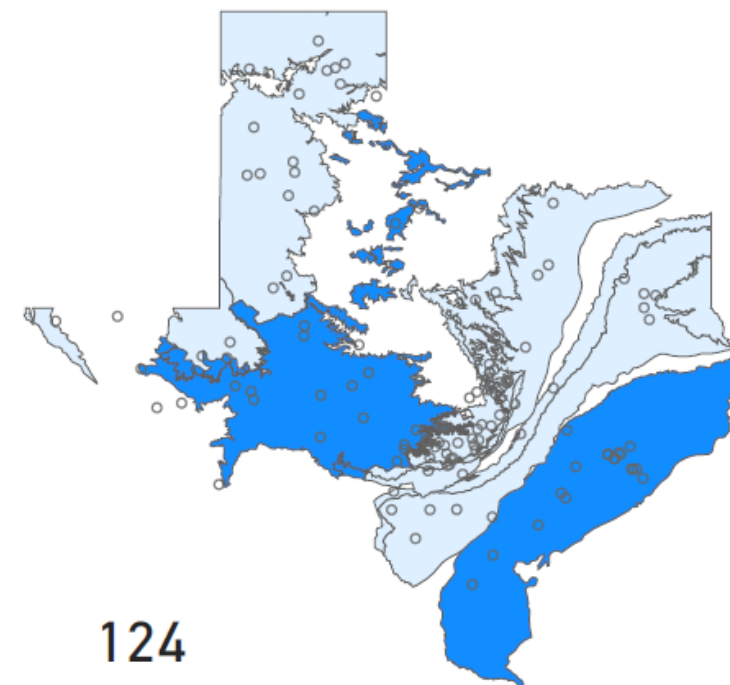
Five Year Change by Aquifer



176

Reporting wells

Ten Year Change by Aquifer



124

Reporting wells

Aquifer	Quarterly change	Annual change	5 year change	10 year change
CARRIZO	-7.80	-8.69	-17.00	-21.52
EDWARDS	-8.05	-10.30	-19.12	-2.58
EDWARDS-TRINITY	-1.50	-2.48	-2.07	0.10
GULF_COAST	-4.89	-3.14	-0.89	5.34
HUECO_BOLSON	-9.98	-7.97	-13.09	-8.26
OGALLALA	-0.49	0.29	-3.39	-4.38
PECOS VALLEY	-1.94	-2.40	0.51	-2.46
SEYMOUR	-1.06	-5.35	-0.85	1.15
TRINITY	-13.11	-15.92	-24.92	-8.47

249

Total active recorder wells

104

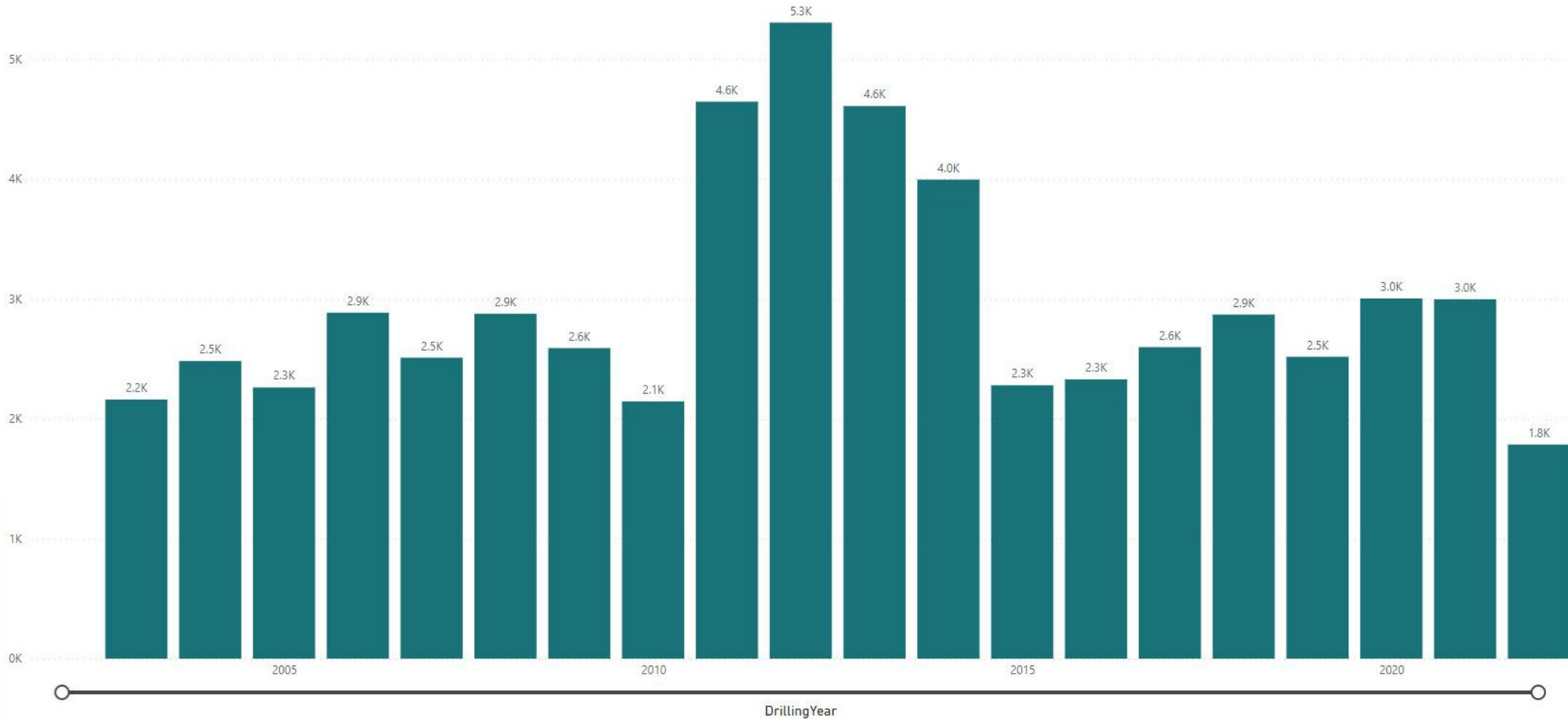
Counties represented

Well Drilling Activity – New Irrigation

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NUMBER OF WELLS DRILLED BY YEAR AND PROPOSED USE

ProposedUse ● Irrigation

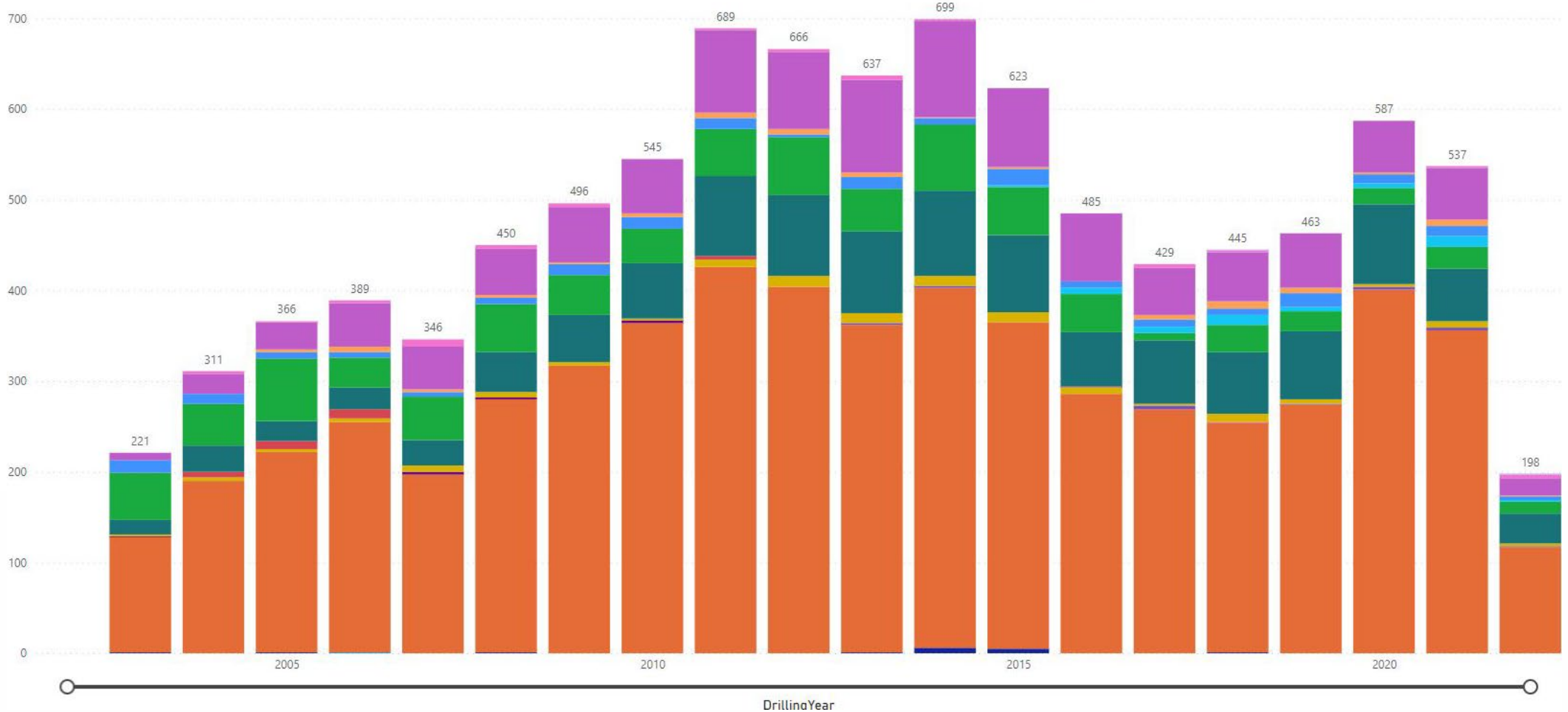


Well Drilling Activity – Replacement

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NUMBER OF WELLS DRILLED BY YEAR AND PROPOSED USE

Proposed Use: Closed-Loop Geothermal, De-watering, Domestic, Environmental Soil Boring, Extraction, Fracking Supply, Industrial, Injection, Irrigation, Monitor, Other, Public Supply, Rig Supply, Stock, Test Well, Unknown

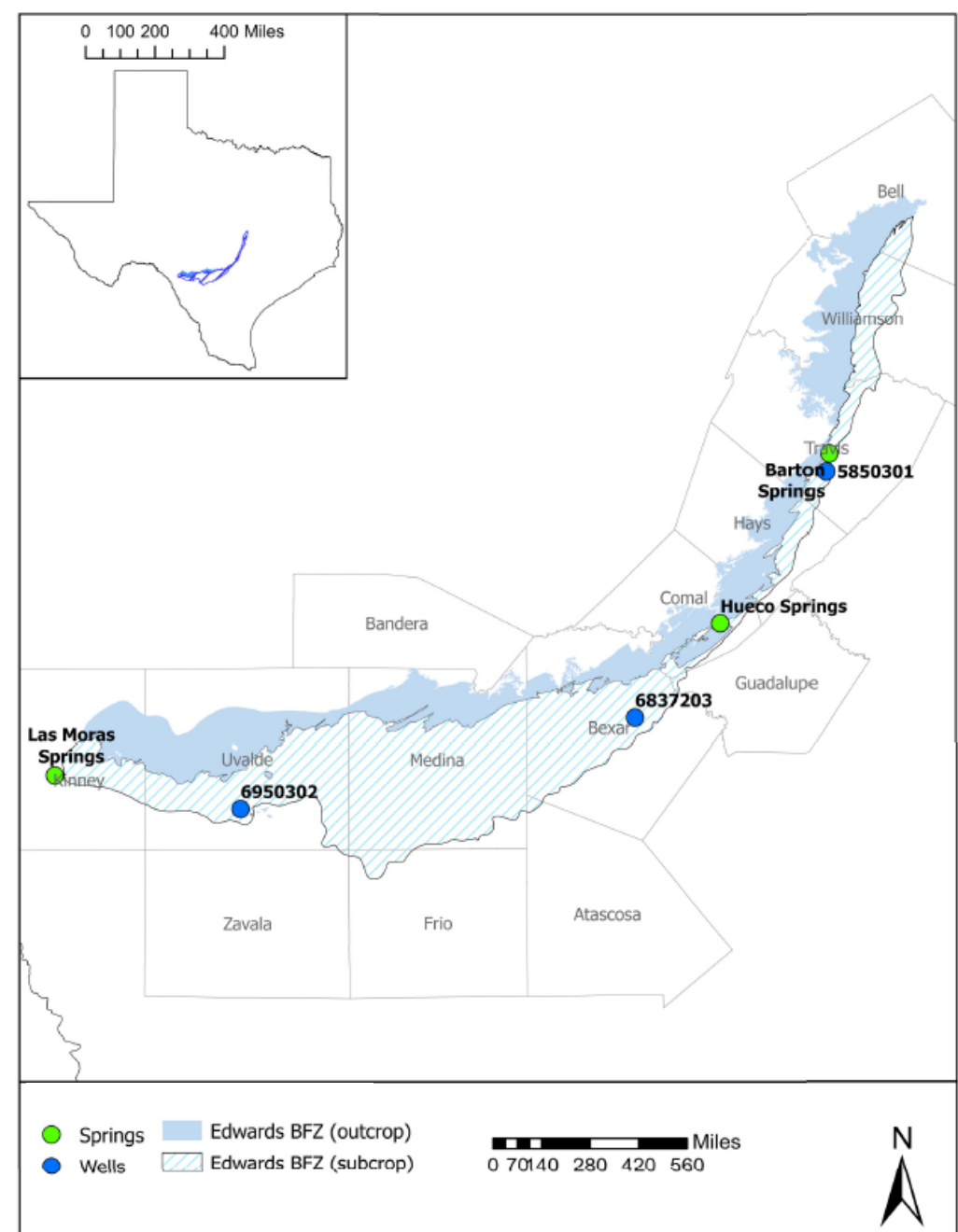




Assessing drought in water level data

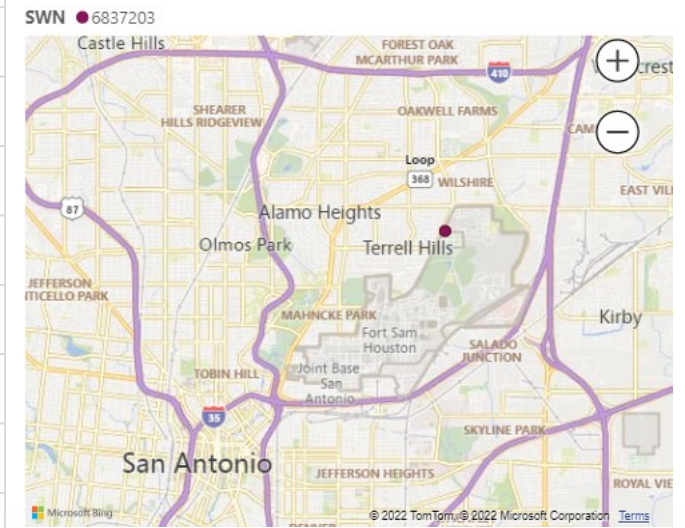
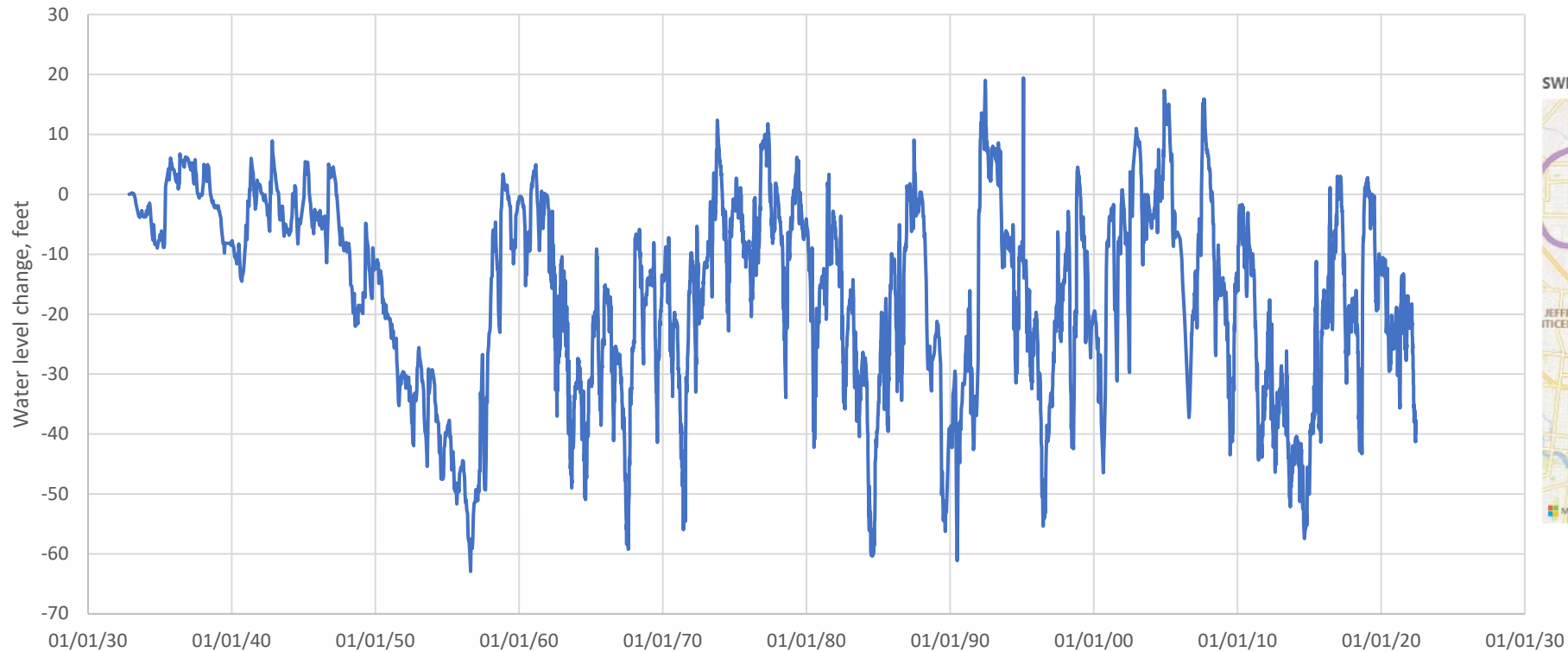
- Variable response across aquifers and individual wells
- Areas of known exceptional or extreme drought conditions
- Aquifers susceptible to drought
- Aquifers that reflect changing conditions quickly
- Wells with long, consistent water level records
- Recorder well data
- Spring discharge data

Edwards (Balcones Fault Zone) Aquifer



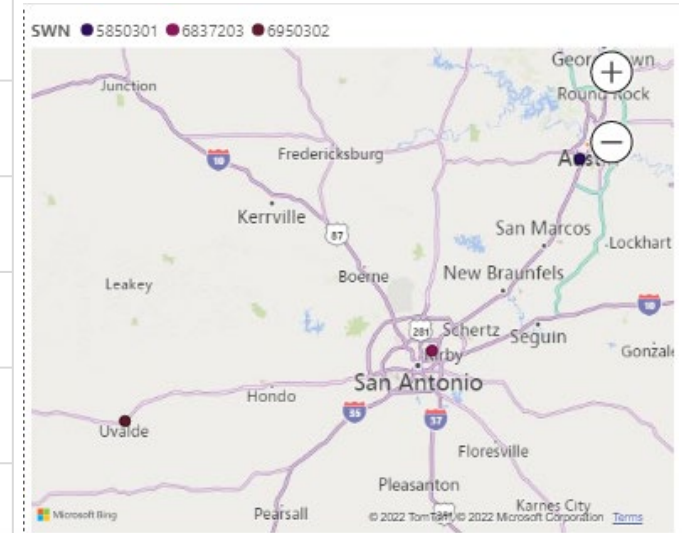
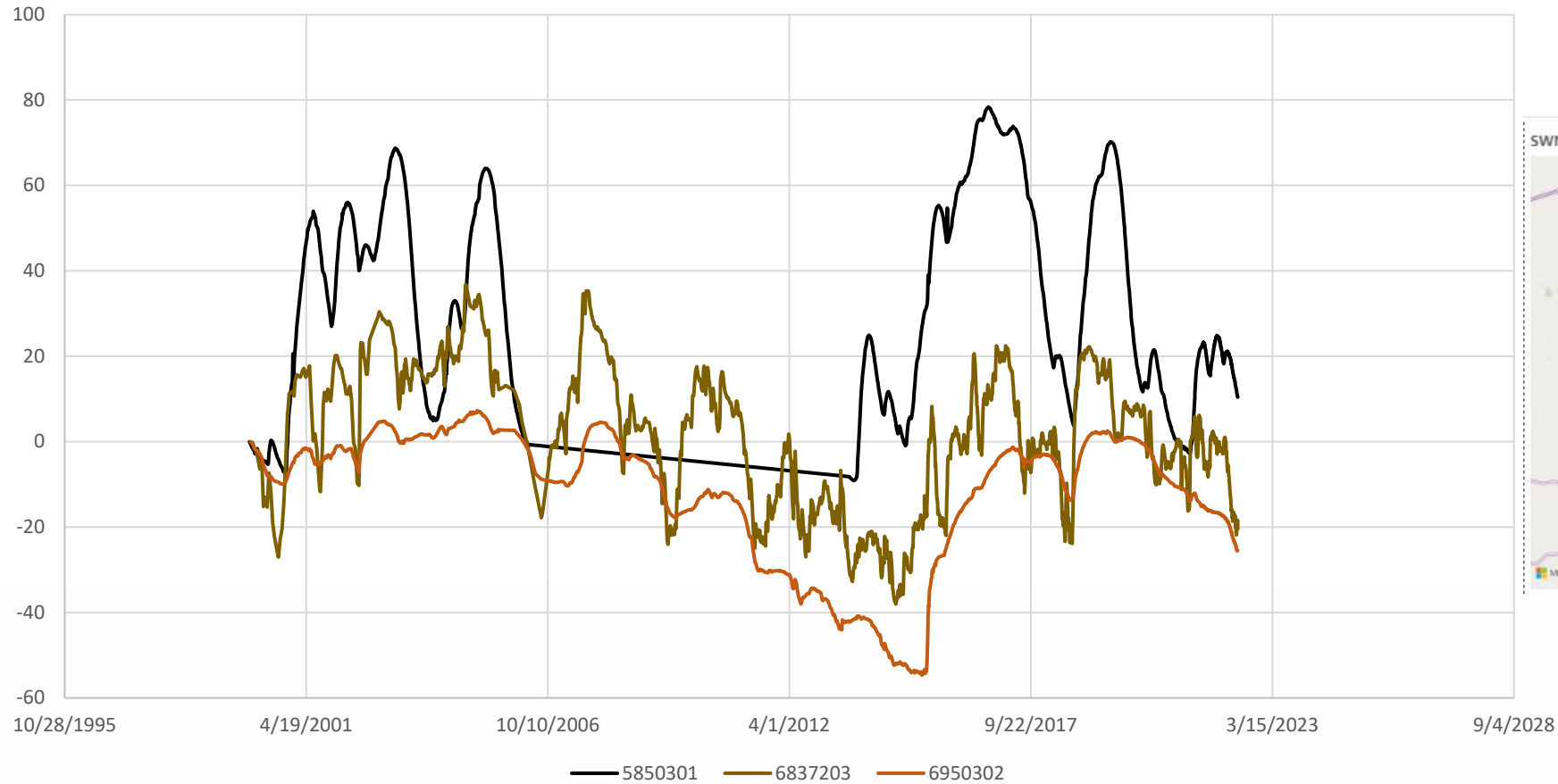
Edwards (Balcones Fault Zone) Aquifer

J-17 Well (6837203) period of record in Bexar County

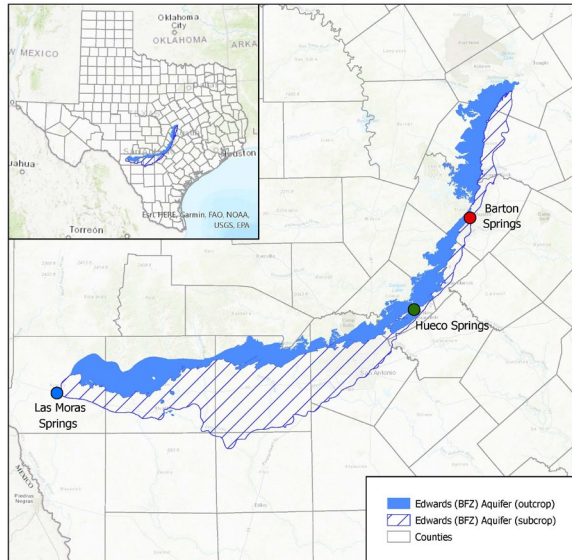


Edwards (Balcones Fault Zone) Aquifer

Water level changes since 2000 in Bexar, Travis and Uvalde counties

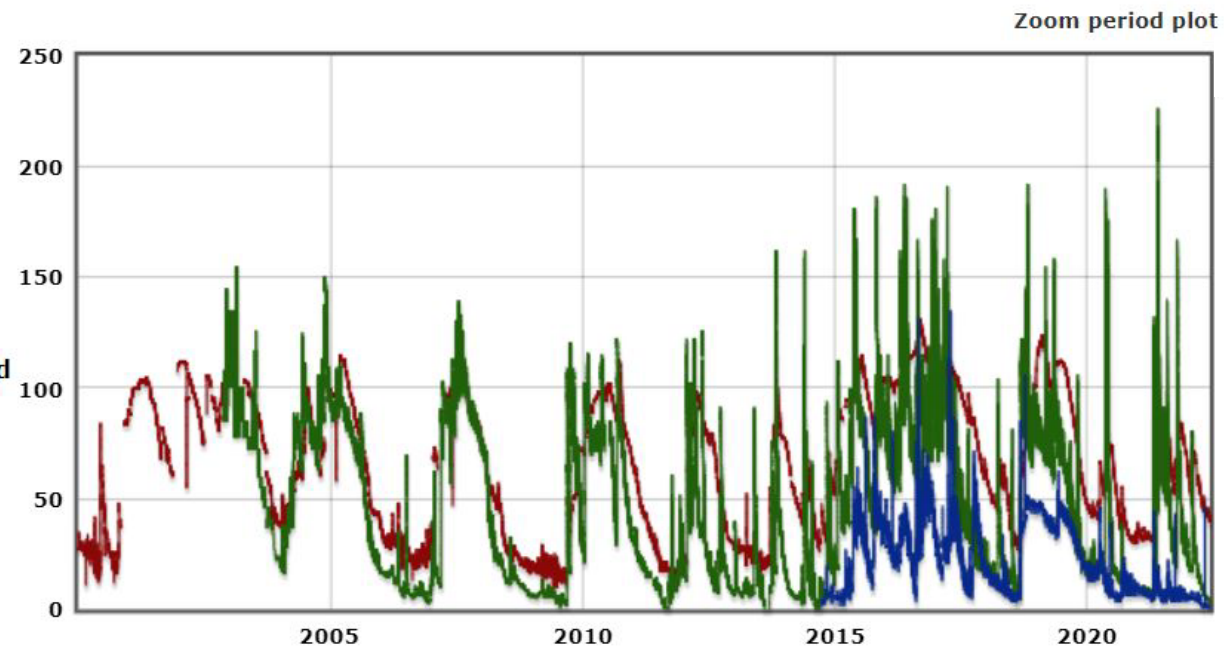


Edwards (Balcones Fault Zone) Aquifer



USGS 08155500 Barton Spgs at Austin, TX
USGS 08168000 Hueco Spgs nr New Braunfels, TX
USGS 08456310 Las Moras Spgs Dws of pool at Brackettville, TX

Discharge, cubic feet per second



Explanation

- 71.6 **USGS 08155500**
- Measured discharge**
- 80.5 **USGS 08168000**
- Measured discharge**
- 38 **USGS 08456310**
- Measured discharge**

Edwards (Balcones Fault Zone) Aquifer

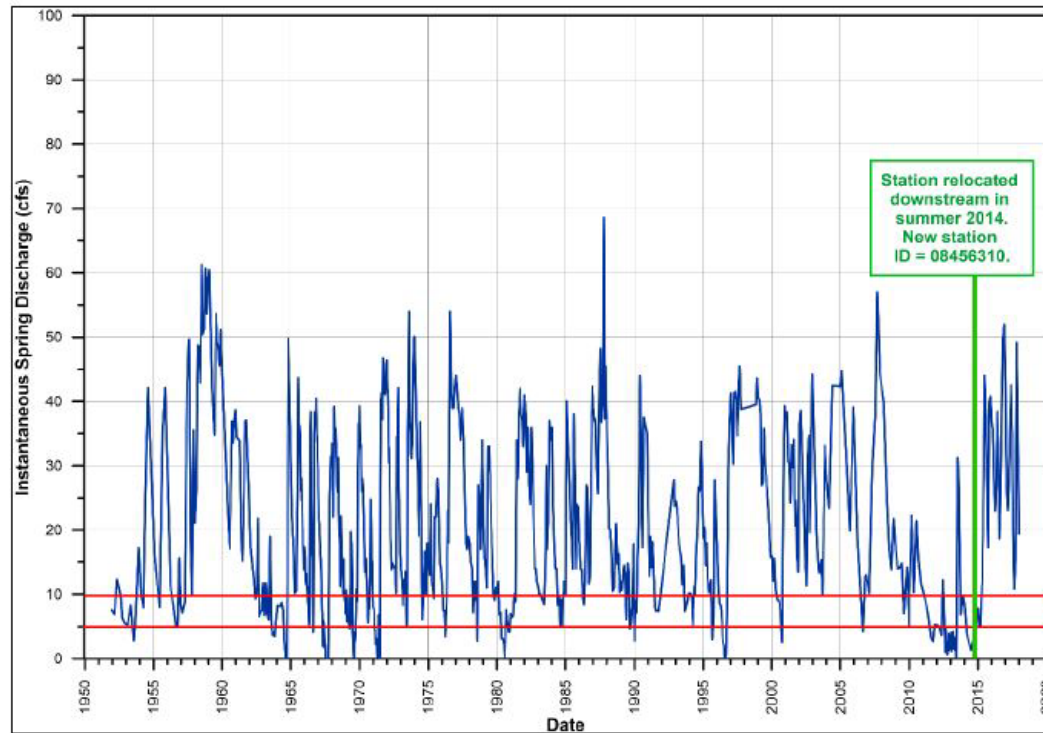
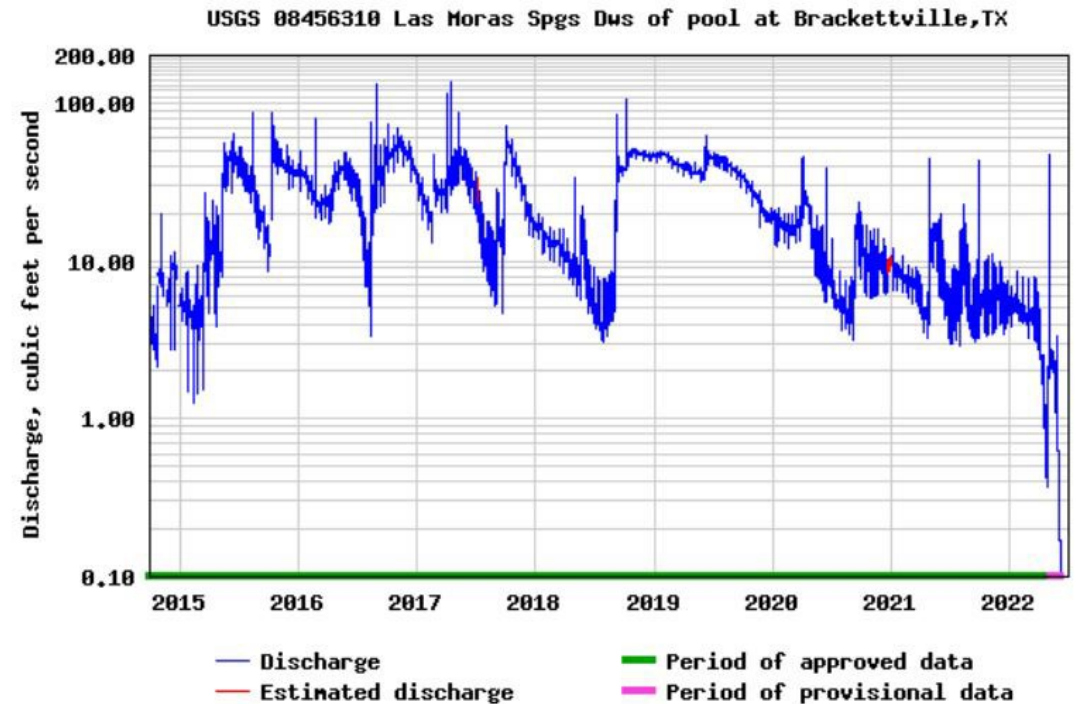


Figure 7-5. Historic Discharge Measurements at Las Moras Springs
Source: U.S. Geological Survey



Edwards (Balcones Fault Zone) Aquifer

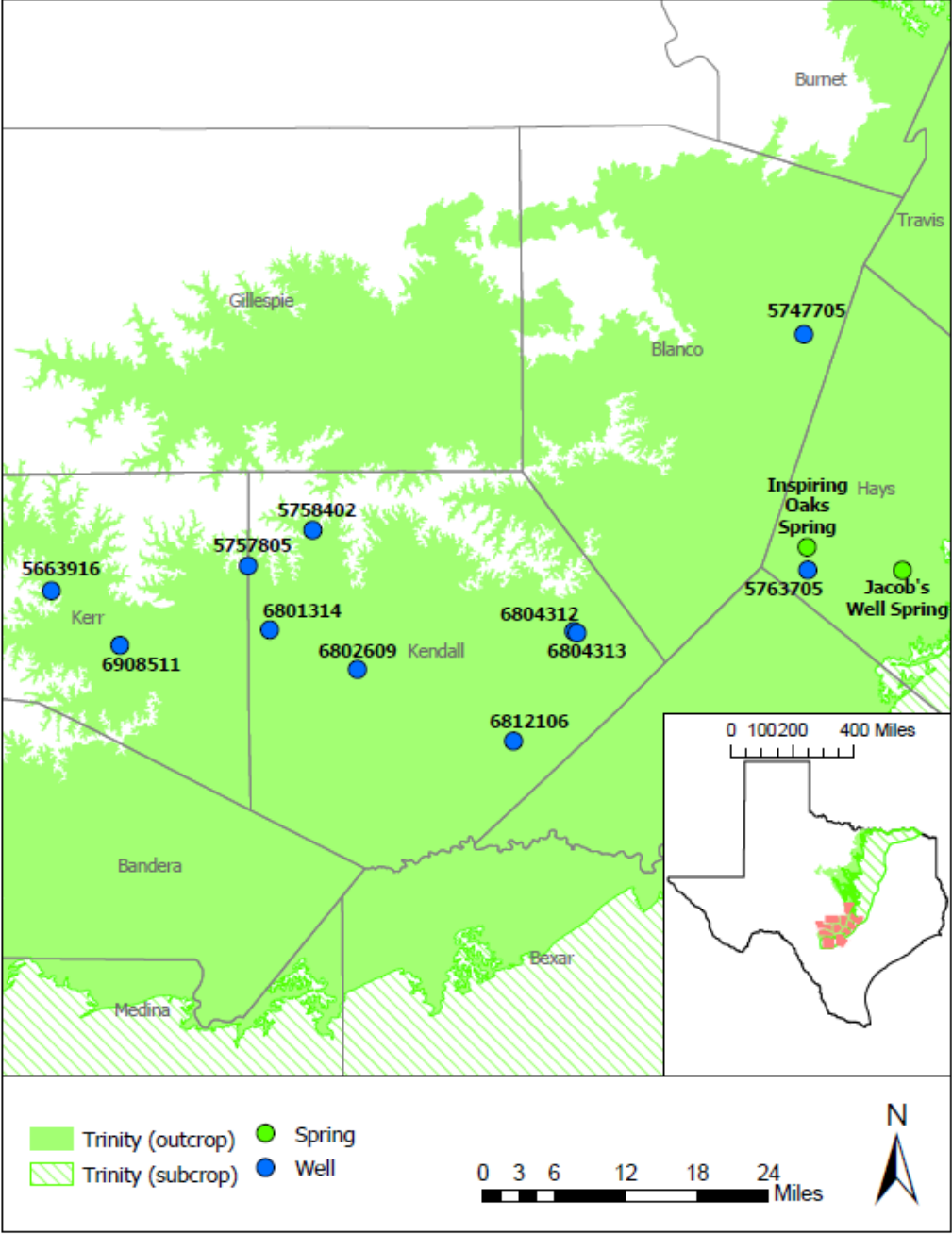


Las Moras Springs, April 2019



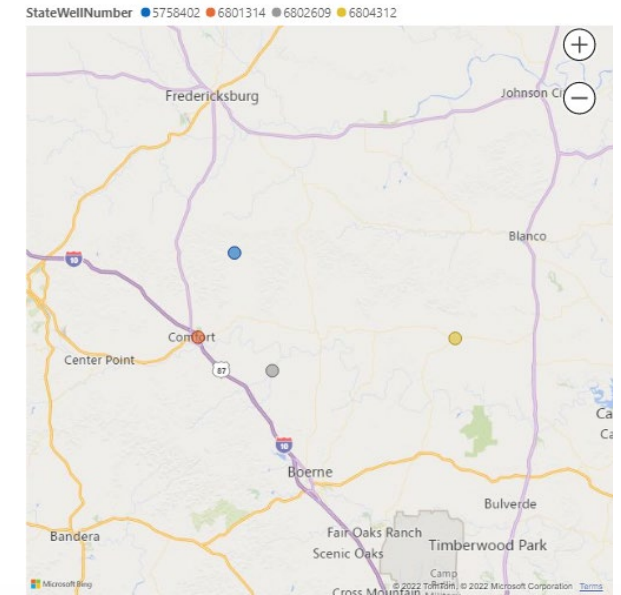
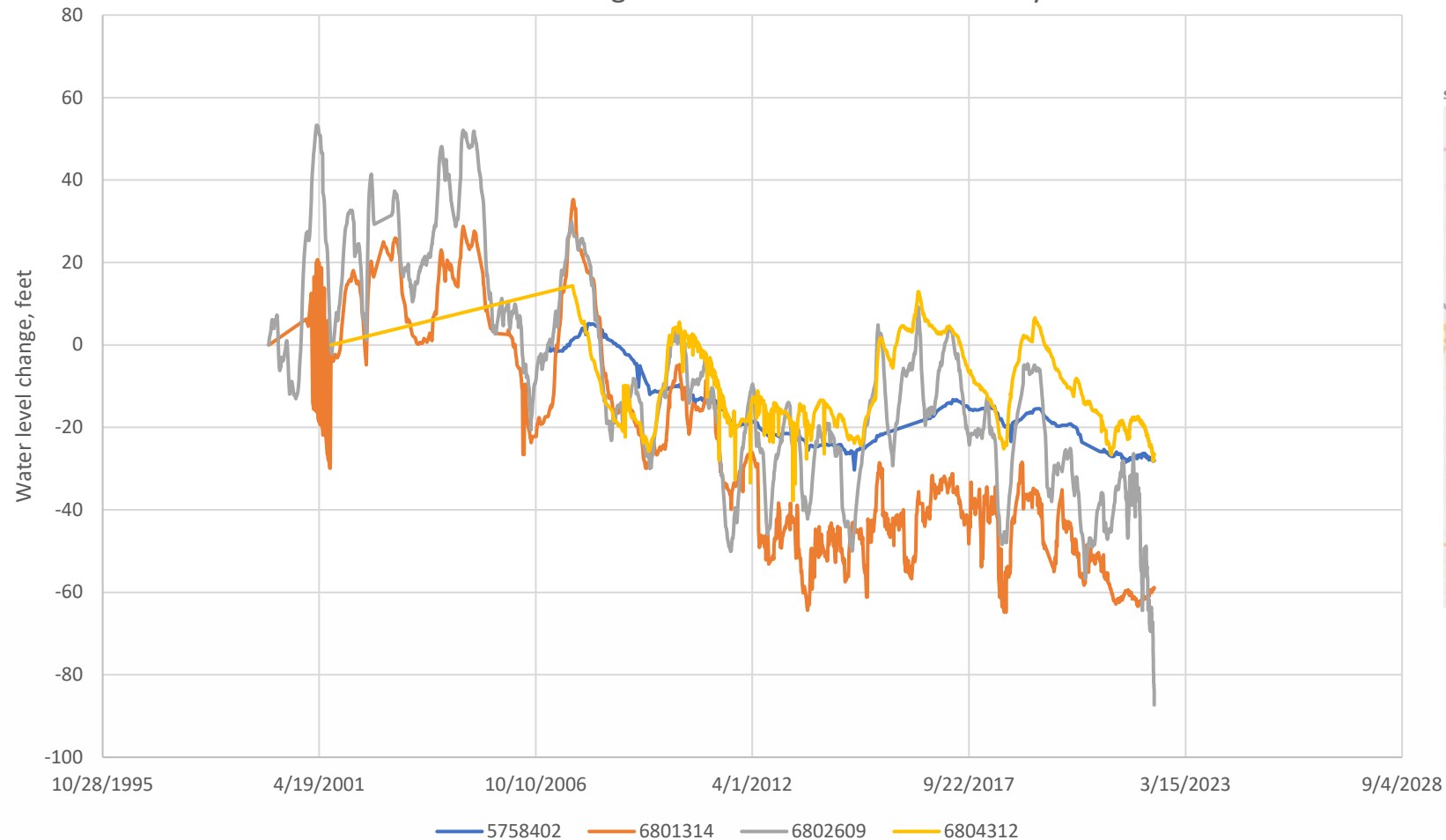
Las Moras Springs, June 2022

Southern Portion of the Trinity Aquifer



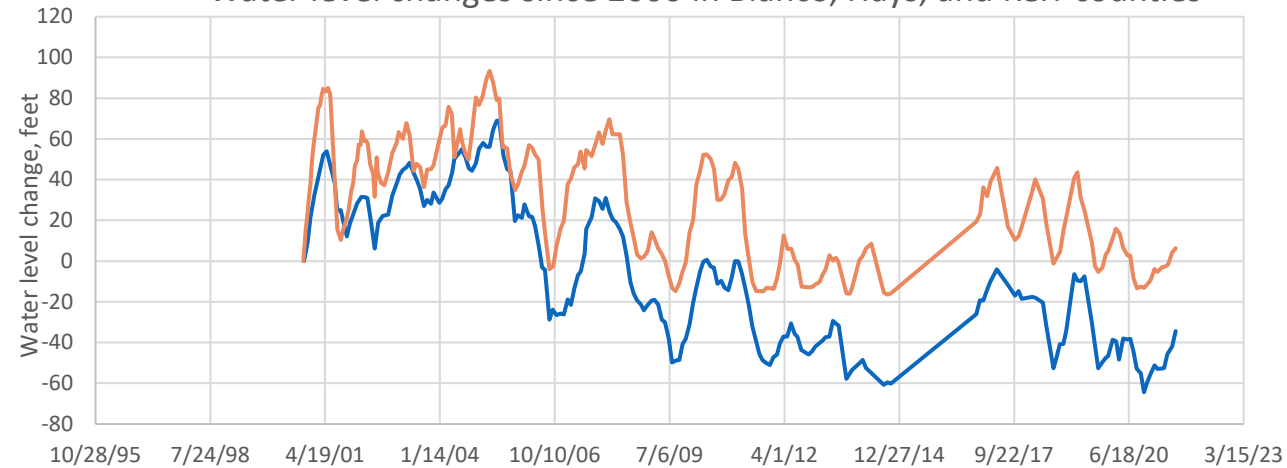
Southern Portion of the Trinity Aquifer

Water level changes since 2000 in Kendall County

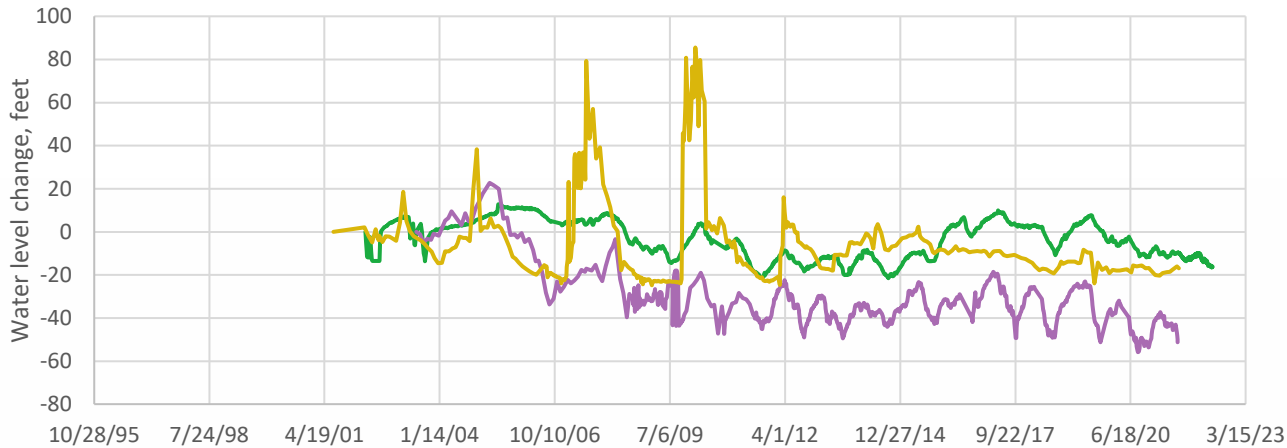


Southern Portion of the Trinity Aquifer

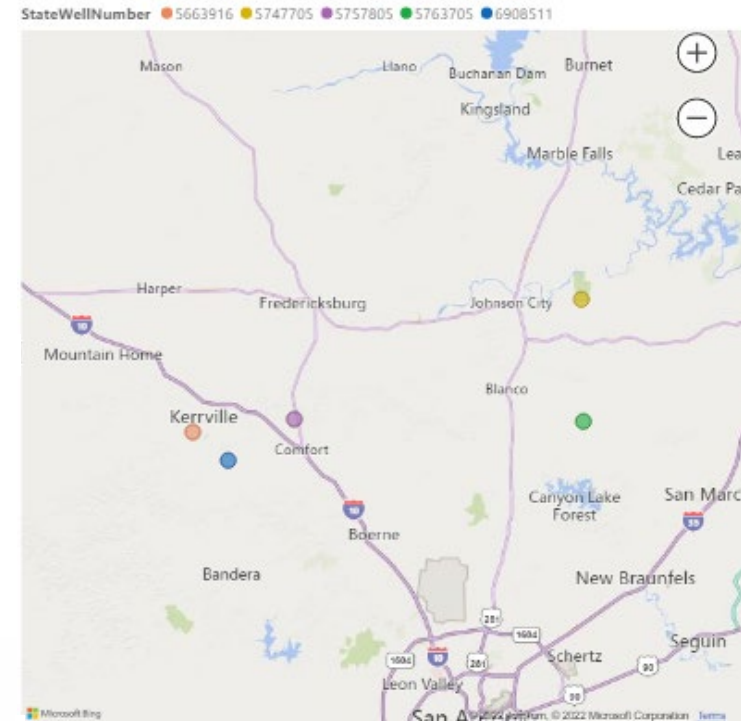
Water level changes since 2000 in Blanco, Hays, and Kerr counties



6908511 5663916

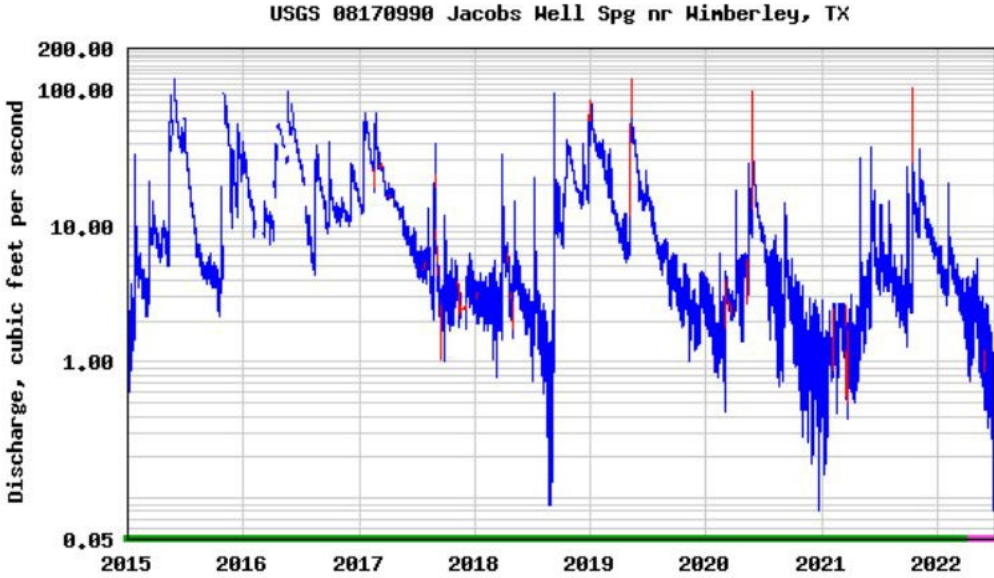
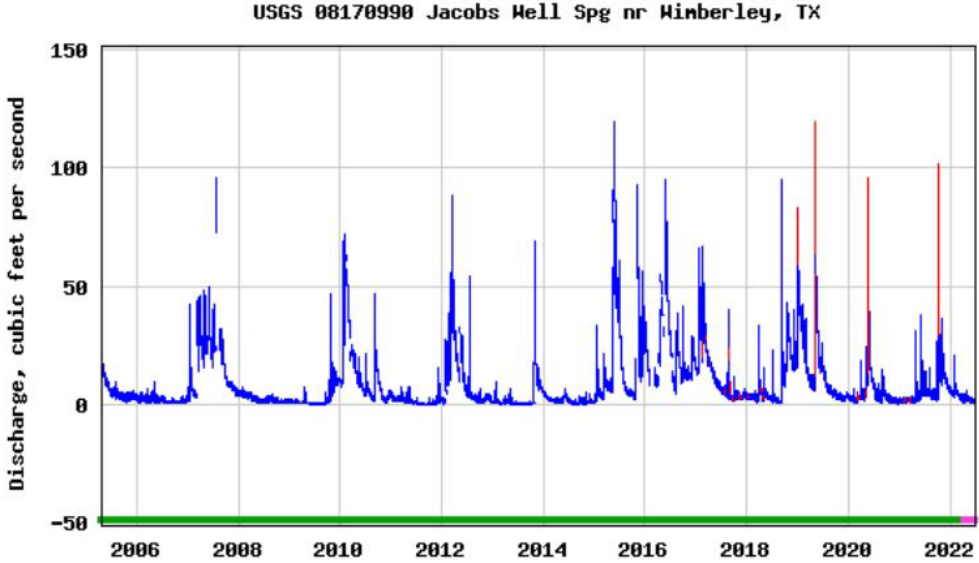


5763705 5757805 5747705





Southern Portion of the Trinity Aquifer



— Discharge
— Estimated discharge
— Period of approved data
— Period of provisional data

Southern Portion of the Trinity Aquifer



June 2020



April 2021

Spring Name	Flow (cfs)		
	2020	2021	2022
Inspiring Oaks Spring	0.5	Dry	Dry



Southern Portion of the Trinity Aquifer



June 2020



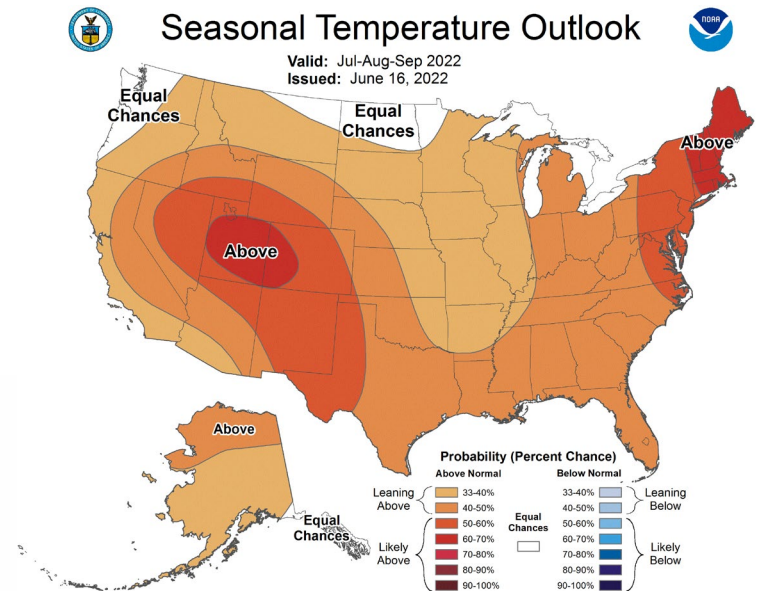
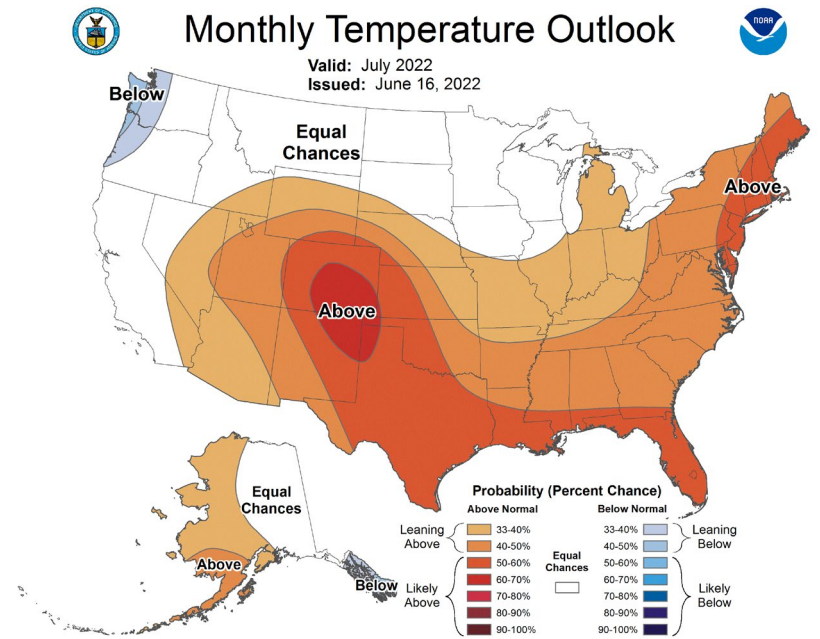
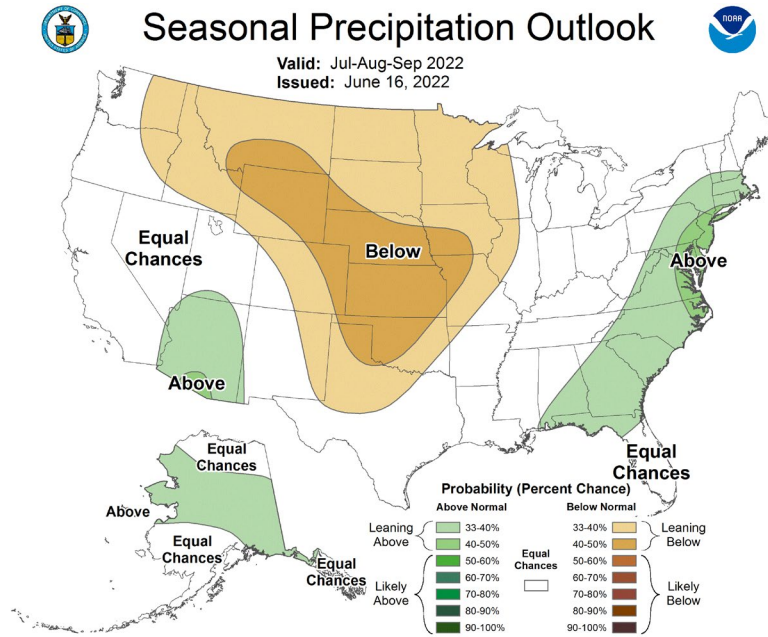
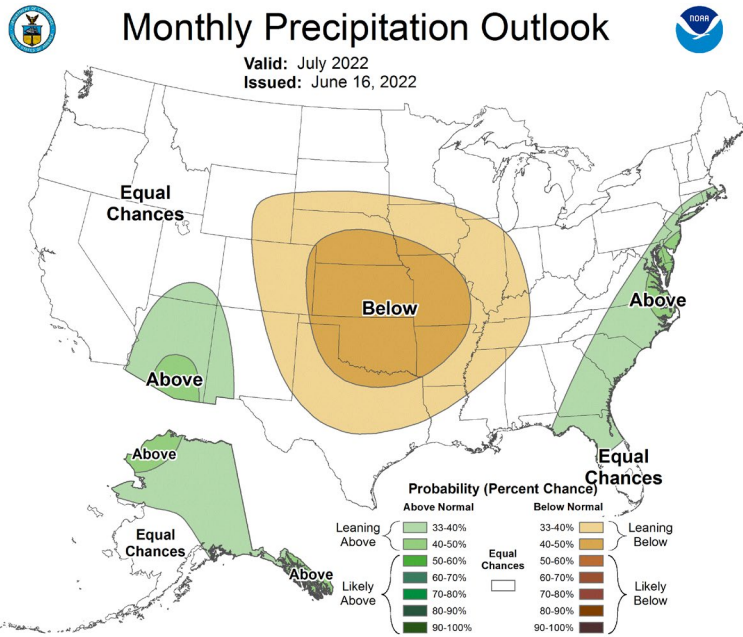
April 2021



Groundwater data challenges

- Vast amount of data
- Heterogeneity of aquifer systems
- Local/regional influences
- Other factors to consider
 - Long term overuse and water level decline
 - Population growth/water use changes
 - Interaction with surface water
 - Cross-formational flow between aquifers

Current drought forecast





Questions?

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