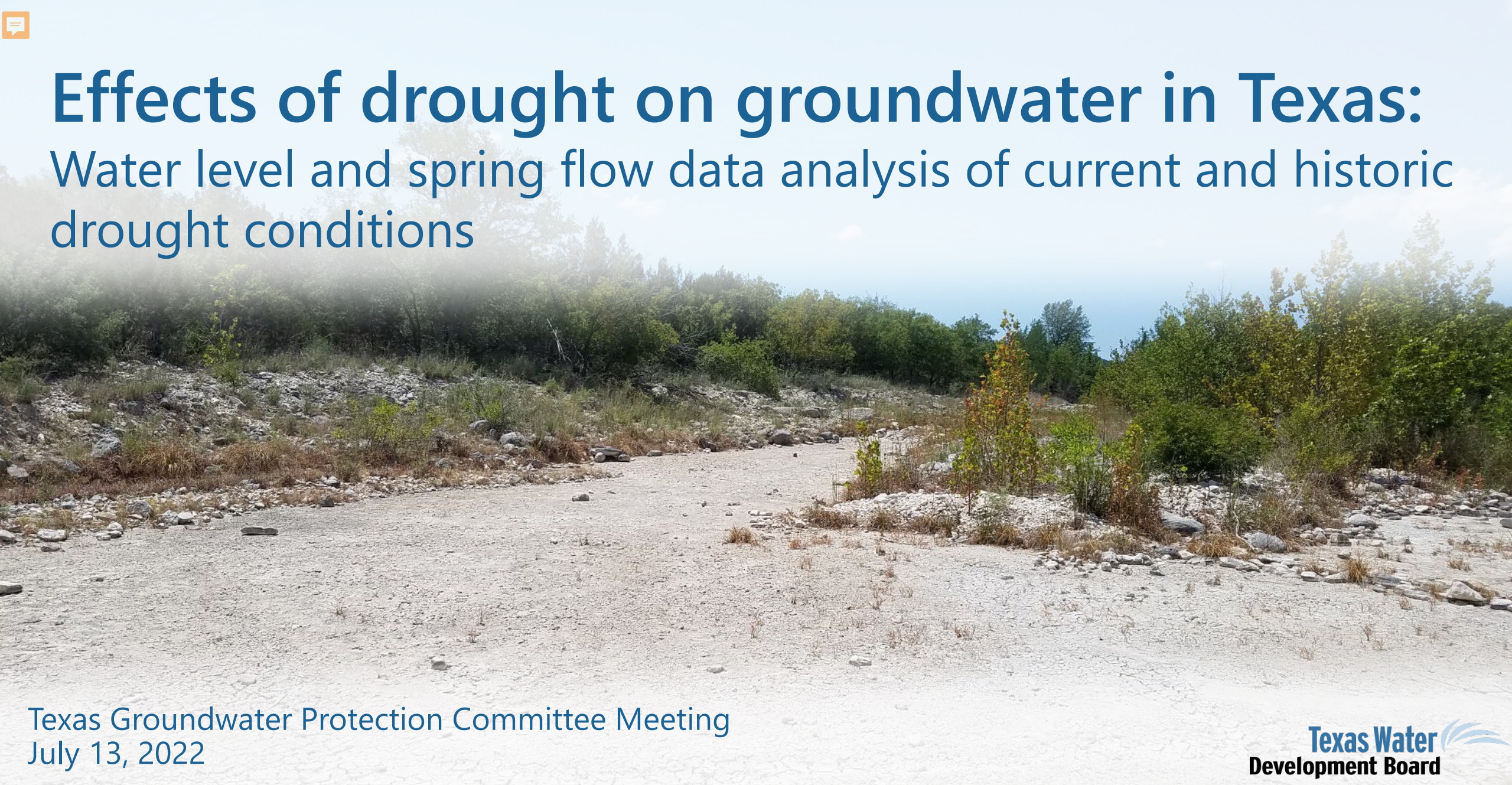
Effects of drought on groundwater in Texas:

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



Texas Groundwater Protection Committee Meeting
July 13, 2022

Texas Water Development Board

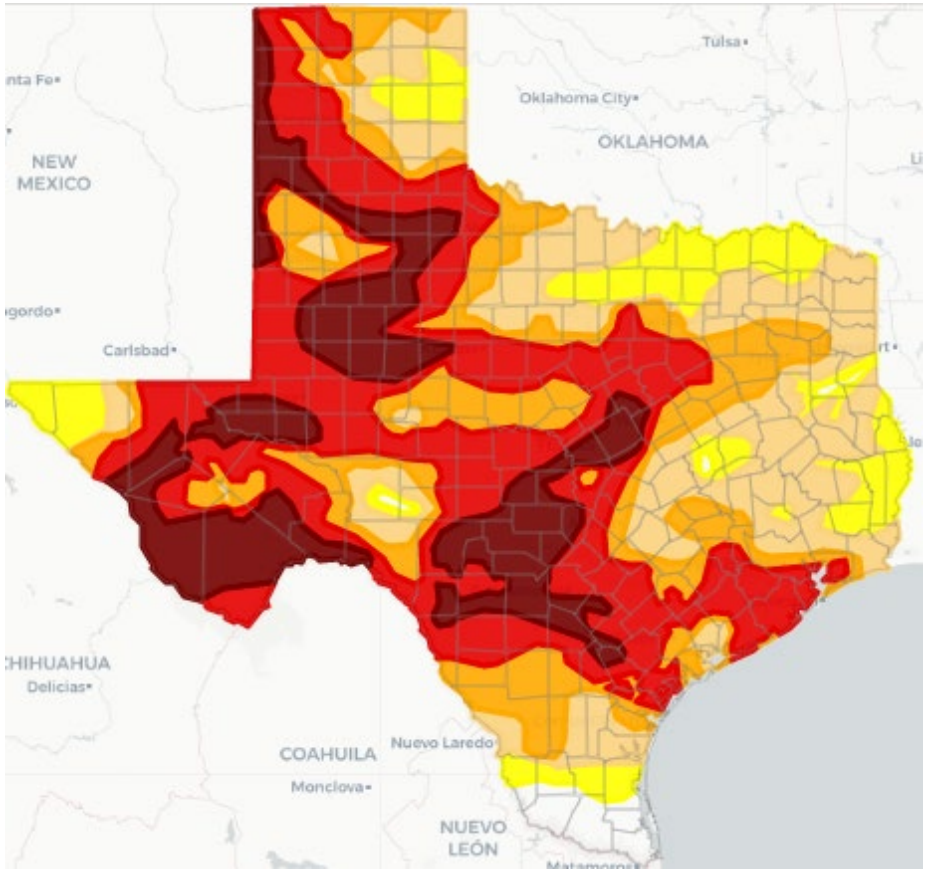
Causes and impacts of drought

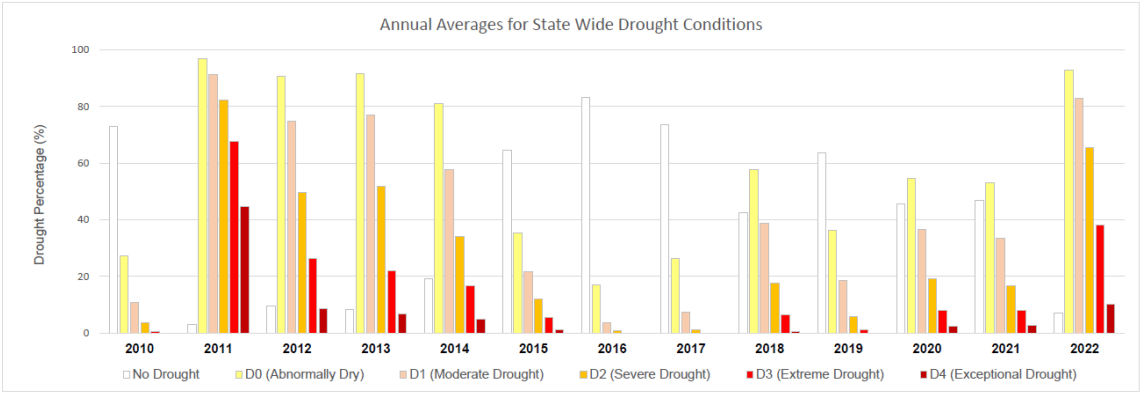
- El Niño-Southern Oscillation (ENSO) and La Niña
- Warmer temperatures → increased evaporation
- Variable precipitation → decreased recharge
- Dwindling surface water supplies
- More reliance on groundwater
- Declines in groundwater levels
- Stressed vegetation and crops

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



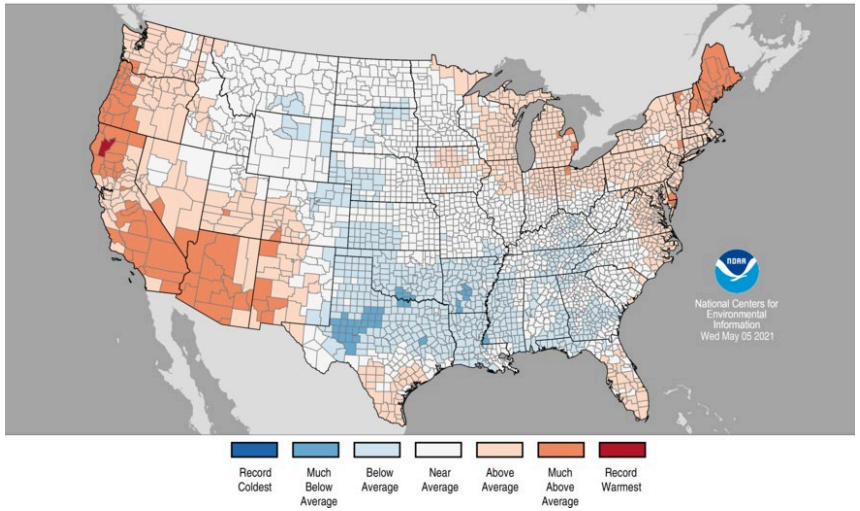


Map Date: 2022-07-05

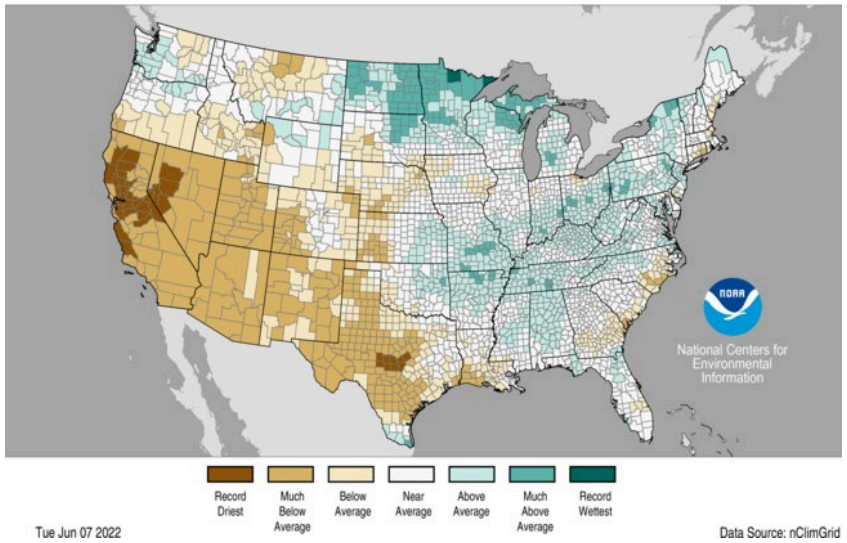
Texas

- 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



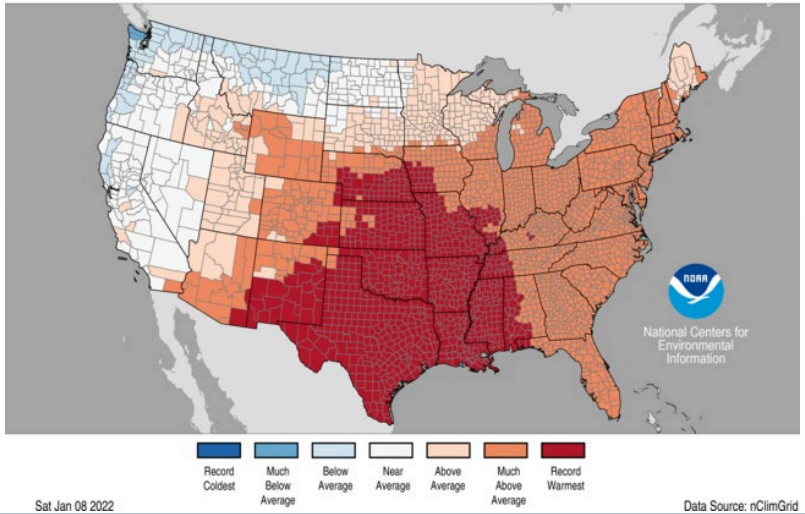
County Precipitation Ranks
January–May 2022
Period: 1895–2022



Tue Jun 07 2022

Data Source: nClimGrid

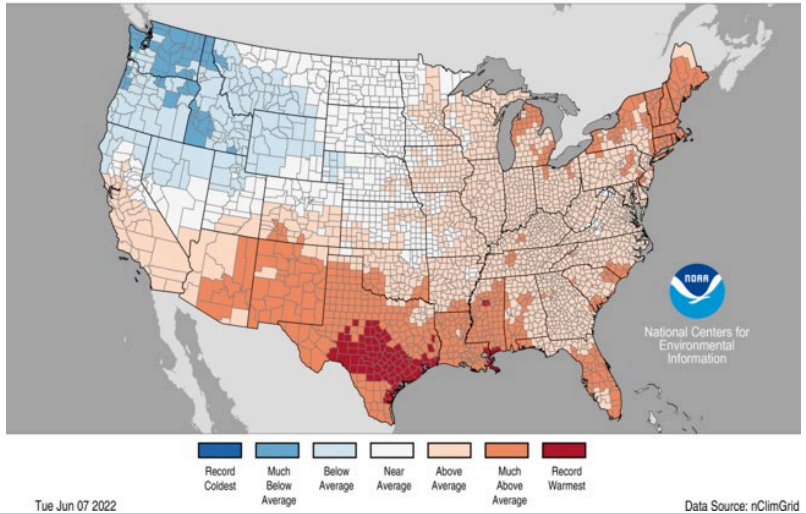
County Average Temperature Ranks
December 2021
Period: 1895–2021



Sat Jan 08 2022

Data Source: nClimGrid

County Average Temperature Ranks
May 2022
Period: 1895–2022



Tue Jun 07 2022

Data Source: nClimGrid

Groundwater response to drought

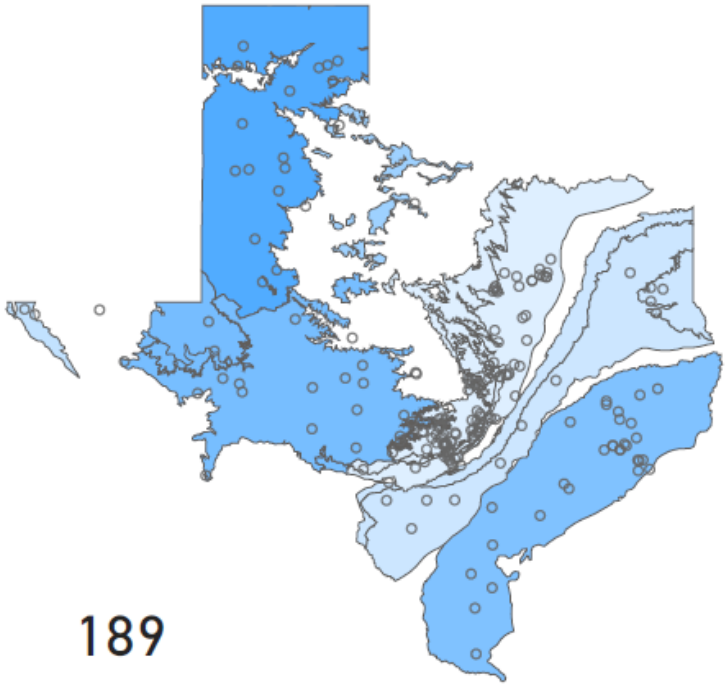
Observations

- 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

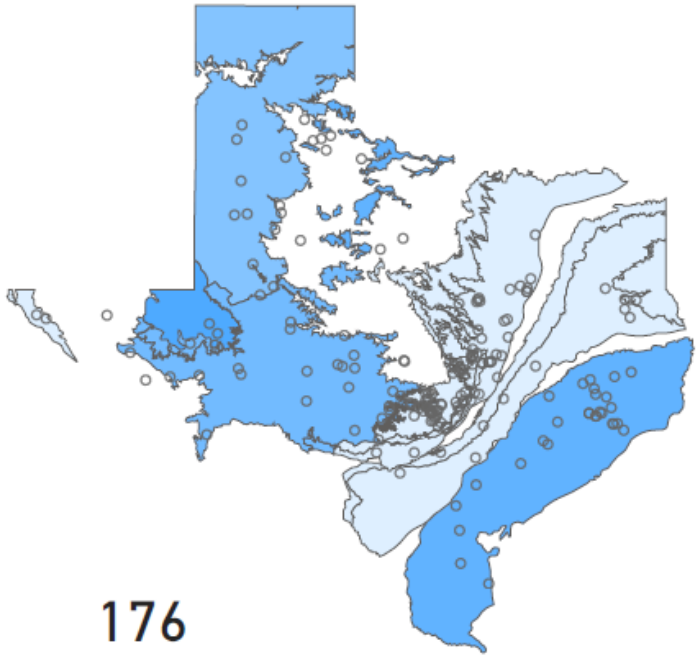
Annual Change by Aquifer



189

Reporting wells

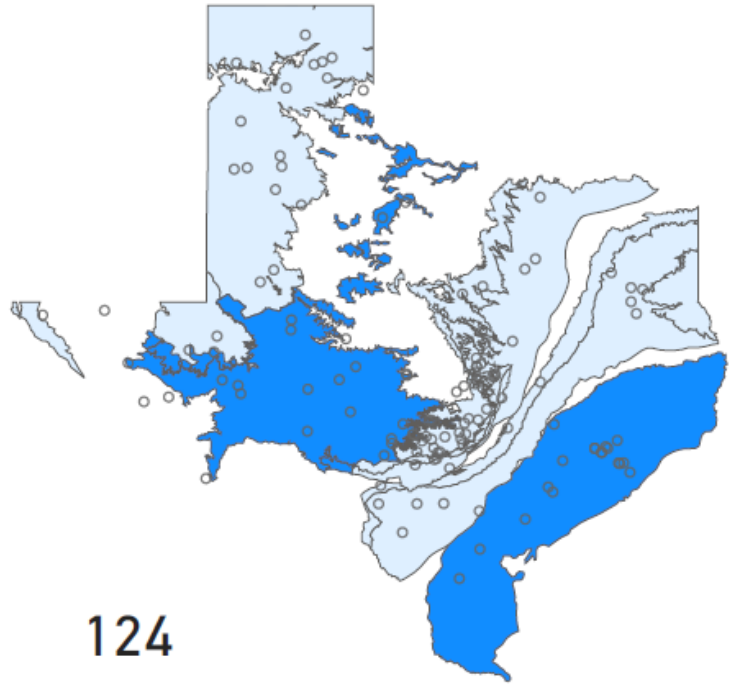
Five Year Change by Aquifer



176

Reporting wells

Ten Year Change by Aquifer



124

Reporting wells

06/30/2022

Reference Date

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

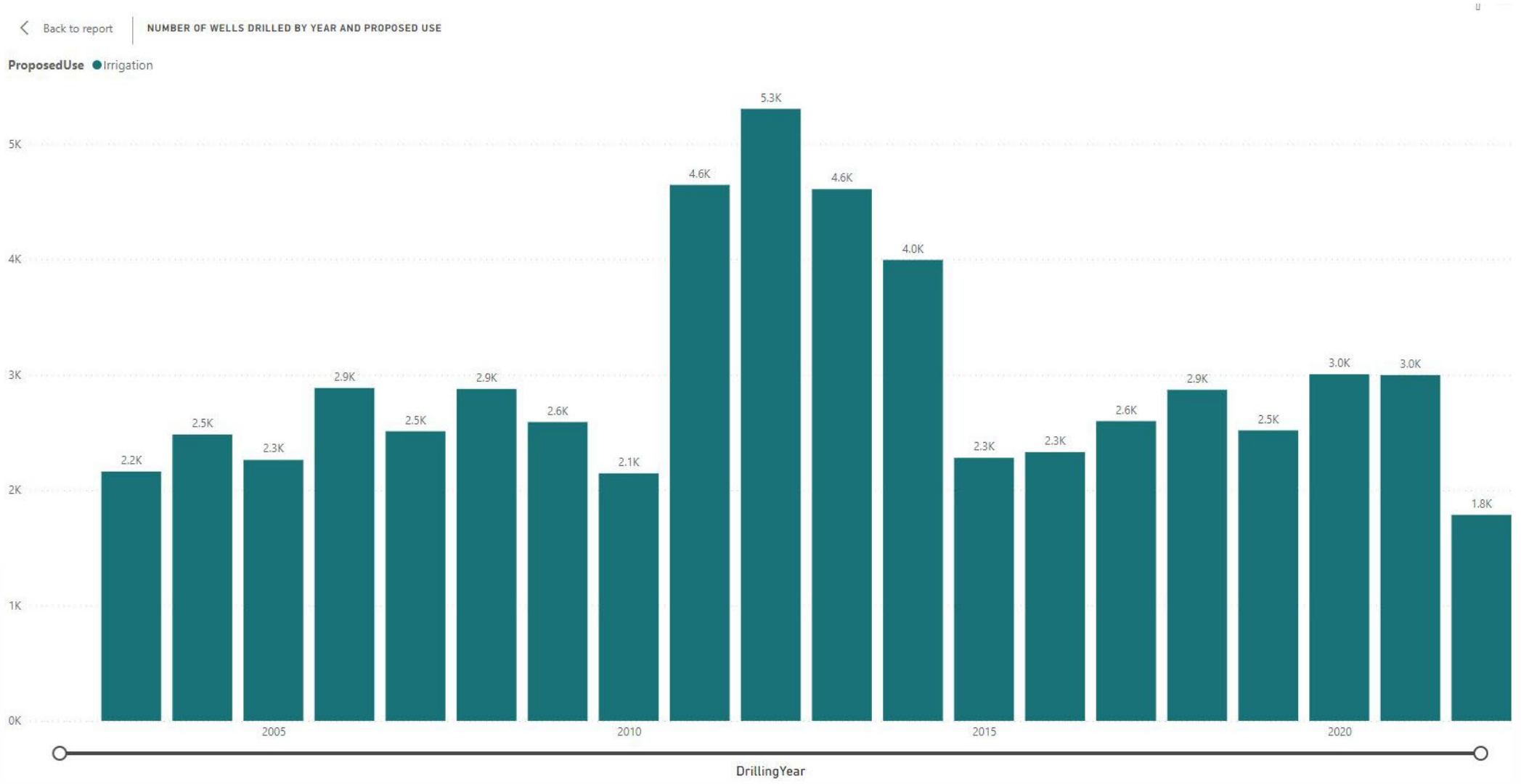
Total active recorder wells

104

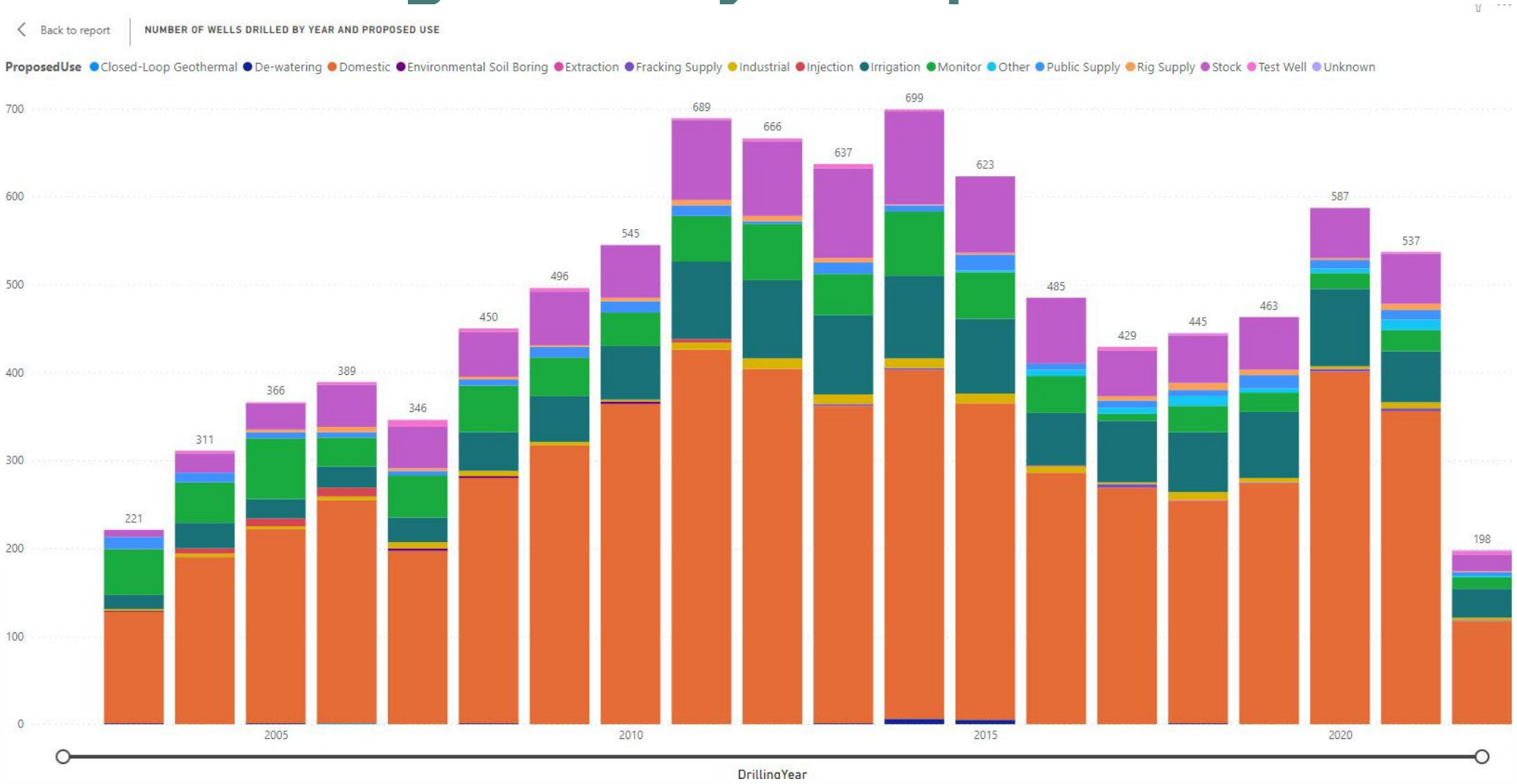
Counties represented

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.

Well Drilling Activity – New Irrigation



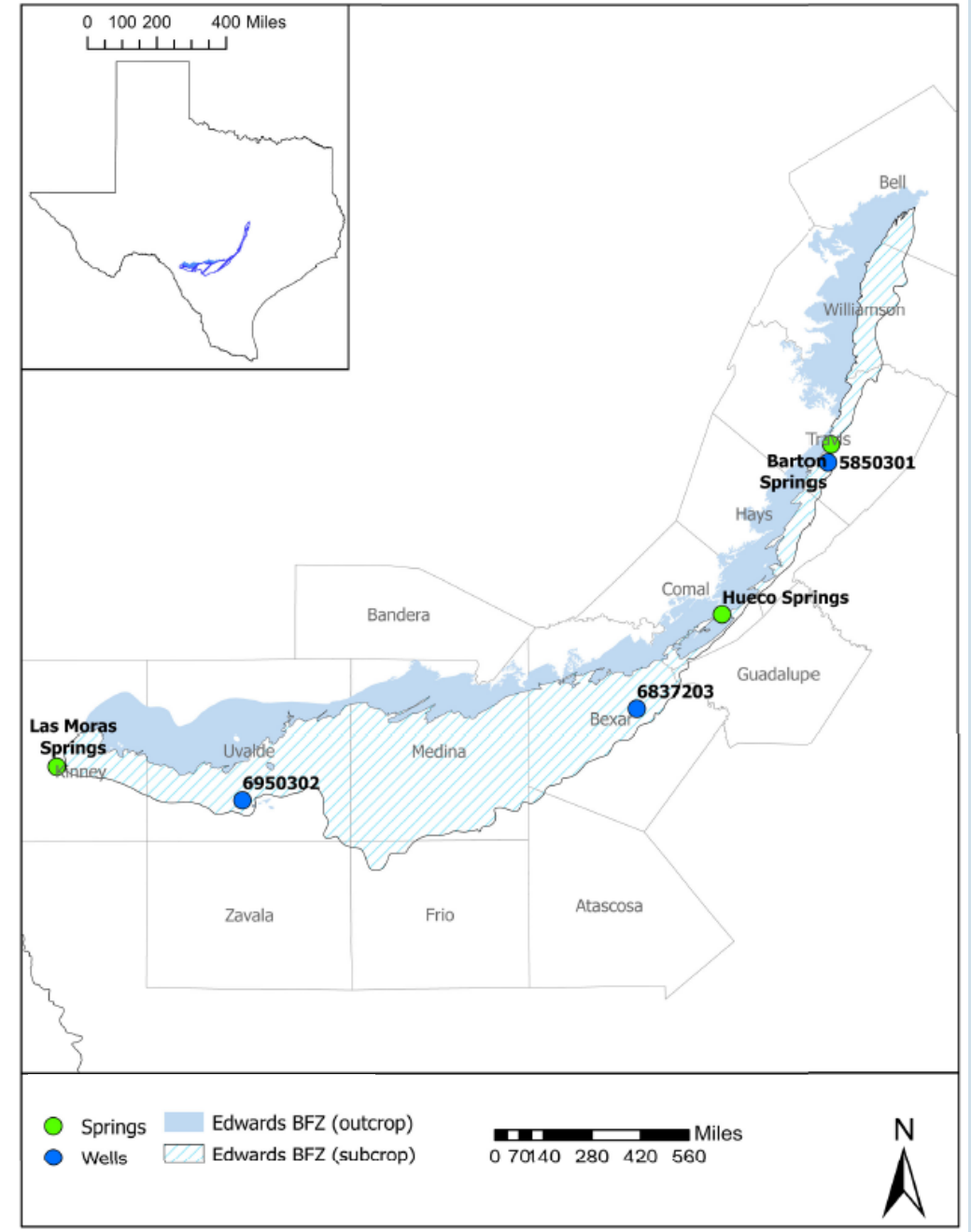
Well Drilling Activity – Replacement



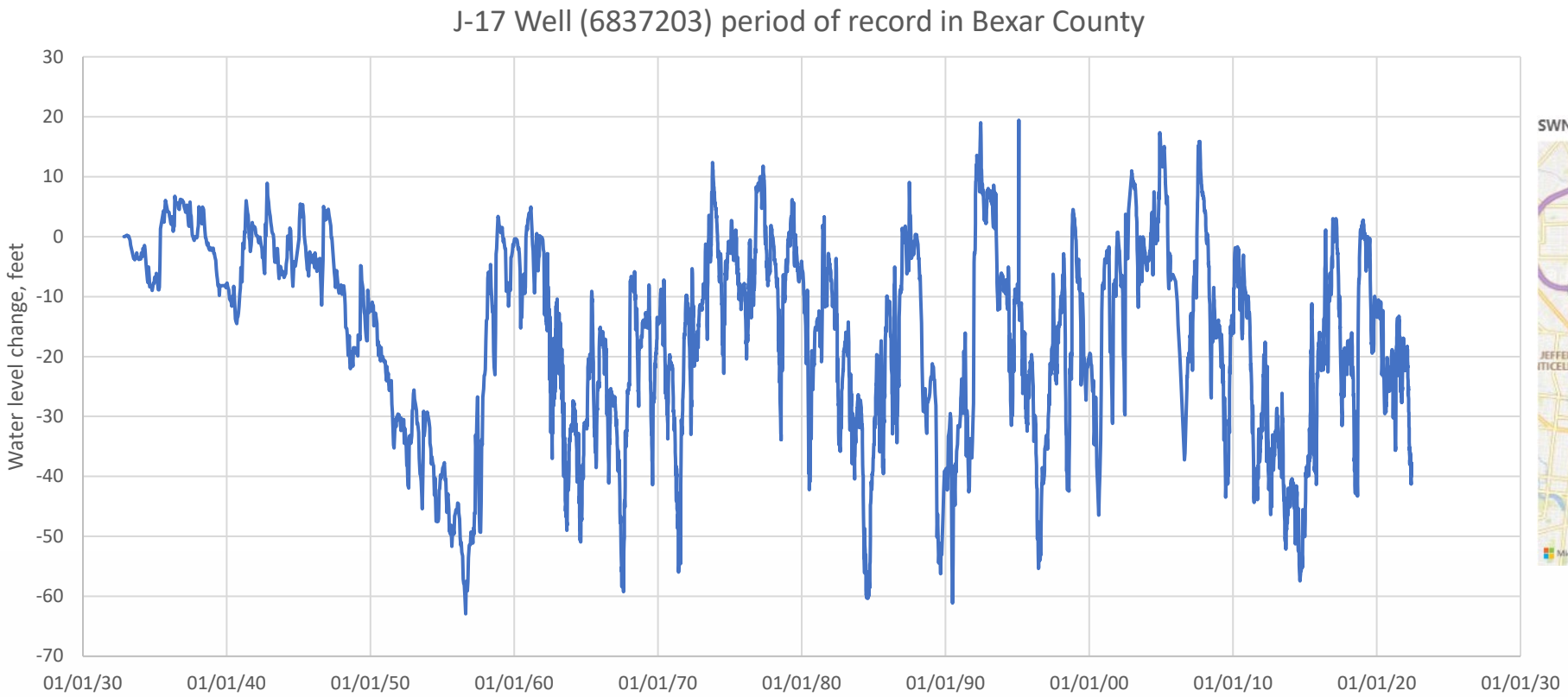
Assessing drought in water level data

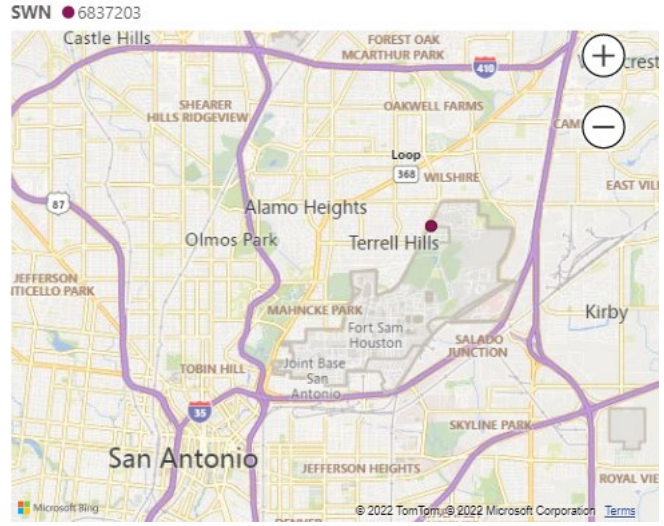
- Variable response across aquifers and individual wells
- Areas of known exceptional or extreme drought conditions
- Aquifers susceptible to drought
- Aquifers that reflect changing conditions quickly
- Wells with long, consistent water level records
- Recorder well data
- Spring discharge data

Edwards (Balcones Fault Zone) Aquifer

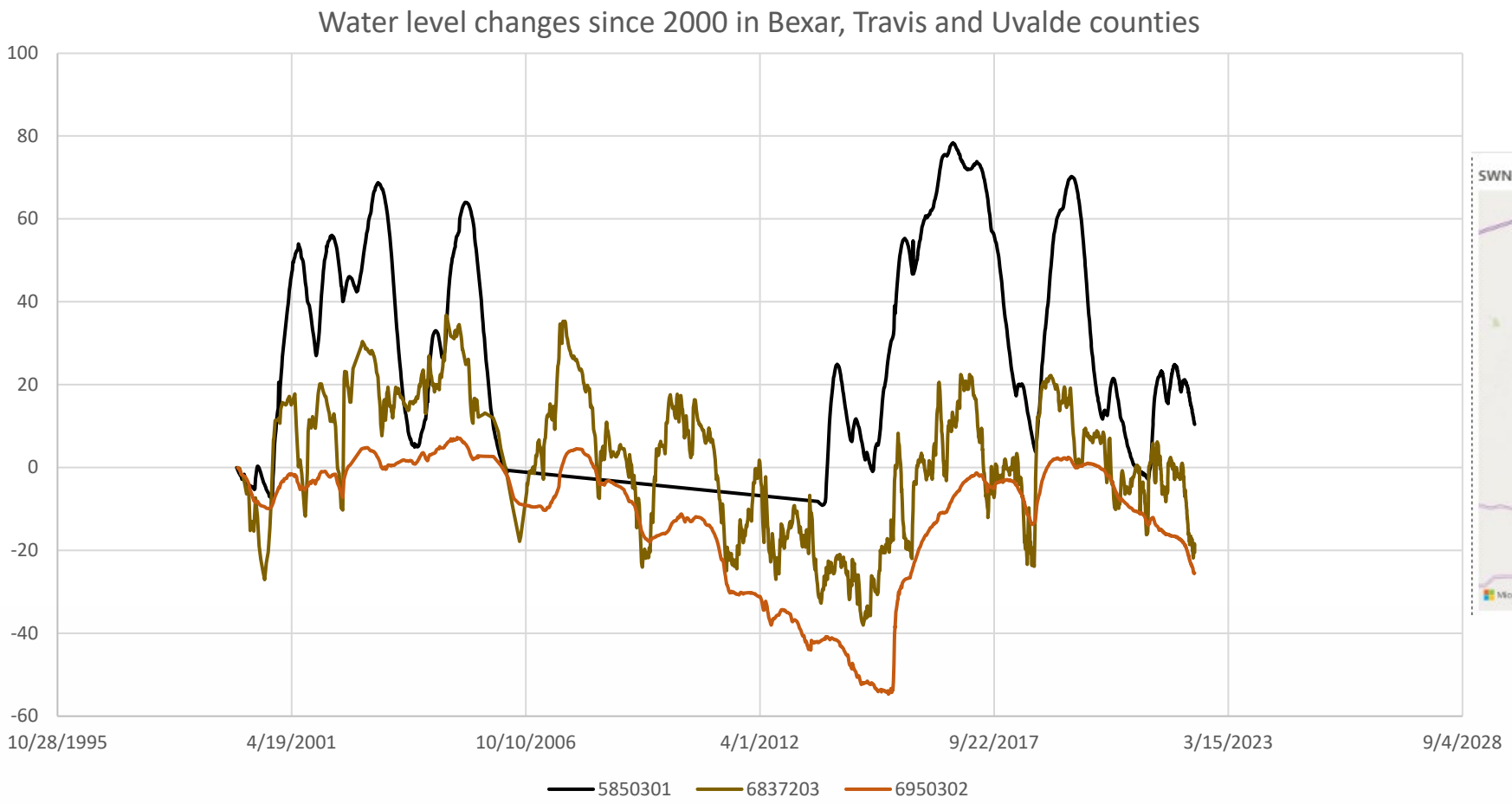


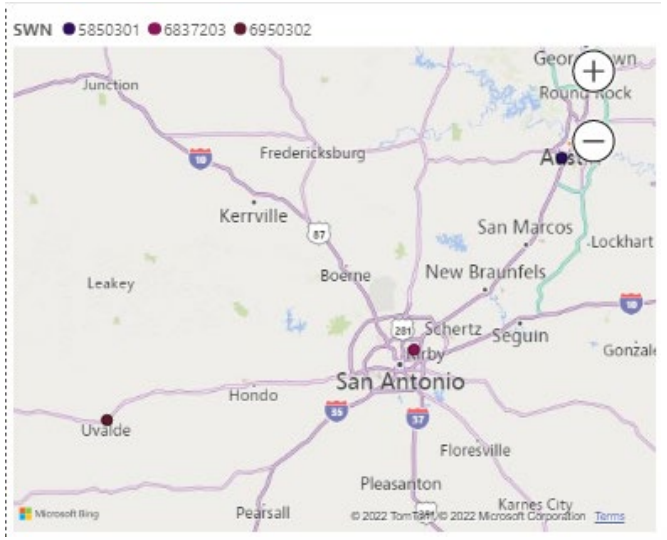
Edwards (Balcones Fault Zone) Aquifer



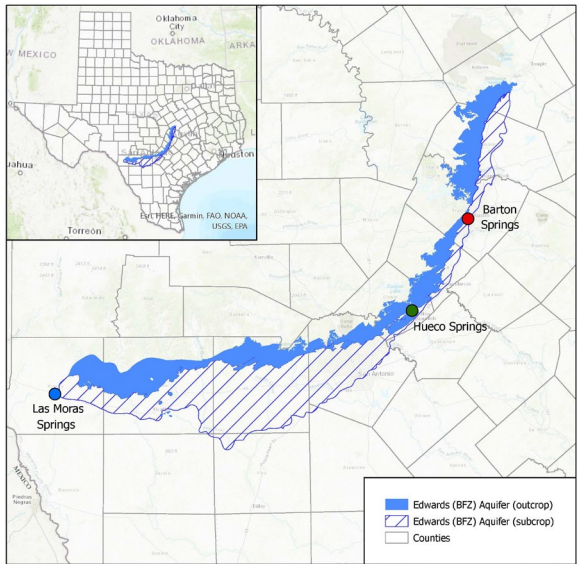


Edwards (Balcones Fault Zone) Aquifer





Edwards (Balcones Fault Zone) Aquifer



Edwards (Balcones Fault Zone) Aquifer

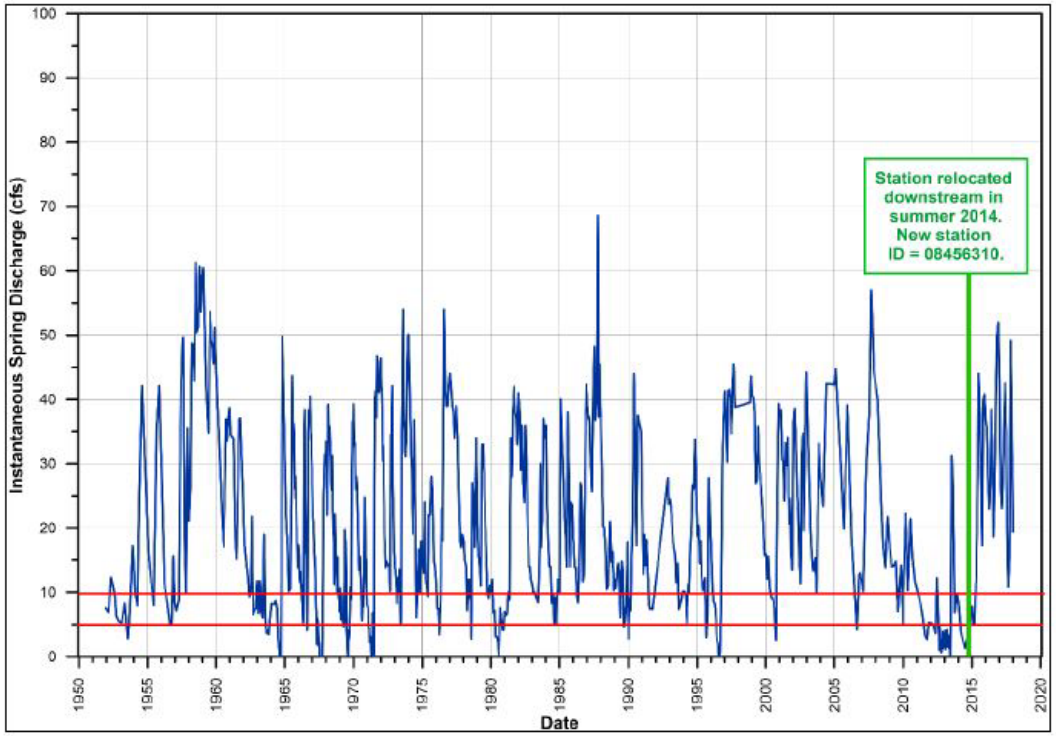
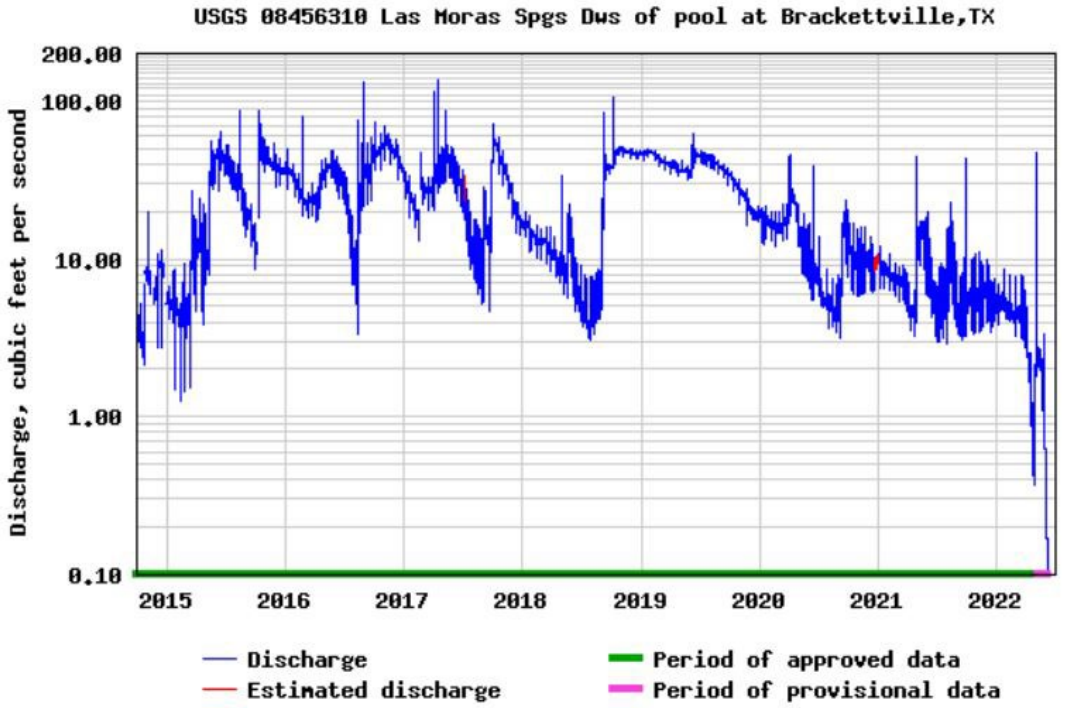


Figure 7-5. Historic Discharge Measurements at Las Moras Springs
Source: U.S. Geological Survey

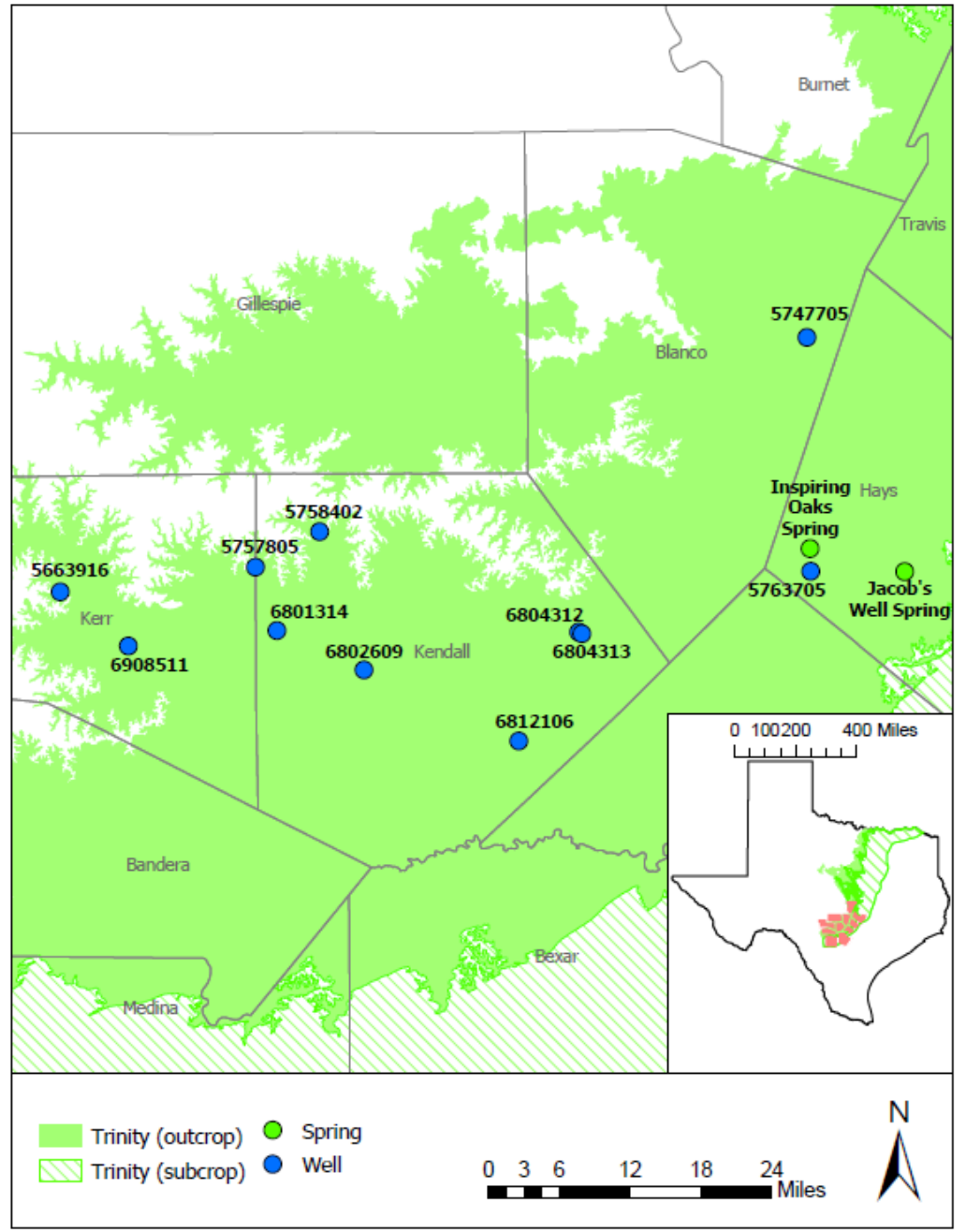


Edwards (Balcones Fault Zone) Aquifer

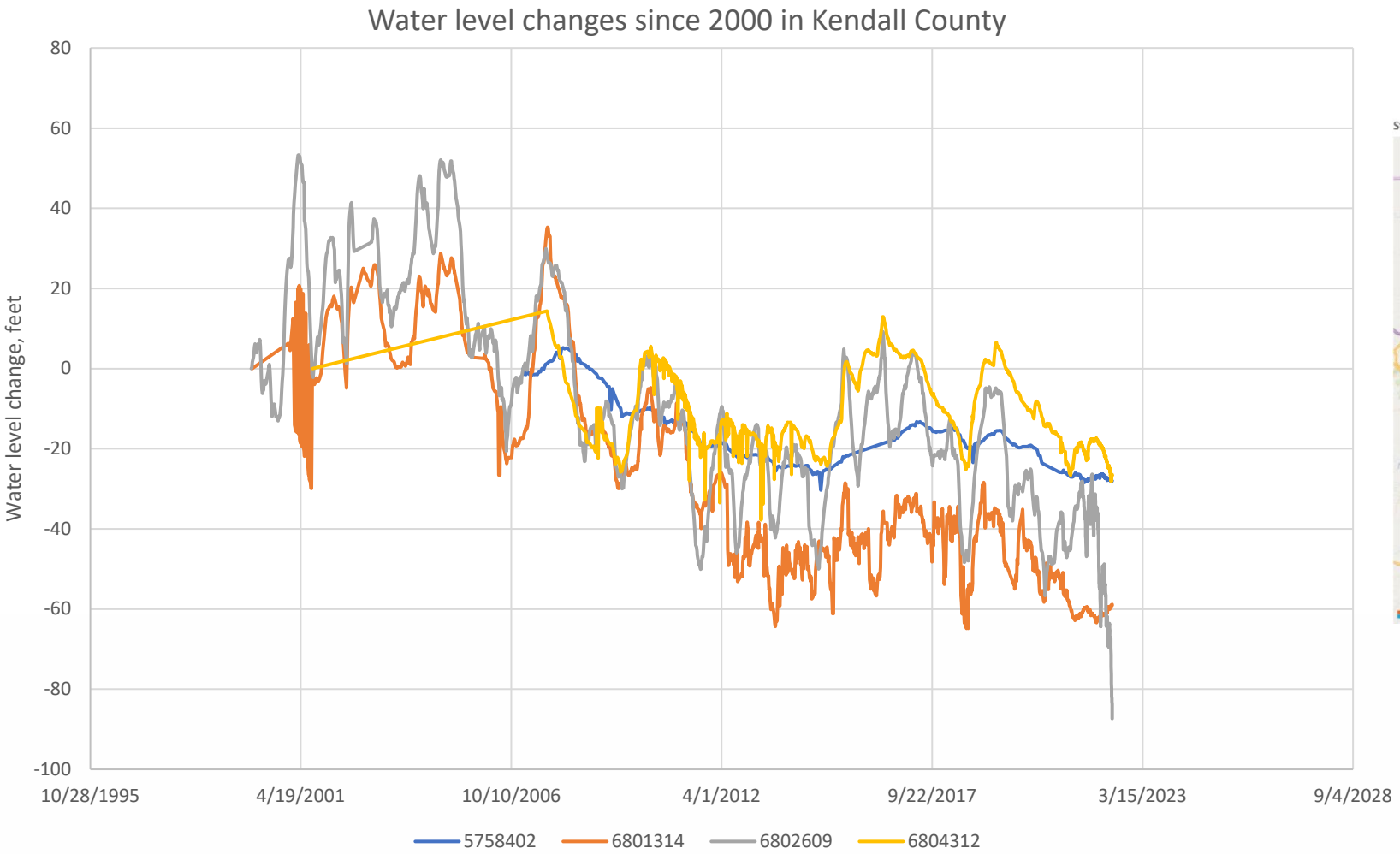
Las Moras Springs, April 2019

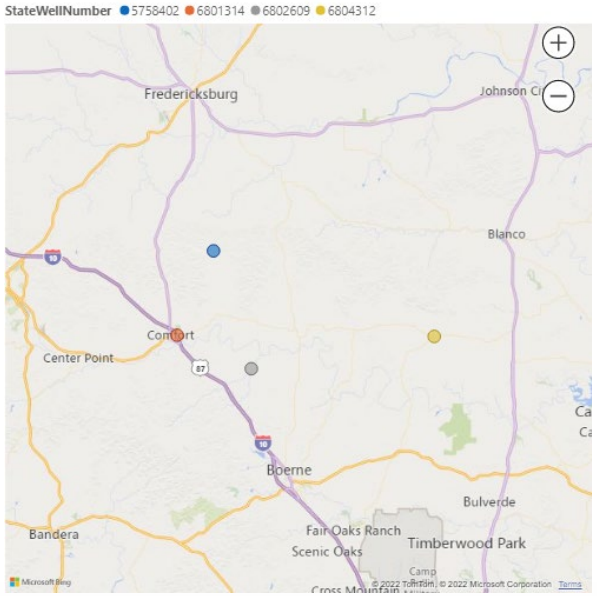
Las Moras Springs, June 2022

Southern Portion of the Trinity Aquifer

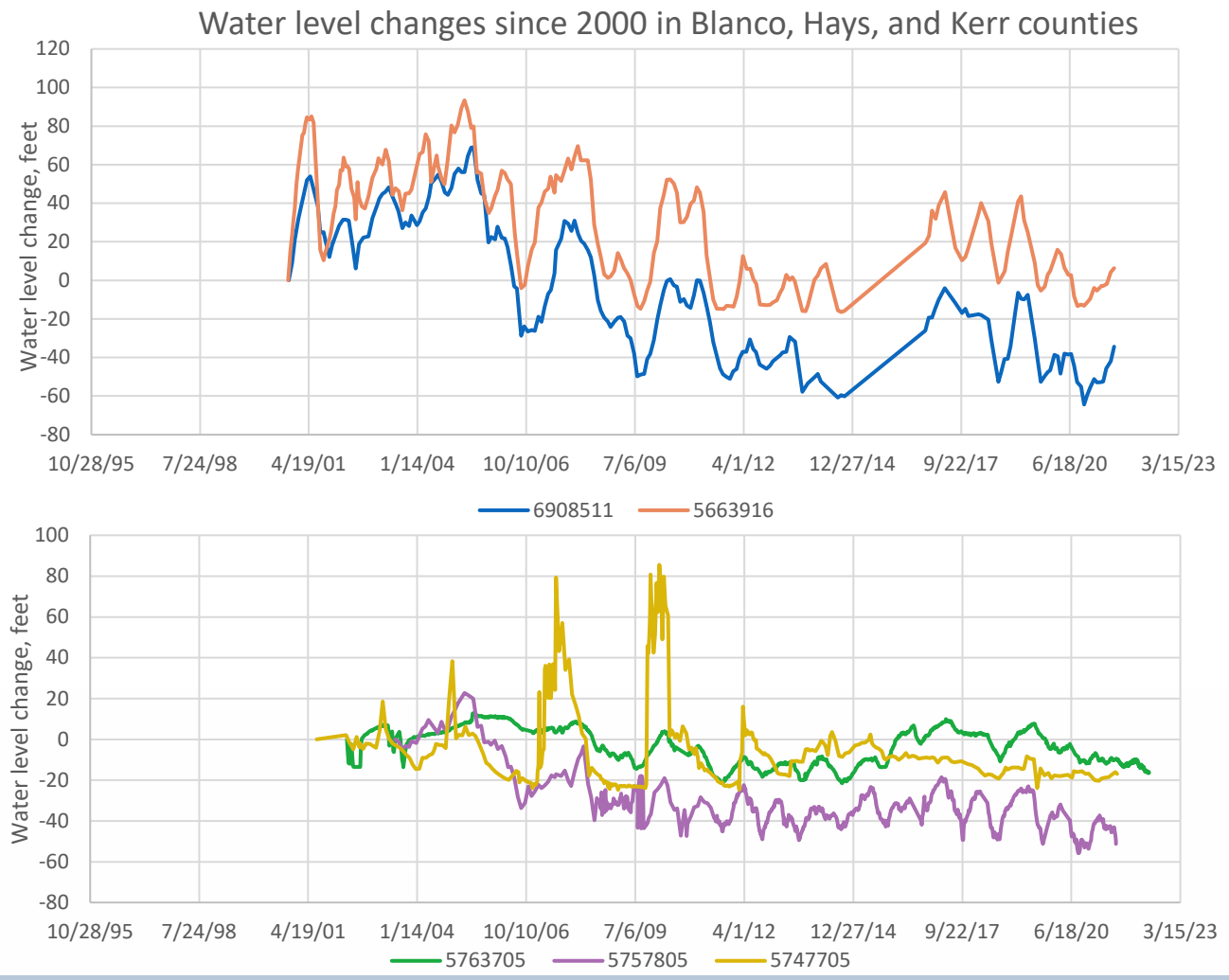


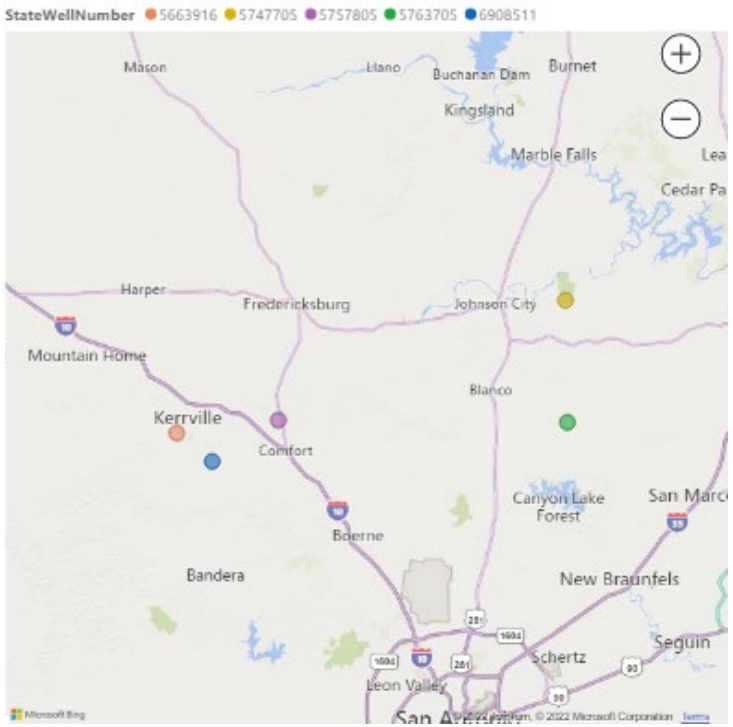
Southern Portion of the Trinity Aquifer



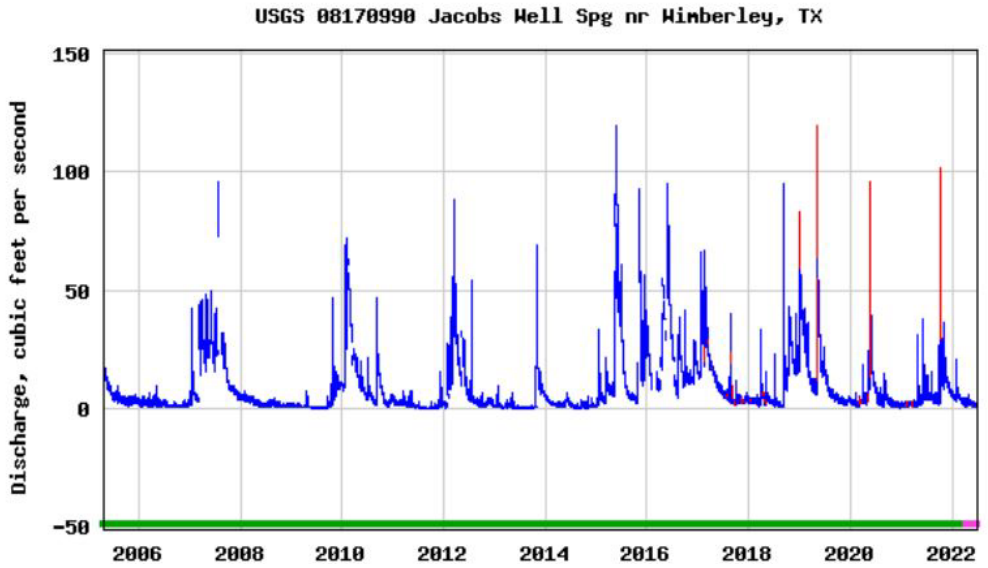


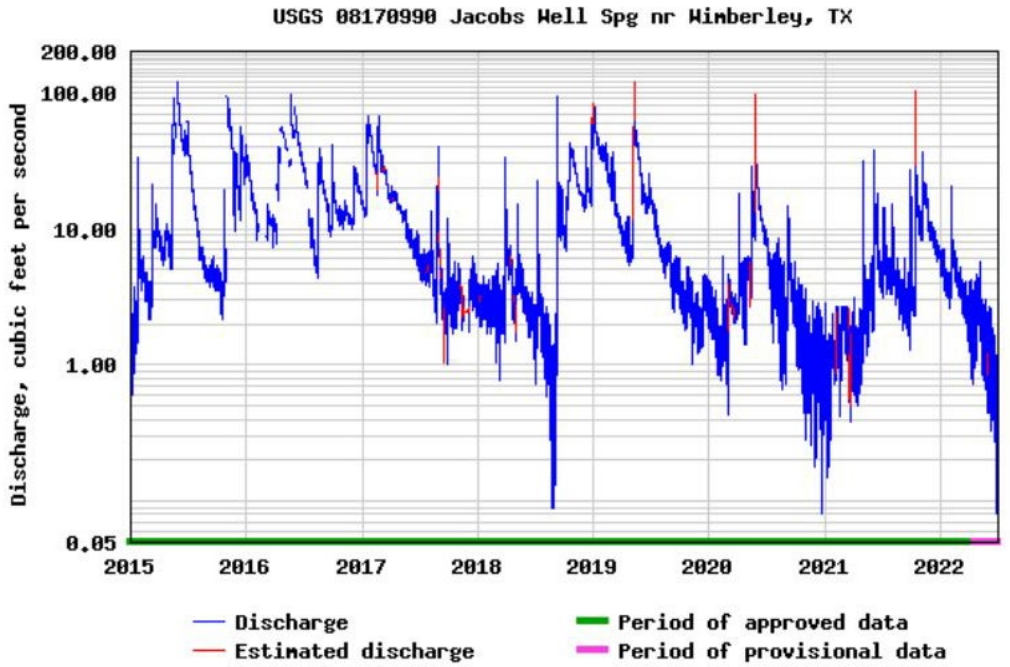
Southern Portion of the Trinity Aquifer





Southern Portion of the Trinity Aquifer





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

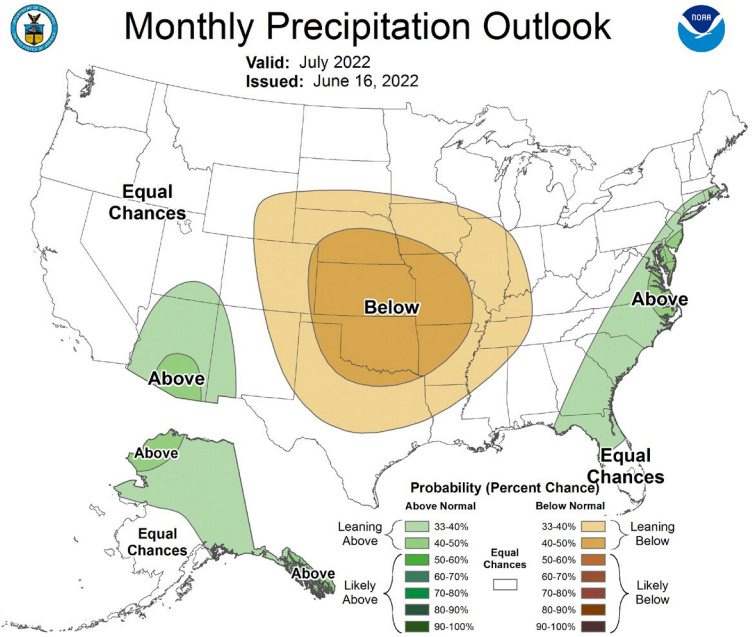
June 2020

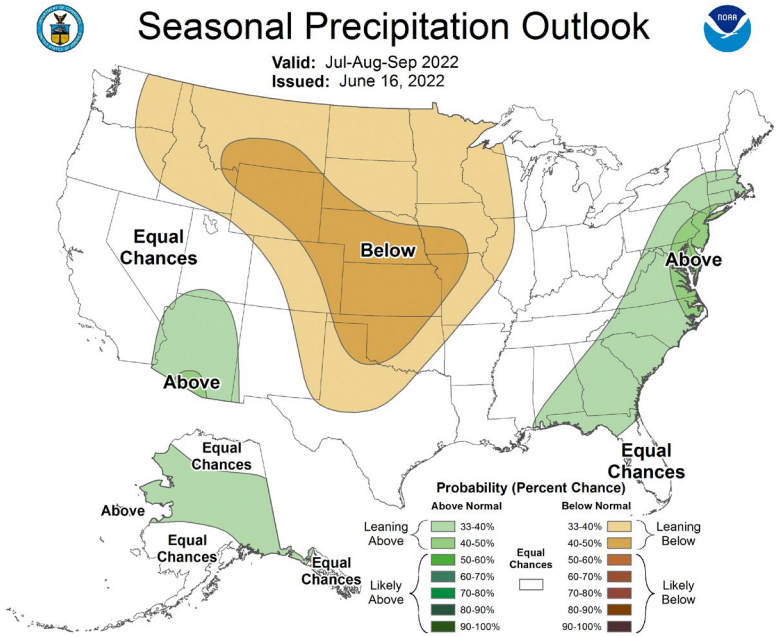
April 2021

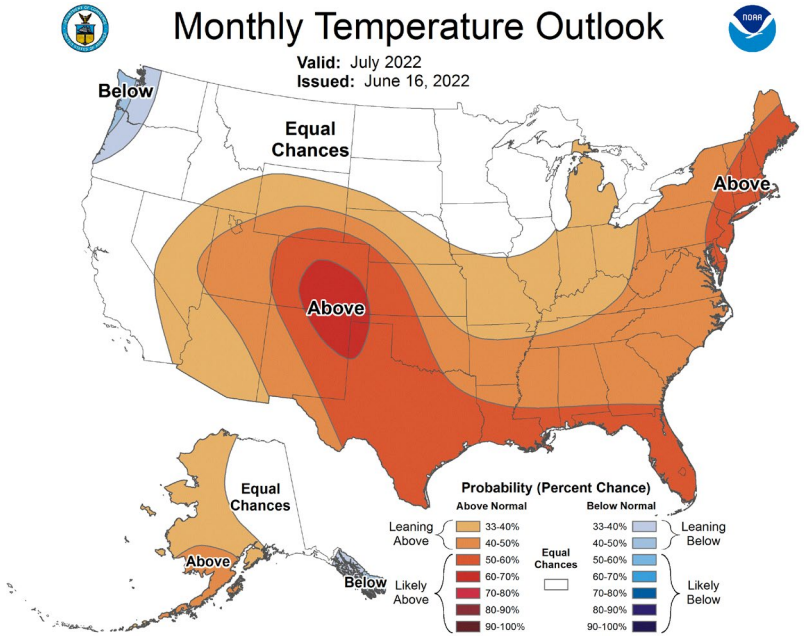
Groundwater data challenges

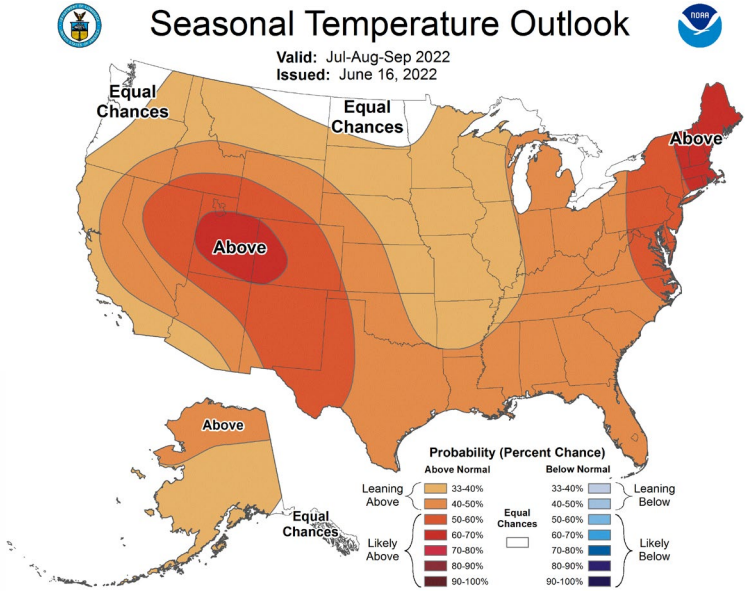
- Vast amount of data
- Heterogeneity of aquifer systems
- Local/regional influences
- Other factors to consider
  - Long term overuse and water level decline
  - Population growth/water use changes
  - Interaction with surface water
  - Cross-formational flow between aquifers

Current drought forecast









Questions?

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Groundwater Monitoring

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512-475-3302