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
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](https://www.twdb.texas.gov). Difference in average monthly water levels for active recorder wells averaged by aquifer. Published 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.

### Quarterly Changes

<table>
<thead>
<tr>
<th>Aquifer</th>
<th>Quarterly change</th>
<th>Annual change</th>
<th>5 year change</th>
<th>10 year change</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARRIZO</td>
<td>-7.80</td>
<td>-8.69</td>
<td>-17.00</td>
<td>-21.52</td>
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<tr>
<td>EDWARDS</td>
<td>-8.05</td>
<td>-10.30</td>
<td>-19.12</td>
<td>-2.58</td>
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<tr>
<td>EDWARDS-TRINITY</td>
<td>-1.50</td>
<td>-2.48</td>
<td>-2.07</td>
<td>0.10</td>
</tr>
<tr>
<td>GULF_COAST</td>
<td>-4.89</td>
<td>-3.14</td>
<td>-0.89</td>
<td>5.34</td>
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<tr>
<td>OGLESSA</td>
<td>-0.49</td>
<td>0.29</td>
<td>-3.39</td>
<td>-4.38</td>
</tr>
<tr>
<td>PECOS VALLEY</td>
<td>-1.94</td>
<td>-2.40</td>
<td>0.51</td>
<td>-2.46</td>
</tr>
<tr>
<td>SEYMOUR</td>
<td>-1.06</td>
<td>-5.35</td>
<td>0.85</td>
<td>1.15</td>
</tr>
</tbody>
</table>

Total active recorder wells: **249**

Counties represented: **104**
Well Drilling Activity – New Irrigation
Well Drilling Activity – Replacement

NUMBER OF WELLS DRILLED BY YEAR AND PROPOSED USE

Proposed Use: Closed-Loop Geothermal, Dewatering, 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

Zoom period plot

Discharge, cubic feet per second

Explanation
- 71.6k USGS 08155500
- Measured discharge
- 80.5k USGS 08168000
- Measured discharge
- 38k USGS 08456310
- Measured discharge
Edwards (Balcones Fault Zone) Aquifer
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

Water level change, feet


-100 -80 -60 -40 -20 0 20 40 60 80

-100 -80 -60 -40 -20 0 20 40 60 80

Water level change, feet


5758402 6801314 6802609 6804312

5758402 6801314 6802609 6804312
Southern Portion of the Trinity Aquifer

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

Water level change, feet

10/28/95  7/24/98  4/19/01  1/14/04  10/10/06  4/1/08  9/22/17  6/18/20  3/15/23

Water level change, feet

10/28/95  7/24/98  4/19/01  1/14/04  10/10/06  4/1/08  9/22/17  6/18/20  3/15/23
Southern Portion of the Trinity Aquifer
### Southern Portion of the Trinity Aquifer

<table>
<thead>
<tr>
<th>Spring Name</th>
<th>Flow (cfs)</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
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</thead>
<tbody>
<tr>
<td>Inspiring Oaks Spring</td>
<td></td>
<td>0.5</td>
<td>Dry</td>
<td>Dry</td>
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</tbody>
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**June 2020**

![Image of Inspiring Oaks Spring in June 2020](image1.jpg)

**April 2021**

![Image of Inspiring Oaks Spring in April 2021](image2.jpg)
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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