Dynamic Hydraulic Boundaries within the Western Edwards Aquifer*

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Abstract

The western physical and hydraulic boundaries of the San Antonio segment of the Edwards Aquifer are neither well understood nor well characterized. Recent investigations of the Edwards Aquifer in Kinney and Uvalde counties have provided additional information that offer insight into the dynamic nature of hydraulic structures and barriers that control groundwater flow within the western Edwards Aquifer. This portion of the San Antonio segment of the Edwards Aquifer is subdivided into three pools (1) Kinney, (2) Uvalde, and (3) San Antonio. The western extent of the Kinney pool of the Edwards Aquifer has been determined to be approximately midway between Brackettville and the Val Verde County line, somewhat farther west than previously thought. The Kinney and Uvalde pools are separated by a hydraulic barrier that allows minimal transfer of groundwater from the Kinney pool to the Uvalde pool when groundwater levels are low, but appreciable flow when the level is high. Conversely, the Uvalde pool is connected with the San Antonio pool via the Knippa Gap, a high-capacity channel that allows significant groundwater flow from west to east, but provides sufficient restriction to maintain higher groundwater levels in the Uvalde pool than in the San Antonio pool.
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Conventional Conceptualization of the Western San Antonio Segment to the Edwards Aquifer

Potentiometric Surface Winter 1973 (Maclay, 1995)
Map illustrating Edwards Aquifer groundwater elevation contours
Water Chemistry Difference between Kinney and Uvalde counties (Magnesium)

<table>
<thead>
<tr>
<th>Magnesium (ppm)</th>
<th>Kinney County</th>
<th>Uvalde County</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;8</td>
<td>321000</td>
<td>321000</td>
</tr>
<tr>
<td>8-20</td>
<td>322000</td>
<td>322000</td>
</tr>
<tr>
<td>20-50</td>
<td>323000</td>
<td>323000</td>
</tr>
<tr>
<td>&gt;50</td>
<td>324000</td>
<td>324000</td>
</tr>
</tbody>
</table>

Edwards Well

Recharge Zone
Salmon Peak is the only significant water-bearing unit in the Edwards Aquifer in the Maverick Basin.

The Salmon Peak is mostly dry in eastern Kinney County.
Geologic Structure in Kinney County

- Salmon Peak
- McKnight
- W. Nueces

Las Moras Springs
Hydraulic Barrier
Kinney Basin Water Budget

- Recharge 70,000 acre-ft
- Pinto Springs
- Springflow 23,000 acre-ft
- Las Moras Springs
- Pumping 6,000 acre-ft
- Mud Springs
- Pinto Creek
- Las Moras Creek
- Floodpain ~41,000 acre-ft
Groundwater Elevation at Index Wells

- Uvalde (J27)
- Hondo
- San Antonio (J17)

Date:
- 1/1/06
- 3/1/06
- 5/1/06
- 7/1/06
- 9/1/06
- 11/1/06
- 1/1/07

Groundwater Elevation (ft, msl)
- 900
- 850
- 800
- 750
- 700
- 650
- 600

Map showing locations of Uvalde, Hondo, and San Antonio with date-specific groundwater elevation data.
Edwards Aquifer Saturated Thickness

Edwards Aquifer: Full Saturated Thickness = 600 ft

Uvalde Salient: Saturated Thickness as Little as 300 ft

Balcones Faulting

Knippa Gap
(Graben)

Edwards Aquifer Outcrop
Flow through Knippa Gap
Uvalde Sub-Basin to
San Antonio Sub-Basin

Flow at the eastern limit of the high-capacity flow channel is 300 ft deep, 4 miles wide, with a GW gradient of ~10 ft/mile & hydraulic conductivity of 1,300 ft/day:

130,000 acre-ft/yr

[Not well constrained, but gives indication of relative volume of water]
Discharge from the Edwards Aquifer

- Nueces & W. Nueces Rivers
- Sabinal River
- Leona River
- Dry Frio River
- Frio River
- Leona River Aquifer
**Depth to Bottom of Discharge Points of Uvalde Sub-Basin**

* Assumes 40 ft Gravel Thickness

- Frio & Dry Frio Rivers: 955 ft *
- Nueces & W. Nueces Rivers: 915 ft *
- Leona River Aquifer: 835 ft at Hwy 90
- Knippa Gap Base: 500 ft at Ft Inge
74,000 acre-ft flow through Leona River gravels

J27 Drought of record = 810 ft
1957

Uvalde Index Well (J27)
Knippa Gap 500 ft
Leona Springs at Hwy 90
Leona Springs at Ft Inge
Kinney Basin & Uvalde Sub-Basin Water Budget (acre-ft)

**Kinney Basin**
- Recharge: 70,000
- Springs: 23,000
- Floodplains: 41,000

**Uvalde Sub-Basin**
- Recharge: 107,000
- Nueces & W. Nueces: ?
- Nueces Floodplain: ?
- Pumping: 83,000
- Leona Floodplain: 80,000

**Frio & Dry**
- Frio Recharge: 135,000
- Knippa Gap: 130,000
Hydraulic Boundaries within the Western Edwards Aquifer

- Kinney basin & Uvalde sub-basin defined
- Hydraulic barrier near Kinney/Uvalde County line
- Outflow through south of Kinney basin
- Knippa Gap is a high-flow restriction
- Excess outflow from Uvalde sub-basin through Leona River floodplain
- Uvalde sub-basin water balance suggests less water provided to San Antonio sub-basin than previously estimated
Acknowledgements

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Note: opinions and conclusions expressed in this talk are those of the authors and do not necessarily represent those of the above mentioned agencies.
Reference