

# FAULT ZONE SALINITY STUDY

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## INTRODUCTION

It has been postulated that salinity in the Carrizo aquifer increases as recharge travels down dip due to dissolving minerals along its path. However, salinity is also increased by the mixing of higher salinity ground-water from formations below the Carrizo moving upward along fault zones (Kreitler, 1979 and Hamlin, 1988).

### **Purpose**

The purpose of this paper is to test the hypothesis that higher salinity ground-water from formations below the Carrizo is moving upward along faults. Ground water from wells at two well sites, close to faults, in Guadalupe and Gonzales Counties will be used to test this theory. Data used in this study is from the following:

- 1) Monitor well drilling program initiated by the Gonzales County Underground Water Conservation District with cooperation by Plum Creek Conservation District in Caldwell County and the Guadalupe County Groundwater Conservation District (Perry, 2021).
- 2) Schertz-Seguin Local Government Corporation's Well Field in western Gonzales County.

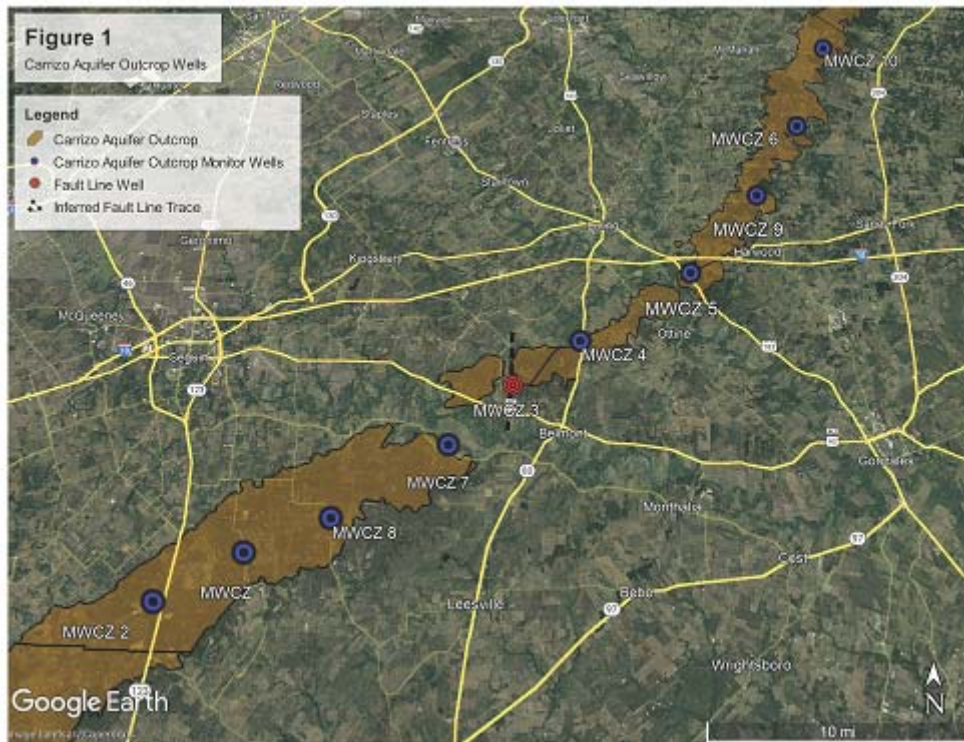
It is assumed that where the salinity of ground water from the fault-line well exceeds the average salinity of other wells in the vicinity of the fault-line well, then there is a possibility of high saline water moving upward along the fault.

### **Scope**

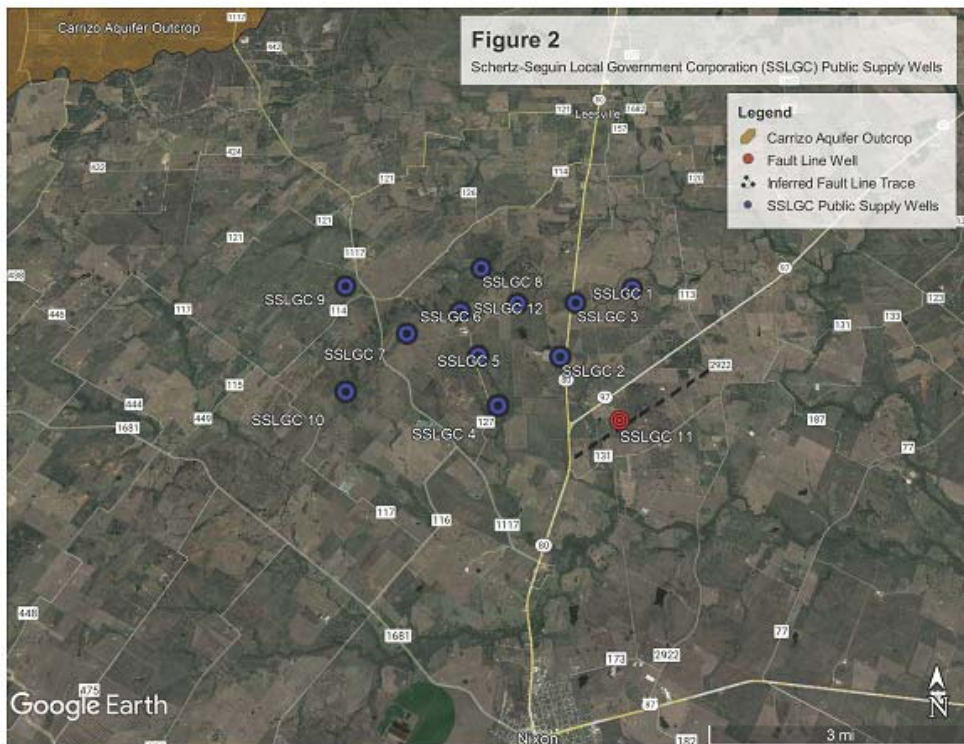
The following fault-line well sites were selected for this study:

- 1) Outcrop Monitoring Well MWCZ-3; and
- 2) Schertz-Seguin Local Government Corporation (SSLGC) Well 11.

The MWCZ-3 well is located in southern Guadalupe County (Figure 1). The Well is located on the outcrop of the Carrizo aquifer under water-table conditions in an area of intense faulting near the Guadalupe River. The top and base of the Carrizo is at +362 and +288 above sea level, respectively and the well screen of 40 feet is set in this interval. The Nash Creek Fault is very close to the MWCZ-3 Well. Other associated outcrop monitor wells (10) drilled by the ground-water districts (2018 - 2020), and used in this study, are located northeast and southwest of the MWCZ-3 well Site. The Nash Creek Fault, MWCZ-3 Well, and other associated outcrop monitor wells are shown on Figure 1.



The SSLGC- 11 is located down dip from the MWCZ-3 Well in western Gonzales County (Figure 2) close to the Sandies-O’Neal Creek Fault. The water level in the well is at +285 and the well is under artesian conditions. Top of the Carrizo is at -530 and the well screen is set from -730 to -1,145 feet below sea level. The SSLGC-11 well site, Sandies-O’Neal Creek Fault, and other associated SSLGC wells are shown on Figure 2.



## METHODOLOGY

The investigation consists of the following:

1) Total dissolved solids concentrations were averaged from wells in the district's outcrop study (9 wells) and from the down dip SSLGC Well Field (11 wells). It was noted that the range of TDS values in the outcrop wells ranged from 104 - 286mg/L and in the down dip SSLGC Well Field, 101 - 171mg/L. Fault-line Wells MWCZ-3 and SSLGC-11 are not included in the above calculations and observations. TDS sample data for the outcrop wells and the SSLGC well field wells are included in Tables 1 and 2, respectively.

**Table 1**  
**Gonzales County Underground Water Conservation District**  
**Guadalupe County Groundwater Conservation District**  
**Outcrop Monitoring Wells**  
**Water Quality Data**

Well ID	Date Sampled	Total Dissolved Solids (Mg/L)
MWCZ 1	2020	122
MWCZ 2	2018	104
*MWCZ 3	2019	474
MWCZ 4	2019	201
MWCZ 5	2019	286
MWCZ 6	2019	156
MWCZ 7	2019	114
MWCZ 8	2019	111
MWCZ 9	2013	226
MWCZ 10	2013	172

\* Fault Line Well not used in averaging of TDS concentrations

**Table 2**  
**Schertz-Seguin Local Government Corporation**  
**Well Field**  
**Water Quality Data**

Well ID	Date Sampled	Total Dissolved Solids (Mg/L)
SSLGC 1	2013	146
SSLGC 2	2013	138
SSLGC 3	2013	132
SSLGC 4	2013	171
SSLGC 5	2013	109
SSLGC 6	2013	109
SSLGC 7	2013	101
SSLGC 8	2013	135
SSLGC 9	2013	111
SSLGC 10	2013	157
*SSLGC 11	2013	211
SSLGC 12	2013	145

\* Fault Line Well not used in averaging of TDS concentrations

2) The average TDS concentration from the district's outcrop study wells and from the down dip SSLGC Well Field wells, were approximately 166 mg/L and 132 mg/L. The TDS concentrations at MWCZ-3 and SSLGC-11 were 474mg/L and 211 mg/L, respectively.

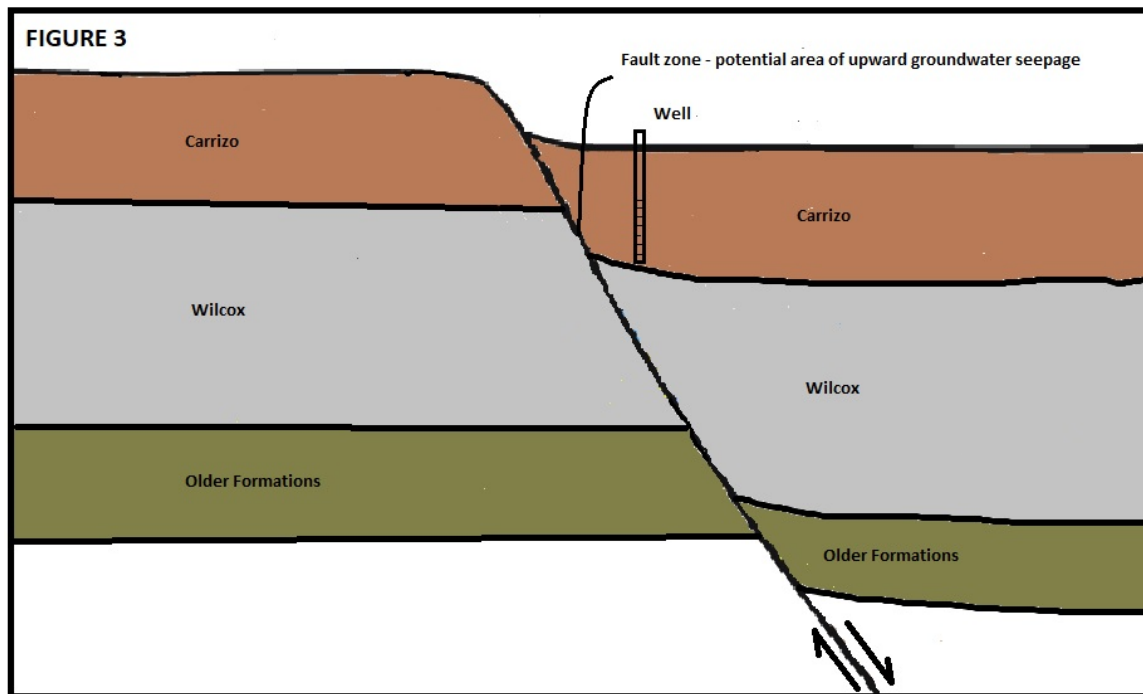
3) Comparison of the TDS fault-line well values with the average TDS values of the associated wells indicates the following calculated factors:

- a) SSLGC-11, 1.6 times higher than the average value for the associated wells; and
- b) MWCZ-3, 2.9 times higher than the average value for the associated wells.

### CONCLUSION

The salinity in the Carrizo outcrop is more variable with TDS values ranging widely as compared to the range of TDS values in the SSLGC Well Field. This salinity comparison indicates, as ground water moves deeper down dip, the change in salinity is complex and becomes less variable. Also, in certain situations, salinity may not increase with depth.

With regard to MWCZ-3, the data suggests upward movement of saline ground water into the Carrizo along the Nash Creek fault and other faults associated with this well. Likewise in the down dip SSLGC-11 well, data also suggests movement of saline water upward into the Carrizo along the Sandies-O'Neal fault. Figure 3 depicts the typical type of faulting in the area and potential for upward movement of ground-water along the fault trace.



In selecting drilling sites for large capacity Carrizo wells, care should be taken not to locate a well site near a fault where water quality is a concern. However, in some situations, overall water quality of the well field can be improved by locating next to a fault.

## REFERENCES

- Hamlin, H.S., 1988, Depositional and ground-water flow systems of the Carrizo-Upper Wilcox, south Texas: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations 175, 61 p.
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