Technical Memorandum

To: Dirk Aaron, General Manager – Clearwater Underground Water Conservation District
From: Michael Keester, PG
Date: May 5, 2020
Subject: Evaluation of Groundwater Pumping in Travis and Williamson Counties

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Over the last few years, the Texas Water Development Board ("TWDB") estimates of groundwater production (TWDB, 2020b) in Travis and Williamson counties have remained relatively stable or generally decreased. These estimates of groundwater pumping are based on Water Use Survey data along with TWDB staff research and professional opinions (http://www.twdb.texas.gov/waterplanning/waterusesurvey/faq.asp). The Texas Water Code and Texas Administrative Code requires any entity that receives a Water Use Survey to complete it within 60 days.

Municipal and industrial are two types of surveys sent out each year. The municipal surveys are primarily for community public water systems. The industrial surveys are for manufacturing and mining users that use more than 10,000,000 gallons per year, "or use a significant volume of water for the industrial sector for a particular area of the state." Electric power generation plants are also included under the industrial surveys.

While the TWDB estimates of groundwater production show a general decrease in recent years, using readily available well databases (TWDB, 2020a; TWDB, 2020c; TCEQ, 2020) we observe a steady increase in the number of wells in each county. Figure 1 and Figure 2 illustrate the reported estimated groundwater pumping and the number of wells from the databases for Travis and Williamson counties, respectively. Figure 3 illustrates the combined values for both counties.

The consistent increase in the number of production wells raises questions about the corresponding decrease in the estimated groundwater pumping. While it is likely groundwater pumping did decrease in the Edwards (BFZ) Aquifer due to a greater utilization of surface water supplies by municipalities, there remain questions regarding the decrease in Trinity Aquifer groundwater pumping. In particular, a decrease in estimated groundwater pumping in the Trinity Aquifer would suggest a corresponding rise in water levels, however, water levels in the Middle and Lower Trinity aquifers in northwest Williamson County have generally declined over the last several years (Keester, 2018a). Also, associated with the growth in wells is signficant rural population growth and growth in the number and surface area of quarries (Keester, 2018b). In addition, there remain questions regarding the estimated amount of irrigation groundwater pumping as there are at least eight irrigation wells associated with three golf courses in Sun City in Williamson County (Keester, 2019). These factors suggest there would be some growth in the amount of groundwater pumping along with the growth in the number of wells.

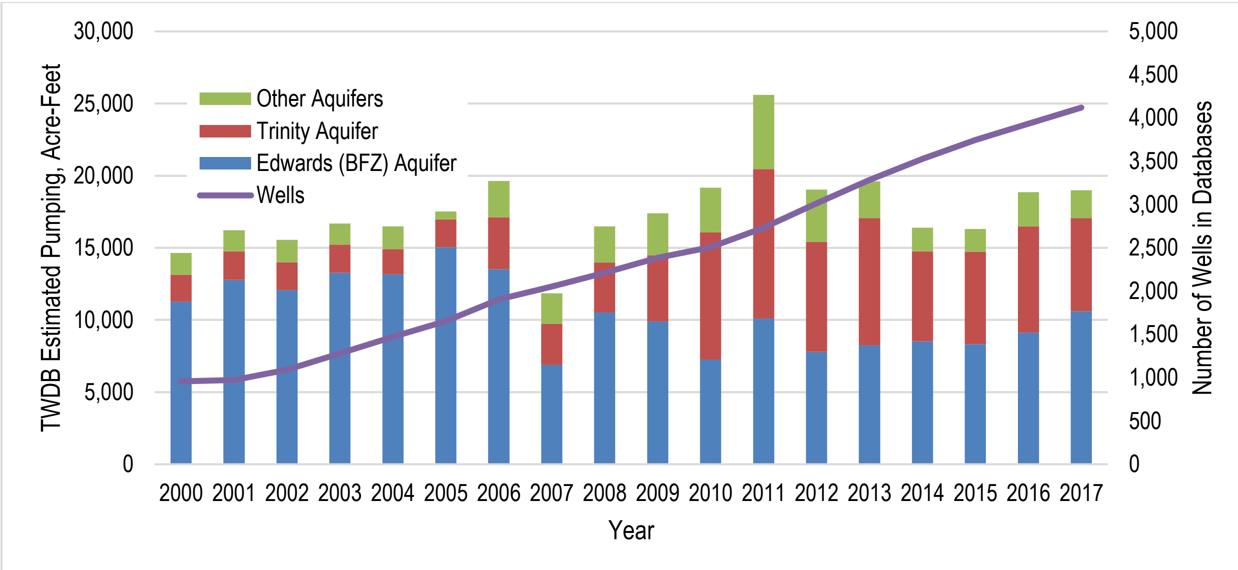

Figure 1. Travis County TWDB reported groundwater pumping estimate and the number of wells in public databases.

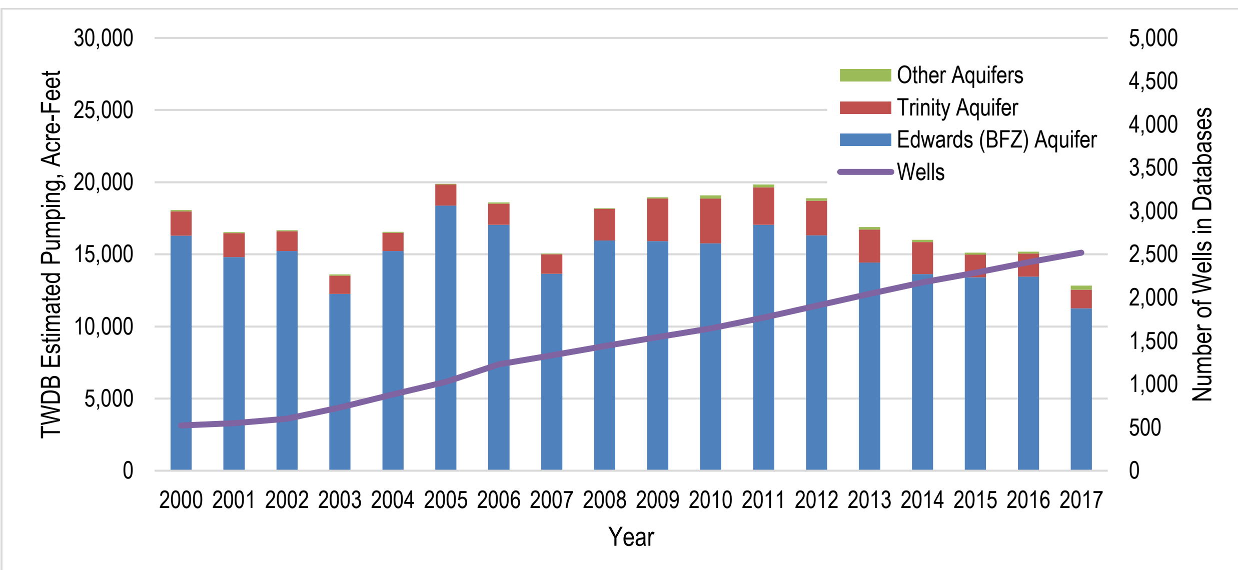

Figure 2. Williamson County TWDB reported groundwater pumping estimate and the number of wells in public databases.

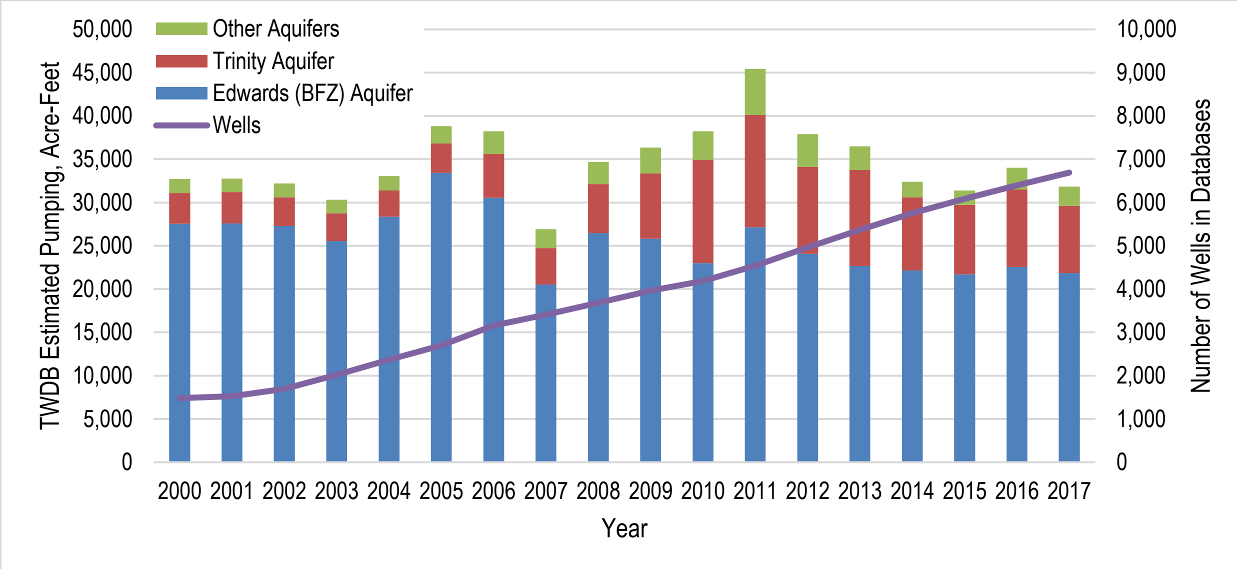

Figure 3. Travis and Williamson counties TWDB reported groundwater pumping estimate and the number of wells in public databases.

Methodology

To assess how groundwater pumping may have changed with the number of wells completed, we began by obtaining all of the wells in Travis and Williamson counties from the TWDB Groundwater Database (TWDB, 2020a), the Submitted Drillers Report Database (TWDB, 2020c), and the Texas Commission on Environmental Quality ("TCEQ") public water supply wells (TCEQ, 2020). From these wells, we excluded wells that would not contribute to groundwater production such as geothermal wells, environmental soil borings, test wells, monitoring wells, injection wells, unused wells, or wells with an associated plugging report. We then cross-referenced the three databases to remove duplicate entries. The result was a total of 7,448 wells within the two counties which is only a portion of the total number of wells as many are not included in the three databases. The Submitted Drillers Report Database was started in 2001 and began collecting all reports in 2003 (TWDB, 2020c). Wells drilled prior to 2003 may not be in one of the databases and would not be reflected in the total number of wells used in our analysis.

As a comparison, the Clearwater Underground Water Conservation Distrit database contained nearly 5,700 wells at the end of 2019. At the end of 2002 which was the first year with well registrations, there were 3,633 wells. Review of the TWDB and TCEQ databases shows about 1,100 existing wells in 2019 or 20 percent of the registered wells within the District. As this comparison suggests, there are many more wells within Travis and Williamson counties than reflected in the public databases. However, it is likely the wells from the three databases provide a reasonably representative sample of the wells within each county and aquifer for assessing potential changes in production. For purposes of our evaluation, we will focus on the number of wells and potential changes in production since 2000.

For wells that were not already associated with an aquifer in one of the databases or from the investigation of subsidence risk due to groundwater pumping (Furnans and others, 2018), we assigned an aquifer to the well based on the depth of the well, the producing interval of the well, the elevation of the aquifer layers as defined in the groundwater availability model for the northern Trinity and Woodbine aquifers (Kelley and others, 2014), or information from other nearby wells. For purposes of this evaluation, we assigned each well to the Edwards (BFZ), Upper Trinity, Middle Trinity, Lower Trinity, Lower Wilcox, or Other (typically alluvial) aquifer. Figure 4 and Figure 5 illustrate the number of wells in each aquifer in Travis and Williamson counties, respectively. Figure 6 shows the combined number of wells from the public databases for the two counties.

We used the databases to determine or estimate the casing size for each of the wells and assigned a maximum potential production amount to each casing size (see Table 1). While there are many well construction factors that control the actual groundwater pumping rate obtainable from a well (for example, depth to water, friction losses, and uphole velocity), the maximum potential production amounts associated with the casing size provide a way for us to develop the relative distribution of groundwater pumping across the study area. The values presented in Table 1 are based on general assumptions regarding potential production and capacity of submersible pumps with diameters that would fit inside the casing.

For wells where the casing size was not available, we used the average casing size associated with the assigned use. We also simplified the use categories associated with each well to match the categories from the TWDB groundwater pumping estimates (TWDB, 2020b). Table 2 provides the use categories from the well databases and associated category from the TWDB groundwater pumping estimates assigned as the well use. The TWDB groundwater pumping estimates do not include domestic groundwater pumping, but Table 2 also shows which wells we included in our domestic use estimates.

For domestic wells, we simply assumed groundwater production of 140 gallon per person per day with three persons per well (0.47 acre-feet per year). For other uses, as a baseline for the groundwater pumping estimates based on the number of wells, we began with the 2003 TWDB groundwater pumping estimate (TWDB, 2020b). For each year from 2000 through 2019, we determined the number of wells within the casing size interval (Table 1) for each type of use (Table 2). We then determined the maximum assigned groundwater pumping associated with the casing size for 2003. Using the maximum assigned pumping, we determined the percentage of the total maximum assigned pumping associated with each casing size in that use category. Next, we muliplied that percentage by the total TWDB estimated 2003 groundwater pumping for that use from the aquifer. We then established the equivalent amount per well for 2003 and used that value for each additional well constructed in future years. Table 3 illustrates the method for calculating the 2003 per well pumping estimate associated with each casing size for irrigation pumping from the Edwards (BFZ) Aquifer.

For subsequent years, we then used the 2003 total estimate associated with each casing size and added the amount per well multiplied by the number of new wells. For example, in 2004 the databases listed 33 irrigation wells with casing more than 4 inches and up to 6 inches in diameter completed in the Edwards (BFZ) Aquifer which is an increase of 17 new wells from the 16 wells reportedly in the aquifer in 2003. Using the 2003 total groundwater pumping estimated for the ">4 to 6" inch casing of 14.42 acre-feet (see Table 3) we add 15.32 acre-feet of additional groundwater pumping (17 wells multiplied by 0.90 acre-feet per well) to determine the estimated 2004 irrigation pumping from the Edwards (BFZ) Aquifer for irrigation use from wells with casing more than 4 inches and up to 6 inches in diameter.

For the layers of the Trinity Aquifer, we followed the same method by first determining the per well estimates for the Trinity Aquifer as a whole. We then used the number of wells associated with each use, casing size, and division of the Trinity to estimate the groundwater pumping from the Upper, Middle, and Lower Trinity aquifers.

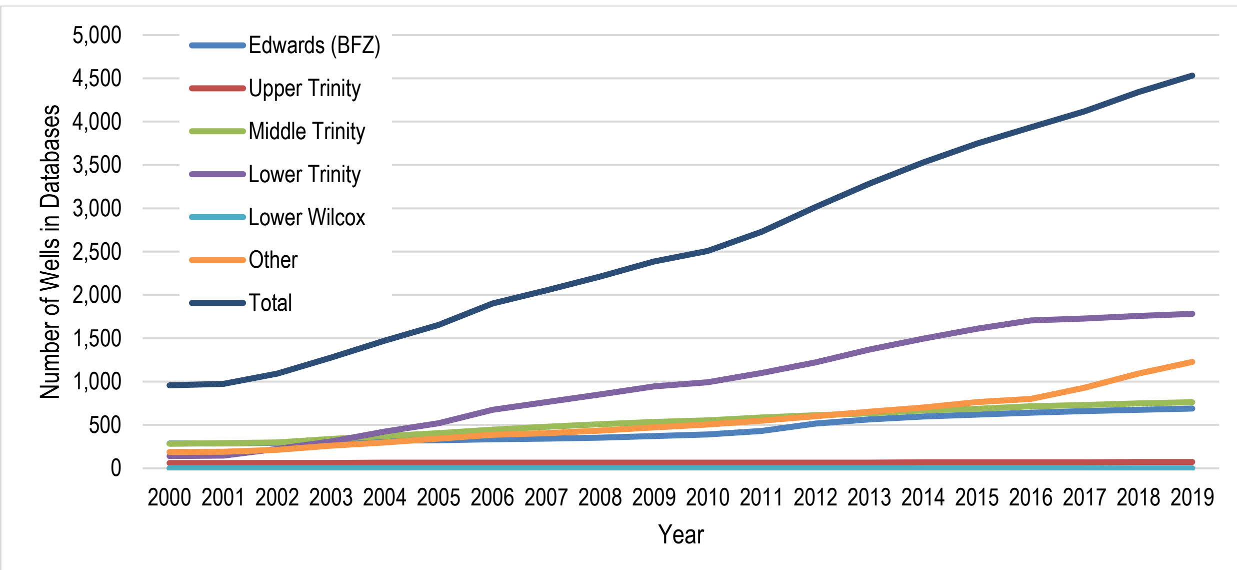

Figure 4. Travis County number of wells in the public databases completed in each aquifer.

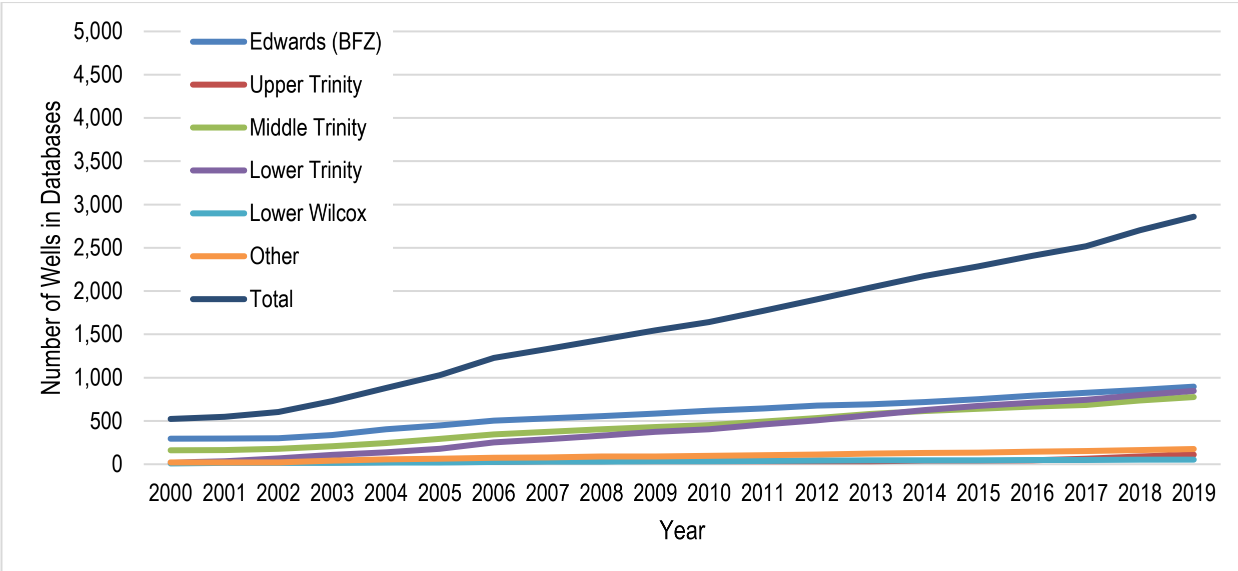

Figure 5. Williamson County number of wells in the public databases completed in each aquifer.

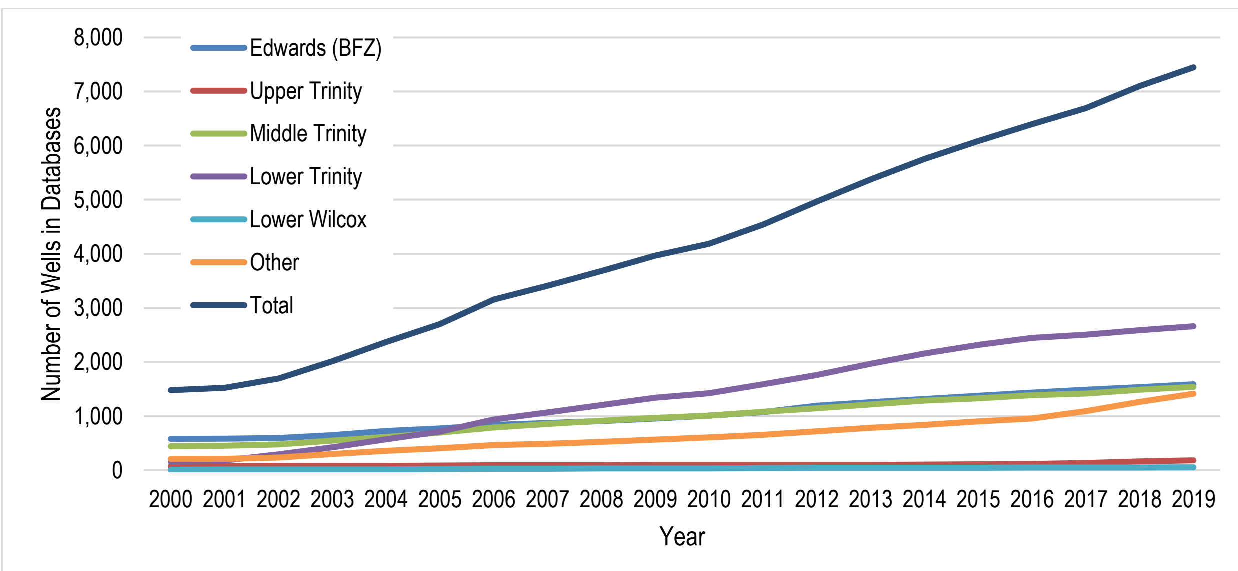

Figure 6. Travis and Williamson counties number of wells in the public databases completed in each aquifer.

Table 1. Casing size and assigned maximum production volume associated with the casing size.

Reported Casing Size (Inches)	Maximum Assigned Pumping (Acre-Feet per Year)
Up to 4	10
>4 to 6	50
>6 to 8	250
>8 to 10	500
>10 to 12	800
More than 12	2,000

Table 2. Use categories applied to wells for estimating groundwater pumping.

Well Use from Database	Applied TWDB Use Category
<null>	Domestic
Commercial	Manufacturing
De-watering	Mining
Domestic	Domestic
Fire	Municipal
Industrial	Manufacturing
Irrigation	Irrigation
Other	Domestic
Public Supply	Municipal
Recreation	Municipal
Rig Supply	Mining
Stock	Livestock
Unknown	Domestic

Table 3. Estimated per well production from the Edwards (BFZ) Aquifer per casing size for irrigation use in 2003.

Casing Size (Inches)	Up to 4	>4 to 6	>6 to 8	>8 to 10	>10 to 12	>12
Number of Wells	3	16	8	25	2	3
Maximum Assigned Pumping (Acre-Feet)	30	800	2,000	12,500	1,600	6,000
Percent of Total Maximum Assigned Pumping	0.1%	3.5%	8.7%	54.5%	7.0%	26.2%
Estimated Actual Pumping (Acre-Feet)*	0.54	14.42	36.04	225.24	28.83	108.12
Estimated Actual Pumping per Well (Acre-Feet)	0.18	0.90	4.50	9.01	14.42	36.04

*TWDB total 2003 estimated groundwater pumping for irrigation use from the Edwards (BFZ) Aquifer = 413.18 acre-feet.

Using the total estimated groundwater pumping per year associated with each aquifer, use, and casing size we evenly distributed the groundwater pumping to wells that were completed on or prior to the year being considered. That is, if a well was completed in 2009, groundwater pumping was only assigned to the well in the year 2009 and following.

For some aquifers, uses, and casing sizes some data were missing for calculating a per well estimate of production. For example, we may have estimated groundwater pumping from the TWDB datasets, but no wells in the databases. Or we may have no wells with a specified casing diameter in the databases until some year after 2003. Table 4 summarizes the assumptions we applied where data were incomplete.

Table 4. Assumed production per well for aquifers, uses, and/or casing sizes without corresponding data for year 2003.

Aquifer	Use Category	Casing Size (Inches)	Estimated Pumping per Well (Acre-Feet per Year)	Comment
Edwards (BFZ)	Mining	>4 to 6	184.4	1,844.4 acre-feet in 2003; No wells in database until 2014; All pumping from TX Crushed Stone
Trinity	Mining	>4 to 6	2	3 wells in database, but no 2003 pumping estimate
Upper Trinity	Irrigation	>4 to 6	2	No wells in database until 2006
Upper Trinity	Manufacturing	>4 to 6	2	No wells in database until 2019
Lower Trinity	Irrigation	>6 to 8	5	No wells in database until 2016
Lower Trinity	Manufacturing	>4 to 6	2	No wells in database until 2004
Lower Wilcox	Irrigation	>4 to 6	Varies	Set total pumping equal to manufacturing estimates. Databases have no manufacturing use wells
Other	Municipal	>4 to 6	2.03	No wells in database until 2019; Used Trinity Aquifer per well estimate
Other	Irrigation	>6 to 8	6.60	No wells in database until 2015; Used Trinity Aquifer per well estimate
Other	Manufacturing	>4 to 6	0.66	No wells in database until 2015; Used Trinity Aquifer per well estimate
Other	Manufacturing	>6 to 8	3.75	5 wells in database, but no 2003 pumping estimate; Used 2002 per well estimate
Other	Livestock	>4 to 6	2.03	No wells in database until 2009; Used Trinity Aquifer per well estimate

Groundwater Pumping Estimates

The groundwater pumping estimates derived from the growth in the number wells suggest that groundwater pumping may be greater than reflected in the TWDB estimates. As previously mentioned, we understand how groundwater pumping could decrease from some sources due to greater reliance on other water supplies. However, review of the well databases, particularly the Submitted Drillers Reports (TWDB, 2020c), indicates that since year 2000 wells have been completed in the Middle and Lower Trinity aquifers at a higher rate than most other aquifers in Travis and Williamson counties with most of the completed wells being between more than 4 and up to 6 inches in diameter (see Table 5 and Table 6). As shown on Table 7 and Table 8, the highest rate of well completions is typically for domestic use with irrigation use commonly the second highest use designation for new wells.

Table 5. Number of new wells per casing size completed since 2000 (TCEQ, 2020; TWDB, 2020a; TWDB, 2020c).

		Maximum Casing Size (Inches)						All
County	**Aquifer**	**4**	**6**	**8**	**10**	**12**	**>12**	**Wells**
Travis	**Edwards (BFZ)**	25	351	8	15	0	6	**405**
	Upper Trinity	0	11	1	0	0	0	**12**
	Middle Trinity	2	435	5	37	0	0	**479**
	Lower Trinity	1	1,624	20	3	18	0	**1,666**
	Lower Wilcox	0	0	0	0	0	0	**0**
	Other	65	917	30	25	10	1	**1,048**
	All Aquifers	*93*	*3,338*	*64*	*80*	*28*	*7*	***3,610***
Williamson	**Edwards (BFZ)**	21	527	23	19	0	14	**603**
	Upper Trinity	1	75	18	0	0	0	**94**
	Middle Trinity	0	583	25	11	0	0	**619**
	Lower Trinity	0	806	21	1	7	2	**837**
	Lower Wilcox	8	31	1	6	0	0	**46**
	Other	3	151	2	1	0	0	**157**
	All Aquifers	*33*	*2,173*	*90*	*38*	*7*	*16*	**2,357**
Total	**Edwards (BFZ)**	46	878	31	34	0	20	**1,009**
	Upper Trinity	1	86	19	0	0	0	**106**
	Middle Trinity	2	1,018	30	48	0	0	**1,098**
	Lower Trinity	1	2,430	41	4	25	2	**2,503**
	Lower Wilcox	8	31	1	6	0	0	**46**
	Other	68	1,068	32	26	10	1	**1,205**
	All Aquifers	*126*	*5,511*	*154*	*118*	*35*	*23*	***5,967***

Table 6. Average number of wells per casing size completed per year from 2000 through 2019 (TCEQ, 2020; TWDB, 2020a; TWDB, 2020c).

		Maximum Casing Size (Inches)						All
County	Aquifer	4	6	8	10	12	>12	Wells
Travis	Edwards (BFZ)	1.25	17.55	0.40	0.75	0	0.3	**20.25**
	Upper Trinity	0.00	0.55	0.05	0.00	0.00	0.00	**0.60**
	Middle Trinity	0.10	21.75	0.25	1.85	0.00	0.00	**23.95**
	Lower Trinity	0.05	81.20	1.00	0.15	0.90	0.00	**83.30**
	Lower Wilcox	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Other	3.25	45.85	1.50	1.25	0.50	0.05	**52.40**
	All Aquifers	*4.65*	*166.90*	*3.20*	*4.00*	*1.40*	*0.35*	***180.5***
Williamson	Edwards (BFZ)	1.05	26.35	1.15	0.95	0.00	0.70	**30.20**
	Upper Trinity	0.05	3.75	0.90	0.00	0.00	0.00	**4.70**
	Middle Trinity	0.00	29.15	1.25	0.55	0.00	0.00	**30.95**
	Lower Trinity	0.00	40.30	1.05	0.05	0.35	0.1	**41.85**
	Lower Wilcox	0.40	1.55	0.05	0.30	0.00	0.00	**2.30**
	Other	0.40	7.55	0.10	0.05	0.00	0.00	**7.85**
	All Aquifers	*1.65*	*108.65*	*4.50*	*1.90*	*0.35*	*0.80*	***117.85***
Total	Edwards (BFZ)	2.30	43.90	1.55	1.70	0.00	1.00	**50.45**
	Upper Trinity	0.05	4.30	0.95	0.00	0.00	0.00	**5.30**
	Middle Trinity	0.10	50.90	1.50	2.40	0.00	0.00	**54.90**
	Lower Trinity	0.05	121.50	2.05	0.20	1.25	0.10	**125.15**
	Lower Wilcox	0.40	1.55	0.05	0.30	0.00	0.00	**2.30**
	Other	3.40	53.40	1.60	1.30	0.50	0.05	**60.25**
	All Aquifers	*6.30*	*275.55*	*7.70*	*5.90*	*1.75*	*1.15*	***298.35***

Table 7. Number of new wells per use category completed since 2000 (TCEQ, 2020; TWDB, 2020a; TWDB, 2020c).

County	Aquifer	Municipal	Irrigation	Manufacturing	Mining	Livestock	Domestic	Total
Travis	Edwards (BFZ)	15	269	7	2	3	109	405
	Upper Trinity	0	5	0	0	0	7	12
	Middle Trinity	53	65	1	0	0	360	479
	Lower Trinity	25	280	3	0	4	1,354	1,666
	Lower Wilcox	0	0	0	0	0	0	0
	Other	39	283	10	19	3	694	1,048
	All Aquifers	132	902	21	21	10	2,524	3,610
Williamson	Edwards (BFZ)	24	108	8	0	20	444	604
	Upper Trinity	1	8	6	0	2	77	94
	Middle Trinity	12	53	22	0	15	517	619
	Lower Trinity	12	70	9	0	8	738	837
	Lower Wilcox	6	6	0	0	1	33	46
	Other	1	18	0	1	4	133	157
	All Aquifers	56	263	45	1	50	1,942	2,357
Total	Edwards (BFZ)	39	377	15	2	23	553	1,009
	Upper Trinity	1	13	6	0	2	84	106
	Middle Trinity	65	118	23	0	15	877	1,098
	Lower Trinity	37	350	12	0	12	2,092	2,503
	Lower Wilcox	6	6	0	0	1	33	46
	Other	40	301	10	20	7	827	1,205
	All Aquifers	188	1,165	66	22	60	4,466	5,967

Table 8. Average number of wells per use category completed per year from 2000 through 2019 (TCEQ, 2020; TWDB, 2020a; TWDB, 2020c).

County	Aquifer	Municipal	Irrigation	Manufacturing	Mining	Livestock	Domestic	Total
Travis	Edwards (BFZ)	0.75	13.45	0.35	0.10	0.15	5.45	**20.25**
	Upper Trinity	0.00	0.25	0.00	0.00	0.00	0.35	**0.60**
	Middle Trinity	2.65	3.25	0.05	0.00	0.00	18.00	**23.95**
	Lower Trinity	1.25	14.00	0.15	0.00	0.20	67.70	**83.30**
	Lower Wilcox	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Other	1.95	14.15	0.50	0.95	0.15	34.70	**52.40**
	All Aquifers	6.60	45.10	1.05	1.05	0.5	126.20	**180.50**
Williamson	Edwards (BFZ)	1.20	5.40	0.40	0.00	1.00	22.20	**30.20**
	Upper Trinity	0.05	0.40	0.30	0.00	0.10	3.85	**4.70**
	Middle Trinity	0.60	2.65	1.10	0.00	0.75	25.85	**30.95**
	Lower Trinity	0.60	3.50	0.45	0.00	0.40	36.90	**41.85**
	Lower Wilcox	0.30	0.30	0.00	0.00	0.05	1.65	**2.30**
	Other	0.05	0.9	0.00	0.05	0.20	6.65	**7.85**
	All Aquifers	2.80	13.15	2.25	0.05	2.50	97.10	**117.85**
Total	Edwards (BFZ)	1.95	18.85	0.75	0.10	1.15	27.65	**50.45**
	Upper Trinity	0.05	0.65	0.30	0.00	0.10	4.20	**5.30**
	Middle Trinity	3.25	5.90	1.15	0.00	0.75	43.85	**54.90**
	Lower Trinity	1.85	17.50	0.60	0.00	0.60	104.60	**125.15**
	Lower Wilcox	0.30	0.30	0.00	0.00	0.05	1.65	**2.30**
	Other	2.00	15.05	0.50	1.00	0.35	41.35	**60.25**
	All Aquifers	9.40	58.25	3.30	1.10	3.00	223.30	**298.35**

Of note, the mining use on Table 7 shows zero wells in the layers of the Trinity Aquifer. However, review of well locations shows several wells completed in a layer of the Trinity Aquifer that are associated with quarries. Review of well records shows that drillers typically designate these wells as industrial or domestic wells. While the industrial wells could be assigned a mining use rather than manufacturing per Table 2, there are many industrial wells that are not associated with mining operations. A detailed well-by-well analysis could better categorize each well, but for our estimation purposes such an evaluation was beyond the scope of this project.

As Figure 3 illustrates, most of the estimated groundwater pumping is from the Edwards (BFZ) Aquifer with most of the produced groundwater for municipal use (TWDB, 2020b). Since 2000, within Travis County most new municipal wells are being completed in the Middle or Lower Trinity while in Williamson County the rate of municipal well completion in the Middle and Lower Trinity since 2000 is about the same as for the Edwards

(BFZ). Figure 7 and Figure 8 illustrate the estimated groundwater pumping along with the associated number of wells designated for municipal use in Travis and Williamson counties, respectively.

As stated above, domestic wells are the most common new well type in both counties. Also in both counties, domestic wells have most commonly been completed in the Lower Trinity Aquifer since 2000 (see Table 8). Figure 9 and Figure 10 illustrate the estimated groundwater pumping along with the associated number of wells designated for domestic use in Travis and Williamson counties, respectively. On Figure 9 we can easily observe the rapid growth of Lower Trinity Aquifer domestic wells along with the estimated groundwater pumping associated with the new wells.

Considering all designated uses, estimated groundwater production based on the growth in the number of wells is similar between the two counties (see Figure 11 and Figure 12). As shown on Figure 13, total estimated groundwater pumping is about 43,000 acre-feet in 2019 with most of the estimated pumping coming from the Edwards (BFZ) Aquifer. While the estimated Edwards (BFZ) Aquifer pumping is higher than other aquifers, it is important to note the significant increase in the number of Middle and Lower Trinity wells illustrated on Figure 13. The growth in the number of Middle and Lower Trinity wells indicates a greater reliance on the aquifer in recent years.

Figure 14 and Figure 15 compare the estimated groundwater pumping based on the growth in the number of wells with the TWDB (2020b) estimated pumping from the Edwards (BFZ) Aquifer in in Travis and Williamson counties, respectively. When we compare the methods, we observe that in the Edwards (BFZ) Aquifer in Williamson County the TWDB estimated groundwater pumping peaks in 2005 then generally declines through 2017. With our estimate of groundwater pumping correlated to the growth in the number of wells, the difference in estimated pumping from the Edwards (BFZ) Aquifer in Williamson County in 2017 is more than 7,000 acre-feet. However, through the year 2012 in Williamson County the estimates are relatively similar.

In Travis County, the TWDB (2020b) estimated Edwards (BFZ) pumping in 2007 is less than half of the 2005 value of just over 15,000 acre-feet. Since 2007, the TWDB (2020b) estimates of Edwards (BFZ) pumping show an increasing trend similar to the estimated groundwater pumping based on the growth in the number of wells (see Figure 14). While the estimated groundwater pumping based on well growth is higher than the TWDB estimate, the difference in 2017 is less than 3,000 acre-feet.

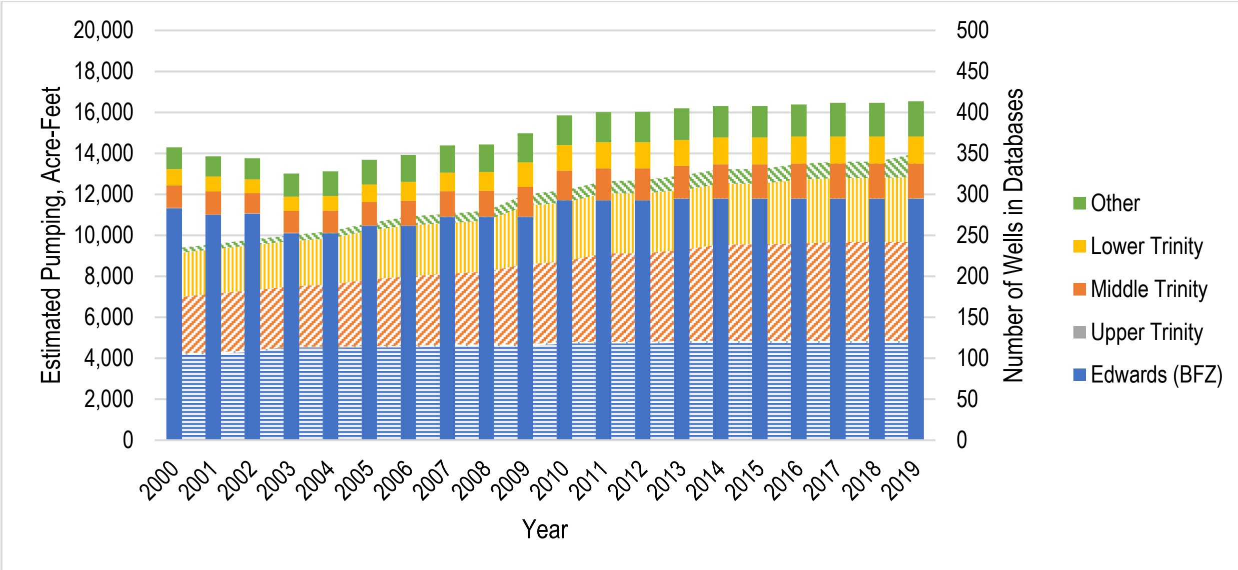

Figure 7. Travis County estimated groundwater pumping (columns) and number of wells (patterned area) designated for municipal use.

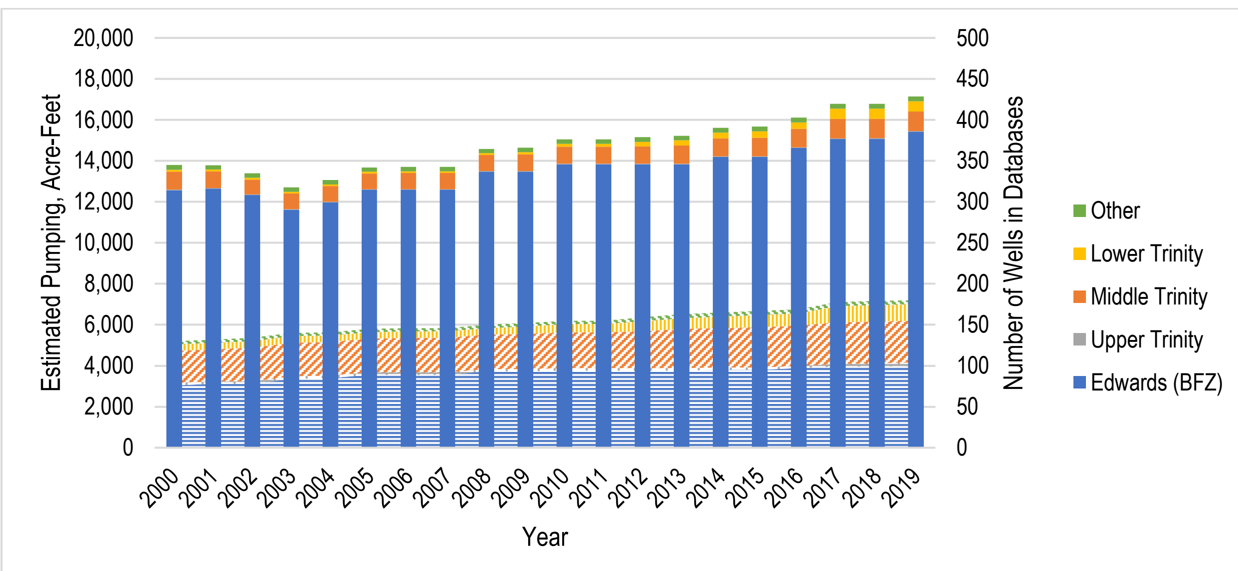

Figure 8. Williamson County estimated groundwater pumping (columns) and number of wells (patterned area) designated for municipal use.

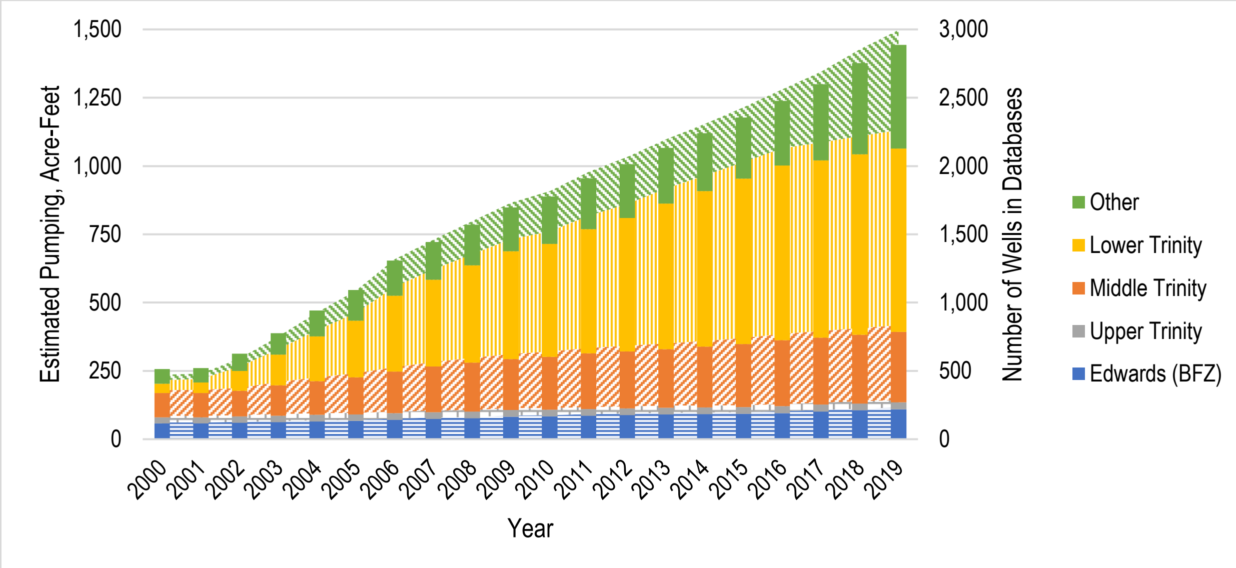

Figure 9. Travis County estimated groundwater pumping (columns) and number of wells (patterned area) designated for domestic use.

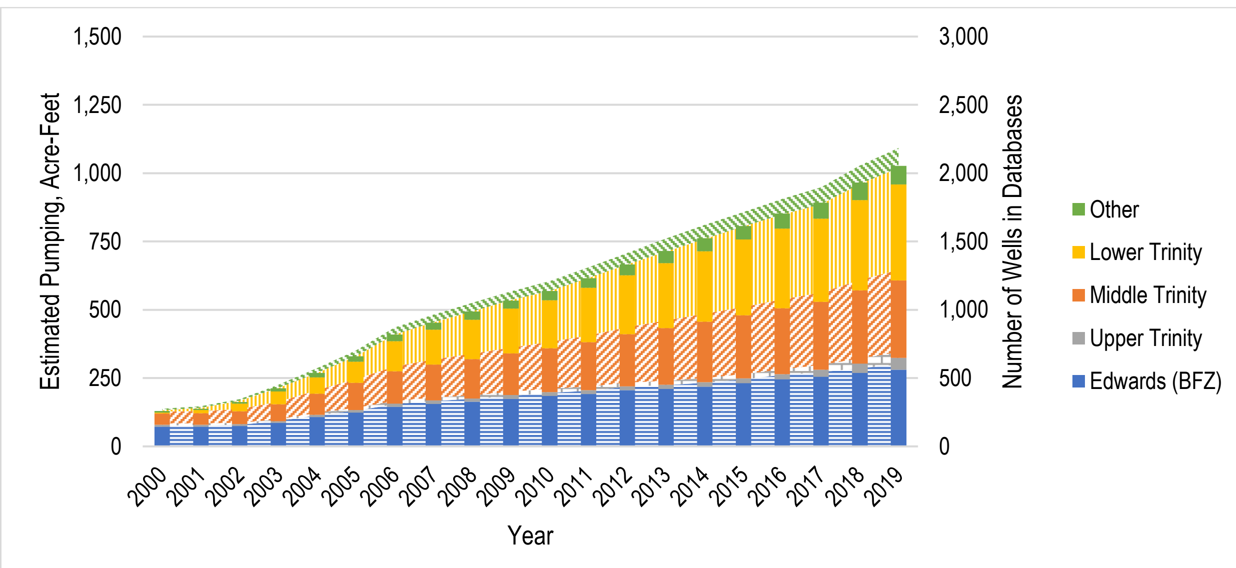

Figure 10. Williamson County estimated groundwater pumping (columns) and number of wells (patterned area) designated for domestic use.

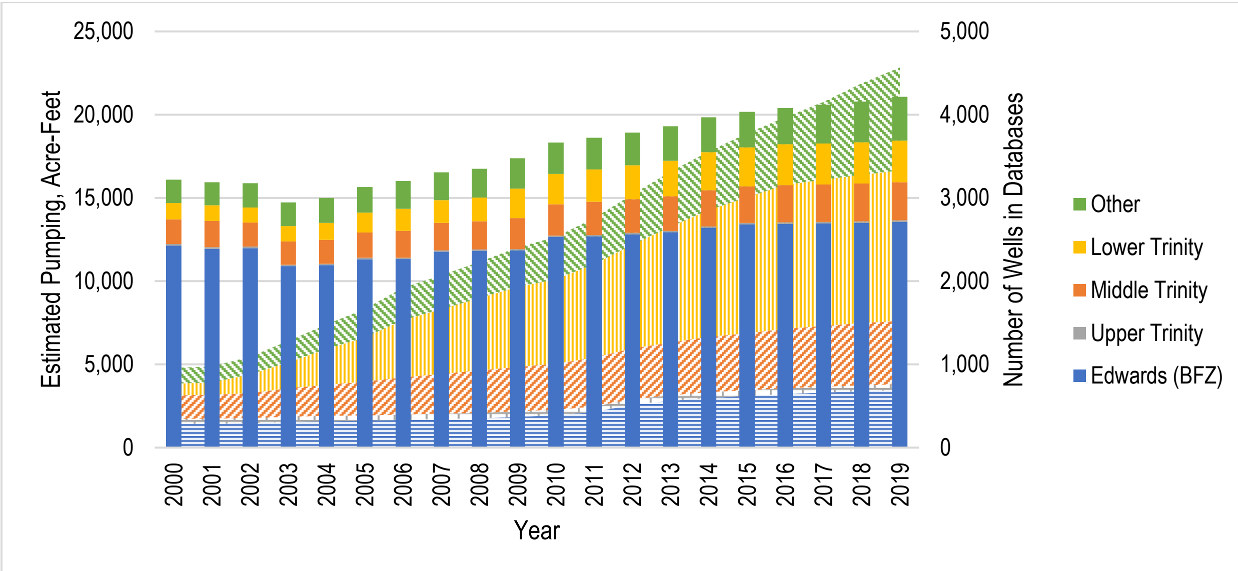

Figure 11. Travis County estimated groundwater pumping (columns) and number of wells (patterned area) for all designated uses.

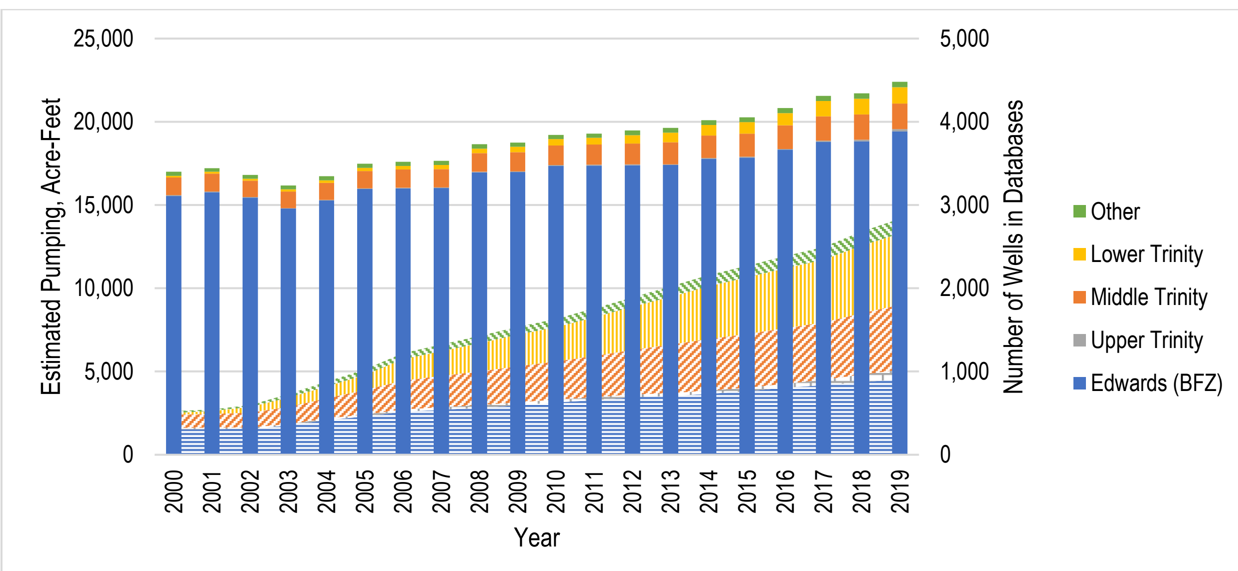

Figure 12. Williamson County estimated groundwater pumping (columns) and number of wells (patterned area) for all designated uses.

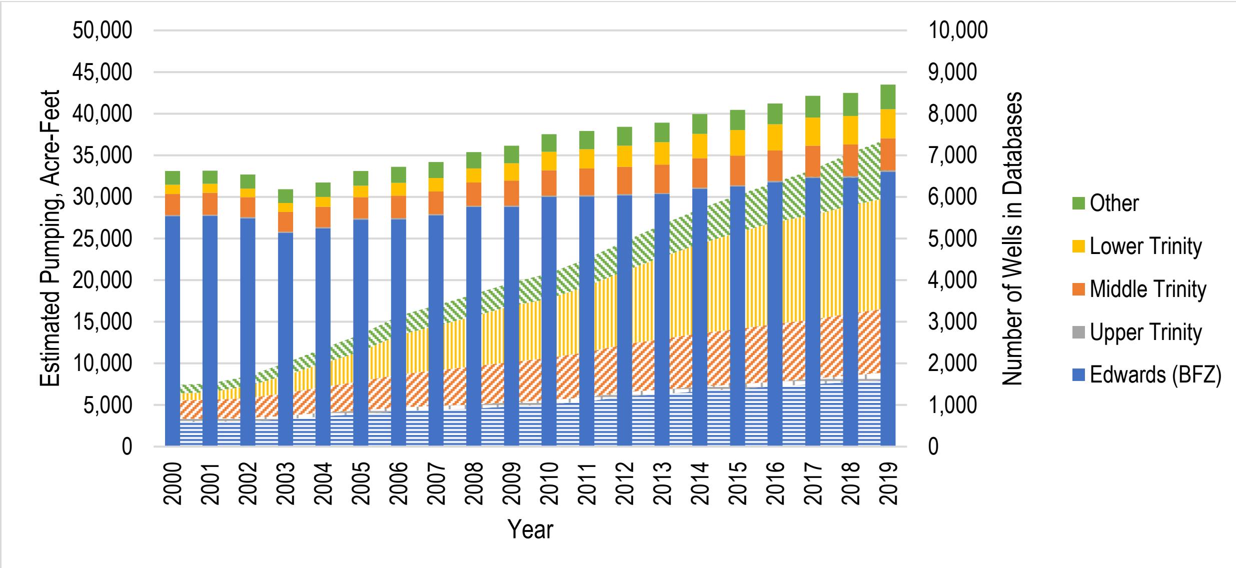

Figure 13. Travis and Williamson counties combined estimated groundwater pumping (columns) and number of wells (patterned area) for all designated uses.

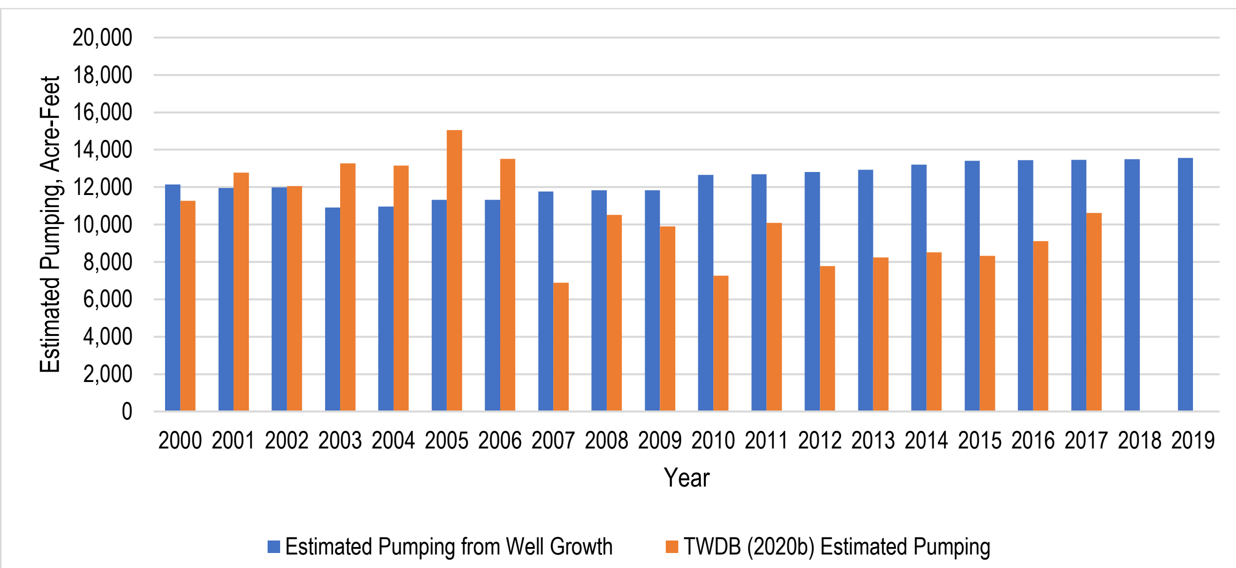

Figure 14. Travis County estimated groundwater pumping from the Edwards (BFZ) Aquifer.

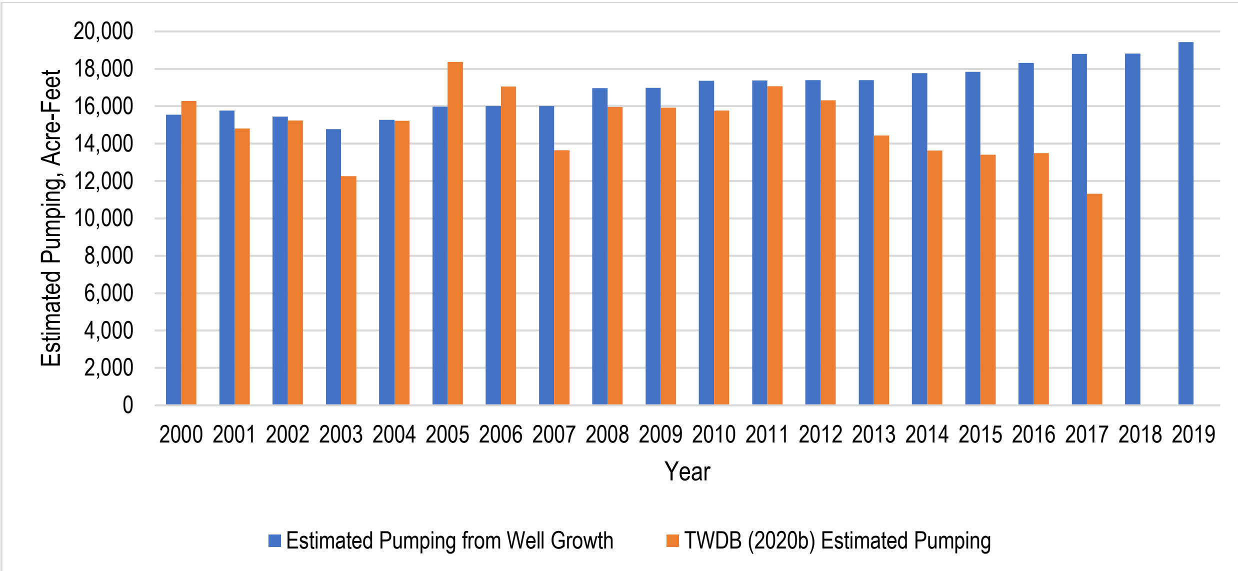

Figure 15. Williamson County estimated groundwater pumping from the Edwards (BFZ) Aquifer.

Figure 16 compares the estimated groundwater pumping based on the growth in the number of wells with the TWDB (2020b) estimated pumping from the Trinity Aquifer in Travis County. The TWDB estimated pumping combines pumping from each layer of the Trinity Aquifer together rather than dividing it between each of the subdivisions. Review of Figure 16 shows that the estimated pumping based on well growth is similar to the TWDB estimate until year 2010. In 2010 through 2013, the TWDB (2020b) estimate of pumping was about double the estimate based on the growth in the number of wells. Since 2013, the TWDB estimated pumping from the Trinity Aquifer is fairly constant at about 6,400 acre-feet per year with about 7,300 acre-feet in 2016. Based on the growth in Lower Trinity Aquifer wells for domestic (67.70 per year) and irrigation (14.00 per year) uses (see Table 8), an underestimation of the per well usage could easily account for the difference in pumping estimates in some years.

Figure 17 compares the estimated groundwater pumping based on the growth in the number of wells with the TWDB (2020b) estimated pumping from the Trinity Aquifer in Williamson County. For Williamson County, we observe a similar pattern to the TWDB pumping estimates in Travis County for the Trinity Aquifer (Figure 16) except in Williamson County the estimates based on well growth are similar only through 2007. TWDB (2020b) estimated pumping from the Trinity Aquifer in Williamson County peaks in 2010 at about 3,000 acre-feet then declines nearly every year through 2017. As shown on Table 8, wells have been added at a rate of 30.95 per year in the Middle Trinity and 41.85 per year in the Lower Trinity since 2000. The increase in the number of wells suggests pumping would increase with the associated uses. While the TWDB (2020b) peak pumping estimate is associated with abnormally dry conditions (https://droughtmonitor.unl.edu/Data/Timeseries.aspx), we would expect a leveling off of estimated pumping (such as Figure 16 shows for Travis County) or a general increase as suggested by the continued growth in the number of wells.

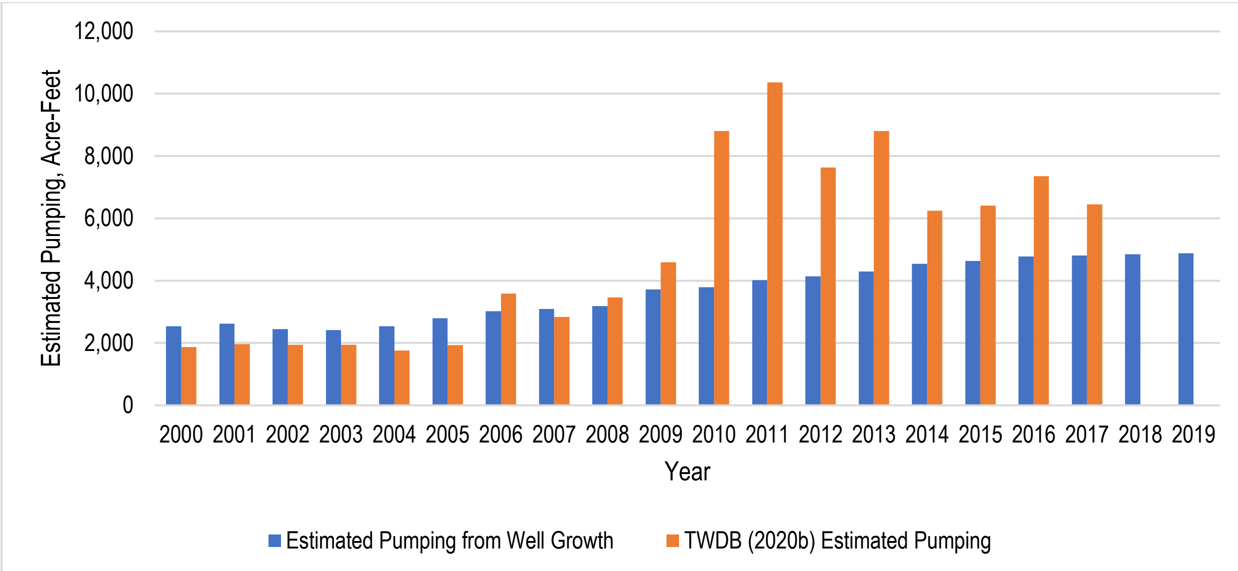

Figure 16. Travis County estimated groundwater pumping from the Trinity Aquifer.

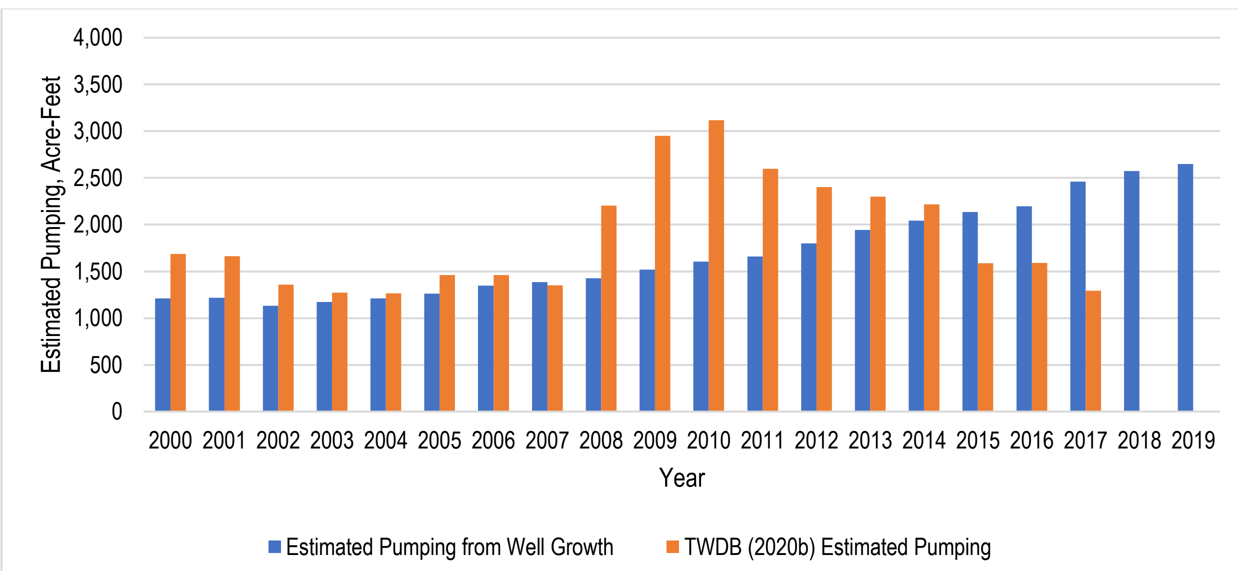

Figure 17. Williamson County estimated groundwater pumping from the Trinity Aquifer.

As shown on Figure 18, for Travis and Williamson counties combined, the TWDB estimate of groundwater pumping and the estimated groundwater pumping based on the growth in the number of wells is similar for the Trinity Aquifer. However, we still observe differing trends in the estimates using the two methods. With domestic and irrigation wells added at average rates of 43.85 per year and 5.90 per year, respectively, in the Middle Trinity since 2000 along with an average of 17.50 irrigation wells and 104.60 domestic wells per year in the Lower Trinity, we would not expect long-term declines in pumping.

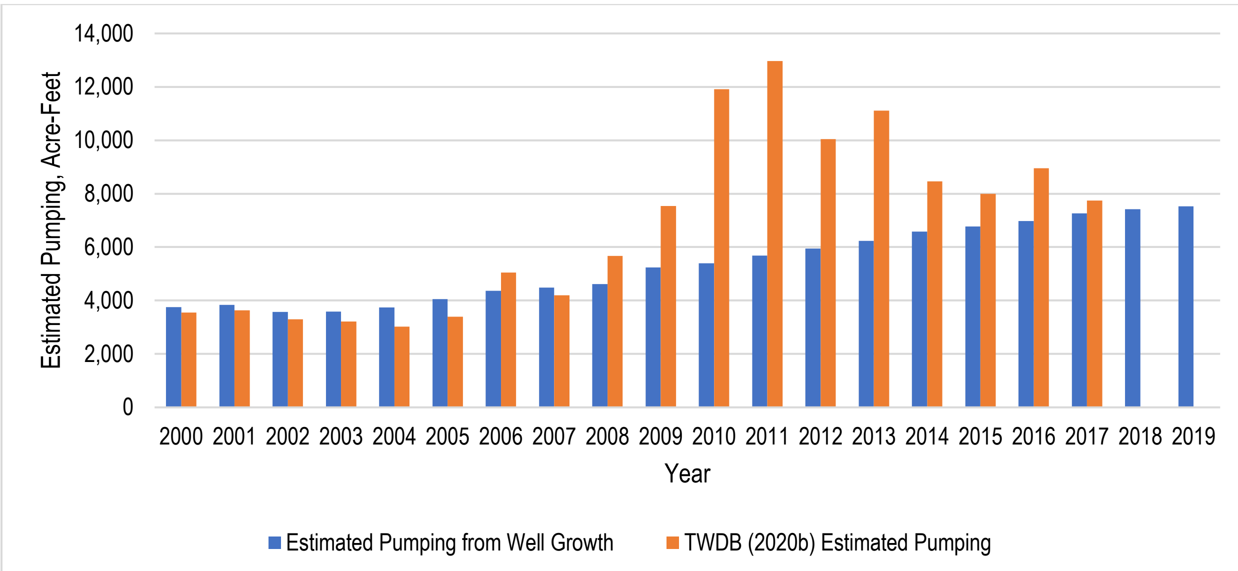

Figure 18. Travis and Williamson counties estimated groundwater pumping from the Trinity Aquifer.

Figure 19 illustrates the total estimated pumping from all aquifers within Travis and Williamson counties. We observe in the figure that pumping estimates from the TWDB and those based on the growth in the number of wells are relatively similar through 2012. We also observe that through 2012 the TWDB estimated pumping generally increased as the number of wells increased as reflected by the estimated pumping from well growth (also see Figure 3). After 2012, the TWDB pumping estimates show a declining trend with much of the declining trend due to the estimated declines in Trinity Aquifer pumping.

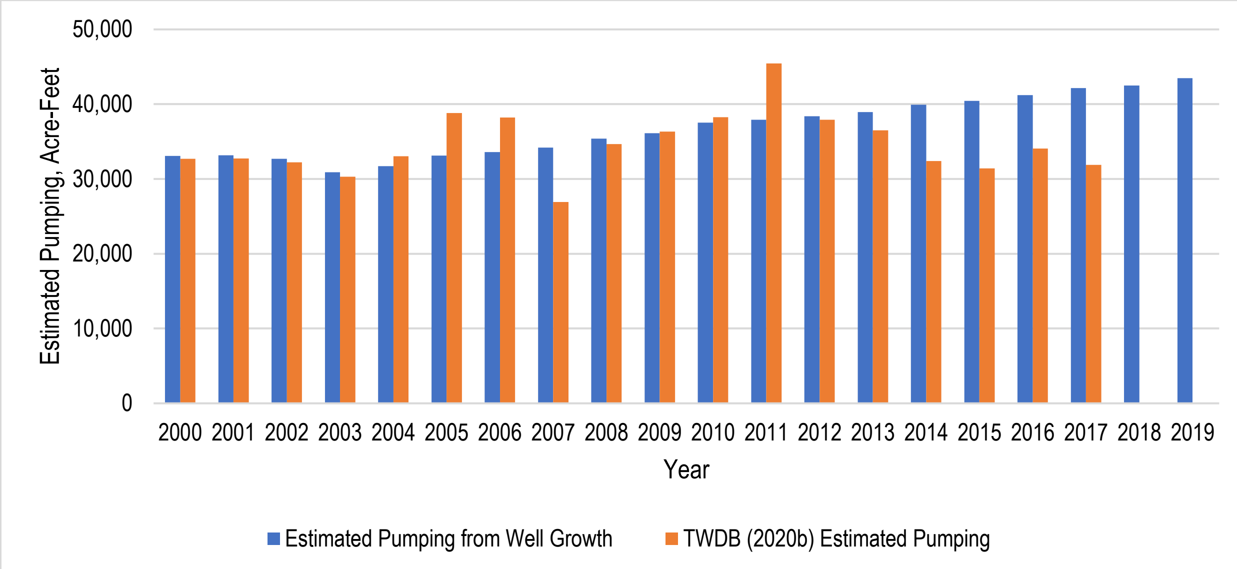

Figure 19. Travis and Williamson counties estimated groundwater pumping from the Edwards (BFZ), Trinity, and other aquifers.

Limitations

Our evaluation of the potential groundwater pumping is correlated to the growth in the number of water wells within our study area. The changes in pumping are tied to the number of wells we were able to identify from readily accessible databases with the assumption that more wells results in more groundwater pumping. While our analysis does account for wells being plugged, it does not consider the transition from groundwater to alternate water supplies. We would expect this limitation to apply primarily to estimates of municipal pumping which would result in a decrease in the total estimated production.

In addition, our evaluation does not address how pumping may vary based on climatic conditions. During a very dry year, pumping may be greater than would be predicted based on the number of wells and a per well pumping amount while the opposite would apply during a wet year. However, the estimate of pumping based on the number of wells should provide a reasonable long-term estimate of the changes in pumping.

Our analysis is also tied to the TWDB estimated groundwater pumping in 2003. To establish a baseline estimate of the amount of pumping per existing well, in most cases we used the 2003 estimated pumping per use and aquifer to determine the estimated production per well, use, casing diameter, and aquifer. While most of the per well estimates are reasonable, an undercount of the number of existing wells would lead to too high of an estimate per well. Also, if the TWDB estimated pumping for 2003 is too low, then the estimated pumping per well would be too low.

TWDB (2020b) estimates of groundwater pumping are based on Water Use Survey data along with TWDB staff research and professional opinions (http://www.twdb.texas.gov/waterplanning/waterusesurvey/faq.asp). It is certainly the best available information regarding estimated groundwater production, but there remains some uncertainty in the estimates when compared with the growth in the number of water wells and estimated use patterns in other nearby areas. In addition, review of the survey data associated with reporting entities reveals some entities with only a few years or a single year of pumping data and subsequent years should potentially be included in pumping estimates.

Conclusions

The growth in the number of wells in Travis and Williamson counties has been relatively consistent since 2000 based on information from publicly available databases. With an increase in the number of groundwater production wells, we would expect a corresponding increase in pumping. However, TWDB pumping estimates suggest pumping has been relatively consistent or decreasing within the two counties, especially in recent years. The pumping estimates derived from the growth in the number wells suggest that pumping may be greater than reflected in the TWDB estimates.

Estimates of pumping based on the growth in the number of wells are inherently uncertain because they do not account for the use of alternate water supplies or the fluctuations in use that may occur under varying climate conditions. Nonetheless, the estimates of pumping based on the growth in the number of wells should provide a reasonable estimate of pumping when building upon a baseline pumping amount. Our observation that the number of production wells is increasing consistently (TCEQ, 2020; TWDB, 2020a; TWDB, 2020c), but pumping estimates (TWDB, 2020b) in Travis and Williamson counties are not following a similar trend suggests the pumping from some aquifers may be more than the current TWDB estimates suggest, particularly in recent years.

Most of the new wells in Travis and Williamson counties are being completed in the Trinity Aquifer. In addition, most of these new wells are for domestic purposes. For these wells, we would not expect annual production to decline significantly unless it becomes too difficult to pump water due to insufficient available drawdown associated with declining water levels. We are aware that such water level declines in the Trinity Aquifer are occurring, which suggests that pumping is continuing to occur and likely increasing with the growth in the number of wells.

Geoscientist Seal

This report documents the work of the following licensed professional geoscientists with LRE Water, LLC, a licensed professional geoscientist firm in the State of Texas (License No. 50516).

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