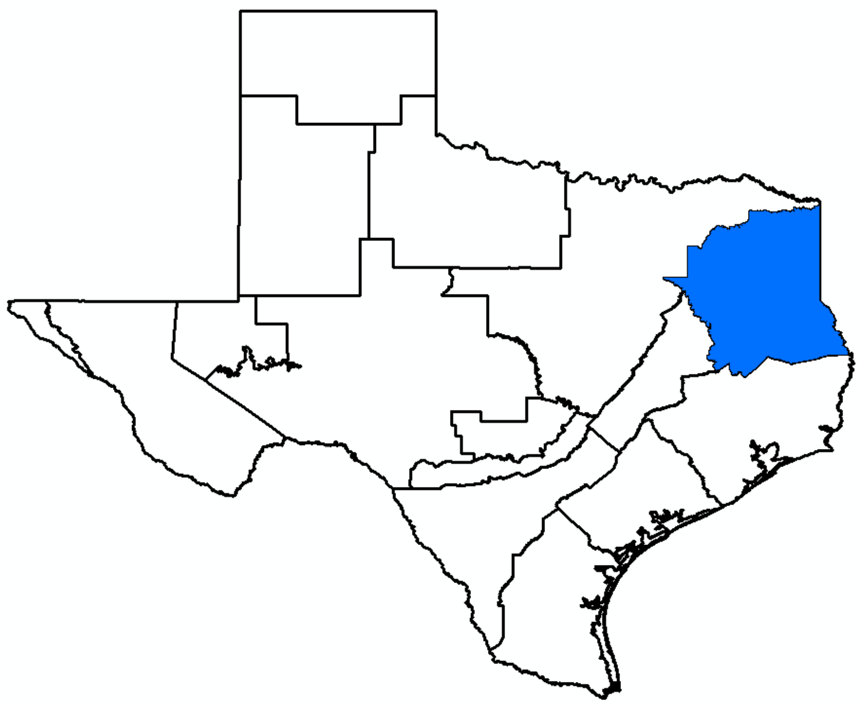
Desired Future Condition Explanatory Report (Final)
Carrizo-Wilcox/Queen City/Sparta Aquifers for Groundwater Management Area 11



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Desired Future Condition Explanatory Report (Final)
Carrizo-Wilcox/Queen City/Sparta Aquifers for Groundwater Management Area 11

Geoscientist and Engineering Seal

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Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 Groundwater Management Area 11

Groundwater Management Area 11 is one of sixteen groundwater management areas in Texas, and covers a large portion of the northeast part of the state (Figure 1).

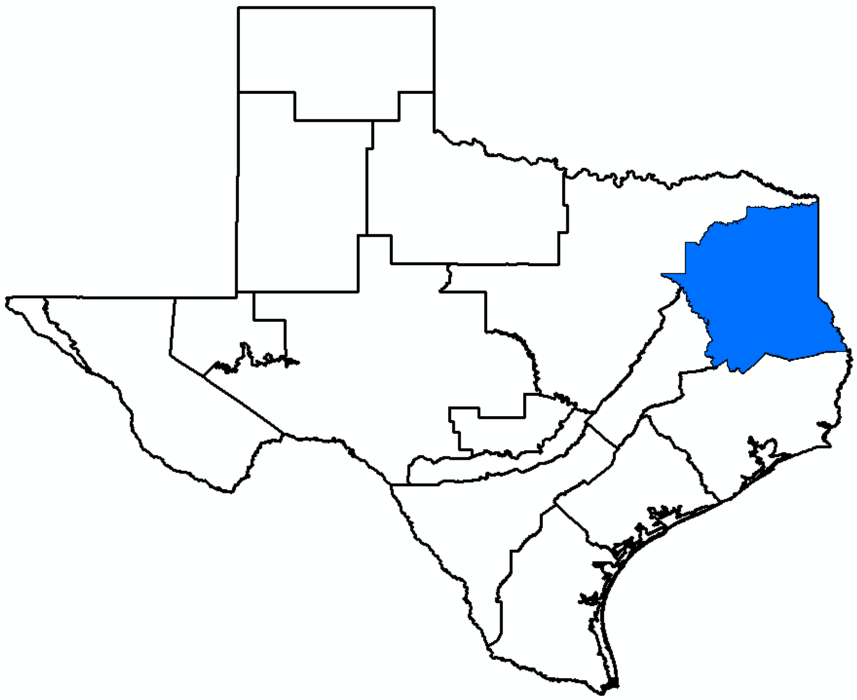

Figure 1. Groundwater Management Area 11

Groundwater Management Area 11 covers all or portions of the following counties: Anderson, Angelina, Bowie, Camp, Cass, Cherokee, Franklin, Gregg, Harrison, Henderson, Hopkins, Houston, Marion, Morris, Nacogdoches, Panola, Rains, Rusk, Sabine, San Augustine, Shelby, Smith, Titus, Trinity, Upshur, Van Zandt, and Wood (Figure 2).

There are four groundwater conservation districts in Groundwater Management Area 11: Neches & Trinity Valleys Groundwater Conservation District, Panola County Groundwater Conservation District, Pineywoods Groundwater Conservation District, and Rusk County Groundwater Conservation District (Figure 3).

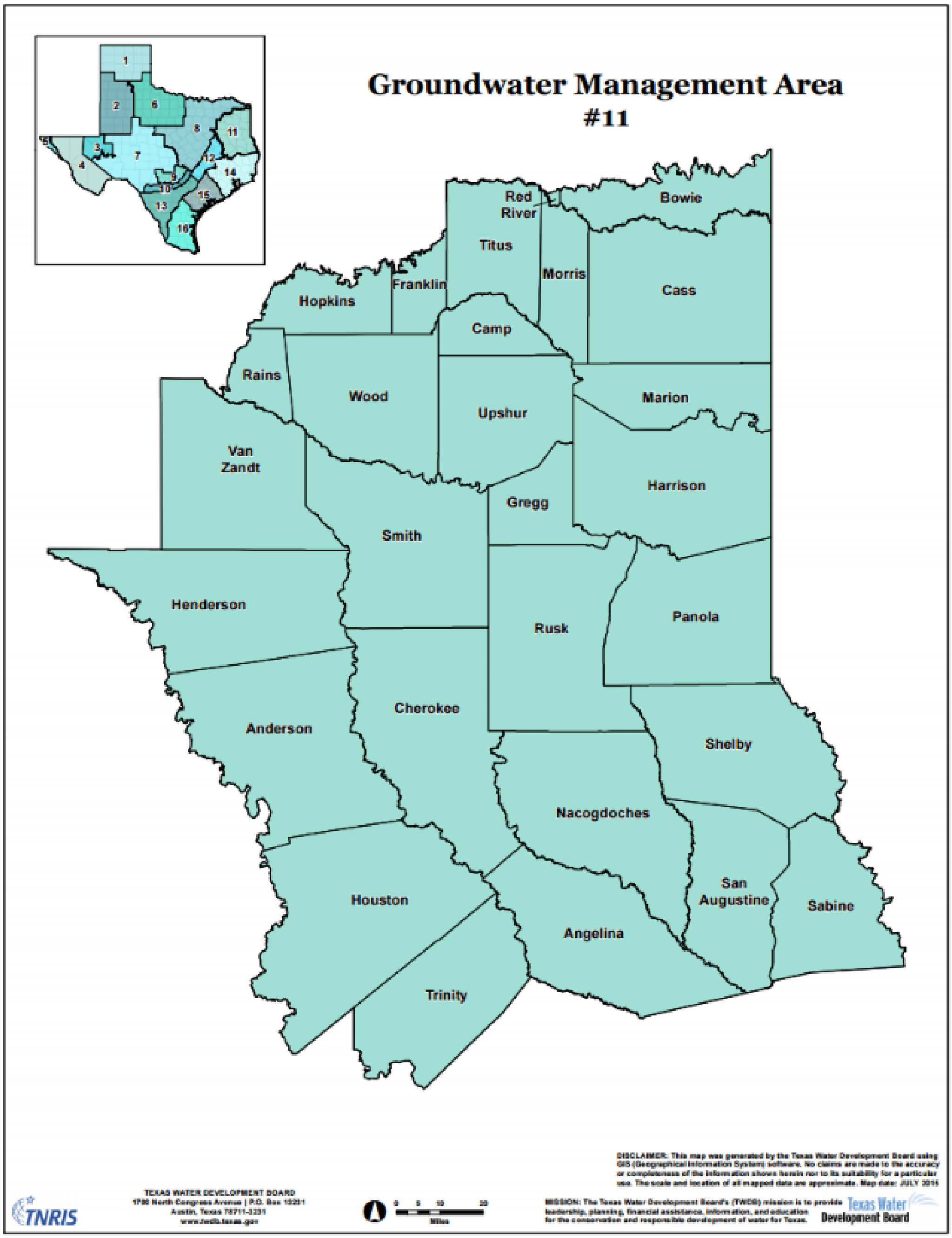

Figure 2. Counties Entirely or Partially in GMA 11 (from TWDB)

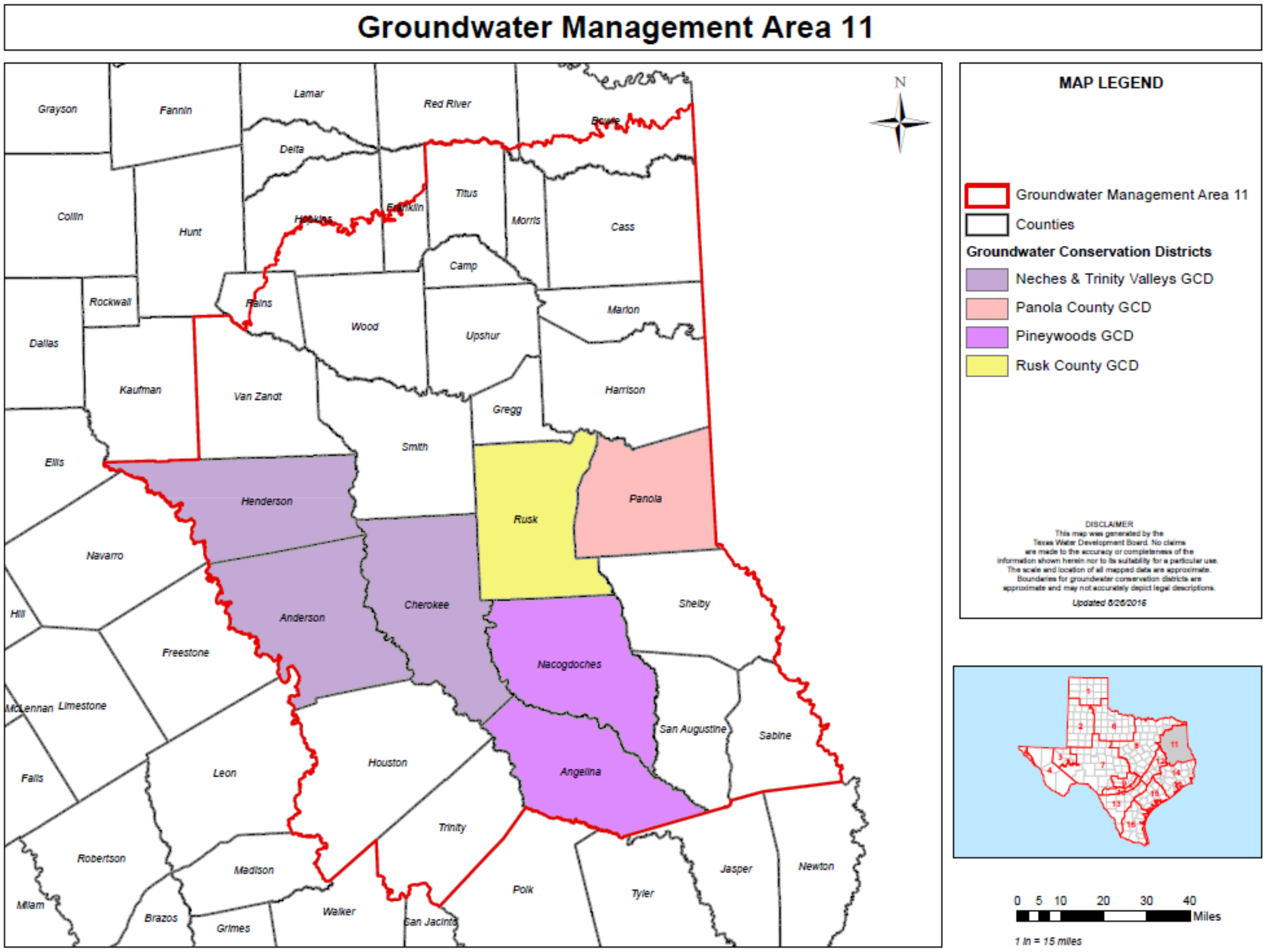

Figure 3. Groundwater Conservation Districts in GMA 11 (from TWDB)

2.0 Desired Future Condition

2.1 Background

The joint planning process is a result of HB 1763 that was adopted by the Texas State Legislature in 2005. Every five years, groundwater conservation districts within a groundwater management area must adopt desired future conditions (DFCs) for relevant aquifers within the groundwater management area. Desired future conditions are defined as a quantified condition of groundwater at a specified time or times in the future. Once the desired future conditions are adopted, the Texas Water Development Board calculates the modeled available groundwater (MAG) for the aquifer, which is the amount of pumping that will achieve the desired future condition. The desired future condition is essentially a planning goal.

As a result of the definition of desired future condition (i.e. quantified condition), and the use of models to calculate the modeled available groundwater, groundwater availability models are an important aspect of developing desired future conditions. The Texas Water Development Board developed groundwater availability models for nearly all aquifers in the state. These are used by groundwater conservation districts and regional planning groups as tools to define groundwater availability. However, as with any model, there are limitations to their use. These limitations must be considered and understood when using the results or output from the model.

In 2010, GMA 11 adopted desired future conditions for the Sparta, Queen City, and Carrizo-Wilcox aquifers. The desired future conditions were expressed in terms of average drawdown from 2000 to 2060. The overall average drawdown for GMA 11 for all aquifers was 17 feet. A table was also included in the desired future condition resolution that listed average drawdown for each county and each model layer. This table was generated from a simulation using the groundwater availability model of the area. This approach provided a means for the Texas Water Development Board to calculate modeled available groundwater values.

The use of average drawdown for purposes of developing desired future conditions is often confusing and misunderstood. Common misunderstandings include stating that the average drawdown is the same everywhere in the entire area of interest (i.e. county). Variations in pumping locations and amounts, and the natural variation of aquifer hydraulic conductivity and thickness will always result in varying drawdowns within the area of interest. In general, a regional average positive drawdown suggests that pumping has increased during the period of interest. Zero drawdown suggests that pumping is relatively constant. Negative drawdown suggests that there has been a pumping reduction. However, as is developed further in the technical memoranda that were developed as part of this proves, the presence of “negative drawdowns”, or groundwater level increases, are the result of model limitations.

In 2010, there were instances where simulated future pumping was less than historic pumping as defined in the calibrated model. This, as expected, resulted in groundwater level recoveries (i.e. negative drawdown). In other instances, (i.e. the Queen City Aquifer) pumping was significantly above historic amounts.

The development of the desired future conditions by GMA 11 in 2010 was based on evaluating a range of alternative model simulations, and understanding the impacts of different amounts of pumping. During the development of the desired future condition in 2010, there was virtually no public input, despite numerous efforts to seek input from key stakeholders in GMA 11 by groundwater conservation district representatives.

In response to specific input from various stakeholders, this round of joint planning included integration of the planned Forestar project and all the recommended and alternative water management strategies in the regional water plans from Region D and Region I. This additional pumping was included as a base case, and the effects of decreasing and increasing the base pumping was evaluated. The process also included a closer evaluation of the output of the model and addressing more fully the limitations of using the model to develop desired future conditions. A key objective of developing the base case was that all pumping was the same as or greater than historic pumping as a means to reduce or eliminate planned groundwater level recoveries. However, as developed as described in the technical memoranda that were developed as part of this process, there continued to be instances of negative drawdown which are attributable to model limitations.

2.2 Adopted Desired Future Condition

Appendix A is the resolution that was adopted by GMA 11 regarding the desired future conditions for the Carrizo-Wilcox, Queen City, and Sparta aquifers. GMA 11 Technical Memorandum 16-02 (Draft 2), dated March 25, 2016, summarizes how the results of groundwater availability model simulations were used to developed the desired future conditions for the Sparta, Queen City, and Carrizo-Wilcox aquifers for GMA 11.

Table 5 from GMA 11 Technical Memorandum 16-02 (Draft 2), dated March 25, 2016 lists the proposed desired future conditions, and is presented below in Table 1. As described in the technical memorandum, the proposed desired future conditions are average drawdowns (in feet) from year 2000 conditions to 2070 conditions were largely based on GAM Scenario 4. Based on an analysis of model output and model limitations, the output from the model was modified to develop the proposed desired future conditions as follows:

- Layers 2 and 4 (the confining units) were eliminated, and Table 5 includes only aquifer units. Areas that have no active cells are designated as NP (for not present).
- Layers 5, 6, 7, and 8 are combined, and a single drawdown value for the Carrizo-Wilcox Aquifer are listed
- All areas that are less than 200 square miles are eliminated (noted as NRS, or not relevant for purposes of joint planning due to size of area).
- Areas with negative drawdown that are greater than 200 square miles have had the negative drawdown cells eliminated from the average drawdown calculation, effectively assuming that those cells have a zero drawdown, and that the negative drawdown areas are a result of model limitations, as discussed (designated in yellow).
- The desired future condition in Panola County for the Carrizo-Wilcox Aquifer is listed as 3 feet. The actual average using all data from the model is 2 feet. If the areas with negative

drawdown are assumed to be zero, the revised average is 4 feet. As presented at the March 22, 2016 GMA 11 meeting, Mr. Wade Oliver (representing the Panola County GCD) evaluated the average drawdown under Scenario 4 using an alternative analytical modeling approach and concluded that the drawdown was 3 feet. Thus, Mr. Oliver's result is consistent with the midpoint between the two GAM-based drawdown approaches. The PowerPoint and a report of Mr. Oliver's analysis are presented in Appendix B.

Table 1. Desired Future Conditions - Average Drawdown (ft) from 2000 to 2070

County	Sparta Aquifer	Queen City Aquifer	Carrizo-Wilcox Aquifer
Anderson	NRS	9	90
Angelina	16	NRS	48
Bowie	NP	NP	5
Camp	NP	NRS	33
Cass	NP	10	68
Cherokee	NRS	14	99
Franklin	NP	NP	14
Gregg	NP	NRS	58
Harrison	NP	1	18
Henderson	NP	5	50
Hopkins	NP	NP	3
Houston	3	6	80
Marion	NP	24	45
Morris	NP	NRS	46
Nacogdoches	5	4	29
Panola	NP	NP	3
Rains	NP	NP	1
Rusk	NP	NRS	23
Sabine	1	NP	9
SanAugustine	2	NP	7
Shelby	NP	NP	1
Smith	NP	17	119
Titus	NP	NRS	11
Trinity	9	NRS	51
Upshur	NP	9	77
VanZandt	NP	NRS	21
Wood	NP	5	89
GMA11	4	10	56

Notes: NP = Not present
NRS = Not Relevant due to size (less than 200 square miles)
Yellow Cells represent average drawdown calculations that assume negative drawdown is zero (model artifact and model limitation)
Green Cell represents the recommended DFC for Panola County as described in report

3.0 Policy Justification

As developed more fully in this report, the proposed desired future condition was adopted after considering:

- Aquifer uses and conditions within Groundwater Management Area 11
- Water supply needs and water management strategies included in the 2016 Regional Water Plans
- Hydrologic conditions within Groundwater Management Area 11 including total estimated recoverable storage, average annual recharge, inflows, and discharge
- Other environmental impacts, including spring flow and other interactions between groundwater and surface water
- The impact on subsidence
- Socioeconomic impacts reasonably expected to occur
- The impact on the interests and rights in private property, including ownership and the rights of landowners and their lessees and assigns in Groundwater Management Area 11 in groundwater as recognized under Texas Water Code Section 36.002
- The feasibility of achieving the desired future condition
- Other information

In addition, the proposed desired future condition provides a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater in Groundwater Management Area 11.

There is no set formula or equation for calculating groundwater availability. This is because an estimate of groundwater availability requires the blending of policy and science. Given that the tools for scientific analysis (groundwater models) contain limitations and uncertainty, policy provides the guidance and defines the bounds that science can use to calculate groundwater availability.

As developed more fully below, many of these factors could only be considered on a qualitative level since the available tools to evaluate these impacts have limitations and uncertainty.

4.0 Technical Justification

4.1 Groundwater Availability Model

The proposed desired future condition for the Carrizo-Wilcox/Queen City/Sparta Aquifers was developed based on simulations of alternative scenarios of future pumping using the Groundwater Availability Model (GAM) of the northern Carrizo-Wilcox, Queen City, and Sparta aquifers (Kelley and others, 2004). This GAM superseded the GAM of the northern Carrizo-Wilcox Aquifer (Fryar and others, 2003). The GAM used in this process was developed to make predictions of groundwater availability through 2050 based on current projections of groundwater demands during drought-of-record conditions (Kelley and others, 2004, pg. xxvii). The calibration period for the GAM was 1980 to 1989, and the verification period was 1990 to 1999. The documentation for the GAM stated that the GAM provides an "integrated tool for the assessment of water management strategies to directly benefit state planners, Regional Water Planning Groups (RWPGs), and Groundwater Conservation Districts (GCDs)". Furthermore, the documentation stated that based on the model grid (one square mile), the GAM is "not capable of predicting aquifer responses at specific points such as a particular well", and that the GAM is "accurate at the scale of tens of miles, which is adequate to understand groundwater availability at the regional scale" (Kelley and others, 2004, pg. xxviii).

Conceptually, the model simulates groundwater flow in eight layers as shown in Figure 4. Due to the vertical interaction between aquifer units that is simulated in the GAM, the proposed desired future condition for all three aquifers were developed together.

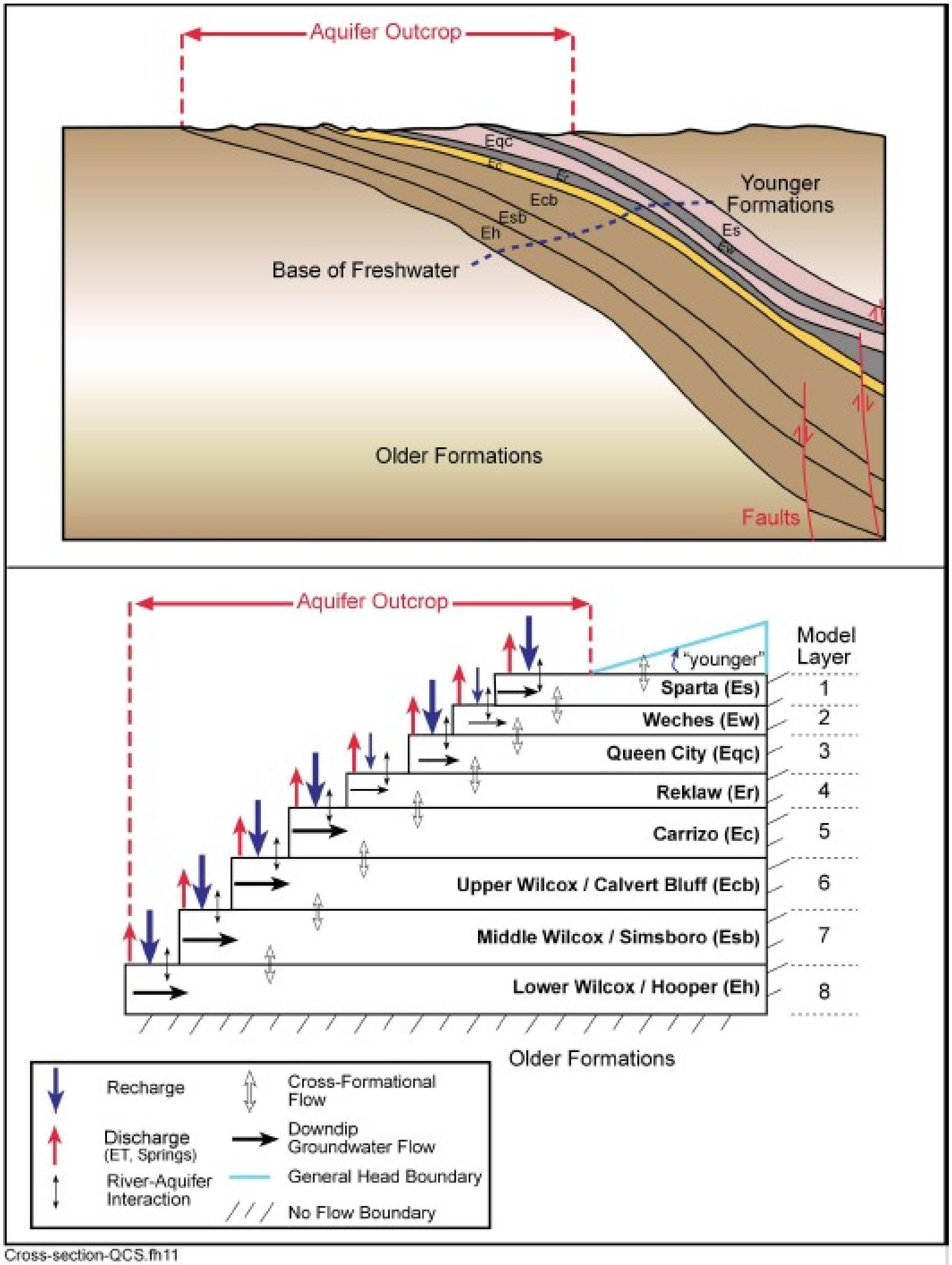

Figure 4. Conceptual Model of Flow (from Kelley and others, 2004, Figure 5.1)

4.2 Limitations of the Groundwater Availability Model

The limitations of the groundwater model for use in this process were of importance to GMA 11 and to stakeholders. Initially, GMA 11 worked to develop a base scenario that included future pumping equal to the current modeled available groundwater (MAG), plus the planned Forestar project and all recommended and alternative strategies from the regional water plans (Region D and Region I) as a base case. This base case was designated as Scenario 4. GMA 11 also reviewed the results of Scenarios 1, 2 and 3, which represented decreased pumping as compared to the base case, and the results of Scenarios 5, 6, and 7, which represented increased pumping as compared to the base case. Details of the results of these scenarios were summarized in Technical Memorandum 15-01, and were discussed at the November 4, 2015 GMA 11 meeting.

The simulations were run from 2000 to 2070. The Groundwater Availability Model (GAM) for the area was calibrated from 1975 to 1999. Thus, the simulations simply started where the calibrated model ended, and continued through the planning period that is defined by the Texas Water Development Board guidelines for this round of joint planning.

The results showed that there were areas within GMA 11 with simulated rising water from 2000 to 2070. This was attributed to the fact that the last year of the calibration period (1999) was a dry year, and the simulation assumed average recharge conditions from 2000 to 2070. With no change in pumping in an area, it would be expected that groundwater levels would rise because of the increased recharge after 1999. To address this issue, an attempt was made to extend the calibration period of the model to 2013.

At the November 4, 2015 meeting where the simulations were discussed, a recommendation was made to attempt to update the calibration period of the model to have a more recent starting date for desired future conditions, and to address negative drawdowns. In general, the attempt was unsuccessful. However, as developed in Technical Memorandum 16-01, the effort yielded a better understanding of the limitations of the model for desired future condition development that were used by GMA 11. In summary, it appears that the rising water levels are a result of the inability of the model to discharge the water that comes from precipitation. The result is that the negative drawdowns in Scenario 4 as documented in Technical Memorandum 15-01 could be considered zero drawdowns.

4.3 Use of the Groundwater Availability Model in the Joint Planning Process

The process of using the groundwater model in developing desired future conditions revolves around the concept of incorporating many of the elements of the nine factors (e.g. current uses and water management strategies in the regional plan). In GMA 11, several model runs were completed and the results discussed prior to adopting a desired future condition. Some critics of the process asserted that the districts were “reverse-engineering” the desired future conditions by specifying pumping (e.g., the modeled available groundwater) and then adopting the resulting drawdown as the desired future condition. However, it must be remembered that among the input parameters for a predictive groundwater model run is pumping, and among the outputs of a predictive groundwater model run is drawdown. Thus, an interactive or iterative approach of running several predictive scenarios with models and then evaluating the results is a necessary (and time-consuming) step in the process of developing desired future conditions.

One part of the reverse-engineering critique of the process has been that "science" should be used in the development of desired future conditions. The critique plays on the unfortunate name of the groundwater models in Texas (Groundwater Availability Models) which could suggest that the models yield an availability number. This is simply a mischaracterization of how the models work (i.e. what is a model input and what is a model output).

The critique also relies on a narrow definition of the term *science* and fails to recognize that the adoption of a desired future condition is primarily a policy decision. The call to use science in the development of desired future conditions seems to equate the term *science* with the terms *facts* and *truth*. Although the Latin origin of the word means knowledge, the term *science* also refers to the application of the scientific method. The scientific method is discussed in many textbooks and can be viewed to quantify cause-and-effect relationships and to make useful predictions.

In the case of groundwater management, the scientific method can be used to understand the relationship between groundwater pumping and drawdown, or groundwater pumping and spring flow. A groundwater model is a tool that can be used to run "experiments" to better understand the cause-and-effect relationships within a groundwater system as they relate to groundwater management.

Much of the consideration of the nine statutory factors involves understanding the effects or the impacts of a desired future condition (e.g. groundwater-surface water interaction and property rights). The use of the models in this manner in evaluating the impacts of alternative futures is an effective means of developing information for the groundwater conservation districts as they develop desired future conditions.

5.0 Factor Consideration

Section 36.108(d) of the Texas Water Code requires that groundwater conservation districts include documentation of how nine listed factors were considered prior to proposing a desired future condition, and how the proposed desired future condition impact each factor. This section of the explanatory report summarizes the information that the groundwater conservation districts used in its deliberations and discussions.

5.1 Aquifer Uses and Conditions

The aquifer uses and conditions were summarized in Technical Memorandum 15-01, and were discussed at the GMA 11 meeting on November 4, 2015.

Historic pumping estimates were developed from the Texas Water Development Board (TWDB) pumping database (1980 and 1984 to 2012) and from the calibrated GAM (1975 to 1999). These estimates were then compared to the current modeled available groundwater (future pumping to meet the desired future condition).

The pumping estimates from TWDB are presented in tabular form in Appendix C for all aquifers. These historic pumping estimates are graphically compared with the calibrated GAM and the current modeled available groundwater (MAG) in Appendix D, organized by aquifer (Sparta, Queen City, and Carrizo-Wilcox). A county map of GMA 11 is also included in Appendix D for reference purposes.

Please note that the estimates for the calibrated GAM also include model input and output. For this GAM, some model cells went dry during the simulation period (1975 to 1999). This causes all pumping in that cell to be set to zero. Thus, in some counties, the input pumping is higher than the output pumping. Since the current DFC is based on a model simulation, the output pumping was used by TWDB to set the MAG.

A brief discussion of the graphs in each aquifer is presented below.

5.1.1 Sparta Aquifer

In general, the TWDB pumping estimates and the calibrated GAM estimates of historic pumping are reasonably close, with a few exceptions. However, these exceptions represent a small amount of pumping.

In general, the modeled available groundwater is higher than the historic pumping, with some notable exceptions. In Houston County, the MAG is higher than the calibrated model, but the TWDB estimates of pumping has increased in recent years. The MAG is lower than the estimated pumping in the last few years.

In Smith and Wood counties, the TWDB includes estimates for pumping from the Sparta Aquifer. The Sparta Aquifer does not exist in these two counties.

Please note that there are no significant differences between input and output pumping from the GAM and that the MAGs are essentially constant from 2010 to 2060. This means that there are no dry cell issues.

5.1.2 Queen City Aquifer

In general, the TWDB pumping estimates and the calibrated GAM estimates of historic pumping are reasonably close, with the exception of Rusk County. However, this exception represents a small amount of pumping.

Except for Rusk County, all MAGs are considerably higher than the estimated historic pumping from the calibrated GAM. In Houston County, the MAG is higher than the calibrated GAM estimate of historic pumping, but lower than a few of the more recent years of estimated pumping from the TWDB pumping database.

Please note that there are no significant differences between input and output pumping from the GAM and that the MAGs are essentially constant from 2010 to 2060. This means that there are no significant dry cell issues.

5.1.3 Carrizo-Wilcox Aquifer

Please note that unlike the Sparta and the Queen City aquifers, there appear to be more instances where TWDB pumping database and calibrated GAM pumping estimates are different. For example, in Anderson County, the rate of increase in pumping is greater in the TWDB database than in the calibrated GAM. The MAG in Anderson County is almost twice the 1999 estimate of pumping from the calibrated model, but about equal to or slightly less than recent pumping estimates from the TWDB database.

In Angelina County, the TWDB database pumping estimates show a decline in pumping during the historic period of record, but these pumping estimates are higher than the calibrated GAM pumping estimates. The MAG in Angelina County is higher than the calibrated GAM historic pumping estimates, but is lower than TWDB pumping estimates of the 1990s.

In Bowie County, the effect of dry cells can be seen in the calibrated GAM estimates. Please note the deviation in input and output pumping estimates in the early 1980s, and the declining MAG values.

In Hopkins County, there appear to be some dry cells (deviation in input and output calibrated GAM pumping and declining MAG). Also, the MAG is lower than both sets of historic pumping. This resulted in “negative drawdown” or recovery for the DFC that was adopted in 2010.

In Nacogdoches County, a significant difference is evident in the TWDB database estimate of historic pumping and the calibrated GAM.

5.1.4 Discussion

Specific issues that needed to be addressed based on this review include resolving differences between TWDB database estimates of historic pumping, calibrated GAM estimates of historic pumping, and developing estimates of future pumping that represent increases in pumping.

The amount of future pumping is largely a policy decision by the representatives of GMA 11. However, from the previous joint planning process, the DFCs and MAGs appear to represent a planning and policy goal of increased pumping in the future. This review was more thorough than during the previous round of joint planning as evidenced by the increased interest in the process now as compared to 2010.

5.2 Water Supply Needs and Water Management Strategies

As described above, the base simulation included estimates of future pumping based on the regional water plan data, and the proposed Forestar project. Six additional simulations would also be completed, three that sequentially increase pumping from the base amounts, and three that sequentially decrease pumping from the base amount. The objective of these simulations is provide the groundwater conservation districts in Groundwater Management Area 11 an opportunity to evaluate alternatives, assess the sensitivity to increases or decreases in pumping, and provide a frame of reference for discussion of the balancing between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater.

Forestar had previously developed three alternative simulations for its proposed project. These simulations were reviewed by the Texas Water Development Board (Oliver, 2012). Scenarios A and B included changes in pumping during the simulation period due to anticipated droughts. Scenario C, on the other hand, represented constant pumping during the simulation period. Because the simulations during the last round of joint planning did not factor changes during drought periods, and because the simulations were based on average conditions during all years, Scenario C of the Forestar proposed project was selected for the simulations as a starting point, since it also included future pumping that was the basis for the DFC and MAG developed in 2010 by GMA 11 (Oliver, 2010).

All simulations used the Scenario C model files as a foundation (Oliver, 2012). These files were selected because they included the Forestar pumping as well as the pumping associated with the DFC adopted in 2010 and the MAG that was issued by the TWDB. The files were modified to extend the simulation to 2070, and thus represented a 71-year simulation (2000 to 2070). Drawdowns were calculated from 1999 conditions (the final stress period of the calibrated model), as was done with the current DFCs.

The well files from Scenario C were replaced by seven new pumping files that were developed as follows:

- Scenario 1 = 70 % of Base Pumping
- Scenario 2 = 80 % of Base Pumping
- Scenario 3 = 90 % of Base Pumping
- Scenario 4 = Base Pumping
- Scenario 5 = 110 % of Base Pumping
- Scenario 6 = 120 % of Base Pumping
- Scenario 7 = 130 % of Base Pumping

Detailed summaries of input pumping are presented in Technical Memorandum 15-01. The base simulation pumping was developed using:

- The simulated pumping file for Scenario C
- The calibrated GAM pumping file
- TWDB pumping database estimates of historic pumping
- Regional Water Group (Regions D and I) groundwater pumping strategies

The results of this analysis are presented in below in Table 1 (Sparta Aquifer), Table 2 (Queen City Aquifer), and Table 3 (Carrizo-Wilcox Aquifer).

5.2.1 Sparta Aquifer

Table 2 summarizes the data associated with developing the base pumping for the simulations for the Sparta Aquifer. Base pumping for the Sparta Aquifer for all but two counties was set equal to that used in the Forestar Scenario C simulations.

Houston County was set higher than Scenario C to reflect the TWDB pumping database pumping estimate. Scenario C included 4,359 AF/yr of pumping in Rusk County. There are only four cells in layer 1 of the model in Rusk County and this pumping was eliminated.

Finally, please note that the TWDB pumping database included estimates of Sparta Aquifer pumping in Morris, Smith and Wood counties that was not included since the aquifer does not exist in these counties.

Region D and Region I had no groundwater pumping strategies for the Sparta Aquifer, so no additional pumping was included.

Table 2. Development of Base Pumping for Simulations - Sparta Aquifer
All Pumping in AF/yr

County	TWDB Pumping Database Estimate for 2012	Calibrated GAM Estimate for 1999	Forestar Scenario C Simulations	RWP Strategies - 2020	RWP Strategies - 2070	Base Pumping for Simulations
Anderson	266	157	616			616
Angelina	93	282	689			689
Cherokee	153	221	359			359
Houston	1,498	709	895			1,498
Morris	6					
Nacogdoches	121	339	408			408
Rusk		0	4,359			0
Sabine	59	66	295			295
San Augustine	175	60	205			205
Smith	961					
Trinity		15	615			615
Wood	54					
Total	**3,386**	**1,849**	**8,441**	**0**	**0**	**4,685**

5.2.2 Queen City Aquifer

Table 3 summarizes the data associated with developing the base pumping for the simulations for the Queen City Aquifer.

Please note that the Scenario C pumping is considerably higher than the historic estimates of pumping, except for Rusk County.

The base pumping for the simulations simply added the pumping for regional water planning group strategies in 2070 to all years in Camp, Smith, Titus, Upshur and Van Zandt counties. It would be reasonable to expect that these strategies could have been absorbed into the current MAG. However, in the interest of investigating the effect of additional pumping, the strategies were simply added to the simulations.

Table 3. Development of Base Pumping for Simulations - Queen City Aquifer
All Pumping in AF/yr

County	TWDB Pumping Database Estimate for 2012	Calibrated GAM Estimate for 1999	Forestar Scenario C Simulations	RWP Strategies - 2020	RWP Strategies - 2070	Base Pumping for Simulations
Anderson	1,050	770	20,852			20,852
Angelina		96	1,100			1,100
Camp	1	253	3,772	0	783	4,555
Cass	19	525	39,115			39,115
Cherokee	906	903	23,403			23,403
Gregg	145	287	7,568			7,568
Harrison	116	408	10,323			10,323
Henderson	645	784	15,838			15,838
Houston	434	244	2,321			2,321
Marion	5	151	15,591			15,591
Morris	25	205	9,577			9,577
Nacogdoches	233	313	4,992			4,992
Rusk		57	58			58
San Augustine		0	7			7
Smith	2,668	1,173	54,158	1,610	5,167	59,325
Titus		2	138	45	45	183
Upshur	619	1,284	25,597	970	1,775	27,372
Van Zandt	236	251	3,872	699	1,005	4,877
Wood	167	1,443	10,105			10,105
Total	**7,269**	**9,149**	**248,387**	**3,324**	**8,775**	**257,162**

5.2.3 Carrizo-Wilcox Aquifer

Table 4 summarizes the data associated with developing the base pumping for the simulations for the Carrizo-Wilcox Aquifer, which is represented in the GAM by four layers (Layers 5 to 8). Because the TWDB considers the Carrizo-Wilcox a single aquifer and all pumping estimates in the pumping database are combined, the calibrated GAM estimates are presented as the sum of the four model layers.

Please note that Table 4 includes an additional column as compared to Tables 1 and 2. In reviewing the individual layer pumping amounts between the calibrated GAM and Scenario C pumping files, there were instances where pumping in individual cells in the Scenario C files was lower than the calibrated model. Thus, the additional column represents the sum of the pumping when the maximum pumping in a cell between the calibrated model and Scenario C is assigned. The 2070 strategies were then added to the sum of maximum pumping column to obtain the base pumping for these simulations.

For all counties except Cass County, it appears that the strategies could have been absorbed into the current MAG. Cass County includes a strategy that represents a significant increase in pumping. In the interest of investigating the effect of additional pumping, all strategies were simply added to the simulations.

Table 4. Development of Base Pumping for Simulations - Carrizo-Wilcox Aquifer All Pumping in AF/yr

County	TWDB Pumping Database Estimate for 2012	Calibrated GAM Estimate for 1999	Forestar Scenario C Simulations	Sum of Maximum Pumping for GAM and Scenario C	RWP Strategies - 2020	RWP Strategies - 2070	Base Pumping for Simulations
Anderson	8,856	4,681	29,066	29,066			29,066
Angelina	10,703	19,386	26,642	26,642	5,600	5,600	32,242
Bowie	2,409	3,524	12,691	12,967	3,700	4,140	17,107
Camp	2,414	1,321	4,045	4,047			4,047
Cass	1,370	2,768	3,767	3,943	11,659	15,224	19,167
Cherokee	6,518	7,856	20,672	20,672	0	250	20,922
Franklin	513	1,489	9,799	10,100			10,100
Gregg	2,047	2,700	7,643	7,643	280	393	8,036
Harrison	4,522	3,998	8,887	9,099	1,842	2,196	11,295
Henderson	6,218	7,610	9,550	9,550	600	4,865	14,415
Hopkins	3,994	4,987	4,245	6,583	820	940	7,523
Houston	2,227	835	22,928	22,929	3,500	3,500	26,429
Marion	558	1,124	2,077	2,080	432	648	2,728
Morris	697	1,255	2,660	2,665			2,665
Nacogdoches	5,562	14,210	21,116	21,117	1,644	3,059	24,176
Panola	4,007	4,447	9,788	9,933			9,933
Rains	537	1,129	1,737	1,956			1,956
Rusk	8,008	7,637	20,829	20,830			20,830
Sabine	285	741	6,849	6,850			6,850
San Augustine	424	632	1,788	1,788			1,788
Shelby	3,176	3,559	12,521	12,521			12,521
Smith	22,456	13,506	33,215	33,215	1,739	2,712	35,927
Titus	543	1,985	11,054	11,089			11,089
Trinity		27	2,214	2,214			2,214
Upshur	3,231	4,549	7,128	7,128			7,128
Van Zandt	4,489	5,779	10,996	11,024			11,024
Wood	7,070	4,455	21,735	21,738			21,738
Total	**112,834**	**126,190**	**325,642**	**329,389**	**31,816**	**43,527**	**372,916**

5.3 Hydrologic Conditions within Groundwater Management Area 11

As required by statute, the groundwater conservation districts in Groundwater Management Area 11 considered total estimated recoverable storage, average annual recharge, inflows, and discharge prior to adopting a proposed desired future condition.

5.3.1 Total Estimated Recoverable Storage

As required by statute, the Texas Water Development Board provided the groundwater conservation districts in Groundwater Management Area 11 with estimates of total recoverable storage (Wade and others, 2014). This report is included as Appendix E.

A summary of total storage and the estimated range of recoverable storage for the three aquifers is presented in Table 5.

Table 5. Summary of Total Storage and the Estimated Range of Recoverable Storage

Aquifer	Total Storage (million acre-feet)	Estimated Range of Recoverable Storage (million acre-feet)
Sparta	55.3	13.8 to 41.5
Queen City	142.0	35.5 to 106.5
Carrizo-Wilcox	2,070.6	517.7 to 1,553.0

These estimates are essentially the sum of three components: 1) the outcrop area, 2) the artesian portion of the downdip area, and 3) the saturated portion of the downdip area. The storage estimates were developed from the groundwater availability model of the area (Kelley and others, 2004)

In the outcrop area, the saturated thickness is the 1999 groundwater elevation minus the aquifer bottom elevation for each model cell. In each cell, the storage is then calculated as the saturated thickness times the area (640 acres) times the specific yield. The model estimates specific yield as either 0.1 or 0.15 depending on the specific cell. These cell storage values are then summed to arrive at a total storage for the Carrizo-Wilcox outcrop areas of 114 million acre-feet.

In the artesian portion of the downdip, the artesian zone thickness is the difference between the 1999 groundwater elevation and the elevation of the top of the aquifer. In each cell, the artesian storage is calculated as the artesian zone thickness times the area (640 acres) times the storativity. Storativity values range between 7.3E-05 to 9.93E-03. Total artesian zone storage is 65 million acre-feet for the Carrizo-Wilcox Aquifer.

In the saturated portion of the downdip area, saturated thickness is calculated differently depending on whether the head is above or below the top of the aquifer. If the head is below the top of the aquifer, the saturated thickness is the difference between the 1999 groundwater elevation and the elevation of the bottom of the aquifer. If the head is above the top of the aquifer, the saturated thickness is the thickness of the aquifer. The storage is then calculated as the saturated zone thickness times the area (640 acres) times the specific yield. The specific yield is either 0.1 or 0.15 depending on the layer. Total storage in the saturated portion of the downdip area is calculated to be 1,879 million acre-feet.

A key parameter in these calculations is the specific yield in the downdip portion of the aquifer. In most cases, the model's estimate of specific yield in the downdip area is never "used" in model. 23,320 cells of the 58,269 cells in the downdip area have an artesian head of over 500 feet, which is about 40 percent of the cells in the model. Unless heads drop below the top of the aquifer, these parameters are simply place holders, and were never calibrated.

In general, a specific yield values of 0.1 to 0.15 is representative of a clean sand. As drilling and electric logs show, interlayered sands and clays are common in the Carrizo-Wilcox. The model has thick layers (about 24 percent of the cells are over 500 feet thick). Thick cells increase the chance of interbedded clay, and this would result in reduced specific yield estimates. Although the higher specific yield values may be appropriate for individual sand units, the thicker layers increase the chance that the overall specific yield value is lower than the place-holder value in the model input files.

If the calculation is made with a specific yield value of 0.001 to reflect the interbedded clays, the total storage for the saturated portion of the downdip area is 188 million acre-feet (as compared to 1,879 million acre-feet reported by the TWDB).

When the model was developed in 2004, it is doubtful that the developers considered the possibility of using the model to calculate total aquifer storage, and simply used place holder values. As described in the technical memoranda and summarized above, the problems with future simulations in the outcrop area may be due flat gradients that restrict flow from the outcrop area to the downdip area. This restriction may be the result of underestimated drawdown due to pumping or drought conditions. If the specific yield were reduced in these areas, gradient might improve conditions to model water into the downdip area, and prevent unrealistic increases in outcrop storage during the calibration period of the GAM.

In summary, the total estimated recoverable storage may be overestimated by one or two orders of magnitude, as evidenced by limitations of the GAM.

5.3.2 Average Annual Recharge, Inflows and Discharge

The groundwater budgets for Groundwater Management Area 11 for the Carrizo-Wilcox Aquifer were spilt into four parts:

- The outcrop area of the Carrizo (Layer 5 of the GAM) in Table 6
- The downdip area of the Carrizo (Layer 5 of the GAM) in Table 7

- The outcrop area of the Wilcox (Layers 6, 7 and 8 of the GAM) in Table 8
- The downdip area of the Wilcox (Layers 6, 7 and 8 of the GAM) in Table 9

For all groundwater budgets, only the areas of the official aquifer boundary are presented. Consequently, there are entries in the water budget tables labeled "Unofficial". These entries represent flows into and out of the official aquifer boundaries from areas within GMA 11 that are not considered official parts of the aquifer.

Each of the groundwater budgets presents a side by side comparison of the average values for the calibration period of the GAM (1975 to 1999) and the average values of Scenario 4 (2000 to 2070) for Scenario 4, the basis of the desired future condition.

Table 6. Groundwater Budget of the Outcrop Area of the Carrizo Aquifer
All Values in AF/yr

	1975-1999	2000-2070
Inflow		
Recharge	117,984	115,143
Reservoir	157	0
GMA 12	536	580
Total	118,676	115,723
Outflow		
Downdip	16,097	24,578
Vertical (Wilcox)	12,331	15,421
Pumping	4,253	12,610
Drain	167	649
ET	19,305	34,927
RIV	0	22
Stream	33,448	26,634
Total	85,600	114,841
Inflow-Outflow	33,076	882
Model Calculated Storage Change	33,075	882
Model Error	1	0

Table 7. Groundwater Budget of the Downdip Area of the Carrizo Aquifer
All Values in AF/yr

	1975-1999	2000-2070
Inflow		
GMA 12	5,427	10,509
Vertical (Reklaw)	39,720	58,774
Outcrop	16,097	24,592
Unofficial	3,444	7,597
Louisiana	4	23
Total	64,691	101,495
Outflow		
Pumping	56,160	133,919
Vertical (Wilcox)	19,682	21,587
Total	75,842	155,506
Inflow-Outflow	-11,151	-54,011
Model Calculated Storage Change	-11,152	-54,012
Model Error	0	0

Table 8. Groundwater Budget of the Outcrop Area of the Wilcox Aquifer All Values in AF/yr

	1975-1999	2000-2070
Inflow		
Recharge	256,075	250,896
Reservoir/River	7,301	8,216
GMA 12	343	311
GMA 8	7	11
Louisiana	N/A	915
Total	263,726	260,349
Outflow		
Downdip	41,097	50,476
Pumping	12,651	42,871
Drain	4,783	4,498
ET	48,503	51,138
Stream	120,690	79,599
Louisiana	119	0
Unofficial	11,035	4,300
Total	238,878	232,882
Inflow-Outflow	24,848	27,467
Model Calculated Storage Change	24,862	27,470
Model Error	-15	-2

**Table 9. Groundwater Budget of the Downdip Area of the Wilcox Aquifer
All Values in AF/yr**

	1975-1999	2000-2070
Inflow		
Recharge	501	1,423
GMA 12	6,267	8,975
Vertical (Carrizo)	32,013	30,548
Outcrop	41,097	50,476
Unofficial	2,035	3,863
Louisiana	N/A	165
Total	81,912	95,449
Outflow		
Pumping	42,763	149,459
GMA 14	34	25
Louisiana	209	N/A
Total	43,006	149,484
Inflow-Outflow	38,907	-54,034
Model Calculated Storage Change	38,906	-54,034
Model Error	0	0

The GAM is not necessarily calibrated to a degree where surface water impacts of increased pumping are particularly reliable or can be viewed as quantitative. However, the GAM is the best tool to address this factor. Since the GAM is an imperfect tool, the conclusion of this analysis is that the increased pumping will cause impacts beyond the reduction in storage.

5.4 Other Environmental Impacts, Including Spring Flow and Other Interactions between Groundwater and Surface Water

The evaluation of all water budget components was discussed in Section 5.3.2 above.

5.5 Subsidence

Subsidence has not been an issue historically in these aquifers.

5.6 Socioeconomic Impacts

The Texas Water Development Board prepared reports on the socioeconomic impacts of not meeting water needs for each of the Regional Planning Groups during development of the 2011 Regional Water Plans. Because the development of this desired future condition used the State

Water Plan demands and water management strategies as an important foundation, it is reasonable to conclude that the socioeconomic impacts associated with this proposed desired future condition can be evaluated in the context of not meeting the listed water management strategies. Groundwater Management Area 11 is covered by Regional Planning Groups D and I. The socioeconomic impact reports for Regions D and I in Appendix F.

5.7 Impact on Private Property Rights

The impact on the interests and rights in private property, including ownership and the rights of landowners and their lessees and assigns in Groundwater Management Area 11 in groundwater is recognized under Texas Water Code Section 36.002.

The desired future conditions adopted by GMA 11 are consistent with protecting property rights of landowners who are currently pumping groundwater and landowners who have chosen to conserve groundwater by not pumping. All current and projected uses (as defined in the Region D plan and the Region I plan as well as the Forestar project) were included in Scenario 4 (the basis for the desired future condition). The increase in pumping associated with meeting the water management strategies will cause impacts to exiting well owners and to surface water. However, as required by Chapter 36 of the Water Code, GMA 11 considered these impacts and balanced them with the increasing demand of water in the GMA 11 area, and concluded that, on balance and with appropriate monitoring and project specific review during the permitting process, all the strategies and the Forestar project can be included in the desired future condition.

5.8 Feasibility of Achieving the Desired Future Condition

Groundwater levels are routinely monitored by the districts and by the TWDB in GMA 11. Evaluating the monitoring data is a routine task for the districts, and the comparison of these data with the desired future condition and model results that were used to develop the DFCs is covered in each district's management plan. These comparisons will be useful to guide the update of the DFCs that are required every five years.

5.9 Other Information

5.9.1 Solicitation of Stakeholder Participation

The groundwater conservation districts of Groundwater Management Area 11 solicited participation and feedback from 826 stakeholders (mostly water user groups). Specifically, a letter was sent to each group in early September, 2015 seeking their input on estimates of future pumping and any other concerns.

The letter template and the list of organizations that received the letter are presented in Appendix G.

No specific response was received from any letter recipient.

5.9.2 Aquifers Not Relevant for Purposes of Joint Planning

As documented in the resolution adopting desired future conditions, the groundwater conservation districts in Groundwater Management Area 11 have classified the following aquifers as not relevant for the purposes of joint planning:

- Gulf Coast Aquifer
- Nacatoch Aquifer
- Trinity Aquifer
- Yegua-Jackson Aquifer

Documentation in support of the classification are presented in Appendix H.

6.0 Discussion of Other Desired Future Conditions Considered

There were 7 scenarios and 7 GAM simulations completed as part of the development of the desired future conditions. Results of these simulations were presented at GMA 11 meetings and in technical memoranda. Based on a review of the materials and recognizing the limitations of the GAM, the groundwater conservation districts in GMA 11 decided that Scenario 4 met all identified future water needs and balanced the property rights of landowners in GMA 11.

7.0 Discussion of Other Recommendations

Public comments were invited and each district held a public hearing on the proposed desired future condition as follows:

Groundwater Conservation District	Date of Public Hearing	Number of Comments Received
Neches & Trinity Valleys GCD	June 16, 2016	None
Panola County GCD	June 16, 2016	One Written
Pineywoods GCD	July 14, 2016	None
Rusk County GCD	July 11, 2016	One Oral

The written comment submitted to Panola County GCD was from Tony Smith, the Senior Project Manager for Carollo Engineers, Inc., in response to cooperative efforts between Region D planning group and GMA 11. Mr. Smith stated that "his analysis indicates that the simulation results from GMA 11 Technical Memo 16-02, Draft 2 (Scenario 4) are adequate to meet or exceed the Region D existing groundwater supplies and the identified Region D groundwater management strategies identified in the 2016 Regional Water Plan", and that "no shortages were found".

The oral comment at the Rusk County GCD public hearing was an expression of concern regarding the proposed DFC in Smith County, and the possible effects on neighboring county's DFC, and recommended that the current DFCs not be changed.

The 2010 DFCs for Rusk County for the Carrizo-Wilcox Aquifer were presented as follows for each individual aquifer.

- Carrizo Aquifer: 6 feet
- Upper Wilcox Aquifer: 6 feet
- Middle Wilcox Aquifer: 23 feet
- Lower Wilcox Aquifer: 21 feet

The 2016 proposed DFCs were adopted as for the entire Carrizo-Wilcox Aquifer as summarized in Table 5 of Tech Memo 16-02 (Scenario 4). For Rusk County, the proposed DFC was 23 feet. However, in Tech Memo 16-01, the drawdowns associated with each individual aquifer for Scenario 4 were listed in Table 5 which provide a means of comparison to the 2010 DFCs:

- Carrizo Aquifer: 8 feet
- Upper Wilcox Aquifer: 9 feet
- Middle Wilcox Aquifer: 34 feet
- Lower Wilcox Aquifer: 38 feet

In general, the higher drawdowns can be attributed primarily to higher pumping in surrounding counties in Scenario 4 as compared with the basis for the 2010 DFC:

- Cherokee County
  - 11,222 AF/yr (current MAG in all years)
  - 20,457 AF/yr (pumping to achieve 2016 DFC)
- Rusk County
  - 20,814 AF/yr (current MAG in 2060)
  - 20,803 AF/yr (pumping to achieve 2016 DFC in 2070)
- Smith County
  - 33,225 AF/yr (current MAG in 2060)
  - 35,865 AF/yr (pumping to achieve 2016 DFC in 2070)

From this summary, pumping in Smith County under the 2016 DFC is not much higher than the current MAG. However, pumping in Cherokee County is higher under the 2016 DFC than the current MAG. The small increases in drawdown in Rusk County between the 2010 DFC and the 2016 DFC appear to be attributable to higher pumping in Cherokee County because of the Forestar project.

The groundwater conservation districts decided to include the Forestar project in the basis for the desired future conditions that were adopted after evaluating the relative impacts in surrounding counties and found that the impacts were minor. The alternative of not changing the DFCs was discussed and was rejected after considering the Forestar project and the regional planning water management strategies. If the desired future condition were to remain unchanged, there would be impacts on the ability of the region to meet its future water demands as defined by the Region D plan and the Region I plan.

8.0 References

Fryar, D., Senger, R., Deeds, N., Pickens, J, Jones, T., Whallon, A.J., and Dean, K.E., 2003. Groundwater Availability Model for the Northern Carrizo-Wilcox Aquifer. INTERA Incorporated report prepared for the Texas Water Development Board, January 31, 2003, 529p.

Kelley, V.A., Deeds, N.E., Fryar, D.G., and Nicot, J.P., 2004. Groundwater Availability Model for the Queen City and Sparta Aquifers. INTERA Incorporated report prepared for the Texas Water Development Board, October 2004, 867p.

Oliver, W., 2010. GAM Task 10-009 Model Run Report. Texas Water Development Board, Groundwater Availability Modeling Section, September 3, 2010, 11p.

Oliver, W., 2012. GAM Run 11-010: Model Runs for the Carrizo-Wilcox, Queen City, and Sparta Aquifers in Groundwater Management Area 11. Texas Water Development Board, Groundwater Availability Modeling Section, July 30, 2012, 34p.

Wade, S., Shi, J., and Seiter-Weatherford, C., 2014. GAM Task 13-034: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 11. Texas Water Development Board, Groundwater Resources Division, April 2, 2014, 30 p.

Appendix A

Desired Future Conditions Resolution

RESOLUTION TO ADOPT DESIRED FUTURE CONDITIONS FOR AQUIFERS IN GROUNDWATER MANAGEMENT AREA 11

THE STATE OF TEXAS §
§
GROUNDWATER MANAGEMENT AREA 11 §
§
GROUNDWATER CONSERVATION DISTRICTS§

WHEREAS, Texas Water Code § 36.108 requires the groundwater conservation districts located in whole or in part in a groundwater management area ("GMA") designated by the Texas Water Development Board to adopt desired future conditions for the relevant aquifers located within the management area;

WHEREAS, the groundwater conservation districts located wholly or partially within Groundwater Management Area 11 ("GMA 11"), as designated by the Texas Water Development Board, as of the date of this resolution are as follows: Neches & Trinity Valleys Groundwater Conservation District, Panola County Groundwater Conservation District, Pineywoods Groundwater Conservation District, and Rusk County Groundwater Conservation District (collectively hereinafter "the GMA 11 Districts");

WHEREAS, the GMA 11 Districts are each local governments operating under Chapter 36, Texas Water Code;

WHEREAS, the GMA 11 Districts desire to fulfill the requirements of Texas Water Code §36.108 through mutual cooperation and joint planning efforts;

WHEREAS, the GMA 11 Districts have had numerous public meetings, including stakeholder meetings for the specific purpose of receiving comments and input from stakeholders within GMA 11, and they have engaged in joint planning efforts to promote comprehensive management of the aquifers located in whole or in part in Groundwater Management Area 11;

WHEREAS, GMA 11 held meetings on February 25, 2015; March 26, 2015; April 8, 2015; May 4, 2015; July 15, 2015; September 3, 2015; November 4, 2015; January 19, 2016; March 22, 2016; and April 28, 2016, in compliance with its statutory duty to publicly consider the desired future conditions considerations listed in § 36.108(d);

WHEREAS, the GMA 11 Districts have considered the following factors, listed in §36.108(d), in establishing the desired future conditions for the aquifer(s):

(1) groundwater availability models and other data or information for the management area;

(2) aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another;

(3) the water supply needs and water management strategies included in the state water plan;

(4) hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the Texas Water Development Board Executive Administrator and the average annual recharge inflows, and discharge;

(5) other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water;

(6) the impact of subsidence;

(7) socioeconomic impacts reasonably expected to occur;

(8) the impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater as recognized under Texas Water Code §36.002;

(9) the feasibility of achieving the desired future conditions; and

(10) any other information relevant to the specific desired future conditions;

WHEREAS, the desired future conditions provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater in the management area;

WHEREAS, after considering the factors listed in 36.108(d), Texas Water Code, the GMA 11 Districts may establish different desired future conditions for: (1) each aquifer, subdivision of an aquifer, or geologic strata located in whole or in part within the boundaries of GMA 11; or (2) each geographic area overlying an aquifer in whole or in part or subdivision of an aquifer within the boundaries of GMA 11;

WHEREAS, the GMA 11 Districts recognize that GMA 11 includes a geographically and hydrologically diverse area with a variety of land uses and a diverse mix of water users;

WHEREAS, at least two-thirds of the GMA 11 Districts had a voting representative in attendance at the April 28, 2016, meeting in accordance with Section 36.108, Texas Water Code; and the following districts had a voting representative in attendance at the meeting: Neches & Trinity Valleys Groundwater Conservation District, Panola County Groundwater Conservation District, Pineywoods Groundwater Conservation District, and Rusk County Groundwater Conservation District, and;

WHEREAS, the member GCDs in which the Carrizo-Wilcox, Queen City, and Sparta aquifers are relevant for joint planning purposes held open meetings within each said district between June 16, 2016 and July 14, 2016 to take public comment on the proposed DFCs for that district during the ninety (90) public comment period of May 5, 2016 thru August 31, 2016, and;

WHEREAS, on November 9, 2016, the district representatives reconvened to review the reports and consider any district-suggested revisions to the proposed desired future conditions.

WHEREAS, on this day of January 11, 2016, at an open meeting duly noticed and held in accordance with law in the City Council Chambers Room of Nacogdoches City Hall at 202 E. Pilar Street, Nacogdoches, Texas, the GCDs within GMA 11, having considered at this meeting comments submitted to the individual districts during the comment period and at this meeting, have voted, 4 districts in favor, 0 districts opposed, to adopt the following DFCs for in the following counties and districts through the year 2070 as follows:

NOW, THEREFORE, BE IT RESOLVED BY THE AUTHORIZED VOTING REPRESENTATIVES OF THE GMA 11 DISTRICTS AS FOLLOWS:

1. The above recitals are true and correct.

2. The authorized voting representatives of the GMA 11 Districts hereby establish the desired future conditions of the aquifer(s) as set forth in Attachment B by the vote reflected in the above recitals.

3. The authorized voting representatives of the GMA 11 Districts declare that the Gulf Coast, Nacatoch, Trinity, and Yegua-Jackson aquifer are non-relevant for the purpose of adopting Desired Future Conditions in Groundwater Management Area 11, as the districts determined that aquifer characteristics, groundwater demands, and current groundwater uses do not warrant adoption of a desired future condition. Technical justification of the non-relevant aquifers, as required by 31 Tex. Admin. Code §356.31, is set forth in Attachment C.

4. The GMA 11 Districts and their agents and representatives, individually and collectively, are further authorized to take all actions necessary to implement this resolution.

5. The desired future conditions of the aquifer(s) adopted by the GMA 11 Districts and attached hereto, along with the explanatory report, and proof of the notice of the meeting in which desired future conditions adoption occurred, shall be submitted to the Texas Water Development Board and sent to the GMA 11 Districts, as required by Section 36.108(d-3), Texas Water Code.

AND IT IS SO ORDERED. PASSED AND ADOPTED on this 11th day of January, 2017.

ATTEST:

Neches & Trinity Valleys Groundwater Conservation District

Panola County Groundwater Conservation District

Pineywoods Groundwater Conservation District

Rusk County Groundwater Conservation District

ATTACHMENTS

A: Copies of notices of January 11, 2017, meeting

B: Desired Future Conditions

C: Non-relevant Aquifers

Attachment A

NOTICE OF A MEETING FOR THE GROUNDWATER MANAGEMENT AREA 11

Notice is hereby given that the groundwater conservation districts (GCD) located wholly or partially within the **Groundwater Management Area 11** (GMA-11) as designated by the Texas Water Development Board (TWDB) consisting of:

Neches and Trinity Valleys Groundwater Conservation District (NTVGCD),
Panola County Groundwater Conservation District (PCGCD),
Pineywoods Groundwater Conservation District (PGCD), and
Rusk County Groundwater Conservation District (RCGCD);

Will hold a **Joint Planning Meeting at 10:00 a.m. on January 11, 2017** in room 119 (Commissioners Room) in Nacogdoches City Hall at 202 E. Pilar, Nacogdoches, TX, for the following purpose:

1. Call meeting to order and establish a quorum.
2. Public comments. [i]
3. Discussion and possible action to approve the minutes of the November 09, 2016 meeting.
4. Discussion and possible action on adopting a resolution for the adoption of Desired Future Conditions for the Carrizo-Wilcox, Queen City, and Sparta Aquifers within the boundaries of GMA 11 and on declaring the Gulf Coast, Nacatoch, Yegua-Jackson, and Trinity Aquifers not relevant for purposes of joint planning.
5. Review and possible action of the approval of the presented explanatory report.
6. Update on the new TWDB Northern Carrizo-Wilcox model.
7. Comments and updates from GMA-11 representatives' on the joint planning process.
8. Report from the GMA-11 representatives for the Region I and Region D regional water planning groups.
9. Discussion of possible agenda items for the next GMA-11 meeting.
10. Set date, time, and place of next meeting.
11. Adjourn meeting.

FILED FOR RECORD
at 9:17 o'clock A M.

DEC 21 2016

MARK STAPLES
County Clerk, Anderson County, Texas
By SW Deputy

Dated and posted prior to 5:00 PM on or before the 30th day of December, 2016.

Leah Adams, GMA-11 Contact
Panola County Groundwater Conservation District

This meeting is available to all persons regardless of disability. If you require special assistance to attend or participate in the meeting, please contact the Panola County GCD at (903) 690-0143 at least 24 hours in advance of the meeting.

[i] PUBLIC COMMENTS: Citizens who desire to address GMA-11 on any matter may sign up to do so prior to this meeting. Public comments will be received during this portion of the meeting. Please limit comments to 3 (three) minute. No discussion or final action will be taken by GMA-11.

Questions, Requests for Information and Comments Submission: Citizens who wish to ask questions, to request additional information, or to submit comments may do so by submitting such information to the following person:

Leah Adams, Panola County GCD, 419 W. Sabine Street, Carthage, Texas 75633
(903) 690-0143 / ladams@pcgcd.org

NOTICE OF A MEETING FOR THE GROUNDWATER MANAGEMENT AREA 11

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Neches and Trinity Valleys Groundwater Conservation District (NTVGCD),
Panola County Groundwater Conservation District (PCGCD),
Pineywoods Groundwater Conservation District (PGCD), and
Rusk County Groundwater Conservation District (RCGCD);

Will hold a **Joint Planning Meeting at 10:00 a.m. on January 11, 2017** in room 119 (Commissioners Room) in Nacogdoches City Hall at 202 E. Pilar, Nacogdoches, TX, for the following purpose:

1. Call meeting to order and establish a quorum.
2. Public comments. [i]
3. Discussion and possible action to approve the minutes of the November 09, 2016 meeting.
4. Discussion and possible action on adopting a resolution for the adoption of Desired Future Conditions for the Carrizo-Wilcox, Queen City, and Sparta Aquifers within the boundaries of GMA 11 and on declaring the Gulf Coast, Nacatoch, Yegua-Jackson, and Trinity Aquifers not relevant for purposes of joint planning.
5. Review and possible action of the approval of the presented explanatory report.
6. Update on the new TWDB Northern Carrizo-Wilcox model.
7. Comments and updates from GMA-11 representatives' on the joint planning process.
8. Report from the GMA-11 representatives for the Region I and Region D regional water planning groups.
9. Discussion of possible agenda items for the next GMA-11 meeting.
10. Set date, time, and place of next meeting.
11. Adjourn meeting.

FILED
At 10:30 O'CLOCK A M
DEC 23 2016
AMY FINCHER
County Clerk, County Court at Law
Angelina County, Texas
By TCO

Dated and posted prior to 5:00 PM on or before the 30th day of December, 2016.

Leah Adams, GMA-11 Contact
Panola County Groundwater Conservation District

This meeting is available to all persons regardless of disability. If you require special assistance to attend or participate in the meeting, please contact the Panola County GCD at (903) 690-0143 at least 24 hours in advance of the meeting.

[i] **PUBLIC COMMENTS**: Citizens who desire to address GMA-11 on any matter may sign up to do so prior to this meeting. Public comments will be received during this portion of the meeting. Please limit comments to 3 (three) minute. No discussion or final action will be taken by GMA-11.

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(903) 690-0143 / ladams@pcgcd.org

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Notice is hereby given that the groundwater conservation districts (GCD) located wholly or partially within the **Groundwater Management Area 11** (GMA-11) as designated by the Texas Water Development Board (TWDB) consisting of:

Neches and Trinity Valleys Groundwater Conservation District (NTVGCD),
Panola County Groundwater Conservation District (PCGCD),
Pineywoods Groundwater Conservation District (PGCD), and
Rusk County Groundwater Conservation District (RCGCD);

Will hold a **Joint Planning Meeting at 10:00 a.m. on January 11, 2017** in room 119 (Commissioners Room) in Nacogdoches City Hall at 202 E. Pilar, Nacogdoches, TX, for the following purpose:

1. Call meeting to order and establish a quorum.
2. Public comments. [i]
3. Discussion and possible action to approve the minutes of the November 09, 2016 meeting.
4. Discussion and possible action on adopting a resolution for the adoption of Desired Future Conditions for the Carrizo-Wilcox, Queen City, and Sparta Aquifers within the boundaries of GMA 11 and on declaring the Gulf Coast, Nacatoch, Yegua-Jackson, and Trinity Aquifers not relevant for purposes of joint planning.
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6. Update on the new TWDB Northern Carrizo-Wilcox model.
7. Comments and updates from GMA-11 representatives' on the joint planning process.
8. Report from the GMA-11 representatives for the Region I and Region D regional water planning groups.
9. Discussion of possible agenda items for the next GMA-11 meeting.
10. Set date, time, and place of next meeting.
11. Adjourn meeting.

FILED FOR RECORD
2016 DEC 21 AM 10:05
LAVERNE LUSK COUNTY CLERK
CHEROKEE COUNTY, TEXAS
_____ DEPUTY

Dated and posted prior to 5:00 PM on or before the 30th day of December, 2016.

Leah Adams, GMA-11 Contact
Panola County Groundwater Conservation District

This meeting is available to all persons regardless of disability. If you require special assistance to attend or participate in the meeting, please contact the Panola County GCD at (903) 690-0143 at least 24 hours in advance of the meeting.

[i] **PUBLIC COMMENTS**: Citizens who desire to address GMA-11 on any matter may sign up to do so prior to this meeting. Public comments will be received during this portion of the meeting. Please limit comments to 3 (three) minute. No discussion or final action will be taken by GMA-11.

Questions, Requests for Information and Comments Submission: Citizens who wish to ask questions, to request additional information, or to submit comments may do so by submitting such information to the following person:

Leah Adams, Panola County GCD, 419 W. Sabine Street, Carthage, Texas 75633
(903) 690-0143 / ladams@pcgcd.org

NOTICE OF A MEETING FOR THE GROUNDWATER MANAGEMENT AREA 11

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8. Report from the GMA-11 representatives for the Region I and Region D regional water planning groups.
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11. Adjourn meeting.

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Dated and posted prior to 5:00 PM on or before the 30th day of December, 2016.

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Panola County Groundwater Conservation District

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8. Report from the GMA-11 representatives for the Region I and Region D regional water planning groups.
9. Discussion of possible agenda items for the next GMA-11 meeting.
10. Set date, time, and place of next meeting.
11. Adjourn meeting.

FILED FOR RECORD
IN MY OFFICE
AT 11:35 O'CLOCK A M

DEC 21 2016

BOBBIE DAVIS
COUNTY CLERK, PANOLA COUNTY, TEXAS
BY Gingfield DEPUTY

COUNTY COURT ★ PANOLA COUNTY, TEXAS

Dated and posted prior to 5:00 PM on or before the 30th day of December, 2016.

Leah Adams, GMA-11 Contact
Panola County Groundwater Conservation District

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8. Report from the GMA-11 representatives for the Region I and Region D regional water planning groups.
9. Discussion of possible agenda items for the next GMA-11 meeting.
10. Set date, time, and place of next meeting.
11. Adjourn meeting.

FILED FOR RECORD
Dec 21, 2016 02:31P
TRUDY MCGILL, COUNTY CLERK
RUSK COUNTY, TEXAS
BY:Esther Hawk, DEPUTY

Dated and posted prior to 5:00 PM on or before the 30th day of December, 2016.

Leah Adams, GMA-11 Contact
Panola County Groundwater Conservation District

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[i] <u>**PUBLIC COMMENTS**</u>: Citizens who desire to address GMA-11 on any matter may sign up to do so prior to this meeting. Public comments will be received during this portion of the meeting. Please limit comments to 3 (three) minute. No discussion or final action will be taken by GMA-11.

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Leah Adams, Panola County GCD, 419 W. Sabine Street, Carthage, Texas 75633
(903) 690-0143 / ladams@pcgcd.org

Leah Adams

From:	Texas Register <TexReg@sos.texas.gov>
Sent:	Tuesday, December 20, 2016 4:41 PM
To:	ladams@pcgcd.org
Subject:	S.O.S. Acknowledgment of Receipt

Acknowledgment of Receipt

Agency: Groundwater Management Area 11

Liaison: Leah Adams

The Office of the Secretary of State has posted

notice of the following meeting:

Board: Groundwater Management Area 11

Committee:

Date: 01/11/2017 10:00 AM "TRD# 2016008539"

Notice posted: 12/20/16 04:41 PM

Proofread your current open meeting notice at:

http://texreg.sos.state.tx.us/public/pub_om_lookup$.startup?Z_TRD=2016008539

Attachment B
Proposed Desired Future Conditions

GMA 11 Technical Memorandum 16-02 (Draft 2), dated March 25, 2016, summarizes how the results of groundwater availability model simulations were used to developed the proposed desired future conditions for the Sparta, Queen City, and Carrizo-Wilcox aquifers for GMA 11.

Table 5 from GMA 11 Technical Memorandum 16-02 (Draft 2), dated March 25, 2016 lists the proposed desired future conditions, and is presented below. As described in the technical memorandum, the proposed desired future conditions are average drawdowns (in feet) from year 2000 conditions to 2070 conditions were largely based on GAM Scenario 4. Based on an analysis of model output and model limitations, the output from the model was modified to develop the proposed desired future conditions as follows:

- Layers 2 and 4 (the confining units) were eliminated, and Table 5 includes only aquifer units. Areas that have no active cells are designated as NP (for not present).
- Layers 5, 6, 7, and 8 are combined, and a single drawdown value for the Carrizo-Wilcox Aquifer are listed
- All areas that are less than 200 square miles are eliminated (noted as NRS, or not relevant for purposes of joint planning due to size of area).
- Areas with negative drawdown that are greater than 200 square miles have had the negative drawdown cells eliminated from the average drawdown calculation, effectively assuming that those cells have a zero drawdown, and that the negative drawdown areas are a result of model limitations, as discussed (designated in yellow).
- The desired future condition in Panola County for the Carrizo-Wilcox Aquifer is listed as 3 feet. The actual average using all data from the model is 2 feet. If the areas with negative drawdown are assumed to be zero, the revised average is 4 feet. As presented at the March 22, 2016 GMA 11 meeting, Mr. Wade Oliver (representing the Panola County GCD) evaluated the average drawdown under Scenario 4 using an alternative analytical modeling approach and concluded that the drawdown was 3 feet. Thus, Mr. Oliver's result is consistent with the midpoint between the two GAM-based drawdown approaches.

TABLE 1. DESIRED FUTURE CONDITIONS - AVERAGE DRAWDOWN (FT) FROM 2000 TO 2070

County	Sparta Aquifer	Queen City Aquifer	Carrizo-Wilcox Aquifer
Anderson	NRS	9	90
Angelina	16	NRS	48
Bowie	NP	NP	5
Camp	NP	NRS	33
Cass	NP	10	68
Cherokee	NRS	14	99
Franklin	NP	NP	14
Gregg	NP	NRS	58
Harrison	NP	1	18
Henderson	NP	5	50
Hopkins	NP	NP	3
Houston	3	6	80
Marion	NP	24	45
Morris	NP	NRS	46
Nacogdoches	5	4	29
Panola	NP	NP	3
Rains	NP	NP	1
Rusk	NP	NRS	23
Sabine	1	NP	9
SanAugustine	2	NP	7
Shelby	NP	NP	1
Smith	NP	17	119
Titus	NP	NRS	11
Trinity	9	NRS	51
Upshur	NP	9	77
VanZandt	NP	NRS	21
Wood	NP	5	89
GMA11	4	10	56

Notes: NP = Not present
NRS = Not Relevant due to size (less than 200 square miles)
Yellow Cells represent average drawdown calculations that assume negative drawdown is zero (model artifact and model limitation)
Green Cell represents the recommended DFC for Panola County as described in report

Attachment C
Non-relevant Aquifer: Gulf Coast

I. INTRODUCTION

The Texas Water Development Board, in its July 2013 document, Explanatory Report for Submittal of Desired Future Conditions to the Texas Water Development Board, offers the following guidance regarding documentation for aquifers that are to be classified not relevant for purposes of joint planning:

> *Districts in a groundwater management area may, as part of the process for adopting and submitting desired future conditions, propose classification of a portion or portions of a relevant aquifer as non-relevant (31 Texas Administrative Code 356.31 (b)). This proposed classification of an aquifer may be made if the districts determine that aquifer characteristics, groundwater demands, and current groundwater uses do not warrant adoption of a desired future condition.*
>
> *The districts must submit to the TWDB the following documentation for the portion of the aquifer proposed to be classified as non-relevant:*
>
> 1. *A description, location, and/or map of the aquifer or portion of the aquifer;*
> 2. *A summary of aquifer characteristics, groundwater demands, and current groundwater uses, including the total estimated recoverable storage as provided by the TWDB, that support the conclusion that desired future conditions in adjacent or hydraulically connected relevant aquifer(s) will not be affected; and*
> 3. *An explanation of why the aquifer or portion of the aquifer is nonrelevant for joint planning purposes.*

This technical memorandum provides the required documentation to classify the Gulf Coast Aquifer as not relevant for purposes of joint planning.

II. AQUIFER DESCRIPTION AND LOCATION

As described in George and others (2011):

> ***The Gulf Coast Aquifer*** *is a major aquifer paralleling the Gulf of Mexico coastline from the Louisiana border to the border of Mexico. It consists of several aquifers, including the Jasper, Evangeline, and Chicot aquifers, which are composed of discontinuous sand, silt, clay, and gravel beds. The maximum total sand thickness of the Gulf Coast Aquifer ranges from 700 feet in the south to 1,300 feet in the north. Freshwater saturated thickness averages about 1,000 feet. Water quality varies with depth and locality: it is generally good in the central and northeastern parts of the aquifer, where the water contains less than 500 milligrams per liter of total dissolved solids, but declines to the south, where it typically contains 1,000 to more than 10,000 milligrams per liter of total dissolved*

solids and where the productivity of the aquifer decreases. High levels of radionuclides, thought mainly to be naturally occurring, are found in some wells in Harris County in the outcrop and in South Texas. The aquifer is used for municipal, industrial, and irrigation purposes. In Harris, Galveston, Fort Bend, Jasper, and Wharton counties, water level declines of as much as 350 feet have led to land subsidence. The regional water planning groups, in their 2006 Regional Water Plans, recommended several water management strategies that use the Gulf Coast Aquifer, including drilling more wells, pumping more water from existing wells, temporary overdrafting, constructing new or expanded treatment plants, desalinating brackish groundwater, developing conjunctive use projects, and reallocating supplies.

Figure 1 (taken from Wade and others, 2014) shows the limited extent of the Gulf Coast Aquifer in GMA 11. Note that it occurs only in a small portion of Angelina, Sabine, and Trinity counties.

NON-RELEVANT AQUIFER: NACATOCH

I. INTRODUCTION

The Texas Water Development Board, in its July 2013 document, Explanatory Report for Submittal of Desired Future Conditions to the Texas Water Development Board, offers the following guidance regarding documentation for aquifers that are to be classified not relevant for purposes of joint planning:

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> 3. *An explanation of why the aquifer or portion of the aquifer is nonrelevant for joint planning purposes.*

This technical memorandum provides the required documentation to classify the Nacatoch Aquifer as not relevant for purposes of joint planning.

II. AQUIFER DESCRIPTION AND LOCATION

As described in George and others (2011):

> ***The Nacatoch Aquifer*** *is a minor aquifer occurring in a narrow band across northeast Texas. The aquifer consists of the Nacatoch Sand, composed of sequences of sandstone separated by impermeable layers of mudstone or clay. These sandstones are marine in origin, coarsen upward, and are laterally discontinuous. The number of sand layers varies throughout the Nacatoch's extent, and the thickness of individual sand units ranges from more than 100 feet in the north to less than 20 feet to the south. Thickness of intervening mudstone units similarly ranges from more than 100 feet to only a few feet. Freshwater saturated thickness averages about 50 feet. The aquifer also includes a hydraulically connected cover of alluvium that is as much as 80 feet thick along major drainages. Groundwater in this aquifer is usually under artesian conditions except in shallow wells where the Nacatoch Formation*

crops out and water table conditions exist. The Mexia-Talco Fault Zone generally delineates the subsurface limit of the aquifer. The groundwater in the aquifer is typically alkaline, high in sodium bicarbonate, and soft. Total dissolved solids in the subsurface increase and are significantly higher south of the Mexia-Talco Fault Zone, where the water contains between 1,000 and 3,000 milligrams per liter of total dissolved solids. Water from the aquifer is extensively used for domestic and livestock purposes. The city of Commerce historically pumped the greatest amount from the Nacatoch Aquifer but has recently attempted to convert to surface water; however, because of recent droughts, the city has pumped 30 to 50 percent of its water from the aquifer. As a result of Commerce's reduced pumping, the declining water levels that had developed around Commerce in Delta and Hunt counties are stabilizing. The North East Texas Regional Water Planning Group, in its 2006 Regional Water Plan, recommended new and supplemental groundwater wells in the Nacatoch Aquifer as a water management strategy.

Figure 1 (taken from Wade and others, 2014) shows the limited extent of the Nacatoch Aquifer in GMA 11. Note that it occurs only in a small portion of Bowie, Henderson, Morris, Red River, and Titus counties.

NON-RELEVANT AQUIFER: TRINITY

I. INTRODUCTION

The Texas Water Development Board, in its July 2013 document, Explanatory Report for Submittal of Desired Future Conditions to the Texas Water Development Board, offers the following guidance regarding documentation for aquifers that are to be classified not relevant for purposes of joint planning:

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> 3. *An explanation of why the aquifer or portion of the aquifer is nonrelevant for joint planning purposes.*

This technical memorandum provides the required documentation to classify the Trinity Aquifer as not relevant for purposes of joint planning.

II. AQUIFER DESCRIPTION AND LOCATION

As described in George and others (2011):

> ***The Trinity Aquifer,*** *a major aquifer, extends across much of the central and northeastern part of the state. It is composed of several smaller aquifers contained within the Trinity Group. Although referred to differently in different parts of the state, they include the Antlers, Glen Rose, Paluxy, Twin Mountains, Travis Peak, Hensell, and Hosston aquifers. These aquifers consist of limestones, sands, clays, gravels, and conglomerates. Their combined freshwater saturated thickness averages about 600 feet in North Texas and about 1,900 feet in Central Texas. In general, groundwater is fresh but very hard in the outcrop of the aquifer. Total dissolved solids increase from less than 1,000 milligrams per liter in the east and southeast to between 1,000 and 5,000 milligrams per liter, or slightly to moderately saline, as the depth to the aquifer increases. Sulfate and chloride concentrations also tend to increase with depth. The Trinity Aquifer discharges to a large number of springs, with most discharging less than 10 cubic feet per second. The aquifer is one of the most extensive and highly used groundwater resources in Texas. Although its primary use is for municipalities, it is also used*

for irrigation, livestock, and other domestic purposes. Some of the state's largest water level declines, ranging from 350 to more than 1,000 feet, have occurred in counties along the IH-35 corridor from McLennan County to Grayson County. These declines are primarily attributed to municipal pumping, but they have slowed over the past decade as a result of increasing reliance on surface water. The regional water planning groups, in their 2006 Regional Water Plans, recommended numerous water management strategies for the Trinity Aquifer, including developing new wells and well fields, pumping more water from existing wells, overdrafting, reallocating supplies, and using surface water and groundwater conjunctively.

Figure 1 (taken from Wade and others, 2014) shows the limited extent of the Trinity Aquifer in GMA 11. Note that it occurs only in a small portion of Henderson County.

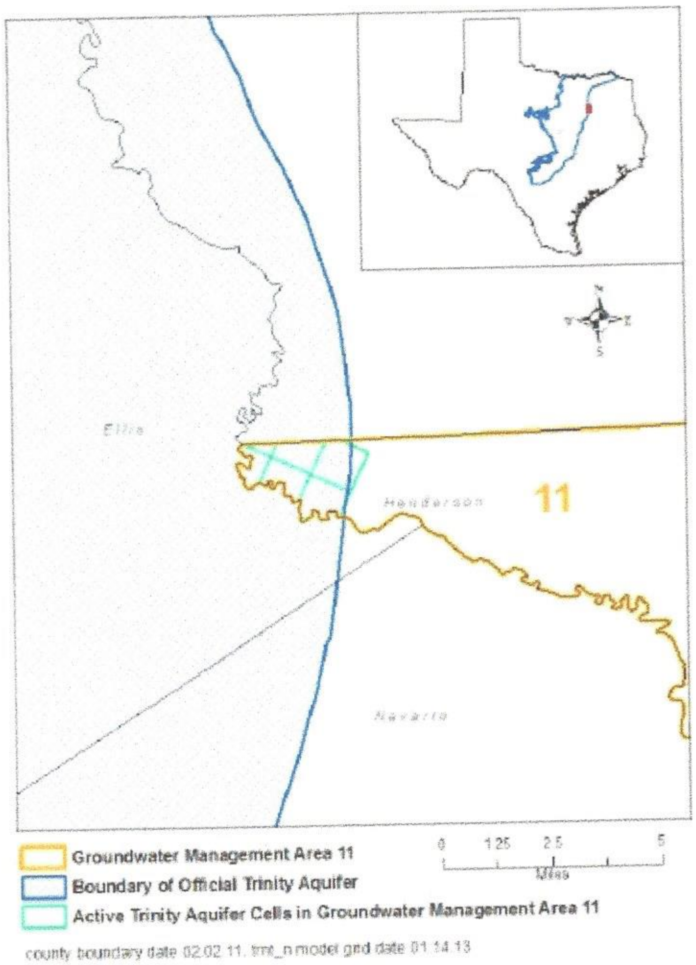

Figure 1. Location of Trinity Aquifer in GMA 11

III. AQUIFER CHARACTERISTICS

Kelley and others (2014) developed an updated groundwater availability model of the Northern Trinity and Woodbine aquifers for four groundwater conservation districts in north Texas. This model covered the entire Northern Trinity Aquifer, including the small portion in Henderson County. Maps of calibrated horizontal hydraulic conductivity are provided in Kelley and others (2014, pg. 8:1-6, 8:1-7, 8:1-8, 8:1-9, 8:1-10, 8:1-11, 8:1-12). Estimated values are typically 0.1 ft/day or less, except for the Hosston Aquifer, which was shown as between 3 and 10 ft/day.

IV. GROUNDWATER DEMANDS AND CURRENT GROUNDWATER USES

The Texas Water Development Board pumping database does not list any pumping from the Trinity Aquifer in Henderson County. However, the database shows 42 AF/yr was pumping from the Trinity Aquifer in Trinity County in 2012.

V. TOTAL ESTIMATED RECOVERABLE STORAGE

Wade and others (2013) documented the total estimated recoverable storage for the Trinity Aquifer in GMA 11 as follows:

County	Total Storage (acre-feet)	25 percent of Total Storage (acre-feet)	75 percent of Total Storage (acre-feet)
Henderson	500,000	125,000	375,000
Total	500,000	125,000	375,000

Total storage is given in the first column. The recoverable storage is assumed to be between 25 and 75 percent of the total storage.

VI. EXPLANATION OF NON-RELEVANCE

Due to its limited areal extent and generally low use, the Trinity Aquifer is classified as not relevant for purposes of joint planning in Groundwater Management Area 11.

VII. REFERENCES

Kelley, V.A., Ewing, J., Jones, T.L., Young, S.C., Deeds, N., Hamlin, S., Jigmond, M., Harding, J., Pinkard, J., Yan, T.T., Scanlon, B., Beach, J., Davidson, T., Laughlin, K., 2014, Final Report: Updated Groundwater Availability Model of the Northern Trinity and Woodbine Aquifers. Report prepared for North Texas GCD, Northern Trinity GCD, Prairielands GCD, and Upper Trinity GCD. August 2014, Volume 1, 990p.

George, P.G., Mace, R.E., and Petrossian, R., 2011. Aquifers of Texas. Texas Water Development Board Report 380, July 2011, 182p.

Wade, S., Shi, J., and Seiter-Weatherford, C. 2014. GAM Task 13-034: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 11. Texas Water Development Board, Groundwater Resources Division, April 2, 2014, 30p.

NON-RELEVANT AQUIFER: YEGUA-JACKSON

I. INTRODUCTION

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>
> 1. *A description, location, and/or map of the aquifer or portion of the aquifer;*
> 2. *A summary of aquifer characteristics, groundwater demands, and current groundwater uses, including the total estimated recoverable storage as provided by the TWDB, that support the conclusion that desired future conditions in adjacent or hydraulically connected relevant aquifer(s) will not be affected; and*
> 3. *An explanation of why the aquifer or portion of the aquifer is nonrelevant for joint planning purposes.*

This technical memorandum provides the required documentation to classify the Yegua-Jackson Aquifer as not relevant for purposes of joint planning.

II. AQUIFER DESCRIPTION AND LOCATION

As described in George and others (2011):

> ***The Yegua-Jackson Aquifer*** *is a minor aquifer stretching across the southeast part of the state. It includes water-bearing parts of the Yegua Formation (part of the upper Claiborne Group) and the Jackson Group (comprising the Whitsett, Manning, Wellborn, and Caddell formations). These geologic units consist of interbedded sand, silt, and clay layers originally deposited as fluvial and deltaic sediments. Freshwater saturated thickness averages about 170 feet. Water quality varies greatly owing to sediment composition in the aquifer formations, and in all areas the aquifer becomes highly mineralized with depth. Most groundwater is produced from the sand units of the aquifer, where the water is fresh and ranges from less than 50 to 1,000 milligrams per liter of total dissolved solids. Some slightly to moderately saline water, with concentrations of total dissolved solids ranging from 1,000 to 10,000 milligrams per liter, also occurs in the aquifer. No significant water level declines have occurred in wells measured by the TWDB. Groundwater for domestic and livestock purposes is available from shallow wells over most of the aquifer's extent. Water is also used for some municipal, industrial, and irrigation purposes. The regional water planning groups, in their 2006*

Regional Water Plans, recommended several water management strategies that use the Yegua-Jackson Aquifer, including drilling more wells and desalinating the water.

Figure 1 (taken from Wade and others, 2014) shows the limited extent of the Yegua-Jackson Aquifer in GMA 11.

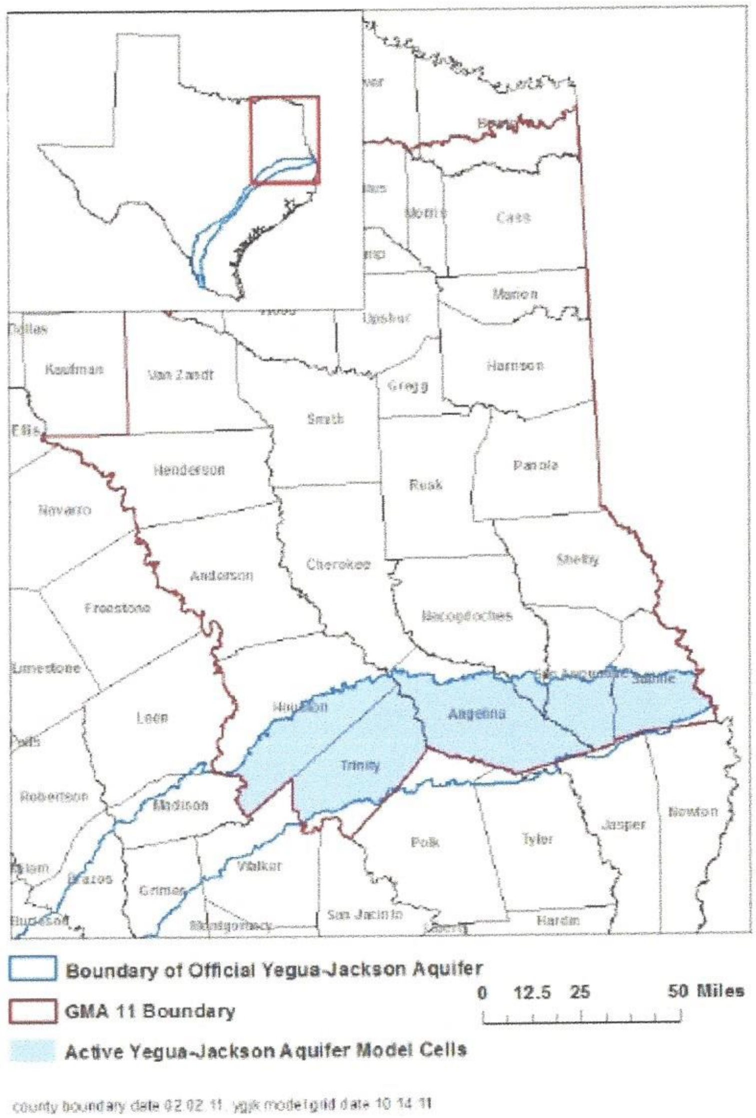


Figure 1. Location of Yegua-Jackson Aquifer in GMA 11

III. AQUIFER CHARACTERISTICS

Deeds and others (2010) developed a groundwater availability model of the Yegua-Jackson Aquifer for the Texas Water Development Board. Maps of calibrated horizontal hydraulic conductivity are provided on pages 8-7, to 8-11. Estimated values in the GMA 11 area vary considerably from less than 1ft/day to over 30 ft/day, depending on the unit and location.

IV. GROUNDWATER DEMANDS AND CURRENT GROUNDWATER USES

The Texas Water Development Board pumping database does not list any pumping from the Trinity Aquifer in Henderson County. However, the database shows 42 AF/yr was pumping from the Trinity Aquifer in Trinity County in 2012.

V. TOTAL ESTIMATED RECOVERABLE STORAGE

Wade and others (2013) documented the total estimated recoverable storage for the Yegua-Jackson Aquifer in GMA 11 as follows:

County	Total Storage (acre-feet)	25 percent of Total Storage (acre-feet)	75 percent of Total Storage (acre-feet)
Angelina	72,000,000	18,000,000	54,000,000
Houston	21,000,000	5,250,000	15,750,000
Nacogdoches	1,400,000	350,000	1,050,000
Sabine	30,000,000	7,500,000	22,500,000
San Augustine	19,000,000	4,750,000	14,250,000
Trinity	83,000,000	20,750,000	62,250,000
Total	226,400,000	56,600,000	169,800,000

Total storage is given in the first column. The recoverable storage is assumed to be between 25 and 75 percent of the total storage.

VI. EXPLANATION OF NON-RELEVANCE

Due to its limited areal extent and generally low use, the Yegua-Jackson Aquifer is classified as not relevant for purposes of joint planning in Groundwater Management Area 11.

VII. REFERENCES

Deeds, N.E., Yan, T., Singh, A., Jones, T.L., Kelley, V.A., Knox, P.R., and Young, S.C., 2010. Final Report: Groundwater Availability Model for the Yegua-Jackson Aquifer. Prepared for the Texas Water Development Board, March 2010, 582p.

George, P.G., Mace, R.E., and Petrossian, R., 2011. Aquifers of Texas. Texas Water Development Board Report 380, July 2011, 182p.

Wade, S., Shi, J., and Seiter-Weatherford, C. 2014. GAM Task 13-034: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 11. Texas Water Development Board, Groundwater Resources Division, April 2, 2014, 30p.

Appendix B

Wade Oliver's PowerPoint Presentation of March 22, 2016 at GMA 11 Meeting regarding Drawdown in Panola County and INTERA Report

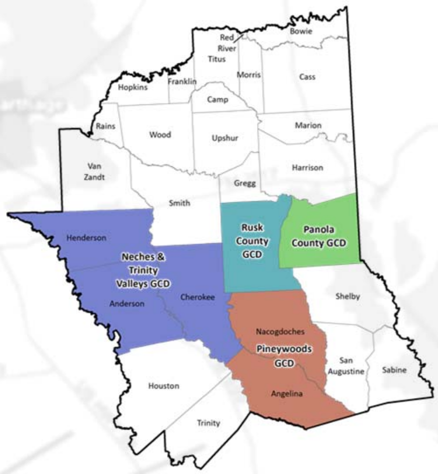
Update on DFC Evaluations

For:

Panola County Groundwater Conservation District
Carthage, Texas

And:
Groundwater Management Area **11**

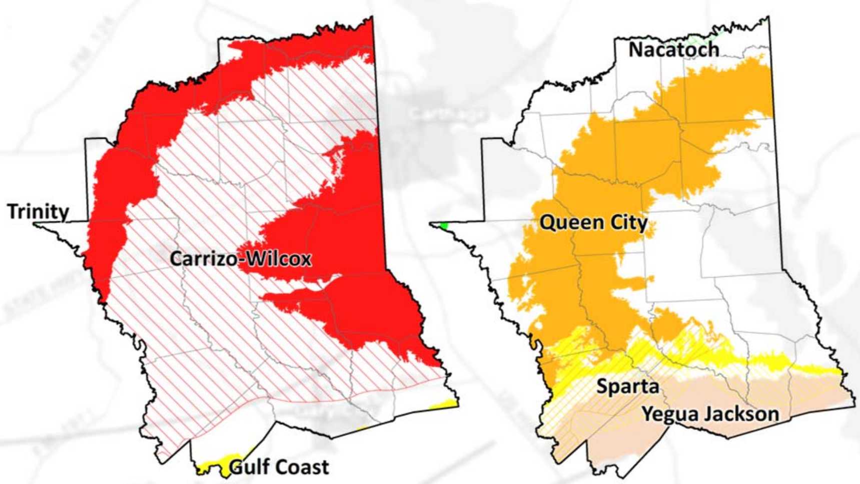
By:
Wade Oliver, P.G.



March 22, 2016

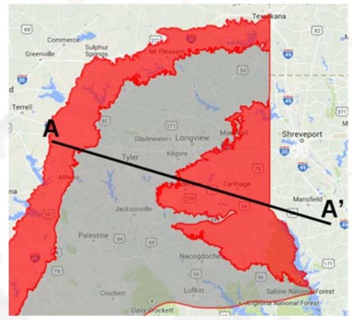
GMA 11 Aquifers

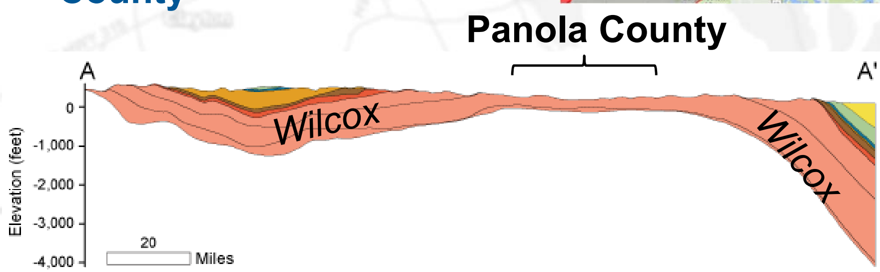
Major Aquifers **Minor Aquifers**



Cross-Section

- **Cross-sections show a vertical slice of the aquifer**
- **The middle Wilcox is the uppermost aquifer unit throughout most of Panola County**





Current DFCs and MAG

Geologic Unit	Classification	Drawdown Associated with DFC (feet)*	Modeled Available Groundwater (2060)
Queen City	Aquifer	-11	0
Reklaw	Confining Unit	-19	0
Carrizo	Aquifer	11	810
Upper Wilcox	Aquifer	2	770
Middle Wilcox	Aquifer	1	5,764
Lower Wilcox	Aquifer	4	725
District Total		**2**	**8,069**

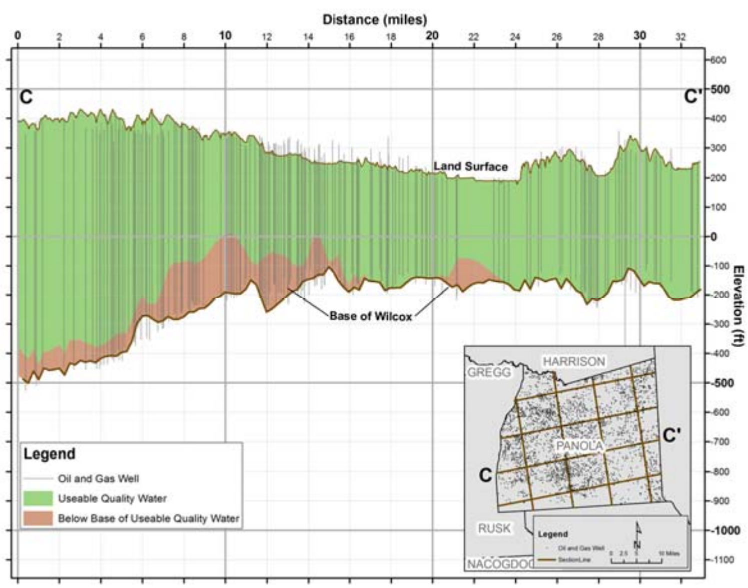
* *Negative drawdown values indicate a water level rise*

Scenario 4 Drawdowns (ft)

County	Layer 1 (Sparta)	Layer 2 (Weches confining Unit)	Layer 3 (Queen City)	Layer 4 (Reclaw confining Unit)	Layer 5 (Carrizo)	Layer 6 (Upper Wilcox)	Layer 7 (Middle Wilcox)	Layer 8 (Lower Wilcox)	Overall
Anderson	-2	2	9	38	95	102	100	63	67
Angelina	16	18	20	56	113	60	7	14	43
Bowie						22	5		5
Camp			18	2	24	24	50		26
Cass			10	28	78	64	64		50
Cherokee	12	16	14	29	80	112	123	80	72
Franklin				-24	-3	8	23		13
Gregg			9	13	49	58	67	86	42
Harrison			1	5	36	21	10	4	15
Henderson			5	24	66	54	50	36	41
Hopkins				-27	-12	-19	-19	-215	-22
Houston	3	3	6	45	99	95	88	39	49
Marion			24	23	51	41	44		38
Morris			17	16	53	45	42		37
Nacogdoches	5	5	4	27	44	43	16	16	24
Panola				-21	6	1	0	5	2
Rains						8	-13	-6	-10
Rusk			-14	-3	8	9	34	38	20
Sabine	1	2		8	17	10	6	5	7
SanAugustine	-8	-7		10	22	13	-1	-2	4
Shelby				-23	15	-5	4	2	1
Smith		-4	17	42	119	138	116	102	87
Titus			1	-6	38	19	5		9
Trinity	9	9	10	44	97	56	32	23	32
Upshur		-6	9	21	66	78	82	115	54
VanZandt			11	15	41	18	22	15	20
Wood		-8	-3	39	119	91	62	127	66
GMA11	4	4	10	29	73	63	49	40	43

5

Cross-Section



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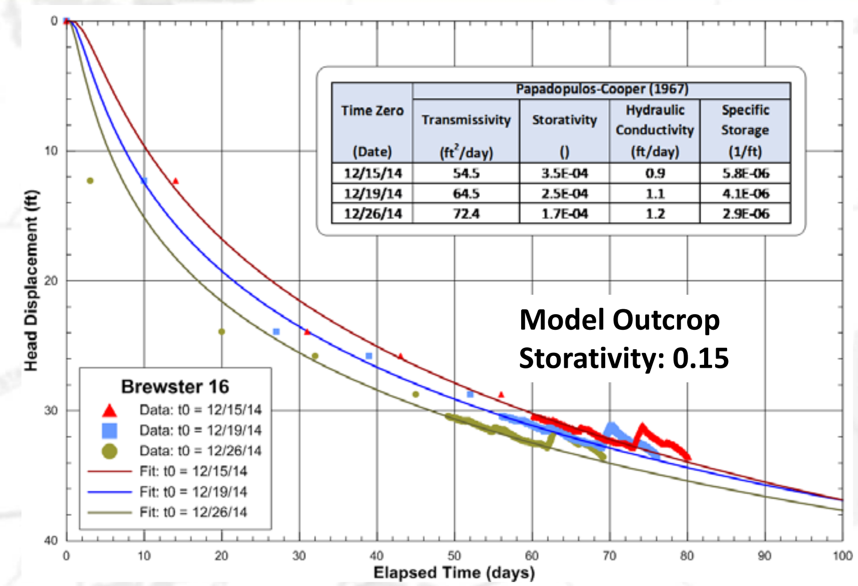
Aquifer Testing



Time Zero	Papadopulos-Cooper (1967)			
	Transmissivity	Storativity	Hydraulic Conductivity	Specific Storage
(Date)	(ft^2/day)	()	(ft/day)	(1/ft)
12/15/14	54.5	3.5E-04	0.9	5.8E-06
12/19/14	64.5	2.5E-04	1.1	4.1E-06
12/26/14	72.4	1.7E-04	1.2	2.9E-06

INTERA 7

Addressing Issues

Purpose

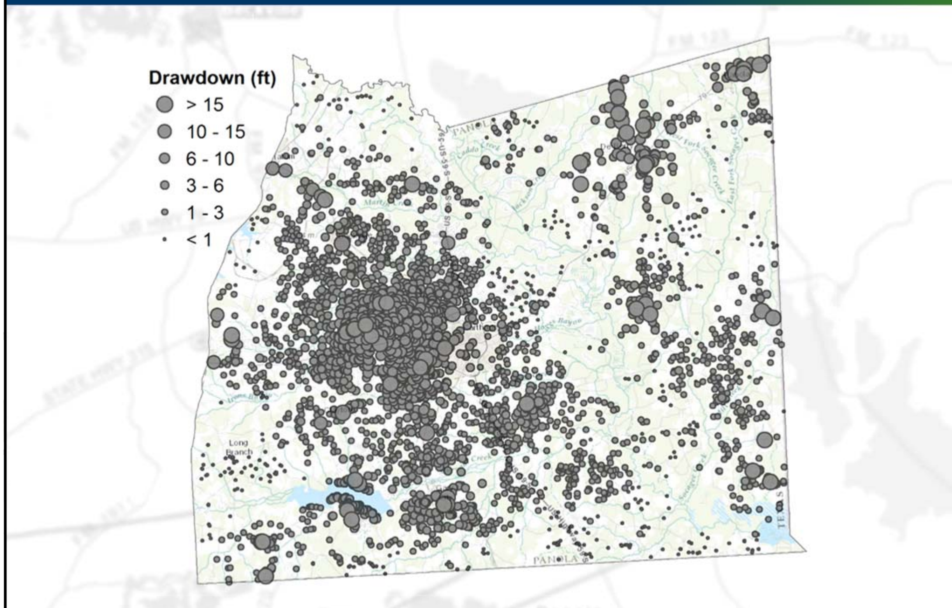
- Better understanding of the relationship between pumping and drawdown in the Wilcox in Panola County for DFC development

Approach

- Used analytic element model (TTIM) with pumping distributed to current District wells based on use and well yield
- Ran GAM scenarios 1 – 7 without Panola pumping to incorporate recharge, lateral flow, etc.
- Superimposed analytic element drawdown on GAM results

INTERA 8

Results



Results

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
Pumping							
Factor	0.7	0.8	0.9	1.0	1.1	1.2	1.3
Pumping (ac-ft/yr)	6,953	7,946	8,940	9,933	10,926	11,920	12,913
Panola County Carrizo-Wilcox Average Drawdowns (feet)							
GAM Average Drawdown*	-4.0	-3.6	-3.3	-3.0	-2.8	-2.5	-2.3
Analytical Tool	4.2	4.8	5.4	6.0	6.6	7.2	7.8
Combined Average Drawdown	*0.2*	*1.2*	*2.1*	*3.0*	*3.8*	*4.6*	*5.5*

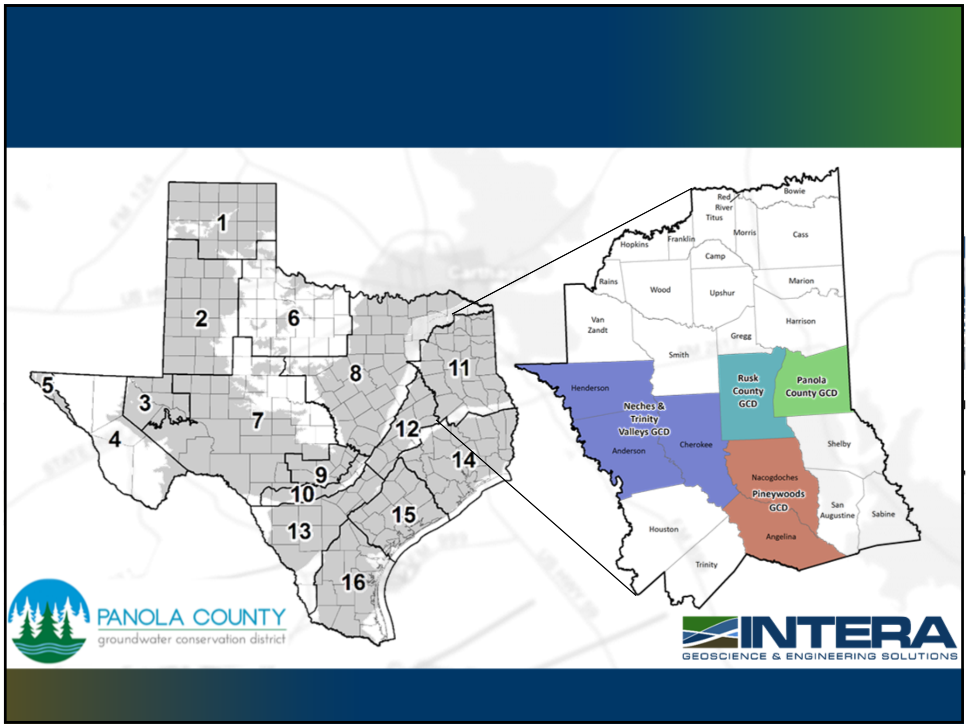
** Scenarios modified to remove pumping in Panola County from GAM*

Summary

- **With unconfined conditions in Panola County, GAM shows no drawdown in Middle Wilcox, the aquifer with the vast majority of pumping**
- **Aquifer tests showing confined conditions in county**
- **Evaluated response of aquifer using alternative analytical tool with confined properties overlaying GAM results**
- **Resulting drawdown more reasonably reflects relationship between pumping and drawdown**

Moving Forward

- **Group units of the Carrizo-Wilcox?**
- **Submit analytical model for use in MAG development?**
- **Buffer language for MAG development?**
  - e.g. the GMA considers TWDB to have adequately matched the DFCs if their calculated drawdowns are within 5 feet or 5 percent of the drawdowns specified as DFCs
- **New model on the horizon**


1
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14
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15
16
Red River
Bowie
Titus
Hopkins
Franklin
Morris
Cass
Camp
Rains
Wood
Upshur
Marion
Van Zandt
Harrison
Gregg
Smith
Henderson
Neches & Trinity Valleys GCD
Rusk County GCD
Panola County GCD
Anderson
Cherokee
Shelby
Nacogdoches
Pineywoods GCD
San Augustine
Sabine
Houston
Angelina
Trinity
PANOLA COUNTY
groundwater conservation district
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

Characterization of Wilcox Aquifer Structure, Composition and Hydraulic Properties in Panola County, Texas

Prepared for:

Panola County Groundwater Conservation District
419 W. Sabine Street
Carthage, TX 75633

Prepared by:

Daniel M. Lupton, P.G.
Timothy F. Dale, P.G.
Wade A. Oliver, P.G.

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54 Sugar Creek Center Blvd, Suite 300
Sugar Land, TX 77478

July 2015

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Geoscientist Seal

This report documents the work of the following Licensed Texas Geoscientists:

Daniel M. Lupton, P.G.

Mr. Lupton worked on the all phases of the project including aquifer structure, lithology and hydraulic properties.

STATE OF TEXAS
DML 7/7/15
DANIEL M. LUPTON
GEOLOGY
11354
LICENSED
PROFESSIONAL GEOSCIENTIST

7/7/2015

Signature Date

Timothy F. Dale, P.G.

Mr. Dale worked on the characterization of hydraulic properties and led all field activities.

STATE OF TEXAS
TFD 07/07/15
TIMOTHY F. DALE
GEOLOGY
No. 2513
LICENSED
PROFESSIONAL GEOSCIENTIST

Timothy F. Dale 07/07/15

Signature Date

Wade A. Oliver, P.G.

Mr. Oliver managed the project, was responsible for technical oversight and assisted in report preparation.

7/7/2015

Signature Date

STATE OF TEXAS
WAO 7/7/15
WADE A. OLIVER
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Table of Contents

List of Figures

List of Tables

1.0 Introduction and Study Objectives

Takeaway in Brief

This report documents the results of the first phase of a hydrogeologic study for Panola County Groundwater Conservation District. This Phase 1 investigation includes delineation of the lower Wilcox within the Carrizo-Wilcox Aquifer, characterization of the sand and clay distributions within the aquifer, and an evaluation of the hydraulic properties of the aquifer.

The Panola County Groundwater Conservation District (PCGCD) commissioned INTERA to perform an analysis of the hydrogeologic units underlying the district. PCGCD is coextensive with Panola County in Texas (Figure 1-1). The analysis focused on characterizing the composition and properties of the upper and lower units of the Wilcox Aquifer in sufficient detail to allow evaluation of local-scale and regional-scale impacts of existing and new production wells.

The original scope proposed for the hydrogeological analysis included five tasks:

Task 1) Lower Wilcox Delineation and Lithologic Characterization

Task 2) Hydraulic Property Characterization

Task 3) Analytical Well Impacts Tool Deployment

Task 4) Evaluation of Regional Pumping Impacts for a Broad Range of Scenarios

Task 5) Development of Mapping Application for District Website

The proposed scope was subsequently amended, and the first two tasks were approved for completion. This report documents the hydrogeological analyses conducted and the subsequent results obtained under Tasks 1 and 2 above.

The purpose of Task 1 was to delineate the composition (distribution of sands and clays) of the Wilcox unit and the lateral and vertical extents of the lower Wilcox. The results of Task 12 are presented in Section 2. The purpose of Task 2 was to evaluate available historical and any newly acquired data related to hydraulic properties, predominantly the formation hydraulic conductivity and storativity and the development of a relationship between lithology and the formation hydraulic properties. This was done to enable estimation of water-level drawdowns throughout the aquifer when reviewing production permit applications.

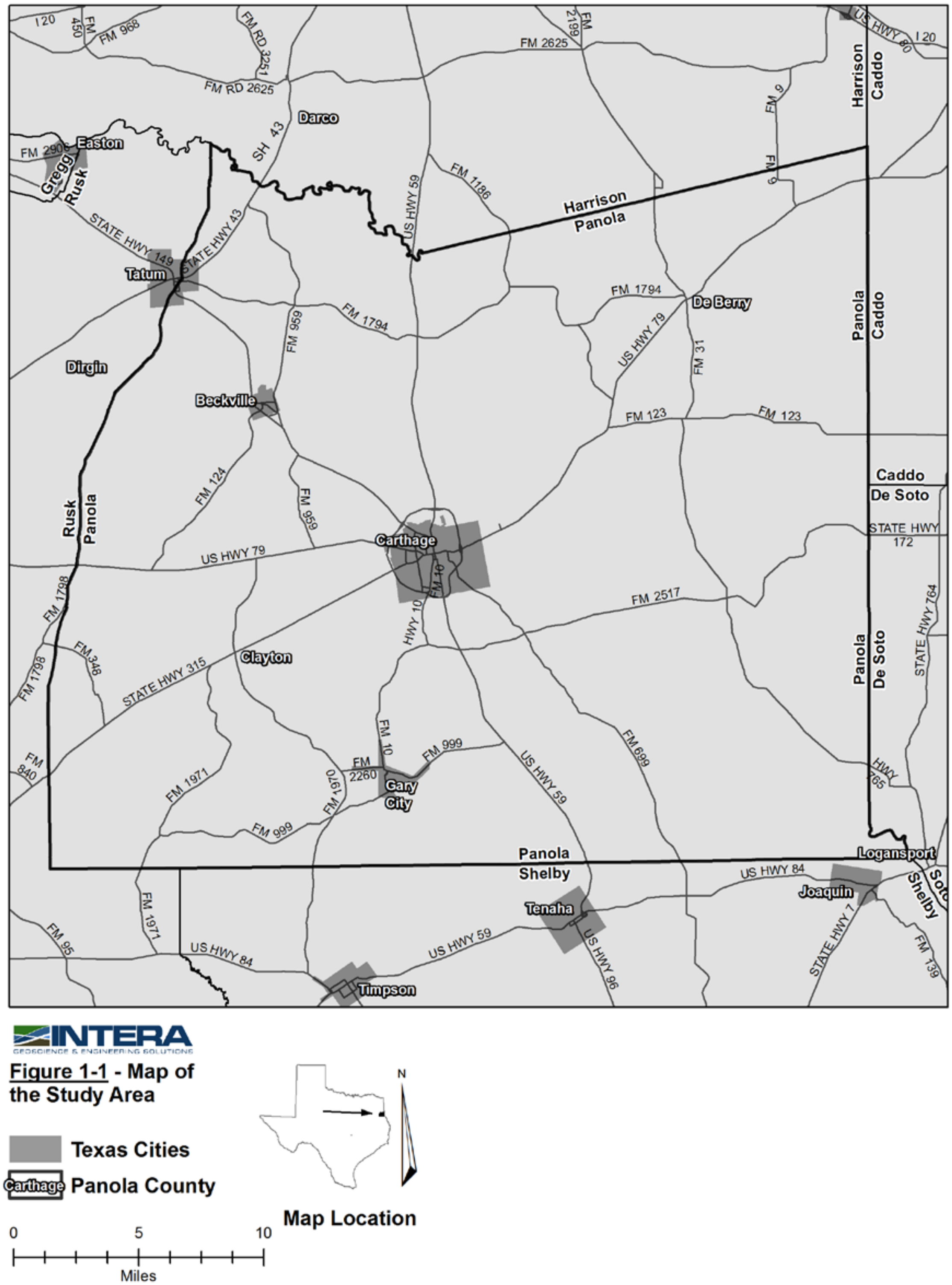


Figure 1-1. Panola County Groundwater Conservation District Base Map

2.0 Lower Wilcox Delineation

Takeaway in Brief

The Wilcox Group of the Carrizo-Wilcox Aquifer is the primary aquifer of interest in Panola County and the focus of the current study. Previous studies of the groundwater resources of the Carrizo-Wilcox Aquifer relevant to Panola County include groundwater availability models developed for the Texas Water Development Board and site investigations for radioactive waste isolation and lignite exploration. The previous work most relevant to the current study is Kaiser (1990) – Wilcox Group (Paleocene-Eocene) in the Sabine Uplift Area, Texas: Depositional Systems and Deep-Basin Lignite.

Hydrogeologic units in the subsurface in Panola County of interest to PCGCD are in the Wilcox Group of the Carrizo-Wilcox aquifer. The Carrizo-Wilcox aquifer is comprised of hydraulically connected sands from the Wilcox Group and the overlying Carrizo Formation of the Claiborne Group (Ashworth and Hopkins, 1995). The Carrizo-Wilcox aquifer is classified as a major aquifer by the Texas Water Development Board (TWDB) (George and others, 2011). Figure 2-1 shows a representative stratigraphic section that includes the Carrizo-Wilcox Aquifer in Texas. The aquifer extends across Texas, from the Rio Grande in the southwest to the Sabine River in the northeast and beyond into Louisiana and Arkansas. Minor changes in nomenclature and the nature of various formations occur across Texas. The aquifer consists of fluvial-deltaic sediments of the upper Paleocene and lower Eocene Wilcox Group and Carrizo Sand. Regionally, the aquifer is bounded below by marine deposits of the Midway Formation and above by the Reklaw and Bigford Formations, representing a semi-confining unit between the Carrizo Sand and the overlying, shallower aquifer of the Queen City Formation. In Panola County, the unit is still bounded below by the Midway Group, but the Reklaw, Bigford and Carrizo Formations have been partially or completely eroded away.

Figure 2-2 shows the surface geologic map (after Barnes, 1968) in the project area. The primary geologic unit at surface in Panola County is the Wilcox Group, with minor amounts of Carrizo Sand in the northeastern and southern portions of the County. In addition, large swaths of Quaternary Alluvium and Quaternary Terrace deposits flank the tributaries and main stretch of the Sabine River going from northwest to southeast through the County. Some small exposures of the Sparta Sand, Weches Formation, Queen City Sand and Reklaw Formation exist to the south and northwest of the study area. The occurrence and distribution of these younger units in Panola County is the result of decreased exposure on the flanks of the Sabine Uplift located towards the east. Sustained uplift and fluvial down cutting are the main factors leading to the Wilcox Group being exposed at surface within Panola County.

Comprehensive regional hydrogeologic descriptions of the Carrizo-Wilcox aquifer have been most recently provided in the development of the conceptual models for the three groundwater availability models commissioned by the TWDB in 2001 (Deeds and others, 2003; Dutton and others, 2003; Fryar and others, 2003), which were summarized in a chapter of a recent TWDB publication (Deeds and others, 2010). These studies considered the southern, central, and northern portions of the aquifer, respectively, and built on the considerable existing literature describing the geology and hydrogeology of the Carrizo-Wilcox at various locations and scales. The seminal regional work on the aquifers in the East Texas Basin was performed by the Bureau of Economic Geology (BEG). In the 1970s and 1980s, the

BEG performed a number of detailed hydrogeologic studies in the Carrizo-Wilcox Aquifer of the East Texas Basin in support of preliminary site characterization for radioactive waste isolation (funded through the National Nuclear Waste Isolation Program overseen by the U.S. Department of Energy). Additionally, the occurrence of economic deposits of lignite in the area further spurred geologic and hydrogeologic characterization of the near surface units (less than 2,000 feet below ground surface).

The most relevant geological study characterizing the hydrogeologic units in Panola County is Kaiser's (1990) Wilcox Group (Paleocene-Eocene) in the Sabine Uplift Area, Texas: Depositional Systems and Deep-Basin Lignite. The study was commissioned in an attempt to investigate techniques for quantifying deep basin lignites using geophysical logs and the deep basin lignite reserves in the Sabine Uplift area. In support of the latter goal, Kaiser created maps of the structural elevation, net sand, percent sand, maximum percent sand and maximum net sand for the upper and lower Wilcox Units within the Sabine Uplift area. The structure maps of the Wilcox units are very relevant to this study as Kaiser spent considerable time evaluating logs in the area and developed a scheme for picking the structural elevations of the contacts used to differentiate the upper and lower Wilcox units. This scheme, which separates the Wilcox into two unique depositional environments, was used in the current analysis as a framework when building the structure within the study area. Kaiser's parsing of the Wilcox into the upper and lower comes from his recognition that the lower Wilcox is texturally similar to the progradational Hooper Formation to the west, while the upper Wilcox is texturally similar to the aggradational Simsboro and Calvert Bluff Formations.

2.1 Structural Setting

Takeaway in Brief

Panola County is located in an area known as the Sabine Uplift. This is a geologic feature that has been present since the deposition of the sediments of the Wilcox group. Due to the uplift, sediments of the Wilcox are thinner in Panola County than in areas of the aquifer to the west. Some faulting occurs in the southern and southwestern portions of Wilcox in Panola County with offsets of 200 to 400 feet in some areas.

Figure 2-3 provides a map of the major structural features of the East Texas Basin and Sabine Uplift areas. Major Wilcox structural elements in the study area include the Sabine Uplift, the East Texas Basin and the Mount Enterprise Fault Zone (MEFZ) (Kaiser, 1990). The sediments that form the Carrizo-Wilcox aquifer are part of a gulfward thickening wedge of Cenozoic sediments deposited in the Rio Grande and Houston Embayments of the Gulf Coast Basin. Deposition in the Rio Grande Embayment was influenced by regional subsidence, episodes of sediment inflow from areas outside of the Gulf Coastal Plain, and eustatic sea-level change (Grubb, 1997). Galloway and others (1994) characterized Cenozoic sequences in the Gulf Coast in several ways. Deposition of Cenozoic sequences is characterized as an offlapping progression of successive, basinward thickening wedges. These depositional wedges aggraded the continental platform and prograded the shelf margin and continental slope from the Cretaceous shelf edge to the current Texas coastline. Deposition occurred along sand-rich, continental margin deltaic depocenters within embayments and was modified by growth faults and salt dome development.

Sediments primarily derived from the paleo-Ouachita Mountains were transported along the axis of the East Texas Embayment to the west of the Sabine Uplift (Figure 2-3) (Kaiser, 1990). Continental scale Wilcox rivers transporting these sediments were also influenced by the occurrence and distribution of salt domes and salt withdraw structures. Deposition on the western flank of the Sabine Uplift greatly outpaced deposition on the uplift. This resulted in thicker assemblages of Wilcox sands and clays on the flanks of the Sabine Uplift and thinner assemblages of Wilcox sands and clays directly atop of the Sabine Uplift. Structurally, the study area is located directly on top of the Sabine Uplift.

North of the MEFZ, Wilcox strata dip gently to the west-southwest towards the East Texas Embayment at around 0.2^{o} to 0.4^{o}, with local perturbations on the dip (about 1^{o}) occurring within the fault blocks. Normal faulting within the study area is present in the southern and southwestern portions. Faults generally have throws of 200 to 400 feet on the Wilcox horizons. Faulting was initially triggered by Jurassic salt tectonism (Ferguson, 1984) and later perpetuated by sedimentary loading during Cenozoic gulfward progradation (Jackson, 1982). Jackson (1982) contends that some of the displacements on the down thrown side of the fault blocks were/are syndepositional and account for the Wilcox overthickening in the central graben portion of the faults. This idea will be discussed in further sections.

2.2 Stratigraphy

Takeaway in Brief

The Wilcox Group is Paleocene to Eocene in age with sediments deposited 50 to 60 million years ago by rivers and river deltas. The Wilcox is divided into upper, middle and lower units throughout much of Texas, but only into upper and lower units in East Texas. The lower Wilcox typically contains shaley thin sands and lignite while the upper Wilcox contains blockier sands interbedded with clays. The Carrizo formation overlying the Wilcox is almost entirely eroded away in Panola County leaving the upper Wilcox exposed at land surface.

Regionally, in the portion of the aquifer stretching from the Rio Grande to the Colorado River, the Wilcox Group is subdivided into a lower, middle, and upper Wilcox (Figure 2-1). The upper Wilcox in the deeper subsurface is correlated to the Carrizo Formation in the outcrop (Bebout and others, 1982; Hamlin, 1988). Bebout and others (1982) mapped the lower contact of the upper Wilcox based on the lower regional marker identified in geophysical logs by Fisher and McGowen (1967). Hamlin (1988) also combined the Carrizo and upper Wilcox and mapped the base of the upper Wilcox as a distinct facies change from a fluvial (bed-load channel system) and mixed alluvial facies in the upper Wilcox to a predominantly marine facies (delta, prodelta) in the middle Wilcox. In comparison, Klemt and others (1976) lithologically picked the base of the Carrizo Aquifer as the top of the Wilcox Group by identifying the base of the major sand units of the Carrizo Formation. Klemt's mapped Carrizo Formation correlates with the Carrizo as mapped in central Texas (Ayers and Lewis, 1985).

Between the Colorado and Trinity rivers, the Carrizo–Wilcox Aquifer system is composed of four hydrostratigraphic units with distinct hydraulic properties: the Hooper, Simsboro, and Calvert Bluff formations of the Wilcox Group and the Carrizo Sand of the Claiborne Group (Figure 2-1). In general, the Simsboro and Carrizo formations contain thicker, more laterally continuous and more permeable sands and, therefore, are more important hydrostratigraphic units when determining groundwater availability. The Calvert Bluff and Hooper formations typically are made up of clay, silt, and sand mixtures, as well as lignite deposits. Because of their relatively low vertical permeability, the Hooper and Calvert Bluff formations act as leaky aquitards that confine fluid pressures in the Simsboro and Carrizo aquifers and restrict groundwater movement between the layers. Although the Hooper and Calvert Bluff formations contain sand units, they are generally finer and less continuous than the sands of the Simsboro and Carrizo formations. Above the Carrizo Formation, the low-permeability marine shale of the Reklaw Formation restricts vertical groundwater movement to the overlying Queen City Formation in the Claiborne Group.

Locally, in the Sabine Uplift area as one moves east of the Trinity River, the Simsboro is no longer as distinctly identifiable, and the Wilcox is divided into informal lower and upper units. The lower Wilcox represents the facies equivalent of the Hooper Formation, and the upper Wilcox includes both the Simsboro and the Calvert Bluff equivalent fluvial and fluvial-deltaic facies, respectively (Kaiser, 1990). In the eastern portion of the Sabine Uplift where PCGCD is located, the Carrizo formation has been almost entirely eroded, leaving the upper Wilcox at surface over the majority of the study area.

During the Paleocene and early Eocene, the Gulf Coast Basin in East Texas and Louisiana was filled primarily by major delta systems in the Mississippi and Houston Embayments and secondarily by a fluvial system in the East Texas Basin (Kaiser, 1990). Paleo-rivers brought sediments from the Ouachita Mountains and deposited them in the East Texas basin as a vertical sequence of progradational (deltaic) to agradational (fluvial) sediments. Kaiser modeled the sediments as highly interconnected north-south trending sand bodies closely mirroring the paleo-rivers and their respective tributaries. The upper and lower Wilcox are distinguished primarily by their geophysical log characteristics and how those characteristics relate to the depositional environment.

In practice, the contact between the lower Wilcox and Midway is picked at the base of the inverted “Christmas tree” pattern (representing a fining upward sequence) on the resistivity/induction log (see Figure 4 in Kaiser (1990)). This is a fairly straightforward pick, as the lower Wilcox represents the first basinward progradational sequence following the deposition of the Midway flooding surface. The exact contact between the lower and upper Wilcox is a bit more problematic in areas. The contact between the lower and upper Wilcox is at the transition between the sharp shaley/thin sands of the lower Wilcox (progradational deltaic) into the thick blocky sands of the upper Wilcox (agradational fluvial). Kaiser (1990) indicates this transition as a thin lignite seam at the top of the lower Wilcox unit.

2.3 Updated Delineation

Takeaway in Brief

The source information to update the Wilcox structure and delineate the boundary between the upper and lower Wilcox in Panola County consisted of Kaiser (1990) and 115 publically available geophysical logs. We developed surfaces for the base of the Wilcox and the contact between the upper and lower Wilcox. We then interpreted resistivity logs to evaluate the sand and clay composition (lithology) of the aquifer.

The bulk of the analysis covered in this study stemmed from two primary pieces of data: structure maps created by Kaiser (1990) and geophysical logs acquired from public sources. As Kaiser (1990) previously developed a structural and stratigraphic model for this area, our primary focus was to add to this data in areas where Kaiser (1990) did not have geophysical log picks. These new log picks were integrated into the structural surfaces to increase data density.

2.3.1 Electric Logs

Geophysical well logs used in the study area were primarily derived from two databases: the Brackish Resource Aquifer Characterization System (BRACS) Database and the Railroad Commission's (RRC) Q-log Database. The BRACS database is maintained by the BRACS group at the TWDB and was designed to store well and geology information in support of projects to characterize the brackish groundwater resources of Texas. The RRC's Q-log database is stored and maintained by its Groundwater Advisory Unit. Any operator drilling a new oil and gas well or reentering an existing well must have a plan for the well design that is approved by the Groundwater Advisory Unit. The well design must show that surface casing is adequately protecting against contamination of the fresh (less than 1,000 mg/L total dissolved solids) and useable (less than 3,000 mg/L) quality water. The Groundwater Advisory Unit uses their Q-log database to determine the base of fresh and useable quality water. Both of these databases are publicly available and can be acquired upon request.

All of the logs used in this study were electric logs. Electric logs are made up of a spontaneous potential (SP) curve on the left side of the log tract and a resistivity curve on the right side of the log tract. An SP log is the measurement of a naturally occurring voltage (or "potential") caused when conductive drilling fluids come in contact with the geologic formations. The primary function of the SP log is to decipher between a sand and a clay in terrigenous depositional environments. To do this, there must be a potential created between the borehole fluid and the formation fluid.

In deep brackish formations, such as the hydrocarbon bearing formations that are targeted by oil and gas wells in the study area, the potential (or voltage) spontaneously created between the borehole and formation fluid is great enough to be clearly recorded on the geophysical log. Unfortunately, in the fresh to slightly saline formations such as the Carrizo-Wilcox, the borehole and formation fluid are too electrochemically similar to create a recordable potential. Therefore, the SP curve on the electric logs was not heavily used in this analysis to decipher the distribution of sands and clays or structural contacts.

The resistivity log is one of the oldest and most common logs run in the oil and gas industry. The log is based on the principle that most rock matrices are electrical insulators and therefore have infinite resistivity (resistance to the flow of electricity), but sedimentary rock is often porous, and the pores are usually fluid (mainly water) bearing. If the water contains soluble salts, it will be conductive and the rock as a whole will exhibit a conductivity which is a function of the porosity, the ionic makeup of the fluid, and the interconnectivity of the pore throats. In practice, a resistivity "spike" or increase in amplitude is indicative of a sand, and the thickness of the spike on the log is directly proportional to the thickness of the sand. These physical attributes of the resistivity curve are used to decipher depositional environment, structural contacts, lithologic changes, water quality, oil/gas/water contacts, etc.

2.3.2 Lithologic Picks from Electric Logs

A shale is an ionically dense material and in turn an excellent conductor of electricity. Because conductivity is the reciprocal of resistivity, a shale is represented by a trough on the resistivity curve. A porous sand filled with fresh to slightly saline water is relatively non-conductive and will be represented on a resistivity log by a spike. In general, the magnitude of the resistivity spike is related to the interconnectivity of the sand unit and the ionic makeup of the water filling the pores. That is, the fresher and more interconnected (permeable) a sand/gravel package is, the higher the magnitude of the resistivity signature. As the water quality in the sand/gravel formation degrades and the sodium and chloride ions increase, the pore fluid within the unit will become more conductive, and the magnitude of the resistivity spike will reduce. At this point, assuming that there is a good contrast between the borehole fluid and the formation fluid, the spontaneous potential or SP log would primarily be used to evaluate the size and location of the sandy units. However, the water quality in the units relevant to this study did not degrade significantly, and therefore the resistivity curve was used to make all of the geophysical log-based sand and clay picks. Sand picks were made on 79 out of the 115 geophysical well logs in the study area (Figure 2-4). Wells that did not have sand picks, which are primarily in the northeastern portion of the study area, are the result of a combination of the structurally high Midway surface and a deeper top logging interval in the logs.

2.3.3 Structural Picks from Electric Logs

Structural picks in the study area were made for the Top of Midway, the contact between the upper and lower Wilcox units, and one pick was made for the top of the upper Wilcox (Figure 2-5). The distribution of picks for the Top of Midway is considered adequate, with the exception of the northern portion of the County. Geophysical logs available from the public data sources were insufficient in this area, and the ones that were available did not have a shallow enough top logging interval. The distribution of picks for the contact between the upper and lower Wilcox is considered adequate for the purposes of this study. Picks for the top of the upper Wilcox (Figure 2-5) are considered inadequate. Again, top logging intervals did not start deep enough in the majority of the wells, which made it impossible to follow the structural picks laterally from wells where a potential pick could be made. However, the Wilcox is either close to ground surface or at ground surface in the majority of the study area. This would functionally make the top of the Wilcox ground surface in the study area. In areas where Carrizo or some type of Quaternary deposit is at ground surface, thicknesses of the total Wilcox will be overestimated by as much as 100 feet.

In an effort to evaluate the structural setting of the Wilcox in the study area, geophysical logs were hung on two cross sections going through the study area. Figures 2-6a and 2-6b represent a section going from West to East through the study area. Figures 2-7a and 2-7b represent a section going from North to South through the study area.

Figure 2-6b is a strike-oriented section going roughly west-east through the study area and was created to show the lateral termination due to pinchout or erosion of the lower Wilcox unit. In the areas where the lower Wilcox is not present, the upper Wilcox is in direct contact with the Midway Formation. Termination of the lower Wilcox was determined by the character of the sediments immediately above the top of the Midway Formation. The lower Wilcox is represented by a progradational fluvial-deltaic depositional environment. Lithologically, the lower Wilcox is identified by a fining upward sequence followed by a series of thin stacked sands. The upper Wilcox represents an agradational series of fluvial sediments characterized in the study area by blocky, high resistivity, sands. In areas where these blocky, high resistivity sands occur down to the top of the Midway Formation, it is determined that the lower Wilcox was either never deposited or eroded, and the upper Wilcox makes up the entire Wilcox Formation. In addition, Kaiser's (1990) structure maps were used to delineate the updip extent of the contact between the upper and lower Wilcox.

Figure 2-7b is a dip-oriented section going roughly north-south through the study area and was created to illustrate faulting associated with the eastern limit of the Elkhart-Mount Enterprise Fault Zone. Regionally, the faults have throws of 100 to 500 feet (Kaiser, 1990). Locally, fault throws are on the order of 100-250 feet, mainly to the south. Faulting in the study area generally begins south of well Q301. Faulting is attributed to movement in the deep Jurassic salts and has been perpetuated by sediment loading of Gulf Coast units (Kaiser, 1990). In some areas of the East Texas Basin, syndepositional faulting can be inferred by the presence of large sand packages (overthickening). This phenomenon can be seen in wells Q3 (updip of fault) and 424190030000 (down-dip of the fault). Large blocky sands have accumulated on the upthrown side of the fault in well Q3. Hydrogeologically, offset due to faulting can also juxtapose transmissive sands on the upthrown side of the fault against non-transmissive clays on the downthrown side of the fault, resulting in restricted flow down-dip of the faults. This cessation of the recharge making it down-dip can result in a sharp water quality change in the sands up- and down-dip of the fault features. In addition, faults can also cause mounding in the potentiometric surface, as they can represent a barrier to groundwater flow.

2.3.4 Digitization of Kaiser (1990) Structural Surfaces

Structural surfaces from Kaiser (1990) for the base of the Wilcox and contact between the upper and lower Wilcox were digitized using ESRI's ArcGIS© v 10.2. Plates from Kaiser (1990) were provided by the Bureau of Economic Geology in a digital (.png) format. Within the figures were cross hatches that represented intersections of latitude and longitude lines. Points representing the exact location of these cross hatches were created as shape files in ArcGIS©, and the .png of the structure maps was georeferenced to these points. A check for consistency between the County boundaries on the georeferenced plates and a shapefile of Texas counties was performed, and the results were agreeable.

After georeferencing the plates, contour lines representing the structural surfaces were digitized for the study area. Of particular importance when digitizing the contour lines were the normal faults that Kaiser resolved in the southern portion of the study area. Offsets as a result of these faults were certainly noticeable in the geophysical logs, but INTERA defaulted to Kaiser's specific fault geometry and offset due to his significant expertise in this area.

Once the contours and fault lines were digitized, they were converted to a raster surface using the ArcGIS© Topo to Raster tool. This process produced a consistent surface in the areas that were not affected by faulting, but not in the areas in and near the faulting. The Topo to Raster tool had an option that allows the user to input a line feature class which can be used to represent the faults (interpolation boundary), but results were less than satisfactory. The rasters representing the structural surfaces were converted into a Triangulated Irregular Network (TIN), and the feature class representing the fault locations was converted to a 3D feature class. Converting the raster to a TIN allowed for a more interactive editing of the surfaces and in turn resulted in a product that more closely reflects the surfaces created by Kaiser (1990). After editing, the TINs were converted back into a raster surface.

2.3.5 Consistency between INTERA's and Kaiser's (1990) Structural Picks

Surfaces representing Kaiser's structural elevation of the base of the Wilcox and contact between the upper and lower Wilcox were sampled to the wells where INTERA made structural picks for the same unit. The two sets of picks were then subtracted to see the difference in elevation between Kaiser's (1990) surface and the structural pick made by INTERA. In areas where there was more than 50 feet of difference, the geophysical log was revisited to confirm that the structural pick that INTERA made did not need adjusting.

After checking all of the structural picks, the next step was to change Kaiser's contours in areas where more information was available. In areas where the electric log picks did not align with the contours from Kaiser (1990), changes were made to the contours as appropriate. Edits to the structural surfaces were concentrated in the areas where Kaiser (1990) had less well control. After the contours were edited, they were converted back into raster surfaces using the same process described above in Section 2.3.4. The resulting structural surfaces are plotted in Figures 2-8 and 2-9. A Digital Elevation Model (DEM) provided by the United States Geological Survey (USGS) was used to subtract ground surface from the base of Wilcox (top of Midway Formation) to get an approximate thickness of the Wilcox Group in PCGCD (Figure 2-10). Minor perturbations of approximately 100 feet will occur in areas with preserved Carrizo, such as the extreme northwestern and southern portions of the district (Figure 2-2). Additionally, accumulations of Quaternary Alluvium could impact the Wilcox thickness calculation by approximately 25 feet (Figure 2-2).

2.4 Lithologic Evaluation of Area Groundwater Wells

Takeaway in Brief

The lithology of an aquifer, evaluated here as percent sand, is often an indicator of its productivity. We evaluated lithology using 79 geophysical logs and rock type descriptions provided by drillers in water well drilling reports. Geophysical logs, which are typically completed for oil and gas wells, are more reliable than drilling reports but often do not extend into the shallow portions of the aquifer. Of the 2,063 drilling reports in the county available for analysis, we used the 695 that were deep enough to represent at least half of the aquifer thickness. The resulting distribution of percent sand is consistent with the north-to-south axis of sediment deposition.

Lithologic data derived from the analysis of geophysical logs was insufficient in the first 100-200 feet of the majority of the geophysical logs. Additionally, the spacing of geophysical logs for the interpretation of sand geometries was considered inadequate. Therefore the data was supplemented with the digitization of 2,063 Submitted Driller's Reports (SDR) (Figure 2-11). In the state of Texas, when a licensed driller oversees the drilling of a groundwater well, he or she is required to log the lithologic changes encountered as the rig drills deeper. These tabulated lithologic changes are annotated onto the driller's report and subsequently submitted to the Texas Department of Licensing and Regulation (TDLR). Since 2001, these forms have been stored in a digital format at the Texas Water Development Board. This database is publically available and is regularly used by hydrologists to evaluate subsurface trends. INTERA accessed this database in an attempt to better understand the distribution of sands and clays within the study area.

This process involved interpreting the lithologic characterizations made by the driller and parsing it into a sand, clay, lignite or other category. Once the picks were parsed into the appropriate category, the percent of the entire borehole thickness represented by sand was calculated. In addition, the base of the Wilcox (top of the Midway) was sampled to each of the wells and, based on the depth of the borehole, a calculation for the percent of the Wilcox aquifer represented was made. This data was combined with the sand picks from geophysical logs, and a histogram showing the distribution of percent of Wilcox aquifer represented was made (Figure 2-12). As can be seen in Figure 2-12, 67 percent of the lithologic picks represent less than half of the thickness of the Wilcox aquifer in the study area. This means that lithologic interpretations using this data will be biased towards the upper portions of the Wilcox aquifer. The remaining 33 percent of the interpretations, or 695 wells, are wells that characterize 50 to 100 percent of the Wilcox aquifer. While some bias towards the upper portions of the Wilcox aquifer remains, these latter wells were used to create a percent sands map for the study area (Figure 2-13).

When creating the sand percent map for the combined upper and lower Wilcox in the study area, careful consideration was taken when selecting the most appropriate interpolation algorithm. Kaiser (1990) represents the Wilcox sand distributions as "a series of north-south trending elongate, channel-fill sands that are tens to hundreds of feet thick and a few thousand feet wide woven into multi-lateral ribbons connected to form complex channel networks". It is worth mentioning that Kaiser (1990) contoured (interpolated) percent sands for the lower Wilcox and percent major sands for the upper Wilcox, while INTERA combined the lower and upper Wilcox and interpolated percent sands for the entire unit. In addition, Kaiser (1990) did not evaluate the distribution of percent sands in the Panola County area for the upper Wilcox due to lack of well data.

The incorporation of drillers' lithologic descriptions into the sand percent calculations greatly enhanced the data density in the shallow subsurface. In addition, following the general directional trend proposed by Kaiser (1990) provided a percent sand distribution that is reflective of the paleodepositional fluvial orientations. Major differences between the INTERA percent sand map and the Kaiser (1990) percent sand maps are in the interconnectivity of the fluvial axis. Due to the updip and outcropped nature of the Wilcox in the study area, combined with the fact that the Wilcox was deposited on a structural high (Sabine Uplift), we feel like the disconnected nature of the fluvial axes is appropriate.

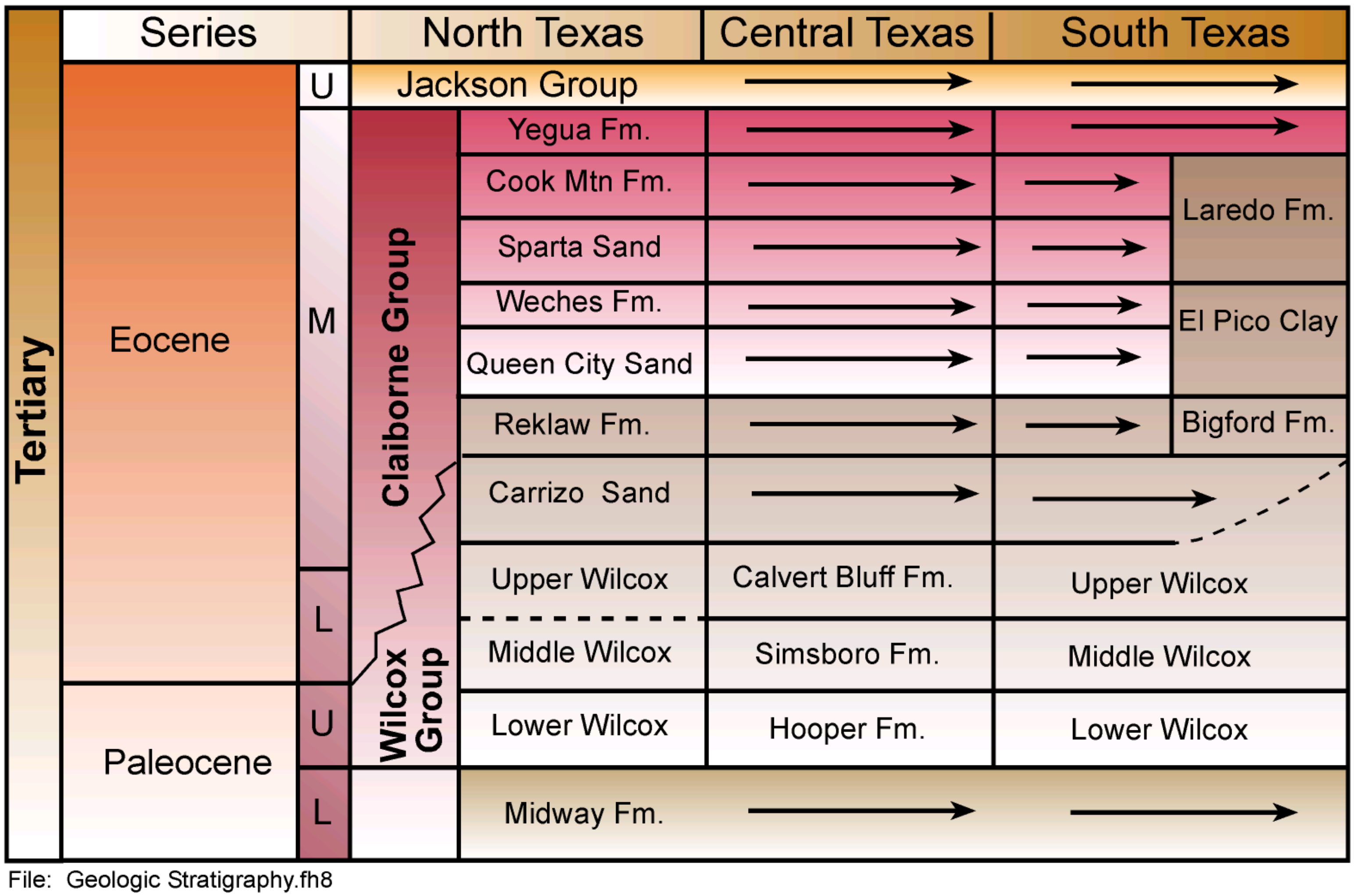


Figure 2-1. Study Area Stratigraphy (from Kelley and others, 2004)

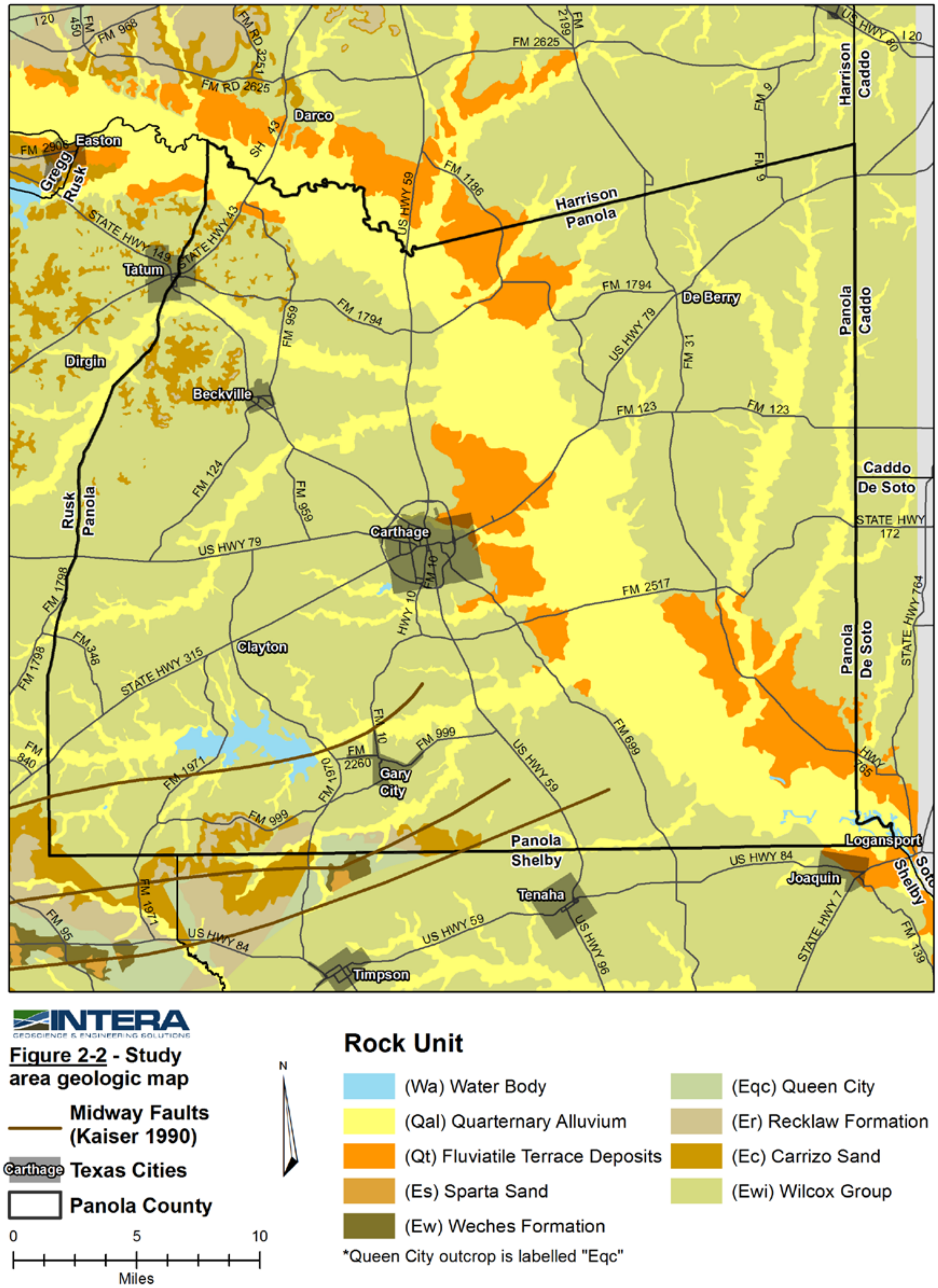


Figure 2-2. Surface Geology of Panola County

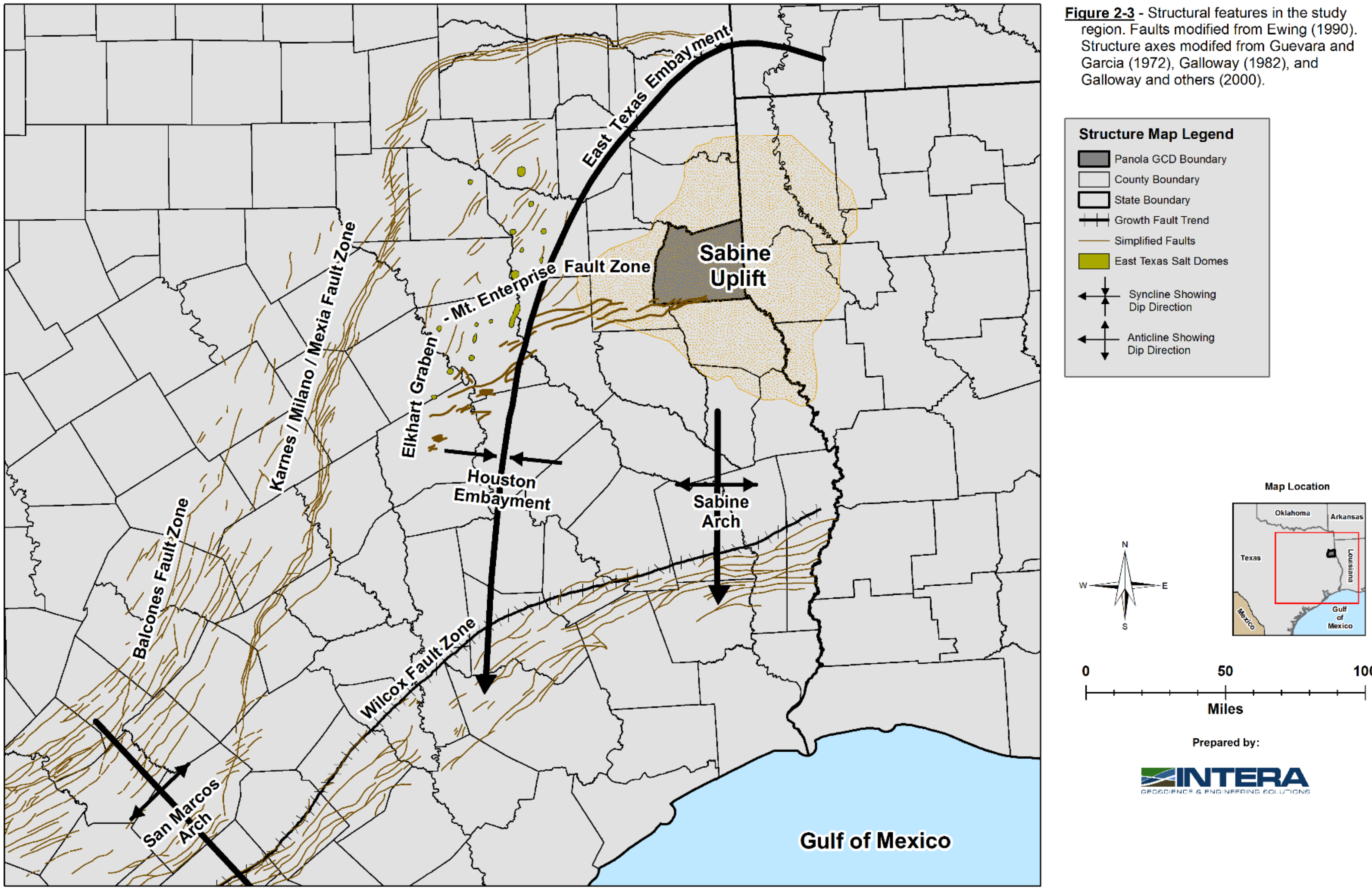


Figure 2-3. Major Structural Features of the East Texas Basin and Sabine Uplift

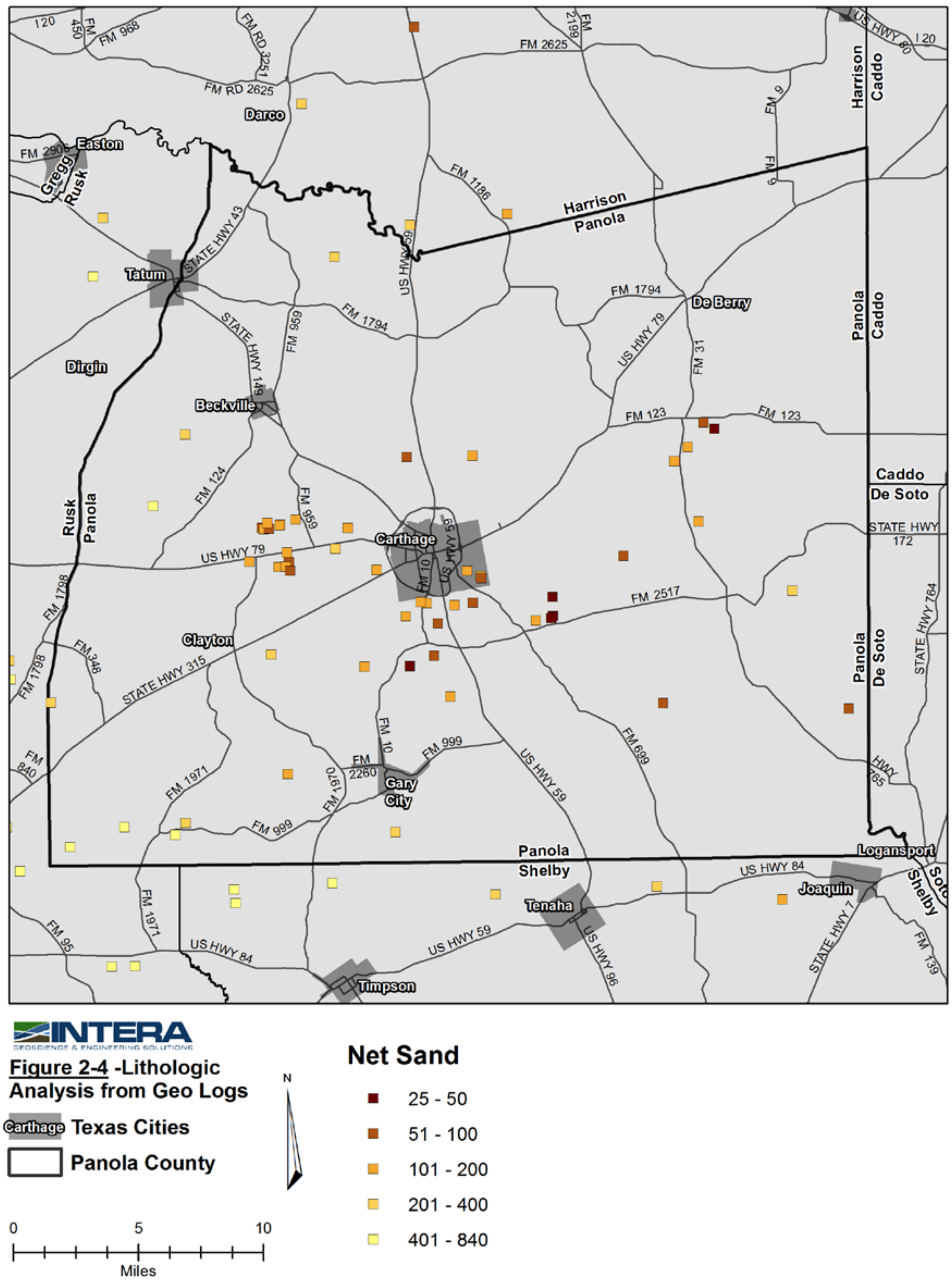


Figure 2-4. Net Sand Thickness (feet) from Geophysical Well Logs

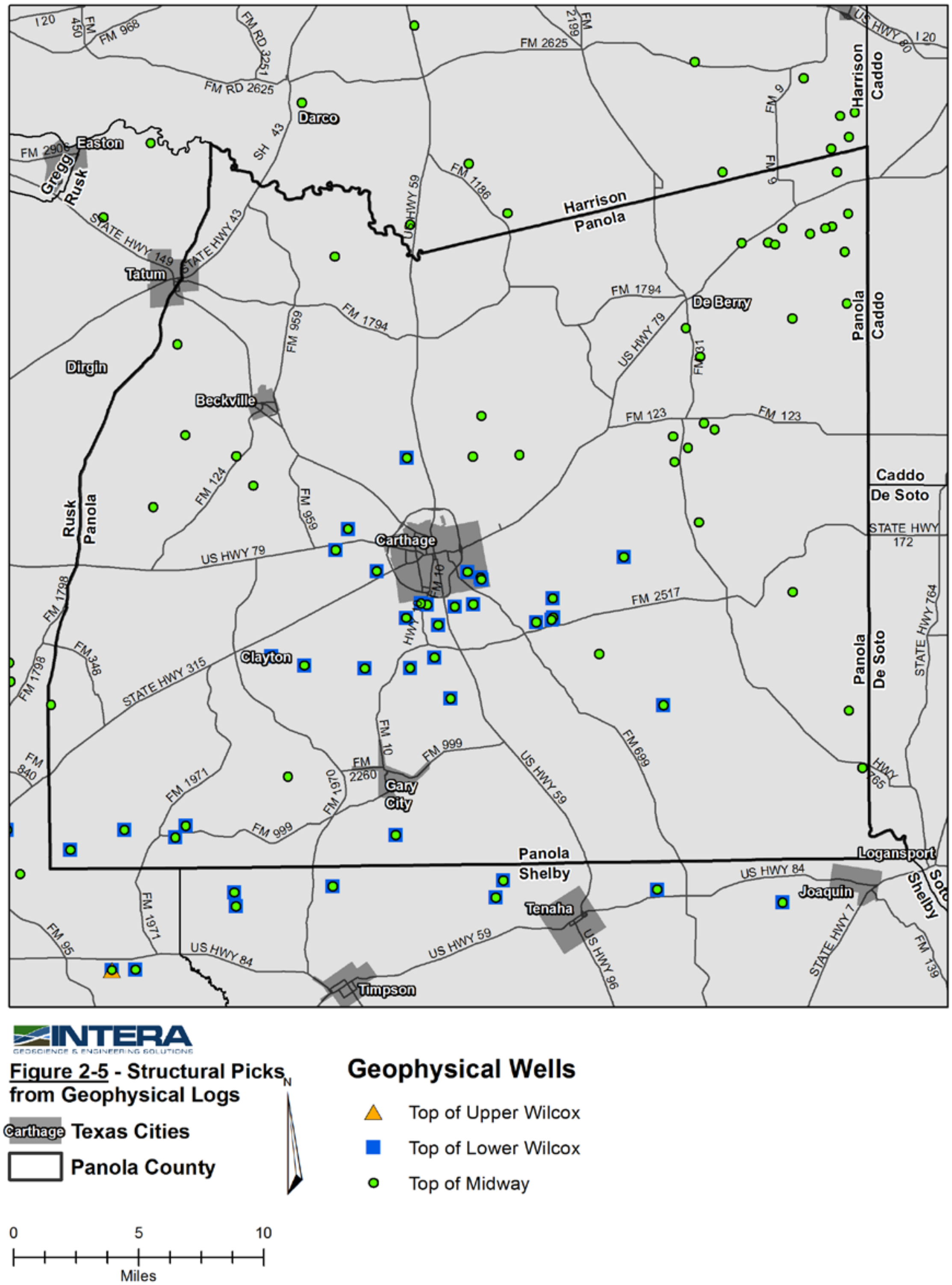


Figure 2-5. Structural Picks from Geophysical Logs

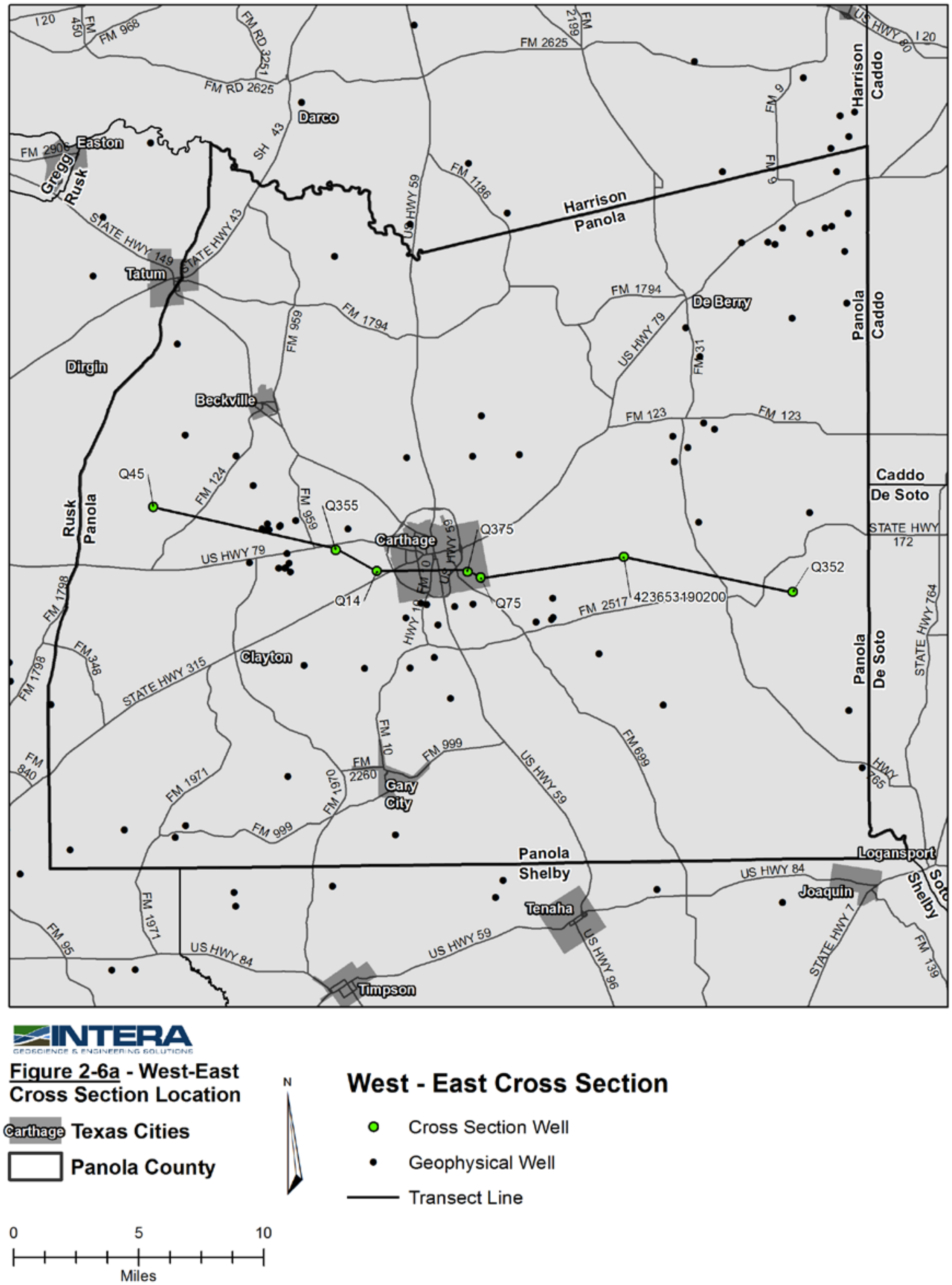


Figure 2-6a. Location Map for West to East Cross Section

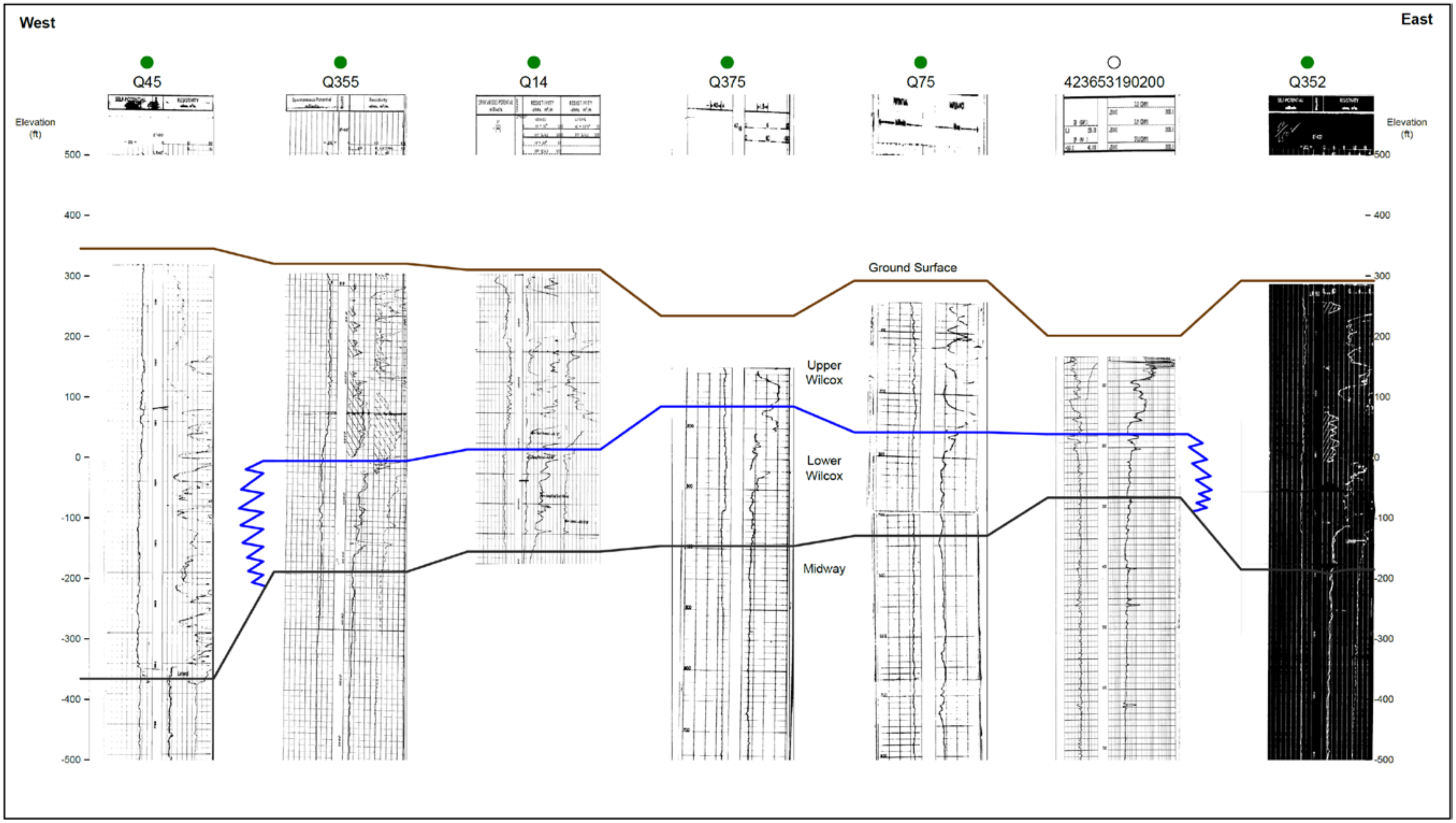


Figure 2-6b
West-East Cross Section

Figure 2-6b. West to East Cross Section

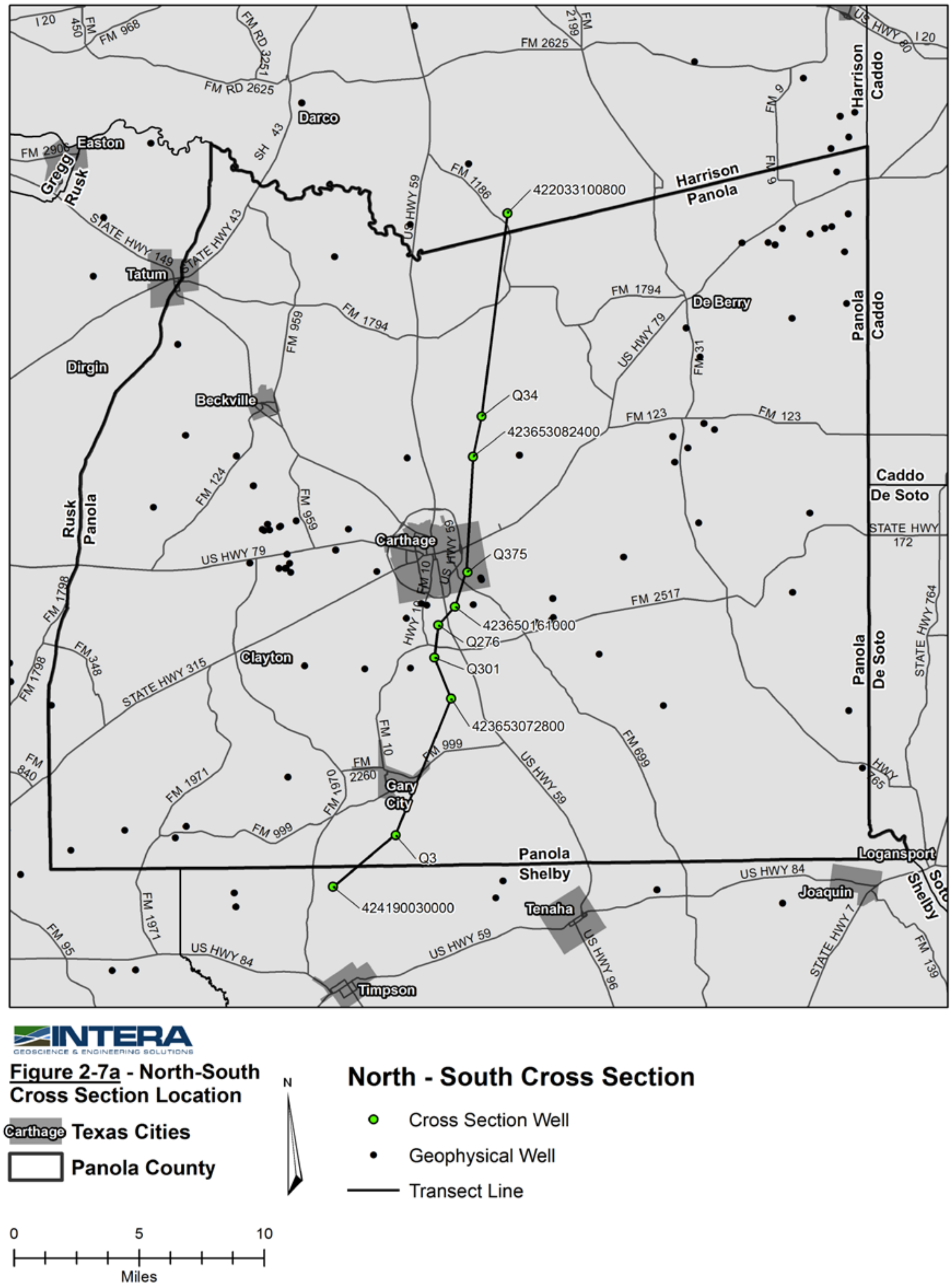


Figure 2-7a. Location Map for North to South Cross Section

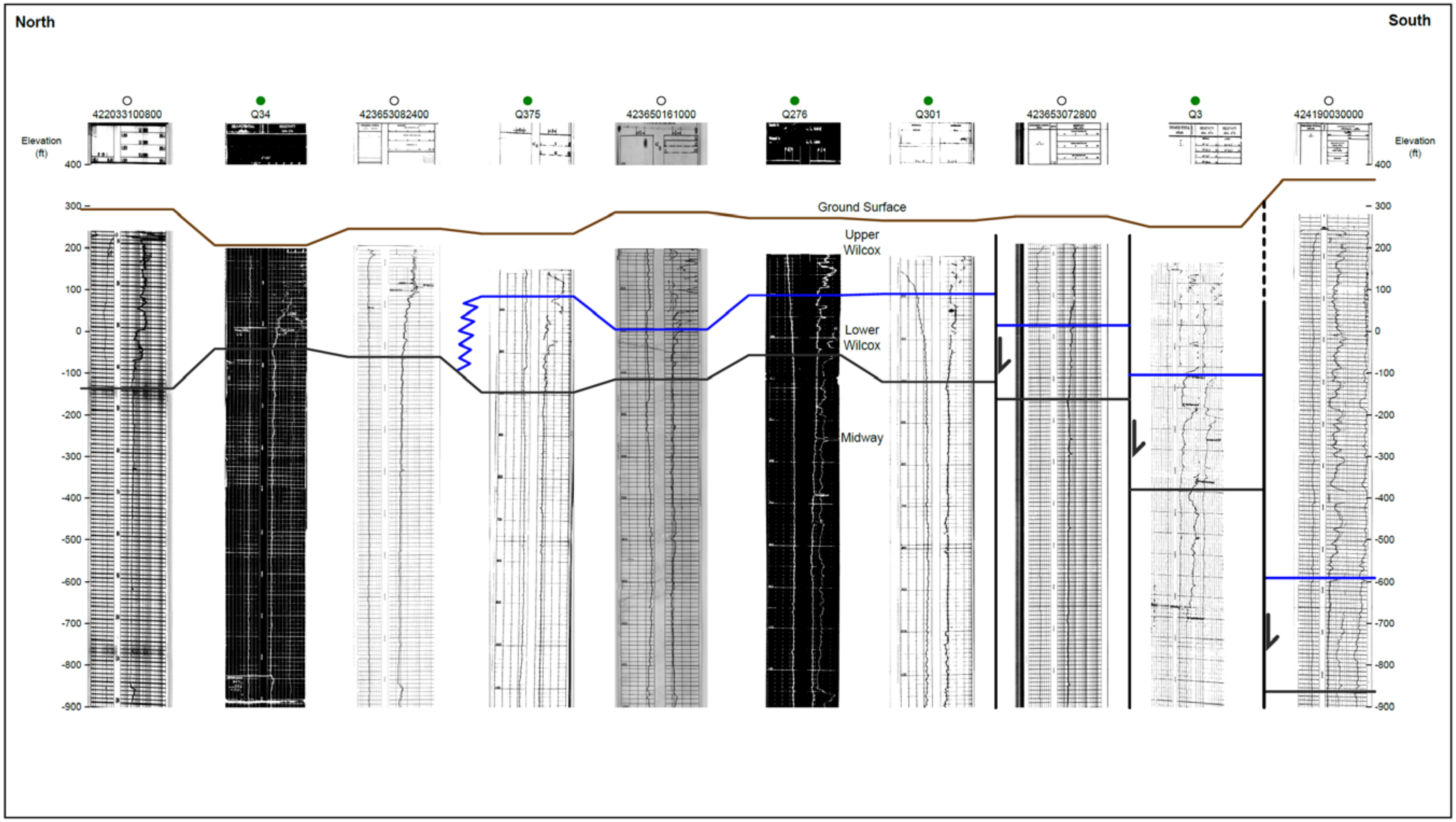


Figure 2-7b
North-South Cross Section

Figure 2-7b. North to South Cross Section

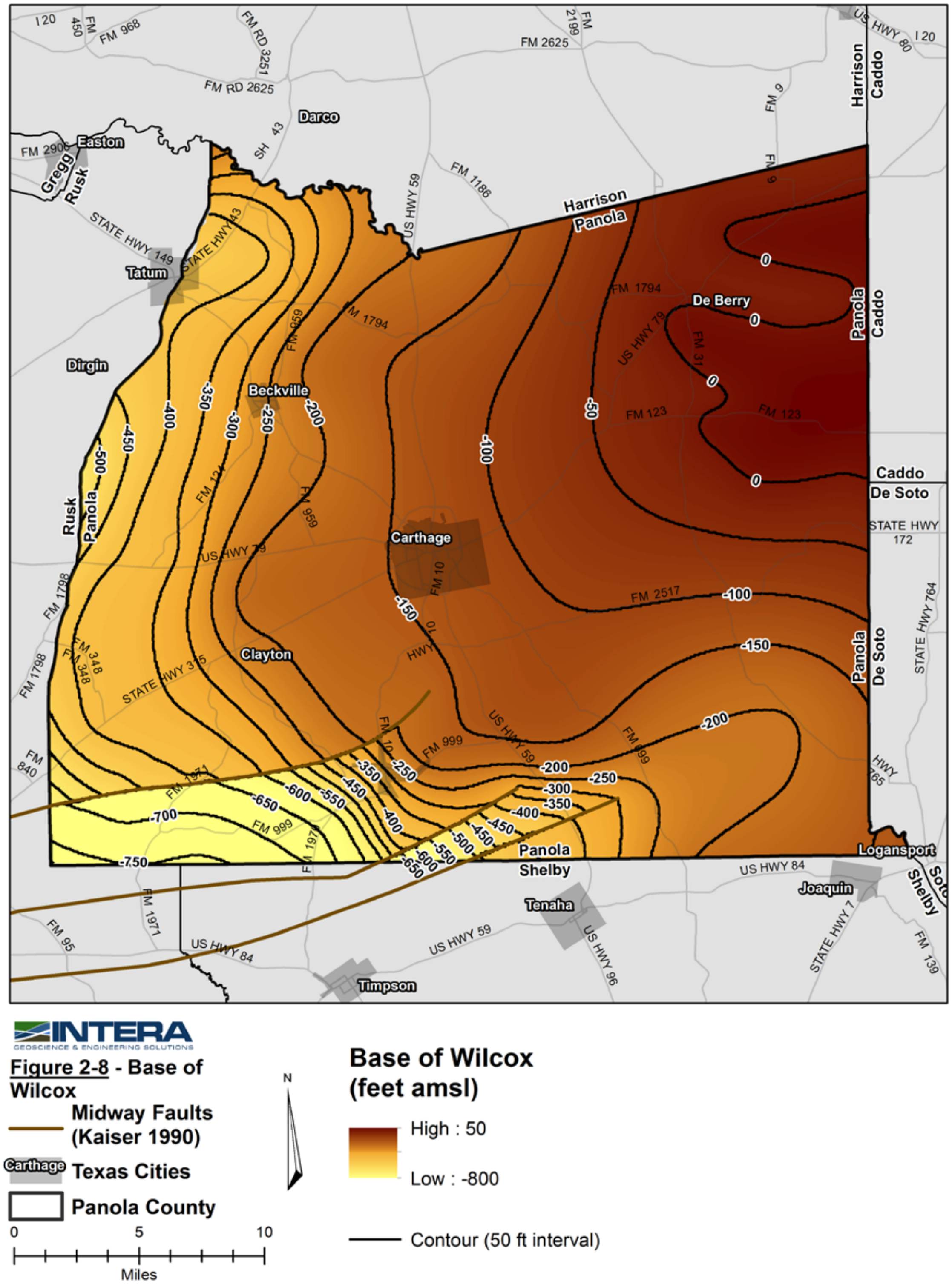


Figure 2-8. Elevation of the Base of Wilcox

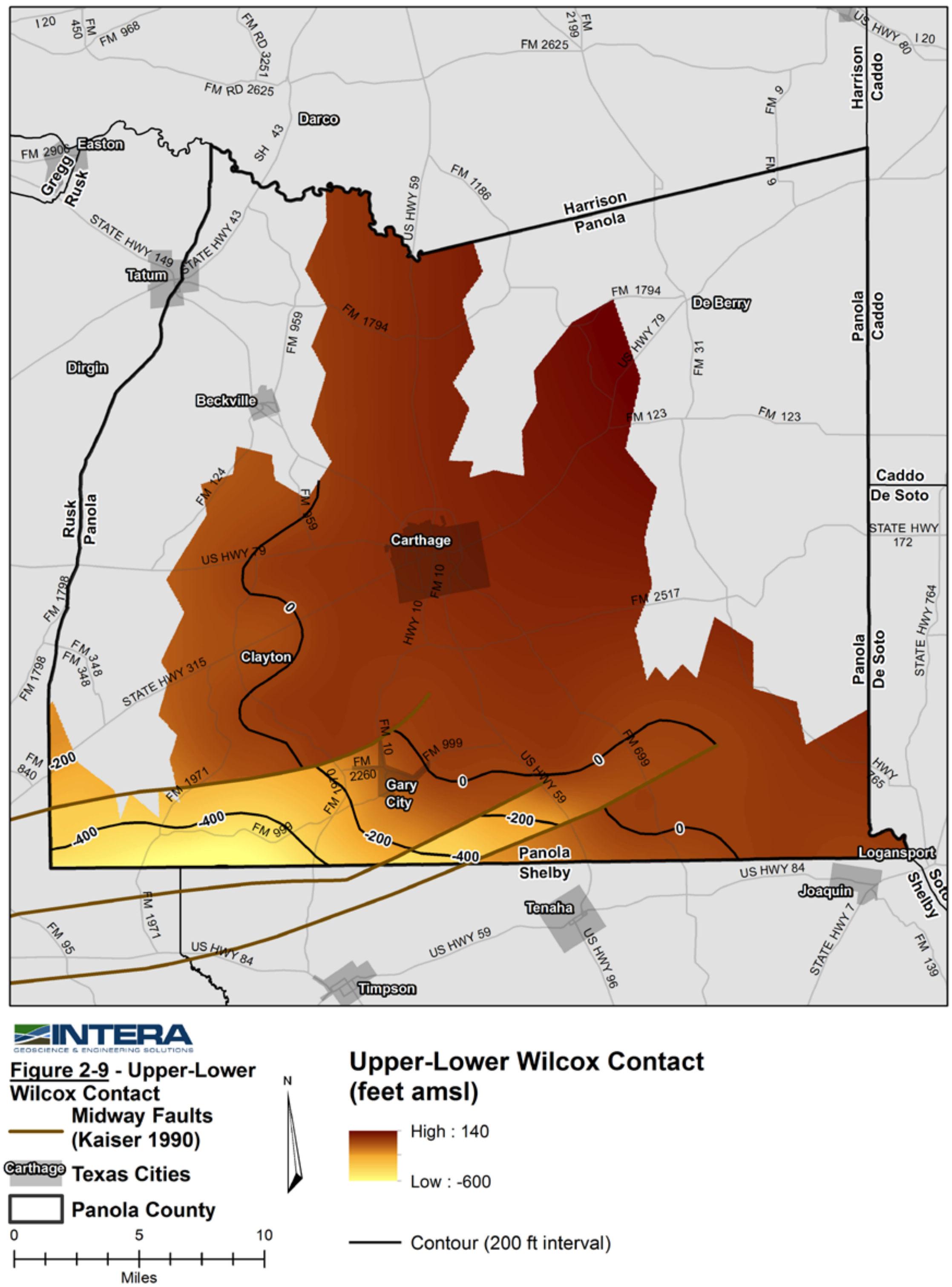


Figure 2-9. Elevation of the Upper-Lower Wilcox Contact

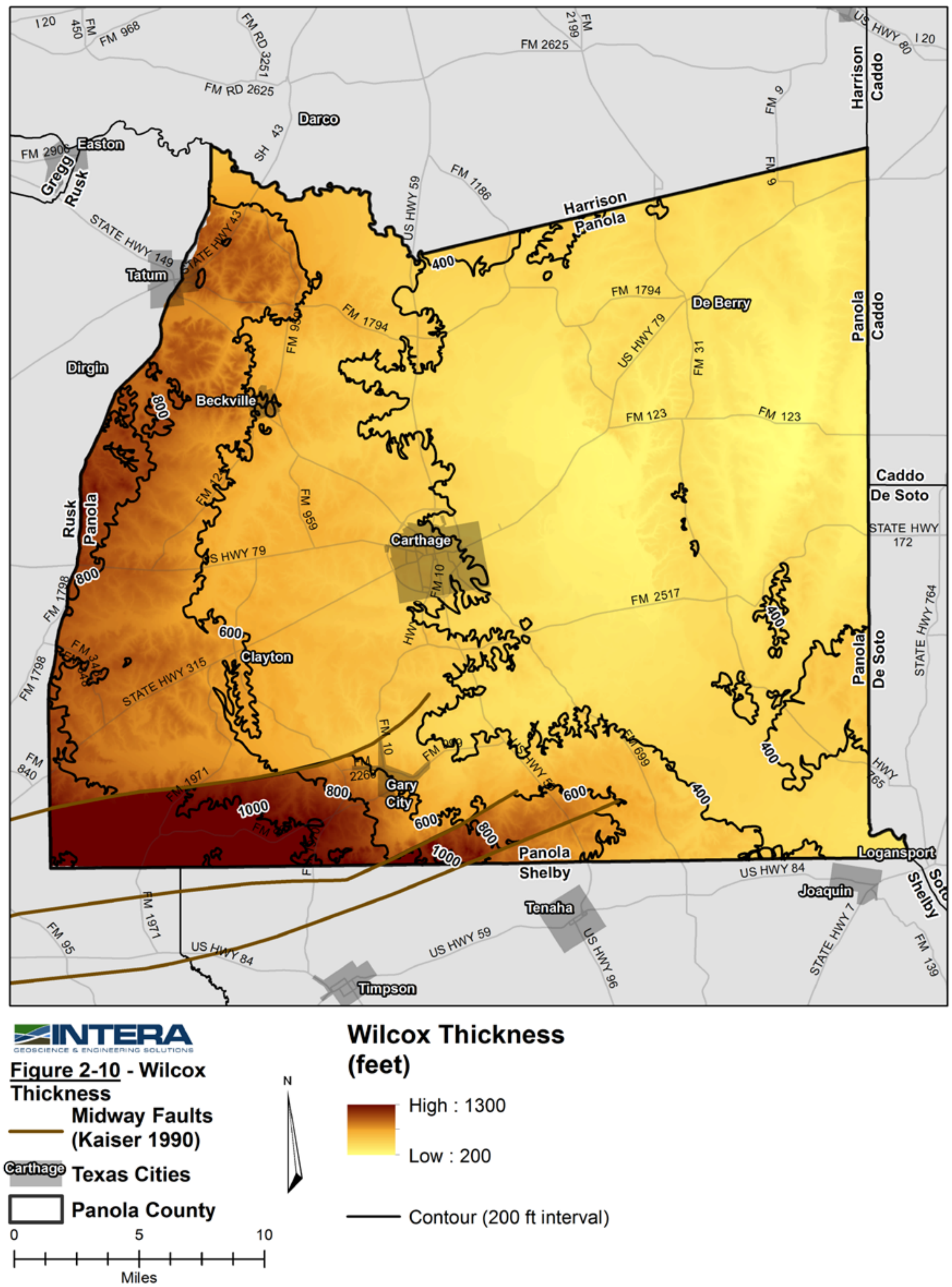


Figure 2-10. Thickness of the Wilcox Group

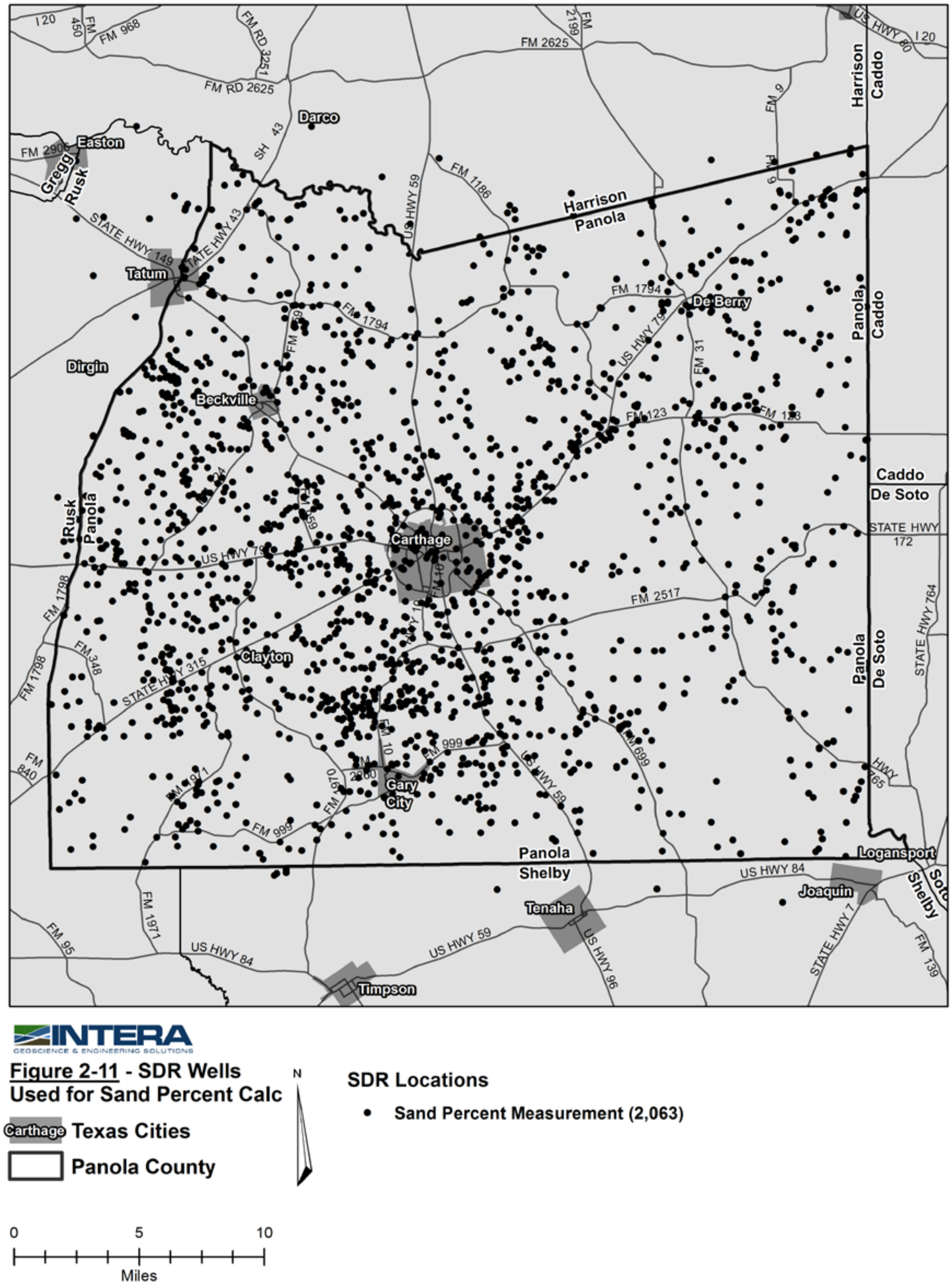


Figure 2-11. Locations of Submitted Drillers Reports (SDRs) from TWDB

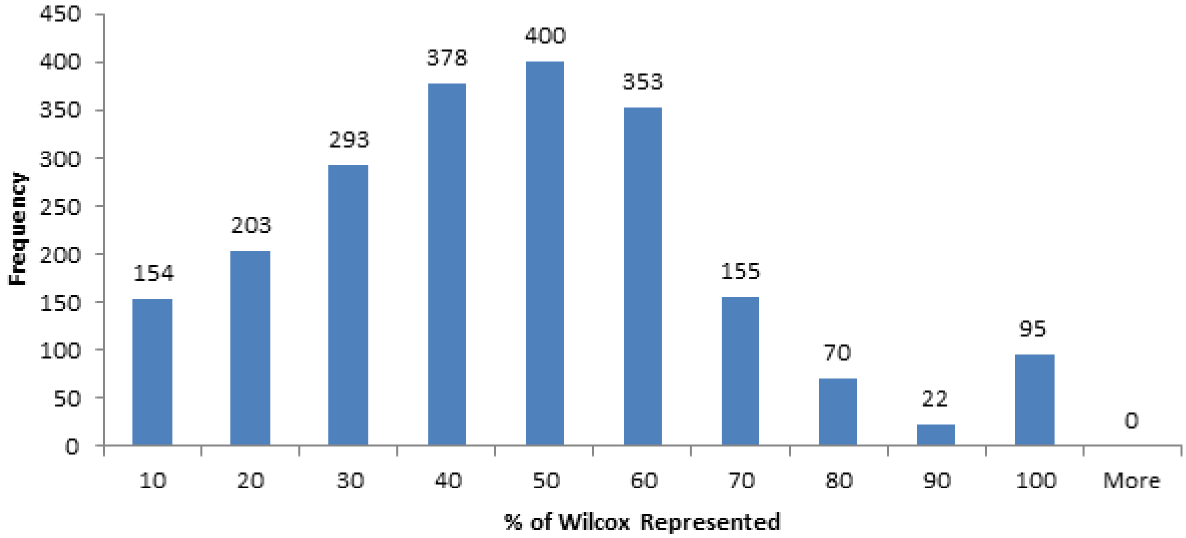


Figure 2-12. Histogram of Percent of Wilcox Represented in Drillers Logs

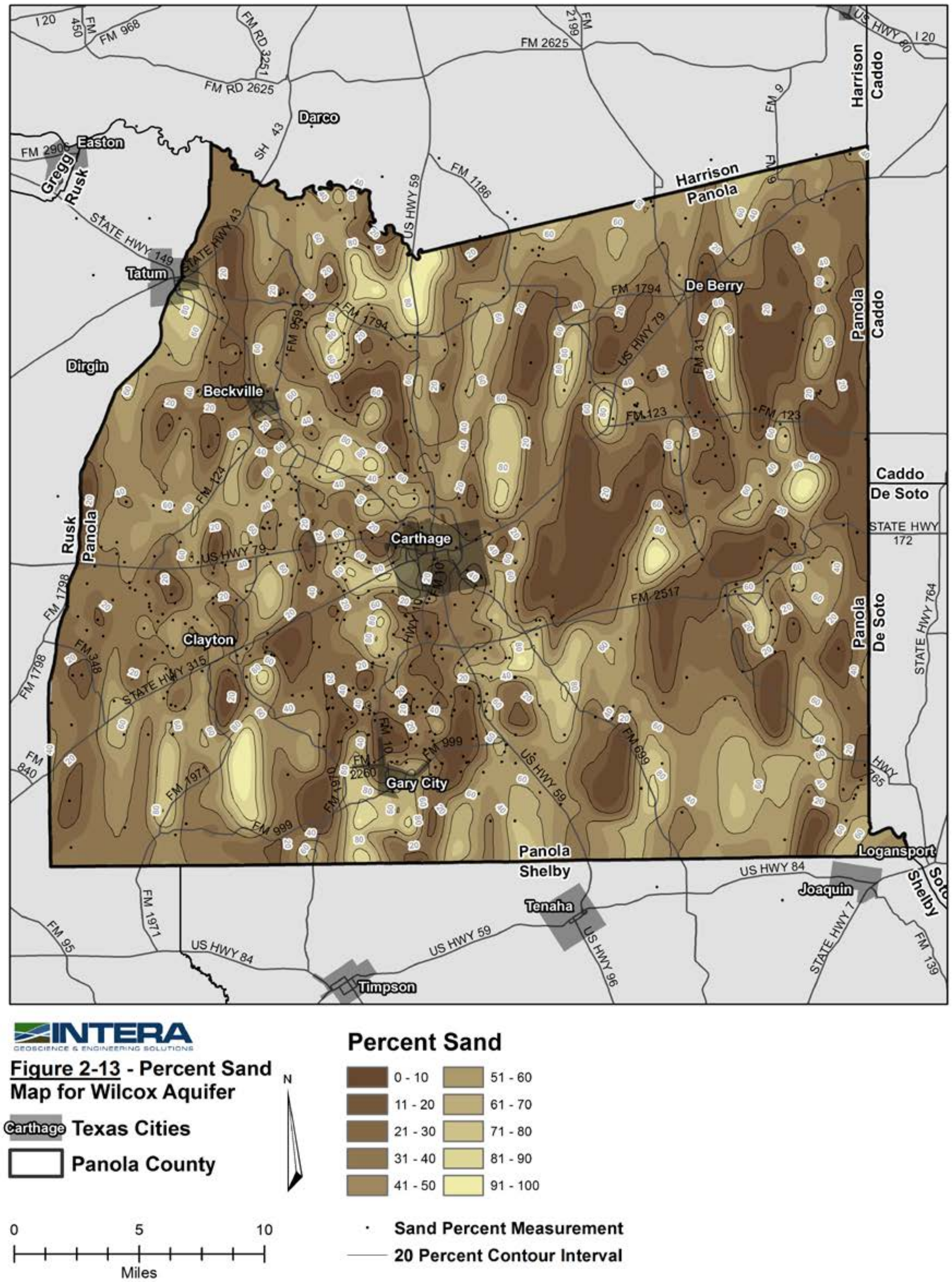


Figure 2-13. Percent Sand in the Wilcox Aquifer

3.0 Hydraulic Property Characterization

Takeaway in Brief

Hydraulic properties such as hydraulic conductivity and storativity are key to defining how water flows through an aquifer and how it responds to pumping. We evaluated the hydraulic properties of the Wilcox in Panola County though the interpretation of aquifer tests from publically available sources and the development procedures for monitoring water levels near oil and gas rig supply water wells.

The hydraulic properties of the Wilcox aquifer are closely related to its composition and are necessary to understand and estimate the response of the aquifer to pumping. Two key hydraulic properties are the formation hydraulic conductivity (which is related to transmissivity) and storativity. Formation hydraulic conductivity describes how easily water can flow through aquifer sediments. Storativity relates to the volume of water the aquifer releases from storage as the hydraulic head (water level as measured in a well) decreases.

To obtain estimates of the aquifer hydraulic properties, aquifer tests are typically conducted following the installation of wells, including most wells for public water supply. Aquifer tests are performed by pumping a well at a constant extraction rate while measuring the changes in water level (drawdown) in the pumping well and/or any nearby monitoring well.

Publically available historical aquifer test data, collected within Panola County, was obtained from various sources. A review and analysis of these data were conducted to obtain estimates of the formation hydraulic properties. In addition, water-level data collected by the PCGCD at a monitoring well located in the vicinity of an active oil and gas water supply well was also analyzed to demonstrate how monitoring activities can be used to evaluate hydraulic properties.

An aquifer test is typically comprised of two phases. The first phase is the drawdown period, when the well is pumping at a constant rate, and the water level in the aquifer near the well is decreasing. The second phase is the recovery period, which starts at the termination of pumping, and the water levels in the aquifer are recovering to the pre-pumping levels. Both phases can be analyzed separately to obtain estimates of the formation hydraulic properties. The majority of the aquifer tests data obtained for the wells in Panola County only included information for the drawdown period, and thus only this information was analyzed.

3.1 Historical Aquifer Tests

Takeaway in Brief

Publically available aquifer tests were compiled from the Texas Commission on Environmental Quality Public Water Supply Well database, from hydrogeologic studies completed for PCGCD well permitting, and estimated from specific capacity. A total of 30 aquifer tests were evaluated for both hydraulic conductivity and storativity. Hydraulic conductivity was estimated from specific capacity information in 1,950 additional wells. Most storativity estimates indicate confined conditions in the aquifer.

Information related to historical aquifer tests was gathered from various sources to provide estimates of formation hydraulic conductivity within Panola County. These sources include the Texas Commission on Environmental Quality (TCEQ), the TWDB, and the PCGCD.

3.1.1 Public Water Supply Wells

Publically available information from the TCEQ was obtained for aquifer tests conducted in public water supply wells located within Panola County and presumed screened within the Wilcox Aquifer. The information was obtained as scanned images of hand-written or typed field notes of recorded water levels and production rates during the aquifer test. The information from the scanned images was then digitized for processing and analysis. A total of 21 aquifer tests had sufficient quantity and quality of water-level drawdown data for analysis. The locations of these 21 aquifer tests are shown in Figure 3-1.

These 21 aquifer tests were analyzed by INTERA using the industry-standard well-test analysis software AQTESOLV (HydroSOLV, 2007). AQTESOLV contains a large suite of analytical solution methods for aquifers conceptualized as unconfined or confined, matrix or fracture flow, leaky responses, multiple potential lateral boundaries and fully or partially penetrating wells. The recorded water-level data over time during the pumping period of the aquifer test is processed to obtain water-level displacement (drawdown) as a function of time since the start of pumping. This data is imported into AQTESOLV, along with well construction and completion information and data on the aquifer configuration and flow model conceptualization. The proper solution method is then selected, and the resultant type-curve is matched to the displacement data to obtain estimates of the formation hydraulic properties.

For the aquifer tests analyzed, the hydrogeological conceptual flow model is assumed to be a confined and non-leaky aquifer with no lateral boundaries (infinite acting). The assumption of a confined system is based on the layering of the sands and clays within the Wilcox and the assumption that the impact of the groundwater pumping is not transmitted vertically through the lower permeable fine-grained layers. As such, the wells were assumed to be fully penetrating because they were screened across the contributing aquifer thickness. Based on these criteria, the Papadopulos-Cooper analytical solution method (Papadopulos and Cooper, 1967) was selected to obtain estimates of the formation transmissivity and storativity. Using the estimated transmissivity value and the aquifer thickness, the formation hydraulic conductivity was then calculated.

Table 3-1 lists the estimated formation hydraulic properties for the public water supply well aquifer tests analyzed. Plots of the observed displacement data overlain with the analytical solution are presented in Appendix A. The analysis results listed in Table 3-1 show a range in formation hydraulic conductivity from 0.7 to 29.4 ft/day, with an average value of 7.7 ft/day and median of 4.3 ft/day. Figure 3-2 presents the estimated formation hydraulic conductivity values overlain on the map of the aquifer test locations (Figure 3-1).

3.1.2 Provided by PCGCD

In addition to the aquifer tests acquired from the TCEQ, the PCGCD provided an additional eight pumping tests performed by various groundwater consultants (Appendix B). The location of these tests are shown in Figure 3-1. The estimated hydraulic conductivity and storativity values provided from these other analyses are listed in Table 3-2 and shown on Figure 3-2. The hydraulic conductivity ranges from a minimum of 3 ft/day to a maximum of 64.6 ft/day, with a median of 11.9 ft/day. The storativity values estimated from these tests are also shown in Table 3-2. However, these exhibit a very wide range and, in some cases are outside reasonable bounds. For instance, Alexander FP 1 shows a storativity of 4.06×10^{-1}, which is higher than would be expected in even a clean, fully unconfined sand. Also, Tiller FP 2 and Tiller FP 3 have calculated storativities far below the compressibility of water, which is not physically achievable. The median storativity of 3.7×10^{-4} is, however, consistent with results of the other aquifer tests indicating primarily confined conditions in the Wilcox Aquifer in Panola County. Though this differs from the conceptualization of the aquifer in the groundwater availability model (unconfined), it is not unexpected given the interbedded sands and clays of the Wilcox combined with well depths of several hundred feet.

Table 3-1. Estimated formation hydraulic properties from public water supply well tests

**No location information provided for this well so will not show up in Figure 3-1 or 3-2*

Number	Test ID	Saturated Thickness (ft)	Transmissivity (ft^2/ day)	Storativity (-)	Hydraulic Conductivity (ft/day)
1	G1830005D*	30	147	7.3×10^{-2}	4.9
2	G1830006C	63	652	3.2×10^{-4}	10.3
3	G1830006D	60	83	1.6×10^{-3}	1.4
4	G1830007B	84	365	2.6×10^{-4}	4.3
5	G1830007C	60	142	4.7×10^{-5}	2.4
6	G1830008C	100	78	9.6×10^{-5}	0.8
7	G1830008D	120	129	1.3×10^{-3}	1.1
8	G1830009B	60	314	1.2×10^{-5}	5.2
9	G1830010B	84	161	2.0×10^{-5}	1.9
10	G1830011E	50	1471	3.1×10^{-3}	29.4
11	G1830014A	24	387	2.8×10^{-4}	16.1
12	G1830014B	50	676	4.9×10^{-4}	13.5
13	G1830021B	129	1440	1.0×10^{-3}	11.2
14	G1830025A	146	99	3.7×10^{-4}	0.7
15	G1830025B	107	122	5.6×10^{-4}	1.1
16	G1830025C	105	176	1.5×10^{-4}	1.7
17	G1830025D	31	713	6.5×10^{-4}	23.0
18	G1830025E	100	100	5.3×10^{-5}	1.0
19	G1830027A	49	810	7.7×10^{-4}	16.5
20	G1830027B	60	821	8.5×10^{-4}	13.7
21	G1830030C	60	150	1.2×10^{-4}	2.5
	Minimum	**24**	**78**	**1.2×10^{-5}**	**0.7**
	Mean	**75**	**430**	**4.1×10^{-3}**	**7.7**
	Median	**60**	**176**	**3.7×10^{-4}**	**4.3**
	Maximum	**146**	**1471**	**7.3×10^{-2}**	**29.4**

Table 3-2. Estimated formation hydraulic properties based on aquifer tests performed for District permitting.

Number	Test ID	Saturated Thickness (ft)	Transmissivity (ft^2/ day)	Storativity (-)	Hydraulic Conductivity (ft/day)
1	Alexander FP 1	184	849.8	$4.06x10^{-1*}$	4.6
2	Alexander FP 2	287	859.7	$1.15x10^{-3}$	3.0
3	Mills FP 1	100	1269.9	$5.81x10^{-8*}$	12.7
4	Mills FP 2	100	1105.3	$8.33x10^{-6*}$	11.1
5	Mills CGU 11-51HH	100	6458.6	$4.43x10^{-4}$	64.6
6	Mills CGU 12-52HH	100	2752.7	$5.20x10^{-4}$	27.5
7	Tiller FP 2	210	1695.2	$3.07x10^{-17*}$	8.1
8	Tiller FP 3	210	6913.1	$5.22x10^{-24*}$	32.9
	Minimum	**100**	**850**	$\mathbf{5.2x10^{-24}}$	**3.0**
	Mean	**161**	**2738**	$\mathbf{5.1x10^{-2}}$	**20.6**
	Median	**142**	**1483**	$\mathbf{2.3x10^{-4}}$	**11.9**
	Maximum	**287**	**6913**	$\mathbf{4.1x10^{-1}}$	**64.6**

**Several of the reported storativity estimates are outside reasonable bounds*

3.1.3 Groundwater Availabilty Model Tests

Mace et al. (2000) developed a database of 7,402 estimates of hydraulic properties in 4,456 groundwater wells in the Carrizo-Wilcox aquifer in Texas. The estimates were based on analysis of both aquifer test data and specific capacity measurements from submitted driller's reports (SDRs).

When a water well is drilled, the driller will sometimes perform a crude aquifer test in an attempt to appropriately size the groundwater pump. The driller may record the groundwater flow rate and the total drawdown at the end of the pumping period. Using these two pieces of information, the specific capacity of the well can be determined by taking the ratio of the flow rate to the total drawdown. The units for specific capacity are gallons per minute per foot (gpm/ft).

One result of Mace et al.'s (2000) work was that they used wells that had both a specific capacity measurement and an aquifer test-derived transmissivity measurement to develop a relationship between the two parameters. A total of 217 wells for the entire Carrizo-Wilcox aquifer were used to develop a best-fit line using a least square regression. The resulting best fit line had an R^2 of 0.91 and is represented by the following equation:

$$T = 1.99Sc^{0.84}$$

where the units of transmissivity (T) and specific conductivity (S_c) are in ft^2/day. Using this relationship, the remaining specific capacity measurements were converted into transmissivity estimates.

The Mace et al. (2000) data were integrated into the groundwater availability model for the Northern Carrizo-Wilcox Aquifer as documented by Fryar et al. (2003). This data was accessed by INTERA from the TWDB and is treated as the best data on hydraulic properties in the study area prior to year 2001.

Within Panola County, INTERA was able to access a total of 293 tests. The transmissivity values were then converted into hydraulic conductivity using the total screen length as the aquifer thickness. The calculated hydraulic conductivity values for this dataset resulted in a minimum of 0.4, a mean of 10.6 and a maximum of 671 ft/day (Figure 3-3). The entire dataset is provided in Appendix C.

3.1.4 Post-2001 Specific Capacity Tests

As required by the TWDB, SDRs completed after 2001 are filed electronically by the driller with the data stored in a database format. This database was accessed for wells located within Panola County and completed in the Wilcox aquifer. If the well had data in the yield (gpm), drawdown (ft), and test duration fields, the specific capacity was calculated. All of these values were tabulated, and the relationship between specific capacity and transmissivity in Section 3.1.3 was used to obtain a transmissivity estimate at each well.

The gravel pack length was considered as representative of the aquifer thickness for conversion from transmissivity to hydraulic conductivity. This evaluation resulted in 1,657 hydraulic conductivity values, with a minimum of 0.1, a mean of 6.6 and a maximum of 131.7 ft/day. These hydraulic conductivity estimates are shown in Figure 3-4. The data utilized in these calculations is provided in Appendix D.

3.2 Ongoing Aquifer Responses

Takeaway in Brief

For the District to be able to gather sufficient information to evaluate hydraulic properties, we purchased and delivered to PCGCD a down-hole transducer for continuous monitoring of water levels. We also developed procedures for operating the transducer and selecting appropriate well pairs. To demonstrate the use of the transducer and the information it can collect, we implemented an aquifer test with District staff near a water supply well used for oil and gas operations. The water level declines and pumping rates were used to evaluate hydraulic conductivity and storativity at the site.

Expanding the availability of hydraulic property information can be a very valuable function of the District in improving the understanding of the aquifer. There are currently a large number of oil and gas industry-related water production wells pumping water from the Wilcox Aquifer, providing supply water to hydraulic fracturing operations. As these production wells are pumping water from the aquifer, the drawdown within the aquifer surrounding the production well can be monitored via a series of non-producing (monitoring) water wells. By monitoring the water levels in non-pumping wells located near these production wells, and by knowing the production rates over time in the pumping well, the formation hydraulic properties can be estimated with minimal to no disruption of the oil and gas operations.

When possible, PCGCD regularly monitors water levels near wells that are being pumped to supply water for hydraulic fracturing operations. The water levels are measured manually, with measurements taken every couple weeks to a month. This frequency of measurements is insufficient for estimating formation hydraulic properties. To obtain water-level measurements at the necessary frequency, INTERA purchased and delivered to the District an electronic sensor that can be deployed in a well which will record the water level (hydraulic head), temperature and specific conductance at a defined frequency. The sensor, an In-Situ Aqua TROLL 200©, is internally powered and stores the three records in internal memory. A cable extending from the sensor to the ground surface allows for retrieval of the stored data records without removal of the sensor.

A review of the production and monitoring wells across the PCGCD was conducted to identify pairs of production and monitoring wells that could be used to obtain information for estimating formation hydraulic properties. Guidelines developed for conducting a review of appropriate well pairs for monitoring are presented in Appendix E. Figures 3-5a and 3-5b present a plot of the production and monitoring wells included in the review. Following the guidelines listed in Appendix E, the well pair of production well Soap 15 and monitoring well Brewster 16 was selected (Figure 3-5b). The wells are similar in total depth and are screened across similar depth intervals (Table 3-3). In addition, the wells are relatively close to each other at a distance of 1,584 ft, with no other production wells located in the vicinity and thus reduced potential for interference effects.

Table 3-3. Information related to selected well pair for monitoring of water levels.

Item	Soap 15	Brewster 16
Radial Distance from Soap 15 (ft)	--	1,584
Screen Interval (ft bgs)	255 to 315	250 to 310
Total Depth (ft bgs)	320	310

bgs: below ground surface

The downhole sensor was installed in monitoring well Brewster 16 on February 13, 2015. Guidelines developed for configuring, installing, retrieving data, and removal of the downhole sensor are presented in Appendix E. The data recorded with the sensor from February 13 to March 5, 2015 is presented in Figure 3-6. The data shows an overall decline in the water levels (depth to water), except for two recovery periods on February 19th and February 26th to 27th. Groundwater production data provided by the owner of Soap 15 indicates an average production rate of approximately 50 gpm. However, no specific data was available for when production periodically ceased, so it was assumed that the two recovery periods in Brewster 16 data correlate to periods of non-production in Soap 15. The data also show constant temperature and a relatively constant specific conductance over time (Figure 3-6).

Because the sensor started recording the Brewster 16 water-level data after the production in Soap 15 commenced, additional manually collected data recorded by PCGCD was used to determine the pre-test static water level. Figure 3-7 presents the combined manually and sensor collected depth to water data starting on October 3, 2014. The manually collected data indicates a static water level of approximately 38 ft (horizontal red line) below the common measurement point. The data curve indicates a decline in the water level from static, corresponding to start of pumping in Soap 15, at some time between November 24 and December 29, 2014.

As part of the analysis method for estimating hydraulic formation properties, the time at which the pumping was initiated in the pumping well (Soap 15) must be known to provide for a determination of the delay from when the pumping is initiated and the water-level drawdown was first observed in the monitoring well (Brewster 16). Because this time frame is unknown, several start times were estimated, and the sensitivity to the estimated hydraulic parameters was evaluated. As the water-level drawdown at early-time is not linear, the slanted red line in Figure 3-7 shows that the initiation of pumping must have occurred after the intersection with the static-water level on approximately December 10, 2014. Using scientific judgement to manually recreate the expected shape of the water-level drawdown curve, three potential starting dates of December 15th, 19th, and 26th were selected with pumping assumed to have initiated at 12:00 PM. The calculated water-level drawdown (head displacement) curves for these three starting times are presented in Figure 3-8.

Following the same process as noted above in Section 3.1, these three data curves were imported into the AQTESOLV well-test analysis software package and analyzed using the Papadopulos-Cooper analytical solution method. The analytical fits to the data curves were based on an average pumping rate of 49 gpm over the entire duration of the data set, while ignoring the two recovery periods due to lack of specific information. The best fit solutions to all three data curves are presented in Figure 3-9, along with the estimated formation hydraulic parameters. The estimated transmissivity values ranged from 54.5 to 72.4 ft^2/day, which is approximately 30 percent change in the value between the two bounding start times. Using a saturated thickness of 60 ft (screened interval), the resultant hydraulic conductivity range is from 0.9 to 1.2 ft/day. This range in hydraulic conductivity is at the low end of the range presented in Table 3-1 for the analysis of the historical aquifer test information. The estimated storativity was 3.5×10^{-4}, which is consistent with results in Tables 3-1 and 3-2 and indicative of confined aquifer conditions.

3.3 Summary of Hydraulic Properties

Takeaway in Brief

The hydraulic conductivity and storativity estimates developed from the sources described in the previous section were compiled. Representative hydraulic conductivities among the aquifer tests were generally from 1 to 12 feet per day, though some were outside this range. Hydraulic conductivities estimated from specific capacity tests exhibited a larger range, but the median values were similar to those from aquifer tests. Storativity estimates indicate confined conditions in the aquifer, which differs from the conceptualization of an unconfined aquifer in the current groundwater availability model.

A summary of the hydraulic conductivity estimates for each data source is listed in Table 3-4. The overall range in the estimates is over three orders of magnitude. The range in the median values for all sources is from 1 to 12 ft/day. The range in estimated values based on the analysis of aquifer tests is smaller than that for the estimates based on the specific capacity measurements. This larger range is expected, given the limited data collected for specific capacity measurements and the uncertainty in the transmissivity estimates based on using the developed relationship.

Storativity is best characterized through aquifer tests using multiple wells (i.e. one or more observation wells in addition to the pumping well), though results shown here include both single- and multiple-well tests. Storativity for an unconfined aquifer – where the aquifer is dewatered – is typically 0.05 to 0.3. Storativity for a confined aquifer – where the aquifer is not dewatered, just depressurized – is typically 10^{-3} to 10^{-5}.

Table 3-5 shows the median storativity among the aquifer tests gathered, conducted and interpreted for this study. In each case, the median storativity of the aquifer is approximately $3x10^{-4}$, indicating a confined response to pumping. This is to be expected due to the interbedded sands and clays of the Wilcox, but differs from the conceptualization of the aquifer as unconfined in the current groundwater availability model (Fryar and others, 2003) since the Wilcox is in outcrop in Panola County. Only 2 of the 30 tests in this study for which storativity could be estimated exhibited unconfined responses (G180005D and Alexander FP 1).

Table 3-4. Summary of hydraulic conductivity estimates.

Data Source	Test Type(s)	Hydraulic Conductivity (ft/day)		
		Minimum	Median	Maximum
Public Water Supply Wells	Single-Well	0.7	4.3	29.4
Provided by PCGCD	Multiple-Well	3.0	11.9	64.6
Groundwater Availability Model Tests	Single-Well and Specific Capacity	0.4	3.4	671
Post-2001 Specific Capacity Tests	Specific Capacity	0.1	1.9	131.7
Ongoing Aquifer Testing	Multiple-Well	--	1.0	--

Table 3-5. Summary of storativity estimates.

Data Source	Test Type	Median Storativity
Public Water Supply Wells	Single-Well	$3.7x10^{-4}$
Provided by PCGCD	Multiple-Well	$2.3x10^{-4}$
Ongoing Aquifer Testing	Multiple-Well	$3.5x10^{-4}$

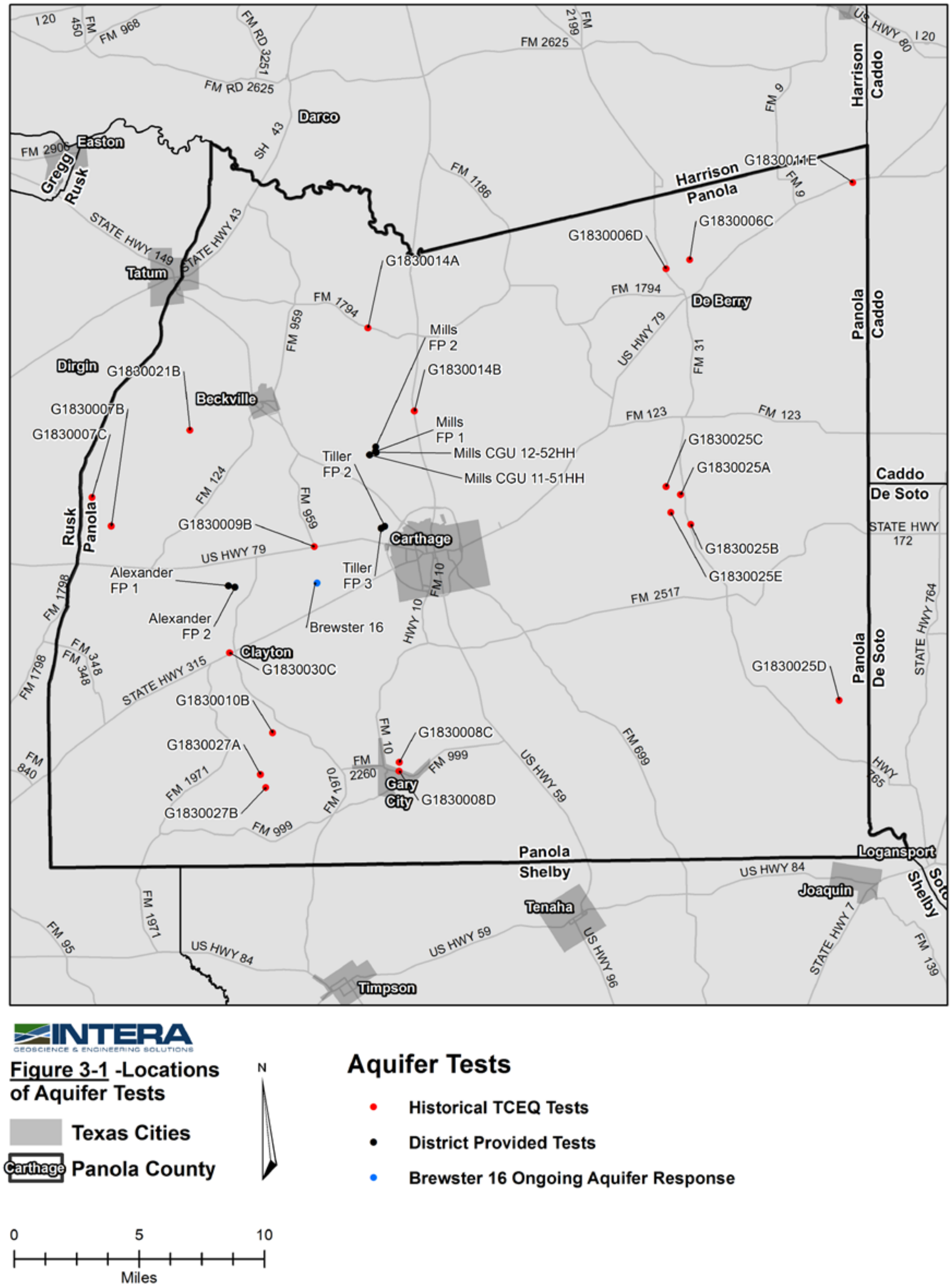


Figure 3-1. Locations of Aquifer Tests

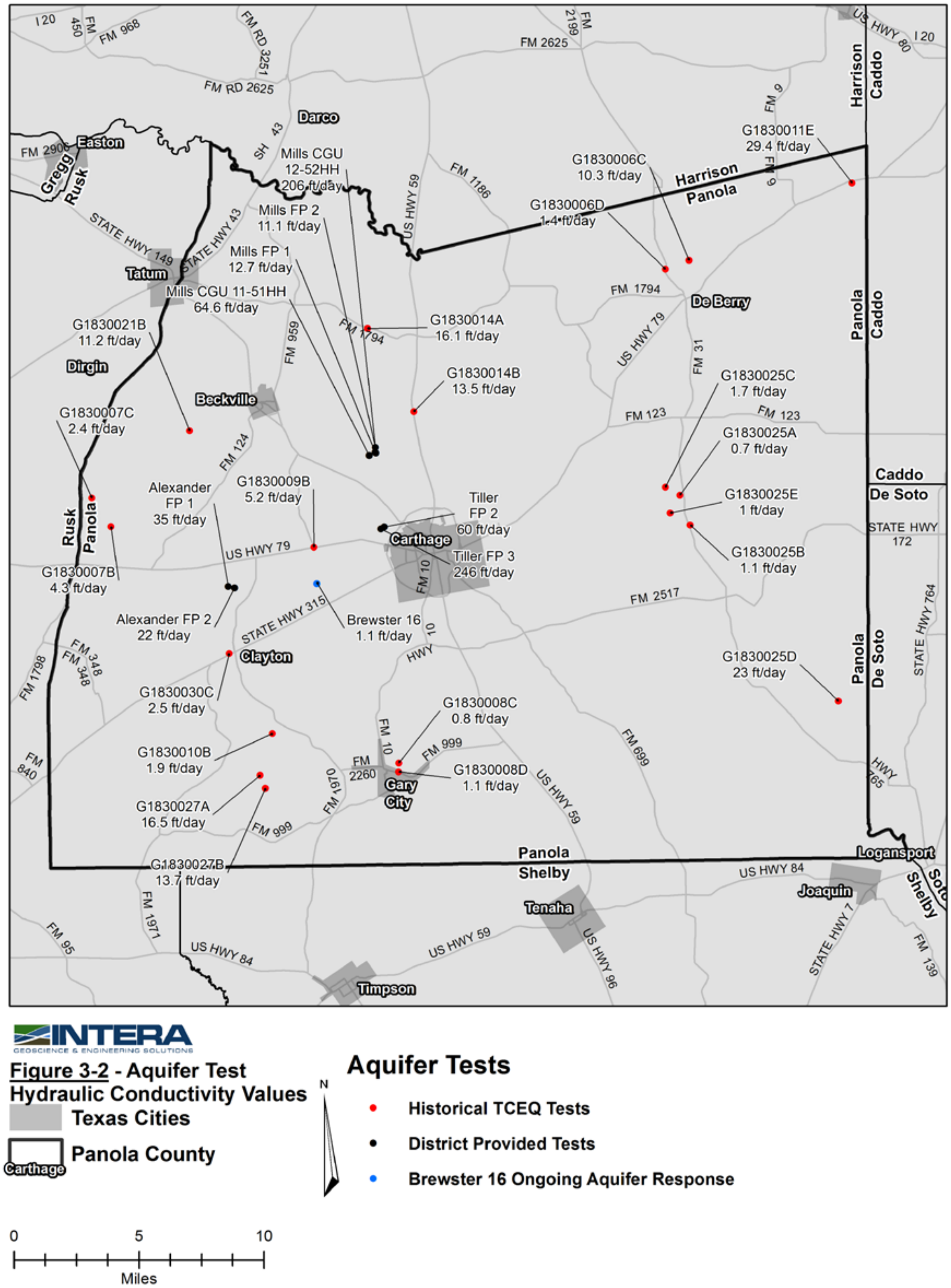


Figure 3-2. Estimated Hydraulic Conductivities from Aquifer Tests

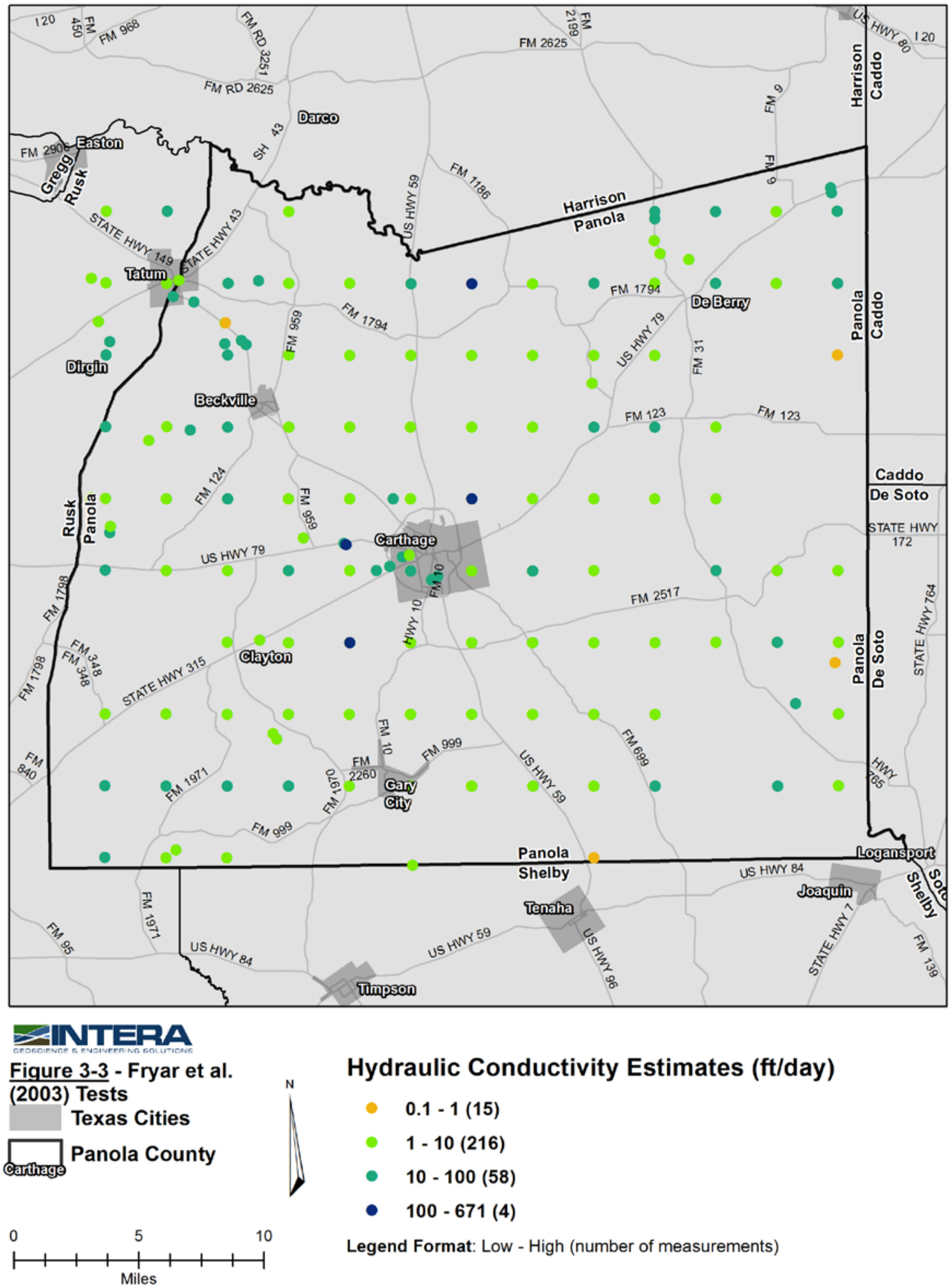


Figure 3-3. Estimated Hydraulic Conductivity from GAM Input Data

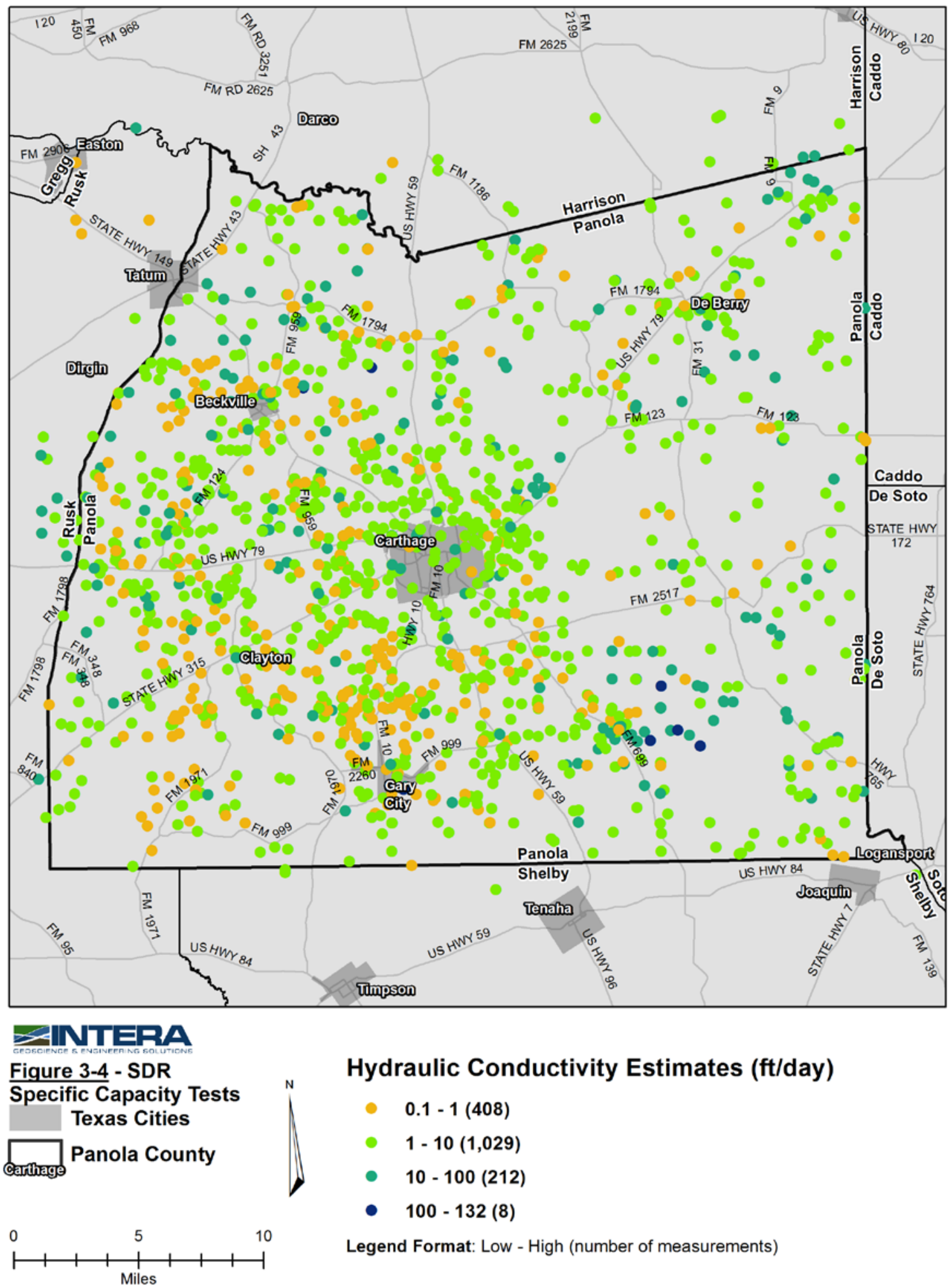


Figure 3-4. Hydraulic Conductivity Estimated from Submitted Drillers Reports

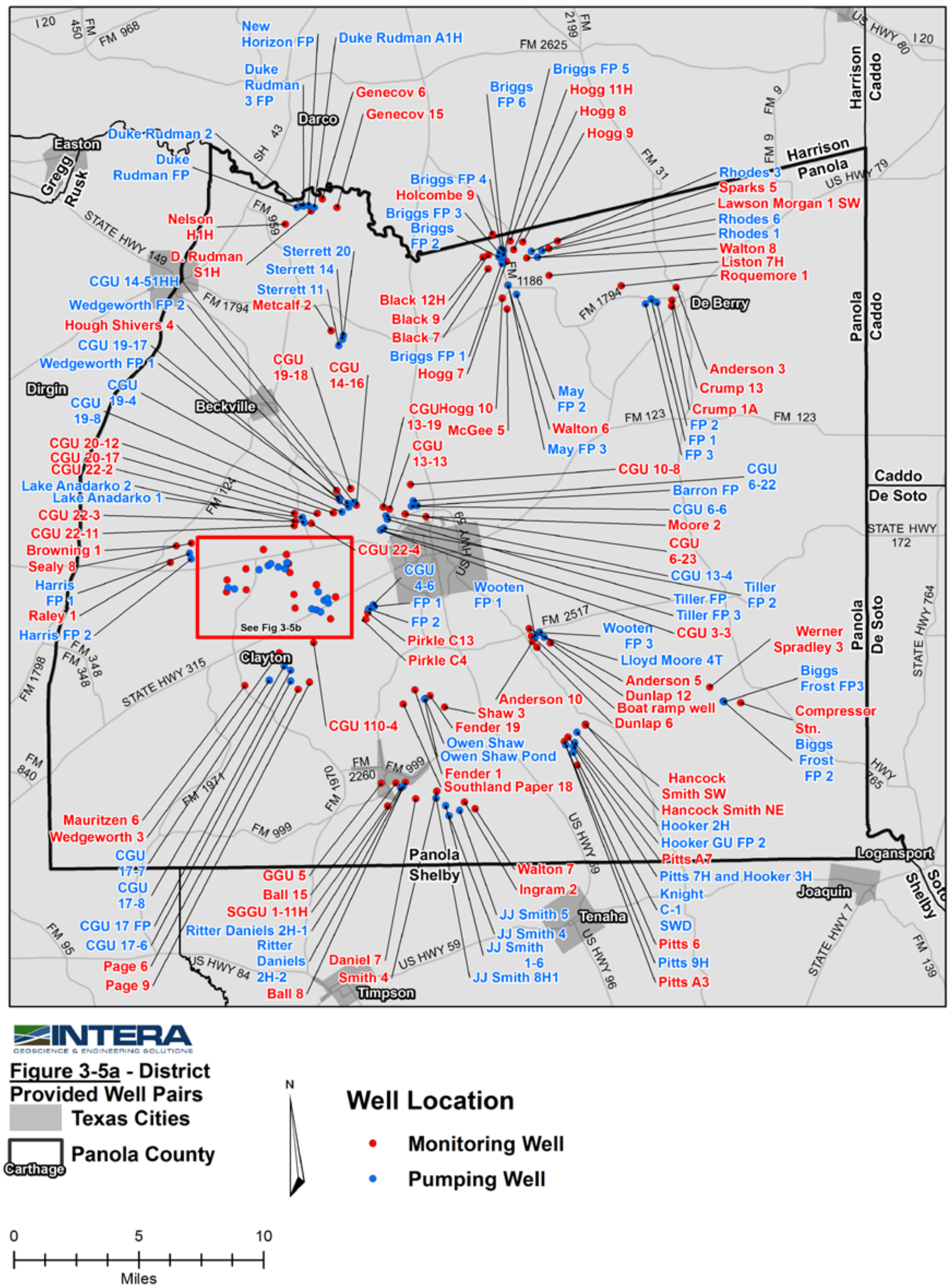


Figure 3-5a. Candidate Production and Monitoring Well Pairs for Aquifer Test

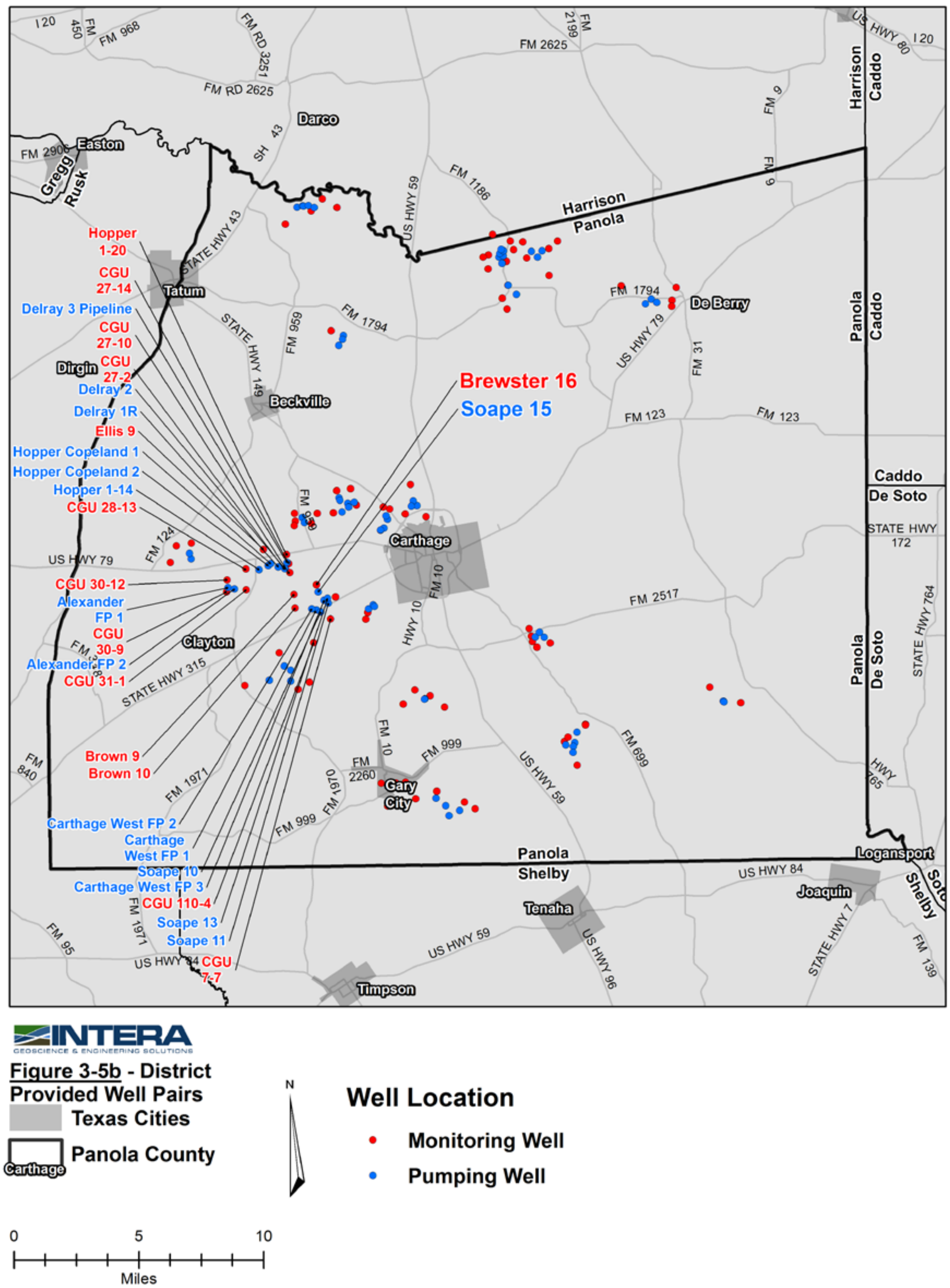


Figure 3-5a. Candidate Production and Monitoring Well Pairs for Aquifer Test (cont.)

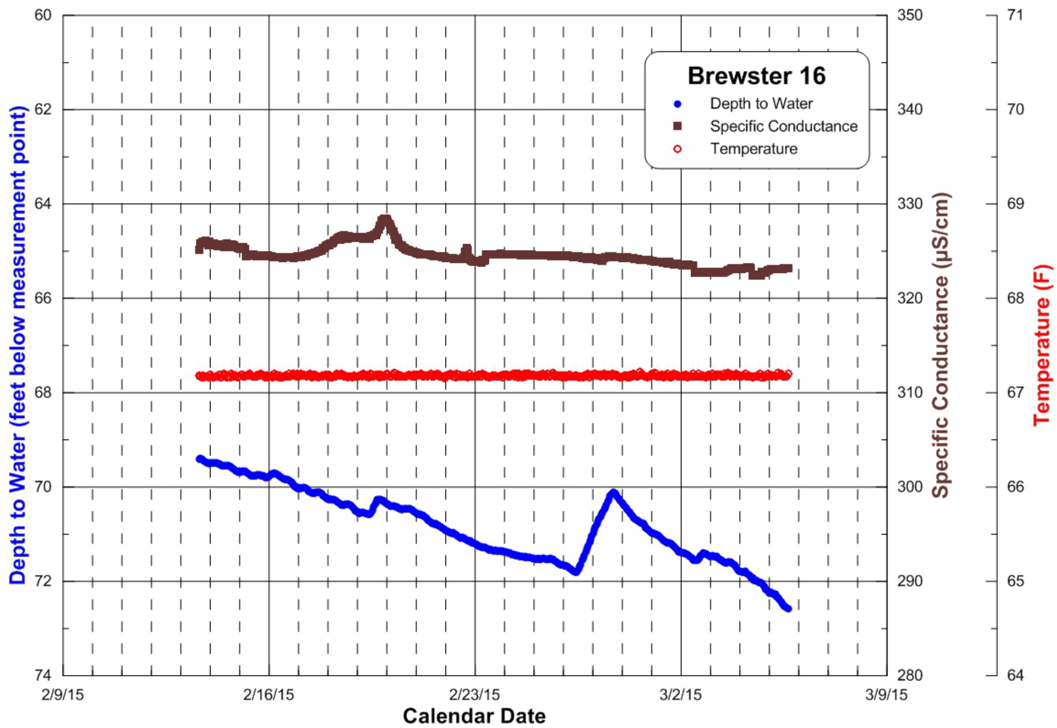


Figure 3-6. Sensor Data Measured from February 13 to March 5, 2015.

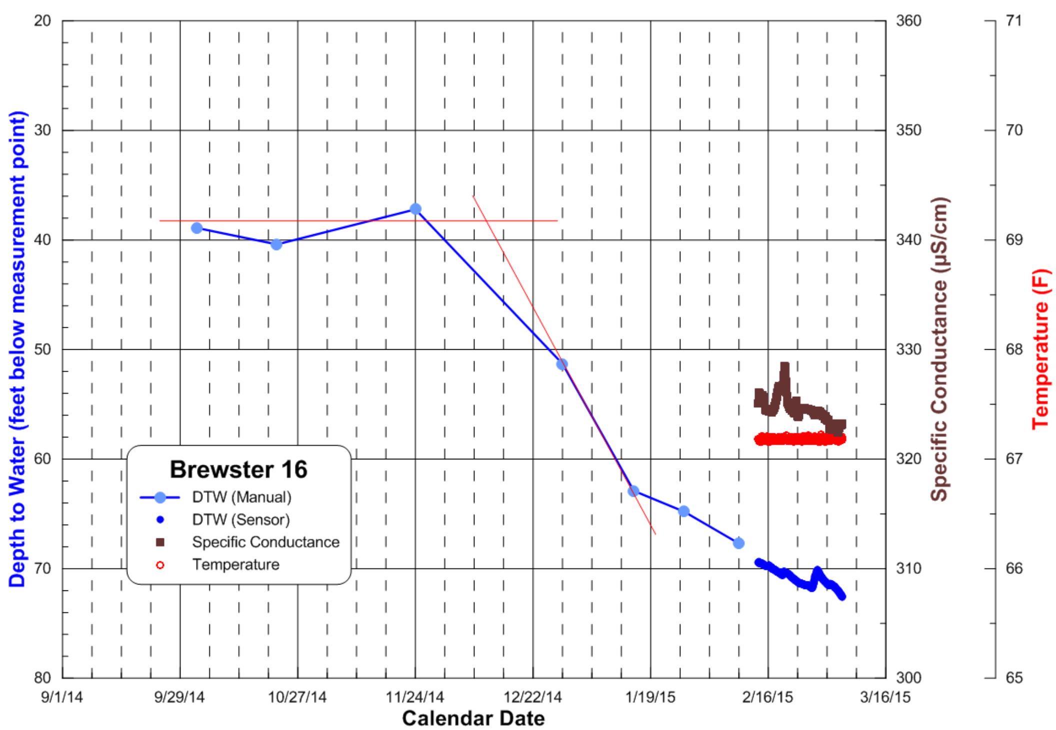


Figure 3-7. Manual and Sensor Data Measured from September 2014 to March 2015.

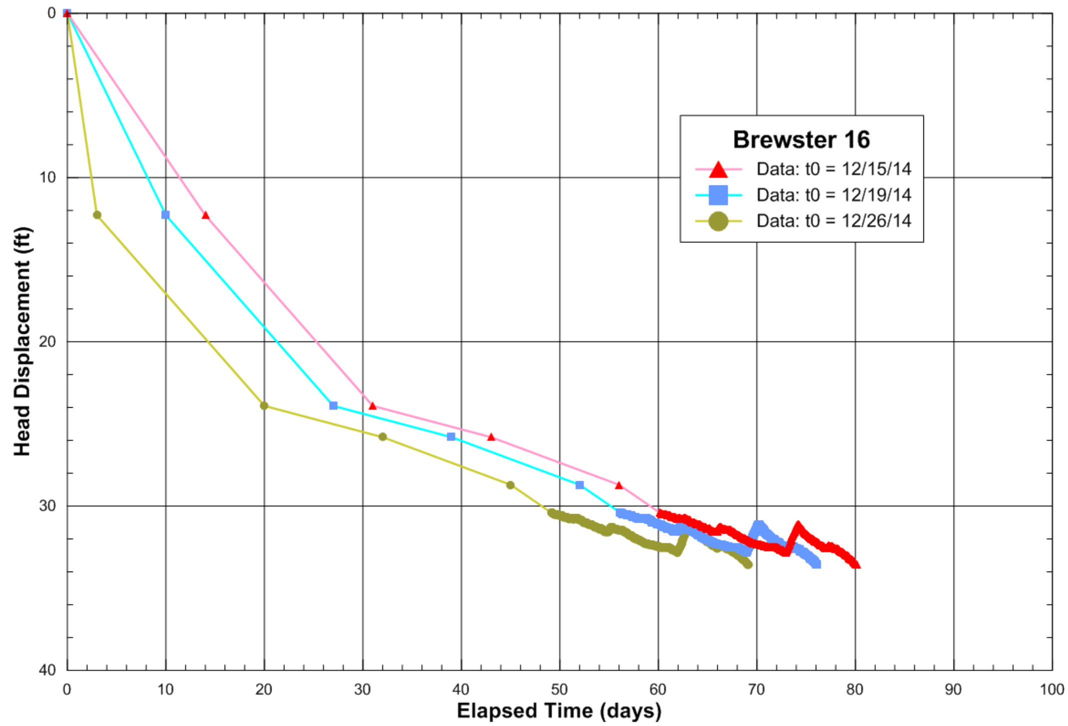
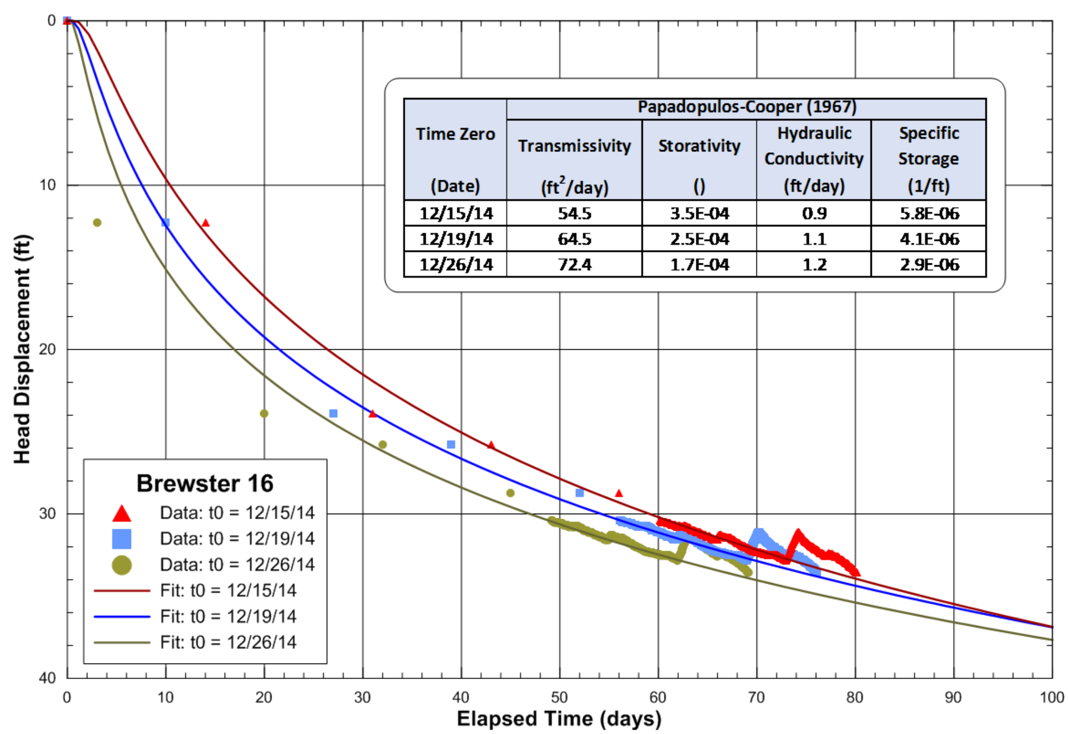


Figure 3-8. Drawdown Based on Three Production Start Times.



Time Zero	Papadopulos-Cooper (1967)			
(Date)	Transmissivity (ft^2/day)	Storativity ()	Hydraulic Conductivity (ft/day)	Specific Storage (1/ft)
12/15/14	54.5	3.5E-04	0.9	5.8E-06
12/19/14	64.5	2.5E-04	1.1	4.1E-06
12/26/14	72.4	1.7E-04	1.2	2.9E-06

Figure 3-9. Analytical Solution Fits to the Drawdown Data.

4.0 Phase 1 Conclusions

4.1 Correlation of Lithology to Aquifer Properties

Takeaway in Brief

Aquifer properties discussed in Section 3 above were compared to the sand percent discussed in Section 2 to look for a relationship. Conceptually, the greater the percent sand, the higher the hydraulic conductivity should be. However, similar to some previous investigations, no clear relationship could be found. This indicates either that a higher resolution of lithology is necessary to develop a relationship or, more likely, that other factors such as the interconnectivity of sand lenses play a larger role in aquifer productivity.

The distribution of percent sands was interpolated using Petra's® "Highly Connected Features (Least Square)" interpolation package, with a spatial trend in the north-south direction. Petra® is a database and GIS software commonly used in the oil and gas industry to evaluate geophysical logs and develop spatial trends in geologic formation. Spatial trends in the north-south direction were taken from Kaiser (1990) and represent sediment provenance areas to the north (paleo-Ouachitas), with fluvial axes oriented in the north-south direction. While Kaiser (1990) portrayed his interpolated sand maps as laterally continuous, INTERA choose not to follow that same trend for two primary reasons: 1) INTERA's data density was much higher, and the data showed that the features were disconnected and 2) the study area is in the updip outcropped portions of the Carrizo-Wilcox Aquifer, and it is likely that any continuous fluvial axis would be bisected and subsequently eroded by fluvial systems that washed across the area after the Wilcox was deposited.

Intuitively, hydraulic conductivity should be positively correlated with percent sand. That is, in areas with high sand percent, there should be higher hydraulic conductivity values. In areas with lower sand percent, there should be lower hydraulic conductivity values. The following is a summary from Mace et al (2000) concerning the relationship between hydraulic conductivity and sand thickness: "Henry and others (1979, 1980) reported hydraulic conductivities of 20-66 ft/day for the Simsboro and Calvert Bluff sands and 3 to 6 ft/day for the interchannel muds. Fogg (1986) found that thicker channel-fill sands in the Wilcox Group were more permeable and continuous than sands deposited in the adjacent floodplain and interchannel basins. Thorkinson and Price (1991) reported hydraulic conductivities ranging from 20 to 60 feet/day in the channel sand deposits and 3 to 7 ft/day in the interchannel muds."

While it seemed there was background data to suggest otherwise, no statistically significant relationship between hydraulic conductivity and sand percent data could be developed for the study area. These findings are consistent with Prudic (1991), who also did not find a conclusive relationship between hydraulic conductivity and sand thickness for the entire region (Mace et al, 2000). Points with hydraulic conductivity measurements were sampled to the percent sand map developed by the lithologic analysis, and the resulting values were plotted to determine a regression equation to best fit the data. R^2 values for the entire hydraulic conductivity dataset (district provided and INTERA analyzed tests (Figure 3-2), Brewster ongoing aquifer response (Figure 3-2), hydraulic conductivity values form the Northern Carrizo-

Wilcox GAM (Figure 3-3) and hydraulic conductivity values from Submitted Driller's Reports (Figure 3-4)) sampled to the percent sand map (Figure 2-13) were extremely low, signifying no statistical correlation.

Subsequent analysis focused on breaking out the hydraulic conductivity measurements by the percent of the Carrizo-Wilcox aquifer that was being represented by the lithologic analysis (Figure 2-13), the idea being that the more representative the lithologic log is of the entire thickness of the aquifer, the better it will represent the distribution of sands and clays. One major issue with this approach is that, as the percent of the Wilcox evaluated goes higher, the number of wells used to interpolate the percent sands goes down. In addition to a lower number of wells, the wells are not regularly distributed, which results in trends developed in an area with good data density being interpolated over large areas with poor to no data density. The resulting regressions between percent sands and wells lithologically logged over 60, 70, 80, 90 and 100 percent of the Carrizo-Wilcox aquifer showed no increase in the correlation coefficient value, signifying no significant statistical correlation.

4.2 Study Implications

Takeaway in Brief

The first phase of the hydrogeologic study documented in this report provides important information on the aquifer structure, lithology and hydraulic properties that is necessary to evaluate local- and regional-scale pumping impacts. Some of the study findings, such as the confined response of the aquifer to pumping, may require particular attention due to their implications for groundwater management.

This hydrogeologic study of the Wilcox Aquifer in Panola County focused on developing the foundation of information necessary to inform management of the aquifer. The structure of the aquifer was evaluated to develop a high-resolution picture of the depth and thickness of the Wilcox. Additionally, the spatial and vertical extent of the lower Wilcox was delineated to ensure the District has the ability to manage it separately if it chooses to do so.

The lithologic makeup of the Wilcox was also evaluated using a wide variety of data sources. While the District and water well drillers understand that conditions in the aquifer can change quickly over short distances, this analysis of sands and clays better shows where and why this is the case.

Hydraulic properties of an aquifer such as hydraulic conductivity and storativity define how water flows through the aquifer and how it responds to pumping. Having the existing information on hydraulic properties from a wide array of sources compiled enables the District to make the best management decisions possible. Good information on hydraulic properties is essential to understand local and regional impacts of pumping

One outcome of this study is that the hydraulic properties gathered through aquifer tests interpreted by both INTERA and other hydrogeologic consulting firms indicated a confined response of the aquifer to pumping. Though Panola County is in the outcrop area of the Wilcox (which is traditionally assumed to be an unconfined area of the aquifer), this is not surprising given the interbedded sands and clays within the Wilcox. Except for very shallow wells or wells in river alluvium, the District can expect a confined response to pumping.

A significance of the confined response to pumping is that confined aquifers generally have much greater and broader reaching drawdowns for a given amount of pumping than unconfined aquifers. This is because, in an unconfined aquifer, the aquifer pore spaces dewater as the water level declines. In a confined aquifer, the aquifer remains fully saturated and water level declines represent a loss of pressure in the aquifer. The groundwater availability model for the aquifer used by the Texas Water Development Board for the development of modeled available groundwater assumes unconfined conditions throughout Panola County. Given this mismatch between the model and on-the-ground conditions, the District will need to take care to adopt management goals that can be achieved. The relationship between pumping and drawdown in the regional-scale groundwater availability model will need to be closely evaluated to determine if they are appropriate for Panola County.

The information developed for Phase 1 of this study, which is documented here, gives the District the necessary foundation on which to evaluate local- and regional-scale pumping impacts. This enables the District to better assess the impacts of new wells on nearby wells and develop long-term management goals that reflect aquifer conditions in Panola County.

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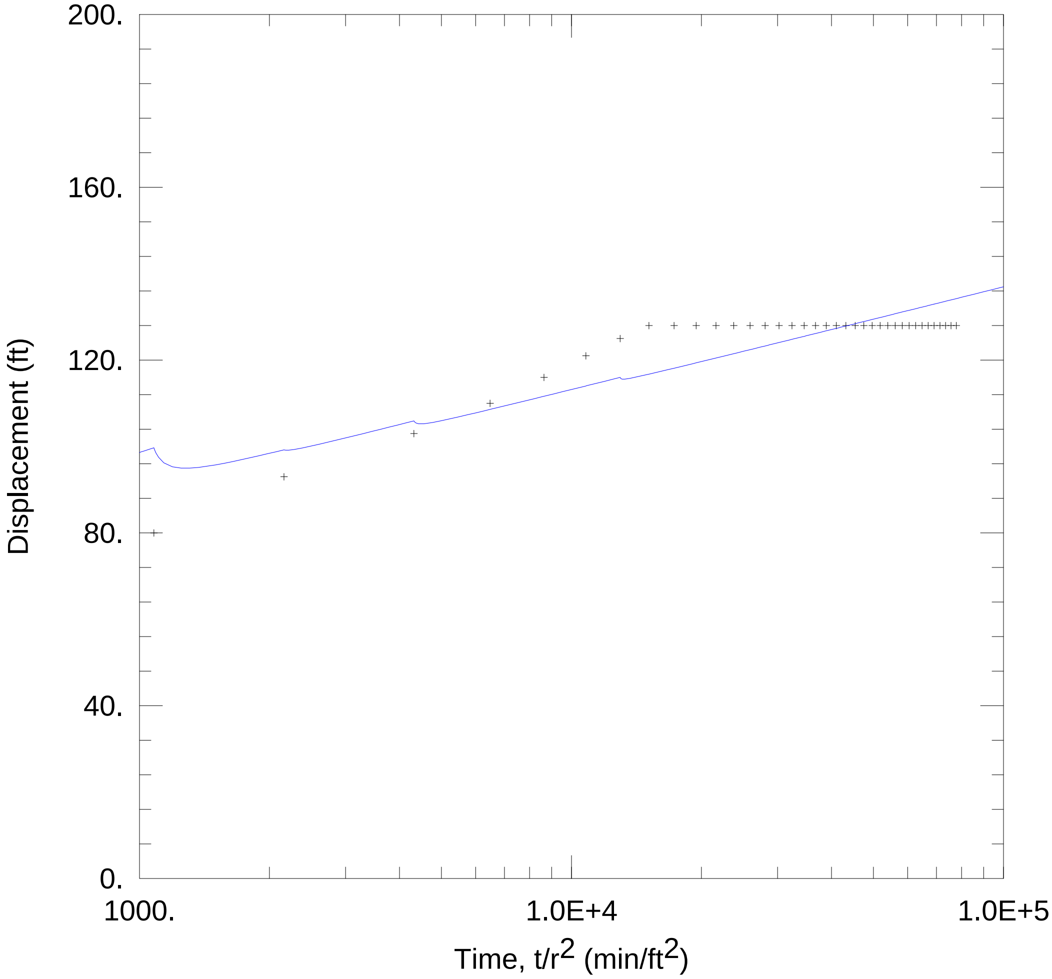
APPENDIX A

Aquifer Test Analysis Plots



WELL TEST ANALYSIS

Data Set: S:\...\Panola_05D.aqt
Date: 07/07/15 Time: 13:12:37

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183007C
Test Date: Unknown

AQUIFER DATA

Saturated Thickness: 226. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
05D	0	0

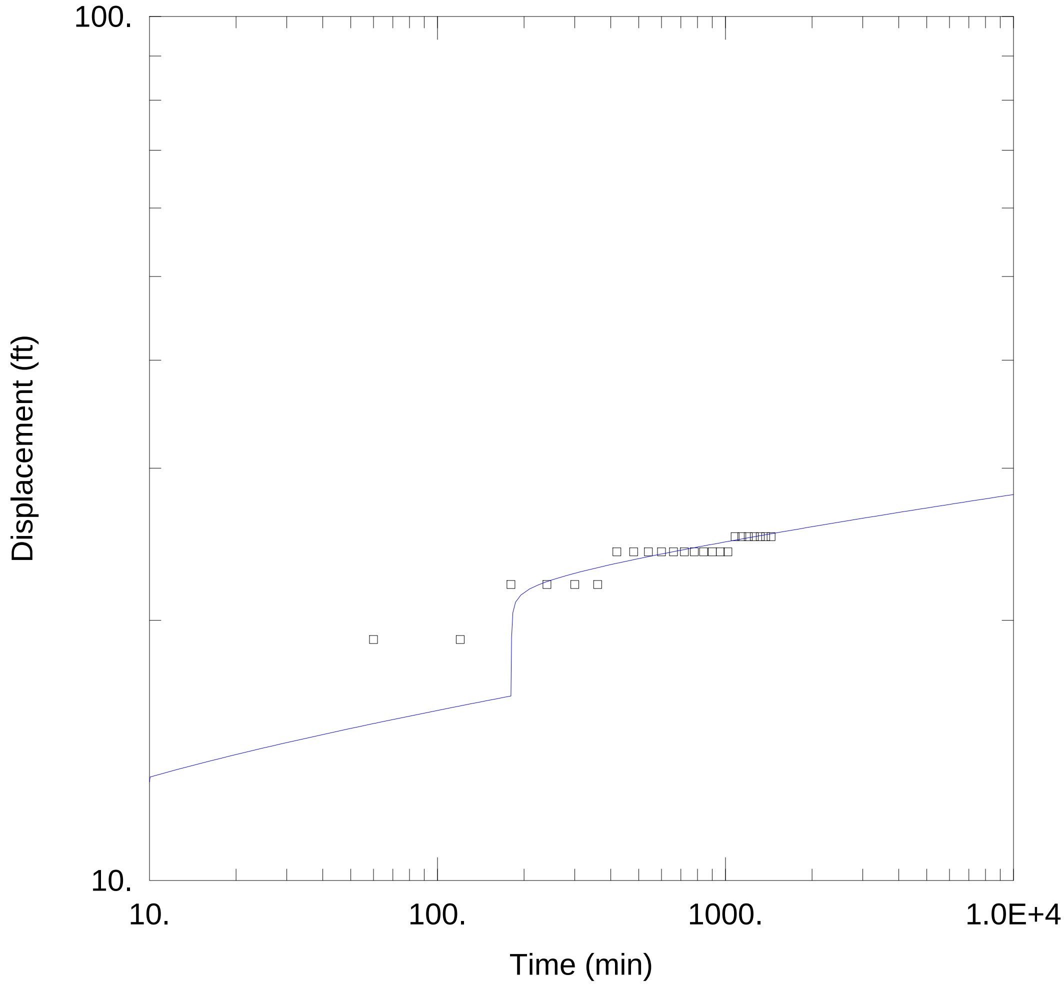
Observation Wells

Well Name	X (ft)	Y (ft)
+ 05D	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 147.2 ft^2/day S = 0.07333
r(w) = 0.1667 ft r(c) = 0.3594 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_06C.aqt
Date: 04/14/15 Time: 10:47:33

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183006C
Test Date: 12/18/79

AQUIFER DATA

Saturated Thickness: 63. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
06C	0	0

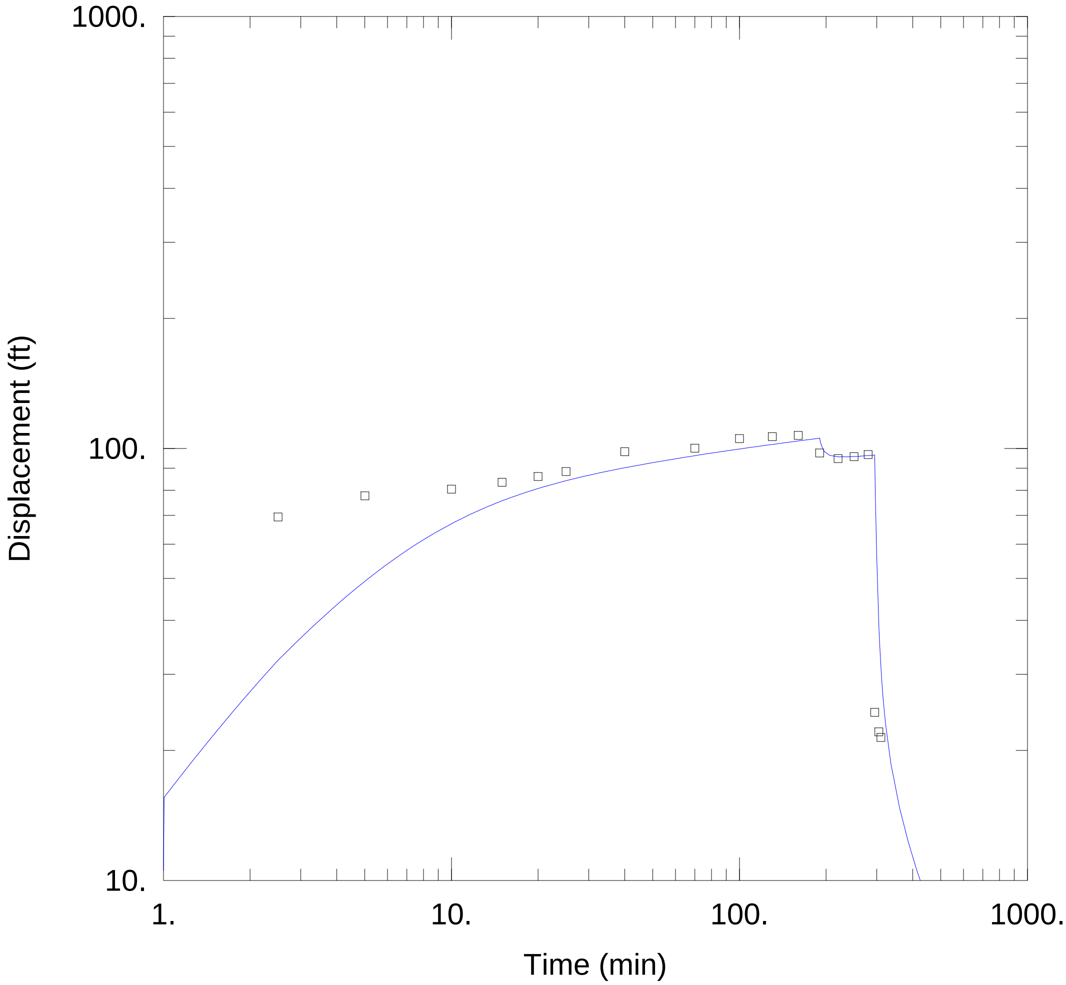
Observation Wells

Well Name	X (ft)	Y (ft)
□ 06C	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Papadopulos-Cooper

T = 652. ft^2/day
S = 0.0003219
r(w) = 0.276 ft
r(c) = 0.4479 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_06D.aqt
Date: 04/14/15 Time: 10:47:40

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183006D
Test Date: 10/31/88

AQUIFER DATA

Saturated Thickness: 60. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
06D	0	0

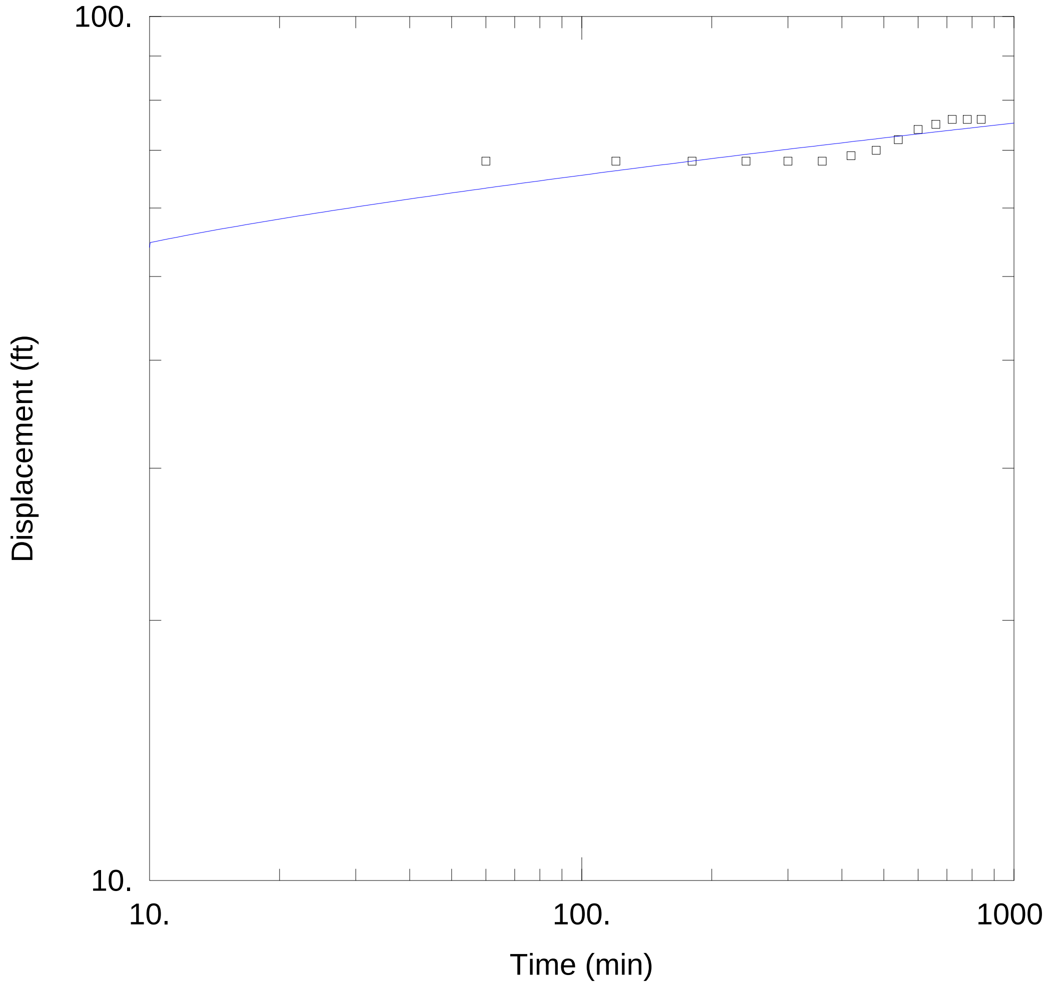
Observation Wells

Well Name	X (ft)	Y (ft)
□ 06D	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Papadopulos-Cooper

T = 82.53 ft^2/day
S = 0.001552
r(w) = 0.25 ft
r(c) = 0.4167 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_07B.aqt
Date: 04/14/15 Time: 10:47:44

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183007B
Test Date: 02/10/1981

AQUIFER DATA

Saturated Thickness: 84. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
07B	0	0

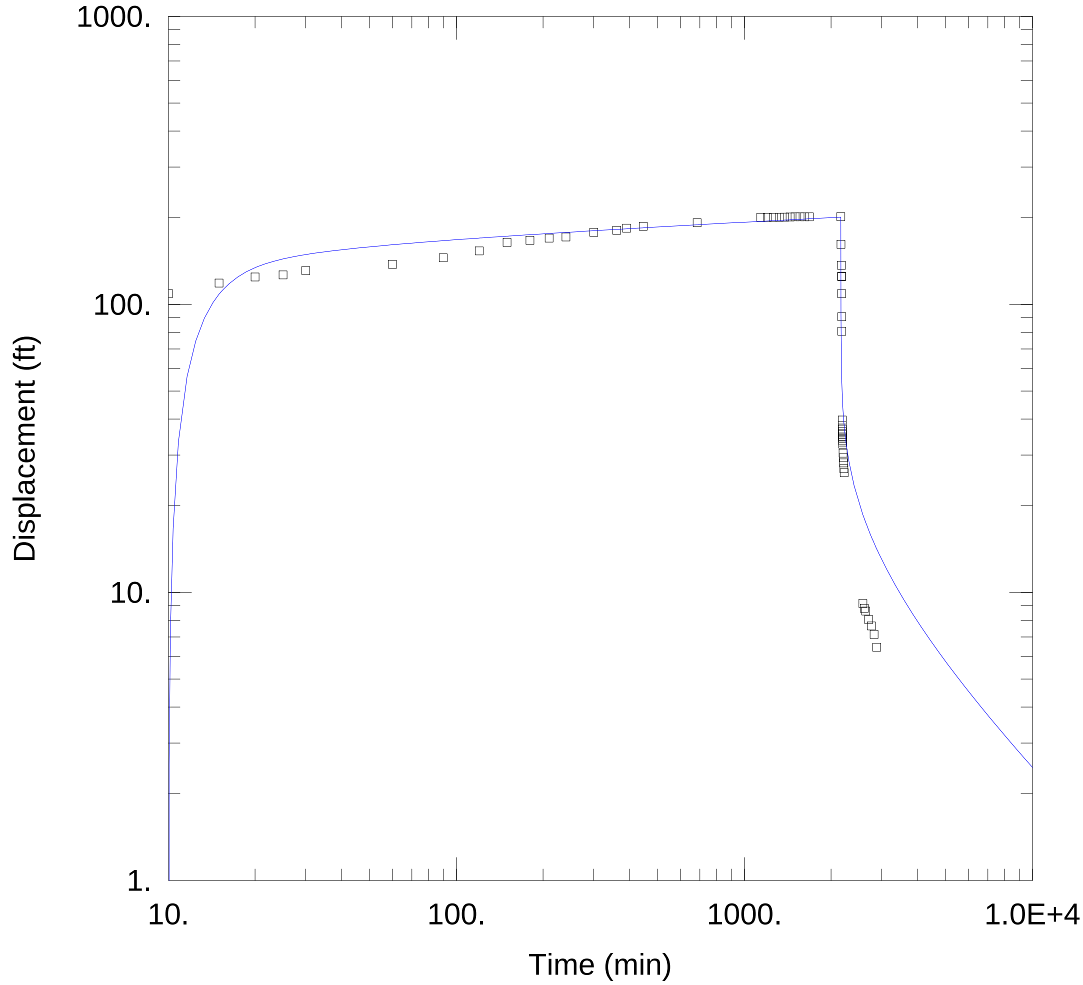
Observation Wells

Well Name	X (ft)	Y (ft)
□ 07B	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Papadopulos-Cooper

T = 365.3 ft^2/day
S = 0.0002592
r(w) = 0.1875 ft
r(c) = 0.3594 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_07C.aqt
Date: 04/14/15 Time: 10:48:53

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183007C
Test Date: 8/22/1995

AQUIFER DATA

Saturated Thickness: 60. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
07C	0	0

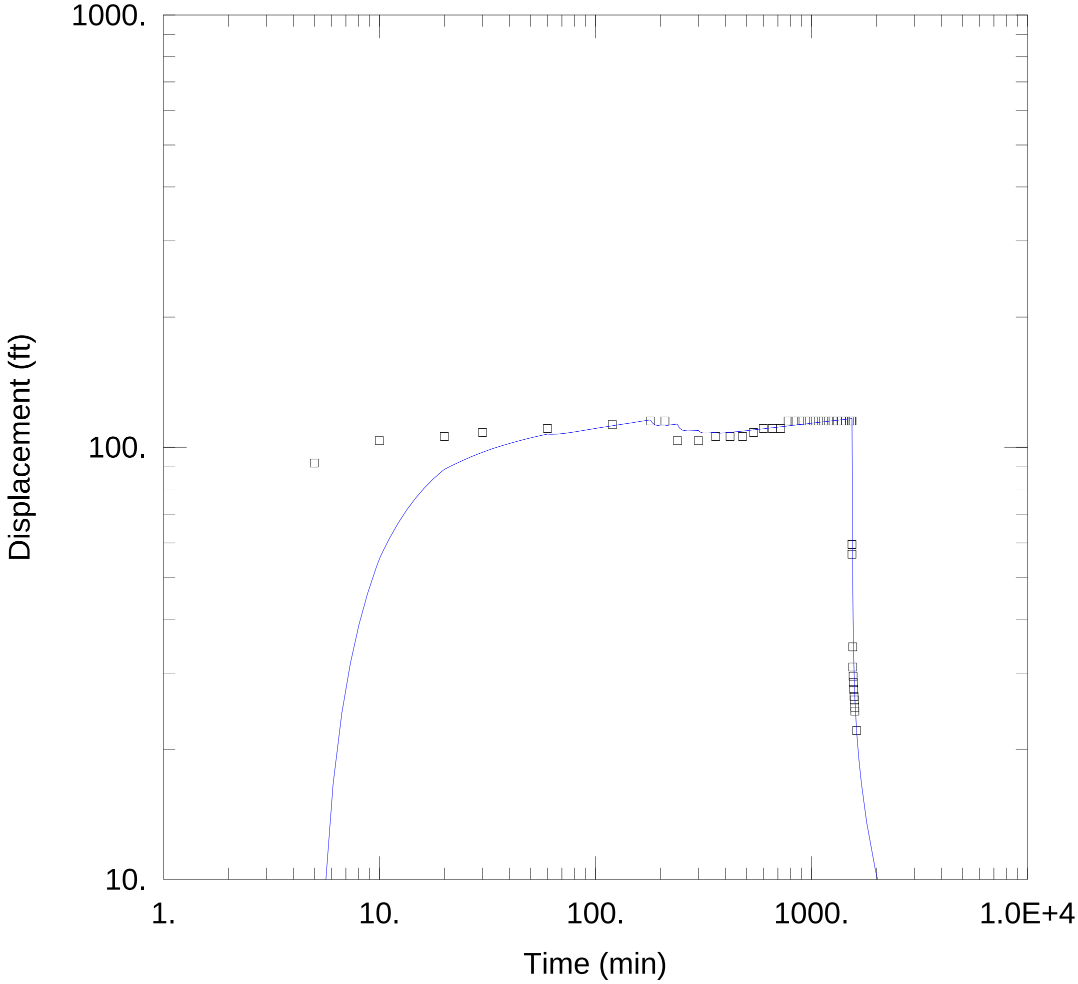
Observation Wells

Well Name	X (ft)	Y (ft)
□ 07C	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 141.5 ft^2/day S = 4.56E-5
r(w) = 0.1667 ft r(c) = 0.3333 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_08C.aqt
Date: 04/14/15 Time: 10:48:57

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183008C
Test Date: Unknown

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
08C	0	0

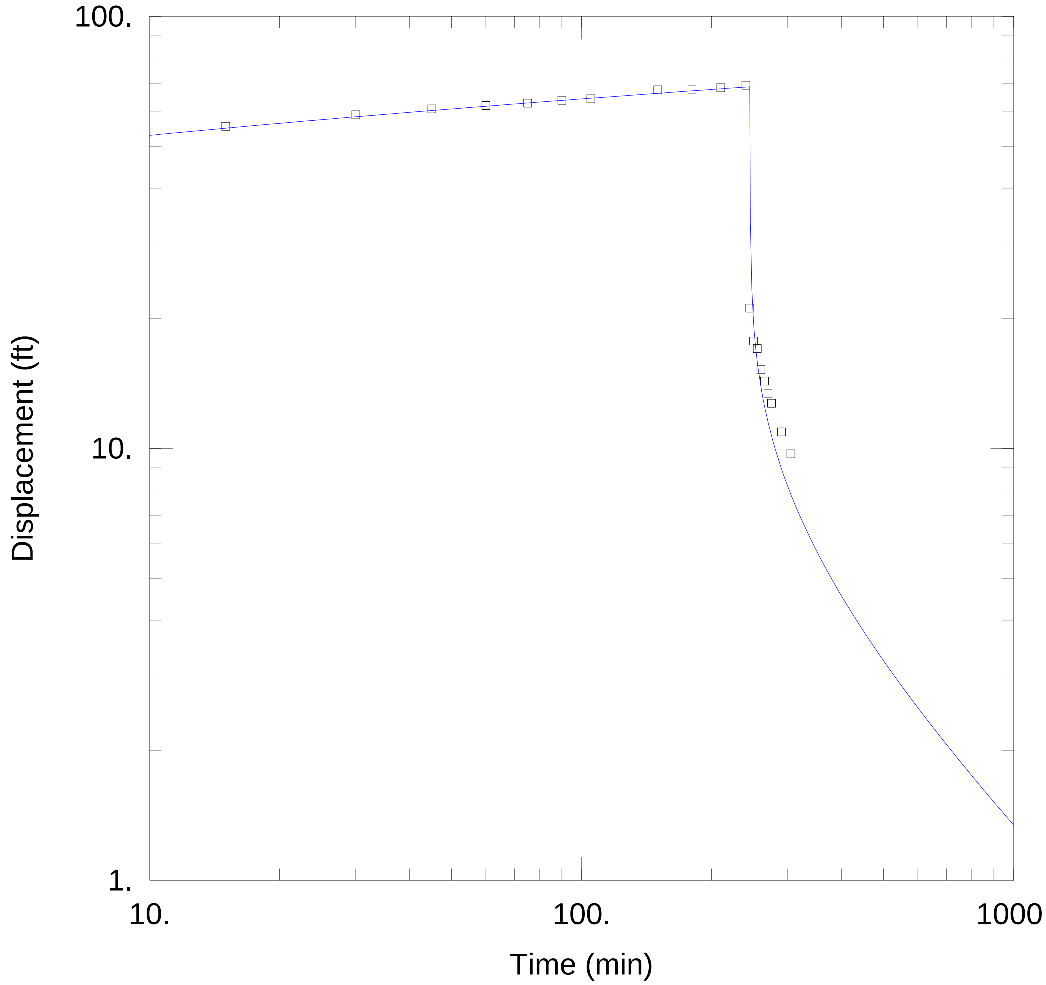
Observation Wells

Well Name	X (ft)	Y (ft)
□ 08C	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 78.15 ft^2/day S = 9.583E-5
r(w) = 0.25 ft r(c) = 0.4167 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_08D.aqt
Date: 04/14/15 Time: 10:48:59

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183008D
Test Date: 5/15/2013

AQUIFER DATA

Saturated Thickness: 120. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
08D	0	0

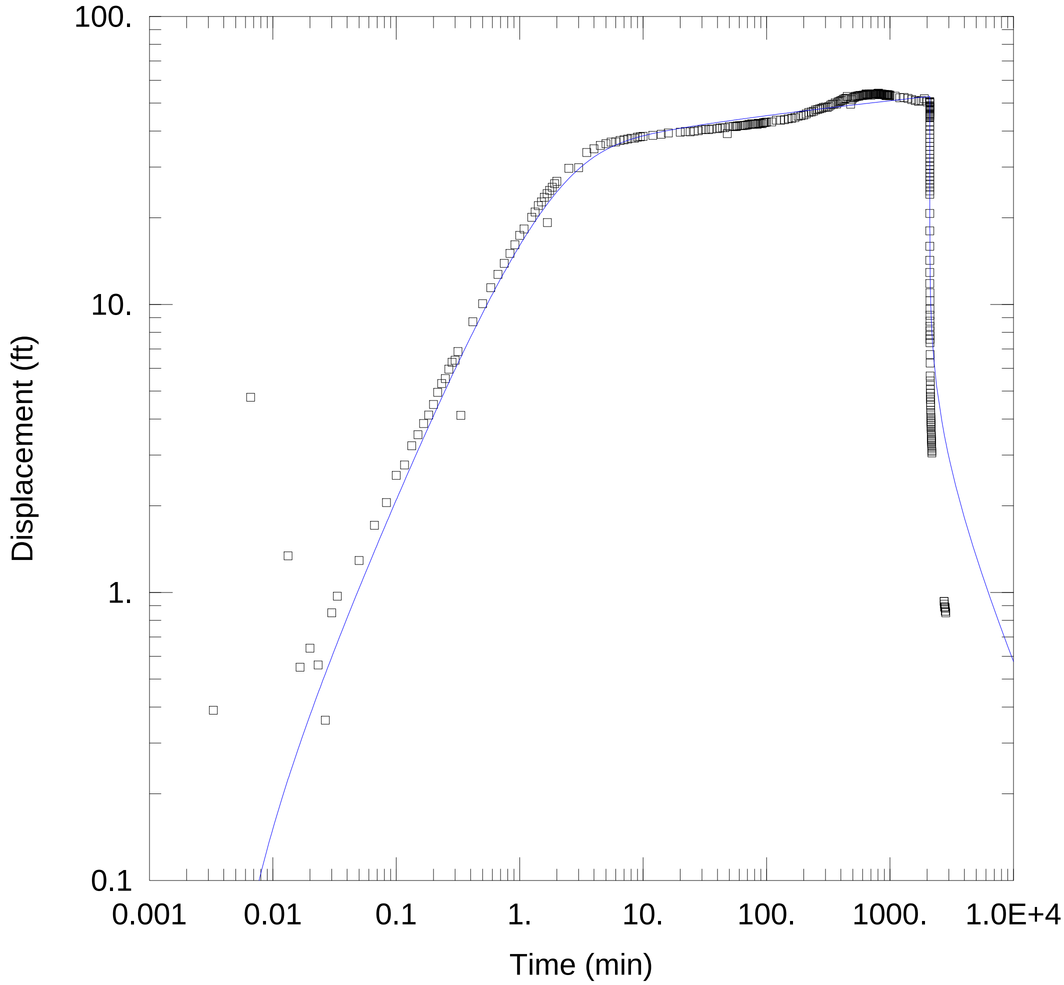
Observation Wells

Well Name	X (ft)	Y (ft)
□ 08D	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 128.6 ft^2/day S = 0.001276
r(w) = 0.1458 ft r(c) = 0.1875 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_09B.aqt
Date: 04/14/15 Time: 10:49:01

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183009B
Test Date: 5/15/2013

AQUIFER DATA

Saturated Thickness: 60. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
09B	0	0

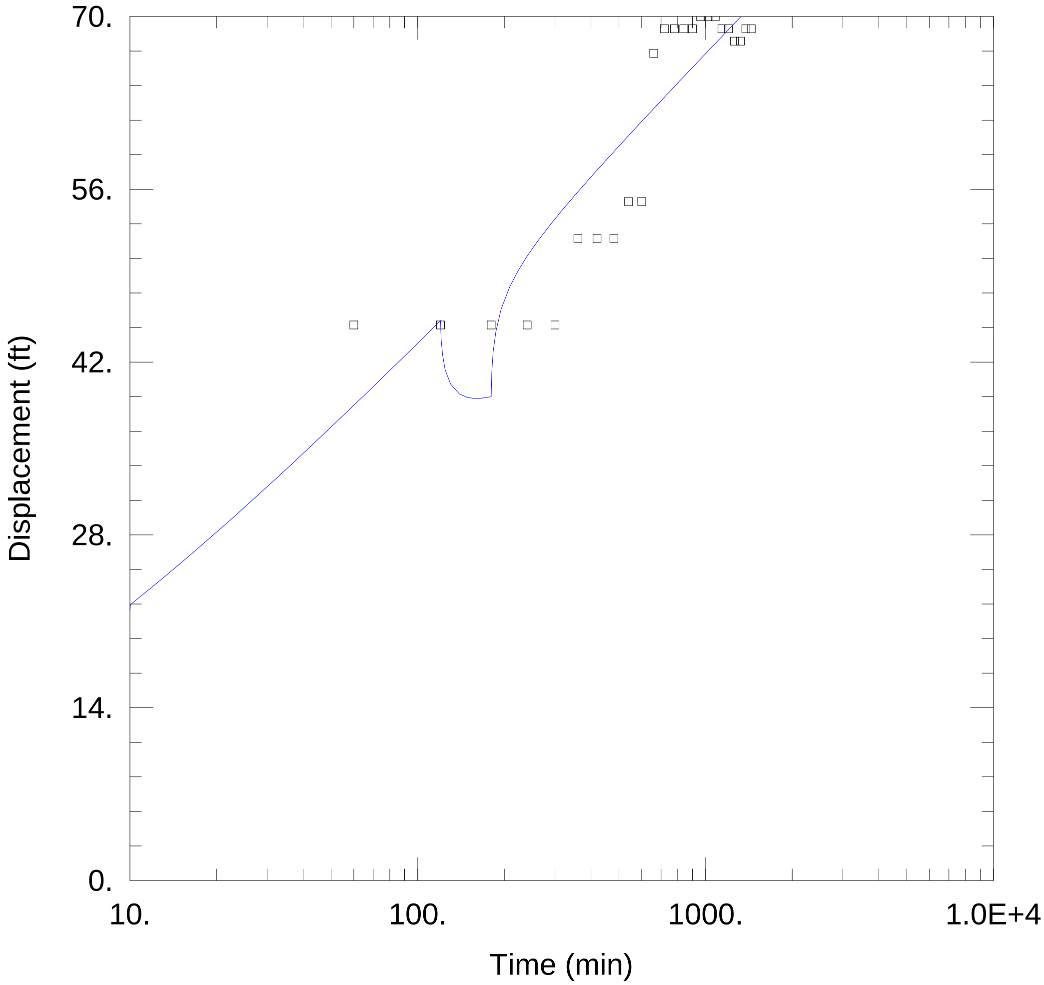
Observation Wells

Well Name	X (ft)	Y (ft)
□ 09B	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 313.6 ft^2/day S = 1.216E-5
r(w) = 0.1875 ft r(c) = 0.3594 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_10A.aqt
Date: 04/14/15 Time: 10:49:37

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183010A
Test Date: 7/23/1966

AQUIFER DATA

Saturated Thickness: 113. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
10A	0	0

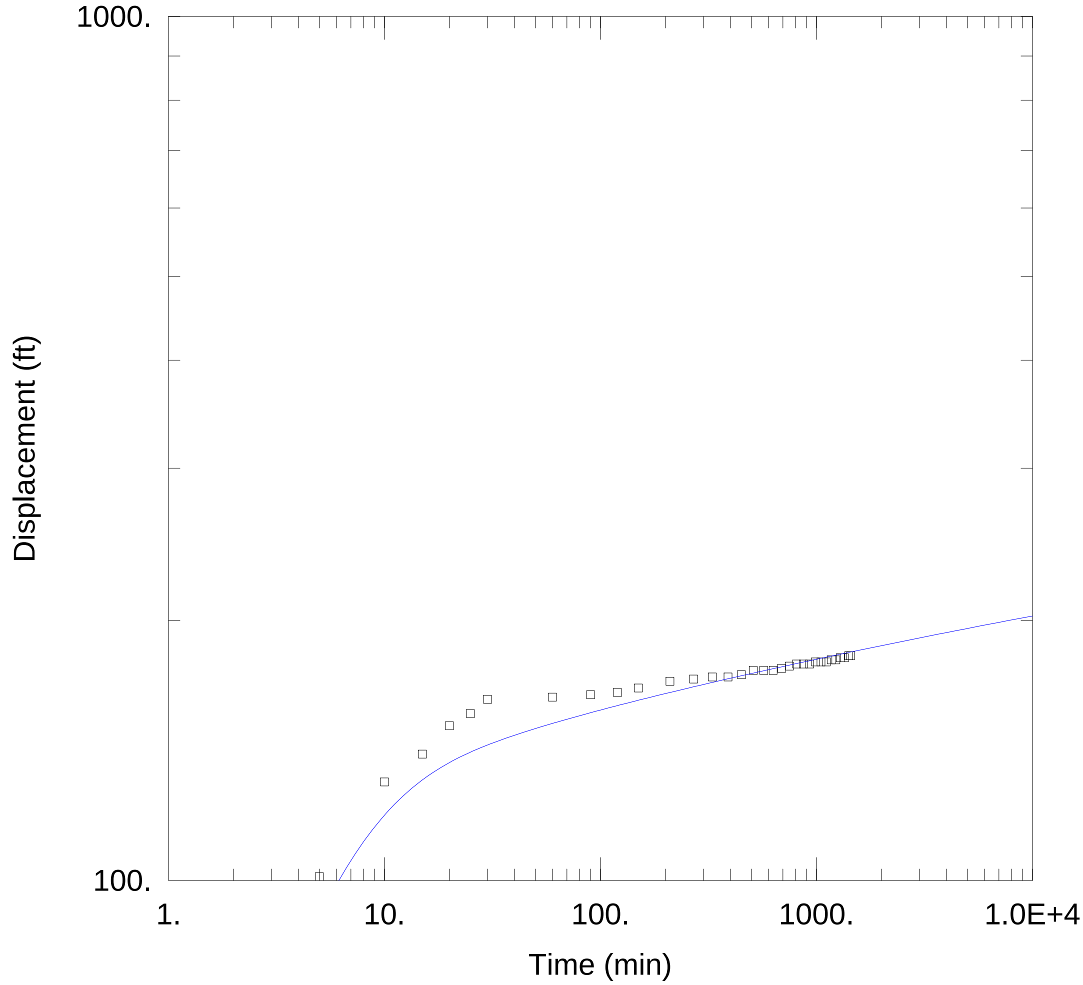
Observation Wells

Well Name	X (ft)	Y (ft)
□ 10A	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 87.42 ft^2/day S = 8.316
r(w) = 0.1667 ft r(c) = 0.3594 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_10B.aqt
Date: 04/14/15 Time: 10:49:39

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183010B
Test Date: 1/3/1985

AQUIFER DATA

Saturated Thickness: 84. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
10B	0	0

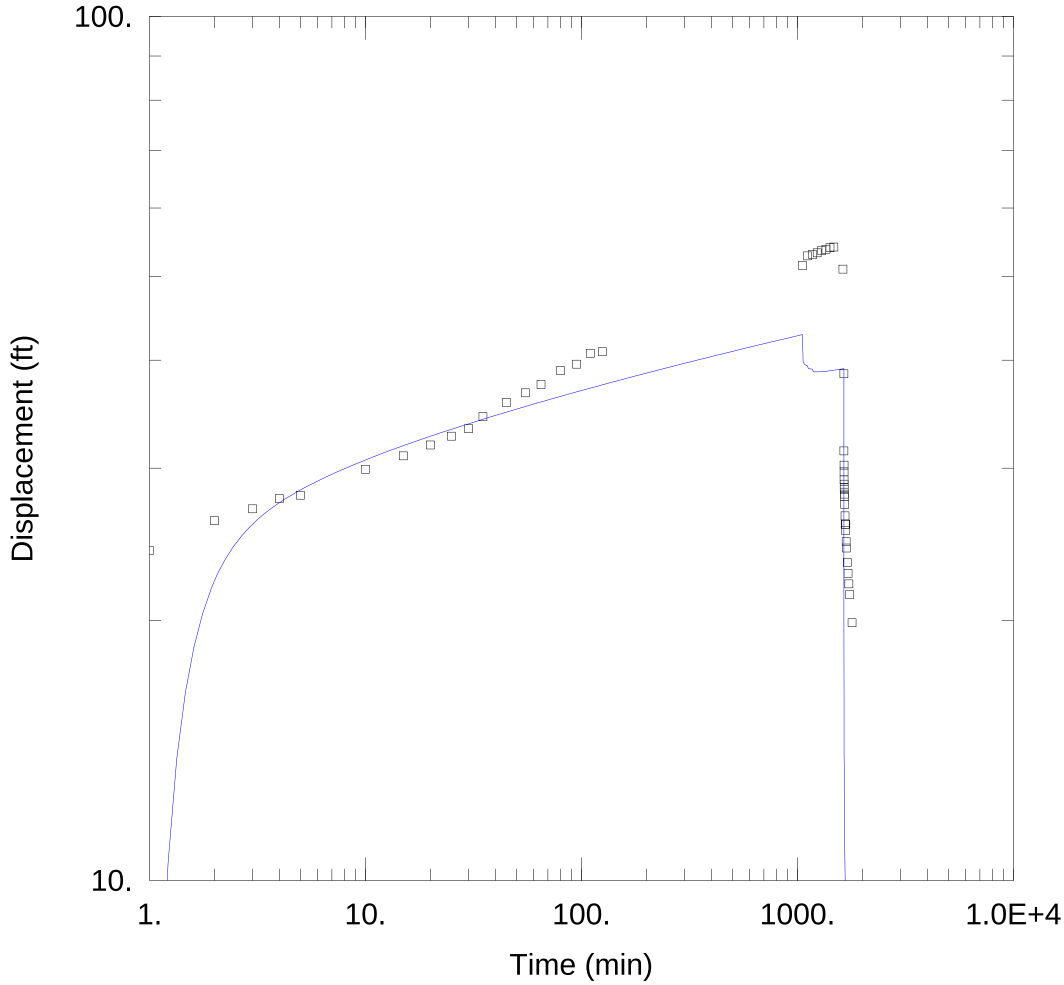
Observation Wells

Well Name	X (ft)	Y (ft)
□ 10B	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 160.5 ft^2/day S = 2.025E-5
r(w) = 0.276 ft r(c) = 0.4479 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_11E.aqt
Date: 04/14/15 Time: 10:49:41

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183011E
Test Date: 7/24/1995

AQUIFER DATA

Saturated Thickness: 50. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
11E	0	0

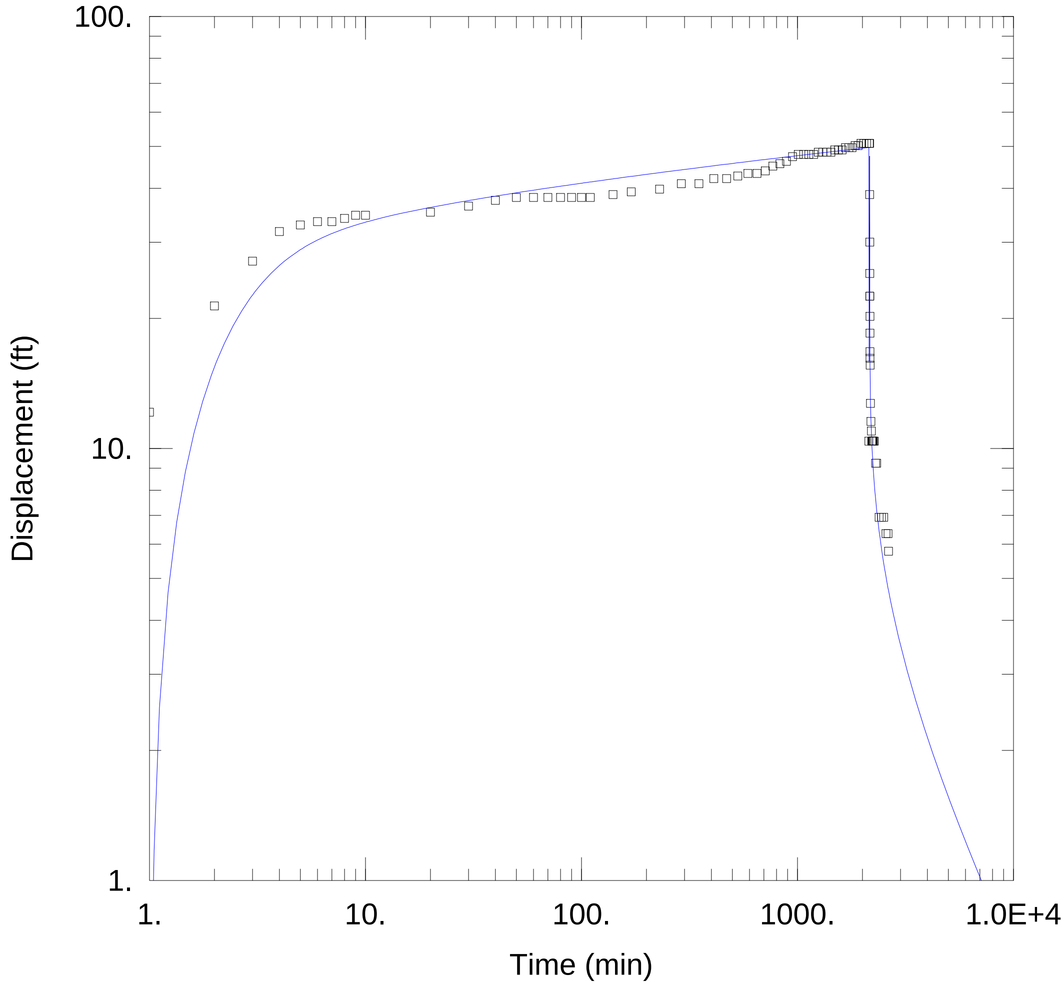
Observation Wells

Well Name	X (ft)	Y (ft)
□ 11E	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 1471. ft^2/day S = 0.00314
r(w) = 0.1667 ft r(c) = 0.4167 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_14A.aqt
Date: 04/14/15 Time: 10:49:44

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183014A
Test Date: 11/28/2001

AQUIFER DATA

Saturated Thickness: 24. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
14A	0	0

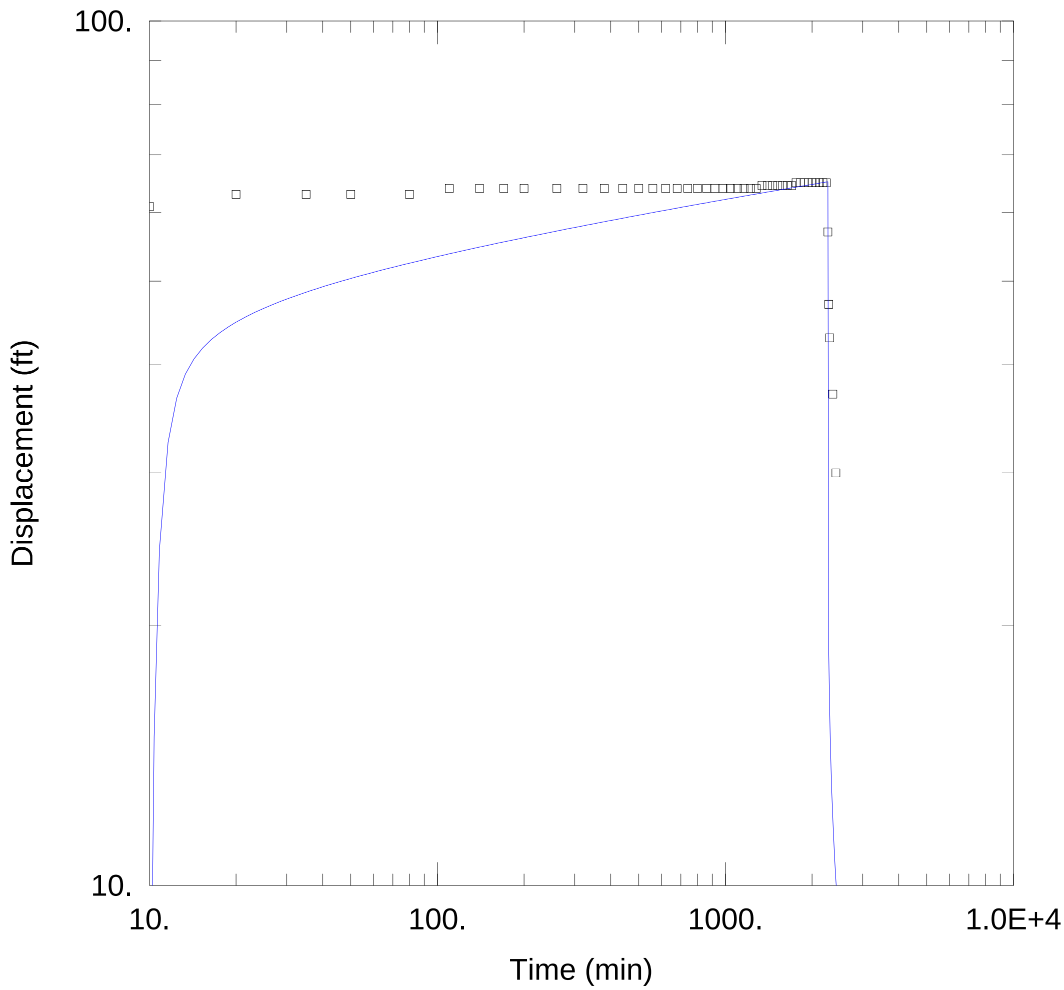
Observation Wells

Well Name	X (ft)	Y (ft)
□ 14A	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 386.7 ft^2/day S = 0.0002763
r(w) = 0.276 ft r(c) = 0.4479 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_14B.aqt
Date: 04/14/15 Time: 10:50:23

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183014B
Test Date: 6/15/2006

AQUIFER DATA

Saturated Thickness: 50. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
14B	0	0

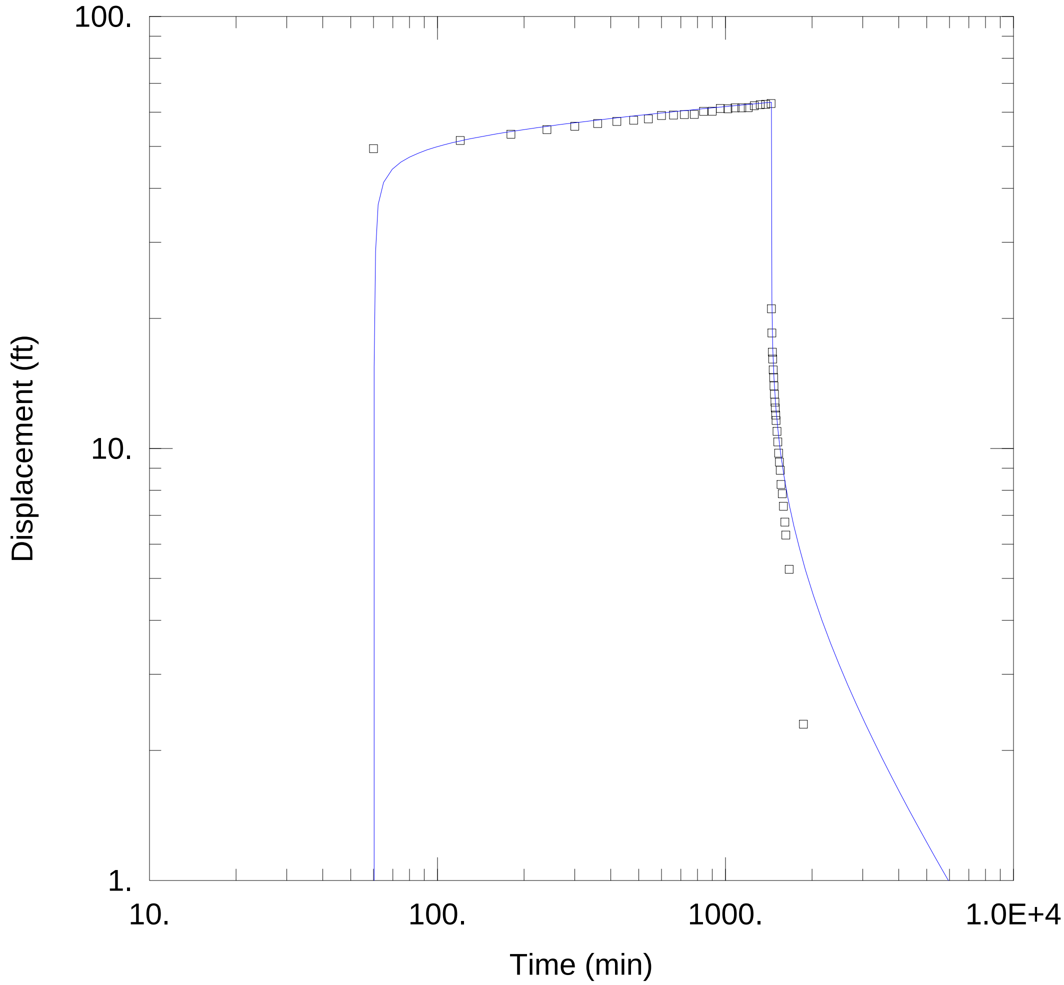
Observation Wells

Well Name	X (ft)	Y (ft)
□ 14B	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Papadopulos-Cooper

T = 675.6 ft^2/day
S = 0.0004948
r(w) = 0.276 ft
r(c) = 0.4479 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_21B.aqt
Date: 04/14/15 Time: 10:50:25

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183021B
Test Date: 5/15/1975

AQUIFER DATA

Saturated Thickness: 129. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
21B	0	0

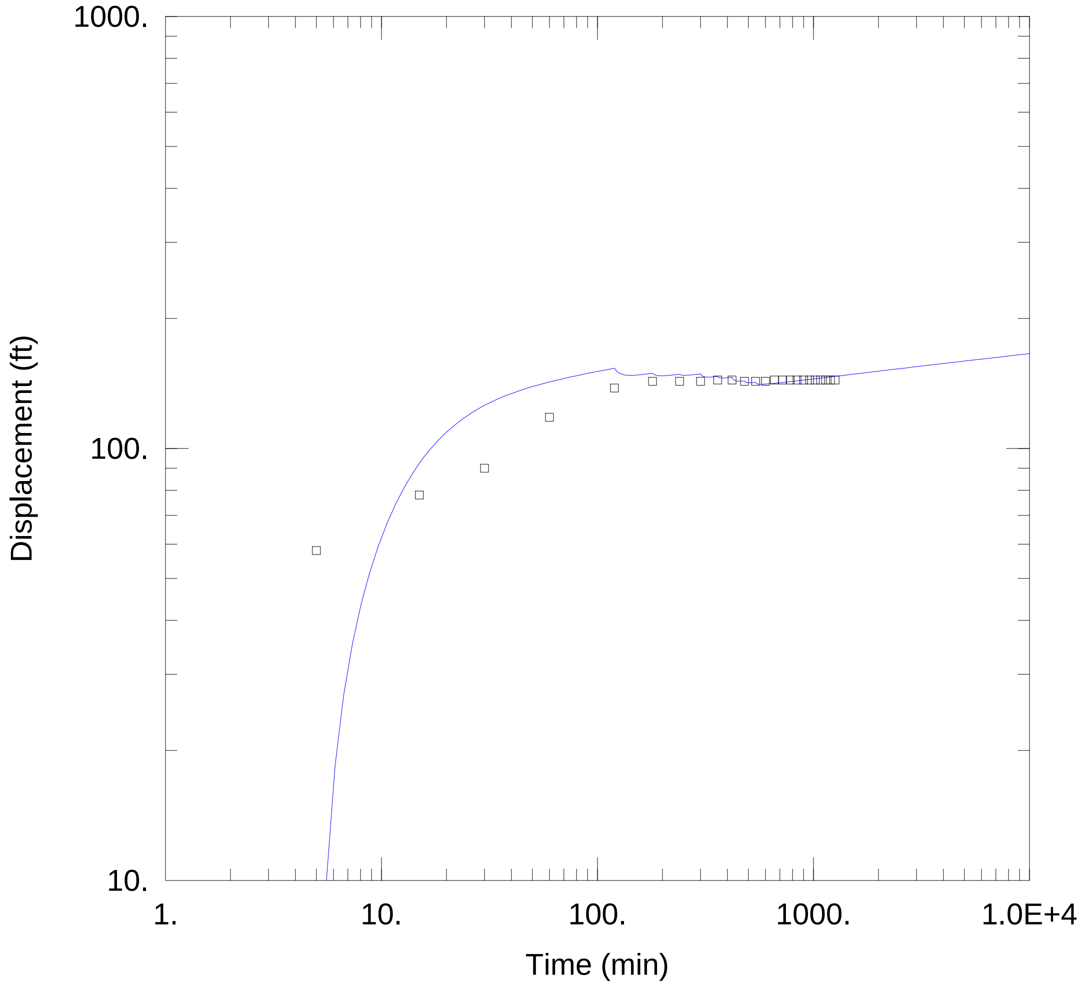
Observation Wells

Well Name	X (ft)	Y (ft)
□ 21B	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 1440. ft^2/day S = 0.001
r(w) = 0.3594 ft r(c) = 0.5833 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_25A.aqt
Date: 04/14/15 Time: 10:50:27

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183025A
Test Date: 9/2/1988

AQUIFER DATA

Saturated Thickness: 146. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
G1830025A	0	0

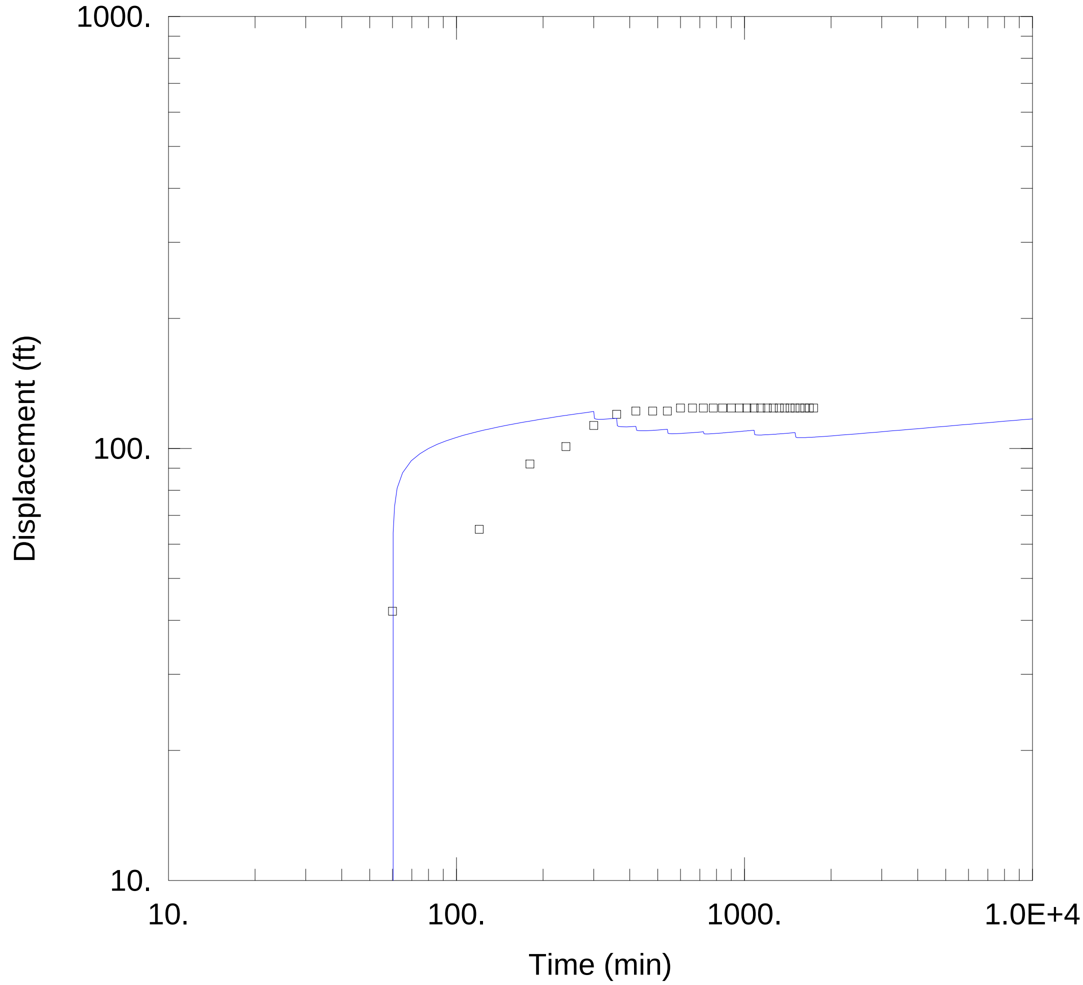
Observation Wells

Well Name	X (ft)	Y (ft)
□ G1830025A	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 98.81 ft^2/day S = 0.0003724
r(w) = 0.276 ft r(c) = 0.4948 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_25B.aqt
Date: 04/14/15 Time: 10:50:29

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183025B
Test Date: 2/23/1989

AQUIFER DATA

Saturated Thickness: 107. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
25B	0	0

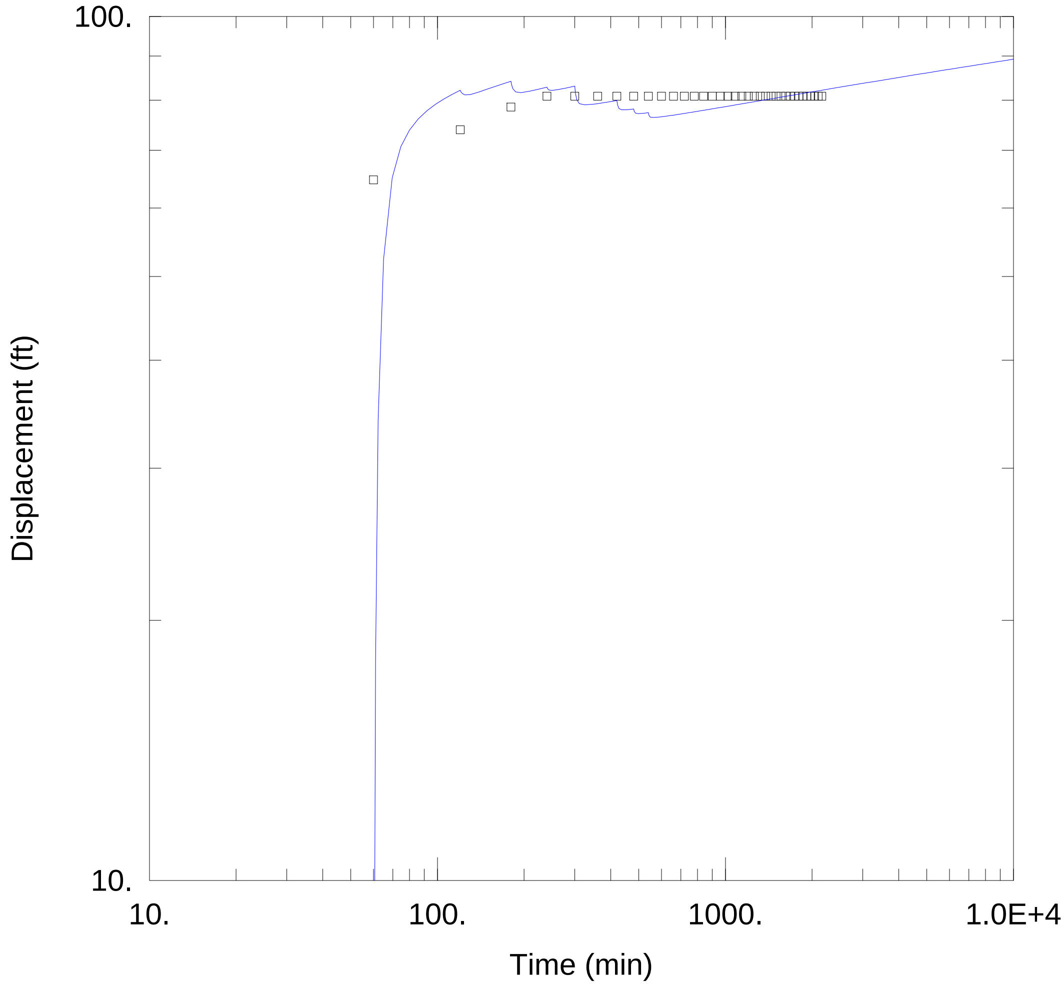
Observation Wells

Well Name	X (ft)	Y (ft)
□ 25B	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 122.3 ft^2/day S = 0.0005603
r(w) = 0.276 ft r(c) = 0.4479 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_25C.aqt
Date: 04/14/15 Time: 10:51:05

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183025C
Test Date: 9/18/1991

AQUIFER DATA

Saturated Thickness: 105. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
25C	0	0

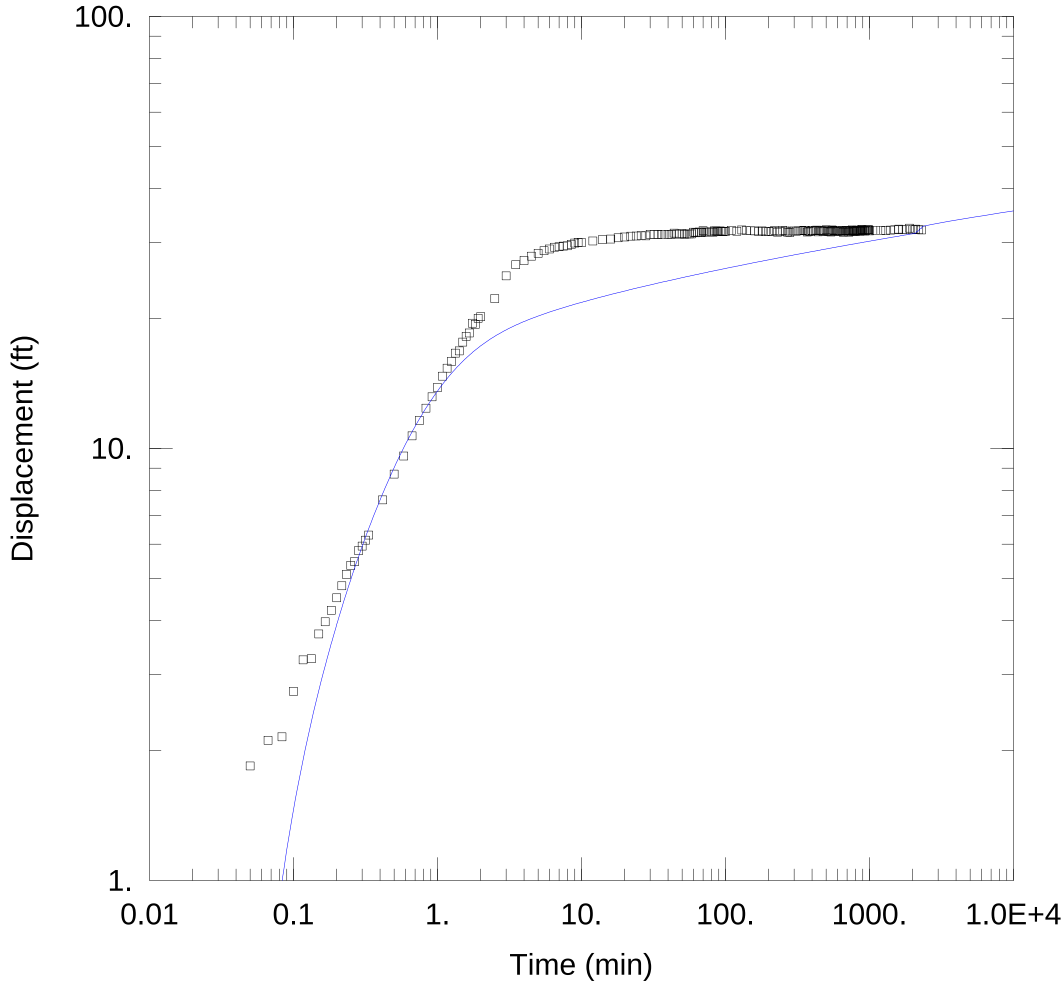
Observation Wells

Well Name	X (ft)	Y (ft)
□ 25C	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 175.7 ft^2/day S = 0.0001478
r(w) = 0.276 ft r(c) = 0.4479 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_25D.aqt
Date: 04/14/15 Time: 10:51:08

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183025D
Test Date: 12/5/1998

AQUIFER DATA

Saturated Thickness: 31. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
25D	0	0

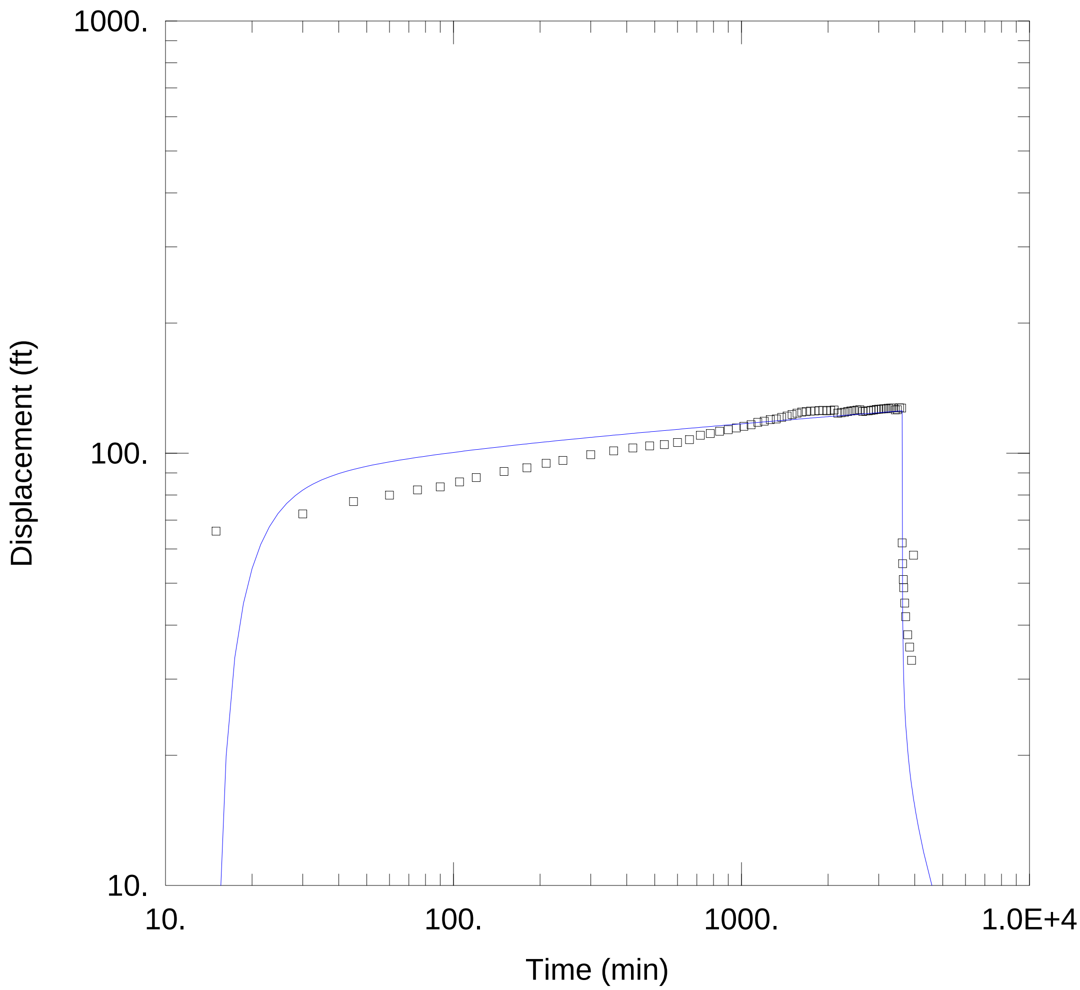
Observation Wells

Well Name	X (ft)	Y (ft)
□ 25D	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 712.5 ft^2/day S = 0.0006529
r(w) = 0.25 ft r(c) = 0.4167 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_25E.aqt
Date: 04/14/15 Time: 10:51:11

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183025E
Test Date: 11/29/1998

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
25E	0	0

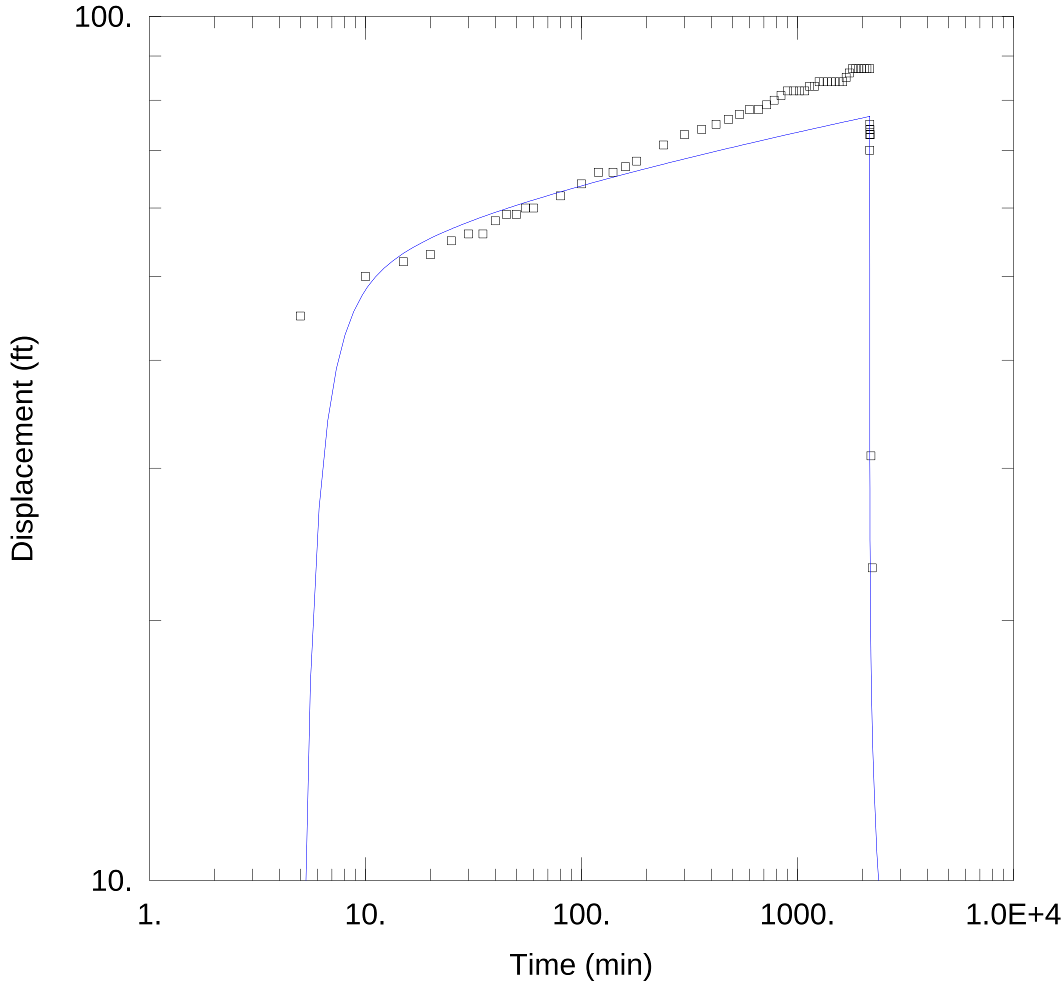
Observation Wells

Well Name	X (ft)	Y (ft)
□ 25E	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 100.2 ft^2/day S = 5.332E-5
r(w) = 0.1875 ft r(c) = 0.3594 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_27A.aqt
Date: 04/14/15
Time: 10:51:13

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: 183027A
Test Date: 11/28/2000

AQUIFER DATA

Saturated Thickness: 49. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
27A	0	0

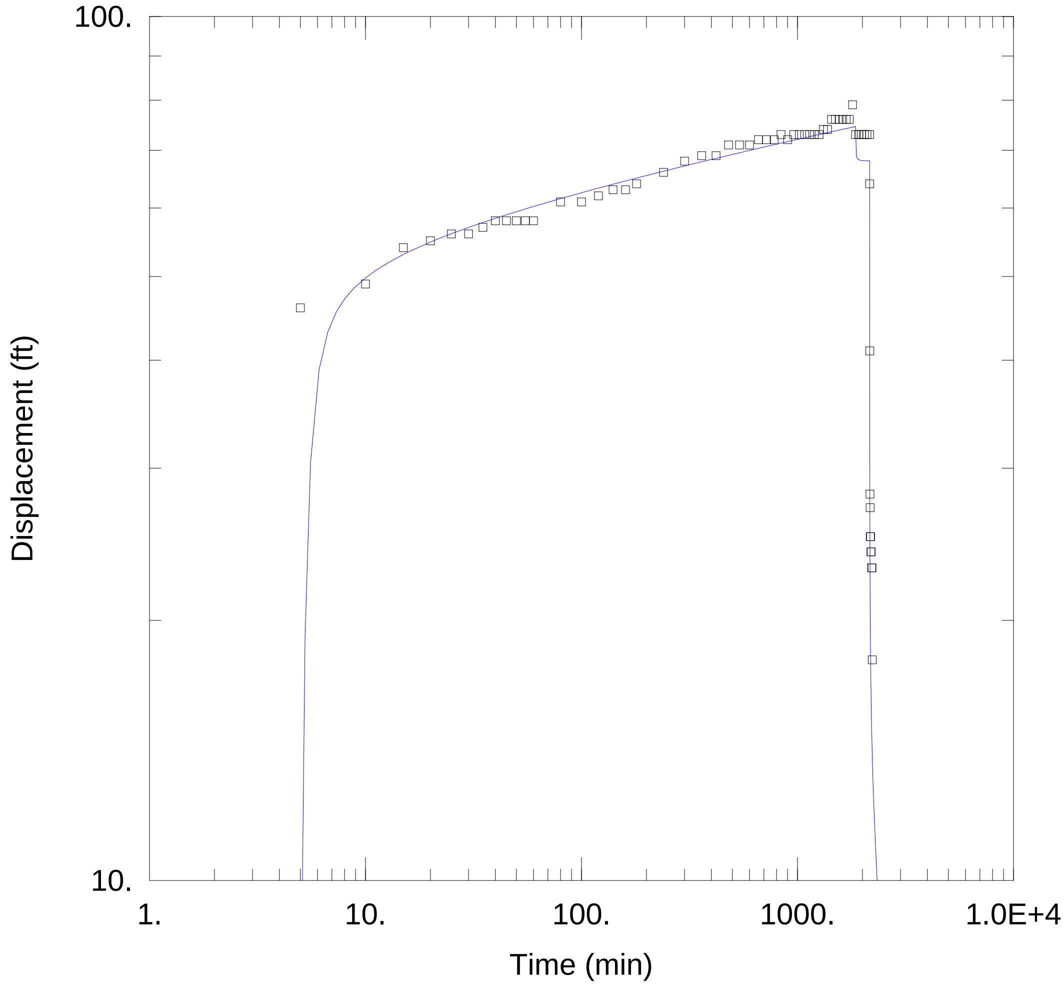
Observation Wells

Well Name	X (ft)	Y (ft)
□ 27A	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Papadopulos-Cooper

T = 809.8 ft^2/day
S = 0.0007688
r(w) = 0.1667 ft
r(c) = 0.5833 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_27B.aqt
Date: 04/14/15 Time: 10:51:55

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: G1830027B
Test Date: 11/20/2000

AQUIFER DATA

Saturated Thickness: 60. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
27B	0	0

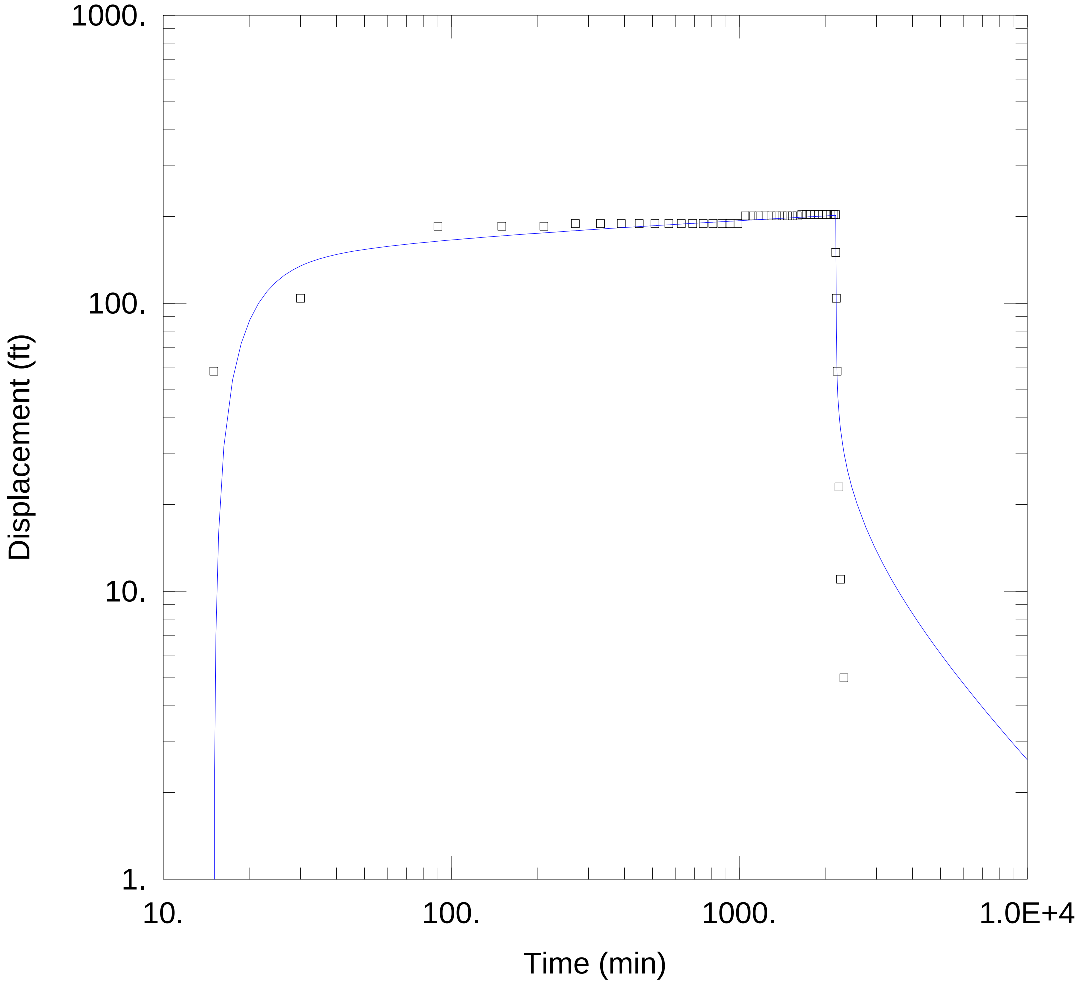
Observation Wells

Well Name	X (ft)	Y (ft)
□ 27B	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 821.4 ft^2/day S = 0.0008492
r(w) = 0.1667 ft r(c) = 0.3333 ft



WELL TEST ANALYSIS

Data Set: S:\...\Panola_30C.aqt
Date: 04/14/15 Time: 10:51:57

PROJECT INFORMATION

Company: INTERA
Client: Panola
Test Well: G1830030C
Test Date: 10/5/2000

AQUIFER DATA

Saturated Thickness: 60. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
30C	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ 30C	0	0

SOLUTION

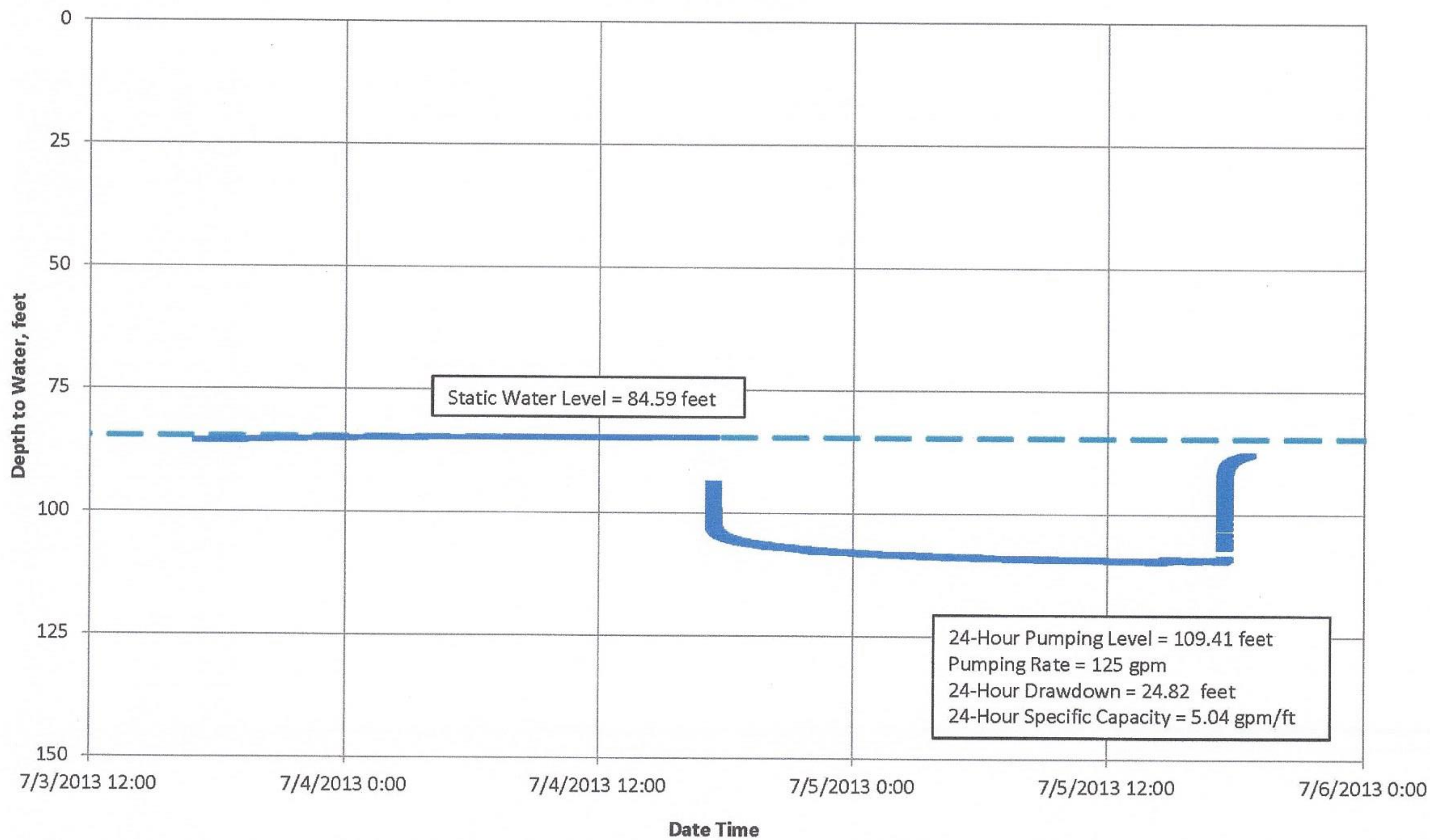
Aquifer Model: Confined Solution Method: Papadopulos-Cooper

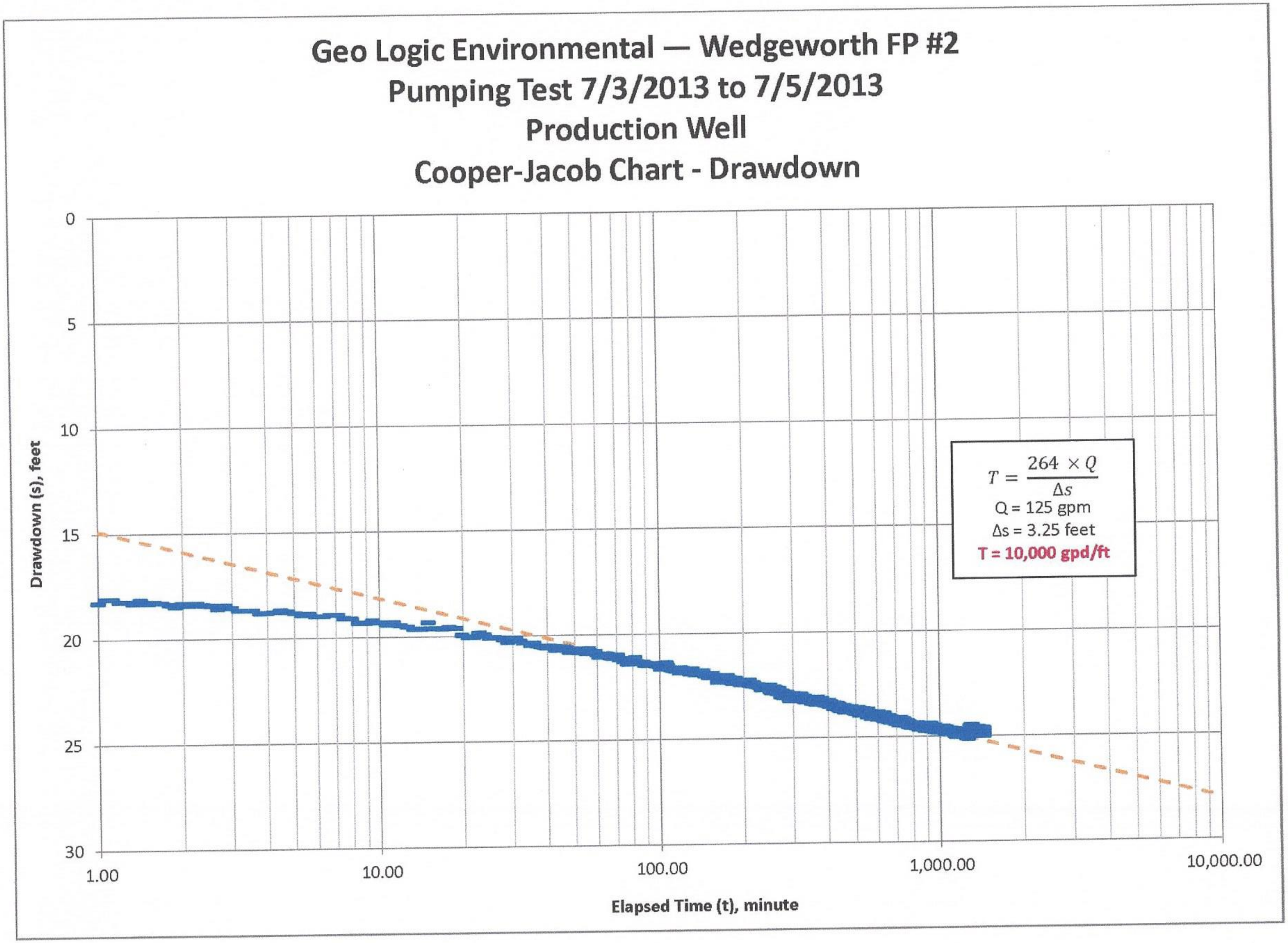
T = 150.3 ft^2/day S = 0.0001173
r(w) = 0.1667 ft r(c) = 0.4583 ft

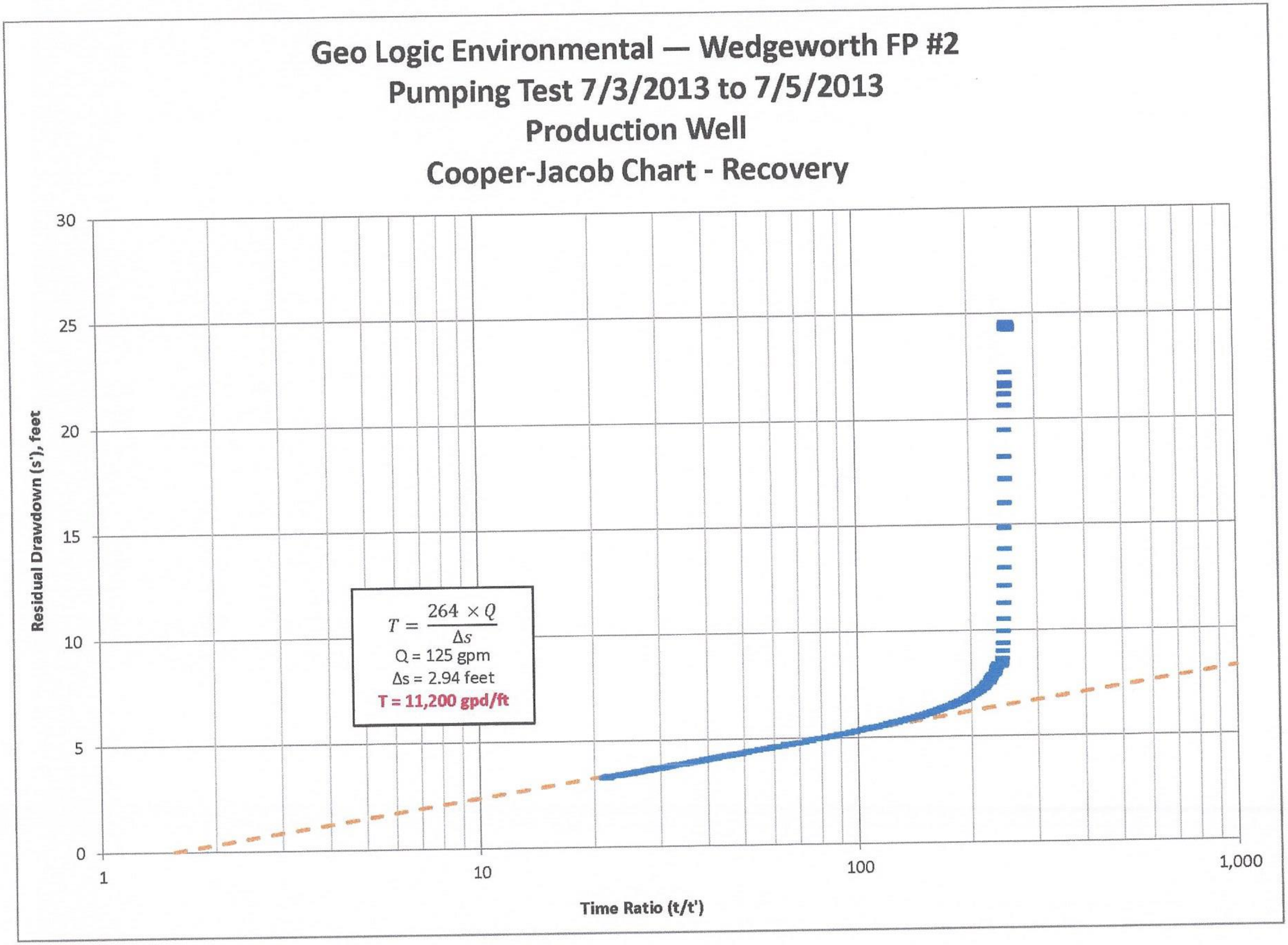
APPENDIX B

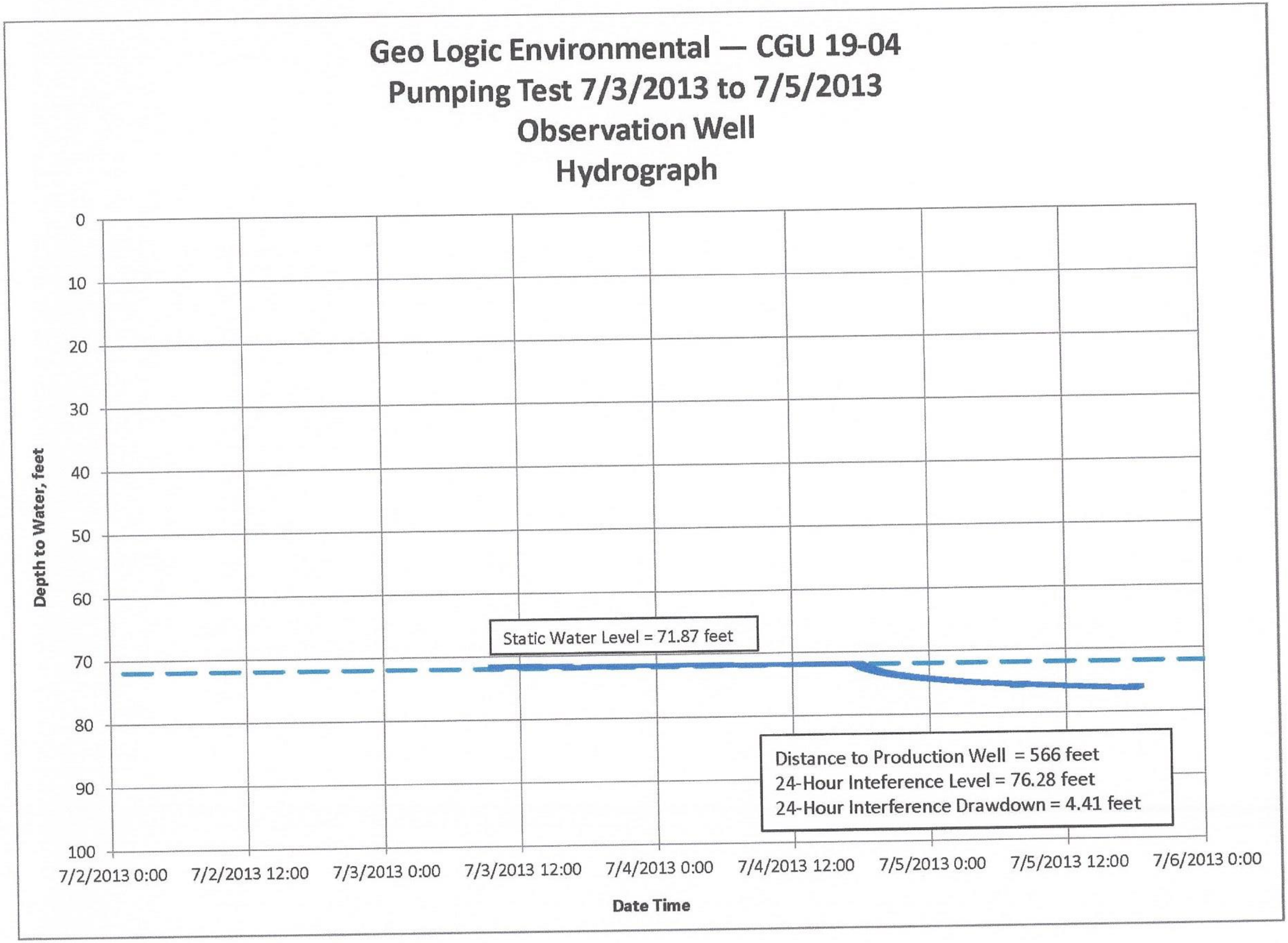
Aquifer Tests Provided to INTERA by the Panola County Groundwater Conservation District

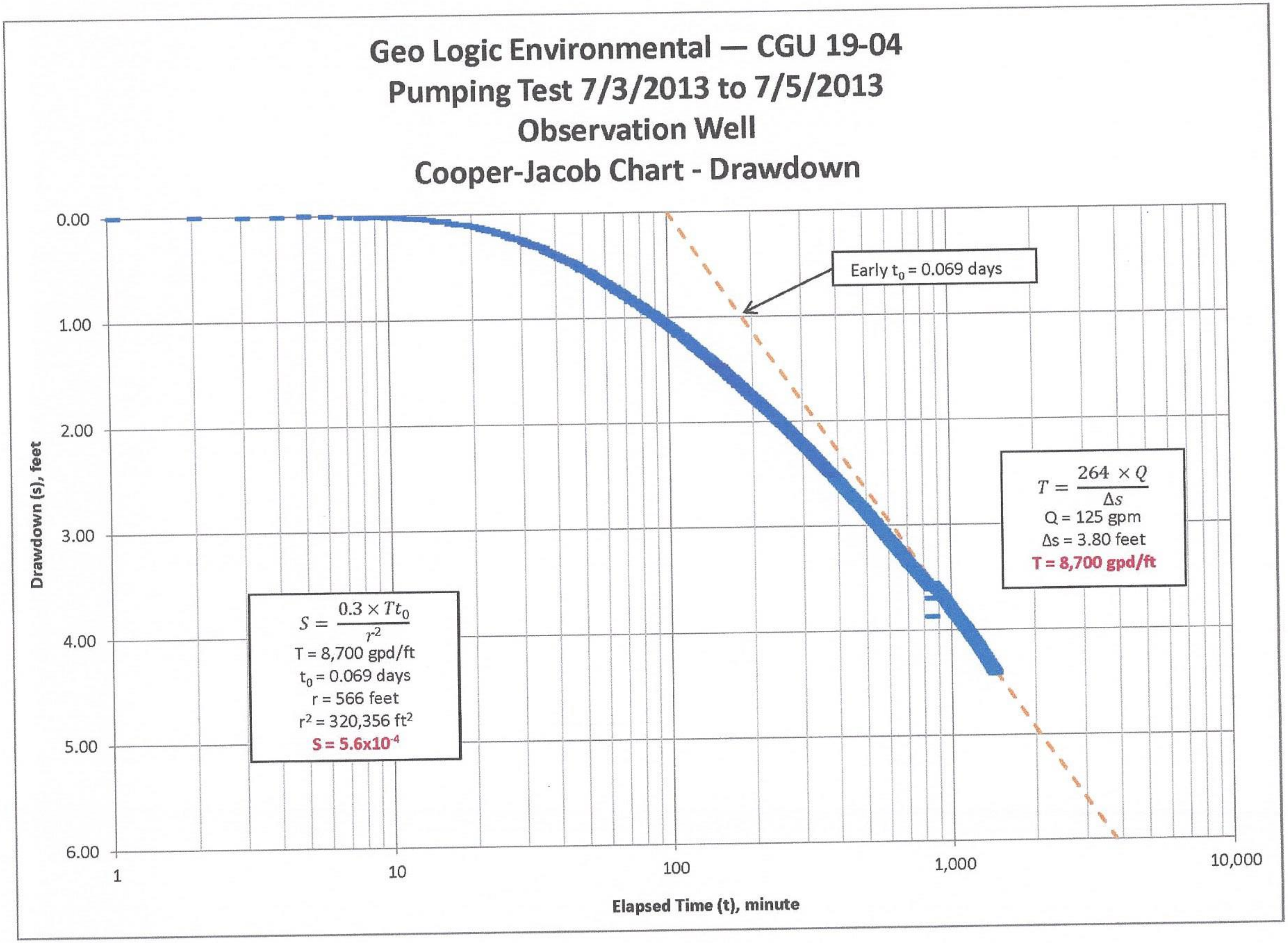
Geo Logic Environmental — Wedgeworth FP #2
Pumping Test 7/3/2013 to 7/5/2013
Production Well
Hydrograph



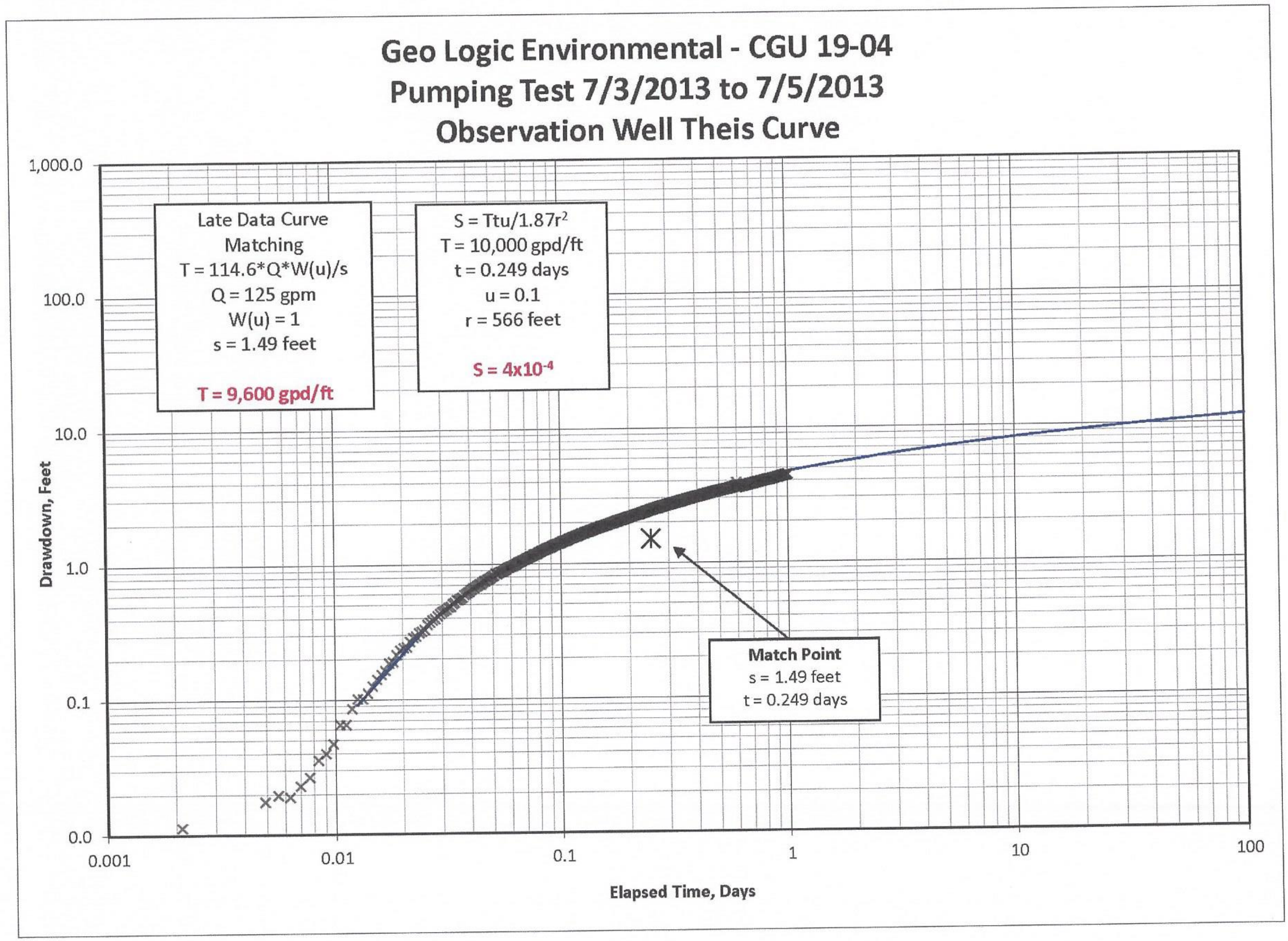

Geo Logic Environmental — Wedgeworth FP #2
Pumping Test 7/3/2013 to 7/5/2013
Production Well
Cooper-Jacob Chart - Drawdown
$T = \frac{264 \times Q}{\Delta s}$
Q = 125 gpm
Δs = 3.25 feet
T = 10,000 gpd/ft
Drawdown (s), feet
0
5
10
15
20
25
30
1.00
10.00
100.00
1,000.00
10,000.00
Elapsed Time (t), minute


Geo Logic Environmental — Wedgeworth FP #2
Pumping Test 7/3/2013 to 7/5/2013
Production Well
Cooper-Jacob Chart - Recovery
Residual Drawdown (s'), feet
30
25
20
15
10
5
0
1
10
100
1,000
Time Ratio (t/t')
$T = \frac{264 \times Q}{\Delta s}$
Q = 125 gpm
Δs = 2.94 feet
T = 11,200 gpd/ft

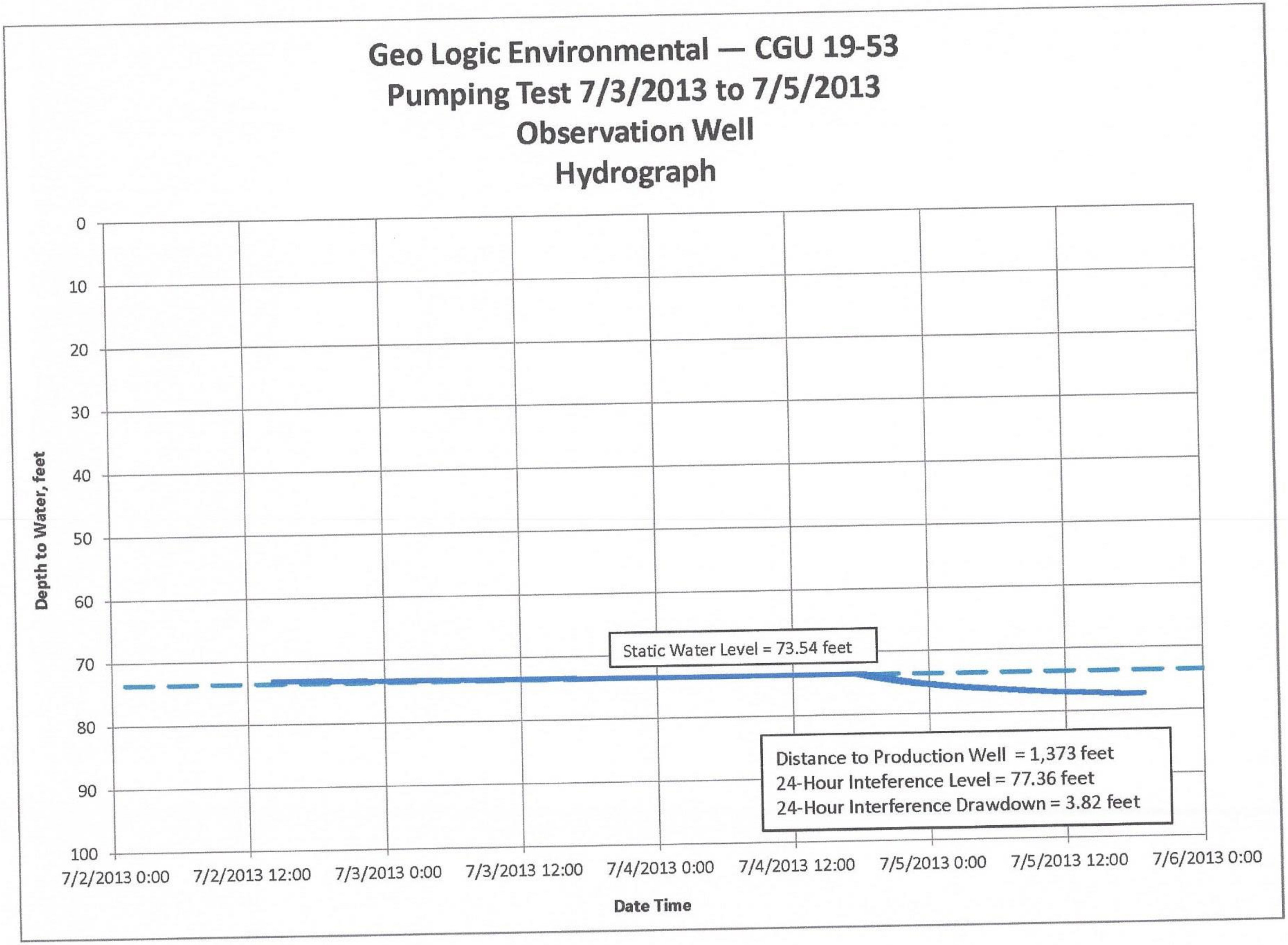

Geo Logic Environmental — CGU 19-04
Pumping Test 7/3/2013 to 7/5/2013
Observation Well
Hydrograph
Depth to Water, feet
0
10
20
30
40
50
60
70
80
90
100
Static Water Level = 71.87 feet
Distance to Production Well = 566 feet
24-Hour Inteference Level = 76.28 feet
24-Hour Interference Drawdown = 4.41 feet
7/2/2013 0:00
7/2/2013 12:00
7/3/2013 0:00
7/3/2013 12:00
7/4/2013 0:00
7/4/2013 12:00
7/5/2013 0:00
7/5/2013 12:00
7/6/2013 0:00
Date Time

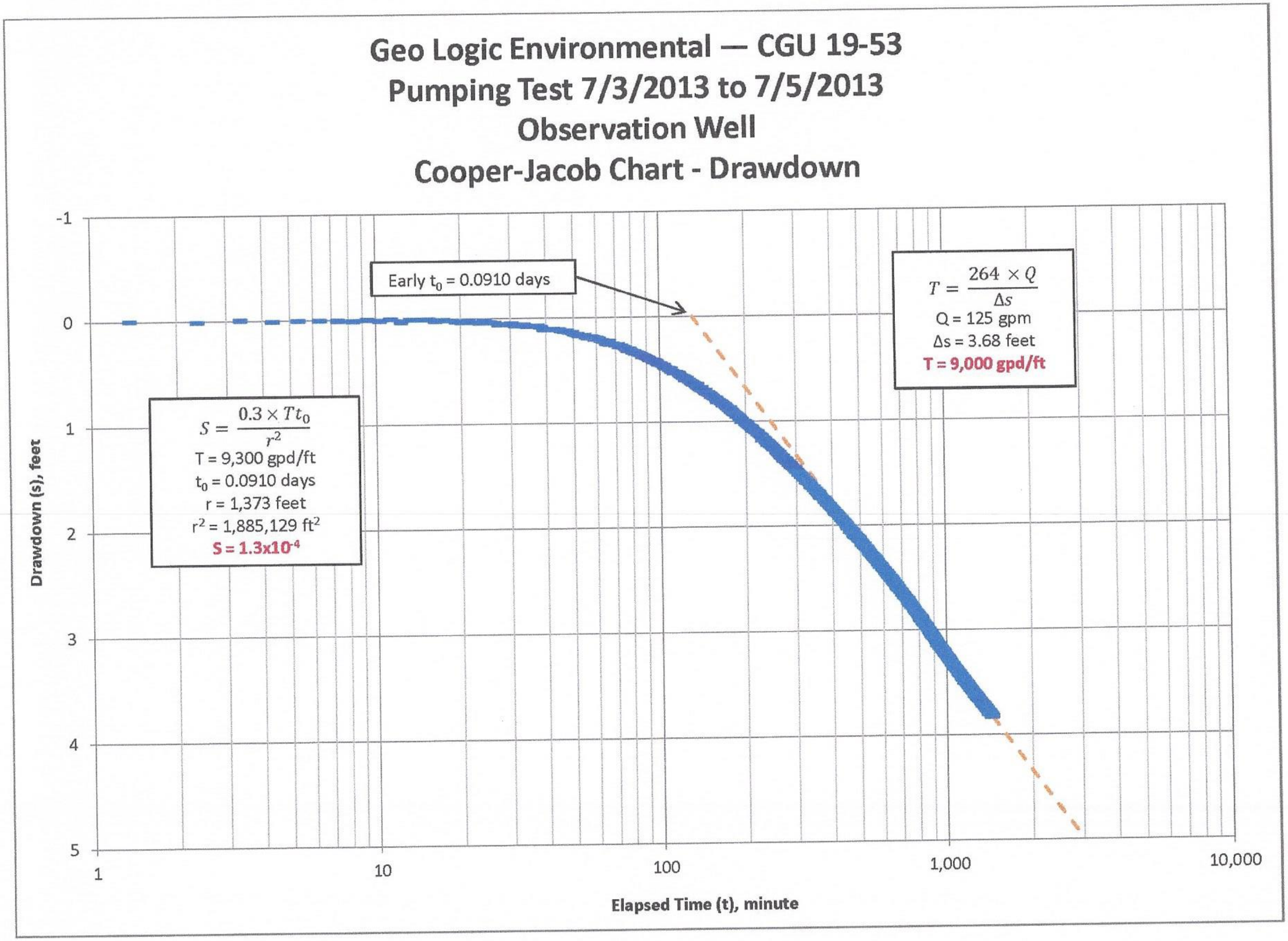


Geo Logic Environmental — CGU 19-04
Pumping Test 7/3/2013 to 7/5/2013
Observation Well
Cooper-Jacob Chart - Drawdown
Early t_0 = 0.069 days
$T = \frac{264 \times Q}{\Delta s}$
Q = 125 gpm
Δs = 3.80 feet
T = 8,700 gpd/ft
$S = \frac{0.3 \times T t_0}{r^2}$
T = 8,700 gpd/ft
t_0 = 0.069 days
r = 566 feet
r^2 = 320,356 ft^2
S = 5.6×10^{-4}
Drawdown (s), feet
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Elapsed Time (t), minute
1
10
100
1,000
10,000

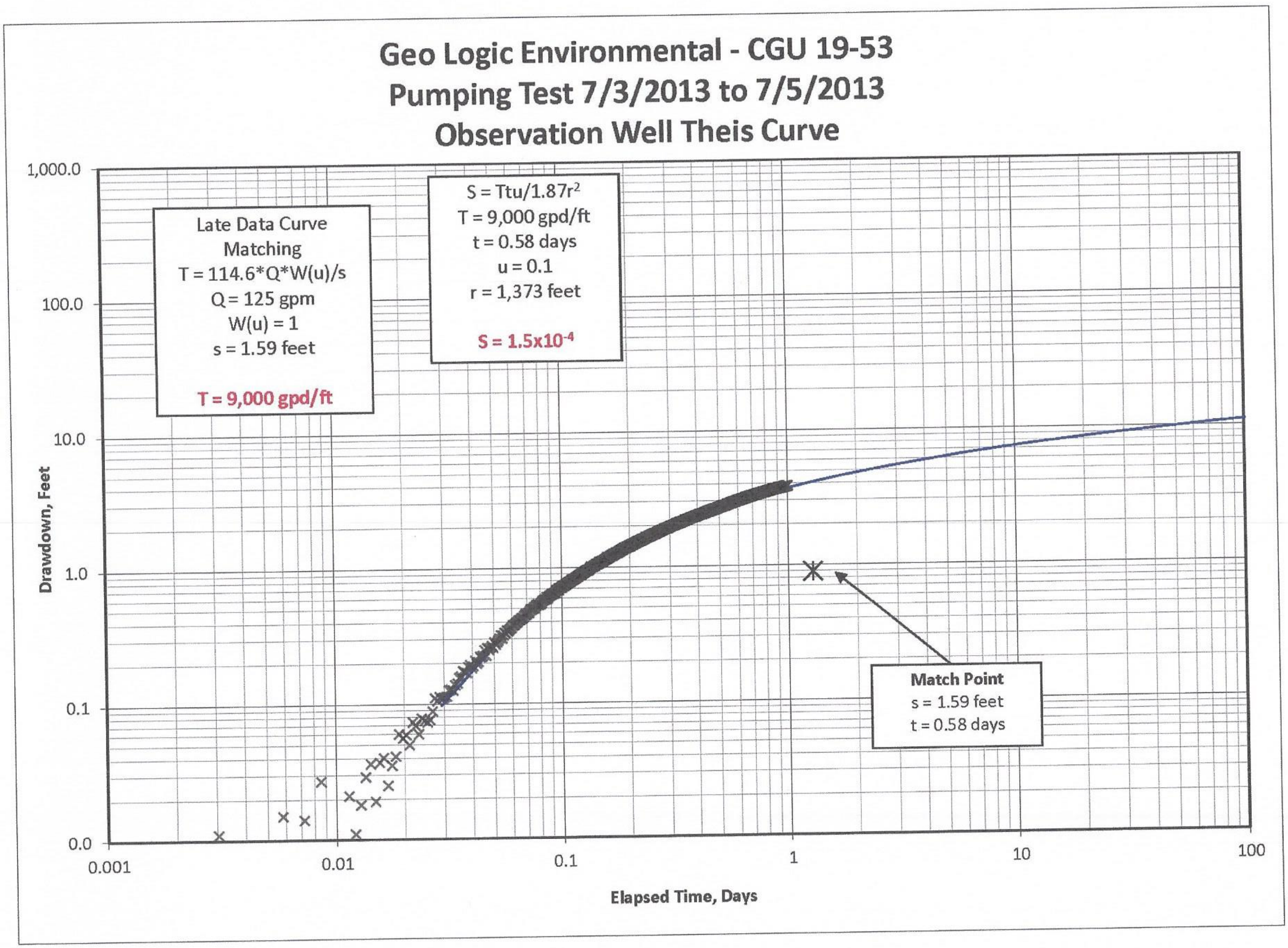


Geo Logic Environmental - CGU 19-04
Pumping Test 7/3/2013 to 7/5/2013
Observation Well Theis Curve
Late Data Curve
Matching
T = 114.6*Q*W(u)/s
Q = 125 gpm
W(u) = 1
s = 1.49 feet
T = 9,600 gpd/ft
S = Ttu/1.87r²
T = 10,000 gpd/ft
t = 0.249 days
u = 0.1
r = 566 feet
S = 4x10⁻⁴
Match Point
s = 1.49 feet
t = 0.249 days
1,000.0
100.0
10.0
1.0
0.1
0.0
Drawdown, Feet
0.001
0.01
0.1
1
10
100
Elapsed Time, Days

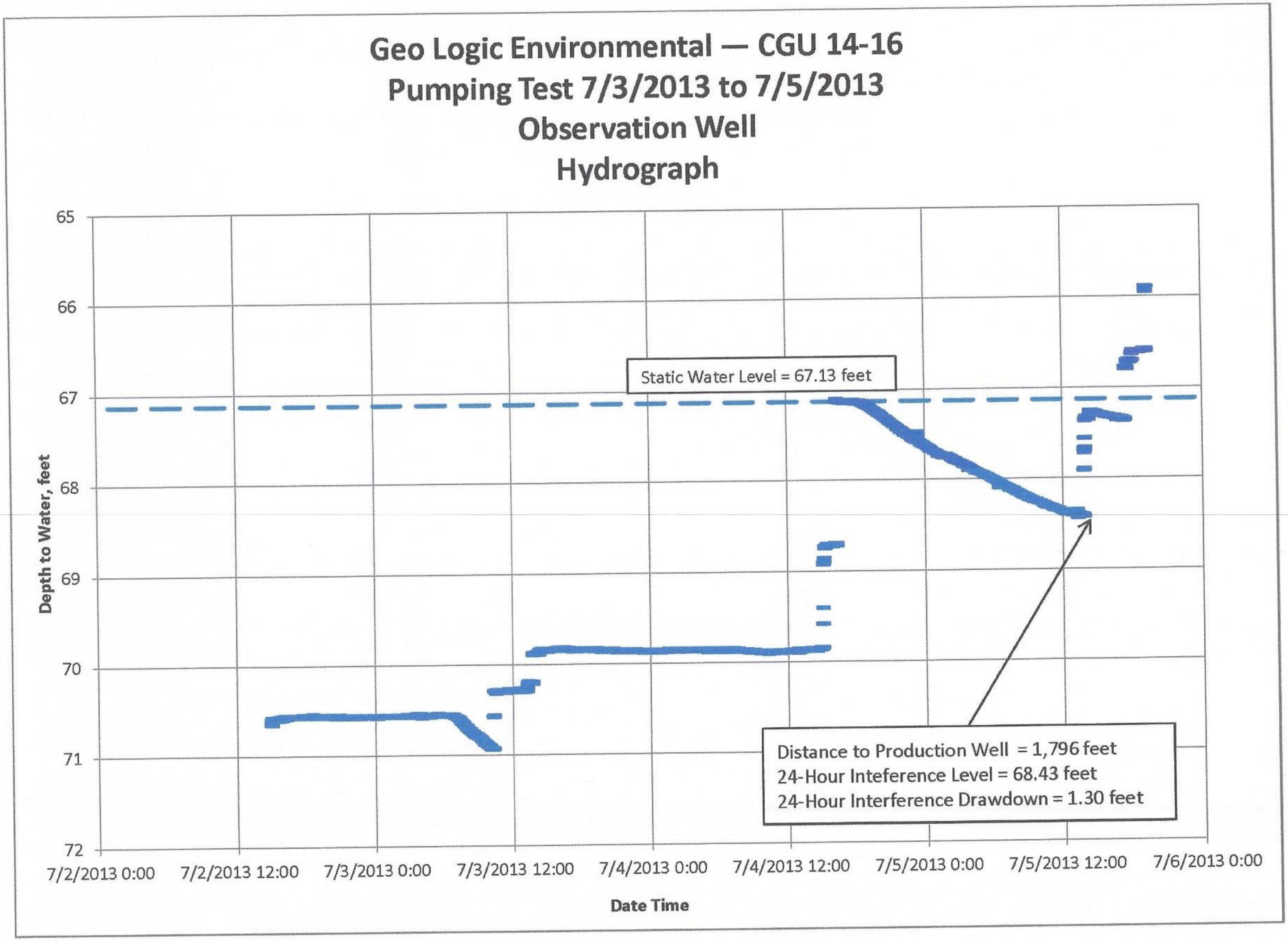

Geo Logic Environmental — CGU 19-53
Pumping Test 7/3/2013 to 7/5/2013
Observation Well
Hydrograph
Depth to Water, feet
0
10
20
30
40
50
60
70
80
90
100
Static Water Level = 73.54 feet
Distance to Production Well = 1,373 feet
24-Hour Inteference Level = 77.36 feet
24-Hour Interference Drawdown = 3.82 feet
7/2/2013 0:00
7/2/2013 12:00
7/3/2013 0:00
7/3/2013 12:00
7/4/2013 0:00
7/4/2013 12:00
7/5/2013 0:00
7/5/2013 12:00
7/6/2013 0:00
Date Time

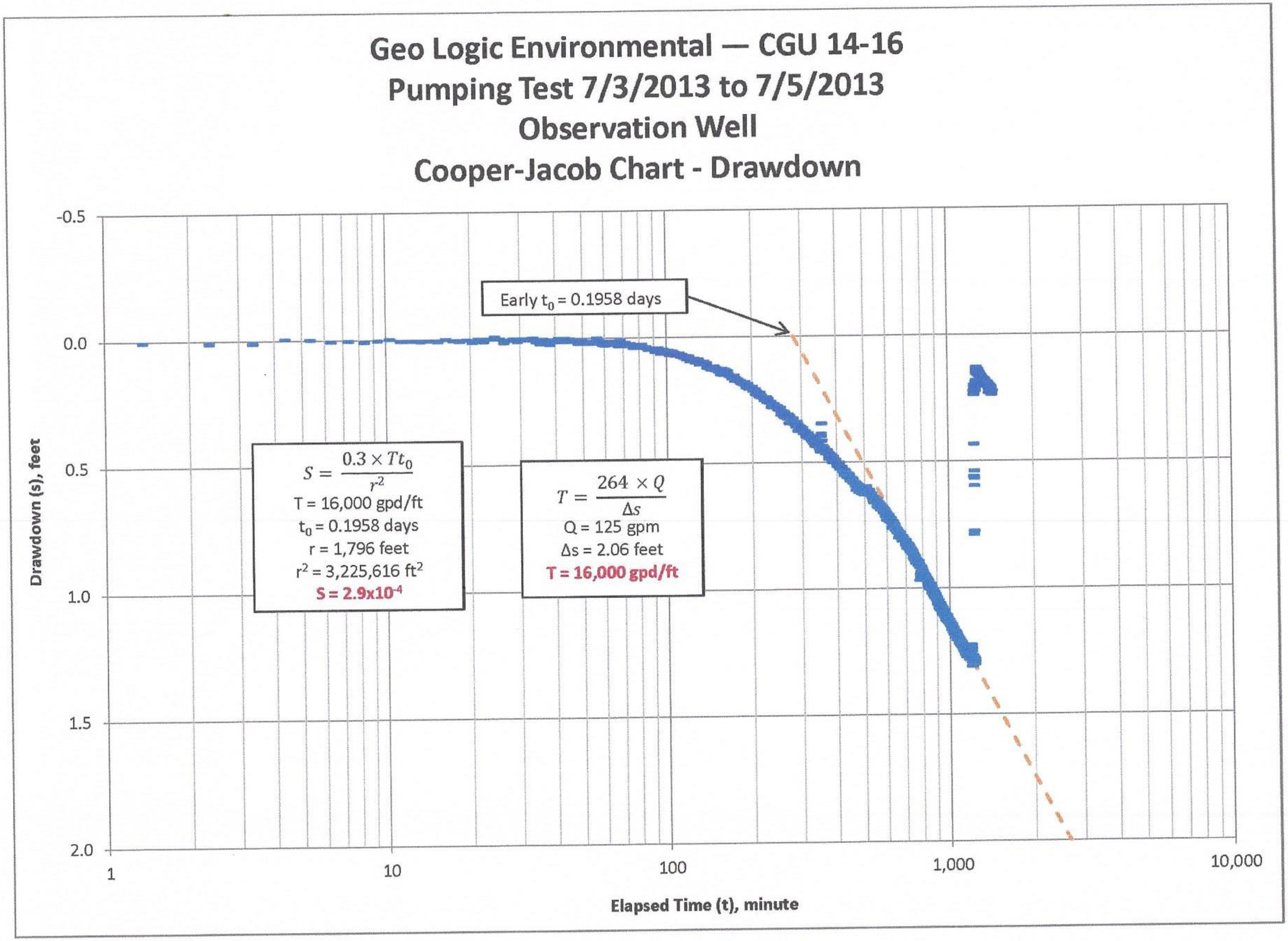


Geo Logic Environmental — CGU 19-53
Pumping Test 7/3/2013 to 7/5/2013
Observation Well
Cooper-Jacob Chart - Drawdown
Early t_0 = 0.0910 days
$T = \frac{264 \times Q}{\Delta s}$
Q = 125 gpm
Δs = 3.68 feet
T = 9,000 gpd/ft
$S = \frac{0.3 \times T t_0}{r^2}$
T = 9,300 gpd/ft
t_0 = 0.0910 days
r = 1,373 feet
r^2 = 1,885,129 ft^2
S = 1.3×10^{-4}
Drawdown (s), feet
-1
0
1
2
3
4
5
1
10
100
1,000
10,000
Elapsed Time (t), minute

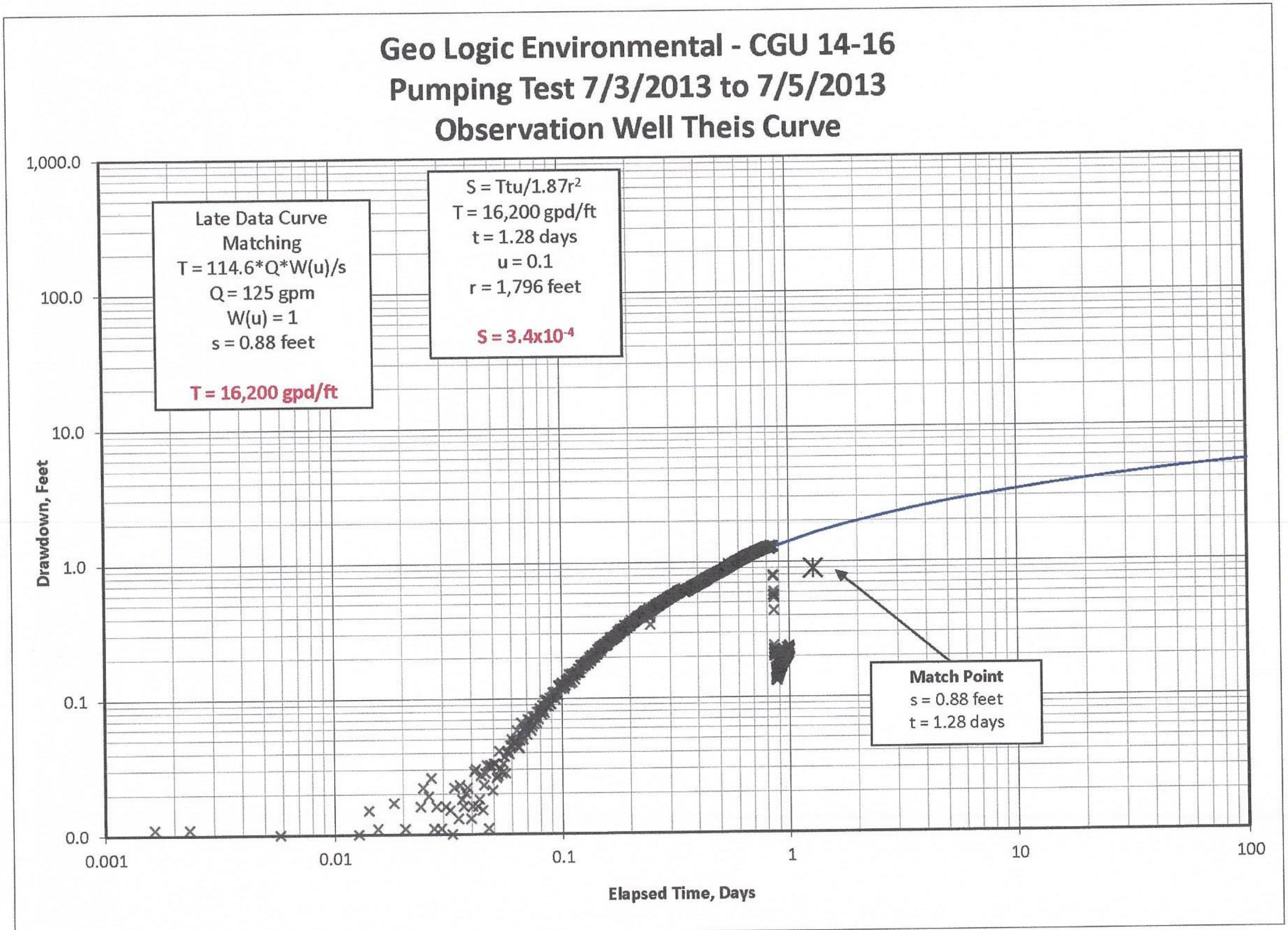


Geo Logic Environmental - CGU 19-53
Pumping Test 7/3/2013 to 7/5/2013
Observation Well Theis Curve
Late Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 125 gpm
W(u) = 1
s = 1.59 feet
T = 9,000 gpd/ft
S = Ttu/1.87r²
T = 9,000 gpd/ft
t = 0.58 days
u = 0.1
r = 1,373 feet
S = 1.5x10⁻⁴
Match Point
s = 1.59 feet
t = 0.58 days
Drawdown, Feet
1,000.0
100.0
10.0
1.0
0.1
0.0
0.001
0.01
0.1
1
10
100
Elapsed Time, Days


Geo Logic Environmental — CGU 14-16
Pumping Test 7/3/2013 to 7/5/2013
Observation Well
Hydrograph
Depth to Water, feet
65
66
67
68
69
70
71
72
Static Water Level = 67.13 feet
Distance to Production Well = 1,796 feet
24-Hour Inteference Level = 68.43 feet
24-Hour Interference Drawdown = 1.30 feet
7/2/2013 0:00
7/2/2013 12:00
7/3/2013 0:00
7/3/2013 12:00
7/4/2013 0:00
7/4/2013 12:00
7/5/2013 0:00
7/5/2013 12:00
7/6/2013 0:00
Date Time

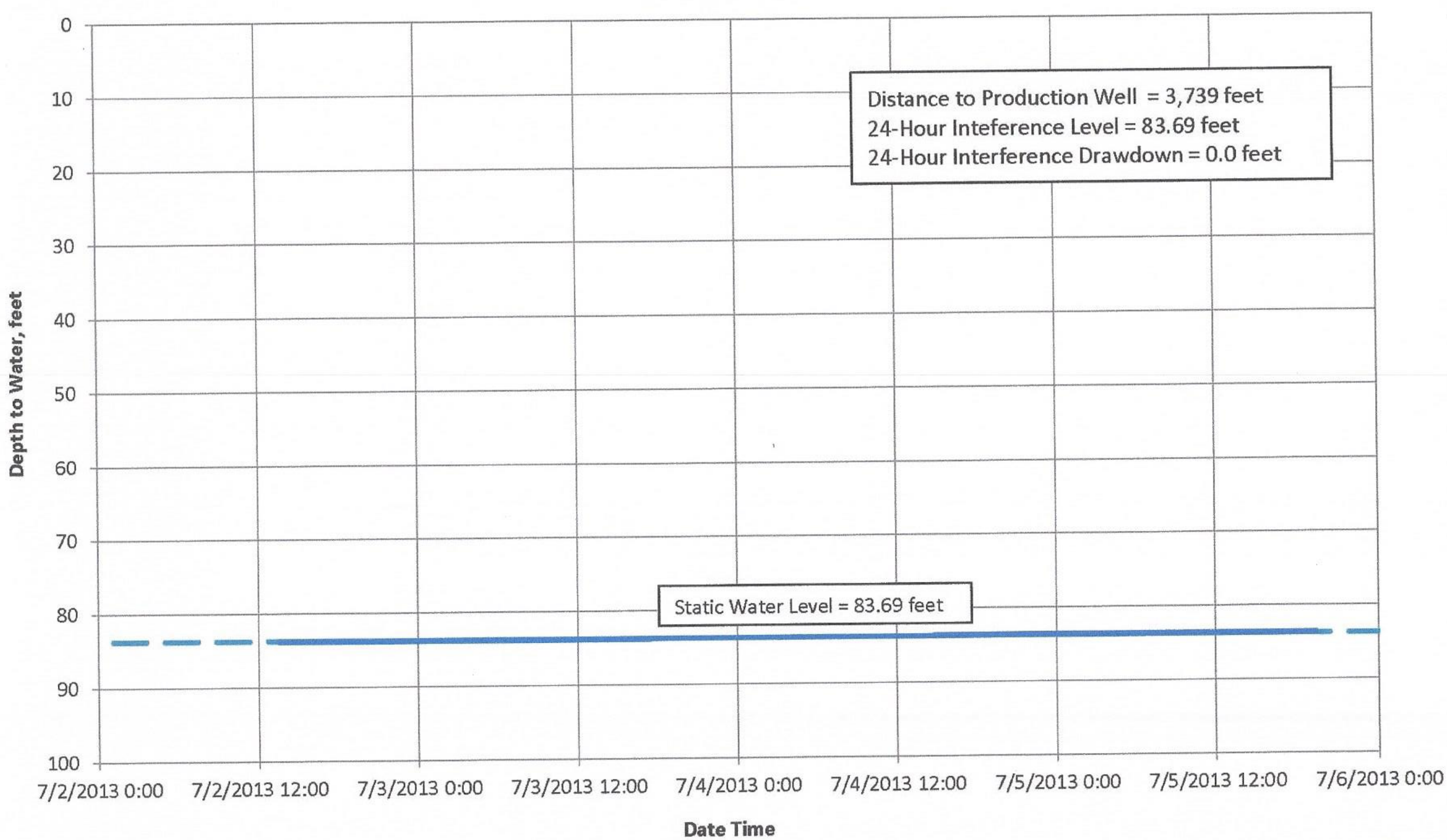


Geo Logic Environmental — CGU 14-16
Pumping Test 7/3/2013 to 7/5/2013
Observation Well
Cooper-Jacob Chart - Drawdown
Early t_0 = 0.1958 days
$S = \frac{0.3 \times Tt_0}{r^2}$
T = 16,000 gpd/ft
t_0 = 0.1958 days
r = 1,796 feet
r^2 = 3,225,616 ft^2
S = 2.9x10^{-4}
$T = \frac{264 \times Q}{\Delta s}$
Q = 125 gpm
Δs = 2.06 feet
T = 16,000 gpd/ft
Drawdown (s), feet
-0.5
0.0
0.5
1.0
1.5
2.0
1
10
100
1,000
10,000
Elapsed Time (t), minute

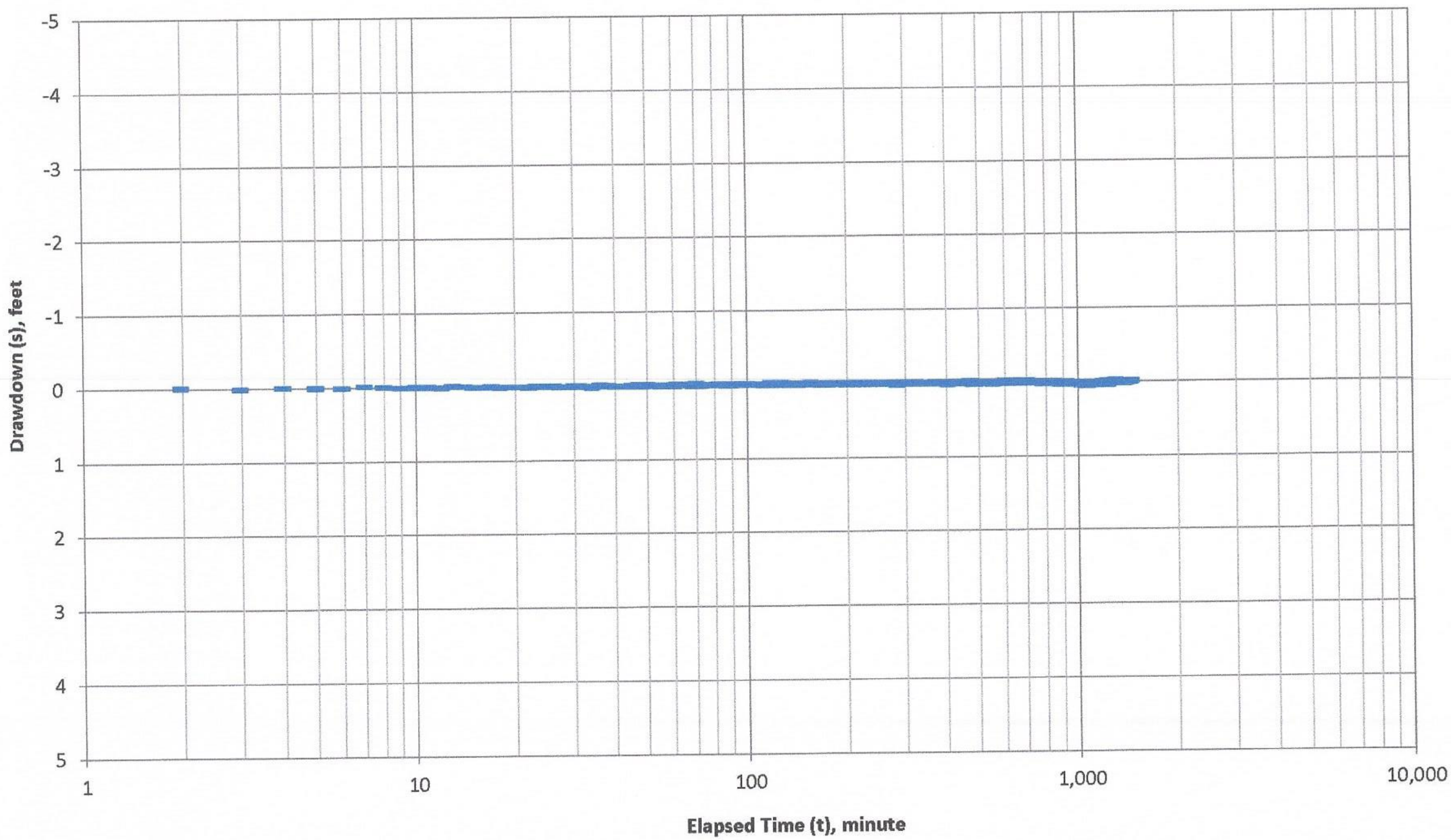


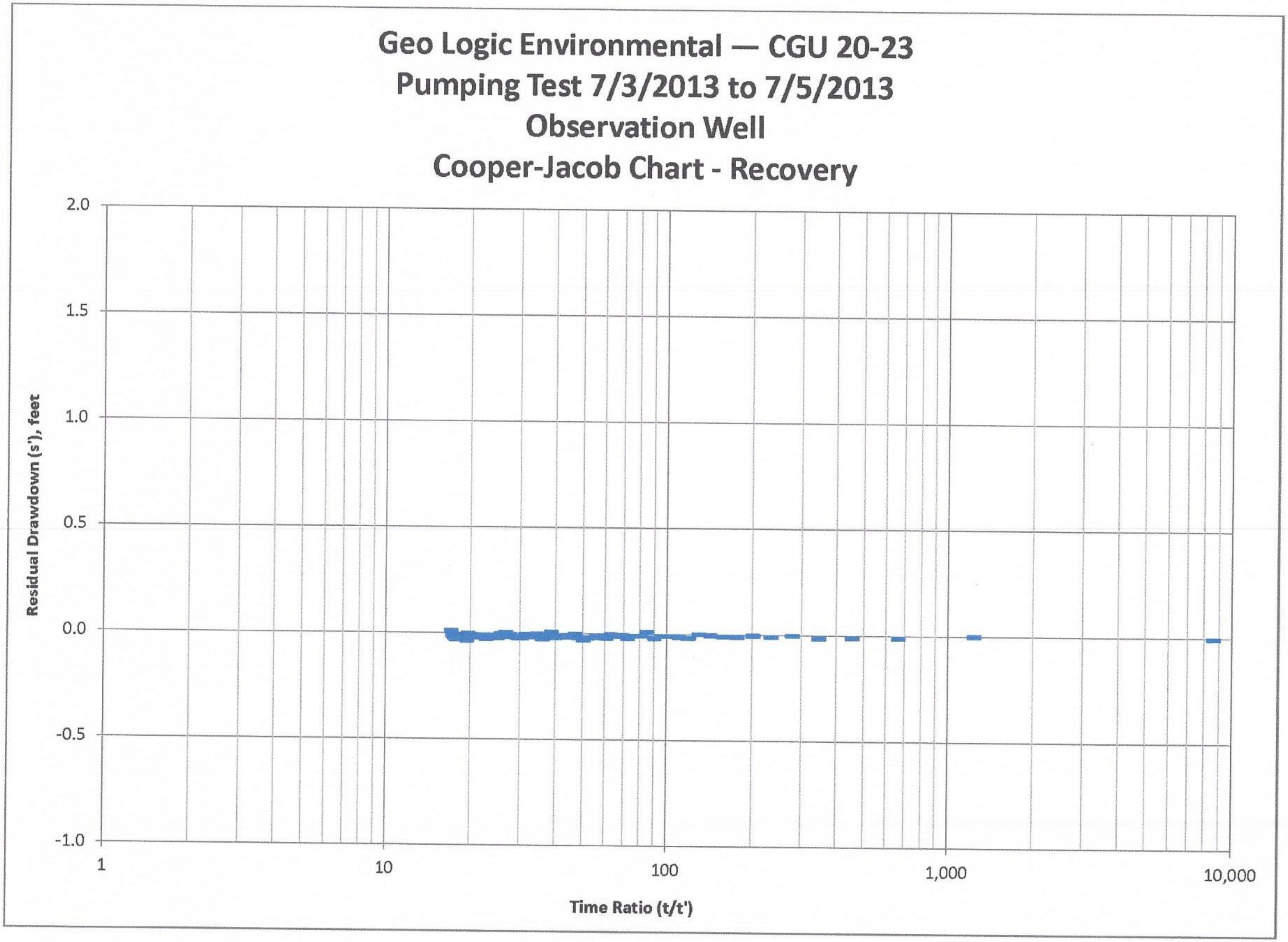
Geo Logic Environmental - CGU 14-16
Pumping Test 7/3/2013 to 7/5/2013
Observation Well Theis Curve
Late Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 125 gpm
W(u) = 1
s = 0.88 feet
T = 16,200 gpd/ft
S = Ttu/1.87r²
T = 16,200 gpd/ft
t = 1.28 days
u = 0.1
r = 1,796 feet
S = 3.4x10⁻⁴
Match Point
s = 0.88 feet
t = 1.28 days
Drawdown, Feet
1,000.0
100.0
10.0
1.0
0.1
0.0
0.001
0.01
0.1
1
10
100
Elapsed Time, Days

Geo Logic Environmental — CGU 20-23
Pumping Test 7/3/2013 to 7/5/2013
Observation Well
Hydrograph

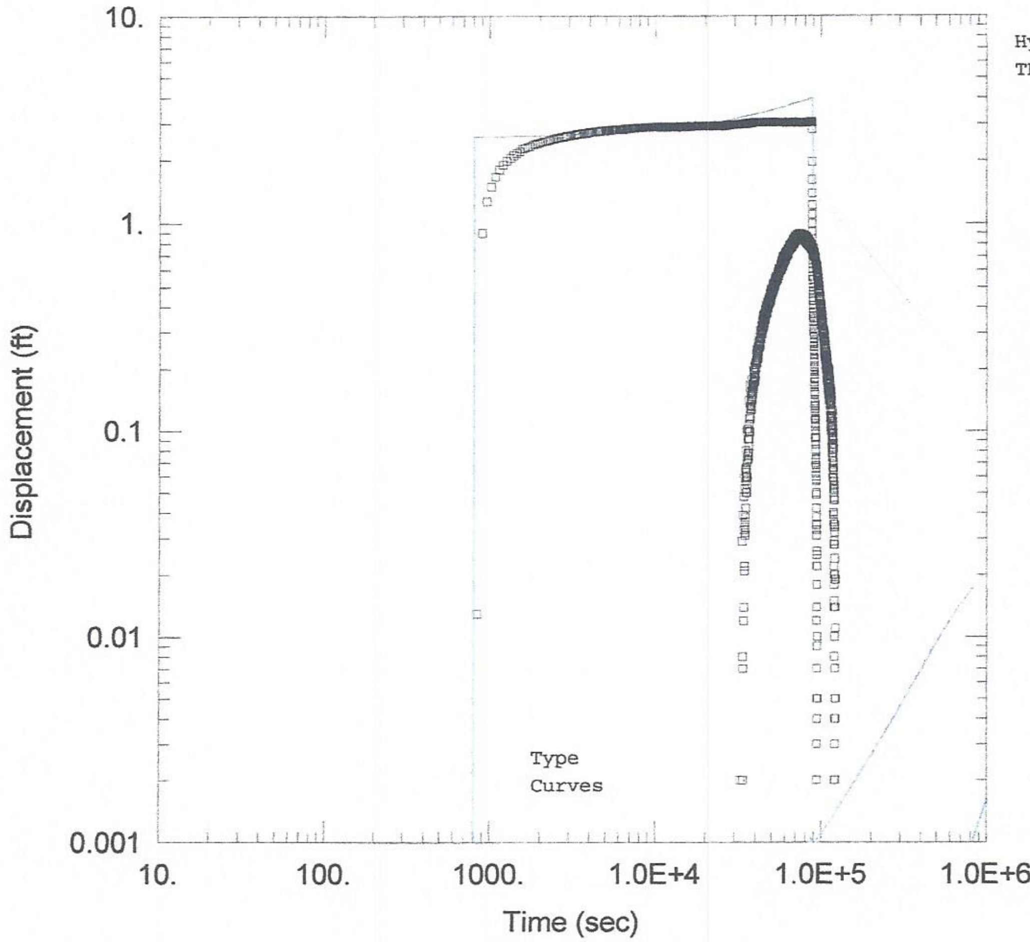


Geo Logic Environmental — CGU 20-23
Pumping Test 7/3/2013 to 7/5/2013
Observation Well
Cooper-Jacob Chart - Drawdown




Geo Logic Environmental — CGU 20-23
Pumping Test 7/3/2013 to 7/5/2013
Observation Well
Cooper-Jacob Chart - Recovery
Residual Drawdown (s'), feet
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
1
10
100
1,000
10,000
Time Ratio (t/t')

Combined Water Level Data From All Monitor Wells
Partially-penetrating, Unconfined Aquifer



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STATE OF TEXAS
1-28-14 MAF
MARTIN A. FORD
GEOLOGY
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PROFESSIONAL GEOSCIENTIST
Mart Ford

WELL TEST ANALYSIS

Data Set: Z:\...\partial penetrate unconfined.aqt
Date: 01/24/14 Time: 10:45:08

AQUIFER DATA

Saturated Thickness: 210. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Tiller FP3	0	0
Tiller FP2	671.17	429.83

Observation Wells

Well Name	X (ft)	Y (ft)
CGU 3-3	14.74	-25.87
CGU 13-53HH	1268.95	1235.74
CGU 3-10	-375.37	-1545.78

SOLUTION

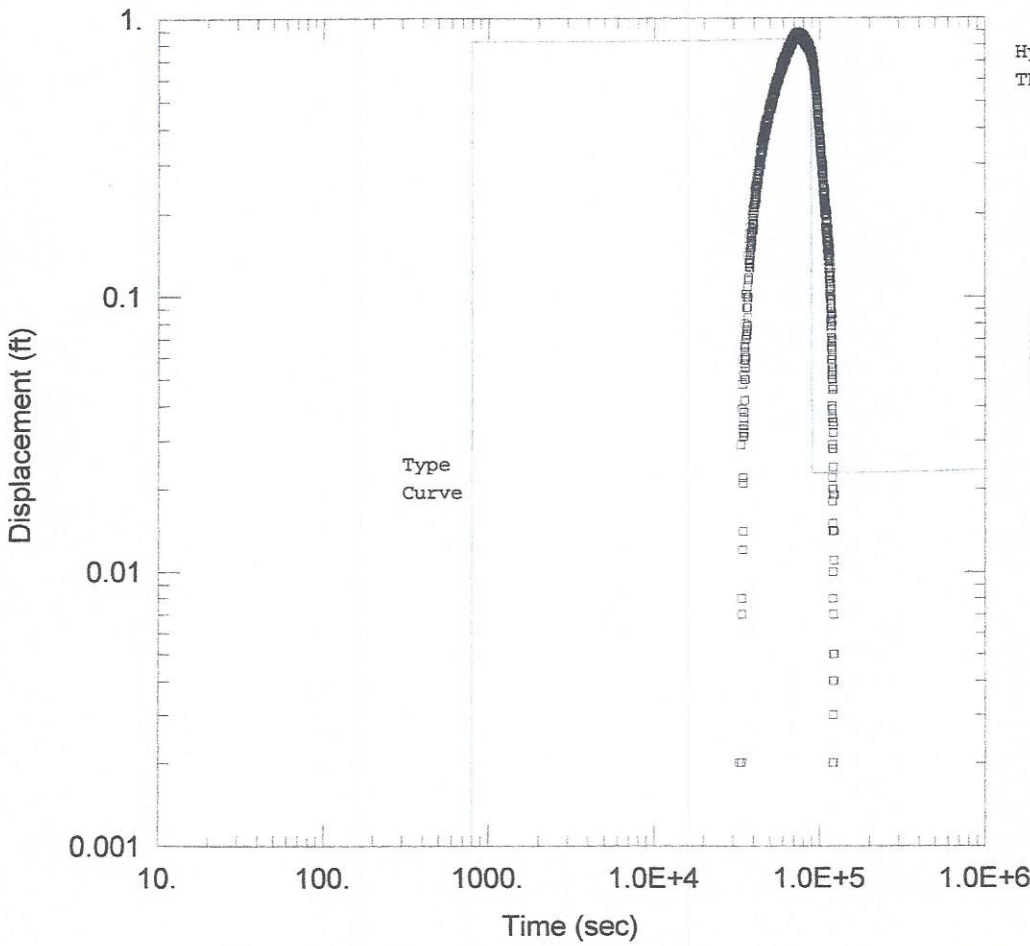
Aquifer Model: Unconfined

Solution Method: Neuman

T = 8523.9 gal/day/ft
Sy = 0.1

S = 2.507E-7
Kz/Kr = 1.492

Water Level Data From CGU 13-53HH Only
Partially-penetrating, Unconfined Aquifer



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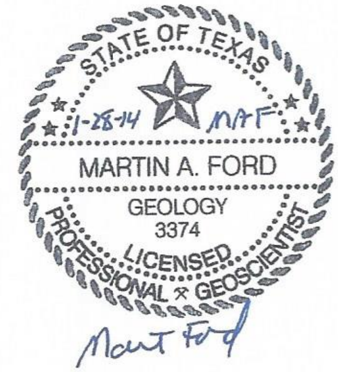


WELL TEST ANALYSIS

Data Set: Z:\...\13_53_only_unconfined.aqt
Date: 01/24/14 Time: 10:10:56

AQUIFER DATA

Saturated Thickness: 210. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Tiller FP3	0	0
Tiller FP2	671.17	429.83

Observation Wells

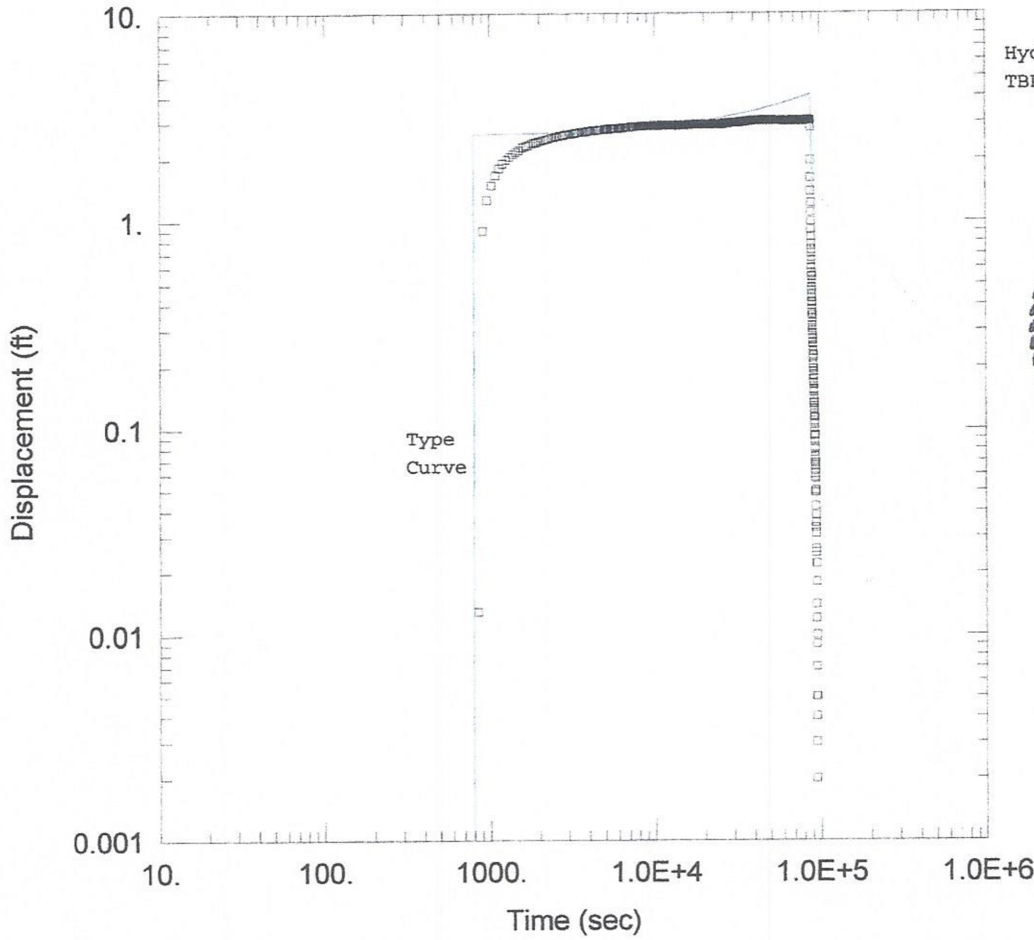
Well Name	X (ft)	Y (ft)
□ CGU 13-53HH	1268.95	1235.74

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 2274. gal/day/ft
S = 1.183E-8
Sy = 0.1
ß = 7.

Water Level Data From CGU 3-3 Only
Partially-penetrating, Unconfined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\3_3_only_unconfined.aqt
Date: 01/24/14 Time: 09:59:46

AQUIFER DATA

Saturated Thickness: 210. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Tiller FP3	0	0
Tiller FP2	671.17	429.83

Observation Wells

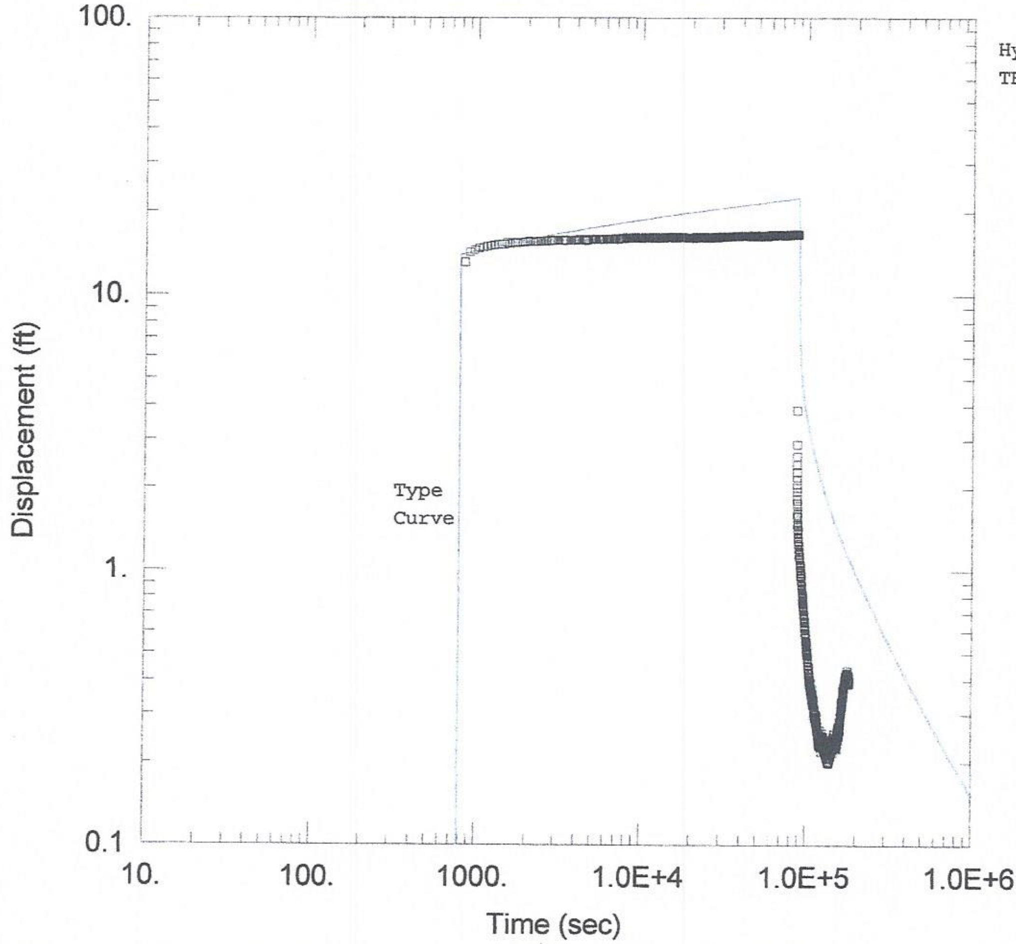
Well Name	X (ft)	Y (ft)
□ CGU 3-3	14.74	-25.87

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 8355. gal/day/ft
S = 2.28E-7
Sy = 0.1
ß = 0.03

Pumping And Recovery Data From Tiller FP#3
Partially-penetrating, Unconfined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\fp3_unconfined.aqt
Date: 01/24/14 Time: 09:44:04

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1302
Location: Panola County
Test Well: Tiller FP3
Test Date: 01/09/14

AQUIFER DATA

Saturated Thickness: 210. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Tiller FP3	0	0

Observation Wells

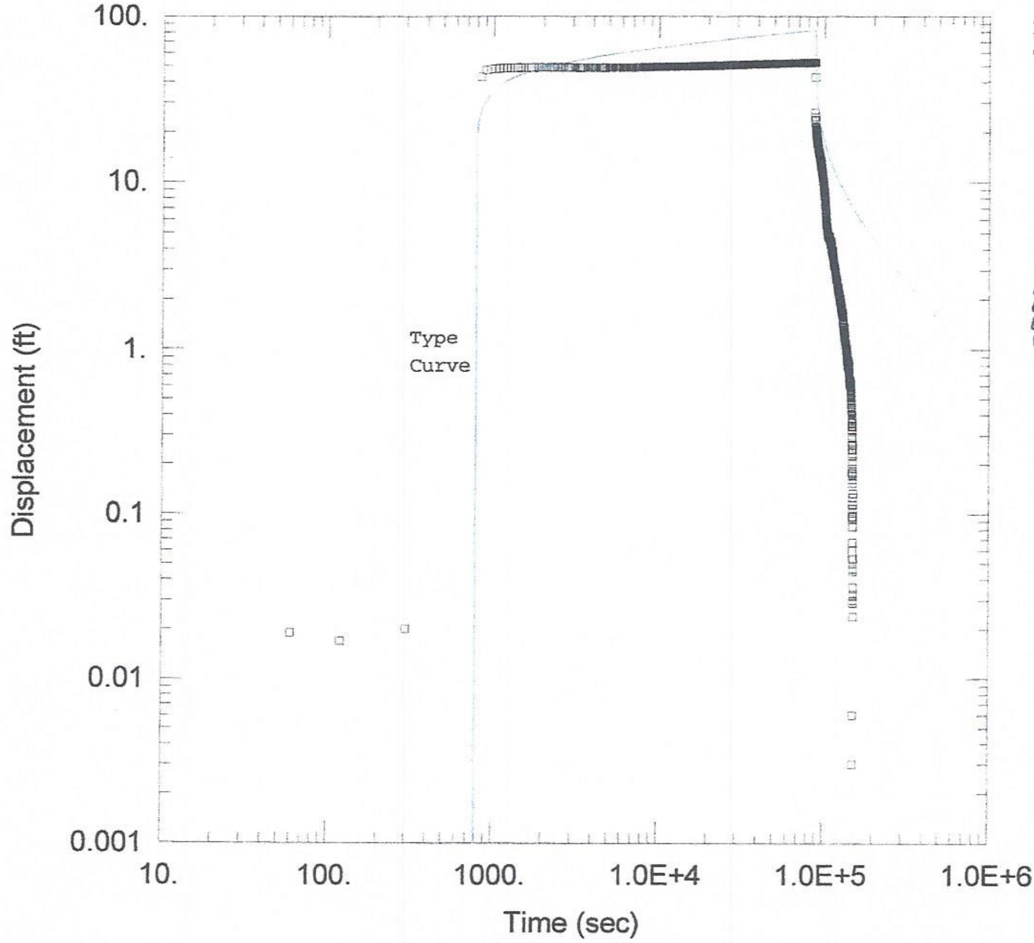
Well Name	X (ft)	Y (ft)
□ Tiller FP3	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 7231.2 gal/day/ft
Sy = 0.1
S = 5.969E-25
ß = 0.001

Pumping And Recovery Data From Tiller FP#2
Partially-penetrating, Unconfined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\fp2_unconfined.aqt
Date: 01/24/14 Time: 09:20:53

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1302
Location: Panola County
Test Well: Tiller FP2
Test Date: 01/09/14

AQUIFER DATA

Saturated Thickness: 210. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
FP2	0	0

Observation Wells

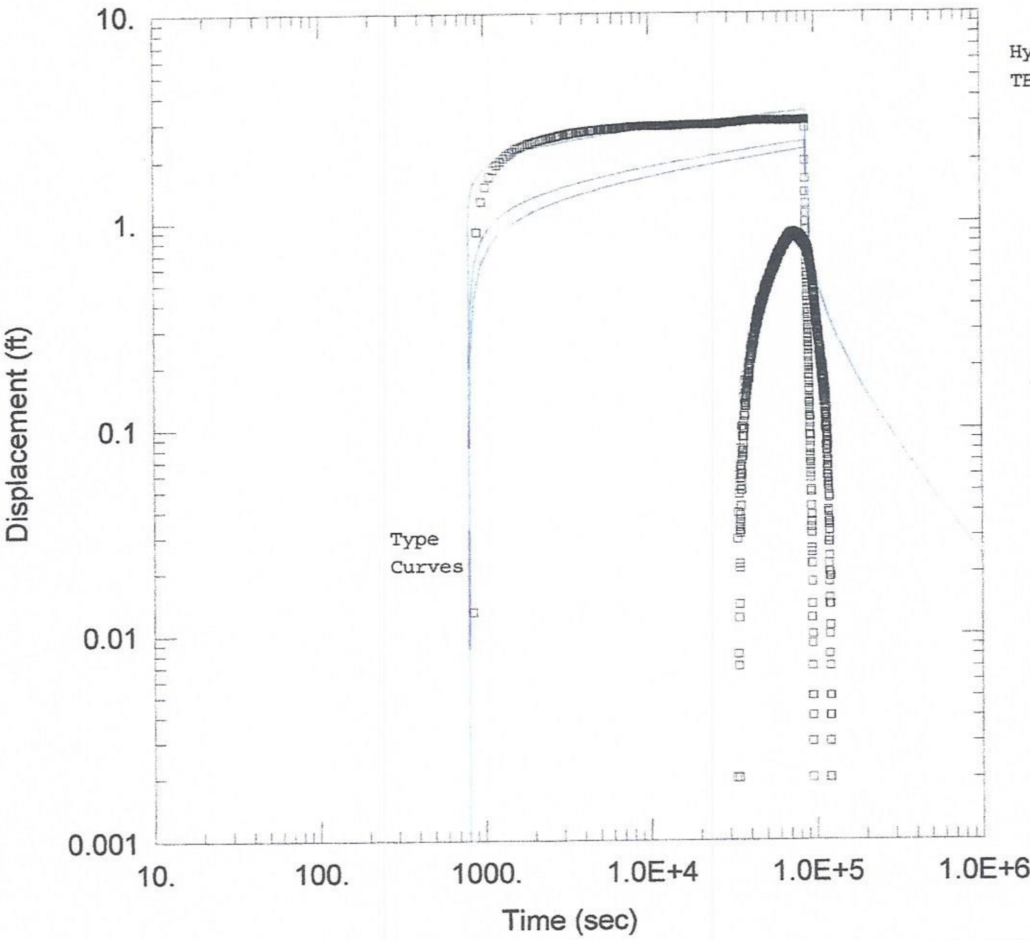
Well Name	X (ft)	Y (ft)
FP2	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 1712.1 gal/day/ft
S = 5.073E-18
Sy = 0.1
ß = 0.1

Combined Water Level Data From All Monitor Wells
Partially-penetrating, Confined Aquifer



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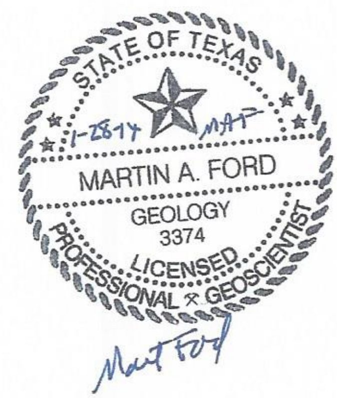


WELL TEST ANALYSIS

Data Set: Z:\...\tiller pump test_partial penetrate.aqt
Date: 01/24/14 Time: 10:33:30

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1302
Location: Panola County
Test Well: Tiller FP3
Test Date: 01/09/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Tiller FP3	0	0
Tiller FP2	671.17	429.83

Observation Wells

Well Name	X (ft)	Y (ft)
□ CGU 3-3	14.74	-25.87
□ CGU 13-53HH	1268.95	1235.74
□ CGU 3-10	-375.37	-1545.78

SOLUTION

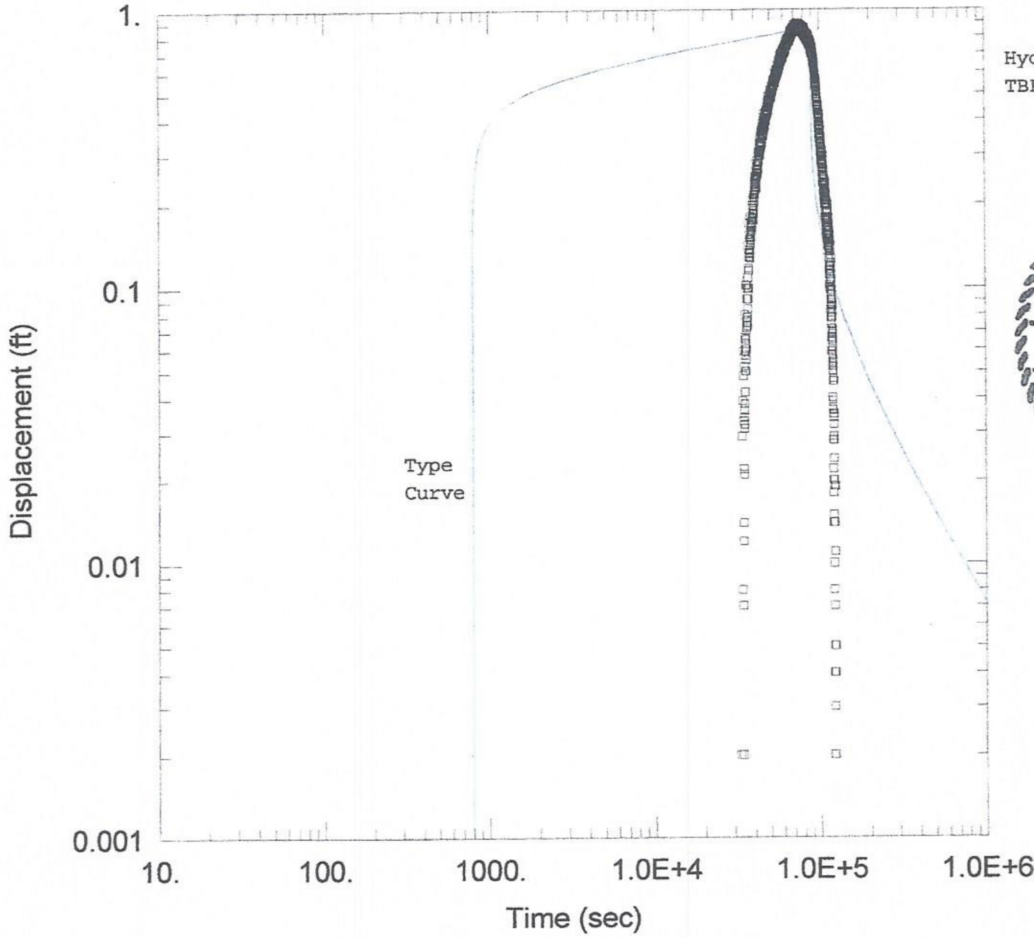
Aquifer Model: Confined

Solution Method: Theis

T = 9.806E+4 gal/day/ft
Kz/Kr = 1.

S = 1.467E-6
b = 210. ft

Water level Data From CGU 13-53HH Only
Partially-penetrating, Confined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\13_53_only.aqt
Date: 01/24/14 Time: 10:04:54

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1302
Location: Panola County
Test Well: Tiller FP3
Test Date: 01/09/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Tiller FP3	0	0
Tiller FP2	671.17	429.83

Observation Wells

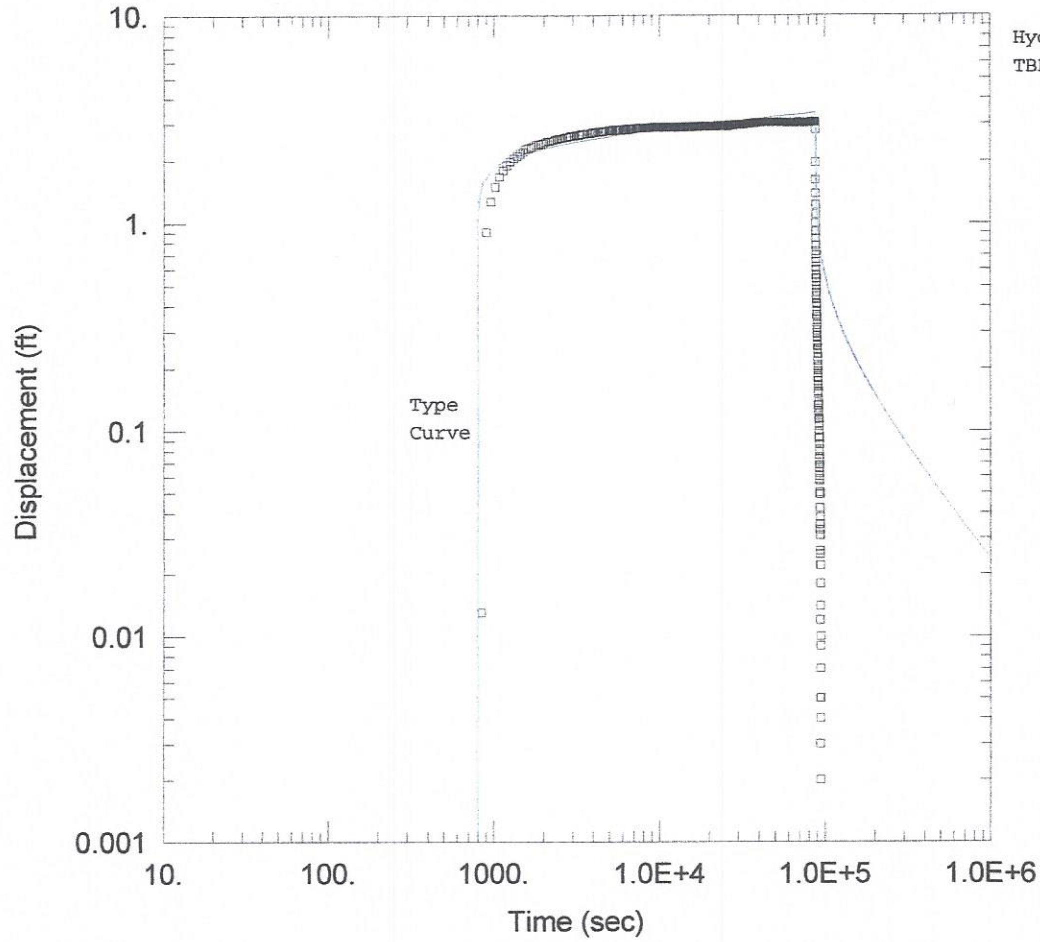
Well Name	X (ft)	Y (ft)
□ CGU 13-53HH	1268.95	1235.74

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 3.277E+5 gal/day/ft
S = 9.589E-7
Kz/Kr = 1.
b = 210. ft

Water Level Data From CGU 3-3 Only
Partially-penetrating, Confined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\3_3_only.aqt
Date: 01/24/14 Time: 09:50:57

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1302
Location: Panola County
Test Well: Tiller FP3
Test Date: 01/09/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Tiller FP3	0	0
Tiller FP2	671.17	429.83

Observation Wells

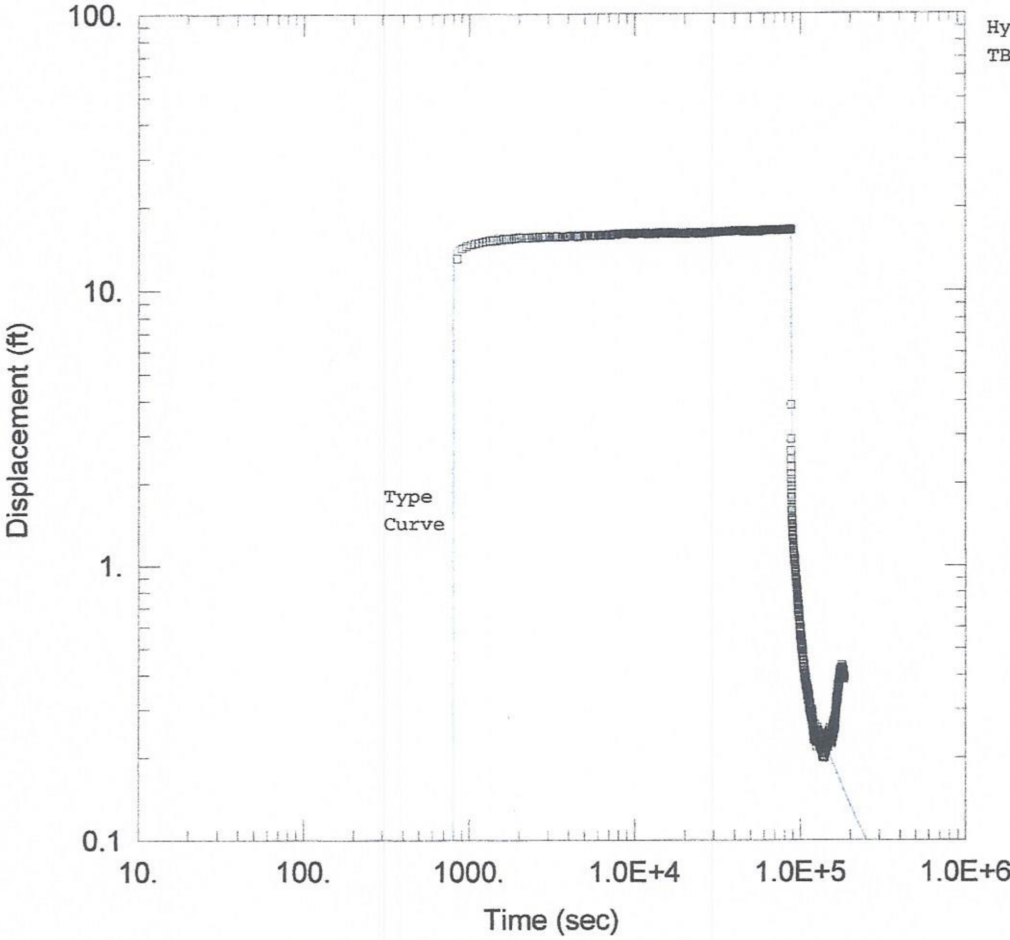
Well Name	X (ft)	Y (ft)
□ CGU 3-3	14.74	-25.87

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 9.806E+4 gal/day/ft
Kz/Kr = 1.
S = 1.467E-6
b = 210. ft

Pumping And Recovery Data From Tiller FP#3
Partially-penetrating, Confined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\fp3.aqt
Date: 01/24/14 Time: 09:37:54

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1302
Location: Panola County
Test Well: Tiller FP3
Test Date: 01/09/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Tiller FP3	0	0

Observation Wells

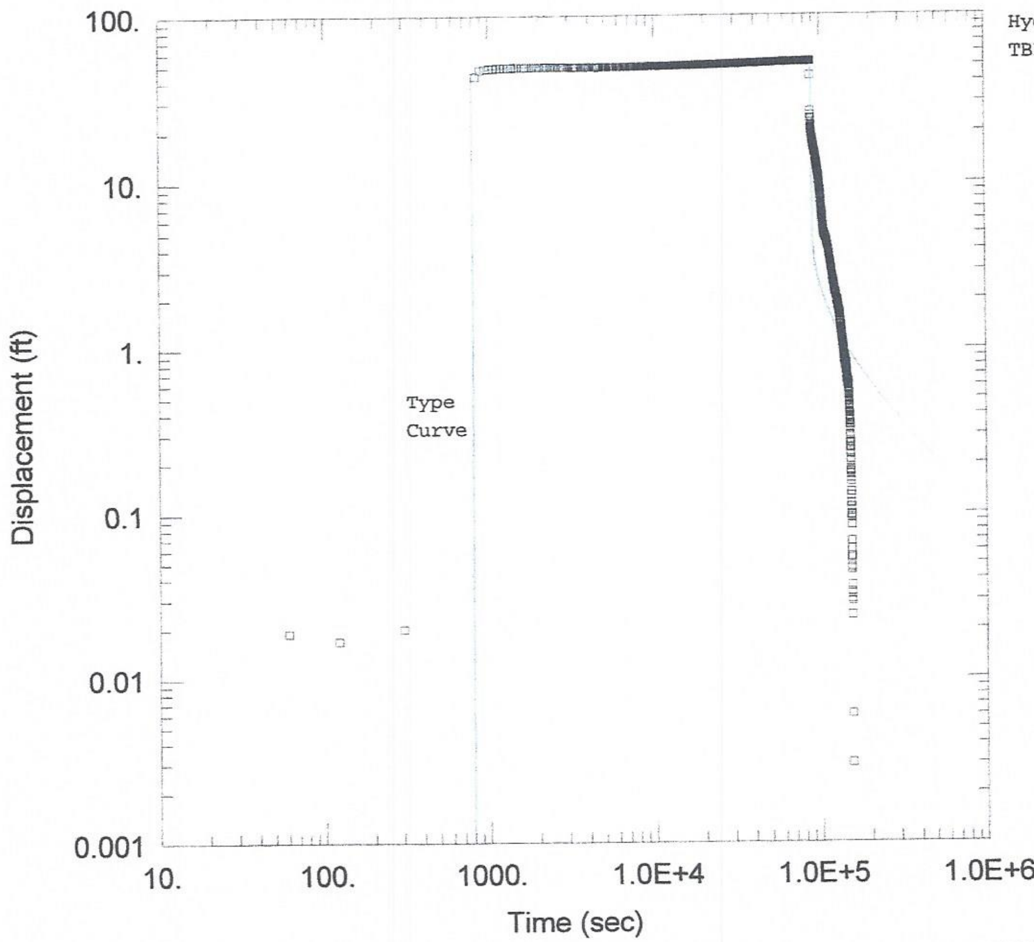
Well Name	X (ft)	Y (ft)
□ Tiller FP3	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 5.171E+4 gal/day/ft
Kz/Kr = 1.
S = 5.215E-24
b = 210. ft

Pumping And Recovery Data From Tiller FP#2
Partially-penetrating, Confined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\fp2.aqt
Date: 01/24/14 Time: 09:33:00

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1302
Location: Panola County
Test Well: Tiller FP2
Test Date: 01/09/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
FP2	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ FP2	0	0

SOLUTION

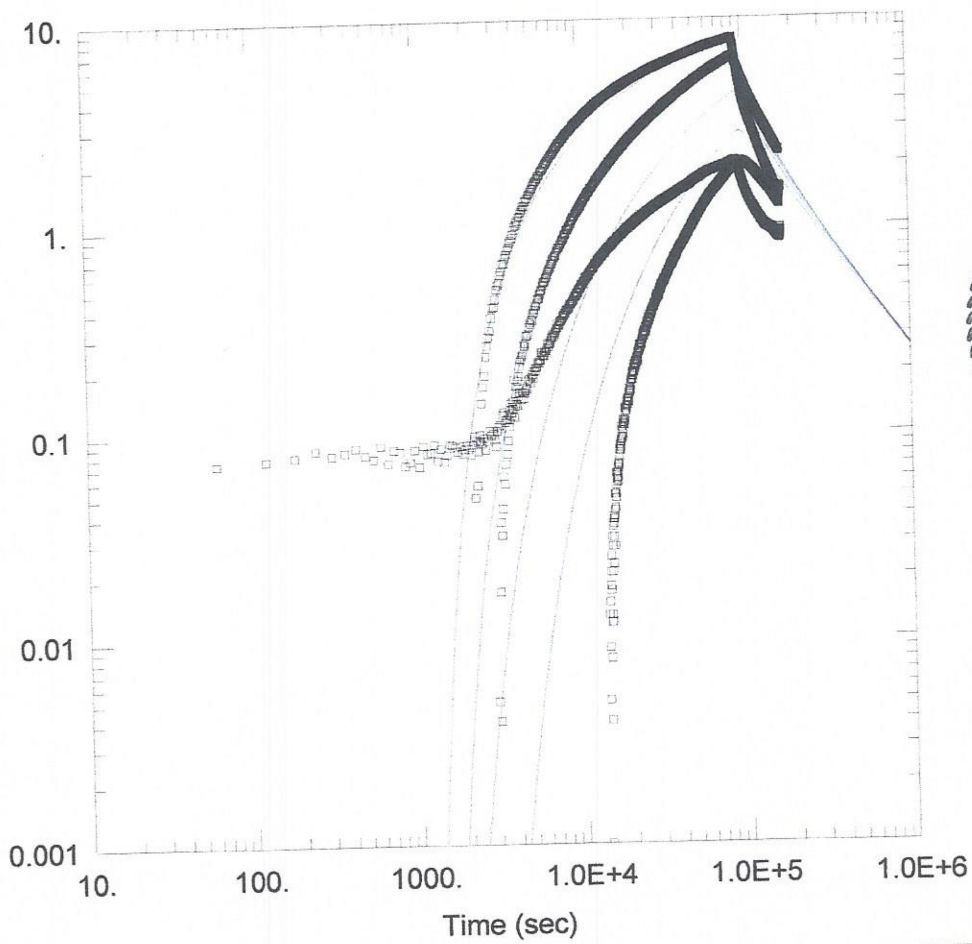
Aquifer Model: Confined

Solution Method: Theis

T = 1.268E+4 gal/day/ft
Kz/Kr = 1.

S = 3.075E-17
b = 210. ft

Combined Water Level Data From All Monitor Wells



WELL TEST ANALYSIS

Data Set: Z:\...\Anadarko Pump Test_1.aqt
Date: 12/13/13 Time: 09:58:21

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1301
Location: Panola County
Test Well: Mills FP1
Test Date: 11/19/13

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Mills FP #2	0	0
Mills FP #1	-65	-1042

Observation Wells

Well Name	X (ft)	Y (ft)
□ CGU 12-10	-728	-404
□ CGU 11-51HH	1233	-1978
□ CGU 12-5	1125	-1
□ CGU 12-52HH	993	2070

SOLUTION

Aquifer Model: Confined

Solution Method: Theis

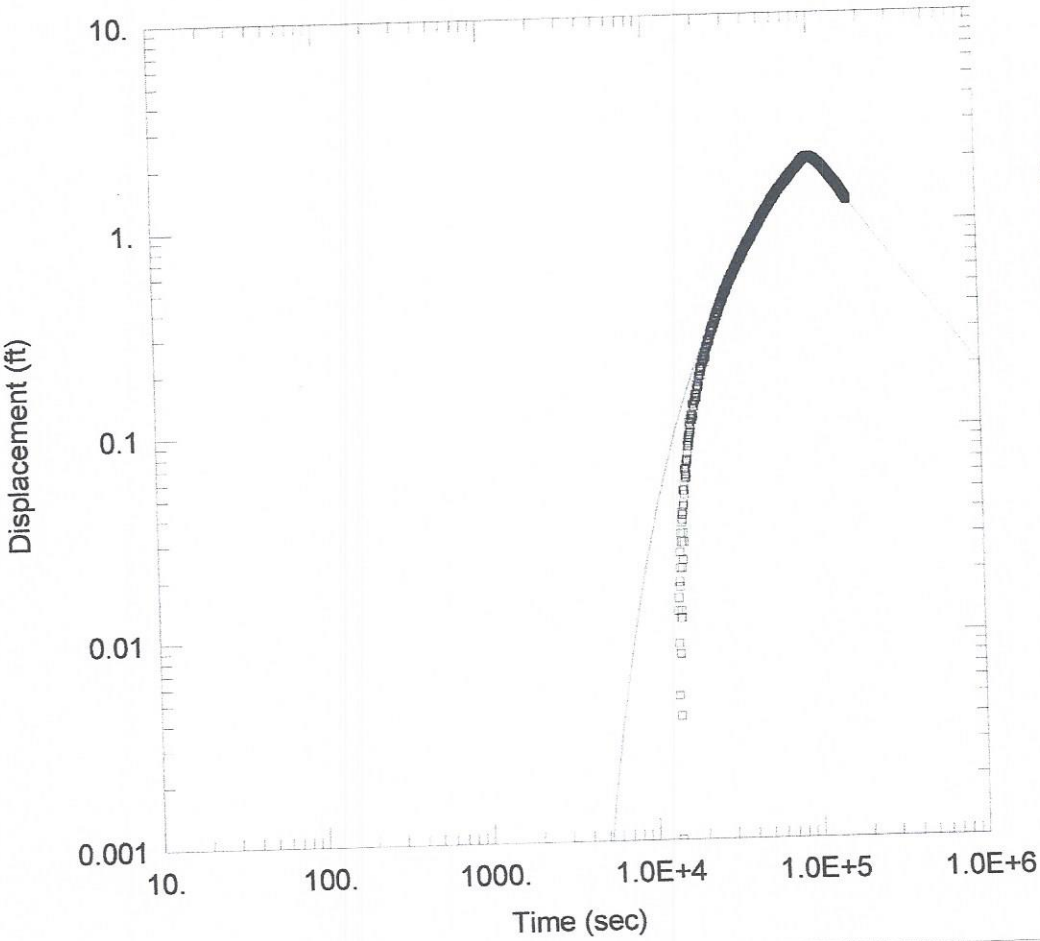
T = 1.598E+4 gal/day/ft

S = 0.0003361

Kz/Kr = 1.

b = 100. ft

Water Level Data From CGU 12-52HH Only



WELL TEST ANALYSIS

Data Set: Z:\...\CGU 12_52HH.aqt
Date: 12/13/13
Time: 10:01:45

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1301
Location: Panola County
Test Well: Mills FP1
Test Date: 11/19/13

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Mills FP #2	0	0
Mills FP #1	-65	-1042

Observation Wells

Well Name	X (ft)	Y (ft)
▫ CGU 12-52HH	993	2070

SOLUTION

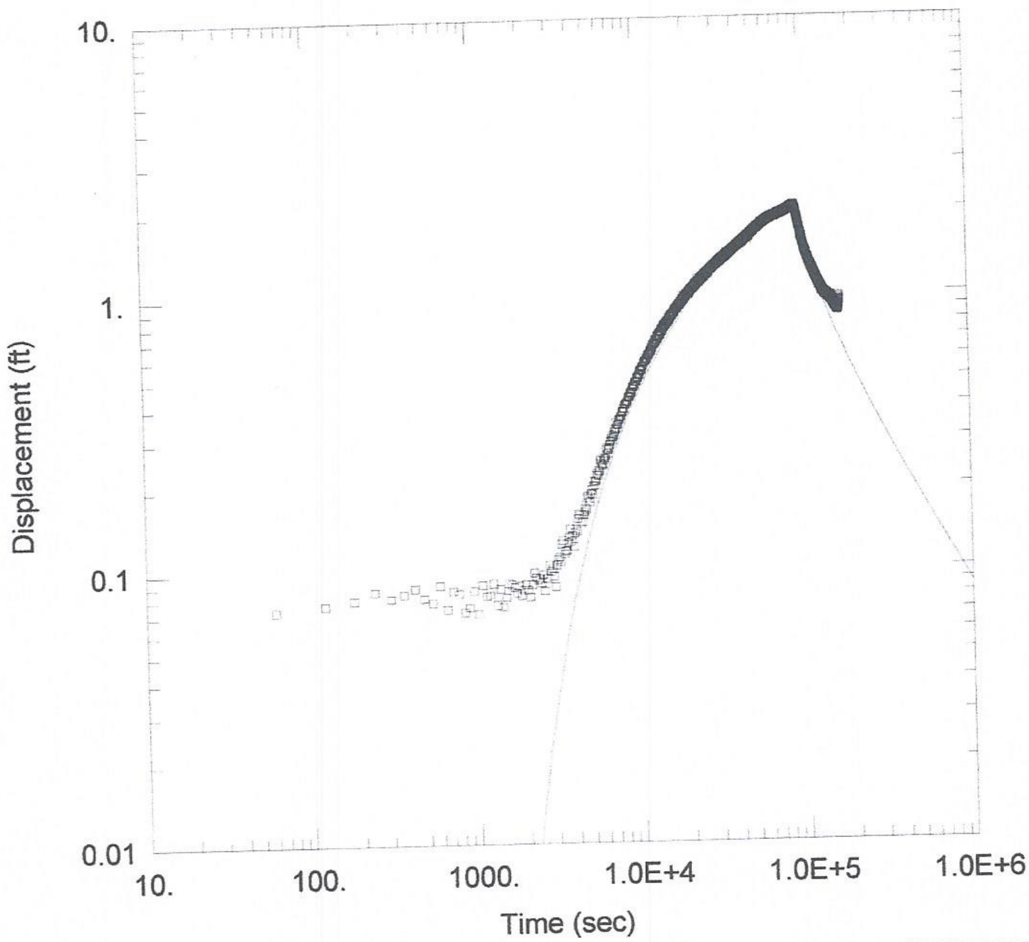
Aquifer Model: Confined

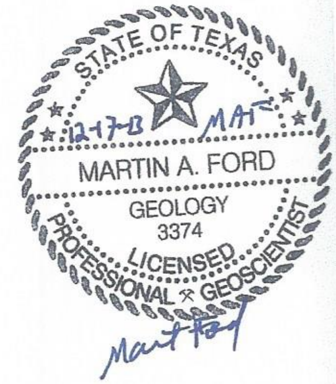
Solution Method: Theis

T = 2.059E+4 gal/day/ft
Kz/Kr = 1.

S = 0.0005204
b = 100. ft

Water Level Data From CGU 11-51HH Only





WELL TEST ANALYSIS

Data Set: Z:\...\CGU 11_51HH.aqt
Date: 12/13/13 Time: 10:00:45

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1301
Location: Panola County
Test Well: Mills FP1
Test Date: 11/19/13

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Mills FP #2	0	0
Mills FP #1	-65	-1042

Observation Wells

Well Name	X (ft)	Y (ft)
□ CGU 11-51HH	1233	-1978

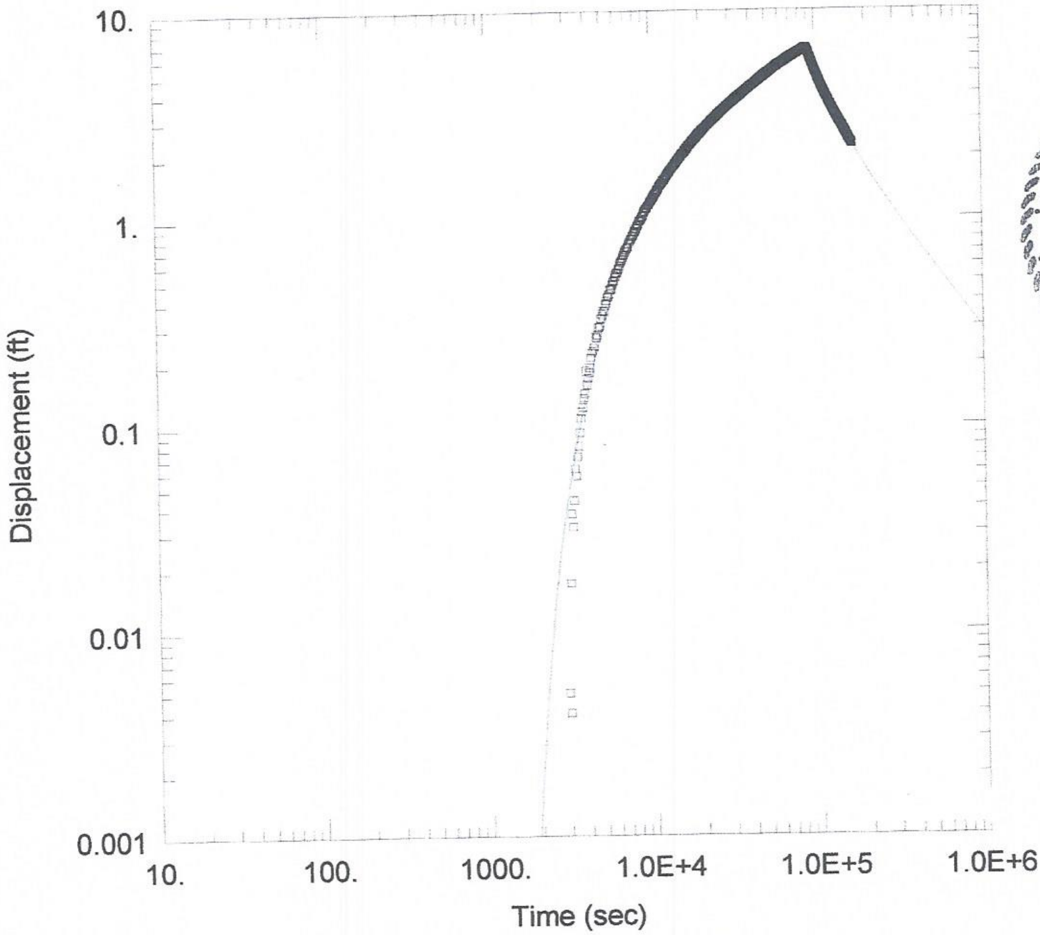
SOLUTION

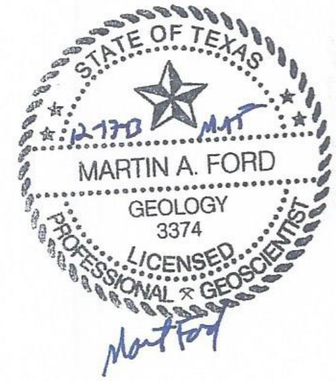
Aquifer Model: Confined

Solution Method: Theis

T = 4.831E+4 gal/day/ft
S = 0.0004429
Kz/Kr = 1.
b = 100. ft

Water Level Data From CGU 12-5 Only





WELL TEST ANALYSIS

Data Set: Z:\...\CGU 12_5.aqt
Date: 12/13/13 Time: 10:01:13

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1301
Location: Panola County
Test Well: Mills FP1
Test Date: 11/19/13

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Mills FP #2	0	0
Mills FP #1	-65	-1042

Observation Wells

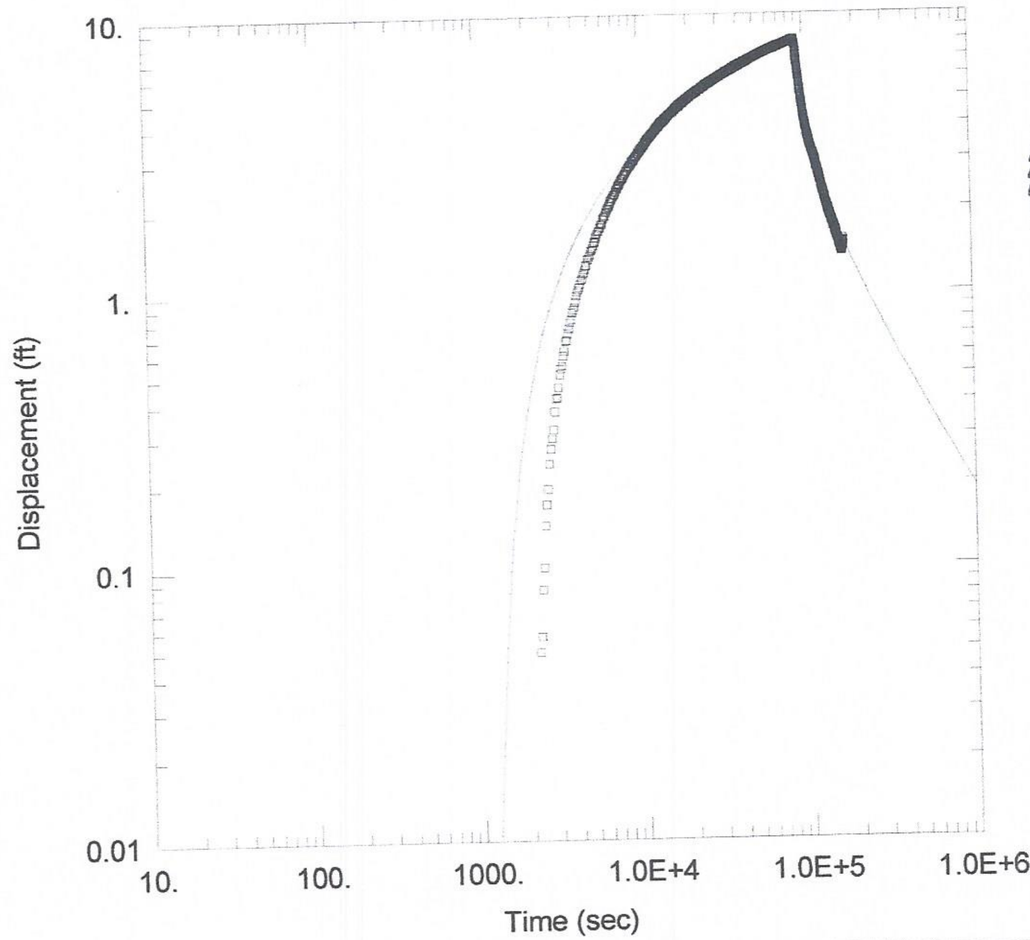
Well Name	X (ft)	Y (ft)
CGU 12-5	1125	-1

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 1.451E+4 gal/day/ft
Kz/Kr = 1.
S = 0.0003409
b = 100. ft

Water Level Data From CGU 12-10 Only



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WELL TEST ANALYSIS

Data Set: Z:\...\CGU12_10.aqt
Date: 12/13/13

Time: 10:02:19

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1301
Location: Panola County
Test Well: Mills FP1
Test Date: 11/19/13

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Mills FP #2	0	0
Mills FP #1	-65	-1042

Observation Wells

Well Name	X (ft)	Y (ft)
CGU 12-10	-728	-404

SOLUTION

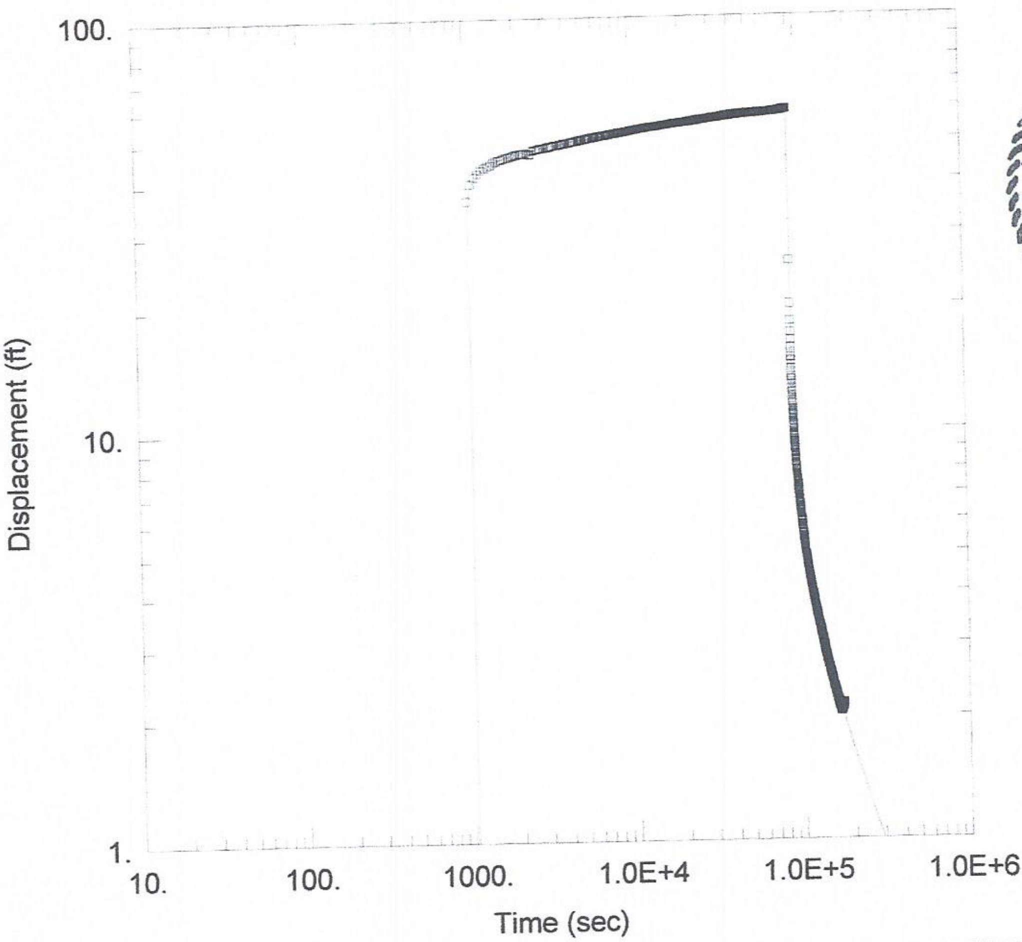
Aquifer Model: Confined

Solution Method: Theis

T = 2.188E+4 gal/day/ft
Kz/Kr = 1.

S = 0.0002046
b = 100. ft

Pumping And Recovery Data From Mills FP #2



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WELL TEST ANALYSIS

Data Set: Z:\...\Mills_FP2_2.aqt
Date: 12/13/13 Time: 10:00:08

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1301
Location: Panola County
Test Well: Mills FP2
Test Date: 11/19/13

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Mills FP #2	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ Mills FP #2	0	0

SOLUTION

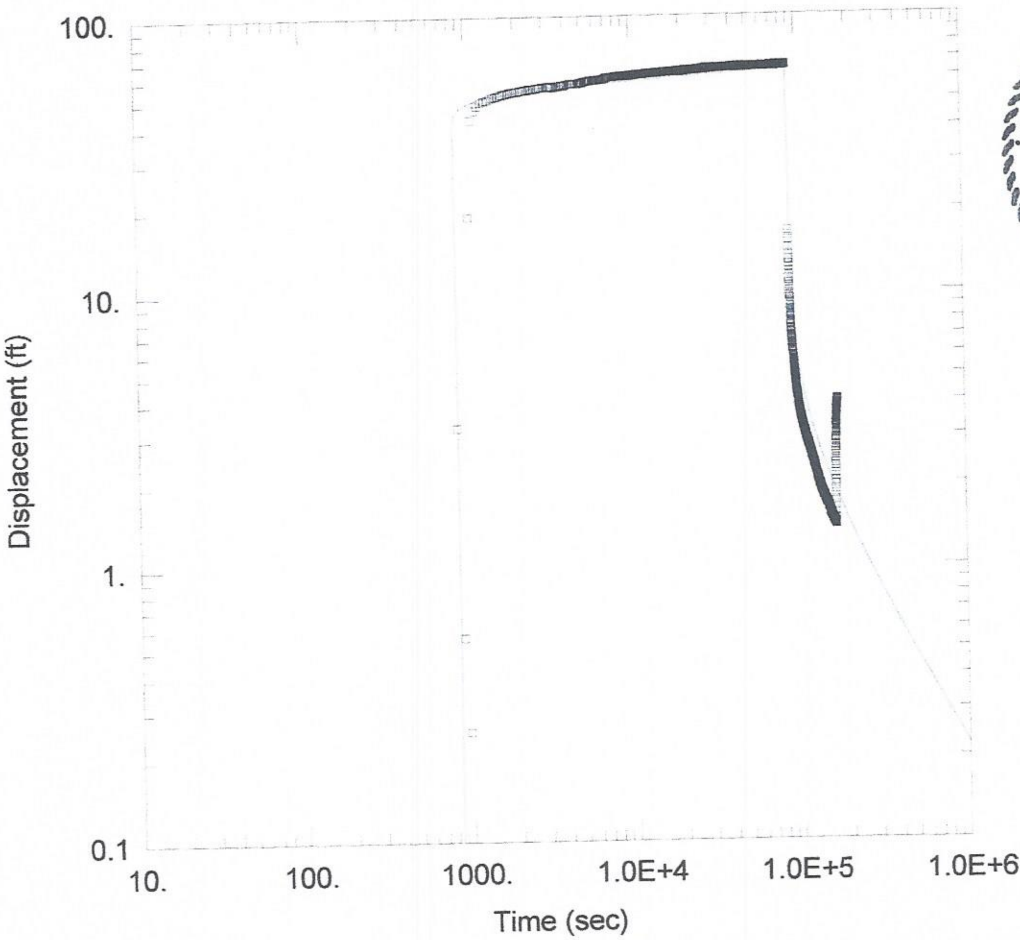
Aquifer Model: Confined

T = 8267.9 gal/day/ft
Kz/Kr = 1.

Solution Method: Theis

S = 8.325E-6
b = 100. ft

Pumping And Recovery Data From Mills FP #1



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WELL TEST ANALYSIS

Data Set: Z:\...\Mills_FP1_1.aqt
Date: 12/13/13 Time: 09:59:28

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1301
Location: Panola County
Test Well: Mills FP1
Test Date: 11/19/13

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Mills FP #1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
Mills FP #1	0	0

SOLUTION

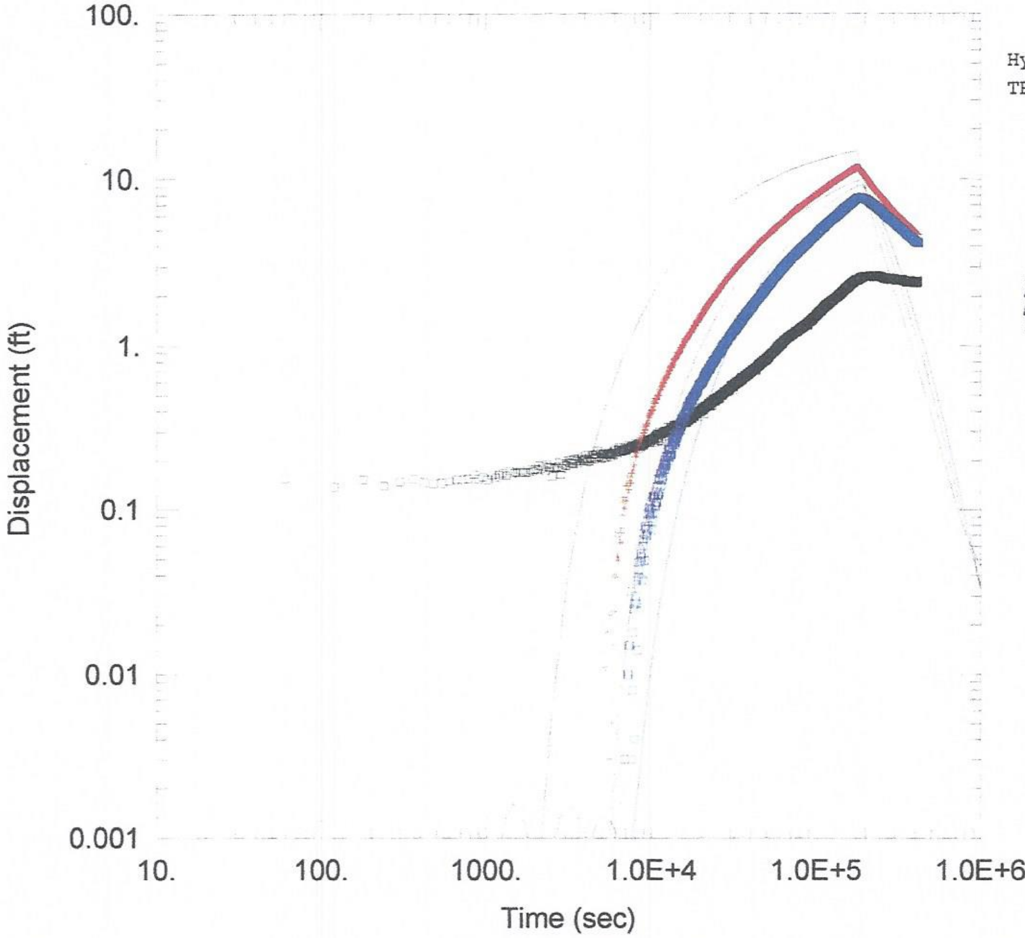
Aquifer Model: Confined

Solution Method: Theis

T = 9498.6 gal/day/ft
Kz/Kr = 1.

S = 5.814E-8
b = 100. ft

Combined Water Level Data From All Monitor Wells
Partially-penetrating, Unconfined Aquifer



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WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0
Alexander #2	1379.32	-302.61

Observation Wells

Well Name	X (ft)	Y (ft)
CGU 30-09	-264.55	-901.99
CGU 30-12	-100.38	1629.52
CGU 31-12	2998.35	692.74

SOLUTION

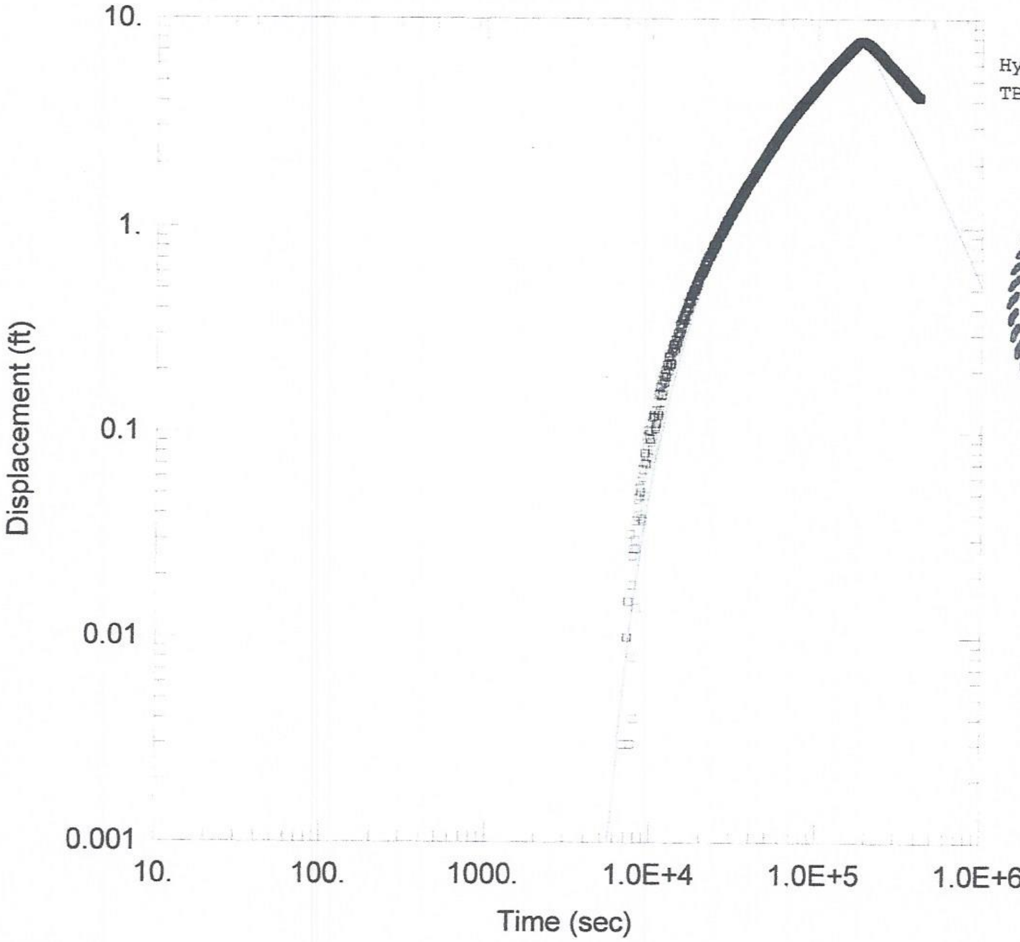
Aquifer Model: Unconfined

Solution Method: Neuman

T = 2459.7 gal/day/ft
Sy = 0.1

S = 0.0001817
Kz/Kr = 0.009322

Water Level Data From CGU 31-12 Only
Partially-penetrating, Unconfined Aquifer



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WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

AQUIFER DATA

Saturated Thickness: 287. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0
Alexander #2	1379.32	-302.61

Observation Wells

Well Name	X (ft)	Y (ft)
CGU 31-12	2998.35	692.74

SOLUTION

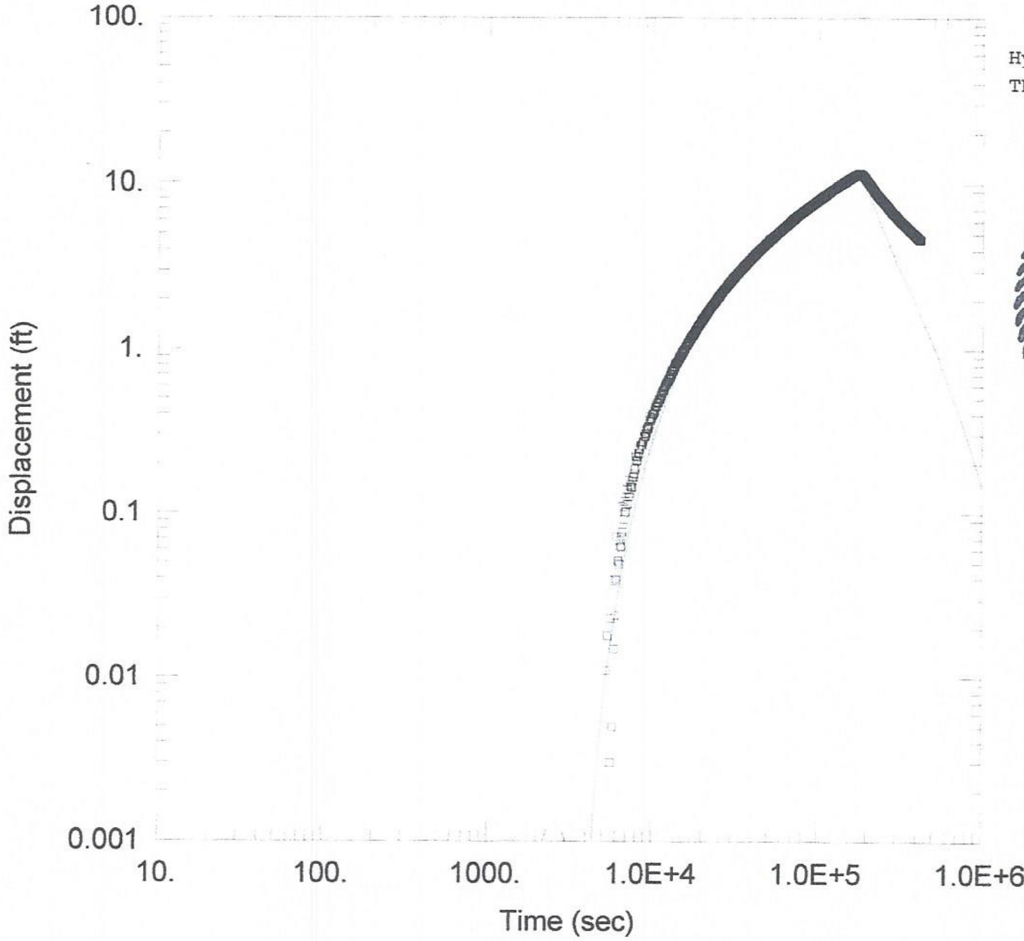
Aquifer Model: Unconfined

Solution Method: Neuman

T = 7391.5 gal/day/ft
Sy = 0.1

S = 0.000337
ß = 0.1

Water Level Data From CGU 30-12 Only
Partially-penetrating, Unconfined Aquifer



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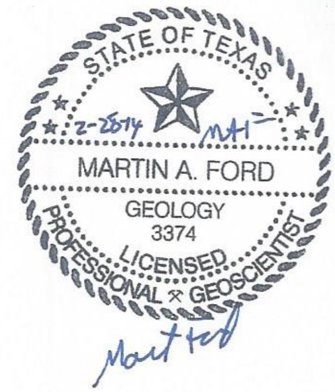


WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

AQUIFER DATA

Saturated Thickness: 287. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0
Alexander #2	1379.32	-302.61

Observation Wells

Well Name	X (ft)	Y (ft)
CGU 30-12	-100.38	1629.52

SOLUTION

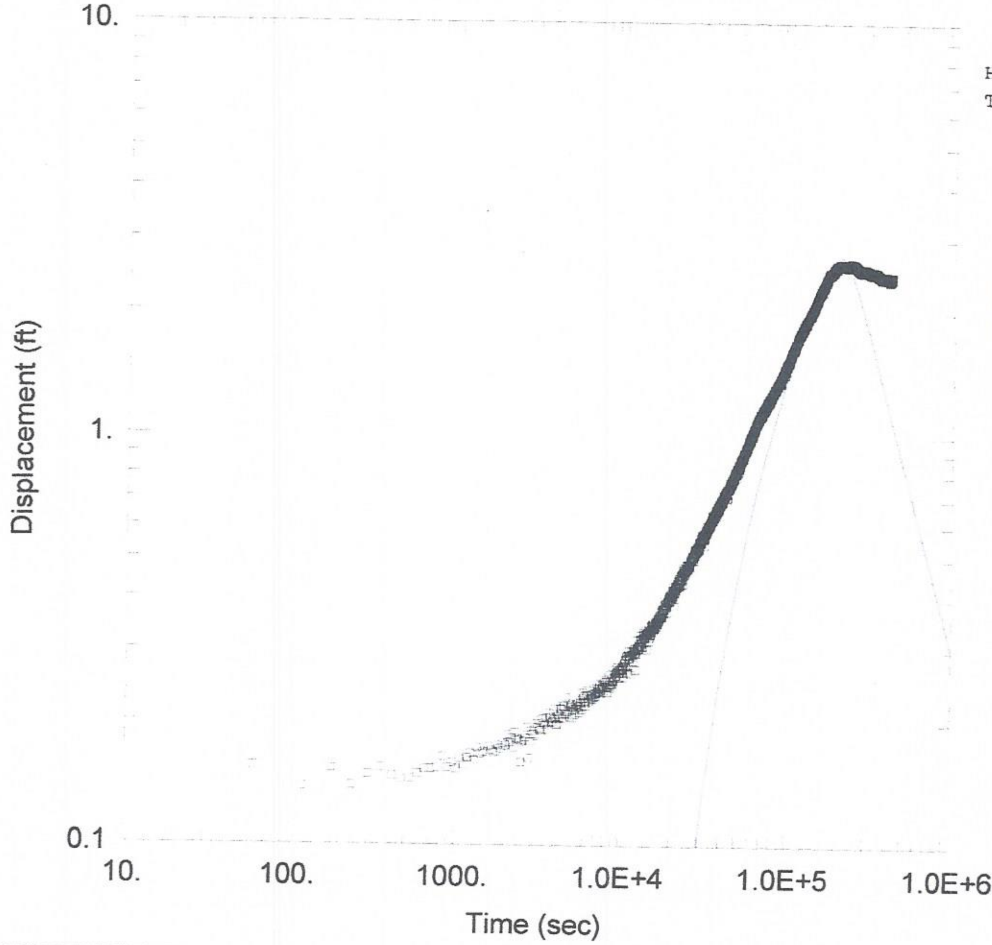
Aquifer Model: Unconfined

Solution Method: Neuman

T = 4334.5 gal/day/ft
Sy = 0.1

S = 0.0002329
ß = 0.1

Water Level Data From CGU 30-09 Only
Partially-penetrating, Unconfined Aquifer



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WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

AQUIFER DATA

Saturated Thickness: 287. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0
Alexander #2	1379.32	-302.61

Observation Wells

Well Name	X (ft)	Y (ft)
CGU 30-09	-264.55	-901.99

SOLUTION

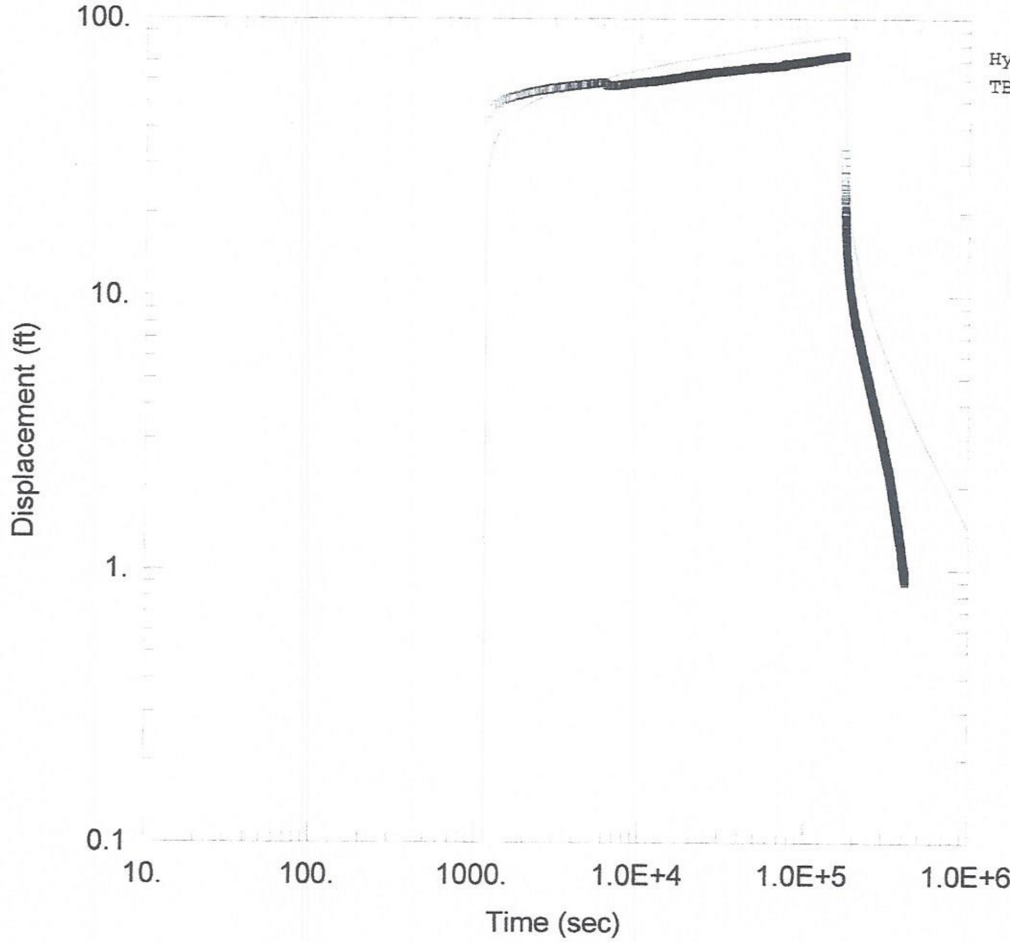
Aquifer Model: Unconfined

Solution Method: Neuman

T = 5935.9 gal/day/ft
Sy = 0.1

S = 0.003167
ß = 0.1

Pumping And Recovery Data From Alexander #2
Partially-penetrating, Unconfined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\Alex_2_unconfined.aqt
Date: 02/21/14 Time: 11:55:17

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

AQUIFER DATA

Saturated Thickness: 287. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #2	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
Alexander #2	0	0

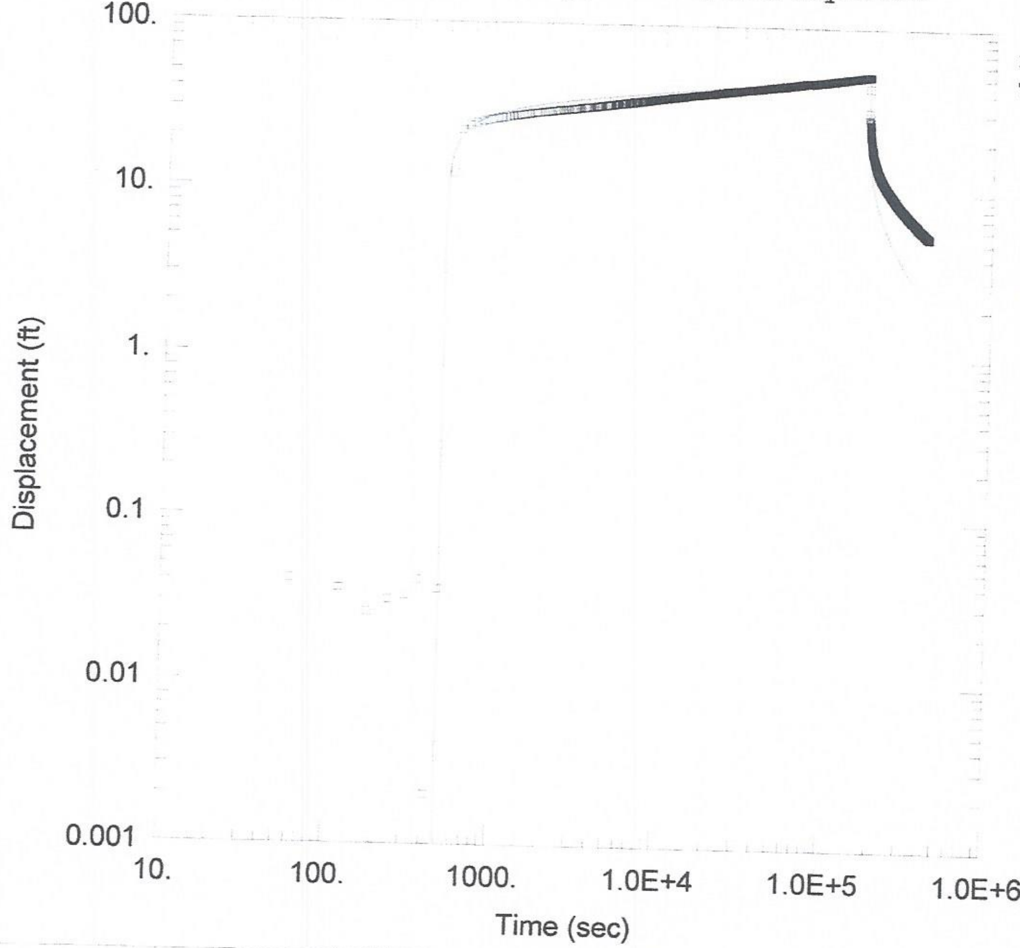
SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 2773.6 gal/day/ft
Sy = 0.1

S = 0.0002276
ß = 0.1

Pumping And Recovery Data From Alexander #1
Partially-penetrating,Unconfined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\Alex_1_unconfined.aqt
Date: 02/21/14
Time: 11:53:19

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

AQUIFER DATA

Saturated Thickness: 184. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0

SOLUTION

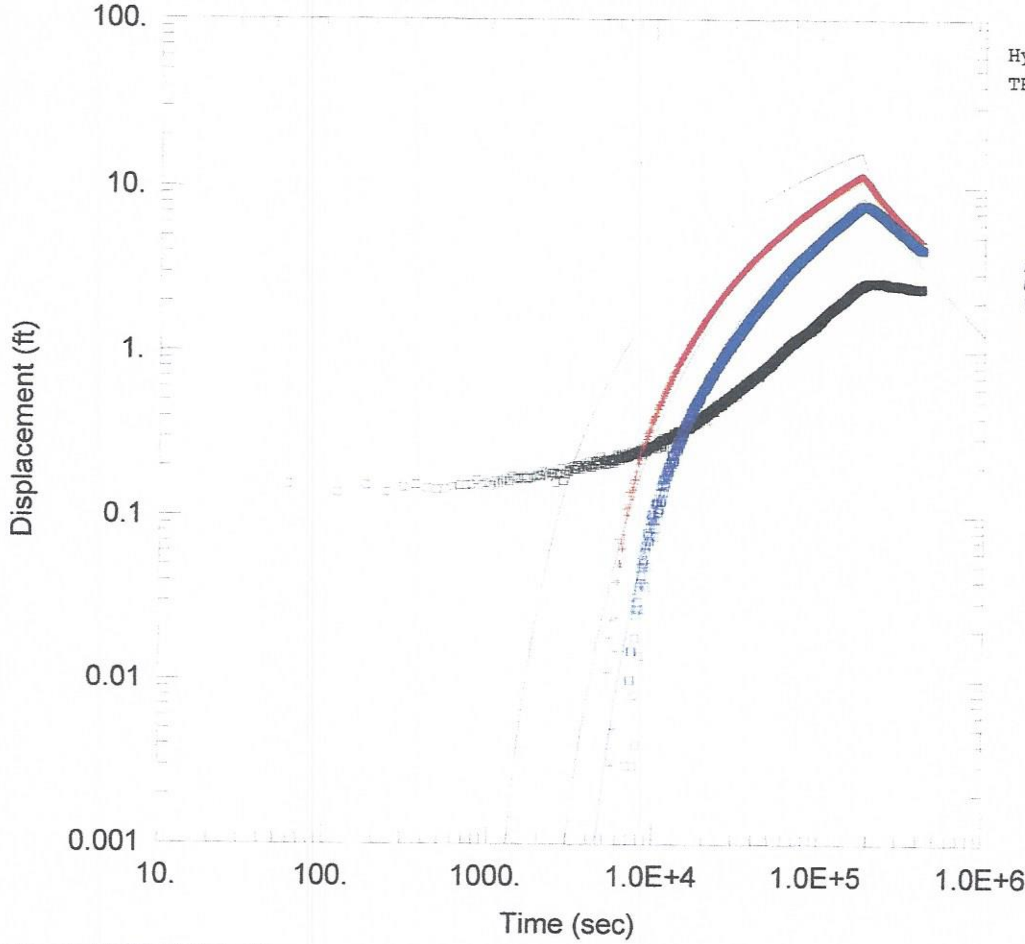
Aquifer Model: Unconfined

Solution Method: Neuman

T = 5335.2 gal/day/ft
Sy = 0.1

S = 0.341
ß = 0.001

Combined Water Level Data From All Monitor Wells
Partially-penetrating, Confined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\Alex FP_confined.aqt
Date: 02/21/14 Time: 14:36:18

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0
Alexander #2	1379.32	-302.61

Observation Wells

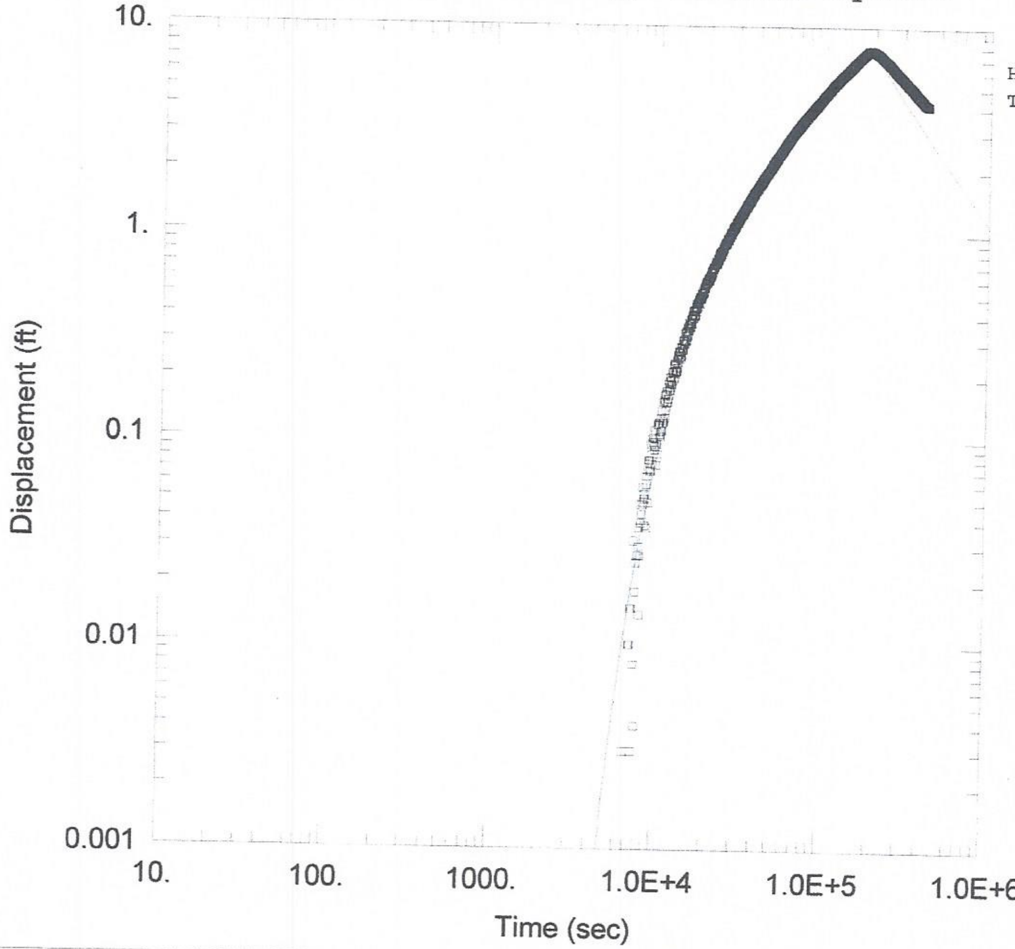
Well Name	X (ft)	Y (ft)
CGU 30-09	-264.55	-901.99
CGU 30-12	-100.38	1629.52
CGU 31-12	2998.35	692.74

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 6209.4 gal/day/ft
S = 0.000222
Kz/Kr = 1.
b = 287. ft

Water Level Data From CGU 31-12 Only
Partially-penetrating, Confined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\31-12 only_confined.aqt
Date: 02/21/14 Time: 14:29:40

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0
Alexander #2	1379.32	-302.61

Observation Wells

Well Name	X (ft)	Y (ft)
CGU 31-12	2998.35	692.74

SOLUTION

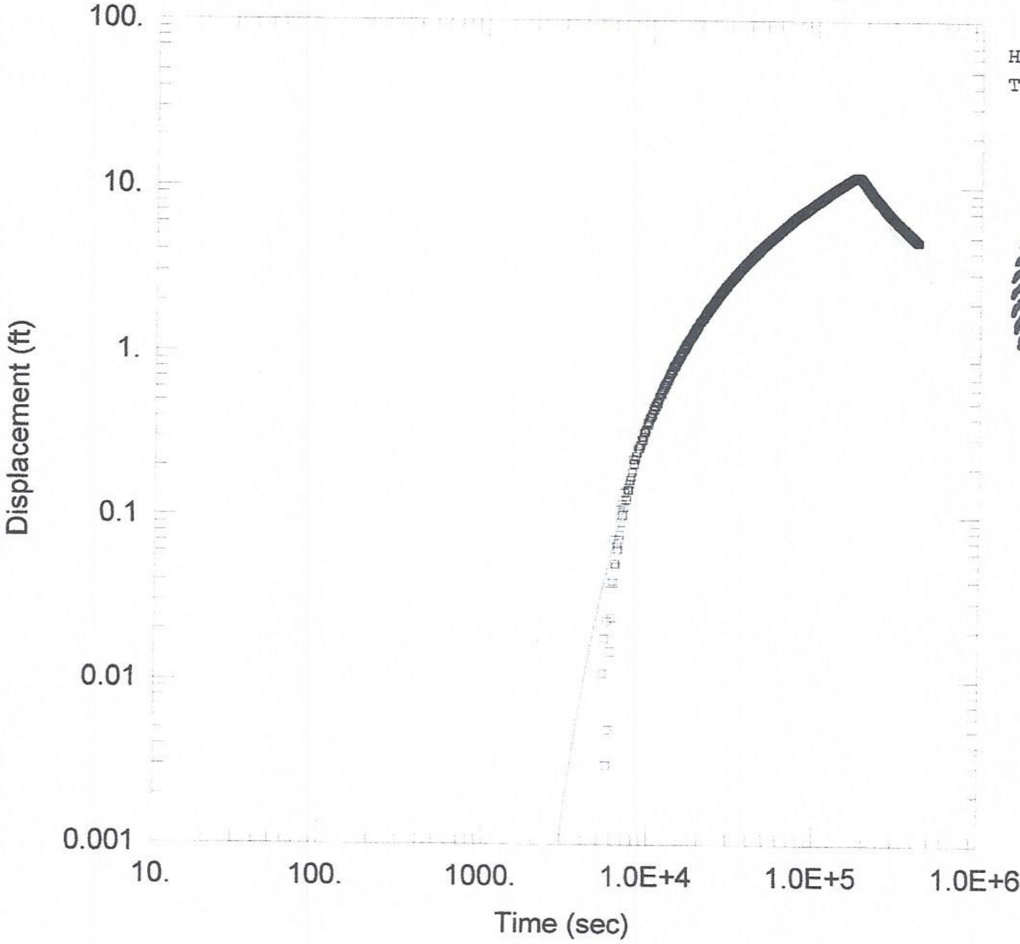
Aquifer Model: Confined

Solution Method: Theis

T = 6687.4 gal/day/ft
Kz/Kr = 1.

S = 0.0002559
b = 287. ft

Water Level Data From CGU 30-12 Only
Partially-penetrating, Confined Aquifer



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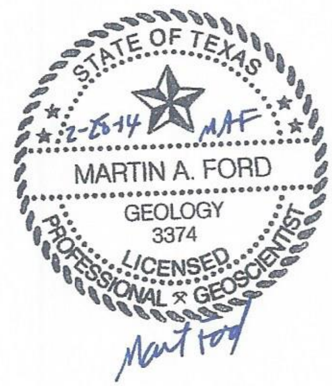


WELL TEST ANALYSIS

Data Set: Z:\...\30-12 only_confined.aqt
Date: 02/21/14 Time: 14:27:36

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0
Alexander #2	1379.32	-302.61

Observation Wells

Well Name	X (ft)	Y (ft)
CGU 30-12	-100.38	1629.52

SOLUTION

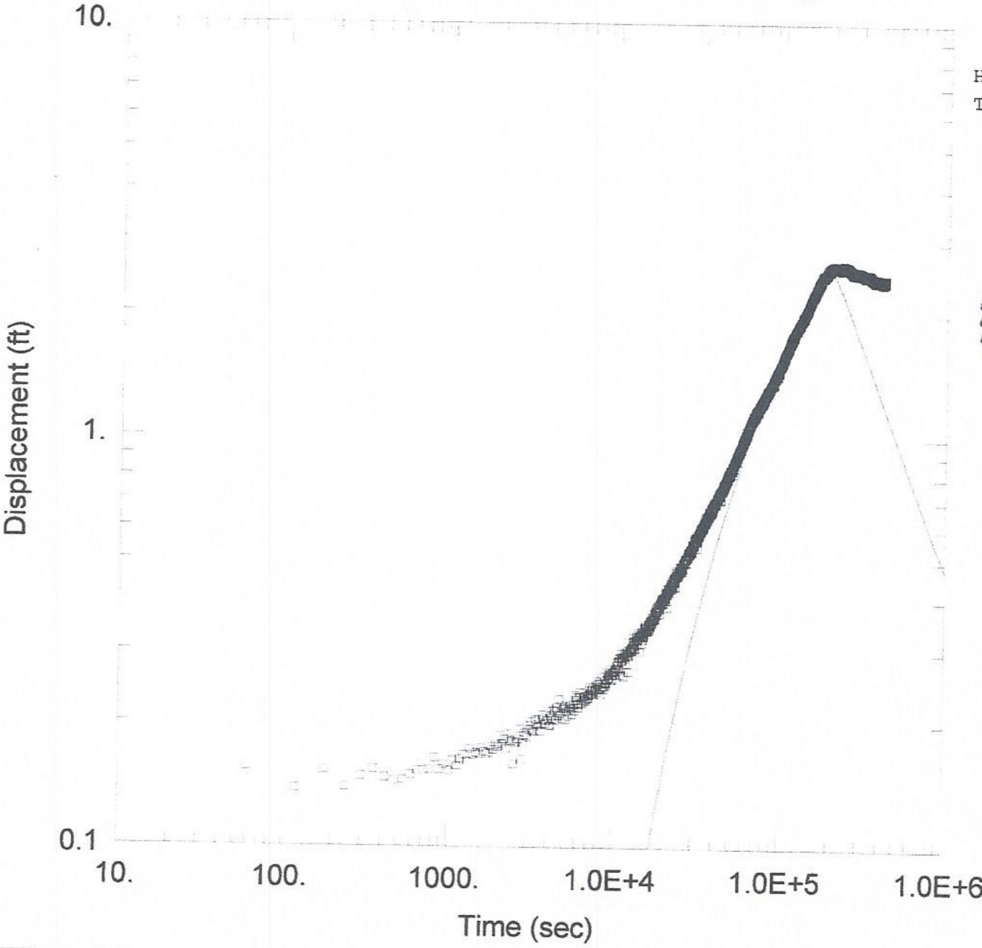
Aquifer Model: Confined

Solution Method: Theis

T = 6153.4 gal/day/ft
Kz/Kr = 1.

S = 0.000216
b = 287. ft

Water Level Data From CGU 30-09 Only
Partially-penetrating, Confined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\30_09 only_confined.aqt
Date: 02/21/14 Time: 13:11:30

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0
Alexander #2	1379.32	-302.61

Observation Wells

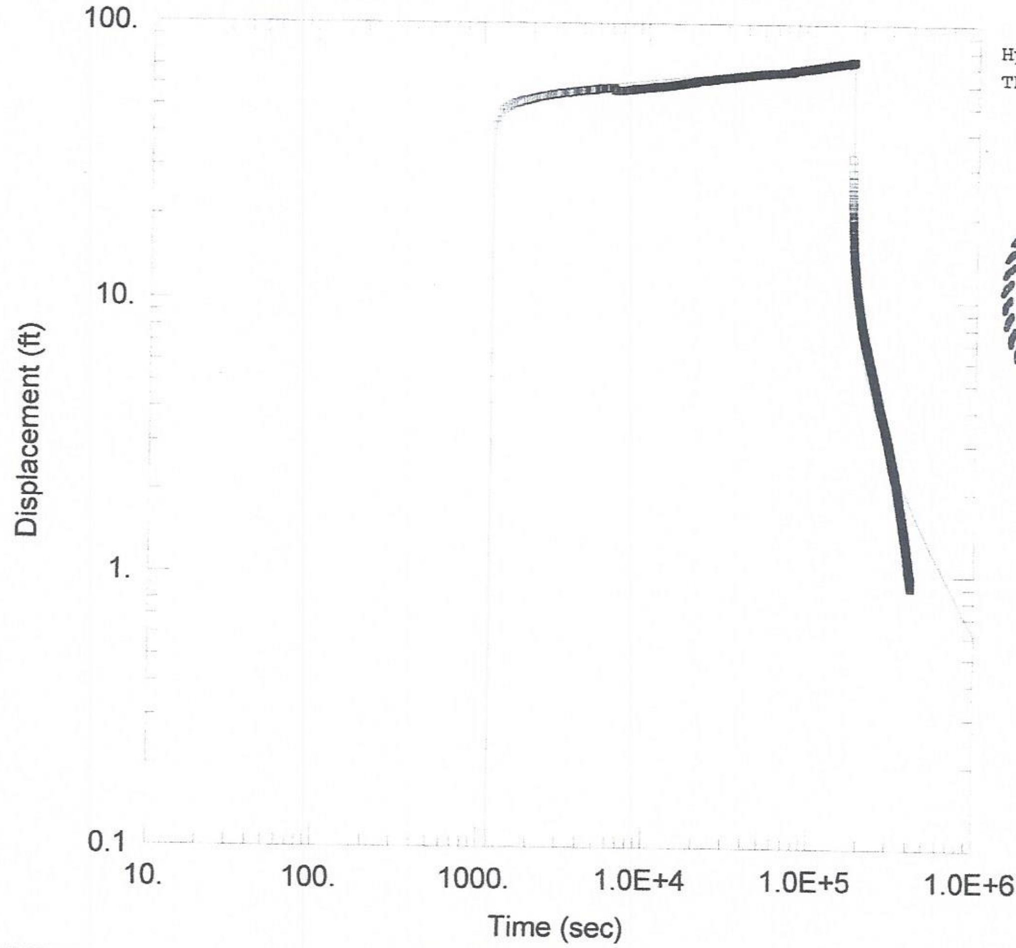
Well Name	X (ft)	Y (ft)
CGU 30-09	-264.55	-901.99

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 1.568E+4 gal/day/ft
S = 0.003073
Kz/Kr = 1.
b = 287. ft

Pumping And Recovery Data From Alexander #2
Partially-penetrating, Confined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\Alex_2_confined.aqt
Date: 02/21/14 Time: 11:54:18

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #2	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
Alexander #2	0	0

SOLUTION

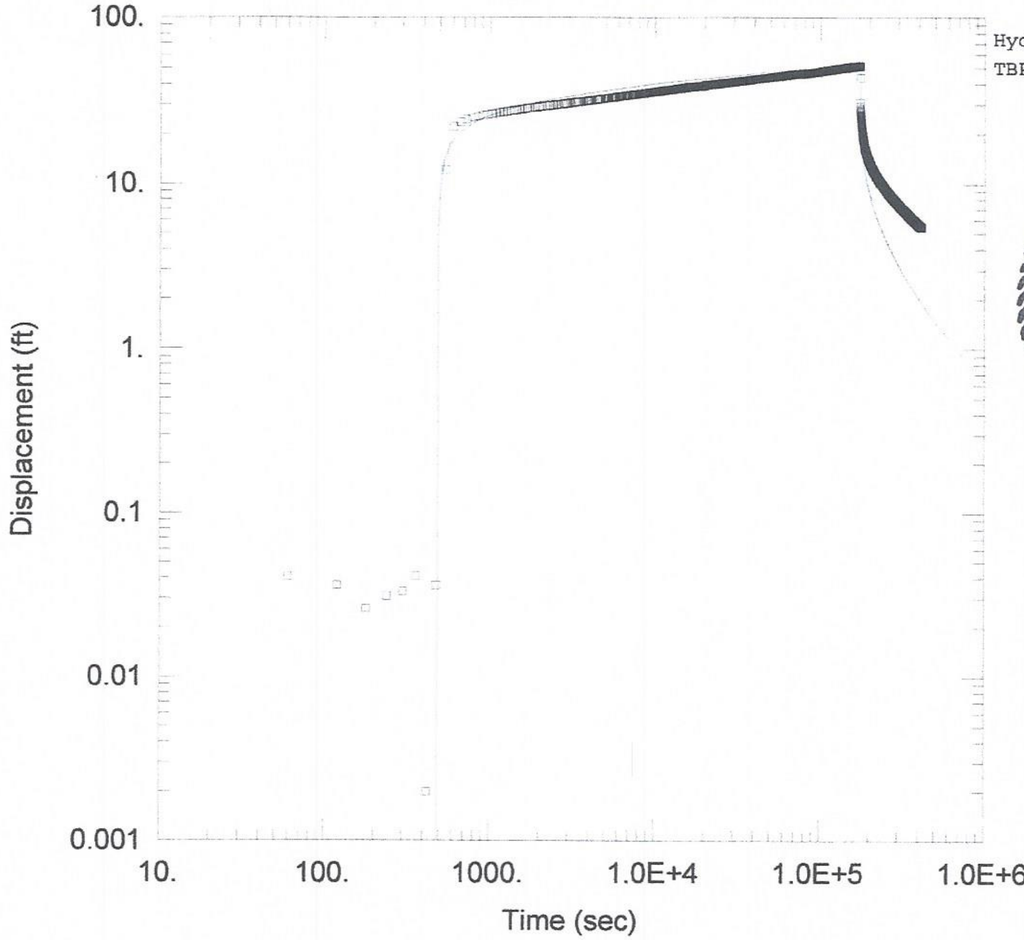
Aquifer Model: Confined

Solution Method: Theis

T = 6430.7 gal/day/ft
Kz/Kr = 1.

S = 0.001147
b = 287. ft

Pumping And Recovery Data From Alexander #1
Partially-penetrating, Confined Aquifer



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WELL TEST ANALYSIS

Data Set: Z:\...\Alex_1_confined.aqt
Date: 02/21/14 Time: 11:51:10

PROJECT INFORMATION

Company: Hydrex
Client: Anadarko
Project: APC 1401
Location: Panola County
Test Well: Alexander FP
Test Date: 02/12/14

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
Alexander #1	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 6356.8 gal/day/ft
S = 0.4064
Kz/Kr = 1.
b = 184. ft

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APPENDIX C

Hydraulic Conductivity Values Derived from Fryar et al. 2003

Number	BEG Label	GAM Easting (ft)	GAM Northing (ft)	Estimated Hydraulic Conductivity (ft/d)	GAM Layer
1	beg2124	6650787	20070618	2.05	6
2	beg2161	6690118	20057425	2.09	6
3	beg2211	6652324	20040279	1.09	6
4	beg2212	6652324	20040279	2.33	6
5	beg2227	6665184	20040933	1.6	6
6	beg2228	6665184	20040933	1.77	6
7	beg2231	6665184	20040933	2.08	6
8	beg2235	6678044	20041592	2.14	6
9	beg2257	6678824	20026423	3.5	6
10	beg2258	6691690	20027087	2.53	6
11	beg2259	6691690	20027087	2.53	6
12	beg2260	6691690	20027087	5.63	6
13	beg2277	6692475	20011918	10.55	6
14	beg2288	6705346	20012588	7.76	6
15	beg7815	6650064	20061153	23.87	6
16	beg0210	6611407	20111428	15.5	5
17	beg1994	6596406	20128734	4.86	5
18	beg1995	6609233	20129368	30.62	5
19	beg1998	6597152	20113564	3.28	5
20	beg1999	6597152	20113564	8.26	5
21	beg2000	6609985	20114197	1.07	5
22	beg2001	6609985	20114197	0.76	5
23	beg2002	6609985	20114197	1.07	5
24	beg2003	6609985	20114197	1.34	5
25	beg2004	6609985	20114197	1.63	5
26	beg2005	6609985	20114197	4.86	5
27	beg2007	6597898	20098393	13.94	5
28	beg2008	6634886	20130648	1.82	5
29	beg2009	6622817	20114836	6.21	5
30	beg2010	6622817	20114836	4.81	5
31	beg2011	6622817	20114836	10.79	5
32	beg2012	6635649	20115479	1.88	5
33	beg2013	6635649	20115479	5.65	5
34	beg2014	6635649	20115479	2.88	5
35	beg2015	6648481	20116127	8.94	5
36	beg2016	6623574	20099666	18.29	5
37	beg2017	6636412	20100309	1.32	5
38	beg2018	6636412	20100309	1.56	5
39	beg2019	6636412	20100309	1.99	5
40	beg2020	6636412	20100309	2.33	5
41	beg2021	6636412	20100309	2.69	5
42	beg2022	6649250	20100957	5.5	5
43	beg2023	6661313	20116779	0.79	5

Number	BEG Label	GAM Easting (ft)	GAM Northing (ft)	Estimated Hydraulic Conductivity (ft/d)	GAM Layer
44	beg2024	6661313	20116779	12.94	5
45	beg2025	6674144	20117437	112.84	5
46	beg2026	6686975	20118099	2.35	5
47	beg2028	6662087	20101610	2.41	5
48	beg2029	6662087	20101610	2.63	5
49	beg2030	6662087	20101610	2.61	5
50	beg2031	6662087	20101610	2.78	5
51	beg2032	6674924	20102268	8.55	5
52	beg2033	6687761	20102931	6.5	5
53	beg2034	6711840	20134607	17.59	5
54	beg2035	6724664	20135283	23.44	5
55	beg2036	6699806	20118767	19.08	5
56	beg2037	6712637	20119439	2.52	5
57	beg2038	6725467	20120116	4.44	5
58	beg2039	6725467	20120116	38.16	5
59	beg2040	6700598	20103598	1.44	5
60	beg2041	6700598	20103598	2.41	5
61	beg2042	6713434	20104271	8.9	5
62	beg2043	6713434	20104271	7.01	5
63	beg2044	6713434	20104271	2.12	5
64	beg2045	6737489	20135965	1.69	5
65	beg2046	6737489	20135965	3.4	5
66	beg2047	6737489	20135965	4.77	5
67	beg2048	6737489	20135965	8.78	5
68	beg2049	6737489	20135965	8.78	5
69	beg2050	6750313	20136651	3.79	5
70	beg2051	6750313	20136651	4.21	5
71	beg2052	6750313	20136651	24.78	5
72	beg2053	6738297	20120797	0.61	5
73	beg2054	6738297	20120797	1.15	5
74	beg2055	6751127	20121484	24.78	5
75	beg2056	6751941	20106317	0.67	5
76	beg2083	6598644	20083223	1.95	5
77	beg2084	6598644	20083223	5.32	5
78	beg2085	6598644	20083223	16.56	5
79	beg2086	6611488	20083857	1.93	5
80	beg2088	6599389	20068052	1.33	5
81	beg2089	6612239	20068687	4.06	5
82	beg2091	6612239	20068687	11.82	5
83	beg2094	6612991	20053516	2.46	5
84	beg2095	6624331	20084496	12.88	5
85	beg2096	6637175	20085140	1.33	5
86	beg2097	6637175	20085140	2.19	5

Number	BEG Label	GAM Easting (ft)	GAM Northing (ft)	Estimated Hydraulic Conductivity (ft/d)	GAM Layer
87	beg2098	6637175	20085140	1.65	5
88	beg2099	6637175	20085140	1.84	5
89	beg2100	6637175	20085140	4.96	5
90	beg2102	6650018	20085788	2.35	5
91	beg2103	6650018	20085788	2.67	5
92	beg2105	6650018	20085788	2.12	5
93	beg2106	6650018	20085788	3.84	5
94	beg2107	6650018	20085788	2.56	5
95	beg2108	6650018	20085788	4.04	5
96	beg2109	6625089	20069326	1.51	5
97	beg2110	6625089	20069326	2.86	5
98	beg2111	6625089	20069326	3.64	5
99	beg2112	6625089	20069326	4.05	5
100	beg2113	6625089	20069326	3.02	5
101	beg2114	6625089	20069326	4.87	5
102	beg2115	6625089	20069326	3.21	5
103	beg2116	6625089	20069326	3.21	5
104	beg2117	6625089	20069326	3.53	5
105	beg2118	6625089	20069326	3.82	5
106	beg2119	6625089	20069326	4.47	5
107	beg2120	6625089	20069326	24.78	5
108	beg2121	6637938	20069970	1.5	5
109	beg2122	6637938	20069970	1.7	5
110	beg2123	6637938	20069970	3.25	5
111	beg2125	6650787	20070618	4.33	5
112	beg2126	6650787	20070618	2.12	5
113	beg2127	6650787	20070618	3.08	5
114	beg2128	6625846	20054155	5.08	5
115	beg2129	6638701	20054800	2.64	5
116	beg2130	6638701	20054800	3.52	5
117	beg2131	6638701	20054800	4.73	5
118	beg2132	6638701	20054800	13.04	5
119	beg2133	6651556	20055449	8.25	5
120	beg2134	6662861	20086441	1.41	5
121	beg2135	6662861	20086441	0.89	5
122	beg2136	6662861	20086441	3.54	5
123	beg2137	6662861	20086441	2.56	5
124	beg2138	6675704	20087100	2.57	5
125	beg2139	6675704	20087100	3.61	5
126	beg2140	6688547	20087763	9.01	5
127	beg2141	6663636	20071272	4.7	5
128	beg2142	6663636	20071272	6.84	5
129	beg2143	6663636	20071272	4.22	5

Number	BEG Label	GAM Easting (ft)	GAM Northing (ft)	Estimated Hydraulic Conductivity (ft/d)	GAM Layer
130	beg2144	6663636	20071272	4.43	5
131	beg2145	6676484	20071930	16.53	5
132	beg2146	6676484	20071930	2.24	5
133	beg2147	6676484	20071930	671.25	5
134	beg2148	6689333	20072594	5.91	5
135	beg2149	6664410	20056103	1.84	5
136	beg2150	6664410	20056103	4.63	5
137	beg2151	6664410	20056103	4.92	5
138	beg2152	6664410	20056103	10.25	5
139	beg2153	6664410	20056103	23.65	5
140	beg2154	6664410	20056103	4.56	5
141	beg2155	6664410	20056103	7.17	5
142	beg2156	6664410	20056103	11.88	5
143	beg2157	6677264	20056761	9.4	5
144	beg2158	6677264	20056761	13.33	5
145	beg2159	6677264	20056761	4.9	5
146	beg2160	6690118	20057425	1.95	5
147	beg2162	6690118	20057425	2.67	5
148	beg2163	6690118	20057425	2.12	5
149	beg2164	6690118	20057425	2.33	5
150	beg2165	6690118	20057425	3.03	5
151	beg2166	6690118	20057425	3.03	5
152	beg2167	6690118	20057425	4.14	5
153	beg2168	6690118	20057425	5.04	5
154	beg2169	6690118	20057425	10.88	5
155	beg2170	6701389	20088430	16.56	5
156	beg2171	6701389	20088430	31.39	5
157	beg2172	6714231	20089103	13.22	5
158	beg2173	6727073	20089780	7.76	5
159	beg2174	6702180	20073262	2.46	5
160	beg2175	6715028	20073935	1.44	5
161	beg2176	6727876	20074613	2.68	5
162	beg2177	6702972	20058093	2.51	5
163	beg2179	6728679	20059445	0.63	5
164	beg2180	6728679	20059445	13.35	5
165	beg2182	6741531	20060127	3.52	5
166	beg2184	6754384	20060815	1.61	5
167	beg2205	6601627	20022540	1.31	5
168	beg2206	6614494	20023175	5.12	5
169	beg2207	6602373	20007369	43.35	5
170	beg2208	6615245	20008005	51.73	5
171	beg2209	6626603	20038986	1.65	5
172	beg2210	6639464	20039630	2.29	5

Number	BEG Label	GAM Easting (ft)	GAM Northing (ft)	Estimated Hydraulic Conductivity (ft/d)	GAM Layer
173	beg2213	6652324	20040279	2.88	5
174	beg2214	6652324	20040279	7.02	5
175	beg2215	6652324	20040279	8.78	5
176	beg2216	6652324	20040279	117.46	5
177	beg2217	6627360	20023815	6.29	5
178	beg2218	6640227	20024460	1.7	5
179	beg2219	6640227	20024460	2.31	5
180	beg2220	6653093	20025110	3.29	5
181	beg2221	6628117	20008645	29.71	5
182	beg2222	6640990	20009290	15.01	5
183	beg2223	6653861	20009940	2.81	5
184	beg2224	6665184	20040933	1.92	5
185	beg2225	6665184	20040933	0.96	5
186	beg2226	6665184	20040933	1.58	5
187	beg2230	6665184	20040933	2.77	5
188	beg2232	6665184	20040933	2.1	5
189	beg2233	6678044	20041592	0.95	5
190	beg2236	6678044	20041592	3.37	5
191	beg2237	6678044	20041592	2.36	5
192	beg2239	6678044	20041592	2.71	5
193	beg2240	6678044	20041592	7.79	5
194	beg2241	6690904	20042256	1.95	5
195	beg2242	6690904	20042256	2.43	5
196	beg2243	6690904	20042256	1.9	5
197	beg2244	6690904	20042256	4.3	5
198	beg2245	6690904	20042256	2.35	5
199	beg2246	6690904	20042256	3.31	5
200	beg2247	6690904	20042256	14.78	5
201	beg2248	6690904	20042256	3.62	5
202	beg2249	6665959	20025764	1.27	5
203	beg2250	6665959	20025764	2.87	5
204	beg2251	6665959	20025764	1.96	5
205	beg2252	6665959	20025764	2.26	5
206	beg2253	6665959	20025764	2.45	5
207	beg2254	6665959	20025764	3.4	5
208	beg2255	6665959	20025764	4.53	5
209	beg2256	6678824	20026423	1.4	5
210	beg2261	6691690	20027087	3.57	5
211	beg2262	6666733	20010594	3.08	5
212	beg2263	6666733	20010594	0.66	5
213	beg2264	6666733	20010594	0.66	5
214	beg2265	6666733	20010594	1.43	5
215	beg2266	6666733	20010594	2.19	5

Number	BEG Label	GAM Easting (ft)	GAM Northing (ft)	Estimated Hydraulic Conductivity (ft/d)	GAM Layer
216	beg2267	6666733	20010594	2.59	5
217	beg2268	6666733	20010594	2.67	5
218	beg2269	6666733	20010594	1.96	5
219	beg2270	6666733	20010594	6.82	5
220	beg2271	6679604	20011254	1.86	5
221	beg2272	6679604	20011254	1.51	5
222	beg2273	6679604	20011254	2.56	5
223	beg2274	6679604	20011254	2.63	5
224	beg2275	6679604	20011254	2.8	5
225	beg2276	6692475	20011918	2.47	5
226	beg2278	6703763	20042925	2.56	5
227	beg2279	6716622	20043599	2.18	5
228	beg2280	6729481	20044277	6.62	5
229	beg2281	6704555	20027756	1.62	5
230	beg2282	6704555	20027756	1.16	5
231	beg2283	6717420	20028430	2.1	5
232	beg2284	6717420	20028430	2.9	5
233	beg2285	6705346	20012588	2.05	5
234	beg2286	6705346	20012588	3.03	5
235	beg2287	6705346	20012588	3.12	5
236	beg2289	6718217	20013262	0.55	5
237	beg2290	6718217	20013262	3.75	5
238	beg2291	6718217	20013262	14.98	5
239	beg2292	6742340	20044960	3.92	5
240	beg2293	6742340	20044960	4.72	5
241	beg2294	6742340	20044960	11.7	5
242	beg2295	6755198	20045648	1.93	5
243	beg2297	6756013	20030481	0.74	5
244	beg2298	6756013	20030481	4.54	5
245	beg2299	6756013	20030481	8.78	5
246	beg2300	6743957	20014624	17.71	5
247	beg2301	6756827	20015313	6.66	5
248	beg2406	6628875	19993475	2.69	5
249	beg2418	6706137	19997419	0.92	5
250	beg7744	6594022	20114424	3.54	5
251	beg7745	6612435	20114927	9.91	5
252	beg7747	6615827	20110534	10.79	5
253	beg7748	6594537	20095187	24.33	5
254	beg7749	6596014	20105296	1.29	5
255	beg7750	6598529	20101263	13.52	5
256	beg7751	6629208	20115662	11.18	5
257	beg7752	6622768	20102059	22.15	5
258	beg7753	6627314	20102083	16.1	5

Number	BEG Label	GAM Easting (ft)	GAM Northing (ft)	Estimated Hydraulic Conductivity (ft/d)	GAM Layer
259	beg7754	6622637	20106412	1.76	5
260	beg7755	6622723	20106416	0.57	5
261	beg7756	6626242	20102942	18.29	5
262	beg7757	6711919	20133090	20.08	5
263	beg7758	6712078	20128434	4.07	5
264	beg7759	6713505	20125771	1.21	5
265	beg7760	6719555	20124873	8.57	5
266	beg7761	6700567	20097614	2.32	5
267	beg7762	6748594	20141527	16.9	5
268	beg7763	6748819	20140525	20.98	5
269	beg7809	6616489	20083395	14.61	5
270	beg7810	6607865	20080737	8.85	5
271	beg7811	6600685	20060918	14.03	5
272	beg7812	6600792	20062241	4.35	5
273	beg7813	6596300	20068002	1.54	5
274	beg7814	6641525	20061836	6.92	5
275	beg7816	6650508	20060871	278.07	5
276	beg7817	6657212	20055736	16.1	5
277	beg7818	6659952	20071084	46.58	5
278	beg7819	6662461	20058944	30.02	5
279	beg7820	6663983	20059427	9.36	5
280	beg7821	6659993	20056790	19.89	5
281	beg7822	6670128	20055178	23.77	5
282	beg7823	6668879	20054405	23.38	5
283	beg7840	6633351	20039830	2.12	5
284	beg7841	6637256	20020255	1.63	5
285	beg7842	6638089	20019080	2.73	5
286	beg7845	6754746	20041263	0.43	5
287	beg7846	6746889	20032223	31.4	5
288	beg7858	6618063	19994559	4.69	5
289	beg7863	6668014	19993930	2.93	5
290	beg2090	6612239	20068687	2.65	4
291	beg2093	6600135	20052882	18.81	4
292	beg2398	6603118	19992199	11.51	4
293	beg2399	6615997	19992834	4.38	4

APPENDIX D

Hydraulic Conductivity Values Derived from Specific Capacity Measurements

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
1	394538	Anadarko Petroluem	Rig Supply	32.143333	-94.475832	310	60	50	1	1.2	231	192	190	1.0
2	392629	Anadarko	Rig Supply	32.132221	-94.478332	340	60	50	1	1.2	231	192	100	1.9
3	390569	BP America	Rig Supply	32.137221	-94.41861	310	80	30	1	2.7	513	376	160	2.4
4	389250	Anadarko	Rig Supply	32.181943	-94.443055	310	80	25	1	3.2	616	439	100	4.4
5	388487	Adam Smith	Domestic	32.281388	-94.391666	360	30	50	2	0.6	116	108	80	1.3
6	386940	BP America	Hydraulic Fracturing Supply	32.119443	-94.415555	200	100	10	1	10.0	1,925	1,142	190	6.0
7	386939	BP America	Hydraulic Fracturing Supply	32.119443	-94.415555	200	100	10	1	10.0	1,925	1,142	190	6.0
8	386701	PetroQuest Energy ,LLC	Rig Supply	32.18361	-94.060833	200	80	10	1	8.0	1,540	947	100	9.5
9	386685	MEMORIAL RESOURCES DEVELOPMENT	Rig Supply	32.019166	-94.094166	350	82	30	2	2.7	526	384	100	3.8
10	386571	Colby McKnight	Domestic	32.227777	-94.4575	270	75	70	2	1.1	206	175	30	5.8
11	386299	Jerry Davis	Domestic	32.008611	-94.526666	281	16	87	4	0.2	35	40	73	0.5
12	386288	SJD Saltwater Disposal, LLC	Rig Supply	32.159722	-94.411111	320	75	1	1	75.0	14,439	6,207	100	62.1
13	385530	Anadarko	Rig Supply	32.109166	-94.415277	120	70	10	1	7.0	1,348	847	90	9.4
14	385138	Samson Lone Star	Rig Supply	32.043055	-94.22611	160	50	1	1	50.0	9,626	4,415	100	44.2
15	384958	Sabine Oil & Gas	Rig Supply	32.224999	-94.205833	260	30	100	1	0.3	58	60	200	0.3
16	383644	BP America	Hydraulic Fracturing Supply	32.129443	-94.413611	270	80	10	1	8.0	1,540	947	100	9.5
17	383576	BP America	Hydraulic Fracturing Supply	32.124443	-94.421666	540	100	50	1	2.0	385	296	420	0.7
18	383062	Willie Scott	Domestic	32.057222	-94.592499	254	75	100	2	0.8	144	130	24	5.4
19	382209	Robert Underwood	Domestic	32.19361	-94.281666	130	40	1	1	40.0	7,701	3,660	70	52.3
20	382144	Joel Mienert	Domestic	32.131666	-94.529166	387	85	100	4	0.9	164	144	30	4.8
21	381812	BP America	Hydraulic Fracturing Supply	32.123888	-94.418332	380	100	50	1	2.0	385	296	240	1.2
22	381720	Enbridge G&P East Texas LP	Industrial	32.226666	-94.475554	290	100	40	1	2.5	481	357	90	4.0
23	380815	Samson Lone Star	Hydraulic Fracturing Supply	32.072221	-94.344999	165	40	1	1	40.0	7,701	3,660	85	43.1
24	380807	Samson Lone Star	Hydraulic Fracturing Supply	32.072221	-94.344444	170	35	1	1	35.0	6,738	3,272	80	40.9
25	380149	Anadarko Petroleum	Rig Supply	32.087777	-94.277777	200	60	25	1	2.4	462	344	190	1.8
26	379685	PetroQuest Energy ,LLC	Rig Supply	32.148333	-94.068332	290	100	1	1	100.0	19,251	7,903	90	87.8
27	378620	Memorial Resource Development	Rig Supply	32.033333	-94.082499	200	70	10	1	7.0	1,348	847	190	4.5
28	378535	Valence Operating Co.	Rig Supply	32.06861	-94.458611	350	70	30	1	2.3	449	336	100	3.4
29	378018	Stephen Hammons	Domestic	32.249444	-94.453333	194	13	46	1	0.3	54	57	32	1.8
30	378007	Anadarko E&P Co.	Rig Supply	32.132221	-94.49111	320	60	40	1	1.5	289	232	190	1.2
31	377931	Mike Powell	Domestic	32.062777	-94.399721	235	15	85	1	0.2	34	38	25	1.5
32	377491	Anadarko	Rig Supply	32.182221	-94.448333	310	100	10	1	10.0	1,925	1,142	100	11.4
33	377106	Virgil Wedgeworth	Domestic	32.184166	-94.391944	203	16	52	2	0.3	59	61	28	2.2
34	377006	BP America	Rig Supply	32.134444	-94.417499	320	100	30	1	3.3	642	454	90	5.0
35	376568	Samson Lone Star	Rig Supply	32.059444	-94.147221	250	25	1	1	25.0	4,813	2,466	60	41.1
36	375905	Sophie Griffith	Domestic	32.003333	-94.537499	380	15	60	12	0.3	48	52	60	0.9
37	375904	Justin Crooms	Domestic	31.998055	-94.533333	360	12	60	3	0.2	39	43	56	0.8
38	375891	Charles Ford	Domestic	32.129166	-94.163055	130	7.6	20	3	0.4	73	73	84	0.9
39	373548	Samson Lone Star	Rig Supply	32.051111	-94.163888	145	75	1	1	75.0	14,439	6,207	80	77.6
40	371140	Anadarko E & P Co	Industrial	32.127499	-94.465277	420	60	40	1	1.5	289	232	100	2.3
41	371023	LARRY DYESS	Domestic	31.982777	-94.07861	199	5	100	1	0.1	10	13	44	0.3
42	371014	Anadarko	Rig Supply	32.147499	-94.472499	260	62	57	2	1.1	209	177	160	1.1
43	370731	BRUCE MAINES	Domestic	32.084166	-94.25	190	14	100	2	0.1	27	32	37	0.9
44	370726	MARK WEST ENERGY	Industrial	32.166666	-94.416666	346	50	60	2	0.8	160	142	27	5.2
45	370722	RUSSELL WATSON	Domestic	32.079166	-94.130832	199	35	40	2	0.9	168	148	39	3.8
46	370718	pIKE/NANCY HOOKER	Domestic	32.015277	-94.386388	73	15	20	2	0.8	144	130	31	4.2
47	370330	JARRETT FIELDS	Domestic	32.05	-94.399166	265	16	100	4	0.2	31	35	75	0.5
48	370290	Floyd Dryer	Domestic	32.253611	-94.428332	300	60	1	1	60.0	11,551	5,146	50	102.9
49	369669	XTO Energy	Rig Supply	32.319166	-94.255	320	20	150	4	0.1	26	30	80	0.4
50	368527	Ryan Bosworth	Domestic	32.111666	-94.489999	355	13	50	2	0.3	50	53	75	0.7
51	366101	Garrett, Barbara	Domestic	32.329999	-94.062777	151	12	80	1	0.2	29	34	25	1.3
52	364974	Valence Operating Company	Rig Supply	32.091666	-94.455833	340	80	20	1	4.0	770	529	200	2.6
53	363758	Keith Festervan	Domestic	32.223888	-94.046388	95	12	39	6	0.3	59	61	54	1.1
54	363471	Jack Harlin	Domestic	32.237221	-94.38611	147	55	40	1	1.4	265	216	27	8.0
55	363406	ANADARKO	Rig Supply	32.187499	-94.436388	330	62	52	1	1.2	230	191	100	1.9
56	361983	PetroQuest	Rig Supply	32.132221	-94.075277	240	100	10	1	10.0	1,925	1,142	200	5.7
57	360289	Samson Lone Star	Rig Supply	32.04861	-94.214722	200	65	1	1	65.0	12,513	5,504	100	55.0
58	359659	B.A MORRIS	Domestic	32.069721	-94.406944	251	10	154	12	0.1	13	17	48	0.3
59	358574	Lester Lewis	Domestic	32.288888	-94.427499	85	20	5	1	4.0	770	529	75	7.1
60	358216	PetroQuest	Rig Supply	32.132221	-94.054166	300	70	10	1	7.0	1,348	847	200	4.2
61	358016	Anadarko	Test Well	32.286944	-94.678888	290	80	70	1	1.1	220	185	110	1.7
62	358013	Anadarko	Test Well	32.298888	-94.671388	300	80	70	1	1.1	220	185	110	1.7
63	357137	PetroQuest	Rig Supply	32.117499	-94.067777	220	70	10	1	7.0	1,348	847	180	4.7
64	356968	Memorial Production Operating	Rig Supply	32.033333	-94.09611	200	75	1	1	75.0	14,439	6,207	100	62.1
65	356768	XTO Energy	Hydraulic Fracturing Supply	32.3125	-94.287499	160	100	10	1	10.0	1,925	1,142	100	11.4
66	355920	Don Vaughan	Stock	32.140555	-94.163333	218	15	74	2	0.2	39	43	26	1.7
67	355915	Larry Bullard	Stock	32.211666	-94.152222	270	42	58	1	0.7	139	126	110	1.1
68	355888	Don Vaughan	Stock	32.139721	-94.165555	272	28	86	2	0.3	63	64	34	1.9
69	355850	Tony Heard	Stock	32.268888	-94.325277	39	35	20	2	1.8	337	264	21	12.6
70	355849	Tony Heard	Stock	32.269443	-94.331388	40	35	20	2	1.8	337	264	21	12.6
71	355831	Richard Ballenger	Stock	32.239721	-94.379721	153	100	70	2	1.4	275	223	59	3.8
72	355777	XTO Energy	Rig Supply	32.356388	-94.449721	370	80	50	2	1.6	308	245	90	2.7
73	355428	Ralph Todd	Domestic	32.046666	-94.555277	253	17	30	2	0.6	109	102	28	3.7
74	355272	Memorial Production Operating	Hydraulic Fracturing Supply	32.020554	-94.360833	260	30	1	1	30.0	5,775	2,875	110	26.1
75	355187	Anadarko E & P	Industrial	32.176943	-94.451666	370	70	10	1	7.0	1,348	847	100	8.5
76	355176	Anadarko E&P Company	Industrial	32.172221	-94.379443	150	75	40	1	1.9	361	280	95	2.9
77	354684	Richard Hoell	Domestic	32.146666	-94.362222	203	100	80	2	1.3	241	199	27	7.4
78	354254	Ashley Morgan	Domestic	32.37361	-94.811388	265	50	50	2	1.0	193	165	25	6.6
79	354243	Mary Garrett	Domestic	32.193055	-94.492499	363	100	100	2	1.0	193	165	28	5.9
80	354228	Sharonda Jones	Domestic	32.168888	-94.506111	83	35	40	2	0.9	168	148	33	4.5
81	353994	Anadarko E&P	Industrial	32.136666	-94.479166	300	120	10	1	12.0	2,310	1,331	150	8.9
82	353987	Anadarko E&P Company	Industrial	32.135833	-94.474721	400	100	10	1	10.0	1,925	1,142	240	4.8
83	353811	Memorial Production Operating, LLC	Hydraulic Fracturing Supply	32.02111	-94.362777	280	35	1	1	35.0	6,738	3,272	100	32.7
84	353500	KEVIN WHITAKER	Domestic	31.982499	-94.128332	115	30	16	1	1.9	361	280	45	6.2
85	352079	BILLY ANDERSON	Stock	32.005555	-94.378332	370	50	90	4	0.6	107	101	127	0.8
86	352077	BILLY ANDERSON	Stock	32.005555	-94.377777	420	50	70	4	0.7	138	124	155	0.8
87	352001	Samson Lone Star	Rig Supply	32.053611	-94.176666	210	50	1	1	50.0	9,626	4,415	100	44.2
88	351659	MORGAN RABON	Irrigation	31.983888	-94.530277	333	96	160	4	0.6	116	108	121	0.9
89	351650	RUSSELL WHITAKER	Domestic	32.140833	-94.559722	333	12	22	4	0.5	105	99	108	0.9
90	351255	Anadarko E&P Company	Industrial	32.169443	-94.430554	360	100	10	1	10.0	1,925	1,142	100	11.4
91	351208	EOG Resources	Hydraulic Fracturing Supply	32.148888	-94.444721	340	60	1	1	60.0	11,551	5,146	100	51.5
92	351075	Anadarko E & P Company	Hydraulic Fracturing Supply	32.170277	-94.374721	250	150	10	1	15.0	2,888	1,606	200	8.0
93	351072	Anadarko	Hydraulic Fracturing Supply	32.171388	-94.372777	260	120	10	1	12.0	2,310	1,331	250	5.3
94	350845	Henry Spann	Domestic	32.019166	-94.18111	94	15	20	2	0.8	144	130	31	4.2
95	350220	Memorial Production Operating	Rig Supply	32.088888	-94.17611	340	80	1	1	80.0	15,401	6,552	100	65.5
96	350219	EOG Resources	Hydraulic Fracturing Supply	32.151388	-94.43861	360	60	1	1	60.0	11,551	5,146	160	32.2
97	349419	Petroquest	Rig Supply	32.125832	-94.084721	230	70	10	1	7.0	1,348	847	190	4.5
98	349264	R Lacy Service LTD	Rig Supply	32.269166	-94.324721	250	20	40	1	0.5	96	92	210	0.4
99	348761	EOG Resources	Hydraulic Fracturing Supply	32.147777	-94.444444	380	80	1	1	80.0	15,401	6,552	100	65.5
100	347060	Chevron	Rig Supply	32.203611	-94.415277	250	100	10	1	10.0	1,925	1,142	80	14.3
101	346983	Chevron	Rig Supply	32.24361	-94.403055	220	65	85	1	0.8	147	132	90	1.5

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
102	346756	EOG Resources	Hydraulic Fracturing Supply	32.170277	-94.454722	320	65	1	1	65.0	12,513	5,504	100	55.0
103	346754	EOG Resources	Hydraulic Fracturing Supply	32.169443	-94.454444	320	65	1	1	65.0	12,513	5,504	100	55.0
104	346597	Anadarko E & P Company	Industrial	32.217777	-94.37861	200	140	10	1	14.0	2,695	1,515	160	9.5
105	346466	Anadarko	Industrial	32.214722	-94.378888	190	120	10	1	12.0	2,310	1,331	160	8.3
106	345891	Samson Lone Star	Rig Supply	32.079721	-94.158333	140	30	1	1	30.0	5,775	2,875	100	28.7
107	344900	Old Bethel Baptist	Domestic	32.106666	-94.508611	125	9	90	3	0.1	19	24	37	0.6
108	344878	Clint Cassell	Domestic	31.982499	-94.229721	177	50	50	1	1.0	193	165	20	8.3
109	344610	Gladys Baker	Stock	32.137499	-94.483888	60	6	20	12	0.3	58	60	14	4.3
110	344608	Robert Fugler	Domestic	32.054444	-94.436388	210	44	80	4	0.6	106	100	72	1.4
111	344607	Patti Landreneau	Domestic	32.103888	-94.103888	305	33	90	3	0.4	71	71	50	1.4
112	344512	Caldwell, Jerry	Domestic	31.975277	-94.353333	300	38	144	1	0.3	51	54	100	0.5
113	344298	VALENCE OPERATING	Rig Supply	32.098333	-94.436388	260	70	89	1	0.8	151	135	120	1.1
114	344294	VALENCE OPERATING	Hydraulic Fracturing Supply	32.09861	-94.447499	240	75	23	1	3.3	628	446	120	3.7
115	342741	LAVERN RHODES	Domestic	32.3025	-94.154722	100	60	10	1	6.0	1,155	744	50	14.9
116	342727	Robert Jones	Domestic	32.0625	-94.489721	215	20	20	2	1.0	193	165	20	8.3
117	342618	ANADARKO E & P COMPANY	Industrial	32.204444	-94.366388	200	80	10	1	8.0	1,540	947	90	10.5
118	341823	EOG Resources	Hydraulic Fracturing Supply	32.170277	-94.450833	330	75	1	1	75.0	14,439	6,207	100	62.1
119	341822	EOG Resources	Hydraulic Fracturing Supply	32.172221	-94.443333	340	70	1	1	70.0	13,476	5,857	100	58.6
120	341020	ANADARKO E & P COMPANY	Industrial	32.18361	-94.42611	310	65	20	1	3.3	626	444	180	2.5
121	340268	XTO ENERGY	Rig Supply	32.3	-94.266943	200	70	10	1	7.0	1,348	847	140	6.0
122	340259	ANADARKO E & P COMPANY	Industrial	32.214166	-94.378054	180	70	10	1	7.0	1,348	847	100	8.5
123	339914	Memorial Resource Development	Rig Supply	32.045555	-94.385555	220	55	1	1	55.0	10,588	4,783	110	43.5
124	337560	James Browning	Domestic	32.170277	-94.548055	420	33	240	12	0.1	26	31	115	0.3
125	336694	PIKE/NANCY HOOKER	Domestic	32.02611	-94.443055	220	30	70	2	0.4	83	81	28	2.9
126	336689	JEB JAMES	Domestic	32.034999	-94.183333	225	35	100	2	0.4	67	68	35	2.0
127	336678	JOHNNY KELLEY	Domestic	32.198333	-94.509444	213	60	50	2	1.2	231	192	33	5.8
128	335011	Billy Carter	Irrigation	32.192499	-94.4125	258	120	100	3	1.2	231	192	88	2.2
129	334611	LOYD WOOD	Domestic	32.006111	-94.48111	320	20	30	1	0.7	128	117	40	2.9
130	334582	LOYD WOOD	Domestic	32.007777	-94.480554	310	15	40	1	0.4	72	72	40	1.8
131	334403	Chevron Texaco	Rig Supply	32.256111	-94.43361	340	70	178	2	0.4	76	75	100	0.8
132	334394	C.T. Investors	Rig Supply	32.047777	-94.287221	120	10	58	2	0.2	33	38	40	0.9
133	334137	Henry Toomey	Domestic	32.017221	-94.18361	390	80	20	2	4.0	770	529	20	26.5
134	333895	David Musick	Domestic	32.011944	-94.325832	300	15	20	2	0.8	144	130	10	13.0
135	333013	Chesapeake Operating	Rig Supply	32.294721	-94.147777	120	70	71	2	1.0	190	163	60	2.7
136	332571	Ritter Construction	Irrigation	31.98361	-94.183333	260	80	10	1	8.0	1,540	947	180	5.3
137	332566	GENE POWELL INVESTMENTS	Rig Supply	32.195555	-94.564444	380	70	194	2	0.4	69	70	130	0.5
138	332490	CHEVRON TEXACO	Rig Supply	32.292777	-94.432499	280	70	105	2	0.7	128	117	100	1.2
139	332489	Johnny Woodfin	Stock	31.983054	-94.456388	250	35	80	4	0.4	84	82	77	1.1
140	332488	CHEVRON TEXACO	Rig Supply	32.269999	-94.445277	400	75	153	2	0.5	94	91	50	1.8
141	332473	CHESAPEAKE OPERATING	Rig Supply	32.160277	-94.316666	190	75	68	2	1.1	212	179	90	2.0
142	332471	CHESAPEAKE OPERATING	Rig Supply	32.297777	-94.156944	140	70	70	2	1.0	193	165	60	2.8
143	332467	CHESAPEAKE OPERATING	Rig Supply	32.164444	-94.310277	180	75	70	2	1.1	206	175	100	1.7
144	332461	CHESAPEAKE OPERATING	Rig Supply	32.295277	-94.150277	100	35	51	2	0.7	132	120	70	1.7
145	332452	CHESAPEAKE OPERATING	Rig Supply	32.136388	-94.352777	240	75	118	2	0.6	122	113	90	1.3
146	332405	MAXIMUS ENERGY	Rig Supply	31.988055	-94.069999	220	75	91	2	0.8	159	140	100	1.4
147	332393	MAXIMUS ENERGY	Rig Supply	31.98111	-94.066111	260	70	128	2	0.5	105	99	100	1.0
148	332384	DEVON ENERGY	Rig Supply	32.07611	-94.375277	280	55	173	2	0.3	61	63	80	0.8
149	332381	DEVON ENERGY	Rig Supply	32.061666	-94.412777	310	65	118	2	0.6	106	100	60	1.7
150	332373	DEVON ENERGY	Rig Supply	32.228332	-94.361388	200	70	144	2	0.5	94	90	70	1.3
151	332367	DEVON ENERGY	Rig Supply	32.2625	-94.223888	220	10	118	2	0.1	16	21	60	0.3
152	332358	DEVON ENERGY	Rig Supply	32.064444	-94.395277	300	65	154	2	0.4	81	80	100	0.8
153	332355	DEVON ENERGY	Rig Supply	32.129999	-94.44611	280	20	194	2	0.1	20	24	80	0.3
154	332353	DEVON ENERGY	Rig Supply	32.115833	-94.39361	210	25	133	2	0.2	36	41	50	0.8
155	332347	DEVON ENERGY	Rig Supply	32.255	-94.237777	230	12	158	2	0.1	15	19	80	0.2
156	332332	TIM HOOPER	Domestic	32.026388	-94.389999	242	20	200	2	0.1	19	24	55	0.4
157	332329	DEVON ENERGY	Rig Supply	32.220277	-94.315833	100	80	35	2	2.3	440	331	70	4.7
158	332327	BUDDY POWELL	Domestic	32.056111	-94.085277	142	20	40	2	0.5	96	92	32	2.9
159	332321	MARK WEST ENERGY	Domestic	32.155277	-94.269721	52	15	15	2	1.0	193	165	27	6.1
160	332317	NOAH LUMAN	Domestic	32.120277	-94.277499	161	17	50	2	0.3	65	67	21	3.2
161	332306	DEVON ENERGY	Rig Supply	32.071943	-94.354444	240	65	144	2	0.5	87	85	90	0.9
162	332302	RALPH FUNK	Domestic	32.043333	-94.220832	98	20	20	2	1.0	193	165	26	6.4
163	332298	DEVON ENERGY	Rig Supply	32.056111	-94.3575	340	40	178	2	0.2	43	47	80	0.6
164	332273	Mel Hanson	Domestic	32.046666	-94.575277	335	15	20	1	0.8	144	130	30	4.3
165	332265	Josh Dunn	Domestic	32.145277	-94.366388	220	15	12	1	1.3	241	199	40	5.0
166	331706	ANADARKO E & P COMPANY	Industrial	32.200277	-94.366943	220	80	10	1	8.0	1,540	947	100	9.5
167	331553	Emmitt Rather	Domestic	32.072499	-94.534444	150	15	20	1	0.8	144	130	40	3.2
168	331544	Roy Pellum	Domestic	32.067777	-94.531666	130	10	20	1	0.5	96	92	30	3.1
169	331464	TOM DERBONNE	Domestic	32.035277	-94.053333	240	20	61	1	0.3	63	65	80	0.8
170	330415	Steven Lunsceford	Domestic	32.056388	-94.306111	185	30	80	3	0.4	72	72	25	2.9
171	330410	Kevin Lindsay	Domestic	32.015555	-94.313055	100	30	30	2	1.0	193	165	40	4.1
172	330401	Rebecca Shubert & Scott Baker	Domestic	32.048888	-94.304444	208	12	60	3	0.2	39	43	28	1.5
173	330397	John Ramsey	Domestic	32.034721	-94.392221	215	12	70	2	0.2	33	38	30	1.3
174	330388	Lowell Hanson / LP	Domestic	32.186944	-94.359166	220	35	50	2	0.7	135	122	63	1.9
175	330381	Ken Fike	Domestic	31.99111	-94.087777	260	16	30	3	0.5	103	97	45	2.2
176	330374	Tony Heard	Domestic	32.269999	-94.33361	217	7	140	2	0.1	10	13	31	0.4
177	330234	Larry Fields	Domestic	31.996388	-94.085277	200	20	50	2	0.4	77	76	32	2.4
178	330221	Sammy Peace	Stock	32.049444	-94.062777	53	20	15	1	1.3	257	210	23	9.1
179	330219	Sammy Peace	Stock	32.049444	-94.062777	40	20	15	1	1.3	257	210	20	10.5
180	330218	Sammy Peace	Stock	32.049444	-94.062777	40	20	15	1	1.3	257	210	20	10.5
181	330215	Sammy Peace	Stock	32.047221	-94.062777	48	15	20	1	0.8	144	130	22	5.9
182	330210	Sammy Peace	Stock	32.047221	-94.066666	52	15	25	1	0.6	116	108	25	4.3
183	330204	Jerry Hudson	Stock	32.095277	-94.287777	215	25	50	2	0.5	96	92	30	3.1
184	330198	Jerry Hudson	Stock	32.095277	-94.28861	215	25	50	2	0.5	96	92	30	3.1
185	330190	Aubrey Sipes	Domestic	32.267221	-94.524166	253	25	70	2	0.4	69	70	38	1.8
186	330182	tony heard	Domestic	32.269999	-94.33361	217	7	140	2	0.1	10	13	31	0.4
187	330174	jason davis	Domestic	32.065555	-94.448333	231	25	70	2	0.4	69	70	26	2.7
188	330153	Kenneth Holmes	Stock	32.056111	-94.214444	64	20	25	2	0.8	154	137	25	5.5
189	330144	Kenneth Holmes	Stock	32.053611	-94.211388	49.5	15	20	2	0.8	144	130	15	8.9
190	330143	Kenneth Holmes	Stock	32.053055	-94.213611	51	15	20	2	0.8	144	130	16	8.1
191	330093	Kenneth Holmes	Stock	32.053055	-94.213611	51	20	15	2	1.3	257	210	21	10.0
192	330091	Kenneth Holmes	Stock	32.057222	-94.208611	39	20	15	2	1.3	257	210	21	10.0
193	330077	bill don davis	Domestic	32.049444	-94.223888	76	10	20	2	0.5	96	92	30	3.1
194	330074	cassie davis	Domestic	32.036944	-94.196666	45	15	15	2	1.0	193	165	17	9.7
195	330071	todd davis	Domestic	32.049444	-94.225554	69	12	30	2	0.4	77	76	33	2.3
196	330065	bobby wiggins	Domestic	32.271943	-94.336388	160	30	40	2	0.8	144	130	30	4.3
197	330058	Sam Allison	Domestic	32.249444	-94.33361	35	15	9	2	1.7	321	254	20	12.7
198	330047	todd Bogenschutz	Domestic	32.140555	-94.504722	378	25	40	2	0.6	120	111	38	2.9
199	330043	Greg Humber	Domestic	32.072777	-94.401111	236	12	100	3	0.1	23	28	26	1.1
200	330033	Dustin Cockerham	Domestic	32.072221	-94.44611	225	15	40	2	0.4	72	72	35	2.1
201	330021	Matt Comer	Domestic	32.065555	-94.441944	201	15	40	2	0.4	72	72	36	2.0
202	330013	John Bertrand	Domestic	32.191944	-94.401666	180	40	40	2	1.0	193	165	30	5.5

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
203	330007	Billy Ross	Domestic	32.263333	-94.437777	190	15	40	2	0.4	72	72	25	2.9
204	329998	Milo Lazarini	Domestic	32.266111	-94.43361	200	25	50	2	0.5	96	92	33	2.8
205	326985	Dave and Emily LaForce	Domestic	32.207222	-94.500555	385	15	55	2	0.3	53	55	35	1.6
206	326965	VALENCE OPERATING	Rig Supply	32.08361	-94.416943	210	70	20	1	3.5	674	473	100	4.7
207	326920	ANADARKO E & P COMPANY	Industrial	32.166943	-94.350277	160	100	10	1	10.0	1,925	1,142	90	12.7
208	326792	ANADARKO E & P COMPANY	Rig Supply	32.183333	-94.38361	245	70	10	1	7.0	1,348	847	100	8.5
209	326773	ANADARKO E & P COMPANY	Industrial	32.133333	-94.416943	260	100	10	1	10.0	1,925	1,142	100	11.4
210	326371	ANADARKO E & P COMPANY	Industrial	32.183333	-94.38361	230	125	40	1	3.1	602	430	90	4.8
211	325479	Samson Lone Star	Rig Supply	32.119166	-94.118332	220	100	1	1	100.0	19,251	7,903	90	87.8
212	324703	Randy Atwood	Irrigation	32.22361	-94.044721	82	25	70	2	0.4	69	70	70	1.0
213	324672	Henry Howard	Domestic	32.121388	-94.531666	220	15	200	3	0.1	14	19	31	0.6
214	322141	Bill Bailey	Irrigation	32.243055	-94.448055	39	10	10	1	1.0	193	165	19	8.7
215	322137	C R Stone	Domestic	32.230832	-94.443333	213	13	26	1	0.5	96	92	16	5.8
216	322053	Gary WSC	Test Well	32.087221	-94.462777	382	35	131	4	0.3	51	54	202	0.3
217	321948	ANADARKO E & P COMPANY	Industrial	32	-94.366666	340	100	20	1	5.0	963	638	110	5.8
218	321943	ANADARKO E & P COMPANY	Industrial	32.166666	-94.366666	160	100	10	1	10.0	1,925	1,142	100	11.4
219	321918	XTO ENERGY	Rig Supply	32.356111	-94.442499	400	70	57	1	1.2	236	196	100	2.0
220	321576	Samson Lone Star	Rig Supply	32.044721	-94.156388	160	120	1	1	120.0	23,102	9,211	70	131.6
221	321526	Gary WSC	Public Supply	32.029166	-94.3625	362	40	69	4	0.6	112	104	182	0.6
222	320712	ROGER ROBINSON	Domestic	31.993888	-94.119999	100	25	37	1	0.7	130	119	40	3.0
223	319840	Tom Harrington	Domestic	32.038888	-94.465833	224	10	110	4	0.1	18	22	59	0.4
224	319597	Margaretha Baker	Domestic	32.139999	-94.391388	200	8	100	2	0.1	15	20	30	0.7
225	319576	John Hamilton	Domestic	32.148333	-94.327777	60	30	20	1	1.5	289	232	30	7.7
226	319483	JACKIE STEPHENS	Domestic	32.090277	-94.083888	200	6	127	1	0.0	9	13	40	0.3
227	317962	George Taylor	Domestic	32.03611	-94.587221	420	20	40	3	0.5	96	92	90	1.0
228	317717	ANADARKO E & P COMPANY	Industrial	32.183333	-94.400277	180	80	10	1	8.0	1,540	947	80	11.8
229	317452	XTO ENERGY	Hydraulic Fracturing Supply	32.358888	-94.424166	370	100	20	1	5.0	963	638	170	3.8
230	317220	XTO ENERGY	Rig Supply	32.35	-94.416666	360	100	40	1	2.5	481	357	160	2.2
231	315636	Pinnergy, Ltd.	Industrial	32.15	-94.566943	560	100	40	1	2.5	481	357	220	1.6
232	315217	L. C. Tew	Domestic	32.27861	-94.208611	200	15	60	1	0.3	48	52	90	0.6
233	314613	Chesapeake Operating	Rig Supply	32.141666	-94.083888	280	70	1	1	70.0	13,476	5,857	90	65.1
234	313445	Johnny Webb	Domestic	31.985833	-94.446666	220	15	50	4	0.3	58	60	50	1.2
235	313296	Jeremy Beralleaux	Domestic	32.138888	-94.378888	230	15	100	4	0.2	29	34	26	1.3
236	313289	Madonna Ashmore	Domestic	32.073054	-94.547499	280	13	41	2	0.3	61	63	28	2.2
237	313284	J R Duke	Domestic	32.106944	-94.459166	298	15	30	1	0.5	96	92	28	3.3
238	313259	Charles R. Reynolds	Domestic	32.123888	-94.179721	82	12	20	6	0.6	116	108	41	2.6
239	313257	Terry Goodwin	Domestic	32.036666	-94.046666	188	9	100	1	0.1	17	22	72	0.3
240	313253	Brad Barnes	Domestic	32.04611	-94.22361	113	15	40	3	0.4	72	72	45	1.6
241	313223	Samson Lone Star	Rig Supply	32.053888	-94.171666	140	100	1	1	100.0	19,251	7,903	60	131.7
242	313049	ANADARKO E & O COMPANY	Industrial	32.18361	-94.416943	190	30	10	1	3.0	578	416	100	4.2
243	313048	ANADARKO E & P COMPANY	Industrial	32.166666	-94.366666	180	70	10	1	7.0	1,348	847	100	8.5
244	312514	ANADARKO E & P COMPANY	Industrial	32.083333	-94.3	170	80	10	1	8.0	1,540	947	80	11.8
245	312163	HOWARD KADE COCKRELL	Domestic	31.986388	-94.122777	120	25	46	1	0.5	105	99	40	2.5
246	311934	ANADARKO E & P COMPANY	Industrial	31.974721	-94.543333	320	80	20	1	4.0	770	529	140	3.8
247	311888	ANADARKO E & P COMPANY	Industrial	32.200277	-94.366666	165	70	10	1	7.0	1,348	847	105	8.1
248	311855	TANOS EXPLORATION, LLC	Rig Supply	32.333333	-94.483333	390	50	90	1	0.6	107	101	180	0.6
249	311482	XTO Energy	Rig Supply	32.289999	-94.462777	452	65	75	1	0.9	167	146	102	1.4
250	310549	ANADARKO E & P COMPANY	Industrial	32.15	-94.516666	340	80	15	1	5.3	1,027	674	140	4.8
251	310134	ANADARKO E & P COMPANY	Industrial	32.048888	-94.282499	210	80	10	1	8.0	1,540	947	180	5.3
252	310088	James Jackson	Domestic	32.062222	-94.514722	340	10	100	1	0.1	19	24	40	0.6
253	310072	VALENCE OPERATING	Hydraulic Fracturing Supply	32.088888	-94.43611	300	78	82	1	1.0	183	158	140	1.1
254	309934	Forest Oil Corporation	Hydraulic Fracturing Supply	32.034444	-94.208333	230	78	1	1	78.0	15,016	6,414	80	80.2
255	309911	Samson Lone Star	Rig Supply	32.051388	-94.203333	140	75	1	1	75.0	14,439	6,207	90	69.0
256	309549	Craig Wimberly	Domestic	32.128332	-94.144999	68	10	22	0.5	0.5	88	85	20	4.3
257	309546	Craig Wimberly	Domestic	32.128332	-94.144999	37	8	10	0.5	0.8	154	137	18	7.6
258	308282	Forest Oil Corporation	Rig Supply	32.021666	-94.194444	160	80	1	1	80.0	15,401	6,552	80	81.9
259	307985	WILDHORSE RESOURCES	Rig Supply	32.013055	-94.33861	220	65	147	3	0.4	85	83	120	0.7
260	307735	ANADARKO E & P COMPANY	Industrial	32.197221	-94.434999	340	55	110	1	0.5	96	92	100	0.9
261	307493	PETROQUEST ENERGY, LLC	Rig Supply	32.08361	-94.100277	300	70	10	1	7.0	1,348	847	180	4.7
262	306888	XTO ENERGY	Hydraulic Fracturing Supply	32.333333	-94.283333	380	80	20	1	4.0	770	529	100	5.3
263	306886	ANADARKO E & P COMPANY	Industrial	32.183333	-94.4	180	70	10	1	7.0	1,348	847	100	8.5
264	306732	Samson Lone Star	Rig Supply	32.055277	-94.222499	160	65	1	1	65.0	12,513	5,504	90	61.2
265	305804	ANADARKO E& P COMPANY	Industrial	32.143333	-94.391388	260	80	20	1	4.0	770	529	100	5.3
266	305691	XTO Energy	Rig Supply	32.361111	-94.47361	205	70	20	1	3.5	674	473	80	5.9
267	304899	DEVON ENERGY	Rig Supply	32.037777	-94.370277	320	65	141	1	0.5	89	86	200	0.4
268	304845	VALENCE OPERATING COMPANY	Rig Supply	32.091388	-94.440555	270	55	85	1	0.6	125	115	120	1.0
269	304724	EOG Resources	Stock	32.066111	-94.350555	220	30	50	1	0.6	116	108	100	1.1
270	304677	ANADARKO E & P COMPANY	Industrial	32.018888	-94.528888	340	55	110	1	0.5	96	92	190	0.5
271	304665	RITTER CONSTRUCTION COMPANY	Domestic	31.999721	-94.183888	120	10	15	1	0.7	128	117	70	1.7
272	304302	Samson Lone Star	Rig Supply	32.052222	-94.217777	260	65	1	1	65.0	12,513	5,504	80	68.8
273	303281	WILDHORSE RESOURCES	Rig Supply	32.014444	-94.336944	220	70	130	1	0.5	104	98	190	0.5
274	302844	Holland, Linda	Domestic	32.101111	-94.149166	120	35	45	1	0.8	150	134	97	1.4
275	302838	Berry, James	Stock	32.160833	-94.094444	270	35	145	1	0.2	46	50	90	0.6
276	302809	Weaver, Pamela	Domestic	32.194444	-94.258333	62	10	42	1	0.2	46	49	52	1.0
277	302236	XTO ENERGY	Hydraulic Fracturing Supply	32.35	-94.416943	400	100	20	1	5.0	963	638	160	4.0
278	300812	XTO Energy	Rig Supply	32.317777	-94.248888	310	50	50	2	1.0	193	165	200	0.8
279	300725	ANADARKO E & P COMPANY	Industrial	32.206388	-94.387221	240	65	85	1	0.8	147	132	90	1.5
280	299968	Ricky Little	Domestic	32.345555	-94.129166	183	25	70	1	0.4	69	70	85	0.8
281	299252	Samson	Rig Supply	32.079443	-94.183054	120	120	1	1	120.0	23,102	9,211	70	131.6
282	298731	ANADARKO E & P COMPANY	Industrial	32.001111	-94.504722	300	60	87	1	0.7	133	121	180	0.7
283	298494	Jenna Stewart	Domestic	32.18861	-94.309166	502	38	80	1	0.5	91	88	110	0.8
284	296252	EOG Resources	Rig Supply	32.063611	-94.344721	230	50	1	1	50.0	9,626	4,415	100	44.2
285	296030	JEREMY MCBRIDE	Domestic	31.985833	-94.145833	320	50	148	1	0.3	65	66	60	1.1
286	294249	ANADARKO E & P COMPANY	Industrial	32.160833	-94.400833	300	55	70	1	0.8	151	135	100	1.3
287	293730	Rob Tuttle	Domestic	32.261944	-94.523332	345	15	120	3	0.1	24	29	91	0.3
288	292061	VALENCE OPERATING	Rig Supply	32.32861	-94.267499	530	70	106	1	0.7	127	117	130	0.9
289	292041	EOG RESOURCES	Hydraulic Fracturing Supply	32.171666	-94.44361	340	70	50	1	1.4	270	219	100	2.2
290	291918	ANADARKO E & P COMPANY	Industrial	32.103333	-94.283888	220	65	85	1	0.8	147	132	150	0.9
291	291897	ANADARKO E & P COMPANY	Industrial	32.084444	-94.305555	220	65	85	1	0.8	147	132	100	1.3
292	291755	ANADARKO E & P COMPANUY	Industrial	32.183333	-94.350277	200	80	20	1	4.0	770	529	100	5.3
293	291754	ANADARKO E & P COMPANY	Industrial	32.2	-94.38361	290	70	20	1	3.5	674	473	90	5.3
294	290982	ANADARKO E & P COMPANY	Industrial	32.183333	-94.350277	200	80	20	1	4.0	770	529	100	5.3
295	290981	ANADARKO E & P COMPANY	Industrial	32.2	-94.38361	290	70	20	1	3.5	674	473	90	5.3
296	290340	RITTER CONSTRUCTION COMPANY	Stock	32.005277	-94.17861	90	35	45	1	0.8	150	134	40	3.3
297	290339	RITTER CONSTRUCTION COMPANY	Stock	32.089166	-94.393333	80	15	20	1	0.8	144	130	30	4.3
298	290198	RITTER CONSTRUCTION COMPANY	Stock	32.000277	-94.15	85	15	5	1	3.0	578	416	75	5.5
299	290190	RITTER CONSTRUCTION COMPANY	Stock	32.073332	-94.368888	160	70	40	1	1.8	337	264	90	2.9
300	289534	Dan Parker	Domestic	32.138055	-94.379443	216	15	40	1	0.4	72	72	28	2.6
301	289529	Jeff Davison	Domestic	32.138888	-94.379721	225	15	123	40	0.1	23	28	35	0.8
302	289524	Tim Harkrider	Domestic	32.139444	-94.381666	218	15	120	1	0.1	24	29	33	0.9
303	289515	CISD	Irrigation	32.160277	-94.35	278	100	100	1	1.0	193	165	37	4.5

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
304	289508	CISD	Irrigation	32.163888	-94.365555	280	100	100	1	1.0	193	165	47	3.5
305	289499	Ashley Morgan	Domestic	32.224166	-94.486666	405	15	60	2	0.3	48	52	30	1.7
306	289052	harelton oil and gas	Rig Supply	32.150277	-94.174721	290	40	2	1	20.0	3,850	2,045	60	34.1
307	288887	JEREMY MCBRIDE	Domestic	31.985833	-94.145833	160	67	51	1	1.3	253	208	30	6.9
308	288866	harleton oil and gas	Rig Supply	32.161944	-94.161111	230	25	10	1	2.5	481	357	75	4.8
309	288443	ANADARKO E & P COMPANY	Industrial	32.1525	-94.400277	290	55	85	1	0.6	125	115	100	1.1
310	288297	ANADARKO E & P COMPANY	Industrial	32.188888	-94.403055	230	150	15	1	10.0	1,925	1,142	80	14.3
311	288225	ANADARKO E & P COMPANY	Industrial	32.1525	-94.405	280	55	85	1	0.6	125	115	100	1.1
312	287722	ANADARKO E & P COMPANY	Industrial	32.153333	-94.504166	400	50	90	1	0.6	107	101	200	0.5
313	287620	VALENCE OPERATING COMPANY	Rig Supply	32.331666	-94.271666	300	60	87	1	0.7	133	121	100	1.2
314	287550	Tondreau, David & JoAnn	Domestic	32.015	-94.372777	240	15	98	1	0.2	29	34	110	0.3
315	286180	Samson	Hydraulic Fracturing Supply	32.070832	-94.140555	280	60	1	1	60.0	11,551	5,146	100	51.5
316	286177	Samson	Hydraulic Fracturing Supply	32.070277	-94.133888	260	30	1	1	30.0	5,775	2,875	100	28.7
317	285560	Samson	Hydraulic Fracturing Supply	32.070277	-94.140277	240	80	1	1	80.0	15,401	6,552	100	65.5
318	285559	Samson	Rig Supply	32.053055	-94.194444	160	100	1	1	100.0	19,251	7,903	100	79.0
319	285558	Samson	Hydraulic Fracturing Supply	32.047499	-94.199444	160	50	1	1	50.0	9,626	4,415	100	44.2
320	285555	Samson	Rig Supply	32.047777	-94.190555	160	100	1	1	100.0	19,251	7,903	75	105.4
321	284964	ANADARKO E & P COMPANY	Industrial	32.183333	-94.383333	225	80	10	1	8.0	1,540	947	100	9.5
322	284922	ANADARKO E & P COMPANY	Industrial	32.184444	-94.35	200	45	150	1	0.3	58	60	130	0.5
323	284921	ANADARKO E & P COMPANY	Industrial	32.15	-94.5	400	80	25	1	3.2	616	439	140	3.1
324	284758	ANADARKO E & P COMPANY	Industrial	32.110277	-94.25	100	140	30	1	4.7	898	602	70	8.6
325	284338	ANADARKO E & P COMPANY	Industrial	32.166943	-94.416666	190	65	10	1	6.5	1,251	796	100	8.0
326	284333	CHEVRON	Rig Supply	32.1	-94.466666	350	80	15	1	5.3	1,027	674	100	6.7
327	284163	ANADARKO E & P COMPANY	Industrial	32.108333	-94.268888	250	50	85	1	0.6	113	106	130	0.8
328	283869	VALENCE OPERATING COMPANY	Rig Supply	32.332499	-94.264444	320	55	110	1	0.5	96	92	110	0.8
329	283527	Red River Drilling	Rig Supply	32.367221	-94.068888	210	80	1	1	80.0	15,401	6,552	90	72.8
330	282755	J.P. Davis	Stock	32.073054	-94.435277	322	47	142	1	0.3	64	65	102	0.6
331	281774	XTO ENERGY, INC.	Hydraulic Fracturing Supply	32.358611	-94.428332	380	50	90	1	0.6	107	101	160	0.6
332	281760	ANADARKO E & P COMPANY	Industrial	32.166666	-94.366943	125	70	5	1	14.0	2,695	1,515	85	17.8
333	281630	Peggy Brightwell	Domestic	32.252777	-94.427777	320	100	1	1	100.0	19,251	7,903	70	112.9
334	280930	PETROQUEST	Rig Supply	32.122221	-94.103333	140	75	40	1	1.9	361	280	90	3.1
335	280901	XTO ENERGY, INC.	Hydraulic Fracturing Supply	32.357777	-94.432221	350	50	90	1	0.6	107	101	130	0.8
336	280500	ANADARKO E & P COMPANY	Industrial	32.153888	-94.515	280	55	85	1	0.6	125	115	110	1.0
337	280457	Floyd Dyer	Domestic	32.253888	-94.427499	300	80	1	1	80.0	15,401	6,552	70	93.6
338	280442	CHEVRON	Rig Supply	32.216666	-94.466666	200	60	70	1	0.9	165	145	90	1.6
339	279147	ANADARKO E & P COMPANY	Industrial	32.083333	-94.2	200	50	10	1	5.0	963	638	90	7.1
340	279146	ANADARKO E & P COMPANY	Industrial	32.183333	-94.35	200	65	10	1	6.5	1,251	796	100	8.0
341	279113	ANADARKO E & P COMPANY	Industrial	32.021388	-94.477221	300	55	70	1	0.8	151	135	190	0.7
342	277747	ANADARKO E & P COMPANY	Industrial	32.064444	-94.2	170	40	70	1	0.6	110	103	100	1.0
343	277638	PETROQUEST	Rig Supply	32.15	-94.083333	260	70	15	1	4.7	898	602	80	7.5
344	277510	Jim Strong	Domestic	32.064444	-94.097777	92	25	1	1	25.0	4,813	2,466	73	33.8
345	277268	ANADARKO E & P COMPANY	Industrial	32.177777	-94.428332	340	60	150	1	0.4	77	76	140	0.5
346	276978	Manuell Munoz	Domestic	32.014444	-94.372499	246	10	50	1	0.2	39	43	31	1.4
347	276974	Nancey Alexander	Domestic	32.03111	-94.370554	269	10	100	1	0.1	19	24	38	0.6
348	276905	Mr Lake	Domestic	31.994999	-94.499444	325	10	40	1	0.3	48	52	32	1.6
349	276785	XTO ENERGY, INC.	Rig Supply	32.303333	-94.313888	320	55	110	1	0.5	96	92	100	0.9
350	276448	Samson	Rig Supply	32.078888	-94.154444	100	75	1	1	75.0	14,439	6,207	85	73.0
351	276444	PANOLA COUNTY RD AND BRIDGE	Domestic	32.293055	-94.542777	335	15	60	1	0.3	48	52	18	2.9
352	276415	Judy Bellows	Domestic	32.040555	-94.305555	181	13	40	1	0.3	63	64	25	2.6
353	275669	ANADASRKO E & P COMPANY LP	Industrial	32.166666	-94.416943	360	90	15	1	6.0	1,155	744	100	7.4
354	274782	XTO ENERGY, INC.	Rig Supply	32.222221	-94.1	75	70	5	1	14.0	2,695	1,515	55	27.6
355	274446	Allison	Stock	32.191944	-94.41861	295	15	10	1	1.5	289	232	93	2.5
356	274418	ANADARKO E & P COMPANY	Industrial	32.192221	-94.352222	230	65	85	1	0.8	147	132	100	1.3
357	274221	PETROQUEST	Rig Supply	32.15	-94.066666	170	70	10	1	7.0	1,348	847	100	8.5
358	274089	Leon Moore	Domestic	32.0075	-94.593888	340	25	40	4	0.6	120	111	100	1.1
359	273996	XTO ENERGY, INC.	Rig Supply	32.241666	-94.201944	200	65	85	1	0.8	147	132	170	0.8
360	273905	ANADARKO E & P COMPANY	Industrial	32.019999	-94.402222	320	55	110	1	0.5	96	92	170	0.5
361	273730	Samson Lone Star	Hydraulic Fracturing Supply	32.1125	-94.107777	240	75	1	1	75.0	14,439	6,207	100	62.1
362	273712	Samson Lone Star	Rig Supply	32.119443	-94.124999	200	50	1	1	50.0	9,626	4,415	90	49.1
363	272996	DEVON ENERGY	Rig Supply	32.038333	-94.357777	300	65	41	1	1.6	305	243	170	1.4
364	272421	Deadwood WSC	Public Supply	32.178888	-94.177221	300	66	186	1	0.4	68	69	150	0.5
365	272264	CHEVRON TEXACO	Rig Supply	32.083333	-94.050277	220	75	10	1	7.5	1,444	897	160	5.6
366	272138	Michael Hadman	Domestic	32.057777	-94.516111	300	15	10	24	1.5	289	232	40	5.8
367	271535	ANADARKO E & P COMPANY	Industrial	32.223332	-94.375554	160	75	10	1	7.5	1,444	897	80	11.2
368	271524	XTO ENERGY	Rig Supply	32.298055	-94.203611	190	40	20	1	2.0	385	296	100	3.0
369	271523	ANADARKO E & P COMPANY	Industrial	32.13361	-94.400277	280	80	20	1	4.0	770	529	100	5.3
370	271189	XTO ENERGY	Rig Supply	32.28361	-94.273888	100	50	50	1	1.0	193	165	40	4.1
371	271069	DEVON ENERGY	Hydraulic Fracturing Supply	32.022777	-94.379443	300	5	118	1	0.0	8	12	180	0.1
372	271056	DEVON ENERGY	Hydraulic Fracturing Supply	32.084166	-94.312777	200	60	33	1	1.8	350	273	100	2.7
373	270995	HENRY HOWARD	Domestic	32.121666	-94.531943	380	50	47	1	1.1	205	174	80	2.2
374	270994	HENRY HOWARD	Stock	32.124166	-94.533054	380	50	52	1	1.0	185	160	80	2.0
375	270992	DEVON ENERGY	Rig Supply	32.03361	-94.391944	300	30	190	1	0.2	30	35	180	0.2
376	270938	Collier, Will	Domestic	32.36	-94.190555	265	100	52	1	1.9	370	286	165	1.7
377	270931	Collier, Will	Domestic	32.3575	-94.189444	280	40	48	1	0.8	160	142	120	1.2
378	270817	XTO ENERGY, INC.	Rig Supply	32.35	-94.4	360	55	100	1	0.6	106	100	250	0.4
379	270576	Classic Operating	Rig Supply	32.280277	-94.51861	420	60	1	1	60.0	11,551	5,146	90	57.2
380	270422	Marvin Ritter	Domestic	32.04611	-94.401944	285	100	40	24	2.5	481	357	85	4.2
381	269531	ANADARKO E & P COMPANY	Industrial	32.13361	-94.4	280	70	20	1	3.5	674	473	100	4.7
382	269319	Classic Hydrocarbon	Rig Supply	32.014444	-94.080554	240	70	1	1	70.0	13,476	5,857	85	68.9
383	268932	Deadwood WSC	Test Well	32.179721	-94.193888	360	42	99	8	0.4	82	80	155	0.5
384	268509	R. LACY SERVICE LTD.	Rig Supply	32.283333	-94.333333	360	65	25	1	2.6	501	368	160	2.3
385	268323	harelton oil and gas	Rig Supply	32.060277	-94.096666	160	35	1	2	35.0	6,738	3,272	65	50.3
386	268315	XTO ENERGY, INC.	Hydraulic Fracturing Supply	32.3	-94.183333	210	100	20	1	5.0	963	638	90	7.1
387	268031	XTO ENERGY	Hydraulic Fracturing Supply	32.301666	-94.183333	220	100	20	1	5.0	963	638	100	6.4
388	267876	Classic Operating	Rig Supply	32.018054	-94.045277	170	80	1	1	80.0	15,401	6,552	100	65.5
389	267338	Eva Harris	Domestic	32.248333	-94.209444	193	50	62	1	0.8	155	138	70	2.0
390	267022	CHEVRON TEXACO	Rig Supply	32.23361	-94.433333	360	50	90	1	0.6	107	101	110	0.9
391	267010	DEVON ENERGY	Rig Supply	32.039166	-94.394999	380	50	44	1	1.1	219	184	180	1.0
392	266373	DEVON ENERGY	Rig Supply	32.034166	-94.379443	400	30	256	1	0.1	23	27	100	0.3
393	266292	XTO ENERGY, INC.	Rig Supply	32.33361	-94.4	240	75	15	1	5.0	963	638	140	4.6
394	266226	Dove Creek Energy	Rig Supply	32.181666	-94.498888	282	85	66	1	1.3	248	204	22	9.3
395	265675	XTO ENERGY, INC.	Hydraulic Fracturing Supply	32.3	-94.183333	200	70	150	1	0.5	90	87	160	0.5
396	265512	Stewart Lipsey	Domestic	32.147777	-94.361111	245	60	1	1	60.0	11,551	5,146	85	60.5
397	265410	DEVON ENERGY PROD CO LP	Hydraulic Fracturing Supply	32.033333	-94.383333	340	60	45	1	1.3	257	210	180	1.2
398	264944	DEVON ENERGY PROD. CO LP	Hydraulic Fracturing Supply	32.016943	-94.383333	320	60	30	1	2.0	385	296	180	1.6
399	264454	MR & MRS JOE HEWITT	Domestic	31.990555	-94.074443	180	15	126	2	0.1	23	28	60	0.5
400	263985	Beckville Disposal	Industrial	32.224999	-94.490277	180	75	1	1	75.0	14,439	6,207	80	77.6
401	262698	DEVON ENERGY	Rig Supply	32.09611	-94.37611	300	45	114	1	0.4	76	76	120	0.6
402	262646	XTO ENERGY	Hydraulic Fracturing Supply	32.33361	-94.433333	290	100	85	1	1.2	226	189	110	1.7
403	261121	ANADARKO E & P COMPANY	Industrial	32.116666	-94.38361	140	75	40	1	1.9	361	280	50	5.6
404	260836	ANADARKO E & P COMPANY	Industrial	32.116666	-95.366943	200	80	10	1	8.0	1,540	947	120	7.9

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
405	260484	ANADARKO E & P COMPANY	Industrial	32.033333	-94.366943	190	75	50	1	1.5	289	232	110	2.1
406	260319	ANADARKO E & P COMPANY	Industrial	32.116666	-94.38361	120	80	5	1	16.0	3,080	1,695	80	21.2
407	259927	EMMER GRAY MALLARD, et al	Rig Supply	32.291388	-94.138055	120	60	46	1	1.3	251	206	50	4.1
408	259261	DEVON ENERGY	Hydraulic Fracturing Supply	32.325277	-94.126943	140	65	45	1	1.4	278	225	60	3.7
409	259029	ANADARKO E & P COMPANY	Industrial	32.200277	-94.366943	200	65	90	1	0.7	139	126	80	1.6
410	258972	ANADARKO E & P COMPANY	Industrial	31.98361	-94.366943	290	75	10	1	7.5	1,444	897	175	5.1
411	257854	ANADARKO E & P COMPANY, INC.	Industrial	32.066943	-94.18361	80	65	5	1	13.0	2,503	1,424	50	28.5
412	256998	Key Production	Rig Supply	32.03611	-94.09611	210	70	143	2	0.5	94	91	80	1.1
413	256995	Comstock Oil & Gas	Rig Supply	32.245555	-94.498888	400	70	208	2	0.3	65	66	100	0.7
414	256987	Chevron Texaco	Rig Supply	32.244721	-94.406666	220	65	139	2	0.5	90	87	100	0.9
415	256986	Chevron Texaco	Rig Supply	32.170832	-94.489444	160	70	66	2	1.1	204	173	80	2.2
416	256985	Chevron Texaco	Rig Supply	32.252222	-94.453611	310	75	112	2	0.7	129	118	80	1.5
417	256984	Chevron Texaco	Rig Supply	32.289444	-94.434444	460	70	164	2	0.4	82	81	200	0.4
418	256981	Devon Energy	Rig Supply	32.089444	-94.244444	100	70	41	2	1.7	329	259	50	5.2
419	256978	Devon Energy	Rig Supply	32.049444	-94.389721	300	50	173	2	0.3	56	58	100	0.6
420	256968	Devon Energy	Rig Supply	32.089166	-94.478888	100	70	49	2	1.4	275	223	50	4.5
421	256963	Devon Energy	Rig Supply	32.098888	-94.267221	260	70	134	2	0.5	101	96	100	1.0
422	256962	Devon Energy	Rig Supply	32.077221	-94.441388	260	75	148	2	0.5	98	93	100	0.9
423	256959	Chesapeake Operating	Rig Supply	32.123888	-94.487777	370	70	184	2	0.4	73	73	100	0.7
424	256958	Chesapeake Operating	Rig Supply	32.097499	-94.358611	260	20	174	2	0.1	22	27	80	0.3
425	256956	Chesapeake Operating	Rig Supply	32.076943	-94.465	280	60	174	2	0.3	66	68	80	0.8
426	256952	Chesapeake Operating	Rig Supply	32.103888	-94.36	260	60	152	2	0.4	76	76	60	1.3
427	256381	XTO ENERGY, INC.	Rig Supply	32.083333	-94.166666	400	65	60	1	1.1	209	177	220	0.8
428	256358	XTO ENERGY	Rig Supply	32.350555	-94.392777	280	100	50	1	2.0	385	296	100	3.0
429	255648	PETROQUEST	Rig Supply	32.033333	-94.083333	260	65	70	1	0.9	179	155	220	0.7
430	255290	GLENN BORDNER	Domestic	31.981943	-94.129999	100	60	21	1	2.9	550	399	40	10.0
431	255265	ANADARKO E & P COMPANY, INC.	Industrial	32.166666	-94.400277	200	65	25	1	2.6	501	368	100	3.7
432	254616	R. LACY	Rig Supply	32.266666	-94.4	280	55	80	1	0.7	132	121	100	1.2
433	254219	PETROQUEST	Rig Supply	32.033333	-94.083333	220	65	85	1	0.8	147	132	180	0.7
434	254174	S. D. TWOMEY	Irrigation	32.13361	-94.3	190	75	50	1	1.5	289	232	110	2.1
435	252691	Action Frac Fluids	Rig Supply	32.091944	-94.04361	140	55	2	1	27.5	5,294	2,672	65	41.1
436	252688	Action Frac Fluids	Rig Supply	32.042777	-94.076388	140	45	3	2	15.0	2,888	1,606	80	20.1
437	251934	JEAN BRANNON TRUST	Domestic	32.060555	-94.400555	240	29	50	2	0.6	112	104	80	1.3
438	251932	DEVON ENERGY	Rig Supply	32.043888	-94.351111	240	30	130	2	0.2	44	48	120	0.4
439	251926	JEFF STEPHENS	Domestic	32.08861	-94.080832	140	35	60	2	0.6	112	105	60	1.7
440	251747	ANADARKO E & P COMPANY, INC.	Industrial	32.1	-94.200277	85	70	5	1	14.0	2,695	1,515	65	23.3
441	251707	VALENCE OPERATING COMPANY	Rig Supply	32.283333	-94.400277	240	80	10	1	8.0	1,540	947	100	9.5
442	251462	XTO ENERGY, INC,.	Rig Supply	32.350277	-94.166943	250	65	90	1	0.7	139	126	100	1.3
443	251260	eog resources	Rig Supply	32.093888	-94.405277	275	25	2	1	12.5	2,406	1,378	45	30.6
444	251211	XTO Energy	Rig Supply	32.289166	-94.241388	180	70	50	1	1.4	270	219	120	1.8
445	250855	ANADARKO E & P COMPANY, INC.	Industrial	32.18361	-94.466666	265	65	35	1	1.9	358	278	100	2.8
446	250837	ANADARKO E & P COMPANY, INC.	Industrial	32.216666	-94.366666	200	70	15	1	4.7	898	602	160	3.8
447	250496	CHEVRON TEXACO	Rig Supply	32.033333	-94.066666	230	60	20	1	3.0	578	416	180	2.3
448	250047	Odum, Kathy	Domestic	32.315	-94.103055	100	12	82	1	0.1	28	33	90	0.4
449	249846	Chevron Texaco	Rig Supply	32.094166	-94.087221	500	60	120	1	0.5	96	92	360	0.3
450	249100	ANADARKO E & P COMPANY	Industrial	32.13361	-94.383333	190	80	15	1	5.3	1,027	674	100	6.7
451	247635	DEVON ENERGY	Rig Supply	32.074166	-94.361111	260	30	117	2	0.3	49	53	100	0.5
452	247534	PETROQUEST	Rig Supply	32.15	-94.066943	200	65	85	1	0.8	147	132	120	1.1
453	247510	VALENCE OPERATING COMPANY	Rig Supply	32.266943	-94.4	300	60	87	1	0.7	133	121	100	1.2
454	247181	R. LACY SERVICES, INC.	Rig Supply	32.266666	-94.383333	250	80	10	1	8.0	1,540	947	100	9.5
455	246301	ELPASO ONSHORE DRILLING	Rig Supply	32.02361	-94.498888	165	70	20	1	3.5	674	473	75	6.3
456	246202	ANADARKO E & P COMPANY	Rig Supply	32.15	-94.366943	300	60	87	1	0.7	133	121	80	1.5
457	245820	CX Operating	Rig Supply	32.008888	-94.199721	240	70	60	1	1.2	225	188	100	1.9
458	245376	ANADARKO E & P COMPANY, INC.	Industrial	32.15	-94.383333	250	65	85	1	0.8	147	132	90	1.5
459	244841	XTO ENERGY	Rig Supply	32.016943	-94.08361	240	80	20	1	4.0	770	529	90	5.9
460	244344	Benefield, Kevin	Domestic	32.343055	-94.163055	110	20	40	1	0.5	96	92	70	1.3
461	243648	ANADARKO E & P COMPANY LP	Rig Supply	32.116943	-94.466666	325	65	25	1	2.6	501	368	105	3.5
462	243563	DEVON ENERGY	Rig Supply	32.069166	-94.359166	360	60	53	2	1.1	218	183	80	2.3
463	243537	DEVON ENERGY	Rig Supply	32.034444	-94.363888	340	60	80	2	0.8	144	130	80	1.6
464	243520	DEVON ENERGY	Rig Supply	32.078888	-94.316666	120	70	53	2	1.3	254	209	80	2.6
465	242526	XTO ENERGY INC.	Rig Supply	32.288888	-94.234999	170	65	40	1	1.6	313	248	90	2.8
466	241538	Classic Operating	Rig Supply	31.988888	-94.1	240	90	75	1	1.2	231	192	90	2.1
467	241535	Chesapeake Operating	Rig Supply	32.199721	-94.065	160	65	1	1	65.0	12,513	5,504	90	61.2
468	241397	NFR ENERGY	Rig Supply	32.181666	-94.472777	270	50	50	1	1.0	193	165	100	1.7
469	240892	ANADARKO E & P COMPANY, INC.	Rig Supply	32.083333	-94.2	80	60	25	1	2.4	462	344	30	11.5
470	239476	Fortson Oil	Rig Supply	32.081388	-94.517221	340	65	100	2	0.7	125	115	100	1.1
471	239216	Goss, Dan	Domestic	32.038888	-94.270277	280	15	59	1	0.3	49	52	115	0.5
472	238947	PATARA OIL & GAS	Rig Supply	32.187221	-94.555555	460	45	100	2	0.5	87	84	120	0.7
473	238945	DEVON ENERGY	Rig Supply	32.062222	-94.383054	300	60	100	2	0.6	116	108	100	1.1
474	238942	DEVON ENERGY	Rig Supply	32.064166	-94.382499	320	60	104	2	0.6	111	104	100	1.0
475	238603	DEVON ENERGY	Rig Supply	32.069721	-94.316666	280	35	130	2	0.3	52	55	100	0.5
476	238131	xto energy inc.	Rig Supply	32.355	-94.403333	280	75	50	2	1.5	289	232	100	2.3
477	237703	Miller, Deon	Domestic	32.254444	-94.2125	160	18	80	1	0.2	43	47	80	0.6
478	237462	DEVON ENERGY	Rig Supply	32.337499	-94.09361	120	65	51	2	1.3	245	202	60	3.4
479	237341	ANADARKO E & P COMPANY, INC	Rig Supply	32.066666	-94.183333	100	90	5	1	18.0	3,465	1,872	80	23.4
480	237140	Samson	Rig Supply	32.051111	-94.205833	100	100	1	1	100.0	19,251	7,903	80	98.8
481	237043	ANADARKO E & P cOMPANY, iNC.	Rig Supply	32.016666	-94.38361	300	80	20	1	4.0	770	529	200	2.6
482	236996	Sun River Operating, Inc.	Rig Supply	32.051388	-94.444166	260	80	5	1	16.0	3,080	1,695	60	28.3
483	236605	Beason, Bobby	Domestic	32.269443	-94.120277	100	7	60	1	0.1	22	27	77	0.4
484	236402	PATARA OIL & GAS	Rig Supply	32.191388	-94.533888	490	60	50	2	1.2	231	192	80	2.4
485	235574	GLASSELL PRODUCING COMPANY	Rig Supply	32.23361	-94.216666	220	80	10	1	8.0	1,540	947	100	9.5
486	234655	ANADARKO E & P COMPANY, INC.	Rig Supply	32.1	-94.216666	110	80	5	1	16.0	3,080	1,695	80	21.2
487	234077	DEVON ENERGY	Rig Supply	32.054166	-94.39861	300	35	273	2	0.1	25	29	100	0.3
488	233915	Classic Operating	Rig Supply	32.026943	-94.094444	240	70	50	1	1.4	270	219	80	2.7
489	233912	Classic Operating	Rig Supply	32.015	-94.051666	260	60	75	1	0.8	154	137	140	1.0
490	233833	BOBBY RITTER	Domestic	31.98361	-94.183333	140	25	10	1	2.5	481	357	100	3.6
491	233558	Devon Energy	Rig Supply	32.206944	-94.336666	220	60	148	2	0.4	78	77	100	0.8
492	233556	Devon Energy	Rig Supply	32.311666	-94.138333	100	70	71	2	1.0	190	163	50	3.3
493	233555	Devon Energy	Rig Supply	32.051944	-94.341666	300	40	148	2	0.3	52	55	60	0.9
494	233554	Devon Energy	Rig Supply	32.215277	-94.340555	160	70	84	2	0.8	160	142	90	1.6
495	233552	Devon Energy	Rig Supply	32.190555	-94.309166	140	60	88	2	0.7	131	120	80	1.5
496	233551	Devon Energy	Rig Supply	32.2575	-94.21861	210	20	139	2	0.1	28	32	100	0.3
497	233005	Patara Oil & Gas	Rig Supply	32.150833	-94.522221	430	70	100	2	0.7	135	122	70	1.7
498	232828	GLASSELL PRODUCTION COMPANY	Rig Supply	32.233333	-94.200277	240	70	10	1	7.0	1,348	847	200	4.2
499	232633	HARLETON OIL & GAS,INC.	Rig Supply	32.183333	-94.18361	260	70	15	1	4.7	898	602	160	3.8
500	232497	ANADARKO E & P cOMPANY, LP	Industrial	32.216666	-94.383333	220	65	85	1	0.8	147	132	100	1.3
501	231777	Griffine, Danny	Domestic	32.223054	-94.442777	400	80	70	2	1.1	220	185	70	2.6
502	230805	TERESA WALKER	Domestic	32.069721	-94.383333	340	25	231	2	0.1	21	26	120	0.2
503	230785	NFR Energy	Rig Supply	32.33361	-94.469999	270	65	75	1	0.9	167	146	70	2.1
504	229868	Classic Operating	Rig Supply	32.015277	-94.051666	160	60	30	1	2.0	385	296	100	3.0
505	229866	Classic Operating	Rig Supply	32.018054	-94.06	240	60	40	1	1.5	289	232	100	2.3

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
506	229851	Classic Operating	Rig Supply	31.969443	-94.009444	180	80	60	1	1.3	257	210	100	2.1
507	228972	XTO Energy	Rig Supply	32.353333	-94.387221	120	65	10	1	6.5	1,251	796	60	13.3
508	227702	Devon Energy	Rig Supply	32.163333	-94.274999	140	70	68	2	1.0	198	169	80	2.1
509	227701	Devon Energy	Rig Supply	32.048888	-94.437499	320	50	218	2	0.2	44	48	100	0.5
510	227699	Devon Energy	Rig Supply	32.09611	-94.447777	340	20	204	2	0.1	19	23	50	0.5
511	227610	Devon Energy	Rig Supply	31.192221	-94.349721	220	65	154	2	0.4	81	80	100	0.8
512	227606	Devon Energy	Rig Supply	32.098888	-94.463888	420	50	184	2	0.3	52	55	140	0.4
513	227605	Devon Energy	Rig Supply	32.183054	-94.282221	200	70	119	2	0.6	113	106	80	1.3
514	227603	Devon Energy	Rig Supply	32.307222	-94.128888	80	10	46	2	0.2	42	46	55	0.8
515	227602	Devon Energy	Rig Supply	32.067221	-94.361388	280	40	174	2	0.2	44	48	160	0.3
516	227601	Devon Energy	Rig Supply	32.06861	-94.360277	360	15	153	2	0.1	19	23	100	0.2
517	227598	Devon Energy	Rig Supply	32.092499	-94.353055	240	20	118	2	0.2	33	37	120	0.3
518	227596	Devon Energy	Rig Supply	32.340833	-94.074166	160	65	128	2	0.5	98	93	100	0.9
519	227594	Devon Energy	Rig Supply	32.100833	-94.453055	360	50	184	2	0.3	52	55	80	0.7
520	227589	Devon Energy	Rig Supply	32.287499	-94.413055	300	65	158	2	0.4	79	78	100	0.8
521	227588	Devon Energy	Rig Supply	32.116666	-94.395555	220	75	138	2	0.5	105	99	120	0.8
522	227584	Devon Energy	Rig Supply	32.064444	-94.324999	300	50	173	2	0.3	56	58	120	0.5
523	227583	Devon Energy	Rig Supply	32.010277	-94.41861	380	60	168	2	0.4	69	70	160	0.4
524	227569	Devon Energy	Rig Supply	32.163333	-94.292499	180	65	114	2	0.6	110	103	120	0.9
525	227563	Devon Energy	Rig Supply	32.087499	-94.353888	280	15	128	2	0.1	23	27	130	0.2
526	227558	Devon Energy	Rig Supply	32.093888	-94.3575	260	15	113	2	0.1	26	30	160	0.2
527	227556	Devon Energy	Rig Supply	32.078054	-94.353888	240	10	98	2	0.1	20	24	140	0.2
528	227534	Winchester Production	Rig Supply	32.365833	-94.070832	200	70	8	2	8.8	1,684	1,021	100	10.2
529	227317	Brad Griffith	Domestic	32.089999	-94.388333	290	20	68	2	0.3	57	59	50	1.2
530	227313	St. Mary Land & Exp.	Rig Supply	32.057222	-94.206666	190	70	88	2	0.8	153	136	90	1.5
531	227281	Chesapeake Operating	Rig Supply	32.301944	-94.179166	220	80	79	2	1.0	195	167	100	1.7
532	227277	Chesapeake Operating	Rig Supply	32.296666	-94.169999	160	75	78	2	1.0	185	160	80	2.0
533	227273	Devon Energy	Rig Supply	32.092499	-94.274166	200	65	118	2	0.6	106	100	100	1.0
534	227258	Devon Energy	Rig Supply	32.113333	-94.37361	260	55	187	2	0.3	57	59	40	1.5
535	227253	Devon Energy	Rig Supply	32.091666	-94.439444	380	30	244	2	0.1	24	28	100	0.3
536	227240	Devon Energy	Rig Supply	32.14361	-94.29361	180	20	2	2	10.0	1,925	1,142	40	28.6
537	227230	Comstock Oil & Gas	Rig Supply	32.2625	-94.415277	260	75	126	2	0.6	115	107	100	1.1
538	227212	Comstock Oil & Gas	Rig Supply	32.255	-94.437499	280	75	129	2	0.6	112	105	100	1.0
539	227108	Comstock Oil & Gas	Rig Supply	32.237499	-94.503888	400	20	198	2	0.1	19	24	100	0.2
540	227103	Comstock Oil & Gas	Rig Supply	32.264444	-94.497777	460	60	182	2	0.3	63	65	100	0.7
541	227097	Devon Energy	Rig Supply	32.067777	-94.310833	260	40	178	2	0.2	43	47	160	0.3
542	227061	Chesapeake Operating	Rig Supply	32.145833	-94.3125	120	15	68	2	0.2	42	46	80	0.6
543	226267	ANADARKO E & P COMPANY, INC.	Rig Supply	32.148888	-94.396666	260	55	85	1	0.6	125	115	100	1.1
544	226250	ANADARKO E & P COMPANY, INC.	Rig Supply	32.116943	-94.383333	250	70	30	1	2.3	449	336	100	3.4
545	226135	DEVON ENERGY	Rig Supply	32.084444	-94.474166	400	30	273	2	0.1	21	26	120	0.2
546	225382	DEVON ENERGY	Rig Supply	32.169443	-94.291388	80	55	42	2	1.3	252	207	30	6.9
547	224511	Samson	Rig Supply	32.409722	-94.144444	260	120	60	1	2.0	385	296	80	3.7
548	223962	Anadarko E & P Company, LP	Rig Supply	32.116666	-94.4	170	65	20	1	3.3	626	444	90	4.9
549	223941	Anadarko E & E Company, LP	Rig Supply	32.33361	-94.38361	250	90	10	1	9.0	1,733	1,046	100	10.5
550	223734	DEVON ENERGY	Rig Supply	32.074443	-94.233333	160	45	105	2	0.4	83	81	60	1.4
551	223409	Samson Lone Star	Rig Supply	32.057222	-94.234721	200	35	1	1	35.0	6,738	3,272	170	19.2
552	223312	Chesapeake Operating	Rig Supply	32.230554	-94.1025	160	70	20	1	3.5	674	473	100	4.7
553	221405	DEVON ENERGY	Rig Supply	32.073888	-94.232499	95	30	84	2	0.4	69	70	75	0.9
554	221393	DEVON ENERGY	Rig Supply	32.024999	-94.436666	280	65	128	2	0.5	98	93	80	1.2
555	221388	DEVON ENERGY	Rig Supply	32.088333	-94.41861	200	40	147	2	0.3	52	55	60	0.9
556	220458	Mr. Aultman	Domestic	31.989444	-94.256111	270	20	50	2	0.4	77	76	30	2.5
557	220454	Davis, Bill Dan	Domestic	31.993888	-94.182777	61	15	15	2	1.0	193	165	26	6.4
558	220447	Davis, Jimmy	Domestic	32.113611	-94.330832	211	20	40	2	0.5	96	92	25	3.7
559	220442	Stallone, Anthony	Domestic	31.961388	-94.295833	361	35	75	2	0.5	90	87	56	1.6
560	220362	XTO Energy, Inc.	Rig Supply	32.35	-94.45	140	70	40	1	1.8	337	264	60	4.4
561	220361	XTO Energy, Inc.	Rig Supply	32.35	-94.45	150	75	40	1	1.9	361	280	70	4.0
562	219878	Samson Lone Star	Rig Supply	32.057222	-94.234721	220	50	15	1	3.3	642	454	100	4.5
563	219843	Red River Ark-La-Tex Drilling	Rig Supply	32.406111	-94.060277	160	100	40	1	2.5	481	357	90	4.0
564	219340	Anadarko E & P Company, LP	Rig Supply	32.116666	-94.4	140	75	40	1	1.9	361	280	80	3.5
565	218643	DEVON ENERGY	Rig Supply	32.066943	-94.389721	260	40	158	2	0.3	49	52	60	0.9
566	218616	DEVON ENERGY	Rig Supply	32.064444	-94.392499	240	15	120	2	0.1	24	29	60	0.5
567	217310	Artis Cooper	Domestic	32.331943	-94.144721	140	60	60	2	1.0	193	165	60	2.8
568	216816	Anadarko E & P Company, Inc.	Rig Supply	32.066943	-94.183333	90	70	25	1	2.8	539	392	70	5.6
569	216591	Don Holland	Irrigation	32.165277	-94.396666	340	60	90	1	0.7	128	117	100	1.2
570	216589	Classic Operating	Rig Supply	32.015277	-94.088888	240	90	40	1	2.3	433	326	100	3.3
571	216093	Anadarko E & P Company, Inc.	Rig Supply	32.066943	-94.183333	60	60	5	1	12.0	2,310	1,331	45	29.6
572	215463	Anadarko E & P Company, Inc.	Rig Supply	32.116666	-94.383333	120	60	5	1	12.0	2,310	1,331	80	16.6
573	215148	ETS Oilfield Services, LP	Rig Supply	32.28361	-94.35	360	45	85	1	0.5	102	97	120	0.8
574	215135	Anadarko E & P Co., LP	Rig Supply	32.229721	-94.468888	300	70	90	1	0.8	150	134	200	0.7
575	214266	Anadarko E & P company, Inc.	Rig Supply	32.08361	-94.216666	100	60	5	1	12.0	2,310	1,331	85	15.7
576	214242	Anadarko E & P Company, Inc.	Rig Supply	32.13361	-94.38361	260	45	70	1	0.6	124	114	100	1.1
577	212330	Bobby Howard	Rig Supply	32.054444	-94.241944	90	30	32	2	0.9	180	156	30	5.2
578	211545	Anadarko E & P Company, Inc.	Rig Supply	32.13361	-94.366943	230	70	15	1	4.7	898	602	100	6.0
579	211513	Patrick Porter	Domestic	31.984721	-94.437777	263	15	20	4	0.8	144	130	63	2.1
580	211502	Anadarko E & P Company, Inc.	Rig Supply	32.2	-94.416943	280	55	85	1	0.6	125	115	100	1.1
581	211445	FORTSON OIL	Rig Supply	32.081943	-94.516388	380	70	120	2	0.6	112	105	60	1.7
582	210909	Basa Resources	Rig Supply	32.057777	-94.544444	380	100	15	1	6.7	1,283	813	100	8.1
583	210887	Sojitz Energy	Rig Supply	32.088888	-94.52111	380	70	60	1	1.2	225	188	100	1.9
584	210885	Sojitz Energy	Rig Supply	32.088888	-94.52111	380	70	60	1	1.2	225	188	100	1.9
585	210504	Anadarko E & P Company, Inc.	Rig Supply	32.08361	-94.2	120	70	5	1	14.0	2,695	1,515	80	18.9
586	210483	Anadarko E & P Company, Inc.	Rig Supply	32.183333	-94.416666	160	70	10	1	7.0	1,348	847	80	10.6
587	210482	Anadarko E & P Company, Inc.	Rig Supply	32.183333	-94.416943	350	70	15	1	4.7	898	602	100	6.0
588	210446	Anadarko E & P Company, Inc.	Rig Supply	32.2	-94.366943	280	55	85	1	0.6	125	115	100	1.1
589	209278	Anadarko E & P Company, Inc.	Rig Supply	32.016943	-94.366943	400	65	20	1	3.3	626	444	200	2.2
590	208979	Chesapeake Operating	Rig Supply	32.225554	-94.204722	100	50	70	1	0.7	138	124	50	2.5
591	208978	Chesapeake Operating	Rig Supply	32.217777	-94.203611	80	45	20	1	2.3	433	326	45	7.3
592	208829	R. Lacy, Inc.	Rig Supply	32.266943	-94.333333	160	75	30	1	2.5	481	357	100	3.6
593	208516	Anadarko E & P Company, Inc.	Rig Supply	32.200277	-94.366943	200	70	15	1	4.7	898	602	100	6.0
594	208514	Anadarko E & P Company, nc.	Rig Supply	32.166943	-94.366943	160	70	10	1	7.0	1,348	847	80	10.6
595	207607	Smith, Bryan	Domestic	32.069443	-94.446666	230	20	93	1	0.2	41	45	90	0.5
596	207571	Anadarko E & P Company, Inc.,	Rig Supply	32.2	-94.366666	190	80	10	1	8.0	1,540	947	100	9.5
597	207400	Skipper Knight	Domestic	32.194999	-94.2625	44	20	10	2	2.0	385	296	26	11.4
598	207399	Judy Ellis	Domestic	32.2125	-94.251944	38	15	10	3	1.5	289	232	18	12.9
599	207397	Joe Allison	Domestic	32.243055	-94.33611	22	17	8	1	2.1	409	311	12	25.9
600	207396	DCP Midstream	Industrial	32.186666	-94.257222	103	30	30	3	1.0	193	165	32	5.2
601	207391	Blake Weems	Domestic	31.994444	-94.328054	81	10	40	2	0.3	48	52	25	2.1
602	207390	Eric Horn	Domestic	32.06861	-94.358333	349	15	60	4	0.3	48	52	59	0.9
603	207387	Buster Ray Soape	Domestic	32.01861	-94.185277	200	8	130	1	0.1	12	16	40	0.4
604	207222	TEXAS AMERICAN	Rig Supply	32.305833	-94.444166	500	60	230	2	0.3	50	53	260	0.2
605	206732	Anadarko E & P Company, Inc.	Rig Supply	32.183333	-94.416666	160	70	10	1	7.0	1,348	847	80	10.6
606	206348	Anadarko E & P Company, Inc.	Rig Supply	32.15	-94.400277	280	70	10	1	7.0	1,348	847	100	8.5

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
607	205871	Anadarko E & P Company, Inc.	Rig Supply	32.18361	-94.366943	250	75	10	1	7.5	1,444	897	90	10.0
608	205779	Sojitz Energy	Rig Supply	32.01	-94.509722	440	85	60	1	1.4	273	221	100	2.2
609	205777	Sojitz Energy	Rig Supply	32.009722	-94.510277	440	85	70	1	1.2	234	194	100	1.9
610	205457	Anadarko E & P Company, Inc.	Rig Supply	32.183333	-94.4	220	65	85	1	0.8	147	132	100	1.3
611	205455	Conoco Phillips Company	Rig Supply	32.03361	-94.233333	200	60	80	1	0.8	144	130	80	1.6
612	205449	Anadarko E & P Co., Inc.	Rig Supply	32.15	-94.366666	260	80	10	1	8.0	1,540	947	80	11.8
613	205273	Anadarko E & P Co, Inc.	Rig Supply	32.183333	-94.416943	220	65	85	1	0.8	147	132	100	1.3
614	205235	Classic Operating	Rig Supply	32.13861	-94.512222	440	70	1	1	70.0	13,476	5,857	190	30.8
615	205231	Samson	Rig Supply	32.313055	-94.19111	160	70	15	1	4.7	898	602	100	6.0
616	203238	Anadarko E & P Company, Inc.	Rig Supply	32.133333	-94.3	220	60	20	1	3.0	578	416	100	4.2
617	203138	Anadarko E & P Company, Inc.	Rig Supply	32.166943	-94.366943	140	70	10	1	7.0	1,348	847	80	10.6
618	203137	Anadarko E & P Company, Inc.	Rig Supply	32.166666	-94.416666	200	65	85	1	0.8	147	132	80	1.6
619	203134	Anadarko E & P Company, Inc.	Rig Supply	32.066666	-94.266943	180	75	50	1	1.5	289	232	100	2.3
620	203133	Exxon Mobil Corporation	Rig Supply	32.083333	-94.200277	80	20	30	1	0.7	128	117	40	2.9
621	202753	Rufus Langford	Stock	32.294721	-94.164444	160	80	60	1	1.3	257	210	100	2.1
622	202742	Devon Energy	Rig Supply	32.2125	-94.337221	200	65	89	2	0.7	141	127	110	1.2
623	202741	Devon Energy	Rig Supply	32.063888	-94.237221	220	55	152	2	0.4	70	70	100	0.7
624	202740	Devon Energy	Rig Supply	32.13111	-94.264444	120	70	94	2	0.7	143	129	60	2.1
625	202737	Chesapeake Operating	Rig Supply	32.296666	-94.149166	140	75	78	2	1.0	185	160	60	2.7
626	202732	Chevron Texaco	Rig Supply	32.220832	-94.39361	170	75	77	2	1.0	188	162	100	1.6
627	202731	Chevron Texaco	Rig Supply	32.197777	-94.415833	220	60	134	2	0.4	86	84	100	0.8
628	202405	XTO Energy, Inc.	Rig Supply	32.335555	-94.305	220	75	70	1	1.1	206	175	160	1.1
629	202356	DEVON ENERGY	Rig Supply	32.066111	-94.444444	240	70	107	2	0.7	126	116	50	2.3
630	202352	DEVON ENERGY	Rig Supply	32.176943	-94.335555	200	75	66	2	1.1	219	184	50	3.7
631	202326	A.C. Exploration	Rig Supply	32.096666	-94.505555	300	65	173	2	0.4	72	73	100	0.7
632	202318	Basic Energy	Rig Supply	32.254166	-94.158055	220	20	122	2	0.2	32	36	120	0.3
633	202314	Chevron Texaco	Rig Supply	32.201944	-94.347777	200	75	99	2	0.8	146	131	100	1.3
634	202312	Chevron Texaco	Rig Supply	32.35	-94.437499	240	70	114	2	0.6	118	110	90	1.2
635	202302	Langston Drlg. Co.	Rig Supply	32.150555	-94.539444	320	70	163	2	0.4	83	81	90	0.9
636	202289	Devon Energy	Rig Supply	32.069999	-94.362222	280	45	173	2	0.3	50	53	80	0.7
637	202287	Devon Energy	Rig Supply	32.096666	-94.254722	180	70	73	2	1.0	185	159	60	2.7
638	202286	Devon Energy	Rig Supply	32.087499	-94.424999	320	60	188	2	0.3	61	63	70	0.9
639	202285	Devon Energy	Rig Supply	32.074721	-94.4	340	50	222	2	0.2	43	47	120	0.4
640	202283	Devon Energy	Rig Supply	32.071388	-94.267221	140	70	114	2	0.6	118	110	80	1.4
641	202281	Devon Energy	Rig Supply	32.189444	-94.506111	260	60	128	2	0.5	90	87	240	0.4
642	202279	Devon Energy	Rig Supply	32.069999	-94.287221	140	60	94	2	0.6	123	113	60	1.9
643	201626	Comstock Oil & Gas	Rig Supply	32.263333	-94.423888	260	75	119	2	0.6	121	112	100	1.1
644	201623	Cathy Brown	Domestic	32.07611	-94.380554	280	20	132	2	0.2	29	34	80	0.4
645	201596	Comstock Oil & Gas	Rig Supply	32.244444	-94.32111	60	15	44	2	0.3	66	67	65	1.0
646	201583	Leanne Dennis	Domestic	32.056944	-94.394721	320	20	105	2	0.2	37	41	70	0.6
647	200480	Chesapeake Operating	Rig Supply	32.29861	-94.155833	160	100	1	1	100.0	19,251	7,903	90	87.8
648	200478	Samson	Rig Supply	32.312777	-94.190555	160	60	15	1	4.0	770	529	100	5.3
649	199756	Devon Energy	Rig Supply	32.045833	-94.358333	320	60	184	2	0.3	63	64	70	0.9
650	199754	Devon Energy	Rig Supply	32.041944	-94.356111	260	30	173	2	0.2	33	38	100	0.4
651	199751	Devon Energy	Rig Supply	32.042499	-94.356944	300	50	172	2	0.3	56	58	100	0.6
652	199748	Devon Energy	Rig Supply	32.097499	-94.398055	340	60	224	2	0.3	52	55	100	0.5
653	199746	Devon Energy	Rig Supply	32.056111	-94.374166	360	35	240	2	0.1	28	33	100	0.3
654	199703	Devon Energy	Rig Supply	32.285277	-94.137499	104	75	78	2	1.0	185	160	80	2.0
655	199702	Devon Energy	Rig Supply	32.175554	-94.325554	200	70	106	2	0.7	127	117	100	1.2
656	199699	Devon Energy	Rig Supply	32.324721	-94.122777	180	50	144	2	0.3	67	68	20	3.4
657	199687	Maximus Operating	Rig Supply	31.983054	-94.078888	230	10	100	2	0.1	19	24	100	0.2
658	199660	Anadarko E & P Company, Inc.	Rig Supply	32.150277	-94.416943	340	65	10	1	6.5	1,251	796	100	8.0
659	199659	XTO Energy, Inc.	Rig Supply	32.133333	-94.316943	90	60	5	1	12.0	2,310	1,331	75	17.8
660	199337	A.C. Exploration	Rig Supply	32.151388	-94.511666	420	70	200	2	0.4	67	68	130	0.5
661	199327	G & A Drilling Company	Rig Supply	32.101388	-94.520554	410	75	156	2	0.5	93	89	70	1.3
662	199323	Valance Operating	Rig Supply	32.24361	-94.39111	360	70	173	2	0.4	78	77	120	0.6
663	199321	Devon Energy	Rig Supply	32.197777	-94.331943	160	75	131	2	0.6	110	103	60	1.7
664	199319	Devon Energy	Rig Supply	32.153611	-94.264166	110	80	52	2	1.5	296	237	70	3.4
665	199091	Katy Resources ETX, LLC	Rig Supply	32.100277	-94.516943	350	65	15	1	4.3	834	566	150	3.8
666	198800	Anadarko E & P Company, Inc.	Rig Supply	32	-94.366943	300	60	87	1	0.7	133	121	100	1.2
667	198777	Anadarko E & P Company	Rig Supply	32.166943	-94.4	240	65	85	1	0.8	147	132	80	1.6
668	197677	Chesapeake Operating	Rig Supply	32.16861	-94.066943	140	65	10	1	6.5	1,251	796	100	8.0
669	197534	Arkla Tex Energy	Rig Supply	32.092499	-94.523054	400	75	174	2	0.4	83	81	80	1.0
670	197531	Chesapeake Operating	Rig Supply	32.120277	-94.385277	180	80	99	2	0.8	156	138	70	2.0
671	197529	Devon Energy	Rig Supply	32.065555	-94.407777	300	60	3	2	20.0	3,850	2,045	100	20.4
672	197307	Anadarko E & P Company, Inc.	Rig Supply	32.08361	-94.316666	240	50	60	1	0.8	160	142	100	1.4
673	197270	Anadarko E & P Company, Inc.	Rig Supply	32.200277	-94.383333	260	55	85	1	0.6	125	115	100	1.1
674	196481	BP America	Rig Supply	32.200277	-94.266943	120	65	5	1	13.0	2,503	1,424	100	14.2
675	196185	Chesapeake Operating	Rig Supply	32.136666	-94.09361	280	100	15	1	6.7	1,283	813	100	8.1
676	196144	Anadarko E & P Company, inc.	Rig Supply	32.1	-94.2	140	70	10	1	7.0	1,348	847	100	8.5
677	196016	Anadarko E & P Company, Inc.	Rig Supply	32.183333	-94.383333	200	65	85	1	0.8	147	132	100	1.3
678	196003	Anadarko E & P Company, Inc.	Rig Supply	32.200277	-94.38361	280	55	85	1	0.6	125	115	100	1.1
679	195479	Sojitz Energy	Rig Supply	32.026666	-94.530277	420	70	60	1	1.2	225	188	100	1.9
680	195477	Sojitz Energy	Rig Supply	32.026666	-94.530277	420	70	40	1	1.8	337	264	100	2.6
681	194270	Anadarko E & P Company Inc	Rig Supply	32.145555	-94.2125	150	75	40	1	1.9	361	280	90	3.1
682	194261	ConocoPhillips	Rig Supply	32.061111	-94.239166	200	65	85	1	0.8	147	132	100	1.3
683	194254	Anadarko E & P Company Inc	Rig Supply	32.149444	-94.404722	260	55	85	1	0.6	125	115	80	1.4
684	194252	Anadarko E & P Company Inc	Rig Supply	32.023054	-94.297777	280	70	25	1	2.8	539	392	120	3.3
685	194246	R Lacy Inc	Rig Supply	32.259444	-94.336388	140	80	10	1	8.0	1,540	947	100	9.5
686	194238	Anadarko E & P Company Inc	Rig Supply	32.034444	-94.292499	270	70	20	1	3.5	674	473	150	3.2
687	193581	Dan Goss - Beck	Domestic	32.044444	-94.305555	260	25	127	1	0.2	38	42	115	0.4
688	193000	PennzEnergy	Industrial	32.34861	-94.091944	90	80	56	1	1.4	275	223	40	5.6
689	191961	Comstock Oil & Gas	Rig Supply	32.256111	-94.501944	400	75	162	2	0.5	89	86	120	0.7
690	191956	Comstock Oil & Gas	Rig Supply	32.229999	-94.519721	460	70	177	2	0.4	76	76	120	0.6
691	191951	Devon Energy	Rig Supply	32.097777	-94.453888	400	25	196	2	0.1	25	29	100	0.3
692	191948	Devon Energy	Rig Supply	32.216666	-94.316666	140	75	94	2	0.8	154	137	80	1.7
693	191947	Devon Energy	Rig Supply	32.06861	-94.308333	320	50	212	2	0.2	45	49	160	0.3
694	191944	Devon Energy	Rig Supply	32.16	-94.29611	160	75	89	2	0.8	162	143	90	1.6
695	191942	Devon Energy	Rig Supply	32.064444	-94.397777	400	55	124	2	0.4	85	83	100	0.8
696	191939	Langston Drlg. Co.	Rig Supply	32.045833	-94.070832	140	75	82	2	0.9	176	153	80	1.9
697	191756	Devon Energy	Rig Supply	32.196944	-94.331943	160	75	131	2	0.6	110	103	60	1.7
698	191734	XTO ENERGY	Rig Supply	32.24111	-94.200555	245	50	10	1	5.0	963	638	60	10.6
699	191733	XTO ENERGY	Rig Supply	32.258611	-94.105	100	60	10	1	6.0	1,155	744	60	12.4
700	191732	XTO ENERGY	Rig Supply	32.242499	-94.2	285	60	10	1	6.0	1,155	744	60	12.4
701	191354	Newfield Exp.	Rig Supply	32.195833	-94.507222	158	60	1	1	60.0	11,551	5,146	63	81.7
702	190698	Anadarko E & P Company Inc	Rig Supply	32.19111	-94.491666	210	65	85	1	0.8	147	132	70	1.9
703	190525	Andrea Webb	Domestic	32.02111	-94.357777	190	30	20	2	1.5	289	232	20	11.6
704	190515	XTO ENERGY	Rig Supply	32.271666	-94.119443	70	40	10	1	4.0	770	529	40	13.2
705	190509	XTO ENERGY	Rig Supply	32.247221	-94.125832	55	40	10	1	4.0	770	529	20	26.5
706	190498	XTO ENERGY	Rig Supply	32.247221	-94.125832	80	40	10	1	4.0	770	529	60	8.8
707	190494	XTO ENERGY	Rig Supply	32.271666	-94.132221	60	20	10	1	2.0	385	296	20	14.8

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
708	190487	XTO ENERGY	Rig Supply	32.298888	-94.043333	160	70	10	1	7.0	1,348	847	60	14.1
709	190310	XTO Energy, Inc.	Rig Supply	32.254444	-94.494721	320	70	20	1	3.5	674	473	120	3.9
710	190283	XTO ENERGY	Rig Supply	32.271666	-94.119443	55	35	10	1	3.5	674	473	40	11.8
711	190178	ConocoPhillips	Rig Supply	32.034721	-94.310277	150	70	10	1	7.0	1,348	847	110	7.7
712	190169	Anadarko E & P Company Inc	Rig Supply	32.210277	-94.501666	200	65	85	1	0.8	147	132	80	1.6
713	189926	Comstock Oil & Gas	Industrial	32.245833	-94.498888	420	60	110	1	0.5	105	99	160	0.6
714	189924	Anadarko E&P Co., LP	Industrial	32.167777	-94.389166	340	65	85	1	0.8	147	132	240	0.5
715	189503	Chesapeake Operating	Rig Supply	32.315277	-94.214166	160	60	1	1	60.0	11,551	5,146	110	46.8
716	189486	Chesapeake Operating	Rig Supply	32.315	-94.214722	160	60	40	1	1.5	289	232	80	2.9
717	189039	Anadarko E & P Co., LP	Rig Supply	32.010555	-94.369443	320	70	100	1	0.7	135	122	160	0.8
718	188793	BEAR CREEK SERVICES	Industrial	32.043333	-94.076388	160	75	43	2	1.7	336	263	60	4.4
719	187903	ConocoPhillips	Rig Supply	32.027777	-94.29611	220	60	30	1	2.0	385	296	100	3.0
720	187739	K & L CONTRACTORS	Rig Supply	32.221943	-94.043055	200	50	170	2	0.3	57	59	60	1.0
721	187332	Anadarko E & P Company Inc	Rig Supply	32.1625	-94.418888	160	70	15	1	4.7	898	602	80	7.5
722	186898	Ezell Allison	Domestic	32.067777	-94.492221	120	20	40	2	0.5	96	92	20	4.6
723	186896	Markis Bowlin	Domestic	31.990833	-94.258055	260	15	40	2	0.4	72	72	20	3.6
724	186835	Anadarko E & P Company Inc	Rig Supply	32.187221	-94.3525	230	80	10	1	8.0	1,540	947	100	9.5
725	186804	Classic Operating	Rig Supply	32	-94.058055	210	100	15	1	6.7	1,283	813	90	9.0
726	186560	Cabot Oil & Gas	Rig Supply	32.000555	-94.335277	302	60	20	3	3.0	578	416	127	3.3
727	186385	ConocoPhillips	Rig Supply	32.060277	-94.285555	180	80	10	1	8.0	1,540	947	115	8.2
728	185884	Classic Energy	Rig Supply	32.07611	-94.469443	120	50	83	2	0.6	116	108	60	1.8
729	185876	Valence Operating	Rig Supply	32.272777	-94.395555	300	70	129	2	0.5	104	99	80	1.2
730	185875	A.C. Exploration	Rig Supply	32.161944	-94.511944	470	75	84	2	0.9	172	150	80	1.9
731	185871	Classic Energy	Rig Supply	32.139166	-94.384999	240	70	129	2	0.5	104	99	90	1.1
732	185868	Chevron Texaco	Rig Supply	32.104444	-94.48361	140	75	87	2	0.9	166	146	60	2.4
733	185863	Classic Energy	Rig Supply	32.141388	-94.369443	90	75	51	2	1.5	283	228	50	4.6
734	185860	Chevron Texaco	Rig Supply	32.256666	-94.465277	460	80	176	2	0.5	88	85	100	0.9
735	185854	Martex Drilling Co.	Rig Supply	32.071388	-94.229443	110	60	75	2	0.8	154	137	60	2.3
736	185850	Devon Energy	Rig Supply	32.167221	-94.287777	180	75	71	2	1.1	203	173	80	2.2
737	185847	Devon Energy	Rig Supply	32.150277	-94.235555	140	65	69	2	0.9	181	157	60	2.6
738	185845	Devon Energy	Rig Supply	32.073888	-94.379443	320	30	198	2	0.2	29	34	120	0.3
739	185843	Devon Energy	Rig Supply	32.065277	-94.381943	310	60	218	2	0.3	53	56	70	0.8
740	185841	Devon Energy	Rig Supply	32.087777	-94.366943	260	70	138	2	0.5	98	93	70	1.3
741	185840	Devon Energy	Rig Supply	32.078054	-94.376388	335	75	154	2	0.5	94	90	105	0.9
742	185839	Devon Energy	Rig Supply	32.060555	-94.380277	300	75	173	2	0.4	83	82	100	0.8
743	185838	Devon Energy	Rig Supply	32.073054	-94.386666	280	35	188	2	0.2	36	40	80	0.5
744	185835	Devon Energy	Rig Supply	32.07611	-94.361944	140	65	93	2	0.7	135	122	50	2.4
745	185834	Devon Energy	Rig Supply	32.163611	-94.295277	160	70	78	2	0.9	173	151	60	2.5
746	185830	Devon Energy	Rig Supply	32.111111	-94.364444	260	15	120	2	0.1	24	29	80	0.4
747	185824	Devon Energy	Rig Supply	32.105277	-94.413611	240	65	138	2	0.5	91	88	80	1.1
748	185001	Anadarko E & P Co., LP	Rig Supply	32.044444	-94.289166	400	60	100	1	0.6	116	108	320	0.3
749	184979	XTO Energy	Rig Supply	32.269443	-94.188055	240	20	10	1	2.0	385	296	230	1.3
750	184978	XTO Energy	Rig Supply	32.269443	-94.188055	120	30	10	1	3.0	578	416	110	3.8
751	184206	Camterra Resources	Rig Supply	32.249721	-94.553888	440	60	178	2	0.3	65	66	140	0.5
752	184199	Comstock Oil & Gas	Rig Supply	32.241666	-94.516388	440	75	169	2	0.4	85	83	160	0.5
753	184195	Devon Energy	Rig Supply	32.191388	-94.295833	120	70	78	2	0.9	173	151	70	2.2
754	184193	Devon Energy	Rig Supply	32.174721	-94.295833	220	70	59	2	1.2	228	191	60	3.2
755	184188	Devon Energy	Rig Supply	32.051944	-94.4	300	40	204	2	0.2	38	42	100	0.4
756	184186	Devon Energy	Rig Supply	32.069999	-94.411388	160	60	102	2	0.6	113	106	80	1.3
757	184183	Devon Energy	Rig Supply	32.314444	-94.115555	90	70	53	2	1.3	254	209	60	3.5
758	184182	Devon Energy	Rig Supply	32.177777	-94.316388	180	75	89	2	0.8	162	143	80	1.8
759	184176	Devon Energy	Rig Supply	32.065555	-94.410555	330	50	162	2	0.3	59	62	130	0.5
760	184174	Devon Energy	Rig Supply	32.060277	-94.395833	330	60	156	2	0.4	74	74	130	0.6
761	184172	Devon Energy	Rig Supply	32.070554	-94.412222	170	65	119	2	0.5	105	99	90	1.1
762	184170	Devon Energy	Rig Supply	32.072777	-94.412222	340	25	228	2	0.1	21	26	140	0.2
763	184169	Devon Energy	Rig Supply	32.065	-94.411666	320	55	192	2	0.3	55	58	120	0.5
764	184166	Devon Energy	Rig Supply	32.106944	-94.435277	150	70	66	2	1.1	204	173	70	2.5
765	184152	Devon Energy	Rig Supply	32.058333	-94.379166	320	20	213	2	0.1	18	23	80	0.3
766	184138	Debra McMillian	Domestic	32.06861	-94.415277	260	30	152	2	0.2	38	42	70	0.6
767	184098	Mr. Ray	Domestic	32.143333	-94.301388	80	60	10	1	6.0	1,155	744	45	16.5
768	183999	Anadarko E & P Company Inc	Rig Supply	32.069166	-94.278332	120	60	10	1	6.0	1,155	744	100	7.4
769	183996	Conoco Phillips	Rig Supply	32.026943	-94.363055	250	50	15	1	3.3	642	454	110	4.1
770	183754	Anadarko E & P Company Inc	Rig Supply	32.034166	-94.367777	300	60	87	1	0.7	133	121	10	12.1
771	183751	Anadarko E & P Company Inc	Rig Supply	32.139999	-94.399166	280	55	85	1	0.6	125	115	100	1.1
772	183735	BP America c/o Brammer Engineering	Rig Supply	32.208888	-94.273888	120	70	15	1	4.7	898	602	80	7.5
773	183710	Anadarko E & P Company Inc	Rig Supply	32.142499	-94.389721	180	60	10	1	6.0	1,155	744	110	6.8
774	183705	Anadarko E & P Company Inc	Rig Supply	32.184166	-94.365833	180	70	10	1	7.0	1,348	847	100	8.5
775	182844	Pioneer Drilling	Industrial	32.026666	-94.518888	220	70	65	1	1.1	207	176	210	0.8
776	182487	ConocoPhillips	Rig Supply	32.046388	-94.305555	130	60	10	1	6.0	1,155	744	90	8.3
777	181940	Goodrich Petroleum	Industrial	32.267221	-94.531666	220	65	60	1	1.1	209	177	160	1.1
778	180883	Terrie King	Domestic	31.994721	-94.215833	90	10	20	20	0.5	96	92	20	4.6
779	180859	DEVON ENERGY	Rig Supply	32.340555	-94.057222	300	80	64	2	1.3	241	199	150	1.3
780	180857	C & S SUPPLY	Industrial	32.361666	-94.065555	220	70	165	2	0.4	82	80	40	2.0
781	180340	Anadarko E & P Co., LP	Industrial	32.135277	-94.398055	240	70	80	1	0.9	168	148	100	1.5
782	179915	XTO Energy	Rig Supply	32.236388	-94.093888	160	50	1	1	50.0	9,626	4,415	110	40.1
783	179899	Chesapeake Operating	Rig Supply	32.210833	-94.04611	180	60	15	1	4.0	770	529	105	5.0
784	179758	Shaon Chhor	Domestic	32.147777	-94.16861	203	20	60	2	0.3	64	66	40	1.6
785	179750	Eddie Pride	Domestic	32.311944	-94.422777	333	40	40	2	1.0	193	165	43	3.8
786	179738	Bobby Pauler	Domestic	32.071943	-94.464444	240	20	90	2	0.2	43	47	23	2.0
787	179577	CHEVRON TEXACO	Rig Supply	32.224999	-94.422777	500	75	142	2	0.5	102	97	120	0.8
788	179576	Bobby Pauler	Domestic	32.07111	-94.466666	350	20	60	3	0.3	64	66	37	1.8
789	179562	1st. Methodist Church	Irrigation	32.151944	-94.33861	265	72	50	3	1.4	277	224	37	6.1
790	179543	Wayne Chappel	Domestic	32.13611	-94.404166	323	30	90	3	0.3	64	66	43	1.5
791	179534	Danny Porter	Domestic	32.151944	-94.156111	190	15	40	2	0.4	72	72	30	2.4
792	179527	Jerry Hudson	Stock	32.094721	-94.287221	230	25	60	2	0.4	80	79	25	3.2
793	179501	Smokey Smith	Domestic	32.132499	-94.415277	260	5	70	2	0.1	14	18	53	0.3
794	179490	Tiffin Stillwell	Domestic	32.059722	-94.217499	205	10	80	2	0.1	24	29	30	1.0
795	179482	Ronnie Porter	Stock	31.97111	-94.439444	262	25	40	3	0.6	120	111	32	3.5
796	179478	Ronnie Porter	Stock	31.972777	-94.439444	272	60	40	2	1.5	289	232	38	6.1
797	179343	Casey Coligan	Domestic	32.004444	-94.374443	312	20	40	2	0.5	96	92	27	3.4
798	179268	Anadarko E & P Company Inc	Rig Supply	32.215833	-94.391944	190	60	15	1	4.0	770	529	100	5.3
799	179123	Pioneer Drilling	Industrial	32.065	-94.508611	340	60	75	1	0.8	154	137	240	0.6
800	177749	Anadarko E & P Company Inc	Rig Supply	32.124166	-94.4025	240	60	12	1	5.0	963	638	100	6.4
801	177534	Anadarko E & P Company Inc	Rig Supply	32.148888	-94.411944	160	75	40	1	1.9	361	280	80	3.5
802	176853	Anadarko E & P Company Inc	Rig Supply	32.044166	-94.289999	240	65	85	1	0.8	147	132	100	1.3
803	176425	BP America c/o Brammer Engineering	Rig Supply	32.113611	-94.431666	280	70	20	1	3.5	674	473	100	4.7
804	176159	Golden Gate Exp.	Rig Supply	32.347777	-94.089444	170	50	63	2	0.8	153	136	70	1.9
805	176157	Classic Operating	Rig Supply	32.249166	-94.515	460	70	1	1	70.0	13,476	5,857	90	65.1
806	176152	Devon Energy	Rig Supply	32.16861	-94.28111	180	70	112	2	0.6	120	111	80	1.4
807	176144	Devon Energy	Rig Supply	32.19361	-94.3	150	80	112	2	0.7	138	124	90	1.4
808	176143	Devon Energy	Rig Supply	32.187499	-94.304166	100	80	54	2	1.5	285	230	60	3.8

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
809	176138	Devon Energy Production	Rig Supply	32.260277	-94.222777	260	50	164	2	0.3	59	61	60	1.0
810	176137	Devon Energy	Rig Supply	32.170832	-94.276943	140	75	73	2	1.0	198	169	60	2.8
811	176125	Energy Drlg.	Rig Supply	32.274721	-94.078888	150	70	114	2	0.6	118	110	60	1.8
812	175946	Acts Baptist Church	Domestic	32.004166	-94.479999	343	10	40	6	0.3	48	52	60	0.9
813	175519	Chesapeake Operating	Rig Supply	32.145277	-94.300833	140	70	64	2	1.1	211	178	70	2.5
814	175516	Chesapeake Operating	Rig Supply	32.114444	-94.461944	340	60	163	2	0.4	71	71	100	0.7
815	175481	XTO Energy, Inc.	Rig Supply	32.22361	-94.098888	160	75	40	1	1.9	361	280	80	3.5
816	175196	Chevron E & P	Rig Supply	32.178054	-94.132221	160	75	40	1	1.9	361	280	80	3.5
817	174890	Classic Operating	Rig Supply	32.2575	-94.52611	340	60	40	1	1.5	289	232	100	2.3
818	174873	Devon Energy	Rig Supply	32.061944	-94.387499	320	50	212	2	0.2	45	49	180	0.3
819	174863	Devon Energy	Rig Supply	32.053055	-94.399166	300	50	202	2	0.2	48	51	70	0.7
820	174860	Devon Energy	Rig Supply	32.190555	-94.324999	240	40	158	2	0.3	49	52	70	0.7
821	174611	Devon Energy	Rig Supply	32.151944	-94.290277	180	60	110	2	0.5	105	99	100	1.0
822	174609	Devon Energy	Rig Supply	32.09111	-94.4525	340	60	193	2	0.3	60	62	100	0.6
823	174608	Devon Energy	Rig Supply	32.170832	-94.304444	180	75	89	2	0.8	162	143	60	2.4
824	173485	Anadarko - Chris Sparks	Rig Supply	32.101666	-94.278888	200	60	10	1	6.0	1,155	744	100	7.4
825	173481	Anadarko - Chris Sparks	Rig Supply	32.105555	-94.211666	120	65	30	1	2.2	417	316	60	5.3
826	173437	Anadarko - Chris Sparks	Rig Supply	32.105555	-94.211666	420	50	155	1	0.3	62	64	80	0.8
827	172708	Chesapeake	Rig Supply	32.114444	-94.508333	420	75	188	2	0.4	77	76	100	0.8
828	172707	Wil-Drill	Rig Supply	32.022777	-94.508333	310	60	164	2	0.4	70	71	70	1.0
829	172704	Chevron Texaco	Rig Supply	32.299721	-94.435277	480	75	148	2	0.5	98	93	90	1.0
830	172699	Winchester Production	Rig Supply	32.283054	-94.074999	120	40	71	2	0.6	108	102	60	1.7
831	172696	Debbie Patrick	Domestic	32.207222	-94.279999	165	90	73	2	1.2	237	197	100	2.0
832	172690	Devon Energy	Rig Supply	32.149721	-94.24361	140	75	64	2	1.2	226	189	60	3.1
833	172688	Devon Energy	Rig Supply	32.121666	-94.288055	160	70	104	2	0.7	130	118	60	2.0
834	172686	Devon Energy	Rig Supply	32.258055	-94.241388	120	75	62	2	1.2	233	194	50	3.9
835	172684	Devon Energy	Rig Supply	32.070554	-94.3575	320	35	228	2	0.2	30	34	100	0.3
836	172682	Devon Energy	Rig Supply	32.066388	-94.370554	300	60	165	2	0.4	70	71	70	1.0
837	172680	Devon Energy	Rig Supply	32.168054	-94.304166	215	70	94	2	0.7	143	129	55	2.3
838	172677	Devon Energy	Rig Supply	32.064444	-94.353888	300	65	154	2	0.4	81	80	110	0.7
839	172665	Comstock Oil & Gas	Rig Supply	32.201944	-94.510277	240	75	174	2	0.4	83	81	90	0.9
840	172661	Comstock Oil & Gas	Rig Supply	32.203888	-94.508333	220	75	122	2	0.6	118	110	120	0.9
841	172650	Comstock Oil & Gas	Rig Supply	32.198888	-94.506111	280	70	138	2	0.5	98	93	160	0.6
842	172635	Newfield Exp.	Rig Supply	32.177777	-94.509722	192	65	1	1	65.0	12,513	5,504	67	82.1
843	171688	Conoco Phillips	Rig Supply	32.033888	-94.357777	260	80	80	1	0.8	144	130	100	1.3
844	171685	Anadarko - Paul Sparks	Rig Supply	32.153888	-94.337777	120	70	30	1	2.3	449	336	80	4.2
845	171641	Anadarko - Chris Sparks	Rig Supply	32.141388	-94.479721	240	70	85	1	0.8	159	140	100	1.4
846	171620	Anadarko - Chris Sparks	Rig Supply	32.179721	-94.358055	130	60	40	1	1.5	289	232	100	2.3
847	171419	DEVON ENERGY	Rig Supply	32.101111	-94.416943	360	60	190	2	0.3	61	63	60	1.0
848	171345	Classic Operating	Rig Supply	32.13111	-94.535277	440	70	1	1	70.0	13,476	5,857	100	58.6
849	170585	Allison, Conrad	Domestic	32.164444	-94.38111	351	60	80	3	0.8	144	130	37	3.5
850	170582	Van Winkle, Billy	Domestic	32.203611	-94.310277	117	40	30	3	1.3	257	210	32	6.6
851	170573	Midstream, Marlin	Domestic	32.191388	-94.267777	33	15	10	3	1.5	289	232	18	12.9
852	170567	Crump, Phillip	Domestic	32.174443	-94.287777	44	20	15	3	1.3	257	210	19	11.1
853	170561	Crump, Phillip	Domestic	32.174443	-94.287777	150	25	25	3	1.0	193	165	19	8.7
854	170554	Atkins, Dan	Domestic	32.318054	-94.160277	111	25	40	2	0.6	120	111	36	3.1
855	170542	Lawless, Joe	Domestic	32.32611	-94.132777	112	30	30	3	1.0	193	165	29	5.7
856	170225	Anadarko - Chris Sparks	Rig Supply	32.065	-94.217221	110	60	10	1	6.0	1,155	744	290	2.6
857	170222	Anadarko - Chris Sparks	Rig Supply	32.099166	-94.304444	300	60	87	1	0.7	133	121	100	1.2
858	170204	Anadarko - Chris Sparks	Rig Supply	32.107222	-94.41	120	60	10	1	6.0	1,155	744	80	9.3
859	170203	Anadarko - Chris Sparks	Rig Supply	32.216666	-94.477499	140	60	10	1	6.0	1,155	744	100	7.4
860	170057	DEVON ENERGY	Domestic	32.077221	-94.394166	280	30	108	2	0.3	53	56	40	1.4
861	170056	DEVON ENERGY	Rig Supply	32.074166	-94.340833	260	70	115	2	0.6	117	109	40	2.7
862	170055	DEVON ENERGY	Domestic	32.069721	-94.386666	140	10	80	2	0.1	24	29	60	0.5
863	169405	DEVON ENERGY	Rig Supply	31.625832	-94.27111	340	60	8	2	7.5	1,444	897	80	11.2
864	168994	Anadarko - Paul Sparks	Rig Supply	32.087221	-94.282499	220	65	85	1	0.8	147	132	80	1.6
865	168993	Anadarko - Paul Sparks	Rig Supply	32.231943	-94.466111	300	60	87	1	0.7	133	121	80	1.5
866	168979	R. Lacy Inc.	Rig Supply	32.270832	-94.394721	300	65	70	1	0.9	179	155	100	1.6
867	168299	PATARA OIL & GAS	Rig Supply	32.1625	-94.556944	320	70	70	1	1.0	193	165	90	1.8
868	168255	DEVON ENERGY	Rig Supply	32.317777	-94.132221	100	75	4	2	18.8	3,610	1,937	80	24.2
869	167719	Anadarko - Paul Sparks	Rig Supply	32.153333	-94.513611	300	60	87	1	0.7	133	121	60	2.0
870	167662	Anadarko - Chris Sparks	Rig Supply	32.096666	-94.246388	120	60	10	1	6.0	1,155	744	108	6.9
871	167630	PATARA OIL & GAS	Rig Supply	32.15	-94.552222	230	65	70	1	0.9	179	155	140	1.1
872	167363	Chinn Exploration	Rig Supply	32.246944	-94.461944	360	50	10	1	5.0	963	638	105	6.1
873	166934	Conoco Phillips	Rig Supply	32.051944	-94.293888	100	80	20	1	4.0	770	529	70	7.6
874	166577	DEVON ENERGY	Rig Supply	32.061111	-94.326666	420	80	100	2	0.8	154	137	70	2.0
875	166306	Sims, James	Domestic	31.937777	-94.343333	258	15	60	4	0.3	48	52	40	1.3
876	165725	Anadarko - Chris Sparks	Rig Supply	32.030277	-94.384721	320	70	50	1	1.4	270	219	180	1.2
877	165495	Comstock Oil and Gas	Rig Supply	32.266388	-94.491944	440	60	196	2	0.3	59	61	100	0.6
878	165491	Comstock Oil and Gas	Rig Supply	32.241944	-94.494166	460	60	202	2	0.3	57	60	160	0.4
879	165490	Comstock Oil and Gas	Rig Supply	32.245833	-94.495555	460	45	202	2	0.2	43	47	180	0.3
880	165488	Devon Energy	Rig Supply	32.104166	-94.372777	280	55	184	2	0.3	58	60	100	0.6
881	165468	Devon Energy	Rig Supply	32.066943	-94.229721	120	20	88	2	0.2	44	48	90	0.5
882	165466	Devon Energy	Rig Supply	32.087499	-94.47861	360	20	230	2	0.1	17	21	150	0.1
883	165465	Devon Energy	Rig Supply	32.14361	-94.217499	120	35	80	2	0.4	84	82	80	1.0
884	165462	Devon Energy	Rig Supply	32.14861	-94.216943	220	20	168	2	0.1	23	28	100	0.3
885	165461	Devon Energy	Rig Supply	32.09361	-94.321666	180	70	114	2	0.6	118	110	100	1.1
886	165460	Devon Energy	Rig Supply	32.108333	-94.366388	240	60	168	2	0.4	69	70	90	0.8
887	165451	Devon Energy	Rig Supply	32.054166	-94.367777	380	55	188	2	0.3	56	59	80	0.7
888	165444	Devon Energy	Rig Supply	32.179443	-94.5125	300	70	162	2	0.4	83	82	100	0.8
889	165439	Chesapeake Operating	Rig Supply	32.301111	-94.179166	220	75	89	2	0.8	162	143	120	1.2
890	165430	Preston Exploration	Rig Supply	32.112222	-94.503888	420	80	1	1	80.0	15,401	6,552	90	72.8
891	165380	Anadarko - Chris Sparks	Rig Supply	32.018332	-94.388888	320	80	50	1	1.6	308	245	180	1.4
892	165254	Anadarko - Chris Sparks	Rig Supply	32.189999	-94.389166	250	60	10	1	6.0	1,155	744	100	7.4
893	164734	Anadarko - Paul Sparks	Rig Supply	32.164166	-94.189166	200	65	85	1	0.8	147	132	80	1.6
894	164725	R. Lacy Inc.	Rig Supply	32.273888	-94.398333	280	60	15	1	4.0	770	529	100	5.3
895	163727	DEVON ENERGY	Rig Supply	32.21	-94.351944	220	65	60	2	1.1	209	177	100	1.8
896	163714	Devon Energy	Rig Supply	32.159722	-94.279999	130	70	73	2	1.0	185	159	40	4.0
897	163710	Devon Energy	Rig Supply	32.070554	-94.356944	360	70	173	2	0.4	78	77	140	0.6
898	163708	Devon Energy	Rig Supply	32.067221	-94.372777	320	60	194	2	0.3	60	62	100	0.6
899	163705	Wynn Crosby	Rig Supply	32.058055	-94.574166	360	80	185	2	0.4	83	82	70	1.2
900	163694	Conoco Phillips	Rig Supply	32.043055	-94.292221	200	60	10	1	6.0	1,155	744	140	5.3
901	163544	R Lacy Inc	Rig Supply	32.267499	-94.290833	120	70	10	1	7.0	1,348	847	80	10.6
902	163241	Hunt Petroleum	Industrial	32.329999	-94.301111	180	70	50	1	1.4	270	219	145	1.5
903	163238	Pioneer Drilling	Industrial	32.017221	-94.497221	220	70	70	1	1.0	193	165	40	4.1
904	163183	Winchester Production	Rig Supply	32.229166	-94.058333	120	25	89	2	0.3	54	57	40	1.4
905	163182	Wynn Crosby Energy	Rig Supply	32.058055	-94.49361	320	70	164	2	0.4	82	81	100	0.8
906	163178	Devon Energy Prod	Rig Supply	32.151944	-94.3	160	60	117	2	0.5	99	94	100	0.9
907	163175	Chevron Texaco	Rig Supply	32.106111	-94.478054	460	15	57	1	0.3	51	54	120	0.4
908	163169	Devon Energy	Rig Supply	32.185277	-94.507777	280	90	140	2	0.6	124	114	140	0.8
909	163075	Anadarko - Chris Sparks	Rig Supply	32.189721	-94.47611	140	75	40	1	1.9	361	280	60	4.7

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
910	162696	Devon Energy	Rig Supply	32.074721	-94.378888	280	70	138	2	0.5	98	93	80	1.2
911	162693	Devon Energy	Rig Supply	32.070554	-94.356388	260	30	168	2	0.2	34	39	80	0.5
912	162678	Devon Energy	Rig Supply	32.077499	-94.385833	340	60	180	2	0.3	64	66	50	1.3
913	162308	Devon Energy	Rig Supply	32.072777	-94.4	240	60	128	2	0.5	90	87	100	0.9
914	162130	Patara Oil & Gas	Rig Supply	32.134721	-94.53861	360	60	40	1	1.5	289	232	200	1.2
915	161890	Chesapeake	Rig Supply	32.006944	-94.39861	340	70	1	1	70.0	13,476	5,857	100	58.6
916	161856	Classic Operating	Rig Supply	31.980277	-94.058611	220	40	60	1	0.7	128	117	120	1.0
917	161559	Preston Exploration	Rig Supply	32.292221	-94.519166	580	80	15	1	5.3	1,027	674	105	6.4
918	161017	DEVON ENERGY	Rig Supply	32.182777	-94.325277	180	80	40	2	2.0	385	296	80	3.7
919	160680	Anadarko - Chris Sparks	Rig Supply	32.191666	-94.482221	200	120	10	1	12.0	2,310	1,331	100	13.3
920	160677	Conoco Phillips	Rig Supply	32.032499	-94.3	170	50	20	1	2.5	481	357	125	2.9
921	160674	Chevron E & P	Rig Supply	32.185555	-94.116943	330	120	20	1	6.0	1,155	744	100	7.4
922	160455	XTO Energy, Inc.	Rig Supply	32.265277	-94.06861	120	75	40	1	1.9	361	280	60	4.7
923	160452	XTO Energy, Inc.	Rig Supply	32.268332	-94.056111	130	75	40	1	1.9	361	280	70	4.0
924	160451	XTO Energy, Inc.	Rig Supply	32.265277	-94.06861	130	75	40	1	1.9	361	280	70	4.0
925	160002	DEVON ENERGY	Rig Supply	32.053611	-94.258611	120	80	30	2	2.7	513	376	80	4.7
926	159816	Chevron E & P	Rig Supply	32.194999	-94.116388	300	80	20	1	4.0	770	529	100	5.3
927	159810	Patara Oil & Gas	Rig Supply	32.156944	-94.552777	260	80	20	1	4.0	770	529	90	5.9
928	159705	Patara Oil & Gas	Rig Supply	32.138333	-94.542777	300	60	87	1	0.7	133	121	80	1.5
929	159702	Basa Resources, Inc.	Rig Supply	32.247221	-94.123888	100	80	20	1	4.0	770	529	70	7.6
930	159322	GOODRICH	Rig Supply	32.161666	-94.555277	443	70	70	1	1.0	193	165	90	1.8
931	159097	R Lacy Inc	Rig Supply	32.264722	-94.288888	100	60	10	1	6.0	1,155	744	20	37.2
932	158308	Anadarko - Chris Sparks	Rig Supply	32.211388	-94.387221	250	65	85	1	0.8	147	132	90	1.5
933	158306	Chesapeake Operating	Rig Supply	32.29361	-94.139444	100	65	71	9	0.9	176	153	70	2.2
934	158296	Chevron Texaco	Rig Supply	32.176388	-94.466666	140	75	71	2	1.1	203	173	80	2.2
935	158293	Anadarko - Chris Sparks	Rig Supply	32.194166	-94.48111	210	65	85	1	0.8	147	132	70	1.9
936	158291	Chevron Texaco	Rig Supply	32.253055	-94.462222	480	70	158	2	0.4	85	83	100	0.8
937	158276	DEVON ENERGY	Rig Supply	32.224166	-94.323888	120	90	60	2	1.5	289	232	50	4.6
938	158271	Devon Energy	Rig Supply	32.1	-94.2625	80	70	53	2	1.3	254	209	50	4.2
939	158269	Devon Energy	Rig Supply	32.080554	-94.338055	280	35	151	2	0.2	45	48	80	0.6
940	158264	Devon Energy	Rig Supply	32.078888	-94.358333	240	60	168	2	0.4	69	70	50	1.4
941	158205	Comstock Oil & Gas	Rig Supply	32.252777	-94.417777	240	80	111	2	0.7	139	125	90	1.4
942	158151	Basa Resources, Inc.	Rig Supply	32.0625	-94.495555	280	70	40	1	1.8	337	264	120	2.2
943	158119	XTO Energy, Inc.	Rig Supply	32.278332	-94.075554	100	70	15	1	4.7	898	602	65	9.3
944	158116	XTO Energy, Inc.	Rig Supply	32.281943	-94.068332	120	90	20	1	4.5	866	584	70	8.3
945	158089	Chevron E & P	Rig Supply	32.149721	-94.138055	175	90	25	1	3.6	693	484	50	9.7
946	157765	CHESAPEAKE OPR. INC.	Rig Supply	31.464166	-94.916943	270	70	10	2	7.0	1,348	847	60	14.1
947	157633	CHESAPEAKE OPERATING, INC.	Rig Supply	32.094166	-94.333054	250	60	50	2	1.2	231	192	70	2.7
948	157628	LACY OPERATIONS LTD	Rig Supply	32.265833	-94.355833	150	60	35	1	1.7	330	260	60	4.3
949	157018	NFR Energy	Rig Supply	32.308333	-94.463888	220	80	1	1	80.0	15,401	6,552	90	72.8
950	156982	GOODRICH	Rig Supply	32.223888	-94.605277	380	70	80	1	0.9	168	148	70	2.1
951	156977	Preston Exploration	Rig Supply	32.292221	-94.483888	460	80	40	1	2.0	385	296	100	3.0
952	156964	GOODRICH	Rig Supply	32.162777	-94.591388	442	65	15	2	4.3	834	566	62	9.1
953	156961	GOODRICH	Rig Supply	32.224443	-94.559444	400	60	10	2	6.0	1,155	744	60	12.4
954	156201	Patara Oil & Gas	Rig Supply	32.133888	-94.542777	560	70	60	1	1.2	225	188	100	1.9
955	156058	Chinn	Rig Supply	32.247499	-94.450555	360	100	10	1	10.0	1,925	1,142	110	10.4
956	155640	Lacy Operations, LTD	Rig Supply	32.264722	-94.38111	16	50	1	1	50.0	9,626	4,415	40	110.4
957	155381	Samson	Rig Supply	32.065555	-94.336388	380	60	40	1	1.5	289	232	90	2.6
958	155071	Anadarko - Chris Sparks	Rig Supply	32.244721	-94.49111	380	60	80	1	0.8	144	130	130	1.0
959	155042	GOODRICH	Rig Supply	32.137777	-94.575554	403	60	60	1	1.0	193	165	83	2.0
960	154924	Anadarko - Chris Sparks	Rig Supply	32.141666	-94.47361	140	50	25	1	2.0	385	296	100	3.0
961	154916	XTO Energy, Inc.	Rig Supply	32.358055	-94.461388	150	70	40	1	1.8	337	264	80	3.3
962	154909	Anadarko - Chris Sparks	Rig Supply	32.126666	-94.303333	180	70	30	1	2.3	449	336	100	3.4
963	154903	Anadarko - Chris Sparks	Rig Supply	32.131388	-94.249444	100	70	15	1	4.7	898	602	85	7.1
964	154771	LACY OPERATIONS, LTD	Rig Supply	32.232777	-94.454166	323	60	70	1	0.9	165	145	93	1.6
965	153604	GOODRICH	Rig Supply	32.135277	-94.546388	480	65	100	2	0.7	125	115	70	1.6
966	153241	GOODRICH	Rig Supply	32.155	-94.555277	443	60	100	1	0.6	116	108	83	1.3
967	153234	CHESAPEAKE OPR.	Rig Supply	32.091388	-94.327221	220	80	50	2	1.6	308	245	70	3.5
968	153213	TEXAS AMERICA	Rig Supply	32.306944	-94.438888	420	20	10	1	2.0	385	296	60	4.9
969	152627	Chevron Texaco	Rig Supply	32.260555	-94.48111	520	70	4	2	17.5	3,369	1,828	120	15.2
970	152625	Devon Energy	Rig Supply	32.146944	-94.238055	120	60	62	2	1.0	186	161	60	2.7
971	152623	Devon Energy	Rig Supply	32.160277	-94.28111	140	80	53	2	1.5	291	233	80	2.9
972	152208	Comstock Oil & Gas	Rig Supply	32.197777	-94.51	170	80	83	2	1.0	186	160	90	1.8
973	152188	Chesapeake Operating	Rig Supply	32.301944	-94.154166	120	75	64	2	1.2	226	189	60	3.1
974	152182	Chevron Texaco	Rig Supply	32.23111	-94.44361	240	65	212	2	0.3	59	61	60	1.0
975	152181	Chevron Texaco	Rig Supply	32.204722	-94.464722	360	80	172	2	0.5	90	87	160	0.5
976	152176	Langston Drilling Co.	Rig Supply	32.229166	-94.108333	220	30	102	2	0.3	57	59	110	0.5
977	152160	Langston	Rig Supply	32.296666	-94.182499	170	75	89	2	0.8	162	143	70	2.0
978	152156	Devon Energy	Rig Supply	32.141388	-94.274443	160	30	91	2	0.3	63	65	70	0.9
979	152143	Devon Energy	Rig Supply	32.139444	-94.308333	120	45	73	2	0.6	119	110	80	1.4
980	152142	Devon Energy	Rig Supply	32.211944	-94.356388	280	60	182	2	0.3	63	65	80	0.8
981	152138	Devon Energy	Rig Supply	32.036944	-94.391944	280	40	138	2	0.3	56	58	110	0.5
982	152128	Devon Energy	Rig Supply	32.186944	-94.279443	300	70	178	2	0.4	76	75	80	0.9
983	152127	Devon Energy	Rig Supply	32.069166	-94.383333	250	65	146	2	0.4	86	84	60	1.4
984	152122	Devon Energy	Rig Supply	32.183888	-94.288055	160	75	98	2	0.8	147	132	80	1.6
985	152121	Devon Energy	Rig Supply	32.07361	-94.414444	160	70	75	2	0.9	180	156	80	1.9
986	152120	Devon Energy	Rig Supply	32.070554	-94.345555	180	65	124	2	0.5	101	96	80	1.2
987	152114	Devon Energy	Rig Supply	32.18361	-94.283054	110	65	69	2	0.9	181	157	50	3.1
988	152095	Devon Energy	Rig Supply	32.091666	-94.366388	260	25	138	2	0.2	35	39	100	0.4
989	152094	Langston	Rig Supply	32.127777	-94.483333	120	75	78	2	1.0	185	160	60	2.7
990	152083	Devon Energy	Rig Supply	32.182221	-94.277777	160	70	102	2	0.7	132	120	70	1.7
991	151671	Preston Exploration	Rig Supply	32.304166	-94.482221	440	80	5	1	16.0	3,080	1,695	90	18.8
992	150887	Basa Resources, Inc.	Rig Supply	32.056111	-94.566666	190	60	40	1	1.5	289	232	110	2.1
993	150456	Anadarko - Chris Sparks	Rig Supply	32.205833	-94.493333	140	70	30	1	2.3	449	336	70	4.8
994	150454	Anadarko - Chris Sparks	Rig Supply	32.129999	-94.463055	260	70	40	1	1.8	337	264	80	3.3
995	150412	Anadarko - Chris Sparks	Rig Supply	32.025554	-94.346666	380	70	40	1	1.8	337	264	100	2.6
996	150219	Anadarko - Chris Sparks	Rig Supply	32.211388	-94.386944	140	60	40	1	1.5	289	232	100	2.3
997	149348	Chinn	Rig Supply	32.250555	-94.44611	460	60	40	1	1.5	289	232	160	1.5
998	149260	Jeff Crooks	Irrigation	32.108611	-94.101944	260	120	5	1	24.0	4,620	2,383	90	26.5
999	149069	Devon Energy	Rig Supply	32.153333	-94.28861	80	60	55	2	1.1	210	178	50	3.6
1000	149044	Devon Energy	Rig Supply	32.188055	-94.282221	120	80	73	2	1.1	211	178	70	2.5
1001	149037	Wynn Crosby Energy	Rig Supply	32.066388	-94.489721	360	70	173	2	0.4	78	77	100	0.8
1002	149025	A.C. Exploration	Rig Supply	32.194166	-94.552777	200	75	121	2	0.6	119	110	100	1.1
1003	148992	Devon Energy	Rig Supply	32.196944	-94.280277	160	70	82	2	0.9	164	145	80	1.8
1004	148983	Comstock Oil and Gas	Rig Supply	32.206111	-94.501944	220	65	33	2	2.0	379	292	70	4.2
1005	148982	Devon Energy	Rig Supply	32.164444	-94.278332	140	70	68	2	1.0	198	169	80	2.1
1006	148979	Devon Energy	Rig Supply	32.086388	-94.262222	120	70	71	2	1.0	190	163	80	2.0
1007	148962	Devin Energy	Rig Supply	32.091944	-94.380554	460	60	143	2	0.4	81	80	60	1.3
1008	148959	Classic Energy	Rig Supply	32.14361	-94.303333	100	75	72	2	1.0	201	171	60	2.8
1009	148955	Paladin Drilling Company	Rig Supply	32.09861	-94.056944	200	75	99	2	0.8	146	131	80	1.6
1010	148945	Chevron Texaco	Rig Supply	32.306944	-94.438055	420	75	172	2	0.4	84	82	130	0.6

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
1011	148897	Anadarko - Chris Sparks	Rig Supply	32.109166	-94.4525	340	35	110	1	0.3	61	63	100	0.6
1012	148823	A.C. Exploration	Rig Supply	32.152777	-94.538055	360	75	129	2	0.6	112	105	100	1.0
1013	148803	Chevron Texaco	Rig Supply	32.252777	-94.468332	500	70	153	2	0.5	88	86	100	0.9
1014	148795	Langston Drilling Company	Rig Supply	32.361111	-94.074166	210	70	131	2	0.5	103	98	90	1.1
1015	148759	GOODRICH	Rig Supply	32.144999	-94.566388	340	50	100	1	0.5	96	92	70	1.3
1016	148731	Chevron Texaco	Rig Supply	32.23861	-94.405833	560	80	83	2	1.0	186	160	160	1.0
1017	148727	Chevron Texaco	Rig Supply	32.23611	-94.39111	490	80	164	2	0.5	94	90	130	0.7
1018	148687	Comstock Oil and Gas	Rig Supply	32.239444	-94.509166	360	80	173	2	0.5	89	86	110	0.8
1019	148678	Devon Energy	Rig Supply	32.089444	-94.38111	380	60	211	2	0.3	55	57	80	0.7
1020	148673	Devon Energy-Southland Paper #13	Rig Supply	32.0625	-94.353055	300	60	184	2	0.3	63	64	80	0.8
1021	148661	Devon Energy	Rig Supply	32.148888	-94.28111	130	80	88	2	0.9	175	152	70	2.2
1022	148656	Devon Energy	Rig Supply	32.07611	-94.396944	350	60	200	2	0.3	58	60	120	0.5
1023	148614	Devon Energy	Rig Supply	32.131666	-94.273054	120	80	96	2	0.8	160	142	60	2.4
1024	148611	Devon Energy	Rig Supply	32.051388	-94.27361	180	45	102	2	0.4	85	83	40	2.1
1025	147948	GOODRICH	Rig Supply	32.128332	-94.558055	363	65	60	1	1.1	209	177	83	2.1
1026	147900	Anadarko - Chris Sparks	Rig Supply	32.142499	-94.43611	320	60	74	1	0.8	156	138	100	1.4
1027	147899	Anadarko - Chris Sparks	Rig Supply	32.120832	-94.390277	100	70	25	1	2.8	539	392	70	5.6
1028	147797	Hunt Petroleum Corporation	Rig Supply	32.222777	-94.300277	110	65	30	1	2.2	417	316	80	4.0
1029	147790	Anadarko - Chris Sparks	Rig Supply	32.161666	-94.463888	400	60	90	1	0.7	128	117	100	1.2
1030	147391	Preston Exploration	Rig Supply	31.99361	-94.373332	380	70	20	1	3.5	674	473	105	4.5
1031	147367	Maximus Operating Ltd	Rig Supply	32.350833	-94.050555	260	55	85	1	0.6	125	115	160	0.7
1032	147300	Preston Exploration	Rig Supply	32.313055	-94.49361	440	70	5	1	14.0	2,695	1,515	110	13.8
1033	146608	Anadarko E & P Company, Inc.	Rig Supply	32.11	-94.406111	190	75	50	1	1.5	289	232	100	2.3
1034	146528	GOODRICH	Rig Supply	32.174721	-94.567221	315	75	60	1	1.3	241	199	95	2.1
1035	146295	Anadarko E & P Company, Inc.	Rig Supply	32.146388	-94.200555	190	75	50	1	1.5	289	232	110	2.1
1036	145745	Anadarko E & P Company, Inc.	Rig Supply	32.016388	-94.339999	220	70	30	1	2.3	449	336	180	1.9
1037	145742	Anadarko E & P Company, Inc.	Rig Supply	32.026943	-94.34111	340	75	30	1	2.5	481	357	180	2.0
1038	145741	Maximus Operating Ltd	Rig Supply	32.357222	-94.050277	110	65	25	1	2.6	501	368	98	3.8
1039	145501	Anadarko E & P Company, Inc.	Rig Supply	32.063611	-94.205277	250	60	85	1	0.7	136	123	120	1.0
1040	145497	Anadarko E & P Company, Inc.	Rig Supply	32.069443	-94.267499	180	70	40	1	1.8	337	264	140	1.9
1041	145171	Preston Exploration	Rig Supply	32.304166	-94.506666	340	80	20	1	4.0	770	529	100	5.3
1042	145134	ConocoPhillips Company	Rig Supply	32.051388	-94.241944	220	70	30	1	2.3	449	336	190	1.8
1043	145131	Anadarko E & P Company, Inc.	Rig Supply	32.134166	-94.2625	100	70	20	1	3.5	674	473	90	5.3
1044	145081	Anadarko E & P Company, Inc.	Rig Supply	32.039999	-94.290833	280	70	25	1	2.8	539	392	250	1.6
1045	144685	REILLY, MIKE	Domestic	32.653055	-97.665	299	60	1	1	60.0	11,551	5,146	100	51.5
1046	144638	Hunt Petroleum Corporation	Rig Supply	32.218332	-94.296388	90	70	20	1	3.5	674	473	12	39.4
1047	144626	ConocoPhillips Company	Rig Supply	32.028332	-94.305	300	65	60	1	1.1	209	177	80	2.2
1048	144121	Devon Energy	Rig Supply	32.076388	-94.356388	300	20	188	2	0.1	20	25	160	0.2
1049	143258	Enduring Resources	Rig Supply	32.084166	-94.585277	560	60	40	1	1.5	289	232	100	2.3
1050	143150	Anadarko E & P Company, Inc.	Rig Supply	32.144166	-94.411388	220	70	30	1	2.3	449	336	180	1.9
1051	143142	Anadarko E & P Company, Inc.	Rig Supply	32.108055	-94.263055	170	70	30	1	2.3	449	336	140	2.4
1052	142192	CHESAPEAKE ENERGY CORPORATION	Rig Supply	32.118332	-94.5025	383	60	80	1	0.8	144	130	80	1.6
1053	142112	CHESAPEAKE OPERATING	Rig Supply	31.301388	-94.429443	363	65	70	1	0.9	179	155	83	1.9
1054	142004	GOODRICH	Rig Supply	32.137777	-94.568332	380	50	10	1	5.0	963	638	60	10.6
1055	141970	Anadarko E & P Company, Inc.	Rig Supply	32.116666	-94.25	170	70	20	1	3.5	674	473	155	3.1
1056	141969	Anadarko E & P Company, Inc.	Rig Supply	32.150277	-94.166943	180	65	30	1	2.2	417	316	100	3.2
1057	141967	ConocoPhillips Company	Rig Supply	32.016666	-94.350277	280	55	85	1	0.6	125	115	200	0.6
1058	141891	XTO Energy Inc.	Rig Supply	32.133333	-94.300277	120	75	40	1	1.9	361	280	100	2.8
1059	141888	Anadarko E & P Company, Inc.	Rig Supply	32.150277	-94.183333	180	75	50	1	1.5	289	232	100	2.3
1060	141568	Wagner Oil	Rig Supply	32.099721	-94.204722	540	50	60	1	0.8	160	142	100	1.4
1061	141533	Hunt Petroleum Corporation	Rig Supply	32.216666	-94.3	120	70	20	1	3.5	674	473	100	4.7
1062	141442	Mike Parker	Domestic	32.168054	-94.349721	265	30	20	2	1.5	289	232	20	11.6
1063	141307	Anadarko E & P Company, Inc.	Rig Supply	32.15	-94.4	300	60	85	1	0.7	136	123	100	1.2
1064	140686	NFR Energy, LLC	Rig Supply	32	-94.466666	480	50	87	1	0.6	111	104	100	1.0
1065	140466	AC Exploration	Rig Supply	32.063333	-94.459166	360	70	5	1	14.0	2,695	1,515	130	11.7
1066	140338	Anadarko Petroleum	Rig Supply	32.166666	-94.400277	330	60	87	1	0.7	133	121	100	1.2
1067	140335	ConocoPhillips Company	Rig Supply	32.033333	-94.3	160	70	20	1	3.5	674	473	130	3.6
1068	139974	Pioneer Drilling	Industrial	32.019166	-94.500555	340	60	80	1	0.8	144	130	220	0.6
1069	139813	Chesapeake Operating, Inc.	Rig Supply	32.1	-94.33361	300	60	80	1	0.8	144	130	100	1.3
1070	139811	Devon Energy Production Company, LP	Rig Supply	32.13361	-94.283333	160	75	40	1	1.9	361	280	100	2.8
1071	139805	Anadarko E & P Company, Inc.	Rig Supply	32.35	-94.533333	400	50	90	1	0.6	107	101	100	1.0
1072	139804	Anadarko E & P Company, Inc.	Rig Supply	32.03361	-94.283333	190	70	20	1	3.5	674	473	160	3.0
1073	139781	Anadarko E & P Company, Inc.	Rig Supply	32.150277	-94.383333	310	70	30	1	2.3	449	336	90	3.7
1074	139141	Devon Energy	Rig Supply	32.07361	-94.4	320	60	194	2	0.3	60	62	100	0.6
1075	139132	A.C. Exploration	Rig Supply	32.051944	-94.511944	460	70	178	2	0.4	76	75	140	0.5
1076	139040	Classic Operating	Rig Supply	32.086388	-94.533888	480	60	10	1	6.0	1,155	744	90	8.3
1077	138903	Devon Energy Production Company, LP	Rig Supply	32.100277	-94.366943	240	65	85	1	0.8	147	132	100	1.3
1078	138888	Anadarko E & P Company, Inc.	Rig Supply	32.133333	-94.266666	130	70	20	1	3.5	674	473	115	4.1
1079	138879	GOODRICH	Rig Supply	32.175554	-94.582499	385	80	50	2	1.6	308	245	55	4.5
1080	138369	Hunt Petroleum	Industrial	32.319443	-94.270832	60	40	20	1	2.0	385	296	50	5.9
1081	138250	Texas American	Rig Supply	32.280554	-94.482499	520	70	5	1	14.0	2,695	1,515	110	13.8
1082	138246	Chinn Exploration	Rig Supply	32.249166	-94.455277	340	80	5	1	16.0	3,080	1,695	110	15.4
1083	138243	Samson	Rig Supply	32.409444	-94.227777	340	100	15	1	6.7	1,283	813	145	5.6
1084	138167	Preston Exploration	Rig Supply	32.003055	-94.380554	260	40	40	1	1.0	193	165	100	1.7
1085	138116	GOODRICH	Rig Supply	32.148055	-94.564444	263	60	80	2	0.8	144	130	23	5.6
1086	137783	ConocoPhillips Company	Rig Supply	32.05	-94.283333	225	65	85	1	0.8	147	132	125	1.1
1087	137644	Devon Energy Production Company, LP	Rig Supply	32.18361	-94.333333	145	70	20	1	3.5	674	473	120	3.9
1088	137642	Devon Energy Production Company, LP	Rig Supply	32.066666	-94.366666	300	65	60	1	1.1	209	177	100	1.8
1089	137637	Anadarko E & P Company, Inc.	Rig Supply	32.100277	-94.266943	200	65	60	1	1.1	209	177	100	1.8
1090	137064	Anadarko E & P Company, Inc.	Rig Supply	32.116943	-94.38361	180	70	30	1	2.3	449	336	80	4.2
1091	136117	Preston Exploration	Rig Supply	32.033888	-94.247499	280	80	5	1	16.0	3,080	1,695	90	18.8
1092	135965	Anadarko E & P Company, Inc.	Rig Supply	32.116666	-94.266666	240	65	85	1	0.8	147	132	200	0.7
1093	135964	Anadarko E & P Company, Inc.	Rig Supply	32.13361	-94.38361	300	60	81	1	0.7	143	128	100	1.3
1094	135963	Anadarko E & P Company, Inc.	Rig Supply	32.2	-94.48361	160	75	40	1	1.9	361	280	100	2.8
1095	135962	Anadarko E & P Company, Inc.	Rig Supply	32.216666	-94.466943	140	65	30	1	2.2	417	316	100	3.2
1096	135959	Anadarko E & P Company, Inc.	Rig Supply	32.216666	-94.483333	160	75	50	1	1.5	289	232	120	1.9
1097	135665	Devon Energy Production Company, LP	Rig Supply	32.066666	-94.216666	200	70	40	1	1.8	337	264	120	2.2
1098	135655	Johnson, Sam	Domestic	32.316111	-94.509444	400	23	118	1	0.2	38	42	100	0.4
1099	135562	Gordon, Anthony & Wright, Carolyn	Domestic	32.183054	-94.339999	215	40	167	1	0.2	46	50	115	0.4
1100	135462	Chesapeake	Rig Supply	32.138333	-94.546666	400	50	40	1	1.3	241	199	100	2.0
1101	135427	Devon Energy Production Company, LP	Rig Supply	32.083333	-94.366943	290	60	70	1	0.9	165	145	100	1.5
1102	135426	ConocoPhillips Company	Rig Supply	32.050277	-94.266943	180	70	30	1	2.3	449	336	100	3.4
1103	135411	Samson	Rig Supply	32.234444	-94.195277	220	50	60	1	0.8	160	142	100	1.4
1104	135391	Cornade (El Paso)	Rig Supply	32.016388	-94.492221	220	70	5	1	14.0	2,695	1,515	110	13.8
1105	135386	Enduring Resources	Rig Supply	32.408333	-94.782777	420	80	5	1	16.0	3,080	1,695	90	18.8
1106	135343	Enduring Resources	Rig Supply	32.027499	-94.59611	460	60	40	1	1.5	289	232	105	2.2
1107	134497	Anadarko E & P Company, Inc.	Rig Supply	32.083333	-94.28361	220	70	63	1	1.1	214	180	100	1.8
1108	134493	ConocoPhillips Company	Rig Supply	32.03361	-94.25	400	60	80	1	0.8	144	130	100	1.3
1109	134251	Goodrich Petroleum	Rig Supply	32.116943	-94.566666	260	75	63	1	1.2	229	191	100	1.9
1110	134211	Preston Exploration	Rig Supply	32.1	-94.474166	200	85	40	1	2.1	409	311	100	3.1
1111	133873	R. Lacy Inc.	Rig Supply	32.25	-94.316943	260	65	60	1	1.1	209	177	100	1.8

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
1112	133870	Anadarko E & P Company, Inc.	Rig Supply	32.216666	-94.450277	180	70	60	1	1.2	225	188	165	1.1
1113	133864	Anadarko E & P Company, Inc.	Rig Supply	32.066943	-94.266666	240	65	85	1	0.8	147	132	236	0.6
1114	133861	Anadarko E & P Company, Inc.	Rig Supply	32.166666	-94.333333	320	65	85	1	0.8	147	132	100	1.3
1115	133238	Devon Energy Production Company, LP	Rig Supply	32.066943	-94.4	160	75	40	1	1.9	361	280	100	2.8
1116	133234	Devon Energy Production Company, LP	Rig Supply	32.2	-94.333333	180	75	50	1	1.5	289	232	100	2.3
1117	133232	ConocoPhillips Company	Rig Supply	32.05	-94.25	280	55	85	1	0.6	125	115	100	1.1
1118	133228	Basa Resources Inc	Rig Supply	32.050277	-94.516666	180	75	50	1	1.5	289	232	100	2.3
1119	133227	Anadarko E & P Company, Inc.	Rig Supply	32.15	-94.450277	190	75	50	1	1.5	289	232	150	1.5
1120	133211	Basa Resources Inc	Rig Supply	32.116943	-94.500277	450	60	155	1	0.4	75	74	100	0.7
1121	133206	Anadarko E & P Company, Inc.	Rig Supply	32.083333	-94.266943	200	65	60	1	1.1	209	177	170	1.0
1122	133203	Devon Energy Production Company, LP	Rig Supply	32.216666	-94.300277	135	70	60	1	1.2	225	188	95	2.0
1123	133198	Devon Energy Production Company, LP	Rig Supply	32.050277	-94.35	300	65	65	1	1.0	193	165	100	1.7
1124	132924	Robinson, Earl	Domestic	32.027499	-94.472777	258	10	40	3	0.3	48	52	28	1.8
1125	132922	Tarjick, Tyler	Domestic	32.14611	-94.382221	230	25	30	2	0.8	160	142	40	3.5
1126	132917	Holmes, Kenneth	Stock	32.061944	-94.211944	174	12	80	3	0.2	29	34	29	1.2
1127	132884	GOODRICH	Rig Supply	32.137221	-94.547777	325	45	60	1.5	0.8	144	130	75	1.7
1128	132877	Samson	Rig Supply	32.244721	-94.16861	180	65	5	1	13.0	2,503	1,424	105	13.6
1129	132871	Chesapeake Operating Inc.	Rig Supply	32.311666	-94.4125	360	80	5	1	16.0	3,080	1,695	90	18.8
1130	132355	Joe Allison	Domestic	32.174721	-94.314722	43	12	15	2	0.8	154	137	18	7.6
1131	131472	Anadarko E & P Company, Inc.	Rig Supply	32.116943	-94.250277	110	60	52	1	1.2	222	186	80	2.3
1132	131468	Anadarko E & P Company, Inc.	Rig Supply	32.15	-94.416943	260	70	65	1	1.1	207	176	190	0.9
1133	131465	Anadarko E & P Company, Inc.	Rig Supply	32.100277	-94.38361	135	70	20	1	3.5	674	473	105	4.5
1134	130185	Devon Energy Production Co., LP	Rig Supply	32.05	-94.383333	280	55	85	1	0.6	125	115	100	1.1
1135	129754	Devon Energy Production Co., LP	Rig Supply	32.15	-94.266666	120	75	40	1	1.9	361	280	100	2.8
1136	129751	Anadarko E & P Company, Inc.	Rig Supply	32.1	-94.233333	180	70	50	1	1.4	270	219	100	2.2
1137	129745	Devon Energy Production Co., LP	Rig Supply	32.216666	-94.33361	160	70	60	1	1.2	225	188	148	1.3
1138	129731	Samson	Rig Supply	32.386666	-94.085555	120	80	5	1	16.0	3,080	1,695	100	17.0
1139	129721	Chesapeake Operating, Inc.	Rig Supply	32.304444	-94.424999	360	100	5	1	20.0	3,850	2,045	90	22.7
1140	129482	Conoco Phillips Company	Rig Supply	32.033333	-94.33361	320	50	94	1	0.5	102	97	120	0.8
1141	129481	Devon Energy Production Co., LP	Rig Supply	32.1	-94.366943	190	75	50	1	1.5	289	232	100	2.3
1142	129477	Devon Energy Production Co., LP	Rig Supply	32.1	-94.366943	320	55	100	1	0.6	106	100	120	0.8
1143	129113	GOODRICH	Rig Supply	32.1525	-94.555833	183	50	45	1	1.1	214	180	80	2.3
1144	129062	BUFFCO PRODUCTION, INC.	Rig Supply	32.299166	-94.421666	300	70	50	1	1.4	270	219	60	3.7
1145	128798	GOODRICH	Rig Supply	31.459166	-94.905	380	65	50	2	1.3	250	206	100	2.1
1146	128530	Peace, Sammy	Stock	32.047221	-94.066666	220	35	80	3	0.4	84	82	65	1.3
1147	128527	Peace, Sammy	Domestic	32.046944	-94.066666	200	35	80	3	0.4	84	82	61	1.4
1148	128519	Baize, Kenneth	Domestic	32.075554	-94.347777	130	10	30	2	0.3	64	66	20	3.3
1149	128515	Rittenberry, John	Stock	32.0075	-94.239444	75	25	20	2	1.3	241	199	30	6.6
1150	128512	Rittenberry, John	Domestic	32.008611	-94.29861	45	15	15	3	1.0	193	165	20	8.3
1151	128460	Collins, Jane	Domestic	32.050555	-94.3025	212	30	70	2	0.4	83	81	32	2.5
1152	128459	Holmes, Kenneth	Stock	32.056111	-94.210555	55	20	10	2	2.0	385	296	23	12.9
1153	128458	Holmes, Kenneth	Stock	32.055555	-94.212222	55	20	10	2	2.0	385	296	23	12.9
1154	128454	Hudson, Jerry	Stock	32.094721	-94.289999	222	35	100	2	0.4	67	68	32	2.1
1155	128450	Fuselier, Palmer	Domestic	32.184721	-94.274443	40	18	10	2	1.8	347	271	22	12.3
1156	128449	Fuselier, Palmer	Domestic	32.183888	-94.274166	40	15	15	2	1.0	193	165	18	9.2
1157	128448	Dukes, Eddie	Domestic	32.194999	-94.270554	42	18	10	2	1.8	347	271	23	11.8
1158	128446	Walker, Ouida	Stock	32.187499	-94.321666	210	25	50	2	0.5	96	92	19	4.9
1159	128445	Walker, Ouida	Stock	32.187499	-94.321666	210	25	50	2	0.5	96	92	19	4.9
1160	128443	Walker, Ouida	Stock	32.18361	-94.31861	210	3	160	2	0.0	4	6	65	0.1
1161	128440	Gillis, Charles	Domestic	32.216111	-94.472221	340	40	40	2	1.0	193	165	30	5.5
1162	128439	Davis, Stan	Domestic	32.1625	-94.353888	40	20	18	2	1.1	214	180	20	9.0
1163	128438	Nixon, Drew	Domestic	32.165555	-94.410277	320	30	50	2	0.6	116	108	30	3.6
1164	128435	Holmes, Kenneth	Stock	32.054166	-94.212222	167	10	140	2	0.1	14	18	26	0.7
1165	127859	Anadarko E & P Company Inc.	Rig Supply	32.15	-94.4	340	55	110	1	0.5	96	92	100	0.9
1166	127836	Conoco Phillips Company	Rig Supply	32.05	-94.3	215	65	85	1	0.8	147	132	100	1.3
1167	127362	Samson	Rig Supply	32.362777	-94.072777	200	65	70	1	0.9	179	155	85	1.8
1168	127103	Anadarko E & P Company Inc.	Rig Supply	32.133333	-94.466666	310	65	87	1	0.7	144	129	100	1.3
1169	127091	Devon Energy Production	Rig Supply	32.05	-94.38361	380	70	90	1	0.8	150	134	100	1.3
1170	127090	Anadarko E & P Company Inc.	Rig Supply	32.08361	-94.316666	210	70	65	1	1.1	207	176	130	1.4
1171	125838	Preston Exploration	Rig Supply	32.305555	-94.489444	460	75	125	1	0.6	116	108	80	1.3
1172	125769	Chesapeake Operating Inc.	Rig Supply	32.190555	-94.523332	460	70	10	1	7.0	1,348	847	110	7.7
1173	125292	Devon Energy Production	Rig Supply	32.08361	-94.366666	275	55	85	1	0.6	125	115	200	0.6
1174	125289	Basa Resources, Inc.	Rig Supply	32.05	-94.55	380	50	90	1	0.6	107	101	100	1.0
1175	124968	Chinn	Rig Supply	32.249721	-94.4525	360	80	40	1	2.0	385	296	100	3.0
1176	124750	JOHN LAMBERT	Domestic	32.232221	-94.358888	260	25	2	1	12.5	2,406	1,378	40	34.4
1177	124692	Anadarko E & P Company Inc.	Rig Supply	32.13361	-94.466666	300	70	85	1	0.8	159	140	100	1.4
1178	124687	Anadarko E & P Company Inc.	Rig Supply	32.166666	-94.400277	140	75	40	1	1.9	361	280	100	2.8
1179	124685	Goodrich Petroleum	Rig Supply	32.116666	-94.53361	200	75	80	1	0.9	180	156	100	1.6
1180	124682	Devon Energy Production	Rig Supply	32.08361	-94.466666	340	55	110	1	0.5	96	92	100	0.9
1181	124388	GOODRICH	Rig Supply	32.263055	-94.536388	280	60	40	1	1.5	289	232	25	9.3
1182	124261	Energen c/o Brammer Engineering	Rig Supply	32.333333	-94.6	440	50	155	1	0.3	62	64	200	0.3
1183	124257	R. Lacy Inc.	Rig Supply	32.250277	-94.366943	150	75	40	1	1.9	361	280	100	2.8
1184	123774	GOODRICH	Rig Supply	32.206111	-94.566111	462	55	2	1	27.5	5,294	2,672	62	43.1
1185	123702	Preston Exploration	Rig Supply	32.07861	-94.266111	160	60	5	1	12.0	2,310	1,331	100	13.3
1186	123298	Anadarko E & P Company Inc.	Rig Supply	32.08361	-94.28361	250	70	50	1	1.4	270	219	100	2.2
1187	123270	Anadarko E & P Company Inc.	Rig Supply	32.2	-94.350277	210	70	60	1	1.2	225	188	170	1.1
1188	123011	Devon Energy Production	Rig Supply	32.183333	-94.516666	380	70	90	1	0.8	150	134	100	1.3
1189	123008	Anadarko E & P Company Inc.	Rig Supply	32.083333	-94.283333	220	40	60	1	0.7	128	117	100	1.2
1190	122996	Devon Energy Production	Rig Supply	32.250277	-94.233333	150	75	40	1	1.9	361	280	100	2.8
1191	122994	Devon Energy Production	Rig Supply	32.200277	-94.35	220	65	85	1	0.8	147	132	100	1.3
1192	122987	Anadarko E & P Company Inc.	Rig Supply	32.18361	-94.38361	230	65	85	1	0.8	147	132	100	1.3
1193	122765	Devon Energy Production	Rig Supply	32.183333	-94.516666	320	55	110	1	0.5	96	92	120	0.8
1194	122761	Anadarko E & P Company Inc.	Rig Supply	32.383333	-94.58361	560	50	90	1	0.6	107	101	100	1.0
1195	122753	Conoco Phillips Company	Rig Supply	32.03361	-94.283333	280	70	85	1	0.8	159	140	100	1.4
1196	122746	Anadarko E & P Company Inc.	Rig Supply	32.166943	-94.383333	200	65	50	1	1.3	250	206	100	2.1
1197	122732	Devon Energy Production	Rig Supply	32.066666	-94.416666	115	75	40	1	1.9	361	280	100	2.8
1198	122388	Chesapeake Operating, Inc.	Rig Supply	32.036944	-94.283054	240	70	20	1	3.5	674	473	100	4.7
1199	122360	O'Benco Inc.	Rig Supply	32.38361	-94.366666	380	70	65	1	1.1	207	176	200	0.9
1200	122345	Classic Hydro Carbon	Rig Supply	32.379166	-94.335555	260	70	75	1	0.9	180	156	90	1.7
1201	122281	Devon Energy Production	Rig Supply	32.13361	-94.266943	115	70	50	1	1.4	270	219	85	2.6
1202	122277	Anadarko E & P Company Inc.	Rig Supply	32.166666	-94.366943	140	75	40	1	1.9	361	280	100	2.8
1203	121943	R. Lacy Inc.	Rig Supply	32.23361	-94.333333	180	75	50	1	1.5	289	232	100	2.3
1204	121942	Devon Energy Production	Rig Supply	32.05	-94.416666	500	60	90	1	0.7	128	117	140	0.8
1205	121939	Devon Energy Production	Rig Supply	32.066666	-94.350277	210	65	85	1	0.8	147	132	100	1.3
1206	121525	GOODRICH	Rig Supply	32.224166	-94.571388	343	60	50	1	1.2	231	192	70	2.7
1207	121131	BUFFCO	Rig Supply	32.069443	-94.556944	372	60	2	1	30.0	5,775	2,875	62	46.4
1208	120826	Devon Energy Production	Rig Supply	32.066943	-94.383333	300	70	80	1	0.9	168	148	100	1.5
1209	120824	Devon Energy Production	Rig Supply	32.2	-94.3	140	75	40	1	1.9	361	280	100	2.8
1210	120821	Devon Energy Production	Rig Supply	32.083333	-94.38361	180	75	50	1	1.5	289	232	150	1.5
1211	120813	Devon Energy Production	Rig Supply	32.166666	-94.316943	280	65	65	1	1.0	193	165	240	0.7
1212	120695	GOODRICH	Rig Supply	32.158888	-94.565833	483	50	100	1.5	0.5	96	92	98	0.9

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
1213	120513	Chesapeake Operating, Inc.	Rig Supply	32.298888	-94.165	120	70	50	1	1.4	270	219	80	2.7
1214	120509	AC Exploration, LLC	Rig Supply	32.138888	-94.53361	480	70	10	1	7.0	1,348	847	90	9.4
1215	119582	Devon Energy Production	Rig Supply	32.1	-94.366666	260	65	70	1	0.9	179	155	220	0.7
1216	119579	Devon Energy Production	Rig Supply	32.1	-94.366666	240	65	70	1	0.9	179	155	200	0.8
1217	119316	Chesapeake Operating Inc.	Rig Supply	32.111666	-94.536666	200	20	75	1	0.3	51	54	80	0.7
1218	119315	Chesapeake Operating Inc.	Rig Supply	32.111666	-94.536666	420	50	200	1	0.3	48	52	80	0.6
1219	119313	Texas American Resources	Rig Supply	32.265	-94.454722	400	60	100	1	0.6	116	108	100	1.1
1220	118839	Anadarko E & P Company Inc.	Rig Supply	32.35	-94.583333	340	60	110	1	0.5	105	99	140	0.7
1221	118827	XTO Energy	Rig Supply	32.108888	-94.332221	240	55	16	1	3.4	662	466	80	5.8
1222	118737	GOODRICH PETROLEUM	Rig Supply	32.055555	-94.585833	403	60	80	1	0.8	144	130	103	1.3
1223	118349	ChevronTexaco	Rig Supply	32.183333	-94.166666	320	50	115	1	0.4	84	82	200	0.4
1224	118348	ChevronTexaco	Rig Supply	32.133333	-94.133333	320	55	110	1	0.5	96	92	100	0.9
1225	118214	GOODRICH PETROLEUM	Rig Supply	32.249444	-94.553333	343	60	70	1	0.9	165	145	113	1.3
1226	118024	Conoco Phillips Company	Rig Supply	32.016666	-94.35	380	60	70	1	0.9	165	145	220	0.7
1227	118022	Hunt Petroleum Corporation	Rig Supply	32.333333	-94.266666	320	65	70	1	0.9	179	155	100	1.6
1228	118016	Anadarko E & P Company Inc.	Rig Supply	32.216943	-94.450277	440	65	70	1	0.9	179	155	100	1.6
1229	117950	Devon Energy Production	Rig Supply	32.166943	-94.316666	190	75	50	1	1.5	289	232	140	1.7
1230	117948	Anadarko E & P Company Inc.	Rig Supply	32.2	-94.383333	180	70	50	1	1.4	270	219	120	1.8
1231	117943	Chevron North America E&P Cp.	Rig Supply	32.15	-94.116943	300	65	70	1	0.9	179	155	220	0.7
1232	117926	Enduring Resources	Rig Supply	32.069999	-94.580554	350	70	75	1	0.9	180	156	80	1.9
1233	117921	Bill Tomlinson	Rig Supply	32.000555	-94.239721	120	70	20	1	3.5	674	473	40	11.8
1234	117907	Chesapeake Operating, Inc.	Rig Supply	32.116666	-94.372499	230	70	75	1	0.9	180	156	110	1.4
1235	117905	Hunt Petroleum	Industrial	32.328054	-94.274721	240	65	70	1	0.9	179	155	140	1.1
1236	117893	Goodrich Petroleum	Rig Supply	32.147777	-94.570277	522	65	10	2	6.5	1,251	796	62	12.8
1237	117882	Buffco Production	Rig Supply	31.274999	-94.4075	355	60	5	2	12.0	2,310	1,331	65	20.5
1238	117749	Chinn Exploration	Rig Supply	32.283333	-94.400277	240	65	85	1	0.8	147	132	140	0.9
1239	117492	XTO Energy Inc.	Rig Supply	32.316666	-94.133333	130	75	40	1	1.9	361	280	100	2.8
1240	117481	Hunt Petroleum Corporation	Rig Supply	32.333333	-94.266943	360	70	50	1	1.4	270	219	150	1.5
1241	117230	Texas American Resources	Rig Supply	32.258333	-94.475832	420	80	5	1	16.0	3,080	1,695	110	15.4
1242	116803	Bill Tomlinson	Rig Supply	32.034721	-94.239999	110	80	5	1	16.0	3,080	1,695	110	15.4
1243	116419	Devon Energy Production	Rig Supply	32.05	-94.416943	320	55	110	1	0.5	96	92	200	0.5
1244	116288	Texas American Resources	Rig Supply	32.271666	-94.474443	370	65	60	1	1.1	209	177	100	1.8
1245	115835	Chevron USA Productions	Rig Supply	32.25	-94.45	260	55	85	1	0.6	125	115	200	0.6
1246	115503	Devon Energy Production	Rig Supply	32.266666	-94.216943	175	75	50	1	1.5	289	232	135	1.7
1247	115218	Chesapeake Operating, Inc.	Rig Supply	32.288888	-94.151111	140	80	5	1	16.0	3,080	1,695	110	15.4
1248	115194	Dorado	Rig Supply	32.297777	-94.393055	340	70	40	1	1.8	337	264	100	2.6
1249	115147	Texas American Resources	Rig Supply	32.268332	-94.488055	460	60	150	1	0.4	77	76	100	0.8
1250	115138	CHESAPEAKE OPR., INC.	Rig Supply	32.244721	-94.477221	535	65	5	2	13.0	2,503	1,424	65	21.9
1251	115124	Samson	Rig Supply	32.372221	-94.078054	180	80	5	1	16.0	3,080	1,695	105	16.1
1252	114899	Chesapeake Operating Inc.	Rig Supply	32.122499	-94.541944	180	70	25	1	2.8	539	392	100	3.9
1253	114881	Loutex	Rig Supply	32.459722	-94.33111	340	75	10	12	7.5	1,444	897	60	15.0
1254	114622	Sterling Energy Inc.	Rig Supply	32.05	-94.416943	340	65	110	1	0.6	114	106	200	0.5
1255	114591	Anadarko E & P Company Inc.	Rig Supply	32.216666	-94.466666	160	70	40	1	1.8	337	264	100	2.6
1256	114589	Hunt Petroleum Corporation	Rig Supply	32.200277	-94.3	140	75	40	1	1.9	361	280	100	2.8
1257	114575	Anadarko E & P Company Inc.	Rig Supply	32	-94.300277	390	65	70	1	0.9	179	155	80	1.9
1258	114021	Devon Energy Production Company L. P.	Rig Supply	32.150277	-94.283333	130	70	40	1	1.8	337	264	90	2.9
1259	113996	Chevron USA Production	Rig Supply	32.18361	-94.400277	280	65	70	1	0.9	179	155	220	0.7
1260	113575	Comstock Oil and Gas Company	Rig Supply	32.233333	-94.316666	130	55	75	1	0.7	141	127	100	1.3
1261	113574	Devon Energy Production Company L. P.	Rig Supply	32.066943	-94.366666	310	55	110	1	0.5	96	92	100	0.9
1262	113557	Devon Energy Production Company L. P.	Rig Supply	32.216943	-94.35	140	60	80	1	0.8	144	130	100	1.3
1263	113500	Goodrich Petroleum	Rig Supply	32.194721	-94.531388	320	50	60	2	0.8	160	142	75	1.9
1264	113489	Forest Oil Corp.	Rig Supply	32.374443	-94.374443	323	70	75	1	0.9	180	156	93	1.7
1265	113480	Chesapeake Operating	Rig Supply	32.174166	-94.527499	243	70	60	1	1.2	225	188	73	2.6
1266	113412	Devon Energy Production Company L. P.	Rig Supply	32.166666	-94.266666	140	70	60	1	1.2	225	188	100	1.9
1267	113406	Devon Energy Production Company L. P.	Rig Supply	32.033333	-94.38361	380	65	70	1	0.9	179	155	230	0.7
1268	113132	Dustin Powell	Domestic	32.227499	-94.412222	440	100	10	1	10.0	1,925	1,142	90	12.7
1269	112697	ConocoPhillips Company	Rig Supply	32.016666	-94.316943	400	65	70	1	0.9	179	155	220	0.7
1270	112685	Chinn Exploration	Rig Supply	32.291944	-94.415277	320	70	20	1	3.5	674	473	120	3.9
1271	112522	Anadarko E & P Company Inc.	Rig Supply	32	-94.28361	380	70	50	1	1.4	270	219	100	2.2
1272	112159	Ken Turner	Domestic	32.158888	-94.32361	252	60	40	2	1.5	289	232	20	11.6
1273	111741	Chesapeake	Rig Supply	32.115833	-94.527221	375	65	70	2	0.9	179	155	75	2.1
1274	111500	Hunt Petroleum Corpration	Rig Supply	32.2	-94.3	150	65	70	1	0.9	179	155	90	1.7
1275	111496	Anadarko E & P Company Inc.	Rig Supply	32.116666	-94.3	260	70	40	1	1.8	337	264	100	2.6
1276	111492	Devon Energy Production Company L. P.	Rig Supply	32.166943	-94.333333	215	65	70	1	0.9	179	155	95	1.6
1277	111200	PIONEER DRILLING	Industrial	32.240833	-94.315555	100	75	25	1	3.0	578	416	90	4.6
1278	110618	Devon Energy Production Company L. P.	Rig Supply	32.23361	-94.25	130	65	40	1	1.6	313	248	100	2.5
1279	110332	Chinn Exploration	Rig Supply	32.287499	-94.412222	340	80	5	1	16.0	3,080	1,695	90	18.8
1280	110030	Devon Energy Production L. P.	Rig Supply	32.15	-94.283333	185	65	60	1	1.1	209	177	85	2.1
1281	109698	Chesapeake Operating	Rig Supply	32.179721	-94.518888	435	55	2	1	27.5	5,294	2,672	65	41.1
1282	109653	Buffco Production	Rig Supply	32.292499	-94.440833	372	60	2	1	30.0	5,775	2,875	62	46.4
1283	109168	Dorado	Rig Supply	32.326388	-94.451111	420	50	60	1	0.8	160	142	100	1.4
1284	109058	Devon Energy Production Company L. P.	Rig Supply	32.183333	-94.3	150	65	60	1	1.1	209	177	90	2.0
1285	109056	Devon Energy Production Company L. P.	Rig Supply	32.250277	-94.25	140	50	40	1	1.3	241	199	150	1.3
1286	109052	Devon Energy Production Company L. P.	Rig Supply	32.283333	-94.133333	130	50	35	1	1.4	275	223	100	2.2
1287	109025	Anadarko E & P Company Inc.	Rig Supply	32.083333	-94.3	260	55	85	1	0.6	125	115	200	0.6
1288	108769	Chevron USA Production	Rig Supply	32.233333	-94.416666	270	65	85	1	0.8	147	132	100	1.3
1289	108354	Jeff Crooks	Rig Supply	32.1625	-94.539166	460	90	5	1	18.0	3,465	1,872	90	20.8
1290	108338	Enduring Resources	Rig Supply	32.002777	-94.602777	360	50	40	1	1.3	241	199	100	2.0
1291	107875	Anadarko E & P Company Inc.	Rig Supply	32.016943	-94.366943	370	66	90	1	0.7	141	127	200	0.6
1292	107722	Hunt Petroleum Corpration	Rig Supply	32.216666	-94.28361	130	75	40	1	1.9	361	280	100	2.8
1293	107644	Chesapeake Operating Inc.	Rig Supply	32.100277	-94.48361	360	60	70	1	0.9	165	145	100	1.5
1294	107533	Anadarko E & P Company Inc.	Rig Supply	32.083333	-94.300277	200	65	85	1	0.8	147	132	100	1.3
1295	106377	Rita Bagley	Domestic	32.191388	-94.070277	180	25	30	6	0.8	160	142	80	1.8
1296	106213	Dorado	Rig Supply	32.280554	-94.467221	480	80	5	1	16.0	3,080	1,695	90	18.8
1297	106196	R. Lacy Inc.	Rig Supply	32.273888	-94.3	130	60	50	1	1.2	231	192	270	0.7
1298	106174	Chevron USA Production	Rig Supply	32.2	-94.433333	355	50	90	1	0.6	107	101	200	0.5
1299	106170	Chevron USA Production	Rig Supply	32.333333	-94.38361	330	55	110	1	0.5	96	92	100	0.9
1300	105683	CLASSIC OIL & GAS	Rig Supply	32.111111	-94.359722	330	60	132	2	0.5	88	85	70	1.2
1301	105520	Jack Phillips	Rig Supply	32.255833	-95.041388	312	55	2	1	27.5	5,294	2,672	62	43.1
1302	105437	STROUD ENERGY	Rig Supply	32.365	-94.102222	120	80	58	1	1.4	266	216	70	3.1
1303	105405	DEVON ENERGY	Rig Supply	32.091666	-94.38111	380	60	123	2	0.5	94	90	100	0.9
1304	105261	G & A DRLG	Rig Supply	32.16861	-94.554166	400	65	184	2	0.4	68	69	80	0.9
1305	105239	G & A DRLG	Rig Supply	32.229166	-94.114444	180	20	110	2	0.2	35	39	60	0.7
1306	105235	R LACY INC	Rig Supply	32.276943	-94.324999	285	70	174	2	0.4	77	77	105	0.7
1307	105230	R LACY INC	Rig Supply	32.258055	-94.326943	120	55	103	2	0.5	103	97	40	2.4
1308	105225	DEVON ENERGY INC	Rig Supply	32.197777	-94.363055	140	75	91	2	0.8	159	140	80	1.8
1309	105220	DEVON ENERGY INC	Rig Supply	32.251944	-94.26	90	80	56	2	1.4	275	223	60	3.7
1310	105217	DEVON ENERGY INC	Rig Supply	32.103611	-94.420832	580	50	105	2	0.5	92	89	80	1.1
1311	105193	DEVON ENERGY	Rig Supply	32.122499	-94.293333	170	80	98	2	0.8	157	139	70	2.0
1312	105130	AC Exploration, LLC	Rig Supply	32.1625	-94.535555	440	80	100	1	0.8	154	137	90	1.5
1313	104994	Chesapeake Operating Inc.	Rig Supply	32.300277	-94.38361	340	55	110	1	0.5	96	92	100	0.9

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
1314	104989	Basa Resources, Inc.	Rig Supply	32.050277	-94.516666	440	50	210	1	0.2	46	49	100	0.5
1315	104855	Chesapeake Operating Inc.	Rig Supply	32.3	-94.15	110	60	40	1	1.5	289	232	70	3.3
1316	104790	Goodrich Petroleum	Rig Supply	32.201944	-94.569443	383	50	75	1.5	0.7	128	117	93	1.3
1317	104543	Brammer Eng. Inc.	Rig Supply	32.040833	-94.329443	260	70	50	1	1.4	270	219	80	2.7
1318	104355	Anadarko E & P Company Inc.	Rig Supply	32.150277	-94.3	360	50	90	1	0.6	107	101	200	0.5
1319	104206	Anadarko E and P Co., LP	Industrial	32.158055	-94.413888	320	60	140	1	0.4	83	81	258	0.3
1320	103845	Chevron USA Production	Rig Supply	32.216666	-94.416943	270	55	85	1	0.6	125	115	100	1.1
1321	103732	Goodrich Petroleum	Rig Supply	31.233333	-94.55	480	50	120	1	0.4	80	79	100	0.8
1322	103450	Goodrich Petroleum	Rig Supply	32.189166	-94.576388	423	55	65	1	0.8	163	144	73	2.0
1323	103378	Chesapeake	Rig Supply	32.129443	-94.489721	323	65	60	2	1.1	209	177	93	1.9
1324	103360	CHEVRON/TEXACO	Rig Supply	32.3	-94.416943	260	65	100	1	0.7	125	115	80	1.4
1325	103280	Anderson, Bobby	Domestic	32.118332	-94.382221	100	15	42	1	0.4	69	70	60	1.2
1326	103276	Duckworth, Rowland	Domestic	32.127499	-94.283333	240	17	50	1	0.3	65	67	60	1.1
1327	103244	Errington, Albert	Domestic	32.068332	-94.600555	340	20	120	1	0.2	32	37	75	0.5
1328	103237	Anderson, Royce	Domestic	32.151111	-94.32361	150	25	84	1	0.3	57	60	55	1.1
1329	103232	Davis, Larry	Domestic	32.121943	-94.282499	245	30	120	1	0.3	48	52	70	0.7
1330	103093	Anadarko E & P Company Inc.	Rig Supply	32.183333	-94.433333	320	55	110	1	0.5	96	92	100	0.9
1331	103012	AC Exploration, LLC	Rig Supply	32.185277	-94.548888	500	70	10	1	7.0	1,348	847	90	9.4
1332	102820	Basa Resources, Inc.	Rig Supply	32.050277	-94.516666	360	60	85	1	0.7	136	123	120	1.0
1333	102116	Anadarko E & P Company Inc.	Rig Supply	32.18361	-94.383333	240	65	80	1	0.8	156	139	120	1.2
1334	102108	Chevron USA Production	Rig Supply	32.35	-94.4	310	60	85	1	0.7	136	123	100	1.2
1335	101978	Goodrich Petroleum	Rig Supply	32.188888	-94.575832	423	60	70	1.5	0.9	165	145	95	1.5
1336	101962	Goodrich Petroleum	Rig Supply	32.259444	-94.534999	443	70	80	2	0.9	168	148	103	1.4
1337	101953	Goodrich Petroleum	Rig Supply	32.18861	-94.574999	372	60	2	1	30.0	5,775	2,875	62	46.4
1338	101949	Goodrich Petroleum	Rig Supply	32.164166	-94.580554	180	75	60	1	1.3	241	199	70	2.8
1339	101945	Chesapeake Operating	Rig Supply	32.113611	-94.490277	320	75	80	2	0.9	180	156	70	2.2
1340	101942	Cabot Oil & Gas	Rig Supply	32.038888	-94.6625	560	65	120	2	0.5	104	99	80	1.2
1341	101934	Comstock	Rig Supply	32.249444	-94.500277	420	80	80	2	1.0	193	165	95	1.7
1342	101742	Harelton c/o Brammer	Rig Supply	32.033333	-94.333333	520	35	140	1	0.3	48	52	100	0.5
1343	101736	Basa Resources, Inc.	Rig Supply	32.050277	-94.516666	400	60	120	1	0.5	96	92	120	0.8
1344	101615	Enduring Resources	Rig Supply	32.009166	-94.586388	520	60	100	1	0.6	116	108	100	1.1
1345	101079	Basa Resources	Rig Supply	32.131666	-94.508888	200	75	40	2	1.9	361	280	55	5.1
1346	101056	Chesapeake	Rig Supply	32.120832	-94.506944	280	80	70	2	1.1	220	185	90	2.1
1347	101041	Goodrich Petroleum	Rig Supply	32.211111	-94.6025	380	65	80	1.5	0.8	156	139	70	2.0
1348	101039	Goodrich Petroleum	Domestic	32.017499	-94.640555	442	50	10	2	5.0	963	638	62	10.3
1349	101038	Goodrich Petroleum	Rig Supply	32.158055	-94.555555	363	20	100	2	0.2	39	43	93	0.5
1350	100884	Comstock Oil and Gas Company	Rig Supply	32.083333	-94.046944	230	65	85	1	0.8	147	132	100	1.3
1351	100878	Enduring Resources	Rig Supply	32.084444	-94.578888	500	80	10	1	8.0	1,540	947	90	10.5
1352	100494	Dorado	Rig Supply	32.339444	-94.445277	320	65	40	1	1.6	313	248	100	2.5
1353	100267	Comstock	Rig Supply	32.243333	-94.511944	403	75	100	2	0.8	144	130	90	1.4
1354	100056	Buffco Production Inc	Rig Supply	32.1	-94.183333	150	75	40	1	1.9	361	280	100	2.8
1355	99187	O'benco	Rig Supply	32.033333	-94.183333	240	65	85	1	0.8	147	132	180	0.7
1356	99040	Glenn Reeves	Domestic	32.078888	-94.138055	163	25	60	3	0.4	80	79	33	2.4
1357	99035	Chesapeake	Rig Supply	32.114166	-94.487499	280	75	60	2	1.3	241	199	95	2.1
1358	98960	Anadarko E & P Company Inc.	Rig Supply	32.000277	-94.3	320	55	110	1	0.5	96	92	150	0.6
1359	98490	Anadarko E & P Company Inc.	Rig Supply	32.18361	-94.383333	260	55	80	1	0.7	132	121	120	1.0
1360	98025	Goodrich	Rig Supply	32.110555	-94.575554	392	55	2	1	27.5	5,294	2,672	62	43.1
1361	98024	Goodrich	Rig Supply	32.17861	-94.624721	552	55	10	2	5.5	1,059	691	62	11.2
1362	97796	Comstock Oil and Gas Company	Rig Supply	32.25	-94.5	480	50	74	1	0.7	130	119	100	1.2
1363	97777	Chevron USA Production	Rig Supply	32.333333	-94.383333	300	60	95	1	0.6	122	112	120	0.9
1364	97433	Comstock Oil and Gas Company	Rig Supply	32.25	-94.5	240	50	85	1	0.6	113	106	160	0.7
1365	97240	JCS Services /Jeff Crooks	Domestic	32.106944	-94.353333	220	95	10	1	9.5	1,829	1,094	150	7.3
1366	97231	Enduring Resources	Rig Supply	32.024443	-94.578332	440	60	15	1	4.0	770	529	100	5.3
1367	97224	Enduring Resources	Rig Supply	32.600277	-94.662222	420	85	20	1	4.3	818	557	100	5.6
1368	97218	AC Exploration, LLC	Rig Supply	32.163888	-94.525277	420	70	20	1	3.5	674	473	80	5.9
1369	96680	Basa Resources, Inc.	Rig Supply	32.133333	-94.5	130	60	40	1	1.5	289	232	90	2.6
1370	96679	Anadarko E & P Company Inc.	Rig Supply	32.166943	-94.4	280	60	80	1	0.8	144	130	140	0.9
1371	96678	Chevron USA Production	Rig Supply	32.25	-94.43361	280	55	80	1	0.7	132	121	200	0.6
1372	96568	O'BENCO	Rig Supply	32.266666	-94.38361	340	70	100	1	0.7	135	122	100	1.2
1373	96105	JoAnn Winkle	Domestic	32.095833	-94.473054	410	35	5	2	7.0	1,348	847	40	21.2
1374	96088	Dorado	Rig Supply	32.313333	-94.177221	140	90	40	1	2.3	433	326	90	3.6
1375	95072	Chesapeake	Rig Supply	32.12611	-94.533054	412	75	5	2	15.0	2,888	1,606	62	25.9
1376	94586	Comstock Oil and Gas Company	Rig Supply	32.25	-94.48361	370	55	90	1	0.6	118	109	150	0.7
1377	94471	Basa Resources, Inc.	Rig Supply	32.05	-94.53361	280	55	85	1	0.6	125	115	200	0.6
1378	93902	Chesapeake Operating Inc.	Rig Supply	32.15	-94.3	190	75	50	1	1.5	289	232	90	2.6
1379	93901	Anadarko E & P Company Inc.	Rig Supply	32.18361	-94.383333	200	75	50	1	1.5	289	232	100	2.3
1380	93682	Jason Heinkel	Domestic	32.029166	-94.245555	50	10	5	2	2.0	385	296	40	7.4
1381	93311	Anadarko E & P Company	Rig Supply	32.166943	-94.416666	340	50	115	1	0.4	84	82	140	0.6
1382	93301	Enduring Resources LLC.	Rig Supply	32.016666	-94.583333	380	50	90	1	0.6	107	101	80	1.3
1383	93203	Chinn Exploration Company	Rig Supply	32.291388	-94.403611	240	40	25	1	1.6	308	245	140	1.8
1384	93181	Samson Lone Star	Rig Supply	32.358888	-94.084721	125	55	15	1	3.7	706	492	85	5.8
1385	92913	XTO Energy	Rig Supply	32.112222	-94.353888	210	40	1	1	40.0	7,701	3,660	50	73.2
1386	92783	Dorado Exploration Inc.	Rig Supply	32.300277	-94.166943	175	43	100	1	0.4	83	81	115	0.7
1387	92361	Anadarko E & P Company Inc.	Rig Supply	32.2	-94.43361	280	65	40	1	1.6	313	248	140	1.8
1388	92084	Penn Virginia	Rig Supply	32.355277	-94.283888	240	40	100	1	0.4	77	76	60	1.3
1389	92004	Danmark Energy L. P.	Rig Supply	32.266666	-94.500277	400	55	90	1	0.6	118	109	120	0.9
1390	91997	Basa Resources, Inc.	Rig Supply	32.050277	-94.516666	330	55	110	1	0.5	96	92	110	0.8
1391	91926	Comstock Oil and Gas Company	Rig Supply	32.23361	-94.483333	420	55	110	1	0.5	96	92	140	0.7
1392	91854	O'BENCO	Rig Supply	32.417221	-94.385555	360	85	125	1	0.7	131	119	100	1.2
1393	91849	Penn Virginia	Rig Supply	32.358055	-94.287221	240	65	100	1	0.7	125	115	100	1.1
1394	91679	Chesapeake Operating, Inc.	Rig Supply	32.118332	-94.480832	360	40	100	1	0.4	77	76	100	0.8
1395	91511	Danmark Energy L. P.	Rig Supply	32.266943	-94.516943	190	65	40	1	1.6	313	248	110	2.3
1396	91508	Anadarko E & P Company Inc.	Rig Supply	32.000277	-94.3	330	50	95	1	0.5	101	96	110	0.9
1397	91489	Chevron Usa Production	Rig Supply	32.3	-94.433333	480	52	71	1	0.7	141	127	200	0.6
1398	91385	BARRY LANGFORD	Rig Supply	32.0625	-94.420832	230	30	20	2	1.5	289	232	20	11.6
1399	90979	Chevron Usa Production	Rig Supply	32.23361	-94.4	220	65	40	1	1.6	313	248	120	2.1
1400	90792	XTO Energy	Rig Supply	32.188888	-94.499444	160	55	1	1	55.0	10,588	4,783	60	79.7
1401	90790	Lacy Operations	Rig Supply	32.251666	-94.333054	320	10	1	1	10.0	1,925	1,142	160	7.1
1402	90673	Will Drill Production	Rig Supply	32.019166	-94.05	200	70	15	1	4.7	898	602	90	6.7
1403	90358	Anadarko E & P Company Inc.	Rig Supply	32.166943	-94.416666	340	55	110	1	0.5	96	92	140	0.7
1404	90086	Steve Milhauser	Rig Supply	32.133333	-94.550277	280	25	67	1	0.4	72	72	140	0.5
1405	90068	Anadarko E & P Company Inc.	Rig Supply	32.15	-94.433333	220	60	48	1	1.3	241	199	140	1.4
1406	90067	Chevron Usa Production	Rig Supply	32.233333	-94.4	400	60	90	1	0.7	128	117	120	1.0
1407	89983	Goodrich Petroleum	Rig Supply	32.15	-94.55	460	60	110	1	0.5	105	99	160	0.6
1408	89798	Basa Resources, Inc.	Rig Supply	32.05	-94.53361	380	50	90	1	0.6	107	101	120	0.8
1409	89705	Anadarko E & P Company Inc.	Rig Supply	32.116943	-94.4	260	60	40	1	1.5	289	232	150	1.5
1410	89581	Goodrich Petroleum	Rig Supply	32.200277	-94.566666	260	60	110	1	0.5	105	99	120	0.8
1411	89572	Preston Exploration	Rig Supply	32.1	-94.48361	200	50	70	1	0.7	138	124	130	1.0
1412	88843	Will Drill Production	Rig Supply	31.994444	-94.075277	220	80	15	0.5	5.3	1,027	674	90	7.5
1413	88773	Chad Nations	Domestic	32.08361	-94.516943	440	20	90	1	0.2	43	47	40	1.2
1414	88709	Comstock Oil and Gas Company	Rig Supply	32.23361	-94.48361	380	50	58	1	0.9	166	146	120	1.2

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1415	88704	Comstock Oil and Gas Company	Rig Supply	32.23361	-94.5125	560	60	135	1	0.4	86	84	140	0.6
1416	88693	Anadarko E & P Company Inc.	Rig Supply	32.166943	-94.416943	340	60	85	1	0.7	136	123	140	0.9
1417	87503	Chevron Texaco	Rig Supply	32.266388	-94.445833	330	65	185	2	0.4	68	69	70	1.0
1418	87496	Devon Energy	Rig Supply	32.28111	-94.170832	170	70	106	2	0.7	127	117	90	1.3
1419	87334	XTO Energy	Rig Supply	32.106944	-94.328888	220	70	1	1	70.0	13,476	5,857	70	83.7
1420	87332	Enduring Resources	Rig Supply	32.024999	-94.608055	500	60	1	1	60.0	11,551	5,146	100	51.5
1421	87284	ME Operating Services Inc.	Rig Supply	32.146388	-95.090277	120	60	10	1	6.0	1,155	744	110	6.8
1422	87129	Devon Energy	Rig Supply	32.213333	-94.29361	70	80	57	2	1.4	270	220	30	7.3
1423	86296	XTO Energy	Rig Supply	32.120554	-94.333888	210	55	1	1	55.0	10,588	4,783	60	79.7
1424	86133	Chevron Usa Production	Rig Supply	32.150277	-94.450277	360	55	90	1	0.6	118	109	120	0.9
1425	86127	Chevron Usa Production	Rig Supply	32.15	-94.483333	400	50	130	1	0.4	74	74	200	0.4
1426	86086	Basa Resources, Inc.	Rig Supply	32.05	-94.533333	240	50	70	1	0.7	138	124	170	0.7
1427	86079	Chesapeake Operating Inc.	Rig Supply	32.116666	-94.516943	460	55	115	1	0.5	92	89	120	0.7
1428	86066	Preston Exploration	Rig Supply	32.033333	-94.23361	220	65	80	1	0.8	156	139	160	0.9
1429	86064	Chesapeake Operating Inc.	Rig Supply	32.016666	-94.266666	320	60	85	1	0.7	136	123	120	1.0
1430	85467	Valance Operating	Rig Supply	32.285277	-94.389444	360	70	180	2	0.4	75	75	80	0.9
1431	85426	Devon Energy	Rig Supply	32.145833	-94.290833	170	65	104	2	0.6	120	111	70	1.6
1432	85417	Devon Energy	Rig Supply	32.100833	-94.377777	350	65	226	2	0.3	55	58	100	0.6
1433	85100	AC Exploration, LLC	Rig Supply	32.167221	-94.527221	420	80	15	1	5.3	1,027	674	120	5.6
1434	85090	Samson Lone Star	Rig Supply	32.410833	-94.141944	280	70	25	1	2.8	539	392	100	3.9
1435	84847	Goodrich Petroleum	Rig Supply	32.069721	-94.156388	243	50	30	2	1.7	321	254	93	2.7
1436	83852	Peoples Energy Production	Rig Supply	32.019721	-94.358888	260	50	1	1	50.0	9,626	4,415	40	110.4
1437	83627	Basa Resources, Inc.	Rig Supply	32.066666	-94.466943	520	65	260	1	0.3	48	52	180	0.3
1438	83587	Chinn Exploration	Rig Supply	32.283054	-94.407222	300	80	25	1	3.2	616	439	100	4.4
1439	83360	AC Exploration, LLC	Rig Supply	32.2	-94.537499	280	70	25	1	2.8	539	392	110	3.6
1440	83358	Chinn Exploration	Rig Supply	31.289166	-94.405833	280	80	25	1	3.2	616	439	100	4.4
1441	83357	Chinn Exploration	Rig Supply	31.289166	-94.405555	100	40	20	1	2.0	385	296	80	3.7
1442	83355	Block T Petroleum	Rig Supply	32.361666	-94.644444	240	70	10	1	7.0	1,348	847	90	9.4
1443	83354	Block T Petroleum	Rig Supply	32.361666	-94.644444	240	70	10	1	7.0	1,348	847	90	9.4
1444	83185	Stroud Energy	Rig Supply	32.203333	-94.527777	320	75	27	0.5	2.8	535	389	100	3.9
1445	83124	Clayton W.S.C.	Public Supply	32.139444	-94.383054	532	104	128	36	0.8	156	139	99	1.4
1446	83044	Goodrich Petroleum	Rig Supply	32.243055	-94.555277	403	70	100	2	0.7	135	122	123	1.0
1447	82999	URS Field Services	Industrial	32.186388	-94.2575	600	18	130	1	0.1	27	31	90	0.3
1448	82967	Preston Exploration	Rig Supply	32.111111	-94.466666	360	85	55	1	1.5	298	238	180	1.3
1449	82470	Chevron Usa Production	Rig Supply	32.150277	-94.466943	360	65	160	1	0.4	78	77	180	0.4
1450	81358	Pioneer Drilling	Industrial	32.072221	-94.503888	260	60	100	1	0.6	116	108	160	0.7
1451	80312	Basa Resources, Inc.	Rig Supply	32.05	-94.48361	220	65	100	1	0.7	125	115	80	1.4
1452	80311	Anadarko E & P Production Company	Rig Supply	32.183333	-94.383333	200	70	80	1	0.9	168	148	80	1.8
1453	80184	Goodrich Petroleum	Rig Supply	32.168054	-94.606111	452	60	2	1	30.0	5,775	2,875	82	35.1
1454	80170	Chesapeake Operating Inc.	Rig Supply	32.130554	-94.486666	320	80	10	1	8.0	1,540	947	90	10.5
1455	79485	Basa Resources, Inc.	Rig Supply	32.05	-94.48361	220	70	80	1	0.9	168	148	80	1.8
1456	78942	Basa Resources, Inc.	Rig Supply	32.172221	-94.517221	2400	60	35	1	1.7	330	260	100	2.6
1457	78824	Anadarko E & P Company	Rig Supply	32.13361	-94.313055	220	50	65	1	0.8	148	132	120	1.1
1458	78514	R. Lacy Inc.	Rig Supply	32.27361	-94.331666	300	55	65	1	0.8	163	144	140	1.0
1459	78483	Anadarko E & P Production Company	Rig Supply	32.403611	-94.542499	260	50	1	1	50.0	9,626	4,415	215	20.5
1460	78477	Anadarko E & P Production Company	Rig Supply	32.012222	-94.317499	260	65	40	1	1.6	313	248	160	1.6
1461	78308	Samson Lone Star	Rig Supply	32.224166	-94.170832	200	60	15	1	4.0	770	529	120	4.4
1462	78294	Don Gibson	Domestic	31.977777	-94.395833	380	50	25	1	2.0	385	296	110	2.7
1463	78284	AC Exploration, LLC	Rig Supply	32.167221	-94.52111	380	80	10	1	8.0	1,540	947	90	10.5
1464	78282	Mathias Service Co.	Industrial	32.180832	-94.336666	100	100	10	1	10.0	1,925	1,142	80	14.3
1465	77869	Goodrich Petroleum	Rig Supply	32.213333	-94.606944	332	50	2	1	25.0	4,813	2,466	82	30.1
1466	77271	Taylor, Wrey	Domestic	32.341944	-94.579443	280	20	93	1	0.2	41	45	80	0.6
1467	77195	Samson Lone Star	Rig Supply	32.362222	-94.109722	120	100	12	1	8.3	1,604	980	80	12.3
1468	76610	R. Lacy Inc.	Rig Supply	32.278332	-94.374999	260	60	85	1	0.7	136	123	120	1.0
1469	76492	Basa Resources, Inc.	Rig Supply	32.172221	-94.517221	200	70	40	1	1.8	337	264	120	2.2
1470	76481	Samson Lone Star	Rig Supply	32.357777	-94.072499	200	80	25	1	3.2	616	439	120	3.7
1471	76461	Anadarko E & P Production Company	Rig Supply	32.213888	-94.38111	190	50	75	1	0.7	128	117	110	1.1
1472	76459	Anadarko E & P Production Company	Rig Supply	32.012222	-94.317499	260	65	40	1	1.6	313	248	120	2.1
1473	76452	Anadarko E & P Production Company	Rig Supply	32.169166	-94.395555	320	65	110	1	0.6	114	106	120	0.9
1474	76142	Devon Energy	Rig Supply	32.161666	-94.306666	150	80	77	2	1.0	200	171	100	1.7
1475	76047	Devon Energy	Rig Supply	32.18611	-94.346944		70	80	2	0.9	168	148	80	1.8
1476	76036	Stroud Energy	Rig Supply	32.363611	-94.096388	180	60	114	2	0.5	101	96	80	1.2
1477	76033	Devon Energy	Rig Supply	32.1025	-94.372777	200	25	139	2	0.2	35	39	50	0.8
1478	76031	Devon Energy	Rig Supply	32.078054	-94.316943	120	70	77	2	0.9	175	152	50	3.0
1479	75850	Devon Energy	Rig Supply	32.213333	-94.340555	200	80	144	2	0.6	107	101	70	1.4
1480	75847	Classic Resources	Rig Supply	32.170832	-94.311111	120	70	88	2	0.8	153	136	50	2.7
1481	75807	Goodrich Petroleum	Rig Supply	31.164444	-94.589166	402	70	10	2	7.0	1,348	847	40	21.2
1482	75805	Goodrich Petroleum	Rig Supply	32.180832	-94.606111	442	60	5	2	12.0	2,310	1,331	62	21.5
1483	75803	Goodrich Petroleum	Rig Supply	32.25	-94.546944	452	65	10	2	6.5	1,251	796	70	11.4
1484	75802	Goodrich Petroleum	Rig Supply	32.188333	-94.595555	582	75	10	2	7.5	1,444	897	80	11.2
1485	75797	Classic Energy	Rig Supply	32.113611	-94.33111	220	70	73	2	1.0	185	159	70	2.3
1486	75796	Goodrich Petroleum	Rig Supply	32.154722	-94.589166	403	65	10	2	6.5	1,251	796	60	13.3
1487	75794	Devon Energy	Rig Supply	32.115833	-94.378888	240	65	178	2	0.4	70	71	60	1.2
1488	75793	Goodrich Petroleum	Rig Supply	32.214444	-94.7075	443	70	5	2	14.0	2,695	1,515	63	24.1
1489	75728	AC Exploration	Rig Supply	32.056944	-94.517499	385	80	25	1	3.2	616	439	125	3.5
1490	75722	Devon Energy	Rig Supply	32.155	-94.300277	70	80	53	2	1.5	291	233	35	6.7
1491	75719	Devon Energy	Rig Supply	32.050277	-94.338055	300	18	278	2	0.1	12	17	60	0.3
1492	75698	Goodrich Petroleum	Rig Supply	32.214166	-94.639444	592	75	10	2	7.5	1,444	897	62	14.5
1493	75591	Devon Energy	Rig Supply	32.252777	-94.242777	120	70	94	2	0.7	143	129	60	2.1
1494	75470	Goodrich Petroleum	Rig Supply	32.223888	-94.571666	420	60	115	1	0.5	100	96	240	0.4
1495	75463	Devon Energy	Rig Supply	32.193055	-94.328888	220	80	95	2	0.8	162	143	70	2.0
1496	75394	Devon Energy	Rig Supply	32.205277	-94.348055	230	80	116	2	0.7	133	121	140	0.9
1497	75216	Cordray, Jack	Domestic	32.390833	-94.053888	170	75	85	1	0.9	170	149	65	2.3
1498	75194	Dixon, Jason and Misty	Domestic	32.2575	-94.437499	200	15	62	1	0.2	47	50	120	0.4
1499	74186	AC Exploration, LLC	Rig Supply	32.181388	-94.535833	230	60	25	1	2.4	462	344	30	11.5
1500	74184	Stroud Energy	Rig Supply	32.202222	-94.524166	265	80	15	1	5.3	1,027	674	105	6.4
1501	73735	Hunt Petroleum	Industrial	32.308055	-94.274443	320	50	100	1	0.5	96	92	310	0.3
1502	73715	Anadarko E & P Co., LP	Industrial	32.195555	-94.424999	200	65	60	1	1.1	209	177	160	1.1
1503	73554	Chalker Energy Partners, LP	Rig Supply	32.032777	-94.214444	220	105	65	1	1.6	311	247	120	2.1
1504	73553	Anadarko E & P Co., LP	Industrial	32.220554	-94.381388	220	60	100	1	0.6	116	108	140	0.8
1505	73545	Pinnergy, Inc.	Rig Supply	32.119999	-94.59111	320	90	55	1	1.6	315	250	160	1.6
1506	73542	Goodrich Petroleum	Rig Supply	32.209166	-94.560833	360	55	125	1	0.4	85	83	160	0.5
1507	72970	Valence Operating Company	Rig Supply	32.277499	-94.397777	280	80	55	1	1.5	280	226	160	1.4
1508	72964	Goodrich Petroleum	Rig Supply	32.212777	-94.53861	420	75	50	1	1.5	289	232	140	1.7
1509	72961	Comstock Oil & Gac	Rig Supply	32.2125	-94.512222	300	115	60	1	1.9	369	285	140	2.0
1510	72960	Chalker Energy Partners, LP	Rig Supply	32.385277	-94.335555	320	85	55	1	1.5	298	238	150	1.6
1511	72947	Anadarko E & P Company, Inc.	Rig Supply	32.134166	-94.2625	100	30	50	1	0.6	116	108	80	1.3
1512	72946	Anadarko E & P Company, Inc.	Rig Supply	32.155555	-94.401944	320	75	55	1	1.4	263	214	120	1.8
1513	72788	Taylor	Rig Supply	32.15	-94.577221	220	55	70	1	0.8	151	135	120	1.1
1514	72171	Stroud Energy	Rig Supply	32.366388	-94.102777	100	80	10	1	8.0	1,540	947	80	11.8
1515	70421	Comstock Oil and Gas	Rig Supply	32.247221	-94.502777	420	60	75	1	0.8	154	137	140	1.0

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
1516	70218	Samson Lone Star	Rig Supply	32.353611	-94.08111	140	65	10	1	6.5	1,251	796	100	8.0
1517	69854	AC Exploration, LLC	Rig Supply	32.169721	-94.519443	360	80	10	1	8.0	1,540	947	90	10.5
1518	69363	Anadarko E & P Co LP	Industrial	32.09611	-94.32111	260	65	65	1	1.0	193	165	240	0.7
1519	69043	Musick, Len	Domestic	32.320277	-94.163055	137	30	93	1	0.3	62	64	80	0.8
1520	68828	Anadarko E & P Co., LP	Industrial	32.180277	-94.428888	300	60	75	1	0.8	154	137	120	1.1
1521	68685	AC Exploration	Rig Supply	32.174721	-94.538055	285	100	15	1	6.7	1,283	813	100	8.1
1522	68667	Samson Lone Star	Rig Supply	32.377777	-94.094166	180	100	5	1	20.0	3,850	2,045	90	22.7
1523	68612	Anadarko E & P Co. LP	Industrial	32.192777	-94.436388	360	60	110	1	0.5	105	99	240	0.4
1524	67653	Woodbine Production	Rig Supply	32.279443	-94.381388	145	70	15	1	4.7	898	602	85	7.1
1525	67652	Woodbine Production	Rig Supply	32.279443	-94.381388	145	70	15	1	4.7	898	602	85	7.1
1526	67651	Woodbine Production	Rig Supply	32.279443	-94.381388	145	70	15	1	4.7	898	602	85	7.1
1527	65560	CT Investco LLC	Rig Supply	32.051666	-94.293333	220	35	15	1	2.3	449	336	30	11.2
1528	65547	Samson Lone Star	Rig Supply	32.362222	-94.080832	140	80	15	1	5.3	1,027	674	100	6.7
1529	65446	Danmark Energy, LP	Rig Supply	32.270832	-94.519999	580	60	145	1	0.4	80	79	180	0.4
1530	64208	Anadarko E & P Co LP	Industrial	32.090555	-94.320277	240	65	70	1	0.9	179	155	215	0.7
1531	64205	Anadarko E & P Co LP	Industrial	32.196666	-94.431388	220	60	60	1	1.0	193	165	200	0.8
1532	63674	James Crooks	Domestic	32.29861	-94.225554	175	150	20	1	7.5	1,444	897	75	12.0
1533	63487	Kivard, Inc.	Domestic	32.258611	-94.2075	160	45	10	1	4.5	866	584	80	7.3
1534	63110	Kivard, Inc.	Domestic	32.251388	-94.222777	225	85	15	1	5.7	1,091	709	105	6.8
1535	62684	Penn Virginia	Rig Supply	32.33861	-94.282777	162	65	2	1	32.5	6,257	3,075	82	37.5
1536	62206	Chalker Energy Partners, LP	Rig Supply	32.035555	-94.208888	200	70	110	1	0.6	123	113	120	0.9
1537	62140	Samson Lone Star	Rig Supply	32.373888	-94.082221	160	100	5	1	20.0	3,850	2,045	90	22.7
1538	60976	Goodrich Petroleum	Rig Supply	32.262777	-94.508611	460	55	110	1	0.5	96	92	120	0.8
1539	60959	Buffco Production	Rig Supply	32.007777	-94.307777	190	65	75	1	0.9	167	146	150	1.0
1540	60958	Anadarko E & P Company, Inc.	Rig Supply	32.078332	-94.304444	220	65	70	1	0.9	179	155	170	0.9
1541	59074	CT Invesco LLC	Rig Supply	32.171943	-94.285833	55	45	5	1	9.0	1,733	1,046	37	28.3
1542	58652	Langston Drilling Company	Rig Supply	32.235277	-94.328054	100	70	25	1	2.8	539	392	80	4.9
1543	58650	Anadarko E & P Company, LP	Rig Supply	32.094444	-94.303888	280	65	85	1	0.8	147	132	200	0.7
1544	58513	AC Exploration	Rig Supply	32.320832	-94.390833	203	70	2	1	35.0	6,738	3,272	83	39.4
1545	58342	Encana, Inc.	Rig Supply	32.433054	-94.334721	290	85	1	1	85.0	16,364	6,895	90	76.6
1546	58133	Anadarko E & P Company, LP	Rig Supply	32.181943	-94.420832	180	60	45	1	1.3	257	210	100	2.1
1547	58132	Ark-La-Tex Energy, LLC	Rig Supply	32.06	-94.512222	320	65	80	1	0.8	156	139	180	0.8
1548	58126	Goodrich Petroleum	Rig Supply	32.010555	-94.47361	300	65	40	1	1.6	313	248	140	1.8
1549	58125	Hunt Petroleum Corporation	Rig Supply	32.292777	-94.280832	120	70	40	1	1.8	337	264	100	2.6
1550	58044	Anadarko E & P Co., LP	Industrial	32.19111	-94.447499	340	60	80	1	0.8	144	130	240	0.5
1551	57693	Panola County Airport c/o Joe Foster	Domestic	32.166666	-94.301111	302	22	54	1	0.4	78	78	162	0.5
1552	57409	Anadarko E & P Co LP	Irrigation	32.115	-94.409166	200	60	50	1	1.2	231	192	190	1.0
1553	57406	Carthage Country Club	Irrigation	32.163611	-94.31	240	65	60	1	1.1	209	177	140	1.3
1554	57032	Ocean Energy	Industrial	32.073888	-94.438333	300	60	75	1	0.8	154	137	290	0.5
1555	56091	Buffco	Rig Supply	32.099721	-94.18861	100	80	10	1	8.0	1,540	947	85	11.1
1556	55761	Hunt Petroleum Company	Rig Supply	32.157222	-94.337499	100	60	40	1	1.5	289	232	85	2.7
1557	55758	Plains Exploration & Production Co.	Rig Supply	32.24111	-94.523888	420	60	75	1	0.8	154	137	160	0.9
1558	55646	Josh Frazier	Domestic	32.139444	-94.111388	262	40	51	1	0.8	151	135	92	1.5
1559	55166	Devon Energy	Rig Supply	32.0625	-94.379443	360	40	176	2	0.2	44	48	130	0.4
1560	55162	Chevron Texaco	Rig Supply	32.169721	-94.496388	140	80	104	2	0.8	148	132	60	2.2
1561	55083	Devon Energy	Rig Supply	32.179443	-94.295833	175	70	126	2	0.6	107	101	100	1.0
1562	55078	Chevron Texaco	Rig Supply	32.29111	-94.429166	300	60	3	2	20.0	3,850	2,045	100	20.4
1563	55064	Devon Energy	Rig Supply	32.1125	-94.404166	120	70	78	2	0.9	173	151	60	2.5
1564	54010	James Broadus	Domestic	32.122221	-94.329443	200	30	40	1	0.8	144	130	95	1.4
1565	53818	Chevron Texaco	Rig Supply	32.252222	-94.470277	480	70	183	2	0.4	74	74	140	0.5
1566	53807	Debbie Baugan	Domestic	32.173888	-94.509166	315	8	150	2	0.1	10	14	30	0.5
1567	53790	Devon Energy	Rig Supply	32.16861	-94.275277	160	75	105	2	0.7	138	124	60	2.1
1568	53607	Harold Wilson, Jr.	Domestic	32.279999	-94.368054	400	35	100	2	0.4	67	68	125	0.5
1569	53588	Bradley Davidson	Domestic	32.276943	-94.370554	320	15	40	2	0.4	72	72	45	1.6
1570	53269	Valence Operating Company	Rig Supply	32.294444	-94.391666	340	70	40	1	1.8	337	264	120	2.2
1571	53259	Hunt Petroleum Corporation	Rig Supply	32.28611	-94.273332	160	70	45	1	1.6	299	239	140	1.7
1572	53257	Anadarko E & P Company, Inc.	Rig Supply	32.180554	-94.398333	200	70	55	1	1.3	245	202	140	1.4
1573	53256	Anadarko E & P Company, Inc.	Rig Supply	32.011388	-94.308611	200	60	40	1	1.5	289	232	140	1.7
1574	53255	BASA Resources, Inc.	Rig Supply	32.169721	-94.513888	200	60	55	1	1.1	210	178	120	1.5
1575	52630	Linda Reed	Domestic	32.169443	-94.455277	52	6	20	1	0.3	58	60	17	3.5
1576	52564	Rodney Boutin	Domestic	32.006944	-94.242777	90	20	40	3	0.5	96	92	30	3.1
1577	52557	Cecil Langford	Domestic	32.059444	-94.401666	124	10	25	2	0.4	77	76	29	2.6
1578	52554	Jay Coco	Domestic	32.191388	-94.342777	400	20	30	2	0.7	128	117	42	2.8
1579	52553	Anthony Templeton	Domestic	32.102222	-94.53861	380	20	30	2	0.7	128	117	50	2.3
1580	52534	Wayne Chappel	Irrigation	32.134444	-94.405833	235	16	150	2	0.1	21	25	38	0.7
1581	52405	Brewer, Donnie	Domestic	32.325832	-94.134999	254	25	73	1	0.3	66	67	165	0.4
1582	52241	Samson Lone Star	Rig Supply	32.261944	-94.153333	100	80	10	1	8.0	1,540	947	85	11.1
1583	52132	XTO Energy, Inc.	Rig Supply	32.129166	-94.342221	400	70	40	1	1.8	337	264	200	1.3
1584	51646	Anadarko E & P Company, Inc.	Rig Supply	32.219443	-94.384999	220	60	105	1	0.6	110	103	130	0.8
1585	51197	Samson Lone Star	Rig Supply	32.387221	-94.077499	200	100	5	1	20.0	3,850	2,045	90	22.7
1586	51193	Samson Lone Star	Rig Supply	32.220554	-94.179721	240	100	30	1	3.3	642	454	90	5.0
1587	50842	Basa Resources, Inc.	Rig Supply	32.06	-94.516111	360	60	110	1	0.5	105	99	130	0.8
1588	50840	Anadarko E & P Company, Inc.	Rig Supply	32.142777	-94.512222	250	70	90	1	0.8	150	134	170	0.8
1589	50838	Anadarko E & P Company, Inc.	Rig Supply	32.199444	-94.369443	250	60	75	1	0.8	154	137	110	1.2
1590	50835	Anadarko E & P Company, Inc.	Rig Supply	32.170554	-94.347221	240	70	45	1	1.6	299	239	160	1.5
1591	50834	Anadarko E & P Company, Inc.	Rig Supply	32.219443	-94.384999	220	60	105	1	0.6	110	103	130	0.8
1592	49335	Anadarko E & P Company, Inc.	Rig Supply	32.2025	-94.370832	220	60	45	1	1.3	257	210	120	1.8
1593	49334	Anadarko E & P Company, Inc.	Rig Supply	32.100277	-94.309444	300	60	90	1	0.7	128	117	180	0.7
1594	48991	McDaniel, Robert	Domestic	32.015833	-94.308333	350	45	80	1	0.6	108	102	70	1.5
1595	47420	Anadarko E & P Company, Inc.	Rig Supply	32.205555	-94.377499	220	75	30	1	2.5	481	357	150	2.4
1596	47377	Goodrich Petroleum	Rig Supply	32.176943	-94.596944	360	70	40	1	1.8	337	264	200	1.3
1597	47371	Pioneer Drilling Company, Ltd.	Rig Supply	32.086944	-94.496944	340	60	80	1	0.8	144	130	140	0.9
1598	47365	Hunt Petroleum Corporation	Rig Supply	32.305	-94.291388	280	75	110	1	0.7	131	120	120	1.0
1599	47360	Goodrich Petroleum	Rig Supply	32.263333	-94.524443	180	60	20	1	3.0	578	416	100	4.2
1600	47357	Anadarko E & P Company, Inc.	Rig Supply	32.085833	-94.303055	200	60	35	1	1.7	330	260	100	2.6
1601	47353	Glassell Producing Company	Rig Supply	32.230832	-94.203333	330	50	100	1	0.5	96	92	210	0.4
1602	47331	Anadarko E & P Company	Rig Supply	32.122221	-94.31	320	50	60	1	0.8	160	142	120	1.2
1603	47182	Hunt Petroleum Corporation	Rig Supply	32.301666	-94.316388	280	80	50	1	1.6	308	245	130	1.9
1604	46723	Hunt Petroleum Corporation	Rig Supply	32.301666	-94.316388	280	80	50	1	1.6	308	245	130	1.9
1605	45534	Newfield Exploration	Rig Supply	31.198055	-94.495277	226	70	60	1	1.2	225	188	66	2.8
1606	45485	Newfield Exploration	Rig Supply	32.174443	-94.507777	210	60	35	1	1.7	330	260	135	1.9
1607	45303	Goodrich Petroleum	Rig Supply	32.265833	-94.514166	180	70	30	1	2.3	449	336	120	2.8
1608	45302	Pioneer Drilling Company	Rig Supply	31.998888	-94.512777	280	70	40	1	1.8	337	264	80	3.3
1609	45300	Hunt Petroleum Corporation	Rig Supply	32.333054	-94.28361	320	70	40	1	1.8	337	264	140	1.9
1610	45192	Anadarko E & P Co., LP	Rig Supply	32.100833	-94.300277	460	60	110	1	0.5	105	99	380	0.3
1611	45191	Anadarko E & P Co., LP	Rig Supply	32.063888	-94.303333	220	60	70	1	0.9	165	145	160	0.9
1612	44969	Ocean Energy	Industrial	32.076388	-94.346666	380	60	120	1	0.5	96	92	180	0.5
1613	44451	Samson	Rig Supply	32.350833	-94.083888	160	80	10	1	8.0	1,540	947	90	10.5
1614	44092	Goodrich Petroleum	Rig Supply	32.172777	-94.615277	360	70	40	1	1.8	337	264	240	1.1
1615	43596	Anadarko E & P Co., LP	Rig Supply	32.17361	-94.365	270	80	55	1	1.5	280	226	150	1.5
1616	43533	Anadarko E & P Co.	Industrial	32.172221	-94.359444	300	100	20	1	5.0	963	638	200	3.2

Record ID	Tracking Number	Owner Name	Proposed Use	Lat (NAD83)	Long (NAD83)	Well Depth (ft)	Yield (gpm)	Drawdown (ft)	Well Test Duration (hours)	Specific Capacity (gpm/ft)	Specific Capacity (ft^2/day)	Estimated Transmissivity (ft^2/day)	Saturated Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)
1617	43488	Hunt Petroleum	Rig Supply	32.296388	-94.297221	130	70	30	1	2.3	449	336	110	3.1
1618	43396	Anadarko E & P Co.	Industrial	32.155833	-94.402222	320	65	100	1	0.7	125	115	250	0.5
1619	43389	Anadarko E& P Co.	Industrial	32.145555	-94.429999	320	70	115	1	0.6	117	109	240	0.5
1620	43323	Samson Lone Star	Industrial	32.317221	-94.17111	240	65	75	1	0.9	167	146	220	0.7
1621	43314	Anadarko E & P Co.	Industrial	32.185833	-94.419443	200	60	20	1	3.0	578	416	160	2.6
1622	43311	Anadarko E & P Co.	Industrial	32.091944	-94.322221	500	60	40	1	1.5	289	232	320	0.7
1623	43150	XTO	Rig Supply	32.119443	-94.358611	320	60	40	1	1.5	289	232	200	1.2
1624	43145	Anadarko E & P Co., LP	Rig Supply	32.092221	-94.299444	220	70	30	1	2.3	449	336	120	2.8
1625	43137	Anadarko E & P Co., LP	Rig Supply	32.137777	-94.492777	340	60	80	1	0.8	144	130	100	1.3
1626	43128	Anadarko E & P Co., LP	Rig Supply	32.18361	-94.373054	210	20	50	1	0.4	77	76	130	0.6
1627	43070	ANADARKO E & P CO., LP	Industrial	32.188333	-94.453055	300	65	75	1	0.9	167	146	30	4.9
1628	43063	GOODRICH PETROLEUM	Industrial	32.267221	-94.531666	220	65	60	1	1.1	209	177	160	1.1
1629	42810	Samson	Rig Supply	32.231388	-94.160833	180	80	20	1	4.0	770	529	85	6.2
1630	42568	Samson	Rig Supply	32.383054	-94.106111	220	70	15	1	4.7	898	602	110	5.5
1631	42357	Anadarko E & P Co., LP	Rig Supply	32.18361	-94.373054	210	70	20	1	3.5	674	473	140	3.4
1632	41269	Pioneer Drilling Company	Rig Supply	32.015833	-94.500833	410	70	60	1	1.2	225	188	130	1.4
1633	41266	Anadarko E & P Co., LP	Rig Supply	32.210555	-94.497499	220	60	50	1	1.2	231	192	140	1.4
1634	40719	Martin Spanial	Domestic	32.244444	-94.142221	342	21	43	1	0.5	94	90	317	0.3
1635	40581	Anadarko E & P Co., LP	Rig Supply	32.146944	-94.396944	200	70	40	1	1.8	337	264	180	1.5
1636	40569	Anadarko, E & P Co., LP	Rig Supply	32.195555	-94.420554	140	60	30	1	2.0	385	296	100	3.0
1637	40568	Anadarko, E & P Co., LP	Rig Supply	32.195555	-94.420554	140	60	30	1	2.0	385	296	100	3.0
1638	40562	Anadarko E & P Company, Inc.	Rig Supply	32.192221	-94.433054	220	60	40	1	1.5	289	232	180	1.3
1639	40441	SAMSON	Rig Supply	32.384166	-94.149444	260	100	40	1	2.5	481	357	90	4.0
1640	40379	SAMSON	Rig Supply	32.536944	-94.142221	426	10	426	1	0.0	5	7	86	0.1
1641	36815	Brumble, Joe	Domestic	32.312777	-94.108333	185	7	152	1	0.0	9	12	165	0.1
1642	36705	Samson Lone Star	Rig Supply	32.36	-94.137777	160	50	10	1	5.0	963	638	65	9.8
1643	34814	Martex Drlg. Co.	Rig Supply	32.359444	-94.460277	150	65	87	2	0.7	144	129	70	1.8
1644	34724	HUNT PETROLEUM	Industrial	32.309722	-94.291666	340	60	80	1	0.8	144	130	220	0.6
1645	34712	ANADARKO E&P COMPANY	Industrial	32.197777	-94.42611	240	60	65	1	0.9	178	154	230	0.7
1646	34615	SAMSON	Rig Supply	32.228888	-94.149444	140	50	20	1	2.5	481	357	70	5.1
1647	33821	HUNT OIL CO.	Industrial	32.3075	-94.28611	140	60	50	1	1.2	231	192	130	1.5
1648	33735	CLASSIC OIL & GAS	Rig Supply	32.125554	-94.339444	220	70	152	2	0.5	89	86	80	1.1
1649	33732	DEVON ENERGY	Rig Supply	32.191944	-94.324166	70	20	44	2	0.5	88	85	45	1.9
1650	33726	SAWYER DRILLING & SERVICE	Rig Supply	32.078054	-94.501944	260	70	174	2	0.4	77	77	80	1.0
1651	33720	EASON PRODUCTION CO.	Rig Supply	32.089166	-94.044444	280	80	91	2	0.9	169	148	120	1.2
1652	33718	WYNN CROSBY ENERGY	Rig Supply	32.066111	-94.499166	320	70	168	2	0.4	80	79	120	0.7
1653	33706	Anadarko E & P Co., LP	Rig Supply	32.160555	-94.355	300	60	75	1	0.8	154	137	250	0.5
1654	33524	DEVON ENERGY	Rig Supply	32.175554	-94.31861	180	80	115	2	0.7	134	122	80	1.5
1655	33513	CHEVRON TEXACO	Rig Supply	32.271943	-94.470554	470	70	183	2	0.4	74	74	70	1.1
1656	33508	SAWYER DRILLING & SERVICE	Rig Supply	32.03111	-94.501388	320	60	198	2	0.3	58	61	80	0.8
1657	33493	DEVON ENERGY	Rig Supply	32.051944	-94.39111	320	55	195	2	0.3	54	57	70	0.8
1658	33379	CHEVRON TEXACO	Rig Supply	32.16861	-94.497777	140	80	94	2	0.9	164	144	60	2.4
1659	33367	G&A DRILLING CO.	Rig Supply	32.244999	-94.145555	240	60	168	2	0.4	69	70	170	0.4
1660	33345	MARTEX DRILLING CO.	Rig Supply	32.174721	-94.308333	110	60	51	2	1.2	226	189	70	2.7
1661	33344	DEVON ENERGY	Rig Supply	32.09611	-94.373332	390	40	244	2	0.2	32	36	80	0.5
1662	33082	Anadarko E & P Co., LP	Rig Supply	32.098055	-94.325554	240	65	75	1	0.9	167	146	220	0.7
1663	32088	Ocean Energy	Rig Supply	32.074443	-94.4	300	60	192	2	0.3	60	62	100	0.6
1664	32079	Chevron Texaco	Rig Supply	32.220832	-94.453888	410	80	190	2	0.4	81	80	160	0.5
1665	32076	Classic Oil and Gas	Rig Supply	32.120832	-94.336944	220	75	134	2	0.6	108	101	80	1.3
1666	32072	Chevron Texaco	Rig Supply	32.224999	-94.453888	410	75	233	2	0.3	62	64	110	0.6
1667	32054	Winchester Production	Rig Supply	32.257777	-94.14861	120	70	98	2	0.7	138	124	70	1.8
1668	32052	Devon Energy	Rig Supply	32.153611	-94.291944	70	65	54	1	1.2	232	193	30	6.4
1669	32038	Chevron Texaco	Rig Supply	32.157222	-94.476943	220	75	158	2	0.5	91	88	70	1.3
1670	32035	Debbie Patrick	Rig Supply	32.1625	-94.286944	150	80	59	2	1.4	261	213	100	2.1
1671	32025	Royce Anderson	Domestic	32.149721	-94.3	200	70	115	1	0.6	117	109	60	1.8
1672	32006	Devon Energy	Rig Supply	32.304722	-94.150277	105	70	73	2	1.0	185	159	45	3.5
1673	32005	Chevron Texaco	Rig Supply	32.158888	-94.495277	290	70	173	2	0.4	78	77	60	1.3
1674	31943	Devon Energy	Rig Supply	32.141388	-94.274999	260	60	163	2	0.4	71	71	80	0.9
1675	28706	Bachman, Charles	Domestic	32.275832	-94.355277	320	30	72	1	0.4	80	79	60	1.3
1676	28704	Young, James	Domestic	32.28111	-94.352222	320	15	225	1	0.1	13	17	55	0.3
1677	28338	Haguewood, Daniel and Patrcia	Domestic	32.282221	-94.358333	320	30	128	1	0.2	45	49	80	0.6
1678	28334	Mayhew, Bill	Domestic	32.065	-94.517499	340	20	130	1	0.2	30	34	80	0.4
1679	25838	Rowdy Richmond	Domestic	32.22861	-94.465277	323	35	10	2	3.5	674	473	43	11.0
1680	25554	Jimmy Fruge	Domestic	32.301388	-94.319721	342	100	60	1	1.7	321	254	112	2.3
1681	24860	Anadarko E & P Co., LP	Industrial	32.152222	-94.401666	260	60	70	1	0.9	165	145	100	1.5
1682	21535	Rueben Martin Jr.	Domestic	32.202222	-94.495833	122	45	27	1	1.7	321	254	62	4.1
1683	21456	Anadarko E & P Co., LP	Industrial	32.143333	-94.497777	220	65	85	2	0.8	147	132	210	0.6
1684	21454	Anadarko E & P Co., LP	Industrial	32.205277	-94.391388	260	80	90	1	0.9	171	150	200	0.7
1685	19968	Ocean Energy	Industrial	32.091944	-94.370832	400	60	120	1	0.5	96	92	380	0.2
1686	19302	JIM HORTON	Domestic	32.782499	-97.672221	200	35	1	1	35.0	6,738	3,272	130	25.2
1687	19261	Ocean Energy	Industrial	32.091944	-94.370832	260	60	60	1	1.0	193	165	250	0.7
1688	19229	Anadarko E & P Co., LP	Industrial	32.088055	-94.286944	200	60	50	1	1.2	231	192	190	1.0
1689	11116	Colle, Jimmy and Angie	Domestic	32.047777	-94.304722	230	50	167	1	0.3	58	60	80	0.7
1690	7211	Pioneer Drilling	Industrial	32.102777	-94.53611	320	50	70	1	0.7	138	124	140	0.9
1691	5242	Rachel Stevens	Domestic	32.065833	-94.387221	322	30	142	1	0.2	41	45	122	0.4

APPENDIX E

Guidelines for Well Pair Selection and Sensor Usage

GUIDELINES FOR WELL PAIR SELECTION AND SENSOR USAGE

Current oil and gas (O&G) industry operations within Panola County include the extraction of groundwater for use in hydraulic fracturing activities. O&G companies have installed groundwater extraction wells in various aquifers within Panola County. In addition to the extraction wells, other wells either previously installed or newly installed are being used by the Panola County Groundwater Conservation District (District) to monitor the changes in groundwater levels resulting from the O&G groundwater extraction activities.

As part of this monitoring by the District, water-level changes over time can be evaluated to obtain estimates of formation transmissivity and storage properties of the pumped aquifer. To perform this data analysis, a production well (PW) and monitoring well (MW) located in close proximity can be selected such that the water-level changes in the MW can be attributed to the extraction of groundwater at the PW.

This document provides guidelines for the selection of a PW and MW pair to monitor (Section 1) and guidelines for the usage of the Aqua TROLL sensor to electronically collect water levels within the pumped aquifer (Section 2).

1.0 Well Pair Selection Guidelines

The following guidelines provide a recommended process for the selection of a PW and MW pair for monitoring of groundwater level changes over time. By selecting a relevant well pair, monitored changes in the groundwater level at the MW along with production volumes and timeframes from the PW can be used to estimate aquifer formation hydraulic properties. The key criteria to use in the well-pair selection process is the depths of the screened intervals, distance between the PW and MW, and distances to other active PWs.

1.1 Screen Depth

For best results, both the PW and MW will need to be screened across similar portions of the aquifer sediments (i.e., same sand intervals or same interbedded intervals). This ensures that there is a direct hydraulic communication between the PW and MW. During the well pair selection process, it will be common for the screened interval depths not to be identical, but they may overlap to some degree. The goal is to select well pairs that are screened across as much of the same sediments as possible. However, this may be restrictive in some locations based on the available wells and their configurations.

1.2 Distance Between Well Pairs

The PW and MW should be located in close enough proximity such that the changes in the groundwater levels within the aquifer due to pumping at the PW are observable at the MW. Groundwater level changes in the MW will be a result of multiple processes. The first is natural fluctuations, such as barometric pressure or earth tides, which can result in daily groundwater level changes on the order of up to a couple feet. The second process is due to groundwater extraction from the PW. The distance from the PW to the MW needs to be sufficiently close, so as to ensure the groundwater level changes caused by the extraction at the PW are significantly large, greater than 3 to 5 feet, such that they are clearly observable and overpower the natural fluctuations. This distance will be based on the formation hydraulic conductivity, which is typically not constant throughout the spatial distribution of the aquifer. However, this should be fairly consistent and will best be determined based on experience from field deployments.

An example spacing distance is based on observed responses from PW Soape 15 and MW Brewster 16. These two wells are located approximately 1,584 ft apart. The pumping at Soape 15 averages approximately 50 gallons per minute. Observed groundwater level changes in Brewster 16 resulting from the extraction at PW Soape 15 are greater than 30 feet. This magnitude of groundwater level change (drawdown) is sufficient to estimate formation hydraulic parameters. Based on the observed magnitude of the groundwater level drawdown, the wells could be significantly further apart, and the impact of the PW on the MW would still be observable. However, as mentioned in Section 1.3 below, the further the distance between the wells, the greater the potential for interference effects from other nearby PWs.

1.3 Distance to additional Production Wells

As noted above, as the distance from the PW and MW pair increases, so does the potential that the groundwater level changes at the MW can be a resultant of more than one PW. If the groundwater level changes in the MW are a result of extraction of groundwater from multiple PWs, these interference effects complicate the analysis for determination of formation hydraulic parameters. Therefore, it is recommended that during the well pair selection process, the MW be located in a region where there is only a single PW nearby.

At some locations within the county, there may not be a well pair that is located at a sufficient distance apart from other PWs, and thus interference effects are observed in the groundwater level changes in the MW. If sufficient groundwater extraction information, such as flow rates and pumping time (on/off), is available from all wells that are relevant PWs, then a more detailed analysis could be conducted to where the interference effects are removed from the data set and estimates of formation hydraulic properties could still be obtained.

2.0 Aqua TROLL Installation and Usage Guidelines

Once the well pair selection process has been completed, the monitoring and collection of the groundwater levels within the selected MW can be undertaken. The PCGCD currently has an In-Situ® Aqua TROLL 200 sensor, which will be used for the electronic monitoring and recording of downhole data within the selected MW.

The following usage guidelines are relevant to the configuration, installation and retrieval of the In-Situ® Aqua TROLL 200 sensor. The sensor is to be submerged in a groundwater well for monitoring of water levels, temperature and specific conductivity. Using the In-Situ® provided Win Situ 5 software, the sensor can be programmed to record data on the Aqua TROLL internal memory and then downloaded to a computer for data processing and viewing.

Section 2.1 provides a list of equipment necessary to properly utilize the sensor. Section 2.2 provides a list of precautions for consideration during usage of the sensor. Section 2.3 lists some pre-installation activities to be conducted prior to mobilizing to the field. Section 2.4 lists a set of recommended steps for downhole installation of the sensor. Section 2.5 describes how to configure the data logger for storing data on the sensor's internal memory. Section 2.6 lists the steps to follow when retrieving the data from the sensor's internal memory. Section 2.7 describes the steps to follow when removing the sensor from the wellbore.

2.1 Equipment List

- Aqua TROLL 200 Sensor
    - measures pressure, temperature, and specific conductivity
    - maximum pressure 100 psig (231 feet)
    - internal data logger
    - internal power source (battery)
- Rugged Twist-Lock Vented Cable
    - communications cable
    - support cable
    - vent tube for atmospheric pressure
    - 200 feet in length
    - cable spool
- Large desiccant cartridge
    - connected to up-hole end of twist-lock cable
    - prevents moisture from vent tube and connector
- TROLL Com adapter
    - Communication device between sensor and computer
- Win Situ 5 software
    - Data acquisition software for configuring and communicating with sensor
- Conductivity Standard
    - Reference fluid with known specific conductivity of 12,890 µS/cm
    - Use to field check senor reading
    - Used to field calibrate sensor (if needed)
- In-Situ web site with complete documentation of the Aqua TROLL 200
    - http://www.in-situ.com/products/water-quality/aqua-troll-instruments/aqua-troll-200-data-logger/overview

2.2 Usage Precautions

- Maximum installation depth is 231 feet below water level (equivalent to a pressure of 100 psig)
- The internal parts of the twist-lock cable and the Aqua TROLL are open to the atmosphere at the connecting ends. These must be kept dry at all times. Moisture getting into the vent tube of the cable or sensor may prevent proper sensor operation and may also damage the equipment.

- Make sure twist-lock connections between the cable, sensor, desiccant cartridge, and/or TROLL Com adapter are secure during deployment.
- When not deployed, keep the red plastic dust caps or a desiccant cartridge attached to the connecting ends of the cable and Aqua TROLL.
- When deployed, secure the large desiccant cartridge to the up-hole end of the cable and periodically replace the desiccant beads.
- Do not bend the twist-lock cable sharply. This can damage the vent tube inside the cable, which prevents the internal parts of the instrument from being open to atmospheric pressure.
- All pressure/water level measurements made are relative to the initial position of the Aqua TROLL within the well, referenced to a manually measured water level made during initial setup. The position of the Aqua TROLL within the well must not move vertically during deployment. If the instrument is moved, the data logger will need to be reconfigured with a new initial/reference position.
- Make sure the cable is fully extended within the well (i.e., not hung up).
- Make sure the excess cable at the surface is secured, so that no slack will fall into the well. Duct tape is a good way to keep the cable static.

2.3 Pre-Installation Activities

- Prior knowledge about the well to be monitored is helpful. For example, knowledge of total well depth, type of surface completion including well cap design, expected water level, and expected drawdown are good things to know before leaving the office.
- Ensure all needed equipment is on hand, including an electric water-level meter (e-line).
- Determine expected installation depth of sensor based on known water level range in well to be monitored.
- Install Win Situ 5 software on a laptop computer to be taken into the field for installation.
- Ensure that all drivers for the TROLL Com adapter have been installed.
- Launch the Win Situ 5 software
- Connect the Aqua Troll sensor to the laptop computer via the TROLL Com adaptor
- Set up a new “Site” prior to installing the sensor in a new well.
    - Click on the “Display the Site List” icon in the upper left-hand portion of the main display area
    - Click on the “Add new Site” icon in the lower left-hand corner of the new window
    - Type in the new Site name in the “Name” box
    - Fill in other information boxes if desired
    - Click on the “Display the Site List” icon on select the Site name just created.
- If desired, check specific conductivity sensor reading against provide standard solution.

2.4 Sensor Installation

- Ensure all connections remain dry and moisture-free during sensor installation.
- If the well has been tightly capped for an extended period of time, uncap it and allow some time (e.g., ~15 minutes) for the water level within the well to equilibrate with the atmosphere.
- With an e-line, take and record a static depth-to-water (DTW) based on the depth below top of casing (BTOC) or depth below standard measurement point (BMP).

- Make sure the Aqua TROLL is securely connected to the down-hole end of the twist-lock cable (the lock should snap shut completely) and lower the instrument into the well.
- Set Aqua TROLL at the desired depth (less than 231 feet below water level)
    - Tape markers have been placed on the twist-lock cable between 50 ft and 175 ft
        - Two pieces of black tape are placed at 50 ft, 100 ft, and 150 ft.
        - One piece of black tape is placed at 25 ft, 125 ft, and 175 ft.
    - Exact depth is not required for accurate readings
    - Ensure the cable is fully extended (hanging straight) and has not coiled up.
- Secure twist-lock cable at surface to prevent sensor from shifting position.
- If sufficient space is available, take and record another DTW measurement with the e-line.
    - If the water level is higher (DTW is lower) than the earlier measurement, the well is probably experiencing a slug effect from the insertion of the instrument. In this case, monitor the water level for several minutes until it approaches the previously measured value and/or stops showing any significant change. When you are confident that the water level is remaining static within a reasonable range (e.g., < 0.1 ft) over the course of several minutes, take and record a measurement to use as the reference DTW for the log setup.

2.5 Data-logger Configuration

- Ensure all connections remain dry and moisture-free during data-logger configuration.
- Launch the Win Situ 5 software on the laptop computer.
- Connect the Aqua TROLL to the laptop computer using the TROLL Com adapter
- Establish connection between the laptop computer and the Aqua TROLL
- To set up a new data-logging file:
    - Click on the “Logging” icon or select View>Logging
    - Click on the “Set up a new log in the connected device” icon located at the bottom left-hand corner of the main window.
    - Ensure the correct Site Name is selected.
    - Enter a unique Log Name to identify the data file.
        - Recommend using the current date as the log name when starting a new log.
    - Select the “Next” arrowhead icon at the bottom of the window.
    - Select the parameters for the instrument to record to the file. Recommend:
        - Pressure, Temperature, Level Depth to Water, Specific Conductivity, and TDS
    - Select the desire units for each parameter.
    - Select the “Next” arrowhead icon at the bottom of the window.
    - Select “Linear” logging.
    - Select the “Next” arrowhead icon at the bottom of the window.
    - Assign a logging interval of 15 minutes.
        - If “Event” logging or a “Linear” logging interval of less than 10 minutes is used, an external battery power source will be necessary due to greater energy use. An external battery is not currently included but can be obtained from In-Situ.
    - Select the “Next” arrowhead icon at the bottom of the window.
    - Choose whether to start and stop the log manually or by setting a scheduled start/stop time.
    - Select the “Next” arrowhead icon at the bottom of the window.
    - Select the option to represent the water level as “Depth to Water (DTW) / Drawdown.”
    - Select the “Next” arrowhead icon at the bottom of the window.

- In the “New Reference” input box, assign the manually measured reference DTW.
    - Select the “Next” arrowhead icon at the bottom of the window.
    - This screen is for the selection of the specific gravity of the water to convert the measured pressure to head. Recommend using the default Fresh Water settings unless water quality analyses indicate otherwise.
    - Select the “Next” arrowhead icon at the bottom of the window.
    - Select “Standard Method” for the specific conductivity compensation method.
    - Select the “Next” arrowhead icon at the bottom of the window.
    - Either accept the default total dissolved solids (TDS) conversion factor of 0.65 or enter another value determined for the aquifer at this Site.
    - Select the “Next” arrowhead icon at the bottom of the window.
    - A summary screen showing the selected options for the log will be displayed. If this is acceptable, accept the choices to create the log.
    - The new log will be added to the main screen of the Logging interface.
        - The icon next to left of the log name indicates whether the log is scheduled (a clock), on standby waiting to be manually started (a clipboard), currently running (a running man), completed/stopped (a green check mark), or if there was an error (a red X).
        - If you opted to manually start the log, you may do so now by selecting the log and either hitting the “Start” arrow icon at the bottom or by right clicking and selecting the Start option.
        - If you opted to start on a schedule, it is a good idea to confirm that the log starts when it is supposed to.
    - Once the log has started running, the sensor will store the recorded data on the internal memory, and the communication between the Aqua TROLL and the laptop computer can be terminated using the “Connect to Device” icon in the bottom right-hand corner of the main window or by selecting File>Disconnect.
- Remove the TROLL Com adapter from the twist-lock cable, and place the large desiccant cartridge onto the cable end. Secure the cable in such a way that exposure to moisture is minimized.

2.6 Data Retrieval

- Ensure all connections remain dry and moisture free during data retrieval.
- Launch the Win Situ 5 software on the laptop computer.
- Establish a connection between the laptop computer and the Aqua TROLL using the TROLL Com adaptor, being careful not to reposition the senor within the well.
- Go to the Logging interface within the Win Situ 5 software, and select the data log you are interested in downloading. The log does not need to be stopped prior to downloading data.
- Either click on the “Download the selected log to the connected PC” arrow icon at the bottom of the main window or right-click on the log and select the “Download” option. If this is the first time you’ve downloaded the log to a particular computer, select the “Download all data option.” It is recommended to download the full log data set each time.
- Select to “OK” arrow icon in the bottom right-hand corner of the new window.
- Select the “OK” button after the download is complete.

- A dialogue box will appear asking if you want to view the data. Select "Yes", and it will take you to the My Data tab within the software.
    - The left-hand portion of the screen provides a file-manager layout
    - The right-hand portion of the screen provides a listing of the item selected in the file-manager layout
- Under the Site Data folder, find the Site Name and then select the downloaded file (with the extension *.wsl)
- Either right-click and select the "Export to CSV" option or use the File>Export to CSV option.
- The exported CSV file will appear under the Exported Data folder identified by the Site Name.
- Double clicking on this CSV file should open the file in Excel to allow the user to check to ensure the most recent data has been downloaded.
- Terminate communication between the Aqua TROLL and the laptop computer using the "Connect to Device" icon in the bottom right-hand corner of the main window or by selecting File>Disconnect.
- Disconnect the laptop computer from the Aqua TROLL, and replace the desiccant cartridge on the cable end. If the desiccant needs to be replaced (i.e., has turned from blue to pale pink), this is a good time to do so.

2.7 Sensor Removal

- Ensure all connections remain dry and moisture-free during data retrieval.
- Launch the Win Situ 5 software on the laptop computer.
- Establish a connection between the laptop computer and the Aqua TROLL using the TROLL Com adapter.
- Go to the Logging interface of the Win Situ 5 software, and select the active log.
- To stop the log, either click on the "Stop" icon at the bottom of the main window, or right-click on the log and use the Stop option.
- Conduct a final data retrieval, using the procedure above, prior to removal.
- Terminate communication between the Aqua TROLL and the laptop computer using the "Connect to Device" icon in the bottom right-hand corner of the main window or by selecting File>Disconnect.
- Disconnect the Aqua TROLL from the laptop computer, and replace the desiccant cartridge on the cable end.
- Carefully pull the cable and Aqua TROLL sensor from the well and store on cable reel.
- There is no particular need to disconnect the Aqua TROLL sensor from the cable. However, if you do disconnect the instrument from the cable, be careful not to get any moisture into either of the terminal ends and ensure both ends are covered with the red plastic caps.

Appendix C

TWDB Historic Pumping Estimates for Groundwater Management Area 11

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
All Values in AF/yr

Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1980	ANDERSON	CARRIZO-WILCOX AQUIFER	2,267	349	854	0	0	139	3,609
1984	ANDERSON	CARRIZO-WILCOX AQUIFER	3,721	455	329	0	102	263	4,870
1985	ANDERSON	CARRIZO-WILCOX AQUIFER	4,277	303	405	0	113	275	5,373
1986	ANDERSON	CARRIZO-WILCOX AQUIFER	4,601	347	382	0	54	275	5,659
1987	ANDERSON	CARRIZO-WILCOX AQUIFER	4,884	346	359	0	54	282	5,925
1988	ANDERSON	CARRIZO-WILCOX AQUIFER	4,938	344	325	0	54	292	5,953
1989	ANDERSON	CARRIZO-WILCOX AQUIFER	5,044	431	303	0	27	303	6,108
1990	ANDERSON	CARRIZO-WILCOX AQUIFER	5,253	0	303	0	21	306	5,883
1991	ANDERSON	CARRIZO-WILCOX AQUIFER	4,910	0	318	0	24	311	5,563
1992	ANDERSON	CARRIZO-WILCOX AQUIFER	5,403	0	318	0	24	374	6,119
1993	ANDERSON	CARRIZO-WILCOX AQUIFER	5,400	0	315	0	171	366	6,252
1994	ANDERSON	CARRIZO-WILCOX AQUIFER	5,872	0	315	0	78	323	6,588
1995	ANDERSON	CARRIZO-WILCOX AQUIFER	6,473	0	430	0	180	321	7,404
1996	ANDERSON	CARRIZO-WILCOX AQUIFER	7,640	0	430	0	265	321	8,656
1997	ANDERSON	CARRIZO-WILCOX AQUIFER	7,324	0	430	0	254	321	8,329
1998	ANDERSON	CARRIZO-WILCOX AQUIFER	7,820	0	411	0	632	281	9,144
1999	ANDERSON	CARRIZO-WILCOX AQUIFER	7,381	0	430	0	309	288	8,408
2000	ANDERSON	CARRIZO-WILCOX AQUIFER	9,225	340	0	0	89	299	9,953
2001	ANDERSON	CARRIZO-WILCOX AQUIFER	8,555	340	0	0	89	146	9,130
2002	ANDERSON	CARRIZO-WILCOX AQUIFER	8,598	445	0	0	75	148	9,266
2003	ANDERSON	CARRIZO-WILCOX AQUIFER	8,920	445	0	0	16	133	9,514
2004	ANDERSON	CARRIZO-WILCOX AQUIFER	8,723	0	0	0	28	142	8,893
2005	ANDERSON	CARRIZO-WILCOX AQUIFER	9,013	0	0	0	52	34	9,099
2006	ANDERSON	CARRIZO-WILCOX AQUIFER	8,428	0	0	0	0	36	8,464
2007	ANDERSON	CARRIZO-WILCOX AQUIFER	7,495	0	0	0	263	36	7,794
2008	ANDERSON	CARRIZO-WILCOX AQUIFER	7,774	0	0	0	167	25	7,966
2009	ANDERSON	CARRIZO-WILCOX AQUIFER	7,930	0	0	0	394	26	8,350
2010	ANDERSON	CARRIZO-WILCOX AQUIFER	8,023	0	0	0	129	25	8,177
2011	ANDERSON	CARRIZO-WILCOX AQUIFER	8,559	0	0	0	229	25	8,813
2012	ANDERSON	CARRIZO-WILCOX AQUIFER	8,627	0	0	0	207	22	8,856
1980	ANDERSON	OTHER AQUIFER	146	0	0	0	0	43	189
1984	ANDERSON	OTHER AQUIFER	22	0	0	0	0	15	37
1985	ANDERSON	OTHER AQUIFER	19	0	0	0	0	17	36
1986	ANDERSON	OTHER AQUIFER	19	0	0	0	0	17	36
1987	ANDERSON	OTHER AQUIFER	17	0	0	0	0	17	34
1988	ANDERSON	OTHER AQUIFER	0	0	0	0	0	18	18
1989	ANDERSON	OTHER AQUIFER	0	0	0	0	0	19	19
1990	ANDERSON	OTHER AQUIFER	26	0	0	0	0	19	45
1991	ANDERSON	OTHER AQUIFER	14	0	0	0	0	19	33
1992	ANDERSON	OTHER AQUIFER	36	0	0	0	0	23	59
1993	ANDERSON	OTHER AQUIFER	56	0	0	0	0	23	79
1994	ANDERSON	OTHER AQUIFER	60	0	0	0	0	20	80
1995	ANDERSON	OTHER AQUIFER	50	0	0	0	0	20	70
1996	ANDERSON	OTHER AQUIFER	83	0	0	0	0	20	103
1997	ANDERSON	OTHER AQUIFER	84	0	0	0	0	20	104
1998	ANDERSON	OTHER AQUIFER	90	0	0	0	0	17	107
1999	ANDERSON	OTHER AQUIFER	85	0	0	0	0	18	103
2000	ANDERSON	OTHER AQUIFER	26	0	0	0	0	19	45
2001	ANDERSON	OTHER AQUIFER	29	0	0	0	0	10	39
2002	ANDERSON	OTHER AQUIFER	28	0	0	0	0	10	38
2003	ANDERSON	OTHER AQUIFER	27	0	0	0	0	9	36
2004	ANDERSON	OTHER AQUIFER	26	0	0	0	0	45	71
2005	ANDERSON	OTHER AQUIFER	28	0	0	0	0	11	39
2006	ANDERSON	OTHER AQUIFER	195	0	0	0	0	11	206
2007	ANDERSON	OTHER AQUIFER	161	0	0	0	0	11	172
2008	ANDERSON	OTHER AQUIFER	179	0	0	0	0	16	195
2009	ANDERSON	OTHER AQUIFER	190	0	0	0	0	17	207
2010	ANDERSON	OTHER AQUIFER	202	0	0	0	0	8	210
2011	ANDERSON	OTHER AQUIFER	209	0	0	0	0	8	217
2012	ANDERSON	OTHER AQUIFER	191	0	0	0	0	6	197
1980	ANDERSON	QUEEN CITY AQUIFER	824	0	753	0	0	289	1,866
1984	ANDERSON	QUEEN CITY AQUIFER	438	0	0	0	11	234	683
1985	ANDERSON	QUEEN CITY AQUIFER	422	0	0	0	12	244	678
1986	ANDERSON	QUEEN CITY AQUIFER	415	0	0	0	6	244	665
1987	ANDERSON	QUEEN CITY AQUIFER	384	0	0	0	6	250	640
1988	ANDERSON	QUEEN CITY AQUIFER	0	0	0	0	6	259	265
1989	ANDERSON	QUEEN CITY AQUIFER	0	0	0	0	1	269	270
1990	ANDERSON	QUEEN CITY AQUIFER	188	0	0	0	2	272	462
1991	ANDERSON	QUEEN CITY AQUIFER	106	0	0	0	2	277	385
1992	ANDERSON	QUEEN CITY AQUIFER	273	0	0	0	2	334	609
1993	ANDERSON	QUEEN CITY AQUIFER	422	0	0	0	1	328	751
1994	ANDERSON	QUEEN CITY AQUIFER	455	0	0	0	0	290	745
1995	ANDERSON	QUEEN CITY AQUIFER	380	0	0	0	0	288	668
1996	ANDERSON	QUEEN CITY AQUIFER	627	0	0	0	0	288	915
1997	ANDERSON	QUEEN CITY AQUIFER	631	0	0	0	0	288	919
1998	ANDERSON	QUEEN CITY AQUIFER	674	0	0	0	0	252	926
1999	ANDERSON	QUEEN CITY AQUIFER	636	0	0	0	0	259	895
2000	ANDERSON	QUEEN CITY AQUIFER	190	0	0	0	7	269	466

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
All Values in AF/yr

Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2001	ANDERSON	QUEEN CITY AQUIFER	217	0	0	0	7	132	356
2002	ANDERSON	QUEEN CITY AQUIFER	220	0	0	0	6	132	358
2003	ANDERSON	QUEEN CITY AQUIFER	212	0	0	0	1	120	333
2004	ANDERSON	QUEEN CITY AQUIFER	205	0	0	0	2	118	325
2005	ANDERSON	QUEEN CITY AQUIFER	220	0	0	0	4	28	252
2006	ANDERSON	QUEEN CITY AQUIFER	838	0	0	0	0	30	868
2007	ANDERSON	QUEEN CITY AQUIFER	695	0	0	0	21	30	746
2008	ANDERSON	QUEEN CITY AQUIFER	773	0	0	0	13	21	807
2009	ANDERSON	QUEEN CITY AQUIFER	818	0	0	0	31	22	871
2010	ANDERSON	QUEEN CITY AQUIFER	872	0	0	0	130	21	1,023
2011	ANDERSON	QUEEN CITY AQUIFER	899	0	0	0	229	21	1,149
2012	ANDERSON	QUEEN CITY AQUIFER	825	0	0	0	207	18	1,050
1980	ANDERSON	SPARTA AQUIFER	256	0	84	0	0	62	402
1984	ANDERSON	SPARTA AQUIFER	197	0	0	0	0	87	284
1985	ANDERSON	SPARTA AQUIFER	192	0	0	0	0	91	283
1986	ANDERSON	SPARTA AQUIFER	189	0	0	0	0	91	280
1988	ANDERSON	SPARTA AQUIFER	0	0	0	0	0	97	97
1989	ANDERSON	SPARTA AQUIFER	0	0	0	0	0	100	100
1990	ANDERSON	SPARTA AQUIFER	70	0	0	0	0	101	171
1991	ANDERSON	SPARTA AQUIFER	39	0	0	0	0	103	142
1992	ANDERSON	SPARTA AQUIFER	100	0	0	0	0	124	224
1993	ANDERSON	SPARTA AQUIFER	155	0	0	0	0	122	277
1994	ANDERSON	SPARTA AQUIFER	167	0	0	0	0	108	275
1995	ANDERSON	SPARTA AQUIFER	140	0	0	0	0	108	248
1996	ANDERSON	SPARTA AQUIFER	231	0	0	0	0	108	339
1997	ANDERSON	SPARTA AQUIFER	233	0	0	0	0	108	341
1998	ANDERSON	SPARTA AQUIFER	249	0	0	0	0	94	343
1999	ANDERSON	SPARTA AQUIFER	235	0	0	0	0	97	332
2000	ANDERSON	SPARTA AQUIFER	70	0	0	0	0	97	167
2001	ANDERSON	SPARTA AQUIFER	64	0	0	0	0	49	113
2002	ANDERSON	SPARTA AQUIFER	65	0	0	0	0	50	115
2003	ANDERSON	SPARTA AQUIFER	64	0	0	0	0	45	109
2004	ANDERSON	SPARTA AQUIFER	62	0	0	0	0	0	62
2005	ANDERSON	SPARTA AQUIFER	66	0	0	0	0	0	66
2006	ANDERSON	SPARTA AQUIFER	271	0	0	0	0	0	271
2007	ANDERSON	SPARTA AQUIFER	224	0	0	0	0	0	224
2008	ANDERSON	SPARTA AQUIFER	249	0	0	0	0	0	249
2009	ANDERSON	SPARTA AQUIFER	264	0	0	0	0	0	264
2010	ANDERSON	SPARTA AQUIFER	281	0	0	0	0	0	281
2011	ANDERSON	SPARTA AQUIFER	290	0	0	0	0	0	290
2012	ANDERSON	SPARTA AQUIFER	266	0	0	0	0	0	266
2008	ANDERSON	UNKNOWN	0	0	11	0	0	0	11
2009	ANDERSON	UNKNOWN	0	0	30	0	0	0	30
2010	ANDERSON	UNKNOWN	0	0	50	0	0	0	50
2011	ANDERSON	UNKNOWN	0	0	43	0	0	0	43
1980	ANGELINA	CARRIZO-WILCOX AQUIFER	8,244	21,296	0	0	0	0	29,540
1984	ANGELINA	CARRIZO-WILCOX AQUIFER	7,989	19,284	0	0	0	0	27,273
1985	ANGELINA	CARRIZO-WILCOX AQUIFER	8,222	19,120	0	0	0	0	27,342
1986	ANGELINA	CARRIZO-WILCOX AQUIFER	7,955	18,582	0	0	0	0	26,537
1987	ANGELINA	CARRIZO-WILCOX AQUIFER	7,673	18,561	0	0	0	0	26,234
1988	ANGELINA	CARRIZO-WILCOX AQUIFER	7,644	16,199	0	0	0	0	23,843
1989	ANGELINA	CARRIZO-WILCOX AQUIFER	7,845	23,578	0	0	0	0	31,423
1990	ANGELINA	CARRIZO-WILCOX AQUIFER	8,354	14,668	0	0	0	0	23,022
1991	ANGELINA	CARRIZO-WILCOX AQUIFER	8,201	13,565	22	0	0	0	21,788
1992	ANGELINA	CARRIZO-WILCOX AQUIFER	9,013	12,404	22	0	0	0	21,439
1993	ANGELINA	CARRIZO-WILCOX AQUIFER	8,816	11,999	22	0	0	0	20,837
1994	ANGELINA	CARRIZO-WILCOX AQUIFER	9,023	12,030	22	0	0	0	21,075
1995	ANGELINA	CARRIZO-WILCOX AQUIFER	9,132	12,552	22	0	0	0	21,706
1996	ANGELINA	CARRIZO-WILCOX AQUIFER	10,161	11,771	22	0	0	0	21,954
1997	ANGELINA	CARRIZO-WILCOX AQUIFER	10,705	11,262	22	0	0	0	21,989
1998	ANGELINA	CARRIZO-WILCOX AQUIFER	12,198	10,922	22	0	0	0	23,142
1999	ANGELINA	CARRIZO-WILCOX AQUIFER	12,266	10,715	22	0	0	0	23,003
2000	ANGELINA	CARRIZO-WILCOX AQUIFER	13,114	12,306	0	0	0	39	25,459
2001	ANGELINA	CARRIZO-WILCOX AQUIFER	12,435	8,995	0	0	0	38	21,468
2002	ANGELINA	CARRIZO-WILCOX AQUIFER	11,995	8,345	0	0	0	36	20,376
2003	ANGELINA	CARRIZO-WILCOX AQUIFER	11,793	9,137	0	0	0	34	20,964
2004	ANGELINA	CARRIZO-WILCOX AQUIFER	11,840	1,914	0	0	0	33	13,787
2005	ANGELINA	CARRIZO-WILCOX AQUIFER	12,984	610	0	0	0	7	13,601
2006	ANGELINA	CARRIZO-WILCOX AQUIFER	12,379	782	0	0	0	7	13,168
2007	ANGELINA	CARRIZO-WILCOX AQUIFER	11,641	20	0	0	0	7	11,668
2008	ANGELINA	CARRIZO-WILCOX AQUIFER	11,767	16	0	0	0	8	11,791
2009	ANGELINA	CARRIZO-WILCOX AQUIFER	11,355	16	0	0	0	8	11,379
2010	ANGELINA	CARRIZO-WILCOX AQUIFER	10,842	0	0	0	0	10	10,852
2011	ANGELINA	CARRIZO-WILCOX AQUIFER	11,894	0	0	0	0	10	11,904
2012	ANGELINA	CARRIZO-WILCOX AQUIFER	10,695	0	0	0	0	8	10,703
1980	ANGELINA	OTHER AQUIFER	2,645	0	0	0	191	70	2,906
1984	ANGELINA	OTHER AQUIFER	2,263	1,002	0	0	191	146	3,602
1985	ANGELINA	OTHER AQUIFER	2,322	892	0	0	153	95	3,462

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All Values in AF/yr

Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1986	ANGELINA	OTHER AQUIFER	2,289	871	0	0	136	85	3,381
1987	ANGELINA	OTHER AQUIFER	2,013	853	0	0	136	88	3,090
1988	ANGELINA	OTHER AQUIFER	2,103	912	0	0	136	100	3,251
1989	ANGELINA	OTHER AQUIFER	2,328	831	0	0	0	88	3,247
1990	ANGELINA	OTHER AQUIFER	2,561	851	0	0	0	87	3,499
1991	ANGELINA	OTHER AQUIFER	2,542	777	0	0	0	88	3,407
1992	ANGELINA	OTHER AQUIFER	2,582	791	0	0	0	124	3,497
1993	ANGELINA	OTHER AQUIFER	2,417	774	0	0	30	122	3,343
1994	ANGELINA	OTHER AQUIFER	2,247	800	0	0	30	100	3,177
1995	ANGELINA	OTHER AQUIFER	2,180	777	0	0	30	100	3,087
1996	ANGELINA	OTHER AQUIFER	2,348	756	0	0	30	91	3,225
1997	ANGELINA	OTHER AQUIFER	2,197	687	0	0	30	89	3,003
1998	ANGELINA	OTHER AQUIFER	2,503	41	0	0	30	100	2,674
1999	ANGELINA	OTHER AQUIFER	2,517	1,023	0	0	30	116	3,686
2000	ANGELINA	OTHER AQUIFER	2,218	709	0	0	0	0	2,927
2001	ANGELINA	OTHER AQUIFER	2,217	761	0	0	0	0	2,978
2002	ANGELINA	OTHER AQUIFER	2,292	904	0	0	0	0	3,196
2003	ANGELINA	OTHER AQUIFER	2,299	918	0	0	0	0	3,217
2004	ANGELINA	OTHER AQUIFER	2,944	798	0	0	0	0	3,742
2005	ANGELINA	OTHER AQUIFER	2,128	799	0	0	0	0	2,927
2006	ANGELINA	OTHER AQUIFER	2,250	864	0	0	0	0	3,114
2007	ANGELINA	OTHER AQUIFER	2,180	971	0	0	0	0	3,151
2008	ANGELINA	OTHER AQUIFER	2,240	890	0	0	0	0	3,130
2009	ANGELINA	OTHER AQUIFER	2,207	902	0	0	0	0	3,109
2010	ANGELINA	OTHER AQUIFER	127	75	0	0	0	0	202
2011	ANGELINA	OTHER AQUIFER	440	81	0	0	0	0	521
2012	ANGELINA	OTHER AQUIFER	351	69	0	0	0	0	420
1980	ANGELINA	QUEEN CITY AQUIFER	150	0	0	0	186	23	359
1984	ANGELINA	QUEEN CITY AQUIFER	214	0	0	0	186	48	448
1985	ANGELINA	QUEEN CITY AQUIFER	187	0	0	0	149	47	383
1986	ANGELINA	QUEEN CITY AQUIFER	136	0	0	0	132	42	310
1987	ANGELINA	QUEEN CITY AQUIFER	105	0	0	0	132	44	281
1988	ANGELINA	QUEEN CITY AQUIFER	60	0	0	0	132	49	241
1989	ANGELINA	QUEEN CITY AQUIFER	224	0	0	0	0	44	268
1990	ANGELINA	QUEEN CITY AQUIFER	134	0	0	0	0	44	178
1991	ANGELINA	QUEEN CITY AQUIFER	143	0	0	0	0	45	188
1992	ANGELINA	QUEEN CITY AQUIFER	92	0	0	0	0	63	155
1993	ANGELINA	QUEEN CITY AQUIFER	75	0	0	0	0	62	137
1994	ANGELINA	QUEEN CITY AQUIFER	67	0	0	0	0	51	118
1995	ANGELINA	QUEEN CITY AQUIFER	31	0	0	0	0	51	82
1996	ANGELINA	QUEEN CITY AQUIFER	76	0	0	0	0	46	122
1997	ANGELINA	QUEEN CITY AQUIFER	59	0	0	0	0	45	104
1998	ANGELINA	QUEEN CITY AQUIFER	67	0	0	0	0	51	118
1999	ANGELINA	QUEEN CITY AQUIFER	68	0	0	0	0	59	127
2000	ANGELINA	QUEEN CITY AQUIFER	2	0	0	0	0	58	60
2001	ANGELINA	QUEEN CITY AQUIFER	7	0	0	0	0	57	64
2002	ANGELINA	QUEEN CITY AQUIFER	8	0	0	0	0	54	62
2003	ANGELINA	QUEEN CITY AQUIFER	8	0	0	0	0	50	58
2004	ANGELINA	QUEEN CITY AQUIFER	8	0	0	0	0	0	8
2005	ANGELINA	QUEEN CITY AQUIFER	8	0	0	0	0	0	8
1980	ANGELINA	SPARTA AQUIFER	150	0	0	0	186	24	360
1984	ANGELINA	SPARTA AQUIFER	214	0	0	0	186	49	449
1985	ANGELINA	SPARTA AQUIFER	187	0	0	0	148	47	382
1986	ANGELINA	SPARTA AQUIFER	136	0	0	0	132	42	310
1987	ANGELINA	SPARTA AQUIFER	105	0	0	0	132	44	281
1988	ANGELINA	SPARTA AQUIFER	60	0	0	0	132	49	241
1989	ANGELINA	SPARTA AQUIFER	224	0	0	0	0	44	268
1990	ANGELINA	SPARTA AQUIFER	134	0	0	0	0	44	178
1991	ANGELINA	SPARTA AQUIFER	143	0	0	0	0	45	188
1992	ANGELINA	SPARTA AQUIFER	92	0	0	0	0	63	155
1993	ANGELINA	SPARTA AQUIFER	75	0	0	0	0	62	137
1994	ANGELINA	SPARTA AQUIFER	67	0	0	0	0	51	118
1995	ANGELINA	SPARTA AQUIFER	31	0	0	0	0	51	82
1996	ANGELINA	SPARTA AQUIFER	76	0	0	0	0	46	122
1997	ANGELINA	SPARTA AQUIFER	59	0	0	0	0	45	104
1998	ANGELINA	SPARTA AQUIFER	67	0	0	0	0	51	118
1999	ANGELINA	SPARTA AQUIFER	68	0	0	0	0	59	127
2000	ANGELINA	SPARTA AQUIFER	2	0	0	0	0	58	60
2001	ANGELINA	SPARTA AQUIFER	0	0	0	0	0	57	57
2002	ANGELINA	SPARTA AQUIFER	0	0	0	0	0	54	54
2003	ANGELINA	SPARTA AQUIFER	0	0	0	0	0	50	50
2004	ANGELINA	SPARTA AQUIFER	0	0	0	0	0	33	33
2005	ANGELINA	SPARTA AQUIFER	0	0	0	0	0	7	7
2006	ANGELINA	SPARTA AQUIFER	88	0	0	0	0	7	95
2007	ANGELINA	SPARTA AQUIFER	73	0	0	0	0	7	80
2008	ANGELINA	SPARTA AQUIFER	81	0	0	0	0	8	89
2009	ANGELINA	SPARTA AQUIFER	96	0	0	0	0	8	104
2010	ANGELINA	SPARTA AQUIFER	112	0	0	0	0	10	122

Groundwater Pumping Estimates from Texas Water Development Board
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All Values in AF/yr

Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2011	ANGELINA	SPARTA AQUIFER	130	0	0	0	0	10	140
2012	ANGELINA	SPARTA AQUIFER	85	0	0	0	0	8	93
2008	ANGELINA	UNKNOWN	0	0	71	0	0	0	71
2009	ANGELINA	UNKNOWN	0	0	43	0	0	0	43
2010	ANGELINA	UNKNOWN	0	0	15	0	0	0	15
2011	ANGELINA	UNKNOWN	0	0	10	0	0	0	10
2012	ANGELINA	UNKNOWN	0	0	27	0	0	0	27
2000	ANGELINA	YEGUA-JACKSON AQUIFER	0	0	0	0	30	76	106
2001	ANGELINA	YEGUA-JACKSON AQUIFER	0	0	0	0	9	74	83
2002	ANGELINA	YEGUA-JACKSON AQUIFER	0	0	0	0	9	70	79
2003	ANGELINA	YEGUA-JACKSON AQUIFER	0	0	0	0	25	67	92
2004	ANGELINA	YEGUA-JACKSON AQUIFER	0	0	0	0	109	133	242
2005	ANGELINA	YEGUA-JACKSON AQUIFER	0	0	0	0	209	26	235
2006	ANGELINA	YEGUA-JACKSON AQUIFER	455	0	0	0	186	27	668
2007	ANGELINA	YEGUA-JACKSON AQUIFER	377	0	0	0	0	28	405
2008	ANGELINA	YEGUA-JACKSON AQUIFER	421	0	0	0	0	33	454
2009	ANGELINA	YEGUA-JACKSON AQUIFER	498	0	0	0	214	31	743
2010	ANGELINA	YEGUA-JACKSON AQUIFER	2,468	1,384	0	0	238	40	4,130
2011	ANGELINA	YEGUA-JACKSON AQUIFER	2,376	975	0	0	265	39	3,655
2012	ANGELINA	YEGUA-JACKSON AQUIFER	1,872	790	0	0	274	33	2,969
1980	BOWIE	BLOSSOM AQUIFER	45	0	0	0	0	20	65
1984	BOWIE	BLOSSOM AQUIFER	59	0	0	0	0	22	81
1985	BOWIE	BLOSSOM AQUIFER	59	0	0	0	0	19	78
1986	BOWIE	BLOSSOM AQUIFER	48	0	0	0	0	21	69
1987	BOWIE	BLOSSOM AQUIFER	49	0	0	0	0	20	69
1988	BOWIE	BLOSSOM AQUIFER	46	0	0	0	0	20	66
1989	BOWIE	BLOSSOM AQUIFER	52	0	0	0	0	20	72
1990	BOWIE	BLOSSOM AQUIFER	66	0	0	0	0	22	88
1991	BOWIE	BLOSSOM AQUIFER	69	0	0	0	0	22	91
1992	BOWIE	BLOSSOM AQUIFER	63	0	0	0	0	18	81
1993	BOWIE	BLOSSOM AQUIFER	66	0	0	0	0	19	85
1994	BOWIE	BLOSSOM AQUIFER	66	0	0	0	0	21	87
1995	BOWIE	BLOSSOM AQUIFER	104	0	0	0	0	20	124
1996	BOWIE	BLOSSOM AQUIFER	106	0	0	0	0	27	133
1997	BOWIE	BLOSSOM AQUIFER	105	0	0	0	0	18	123
1998	BOWIE	BLOSSOM AQUIFER	99	0	0	0	0	19	118
1999	BOWIE	BLOSSOM AQUIFER	86	0	0	0	0	20	106
2000	BOWIE	BLOSSOM AQUIFER	62	0	0	0	0	20	82
2001	BOWIE	BLOSSOM AQUIFER	53	0	0	0	0	7	60
2002	BOWIE	BLOSSOM AQUIFER	62	0	0	0	0	7	69
2003	BOWIE	BLOSSOM AQUIFER	78	0	0	0	0	7	85
2004	BOWIE	BLOSSOM AQUIFER	75	0	0	0	0	0	75
2005	BOWIE	BLOSSOM AQUIFER	81	0	0	0	0	0	81
1980	BOWIE	CARRIZO-WILCOX AQUIFER	1,653	42	0	0	0	286	1,981
1984	BOWIE	CARRIZO-WILCOX AQUIFER	1,492	45	0	0	0	301	1,838
1985	BOWIE	CARRIZO-WILCOX AQUIFER	1,586	44	0	0	0	258	1,888
1986	BOWIE	CARRIZO-WILCOX AQUIFER	1,584	39	18	0	0	298	1,939
1987	BOWIE	CARRIZO-WILCOX AQUIFER	1,234	22	18	0	0	274	1,548
1988	BOWIE	CARRIZO-WILCOX AQUIFER	1,488	7	17	0	0	275	1,787
1989	BOWIE	CARRIZO-WILCOX AQUIFER	1,636	5	0	0	0	283	1,924
1990	BOWIE	CARRIZO-WILCOX AQUIFER	1,340	27	0	0	0	319	1,686
1991	BOWIE	CARRIZO-WILCOX AQUIFER	1,394	17	0	0	0	321	1,732
1992	BOWIE	CARRIZO-WILCOX AQUIFER	1,286	1	0	0	0	262	1,549
1993	BOWIE	CARRIZO-WILCOX AQUIFER	1,351	17	0	0	0	280	1,648
1994	BOWIE	CARRIZO-WILCOX AQUIFER	1,194	16	0	0	0	311	1,521
1995	BOWIE	CARRIZO-WILCOX AQUIFER	945	15	0	0	0	296	1,256
1996	BOWIE	CARRIZO-WILCOX AQUIFER	760	16	0	0	0	395	1,171
1997	BOWIE	CARRIZO-WILCOX AQUIFER	725	17	0	0	0	258	1,000
1998	BOWIE	CARRIZO-WILCOX AQUIFER	682	3	0	0	0	267	952
1999	BOWIE	CARRIZO-WILCOX AQUIFER	592	3	0	0	0	287	882
2000	BOWIE	CARRIZO-WILCOX AQUIFER	977	3	0	0	0	293	1,273
2001	BOWIE	CARRIZO-WILCOX AQUIFER	1,103	3	0	0	0	173	1,279
2002	BOWIE	CARRIZO-WILCOX AQUIFER	1,119	15	0	0	0	163	1,297
2003	BOWIE	CARRIZO-WILCOX AQUIFER	1,075	20	0	0	0	160	1,255
2004	BOWIE	CARRIZO-WILCOX AQUIFER	1,054	12	0	0	0	0	1,066
2005	BOWIE	CARRIZO-WILCOX AQUIFER	1,126	25	0	0	0	0	1,151
2006	BOWIE	CARRIZO-WILCOX AQUIFER	991	25	0	0	0	0	1,016
2007	BOWIE	CARRIZO-WILCOX AQUIFER	838	35	0	0	0	0	873
2008	BOWIE	CARRIZO-WILCOX AQUIFER	910	43	0	0	0	0	953
2009	BOWIE	CARRIZO-WILCOX AQUIFER	951	29	0	0	0	0	980
2010	BOWIE	CARRIZO-WILCOX AQUIFER	1,008	31	0	0	1,246	0	2,285
2011	BOWIE	CARRIZO-WILCOX AQUIFER	1,084	26	0	0	762	0	1,872
2012	BOWIE	CARRIZO-WILCOX AQUIFER	996	31	0	0	1,382	0	2,409
1980	BOWIE	NACATOCH AQUIFER	802	3	0	0	515	176	1,496
1984	BOWIE	NACATOCH AQUIFER	729	0	0	0	1,374	223	2,326
1985	BOWIE	NACATOCH AQUIFER	694	0	0	0	1,239	191	2,124
1986	BOWIE	NACATOCH AQUIFER	568	0	0	0	1,834	221	2,623
1987	BOWIE	NACATOCH AQUIFER	587	0	0	0	1,500	201	2,288

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1988	BOWIE	NACATOCH AQUIFER	542	0	0	0	1,425	203	2,170
1989	BOWIE	NACATOCH AQUIFER	620	0	0	0	774	210	1,604
1990	BOWIE	NACATOCH AQUIFER	799	0	0	0	938	236	1,973
1991	BOWIE	NACATOCH AQUIFER	838	0	0	0	0	237	1,075
1992	BOWIE	NACATOCH AQUIFER	773	0	0	0	0	193	966
1993	BOWIE	NACATOCH AQUIFER	806	0	0	0	422	206	1,434
1994	BOWIE	NACATOCH AQUIFER	763	0	0	0	78	229	1,070
1995	BOWIE	NACATOCH AQUIFER	972	0	0	0	55	218	1,245
1996	BOWIE	NACATOCH AQUIFER	950	0	0	0	45	291	1,286
1997	BOWIE	NACATOCH AQUIFER	936	0	0	0	40	190	1,166
1998	BOWIE	NACATOCH AQUIFER	881	0	0	0	48	196	1,125
1999	BOWIE	NACATOCH AQUIFER	765	0	0	0	50	211	1,026
2000	BOWIE	NACATOCH AQUIFER	679	0	0	0	0	215	894
2001	BOWIE	NACATOCH AQUIFER	698	0	0	0	0	91	789
2002	BOWIE	NACATOCH AQUIFER	674	0	0	0	0	86	760
2003	BOWIE	NACATOCH AQUIFER	729	0	0	0	0	85	814
2004	BOWIE	NACATOCH AQUIFER	702	0	0	0	255	219	1,176
2005	BOWIE	NACATOCH AQUIFER	758	0	0	0	240	52	1,050
2006	BOWIE	NACATOCH AQUIFER	904	0	0	0	5	53	962
2007	BOWIE	NACATOCH AQUIFER	751	0	0	0	55	35	841
2008	BOWIE	NACATOCH AQUIFER	833	0	0	0	71	23	927
2009	BOWIE	NACATOCH AQUIFER	878	0	0	0	455	26	1,359
2010	BOWIE	NACATOCH AQUIFER	911	0	0	0	452	65	1,428
2011	BOWIE	NACATOCH AQUIFER	986	0	0	0	278	67	1,331
2012	BOWIE	NACATOCH AQUIFER	920	0	0	0	504	42	1,466
1980	BOWIE	OTHER AQUIFER	286	0	0	0	515	81	882
1984	BOWIE	OTHER AQUIFER	104	3	0	0	1,374	47	1,528
1985	BOWIE	OTHER AQUIFER	121	3	0	0	1,239	41	1,404
1986	BOWIE	OTHER AQUIFER	115	0	0	0	1,834	47	1,996
1987	BOWIE	OTHER AQUIFER	126	0	0	0	1,500	43	1,669
1988	BOWIE	OTHER AQUIFER	86	0	0	0	1,425	43	1,554
1989	BOWIE	OTHER AQUIFER	98	0	16	0	774	45	933
1990	BOWIE	OTHER AQUIFER	278	0	16	0	938	51	1,283
1991	BOWIE	OTHER AQUIFER	289	0	21	0	0	51	361
1992	BOWIE	OTHER AQUIFER	287	0	21	0	0	42	350
1993	BOWIE	OTHER AQUIFER	275	0	21	0	422	45	763
1994	BOWIE	OTHER AQUIFER	214	0	21	0	0	50	285
1995	BOWIE	OTHER AQUIFER	289	0	25	0	0	48	362
1996	BOWIE	OTHER AQUIFER	278	0	30	0	0	64	372
1997	BOWIE	OTHER AQUIFER	289	0	30	0	0	42	361
1998	BOWIE	OTHER AQUIFER	272	0	30	0	0	43	345
1999	BOWIE	OTHER AQUIFER	236	0	30	0	0	47	313
2000	BOWIE	OTHER AQUIFER	200	0	0	0	0	48	248
2001	BOWIE	OTHER AQUIFER	101	0	0	0	0	16	117
2002	BOWIE	OTHER AQUIFER	112	0	0	0	0	15	127
2003	BOWIE	OTHER AQUIFER	59	0	0	0	0	15	74
2004	BOWIE	OTHER AQUIFER	54	0	0	0	3,439	39	3,532
2005	BOWIE	OTHER AQUIFER	58	0	0	0	3,238	9	3,305
2006	BOWIE	OTHER AQUIFER	267	0	0	0	70	10	347
2007	BOWIE	OTHER AQUIFER	221	0	0	0	750	6	977
2008	BOWIE	OTHER AQUIFER	246	0	0	0	955	35	1,236
2009	BOWIE	OTHER AQUIFER	259	0	0	0	6,145	40	6,444
2010	BOWIE	OTHER AQUIFER	276	0	0	0	6,098	17	6,391
2011	BOWIE	OTHER AQUIFER	299	0	0	0	3,749	17	4,065
2012	BOWIE	OTHER AQUIFER	279	0	0	0	6,801	11	7,091
2008	BOWIE	UNKNOWN	0	0	0	0	0	0	0
2009	BOWIE	UNKNOWN	0	0	0	0	0	0	0
2010	BOWIE	UNKNOWN	0	0	0	0	0	0	0
2011	BOWIE	UNKNOWN	0	0	0	0	0	0	0
1980	CAMP	CARRIZO-WILCOX AQUIFER	1,327	0	119	0	0	111	1,557
1984	CAMP	CARRIZO-WILCOX AQUIFER	1,547	178	61	0	130	92	2,008
1985	CAMP	CARRIZO-WILCOX AQUIFER	1,560	179	63	0	128	79	2,009
1986	CAMP	CARRIZO-WILCOX AQUIFER	1,495	181	59	0	86	94	1,915
1987	CAMP	CARRIZO-WILCOX AQUIFER	1,560	0	56	0	86	90	1,792
1988	CAMP	CARRIZO-WILCOX AQUIFER	1,598	0	57	0	86	88	1,829
1989	CAMP	CARRIZO-WILCOX AQUIFER	1,515	0	53	0	54	93	1,715
1990	CAMP	CARRIZO-WILCOX AQUIFER	1,585	0	53	0	70	110	1,818
1991	CAMP	CARRIZO-WILCOX AQUIFER	1,683	0	11	0	70	110	1,874
1992	CAMP	CARRIZO-WILCOX AQUIFER	1,263	0	11	0	71	128	1,473
1993	CAMP	CARRIZO-WILCOX AQUIFER	1,364	0	11	0	21	135	1,531
1994	CAMP	CARRIZO-WILCOX AQUIFER	1,471	0	11	0	9	154	1,645
1995	CAMP	CARRIZO-WILCOX AQUIFER	1,284	0	18	0	9	158	1,469
1996	CAMP	CARRIZO-WILCOX AQUIFER	1,254	0	18	0	12	157	1,441
1997	CAMP	CARRIZO-WILCOX AQUIFER	1,414	0	18	0	12	134	1,578
1998	CAMP	CARRIZO-WILCOX AQUIFER	1,409	0	18	0	12	139	1,578
1999	CAMP	CARRIZO-WILCOX AQUIFER	1,272	0	18	0	12	142	1,444
2000	CAMP	CARRIZO-WILCOX AQUIFER	1,432	0	0	0	0	149	1,581
2001	CAMP	CARRIZO-WILCOX AQUIFER	1,355	0	0	0	0	234	1,589

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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2002	CAMP	CARRIZO-WILCOX AQUIFER	1,340	430	0	0	0	164	1,934
2003	CAMP	CARRIZO-WILCOX AQUIFER	1,356	36	0	0	0	153	1,545
2004	CAMP	CARRIZO-WILCOX AQUIFER	1,442	0	0	0	0	381	1,823
2005	CAMP	CARRIZO-WILCOX AQUIFER	1,531	0	0	0	0	372	1,903
2006	CAMP	CARRIZO-WILCOX AQUIFER	1,578	0	0	0	0	394	1,972
2007	CAMP	CARRIZO-WILCOX AQUIFER	1,442	0	0	0	0	381	1,823
2008	CAMP	CARRIZO-WILCOX AQUIFER	1,507	0	0	0	3	380	1,890
2009	CAMP	CARRIZO-WILCOX AQUIFER	1,655	0	0	0	0	378	2,033
2010	CAMP	CARRIZO-WILCOX AQUIFER	1,801	0	0	0	0	783	2,584
2011	CAMP	CARRIZO-WILCOX AQUIFER	1,783	0	0	0	0	782	2,565
2012	CAMP	CARRIZO-WILCOX AQUIFER	1,676	0	0	0	0	738	2,414
1980	CAMP	QUEEN CITY AQUIFER	168	0	37	0	0	166	371
1984	CAMP	QUEEN CITY AQUIFER	200	20	21	0	15	137	393
1985	CAMP	QUEEN CITY AQUIFER	202	20	21	0	14	119	376
1986	CAMP	QUEEN CITY AQUIFER	188	20	20	0	10	141	379
1987	CAMP	QUEEN CITY AQUIFER	213	0	19	0	10	135	377
1988	CAMP	QUEEN CITY AQUIFER	204	0	19	0	10	133	366
1989	CAMP	QUEEN CITY AQUIFER	228	0	18	0	6	140	392
1990	CAMP	QUEEN CITY AQUIFER	165	0	18	0	8	165	356
1991	CAMP	QUEEN CITY AQUIFER	163	0	4	0	8	166	341
1992	CAMP	QUEEN CITY AQUIFER	159	0	4	0	8	192	363
1993	CAMP	QUEEN CITY AQUIFER	161	0	4	0	2	202	369
1994	CAMP	QUEEN CITY AQUIFER	152	0	4	0	8	231	395
1995	CAMP	QUEEN CITY AQUIFER	128	0	6	0	8	238	380
1996	CAMP	QUEEN CITY AQUIFER	142	0	6	0	11	236	395
1997	CAMP	QUEEN CITY AQUIFER	153	0	6	0	11	202	372
1998	CAMP	QUEEN CITY AQUIFER	152	0	6	0	11	209	378
1999	CAMP	QUEEN CITY AQUIFER	138	0	6	0	11	215	370
2000	CAMP	QUEEN CITY AQUIFER	5	0	0	0	0	223	228
2001	CAMP	QUEEN CITY AQUIFER	5	0	0	0	0	352	357
2002	CAMP	QUEEN CITY AQUIFER	5	0	0	0	0	248	253
2003	CAMP	QUEEN CITY AQUIFER	5	0	0	0	0	230	235
2004	CAMP	QUEEN CITY AQUIFER	5	0	0	0	0	0	5
2005	CAMP	QUEEN CITY AQUIFER	5	0	0	0	0	0	5
2006	CAMP	QUEEN CITY AQUIFER	1	0	0	0	0	0	1
2007	CAMP	QUEEN CITY AQUIFER	1	0	0	0	0	0	1
2008	CAMP	QUEEN CITY AQUIFER	1	0	0	0	0	0	1
2009	CAMP	QUEEN CITY AQUIFER	1	0	0	0	0	0	1
2010	CAMP	QUEEN CITY AQUIFER	1	0	0	0	0	0	1
2011	CAMP	QUEEN CITY AQUIFER	1	0	0	0	0	0	1
2012	CAMP	QUEEN CITY AQUIFER	1	0	0	0	0	0	1
2008	CAMP	UNKNOWN	0	0	3	0	0	0	3
2009	CAMP	UNKNOWN	0	0	3	0	0	0	3
2010	CAMP	UNKNOWN	0	0	2	0	0	0	2
2011	CAMP	UNKNOWN	0	0	5	0	0	0	5
1980	CASS	CARRIZO-WILCOX AQUIFER	3,047	0	902	0	0	79	4,028
1984	CASS	CARRIZO-WILCOX AQUIFER	3,291	11	567	3	0	183	4,055
1985	CASS	CARRIZO-WILCOX AQUIFER	3,266	11	629	1	0	159	4,066
1986	CASS	CARRIZO-WILCOX AQUIFER	3,172	11	756	3	0	157	4,099
1987	CASS	CARRIZO-WILCOX AQUIFER	3,162	2	689	0	0	156	4,009
1988	CASS	CARRIZO-WILCOX AQUIFER	3,103	1	792	0	0	168	4,064
1989	CASS	CARRIZO-WILCOX AQUIFER	3,051	1	767	1	0	173	3,993
1990	CASS	CARRIZO-WILCOX AQUIFER	2,780	1	767	0	0	174	3,722
1991	CASS	CARRIZO-WILCOX AQUIFER	2,500	0	819	0	0	178	3,497
1992	CASS	CARRIZO-WILCOX AQUIFER	1,981	0	819	0	0	177	2,977
1993	CASS	CARRIZO-WILCOX AQUIFER	1,818	0	819	0	6	165	2,808
1994	CASS	CARRIZO-WILCOX AQUIFER	1,801	0	819	0	0	176	2,796
1995	CASS	CARRIZO-WILCOX AQUIFER	1,898	0	822	0	0	164	2,884
1996	CASS	CARRIZO-WILCOX AQUIFER	1,754	0	822	0	0	170	2,746
1997	CASS	CARRIZO-WILCOX AQUIFER	1,796	0	822	0	0	154	2,772
1998	CASS	CARRIZO-WILCOX AQUIFER	1,751	0	481	0	0	166	2,398
1999	CASS	CARRIZO-WILCOX AQUIFER	1,649	0	741	0	0	188	2,578
2000	CASS	CARRIZO-WILCOX AQUIFER	1,210	0	0	0	0	173	1,383
2001	CASS	CARRIZO-WILCOX AQUIFER	1,150	0	0	0	0	115	1,265
2002	CASS	CARRIZO-WILCOX AQUIFER	1,132	0	0	0	0	113	1,245
2003	CASS	CARRIZO-WILCOX AQUIFER	1,256	0	0	0	0	105	1,361
2004	CASS	CARRIZO-WILCOX AQUIFER	1,283	0	0	0	0	143	1,426
2005	CASS	CARRIZO-WILCOX AQUIFER	1,382	0	0	0	0	18	1,400
2006	CASS	CARRIZO-WILCOX AQUIFER	1,248	0	0	0	0	18	1,266
2007	CASS	CARRIZO-WILCOX AQUIFER	1,131	0	0	0	0	18	1,149
2008	CASS	CARRIZO-WILCOX AQUIFER	1,502	0	0	0	0	12	1,514
2009	CASS	CARRIZO-WILCOX AQUIFER	1,294	0	0	0	0	13	1,307
2010	CASS	CARRIZO-WILCOX AQUIFER	1,643	0	0	0	0	27	1,670
2011	CASS	CARRIZO-WILCOX AQUIFER	1,380	0	0	0	0	28	1,408
2012	CASS	CARRIZO-WILCOX AQUIFER	1,351	0	0	0	0	19	1,370
1980	CASS	QUEEN CITY AQUIFER	394	0	316	0	0	249	959
1984	CASS	QUEEN CITY AQUIFER	450	0	0	0	0	167	617
1985	CASS	QUEEN CITY AQUIFER	487	0	0	0	0	146	633

Groundwater Pumping Estimates from Texas Water Development Board
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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1986	CASS	QUEEN CITY AQUIFER	471	0	0	0	0	144	615
1987	CASS	QUEEN CITY AQUIFER	462	0	0	0	0	144	606
1988	CASS	QUEEN CITY AQUIFER	469	0	0	0	0	154	623
1989	CASS	QUEEN CITY AQUIFER	484	0	0	0	0	160	644
1990	CASS	QUEEN CITY AQUIFER	713	0	0	0	0	160	873
1991	CASS	QUEEN CITY AQUIFER	720	0	0	0	0	163	883
1992	CASS	QUEEN CITY AQUIFER	714	0	0	0	0	163	877
1993	CASS	QUEEN CITY AQUIFER	743	0	0	0	6	153	902
1994	CASS	QUEEN CITY AQUIFER	714	0	0	0	9	164	887
1995	CASS	QUEEN CITY AQUIFER	777	0	0	0	8	153	938
1996	CASS	QUEEN CITY AQUIFER	784	0	0	0	11	158	953
1997	CASS	QUEEN CITY AQUIFER	783	0	0	0	11	143	937
1998	CASS	QUEEN CITY AQUIFER	763	0	0	0	11	154	928
1999	CASS	QUEEN CITY AQUIFER	719	0	0	0	11	175	905
2000	CASS	QUEEN CITY AQUIFER	118	0	0	0	0	161	279
2001	CASS	QUEEN CITY AQUIFER	84	0	0	0	0	74	158
2002	CASS	QUEEN CITY AQUIFER	74	0	0	0	0	73	147
2003	CASS	QUEEN CITY AQUIFER	22	0	0	0	0	68	90
2004	CASS	QUEEN CITY AQUIFER	21	0	0	0	0	31	52
2005	CASS	QUEEN CITY AQUIFER	29	0	0	0	0	4	33
2006	CASS	QUEEN CITY AQUIFER	36	0	0	0	0	4	40
2007	CASS	QUEEN CITY AQUIFER	31	0	0	0	0	4	35
2008	CASS	QUEEN CITY AQUIFER	33	0	0	0	0	8	41
2009	CASS	QUEEN CITY AQUIFER	33	0	0	0	0	8	41
2010	CASS	QUEEN CITY AQUIFER	40	0	0	0	0	8	48
2011	CASS	QUEEN CITY AQUIFER	16	0	0	0	0	8	24
2012	CASS	QUEEN CITY AQUIFER	13	0	0	0	0	6	19
2000	CASS	UNKNOWN	0	0	0	0	0	0	0
2001	CASS	UNKNOWN	0	0	0	0	0	0	0
2002	CASS	UNKNOWN	0	0	0	0	0	0	0
2008	CASS	UNKNOWN	0	0	0	0	0	0	0
2009	CASS	UNKNOWN	0	0	5	0	0	0	5
2010	CASS	UNKNOWN	0	0	10	0	0	0	10
2011	CASS	UNKNOWN	0	0	8	0	0	0	8
1980	CHEROKEE	CARRIZO-WILCOX AQUIFER	4,850	0	0	333	25	0	5,208
1984	CHEROKEE	CARRIZO-WILCOX AQUIFER	4,636	0	117	408	58	252	5,471
1985	CHEROKEE	CARRIZO-WILCOX AQUIFER	4,878	0	120	218	36	269	5,521
1986	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,020	0	111	293	45	247	5,716
1987	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,450	0	89	510	45	233	6,327
1988	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,574	0	80	439	45	220	6,358
1989	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,408	0	53	347	48	226	6,082
1990	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,099	0	53	343	50	301	5,846
1991	CHEROKEE	CARRIZO-WILCOX AQUIFER	4,521	0	81	262	41	298	5,203
1992	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,349	0	81	136	41	407	6,014
1993	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,357	4	81	166	6	453	6,067
1994	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,714	0	81	162	7	423	6,387
1995	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,761	0	81	133	7	389	6,371
1996	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,588	2	81	131	7	424	6,233
1997	CHEROKEE	CARRIZO-WILCOX AQUIFER	5,907	0	81	108	7	340	6,443
1998	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,560	0	81	118	7	335	7,101
1999	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,302	0	81	115	7	335	6,840
2000	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,565	7	0	132	14	303	7,021
2001	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,468	9	0	128	12	307	6,924
2002	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,134	5	0	86	7	296	6,528
2003	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,234	6	0	119	4	246	6,609
2004	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,886	23	0	115	10	104	7,138
2005	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,759	23	0	124	23	39	6,968
2006	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,583	10	0	136	19	41	6,789
2007	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,120	9	0	155	106	40	6,430
2008	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,120	10	0	127	57	39	6,353
2009	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,261	5	0	167	64	34	6,531
2010	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,530	5	0	121	88	38	6,782
2011	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,984	0	0	181	4	38	7,207
2012	CHEROKEE	CARRIZO-WILCOX AQUIFER	6,191	0	0	170	123	34	6,518
2000	CHEROKEE	OTHER AQUIFER	0	0	0	0	2	88	90
2001	CHEROKEE	OTHER AQUIFER	0	0	0	0	1	89	90
2002	CHEROKEE	OTHER AQUIFER	0	0	0	0	2	86	88
2003	CHEROKEE	OTHER AQUIFER	0	0	0	0	1	72	73
2004	CHEROKEE	OTHER AQUIFER	0	0	0	0	1	70	71
2005	CHEROKEE	OTHER AQUIFER	0	0	0	0	3	26	29
2006	CHEROKEE	OTHER AQUIFER	81	0	0	0	2	27	110
2007	CHEROKEE	OTHER AQUIFER	67	0	0	0	13	26	106
2008	CHEROKEE	OTHER AQUIFER	76	0	0	0	7	26	109
2009	CHEROKEE	OTHER AQUIFER	110	0	0	0	8	23	141
2010	CHEROKEE	OTHER AQUIFER	145	0	0	0	11	26	182
2011	CHEROKEE	OTHER AQUIFER	157	0	0	0	0	26	183
2012	CHEROKEE	OTHER AQUIFER	145	0	0	0	15	23	183
1980	CHEROKEE	QUEEN CITY AQUIFER	428	0	53	0	25	380	886

Groundwater Pumping Estimates from Texas Water Development Board
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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1984	CHEROKEE	QUEEN CITY AQUIFER	205	0	0	0	59	252	516
1985	CHEROKEE	QUEEN CITY AQUIFER	194	0	0	0	36	269	499
1986	CHEROKEE	QUEEN CITY AQUIFER	125	0	0	0	45	247	417
1987	CHEROKEE	QUEEN CITY AQUIFER	73	0	0	0	45	233	351
1988	CHEROKEE	QUEEN CITY AQUIFER	126	0	0	0	45	220	391
1989	CHEROKEE	QUEEN CITY AQUIFER	247	0	0	0	48	226	521
1990	CHEROKEE	QUEEN CITY AQUIFER	113	0	0	0	50	301	464
1991	CHEROKEE	QUEEN CITY AQUIFER	111	0	0	0	41	298	450
1992	CHEROKEE	QUEEN CITY AQUIFER	178	0	0	0	41	407	626
1993	CHEROKEE	QUEEN CITY AQUIFER	97	0	0	0	6	453	556
1994	CHEROKEE	QUEEN CITY AQUIFER	77	0	0	0	19	423	519
1995	CHEROKEE	QUEEN CITY AQUIFER	82	0	0	0	20	389	491
1996	CHEROKEE	QUEEN CITY AQUIFER	80	0	0	0	20	424	524
1997	CHEROKEE	QUEEN CITY AQUIFER	83	0	0	0	20	340	443
1998	CHEROKEE	QUEEN CITY AQUIFER	92	0	0	0	20	335	447
1999	CHEROKEE	QUEEN CITY AQUIFER	89	0	0	0	20	335	444
2000	CHEROKEE	QUEEN CITY AQUIFER	94	0	0	0	16	215	325
2001	CHEROKEE	QUEEN CITY AQUIFER	82	0	0	0	13	217	312
2002	CHEROKEE	QUEEN CITY AQUIFER	117	0	0	0	21	210	348
2003	CHEROKEE	QUEEN CITY AQUIFER	88	0	0	0	12	174	274
2004	CHEROKEE	QUEEN CITY AQUIFER	147	0	0	0	11	383	541
2005	CHEROKEE	QUEEN CITY AQUIFER	158	0	0	0	26	142	326
2006	CHEROKEE	QUEEN CITY AQUIFER	448	0	0	0	21	149	618
2007	CHEROKEE	QUEEN CITY AQUIFER	413	0	0	0	119	145	677
2008	CHEROKEE	QUEEN CITY AQUIFER	434	0	0	0	64	142	640
2009	CHEROKEE	QUEEN CITY AQUIFER	504	0	0	0	72	124	700
2010	CHEROKEE	QUEEN CITY AQUIFER	632	0	0	0	99	140	871
2011	CHEROKEE	QUEEN CITY AQUIFER	677	0	0	0	4	140	821
2012	CHEROKEE	QUEEN CITY AQUIFER	643	0	0	0	139	124	906
1980	CHEROKEE	SPARTA AQUIFER	6	0	28	0	0	204	238
1984	CHEROKEE	SPARTA AQUIFER	2	0	0	0	0	81	83
1985	CHEROKEE	SPARTA AQUIFER	3	0	0	0	0	88	91
1986	CHEROKEE	SPARTA AQUIFER	2	0	0	0	0	80	82
1987	CHEROKEE	SPARTA AQUIFER	2	0	0	0	0	76	78
1988	CHEROKEE	SPARTA AQUIFER	2	0	0	0	0	72	74
1989	CHEROKEE	SPARTA AQUIFER	2	0	0	0	0	74	76
1990	CHEROKEE	SPARTA AQUIFER	3	0	0	0	0	99	102
1991	CHEROKEE	SPARTA AQUIFER	3	0	0	0	0	98	101
1992	CHEROKEE	SPARTA AQUIFER	27	0	0	0	0	134	161
1993	CHEROKEE	SPARTA AQUIFER	6	0	0	0	0	149	155
1994	CHEROKEE	SPARTA AQUIFER	1	0	0	0	2	139	142
1995	CHEROKEE	SPARTA AQUIFER	0	0	0	0	2	128	130
1996	CHEROKEE	SPARTA AQUIFER	0	0	0	0	2	140	142
1997	CHEROKEE	SPARTA AQUIFER	0	0	0	0	2	112	114
1998	CHEROKEE	SPARTA AQUIFER	0	0	0	0	2	110	112
1999	CHEROKEE	SPARTA AQUIFER	0	0	0	0	2	110	112
2000	CHEROKEE	SPARTA AQUIFER	0	0	0	0	1	100	101
2001	CHEROKEE	SPARTA AQUIFER	0	0	0	0	1	101	102
2002	CHEROKEE	SPARTA AQUIFER	0	0	0	0	0	97	97
2003	CHEROKEE	SPARTA AQUIFER	0	0	0	0	0	81	81
2004	CHEROKEE	SPARTA AQUIFER	0	0	0	0	1	0	1
2005	CHEROKEE	SPARTA AQUIFER	0	0	0	0	1	0	1
2006	CHEROKEE	SPARTA AQUIFER	81	0	0	0	1	0	82
2007	CHEROKEE	SPARTA AQUIFER	67	0	0	0	7	0	74
2008	CHEROKEE	SPARTA AQUIFER	76	0	0	0	4	0	80
2009	CHEROKEE	SPARTA AQUIFER	110	0	0	0	4	0	114
2010	CHEROKEE	SPARTA AQUIFER	145	0	0	0	6	0	151
2011	CHEROKEE	SPARTA AQUIFER	157	0	0	0	0	0	157
2012	CHEROKEE	SPARTA AQUIFER	145	0	0	0	8	0	153
2008	CHEROKEE	UNKNOWN	0	0	101	0	0	0	101
2009	CHEROKEE	UNKNOWN	0	0	77	0	0	0	77
2010	CHEROKEE	UNKNOWN	0	0	53	0	0	0	53
2011	CHEROKEE	UNKNOWN	0	0	30	0	0	0	30
2012	CHEROKEE	UNKNOWN	0	0	3	0	0	0	3
1980	FRANKLIN	CARRIZO-WILCOX AQUIFER	305	0	552	0	0	342	1,199
1984	FRANKLIN	CARRIZO-WILCOX AQUIFER	265	0	631	0	0	423	1,319
1985	FRANKLIN	CARRIZO-WILCOX AQUIFER	302	0	768	0	0	446	1,516
1986	FRANKLIN	CARRIZO-WILCOX AQUIFER	318	0	1,222	0	0	413	1,953
1987	FRANKLIN	CARRIZO-WILCOX AQUIFER	331	0	1,117	0	0	395	1,843
1988	FRANKLIN	CARRIZO-WILCOX AQUIFER	450	0	1,153	0	0	410	2,013
1989	FRANKLIN	CARRIZO-WILCOX AQUIFER	456	0	706	0	0	378	1,540
1990	FRANKLIN	CARRIZO-WILCOX AQUIFER	383	0	706	0	0	521	1,610
1991	FRANKLIN	CARRIZO-WILCOX AQUIFER	282	0	1,399	0	0	516	2,197
1992	FRANKLIN	CARRIZO-WILCOX AQUIFER	275	0	1,399	0	0	637	2,311
1993	FRANKLIN	CARRIZO-WILCOX AQUIFER	162	0	1,399	0	3	668	2,232
1994	FRANKLIN	CARRIZO-WILCOX AQUIFER	310	0	1,408	0	2	582	2,302
1995	FRANKLIN	CARRIZO-WILCOX AQUIFER	125	0	1,354	0	2	572	2,053
1996	FRANKLIN	CARRIZO-WILCOX AQUIFER	178	0	1,354	0	3	567	2,102

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1997	FRANKLIN	CARRIZO-WILCOX AQUIFER	92	0	895	0	3	460	1,450
1998	FRANKLIN	CARRIZO-WILCOX AQUIFER	122	0	894	0	3	452	1,471
1999	FRANKLIN	CARRIZO-WILCOX AQUIFER	289	0	895	0	3	484	1,671
2000	FRANKLIN	CARRIZO-WILCOX AQUIFER	198	0	0	0	0	449	647
2001	FRANKLIN	CARRIZO-WILCOX AQUIFER	176	0	0	0	0	249	425
2002	FRANKLIN	CARRIZO-WILCOX AQUIFER	64	0	0	0	0	229	293
2003	FRANKLIN	CARRIZO-WILCOX AQUIFER	70	0	0	0	0	225	295
2004	FRANKLIN	CARRIZO-WILCOX AQUIFER	41	0	0	0	0	217	258
2005	FRANKLIN	CARRIZO-WILCOX AQUIFER	51	0	0	0	0	428	479
2006	FRANKLIN	CARRIZO-WILCOX AQUIFER	52	0	0	0	0	426	478
2007	FRANKLIN	CARRIZO-WILCOX AQUIFER	42	0	0	0	33	335	410
2008	FRANKLIN	CARRIZO-WILCOX AQUIFER	45	0	0	0	0	444	489
2009	FRANKLIN	CARRIZO-WILCOX AQUIFER	34	0	0	0	0	440	474
2010	FRANKLIN	CARRIZO-WILCOX AQUIFER	22	0	0	0	0	517	539
2011	FRANKLIN	CARRIZO-WILCOX AQUIFER	22	0	0	0	0	516	538
2012	FRANKLIN	CARRIZO-WILCOX AQUIFER	18	0	0	0	0	495	513
2008	FRANKLIN	UNKNOWN	0	0	2	0	0	0	2
2009	FRANKLIN	UNKNOWN	0	0	1	0	0	0	1
2010	FRANKLIN	UNKNOWN	0	0	1	0	0	0	1
2011	FRANKLIN	UNKNOWN	0	0	15	0	0	0	15
2012	FRANKLIN	UNKNOWN	0	0	1	0	0	0	1
1980	GREGG	CARRIZO-WILCOX AQUIFER	690	250	152	1	0	47	1,140
1984	GREGG	CARRIZO-WILCOX AQUIFER	700	196	2,672	1	0	45	3,614
1985	GREGG	CARRIZO-WILCOX AQUIFER	688	186	129	1	0	36	1,040
1986	GREGG	CARRIZO-WILCOX AQUIFER	629	186	66	1	0	36	918
1987	GREGG	CARRIZO-WILCOX AQUIFER	372	161	66	1	0	33	633
1988	GREGG	CARRIZO-WILCOX AQUIFER	461	161	61	1	0	38	722
1989	GREGG	CARRIZO-WILCOX AQUIFER	368	161	29	1	0	41	600
1990	GREGG	CARRIZO-WILCOX AQUIFER	409	161	29	1	0	40	640
1991	GREGG	CARRIZO-WILCOX AQUIFER	513	161	11	1	0	41	727
1992	GREGG	CARRIZO-WILCOX AQUIFER	605	161	0	1	0	46	813
1993	GREGG	CARRIZO-WILCOX AQUIFER	627	161	0	1	20	43	852
1994	GREGG	CARRIZO-WILCOX AQUIFER	628	161	0	1	25	38	853
1995	GREGG	CARRIZO-WILCOX AQUIFER	583	161	0	19	25	38	826
1996	GREGG	CARRIZO-WILCOX AQUIFER	603	161	0	64	25	38	891
1997	GREGG	CARRIZO-WILCOX AQUIFER	552	162	0	113	25	40	892
1998	GREGG	CARRIZO-WILCOX AQUIFER	502	24	0	1	25	36	588
1999	GREGG	CARRIZO-WILCOX AQUIFER	563	24	0	101	25	44	757
2000	GREGG	CARRIZO-WILCOX AQUIFER	1,189	0	0	42	0	42	1,273
2001	GREGG	CARRIZO-WILCOX AQUIFER	1,158	0	0	258	0	36	1,452
2002	GREGG	CARRIZO-WILCOX AQUIFER	1,170	0	0	25	0	31	1,226
2003	GREGG	CARRIZO-WILCOX AQUIFER	1,242	0	0	267	0	24	1,533
2004	GREGG	CARRIZO-WILCOX AQUIFER	1,268	1	0	194	0	47	1,510
2005	GREGG	CARRIZO-WILCOX AQUIFER	3,567	0	0	242	7	23	3,839
2006	GREGG	CARRIZO-WILCOX AQUIFER	3,240	0	0	242	19	19	3,520
2007	GREGG	CARRIZO-WILCOX AQUIFER	1,648	0	0	242	0	23	1,913
2008	GREGG	CARRIZO-WILCOX AQUIFER	1,787	0	0	243	0	11	2,041
2009	GREGG	CARRIZO-WILCOX AQUIFER	1,855	3	0	242	0	12	2,112
2010	GREGG	CARRIZO-WILCOX AQUIFER	3,114	3	0	242	0	14	3,373
2011	GREGG	CARRIZO-WILCOX AQUIFER	2,448	3	0	242	13	15	2,721
2012	GREGG	CARRIZO-WILCOX AQUIFER	1,788	2	0	243	3	11	2,047
2006	GREGG	OTHER AQUIFER	22	0	0	0	0	0	22
2007	GREGG	OTHER AQUIFER	18	0	0	0	0	0	18
2008	GREGG	OTHER AQUIFER	20	0	0	0	0	0	20
2009	GREGG	OTHER AQUIFER	63	0	0	0	0	0	63
2010	GREGG	OTHER AQUIFER	106	0	0	0	0	0	106
2011	GREGG	OTHER AQUIFER	83	0	0	0	0	0	83
2012	GREGG	OTHER AQUIFER	83	0	0	0	0	0	83
1980	GREGG	QUEEN CITY AQUIFER	340	28	153	0	0	62	583
1984	GREGG	QUEEN CITY AQUIFER	258	0	1,312	0	0	57	1,627
1985	GREGG	QUEEN CITY AQUIFER	221	0	0	0	0	46	267
1986	GREGG	QUEEN CITY AQUIFER	208	0	90	0	0	46	344
1987	GREGG	QUEEN CITY AQUIFER	168	0	0	0	0	42	210
1989	GREGG	QUEEN CITY AQUIFER	192	0	0	0	0	53	245
1990	GREGG	QUEEN CITY AQUIFER	203	0	0	0	0	52	255
1991	GREGG	QUEEN CITY AQUIFER	211	0	0	0	0	53	264
1992	GREGG	QUEEN CITY AQUIFER	317	0	0	0	0	60	377
1993	GREGG	QUEEN CITY AQUIFER	275	0	0	0	0	56	331
1994	GREGG	QUEEN CITY AQUIFER	283	0	0	0	0	49	332
1995	GREGG	QUEEN CITY AQUIFER	518	0	0	0	0	49	567
1996	GREGG	QUEEN CITY AQUIFER	526	0	0	0	0	49	575
1997	GREGG	QUEEN CITY AQUIFER	532	0	0	0	0	52	584
1998	GREGG	QUEEN CITY AQUIFER	484	0	0	0	0	47	531
1999	GREGG	QUEEN CITY AQUIFER	542	0	0	0	0	57	599
2000	GREGG	QUEEN CITY AQUIFER	31	0	0	0	0	53	84
2001	GREGG	QUEEN CITY AQUIFER	31	0	0	0	0	38	69
2002	GREGG	QUEEN CITY AQUIFER	32	0	0	0	0	32	64
2003	GREGG	QUEEN CITY AQUIFER	32	0	0	0	0	24	56

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
All Values in AF/yr

Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2004	GREGG	QUEEN CITY AQUIFER	31	0	0	0	0	1	32
2005	GREGG	QUEEN CITY AQUIFER	33	0	0	0	2	0	35
2006	GREGG	QUEEN CITY AQUIFER	36	0	0	0	5	0	41
2007	GREGG	QUEEN CITY AQUIFER	29	0	0	0	0	0	29
2008	GREGG	QUEEN CITY AQUIFER	33	0	0	0	0	9	42
2009	GREGG	QUEEN CITY AQUIFER	102	0	0	0	0	10	112
2010	GREGG	QUEEN CITY AQUIFER	174	0	0	0	0	12	186
2011	GREGG	QUEEN CITY AQUIFER	136	0	0	0	3	12	151
2012	GREGG	QUEEN CITY AQUIFER	136	0	0	0	1	8	145
2008	GREGG	UNKNOWN	0	0	104	0	0	0	104
2009	GREGG	UNKNOWN	0	0	106	0	0	0	106
2010	GREGG	UNKNOWN	0	0	107	0	0	0	107
2011	GREGG	UNKNOWN	0	0	31	0	0	0	31
2012	GREGG	UNKNOWN	0	0	32	0	0	0	32
1980	HARRISON	CARRIZO-WILCOX AQUIFER	2,398	72	468	0	0	191	3,129
1984	HARRISON	CARRIZO-WILCOX AQUIFER	2,577	116	330	0	20	289	3,332
1985	HARRISON	CARRIZO-WILCOX AQUIFER	2,558	136	261	0	95	236	3,286
1986	HARRISON	CARRIZO-WILCOX AQUIFER	2,624	144	248	0	95	59	3,170
1987	HARRISON	CARRIZO-WILCOX AQUIFER	2,696	125	211	0	95	257	3,384
1988	HARRISON	CARRIZO-WILCOX AQUIFER	2,753	131	182	0	95	69	3,230
1989	HARRISON	CARRIZO-WILCOX AQUIFER	2,427	122	181	0	32	71	2,833
1990	HARRISON	CARRIZO-WILCOX AQUIFER	2,505	102	195	0	50	71	2,923
1991	HARRISON	CARRIZO-WILCOX AQUIFER	2,529	110	195	0	50	73	2,957
1992	HARRISON	CARRIZO-WILCOX AQUIFER	2,519	57	167	0	50	56	2,849
1993	HARRISON	CARRIZO-WILCOX AQUIFER	2,471	155	198	0	39	57	2,920
1994	HARRISON	CARRIZO-WILCOX AQUIFER	2,614	142	196	0	34	59	3,045
1995	HARRISON	CARRIZO-WILCOX AQUIFER	2,661	104	207	0	34	60	3,066
1996	HARRISON	CARRIZO-WILCOX AQUIFER	2,571	102	207	0	39	53	2,972
1997	HARRISON	CARRIZO-WILCOX AQUIFER	2,558	110	208	0	39	59	2,974
1998	HARRISON	CARRIZO-WILCOX AQUIFER	2,702	123	197	0	34	66	3,122
1999	HARRISON	CARRIZO-WILCOX AQUIFER	2,534	123	197	0	34	72	2,960
2000	HARRISON	CARRIZO-WILCOX AQUIFER	3,852	173	3	0	39	65	4,132
2001	HARRISON	CARRIZO-WILCOX AQUIFER	3,657	211	3	0	37	35	3,943
2002	HARRISON	CARRIZO-WILCOX AQUIFER	3,913	179	6	0	42	32	4,172
2003	HARRISON	CARRIZO-WILCOX AQUIFER	3,763	169	4	0	29	30	3,995
2004	HARRISON	CARRIZO-WILCOX AQUIFER	3,697	130	4	0	125	40	3,996
2005	HARRISON	CARRIZO-WILCOX AQUIFER	4,005	151	5	0	112	77	4,350
2006	HARRISON	CARRIZO-WILCOX AQUIFER	4,224	239	3	0	95	65	4,626
2007	HARRISON	CARRIZO-WILCOX AQUIFER	3,451	251	3	0	124	66	3,895
2008	HARRISON	CARRIZO-WILCOX AQUIFER	3,575	219	3	0	0	55	3,852
2009	HARRISON	CARRIZO-WILCOX AQUIFER	3,464	8,735	4	0	708	62	12,973
2010	HARRISON	CARRIZO-WILCOX AQUIFER	3,712	111	4	0	626	50	4,503
2011	HARRISON	CARRIZO-WILCOX AQUIFER	4,090	145	5	0	642	50	4,932
2012	HARRISON	CARRIZO-WILCOX AQUIFER	3,918	146	4	0	411	43	4,522
2006	HARRISON	OTHER AQUIFER	32	0	0	0	0	0	32
2007	HARRISON	OTHER AQUIFER	27	0	0	0	0	0	27
2008	HARRISON	OTHER AQUIFER	30	0	0	0	0	0	30
2009	HARRISON	OTHER AQUIFER	27	0	0	0	0	0	27
2010	HARRISON	OTHER AQUIFER	25	0	0	0	0	0	25
2011	HARRISON	OTHER AQUIFER	27	0	0	0	0	0	27
2012	HARRISON	OTHER AQUIFER	26	0	0	0	0	0	26
1980	HARRISON	QUEEN CITY AQUIFER	345	8	309	0	0	133	795
1984	HARRISON	QUEEN CITY AQUIFER	375	0	48	0	0	115	538
1985	HARRISON	QUEEN CITY AQUIFER	334	0	0	0	0	95	429
1986	HARRISON	QUEEN CITY AQUIFER	346	0	0	0	0	23	369
1987	HARRISON	QUEEN CITY AQUIFER	376	0	0	0	0	102	478
1988	HARRISON	QUEEN CITY AQUIFER	344	0	0	0	0	28	372
1989	HARRISON	QUEEN CITY AQUIFER	265	0	0	0	0	28	293
1990	HARRISON	QUEEN CITY AQUIFER	296	0	0	0	0	28	324
1991	HARRISON	QUEEN CITY AQUIFER	326	0	0	0	0	28	354
1992	HARRISON	QUEEN CITY AQUIFER	333	0	0	0	0	21	354
1993	HARRISON	QUEEN CITY AQUIFER	321	0	0	0	0	21	342
1994	HARRISON	QUEEN CITY AQUIFER	317	0	0	0	0	21	338
1995	HARRISON	QUEEN CITY AQUIFER	272	0	0	0	0	21	293
1996	HARRISON	QUEEN CITY AQUIFER	218	0	0	0	0	18	236
1997	HARRISON	QUEEN CITY AQUIFER	170	0	0	0	0	20	190
1998	HARRISON	QUEEN CITY AQUIFER	179	0	0	0	0	23	202
1999	HARRISON	QUEEN CITY AQUIFER	169	0	0	0	0	24	193
2000	HARRISON	QUEEN CITY AQUIFER	105	0	0	0	0	22	127
2001	HARRISON	QUEEN CITY AQUIFER	103	0	0	0	0	13	116
2002	HARRISON	QUEEN CITY AQUIFER	90	0	0	0	0	11	101
2003	HARRISON	QUEEN CITY AQUIFER	108	0	0	0	0	11	119
2004	HARRISON	QUEEN CITY AQUIFER	104	0	0	0	0	0	104
2005	HARRISON	QUEEN CITY AQUIFER	112	0	0	0	0	0	112
2006	HARRISON	QUEEN CITY AQUIFER	146	0	0	0	0	0	146
2007	HARRISON	QUEEN CITY AQUIFER	121	0	0	0	0	0	121
2008	HARRISON	QUEEN CITY AQUIFER	135	0	0	0	0	0	135
2009	HARRISON	QUEEN CITY AQUIFER	122	0	0	0	0	0	122

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2010	HARRISON	QUEEN CITY AQUIFER	111	0	0	0	0	0	111
2011	HARRISON	QUEEN CITY AQUIFER	124	0	0	0	0	0	124
2012	HARRISON	QUEEN CITY AQUIFER	116	0	0	0	0	0	116
2008	HARRISON	UNKNOWN	0	0	707	0	0	0	707
2009	HARRISON	UNKNOWN	0	0	801	0	0	0	801
2010	HARRISON	UNKNOWN	0	0	894	0	0	0	894
2011	HARRISON	UNKNOWN	0	0	624	0	0	0	624
2012	HARRISON	UNKNOWN	0	0	490	0	0	0	490
1980	HENDERSON	CARRIZO-WILCOX AQUIFER	2,658	0	304	0	100	386	3,448
1984	HENDERSON	CARRIZO-WILCOX AQUIFER	3,677	0	925	0	20	470	5,092
1985	HENDERSON	CARRIZO-WILCOX AQUIFER	3,708	0	906	0	70	462	5,146
1986	HENDERSON	CARRIZO-WILCOX AQUIFER	3,444	0	819	8	70	632	4,973
1987	HENDERSON	CARRIZO-WILCOX AQUIFER	3,691	0	411	1	70	379	4,552
1988	HENDERSON	CARRIZO-WILCOX AQUIFER	3,874	0	456	0	70	594	4,994
1989	HENDERSON	CARRIZO-WILCOX AQUIFER	3,704	0	102	0	20	607	4,433
1990	HENDERSON	CARRIZO-WILCOX AQUIFER	3,104	0	199	0	21	613	3,937
1991	HENDERSON	CARRIZO-WILCOX AQUIFER	2,944	0	200	1	21	625	3,791
1992	HENDERSON	CARRIZO-WILCOX AQUIFER	2,930	0	374	0	21	473	3,798
1993	HENDERSON	CARRIZO-WILCOX AQUIFER	3,329	0	374	1	20	451	4,175
1994	HENDERSON	CARRIZO-WILCOX AQUIFER	3,451	0	387	1	20	464	4,323
1995	HENDERSON	CARRIZO-WILCOX AQUIFER	3,629	0	475	0	20	459	4,583
1996	HENDERSON	CARRIZO-WILCOX AQUIFER	3,643	0	475	0	20	563	4,701
1997	HENDERSON	CARRIZO-WILCOX AQUIFER	3,447	1	492	0	20	434	4,394
1998	HENDERSON	CARRIZO-WILCOX AQUIFER	3,771	0	153	0	20	499	4,443
1999	HENDERSON	CARRIZO-WILCOX AQUIFER	3,767	0	474	0	20	490	4,751
2000	HENDERSON	CARRIZO-WILCOX AQUIFER	5,081	0	2	0	0	485	5,568
2001	HENDERSON	CARRIZO-WILCOX AQUIFER	4,953	0	0	0	0	294	5,247
2002	HENDERSON	CARRIZO-WILCOX AQUIFER	4,934	0	2	0	2	80	5,018
2003	HENDERSON	CARRIZO-WILCOX AQUIFER	4,601	0	2	0	22	242	4,867
2004	HENDERSON	CARRIZO-WILCOX AQUIFER	4,639	0	2	0	38	266	4,945
2005	HENDERSON	CARRIZO-WILCOX AQUIFER	5,066	187	2	0	40	327	5,622
2006	HENDERSON	CARRIZO-WILCOX AQUIFER	4,883	180	2	0	116	311	5,492
2007	HENDERSON	CARRIZO-WILCOX AQUIFER	4,607	169	2	0	136	313	5,227
2008	HENDERSON	CARRIZO-WILCOX AQUIFER	4,865	124	2	0	151	381	5,523
2009	HENDERSON	CARRIZO-WILCOX AQUIFER	5,392	124	2	0	0	192	5,710
2010	HENDERSON	CARRIZO-WILCOX AQUIFER	5,688	122	2	0	80	299	6,191
2011	HENDERSON	CARRIZO-WILCOX AQUIFER	6,255	122	2	0	30	299	6,708
2012	HENDERSON	CARRIZO-WILCOX AQUIFER	5,738	122	2	0	109	247	6,218
2006	HENDERSON	NACATOCH AQUIFER	7	0	0	0	0	0	7
2007	HENDERSON	NACATOCH AQUIFER	6	0	0	0	0	0	6
2008	HENDERSON	NACATOCH AQUIFER	6	0	0	0	0	0	6
2009	HENDERSON	NACATOCH AQUIFER	9	0	0	0	0	0	9
2010	HENDERSON	NACATOCH AQUIFER	13	0	0	0	0	0	13
2011	HENDERSON	NACATOCH AQUIFER	14	0	0	0	0	0	14
2012	HENDERSON	NACATOCH AQUIFER	12	0	0	0	0	0	12
1980	HENDERSON	OTHER AQUIFER	29	0	0	147	0	88	264
1984	HENDERSON	OTHER AQUIFER	37	0	0	104	0	107	248
1985	HENDERSON	OTHER AQUIFER	36	0	0	117	0	105	258
1986	HENDERSON	OTHER AQUIFER	30	0	0	113	0	144	287
1987	HENDERSON	OTHER AQUIFER	34	0	0	85	0	87	206
1988	HENDERSON	OTHER AQUIFER	38	0	0	16	0	136	190
1989	HENDERSON	OTHER AQUIFER	44	0	0	0	0	139	183
1990	HENDERSON	OTHER AQUIFER	40	0	0	0	0	140	180
1991	HENDERSON	OTHER AQUIFER	48	0	0	0	0	143	191
1992	HENDERSON	OTHER AQUIFER	23	0	0	0	0	108	131
1993	HENDERSON	OTHER AQUIFER	26	0	0	0	0	103	129
1994	HENDERSON	OTHER AQUIFER	25	0	0	0	0	106	131
1995	HENDERSON	OTHER AQUIFER	27	0	0	0	0	105	132
1996	HENDERSON	OTHER AQUIFER	33	0	0	0	0	129	162
1997	HENDERSON	OTHER AQUIFER	32	0	0	0	0	100	132
1998	HENDERSON	OTHER AQUIFER	35	0	0	0	0	115	150
1999	HENDERSON	OTHER AQUIFER	35	0	0	0	0	113	148
2000	HENDERSON	OTHER AQUIFER	46	0	0	0	0	111	157
2001	HENDERSON	OTHER AQUIFER	34	0	0	0	0	71	105
2002	HENDERSON	OTHER AQUIFER	35	0	0	0	0	20	55
2003	HENDERSON	OTHER AQUIFER	32	0	0	0	0	59	91
2004	HENDERSON	OTHER AQUIFER	32	0	0	0	0	61	93
2005	HENDERSON	OTHER AQUIFER	45	0	0	0	0	75	120
2006	HENDERSON	OTHER AQUIFER	264	0	0	0	0	72	336
2007	HENDERSON	OTHER AQUIFER	204	0	0	0	0	72	276
2008	HENDERSON	OTHER AQUIFER	233	0	0	0	0	104	337
2009	HENDERSON	OTHER AQUIFER	321	0	0	0	0	24	345
2010	HENDERSON	OTHER AQUIFER	391	0	0	0	0	65	456
2011	HENDERSON	OTHER AQUIFER	431	0	0	0	0	65	496
2012	HENDERSON	OTHER AQUIFER	384	0	0	0	0	54	438
1980	HENDERSON	QUEEN CITY AQUIFER	268	0	0	0	0	265	533
1984	HENDERSON	QUEEN CITY AQUIFER	172	0	0	0	0	323	495
1985	HENDERSON	QUEEN CITY AQUIFER	164	0	0	0	0	318	482

Groundwater Pumping Estimates from Texas Water Development Board
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1986	HENDERSON	QUEEN CITY AQUIFER	158	0	0	0	0	435	593
1987	HENDERSON	QUEEN CITY AQUIFER	154	0	0	0	0	262	416
1988	HENDERSON	QUEEN CITY AQUIFER	154	0	0	0	0	410	564
1989	HENDERSON	QUEEN CITY AQUIFER	178	0	0	0	0	420	598
1990	HENDERSON	QUEEN CITY AQUIFER	465	0	0	0	0	424	889
1991	HENDERSON	QUEEN CITY AQUIFER	512	0	0	0	0	431	943
1992	HENDERSON	QUEEN CITY AQUIFER	540	0	0	0	0	327	867
1993	HENDERSON	QUEEN CITY AQUIFER	635	0	0	0	0	311	946
1994	HENDERSON	QUEEN CITY AQUIFER	539	0	0	0	0	321	860
1995	HENDERSON	QUEEN CITY AQUIFER	452	0	0	0	0	318	770
1996	HENDERSON	QUEEN CITY AQUIFER	474	0	0	0	0	391	865
1997	HENDERSON	QUEEN CITY AQUIFER	611	0	0	0	0	301	912
1998	HENDERSON	QUEEN CITY AQUIFER	668	0	0	0	0	347	1,015
1999	HENDERSON	QUEEN CITY AQUIFER	668	0	0	0	0	340	1,008
2000	HENDERSON	QUEEN CITY AQUIFER	264	0	0	0	0	335	599
2001	HENDERSON	QUEEN CITY AQUIFER	264	0	0	0	0	153	417
2002	HENDERSON	QUEEN CITY AQUIFER	259	0	0	0	0	42	301
2003	HENDERSON	QUEEN CITY AQUIFER	328	0	0	0	1	126	455
2004	HENDERSON	QUEEN CITY AQUIFER	330	0	0	0	1	104	435
2005	HENDERSON	QUEEN CITY AQUIFER	345	0	0	0	1	128	474
2006	HENDERSON	QUEEN CITY AQUIFER	387	0	0	0	3	122	512
2007	HENDERSON	QUEEN CITY AQUIFER	336	0	0	0	3	122	461
2008	HENDERSON	QUEEN CITY AQUIFER	368	0	0	0	4	17	389
2009	HENDERSON	QUEEN CITY AQUIFER	451	0	0	0	150	240	841
2010	HENDERSON	QUEEN CITY AQUIFER	354	0	0	0	53	147	554
2011	HENDERSON	QUEEN CITY AQUIFER	528	0	0	0	20	149	697
2012	HENDERSON	QUEEN CITY AQUIFER	450	0	0	0	72	123	645
2008	HENDERSON	UNKNOWN	0	0	45	0	0	0	45
2009	HENDERSON	UNKNOWN	0	0	56	0	0	0	56
2010	HENDERSON	UNKNOWN	0	0	66	0	0	0	66
2011	HENDERSON	UNKNOWN	0	0	52	0	0	0	52
1980	HOPKINS	CARRIZO-WILCOX AQUIFER	583	0	73	0	0	1,496	2,152
1984	HOPKINS	CARRIZO-WILCOX AQUIFER	908	0	0	0	0	1,670	2,578
1985	HOPKINS	CARRIZO-WILCOX AQUIFER	1,023	0	67	0	0	1,666	2,756
1986	HOPKINS	CARRIZO-WILCOX AQUIFER	1,016	0	138	0	0	1,485	2,639
1987	HOPKINS	CARRIZO-WILCOX AQUIFER	1,072	0	127	0	0	1,517	2,716
1988	HOPKINS	CARRIZO-WILCOX AQUIFER	1,052	0	133	0	0	1,246	2,431
1989	HOPKINS	CARRIZO-WILCOX AQUIFER	1,038	0	187	0	0	1,322	2,547
1990	HOPKINS	CARRIZO-WILCOX AQUIFER	962	0	120	0	0	2,253	3,335
1991	HOPKINS	CARRIZO-WILCOX AQUIFER	909	0	147	0	0	2,297	3,353
1992	HOPKINS	CARRIZO-WILCOX AQUIFER	1,128	0	143	0	0	2,670	3,941
1993	HOPKINS	CARRIZO-WILCOX AQUIFER	1,494	0	144	0	0	2,569	4,207
1994	HOPKINS	CARRIZO-WILCOX AQUIFER	1,579	0	145	0	0	2,800	4,524
1995	HOPKINS	CARRIZO-WILCOX AQUIFER	1,729	0	145	0	0	2,605	4,479
1996	HOPKINS	CARRIZO-WILCOX AQUIFER	1,692	0	145	0	0	2,536	4,373
1997	HOPKINS	CARRIZO-WILCOX AQUIFER	1,609	0	143	0	0	2,417	4,169
1998	HOPKINS	CARRIZO-WILCOX AQUIFER	1,792	0	78	0	0	1,873	3,743
1999	HOPKINS	CARRIZO-WILCOX AQUIFER	1,604	0	78	0	0	1,849	3,531
2000	HOPKINS	CARRIZO-WILCOX AQUIFER	1,619	0	67	0	0	1,825	3,511
2001	HOPKINS	CARRIZO-WILCOX AQUIFER	1,601	0	67	0	0	1,009	2,677
2002	HOPKINS	CARRIZO-WILCOX AQUIFER	1,873	0	67	0	0	997	2,937
2003	HOPKINS	CARRIZO-WILCOX AQUIFER	1,897	0	67	0	0	995	2,959
2004	HOPKINS	CARRIZO-WILCOX AQUIFER	1,859	0	67	0	0	810	2,736
2005	HOPKINS	CARRIZO-WILCOX AQUIFER	1,605	0	67	0	0	1,849	3,521
2006	HOPKINS	CARRIZO-WILCOX AQUIFER	1,745	0	67	0	241	1,960	4,013
2007	HOPKINS	CARRIZO-WILCOX AQUIFER	1,564	0	17	0	201	1,509	3,291
2008	HOPKINS	CARRIZO-WILCOX AQUIFER	1,493	0	0	0	16	1,636	3,145
2009	HOPKINS	CARRIZO-WILCOX AQUIFER	1,579	0	0	0	210	1,544	3,333
2010	HOPKINS	CARRIZO-WILCOX AQUIFER	1,412	0	0	0	2,317	1,469	5,198
2011	HOPKINS	CARRIZO-WILCOX AQUIFER	1,776	0	0	0	315	1,487	3,578
2012	HOPKINS	CARRIZO-WILCOX AQUIFER	1,652	0	0	0	880	1,462	3,994
1980	HOPKINS	NACATOCH AQUIFER	276	0	0	0	0	175	451
1984	HOPKINS	NACATOCH AQUIFER	230	0	0	0	0	196	426
1985	HOPKINS	NACATOCH AQUIFER	213	0	0	0	0	106	319
1986	HOPKINS	NACATOCH AQUIFER	247	0	0	0	0	95	342
1987	HOPKINS	NACATOCH AQUIFER	264	0	0	0	0	97	361
1988	HOPKINS	NACATOCH AQUIFER	295	0	0	0	0	79	374
1989	HOPKINS	NACATOCH AQUIFER	263	0	0	0	0	84	347
1990	HOPKINS	NACATOCH AQUIFER	326	0	0	0	0	143	469
1991	HOPKINS	NACATOCH AQUIFER	338	0	0	0	0	146	484
1992	HOPKINS	NACATOCH AQUIFER	334	0	0	0	0	170	504
1993	HOPKINS	NACATOCH AQUIFER	365	0	0	0	0	164	529
1994	HOPKINS	NACATOCH AQUIFER	402	0	0	0	0	179	581
1995	HOPKINS	NACATOCH AQUIFER	444	0	0	0	0	166	610
1996	HOPKINS	NACATOCH AQUIFER	438	0	0	0	0	162	600
1997	HOPKINS	NACATOCH AQUIFER	354	0	0	0	0	155	509
1998	HOPKINS	NACATOCH AQUIFER	394	0	0	0	0	120	514
1999	HOPKINS	NACATOCH AQUIFER	353	0	0	0	0	119	472

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
All Values in AF/yr

Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2000	HOPKINS	NACATOCH AQUIFER	350	0	0	0	0	117	467
2001	HOPKINS	NACATOCH AQUIFER	353	0	0	0	0	35	388
2002	HOPKINS	NACATOCH AQUIFER	354	0	0	0	0	35	389
2003	HOPKINS	NACATOCH AQUIFER	356	0	0	0	0	34	390
2004	HOPKINS	NACATOCH AQUIFER	359	0	0	0	0	131	490
2005	HOPKINS	NACATOCH AQUIFER	415	0	0	0	0	299	714
2006	HOPKINS	NACATOCH AQUIFER	480	0	0	0	0	316	796
2007	HOPKINS	NACATOCH AQUIFER	405	0	0	0	0	243	648
2008	HOPKINS	NACATOCH AQUIFER	414	0	0	0	0	635	1,049
2009	HOPKINS	NACATOCH AQUIFER	459	0	0	0	0	600	1,059
2010	HOPKINS	NACATOCH AQUIFER	494	0	0	0	0	521	1,015
2011	HOPKINS	NACATOCH AQUIFER	509	0	0	0	0	532	1,041
2012	HOPKINS	NACATOCH AQUIFER	590	0	0	0	0	523	1,113
1980	HOPKINS	OTHER AQUIFER	31	0	0	0	0	0	31
1984	HOPKINS	OTHER AQUIFER	87	0	0	0	0	0	87
1985	HOPKINS	OTHER AQUIFER	44	0	0	0	0	0	44
1986	HOPKINS	OTHER AQUIFER	100	0	0	0	0	0	100
1987	HOPKINS	OTHER AQUIFER	110	0	0	0	0	0	110
1988	HOPKINS	OTHER AQUIFER	98	0	0	0	0	0	98
1989	HOPKINS	OTHER AQUIFER	107	0	0	0	0	0	107
1990	HOPKINS	OTHER AQUIFER	106	0	0	0	0	0	106
1991	HOPKINS	OTHER AQUIFER	107	0	0	0	0	0	107
1992	HOPKINS	OTHER AQUIFER	107	0	0	0	0	0	107
1993	HOPKINS	OTHER AQUIFER	79	0	0	0	0	0	79
1994	HOPKINS	OTHER AQUIFER	84	0	0	0	0	0	84
1995	HOPKINS	OTHER AQUIFER	92	0	0	0	0	0	92
1996	HOPKINS	OTHER AQUIFER	94	0	0	0	0	0	94
1997	HOPKINS	OTHER AQUIFER	92	0	0	0	0	0	92
1998	HOPKINS	OTHER AQUIFER	102	0	0	0	0	0	102
1999	HOPKINS	OTHER AQUIFER	92	0	0	0	0	0	92
2000	HOPKINS	OTHER AQUIFER	15	0	0	0	0	0	15
2001	HOPKINS	OTHER AQUIFER	11	0	0	0	0	0	11
2002	HOPKINS	OTHER AQUIFER	12	0	0	0	0	0	12
2003	HOPKINS	OTHER AQUIFER	11	0	0	0	0	0	11
2004	HOPKINS	OTHER AQUIFER	11	0	0	0	0	0	11
2005	HOPKINS	OTHER AQUIFER	12	0	0	0	0	0	12
2008	HOPKINS	UNKNOWN	0	0	747	0	0	0	747
2009	HOPKINS	UNKNOWN	0	0	745	0	0	0	745
2010	HOPKINS	UNKNOWN	0	0	742	0	0	0	742
2011	HOPKINS	UNKNOWN	0	0	754	0	0	0	754
1980	HOUSTON	CARRIZO-WILCOX AQUIFER	641	0	0	0	0	45	686
1984	HOUSTON	CARRIZO-WILCOX AQUIFER	586	0	0	0	0	70	656
1985	HOUSTON	CARRIZO-WILCOX AQUIFER	633	0	0	0	0	72	705
1986	HOUSTON	CARRIZO-WILCOX AQUIFER	577	0	0	0	0	53	630
1987	HOUSTON	CARRIZO-WILCOX AQUIFER	702	0	0	0	1	61	764
1988	HOUSTON	CARRIZO-WILCOX AQUIFER	722	0	0	0	0	65	787
1989	HOUSTON	CARRIZO-WILCOX AQUIFER	566	0	0	0	0	66	632
1990	HOUSTON	CARRIZO-WILCOX AQUIFER	390	0	0	0	0	67	457
1991	HOUSTON	CARRIZO-WILCOX AQUIFER	196	0	0	0	0	68	264
1992	HOUSTON	CARRIZO-WILCOX AQUIFER	195	0	0	0	0	67	262
1993	HOUSTON	CARRIZO-WILCOX AQUIFER	340	0	0	0	0	64	404
1994	HOUSTON	CARRIZO-WILCOX AQUIFER	803	0	0	0	35	69	907
1995	HOUSTON	CARRIZO-WILCOX AQUIFER	856	0	0	0	30	62	948
1996	HOUSTON	CARRIZO-WILCOX AQUIFER	917	0	0	0	41	62	1,020
1997	HOUSTON	CARRIZO-WILCOX AQUIFER	897	0	0	0	41	54	992
1998	HOUSTON	CARRIZO-WILCOX AQUIFER	911	0	0	0	41	61	1,013
1999	HOUSTON	CARRIZO-WILCOX AQUIFER	965	0	0	0	41	64	1,070
2000	HOUSTON	CARRIZO-WILCOX AQUIFER	948	0	0	0	115	65	1,128
2001	HOUSTON	CARRIZO-WILCOX AQUIFER	1,072	0	0	0	85	40	1,197
2002	HOUSTON	CARRIZO-WILCOX AQUIFER	1,050	0	0	0	151	39	1,240
2003	HOUSTON	CARRIZO-WILCOX AQUIFER	1,250	0	0	0	54	38	1,342
2004	HOUSTON	CARRIZO-WILCOX AQUIFER	1,059	0	0	0	114	67	1,240
2005	HOUSTON	CARRIZO-WILCOX AQUIFER	1,092	0	0	0	165	31	1,288
2006	HOUSTON	CARRIZO-WILCOX AQUIFER	854	0	0	0	205	26	1,085
2007	HOUSTON	CARRIZO-WILCOX AQUIFER	1,171	0	0	0	269	23	1,463
2008	HOUSTON	CARRIZO-WILCOX AQUIFER	1,766	0	0	0	66	30	1,862
2009	HOUSTON	CARRIZO-WILCOX AQUIFER	1,624	0	0	0	89	30	1,743
2010	HOUSTON	CARRIZO-WILCOX AQUIFER	1,659	0	0	0	48	28	1,735
2011	HOUSTON	CARRIZO-WILCOX AQUIFER	2,229	0	0	0	30	29	2,288
2012	HOUSTON	CARRIZO-WILCOX AQUIFER	1,963	0	0	0	246	18	2,227
1980	HOUSTON	OTHER AQUIFER	909	0	0	0	0	202	1,111
1984	HOUSTON	OTHER AQUIFER	1,490	10	78	0	0	274	1,852
1985	HOUSTON	OTHER AQUIFER	1,399	5	125	0	0	278	1,807
1986	HOUSTON	OTHER AQUIFER	1,433	5	119	0	1	207	1,765
1987	HOUSTON	OTHER AQUIFER	1,256	0	108	0	0	237	1,601
1988	HOUSTON	OTHER AQUIFER	1,046	0	111	0	1	250	1,408
1989	HOUSTON	OTHER AQUIFER	1,112	0	103	0	0	254	1,469
1990	HOUSTON	OTHER AQUIFER	1,256	0	103	0	0	259	1,618

Groundwater Pumping Estimates from Texas Water Development Board
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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1991	HOUSTON	OTHER AQUIFER	1,241	0	143	0	0	265	1,649
1992	HOUSTON	OTHER AQUIFER	1,224	0	143	0	0	259	1,626
1993	HOUSTON	OTHER AQUIFER	1,022	0	140	0	0	246	1,408
1994	HOUSTON	OTHER AQUIFER	901	0	140	0	0	265	1,306
1995	HOUSTON	OTHER AQUIFER	943	0	140	0	0	239	1,322
1996	HOUSTON	OTHER AQUIFER	965	0	140	0	0	239	1,344
1997	HOUSTON	OTHER AQUIFER	981	0	140	0	0	210	1,331
1998	HOUSTON	OTHER AQUIFER	997	0	140	0	0	237	1,374
1999	HOUSTON	OTHER AQUIFER	1,055	0	140	0	0	249	1,444
2000	HOUSTON	OTHER AQUIFER	1,212	0	0	0	32	253	1,497
2001	HOUSTON	OTHER AQUIFER	1,297	0	0	0	24	146	1,467
2002	HOUSTON	OTHER AQUIFER	1,299	0	0	0	42	141	1,482
2003	HOUSTON	OTHER AQUIFER	1,303	0	0	0	15	142	1,460
2004	HOUSTON	OTHER AQUIFER	1,225	0	0	0	19	123	1,367
2005	HOUSTON	OTHER AQUIFER	1,216	0	0	0	28	56	1,300
2006	HOUSTON	OTHER AQUIFER	1,224	0	0	0	34	47	1,305
2007	HOUSTON	OTHER AQUIFER	1,234	0	0	0	45	43	1,322
2008	HOUSTON	OTHER AQUIFER	1,285	0	0	0	11	51	1,347
2009	HOUSTON	OTHER AQUIFER	1,268	0	0	0	15	51	1,334
2010	HOUSTON	OTHER AQUIFER	1,251	0	0	0	73	53	1,377
2011	HOUSTON	OTHER AQUIFER	208	0	0	0	45	56	309
2012	HOUSTON	OTHER AQUIFER	195	0	0	0	373	35	603
1980	HOUSTON	QUEEN CITY AQUIFER	131	0	0	0	0	112	243
1984	HOUSTON	QUEEN CITY AQUIFER	165	1	0	0	14	115	295
1985	HOUSTON	QUEEN CITY AQUIFER	167	1	0	0	12	117	297
1986	HOUSTON	QUEEN CITY AQUIFER	168	1	0	0	12	87	268
1987	HOUSTON	QUEEN CITY AQUIFER	166	0	0	0	12	100	278
1988	HOUSTON	QUEEN CITY AQUIFER	174	0	0	0	12	105	291
1989	HOUSTON	QUEEN CITY AQUIFER	165	0	0	0	12	107	284
1990	HOUSTON	QUEEN CITY AQUIFER	163	0	0	0	12	109	284
1991	HOUSTON	QUEEN CITY AQUIFER	158	0	0	0	12	112	282
1992	HOUSTON	QUEEN CITY AQUIFER	147	0	0	0	12	109	268
1993	HOUSTON	QUEEN CITY AQUIFER	142	0	0	0	101	104	347
1994	HOUSTON	QUEEN CITY AQUIFER	147	0	0	0	35	112	294
1995	HOUSTON	QUEEN CITY AQUIFER	145	0	0	0	30	101	276
1996	HOUSTON	QUEEN CITY AQUIFER	145	0	0	0	41	101	287
1997	HOUSTON	QUEEN CITY AQUIFER	135	0	0	0	41	89	265
1998	HOUSTON	QUEEN CITY AQUIFER	137	0	0	0	41	100	278
1999	HOUSTON	QUEEN CITY AQUIFER	145	0	0	0	41	105	291
2000	HOUSTON	QUEEN CITY AQUIFER	118	0	0	0	147	107	372
2001	HOUSTON	QUEEN CITY AQUIFER	126	0	0	0	109	49	284
2002	HOUSTON	QUEEN CITY AQUIFER	127	0	0	0	192	47	366
2003	HOUSTON	QUEEN CITY AQUIFER	133	0	0	0	68	48	249
2004	HOUSTON	QUEEN CITY AQUIFER	115	0	0	0	152	37	304
2005	HOUSTON	QUEEN CITY AQUIFER	115	0	0	0	221	17	353
2006	HOUSTON	QUEEN CITY AQUIFER	93	0	0	0	273	14	380
2007	HOUSTON	QUEEN CITY AQUIFER	94	0	0	0	359	13	466
2008	HOUSTON	QUEEN CITY AQUIFER	92	0	0	0	88	11	191
2009	HOUSTON	QUEEN CITY AQUIFER	122	0	0	0	119	11	252
2010	HOUSTON	QUEEN CITY AQUIFER	94	0	0	0	64	19	177
2011	HOUSTON	QUEEN CITY AQUIFER	98	0	0	0	40	20	158
2012	HOUSTON	QUEEN CITY AQUIFER	93	0	0	0	328	13	434
1980	HOUSTON	SPARTA AQUIFER	38	0	0	0	0	315	353
1984	HOUSTON	SPARTA AQUIFER	86	6	32	0	12	387	523
1985	HOUSTON	SPARTA AQUIFER	79	3	33	0	12	392	519
1986	HOUSTON	SPARTA AQUIFER	78	3	32	0	12	292	417
1987	HOUSTON	SPARTA AQUIFER	77	0	29	0	12	334	452
1988	HOUSTON	SPARTA AQUIFER	82	0	30	0	12	352	476
1989	HOUSTON	SPARTA AQUIFER	72	0	27	0	12	358	469
1990	HOUSTON	SPARTA AQUIFER	95	0	27	0	11	365	498
1991	HOUSTON	SPARTA AQUIFER	101	0	38	0	11	372	522
1992	HOUSTON	SPARTA AQUIFER	90	0	38	0	11	365	504
1993	HOUSTON	SPARTA AQUIFER	94	0	37	0	0	346	477
1994	HOUSTON	SPARTA AQUIFER	102	0	37	0	76	371	586
1995	HOUSTON	SPARTA AQUIFER	95	0	37	0	65	335	532
1996	HOUSTON	SPARTA AQUIFER	94	0	37	0	88	335	554
1997	HOUSTON	SPARTA AQUIFER	90	0	37	0	88	295	510
1998	HOUSTON	SPARTA AQUIFER	91	0	37	0	88	333	549
1999	HOUSTON	SPARTA AQUIFER	97	0	37	0	88	350	572
2000	HOUSTON	SPARTA AQUIFER	6	0	0	0	314	299	619
2001	HOUSTON	SPARTA AQUIFER	7	0	0	0	234	177	418
2002	HOUSTON	SPARTA AQUIFER	7	0	0	0	413	171	591
2003	HOUSTON	SPARTA AQUIFER	7	0	0	0	147	172	326
2004	HOUSTON	SPARTA AQUIFER	7	0	0	0	76	174	257
2005	HOUSTON	SPARTA AQUIFER	8	0	0	0	110	79	197
2006	HOUSTON	SPARTA AQUIFER	31	0	0	0	137	67	235
2007	HOUSTON	SPARTA AQUIFER	26	0	0	0	180	60	266
2008	HOUSTON	SPARTA AQUIFER	35	0	0	0	44	68	147

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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2009	HOUSTON	SPARTA AQUIFER	116	0	0	0	59	68	243
2010	HOUSTON	SPARTA AQUIFER	324	0	0	0	32	78	434
2011	HOUSTON	SPARTA AQUIFER	1,357	0	0	0	20	81	1,458
2012	HOUSTON	SPARTA AQUIFER	1,282	0	0	0	164	52	1,498
2008	HOUSTON	UNKNOWN	0	0	7	0	0	0	7
2009	HOUSTON	UNKNOWN	0	0	10	0	0	0	10
2010	HOUSTON	UNKNOWN	0	0	13	0	0	0	13
2011	HOUSTON	UNKNOWN	0	0	120	0	0	0	120
2012	HOUSTON	UNKNOWN	0	0	66	0	0	0	66
2000	HOUSTON	YEGUA-JACKSON AQUIFER	0	0	0	0	0	56	56
2001	HOUSTON	YEGUA-JACKSON AQUIFER	0	0	0	0	0	19	19
2002	HOUSTON	YEGUA-JACKSON AQUIFER	0	0	0	0	0	18	18
2003	HOUSTON	YEGUA-JACKSON AQUIFER	0	0	0	0	0	18	18
2004	HOUSTON	YEGUA-JACKSON AQUIFER	0	0	0	0	0	18	18
2005	HOUSTON	YEGUA-JACKSON AQUIFER	0	0	0	0	0	8	8
2006	HOUSTON	YEGUA-JACKSON AQUIFER	43	0	0	0	0	7	50
2007	HOUSTON	YEGUA-JACKSON AQUIFER	36	0	0	0	0	6	42
2008	HOUSTON	YEGUA-JACKSON AQUIFER	40	0	0	0	0	0	40
2009	HOUSTON	YEGUA-JACKSON AQUIFER	160	0	0	0	0	0	160
2010	HOUSTON	YEGUA-JACKSON AQUIFER	500	0	0	0	0	12	512
2011	HOUSTON	YEGUA-JACKSON AQUIFER	546	0	0	0	0	13	559
2012	HOUSTON	YEGUA-JACKSON AQUIFER	462	0	0	0	0	8	470
1980	MARION	CARRIZO-WILCOX AQUIFER	527	9	7	0	0	22	565
1984	MARION	CARRIZO-WILCOX AQUIFER	520	14	0	0	0	31	565
1985	MARION	CARRIZO-WILCOX AQUIFER	547	25	69	0	0	24	665
1986	MARION	CARRIZO-WILCOX AQUIFER	499	25	65	0	0	19	608
1987	MARION	CARRIZO-WILCOX AQUIFER	494	18	61	0	0	21	594
1988	MARION	CARRIZO-WILCOX AQUIFER	503	33	60	0	0	23	619
1989	MARION	CARRIZO-WILCOX AQUIFER	518	34	56	0	0	23	631
1990	MARION	CARRIZO-WILCOX AQUIFER	370	26	56	0	0	23	475
1991	MARION	CARRIZO-WILCOX AQUIFER	399	35	53	0	0	23	510
1992	MARION	CARRIZO-WILCOX AQUIFER	364	0	53	0	0	25	442
1993	MARION	CARRIZO-WILCOX AQUIFER	440	0	53	0	55	27	575
1994	MARION	CARRIZO-WILCOX AQUIFER	439	0	53	0	63	25	580
1995	MARION	CARRIZO-WILCOX AQUIFER	483	0	83	1	59	20	646
1996	MARION	CARRIZO-WILCOX AQUIFER	474	0	83	1	55	22	635
1997	MARION	CARRIZO-WILCOX AQUIFER	472	0	83	74	55	26	710
1998	MARION	CARRIZO-WILCOX AQUIFER	527	0	83	88	55	19	772
1999	MARION	CARRIZO-WILCOX AQUIFER	402	0	83	100	55	21	661
2000	MARION	CARRIZO-WILCOX AQUIFER	657	1	0	99	0	144	901
2001	MARION	CARRIZO-WILCOX AQUIFER	686	1	0	96	0	18	801
2002	MARION	CARRIZO-WILCOX AQUIFER	654	0	0	0	0	17	671
2003	MARION	CARRIZO-WILCOX AQUIFER	628	0	0	82	0	17	727
2004	MARION	CARRIZO-WILCOX AQUIFER	642	0	0	60	0	50	752
2005	MARION	CARRIZO-WILCOX AQUIFER	720	0	0	82	0	6	808
2006	MARION	CARRIZO-WILCOX AQUIFER	812	0	0	79	0	6	897
2007	MARION	CARRIZO-WILCOX AQUIFER	693	0	0	73	0	6	772
2008	MARION	CARRIZO-WILCOX AQUIFER	714	0	0	74	0	4	792
2009	MARION	CARRIZO-WILCOX AQUIFER	621	0	0	81	0	4	706
2010	MARION	CARRIZO-WILCOX AQUIFER	394	0	0	91	0	12	497
2011	MARION	CARRIZO-WILCOX AQUIFER	556	0	0	75	0	12	643
2012	MARION	CARRIZO-WILCOX AQUIFER	469	0	0	82	0	7	558
2006	MARION	OTHER AQUIFER	12	0	0	0	0	0	12
2007	MARION	OTHER AQUIFER	10	0	0	0	0	0	10
2008	MARION	OTHER AQUIFER	11	0	0	0	0	0	11
2009	MARION	OTHER AQUIFER	7	0	0	0	0	0	7
2010	MARION	OTHER AQUIFER	3	0	0	0	0	0	3
2011	MARION	OTHER AQUIFER	3	0	0	0	0	0	3
2012	MARION	OTHER AQUIFER	2	0	0	0	0	0	2
1980	MARION	QUEEN CITY AQUIFER	352	0	6	0	0	40	398
1984	MARION	QUEEN CITY AQUIFER	303	0	0	0	0	57	360
1985	MARION	QUEEN CITY AQUIFER	303	0	0	0	0	44	347
1986	MARION	QUEEN CITY AQUIFER	284	0	0	0	0	35	319
1987	MARION	QUEEN CITY AQUIFER	255	0	0	0	0	40	295
1988	MARION	QUEEN CITY AQUIFER	272	0	0	0	0	43	315
1989	MARION	QUEEN CITY AQUIFER	283	0	0	0	0	42	325
1990	MARION	QUEEN CITY AQUIFER	391	0	0	0	0	42	433
1991	MARION	QUEEN CITY AQUIFER	381	0	0	0	0	43	424
1992	MARION	QUEEN CITY AQUIFER	314	0	0	0	0	48	362
1993	MARION	QUEEN CITY AQUIFER	364	0	0	0	0	52	416
1994	MARION	QUEEN CITY AQUIFER	338	0	0	0	0	48	386
1995	MARION	QUEEN CITY AQUIFER	273	0	0	0	0	39	312
1996	MARION	QUEEN CITY AQUIFER	267	1	0	0	0	44	312
1997	MARION	QUEEN CITY AQUIFER	279	3	0	0	0	53	335
1998	MARION	QUEEN CITY AQUIFER	312	3	0	0	0	39	354
1999	MARION	QUEEN CITY AQUIFER	237	3	0	0	0	44	284
2000	MARION	QUEEN CITY AQUIFER	138	3	0	0	0	290	431
2001	MARION	QUEEN CITY AQUIFER	121	3	0	0	0	38	162

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
All Values in AF/yr

Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2002	MARION	QUEEN CITY AQUIFER	122	0	0	0	0	34	156
2003	MARION	QUEEN CITY AQUIFER	133	0	0	0	0	34	167
2004	MARION	QUEEN CITY AQUIFER	129	0	0	0	0	0	129
2005	MARION	QUEEN CITY AQUIFER	139	0	0	0	0	0	139
2006	MARION	QUEEN CITY AQUIFER	35	0	0	0	0	0	35
2007	MARION	QUEEN CITY AQUIFER	30	0	0	0	0	0	30
2008	MARION	QUEEN CITY AQUIFER	31	0	0	0	0	0	31
2009	MARION	QUEEN CITY AQUIFER	24	0	0	0	0	0	24
2010	MARION	QUEEN CITY AQUIFER	6	0	0	0	0	0	6
2011	MARION	QUEEN CITY AQUIFER	6	0	0	0	0	0	6
2012	MARION	QUEEN CITY AQUIFER	5	0	0	0	0	0	5
2000	MARION	UNKNOWN	0	0	0	0	0	0	0
2001	MARION	UNKNOWN	0	0	0	0	0	0	0
2002	MARION	UNKNOWN	0	0	0	0	0	0	0
2008	MARION	UNKNOWN	0	0	82	0	0	0	82
2009	MARION	UNKNOWN	0	0	96	0	0	0	96
2010	MARION	UNKNOWN	0	0	109	0	0	0	109
2011	MARION	UNKNOWN	0	0	87	0	0	0	87
2012	MARION	UNKNOWN	0	0	17	0	0	0	17
1980	MORRIS	CARRIZO-WILCOX AQUIFER	1,048	221	0	0	0	77	1,346
1984	MORRIS	CARRIZO-WILCOX AQUIFER	830	15	0	0	170	79	1,094
1985	MORRIS	CARRIZO-WILCOX AQUIFER	857	7	0	0	151	75	1,090
1986	MORRIS	CARRIZO-WILCOX AQUIFER	712	6	0	0	151	76	945
1987	MORRIS	CARRIZO-WILCOX AQUIFER	654	6	0	0	151	82	893
1988	MORRIS	CARRIZO-WILCOX AQUIFER	728	0	0	0	84	87	899
1989	MORRIS	CARRIZO-WILCOX AQUIFER	709	6,412	0	0	0	90	7,211
1990	MORRIS	CARRIZO-WILCOX AQUIFER	527	6,412	0	0	0	90	7,029
1991	MORRIS	CARRIZO-WILCOX AQUIFER	533	6,412	32	0	0	92	7,069
1992	MORRIS	CARRIZO-WILCOX AQUIFER	513	40	32	0	0	136	721
1993	MORRIS	CARRIZO-WILCOX AQUIFER	503	32	32	0	0	128	695
1994	MORRIS	CARRIZO-WILCOX AQUIFER	446	31	32	0	0	102	611
1995	MORRIS	CARRIZO-WILCOX AQUIFER	512	34	32	0	0	113	691
1996	MORRIS	CARRIZO-WILCOX AQUIFER	500	31	32	0	0	107	670
1997	MORRIS	CARRIZO-WILCOX AQUIFER	621	30	32	0	0	85	768
1998	MORRIS	CARRIZO-WILCOX AQUIFER	638	30	32	0	0	91	791
1999	MORRIS	CARRIZO-WILCOX AQUIFER	490	32	32	0	0	102	656
2000	MORRIS	CARRIZO-WILCOX AQUIFER	559	88	0	0	0	104	751
2001	MORRIS	CARRIZO-WILCOX AQUIFER	562	25	0	0	0	43	630
2002	MORRIS	CARRIZO-WILCOX AQUIFER	552	21	0	0	0	53	626
2003	MORRIS	CARRIZO-WILCOX AQUIFER	508	76	0	0	0	62	646
2004	MORRIS	CARRIZO-WILCOX AQUIFER	499	79	0	0	0	141	719
2005	MORRIS	CARRIZO-WILCOX AQUIFER	548	196	0	0	0	63	807
2006	MORRIS	CARRIZO-WILCOX AQUIFER	625	72	0	0	0	68	765
2007	MORRIS	CARRIZO-WILCOX AQUIFER	550	77	0	0	0	68	695
2008	MORRIS	CARRIZO-WILCOX AQUIFER	585	20	0	0	0	52	657
2009	MORRIS	CARRIZO-WILCOX AQUIFER	645	23	0	0	0	58	726
2010	MORRIS	CARRIZO-WILCOX AQUIFER	691	23	0	0	0	78	792
2011	MORRIS	CARRIZO-WILCOX AQUIFER	685	23	0	0	0	82	790
2012	MORRIS	CARRIZO-WILCOX AQUIFER	621	19	0	0	0	57	697
2006	MORRIS	OTHER AQUIFER	6	0	0	0	0	0	6
2007	MORRIS	OTHER AQUIFER	5	0	0	0	0	0	5
2008	MORRIS	OTHER AQUIFER	5	0	0	0	0	0	5
2009	MORRIS	OTHER AQUIFER	6	0	0	0	0	0	6
2010	MORRIS	OTHER AQUIFER	7	0	0	0	0	0	7
2011	MORRIS	OTHER AQUIFER	6	0	0	0	0	0	6
2012	MORRIS	OTHER AQUIFER	6	0	0	0	0	0	6
1980	MORRIS	QUEEN CITY AQUIFER	201	0	0	0	0	80	281
1984	MORRIS	QUEEN CITY AQUIFER	154	0	0	0	85	65	304
1985	MORRIS	QUEEN CITY AQUIFER	153	0	0	0	74	64	291
1986	MORRIS	QUEEN CITY AQUIFER	149	0	0	0	74	64	287
1987	MORRIS	QUEEN CITY AQUIFER	130	0	0	0	74	68	272
1988	MORRIS	QUEEN CITY AQUIFER	131	0	0	0	41	72	244
1989	MORRIS	QUEEN CITY AQUIFER	143	0	0	0	0	75	218
1990	MORRIS	QUEEN CITY AQUIFER	278	0	0	0	0	76	354
1991	MORRIS	QUEEN CITY AQUIFER	278	0	0	0	0	77	355
1992	MORRIS	QUEEN CITY AQUIFER	259	0	0	0	0	114	373
1993	MORRIS	QUEEN CITY AQUIFER	285	0	0	0	0	107	392
1994	MORRIS	QUEEN CITY AQUIFER	284	0	0	0	0	85	369
1995	MORRIS	QUEEN CITY AQUIFER	240	0	0	0	0	94	334
1996	MORRIS	QUEEN CITY AQUIFER	240	0	0	0	0	89	329
1997	MORRIS	QUEEN CITY AQUIFER	205	0	0	0	0	72	277
1998	MORRIS	QUEEN CITY AQUIFER	211	0	0	0	0	77	288
1999	MORRIS	QUEEN CITY AQUIFER	162	0	0	0	0	86	248
2000	MORRIS	QUEEN CITY AQUIFER	103	0	0	0	0	90	193
2001	MORRIS	QUEEN CITY AQUIFER	91	0	0	0	0	52	143
2002	MORRIS	QUEEN CITY AQUIFER	92	0	0	0	0	65	157
2003	MORRIS	QUEEN CITY AQUIFER	94	0	0	0	0	76	170
2004	MORRIS	QUEEN CITY AQUIFER	92	0	0	0	0	0	92

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
All Values in AF/yr

Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2005	MORRIS	QUEEN CITY AQUIFER	98	0	0	0	0	0	98
2006	MORRIS	QUEEN CITY AQUIFER	23	0	0	0	0	0	23
2007	MORRIS	QUEEN CITY AQUIFER	19	0	0	0	0	0	19
2008	MORRIS	QUEEN CITY AQUIFER	21	0	0	0	0	0	21
2009	MORRIS	QUEEN CITY AQUIFER	24	0	0	0	0	0	24
2010	MORRIS	QUEEN CITY AQUIFER	27	0	0	0	0	0	27
2011	MORRIS	QUEEN CITY AQUIFER	25	0	0	0	0	0	25
2012	MORRIS	QUEEN CITY AQUIFER	25	0	0	0	0	0	25
2006	MORRIS	SPARTA AQUIFER	6	0	0	0	0	0	6
2007	MORRIS	SPARTA AQUIFER	5	0	0	0	0	0	5
2008	MORRIS	SPARTA AQUIFER	5	0	0	0	0	0	5
2009	MORRIS	SPARTA AQUIFER	6	0	0	0	0	0	6
2010	MORRIS	SPARTA AQUIFER	7	0	0	0	0	0	7
2011	MORRIS	SPARTA AQUIFER	6	0	0	0	0	0	6
2012	MORRIS	SPARTA AQUIFER	6	0	0	0	0	0	6
2008	MORRIS	UNKNOWN	0	0	0	0	0	0	0
2009	MORRIS	UNKNOWN	0	0	0	0	0	0	0
2010	MORRIS	UNKNOWN	0	0	0	0	0	0	0
2011	MORRIS	UNKNOWN	0	0	0	0	0	0	0
1980	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	6,558	21	0	0	0	432	7,011
1984	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	6,701	0	0	0	19	381	7,101
1985	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	6,874	0	0	0	39	277	7,190
1986	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,148	0	0	0	40	290	7,478
1987	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,260	0	0	0	40	280	7,580
1988	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,806	0	0	0	40	281	8,127
1989	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,922	0	0	0	138	292	8,352
1990	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,481	0	0	0	140	349	7,970
1991	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,235	0	0	0	140	349	7,724
1992	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,744	0	0	0	140	350	8,234
1993	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	8,250	0	0	0	980	360	9,590
1994	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,861	0	0	0	1,117	391	9,369
1995	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	8,532	0	0	0	1,016	352	9,900
1996	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,218	0	0	0	1,016	472	8,706
1997	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,351	0	0	0	1,016	329	8,696
1998	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,152	0	0	0	1,016	295	8,463
1999	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,113	0	0	0	1,016	320	8,449
2000	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,801	0	0	0	186	333	8,320
2001	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,678	20	0	0	419	320	8,437
2002	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,288	31	0	0	187	321	7,827
2003	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	6,665	20	0	0	395	278	7,358
2004	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,140	11	0	0	281	340	7,772
2005	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	7,461	32	0	0	206	83	7,782
2006	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	6,924	27	0	0	248	92	7,291
2007	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	5,911	110	0	0	143	77	6,241
2008	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	6,157	31	0	0	145	82	6,415
2009	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	5,258	24	0	0	226	84	5,592
2010	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	5,871	30	0	0	141	184	6,226
2011	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	6,268	36	0	0	298	182	6,784
2012	NACOGDOCHES	CARRIZO-WILCOX AQUIFER	5,336	25	0	0	31	170	5,562
1980	NACOGDOCHES	OTHER AQUIFER	34	0	0	0	0	51	85
1984	NACOGDOCHES	OTHER AQUIFER	22	0	0	0	0	45	67
1985	NACOGDOCHES	OTHER AQUIFER	16	0	0	0	0	33	49
1986	NACOGDOCHES	OTHER AQUIFER	21	0	0	0	0	35	56
1987	NACOGDOCHES	OTHER AQUIFER	26	0	0	0	0	33	59
1988	NACOGDOCHES	OTHER AQUIFER	21	0	0	0	0	32	53
1989	NACOGDOCHES	OTHER AQUIFER	23	0	0	0	0	35	58
1990	NACOGDOCHES	OTHER AQUIFER	16	0	0	0	0	41	57
1991	NACOGDOCHES	OTHER AQUIFER	15	0	0	0	0	41	56
1992	NACOGDOCHES	OTHER AQUIFER	14	0	0	0	0	41	55
1993	NACOGDOCHES	OTHER AQUIFER	13	0	0	0	0	42	55
1994	NACOGDOCHES	OTHER AQUIFER	9	0	0	0	0	46	55
1995	NACOGDOCHES	OTHER AQUIFER	22	0	0	0	0	41	63
1996	NACOGDOCHES	OTHER AQUIFER	22	0	0	0	0	55	77
1997	NACOGDOCHES	OTHER AQUIFER	5	0	0	0	0	38	43
1998	NACOGDOCHES	OTHER AQUIFER	5	0	0	0	0	34	39
1999	NACOGDOCHES	OTHER AQUIFER	5	0	0	0	0	37	42
2000	NACOGDOCHES	OTHER AQUIFER	1	0	0	0	0	39	40
2001	NACOGDOCHES	OTHER AQUIFER	1	0	0	0	0	37	38
2002	NACOGDOCHES	OTHER AQUIFER	1	0	0	0	0	37	38
2003	NACOGDOCHES	OTHER AQUIFER	1	0	0	0	0	32	33
2004	NACOGDOCHES	OTHER AQUIFER	1	0	0	0	0	31	32
2005	NACOGDOCHES	OTHER AQUIFER	1	0	0	0	0	8	9
2006	NACOGDOCHES	OTHER AQUIFER	56	0	0	0	0	8	64
2007	NACOGDOCHES	OTHER AQUIFER	46	0	0	0	0	7	53
2008	NACOGDOCHES	OTHER AQUIFER	51	0	0	0	0	7	58
2009	NACOGDOCHES	OTHER AQUIFER	63	0	0	0	0	8	71
2010	NACOGDOCHES	OTHER AQUIFER	74	0	0	0	0	17	91
2011	NACOGDOCHES	OTHER AQUIFER	63	0	0	0	0	17	80

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2012	NACOGDOCHES	OTHER AQUIFER	61	0	0	0	0	15	76
1980	NACOGDOCHES	QUEEN CITY AQUIFER	96	0	0	0	0	144	240
1984	NACOGDOCHES	QUEEN CITY AQUIFER	62	0	0	0	0	127	189
1985	NACOGDOCHES	QUEEN CITY AQUIFER	46	0	0	0	0	92	138
1986	NACOGDOCHES	QUEEN CITY AQUIFER	59	0	0	0	0	97	156
1987	NACOGDOCHES	QUEEN CITY AQUIFER	72	0	0	0	0	93	165
1988	NACOGDOCHES	QUEEN CITY AQUIFER	59	0	0	0	0	93	152
1989	NACOGDOCHES	QUEEN CITY AQUIFER	64	0	0	0	0	97	161
1990	NACOGDOCHES	QUEEN CITY AQUIFER	43	0	0	0	0	116	159
1991	NACOGDOCHES	QUEEN CITY AQUIFER	41	0	0	0	0	116	157
1992	NACOGDOCHES	QUEEN CITY AQUIFER	38	0	0	0	0	116	154
1993	NACOGDOCHES	QUEEN CITY AQUIFER	37	0	0	0	0	119	156
1994	NACOGDOCHES	QUEEN CITY AQUIFER	24	0	0	0	0	129	153
1995	NACOGDOCHES	QUEEN CITY AQUIFER	61	0	0	0	0	116	177
1996	NACOGDOCHES	QUEEN CITY AQUIFER	60	0	0	0	0	156	216
1997	NACOGDOCHES	QUEEN CITY AQUIFER	14	0	0	0	0	109	123
1998	NACOGDOCHES	QUEEN CITY AQUIFER	14	0	0	0	0	98	112
1999	NACOGDOCHES	QUEEN CITY AQUIFER	14	0	0	0	0	106	120
2000	NACOGDOCHES	QUEEN CITY AQUIFER	2	0	0	0	0	110	112
2001	NACOGDOCHES	QUEEN CITY AQUIFER	2	0	0	0	0	106	108
2002	NACOGDOCHES	QUEEN CITY AQUIFER	2	0	0	0	0	106	108
2003	NACOGDOCHES	QUEEN CITY AQUIFER	2	0	0	0	0	92	94
2004	NACOGDOCHES	QUEEN CITY AQUIFER	2	0	0	0	0	124	126
2005	NACOGDOCHES	QUEEN CITY AQUIFER	2	0	0	0	0	30	32
2006	NACOGDOCHES	QUEEN CITY AQUIFER	159	0	0	0	0	34	193
2007	NACOGDOCHES	QUEEN CITY AQUIFER	131	0	0	0	0	28	159
2008	NACOGDOCHES	QUEEN CITY AQUIFER	146	0	0	0	0	30	176
2009	NACOGDOCHES	QUEEN CITY AQUIFER	177	0	0	0	0	31	208
2010	NACOGDOCHES	QUEEN CITY AQUIFER	210	0	0	0	0	67	277
2011	NACOGDOCHES	QUEEN CITY AQUIFER	178	0	0	0	0	66	244
2012	NACOGDOCHES	QUEEN CITY AQUIFER	171	0	0	0	0	62	233
1980	NACOGDOCHES	SPARTA AQUIFER	108	0	0	0	0	162	270
1984	NACOGDOCHES	SPARTA AQUIFER	70	0	0	0	0	142	212
1985	NACOGDOCHES	SPARTA AQUIFER	52	0	0	0	0	104	156
1986	NACOGDOCHES	SPARTA AQUIFER	66	0	0	0	0	109	175
1987	NACOGDOCHES	SPARTA AQUIFER	81	0	0	0	0	105	186
1988	NACOGDOCHES	SPARTA AQUIFER	67	0	0	0	0	105	172
1989	NACOGDOCHES	SPARTA AQUIFER	72	0	0	0	0	109	181
1990	NACOGDOCHES	SPARTA AQUIFER	49	0	0	0	0	131	180
1991	NACOGDOCHES	SPARTA AQUIFER	47	0	0	0	0	131	178
1992	NACOGDOCHES	SPARTA AQUIFER	43	0	0	0	0	131	174
1993	NACOGDOCHES	SPARTA AQUIFER	42	0	0	0	0	135	177
1994	NACOGDOCHES	SPARTA AQUIFER	27	0	0	0	0	147	174
1995	NACOGDOCHES	SPARTA AQUIFER	70	0	0	0	0	132	202
1996	NACOGDOCHES	SPARTA AQUIFER	69	0	0	0	0	177	246
1997	NACOGDOCHES	SPARTA AQUIFER	16	0	0	0	0	123	139
1998	NACOGDOCHES	SPARTA AQUIFER	16	0	0	0	0	110	126
1999	NACOGDOCHES	SPARTA AQUIFER	15	0	0	0	0	120	135
2000	NACOGDOCHES	SPARTA AQUIFER	2	0	0	0	0	125	127
2001	NACOGDOCHES	SPARTA AQUIFER	2	0	0	0	0	120	122
2002	NACOGDOCHES	SPARTA AQUIFER	2	0	0	0	0	120	122
2003	NACOGDOCHES	SPARTA AQUIFER	2	0	0	0	0	104	106
2004	NACOGDOCHES	SPARTA AQUIFER	2	0	0	0	0	0	2
2005	NACOGDOCHES	SPARTA AQUIFER	2	0	0	0	0	0	2
2006	NACOGDOCHES	SPARTA AQUIFER	112	0	0	0	0	0	112
2007	NACOGDOCHES	SPARTA AQUIFER	93	0	0	0	0	0	93
2008	NACOGDOCHES	SPARTA AQUIFER	103	0	0	0	0	0	103
2009	NACOGDOCHES	SPARTA AQUIFER	125	0	0	0	0	0	125
2010	NACOGDOCHES	SPARTA AQUIFER	149	0	0	0	0	0	149
2011	NACOGDOCHES	SPARTA AQUIFER	125	0	0	0	0	0	125
2012	NACOGDOCHES	SPARTA AQUIFER	121	0	0	0	0	0	121
2008	NACOGDOCHES	UNKNOWN	0	0	345	0	0	0	345
2009	NACOGDOCHES	UNKNOWN	0	0	352	0	0	0	352
2010	NACOGDOCHES	UNKNOWN	0	0	359	0	0	0	359
2011	NACOGDOCHES	UNKNOWN	0	0	825	0	0	0	825
2012	NACOGDOCHES	UNKNOWN	0	0	683	0	0	0	683
2006	NACOGDOCHES	YEGUA-JACKSON AQUIFER	19	0	0	0	0	0	19
2007	NACOGDOCHES	YEGUA-JACKSON AQUIFER	15	0	0	0	0	0	15
2008	NACOGDOCHES	YEGUA-JACKSON AQUIFER	17	0	0	0	0	0	17
2009	NACOGDOCHES	YEGUA-JACKSON AQUIFER	21	0	0	0	0	0	21
2010	NACOGDOCHES	YEGUA-JACKSON AQUIFER	25	0	0	0	0	0	25
2011	NACOGDOCHES	YEGUA-JACKSON AQUIFER	21	0	0	0	0	0	21
2012	NACOGDOCHES	YEGUA-JACKSON AQUIFER	20	0	0	0	0	0	20
1980	PANOLA	CARRIZO-WILCOX AQUIFER	2,233	0	244	2	0	708	3,187
1984	PANOLA	CARRIZO-WILCOX AQUIFER	2,316	0	358	125	0	654	3,453
1985	PANOLA	CARRIZO-WILCOX AQUIFER	2,495	15	426	11	0	640	3,587
1986	PANOLA	CARRIZO-WILCOX AQUIFER	2,188	16	3,305	20	0	670	6,199
1987	PANOLA	CARRIZO-WILCOX AQUIFER	2,229	20	989	24	0	695	3,957

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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1988	PANOLA	CARRIZO-WILCOX AQUIFER	2,290	20	1,047	16	0	705	4,078
1989	PANOLA	CARRIZO-WILCOX AQUIFER	2,203	19	1,078	17	0	747	4,064
1990	PANOLA	CARRIZO-WILCOX AQUIFER	2,212	59	1,078	17	0	858	4,224
1991	PANOLA	CARRIZO-WILCOX AQUIFER	2,184	14	1,044	155	0	869	4,266
1992	PANOLA	CARRIZO-WILCOX AQUIFER	2,381	20	1,051	0	0	812	4,264
1993	PANOLA	CARRIZO-WILCOX AQUIFER	2,324	20	1,064	0	0	815	4,223
1994	PANOLA	CARRIZO-WILCOX AQUIFER	2,322	20	1,064	0	0	1,090	4,496
1995	PANOLA	CARRIZO-WILCOX AQUIFER	2,395	20	1,045	0	0	1,059	4,519
1996	PANOLA	CARRIZO-WILCOX AQUIFER	2,306	0	1,944	0	0	1,126	5,376
1997	PANOLA	CARRIZO-WILCOX AQUIFER	2,268	0	1,947	0	0	1,128	5,343
1998	PANOLA	CARRIZO-WILCOX AQUIFER	2,186	0	1,947	0	0	1,118	5,251
1999	PANOLA	CARRIZO-WILCOX AQUIFER	2,219	0	1,947	0	0	1,216	5,382
2000	PANOLA	CARRIZO-WILCOX AQUIFER	2,743	0	7	0	0	1,238	3,988
2001	PANOLA	CARRIZO-WILCOX AQUIFER	2,808	921	7	0	0	1,264	5,000
2002	PANOLA	CARRIZO-WILCOX AQUIFER	2,564	473	7	0	0	1,254	4,298
2003	PANOLA	CARRIZO-WILCOX AQUIFER	2,588	513	7	0	0	1,249	4,357
2004	PANOLA	CARRIZO-WILCOX AQUIFER	2,589	424	7	0	0	1,270	4,290
2005	PANOLA	CARRIZO-WILCOX AQUIFER	2,546	498	8	0	0	320	3,372
2006	PANOLA	CARRIZO-WILCOX AQUIFER	3,148	185	7	0	18	333	3,691
2007	PANOLA	CARRIZO-WILCOX AQUIFER	2,689	338	7	0	31	327	3,392
2008	PANOLA	CARRIZO-WILCOX AQUIFER	2,444	260	1	0	64	304	3,073
2009	PANOLA	CARRIZO-WILCOX AQUIFER	2,637	408	1	0	31	314	3,391
2010	PANOLA	CARRIZO-WILCOX AQUIFER	5,203	0	483	0	346	136	6,168
2011	PANOLA	CARRIZO-WILCOX AQUIFER	3,617	0	562	0	383	139	4,701
2012	PANOLA	CARRIZO-WILCOX AQUIFER	3,256	0	518	0	137	96	4,007
2008	PANOLA	UNKNOWN	0	0	1,297	0	0	0	1,297
2009	PANOLA	UNKNOWN	0	0	1,319	0	0	0	1,319
2010	PANOLA	UNKNOWN	0	0	1,340	0	0	0	1,340
2011	PANOLA	UNKNOWN	0	0	629	0	0	0	629
2012	PANOLA	UNKNOWN	0	0	1,050	0	0	0	1,050
1980	RAINS	CARRIZO-WILCOX AQUIFER	166	0	0	0	0	149	315
1984	RAINS	CARRIZO-WILCOX AQUIFER	68	0	0	0	0	211	279
1985	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	197	197
1986	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	183	183
1987	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	200	200
1988	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	192	192
1989	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	202	202
1990	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	252	252
1991	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	251	251
1992	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	223	223
1993	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	217	217
1994	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	233	233
1995	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	233	233
1996	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	229	229
1997	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	227	227
1998	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	211	211
1999	RAINS	CARRIZO-WILCOX AQUIFER	0	0	0	0	0	220	220
2000	RAINS	CARRIZO-WILCOX AQUIFER	248	0	0	0	0	216	464
2001	RAINS	CARRIZO-WILCOX AQUIFER	265	0	0	0	0	200	465
2002	RAINS	CARRIZO-WILCOX AQUIFER	274	0	0	0	0	182	456
2003	RAINS	CARRIZO-WILCOX AQUIFER	288	0	0	0	0	190	478
2004	RAINS	CARRIZO-WILCOX AQUIFER	269	0	0	0	0	218	487
2005	RAINS	CARRIZO-WILCOX AQUIFER	296	0	0	0	0	28	324
2006	RAINS	CARRIZO-WILCOX AQUIFER	315	0	0	0	0	27	342
2007	RAINS	CARRIZO-WILCOX AQUIFER	261	0	0	0	58	24	343
2008	RAINS	CARRIZO-WILCOX AQUIFER	299	0	0	0	0	24	323
2009	RAINS	CARRIZO-WILCOX AQUIFER	276	0	0	0	0	24	300
2010	RAINS	CARRIZO-WILCOX AQUIFER	819	0	0	0	0	21	840
2011	RAINS	CARRIZO-WILCOX AQUIFER	544	0	0	0	7	21	572
2012	RAINS	CARRIZO-WILCOX AQUIFER	465	0	0	0	53	19	537
1980	RAINS	OTHER AQUIFER	55	0	0	0	0	49	104
1984	RAINS	OTHER AQUIFER	22	0	0	0	0	53	75
1985	RAINS	OTHER AQUIFER	0	0	0	0	0	49	49
1986	RAINS	OTHER AQUIFER	0	0	0	0	0	46	46
1987	RAINS	OTHER AQUIFER	0	0	0	0	0	50	50
1988	RAINS	OTHER AQUIFER	0	0	0	0	0	48	48
1989	RAINS	OTHER AQUIFER	0	0	0	0	0	51	51
1990	RAINS	OTHER AQUIFER	0	0	0	0	0	64	64
1992	RAINS	OTHER AQUIFER	0	0	0	0	0	57	57
1993	RAINS	OTHER AQUIFER	0	0	0	0	0	56	56
1994	RAINS	OTHER AQUIFER	0	0	0	0	0	60	60
1995	RAINS	OTHER AQUIFER	0	0	0	0	0	60	60
1996	RAINS	OTHER AQUIFER	0	0	0	0	0	59	59
1997	RAINS	OTHER AQUIFER	0	0	0	0	0	58	58
1998	RAINS	OTHER AQUIFER	0	0	0	0	0	54	54
1999	RAINS	OTHER AQUIFER	0	0	0	0	0	56	56
2000	RAINS	OTHER AQUIFER	29	0	0	0	0	54	83
2001	RAINS	OTHER AQUIFER	31	0	0	0	0	51	82

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2002	RAINS	OTHER AQUIFER	32	0	0	0	0	46	78
2003	RAINS	OTHER AQUIFER	33	0	0	0	0	48	81
2004	RAINS	OTHER AQUIFER	31	0	0	0	0	0	31
2005	RAINS	OTHER AQUIFER	34	0	0	0	0	0	34
2006	RAINS	OTHER AQUIFER	36	0	0	0	0	0	36
2007	RAINS	OTHER AQUIFER	30	0	0	0	0	0	30
2008	RAINS	OTHER AQUIFER	34	0	0	0	0	0	34
2009	RAINS	OTHER AQUIFER	32	0	0	0	0	0	32
2010	RAINS	OTHER AQUIFER	30	0	0	0	0	0	30
2011	RAINS	OTHER AQUIFER	28	0	0	0	0	0	28
2012	RAINS	OTHER AQUIFER	24	0	0	0	0	0	24
2008	RAINS	UNKNOWN	0	0	0	0	0	0	0
2009	RAINS	UNKNOWN	0	0	0	0	0	0	0
2010	RAINS	UNKNOWN	0	0	0	0	0	0	0
2011	RAINS	UNKNOWN	0	0	0	0	0	0	0
1980	RUSK	CARRIZO-WILCOX AQUIFER	4,725	0	562	0	0	558	5,845
1984	RUSK	CARRIZO-WILCOX AQUIFER	4,364	0	1,604	0	33	535	6,536
1985	RUSK	CARRIZO-WILCOX AQUIFER	5,459	0	2,286	0	38	479	8,262
1986	RUSK	CARRIZO-WILCOX AQUIFER	5,097	0	2,389	0	19	451	7,956
1987	RUSK	CARRIZO-WILCOX AQUIFER	4,944	0	1,928	0	19	430	7,321
1988	RUSK	CARRIZO-WILCOX AQUIFER	5,527	0	1,855	0	19	447	7,848
1989	RUSK	CARRIZO-WILCOX AQUIFER	5,295	0	1,890	0	32	455	7,672
1990	RUSK	CARRIZO-WILCOX AQUIFER	5,353	0	1,702	0	27	479	7,561
1991	RUSK	CARRIZO-WILCOX AQUIFER	5,225	0	1,142	18	27	487	6,899
1992	RUSK	CARRIZO-WILCOX AQUIFER	5,254	0	1,133	24	27	468	6,906
1993	RUSK	CARRIZO-WILCOX AQUIFER	5,514	0	1,106	23	149	479	7,271
1994	RUSK	CARRIZO-WILCOX AQUIFER	5,275	0	1,077	18	38	441	6,849
1995	RUSK	CARRIZO-WILCOX AQUIFER	5,968	0	1,093	20	151	391	7,623
1996	RUSK	CARRIZO-WILCOX AQUIFER	6,199	0	1,093	179	149	333	7,953
1997	RUSK	CARRIZO-WILCOX AQUIFER	5,863	0	1,105	14	149	346	7,477
1998	RUSK	CARRIZO-WILCOX AQUIFER	6,135	0	1,105	18	149	401	7,808
1999	RUSK	CARRIZO-WILCOX AQUIFER	5,621	0	1,105	18	149	433	7,326
2000	RUSK	CARRIZO-WILCOX AQUIFER	7,154	0	38	11	18	436	7,657
2001	RUSK	CARRIZO-WILCOX AQUIFER	6,526	184	7	12	49	221	6,999
2002	RUSK	CARRIZO-WILCOX AQUIFER	6,635	143	6	97	49	217	7,147
2003	RUSK	CARRIZO-WILCOX AQUIFER	6,724	150	6	99	73	201	7,253
2004	RUSK	CARRIZO-WILCOX AQUIFER	6,696	176	6	113	92	221	7,304
2005	RUSK	CARRIZO-WILCOX AQUIFER	6,644	210	3	0	92	231	7,180
2006	RUSK	CARRIZO-WILCOX AQUIFER	6,887	188	0	287	100	202	7,664
2007	RUSK	CARRIZO-WILCOX AQUIFER	6,137	71	0	356	25	216	6,805
2008	RUSK	CARRIZO-WILCOX AQUIFER	6,529	188	0	147	29	209	7,102
2009	RUSK	CARRIZO-WILCOX AQUIFER	6,347	196	0	183	0	194	6,920
2010	RUSK	CARRIZO-WILCOX AQUIFER	6,822	0	173	358	0	224	7,577
2011	RUSK	CARRIZO-WILCOX AQUIFER	8,226	0	160	1,023	172	223	9,804
2012	RUSK	CARRIZO-WILCOX AQUIFER	7,399	0	115	245	69	180	8,008
2001	RUSK	OTHER AQUIFER	0	0	0	0	0	0	0
2002	RUSK	OTHER AQUIFER	0	0	0	0	0	0	0
2006	RUSK	OTHER AQUIFER	44	0	0	0	0	0	44
2007	RUSK	OTHER AQUIFER	36	0	0	0	0	0	36
2008	RUSK	OTHER AQUIFER	40	0	0	0	0	0	40
2009	RUSK	OTHER AQUIFER	52	0	0	0	0	0	52
2010	RUSK	OTHER AQUIFER	64	0	0	0	0	0	64
2011	RUSK	OTHER AQUIFER	68	0	0	0	136	0	204
2012	RUSK	OTHER AQUIFER	64	0	0	2,132	54	0	2,250
1980	RUSK	QUEEN CITY AQUIFER	67	0	72	0	0	35	174
1984	RUSK	QUEEN CITY AQUIFER	32	0	86	0	0	31	149
1985	RUSK	QUEEN CITY AQUIFER	32	0	206	0	0	28	266
1986	RUSK	QUEEN CITY AQUIFER	25	0	195	0	0	27	247
1987	RUSK	QUEEN CITY AQUIFER	22	0	183	0	0	25	230
1988	RUSK	QUEEN CITY AQUIFER	30	0	165	0	0	26	221
1989	RUSK	QUEEN CITY AQUIFER	41	0	153	0	0	27	221
1990	RUSK	QUEEN CITY AQUIFER	39	0	153	0	0	28	220
1991	RUSK	QUEEN CITY AQUIFER	45	0	99	0	0	28	172
1992	RUSK	QUEEN CITY AQUIFER	44	0	99	0	0	27	170
1993	RUSK	QUEEN CITY AQUIFER	48	0	96	0	0	28	172
1994	RUSK	QUEEN CITY AQUIFER	32	0	96	0	0	26	154
1995	RUSK	QUEEN CITY AQUIFER	35	0	96	0	0	23	154
1996	RUSK	QUEEN CITY AQUIFER	26	0	96	0	0	20	142
1997	RUSK	QUEEN CITY AQUIFER	26	0	96	0	0	21	143
1998	RUSK	QUEEN CITY AQUIFER	27	0	96	0	0	24	147
1999	RUSK	QUEEN CITY AQUIFER	25	0	96	0	0	26	147
2000	RUSK	QUEEN CITY AQUIFER	5	0	0	0	0	26	31
2001	RUSK	QUEEN CITY AQUIFER	5	0	0	0	0	15	20
2002	RUSK	QUEEN CITY AQUIFER	4	0	0	0	0	14	18
2003	RUSK	QUEEN CITY AQUIFER	5	0	0	0	0	14	19
2004	RUSK	QUEEN CITY AQUIFER	4	0	0	0	0	0	4
2005	RUSK	QUEEN CITY AQUIFER	5	0	0	0	0	0	5
2008	RUSK	UNKNOWN	0	0	1,233	0	0	0	1,233

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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2009	RUSK	UNKNOWN	0	0	1,059	0	0	0	1,059
2010	RUSK	UNKNOWN	0	0	885	0	0	0	885
2011	RUSK	UNKNOWN	0	0	387	0	0	0	387
2012	RUSK	UNKNOWN	0	0	310	0	0	0	310
1980	SABINE	CARRIZO-WILCOX AQUIFER	214	0	0	0	0	65	279
1984	SABINE	CARRIZO-WILCOX AQUIFER	81	0	0	0	0	64	145
1985	SABINE	CARRIZO-WILCOX AQUIFER	48	0	0	0	0	57	105
1986	SABINE	CARRIZO-WILCOX AQUIFER	46	0	0	0	0	60	106
1987	SABINE	CARRIZO-WILCOX AQUIFER	44	0	0	0	0	73	117
1988	SABINE	CARRIZO-WILCOX AQUIFER	46	0	0	0	50	75	171
1989	SABINE	CARRIZO-WILCOX AQUIFER	72	0	0	0	0	76	148
1990	SABINE	CARRIZO-WILCOX AQUIFER	77	0	0	0	0	84	161
1991	SABINE	CARRIZO-WILCOX AQUIFER	72	0	0	0	0	86	158
1992	SABINE	CARRIZO-WILCOX AQUIFER	82	0	0	0	0	74	156
1993	SABINE	CARRIZO-WILCOX AQUIFER	94	0	0	0	0	77	171
1994	SABINE	CARRIZO-WILCOX AQUIFER	102	0	0	0	0	28	130
1995	SABINE	CARRIZO-WILCOX AQUIFER	91	0	0	0	0	22	113
1996	SABINE	CARRIZO-WILCOX AQUIFER	97	0	0	0	0	20	117
1997	SABINE	CARRIZO-WILCOX AQUIFER	90	0	0	0	0	46	136
1998	SABINE	CARRIZO-WILCOX AQUIFER	116	0	0	0	0	97	213
1999	SABINE	CARRIZO-WILCOX AQUIFER	63	0	0	0	0	92	155
2000	SABINE	CARRIZO-WILCOX AQUIFER	245	0	0	0	0	116	361
2001	SABINE	CARRIZO-WILCOX AQUIFER	250	0	0	0	0	102	352
2002	SABINE	CARRIZO-WILCOX AQUIFER	292	0	0	0	0	103	395
2003	SABINE	CARRIZO-WILCOX AQUIFER	375	0	0	0	0	110	485
2004	SABINE	CARRIZO-WILCOX AQUIFER	352	0	0	0	0	85	437
2005	SABINE	CARRIZO-WILCOX AQUIFER	389	0	0	0	0	45	434
2006	SABINE	CARRIZO-WILCOX AQUIFER	107	0	0	0	0	46	153
2007	SABINE	CARRIZO-WILCOX AQUIFER	223	0	0	0	0	45	268
2008	SABINE	CARRIZO-WILCOX AQUIFER	200	0	0	0	0	55	255
2009	SABINE	CARRIZO-WILCOX AQUIFER	532	0	0	0	0	57	589
2010	SABINE	CARRIZO-WILCOX AQUIFER	177	0	0	0	0	7	184
2011	SABINE	CARRIZO-WILCOX AQUIFER	323	0	0	0	0	7	330
2012	SABINE	CARRIZO-WILCOX AQUIFER	279	0	0	0	0	6	285
2006	SABINE	GULF COAST AQUIFER	5	0	0	0	0	0	5
2007	SABINE	GULF COAST AQUIFER	4	0	0	0	0	0	4
2008	SABINE	GULF COAST AQUIFER	148	0	0	0	0	0	148
2009	SABINE	GULF COAST AQUIFER	11	0	0	0	0	0	11
2010	SABINE	GULF COAST AQUIFER	18	0	0	0	0	0	18
2011	SABINE	GULF COAST AQUIFER	20	0	0	0	0	0	20
2012	SABINE	GULF COAST AQUIFER	18	0	0	0	0	0	18
1980	SABINE	OTHER AQUIFER	415	132	0	0	0	42	589
1984	SABINE	OTHER AQUIFER	264	433	0	0	0	40	737
1985	SABINE	OTHER AQUIFER	273	417	0	0	0	36	726
1986	SABINE	OTHER AQUIFER	255	420	0	0	0	38	713
1987	SABINE	OTHER AQUIFER	274	457	0	0	0	46	777
1988	SABINE	OTHER AQUIFER	312	418	0	0	0	47	777
1989	SABINE	OTHER AQUIFER	322	432	0	0	0	48	802
1990	SABINE	OTHER AQUIFER	330	374	0	0	0	53	757
1991	SABINE	OTHER AQUIFER	319	364	0	0	0	54	737
1992	SABINE	OTHER AQUIFER	281	402	0	0	0	47	730
1993	SABINE	OTHER AQUIFER	294	455	0	0	0	49	798
1994	SABINE	OTHER AQUIFER	287	512	0	0	0	18	817
1995	SABINE	OTHER AQUIFER	271	451	0	0	0	14	736
1996	SABINE	OTHER AQUIFER	285	368	0	0	0	13	666
1997	SABINE	OTHER AQUIFER	276	374	0	0	0	29	679
1998	SABINE	OTHER AQUIFER	356	260	0	0	0	61	677
1999	SABINE	OTHER AQUIFER	192	158	0	0	0	58	408
2000	SABINE	OTHER AQUIFER	327	214	0	0	0	20	561
2001	SABINE	OTHER AQUIFER	270	225	0	0	0	4	499
2002	SABINE	OTHER AQUIFER	258	242	0	0	0	4	504
2003	SABINE	OTHER AQUIFER	218	140	0	0	0	4	362
2004	SABINE	OTHER AQUIFER	205	95	0	0	0	0	300
2005	SABINE	OTHER AQUIFER	306	130	0	0	0	0	436
2006	SABINE	OTHER AQUIFER	193	93	0	0	0	0	286
2007	SABINE	OTHER AQUIFER	194	93	0	0	0	0	287
2008	SABINE	OTHER AQUIFER	198	0	0	0	0	0	198
2009	SABINE	OTHER AQUIFER	30	0	0	0	0	0	30
2010	SABINE	OTHER AQUIFER	48	0	0	0	0	0	48
2011	SABINE	OTHER AQUIFER	52	0	0	0	0	0	52
2012	SABINE	OTHER AQUIFER	122	0	0	0	0	0	122
1980	SABINE	SPARTA AQUIFER	160	0	0	0	0	35	195
1984	SABINE	SPARTA AQUIFER	44	0	0	0	0	34	78
1985	SABINE	SPARTA AQUIFER	38	0	0	0	0	31	69
1986	SABINE	SPARTA AQUIFER	37	0	0	0	0	33	70
1987	SABINE	SPARTA AQUIFER	38	0	0	0	0	40	78
1988	SABINE	SPARTA AQUIFER	39	0	0	0	0	40	79
1989	SABINE	SPARTA AQUIFER	41	0	0	0	0	41	82

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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1990	SABINE	SPARTA AQUIFER	42	0	0	0	0	45	87
1991	SABINE	SPARTA AQUIFER	40	0	0	0	0	46	86
1992	SABINE	SPARTA AQUIFER	42	0	0	0	0	40	82
1993	SABINE	SPARTA AQUIFER	45	0	0	0	0	41	86
1994	SABINE	SPARTA AQUIFER	46	0	0	0	0	15	61
1995	SABINE	SPARTA AQUIFER	31	0	0	0	0	12	43
1996	SABINE	SPARTA AQUIFER	31	0	0	0	0	11	42
1997	SABINE	SPARTA AQUIFER	30	0	0	0	0	25	55
1998	SABINE	SPARTA AQUIFER	39	0	0	0	0	52	91
1999	SABINE	SPARTA AQUIFER	21	0	0	0	0	50	71
2000	SABINE	SPARTA AQUIFER	3	0	0	0	0	63	66
2001	SABINE	SPARTA AQUIFER	3	0	0	0	0	52	55
2002	SABINE	SPARTA AQUIFER	3	0	0	0	0	52	55
2003	SABINE	SPARTA AQUIFER	3	0	0	0	0	56	59
2004	SABINE	SPARTA AQUIFER	3	0	0	0	0	27	30
2005	SABINE	SPARTA AQUIFER	3	0	0	0	0	15	18
2006	SABINE	SPARTA AQUIFER	15	0	0	0	0	15	30
2007	SABINE	SPARTA AQUIFER	12	0	0	0	0	15	27
2008	SABINE	SPARTA AQUIFER	14	0	0	0	0	27	41
2009	SABINE	SPARTA AQUIFER	34	0	0	0	0	28	62
2010	SABINE	SPARTA AQUIFER	56	0	0	0	0	3	59
2011	SABINE	SPARTA AQUIFER	61	0	0	0	0	3	64
2012	SABINE	SPARTA AQUIFER	57	0	0	0	0	2	59
2008	SABINE	UNKNOWN	0	0	138	0	0	0	138
2009	SABINE	UNKNOWN	0	0	201	0	0	0	201
2010	SABINE	UNKNOWN	0	0	264	0	0	0	264
2011	SABINE	UNKNOWN	0	0	222	0	0	0	222
2012	SABINE	UNKNOWN	0	0	37	0	0	0	37
2000	SABINE	YEGUA-JACKSON AQUIFER	0	0	0	0	0	53	53
2001	SABINE	YEGUA-JACKSON AQUIFER	0	0	0	0	0	50	50
2002	SABINE	YEGUA-JACKSON AQUIFER	0	0	0	0	0	51	51
2003	SABINE	YEGUA-JACKSON AQUIFER	0	0	0	0	0	54	54
2004	SABINE	YEGUA-JACKSON AQUIFER	0	0	0	0	0	118	118
2005	SABINE	YEGUA-JACKSON AQUIFER	0	0	0	0	0	62	62
2006	SABINE	YEGUA-JACKSON AQUIFER	127	0	0	0	0	63	190
2007	SABINE	YEGUA-JACKSON AQUIFER	105	0	0	0	0	62	167
2008	SABINE	YEGUA-JACKSON AQUIFER	117	0	0	0	0	30	147
2009	SABINE	YEGUA-JACKSON AQUIFER	294	0	0	0	0	31	325
2010	SABINE	YEGUA-JACKSON AQUIFER	706	0	0	0	0	8	714
2011	SABINE	YEGUA-JACKSON AQUIFER	608	0	0	0	0	8	616
2012	SABINE	YEGUA-JACKSON AQUIFER	581	0	0	0	0	6	587
1980	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	283	0	0	0	0	79	362
1984	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	131	0	0	0	0	67	198
1985	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	122	0	0	0	0	60	182
1986	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	134	0	0	0	0	68	202
1987	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	126	0	0	0	0	74	200
1988	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	135	0	0	0	100	76	311
1989	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	144	0	0	0	0	77	221
1990	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	140	0	0	0	0	85	225
1991	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	106	0	0	0	0	87	193
1992	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	88	0	0	0	0	93	181
1993	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	95	0	0	0	39	93	227
1994	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	99	3	0	0	75	31	208
1995	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	115	3	0	0	77	33	228
1996	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	87	3	0	0	77	29	196
1997	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	102	2	0	0	77	53	234
1998	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	106	2	0	0	77	103	288
1999	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	108	3	0	0	77	98	286
2000	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	241	3	0	0	112	128	484
2001	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	289	4	0	0	82	83	458
2002	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	294	4	0	0	82	84	464
2003	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	381	5	0	0	50	83	519
2004	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	276	3	0	0	50	131	460
2005	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	359	3	0	0	50	40	452
2006	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	309	3	0	0	63	40	415
2007	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	298	5	0	0	0	42	345
2008	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	329	4	0	0	0	109	442
2009	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	352	6	0	0	0	111	469
2010	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	386	5	0	0	0	27	418
2011	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	416	4	0	0	14	27	461
2012	SAN AUGUSTINE	CARRIZO-WILCOX AQUIFER	395	3	0	0	0	26	424
1980	SAN AUGUSTINE	OTHER AQUIFER	300	0	0	0	0	101	401
1984	SAN AUGUSTINE	OTHER AQUIFER	249	0	0	0	0	85	334
1985	SAN AUGUSTINE	OTHER AQUIFER	245	0	0	0	0	77	322
1986	SAN AUGUSTINE	OTHER AQUIFER	248	0	0	0	0	87	335
1987	SAN AUGUSTINE	OTHER AQUIFER	234	0	0	0	0	94	328
1988	SAN AUGUSTINE	OTHER AQUIFER	240	0	0	0	0	97	337
1989	SAN AUGUSTINE	OTHER AQUIFER	227	0	0	0	0	99	326

Groundwater Pumping Estimates from Texas Water Development Board
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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1990	SAN AUGUSTINE	OTHER AQUIFER	217	0	0	0	0	110	327
1991	SAN AUGUSTINE	OTHER AQUIFER	176	0	0	0	0	113	289
1992	SAN AUGUSTINE	OTHER AQUIFER	197	0	0	0	0	120	317
1993	SAN AUGUSTINE	OTHER AQUIFER	220	0	0	0	0	121	341
1994	SAN AUGUSTINE	OTHER AQUIFER	231	0	0	0	0	40	271
1995	SAN AUGUSTINE	OTHER AQUIFER	250	0	0	0	0	44	294
1996	SAN AUGUSTINE	OTHER AQUIFER	240	0	0	0	0	38	278
1997	SAN AUGUSTINE	OTHER AQUIFER	253	0	0	0	0	69	322
1998	SAN AUGUSTINE	OTHER AQUIFER	264	0	0	0	0	134	398
1999	SAN AUGUSTINE	OTHER AQUIFER	267	0	0	0	0	128	395
2000	SAN AUGUSTINE	OTHER AQUIFER	411	0	0	0	0	167	578
2001	SAN AUGUSTINE	OTHER AQUIFER	338	0	0	0	0	160	498
2002	SAN AUGUSTINE	OTHER AQUIFER	342	0	0	0	0	160	502
2003	SAN AUGUSTINE	OTHER AQUIFER	310	0	0	0	0	159	469
2004	SAN AUGUSTINE	OTHER AQUIFER	305	0	0	0	0	40	345
2005	SAN AUGUSTINE	OTHER AQUIFER	316	0	0	0	0	12	328
2006	SAN AUGUSTINE	OTHER AQUIFER	194	0	0	0	0	12	206
2007	SAN AUGUSTINE	OTHER AQUIFER	188	0	0	0	0	13	201
2008	SAN AUGUSTINE	OTHER AQUIFER	98	0	0	0	0	0	98
2009	SAN AUGUSTINE	OTHER AQUIFER	109	0	0	0	0	0	109
2010	SAN AUGUSTINE	OTHER AQUIFER	119	0	0	0	0	7	126
2011	SAN AUGUSTINE	OTHER AQUIFER	124	0	0	0	0	7	131
2012	SAN AUGUSTINE	OTHER AQUIFER	118	0	0	0	0	6	124
1980	SAN AUGUSTINE	SPARTA AQUIFER	51	0	0	0	0	50	101
1984	SAN AUGUSTINE	SPARTA AQUIFER	59	0	0	0	0	43	102
1985	SAN AUGUSTINE	SPARTA AQUIFER	50	0	0	0	0	38	88
1986	SAN AUGUSTINE	SPARTA AQUIFER	58	0	0	0	0	43	101
1987	SAN AUGUSTINE	SPARTA AQUIFER	48	0	0	0	0	47	95
1988	SAN AUGUSTINE	SPARTA AQUIFER	42	0	0	0	0	48	90
1989	SAN AUGUSTINE	SPARTA AQUIFER	41	0	0	0	0	49	90
1990	SAN AUGUSTINE	SPARTA AQUIFER	37	0	0	0	0	54	91
1991	SAN AUGUSTINE	SPARTA AQUIFER	28	0	0	0	0	55	83
1992	SAN AUGUSTINE	SPARTA AQUIFER	29	0	0	0	0	58	87
1993	SAN AUGUSTINE	SPARTA AQUIFER	37	0	0	0	39	58	134
1994	SAN AUGUSTINE	SPARTA AQUIFER	47	0	0	0	0	19	66
1995	SAN AUGUSTINE	SPARTA AQUIFER	42	0	0	0	0	21	63
1996	SAN AUGUSTINE	SPARTA AQUIFER	32	0	0	0	0	18	50
1997	SAN AUGUSTINE	SPARTA AQUIFER	32	0	0	0	0	33	65
1998	SAN AUGUSTINE	SPARTA AQUIFER	33	0	0	0	0	64	97
1999	SAN AUGUSTINE	SPARTA AQUIFER	34	0	0	0	0	61	95
2000	SAN AUGUSTINE	SPARTA AQUIFER	29	0	0	0	0	80	109
2001	SAN AUGUSTINE	SPARTA AQUIFER	30	0	0	0	0	76	106
2002	SAN AUGUSTINE	SPARTA AQUIFER	31	0	0	0	0	77	108
2003	SAN AUGUSTINE	SPARTA AQUIFER	26	0	0	0	0	76	102
2004	SAN AUGUSTINE	SPARTA AQUIFER	25	0	0	0	0	159	184
2005	SAN AUGUSTINE	SPARTA AQUIFER	27	0	0	0	0	49	76
2006	SAN AUGUSTINE	SPARTA AQUIFER	95	0	0	0	0	49	144
2007	SAN AUGUSTINE	SPARTA AQUIFER	78	0	0	0	0	52	130
2008	SAN AUGUSTINE	SPARTA AQUIFER	85	0	0	0	0	0	85
2009	SAN AUGUSTINE	SPARTA AQUIFER	113	0	0	0	0	0	113
2010	SAN AUGUSTINE	SPARTA AQUIFER	142	0	0	0	0	27	169
2011	SAN AUGUSTINE	SPARTA AQUIFER	158	0	0	0	0	27	185
2012	SAN AUGUSTINE	SPARTA AQUIFER	150	0	0	0	0	25	175
2008	SAN AUGUSTINE	UNKNOWN	0	0	53	0	0	0	53
2009	SAN AUGUSTINE	UNKNOWN	0	0	167	0	0	0	167
2010	SAN AUGUSTINE	UNKNOWN	0	0	281	0	0	0	281
2011	SAN AUGUSTINE	UNKNOWN	0	0	984	0	0	0	984
2012	SAN AUGUSTINE	UNKNOWN	0	0	369	0	0	0	369
2006	SAN AUGUSTINE	YEGUA-JACKSON AQUIFER	110	0	0	0	0	0	110
2007	SAN AUGUSTINE	YEGUA-JACKSON AQUIFER	91	0	0	0	0	0	91
2008	SAN AUGUSTINE	YEGUA-JACKSON AQUIFER	99	0	0	0	0	0	99
2009	SAN AUGUSTINE	YEGUA-JACKSON AQUIFER	132	0	0	0	0	0	132
2010	SAN AUGUSTINE	YEGUA-JACKSON AQUIFER	166	0	0	0	0	0	166
2011	SAN AUGUSTINE	YEGUA-JACKSON AQUIFER	184	0	0	0	0	0	184
2012	SAN AUGUSTINE	YEGUA-JACKSON AQUIFER	175	0	0	0	0	0	175
1980	SHELBY	CARRIZO-WILCOX AQUIFER	2,015	23	0	0	0	748	2,786
1984	SHELBY	CARRIZO-WILCOX AQUIFER	2,661	2	0	0	5	584	3,252
1985	SHELBY	CARRIZO-WILCOX AQUIFER	1,891	4	0	0	12	561	2,468
1986	SHELBY	CARRIZO-WILCOX AQUIFER	1,645	4	0	0	13	588	2,250
1987	SHELBY	CARRIZO-WILCOX AQUIFER	1,753	0	0	0	13	664	2,430
1988	SHELBY	CARRIZO-WILCOX AQUIFER	1,439	0	0	0	39	684	2,162
1989	SHELBY	CARRIZO-WILCOX AQUIFER	1,591	0	0	0	11	721	2,323
1990	SHELBY	CARRIZO-WILCOX AQUIFER	1,600	52	0	0	12	785	2,449
1991	SHELBY	CARRIZO-WILCOX AQUIFER	1,673	66	0	0	12	801	2,552
1992	SHELBY	CARRIZO-WILCOX AQUIFER	1,875	63	0	0	12	779	2,729
1993	SHELBY	CARRIZO-WILCOX AQUIFER	1,681	49	0	0	29	781	2,540
1994	SHELBY	CARRIZO-WILCOX AQUIFER	1,568	57	0	0	32	1,107	2,764
1995	SHELBY	CARRIZO-WILCOX AQUIFER	1,501	45	0	0	29	1,137	2,712

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1996	SHELBY	CARRIZO-WILCOX AQUIFER	1,478	50	0	0	29	1,161	2,718
1997	SHELBY	CARRIZO-WILCOX AQUIFER	1,494	57	0	0	29	1,201	2,781
1998	SHELBY	CARRIZO-WILCOX AQUIFER	1,623	62	0	0	29	1,231	2,945
1999	SHELBY	CARRIZO-WILCOX AQUIFER	1,716	71	0	0	29	1,329	3,145
2000	SHELBY	CARRIZO-WILCOX AQUIFER	2,351	64	0	0	26	1,393	3,834
2001	SHELBY	CARRIZO-WILCOX AQUIFER	1,975	48	0	0	20	1,048	3,091
2002	SHELBY	CARRIZO-WILCOX AQUIFER	1,927	36	0	0	24	1,051	3,038
2003	SHELBY	CARRIZO-WILCOX AQUIFER	1,913	14	0	0	22	1,074	3,023
2004	SHELBY	CARRIZO-WILCOX AQUIFER	1,931	1	0	0	20	1,099	3,051
2005	SHELBY	CARRIZO-WILCOX AQUIFER	2,155	1	0	0	23	562	2,741
2006	SHELBY	CARRIZO-WILCOX AQUIFER	2,062	1	0	0	27	588	2,678
2007	SHELBY	CARRIZO-WILCOX AQUIFER	1,888	0	0	0	20	579	2,487
2008	SHELBY	CARRIZO-WILCOX AQUIFER	1,757	0	0	0	25	530	2,312
2009	SHELBY	CARRIZO-WILCOX AQUIFER	2,046	0	0	0	0	571	2,617
2010	SHELBY	CARRIZO-WILCOX AQUIFER	2,484	0	0	0	0	459	2,943
2011	SHELBY	CARRIZO-WILCOX AQUIFER	2,910	0	0	0	13	452	3,375
2012	SHELBY	CARRIZO-WILCOX AQUIFER	2,731	0	0	0	8	437	3,176
2008	SHELBY	UNKNOWN	0	0	77	0	0	0	77
2009	SHELBY	UNKNOWN	0	0	359	0	0	0	359
2010	SHELBY	UNKNOWN	0	0	640	0	0	0	640
2011	SHELBY	UNKNOWN	0	0	1,380	0	0	0	1,380
2012	SHELBY	UNKNOWN	0	0	240	0	0	0	240
1980	SMITH	CARRIZO-WILCOX AQUIFER	16,100	10	329	0	25	90	16,554
1984	SMITH	CARRIZO-WILCOX AQUIFER	17,466	1,004	358	0	0	108	18,936
1985	SMITH	CARRIZO-WILCOX AQUIFER	17,215	1,020	506	0	0	91	18,832
1986	SMITH	CARRIZO-WILCOX AQUIFER	16,672	853	499	0	0	97	18,121
1987	SMITH	CARRIZO-WILCOX AQUIFER	17,175	744	465	0	0	91	18,475
1988	SMITH	CARRIZO-WILCOX AQUIFER	23,727	662	473	0	92	96	25,050
1989	SMITH	CARRIZO-WILCOX AQUIFER	16,878	637	441	0	20	99	18,075
1990	SMITH	CARRIZO-WILCOX AQUIFER	14,728	464	441	0	5	102	15,740
1991	SMITH	CARRIZO-WILCOX AQUIFER	14,744	390	435	0	5	104	15,678
1992	SMITH	CARRIZO-WILCOX AQUIFER	15,972	377	435	0	5	93	16,882
1993	SMITH	CARRIZO-WILCOX AQUIFER	17,194	328	422	0	57	87	18,088
1994	SMITH	CARRIZO-WILCOX AQUIFER	17,752	406	422	0	62	95	18,737
1995	SMITH	CARRIZO-WILCOX AQUIFER	19,503	418	161	0	56	89	20,227
1996	SMITH	CARRIZO-WILCOX AQUIFER	19,278	457	167	0	62	79	20,043
1997	SMITH	CARRIZO-WILCOX AQUIFER	18,764	406	167	0	62	79	19,478
1998	SMITH	CARRIZO-WILCOX AQUIFER	20,340	343	164	0	62	90	20,999
1999	SMITH	CARRIZO-WILCOX AQUIFER	20,937	387	165	0	62	100	21,651
2000	SMITH	CARRIZO-WILCOX AQUIFER	21,988	0	0	0	129	95	22,212
2001	SMITH	CARRIZO-WILCOX AQUIFER	21,336	0	0	0	86	49	21,471
2002	SMITH	CARRIZO-WILCOX AQUIFER	20,440	0	0	0	86	45	20,571
2003	SMITH	CARRIZO-WILCOX AQUIFER	20,815	263	0	0	79	42	21,199
2004	SMITH	CARRIZO-WILCOX AQUIFER	19,198	310	0	0	109	58	19,675
2005	SMITH	CARRIZO-WILCOX AQUIFER	19,771	289	0	0	103	152	20,315
2006	SMITH	CARRIZO-WILCOX AQUIFER	20,230	361	0	0	249	166	21,006
2007	SMITH	CARRIZO-WILCOX AQUIFER	19,611	453	0	0	0	168	20,232
2008	SMITH	CARRIZO-WILCOX AQUIFER	21,683	361	0	0	0	100	22,144
2009	SMITH	CARRIZO-WILCOX AQUIFER	11,334	196	0	0	251	128	11,909
2010	SMITH	CARRIZO-WILCOX AQUIFER	9,615	179	0	0	38	177	10,009
2011	SMITH	CARRIZO-WILCOX AQUIFER	12,990	154	0	0	180	178	13,502
2012	SMITH	CARRIZO-WILCOX AQUIFER	21,868	156	263	0	41	128	22,456
1992	SMITH	OTHER AQUIFER	0	58	0	0	0	0	58
1993	SMITH	OTHER AQUIFER	0	46	0	0	0	0	46
1994	SMITH	OTHER AQUIFER	0	49	0	0	0	0	49
1995	SMITH	OTHER AQUIFER	0	59	0	0	0	0	59
1996	SMITH	OTHER AQUIFER	0	40	0	0	0	0	40
1997	SMITH	OTHER AQUIFER	0	51	0	0	0	0	51
1998	SMITH	OTHER AQUIFER	0	7	0	0	0	0	7
1999	SMITH	OTHER AQUIFER	0	62	0	0	0	0	62
2000	SMITH	OTHER AQUIFER	0	57	0	0	0	0	57
2001	SMITH	OTHER AQUIFER	0	70	0	0	0	0	70
2002	SMITH	OTHER AQUIFER	0	71	0	0	0	0	71
2003	SMITH	OTHER AQUIFER	0	71	0	0	0	0	71
2008	SMITH	OTHER AQUIFER	0	133	0	0	0	0	133
2009	SMITH	OTHER AQUIFER	0	162	0	0	0	0	162
2010	SMITH	OTHER AQUIFER	0	180	0	0	0	0	180
2011	SMITH	OTHER AQUIFER	0	167	0	0	0	0	167
2012	SMITH	OTHER AQUIFER	0	120	0	0	0	0	120
1980	SMITH	QUEEN CITY AQUIFER	378	0	360	0	25	333	1,096
1984	SMITH	QUEEN CITY AQUIFER	343	44	147	0	0	403	937
1985	SMITH	QUEEN CITY AQUIFER	307	35	309	0	0	339	990
1986	SMITH	QUEEN CITY AQUIFER	312	32	273	0	0	367	984
1987	SMITH	QUEEN CITY AQUIFER	274	0	257	0	228	339	1,098
1988	SMITH	QUEEN CITY AQUIFER	288	0	266	0	91	358	1,003
1989	SMITH	QUEEN CITY AQUIFER	252	0	248	0	19	371	890
1990	SMITH	QUEEN CITY AQUIFER	518	0	248	0	5	381	1,152
1991	SMITH	QUEEN CITY AQUIFER	486	0	245	0	5	387	1,123

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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1992	SMITH	QUEEN CITY AQUIFER	473	0	245	0	5	349	1,072
1993	SMITH	QUEEN CITY AQUIFER	507	0	238	0	57	326	1,128
1994	SMITH	QUEEN CITY AQUIFER	444	0	238	0	51	356	1,089
1995	SMITH	QUEEN CITY AQUIFER	680	0	90	0	44	332	1,146
1996	SMITH	QUEEN CITY AQUIFER	658	0	92	0	50	295	1,095
1997	SMITH	QUEEN CITY AQUIFER	589	0	92	0	50	295	1,026
1998	SMITH	QUEEN CITY AQUIFER	638	0	91	0	50	337	1,116
1999	SMITH	QUEEN CITY AQUIFER	658	0	92	0	50	372	1,172
2000	SMITH	QUEEN CITY AQUIFER	76	0	0	0	54	352	482
2001	SMITH	QUEEN CITY AQUIFER	75	0	0	0	34	201	310
2002	SMITH	QUEEN CITY AQUIFER	71	0	0	0	34	187	292
2003	SMITH	QUEEN CITY AQUIFER	74	0	0	0	31	175	280
2004	SMITH	QUEEN CITY AQUIFER	74	0	0	0	61	163	298
2005	SMITH	QUEEN CITY AQUIFER	83	0	0	0	57	430	570
2006	SMITH	QUEEN CITY AQUIFER	615	0	0	0	139	470	1,224
2007	SMITH	QUEEN CITY AQUIFER	517	0	0	0	0	476	993
2008	SMITH	QUEEN CITY AQUIFER	586	0	0	0	0	433	1,019
2009	SMITH	QUEEN CITY AQUIFER	941	0	0	0	141	327	1,409
2010	SMITH	QUEEN CITY AQUIFER	2,436	0	0	0	22	424	2,882
2011	SMITH	QUEEN CITY AQUIFER	2,415	0	0	0	101	427	2,943
2012	SMITH	QUEEN CITY AQUIFER	2,339	0	0	0	23	306	2,668
2000	SMITH	SPARTA AQUIFER	0	0	0	0	25	0	25
2001	SMITH	SPARTA AQUIFER	0	0	0	0	17	0	17
2002	SMITH	SPARTA AQUIFER	0	0	0	0	17	0	17
2003	SMITH	SPARTA AQUIFER	0	0	0	0	16	0	16
2004	SMITH	SPARTA AQUIFER	0	0	0	0	24	0	24
2005	SMITH	SPARTA AQUIFER	0	0	0	0	22	0	22
2006	SMITH	SPARTA AQUIFER	400	0	0	0	54	0	454
2007	SMITH	SPARTA AQUIFER	335	0	0	0	0	0	335
2008	SMITH	SPARTA AQUIFER	378	0	0	0	0	0	378
2009	SMITH	SPARTA AQUIFER	614	0	0	0	26	0	640
2010	SMITH	SPARTA AQUIFER	857	0	0	0	4	0	861
2011	SMITH	SPARTA AQUIFER	961	0	0	0	19	0	980
2012	SMITH	SPARTA AQUIFER	957	0	0	0	4	0	961
2008	SMITH	UNKNOWN	0	0	97	0	0	0	97
2009	SMITH	UNKNOWN	0	0	101	0	0	0	101
2010	SMITH	UNKNOWN	0	0	105	0	0	0	105
2011	SMITH	UNKNOWN	0	0	91	0	0	0	91
2012	SMITH	UNKNOWN	0	0	1	0	0	0	1
1980	TITUS	CARRIZO-WILCOX AQUIFER	422	316	0	62	0	356	1,156
1984	TITUS	CARRIZO-WILCOX AQUIFER	486	235	165	16	0	426	1,328
1985	TITUS	CARRIZO-WILCOX AQUIFER	409	290	359	2	0	362	1,422
1986	TITUS	CARRIZO-WILCOX AQUIFER	436	74	1,475	85	0	358	2,428
1987	TITUS	CARRIZO-WILCOX AQUIFER	448	145	319	4	0	376	1,292
1988	TITUS	CARRIZO-WILCOX AQUIFER	423	57	320	4	50	389	1,243
1989	TITUS	CARRIZO-WILCOX AQUIFER	446	242	318	31	0	400	1,437
1990	TITUS	CARRIZO-WILCOX AQUIFER	407	209	318	4	0	416	1,354
1991	TITUS	CARRIZO-WILCOX AQUIFER	405	115	1,736	4	0	424	2,684
1992	TITUS	CARRIZO-WILCOX AQUIFER	410	122	1,736	4	0	304	2,576
1993	TITUS	CARRIZO-WILCOX AQUIFER	430	112	1,729	4	0	322	2,597
1994	TITUS	CARRIZO-WILCOX AQUIFER	446	300	1,729	4	0	387	2,866
1995	TITUS	CARRIZO-WILCOX AQUIFER	487	120	1,729	0	0	375	2,711
1996	TITUS	CARRIZO-WILCOX AQUIFER	500	295	1,729	0	0	395	2,919
1997	TITUS	CARRIZO-WILCOX AQUIFER	527	223	1,729	0	0	356	2,835
1998	TITUS	CARRIZO-WILCOX AQUIFER	541	176	1,729	0	0	362	2,808
1999	TITUS	CARRIZO-WILCOX AQUIFER	535	199	1,729	0	0	383	2,846
2000	TITUS	CARRIZO-WILCOX AQUIFER	91	194	0	0	0	358	643
2001	TITUS	CARRIZO-WILCOX AQUIFER	92	104	0	0	0	184	380
2002	TITUS	CARRIZO-WILCOX AQUIFER	91	90	0	0	0	176	357
2003	TITUS	CARRIZO-WILCOX AQUIFER	92	104	0	0	0	154	350
2004	TITUS	CARRIZO-WILCOX AQUIFER	97	96	0	0	0	173	366
2005	TITUS	CARRIZO-WILCOX AQUIFER	102	93	0	0	0	183	378
2006	TITUS	CARRIZO-WILCOX AQUIFER	118	94	0	22	0	201	435
2007	TITUS	CARRIZO-WILCOX AQUIFER	100	80	0	0	0	157	337
2008	TITUS	CARRIZO-WILCOX AQUIFER	111	100	0	0	0	190	401
2009	TITUS	CARRIZO-WILCOX AQUIFER	115	91	0	0	46	198	450
2010	TITUS	CARRIZO-WILCOX AQUIFER	120	90	1	0	0	226	437
2011	TITUS	CARRIZO-WILCOX AQUIFER	141	90	1	0	109	224	565
2012	TITUS	CARRIZO-WILCOX AQUIFER	155	132	2	0	46	208	543
2002	TITUS	NACATOCH AQUIFER	63	0	0	0	0	0	63
2007	TITUS	NACATOCH AQUIFER	100	0	0	0	0	0	100
2008	TITUS	NACATOCH AQUIFER	100	0	0	0	0	0	100
2009	TITUS	NACATOCH AQUIFER	100	0	0	0	0	0	100
1980	TITUS	OTHER AQUIFER	128	0	0	0	0	59	187
1984	TITUS	OTHER AQUIFER	97	0	0	0	0	55	152
1985	TITUS	OTHER AQUIFER	125	0	0	0	0	46	171
1986	TITUS	OTHER AQUIFER	108	0	0	0	0	46	154
1987	TITUS	OTHER AQUIFER	48	0	0	0	0	48	96

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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1988	TITUS	OTHER AQUIFER	46	0	0	0	0	50	96
1989	TITUS	OTHER AQUIFER	48	0	0	0	0	51	99
1990	TITUS	OTHER AQUIFER	96	0	0	0	0	53	149
1991	TITUS	OTHER AQUIFER	98	0	0	0	0	54	152
1992	TITUS	OTHER AQUIFER	100	0	0	0	0	39	139
1993	TITUS	OTHER AQUIFER	99	0	0	0	0	41	140
1994	TITUS	OTHER AQUIFER	102	0	0	0	0	49	151
1995	TITUS	OTHER AQUIFER	114	0	0	0	0	47	161
1996	TITUS	OTHER AQUIFER	117	0	0	0	0	50	167
1997	TITUS	OTHER AQUIFER	125	0	0	0	0	45	170
1998	TITUS	OTHER AQUIFER	128	0	0	0	0	46	174
1999	TITUS	OTHER AQUIFER	127	0	0	0	0	48	175
2000	TITUS	OTHER AQUIFER	8	0	0	0	0	45	53
2001	TITUS	OTHER AQUIFER	8	0	0	0	0	26	34
2002	TITUS	OTHER AQUIFER	9	0	0	0	0	25	34
2003	TITUS	OTHER AQUIFER	9	0	0	0	0	22	31
2004	TITUS	OTHER AQUIFER	9	0	0	0	0	0	9
2005	TITUS	OTHER AQUIFER	9	0	0	0	0	0	9
2008	TITUS	UNKNOWN	0	0	400	0	0	0	400
2009	TITUS	UNKNOWN	0	0	402	0	0	0	402
2010	TITUS	UNKNOWN	0	0	405	0	0	0	405
2011	TITUS	UNKNOWN	0	0	91	0	0	0	91
1988	TRINITY	GULF COAST AQUIFER	24	0	0	0	0	0	24
1989	TRINITY	GULF COAST AQUIFER	24	0	0	0	0	0	24
1990	TRINITY	GULF COAST AQUIFER	39	0	0	0	0	0	39
1991	TRINITY	GULF COAST AQUIFER	39	0	0	0	0	0	39
1992	TRINITY	GULF COAST AQUIFER	39	0	0	0	0	0	39
1993	TRINITY	GULF COAST AQUIFER	31	0	0	0	0	0	31
1994	TRINITY	GULF COAST AQUIFER	35	0	0	0	0	0	35
1995	TRINITY	GULF COAST AQUIFER	53	0	0	0	0	0	53
1996	TRINITY	GULF COAST AQUIFER	38	0	0	0	0	0	38
1997	TRINITY	GULF COAST AQUIFER	38	0	0	0	0	0	38
1998	TRINITY	GULF COAST AQUIFER	38	0	0	0	0	0	38
1999	TRINITY	GULF COAST AQUIFER	21	0	0	0	0	0	21
2000	TRINITY	GULF COAST AQUIFER	73	0	0	0	0	0	73
2001	TRINITY	GULF COAST AQUIFER	140	0	0	0	0	0	140
2002	TRINITY	GULF COAST AQUIFER	141	0	0	0	0	0	141
2003	TRINITY	GULF COAST AQUIFER	139	0	0	0	0	0	139
2004	TRINITY	GULF COAST AQUIFER	147	0	0	0	0	0	147
2005	TRINITY	GULF COAST AQUIFER	82	0	0	0	0	0	82
2006	TRINITY	GULF COAST AQUIFER	396	0	0	0	0	0	396
2007	TRINITY	GULF COAST AQUIFER	492	0	0	0	0	0	492
2008	TRINITY	GULF COAST AQUIFER	349	0	0	0	0	0	349
2009	TRINITY	GULF COAST AQUIFER	367	0	0	0	0	0	367
2010	TRINITY	GULF COAST AQUIFER	419	0	0	0	0	0	419
2011	TRINITY	GULF COAST AQUIFER	460	0	0	0	0	0	460
2012	TRINITY	GULF COAST AQUIFER	333	0	0	0	0	0	333
1980	TRINITY	OTHER AQUIFER	1,325	0	0	0	0	136	1,461
1984	TRINITY	OTHER AQUIFER	501	0	0	0	0	224	725
1985	TRINITY	OTHER AQUIFER	528	0	0	0	0	224	752
1986	TRINITY	OTHER AQUIFER	549	0	0	0	0	224	773
1987	TRINITY	OTHER AQUIFER	695	0	0	0	0	210	905
1988	TRINITY	OTHER AQUIFER	785	0	0	0	50	222	1,057
1989	TRINITY	OTHER AQUIFER	863	0	0	0	3	193	1,059
1990	TRINITY	OTHER AQUIFER	976	0	0	0	4	191	1,171
1991	TRINITY	OTHER AQUIFER	1,049	0	8	0	4	195	1,256
1992	TRINITY	OTHER AQUIFER	891	0	8	0	4	234	1,137
1993	TRINITY	OTHER AQUIFER	754	0	8	0	3	214	979
1994	TRINITY	OTHER AQUIFER	832	0	8	0	3	180	1,023
1995	TRINITY	OTHER AQUIFER	640	0	8	0	3	180	831
1996	TRINITY	OTHER AQUIFER	767	0	8	0	3	174	952
1997	TRINITY	OTHER AQUIFER	1,125	0	8	0	3	187	1,323
1998	TRINITY	OTHER AQUIFER	1,126	0	8	0	3	164	1,301
1999	TRINITY	OTHER AQUIFER	613	0	8	0	3	174	798
2000	TRINITY	OTHER AQUIFER	1,199	0	0	0	0	0	1,199
2001	TRINITY	OTHER AQUIFER	843	0	0	0	0	0	843
2002	TRINITY	OTHER AQUIFER	787	0	0	0	0	0	787
2003	TRINITY	OTHER AQUIFER	784	0	0	0	0	0	784
2004	TRINITY	OTHER AQUIFER	767	0	0	0	0	0	767
2005	TRINITY	OTHER AQUIFER	832	0	0	0	0	0	832
2006	TRINITY	OTHER AQUIFER	460	0	0	0	0	0	460
2007	TRINITY	OTHER AQUIFER	456	0	0	0	0	0	456
2008	TRINITY	OTHER AQUIFER	507	0	0	0	0	0	507
2009	TRINITY	OTHER AQUIFER	724	0	0	0	0	0	724
2010	TRINITY	OTHER AQUIFER	416	0	0	0	0	0	416
2011	TRINITY	OTHER AQUIFER	297	0	0	0	0	0	297
2012	TRINITY	OTHER AQUIFER	253	0	0	0	0	0	253
2000	TRINITY	TRINITY AQUIFER	0	0	0	0	0	0	0

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
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Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2001	TRINITY	TRINITY AQUIFER	0	0	0	0	0	0	0
2002	TRINITY	TRINITY AQUIFER	0	0	0	0	0	0	0
2003	TRINITY	TRINITY AQUIFER	0	0	0	0	0	0	0
2005	TRINITY	TRINITY AQUIFER	0	0	0	0	0	0	0
2006	TRINITY	TRINITY AQUIFER	0	0	0	0	50	0	50
2007	TRINITY	TRINITY AQUIFER	0	0	0	0	0	0	0
2009	TRINITY	TRINITY AQUIFER	0	0	0	0	0	0	0
2011	TRINITY	TRINITY AQUIFER	0	0	0	0	43	0	43
2012	TRINITY	TRINITY AQUIFER	0	0	0	0	42	0	42
2008	TRINITY	UNKNOWN	0	0	0	0	0	0	0
2009	TRINITY	UNKNOWN	0	0	0	0	0	0	0
2010	TRINITY	UNKNOWN	0	0	6	0	0	0	6
2011	TRINITY	UNKNOWN	0	0	3	0	0	0	3
2000	TRINITY	YEGUA-JACKSON AQUIFER	0	0	0	0	0	162	162
2001	TRINITY	YEGUA-JACKSON AQUIFER	0	0	0	0	0	88	88
2002	TRINITY	YEGUA-JACKSON AQUIFER	0	0	0	0	0	82	82
2003	TRINITY	YEGUA-JACKSON AQUIFER	0	0	0	0	0	91	91
2004	TRINITY	YEGUA-JACKSON AQUIFER	0	0	0	0	0	91	91
2005	TRINITY	YEGUA-JACKSON AQUIFER	0	0	0	0	0	28	28
2006	TRINITY	YEGUA-JACKSON AQUIFER	194	0	0	0	50	28	272
2007	TRINITY	YEGUA-JACKSON AQUIFER	162	0	0	0	0	23	185
2008	TRINITY	YEGUA-JACKSON AQUIFER	179	0	0	0	0	20	199
2009	TRINITY	YEGUA-JACKSON AQUIFER	186	0	0	0	0	19	205
2010	TRINITY	YEGUA-JACKSON AQUIFER	390	0	0	0	0	24	414
2011	TRINITY	YEGUA-JACKSON AQUIFER	472	0	0	0	43	23	538
2012	TRINITY	YEGUA-JACKSON AQUIFER	434	0	0	0	41	18	493
1980	UPSHUR	CARRIZO-WILCOX AQUIFER	2,388	296	1	0	0	55	2,740
1984	UPSHUR	CARRIZO-WILCOX AQUIFER	3,077	157	1	0	0	113	3,348
1985	UPSHUR	CARRIZO-WILCOX AQUIFER	3,113	99	0	0	0	98	3,310
1986	UPSHUR	CARRIZO-WILCOX AQUIFER	2,687	90	0	0	0	106	2,883
1987	UPSHUR	CARRIZO-WILCOX AQUIFER	2,819	121	0	0	0	101	3,041
1988	UPSHUR	CARRIZO-WILCOX AQUIFER	2,919	163	0	0	0	98	3,180
1989	UPSHUR	CARRIZO-WILCOX AQUIFER	2,869	157	0	0	0	98	3,124
1990	UPSHUR	CARRIZO-WILCOX AQUIFER	2,800	171	0	0	0	131	3,102
1991	UPSHUR	CARRIZO-WILCOX AQUIFER	2,775	188	1	0	0	130	3,094
1992	UPSHUR	CARRIZO-WILCOX AQUIFER	2,479	225	1	0	0	191	2,896
1993	UPSHUR	CARRIZO-WILCOX AQUIFER	2,664	206	1	0	11	208	3,090
1994	UPSHUR	CARRIZO-WILCOX AQUIFER	2,890	146	1	0	15	190	3,242
1995	UPSHUR	CARRIZO-WILCOX AQUIFER	2,911	150	1	0	15	167	3,244
1996	UPSHUR	CARRIZO-WILCOX AQUIFER	2,882	146	1	0	15	239	3,283
1997	UPSHUR	CARRIZO-WILCOX AQUIFER	3,054	164	1	0	15	150	3,384
1998	UPSHUR	CARRIZO-WILCOX AQUIFER	3,355	160	1	0	15	150	3,681
1999	UPSHUR	CARRIZO-WILCOX AQUIFER	3,350	129	1	0	15	154	3,649
2000	UPSHUR	CARRIZO-WILCOX AQUIFER	3,397	153	0	0	0	152	3,702
2001	UPSHUR	CARRIZO-WILCOX AQUIFER	3,315	183	0	0	0	98	3,596
2002	UPSHUR	CARRIZO-WILCOX AQUIFER	3,275	134	0	0	0	94	3,503
2003	UPSHUR	CARRIZO-WILCOX AQUIFER	3,340	100	0	0	0	95	3,535
2004	UPSHUR	CARRIZO-WILCOX AQUIFER	3,272	31	0	0	0	221	3,524
2005	UPSHUR	CARRIZO-WILCOX AQUIFER	3,638	35	0	0	0	128	3,801
2006	UPSHUR	CARRIZO-WILCOX AQUIFER	3,630	47	0	0	0	120	3,797
2007	UPSHUR	CARRIZO-WILCOX AQUIFER	3,060	38	0	0	100	106	3,304
2008	UPSHUR	CARRIZO-WILCOX AQUIFER	2,942	46	0	0	0	127	3,115
2009	UPSHUR	CARRIZO-WILCOX AQUIFER	2,982	36	0	0	0	135	3,153
2010	UPSHUR	CARRIZO-WILCOX AQUIFER	3,246	41	0	0	58	100	3,445
2011	UPSHUR	CARRIZO-WILCOX AQUIFER	3,519	32	0	0	54	101	3,706
2012	UPSHUR	CARRIZO-WILCOX AQUIFER	3,105	35	0	0	1	90	3,231
2004	UPSHUR	OTHER AQUIFER	0	0	0	0	0	43	43
2005	UPSHUR	OTHER AQUIFER	0	0	0	0	0	25	25
2006	UPSHUR	OTHER AQUIFER	0	0	0	0	0	24	24
2007	UPSHUR	OTHER AQUIFER	0	0	0	0	0	21	21
2008	UPSHUR	OTHER AQUIFER	0	0	0	0	0	13	13
2009	UPSHUR	OTHER AQUIFER	0	0	0	0	0	13	13
2010	UPSHUR	OTHER AQUIFER	0	0	0	0	0	15	15
2011	UPSHUR	OTHER AQUIFER	0	0	0	0	0	15	15
2012	UPSHUR	OTHER AQUIFER	0	0	0	0	0	14	14
1980	UPSHUR	QUEEN CITY AQUIFER	803	16	1	0	0	364	1,184
1984	UPSHUR	QUEEN CITY AQUIFER	694	0	0	0	0	341	1,035
1985	UPSHUR	QUEEN CITY AQUIFER	677	0	0	0	0	296	973
1986	UPSHUR	QUEEN CITY AQUIFER	631	0	0	0	0	316	947
1987	UPSHUR	QUEEN CITY AQUIFER	666	0	0	0	0	303	969
1988	UPSHUR	QUEEN CITY AQUIFER	601	0	0	0	0	296	897
1989	UPSHUR	QUEEN CITY AQUIFER	615	0	0	0	0	296	911
1990	UPSHUR	QUEEN CITY AQUIFER	843	0	0	0	0	399	1,242
1991	UPSHUR	QUEEN CITY AQUIFER	857	0	0	0	0	395	1,252
1992	UPSHUR	QUEEN CITY AQUIFER	850	0	0	0	0	580	1,430
1993	UPSHUR	QUEEN CITY AQUIFER	819	1	0	0	4	630	1,454
1994	UPSHUR	QUEEN CITY AQUIFER	781	0	0	0	0	578	1,359
1995	UPSHUR	QUEEN CITY AQUIFER	846	0	0	0	0	506	1,352

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1996	UPSHUR	QUEEN CITY AQUIFER	814	0	0	0	0	724	1,538
1997	UPSHUR	QUEEN CITY AQUIFER	836	0	0	0	0	453	1,289
1998	UPSHUR	QUEEN CITY AQUIFER	918	0	0	0	0	452	1,370
1999	UPSHUR	QUEEN CITY AQUIFER	917	0	0	0	0	463	1,380
2000	UPSHUR	QUEEN CITY AQUIFER	384	0	0	0	0	460	844
2001	UPSHUR	QUEEN CITY AQUIFER	408	0	0	0	0	297	705
2002	UPSHUR	QUEEN CITY AQUIFER	400	0	0	0	0	284	684
2003	UPSHUR	QUEEN CITY AQUIFER	389	0	0	0	0	288	677
2004	UPSHUR	QUEEN CITY AQUIFER	383	0	0	0	0	111	494
2005	UPSHUR	QUEEN CITY AQUIFER	396	0	0	0	0	64	460
2006	UPSHUR	QUEEN CITY AQUIFER	550	0	0	0	0	60	610
2007	UPSHUR	QUEEN CITY AQUIFER	495	0	0	0	100	53	648
2008	UPSHUR	QUEEN CITY AQUIFER	526	0	0	0	0	63	589
2009	UPSHUR	QUEEN CITY AQUIFER	561	0	0	0	0	67	628
2010	UPSHUR	QUEEN CITY AQUIFER	590	0	0	0	58	50	698
2011	UPSHUR	QUEEN CITY AQUIFER	585	0	0	0	54	50	689
2012	UPSHUR	QUEEN CITY AQUIFER	573	0	0	0	1	45	619
2008	UPSHUR	UNKNOWN	0	0	28	0	0	0	28
2009	UPSHUR	UNKNOWN	0	0	35	0	0	0	35
2010	UPSHUR	UNKNOWN	0	0	41	0	0	0	41
2011	UPSHUR	UNKNOWN	0	0	44	0	0	0	44
2012	UPSHUR	UNKNOWN	0	0	1	0	0	0	1
1980	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,644	684	1,795	0	0	627	5,750
1984	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,716	343	888	0	0	774	4,721
1985	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,631	191	1,291	0	0	664	4,777
1986	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,733	268	1,039	0	0	752	4,792
1987	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,731	422	947	0	0	677	4,777
1988	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,855	396	923	0	0	700	4,874
1989	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,808	415	778	0	0	721	4,722
1990	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,801	159	778	0	0	759	4,497
1991	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,819	156	1,061	0	0	769	4,805
1992	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,798	190	1,044	0	0	818	4,850
1993	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,911	339	1,044	0	19	787	5,100
1994	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,891	139	1,067	0	30	821	4,948
1995	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,033	255	1,074	0	19	848	5,229
1996	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,012	574	1,093	0	112	793	5,584
1997	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,326	178	1,093	0	91	844	5,532
1998	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,644	258	669	0	623	784	5,978
1999	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,504	292	673	0	146	838	5,453
2000	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,522	0	225	0	33	835	3,615
2001	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,071	0	73	0	33	305	3,482
2002	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,867	0	102	0	33	300	3,302
2003	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,916	0	252	0	0	314	3,482
2004	VAN ZANDT	CARRIZO-WILCOX AQUIFER	2,755	0	337	0	0	296	3,388
2005	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,871	0	220	0	0	501	4,592
2006	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,617	0	384	0	80	512	4,593
2007	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,257	0	156	0	0	332	3,745
2008	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,185	289	0	0	0	514	3,988
2009	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,076	253	0	0	33	543	3,905
2010	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,910	0	0	0	87	469	4,466
2011	VAN ZANDT	CARRIZO-WILCOX AQUIFER	4,410	189	0	0	143	470	5,212
2012	VAN ZANDT	CARRIZO-WILCOX AQUIFER	3,891	167	0	0	1	430	4,489
1980	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1984	VAN ZANDT	OTHER AQUIFER	6	0	0	0	0	10	16
1985	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1986	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1987	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1988	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1989	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1990	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1991	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1992	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1993	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1994	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1995	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1996	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1997	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1998	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
1999	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
2000	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	4	4
2001	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	2	2
2002	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	2	2
2003	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	2	2
2004	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	49	49
2005	VAN ZANDT	OTHER AQUIFER	0	0	0	0	0	83	83
2006	VAN ZANDT	OTHER AQUIFER	54	0	0	0	0	85	139
2007	VAN ZANDT	OTHER AQUIFER	45	0	0	0	0	55	100
2008	VAN ZANDT	OTHER AQUIFER	50	0	0	0	0	44	94

Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
All Values in AF/yr

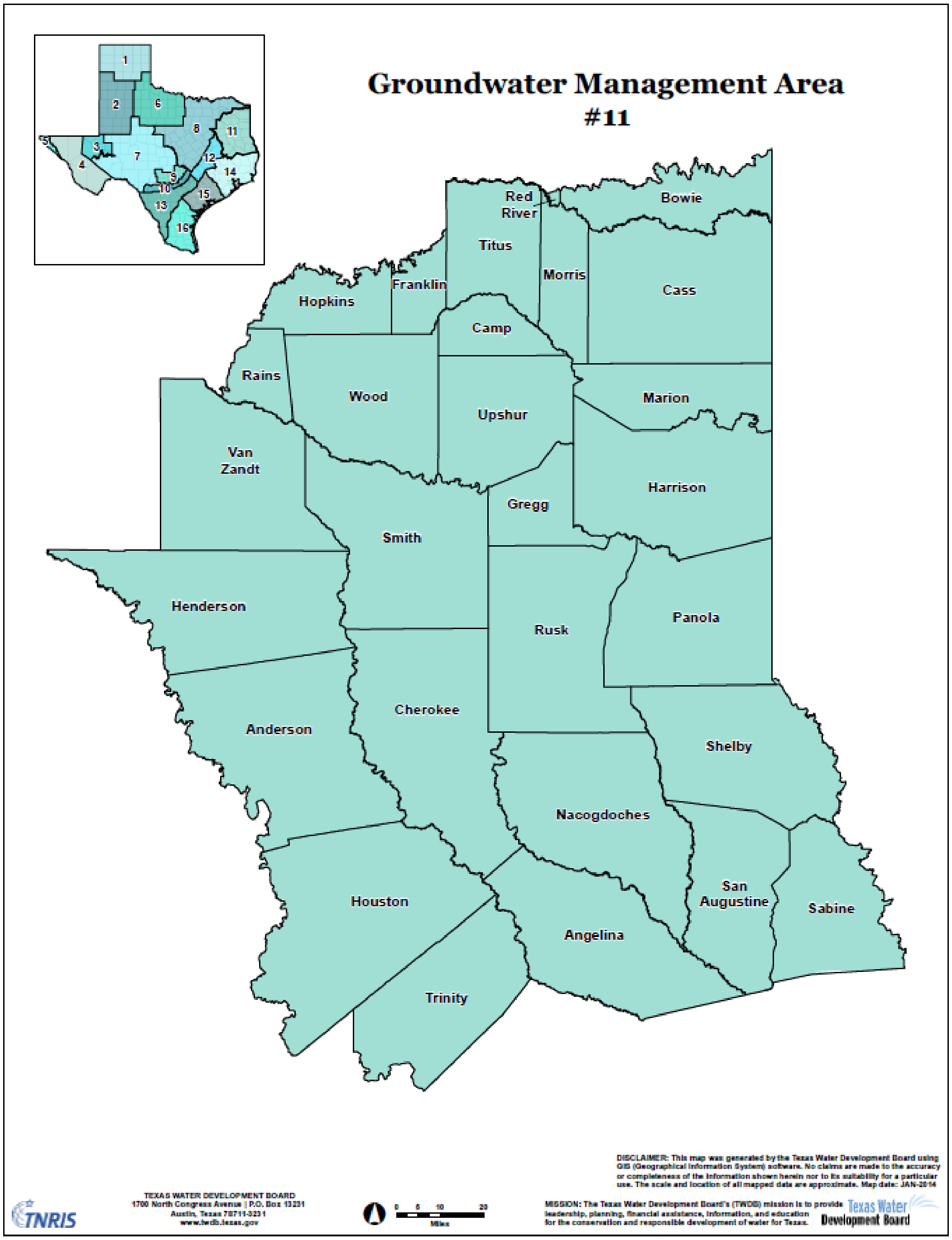
Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
2009	VAN ZANDT	OTHER AQUIFER	102	0	0	0	0	47	149
2010	VAN ZANDT	OTHER AQUIFER	155	0	0	0	0	43	198
2011	VAN ZANDT	OTHER AQUIFER	168	0	0	0	0	43	211
2012	VAN ZANDT	OTHER AQUIFER	147	0	0	0	0	39	186
1980	VAN ZANDT	QUEEN CITY AQUIFER	71	0	0	0	0	101	172
1984	VAN ZANDT	QUEEN CITY AQUIFER	102	0	58	0	0	125	285
1985	VAN ZANDT	QUEEN CITY AQUIFER	112	0	239	0	0	107	458
1986	VAN ZANDT	QUEEN CITY AQUIFER	125	0	4	0	0	121	250
1987	VAN ZANDT	QUEEN CITY AQUIFER	122	0	3	0	0	109	234
1988	VAN ZANDT	QUEEN CITY AQUIFER	120	0	4	0	0	113	237
1989	VAN ZANDT	QUEEN CITY AQUIFER	56	0	3	0	0	116	175
1990	VAN ZANDT	QUEEN CITY AQUIFER	136	0	3	0	0	122	261
1991	VAN ZANDT	QUEEN CITY AQUIFER	145	0	24	0	0	124	293
1992	VAN ZANDT	QUEEN CITY AQUIFER	137	0	24	0	0	132	293
1993	VAN ZANDT	QUEEN CITY AQUIFER	127	0	24	0	0	127	278
1994	VAN ZANDT	QUEEN CITY AQUIFER	123	0	24	0	0	132	279
1995	VAN ZANDT	QUEEN CITY AQUIFER	0	0	24	0	0	137	161
1996	VAN ZANDT	QUEEN CITY AQUIFER	0	0	24	0	0	128	152
1997	VAN ZANDT	QUEEN CITY AQUIFER	0	0	24	0	0	136	160
1998	VAN ZANDT	QUEEN CITY AQUIFER	0	0	15	0	0	126	141
1999	VAN ZANDT	QUEEN CITY AQUIFER	0	0	14	0	0	135	149
2000	VAN ZANDT	QUEEN CITY AQUIFER	0	0	0	0	0	135	135
2001	VAN ZANDT	QUEEN CITY AQUIFER	0	0	0	0	0	37	37
2002	VAN ZANDT	QUEEN CITY AQUIFER	0	0	0	0	0	36	36
2003	VAN ZANDT	QUEEN CITY AQUIFER	0	0	0	0	0	38	38
2006	VAN ZANDT	QUEEN CITY AQUIFER	39	0	0	0	0	0	39
2007	VAN ZANDT	QUEEN CITY AQUIFER	33	0	0	0	0	0	33
2008	VAN ZANDT	QUEEN CITY AQUIFER	36	0	0	0	0	0	36
2009	VAN ZANDT	QUEEN CITY AQUIFER	73	0	0	0	0	0	73
2010	VAN ZANDT	QUEEN CITY AQUIFER	112	0	0	0	0	0	112
2011	VAN ZANDT	QUEEN CITY AQUIFER	121	0	0	0	0	0	121
2012	VAN ZANDT	QUEEN CITY AQUIFER	236	0	0	0	0	0	236
2008	VAN ZANDT	UNKNOWN	0	0	113	0	0	0	113
2009	VAN ZANDT	UNKNOWN	0	0	118	0	0	0	118
2010	VAN ZANDT	UNKNOWN	0	0	123	0	0	0	123
2011	VAN ZANDT	UNKNOWN	0	0	123	0	0	0	123
2012	VAN ZANDT	UNKNOWN	0	0	1	0	0	0	1
1980	WOOD	CARRIZO-WILCOX AQUIFER	3,301	22	4	0	0	136	3,463
1984	WOOD	CARRIZO-WILCOX AQUIFER	4,208	3	1,003	0	328	141	5,683
1985	WOOD	CARRIZO-WILCOX AQUIFER	4,220	3	1,547	0	382	133	6,285
1986	WOOD	CARRIZO-WILCOX AQUIFER	4,186	3	1,387	0	400	136	6,112
1987	WOOD	CARRIZO-WILCOX AQUIFER	4,486	41	1,319	0	187	142	6,175
1988	WOOD	CARRIZO-WILCOX AQUIFER	4,681	38	1,204	0	76	135	6,134
1989	WOOD	CARRIZO-WILCOX AQUIFER	4,483	8	1,121	0	195	141	5,948
1990	WOOD	CARRIZO-WILCOX AQUIFER	3,628	2	4	0	165	181	3,980
1991	WOOD	CARRIZO-WILCOX AQUIFER	3,542	4	0	0	165	180	3,891
1992	WOOD	CARRIZO-WILCOX AQUIFER	3,686	2	0	0	165	255	4,108
1993	WOOD	CARRIZO-WILCOX AQUIFER	3,769	0	0	0	71	251	4,091
1994	WOOD	CARRIZO-WILCOX AQUIFER	4,009	0	0	0	135	253	4,397
1995	WOOD	CARRIZO-WILCOX AQUIFER	4,149	0	0	0	131	255	4,535
1996	WOOD	CARRIZO-WILCOX AQUIFER	4,244	0	0	0	103	272	4,619
1997	WOOD	CARRIZO-WILCOX AQUIFER	4,593	0	0	0	103	225	4,921
1998	WOOD	CARRIZO-WILCOX AQUIFER	4,787	0	0	0	103	210	5,100
1999	WOOD	CARRIZO-WILCOX AQUIFER	4,500	0	0	0	103	226	4,829
2000	WOOD	CARRIZO-WILCOX AQUIFER	4,697	2	0	0	103	208	5,010
2001	WOOD	CARRIZO-WILCOX AQUIFER	4,830	0	0	0	78	171	5,079
2002	WOOD	CARRIZO-WILCOX AQUIFER	4,943	0	0	0	78	181	5,202
2003	WOOD	CARRIZO-WILCOX AQUIFER	5,138	193	0	0	81	181	5,593
2004	WOOD	CARRIZO-WILCOX AQUIFER	5,608	193	0	0	83	493	6,377
2005	WOOD	CARRIZO-WILCOX AQUIFER	5,819	460	0	0	82	80	6,441
2006	WOOD	CARRIZO-WILCOX AQUIFER	5,257	677	0	0	3	63	6,000
2007	WOOD	CARRIZO-WILCOX AQUIFER	5,041	629	0	0	56	50	5,776
2008	WOOD	CARRIZO-WILCOX AQUIFER	4,935	617	0	0	0	63	5,615
2009	WOOD	CARRIZO-WILCOX AQUIFER	6,235	617	0	0	0	67	6,919
2010	WOOD	CARRIZO-WILCOX AQUIFER	5,565	663	0	0	215	63	6,506
2011	WOOD	CARRIZO-WILCOX AQUIFER	5,792	663	0	0	163	63	6,681
2012	WOOD	CARRIZO-WILCOX AQUIFER	6,238	663	0	0	109	60	7,070
2004	WOOD	OTHER AQUIFER	0	0	0	0	0	35	35
2005	WOOD	OTHER AQUIFER	0	0	0	0	0	6	6
2006	WOOD	OTHER AQUIFER	0	0	0	0	0	4	4
2007	WOOD	OTHER AQUIFER	0	0	0	0	0	4	4
2008	WOOD	OTHER AQUIFER	0	0	0	0	0	4	4
2009	WOOD	OTHER AQUIFER	0	0	0	0	0	4	4
2010	WOOD	OTHER AQUIFER	0	0	0	0	0	4	4
2011	WOOD	OTHER AQUIFER	0	0	0	0	0	4	4
2012	WOOD	OTHER AQUIFER	0	0	0	0	0	4	4
1980	WOOD	QUEEN CITY AQUIFER	520	0	2,842	0	0	409	3,771
1984	WOOD	QUEEN CITY AQUIFER	165	0	2,616	0	137	424	3,342

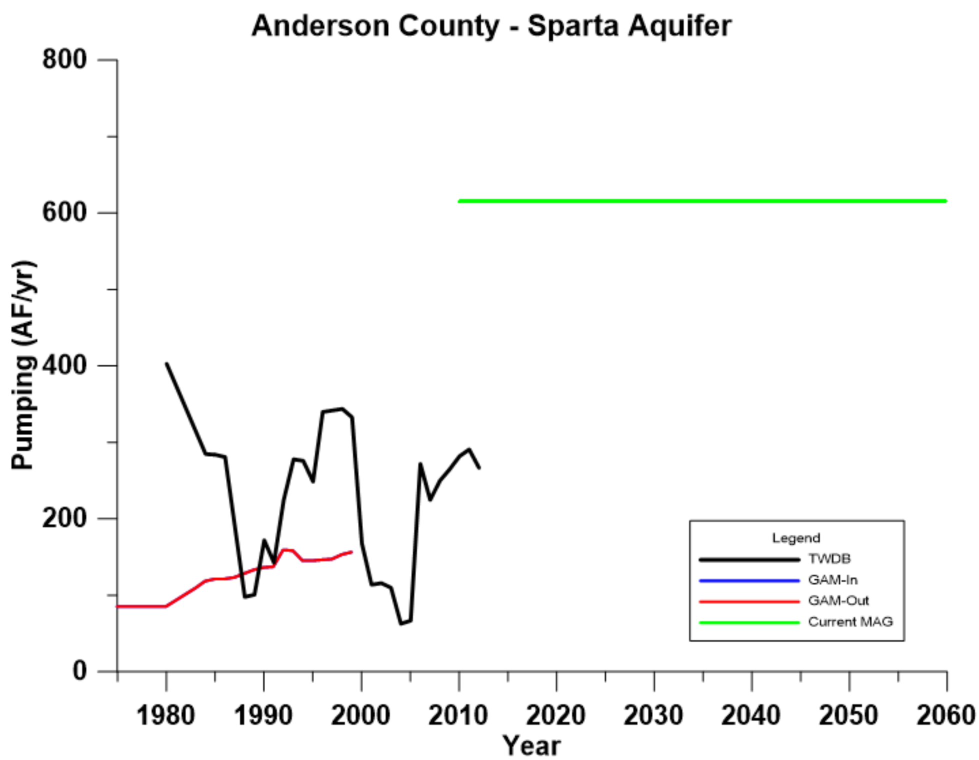
Groundwater Pumping Estimates from Texas Water Development Board
Organized by County and Aquifer
All Values in AF/yr

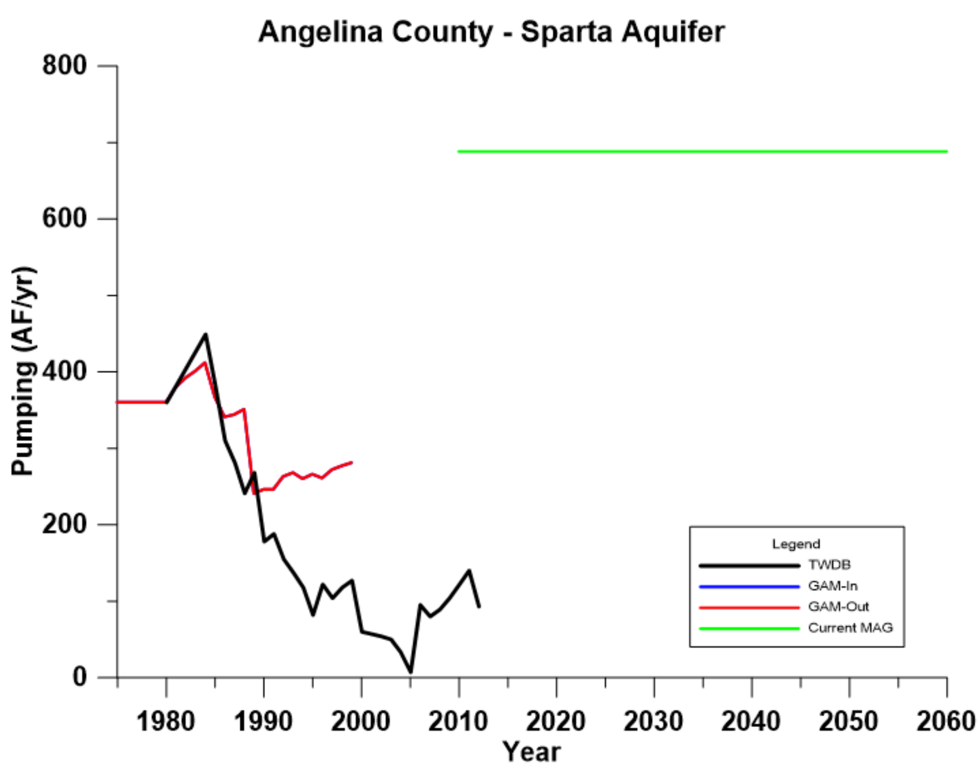
Year	County	Aquifer	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
1985	WOOD	QUEEN CITY AQUIFER	161	0	3,182	0	128	400	3,871
1986	WOOD	QUEEN CITY AQUIFER	168	0	2,619	0	133	410	3,330
1987	WOOD	QUEEN CITY AQUIFER	170	0	2,258	0	63	427	2,918
1988	WOOD	QUEEN CITY AQUIFER	166	0	2,034	0	26	406	2,632
1989	WOOD	QUEEN CITY AQUIFER	165	0	2,040	0	65	426	2,696
1990	WOOD	QUEEN CITY AQUIFER	198	0	3,157	0	54	545	3,954
1991	WOOD	QUEEN CITY AQUIFER	214	0	2,841	0	54	542	3,651
1992	WOOD	QUEEN CITY AQUIFER	223	0	2,488	0	54	770	3,535
1993	WOOD	QUEEN CITY AQUIFER	233	0	2,535	0	23	757	3,548
1994	WOOD	QUEEN CITY AQUIFER	237	0	2,626	0	0	761	3,624
1995	WOOD	QUEEN CITY AQUIFER	309	0	560	0	0	766	1,635
1996	WOOD	QUEEN CITY AQUIFER	336	0	560	0	0	819	1,715
1997	WOOD	QUEEN CITY AQUIFER	246	0	488	0	0	676	1,410
1998	WOOD	QUEEN CITY AQUIFER	256	0	280	0	0	629	1,165
1999	WOOD	QUEEN CITY AQUIFER	241	0	280	0	0	678	1,199
2000	WOOD	QUEEN CITY AQUIFER	382	0	0	0	46	617	1,045
2001	WOOD	QUEEN CITY AQUIFER	331	0	0	0	34	510	875
2002	WOOD	QUEEN CITY AQUIFER	362	0	0	0	34	536	932
2003	WOOD	QUEEN CITY AQUIFER	378	0	0	0	36	539	953
2004	WOOD	QUEEN CITY AQUIFER	266	0	0	0	36	130	432
2005	WOOD	QUEEN CITY AQUIFER	264	0	0	0	28	21	313
2006	WOOD	QUEEN CITY AQUIFER	256	0	0	0	1	17	274
2007	WOOD	QUEEN CITY AQUIFER	130	0	0	0	24	13	167
2008	WOOD	QUEEN CITY AQUIFER	163	0	0	0	0	17	180
2009	WOOD	QUEEN CITY AQUIFER	172	0	0	0	0	18	190
2010	WOOD	QUEEN CITY AQUIFER	181	0	0	0	91	17	289
2011	WOOD	QUEEN CITY AQUIFER	131	0	0	0	69	17	217
2012	WOOD	QUEEN CITY AQUIFER	105	0	0	0	46	16	167
2004	WOOD	SPARTA AQUIFER	0	0	0	0	0	35	35
2005	WOOD	SPARTA AQUIFER	0	0	0	0	0	6	6
2006	WOOD	SPARTA AQUIFER	53	0	0	0	0	4	57
2007	WOOD	SPARTA AQUIFER	44	0	0	0	0	4	48
2008	WOOD	SPARTA AQUIFER	49	0	0	0	0	4	53
2009	WOOD	SPARTA AQUIFER	54	0	0	0	0	4	58
2010	WOOD	SPARTA AQUIFER	59	0	0	0	0	4	63
2011	WOOD	SPARTA AQUIFER	64	0	0	0	0	4	68
2012	WOOD	SPARTA AQUIFER	50	0	0	0	0	4	54
2008	WOOD	UNKNOWN	0	0	5	0	0	0	5
2009	WOOD	UNKNOWN	0	0	8	0	0	0	8
2010	WOOD	UNKNOWN	0	0	12	0	0	0	12
2011	WOOD	UNKNOWN	0	0	12	0	0	0	12
2012	WOOD	UNKNOWN	0	0	2	0	0	0	2

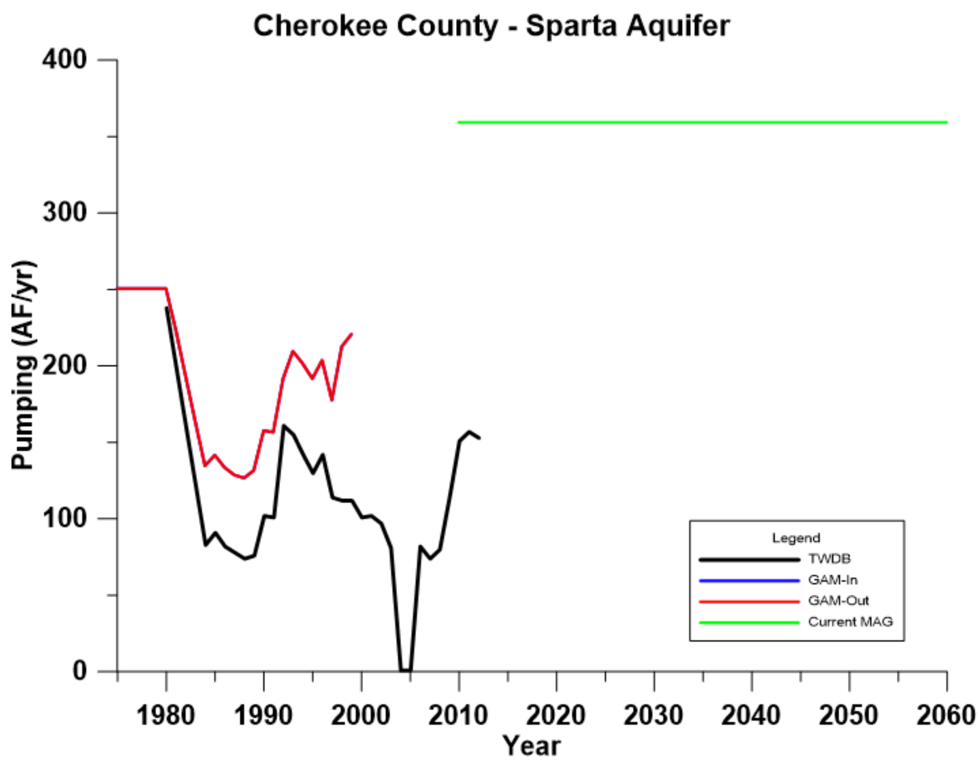
Appendix D

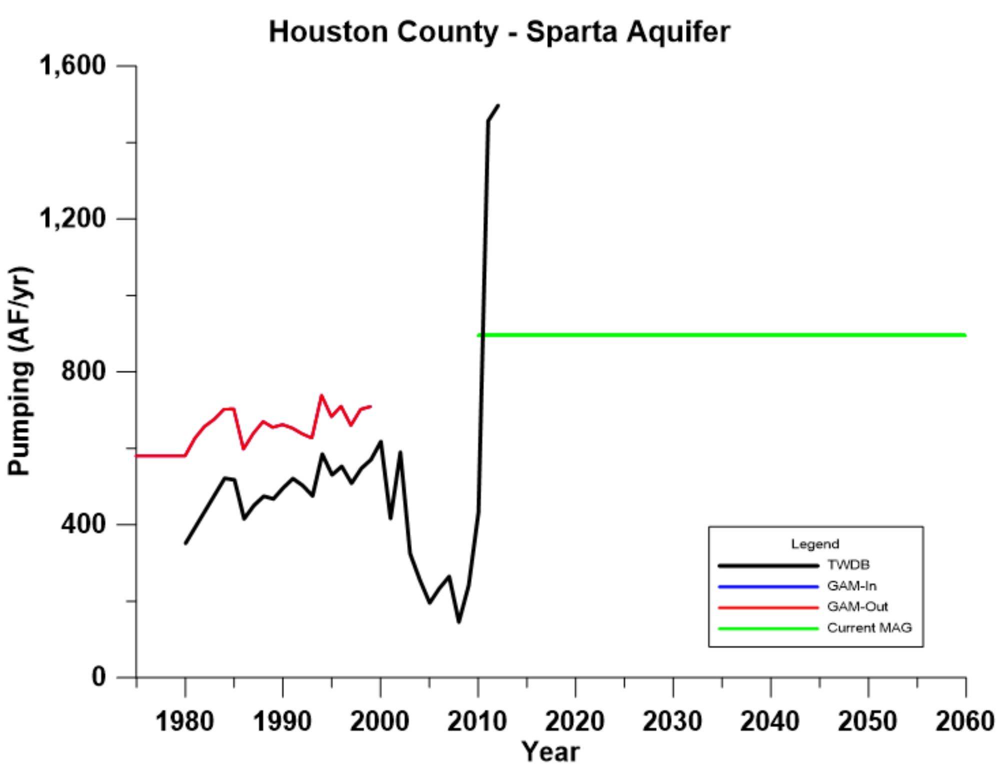
Graphical comparison of TWDB Historic Pumping Estimates, Calibrated GAM Pumping Estimates and Modeled Available Groundwater for Groundwater Management Area 11

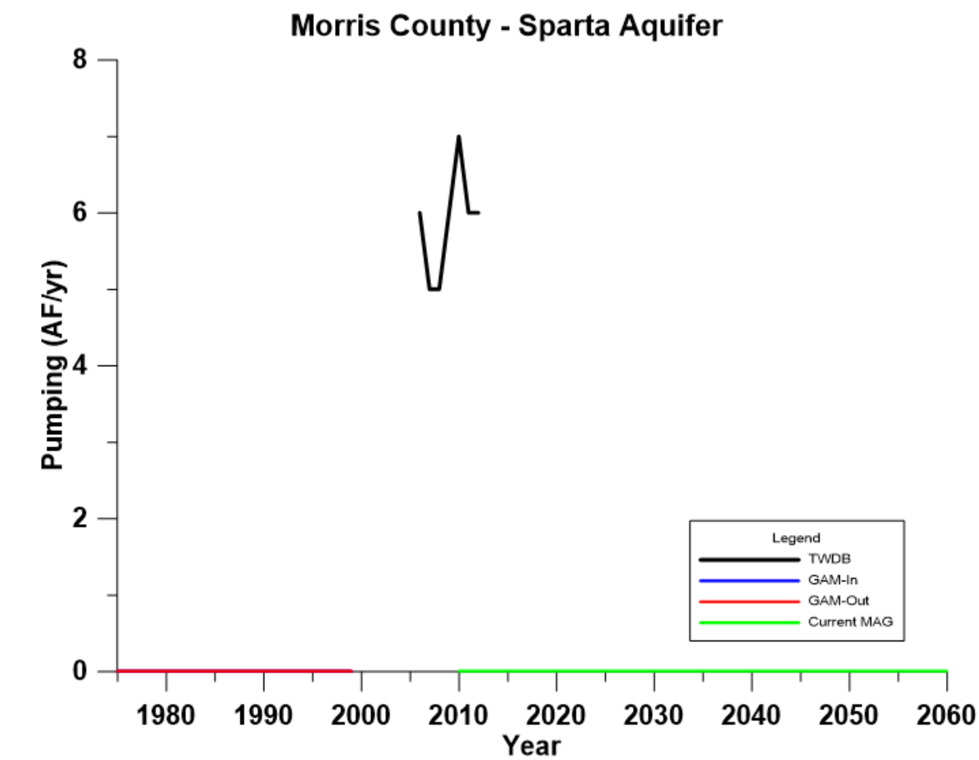

Groundwater Management Area
#11
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Red River
Bowie
Titus
Morris
Cass
Franklin
Hopkins
Camp
Rains
Wood
Upshur
Marion
Van Zandt
Gregg
Harrison
Smith
Henderson
Rusk
Panola
Anderson
Cherokee
Shelby
Nacogdoches
San Augustine
Sabine
Houston
Angelina
Trinity
DISCLAIMER: This map was generated by the Texas Water Development Board using GIS (Geographical Information System) software. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate. Map date: JAN-2014
TNRIS
TEXAS WATER DEVELOPMENT BOARD
1700 North Congress Avenue | P.O. Box 13231
Austin, Texas 78711-3231
www.twdb.texas.gov
0 5 10 20
Miles
MISSION: The Texas Water Development Board's (TWDB) mission is to provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas.
Texas Water Development Board

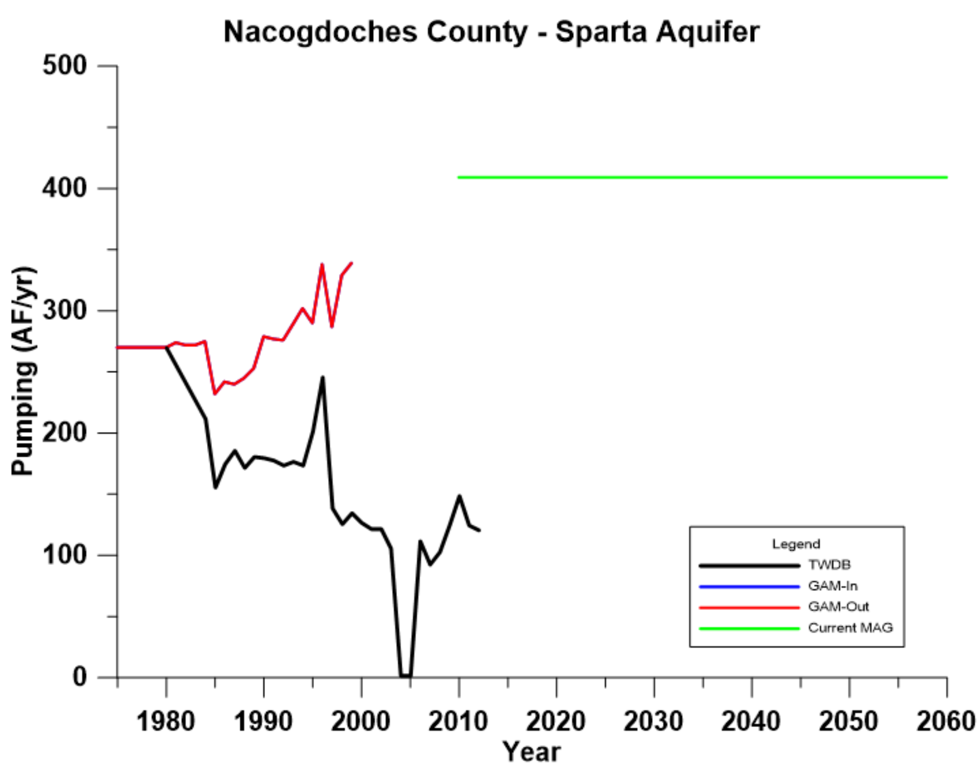

Anderson County - Sparta Aquifer
800
600
400
200
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

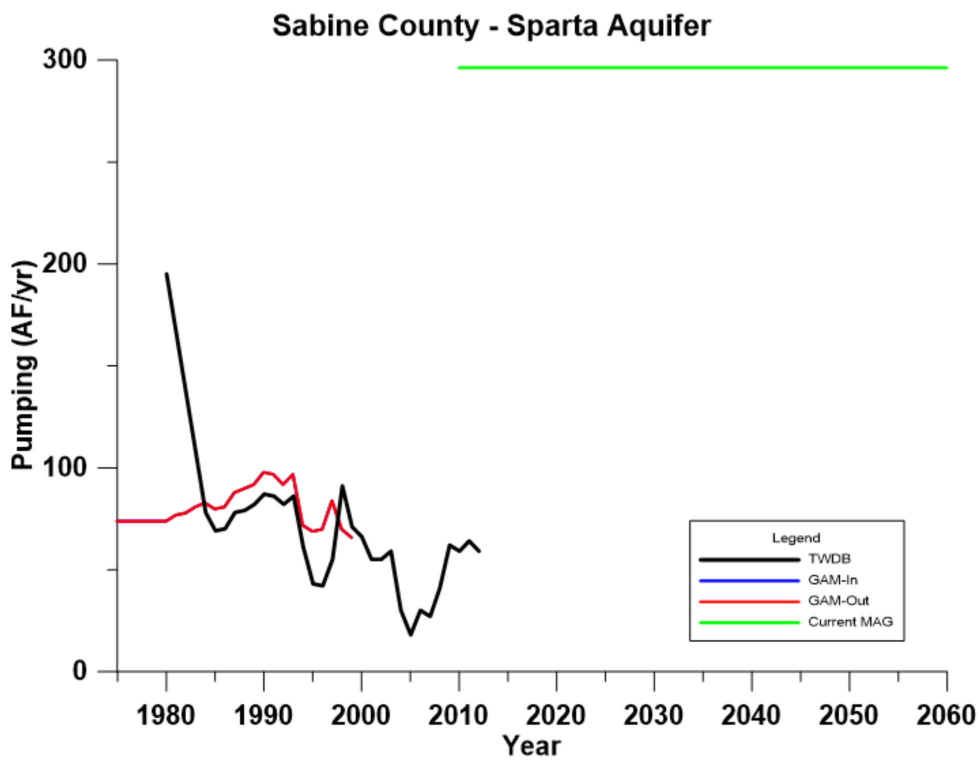

Angelina County - Sparta Aquifer
800
600
400
200
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG


Cherokee County - Sparta Aquifer
400
300
200
100
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

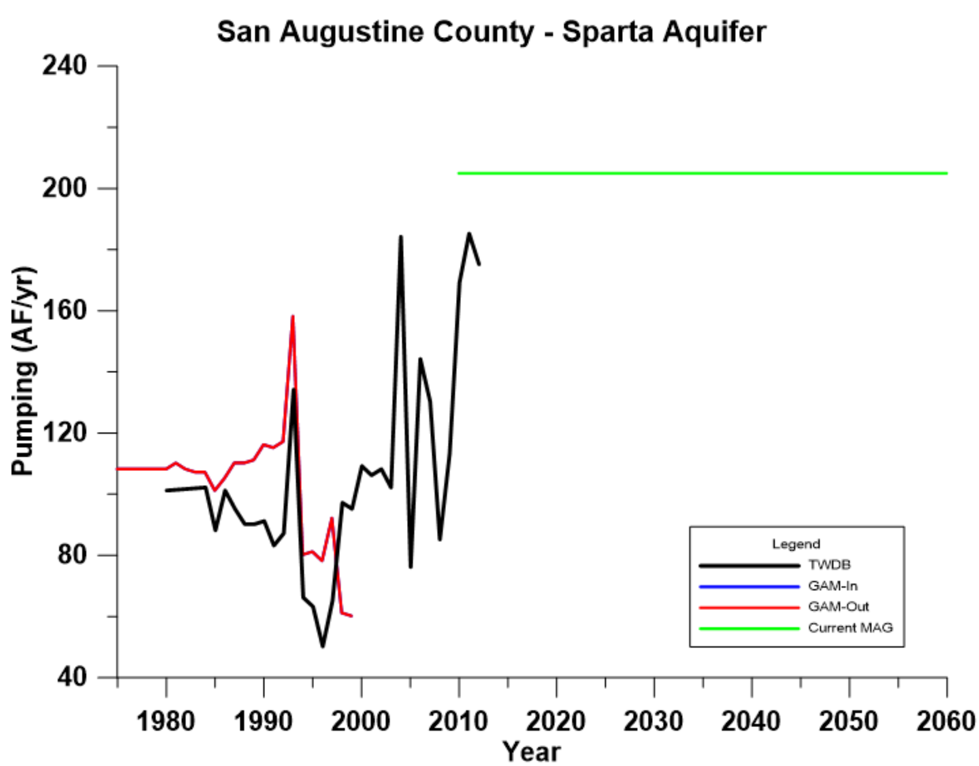

Houston County - Sparta Aquifer
1,600
1,200
800
400
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG


Morris County - Sparta Aquifer
Pumping (AF/yr)
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

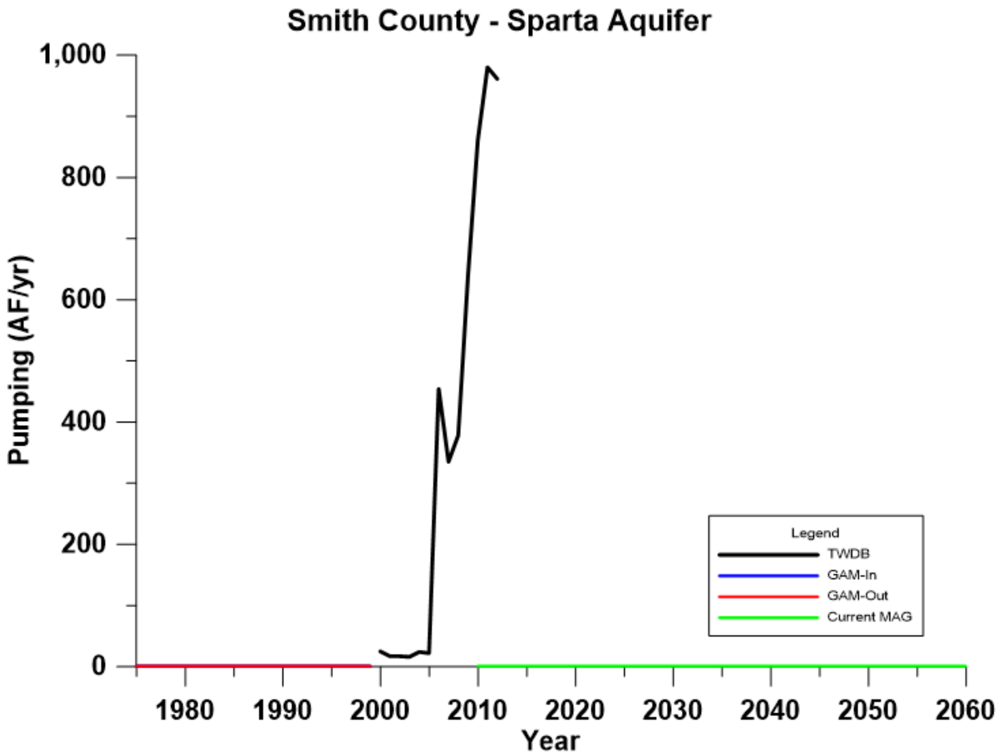

Nacogdoches County - Sparta Aquifer
Pumping (AF/yr)
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

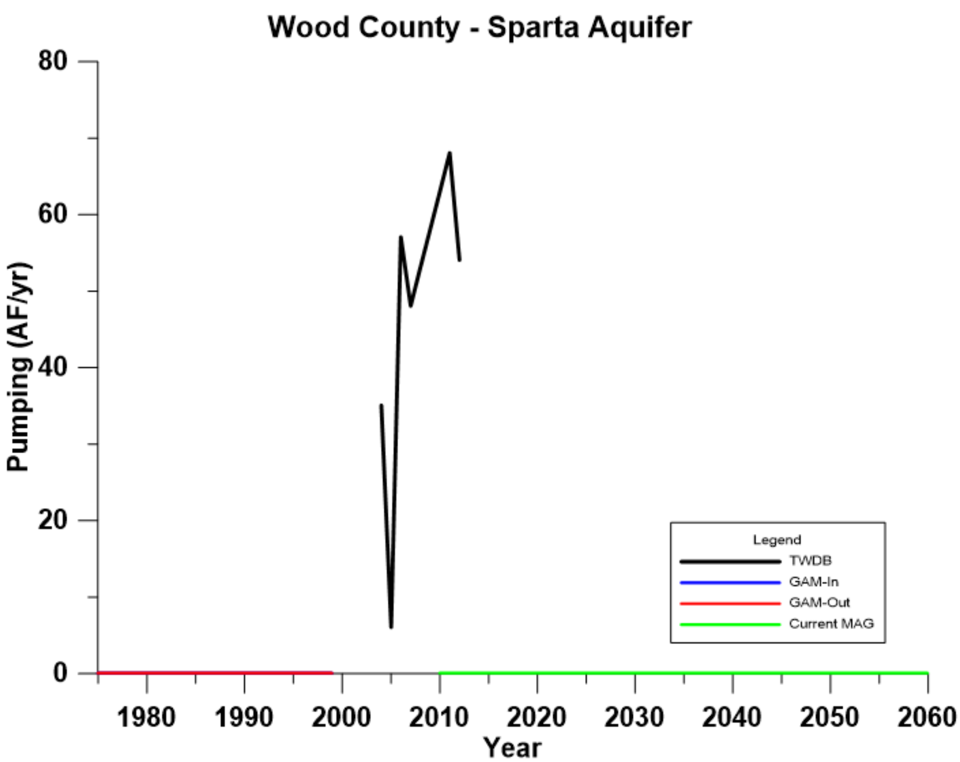


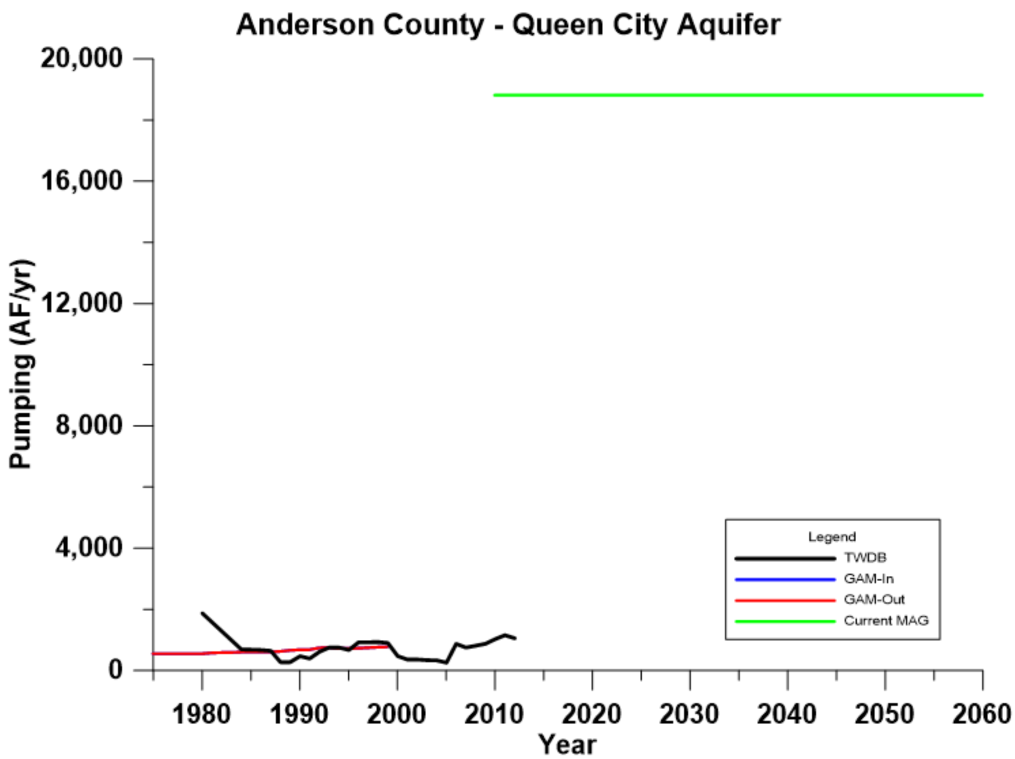
Sabine County - Sparta Aquifer
300
200
100
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

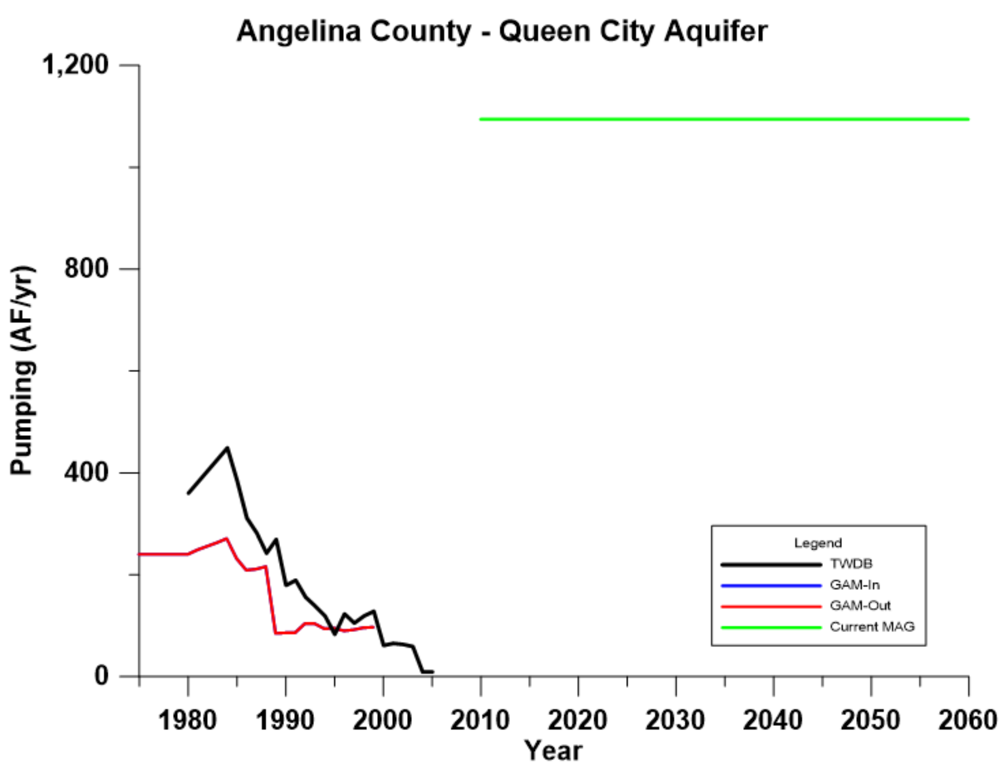


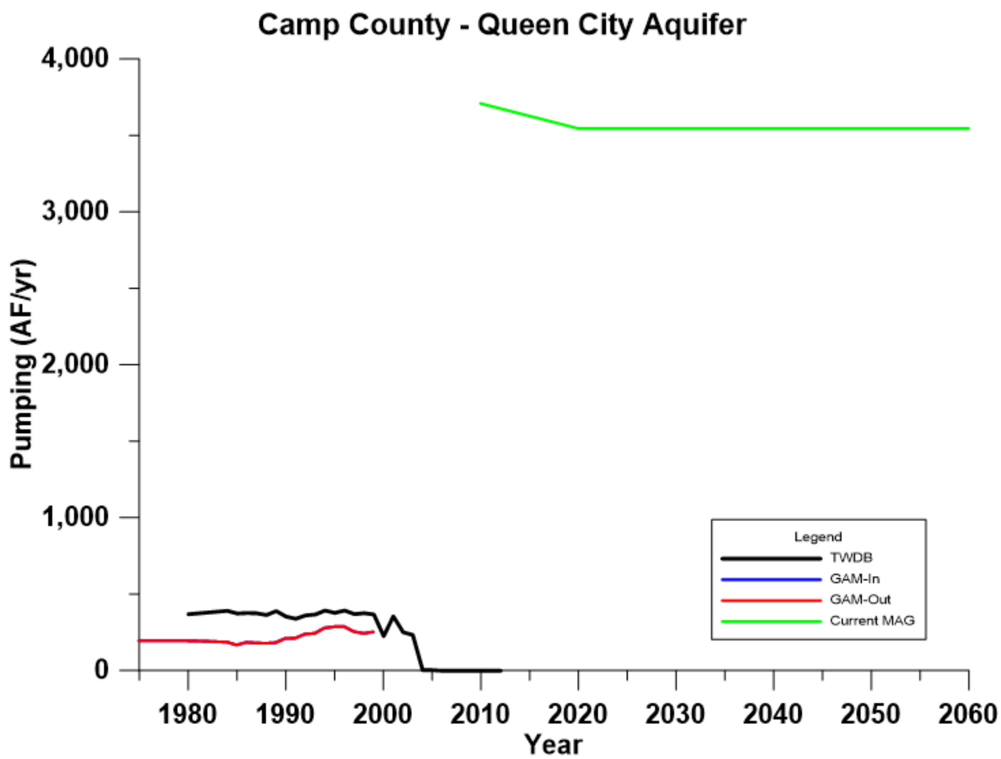
San Augustine County - Sparta Aquifer
240
200
160
120
80
40
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

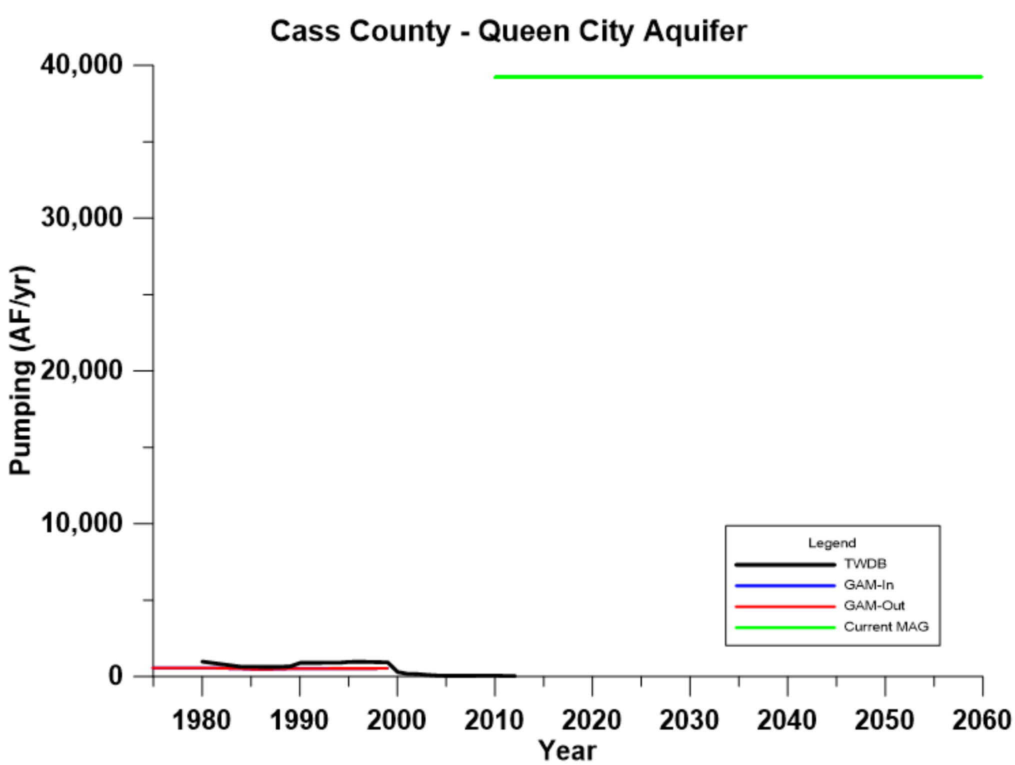

Smith County - Sparta Aquifer
Pumping (AF/yr)
1,000
800
600
400
200
0
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

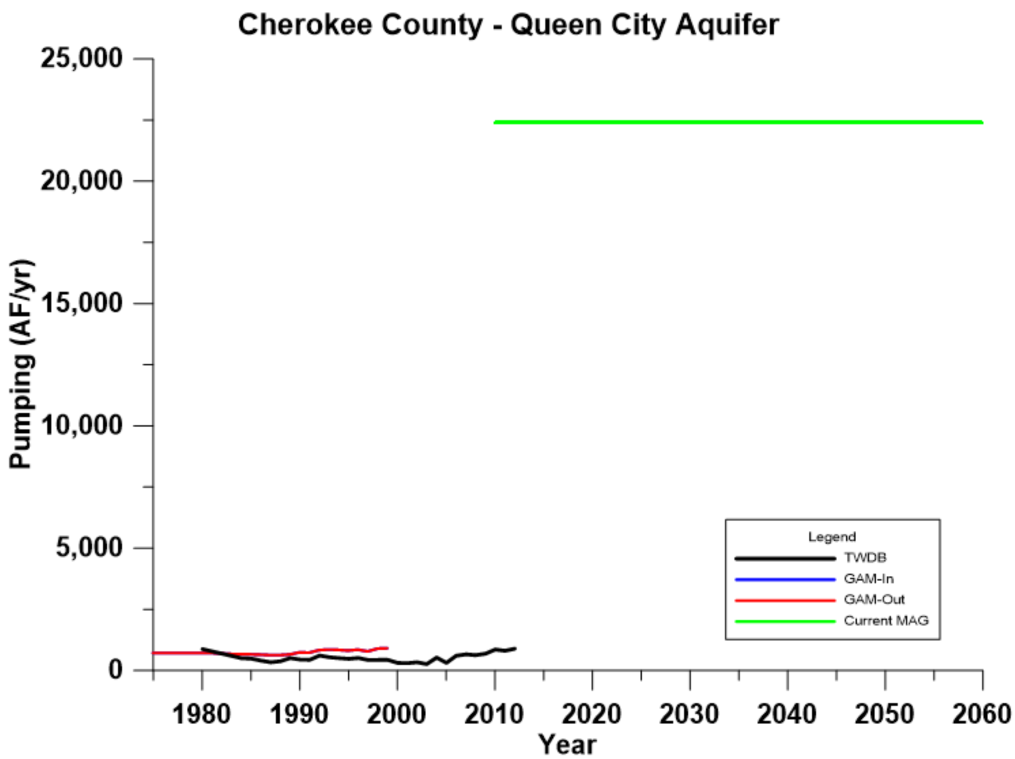

Wood County - Sparta Aquifer
Pumping (AF/yr)
80
60
40
20
0
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

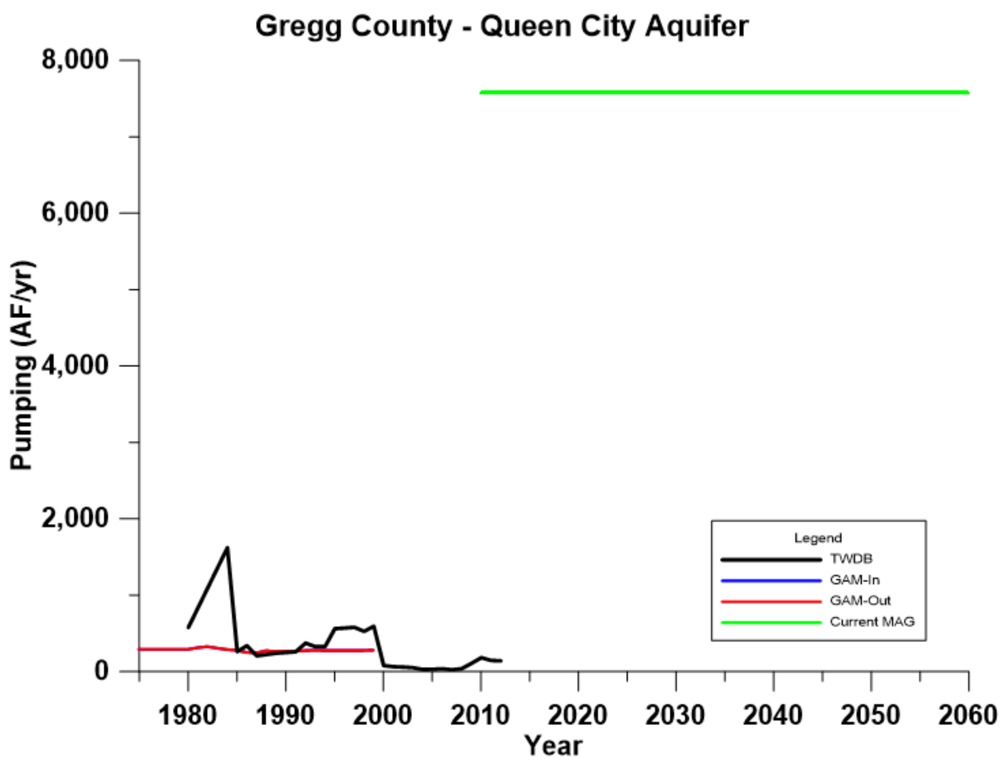

Anderson County - Queen City Aquifer
20,000
16,000
12,000
8,000
4,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

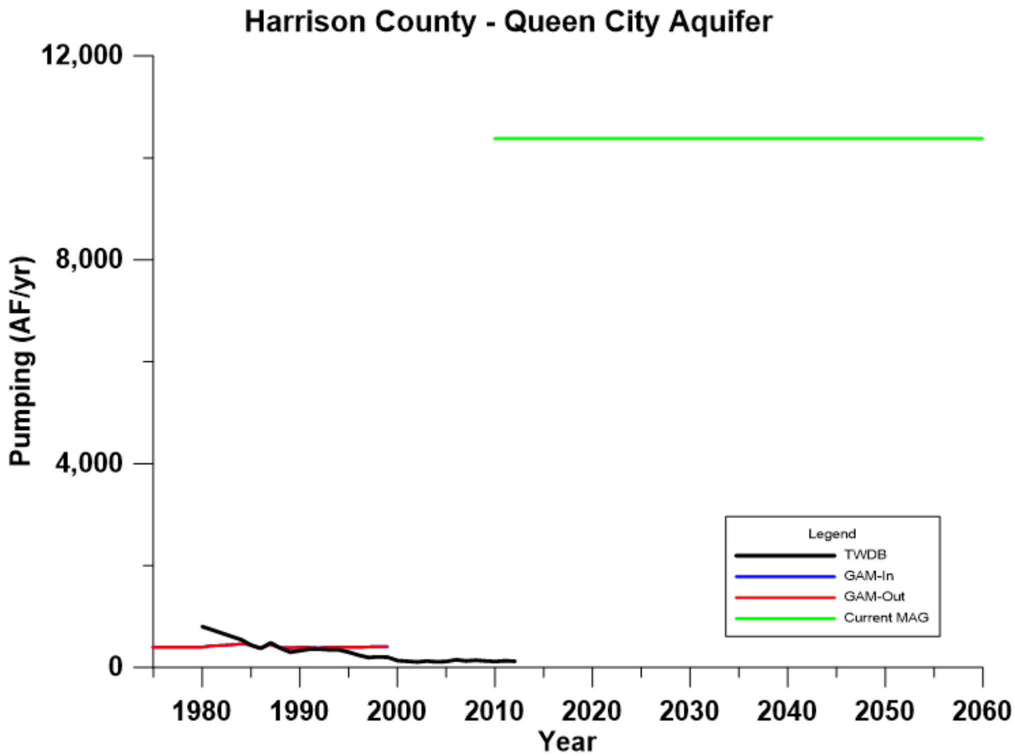

Angelina County - Queen City Aquifer
1,200
800
400
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

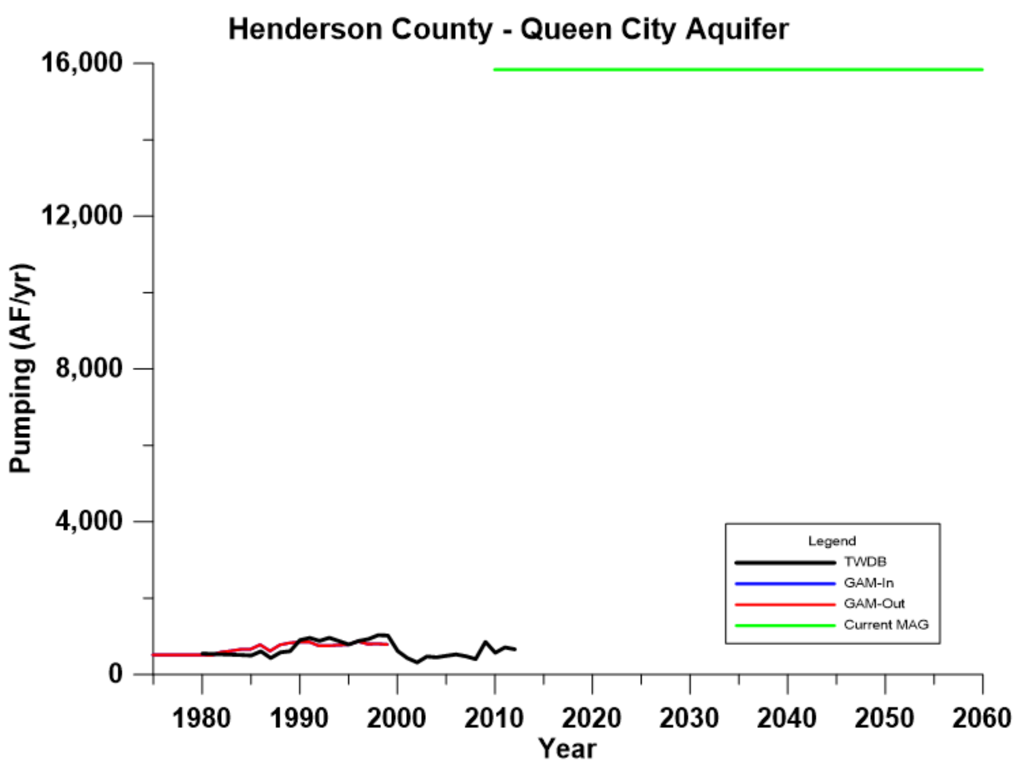

Camp County - Queen City Aquifer
4,000
3,000
2,000
1,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

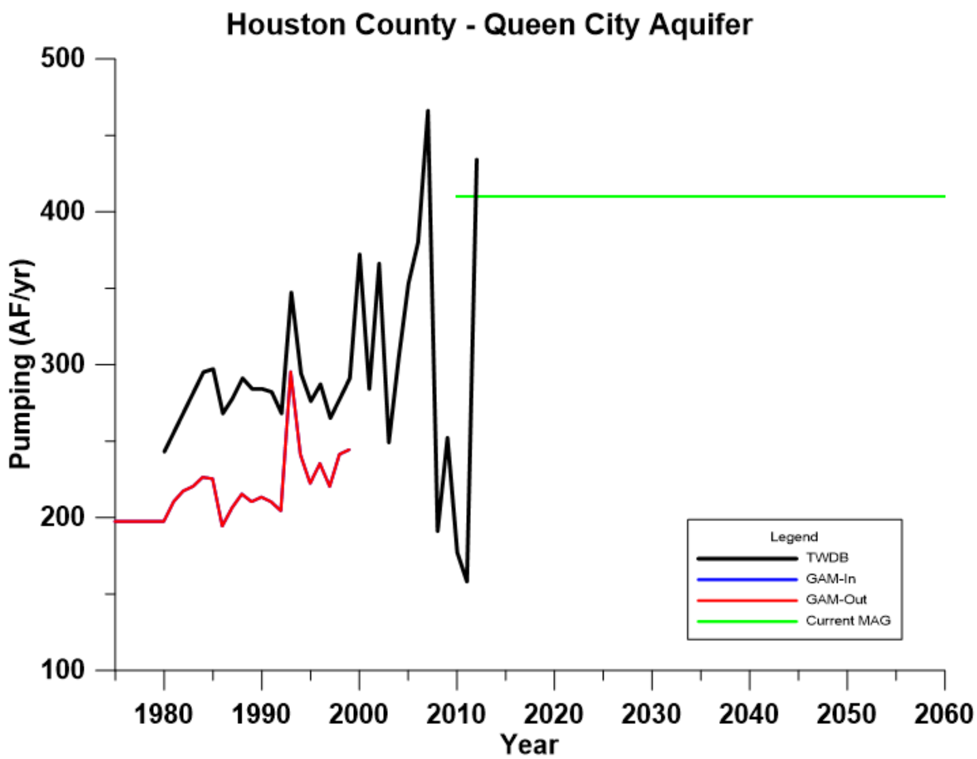

Cass County - Queen City Aquifer
40,000
30,000
20,000
10,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

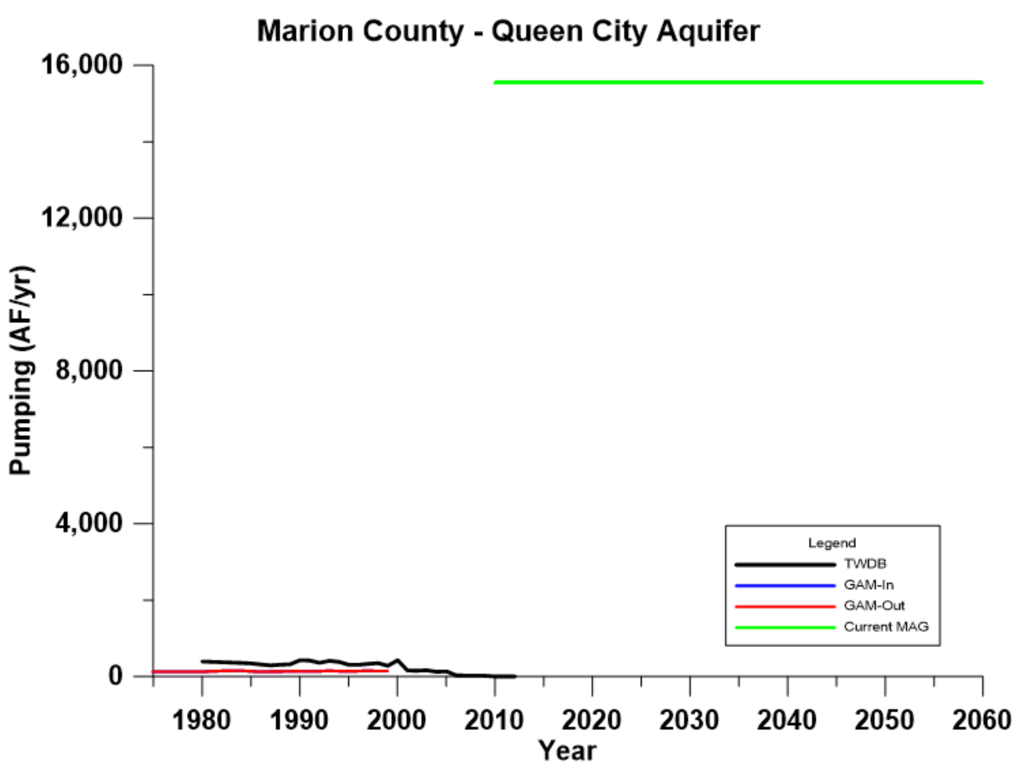

Cherokee County - Queen City Aquifer
25,000
20,000
15,000
10,000
5,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

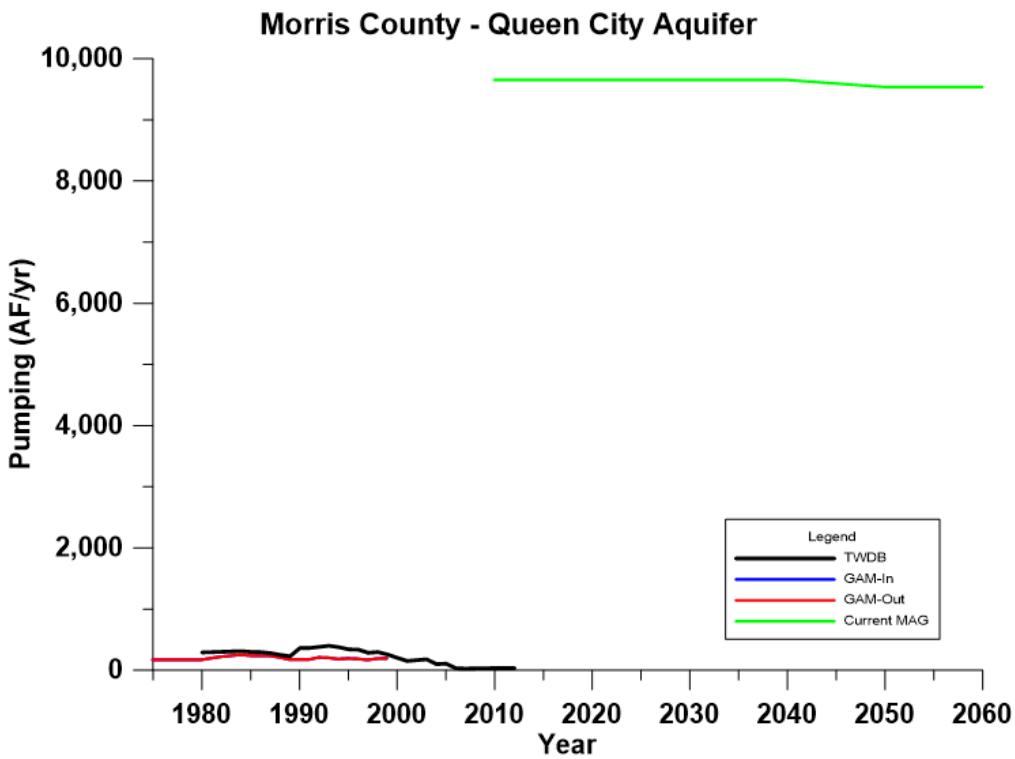

Gregg County - Queen City Aquifer
8,000
6,000
4,000
2,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

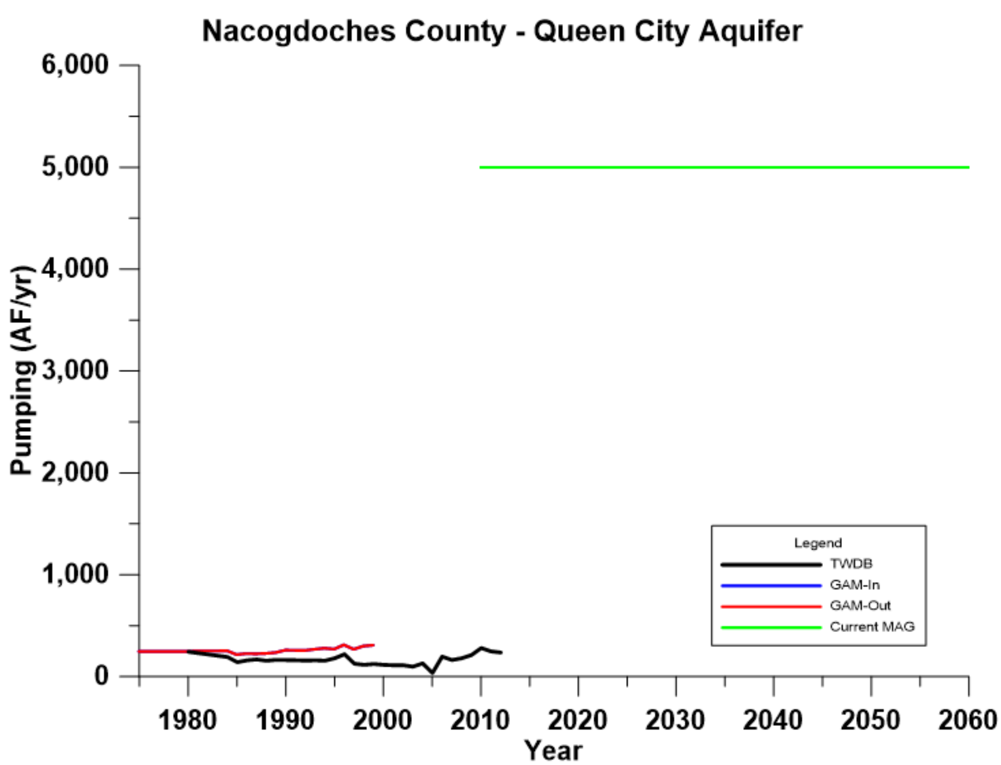

Harrison County - Queen City Aquifer
12,000
8,000
4,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

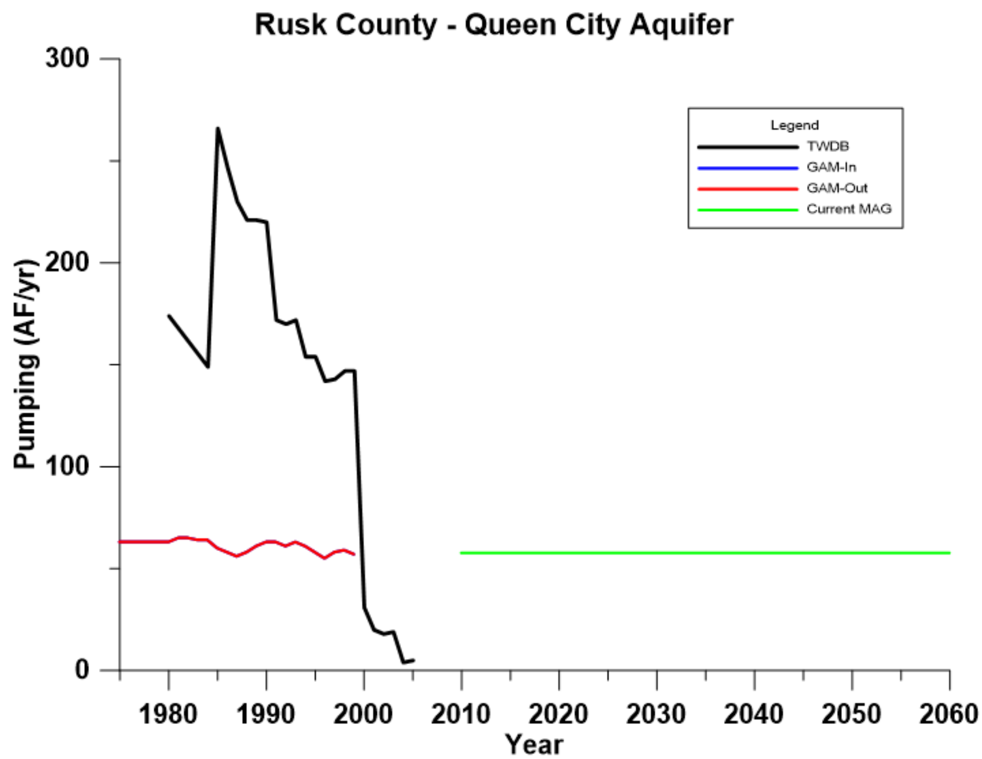

Henderson County - Queen City Aquifer
16,000
12,000
8,000
4,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG


Houston County - Queen City Aquifer
500
400
300
200
100
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

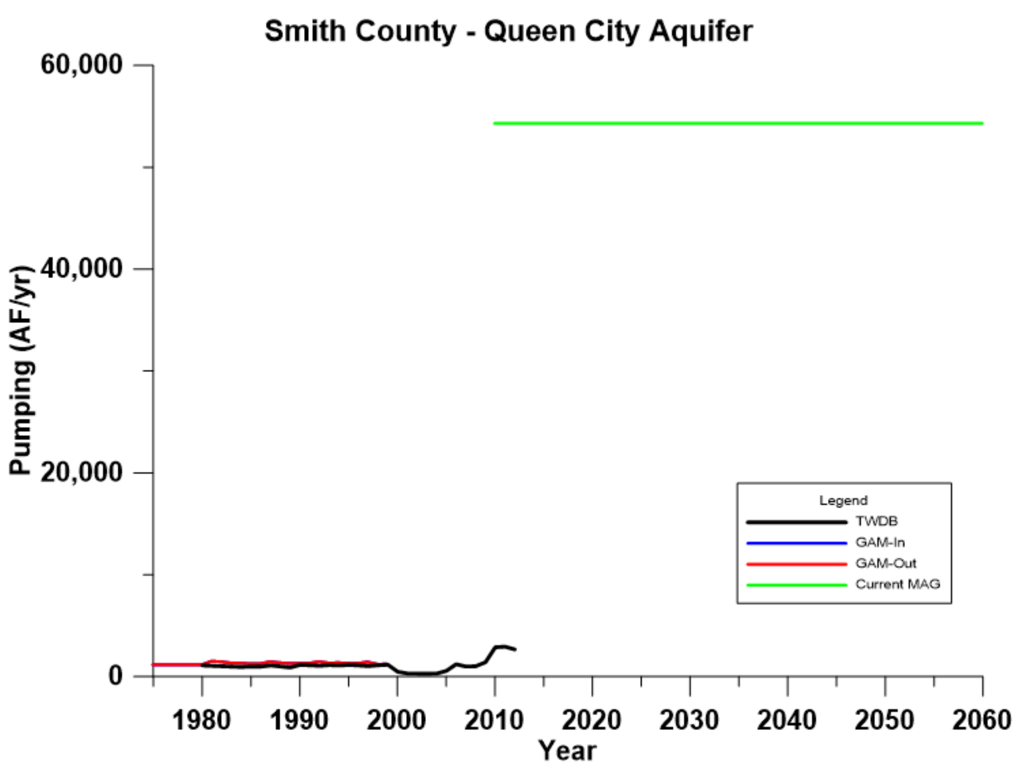

Marion County - Queen City Aquifer
16,000
12,000
8,000
4,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG


Morris County - Queen City Aquifer
10,000
8,000
6,000
4,000
2,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

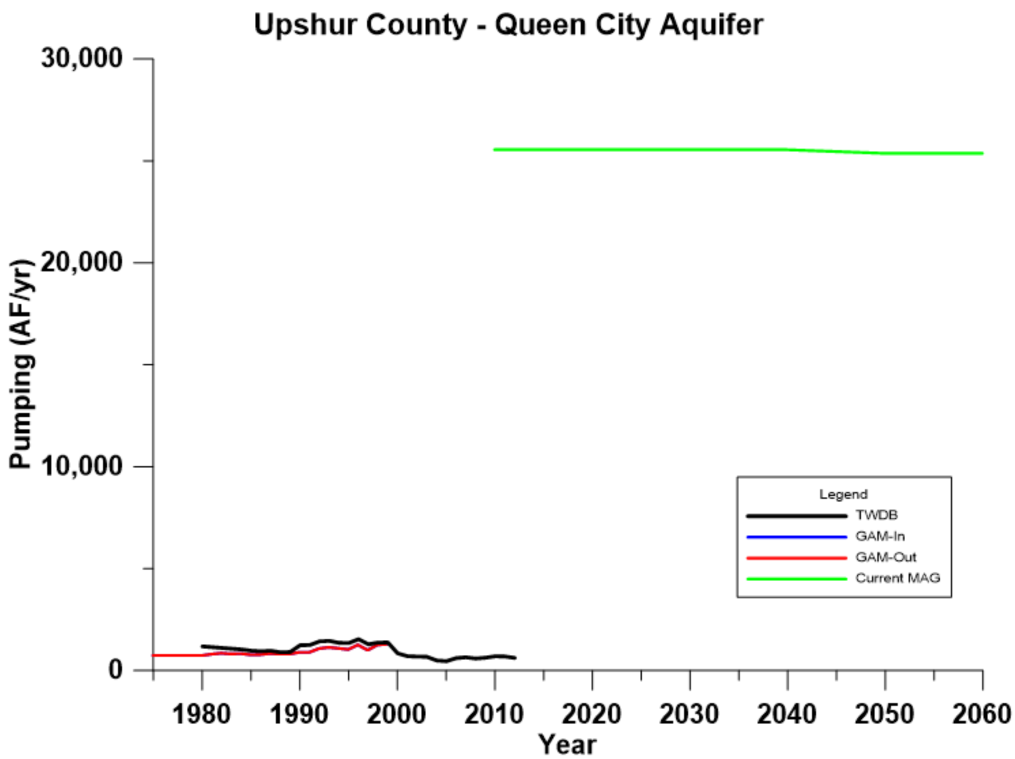

Nacogdoches County - Queen City Aquifer
6,000
5,000
4,000
3,000
2,000
1,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

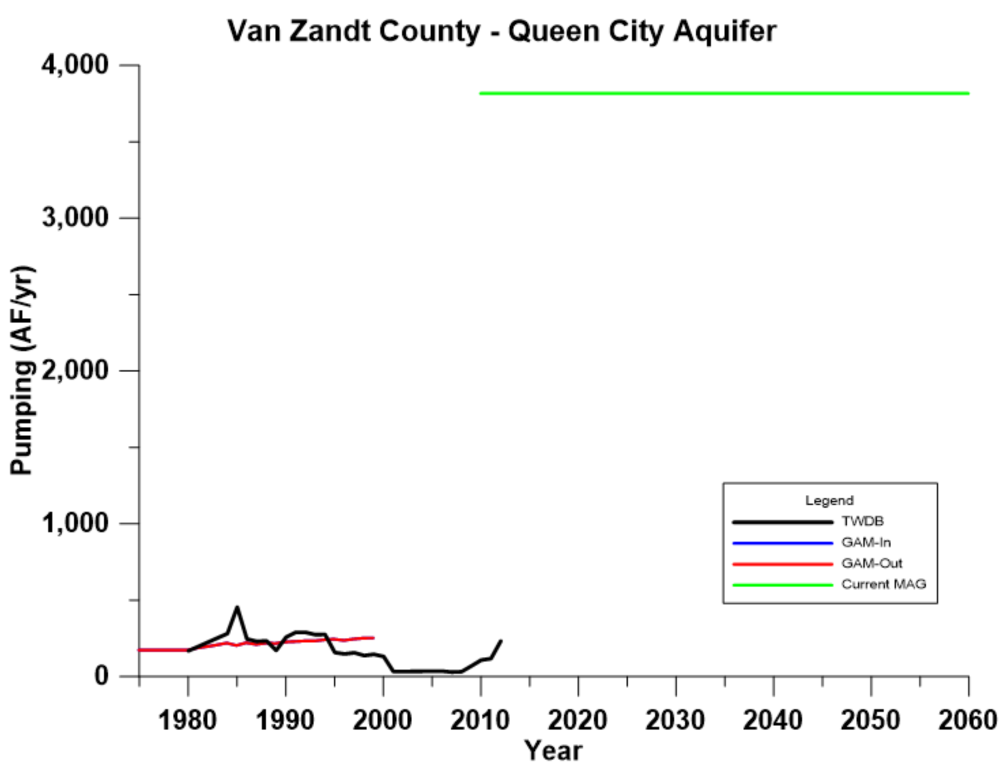


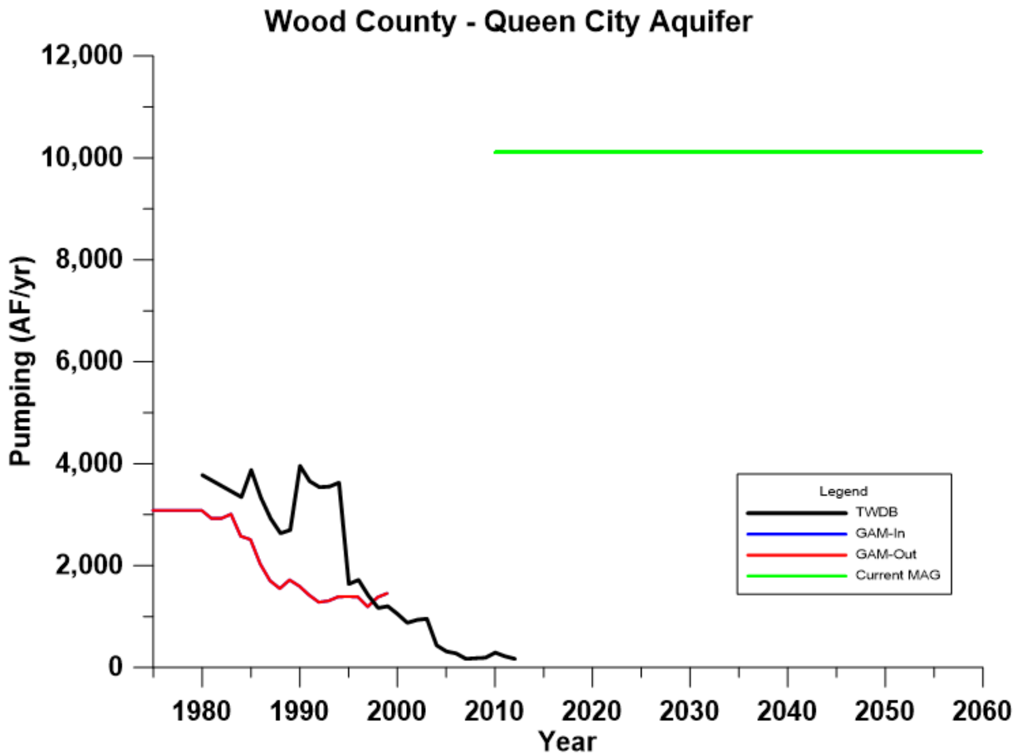
Rusk County - Queen City Aquifer
Legend
TWDB
GAM-In
GAM-Out
Current MAG
Pumping (AF/yr)
300
200
100
0
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year

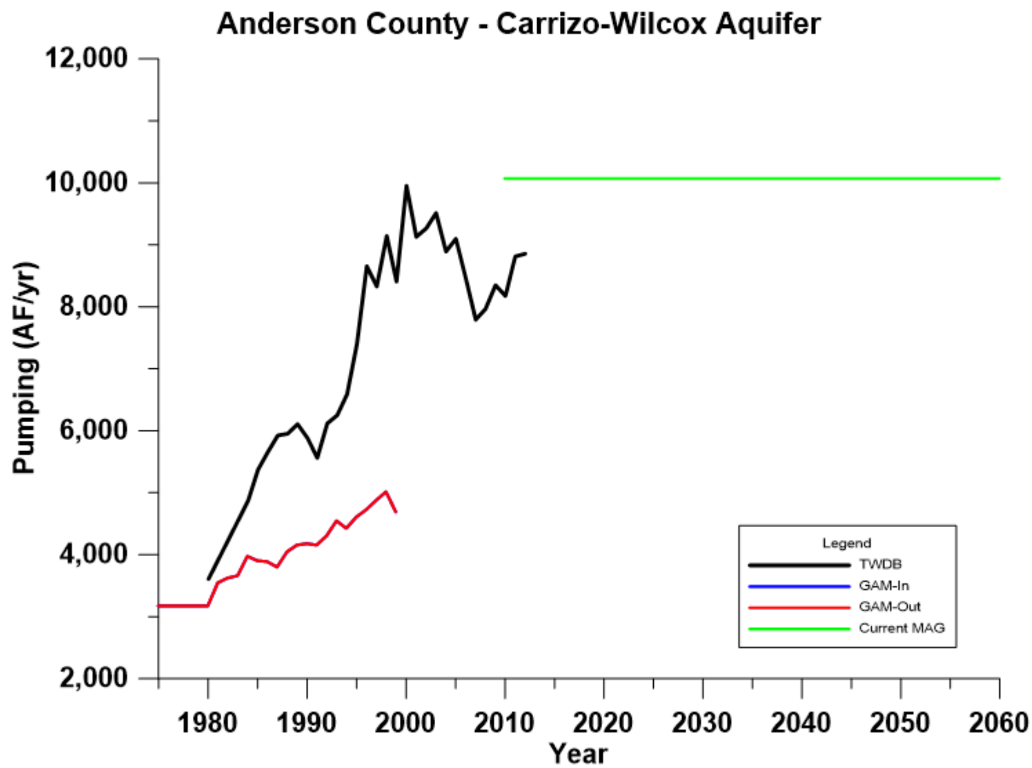


Smith County - Queen City Aquifer
Legend
TWDB
GAM-In
GAM-Out
Current MAG
Pumping (AF/yr)
60,000
40,000
20,000
0
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year

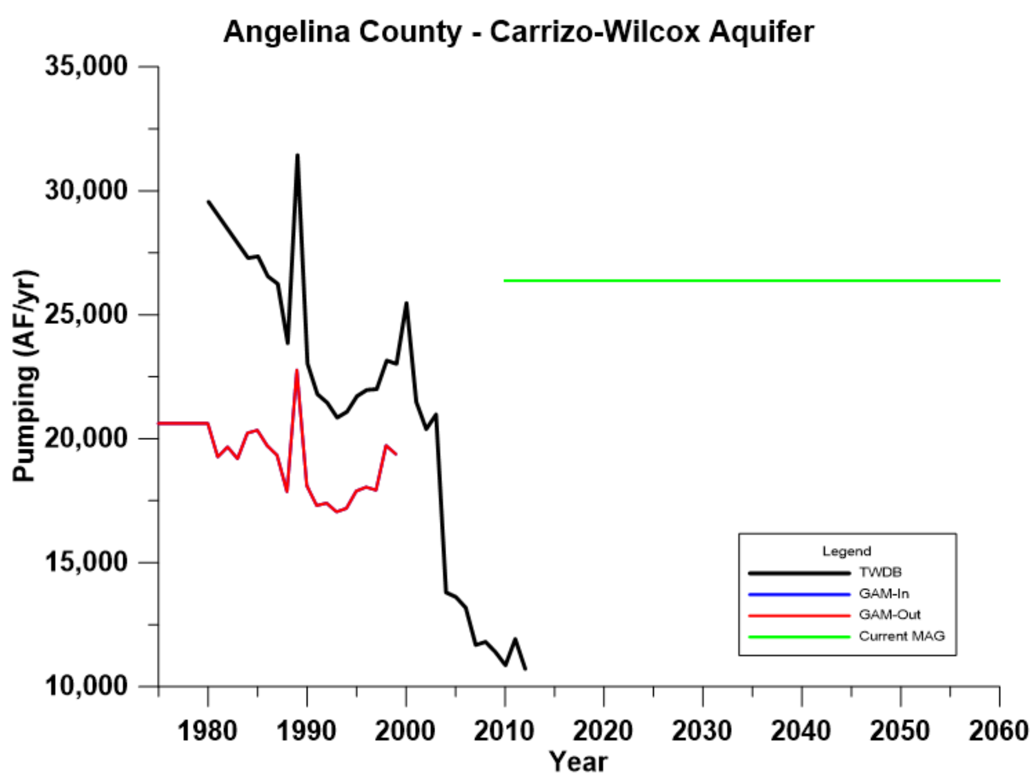

Upshur County - Queen City Aquifer
30,000
20,000
10,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG


Van Zandt County - Queen City Aquifer
4,000
3,000
2,000
1,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

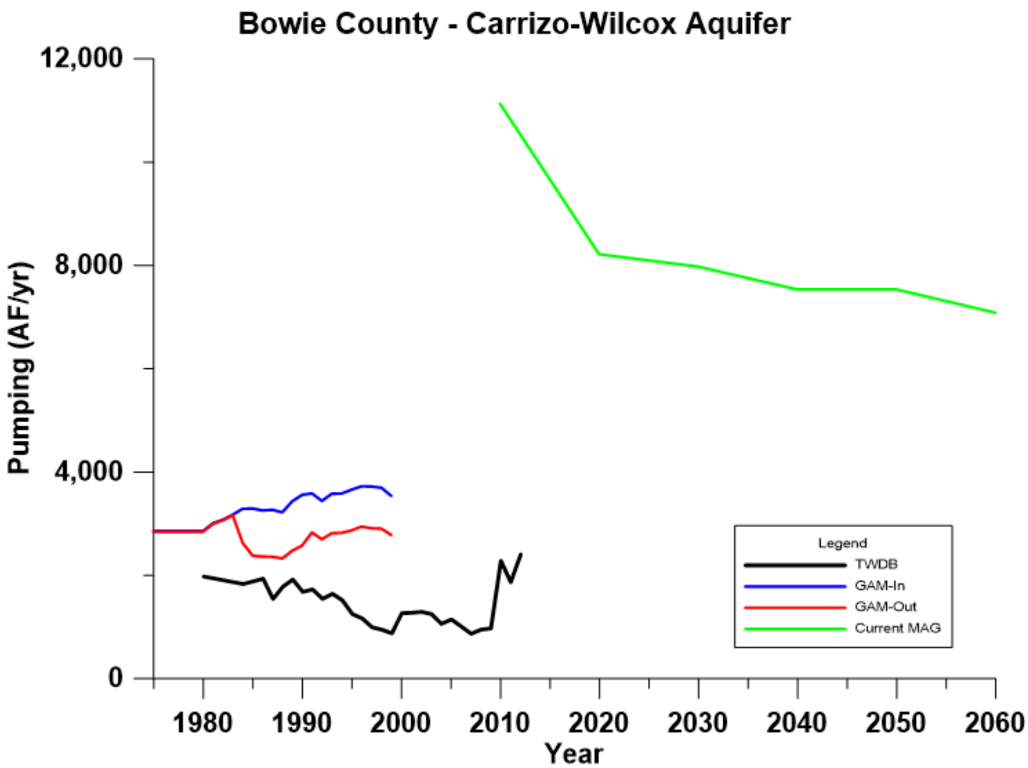

Wood County - Queen City Aquifer
12,000
10,000
8,000
6,000
4,000
2,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

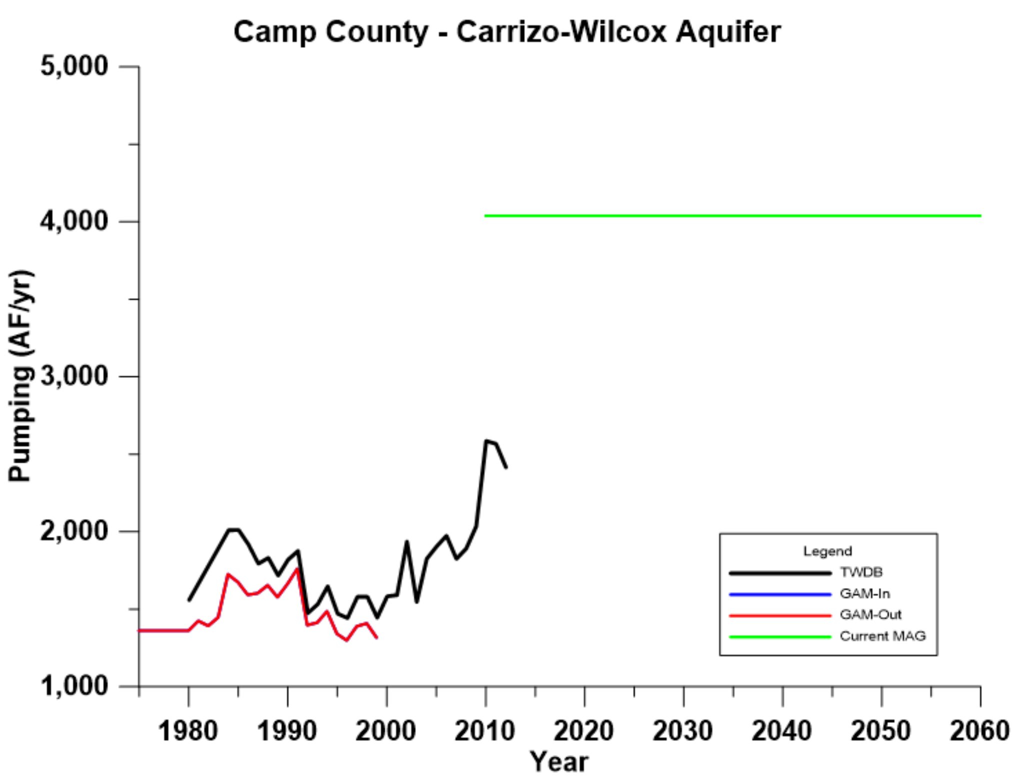


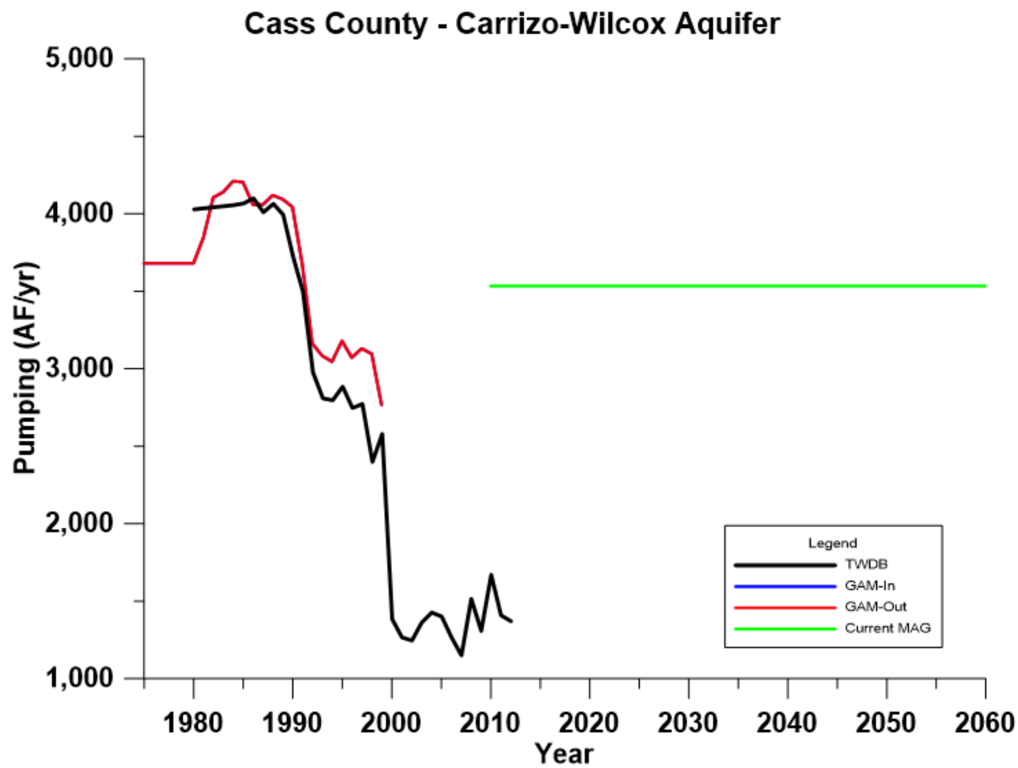
Anderson County - Carrizo-Wilcox Aquifer
12,000
10,000
8,000
6,000
4,000
2,000
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

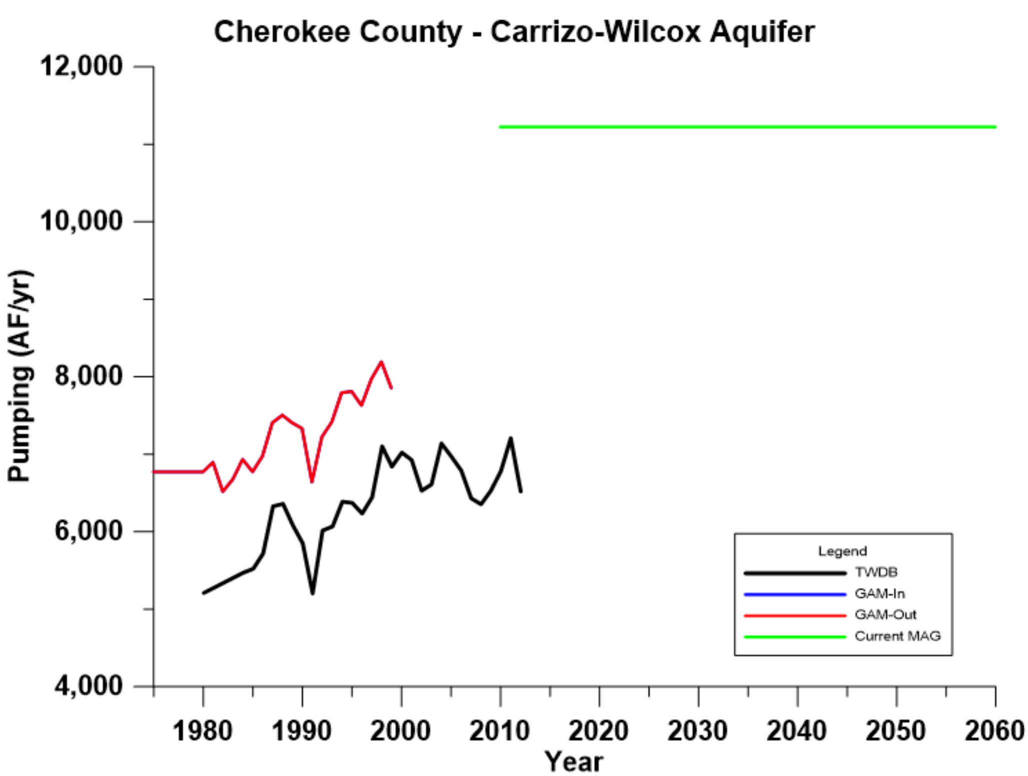


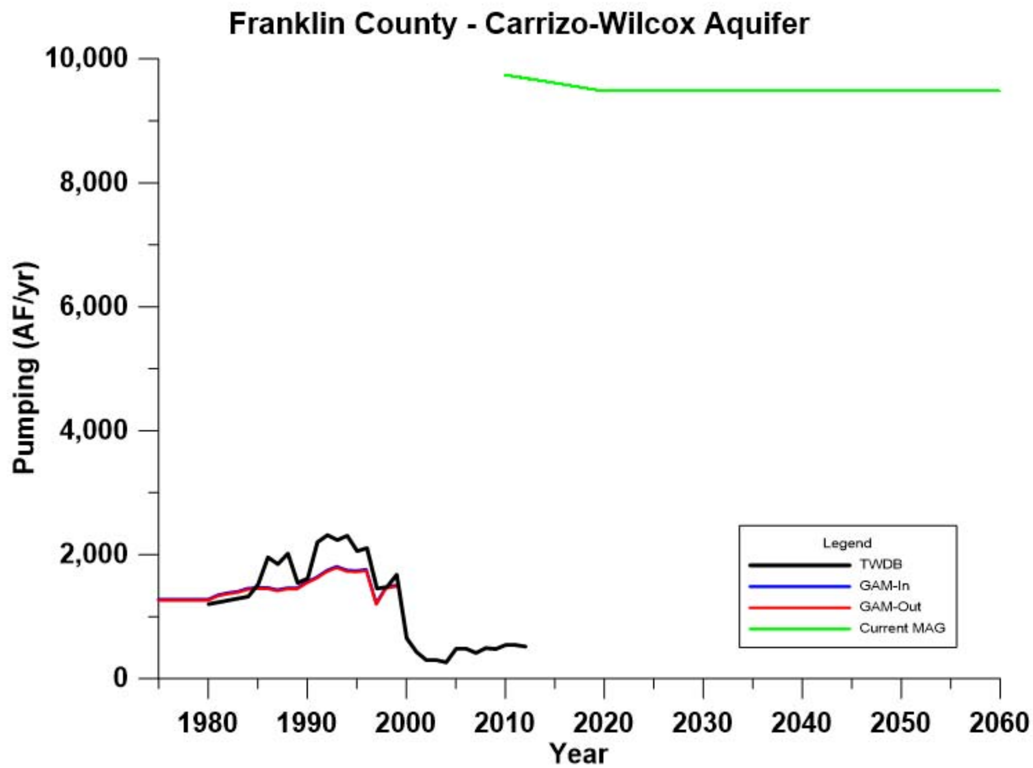
Angelina County - Carrizo-Wilcox Aquifer
35,000
30,000
25,000
20,000
15,000
10,000
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG


Bowie County - Carrizo-Wilcox Aquifer
12,000
8,000
4,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

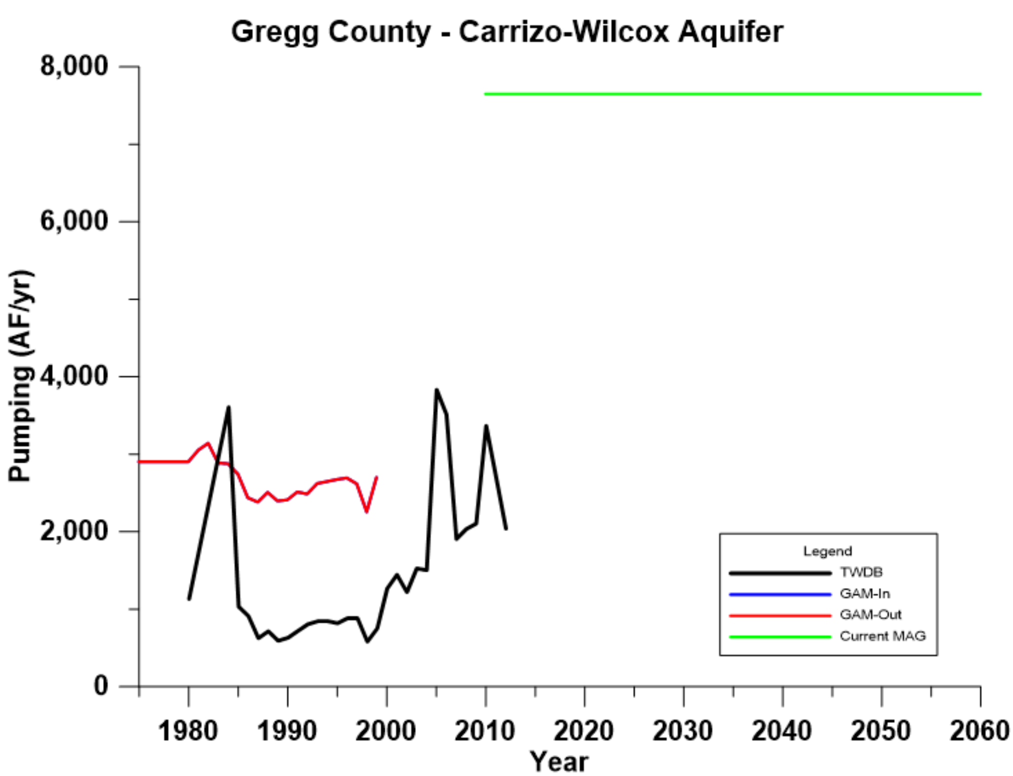

Camp County - Carrizo-Wilcox Aquifer
5,000
4,000
3,000
2,000
1,000
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG


Cass County - Carrizo-Wilcox Aquifer
Pumping (AF/yr)
5,000
4,000
3,000
2,000
1,000
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

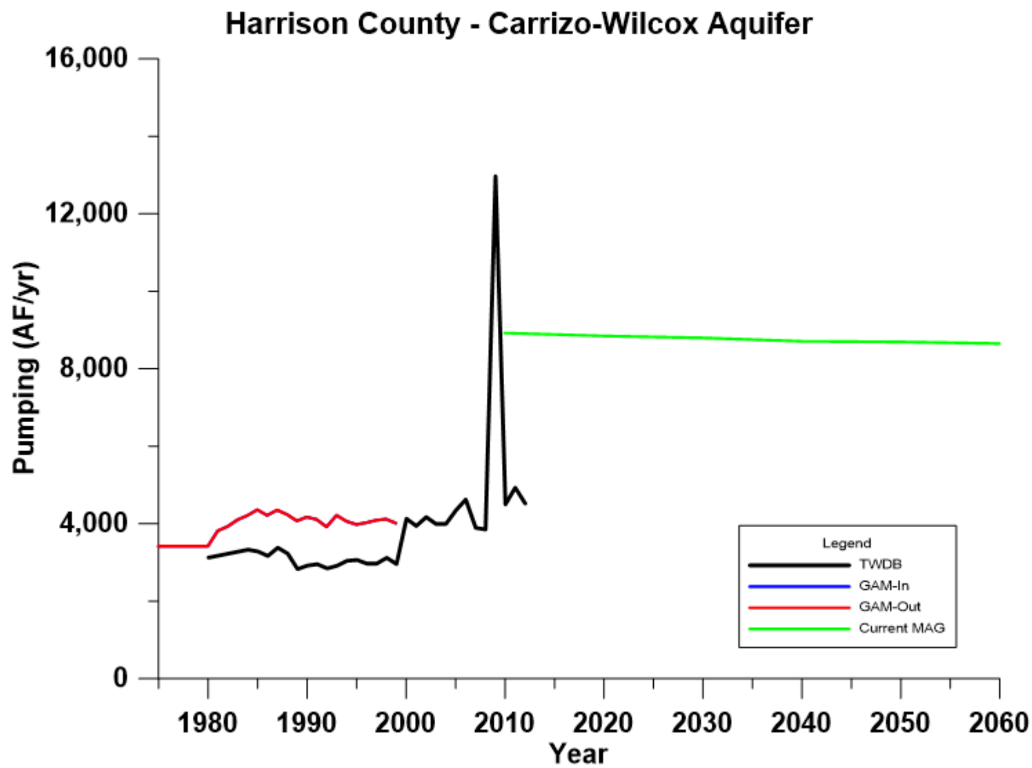

Cherokee County - Carrizo-Wilcox Aquifer
Pumping (AF/yr)
12,000
10,000
8,000
6,000
4,000
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG



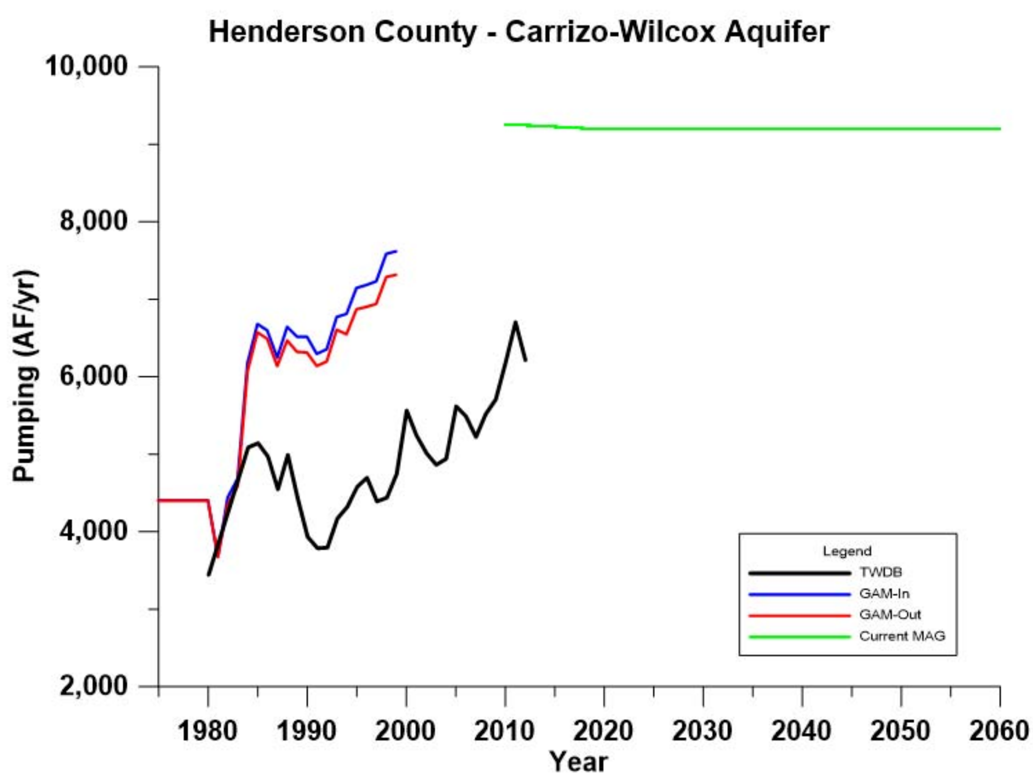
Franklin County - Carrizo-Wilcox Aquifer
10,000
8,000
6,000
4,000
2,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG



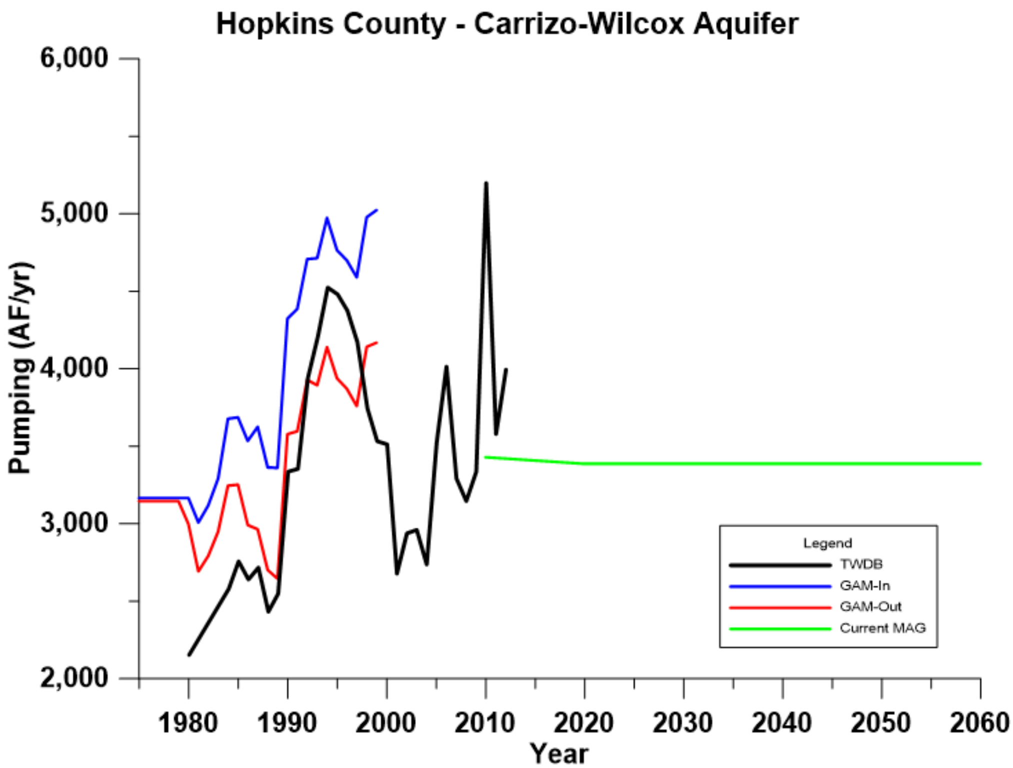
Gregg County - Carrizo-Wilcox Aquifer
8,000
6,000
4,000
2,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

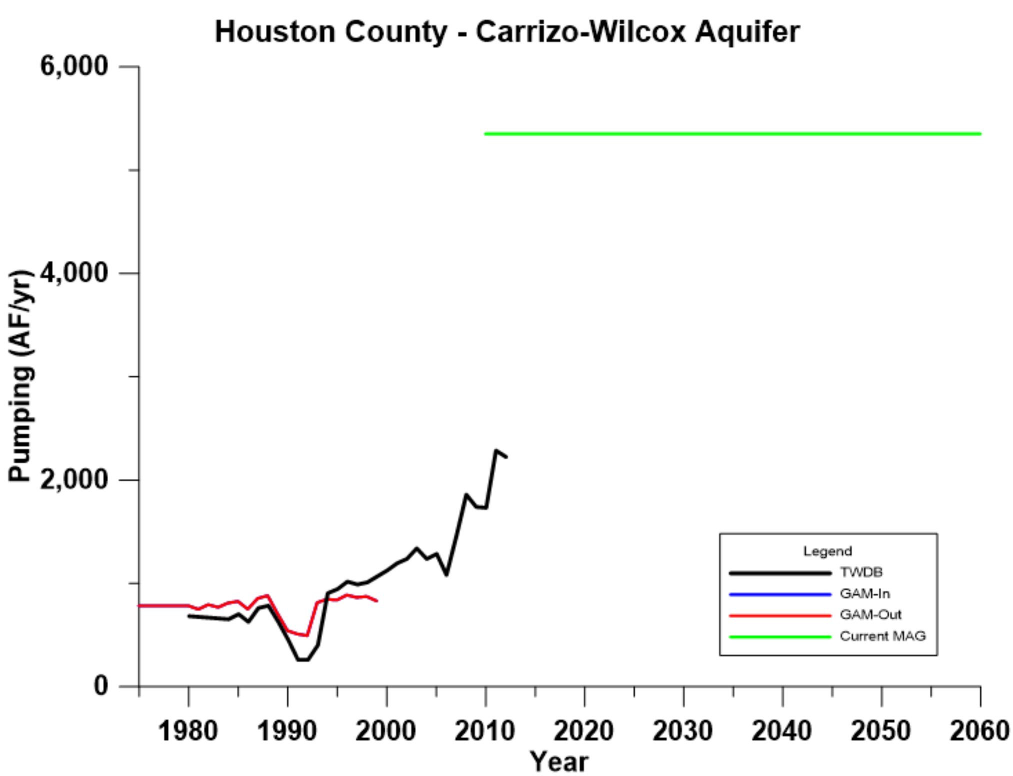


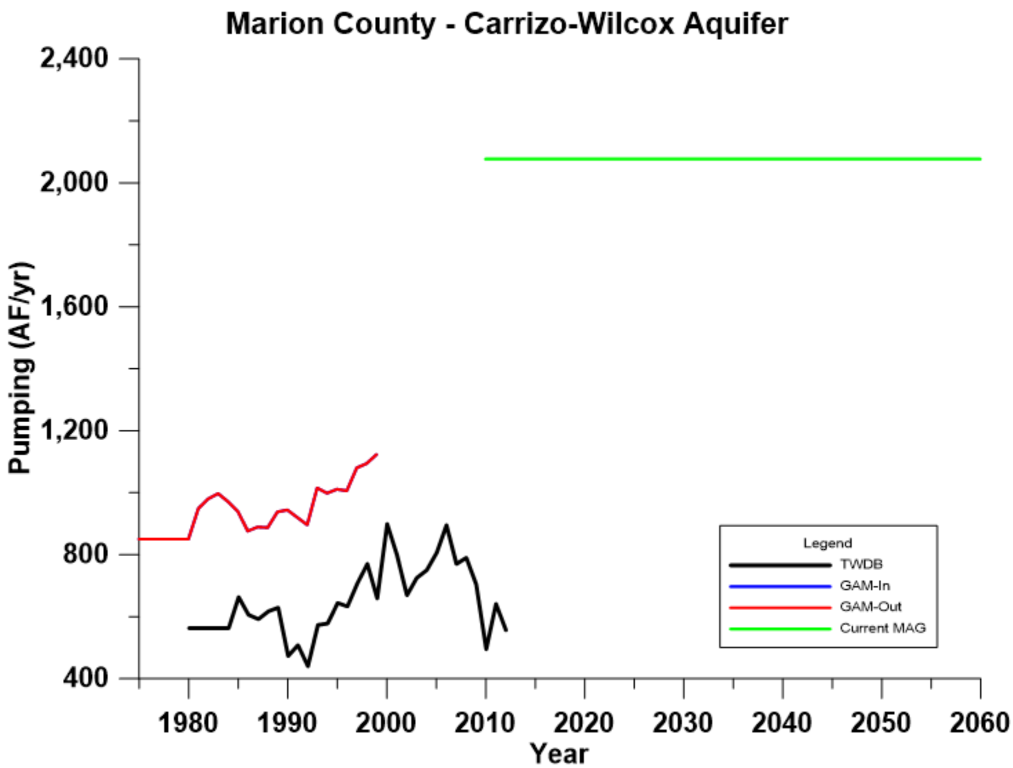
Harrison County - Carrizo-Wilcox Aquifer
16,000
12,000
8,000
4,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

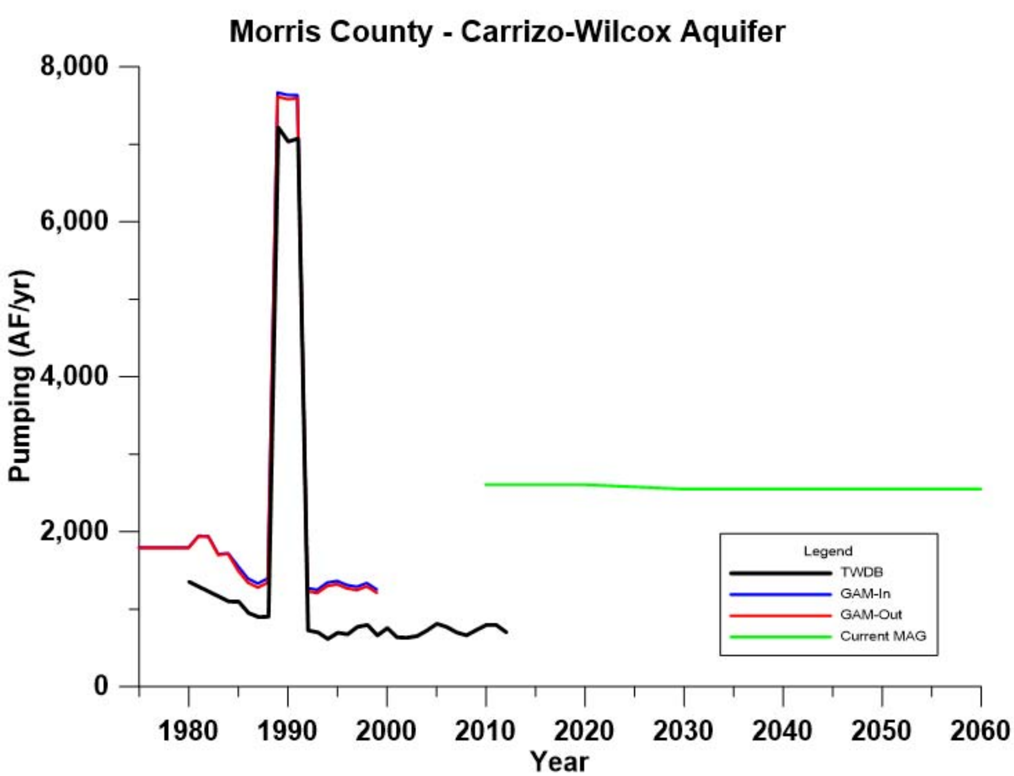


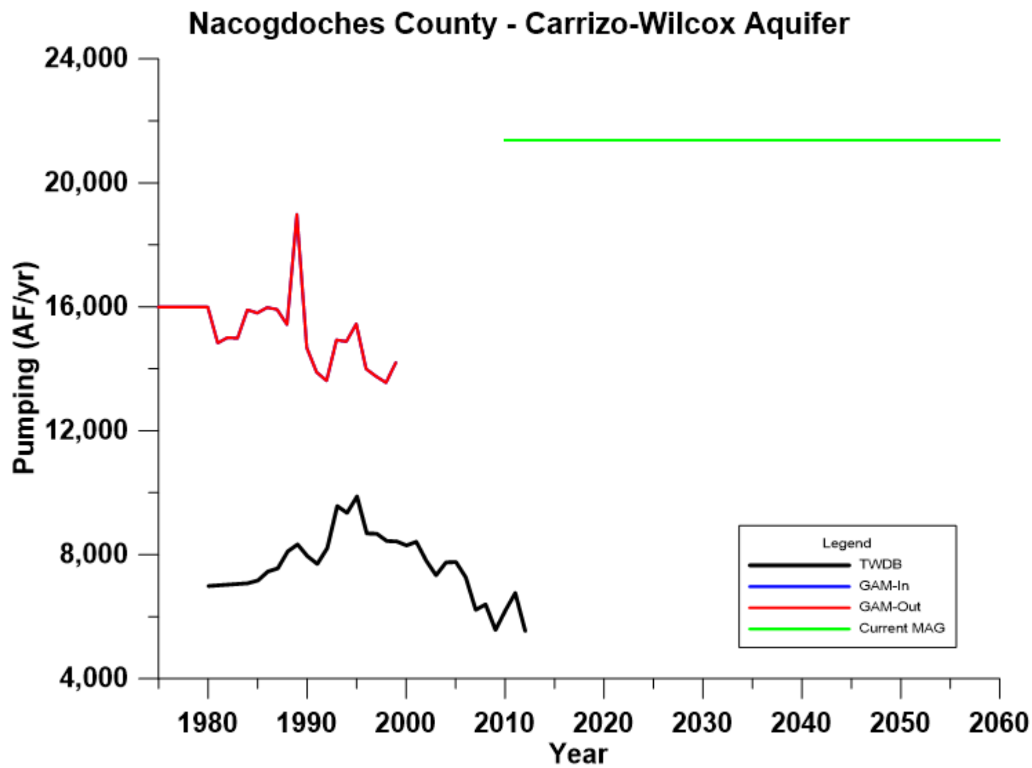
Henderson County - Carrizo-Wilcox Aquifer
10,000
8,000
6,000
4,000
2,000
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

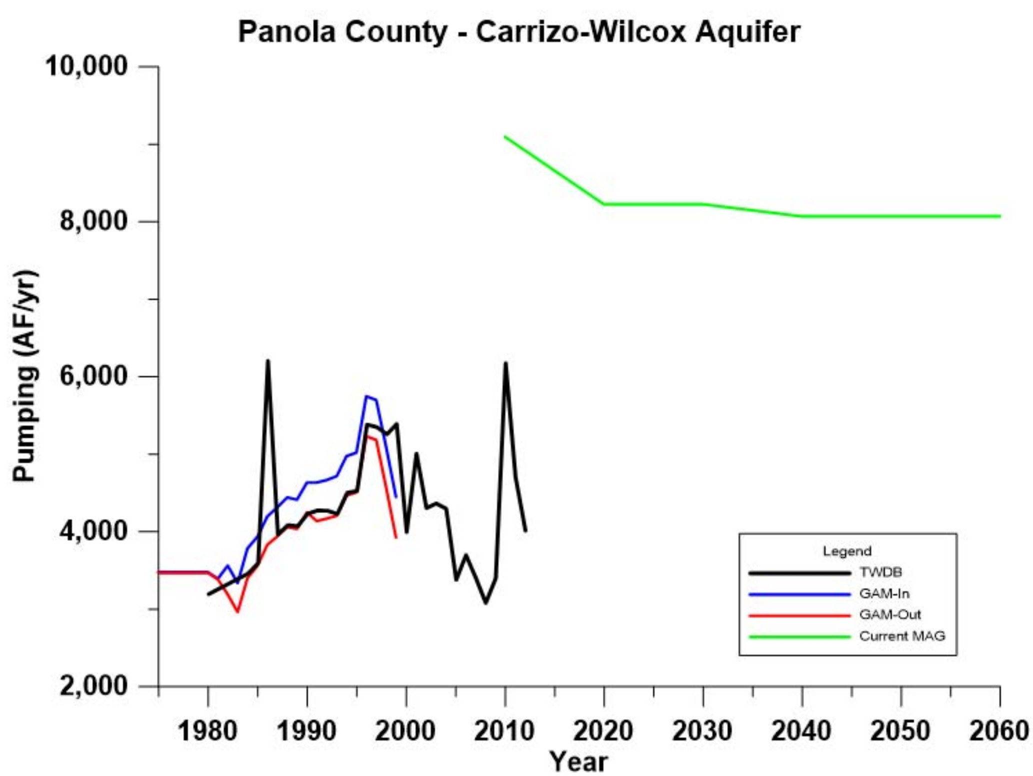

Hopkins County - Carrizo-Wilcox Aquifer
Pumping (AF/yr)
6,000
5,000
4,000
3,000
2,000
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

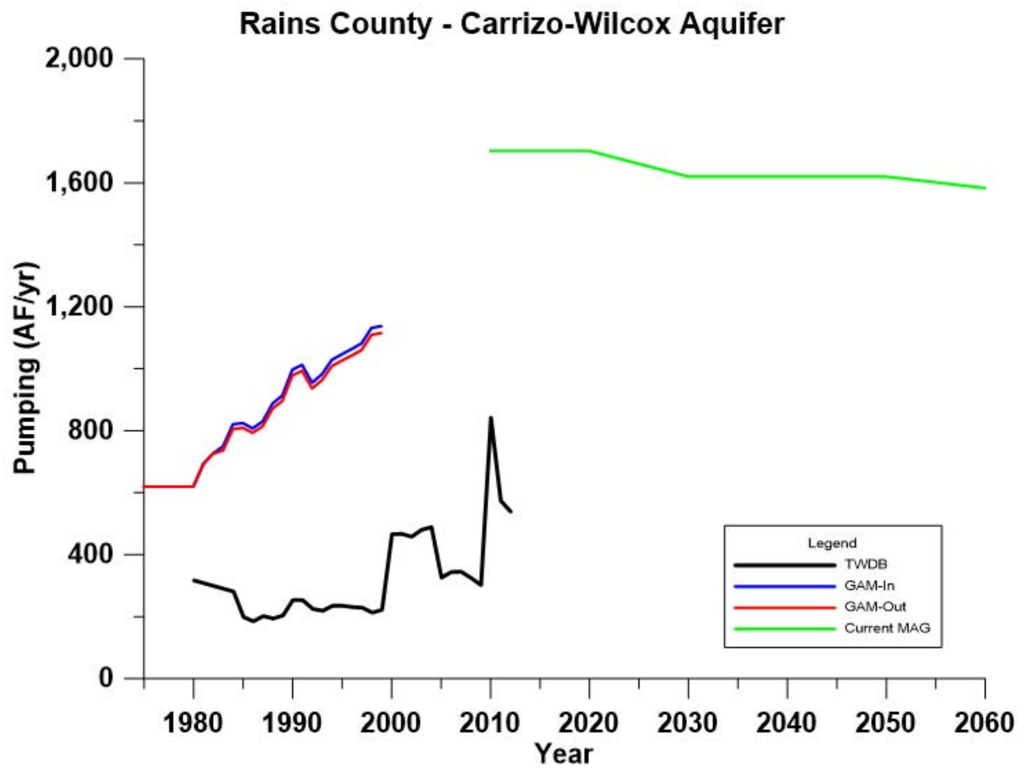

Houston County - Carrizo-Wilcox Aquifer
Pumping (AF/yr)
6,000
4,000
2,000
0
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

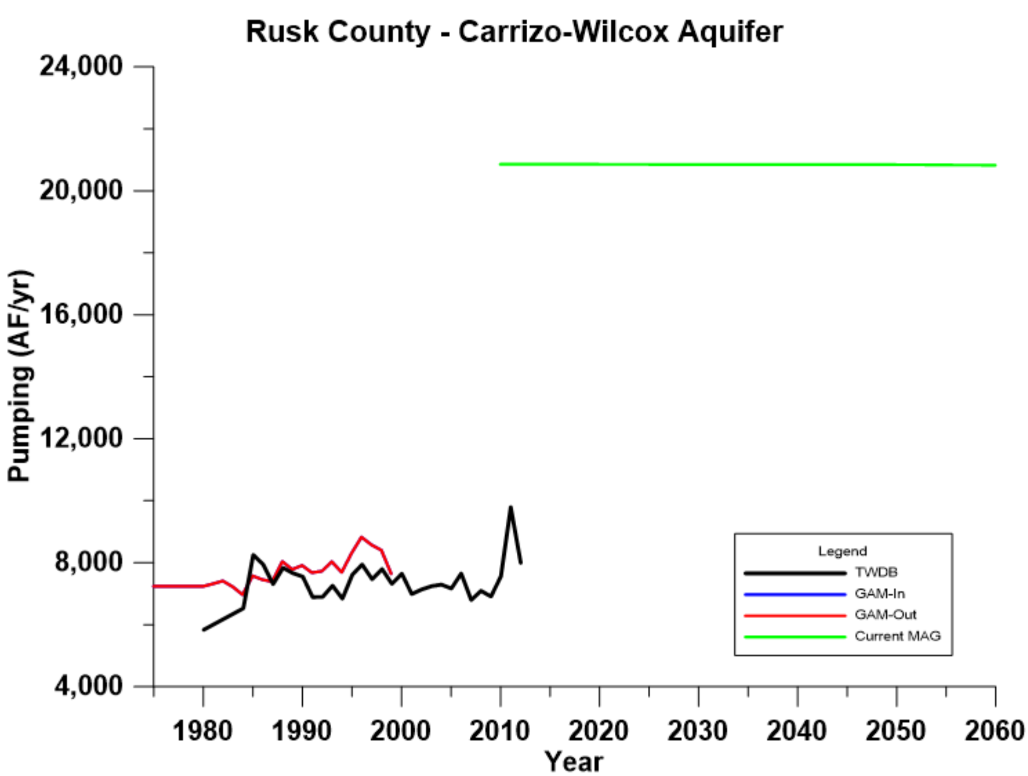

Marion County - Carrizo-Wilcox Aquifer
2,400
2,000
1,600
1,200
800
400
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

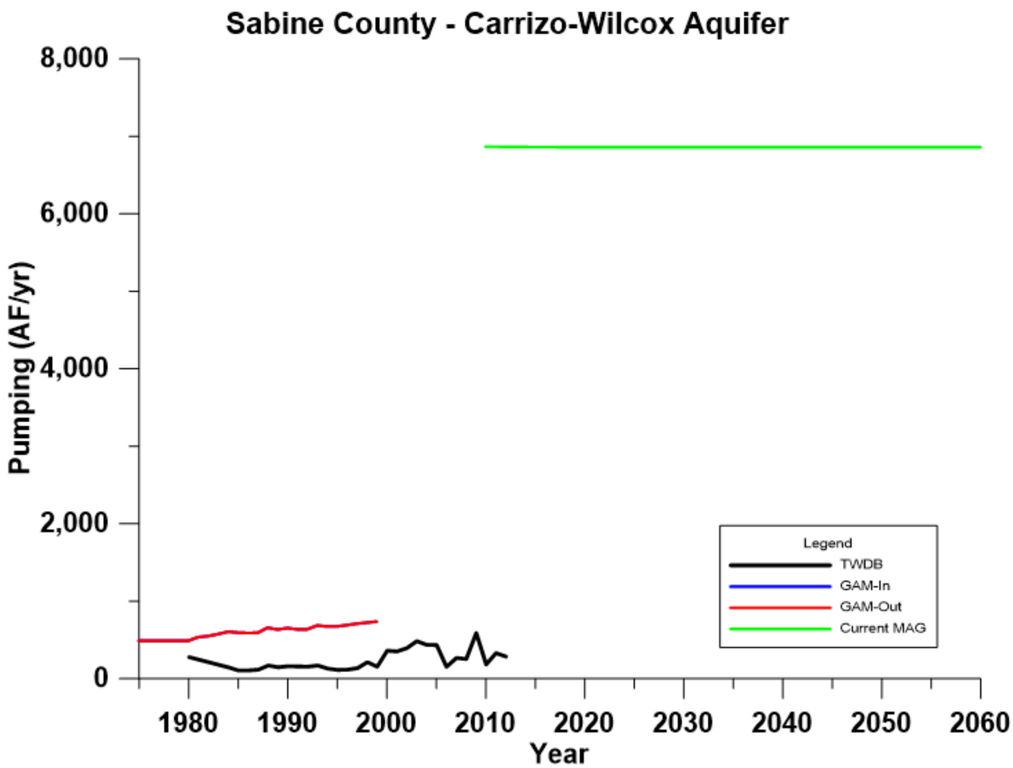

Morris County - Carrizo-Wilcox Aquifer
8,000
6,000
4,000
2,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

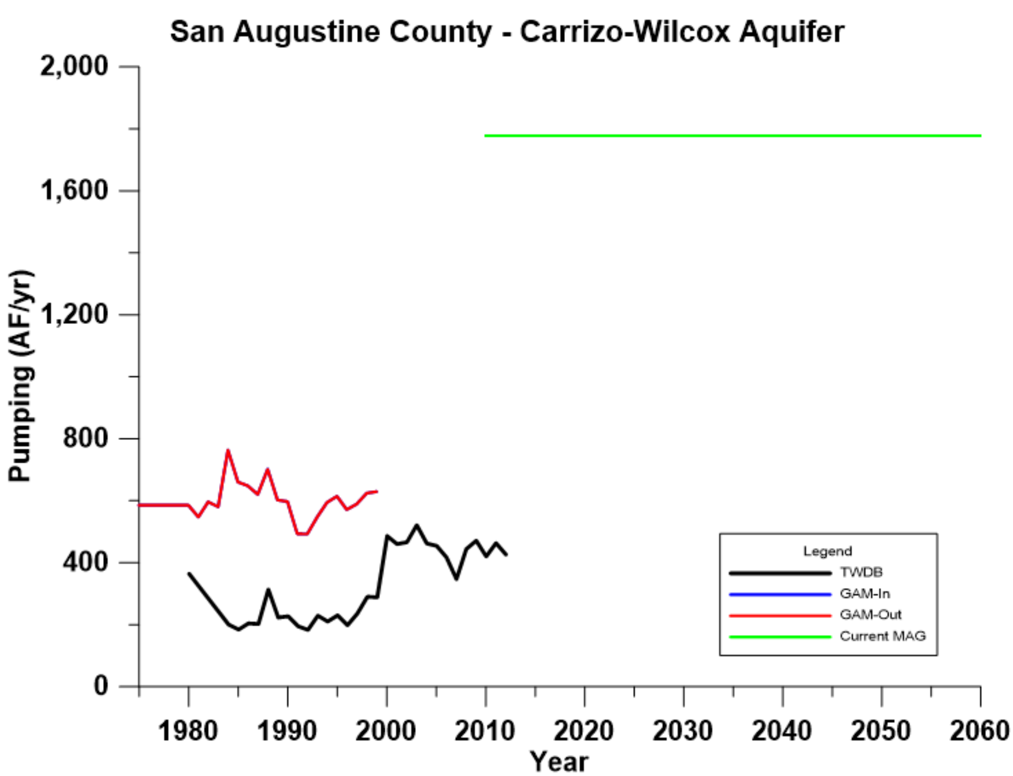

Nacogdoches County - Carrizo-Wilcox Aquifer
Pumping (AF/yr)
24,000
20,000
16,000
12,000
8,000
4,000
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

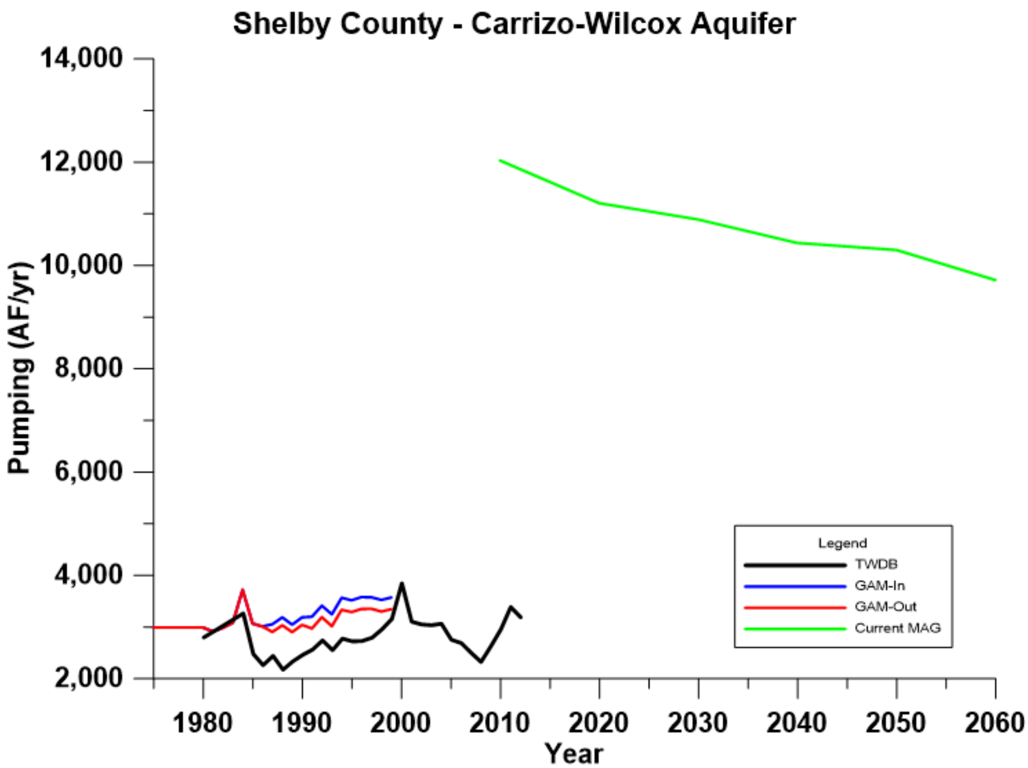

Panola County - Carrizo-Wilcox Aquifer
Pumping (AF/yr)
10,000
8,000
6,000
4,000
2,000
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

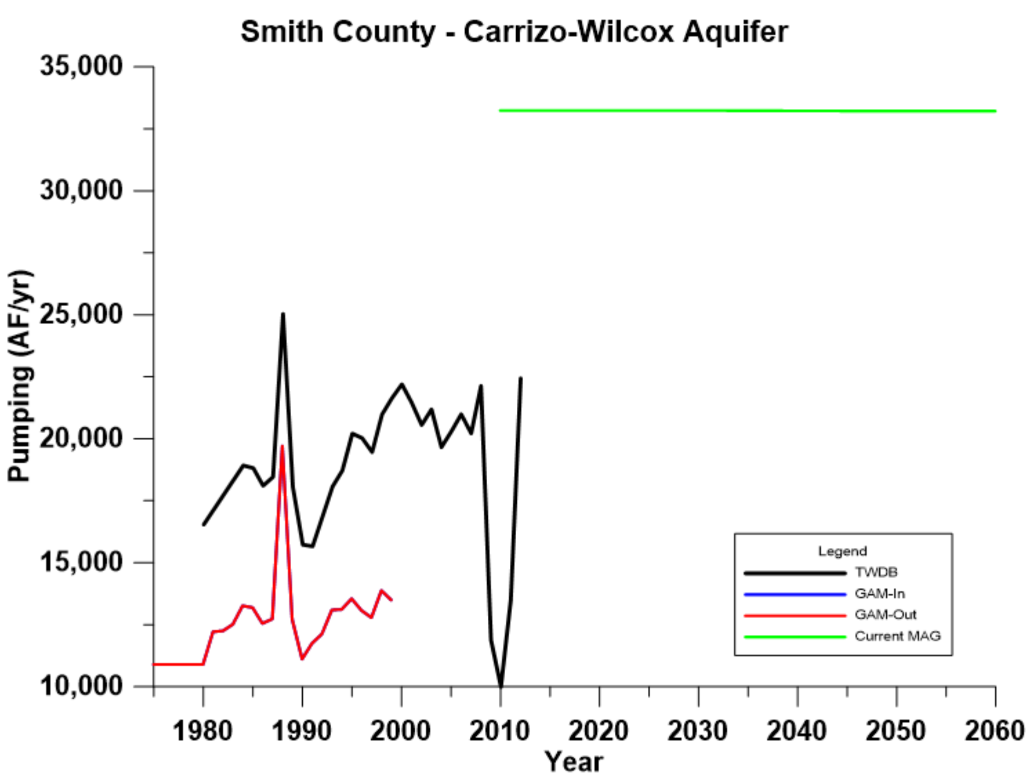

Rains County - Carrizo-Wilcox Aquifer
2,000
1,600
1,200
800
400
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

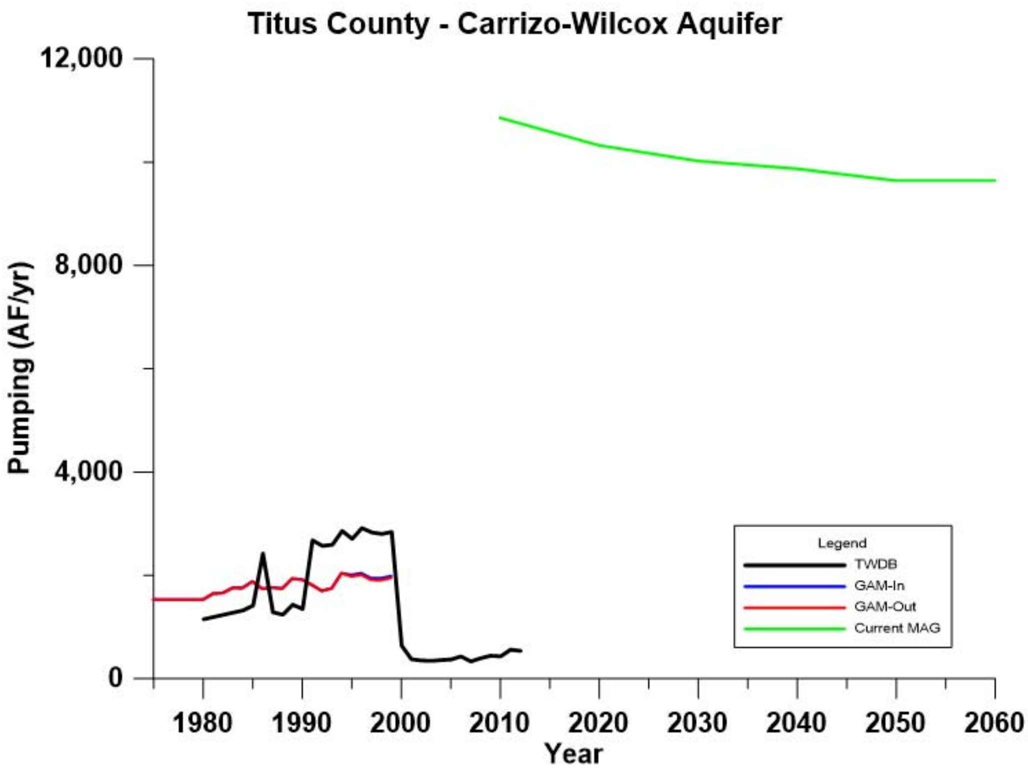

Rusk County - Carrizo-Wilcox Aquifer
24,000
20,000
16,000
12,000
8,000
4,000
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

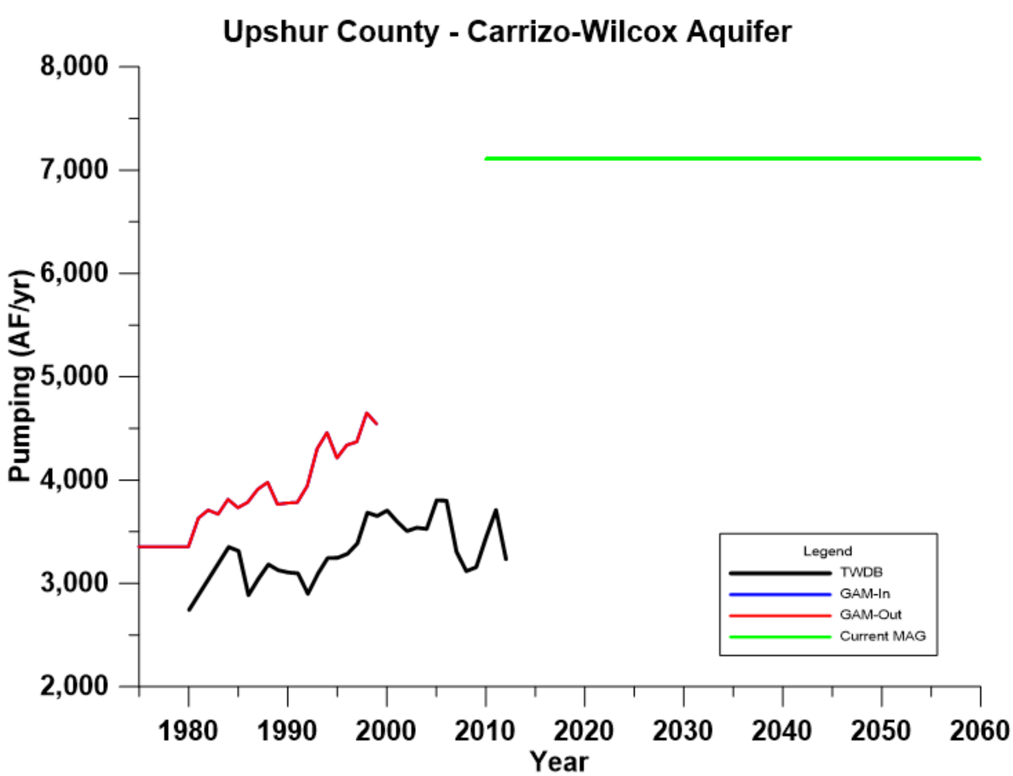

Sabine County - Carrizo-Wilcox Aquifer
8,000
6,000
4,000
2,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

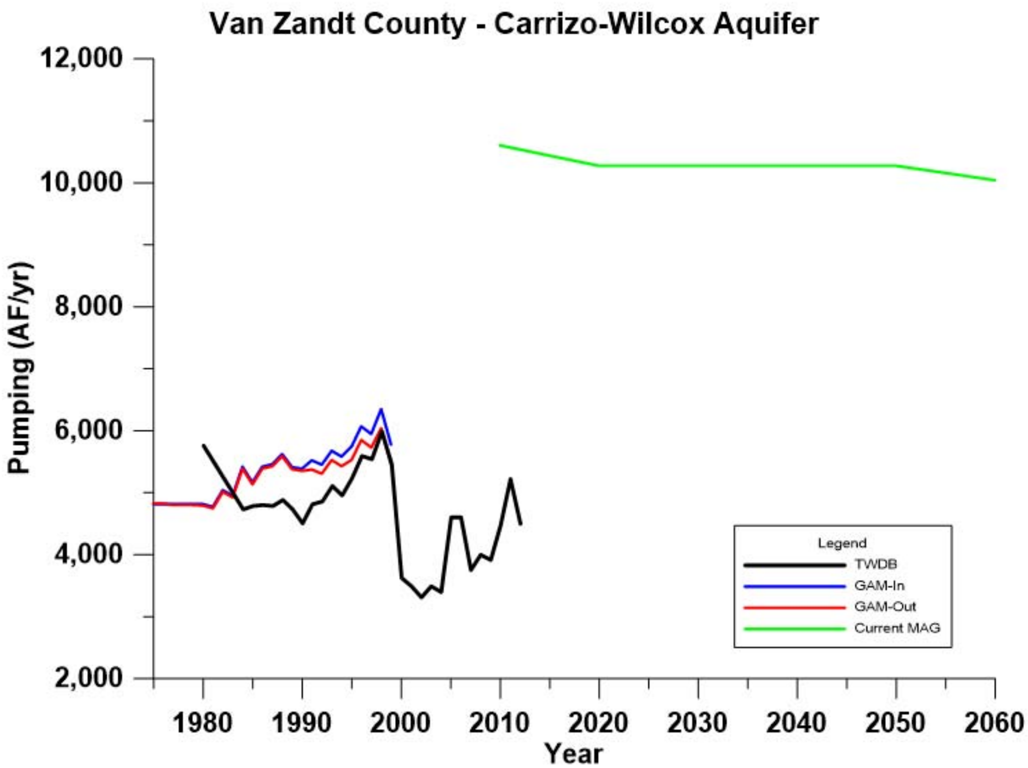

San Augustine County - Carrizo-Wilcox Aquifer
2,000
1,600
1,200
800
400
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG


Shelby County - Carrizo-Wilcox Aquifer
Pumping (AF/yr)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

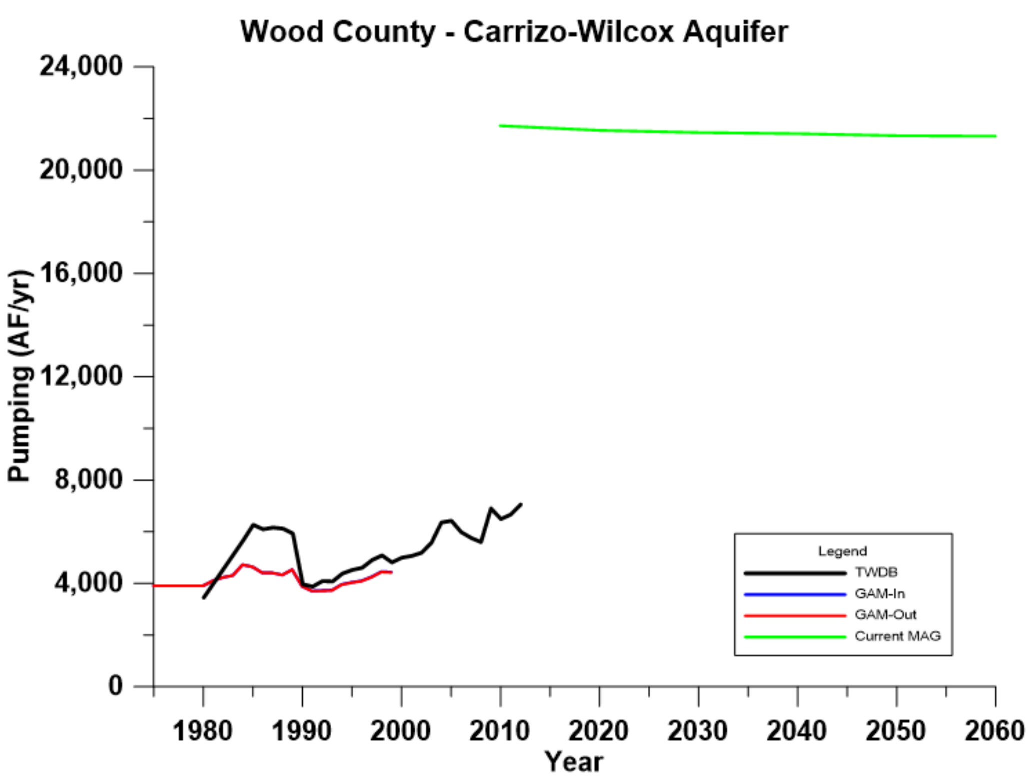

Smith County - Carrizo-Wilcox Aquifer
Pumping (AF/yr)
35,000
30,000
25,000
20,000
15,000
10,000
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG


Titus County - Carrizo-Wilcox Aquifer
12,000
8,000
4,000
0
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG


Upshur County - Carrizo-Wilcox Aquifer
8,000
7,000
6,000
5,000
4,000
3,000
2,000
Pumping (AF/yr)
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG



Van Zandt County - Carrizo-Wilcox Aquifer
Pumping (AF/yr)
12,000
10,000
8,000
6,000
4,000
2,000
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG



Wood County - Carrizo-Wilcox Aquifer
Pumping (AF/yr)
24,000
20,000
16,000
12,000
8,000
4,000
0
1980
1990
2000
2010
2020
2030
2040
2050
2060
Year
Legend
TWDB
GAM-In
GAM-Out
Current MAG

Appendix E

TWDB GAM Task 13-034: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 11

GAM Task 13-034: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 11

by Shirley Wade, Ph.D., P.G., Jerry Shi, Ph.D., P.G.,
and Chelsea Seiter-Weatherford
Texas Water Development Board
Groundwater Resources Division
(512) 936-0883
April 2, 2014

STATE OF TEXAS
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The seals appearing on this document were authorized by Shirley C. Wade, P.G. 525, Jianyou (Jerry) Shi, P.G. 11113, and Cynthia K. Ridgeway, P.G. 471 on April 2, 2014. Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by Chelsea Seiter-Weatherford under her direct supervision.

The total estimated recoverable storage in this report was calculated as follows: the Trinity Aquifer (Jerry Shi), the Nacatoch Aquifer (Chelsea Seiter-Weatherford), and the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Gulf Coast aquifers (Shirley Wade).

GAM TASK 13-034: TOTAL ESTIMATED RECOVERABLE STORAGE FOR AQUIFERS IN GROUNDWATER MANAGEMENT AREA 11

by Shirley Wade, Ph.D., P.G., Jerry Shi, Ph.D., P.G.,
and Chelsea Seiter-Weatherford
Texas Water Development Board
Groundwater Resources Division
(512) 936-0883
April 2, 2014

EXECUTIVE SUMMARY:

Texas Water Code, §36.108 (d) (Texas Water Code, 2011) states that, before voting on the proposed desired future conditions for a relevant aquifer within a groundwater management area, the groundwater conservation districts shall consider the total estimated recoverable storage as provided by the executive administrator of the Texas Water Development Board (TWDB) along with other factors listed in §36.108 (d). Texas Administrative Code Rule §356.10(24) (Texas Administrative Code, 2011) defines the total estimated recoverable storage as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25 percent and 75 percent of the porosity-adjusted aquifer volume.

This report discusses the methods, assumptions, and results of an analysis to estimate the total recoverable storage for the Trinity, Nacatoch, Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Gulf Coast aquifers within Groundwater Management Area 11. Tables 1 through 14 summarize the total estimated recoverable storage required by the statute. Figures 2 through 8 indicate the official extent of the aquifers in Groundwater Management Area 11 used to estimate the total recoverable storage.

DEFINITION OF TOTAL ESTIMATED RECOVERABLE STORAGE:

The total estimated recoverable storage is defined as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25 percent and 75 percent of the porosity-adjusted aquifer volume. In other words, we assume that only 25 to 75 percent of groundwater held within an aquifer can be removed by pumping.

The total recoverable storage was estimated for the portion of the aquifer within Groundwater Management Area 11 that lies within the official lateral aquifer boundaries as delineated by George and others (2011). Total estimated recoverable storage values may include a mixture of water quality types, including fresh, brackish, and saline groundwater, because the available data and the existing groundwater availability models do not permit the differentiation between different water quality types. The total estimated recoverable storage values do not take into account the effects of land surface subsidence, degradation of water quality, or any changes to surface water-groundwater interaction that may occur as the result of extracting groundwater from the aquifer.

METHODS:

To estimate the total recoverable storage of an aquifer, we first calculated the total storage in an aquifer within the official aquifer boundary. The total storage is the volume of groundwater removed by pumping that completely drains the aquifer.

Aquifers can be either unconfined or confined (Figure 1). A well screened in an unconfined aquifer will have a water level equal to the water level in the aquifer outside the well. A confined aquifer is bounded by low permeable geologic units at the top and bottom, and the aquifer is under hydraulic pressure above the ambient atmospheric pressure. The water level in a well screened in a confined aquifer will be above the top of the aquifer. As a result, calculation of total storage is different between unconfined and confined aquifers. For an unconfined aquifer, the total storage is equal to the volume of groundwater removed by pumping that makes the water level fall to the aquifer bottom. For a confined aquifer, the total storage contains two parts. The first part is the groundwater released from the aquifer when the water level falls from above the top of the aquifer to the top of the aquifer. The reduction of hydraulic pressure in the aquifer by pumping causes expansion of groundwater and deformation of aquifer solids. The aquifer is still fully saturated to this point. The second part, just like unconfined aquifer, is the groundwater released from the aquifer when the water level falls from the top to the bottom of the aquifer. Given the same aquifer area and water level drop, the amount of water released in the second part is much greater than the first part. The difference is quantified by two parameters: storativity related to confined aquifers and specific yield related to unconfined aquifers. For example, storativity values range from 10^{-5} to 10^{-3} for most confined aquifers, while the specific yield values can be 0.01 to 0.3 for most unconfined aquifers. The equations for calculating the total storage are presented below:

- for unconfined aquifers

$$Total\ Storage\ = V_{drained} = Area \times S_y \times (Water\ Level - Bottom)$$

- for confined aquifers

$$Total\ Storage\ = V_{confined} + V_{drained}$$

  - confined part

$$V_{confined} = \ Area \times [\ S \times (Water\ Level - Top)]$$

or

$$V_{confined} = \ Area \times [\ S_s\ \times (\mathrm{Top} - \mathrm{Bottom}) \times (Water\ Level - Top)]$$

  - unconfined part

$$V_{drained} = \ Area \times \left[S_y \times (Top - Bottom)\right]$$

where:

- $V_{drained}$ = storage volume due to water draining from the formation (acre-feet)
- $V_{confined}$ = storage volume due to elastic properties of the aquifer and water(acre-feet)
- *Area* = area of aquifer (acre)
- *Water Level* = groundwater elevation (feet above mean sea level)
- *Top* = elevation of aquifer top (feet above mean sea level)
- *Bottom* = elevation of aquifer bottom (feet above mean sea level)
- S_y = specific yield (no units)
- S_s = specific storage (1/feet)
- S = storativity or storage coefficient (no units)

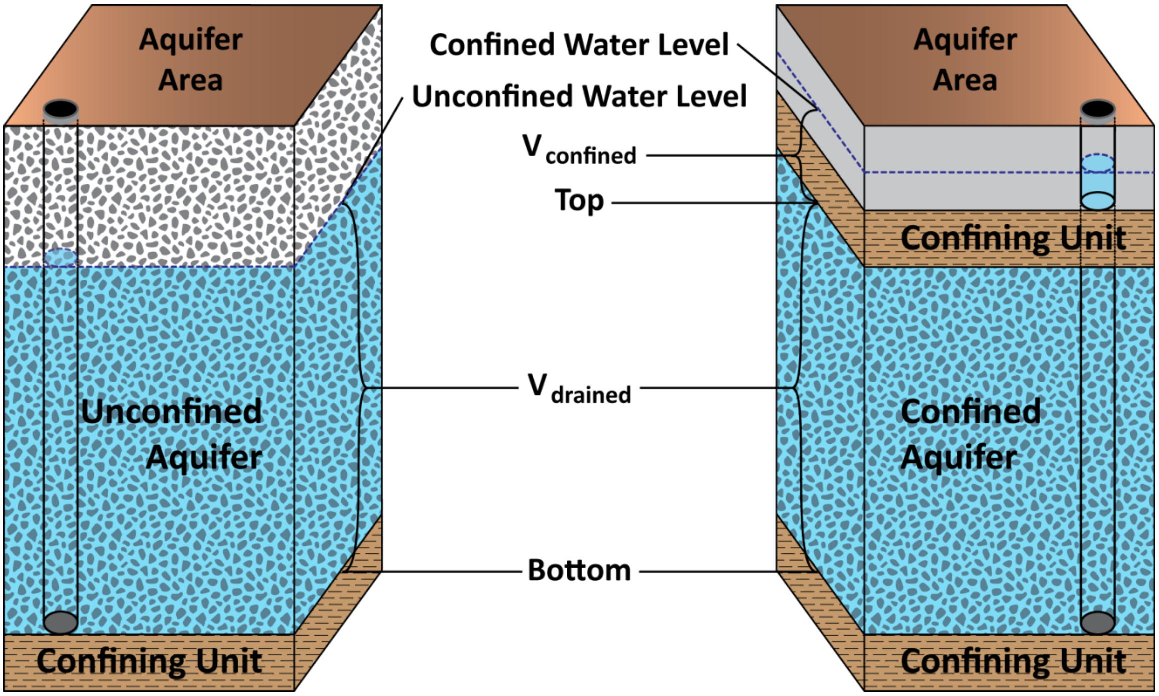

FIGURE 1. SCHEMATIC GRAPH SHOWING THE DIFFERENCE BETWEEN UNCONFINED AND CONFINED AQUIFERS.

As presented in the equations, calculation of the total storage requires data, such as aquifer top, aquifer bottom, aquifer storage properties, and water level. For the Trinity, Nacatoch, Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Gulf Coast aquifers within Groundwater Management Area 11 we extracted this information from existing groundwater availability model input and output files on a cell-by-cell basis.

The recoverable storage for each of the aquifers listed above was the product of its total storage and an estimated factor ranging from 25 percent to 75 percent.

PARAMETERS AND ASSUMPTIONS:

Trinity Aquifer

- We used version 1.01 of the groundwater availability model for the northern part of the Trinity Aquifer and the Woodbine Aquifer to estimate the total recoverable storage for the Trinity Aquifer. The Woodbine Aquifer is not present in Groundwater

Management Area 11. See Bené and others (2004) for assumptions and limitations of the groundwater availability model.

- This groundwater availability model includes seven layers which generally represent the Woodbine Aquifer (Layer 1), the Washita and Fredericksburg Confining Unit (Layer 2), the Paluxy Aquifer Unit of the Trinity Aquifer (Layer 3), the Glen Rose Confining Unit of the Trinity Aquifer (Layer 4), the Hensell Sand Aquifer Unit of the Trinity Aquifer (Layer 5), the Twin Mountains Confining Units of the Trinity Aquifer (Layer 6), and the Hosston Aquifer Unit of the Trinity Aquifer (Layer 7). To develop the estimates for the total estimated recoverable storage, we used Layers 3 through 7 (the Trinity Aquifer).
- The down-dip boundary of the model is the Luling-Mexia-Talco Fault Zone, which probably allows minimal groundwater flow across the fault zone (Bené and others, 2004). The groundwater in the official extent of the northern portion of the Trinity Aquifer aquifers ranges from fresh to moderately saline (brackish) in composition (Bené and others, 2004).

Nacatoch Aquifer

- We used version 1.01 of the groundwater availability model for the Nacatoch Aquifer. See Beach and others (2009) for assumptions and limitations of the groundwater availability model for the Nacatoch Aquifer.
- This groundwater availability model includes two layers which represent the Midway Group, and alluvium and terrace deposits (Layer 1), and the Nacatoch Aquifer (Layer 2).
- The total estimated recoverable storage for the Nacatoch Aquifer was calculated using Layer 2.
- Groundwater in the Nacatoch Aquifer is generally fresh within Groundwater Management Area 11 (Beach and others, 2009). Groundwater with total dissolved solids of less than 1,000 milligrams per liter is defined as fresh. Groundwater with total dissolved solids between 1,000 to 10,000 milligrams per liter is defined as brackish, and groundwater with total dissolved solids between 10,000 and 35,000 milligrams per liter is defined as saline (George and others, 2011).

Carrizo-Wilcox, Queen City, and Sparta aquifers

- We used Version 2.01 of the groundwater availability model for the northern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. See Fryar and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the northern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.
- The groundwater availability model includes eight layers that generally correspond to the Sparta Aquifer (Layer 1), the Weches Confining Unit (Layer 2), the Queen City Aquifer (Layer 3), the Reklaw Confining Unit (Layer 4), the Carrizo Aquifer (Layer 5), the Upper Wilcox Aquifer (Layer 6), the Middle Wilcox Aquifer (Layer 7), and the Lower Wilcox Aquifer (Layer 8).
- In the Sabine Uplift area, the Simsboro Formation (Middle Wilcox Aquifer) is not distinguishable and the Wilcox Group is informally divided into the Upper Wilcox and the Lower Wilcox aquifers (Fryar and others, 2003). In the current version of the groundwater availability model, layers 6 and 7 represent the Upper Wilcox and Lower Wilcox aquifers in this area. Layer 8 is included in the model in this area, but it is of nominal thickness and is not intended to represent the Lower Wilcox aquifer.

Yegua-Jackson Aquifer and the Catahoula Formation portion of the Gulf Coast Aquifer System

- We used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer to estimate the total recoverable storages of the Yegua-Jackson Aquifer and parts of the Catahoula Formation. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes five layers which represent the outcrop section for the Yegua-Jackson Aquifer and the Catahoula Formation and other younger overlying units (Layer 1), the upper portion of the Jackson Group (Layer 2), the lower portion of the Jackson Group (Layer 3), the upper portion of the Yegua Group (Layer 4), and the lower portion of the Yegua Group (Layer 5). To develop the estimates for the total estimated recoverable storage in the Yegua-Jackson Aquifer, we used layers

1 through 5. However, we only used model cells in Layer 1 to evaluate the outcrop area of the Yegua-Jackson Aquifer.

- The down-dip boundary for the Yegua-Jackson Aquifer in this model was set to approximately coincide with the extent of the available geologic data, much deeper than any portion of the aquifer that is used for groundwater supply (Deeds and others, 2010). Consequently, the model extends into zones of brackish and saline groundwater. The groundwater in the official extent of the Yegua-Jackson Aquifer ranges from fresh to brackish in composition (Deeds and others, 2010).

Gulf Coast Aquifer System

- We used version 3.01 of the groundwater availability model for the northern portion of the Gulf Coast Aquifer system for this analysis. See Kasmarek (2013) for assumptions and limitations of the model.
- The model has four layers which represent the Chicot Aquifer (Layer 1), the Evangeline Aquifer (Layer 2), the Burkeville confining unit (Layer 3), and the Jasper Aquifer and parts of the Catahoula Formation in direct hydrologic communication with the Jasper Aquifer (Layer 4).
- The southeastern boundary of flow in each hydrogeologic unit of the model was set at the down-dip limit of freshwater (up to 10,000 milligrams per liter of total dissolved solids; Kasmarek, 2013).

RESULTS:

Tables 1 through 14 summarize the total estimated recoverable storage required by statute. The county and groundwater conservation district total storage estimates are rounded to two significant digits. Figures 2 through 8 indicate the extent of the groundwater availability models in Groundwater Management Area 11 from which the storage information was extracted.

TABLE 1. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE TRINITY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Henderson	500,000	125,000	375,000
Total	**500,000**	**125,000**	**375,000**

TABLE 2. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT FOR THE TRINITY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Neches & Trinity Valleys GCD	500,000	125,000	375,000
Total	**500,000**	**125,000**	**375,000**

FIGURE 2 EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN TRINITY AND WOODBINE AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE TRINITY AQUIFER (TABLES 1 AND 2) WITHIN GROUNDWATER MANAGEMENT AREA 11.

TABLE 3. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE NACATOCH AQUIFER IN GROUNDWATER MANAGEMENT AREA 11. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Bowie	140,000	35,000	105,000
Henderson	9,800	2,450	7,350
Morris	2,900	725	2,175
Red River	11,000	2,750	8,250
Titus	15,000	3,750	11,250
Total	**178,700**	**44,675**	**134,025**

TABLE 4. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[1] FOR THE NACATOCH AQUIFER IN GROUNDWATER MANAGEMENT AREA 11. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	160,000	40,000	120,000
Neches & Trinity Valleys GCD	9,800	2,450	7,350
Total	**169,800**	**42,450**	**127,350**

[1] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to two significant digits.

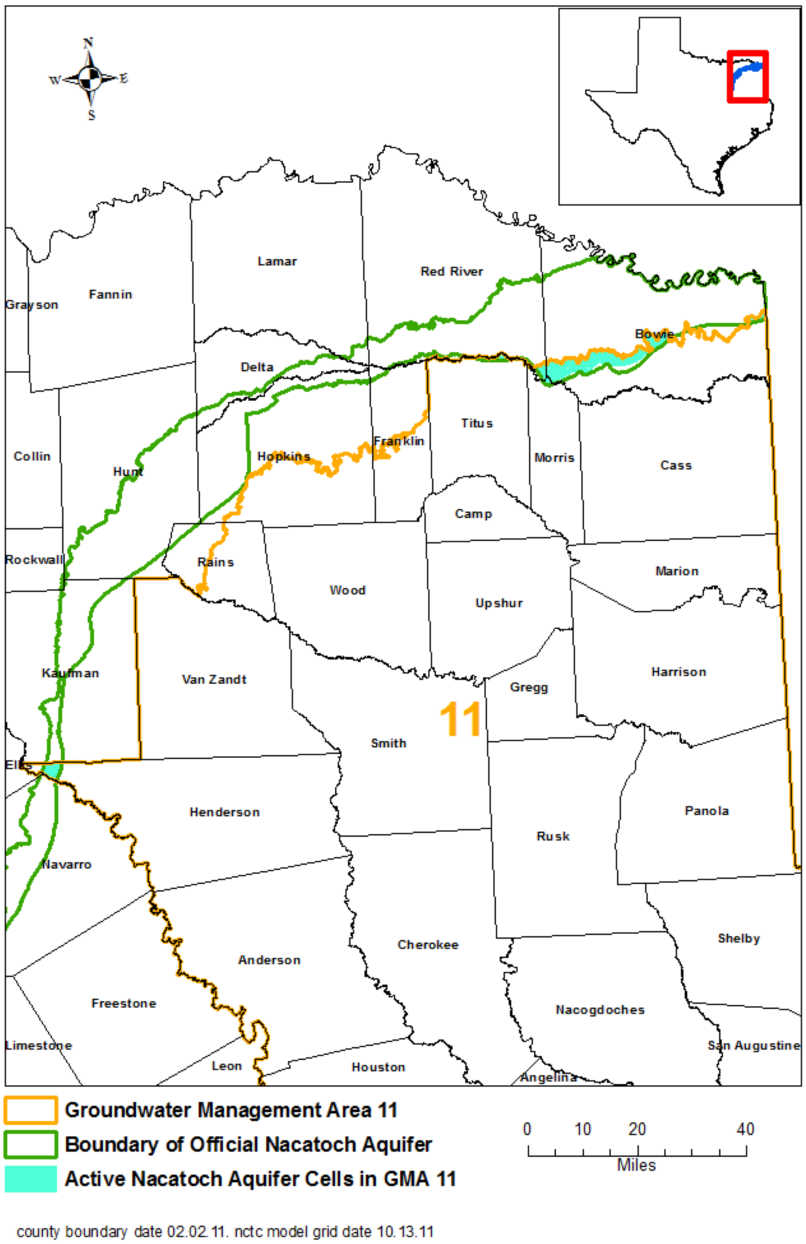

FIGURE 3. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NACATOCH AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE NACATOCH AQUIFER (TABLES 3 AND 4) WITHIN GROUNDWATER MANAGEMENT AREA 11.

TABLE 5. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE CARRIZO-WILCOX AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Anderson	170,000,000	42,500,000	127,500,000
Angelina	130,000,000	32,500,000	97,500,000
Bowie	6,400,000	1,600,000	4,800,000
Camp	15,000,000	3,750,000	11,250,000
Cass	60,000,000	15,000,000	45,000,000
Cherokee	200,000,000	50,000,000	150,000,000
Franklin	6,000,000	1,500,000	4,500,000
Gregg	21,000,000	5,250,000	15,750,000
Harrison	40,000,000	10,000,000	30,000,000
Henderson	66,000,000	16,500,000	49,500,000
Hopkins	7,000,000	1,750,000	5,250,000
Houston	390,000,000	97,500,000	292,500,000
Marion	25,000,000	6,250,000	18,750,000
Morris	16,000,000	4,000,000	12,000,000
Nacogdoches	210,000,000	52,500,000	157,500,000
Panola	33,000,000	8,250,000	24,750,000
Rains	3,200,000	800,000	2,400,000
Red River	33,000	8,250	24,750
Rusk	100,000,000	25,000,000	75,000,000
Sabine	78,000,000	19,500,000	58,500,000

County	***Total Storage (acre-feet)***	***25 percent of Total Storage (acre-feet)***	***75 percent of Total Storage (acre-feet)***
San Augustine	110,000,000	27,500,000	82,500,000
Shelby	85,000,000	21,250,000	63,750,000
Smith	100,000,000	25,000,000	75,000,000
Titus	13,000,000	3,250,000	9,750,000
Trinity	43,000,000	10,750,000	32,250,000
Upshur	45,000,000	11,250,000	33,750,000
Van Zandt	35,000,000	8,750,000	26,250,000
Wood	54,000,000	13,500,000	40,500,000
Total	**2,061,633,000**	**515,408,250**	**1,546,224,750**

TABLE 6. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT [2] FOR THE CARRIZO-WILCOX AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	890,000,000	222,500,000	667,500,000
Anderson County UWCD[3]	7,600,000	1,900,000	5,700,000
Deep East Texas GCD[4]	270,000,000	67,500,000	202,500,000
Neches & Trinity Valleys GCD	430,000,000	107,500,000	322,500,000
Panola County GCD	33,000,000	8,250,000	24,750,000
Pineywoods GCD	340,000,000	85,000,000	255,000,000
Rusk County GCD	100,000,000	25,000,000	75,000,000
Total	**2,070,600,000**	**517,650,000**	**1,552,950,000**

[2] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to two significant digits.
[3] UWCD stands for Underground Water Conservation District
[4] Deep East Texas Groundwater Conservation District is pending confirmation.

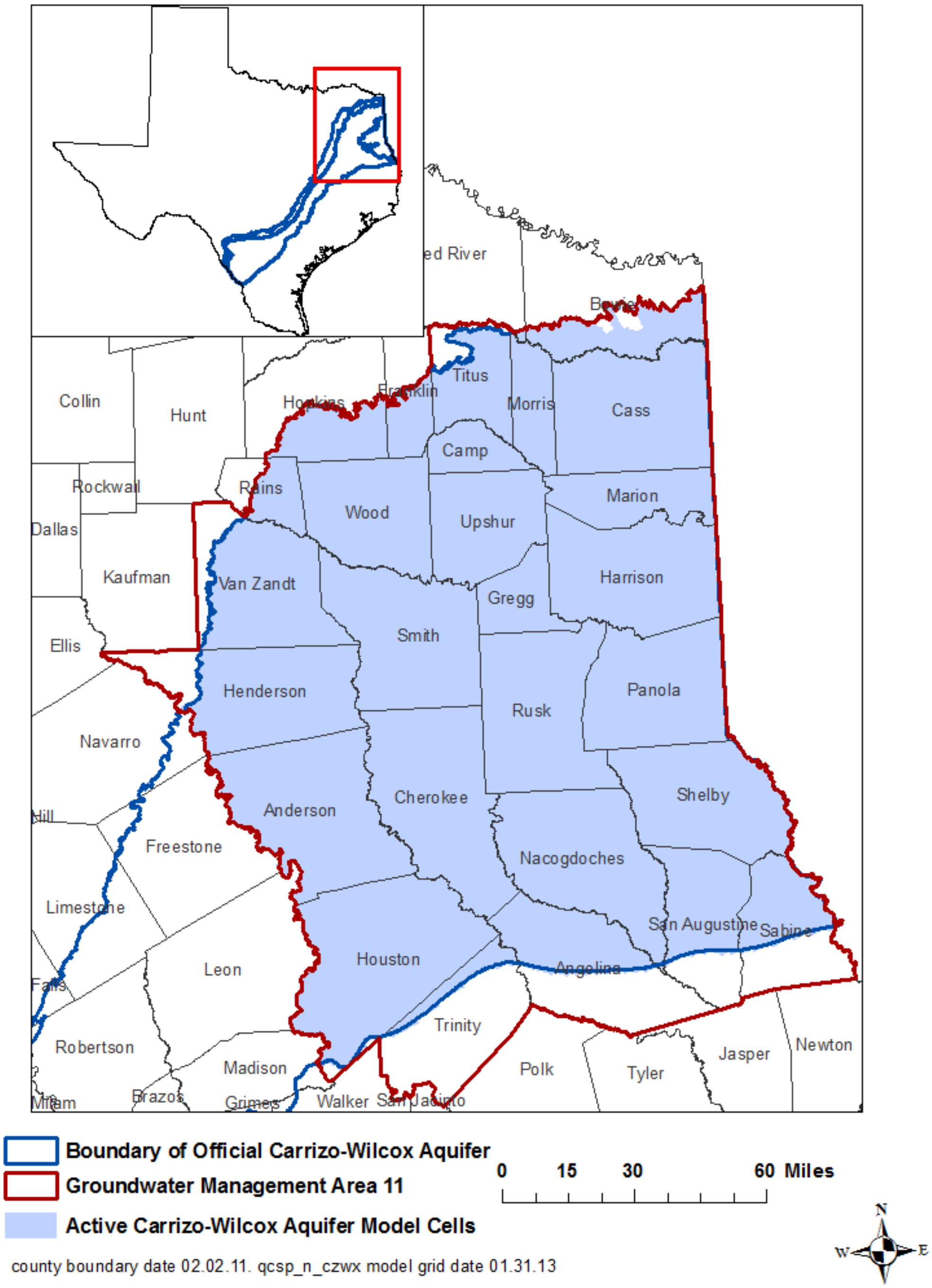

FIGURE 4. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PART OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE CARRIZO-WILCOX AQUIFER (TABLES 5 AND 6) WITHIN GROUNDWATER MANAGEMENT AREA 11.

TABLE 7. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE QUEEN CITY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Anderson	19,000,000	4,750,000	14,250,000
Angelina	2,000,000	500,000	1,500,000
Camp	600,000	150,000	450,000
Cass	8,000,000	2,000,000	6,000,000
Cherokee	15,000,000	3,750,000	11,250,000
Gregg	1,500,000	375,000	1,125,000
Harrison	1,200,000	300,000	900,000
Henderson	6,700,000	1,675,000	5,025,000
Houston	37,000,000	9,250,000	27,750,000
Marion	2,500,000	625,000	1,875,000
Morris	1,300,000	325,000	975,000
Nacogdoches	4,500,000	1,125,000	3,375,000
Rusk	58,000	14,500	43,500
Smith	23,000,000	5,750,000	17,250,000
Titus	63,000	15,750	47,250
Trinity	1,900,000	475,000	1,425,000
Upshur	7,800,000	1,950,000	5,850,000
Van Zandt	1,200,000	300,000	900,000
Wood	8,700,000	2,175,000	6,525,000
Total	**142,021,000**	**35,505,250**	**106,515,750**

TABLE 8. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[5] FOR THE QUEEN CITY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	95,000,000	23,750,000	71,250,000
Anderson County UWCD[6]	550,000	137,500	412,500
Neches & Trinity Valleys GCD	40,000,000	10,000,000	30,000,000
Pineywoods GCD	6,500,000	1,625,000	4,875,000
Rusk County GCD	58,000	14,500	43,500
Total	**142,108,000**	**35,527,000**	**106,581,000**

[5] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to two significant digits.
[6] UWCD stands for Underground Water Conservation District

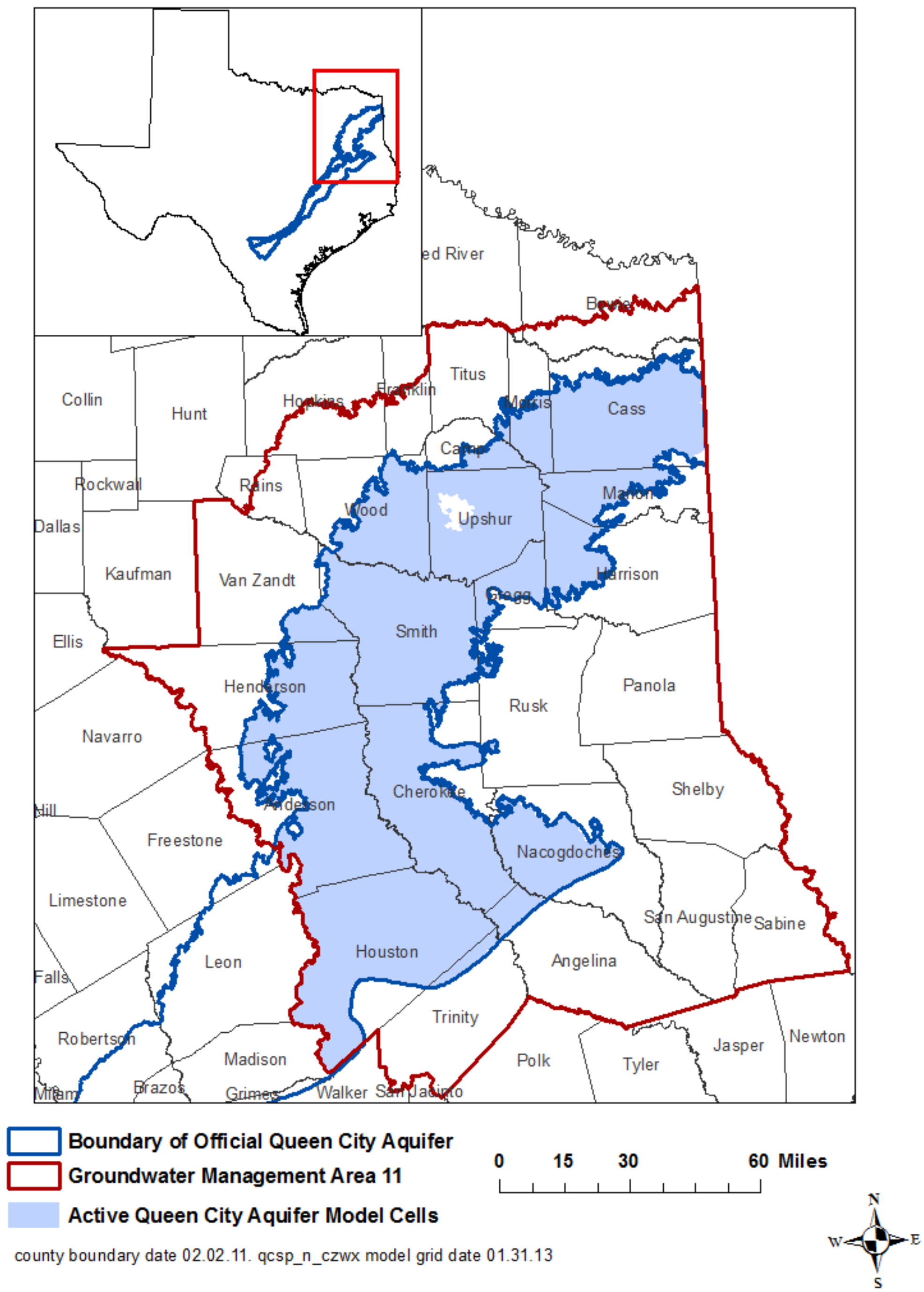

FIGURE 5. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PART OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE QUEEN CITY AQUIFER (TABLES 7 AND 8) WITHIN GROUNDWATER MANAGEMENT AREA 11.

TABLE 9. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE SPARTA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Anderson	640,000	160,000	480,000
Angelina	5,200,000	1,300,000	3,900,000
Cherokee	1,700,000	425,000	1,275,000
Houston	25,000,000	6,250,000	18,750,000
Nacogdoches	3,900,000	975,000	2,925,000
Sabine	6,000,000	1,500,000	4,500,000
San Augustine	6,800,000	1,700,000	5,100,000
Trinity	6,100,000	1,525,000	4,575,000
Total	**55,340,000**	**13,835,000**	**41,505,000**

TABLE 10. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[7] FOR THE SPARTA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	32,000,000	8,000,000	24,000,000
Deep East Texas GCD[8]	13,000,000	3,250,000	9,750,000
Neches & Trinity Valleys GCD	2,300,000	575,000	1,725,000
Pineywoods GCD	9,100,000	2,275,000	6,825,000
Total	**56,400,000**	**14,100,000**	**42,300,000**

[7] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to two significant digits.
[8] Deep East Texas Groundwater Conservation District is pending confirmation.

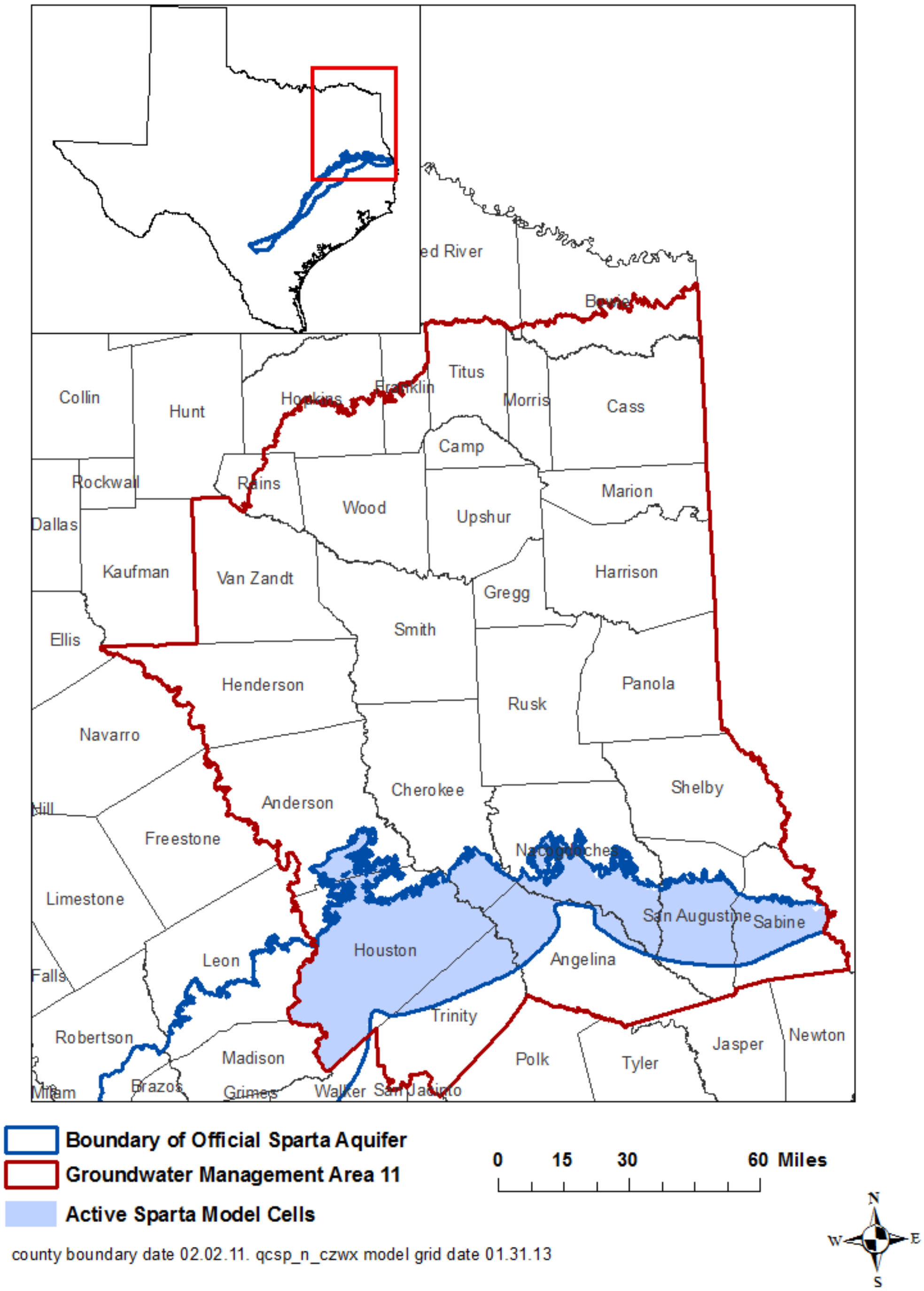

FIGURE 6. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PART OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE SPARTA AQUIFER (TABLES 9 AND 10) WITHIN GROUNDWATER MANAGEMENT AREA 11.

TABLE 11. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE YEGUA-JACKSON AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Angelina	72,000,000	18,000,000	54,000,000
Houston	21,000,000	5,250,000	15,750,000
Nacogdoches	1,400,000	350,000	1,050,000
Sabine	30,000,000	7,500,000	22,500,000
San Augustine	19,000,000	4,750,000	14,250,000
Trinity	83,000,000	20,750,000	62,250,000
Total	**226,400,000**	**56,600,000**	**169,800,000**

TABLE 12. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[9] FOR THE YEGUA-JACKSON AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25percent of Total Storage (acre-feet)*	*75percent of Total Storage (acre-feet)*
No District	100,000,000	25,000,000	75,000,000
Deep East Texas GCD[10]	49,000,000	12,250,000	36,750,000
Pineywoods GCD	74,000,000	18,500,000	55,500,000
Total	**223,000,000**	**55,750,000**	**167,250,000**

[9] The total estimated recoverable storages values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to two significant digits.
[10] Deep East Texas Groundwater Conservation District is pending confirmation.

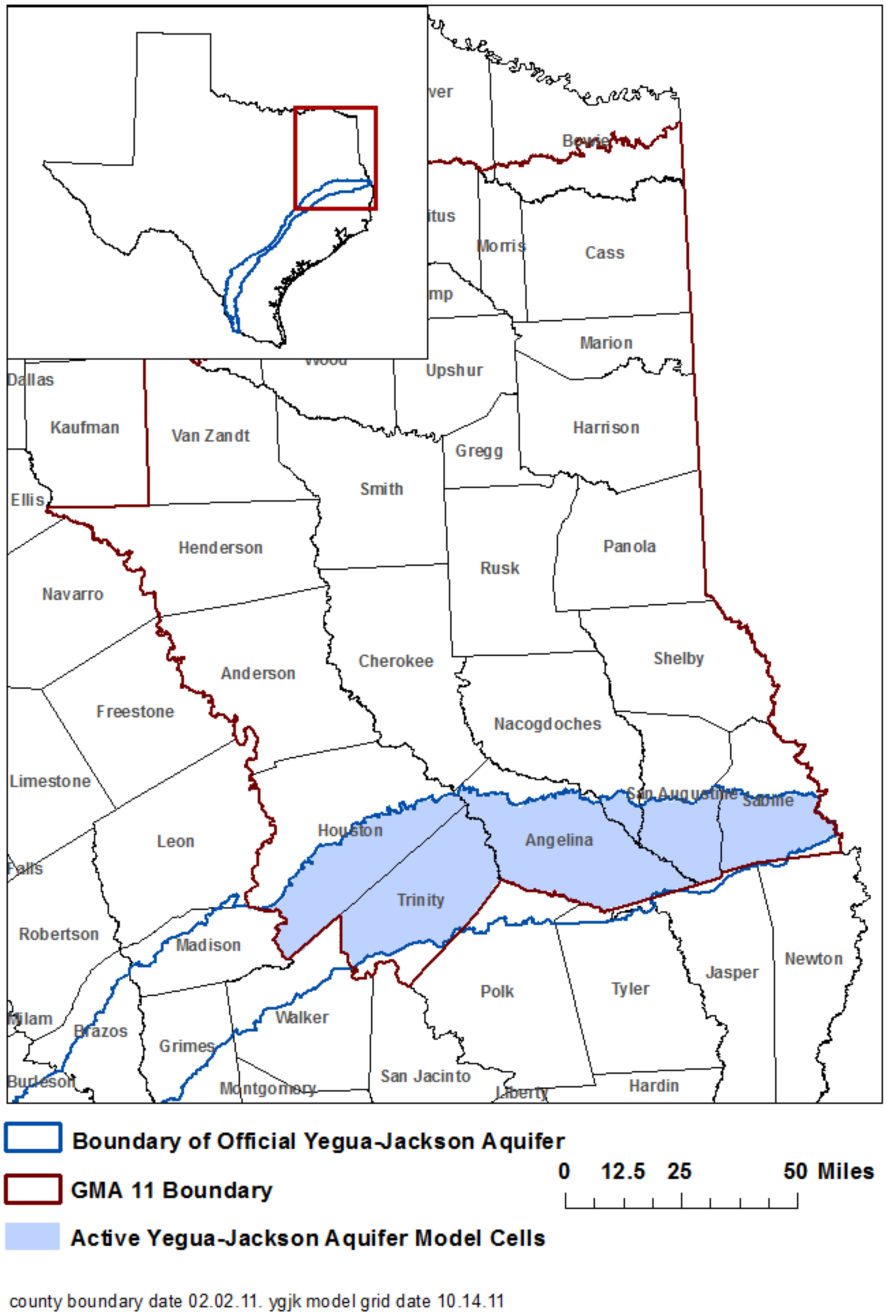

FIGURE 7. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE YEGUA-JACKSON AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE (TABLES 11 AND 12) FOR THE YEGUA-JACKSON AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 11.

TABLE 13. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE GULF COAST AQUIFER SYSTEM WITHIN GROUNDWATER MANAGEMENT AREA 11. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Angelina	27,000	6,750	20,250
Sabine	120,000	30,000	90,000
Trinity	1,300,000	325,000	975,000
Total	**1,447,000**	**361,750**	**1,085,250**

TABLE 14. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[11] FOR THE GULF COAST AQUIFER SYSTEM WITHIN GROUNDWATER MANAGEMENT AREA 11. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25percent of Total Storage (acre-feet)*	*75percent of Total Storage (acre-feet)*
No District	1,400,000	350,000	1,050,000
Pineywoods GCD	27,000	6,750	20,250
Total	**1,427,000**	**356,750**	**1,070,250**

[11] The total estimated recoverable storages values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to two significant digits.

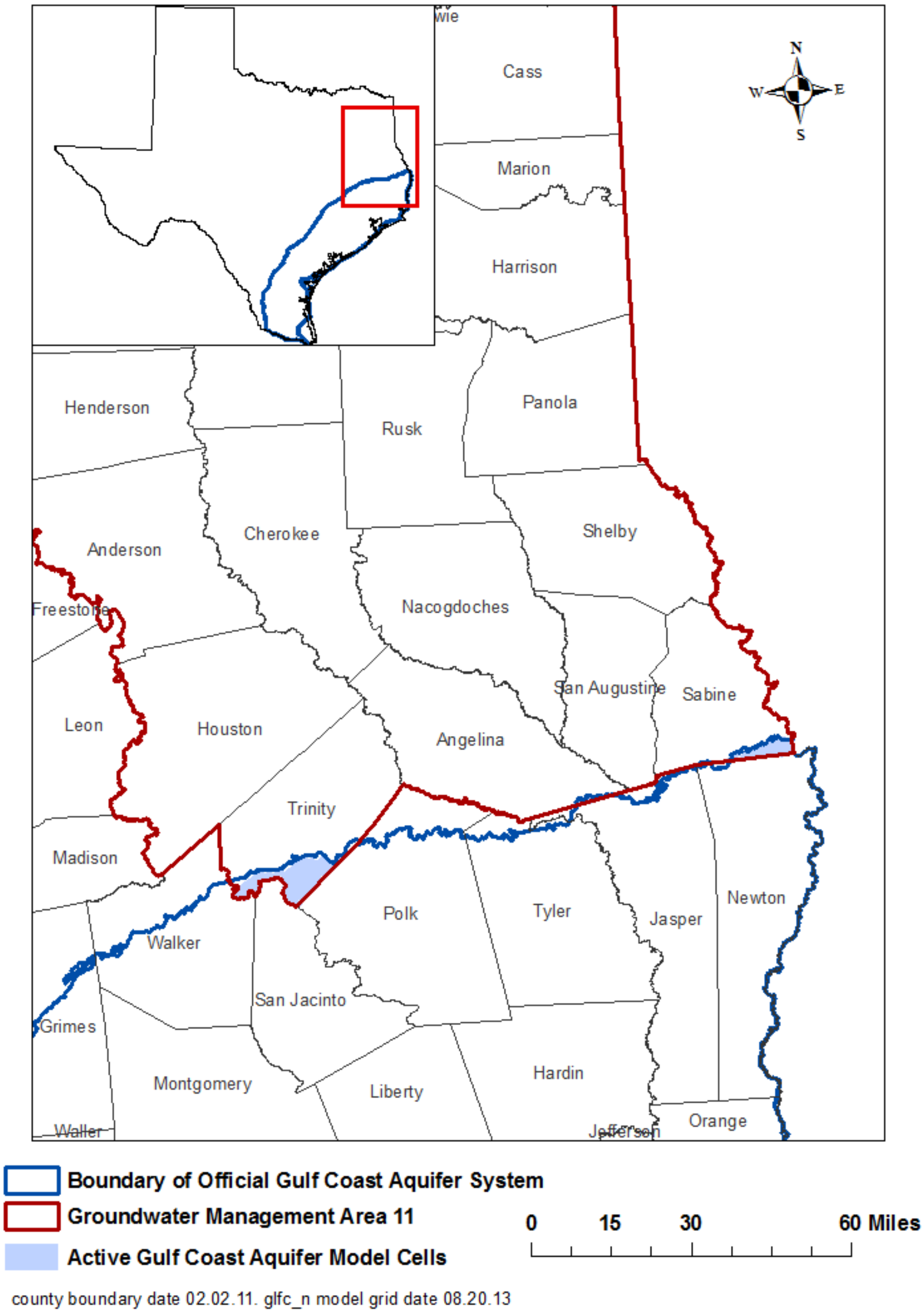

FIGURE 8. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE GULF COAST AQUIFER SYSTEM USED TO ESTIMATE TOTAL RECOVERABLE STORAGE (TABLES 13 AND 14) FOR THE GULF COAST AQUIFER SYSTEM WITHIN GROUNDWATER MANAGEMENT AREA 11.

LIMITATIONS

The groundwater models used in completing this analysis are the best available scientific tools that can be used to meet the stated objective(s). To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

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Appendix F

Region D and Region I Socioeconomic Impact Reports from TWDB

June 4, 2010

Mr. Richard LeTourneau
Chairman, North East Texas
Regional Water Planning Group
P.O. Box 12071
Longview, Texas 75607

Re: Socioeconomic Impact Analysis of Not Meeting Water Needs for the 2011 North East Texas Regional Water Plan

Dear Chairman LeTourneau:

We have received your request for technical assistance to complete the socioeconomic impact analysis of not meeting water needs. In response, enclosed is a report that describes our methodology and presents the results. Section 1 provides an overview of the methodology, and Section 2 presents results at the regional level, and Appendix 2 show results for individual water user groups.

If you have any questions or comments, please feel free to contact me at (512) 463-7928 or by email at stuart.norvell@twdb.state.tx.us.

Sincerely,

Stuart D. Norvell
Manager, Water Planning Research and Analysis
Water Resources Planning Division

SN/ao

Enclosure

c. Temple Mckinnon, TWDB
S. Doug Shaw, TWDB

Socioeconomic Impacts of Projected Water Shortages for the Northeast Texas Regional Water Planning Area (Region D)

Prepared in Support of the 2011 Northeast Texas Regional Water Plan

Stuart D. Norvell, Managing Economist
Water Resources Planning Division
Texas Water Development Board
Austin, Texas

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Austin, Texas

February, 2010

Table of Contents

Tables

Introduction

Water shortages during drought would likely curtail or eliminate economic activity in business and industries reliant on water. For example, without water farmers cannot irrigate; refineries cannot produce gasoline, and paper mills cannot make paper. Unreliable water supplies would not only have an immediate and real impact on existing businesses and industry, but they could also adversely affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages would disrupt activity in homes, schools and government and could adversely affect public health and safety. For all of the above reasons, it is important to analyze and understand how restricted water supplies during drought could affect communities throughout the state.

Administrative rules require that regional water planning groups evaluate the impacts of not meeting water needs as part of the regional water planning process, and rules direct TWDB staff to provide technical assistance: "*The executive administrator shall provide available technical assistance to the regional water planning groups, upon request, on water supply and demand analysis, including methods to evaluate the social and economic impacts of not meeting needs*" [(§357.7 (4)(A)]. Staff of the TWDB's Water Resources Planning Division designed and conducted this report in support of the Northeast Texas Regional Water Planning Group (Region D).

This document summarizes the results of our analysis and discusses the methodology used to generate the results. Section 1 outlines the overall methodology and discusses approaches and assumptions specific to each water use category (i.e., irrigation, livestock, mining, steam-electric, municipal and manufacturing). Section 2 presents the results for each category where shortages are reported at the regional planning area level and river basin level. Results for individual water user groups are not presented, but are available upon request.

1. Methodology

Section 1 provides a general overview of how economic and social impacts were measured. In addition, it summarizes important clarifications, assumptions and limitations of the study.

1.1 Economic Impacts of Water Shortages

1.1.1 General Approach

Economic analysis as it relates to water resources planning generally falls into two broad areas. Supply side analysis focuses on costs and alternatives of developing new water supplies or implementing programs that provide additional water from current supplies. Demand side analysis concentrates on impacts or benefits of providing water to people, businesses and the environment. Analysis in this report focuses strictly on demand side impacts. When analyzing the economic impacts of water shortages as defined in Texas water planning, three potential scenarios are possible:

1) Scenario 1 involves situations where there are physical shortages of raw surface or groundwater due to drought of record conditions. For example, City A relies on a reservoir with average conservation storage of 500 acre-feet per year and a firm yield of 100 acre feet. In 2010, the city uses about 50 acre-feet per year, but by 2030 their demands are expected to increase to 200 acre-feet. Thus, in 2030 the reservoir would not have enough water to meet the city's demands,

and people would experience a shortage of 100 acre-feet assuming drought of record conditions. Under normal or average climatic conditions, the reservoir would likely be able to provide reliable water supplies well beyond 2030.

2) Scenario 2 is a situation where despite drought of record conditions, water supply sources can meet existing use requirements; however, limitations in water infrastructure would preclude future water user groups from accessing these water supplies. For example, City B relies on a river that can provide 500 acre-feet per year during drought of record conditions and other constraints as dictated by planning assumptions. In 2010, the city is expected to use an estimated 100 acre-feet per year and by 2060 it would require no more than 400 acre-feet. But the intake and pipeline that currently transfers water from the river to the city's treatment plant has a capacity of only 200 acre-feet of water per year. Thus, the city's water supplies are adequate even under the most restrictive planning assumptions, but their conveyance system is too small. This implies that at some point – perhaps around 2030 - infrastructure limitations would constrain future population growth and any associated economic activity or impacts.

3) Scenario 3 involves water user groups that rely primarily on aquifers that are being depleted. In this scenario, projected and in some cases existing demands may be unsustainable as groundwater levels decline. Areas that rely on the Ogallala aquifer are a good example. In some communities in the region, irrigated agriculture forms a major base of the regional economy. With less irrigation water from the Ogallala, population and economic activity in the region could decline significantly assuming there are no offsetting developments.

Assessing the social and economic effects of each of the above scenarios requires various levels and methods of analysis and would generate substantially different results for a number of reasons; the most important of which has to do with the time frame of each scenario. Scenario 1 falls into the general category of static analysis. This means that models would measure impacts for a small interval of time such as a drought. Scenarios 2 and 3, on the other hand imply a dynamic analysis meaning that models are concerned with changes over a much longer time period.

Since administrative rules specify that planning analysis be evaluated under drought of record conditions (a static and random event), socioeconomic impact analysis developed by the TWDB for the state water plan is based on assumptions of Scenario 1. Estimated impacts under scenario 1 are point estimates for years in which needs are reported (2010, 2020, 2030, 2040, 2050 and 2060). They are independent and distinct "what if" scenarios for a particular year and shortages are assumed to be temporary events resulting from drought of record conditions. Estimated impacts measure what would happen if water user groups experience water shortages for a period of one year.

The TWDB recognize that dynamic models may be more appropriate for some water user groups; however, combining approaches on a statewide basis poses several problems. For one, it would require a complex array of analyses and models, and might require developing supply and demand forecasts under "normal" climatic conditions as opposed to drought of record conditions. Equally important is the notion that combining the approaches would produce inconsistent results across regions resulting in a so-called "apples to oranges" comparison.

A variety tools are available to estimate economic impacts, but by far, the most widely used today are input-output models (IO models) combined with social accounting matrices (SAMs). Referred to as IO/SAM models, these tools formed the basis for estimating economic impacts for agriculture (irrigation and livestock water uses) and industry (manufacturing, mining, steam-electric and commercial business activity for municipal water uses).

Since the planning horizon extends through 2060, economic variables in the baseline are adjusted in accordance with projected changes in demographic and economic activity. Growth rates for municipal water use sectors (i.e., commercial, residential and institutional) are based on TWDB population forecasts. Future values for manufacturing, agriculture, and mining and steam-electric activity are based on the same underlying economic forecasts used to estimate future water use for each category.

The following steps outline the overall process.

Step 1*: Generate IO/SAM Models and Develop Economic Baseline*

IO/SAM models were estimated using propriety software known as IMPLAN PRO™ (Impact for Planning Analysis). IMPLAN is a modeling system originally developed by the U.S. Forestry Service in the late 1970s. Today, the Minnesota IMPLAN Group (MIG Inc.) owns the copyright and distributes data and software. It is probably the most widely used economic impact model in existence. IMPLAN comes with databases containing the most recently available economic data from a variety of sources.[1] Using IMPLAN software and data, transaction tables conceptually similar to the one discussed previously were estimated for each county in the region and for the region as a whole. Each transaction table contains 528 economic sectors and allows one to estimate a variety of economic statistics including:

- **total sales -** total production measured by sales revenues;
- **intermediate sales -** sales to other businesses and industries within a given region;
- **final sales –** sales to end users in a region and exports out of a region**;**
- **employment -** number of full and part-time jobs (annual average) required by a given industry including self-employment;
- **regional income -** total payroll costs (wages and salaries plus benefits) paid by industries, corporate income, rental income and interest payments; and
- **business taxes -** sales, excise, fees, licenses and other taxes paid during normal operation of an industry (does not include income taxes).

TWDB analysts developed an economic baseline containing each of the above variables using year 2000 data. Since the planning horizon extends through 2060, economic variables in the baseline were allowed to change in accordance with projected changes in demographic and economic activity. Growth rates for municipal water use sectors (i.e., commercial, residential and institutional) are based on TWDB population forecasts. Projections for manufacturing, agriculture, and mining and steam-electric activity are based on the same underlying economic forecasts used to estimate future water use for each category. Monetary impacts in future years are reported in constant year 2006 dollars.

It is important to stress that employment, income and business taxes are the most useful variables when comparing the relative contribution of an economic sector to a regional economy. Total sales as reported in IO/SAM models are less desirable and can be misleading because they include sales to other industries in the region for use in the production of other goods. For example, if a mill buys grain from local farmers and uses it to produce feed, sales of both the processed feed and raw corn are counted as "output" in an IO model. Thus, total sales double-count or overstate the true economic value of goods

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[1]The IMPLAN database consists of national level technology matrices based on benchmark input-output accounts generated by the U.S. Bureau of Economic Analysis and estimates of final demand, final payments, industry output and employment for various economic sectors. IMPLAN regional data (i.e. states, a counties or groups of counties within a state) are divided into two basic categories: 1) data on an industry basis including value-added, output and employment, and 2) data on a commodity basis including final demands and institutional sales. State-level data are balanced to national totals using a matrix ratio allocation system and county data are balanced to state totals.

and services produced in an economy. They are not consistent with commonly used measures of output such as Gross National Product (GNP), which counts only final sales.

Another important distinction relates to terminology. Throughout this report, the term *sector* refers to economic subdivisions used in the IMPLAN database and resultant input-output models (528 individual sectors based on Standard Industrial Classification Codes). In contrast, the phrase *water use category* refers to water user groups employed in state and regional water planning including irrigation, livestock, mining, municipal, manufacturing and steam electric. Each IMPLAN sector was assigned to a specific water use category.

Step 2: *Estimate Direct and Indirect Economic Impacts of Water Needs*

Direct impacts are reductions in output by sectors experiencing water shortages. For example, without adequate cooling and process water a refinery would have to curtail or cease operation, car washes may close, or farmers may not be able to irrigate and sales revenues fall. Indirect impacts involve changes in inter-industry transactions as supplying industries respond to decreased demands for their services, and how seemingly non-related businesses are affected by decreased incomes and spending due to direct impacts. For example, if a farmer ceases operations due to a lack of irrigation water, they would likely reduce expenditures on supplies such as fertilizer, labor and equipment, and businesses that provide these goods would suffer as well.

Direct impacts accrue to immediate businesses and industries that rely on water and without water industrial processes could suffer. However, output responses may vary depending upon the severity of shortages. A small shortage relative to total water use would likely have a minimal impact, but large shortages could be critical. For example, farmers facing small shortages might fallow marginally productive acreage to save water for more valuable crops. Livestock producers might employ emergency culling strategies, or they may consider hauling water by truck to fill stock tanks. In the case of manufacturing, a good example occurred in the summer of 1999 when Toyota Motor Manufacturing experienced water shortages at a facility near Georgetown, Kentucky.[2] As water levels in the Kentucky River fell to historic lows due to drought, plant managers sought ways to curtail water use such as reducing rinse operations to a bare minimum and recycling water by funneling it from paint shops to boilers. They even considered trucking in water at a cost of 10 times what they were paying. Fortunately, rains at the end of the summer restored river levels, and Toyota managed to implement cutbacks without affecting production, but it was a close call. If rains had not replenished the river, shortages could have severely reduced output.[3]

To account for uncertainty regarding the relative magnitude of impacts to farm and business operations, the following analysis employs the concept of elasticity. Elasticity is a number that shows how a change in one variable will affect another. In this case, it measures the relationship between a percentage reduction in water availability and a percentage reduction in output. For example, an elasticity of 1.0 indicates that a 1.0 percent reduction in water availability would result in a 1.0 percent reduction in economic output. An elasticity of 0.50 would indicate that for every 1.0 percent of unavailable water, output is reduced by 0.50 percent and so on. Output elasticities used in this study are:[4]

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[2] Royal, W. "*High And Dry - Industrial Centers Face Water Shortages*." in Industry Week, Sept, 2000.

[3] The efforts described above are not planned programmatic or long-term operational changes. They are emergency measures that individuals might pursue to alleviate what they consider a temporary condition. Thus, they are not characteristic of long-term management strategies designed to ensure more dependable water supplies such as capital investments in conservation technology or development of new water supplies.

[4] Elasticities are based on one of the few empirical studies that analyze potential relationships between economic output and water shortages in the United States. The study, conducted in California, showed that a significant number of industries would suffer reduced output during water shortages. Using a survey based approach researchers posed two scenarios to different industries. In

- if water needs are 0 to 5 percent of total water demand, no corresponding reduction in output is assumed;
- if water needs are 5 to 30 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 0.50 percent reduction in output;
- if water needs are 30 to 50 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 0.75 percent reduction in output; and
- if water needs are greater than 50 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 1.0 percent (i.e., a proportional reduction).

In some cases, elasticities are adjusted depending upon conditions specific to a given water user group.

Once output responses to water shortages were estimated, direct impacts to total sales, employment, regional income and business taxes were derived using regional level economic multipliers estimating using IO/SAM models. The formula for a given IMPLAN sector is:

$D_{i,t} = Q_{i,t} *_{,} S_{i,t} * E_Q * RFD_i * DM_{i(Q, L, I, T)}$

where:

$D_{i,t}$ = direct economic impact to sector *i* in period *t*

$Q_{i,t}$ = total sales for sector *i* in period *t* in an affected county

$RFD_{i,}$ = ratio of final demand to total sales for sector *i* for a given region

$S_{i,t}$ = water shortage as percentage of total water use in period *t*

E_Q = elasticity of output and water use

$DM_{i(L, I, T)}$ = direct output multiplier coefficients for labor (L), income (I) and taxes (T) for sector *i*.

Secondary impacts were derived using the same formula used to estimate direct impacts; however, indirect multiplier coefficients are used. Methods and assumptions specific to each water use sector are discussed in Sections 1.1.2 through 1.1.4.

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the first scenario, they asked how a 15 percent cutback in water supply lasting one year would affect operations. In the second scenario, they asked how a 30 percent reduction lasting one year would affect plant operations. In the case of a 15 percent shortage, reported output elasticities ranged from 0.00 to 0.76 with an average value of 0.25. For a 30 percent shortage, elasticities ranged from 0.00 to 1.39 with average of 0.47. For further information, see, California Urban Water Agencies, "*Cost of Industrial Water Shortages,*" Spectrum Economics, Inc. November, 1991.

General Assumptions and Clarification of the Methodology

As with any attempt to measure and quantify human activities at a societal level, assumptions are necessary and every model has limitations. Assumptions are needed to maintain a level of generality and simplicity such that models can be applied on several geographic levels and across different economic sectors. In terms of the general approach used here several clarifications and cautions are warranted:

1. Shortages as reported by regional planning groups are the starting point for socioeconomic analyses.

2. Estimated impacts are point estimates for years in which needs are reported (i.e., 2010, 2020, 2030, 2040, 2050 and 2060).They are independent and distinct "what if" scenarios for each particular year and water shortages are assumed to be temporary events resulting from severe drought conditions combined with infrastructure limitations. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals and resultant impacts are measured. Given, that reported figures are not cumulative in nature, it is inappropriate to sum impacts over the entire planning horizon. Doing so, would imply that the analysis predicts that drought of record conditions will occur every ten years in the future, which is not the case. Similarly, authors of this report recognize that in many communities needs are driven by population growth, and in the future total population will exceed the amount of water available due to infrastructure limitations, regardless of whether or not there is a drought. This implies that infrastructure limitations would constrain economic growth. However, since needs as defined by planning rules are based upon water supply and demand under the assumption of drought of record conditions, it improper to conduct economic analysis that focuses on growth related impacts over the planning horizon. Figures generated from such an analysis would presume a 50-year drought of record, which is unrealistic. Estimating lost economic activity related to constraints on population and commercial growth due to lack of water would require developing water supply and demand forecasts under "normal" or "most likely" future climatic conditions.

3. While useful for planning purposes, this study is not a benefit-cost analysis. Benefit cost analysis is a tool widely used to evaluate the economic feasibility of specific policies or projects as opposed to estimating economic impacts of unmet water needs. Nevertheless, one could include some impacts measured in this study as part of a benefit cost study if done so properly. Since this is not a benefit cost analysis, future impacts are not weighted differently. In other words, estimates are not discounted. If used as a measure of economic benefits, one should incorporate a measure of uncertainty into the analysis. In this type of analysis, a typical method of discounting future values is to assign probabilities of the drought of record recurring again in a given year, and weight monetary impacts accordingly. This analysis assumes a probability of one.

4. IO multipliers measure the strength of backward linkages to supporting industries (i.e., those who sell inputs to an affected sector). However, multipliers say nothing about forward linkages consisting of businesses that purchase goods from an affected sector for further processing. For example, ranchers in many areas sell most of their animals to local meat packers who process animals into a form that consumers ultimately see in grocery stores and restaurants. Multipliers do not capture forward linkages to meat packers, and since meat packers sell livestock purchased from ranchers as "final sales," multipliers for the ranching sector do fully account for all losses to a region's economy. Thus, as mentioned previously, in some cases closely linked sectors were moved from one water use category to another.

5. Cautions regarding interpretations of direct and secondary impacts are warranted. IO/SAM multipliers are based on "fixed-proportion production functions," which basically means that input use - including labor - moves in lockstep fashion with changes in levels of output. In a

scenario where output (i.e., sales) declines, losses in the immediate sector or supporting sectors could be much less than predicted by an IO/SAM model for several reasons. For one, businesses will likely expect to continue operating so they might maintain spending on inputs for future use; or they may be under contractual obligations to purchase inputs for an extended period regardless of external conditions. Also, employers may not lay-off workers given that experienced labor is sometimes scarce and skilled personnel may not be readily available when water shortages subside. Lastly people who lose jobs might find other employment in the region. As a result, direct losses for employment and secondary losses in sales and employment should be considered an upper bound. Similarly, since projected population losses are based on reduced employment in the region, they should be considered an upper bound as well.

6. IO models are static. Models and resultant multipliers are based upon the structure of the U.S. and regional economies in 2006. In contrast, water shortages are projected to occur well into the future. Thus, the analysis assumes that the general structure of the economy remains the same over the planning horizon, and the farther out into the future we go, this assumption becomes less reliable.

7. Impacts are annual estimates. If one were to assume that conditions persisted for more than one year, figures should be adjusted to reflect the extended duration. The drought of record in most regions of Texas lasted several years.

8. Monetary figures are reported in constant year 2006 dollars.

1.1.2 Impacts to Agriculture

Irrigated Crop Production

The first step in estimating impacts to irrigation required calculating gross sales for IMPLAN crop sectors. Default IMPLAN data do not distinguish irrigated production from dry-land production. Once gross sales were known other statistics such as employment and income were derived using IMPLAN direct multiplier coefficients. Gross sales for a given crop are based on two data sources:

1) county-level statistics collected and maintained by the TWDB and the USDA Farm Services Agency (FSA) including the number of irrigated acres by crop type and water application per acre, and

2) regional-level data published by the Texas Agricultural Statistics Service (TASS) including prices received for crops (marketing year averages), crop yields and crop acreages.

Crop categories used by the TWDB differ from those used in IMPLAN datasets. To maintain consistency, sales and other statistics are reported using IMPLAN crop classifications. Table 1 shows the TWDB crops included in corresponding IMPLAN sectors, and Table 2 summarizes acreage and estimated annual water use for each crop classification (five-year average from 2003-2007). Table 3 displays average (2003-2007) gross revenues per acre for IMPLAN crop categories.

Table 1: Crop Classifications Used in TWDB Water Use Survey and Corresponding IMPLAN Crop Sectors	
IMPLAN Category	**TWDB Category**
Oilseeds	Soybeans and "other oil crops"
Grains	Grain sorghum, corn, wheat and "other grain crops"
Vegetable and melons	"Vegetables" and potatoes
Tree nuts	Pecans
Fruits	Citrus, vineyard and other orchard
Cotton	Cotton
Sugarcane and sugar beets	Sugarcane and sugar beets
All "other" crops	"Forage crops", peanuts, alfalfa, hay and pasture, rice and "all other crops"

Table 2: Summary of Irrigated Crop Acreage and Water Demand for the Northeast Texas Regional Water Planning Area (average 2003-2007)

Sector	Acres (1000s)	Distribution of acres	Water use (1000s of AF)	Distribution of water use
Oilseeds	3	19%	3	16%
Grains	5	28%	5	25%
Vegetable and melons	<1	<1%	0	<1%
Fruits	<1	<1%	<1	<1%
All other crops	9	53%	12	59%
Total	17	100%	21	100%

Source: Water demand figures are a 5- year average (2003-2007) of the TWDB's annual Irrigation Water Use Estimates. Statistics for irrigated crop acreage are based upon annual survey data collected by the TWDB and the Farm Service Agency. Values do not include acreage or water use for the TWDB categories classified by the Farm Services Agency as "failed acres," "golf course" or "waste water."

Table 3: Average Gross Sales Revenues per Acre for Irrigated Crops for the Northeast Texas Regional Water Planning Area (2003-2007)		
IMPLAN Sector	**Gross revenues per acre**	**Crops included in estimates**
Oilseeds	$202	Irrigated figure is based on five-year (2003-2007) average weighted by acreage for "irrigated soybeans" and "irrigated 'other' oil crops".
Grains	$397	Based on five-year (2003-2007) average weighted by acreage for "irrigated grain sorghum," "irrigated corn", "irrigated wheat" and "irrigated 'other' grain crops."
Vegetable and melons	$5,335	Based on five-year (2003-2007) average weighted by acreage for "irrigated shallow and deep root vegetables", "irrigated Irish potatoes" and "irrigated melons."
Fruits	$3,502	Based on five-year (2003-2007) average weighted by acreage for "irrigated citrus", "irrigated vineyards" and "irrigated 'other' orchard."
All Other Crops	$253	Irrigated figure is based on five-year (2003-2007) average weighted by acreage for "irrigated 'forage' crops", "irrigated peanuts", "irrigated alfalfa", "irrigated 'hay' and pasture" and "irrigated 'all other' crops."
*Figures are rounded. Source: Based on data from the Texas Agricultural Statistics Service, Texas Water Development Board, and Texas A&M University.		

An important consideration when estimating impacts to irrigation was determining which crops are affected by water shortages. One approach is the so-called rationing model, which assumes that farmers respond to water supply cutbacks by fallowing the lowest value crops in the region first and the highest valued crops last until the amount of water saved equals the shortage.[5] For example, if farmer A grows vegetables (higher value) and farmer B grows wheat (lower value) and they both face a proportionate cutback in irrigation water, then farmer B will sell water to farmer A. Farmer B will fallow her irrigated acreage before farmer A fallows anything. Of course, this assumes that farmers can and do transfer enough water to allow this to happen. A different approach involves constructing farm-level profit maximization models that conform to widely-accepted economic theory that farmers make decisions based on marginal net returns. Such models have good predictive capability, but data requirements and complexity are high. Given that a detailed analysis for each region would require a substantial amount of farm-level data and analysis, the following investigation assumes that projected shortages are distributed equally across predominant crops in the region. Predominant in this case are crops that comprise at least one percent of total acreage in the region.

The following steps outline the overall process used to estimate direct impacts to irrigated agriculture:

1. *Distribute shortages across predominant crop types in the region*. Again, unmet water needs were distributed equally across crop sectors that constitute one percent or more of irrigated acreage.

2. *Estimate associated reductions in output for affected crop sectors*. Output reductions are based on elasticities discussed previously and on estimated values per acre for different crops. Values per acre stem from the same data used to estimate output for the year 2006 baseline. Using multipliers, we then generate estimates of forgone income, jobs, and tax revenues based on reductions in gross sales and final demand.

Livestock

The approach used for the livestock sector is basically the same as that used for crop production. As is the case with crops, livestock categorizations used by the TWDB differ from those used in IMPLAN datasets, and TWDB groupings were assigned to a given IMPLAN sector (Table 4). Then we:

1) *Distribute projected water needs equally among predominant livestock sectors and estimate lost output*: As is the case with irrigation, shortages are assumed to affect all livestock sectors equally; however, the category of "other" is not included given its small size. If water needs were small relative to total demands, we assume that producers would haul in water by truck to fill stock tanks. The cost per acre-foot ($24,000) is based on 2008 rates charged by various water haulers in Texas, and assumes that the average truck load is 6,500 gallons at a hauling distance of 60 miles.

3) *Estimate reduced output in forward processors for livestock sectors*. Reductions in output for livestock sectors are assumed to have a proportional impact on forward processors in the region such as meat packers. In other words, if the cows were gone, meat-packing plants or fluid milk manufacturers) would likely have little to process. This is not an unreasonable premise. Since the

[5] The rationing model was initially proposed by researchers at the University of California at Berkeley, and was then modified for use in a study conducted by the U.S. Environmental Protection Agency that evaluated how proposed water supply cutbacks recommended to protect water quality in the Bay/Delta complex in California would affect farmers in the Central Valley. See, Zilberman, D., Howitt, R. and Sunding, D. "*Economic Impacts of Water Quality Regulations in the San Francisco Bay and Delt*a." Western Consortium for Public Health. May 1993.

1950s, there has been a major trend towards specialized cattle feedlots, which in turn has decentralized cattle purchasing from livestock terminal markets to direct sales between producers and slaughterhouses. Today, the meat packing industry often operates large processing facilities near high concentrations of feedlots to increase capacity utilization.[6] As a result, packers are heavily dependent upon nearby feedlots. For example, a recent study by the USDA shows that on average meat packers obtain 64 percent of cattle from within 75 miles of their plant, 82 percent from within 150 miles and 92 percent from within 250 miles.[7]

Table 4: Description of Livestock Sectors

IMPLAN Category	TWDB Category
Cattle ranching and farming	Cattle, cow calf, feedlots and dairies
Poultry and egg production	Poultry production.
Other livestock	Livestock other than cattle and poultry (i.e., horses, goats, sheep, hogs)
Milk manufacturing	Fluid milk manufacturing, cheese manufacturing, ice cream manufacturing etc.
Meat packing	Meat processing present in the region from slaughter to final processing

1.1.3 Impacts to Municipal Water User Groups

Disaggregation of Municipal Water Demands

Estimating the economic impacts for the municipal water user groups is complicated for a number of reasons. For one, municipal use comprises a range of consumers including commercial businesses, institutions such as schools and government and households. However, reported water needs are not distributed among different municipal water users. In other words, how much of a municipal need is commercial and how much is residential (domestic)?

The amount of commercial water use as a percentage of total municipal demand was estimated based on "GED" coefficients (gallons per employee per day) published in secondary sources.[8] For example, if year 2006 baseline data for a given economic sector (e.g., amusement and recreation services) shows employment at 30 jobs and the GED coefficient is 200, then average daily water use by that sector is (30 x

[6] Ferreira, W.N. "*Analysis of the Meat Processing Industry in the United States*." Clemson University Extension Economics Report ER211, January 2003.

[7] Ward, C.E. "*Summary of Results from USDA's Meatpacking Concentration Study*." Oklahoma Cooperative Extension Service, OSU Extension Facts WF-562.

[8] Sources for GED coefficients include: Gleick, P.H., Haasz, D., Henges-Jeck, C., Srinivasan, V., Wolff, G. Cushing, K.K., and Mann, A. "*Waste Not, Want Not*: *The Potential for Urban Water Conservation in California*." Pacific Institute. November 2003. U.S. Bureau of the Census. 1982 Census of Manufacturers: Water Use in Manufacturing. USGPO, Washington D.C. See also: "*U.S. Army Engineer Institute for Water Resources, IWR Report 88-R-6.*," Fort Belvoir, VA. See also, Joseph, E. S., 1982, "*Municipal and Industrial Water Demands of the Western United States*." Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, v. 108, no. WR2, p. 204-216. See also, Baumann, D. D., Boland, J. J., and Sims, J. H., 1981, "*Evaluation of Water Conservation for Municipal and Industrial Water Supply*." U.S. Army Corps of Engineers, Institute for Water Resources, Contract no. 82-C1.

200 = 6,000 gallons) or 6.7 acre-feet per year. Water not attributed to commercial use is considered domestic, which includes single and multi-family residential consumption, institutional uses and all use designated as “county-other.” Based on our analysis, commercial water use is about 5 to 35 percent of municipal demand. Less populated rural counties occupy the lower end of the spectrum, while larger metropolitan counties are at the higher end.

After determining the distribution of domestic versus commercial water use, we developed methods for estimating impacts to the two groups.

Domestic Water Uses

Input output models are not well suited for measuring impacts of shortages for domestic water uses, which make up the majority of the municipal water use category. To estimate impacts associated with domestic water uses, municipal water demand and needs are subdivided into residential, and commercial and institutional use. Shortages associated with residential water uses are valued by estimating proxy demand functions for different water user groups allowing us to estimate the marginal value of water, which would vary depending upon the level of water shortages. The more severe the water shortage, the more costly it becomes. For instance, a 2 acre-foot shortage for a group of households that use 10 acre-feet per year would not be as severe as a shortage that amounted to 8 acre-feet. In the case of a 2 acre-foot shortage, households would probably have to eliminate some or all outdoor water use, which could have implicit and explicit economic costs including losses to the horticultural and landscaping industry. In the case of an 8 acre-foot shortage, people would have to forgo all outdoor water use and most indoor water consumption. Economic impacts would be much higher in the latter case because people, and would be forced to find emergency alternatives assuming alternatives were available.

To estimate the value of domestic water uses, TWDB staff developed marginal loss functions based on constant elasticity demand curves. This is a standard and well-established method used by economists to value resources such as water that have an explicit monetary cost.

A constant price elasticity of demand is estimated using a standard equation:

$$w = kc^{(-\varepsilon)}$$

where:

- w is equal to average monthly residential water use for a given water user group measured in thousands of gallons;
- k is a constant intercept;
- c is the average cost of water per 1,000 gallons; and
- ε is the price elasticity of demand.

Price elasticities (-0.30 for indoor water use and -0.50 for outdoor use) are based on a study by Bell et al.[9] that surveyed 1,400 water utilities in Texas that serve at least 1,000 people to estimate demand elasticity for several variables including price, income, weather etc. Costs of water and average use per month per household are based on data from the Texas Municipal League's annual water and

[9] Bell, D.R. and Griffin, R.C. “*Community Water Demand in Texas as a Century is Turned*.” Research contract report prepared for the Texas Water Development Board. May 2006.

wastewater rate surveys - specifically average monthly household expenditures on water and wastewater in different communities across the state. After examining variance in costs and usage, three different categories of water user groups based on population (population less than 5,000, cities with populations ranging from 5,000 to 99,999 and cities with populations exceeding 100,000) were selected to serve as proxy values for municipal water groups that meet the criteria (Table 5).[10]

Table 5: Water Use and Costs Parameters Used to Estimated Water Demand Functions (average monthly costs per acre-foot for delivered water and average monthly use per household)

Community Population	Water	Wastewater	Total monthly cost	Avg. monthly use (gallons)
Less than or equal to 5,000	$1,335	$1,228	$2,563	6,204
5,000 to 100,000	$1,047	$1,162	$2,209	7,950
Great than or equal to 100,000	$718	$457	$1,190	8,409

Source: Based on annual water and wastewater rate surveys published by the Texas Municipal League.

As an example, Table 6 shows the economic impact per acre-foot of domestic water needs for municipal water user groups with population exceeding 100,000 people. There are several important assumptions incorporated in the calculations:

1) Reported values are net of the variable costs of treatment and distribution such as expenses for chemicals and electricity since using less water involves some savings to consumers and utilities alike; and for outdoor uses we do not include any value for wastewater.

2) Outdoor and “non-essential” water uses would be eliminated before indoor water consumption was affected, which is logical because most water utilities in Texas have drought contingency plans that generally specify curtailment or elimination of outdoor water use during droughts.[11] Determining how much water is used for outdoor purposes is based on several secondary sources. The first is a major study sponsored by the American Water Works Association, which surveyed cities in states including Colorado, Oregon, Washington, California, Florida and Arizona. On average across all cities surveyed 58 percent of single family residential water use was for outdoor activities. In cities with climates comparable to large metropolitan areas of Texas, the average was 40 percent.[12] Earlier findings of the U.S. Water Resources Council showed a national

[10] Ideally, one would want to estimate demand functions for each individual utility in the state. However, this would require an enormous amount of time and resources. For planning purposes, we believe the values generated from aggregate data are more than sufficient.

[11] In Texas, state law requires retail and wholesale water providers to prepare and submit plans to the Texas Commission on Environmental Quality (TCEQ). Plans must specify demand management measures for use during drought including curtailment of “non-essential water uses.” Non-essential uses include, but are not limited to, landscape irrigation and water for swimming pools or fountains. For further information see the Texas Environmental Quality Code §288.20.

[12] See, Mayer, P.W., DeOreo, W.B., Opitz, E.M., Kiefer, J.C., Davis, W., Dziegielewski, D., Nelson, J.O. “*Residential End Uses of Water*.” Research sponsored by the American Water Works Association and completed by Aquacraft, Inc. and Planning and Management Consultants, Ltd. (PMCL@CDM).

average of 33 percent. Similarly, the United States Environmental Protection Agency (USEPA) estimated that landscape watering accounts for 32 percent of total residential and commercial water use on annual basis.[13] A study conducted for the California Urban Water Agencies (CUWA) calculated average annual values ranging from 25 to 35 percent.[14] Unfortunately, there does not appear to be any comprehensive research that has estimated non-agricultural outdoor water use in Texas. As an approximation, an average annual value of 30 percent based on the above references was selected to serve as a rough estimate in this study.

3) As shortages approach 100 percent values become immense and theoretically infinite at 100 percent because at that point death would result, and willingness to pay for water is immeasurable. Thus, as shortages approach 80 percent of monthly consumption, we assume that households and non-water intensive commercial businesses (those that use water only for drinking and sanitation would have water delivered by tanker truck or commercial water delivery companies. Based on reports from water companies throughout the state, we estimate that the cost of trucking in water is around $21,000 to $27,000 per acre-feet assuming a hauling distance of between 20 to 60 miles. This is not an unreasonable assumption. The practice was widespread during the 1950s drought and recently during droughts in this decade. For example, in 2000 at the heels of three consecutive drought years Electra - a small town in North Texas - was down to its last 45 days worth of reservoir water when rain replenished the lake, and the city was able to refurbish old wells to provide supplemental groundwater. At the time, residents were forced to limit water use to 1,000 gallons per person per month - less than half of what most people use - and many were having water delivered to their homes by private contractors.[15] In 2003 citizens of Ballinger, Texas, were also faced with a dwindling water supply due to prolonged drought. After three years of drought, Lake Ballinger, which supplies water to more than 4,300 residents in Ballinger and to 600 residents in nearby Rowena, was almost dry. Each day, people lined up to get water from a well in nearby City Park. Trucks hauling trailers outfitted with large plastic and metal tanks hauled water to and from City Park to Ballinger.[16]

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[13] U.S. Environmental Protection Agency. *"Cleaner Water through Conservation*." USEPA Report no. 841-B-95-002. April, 1995.

[14] Planning and Management Consultants, Ltd. "*Evaluating Urban Water Conservation Programs: A Procedures Manual*." Prepared for the California Urban Water Agencies. February 1992.

[15] Zewe, C. "*Tap Threatens to Run Dry in Texas Town*." July 11, 2000. CNN Cable News Network.

[16] Associated Press, "*Ballinger Scrambles to Finish Pipeline before Lake Dries Up*." May 19, 2003.

Table 6: Economic Losses Associated with Domestic Water Shortages in Communities with Populations Exceeding 100,000 people				
Water shortages as a percentage of total monthly household demands	**No. of gallons remaining per household per day**	**No of gallons remaining per person per day**	**Economic loss (per acre-foot)**	**Economic loss (per gallon)**
1%	278	93	$748	$0.00005
5%	266	89	$812	$0.0002
10%	252	84	$900	$0.0005
15%	238	79	$999	$0.0008
20%	224	75	$1,110	$0.0012
25%	210	70	$1,235	$0.0015
30%[a]	196	65	$1,699	$0.0020
35%	182	61	$3,825	$0.0085
40%	168	56	$4,181	$0.0096
45%	154	51	$4,603	$0.011
50%	140	47	$5,109	$0.012
55%	126	42	$5,727	$0.014
60%	112	37	$6,500	$0.017
65%	98	33	$7,493	$0.02
70%	84	28	$8,818	$0.02
75%	70	23	$10,672	$0.03
80%	56	19	$13,454	$0.04
85%	42	14	$18,091 ($24,000)[b]	$0.05 ($0.07)[b]
90%	28	9	$27,363 ($24,000)	$0.08 ($0.07)
95%	14	5	$55,182 ($24,000)	$0.17 ($0.07)
99%	3	0.9	$277,728 ($24,000)	$0.85 ($0.07)
99.9%	1	0.5	$2,781,377 ($24,000)	$8.53 ($0.07)
100%	0	0	Infinite ($24,000)	Infinite ($0.07)

[a] The first 30 percent of needs are assumed to be restrictions of outdoor water use; when needs reach 30 percent of total demands all outdoor water uses would be restricted. Needs greater than 30 percent include indoor use

[b] As shortages approach 100 percent the value approaches infinity assuming there are not alternatives available; however, we assume that communities would begin to have water delivered by tanker truck at an estimated cost of $24,000 per acre-foot when shortages breached 85 percent.

Commercial Businesses

Effects of water shortages on commercial sectors were estimated in a fashion similar to other business sectors meaning that water shortages would affect the ability of these businesses to operate. This is particularly true for "water intensive" commercial sectors that are need large amounts of water (in addition to potable and sanitary water) to provide their services. These include:

- car-washes,
- laundry and cleaning facilities,
- sports and recreation clubs and facilities including race tracks,
- amusement and recreation services,
- hospitals and medical facilities,
- hotels and lodging places, and
- eating and drinking establishments.

A key assumption is that commercial operations would not be affected until water shortages were at least 50 percent of total municipal demand. In other words, we assume that residential water consumers would reduce water use including all non-essential uses before businesses were affected.

An example will illustrate the breakdown of municipal water needs and the overall approach to estimating impacts of municipal needs. Assume City A experiences an unexpected shortage of 50 acre-feet per year when their demands are 200 acre-feet per year. Thus, shortages are only 25 percent of total municipal use and residents of City A could eliminate needs by restricting landscape irrigation. City B, on the other hand, has a deficit of 150 acre-feet in 2020 and a projected demand of 200 acre-feet. Thus, total shortages are 75 percent of total demand. Emergency outdoor and some indoor conservation measures could eliminate 50 acre-feet of projected needs, yet 50 acre-feet would still remain. To eliminate" the remaining 50 acre-feet water intensive commercial businesses would have to curtail operations or shut down completely.

Three other areas were considered when analyzing municipal water shortages: 1) lost revenues to water utilities, 2) losses to the horticultural and landscaping industries stemming for reduction in water available for landscape irrigation, and 3) lost revenues and related economic impacts associated with reduced water related recreation.

Water Utility Revenues

Estimating lost water utility revenues was straightforward. We relied on annual data from the "*Water and Wastewater Rate Survey*" published annually by the Texas Municipal League to calculate an average value per acre-foot for water and sewer. For water revenues, average retail water and sewer rates multiplied by total water needs served as a proxy. For lost wastewater, total unmet needs were adjusted for return flow factor of 0.60 and multiplied by average sewer rates for the region. Needs reported as "county-other" were excluded under the presumption that these consist primarily of self-supplied water uses. In addition, 15 percent of water demand and needs are considered non-billed or "unaccountable" water that comprises things such as leakages and water for municipal government functions (e.g., fire departments). Lost tax receipts are based on current rates for the "miscellaneous gross receipts tax, "which the state collects from utilities located in most incorporated cities or towns in Texas. We do not include lost water utility revenues when aggregating impacts of municipal water shortages to regional and state levels to prevent double counting.

Horticultural and Landscaping Industry

The horticultural and landscaping industry, also referred to as the "green Industry," consists of businesses that produce, distribute and provide services associated with ornamental plants, landscape and garden supplies and equipment. Horticultural industries often face big losses during drought. For example, the recent drought in the Southeast affecting the Carolinas and Georgia horticultural and landscaping businesses had a harsh year. Plant sales were down, plant mortality increased, and watering costs increased. Many businesses were forced to close locations, lay off employees, and even file for bankruptcy. University of Georgia economists put statewide losses for the industry at around $3.2 billion during the 3-year drought that ended in 2008.[17] Municipal restrictions on outdoor watering play a significant role. During drought, water restrictions coupled with persistent heat has a psychological effect on homeowners that reduces demands for landscaping products and services. Simply put, people were afraid to spend any money on new plants and landscaping.

In Texas, there do not appear to be readily available studies that analyze the economic effects of water shortages on the industry. However, authors of this report believe negative impacts do and would result in restricting landscape irrigation to municipal water consumers. The difficulty in measuring them is two-fold. First, as noted above, data and research for these types of impacts that focus on Texas are limited; and second, economic data provided by IMPLAN do not disaggregate different sectors of the green industry to a level that would allow for meaningful and defensible analysis.[18]

Recreational Impacts

Recreational businesses often suffer when water levels and flows in rivers, springs and reservoirs fall significantly during drought. During droughts, many boat docks and lake beaches are forced to close, leading to big losses for lakeside business owners and local communities. Communities adjacent to popular river and stream destinations such as Comal Springs and the Guadalupe River also see their business plummet when springs and rivers dry up. Although there are many examples of businesses that have suffered due to drought, dollar figures for drought-related losses to the recreation and tourism industry are not readily available, and very difficult to measure without extensive local surveys. Thus, while they are important, economic impacts are not measured in this study.

Table 7 summarizes impacts of municipal water shortages at differing levels of magnitude, and shows the ranges of economic costs or losses per acre-foot of shortage for each level.

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[17] Williams, D. *"Georgia landscapers eye rebound from Southeast drought."* Atlanta Business Chronicle, Friday, June 19, 2009

[18] Economic impact analyses prepared by the TWDB for 2006 regional water plans did include estimates for the horticultural industry. However, year 2000 and prior IMPLAN data were disaggregated to a finer level. In the current dataset (2006), the sector previously listed as "Landscaping and Horticultural Services" (IMPLAN Sector 27) is aggregated into "Services to Buildings and Dwellings" (IMPLAN Sector 458).

Table 7: Impacts of Municipal Water Shortages at Different Magnitudes of Shortages		
Water shortages as percent of total municipal demands	Impacts	Economic costs per acre-foot*
0-30%	✓ Lost water utility revenues ✓ Restricted landscape irrigation and non-essential water uses	$730 - $2,040
30-50%	✓ Lost water utility revenues ✓ Elimination of landscape irrigation and non-essential water uses ✓ Rationing of indoor use	$2,040 - $10,970
>50%	✓ Lost water utility revenues ✓ Elimination of landscape irrigation and non-essential water uses ✓ Rationing of indoor use ✓ Restriction or elimination of commercial water use ✓ Importing water by tanker truck	$10,970 - varies
*Figures are rounded		

1.1.4 Industrial Water User Groups

Manufacturing

Impacts to manufacturing were estimated by distributing water shortages among industrial sectors at the county level. For example, if a planning group estimates that during a drought of record water supplies in County A would only meet 50 percent of total annual demands for manufactures in the county, we reduced output for each sector by 50 percent. Since projected manufacturing demands are based on TWDB Water Uses Survey data for each county, we only include IMPLAN sectors represented in the TWBD survey database. Some sectors in IMPLAN databases are not part of the TWDB database given that they use relatively small amounts of water - primarily for on-site sanitation and potable purposes. To maintain consistency between IMPLAN and TWDB databases, Standard Industrial Classification (SIC) codes both databases were cross referenced in county with shortages. Non-matches were excluded when calculating direct impacts.

Mining

The process of mining is very similar to that of manufacturing. We assume that within a given county, shortages would apply equally to relevant mining sectors, and IMPLAN sectors are cross referenced with TWDB data to ensure consistency.

In Texas, oil and gas extraction and sand and gravel (aggregates) operations are the primary mining industries that rely on large volumes of water. For sand and gravel, estimated output reductions are straightforward; however, oil and gas is more complicated for a number of reasons. IMPLAN does not necessarily report the physical extraction of minerals by geographic local, but rather the sales revenues reported by a particular corporation.

For example, at the state level revenues for IMPLAN sector 19 (oil and gas extraction) and sector 27 (drilling oil and gas wells) totals $257 billion. Of this, nearly $85 billion is attributed to Harris County. However, only a very small fraction (less than one percent) of actual production takes place in the county. To measure actual potential losses in well head capacity due to water shortages, we relied on county level production data from the Texas Railroad Commission (TRC) and average well-head market prices for crude and gas to estimate lost revenues in a given county. After which, we used to IMPLAN ratios to estimate resultant losses in income and employment.

Other considerations with respect to mining include:

1) Petroleum and gas extraction industry only uses water in significant amounts for secondary recovery. Known in the industry as enhanced or water flood extraction, secondary recovery involves pumping water down injection wells to increase underground pressure thereby pushing oil or gas into other wells. IMPLAN output numbers do not distinguish between secondary and non-secondary recovery. To account for the discrepancy, county-level TRC data that show the proportion of barrels produced using secondary methods were used to adjust IMPLAN data to reflect only the portion of sales attributed to secondary recovery.

2) A substantial portion of output from mining operations goes directly to businesses that are classified as manufacturing in our schema. Thus, multipliers measuring backward linkages for a given manufacturer might include impacts to a supplying mining operation. Care was taken not to double count in such situations if both a mining operation and a manufacturer were reported as having water shortages.

Steam-electric

At minimum without adequate cooling water, power plants cannot safely operate. As water availability falls below projected demands, water levels in lakes and rivers that provide cooling water would also decline. Low water levels could affect raw water intakes and outfalls at electrical generating units in several ways. For one, power plants are regulated by thermal emission guidelines that specify the maximum amount of heat that can go back into a river or lake via discharged cooling water. Low water levels could result in permit compliance issues due to reduced dilution and dispersion of heat and subsequent impacts on aquatic biota near outfalls.[19] However, the primary concern would be a loss of head (i.e., pressure) over intake structures that would decrease flows through intake tunnels. This would affect safety related pumps, increase operating costs and/or result in sustained shut-downs. Assuming plants did shutdown, they would not be able to generate electricity.

[19] Section 316 (b) of the Clean Water Act requires that thermal wastewater discharges do not harm fish and other wildlife.

Among all water use categories steam-electric is unique and cautions are needed when applying methods used in this study. Measured changes to an economy using input-output models stem directly from changes in sales revenues. In the case of water shortages, one assumes that businesses will suffer lost output if process water is in short supply. For power generation facilities this is true as well. However, the electric services sector in IMPLAN represents a corporate entity that may own and operate several electrical generating units in a given region. If one unit became inoperable due to water shortages, plants in other areas or generation facilities that do not rely heavily on water such as gas powered turbines might be able to compensate for lost generating capacity. Utilities could also offset lost production via purchases on the spot market.[20] Thus, depending upon the severity of the shortages and conditions at a given electrical generating unit, energy supplies for local and regional communities could be maintained. But in general, without enough cooling water, utilities would have to throttle back plant operations, forcing them to buy or generate more costly power to meet customer demands.

Measuring impacts end users of electricity is not part of this study as it would require extensive local and regional level analysis of energy production and demand. To maintain consistency with other water user groups, impacts of steam-electric water shortages are measured in terms of lost revenues (and hence income) and jobs associated with shutting down electrical generating units.

1.2 Social Impacts of Water Shortages

As the name implies, the effects of water shortages can be social or economic. Distinctions between the two are both semantic and analytical in nature – more so analytic in the sense that social impacts are harder to quantify. Nevertheless, social effects associated with drought and water shortages are closely tied to economic impacts. For example, they might include:

- demographic effects such as changes in population,
- disruptions in institutional settings including activity in schools and government,
- conflicts between water users such as farmers and urban consumers,
- health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations),
- mental and physical stress (e.g., anxiety, depression, domestic violence),
- public safety issues from forest and range fires and reduced fire fighting capability,
- increased disease caused by wildlife concentrations,
- loss of aesthetic and property values, and
- reduced recreational opportunities.[21]

[20] Today, most utilities participate in large interstate "power pools" and can buy or sell electricity "on the grid" from other utilities or power marketers. Thus, assuming power was available to buy, and assuming that no contractual or physical limitations were in place such as transmission constraints; utilities could offset lost power that resulted from waters shortages with purchases via the power grid.

[21] Based on information from the website of the National Drought Mitigation Center at the University of Nebraska Lincoln. Available online at: http://www.drought.unl.edu/risk/impacts.htm. See also, Vanclay, F. "*Social Impact Assessment*." in Petts, J. (ed) International Handbook of Environmental Impact Assessment. 1999.

Social impacts measured in this study focus strictly on demographic effects including changes in population and school enrollment. Methods are based on demographic projection models developed by the Texas State Data Center and used by the TWDB for state and regional water planning. Basically, the social impact model uses results from the economic component of the study and assesses how changes in labor demand would affect migration patterns in a region. Declines in labor demand as measured using adjusted IMPLAN data are assumed to affect net economic migration in a given regional water planning area. Employment losses are adjusted to reflect the notion that some people would not relocate but would seek employment in the region and/or public assistance and wait for conditions to improve. Changes in school enrollment are simply the proportion of lost population between the ages of 5 and 17.

2. Results

Section 2 presents the results of the analysis at the regional level. Included are baseline economic data for each water use category, and estimated economics impacts of water shortages for water user groups with reported deficits. According to the 2011 *Northeast Texas Regional Water Plan*, during severe drought municipal and steam-electric water user groups would experience water shortages in the absence of new water management strategies.

2.1 Overview of Regional Economy

On an annual basis, the Northeast Texas regional economy generates nearly $27 billion in gross state product for Texas ($25 billion in income and $2 billion worth of business taxes) and supports 317,231 jobs (Table 8). Generating about $13 billion worth of income per year agriculture, manufacturing, and mining are the primary base economic sectors in the region.[22] Municipal sectors also generate substantial amounts of income and are major employers. However, while municipal sectors are the largest employer and source of wealth, many businesses that make up the municipal category such as restaurants and retail stores are non-basic industries meaning they exist to provide services to people who work would in base industries such as manufacturing, agriculture and mining. In other words, without base industries such agriculture, many municipal jobs in the region would not exist.

[22] Base industries are those that supply markets outside of the region. These industries are crucial to the local economy and are called the economic base of a region. Appendix A shows how IMPLAN's 529 sectors were allocated to water use category, and shows economic data for each sector.

Table 8: The Northeast Texas Regional Economy by Water User Group ($millions)*						
Water Use Category	**Total sales**	**Intermediate sales**	**Final sales**	**Jobs**	**Income**	**Business taxes**
Irrigation	$5.81	$2.44	$3.36	193	$2.88	$0.11
Livestock	$3,023.19	$1,484.70	$1,538.50	20,284	$509.63	$29.61
Manufacturing	$16,567.24	$2,542.98	$14,024.26	55,787	$4,008.66	$98.26
Mining	$13,982.68	$11,619.70	$2,362.97	12,748	$8,032.41	$854.58
Steam-electric	$615.14	$173.05	$442.09	1,439	$427.15	$72.90
Municipal	$19,500.64	$4,954.57	$14,546.07	226,780	$11,498.42	$1,120.28
Regional total	$53,694.70	$20,777.44	$32,917.25	317,231	$24,479.15	$2,175.74

[a] Appendix 1 displays data for individual IMPLAN sectors that make up each water use category. Based on data from the Texas Water Development Board, and year 2006 data from the Minnesota IMPLAN Group, Inc.

2.1 Impacts of Municipal Water Shortages

Water shortages are projected to occur in a significant number of communities throughout the region. Deficits range from approximately 2 to 100 percent of total annual water use. At the regional level, the estimated economic value of domestic water shortages totals $12 million in 2010 and $173 million in 2060 (Table 9). Due to curtailment of commercial business activity, municipal shortages would reduce gross state product (income plus taxes) by nearly $2 million in 2010 and $115 million in 2060.

Table 9: Economic Impacts of Water Shortages for Municipal Water User Groups ($millions)					
Decade	**Monetary value of domestic water shortages**	**Lost income from reduced commercial business activity***	**Lost state and local taxes from reduced commercial business activity**	**Lost jobs from reduced commercial business activity**	**Lost water utility revenues**
2010	$12.46	$1.70	$0.06	15	$1.95
2020	$16.63	$5.47	$0.21	49	$3.10
2030	$21.72	$8.26	$0.30	70	$4.49
2040	$35.69	$15.90	$0.38	91	$6.37
2050	$63.29	$29.88	$0.78	184	$13.87
2060	$172.82	$113.00	$2.20	505	$29.50

*Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.3 Impacts of Steam-electric Water Shortages

Water shortages for electrical generating units are projected to occur in the counties of Titus, Hunt, Harrison and Lamar. These shortages would result in estimated losses of gross state product totaling $356 million dollars in 2010, and $2.1 billion in 2060 (Table 10).

Table 10: Economic Impacts of Water Shortages for Steam-electric Water User Groups ($millions)

Decade	Lost income due to reduced electrical generation	Lost state and local business tax revenues due to reduced electrical generation	Lost jobs due to reduced electrical generation
2010	$355.79	$51.07	1,209
2020	$509.28	$73.10	1,731
2030	$611.81	$87.82	2,080
2040	$855.10	$122.74	2,907
2050	$1,310.62	$188.12	4,455
2060	$1,847.21	$265.14	6,279

*Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.4 Social Impacts of Water Shortages

As discussed previously, estimated social impacts focus on changes in population and school enrollment in the region. In 2010, estimated population losses total 1,472 with corresponding reductions in school enrollment of 415 students (Table 11). In 2060, population in the region could decline by 8,171 and school enrollment would fall by 2,318.

Table 11: Social Impacts of Water Shortages (2010-2060)

Year	Population Losses	Declines in School Enrollment
2010	1,472	415
2020	2,144	608
2030	2,590	735
2040	3,611	1,024
2050	5,588	1,585
2060	8,171	2,318

2.5 Distribution of Impacts by Major River Basin

Administrative rules require that impacts are presented by both planning region and major river basin. To meet rule requirements, impacts were allocated among basins based on the distribution of water shortages in relevant basins. For example, if 50 percent of water shortages in River Basin A and 50 percent occur in River Basin B, then impacts were split equally among the two basins. Table 12 displays the results.

Table 12: Distribution of Impacts by Major River Basin (2010-2060)

Water Use	2010	2020	2030	2040	2050	2060
Municipal						
Cypress	3%	9%	13%	13%	8%	5%
Neches	0%	0%	0%	0%	1%	1%
Red	13%	11%	10%	8%	4%	2%
Sabine	25%	28%	30%	32%	53%	66%
Sulphur	59%	51%	47%	47%	35%	26%
Trinity	0%	0%	0%	0%	0%	1%
Steam-electric						
Cypress	0%	0%	0%	7%	32%	40%
Red	0%	0%	6%	12%	10%	10%
Sabine	100%	100%	94%	81%	58%	50%

Appendix 1: Economic Data for Individual IMPLAN Sectors for the Northeast Texas Regional Water Planning Area

Economic Data for Agricultural Water User Groups ($millions)									
Water Use Category	**IMPLAN Sector**	**IMPLAN Code**	**Total Sales**	**Intermediate Sales**	**Final Sales**	**Jobs**	**Income**	**Business Taxes**
Irrigation	Oilseed Farming	1	$0.64	$0.01	$0.63	23	$0.34	$0.01
Irrigation	Grain Farming	2	$2.22	$0.46	$1.75	130	$1.02	$0.04
Irrigation	Vegetable and Melon Farming	3	$0.03	$0.00	$0.03	1	$0.02	$0.00
Irrigation	Fruit Farming	5	$0.84	$0.26	$0.58	17	$0.48	$0.02
Irrigation	All "Other" Crop Farming	10	$2.08	$1.70	$0.38	22	$1.02	$0.04
	Total irrigation		**$5.81**	**$2.44**	**$3.36**	**193**	**$2.88**	**$0.11**
Livestock	Poultry processing	70	$1,127.04	$358.60	$768.44	5,019	$166.48	$7.66
Livestock	Cattle ranching and farming	11	$737.44	$511.34	$226.10	11,334	$58.26	$15.50
Livestock	Poultry and egg production	12	$441.75	$346.22	$95.54	1,813	$148.72	$1.50
Livestock	Rendering and meat byproduct processing	69	$289.77	$160.80	$128.97	515	$78.22	$2.25
Livestock	Dry- condensed- and evaporated dairy products	65	$119.97	$28.09	$91.88	149	$26.21	$0.77
Livestock	Fluid milk manufacturing	62	$108.80	$26.18	$82.63	189	$9.10	$0.54
Livestock	Creamery butter manufacturing	63	$75.33	$8.54	$66.79	158	$5.90	$0.33
Livestock	Animal- except poultry- slaughtering	67	$64.83	$17.33	$47.49	155	$11.52	$0.64
Livestock	Meat processed from carcasses	68	$35.92	$10.60	$25.32	85	$2.85	$0.15
Livestock	Animal production- except cattle and poultry	13	$16.36	$13.87	$2.49	853	$1.59	$0.25
Livestock	Ice cream and frozen dessert manufacturing	66	$5.99	$3.14	$2.85	14	$0.79	$0.03
	Total livestock		**$3,023.19**	**$1,484.70**	**$1,538.50**	**20,284**	**$509.63**	**$29.61**
	Total agriculture		**$3,029.00**	**$1,487.14**	**$1,541.86**	**20,477**	**$512.51**	**$29.72**

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Mining and Steam-electric Water User Groups ($millions)									
Water Use Category	**IMPLAN Sector**	**IMPLAN Code**	**Total Sales**	**Intermediate Sales**	**Final Sales**	**Jobs**	**Income**	**Business Taxes**
Mining	Oil and gas extraction	19	$12,250.70	$11,377.07	$873.63	7,562	$7,019.74	$769.86
Mining	Coal mining	20	$370.11	$138.69	$231.42	641	$174.10	$30.73
Mining	Iron ore mining	21	$4.81	$0.00	$4.81	14	$1.71	$0.15
Mining	Sand- gravel- clay- and refractory mining	25	$16.46	$1.74	$14.73	52	$9.80	$0.62
Mining	Other nonmetallic mineral mining	26	$14.56	$1.46	$13.11	95	$5.60	$0.27
Mining	Drilling oil and gas wells	27	$619.84	$3.09	$616.74	976	$183.05	$24.13
Mining	Support activities for oil and gas operations	28	$702.66	$97.60	$605.07	3,382	$637.25	$28.69
Mining	Support activities for other mining	29	$3.53	$0.05	$3.48	26	$1.17	$0.14
	Total mining		**$13,982.68**	**$11,619.70**	**$2,362.97**	**12,748**	**$8,032.41**	**$854.58**
Steam-electric	**Power generation and supply**	**30**	**$615.14**	**$173.05**	**$442.09**	**1,439**	**$427.15**	**$72.90**
Based on year 2006 data from the Minnesota IMPLAN Group, Inc.								

Economic Data for Manufacturing Water User Groups ($millions)									
Water Use Category	**IMPLAN Sector**	**IMPLAN Code**	**Total Sales**	**Intermediate Sales**	**Final Sales**	**Jobs**	**Income**	**Business Taxes**
Manufacturing	Aircraft manufacturing	351	$2,505.75	$127.48	$2,378.27	4,977	$429.37	$8.98
Manufacturing	Iron and steel mills	203	$1,352.36	$97.41	$1,254.95	1,597	$274.45	$10.40
Manufacturing	Railroad rolling stock manufacturing	356	$978.70	$28.32	$950.38	2,656	$162.81	$3.56
Manufacturing	Aluminum sheet- plate- and foil manufacturing	211	$796.77	$21.63	$775.14	870	$122.82	$7.73
Manufacturing	New residential 1-unit structures- all	33	$735.42	$0.00	$735.42	4,989	$240.75	$3.79
Manufacturing	Construction machinery manufacturing	259	$651.24	$88.88	$562.36	951	$101.95	$3.07
Manufacturing	Ammunition manufacturing	256	$633.28	$2.51	$630.77	2,525	$230.10	$15.10
Manufacturing	Petrochemical manufacturing	147	$614.14	$281.38	$332.76	83	$24.47	$1.40
Manufacturing	Commercial and institutional buildings	38	$411.68	$0.00	$411.68	4,351	$206.26	$2.54
Manufacturing	Travel trailer and camper manufacturing	349	$307.85	$16.72	$291.13	1,558	$71.23	$0.99
Manufacturing	Farm machinery and equipment manufacturing	257	$306.39	$50.28	$256.10	710	$76.49	$0.79
Manufacturing	Industrial gas manufacturing	148	$293.03	$154.09	$138.95	276	$120.30	$1.83
Manufacturing	Automobile and light truck manufacturing	344	$292.35	$0.31	$292.04	215	$17.59	$0.57
Manufacturing	Soap and other detergent manufacturing	163	$268.23	$71.65	$196.58	306	$53.13	$1.20
Manufacturing	Broadcast and wireless communications equipment	307	$251.91	$59.72	$192.19	477	$33.18	$0.82
Manufacturing	Fabricated structural metal manufacturing	233	$249.07	$12.90	$236.17	1,031	$80.83	$1.30
Manufacturing	Motor vehicle parts manufacturing	350	$244.17	$19.63	$224.53	709	$47.47	$0.73
Manufacturing	Plastics plumbing fixtures and all other plastics	177	$210.34	$152.38	$57.96	1,077	$78.31	$1.35
Manufacturing	Paperboard container manufacturing	126	$198.08	$2.10	$195.98	671	$43.11	$1.67
Manufacturing	Other new construction	41	$179.47	$0.00	$179.47	1,996	$95.66	$0.75
Manufacturing	Sugar manufacturing	56	$167.81	$69.90	$97.90	308	$12.14	$0.66
Manufacturing	Logging	14	$161.21	$120.46	$40.75	648	$42.34	$1.43
Manufacturing	Machine shops	243	$161.17	$38.90	$122.27	1,175	$75.00	$1.20
Manufacturing	AC- refrigeration- and forced air heating	278	$147.38	$0.00	$147.38	501	$23.90	$0.59
Manufacturing	Oil and gas field machinery and equipment	261	$145.34	$5.41	$139.93	415	$32.45	$0.66
Manufacturing	Ferrous metal foundries	221	$133.16	$0.13	$133.03	579	$58.69	$1.31
	All other manufacturing		**$4,170.97**	**$1,120.79**	**$3,050.17**	**20,136**	**$1,253.87**	**$23.87**
	Total manufacturing		**$16,567.24**	**$2,542.98**	**$14,024.26**	**55,787**	**$4,008.66**	**$98.26**
Based on year 2006 data from the Minnesota IMPLAN Group, Inc.								

Economic Data for Municipal Water User Groups ($millions)								
Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Manufacturing	Owner-occupied dwellings	509	$1,807.96	$0.00	$1,807.96	0	$1,400.57	$213.78
Manufacturing	Wholesale trade	390	$1,557.67	$745.76	$811.92	10,584	$820.08	$230.39
Manufacturing	State & Local Education	503	$996.46	$0.00	$996.46	27,388	$996.47	$0.00
Manufacturing	Monetary authorities and depository credit in	430	$895.44	$294.92	$600.52	4,448	$628.79	$11.45
Manufacturing	Hospitals	467	$821.38	$0.00	$821.38	7,287	$433.85	$5.54
Manufacturing	Food services and drinking places	481	$767.39	$97.99	$669.40	16,686	$303.65	$35.45
Manufacturing	Offices of physicians- dentists- and other he	465	$756.19	$0.00	$756.19	6,709	$534.38	$4.68
Manufacturing	Telecommunications	422	$726.78	$249.63	$477.14	1,439	$331.43	$56.33
Manufacturing	Truck transportation	394	$681.44	$368.98	$312.46	5,474	$300.10	$6.84
Manufacturing	Motor vehicle and parts dealers	401	$568.65	$61.83	$506.81	5,346	$292.98	$83.12
Manufacturing	State & Local Non-Education	504	$524.33	$0.00	$524.33	10,370	$524.33	$0.00
Manufacturing	General merchandise stores	410	$504.83	$53.21	$451.62	8,857	$230.75	$73.66
Manufacturing	Real estate	431	$359.85	$142.45	$217.40	2,035	$208.35	$44.20
Manufacturing	Nursing and residential care facilities	468	$339.28	$0.00	$339.28	8,031	$200.69	$4.73
Manufacturing	Federal Non-Military	506	$328.08	$0.00	$328.08	2,209	$328.08	$0.00
Manufacturing	Other State and local government enterprises	499	$305.70	$99.55	$206.16	1,537	$104.50	$0.04
Manufacturing	Building material and garden supply stores	404	$300.00	$46.52	$253.47	3,759	$139.36	$42.39
Manufacturing	Health and personal care stores	406	$264.57	$42.23	$222.35	2,689	$140.68	$40.88
Manufacturing	Home health care services	464	$257.05	$0.00	$257.05	7,229	$156.03	$0.92
Manufacturing	Management of companies and enterprises	451	$257.00	$241.68	$15.32	1,854	$119.18	$1.90
Manufacturing	Automotive repair and maintenance- except car	483	$242.19	$57.53	$184.66	3,205	$90.94	$18.03
Manufacturing	Food and beverage stores	405	$239.76	$32.06	$207.71	4,181	$122.20	$26.76
Manufacturing	Civic- social- professional and similar organ	493	$220.06	$77.32	$142.74	7,353	$93.14	$0.59
Manufacturing	Pipeline transportation	396	$218.03	$95.35	$122.68	273	$73.24	$15.51
Manufacturing	Legal services	437	$217.14	$137.81	$79.33	2,005	$133.41	$4.21
Manufacturing	Gasoline stations	407	$215.67	$32.75	$182.92	3,083	$116.04	$31.54
Manufacturing	All other municipal		$4,205.07	$1,634.57	$2,570.50	62,435	$2,186.63	$157.86
Manufacturing	**Total**		**$19,500.64**	**$4,954.57**	**$14,546.07**	**226,780**	**$11,498.42**	**$1,120.28**
Based on year 2006 data from the Minnesota IMPLAN Group, Inc.								

Appendix 2: Impacts by Water User Group Northeast Texas Regional Water Planning Area

Municipal ($millions)	2010	2020	2030	2040	2050	2060
Able Springs WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$2.14	$38.81
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$2.74	$9.09
Bi-County WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$1.35	$20.64
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$1.47	$4.61
Campbell WSC						
Monetary value of domestic water shortages	$0.14	$1.50	$3.00	$6.29	$14.68	$32.27
Lost income from reduced commercial business activity	$0.00	$0.00	$0.28	$0.59	$1.25	$2.30
Lost jobs due to reduced commercial business activity	0	0	11	24	50	92
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.04	$0.09	$0.19	$0.36
Lost utility revenues	$0.14	$0.29	$0.51	$0.85	$1.60	$2.78
Canton						
Monetary value of domestic water shortages	$0.00	$0.01	$0.03	$0.35	$6.50	$26.60
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$1.77	$10.26
Lost jobs due to reduced commercial business activity	0	0	0	0	56	323
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.25	$1.46
Lost utility revenues	$0.00	$0.01	$0.05	$0.35	$1.21	$2.63
Cash SUD						
Monetary value of domestic water shortages	$0.01	$0.41	$1.40	$4.82	$10.18	$18.29
Lost utility revenues	$0.02	$0.08	$0.18	$0.35	$0.75	$1.34
Celeste						
Monetary value of domestic water shortages	$0.00	$0.15	$0.48	$2.29	$3.11	$4.15
Lost utility revenues	$0.00	$0.23	$0.53	$0.76	$0.95	$1.15

Municipal cont. ($millions)						
	2010	2020	2030	2040	2050	2060
Central Bowie WSC						
Monetary value of domestic water shortages	$6.69	$6.34	$7.17	$9.90	$10.96	$11.93
Lost income from reduced commercial business activity	$0.00	$1.05	$1.29	$1.52	$1.76	$1.99
Lost jobs due to reduced commercial business activity	0	33	41	48	55	63
Lost state and local taxes from reduced commercial business activity	$0.00	$0.15	$0.18	$0.22	$0.25	$0.28
Lost utility revenues	$0.63	$0.73	$0.83	$0.93	$1.03	$1.14
Clarksville City						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.01	$0.01	$0.61
Lost utility revenues	$0.00	$0.00	$0.00	$0.01	$0.02	$1.05
Combined Consumers WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.08	$0.24	$0.49
Lost utility revenues	$0.00	$0.00	$0.00	$0.17	$0.47	$0.84
County-other (Bowie)						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.12	$0.67
County-other (Harrison)						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.06	$0.28	$0.72
County-other (Hunt)						
Monetary value of domestic water shortages	$0.33	$1.75	$1.94	$2.34	$2.30	$2.24
County-other (Rains)						
Monetary value of domestic water shortages	$0.25	$0.44	$0.58	$0.57	$0.56	$0.56
County-other (Van Zandt)						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.18	$0.46
Crystal Systems, Inc.						
Monetary value of domestic water shortages	$0.35	$0.41	$0.44	$0.48	$0.45	$0.44
Lost utility revenues	$0.38	$0.44	$0.48	$0.52	$0.49	$0.48
Grand Saline						
Monetary value of domestic water shortages	$0.00	$0.00	$0.05	$0.14	$0.31	$2.21
Lost utility revenues	$0.00	$0.00	$0.07	$0.16	$0.27	$0.43

Municipal cont. ($millions)						
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Hickory Creek SUD						
Monetary value of domestic water shortages	$0.08	$0.26	$0.41	$0.43	$0.41	$0.39
Lost utility revenues	$0.12	$0.29	$0.40	$0.42	$0.40	$0.38
Hooks						
Monetary value of domestic water shortages	$4.29	$4.77	$5.29	$5.84	$6.62	$4.21
Lost income from reduced commercial business activity	$0.36	$0.40	$0.45	$0.49	$0.56	$0.65
Lost jobs due to reduced commercial business activity	15	16	18	20	22	26
Lost state and local taxes from reduced commercial business activity	$0.06	$0.06	$0.07	$0.08	$0.09	$0.10
Lost utility revenues	$0.20	$0.23	$0.25	$0.28	$0.32	$0.37
Liberty City WSC						
Monetary value of domestic water shortages	$0.07	$0.15	$0.23	$1.10	$1.41	$1.90
Lost utility revenues	$0.08	$0.15	$0.20	$0.23	$0.28	$0.34
Lindale						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.11	$0.34
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.14	$0.33
Lindale Rural WSC						
Monetary value of domestic water shortages	$0.00	$0.04	$0.09	$0.14	$0.22	$0.33
Lost utility revenues	$0.00	$0.07	$0.13	$0.17	$0.24	$0.33
Macedonia-Eylau MUD #1						
Monetary value of domestic water shortages	$0.04	$0.10	$0.14	$0.20	$0.19	$0.19
Lost utility revenues	$0.08	$0.18	$0.24	$0.31	$0.30	$0.30
Mineola						
Monetary value of domestic water shortages	$0.00	$0.00	$0.03	$0.05	$0.11	$0.18
Lost utility revenues	$0.00	$0.00	$0.05	$0.10	$0.18	$0.28
New Boston						
Monetary value of domestic water shortages	$0.13	$0.19	$0.26	$0.31	$0.31	$0.31
Lost utility revenues	$0.14	$0.19	$0.23	$0.27	$0.27	$0.27

Municipal cont. ($millions)						
	2010	2020	2030	2040	2050	2060
North Hunt WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.02	$0.05	$0.08	$0.14
Lost utility revenues	$0.00	$0.00	$0.05	$0.11	$0.18	$0.28
R P M WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.10	$1.75
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.08	$0.25
Redwater						
Monetary value of domestic water shortages	$0.00	$0.00	$0.02	$0.05	$0.12	$0.94
Lost utility revenues	$0.00	$0.00	$0.04	$0.06	$0.12	$0.20
Van						
Monetary value of domestic water shortages	$0.08	$0.10	$0.11	$0.12	$0.11	$0.10
Lost utility revenues	$0.16	$0.20	$0.22	$0.24	$0.22	$0.20
Wake Village						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.03	$0.10
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.04	$0.15
Waskom						
Monetary value of domestic water shortages	$0.00	$0.00	$0.02	$0.04	$0.10	$0.70
Lost utility revenues	$0.00	$0.00	$0.02	$0.05	$0.09	$0.14
West Gregg WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.01	$0.02	$0.02	$0.13
Lost utility revenues	$0.00	$0.01	$0.01	$0.02	$0.02	$0.14
Winona						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02
Wolfe City						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01

Steam-electric ($millions)						
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Harrison County						
Reduced income from lost electrical generation	$0.00	$0.00	$0.00	$47.54	$175.50	$331.50
Reduced business taxes from lost electrical generation	$0.00	$0.00	$0.00	$6.82	$25.19	$47.58
Reduced jobs from lost electrical generation	0	0	0	162	597	1,127
Hunt County						
Reduced income from lost electrical generation	$355.79	$509.28	$595.39	$700.37	$828.37	$984.38
Reduced business taxes from lost electrical generation	$51.07	$73.10	$85.46	$100.53	$118.90	$141.29
Reduced jobs from lost electrical generation	1,209	1,731	2,024	2,381	2,816	3,346
Lamar County						
Reduced income from lost electrical generation	$0.00	$0.00	$16.41	$91.55	$163.14	$250.37
Reduced business taxes from lost electrical generation	$0.00	$0.00	$2.36	$13.14	$23.42	$35.94
Reduced jobs from lost electrical generation	0	0	56	311	555	851
Titus County						
Reduced income from lost electrical generation	$0.00	$0.00	$0.00	$15.63	$143.61	$280.96
Reduced business taxes from lost electrical generation	$0.00	$0.00	$0.00	$2.24	$20.61	$40.33
Reduced jobs from lost electrical generation	0	0	0	53	488	955

TEXAS WATER DEVELOPMENT BOARD

June 1, 2010

Mr. Kelley Holcomb
Chairman, East Texas Regional Water Planning Group
c/o General Manager, Angelina & Neches River Authority
P.O. Box 387
Lufkin, Texas 75902-0387

Re: Socioeconomic Impact Analysis of Not Meeting Water Needs for the 2011 East Texas Regional Water Plan

Dear Chairman Holcomb:

We have received your request for technical assistance to complete the socioeconomic impact analysis of not meeting water needs. In response, enclosed is a report that describes our methodology and presents the results. Section 1 provides an overview of the methodology, and Section 2 presents results for at the regional level, and Appendix 2 show results for individual water user groups.

If you have any questions or comments, please feel free to contact me at (512) 463-7928 or by email at stuart.norvell@twdb.state.tx.us.

Sincerely,

Stuart D. Norvell
Manager, Water Planning Research and Analysis
Water Resources Planning Division

SN/ao

Enclosure

c. Temple Mckinnon, TWDB
S. Doug Shaw, TWDB

Socioeconomic Impacts of Projected Water Shortages for the East Texas Regional Water Planning Area (Region I)

Prepared in Support of the 2011 East Texas Regional Water Plan

Stuart D. Norvell, Managing Economist
Water Resources Planning Division
Texas Water Development Board
Austin, Texas

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Water Resources Planning Division
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Austin, Texas

May 2010

Table of Contents

Tables

Introduction

Water shortages during drought would likely curtail or eliminate economic activity in business and industries reliant on water. For example, without water farmers cannot irrigate; refineries cannot produce gasoline, and paper mills cannot make paper. Unreliable water supplies would not only have an immediate and real impact on existing businesses and industry, but they could also adversely affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages would disrupt activity in homes, schools and government and could adversely affect public health and safety. For all of the above reasons, it is important to analyze and understand how restricted water supplies during drought could affect communities throughout the state.

Administrative rules require that regional water planning groups evaluate the impacts of not meeting water needs as part of the regional water planning process, and rules direct TWDB staff to provide technical assistance: "*The executive administrator shall provide available technical assistance to the regional water planning groups, upon request, on water supply and demand analysis, including methods to evaluate the social and economic impacts of not meeting needs*" [(§357.7 (4)(A)]. Staff of the TWDB's Water Resources Planning Division designed and conducted this report in support of the Northeast Texas Regional Water Planning Group (Region I).

This document summarizes the results of our analysis and discusses the methodology used to generate the results. Section 1 outlines the overall methodology and discusses approaches and assumptions specific to each water use category (i.e., irrigation, livestock, mining, steam-electric, municipal and manufacturing). Section 2 presents the results for each category where shortages are reported at the regional planning area level and river basin level. Results for individual water user groups are not presented, but are available upon request.

1. Methodology

Section 1 provides a general overview of how economic and social impacts were measured. In addition, it summarizes important clarifications, assumptions and limitations of the study.

1.1 Economic Impacts of Water Shortages

1.1.1 General Approach

Economic analysis as it relates to water resources planning generally falls into two broad areas. Supply side analysis focuses on costs and alternatives of developing new water supplies or implementing programs that provide additional water from current supplies. Demand side analysis concentrates on impacts or benefits of providing water to people, businesses and the environment. Analysis in this report focuses strictly on demand side impacts. When analyzing the economic impacts of water shortages as defined in Texas water planning, three potential scenarios are possible:

1) Scenario 1 involves situations where there are physical shortages of raw surface or groundwater due to drought of record conditions. For example, City A relies on a reservoir with average conservation storage of 500 acre-feet per year and a firm yield of 100 acre feet. In 2010, the city uses about 50 acre-feet per year, but by 2030 their demands are expected to increase to 200 acre-feet. Thus, in 2030 the reservoir would not have enough water to meet the city's demands,

and people would experience a shortage of 100 acre-feet assuming drought of record conditions. Under normal or average climatic conditions, the reservoir would likely be able to provide reliable water supplies well beyond 2030.

2) Scenario 2 is a situation where despite drought of record conditions, water supply sources can meet existing use requirements; however, limitations in water infrastructure would preclude future water user groups from accessing these water supplies. For example, City B relies on a river that can provide 500 acre-feet per year during drought of record conditions and other constraints as dictated by planning assumptions. In 2010, the city is expected to use an estimated 100 acre-feet per year and by 2060 it would require no more than 400 acre-feet. But the intake and pipeline that currently transfers water from the river to the city's treatment plant has a capacity of only 200 acre-feet of water per year. Thus, the city's water supplies are adequate even under the most restrictive planning assumptions, but their conveyance system is too small. This implies that at some point – perhaps around 2030 - infrastructure limitations would constrain future population growth and any associated economic activity or impacts.

3) Scenario 3 involves water user groups that rely primarily on aquifers that are being depleted. In this scenario, projected and in some cases existing demands may be unsustainable as groundwater levels decline. Areas that rely on the Ogallala aquifer are a good example. In some communities in the region, irrigated agriculture forms a major base of the regional economy. With less irrigation water from the Ogallala, population and economic activity in the region could decline significantly assuming there are no offsetting developments.

Assessing the social and economic effects of each of the above scenarios requires various levels and methods of analysis and would generate substantially different results for a number of reasons; the most important of which has to do with the time frame of each scenario. Scenario 1 falls into the general category of static analysis. This means that models would measure impacts for a small interval of time such as a drought. Scenarios 2 and 3, on the other hand imply a dynamic analysis meaning that models are concerned with changes over a much longer time period.

Since administrative rules specify that planning analysis be evaluated under drought of record conditions (a static and random event), socioeconomic impact analysis developed by the TWDB for the state water plan is based on assumptions of Scenario 1. Estimated impacts under scenario 1 are point estimates for years in which needs are reported (2010, 2020, 2030, 2040, 2050 and 2060). They are independent and distinct "what if" scenarios for a particular year and shortages are assumed to be temporary events resulting from drought of record conditions. Estimated impacts measure what would happen if water user groups experience water shortages for a period of one year.

The TWDB recognize that dynamic models may be more appropriate for some water user groups; however, combining approaches on a statewide basis poses several problems. For one, it would require a complex array of analyses and models, and might require developing supply and demand forecasts under "normal" climatic conditions as opposed to drought of record conditions. Equally important is the notion that combining the approaches would produce inconsistent results across regions resulting in a so-called "apples to oranges" comparison.

A variety tools are available to estimate economic impacts, but by far, the most widely used today are input-output models (IO models) combined with social accounting matrices (SAMs). Referred to as IO/SAM models, these tools formed the basis for estimating economic impacts for agriculture (irrigation and livestock water uses) and industry (manufacturing, mining, steam-electric and commercial business activity for municipal water uses).

Since the planning horizon extends through 2060, economic variables in the baseline are adjusted in accordance with projected changes in demographic and economic activity. Growth rates for municipal water use sectors (i.e., commercial, residential and institutional) are based on TWDB population forecasts. Future values for manufacturing, agriculture, and mining and steam-electric activity are based on the same underlying economic forecasts used to estimate future water use for each category.

The following steps outline the overall process.

Step 1*: Generate IO/SAM Models and Develop Economic Baseline*

IO/SAM models were estimated using propriety software known as IMPLAN PRO™ (Impact for Planning Analysis). IMPLAN is a modeling system originally developed by the U.S. Forestry Service in the late 1970s. Today, the Minnesota IMPLAN Group (MIG Inc.) owns the copyright and distributes data and software. It is probably the most widely used economic impact model in existence. IMPLAN comes with databases containing the most recently available economic data from a variety of sources.[1] Using IMPLAN software and data, transaction tables conceptually similar to the one discussed previously were estimated for each county in the region and for the region as a whole. Each transaction table contains 528 economic sectors and allows one to estimate a variety of economic statistics including:

- **total sales -** total production measured by sales revenues;
- **intermediate sales -** sales to other businesses and industries within a given region;
- **final sales –** sales to end users in a region and exports out of a region**;**
- **employment -** number of full and part-time jobs (annual average) required by a given industry including self-employment;
- **regional income -** total payroll costs (wages and salaries plus benefits) paid by industries, corporate income, rental income and interest payments; and
- **business taxes -** sales, excise, fees, licenses and other taxes paid during normal operation of an industry (does not include income taxes).

TWDB analysts developed an economic baseline containing each of the above variables using year 2000 data. Since the planning horizon extends through 2060, economic variables in the baseline were allowed to change in accordance with projected changes in demographic and economic activity. Growth rates for municipal water use sectors (i.e., commercial, residential and institutional) are based on TWDB population forecasts. Projections for manufacturing, agriculture, and mining and steam-electric activity are based on the same underlying economic forecasts used to estimate future water use for each category. Monetary impacts in future years are reported in constant year 2006 dollars.

It is important to stress that employment, income and business taxes are the most useful variables when comparing the relative contribution of an economic sector to a regional economy. Total sales as reported in IO/SAM models are less desirable and can be misleading because they include sales to other industries in the region for use in the production of other goods. For example, if a mill buys grain from local farmers and uses it to produce feed, sales of both the processed feed and raw corn are counted as "output" in an IO model. Thus, total sales double-count or overstate the true economic value of goods

[1]The IMPLAN database consists of national level technology matrices based on benchmark input-output accounts generated by the U.S. Bureau of Economic Analysis and estimates of final demand, final payments, industry output and employment for various economic sectors. IMPLAN regional data (i.e. states, a counties or groups of counties within a state) are divided into two basic categories: 1) data on an industry basis including value-added, output and employment, and 2) data on a commodity basis including final demands and institutional sales. State-level data are balanced to national totals using a matrix ratio allocation system and county data are balanced to state totals.

and services produced in an economy. They are not consistent with commonly used measures of output such as Gross National Product (GNP), which counts only final sales.

Another important distinction relates to terminology. Throughout this report, the term *sector* refers to economic subdivisions used in the IMPLAN database and resultant input-output models (528 individual sectors based on Standard Industrial Classification Codes). In contrast, the phrase *water use category* refers to water user groups employed in state and regional water planning including irrigation, livestock, mining, municipal, manufacturing and steam electric. Each IMPLAN sector was assigned to a specific water use category.

Step 2: *Estimate Direct and Indirect Economic Impacts of Water Needs*

Direct impacts are reductions in output by sectors experiencing water shortages. For example, without adequate cooling and process water a refinery would have to curtail or cease operation, car washes may close, or farmers may not be able to irrigate and sales revenues fall. Indirect impacts involve changes in inter-industry transactions as supplying industries respond to decreased demands for their services, and how seemingly non-related businesses are affected by decreased incomes and spending due to direct impacts. For example, if a farmer ceases operations due to a lack of irrigation water, they would likely reduce expenditures on supplies such as fertilizer, labor and equipment, and businesses that provide these goods would suffer as well.

Direct impacts accrue to immediate businesses and industries that rely on water and without water industrial processes could suffer. However, output responses may vary depending upon the severity of shortages. A small shortage relative to total water use would likely have a minimal impact, but large shortages could be critical. For example, farmers facing small shortages might fallow marginally productive acreage to save water for more valuable crops. Livestock producers might employ emergency culling strategies, or they may consider hauling water by truck to fill stock tanks. In the case of manufacturing, a good example occurred in the summer of 1999 when Toyota Motor Manufacturing experienced water shortages at a facility near Georgetown, Kentucky.[2] As water levels in the Kentucky River fell to historic lows due to drought, plant managers sought ways to curtail water use such as reducing rinse operations to a bare minimum and recycling water by funneling it from paint shops to boilers. They even considered trucking in water at a cost of 10 times what they were paying. Fortunately, rains at the end of the summer restored river levels, and Toyota managed to implement cutbacks without affecting production, but it was a close call. If rains had not replenished the river, shortages could have severely reduced output.[3]

To account for uncertainty regarding the relative magnitude of impacts to farm and business operations, the following analysis employs the concept of elasticity. Elasticity is a number that shows how a change in one variable will affect another. In this case, it measures the relationship between a percentage reduction in water availability and a percentage reduction in output. For example, an elasticity of 1.0 indicates that a 1.0 percent reduction in water availability would result in a 1.0 percent reduction in economic output. An elasticity of 0.50 would indicate that for every 1.0 percent of unavailable water, output is reduced by 0.50 percent and so on. Output elasticities used in this study are:[4]

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[2] Royal, W. "*High And Dry - Industrial Centers Face Water Shortages*." in Industry Week, Sept, 2000.

[3] The efforts described above are not planned programmatic or long-term operational changes. They are emergency measures that individuals might pursue to alleviate what they consider a temporary condition. Thus, they are not characteristic of long-term management strategies designed to ensure more dependable water supplies such as capital investments in conservation technology or development of new water supplies.

[4] Elasticities are based on one of the few empirical studies that analyze potential relationships between economic output and water shortages in the United States. The study, conducted in California, showed that a significant number of industries would suffer reduced output during water shortages. Using a survey based approach researchers posed two scenarios to different industries. In

- if water needs are 0 to 5 percent of total water demand, no corresponding reduction in output is assumed;

- if water needs are 5 to 30 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 0.50 percent reduction in output;

- if water needs are 30 to 50 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 0.75 percent reduction in output; and

- if water needs are greater than 50 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 1.0 percent (i.e., a proportional reduction).

In some cases, elasticities are adjusted depending upon conditions specific to a given water user group.

Once output responses to water shortages were estimated, direct impacts to total sales, employment, regional income and business taxes were derived using regional level economic multipliers estimating using IO/SAM models. The formula for a given IMPLAN sector is:

$D_{i,t} = Q_{i,t} *_{,} S_{i,t} * E_Q * RFD_i * DM_{i(Q, L, I, T)}$

where:

$D_{i,t}$ = direct economic impact to sector *i* in period *t*

$Q_{i,t}$ = total sales for sector *i* in period *t* in an affected county

$RFD_{i,}$ = ratio of final demand to total sales for sector *i* for a given region

$S_{i,t}$ = water shortage as percentage of total water use in period *t*

E_Q = elasticity of output and water use

$DM_{i(L, I, T)}$ = direct output multiplier coefficients for labor (L), income (I) and taxes (T) for sector *i*.

Secondary impacts were derived using the same formula used to estimate direct impacts; however, indirect multiplier coefficients are used. Methods and assumptions specific to each water use sector are discussed in Sections 1.1.2 through 1.1.4.

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the first scenario, they asked how a 15 percent cutback in water supply lasting one year would affect operations. In the second scenario, they asked how a 30 percent reduction lasting one year would affect plant operations. In the case of a 15 percent shortage, reported output elasticities ranged from 0.00 to 0.76 with an average value of 0.25. For a 30 percent shortage, elasticities ranged from 0.00 to 1.39 with average of 0.47. For further information, see, California Urban Water Agencies, "*Cost of Industrial Water Shortages,*" Spectrum Economics, Inc. November, 1991.

General Assumptions and Clarification of the Methodology

As with any attempt to measure and quantify human activities at a societal level, assumptions are necessary and every model has limitations. Assumptions are needed to maintain a level of generality and simplicity such that models can be applied on several geographic levels and across different economic sectors. In terms of the general approach used here several clarifications and cautions are warranted:

1. Shortages as reported by regional planning groups are the starting point for socioeconomic analyses.

2. Estimated impacts are point estimates for years in which needs are reported (i.e., 2010, 2020, 2030, 2040, 2050 and 2060).They are independent and distinct "what if" scenarios for each particular year and water shortages are assumed to be temporary events resulting from severe drought conditions combined with infrastructure limitations. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals and resultant impacts are measured. Given, that reported figures are not cumulative in nature, it is inappropriate to sum impacts over the entire planning horizon. Doing so, would imply that the analysis predicts that drought of record conditions will occur every ten years in the future, which is not the case. Similarly, authors of this report recognize that in many communities needs are driven by population growth, and in the future total population will exceed the amount of water available due to infrastructure limitations, regardless of whether or not there is a drought. This implies that infrastructure limitations would constrain economic growth. However, since needs as defined by planning rules are based upon water supply and demand under the assumption of drought of record conditions, it improper to conduct economic analysis that focuses on growth related impacts over the planning horizon. Figures generated from such an analysis would presume a 50-year drought of record, which is unrealistic. Estimating lost economic activity related to constraints on population and commercial growth due to lack of water would require developing water supply and demand forecasts under "normal" or "most likely" future climatic conditions.

3. While useful for planning purposes, this study is not a benefit-cost analysis. Benefit cost analysis is a tool widely used to evaluate the economic feasibility of specific policies or projects as opposed to estimating economic impacts of unmet water needs. Nevertheless, one could include some impacts measured in this study as part of a benefit cost study if done so properly. Since this is not a benefit cost analysis, future impacts are not weighted differently. In other words, estimates are not discounted. If used as a measure of economic benefits, one should incorporate a measure of uncertainty into the analysis. In this type of analysis, a typical method of discounting future values is to assign probabilities of the drought of record recurring again in a given year, and weight monetary impacts accordingly. This analysis assumes a probability of one.

4. IO multipliers measure the strength of backward linkages to supporting industries (i.e., those who sell inputs to an affected sector). However, multipliers say nothing about forward linkages consisting of businesses that purchase goods from an affected sector for further processing. For example, ranchers in many areas sell most of their animals to local meat packers who process animals into a form that consumers ultimately see in grocery stores and restaurants. Multipliers do not capture forward linkages to meat packers, and since meat packers sell livestock purchased from ranchers as "final sales," multipliers for the ranching sector do fully account for all losses to a region's economy. Thus, as mentioned previously, in some cases closely linked sectors were moved from one water use category to another.

5. Cautions regarding interpretations of direct and secondary impacts are warranted. IO/SAM multipliers are based on "fixed-proportion production functions," which basically means that input use - including labor - moves in lockstep fashion with changes in levels of output. In a

scenario where output (i.e., sales) declines, losses in the immediate sector or supporting sectors could be much less than predicted by an IO/SAM model for several reasons. For one, businesses will likely expect to continue operating so they might maintain spending on inputs for future use; or they may be under contractual obligations to purchase inputs for an extended period regardless of external conditions. Also, employers may not lay-off workers given that experienced labor is sometimes scarce and skilled personnel may not be readily available when water shortages subside. Lastly people who lose jobs might find other employment in the region. As a result, direct losses for employment and secondary losses in sales and employment should be considered an upper bound. Similarly, since projected population losses are based on reduced employment in the region, they should be considered an upper bound as well.

6. IO models are static. Models and resultant multipliers are based upon the structure of the U.S. and regional economies in 2006. In contrast, water shortages are projected to occur well into the future. Thus, the analysis assumes that the general structure of the economy remains the same over the planning horizon, and the farther out into the future we go, this assumption becomes less reliable.

7. Impacts are annual estimates. If one were to assume that conditions persisted for more than one year, figures should be adjusted to reflect the extended duration. The drought of record in most regions of Texas lasted several years.

8. Monetary figures are reported in constant year 2006 dollars.

1.1.2 Impacts to Agriculture

Irrigated Crop Production

The first step in estimating impacts to irrigation required calculating gross sales for IMPLAN crop sectors. Default IMPLAN data do not distinguish irrigated production from dry-land production. Once gross sales were known other statistics such as employment and income were derived using IMPLAN direct multiplier coefficients. Gross sales for a given crop are based on two data sources:

1) county-level statistics collected and maintained by the TWDB and the USDA Farm Services Agency (FSA) including the number of irrigated acres by crop type and water application per acre, and

2) regional-level data published by the Texas Agricultural Statistics Service (TASS) including prices received for crops (marketing year averages), crop yields and crop acreages.

Crop categories used by the TWDB differ from those used in IMPLAN datasets. To maintain consistency, sales and other statistics are reported using IMPLAN crop classifications. Table 1 shows the TWDB crops included in corresponding IMPLAN sectors, and Table 2 summarizes acreage and estimated annual water use for each crop classification (five-year average from 2003-2007). Table 3 displays average (2003-2007) gross revenues per acre for IMPLAN crop categories.

Table 1: Crop Classifications Used in TWDB Water Use Survey and Corresponding IMPLAN Crop Sectors	
IMPLAN Category	**TWDB Category**
Oilseeds	Soybeans and “other oil crops”
Grains	Grain sorghum, corn, wheat and “other grain crops”
Vegetable and melons	“Vegetables” and potatoes
Tree nuts	Pecans
Fruits	Citrus, vineyard and other orchard
Cotton	Cotton
Sugarcane and sugar beets	Sugarcane and sugar beets
All “other” crops	“Forage crops”, peanuts, alfalfa, hay and pasture, rice and “all other crops”

Table 2: Summary of Irrigated Crop Acreage and Water Demand for the East Texas Regional Water Planning Area (average 2003-2007)

Sector	Acres (1000s)	Distribution of acres	Water use (1000s of AF)	Distribution of water use
Grains	<1	<1%	<1	<1%
Vegetable and melons	<1	3%	<1	<1%
Fruits	<1	<1%	<1%	<1%
Cotton	<1	2%	0.58	1%
Rice	22	93%	108	99%
Total	23	100%	109	100%

Source: Water demand figures are a 5- year average (2003-2007) of the TWDB’s annual Irrigation Water Use Estimates. Statistics for irrigated crop acreage are based upon annual survey data collected by the TWDB and the Farm Service Agency. Values do not include acreage or water use for the TWDB categories classified by the Farm Services Agency as “failed acres,” “golf course” or “waste water.”

Table 3: Average Gross Sales Revenues per Acre for Irrigated Crops for the East Texas Regional Water Planning Area (2003-2007)		
IMPLAN Sector	**Gross revenues per acre**	**Crops included in estimates**
Grains	$442	Based on five-year (2003-2007) average weighted by acreage for "irrigated grain sorghum," "irrigated corn", "irrigated wheat" and "irrigated 'other' grain crops."
Vegetable and melons	$6,184	Based on five-year (2003-2007) average weighted by acreage for "irrigated shallow and deep root vegetables", "irrigated Irish potatoes" and "irrigated melons."
Fruits	$3,502	Based on five-year (2003-2007) average weighted by acreage for "irrigated citrus", "irrigated vineyards" and "irrigated 'other' orchard."
Cotton	$400	Based on five-year (2003-2007) average weighted by acreage for "irrigated cotton."
All Other Crops	$500	Irrigated figure is based on five-year (2003-2007) average weighted by acreage for "irrigated 'forage' crops", "irrigated peanuts", "irrigated alfalfa", "irrigated 'hay' and pasture" and "irrigated 'all other' crops."
*Figures are rounded. Source: Based on data from the Texas Agricultural Statistics Service, Texas Water Development Board, and Texas A&M University.		

An important consideration when estimating impacts to irrigation was determining which crops are affected by water shortages. One approach is the so-called rationing model, which assumes that farmers respond to water supply cutbacks by fallowing the lowest value crops in the region first and the highest valued crops last until the amount of water saved equals the shortage.[5] For example, if farmer A grows vegetables (higher value) and farmer B grows wheat (lower value) and they both face a proportionate cutback in irrigation water, then farmer B will sell water to farmer A. Farmer B will fallow her irrigated acreage before farmer A fallows anything. Of course, this assumes that farmers can and do transfer enough water to allow this to happen. A different approach involves constructing farm-level profit maximization models that conform to widely-accepted economic theory that farmers make decisions based on marginal net returns. Such models have good predictive capability, but data requirements and complexity are high. Given that a detailed analysis for each region would require a substantial amount of farm-level data and analysis, the following investigation assumes that projected shortages are distributed equally across predominant crops in the region. Predominant in this case are crops that comprise at least one percent of total acreage in the region.

The following steps outline the overall process used to estimate direct impacts to irrigated agriculture:

1. *Distribute shortages across predominant crop types in the region*. Again, unmet water needs were distributed equally across crop sectors that constitute one percent or more of irrigated acreage.

2. *Estimate associated reductions in output for affected crop sectors*. Output reductions are based on elasticities discussed previously and on estimated values per acre for different crops. Values per acre stem from the same data used to estimate output for the year 2006 baseline. Using multipliers, we then generate estimates of forgone income, jobs, and tax revenues based on reductions in gross sales and final demand.

Livestock

The approach used for the livestock sector is basically the same as that used for crop production. As is the case with crops, livestock categorizations used by the TWDB differ from those used in IMPLAN datasets, and TWDB groupings were assigned to a given IMPLAN sector (Table 4). Then we:

1) *Distribute projected water needs equally among predominant livestock sectors and estimate lost output*: As is the case with irrigation, shortages are assumed to affect all livestock sectors equally; however, the category of "other" is not included given its small size. If water needs were small relative to total demands, we assume that producers would haul in water by truck to fill stock tanks. The cost per acre-foot ($24,000) is based on 2008 rates charged by various water haulers in Texas, and assumes that the average truck load is 6,500 gallons at a hauling distance of 60 miles.

3) *Estimate reduced output in forward processors for livestock sectors*. Reductions in output for livestock sectors are assumed to have a proportional impact on forward processors in the region such as meat packers. In other words, if the cows were gone, meat-packing plants or fluid milk manufacturers) would likely have little to process. This is not an unreasonable premise. Since the

[5] The rationing model was initially proposed by researchers at the University of California at Berkeley, and was then modified for use in a study conducted by the U.S. Environmental Protection Agency that evaluated how proposed water supply cutbacks recommended to protect water quality in the Bay/Delta complex in California would affect farmers in the Central Valley. See, Zilberman, D., Howitt, R. and Sunding, D. "*Economic Impacts of Water Quality Regulations in the San Francisco Bay and Delt*a." Western Consortium for Public Health. May 1993.

1950s, there has been a major trend towards specialized cattle feedlots, which in turn has decentralized cattle purchasing from livestock terminal markets to direct sales between producers and slaughterhouses. Today, the meat packing industry often operates large processing facilities near high concentrations of feedlots to increase capacity utilization.[6] As a result, packers are heavily dependent upon nearby feedlots. For example, a recent study by the USDA shows that on average meat packers obtain 64 percent of cattle from within 75 miles of their plant, 82 percent from within 150 miles and 92 percent from within 250 miles.[7]

Table 4: Description of Livestock Sectors

IMPLAN Category	TWDB Category
Cattle ranching and farming	Cattle, cow calf, feedlots and dairies
Poultry and egg production	Poultry production.
Other livestock	Livestock other than cattle and poultry (i.e., horses, goats, sheep, hogs)
Milk manufacturing	Fluid milk manufacturing, cheese manufacturing, ice cream manufacturing etc.
Meat packing	Meat processing present in the region from slaughter to final processing

1.1.3 Impacts to Municipal Water User Groups

Disaggregation of Municipal Water Demands

Estimating the economic impacts for the municipal water user groups is complicated for a number of reasons. For one, municipal use comprises a range of consumers including commercial businesses, institutions such as schools and government and households. However, reported water needs are not distributed among different municipal water users. In other words, how much of a municipal need is commercial and how much is residential (domestic)?

The amount of commercial water use as a percentage of total municipal demand was estimated based on "GED" coefficients (gallons per employee per day) published in secondary sources.[8] For example, if year 2006 baseline data for a given economic sector (e.g., amusement and recreation services) shows employment at 30 jobs and the GED coefficient is 200, then average daily water use by that sector is (30 x

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[6] Ferreira, W.N. "*Analysis of the Meat Processing Industry in the United States*." Clemson University Extension Economics Report ER211, January 2003.

[7] Ward, C.E. "*Summary of Results from USDA's Meatpacking Concentration Study*." Oklahoma Cooperative Extension Service, OSU Extension Facts WF-562.

[8] Sources for GED coefficients include: Gleick, P.H., Haasz, D., Henges-Jeck, C., Srinivasan, V., Wolff, G. Cushing, K.K., and Mann, A. "*Waste Not, Want Not*: *The Potential for Urban Water Conservation in California*." Pacific Institute. November 2003. U.S. Bureau of the Census. 1982 Census of Manufacturers: Water Use in Manufacturing. USGPO, Washington D.C. See also: "*U.S. Army Engineer Institute for Water Resources, IWR Report 88-R-6.*," Fort Belvoir, VA. See also, Joseph, E. S., 1982, "*Municipal and Industrial Water Demands of the Western United States*." Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, v. 108, no. WR2, p. 204-216. See also, Baumann, D. D., Boland, J. J., and Sims, J. H., 1981, "*Evaluation of Water Conservation for Municipal and Industrial Water Supply*." U.S. Army Corps of Engineers, Institute for Water Resources, Contract no. 82-C1.

200 = 6,000 gallons) or 6.7 acre-feet per year. Water not attributed to commercial use is considered domestic, which includes single and multi-family residential consumption, institutional uses and all use designated as "county-other." Based on our analysis, commercial water use is about 5 to 35 percent of municipal demand. Less populated rural counties occupy the lower end of the spectrum, while larger metropolitan counties are at the higher end.

After determining the distribution of domestic versus commercial water use, we developed methods for estimating impacts to the two groups.

Domestic Water Uses

Input output models are not well suited for measuring impacts of shortages for domestic water uses, which make up the majority of the municipal water use category. To estimate impacts associated with domestic water uses, municipal water demand and needs are subdivided into residential, and commercial and institutional use. Shortages associated with residential water uses are valued by estimating proxy demand functions for different water user groups allowing us to estimate the marginal value of water, which would vary depending upon the level of water shortages. The more severe the water shortage, the more costly it becomes. For instance, a 2 acre-foot shortage for a group of households that use 10 acre-feet per year would not be as severe as a shortage that amounted to 8 acre-feet. In the case of a 2 acre-foot shortage, households would probably have to eliminate some or all outdoor water use, which could have implicit and explicit economic costs including losses to the horticultural and landscaping industry. In the case of an 8 acre-foot shortage, people would have to forgo all outdoor water use and most indoor water consumption. Economic impacts would be much higher in the latter case because people, and would be forced to find emergency alternatives assuming alternatives were available.

To estimate the value of domestic water uses, TWDB staff developed marginal loss functions based on constant elasticity demand curves. This is a standard and well-established method used by economists to value resources such as water that have an explicit monetary cost.

A constant price elasticity of demand is estimated using a standard equation:

$w = kc^{(-\varepsilon)}$

where:

- w is equal to average monthly residential water use for a given water user group measured in thousands of gallons;
- k is a constant intercept;
- c is the average cost of water per 1,000 gallons; and
- ε is the price elasticity of demand.

Price elasticities (-0.30 for indoor water use and -0.50 for outdoor use) are based on a study by Bell et al.[9] that surveyed 1,400 water utilities in Texas that serve at least 1,000 people to estimate demand elasticity for several variables including price, income, weather etc. Costs of water and average use per month per household are based on data from the Texas Municipal League's annual water and

[9] Bell, D.R. and Griffin, R.C. "*Community Water Demand in Texas as a Century is Turned*." Research contract report prepared for the Texas Water Development Board. May 2006.

wastewater rate surveys - specifically average monthly household expenditures on water and wastewater in different communities across the state. After examining variance in costs and usage, three different categories of water user groups based on population (population less than 5,000, cities with populations ranging from 5,000 to 99,999 and cities with populations exceeding 100,000) were selected to serve as proxy values for municipal water groups that meet the criteria (Table 5).[10]

Table 5: Water Use and Costs Parameters Used to Estimated Water Demand Functions (average monthly costs per acre-foot for delivered water and average monthly use per household)

Community Population	Water	Wastewater	Total monthly cost	Avg. monthly use (gallons)
Less than or equal to 5,000	$1,335	$1,228	$2,563	6,204
5,000 to 100,000	$1,047	$1,162	$2,209	7,950
Great than or equal to 100,000	$718	$457	$1,190	8,409

Source: Based on annual water and wastewater rate surveys published by the Texas Municipal League.

As an example, Table 6 shows the economic impact per acre-foot of domestic water needs for municipal water user groups with population exceeding 100,000 people. There are several important assumptions incorporated in the calculations:

1) Reported values are net of the variable costs of treatment and distribution such as expenses for chemicals and electricity since using less water involves some savings to consumers and utilities alike; and for outdoor uses we do not include any value for wastewater.

2) Outdoor and "non-essential" water uses would be eliminated before indoor water consumption was affected, which is logical because most water utilities in Texas have drought contingency plans that generally specify curtailment or elimination of outdoor water use during droughts.[11] Determining how much water is used for outdoor purposes is based on several secondary sources. The first is a major study sponsored by the American Water Works Association, which surveyed cities in states including Colorado, Oregon, Washington, California, Florida and Arizona. On average across all cities surveyed 58 percent of single family residential water use was for outdoor activities. In cities with climates comparable to large metropolitan areas of Texas, the average was 40 percent.[12] Earlier findings of the U.S. Water Resources Council showed a national

[10] Ideally, one would want to estimate demand functions for each individual utility in the state. However, this would require an enormous amount of time and resources. For planning purposes, we believe the values generated from aggregate data are more than sufficient.

[11] In Texas, state law requires retail and wholesale water providers to prepare and submit plans to the Texas Commission on Environmental Quality (TCEQ). Plans must specify demand management measures for use during drought including curtailment of "non-essential water uses." Non-essential uses include, but are not limited to, landscape irrigation and water for swimming pools or fountains. For further information see the Texas Environmental Quality Code §288.20.

[12] See, Mayer, P.W., DeOreo, W.B., Opitz, E.M., Kiefer, J.C., Davis, W., Dziegielewski, D., Nelson, J.O. "*Residential End Uses of Water*." Research sponsored by the American Water Works Association and completed by Aquacraft, Inc. and Planning and Management Consultants, Ltd. (PMCL@CDM).

average of 33 percent. Similarly, the United States Environmental Protection Agency (USEPA) estimated that landscape watering accounts for 32 percent of total residential and commercial water use on annual basis.[13] A study conducted for the California Urban Water Agencies (CUWA) calculated average annual values ranging from 25 to 35 percent.[14] Unfortunately, there does not appear to be any comprehensive research that has estimated non-agricultural outdoor water use in Texas. As an approximation, an average annual value of 30 percent based on the above references was selected to serve as a rough estimate in this study.

3) As shortages approach 100 percent values become immense and theoretically infinite at 100 percent because at that point death would result, and willingness to pay for water is immeasurable. Thus, as shortages approach 80 percent of monthly consumption, we assume that households and non-water intensive commercial businesses (those that use water only for drinking and sanitation would have water delivered by tanker truck or commercial water delivery companies. Based on reports from water companies throughout the state, we estimate that the cost of trucking in water is around $21,000 to $27,000 per acre-feet assuming a hauling distance of between 20 to 60 miles. This is not an unreasonable assumption. The practice was widespread during the 1950s drought and recently during droughts in this decade. For example, in 2000 at the heels of three consecutive drought years Electra - a small town in North Texas - was down to its last 45 days worth of reservoir water when rain replenished the lake, and the city was able to refurbish old wells to provide supplemental groundwater. At the time, residents were forced to limit water use to 1,000 gallons per person per month - less than half of what most people use - and many were having water delivered to their homes by private contractors.[15] In 2003 citizens of Ballinger, Texas, were also faced with a dwindling water supply due to prolonged drought. After three years of drought, Lake Ballinger, which supplies water to more than 4,300 residents in Ballinger and to 600 residents in nearby Rowena, was almost dry. Each day, people lined up to get water from a well in nearby City Park. Trucks hauling trailers outfitted with large plastic and metal tanks hauled water to and from City Park to Ballinger.[16]

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[13] U.S. Environmental Protection Agency. *"Cleaner Water through Conservation*." USEPA Report no. 841-B-95-002. April, 1995.

[14] Planning and Management Consultants, Ltd. "*Evaluating Urban Water Conservation Programs: A Procedures Manual*." Prepared for the California Urban Water Agencies. February 1992.

[15] Zewe, C. "*Tap Threatens to Run Dry in Texas Town*." July 11, 2000. CNN Cable News Network.

[16] Associated Press, "*Ballinger Scrambles to Finish Pipeline before Lake Dries Up*." May 19, 2003.

Table 6: Economic Losses Associated with Domestic Water Shortages in Communities with Populations Exceeding 100,000 people				
Water shortages as a percentage of total monthly household demands	**No. of gallons remaining per household per day**	**No of gallons remaining per person per day**	**Economic loss (per acre-foot)**	**Economic loss (per gallon)**
1%	278	93	$748	$0.00005
5%	266	89	$812	$0.0002
10%	252	84	$900	$0.0005
15%	238	79	$999	$0.0008
20%	224	75	$1,110	$0.0012
25%	210	70	$1,235	$0.0015
30%[a]	196	65	$1,699	$0.0020
35%	182	61	$3,825	$0.0085
40%	168	56	$4,181	$0.0096
45%	154	51	$4,603	$0.011
50%	140	47	$5,109	$0.012
55%	126	42	$5,727	$0.014
60%	112	37	$6,500	$0.017
65%	98	33	$7,493	$0.02
70%	84	28	$8,818	$0.02
75%	70	23	$10,672	$0.03
80%	56	19	$13,454	$0.04
85%	42	14	$18,091 ($24,000)[b]	$0.05 ($0.07)[b]
90%	28	9	$27,363 ($24,000)	$0.08 ($0.07)
95%	14	5	$55,182 ($24,000)	$0.17 ($0.07)
99%	3	0.9	$277,728 ($24,000)	$0.85 ($0.07)
99.9%	1	0.5	$2,781,377 ($24,000)	$8.53 ($0.07)
100%	0	0	Infinite ($24,000)	Infinite ($0.07)

[a] The first 30 percent of needs are assumed to be restrictions of outdoor water use; when needs reach 30 percent of total demands all outdoor water uses would be restricted. Needs greater than 30 percent include indoor use

[b] As shortages approach 100 percent the value approaches infinity assuming there are not alternatives available; however, we assume that communities would begin to have water delivered by tanker truck at an estimated cost of $24,000 per acre-foot when shortages breached 85 percent.

Commercial Businesses

Effects of water shortages on commercial sectors were estimated in a fashion similar to other business sectors meaning that water shortages would affect the ability of these businesses to operate. This is particularly true for “water intensive” commercial sectors that are need large amounts of water (in addition to potable and sanitary water) to provide their services. These include:

- car-washes,
- laundry and cleaning facilities,
- sports and recreation clubs and facilities including race tracks,
- amusement and recreation services,
- hospitals and medical facilities,
- hotels and lodging places, and
- eating and drinking establishments.

A key assumption is that commercial operations would not be affected until water shortages were at least 50 percent of total municipal demand. In other words, we assume that residential water consumers would reduce water use including all non-essential uses before businesses were affected.

An example will illustrate the breakdown of municipal water needs and the overall approach to estimating impacts of municipal needs. Assume City A experiences an unexpected shortage of 50 acre-feet per year when their demands are 200 acre-feet per year. Thus, shortages are only 25 percent of total municipal use and residents of City A could eliminate needs by restricting landscape irrigation. City B, on the other hand, has a deficit of 150 acre-feet in 2020 and a projected demand of 200 acre-feet. Thus, total shortages are 75 percent of total demand. Emergency outdoor and some indoor conservation measures could eliminate 50 acre-feet of projected needs, yet 50 acre-feet would still remain. To eliminate” the remaining 50 acre-feet water intensive commercial businesses would have to curtail operations or shut down completely.

Three other areas were considered when analyzing municipal water shortages: 1) lost revenues to water utilities, 2) losses to the horticultural and landscaping industries stemming for reduction in water available for landscape irrigation, and 3) lost revenues and related economic impacts associated with reduced water related recreation.

Water Utility Revenues

Estimating lost water utility revenues was straightforward. We relied on annual data from the “*Water and Wastewater Rate Survey*” published annually by the Texas Municipal League to calculate an average value per acre-foot for water and sewer. For water revenues, average retail water and sewer rates multiplied by total water needs served as a proxy. For lost wastewater, total unmet needs were adjusted for return flow factor of 0.60 and multiplied by average sewer rates for the region. Needs reported as “county-other” were excluded under the presumption that these consist primarily of self-supplied water uses. In addition, 15 percent of water demand and needs are considered non-billed or “unaccountable” water that comprises things such as leakages and water for municipal government functions (e.g., fire departments). Lost tax receipts are based on current rates for the “miscellaneous gross receipts tax, “which the state collects from utilities located in most incorporated cities or towns in Texas. We do not include lost water utility revenues when aggregating impacts of municipal water shortages to regional and state levels to prevent double counting.

Horticultural and Landscaping Industry

The horticultural and landscaping industry, also referred to as the "green Industry," consists of businesses that produce, distribute and provide services associated with ornamental plants, landscape and garden supplies and equipment. Horticultural industries often face big losses during drought. For example, the recent drought in the Southeast affecting the Carolinas and Georgia horticultural and landscaping businesses had a harsh year. Plant sales were down, plant mortality increased, and watering costs increased. Many businesses were forced to close locations, lay off employees, and even file for bankruptcy. University of Georgia economists put statewide losses for the industry at around $3.2 billion during the 3-year drought that ended in 2008.[17] Municipal restrictions on outdoor watering play a significant role. During drought, water restrictions coupled with persistent heat has a psychological effect on homeowners that reduces demands for landscaping products and services. Simply put, people were afraid to spend any money on new plants and landscaping.

In Texas, there do not appear to be readily available studies that analyze the economic effects of water shortages on the industry. However, authors of this report believe negative impacts do and would result in restricting landscape irrigation to municipal water consumers. The difficulty in measuring them is two-fold. First, as noted above, data and research for these types of impacts that focus on Texas are limited; and second, economic data provided by IMPLAN do not disaggregate different sectors of the green industry to a level that would allow for meaningful and defensible analysis.[18]

Recreational Impacts

Recreational businesses often suffer when water levels and flows in rivers, springs and reservoirs fall significantly during drought. During droughts, many boat docks and lake beaches are forced to close, leading to big losses for lakeside business owners and local communities. Communities adjacent to popular river and stream destinations such as Comal Springs and the Guadalupe River also see their business plummet when springs and rivers dry up. Although there are many examples of businesses that have suffered due to drought, dollar figures for drought-related losses to the recreation and tourism industry are not readily available, and very difficult to measure without extensive local surveys. Thus, while they are important, economic impacts are not measured in this study.

Table 7 summarizes impacts of municipal water shortages at differing levels of magnitude, and shows the ranges of economic costs or losses per acre-foot of shortage for each level.

[17] Williams, D. *"Georgia landscapers eye rebound from Southeast drought."* Atlanta Business Chronicle, Friday, June 19, 2009

[18] Economic impact analyses prepared by the TWDB for 2006 regional water plans did include estimates for the horticultural industry. However, year 2000 and prior IMPLAN data were disaggregated to a finer level. In the current dataset (2006), the sector previously listed as "Landscaping and Horticultural Services" (IMPLAN Sector 27) is aggregated into "Services to Buildings and Dwellings" (IMPLAN Sector 458).

Table 7: Impacts of Municipal Water Shortages at Different Magnitudes of Shortages		
Water shortages as percent of total municipal demands	Impacts	Economic costs per acre-foot*
0-30%	✓ Lost water utility revenues ✓ Restricted landscape irrigation and non-essential water uses	$730 - $2,040
30-50%	✓ Lost water utility revenues ✓ Elimination of landscape irrigation and non-essential water uses ✓ Rationing of indoor use	$2,040 - $10,970
>50%	✓ Lost water utility revenues ✓ Elimination of landscape irrigation and non-essential water uses ✓ Rationing of indoor use ✓ Restriction or elimination of commercial water use ✓ Importing water by tanker truck	$10,970 - varies
*Figures are rounded		

1.1.4 Industrial Water User Groups

Manufacturing

Impacts to manufacturing were estimated by distributing water shortages among industrial sectors at the county level. For example, if a planning group estimates that during a drought of record water supplies in County A would only meet 50 percent of total annual demands for manufactures in the county, we reduced output for each sector by 50 percent. Since projected manufacturing demands are based on TWDB Water Uses Survey data for each county, we only include IMPLAN sectors represented in the TWBD survey database. Some sectors in IMPLAN databases are not part of the TWDB database given that they use relatively small amounts of water - primarily for on-site sanitation and potable purposes. To maintain consistency between IMPLAN and TWDB databases, Standard Industrial Classification (SIC) codes both databases were cross referenced in county with shortages. Non-matches were excluded when calculating direct impacts.

Mining

The process of mining is very similar to that of manufacturing. We assume that within a given county, shortages would apply equally to relevant mining sectors, and IMPLAN sectors are cross referenced with TWDB data to ensure consistency.

In Texas, oil and gas extraction and sand and gravel (aggregates) operations are the primary mining industries that rely on large volumes of water. For sand and gravel, estimated output reductions are straightforward; however, oil and gas is more complicated for a number of reasons. IMPLAN does not necessarily report the physical extraction of minerals by geographic local, but rather the sales revenues reported by a particular corporation.

For example, at the state level revenues for IMPLAN sector 19 (oil and gas extraction) and sector 27 (drilling oil and gas wells) totals $257 billion. Of this, nearly $85 billion is attributed to Harris County. However, only a very small fraction (less than one percent) of actual production takes place in the county. To measure actual potential losses in well head capacity due to water shortages, we relied on county level production data from the Texas Railroad Commission (TRC) and average well-head market prices for crude and gas to estimate lost revenues in a given county. After which, we used to IMPLAN ratios to estimate resultant losses in income and employment.

Other considerations with respect to mining include:

1) Petroleum and gas extraction industry only uses water in significant amounts for secondary recovery. Known in the industry as enhanced or water flood extraction, secondary recovery involves pumping water down injection wells to increase underground pressure thereby pushing oil or gas into other wells. IMPLAN output numbers do not distinguish between secondary and non-secondary recovery. To account for the discrepancy, county-level TRC data that show the proportion of barrels produced using secondary methods were used to adjust IMPLAN data to reflect only the portion of sales attributed to secondary recovery.

2) A substantial portion of output from mining operations goes directly to businesses that are classified as manufacturing in our schema. Thus, multipliers measuring backward linkages for a given manufacturer might include impacts to a supplying mining operation. Care was taken not to double count in such situations if both a mining operation and a manufacturer were reported as having water shortages.

Steam-electric

At minimum without adequate cooling water, power plants cannot safely operate. As water availability falls below projected demands, water levels in lakes and rivers that provide cooling water would also decline. Low water levels could affect raw water intakes and outfalls at electrical generating units in several ways. For one, power plants are regulated by thermal emission guidelines that specify the maximum amount of heat that can go back into a river or lake via discharged cooling water. Low water levels could result in permit compliance issues due to reduced dilution and dispersion of heat and subsequent impacts on aquatic biota near outfalls.[19] However, the primary concern would be a loss of head (i.e., pressure) over intake structures that would decrease flows through intake tunnels. This would affect safety related pumps, increase operating costs and/or result in sustained shut-downs. Assuming plants did shutdown, they would not be able to generate electricity.

[19] Section 316 (b) of the Clean Water Act requires that thermal wastewater discharges do not harm fish and other wildlife.

Among all water use categories steam-electric is unique and cautions are needed when applying methods used in this study. Measured changes to an economy using input-output models stem directly from changes in sales revenues. In the case of water shortages, one assumes that businesses will suffer lost output if process water is in short supply. For power generation facilities this is true as well. However, the electric services sector in IMPLAN represents a corporate entity that may own and operate several electrical generating units in a given region. If one unit became inoperable due to water shortages, plants in other areas or generation facilities that do not rely heavily on water such as gas powered turbines might be able to compensate for lost generating capacity. Utilities could also offset lost production via purchases on the spot market.[20] Thus, depending upon the severity of the shortages and conditions at a given electrical generating unit, energy supplies for local and regional communities could be maintained. But in general, without enough cooling water, utilities would have to throttle back plant operations, forcing them to buy or generate more costly power to meet customer demands.

Measuring impacts end users of electricity is not part of this study as it would require extensive local and regional level analysis of energy production and demand. To maintain consistency with other water user groups, impacts of steam-electric water shortages are measured in terms of lost revenues (and hence income) and jobs associated with shutting down electrical generating units.

1.2 Social Impacts of Water Shortages

As the name implies, the effects of water shortages can be social or economic. Distinctions between the two are both semantic and analytical in nature – more so analytic in the sense that social impacts are harder to quantify. Nevertheless, social effects associated with drought and water shortages are closely tied to economic impacts. For example, they might include:

- demographic effects such as changes in population,
- disruptions in institutional settings including activity in schools and government,
- conflicts between water users such as farmers and urban consumers,
- health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations),
- mental and physical stress (e.g., anxiety, depression, domestic violence),
- public safety issues from forest and range fires and reduced fire fighting capability,
- increased disease caused by wildlife concentrations,
- loss of aesthetic and property values, and
- reduced recreational opportunities.[21]

[20] Today, most utilities participate in large interstate "power pools" and can buy or sell electricity "on the grid" from other utilities or power marketers. Thus, assuming power was available to buy, and assuming that no contractual or physical limitations were in place such as transmission constraints; utilities could offset lost power that resulted from waters shortages with purchases via the power grid.

[21] Based on information from the website of the National Drought Mitigation Center at the University of Nebraska Lincoln. Available online at: http://www.drought.unl.edu/risk/impacts.htm. See also, Vanclay, F. "*Social Impact Assessment*." in Petts, J. (ed) International Handbook of Environmental Impact Assessment. 1999.

Social impacts measured in this study focus strictly on demographic effects including changes in population and school enrollment. Methods are based on demographic projection models developed by the Texas State Data Center and used by the TWDB for state and regional water planning. Basically, the social impact model uses results from the economic component of the study and assesses how changes in labor demand would affect migration patterns in a region. Declines in labor demand as measured using adjusted IMPLAN data are assumed to affect net economic migration in a given regional water planning area. Employment losses are adjusted to reflect the notion that some people would not relocate but would seek employment in the region and/or public assistance and wait for conditions to improve. Changes in school enrollment are simply the proportion of lost population between the ages of 5 and 17.

2. Results

Section 2 presents the results of the analysis at the regional level. Included are baseline economic data for each water use category, and estimated economics impacts of water shortages for water user groups with reported deficits. According to the 2011 *Rio Grande Regional Water Plan*, during severe drought irrigation, livestock, municipal, manufacturing, mining and steam-electric water user groups would experience water shortages in the absence of new water management strategies.

2.1 Overview of Regional Economy

On an annual basis, the East Texas regional economy generates $34 billion in gross state product for Texas ($32 billion in income and $2 billion worth of business taxes) and supports 481,393 jobs (Table 8). Generating about $12 billion worth of income per year, agriculture, manufacturing, and mining are the primary base economic sectors in the region.[22] Municipal sectors also generate substantial amounts of income and are major employers. However, while municipal sectors are the largest employer and source of wealth, many businesses that make up the municipal category such as restaurants and retail stores are non-basic industries meaning they exist to provide services to people who work would in base industries such as manufacturing, agriculture and mining. In other words, without base industries such agriculture, many municipal jobs in the region would not exist.

[22] Base industries are those that supply markets outside of the region. These industries are crucial to the local economy and are called the economic base of a region. Appendix A shows how IMPLAN's 529 sectors were allocated to water use category, and shows economic data for each sector.

Table 8: The East Texas Regional Economy by Water User Group ($millions)*						
Water Use Category	Total sales	Intermediate sales	Final sales	Jobs	Income	Business taxes
Irrigation	$78.03	$8.73	$69.30	618	$20.24	$0.85
Livestock	$2,637.85	$1,339.95	$1,297.90	16,521	$499.23	$21.09
Manufacturing	$62,475.81	$19,826.73	$42,649.08	80,609	$9,096.38	$255.38
Mining	$3,693.95	$1,475.81	$2,218.13	7,862	$1,831.54	$200.96
Steam-electric	$990.40	$278.62	$711.78	1,893	$687.65	$117.45
Municipal	$33,562.37	$9,053.48	$24,508.89	373,890	$19,618.82	$1,723.75
Regional total	$103,438.41	$31,983.32	$71,455.08	481,393	$31,753.86	$2,319.48

[a] Appendix 1 displays data for individual IMPLAN sectors that make up each water use category. Based on data from the Texas Water Development Board, and year 2006 data from the Minnesota IMPLAN Group, Inc.

2.2 Impacts of Agricultural Water Shortages

According to the 2011 *East Texas Regional Water Plan*, during severe drought the counties of Hardin, Houston, San Augustine and Smith would experiences shortages of irrigation water. In 2010, shortages range from about 1 to 48 percent of annual irrigation demands, and farmers would be short nearly 1,675 acre-feet in 2010 and nearly 3,420 acre-feet in 2060. Shortages of these magnitudes would reduce gross state product (income plus state and local business taxes) by less than $1 million per year in each decade.

Table 9: Economic Impacts of Water Shortages for Irrigation Water User Groups ($millions)			
Decade	Lost income from reduced crop production [a]	Lost state and local tax revenues from reduced crop production	Lost jobs from reduced crop production
2010	$0.18	$0.03	2
2020	$0.19	$0.03	2
2030	$0.23	$0.03	2
2040	$0.40	$0.04	2
2050	$0.48	$0.05	2
2060	$0.57	$0.05	3

*Changes to income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

Shortages for livestock producers are reported for Angelina, Henderson, Houston, Nacogdoches, Sabine, San Augustine, and Shelby counties. Shortages of these magnitudes would reduce gross state product (income plus state and local business taxes) by $14 million per year in 2010, and $551 million in 2060 (Table 10).

Table 10: Economic Impacts of Water Shortages for Livestock Water User Groups ($millions)[a]

Decade	Lost income from reduced livestock production[b]	Lost state and local tax revenues from reduced livestock production	Lost jobs from reduced livestock crop production
2010	$13.22	$0.60	124
2020	$53.29	$2.43	500
2030	$92.78	$4.23	873
2040	$266.31	$12.12	2,495
2050	$390.77	$17.79	3,660
2060	$527.74	$24.02	4,942

[a] Includes impacts to forward processors (meat packing and poultry processing).

[b] Changes to income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.3 Impacts of Municipal Water Shortages

Water shortages are projected to occur in a significant number of communities in the region. Deficits range from approximately 1 to roughly 75 percent of total annual water use. At the regional level, the estimated economic value of domestic water shortages totals $19 million in 2010 and $157 million in 2060 (Table 11). Due to curtailment of commercial business activity operation, municipal shortages would reduce gross state product (income plus taxes) by an estimated $34 million in 2020 and $162 million in 2060.

Table 11: Economic Impacts of Water Shortages for Municipal Water User Groups ($millions)					
Decade	Monetary value of domestic water shortages	Lost income from reduced commercial business activity*	Lost state and local taxes from reduced commercial business activity	Lost jobs from reduced commercial business activity	Lost water utility revenues
2010	$19.03	$0.00	$0.00	0	$6.16
2020	$65.60	$33.91	$3.61	754	$10.21
2030	$84.52	$42.30	$4.50	941	$12.92
2040	$102.76	$51.89	$5.53	1,156	$16.54
2050	$193.14	$129.22	$13.84	2,898	$22.23
2060	$162.16	$162.23	$17.55	3,683	$29.75

*Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.4 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in Angelina, Henderson, Houston, Nacogdoches, Sabine, San Augustine, and Shelby counties. In 2010, the East Texas planning group estimates that these manufacturers would be short about 3,400 acre-feet; and by 2060, this figure increases to nearly 50,000 acre-feet. Shortages of these magnitudes would reduce gross state product (income plus taxes) by an estimated $41 million in 2010 and $1.2 billion in 2060 (Table 12).

Table 12: Economic Impacts of Water Shortages for Manufacturing Water User Groups ($millions)			
Decade	Lost income due to reduced manufacturing output	Lost state and local business tax revenues due to reduced manufacturing output	Lost jobs due to reduced manufacturing output
2010	$40.43	$1.28	79
2020	$292.52	$9.01	651
2030	$397.41	$12.09	1,114
2040	$878.32	$26.94	2,038
2050	$1,026.90	$31.44	2,516
2060	$1,188.24	$36.33	3,046

*Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.5 Impacts of Mining Water Shortages

Ming water shortages in Region I are projected to occur in San Augustine, Angelina, Jefferson, Nacogdoches, Newton and Rusk counties, and would primarily affect extraction of gas in the Haynesville shale formation. Combined shortages for each county would result in estimated losses in gross state product totaling $1.2 billion dollars in 2010, and about $900 million 2060 (Table 13).

Table 13: Economic Impacts of Water Shortages for Mining Water User Groups ($millions)

Decade	Lost income due to reduced mining output	Lost state and local business tax revenues due to reduced mining output	Lost jobs due to reduced mining output
2010	$1,105.82	$99.40	8,178
2020	$2,226.70	$222.67	16,468
2030	$701.19	$70.12	5,186
2040	$749.60	$74.96	5,544
2050	$797.20	$79.72	5,896
2060	$834.13	$83.41	6,169

*Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.6 Impacts of Steam-electric Water Shortages

Water shortages for electrical generating units are projected to occur in Anderson, Angelina, Jefferson, Nacogdoches, Newton, and Rusk counties, and would result in estimated losses of gross state product totaling $119 million dollars in 2020, and $3.7 billion 2060 (Table 14).

Table 14: Economic Impacts of Water Shortages for Steam-electric Water User Groups ($millions)			
Decade	Lost income due to reduced electrical generation	Lost state and local business tax revenues due to reduced electrical generation	Lost jobs due to reduced electrical generation
2010	$104.61	$15.01	356
2020	$640.67	$91.96	2,178
2030	$853.57	$122.52	2,902
2040	$1,662.28	$238.59	5,651
2050	$2,682.62	$385.05	9,119
2060	$3,244.45	$465.69	11,029

*Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.7 Social Impacts of Water Shortages

As discussed previously, estimated social impacts focus on changes in population and school enrollment in the region. In 2010, estimated population losses total 10,511 with corresponding reductions in school enrollment of 2,965 students (Table 15). In 2060, population in the region would decline by 34,773 and school enrollment would fall by 9,865.

Table 15: Social Impacts of Water Shortages (2010-2060)		
Year	Population Losses	Declines in School Enrollment
2010	10,511	2,965
2020	24,754	7,023
2030	13,269	3,764
2040	20,337	5,770
2050	29,015	8,232
2060	34,773	9,865

2.8 Distribution of Impacts by Major River Basin

Administrative rules require that impacts are presented by both planning region and major river basin. To meet rule requirements, impacts were allocated among basins based on the distribution of water shortages in relevant basins. For example, if 50 percent of water shortages in River Basin A and 50 percent occur in River Basin B, then impacts were split equally among the two basins. Table 16 displays the results.

Table 16: Distribution of Impacts by Major River Basin (2010-2060)						
Water Use	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Irrigation						
Neches	100%	100%	90%	82%	76%	70%
Trinity	0%	0%	10%	18%	24%	30%
Livestock						
Neches	48%	36%	38%	38%	39%	38%
Sabine	52%	61%	57%	56%	56%	56%
Trinity	<1%	4%	5%	5%	6%	5%
Manufacturing						
Neches	93%	66%	54%	48%	45%	42%
Sabine	6%	33%	45%	51%	54%	57%
Trinity	<1%	<1%	<1%	<1%	<1%	<1%
Mining						
Neches	>99%	>99%	>99%	>99%	99%	99%
Neches-Trinity	0%	0%	0%	0%	<1%	<1%
Sabine	0%	0%	0%	<1%	1%	1%
Trinity	<1%	<1%	<1%	<1%	<1%	<1%
Municipal						
Neches	96%	96%	96%	96%	97%	97%
Sabine	4%	4%	4%	4%	3%	3%
Trinity	<1%	<1%	<1%	<1%	<1%	<1%
Steam-electric						
Neches	100%	100%	93%	88%	84%	73%
Sabine	0%	0%	7%	12%	16%	27%

Appendix 1: Economic Data for Individual IMPLAN Sectors for the East Texas Regional Water Planning Area

Economic Data for Agricultural Water User Groups ($millions)									
Water Use Category	**IMPLAN Sector**	**IMPLAN Code**	**Total Sales**	**Intermediate Sales**	**Final Sales**	**Jobs**	**Income**	**Business Taxes**
Irrigation	Rice milling	49	$52.89	$0.40	$52.48	88	$6.26	$0.38
Irrigation	Rice	10	$11.49	$7.41	$4.08	164	$5.62	$0.22
Irrigation	Fruit Farming	5	$9.66	$0.81	$8.86	269	$5.53	$0.21
Irrigation	Vegetable and Melon Farming	3	$3.72	$0.10	$3.62	92	$2.73	$0.04
Irrigation	Cotton Farming	8	$0.22	$0	$0.22	3	$0.08	$0.00
Irrigation	Grain Farming	2	$0.05	$0.01	$0.04	2	$0.02	$0.00
	Total irrigation		**$78.03**	**$8.73**	**$69.30**	**618**	**$20.24**	**$0.85**
Livestock	Poultry processing	70	$1,085.13	$345.26	$739.86	4,772	$171.09	$7.77
Livestock	Poultry and egg production	12	$746.27	$584.87	$161.39	2,459	$251.12	$2.53
Livestock	Meat processed from carcasses	68	$380.67	$112.30	$268.36	867	$42.62	$2.18
Livestock	Cattle ranching and farming	11	$378.89	$262.72	$116.17	6,997	$29.93	$7.96
Livestock	Animal production- except cattle and poultry	13	$38.71	$32.82	$5.89	1,412	$3.76	$0.60
Livestock	Fluid milk manufacturing	62	$8.19	$1.97	$6.22	14	$0.71	$0.04
	Total livestock		**$2,637.85**	**$1,339.95**	**$1,297.90**	**16,521**	**$499.23**	**$21.09**
	Total agriculture		**$2,715.88**	**$1,348.69**	**$1,367.20**	**17,139**	**$519.46**	**$21.93**
Based on year 2006 data from the Minnesota IMPLAN Group, Inc.								

Economic Data for Mining and Steam-electric Water User Groups ($millions)								
Water Use Category	**IMPLAN Sector**	**IMPLAN Code**	**Total Sales**	**Intermediate Sales**	**Final Sales**	**Jobs**	**Income**	**Business Taxes**
Mining	Drilling oil and gas wells	27	$1,443.30	$7.20	$1,436.09	2,304	$419.03	$55.25
Mining	Oil and gas extraction	19	$1,377.01	$1,278.81	$98.20	1,902	$791.16	$84.41
Mining	Support activities for oil and gas operations	28	$532.90	$74.02	$458.88	2,706	$482.88	$22.17
Mining	Coal mining	20	$298.50	$111.86	$186.64	734	$115.80	$37.78
Mining	Sand- gravel- clay- and refractory mining	25	$20.75	$2.19	$18.56	138	$12.09	$0.62
Mining	Other nonmetallic mineral mining	26	$11.66	$1.17	$10.50	36	$6.17	$0.44
Mining	Stone mining and quarrying	24	$5.57	$0.57	$5.00	29	$3.07	$0.07
Mining	Iron ore mining	21	$4.26	-$0.01	$4.27	13	$1.34	$0.23
	Total mining		**$3,693.95**	**$1,475.81**	**$2,218.13**	**7,862**	**$1,831.54**	**$200.96**
Steam-electric	**Power generation and supply**	**30**	**$990.40**	**$278.62**	**$711.78**	**1,893**	**$687.65**	**$117.45**
Based on year 2006 data from the Minnesota IMPLAN Group, Inc.								

Economic Data for Manufacturing Water User Groups ($millions)									
Water Use Category	**IMPLAN Sector**	**IMPLAN Code**	**Total Sales**	**Intermediate Sales**	**Final Sales**	**Jobs**	**Income**	**Business Taxes**
Manufacturing	Petroleum refineries	142	$35,420.78	$13,165.92	$22,254.85	4,227	$1,693.35	$71.73
Manufacturing	Petrochemical manufacturing	147	$7,340.32	$3,363.10	$3,977.22	903	$823.05	$46.91
Manufacturing	New residential 1-unit structures- all	33	$1,488.13	$0.00	$1,488.13	9,677	$519.58	$8.18
Manufacturing	Plastics material and resin manufacturing	152	$1,297.60	$51.39	$1,246.21	902	$248.53	$8.15
Manufacturing	Paper and paperboard mills	125	$1,199.74	$0.28	$1,199.46	1,922	$394.51	$10.43
Manufacturing	AC- refrigeration- and forced air heating	278	$947.25	$0.00	$947.24	2,853	$234.89	$5.77
Manufacturing	Synthetic rubber manufacturing	153	$899.08	$22.05	$877.03	1,061	$263.14	$6.33
Manufacturing	Commercial and institutional buildings	38	$855.47	$0.00	$855.47	8,436	$445.87	$5.48
Manufacturing	Pesticide and other agricultural chemical man	159	$724.82	$121.45	$603.37	460	$218.41	$3.81
Manufacturing	Other basic organic chemical manufacturing	151	$706.58	$131.74	$574.84	621	$103.32	$4.05
Manufacturing	Other basic inorganic chemical manufacturing	150	$662.12	$145.88	$516.24	1,201	$213.52	$2.43
Manufacturing	Reconstituted wood product manufacturing	114	$578.60	$242.21	$336.39	1,216	$312.29	$2.90
Manufacturing	Sawmills	112	$524.45	$465.15	$59.30	1,810	$173.11	$3.00
Manufacturing	Industrial gas manufacturing	148	$489.53	$257.41	$232.12	490	$193.08	$2.93
Manufacturing	Sheet metal work manufacturing	236	$460.57	$25.10	$435.47	1,924	$225.10	$2.97
Manufacturing	Logging	14	$448.42	$335.08	$113.34	1,805	$117.91	$3.97
Manufacturing	Iron and steel mills	203	$443.31	$31.93	$411.38	519	$92.33	$3.50
Manufacturing	Ferrous metal foundries	221	$384.48	$0.38	$384.10	1,900	$148.93	$2.96
Manufacturing	Other new construction	41	$374.53	$0.00	$374.53	3,869	$206.68	$1.62
Manufacturing	Fabricated structural metal manufacturing	233	$335.65	$17.38	$318.27	1,183	$132.54	$2.13
Manufacturing	Tire manufacturing	179	$325.28	$0.07	$325.21	1,148	$104.18	$10.68
Manufacturing	Ship building and repairing	357	$320.54	$1.86	$318.69	1,673	$129.83	$1.45
Manufacturing	New residential additions and alterations-all	35	$213.35	$0.00	$213.35	1,151	$82.45	$1.16
Manufacturing	Forest nurseries- forest products- and timber	15	$209.23	$3.23	$206.01	260	$62.29	$9.46
Manufacturing	Metal valve manufacturing	248	$199.73	$21.63	$178.10	698	$91.21	$1.18
Manufacturing	Plastics plumbing fixtures and all other plastics	177	$194.82	$141.13	$53.68	1,068	$66.44	$1.14
Manufacturing	**All other manufacturing**		**$4,280.97**	**$1,186.11**	**$3,094.87**	**22,438**	**$1,451.56**	**$26.15**
Manufacturing	**Total manufacturing**		**$62,475.81**	**$19,826.73**	**$42,649.08**	**80,609**	**$9,096.38**	**$255.38**
Based on year 2006 data from the Minnesota IMPLAN Group, Inc.								

Economic Data for Municipal Water User Groups ($millions)								
Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Manufacturing	Owner-occupied dwellings	509	$2,769.76	$0.00	$2,769.76	0	$2,145.64	$327.51
Manufacturing	Wholesale trade	390	$1,979.48	$947.70	$1,031.78	12,668	$1,042.46	$292.48
Manufacturing	State & Local Education	503	$1,884.71	$0.00	$1,884.70	46,257	$1,884.71	$0.00
Manufacturing	Hospitals	467	$1,727.97	$0.00	$1,727.96	15,876	$892.06	$11.37
Manufacturing	Offices of physicians- dentists- and other he	465	$1,682.35	$0.00	$1,682.35	12,751	$1,205.26	$10.56
Manufacturing	Food services and drinking places	481	$1,324.54	$169.14	$1,155.40	27,969	$537.72	$62.79
Manufacturing	Monetary authorities and depository credit in	430	$1,099.85	$362.24	$737.61	5,913	$772.33	$14.07
Manufacturing	Architectural and engineering services	439	$1,009.63	$636.44	$373.19	8,507	$531.11	$4.42
Manufacturing	State & Local Non-Education	504	$958.83	$0.00	$958.83	17,038	$958.83	$0.00
Manufacturing	Telecommunications	422	$942.90	$323.87	$619.03	2,611	$390.63	$65.05
Manufacturing	Motor vehicle and parts dealers	401	$866.67	$94.24	$772.43	7,972	$447.32	$126.86
Manufacturing	Legal services	437	$771.37	$489.56	$281.81	5,986	$486.47	$15.24
Manufacturing	Real estate	431	$737.30	$291.86	$445.44	4,444	$426.85	$90.59
Manufacturing	General merchandise stores	410	$729.87	$76.93	$652.94	12,607	$335.61	$106.88
Manufacturing	Lessors of nonfinancial intangible assets	436	$688.93	$375.69	$313.23	39	$323.18	$31.68
Manufacturing	Truck transportation	394	$676.79	$366.46	$310.33	5,415	$299.17	$6.80
Manufacturing	Pipeline transportation	396	$582.34	$254.68	$327.66	925	$168.62	$35.48
Manufacturing	Other State and local government enterprises	499	$490.03	$159.57	$330.46	2,341	$179.70	$0.06
Manufacturing	Food and beverage stores	405	$478.57	$63.98	$414.58	8,897	$240.01	$52.64
Manufacturing	Nursing and residential care facilities	468	$448.72	$0.00	$448.72	10,615	$265.53	$6.25
Manufacturing	Building material and garden supply stores	404	$435.38	$67.52	$367.86	5,102	$205.30	$62.45
Manufacturing	Home health care services	464	$390.02	$0.00	$390.02	11,031	$236.27	$1.39
Manufacturing	Management of companies and enterprises	451	$388.18	$365.05	$23.13	1,671	$243.23	$3.88
Manufacturing	Securities- commodity contracts- investments	426	$373.14	$247.80	$125.34	3,209	$128.28	$3.80
Manufacturing	Automotive repair and maintenance- except car	483	$344.16	$81.75	$262.41	4,607	$127.97	$25.40
Manufacturing	Waste management and remediation services	460	$320.28	$180.02	$140.26	1,915	$152.72	$12.34
Manufacturing	All other municipal		$9,460.62	$3,498.97	$5,961.65	137,524	$4,991.87	$353.80
Manufacturing	**Total**		**$33,562.37**	**$9,053.48**	**$24,508.89**	**373,890**	**$19,618.82**	**$1,723.75**
Based on year 2006 data from the Minnesota IMPLAN Group, Inc.								

Appendix 2: Impacts by Water User Group

Irrigation ($millions)						
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Hardin County						
Reduced income from lost crop production	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10
Reduced business taxes from lost crop production	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Reduced jobs from lost crop production	2	2	2	2	2	2
Houston County						
Reduced income from lost crop production	$0.058	$0.068	$0.100	$0.271	$0.349	$0.436
Reduced business taxes from lost crop production	$0.004	$0.004	$0.006	$0.017	$0.022	$0.027
Reduced jobs from lost crop production	0	0	0	0	0	0
San Augustine County						
Reduced income from lost crop production	$0.020	$0.020	$0.020	$0.020	$0.020	$0.020
Reduced business taxes from lost crop production	$0.001	$0.001	$0.001	$0.001	$0.001	$0.001
Reduced jobs from lost crop production	0	0	0	0	0	0
Smith						
Reduced income from lost crop production	$0.001	$0.004	$0.007	$0.010	$0.013	$0.017
Reduced business taxes from lost crop production	$0.000	$0.000	$0.000	$0.001	$0.001	$0.001
Reduced jobs from lost crop production	0	0	0	0	0	0

Livestock ($millions)						
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Angelina County						
Reduced income from lost livestock production	$0.00	$0.00	$0.00	$0.08	$0.23	$0.40
Reduced business taxes from lost livestock production	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02
Reduced jobs from lost crop livestock production	0	0	0	1	3	5
Henderson County						
Reduced income from lost livestock production	$0.00	$0.13	$0.98	$1.75	$2.53	$3.27
Reduced business taxes from lost livestock production	$0.00	$0.01	$0.05	$0.09	$0.13	$0.17
Reduced jobs from lost crop livestock production	0	2	12	22	31	40
Houston County						
Reduced income from lost livestock production	$0.33	$0.95	$1.82	$2.76	$3.77	$4.87
Reduced business taxes from lost livestock production	$0.02	$0.05	$0.09	$0.14	$0.19	$0.25
Reduced jobs from lost crop livestock production	4	12	22	34	46	60
Nacogdoches County						
Reduced income from lost livestock production	$0.00	$0.00	$3.45	$7.97	$26.40	$38.40
Reduced business taxes from lost livestock production	$0.00	$0.00	$0.16	$0.36	$1.20	$1.74
Reduced jobs from lost crop livestock production	0	0	32	74	246	358
Sabine County						
Reduced income from lost livestock production	$0.53	$1.14	$1.84	$2.65	$7.18	$9.24
Reduced business taxes from lost livestock production	$0.02	$0.05	$0.08	$0.12	$0.33	$0.42
Reduced jobs from lost crop livestock production	5	11	17	25	67	86
San Augustine County						
Reduced income from lost livestock production	$1.30	$2.41	$3.71	$10.40	$13.88	$17.70
Reduced business taxes from lost livestock production	$0.06	$0.11	$0.17	$0.47	$0.63	$0.80
Reduced jobs from lost crop livestock production	12	22	35	97	129	165
Shelby County						
Reduced income from lost livestock production	$11.07	$48.66	$80.98	$240.70	$336.76	$453.86
Reduced business taxes from lost livestock production	$0.50	$2.21	$3.68	$10.93	$15.30	$20.62
Reduced jobs from lost crop livestock production	103	453	754	2,243	3,137	4,228

Manufacturing ($millions)						
	2010	2020	2030	2040	2050	2060
Angelina County						
Reduced income from lost manufacturing	$37.70	$254.28	$314.02	$749.13	$858.12	$975.28
Reduced business taxes from lost manufacturing	$1.18	$7.93	$9.79	$23.36	$26.75	$30.41
Reduced jobs from lost crop livestock manufacturing	45	305	376	898	1,028	1,169
Hardin County						
Reduced income from lost manufacturing	$0.38	$0.65	$1.78	$2.29	$2.74	$3.22
Reduced business taxes from lost manufacturing	$0.02	$0.03	$0.08	$0.10	$0.12	$0.14
Reduced jobs from lost crop livestock manufacturing	4	6	17	22	26	31
Houston County						
Reduced income from lost manufacturing	$0.10	$0.16	$0.23	$0.29	$0.39	$0.49
Reduced business taxes from lost manufacturing	$0.00	$0.01	$0.01	$0.01	$0.02	$0.02
Reduced jobs from lost crop livestock manufacturing	1	2	2	3	4	5
Newton County						
Reduced income from lost manufacturing	$1.16	$2.06	$5.76	$7.43	$8.94	$10.39
Reduced business taxes from lost manufacturing	$0.01	$0.02	$0.06	$0.08	$0.09	$0.11
Reduced jobs from lost crop livestock manufacturing	7	13	36	47	56	65
Orange County						
Reduced income from lost manufacturing	$0.00	$33.43	$72.49	$111.43	$146.00	$184.89
Reduced business taxes from lost manufacturing	$0.00	$0.92	$1.99	$3.06	$4.01	$5.07
Reduced jobs from lost crop livestock manufacturing	0	294	637	979	1,282	1,624
Panola County						
Reduced income from lost manufacturing	$1.10	$1.33	$1.51	$1.68	$1.84	$2.14
Reduced business taxes from lost manufacturing	$0.07	$0.09	$0.10	$0.11	$0.12	$0.14
Reduced jobs from lost crop livestock manufacturing	22	27	30	34	37	43
Polk County						
Reduced income from lost manufacturing	$0.00	$0.61	$1.56	$5.11	$6.93	$8.53
Reduced business taxes from lost manufacturing	$0.00	$0.02	$0.06	$0.19	$0.26	$0.32
Reduced jobs from lost crop livestock manufacturing	0	6	14	47	64	79
San Augustine County						
Reduced income from lost manufacturing	$0.00	$0.00	$0.00	$0.00	$0.01	$0.04
Reduced business taxes from lost manufacturing	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Reduced jobs from lost crop livestock manufacturing	0	0	0	0	0	0

Manufacturing cont. ($millions)						
	2010	2020	2030	2040	2050	2060
Shelby County						
Reduced income from lost manufacturing	$0.00	$0.00	$0.00	$0.00	$0.19	$0.46
Reduced business taxes from lost manufacturing	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02
Reduced jobs from lost crop livestock manufacturing	0	0	0	0	2	4
Smith County						
Reduced income from lost manufacturing	$0.00	$0.00	$0.06	$0.96	$1.73	$2.80
Reduced business taxes from lost manufacturing	$0.00	$0.00	$0.00	$0.04	$0.06	$0.10
Reduced jobs from lost crop livestock manufacturing	0	0	1	9	16	26

Mining ($millions)	2010	2020	2030	2040	2050	2060
Anderson County						
Reduced income from lost mining output	$0.34	$0.41	$0.84	$1.31	$1.78	$2.23
Reduced business taxes from lost mining output	$0.03	$0.04	$0.08	$0.13	$0.18	$0.22
Reduced jobs from lost mining output	2	3	6	10	13	16
Angelina County						
Reduced income from lost mining output	$149.06	$298.79	$0.00	$0.56	$1.12	$1.65
Reduced business taxes from lost mining output	$3.73	$29.88	$0.00	$0.06	$0.11	$0.16
Reduced jobs from lost mining output	1,102	2,210	0	4	8	12
Cherokee County						
Reduced income from lost mining output	$36.70	$111.91	$0.00	$0.00	$0.00	$0.15
Reduced business taxes from lost mining output	$3.67	$11.19	$0.00	$0.00	$0.00	$0.01
Reduced jobs from lost mining output	271	828	0	0	0	1
Hardin County						
Reduced income from lost mining output	$582.15	$645.67	$688.44	$731.06	$773.98	$806.71
Reduced business taxes from lost mining output	$58.22	$64.57	$68.84	$73.11	$77.40	$80.67
Reduced jobs from lost mining output	4,305	4,775	5,091	5,407	5,724	5,966
Jefferson County						
Reduced income from lost mining output	$0.00	$0.00	$0.00	$0.00	$0.09	$0.17
Reduced business taxes from lost mining output	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02
Reduced jobs from lost mining output	0	0	0	0	1	1
Nacogdoches County						
Reduced income from lost mining output	$186.88	$523.80	$0.00	$0.00	$0.00	$0.00
Reduced business taxes from lost mining output	$18.69	$52.38	$0.00	$0.00	$0.00	$0.00
Reduced jobs from lost mining output	1,382	3,874	0	0	0	0
Rusk County						
Reduced income from lost mining output	$0.00	$0.00	$0.00	$0.56	$1.12	$1.65
Reduced business taxes from lost mining output	$0.00	$0.00	$0.00	$0.06	$0.11	$0.16
Reduced jobs from lost mining output	0	0	0	4	8	12
Shelby County						
Reduced income from lost mining output	$112.36	$524.33	$0.00	$0.00	$0.00	$0.00
Reduced business taxes from lost mining output	$11.24	$52.43	$0.00	$0.00	$0.00	$0.00
Reduced jobs from lost mining output	831	3,878	0	0	0	0

Mining cont. ($millions)						
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Smith County						
Reduced income from lost manufacturing	$0.88	$9.44	$11.91	$16.10	$19.10	$21.57
Reduced business taxes from lost manufacturing	$0.09	$0.94	$1.19	$1.61	$1.91	$2.16
Reduced jobs from lost crop livestock manufacturing	7	70	88	119	141	160

Steam-electric ($millions)						
	2010	2020	2030	2040	2050	2060
Anderson County						
Reduced income from lost electrical generation	$0.00	$179.52	$209.88	$246.90	$292.01	$347.00
Reduced business taxes from lost electrical generation	$0.00	$25.77	$30.13	$35.44	$41.91	$49.81
Reduced jobs from lost electrical generation	0	610	713	839	993	1,180
Angelina County						
Reduced income from lost electrical generation	$63.51	$31.76	$63.51	$63.51	$63.51	$63.51
Reduced business taxes from lost electrical generation	$9.12	$4.56	$9.12	$9.12	$9.12	$9.12
Reduced jobs from lost electrical generation	216	108	216	216	216	216
Jefferson County						
Reduced income from lost electrical generation	$0.00	$426.37	$498.46	$1,172.73	$1,387.03	$1,648.27
Reduced business taxes from lost electrical generation	$0.00	$61.20	$71.55	$168.33	$199.09	$236.58
Reduced jobs from lost electrical generation	0	1,449	1,694	3,987	4,715	5,603
Nacogdoches County						
Reduced income from lost electrical generation	$41.09	$3.02	$21.56	$44.19	$713.97	$848.43
Reduced business taxes from lost electrical generation	$5.90	$0.43	$3.10	$6.34	$102.48	$121.78
Reduced jobs from lost electrical generation	140	10	73	150	2,427	2,884
Newton County						
Reduced income from lost electrical generation	$0.00	$0.00	$60.14	$134.94	$226.10	$337.25
Reduced business taxes from lost electrical generation	$0.00	$0.00	$8.63	$19.37	$32.45	$48.41
Reduced jobs from lost electrical generation	0	0	204	459	769	1,146

Municipal ($millions)						
	2010	2020	2030	2040	2050	2060
Athens						
Monetary value of domestic water shortages	$0.00	$1.25	$1.68	$1.34	$1.76	$2.32
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.09	$0.13	$0.18
Lost jobs due to reduced commercial business activity	0	0	0	3	5	7
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.01	$0.02	$0.03
Lost utility revenues	$0.00	$0.09	$0.12	$0.15	$0.21	$0.27
Brownsboro						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.06
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01
Bullard						
Monetary value of domestic water shortages	$0.00	$0.01	$0.05	$0.11	$0.25	$0.40
Lost utility revenues	$0.00	$0.02	$0.07	$0.13	$0.22	$0.34
Community Water Company						
Monetary value of domestic water shortages	$0.08	$0.97	$1.22	$1.84	$2.74	$4.27
Lost utility revenues	$0.07	$0.15	$0.20	$0.23	$0.30	$0.40
County-other (Anderson)						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07
County-other (Angelina)						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.11
County-other (Hardin)						
Monetary value of domestic water shortages	$0.16	$0.30	$0.33	$0.35	$0.41	$0.55
County-other (Henderson)						
Monetary value of domestic water shortages	$0.11	$0.26	$0.44	$0.59	$0.93	$1.62
County-other (Jasper)						
Monetary value of domestic water shortages	$0.10	$0.19	$0.23	$0.15	$0.13	$0.13
County-other (Orange)						
Monetary value of domestic water shortages	$0.12	$0.08	$0.04	$0.01	$0.00	$0.00

Municipal (cont.)						
	2010	2020	2030	2040	2050	2060
County-other (Polk)						
Monetary value of domestic water shortages	$0.27	$0.68	$5.21	$3.93	$4.73	$5.83
County-other (Sabine)						
Monetary value of domestic water shortages	$1.26	$1.34	$1.39	$1.44	$1.49	$1.74
County-other (San Augustine)						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01
County-other (Shelby)						
Monetary value of domestic water shortages	$0.31	$0.40	$0.53	$0.55	$0.61	$0.69
County-other (Trinity)						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.01	$0.03	$0.07
County-other (Tyler)						
Monetary value of domestic water shortages	$0.00	$0.15	$0.27	$0.29	$0.27	$0.27
D&M WSC						
Monetary value of domestic water shortages	$0.00	$0.02	$0.07	$0.14	$0.29	$1.89
Lost utility revenues	$0.00	$0.00	$0.04	$0.12	$0.32	$0.55
Diboll						
Monetary value of domestic water shortages	$0.03	$0.24	$0.61	$3.57	$5.99	$10.75
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$2.28	$4.21
Lost jobs due to reduced commercial business activity	0	0	0	0	72	133
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.33	$0.60
Lost utility revenues	$0.06	$0.33	$0.66	$1.09	$1.70	$2.54
Four Way WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.31
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.40
Frankston						
Monetary value of domestic water shortages	$0.00	$0.00	$0.01	$0.03	$0.05	$0.07
Lost utility revenues	$0.00	$0.00	$0.01	$0.04	$0.07	$0.10

Municipal (cont.)						
	2010	2020	2030	2040	2050	2060
Hudson						
Monetary value of domestic water shortages	$0.00	$0.00	$0.14	$0.58	$5.00	$9.31
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.00	$3.35
Lost jobs due to reduced commercial business activity	0	0	0	0	0	106
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.48
Lost utility revenues	$0.00	$0.00	$0.22	$0.63	$1.25	$2.07
Hudson WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.11	$0.60	$4.67
Lost utility revenues	$0.00	$0.00	$0.00	$0.18	$0.65	$1.29
Jackson WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.03	$0.09
Lost utility revenues	$0.00	$0.00	$0.07	$0.15	$0.21	$0.28
Lilly Grove SUD						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.24	$0.64
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.39	$0.82
Lindale Rural WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.13
Lufkin						
Monetary value of domestic water shortages	$16.57	$59.57	$71.97	$86.30	$165.27	$112.62
Lost income from reduced commercial business activity	$0.00	$33.91	$42.30	$51.80	$126.81	$154.49
Lost jobs due to reduced commercial business activity	0	754	941	1,152	2,821	3,437
Lost state and local taxes from reduced commercial business activity	$0.00	$3.61	$4.50	$5.51	$13.49	$16.44
Lost utility revenues	$5.99	$9.45	$11.18	$13.14	$15.54	$18.40
Mauriceville SUD						
Monetary value of domestic water shortages	$0.00	$0.03	$0.08	$0.10	$0.18	$0.26
Lost utility revenues	$0.00	$0.07	$0.14	$0.17	$0.28	$0.36

Municipal (cont.)						
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
New Summerfield WSC						
Monetary value of domestic water shortages	$0.00	$0.07	$0.18	$1.12	$1.63	$2.34
Lost utility revenues	$0.00	$0.00	$0.07	$0.13	$0.21	$0.29
Rusk WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.04	$0.12	$0.24
Lost utility revenues	$0.00	$0.00	$0.00	$0.07	$0.20	$0.37
Swift WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.06	$0.24	$0.49
Lost utility revenues	$0.00	$0.00	$0.00	$0.11	$0.42	$0.75
Whitehorse						
Monetary value of domestic water shortages	$0.02	$0.05	$0.07	$0.11	$0.16	$0.26
Lost utility revenues	$0.05	$0.10	$0.14	$0.18	$0.27	$0.39

Appendix G

Letter Template and List of Stakeholders Receiving Letter Soliciting Input and Participation

September 8, 2015

Groundwater Management Area 11

«First_Name» «Last_Name»
«Org_Name»
«Address»
«City», «State» «Zip»

Dear «First_Name» «Last_Name»:

The Groundwater Management Area 11 (GMA 11) is reaching out to request your participation and feedback in the GMA 11's joint planning efforts in adopting the Desired Future Conditions (DFCs) for relevant aquifers of our groundwater management area that your organization is located within. As required in section 36.108 of the Texas Water Code requires the GMA 11 to review and consider specific factors before voting on the proposed DFCs by May 1, 2016 and in doing so the GMA 11 would also like to consider any of your concerns. Once adopted, the DFCs will be considered as groundwater planning numbers in the State Water Plan.

A DFC is defined in Title 31, Part 10, §356.10 (6) of the Texas Administrative Code as "the desired, quantified condition of groundwater resources (such as water levels, spring flows, or volumes) within a management area at one or more specified future times as defined by participating groundwater conservation districts within a groundwater management area as part of the joint planning process."

The GMA 11 members are in the process of developing the desired future conditions (DFCs) and would like your participation and input on setting the DFC in your area. As the attached map shows, GMA 11 covers the northern part of the Carrizo-Wilcox aquifer and includes all and/or part of 27 counties from Bowie County to Angelina County in the north and south and Henderson County to Panola County from west to east.

As part of this process, GMA 11 has identified through review of estimates of future pumping from each regional water plan and state historic pumping data initial simulations for projected groundwater use. Available for you to review are the initial simulations for groundwater usage located at http://pcgcd.org/gma-11/ or http://www.rcgcd.org/GMA11.htm. You may also view a map of the GMA 11 Administrative Boundary at this website or at:

http://www.twdb.texas.gov/groundwater/management_areas/gma11.asp.

We welcome any corrections and/or updates for inclusion in future DFC predictions. Please provide comments by October 9, 2015 through mail, email, or fax to:

Leah Adams
Panola County GCD
419 West Sabine Street
Carthage, TX 75633
ladams@pcgcd.org
Phone: 903-690-0143
Fax: 903-690-0135

The next GMA 11 meeting will be on November 4, 2015 at 10:30AM at the Nacogdoches City Council Chambers, room 119 in the Nacogdoches City Hall to discuss the proposed DFCs for GMA 11 and would appreciate your participation. If you would like receive notices for all GMA 11 meetings, please contact the GMA 11 administrative contact at the contact information provided above. We thank you in advance for your participation.

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Anderson	Anderson County
Anderson	Anderson County Cedar Creek WSC
Anderson	Anderson County FWSD 1
Anderson	Azleway Pine Mountain
Anderson	Bassett Road Moble Home Park
Anderson	BBS WSC
Anderson	BCY WSC
Anderson	BRUSHY CREEK WSC
Anderson	Camp Betty Perot
Anderson	Cayuga WSC
Anderson	City of Elkhart
Anderson	City of Frankston
Anderson	City of Palestine
Anderson	Dogwood Hills
Anderson	Dogwood Springs WSC
Anderson	Dogwood Springs WSC Plant 1
Anderson	Edgewood Shores Water Supply
Anderson	Four Pines WSC
Anderson	Frankston Rural WSC
Anderson	Kickory Ridge MHP
Anderson	Lake Ioni Water Supply
Anderson	Lakeview Methodist Conference Center
Anderson	Lone Pine WSC
Anderson	Montalba WSC
Anderson	Mountain Pure TX
Anderson	Neches WSC
Anderson	Norwood WSC
Anderson	Pleasant Springs WSC
Anderson	Sanderson Farms Palestine Facility
Anderson	Sandy Hills Moble Home Park
Anderson	Slocum WSC
Anderson	TJCD Coffield Michael
Anderson	Upper Neches River Municipal Water Authority
Anderson	Walmart Distribution Center
Anderson	Walston Springs WSC
Angelina	ABITIBI CONSOLIDATED

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Angelina	Angelina County
Angelina	ANGELINA COUNTY FWSD 1
Angelina	ANGELINA WSC
Angelina	BEULAH WSC
Angelina	BILL WILLIAMS WATER SYSTEM
Angelina	CASSELS BOYKIN COUNTY PARK
Angelina	CENTRAL WCID OF ANGELINA COUNTY
Angelina	City of Burke
Angelina	City of Diboll
Angelina	City of Hudson
Angelina	City of Huntington
Angelina	City of Lufkin
Angelina	City of Zavalla
Angelina	DADS LUFKIN STATE SUPPORTED LIVING CENTE
ANGELINA	FOUR WAY SUD
Angelina	HOLLYWOOD MOTEL
Angelina	HUDSON WSC
Angelina	JANES SHADY ACRES R V PARK
Angelina	KERVINS RV PARK
Angelina	KNUPPS KORNER STORE
Angelina	LAKESIDE WATER COMPANY
Angelina	LAKEVIEW
Angelina	LUFKIN CREOSOTING
Angelina	M & M WSC
Angelina	PINE OAKS OASIS
Angelina	PLEASURE POINT
Angelina	POLLOK-REDTOWN WSC
Angelina	PRAIRIE GROVE WSC
Angelina	RAYBURN LODGE & WHITE CAPP CAFE
Angelina	RAYLAKE WSC
Angelina	REDLAND WSC
Angelina	ROCKY CREEK ESTATES WS
Angelina	SUN N FUN ASSOCIATION
Angelina	TX AIRSTREAM HARBOR WATER
Angelina	USCOE HANKS CREEK PARK
Angelina	USFS ANGELINA DISTRICT

Appendix F

List of Stakeholders Receiving Letter

County	Organization Name
Angelina	USFS CANEY CREEK RECREATION AREA
Angelina	USFS ZAVALLA WORK CENTER
Angelina	WALNUT BEND WATER SYSTEM
Angelina	WALNUT RIDGE ESTATES WATER SYSTEM
Angelina	WOODLAWN WSC
Bowie	Big Creek Landing
Bowie	Bowie County
Bowie	Bowie County Rest Area
Bowie	Burns Redbank WSC
Bowie	Central Bowie County WSC
Bowie	Cinema City 6
Bowie	City of Dekalb
Bowie	City of Hooks
Bowie	City of Leary
Bowie	City of Maud
Bowie	City of Nash
Bowie	City of New Boston
Bowie	City of Redwater
Bowie	City of Texarkana
Bowie	City of Wake Village
Bowie	City Redwater
Bowie	Codys Mobile Home Park
Bowie	Crystal Springs Beach
Bowie	Eats Café Water System
Bowie	El Chaparral Mobile Home Park
Bowie	EZ Mart Store 3
Bowie	Federal Correctional Institute Texarkana
Bowie	Harrison Mobile Home Park
Bowie	International Paper County Water District
Bowie	Kelly Creek Landing
Bowie	LE Kwick Stop
Bowie	Leroys Mobile Home Park
Bowie	Lindblad Water System
Bowie	Lone Star Army Ammunition Plant
Bowie	Macedonia EYLUA MUD 1
Bowie	Nash

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Bowie	Northeast TX Restitution Center
Bowie	Oak Grove WSC
Bowie	Red Lick Preschool
Bowie	Sherwood Forest Subdivision
Bowie	Texamericas Center
Bowie	Texarkana
Bowie	Texarkana Mobile Home Park
Bowie	Trails West Mobile Home Park
Bowie	Triple C Truck Terminal
Bowie	Wake Village
Bowie	Woodlands Estates
Camp	Barefoot Bay Marina
Camp	BI County WSC 1
CAMP	BI-COUNTY WSC
Camp	Camp Branch Estates
Camp	Camp County
Camp	Camp Shiloh Lutheran Retreat Center
Camp	Cherokee Point Water CO
Camp	City of Pittsburg
CAMP	CYPRESS SPRINGS SUD
Camp	HAB WSC
Camp	Havenport Water System
Camp	Hidden Village RV Park
Camp	Newsome WSC
Camp	Northeast Texas MWD Pittsburg Plant
Camp	Thunderbird Point Water System
Camp	Woodland Harbor
Cass	Antioch General Store
Cass	Atlanta
Cass	Bloomburg WSC
Cass	Braddocks Bar B Q
Cass	Cass County
Cass	City of Atlanta
Cass	City of Avinger
Cass	City of Domino
Cass	City of Douglassville

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Cass	City of Hughes Springs
Cass	City of Linden
Cass	City of Marietta
Cass	City of Queen City
Cass	Eastern Cass WSC
Cass	Fats 7 Burger King
Cass	Gibson Recycling Water System
Cass	Green Hills Subdivision
Cass	Holly Springs WSC
Cass	Holly Springs WSC East Meter
Cass	International Paper Texarkana Mill
Cass	Kildare Kosy Kitchen Club
Cass	Sleepy Hollow Catfish House
Cass	South Lakewood Grocery
Cass	Spring Valley Subdivision
Cass	Springdale Baptist Church
Cass	Sulphur River Gathering LP
Cass	Vaughans Catfish Restaurant
Cass	Vickys Playcare
Cass	Western Cass WSC
Cass	Whispering Pines Subdivision
Cass	Wooden Indian
Cherokee	Afton Grove WSC
Cherokee	Alto Rural WSC
Cherokee	Blackjack WSC
Cherokee	Cherokee County
Cherokee	City of Alto
Cherokee	City of Cuney
Cherokee	City of Gallatin
Cherokee	City of Jacksonville
Cherokee	City of New Summerfield
Cherokee	City of Reklaw
Cherokee	City of Rusk
Cherokee	City of Wells
Cherokee	CRAFT TURNEY WSC MAIN
Cherokee	Dialville Oakland WSC

Appendix F

List of Stakeholders Receiving Letter

County	Organization Name
Cherokee	Forest WSC
Cherokee	Gallatin WSC
Cherokee	Gum Creek WSC
Cherokee	Iron Hill WSC
Cherokee	Luminant
Cherokee	Maydelle WSC
Cherokee	Mountain View Camp
Cherokee	New Concord WSC
Cherokee	North Cherokee WSC
Cherokee	Rusk Rural WSC
Cherokee	Rusk State Hospital
Cherokee	Stryker Lake WSC
Cherokee	Texas State Railroad Rusk
Cherokee	West Jacksonville Water Supply
Franklin	City of Mount Vernon
Franklin	Cypress Spings SUD
Franklin	Cypress Spings SUD NE
Franklin	Deer Cove POA WS
Franklin	Franklin County
Franklin	Indian Springs Water Company
Franklin	Kings Country 1 and 2
Franklin	Winnsboro
Gregg	C & C Mobile Home Park
Gregg	Christian Heritage School
Gregg	City of Clarksville City
Gregg	City of Easton
Gregg	City of Gladewater
Gregg	City of Kilgore
Gregg	City of Longview
Gregg	City of Warren City
Gregg	City of White Oak
GREGG	CROSS ROADS SUD
Gregg	Danville Mobile Home Village
Gregg	EJ Water Company
Gregg	Elderville WSC
Gregg	Forest Lake Subdivion

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Gregg	Garden Acres Subdivision
Gregg	Gladewater
Gregg	Gregg County
Gregg	Jones Mobile Home Park
Gregg	Liberty City WSC
Gregg	Liberty Danville FWSD 2
Gregg	Lone Star Speedway Water System
Gregg	Richards MHP
Gregg	Sun Acres Mobile Home Park
Gregg	Tryon Road SUD
Gregg	West Gregg SUD
HARDIN	CITY OF KOUNTZE
HARDIN	CITY OF SILSBEE
HARDIN	CITY OF SOUR LAKE
HARDIN	LAKE LIVINGSTON BIG THICKET RETREAT
HARDIN	LUMBERTON MUD
HARDIN	NORTH HARDIN WSC
HARDIN	WEST HARDIN WSC
Harrison	Bass Fishing and Rentals
Harrison	Big Oak MHP
Harrison	Blocker Crossroads Water Supply Corporate
Harrison	C & C Service and Supply
Harrison	Caddo Lake WSC
Harrison	Caddo Lake WSC Mossy Acres
Harrison	Camp Fern
Harrison	Circle H Mobile Home Park
Harrison	City of Hallsville
Harrison	City of Marshall
Harrison	City of Scottsville
Harrison	City of Waskom
Harrison	Clearwater Distribution
Harrison	Country Pines RV Park
Harrison	Country Villa Mobile Home Park
Harrison	Cypress Hills Golf
Harrison	Cypress Valley WSC
Harrison	Cypress Valley WSC Plant

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Harrison	Cypress Village Water System
HARRISON	DIANA SUD
Harrison	Eastman Chemical Company Texas Operation
Harrison	Elysian Fields WSC
Harrison	Galindos Restaurant
Harrison	Gill WSC
Harrison	Gum Springs RV Park
Harrison	Gum Springs WSC
HARRISON	GUM SPRINGS WSC
Harrison	Gum Springs WSC 1
Harrison	Hallelujah Hill MHP
Harrison	Harleton WSC
Harrison	Harrison County
Harrison	Harrison County Power Project
Harrison	Hillcrest Mobile Home Park
Harrison	Hitchin Post RV Park
Harrison	Holiday Springs Mobile Home Park
Harrison	Johnson Mobile Home Park
Harrison	Karnack WSC
Harrison	Leigh WSC
Harrison	Leigh WSC Port Caddo
Harrison	Longhorn Army Ammunition Plant
Harrison	Millennium Rail
Harrison	North Harrison WSC
Harrison	Old Town WSC
Harrison	Pergan Marshall
Harrison	Pine Hill Mobile Home Park
Harrison	Pirkey Power Plant SWEPCO
Harrison	Sabine Mining CO Lignite Mine
Harrison	Sabine Valley Rehabilitation Center
Harrison	Saddlewood Estates
Harrison	Shadowood Water CO
Harrison	Southford Mobile Home Park
Harrison	Talley WSC
Harrison	Timberbrook Mobile Home Park
Harrison	TPWD Caddo Lake State Park

Appendix F

List of Stakeholders Receiving Letter

County	Organization Name
Harrison	TXDOT Comfort Station H
Harrison	Waskcom Rural WSC
Harrison	West Harrison WSC
Harrison	Whispering Pines Mobile Home Park
Henderson	4D Mobile Home Park
Henderson	Andrews Center
Henderson	Athens Municipal Water Authority
Henderson	Athens Water System Coop
Henderson	Bethel Ash WSC
Henderson	Blue Water Key Water System
Henderson	Camp Lone Star
Henderson	Camp Meisenbach Circle Ten Council
Henderson	Caney Cove Water System
Henderson	Cape Tranquility System
Henderson	Carrizo Water Copr Forest Grove
Henderson	Chandler Water Co
Henderson	Christian Youth Foundation
Henderson	City of Athens
Henderson	City of Berryville
Henderson	City of Brownsboro
Henderson	City of Chandler
Henderson	City of Coffee City
Henderson	City of Cross Roads
Henderson	City of Enchanted Oaks
Henderson	City of Eustace
Henderson	City of Gun Barrel City
Henderson	City of Log Cabin
Henderson	City of Malakof
Henderson	City of Murchison
HENDERSON	CITY OF MURCHISON
Henderson	City of Payne Springs
Henderson	City of Seven Points
Henderson	City of Star Harbor
Henderson	City of Trinidad
Henderson	Clear Creek Resort Water System
Henderson	Coon Creek Club

Appendix F

List of Stakeholders Receiving Letter

County	Organization Name
Henderson	County Line Express Hauling
Henderson	CRC WSC
Henderson	Cresent Heights WSC
Henderson	Cross Roads ISD Water System
Henderson	Dal High Water System
Henderson	Debs Deli & Grocery
Henderson	Dogwood Estates Water Company
Henderson	East Cedar Creek
Henderson	East Cedar Creek FWSD
Henderson	Echo Hills POA Water System
Henderson	Echo Lake Water System
Henderson	Flat Creek Cove Property Owners Association
Henderson	Henderson County
Henderson	La Poynor ISD
Henderson	Lake Palestine Resort
Henderson	Lake Utility Company
Henderson	Lake View Mgmt & Development
Henderson	Lakeview Beverage
Henderson	Lakewood Water East
Henderson	Lakewood Water West
Henderson	Leagueville WSC
Henderson	Lollipop Water Works Inc
Henderson	Moore Station WSC
Henderson	North Loop Apartments
Henderson	Oakwood Subdivision Water System
Henderson	Payne Springs WSC
Henderson	Point Royal Water System
Henderson	Poynor Community WSC
Henderson	Roher Springs
Henderson	Ruth Springs Water Coop
Henderson	Staway Ranch & RV Park
Henderson	Sunny Glen Resort
Henderson	The Feed Box
Henderson	Three Community WSC
Henderson	TPWD Purtis Crrek State
Henderson	Trevor Rees-Jones Scout Camp

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Henderson	Tristream East Texas Eustace System
Henderson	Twin Oaks MHP Henderson
Henderson	Union Hill WSC
Henderson	Virgina Hill WSC
Henderson	West Cedar Creek MUD
Henderson	Woodmere Park
Hopkins	Brashear WSC
Hopkins	Brinker WSC
Hopkins	City of Como
Hopkins	City of Cumby
Hopkins	City of Seymour
Hopkins	City of Sulpher Springs
Hopkins	Cornersville WSC
Hopkins	Gafford Chapel WSC
Hopkins	Hopkins County
HOPKINS	JONES WSC
Hopkins	Martin Springs WSC
Hopkins	Miller Grove WSC
Hopkins	North Hopkins Industrial Park
Hopkins	North Hopkins WSC
Hopkins	Pickton WSC
Hopkins	Pleasant Hill WSC 2
Hopkins	Shady Grove NO 2 WSC
Hopkins	Shirley WSC
Houston	City of Crockett
Houston	CITY OF GRAPELAND
Houston	City of Kennard
Houston	City of Latexo
Houston	City of Lovelady
Houston	CONSOLIDATED WSC
Houston	Houston County
Houston	HOUSTON COUNTY WCID 1
Houston	LATEXO FACILITY
Houston	PREMIUM WATERS
Houston	RATCLIFF WORK CENTER
Houston	RATCLIFF WSC

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Houston	TDCJ EASTHAM UNIT
HUNT	ABLES SPRINGS WSC
HUNT	COMBINED CONSUMERS SUD
HUNT	MACBEE SUD
JASPER	CITY OF JASPER
JASPER	CITY OF KIRBYVILLE
JASPER	JASPER COUNTY WCID 1
JEFFERSON	BEVIL OAKS MUD
JEFFERSON	CITY OF BEAUMONT WATER UTILITY DEPT
JEFFERSON	CITY OF CHINA
JEFFERSON	CITY OF GROVES
JEFFERSON	CITY OF NEDERLAND
JEFFERSON	CITY OF NOME
JEFFERSON	CITY OF PORT ARTHUR
JEFFERSON	CITY OF PORT NECHES
JEFFERSON	JEFFERSON COUNTY WCID 10
JEFFERSON	MEEKER MWD
JEFFERSON	WEST JEFFERSON COUNTY MWD
Marion	Big Cypress Marina
Marion	Budget Inn Motel
Marion	City of Jefferson
Marion	Creek Water Utility
Marion	Crestwood Water CO
Marion	East Marion County Water Supply
Marion	Genes Truck Stop WS
Marion	Holiday Harbor
Marion	Indian Hills Harbor
Marion	Island View Landing
Marion	Jefferson
Marion	Kellyville Berea WSC
Marion	Marion County
Marion	Mims WSC
Marion	Northeast Texas Municipal Water District
Marion	Pine Harbor Subdivision
Marion	Shady Shores Water System
Marion	Tejas Village

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Marion	USCOE Alley Creek Park
Marion	Wilkes Lodge Water System
Marion	Wilkes Power Plant SEWPCO
Morris	BI County WSC 3
Morris	City of Daingerfield
Morris	City of Lone Star
Morris	City of Naples
Morris	City of Omaha
Morris	Daingerfield
Morris	Lone Star Tubular Operations
Morris	Morris County
Morris	Omaha
Morris	Texas Operations Diviion Highway 259
MORRIS	TRI SUD
Nacogdoches	APPLEBY WSC
Nacogdoches	CARO WSC
Nacogdoches	CENTRAL HEIGHTS WSC
Nacogdoches	City of Chireno
Nacogdoches	City of Cushing
Nacogdoches	CITY OF CUSHING
Nacogdoches	City of Garrison
Nacogdoches	City of Nacogdoches
NACOGDOCHES	D & M WSC
Nacogdoches	ETOILE WSC
Nacogdoches	LIBBY WSC
Nacogdoches	LILBERT LOONEYVILLE WSC
NACOGDOCHES	LILLY GROVE SUD
Nacogdoches	MELROSE WSC
Nacogdoches	NACOGDOCHES BOYS RANCH
Nacogdoches	Nacogdoches County
Nacogdoches	NACOGDOCHES COUNTY MUD 1
Nacogdoches	RAYBURN HIDEAWAY
Nacogdoches	SACUL WSC
Nacogdoches	SHIRLEY CREEK MARINA
NACOGDOCHES	SWIFT WSC
Nacogdoches	THE GERMAN HAUS RESTAURANT AND PUB

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Nacogdoches	TONKAWA SPRING
Nacogdoches	UNION SPRINGS WATER
Nacogdoches	WODEN WSC
NEWTON	CITY OF NEWTON
NEWTON	SOUTH NEWTON WSC
ORANGE	CITY OF BRIDGE CITY
ORANGE	CITY OF ORANGE
ORANGE	CITY OF PINEHURST
ORANGE	CITY OF ROSE CITY
ORANGE	MAURICEVILLE MUD
ORANGE	ORANGEFIELD WSC
Panola	A & P WSC
Panola	City of Beckville
Panola	City of Carthage
Panola	City of Gary
Panola	Clayton WSC Plant 1
Panola	Country Lakes Water Supply
Panola	Daniel Springs Baptist Camp
Panola	Deadwood WSC
Panola	Deberry WSC
Panola	East Texas Gas Plant
Panola	Fairplay WSC
Panola	Gary WSC
Panola	Hollands Quarter WSC
Panola	Luminant
Panola	Murvaul WSC
Panola	Panola County
Panola	Panola-Bethany WSC
Panola	Pirtle Scout Reservation Water System
Panola	Rehobeth WSC
Panola	Riderville WSC
Panola	Rock Hill WSC
Panola	South Murvaul WSC
POLK	CITY OF CORRIGAN
Rains	Alba
Rains	American Aero Crane

Appendix F

List of Stakeholders Receiving Letter

County	Organization Name
Rains	Bright Star Salem SUD
Rains	Bright Star Salem SUD 2
Rains	City of East Tawakoni
Rains	City of Emory
Rains	City of Point
RAINS	GOLDEN WSC
Rains	MHC Lake Tawakoni Campgrounds
Rains	Rains County
Rains	South Rains SUD
Red River	410 WSC
Red River	City of Annona
Red River	City of Avery
Red River	City of Bogata
Red River	City of Clarksville
Red River	City of Detroit
Red River	Lorettas
Red River	Red River County
Red River	Red River County WSC
Red River	Rose Acre Farms
Red River	The Bakers Dozen
Rusk	A & P Water Company
Rusk	Arlam Concord WSC
Rusk	Bryce Springs Inc
Rusk	CHALK HILL SUD
Rusk	Church Hill WSC
Rusk	City of Henderson
Rusk	City of Mount Enterprise
Rusk	City of New London
Rusk	City of Overton
Rusk	City of Tatum
Rusk	Crims Chapel WSC
Rusk	CROSS ROADS SUD
Rusk	Crystal Farms WSC
Rusk	Dirgin WSC
Rusk	Ebenezer WSC
Rusk	Gaston WSC

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Rusk	Goodsprings WSC
Rusk	Herrings Café
Rusk	Holmes Mobile Home Park
Rusk	Jacobs WSC
Rusk	Kennedy Road WSC
Rusk	Laneville WSC
Rusk	Leveretts Chapel WSC
Rusk	Luminant
Rusk	Martin Creek Lake State Park
Rusk	Martin Lake Steam Electric Station
Rusk	Minden Brachfield WSC
Rusk	Mt Enterprise WSC
Rusk	New Prospect WSC
Rusk	Oakland WSC
Rusk	Pine Hill Chapman WSC
Rusk	Pine Springs Baptist Camp
Rusk	Pleasant Hill WSC
Rusk	Price WSC
Rusk	Rusk County
Rusk	Shan D Water Supply
Rusk	South Rusk County WSC
Rusk	Southern Utilities
Rusk	Stafford Country Estates
Rusk	Tenaska Gateway Generating Station
Sabine	BEECHWOOD WSC
Sabine	BROOKELAND FWSD
Sabine	City of Hemphill
Sabine	City of Pineland
Sabine	EL CAMINO BAY WATER SYSTEM
Sabine	FRONTIER PARK MARINA
Sabine	G-M WSC
Sabine	LAKESHORES INC
Sabine	LOWES CREEK MARINA
Sabine	MID LAKE KAMP GROUND
Sabine	PARADISE POINT MARINA
Sabine	PENDLETON HARBOR

Appendix F

List of Stakeholders Receiving Letter

County	Organization Name
Sabine	RUSTY ANCHOR CAFEQ
Sabine	Sabine County
Sabine	SOUTH SABINE WSC
Sabine	SUPER 8 MOTEL
Sabine	TEMPLE INLAND PINELAND
Sabine	TIMBERLANE ESTATES PROPERTY OWNERS ASSOC
Sabine	TIMBERLANE WATER SYSTEM
Sabine	USCOE MILL CREEK PARK
Sabine	USFS LAKEVIEW RECREATION AREA
San Augustine	ANTHONY HARBOR SUBDIVISION
San Augustine	BLAND LAKE RURAL WSC
San Augustine	City of Broaddus
San Augustine	CITY OF SAN AUGUSTINE
San Augustine	City of San Augustine
San Augustine	DENNING WSC
San Augustine	HICKORY HOLLOW WATER SYSTEM
San Augustine	JACKSON HILL PARK & MARINA
San Augustine	NEW WSC
San Augustine	PINEYWOODS CONSERVATION CENTER SFA
San Augustine	San Augustine County
San Augustine	SAN AUGUSTINE RURAL WSC
San Augustine	SUTTON HILLS ESTATES
San Augustine	USCOE JACKSON HILL PARK
San Augustine	USFS HARVEY CREEK RECREATION AREA
San Augustine	USFS TOWNSEND RECREATION AREA
Shelby	Buena Vista WSC
Shelby	Camp Huawni Water System
Shelby	Choice WSC
Shelby	City of Center
Shelby	City of Huxley
Shelby	City of Joaquin
Shelby	City of Tenaha
Shelby	City of Timpson
Shelby	East Lamar WSC
Shelby	Five Way WSC
Shelby	Flat Fork WSC

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Shelby	Haslam Community
Shelby	Huber WSC
Shelby	McClelland WSC
Shelby	Parmer RV Park
Shelby	Paxton WSC
Shelby	Rolling Hills Subdivision
Shelby	Sandy Hills WSC
Shelby	Shelby County
Shelby	Shelbyville WSC
Shelby	Tennessee WSC
Shelby	Timpson Rural WSC
Shelby	Woodland Shores Subdivision
Smith	American Ecology & Enviromental Service
Smith	Big T Industrial Park
Smith	Carroll WSC Well
Smith	Carroll WSC Well 4
Smith	City oF Arp
Smith	City of Bullard
Smith	City of Lindale
Smith	City of Noonday
Smith	City of Troup
Smith	City of Tyler
Smith	City of Whitehouse
Smith	City of Winona
Smith	Community Water Company Montogomery Garden
Smith	Crystal Systems
SMITH	CRYSTAL SYSTEMS TEXAS, INC
Smith	Dean WSC
Smith	East Lake Woods
Smith	East Texas MUD of Smith County
Smith	Emerald Bay MUD
Smith	Enchanted Lakes Water System
Smith	Garden Valley Water CO
Smith	Heights Water
Smith	Hideaway
Smith	Jackson Texaco Station

Appendix F

List of Stakeholders Receiving Letter

County	Organization Name
Smith	Jackson WSC
Smith	John Soules Foods
Smith	Lamplighter Mobile Home Park
Smith	Lindale
Smith	Lindale Rural WSC
Smith	Mercy Ships Training Center
Smith	Morriss Country Meat Market
Smith	Mount Sylvan Water System
Smith	Overton
Smith	Pine Cove Conference Center
Smith	Pine Cove Ranch Camp
Smith	Pine Cove Towers Camp
Smith	Pine Ridge WSC
Smith	Pine Ridge WSC South
Smith	Pine Trail Shores
Smith	Rockin C Ranch
Smith	Sand Flat WSC
Smith	Sierra Club
Smith	Sky Ranch Retreat Center
Smith	Smith County
SMITH	SMITH COUNTY MUD #1
Smith	Southern Utilities
SMITH	SOUTHERN UTILITIES COMPANY
Smith	Southpark Mobile Home Estates
Smith	Spring Lake Mobile Home Park
Smith	Star Mountain WSC
Smith	Starrville WSC
Smith	Starrville-Friendship WSC
Smith	Teen Mania Ministries
Smith	The Villages Resort
Smith	TPWD Tyler State Park
Smith	Twin Oaks Ranch
Smith	Tyler
Smith	Tyler Pipe Company
Smith	Walnut Grove WSC
Smith	Whispering Pines RV & Cabin Resort

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Smith	Willow Branch RV Park
Smith	Winona
Smith	Wright City WSC
Smith	Yellow Rose RV Park
Titus	City of Mount Pleasant
Titus	City of Talco
Titus	City of Winfield
Titus	Monticello Train Maintenance Facility
Titus	Northeast Texas Community College
Titus	Ranch Village Mobile Home Park
Titus	Titus County
Titus	Town of Millers Cove
Titus	TPWD Lake Bob Sandlin State Park
Titus	Tri SUD
Trinity	APPLE SPRINGS WSC
Trinity	BELL WATER SUBDIVISION
TRINITY	BETHEL-ASH WSC
Trinity	CAMP MANAGEMENT INC
Trinity	CENTERVILLE WSC
Trinity	City of Groveton
Trinity	City of Trinity
Trinity	DEER RUN AND WHITE ROCK CITY MARINA
Trinity	EAGLE FALLS SUBDIVISION
Trinity	GLENDALE WSC
Trinity	HOPE CENTER FOR YOUTH GIRLS
Trinity	LAKE LIVINGSTON OAKRIDGE WATER
Trinity	LONE STAR EXPEDITIONS
Trinity	NIGTON WAKEFIELD WSC
Trinity	NOGALUS CENTRALIA WSC
Trinity	PENNINGTON WSC
Trinity	TRA TRINITY COUNTY REGIONAL
Trinity	Trinity County
Trinity	TRINITY PINES CONFERENCE CENTER
Trinity	TRINITY RURAL WSC
Trinity	TRINITY RURAL WSC 3
Trinity	WESTWOOD SHORES MUD

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Trinity	WHISPERING PINES GOLF CLUB
Trinity	WOODLAKE JOSSERAND WSC
Trinity	YMCA CAMP CULLEN
TYLER	CITY OF COLMESNEIL
TYLER	CITY OF WOODVILLE
TYLER	IVANHOE LAND OF LAKES
TYLER	LAKE LIVINGSTON WAYWARD WINDS OASIS
TYLER	TYLER COUNTY WSC
Upshur	Big Sandy
Upshur	Brookshires Camp Joy Water System
Upshur	Camp Glimont
Upshur	City of Big Sandy
Upshur	City of East Mountain
Upshur	City of Gilmer
Upshur	City of Ore City
Upshur	Diana SUD
Upshur	East Mountain
UPSHUR	FOUKE WSC
Upshur	Friendship Water System
Upshur	Glenwood WSC
Upshur	Harmony ISD
Upshur	International Alert Academy
Upshur	Lakeview Camping Resort
Upshur	Latch Grocery
Upshur	Pritchett WSC
UPSHUR	SHARON WSC
Upshur	Tuels M&E T Restaurant
Upshur	Union Grove WSC
Upshur	Upshur County
Upshur	Verns Truck Plaza
Van Zandt	Ben Wheeler WSC
Van Zandt	Big Willies BBQ
Van Zandt	Canton
Van Zandt	Canton Travel Plaza
Van Zandt	City of Canton
Van Zandt	City of Edgewood

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Van Zandt	City of Edom
Van Zandt	City of Grand Saline
Van Zandt	City of Van
Van Zandt	City of Wills Point
Van Zandt	Corinth WSC
Van Zandt	Crooked Creek WSC
Van Zandt	Dynegy Midstream Services
Van Zandt	Edom WSC
Van Zandt	Fruitvale WSC
Van Zandt	Gator Creek Enterprises
Van Zandt	Golden WSC
Van Zandt	Henry Lewis RV Park
Van Zandt	Hydration Source
Van Zandt	JCs Buffet
Van Zandt	Lakewood Trails Water System
Van Zandt	Little Hope-Moore Water Supply
Van Zandt	MacBee SUD
Van Zandt	Martins Mill WSC
Van Zandt	Mytle Springs WSC
Van Zandt	Pruitt Sandflat WSC
VAN ZANDT	R P M WSC
Van Zandt	Rons Trading Post
Van Zandt	RPM WSC
Van Zandt	Shady Acres
Van Zandt	South Tawakoni WSC
Van Zandt	Tall Oaks Estates Water System
Van Zandt	Twin Lakes Golf Course INC
Van Zandt	Van Zandt at Fossil Creek
Van Zandt	Van Zandt County
Van Zandt	Wagon Train RV Park
Van Zandt	Wills Point
Wood	B & D Water CO
Wood	Big Wood Springs Water System
Wood	Bright Star Salem SUD
Wood	Brookhaven Retreat
Wood	C&C Corner Store

Appendix F
List of Stakeholders Receiving Letter

County	Organization Name
Wood	Chaney Point RV Park
Wood	City of Alba
Wood	City of Hawkins
Wood	City of Mineola
Wood	City of Quitman
Wood	City of Winnsboro
Wood	City of Yantis
Wood	Clear Lakes
Wood	Dees Mexican Restaurant
Wood	Eagle Point Estates WS
Wood	Fouke WSC
Wood	Harmony Springs
Wood	Hawkins
Wood	Hideaway Harbor
Wood	Highland Shores RV Park
Wood	Holly Lake Ranch
WOOD	HOLLY RANCH WATER COMPANY
Wood	Hurleys RV Park
Wood	Indian Creek RV Park
Wood	Jarvis Christian College
Wood	Jones WSC
Wood	Lake Fork WSC
Wood	Mineola
Wood	New Hope SUD
Wood	Piney Wood Springs
Wood	Quail Hollow RV Park
Wood	Quitman
Wood	Ramey WSC
Wood	Sharon WSC
Wood	Tamerarias Restaurant
Wood	Whites Landing
Wood	Wood County
Wood	Wood County Bottling Plant
Wood	Wooded Shores RV Park

Appendix H

Documentation for Aquifers Classified as Not Relevant for Purposes of Joint Planning

Gulf Coast Aquifer: Not Relevant for Purposes of Joint Planning
GMA 11 Technical Memorandum 16-03

Nacatoch Aquifer: Not Relevant for Purposes of Joint Planning
GMA 11 Technical Memorandum 16-04

Trinity Aquifer: Not Relevant for Purposes of Joint Planning
GMA 11 Technical Memorandum 16-05

Yegua-Jackson Aquifer: Not Relevant for Purposes of Joint Planning
GMA 11 Technical Memorandum 16-06

Geoscientist and Engineering Seal

This report documents the work and supervision of work of the following licensed Texas Professional Geoscientist and licensed Texas Professional Engineers:

William R. Hutchison, Ph.D., P.E. (96287), P.G. (286)

Dr. Hutchison completed the analyses and model simulations described in this report, and was the principal author of the final report.

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Gulf Coast Aquifer: Not Relevant for Purposes of Joint Planning

GMA 11 Technical Memorandum 16-03, Final

William R. Hutchison, Ph.D., P.E., P.G.
November 17, 2016

Introduction

The Texas Water Development Board, in its July 2013 document, Explanatory Report for Submittal of Desired Future Conditions to the Texas Water Development Board, offers the following guidance regarding documentation for aquifers that are to be classified not relevant for purposes of joint planning:

> *Districts in a groundwater management area may, as part of the process for adopting and submitting desired future conditions, propose classification of a portion or portions of a relevant aquifer as non-relevant (31 Texas Administrative Code 356.31 (b)). This proposed classification of an aquifer may be made if the districts determine that aquifer characteristics, groundwater demands, and current groundwater uses do not warrant adoption of a desired future condition.*
>
> *The districts must submit to the TWDB the following documentation for the portion of the aquifer proposed to be classified as non-relevant:*
>
> 1. *A description, location, and/or map of the aquifer or portion of the aquifer;*
> 2. *A summary of aquifer characteristics, groundwater demands, and current groundwater uses, including the total estimated recoverable storage as provided by the TWDB, that support the conclusion that desired future conditions in adjacent or hydraulically connected relevant aquifer(s) will not be affected; and*
> 3. *An explanation of why the aquifer or portion of the aquifer is non-relevant for joint planning purposes.*

This technical memorandum provides the required documentation to classify the Gulf Coast Aquifer as not relevant for purposes of joint planning.

Aquifer Description and Location

As described in George and others (2011):

> ***The Gulf Coast Aquifer*** *is a major aquifer paralleling the Gulf of Mexico coastline from the Louisiana border to the border of Mexico. It consists of several aquifers, including the Jasper, Evangeline, and Chicot aquifers, which are composed of discontinuous sand, silt, clay, and gravel beds. The maximum total sand thickness of the Gulf Coast Aquifer ranges from 700 feet in the south to 1,300 feet in the north. Freshwater saturated thickness averages about 1,000 feet. Water quality varies with depth and locality: it is generally good in the*

> *central and northeastern parts of the aquifer, where the water contains less than 500 milligrams per liter of total dissolved solids, but declines to the south, where it typically contains 1,000 to more than 10,000 milligrams per liter of total dissolved solids and where the productivity of the aquifer decreases. High levels of radionuclides, thought mainly to be naturally occurring, are found in some wells in Harris County in the outcrop and in South Texas. The aquifer is used for municipal, industrial, and irrigation purposes. In Harris, Galveston, Fort Bend, Jasper, and Wharton counties, water level declines of as much as 350 feet have led to land subsidence. The regional water planning groups, in their 2006 Regional Water Plans, recommended several water management strategies that use the Gulf Coast Aquifer, including drilling more wells, pumping more water from existing wells, temporary overdrafting, constructing new or expanded treatment plants, desalinating brackish groundwater, developing conjunctive use projects, and reallocating supplies.*

Figure 1 (taken from Wade and others, 2014) shows the limited extent of the Gulf Coast Aquifer in GMA 11. Note that it occurs only in a small portion of Angelina, Sabine, and Trinity counties.

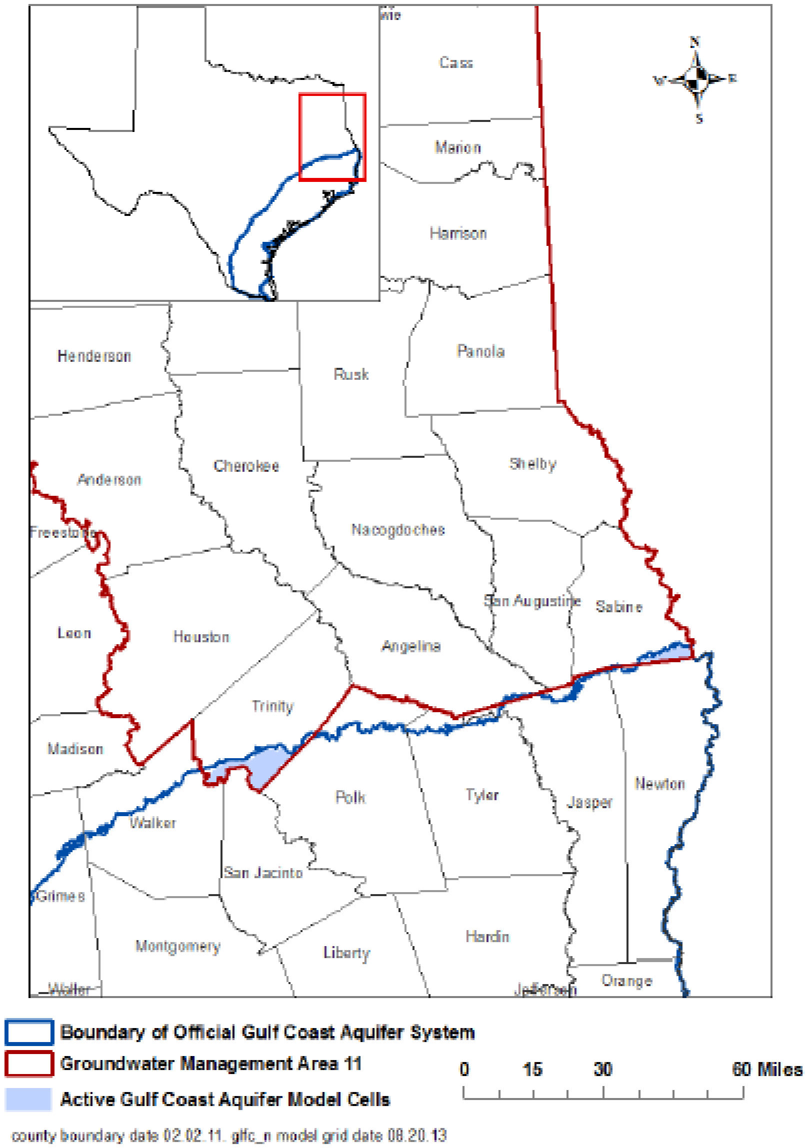

Figure 1. Location of Gulf Coast Aquifer in GMA 11

Aquifer Characteristics

The Jasper Aquifer is the relevant formation within the Gulf Coast Aquifer system in GMA 11. Previous studies (i.e. Chowdhury and others, 2004, pg. 36) noted that hydraulic conductivity in the Jasper is about 1 ft/day.

Gulf Coast Aquifer: Not Relevant for Purposes of Joint Planning

GMA 11 Technical Memorandum 16-03, Final

William R. Hutchison, Ph.D., P.E., P.G.
November 17, 2016

Groundwater Demands and Current Groundwater Uses

The Texas Water Development Board pumping database shows 2012 groundwater pumping for the Gulf Coast Aquifer as follows:

- Sabine: 18 AF/yr
- Trinity: 333 AF/yr

No pumping was listed for Angelina County.

Total Estimated Recoverable Storage

Wade and others (2013) documented the total estimated recoverable storage for the Gulf Coast Aquifer in GMA 11 as follows:

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Angelina	27,000	6,750	20,250
Sabine	120,000	30,000	90,000
Trinity	1,300,000	325,000	975,000
Total	1,447,000	361,750	1,085,250

Total storage is given in the first column. The recoverable storage is assumed to be between 25 and 75 percent of the total storage.

Explanation of Non-Relevance

Due to its limited areal extent and generally low use, the Gulf Coast Aquifer is classified as not relevant for purposes of joint planning in Groundwater Management Area 11.

References

Chowdhury, A.H., Wade, S., Mace, R.E., Ridgeway, C., 2004. Groundwater Availability Model of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999. Texas Water Development Board, Groundwater Availability Modeling Section, September 27, 2004, 114p.

George, P.G., Mace, R.E., and Petrossian, R., 2011. Aquifers of Texas. Texas Water Development Board Report 380, July 2011, 182p.

Wade, S., Shi, J., and Seiter-Weatherford, C. 2014. GAM Task 13-034: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 11. Texas Water Development Board, Groundwater Resources Division, April 2, 2014, 30p.

Nacatoch Aquifer: Not Relevant for Purposes of Joint Planning

GMA 11 Technical Memorandum 16-04, Final

William R. Hutchison, Ph.D., P.E., P.G.
November 17, 2016

Introduction

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> 1. *A description, location, and/or map of the aquifer or portion of the aquifer;*
> 2. *A summary of aquifer characteristics, groundwater demands, and current groundwater uses, including the total estimated recoverable storage as provided by the TWDB, that support the conclusion that desired future conditions in adjacent or hydraulically connected relevant aquifer(s) will not be affected; and*
> 3. *An explanation of why the aquifer or portion of the aquifer is non-relevant for joint planning purposes.*

This technical memorandum provides the required documentation to classify the Nacatoch Aquifer as not relevant for purposes of joint planning.

Aquifer Description and Location

As described in George and others (2011):

> ***The Nacatoch Aquifer*** *is a minor aquifer occurring in a narrow band across northeast Texas. The aquifer consists of the Nacatoch Sand, composed of sequences of sandstone separated by impermeable layers of mudstone or clay. These sandstones are marine in origin, coarsen upward, and are laterally discontinuous. The number of sand layers varies throughout the Nacatoch's extent, and the thickness of individual sand units ranges from more than 100 feet in the north to less than 20 feet to the south. Thickness of intervening mudstone*

> *units similarly ranges from more than 100 feet to only a few feet. Freshwater saturated thickness averages about 50 feet. The aquifer also includes a hydraulically connected cover of alluvium that is as much as 80 feet thick along major drainages. Groundwater in this aquifer is usually under artesian conditions except in shallow wells where the Nacatoch Formation crops out and water table conditions exist. The Mexia-Talco Fault Zone generally delineates the subsurface limit of the aquifer. The groundwater in the aquifer is typically alkaline, high in sodium bicarbonate, and soft. Total dissolved solids in the subsurface increase and are significantly higher south of the Mexia-Talco Fault Zone, where the water contains between 1,000 and 3,000 milligrams per liter of total dissolved solids. Water from the aquifer is extensively used for domestic and livestock purposes. The city of Commerce historically pumped the greatest amount from the Nacatoch Aquifer but has recently attempted to convert to surface water; however, because of recent droughts, the city has pumped 30 to 50 percent of its water from the aquifer. As a result of Commerce's reduced pumping, the declining water levels that had developed around Commerce in Delta and Hunt counties are stabilizing. The North East Texas Regional Water Planning Group, in its 2006 Regional Water Plan, recommended new and supplemental groundwater wells in the Nacatoch Aquifer as a water management strategy.*

Figure 1 (taken from Wade and others, 2014) shows the limited extent of the Nacatoch Aquifer in GMA 11. Note that it occurs only in a small portion of Bowie, Henderson, Morris, Red River, and Titus counties.

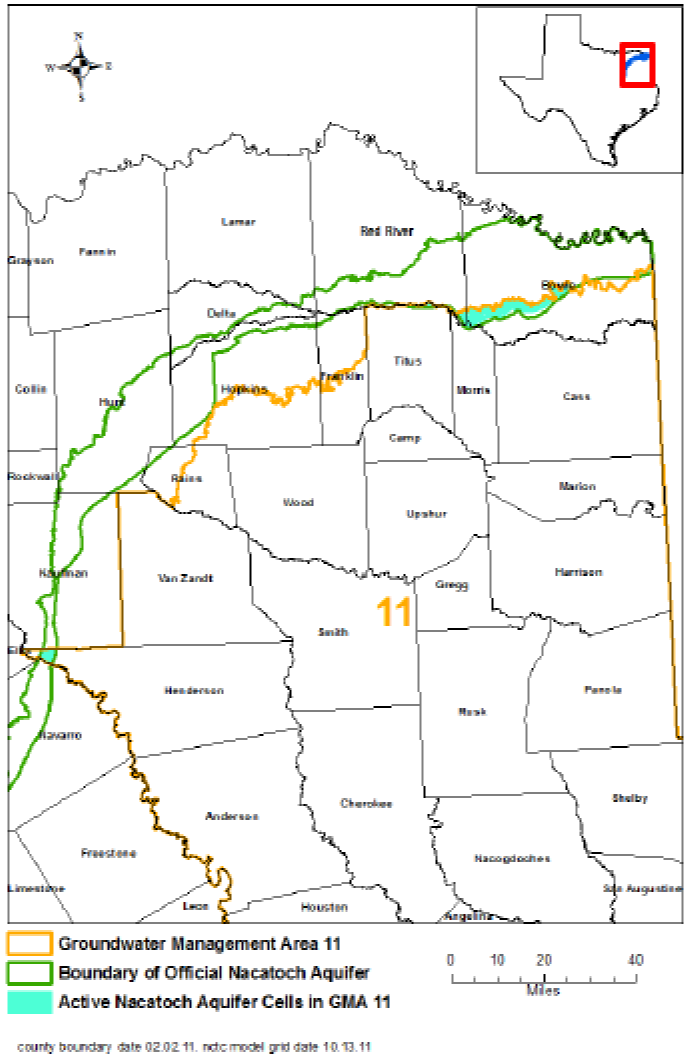

Figure 1. Location of Nacatoch Aquifer in GMA 11

Aquifer Characteristics

Beach and others (2009) developed a groundwater availability model for the Nacatoch Aquifer for the Texas Water Development Board. This study appears to document only two estimates of hydraulic conductivity in GMA 11 (Beach and others, 2009, pg. 4-57) in Bowie County (1 to 3 ft/day). The groundwater modeling effort included developing estimates of hydraulic conductivity throughout the area (Beach and others, 2009, pp 8-4 and 8-5).

Nacatoch Aquifer: Not Relevant for Purposes of Joint Planning

GMA 11 Technical Memorandum 16-04, Final

William R. Hutchison, Ph.D., P.E., P.G.
November 17, 2016

Groundwater Demands and Current Groundwater Uses

The Texas Water Development Board pumping database shows 2012 groundwater pumping for the Nacatoch Aquifer as follows:

- Bowie: 1,466 AF/yr
- Henderson: 12 AF/yr
- Hopkins: 1,113 AF/yr
- Titus: 100 AF/yr

No pumping estimates are listed for Morris or Red River counties.

Total Estimated Recoverable Storage

Wade and others (2013) documented the total estimated recoverable storage for the Nacatoch Aquifer in GMA 11 as follows:

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Bowie	140,000	35,000	105,000
Henderson	9,800	2,450	7,350
Morris	2,900	725	2,175
Red River	11,000	2,750	8,250
Titus	15,000	3,750	11,250
Total	178,700	44,675	134,025

Total storage is given in the first column. The recoverable storage is assumed to be between 25 and 75 percent of the total storage.

Explanation of Non-Relevance

Due to its limited areal extent and generally low use, the Nacatoch Aquifer is classified as not relevant for purposes of joint planning in Groundwater Management Area 11.

References

Beach, J.A., Huang, Y., Symank, L., Ashworth, J.B., Davidson, T., Vreugdenhil, A.M., and Deeds, N.E., 2009. Final Report: Nacatoch Aquifer Groundwater Availability Model. Prepared for the Texas Water Development Board, January 2009, 304p.

George, P.G., Mace, R.E., and Petrossian, R., 2011. Aquifers of Texas. Texas Water Development Board Report 380, July 2011, 182p.

Wade, S., Shi, J., and Seiter-Weatherford, C. 2014. GAM Task 13-034: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 11. Texas Water Development Board, Groundwater Resources Division, April 2, 2014, 30p.

Trinity Aquifer: Not Relevant for Purposes of Joint Planning

GMA 11 Technical Memorandum 16-05, Final

William R. Hutchison, Ph.D., P.E., P.G.
November 17, 2016

Introduction

The Texas Water Development Board, in its July 2013 document, Explanatory Report for Submittal of Desired Future Conditions to the Texas Water Development Board, offers the following guidance regarding documentation for aquifers that are to be classified not relevant for purposes of joint planning:

> *Districts in a groundwater management area may, as part of the process for adopting and submitting desired future conditions, propose classification of a portion or portions of a relevant aquifer as non-relevant (31 Texas Administrative Code 356.31 (b)). This proposed classification of an aquifer may be made if the districts determine that aquifer characteristics, groundwater demands, and current groundwater uses do not warrant adoption of a desired future condition.*
>
> *The districts must submit to the TWDB the following documentation for the portion of the aquifer proposed to be classified as non-relevant:*
>
> 1. *A description, location, and/or map of the aquifer or portion of the aquifer;*
> 2. *A summary of aquifer characteristics, groundwater demands, and current groundwater uses, including the total estimated recoverable storage as provided by the TWDB, that support the conclusion that desired future conditions in adjacent or hydraulically connected relevant aquifer(s) will not be affected; and*
> 3. *An explanation of why the aquifer or portion of the aquifer is non-relevant for joint planning purposes.*

This technical memorandum provides the required documentation to classify the Trinity Aquifer as not relevant for purposes of joint planning.

Aquifer Description and Location

As described in George and others (2011):

> ***The Trinity Aquifer,*** *a major aquifer, extends across much of the central and northeastern part of the state. It is composed of several smaller aquifers contained within the Trinity Group. Although referred to differently in different parts of the state, they include the Antlers, Glen Rose, Paluxy, Twin Mountains, Travis Peak, Hensell, and Hosston aquifers. These aquifers consist of limestones, sands, clays, gravels, and conglomerates. Their combined freshwater saturated thickness averages about 600 feet in North Texas and about 1,900 feet in Central Texas. In*

> *general, groundwater is fresh but very hard in the outcrop of the aquifer. Total dissolved solids increase from less than 1,000 milligrams per liter in the east and southeast to between 1,000 and 5,000 milligrams per liter, or slightly to moderately saline, as the depth to the aquifer increases. Sulfate and chloride concentrations also tend to increase with depth. The Trinity Aquifer discharges to a large number of springs, with most discharging less than 10 cubic feet per second. The aquifer is one of the most extensive and highly used groundwater resources in Texas. Although its primary use is for municipalities, it is also used for irrigation, livestock, and other domestic purposes. Some of the state's largest water level declines, ranging from 350 to more than 1,000 feet, have occurred in counties along the IH-35 corridor from McLennan County to Grayson County. These declines are primarily attributed to municipal pumping, but they have slowed over the past decade as a result of increasing reliance on surface water. The regional water planning groups, in their 2006 Regional Water Plans, recommended numerous water management strategies for the Trinity Aquifer, including developing new wells and well fields, pumping more water from existing wells, overdrafting, reallocating supplies, and using surface water and groundwater conjunctively.*

Figure 1 (taken from Wade and others, 2014) shows the limited extent of the Trinity Aquifer in GMA 11. Note that it occurs only in a small portion of Henderson County.

William R. Hutchison, Ph.D., P.E., P.G.

Figure 1. Location of Trinity Aquifer in GMA 11

Aquifer Characteristics

Kelley and others (2014) developed an updated groundwater availability model of the Northern Trinity and Woodbine aquifers for four groundwater conservation districts in north Texas. This model covered the entire Northern Trinity Aquifer, including the small portion in Henderson County. Maps of calibrated horizontal hydraulic conductivity are provided in Kelley and others (2014, pg. 8:1-6, 8:1-7, 8:1-8, 8:1-9, 8:1-10, 8:1-11, 8:1-12). Estimated values are typically 0.1 ft/day or less, except for the Hosston Aquifer, which was shown as between 3 and 10 ft/day.

Trinity Aquifer: Not Relevant for Purposes of Joint Planning

GMA 11 Technical Memorandum 16-05, Final

William R. Hutchison, Ph.D., P.E., P.G.
November 17, 2016

Groundwater Demands and Current Groundwater Uses

The Texas Water Development Board pumping database does not list any pumping from the Trinity Aquifer in Henderson County. However, the database shows 42 AF/yr was pumping from the Trinity Aquifer in Trinity County in 2012.

Total Estimated Recoverable Storage

Wade and others (2013) documented the total estimated recoverable storage for the Trinity Aquifer in GMA 11 as follows:

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Henderson	500,000	125,000	375,000
Total	500,000	125,000	375,000

Total storage is given in the first column. The recoverable storage is assumed to be between 25 and 75 percent of the total storage.

Explanation of Non-Relevance

Due to its limited areal extent and generally low use, the Trinity Aquifer is classified as not relevant for purposes of joint planning in Groundwater Management Area 11.

References

Kelley, V.A., Ewing, J., Jones, T.L., Young, S.C., Deeds, N., Hamlin, S., Jigmond, M., Harding, J., Pinkard, J., Yan, T.T., Scanlon, B., Beach, J., Davidson, T., Laughlin, K., 2014, Final Report: Updated Groundwater Availability Model of the Northern Trinity and Woodbine Aquifers. Report prepared for North Texas GCD, Northern Trinity GCD, Prairielands GCD, and Upper Trinity GCD. August 2014, Volume 1, 990p.

George, P.G., Mace, R.E., and Petrossian, R., 2011. Aquifers of Texas. Texas Water Development Board Report 380, July 2011, 182p.

Wade, S., Shi, J., and Seiter-Weatherford, C. 2014. GAM Task 13-034: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 11. Texas Water Development Board, Groundwater Resources Division, April 2, 2014, 30p.

Yegua-Jackson Aquifer: Not Relevant for Purposes of Joint Planning

GMA 11 Technical Memorandum 16-06, Final

William R. Hutchison, Ph.D., P.E., P.G.
November 17, 2016

Introduction

The Texas Water Development Board, in its July 2013 document, Explanatory Report for Submittal of Desired Future Conditions to the Texas Water Development Board, offers the following guidance regarding documentation for aquifers that are to be classified not relevant for purposes of joint planning:

> *Districts in a groundwater management area may, as part of the process for adopting and submitting desired future conditions, propose classification of a portion or portions of a relevant aquifer as non-relevant (31 Texas Administrative Code 356.31 (b)). This proposed classification of an aquifer may be made if the districts determine that aquifer characteristics, groundwater demands, and current groundwater uses do not warrant adoption of a desired future condition.*
>
> *The districts must submit to the TWDB the following documentation for the portion of the aquifer proposed to be classified as non-relevant:*
>
> 1. *A description, location, and/or map of the aquifer or portion of the aquifer;*
> 2. *A summary of aquifer characteristics, groundwater demands, and current groundwater uses, including the total estimated recoverable storage as provided by the TWDB, that support the conclusion that desired future conditions in adjacent or hydraulically connected relevant aquifer(s) will not be affected; and*
> 3. *An explanation of why the aquifer or portion of the aquifer is non-relevant for joint planning purposes.*

This technical memorandum provides the required documentation to classify the Yegua-Jackson Aquifer as not relevant for purposes of joint planning.

Aquifer Description and Location

As described in George and others (2011):

> ***The Yegua-Jackson Aquifer*** *is a minor aquifer stretching across the southeast part of the state. It includes water-bearing parts of the Yegua Formation (part of the upper Claiborne Group) and the Jackson Group (comprising the Whitsett, Manning, Wellborn, and Caddell formations). These geologic units consist of interbedded sand, silt, and clay layers originally deposited as fluvial and deltaic sediments. Freshwater saturated thickness averages about 170 feet. Water quality*

> *varies greatly owing to sediment composition in the aquifer formations, and in all areas the aquifer becomes highly mineralized with depth. Most groundwater is produced from the sand units of the aquifer, where the water is fresh and ranges from less than 50 to 1,000 milligrams per liter of total dissolved solids. Some slightly to moderately saline water, with concentrations of total dissolved solids ranging from 1,000 to 10,000 milligrams per liter, also occurs in the aquifer. No significant water level declines have occurred in wells measured by the TWDB. Groundwater for domestic and livestock purposes is available from shallow wells over most of the aquifer's extent. Water is also used for some municipal, industrial, and irrigation purposes. The regional water planning groups, in their 2006 Regional Water Plans, recommended several water management strategies that use the Yegua-Jackson Aquifer, including drilling more wells and desalinating the water.*

Figure 1 (taken from Wade and others, 2014) shows the limited extent of the Yegua-Jackson Aquifer in GMA 11.

Yegua-Jackson Aquifer: Not Relevant for Purposes of Joint Planning

GMA 11 Technical Memorandum 16-06, Final

William R. Hutchison, Ph.D., P.E., P.G.
November 17, 2016

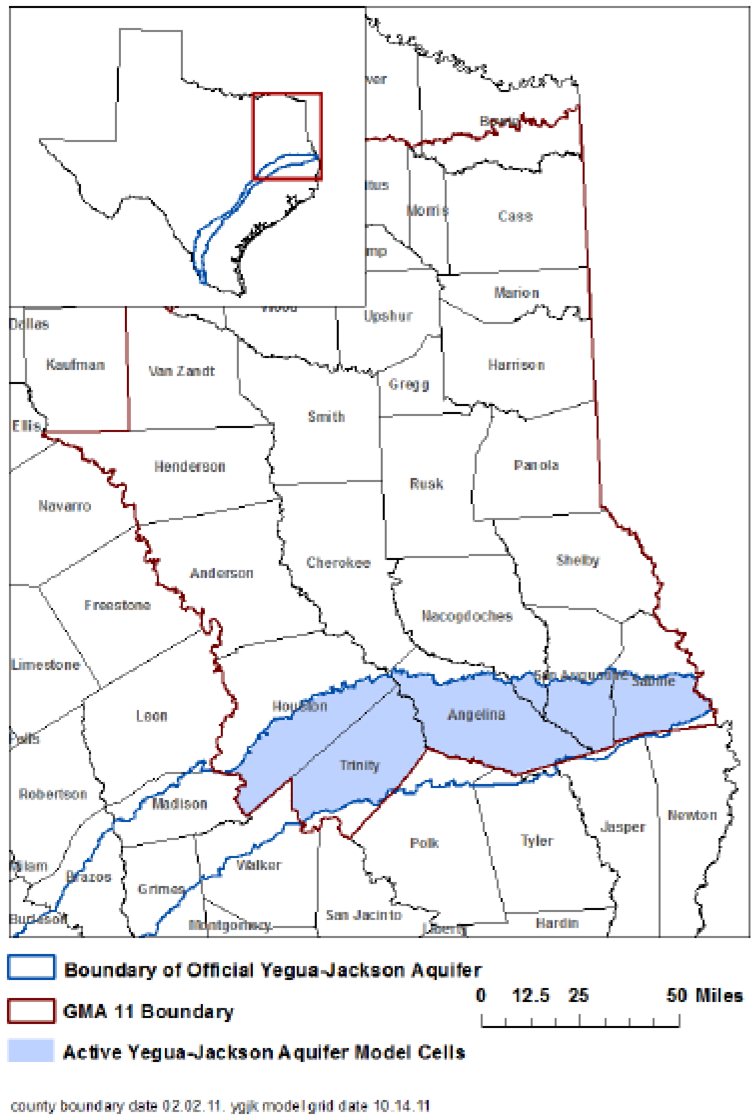

Figure 1. Location of Yegua-Jackson Aquifer in GMA 11

Aquifer Characteristics

Deeds and others (2010) developed a groundwater availability model of the Yegua-Jackson Aquifer for the Texas Water Development Board. Maps of calibrated horizontal hydraulic conductivity are provided on pages 8-7, to 8-11. Estimated values in the GMA 11 area vary considerably from less than 1ft/day to over 30 ft/day, depending on the unit and location.

Yegua-Jackson Aquifer: Not Relevant for Purposes of Joint Planning

GMA 11 Technical Memorandum 16-06, Final

William R. Hutchison, Ph.D., P.E., P.G.
November 17, 2016

Groundwater Demands and Current Groundwater Uses

The Texas Water Development Board pumping database does not list any pumping from the Trinity Aquifer in Henderson County. However, the database shows 42 AF/yr was pumping from the Trinity Aquifer in Trinity County in 2012.

Total Estimated Recoverable Storage

Wade and others (2013) documented the total estimated recoverable storage for the Yegua-Jackson Aquifer in GMA 11 as follows:

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Angelina	72,000,000	18,000,000	54,000,000
Houston	21,000,000	5,250,000	15,750,000
Nacogdoches	1,400,000	350,000	1,050,000
Sabine	30,000,000	7,500,000	22,500,000
San Augustine	19,000,000	4,750,000	14,250,000
Trinity	83,000,000	20,750,000	62,250,000
Total	226,400,000	56,600,000	169,800,000

Total storage is given in the first column. The recoverable storage is assumed to be between 25 and 75 percent of the total storage.

Explanation of Non-Relevance

Due to its limited areal extent and generally low use, the Yegua-Jackson Aquifer is classified as not relevant for purposes of joint planning in Groundwater Management Area 11.

References

Deeds, N.E., Yan, T., Singh, A., Jones, T.L., Kelley, V.A., Knox, P.R., and Young, S.C., 2010. Final Report: Groundwater Availability Model for the Yegua-Jackson Aquifer. Prepared for the Texas Water Development Board, March 2010, 582p.

George, P.G., Mace, R.E., and Petrossian, R., 2011. Aquifers of Texas. Texas Water Development Board Report 380, July 2011, 182p.

Wade, S., Shi, J., and Seiter-Weatherford, C. 2014. GAM Task 13-034: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 11. Texas Water Development Board, Groundwater Resources Division, April 2, 2014, 30p.