AGS
Advanced Groundwater Solutions, LLC
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Technical Memorandum

TO: Mr. Nathan Jones, Director
Administration, Procurement, Water, Environmental and Distribution Services
Facilities & Energy Services Division of Operations
Texas A&M University

FROM: Christopher Drabek, P.G. and Ye Hong Chen, PhD, E.I.T.

SUBJECT: Texas A&M University RELLIS Campus Simsboro Well
Aquifer Evaluation Report

DATE: August 12, 2024

Introduction

On behalf of Texas A&M University (TAMU), Advanced Groundwater Solutions, LLC (AGS) has prepared an Aquifer Evaluation Report (AER) for the future TAMU RELLIS Campus Well (RELLIS Well) that is planned to be completed in the Simsboro Aquifer. It is our understanding that the permit request is for 1,934.8 acre-feet per year from the Simsboro Aquifer and that the proposed well is planned to have a pumping rate of 2,800 gallons per minute (gpm).

For a single well application, Brazos Valley Groundwater Conservation District (BVGCD, District) Rule 8.4(b)(7)(D) allows an applicant to request the District to engage its hydrologist to complete the report to address requirements of BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year.

AGS has evaluated the hydrogeological conditions, mapping of BVGCD permitted and registered Simsboro wells within one mile of the proposed RELLIS Well, the water level drawdown estimates developed using the Texas Water Development Board (TWDB) Groundwater Availability Model (GAM) and analytical tools and the proposed well pumping effects on the applicable Desired Future Conditions (DFCs) adopted by the District.

Hydrogeologic Conditions

Rule 8.4(b)(7)(B)(1)

The proposed RELLIS Well location is shown on Figure 1 below, with the well located about 1.5 miles to the southwest of the intersection of State Highway 21 and State Highway 47 in Brazos County.

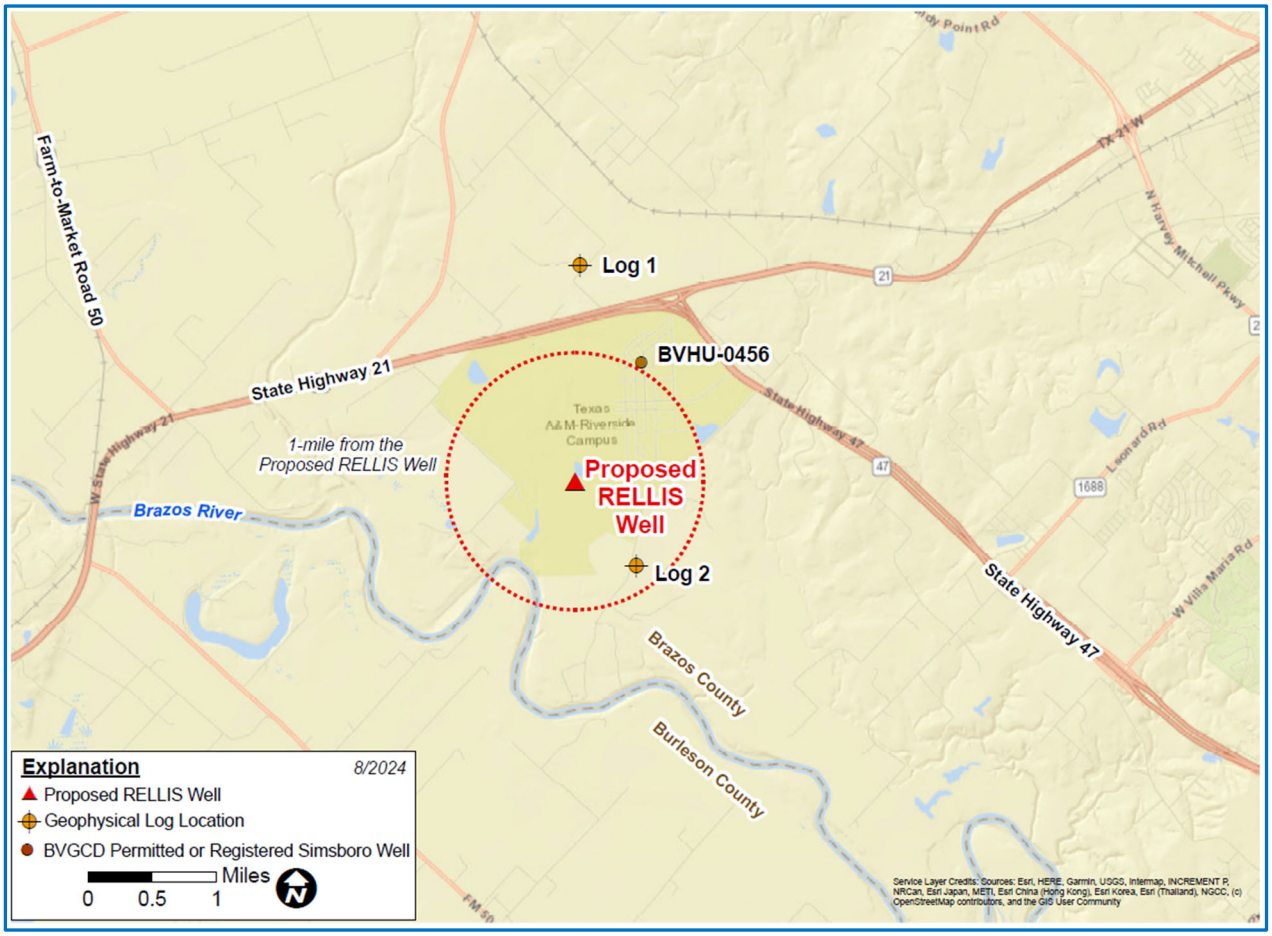

Figure 1. Proposed Texas A&M University RELLIS Campus Simsboro Well Location Map

Surface Geology

Surface geology based on the 2014 Geologic Database of Texas is shown on Figure 2 and is in agreement with the geologic formations shown on the Geologic Atlas of Texas, Austin Sheet (1981). Both sources indicated that Fluviatile Terrace Deposits (Qt) are present at land surface in the vicinity of the proposed well. The proposed well site has a land surface elevation of about 251 feet above sea level, based on estimates from the United States Geological Survey (USGS) Bryan West, Texas topographic map (1980).

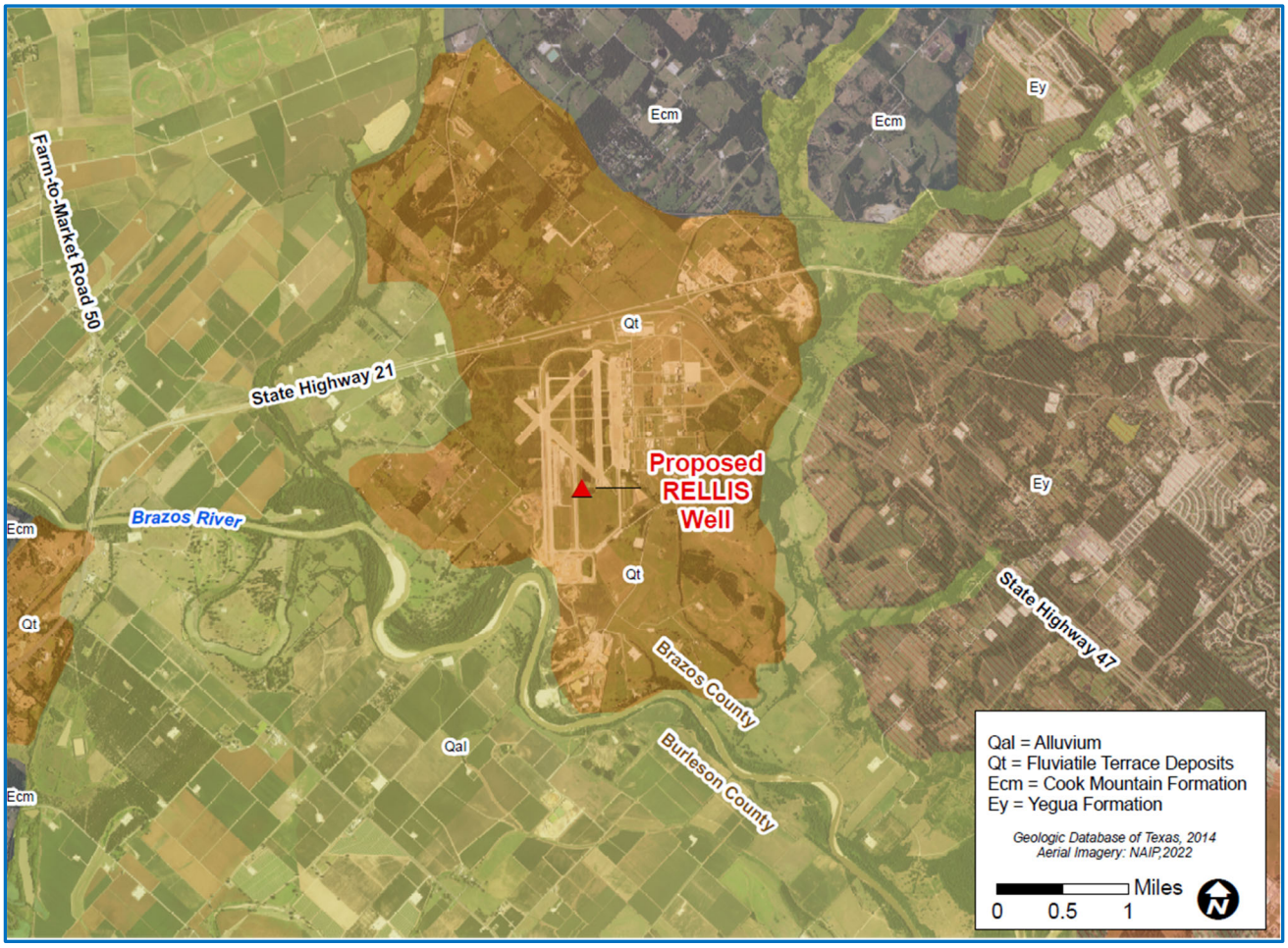

Figure 2. Surface Geology in the Vicinity of the
Proposed Texas A&M University RELLIS Campus Simsboro Well

Depth Interval of the Proposed Water Bearing Zone

As shown on Figure 1, Texas A&M University Well 6 (Log 1) is located about 1.7 miles to the north of the proposed RELLIS Well. The geophysical log shows the top of the Simsboro Aquifer at a depth of about 2,572 feet (-2,305 feet, relative to seal level (rsl)) and the base of the Simsboro Aquifer at a depth of about 3,200 feet (-2,933 feet, rsl). A sand thickness of about 550 feet was estimated from the geophysical log.

The Langham Petroleum, Broach #1 (Log 2) oil and/or gas well or test hole is located about 0.8 miles to the southeast of the proposed RELLIS Well and shows the top of the Simsboro Aquifer at a depth of about 2,900 feet (-2,656 feet, rsl) and the base of the Simsboro Aquifer at a depth of about 3,390 feet (-3,146 feet, rsl). A sand thickness of about 490 feet was estimated from the geophysical log.

Based on the review of the two geophysical logs, the top of the Simsboro Aquifer is estimated to occur at a depth of about 2,780 feet (-2,529 feet, rsl) and the base of the Simsboro Aquifer at a depth of about 3,305 feet (-3,054 feet, rsl).

Site specific information will be available once the test hole is drilled and logged for the proposed RELLIS Well.

Anticipated Thickness of the Water Bearing Zone

Based on the review of the two geophysical logs in the vicinity of the proposed RELLIS Well, the thickness of the water bearing zone is estimated to be about 500 feet.

A Statement of whether the water bearing zone is anticipated to be in unconfined or confined condition

The water bearing zone of the proposed RELLIS Well will be under confined conditions. As shown on Figure 1, Texas A&M Well 8 (BVHU-0456) is located about 5,800 feet to the northeast of the proposed RELLIS Well. The Well 8 Layne Texas Driller's Log shows about 1,400 feet of shale or other low permeability sediments from land surface down to a depth of about 3,000 feet. A water level of about 255 feet below ground level was measured in Well 8 by BVGCD in June 2023, which demonstrates that the aquifer is under confined conditions as the artesian pressure rises above the top of the aquifer.

Description of any Hydraulic Features or Geologic Features Located within One Mile of the Proposed Well Site

The Brazos River is located about 4,000 feet to the southwest of the proposed RELLIS Well. Review of aerial imagery shows a couple of ponds located in proximity to the proposed well location. No geologic features were identified within one mile of the proposed RELLIS Well.

Simsboro Aquifer Wells Within 1-mile of the Proposed Texas A&M University RELLIS Campus Simsboro Well

Rule 8.4(b)(7)(B)(2)

There are no BVGCD permitted or registered Simsboro wells within 1-mile of the proposed RELLIS Well. Texas A&M Well 8 (BVHU-0456) is the closest BVGCD permitted and / or registered Simsboro well to the proposed well. TAMU Well 8 is located about 5,800 feet to the northeast of the proposed RELLIS Well.

Interference Drawdown Estimates

Rule 8.4(b)(7)(B)(3)

BVGCD Rule 8.4(b)(7)(B)(3) requires an estimate of water level drawdown caused by the well(s) pumping at the permitted rate for 1 year, 10 years and 20 years at a distance of five miles from a well(s) producing 3,000 or less acre feet per year using the most recent version of the TWDB approved Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM. An estimate of the drawdown at locations of existing registered and permitted wells in the BVGCD

database that are located within one mile and screen the same aquifer as the well(s) is required to be developed using an analytical tool.

Appropriate analytical models are generally used to provide estimates of pumping effects at or near the well(s) over shorter time horizons. Regional numerical models like the TWDB GAMs are generally used to account for regional variability in the aquifer such as changes in transmissivity and faulting as well as recharge, leakage between aquifers, stream-aquifer interaction, other pumping, and other factors impacting water levels. Appropriate numerical models can provide more reliable estimates of pumping effects on a more regional scale and over longer time horizons.

Groundwater Availability Model Simulation

AGS utilized Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020) to isolate the pumping effects of the proposed RELLIS Well after 1 year, 10 years and 20 years of pumping. An average continuous pumping rate of 1,200 gpm was assigned to GAM node 168891 for the proposed RELLIS Well. Pumping must be assigned to the center of the model node, so the following GAM results show the estimated drawdown simulated at the center of the model node even though the proposed well is planned to be geographically located about 2,200 feet to the northwest of the center of the model node.

Two GAM simulations were completed with the first simulation (the baseline run) using the unmodified Groundwater Management Area (GMA) 12 "S-19" DFC run and with the second simulation (the modified run) being identical to the baseline except that the requested 1,934.8 ac-ft/yr of pumping was included in the MODFLOW WEL file. The simulated water levels from each simulation were compared by subtracting the simulated water level elevations of the baseline run from the modified run. This comparison isolates the pumping effects of the requested pumping. GMA 12 "S-19" includes additional regional pumping, which gradually increases through time. GMA 12 "S-19" was approved in 2021 and does not include all of the pumping from the Simsboro Aquifer that has been permitted by BVGCD to date.

Figures 3, 4 and 5 show the simulated effects after 1 year, 10 years and 20 years of pumping 1,200 gpm from the proposed RELLIS Well, respectively. The contours shown on Figures 3, 4 and 5 are centered on the GAM pumping node. The locations of the BVGCD permitted and/or registered Simsboro wells in the vicinity of the proposed RELLIS Well are also shown on the figures.

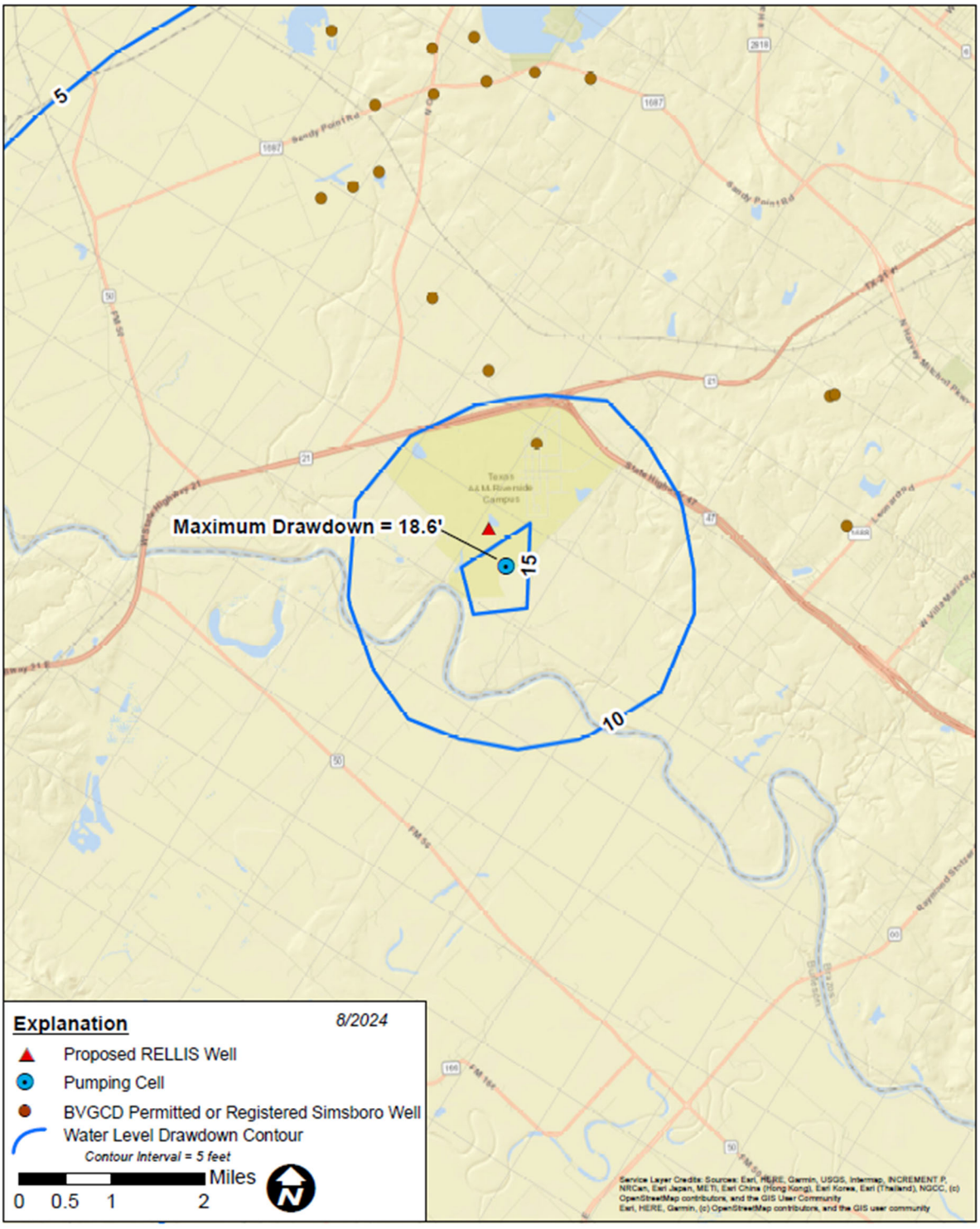

Figure 3. GAM Simulated Drawdown in the Simsboro Aquifer after Pumping the Proposed Texas A&M University RELLIS Campus Well at 1,200 gpm for One Year

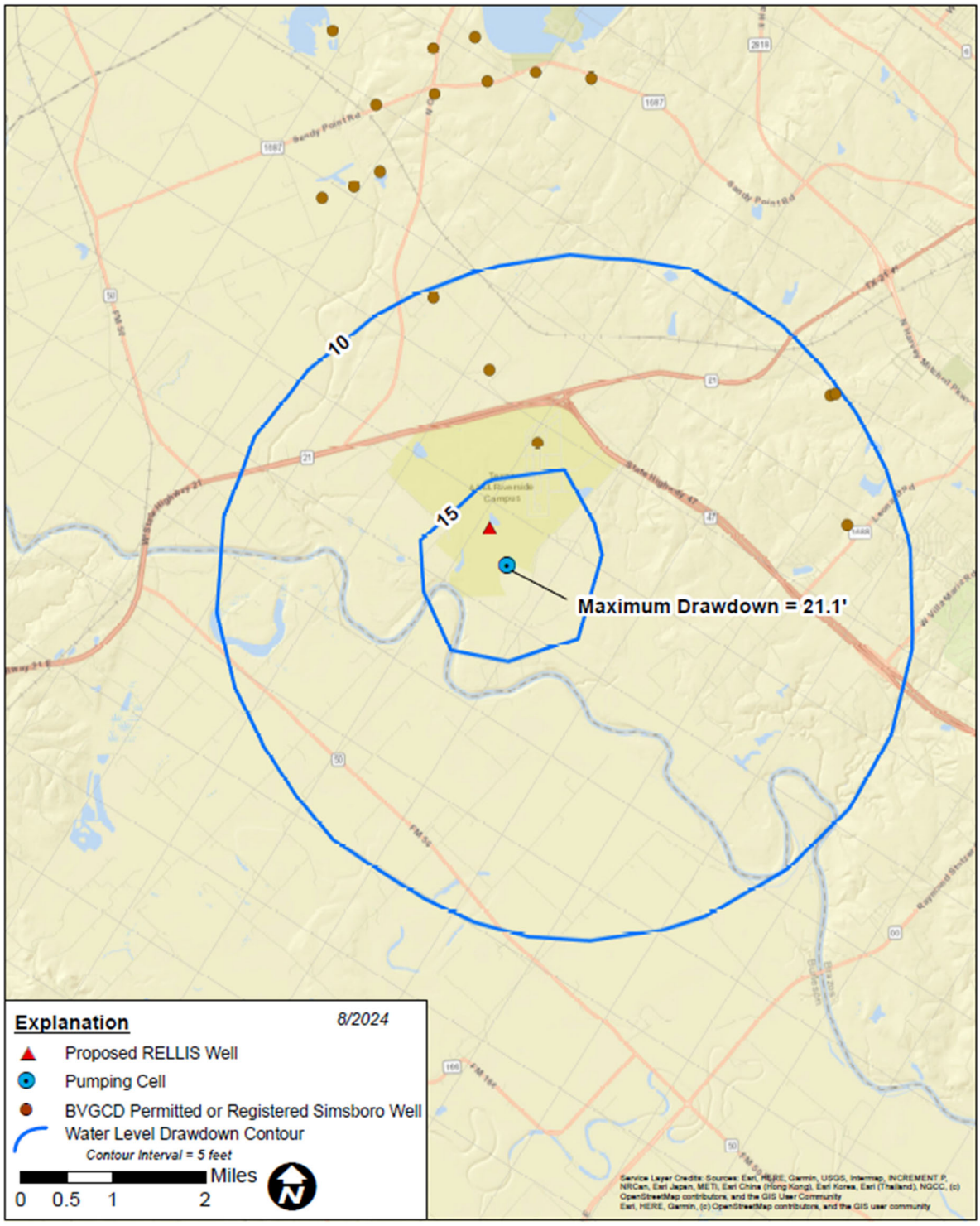

Figure 4. GAM Simulated Drawdown in the Simsboro Aquifer after Pumping the Proposed Texas A&M University RELLIS Campus Well at 1,200 gpm for 10 Years

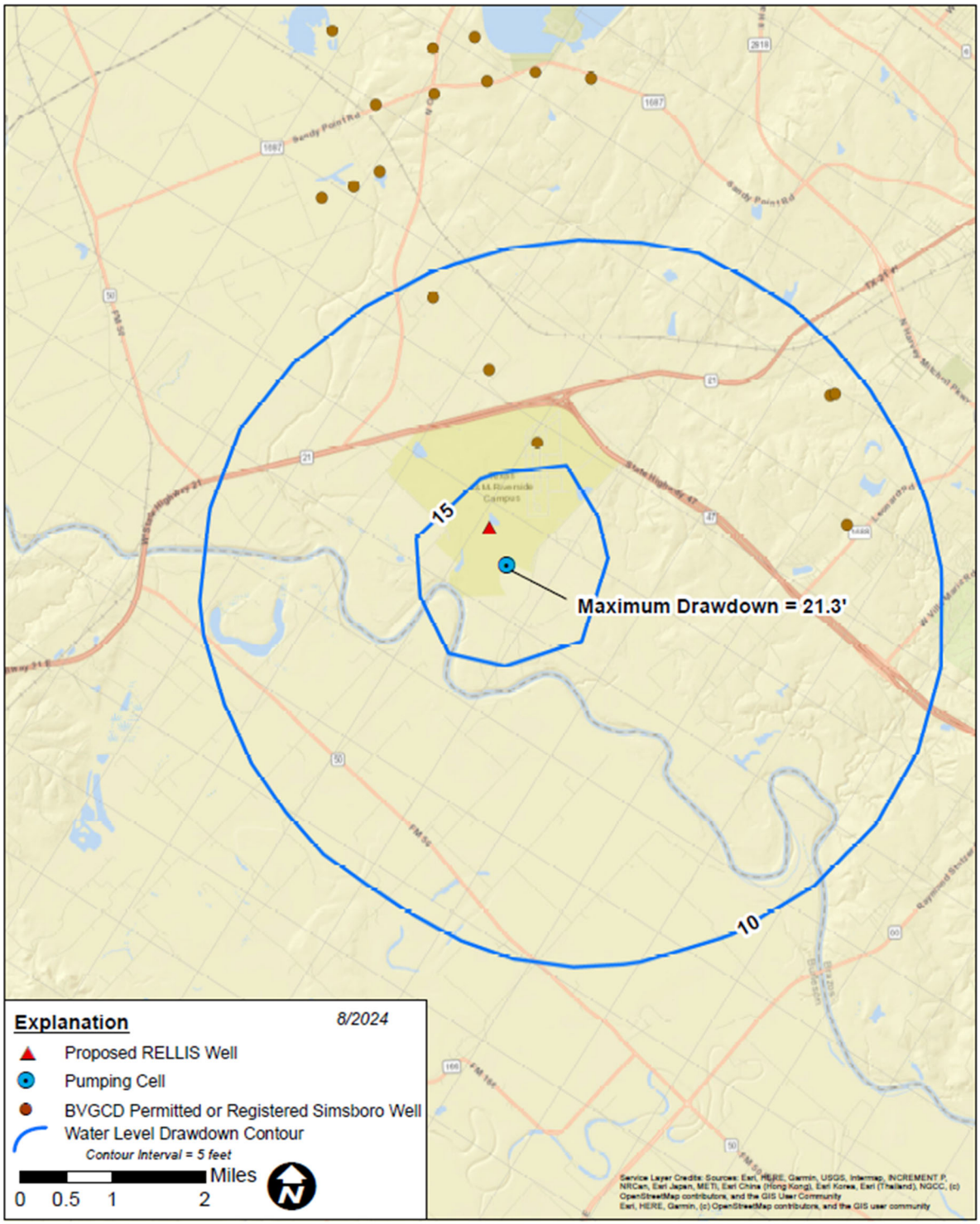

Figure 5. GAM Simulated Drawdown in the Simsboro Aquifer after Pumping the Proposed Texas A&M University RELLIS Campus Well at 1,200 gpm for 20 Years

Figure 3 shows a maximum GAM simulated drawdown of about 18.6 feet in the Simsboro Aquifer at the pumping node after pumping the proposed RELLIS Well at 1,200 gpm for one year. The 1-year GAM simulated interference drawdown shown on Figure 3 is estimated to be about 11 to 15 feet at one mile from the proposed well and about 6 to 8 feet at a distance of five miles from the proposed well, depending on the direction from the proposed well.

Figure 4 shows a maximum GAM simulated drawdown of about 21.1 feet in the Simsboro Aquifer at the pumping node after pumping the proposed RELLIS Well at 1,200 gpm for 10 years. The 1-year GAM simulated interference drawdown shown on Figure 4 is estimated to be about 13 to 18 feet at one mile from the proposed well and about 8 to 10 feet at a distance of five miles from the proposed well, depending on the direction from the proposed well.

Figure 5 shows a maximum GAM simulated drawdown of about 21.3 feet in the Simsboro Aquifer at the pumping node after pumping the proposed RELLIS Well at 1,200 gpm for 20 years. The 20-year GAM simulated interference drawdown shown on Figure 5 is estimated to be about 14 to 19 feet at one mile from the proposed well and about 9 to 11 feet at a distance of five miles from the proposed well, depending on the direction from the proposed well.

This AER is based on the hydrogeologic information available today, the information provided by the applicant, and the models and tools available at this time. New scientific or hydrogeologic information or updated models may change the findings of this evaluation.

Analytical Model Simulation

AGS estimated the drawdown at the pumping well using a Theis analytical model and calculating the drawdown at a distance of one foot from the well. Simsboro Aquifer properties from the GAM at the proposed well location were used in the analytical simulations, with a transmissivity value of about 72,876 gallons per day per foot (gpd/ft) and a storage value of 0.00013.

Table 1 provides a summary of the analytical model simulated drawdown estimates at the proposed RELLIS Well after pumping 1,200 gpm for 1 day, 30 days and 365 days. As mentioned, Texas A&M University Well 8 (BVHU-0456) is the closest BVGCD permitted Simsboro well to the proposed well and is located about 5,800 feet to the northeast of the proposed RELLIS Well. Although this well is located over a mile from the proposed well, simulated drawdown estimates are included in Table 1.

Table 1. Theis Analytical Simulated Drawdown at the proposed Texas A&M University RELLIS Campus Well and Texas A&M University Well 8 After Pumping the Proposed Texas A&M University RELLIS Campus Well at a rate of 1,200 gpm for 1 Day, 30 Days and 365 Days.

Well	Simulated Drawdown After 1 Day of Pumping (feet)	Simulated Drawdown After 30 Days of Pumping (feet)	Simulated Drawdown After 365 Days of Pumping (feet)
Proposed RELLIS Well	36	42	47
Texas A&M Well 8	3	10	14

Figures 6, 7 and 8 show the Theis analytical simulated pumping effects after 1 day, 30 days and 365 days of pumping 1,200 gpm from the proposed RELLIS Well, respectively.

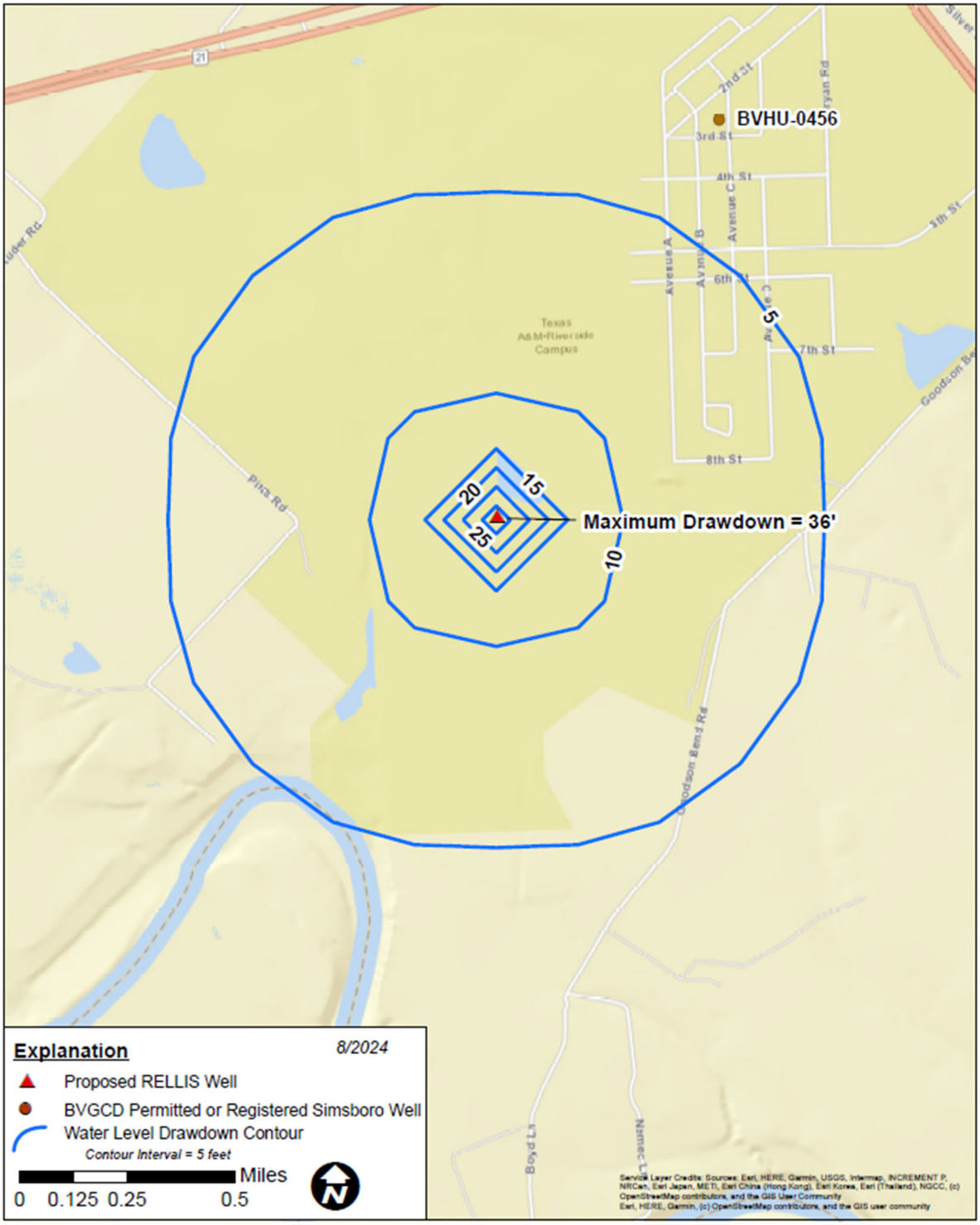

Figure 6. Theis Analytical Simulated Drawdown after Pumping the Proposed Texas A&M University RELLIS Campus Well at 1,200 gpm for One Day

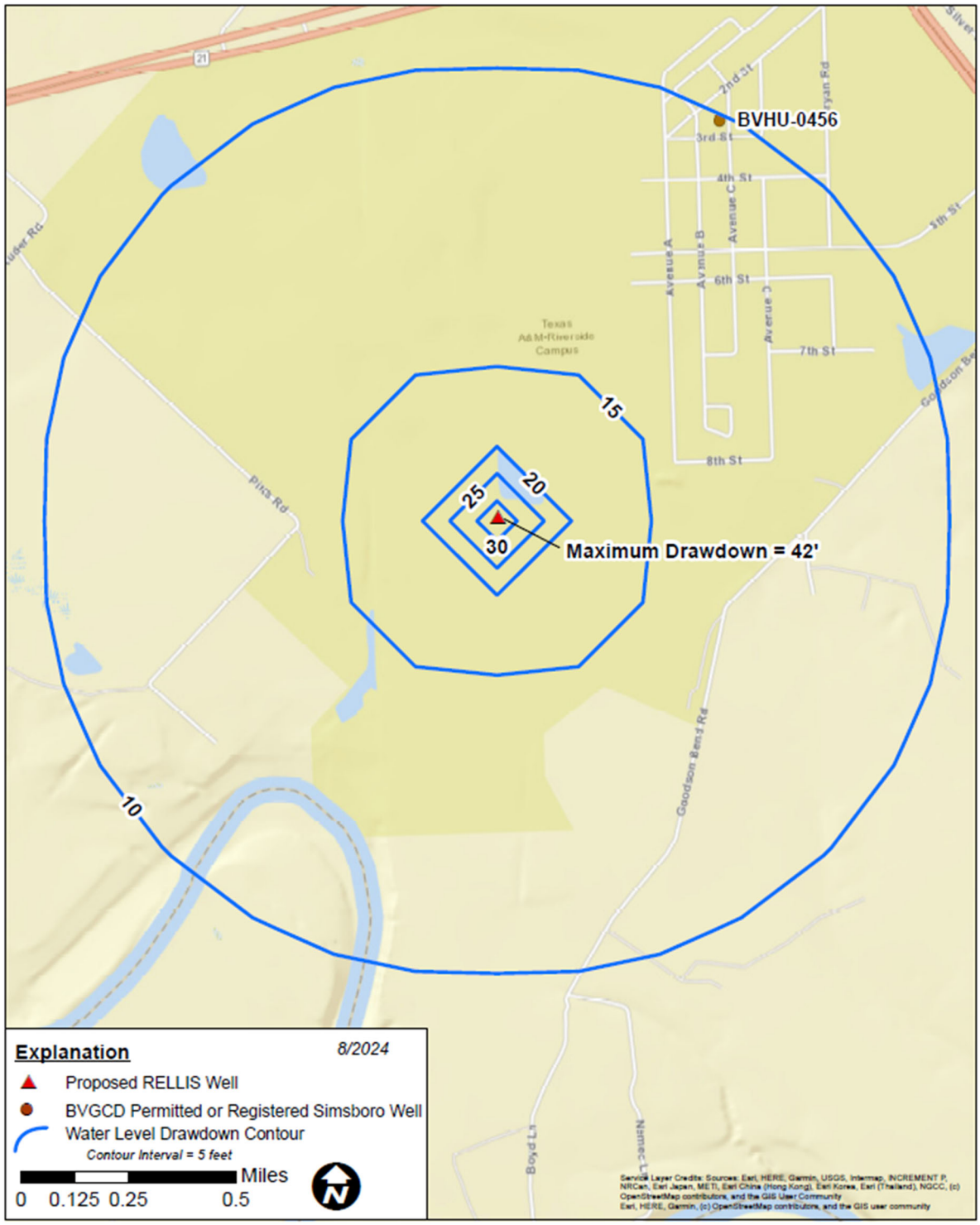

Figure 7. Theis Analytical Simulated Drawdown after Pumping the Proposed Texas A&M University RELLIS Campus Well at 1,200 gpm for 30 Days

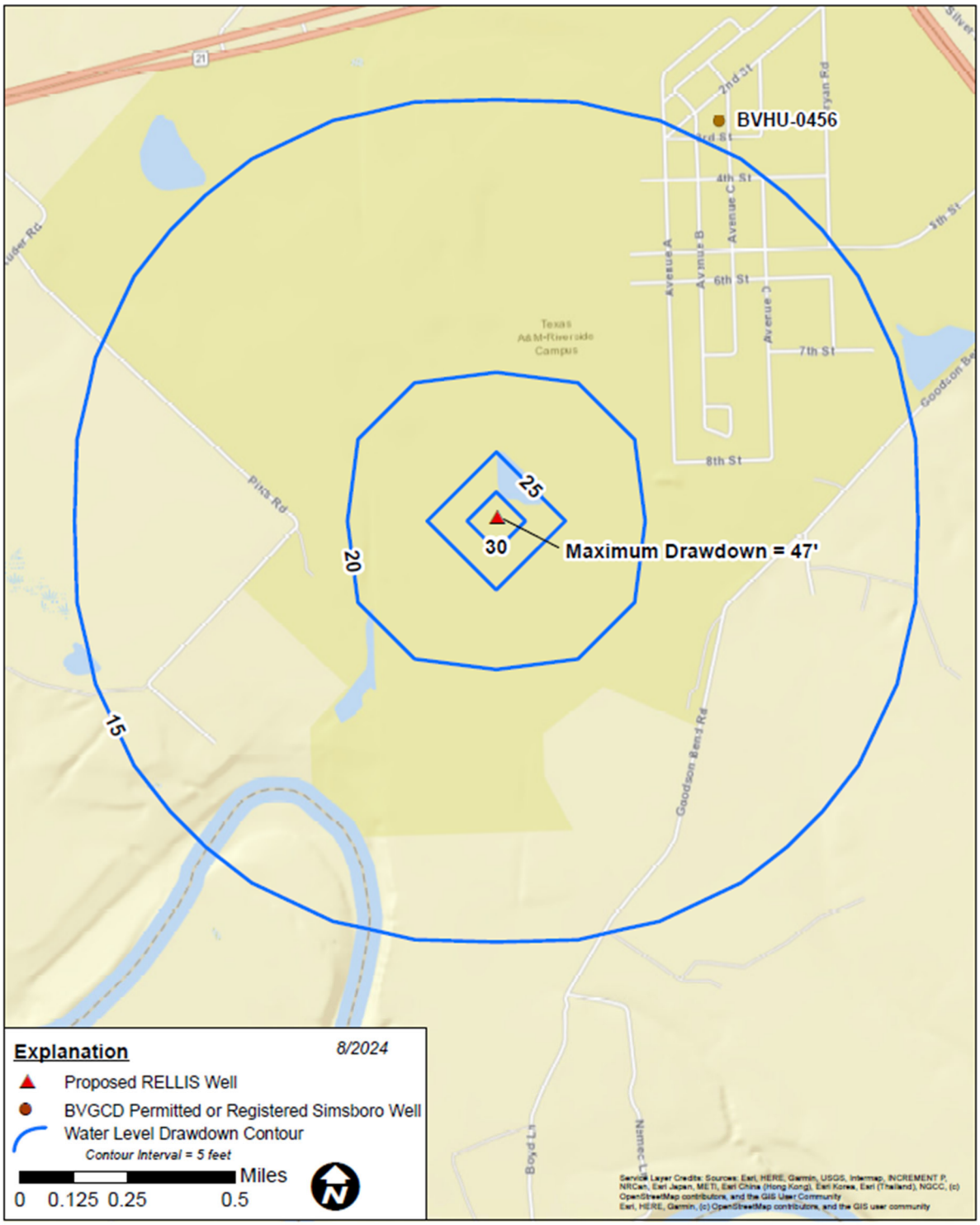

Figure 8. Theis Analytical Simulated Drawdown after Pumping the Proposed Texas A&M University RELLIS Campus Well at 1,200 gpm for 365 Days

Effects of Proposed Production on Applicable Desired Future Conditions Adopted by Brazos Valley Groundwater Conservation District

Rule 8.4(b)(7)(B)(4)

BVGCD Rule 8.4(b)(7)(B)(4) requires an evaluation of the pumping effects due to the proposed RELLIS Well on the applicable DFCs adopted by BVGCD.

Modeled Available Groundwater

The GMA 12 Modeled Available Groundwater (MAG) for the Simsboro Aquifer component of the Carrizo-Wilcox Aquifer system in Brazos County developed during the 2021 joint planning cycle increases each decade from 37,282 acre-feet in 2020 to 64,421 acre-feet in 2070. The requested allocation from the proposed RELLIS Well of 1,934.8 acre-feet per year from the Simsboro Aquifer represents about 5.2 percent of the 2020 Brazos County Simsboro MAG of 37,282 acre-feet and about 3.0 percent of the 2060 Brazos County Simsboro MAG of 64,421 acre-feet.

TWDB Exempt Use Estimates

Projected estimates of exempt groundwater use for Groundwater Conservations Districts in GMA 12 were provided by the TWDB in May 2020. The estimated exempt use is provided on a District basis, combining exempt estimates for Brazos and Robertson Counties. Decadal estimates of exempt pumping are provided for the Carrizo-Wilcox Aquifer, which is comprised of the Carrizo Aquifer, Calvert Bluff Formation, Simsboro Aquifer and Hooper Aquifer. The BVGCD Carrizo-Wilcox Aquifer exempt use estimates increase slightly by decade from 2020 (3,913 acre-feet) to 2070 (3,953 acre-feet) and the 2080 exempt use estimates are the same as those from 2070. The proposed RELLIS Well is planned to be completed in the Simsboro Aquifer. It is estimated that the proposed RELLIS Well would have nominal effects on Simsboro exempt wells.

Currently Established Simsboro Aquifer DFC

Model simulations were performed to evaluate pumping impacts of the proposed RELLIS Well on the currently established DFC for the Simsboro Aquifer within the boundaries of BVGCD. The average Simsboro drawdown in BVGCD between 2000 to 2070 was reviewed based on the most recently approved GMA 12 Run, S-19, and S-19 plus the RELLIS Well pumping. Simulated RELLIS Well pumping starts in 2026 and is held constant through 2070. Figure 9 shows the 2000 to 2070 Simsboro Aquifer drawdown plots based on S-19 and S-19 plus the RELLIS Well pumping simulations.

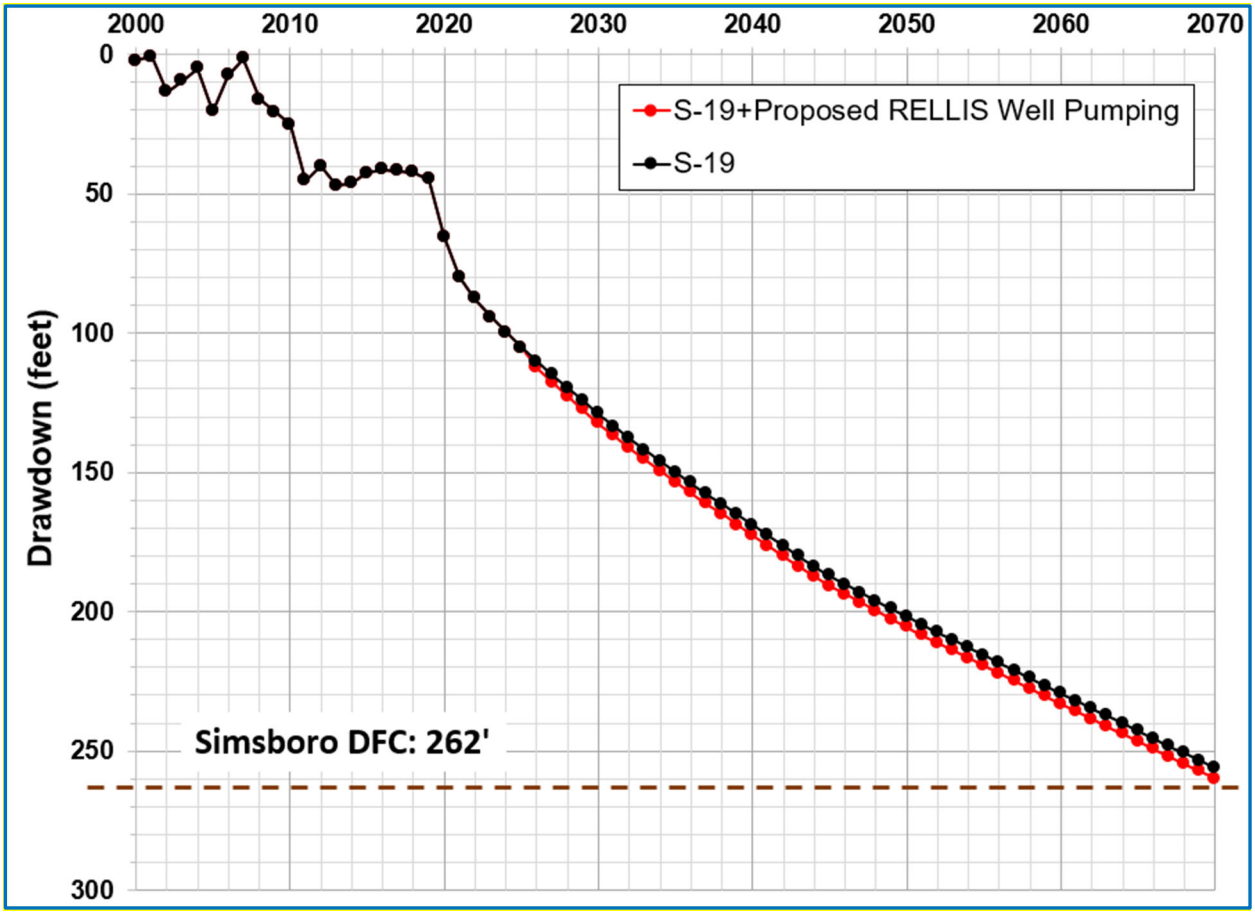

Figure 9. Simulated Simsboro Aquifer DFC Drawdown (2000 – 2070)

The currently adopted BVGCD Simsboro Aquifer DFC is 262' of drawdown at 2070. The model simulation shows the BVGCD average Simsboro drawdown at 2070 based on S-19 plus the proposed RELLIS Well pumping to be about 4 feet greater than the S-19 run.

Estimated Long-term impacts at the Proposed Texas A&M University RELLIS Campus Simsboro Well based on the GMA 12 2021 DFC Run

As a way of evaluating potential long-term estimated water level decline at the proposed RELLIS Well, AGS plotted the simulated water level decline at the proposed well location based on the 2021 GMA 12 DFC/MAG projections for the Simsboro Aquifer as shown on Figure 10 below. The water level projections shown in the figure below are from the TWDB approved DFC/MAG run known as GMA 12 "S-19", but do not include the local impacts from the proposed RELLIS Well discussed in this memorandum, nor do they include all of the pumping from the Simsboro Aquifer that has been recently permitted. The DFC run includes pumping estimates from the Groundwater Conservation Districts in GMA 12 as of about December 2021 that yield DFCs so that the TWDB can estimate the MAG. The detailed assumptions for the DFC simulation can be found in the GMA 12 Explanatory Report (Daniel B. Stephens & Associates and others, 2022) and

documentation of the TWDB MAG run can be found in GAM Run 21-017 MAG: Modeled Available Groundwater for the Aquifers in GMA 12 (Shi and Harding, 2022).

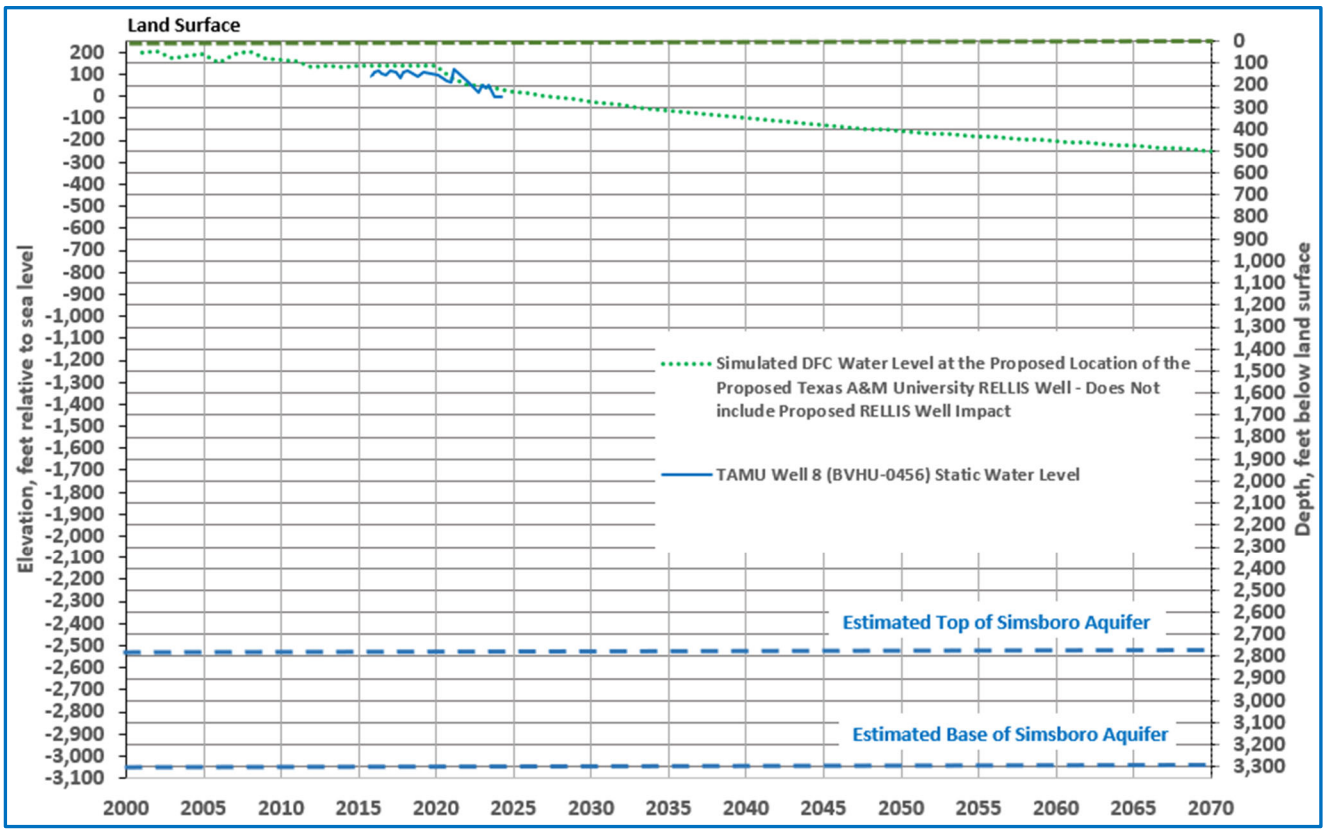

Figure 10. Projected GMA 12 2021 Planning Cycle DFC Water Level Change at the Proposed Texas A&M University RELLIS Campus Simsboro Well

The graph illustrates the relationship between the land surface, estimated static water level through time and the estimated top and bottom of the Simsboro Aquifer based on review of available geophysical logs near the proposed well location.

Historical static water level measurements are also shown on Figure 10 for Texas A&M Well 8 (BVHU-0456). The water levels measured in Well 8 follow a similar trend as the water levels projected in the DFC run.

Available drawdown in wells in the Simsboro Aquifer will decline over time based on the DFC simulation. The green dashed line does not include the impact of the proposed RELLIS Well. Although not evaluated or discussed in detail herein, these levels of water level decline in wells and artesian head decline in the aquifer will have some impact on vertical leakage, intercepted discharge, reduction in confined and unconfined storage, and potential flow directions in the aquifer. Pumping by the proposed well will have some of the same type effects on the aquifer.

Conclusions

AGS has prepared this AER for the future Texas A&M University RELLIS Campus Well that is planned to be completed in the Simsboro Aquifer. The permit request is for 1,934.8 acre-feet per year from the Simsboro Aquifer.

Evaluation of the hydrogeological conditions, BVGCD permitted and registered Simsboro wells, GAM and analytical groundwater modeling results, and the effects on the DFCs adopted by the District show that the requested groundwater production of 1,934.8 acre-feet per year from the Simsboro Aquifer is reasonable and that the pumping from the proposed RELLIS well should have limited effects on wells completed in the Simsboro Aquifer.

References

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Brazos Valley Groundwater Conservation District, 2024, Public Map, https://brazosvalleygcd.halff.com/Map/Public

Daniel B. Stephens & Associates, INTERA Incorporated, and Ground Water Consultants, LLC, 2022, Desired Future Condition Explanatory Report for Groundwater Management Area 12, 859 p.

INTERA Incorporated, D.B. Stephens & Associates, and Ground Water Consultants, LLC, 2020, GMA 12 Update to the Groundwater Availability Model for the Central Portion of the Sparta, Queen City, Carrizo-Wilcox Aquifers: Update to Improve Representation of the Transmissive Properties of the Simsboro Aquifer in the Vicinity of the Vista Ridge Well Field, 30 p.

Shi, J. and Harding, J., 2022, GAM RUN 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12, 36 p.

Texas Water Development Board, 2024, Groundwater Management Area 12 Webpage, https://www.twdb.texas.gov/groundwater/management_areas/gma12.asp

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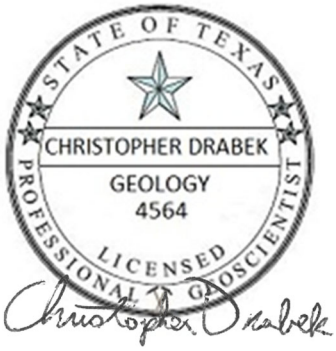
University of Texas, Bureau of Economic Geology, 1981, The Geologic Atlas of Texas, Austin Sheet, Scale 1:250,000.

U. S. Geological Survey, 1980, Bryan West, Texas 7.5 Minute Topographic Quadrangle Map.

Geoscientist's Seal:



The seal appearing on this document was authorized by Christopher Drabek, P.G. 4564 on 8/12/2024.
Advanced Groundwater Solutions, LLC (TBPG Firm Registration No. 50639)