



## **THORNHILL GROUP, INC.**

Professional Hydrogeologists • Water Resources Specialists

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July 28, 2023

Mr. Mark Hoelscher  
Cula D'Brazos, LLC  
1108 Kinney Avenue  
Austin, Texas 78704

Re: Aquifer Evaluation Report –  
Drilling/Production Permit Applications for Seven (7) New Simsboro Wells to be  
Completed on Cula D'Brazos, LLC Properties, Robertson County, Texas

Dear Mr. Hoelscher:

Per your request and in compliance with the rules of the Brazos Valley Groundwater Conservation District (BVGCD), Thornhill Group, Inc. (TGI) provides herein an evaluation of the projected effect of Cula D'Brazos, LLC, herein referenced as Cula D'Brazos or Hoelscher Family, completing seven (7) new wells into the Simsboro Aquifer underlying two (2) separate properties in Robertson County, Texas to produce an annual allocation of groundwater of 12,000 acre-feet per year. Figure 1 illustrates the locations of the individual Hoelscher properties. The Hoelscher properties are located west and southwest of the City of Hearne between Farm Road 1644 (FM 1644) and the Brazos River (east to west) and between FM 485 and United States Highway 190/79 (US 190/79) (north to south). The nearest boundary to Hearne for the northern property (Property 1) is about 4.25 miles west from the intersection of US 190/79 and US 190/State Highway 6 (SH 6). The nearest boundary for the southern property (Property 2) to the City of Hearne is about 3.65 miles west-southwest from the highway intersections in the City. The northern boundary of Property 1 is along FM 485 and the eastern boundary is slightly less than one-half mile west of FM 1644. The western boundary of Hoelscher's Property 1 is the Brazos River. Property 2 is in an area known as Valley Junction and the property is bounded on the west by the Brazos River and on the east by FM 1644, except between 110 and 115 acres at the northeast boundary lie on the east side of FM 1644. The southern property boundary for Property 2 is along US 190/79. The total acreage for the properties is approximately 1,352.5 acres based on geographic information system (GIS) mapping. Requested production is equivalent to that allowed by the BVGCD Rules for well spacing and allocation on a property-by-property basis.

TGI conducted its evaluations and prepared this report in compliance with the rules and guidelines provided by the BVGCD, specifically in Rule 8.4(b)(7)(B) for wells (and multiple wells) capable of producing 800 or more acre-feet per year. TGI's evaluations focused on

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assessing local aquifer conditions and parameters, and the extent to which production from the subject wells may influence other groundwater users in the BVGCD. TGI's evaluations are based on previous investigations conducted in the District, including permit applications and field-testing associated with several local landowners. Additionally, TGI relied upon reported data, published reports, the applicable groundwater availability model (GAM), and TGI's extensive experience with and knowledge of the Simsboro Aquifer in Central Texas, within the BVGCD, and particularly in Robertson County. Specifically, TGI's work was conducted to accomplish the following goals:

- ❖ Assessing the local hydrogeologic setting, focusing on the physical characteristics and hydraulic parameters of the local Simsboro Aquifer;
- ❖ Estimating and calculating the potential short-term and long-term drawdown at each of the wells, including interference drawdown between wells;
- ❖ Evaluating potential interference drawdown from other pumpage in the area and predicting long-term water levels in the proposed well-field area;
- ❖ Establishing a target maximum proposed pumping rate for each well and for the aggregated well field;
- ❖ Modeling to assess the feasibility of the targeted pumping rate and the potential impacts (e.g., artesian pressure reduction) to the aquifer and other nearby well owners (e.g., drawdown); and,
- ❖ Providing this Hydrogeological Evaluation Report in compliance with District rules.

For convenience, applicable illustrations and supporting documentation are included in the following attachments:

- Attachment 1 – Figures
- Attachment 2 – Tables
- Attachment 3 – Reference Materials
- Attachment 4 – Selected References

## Proposed Pumping Locations and Permit Pumping Rates

Figure 1 illustrates the locations for the proposed Simsboro wells on each of the two (2) Hoelscher properties. Proposed well identifications, coordinates, and estimated land-surface elevations in feet above mean sea level (MSL) as estimated from Google Earth are as provided in the following tabulation:

<b>Well Identification</b>	<b>Latitude*</b>	<b>Longitude*</b>	<b>Est. Land Surface Elevation</b>
No. 1	30°51’43.89”N	96°40’17.45”W	273 feet AMSL
No. 2	30°51’34.60”N	96°40’42.46”W	271 feet AMSL
No. 3	30°50’34.78”N	96°38’37.34”W	272 feet AMSL
No. 4	30°50’23.69”N	96°38’59.56”W	270 feet AMSL
No. 5	30°50’13.70”N	96°39’19.99”W	268 feet AMSL
No. 6	30°50’01.62”N	96°39’42.96”W	267 feet AMSL
No. 7	30°50’02.16”N	96°38’53.17”W	272 feet AMSL

\*Coordinate system is NAD83 State Plane Texas Central (feet)

The proposed production capacities in gallons per minute (gpm) and requested permit allocations in acre-feet per year are as follows:

<b>Property Identification And Acreage</b>	<b>Well Identification</b>	<b>Maximum Pumping Rate</b>	<b>Annual Allocation</b>
1 (946 acres)	No. 1	2,200 gpm	2,839 acre-feet
	No. 2	2,300 gpm	2,968 acre-feet
2 (406.6 acres*)	No. 3	1,000 gpm	1,290 acre-feet
	No. 4	950 gpm	1,226 acre-feet
	No. 5	900 gpm	1,161 acre-feet
	No. 6	900 gpm	1,161 acre-feet
	No. 7	1,050 gpm	1,355 acre-feet
<b>Total Annual Allocation</b>			<b>12,000 acre-feet</b>

The radii attributed to the pumping rates for each of the wells lie within each of the Hoelscher property boundaries. The Cula D’Brazos property has one Simsboro domestic Simsboro well located in the northeastern corner of Property 1. The Hoelscher Simsboro well has been assigned as TWDB Well No. 59-11-204 and BVGCD registration number BVR-1506. The nearest known existing wells completed into the Simsboro Aquifer are historic use wells owned by Upwell/Brazos Valley Farms and are along the northern property line of Property 1. Otherwise, the nearest wells to proposed Hoelscher wells for Property 1 are more than one mile from the proposed Simsboro wells. Well BVR-1506 is 1,250 feet deep and is not within the pumping rate spacing radii of either of the proposed Property 1 wells. Otherwise, there are three (3) wells within one mile of the proposed Property 1 wells; each of the wells has a historic use permit and they are owned by UW/Brazos Valley Farms. There are two (2) registered or permitted Simsboro wells located between 3,700 and 4,450 feet east of proposed Well No. 3 (Property 2). The proposed overlap of well radii for Well No. 1 and Well No. 2 (Property 1) complies with the requirements of the District and is similar to overlaps in previous permit applications. As will be discussed later in this report, the overlap is reasonable based on local hydrogeological conditions, will result in minimal effects on interference drawdown between the proposed Cula D’Brazos wells, and will not significantly

change impacts on surrounding wells. The proposed well locations comply with the BVGCD rules regarding spacing between wells and allocation of acreage per well.

## Hydrogeologic Conditions and Aquifer Characteristics

### Geologic Setting

Figure 2 illustrates the locations of each of the Hoelscher properties and wells with respect to the Major Aquifers as delineated by the TWDB. Figure 3 shows the extents of the Minor Aquifers delineated by TWDB in relation to the Cula D’Brazos properties and wells. Figure 4 provides a Surface Geology Map. The following provides aquifer and geologic summaries for each of the Hoelscher properties:

- Northern Property (Property 1) – the extent of Property 1 overlies downdip portions of the Carrizo-Wilcox Aquifer, which is the only Major Aquifer beneath the property. The northern property also lies atop the Brazos River Alluvium Aquifer which is the only Minor Aquifer underlying Property 1. The Reklaw likely subcrops the alluvial deposits across the entirety of Property 1, although it is possible that the Carrizo subcrops the Brazos River Alluvium under far northwestern parts of the property. Essentially, the entire local thicknesses of the Carrizo, Calvert Bluff, Simsboro, and Hooper are present beneath Property 1; the Carrizo may be relatively shallow and thin.

The TWDB/BEG map a known fault between 6 and 7 miles west-southwest of the Hoelscher properties. Land surface elevation generally ranges from 270 to 285 feet above mean sea level (MSL) across the northern tract. Geologic dip is generally to the south-southeast and it gets steeper with depth in the stratigraphic section and in a downdip direction. The local dip on the base of the Wilcox is estimated to be 95 feet per mile beneath Property 1 (see Attachment 3). Elevations, depths, and thicknesses of key formations are provided in the table below:

Layer	Elevation	Depth	Thickness
Land Surface	270 to 285 feet AMSL	Not Applicable	Not Applicable
Base of Alluvium	210 to 220 feet AMSL	50 to 75 feet BGL	50 to 75 feet
Base of Reklaw	160 to 175 feet AMSL	95 to 125 feet BGL	20 to 75 feet
Base of Carrizo	100 to 140 feet AMSL	130 to 185 feet BGL	5 to 90 feet
Base of Calvert Bluff	550 to 715 feet BMSL	820 to 1,000 feet BGL	635 to 870 feet
Base of Simsboro	995 to 1,190 feet BMSL	1,265 to 1,475 feet BGL	265 to 655 feet
Base of Hooper	1,510 to 1,750 feet BMSL	1,780 to 2,035 feet BGL	305 to 560 feet

- Southern Property (Property 2) – the Cula D’Brazos Property 2 lies atop downdip portions of the Carrizo-Wilcox Aquifer and is completely within the boundaries of the Brazos River

Alluvium Aquifer. TWDB/BEG surface geology maps and GAM files indicate that the Brazos River Alluvium deposits on the Hoelscher southern property are directly (unconformably) underlain by the Reklaw Formation. If the Queen City is present, it is very thin. Herein, TGI considers the Queen City absent beneath Property 2. The complete local thicknesses of the Carrizo, Calvert Bluff, Simsboro, and Hooper occur beneath the Cula D’Brazos southern property.

- Land surface elevation generally ranges from 260 to 275 feet AMSL across Property 2. As stated earlier, known faults are mapped between 6 and 7 miles west-southwest of the subject property. The local dip of the base of the Wilcox ranges from 100 to 110 feet per mile. The table below provides estimates for elevations, depths, and thicknesses of formations beneath the two properties located atop the alluvial deposits:

Layer	Elevation	Depth	Thickness
Land Surface	260 to 275 feet AMSL	Not Applicable	Not Applicable
Base of Alluvium	205 to 225 feet AMSL	35 to 70 feet BGL	35 to 70 feet
Base of Reklaw	95 to 170 feet AMSL	90 to 180 feet BGL	20 to 145 feet
Base of Carrizo	+40 to -35 feet MSL	220 to 310 feet BGL	40 to 220 feet
Base of Calvert Bluff	795 to 880 feet BMSL	1,055 to 1,155 feet BGL	745 to 935 feet
Base of Simsboro	1,290 to 1,390 feet BMSL	1,550 to 1,665 feet BGL	395 to 610 feet
Base of Hooper	1,870 to 2,010 feet BMSL	2,130 to 2,285 feet BGL	465 to 735 feet

### Aquifer Conditions and Hydraulic Parameters

This report focuses on proposed permitted production from the Simsboro Aquifer. The top of the Simsboro Formation and well depths are estimated to be in the following depth ranges:

Property Identification	Depth – Top of Simsboro	Depth – Simsboro Wells
Property 1	900 to 920 feet BGL	1,360 to 1,400 feet BGL
Property 2	1,050 to 1,200 feet BGL	1,450 to 1,650 feet BGL

Figure 5 illustrates locations for registered and permitted Simsboro wells within five (5) miles of the proposed Hoelscher Simsboro wells. Attachment 4 provides available well records for selected nearby Simsboro wells. Figure 6 shows locations for registered and permitted Simsboro wells within one (1) mile of the proposed Cula D’Brazos well locations. Figure 6a, Figure 6b, Figure 6c, and Figure 6d provide the locations for Simsboro wells within one (1) mile of the proposed well locations on maps with a scale of 1”=1,000 feet per BVGCD Rules.

Net sand thicknesses for the Simsboro, as mapped by the BEG (see Attachment 3), range as follows:

- Property 1 – 210 to 400 feet
- Property 2 – 350 to 400 feet

TGI extracted hydraulic data for the subject property and nearby areas from the currently-used version of the groundwater availability model (GAM) for the Central Portion of the Sparta, Queen City, and Carrizo-Wilcox Aquifers (Young, et al., 2018). Note that the hydraulic units are: gallons per day per square foot (gpd/ft<sup>2</sup>) for hydraulic conductivity; gallons per day per foot (gpd/ft) for transmissivity; and, dimensionless for storage coefficient. The following table provides a summary of estimated parameters extracted from the GAM datasets to those derived by TGI for the local Carrizo and Simsboro aquifers across the Hoelscher properties:

<u>Property I.D.</u>	<u>Parameter</u>	<u>GAM Estimate Range</u>	<u>TGI Estimate Range</u>
Property 1	Thickness	460 feet	250 to 400 feet
	Hydraulic Conductivity	100 to 105 gpd/ft <sup>2</sup>	150 to 175 gpd/ft <sup>2</sup>
	Transmissivity	45,000 to 48,000 gpd/ft	37,500 to 70,000 gpd/ft
	Storage Coefficient*	0.000152	0.0001 (0.001)
Property 2	Thickness	490 to 510 feet	350 to 40feet
	Hydraulic Conductivity	150 to 180 gpd/ft <sup>2</sup>	150 to 200 gpd/ft <sup>2</sup>
	Transmissivity	75,000 to 91,230 gpd/ft	52,500 to 80,000 gpd/ft
	Storage Coefficient*	0.000148	0.0001 (0.0005)

The asterisk (\*) indicates that TGI used a slightly higher storage coefficient for the 10-year analytical model to represent leakage and recharge conditions.

Figure 7 provides two hydrographs illustrating water-level measurements collected for Texas Water Development Board (TWDB) and/or BVGCD Simsboro monitoring wells: the first chart illustrates data for TWDB Well No. 59-04-701 (BVHU-0013) which is the City of Hearne Well #4, also known as the POW well, which is 3.7 miles east-northeast from the center of the Hoelscher Property 1 and 3.9 miles northeast from the center of Cula D’Brazos Property 2; and, the second wells is TWDB Well No. 59-11-703 which is a City of Gause well located in Milam County and is 5.7 miles southwest of the center of the northern Hoelscher property and is 5.1 miles west-southwest from the center of the Hoelscher Property 2. Water levels declined from 1979 to 1999 by approximately 70 feet in the Hearne POW Well. Additionally, Advanced Groundwater Solutions (AGS) reported that water-levels (i.e., Simsboro artesian pressures) declined between 1999 and 2023 by 85 feet in the Gause Well and by 81 feet in Hearne’s POW well (see AGS, May 11, 2023). AGS mapped water-level declines in the Simsboro of between 65 and 75 feet in vicinity of the both of the Hoelscher properties from 1999 to 2023 (AGS, May 11, 2023). Based on the updated data provided by AGS, current depths to water on the subject property will likely range from 150 to 250 feet BGL. Therefore, water levels will probably rise between 650 and 770 feet above the top of the Simsboro aquifer in new wells on Property 1 and artesian head will be likely be between 850 and 1,050 feet in Simsboro wells on the Hoelscher Property 2. The water levels verify that the local Simsboro is under artesian or confined conditions with hundreds of feet of artesian head.

## Projected Effects of Proposed Pumping

The immediate impacts from production will be artesian head decline (i.e., drawdown) at the pumping wells. As the wells pump, artesian pressure or potentiometric head around the wells will decline forming a cone of depression. As production continues the cone of depression will extend radially from the well field until an aquifer boundary is reached or the production rate reaches equilibrium with the captured groundwater flows. Due to the distance of the proposed wells from the outcrop of the aquifer, reduction in artesian pressure is the only anticipated measurable effect from the proposed pumping. The aquifer will remain completely full and there will be only an infinitesimal reduction in storage. Pumping from the Simsboro aquifers will cause some vertical leakage from overlying and underlying zones. While leakage can serve to dampen drawdown due to boundary effects and inflows, the leakage will likely not result in any identifiable water-level changes or water-quality variations in any of the overlying or underlying zones.

### Drawdown Simulations Using the GAM

TGI utilized the recently released revision and update of the Central Portion of the Sparta, Queen City, and Carrizo-Wilcox Aquifers GAM to calculate drawdown due to the proposed pumping for continuous pumping periods of one (1) year and 10 years from the Simsboro Aquifer. Cula D’Brazos, LLC has requested a permit allocation for the Simsboro Aquifer of 12,000 acre-feet per year. Figure 8 and Figure 9 provide maps showing modeled drawdown contours after one (1) year and 10 years of pumping at the maximum authorized annual rate, respectively. Table 1 and Table 2 provide modeled drawdown at specific registered and permitted Simsboro well sites after one (1) year and 10 years of continuous pumping, respectively. The GAM predicts Simsboro artesian pressure declines as follows:

<b>Distance from Property</b>	<b>Property 1</b>	<b>Property 2</b>
<i>GAM Drawdown – 1 Year of Pumping*</i>		
Adjacent	65 feet	55 feet
One (1) Mile	40 to 55 feet	38 to 52 feet
Five (5) Miles	7 to 20 feet	15 to 18 feet
<i>GAM Drawdown – 10 Years of Pumping*</i>		
Adjacent	71 feet	65 feet
One (1) Mile	47 to 65 feet	45 to 62 feet
Five (5) Miles	9 to 30 feet	25 to 30 feet

The asterisk (\*) indicates that direct interference between properties was not directly accounted for the five (5) mile radii.

Based on the geologic structure, estimates of current artesian head, and drawdown calculated from the GAM simulations, the Simsboro aquifer will remain full and under

artesian conditions in the well-field areas and within the five-mile radii. Note that due to the depth of the local Simsboro and the prolific transmissivity of the aquifer, the overlap of well radii on the Hoelscher Property 1 will not cause adverse interference drawdown effects on the Cula D’Brazos wells or on other local wells.

### Drawdown Simulations Using Analytical Modeling

Due to the scale and configuration of the GAM grid, the GAM probably does not provide accurate drawdown calculations for the specific well sites and areas in the immediate vicinity of the proposed well field. Therefore, for comparison purposes and per the BVGCD rules TGI used an analytical modeling program based on the Theis non-equilibrium equation to calculate theoretical potentiometric head declines at and surrounding the proposed production wells. TGI has used the Theis model for several previous submittals to the BVGCD as well as for evaluations and submittals to numerous districts across the State of Texas. The Theis model incorporates many assumptions, most of which are sufficiently satisfied in the local Simsboro aquifer. However, the Theis model assumes an aquifer that is uniform over an infinite area. To account for recharge boundaries and possible inter-aquifer leakage into the producing aquifers, TGI modeled long-term pumping (i.e., from one to 10 years) by incorporating a leaky artesian storage coefficient. However, it is likely that, while the Theis model likely provides more reliable results within and near the well field, it probably overstates drawdown at distance from the pumping center. Also, the Theis model is more accurate for shorter pumping durations; therefore, the 10-year calculation likely overestimates drawdown from the well fields.

Figure 10 and Figure 11 provide drawdown contours from Theis calculations due to pumping the Simsboro wells proposed after one (1) and 10 years, respectively. Table 1 and Table 2 provide drawdown values at specific well locations. The analytical calculations predict Simsboro artesian pressure declines as follows:

<b>Distance from Property</b>	<b>Property 1</b>	<b>Property 2</b>
<i>Analytical Drawdown – 1 Year of Pumping*</i>		
Adjacent	98 feet	94 feet
One (1) Mile	81 to 92 feet	78 to 92 feet
Five (5) Miles	53 to 60 feet	52 to 60 feet
<i>Analytical Drawdown – 10 Years of Pumping*</i>		
Adjacent	105 feet	102 feet
One (1) Mile	90 to 102 feet	86 to 102 feet
Five (5) Miles	62 to 70 feet	60 to 70 feet

The asterisk (\*) indicates that direct interference between properties was not accounted for the five (5) mile radii.



## Conclusions

Based on our review of the BVGCD rules and the work conducted as described herein, TGI concludes the following:

- ❖ The proposed wells and pumping amounts for the Cula D'Brazos properties can be completed and produced in accordance with the well spacing and production-based acreage (i.e., allocation) rules set forth by the BVGCD;
- ❖ The predicted drawdown derived from the Theis analytical model are more accurate than the GAM predictions for the proposed well sites and areas near the well field;
- ❖ GAM-predicted drawdown probably provides a more reasonable estimate of future impacts at greater distances from the proposed well field and for longer time periods. The updated GAM predicts significantly less drawdown regionally than the previous version of the GAM; and,
- ❖ Production from the proposed pumping will cause only infinitesimal reduction in aquifer storage as the local Simsboro Aquifer will stay completely full and groundwater in the formation will remain under considerable artesian pressure within the well-field areas and the five-mile study radius.

We very much appreciate the opportunity to again assist you in our specialty. If you have any questions, please call.



Sincerely,  
**THORNHILL GROUP, INC.**



Michael R. Thornhill, P.G.  
President

The seal appearing on this document was authorized  
by Michael R. Thornhill, P.G. on July 28, 2023

Attachments