



## **THORNHILL GROUP, INC.**

Professional Hydrogeologists • Water Resources Specialists

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July 9, 2023

Mr. Kevin Meier  
DTB Investments, LP  
P.O. Box 1715  
Bandera, TX 78003

Re: Aquifer Evaluation Report –  
Drilling/Production Permit Applications for Seven (7) New Simsboro Wells and  
Seven (7) New Carrizo Wells to be Completed on the Astin Farms Property,  
Robertson County, Texas

Dear Mr. Meier:

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 DTB Investments, LP herein referenced as DTB, completing wells on the Astin Farms Property in Robertson County, Texas and producing groundwater as follows:

- 15,227 acre-feet per year from seven (7) proposed new production wells to be completed in the Simsboro Aquifer; and,
- 7,613 acre-feet per year from seven (7) proposed new production wells to be completed in the Carrizo Aquifer.

DTB's Astin Farms Property consists of approximately 2,156 contiguous acres (per landowner documents) located in Robertson County about one-half mile south of the community of Mumford and less than 0.4 mile north of the community of Astin. The farm may also be known as Hollybrook Plantation. The figures in this report reference "Hollybrook Property". The farm extends west to east from the Brazos River to about 2.4 miles east of Farm Road 50 (FM 50), which essentially bisects (i.e., west/east) the farm. The subject property lies principally along County Road 206 (CR 206) and County Road 203 (CR 203). The center of Astin Farms is approximately 11 miles south of the City of Hearne and is about 5 miles west of Lake Bryan.

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 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 Carrizo and Simsboro aquifers 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 Carrizo and Simsboro aquifers;
- ❖ 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 fields;
- ❖ Modeling to assess the feasibility of the targeted pumping rate and the potential impacts (e.g., artesian pressure reduction) to the aquifers 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

Proposed wells will be completed on the DTB property into both the Carrizo Aquifer and the Simsboro Aquifer. Well sites will be paired such that one Carrizo well and one Simsboro well will be completed at each location – with wells spaced 50 feet apart. Figure 1 provides a map showing the locations and a tabulation of coordinates for the proposed Carrizo Aquifer wells. Figure 2 illustrates the locations and coordinates for the proposed Simsboro wells on the Hollybrook property. Proposed well identifications, coordinates, and estimated land-surface elevations in feet above mean sea level (MSL) as estimated from Google Earth are as follows:

<u>Well Identification</u>	<u>Latitude*</u>	<u>Longitude*</u>	<u>Est. Land Surface Elevation</u>
<i>Carrizo Aquifer Well Sites</i>			
C1	30°42'57.33" N	96°34'56.30" W	255 feet AMSL
C2	30°43'03.25" N	96°34'25.20" W	254 feet AMSL
C3	30°43'14.53" N	96°34'04.00" W	252 feet AMSL
C4	30°43'19.17" N	96°33'27.96" W	247 feet AMSL
C5	30°43'40.49" N	96°32'48.44" W	246 feet AMSL
C6	30°44'02.17" N	96°32'14.28" W	245 feet AMSL
C7	30°44'20.07" N	96°31'48.35" W	245 feet AMSL
<i>Simsboro Aquifer Well Sites</i>			
S1	30°42'57.58" N	96°34'55.78" W	255 feet AMSL
S2	30°43'03.51" N	96°34'24.69" W	254 feet AMSL
S3	30°43'14.83" N	96°34'03.53" W	252 feet AMSL
S4	30°43'19.45" N	96°33'27.48" W	247 feet AMSL
S5	30°43'40.16" N	96°32'48.89" W	246 feet AMSL
S6	30°44'01.97" N	96°32'14.83" W	245 feet AMSL
S7	30°44'19.75" N	96°31'48.87" W	245 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:

<u>Well Identification</u>	<u>Maximum Pumping Rate</u>	<u>Annual Permit Allocation</u>
<i>Carrizo Aquifer Wells Production</i>		
C1	975 gpm	1,258 acre-feet
C2	525 gpm	677 acre-feet
C3	525 gpm	677 acre-feet
C4	1,100 gpm	1,419 acre-feet
C5	1,075 gpm	1,387 acre-feet
C6	950 gpm	1,226 acre-feet
C7	750 gpm	968 acre-feet
<b>Total Carrizo Allocation</b>		<b>7,613 acre-feet</b>
<i>Simsboro Aquifer Wells Production</i>		
S1	1,950 gpm	2,452 acre-feet
S2	1,050 gpm	1,290 acre-feet
S3	1,050 gpm	2,710 acre-feet
S4	2,200 gpm	2,839 acre-feet
S5	2,150 gpm	2,452 acre-feet
S6	1,900 gpm	1,936 acre-feet
S7	1,050 gpm	1,290 acre-feet
<b>Total</b>		<b>15,227 acre-feet</b>

The proposed well sites for each aquifer are spaced between 2,170 and 3,960 feet apart, and the radii attributed to the pumping rates for each of the wells lie within the Hollybrook property boundaries. The nearest known registered, non-exempt and/or permitted wells completed within the Carrizo Aquifer are located about 7,000 feet from the nearest proposed well. The nearest known existing wells completed into the Simsboro Aquifer are 8,990 feet from the nearest proposed Simsboro well. Therefore, the proposed well locations comply with the BVGCD rules regarding spacing between wells and allocation of acreage per well.

## Hydrogeologic Conditions and Aquifer Characteristics

### Surface Geologic Setting

Figure 3 illustrates that the entire Astin Farms area is underlain by the Carrizo-Wilcox Aquifer, a Major Aquifer delineated by the TWDB. Figure 4 shows that the entire DTB tract is located atop the Brazos River Alluvium Aquifer, a Minor Aquifer in Texas. Brazos River Alluvium wells will be utilized for irrigation purposes on the Hollybrook property. The Sparta aquifer occurs immediately below the Brazos River Alluvium and the subcrop of the Sparta Sand is present beneath the entirety of the subject property. The entire thicknesses of the Queen City and Carrizo aquifers occur beneath the Astin Farms property. The entire section of the Wilcox Group occurs at considerable depth, and the Simsboro is known to be prolific locally based on the development of well fields for the City of Bryan, the City of College Station, and other users.

Figure 5 is a Surface Geology Map illustrating that the entirety of Astin Farms lies atop Brazos River alluvial sediments, which were deposited in the ancient and present-day floodplains of the Brazos River. The Sparta Sand subcrops directly below the alluvial deposits across the entirety of the DTB property. The Weches Formation underlies the Sparta and separates the Sparta from the underlying Queen City Formation. The Reklaw Formation directly underlies the Queen City and lies atop the Carrizo Sand. The Wilcox Group underlies the Carrizo including, from younger to older or shallower to deeper, the Calvert Bluff, Simsboro, and Hooper formations.

Due to the inherent nature of the floodplain and farming operations the topography across the DTB property is relatively flat with land surface elevations between 245 and 255 feet above mean sea level (MSL) (see GoogleEarth). Geologic units dip generally from the north-northwest to the south-southeast and dip angles typically increase with depth in the geologic section. Locally, the dip along the base of the Wilcox Group is between 115 and 120 feet per mile (see Attachment 3). There are no faults mapped locally at land surface across the subject property, and the BEG and TWDB maps major faults 10 to 15 miles generally to the west (BEG, 1974 and TWDB Web Site, 2023). Based on available structural geology maps and GAM

datasets estimates of the elevations and thicknesses of hydrostratigraphic layers beneath the Hollybrook property are summarized in the table below:

Layer	Elevation	Depth	Thickness
Land Surface	245 to 255 feet AMSL	Not Applicable	Not Applicable
Base of Alluvium	105 to 200 feet AMSL	45 to 150 feet BGL	35 to 70 feet
Base of Sparta	105 to 150 feet AMSL	95 to 150 feet BGL	20 to 50 feet
Base of Weches	70 to 120 feet AMSL	125 to 185 feet BGL	15 to 40 feet
Base of Queen City	135 to 200 feet BMSL	380 to 455 feet BGL	260 to 320 feet
Base of Reklaw	245 to 305 feet BMSL	490 to 560 feet BGL	60 to 110 feet
Base of Carrizo	510 to 590 feet BMSL	755 to 845 feet BGL	250 to 290 feet
Base of Calvert Bluff	1,460 to 1,580 feet BMSL	1,705 to 1,835 feet BGL	950 to 990 feet
Base of Simsboro	1,970 to 2,140 feet BMSL	2,215 to 2,395 feet BGL	510 to 560 feet
Base of Hooper	2,830 to 3,060 feet BMSL	3,075 to 3,315 feet BGL	750 to 1,080 feet

### Aquifer Conditions and Hydraulic Parameters

This report focuses on proposed permitted production from the Carrizo and Simsboro aquifers. As noted above the depth to the top of the Carrizo Aquifer reportedly ranges in depth between 490 and 560 feet BGL. Net sand thickness in the local Carrizo ranges from 100 to 200 feet and is likely 150 feet or more across most of the property. Wells completed in the Carrizo Aquifer on the subject property will likely range from 800 to 1,000 feet in depth. Figure 6 illustrates locations of registered and permitted Carrizo wells within five (5) miles of the proposed wells on the Astin Farms property. Figure 7, Figure 7a, Figure 7b, Figure 7c, and Figure 7d show that there are no known (i.e., registered or permitted within the BVGCD) Carrizo wells within one (1) mile of the proposed Astin Farms Carrizo wells. Attachment 4 provides well records for selected nearby Carrizo wells.

The top of the Simsboro Formation is estimated to be at depths of between 1,700 and 1,850 feet BGL. Net sand thickness maps indicate productive sands of between 400 and 500 feet, with some sands exceeding 500 feet in thickness. As most of the Simsboro Formation is comprised of sand, it is likely that Simsboro wells on the Astin Farms property will be between 2,300 and 2,700 feet deep. The nearest existing Simsboro wells (i.e., the City of Bryan) are between 2,900 and 3,000 feet deep. Figure 8 illustrates locations for registered and permitted Simsboro wells within five (5) miles of the proposed DTB wells. Figure 9, Figure 9a, Figure 9b, Figure 9c, and Figure 9d demonstrate that there are no known Simsboro wells within one (1) mile of the proposed Astin Farms wells. Attachment 4 provides available well records for selected nearby Simsboro wells.

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). 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 Astin Farms property:

<u>Parameter</u>	<u>GAM</u>	
	<u>Estimates Range</u>	<u>TGI Estimates*</u>
<b><u>Carrizo Aquifer</u></b>		
Sand Thickness	250 to 285 feet	125 to 200 feet
Hydraulic Conductivity	80 to 100 gpd/ft <sup>2</sup>	150 to 200 gpd/ft <sup>2</sup>
Transmissivity	23,000 to 26,000 gpd/ft	20,000 to 30,000 gpd/ft
Storage Coefficient	1.26 x 10 <sup>-4</sup> to 1.44 x 10 <sup>-4</sup>	10 <sup>-4</sup>
<b><u>Simsboro Aquifer</u></b>		
Sand Thickness	510 to 560 feet	450 to 500 feet
Hydraulic Conductivity	295 to 310 gpd/ft <sup>2</sup>	150 to 250 gpd/ft <sup>2</sup>
Transmissivity	155,000 to 175,000 gpd/ft	80,000 to 120,000 gpd/ft
Storage Coefficient	1.21 x 10 <sup>-4</sup> to 1.29 x 10 <sup>-4</sup>	10 <sup>-4</sup>

Figure 10 provides a hydrograph showing measured water levels for a well completed into the Carrizo Aquifer and located in Burleson County about two (2) miles west-southwest from the Astin Farms property. The well (TWDB No. 59-20-410) shows artesian head declines of as much as 17 feet from 2008 to 2022. Similarly, Advanced Groundwater Solutions, LLC (AGS) reported artesian pressure declines of 16 feet and 43 feet between 1999 and 2023 at two Carrizo monitoring wells located in Brazos County within five (5) miles of Astin Farms. Current depths-to-water at the proposed DTB Carrizo wells sites will likely range from 30 to 50 feet BGL indicating that the local aquifer has between 460 and 530 feet of artesian head.

Figure 11 provides a hydrograph illustrating water-level measurements collected for nearby TWDB/BVGCD Simsboro monitoring well (BVGCD No. BVHU-0009, TWDB No. 59-21-209) which is the City of Bryan Well No. 16 and located within five (5) miles of the subject property (see Figure 7). Water levels in the well declined by about 170 feet from 1978 to early 2021. AGS reported artesian head decline of 93 feet between 1999 and 2023 in TWDB Well No. 59-21-412 which is located within three (3) miles of Astin Farms (AGS, May 11, 2023). Drawdown maps presented by AGS show a cone of depression generally centered around the City of College Station, City of Bryan, and the Wellborn Special Utility District (SUD) well fields with between 100 and 111 feet of artesian head decline between 1999 and 2023 in northwestern Brazos and southwestern Robertson counties (AGS, May 11, 2023). The AGS map shows between 80 and 90 feet of artesian head decline in the Simsboro beneath the Astin Farms property. Based on the updated data provided by AGS, current depths to water on the subject property will likely range from 200 to 275 feet BGL. Therefore, water levels will probably rise between 1,400 and 1,650 feet above the top of the aquifer in the new wells,

verifying 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 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 both the Carrizo and Simsboro aquifers will cause some vertical leakage from overlying and underlying zones. The Calvert Bluff is not utilized in the area due to its depth and poor water quality. Leakage from the Calvert Bluff will be very slow and spread over a large area. Therefore, there are no anticipated water-quality risks due to Simsboro pumping. The Carrizo Aquifer is overlain by the Reklaw Formation, the Queen City Aquifer, the Weches Formation, and the Sparta Sand. 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 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 Carrizo Aquifer and the Simsboro Aquifer.

The requested permit allocation for the Carrizo Aquifer on the Astin Farms property is 7,613 acre-feet per year. Figure 12 and Figure 13 provide maps showing modeled drawdown contours after one (1) year and 10 years of pumping at the maximum authorized rate, respectively. Table 1 and Table 2 provide modeled drawdown at specific registered and permitted Carrizo well sites after one (1) year and 10 years of continuous pumping, respectively. Generally, modeled artesian head declines are as high as 100 feet immediately off the Astin Farms property and range from about 68 to 92 feet at a distance of one (1) mile of the proposed Carrizo wells after one (1) year of continuous pumping of the allocated pumping. GAM-simulated declines after one (1) year range from 17 to 44 feet at a distance of five (5) miles from the subject proposed Carrizo wells. After 10 years of pumping the proposed Carrizo wells drawdown (i.e., artesian head decline) will, according to the GAM, be

as much as 123 feet immediately off of the subject property and will range from 80 to 110 feet one (1) mile from the proposed well locations and will be from 24 to 59 feet five (5) miles from the wells.

DTB has requested a permit allocation for the Simsboro Aquifer on the Hollybrook property of 15,277 acre-feet per year. Figure 14 and Figure 15 provide maps showing modeled drawdown contours after one (1) year and 10 years of pumping at the maximum authorized rate, respectively. Table 3 and Table 4 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 that Simsboro artesian pressure will decline by as much as 82 feet immediately adjacent to the Astin Farms property and from 62 to 74 feet one (1) mile from the proposed wells within the first year of pumping. Declines during the initial year are simulated to be 38 to 48 feet five (5) miles of the wells. After 10 years of pumping the proposed Simsboro wells drawdown (i.e., artesian head decline) will be as much as 102 feet adjacent to the subject property and range from 83 to 95 feet one (1) mile from the well locations. Simulated drawdown ranges from 57 to 72 feet five (5) miles from the wells. Many of the City of Bryan and City of College Station Simsboro wells are within five (5) miles of Astin Farms. Artesian pressure declines in the College Station, Bryan, and Wellborn SUD wells are modeled to be 45 to 65 feet after one (1) year of pumping and 67 to 85 feet after 10 years of pumping at Astin Farms. 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 area and within the five-mile radius. Local wells will continue to maintain hundreds of feet of artesian head.

### [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 fields. 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 Carrizo and Simsboro aquifers. 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 16 and Figure 17 provide the Theis-modeled drawdown contours for pumping periods of one (1) year and 10 years, respectively. Table 1 provides the tabulated drawdown at specific Carrizo well sites, based on the locations and designations of aquifers provided by BVGCD in their database files. One-year drawdown calculations resulted in pressure reductions of 150 feet immediately adjacent to the subject property and 110 to 137 feet at one (1) mile from the proposed Carrizo wells. The drawdown after one (1) year five (5) miles from the wells is calculated to be between 68 and 80 feet. The Theis-calculated drawdown after 10 years is as much as 163 feet adjacent to the Astin Farms property and from 125 to 151 feet one (1) mile from the proposed wells. The 10-year drawdown five (5) miles from the wells is calculated to range from 82 to 93 feet.

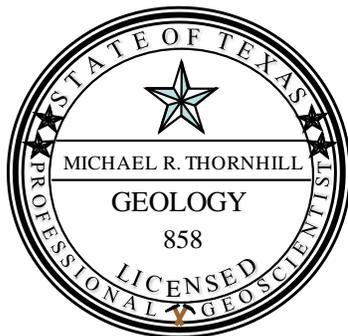
Figure 18 and Figure 19 provide drawdown contours from Theis calculations due to pumping the Simsboro wells proposed for Astin Farms after one (1) and 10 years, respectively. Table 2 provides drawdown values at specific well locations. The analytical model calculated artesian pressure declines of as much as 98 feet adjacent to the subject property after one (1) year of pumping. Drawdown at a distance of one (1) mile was modeled to be 77 to 91 feet after the first year of pumping. At five (5) miles away the drawdown calculation resulted in 53 to 59 feet after a year. After 10 years the calculated drawdown at the Astin Farms property line is as much as 107 feet and the drawdown at a distance of a mile was modeled to be 85 to 100 feet. The drawdown at five (5) miles was modeled to be between 62 and 67 feet.

## 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 Astin Farms (aka Hollybrook Plantation) 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 Carrizo and Simsboro aquifers 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.



The seal appearing on this document was authorized by Michael R. Thornhill, P.G. on July 9, 2023.

## Attachments

Sincerely,  
**THORNHILL GROUP, INC.**



Michael R. Thornhill, P.G.  
President