THORNHILL GROUP, INC.

Professional Hydrogeologists • Water Resources Specialists

August 4, 2015

Mr. W. John Seifert, Jr., P.E.
Principal
LBG-Guyton Associates
11111 Katy Freeway, Suite 850
Houston, Texas 77079

Re: Stakeholder Meeting Comments –
DRAFT Technical Memorandum Regarding Groundwater Production and Water-Level Monitoring Program

Dear Mr. Seifert:

On behalf of Quadvest Water and Sewer Utility (Quadvest), Thornhill Group, Inc. (TGI) provides herein stakeholder comments for the referenced Technical Memorandum and the accompanying presentation titled "Status Report – Groundwater Production and Water-Level Monitoring Program Assessment", which you presented at the Stakeholder Meeting held at the Lone Star Groundwater Conservation District (LSGCD) board room on July 29, 2015.

STATED OBJECTIVES OF TASK 1

The technical memorandum represents a partial completion of Task 1 of the Strategic Planning Study, accounting for the first two of the three bullets below as provided in your presentation:

- "Collection and analysis of groundwater production, and water-level data from public and private sources for the Chicot , Evangeline, Jasper and Catahoula aquifers in Montgomery and surrounding counties. Provide recommendations from analysis."
- "Compile and analyze static water level and groundwater production data and surface water use in part of north Harris County. Provide conclusions from analysis."
- "Review production and monitoring data after January 1, 2016 scheduled conversion and provide results regarding aquifer response due to conversion. Data for review shall be collected for about a one-year period following conversion."

TGI has assessed the data, information and analyses reported in the DRAFT Technical Memorandum and the associated PowerPoint presentation.

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STAKEHOLDER COMMENT 1 – REPORTED GROUNDWATER PUMPING

As has been clearly delineated for decades, the Gulf Coast Aquifer system is comprised of three distinct regional aquifers and one prominent confining layer. Within Montgomery County, most of the pumping is known to be from the Evangeline and Jasper aquifers, while in Harris County most of the pumping is from the Evangeline and Chicot aquifers. The areal and vertical distribution of pumping are critical is any evaluations of aquifer water levels. The LBG Task 1 work is deficient due to the following:

- **Pumping is not reported by aquifer –** data and information are available to determine, at least with some level of confidence, the aquifer from which most wells produce. GMA 14 consultants have made some sort of delineation of pumping per aquifer for historic and projected future pumping. Well completion information should be available for such determinations. Importantly, the pumping reductions for North Harris County Regional Water Authority (NHCRWA) were provided by aquifer.
- **Pumping is reported only by county/geographic area –** pumping reported by geographic area or political subdivision is of very limited usefulness, especially when not delineated by aquifer. Useful pumping data should cover at least the extent of the area that contributes groundwater flow to the pumping area, which for the Jasper aquifer likely includes most of the counties within GMA 14, and some counties outside of GMA 14 – certainly more than the five (5) counties (and part of a sixth) included in the subject memorandum.
- **Site-specific pumping amounts and changes are not provided –** an analysis of water levels and water-level changes in an aquifer should always include data to correlate the actual spatial and temporal distribution of pumping changes to the spatial and temporal distribution of water-level changes. LBG's assessment shows a general location of pumping wells (per aquifer), but does not show any values for historical or current pumping at the well sites. Charts showing pumping should be correlated to hydrographs.

STAKEHOLDER COMMENT 2 – SELECTED WELLS

Groundwater availability, well productivity and economics of producing groundwater depend primarily on the amount of water stored in the aquifer, the geometry of the aquifer and the hydraulic characteristics (e.g., transmissivity) of the aquifer. Additionally, artesian water levels are very sensitive to precise locations, timing and magnitude of pumping. Therefore, the interpretation of water-level data must be carefully correlated to regional, local and site-specific aquifer and pumping conditions in order to provide meaningful information. The subject DRAFT Technical Memorandum provides less than optimal information due to the following:

- **Information for very few wells and limited areas is represented in the report –**
  - For Montgomery County:
    - Out of seven (7) reported Catahoula wells, hydrographs are provided for two (2) wells near Lake Conroe;

- Out of 91 reported Jasper wells, hydrographs are provided for three (3) wells in the artesian part of the aquifer, and one (1) "shallow" well near the outcrop area, but not within the outcrop area;
- Out of 76 reported Evangeline wells, hydrographs are provided for three (3) wells in artesian portions of the aquifer, and for two "shallow" wells located within the outcrop area of the Evangeline;
- Out of 14 reported Chicot wells, hydrographs for four (4) wells, all located within the outcrop of the Chicot, are provided – two of the wells are near the southern county line, and two (2) are called "shallow wells" and are located near the updip extent of the outcrop;

  - For the NHCRWA area, hydrographs were provided for six (6) Jasper wells, six (6) Evangeline wells, and three (3) Chicot wells;
  - For Grimes, Liberty San Jacinto, Walker and Waller counties combined, hydrographs were provided for three (3) Catahoula wells, five (5) Jasper wells and nine (9) Evangeline wells.

- **Well completion information is not provided for monitoring wells –**
  - Delineating the exact zone of completion is important in discerning what changes in water levels may mean, particularly with respect to exact zones and locations of pumping;
  - "Shallow wells" do not necessarily mean "water table" wells, and depending on site-specific geology and well completion, wells completed in the outcrop area of an aquifer may exhibit artesian conditions;
- **LBG stated that the majority of wells used as monitoring wells are production wells that are actively pumped –**
  - The hydrograph provided for well MJ-3 (TS-60-53-713) shows periodic short-term fluctuations of 50 feet or more. It is impossible from the information provided to discern the exact cause(s) of the fluctuations, but they likely are due to seasonal pumping in the well and in nearby wells.
  - The USGS reports that "static water levels" are measured after pumps have been off for a period of time ranging from one (1) hour to days. Therefore, the basis for "static water level" may not be consistent from well to well, or from time to time. As an example, depending on well efficiencies, short recovery times prior to measuring "static water levels" could lead to falsely deep water levels;
  - Therefore, the pumping history for selected monitoring wells and wells in the area must be provided in order to accurately assess water levels in selected wells.

STAKEHOLDER COMMENT 3 – PUMPING AND WATER LEVELS

Basic groundwater science shows that artesian water levels and changes in water levels are very sensitive to aquifer transmissivity and the precise location, duration, timing and magnitude of pumping. Therefore, monitoring data can show significant site-specific and local changes. An example of this was provided by LBG in its assessment of water levels and pumping in the NHCRWA area. LBG reports that the rate of water-level declines for Jasper wells in north Harris County decreased from 15 feet per year to five (5) feet per year (or less) due to an average

reduction in pumpage of only 3.6 MGD (about 4,030 acre-feet per year). With the information provided in the DRAFT Technical Memorandum it is not possible to assess whether the change is due primarily to site-specific pumping rate changes in the selected monitoring wells or other cause.

Also, it is important to understand that noticeable artesian drawdown extends out from well fields, especially large pumping centers, for many tens of miles – far beyond county lines. The DRAFT Technical Memorandum could be considerably improved by:

- **Distinguishing between artesian drawdown and aquifer storage depletion;**
- **Providing pumping by aquifer, with specific timing, locations and magnitudes;**
- **Providing regional water-level contour maps for various time periods, and illustrating pumping distribution by aquifer;**

STAKEHOLDER COMMENT 4 – EXTENT OF MONITORING NETWORK

The monitoring network for both pumping and water levels should be spaced across the entire area affected by pumping in Montgomery County, and should also be useful in delineating effects from pumping from other areas. The monitoring network should include sufficient well coverage, with appropriately completed wells, to effectively monitor artesian pressure and aquifer storage changes.

We appreciate this opportunity to provide stakeholder comments regarding the on-going Task 1 work and the entirety of the Strategic Planning Study. We look forward to working with you in order to develop the best scientific understanding of the aquifers in the region, in order to develop optimal aquifer management.

If you have any questions, please call.

Sincerely,
THORNHILL GROUP, INC.

Michael R. Thornhill, P.G.
President

cc: Mr. Simon Sequeira, Quadvest
Mr. Marty Jones, Sprouse, Shrader, Smith, PLLC
Mr. Richard Tramm, LSGCD
LSGCD Board Members
Ms. Kathy Jones, General Manager - LSGCD