Appendix F: Stakeholder Comments

The TWDB received three sets of comments from the following stakeholders: Goliad County Groundwater Conservation District, Victoria County Groundwater Conservation District, and Dr. Steve Young of Intera Incorporated. Those comments have been summarized in the following sections, with responses from the TWDB in blue. Please send an email to gam@twdb.texas.gov if you wish to review the comments in their entirety.

Goliad County Groundwater Conservation District

1. "Not only has groundwater usage increased for hydraulic fracturing in Karnes and Dewitt County, but it has also increased due to a large increase in temporary workers in those counties. The pumping numbers in Appendices C and D (water budget) of the Numerical Model Report do not reflect these increases. This causes ground water flowing into Goliad County to be higher than what it is."

   Pumping in both DeWitt County and Karnes County has increased over the study period (Tables C10 and C21 in Appendix C, respectively)

2. Goliad County Groundwater Conservation District raised issues with calibrated water levels at multiple well locations. Water levels were not accurate compared to monitoring data at these individual wells.

   Like all regional models, this groundwater flow model is not designed to exactly match measured water levels at specific wells. In Goliad County, the model reflected the regional water level change (presented during the stakeholder meeting in May 2022) and matched the water level at specific wells within 50 feet. However, due to the uncertainty related to the model input parameters and its regional scale, this numerical flow model should be used with field monitoring and for regional groundwater flow evaluation.

3. "The TWDB doesn't have any storativity values for Goliad County. Any method used to determine storativity values from nothing could be problematic. This a known problem that for many years the TWDB has failed to correct. This along with modeled pumping probably explains some of the large deviations we are seeing in measured and modeled water levels in Goliad County."

   At multiple stages of the conceptual and numerical model development, the TWDB asked for available data from stakeholders. The TWDB also provided stakeholders with information on where data gaps exist. The TWDB used all available data to construct this model. There was no available pump test data in Goliad County. The

TWDB agrees that the lack of pump test data in Goliad County may help to explain deviations between modeled and measured water levels.

4. "The recharge values shown in Table C14 of the Numerical Model Report for Goliad County are totally unrealistic. These values are generated using a curve developed based on stream baseflow data. This curve may be valid to be used in an aquifer application like the Edwards Aquifer, but it is absurd to use this methodology for Goliad County recharge."

   According to Scanlon and others (2011), all methods of estimating recharge are dependent on the validity of assumptions in the conversion of a metric into a recharge value. Dr. Shi used stream baseflow for two reasons: 1) its applicability across the entire study area, and 2) the limited available data to employ other techniques such as chloride mass balance. The method used by Dr. Shi is a reasonable method for estimating recharge. In addition, the recharge value for Goliad County used in this model is consistent with multiple studies from stream baseflow.

5. "The water budget values for Goliad County for aquifer to stream flow and for evapotranspiration are not representative of the scientific studies in which GCGCD is involved. Aquifer to stream flow values is much too high."

   This model was calibrated to the stream baseflow including sub-basins at/near Goliad County. The stream baseflow was from stream flux measurements at gages. Therefore, this model did not over-estimate the groundwater discharge to the streams. However, uncertainties still exist mainly due to the uncertainty and lack of high-quality stream flux data and impacts from human activities. Those uncertainties should be evaluated when using this model for future scenarios.

6. "In conclusion, if the new draft GAM is not revised to reflect a declining water level and a realistic groundwater level drawdown for Goliad County, GCGCD will not be able to use the new GAM for management of groundwater in Goliad County. It will be necessary to create a local model that will reflect the aquifer conditions that GCGCD has recorded in the last 20 years and provide a realistic DFC. GCGCD requests that the TWDB do a local calibration, local error checking or a local model utilizing our monitor wells to provide an accurate modeled groundwater level for Goliad County.

   This groundwater flow model closely reproduced the regional water level changes in Goliad County (as well as other counties) between 1980 and 2015, as presented in the stakeholder meeting in May 2022. As a result, this model can predict water

level changes for future scenarios at a regional scale such as Goliad County. A locally refined model specific to Goliad County would be required to evaluate hydraulic conditions at a local scale.

Victoria County Groundwater Conservation District

1. "The model simulates groundwater flow dynamics from the year 1981 - 2015. Pseudo-steady state conditions at the end of the year 1980. While this assumption could be reasonable over much of the model domain, the assumption of pseudo steady-state is perhaps not suitable for portions of the model (e.g., Kingsville area, Victoria area) that have historically used relatively large amounts of water compared to rest of the area."

   Use of steady state conditions can help define aquifer properties and certain boundary conditions. Because the TWDB constructed this model using more than 10,000 pumping tests and specific capacity tests, sand fractions, and stream baseflow studies, among others, the steady state for this model provides a reasonable set of initial water levels for the transient period (1981 to 2015). For the Kingsville area, greater uncertainties do exist regarding the groundwater withdrawal. This has been discussed in the numerical model report and should be further investigated.

2. "The impacts of pumping on spring discharges is a major concern for several stakeholders in the region. While the model improves over the previous iteration, there is still a need for additional data collection and better characterization and refinement of spring flows."

   The TWDB agrees that additional data collection of these springs would improve this model. At this time, the TWDB used all available spring data in the study area.

3. "The assumption of constant evaporation rates across all periods and the extinction depth of 10 feet that were arbitrarily assigned to capture regional-scale behavior can cause large local deviations within the model, especially along the riparian areas as well as hinterland areas. Phreatophytes are fairly common in the study region and there impacts locally on groundwater intake is also a concern to some stakeholders. All in all, ET estimates must be viewed with caution and are likely underestimated in riparian areas."

   The TWDB agrees that modeling of evapotranspiration in the study area could be improved. This would require additional data on root extinction depths, evapotranspiration rates, and the spatial distribution of the various phreatophytes in the study area.

4. "The assumption of GHB boundaries (with constant heads) being 5 miles away from the active model area is a critical assumption. Cone of depressions with diameters extending 5 sq. miles have been observed in areas with otherwise modest levels of pumping (e.g., Kingsville, TX). With a greater interest in development of brackish groundwater along the coast, the presence of GHB in Layers 2 – 4 (Evangeline, Burkeville Confining Unit and Jasper) could lead to incorrect (underestimation) of drawdowns along the coast."

   The TWDB agrees that this could be a valid criticism of that assumption. Because the general head along the hydraulic upgradient is used to simulate the interaction between the Gulf Coast Aquifer System and the Yegua-Jackson Aquifer, it may under/over-estimate drawdown if the pumping location is nearby. In this case, a sensitivity analysis regarding the general head parameters (head and conductance) may help minimize the issue. However, this boundary should have minimal impacts if the study area is located near the Gulf Coast, which is more 100 miles away from the general head boundary.

5. "The inclusion of faults and their parameterization is fairly simplistic. While this consistent with the scope of the model (i.e., simulating a large regional domain), local variations caused by faults could be of specific interest to GCDs."

   Yes, the model is intended for regional scale analyses and not for localized simulations.

6. "It is unclear and perhaps unlikely that the calibration of hydraulic conductivity over such a large domain is capable of appropriately scaling down the effects of partial penetration of the wells, the localized nature of specific capacity tests (and its upscaling to a regional scale model)."

   In the numerical model report, the TWDB discussed that calibrated hydraulic conductivity was generally lower than the values from the pumping tests. This is due to preferential screening of permeable intervals during well installation. We also compared the hydraulic conductivity values from specific capacity tests with those from pumping tests at the same wells and discovered that the hydraulic conductivity values were comparable.

7. "The authors also did not calibrate storativity values as part of the model calibration. While this step is laudable from a parsimony perspective, it is unclear how it might affect the calibration of the hydraulic conductivity values. As both storage and hydraulic conductivities are jointly estimated from pumping test data, the assumption of independence among the two is clearly not correct and also

impact the calibrated hydraulic conductivity values. Additional explorations of the role of calibrated hydraulic conductivity (and storage coefficients used in the model) must explored to ensure there are no smaller scale impacts that could affect groundwater planning process."

The storativity field in the model was based on pumping tests and sand fraction correlation. The TWDB agrees that adjusting the storativity at certain locations may help the model calibration. However, our experience tells us that a flow model is not as sensitive to storativity as to hydraulic conductivity. Having said that, additional explorations of the storativity may be needed when using the model for predictive simulations.

8. "Figure 2.9.5 indicates that the model is unable to capture the observed hydraulic conductivities past 500 ft/d. This result again indicates the leverage exerted by lower K values as well brings to light the likely inappropriateness of higher K values used in the study."

   The lower hydraulic conductivity in the model in comparison with its correlated pumping test value is consistent with that of a well that is often screened in permeable intervals while a model layer also contains low permeable intervals. This flow model does not use higher hydraulic conductivity in general.

9. "The estimation of recharge and its calibration is also unclear. For example, recharge due to precipitation in Refugio is lower than Victoria in average year, but there is an opposite trend in 1980."

   The recharge was based on the correlation between precipitation and stream baseflow. The term "Average" was used for the whole study area. The precipitation in Refugio County was lower than Victoria County in 1985 but higher in 1980.

10. "The sparsity of head targets in Refugio, Calhoun, eastern portions of the Jackson County and the sparsity of calibration targets in Evangeline aquifer in the Victoria County are noteworthy. Clearly, the fewer the calibration targets the larger is the expected errors with the model in these areas."

    The TWDB used all available data in the head calibration.

11. "The baseflow calibration does not include much of the drainage area along the Gulf Coast, which is where the baseflow contributions are likely to be the highest."

Baseflow calibrations were performed based on the availability of surface water gage data. The TWDB agrees that there are data gaps that, if resolved, could improve the baseflow calibration.

12. "Head residuals of model calibration in Calhoun and Victoria counties are noteworthy indicating the model has difficulties capturing the observed heads."

    The TWDB believes the model captures observed heads reasonably well (residual mean square error less than 5%) considering the regional scale of the model. The spatial distribution of head residuals also does not suggest any major spatial bias of the calibration.

13. "The water budgets presentation is confusing. It is unclear, if the budget add up correctly. A table with inflows and outflows would be useful as compared to the chart in Figure 3.4.1."

    We have added Table 3.4.1 to the above report characterizing water budget values for the initial (1980) and final (2015) stress periods of the transient model.

14. "The sensitivity analysis is adequate for a global (overall model assessment) and it would be useful to follow it up with GMA and District wide assessments."

    The TWDB currently only has the resources to perform sensitivity analyses as presented in this report.

15. "The general assumptions presented are important. In addition, to these global model level assumptions, site-specific assumptions pertaining to each district, county and GCD must also be understood for proper regional applications of the model."

    The TWDB agrees that local level assumptions and impacts of regional level assumptions on specific sites is an important avenue for further exploration.

Dr. Steve Young

"For the wells in Appendix E where specific capacities were used to estimate hydraulic conductivity values, the reports would be greatly improved if they were modified to provide the following: 1) the specific capacity calculated at the well; 2) the assumptions and equations used to calculate a hydraulic conductivity from the specific capacity value; 3) the data from the driller logs used to calculate the specific capacity value such as pumping rate, drawdown, and length of pumping, and 4) a level of confidence in the calculated hydraulic conductivity test.

For wells in Appendix E where aquifer pumping tests were used to estimate hydraulic conductivity values, the reports would be greatly improved if they were modified to provide the following: 1) the pumping rate; 2) the length of pumping period, 3) whether the pumping, recovery, or both pumping & recovery periods were used in the analysis, 3) the analysis method, and, 4) a level of confidence in the calculated hydraulic conductivity test."

The TWDB is happy to provide this tabular data upon request. Please email gam@twdb.texas.gov to submit these requests.