GAM run 04-21version 2

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REQUESTOR:

Randy Williams on behalf of Turner, Collie, and Braden representing the Lower Colorado Regional Planning Group and Lavaca Regional Planning Group.

DESCRIPTION OF REQUEST:

Mr. Williams requested the predictive model input files for Groundwater Availability Model (GAM) of the central part of the Gulf Coast aquifer for drought-of-record recharge conditions to 2050 with pumpage developed from the 2002 State Water Plan (SWP).

METHODS:

Groundwater pumping from the central part of the Gulf Coast aquifer for the predictive modeling period was based on pumpage data sets developed from the 2002 SWP. To estimate annual pumping volumes at the county level for seven water use categories, we compared water demand projections with currently available surface water and groundwater supplies and strategies for additional development from the 2002 SWP. We assumed that for each county and water user group, the sum of surface water and groundwater supplies and strategies must not exceed demands. Where the supply plus strategy sum was less than demands, pumping volumes were set at 100 percent of groundwater supplies and strategies, but where the supply plus strategy sum exceeds demands, pumping volumes were set at less than 100 percent of groundwater supplies and strategies. We used weighting factors to adjust pumping volumes relative to this supply to balance demand.

Within each county, we distributed pumping volumes to model grid cells using documented well locations, demographic data, and land-use patterns. We distributed pumping volumes to specific model layers based on well depth, screen information, and aquifer structure. Spatial distribution of pumping volumes in the predictive modeling period follows the same footprint of pumping distribution as in the calibration period.

The Lower Guadalupe Water Supply Project (LGWSP) includes a Gulf Coast aquifer groundwater strategy that was not quantified in the 2001 South Central Texas Regional Water Plan and therefore was not included in the pumpage data set for this model run. During the development and review of this request, it was brought to our attention that pumpage data from the 2002 SWP had errors that were propagated into the FinalPredictive.exe raw pumpage file posted on our web page:

(http://www.twdb.state.tx.us/gam/resources/resources.htm). This affected pumpage lies within the Colorado-Lavaca River Basin in Wharton County. We have corrected the errors in the pumpage files that accompany this model run. In addition, the consultants for the South Central Texas Regional Water Planning Group have informed us that the City of Victoria has recently switched to surface water and may only use about ten percent of the groundwater assigned in the model pumpage file at that location.

During the review process, we observed that the spatial distribution of the drought-of-record recharge was not consistent with the average annual recharge distribution in the model. In addition, some areas had minimal to no recharge. However, this discrepancy in local recharge assignment did not affect model wide simulated water levels or the water budget when compared to model results using average annual recharge. This indicates that the model is not sensitive to recharge due to a long delay in the arrival of the recharge water into the aquifer. However, as this drought-of-record recharge distribution may affect local groundwater availability estimates, we re-developed the drought-of-record recharge to obtain a better spatial distribution that matches average annual recharge.

PARAMETERS AND ASSUMPTIONS:

- See Waterstone (2003) and Chowdhury and others (2004) for assumptions, calibration errors, and model limitations.
- The model files include data sets for 2000 to 2049. The predictive model has a total of 155 stress periods with annual stress periods from 2000 to 2039 (stress periods 1 to 40) and monthly stress periods from 2039 to 2049 (stress periods 41 to 155). The model has drought-of-record recharge from 2044 to 2049 and average recharge for the preceding years.
- The model has monthly drought-of-record recharge from 2044 to 2049. We developed the monthly drought-of-record recharge based on 1951 to 1956 rainfall records. This recharge estimation assumes a linear relationship between recharge rate and rainfall in addition to considering the soil variability factors built into the average annual recharge. We developed a recharge factor on a cell-by-cell basis, which is a ratio of the average annual rainfall (1960 to 1990) and average annual model calibrated recharge. The recharge factor thus obtained was multiplied to the monthly rainfall to obtain the drought-of-record recharge.
- The model has average evapotranspiration (ET) rates for all stress periods. We used the ET rates from the transient calibration year 1999 and uniformly assigned the rate for all stress periods in the predictive model. The ET rate for 1999 was chosen as it represented an average year in terms of historical rainfall and Palmer Drought Severity Indices (PDSI).

RESULTS:

Predictive model data files are available upon request.

LIMITATIONS:

Hydraulic conductivity used for calibration of the model reflects partial completion of the wells in the Evangeline aquifer. Therefore, where wells fully-penetrate the entire thickness of the Evangeline aquifer, usage of the model may overestimate drawdown. If additional data becomes available, the model layers may be further refined in the future to address partial completion of wells in the Evangeline aquifer. Very few calibration targets are available in the down-dip areas of the Jasper aquifer. Therefore, the simulated water levels could not be compared to measured water levels producing greater uncertainty for the area. The model appears to underestimate baseflow in some of the studied reaches (Chowdhury and others, 2004).

A regional flow model constructed with a grid size of 1 mile by 1 mile is best suited to answer regional-scale groundwater issues such as predicting aquifer-wide water-level fluctuations under various pumping or recharge conditions. The model in its current state may not predict water-level declines around a single well. The model relies on estimates of aquifer properties and stresses and the small-scale spatial variability in storativity and/or hydraulic conductivity present in the aquifer could not be translated to the scale of the model. The predicted water levels should however be accurate at the scale of tens of miles when a group of wells or water levels in an entire county is considered. This model can be further refined at a smaller scale, or alternatively, analytical equations can be used to address local groundwater issues such as developing well-spacing rules. This model, like most groundwater models, is more appropriate to determining relative changes to water levels from application of pumpage reflecting varying water-management scenarios rather than assessing absolute changes to water levels in the future.

REFERENCES:

Chowdhury, A. H., Wade, S., Mace, R., E., and Ridgeway, C., 2004, Groundwater availability model of the central Gulf Coast aquifer system: Numerical simulations through 1999: TWDB Model Summary Report, 113 p.

Waterstone, 2003, Groundwater availability of the central Gulf Coast aquifer—Numerical simulations to 2050, Central Gulf Coast, Texas: contract draft report submitted to the Texas Water Development Board, Austin, Texas, variously paginated.