GAM Run 05-32

by Richard M. Smith, P.G.
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0877
August 15, 2005

REQUESTOR:

Mr. Steve Petersen, associated with Malcolm Pirnie, Inc., Houston, Texas, on behalf of the San Patricio Municipal Water District (SPMWD).

DESCRIPTION OF REQUEST:

Mr. Petersen requested that we run the Groundwater Availability Model (GAM) for the central part of the Gulf Coast aquifer for 60-year predictive simulations for Bee and San Patricio counties using the following scenarios described in GAM Run 05-01:

- **Scenario 1**: Two runs that reflect the effects of proposed pumping sites using 25,200 acre-feet per year from the Evangeline aquifer. The first run uses 11,200 acre-feet per year for SPMWD proposed pumping sites in Bee County and a total of 14,000 acre-feet for the Lower Guadalupe Water Supply Project (LGWSP) well fields in Goliad, Victoria, and Refugio counties. The second run uses 11,200 acre-feet per year for SPMWD proposed pumping sites in San Patricio County and a total of 14,000 acre-feet for the Lower Guadalupe Water Supply Project (LGWSP) well fields in Goliad, Victoria, and Refugio counties. Mr. Petersen provided locations of the proposed well fields and requested that we assume each well field includes up to seven wells screened between 500 and 800 feet below land surface. Requested deliverables for each run include:
    1. hydraulic head maps for the Chicot aquifer in Bee and San Patricio counties
    2. drawdown maps for the Chicot aquifer in Bee and San Patricio counties

- **Scenario 2**: The same runs and deliverables as scenario 1 except that the total pumpage increases to 45,000 acre-feet per year, SPMWD pumps 31,000 acre-feet per year, and each well field includes up to 28 wells.

METHODS:

We used a variation of the GAM for the central part of the Gulf Coast aquifer that better represents fully penetrating wells completed in the Evangeline aquifer (see GAM run 05-04, http://www.twdb.state.tx.us/gam/GAMruns/GR05-04.pdf). We completed four different model simulations with average recharge to address the two scenarios. We extended the 50-year predictive model datasets an additional ten years to address the 60-year simulation period requested.

For scenarios 1 and 2, we developed four different pumpage datasets using the locations provided by Mr. Petersen and the combinations requested for the proposed strategies (see GAM run 05-01 for details). We contoured water levels from each model run using Processing MODFLOW for Windows (PMWIN) and contoured drawdowns from the model runs for 2005, 2010, 2020, 2030, 2040, 2050, and 2060 using 2000 water levels as the baseline.

PARAMETERS AND ASSUMPTIONS:

- See Waterstone and Parsons (2003) and Chowdhury and others (2004) for assumptions and limitations of the GAM. Root mean squared error for the entire central part of the Gulf Coast aquifer model is up to 51 feet at the end of the transient model simulation in 1999 (see GAM run 05-04).

- The variation of the GAM used assumes that pumping in the Evangeline aquifer occurs throughout the entire depth of the Evangeline aquifer (see GAM run 05-04).

- We used annual stress periods for the predictive simulations, so discharge from the proposed well fields was based on annual withdrawal rates.

- For scenarios 1 and 2, we assumed all proposed wells were drilled within the same one square mile grid where the proposed well fields were simulated.

- Model results reflect average recharge rates based on historical climate from 1960 to 1999 throughout the predictive period (2000 through 2060). For Bee County, this is approximately 18,829 acre-feet per year of recharge for the Chicot aquifer and 4,836 acre-feet per year for the Evangeline aquifer. For San Patricio County this is approximately 12,061 acre-feet per year for the Chicot aquifer and 152 acre-feet per year for the Evangeline aquifer.

RESULTS:

The results of these model runs are shown in the attached figures. Please note that all maps shown are oriented with north at the top, scale can be ascertained by observing the county boundaries shown, and all elevations are in feet above mean sea level. White cells shown in the figures are dry cells. Model cells go dry when the pumpage exceeds the ability of the cell to transmit water and water levels in that cell drop below the base of the aquifer. When a model cell goes dry, the pumpage from that cell turns off in the model and the cell becomes inactive.

Scenario 1, proposed pumping sites using 25,200 acre-feet per year from the Evangeline aquifer:

A. Bee County SPMWD pumping

- Hydraulic heads: Figures 1 through 7 show the maps of hydraulic head levels in the Chicot aquifer for Bee and San Patricio counties for the 25,200 acre-feet per year combined pumping in Bee County.

- Drawdown maps: Figures 8 through 14 show the drawdown maps of the Chicot aquifer in Bee and San Patricio counties for the 25,200 acre-feet per year combined pumping in Bee County.

B. San Patricio SPMWD pumping

- Hydraulic heads: Figures 15 through 21 show the maps of hydraulic head levels in the Chicot aquifer for Bee and San Patricio counties for the 25,200 acre-feet per year combined pumping in San Patricio County.

- Drawdown maps: Figures 22 through 28 show the drawdown maps of the Chicot aquifer in Bee and San Patricio counties for the 25,200 acre-feet per year combined pumping in San Patricio County.

Scenario 2, proposed pumping sites using 45,000 acre-feet per year from the Evangeline aquifer:

A. Bee County SPMWD pumping

- Hydraulic head: Maps on Figures 29 through 35 showing hydraulic head levels in the Chicot aquifer for Bee and San Patricio counties for the 45,000 acre-feet per year combined pumping in Bee County.

- Drawdown maps: Maps on Figures 36 through 42 show the drawdown maps of the Chicot aquifer in Bee and San Patricio counties for the 45,000 acre-feet per year combined pumping in Bee County.

B. San Patricio SPMWD pumping

- Hydraulic head: Maps on Figures 43 through 49 showing hydraulic head levels in the Chicot aquifer for Bee and San Patricio counties for the 45,000 acre-feet per year combined pumping in San Patricio County.

- Drawdown maps: Maps on Figures 50 through 56 show the drawdown maps of the Chicot aquifer in Bee and San Patricio counties for the 45,000 acre-feet per year combined pumping in San Patricio County.

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: Texas Water Development Board, 108 p.

Waterstone Environmental Hydrology and Engineering, Inc., and Parsons Engineering Science, Inc., 2003, Groundwater availability of the central Gulf Coast aquifer: Numerical simulations to 2050 central Gulf Coast, Texas: unpublished report prepared for the Texas Water Development Board, 156 p.

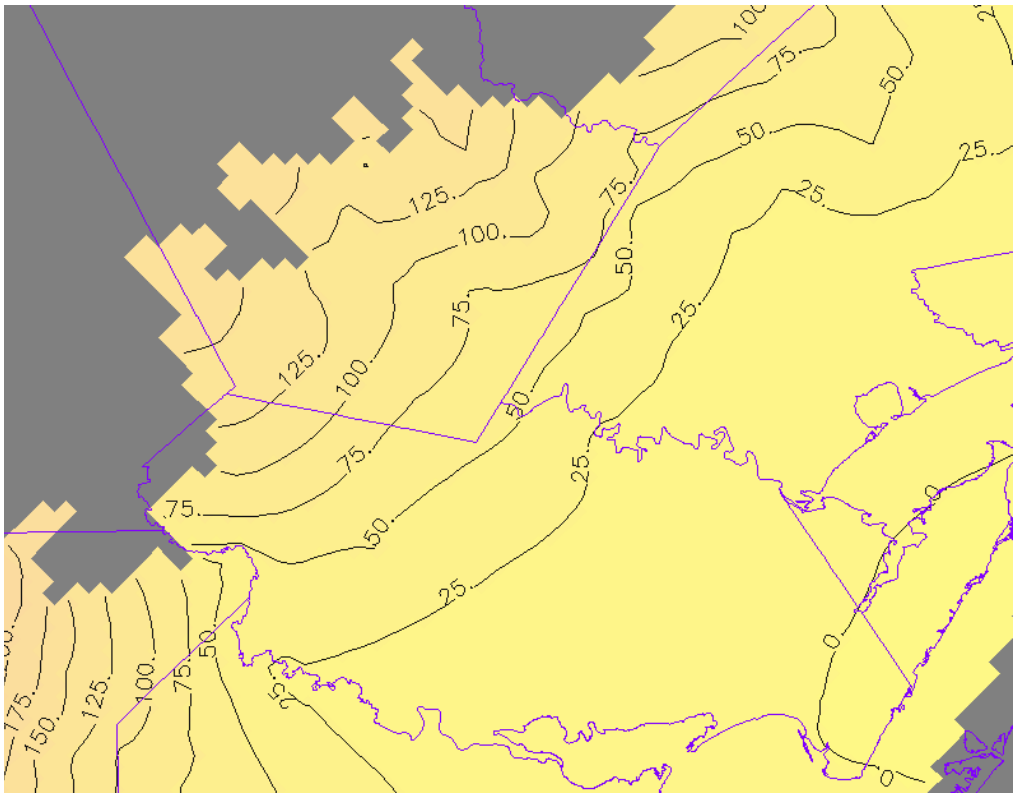

Figure 1: Water levels in the Chicot aquifer in 2005 in Bee and San Patricio counties with pumping described in scenario 1 – first model run. Contour interval is 25 feet.

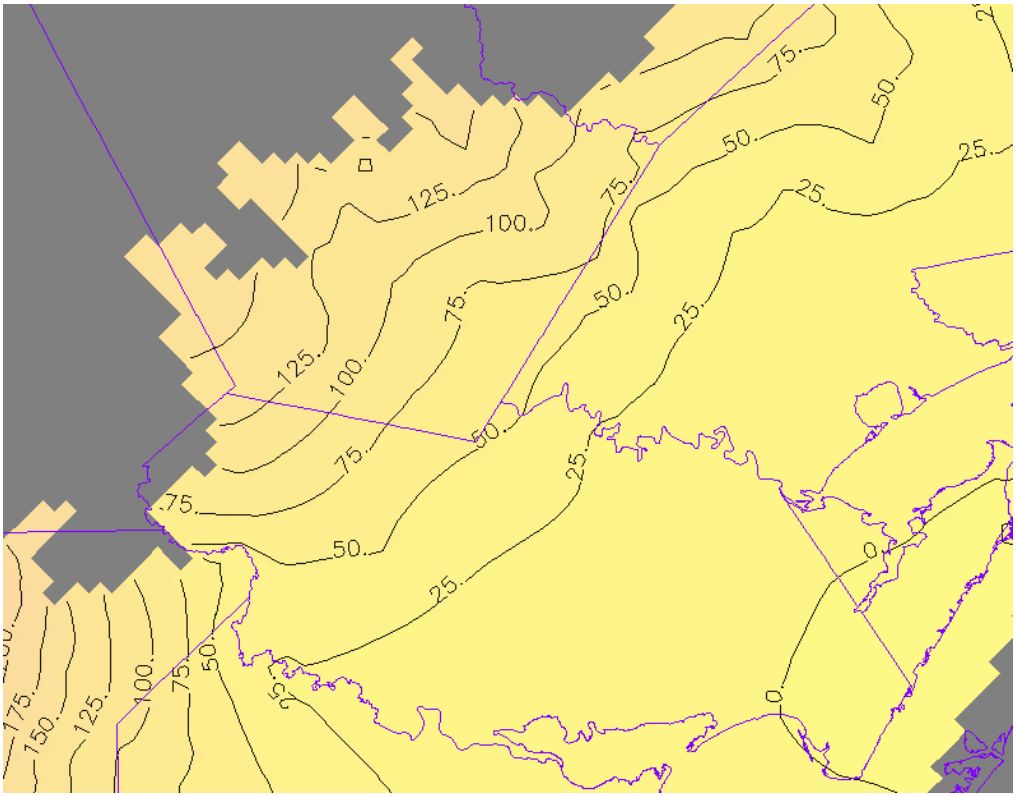

Figure 2: Water levels in the Chicot aquifer in 2010 in Bee and San Patricio counties with pumping described in scenario 1 – first model run. Contour interval is 25 feet.

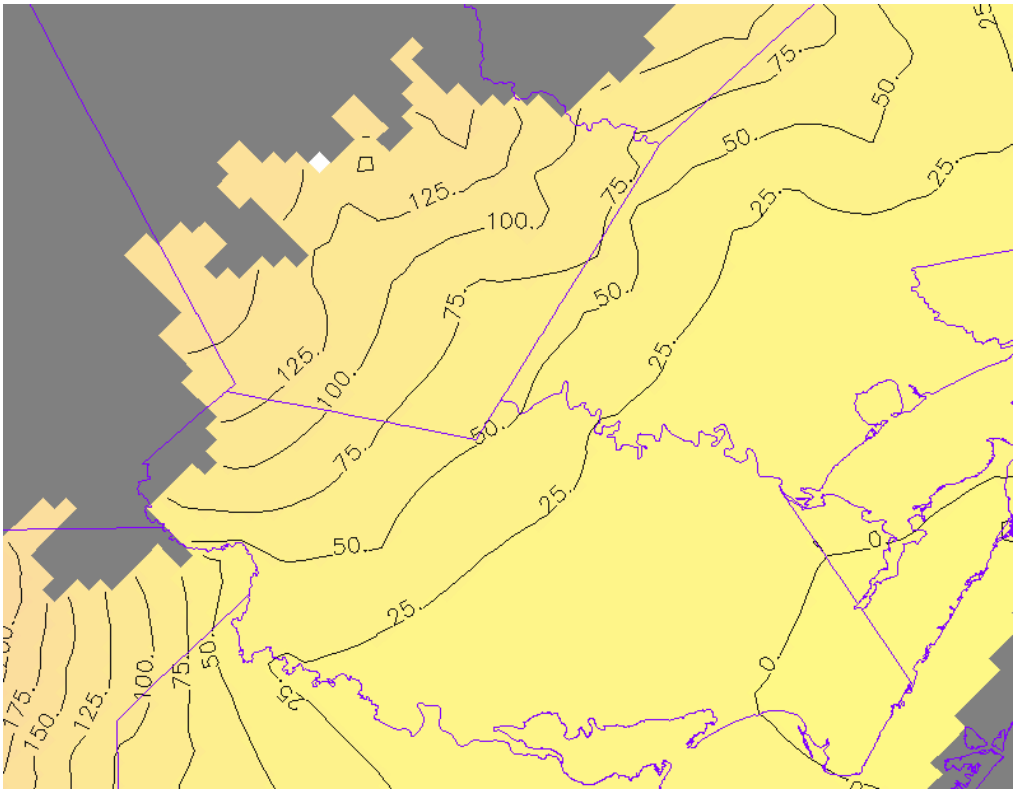

Figure 3: Water levels in the Chicot aquifer in 2020 in Bee and San Patricio counties with pumping described in scenario 1 – first model run. Contour interval is 25 feet.

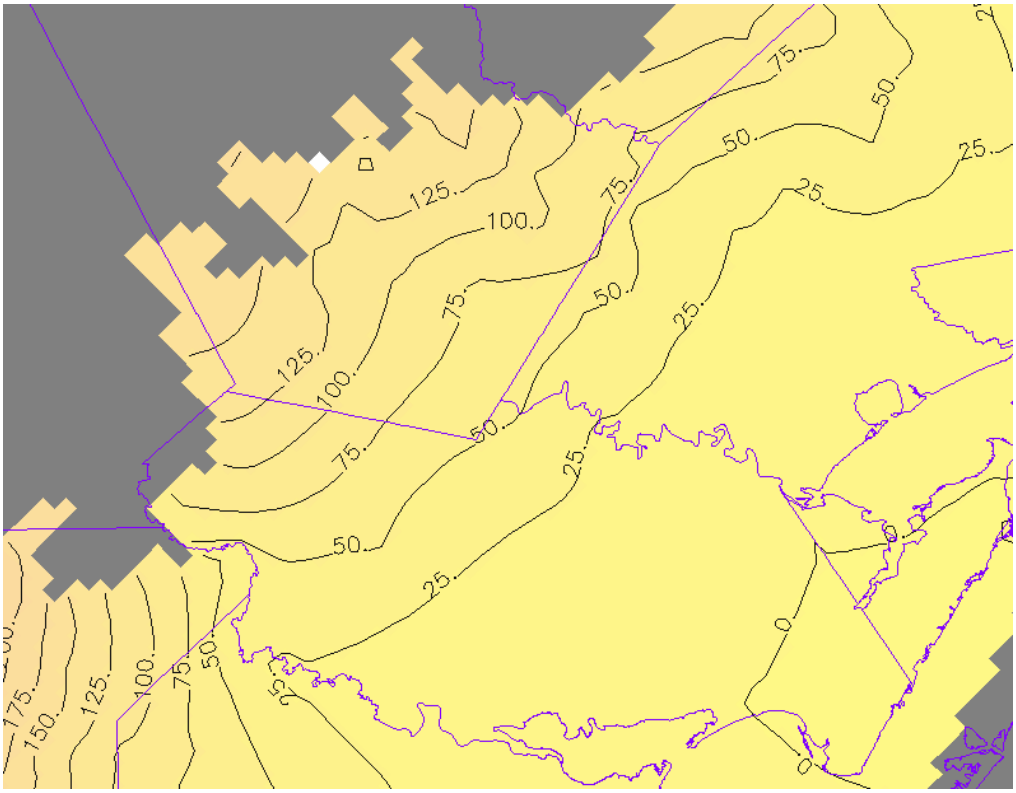

Figure 4: Water levels in the Chicot aquifer in 2030 in Bee and San Patricio counties with pumping described in scenario 1 – first model run. Contour interval is 25 feet.

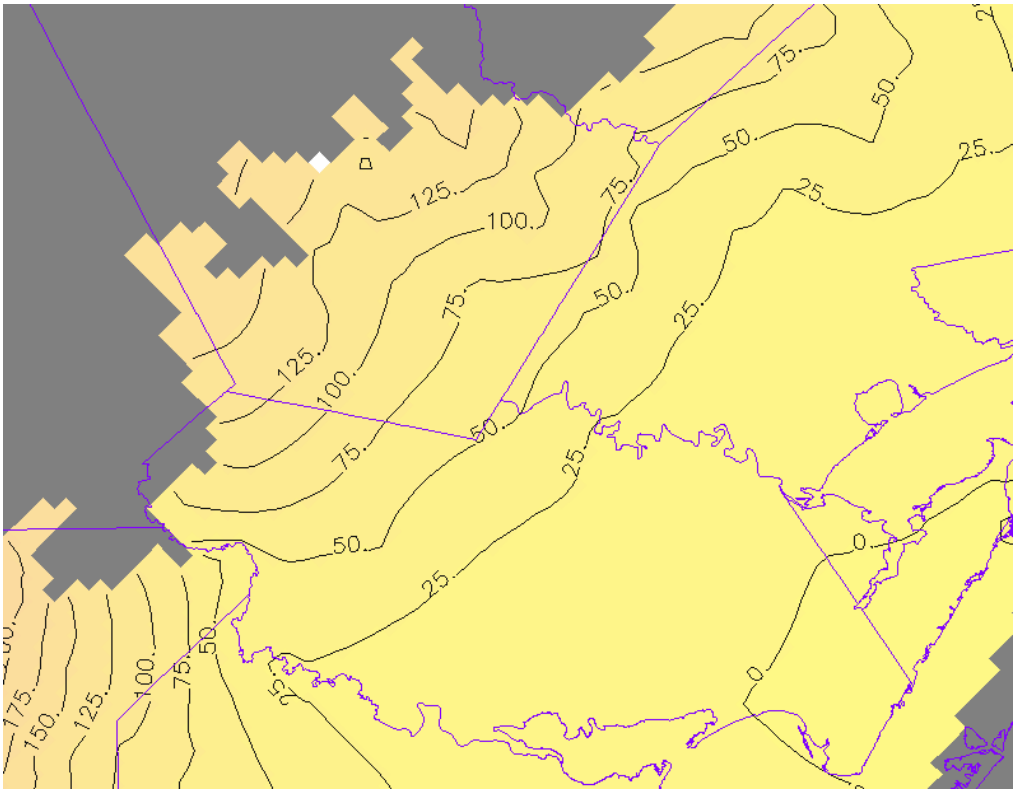

Figure 5: Water levels in the Chicot aquifer in 2040 in Bee and San Patricio counties with pumping described in scenario 1 – first model run. Contour interval is 25 feet.

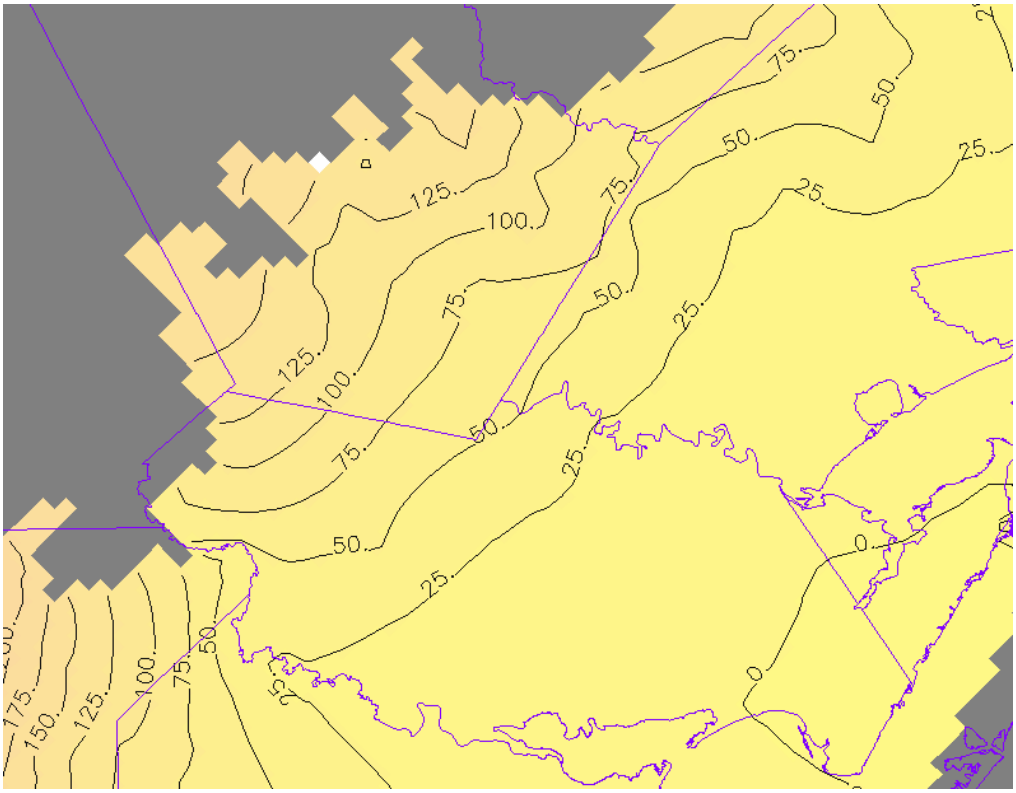

Figure 6: Water levels in the Chicot aquifer in 2050 in Bee and San Patricio counties with pumping described in scenario 1 – first model run. Contour interval is 25 feet.

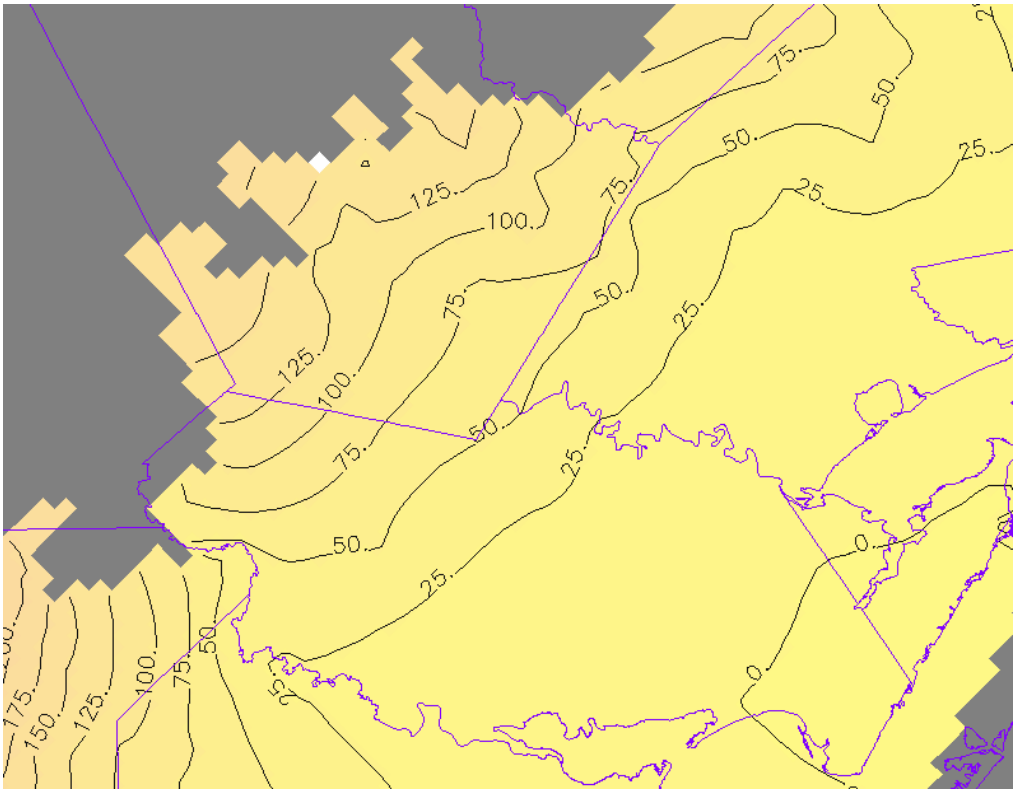

Figure 7: Water levels in the Chicot aquifer in 2060 in Bee and San Patricio counties with pumping described in scenario 1 – first model run. Contour interval is 25 feet.

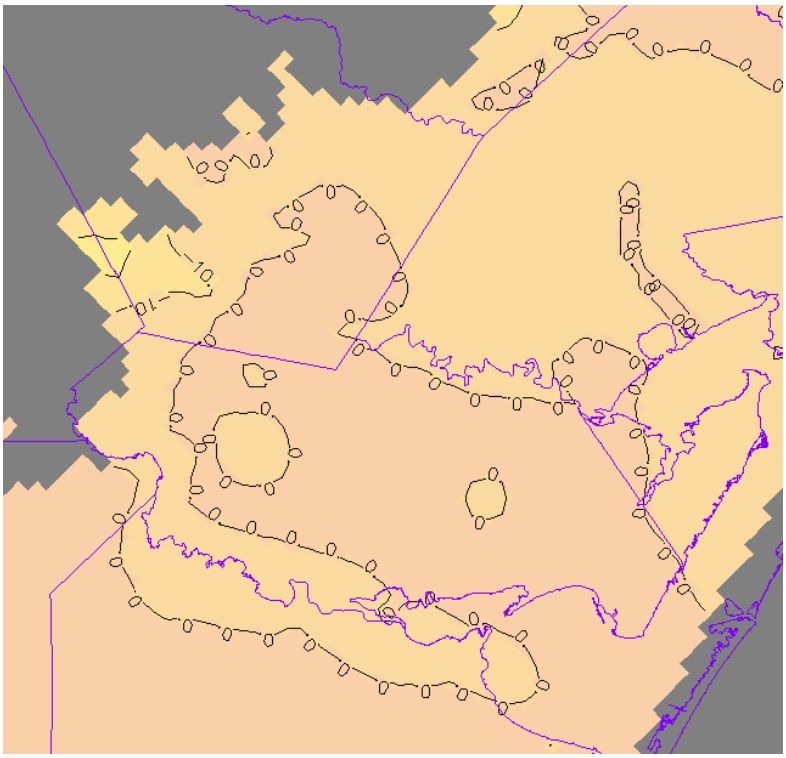

Figure 8: Drawdown map for 2005 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- first model run. Contour interval is 10 feet and negative values indicate rising water levels.

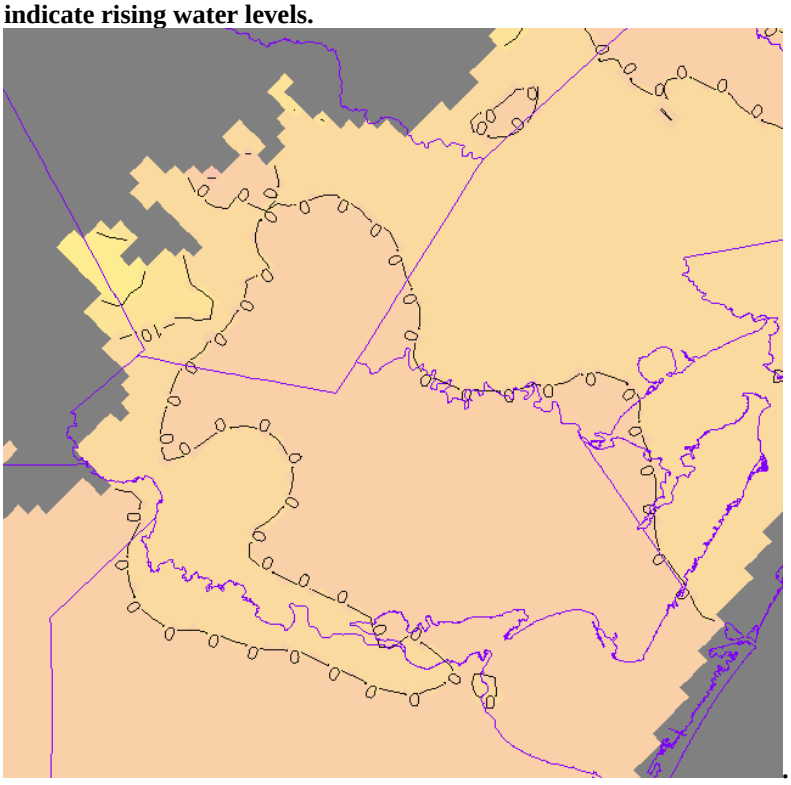

Figure 9: Drawdown map for 2010 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- first model run. Contour interval is 10 feet and negative values indicate rising water levels.

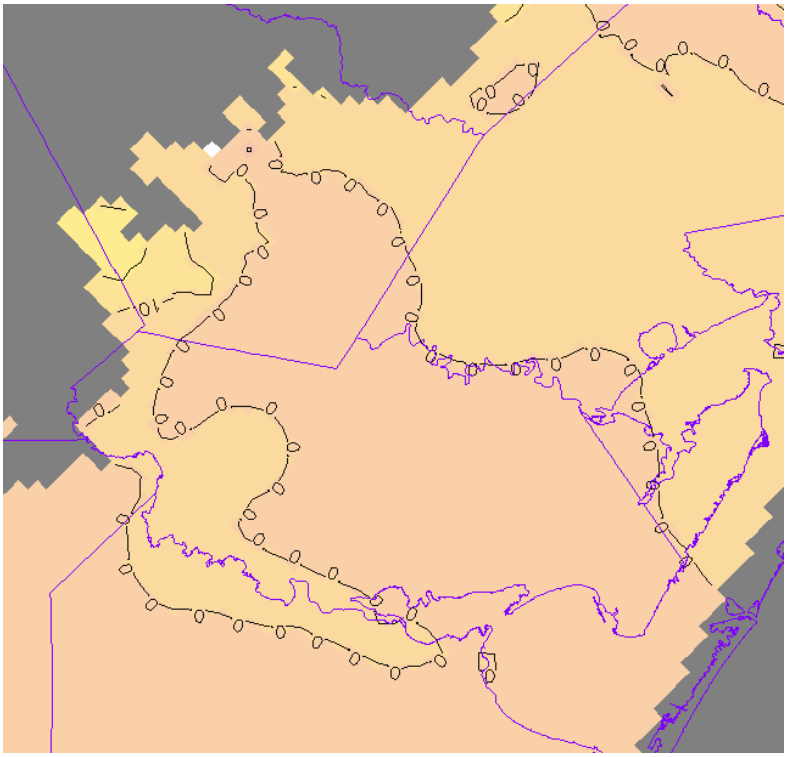

Figure 10: Drawdown map for 2020 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- first model run. Contour interval is 10 feet and negative values indicate rising water levels.

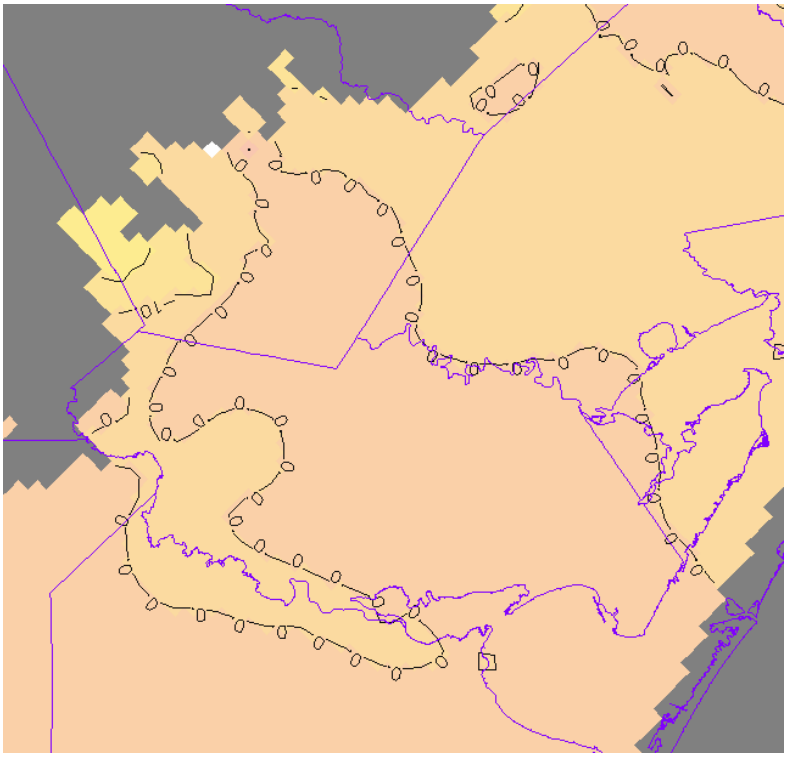

Figure 11: Drawdown map for 2030 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- first model run. Contour interval is 10 feet and negative values indicate rising water levels.

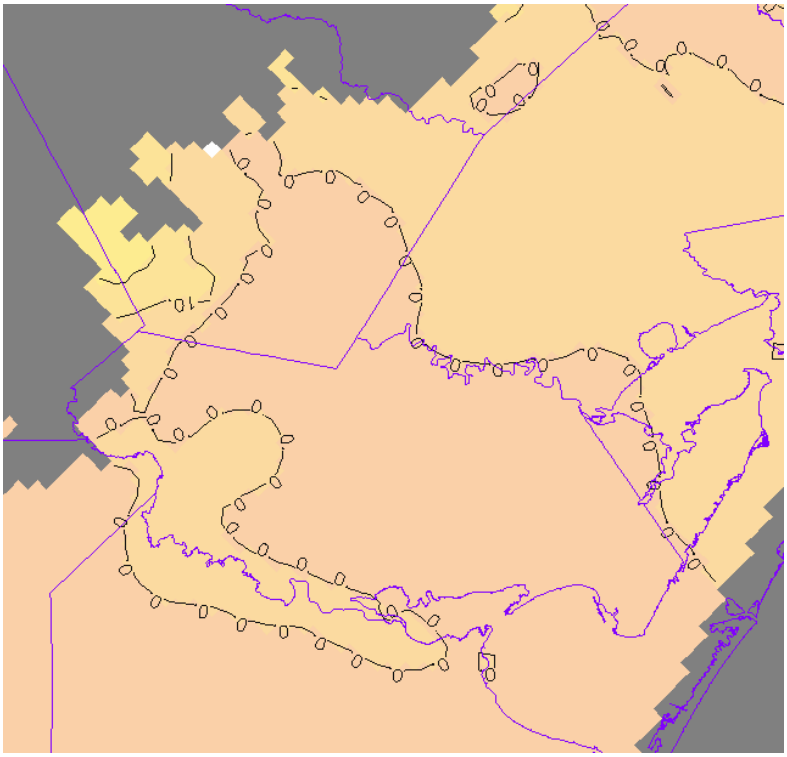

Figure 12: Drawdown map for 2040 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- first model run. Contour interval is 10 feet and negative values indicate rising water levels.

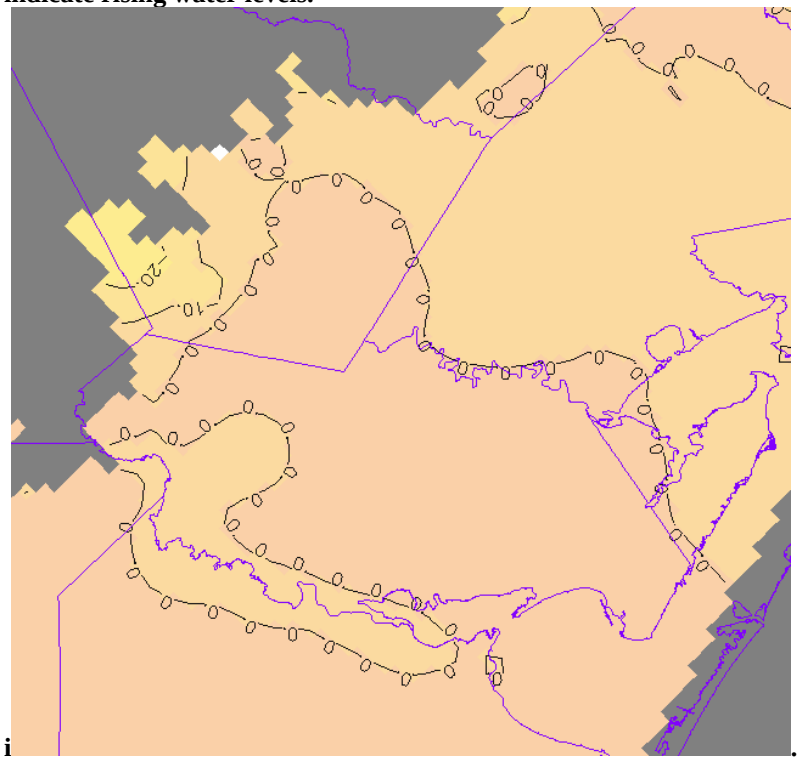

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Figure 13: Drawdown map for 2050 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- first model run. Contour interval is 10 feet and negative values indicate rising water levels.

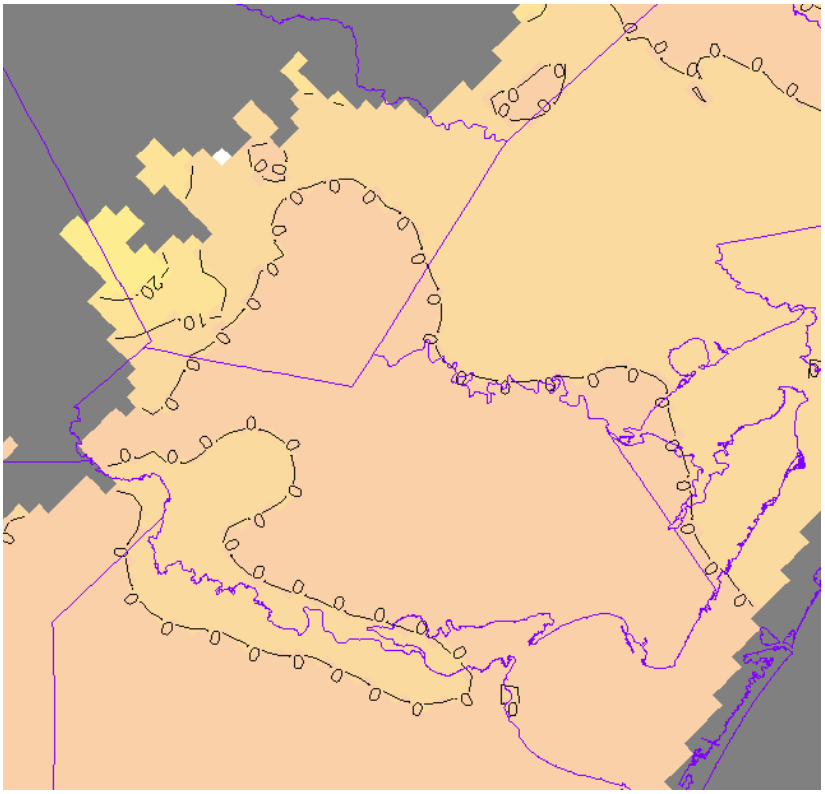

Figure 14: Drawdown map for 2060 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- first model run. Contour interval is 10 feet and negative values indicate rising water levels.

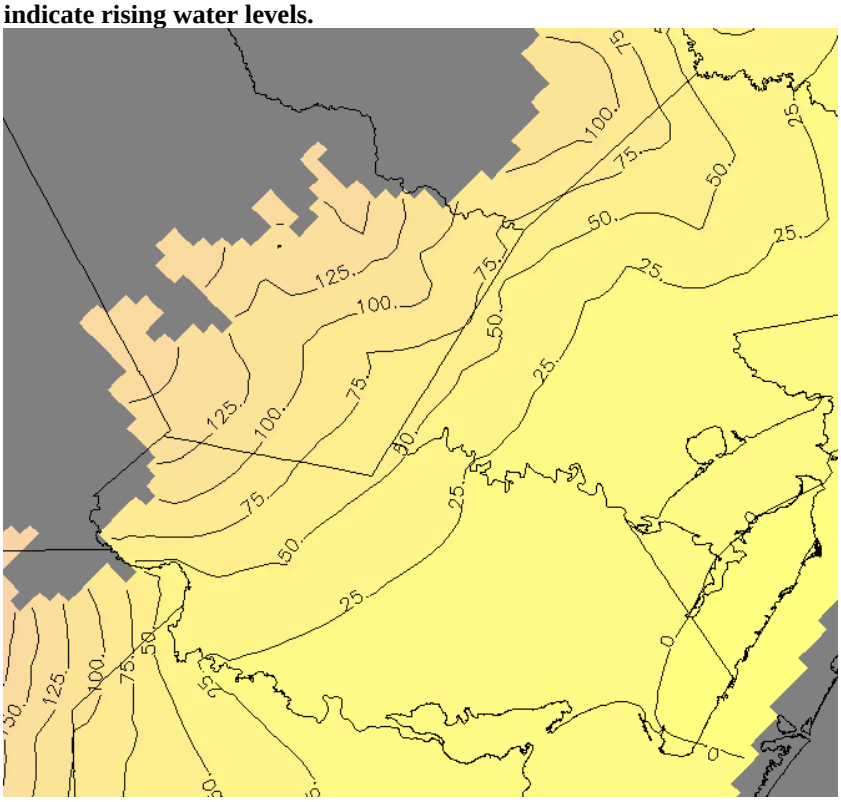

Figure 15: Water levels in the Chicot aquifer in 2005 in Bee and San Patricio counties with pumping described in scenario 1 – second model run. Contour interval is 25 feet.

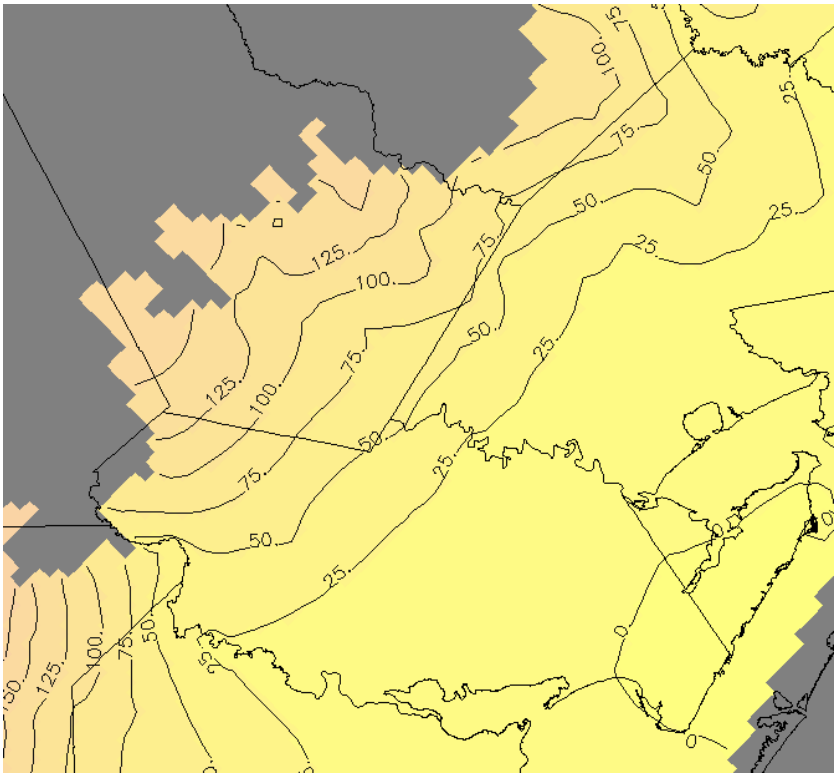

Figure 16: Water levels in the Chicot aquifer in 2010 in Bee and San Patricio counties with pumping described in scenario 1 – second model run. Contour interval is 25 feet.

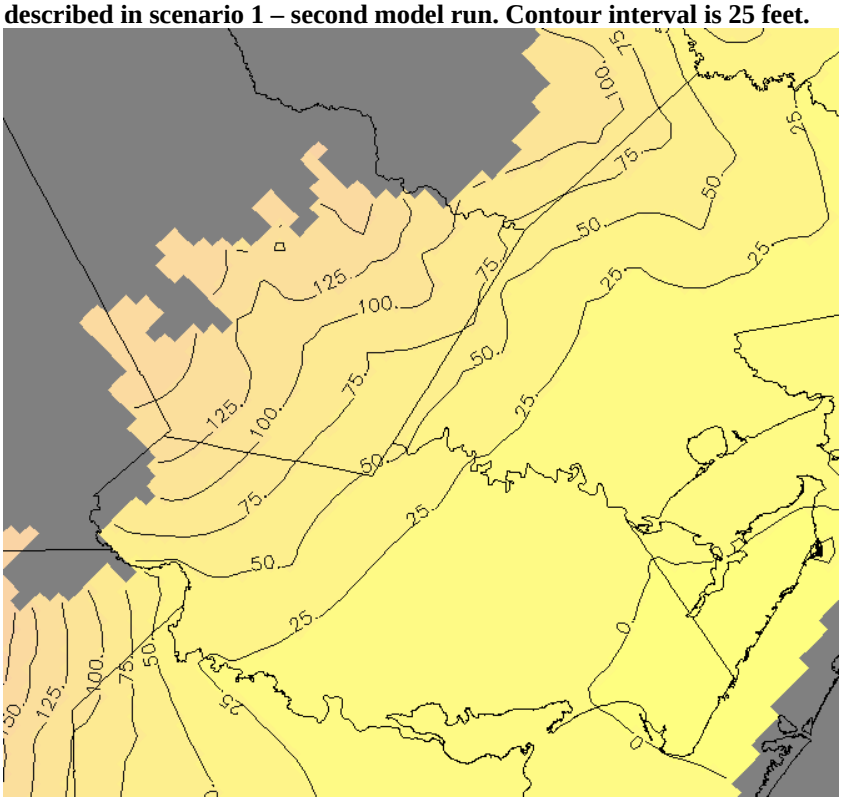

Figure 17: Water levels in the Chicot aquifer in 2020 in Bee and San Patricio counties with pumping described in scenario 1 – second model run. Contour interval is 25 feet.

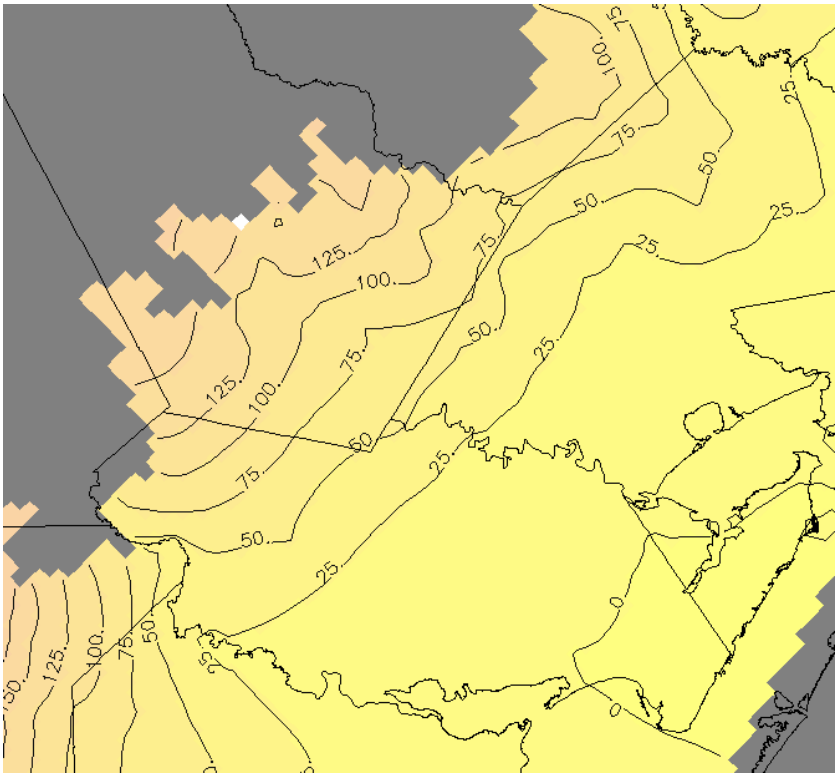

Figure 18: Water levels in the Chicot aquifer in 2030 in Bee and San Patricio counties with pumping described in scenario 1 – second model run. Contour interval is 25 feet.

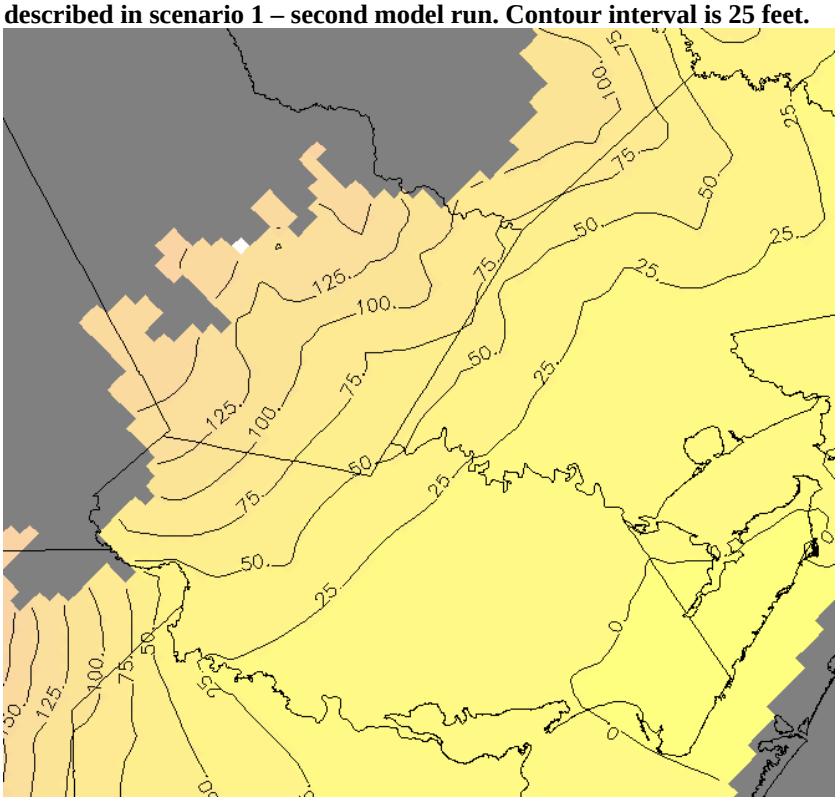

Figure 19: Water levels in the Chicot aquifer in 2040 in Bee and San Patricio counties with pumping described in scenario 1 – second model run. Contour interval is 25 feet.

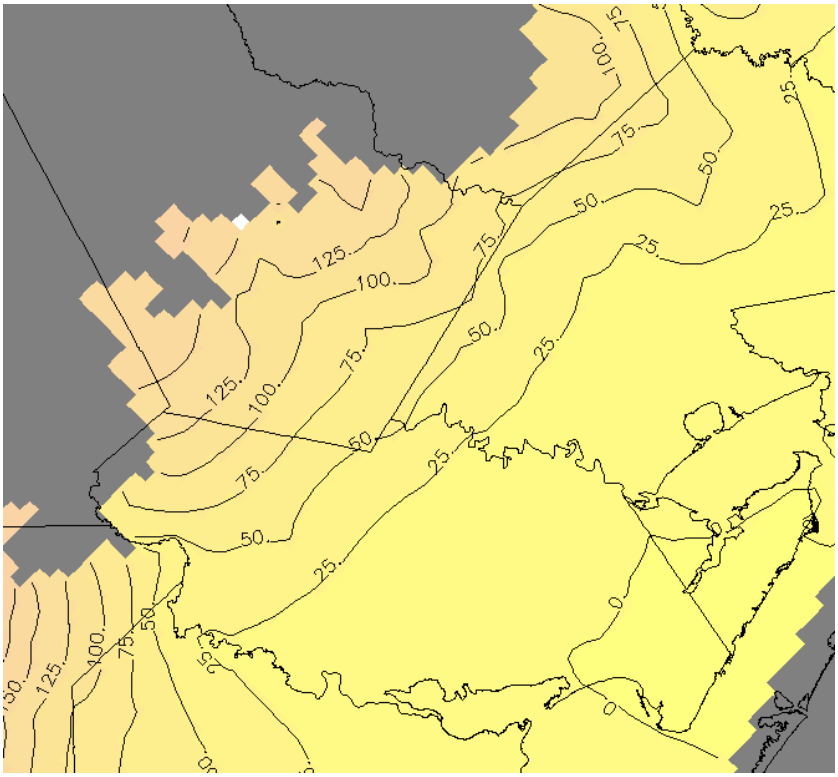

Figure 20: Water levels in the Chicot aquifer in 2050 in Bee and San Patricio counties with pumping described in scenario 1 – second model run. Contour interval is 25 feet.

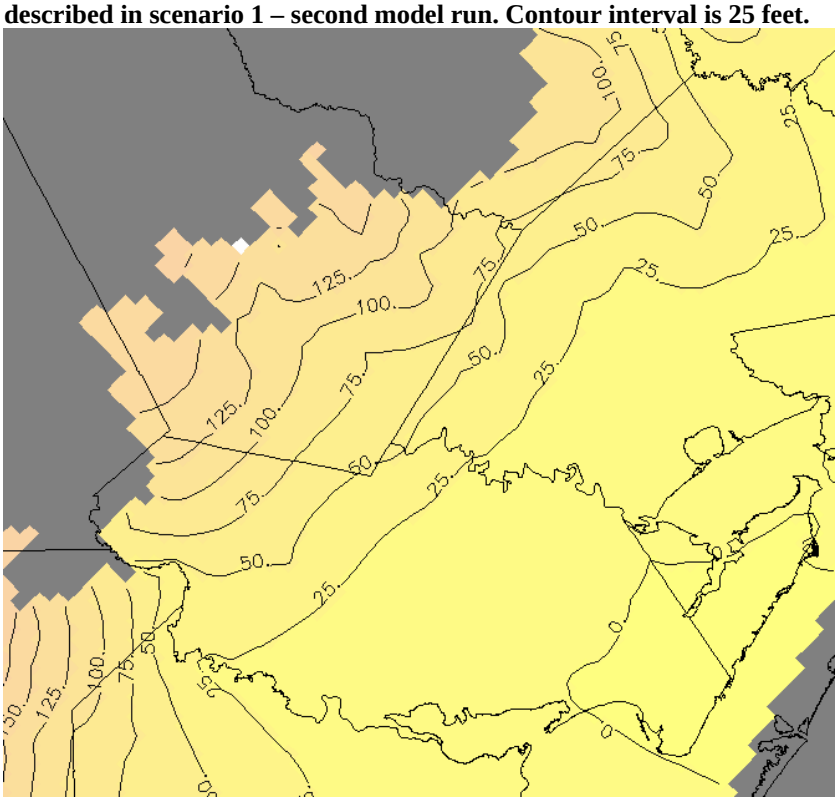

Figure 21: Water levels in the Chicot aquifer in 2060 in Bee and San Patricio counties with pumping described in scenario 1 – second model run. Contour interval is 25 feet.

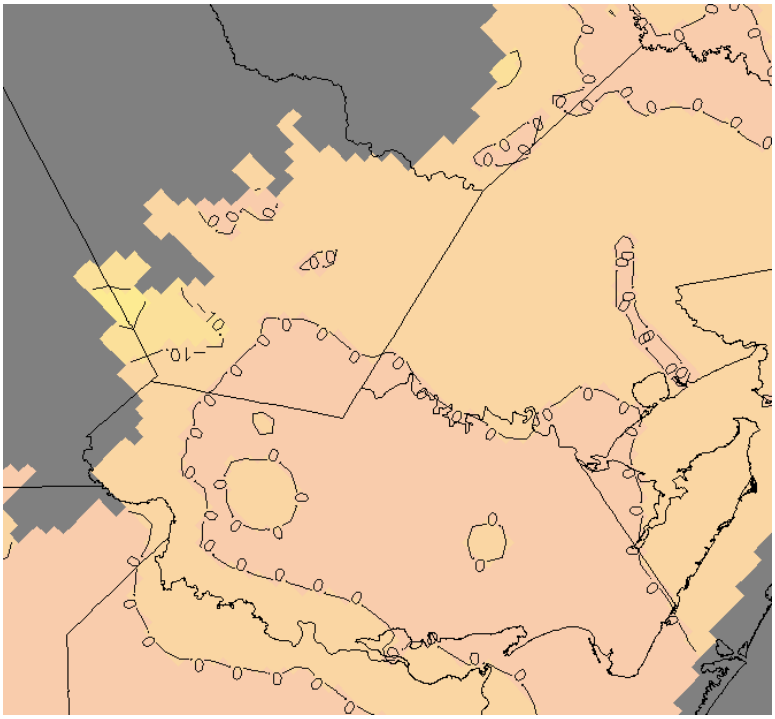

Figure 22: Drawdown map for 2005 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- second model run. Contour interval is 10 feet and negative values indicate rising water levels.

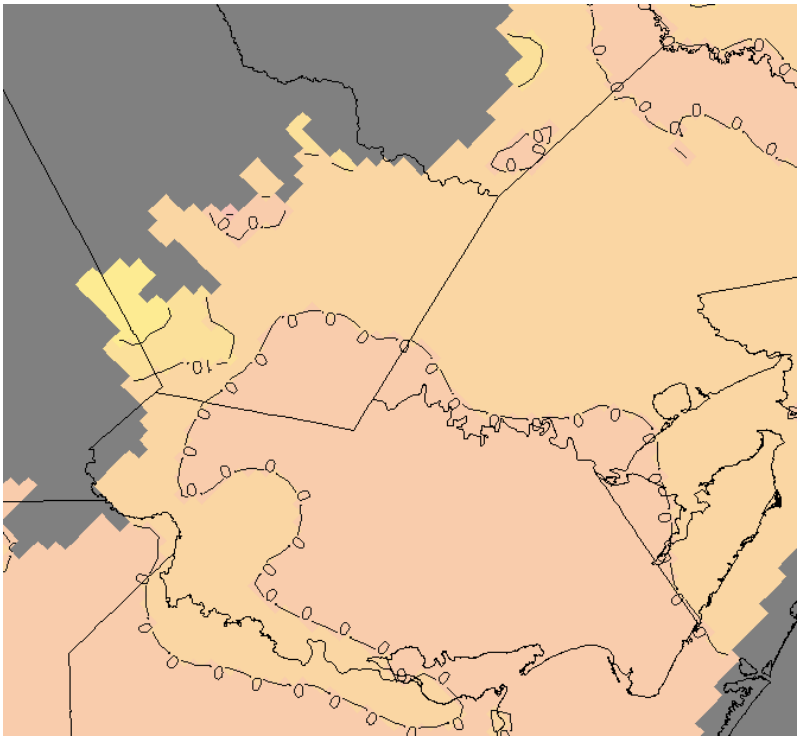

Figure 23: Drawdown map for 2010 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- second model run. Contour interval is 10 feet and negative values indicate rising water levels.

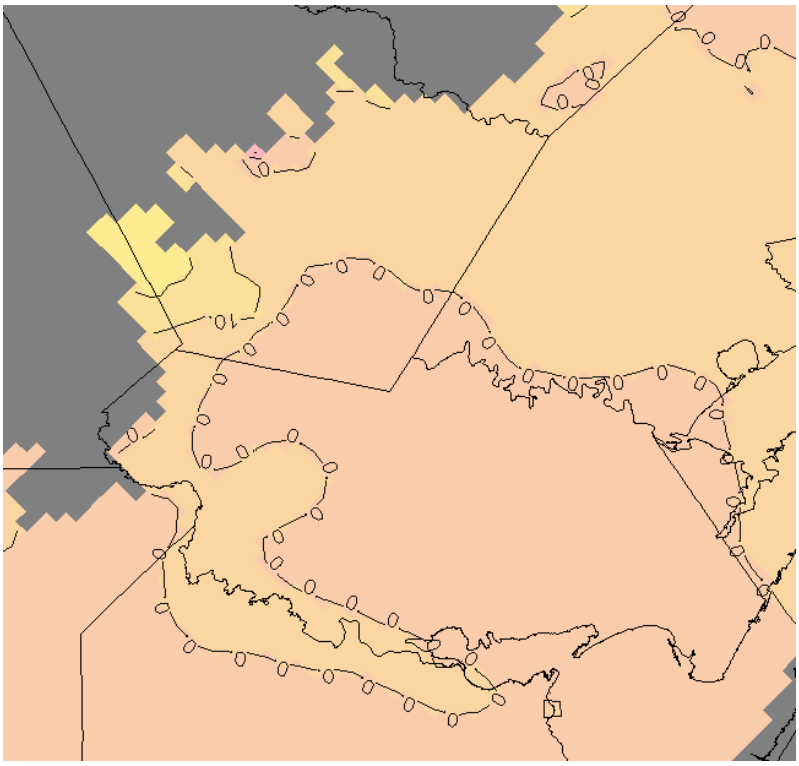

Figure 24: Drawdown map for 2020 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- second model run. Contour interval is 10 feet and negative values indicate rising water levels.

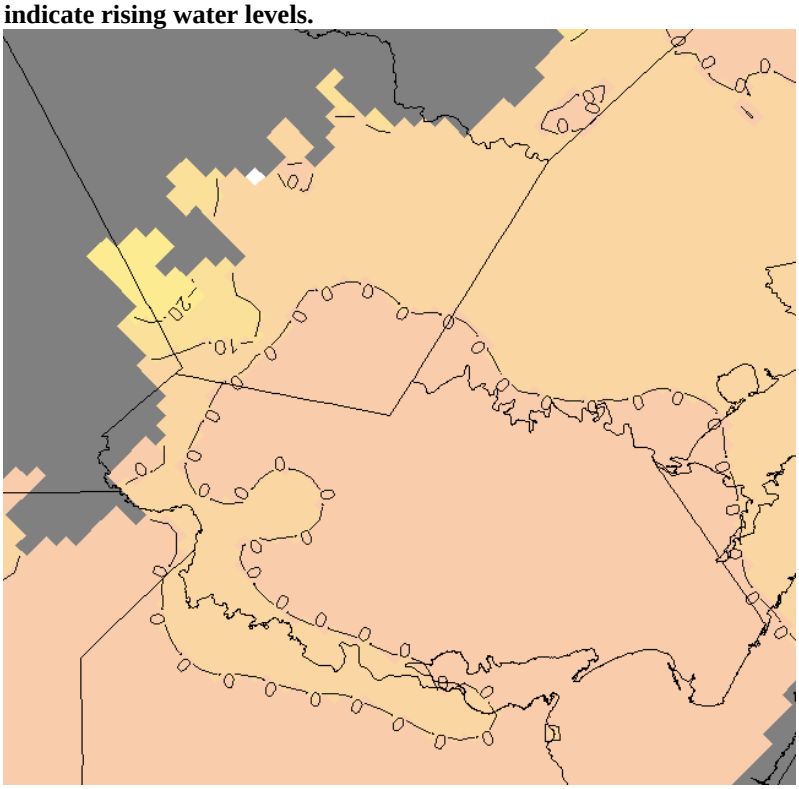

Figure 25: Drawdown map for 2030 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- second model run. Contour interval is 10 feet and negative values indicate rising water levels.

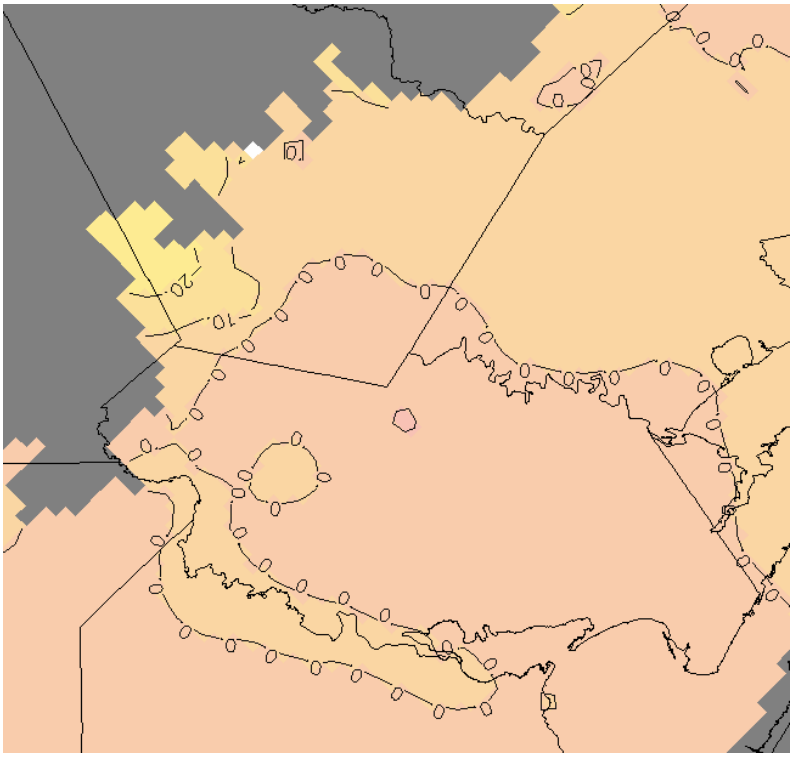

Figure 26: Drawdown map for 2040 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- second model run. Contour interval is 10 feet and negative values indicate rising water levels.

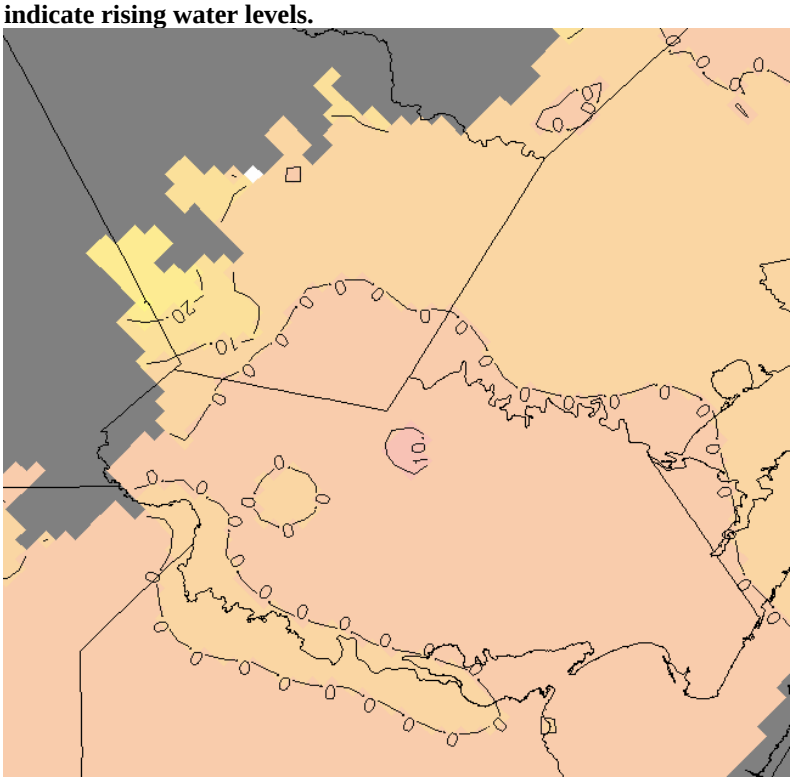

Figure 27: Drawdown map for 2050 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- second model run. Contour interval is 10 feet and negative values indicate rising water levels.

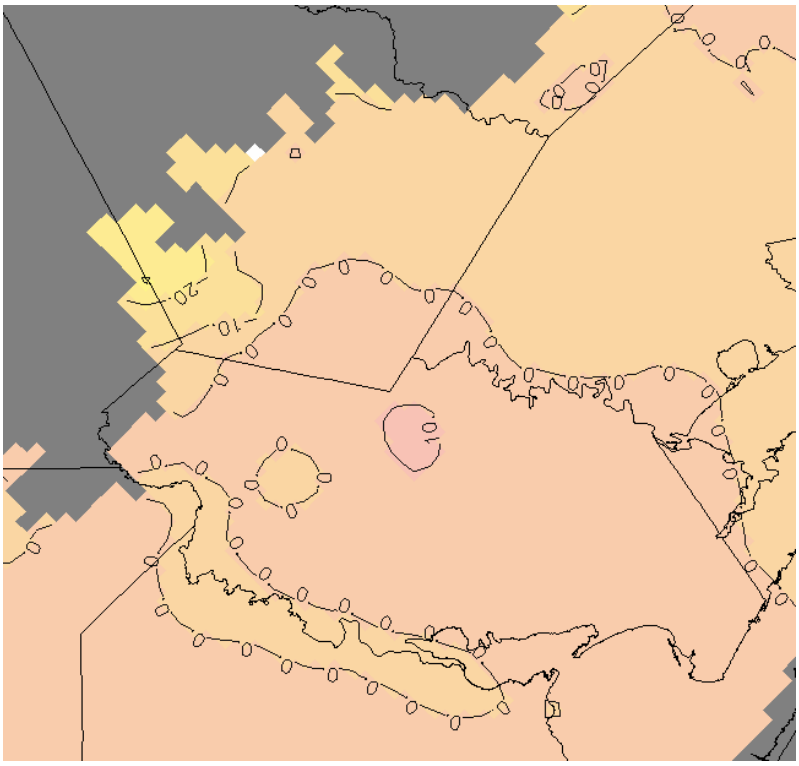

Figure 28: Drawdown maps for 2060 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 1 -- second model run. Contour interval is 10 feet and negative values indicate rising water levels.

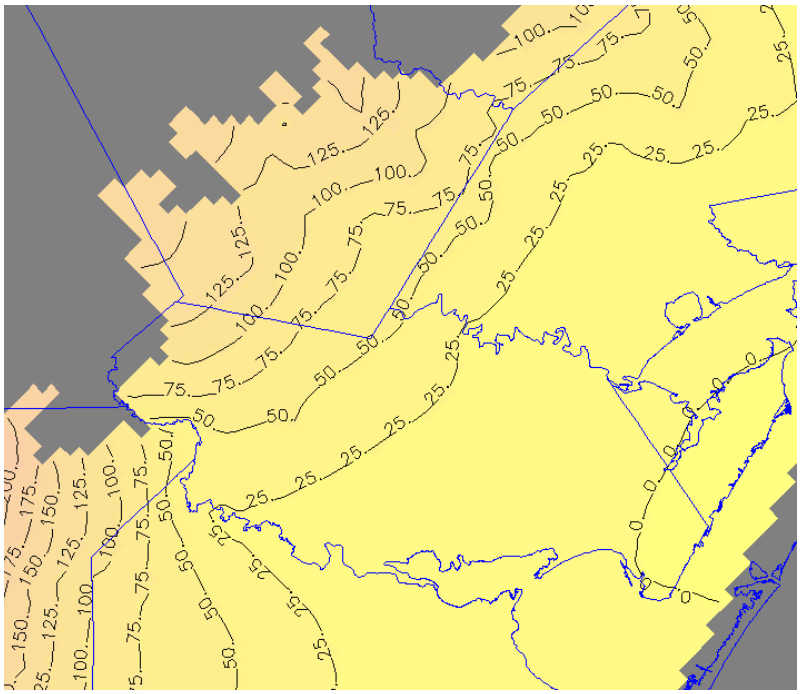

Figure 29 :Water levels in the Chicot aquifer in 2005 in Bee and San Patricio counties with pumping described in scenario 2 – first model run in the scenario. Contour interval is 25 feet.

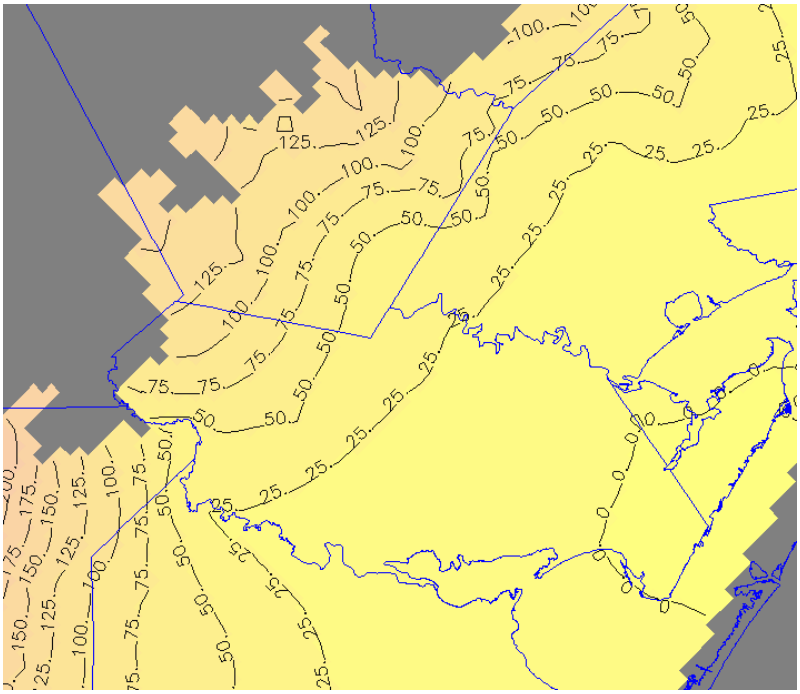

Figure 30:Water levels in the Chicot aquifer in 2010 in Bee and San Patricio counties with pumping described in scenario 2 – first model run in the scenario. Contour interval is 25 feet.

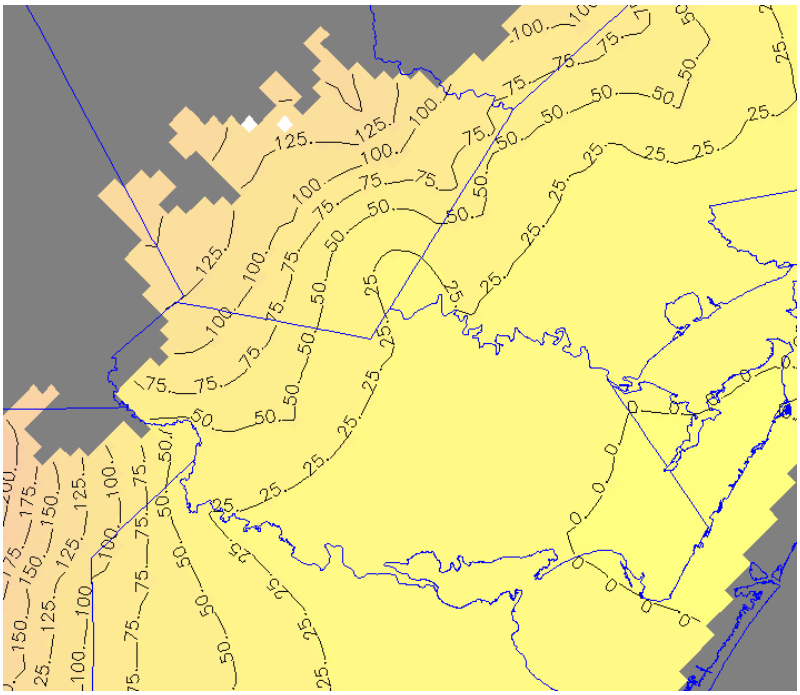

Figure 31:Water levels in the Chicot aquifer in 2020 in Bee and San Patricio counties with pumping described in scenario 2 – first model run in the scenario. Contour interval is 25 feet.

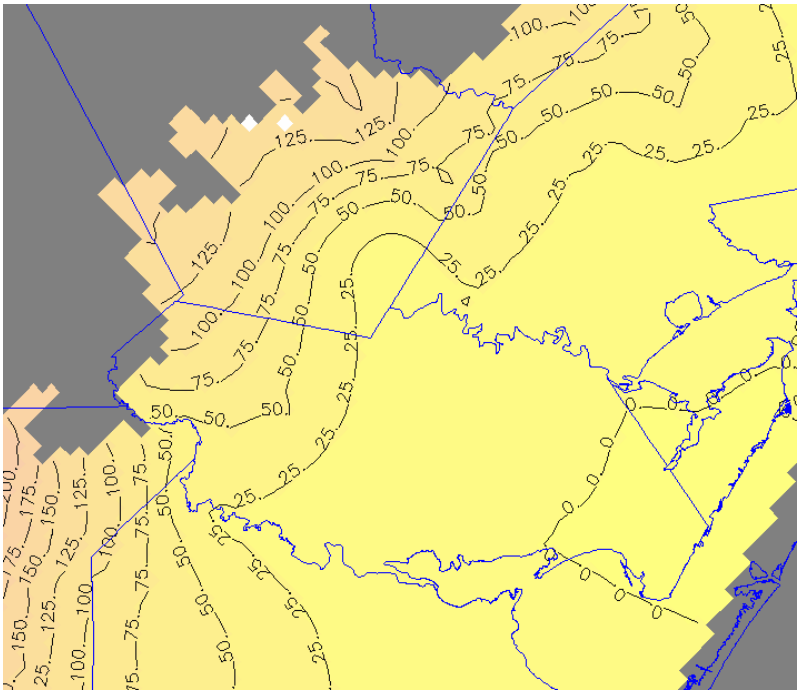

Figure 32:Water levels in the Chicot aquifer in 2030 in Bee and San Patricio counties with pumping described in scenario 2 – first model run in the scenario. Contour interval is 25 feet.

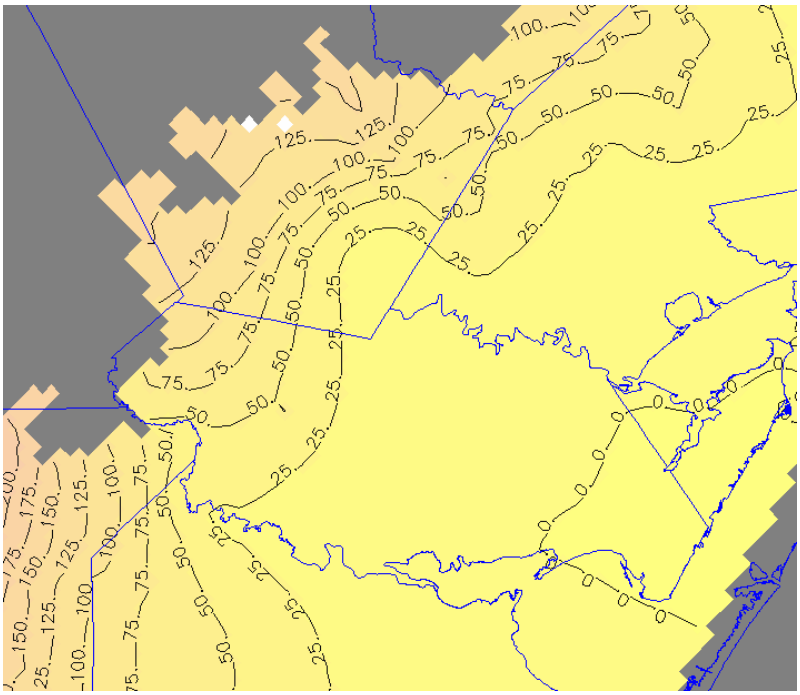

Figure 33:Water levels in the Chicot aquifer in 2040 in Bee and San Patricio counties with pumping described in scenario 2 – first model run in the scenario. Contour interval is 25 feet.

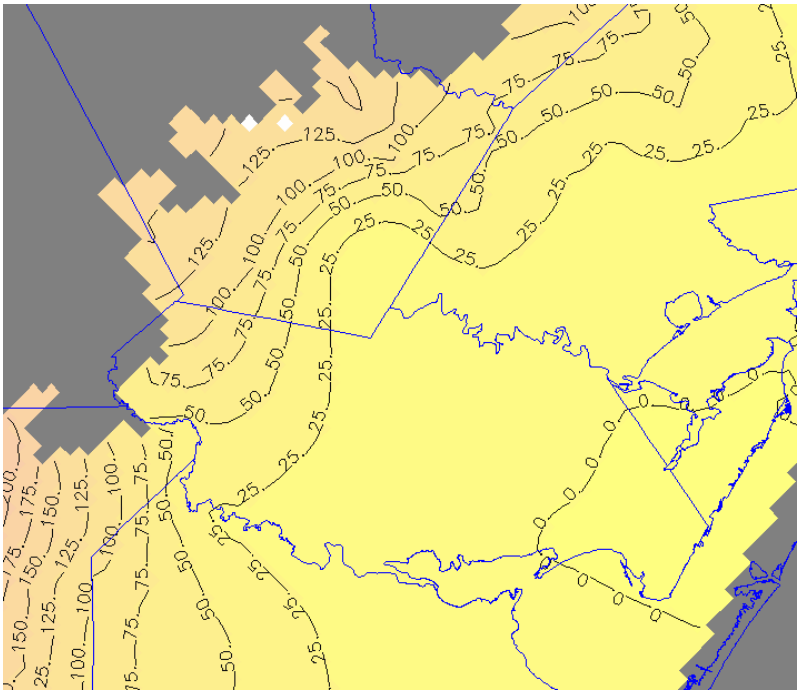

Figure 34:Water levels in the Chicot aquifer in 2050 in Bee and San Patricio counties with pumping described in scenario 2 – first model run in the scenario. Contour interval is 25 feet.

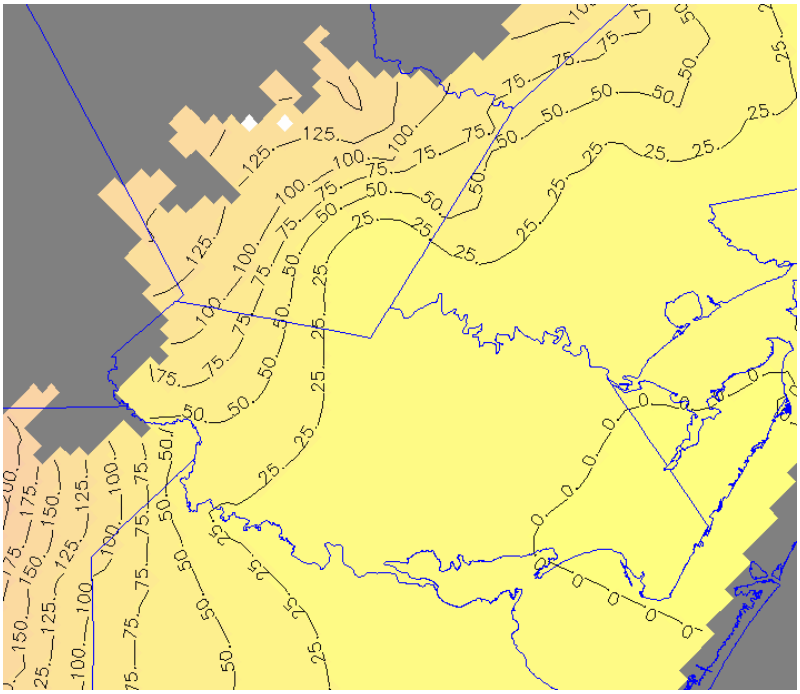

Figure 35: Water levels in the Chicot aquifer in 2060 in Bee and San Patricio counties with pumping described in scenario 2 – first model run in the scenario. Contour interval is 25 feet.

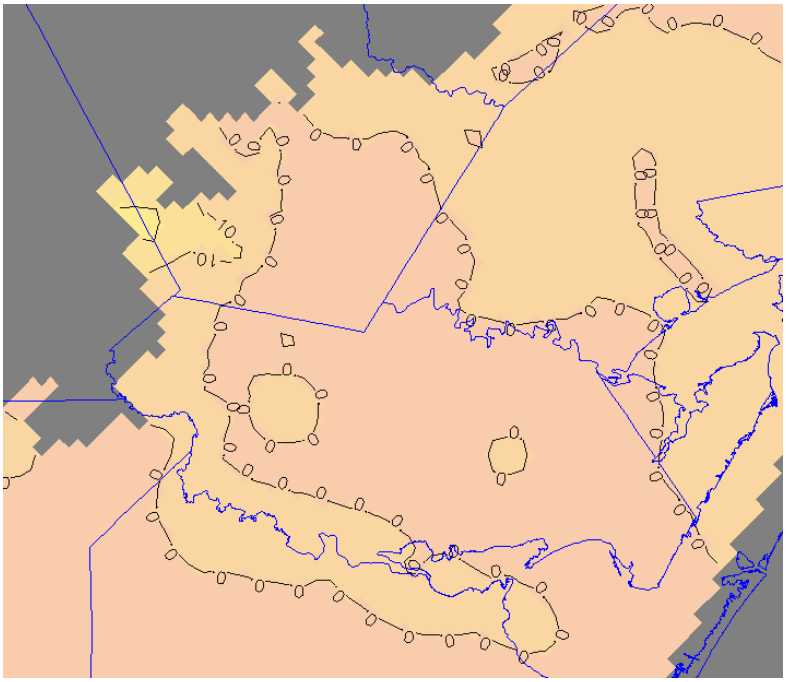

Figure 36: Drawdown map for 2005 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- first model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

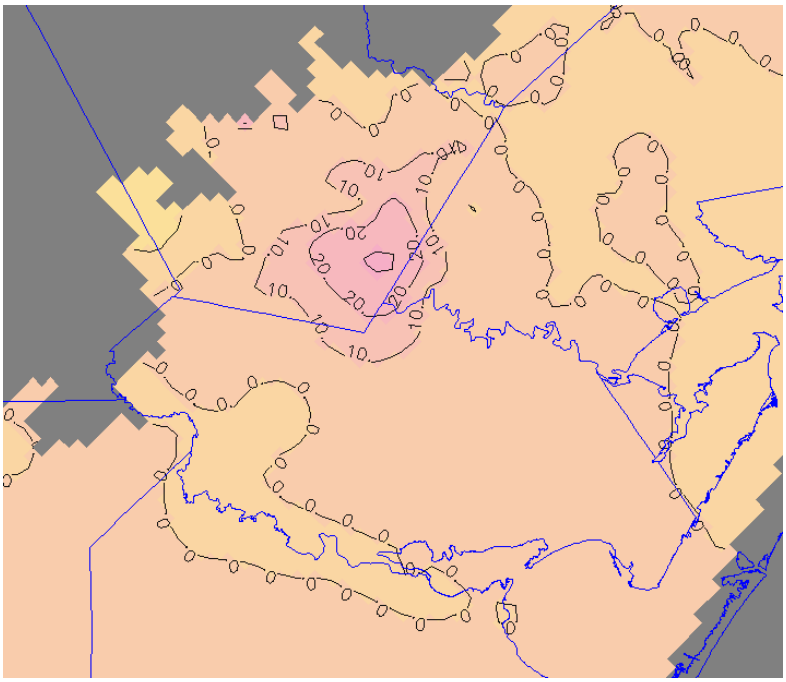

Figure 37: Drawdown map for 2010 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- first model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

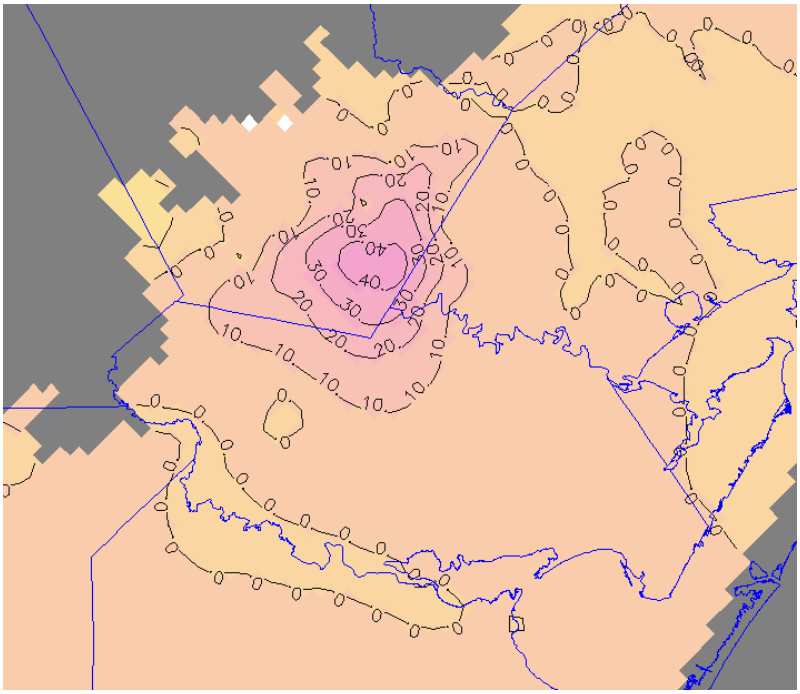

Figure 38: Drawdown map for 2020 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- first model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

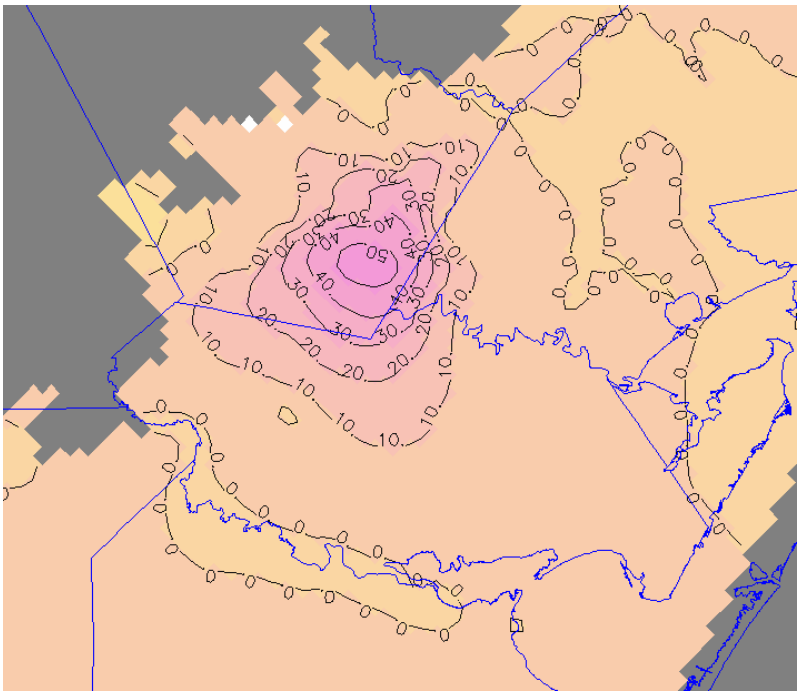

Figure 39: Drawdown map for 2030 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- first model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

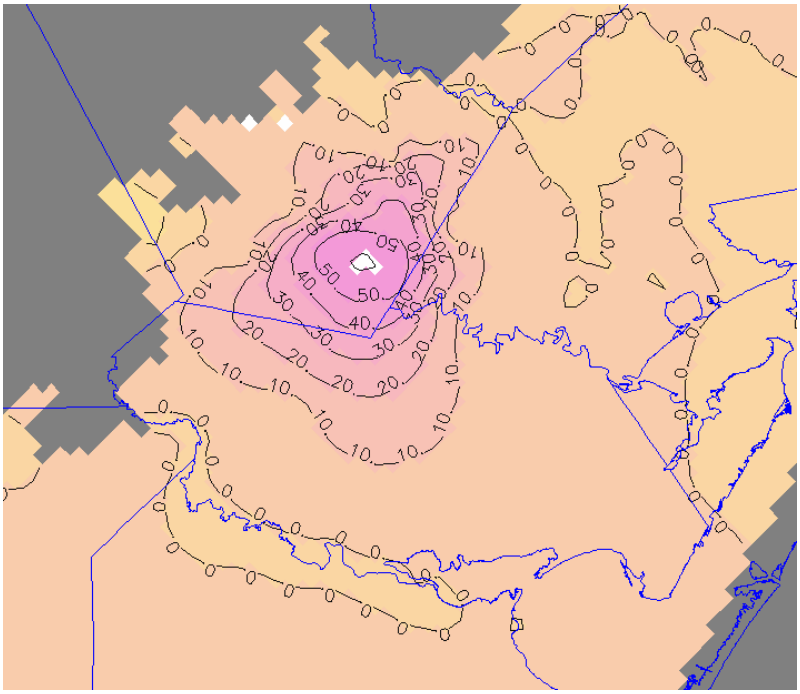

Figure 40: Drawdown map for 2040 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- first model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

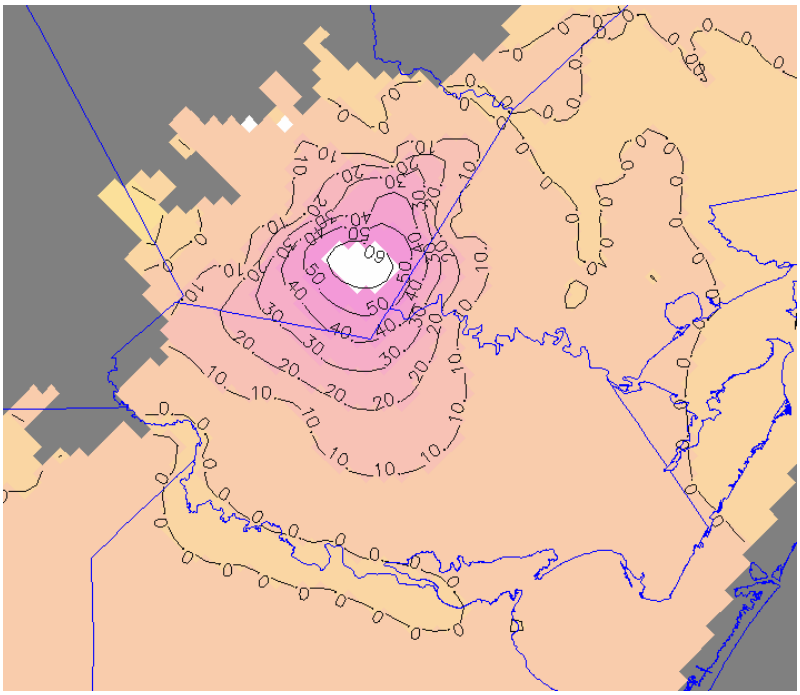

Figure 41: Drawdown map for 2050 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- first model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

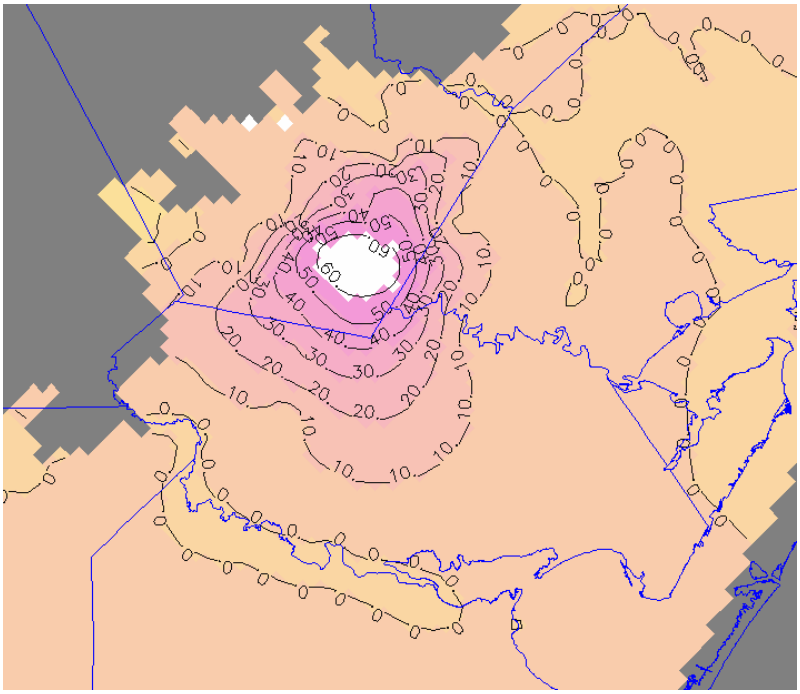

Figure 42: Drawdown map for 2060 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- first model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

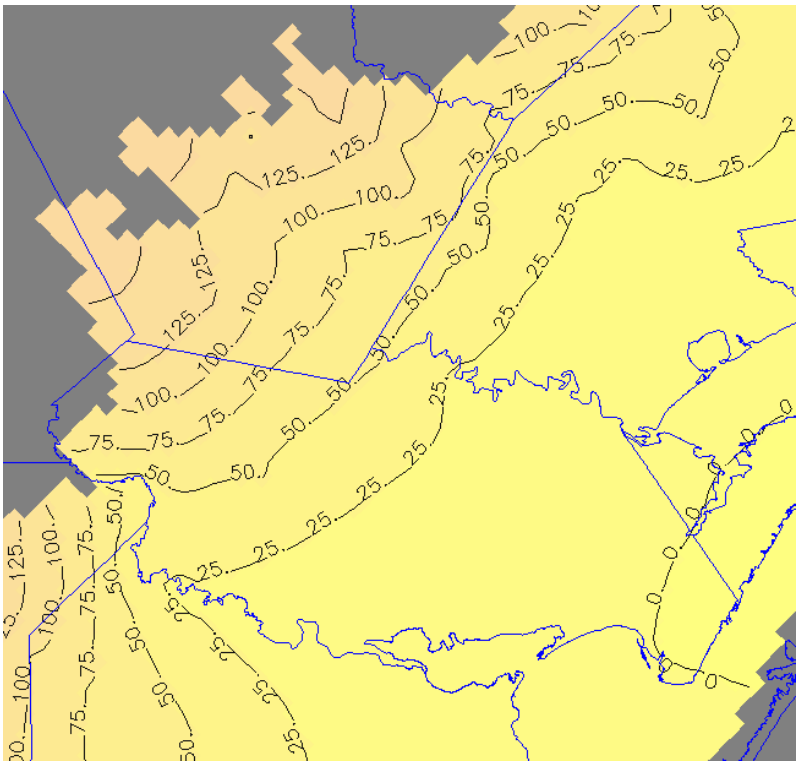

Figure 43: Water levels in the Chicot aquifer in 2005 in Bee and San Patricio counties with pumping described in scenario 2 – second model run in the scenario. Contour interval is 25 feet.

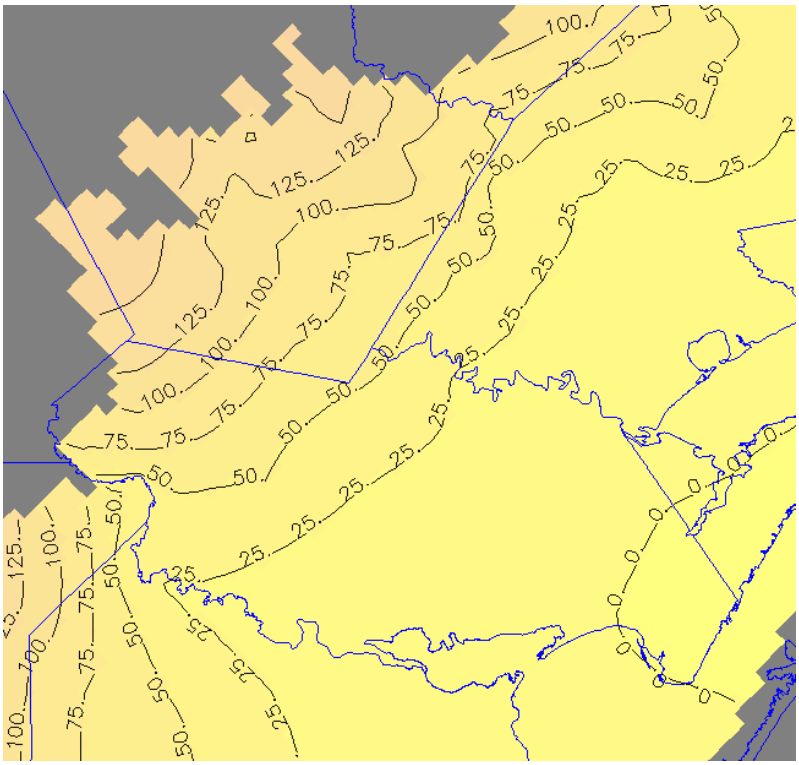

Figure 44: Water levels in the Chicot aquifer in 2010 in Bee and San Patricio counties with pumping described in scenario 2 – second model run in the scenario. Contour interval is 25 feet.

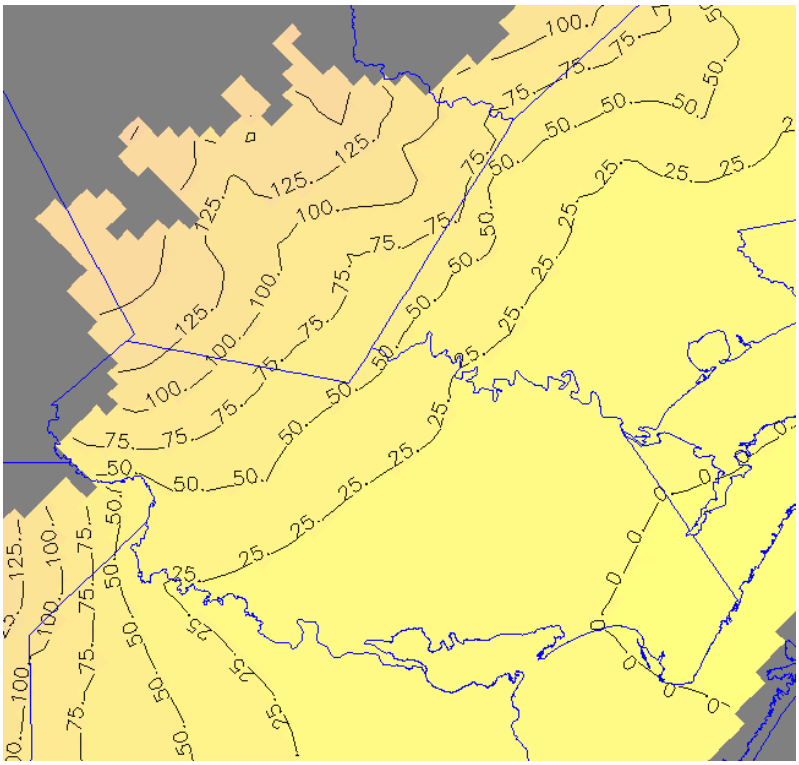

Figure 45: Water levels in the Chicot aquifer in 2020 in Bee and San Patricio counties with pumping described in scenario 2 – second model run in the scenario. Contour interval is 25 feet.

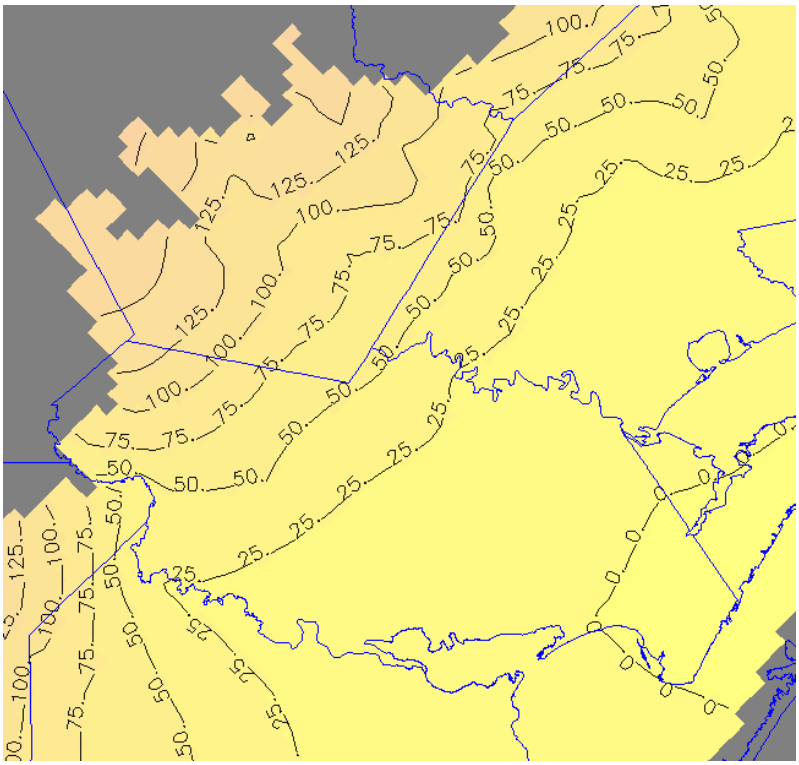

Figure 46: Water levels in the Chicot aquifer in 2030 in Bee and San Patricio counties with pumping described in scenario 2 – second model run in the scenario. Contour interval is 25 feet.

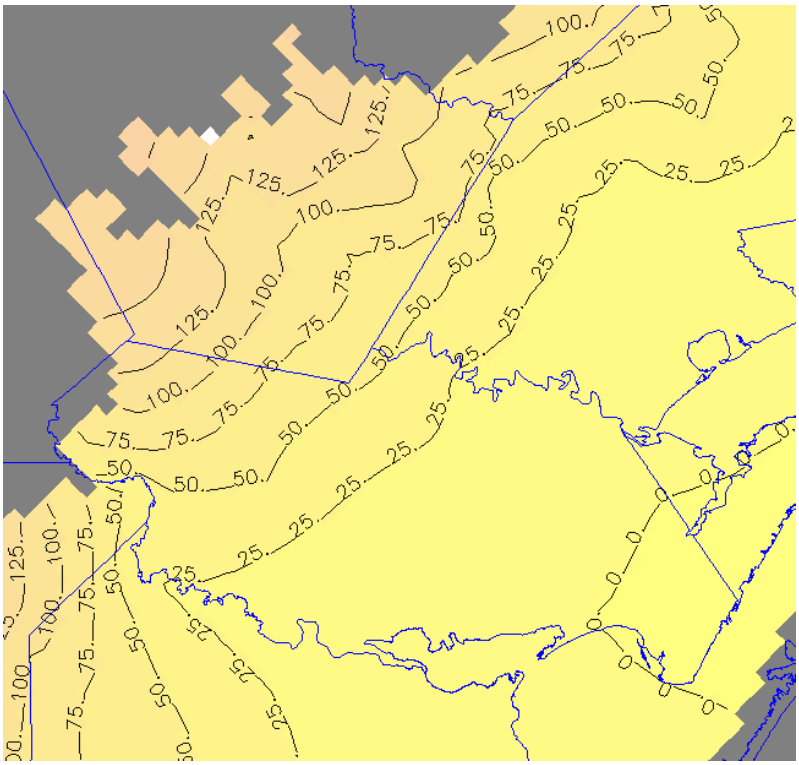

Figure 47: Water levels in the Chicot aquifer in 2040 in Bee and San Patricio counties with pumping described in scenario 2 – second model run in the scenario. Contour interval is 25 feet.

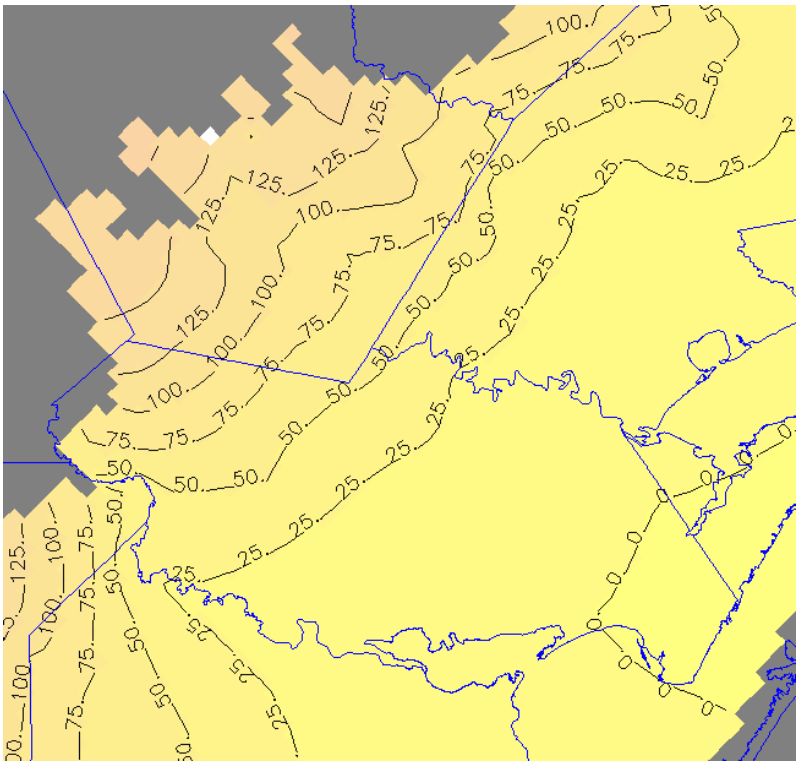

Figure 48: Water levels in the Chicot aquifer in 2050 in Bee and San Patricio counties with pumping described in scenario 2 – second model run in the scenario. Contour interval is 25 feet.

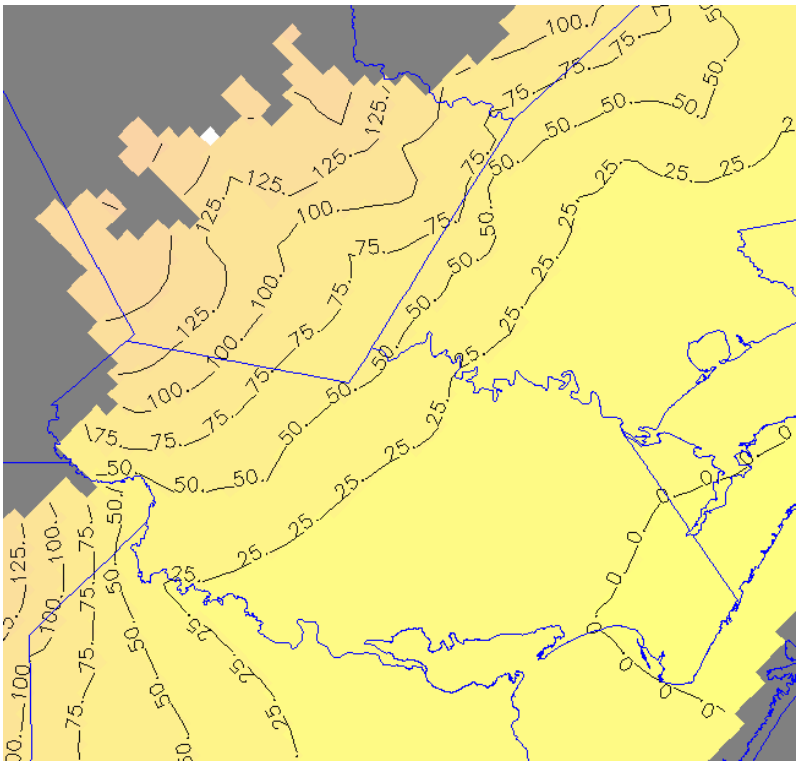

Figure 49: Water levels in the Chicot aquifer in 2060 in Bee and San Patricio counties with pumping described in scenario 2 – second model run in the scenario. Contour interval is 25 feet.

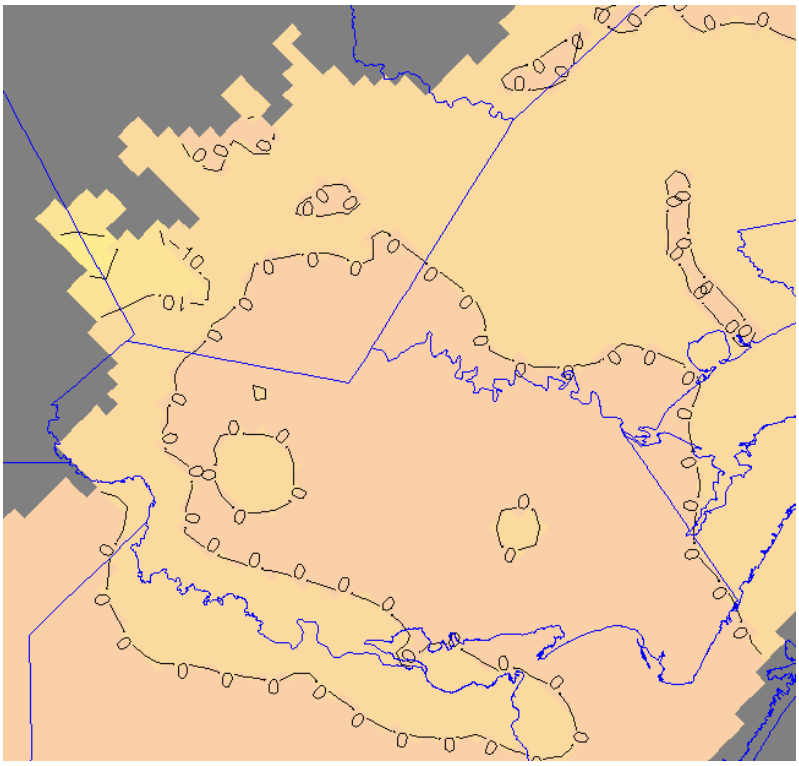

Figure 50: Drawdown map for 2005 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- second model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

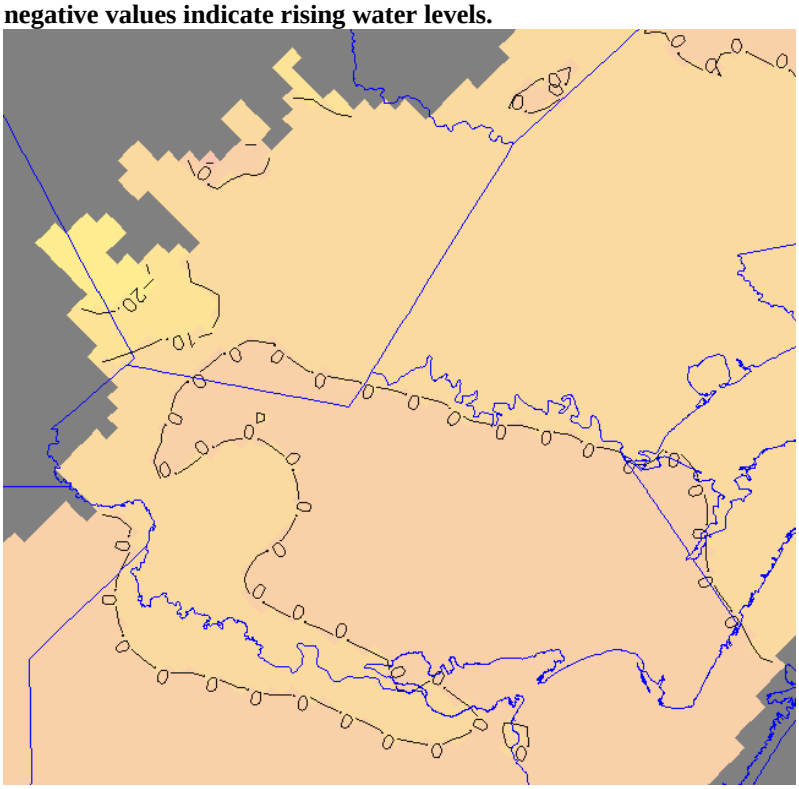

Figure 51: Drawdown map for 2010 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- second model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

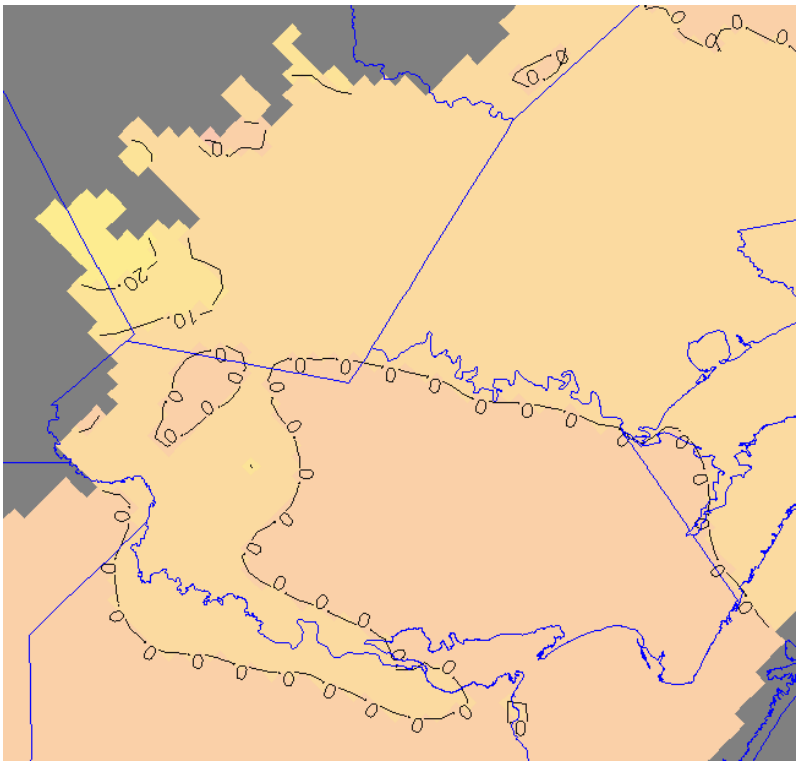

Figure 52: Drawdown map for 2020 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- second model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

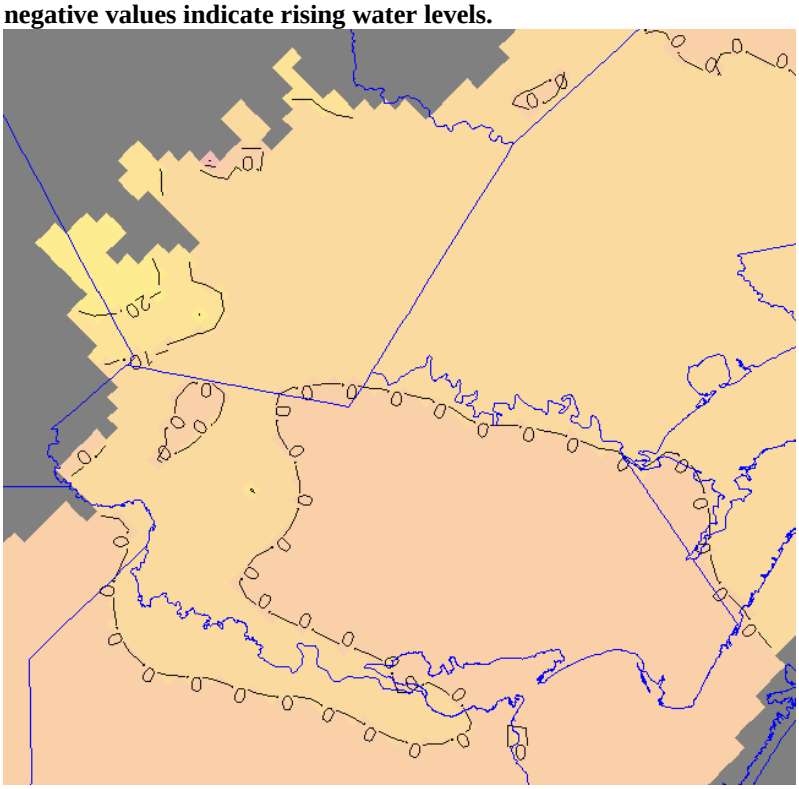

Figure 53: Drawdown map for 2030 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- second model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

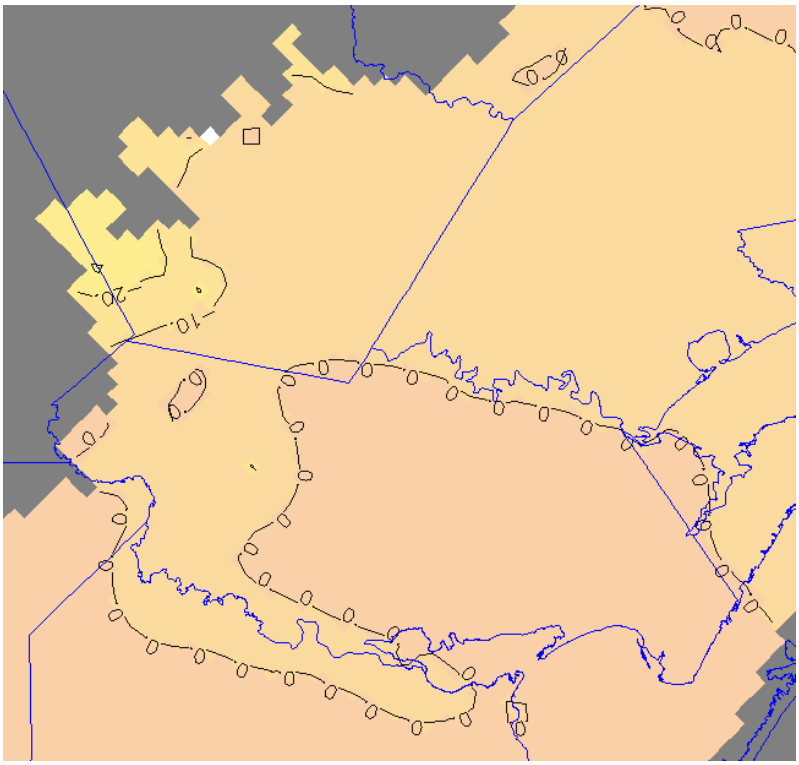

Figure 54: Drawdown map for 2040 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- second model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

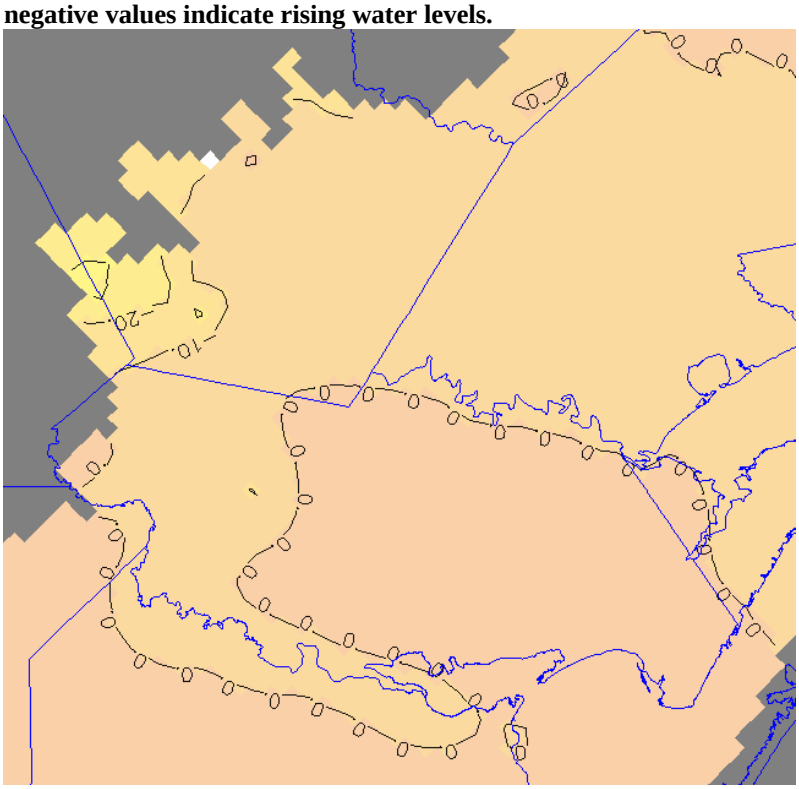

Figure 55: Drawdown map for 2050 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- second model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.

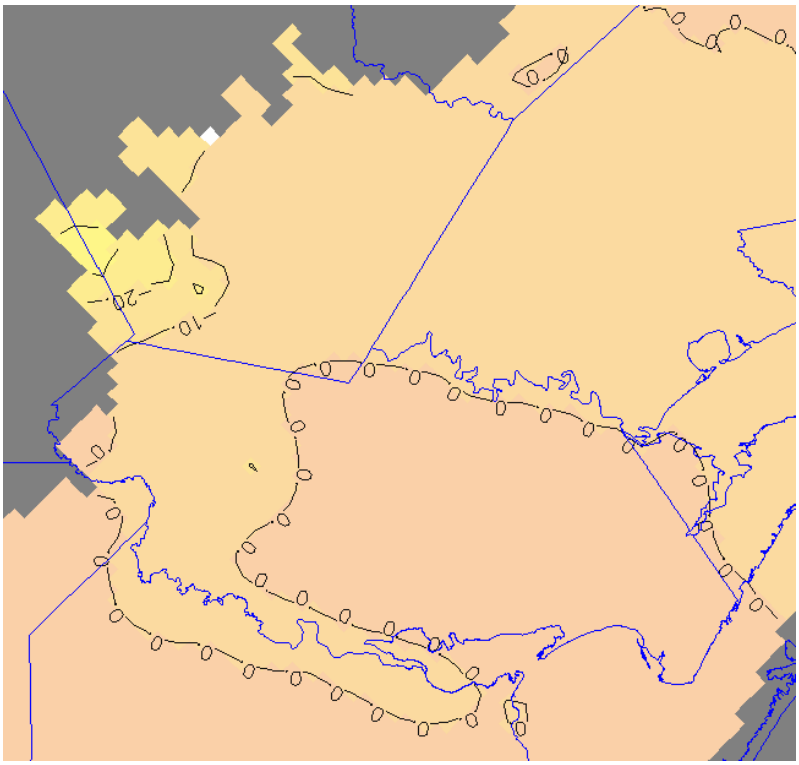

Figure 56: Drawdown map for 2060 in the Chicot aquifer in Bee and San Patricio counties with pumping described in scenario 2 -- second model run in the scenario. Contour interval is 10 feet and negative values indicate rising water levels.