GAM Run 09-010

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Groundwater Availability Modeling Section
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The seal appearing on this document was authorized by Roberto Anaya, P.G. 480, on September 16, 2010.

EXECUTIVE SUMMARY:

The groundwater availability model for the central part of the Gulf Coast Aquifer System was used with a constant specified annual pumpage for a 61-year predictive simulation along with average recharge rates, evapotranspiration rates, and initial streamflows. Based on the model run we then calculated average drawdown after 61 years for each county within Groundwater Management 15, to assist members of Groundwater Management Area 15 with determining desired future conditions for the Gulf Coast Aquifer System. Overall an average of 11.4 feet of drawdown was simulated in the Gulf Coast Aquifer within Groundwater Management Area 15 assuming a pumping volume of 479,663 acre-feet per year.

REQUESTOR:

Mr. Neil Hudgins of the Coastal Bend Groundwater Conservation District acting on behalf of Groundwater Management Area 15.

DESCRIPTION OF REQUEST:

Mr. Hudgins requested a model run using the groundwater availability model for the central part of the Gulf Coast Aquifer. This model run would be a 61-year predictive simulation using initial water levels from the end of the 1999 historical calibration period and average recharge conditions. Each year of the model run will include pumpage amounts as specified by the members of Groundwater Management Area 15.

METHODS:

Recharge, evapotranspiration rates, and initial streamflows were averaged for the historic calibration-verification runs, representing 1981 to 1999. These averages were then used for each year of the 61-year predictive simulation along with the requsted pumpage volumes.

PARAMETERS AND ASSUMPTIONS:

The groundwater availability model for the central part of the Gulf Coast Aquifer was used for this model run. The parameters and assumptions for this model are described below:

- We used Version 1.01 of the groundwater availability model for the central part of the Gulf Coast Aquifer. This model assumes partial penetrating wells in the Evangeline Aquifer due to a lack of data for aquifer properties in the lower portion of the aquifer.

- See Chowdhury and others (2004) and Waterstone and others (2003) for assumptions and limitations of the groundwater availability model for the central part of the Gulf Coast Aquifer.

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the entire model for 1999 is 26 feet, which is 4.6 percent of the hydraulic head drop across the model area (Chowdhury and others, 2004).

- The model includes four layers representing: the Chicot Aquifer (Layer 1), the Evangeline Aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the Jasper Aquifer (Layer 4).

- Recharge rates, evapotranspiration rates, and initial streamflows are averages from the 1981 to 1999 calibration and verification time period.

- Pumpage amounts and the distribution used for the 61-year predictive simulation were specified by the members of Groundwater Management Area 15. Details on this pumpage are given below.

Specified Pumpage

The pumpage volume amounts specified by the members of Groundwater Management Area 15 were based on the initial distribution of pumpage constructed for GAM Run 07-12 (Donnelly, 2007a). The assumptions used to create initial distribution of pumpage are detailed in the GAM Run 07-12 report and will not be repeated in this report. The following modifications were made to the initial distribution of pumpage to create the requested pumpage used in this simulation.

The initial distribution of pumpage totals constructed for GAM run 07-12 (Donnelly, 2007a) was used to construct a new base pumpage distribution for the fourteen counties of Groundwater Management Area 15. The new base pumpage volumes actually used for each county in this model simulation are shown in Table 1. The geographic distribution of new base pumpage was developed by uniformly distributing, in equal amounts to each cell within the active model portion of each aquifer, any additional pumpage specified by members of Grondwater Management Area 15 above the initial distribution of pumpage used in GAM run 07-12 (Donnelly, 2007a). For specified pumpage reductions relative to the initial distribution of pumpage used in GAM run 07-12 (Donnelly, 2007a), the intial pumpage distribution was scaled down by the percent difference between the initial distribution of pumpage and the specified pumpage. In addition to specifying total pumpage for each county, members of Groundwater Management Area 15 also had the option of specifying where pumpage would be allocated independent of the initial distribution of pumpage used in GAM run 07-12 (Donnelly, 2007a). The following pumpage specifications further clarify the pumpage volumes shown in Table 1.

- Bee County—A total of 9,500 acre-feet per year of pumpage was specified for the active model area of the Chicot Aquifer. A total of 12,000 acre-feet per year of pumpage was specified for the active model area of the Evangeline Aquifer. A total of 75 acre-feet per year of pumpage was specified for the active model area of the Burkeville Confining Unit. A total of 600 acre-feet per year of pumpage was specified for the active model area of the Jasper Aquifer. The total actual pumpage used for Bee County for this model run was 22,175 acre-feet per year. The portions of pumpage for Bee County within Groundwater Management Area 15 are shown in Table 1.

- Goliad County—A total of 699 acre-feet per year of pumpage was specified for the active model area of the Chicot Aquifer. A total of 10,374 acre-feet per year of pumpage was specified for the active model area of the Evangeline Aquifer. A total of 299 acre-feet per year of pumpage was specified for the Burkeville Confining Unit. A total of 100 acre-feet

per year of pumpage was specified for the Jasper Aquifer. The total actual pumpage used for Goliad County for this model run was 11,472 acre-feet per year. Goliad County submitted maps to specify desired pumpage distributions independent of the initial distribution of pumpage used in GAM run 07-12 (Donnelly, 2007a).

- Refugio County—A total of 6,254 acre-feet per year of pumpage was specified for the active model area of the Chicot Aquifer. A total of 22,500 acre-feet per year of pumpage was specified for the active model area of the Evangeline Aquifer. No pumpage was specified for the Burkeville Confining Unit or Jasper Aquifer. The total actual pumpage used for Refugio County for this model run was 28,753 acre-feet per year. Refugio County submitted maps to specify desired pumpage distributions independent of the initial distribution of pumpage used in GAM run 07-12 (Donnelly, 2007a).

- San Patricio County—Although, San Patricio County is not in Groundwater Management Area 15, a Groundwater Management Area 15 member requested pumpage be specified for this county since it was adjacent to Groundwater Management Area 15. A total of 9,000 acre-feet per year of pumpage was specified for the active model area of the Chicot Aquifer. A total of 9,000 acre-feet per year of pumpage was specified for the active model area of the Evangeline Aquifer. No pumpage was specified for the Burkeville Confining Unit or Jasper Aquifer. The total actual pumpage used for San Patricio County for this model run was 18,000 acre-feet per year and is not listed in Table 1.

- All other counties—The GAM run 07-12 initial pumpage distribution was used for all other counties within the groundwater availability model for the central part of the Gulf Coast Aquifer not specified above.

Geographical Information System (GIS) spatial analysis techniques and programming scripts were used to generate a MODFLOW well file from the specified base pumpage requests noted previously. The actual pumpage volumes calculated and used in this model simulation are listed in Table 1. It is important to note that the values shown in Table 1 do not always match exactly with the specified pumpage requests from members of Groundwater Management Area 15. This may be due to the precision or rounding errors inherent in the development of the MODFLOW well file. In all cases, the pumpage that was specified by the members of the groundwater management area was adhered to as closely as possible. Differences between the specified pumpage and the actual model pumpage are small (less than 1 percent) and therefore, will not impact the overall conclusions of this model simulation. It should also be noted that some of the well outflow values in the water budget tables of Appendix A may be less than the pumpage values shown in Table 1. As the model simulation progresses through time, some of the model cells of an aquifer may go dry due to excessive pumpage. These dry cells will no longer be active in the model at that point in time and will remain deactivated through the end of the simulation. Consequently, this will result in a decreased well outflow component of the water budget values relative to what was input into the MODFLOW well file.

Table 1. Pumpage used for each county in this model simulation developed from pumpage specifications as requested by the members of Groundwater Management Area 15. Pumpage is reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

County	Groundwater Management Area 15 pumpage for this run				
	Chicot Aquifer (Layer 1)	Evangeline Aquifer (Layer 2)	Burkeville Confining Unit (Layer 3)	Jasper Aquifer (Layer 4)	Gulf Coast Aquifer Total (all layers)
Aransas	1,826	0	--	--	1,826
Bee (in GMA 15)	3,634	5,277	17	280	9,208
Calhoun	2,881	62	0	--	2,943
Colorado	24,448	22,649	0	900	47,997
DeWitt	999	7,659	162	6,281	15,101
Fayette	--	887	153	7,655	8,695
Goliad	699	10,374	299	100	11,472
Jackson	54,679	20,211	0	0	74,890
Karnes	--	103	500	2,999	3,602
Lavaca	3,034	12,398	147	4,599	20,178
Matagorda	35,673	9,327	0	0	45,000
Refugio	6,254	22,499	0	--	28,753
Victoria	7,999	26,999	0	0	34,998
Wharton	108,650	66,350	0	0	175,000
GMA 15 Totals	250,776	204,795	1,278	22,814	479,663

RESULTS:

Groundwater flow simulation results from this model run are described for the Gulf Coast Aquifer System (all model layers), the Chicot Aquifer (layer 1 in the model), the Evangeline Aquifer (layer 2), the Burkeville Confining Unit (layer 3), and the Jasper Aquifer (layer 4).

County-averaged groundwater level drawdowns are listed in Table 2. Maps of water level drawdowns for the Chicot Aquifer, the Evangeline Aquifer, the Burkeville Confining Unit, and the Jasper Aquifer were created to show average drawdown distributions by county (Figures 1 through 7).

Included in Appendix A are the model simulation results of the water budgets after running the model for 61 years using specified base pumpage volumes. The components of the water budget are described below.

- Wells — water produced from pumpage wells in each aquifer. This component is always shown as "Outflow" from the water budget, because all wells included in the model produce (rather than inject) water. Wells are modeled using the MODFLOW Well package.

- Springs — water that drains from an aquifer if water levels are above the elevation of the spring. Near the coast, some springs may represent wetlands. The springs component is always shown as "Outflow", or discharge, from the water budget. Springs and wetlands are modeled using the MODFLOW Drain package.

- Recharge — simulates areally distributed recharge due to precipitation falling on the outcrop areas of aquifers. Recharge is always shown as "Inflow" into the water budget.

- Vertical leakage (from upper or lower unit) — describes the vertical flow, or leakage, between two aquifers. This flow is controlled by the water levels in each aquifer and aquifer properties of each aquifer that define the amount of flow or leakage that can occur. "Inflow" to an aquifer from an overlying or underlying aquifer will always equal the "Outflow" from the other aquifer.

- Lateral flow — describes lateral flow within an aquifer between a county and adjacent counties.

- Evapotranspiration — water that flows out of an aquifer due to direct evaporation and plant transpiration. This component of the budget will always be shown as "Outflow". Evapotranspiration is modeled using the MODFLOW Evapotranspiration package.

- Rivers and Streams — water that flows between streams or rivers and the underlying aquifer. The direction and amount of flow depends on the water level in the stream or river and the aquifer. In areas where water levels in the stream or river are above the water level in the aquifer, water flows into the aquifer from the losing stream or river and is shown as "Inflow" in the budget. In areas where water levels in the aquifer are above the water level in the stream or river, water flows out of the aquifer and into the gaining stream or river and is shown as "Outflow" in the budget. Rivers and streams are modeled using the MODFLOW Stream or River packages.

- General-Head Boundary — the model uses general-head boundaries to simulate the movement of water out of or into the Chicot Aquifer along the Gulf Coast.

- Change In Storage — change in volume of water stored in the aquifer. This component of the budget is an accounting of water moving both into and out of the aquifer because this is a regional budget, and water levels will decline in some areas (water is removed from storage) and will rise in other areas (water is added to storage).

Table 2. Average water level drawdowns of the Gulf Coast Aquifer System for each aquifer in Groundwater Management Area 15. The drawdown values were simulated based on pumpage volumes specified by the members of Groundwater Management Area 15. Drawdown values indicate water level declines in feet for the period between the end of 1999 and the end of 2060 with negative values indicating a rise in water levels.

Drawdown in 2060 (1999 Starting Conditions)

County	Chicot	Evangeline	Chicot+ Evangeline	Burkeville	Jasper	Overall	Overall (without Burkeville)
Aransas	-0.1	25	0.5	0	0	0.5	0.5
Bee in GMA 15	3	13.6	10	9.3	4.8	8.5	8.1
Calhoun	-1	9.1	1.9	2.6	0	1.9	1.9
Colorado	5.2	8.9	7.2	13.9	20.4	12.4	11.9
DeWitt	0.2	5.4	4.6	14.5	22.3	14.7	14.9
Fayette	0	13.5	13.5	39.5	46.4	39.6	39.7
Goliad	-1.3	3.4	2.4	7.2	9.1	5.8	5.2
Jackson	12.4	15.5	14	11.4	19.1	14.1	15
Karnes	0	-0.4	-0.4	15.7	15.4	14	13.4
Lavaca	4.7	5.1	5	14.1	28.6	15.4	16
Matagorda	3.2	17.7	7.7	14.4	0	8.4	7.7
Refugio	0.5	31.5	14.7	12.5	0	14.4	14.7
Victoria	-9.4	3.4	-2.7	3.2	7.4	0.6	-0.4
Wharton	11.7	3.8	7.7	18.4	21.1	13.5	11.8
GMA 15	**3.3**	**9.9**	**6.7**	**12.9**	**20.4**	**11.4**	**10.8**

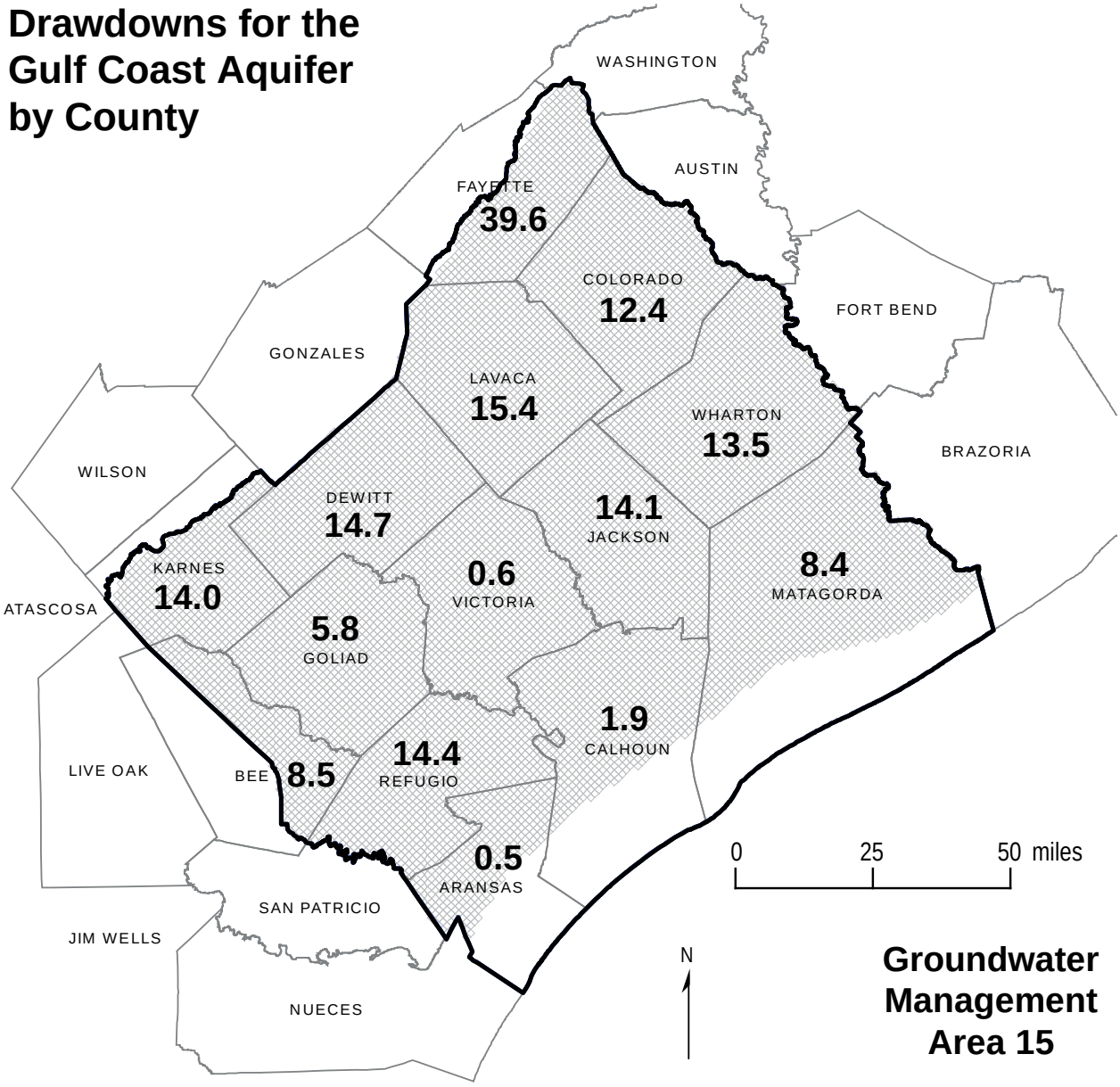

Figure 1. Average drawdown for the Gulf Coast Aquifer in each county of Groundwater Management Area 15. The drawdown values are based on modeling 100 percent of the 479,663 acre-feet per year "base" pumpage specified by the members of Groundwater Management Area 15. The bold font values indicate the water level declines in feet for the period between the end of 1999 and the end of 2060 with negative values indicating a rise in water levels.

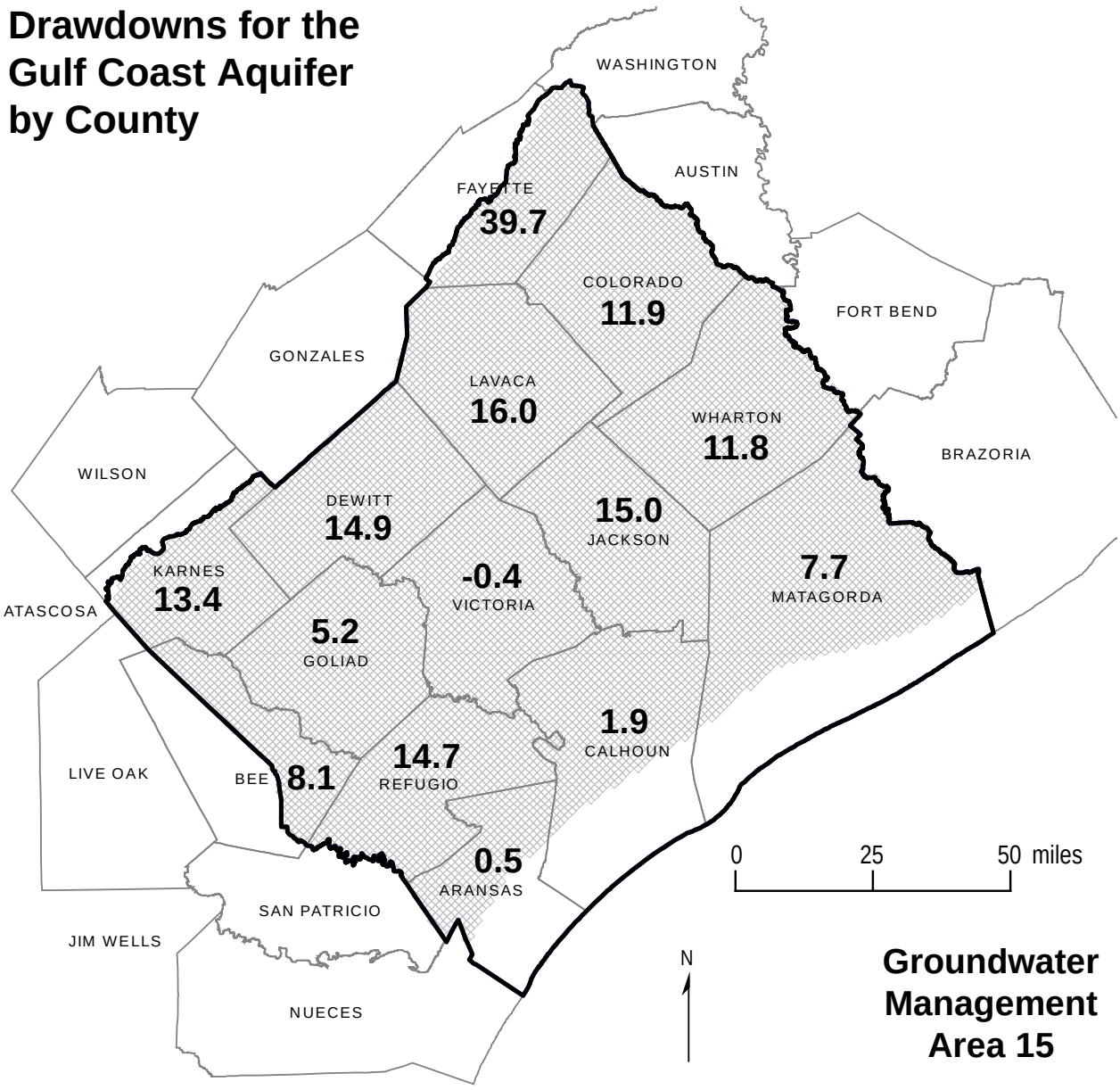

Figure 2. Average drawdown for the Gulf Coast Aquifer (excluding the Burkeville confining unit) in each county of Groundwater Management Area 15. The drawdown values are based on modeling 100 percent of the 479,663 acre-feet per year "base" pumpage specified by the members of Groundwater Management Area 15. The bold font values indicate the water level declines in feet for the period between the end of 1999 and the end of 2060 with negative values indicating a rise in water levels.

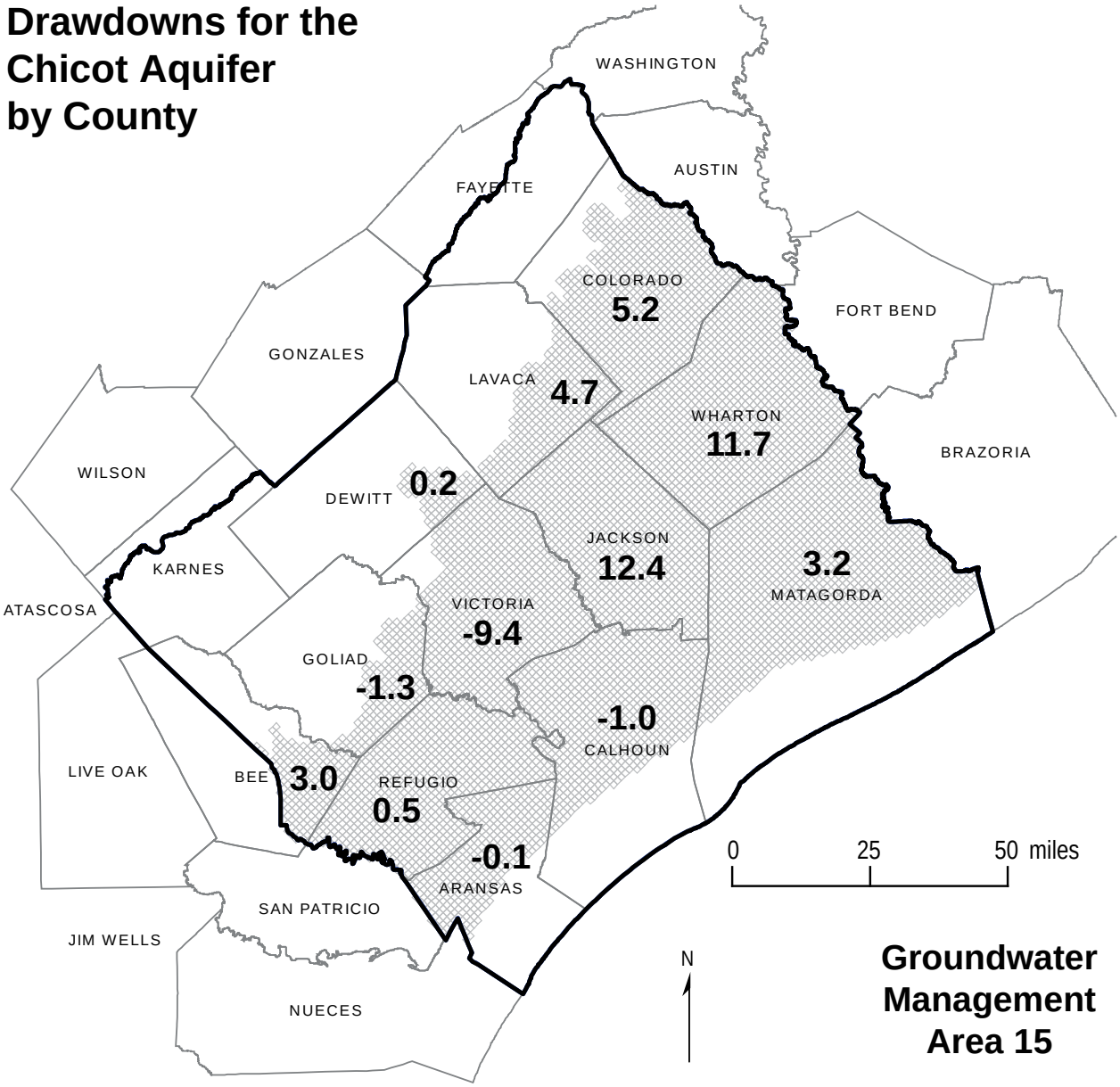

Figure 3. Average drawdown for the Chicot Aquifer in each county of Groundwater Management Area 15. The drawdown values are based on modeling 100 percent of the 250,776 acre-feet per year "base" pumpage specified by the members of Groundwater Management Area 15. The bold font values indicate the water level declines in feet for the period between the end of 1999 and the end of 2060 with negative values indicating a rise in water levels.

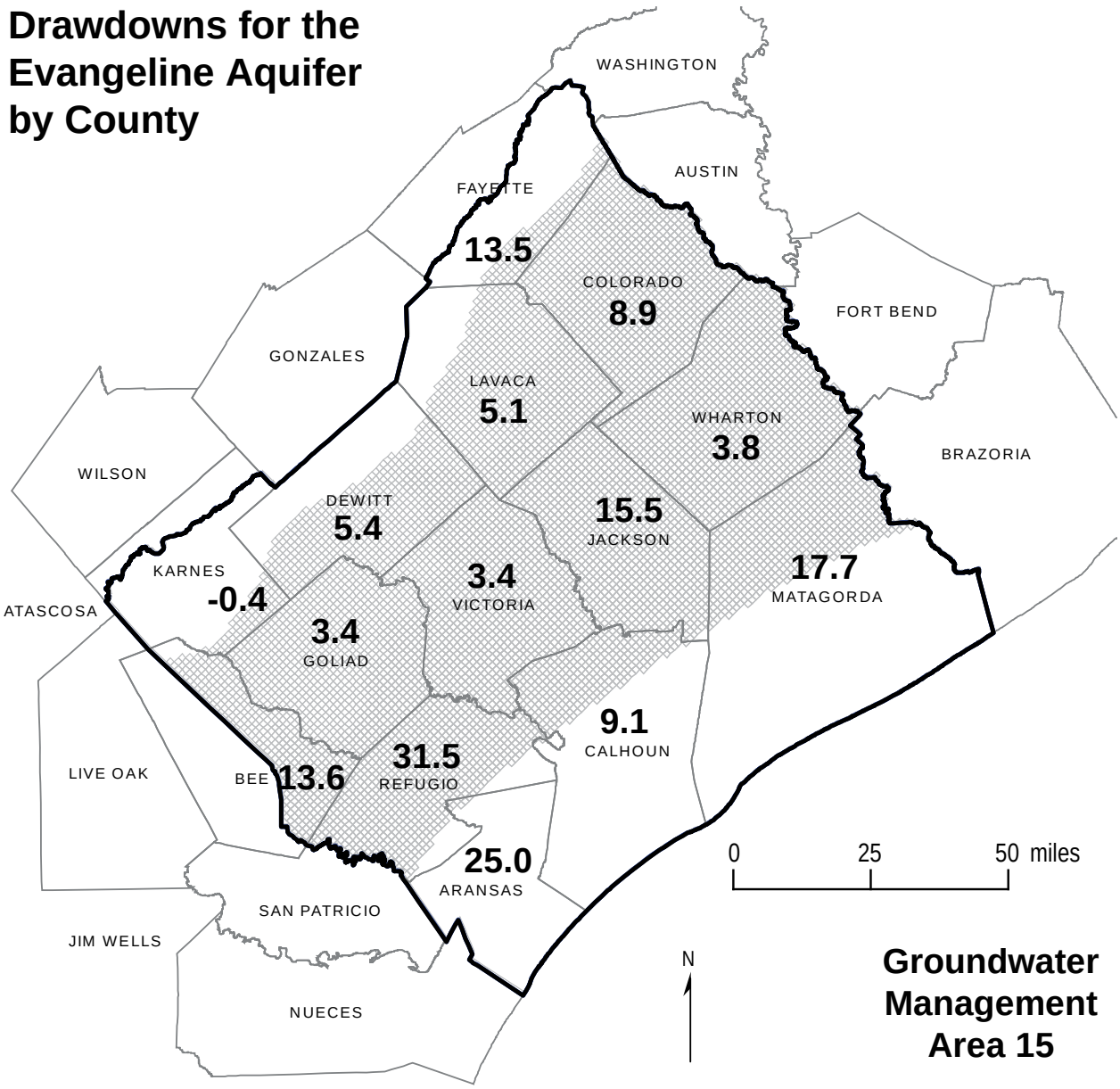

Figure 4. Average drawdown for the Evangeline Aquifer in each county of Groundwater Management Area 15. The drawdown values are based on modeling 100 percent of the 204,795 acre-feet per year "base" pumpage specified by the members of Groundwater Management Area 15. The bold font values indicate the water level declines in feet for the period between the end of 1999 and the end of 2060 with negative values indicating a rise in water levels.

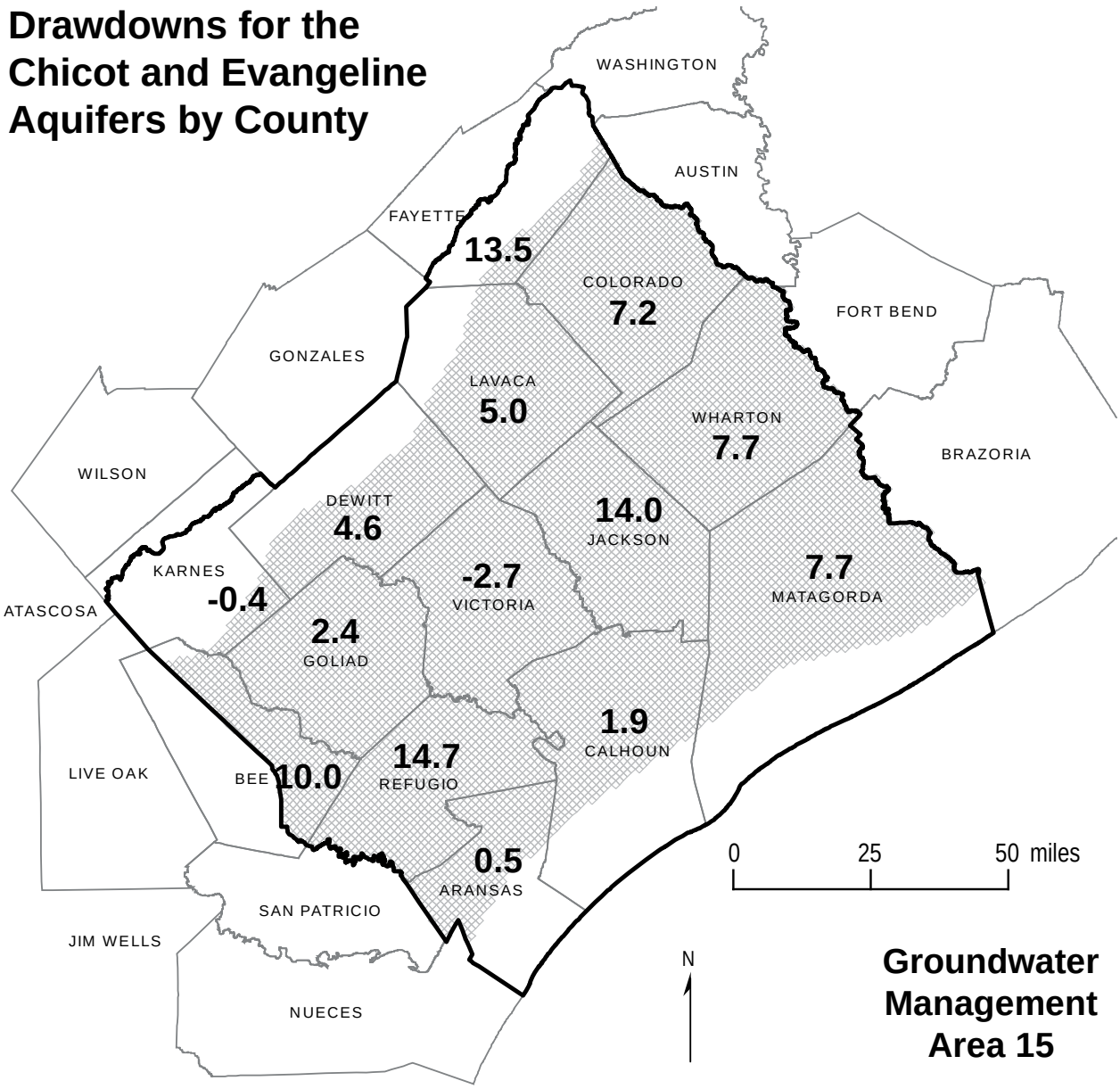

Figure 5. Combined average drawdown for the Chicot and Evangeline Aquifers in each county of Groundwater Management Area 15. The drawdown values are based on modeling 100 percent of the 455,571 acre-feet per year "base" pumpage specified by the members of Groundwater Management Area 15. The bold font values indicate the water level declines in feet for the period between the end of 1999 and the end of 2060 with negative values indicating a rise in water levels.

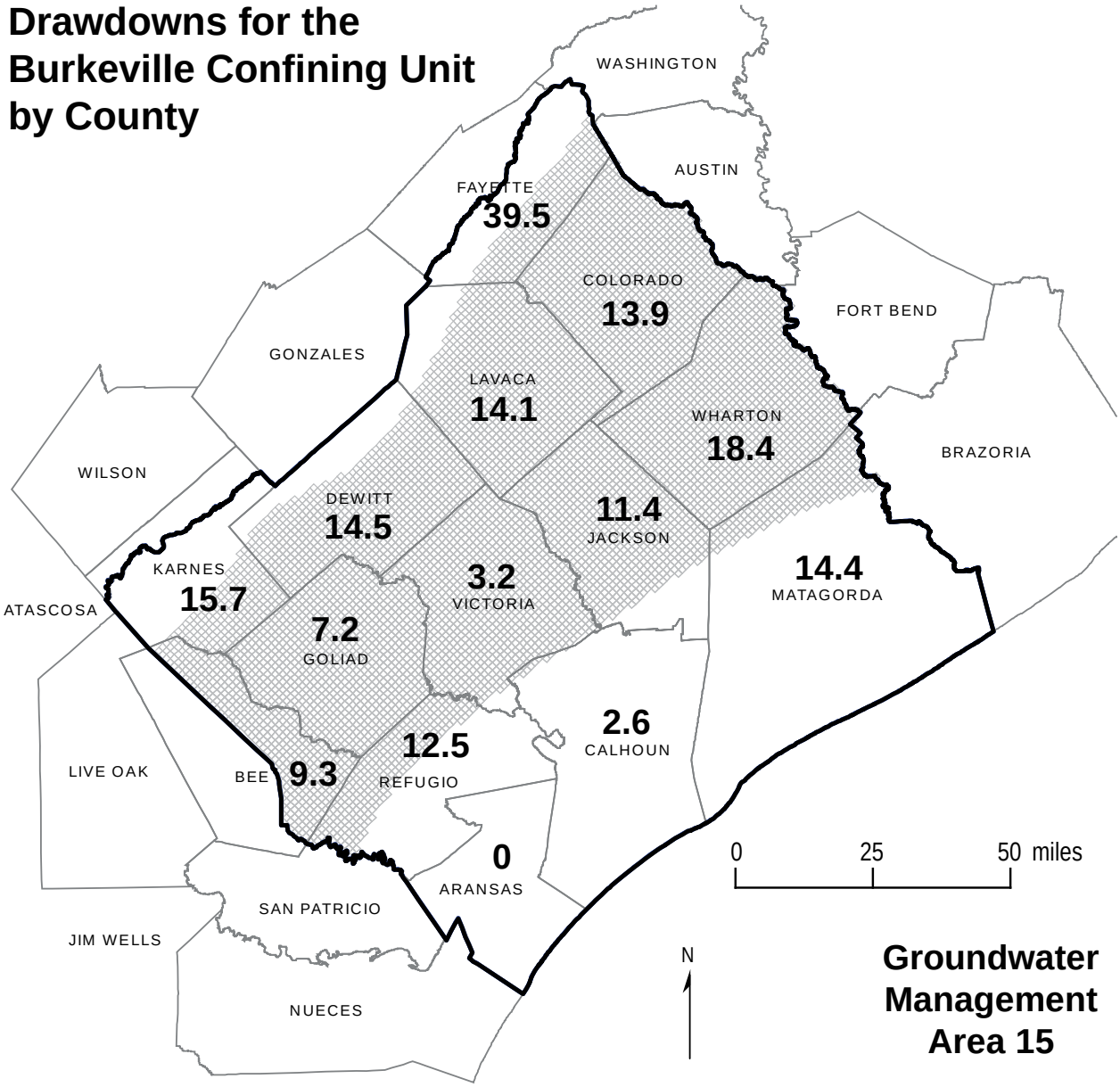

Figure 6. Average drawdown for the Burkeville Confining Unit in each county of Groundwater Management Area 15. The drawdown values are based on modeling 100 percent of the 1,278 acre-feet per year "base" pumpage specified by the members of Groundwater Management Area 15. The bold font values indicate the water level delines in feet for the period between the end of 1999 and the end of 2060.

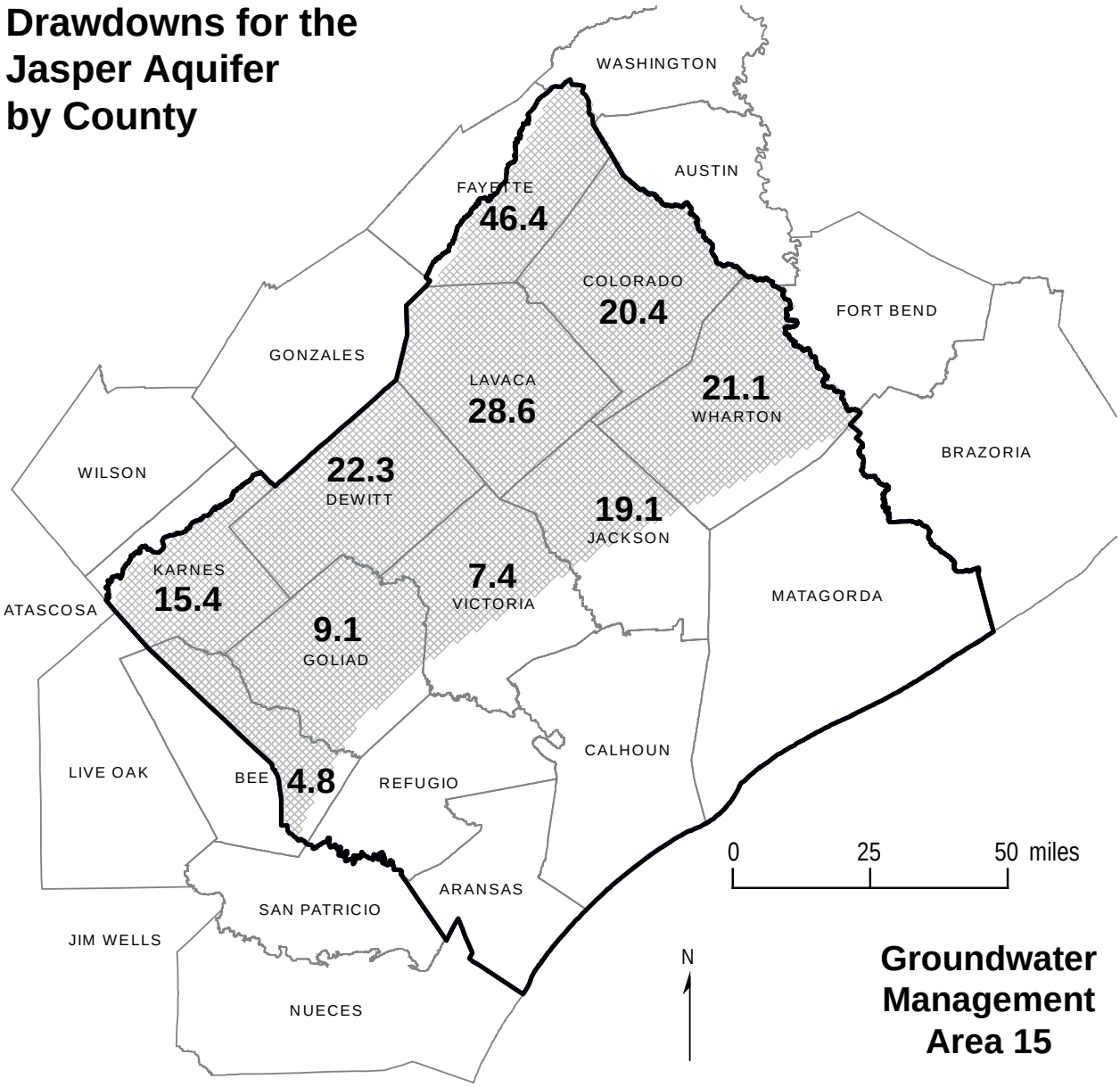

Figure 7. Average drawdown for the Jasper Aquifer in each county of Groundwater Management Area 15. The drawdown values are based on modeling 100 percent of the 22,814 acre-feet per year "base" pumpage specified by the members of Groundwater Management Area 15. The bold font values indicate the water level delines in feet for the period between the end of 1999 and the end of 2060.

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, unpublished report, 114 p.

Donnelly, A.C.A., 2007a, GAM Run 07-12, Texas Water Development Board GAM Run Report, 39 p.

Waterstone Engineering, Inc., and Parsons, Inc., 2003, Groundwater Availability of the Central Gulf Coast Aquifer: Numerical Simulations to 2050 Central Gulf Coast, Texas- Final Report: contract report to the Texas Water Development Board, 158 p.

Appendix A

Water budget tables for end of year 2060 of the 61-year period predictive groundwater availability model run for each groundwater conservation district

Table A-1. Water budgets for Aransas County at the end of 2060 model simulation period using requested 1,826 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Aransas County	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	164	0	--	--
River losses	0	0	--	--
Stream losses	2,466	0	--	--
Water inflows from bays and/or gulf	1,202	--	--	--
Vertical leakage from upper unit	--	55	--	--
Vertical leakage from lower unit	0	0	--	--
Lateral inflows from adjacent county(s)	3,999	39	--	--
Total Inflows	*7,831*	*94*	--	--
Outflows				
Wells	1,826	0	--	--
Springs	11	0	--	--
Evapotranspiration	734	0	--	--
River gains	0	0	--	--
Stream gains	640	0	--	--
Water outflows to bays and/or gulf	3,149	--	--	--
Vertical leakage to upper unit	--	0	--	--
Vertical leakage to lower unit	55	0	--	--
Lateral outflows to adjacent county(s)	1,418	94	--	--
Total Outflows	*7,833*	*94*	--	--
Inflows - Outflows	-2	0	--	--
Change In Storage	-1	0	--	--
Model Error (acre-feet)	-1	0	--	--
Model Error (%)	0.01%	0.00%	--	--

Table A-2. Water budgets for Groundwater Management Area 15 portion of Bee County Groundwater Conservation District at the end of 2060 model simulation period using requested 9,208 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

GMA 15 Portion of Bee County Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	8,938	2,237	46	1
River losses	0	0	0	0
Stream losses	5,814	5,141	89	32
Water inflows from bays and/or gulf	--	--	--	--
Vertical leakage from upper unit	--	3,650	210	325
Vertical leakage from lower unit	0	203	108	--
Lateral inflows from adjacent county(s)	954	4,123	35	515
Total Inflows	*15,706*	*15,354*	*488*	*873*
Outflows				
Wells	3,635	5,311	17	283
Springs	0	0	0	0
Evapotranspiration	68	0	0	0
River gains	0	0	0	0
Stream gains	2,120	1,368	0	0
Water outflows to bays and/or gulf	--	--	--	--
Vertical leakage to upper unit	--	0	203	108
Vertical leakage to lower unit	3,650	210	325	--
Lateral outflows to adjacent county(s)	6,368	8,526	66	595
Total Outflows	*15,841*	*15,415*	*611*	*986*
Inflows - Outflows	-135	-61	-123	-113
Change In Storage	-135	-62	-123	-112
Model Error (acre-feet)	0	1	0	-1
Model Error (%)	0.00%	0.01%	0.00%	0.10%

Table A-3. Water budgets for Calhoun County at the end of 2060 model simulation period using requested 2,942 acre-feet per year "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Calhoun County	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	3,085	0	0	--
River losses	3,227	0	0	--
Stream losses	4,129	0	0	--
Water inflows from bays and/or gulf	767	--	--	--
Vertical leakage from upper unit	--	1,781	0	--
Vertical leakage from lower unit	0	5	0	--
Lateral inflows from adjacent county(s)	13,533	613	0	--
Total Inflows	*24,741*	*2,399*	*0*	--
Outflows				
Wells	2,881	62	0	--
Springs	1,048	0	0	--
Evapotranspiration	1,242	0	0	--
River gains	0	0	0	--
Stream gains	2,277	0	0	--
Water outflows to bays and/or gulf	10,350	--	--	--
Vertical leakage to upper unit	--	0	5	--
Vertical leakage to lower unit	1,781	0	0	--
Lateral outflows to adjacent county(s)	5,171	2,340	0	--
Total Outflows	*24,750*	*2,402*	*5*	--
Inflows - Outflows	-9	-3	-5	--
Change In Storage	-9	-3	-5	--
Model Error (acre-feet)	0	0	0	--
Model Error (%)	0.00%	0.00%	0.00%	--

Table A-4. Water budgets for Coastal Bend Groundwater Conservation District at the end of 2060 model simulation period using requested 175,000 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Coastal Bend Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	21,734	0	0	0
River losses	537	0	0	0
Stream losses	120,720	0	0	0
Water inflows from bays and/or gulf	--	--	--	--
Vertical leakage from upper unit	--	38,030	0	0
Vertical leakage from lower unit	0	2,356	977	--
Lateral inflows from adjacent county(s)	33,815	29,010	60	218
Total Inflows	*176,806*	*69,396*	*1,037*	*218*
Outflows				
Wells	108,650	66,350	0	0
Springs	9	0	0	0
Evapotranspiration	233	0	0	0
River gains	0	0	0	0
Stream gains	13,318	0	0	0
Water outflows to bays and/or gulf	--	--	--	--
Vertical leakage to upper unit	--	0	2,356	977
Vertical leakage to lower unit	38,030	0	0	--
Lateral outflows to adjacent county(s)	17,908	3,099	14	108
Total Outflows	*178,148*	*69,449*	*2,370*	*1,085*
Inflows - Outflows	-1,342	-53	-1,333	-867
Change In Storage	-1,341	-41	-1,332	-866
Model Error (acre-feet)	-1	-12	-1	-1
Model Error (%)	0.00%	0.02%	0.04%	0.09%

Table A-5. Water budgets for Coastal Plains Groundwater Conservation District at the end of 2060 model simulation period using requested 45,000 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Coastal Plains Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	23,063	0	0	--
River losses	802	0	0	--
Stream losses	62,372	0	0	--
Water inflows from bays and/or gulf	1,753	--	--	--
Vertical leakage from upper unit	--	10,219	0	--
Vertical leakage from lower unit	0	266	0	--
Lateral inflows from adjacent county(s)	13,146	2,802	7	--
Total Inflows	*101,136*	*13,287*	*7*	--
Outflows				
Wells	35,571	9,327	0	--
Springs	197	0	0	--
Evapotranspiration	3,018	0	0	--
River gains	0	0	0	--
Stream gains	26,986	0	0	--
Water outflows to bays and/or gulf	8,972	--	--	--
Vertical leakage to upper unit	--	0	266	--
Vertical leakage to lower unit	10,219	0	0	--
Lateral outflows to adjacent county(s)	16,369	3,985	11	--
Total Outflows	*101,332*	*13,312*	*277*	--
Inflows - Outflows	-196	-25	-270	--
Change In Storage	-196	-19	-269	--
Model Error (acre-feet)	0	-6	-1	--
Model Error (%)	0.00%	0.05%	0.36%	--

Table A-6. Water budgets for Colorado County Groundwater Conservation District at the end of 2060 model simulation period using requested 47,997 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Colorado County Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	35,125	2,501	0	0
River losses	1,408	0	0	0
Stream losses	32,511	5,120	0	0
Water inflows from bays and/or gulf	--	--	--	--
Vertical leakage from upper unit	--	26,257	754	858
Vertical leakage from lower unit	331	541	120	--
Lateral inflows from adjacent county(s)	9,377	8,980	31	295
Total Inflows	*78,752*	*43,399*	*905*	*1,153*
Outflows				
Wells	24,448	22,649	0	900
Springs	5	0	0	0
Evapotranspiration	55	0	0	0
River gains	0	0	0	0
Stream gains	8,629	1,991	0	0
Water outflows to bays and/or gulf	--	--	--	--
Vertical leakage to upper unit	--	331	541	120
Vertical leakage to lower unit	26,257	754	858	--
Lateral outflows to adjacent county(s)	20,179	17,722	60	487
Total Outflows	*79,573*	*43,447*	*1,459*	*1,507*
Inflows - Outflows	-821	-48	-554	-354
Change In Storage	-820	-50	-552	-355
Model Error (acre-feet)	-1	2	-2	1
Model Error (%)	0.00%	0.00%	0.14%	0.07%

Table A-7. Water budgets for Evergreen Underground Water Conservation District at the end of 2060 model simulation period using requested 3,602 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Evergreen Underground Water Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	--	884	2	417
River losses	--	0	0	0
Stream losses	--	362	237	769
Water inflows from bays and/or gulf	--	--	--	--
Vertical leakage from upper unit	--	0	263	388
Vertical leakage from lower unit	--	14	67	--
Lateral inflows from adjacent county(s)	--	157	22	465
Total Inflows	--	*1,417*	*591*	*2,039*
Outflows				
Wells	--	103	244	2,726
Springs	--	0	0	0
Evapotranspiration	--	0	1	65
River gains	--	0	0	0
Stream gains	--	383	8	430
Water outflows to bays and/or gulf	--	--	--	--
Vertical leakage to upper unit	--	0	14	67
Vertical leakage to lower unit	--	263	388	--
Lateral outflows to adjacent county(s)	--	672	16	695
Total Outflows	--	*1,421*	*671*	*3,983*
Inflows - Outflows	--	-4	-80	-1,944
Change In Storage	--	-4	-79	-1,943
Model Error (acre-feet)	--	0	-1	-1
Model Error (%)	--	0.00%	0.15%	0.03%

Table A-8. Water budgets for Fayette County Groundwater Conservation District at the end of 2060 model simulation period using requested 8,695 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Fayette County Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	--	1,737	3	354
River losses	--	0	272	202
Stream losses	--	767	347	1,244
Water inflows from bays and/or gulf	--	--	--	--
Vertical leakage from upper unit	--	0	1,094	1,734
Vertical leakage from lower unit	--	0	11	--
Lateral inflows from adjacent county(s)	--	77	6	414
Total Inflows	--	*2,581*	*1,733*	*3,948*
Outflows				
Wells	--	888	113	7,344
Springs	--	0	0	0
Evapotranspiration	--	0	19	5
River gains	--	0	0	0
Stream gains	--	76	0	19
Water outflows to bays and/or gulf	--	--	--	--
Vertical leakage to upper unit	--	0	0	11
Vertical leakage to lower unit	--	1,094	1,734	--
Lateral outflows to adjacent county(s)	--	565	11	236
Total Outflows	--	*2,623*	*1,877*	*7,615*
Inflows - Outflows	--	-42	-144	-3,667
Change In Storage	--	-41	-145	-3,667
Model Error (acre-feet)	--	-1	1	0
Model Error (%)	--	0.04%	0.05%	0.00%

Table A-9. Water budgets for Goliad County Groundwater Conservation District at the end of 2060 model simulation period using requested 11,472 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Goliad County Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	10,511	7,981	0	0
River losses	1,519	0	0	0
Stream losses	3,286	18,259	0	0
Water inflows from bays and/or gulf	--	--	--	--
Vertical leakage from upper unit	--	4,064	669	520
Vertical leakage from lower unit	85	522	426	--
Lateral inflows from adjacent county(s)	803	4,097	35	401
Total Inflows	*16,204*	*34,923*	*1,130*	*921*
Outflows				
Wells	700	10,375	300	100
Springs	6	1	0	0
Evapotranspiration	179	32	0	0
River gains	0	0	0	0
Stream gains	7,367	11,039	0	0
Water outflows to bays and/or gulf	--	--	--	--
Vertical leakage to upper unit	--	85	522	426
Vertical leakage to lower unit	4,064	669	520	--
Lateral outflows to adjacent county(s)	3,894	12,751	56	622
Total Outflows	*16,210*	*34,952*	*1,398*	*1,148*
Inflows - Outflows	-6	-29	-268	-227
Change In Storage	-6	-29	-269	-226
Model Error (acre-feet)	0	0	1	-1
Model Error (%)	0.00%	0.00%	0.07%	0.09%

Table A-10. Water budgets for Lavaca County Groundwater Conservation District at the end of 2060 model simulation period using requested 20,177 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Lavaca County Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	18,277	6,108	2	171
River losses	0	0	0	0
Stream losses	12,541	13,956	281	729
Water inflows from bays and/or gulf	--	--	--	--
Vertical leakage from upper unit	--	8,108	1,196	1,715
Vertical leakage from lower unit	5	104	44	--
Lateral inflows from adjacent county(s)	1,346	3,033	13	539
Total Inflows	*32,169*	*31,309*	*1,536*	*3,154*
Outflows				
Wells	3,034	12,399	138	4,408
Springs	0	0	0	0
Evapotranspiration	2	3	0	2
River gains	0	0	0	0
Stream gains	3,509	3,656	0	0
Water outflows to bays and/or gulf	--	--	--	--
Vertical leakage to upper unit	--	5	104	44
Vertical leakage to lower unit	8,108	1,196	1,715	--
Lateral outflows to adjacent county(s)	17,886	14,076	39	664
Total Outflows	*32,539*	*31,335*	*1,996*	*5,118*
Inflows - Outflows	-370	-26	-460	-1,964
Change In Storage	-372	-28	-459	-1,963
Model Error (acre-feet)	2	2	-1	-1
Model Error (%)	0.01%	0.01%	0.05%	0.02%

Table A-11. Water budgets for Pecan Valley Groundwater Conservation District at the end of 2060 model simulation period using requested 15,100 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Pecan Valley Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	4,570	5,760	28	243
River losses	0	0	0	0
Stream losses	2,945	11,432	450	1,383
Water inflows from bays and/or gulf	--	--	--	--
Vertical leakage from upper unit	--	4,517	3,148	3,623
Vertical leakage from lower unit	0	8	23	--
Lateral inflows from adjacent county(s)	12	1,317	7	810
Total Inflows	*7,527*	*23,034*	*3,656*	*6,059*
Outflows				
Wells	999	6,933	122	6,274
Springs	0	0	0	0
Evapotranspiration	11	56	0	0
River gains	0	0	0	0
Stream gains	636	5,748	0	289
Water outflows to bays and/or gulf	--	--	--	--
Vertical leakage to upper unit	--	0	8	23
Vertical leakage to lower unit	4,517	3,148	3,623	--
Lateral outflows to adjacent county(s)	1,365	7,209	37	740
Total Outflows	*7,528*	*23,094*	*3,790*	*7,326*
Inflows - Outflows	-1	-60	-134	-1,267
Change In Storage	0	-60	-134	-1,267
Model Error (acre-feet)	-1	0	0	0
Model Error (%)	0.01%	0.00%	0.00%	0.00%

Table A-12. Water budgets for Refugio Groundwater Conservation District at the end of 2060 model simulation period using requested 28,752 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Refugio Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	14,668	0	0	--
River losses	0	0	0	--
Stream losses	33,905	0	0	--
Water inflows from bays and/or gulf	0	--	--	--
Vertical leakage from upper unit	--	10,649	0	--
Vertical leakage from lower unit	0	325	0	--
Lateral inflows from adjacent county(s)	12,064	12,072	36	--
Total Inflows	*60,637*	*23,046*	*36*	--
Outflows				
Wells	6,254	22,501	0	--
Springs	96	0	0	--
Evapotranspiration	1,763	0	0	--
River gains	0	0	0	--
Stream gains	25,934	--	--	--
Water outflows to bays and/or gulf	5,475	0	0	--
Vertical leakage to upper unit	--	0	325	--
Vertical leakage to lower unit	10,649	0	0	--
Lateral outflows to adjacent county(s)	10,516	549	4	--
Total Outflows	*60,687*	*23,050*	*329*	--
Inflows - Outflows	-50	-4	-293	--
Change In Storage	-49	-5	-293	--
Model Error (acre-feet)	-1	1	0	--
Model Error (%)	0.00%	0.00%	0.00%	--

Table A-13. Water budgets for Texana Groundwater Conservation District at the end of 2060 model simulation period using requested 74,890 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Texana Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	11,760	0	0	0
River losses	4,179	0	0	0
Stream losses	56,980	0	0	0
Water inflows from bays and/or gulf	920	--	--	--
Vertical leakage from upper unit	--	14,754	0	4
Vertical leakage from lower unit	0	1,078	413	--
Lateral inflows from adjacent county(s)	24,122	12,638	24	132
Total Inflows	*97,961*	*28,470*	*437*	*136*
Outflows				
Wells	54,679	20,211	0	0
Springs	75	0	0	0
Evapotranspiration	448	0	0	0
River gains	0	0	0	0
Stream gains	16,703	0	0	0
Water outflows to bays and/or gulf	133	--	--	--
Vertical leakage to upper unit	--	0	1,078	413
Vertical leakage to lower unit	14,754	0	4	--
Lateral outflows to adjacent county(s)	12,420	8,299	8	36
Total Outflows	*99,212*	*28,510*	*1,090*	*449*
Inflows - Outflows	-1,251	-40	-653	-313
Change In Storage	-1,252	-31	-653	-313
Model Error (acre-feet)	1	-9	0	0
Model Error (%)	0.00%	0.03%	0.00%	0.00%

Table A-14. Water budgets for Victoria County Groundwater Conservation District at the end of 2060 model simulation period using requested 34,997 acre-feet per year total "base" pumpage. Water budget values are reported in acre-feet per year. A dashed line indicates the aquifer does not exist or was not modeled for that county.

Victoria County Groundwater Conservation District	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Inflows				
Recharge	24,832	743	0	0
River losses	1,056	0	0	0
Stream losses	46,251	2,327	0	0
Water inflows from bays and/or gulf	0	--	--	--
Vertical leakage from upper unit	--	18,605	58	67
Vertical leakage from lower unit	2	847	532	--
Lateral inflows from adjacent county(s)	7,008	10,672	37	456
Total Inflows	*79,149*	*33,194*	*627*	*523*
Outflows				
Wells	7,999	26,999	0	0
Springs	1,475	0	0	0
Evapotranspiration	925	26	0	0
River gains	0	0	0	0
Stream gains	29,909	1,925	0	0
Water outflows to bays and/or gulf	472	--	--	--
Vertical leakage to upper unit	--	2	847	532
Vertical leakage to lower unit	18,605	58	67	--
Lateral outflows to adjacent county(s)	19,788	4,189	10	146
Total Outflows	*79,173*	*33,199*	*924*	*678*
Inflows - Outflows	-24	-5	-297	-155
Change In Storage	-22	-6	-299	-154
Model Error (acre-feet)	-2	1	2	-1
Model Error (%)	0.00%	0.00%	0.22%	0.15%

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