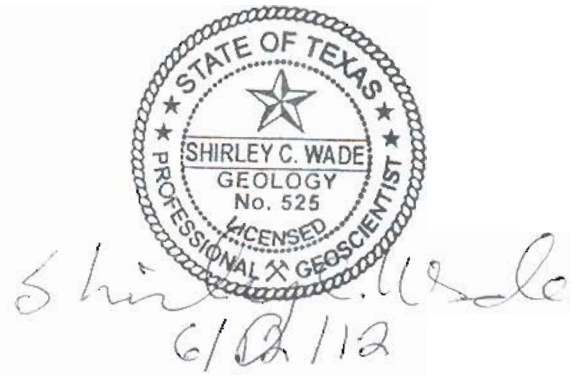
GAM RUN 11-007 ADDENDUM: ADDITIONAL INFORMATION FOR GROUNDWATER MANAGEMENT AREA 13 MODEL RUNS TO ESTIMATE DRAWDOWNS UNDER ASSUMED FUTURE PUMPING FOR QUEEN CITY, SPARTA, AND CARRIZO-WILCOX AQUIFERS

by Shirley Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 936-0883
June 12, 2012



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EXECUTIVE SUMMARY:

Groundwater Management Area 13 requested a model run to estimate drawdowns with pumping added to scenario 4 from GAM Run 09-034. Two pumping scenarios (5a and 5b) for Groundwater Management Area 13 (GMA 13) were run using the groundwater availability model for the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers. Drawdown maps for scenarios 4, 5a, and 5b are shown for comparison and water budgets for scenarios 4, 5a, and 5b are also listed with the water budgets from the historical model.

REQUESTOR:

This report is follow-up information for a run requested by Mr. Mike Mahoney from the Evergreen Underground Water Conservation District acting on behalf of Groundwater Management Area 13.

DESCRIPTION OF REQUEST:

Mr. Mahoney requested a model run to estimate drawdowns using the groundwater availability model for the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers. The model run was a 61-year simulation using initial water levels from the end of the historic calibration period and average recharge conditions. Each year of the model run included pumping specified by the members of Groundwater Management Area 13. The pumping included in the request consisted of the same pumping included in scenario 4 of GAM Run 09-034 (Wade and Jigmond, 2010) plus 4,600 acre-feet per year additional pumping in the Carrizo Aquifer at new and existing locations in Guadalupe and western Gonzales counties and up to 35,000 acre-feet per year additional pumping in the Carrizo Aquifer at new locations in Caldwell County or Gonzales County.

PARAMETERS AND ASSUMPTIONS:

Details on the parameters and assumptions are provided in the report for GAM Run 11-007.

METHODS AND RESULTS:

Groundwater Management Area 13, located in south central Texas, includes the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers. For the simulation we used average recharge and evapotranspiration rates and initial streamflows based on the historic calibration-verification runs, representing 1981 to 1999. These averages were then used for each year of the 61-year predictive simulations along with the specified pumping.

Pumping amounts and locations were the same as those used for GAM Run 09-034 (Wade and Jigmond, 2010) with the addition of 39,600 acre-feet per year of pumping in Caldwell, Guadalupe, and Gonzales counties (Tables 1 through 6). Two pumping scenarios were modeled, scenario 5a with 35,000 acre-feet per year additional pumping in a downdip portion of the Carrizo Aquifer in eastern Gonzales County and scenario 5b with 35,000 acre feet per year additional pumping in the updip part of the Carrizo Aquifer in eastern Caldwell County. Additional pumping of 4,600 acre-feet per year in the Carrizo Aquifer in western Gonzales and Guadalupe counties was included in both scenarios 5a and 5b. The amount of pumping used in the model was less than the requested pumping in some counties due to model cells going dry. Dry cells significantly reduce pumping in Uvalde County and to a lesser degree in Caldwell, Guadalupe, Medina, and Zavala counties. Scenario 5b had one additional dry cell in the Carrizo Aquifer in Caldwell County besides those that occurred in Scenarios 4 and 5a. The dry cell reduced pumping by 1,752 acre-feet per year.

Maps of estimated Carrizo Aquifer water level drawdowns from scenarios 4, 5a, and 5b are shown in Figures 1, 2, and 3 respectively.

The model water budgets for Groundwater Management Area 13 list the balance of water inflows to and outflows from the aquifers. Water budgets for each scenario for all layers combined are listed in tables 1 through 12. The components of the water budget are described below:

- Recharge — simulates areally distributed recharge due to precipitation falling on the outcrop (where the aquifer is exposed at land surface) areas of aquifers. Recharge is always shown as “Inflow” into the water budget.
- Reservoirs and Streams — water that flows between streams and reservoirs and an aquifer. The direction and amount of flow depends on the water level in the stream or reservoir and the aquifer. In areas where water levels in the stream or reservoir are above the water level in the aquifer, water flows into the aquifer 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 reservoir, water flows out of the aquifer and into the stream and is shown as “Outflow” in the budget. Reservoir and streams are modeled in the model using the MODFLOW Stream and River packages.
- Vertical leakage — describes the vertical flow, or leakage, between two layers (aquifers or confining units) in the model. This flow is controlled by the water levels in each of the layers and aquifer properties of each layer that define the amount of leakage that can occur. “Inflow” to an aquifer from an overlying or underlying layer will always equal the “Outflow” from the other layer.
- Lateral flow — describes lateral flow within an aquifer between a county and adjacent counties.
- Wells — water produced from wells in each aquifer. In the model 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 simulated in the model using the MODFLOW Well (WEL) package.

- Springs — water that naturally discharges from an aquifer when water levels rise above the elevation of the spring. This component is always shown as “Outflow”, or discharge, from the water budget. Spring flows are simulated in the model using the MODFLOW Drain (DRN) package.

- 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 in the model using the MODFLOW Evapotranspiration (EVT) package.

- Storage—water stored in the aquifer. The storage component that is included in “Inflow” is water that is removed from storage in the aquifer (that is, water levels decline). The storage component that is included in “Outflow” is water that is added back into storage in the aquifer (that is, water levels increase). This component of the budget is often seen as water both going into and out of the aquifer because this is a regional budget, and water levels will decline in some areas (water is being removed from storage) and will rise in others (water is being added to storage).

- General-Head Boundary (GHB)—The model uses general head boundaries to simulate groundwater flow across the northeastern lateral aquifer boundaries and vertical movement of groundwater between the Sparta Aquifer (layer 1) and younger sediments that overlie the Sparta Aquifer in the downdip portions (areas where the layer is confined or covered by other aquifers or geologic formations) are simulated using general head boundaries.

LIMITATIONS:

Details on the model limitations are given in the main report for GAM Run 11-007.

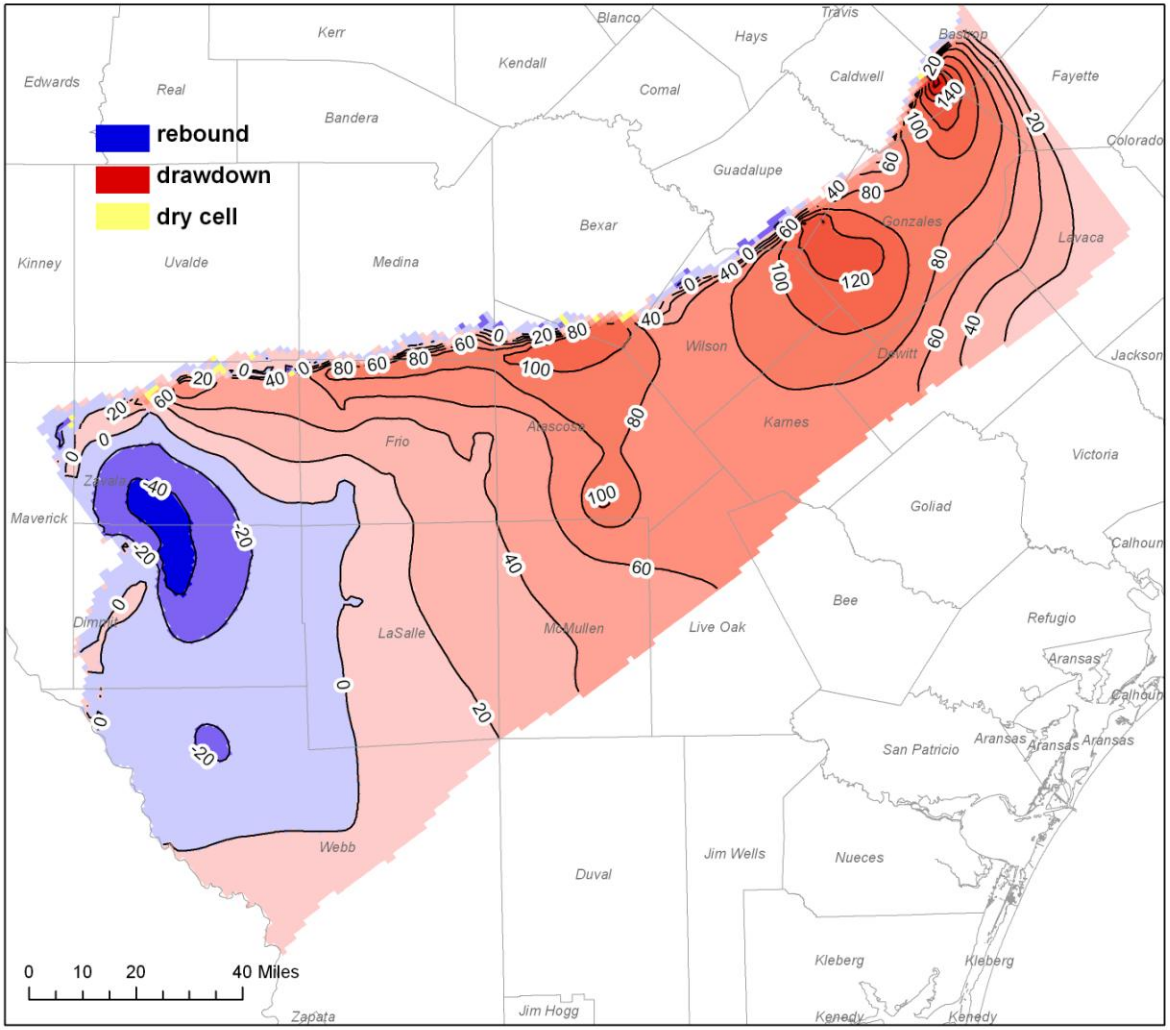

FIGURE 1: ESTIMATED CARRIZO AQUIFER WATER LEVEL DRAWDOWN IN FEET FROM 2000 TO 2060 FOR SCENARIO 4. CONTOUR INTERVAL IS 20 FEET.

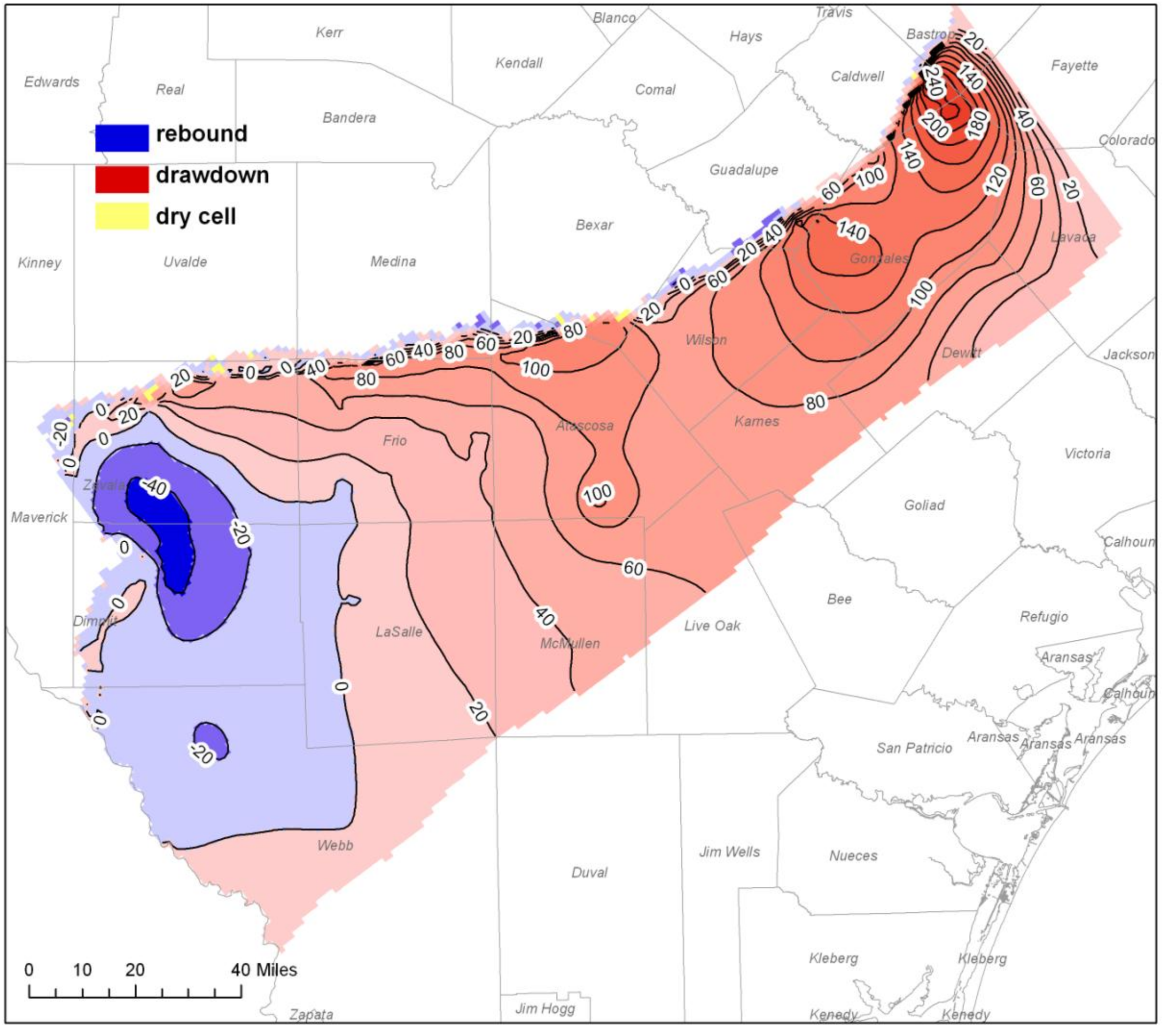

FIGURE 2: ESTIMATED CARRIZO AQUIFER WATER LEVEL DRAWDOWN IN FEET FROM 2000 TO 2060 FOR SCENARIO 5A. CONTOUR INTERVAL IS 20 FEET.

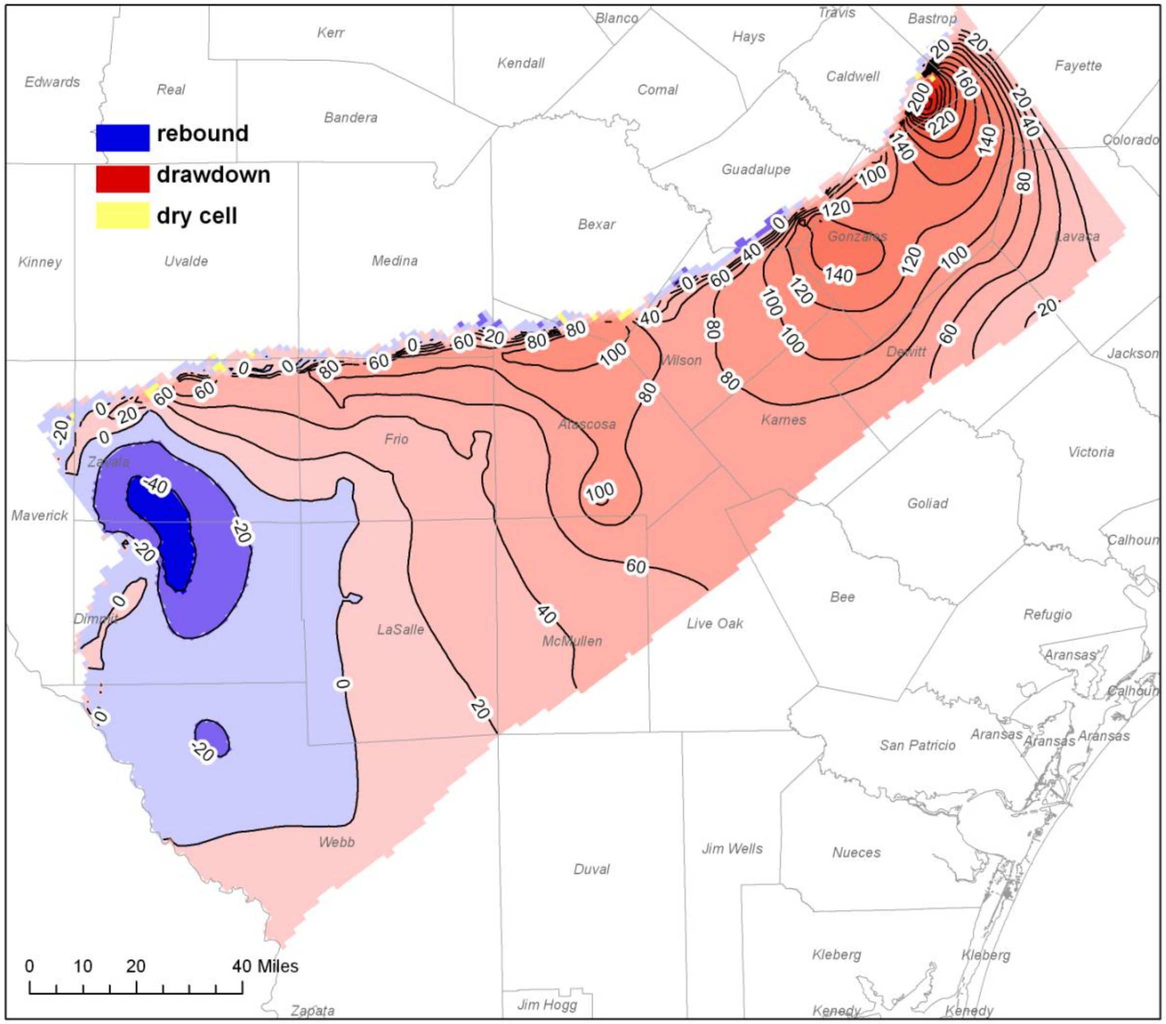

FIGURE 3: ESTIMATED CARRIZO AQUIFER WATER LEVEL DRAWDOWN IN FEET FROM 2000 TO 2060 FOR SCENARIO 5B. CONTOUR INTERVAL IS 20 FEET.

TABLE 1. SUMMARY OF WATER BUDGETS FOR BEXAR COUNTY. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	13,725	6,265	13,081	13,081	13,081	13,081	13,081	13,081
Reservoir Losses	1,662	1,652	1,732	1,801	1,732	1,802	1,732	1,802
Stream Losses	4,937	4,403	8,386	9,464	8,388	9,468	8,388	9,468
Head Dependent Bounds	0	0	0	0	0	0	0	0
Lateral Flow	1,745	1,770	14,253	15,783	14,230	15,724	14,231	15,726
Total Inflow	22,069	14,090	37,452	40,129	37,431	40,075	37,432	40,077
Outflow								
Wells	13,341	14,769	26,250	26,107	26,250	26,107	26,250	26,107
Springs	102	116	202	197	202	197	202	197
Evapotranspiration	26	33	292	379	292	379	292	379
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	1,920	1,954	919	773	919	773	919	773

Flow term	**Historical average**	**1999**	**Scenario 4 decadel average**	**Scenario 4 2060**	**Scenario 5a decadel average**	**Scenario 5a 2060**	**Scenario 5b decadel average**	**Scenario 5b 2060**
Head Dependent Bounds	0	0	0	0	0	0	0	0
Lateral Flow	15,851	16,112	28,680	28,484	28,707	28,533	28,707	28,532
Total Outflow	31,240	32,984	56,343	55,940	56,370	55,989	56,370	55,988
Inflow - Outflow	-9,171	-18,894	-18,891	-15,811	-18,939	-15,914	-18,938	-15,911
Storage Change	-9,170	-18,894	-18,891	-15,811	-18,938	-15,915	-18,938	-15,912
Model Error	-1	0	0	0	-1	1	0	1
Model Error (percent)	0	0	0	0	0	0	0	0

TABLE 2. SUMMARY OF WATER BUDGETS FOR CALDWELL COUNTY. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	**Historical average**	**1999**	**Scenario 4 decadel average**	**Scenario 4 2060**	**Scenario 5a decadel average**	**Scenario 5a 2060**	**Scenario 5b decadel average**	**Scenario 5b 2060**
Inflow								
Recharge	16,874	11,043	16,499	16,484	16,499	16,484	16,499	16,484
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	2,402	1,442	5,140	6,159	5,256	6,400	5,281	6,437
Head Dependent Bounds	0	0	0	0	0	0	0	0
Lateral Flow	3,831	3,821	21,209	23,789	20,771	23,961	30,881	42,732
Total Inflow	23,107	16,306	42,848	46,432	42,526	46,845	52,661	65,653
Outflow								
Wells	3,417	3,744	44,449	43,928	44,449	43,928	63,032	71,926
Springs	55	0	200	208	200	208	200	208
Evapotranspiration	251	550	368	383	368	383	368	383
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	10,643	11,102	3,540	2,340	3,480	2,202	3,479	2,193
Head Dependent Bounds	0	0	0	0	0	0	0	0

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Lateral Flow	10,797	9,873	11,420	11,340	15,406	16,467	9,900	8,963
Total Outflow	25,163	25,269	59,977	58,199	63,903	63,188	76,979	83,673
Inflow - Outflow	-2,056	-8,963	-17,129	-11,767	-21,377	-16,343	-24,318	-18,020
Storage Change	-2,051	-8,963	-17,128	-11,767	-21,376	-16,343	-24,318	-18,020
Model Error	-5	0	-1	0	-1	0	0	0
Model Error (percent)	0	0	0	0	0	0	0	0

TABLE 3. SUMMARY OF WATER BUDGETS FOR EVERGREEN UNDERGROUND WATER CONSERVATION DISTRICT. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	61,537	33,741	59,409	59,409	59,409	59,409	59,409	59,409
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	18,275	13,164	29,497	31,393	29,527	31,443	29,526	31,441
Head Dependent Bounds	9,100	9,559	11,799	12,928	11,822	12,992	11,822	12,990
Lateral Flow	73,399	79,669	91,247	91,814	91,535	92,295	91,553	92,301
Total Inflow	162,311	136,133	191,952	195,544	192,293	196,139	192,310	196,141
Outflow								
Wells	153,092	185,156	200,558	203,278	200,558	203,278	200,558	203,278
Springs	1,405	1,044	404	184	404	183	404	183
Evapotranspiration	807	320	282	96	282	96	282	96
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	15,232	13,680	7,787	6,166	7,770	6,120	7,770	6,122
Head Dependent Bounds	14,170	12,907	9,651	8,054	9,615	7,968	9,616	7,970

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Lateral Flow	22,099	19,204	39,031	40,440	40,808	43,486	40,744	43,453
Total Outflow	206,805	232,311	257,713	258,218	259,437	261,131	259,374	261,102
Inflow - Outflow	-44,494	-96,178	-65,761	-62,674	-67,144	-64,992	-67,064	-64,961
Storage Change	-44,493	-96,176	-65,762	-62,672	-67,145	-64,991	-67,064	-64,958
Model Error	-1	-2	1	-2	1	-1	0	-3
Model Error (percent)	0	0	0	0	0	0	0	0

TABLE 4. SUMMARY OF WATER BUDGETS FOR GONZALES COUNTY UNDERGROUND WATER CONSERVATION DISTRICT. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	21,281	14,387	21,054	21,054	21,054	21,054	21,054	21,054
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	2,277	1,728	4,876	7,100	5,387	7,662	5,406	7,720
Head Dependent Bounds	276	257	799	1,037	881	1,266	863	1,224
Lateral Flow	17,845	15,644	70,634	78,588	86,054	105,828	82,723	101,670
Total Inflow	41,679	32,016	97,363	107,779	113,376	135,810	110,046	131,668
Outflow								
Wells	4,282	4,044	107,012	114,174	132,170	153,572	131,879	151,821
Springs	484	352	100	20	98	17	99	18
Evapotranspiration	515	588	186	75	178	63	179	63
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	16,179	16,099	5,888	3,621	5,455	2,898	5,510	2,983
Head Dependent Bounds	5,477	5,569	3,229	2,667	3,076	2,315	3,106	2,365

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Lateral Flow	12,045	10,718	5,551	6,314	6,102	7,406	6,109	7,470
Total Outflow	38,982	37,370	121,966	126,871	147,079	166,271	146,882	164,720
Inflow - Outflow	2,697	-5,354	-24,603	-19,092	-33,703	-30,461	-36,836	-33,052
Storage Change	2,697	-5,353	-24,602	-19,092	-33,703	-30,460	-36,834	-33,051
Model Error	0	-1	-1	0	0	-1	-2	-1
Model Error (percent)	0	0	0	0	0	0	0	0

Note: These flows include the Plum Creek/Gonzales overlap area.

TABLE 5. SUMMARY OF WATER BUDGETS FOR GUADALUPE COUNTY GROUNDWATER CONSERVATION DISTRICT. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	18,223	10,737	17,896	17,896	17,896	17,896	17,896	17,896
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	3,261	3,333	5,926	7,220	5,990	7,379	5,987	7,373
Head Dependent Bounds	0	0	0	0	0	0	0	0
Lateral Flow	1,242	1,259	3,092	4,044	3,142	4,088	3,141	4,086
Total Inflow	22,726	15,329	26,914	29,160	27,028	29,363	27,024	29,355
Outflow								
Wells	5,306	6,067	12,162	14,043	12,362	14,243	12,362	14,243
Springs	3	0	17	41	17	41	17	41
Evapotranspiration	7	1	43	67	43	67	43	67
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	4,907	4,516	2,632	2,193	2,625	2,175	2,626	2,175
Head Dependent Bounds	0	0	0	0	0	0	0	0

Flow term	**Historical average**	**1999**	**Scenario 4 decadel average**	**Scenario 4 2060**	**Scenario 5a decadel average**	**Scenario 5a 2060**	**Scenario 5b decadel average**	**Scenario 5b 2060**
Lateral Flow	16,143	15,131	24,454	23,979	25,444	25,475	25,410	25,478
Total Outflow	26,366	25,715	39,308	40,323	40,491	42,001	40,458	42,004
Inflow - Outflow	-3,640	-10,386	-12,394	-11,163	-13,463	-12,638	-13,434	-12,649
Storage Change	-3,640	-10,386	-12,395	-11,162	-13,465	-12,637	-13,435	-12,648
Model Error	0	0	1	-1	2	-1	1	-1
Model Error (percent)	0	0	0	0	0	0	0	0

TABLE 6. SUMMARY OF WATER BUDGETS FOR MAVERICK COUNTY. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	4,342	2,534	4,251	4,146	4,251	4,146	4,251	4,146
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	3,008	2,140	2,057	1,763	2,057	1,763	2,057	1,763
Head Dependent Bounds	0	0	0	0	0	0	0	0
Lateral Flow	718	514	543	515	543	515	543	515
Total Inflow	8,068	5,188	6,851	6,424	6,851	6,424	6,851	6,424
Outflow								
Wells	2,266	2,439	1,813	1,531	1,813	1,531	1,813	1,531
Springs	0	0	0	0	0	0	0	0
Evapotranspiration	23	17	183	195	183	195	183	195
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	447	352	128	202	128	202	128	202
Head Dependent Bounds	0	0	0	0	0	0	0	0

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Lateral Flow	3,215	3,291	3,395	3,436	3,395	3,436	3,395	3,436
Total Outflow	5,951	6,099	5,519	5,364	5,519	5,364	5,519	5,364
Inflow - Outflow	2,117	-911	1,332	1,060	1,332	1,060	1,332	1,060
Storage Change	2,117	-910	1,331	1,061	1,331	1,061	1,331	1,061
Model Error	0	-1	1	-1	1	-1	1	-1
Model Error (percent)	0	0	0	0	0	0	0	0

TABLE 7. SUMMARY OF WATER BUDGETS FOR MCMULLEN GROUNDWATER CONSERVATION DISTRICT. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	0	0	0	0	0	0	0	0
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	0	0	0	0	0	0	0	0
Head Dependent Bounds	370	462	841	1,072	841	1,074	842	1,075
Lateral Flow	5,266	5,293	5,629	6,545	5,625	6,545	5,625	6,545
Total Inflow	5,636	5,755	6,470	7,617	6,466	7,619	6,467	7,620
Outflow								
Wells	1,390	158	2,250	2,250	2,250	2,250	2,250	2,250
Springs	0	0	0	0	0	0	0	0
Evapotranspiration	0	0	0	0	0	0	0	0
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	0	0	0	0	0	0	0	0
Head Dependent Bounds	3,510	3,011	1,911	1,441	1,910	1,437	1,909	1,437

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Lateral Flow	3,493	3,561	5,882	7,986	5,897	8,028	5,899	8,028
Total Outflow	8,393	6,730	10,043	11,677	10,057	11,715	10,058	11,715
Inflow - Outflow	-2,757	-975	-3,573	-4,060	-3,591	-4,096	-3,591	-4,095
Storage Change	-2,758	-973	-3,574	-4,060	-3,590	-4,095	-3,592	-4,095
Model Error	1	-2	1	0	-1	-1	1	0
Model Error (percent)	0	0	0	0	0	0	0	0

TABLE 8. SUMMARY OF WATER BUDGETS FOR MEDINA COUNTY GROUNDWATER CONSERVATION DISTRICT. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	14,155	11,420	13,540	13,540	13,540	13,540	13,540	13,540
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	2,156	1,472	2,493	2,521	2,493	2,521	2,493	2,521
Head Dependent Bounds	0	0	0	0	0	0	0	0
Lateral Flow	1,326	1,517	1,647	1,670	1,648	1,670	1,648	1,670
Total Inflow	17,637	14,409	17,680	17,731	17,681	17,731	17,681	17,731
Outflow								
Wells	4,134	4,394	2,542	2,534	2,542	2,534	2,542	2,534
Springs	0	0	0	0	0	0	0	0
Evapotranspiration	73	113	306	354	306	354	306	354
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	587	432	292	316	292	316	292	316
Head Dependent Bounds	0	0	0	0	0	0	0	0

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Lateral Flow	29,791	30,014	24,161	22,013	24,164	22,020	24,173	22,018
Total Outflow	34,585	34,953	27,301	25,217	27,304	25,224	27,313	25,222
Inflow - Outflow	-16,948	-20,544	-9,621	-7,486	-9,623	-7,493	-9,632	-7,491
Storage Change	-16,948	-20,544	-9,620	-7,487	-9,623	-7,494	-9,632	-7,491
Model Error	0	0	-1	1	0	1	0	0
Model Error (percent)	0	0	0	0	0	0	0	0

TABLE 9. SUMMARY OF WATER BUDGETS FOR PLUM CREEK CONSERVATION DISTRICT. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	6,049	3,928	5,859	5,844	5,859	5,844	5,859	5,844
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	1,208	700	3,050	3,477	3,051	3,479	3,051	3,479
Head Dependent Bounds	0	0	0	0	0	0	0	0
Lateral Flow	2,243	2,297	4,895	5,554	4,911	5,599	4,913	5,605
Total Inflow	9,500	6,925	13,804	14,875	13,821	14,922	13,823	14,928
Outflow								
Wells	2,295	2,542	13,880	13,360	13,880	13,360	13,880	13,360
Springs	14	0	0	0	0	0	0	0
Evapotranspiration	137	105	195	213	195	213	195	213
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	6,893	7,138	1,829	1,046	1,807	979	1,804	970
Head Dependent Bounds	0	0	0	0	0	0	0	0

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Lateral Flow	1,613	1,475	4,824	5,217	4,918	5,458	4,934	5,501
Total Outflow	10,952	11,260	20,728	19,836	20,800	20,010	20,813	20,044
Inflow - Outflow	-1,452	-4,335	-6,924	-4,961	-6,979	-5,088	-6,990	-5,116
Storage Change	-1,452	-4,336	-6,923	-4,960	-6,978	-5,087	-6,990	-5,115
Model Error	0	1	-1	-1	-1	-1	0	-1
Model Error (percent)	0	0	0	0	0	0	0	0

Note: These flows do not include the Plum Creek/Gonzales overlap area.

TABLE 10. SUMMARY OF WATER BUDGETS FOR UVALDE COUNTY GROUNDWATER CONSERVATION DISTRICT. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	3,790	2,567	3,763	3,763	3,763	3,763	3,763	3,763
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	1,233	742	1,340	1,317	1,340	1,317	1,340	1,317
Head Dependent Bounds	0	0	0	0	0	0	0	0
Lateral Flow	256	214	256	348	256	348	256	348
Total Inflow	5,279	3,523	5,359	5,428	5,359	5,428	5,359	5,428
Outflow								
Wells	609	245	1,253	828	1,253	828	1,253	828
Springs	0	0	0	0	0	0	0	0
Evapotranspiration	0	0	3	6	3	6	3	6
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	51	131	30	31	30	31	30	31
Head Dependent Bounds	0	0	0	0	0	0	0	0

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Lateral Flow	9,054	8,814	7,155	6,959	7,155	6,959	7,156	6,960
Total Outflow	9,714	9,190	8,441	7,824	8,441	7,824	8,442	7,825
Inflow - Outflow	-4,435	-5,667	-3,082	-2,396	-3,082	-2,396	-3,083	-2,397
Storage Change	-4,435	-5,667	-3,080	-2,397	-3,080	-2,397	-3,081	-2,397
Model Error	0	0	-2	1	-2	1	-2	0
Model Error (percent)	0	0	0	0	0	0	0	0

TABLE 11. SUMMARY OF WATER BUDGETS FOR WEBB COUNTY CONSERVATION DISTRICT. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	15,995	7,609	15,377	15,377	15,377	15,377	15,377	15,377
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	129,874	24,069	37,115	33,724	37,115	33,724	37,115	33,724
Head Dependent Bounds	6,601	6,335	5,556	5,125	5,556	5,125	5,556	5,125
Lateral Flow	4,498	4,372	4,412	4,322	4,412	4,322	4,412	4,322
Total Inflow	156,968	42,385	62,460	58,548	62,460	58,548	62,460	58,548
Outflow								
Wells	706	916	916	916	916	916	916	916
Springs	0	0	0	0	0	0	0	0
Evapotranspiration	2,701	9,902	5,824	5,883	5,824	5,883	5,824	5,883
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	51,044	281,942	15,325	15,535	15,325	15,535	15,325	15,535
Head Dependent Bounds	967	828	794	809	794	809	794	809

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Lateral Flow	10,157	9,703	10,227	10,612	10,227	10,613	10,228	10,614
Total Outflow	65,575	303,291	33,086	33,755	33,086	33,756	33,087	33,757
Inflow - Outflow	91,393	-260,906	29,374	24,793	29,374	24,792	29,373	24,791
Storage Change	91,397	-260,898	29,381	24,802	29,381	24,801	29,380	24,800
Model Error	-4	-8	-7	-9	-7	-9	-7	-9
Model Error (percent)	0	0	0	0	0	0	0	0

TABLE 12. SUMMARY OF WATER BUDGETS FOR WINTERGARDEN GROUNDWATER CONSERVATION COUNTY CONSERVATION DISTRICT. BUDGETS ARE FOR ALL LAYERS IN ACRE-FEET PER YEAR.

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Inflow								
Recharge	49,420	26,602	48,300	48,300	48,300	48,300	48,300	48,300
Reservoir Losses	0	0	0	0	0	0	0	0
Stream Losses	33,039	30,171	35,565	34,119	35,565	34,119	35,565	34,119
Head Dependent Bounds	6,597	7,117	8,257	8,686	8,258	8,688	8,258	8,689
Lateral Flow	32,513	30,414	26,740	26,111	26,739	26,112	26,733	26,117
Total Inflow	121,569	94,304	118,862	117,216	118,862	117,219	118,856	117,225
Outflow								
Wells	87,422	61,874	46,281	45,769	46,281	45,769	46,281	45,769
Springs	0	0	0	0	0	0	0	0
Evapotranspiration	2,632	862	958	660	958	660	958	660
Reservoir Gains	0	0	0	0	0	0	0	0
Stream Gains	26,574	20,942	11,308	9,800	11,308	9,800	11,307	9,799
Head Dependent Bounds	9,829	8,845	7,308	6,825	7,307	6,824	7,307	6,823

Flow term	Historical average	1999	Scenario 4 decadel average	Scenario 4 2060	Scenario 5a decadel average	Scenario 5a 2060	Scenario 5b decadel average	Scenario 5b 2060
Lateral Flow	25,666	31,916	31,287	31,570	31,293	31,589	31,308	31,599
Total Outflow	152,123	124,439	97,142	94,624	97,147	94,642	97,161	94,650
Inflow - Outflow	-30,554	-30,135	21,720	22,592	21,715	22,577	21,695	22,575
Storage Change	-30,553	-30,135	21,720	22,594	21,714	22,578	21,695	22,574
Model Error	-1	0	0	-2	1	-1	0	1
Model Error (percent)	0	0	0	0	0	0	0	0