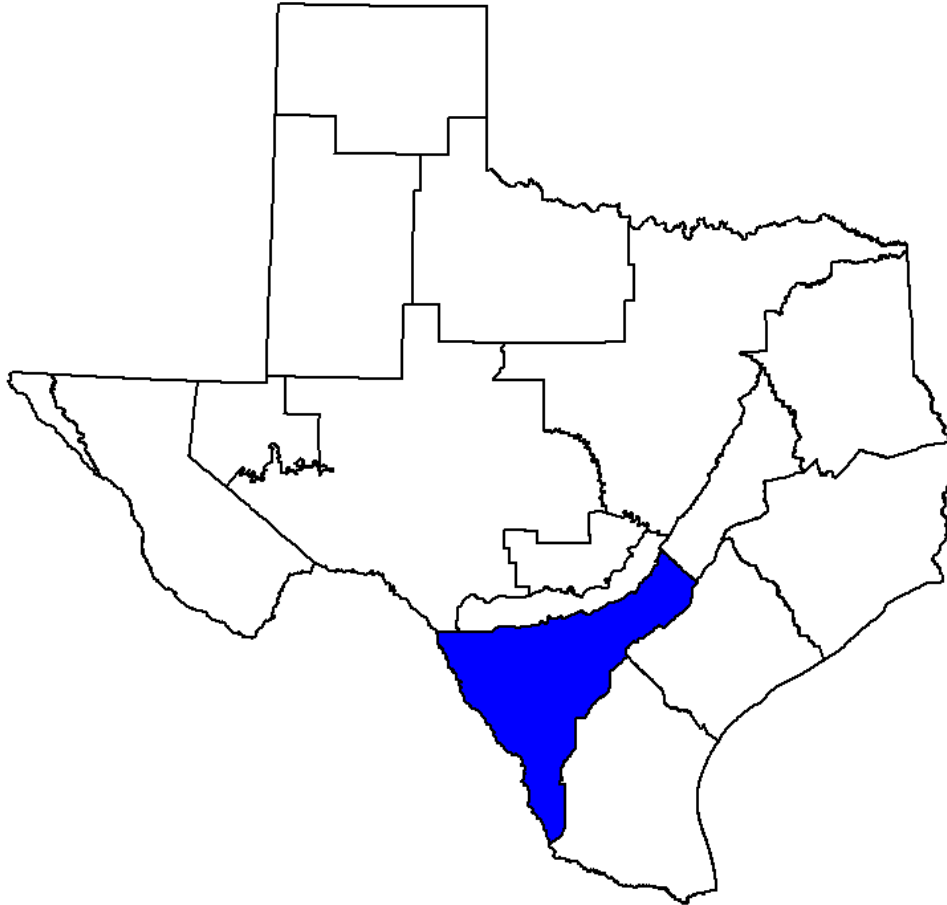


**GMA 13 Model Simulation Documentation:
Legacy WSC (Webb County) Scenario**



Prepared for:
Groundwater Management Area 13

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Professional Engineer and Professional Geoscientist Seals

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Draft Report for Review – To be Stamped when Finalized

1.0 Introduction

Legacy WSC provided a detailed request to include groundwater pumping in Webb County in a GMA 13 Model simulation to advance the joint planning process. This request was transmitted in an email from Jordan Furnans of Spheros Environmental on February 26, 2026. Specific proposed pumping locations and amounts were provided. Total pumping for the request totaled about 50,000 AF/yr from the Carrizo Aquifer.

The requested pumping amount is higher than that previously requested or simulated. At a GMA 13 meeting on June 14, 2024, Legacy WSC representatives made a presentation that included an estimated a total 2060 “water delivery” of 32,960 AF/yr. This total was rounded up to 33,000 AF/yr and added to the estimated current pumping in Webb County (6,380 AF/yr) and included in a preliminary bounding simulation named “MAG Simulation”. The results of this simulation were summarized at the GMA 13 meeting of February 13, 2026.

Because the new requested amount is higher than previously requested, this simulation is limited to running a baseline simulation pumping in all counties of GMA 13 except Webb County in order to robustly identify and characterize the potential impacts of increased pumping in Webb County.

The simulation documented in this Technical Memorandum used the R95 Baseline scenario for all files except the WEL file. As discussed at the GMA 13 meeting of February 13, 2026, the R95 Baseline assumed 95 percent of average recharge and groundwater pumping held constant at 2017 amounts (the last year of the calibrated model) through 2080.

As noted above, the WEL files from the R95 Baseline scenario included about 6,380 AF/yr of Webb County pumping (2017 pumping from the calibrated GMA 13 Model). The pumping locations and amounts provided by Dr. Furnans were added to the R95 Baseline scenario WEL file and named *WebbRequest.wel* using a simple cut-and-paste addition at the end of the baseline WEL file.

All files used in the simulation (including output) can be downloaded from:

https://drive.google.com/drive/folders/1A0wcb9aUI_toRVUIh2DPeCGRBTy8fWkH?usp=sharing

2.0 Simulation Results

The model output was processed to evaluate the following:

- Carrizo-Wilcox Aquifer pumping by county
- Average drawdown by county and groundwater conservation district
- Source of the increased pumping

2.1 Pumping

Groundwater pumping in the GMA 13 Model is specified through the WEL file. One of the features of MODFLOW 6 (the underlying code of the GMA 13 Model) is that reductions in pumping are applied when the groundwater elevation approaches the bottom of a cell. Therefore, input pumping and output pumping may not be the same. Consequently, pumping was obtained from the model output file named *GMA13-WebbRequest.cbb* using the Fortan post-processor *getpump.exe*.

Output pumping for the Carrizo-Wilcox Aquifer for the baseline simulation and the Webb Request simulation are presented on the right side of Table 1. For context, the left side of Table 1 presents a comparison of the baseline simulation and the current Modeled Available Groundwater (MAG) values. The MAGs were reported by decade from 2020 to 2080 by TWDB in 2022 (GAM Run 21-018 MAG). The reported values vary by decade, and only the maximum value is presented in Table 1.

Table 1. Groundwater Pumping Comparison - Baseline and Webb Request Scenarios

County	Baseline	Curr et MAG (Maximum)	MAG-Baseline	County	Baseline	Webb Request	Webb Request - Baseline
Atascosa	42,934	59,982	17,048	Atascosa	42,934	42,933	-1
Bexar	16,621	70,145	53,524	Bexar	16,621	16,615	-6
Caldwell	3,698	49,635	45,937	Caldwell	3,698	3,698	0
Dimmit	55,692	3,895	-51,797	Dimmit	55,692	53,330	-2,362
Frio	100,729	114,827	14,098	Frio	100,729	100,729	0
Gonzales	54,574	103,707	49,133	Gonzales	54,574	54,574	0
Guadalupe	7,562	55,637	48,075	Guadalupe	7,562	7,562	0
Karnes	450	1,043	593	Karnes	450	450	0
LaSalle	25,704	6,554	-19,150	LaSalle	25,704	25,704	0
Maverick	1,632	547	-1,085	Maverick	1,632	1,627	-5
McMullen	4,647	7,789	3,142	McMullen	4,647	4,647	0
Medina	3,712	2,635	-1,077	Medina	3,712	3,704	-8
Uvalde	126	0	-126	Uvalde	126	126	0
Webb	6,494	912	-5,582	Webb	6,494	56,361	49,867
Wilson	24,983	125,670	100,687	Wilson	24,983	24,983	0
Zavala	46,686	38,303	-8,383	Zavala	46,686	46,680	-6

Please note that the increase in Webb County pumping totals 49,867 AF/yr as compared to the baseline. This is less than the full request of 50,231 AF/yr due to pumping reductions applied by the model. Details of the reductions are included in the output files that can be downloaded at the link provided above.

In addition, pumping is reduced by about 2,400 AF/yr in Dimmit County that is attributable to additional drawdown associated with the increased pumping in Webb County. Also, there are five counties where pumping is reduced by less than 10 AF/yr that is considered insignificant in the

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context of the purposes of this simulation. However, as noted below, the reduction in pumping in Maverick County appears to have a minor influence in the analysis of sources of pumping.

2.2 Average Drawdown

Average drawdown in the Carrizo-Wilcox Aquifer was calculated annually from the model output file (*GMA13-WebbRequest.hds*) using the Fortran post-processor named *getdd.exe*. Please note that drawdown is based on a baseline year of 2017 (the last year of the calibration period).

Average drawdown in 2080 for the Carrizo-Wilcox Aquifer by county is presented on the left side of Table 2, and average drawdown for the Carrizo-Wilcox Aquifer by groundwater conservation district (GCD) is presented on the right side of Table 2. Both sides of the table, the baseline drawdown and the Webb Request Scenario drawdown are presented. Please note that the outcrop and downdip areas are calculated separately.

Table 2. Average Drawdown in 2080 Comparison - Baseline and Webb Request Scenarios

County	Average Drawdown (ft - 2017 Baseline)			
	Baseline Pumping		Webb Request	
	Outcrop	Downdip	Outcrop	Downdip
Atascosa	3	9	7	26
Bexar	3	3	3	3
Caldwell	7	9	7	9
Dimmit	87	129	119	239
Frio	28	50	40	97
Gonzales	20	18	20	18
Guadalupe	13	18	13	18
Karnes	0	10	0	12
LaSalle	0	91	0	275
Maverick	14	25	19	31
McMullen	0	52	0	157
Medina	7	10	8	12
Uvalde	5	6	6	7
Webb	39	99	103	594
Wilson	4	6	4	7
Zavala	28	69	39	108

Note: Baseline Pumping is 2017 pumping constant from 2018 to 2080

GCD	Average Drawdown (ft - 2017 Baseline)			
	Baseline		Webb Request	
	Outcrop	Downdip	Outcrop	Downdip
EUWCD	11	23	16	45
GCUWCD	16	17	16	18
GCGCD	13	18	13	18
MGCD	0	52	0	157
MCGCD	7	10	8	12
PCCD	5	5	5	5
UCUWCD	5	6	6	7
WGCD	60	96	83	215

Note: Baseline Pumping is 2017 pumping constant from 2018 to 2080

Please note that the Webb Request Scenario results in increased drawdowns in several counties and GCDs. Of note are the three counties of Wintergarden GCD (Dimmit, LaSalle, and Zavala) and McMullen County (same as McMullen GCD or MGCD).

Figure 1 presents the average annual drawdown in the downdip portion of Webb County, and Figure 2 presents the average annual drawdown in Wintergarden GCD.

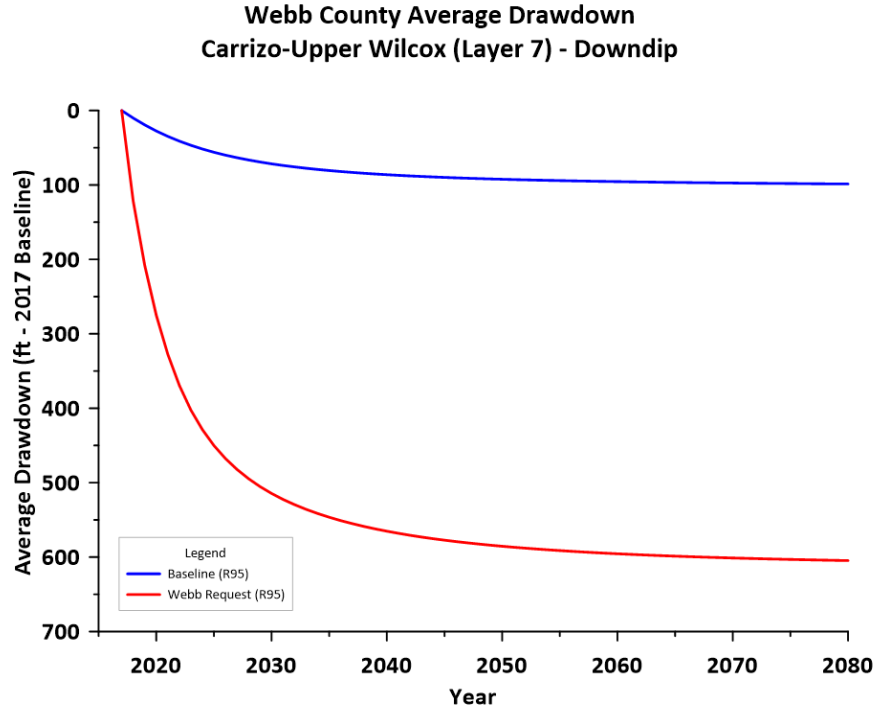


Figure 1. Average Drawdown in Carrizo-Wilcox Aquifer (Downdip) - Webb County

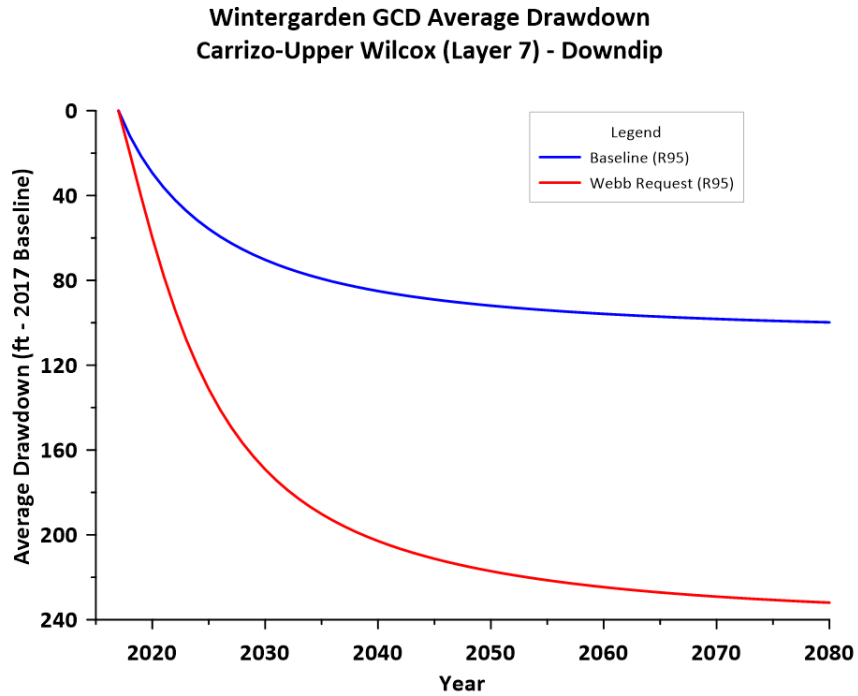


Figure 2. Average Drawdown in Carrizo-Wilcox Aquifer (Downdip) - Wintergarden GCD

3.0 Groundwater Budget Analysis for Webb County

3.1 Zone Specification

Identifying and quantifying the sources of the increased pumping was accomplished by using the USGS program ZoneBudget. Each cell in the model domain was assigned a “zone number” as follows:

- Layer 1 (alluvium) was assigned zone number 1
- Layers 2 to 9 were assigned a zone number that is the same as the county code in the grid file of the GMA 13 model. Please note that Mexico is assigned a zone number of 801.

This zone number specification was accomplished using the Fortran program named *GMA13CountyZone.exe*.

ZoneBudget reads this zone file, a file specifying cell linkages, and the simulation output files to develop groundwater budgets for each zone. Table 3 summarizes the ZoneBudget input and output files for each scenario. Please note that the csv output files represent the raw output from ZoneBudget, while the xlsx files represents the processed output (i.e. unit conversions and calculating net flow components). For the purposes of this Technical Memorandum, only Webb County data were processed and presented in the xlsx files.

Table 3. Summary of ZoneBudget Input and Output Files

R95 Baseline Scenario

Input/Output	File Type	File Name
Input Files	NAM	baaseline.nam
	BUD	GMA13-predR95baseline.cbb
	ZON	GMA13CountyZone.zon
	GRB	GMA13-1SS.dis.grb
Output Files	CSV	baseline.csv
	XLSX	CountyR95BaselineWB.xlsx

Webb Request Scenario

Input/Output	File Type	File Name
Input Files	NAM	WebbRequest.nam
	BUD	GMA13-WebbRequest.cbb
	ZON	GMA13CountyZone.zon
	GRB	GMA13-1SS.dis.grb
Output Files	CSV	WebbRequest.csv
	XLSX	CountyWebbRequestWB.xlsx

3.2 Webb County Groundwater Budgets

Table 4 presents the groundwater budgets for all aquifers of Webb County (Zone 240) for the R95 Baseline Scenario and the Webb Request Scenario. The pumping in Table 4 is different from the pumping in Table 2 (presented above). Table 2 presents only the Carrizo-Wilcox pumping. Table 4 presents all pumping and includes a small amount of pumping in the Sparta Aquifer in Webb County.

On the right side of Table 4, the differences in each component of inflow, outflow, and storage are calculated. For inflow, the difference is calculated as Webb Request Scenario minus Baseline Scenario to quantify induced inflow. For outflow, the difference is Baseline Scenario minus Webb Request Scenario to quantify captured outflow. For storage, the difference is Baseline Scenario minus Webb Request to calculate the increase in storage depletion.

Table 4. Webb County Groundwater Budgets: Baseline and Webb Request Scenarios

	Baseline (AF/yr)	Webb Request (AF/yr)	Difference (AF/yr)
Inflow			
Overlying Formations (GHB)	10,995	16,394	5,399
Recharge (RCH)	12,735	12,735	0
Alluvium (1)	0	7,119	7,119
Dimmit (64)	0	5,414	5,414
LaSalle (139)	0	9,090	9,090
Maverick (159)	1,000	929	-71
McMullen (162)	34	220	186
Total Inflow	24,765	51,900	
Outflow			
Pumping	6,949	57,178	50,229
Evapotranspiration	454	433	20
Alluvium (1)	2,318	0	2,318
Dimmit (64)	3,351	0	3,351
LaSalle (139)	8,261	0	8,261
Mexico (801)	5,473	3,710	1,763
Total Outflow	26,805	61,321	
Storage Change			
Confined	-728	-4,164	3,437
Unconfined	-1,312	-5,257	3,945
Total Storage Change	-2,040	-9,421	7,381
Inflow - Outflow	-2,040	-9,421	
Model Error	0	0	

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Please note that, in the Baseline Scenario, groundwater flowed out of Webb County to the Alluvium, to Dimmit County, to LaSalle County, and to Mexico. In the Webb Request Scenario, these outflow components are fully captured and additional inflow is induced from these sources. Additional inflow is also induced from the overlying formations and McMullen County. Maverick County is shown as a small “negative” inflow difference. This appears to be due to minor reduction in pumping in Maverick County due to the increased pumping in Webb County (please see Table 1, previously presented).

3.3 Sources of Increased Pumping

Table 5 presents a reorganization of the differences in Table 4 to summarize and quantify the sources of the increased pumping associated with the Webb Request Scenario. Please note that storage decline represents 15 percent of the pumping increase. Over half the increased pumping is sourced from Dimmit and LaSalle counties. Finally, about 19 percent of the increase pumping is sourced from the alluvium.

Table 5. Summary of Sources of Increased Pumping – Webb Request Scenario

	AF/yr	% of Pumping Increase
Pumping Increase	50,229	100
Induced Inflow		
Overlying Formations (GHB)	5,399	11
Alluvium	9,437	19
Dimmit	8,765	17
LaSalle	17,350	35
Maverick	-71	0
Captured Outflow		
Evapotranspiration	20	0
Mexico	1,763	4
Storage	7,381	15

3.4 Summary of Inflows, Outflows, and Storage Change

The annual values from the Webb County groundwater budgets were summed to characterize inflows, outflows, and annual storage change. Total annual storage in Webb County was then

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calculated using the 2017 total storage (about 28 million acre-feet). The results are summarized as follows:

- Figure 3: Total Inflow
- Figure 4: Total Outflow
- Figure 5: Annual Storage Change
- Figure 6: Total Storage

Please note that these figures begin in 1980 (the beginning of the calibration period), and include the results of the calibrated model to provide context to the changes in the two predictive scenarios (R95 Baseline and Webb Request).

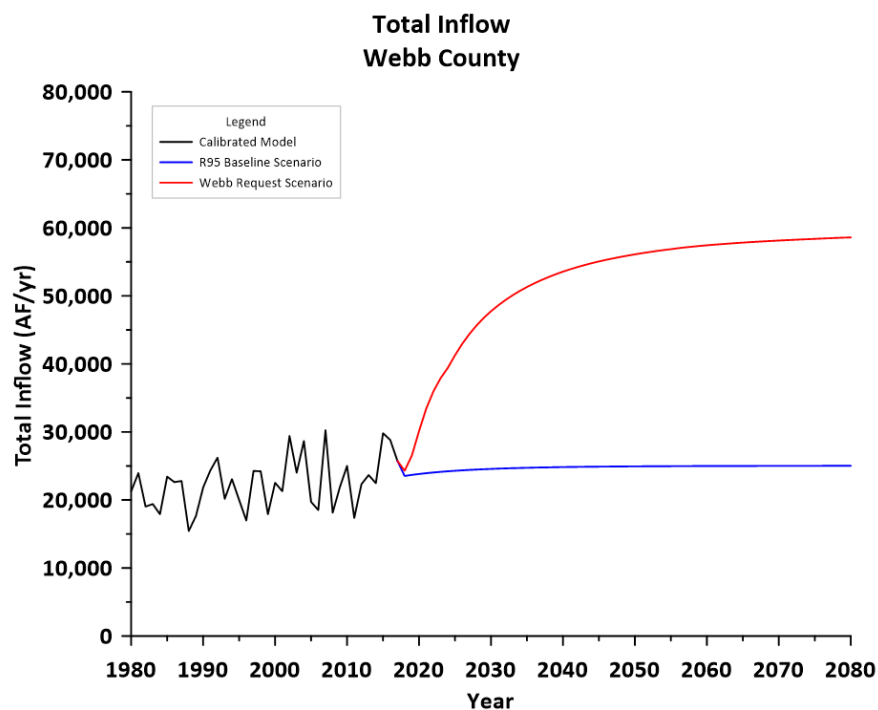


Figure 3. Webb County Total Inflow

Please note that from 1980 to 2017 (calibrated model), the inflow varies as a result of changes in pumping and recharge.

After 2018 under the R95 Baseline Scenario, the inflow remains fairly constant because there is no change to the recharge (all years assume 95 percent of the average recharge from 1981 to 2017) and pumping remains constant at 2017 amounts.

In the Webb Request Scenario inflow increases (induced inflow in response to the increased pumping) and levels off as the system attempts to reach equilibrium under a higher pumping condition.

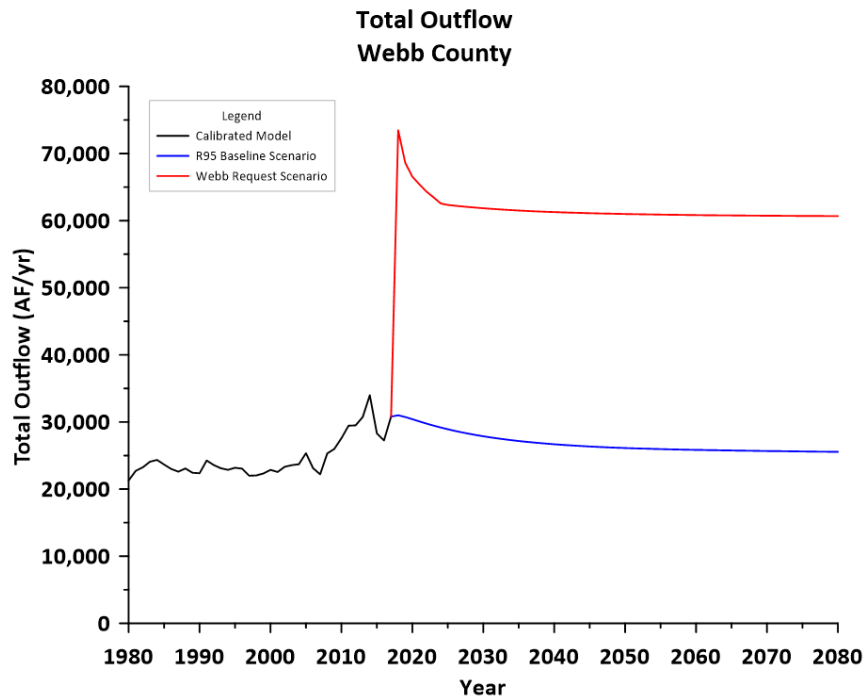


Figure 4. Webb County Total Outflow

Please note that total outflow from 1980 to 2017 increases from about 20,000 AF/yr to about 30,000 AF/yr in response to increasing pumping during that period.

For the R95 Baseline Scenario, outflow declines slightly. Pumping is constant, but other outflow components are captured by the constant pumping that was higher in 2017 as compared to pumping from 1980 to about 2010. This is another example of the system reaching an equilibrium condition.

Finally, in the Webb Request Scenario, the outflow increases in 2018 as a result of the increased pumping associated with the scenario. However, it drops after a few years to a near-equilibrium level as a result of captured outflow from other components.

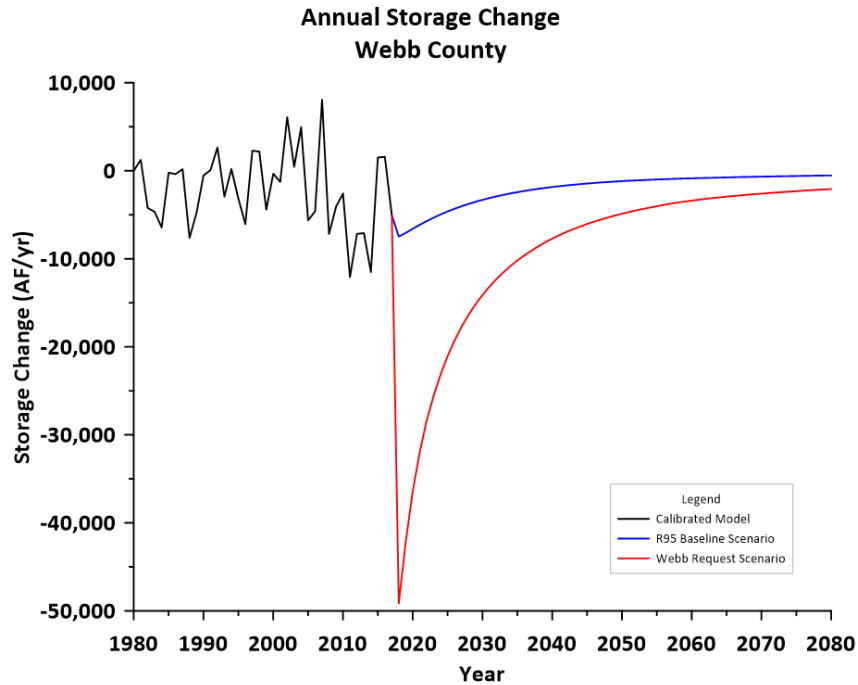


Figure 5. Webb County Annual Storage Change

During the calibration period, the annual storage change varies and is positive in some years and negative in other years. After 2010, there is a persistence of negative values due to the increased pumping in the last several years.

In the R95 Baseline Scenario, the storage change is slowly increasing to an equilibrium level as inflow is induced and natural outflow is captured in response to the 2017 pumping amounts that were assumed in the scenario.

The Webb Request Scenario storage change is nearly 50,000 AF/yr in 2018 as the initial response to the increased pumping is storage change. However, in later years, the annual storage change decreases as inflow is induced and natural outflow is captured. In later years, the annual storage change approaches zero which is indicative of nearly reaching a new equilibrium condition.

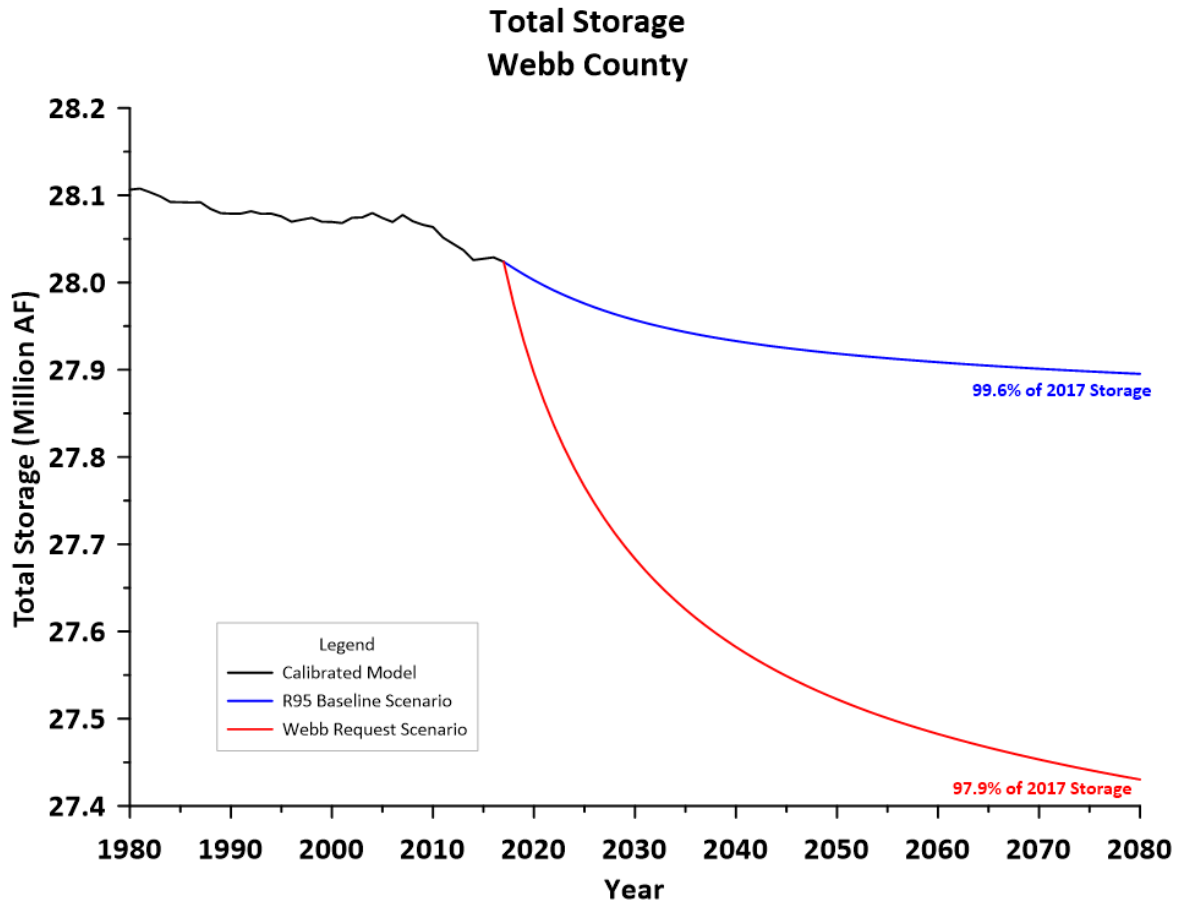


Figure 6. Webb County Total Storage

The total groundwater storage in Webb County for all aquifers was estimated to be about 28 million AF (28,023,826 AF) in 2017 for the Sparta, Queen City, and Carrizo-Wilcox Aquifers in Webb County (as presented at the GMA 13 meeting of February 13, 2026). Using this value for 2017, total storage in each year from 1980 to 2080 for the calibrated model, the R95 Baseline Scenario, and the Webb Request Scenario were calculated using the groundwater budgets estimates of annual storage change.

The source analysis included a calculation that 15 percent of the increased pumping associated with the Webb Request Scenario would be sourced from storage. By 2080, this increased pumping would reduce storage to about 27.4 million AF, which is about 97.9 percent of the storage in 2017.

This analysis highlights the source of increased pumping over the long term is largely induced inflow and captured natural outflow. Although frequently misunderstood and misused, total storage is not a good metric to characterize the potential productivity of an aquifer system because of the dynamic nature of groundwater flow systems.