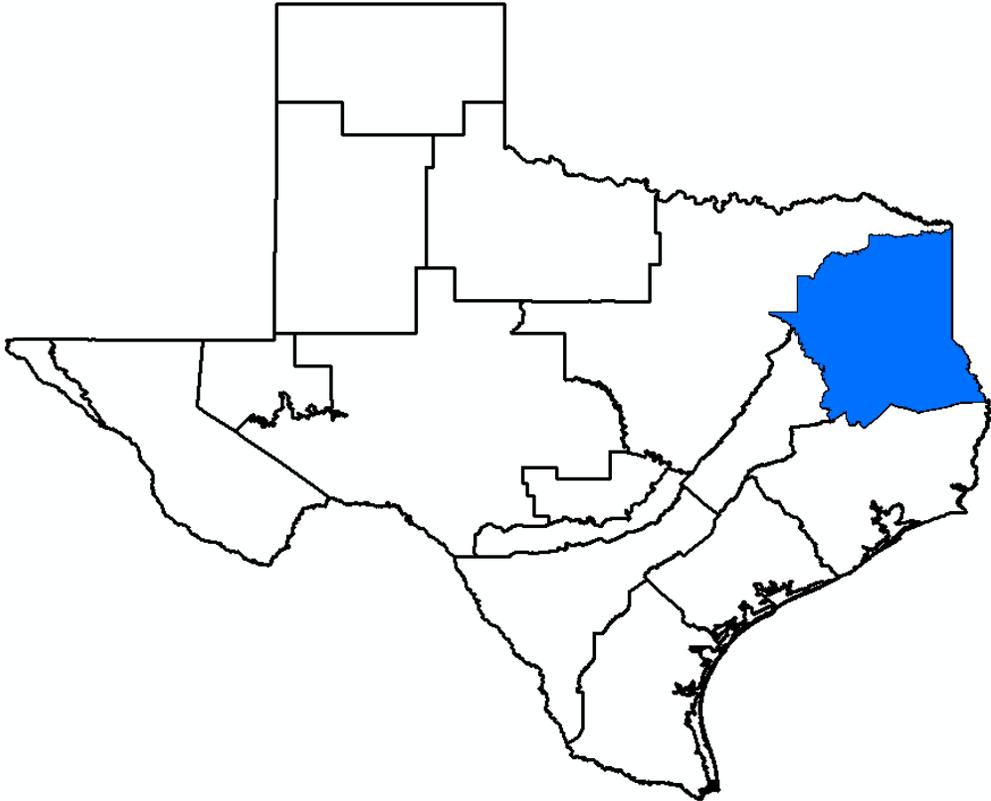


GMA 11 Joint Planning Updated Pumping Scenarios (Agenda Item 3)



William R. Hutchison, Ph.D., P.E., P.G.

GMA 11 Meeting

March 10, 2026

Topics

- Sustainable Yield Review
- Results of updated pumping simulations (Tech Memo 26-02)
 - Dry well analysis
 - Surface water impacts
 - Induced interbasin flow
 - Average drawdown
- Next steps
 - Proposed DFC deadline is May 1, 2026

Sustainable Yield

- Definition: the amount of water that can be pumped from an aquifer over a specified period without causing negative or undesirable effects
 - Undesirable effects can be hydrogeologic, environmental, or economic
- From a joint planning perspective, task is to quantify, analyze, and balance “predicted” decline with other alternative scenarios (what is an “acceptable” decline?)
- Simulations presented in Tech Memo 26-02 provide a method to define “undesirable” effects
 - Dry wells
 - Surface water impacts of increased pumping)

Sustainable Yield

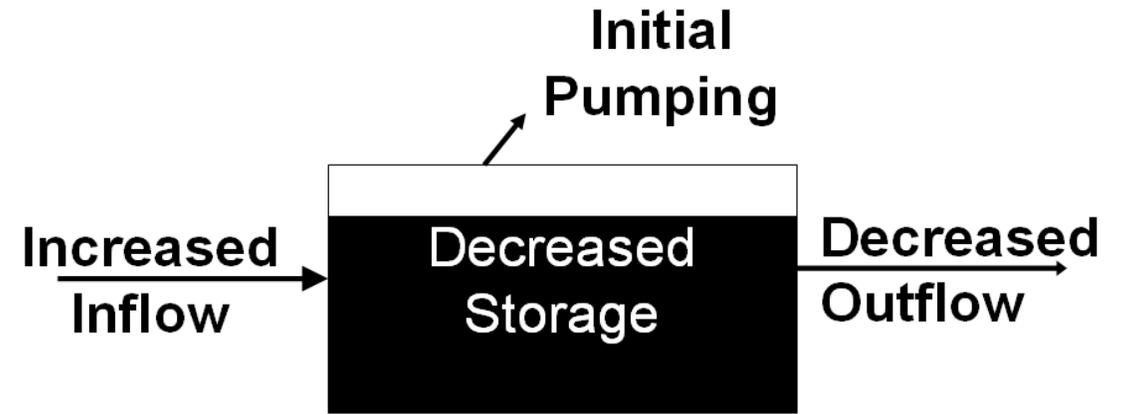
- Definition: the amount of water that can be pumped from an aquifer over a **specified period** without causing negative or undesirable effects
 - Undesirable effects can be hydrogeologic, environmental, or economic
- From a joint planning perspective, task is to quantify, analyze, and balance “predicted” decline with other alternative scenarios (what is an “acceptable” decline?)
- Simulations presented in Tech Memo 26-02 provide a method to define “undesirable” effects
 - Dry wells
 - Surface water impacts of increased pumping)

House Natural Committee Meeting (2/10/2026)

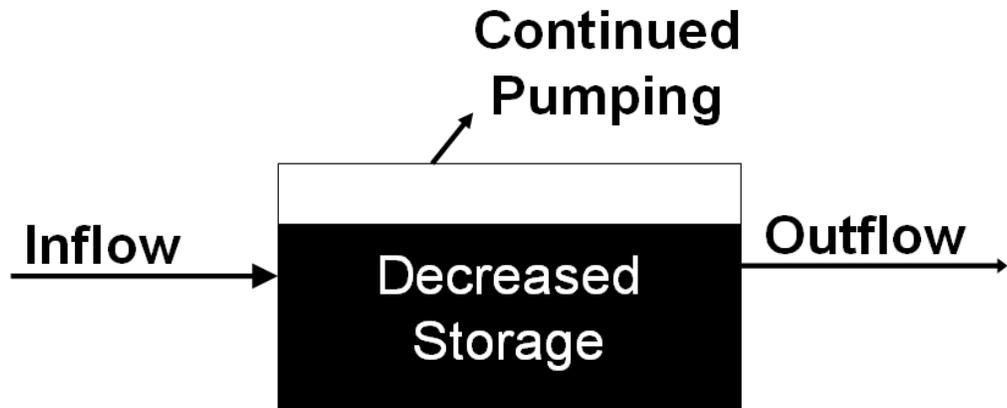
- Sustainability concepts and definitions are not consistent:
 - What is the maximum amount of groundwater can be produced annually in perpetuity?
 - MAG should be a cap
 - TERS should be replaced with “maximum sustainable production”
 - 95% of current DFCs are “unsustainable”
 - Exaggeration based on different standard and definition



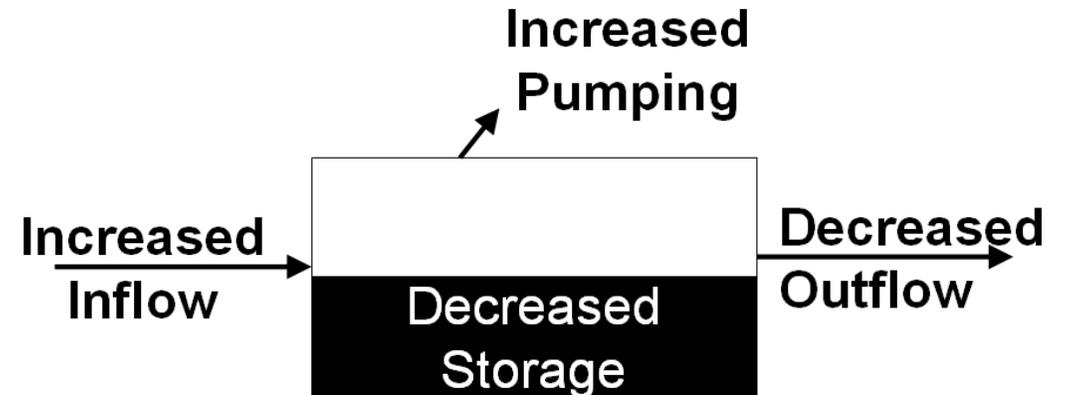
Equilibrium: Inflow = Outflow



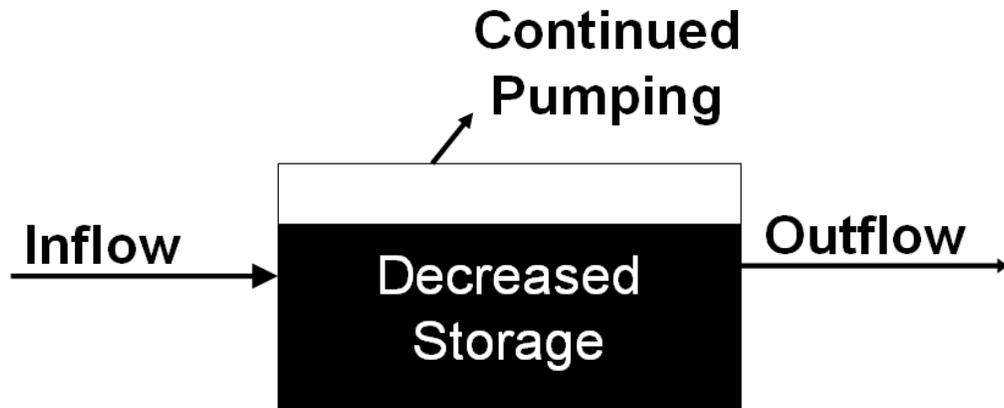
Nonequilibrium: Inflow \neq Outflow



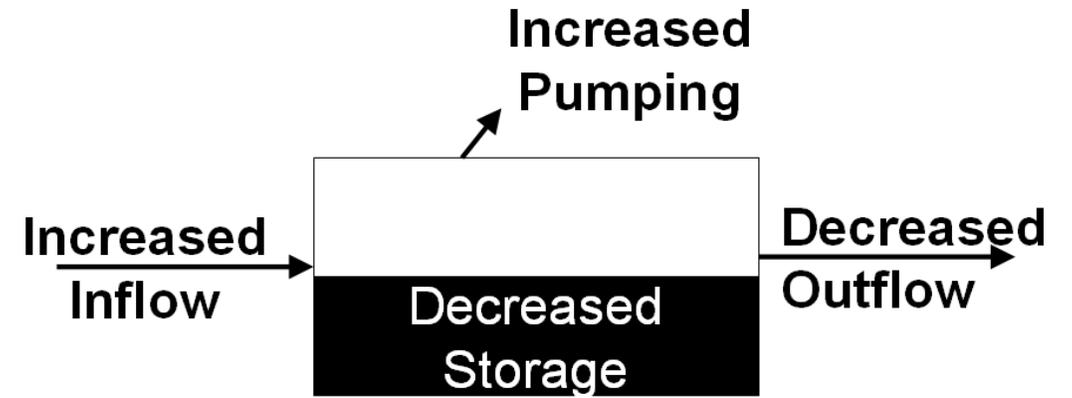
New Equilibrium: Inflow = Outflow



Nonequilibrium: Inflow \neq Outflow



New Equilibrium: Inflow = Outflow



Nonequilibrium: Inflow \neq Outflow

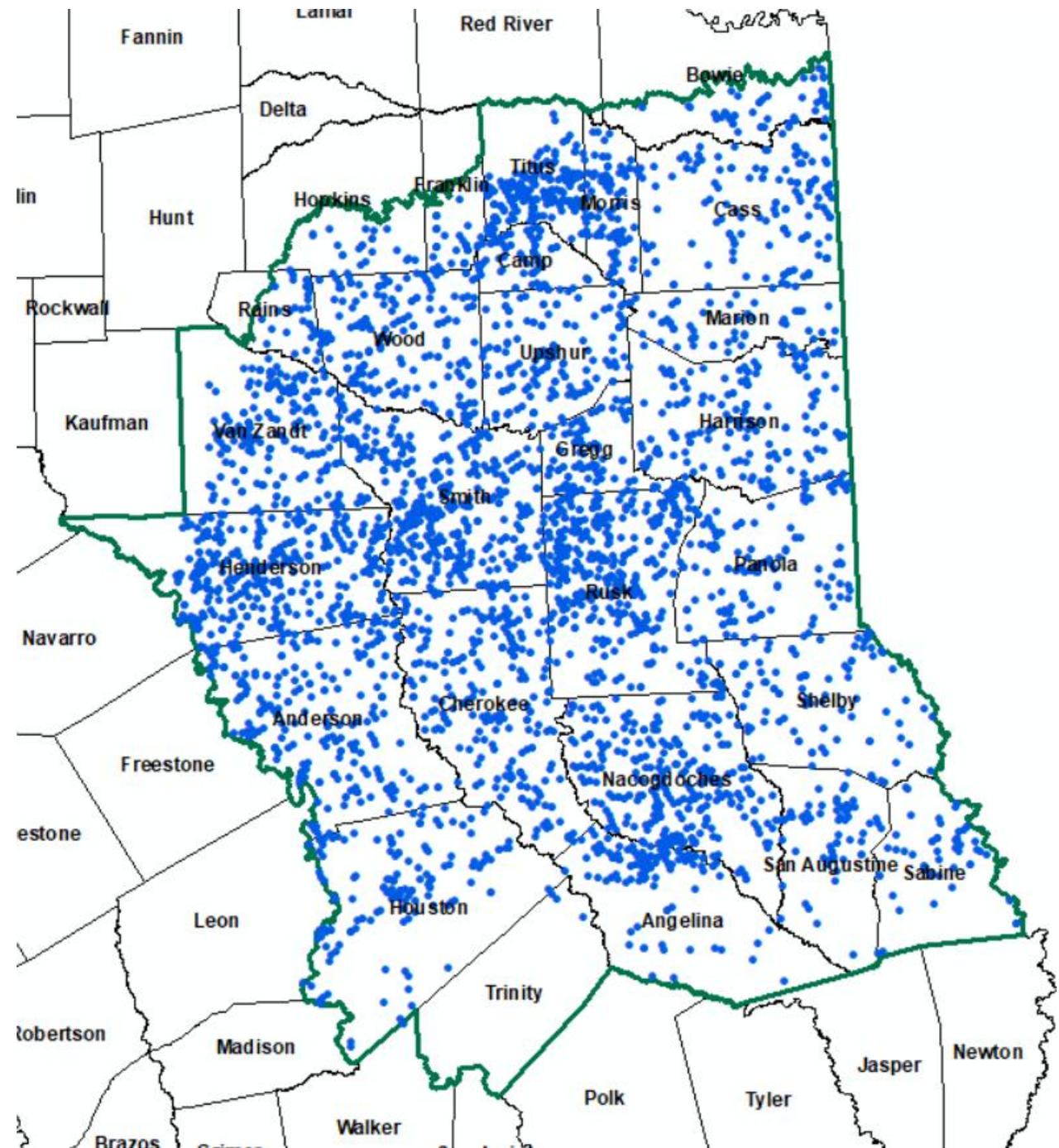
Time to reach equilibrium = ????

GMA 11 Application

- Current DFC is a “maximum sustainable production”
 - Resulted in dry wells and surface impacts that are “unacceptable”
- Two specific metrics to evaluate “sustainability” or “sustainable yield” (discussed at GMA 11 meeting in October 2025):
 - Impacts to streamflow
 - Quantifying number of “dry wells”
- Simulations completed in response to October 2025 meeting were designed to focus on reducing “undesirable impacts”
- GMA 11 has focused on adopted a DFC that recognizes aquifer limits
 - Tech Memo 26-02 analyzes reductions in “maximum sustainable pumping” to address “unacceptable impacts”

Well Locations in GMA 11

- TWDB Database (Well Locations and Depths)
- 5,786 wells in GMA 11
- 4,217 wells with good depths (depicted on map)



GMA 11 Meeting of October 14, 2025

- Evaluated 4,217 wells in GMA 11
- Compared simulated groundwater levels from Scenario 33 (basis for current DFC) in 2080 with well bottom elevation
 - 20 feet higher than well bottom
- 515 wells would “go dry”
 - Revised from 568 with updated GAM
- Updated simulations recommended to assess reductions in dry wells

Aquifer	Total Wells	Scen 33 (current DFC)	
		Dry Wells	Dry Well %
Sparta	155	7	4.5
Queen City	288	133	46.2
Carrizo-Wilcox	3405	297	8.7
All (including other formations)	4217	515	12.2

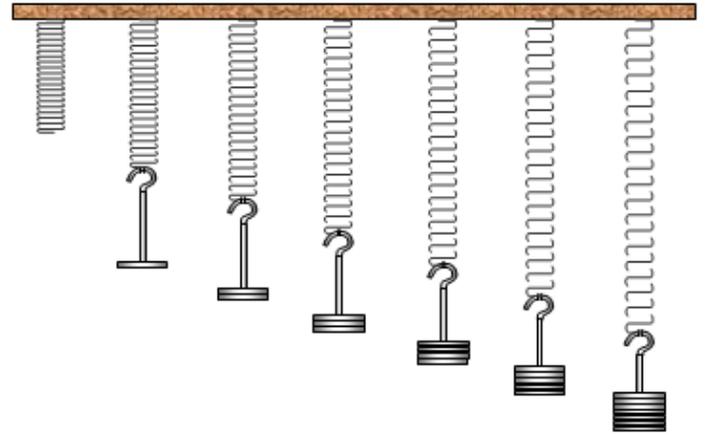
County	Count	Avg Depth (ft)	Scen 33 (Current DFC)				
			Dry Wells	Dry Well %	CW Count	CW Dry Wells	CW Dry Well %
Anderson	237	699	22	9.3	184	9	4.9
Angelina	118	1243	0	0.0	92	0	0.0
Bowie	50	207	3	6.0	46	2	4.3
Camp	80	415	4	5.0	72	3	4.2
Cass	162	366	28	17.3	115	1	0.9
Cherokee	255	408	84	32.9	154	54	35.1
Franklin	40	343	10	25.0	40	10	25.0
Gregg	107	457	12	11.2	100	5	5.0
Harrison	188	255	11	5.9	169	5	3.0
Henderson	370	444	44	11.9	314	30	9.6
Hopkins	25	357	1	4.0	25	1	4.0
Houston	155	756	1	0.6	40	0	0.0
Marion	61	334	3	4.9	36	0	0.0
Morris	98	292	21	21.4	68	7	10.3
Nacogdoches	315	439	25	7.9	229	11	4.8
Panola	136	263	2	1.5	133	2	1.5
Rains	31	203	3	9.7	30	3	10.0
Rusk	428	448	39	9.1	415	38	9.2
Sabine	55	831	1	1.8	31	1	3.2
SanAugustine	65	543	0	0.0	29	0	0.0
Shelby	105	360	3	2.9	103	3	2.9
Smith	375	645	105	28.0	282	36	12.8
Titus	190	275	41	21.6	187	39	20.9
Trinity	3	518	0	0.0	0	0	0.0
Upshur	150	473	17	11.3	129	9	7.0
VanZandt	218	371	16	7.3	209	11	5.3
Wood	200	462	19	9.5	173	17	9.8

Updated Pumping Scenarios

- GMA 11 meeting of October 14, 2025
 - Summarized dry well analysis
 - Summarized surface water impact analysis
- Recommended a series of simulations to reduce impacts to wells and surface water
 - Reduced Queen City pumping (QC)
 - Reduced Carrizo-Wilcox pumping (CW)
- Summarize results
 - Dry well analysis
 - Surface water impact analysis (by river basin)
- Documented in Tech Memo 26-02

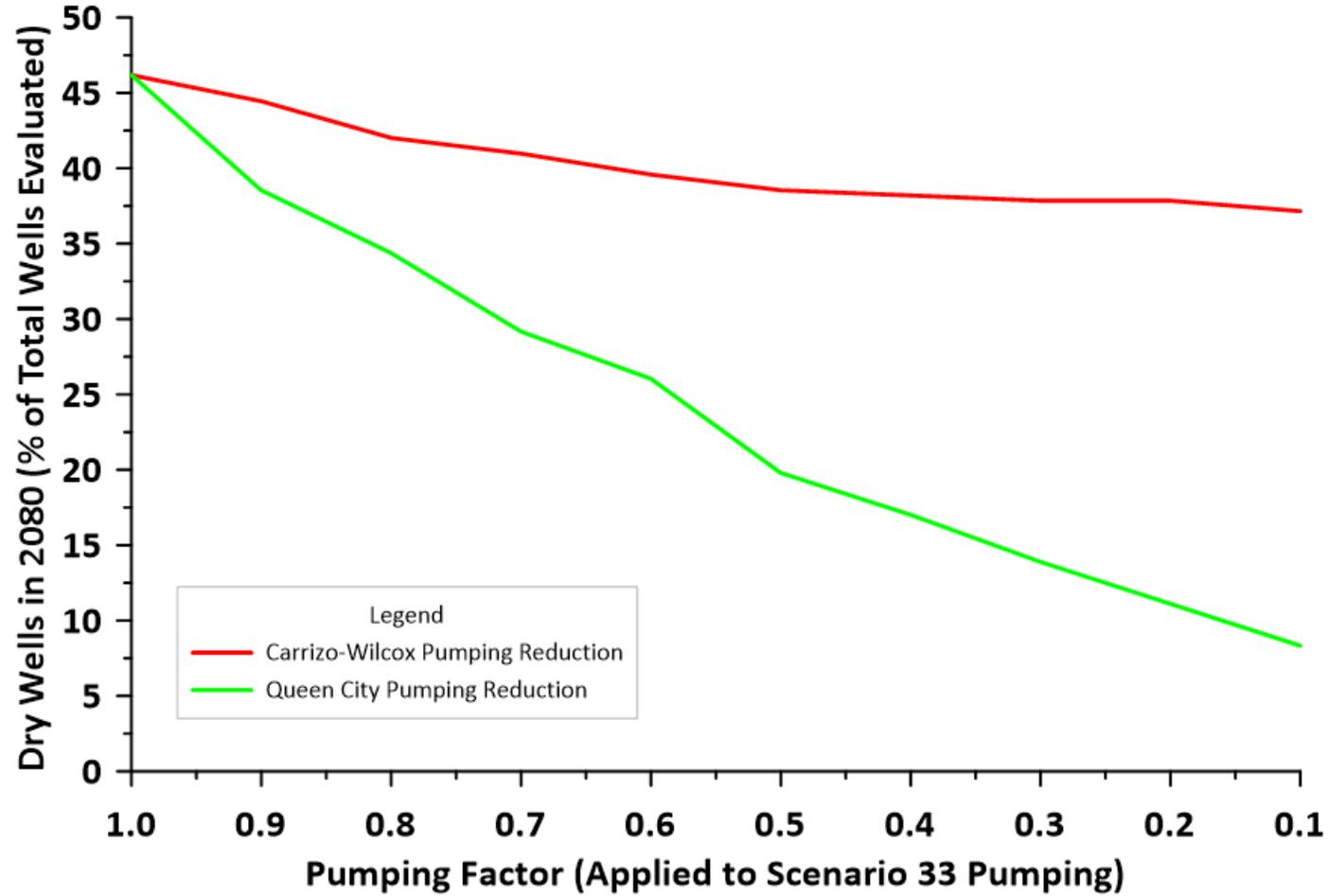
Summary of CW and QC Scenarios

- Pumping factors applied to Queen City and Carrizo-Wilcox (individually)
 - Reductions applied cell-by-cell
 - Cell minimum = 2013 cell pumping
- Also completed:
 - Scenario 33 from 2021 (basis for current DFC) with updated specific yield values
 - Baseline (2013 pumping through 2080)



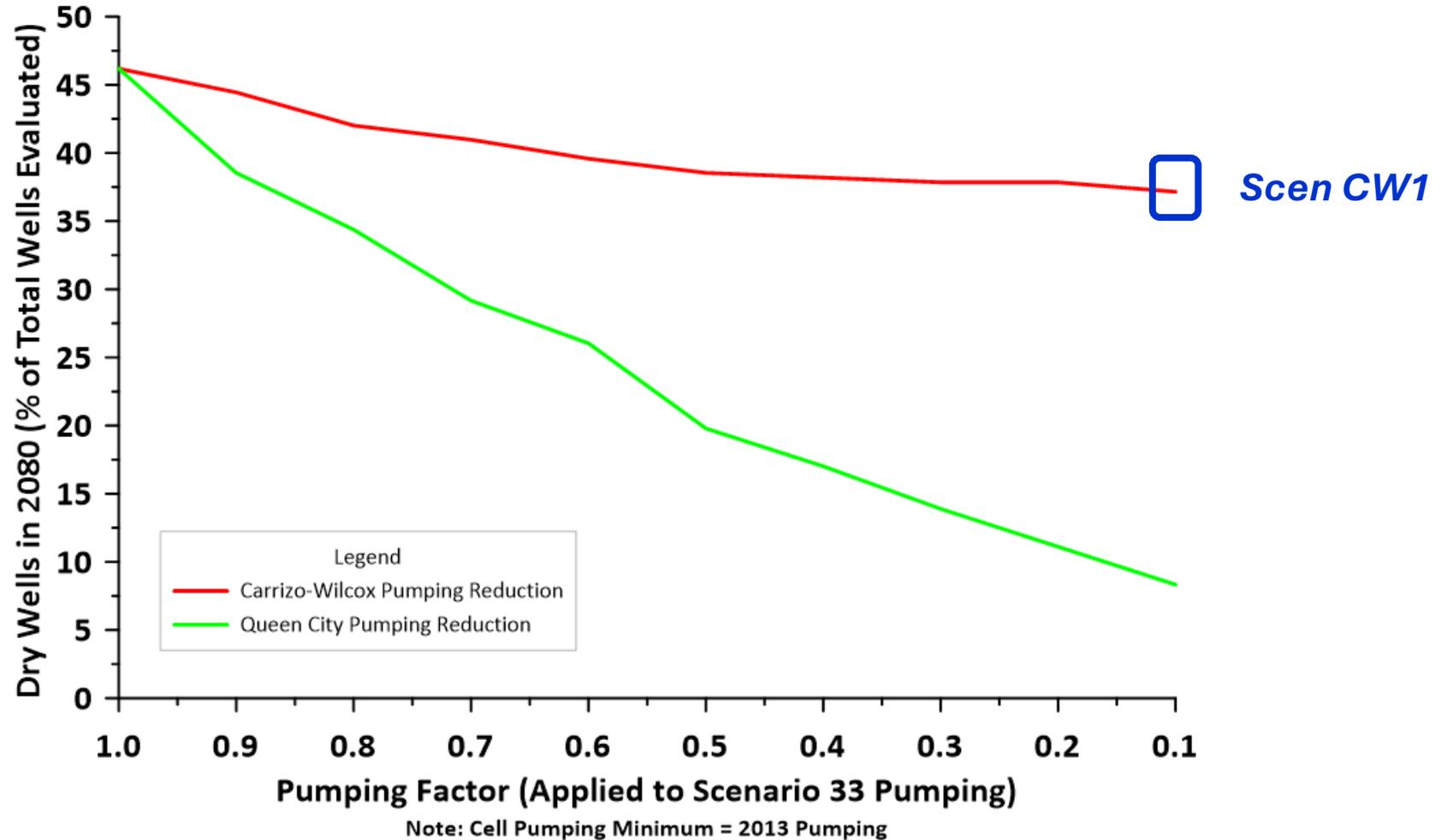
Factor Applied	CW Scenario	QC Scenario
1.0	Scenario 33	
0.9	CW9	QC9
0.8	CW8	QC8
0.7	CW7	QC7
0.6	CW6	QC6
0.5	CW5	QC5
0.4	CW4	QC4
0.3	CW3	QC3
0.2	CW2	QC2
0.1	CW1	QC1

**GMA 11 Queen City Aquifer Wells
Dry Well % in 2080
Pumping Reductions Applied to Aquifers Individually**

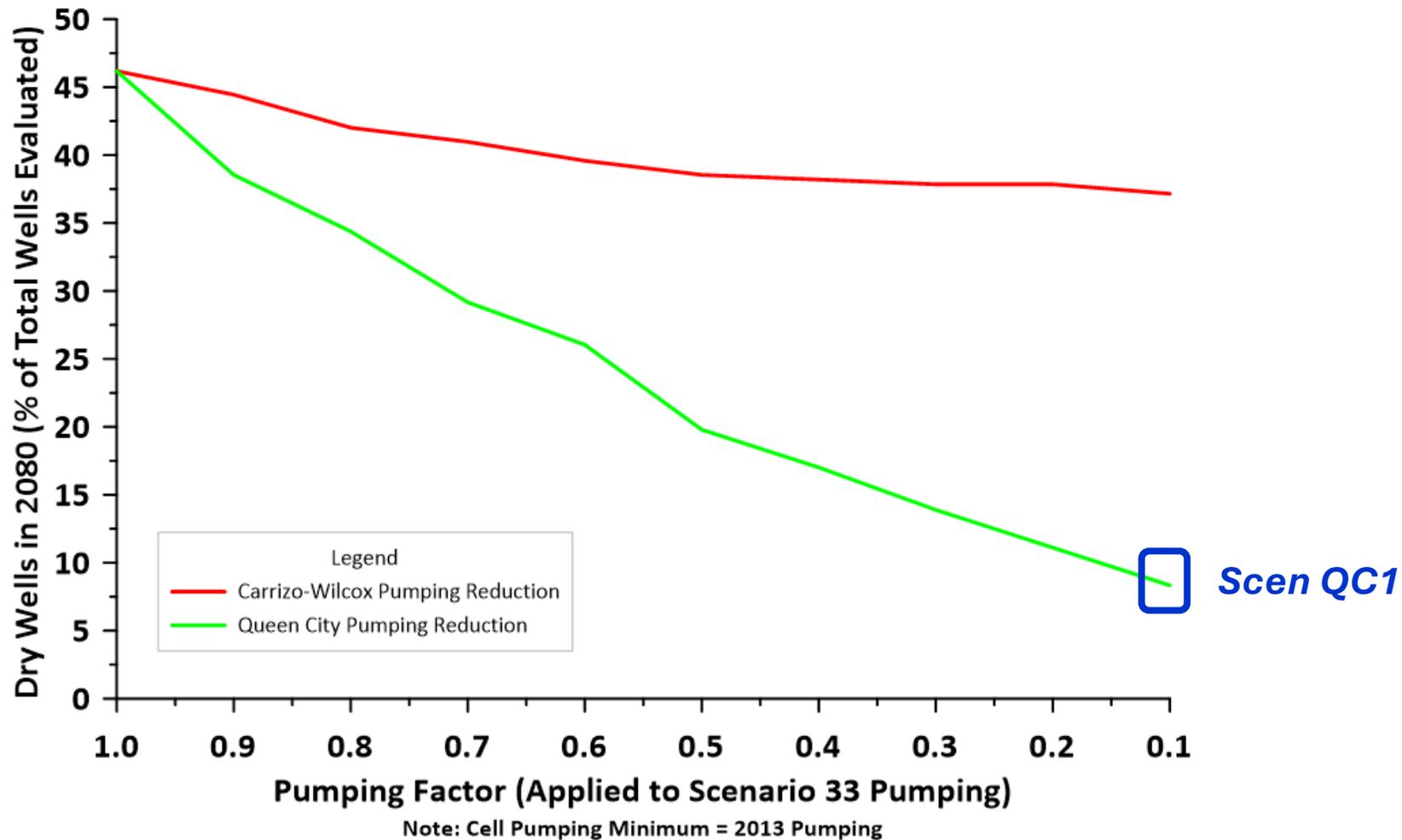


Note: Cell Pumping Minimum = 2013 Pumping

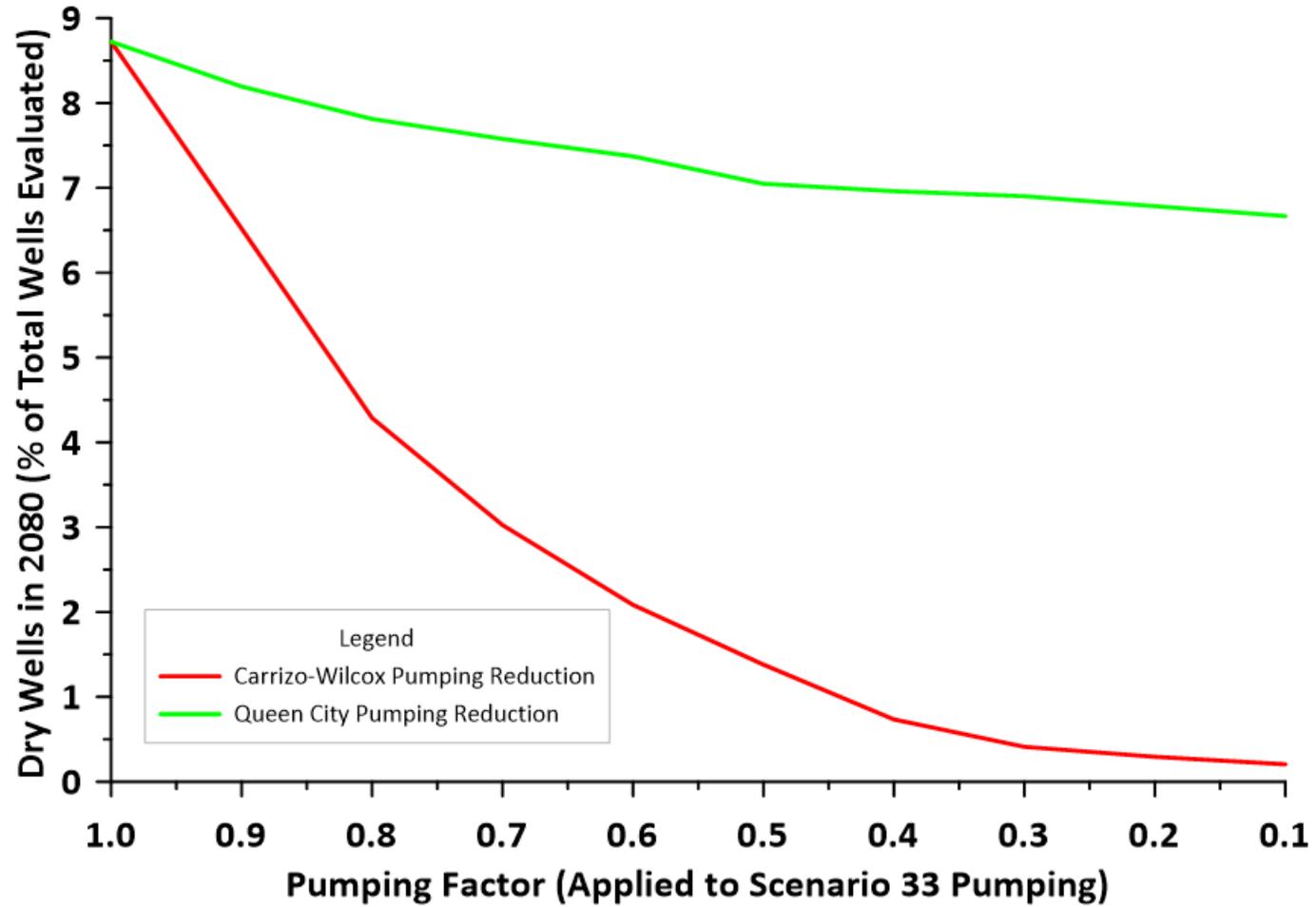
**GMA 11 Queen City Aquifer Wells
Dry Well % in 2080
Pumping Reductions Applied to Aquifers Individually**



**GMA 11 Queen City Aquifer Wells
Dry Well % in 2080
Pumping Reductions Applied to Aquifers Individually**

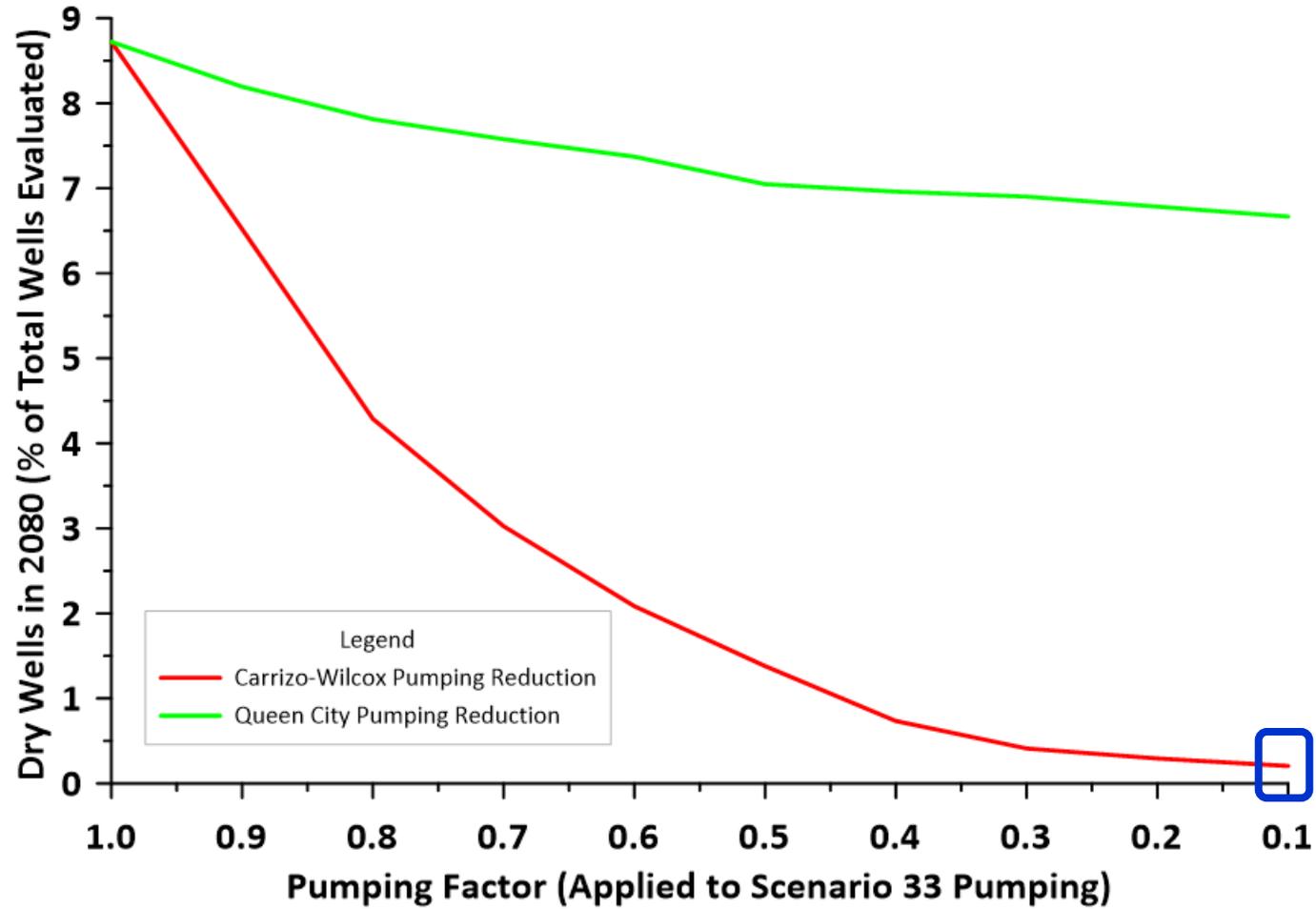


**GMA 11 Carrizo-Wilcox Aquifer Wells
Dry Well % in 2080
Pumping Reductions Applied to Aquifers Individually**



Note: Cell Pumping Minimum = 2013 Pumping

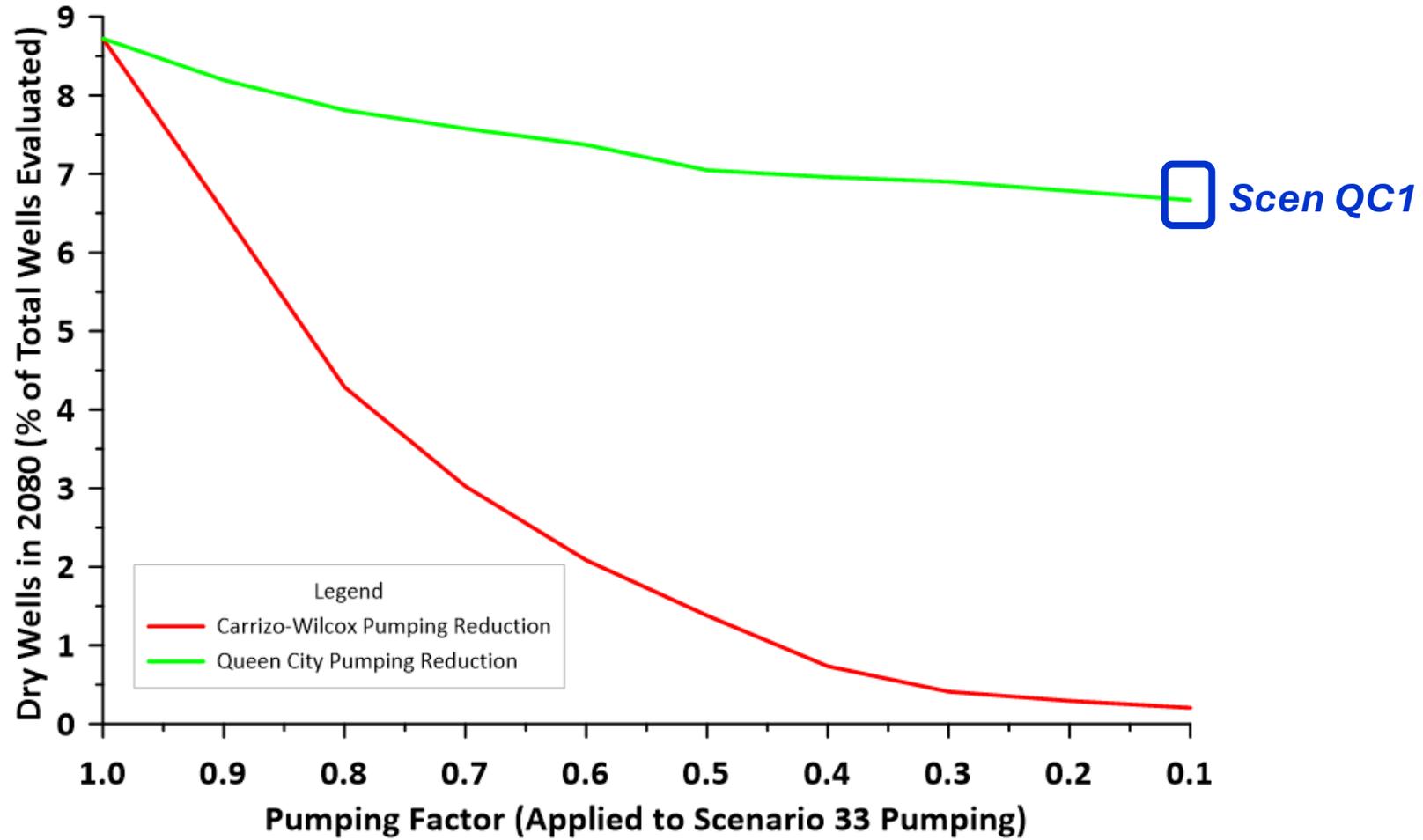
**GMA 11 Carrizo-Wilcox Aquifer Wells
Dry Well % in 2080
Pumping Reductions Applied to Aquifers Individually**



Scen CW1

Note: Cell Pumping Minimum = 2013 Pumping

**GMA 11 Carrizo-Wilcox Aquifer Wells
Dry Well % in 2080
Pumping Reductions Applied to Aquifers Individually**



Note: Cell Pumping Minimum = 2013 Pumping

Summary of CW and QC Scenarios

- Pumping reductions result in fewer dry wells
 - Reductions in Queen City pumping have the most benefit
- Vertical connection evident
 - Reductions in Queen City pumping results in fewer dry wells in Carrizo-Wilcox Aquifer
 - Reductions in Carrizo-Wilcox pumping results in fewer dry wells in Queen City Aquifer
- 90% reduction in Scenario 33 pumping in Queen City Aquifer still represents a large increase in historic pumping (2013 or 2023)

Scenario 26.1

- Developed based on first 20 simulations
 - CW and QC scenarios were “global” pumping reductions
 - Identified counties with more than 10% dry wells
- Identified targeted pumping reductions
 - Objective = no county with more than 10% dry wells (overall and Carrizo-Wilcox Aquifer)
 - Limiting dry wells to 10% is an example of avoiding an “undesirable impact”
- Pumping Comparisons by Aquifer
 - Baseline (2018 pumping)
 - Scen 33 (Current DFC/MAG)
 - Scen 26.1

Scenario 26.1 Pumping

Sparta Aquifer

County	Baseline (AF/yr)	Current MAG (Scen 33)		Scen 26.1	
		AF/yr	% of Baseline	AF/yr	% of Baseline
Anderson	39	307	787	307	787
Angelina	292	390	134	390	134
Cherokee	192	351	183	351	183
Houston	683	1,481	217	1,481	217
Nacogdoches	228	362	159	362	159
Sabine	47	49	104	49	104
San Augustine	20	166	830	166	830
Trinity	15	152	1,013	152	1,013
Total	1,516	3,258	215	3,258	215

Queen City Aquifer

County	Baseline (AF/yr)	Current MAG (Scen 33)		Scen 26.1	
		AF/yr	% of Baseline	AF/yr	% of Baseline
Anderson	626	16,580	2,649	1,727	276
Angelina	83	1,094	1,318	109	131
Camp	64	1,593	2,489	191	298
Cass	504	16,468	3,267	1,818	361
Cherokee	944	8,806	933	1,425	151
Gregg	204	2,510	1,230	328	161
Harrison	342	3,535	1,034	501	146
Henderson	652	10,663	1,635	1,220	187
Houston	188	2,294	1,220	340	181
Marion	147	7,384	5,023	781	531
Morris	116	3,276	2,824	355	306
Nacogdoches	282	2,944	1,044	298	106
Rusk	25	59	236	26	104
Smith	1,048	32,556	3,106	3,393	324
Upshur	1,238	12,156	982	1,673	135
Van Zandt	228	2,341	1,027	308	135
Wood	1,537	6,505	423	1,545	101
Total	8,228	130,764	1,589	16,038	195

Scenario 26.1 Pumping

Sparta Aquifer

County	Baseline (AF/yr)	Current MAG (Scen 33)		Scen 26.1	
		AF/yr	% of Baseline	AF/yr	% of Baseline
Anderson	39	307	787	307	787
Angelina	292	390	134	390	134
Cherokee	192	351	183	351	183
Houston	683	1,481	217	1,481	217
Nacogdoches	228	362	159	362	159
Sabine	47	49	104	49	104
San Augustine	20	166	830	166	830
Trinity	15	152	1,013	152	1,013
Total	1,516	3,258	215	3,258	215

Scen 26.1 Sparta Aquifer Pumping

- **No Change in Sparta Compared to Scen 33**
- **Small AF increase from baseline**
- **Large % increase from baseline**

Queen City Aquifer

County	Baseline (AF/yr)	Current MAG (Scen 33)		Scen 26.1	
		AF/yr	% of Baseline	AF/yr	% of Baseline
Anderson	626	16,580	2,649	1,727	276
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Scenario 26.1 Pumping

Sparta Aquifer

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Queen City Aquifer

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Van Zandt	228	2,341	1,027	308	135
Wood	1,537	6,505	423	1,545	101
Total	8,228	130,764	1,589	16,038	195

Scen 26.1 Queen City Aquifer Pumping

- Increase compared to baseline
- Large decrease compared Scen 33

Scenario 26.1 Pumping

Carrizo-Wilcox Aquifer

County	Baseline (AF/yr)	Current MAG (Sc en 33)		Scen 26.1	
		AF/yr	% of Baseline	AF/yr	% of Baseline
Anderson	4,689	27,006	576	7,500	160
Angelina	21,628	27,592	128	27,592	128
Bowie	2,712	9,638	355	9,638	355
Camp	1,142	3,859	338	3,859	338
Cass	2,306	13,633	591	8,500	369
Cherokee	8,231	15,231	185	9,500	115
Franklin	592	5,728	968	1,500	253
Gregg	2,789	6,068	218	6,068	218
Harrison	3,395	9,090	268	9,090	268
Henderson	6,579	7,217	110	7,217	110
Hopkins	2,605	4,749	182	3,500	134
Houston	831	2,354	283	2,354	283
Marion	1,133	1,965	173	1,965	173
Morris	1,106	2,569	232	1,500	136

County	Baseline (AF/yr)	Current MAG (Sc en 33)		Scen 26.1	
		AF/yr	% of Baseline	AF/yr	% of Baseline
Nacogdoches	13,661	20,845	153	20,845	153
Panola	2,645	4,996	189	4,996	189
Rains	682	1,410	207	682	100
Rusk	6,364	14,009	220	14,009	220
Sabine	721	1,387	192	1,387	192
San Augustine	700	587	84	587	84
Shelby	2,502	6,315	252	5,500	220
Smith	13,886	25,529	184	18,000	130
Titus	1,719	7,531	438	1,900	111
Trinity	28	267	954	100	357
Upshur	4,877	6,653	136	6,653	136
Van Zandt	4,458	6,927	155	5,000	112
Wood	5,071	17,890	353	10,000	197
Total	117,052	251,045	214	189,442	162

Scenario 26.1 Pumping – Counties with No Change from Current MAG

Carrizo-Wilcox Aquifer

County	Baseline (AF/yr)	Current MAG (Scen 33)		Scen 26.1	
		AF/yr	% of Baseline	AF/yr	% of Baseline
Anderson	4,689	27,006	576	7,500	160
Angelina	21,628	27,592	128	27,592	128
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Total	117,052	251,045	214	189,442	162

Scenario 26.1 Pumping – Counties with Reductions from Current MAG

Carrizo-Wilcox Aquifer

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		AF/yr	% of Baseline	AF/yr	% of Baseline
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Scenario 26.1 Results – Dry Well Analysis

- Results organized by:
 - Aquifer
 - County

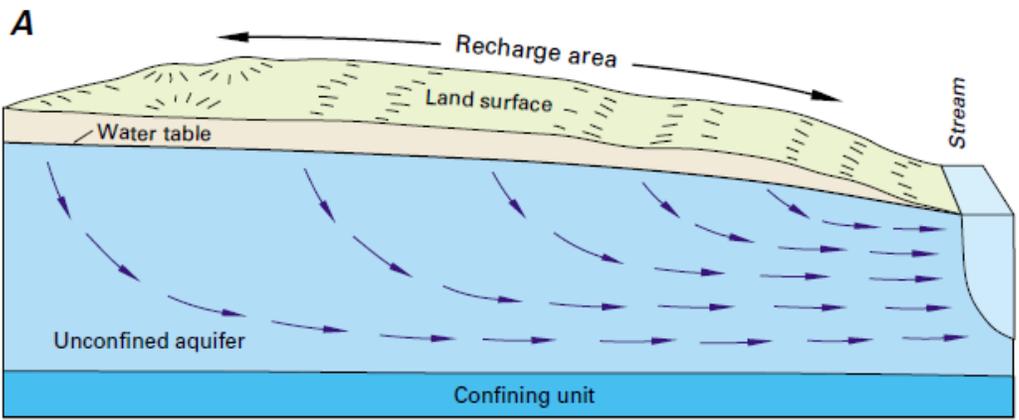
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All (including other formations)	4217	515	12.2	87	2.1

**Scenario 26.1
Results:
Dry Well Analysis
by County**

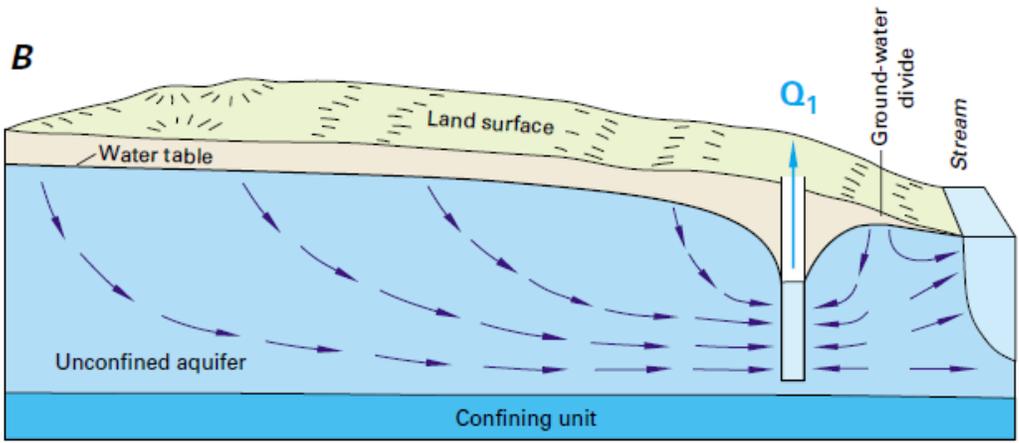
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Bowie	50	207	3	6.0	46	2	4.3	3	6.0	46	2	4.3
Camp	80	415	4	5.0	72	3	4.2	0	0.0	72	0	0.0
Cass	162	366	28	17.3	115	1	0.9	2	1.2	115	0	0.0
Cherokee	255	408	84	32.9	154	54	35.1	16	6.3	154	11	7.1
Franklin	40	343	10	25.0	40	10	25.0	0	0.0	40	0	0.0
Gregg	107	457	12	11.2	100	5	5.0	2	1.9	100	0	0.0
Harrison	188	255	11	5.9	169	5	3.0	4	2.1	169	4	2.4
Henderson	370	444	44	11.9	314	30	9.6	7	1.9	314	4	1.3
Hopkins	25	357	1	4.0	25	1	4.0	1	4.0	25	1	4.0
Houston	155	756	1	0.6	40	0	0.0	0	0.0	40	0	0.0
Marion	61	334	3	4.9	36	0	0.0	0	0.0	36	0	0.0
Morris	98	292	21	21.4	68	7	10.3	5	5.1	68	2	2.9
Nacogdoches	315	439	25	7.9	229	11	4.8	12	3.8	229	7	3.1
Panola	136	263	2	1.5	133	2	1.5	1	0.7	133	1	0.8
Rains	31	203	3	9.7	30	3	10.0	1	3.2	30	1	3.3
Rusk	428	448	39	9.1	415	38	9.2	13	3.0	415	12	2.9
Sabine	55	831	1	1.8	31	1	3.2	1	1.8	31	1	3.2
SanAugustine	65	543	0	0.0	29	0	0.0	0	0.0	29	0	0.0
Shelby	105	360	3	2.9	103	3	2.9	2	1.9	103	2	1.9
Smith	375	645	105	28.0	282	36	12.8	6	1.6	282	3	1.1
Titus	190	275	41	21.6	187	39	20.9	0	0.0	187	0	0.0
Trinity	3	518	0	0.0	0	0	0.0	0	0.0	0	0	0.0
Upshur	150	473	17	11.3	129	9	7.0	3	2.0	129	2	1.6
VanZandt	218	371	16	7.3	209	11	5.3	2	0.9	209	2	1.0
Wood	200	462	19	9.5	173	17	9.8	0	0.0	173	0	0.0

Scenario 26.1 - Surface Water Impacts

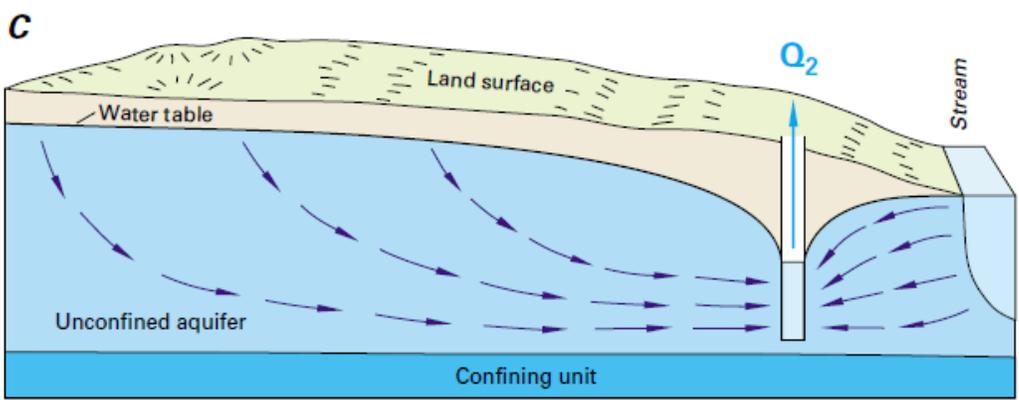
- Groundwater budget analysis for each scenario completed by river basin in GMA 11
 - Cypress
 - Neches
 - Sabine
 - Sulphur
 - Trinity
- Assess general character of streams in each basin (gaining or losing)
- Detailed results in Tech Memo 26-02
 - Summaries of surface water-groundwater interaction by basin presented today



No Pumping Condition

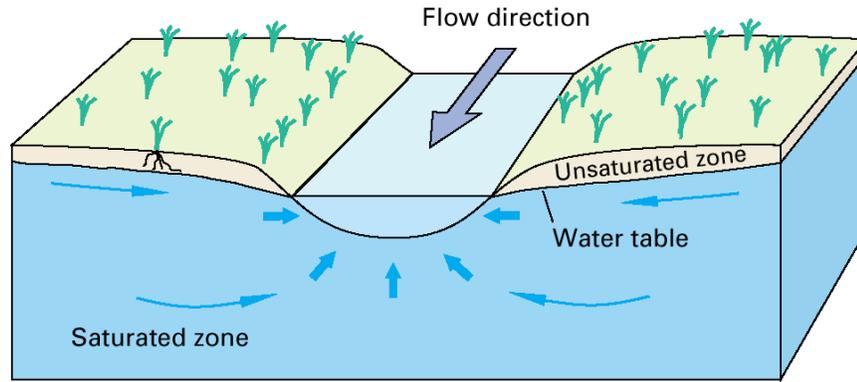


After Initial Pumping

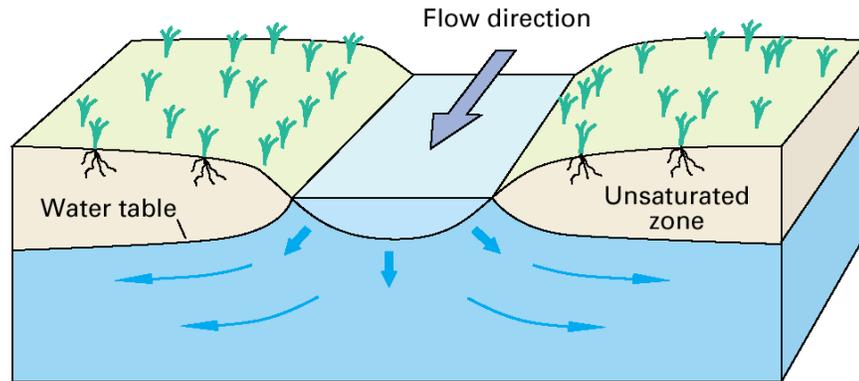


After Prolonged Pumping

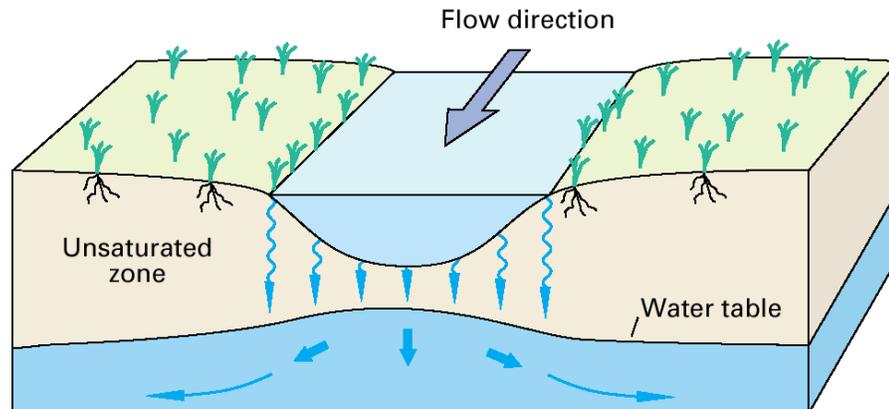
From Alley and others (1999)



Gaining Stream

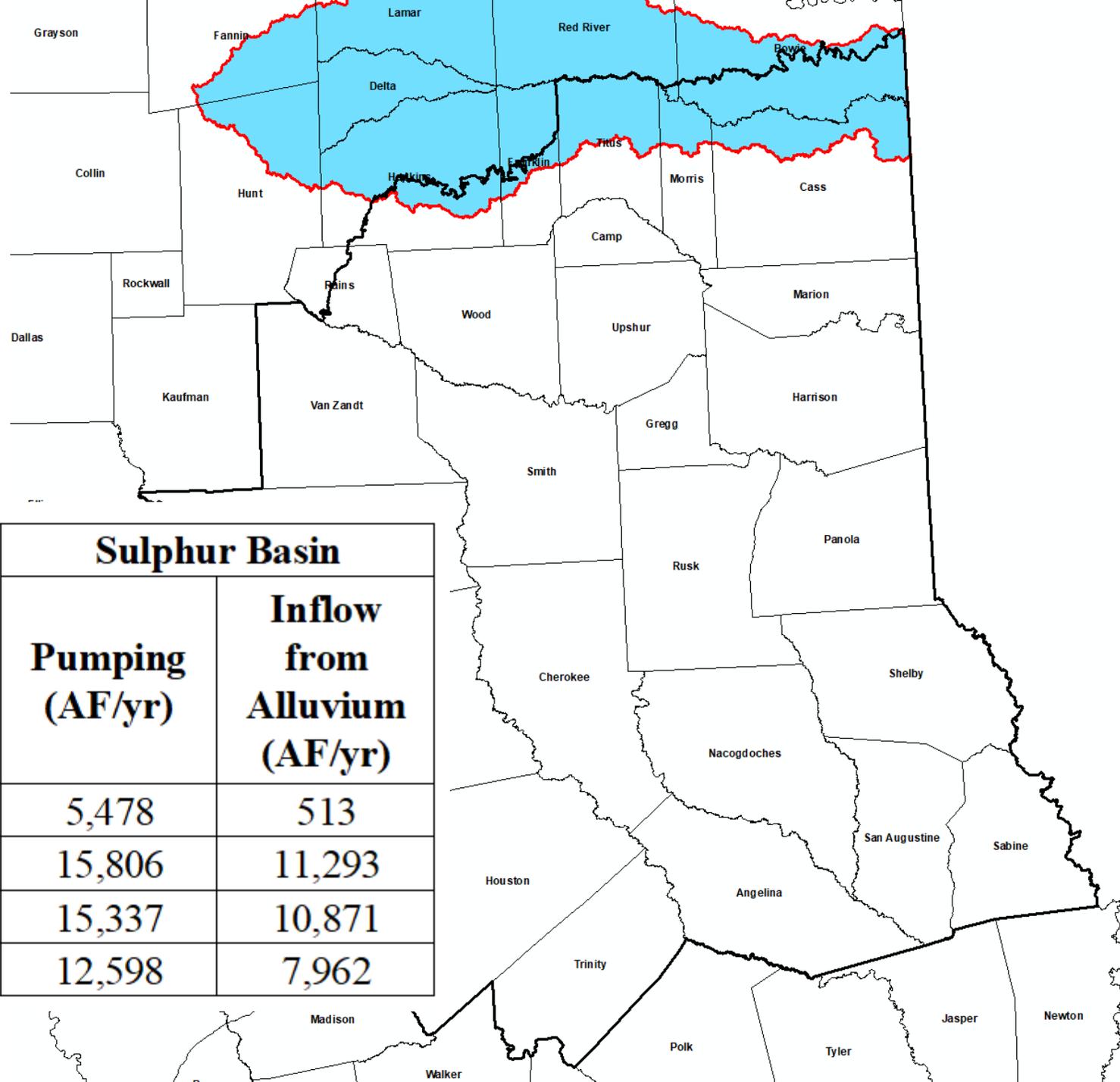


Losing Stream



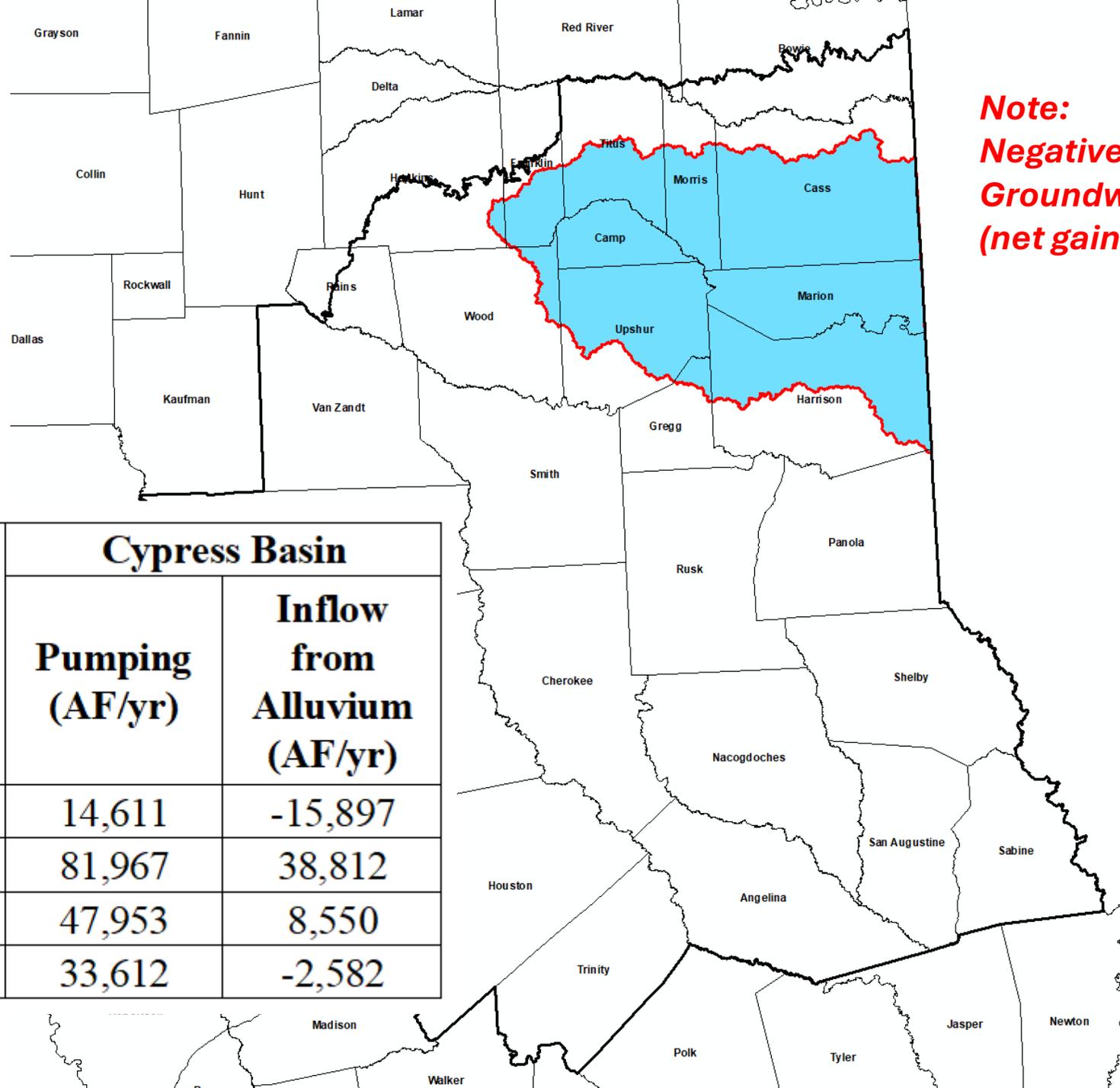
Disconnected Stream

Sulphur



Scenario	Sulphur Basin	
	Pumping (AF/yr)	Inflow from Alluvium (AF/yr)
Baseline	5,478	513
Scenario 33	15,806	11,293
Scenario QC1	15,337	10,871
Scenario 26.1	12,598	7,962

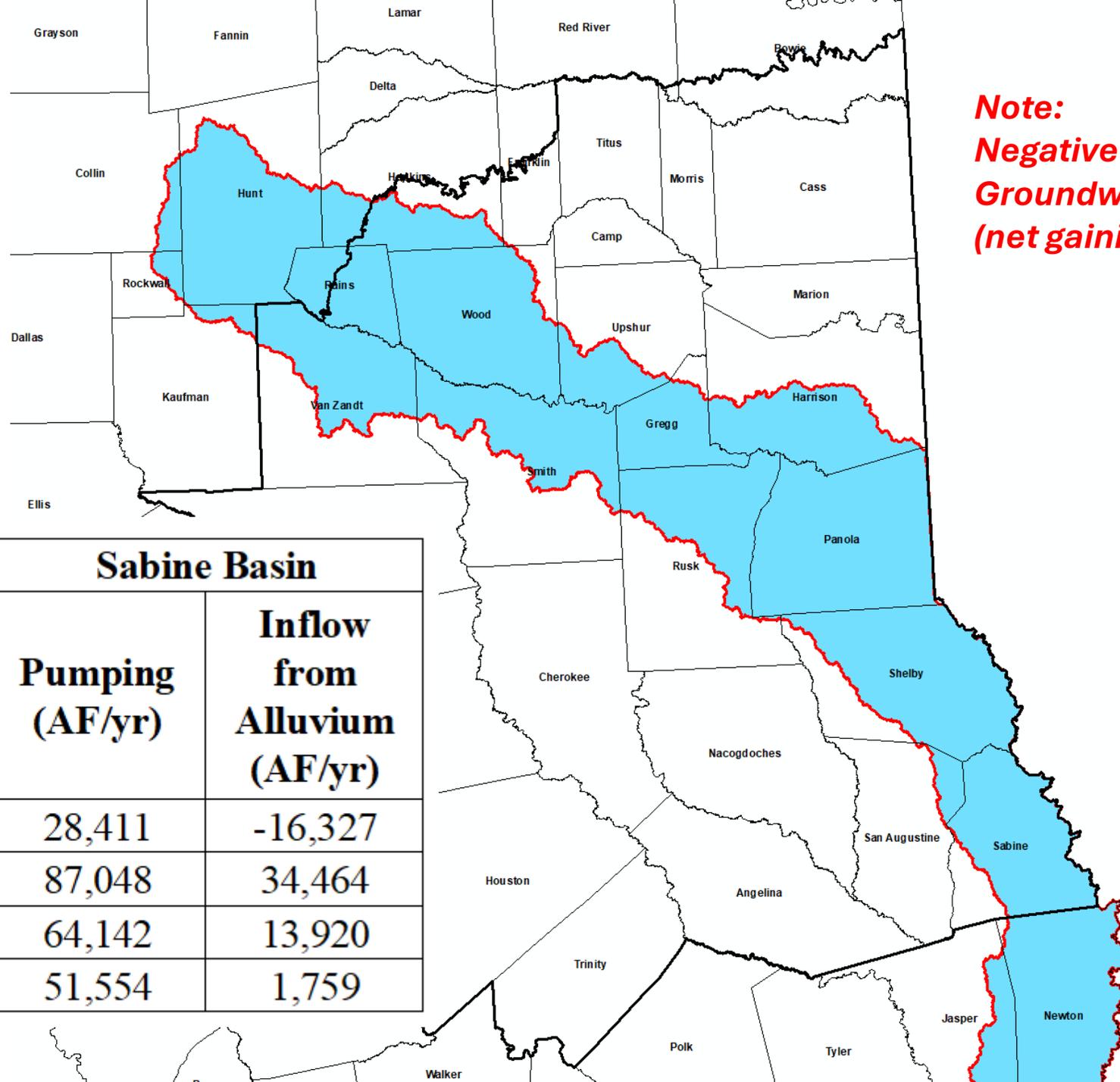
Cypress



Note:
*Negative Inflow from Alluvium =
 Groundwater flow into stream
 (net gaining stream condition)*

Scenario	Cypress Basin	
	Pumping (AF/yr)	Inflow from Alluvium (AF/yr)
Baseline	14,611	-15,897
Scenario 33	81,967	38,812
Scenario QC1	47,953	8,550
Scenario 26.1	33,612	-2,582

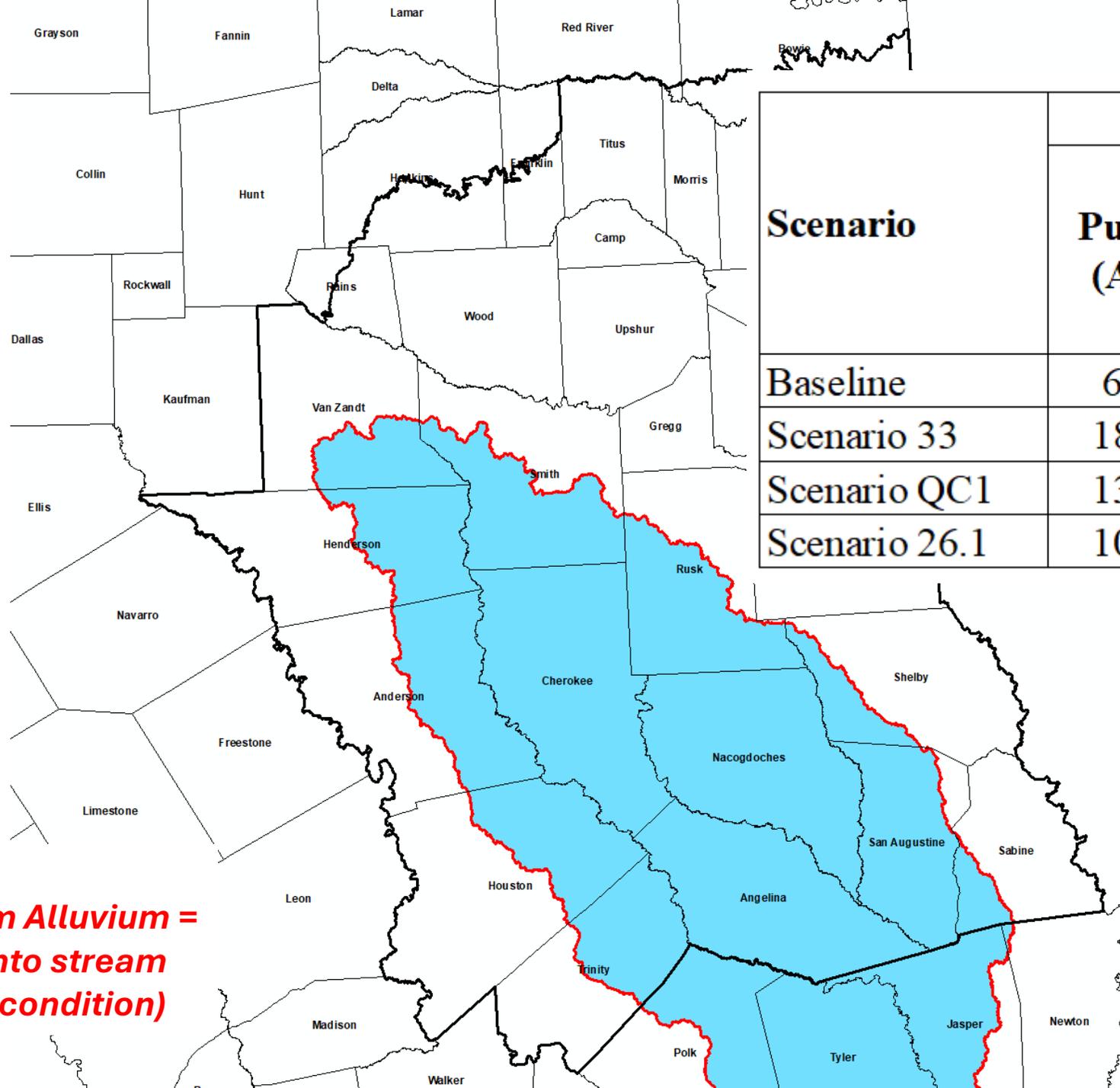
Sabine



Note:
*Negative Inflow from Alluvium =
 Groundwater flow into stream
 (net gaining stream condition)*

Scenario	Sabine Basin	
	Pumping (AF/yr)	Inflow from Alluvium (AF/yr)
Baseline	28,411	-16,327
Scenario 33	87,048	34,464
Scenario QC1	64,142	13,920
Scenario 26.1	51,554	1,759

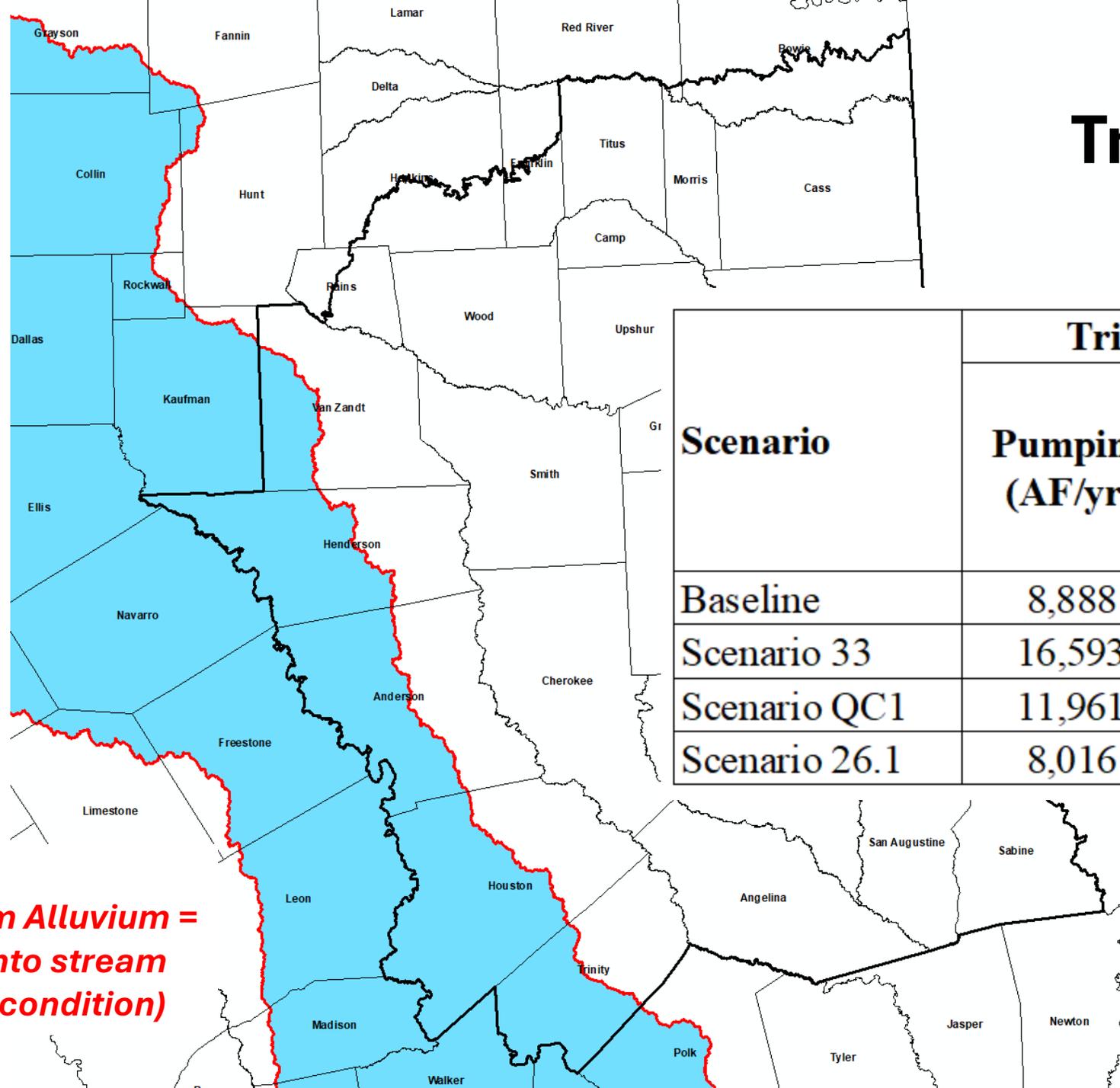
Neches



Scenario	Neches Basin	
	Pumping (AF/yr)	Inflow from Alluvium (AF/yr)
Baseline	69,405	-10,590
Scenario 33	183,651	58,852
Scenario QC1	130,962	17,050
Scenario 26.1	102,959	6,933

Note:
Negative Inflow from Alluvium =
Groundwater flow into stream
(net gaining stream condition)

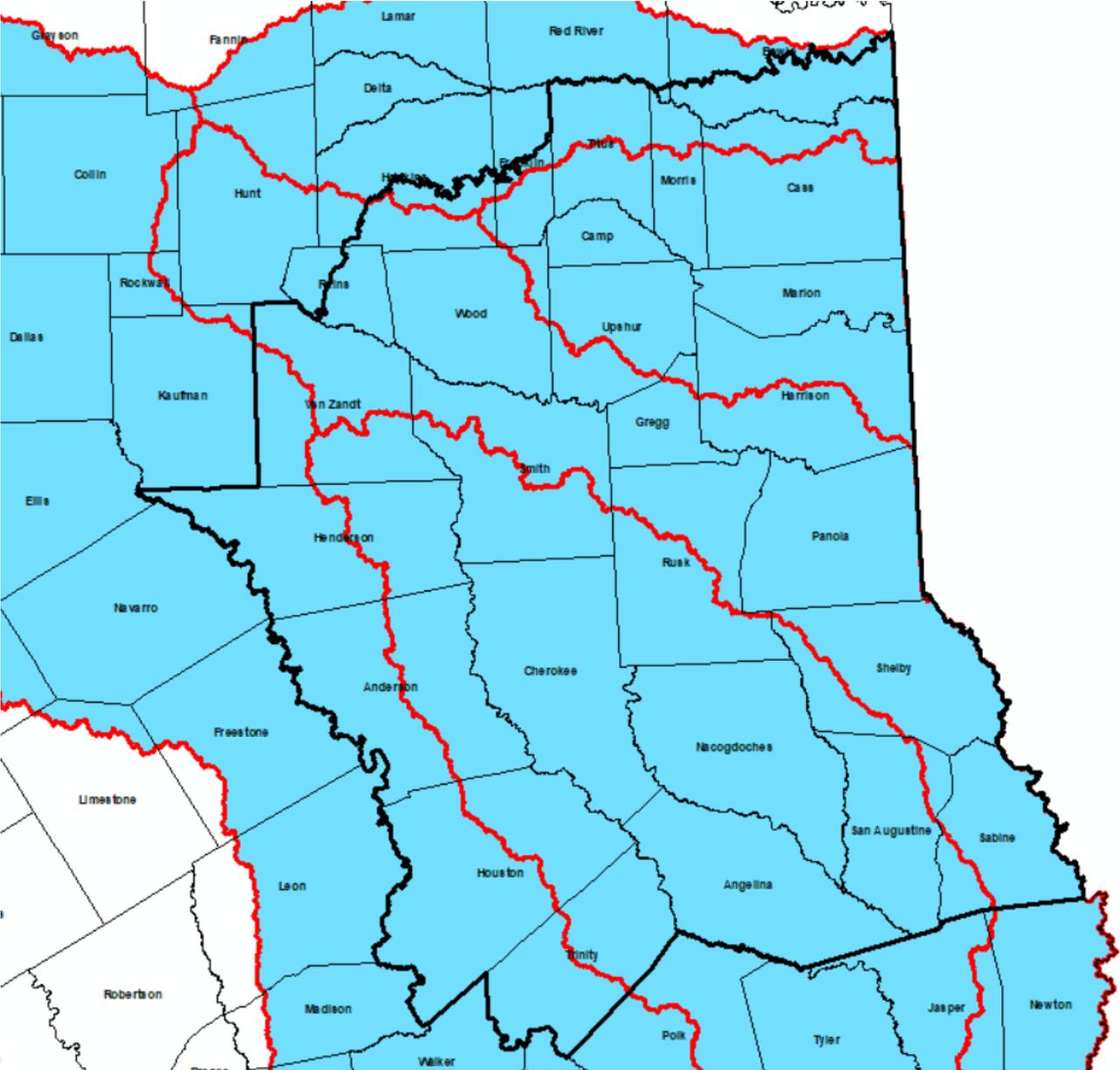
Trinity



Scenario	Trinity Basin	
	Pumping (AF/yr)	Inflow from Alluvium (AF/yr)
Baseline	8,888	-5,770
Scenario 33	16,593	5,386
Scenario QC1	11,961	2,276
Scenario 26.1	8,016	-4,212

Note:
Negative Inflow from Alluvium =
Groundwater flow into stream
(net gaining stream condition)

GMA 11



Scenario	Total GMA 11	
	Pumping (AF/yr)	Inflow from Alluvium (AF/yr)
Baseline	126,794	-48,071
Scenario 33	385,065	148,807
Scenario QC1	270,355	52,667
Scenario 26.1	208,739	9,860

Note:
Negative Inflow from Alluvium = Groundwater flow into stream (net gaining stream condition)

Basin Groundwater Budgets

- Pumping varies by basin
 - Basin pumping as a percentage of GMA 11 pumping (for each scenario)
 - Sulphur Basin: 4 to 6 percent
 - Cypress Basin: 12 to 21 percent
 - Sabine Basin: 22 to 25 percent
 - Neches Basin: 48 to 55 percent
 - Trinity Basin: 4 to 7 percent
- Quantified interbasin flow induced by increased pumping

Induced Interbasin Flow

- Discussed in more detail in Tech Memo 26-02
- Example: Neches Basin (highest pumping)

Scenario	Neches Basin		
	Pumping (AF/yr)	Inflow from Sabine (AF/yr)	Inflow from Trinity (AF/yr)
Baseline	69,405	4,156	4,731
Scenario 33	183,651	8,435	23,671
Scenario QC1	130,962	8,292	22,336
Scenario 26.1	102,959	5,638	11,765

Decadal Drawdowns - Scenario 26.1 (Required by HB 2078)

- GMA 11 has historically chosen to articulate DFCs as average drawdown by county and aquifer at end of period
 - DFC in 2021 used 2080 as the end of the planning period
- HB 2078 now requires to also include “intermediate” (decadal) values
- Comparison with current DFCs
 - Carrizo-Wilcox Aquifer

**Scenario 26.1 Average Drawdown (ft) by Decade
Queen City Aquifer (2013 Baseline)**

**Scenario 26.1 Average Drawdown (ft) by Decade
Sparta Aquifer (2013 Baseline)**

County	2030	2040	2050	2060	2070	2080
Anderson	6	6	6	6	6	6
Angelina	3	3	3	3	3	3
Cass	8	8	9	9	9	9
Cherokee	3	3	3	3	3	3
Houston	2	2	2	2	2	2
Marion	5	5	5	5	5	5
Nacogdoches	5	5	5	5	5	5
Rusk	18	20	22	22	23	23
Sabine	1	1	1	1	1	1
SanAugustine	2	2	2	2	2	2
Shelby	7	9	9	10	10	10
Smith	3	3	3	3	3	3
Trinity	3	3	3	3	3	3
Upshur	2	2	2	2	2	2
Wood	2	2	2	2	2	2

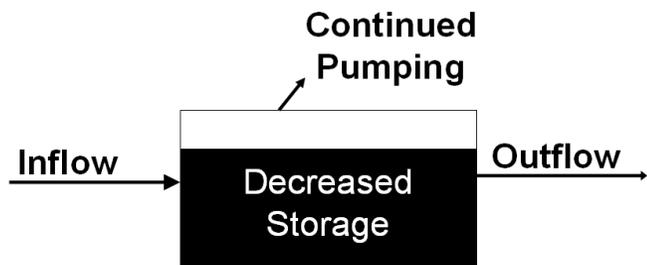
County	2030	2040	2050	2060	2070	2080
Anderson	4	4	4	4	4	4
Angelina	11	11	11	11	11	11
Camp	2	2	2	2	2	2
Cass	3	3	3	3	3	3
Cherokee	3	3	3	3	3	3
Gregg	6	7	7	7	7	8
Harrison	2	2	2	2	2	2
Henderson	2	3	3	3	3	3
Houston	3	3	3	3	3	3
Marion	4	4	4	4	4	4
Morris	5	5	5	5	5	5
Nacogdoches	8	8	8	8	8	8
Rusk	8	9	9	10	10	10
Sabine	3	3	3	3	3	3
SanAugustine	5	5	5	5	5	5
Shelby	6	6	7	7	7	7
Smith	4	5	5	5	5	5
Titus	1	1	1	1	1	1
Trinity	7	7	7	7	7	7
Upshur	5	5	5	5	5	5
VanZandt	2	2	2	2	2	2
Wood	2	2	2	2	2	2

**Scenario 26.1 Average Draw down (ft) by Decade
Carrizo-Wilcox Aquifer (2013 Baseline)**

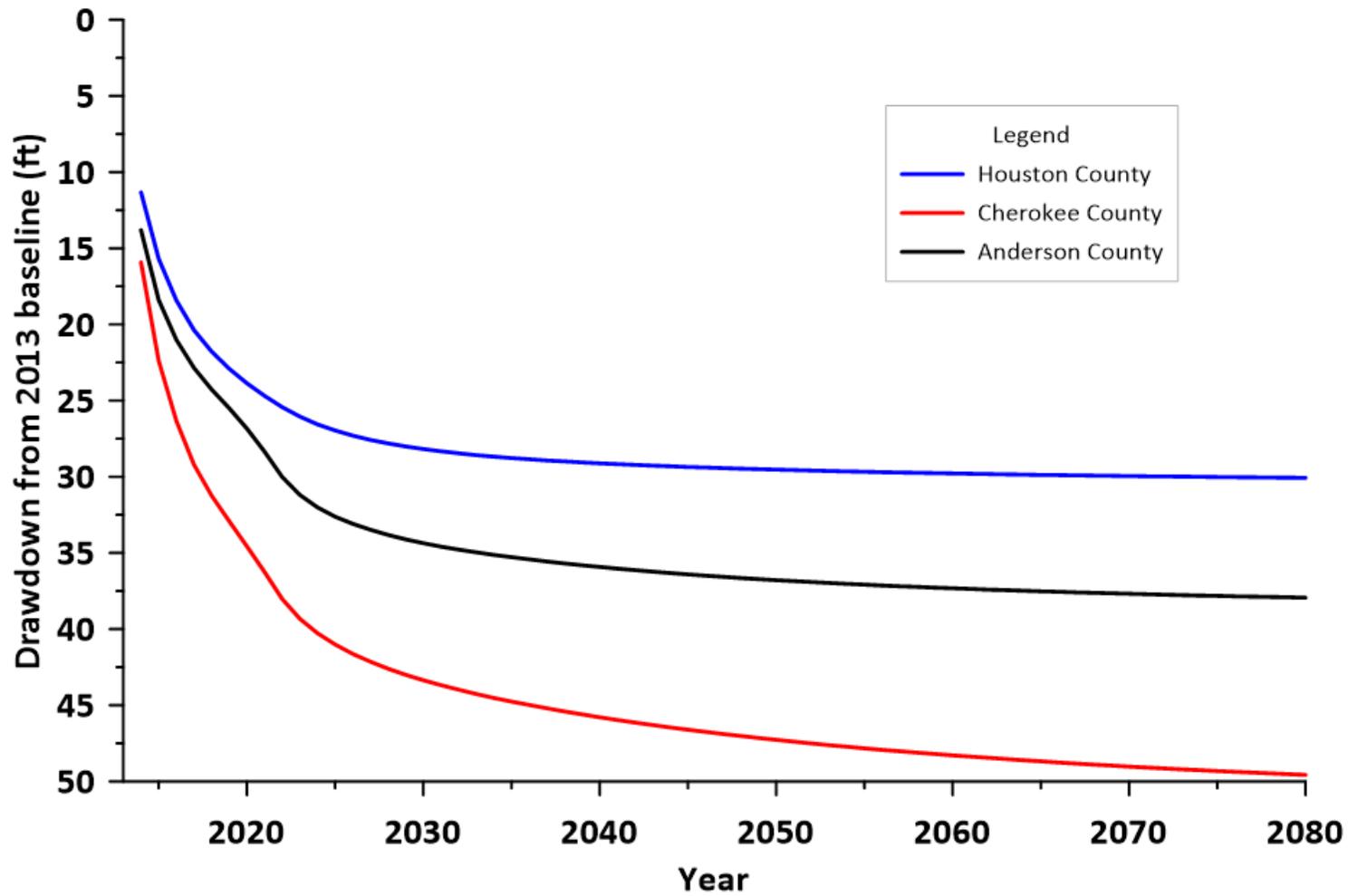
County	2030	2040	2050	2060	2070	2080
Anderson	34	36	37	37	38	38
Angelina	42	42	43	43	43	43
Bowie	12	13	13	13	13	13
Camp	32	34	36	37	37	37
Cass	41	41	41	42	42	42
Cherokee	43	46	47	48	49	50
Franklin	15	16	17	18	18	18
Gregg	44	47	49	51	51	52
Harrison	20	21	22	22	22	22
Henderson	31	34	36	37	38	39
Hopkins	12	13	14	15	15	15
Houston	28	29	30	30	30	30
Marion	23	24	24	24	24	24
Morris	25	26	26	26	26	26

County	2030	2040	2050	2060	2070	2080
Nacogdoches	47	49	49	50	50	50
Panola	20	21	21	21	21	21
Rains	2	2	3	3	3	3
Rusk	45	48	51	52	53	54
Sabine	8	8	8	8	8	8
San Augustine	17	17	17	17	17	17
Shelby	17	17	17	18	18	18
Smith	67	71	74	75	77	77
Titus	9	9	9	10	10	10
Trinity	26	27	27	27	27	27
Upshur	44	48	50	51	52	52
VanZandt	18	20	22	23	23	24
Wood	35	38	39	40	40	41

Average Drawdown in Carrizo-Wilcox Aquifer Anderson, Cherokee, and Houston Counties Scenario 26.1



New Equilibrium: Inflow = Outflow



***Carrizo-Wilcox Aquifer
Compare 2080 Drawdowns***

County	Average Drawdown (ft) 2013 to 2080		
	Current DFC	Scenario 33	Scenario 26.1
Anderson	155	180	38
Angelina	67	65	43
Bowie	12	18	13
Camp	85	100	37
Cass	79	92	42
Cherokee	176	177	50
Franklin	102	120	18
Gregg	109	116	52
Harrison	26	36	22
Henderson	106	155	39
Hopkins	61	80	15
Houston	86	83	30
Marion	32	53	24
Morris	78	95	26

County	Average Drawdown (ft) 2013 to 2080		
	Current DFC	Scenario 33	Scenario 26.1
Nacogdoches	73	80	50
Panola	21	26	21
Rains	17	25	3
Rusk	86	96	54
Sabine	9	10	8
SanAugustine	22	24	17
Shelby	17	25	18
Smith	265	263	77
Titus	66	87	10
Trinity	56	54	27
Upshur	149	144	52
VanZandt	55	89	24
Wood	122	161	41

Notes:

Current DFC values are from original GAM and not area weighted averages

Scen 26.1 and Scen 33 is based the updated model and are area weighted averages

Joint Planning and GAM Accuracy (Anticipated Comments)

- “The GAM is inaccurate and cannot be used to make these type of decisions”
 - All model can be improved
 - Recommendations will be made to improve current model in explanatory report
 - TWDB has historically been receptive to updating models in response to GMA comments
 - Joint planning extends to 2080, but updated every five years
 - An improved model will better inform 2031 joint planning cycle
 - Increased public participation will improve defining “unacceptable impacts”
 - Joint planning is an example of “Adaptive Management”
 - Incorporates new data and models into decision-making

Next Steps (1)

- GMA 11 decides on proposed DFC
 - Could choose one of the scenarios presented to advance as basis for proposed DFC:
 - Baseline
 - Scenario 33 (basis for 2021 DFC)
 - Scenario QC1
 - Scenario 26.1
 - Could direct me to develop a different scenario (further adjustments to pumping to achieve some objective)
 - Examples of objectives:
 - More pumping in a particular county
 - Relax dry well standard of Scenario 26.1 (10%) resulting in higher pumping
- If an existing scenario is chosen (e.g. Scenario 26.1):
 - I will prepare draft Explanatory Report
 - Draft available before next meeting
 - GMA 11 would vote on a proposed DFC at next meeting

Next Steps (2)

- If requested to develop a new scenario
 - Make requested adjustments
 - Prepare new draft Tech Memo documenting scenario results
 - Budget increase = \$6,000
 - Decide whether to meet to approve advancing new scenario to be basis for proposed DFC
 - Additional meeting would require a budget increase of \$1,500
 - Prepare a draft Explanatory Report
 - GMA 11 would vote on a proposed DFC prior to May 1, 2026

Budget and Invoicing Update

GMA 11 Support Task List and Invoicing Schedule

William R. Hutchison, Ph.D, P.E., P.G.

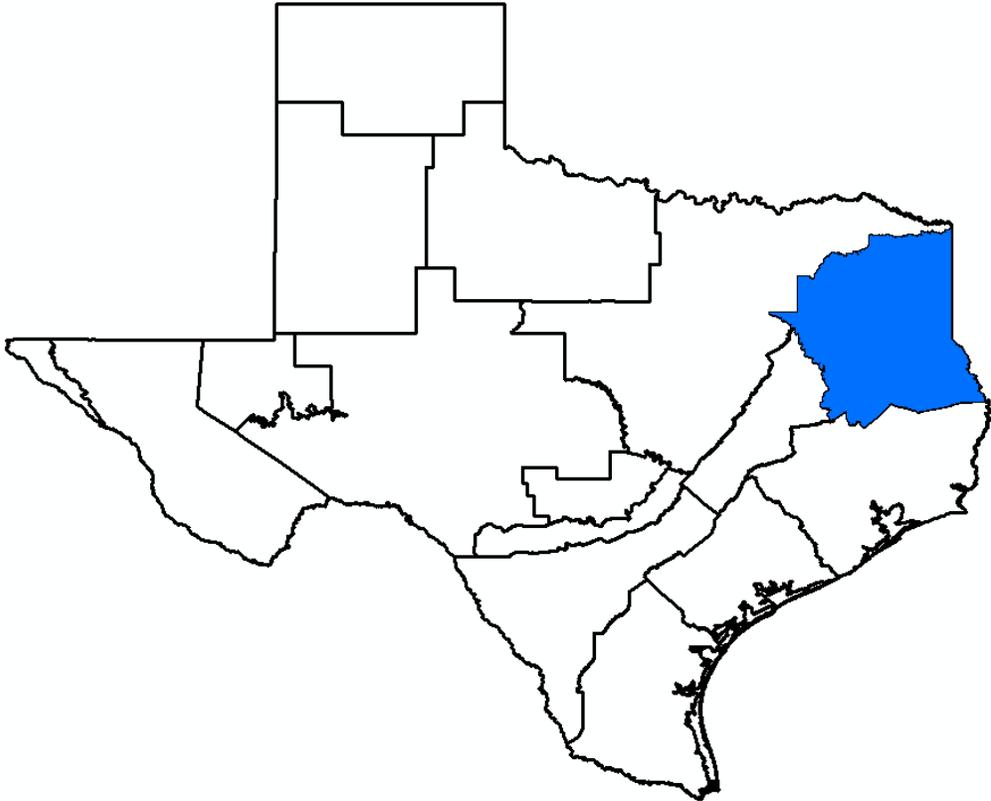
Invoice 3 (March 11, 2026)

Task No.	Task	Number	Unit Cost	Total Budget	Past Invoice Amount	Current Invoice Amount	Remaining Budget	Invoice Date
1	Meetings	5	\$1,500	\$7,500	\$3,000	\$1,500	\$3,000	3 of 5
2	DFC Compare	1	\$6,500	\$6,500	\$6,500	\$0	\$0	5/16/2024
3	Factor Evaluation	1	\$6,000	\$6,000	\$6,000	\$0	\$0	10/15/2025
4	GAM Simulation and Tech Memo	1	\$12,000	\$12,000	\$0	\$12,000	\$0	3/11/2026
5	Draft Explanatory Report and Not Relevant Documentation	1	\$8,000	\$8,000	\$0	\$0	\$8,000	
6	Respond to Public Comments and Revise Explanatory Report	1	\$5,000	\$5,000	\$0	\$0	\$5,000	
7	Prepare Final Explanatory Report and Submit	1	\$5,000	\$5,000	\$0	\$0	\$5,000	
Total				\$50,000	\$15,500	\$13,500	\$21,000	
Individual District Share				\$12,500	\$3,875	\$3,375	\$5,250	

Assumes Lump Sum Invoicing at Completion of Task (Except Task 1 - invoiced after each meeting)

Assumed individual invoices for each GCD (1/4 of total)

Resolution to Submit Minor Update of GAM to TWDB (Agenda Item 7)



William R. Hutchison, Ph.D., P.E., P.G.
GMA 11 Meeting
March 10, 2026

Specific Yield Issues

- Specific yield values in model needed to be modified
- Issue was known in 2021 and 2022
 - Analyses completed at the time (for the GMA 13 GAM update) demonstrated that these updates would not significantly affect results
- Issue was discussed during a meeting with TWDB and TRA on December 15, 2025
- Documentation in Technical Memorandum 26-01
- In summary:
 - Alluvium = 0.1 (updated)
 - Bedrock Aquifers = 7.14 E-04 (unchanged)
- No significant change in calibration statistics
- Summary comparison of dry well analysis presented at GMA 11 meeting of October 14, 2025

Statistic	Sparta Aquifer		Queen City Aquifer		Carrizo-Wilcox Aquifer	
	Panday and others (2020)	Proposed Updated	Panday and others (2020)	Proposed Updated	Panday and others (2020)	Proposed Updated
Residual Mean	324.48	324.48	375.75	375.75	280.75	280.75
Absolute Residual Mean	31.10	31.05	46.04	45.98	72.47	72.29
Residual Standard Deviation	119.71	119.71	90.79	90.79	127.55	127.55
Sum of Squared Residuals	770,564	768,750	7,567,230	7,543,916	108,574,003	107,662,997
Root Mean Square Error	42.09	42.04	64.89	64.79	103.42	102.99
Minimum Residual	157.19	157.19	45.00	45.00	-377.00	-377.00
Maximum Residual	543.44	543.44	615.40	615.40	615.40	615.40
Number of Observations	435	435	1,797	1,797	10,151	10,151
Range in Observations	979.00	979.00	611.00	611.00	2,233.00	2,233.00
Scaled Residual Standard Deviation	0.1223	0.1223	0.1486	0.1486	0.0571	0.0571
Scaled Absolute Residual Mean	0.0318	0.0317	0.0754	0.0752	0.0325	0.0324
Scaled Root Mean Square Error	0.0430	0.0429	0.1062	0.1060	0.0463	0.0461
Scaled Residual Mean	0.3314	0.3314	0.6150	0.6150	0.1257	0.1257

Statistic	Sparta Aquifer		Queen City Aquifer		Carrizo-Wilcox Aquifer	
	Panday and others (2020)	Proposed Updated	Panday and others (2020)	Proposed Updated	Panday and others (2020)	Proposed Updated
Residual Mean	324.48	324.48	375.75	375.75	280.75	280.75
Absolute Residual Mean	31.10	31.05	46.04	45.98	72.47	72.29
Residual Standard Deviation	119.71	119.71	90.79	90.79	127.55	127.55
Sum of Squared Residuals	770,564	768,750	7,567,230	7,543,916	108,574,003	107,662,997
Root Mean Square Error	42.09	42.04	64.89	64.79	103.42	102.99
Minimum Residual	157.19	157.19	45.00	45.00	-377.00	-377.00
Maximum Residual	543.44	543.44	615.40	615.40	615.40	615.40
Number of Observations	435	435	1,797	1,797	10,151	10,151
Range in Observations	979.00	979.00	611.00	611.00	2,233.00	2,233.00
Scaled Residual Standard Deviation	0.1223	0.1223	0.1486	0.1486	0.0571	0.0571
Scaled Absolute Residual Mean	0.0318	0.0317	0.0754	0.0752	0.0325	0.0324
Scaled Root Mean Square Error	0.0430	0.0429	0.1062	0.1060	0.0463	0.0461
Scaled Residual Mean	0.3314	0.3314	0.6150	0.6150	0.1257	0.1257

TWDB Standard < 0.10

Comparison of Dry Well Analysis with Updated Specific Yield Values in GAM

Aquifer	Well Count	Original Scenario 33 (Basis for DFC)		Updated Scenario 33 (Adjusted Specific Yield Values)	
		Dry Wells in 2080 (Count)	Dry Wells in 2080 (% of Well Count)	Dry Wells in 2080 (Count)	Dry Wells in 2080 (% of Well Count)
Sparta	155	7	5	7	5
Queen City	288	139	48	133	46
Carrizo-Wilcox	3405	340	10	297	9
All	4217	568	13	515	12