

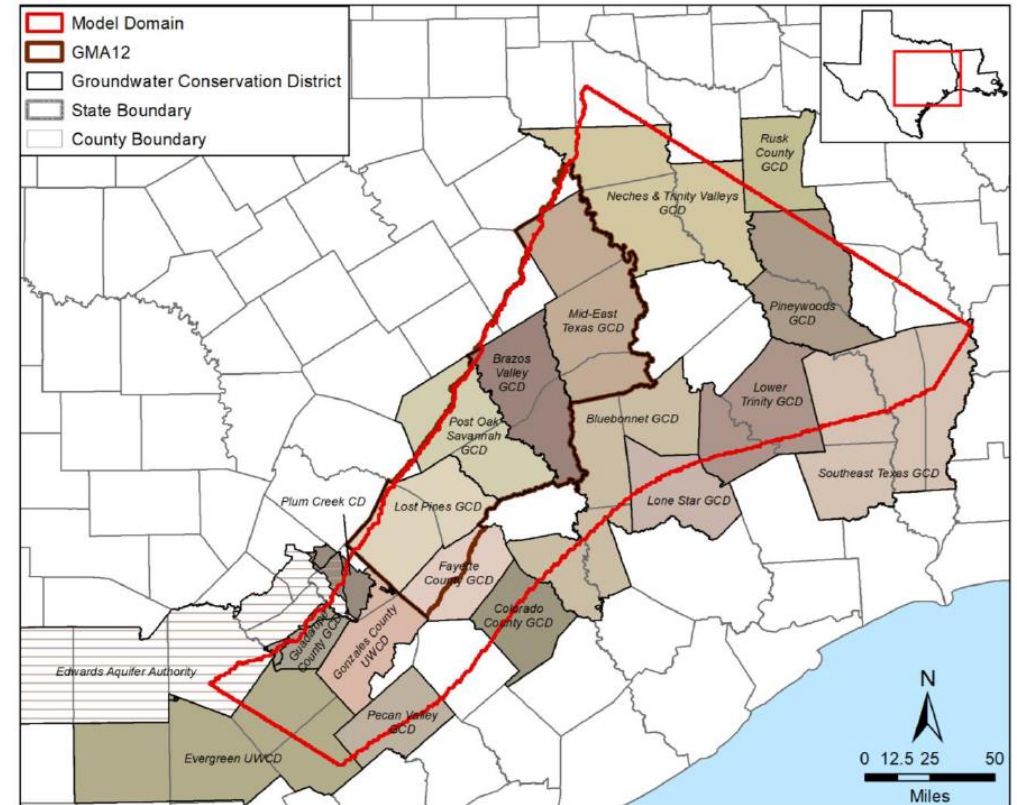
PS4-2mod: Draft Final Results

Presented to GMA-12
April 16, 2026

Gretchen Miller, Ph.D., P.E., P.G.

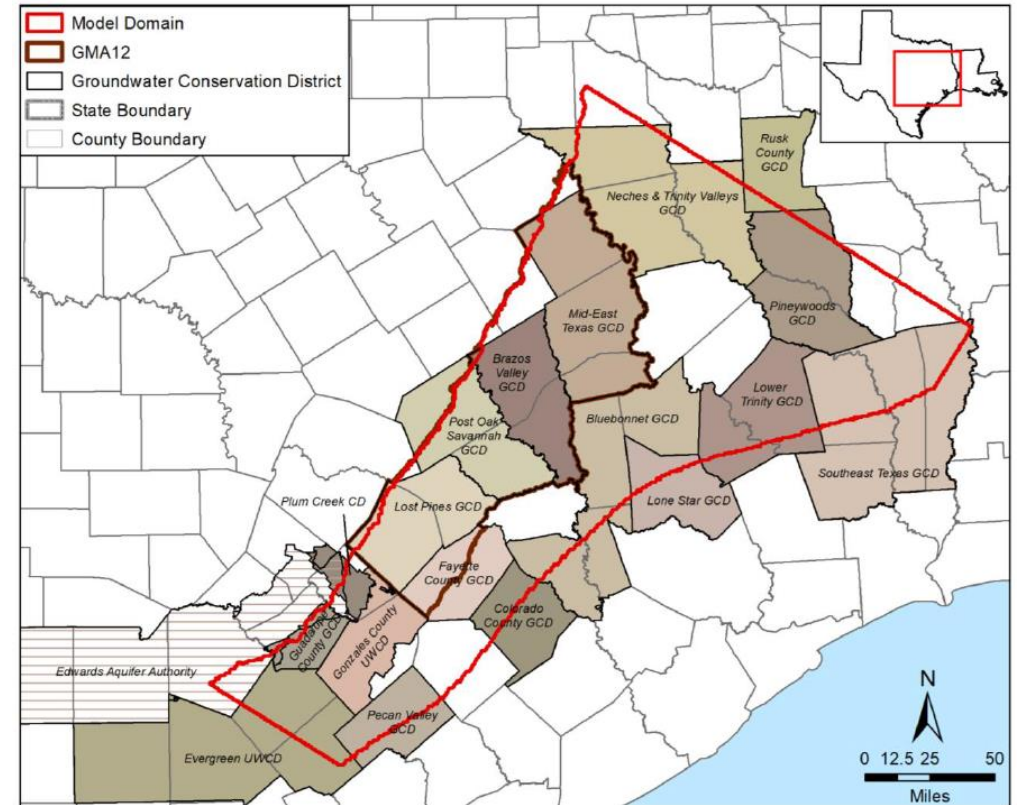
GMA-12 Modeling

- PS4-2: Realistic Scenario
 - Districts provide best estimates as to future pumping based on existing permits
 - BVGCD, LPGCD, POSGCD, provided major updates
 - FCGCD maintained PS3-19
 - METGCD provided minor updates



GMA-12 Modeling

- **PS4-2 and PS4-2 File Versions:**
 - V2 – Presented in April 2025
 - V3 to V6 – Internal tests and compilations, not presented
 - V7 – Presented March 17, 2026
 - V8 – This version (April 16, 2025)
 - Corrects issue with distribution of GMA-13 pumping between Calvert Bluff and Carrizo layers
- **Recommend PS4-2_v8.wel as final well file for PS4-2mod simulations**



Total pumping same as March 17 presentation

Pumping (afy) in 2079

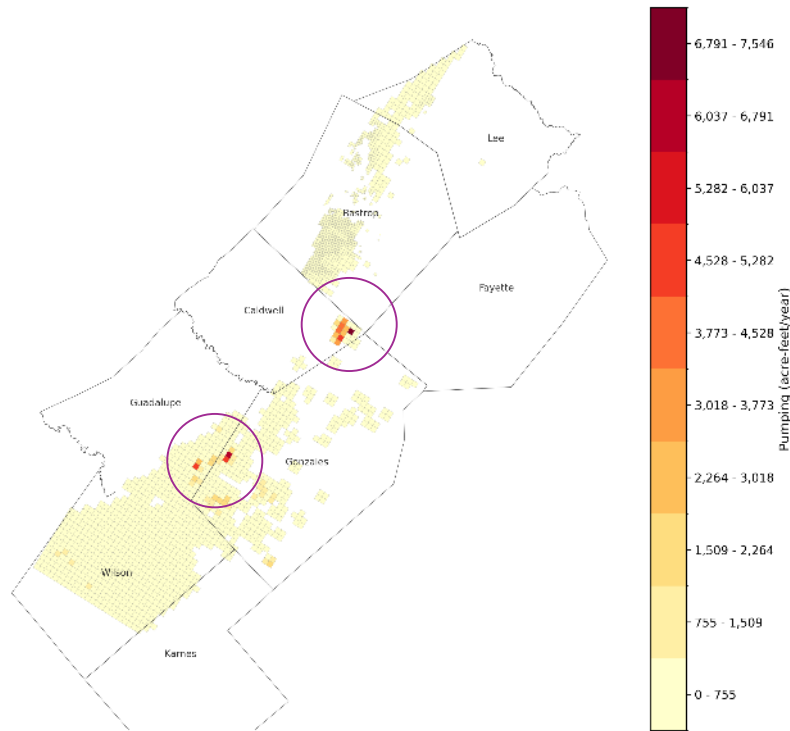
	Aquifer	Alluvium	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
BVGCD	PS3-19	60,059	13,152	1,268	5,495	1,724	147,145	2,137
	PS4-2	60,059	13,151	1,268	5,495	1,724	190,150	2,137
	PS4-2 Modified	60,059	13,152	1,268	5,495	1,724	190,150	2,137
LPGCD	PS3-19	200	2,764	1,773	12,973	5,560	81,815	3,275
	PS4-2	932	3,200	1,841	12,358	3,780	53,194	2,255
	PS4-2 Modified	932	3,200	1,841	12,358	3,780	53,194	2,251
METGCD	PS3-19	-	3,380	1,615	10,522	4,218	6,865	5,248
	PS4-2	-	3,380	1,615	10,522	4,218	6,865	5,248
	PS4-2 Modified	-	4,302	2,133	4,243	6,436	4,297	4,950
POSGCD	PS3-19	35,806	4,102	7,833	18,194	4,758	79,379	3,124
	PS4-2	35,806	5,474	1,241	15,169	2,337	95,166	1,763
	PS4-2 Modified	35,806	5,474	1,241	15,169	2,337	95,166	1,763
FCGCD	PS3-19	-	2,851	2,811	5,152	-	-	-
	PS4-2	-	2,851	2,811	5,152	-	-	-
	PS4-2 Modified	-	2,851	2,811	5,152	-	-	-

GMA-13 pumping total unchanged, distribution altered

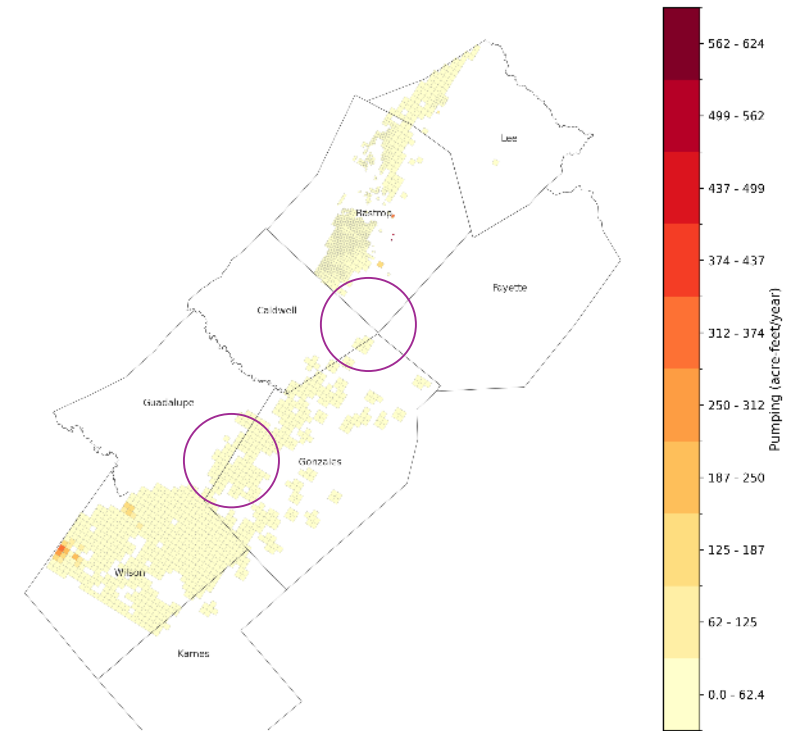
PS4-2_v7.wel (March 17)

PS4-2_v8.wel (April 2)

8 - Calvert Bluff Pumping in 2080



8 - Calvert Bluff Pumping in 2080

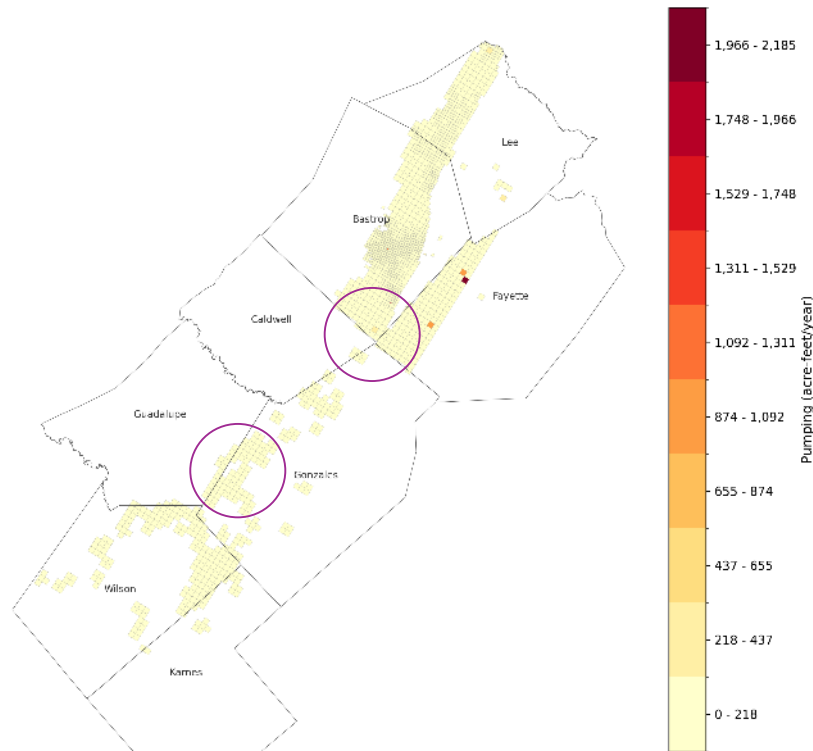


GMA-13 pumping total unchanged, distribution altered

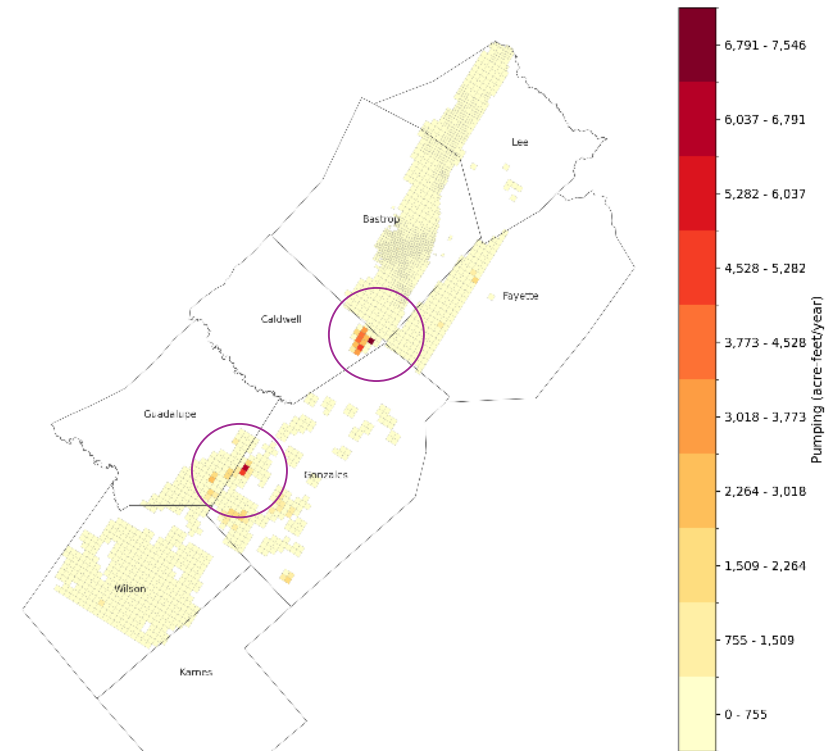
PS4-2_v7 (March 17)

PS4-2_v8 (April 2)

7 - Carrizo Pumping in 2080



7 - Carrizo Pumping in 2080



Drawdown based on PS4-2_v7.wel

Layer		BVGCD	FCGCD	LPGCD	METGCD	POSGCD
3	Sparta	56	52	21	22	46
5	Queen City	45	84	30	19	30
7	Carrizo	82	142	130	45	169
8	Calvert Bluff	118	232	151	58	189
9	Simsboro	283	312	269	85	370
10	Hooper	191	216	166	76	238

Drawdown = $WL_{31Dec80} - WL_{01Jan11}$ (ft)

Grid file: czwx_v3_02_MFUSG_ModelGrid121823.intera.csv

DD Calculation Code: Spheros Python Script

Drawdown based on PS4-2_v8.wel

Layer		BVGCD	FCGCD	LPGCD	METGCD	POSGCD
3	Sparta	57	57	22	22	46
5	Queen City	46	96	31	19	30
7	Carrizo	83	173	139	45	170
8	Calvert Bluff	119	184	141	58	189
9	Simsboro	283	276	261	85	369
10	Hooper	190	182	157	76	236

Drawdown = $WL_{31Dec80} - WL_{01Jan11}$ (ft)

Grid file: czwx_v3_02_MFUSG_ModelGrid121823.intera.csv

DD Calculation Code: Spheros Python Script

Difference between v7 and v8 .wel files

Layer		BVGCD	FCGCD	LPGCD	METGCD	POSGCD
3	Sparta	-0.9	-4.5	-0.5	-0.2	0.0
5	Queen City	-1.3	-11.8	-1.4	0.1	0.0
7	Carrizo	-1.3	-31.3	-8.7	-0.1	-1.3
8	Calvert Bluff	-0.5	NR	9.9	-0.2	0.1
9	Simsboro	0.3	NR	7.7	0.3	1.0
10	Hooper	0.8	NR	8.8	-0.1	1.6

Difference = v7 – v8

Drawdown = $WL_{31Dec80} - WL_{01Jan11}$ (ft)

Grid file: czwx_v3_02_MFUSG_ModelGrid121823.intera.csv

DD Calculation Code: Spheros Python Script

LPGCD Water Balance 2080 (PS4-2_v7.wel)

Layer		Lateral Flow			Recharge	Surface Water	Pumping	Storage	GHB	Vertical Flow
		POSGCD	FCGCD	BVGCD/ METGCD						
3	Sparta	-4	-2,721	0	12,364	-1,142	-3,153	1,606	-2,272	-4,870
5	Queen City	834	-4,872	0	11,597	-1,049	-1,837	5,283	0	-6,931
7	Carrizo	-7,013	-4,448	0	9,235	4,827	-12,356	9,473	0	-3,164
8	Calvert Bluff	-662	-378	0	22,596	2,850	-3,780	12,393	0	-27,321
9	Simsboro	-17,837	-2,456	0	6,394	7,749	-53,194	5,747	0	54,011
10	Hooper	745	-989	0	7,248	162	-2,255	873	0	-7,760

Values in acre-feet per year
 Positive = Into Aquifer
 Negative = Out of Aquifer

LPGCD Water Balance 2080 (PS4-2_v8.wel)

Layer		Lateral Flow			Recharge	Surface Water	Pumping	Storage	GHB	Vertical Flow
		POSGCD	FCGCD	BVGCD/ METGCD						
3	Sparta	-3	-2,799	0	12,364	-1,014	-3,153	1,720	-2,230	-5,192
5	Queen City	836	-5,464	0	11,597	-1,018	-1,837	6,140	0	-7,389
7	Carrizo	-6,958	-4,498	0	9,235	4,798	-12,356	11,598	0	4,112
8	Calvert Bluff	-656	-647	0	22,596	1,843	-3,780	10,617	0	-32,701
9	Simsboro	-18,055	-1,951	0	6,394	7,448	-53,194	5,700	0	53,628
10	Hooper	711	-824	0	7,248	95	-2,255	833	0	-8,159

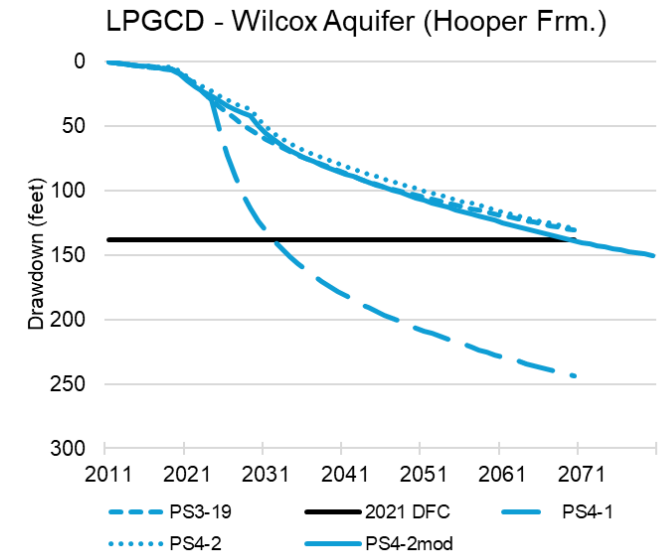
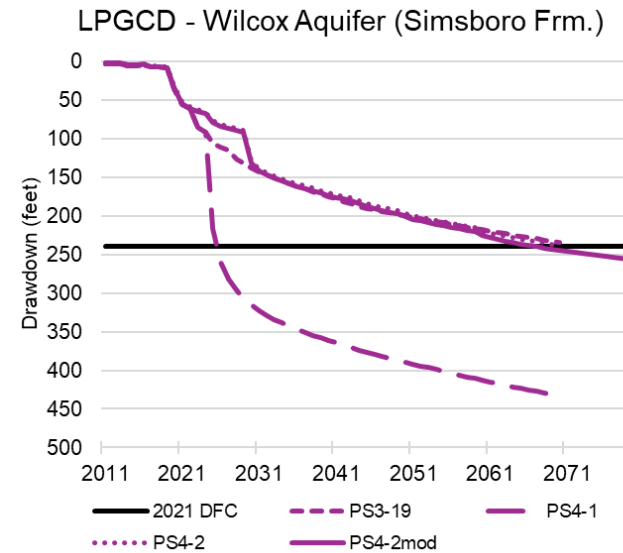
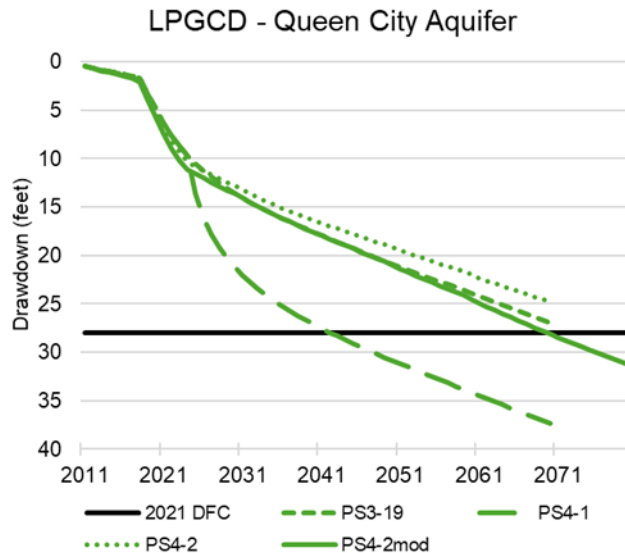
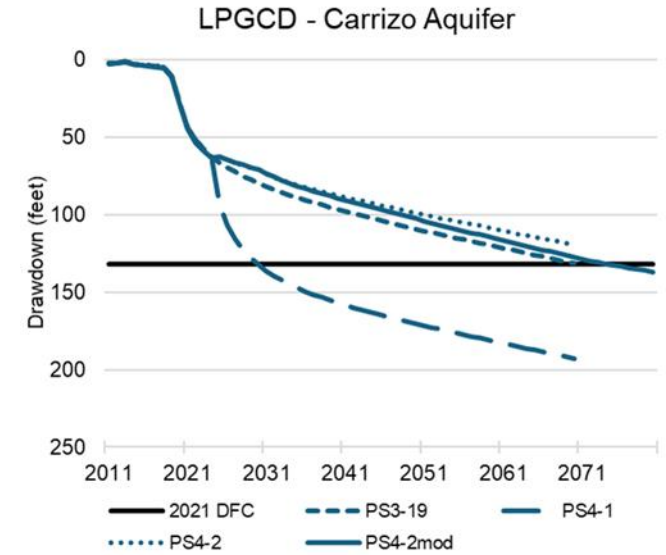
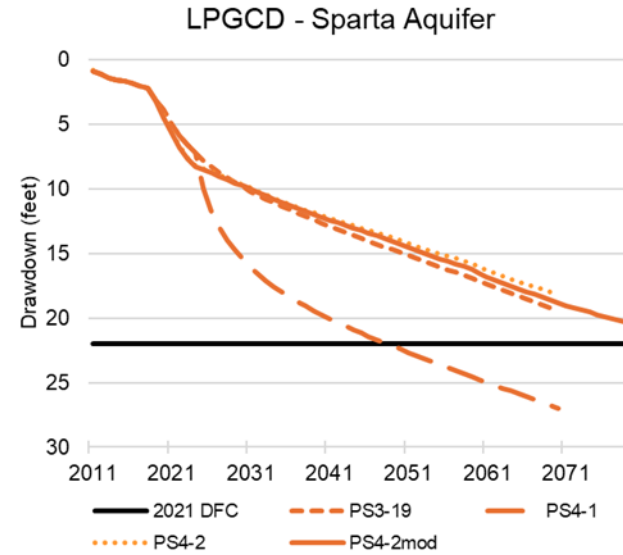
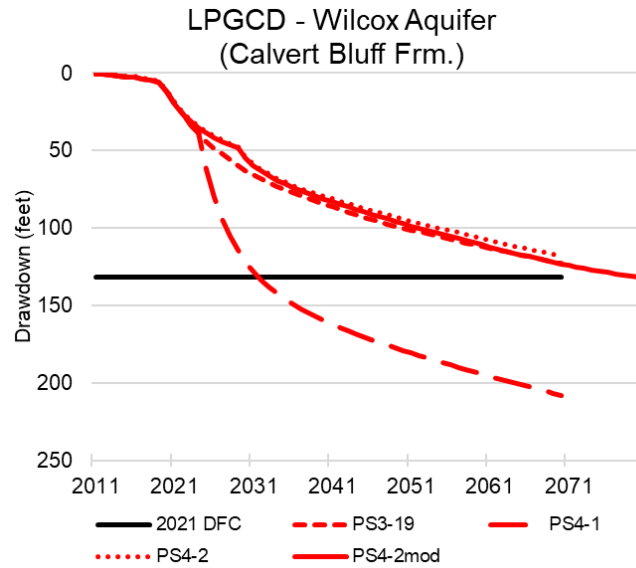
Values in acre-feet per year
 Positive = Into Aquifer
 Negative = Out of Aquifer

Difference between v8 and v7 .wel files

Layer		Lateral Flow			Recharge	Surface Water	Pumping	Storage	GHB	Vertical Flow
		POSGCD	FCGCD	BVGCD/ METGCD						
3	Sparta	1	-79	0	0	128	0	113	42	-323
5	Queen City	2	-592	0	0	31	0	857	0	-458
7	Carrizo	55	-50	0	0	-30	0	2,125	0	7,275
8	Calvert Bluff	6	-269	0	0	-1,007	0	-1,776	0	-5,380
9	Simsboro	-218	505	0	0	-301	0	-48	0	-383
10	Hooper	-34	166	0	0	-67	0	-40	0	-399

Values in acre-feet per year
 Positive = Into Aquifer
 Negative = Out of Aquifer

Average drawdown values over time

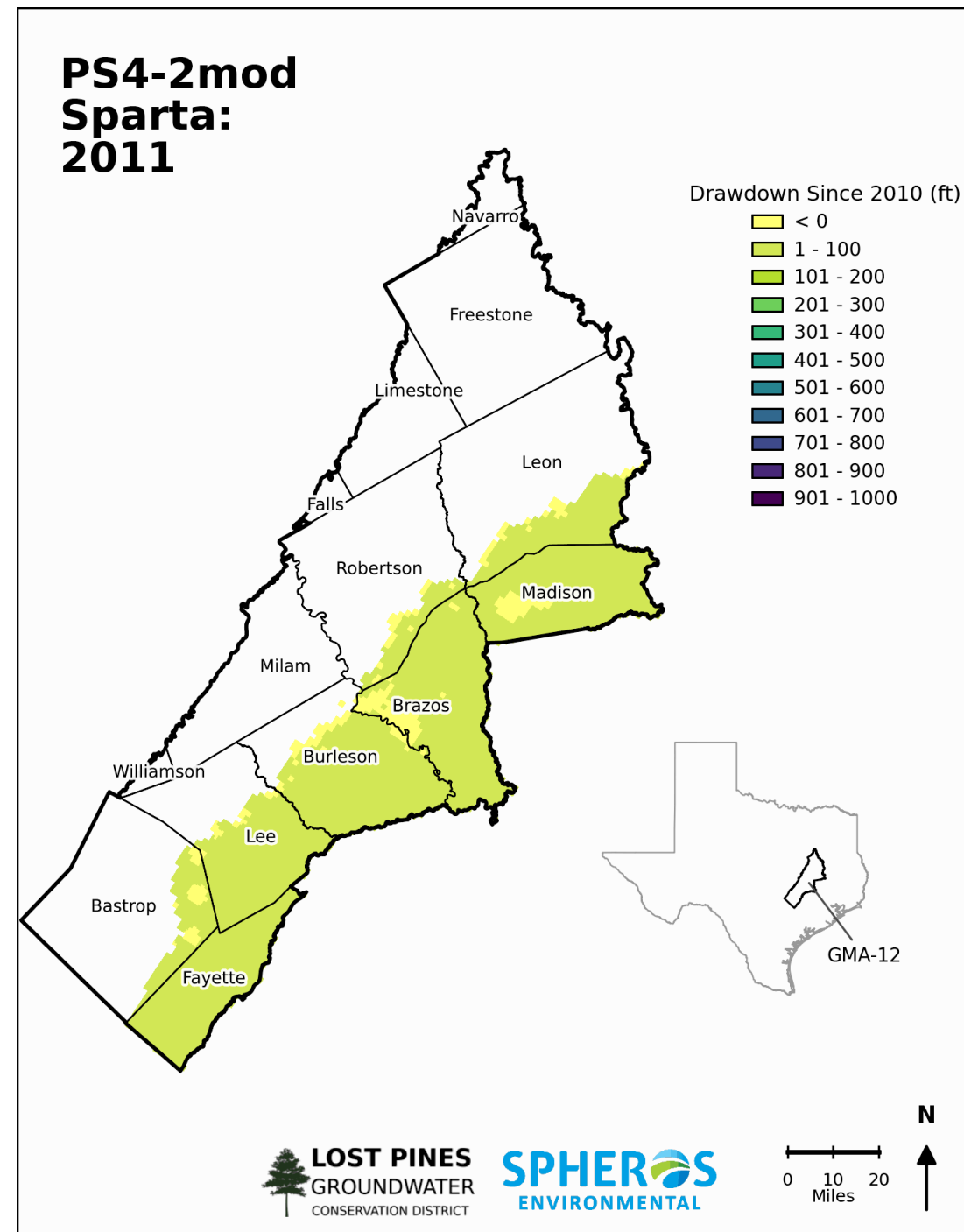


PS4-2mod Drawdown Sparta Aquifer

Model: Central SP-QC-CW GAM v.3.02

Drawdown = $WL_{31Dec80} - WL_{01Jan11}$ (ft)

DD Calculation Code: Spheros Python Script

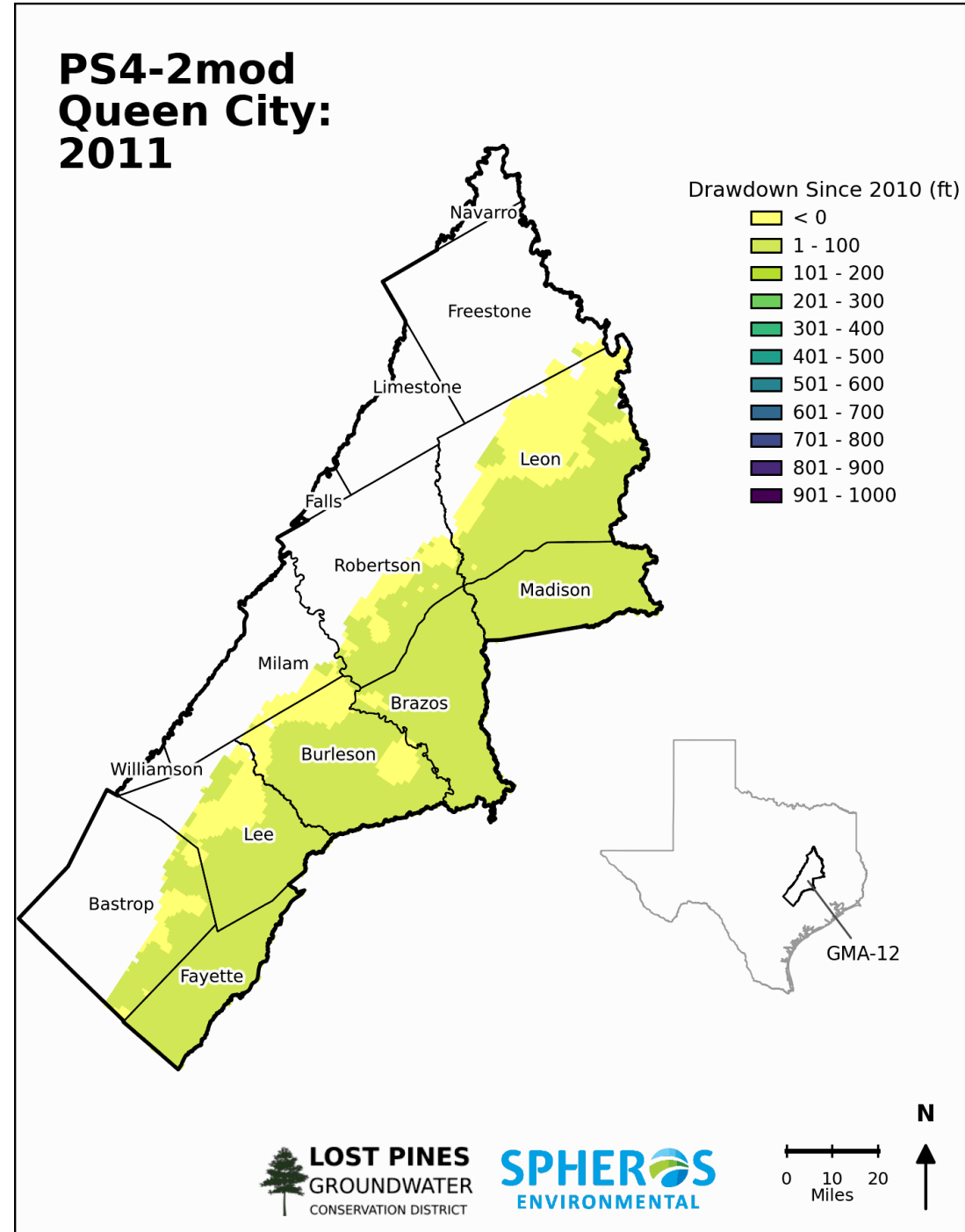


PS4-2mod Drawdown Queen City Aquifer

Model: Central SP-QC-CW GAM v.3.02

Drawdown = $WL_{31Dec80} - WL_{01Jan11}$ (ft)

DD Calculation Code: Spheros Python Script

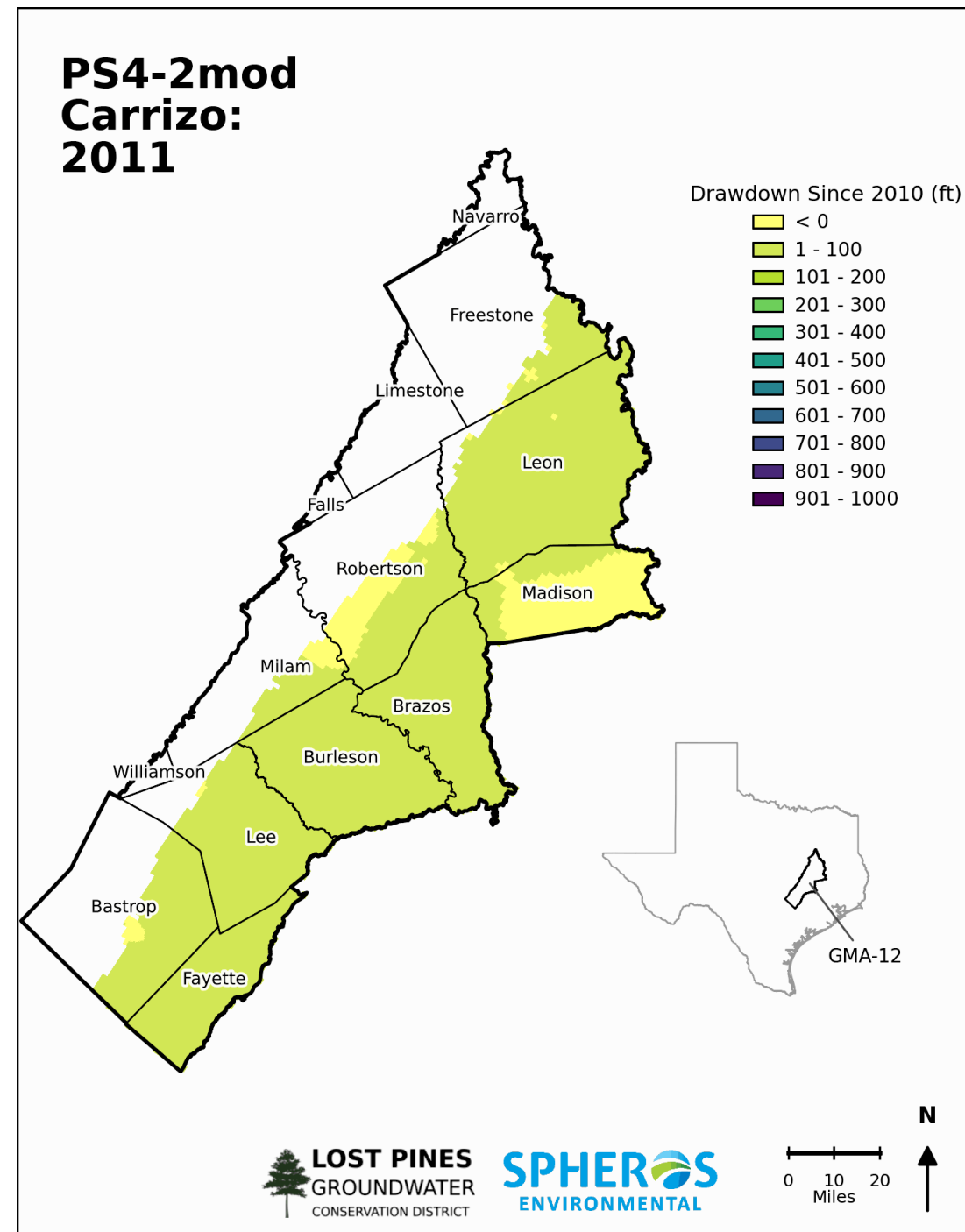


PS4-2mod Drawdown Carrizo Aquifer

Model: Central SP-QC-CW GAM v.3.02

Drawdown = $WL_{31Dec80} - WL_{01Jan11}$ (ft)

DD Calculation Code: Spheros Python Script

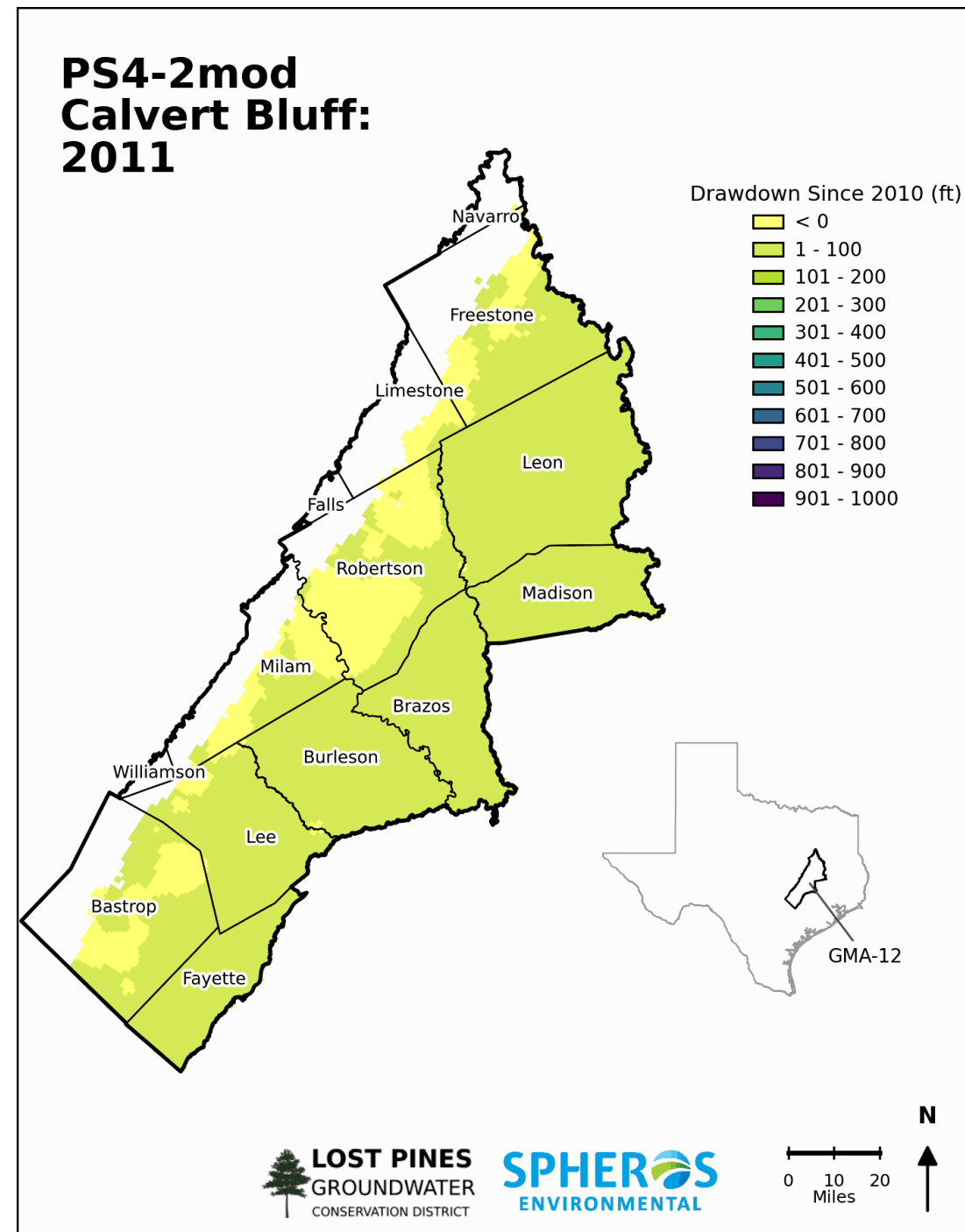


PS4-2mod Drawdown Calvert Bluff Aquifer

Model: Central SP-QC-CW GAM v.3.02

Drawdown = $WL_{31Dec80} - WL_{01Jan11}$ (ft)

DD Calculation Code: Spheros Python Script

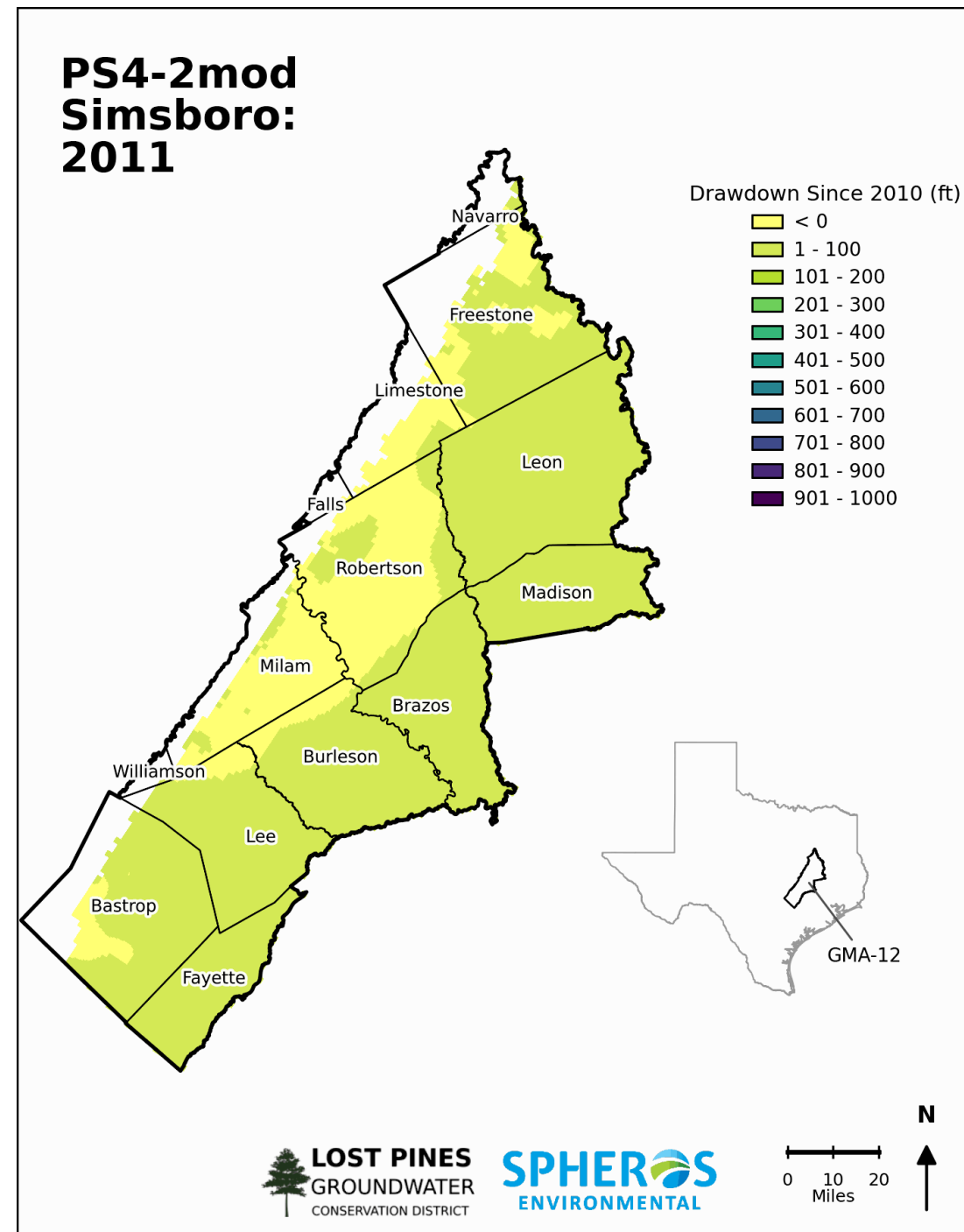


PS4-2mod Drawdown Simsboro Aquifer

Model: Central SP-QC-CW GAM v.3.02

Drawdown = $WL_{31Dec80} - WL_{01Jan11}$ (ft)

DD Calculation Code: Spheros Python Script

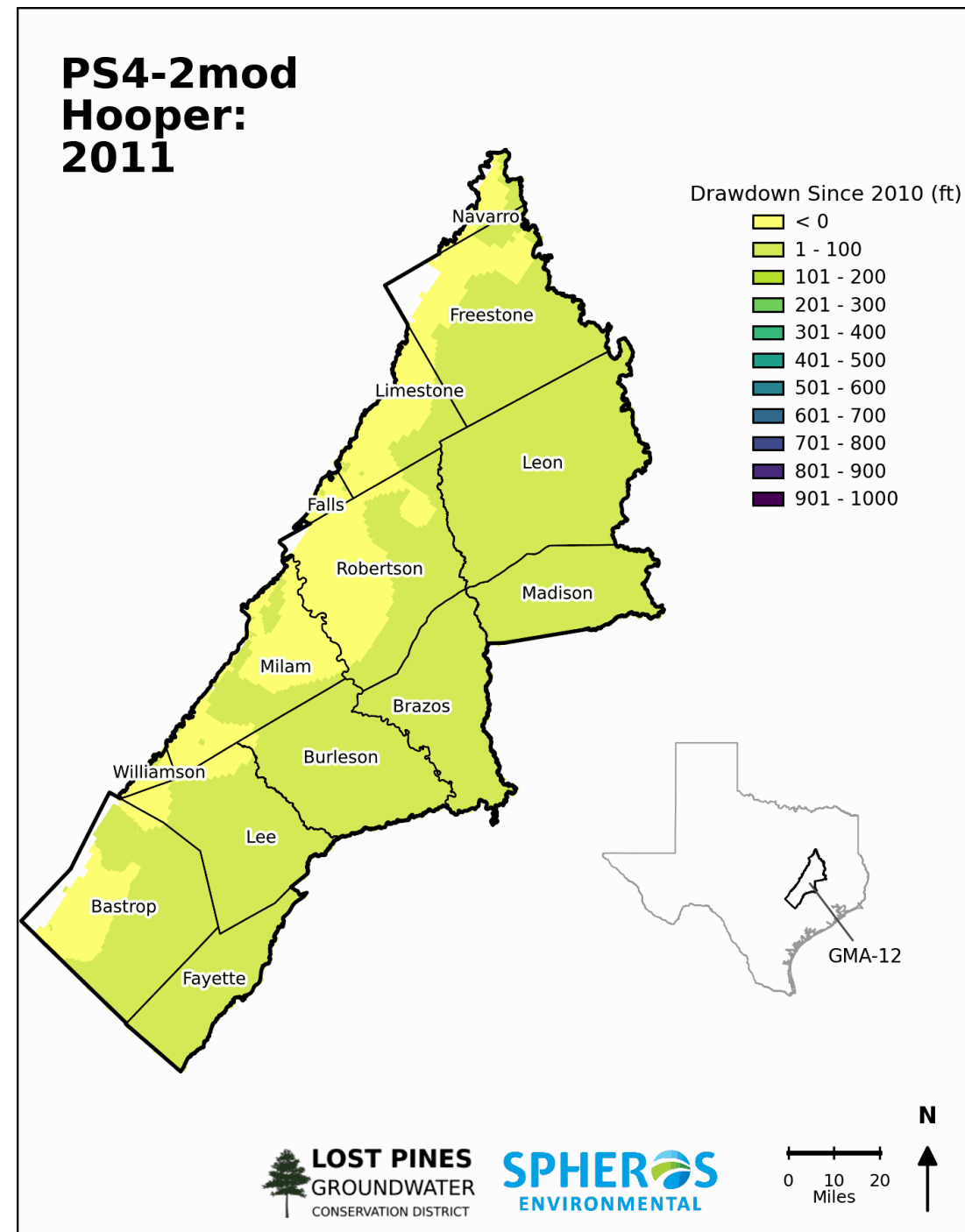


PS4-2mod Drawdown Hooper Aquifer

Model: Central SP-QC-CW GAM v.3.02

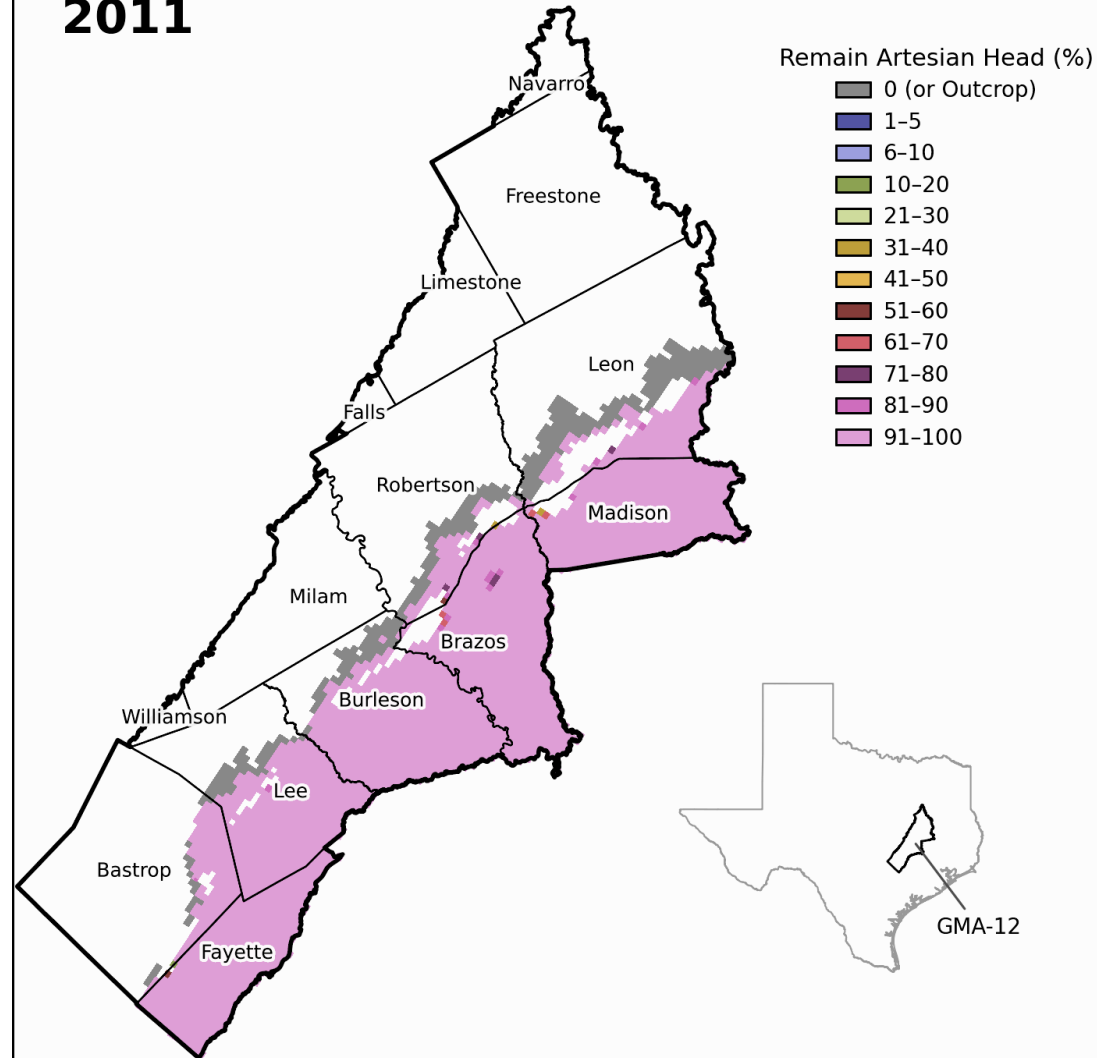
Drawdown = $WL_{31Dec80} - WL_{01Jan11}$ (ft)

DD Calculation Code: Spheros Python Script



PS4-2mod Artesian Head Sparta Aquifer

PS4-2mod
Sparta:
2011



Model: Central SP-QC-CW GAM v.3.02

$$H_{a,remain} = H_{a,31Dec80} / H_{a,01Jan11} * 100\%$$

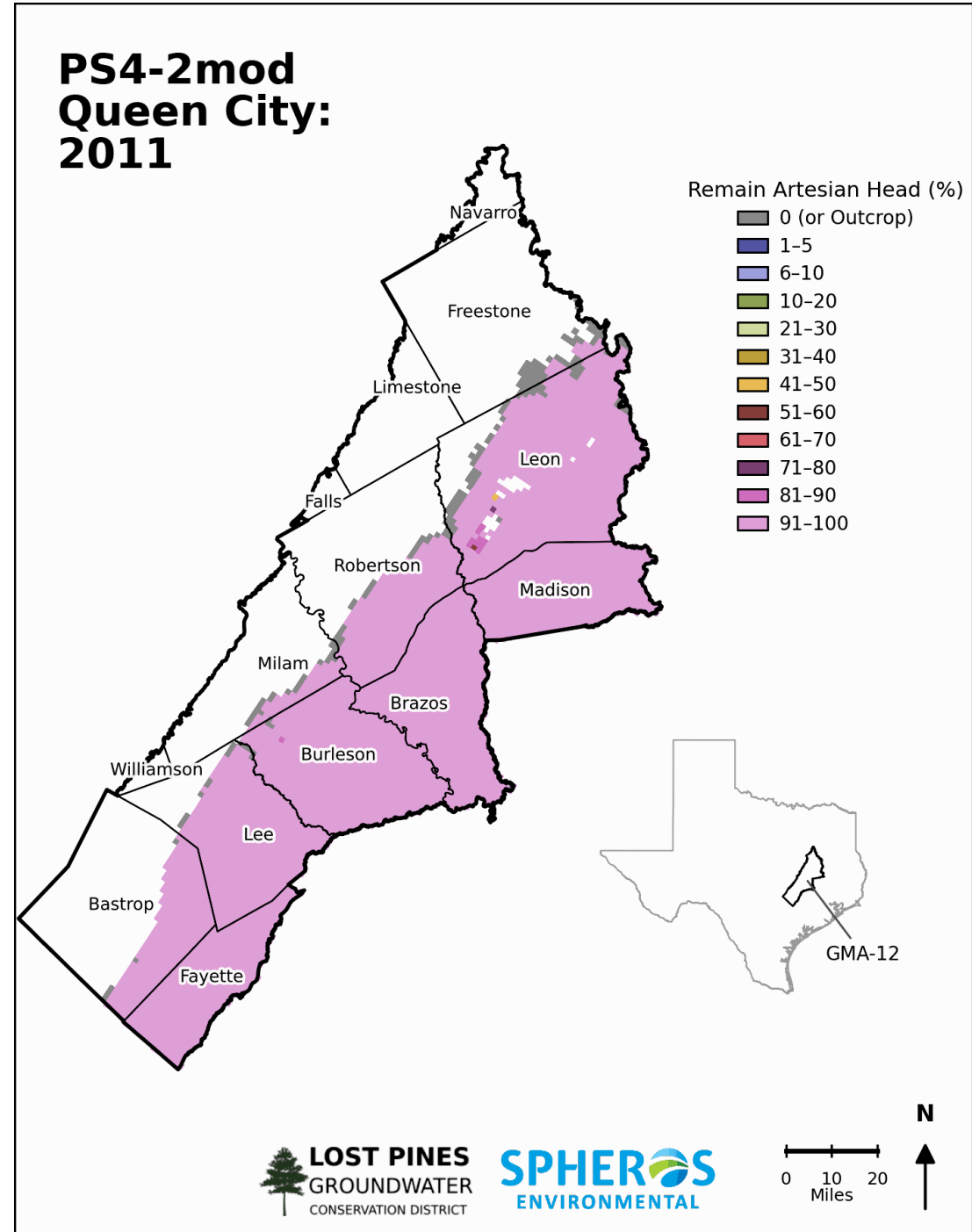
Artesian Head Code: Spheros Python Script

PS4-2mod Artesian Head Queen City Aquifer

Model: Central SP-QC-CW GAM v.3.02

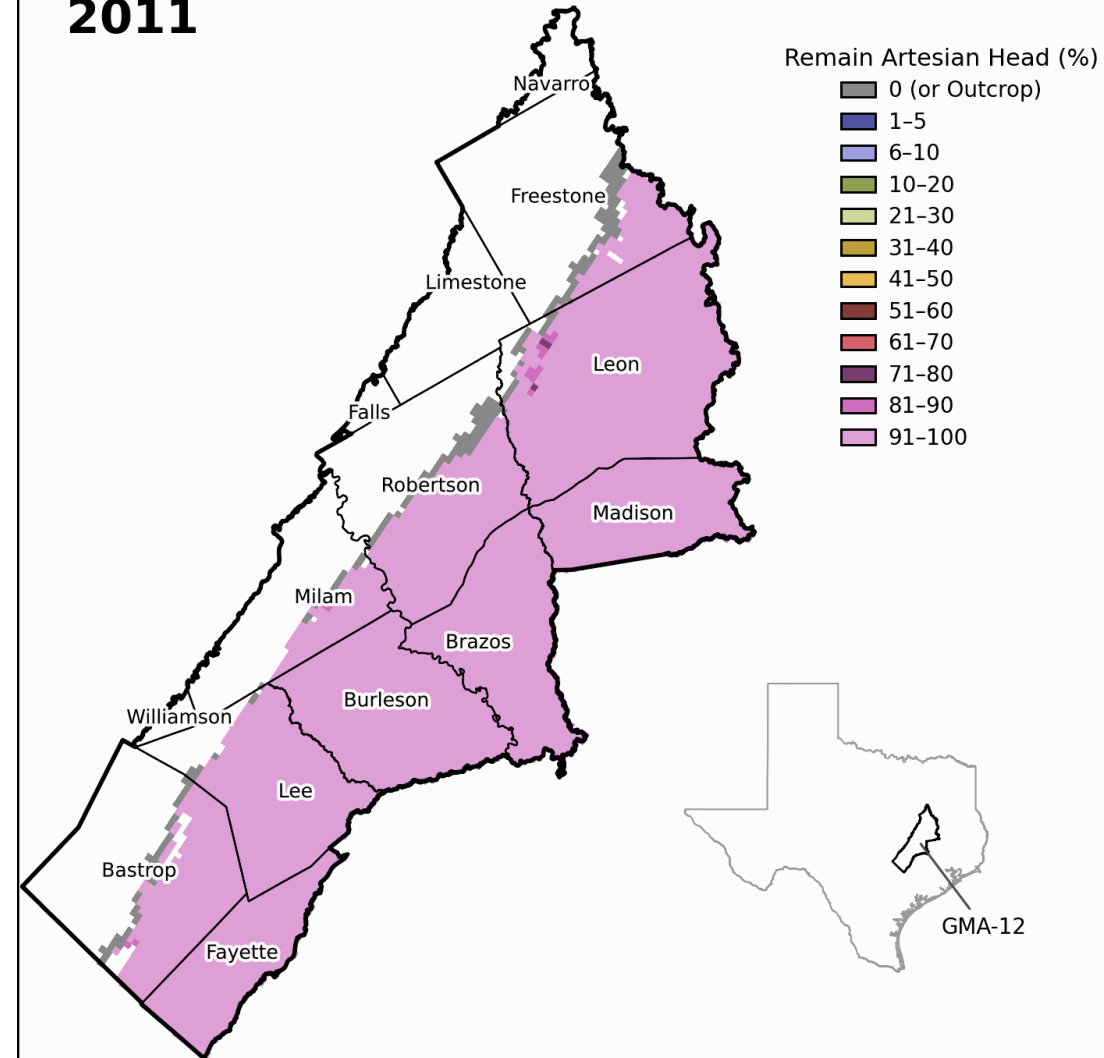
$$H_{a,\text{remain}} = H_{a,31\text{Dec}80} / H_{a,01\text{Jan}11} * 100\%$$

Artesian Head Code: Spheros Python Script



PS4-2mod Artesian Head Carrizo Aquifer

PS4-2mod
Carrizo:
2011



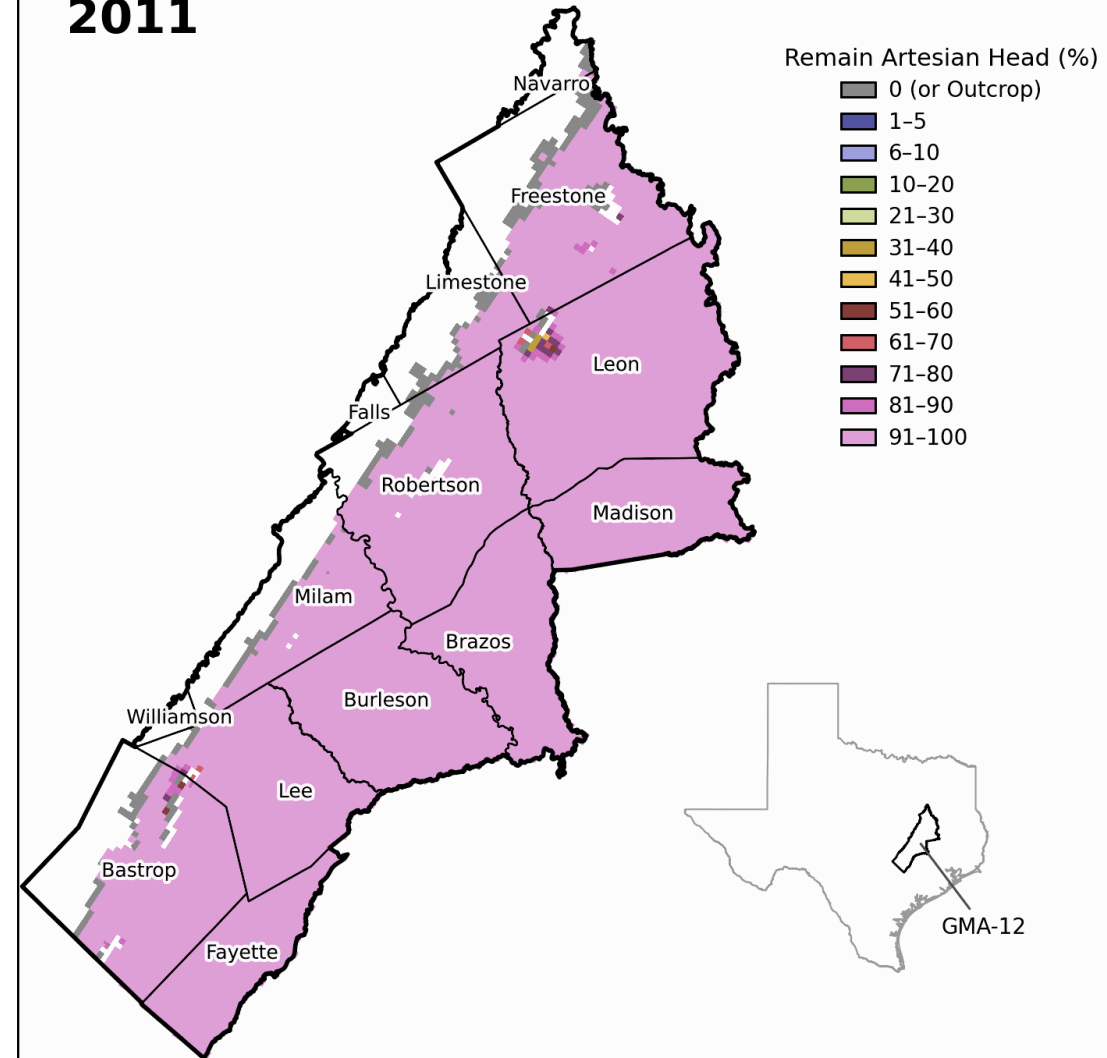
Model: Central SP-QC-CW GAM v.3.02

$$H_{a,remain} = H_{a,31Dec80} / H_{a,01Jan11} * 100\%$$

Artesian Head Code: Spheros Python Script

PS4-2mod Artesian Head Calvert Bluff Aquifer

PS4-2mod
Calvert Bluff:
2011



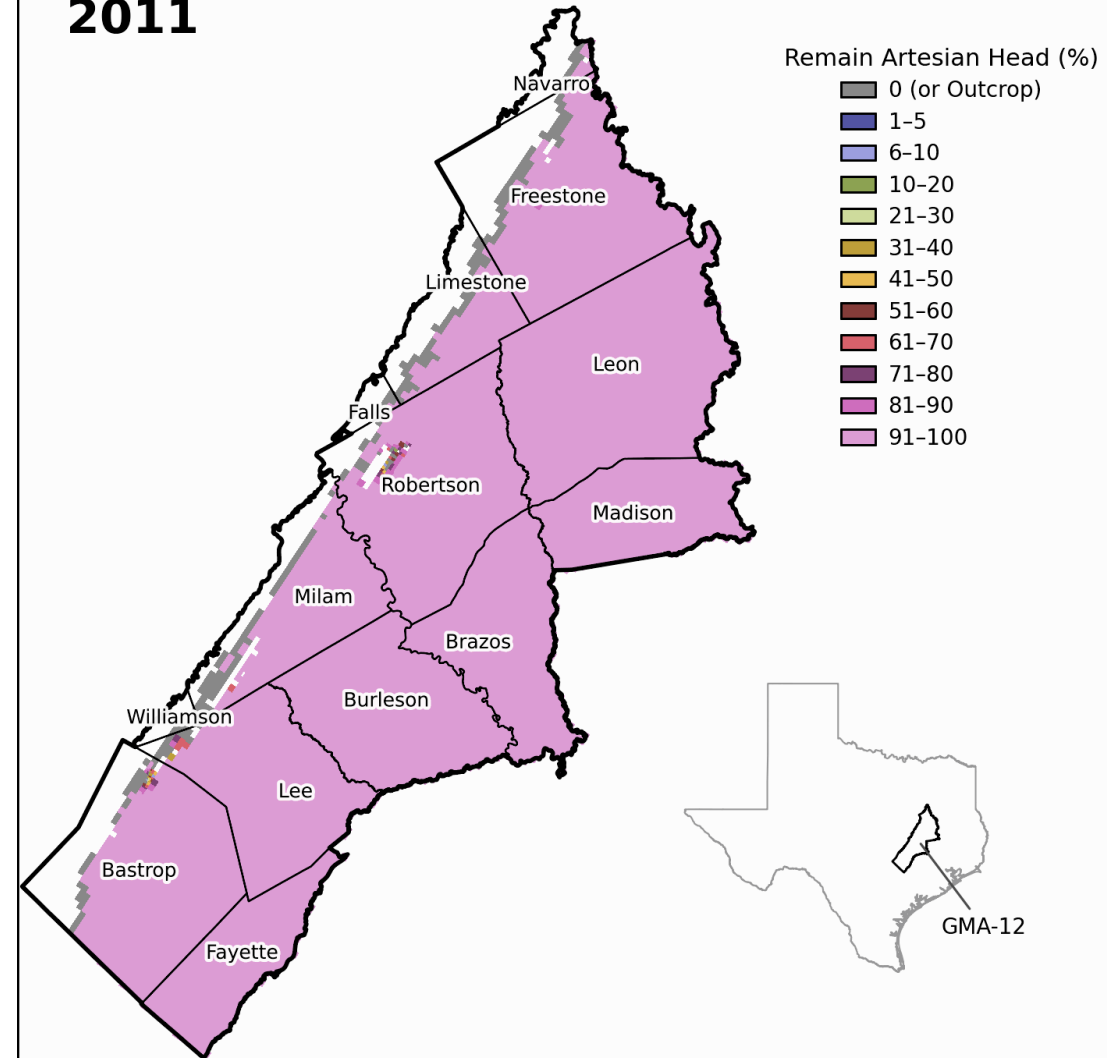
Model: Central SP-QC-CW GAM v.3.02

$$H_{a,remain} = H_{a,31Dec80} / H_{a,01Jan11} * 100\%$$

Artesian Head Code: Spheros Python Script

PS4-2mod Artesian Head Simsboro Aquifer

PS4-2mod
Simsboro:
2011



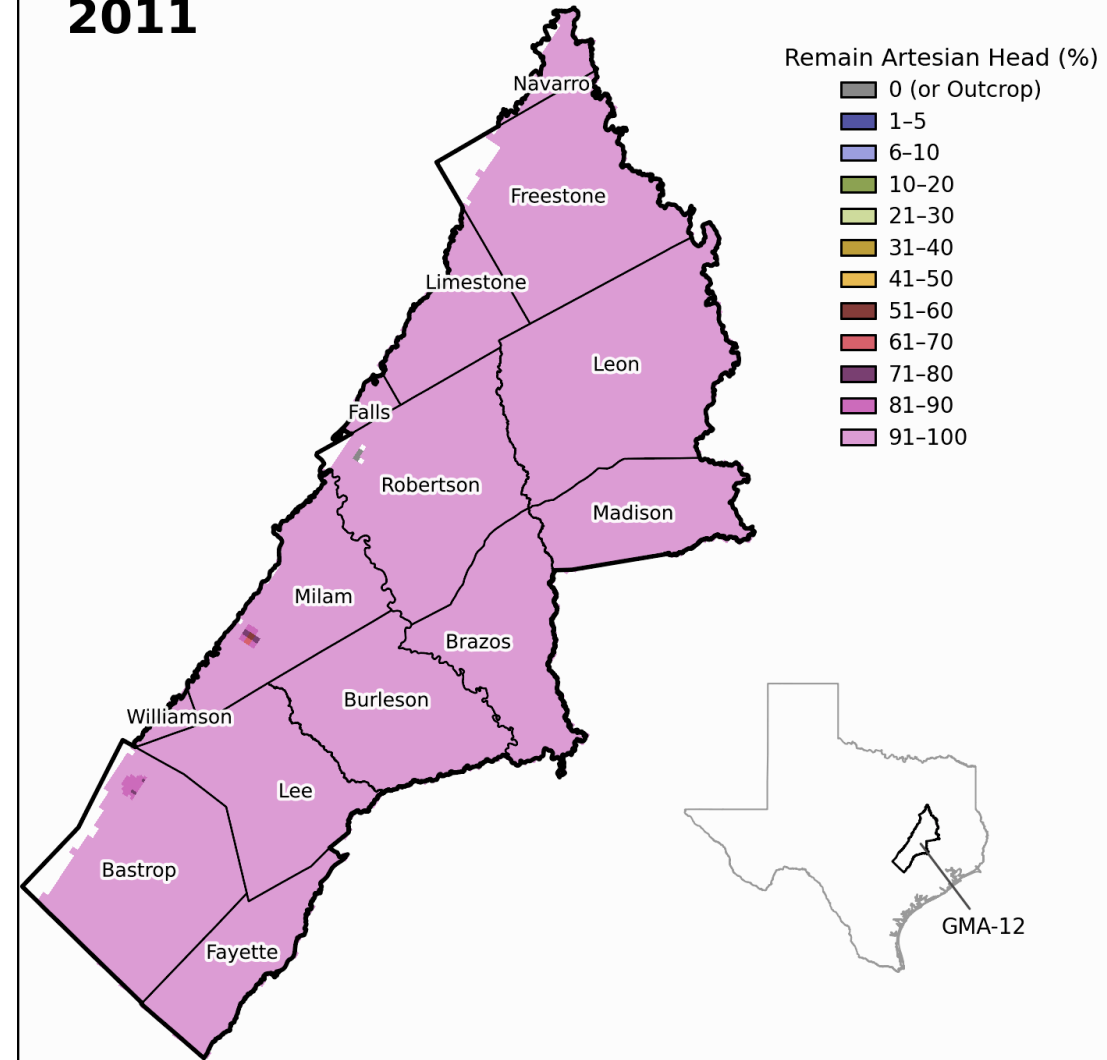
Model: Central SP-QC-CW GAM v.3.02

$$H_{a,remain} = H_{a,31Dec80} / H_{a,01Jan11} * 100\%$$

Artesian Head Code: Spheros Python Script

PS4-2mod Artesian Head Hooper Aquifer

PS4-2mod
Hooper:
2011



Model: Central SP-QC-CW GAM v.3.02

$$H_{a,remain} = H_{a,31Dec80} / H_{a,01Jan11} * 100\%$$

Artesian Head Code: Spheros Python Script

Existing DFCs in 2070 compared to *PS4-2mod drawdowns in 2080*

Layer		BVGCD	FCGCD	LPGCD	METGCD	POSGCD
3	Sparta	53 57	43 57	22 22	25 22	32 46
5	Queen City	44 46	73 96	28 31	20 19	30 30
7	Carrizo	84 83	140 173	134 139	48 45	146 170
8	Calvert Bluff	111 119	NR	132 141	57 58	156 189
9	Simsboro	262 283	NR	240 261	76 85	278 369
10	Hooper	167 190	NR	138 157	69 76	178 236

GMA-12 Remaining Artesian Head PS4-2mod (Aquifer-wide Average – Confined Layers)

Layer		BVGCD	FCGCD	LPGCD	METGCD	POSGCD
3	Sparta	66%	88%	83%	81%	88%
5	Queen City	85%	89%	78%	88%	94%
7	Carrizo	79%	90%	70%	84%	65%
8	Calvert Bluff	62%	NR	69%	84%	60%
9	Simsboro	69%	NR	80%	94%	65%
10	Hooper	87%	NR	88%	96%	79%

Summary

- **Addition of GMA-13 increases drawdown in LPGCD and FCGCD**
 - Noticeable as cone of depression in later timesteps
- **Recommend PS4-2_v8.wel as final well file for PS4-2mod simulations**
 - Incorporates GMA-11, GMA-13, and Williamson County as best as currently possible

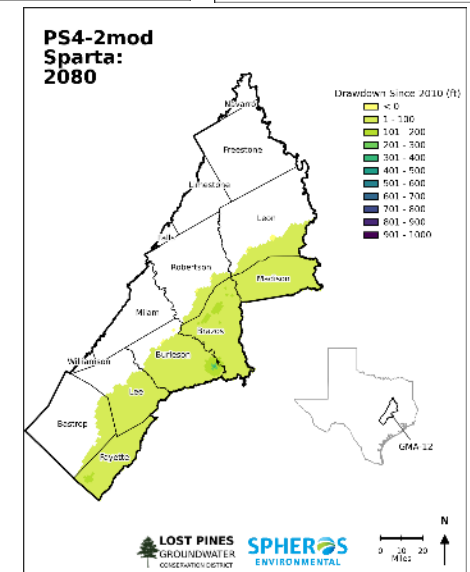
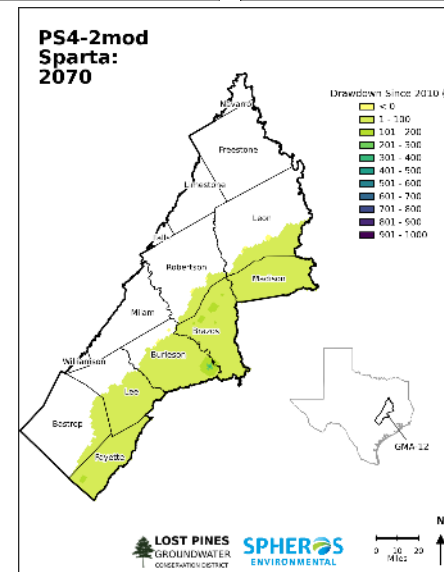
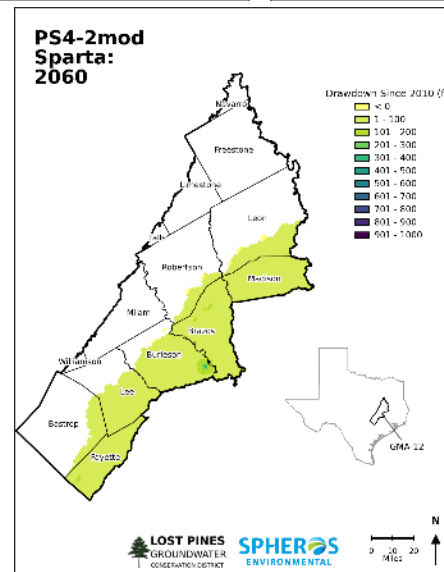
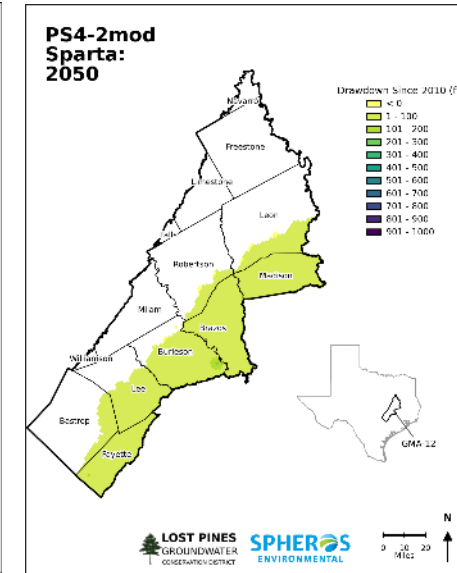
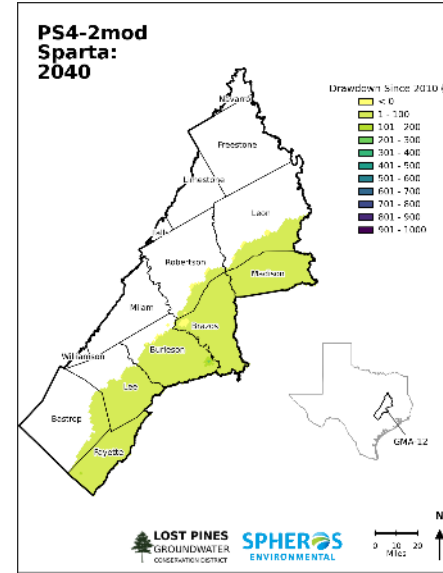
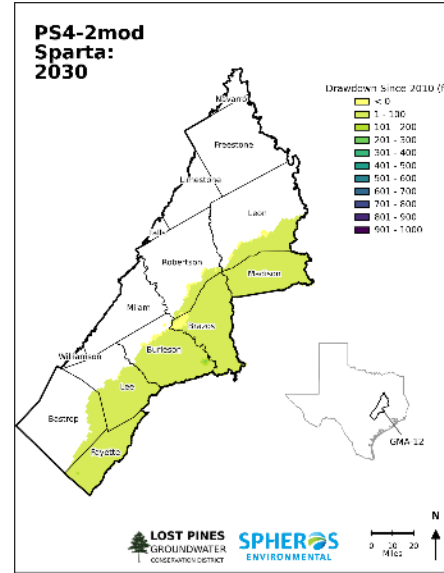
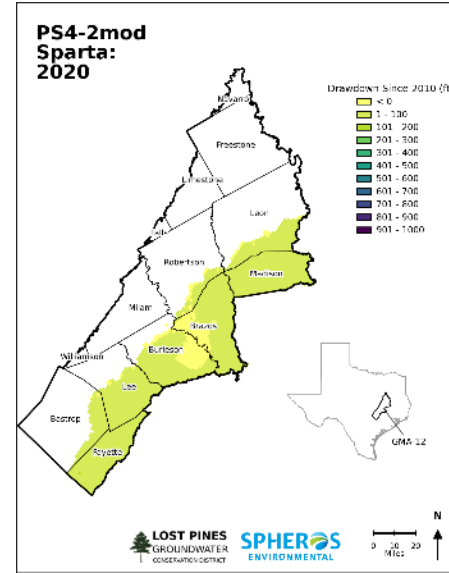
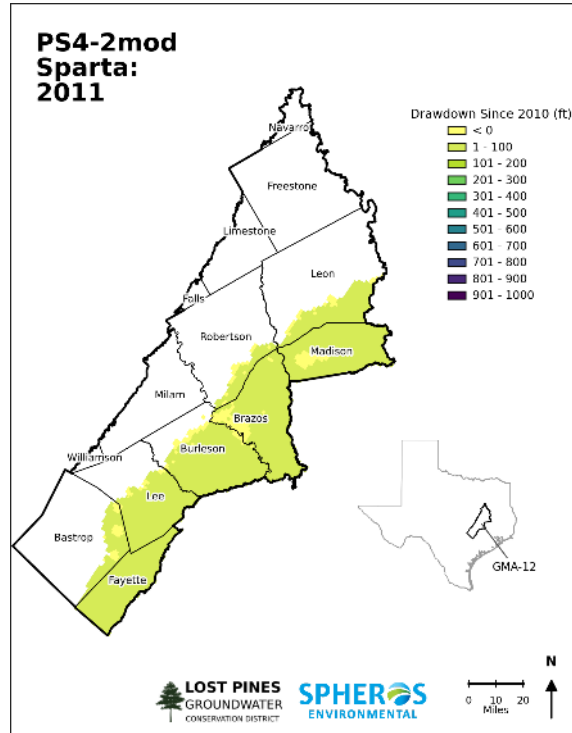
Consideration of Factor 9: Other

- **Texas Water Code Section 36.108 (d)(9):**
 - "Before voting on the proposed desired future conditions of the aquifers under Subsection (d-2), the districts shall consider...(9) any other information relevant to the specific desired future conditions."
- **Prior Round Explanatory Report**
 - Does not record any specific additional information, but references list of topics covered, presentations provided in appendix
 - Presentations and minutes available at <https://posgcd.org/gma12/>
- **Additional relevant topics?**

Backup Slides of Animations

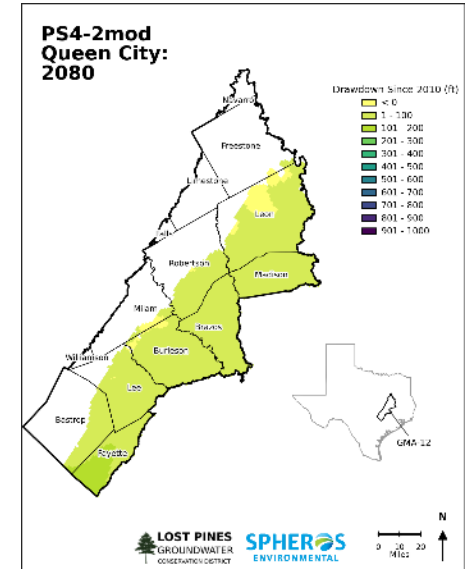
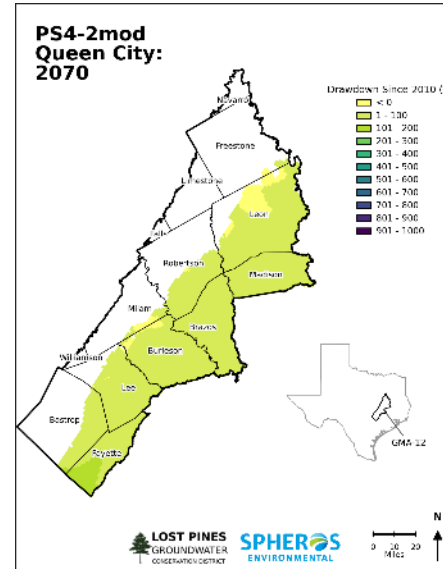
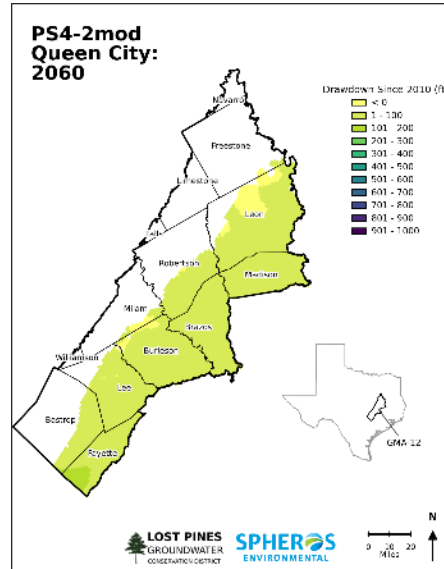
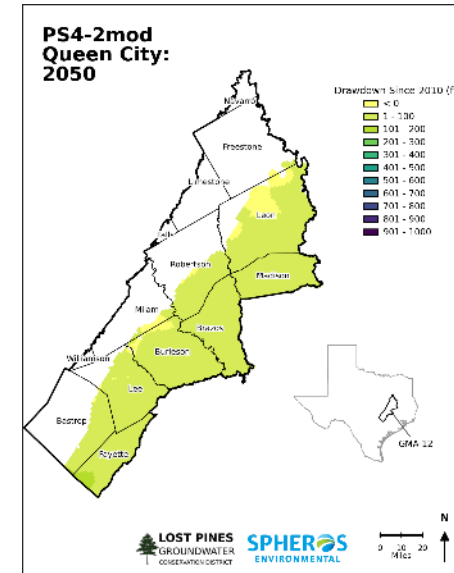
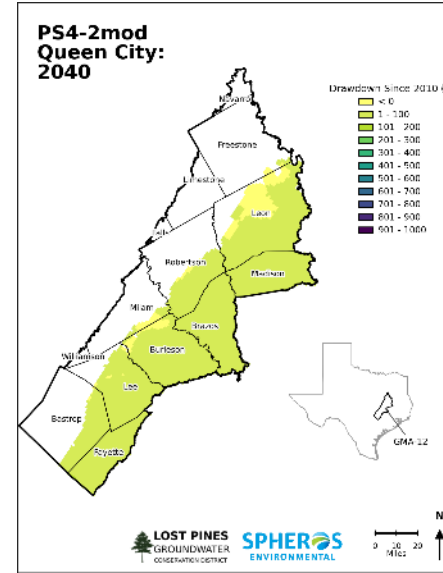
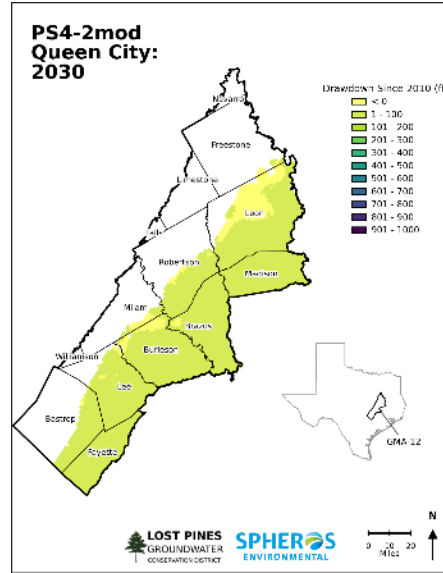
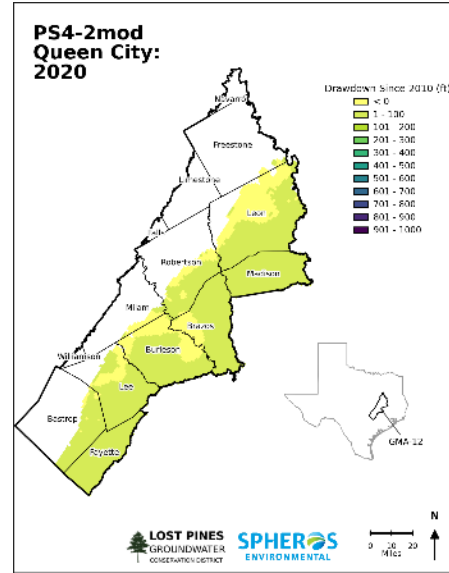
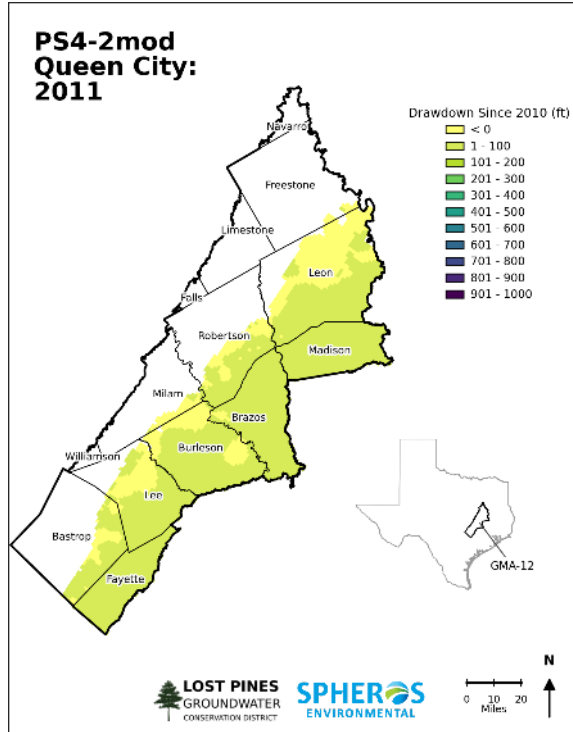
PS4-2mod Drawdown Sparta Aquifer

Central SP-QC-CW GAM v.3.02
Layer 3



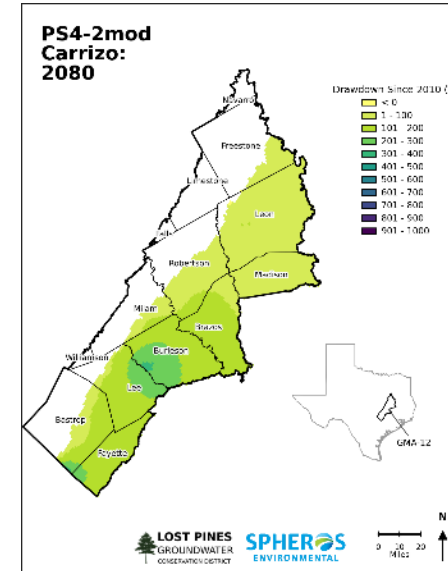
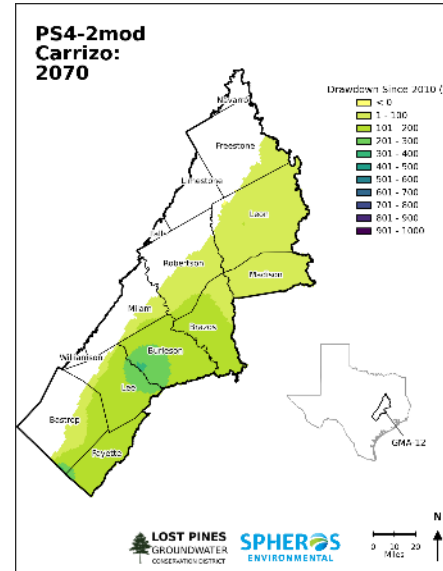
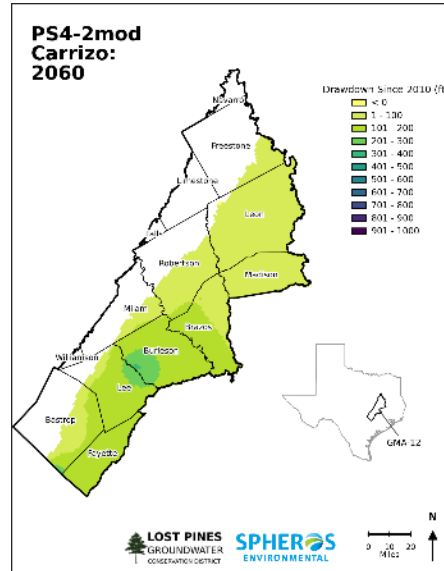
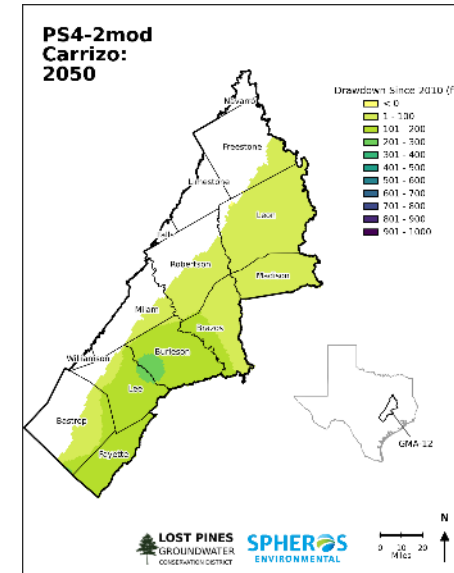
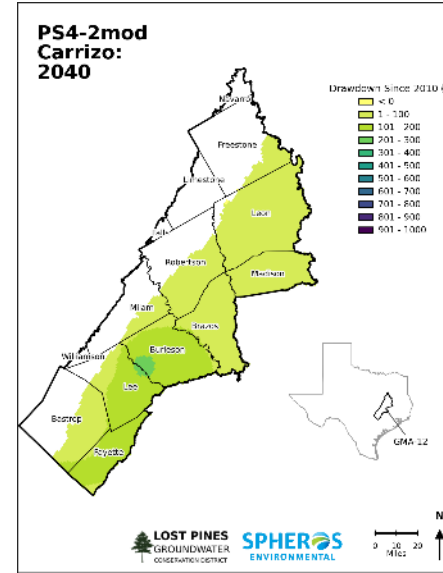
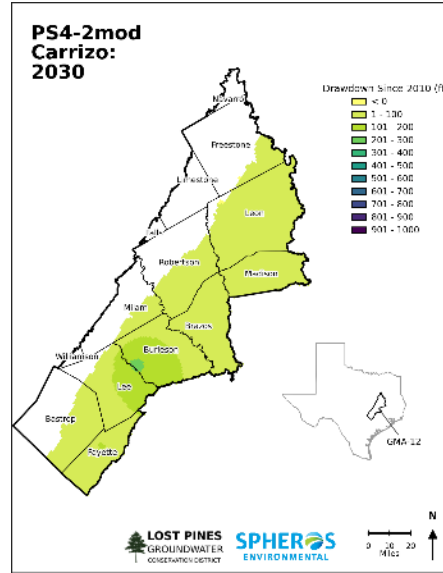
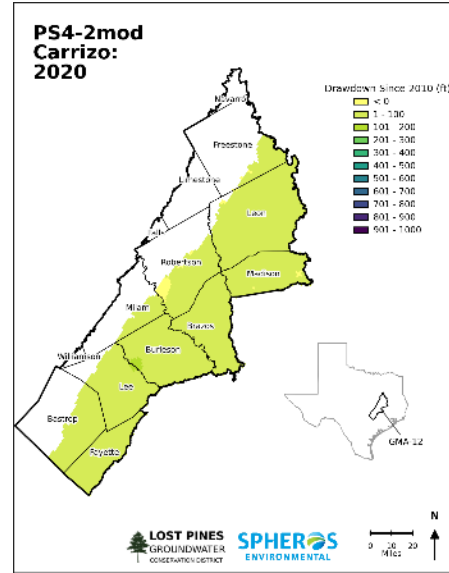
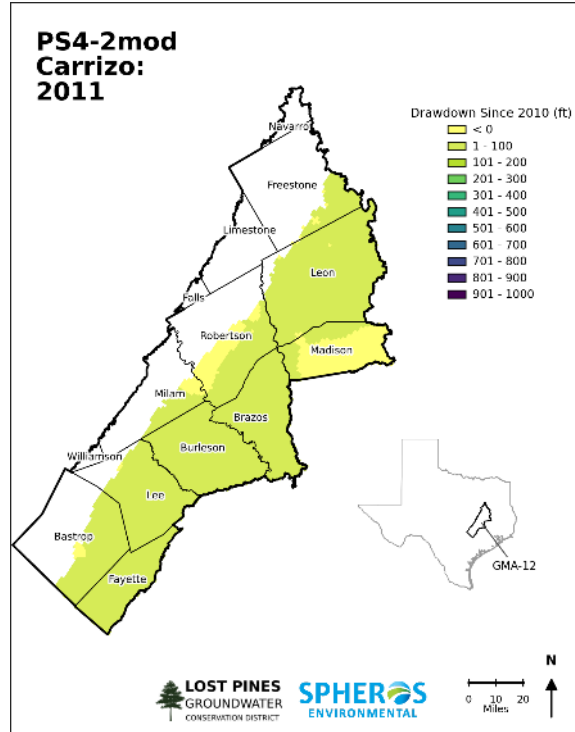
PS4-2mod Drawdown Queen City Aquifer

Central SP-QC-CW GAM v.3.02
Layer 5



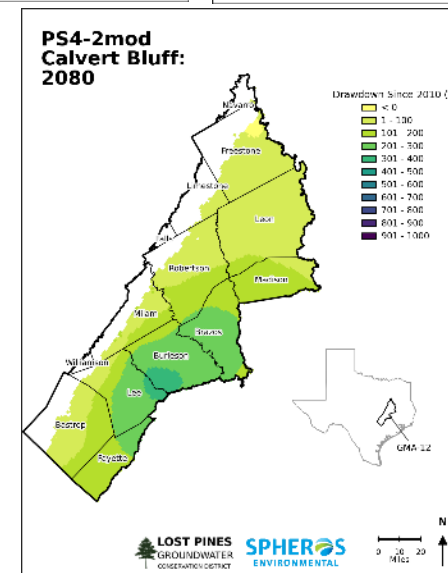
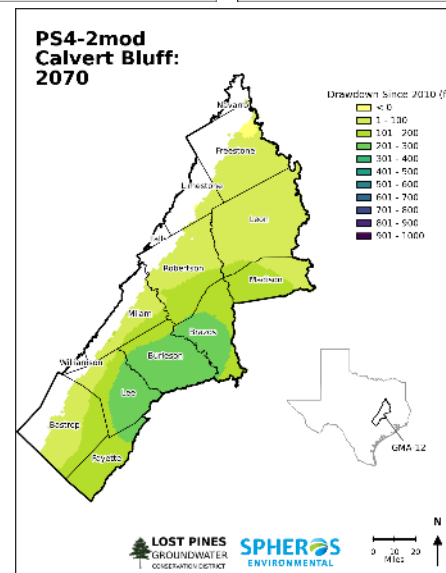
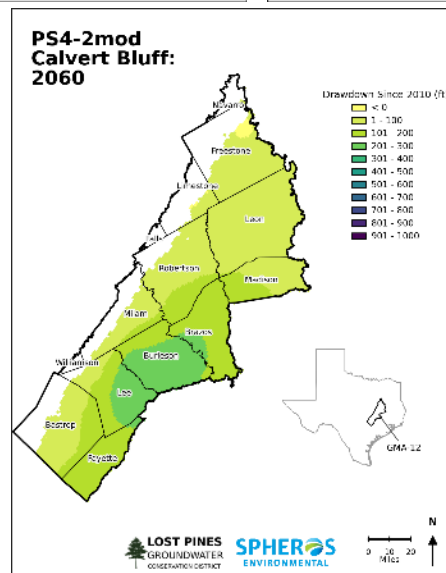
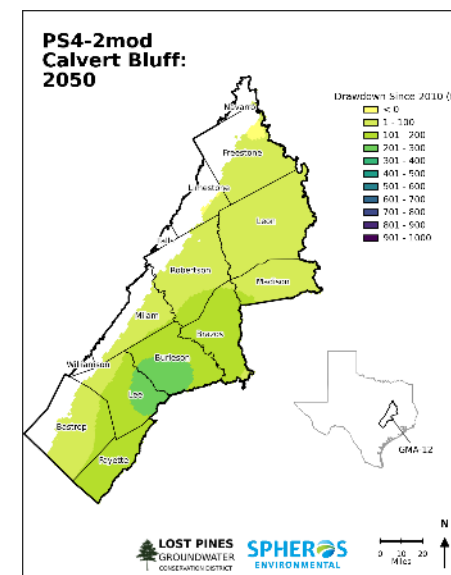
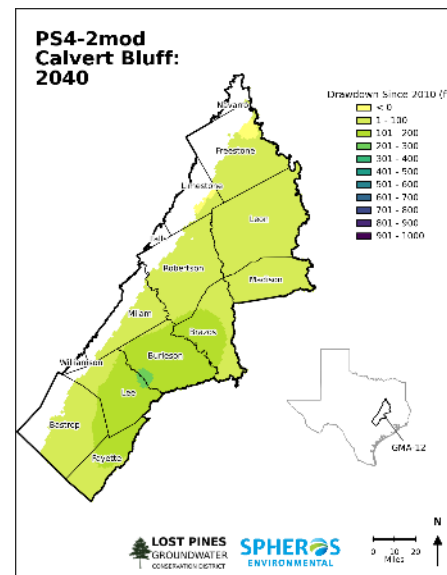
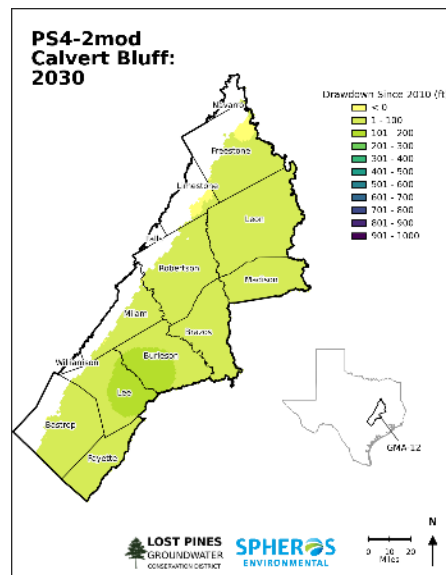
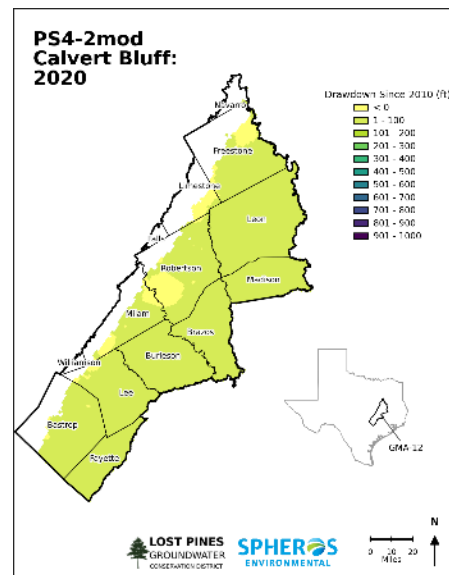
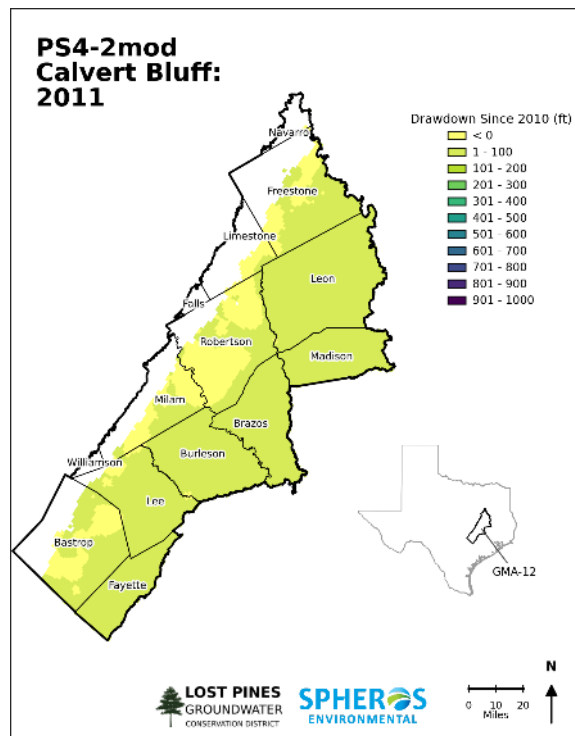
PS4-2mod Drawdown Carrizo Aquifer

Central SP-QC-CW GAM v.3.02
Layer 7



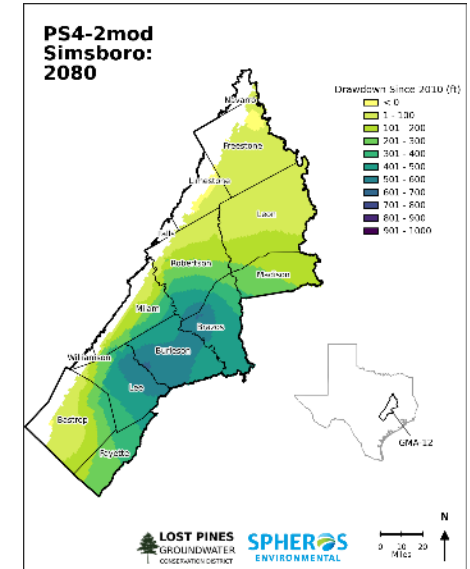
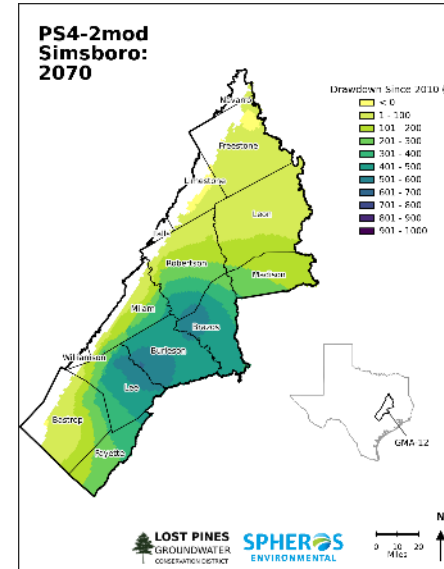
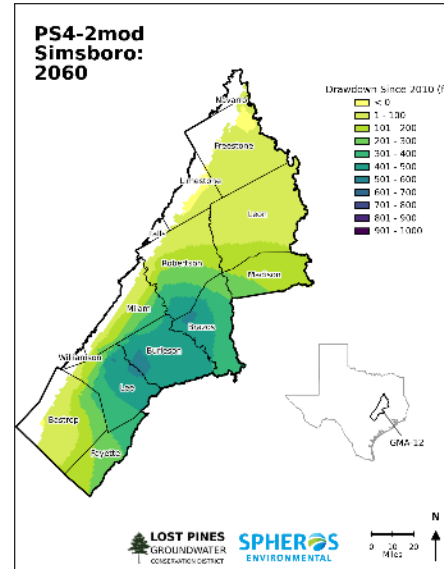
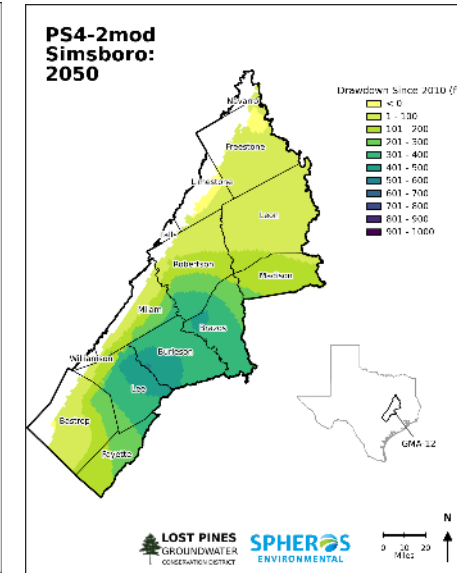
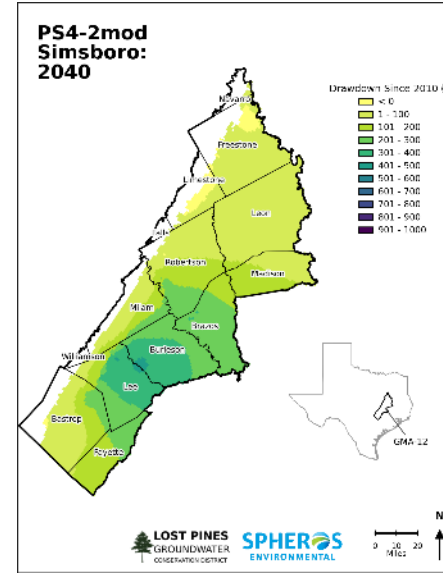
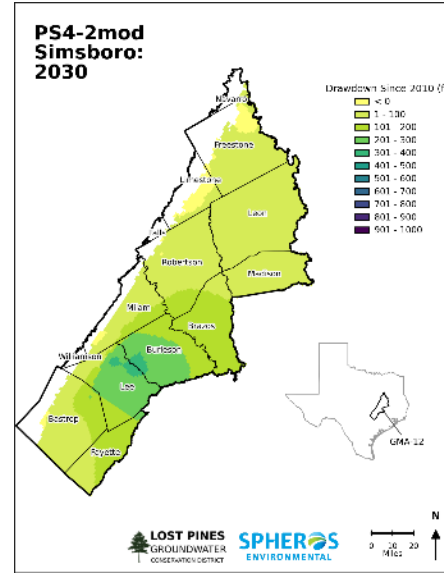
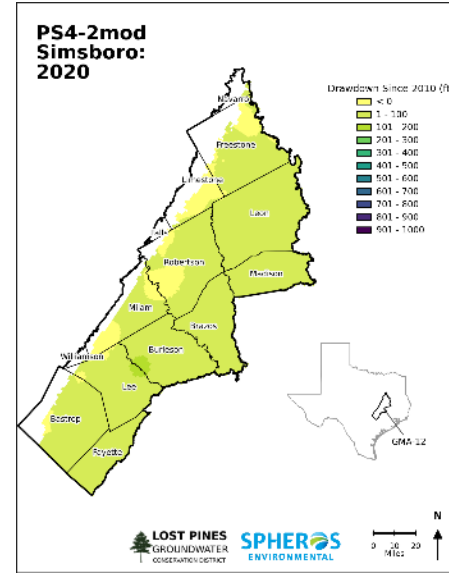
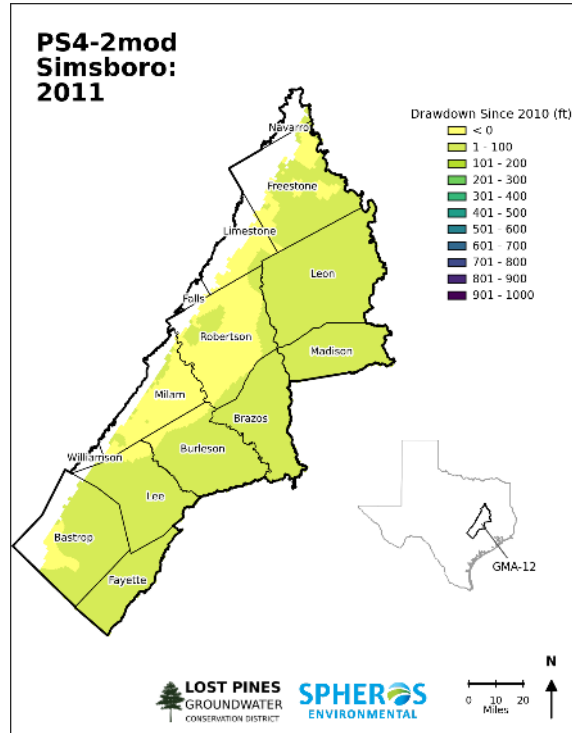
PS4-2mod Drawdown Calvert Bluff Aquifer

Central SP-QC-CW GAM v.3.02
Layer 8



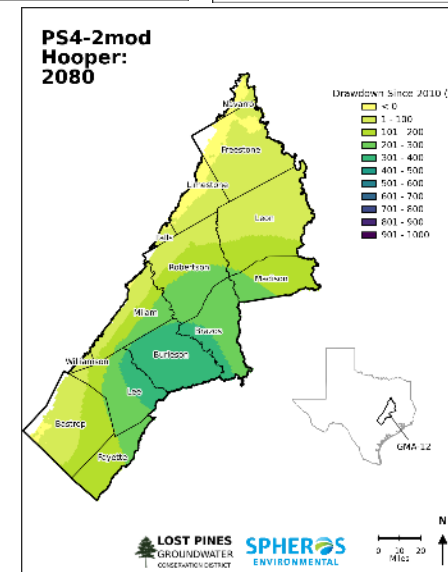
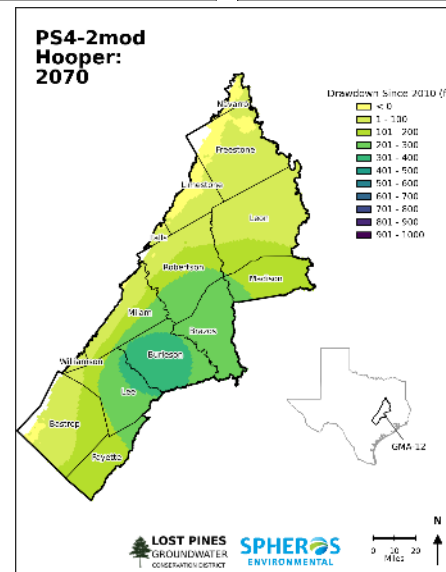
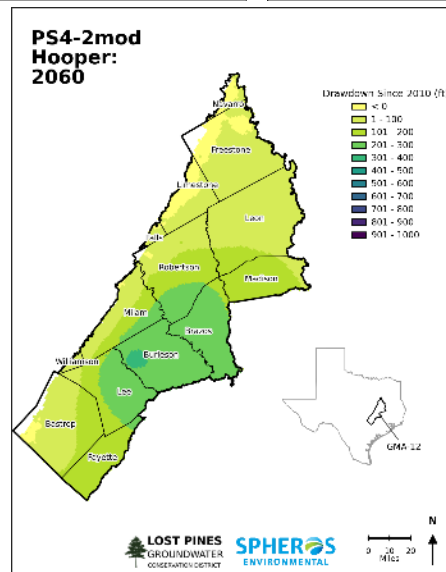
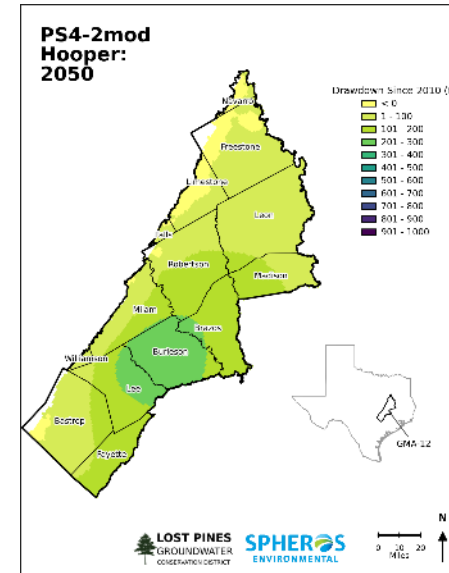
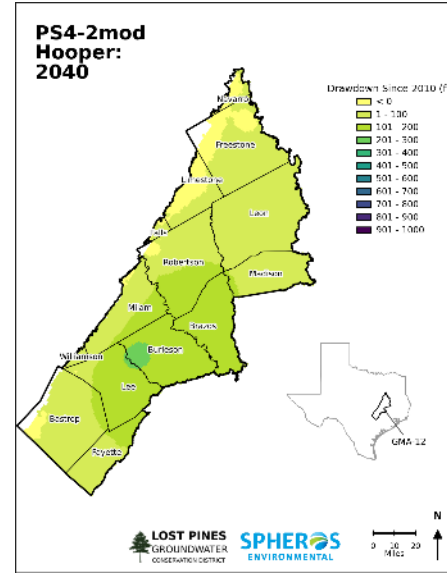
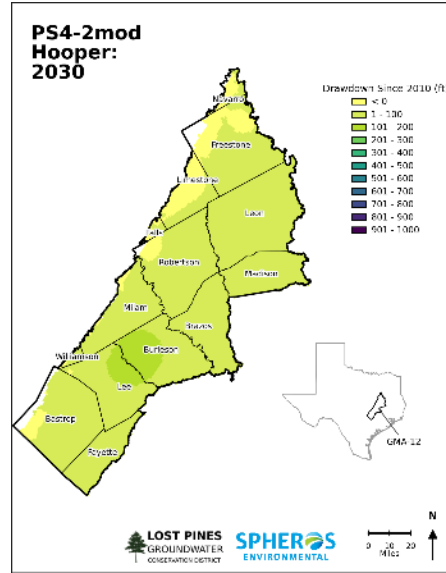
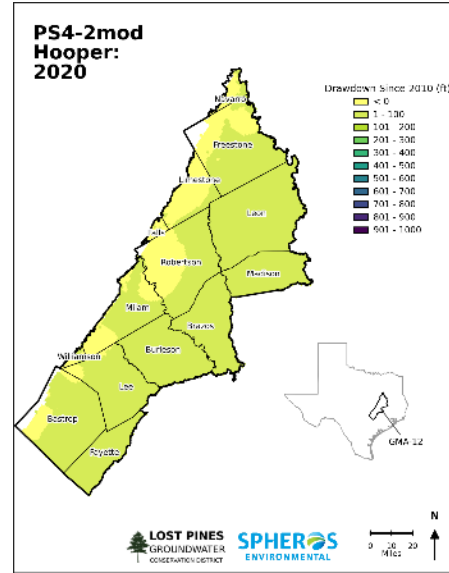
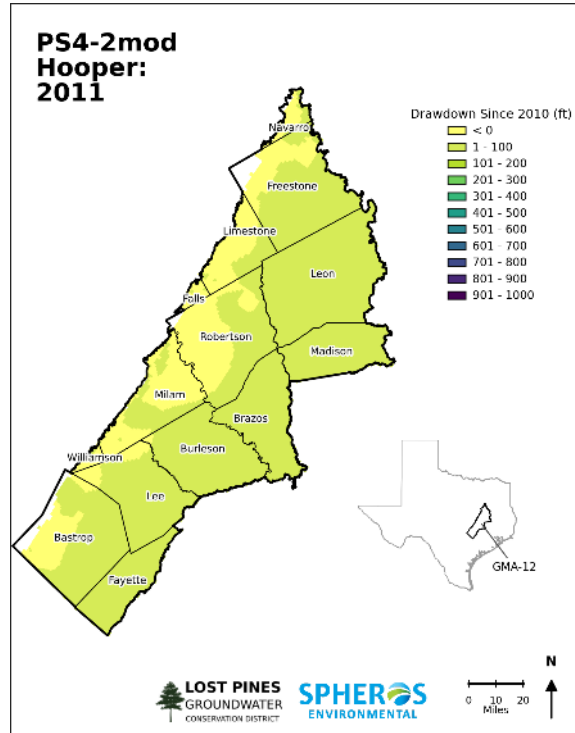
PS4-2mod Drawdown Simsboro Aquifer

Central SP-QC-CW GAM v.3.02
Layer 9



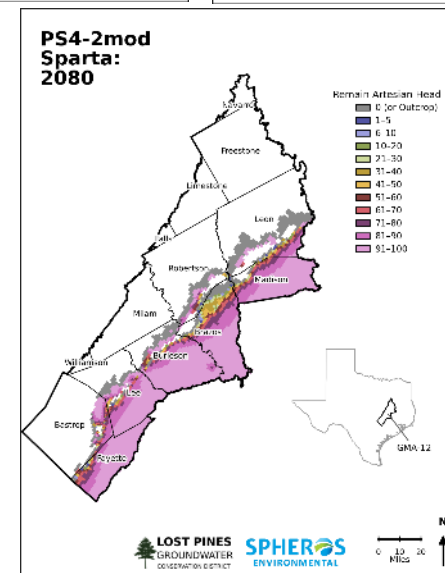
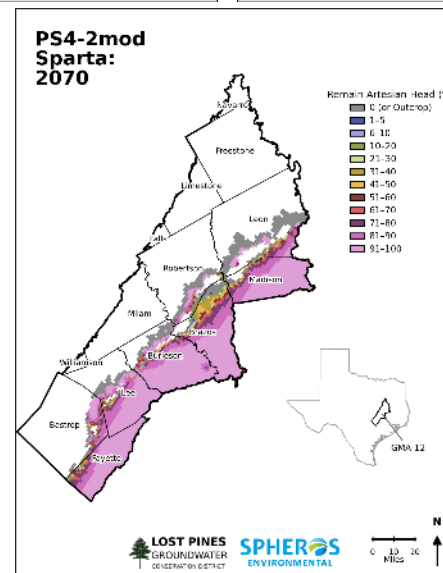
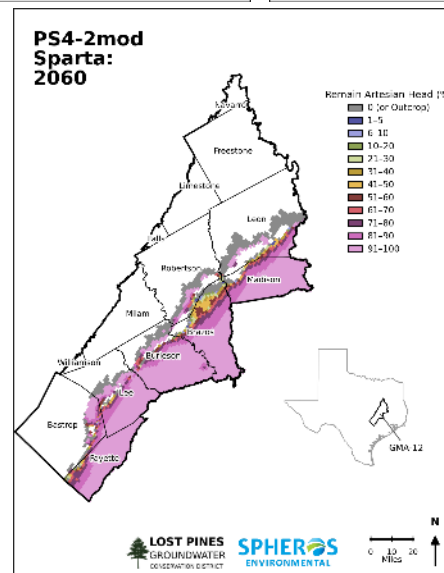
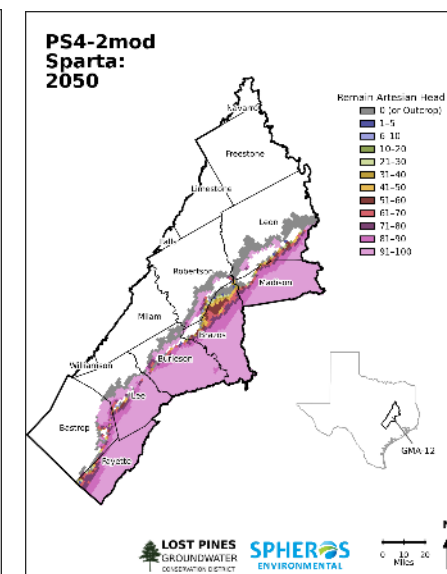
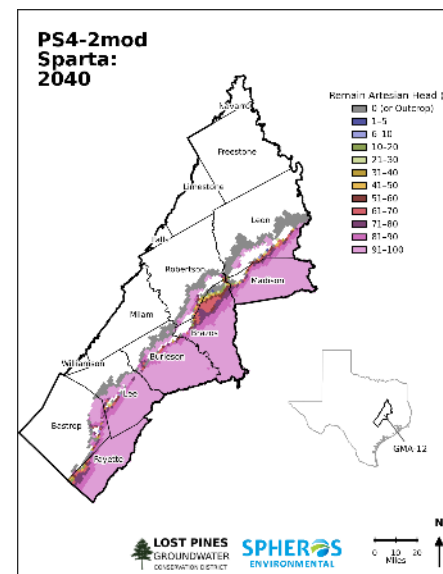
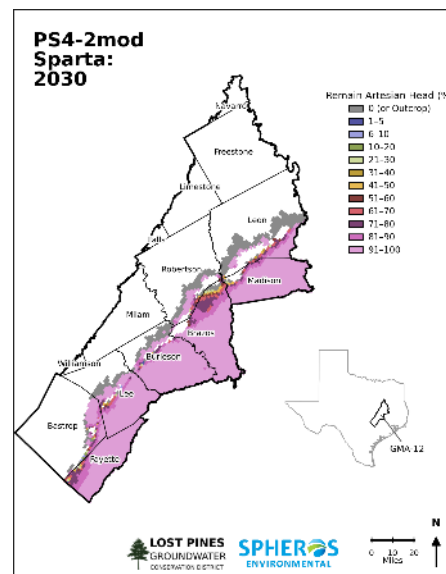
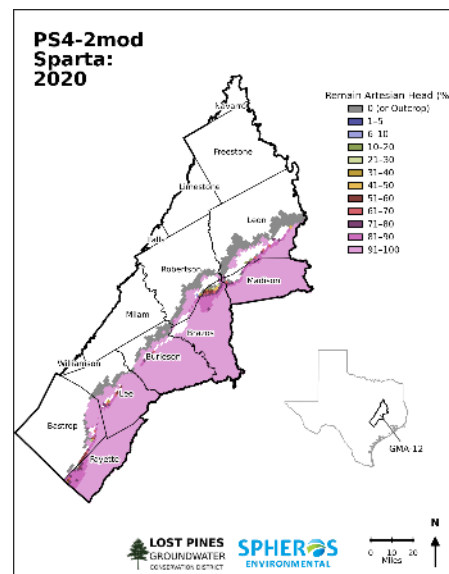
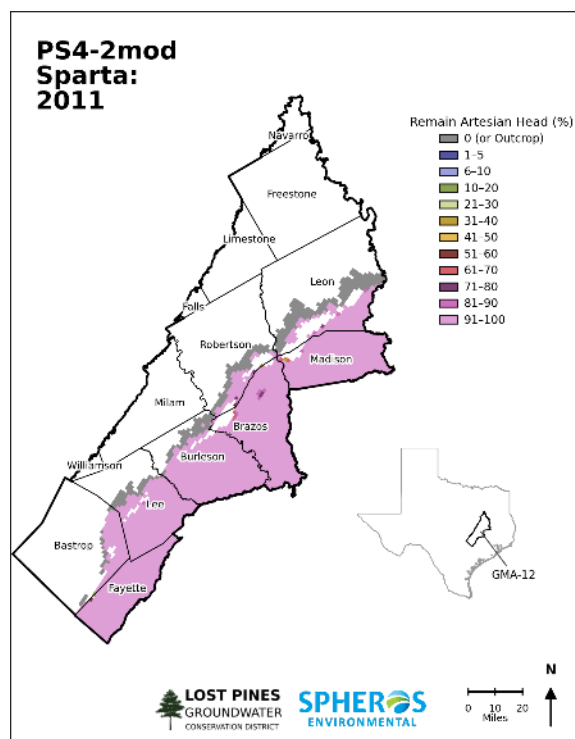
PS4-2mod Drawdown Hooper Aquifer

Central SP-QC-CW GAM v.3.02
Layer 10



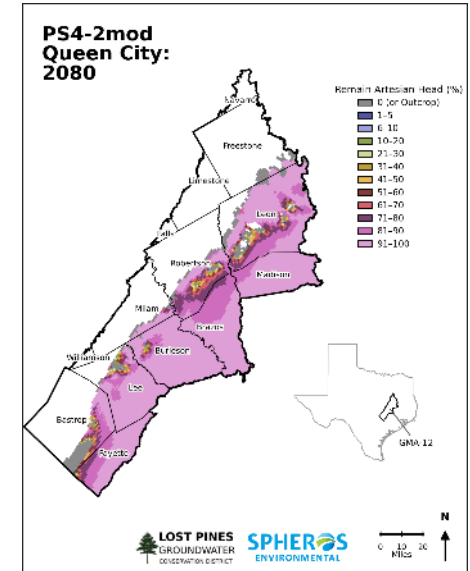
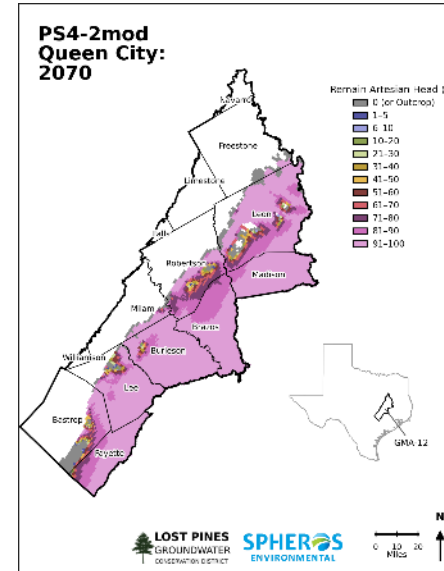
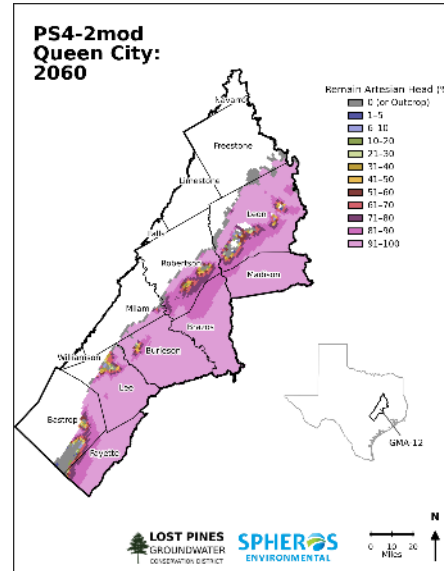
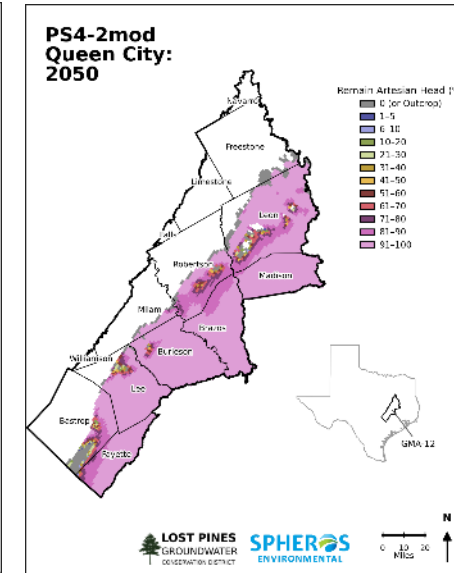
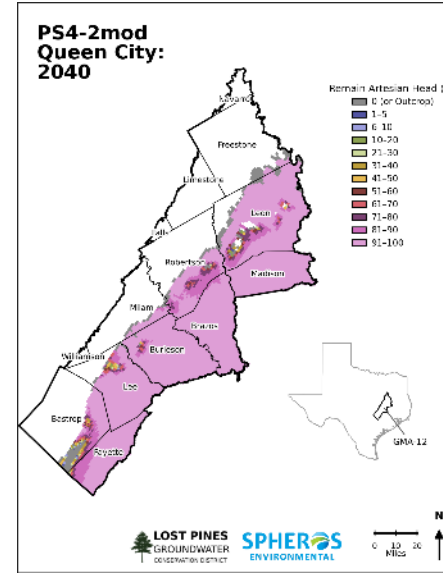
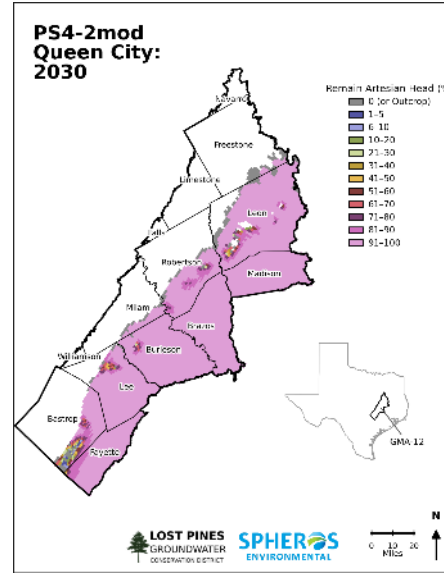
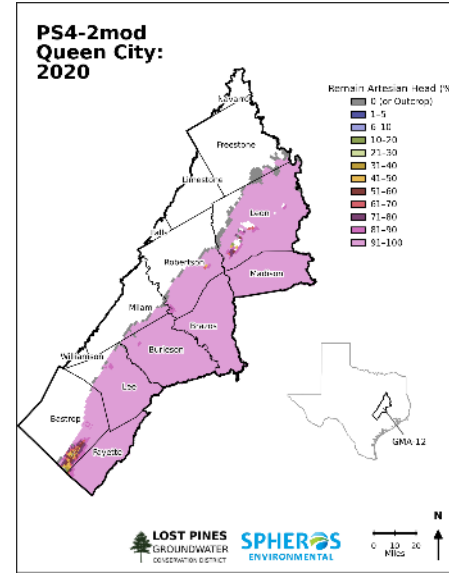
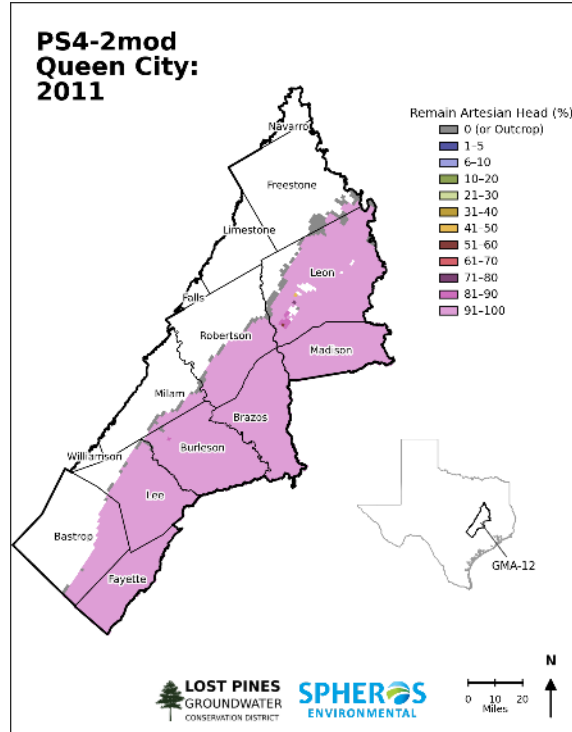
PS4-2mod Artesian Head Sparta Aquifer

Central SP-QC-CW GAM v.3.02
Layer 3



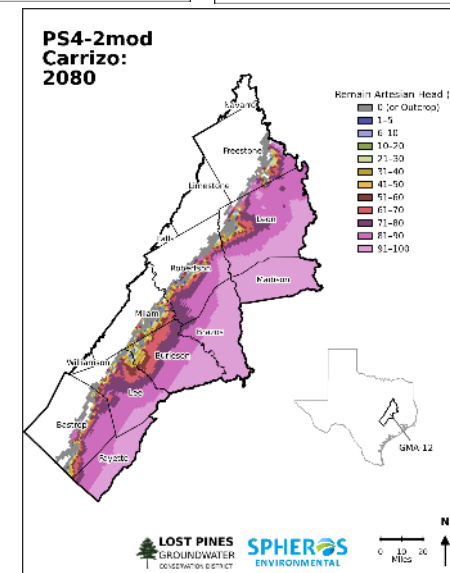
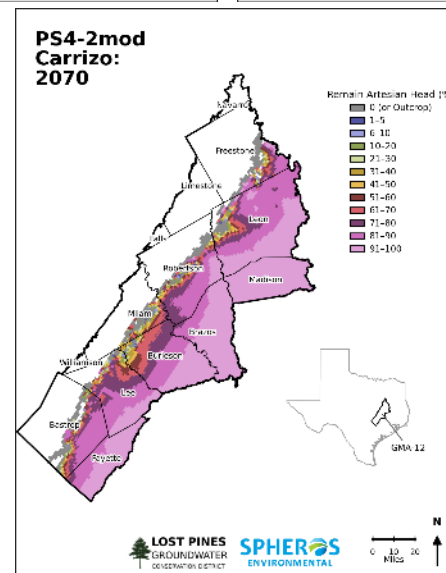
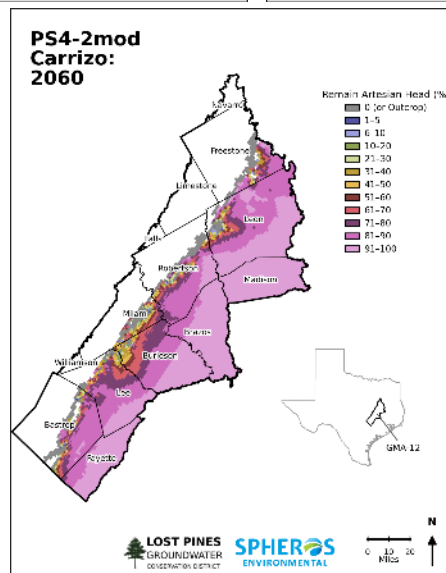
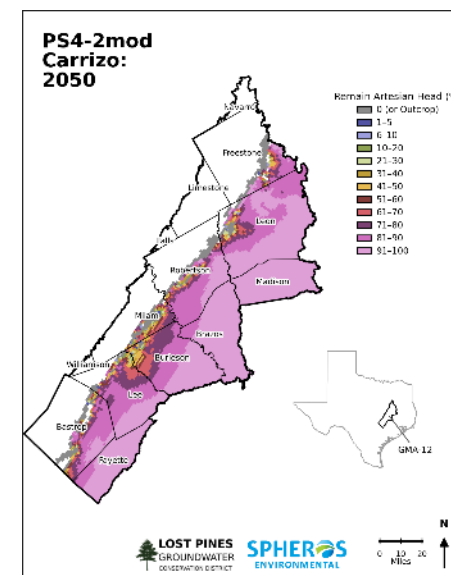
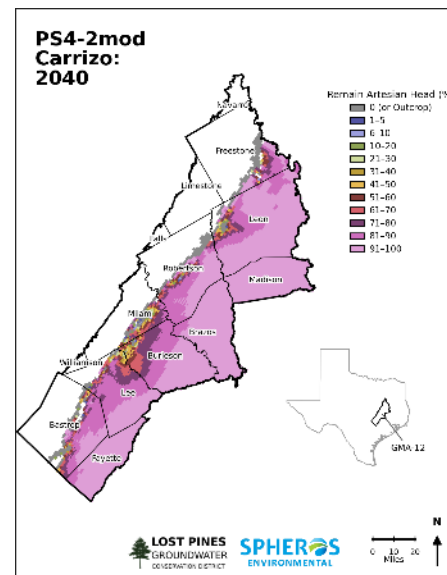
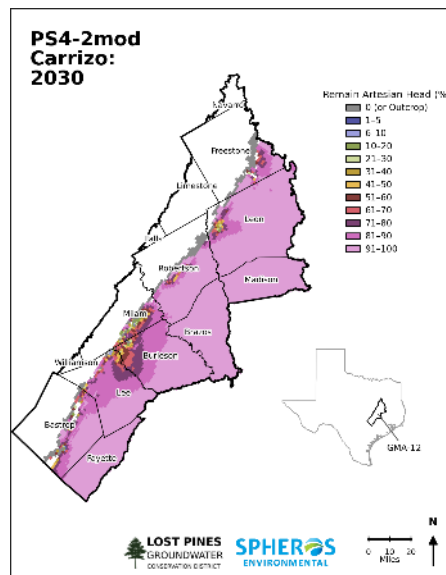
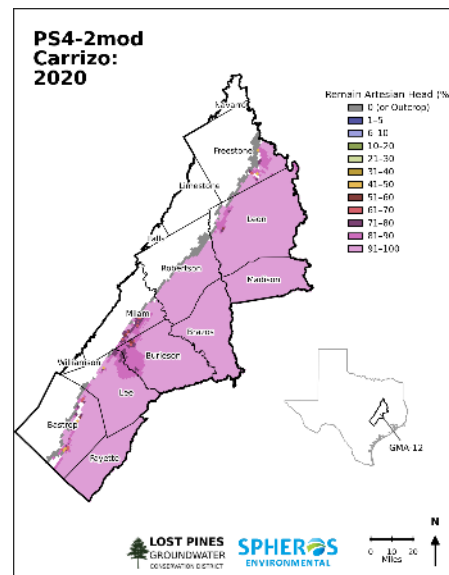
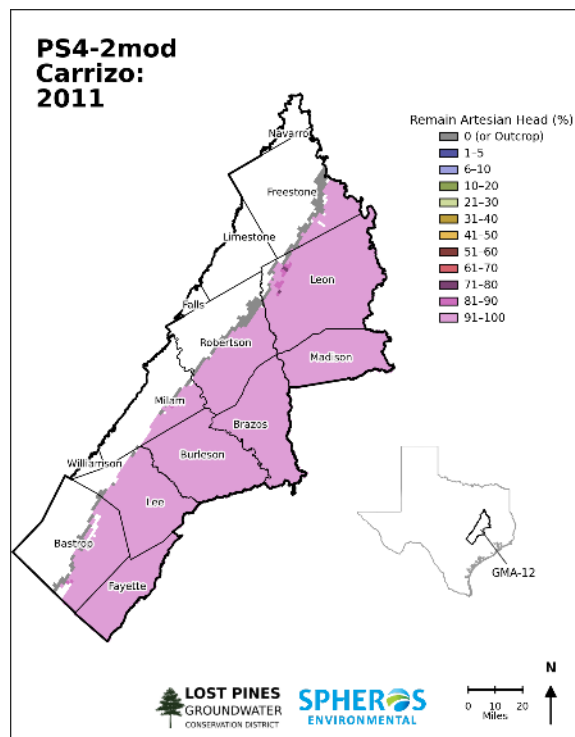
PS4-2mod Artesian Head Queen City Aquifer

Central SP-QC-CW GAM v.3.02
Layer 5



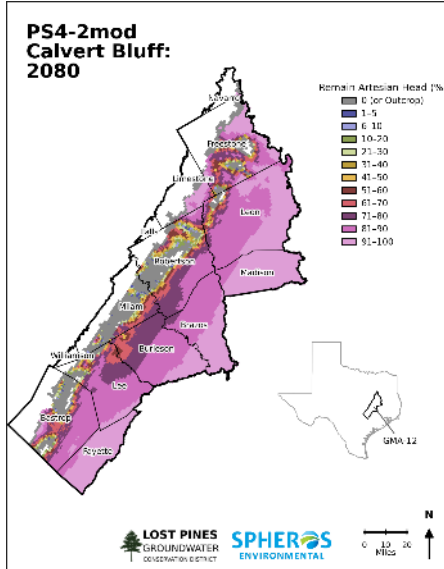
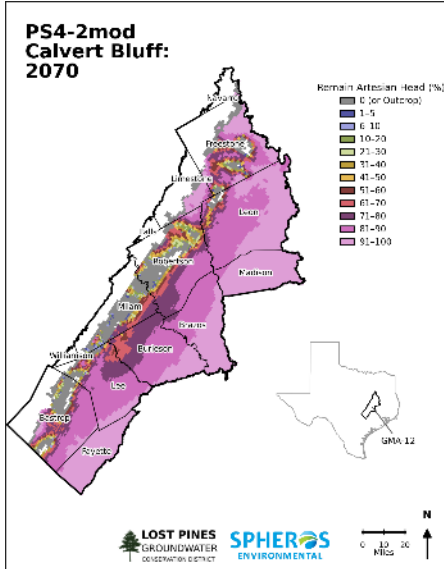
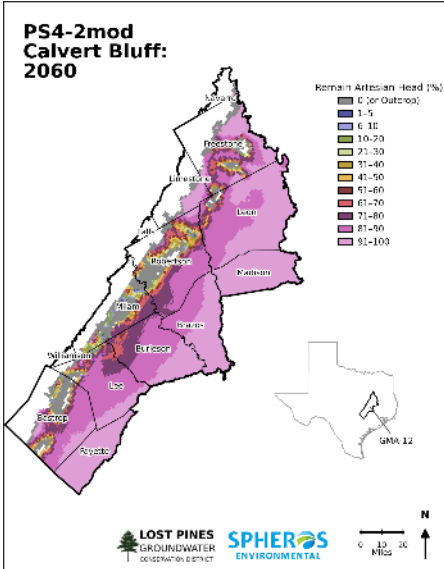
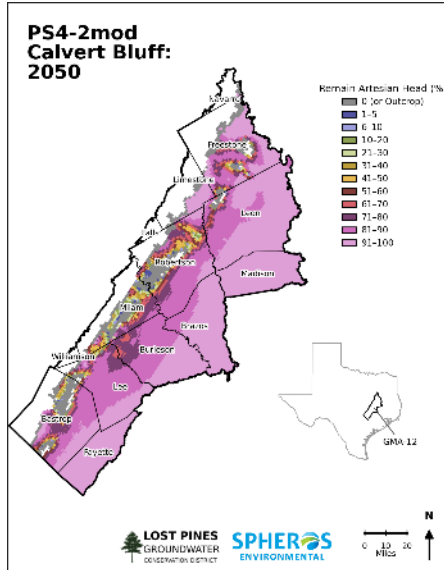
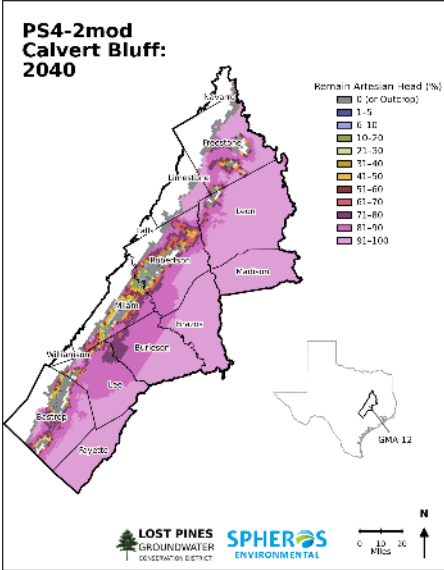
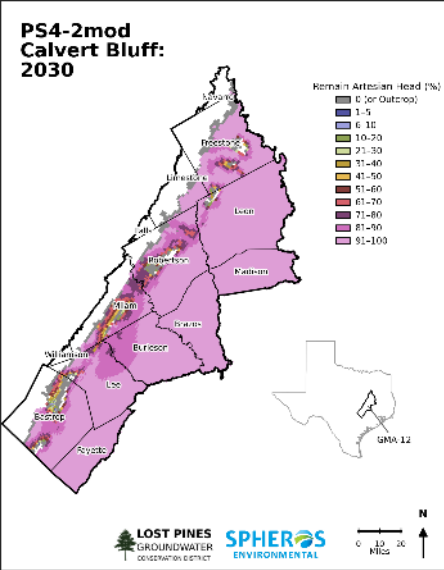
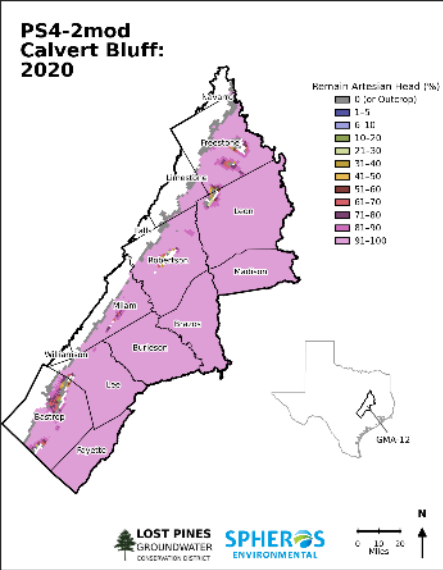
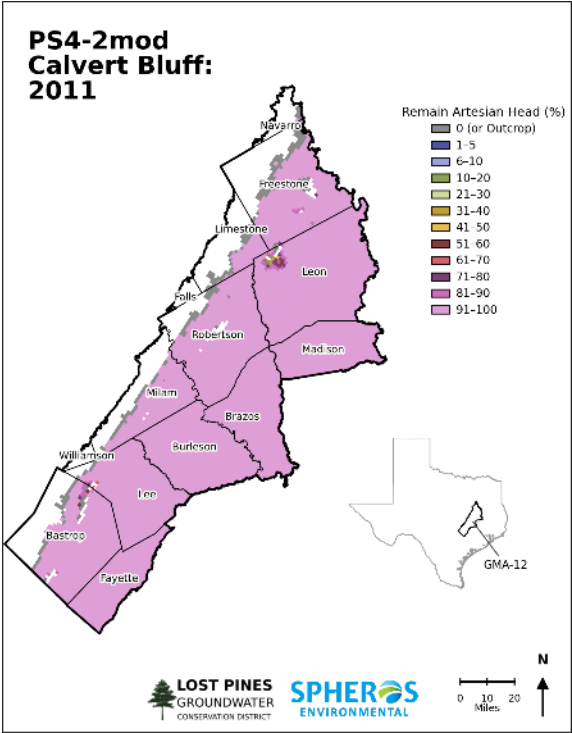
PS4-2mod Artesian Head Carrizo Aquifer

Central SP-QC-CW GAM v.3.02
Layer 7



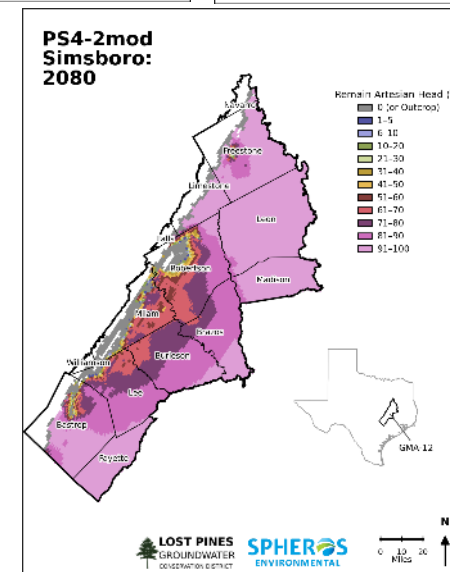
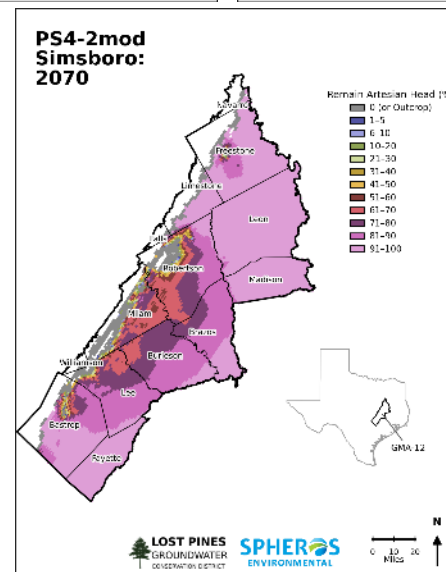
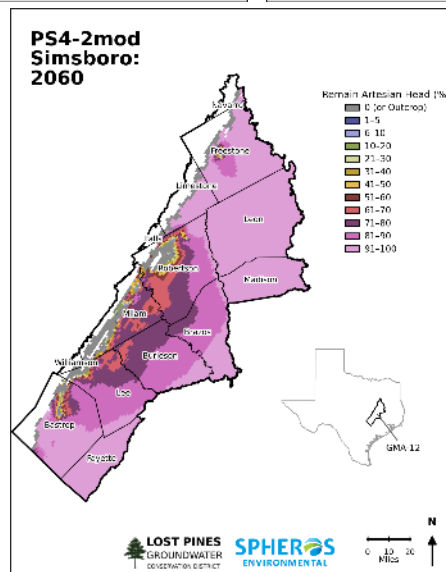
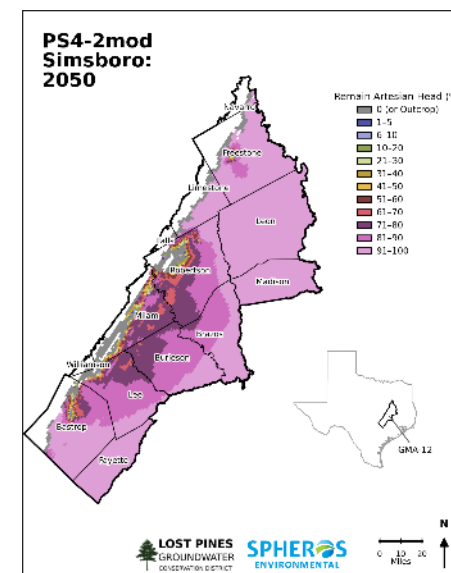
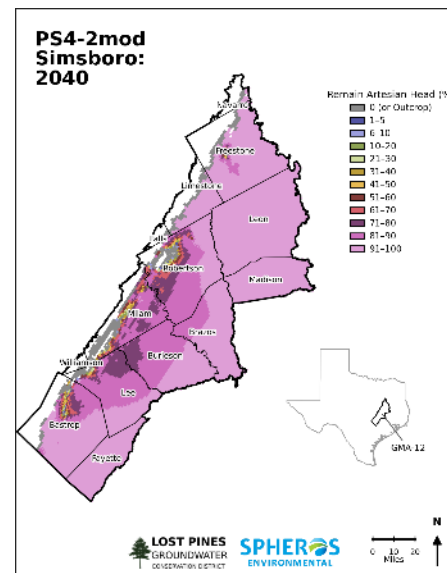
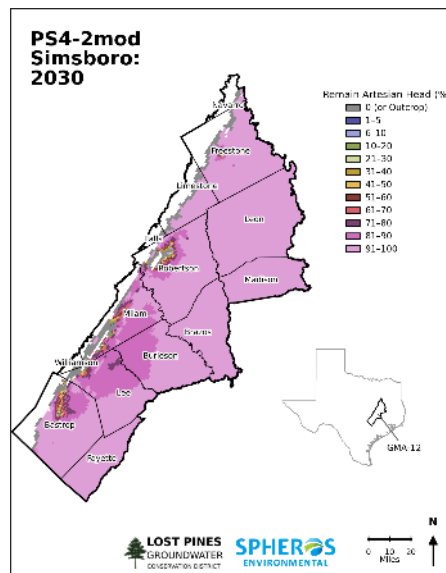
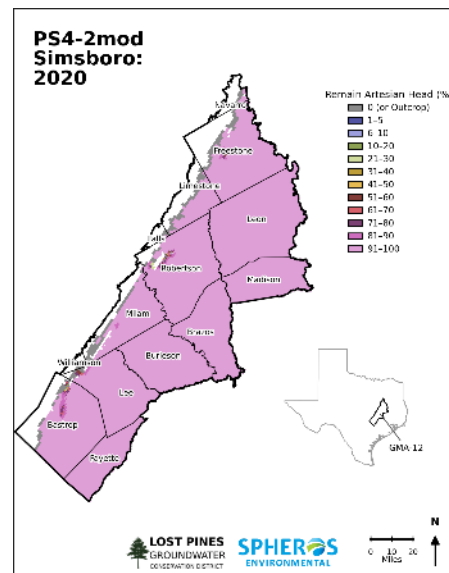
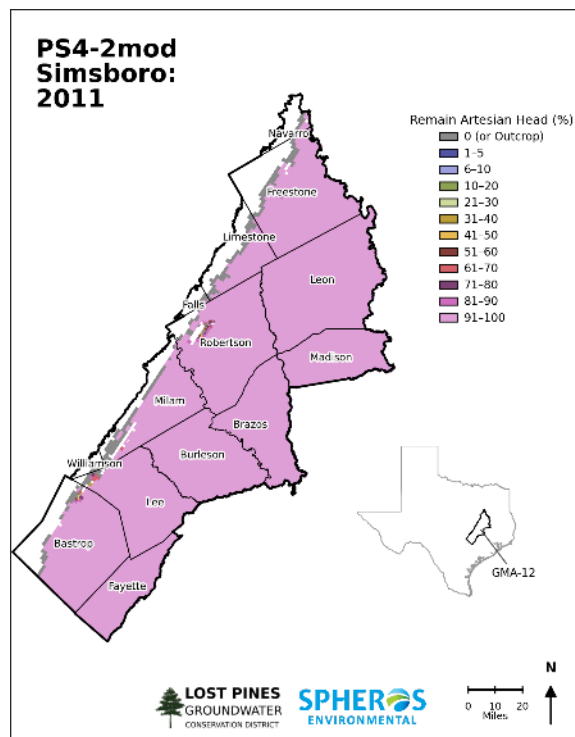
PS4-2mod Artesian Head Calvert Bluff Aquifer

Central SP-QC-CW GAM v.3.02
Layer 8



PS4-2mod Artesian Head Simsboro Aquifer

Central SP-QC-CW GAM v.3.02
Layer 9



PS4-2mod Artesian Head Hooper Aquifer

Central SP-QC-CW GAM v.3.02
Layer 10

