

GMA12 Joint Planning

Documentation of Approach Used to Calculate Average Drawdowns for Desired Future Conditions

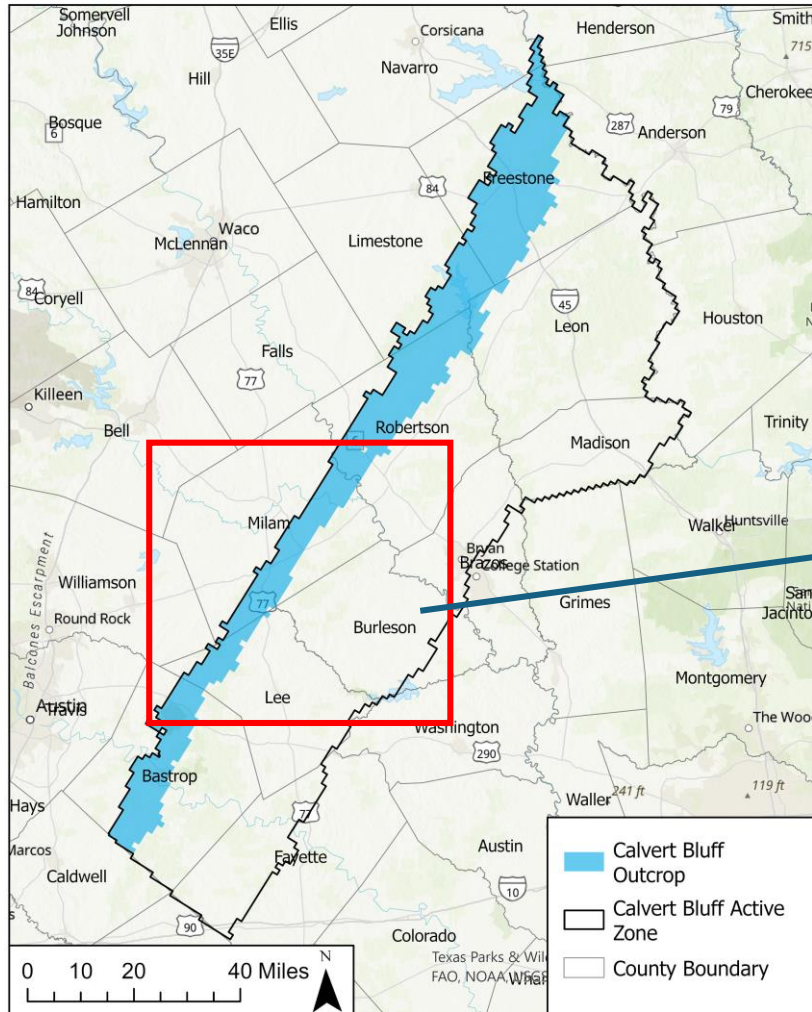
January 22, 2026

Outline

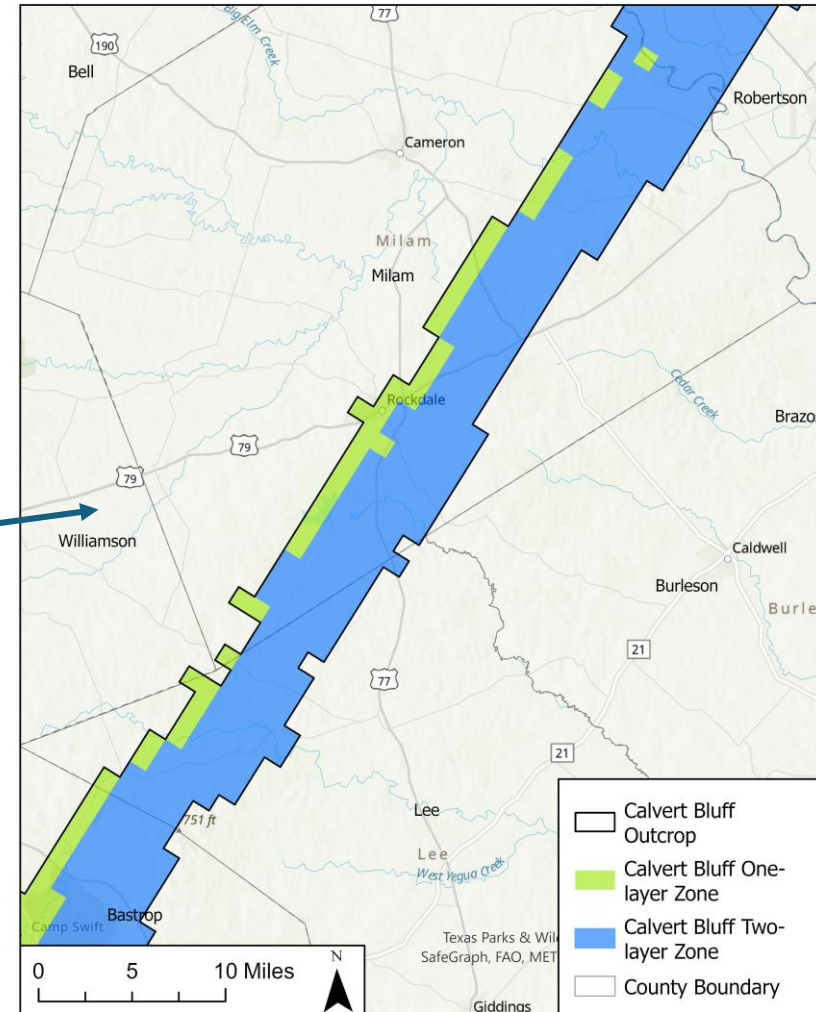
- Review Assumptions for DFC Calculations
 - Sept 3, 2025 notes
 - High Level Review
- Potential Issues with TWDB Grid File
 - Location of Inactive Cells in Outcrops
 - Assignment of grid cells to County
- Excel Application
 - Approach
 - Comparison

Example Aquifer: Calvert Bluff

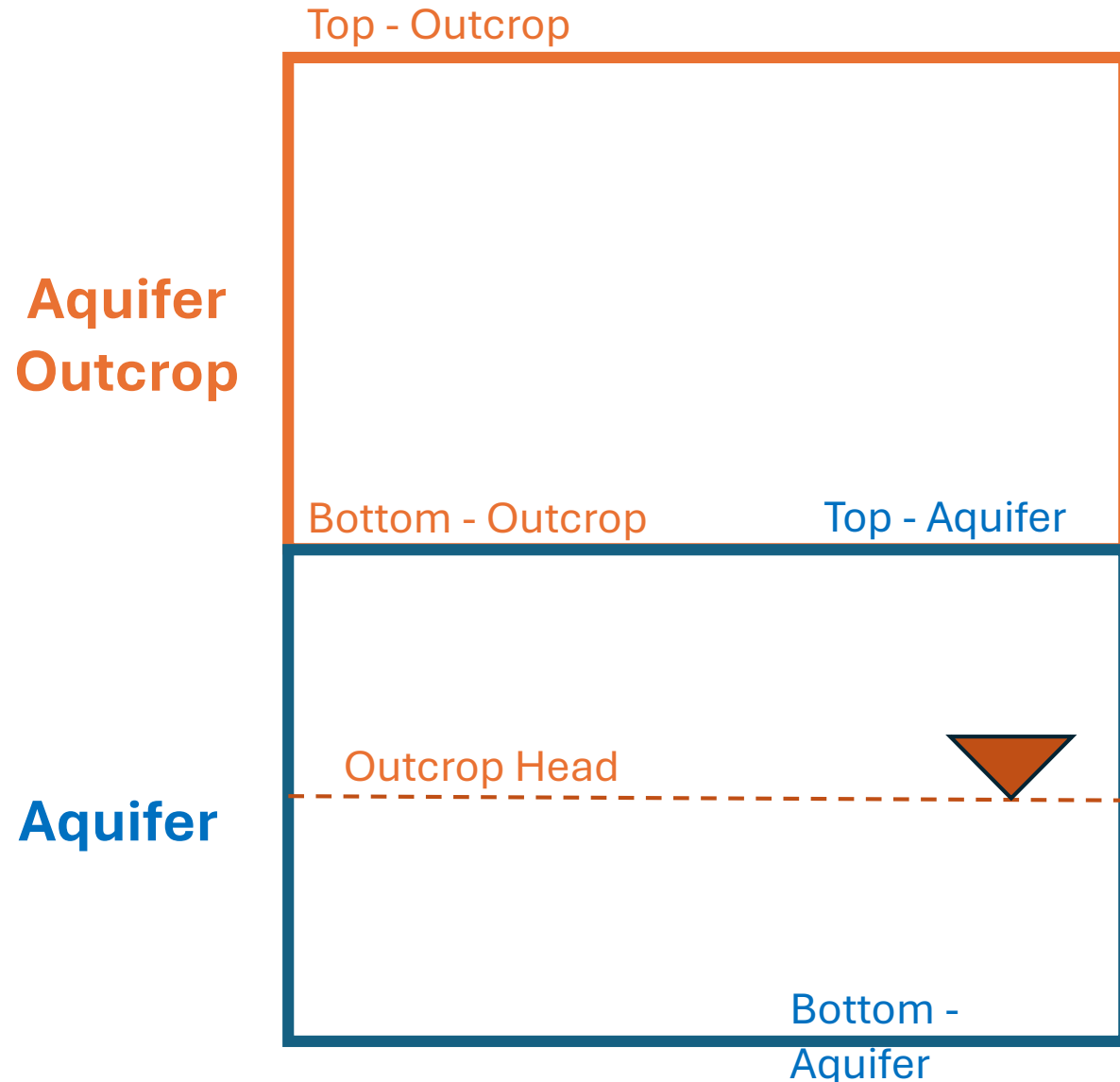
**GMA 12 model
Outcrop**



**Inset
Aquifer Composition**



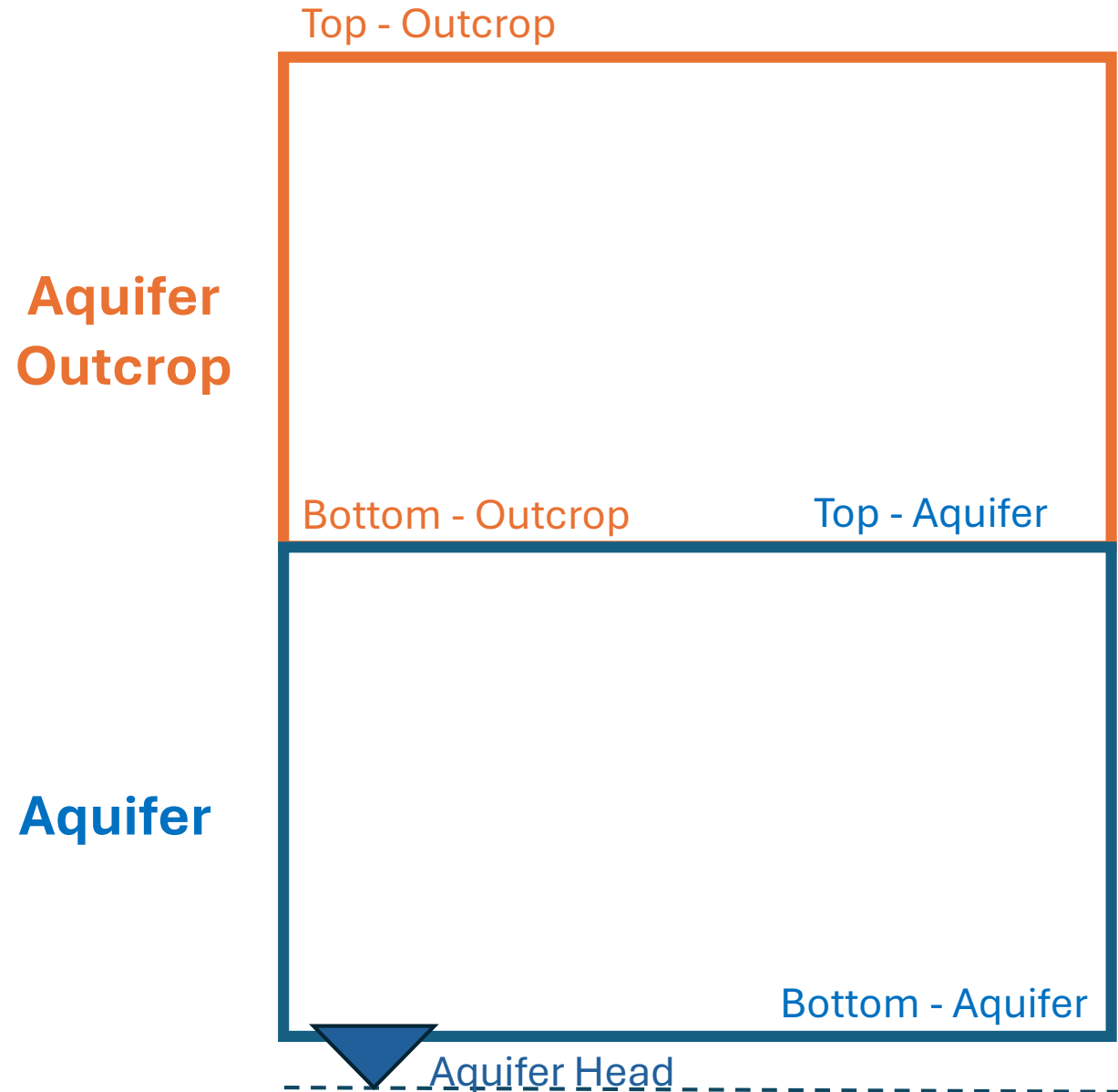
Case for 2 Layers: Water Table below Outcrop Bottom and Above Aquifer Bottom



When the outcrop head ($h_{outcrop}$) is below the outcrop bottom elevation, the final head (h) defaults to the aquifer head ($h_{aquifer}$)

$$h = h_{aquifer}$$

Case for 2 Layers: Aquifer Water Table Below Aquifer bottom

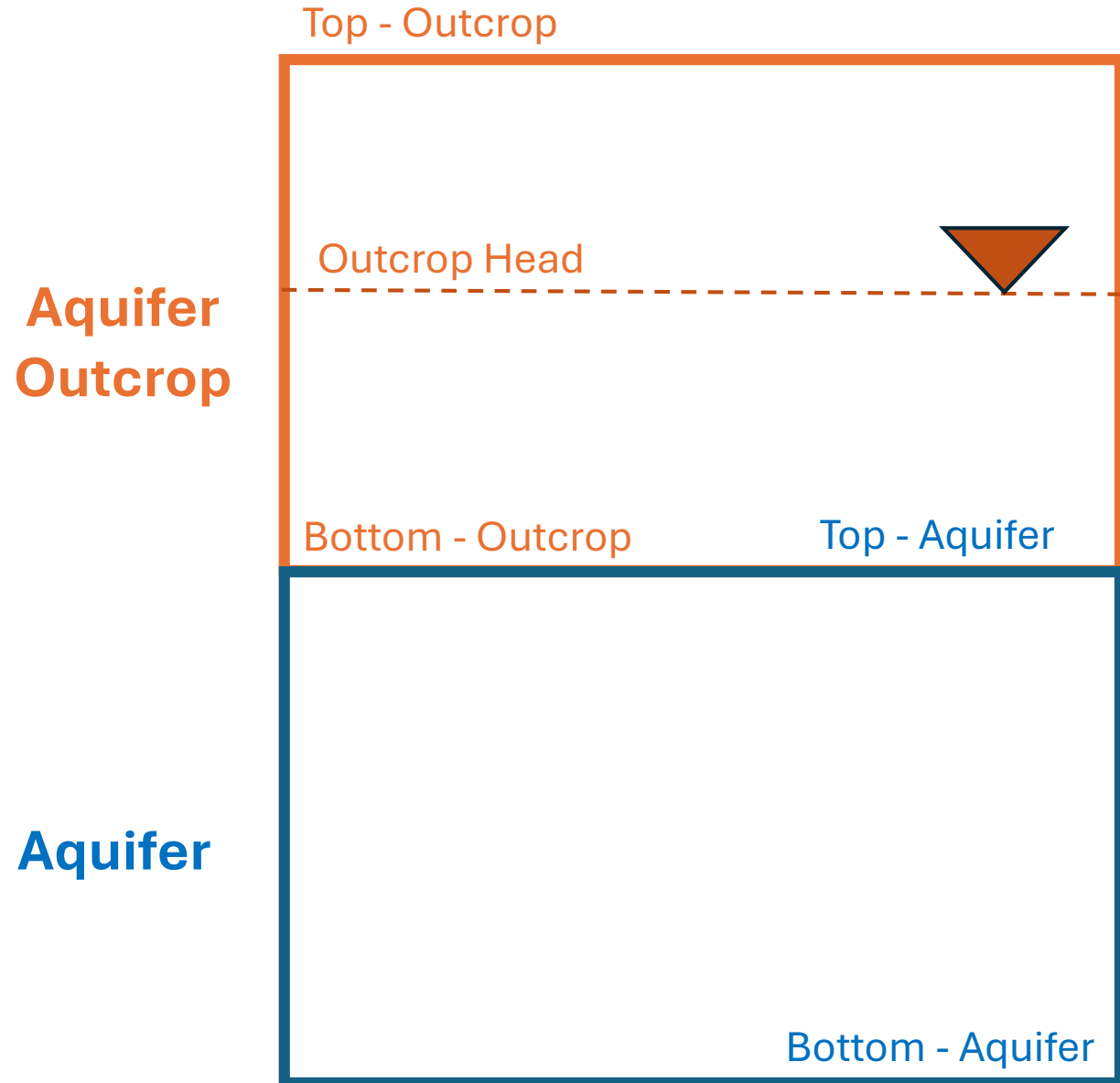


When the aquifer head ($h_{outcrop}$) is below the aquifer bottom elevation ($b_{aquifer}$), the final head (h) defaults to the aquifer bottom elevation ($b_{aquifer}$)

if $h_{aquifer} < b_{aquifer}$, then:

$$h = b_{aquifer}$$

Case for 2 Layers : Water Table above Outcrop Bottom



When outcrop head ($h_{outcrop}$) is above the outcrop bottom elevation ($b_{outcrop}$), the final head (h) is a weighted average of aquifer head ($h_{aquifer}$) and outcrop head ($h_{outcrop}$).

if $h_{outcrop} > b_{outcrop}$, then:

$$h = \frac{h_{outcrop} \times weight_{outcrop} + h_{aquifer} \times weight_{aquifer}}{weight_{outcrop} + weight_{aquifer}}$$

Options for Weights:

- Transmissivity
- Saturated Thickness
- Layer Thickness
- No Weighting

General Workflow

- Delineate the active zone using active cells (TDS < 3000 mg/L) in TWDB model grid file for each aquifer (Carrizo, Calvert Bluff, Simsboro, Hooper);
- Locate zones with two model layers (Layer 2 and the layer below) for each aquifer;
- Average the simulated head/drawdown of layer 2 and the layer below in the two-layer zones; Uses three methods for averaging:
 - No weighting
 - **Weighted by Transmissivity**
 $weight = Transmissivity$
 - Weighted by Saturated Thickness

$$weight = Saturated\ Thickness = h_{aquifer} - b_{aquifer},$$

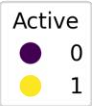
Where $h_{aquifer}$ represents the aquifer head, and $b_{aquifer}$ represents the aquifer bottom elevation

- Calculate averaged drawdown for DFC, drawdown calculation for the target zones is weighted by model grid size, from January 2011 to December 2069.

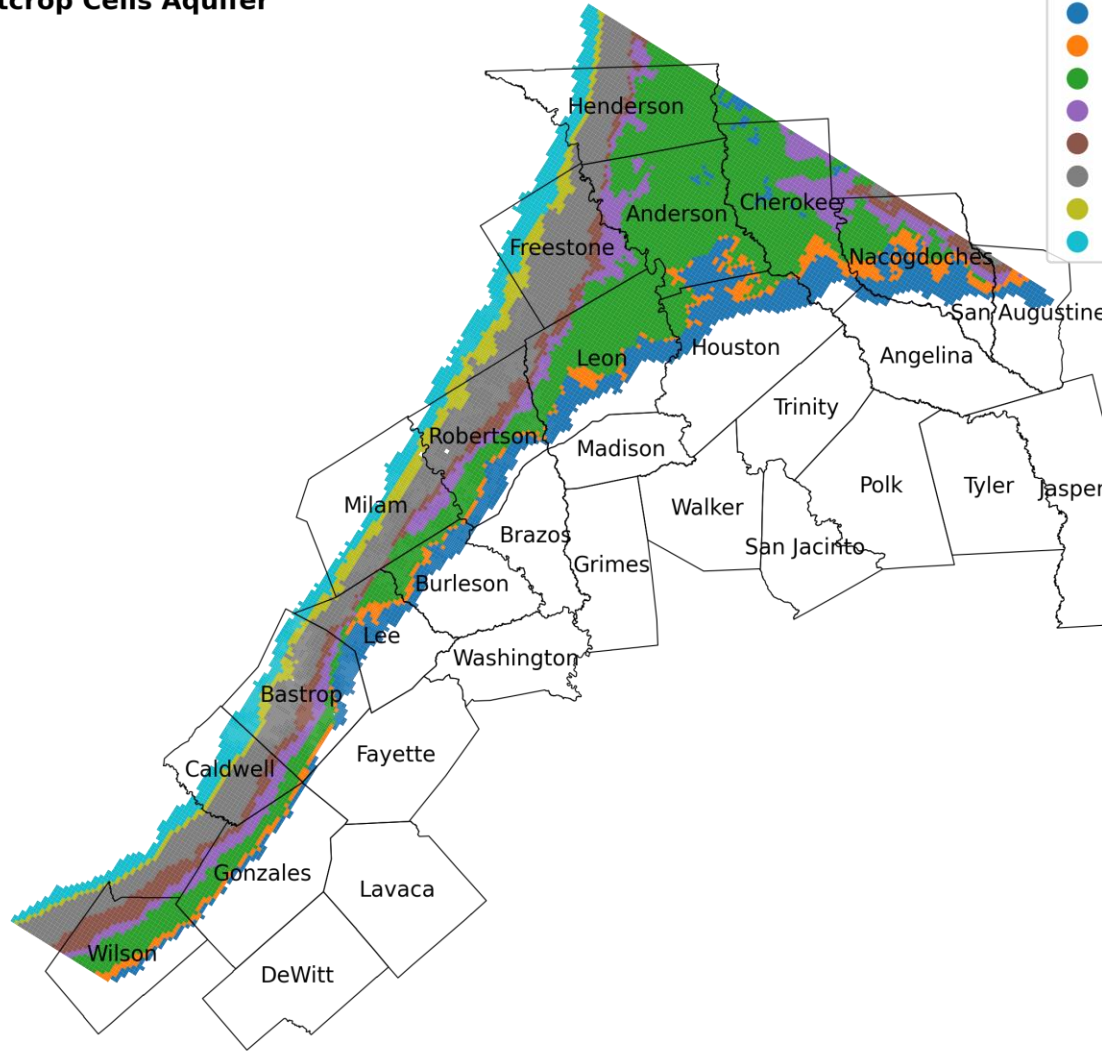
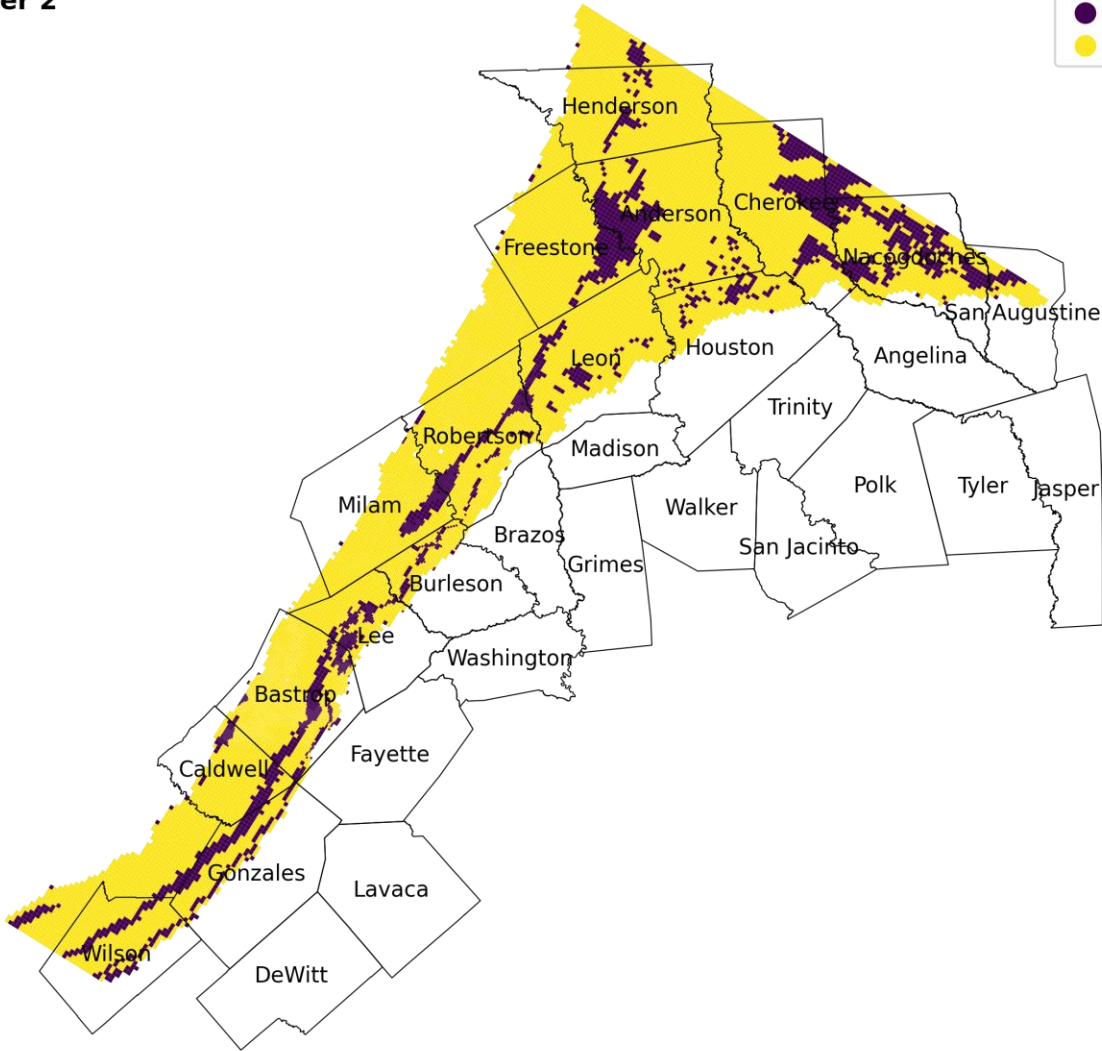
Potential Issues with TWDB Grid File

Location of inactive cells in Outcrop

Layer 2

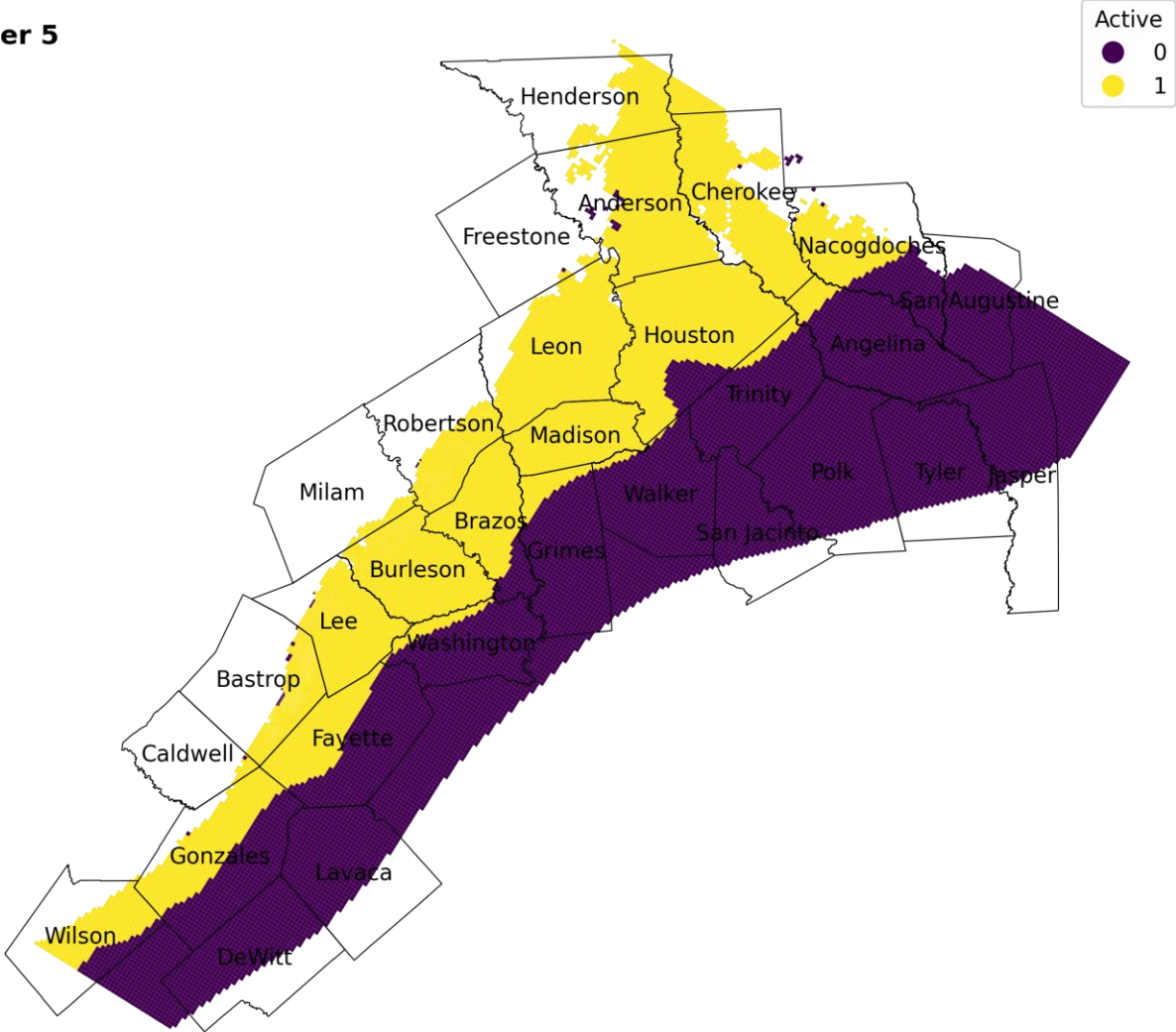


Outcrop Cells Aquifer

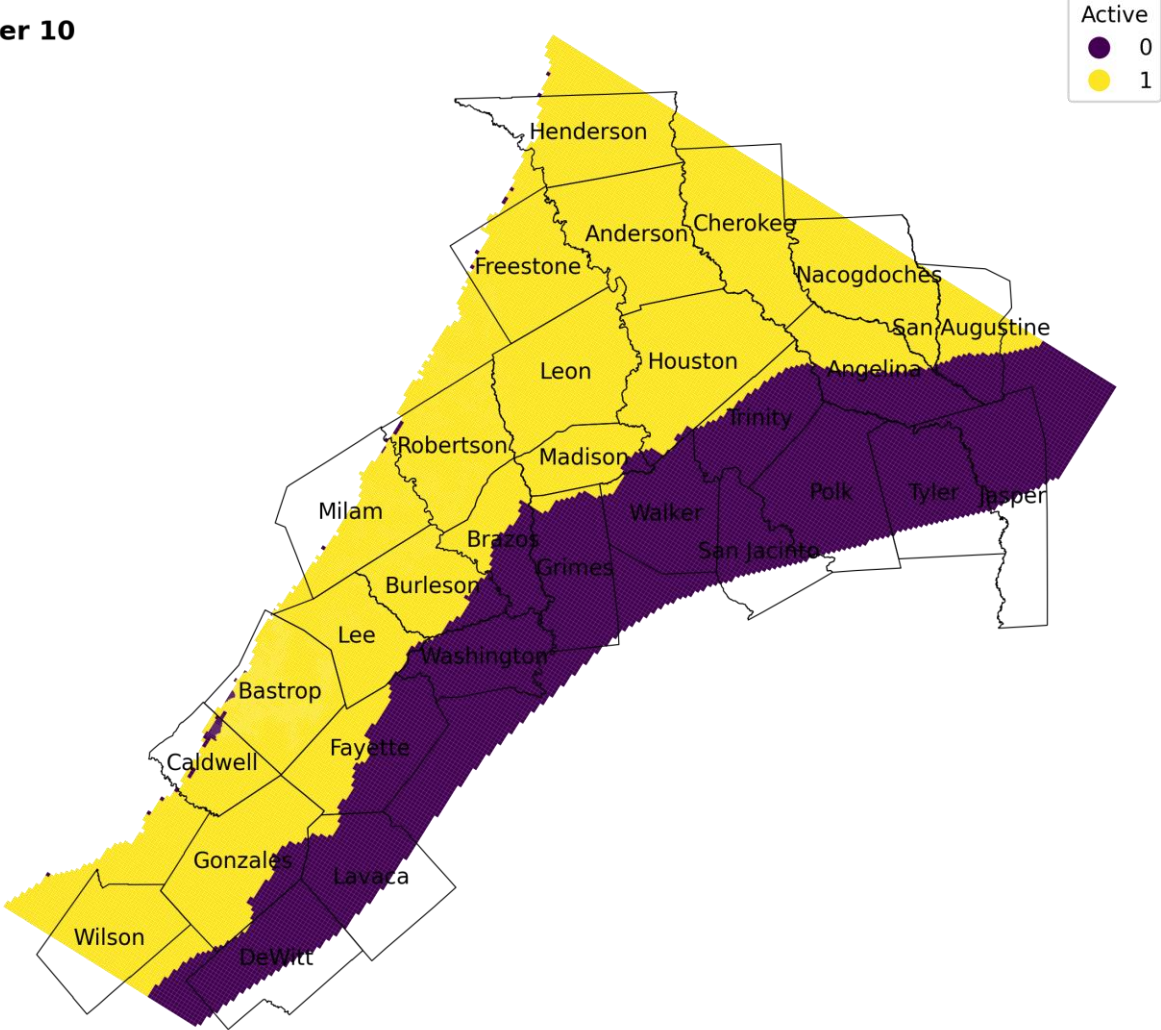


Location of inactive cells in Aquifers

Layer 5

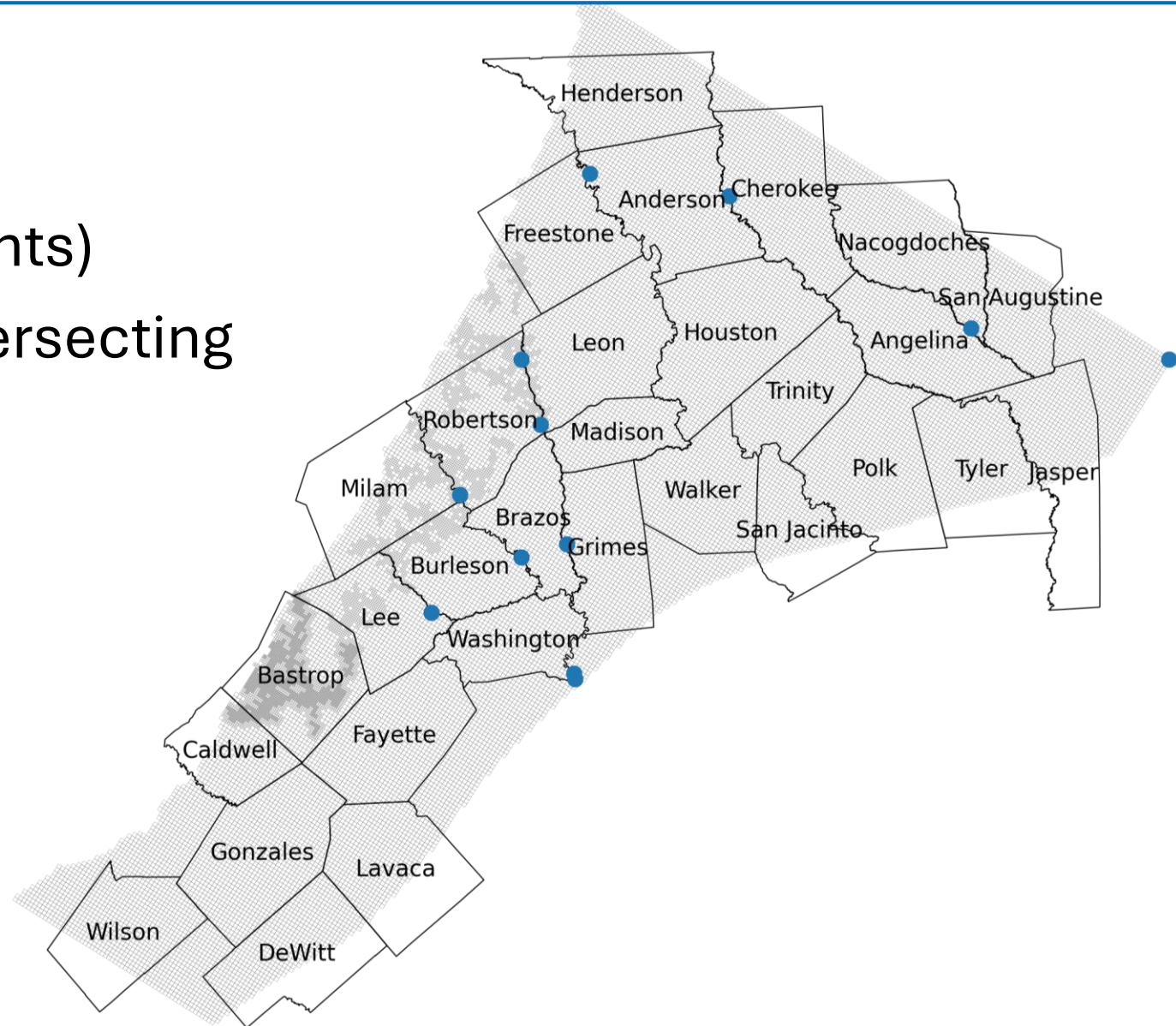


Layer 10



County Mismatch

- 11 Locations (blue points)
- Affects all aquifers intersecting the locations.



Excel Application

Spreadsheet structure

	A	B	C
1	# nodes	767	
2	# Outcrop Cells	215	
3	# Paired Outcrop Cells	65	
4	# Aquifer Cells w/o Paired	637	
5	# Dry Paired Outcrop Cells - head start	0	
6	# Dry Paired Outcrop Cells - head end	0	
7	# Dry Aquifer w/o Paired Cells - head start	0	
8	# Dry Aquifer w/o Paired Cells - head end	0	
9	Average Head Start	258.3321	feet
10	Average Head End	213.5409	feet
11	Average Drawdown	44.7912	feet
12			
13			
14			
15			
16			
17			
18			

< > readme data main OutcropCells AquiferCells Results +

- **Readme:** Information and Instructions
- **Data:** all data associated to the model grid
- **Main:** main sheet, core for calculations
- **OutcropCells:** Calculations for outcrop grid cells “paired” with an aquifer cell.
- **AquiferCells:** Calculations for aquifer cells without paired nodes
- **Results:** Summary of results for Outcrop grid cells, aquifer cells, paired cells, dry cells, average heads *weighted by transmissivity* and drawdown.

Applications

		Spreadsheet	INTERA's script	Difference
POSGCD	Sparta	44.79122536	44.7577	0.0335
	Weches	0.8258	0.8258	0.0000
	Queen City	28.1616	28.1169	0.0446
	Reklaw	20.0748	20.0748	0.0000
	Carrizo	161.1963	161.1406	0.0557
	Calvert Bluff	175.8654	175.7507	0.1147
	Simsboro	350.9288	350.7465	0.1823
	Hooper	216.5223	216.4331	0.0892
METGCD	Sparta	28.0144	28.0225	-0.0081
	Weches	4.2210	4.2210	0.0000
	Queen City	22.4023	22.4036	-0.0013
	Reklaw	7.3440	7.3440	0.0000
	Carrizo	47.0950	47.0953	-0.0004
	Calvert Bluff	60.9267	60.9548	-0.0280
	Simsboro	86.5453	86.5719	-0.0266
	Hooper	76.4575	76.4767	-0.0192

		Spreadsheet	INTERA's script	Difference
BVGCD	Sparta	53.6810	53.7067	-0.0258
	Weches	7.9455	7.9455	0.0000
	Queen City	44.0086	44.0190	-0.0104
	Reklaw	7.7044	7.7044	0.0000
	Carrizo	78.7442	78.7327	0.0116
	Calvert Bluff	110.4808	110.4635	0.0173
	Simsboro	270.7840	270.7580	0.0259
	Hooper	177.0099	177.0043	0.0056
LPGCD	Sparta	20.4472	20.4541	-0.0069
	Weches	6.8744	6.8744	0.0000
	Queen City	25.2248	25.2252	-0.0004
	Reklaw	15.3435	15.3435	0.0000
	Carrizo	120.4888	120.5933	-0.1045
	Calvert Bluff	125.5846	125.7149	-0.1303
	Simsboro	241.6585	241.8623	-0.2038
	Hooper	135.3561	135.4738	-0.1177
Fayette	Sparta	41.9574	41.9574	0.0000
	Weches	-	-	-
	Queen City	69.7782	69.7782	0.0000
	Reklaw	-	-	-
	Carrizo	131.7412	131.7412	0.0000
	Calvert Bluff	140.9887	140.9887	0.0000
	Simsboro	226.2797	226.2797	0.0000
	Hooper	121.3217	121.3217	0.0000