Preliminary Differences Between the Previous and Updated GAMs and the Impact on DFCs and MAGs

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October 17, 2018

What is a GAM?

- Groundwater Availability Model
- Regional three-dimensional groundwater flow model
- Carrizo-Wilcox GAM developed in 2001
- Replaced by the Queen City-Sparta GAM in 2004

The Previous GAM

- MODFLOW
- Uniform one-mile grid spacing
- Eight Layers
- Very flow restrictive to sometimes sealing faults
- Calibration 1980-1999

The Updated GAM

- MODFLOW-USG (unstructured grid)
- Non-uniform grid
- Ten layers
- Updated faults so not sealing
- Calibration 1930-2010

Model Differences

- Addition of two new model layers:
  - River alluvium
  - Shallow groundwater flow system
- Updating of location and characteristics of faults
- Calibration time period 1930-2010
- Grid refinement around rivers and streams
- Improving surface water-groundwater interactions *(grid refinement, two new layers)*
- Some localized changes in aquifer properties and structure

Approved DFCs

GCD or County	Average Aquifer Drawdown (ft) measured from January 2000 through December 2069					
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
BVGCD	12	12	61	125	295	207
FCGCD	47	64	110	Declared as non-relevant		
LPGCD	5	15	62	100	240	165
METGCD	5	2	80	90	138	125
POSGCD	28	30	67	149	318	205
Falls	--	--	--	--	-2	27
Limestone	--	--	--	11	50	50
Navarro	--	--	--	-1	3	3
Williamson	--	--	--	-11	47	69
GMA-12	***16***	***16***	***75***	***114***	***228***	***168***

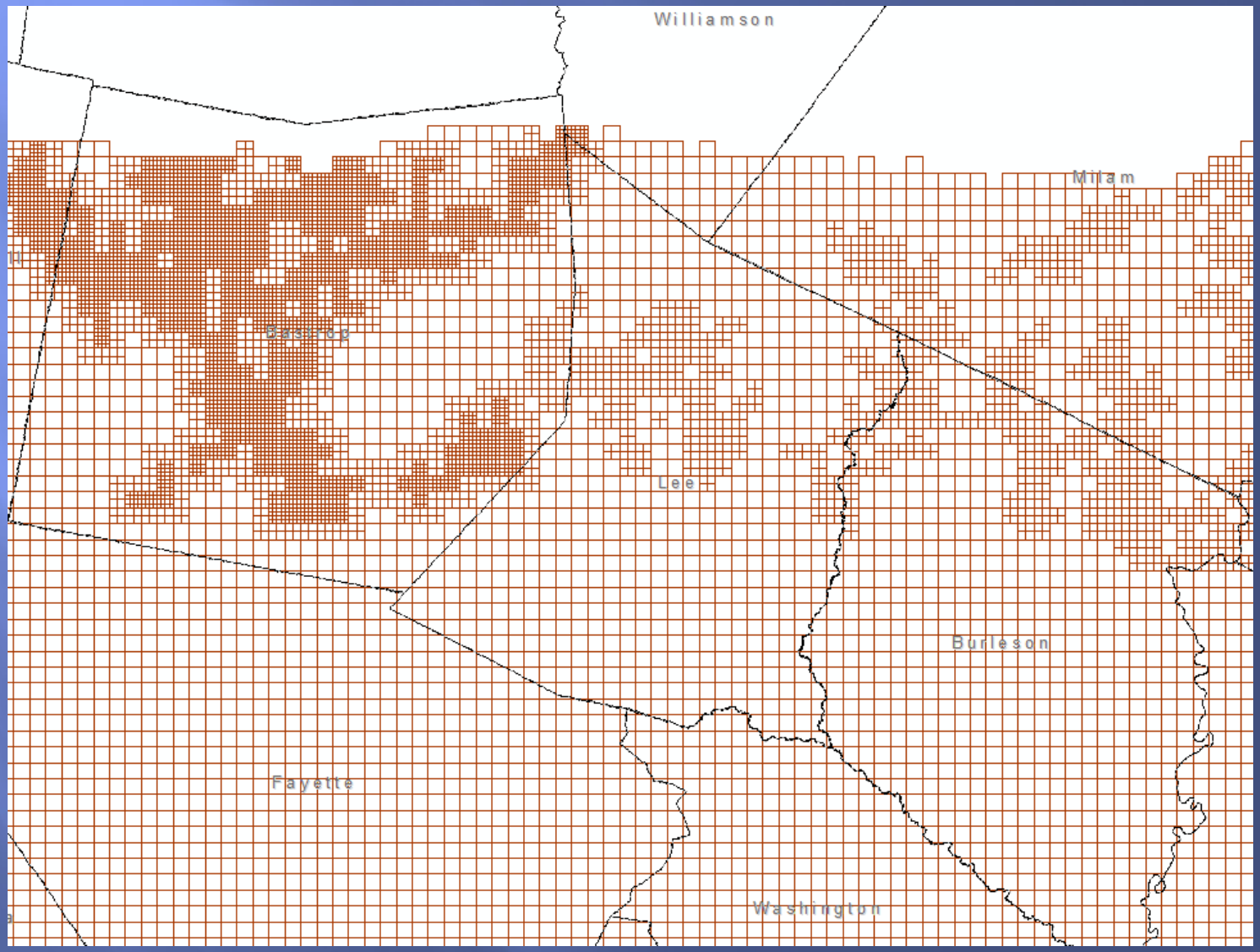
Calibration Time Period

- Previous GAM calibrated from 1980 to 1999
- Predictive run was 2000 to 2070
- All DFC statements were therefore stated as “Drawdowns from January 2000 to [future date]”
- Updated GAM calibrated through 2010
- Predictive run is now 2011 to 2070
- DFC statements will need to be revised

Grid Refinement

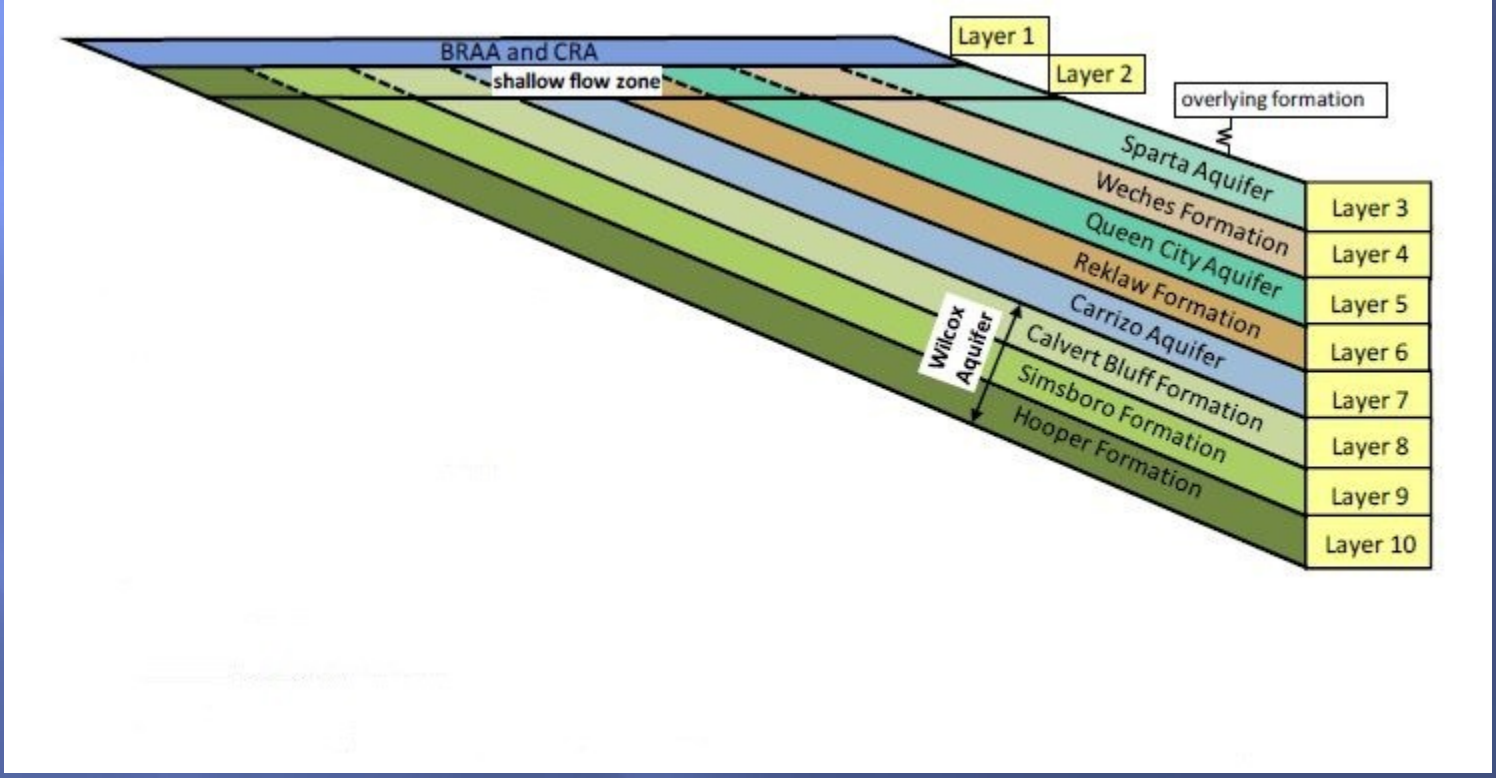
- Original GAM grid was retained
- Grid in the updated GAM was refined around the rivers and streams
- Done to enhance the resolution on surface-water/groundwater interactions
- Selected model cells containing river or streams divided up into either four or sixteen cells
- Refinement was done by converting the previous MODFLOW model to MODFLOW-USG (unstructured grid)

Grid Refinement



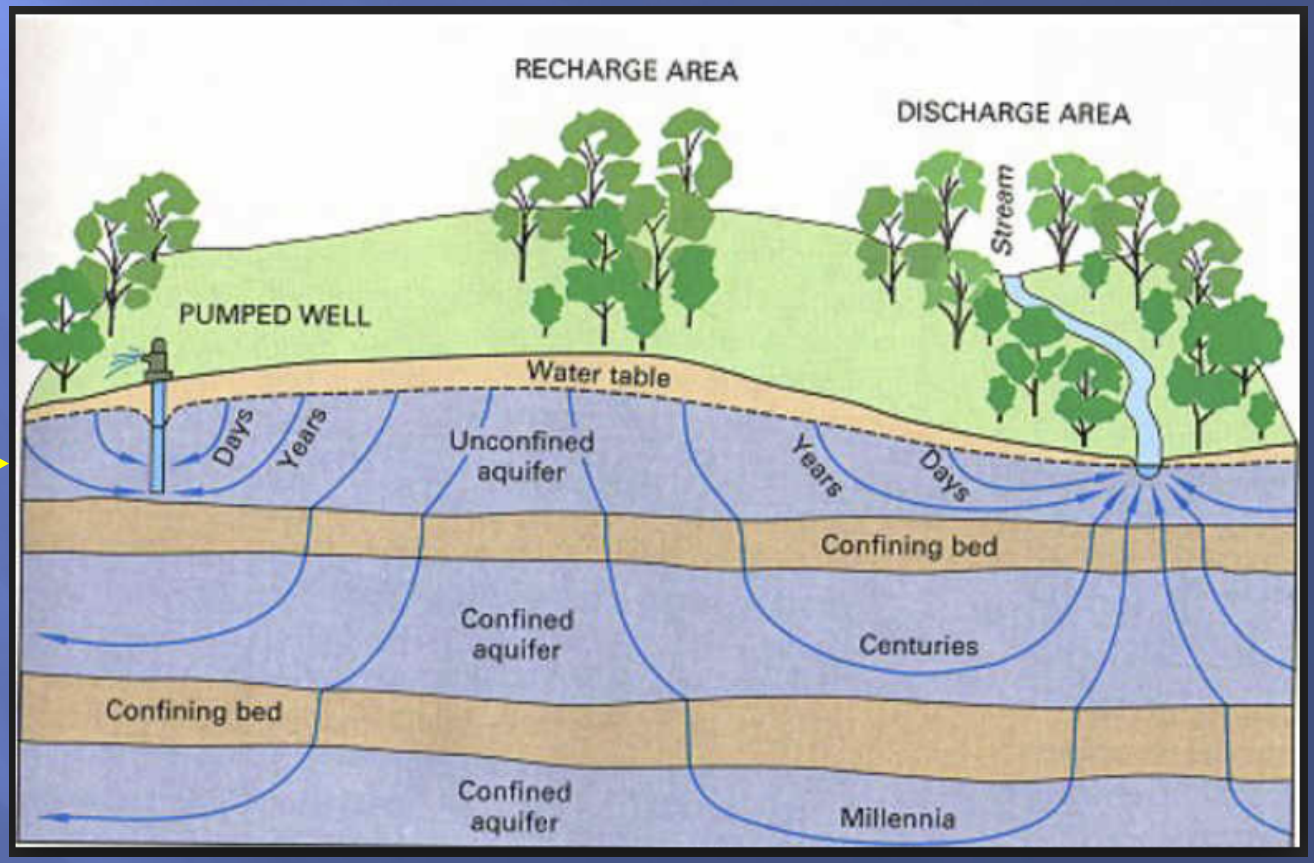
Additional Layers

- Updated GAM includes two new layers
  - Layer 1- River alluvium
  - Layer 2- Shallow groundwater flow systems



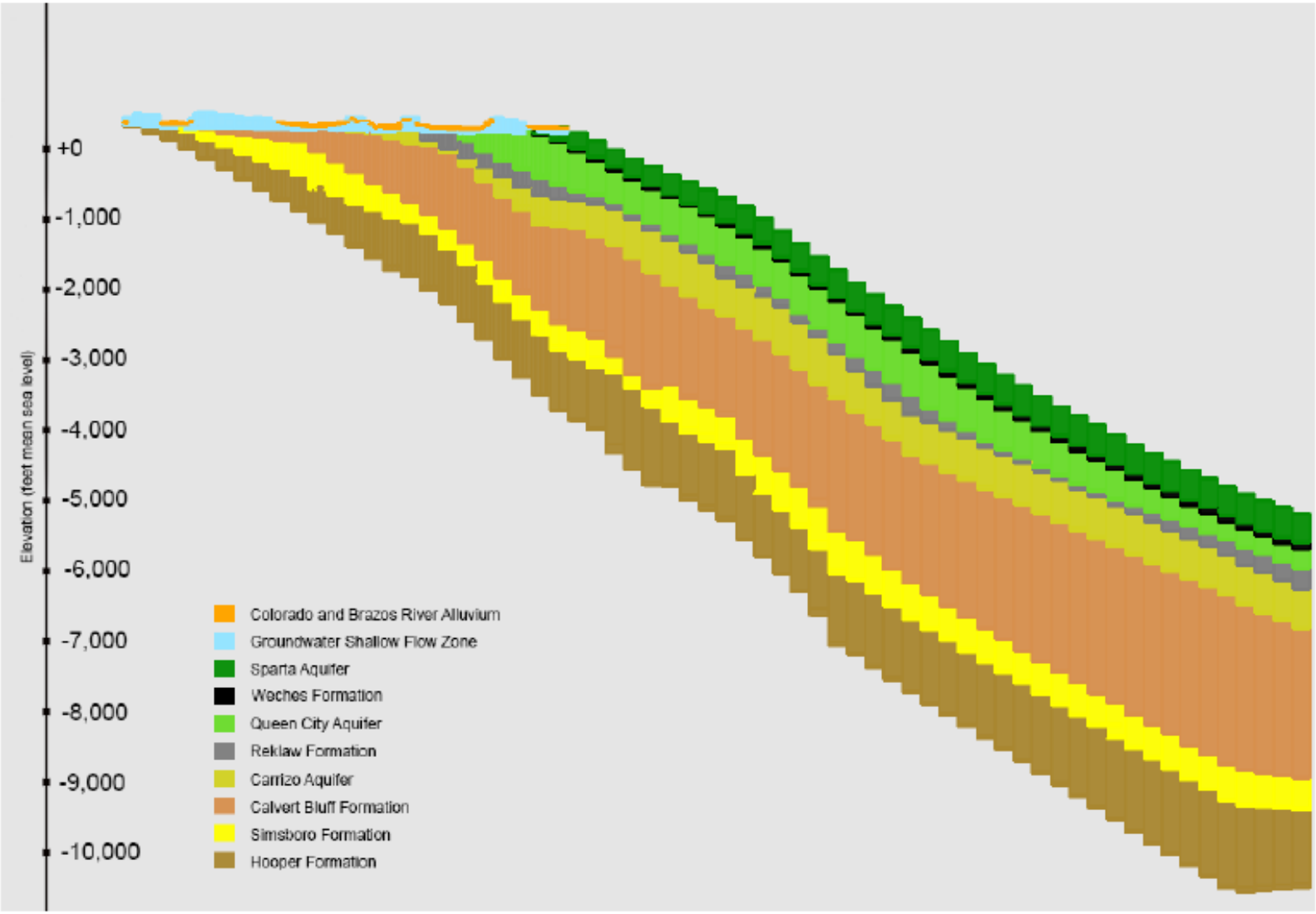
Addition of Layer 2

Layer 2 ⟶



from Winter and others, 1999

Additional Layers



Addition of Layer 1

- Layer 1 is only present for the Brazos and Colorado Rivers
- Adds a significant amount of pumpage to the model which was not previously included because the alluvium was not present in the GAM (mainly in the Brazos River Alluvium)

Addition of Layer 2

- Layer 2 is the shallow flow systems associated with all of the deeper aquifers
- Layer 2 is defined as the land surface or bottom of the alluvium (top) to 25 to 75 feet below the predevelopment water level (bottom)

Results- DFC vs. New GAM

Aquifer	DFC (feet)	Drawdown with New GAM (feet)
Sparta	5	~25
Queen City	15	~25-30
Carrizo	62	~100
Calvert Bluff	100	~85-90
Simsboro	240	~145-150
Hooper	165	~100-105

NOTE: This uses the county-wide average drawdowns

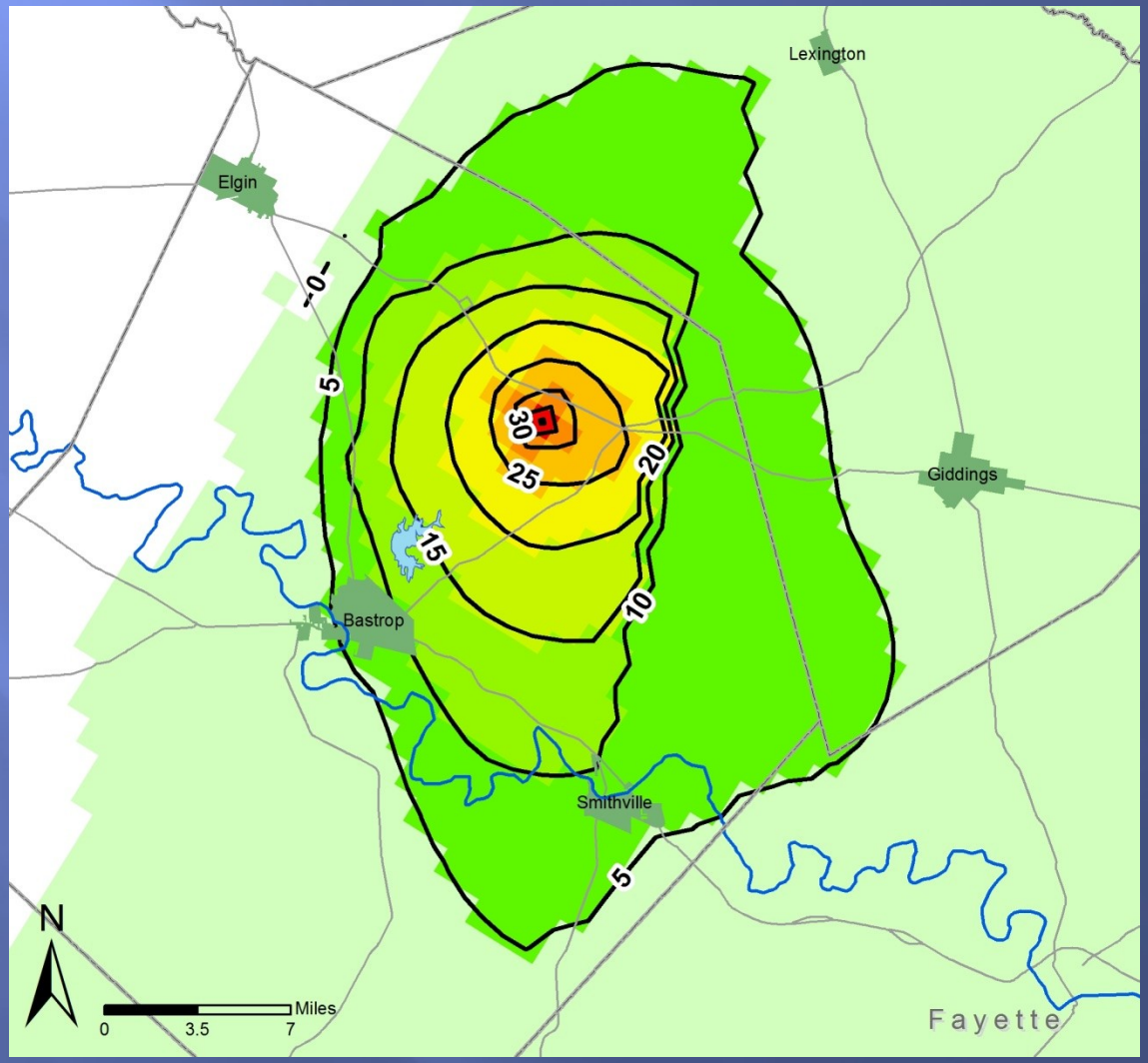
Increasing the Pumpage??

- How much additional pumpage would be required to achieve the currently adopted DFCs with the updated GAM?
  - Simsboro- Increase of more than 150%
  - Hooper- Increase of 100%
  - Did not evaluate decreases in pumpage

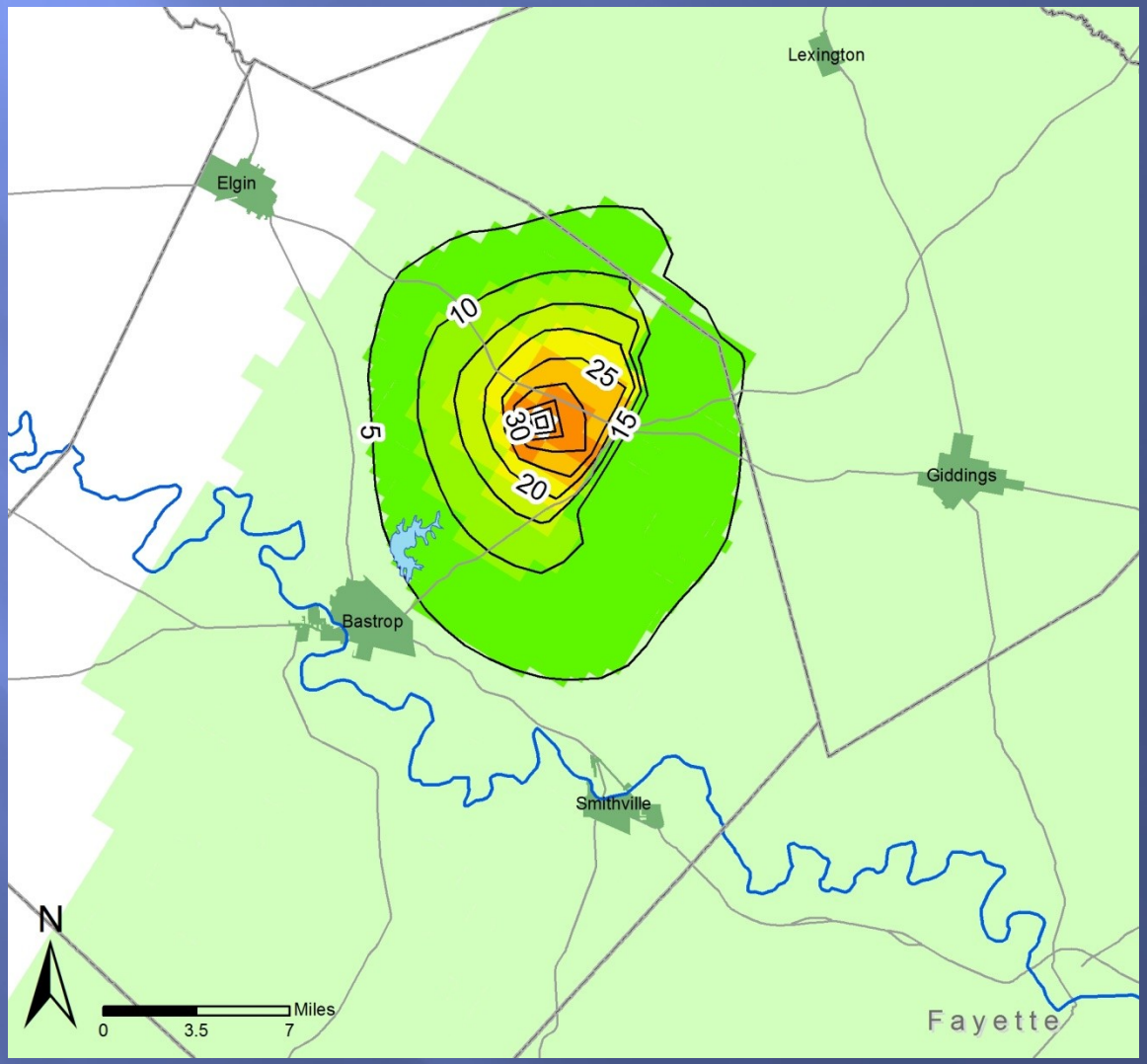
What does it mean?

- How much does the use of the new GAM impact the permit evaluations?
- Thomas Turfgrass recently received a permit for 2,200 acre-feet/year from a single Simsboro well located in Bastrop County
- Permit evaluation included evaluating the impact with the GAM
- Repeated the simulation using the updated GAM

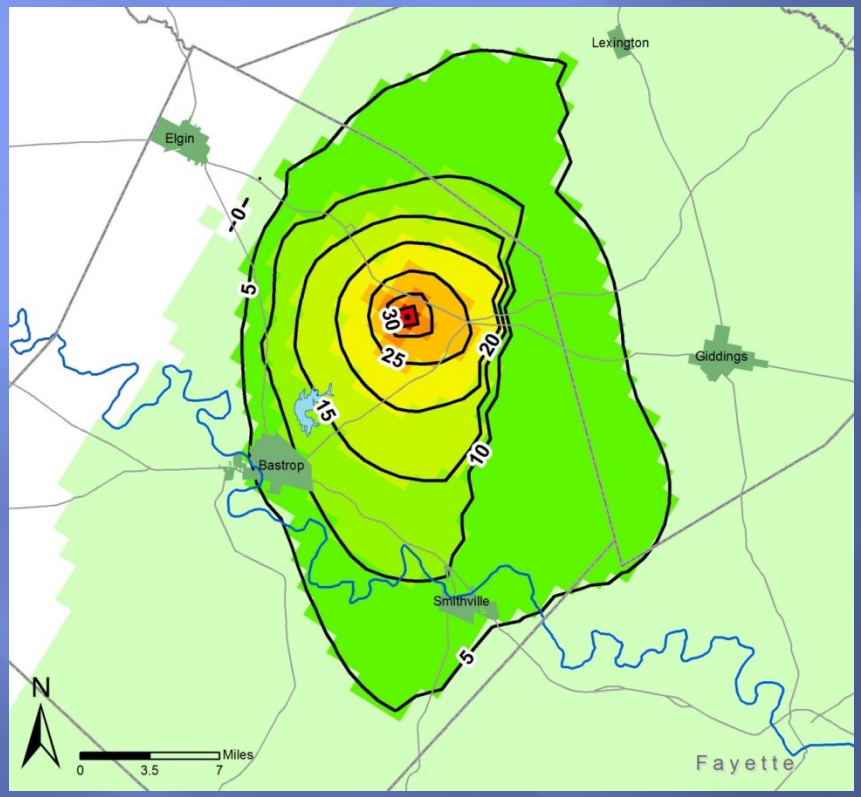
Thomas Turfgrass- Old GAM

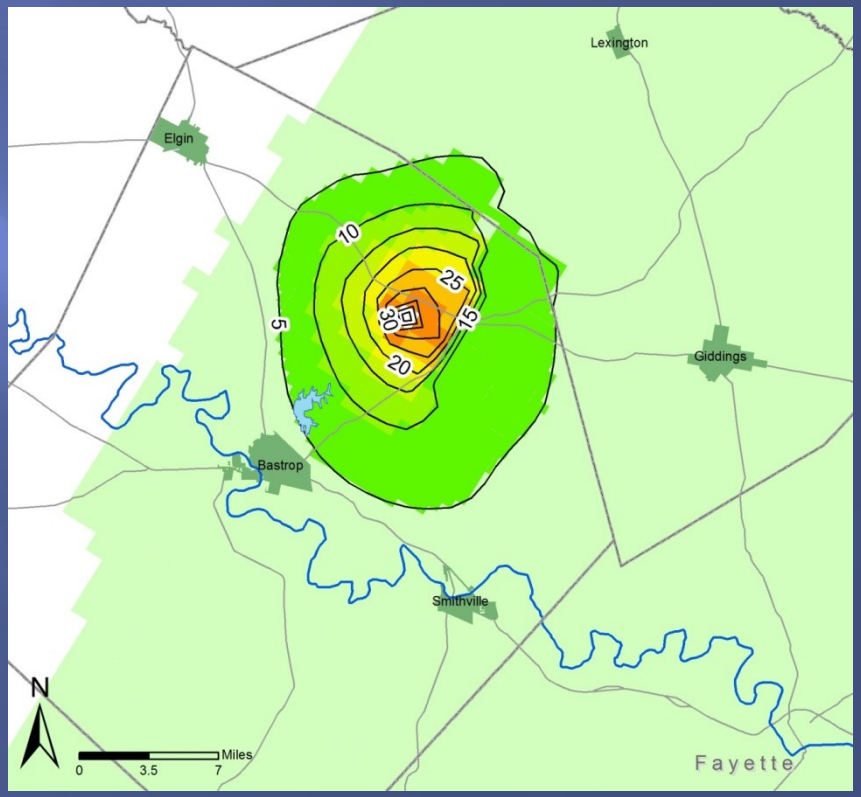


Thomas Turfgrass- New GAM



Old vs. New GAM





Summary

- Several significant differences between the previous and updated GAMs- faults, calibration time period, grid, layering
- Updated GAM significantly impacts calculated drawdowns from previous GAM run
- Drawdowns in Sparta, Queen City, and Carrizo are higher than using previous GAM
- Drawdowns in all three Wilcox aquifers are lower than using the previous GAM
- Results from permit evaluations using the GAMs appear to be similar