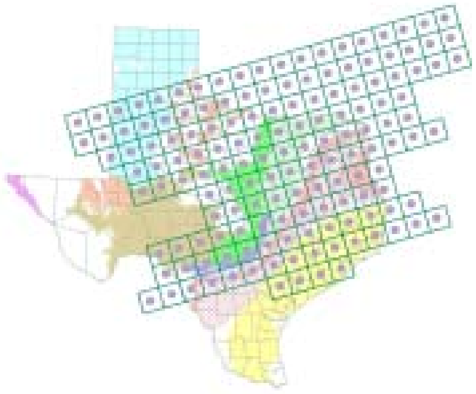
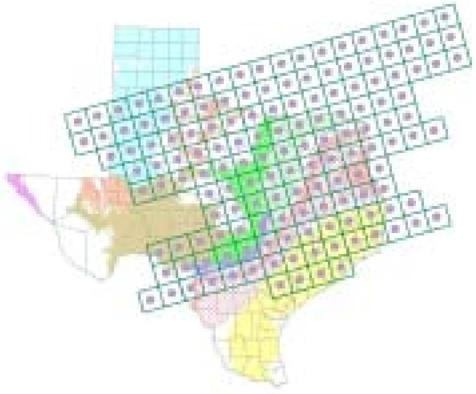
texas water development board



outline

- model parameters
- steady-state calibration



Modeling Team

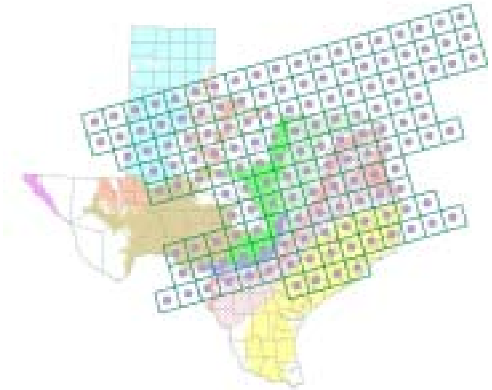
- Ali Chowdhury
- Robert Mace

Data Team

Structure: • Roberto Anaya
• Richard Smith

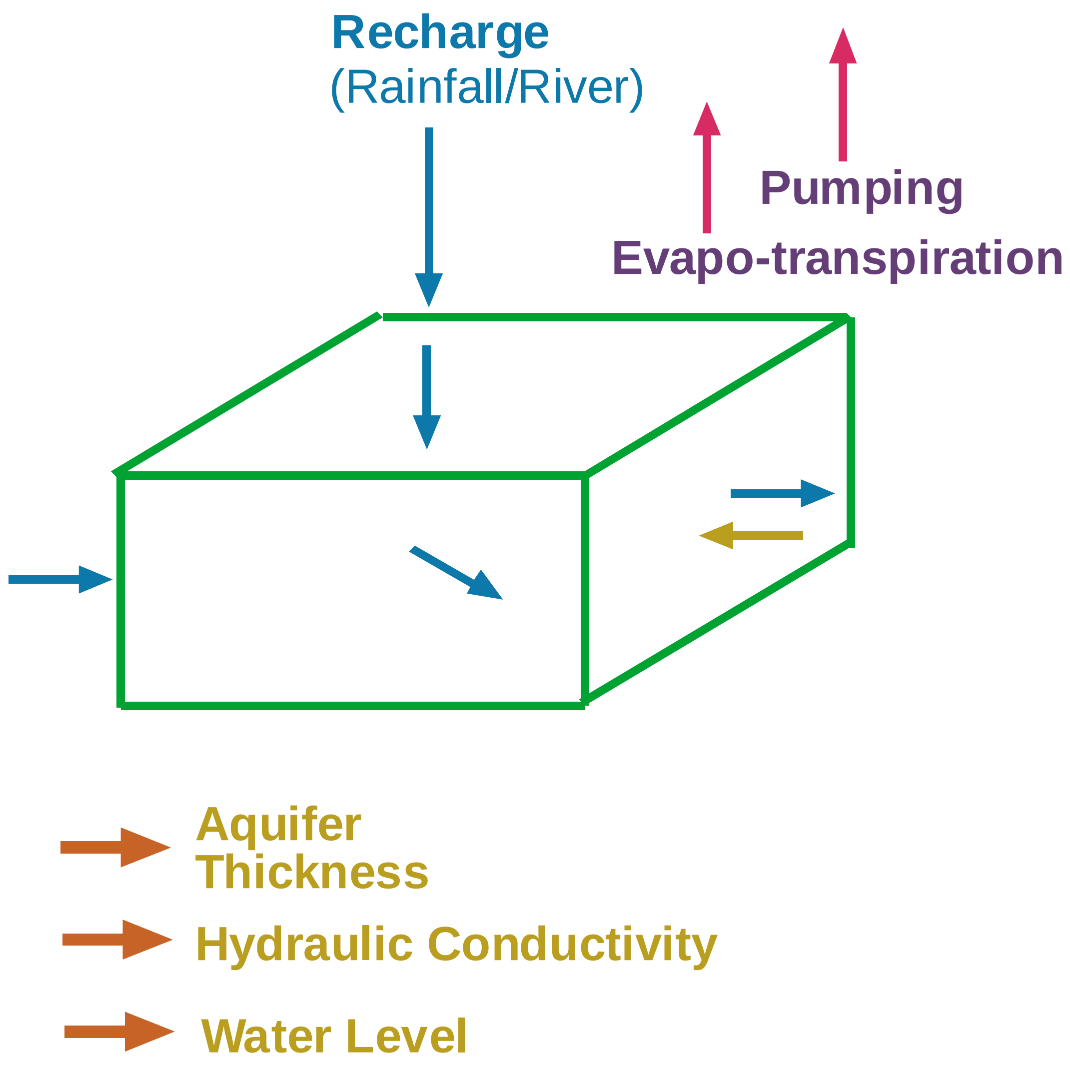
Pumping: • Ian Jones

What is a groundwater model?

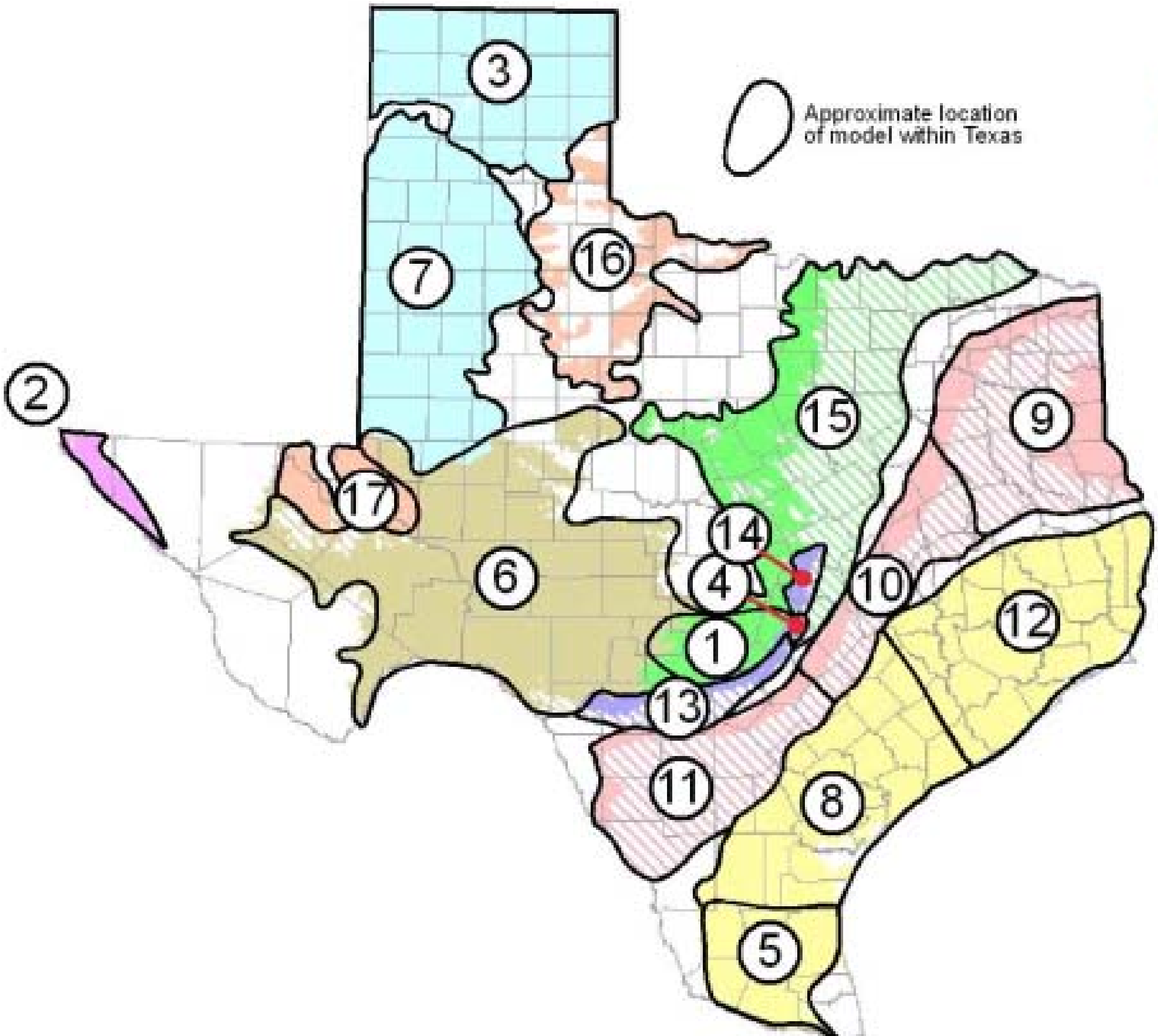


- a tool to estimate field conditions
- allows effective use of available data and account for complexities
- expands our ability to better understand and manage the water resources
- increases prediction accuracy of future events to a level far beyond "best judgement" decisions

A Model Cell


Recharge
(Rainfall/River)
Pumping
Evapo-transpiration
Aquifer
Thickness
Hydraulic Conductivity
Water Level

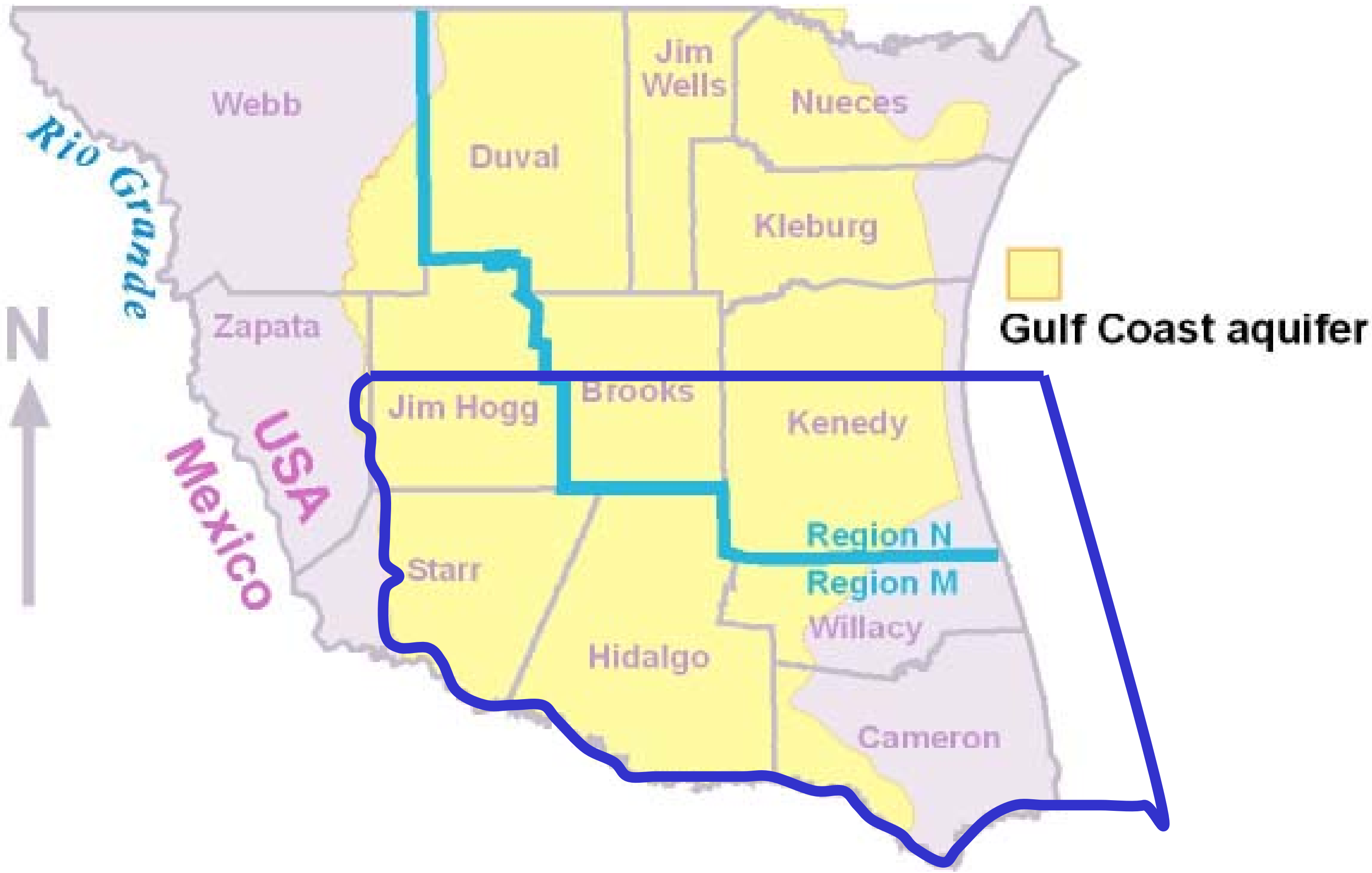
Location of Completed, Ongoing, and Proposed Models for GAM



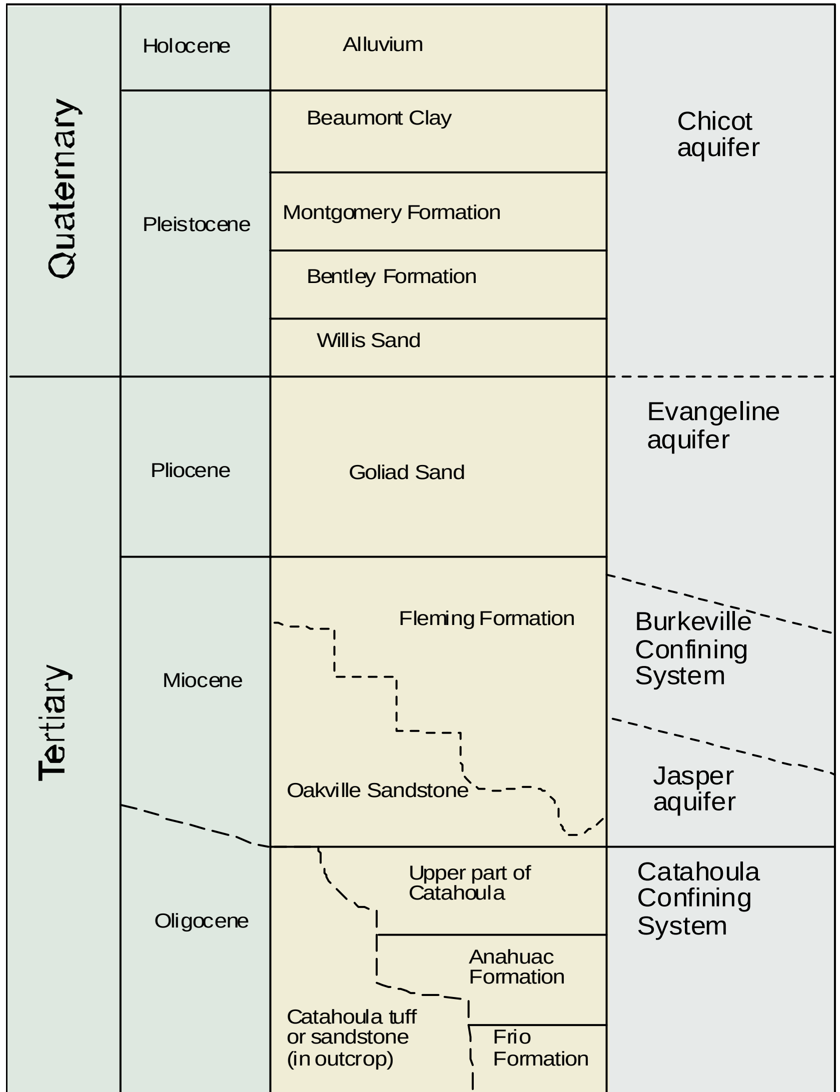
c = completed
o = ongoing
p = proposed

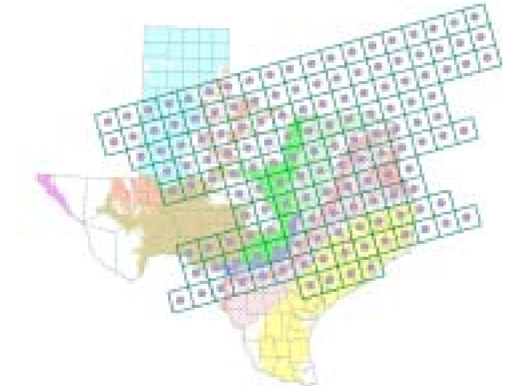
1. Trinity (Hill Country) c
2. Hueco Bolson c
3. Ogallala (northern part) c
4. Edwards (Barton Springs segment) c
5. Lower Rio Grande Valley o
6. Edwards-Trinity Plateau o
7. Ogallala (southern part) o
8. Gulf Coast (central part) o
9. Carrizo-Wilcox (northern part) o
10. Carrizo-Wilcox (central part) o
11. Carrizo-Wilcox (southern part) o
12. Gulf Coast (northern part) o
13. Edwards (San Antonio segment) o
14. Edwards (northern segment) p
15. Trinity (northern part) p
16. Seymour p
17. Pecos Alluvium p

Model area and extent of the Gulf Coast aquifer

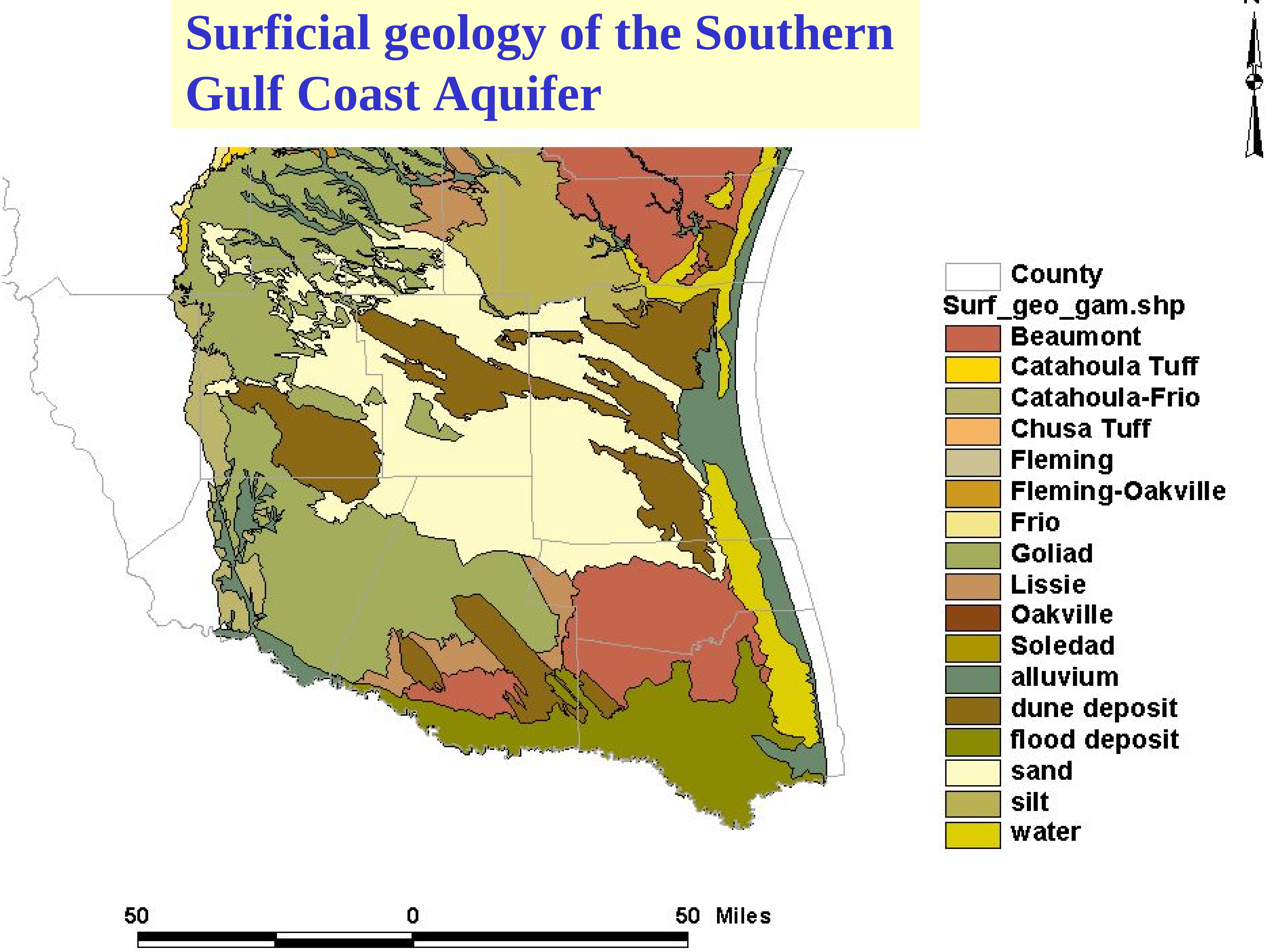


Stratigraphic sequence

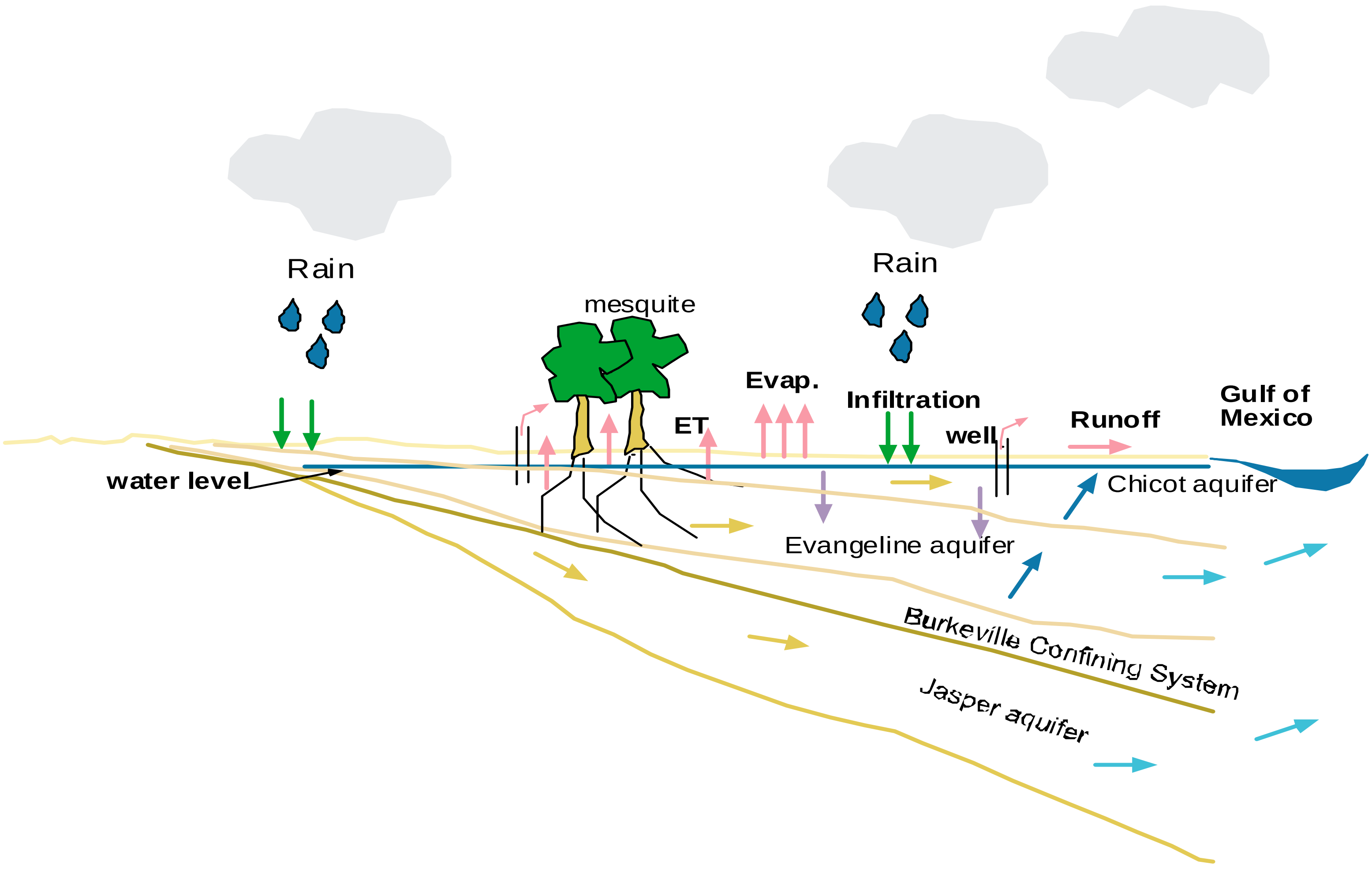




Surficial geology of the Southern Gulf Coast Aquifer



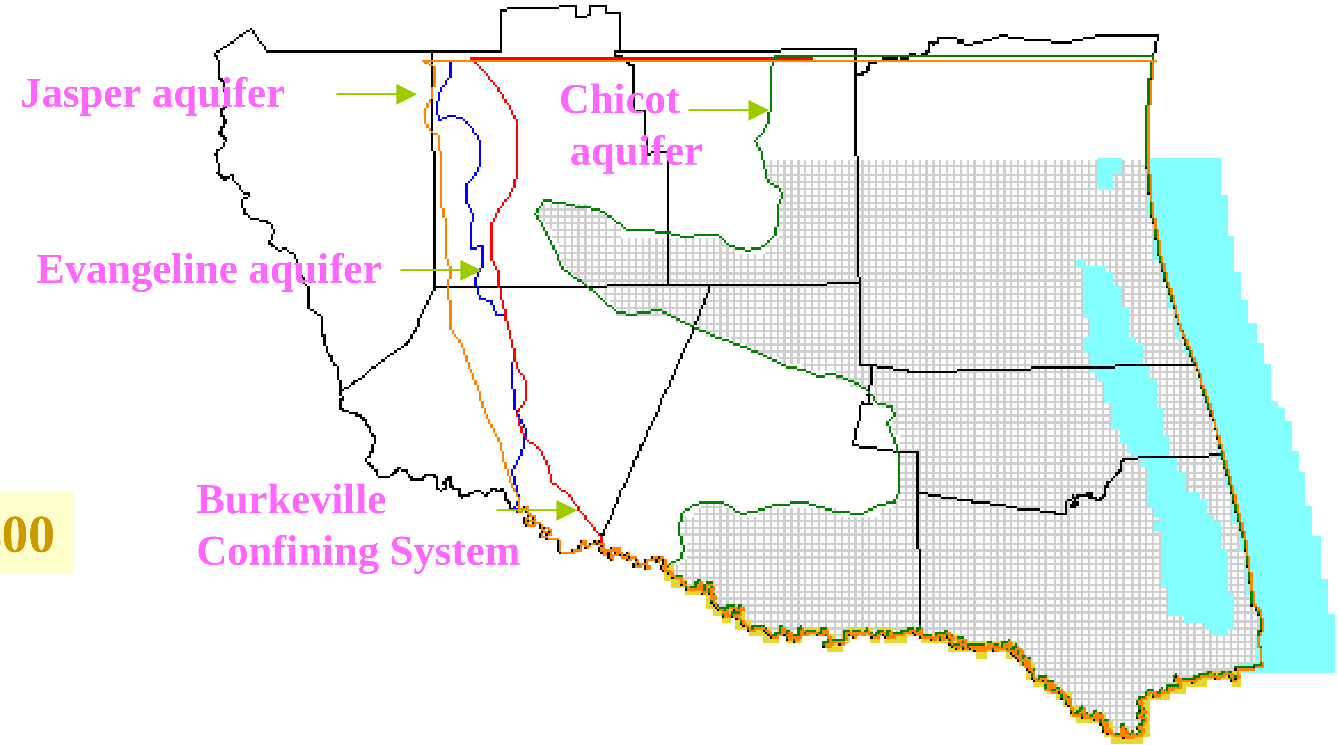
Conceptual model of the groundwater flow system, southern Gulf Coast aquifer



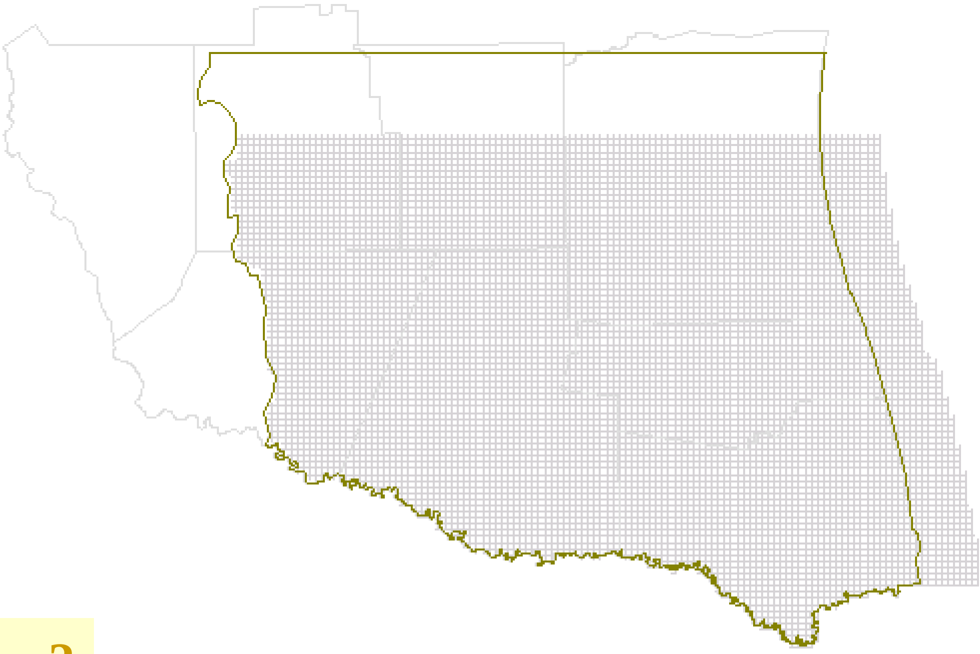
Chicot Aquifer

Model Layer 1

Active Cells = 5400



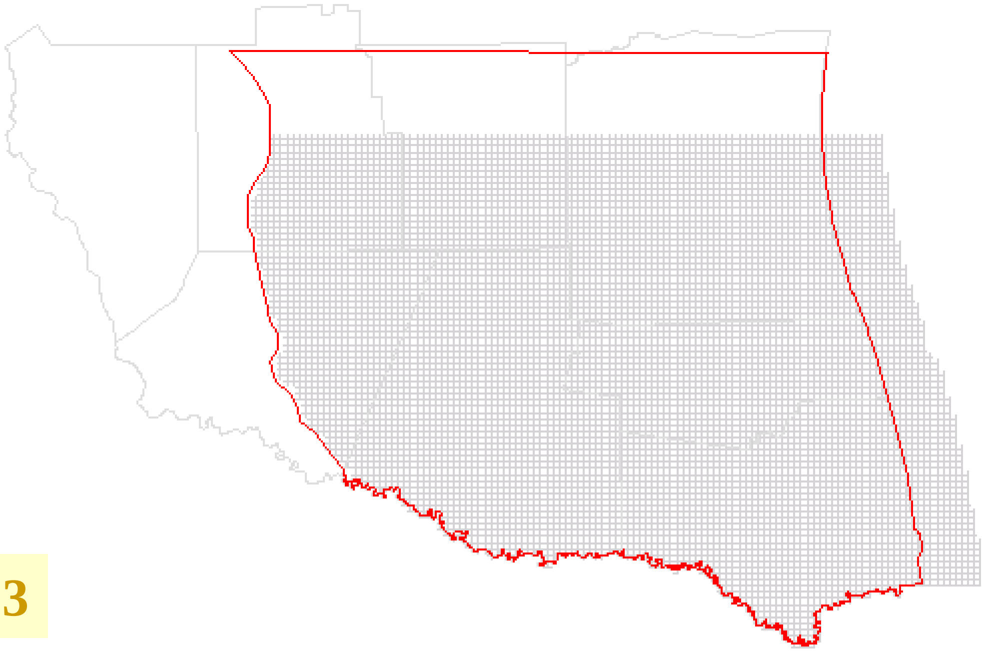
Evangeline Aquifer



Model Layer 2

Active Cells 7456

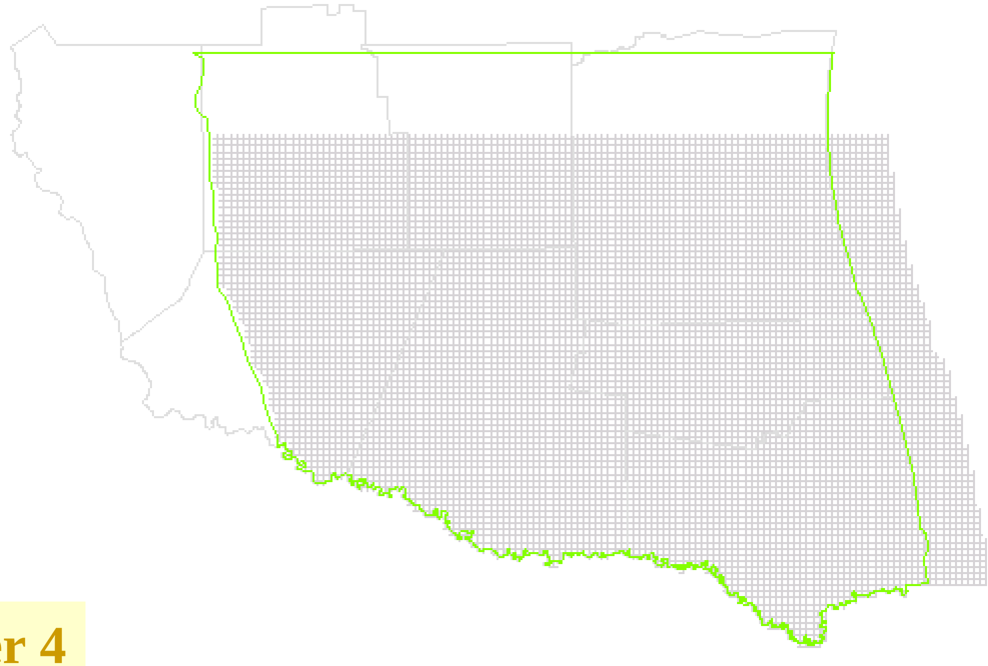
Burkeville Confining System



Model Layer 3

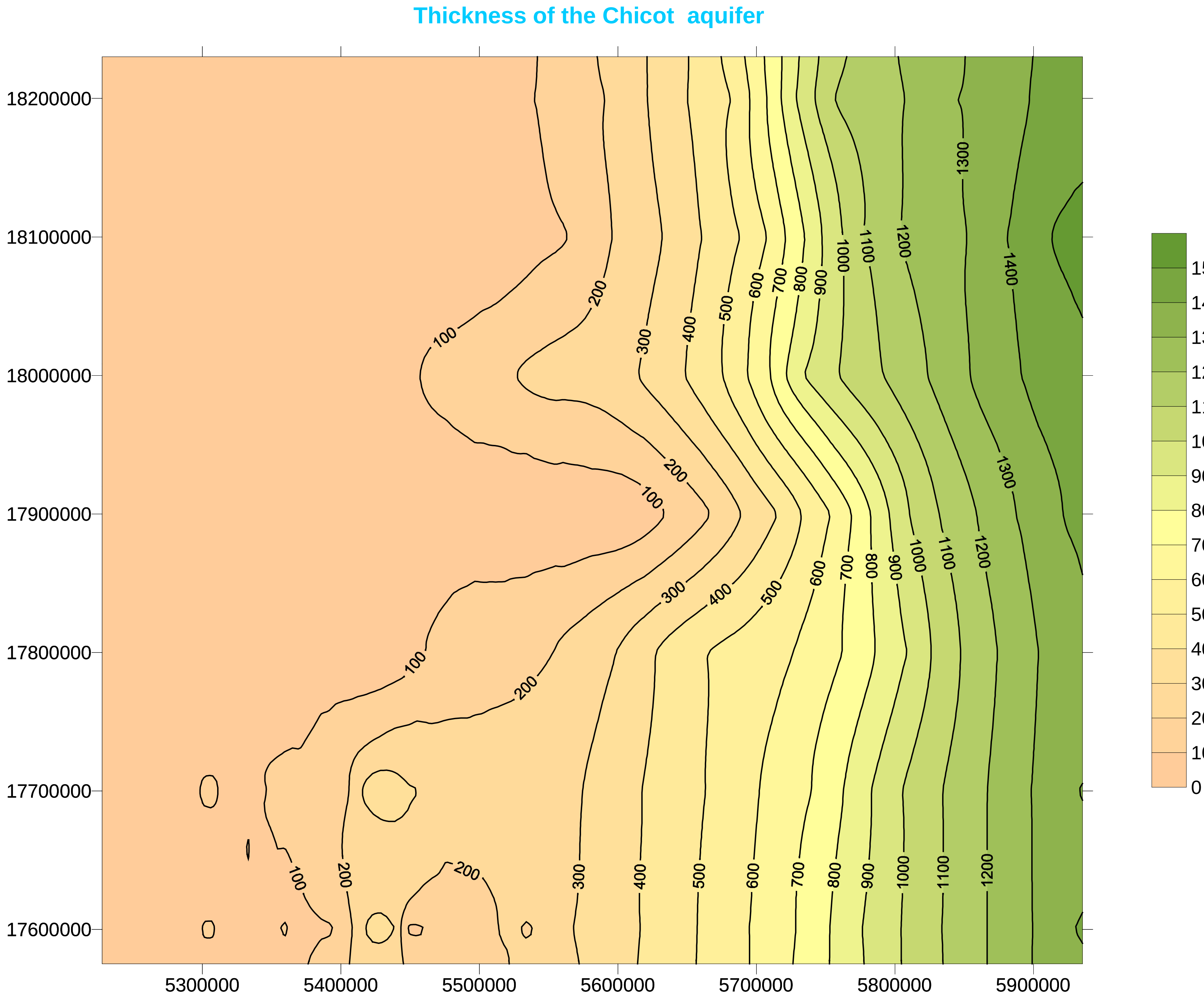
Active Cells = 7270

Jasper Aquifer

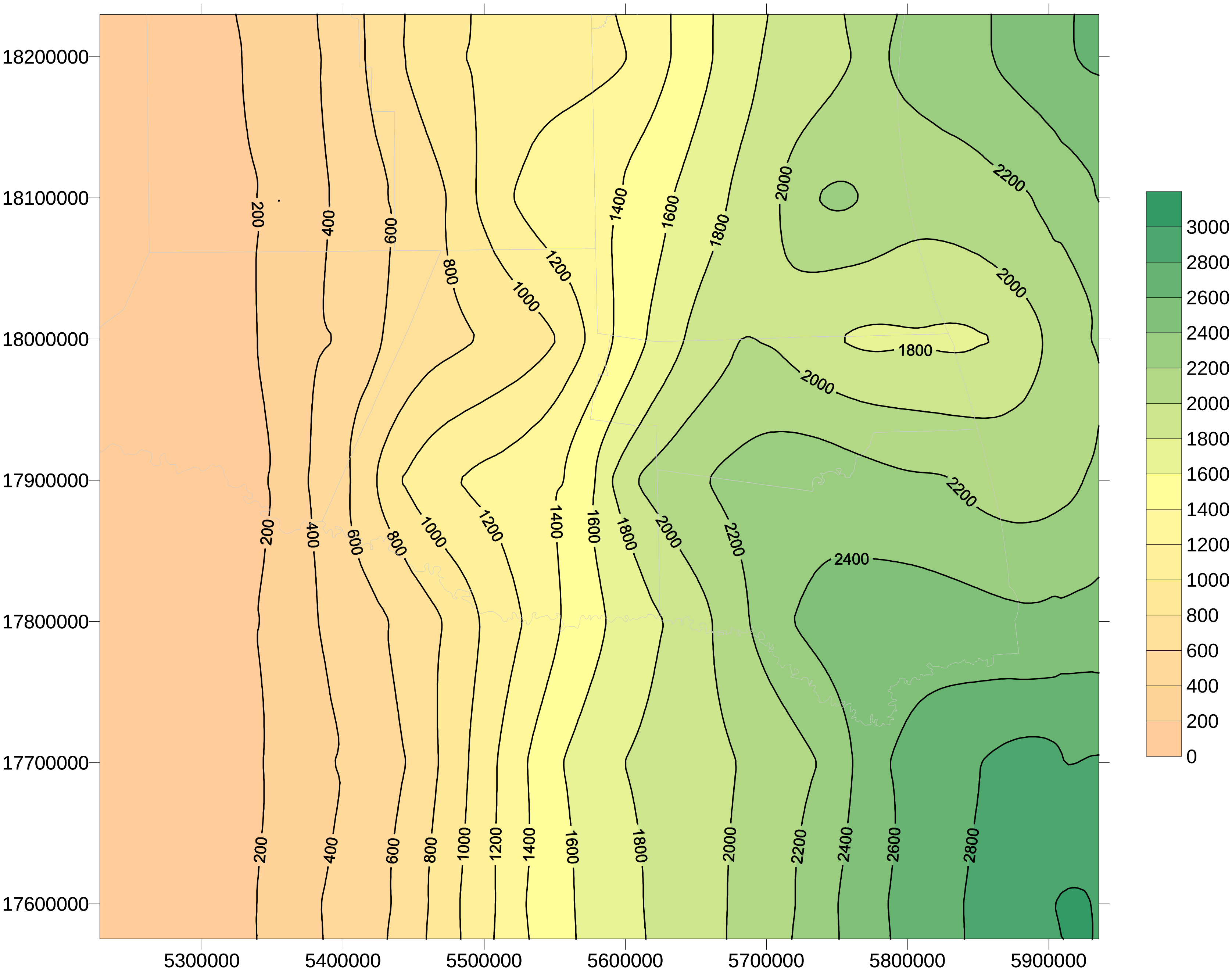


Model Layer 4

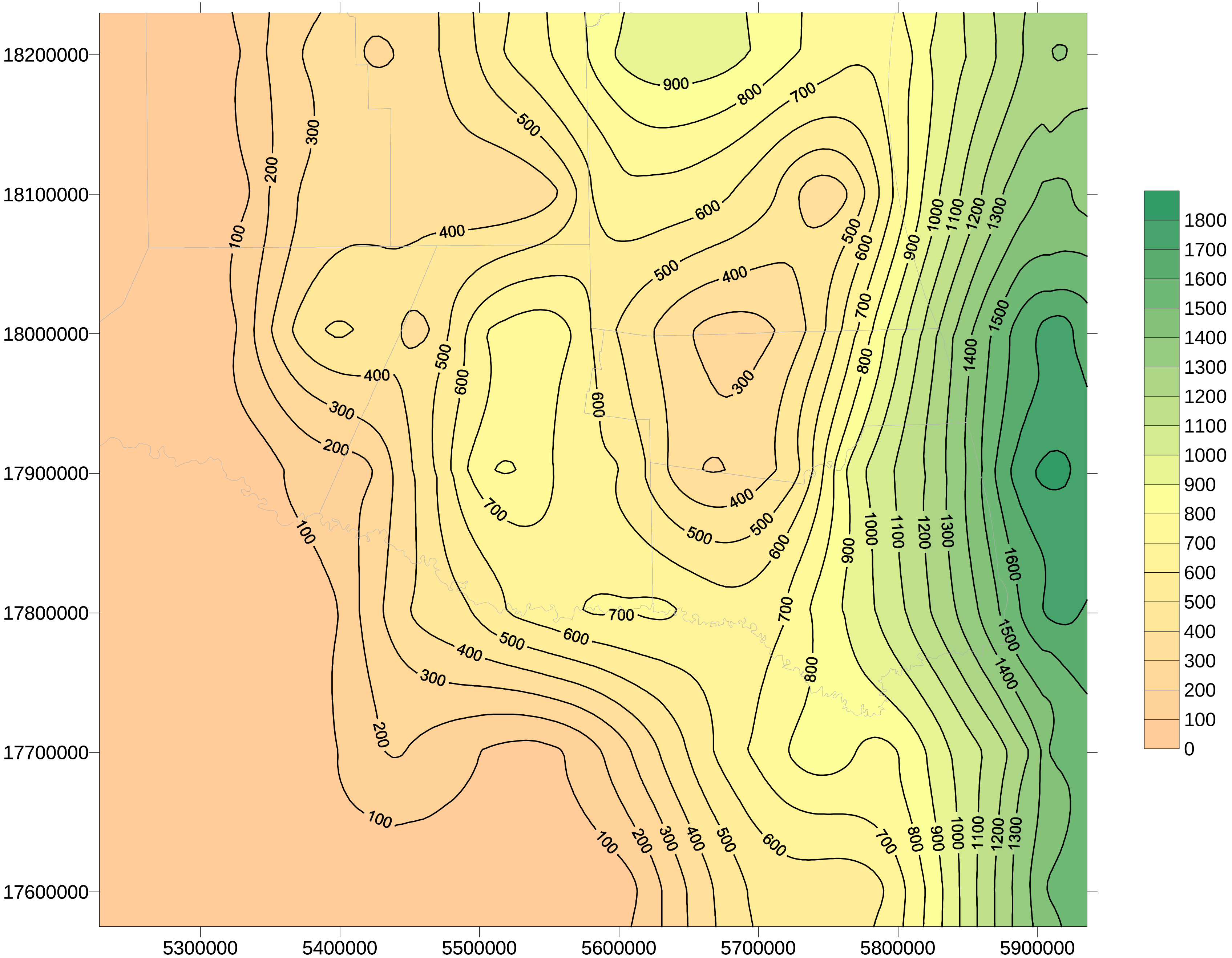
Active cells = 7667


Thickness of the Chicot aquifer
18200000
18100000
18000000
17900000
17800000
17700000
17600000
5300000
5400000
5500000
5600000
5700000
5800000
5900000
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0

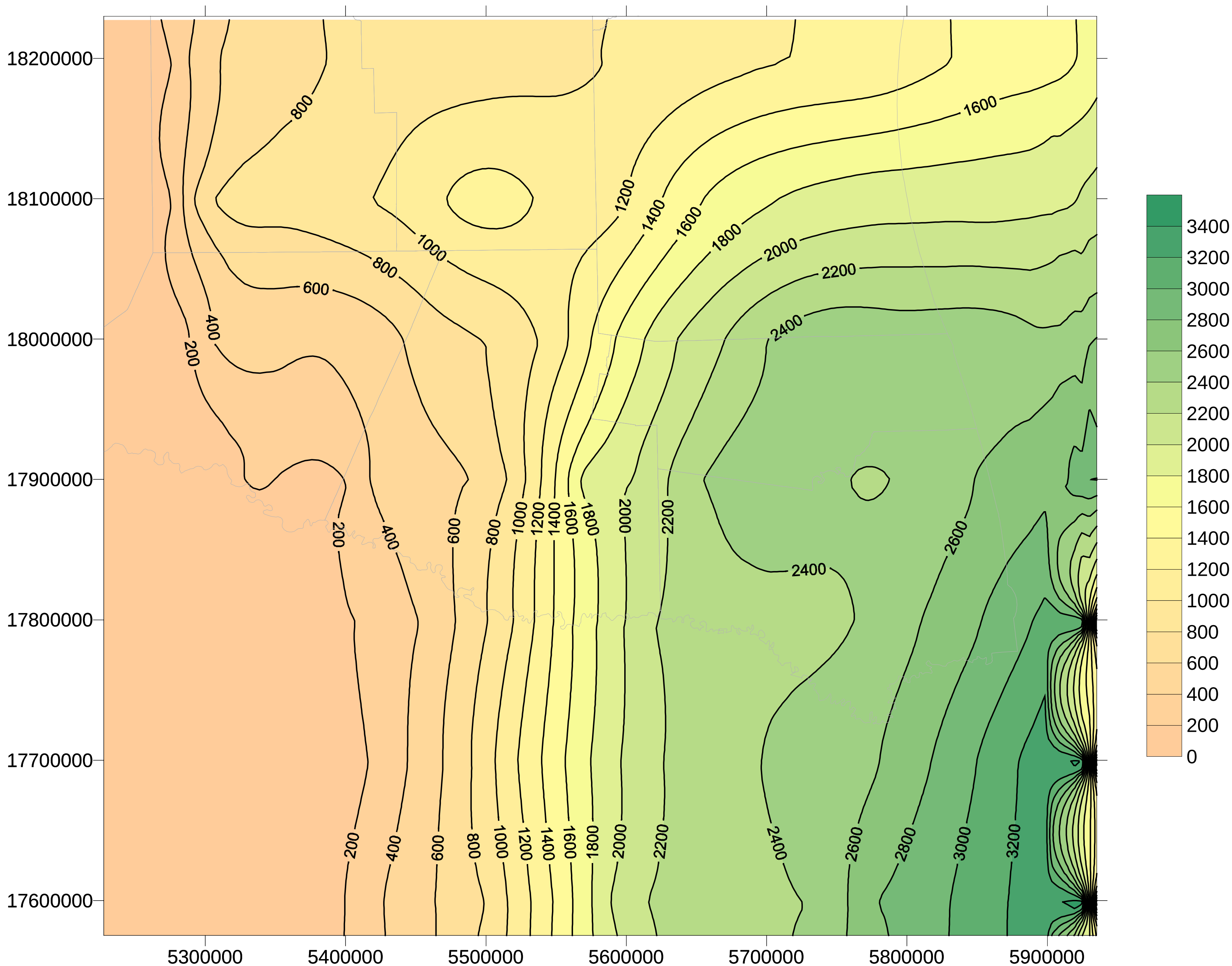
Approximate thickness of the Evangeline aquifer



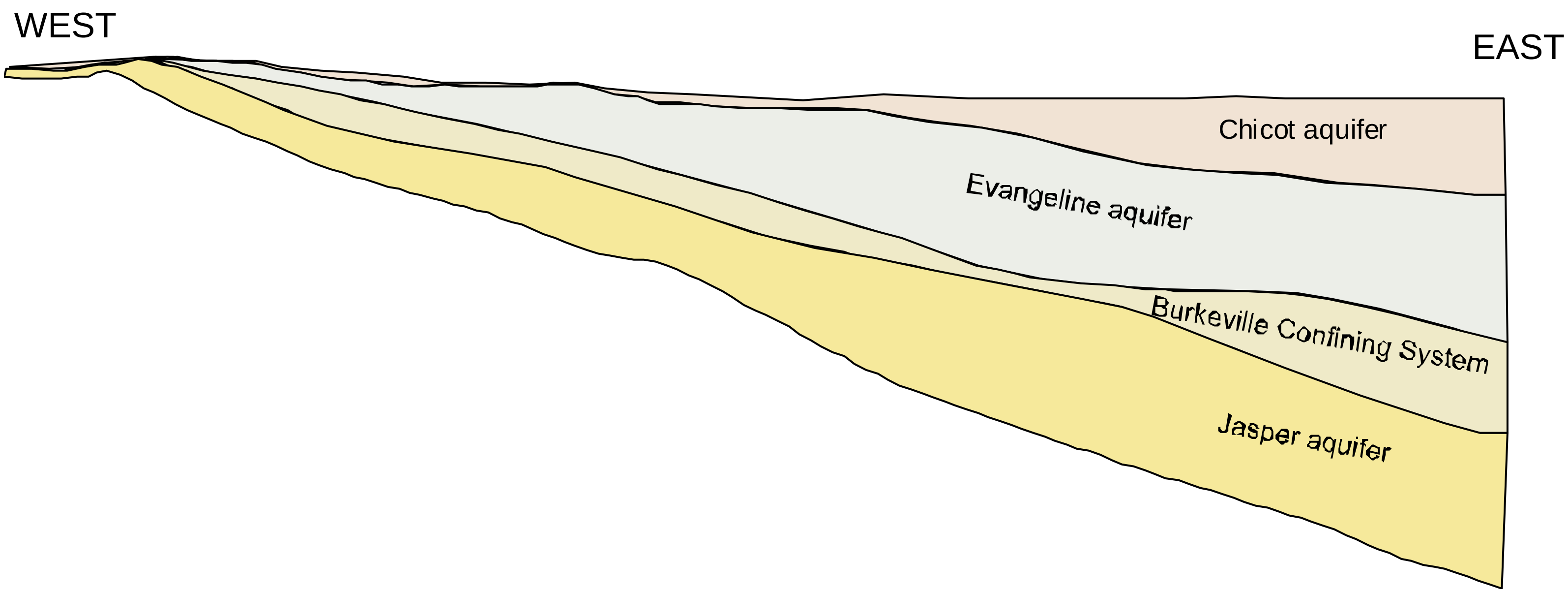
Approximate thickness of the Burkeville Confining System



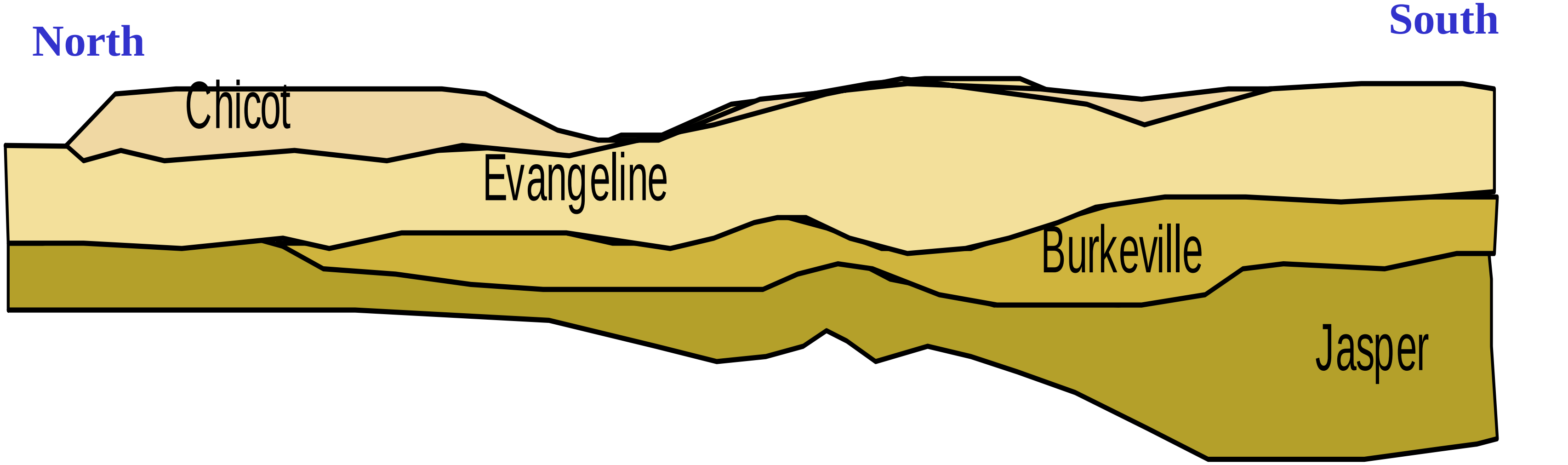
Approximate thickness of the Jasper aquifer



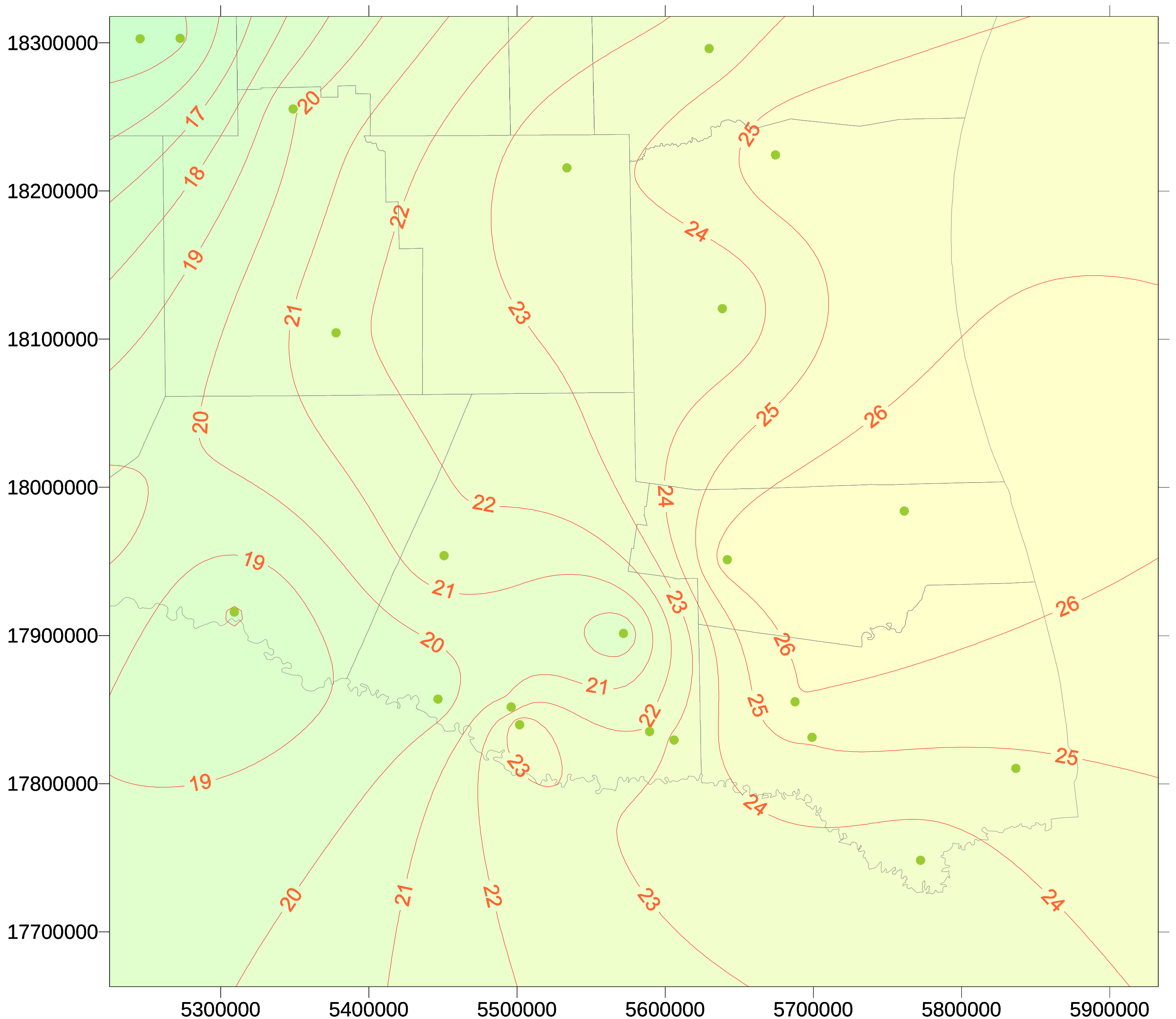
Aquifer geometry along an east-west cross-section



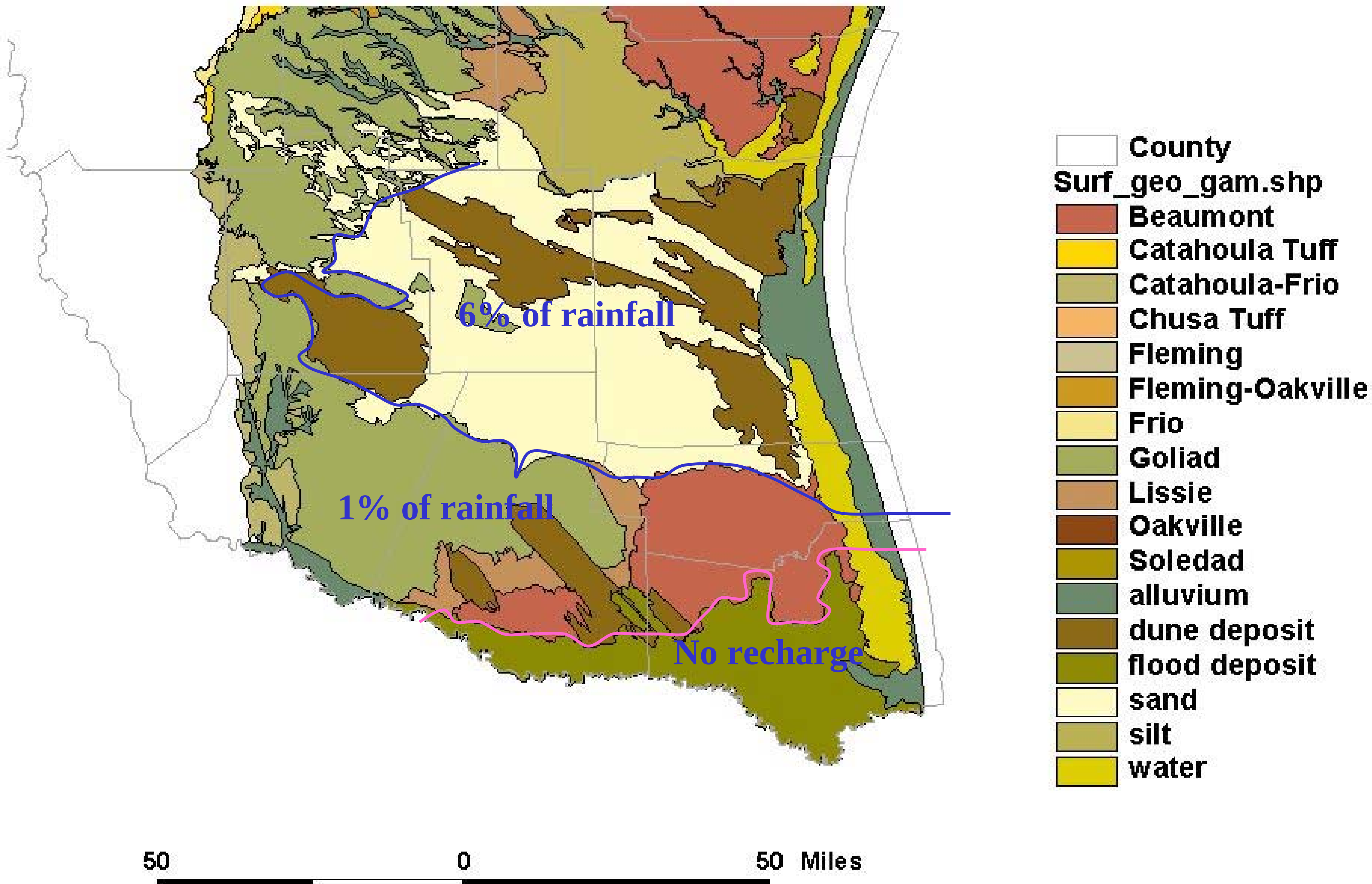
Aquifer geometry along a north-south cross-section



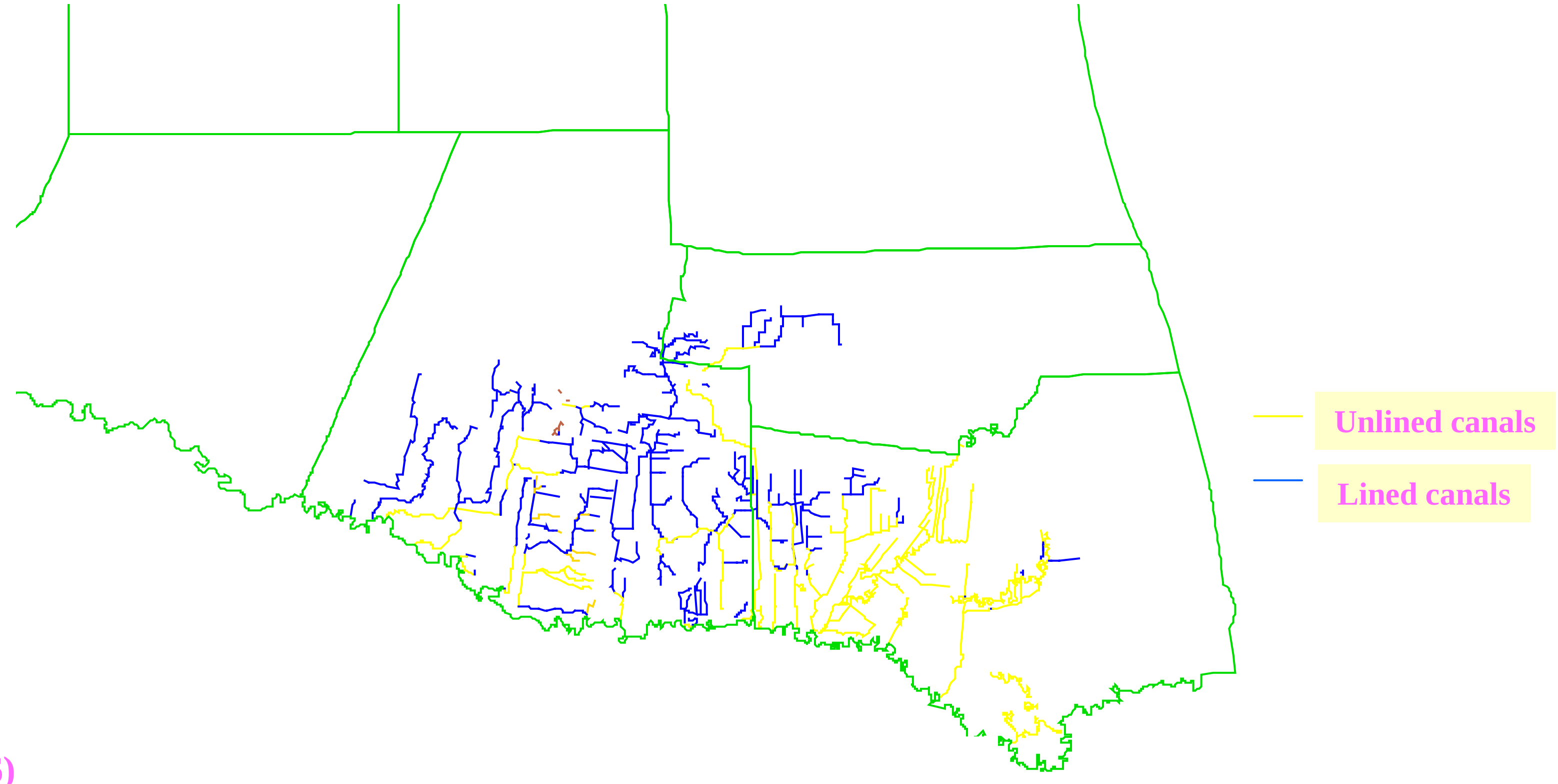
Average rainfall (in/yr) map, 1930-1980



Recharge distribution based on geology



Canal Losses as Recharge?



(TBWE, 1946)
Resacas = .004 cu-ft/d =3.35E-5 acre-ft/yr
Concrete canals = 0.08 to 0.3 cu-ft/d = 6.7E-4 to 2.5E-3 acre-ft/yr
Cylinder tests = .0337 cu-ft/d = 2.8E-4 acre-ft/yr

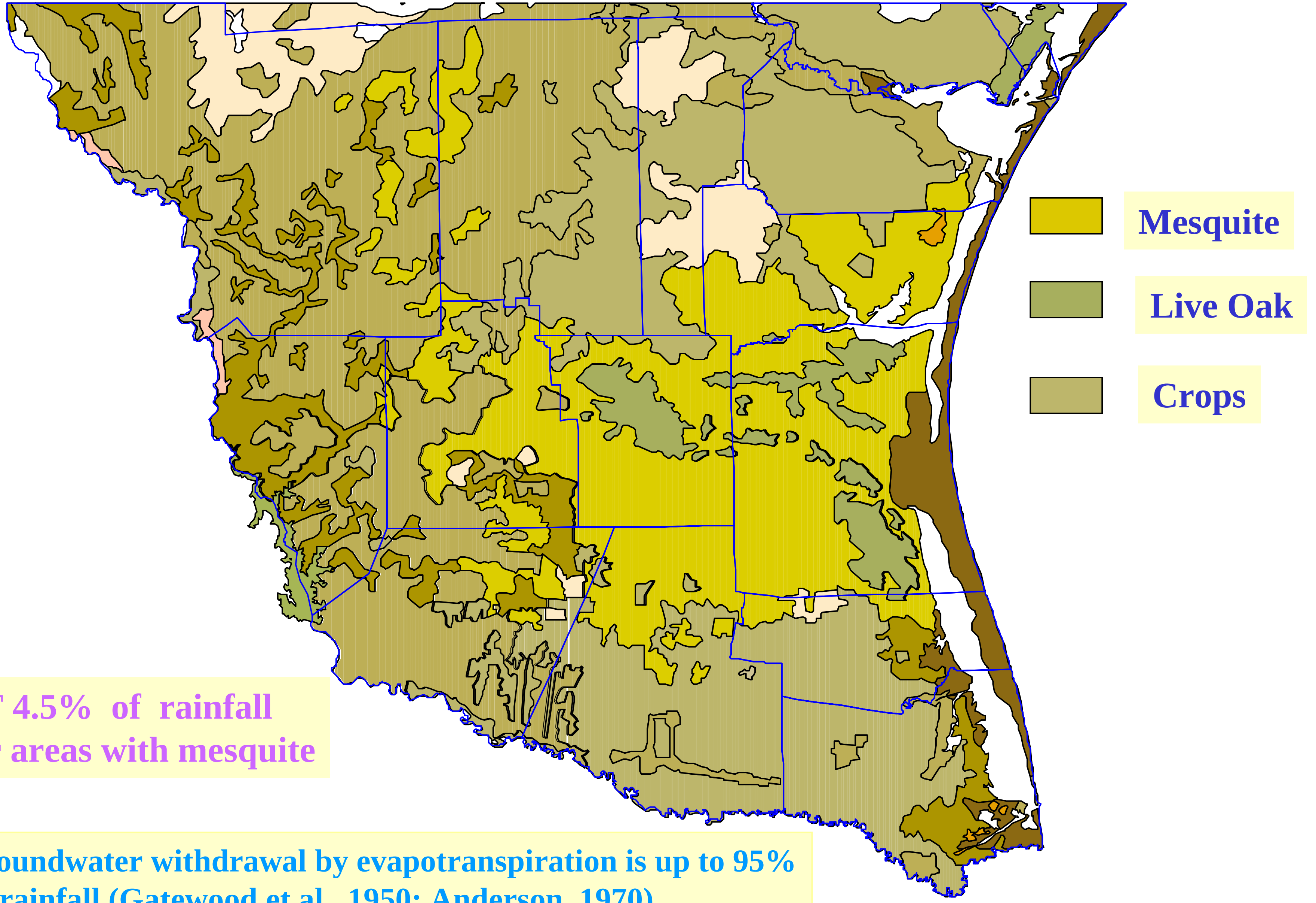
Fipps (2000)
Unlined canals = 54 to 1037 acre-ft/yr
Concrete canals = 90 to 1220 acre-ft/yr

- → Losses may not reach the groundwater
- → May reach only the shallow perched areas
- → Discharge through ditches to surface water courses

Recharge for the Gulf Coast aquifer

Source	Recharge (in/yr)
Groschen (1985)	0.06
Ryder (1988)	0 to 6
Dutton and Richter (1990)	0.1 to 0.4
Noble and others (1996)	6
Hay (1999)	.00004 to .04
Harden and Associates (2001)	3
This study TWDB (2002)	**0 to 1.06**

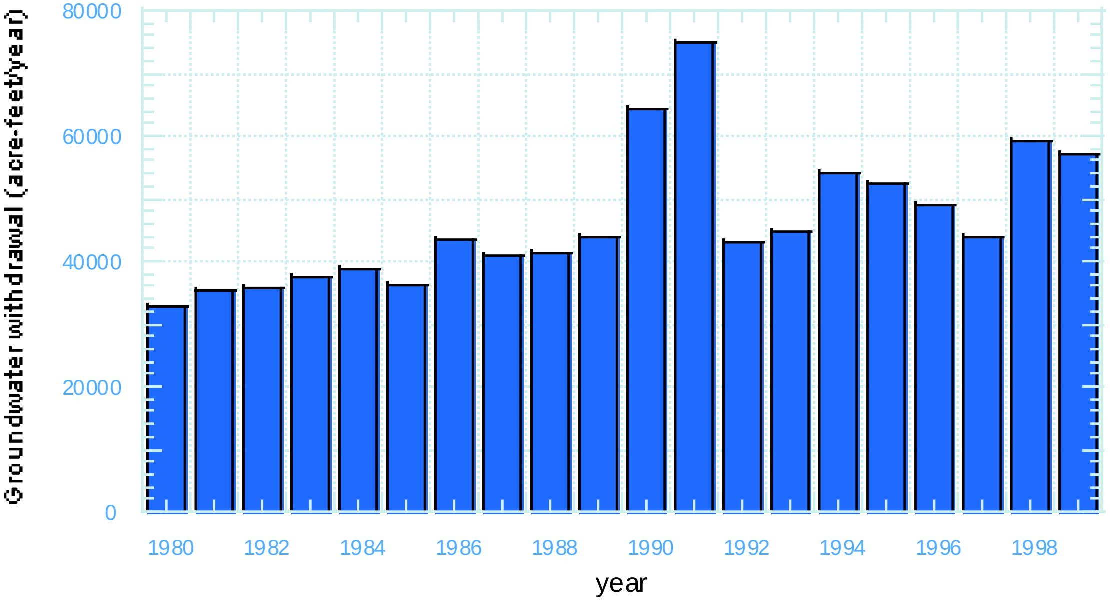
Vegetation map and Evapotranspiration



ET 4.5% of rainfall for areas with mesquite

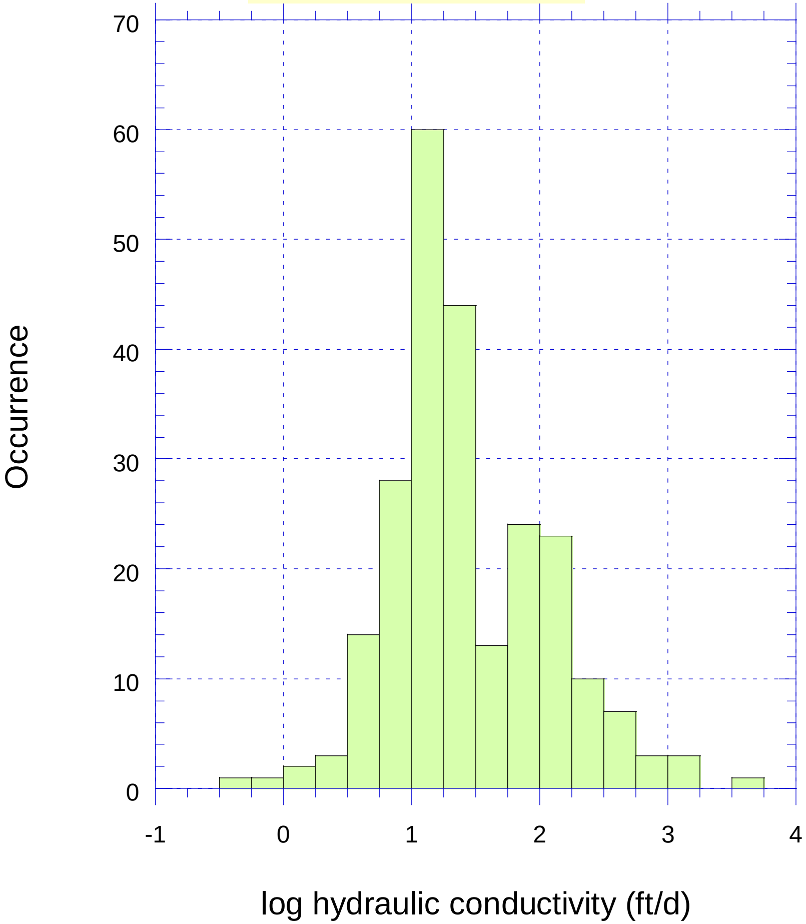
Groundwater withdrawal by evapotranspiration is up to 95% of rainfall (Gatewood et al., 1950; Anderson, 1970).

Groundwater withdrawal within the model area (1980-1999)

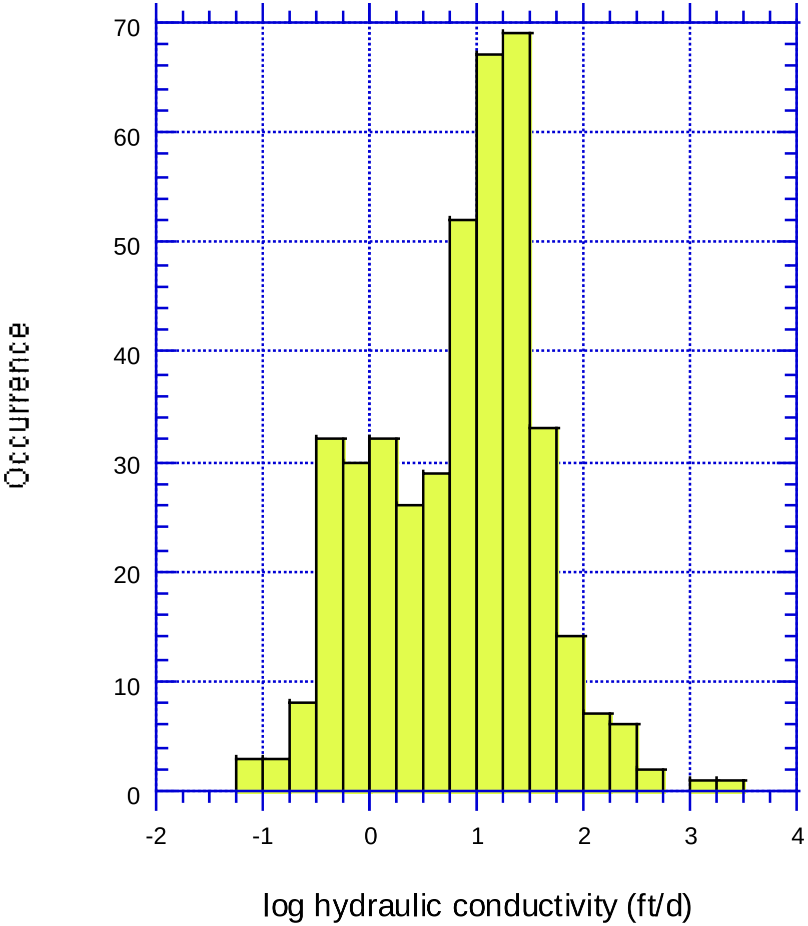


Hydraulic Conductivity

Chicot aquifer



Evangeline aquifer

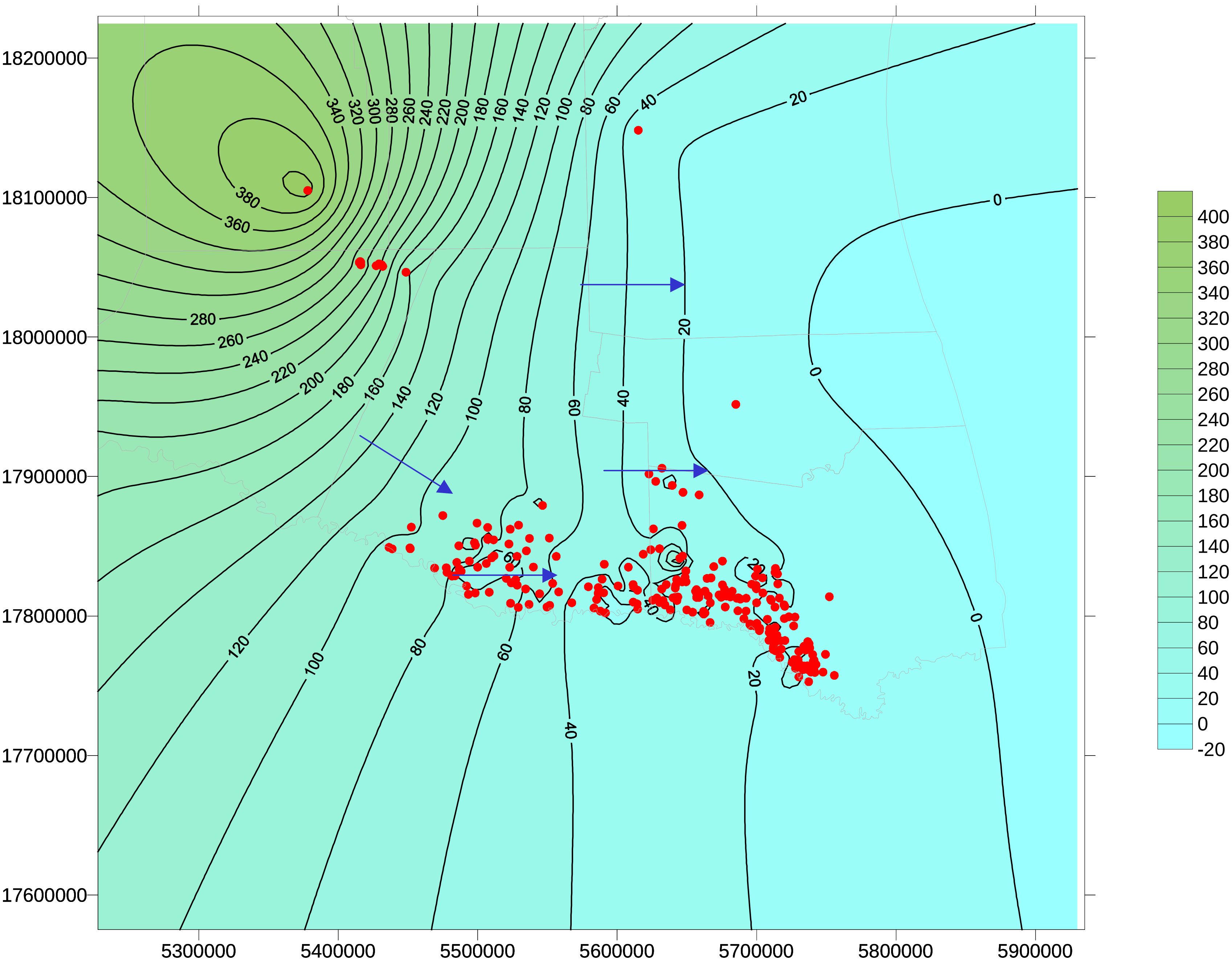


Hydraulic Conductivity

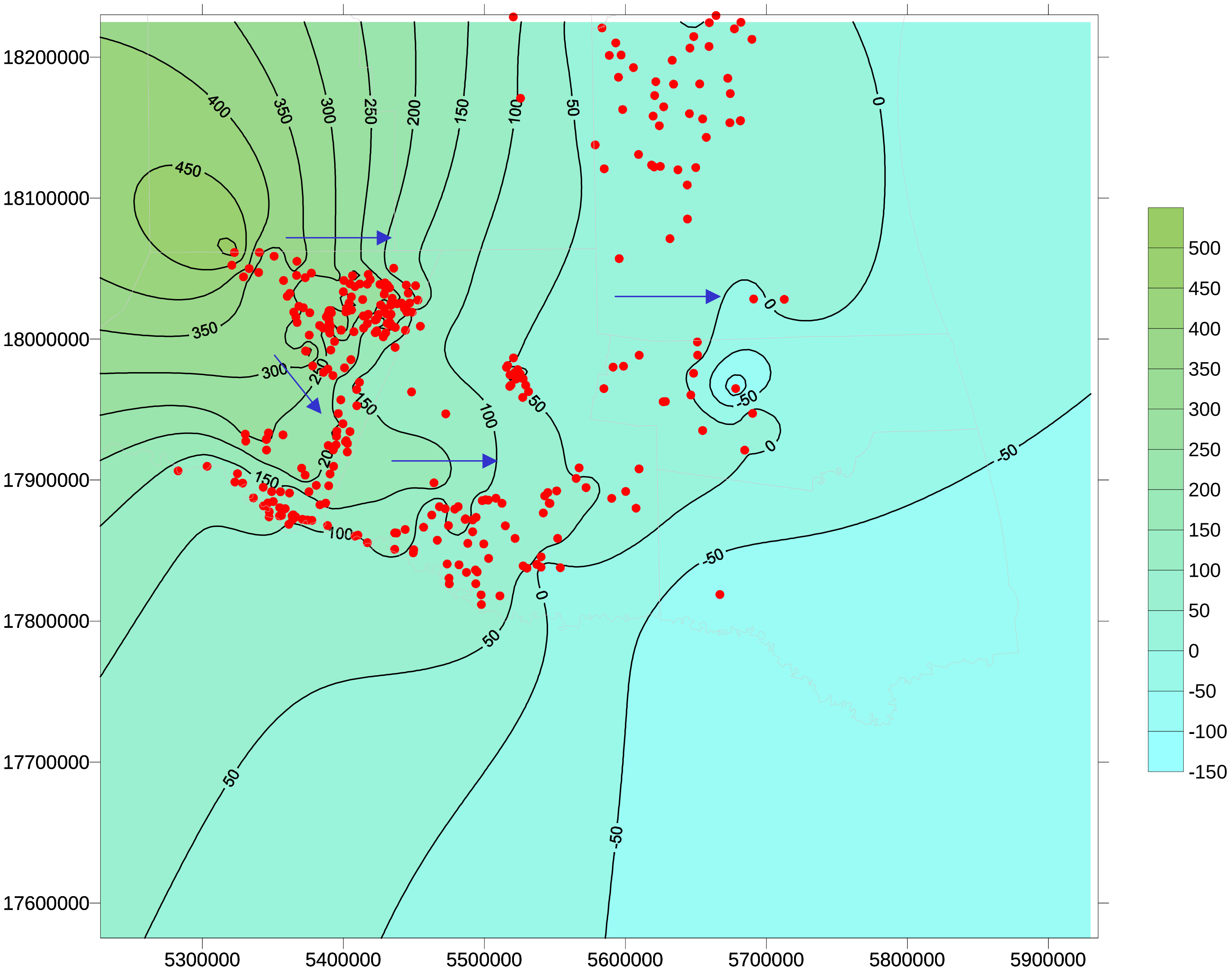
used in model calibration

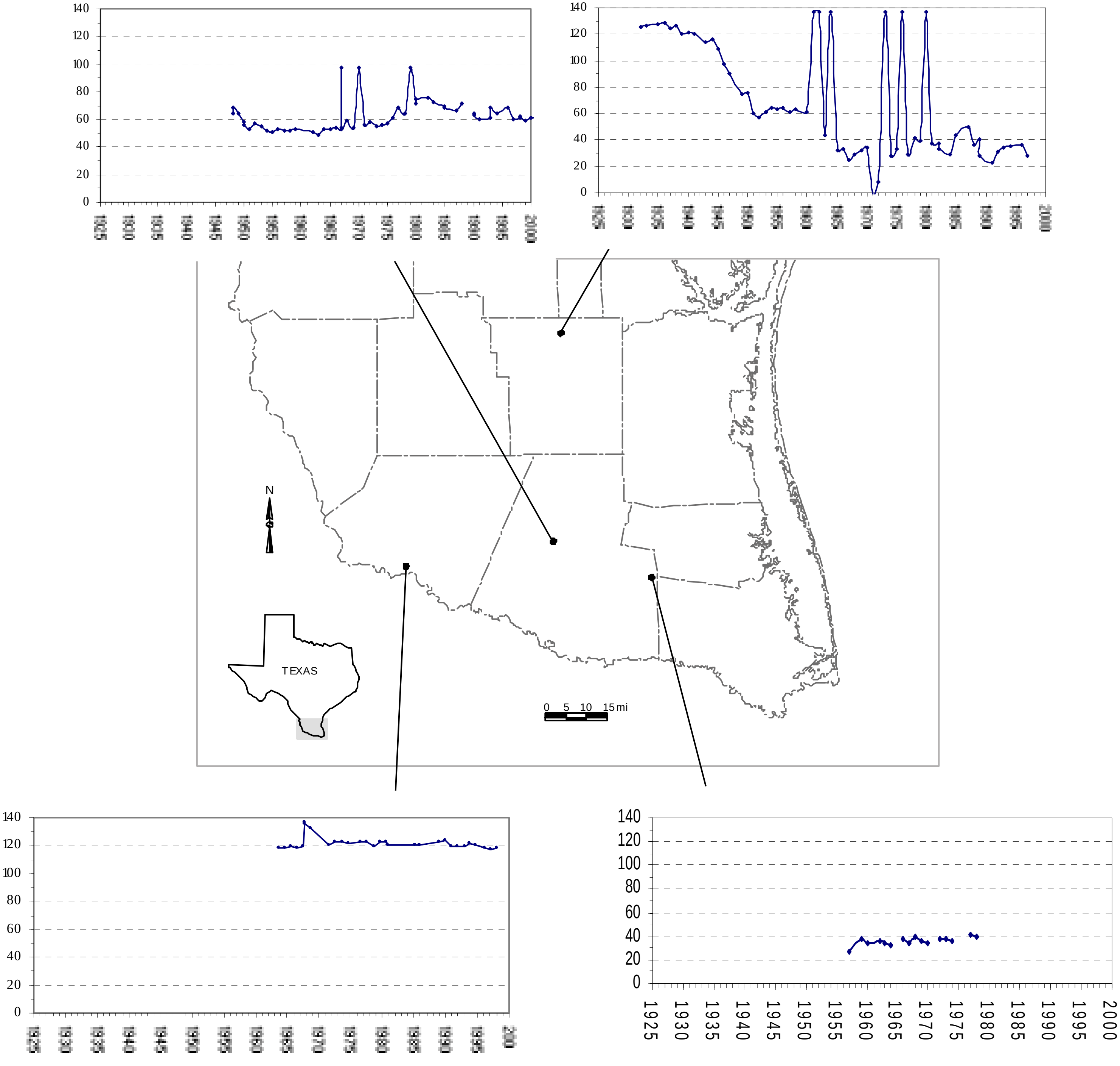
- Chicot aquifer, Kh =17 ft/d, Kv = .01 ft/d
- Evangeline aquifer, Kh = 3 ft/d, Kv =.001 ft/d
- Burkeville Confining System, Kh = .001 ft/d, Kv = 1E-9 ft/d
- Jasper aquifer, Kh = 1.8 ft/d, Kv = .01 ft/d

Water level in the Chicot aquifer, 1930-1980

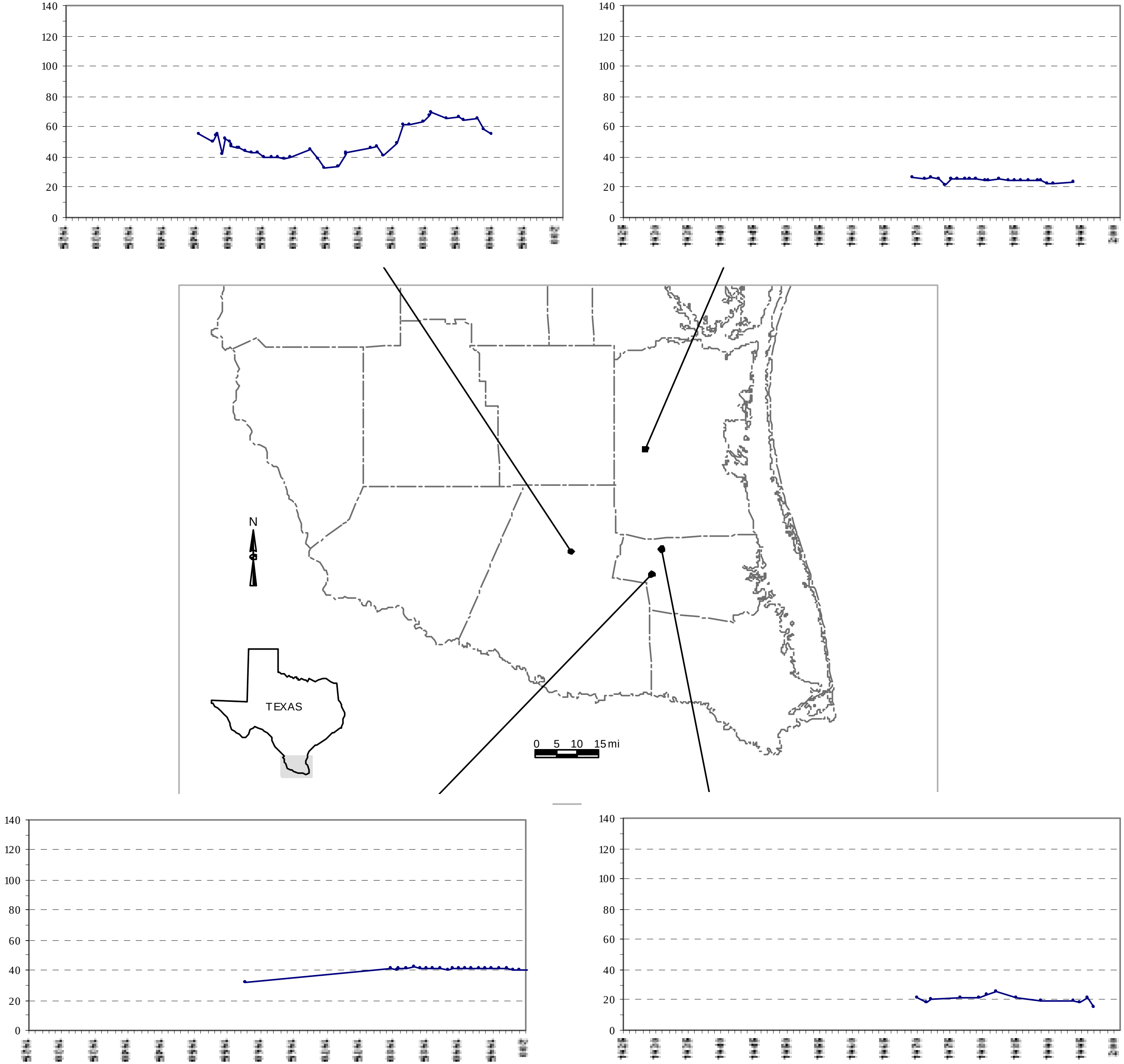


Water level in the Evangeline aquifer, 1930-1980



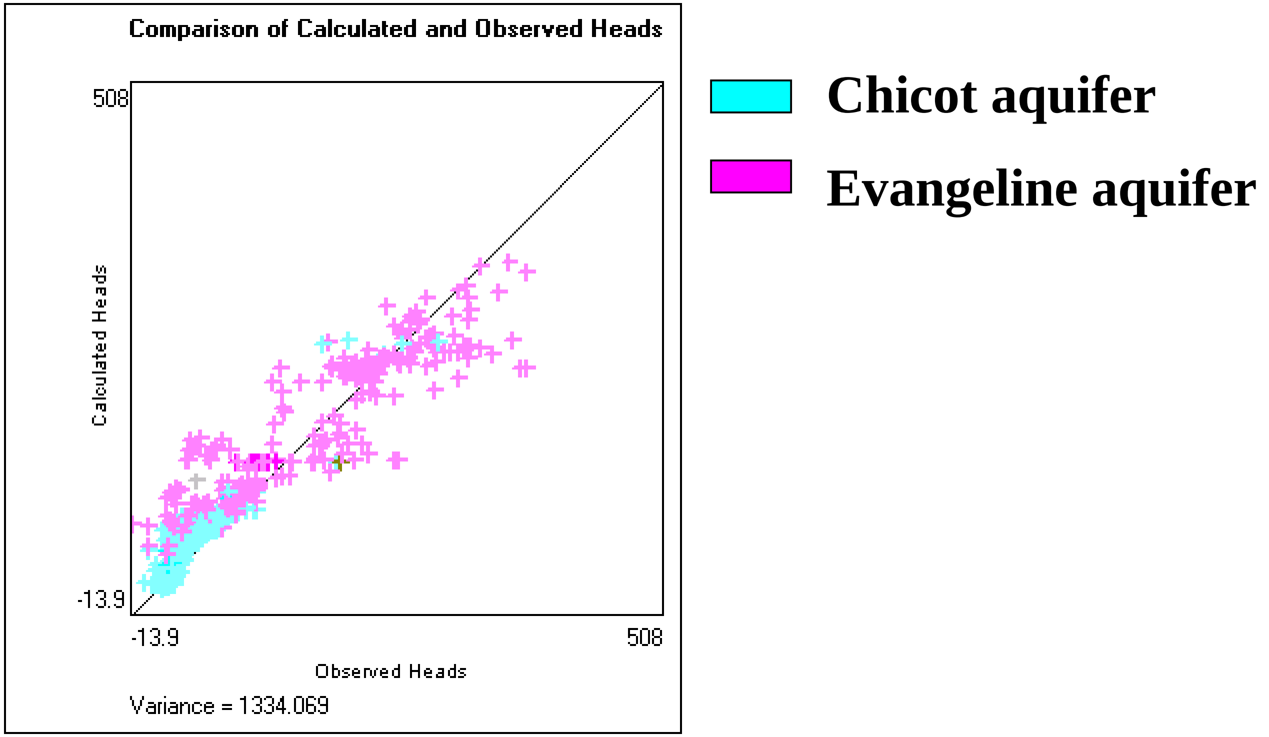


140
120
100
80
60
40
20
0
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
N
TEXAS
0 5 10 15 mi



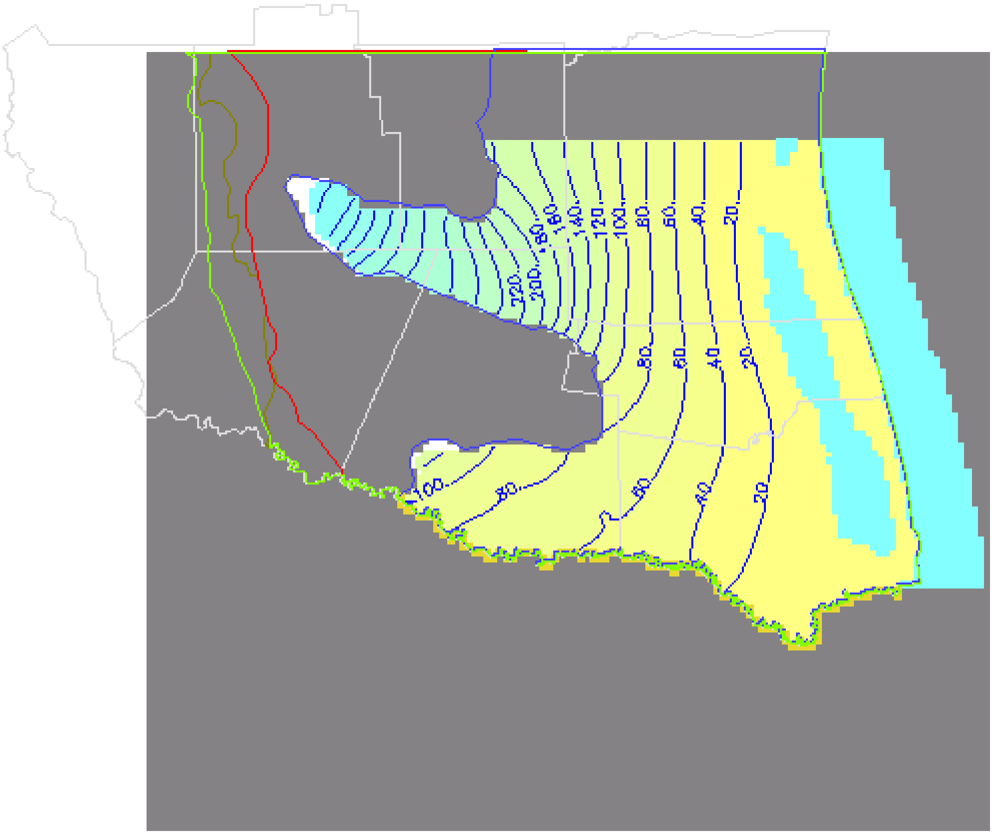
140
120
100
80
60
40
20
0
N
TEXAS
0 5 10 15 mi

Matching measured and simulated water levels

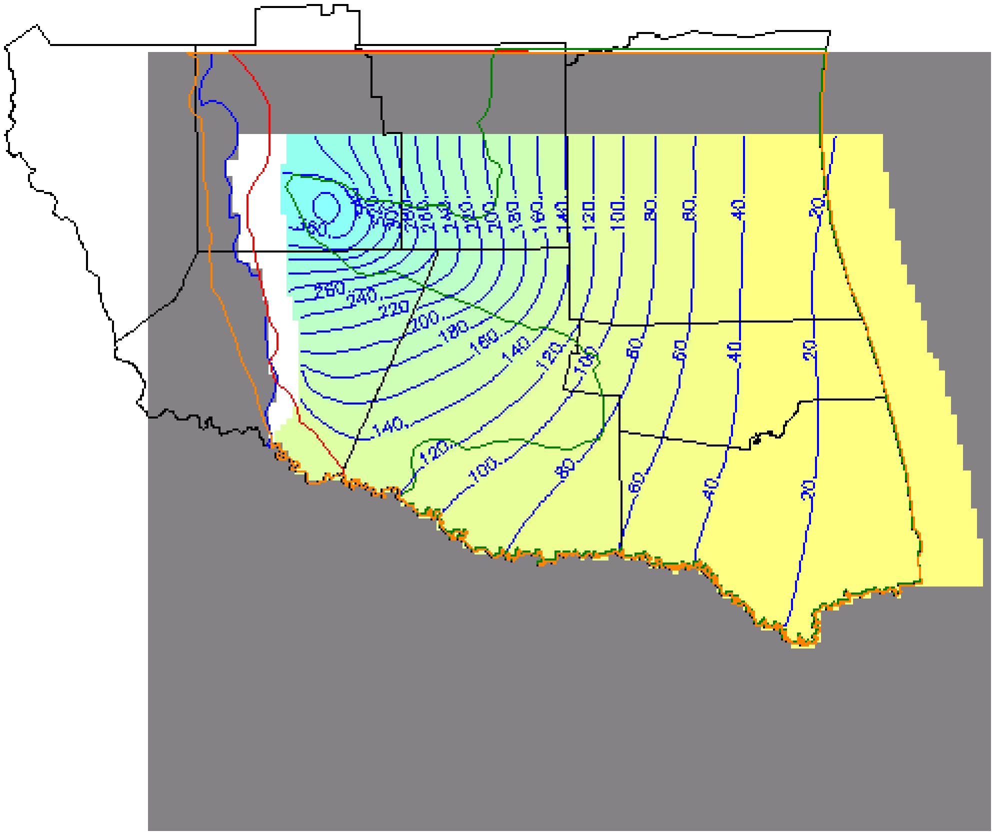


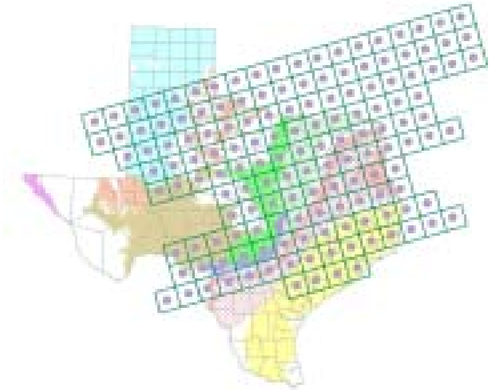
Root Mean Squared Error (RMS) = 36 feet

Simulated water levels, Chicot aquifer



Simulated water levels, Evangeline aquifer





Next Step..

- Transient Verification (1980-2000)
- Predictive Model Runs (2000-2050)

TEXAS WATER DEVELOPMENT BOARD

Participant	Affiliation
Glenn Jarvis	Law Offices MP, Region M
Lee Kirkpatrick	Texas State bank, Region M
Mary Lou Campbell	Mercedes, Region M
Robert Gonzalez	Eagle Pass Waterworks, Region M
Charles Browning	North Alamo Water Supply Corporation
Guadalupe Carlos Garza	Roma
Mercurio Martinez	Webb County Judge
James Matz	Harlingen
Donald McGhee	Hydro Systems Inc. - Harlingen
Adrian Montemayor	Water Utilities, Laredo
Ray Prewett	Texas Citrus Mutual
Xavier Villarreal	T & J Office Supply
Israil Tamez	Willacy County
Eleanor Garcier, Jr.	City of Raymondville
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Robert Gonzalez	City of Eagle Pass
Ali Chowdhury	TWDB, Austin
Ralph Boecker	TWDB, Austin
Ernesto Alanis	City of Edinburgh
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Ernesto Reyes	USFWS
Randy Blackmanship	TPWD
Felipe C.	CILA Sec. Mexico
Garey Carter	AEP
James Oliver	Olmito WSC
Monica Monk	USFWS
A. Salgado	MEXCON
Jim Darling	City of McAllen
Lucile H.	BPUB
Tomas Rodriguez	Webb County
Sonny Hinojosa	Hidalgo County Irrigation District #2

The Third Stakeholder Advisory Forum for the Lower Rio Grande Valley GAM was held on April 26, 2002 in McAllen in conjunction with the Region M RWPG meeting.

Q: Would the model help locate potential aquifers and estimate groundwater availability?

A: The GAM model will help estimate groundwater availability in the aquifer. The model could locate drawdown areas, identify pumping effect on the Rio Grande and other source areas.

Q: Could the model estimate volumes of fresh and brackish waters in the aquifers?

A: We said that the model itself does not consider water quality. We could however estimate the volumes based on water quality distribution in the aquifers. We indicated that we are trying to better understand the geochemical evolution of the groundwater using isotopes and chemical parameters that will help answer questions related to water quality issues.

Q: NRS Consulting is installing major desalination wells for a number of Water Supply Authorities in the Valley. They inquired whether the model would be able to determine what quality waters would they be drawing over time and how pumping may negatively impact the groundwater source areas.

A: We said the model would identify the extent of the drawdown cone over different times. MT3D code when used in combination with MODFLOW should be able to determine solute migration.

Q: Some members asked whether they should be clearing the mesquite for making more groundwater available?

A: Model calibration indicated that a significant amount of groundwater is lost to evapo-transpiration. We indicated that mesquites with their deep root systems act as a significant sink for the groundwater. We said that several studies suggest that removal of phreatophytes cause a rise in the water table.