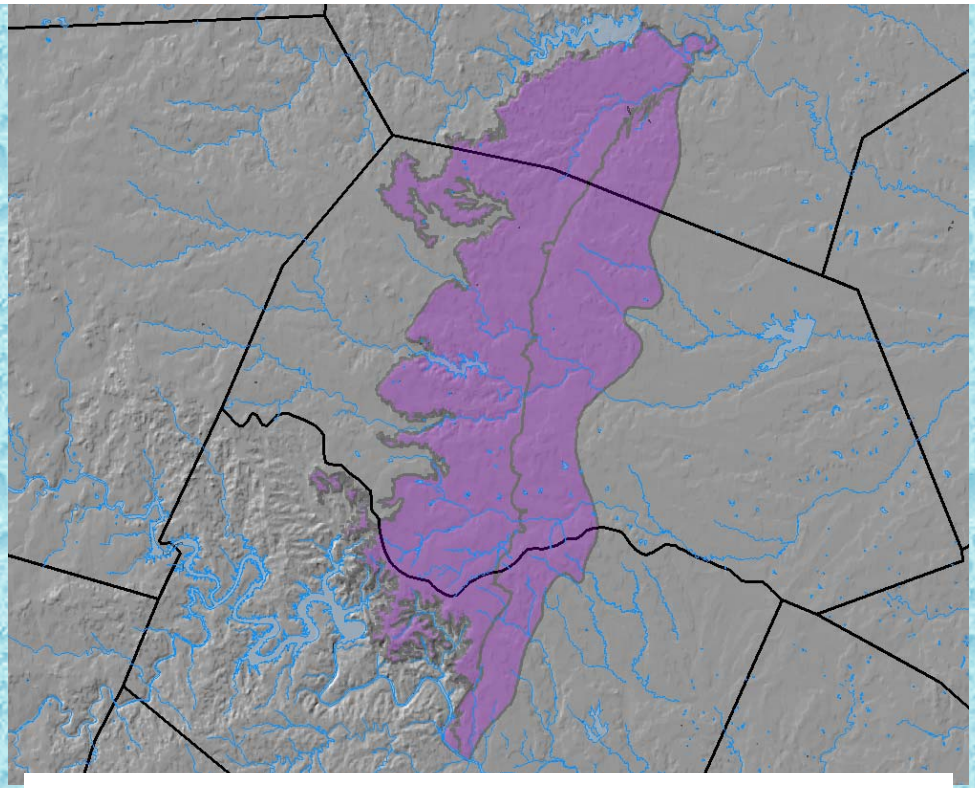
NORTHERN SEGMENT OF THE EDWARDS AQUIFER GROUNDWATER AVAILABILITY MODEL



Sixth Stakeholder Advisory Forum

July 2003

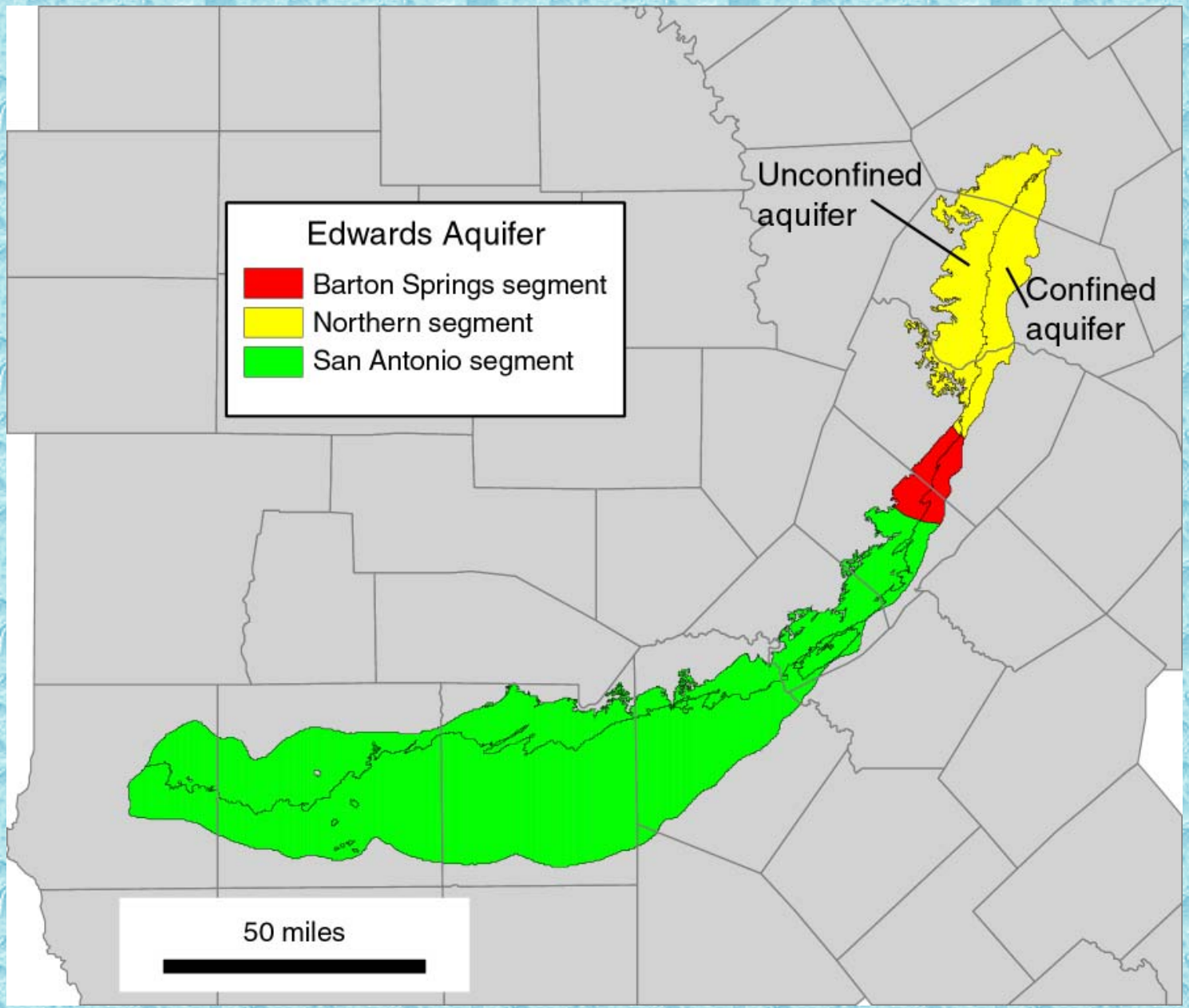
GAM Groundwater Availability Modeling

texas water development board

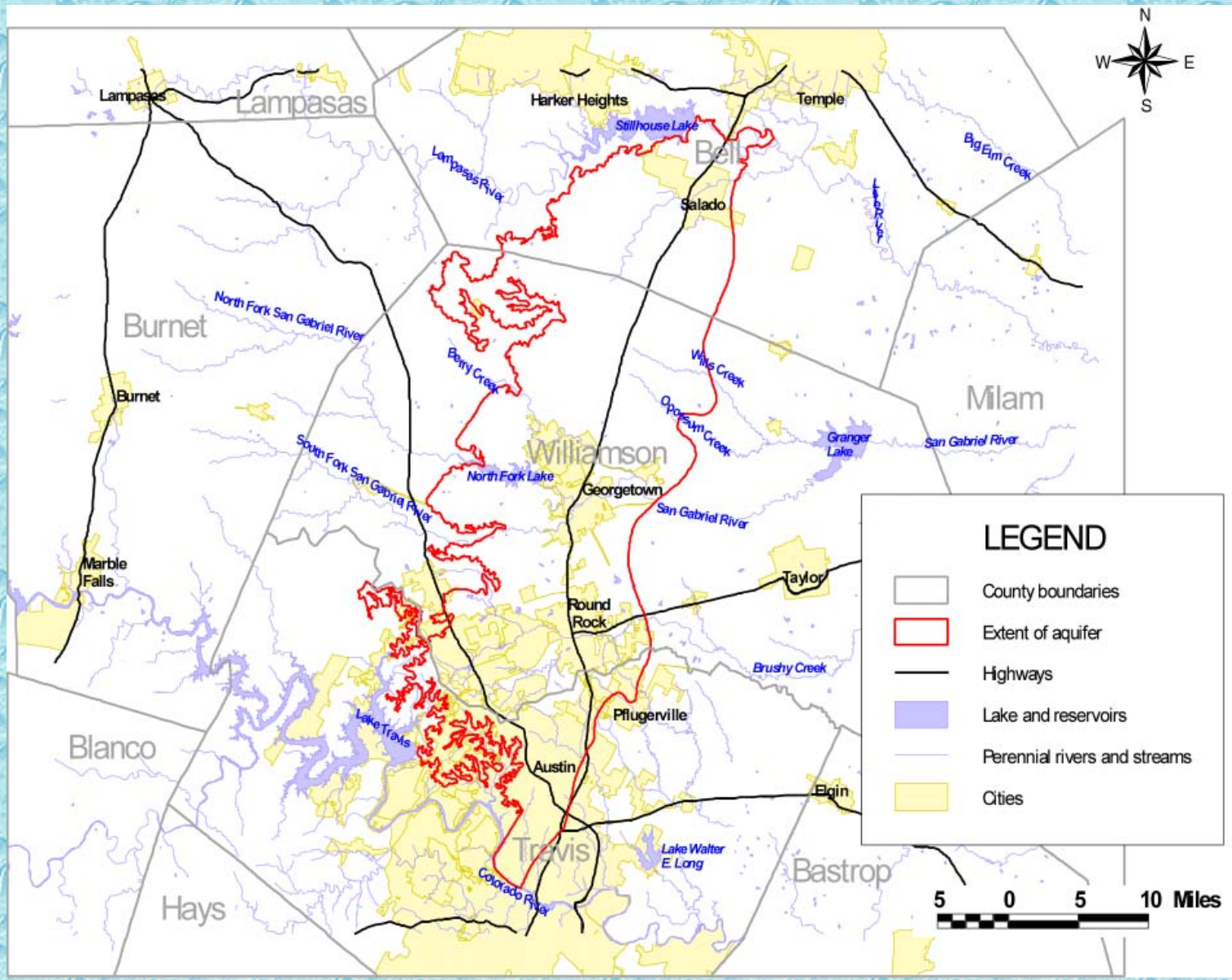
OUTLINE

- Review
  - Geology and hydrogeology
  - Steady-state model
  - Historic transient model
- Predictive model
- Sensitivity analysis

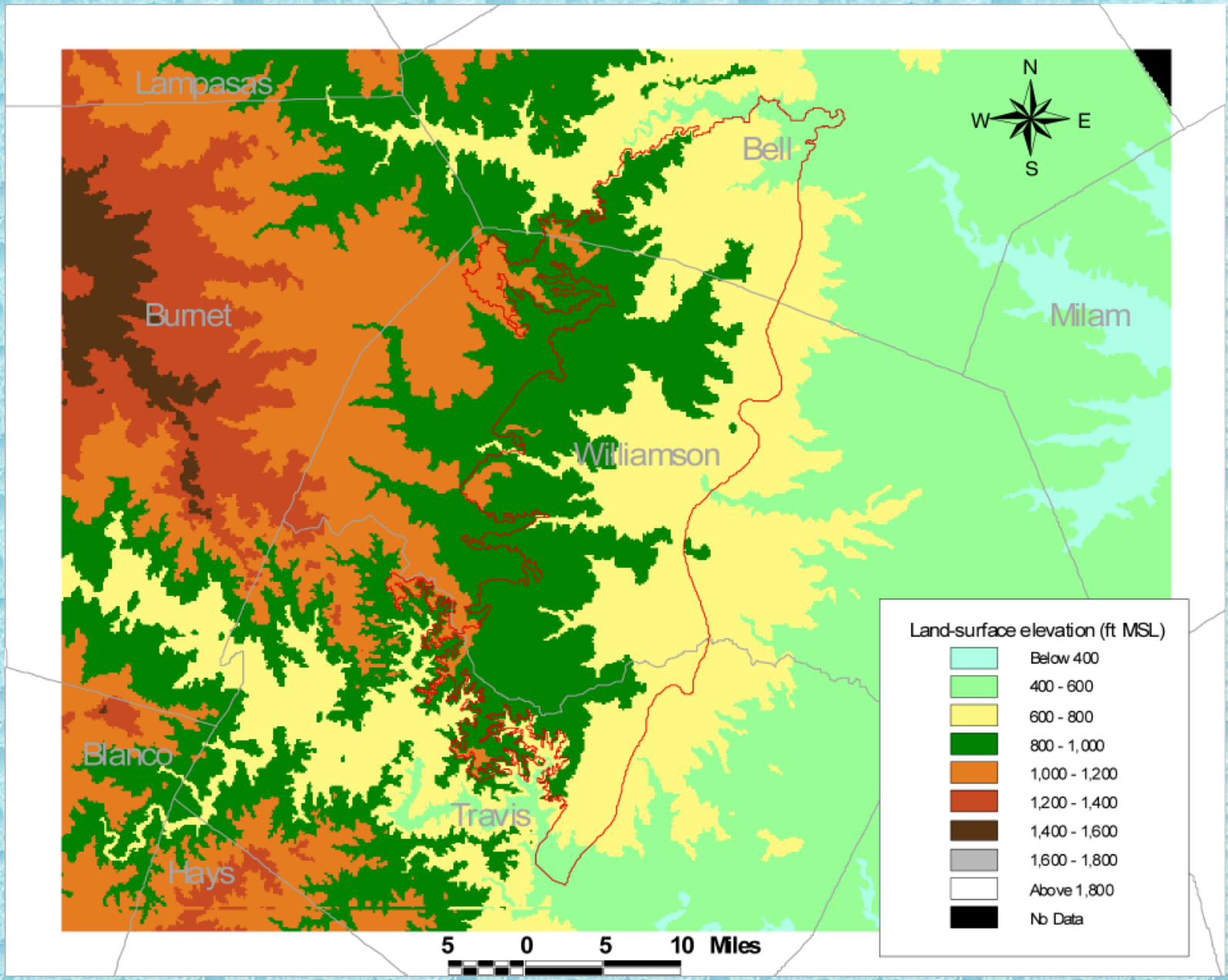
INTRODUCTION



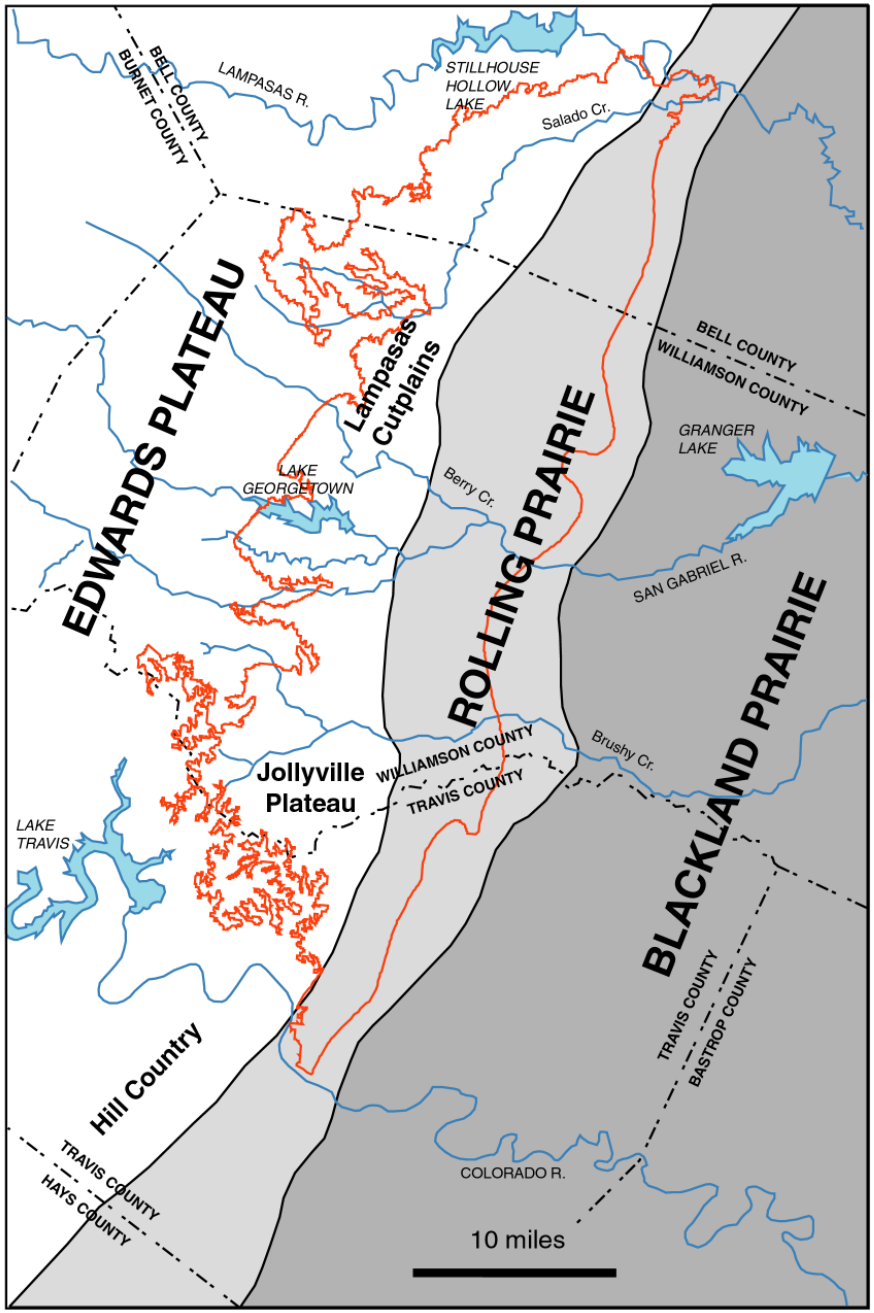
EDWARDS AQUIFER


N
W
E
S
Lampasas
Lampasas
Harker Heights
Temple
Stillhouse Lake
Bell
Lampasas River
Big Elm Creek
Salado
Leon River
North Fork San Gabriel River
Burnet
Burnet
Berry Creek
Willis Creek
Opossum Creek
Milam
Granger Lake
San Gabriel River
South Fork San Gabriel River
North Fork Lake
Williamson
Georgetown
San Gabriel River
Marble Falls
Taylor
Round Rock
Brushy Creek
Pflugerville
Lake Travis
Blanco
Austin
Elgin
Travis
Lake Walter E. Long
Colorado River
Bastrop
Hays
LEGEND
County boundaries
Extent of aquifer
Highways
Lake and reservoirs
Perennial rivers and streams
Cities
5 0 5 10 Miles

STUDY AREA

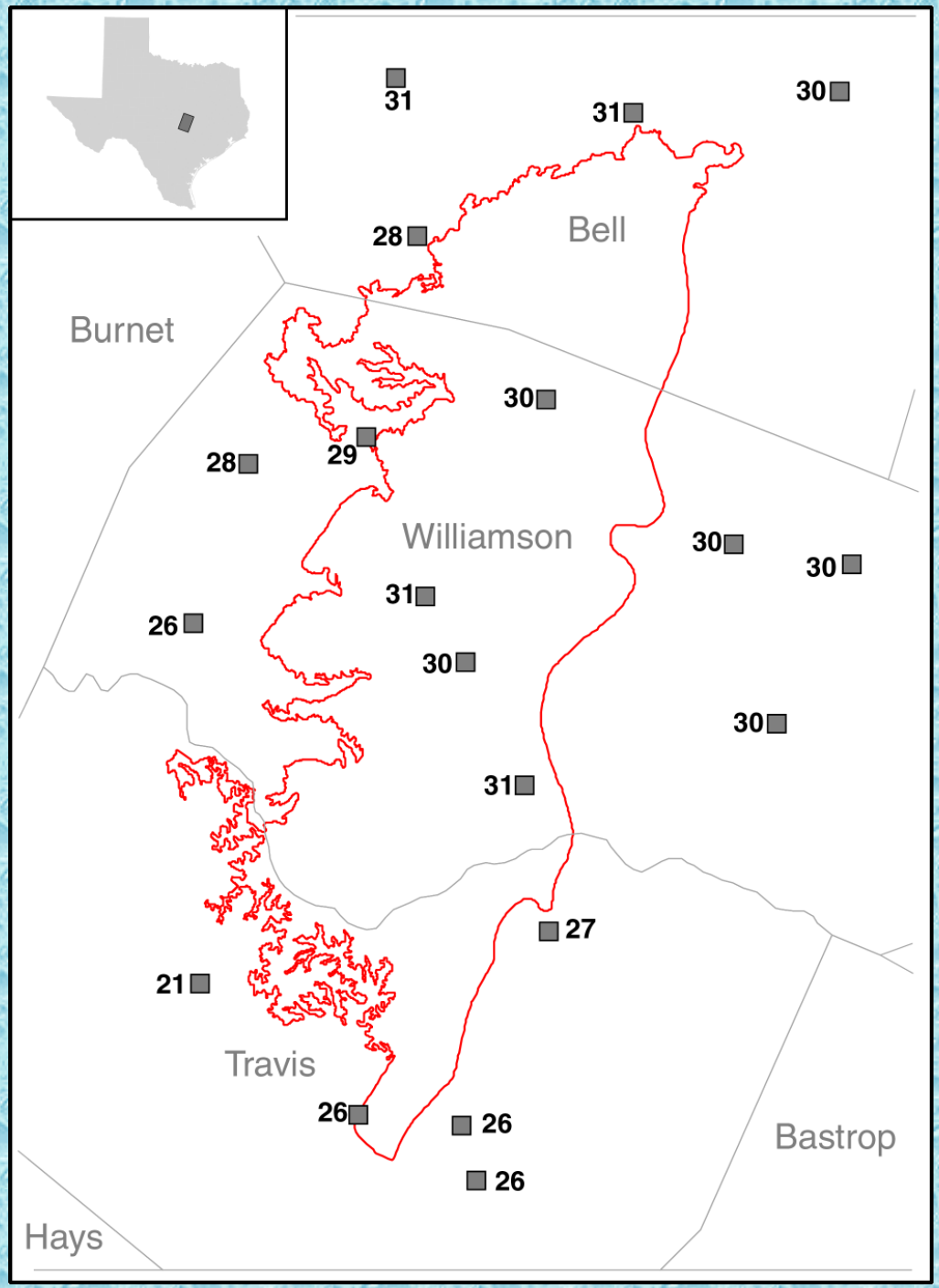

Lampasas
Bell
Burnet
Milam
Williamson
Blanco
Travis
Hays
N
W
E
S
Land-surface elevation (ft MSL)
Below 400
400 - 600
600 - 800
800 - 1,000
1,000 - 1,200
1,200 - 1,400
1,400 - 1,600
1,600 - 1,800
Above 1,800
No Data
5 0 5 10 Miles

TOPOGRAPHY

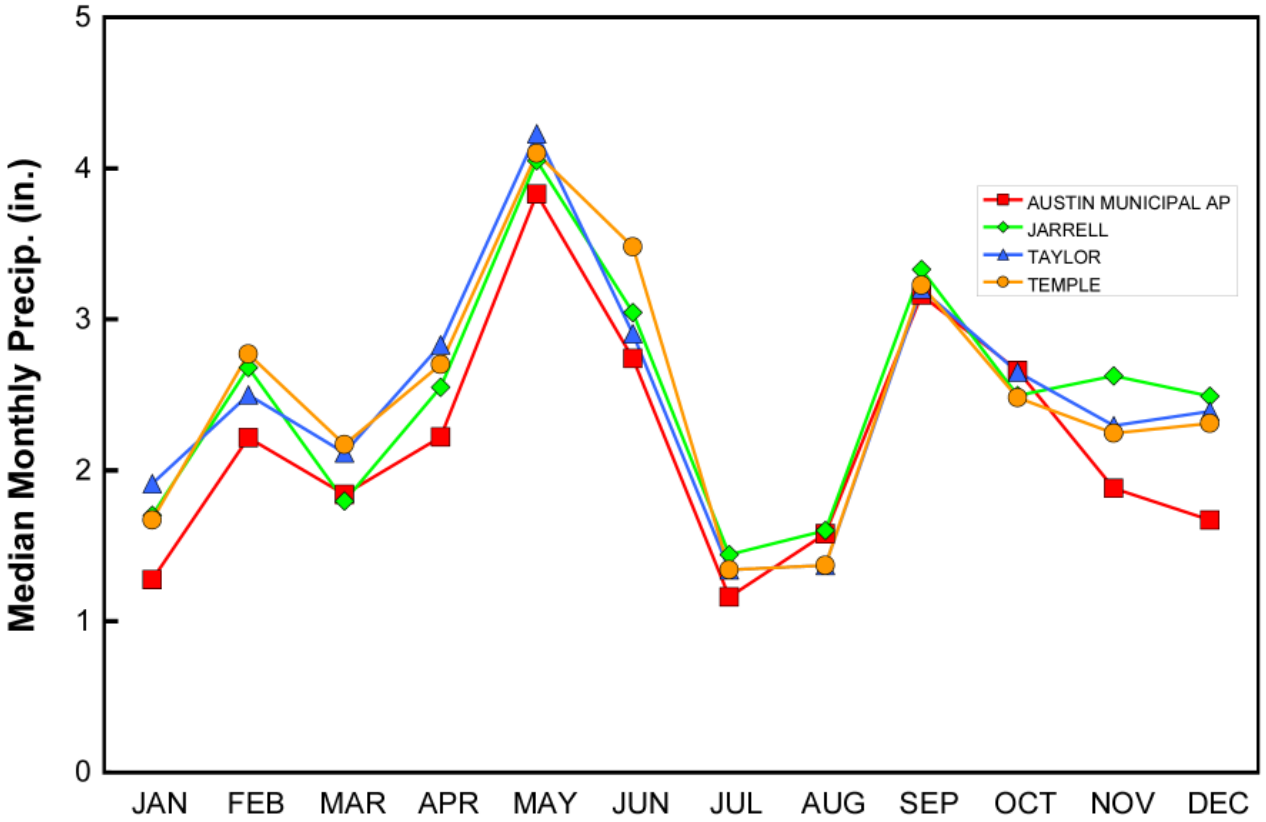


Modified from Senger et al. (1990)

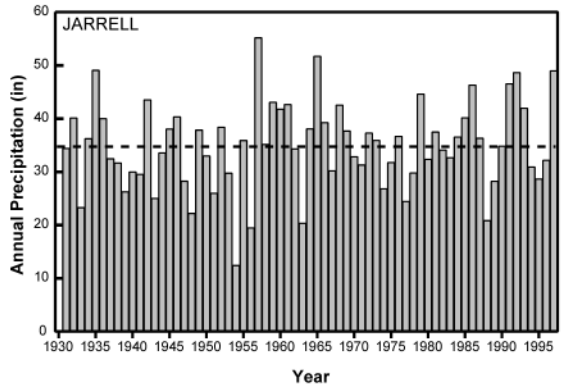
PHYSIOGRAPHIC PROVINCES

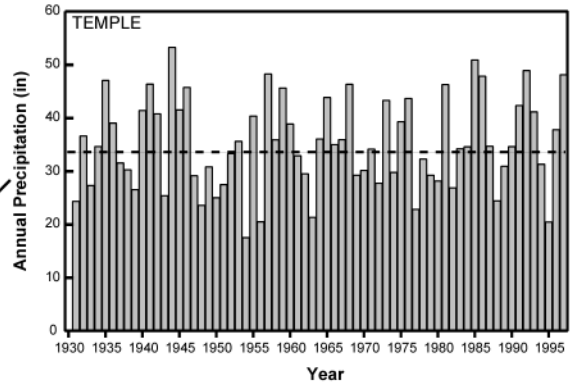


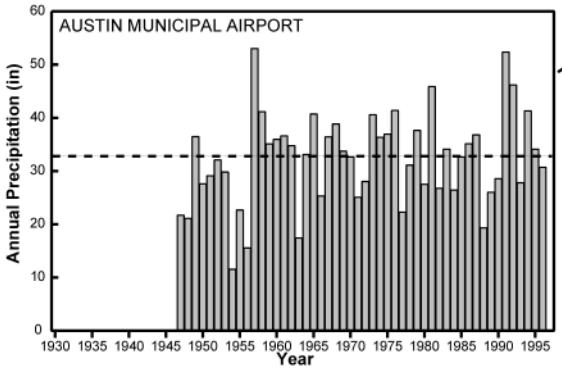
AVERAGE ANNUAL PRECIPITATION

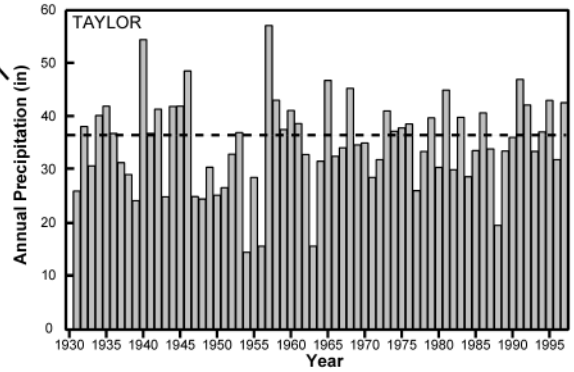


SEASONAL PRECIPITATION

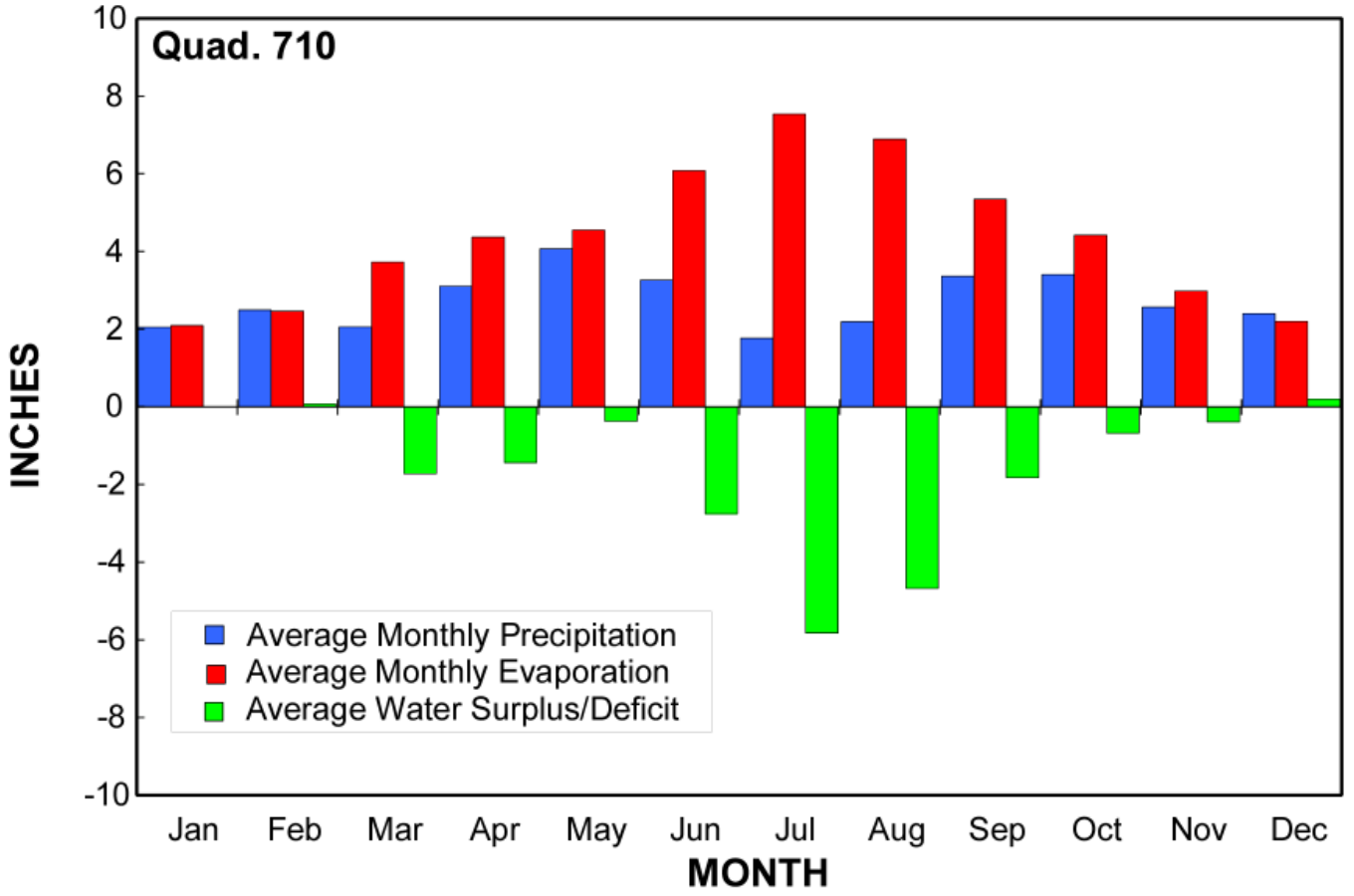








HISTORIC PRECIPITATION

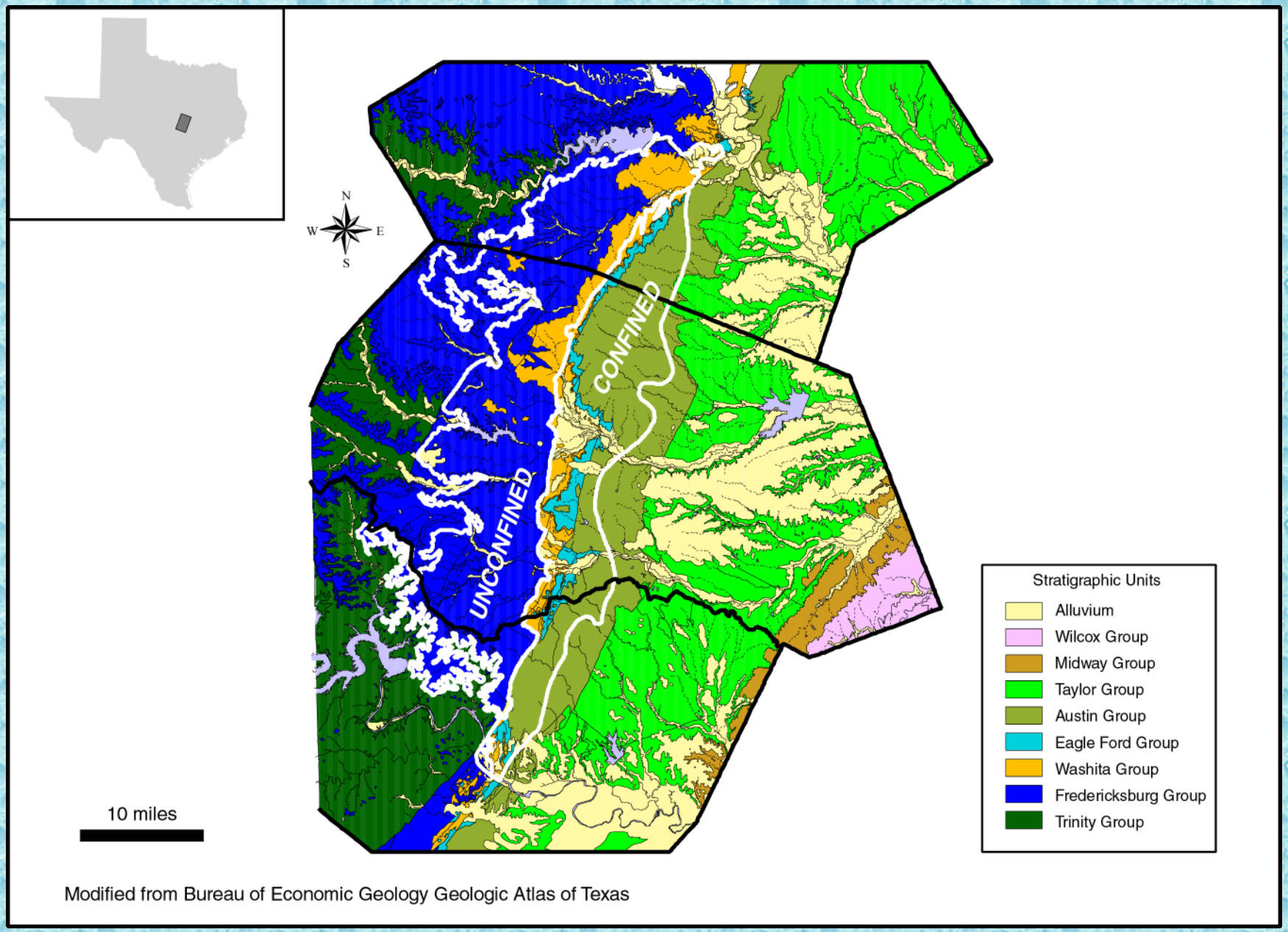


EVAPORATION

HYDROGEOLOGY

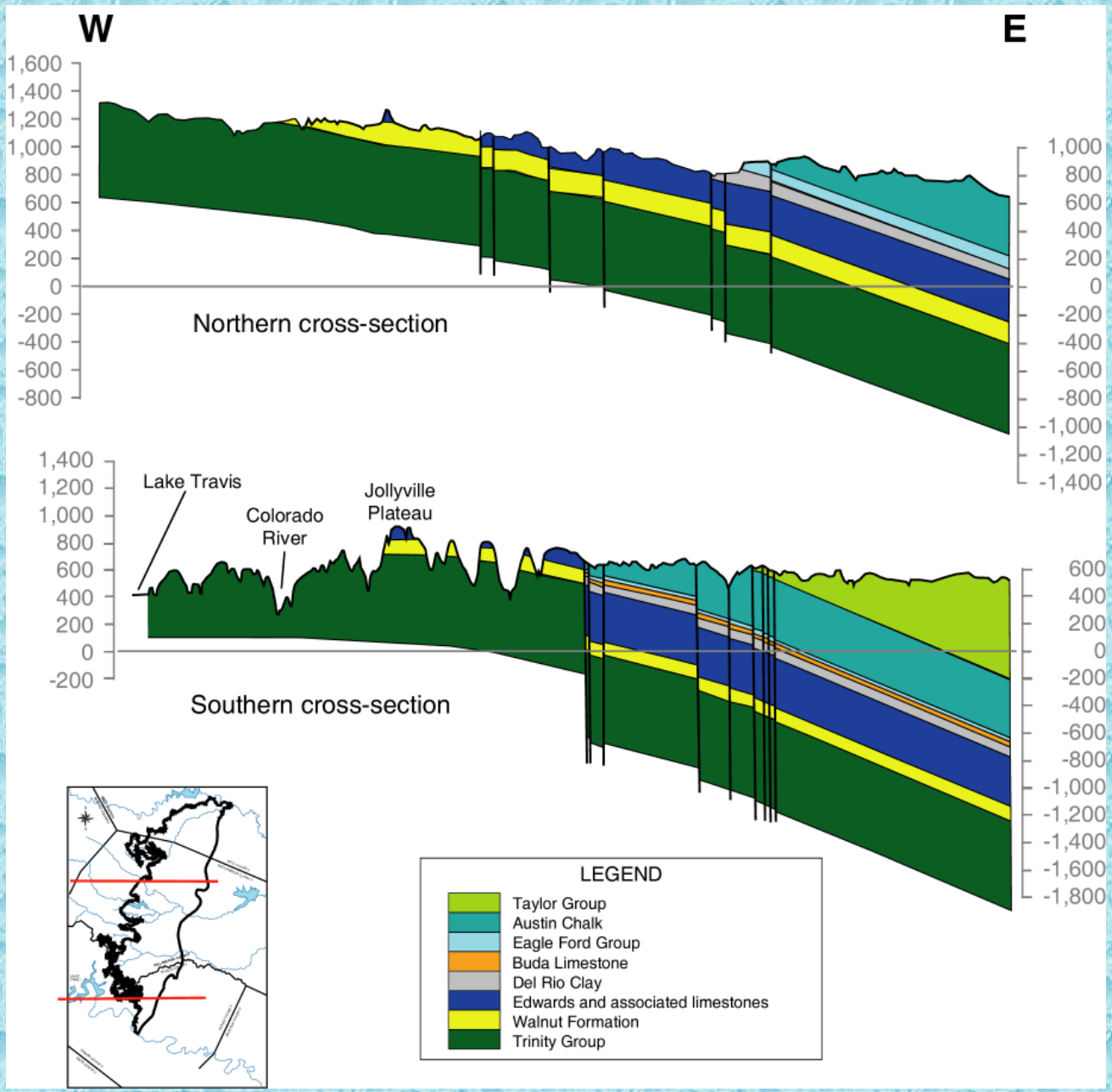
Series	Group	Stratigraphic Unit			Hydrologic Unit	Maximum Thickness (feet)
Gulf	Navarro				Navarro and Taylor Group	850
	Taylor					
	Austin				Austin Chalk	450
Comanche	Eagle Ford					50
	Washita	Buda Limestone				50
		Del Rio Clay				60
		Georgetown Formation			Edwards and associated limestones	100
	Fredericksburg	Edwards Limestone				200
		Comanche Peak Limestone				50
		Walnut Formation				150
	Trinity	Paluxy Formation			Upper Trinity	10
		Glen Rose	Upper Member			450
			Lower Member		Middle Trinity	450
		Travis Peak	Hensell Sand Member			100
			Cow Cr. Limestone Member			100
			Hammett Shale Member			50
			Sligo Member		Lower Trinity	150
			Hosston Member			850

HYDROSTRATIGRAPHY

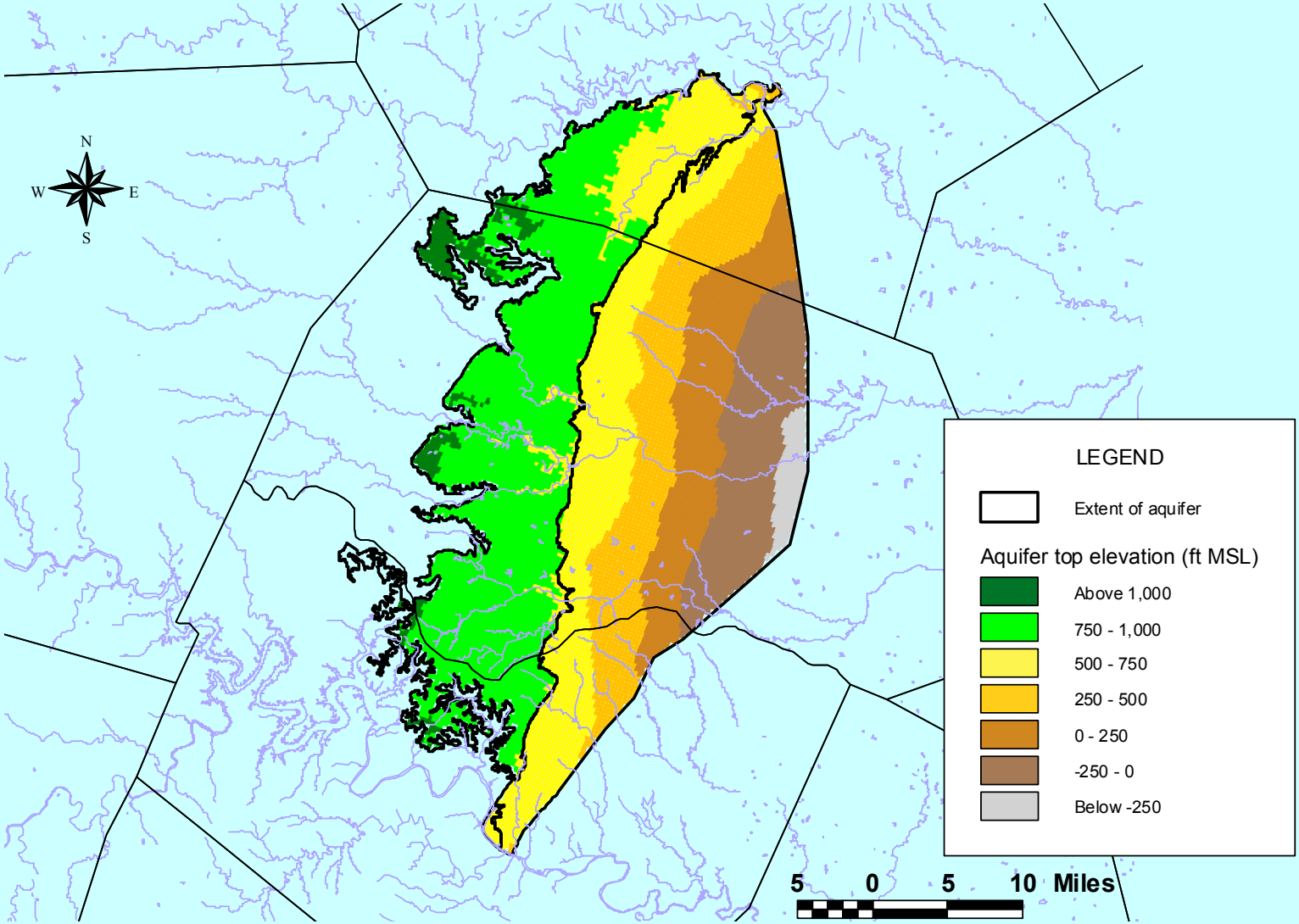


Modified from Bureau of Economic Geology Geologic Atlas of Texas

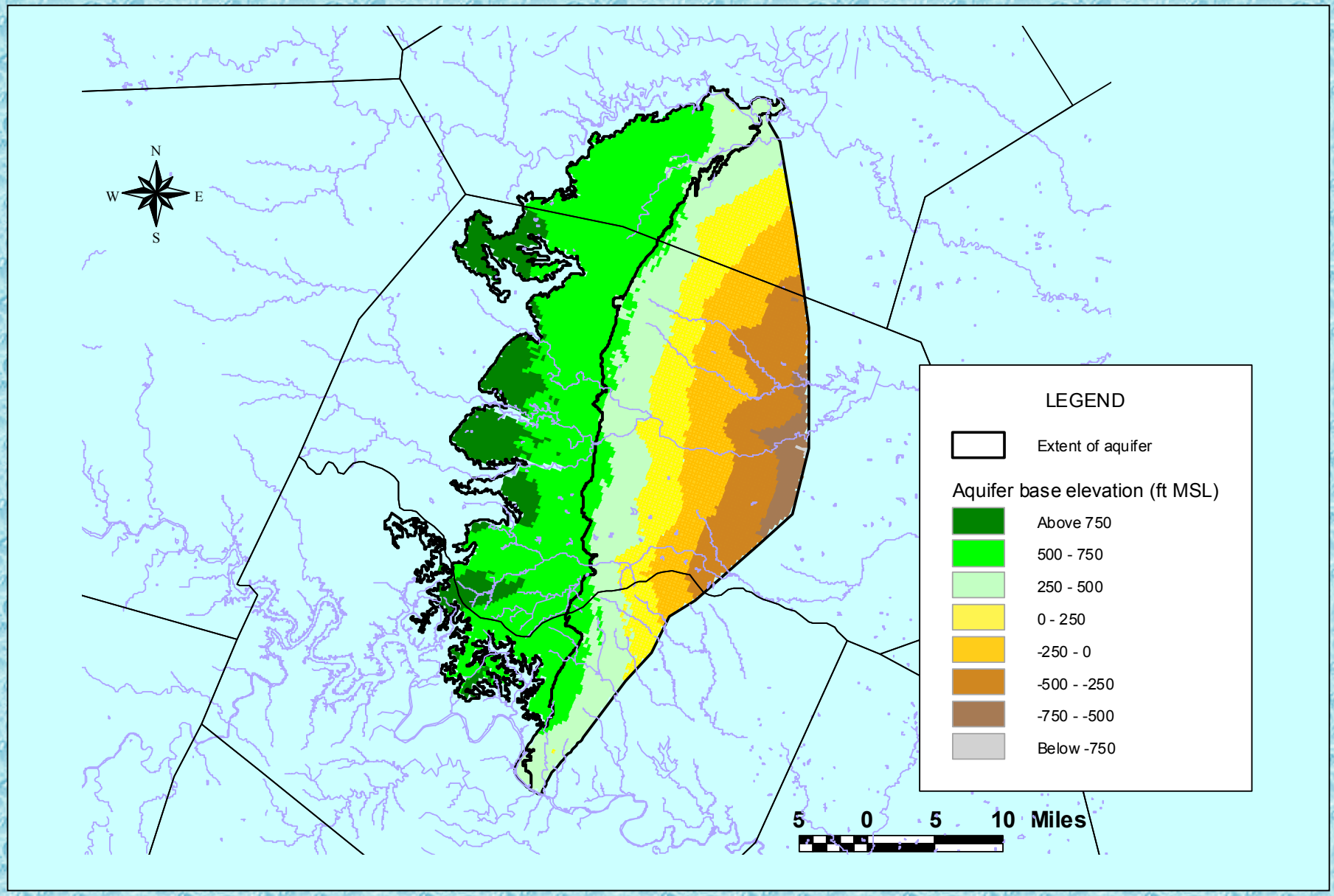
SURFACE GEOLOGY



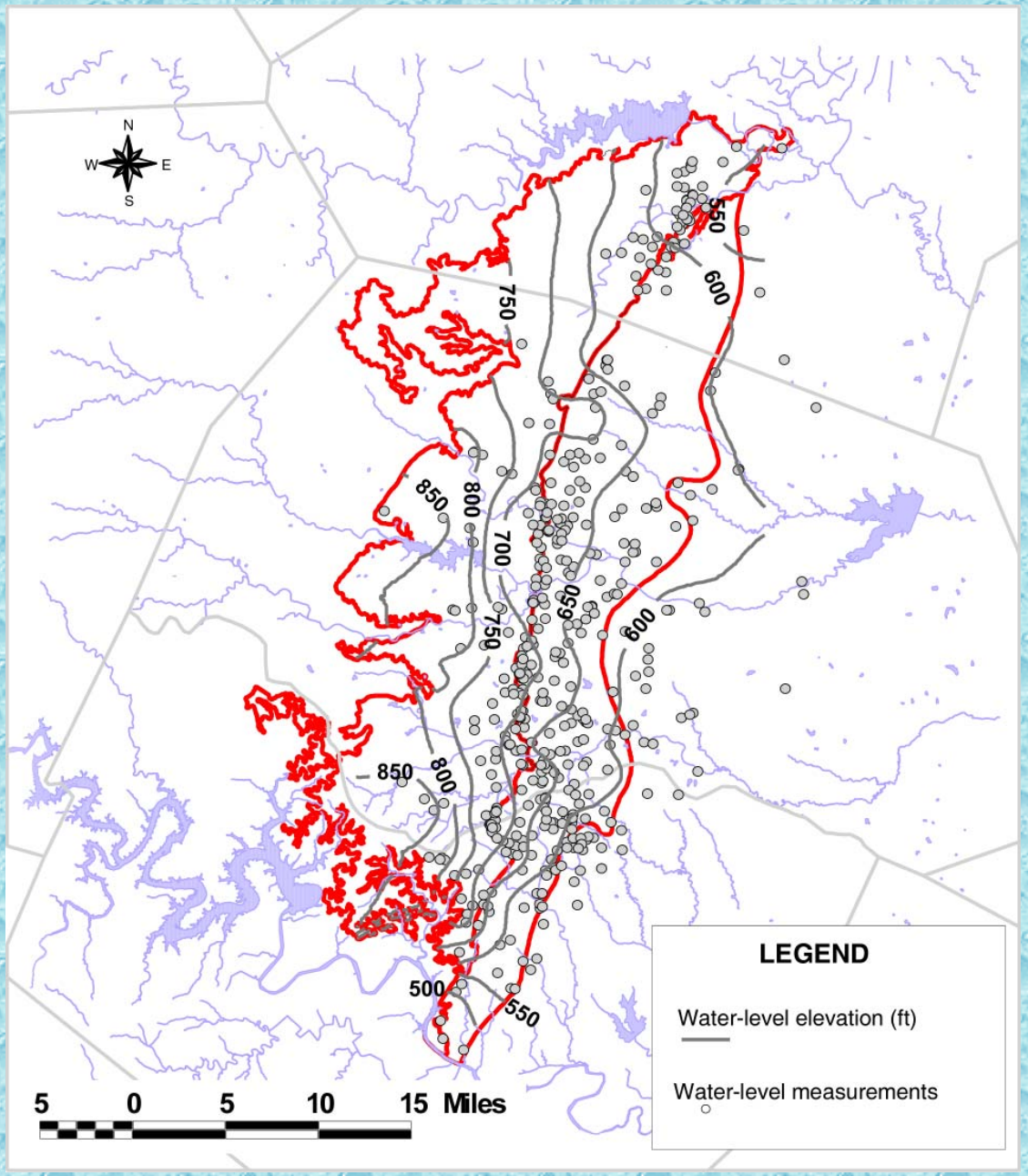
GEOLOGIC CROSS SECTIONS



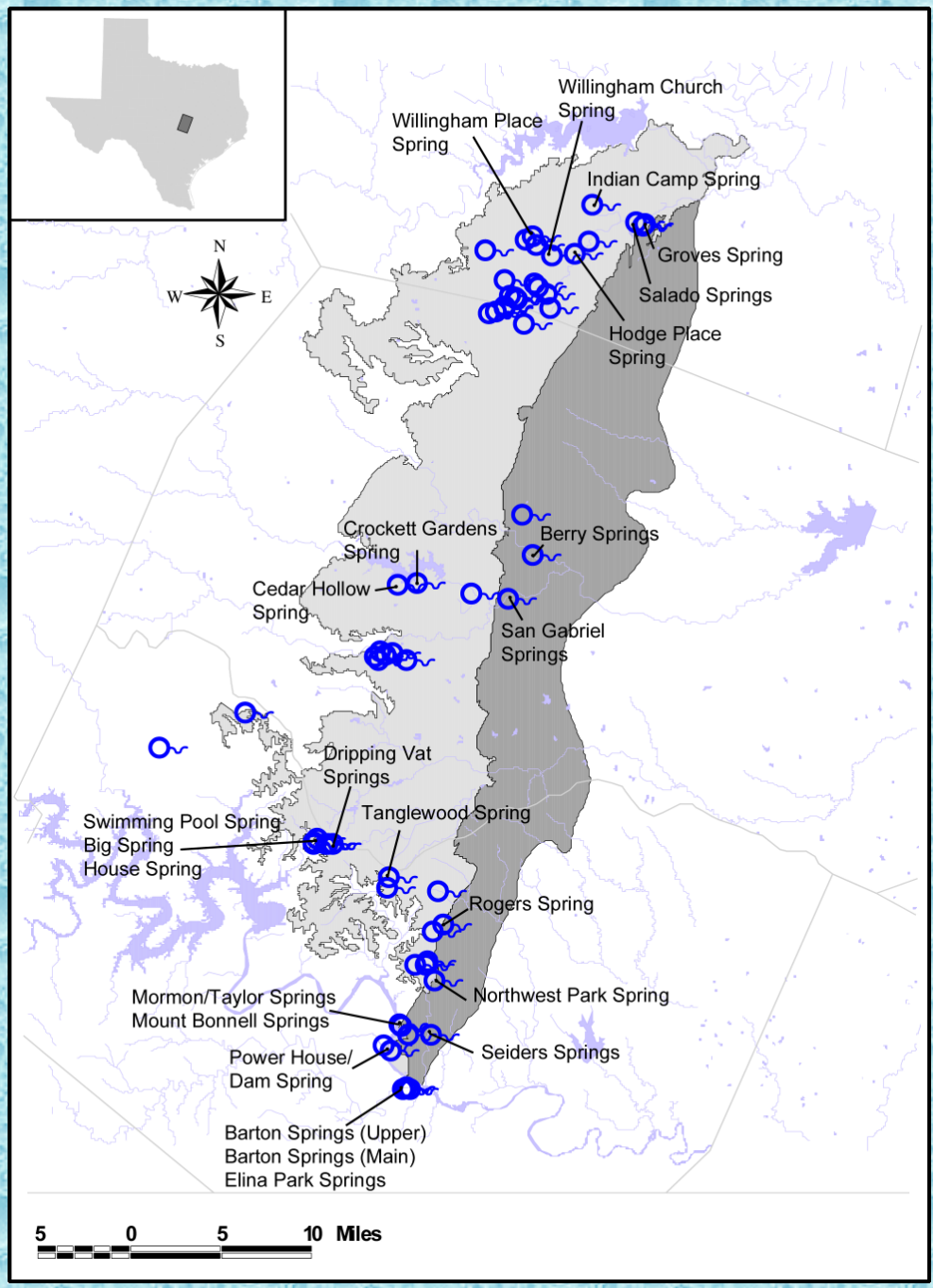
AQUIFER TOP ELEVATION



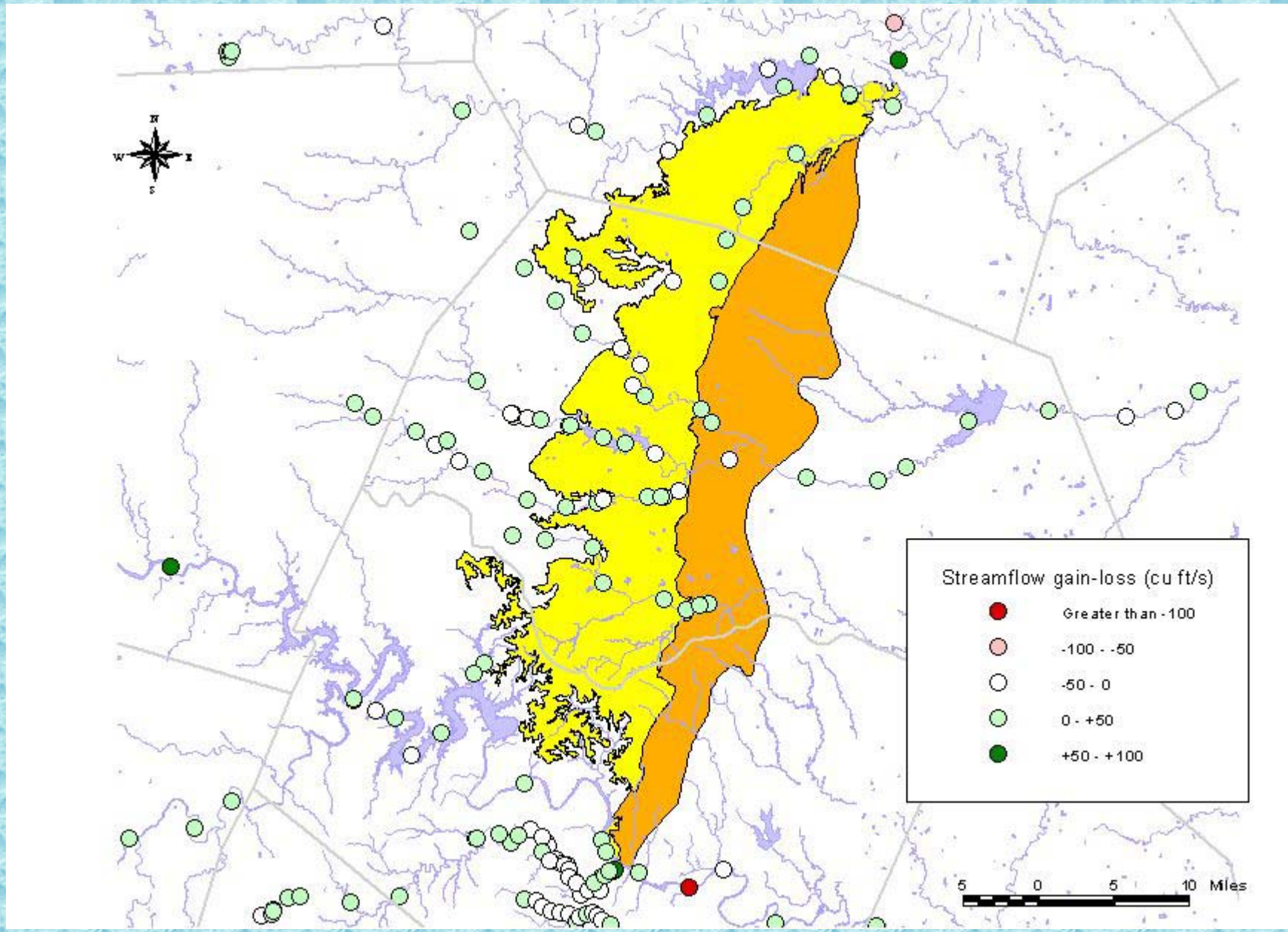
AQUIFER BASE ELEVATION



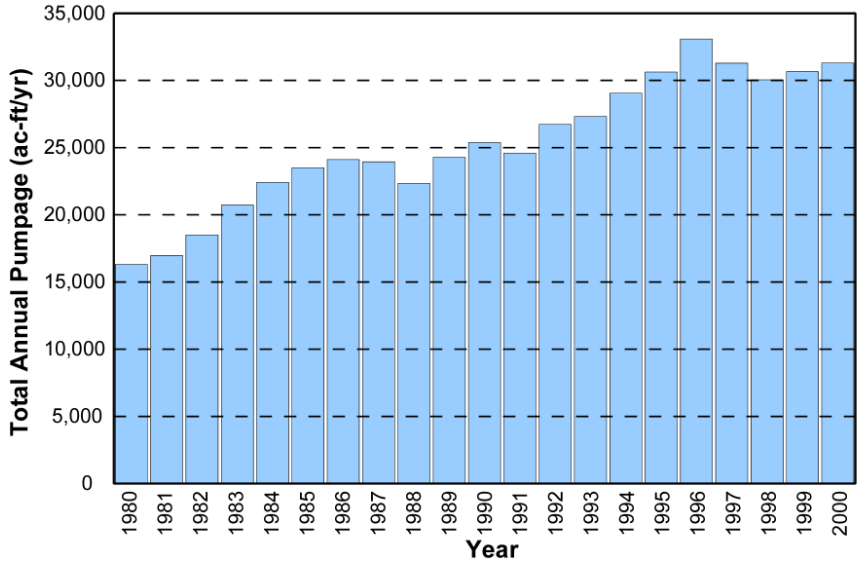
WATER LEVELS

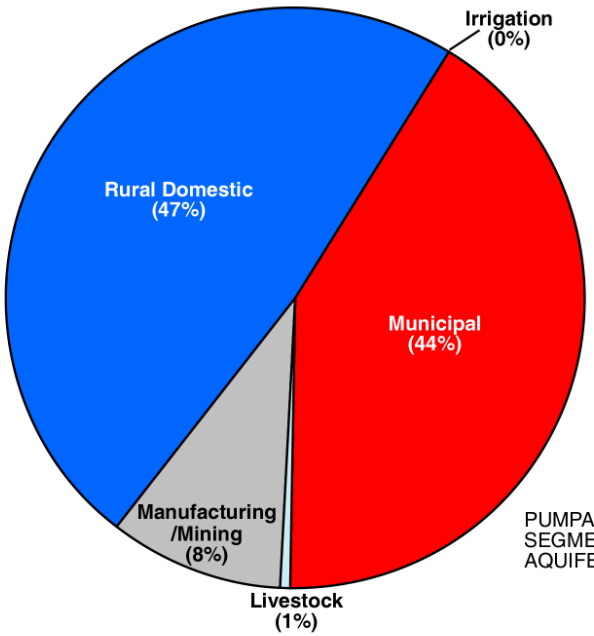


MAJOR SPRINGS



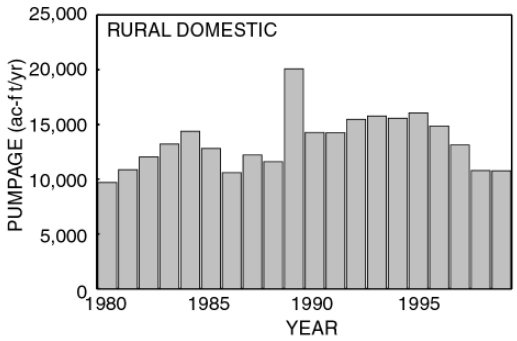
STREAMFLOW GAIN-LOSS

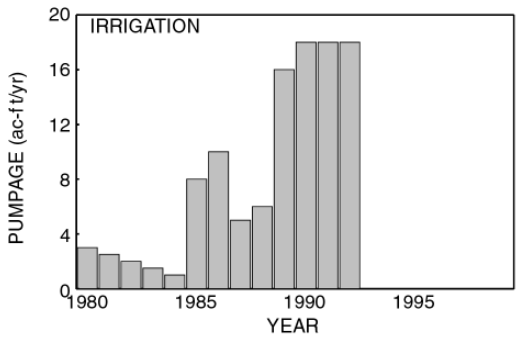


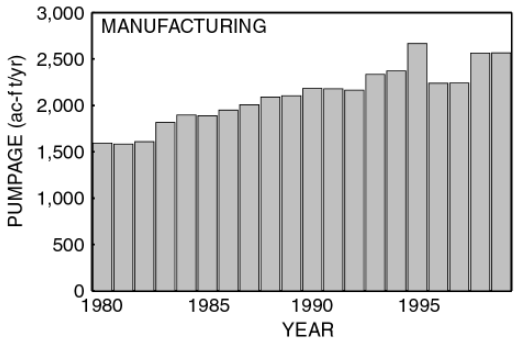


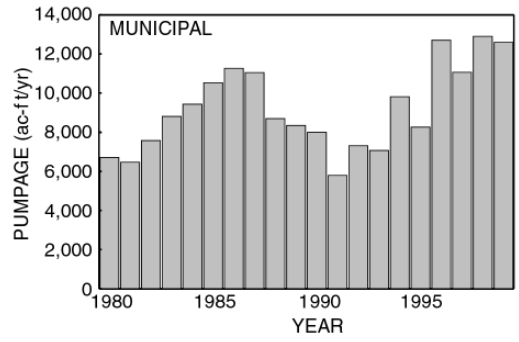
PUMPAGE FROM THE NORTHERN SEGMENT OF THE EDWARDS AQUIFER (1999)

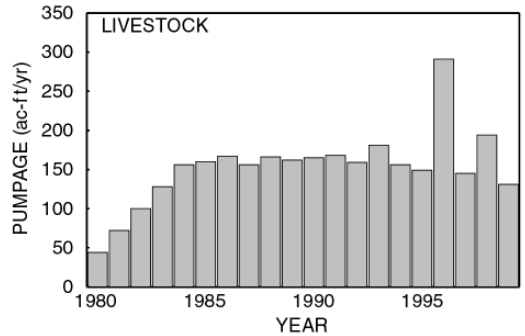
HISTORIC PUMPAGE: TOTAL



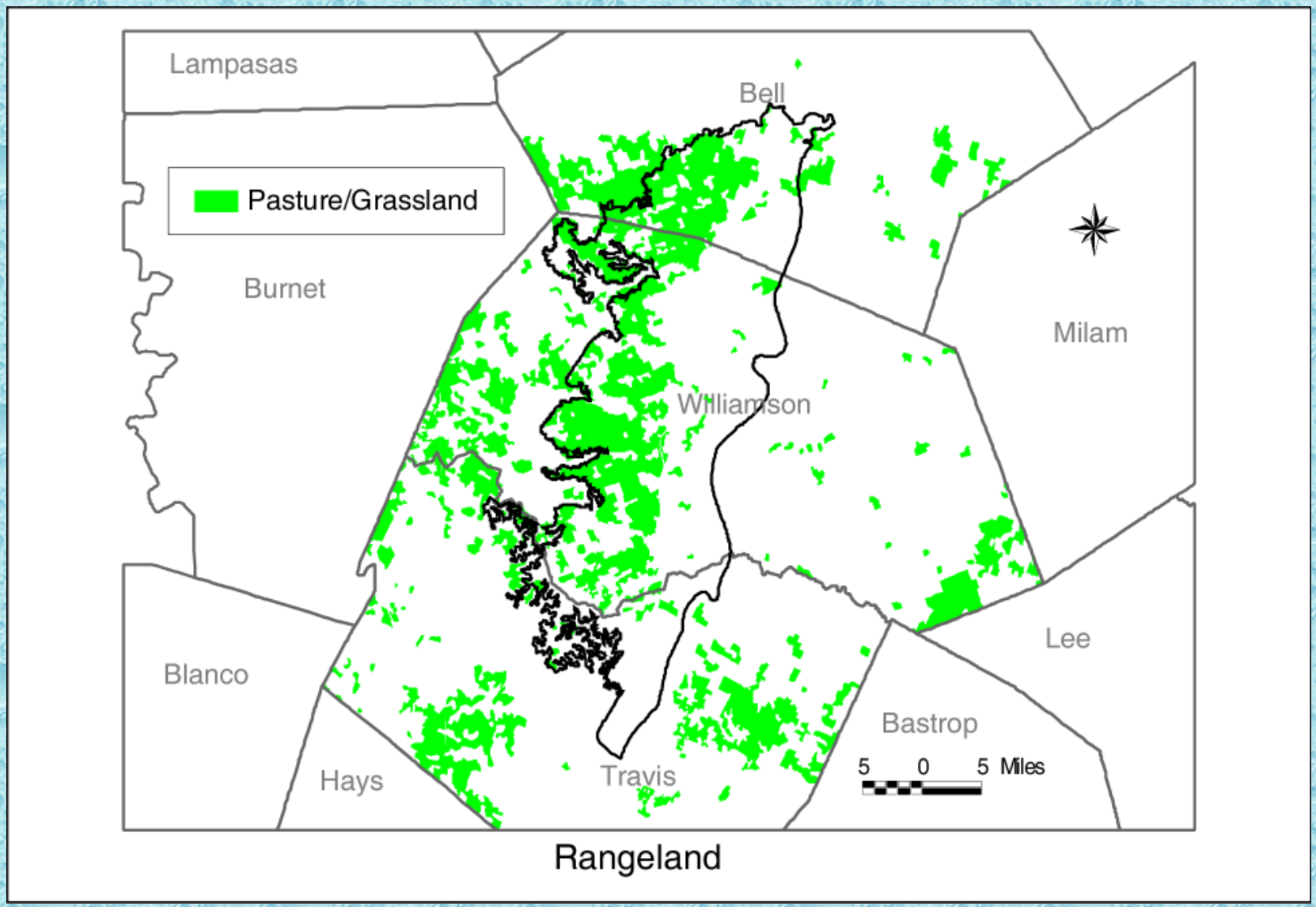




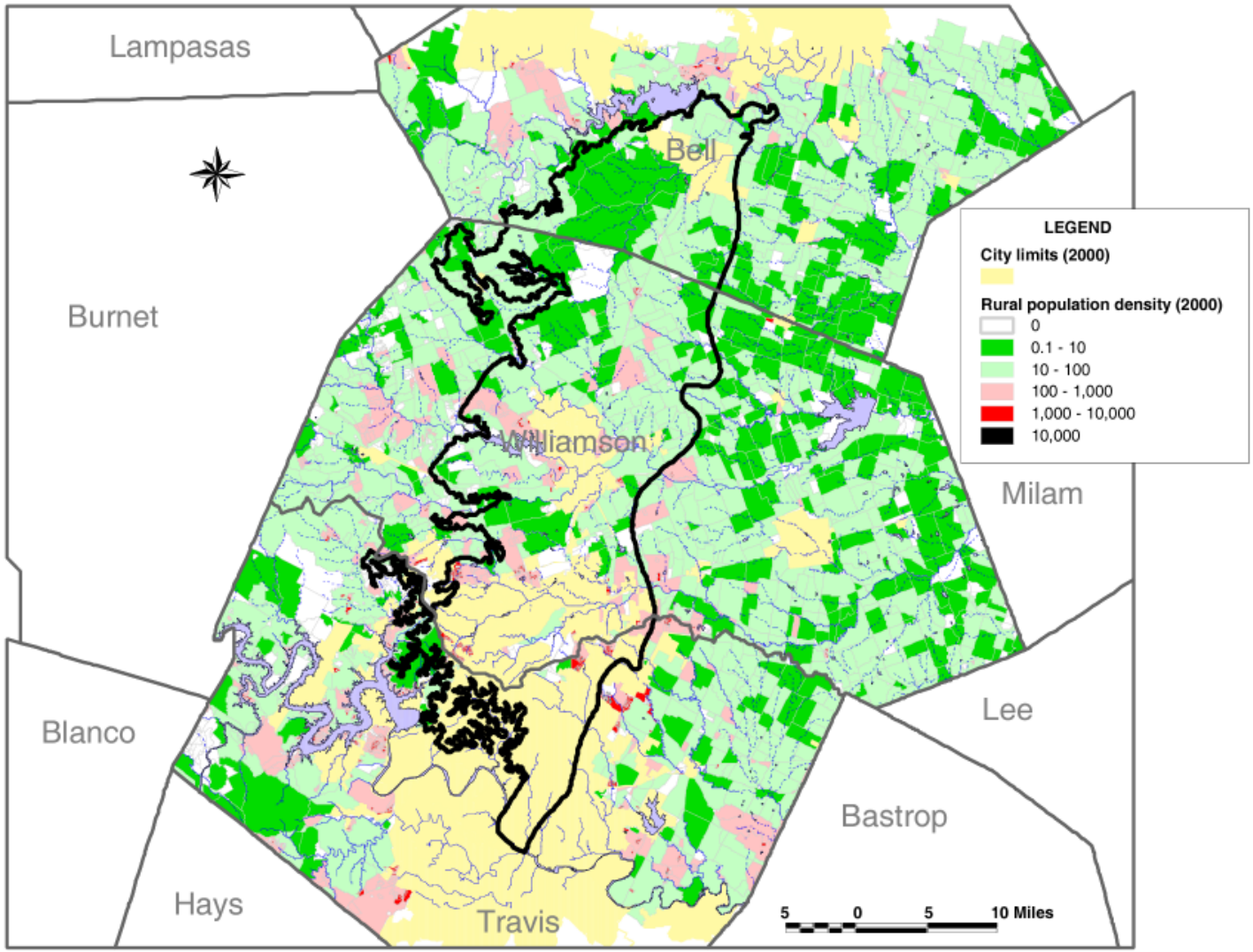




HISTORIC PUMPAGE

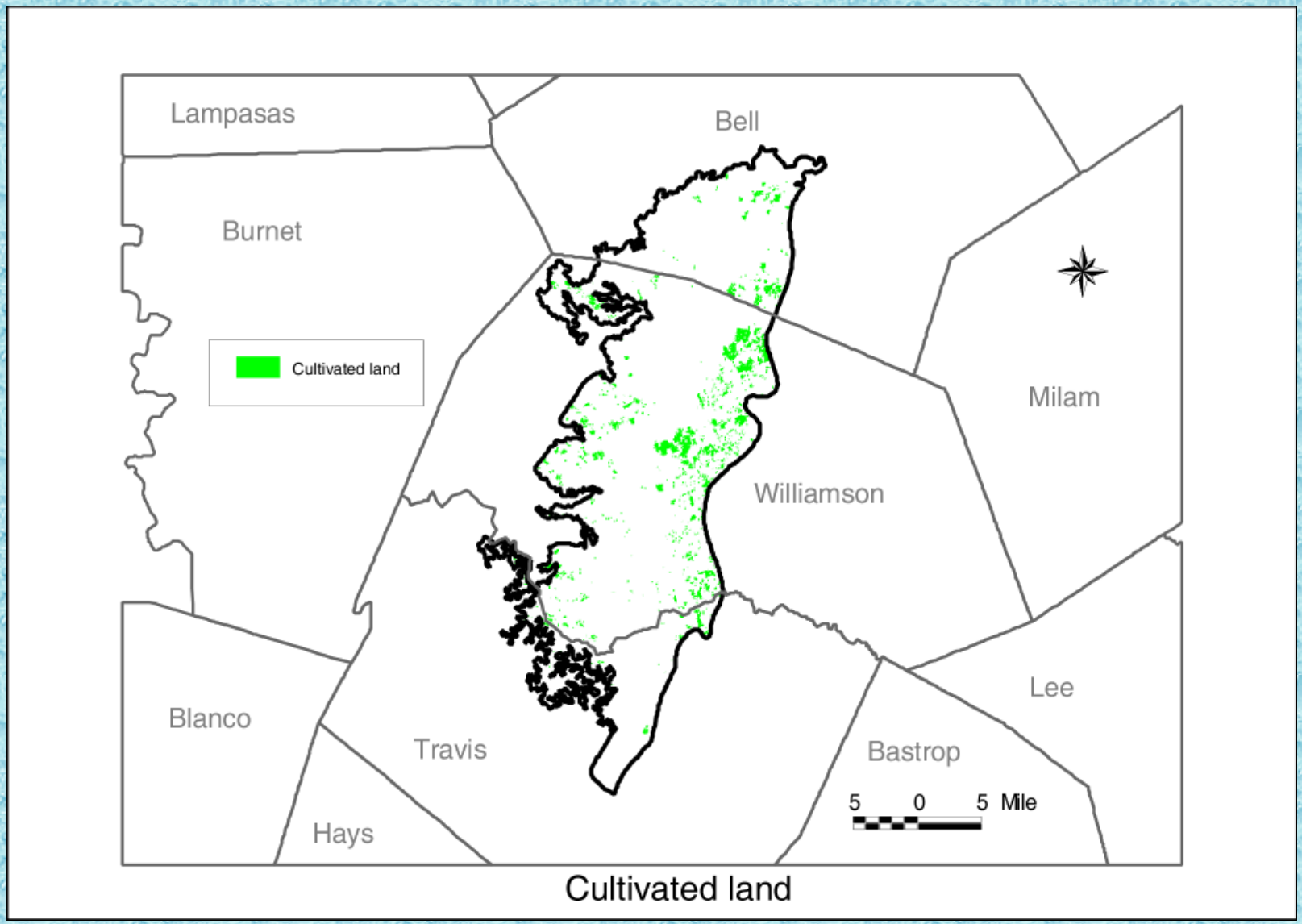

Lampasas
Bell
Pasture/Grassland
Burnet
Milam
Williamson
Lee
Blanco
Bastrop
Hays
Travis
5 0 5 Miles
Rangeland

RANGELAND



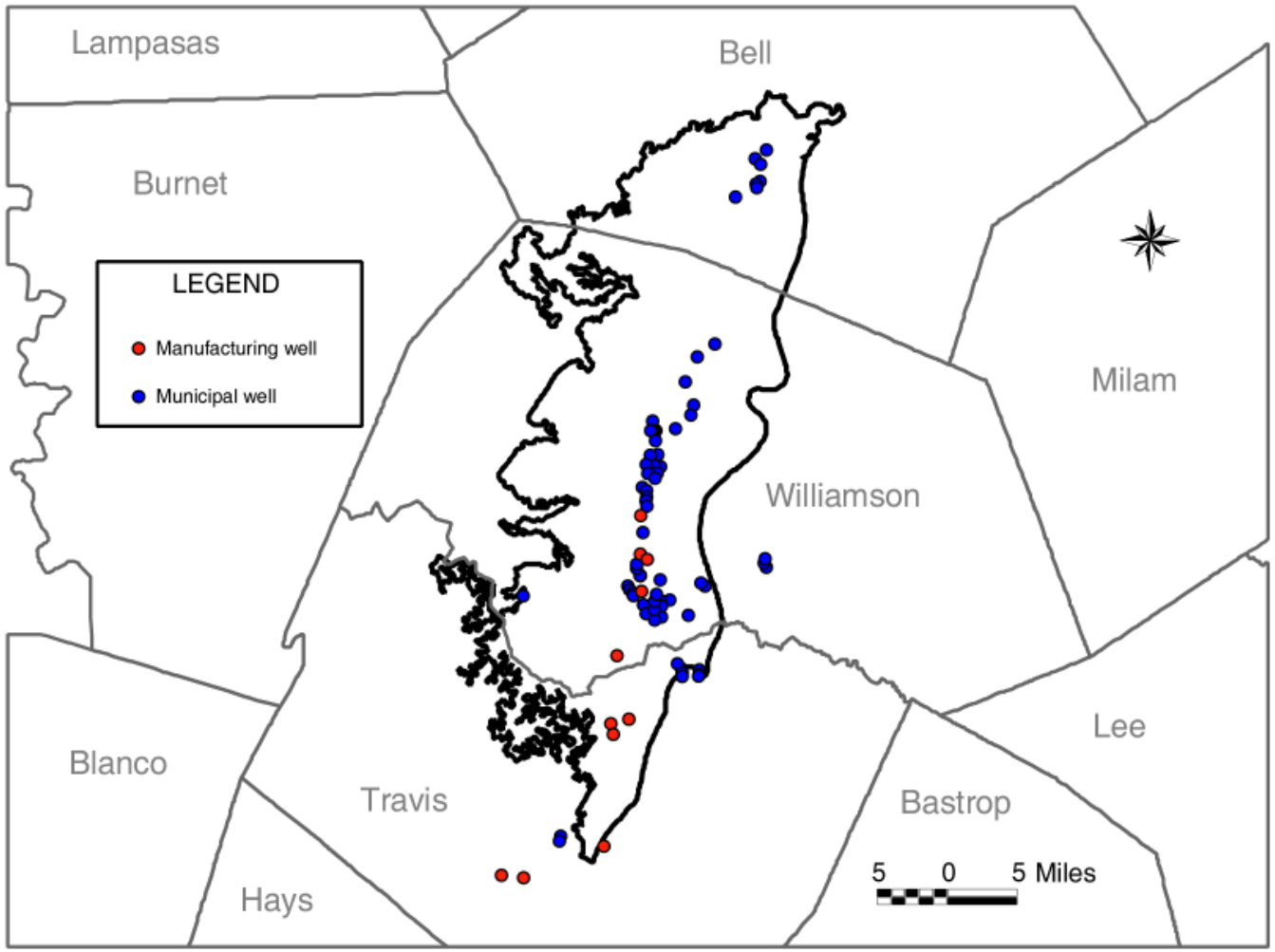
Rural population distribution

RURAL POPULATION



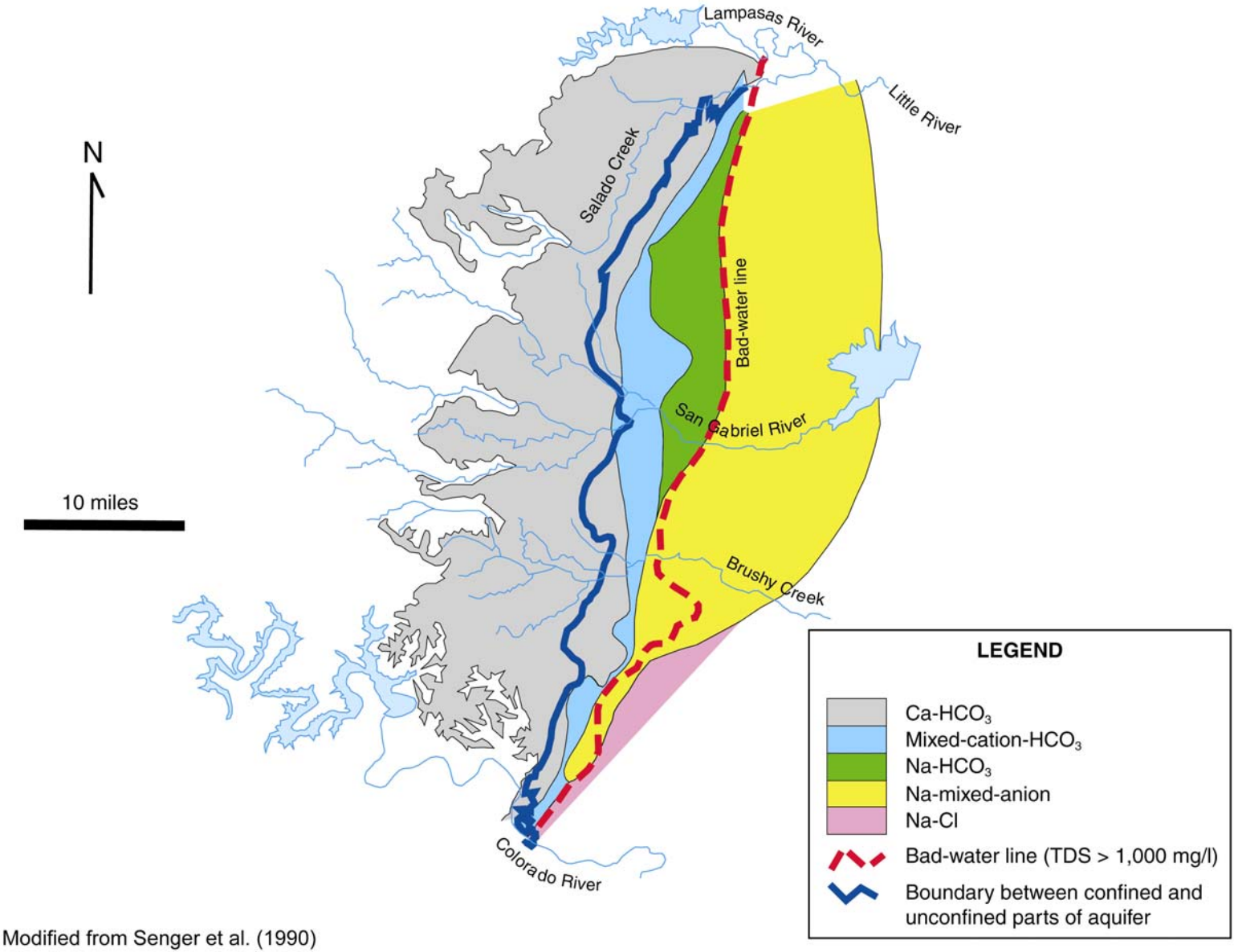
Cultivated land

CULTIVATED LAND



Industrial and municipal wells

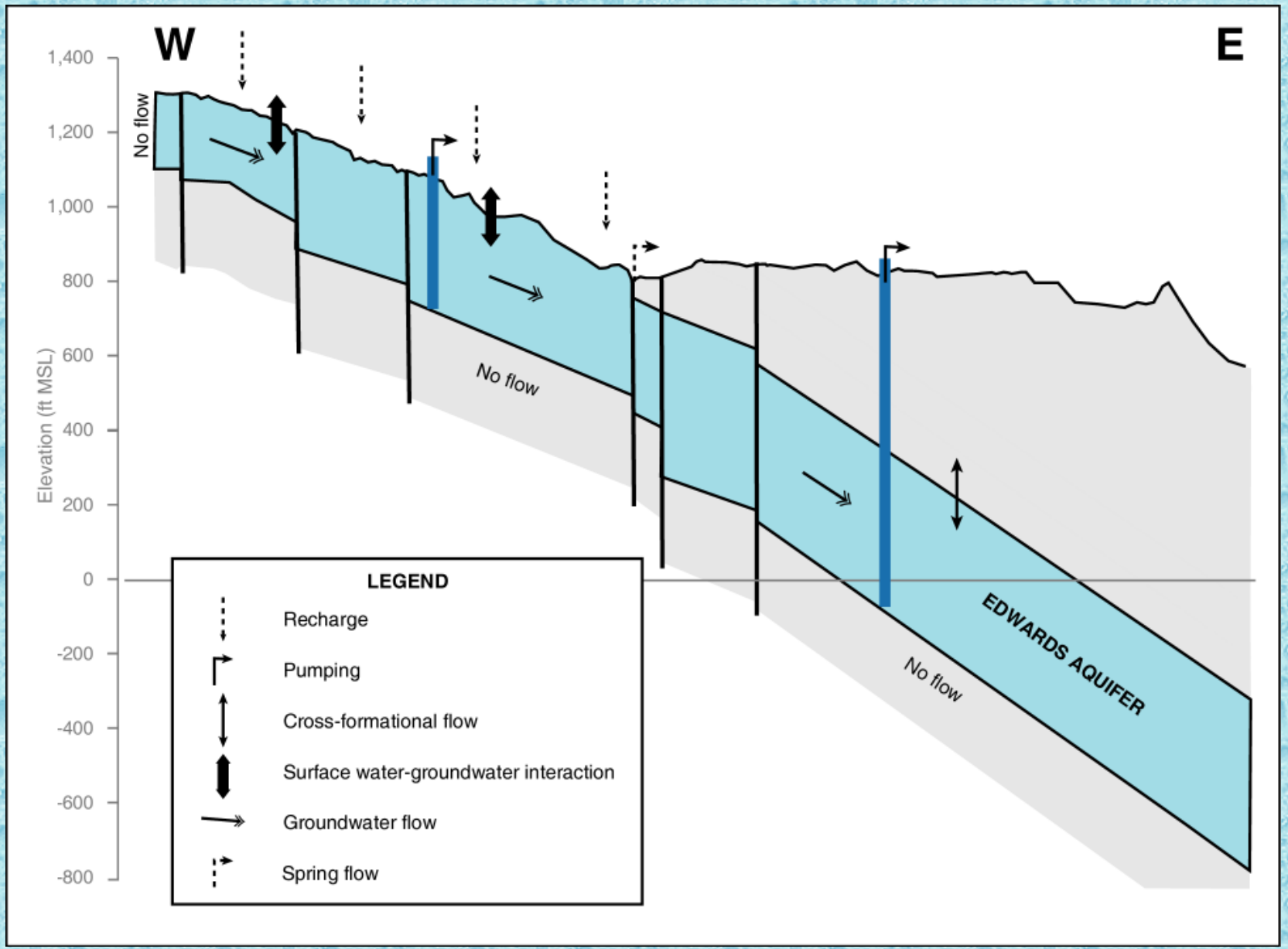
INDUSTRIAL/MUNICIPAL WELLS



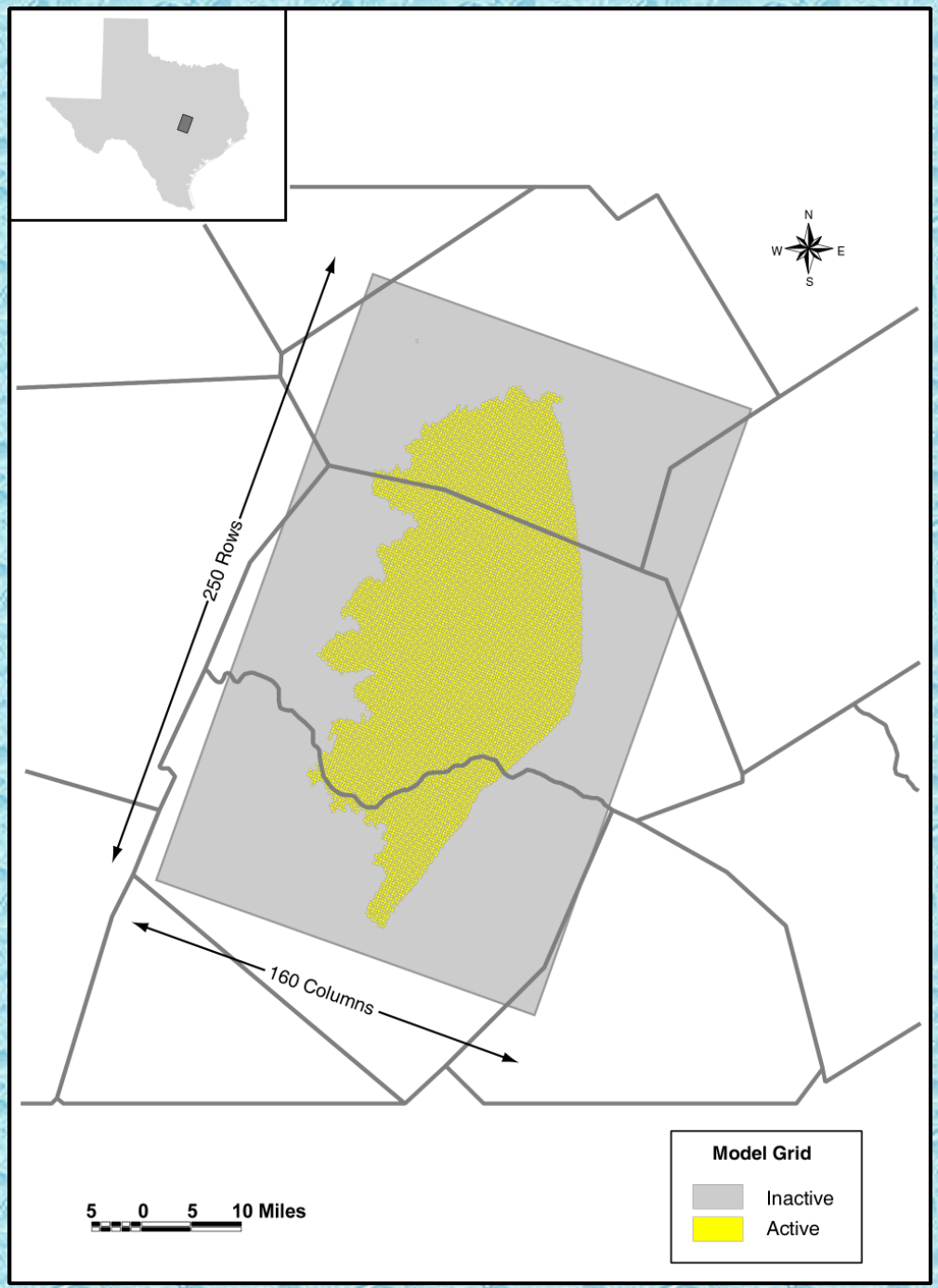
Modified from Senger et al. (1990)

GROUNDWATER QUALITY

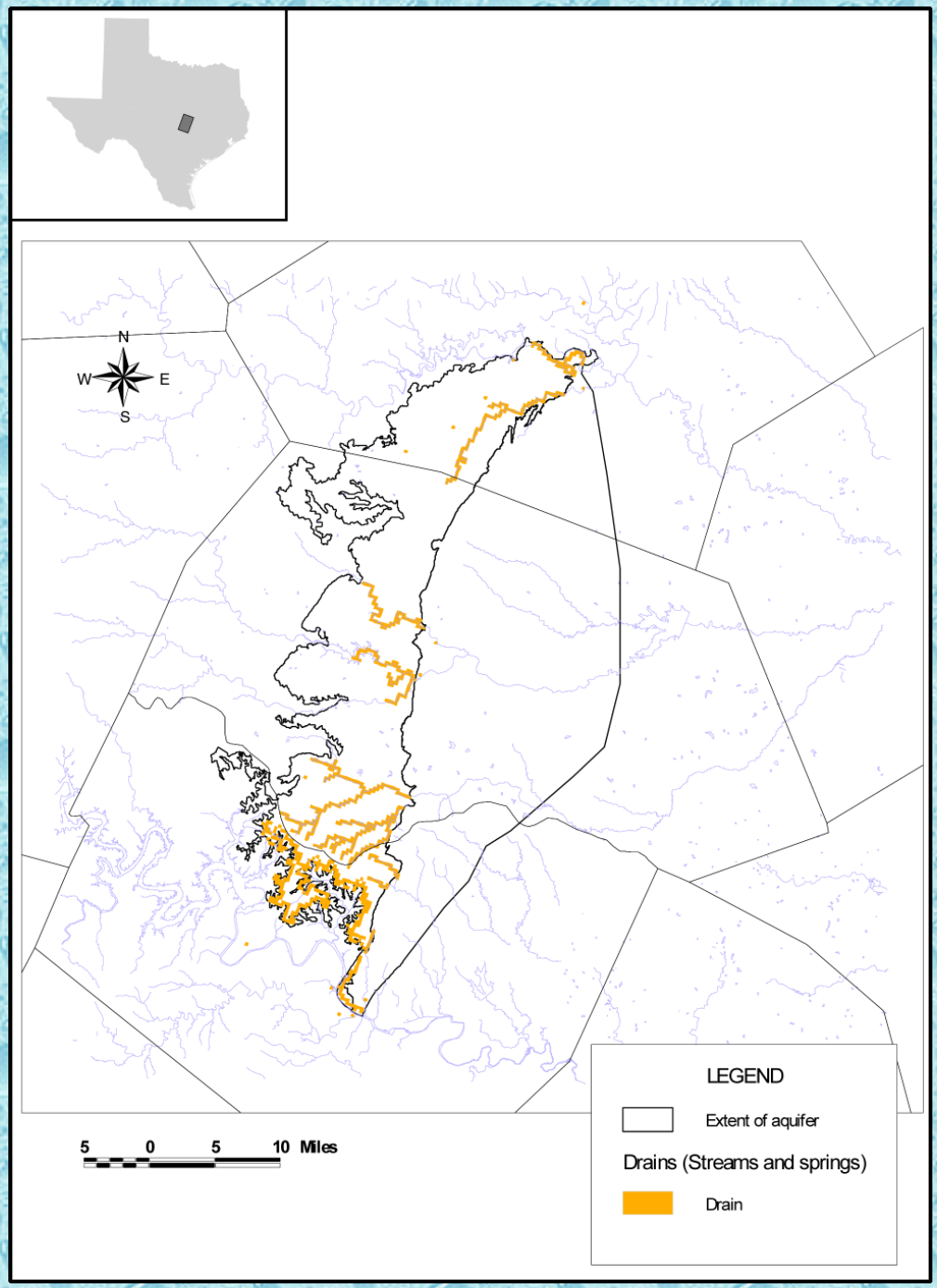
MODEL



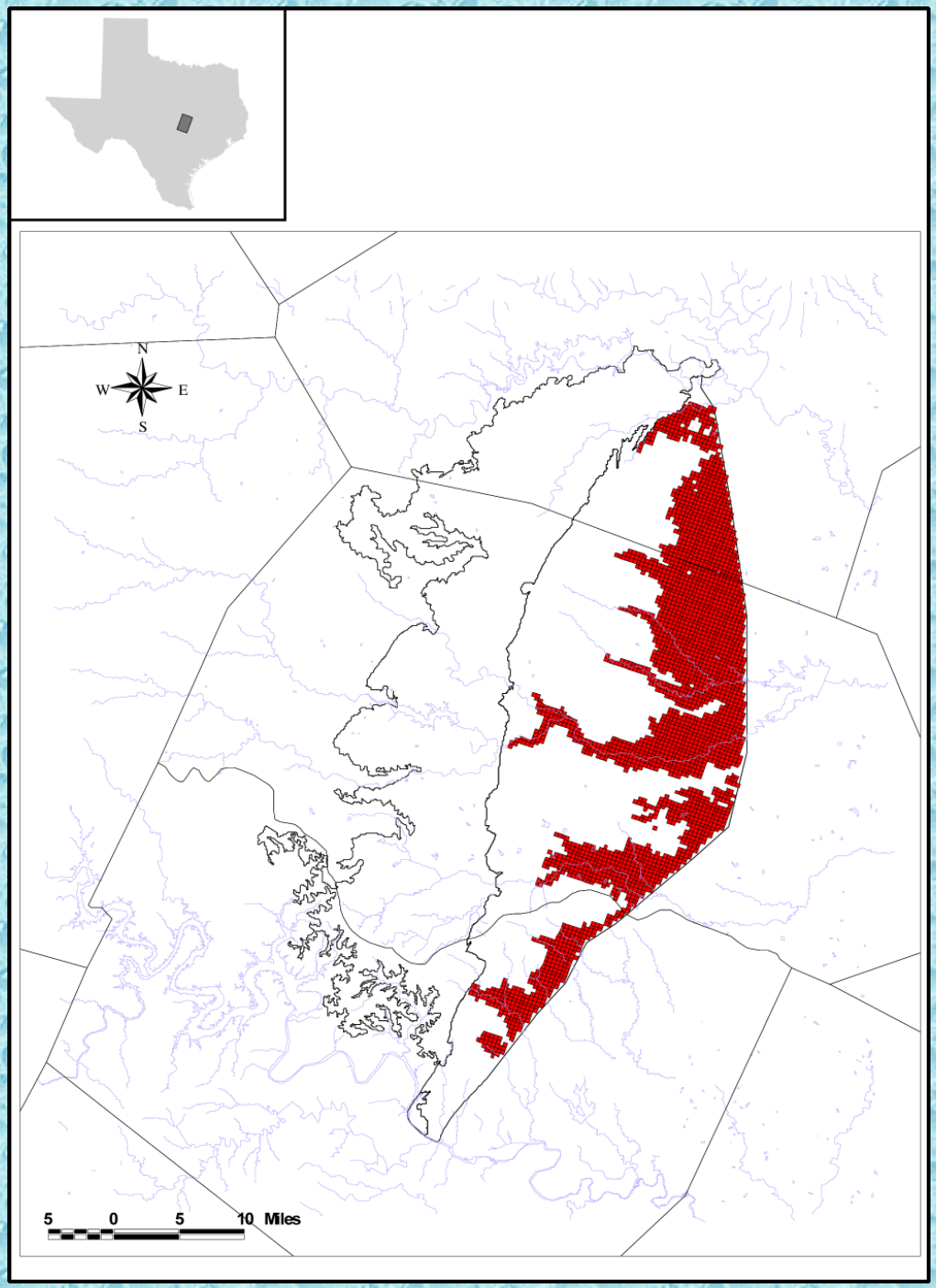
CONCEPTUAL MODEL


N
W
E
S
250 Rows
160 Columns
5 0 5 10 Miles
Model Grid
Inactive
Active

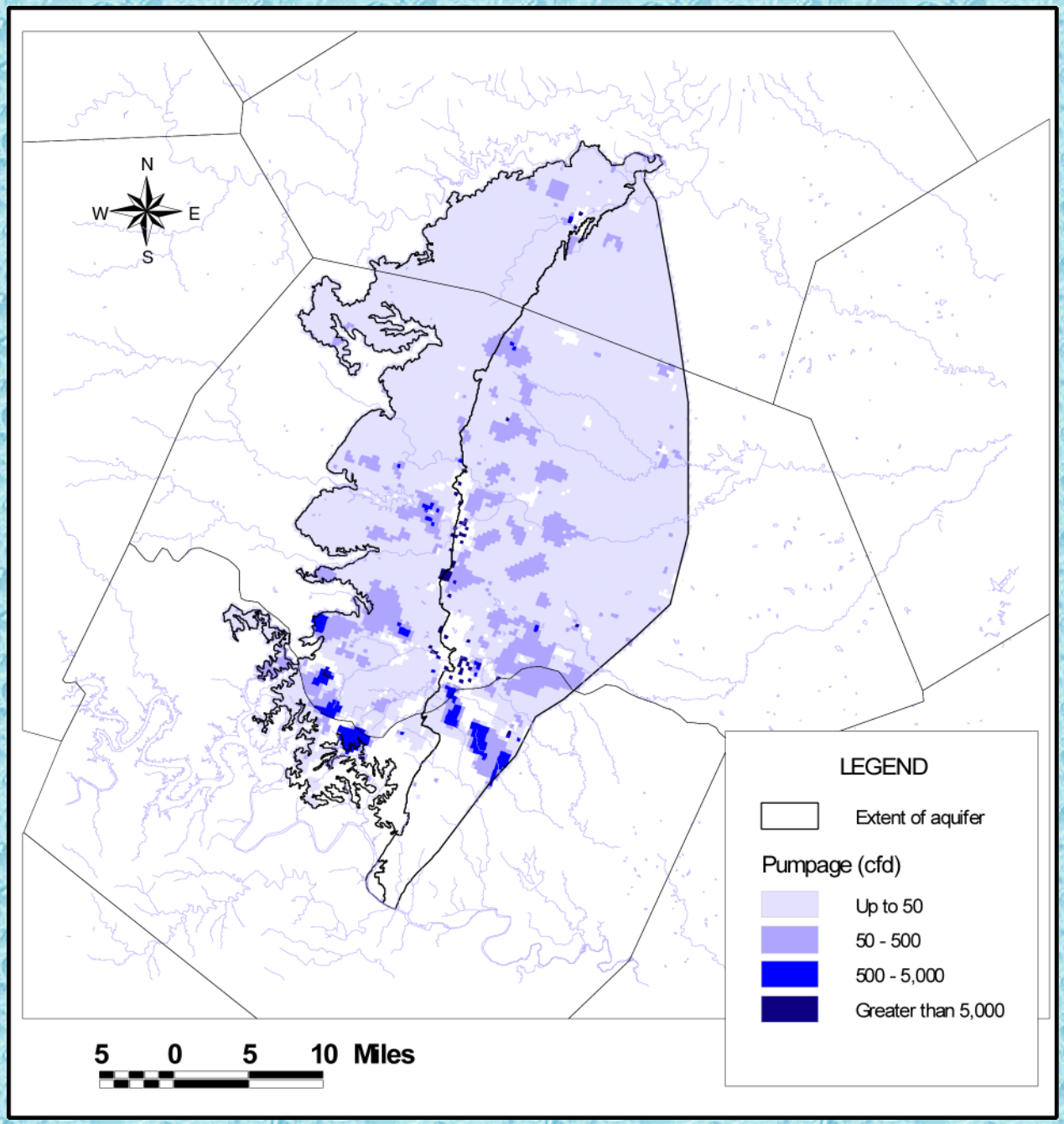
MODEL GRID



DRAINS (STREAMS)

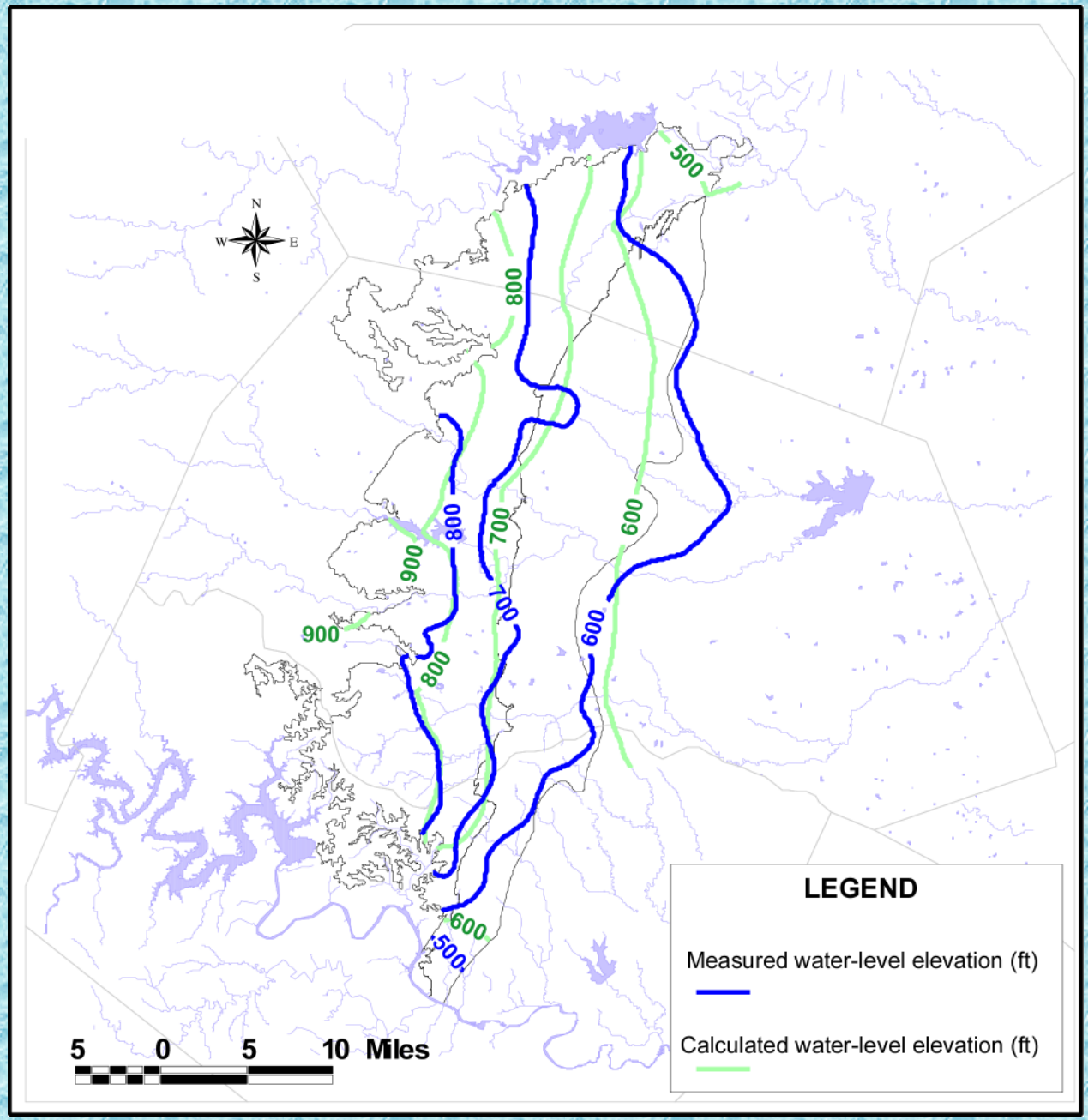


GENERAL-HEAD BOUNDARY (INTER-AQUIFER FLOW)

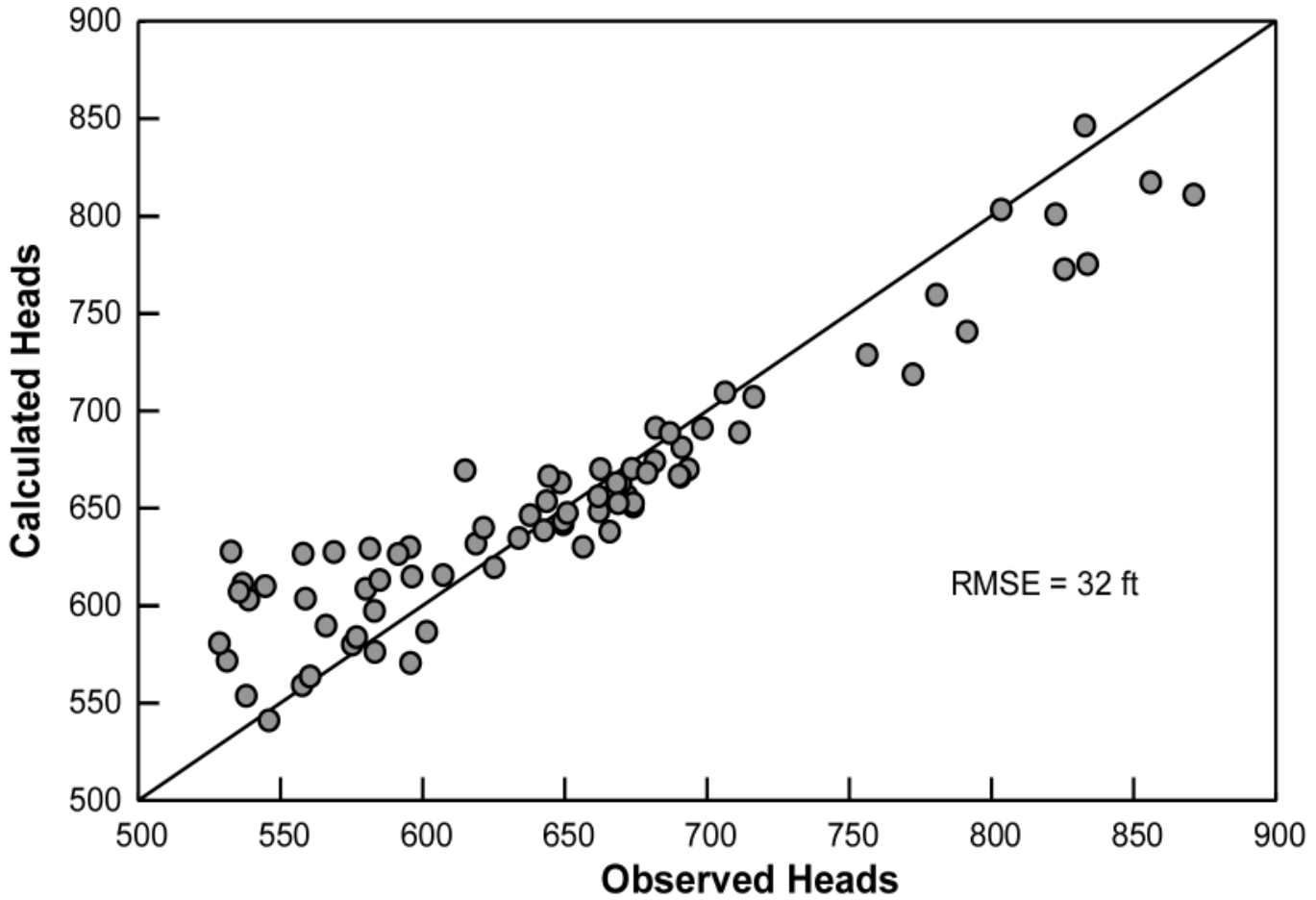


TOTAL PUMPAGE

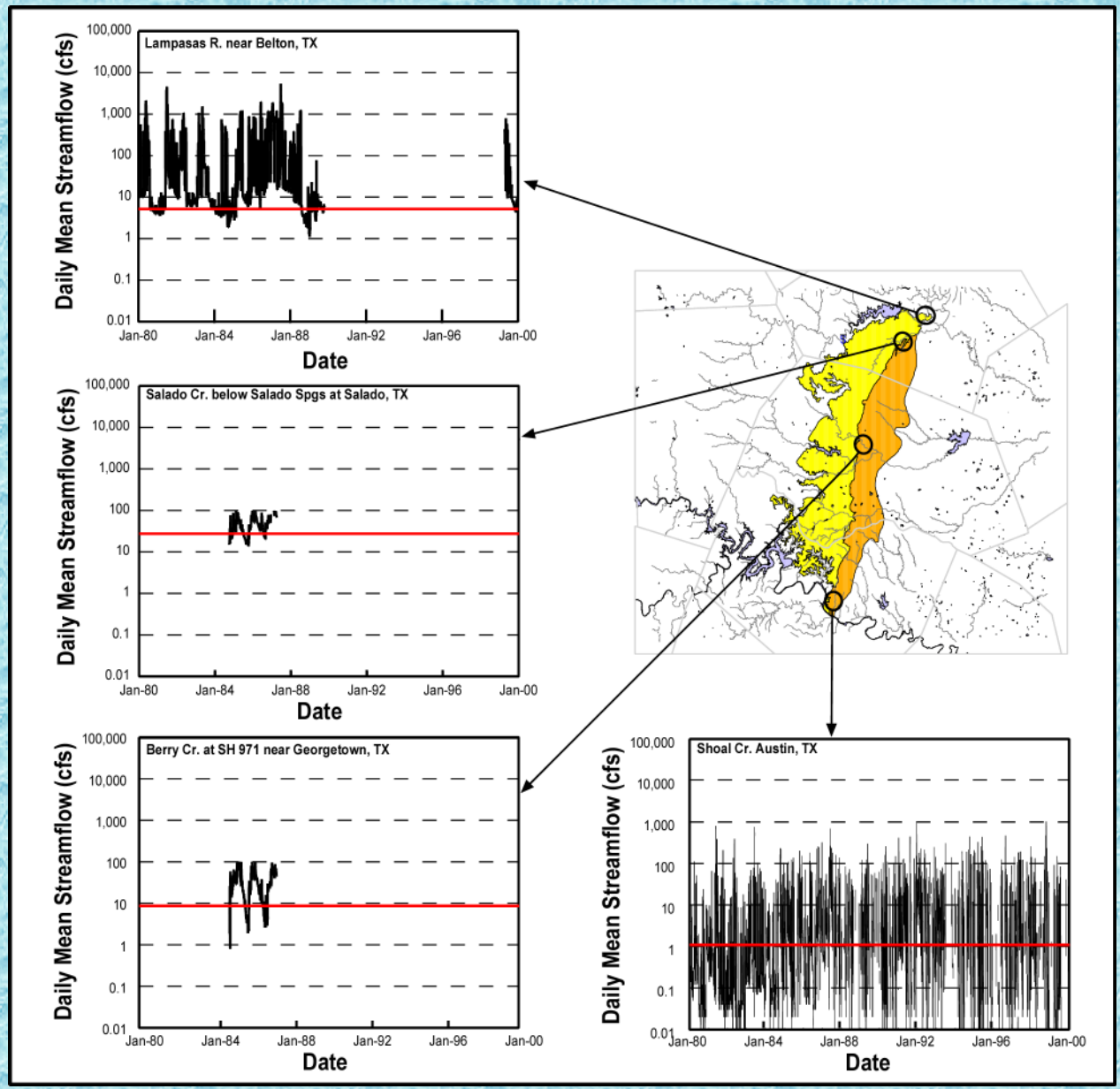
MODEL RESULTS: STEADY-STATE MODEL



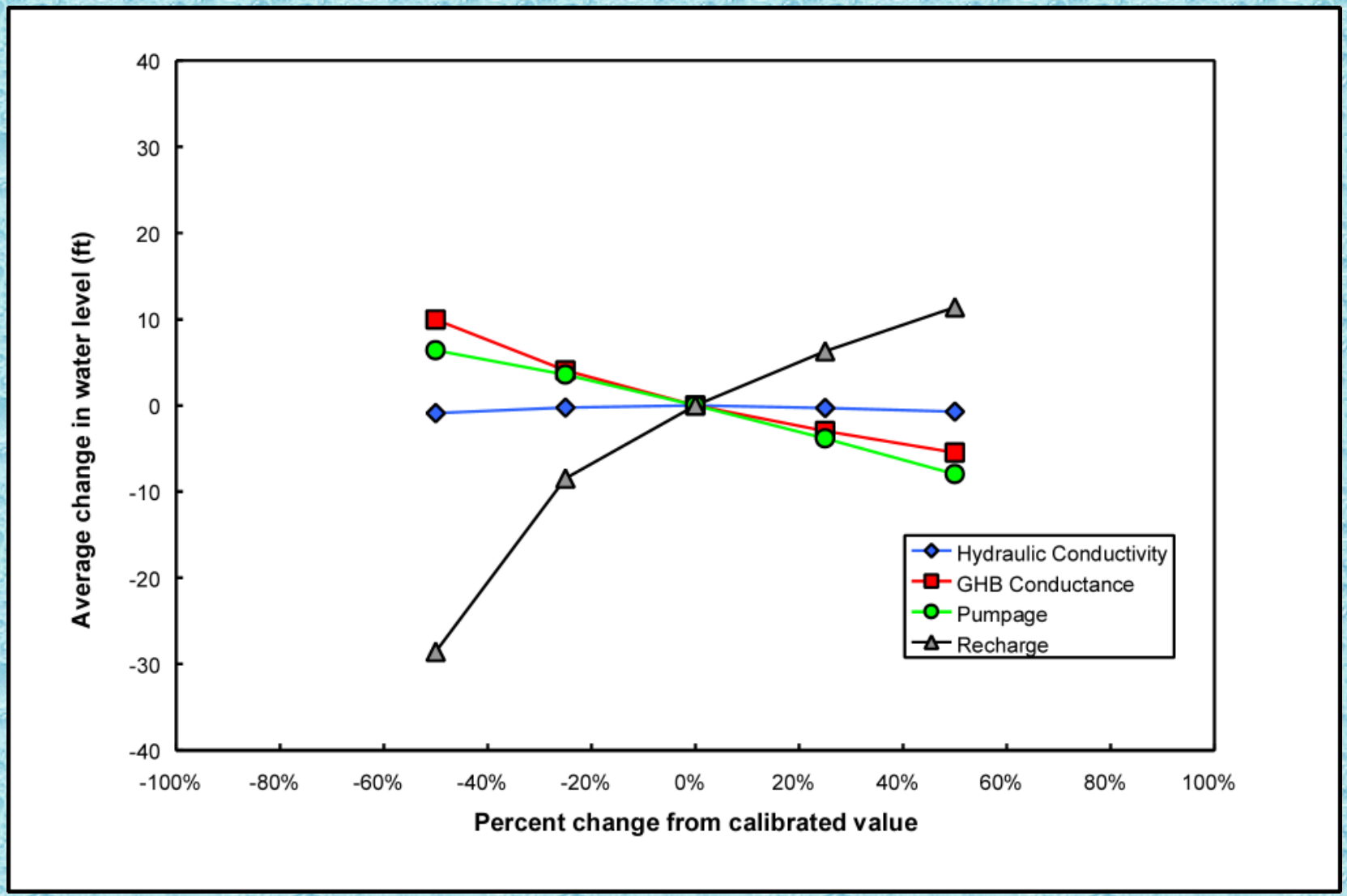
MEASURED vs. SIMULATED WATER LEVELS



MEASURED vs. SIMULATED WATER LEVELS

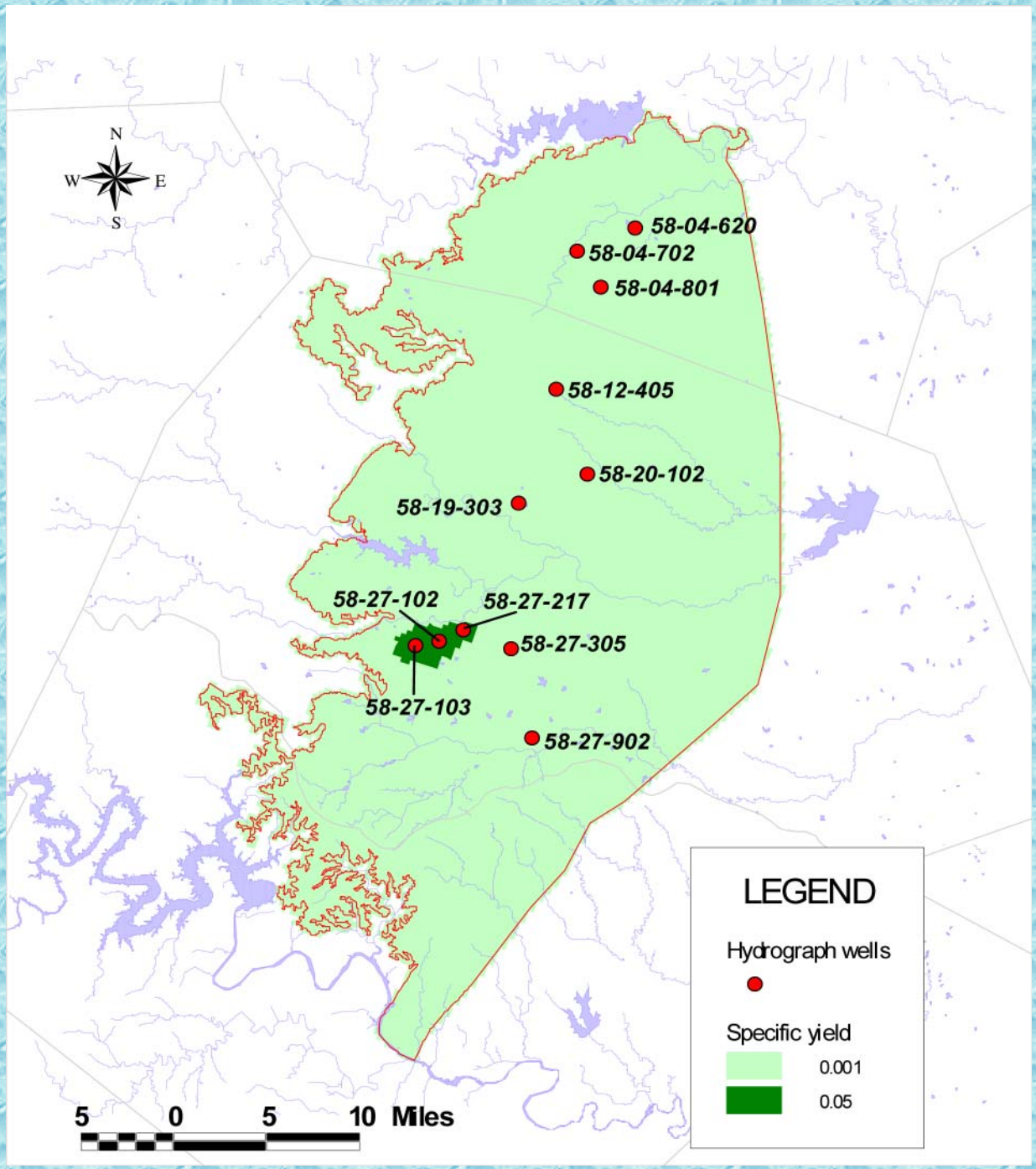


MEASURED vs. SIMULATED STREAM DISCHARGE

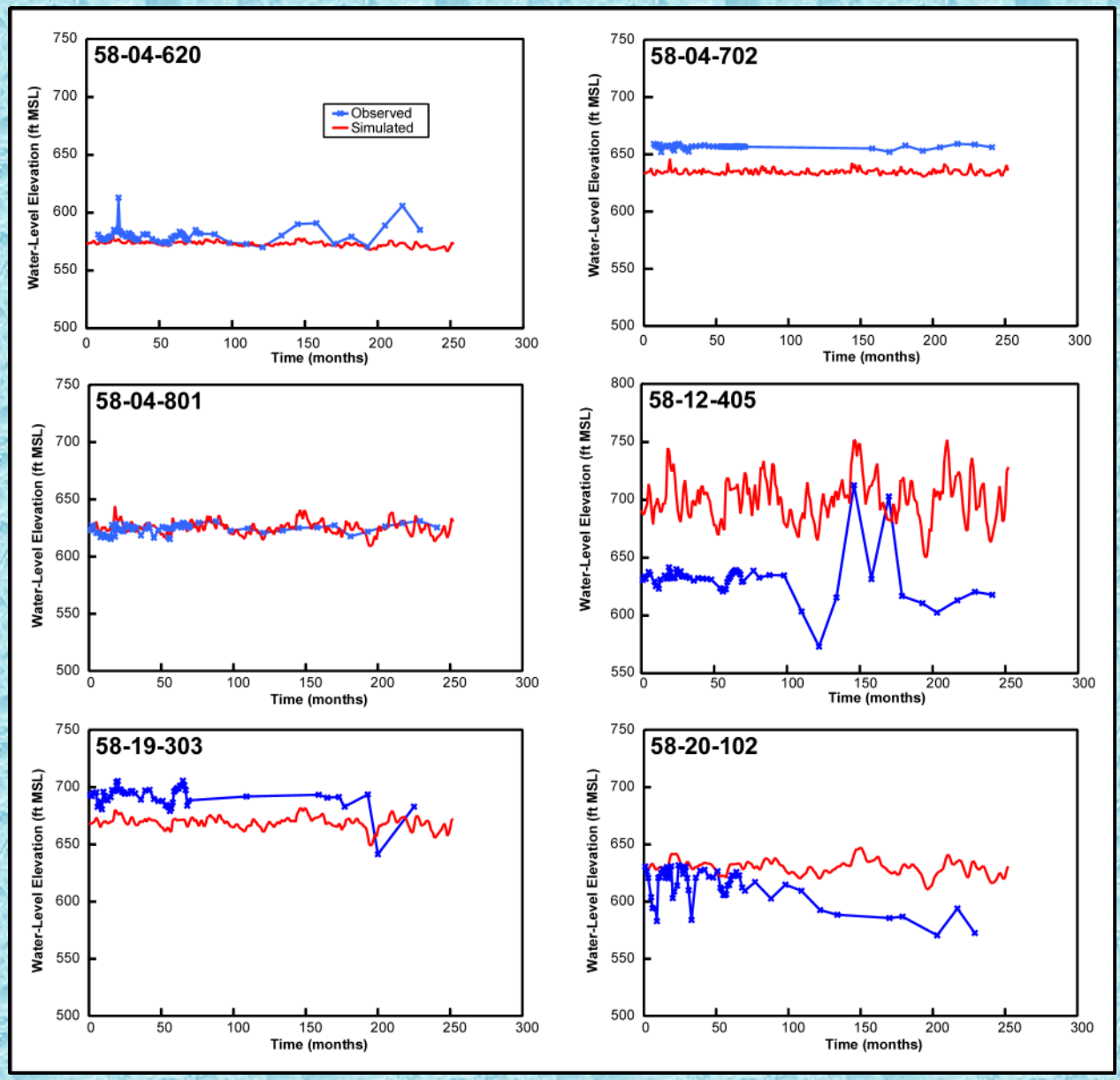


SENSITIVITY ANALYSIS: STEADY-STATE

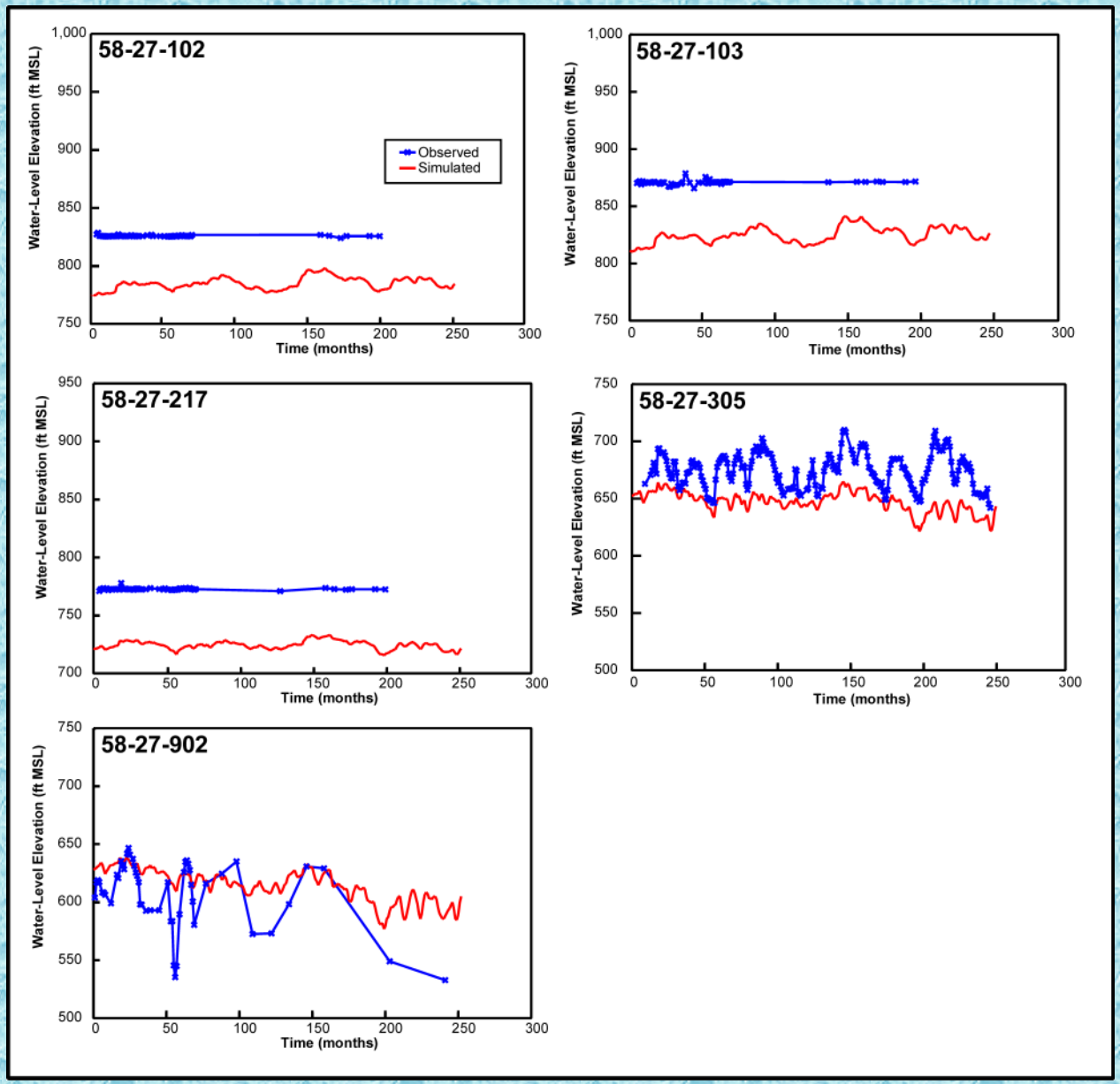
MODEL RESULTS: TRANSIENT MODEL



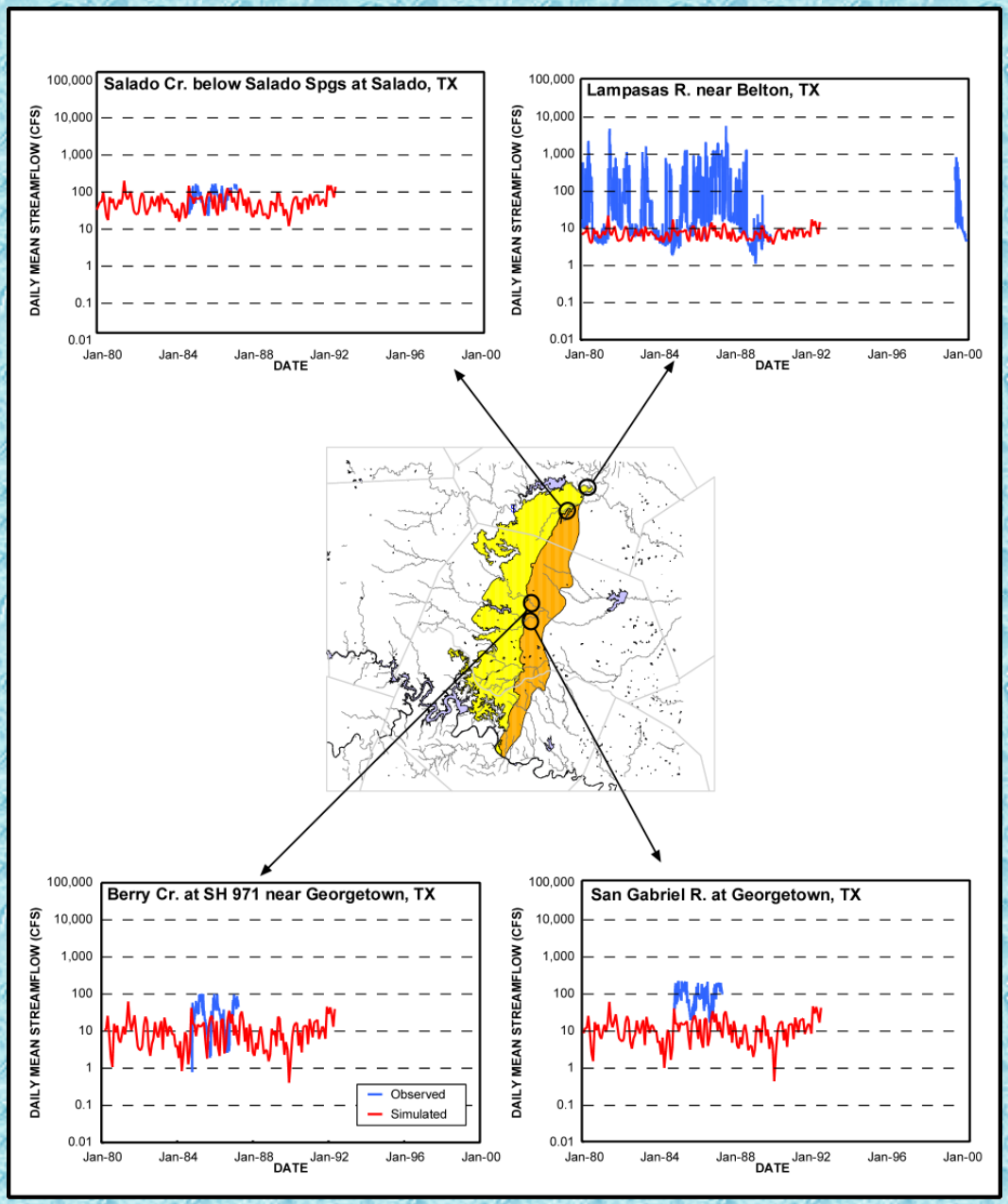
SPECIFIC YIELD



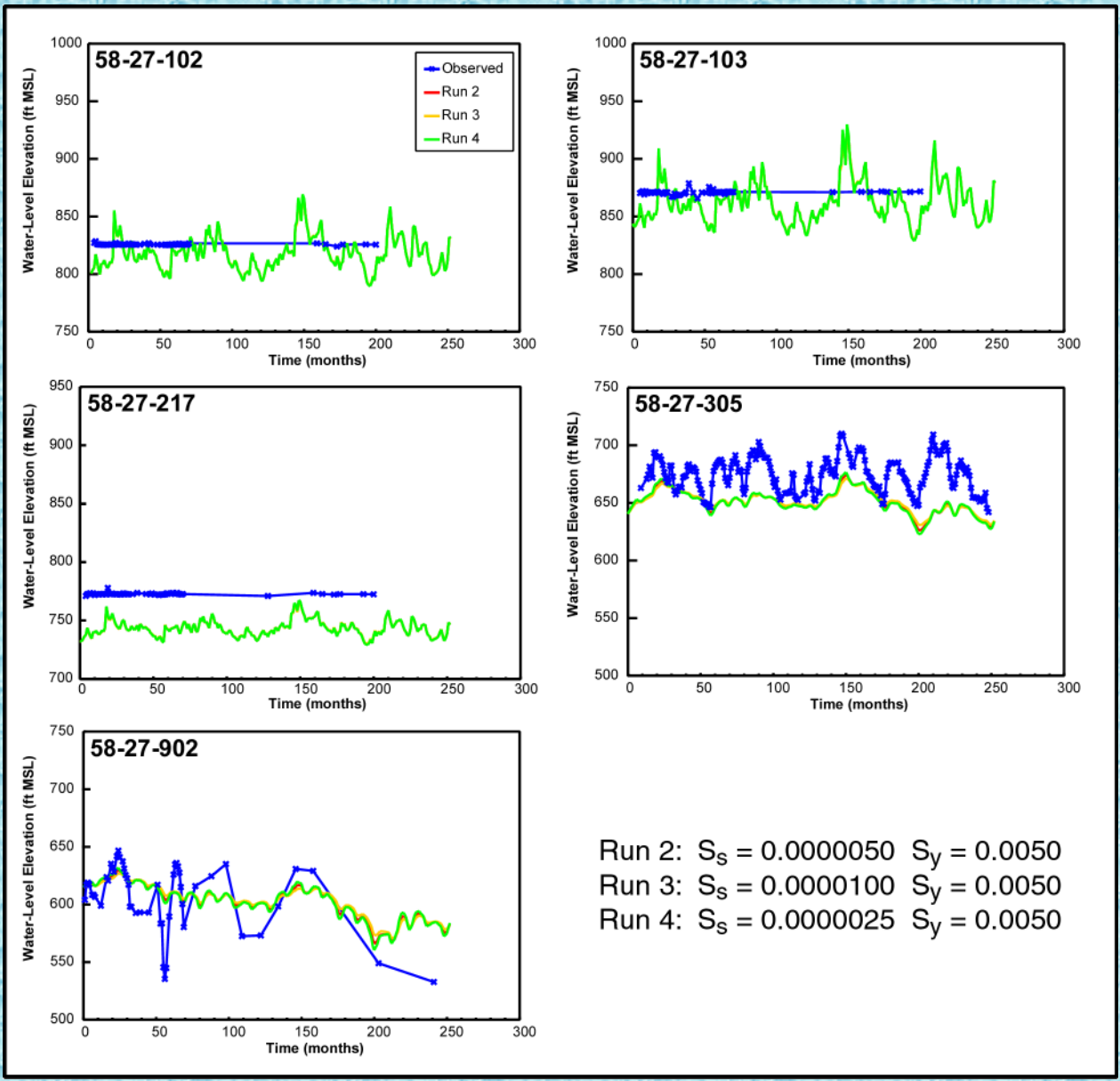
MEASURED vs. SIMULATED WATER LEVELS



MEASURED vs. SIMULATED WATER LEVELS

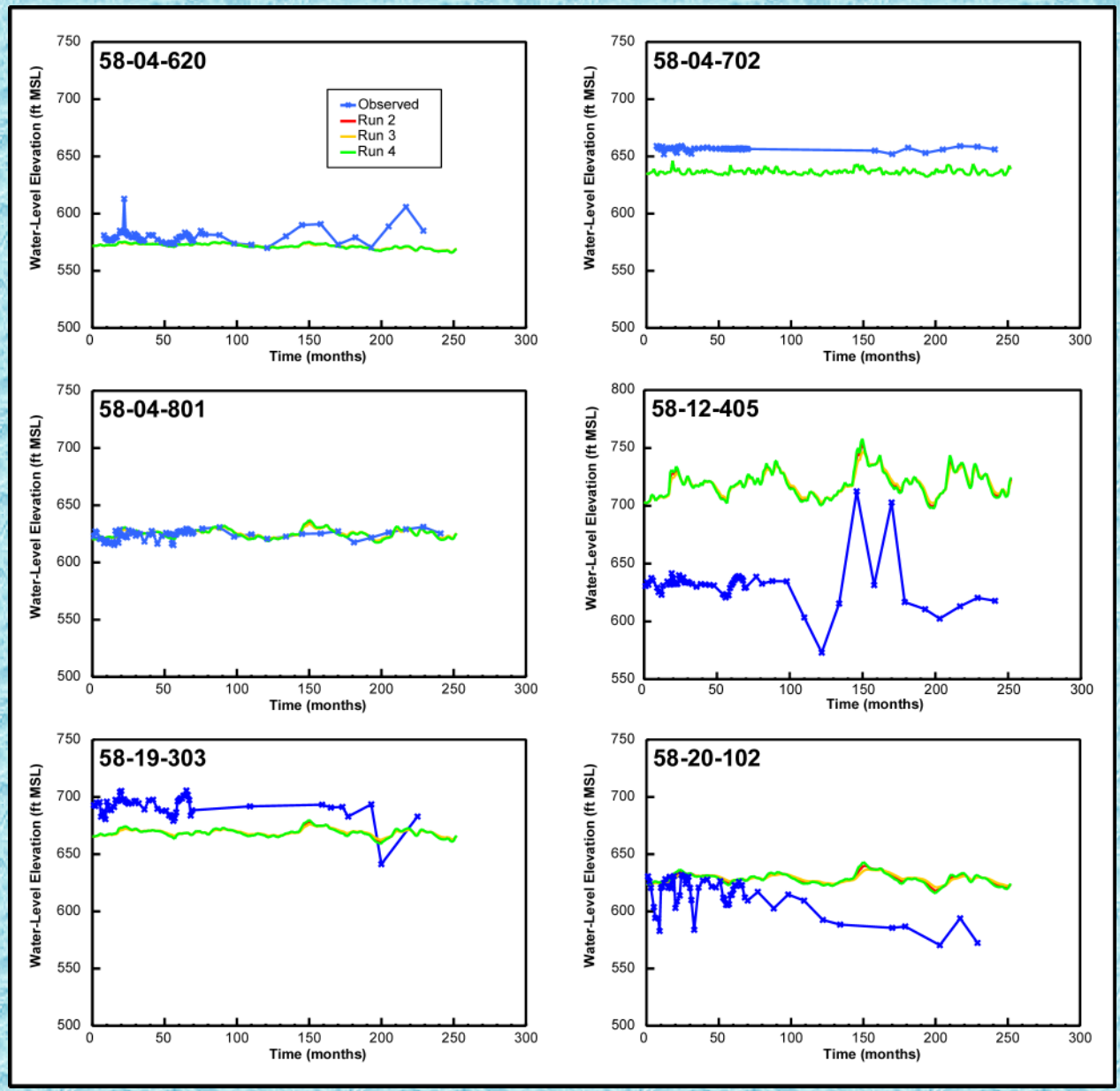


MEASURED vs. SIMULATED STREAM DISCHARGE

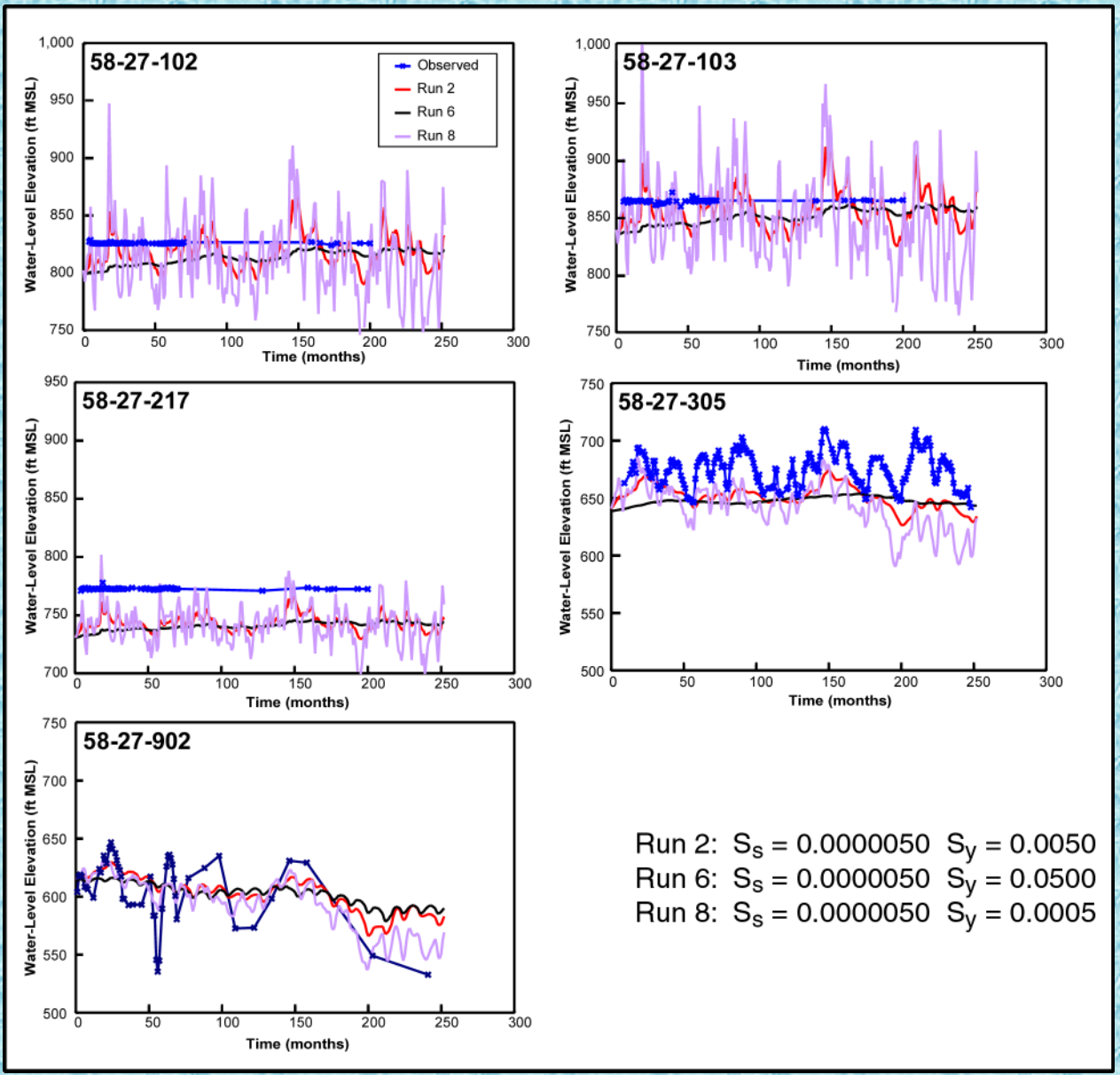


Run 2: S_s = 0.0000050 S_y = 0.0050
Run 3: S_s = 0.0000100 S_y = 0.0050
Run 4: S_s = 0.0000025 S_y = 0.0050

SENSITIVITY ANALYSIS: SPECIFIC STORAGE

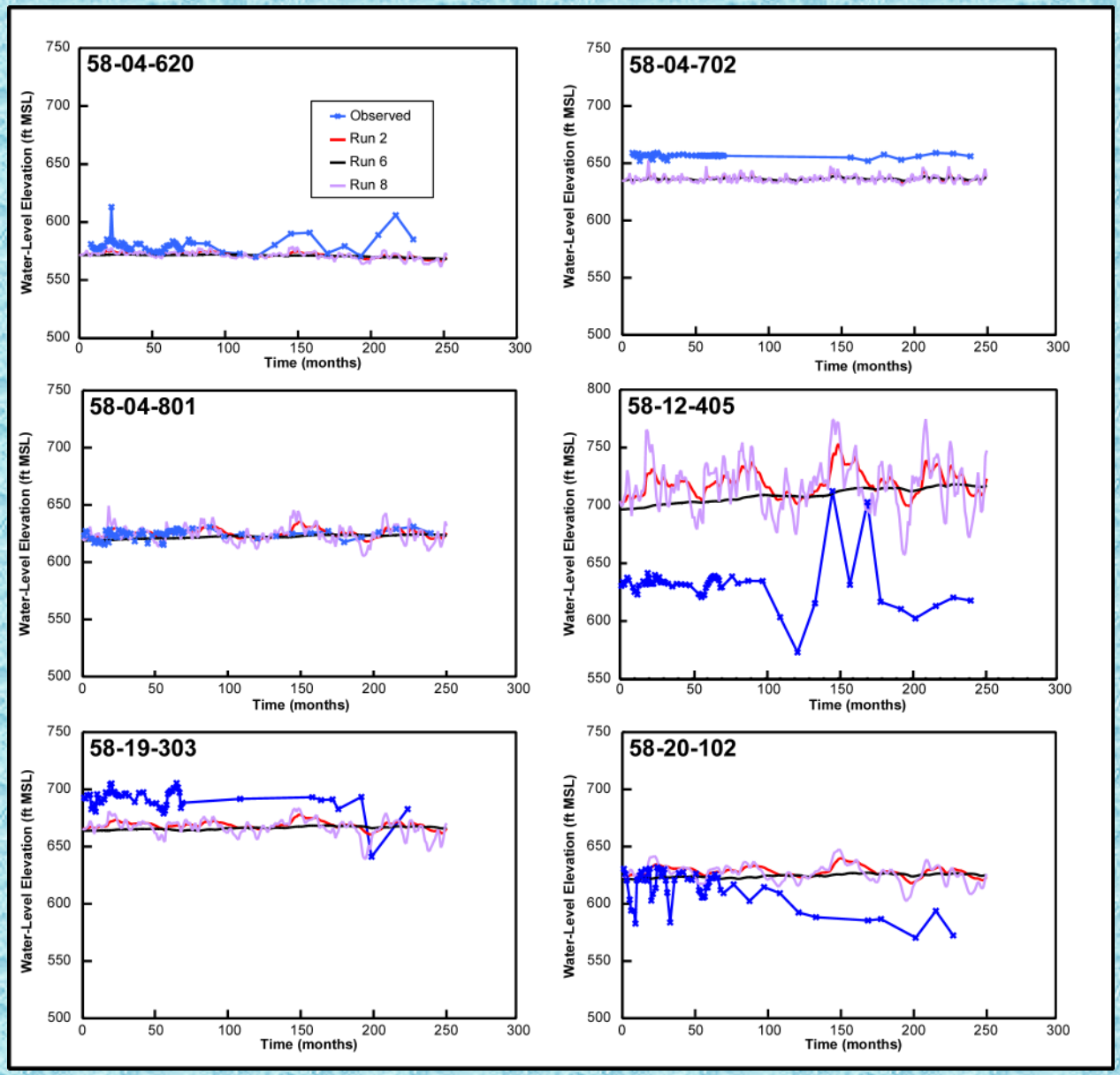


SENSITIVITY ANALYSIS: SPECIFIC STORAGE



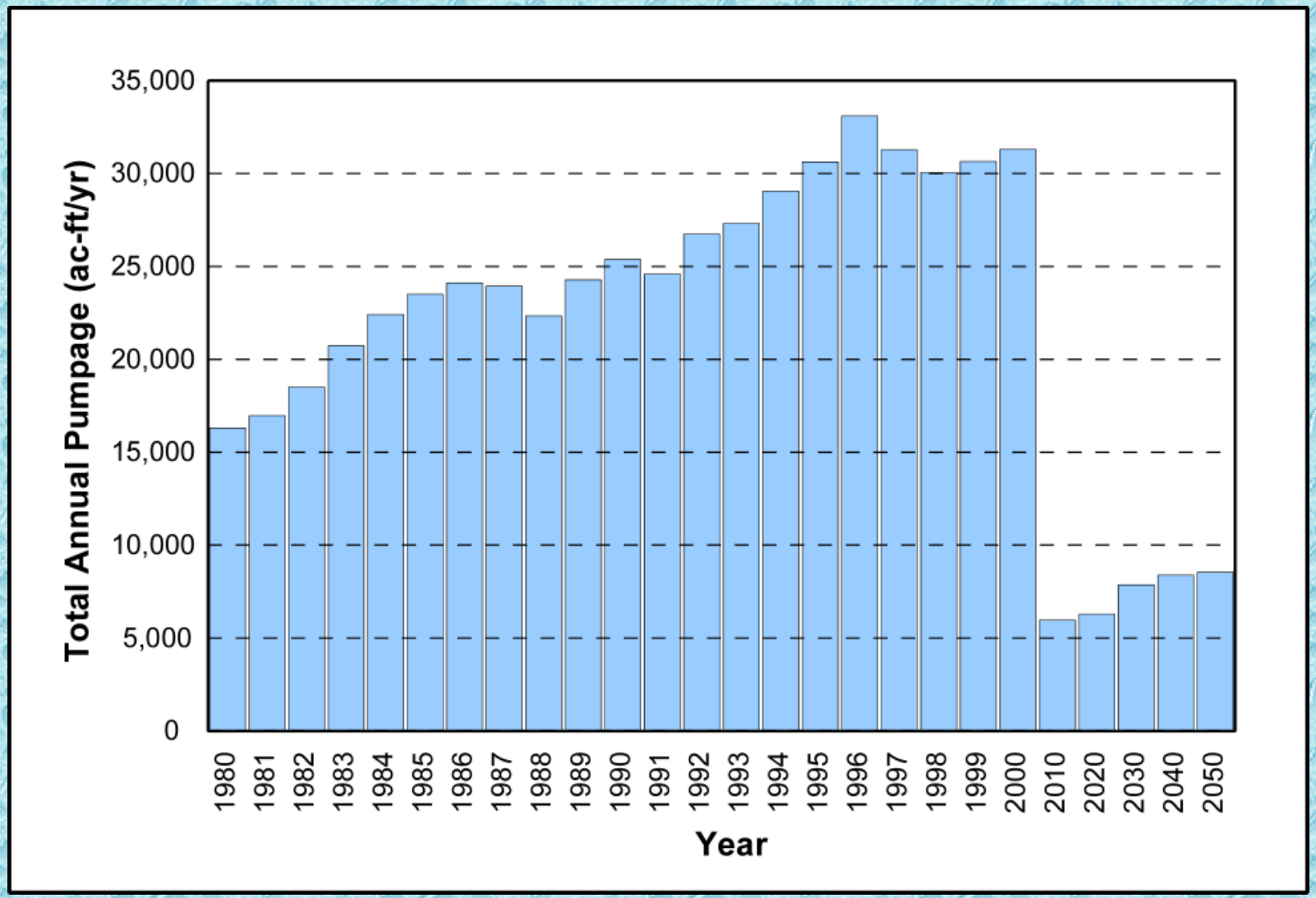
Run 2: $S_s = 0.0000050$ $S_y = 0.0050$
Run 6: $S_s = 0.0000050$ $S_y = 0.0500$
Run 8: $S_s = 0.0000050$ $S_y = 0.0005$

SENSITIVITY ANALYSIS: SPECIFIC YIELD

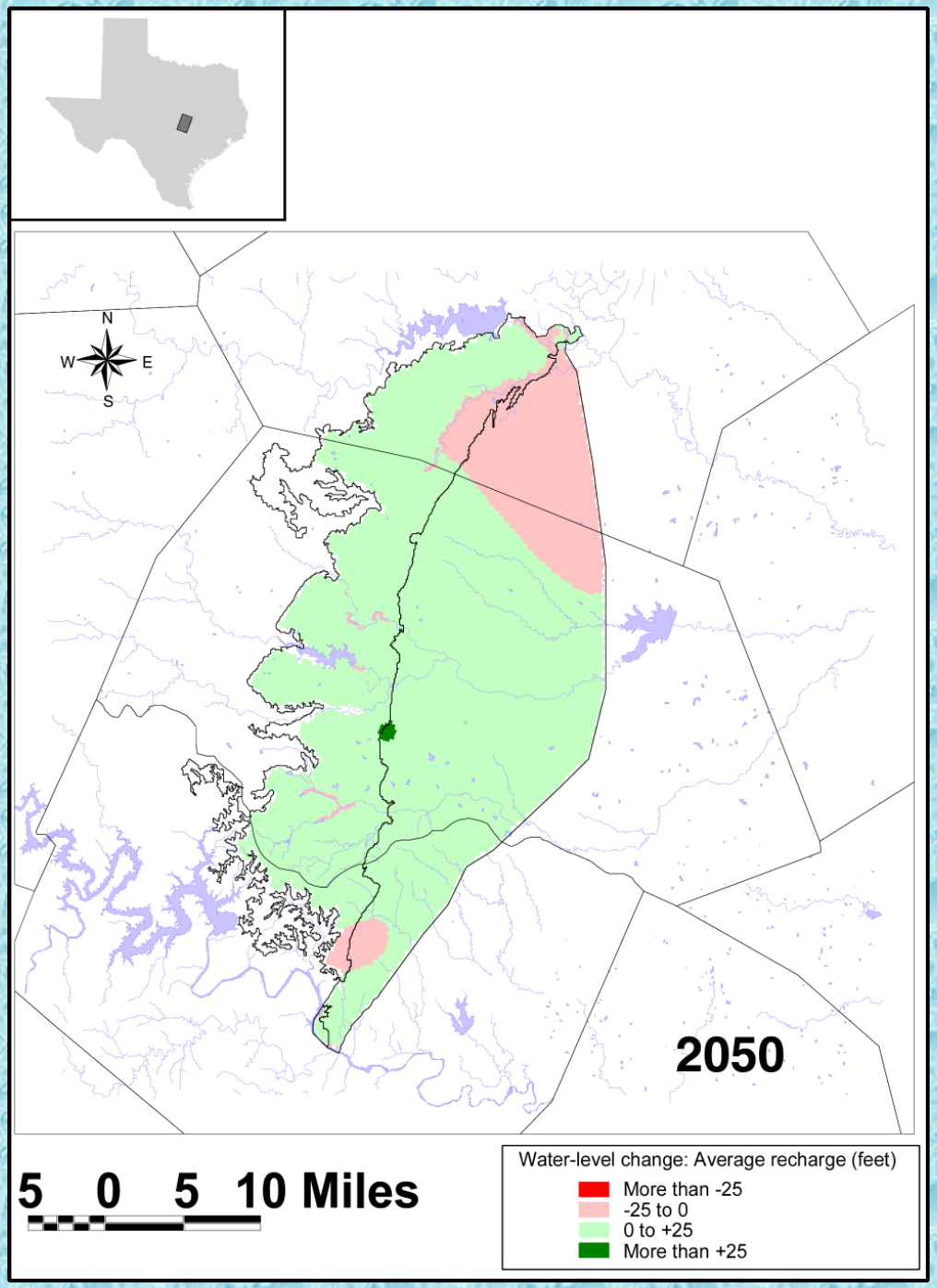


SENSITIVITY ANALYSIS: SPECIFIC YIELD

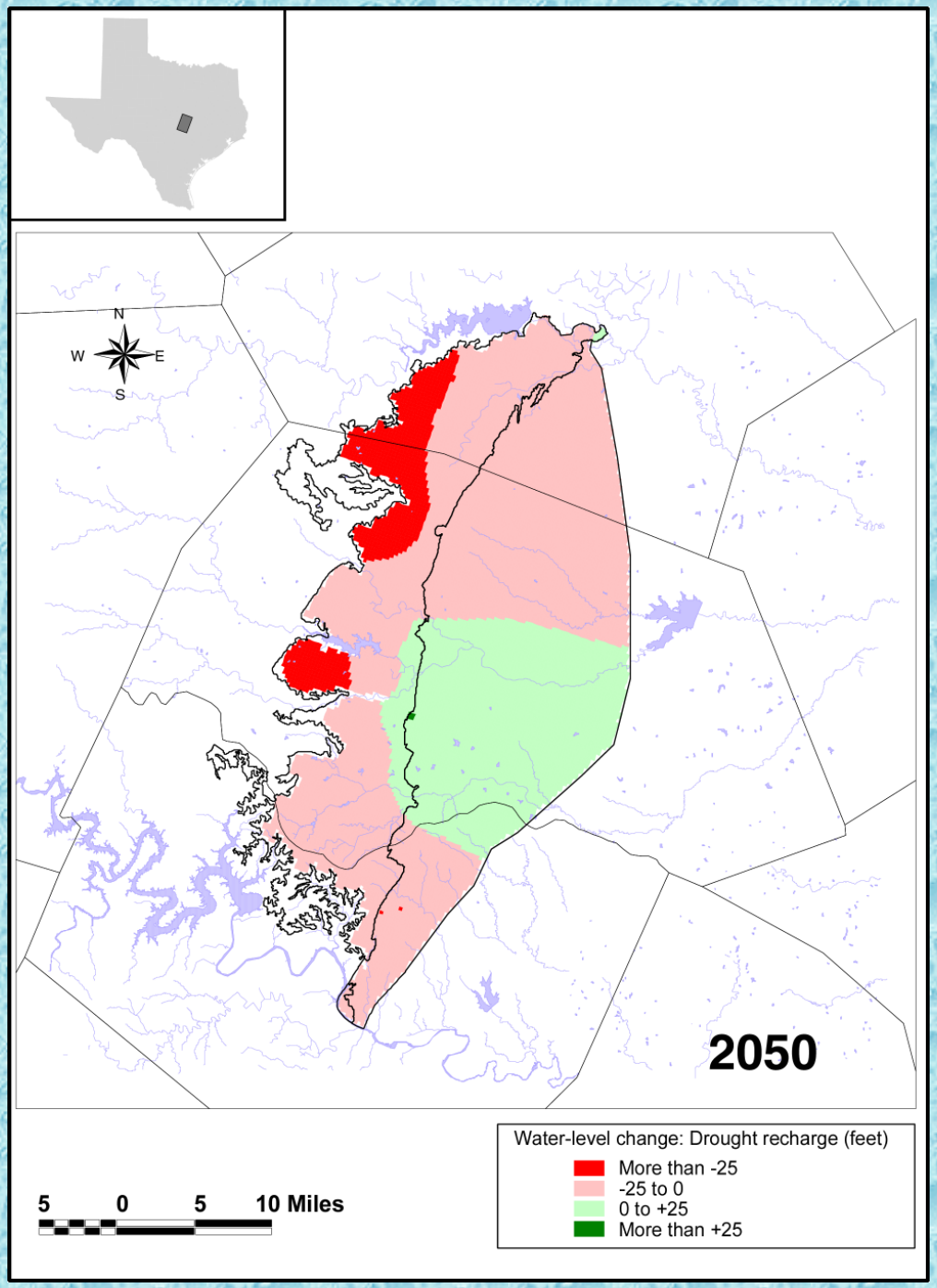
MODEL RESULTS
PREDICTIVE MODEL



TOTAL PUMPAGE



WATER-LEVEL CHANGES: AVERAGE RECHARGE



WATER-LEVEL CHANGES: DROUGHT RECHARGE

CONCLUSIONS

- Tool to evaluate groundwater resource management strategies
- Based on available geologic and hydrologic data
- Steady-state and transient runs
  - Average recharge of 20% annual precipitation
  - Approximately 50-70% of groundwater flow in unconfined part of aquifer
  - Groundwater extraction less than 20% of discharge
- Predictive model runs (2000-2050)
  - Average recharge conditions
    - Water-level rise throughout most of model area
  - Drought-of-record conditions
    - Water-level declines in unconfined part of aquifer
    - Water-level rise associated with lower pumping rates

GAM SCHEDULE

SCHEDULE

2002

- SAF Meeting 1— Mar
- SAF Meeting 2 — June
- SAF Meeting 3— Sept.
- SAF Meeting 4 — Dec.

- June —Draft conceptual model
- Sept. —Initial model design
- Dec. —Calibrate steady-state model

2003

- SAF Meeting 5 — Apr.
- SAF Meeting 6— Jul.

- Apr. —Calibrate transient model
- May. —Complete model predictions
- Jun. —Prepare draft report
- Aug. —Present SAF Model Seminar
- Deliver Final Product

animation


TEXAS WATER DEVELOPMENT BOARD

Northern Segment of the Edwards Aquifer
Stakeholder Advisory Forum 5
April 24, 2003

	Name		Affiliation
1	Leland	Gersbach	Clearwater UWCD
2	Horace	Grace	Clearwater UWCD
3	Ethan	Ham	Clearwater UWCD
4	Glenn	Hodge	Landowner
5	Cheryl	Maxwell	Clearwater UWCD
6	Chris	McGregor	Salado Village Voice
7	Judy	Parker	Clearwater UWCD
8	Ricky	Preston	Salado WSC
9	Phil	Savoy	Murfee Eng. Co.
10	James	Sloan	TCEQ
11	Paul	Stanford	Landowner
12	Ned	Troshanov	Edwards Aquifer Authority
13	Martha	Underwood	Killeen Daily Herald

NORTHERN SEGMENT OF THE EDWARDS AQUIFER GROUNDWATER AVAILABILITY MODEL

Stakeholder Advisory Forum #6, July 17, 2003

Thirteen people attended the sixth Stakeholder Advisory Forum for the northern segment of the Edwards aquifer groundwater availability model. This meeting was held at the Salado Civic Center, Salado, TX. The stakeholders present represented the Texas Commission on Environmental Quality, Clearwater UWCD, Salado WSC, Murfee Engineering Co., Edwards Aquifer Authority, the Killeen Daily Herald, and the Salado Village Voice.

At the meeting, Dr. Ian Jones outlined the work conducted to construct the groundwater availability model. The topics covered in the presentation included review of the geology, hydrogeology, and climate of the study area, model input data, steady-state and transient model calibration and sensitivity analysis, and the results of predictive runs.

Questions were asked during the presentation pertaining to whether projected pumping rates were realistic. The response to these questions was that pumping projections are part of the process of developing groundwater management strategies and thus subject to change to meet the needs of the user. Additional questions were asked pertaining to the impact of cross-formational flow between the Edwards aquifer and underlying Trinity aquifer. The response to these questions was that more study is needed to determine whether cross-formational flow from the Trinity is significant.