A map of Texas is shown with a grid overlay. The grid is composed of green lines forming a rectangular pattern. Within the grid, there are purple dots in each cell. The map is divided into several colored regions: a light blue region in the north, a yellow region in the south, a green region in the center, and a pink region in the east. The text 'GGAM' is overlaid in large, blue, stylized letters with a black outline.

GGAM

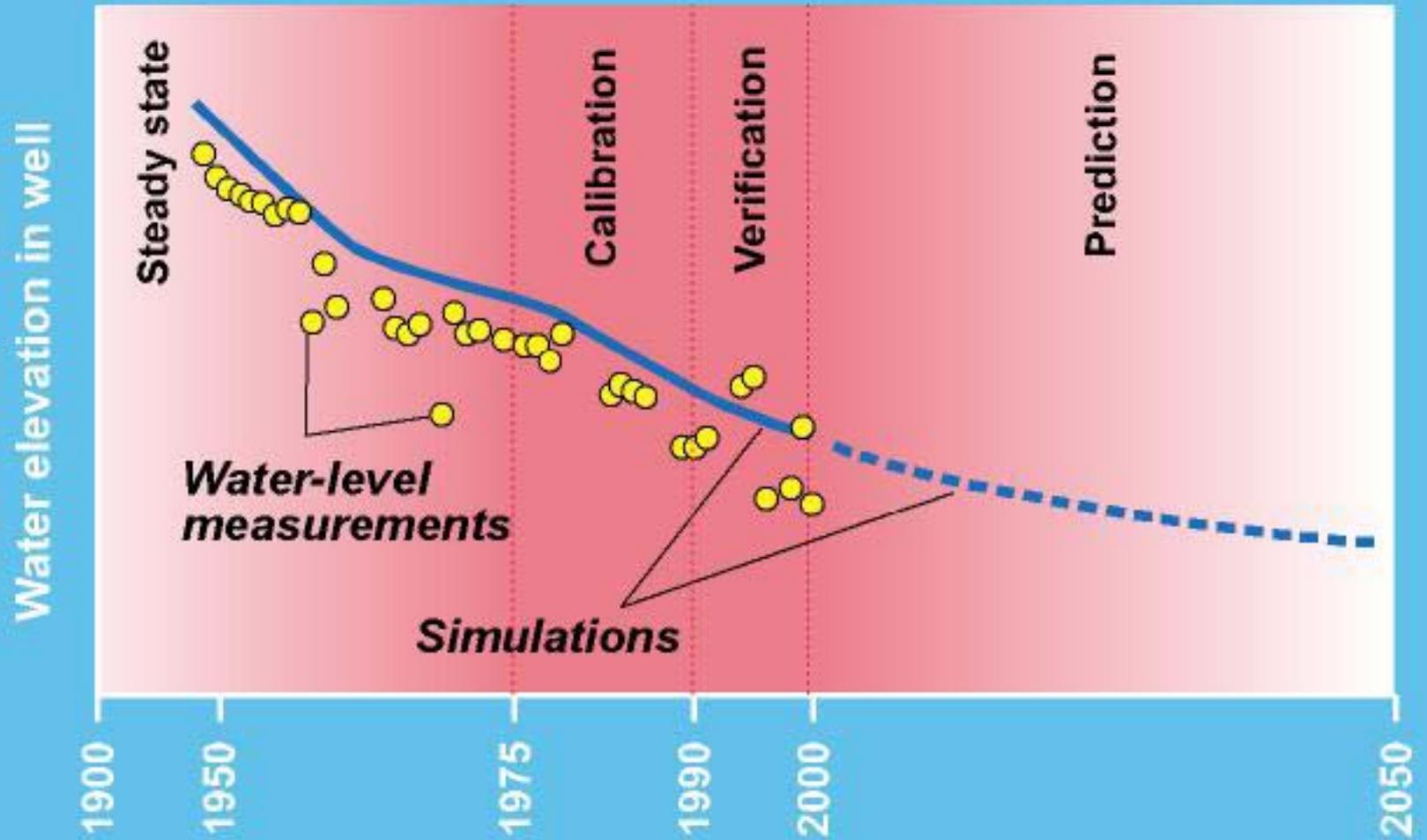
**Groundwater
Availability
Modeling**

texas water development board

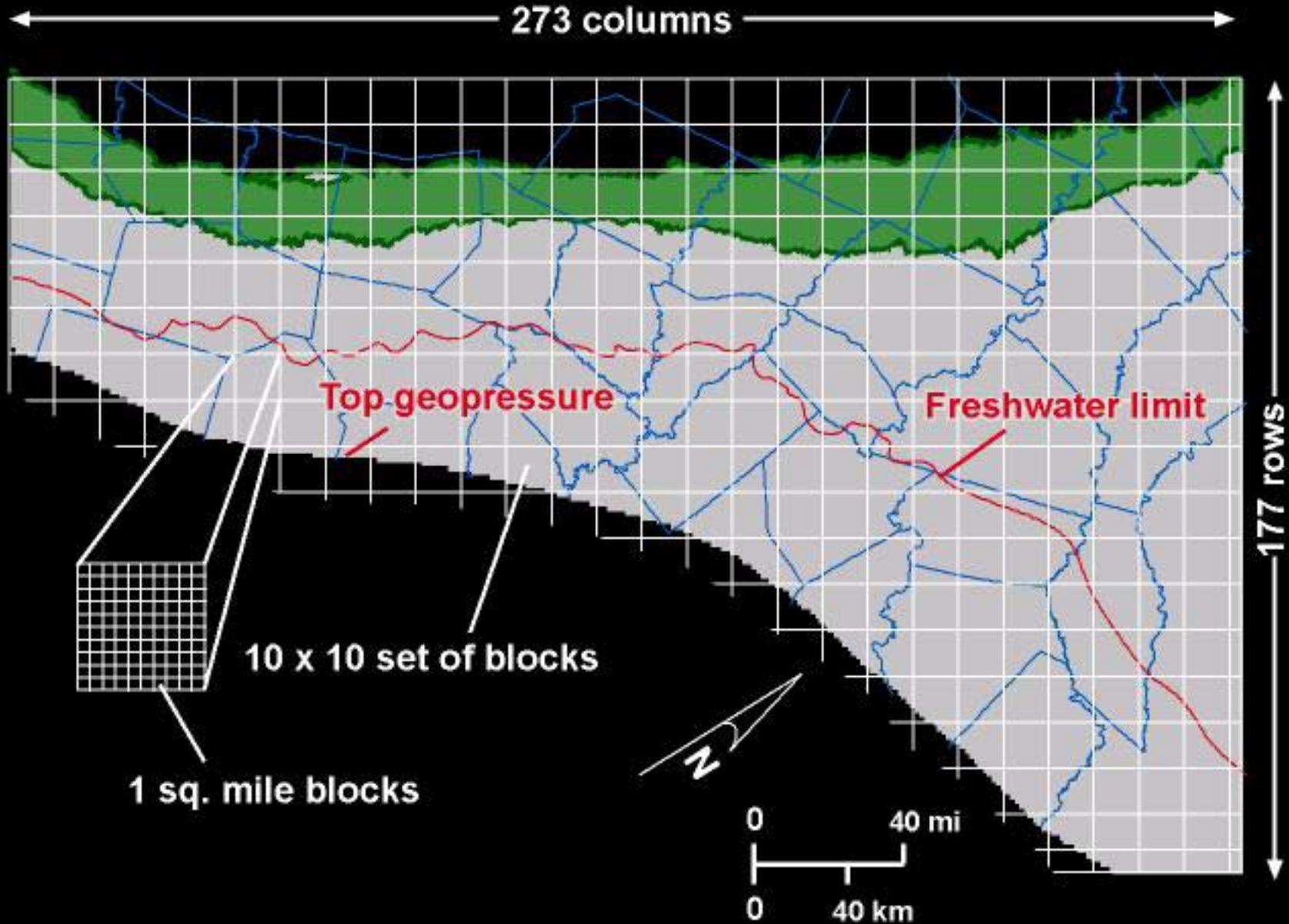
**STAKEHOLDER ADVISORY FORUM (SAF)
Central Carrizo-Wilcox Aquifer GAM Model
October 22, 2002**

- **Welcome and introductions**
- **Recharge rates in model**
- **Model calibration and verification**
- **Predictive simulation results for
2000 to 2050**

MODELING PERIODS



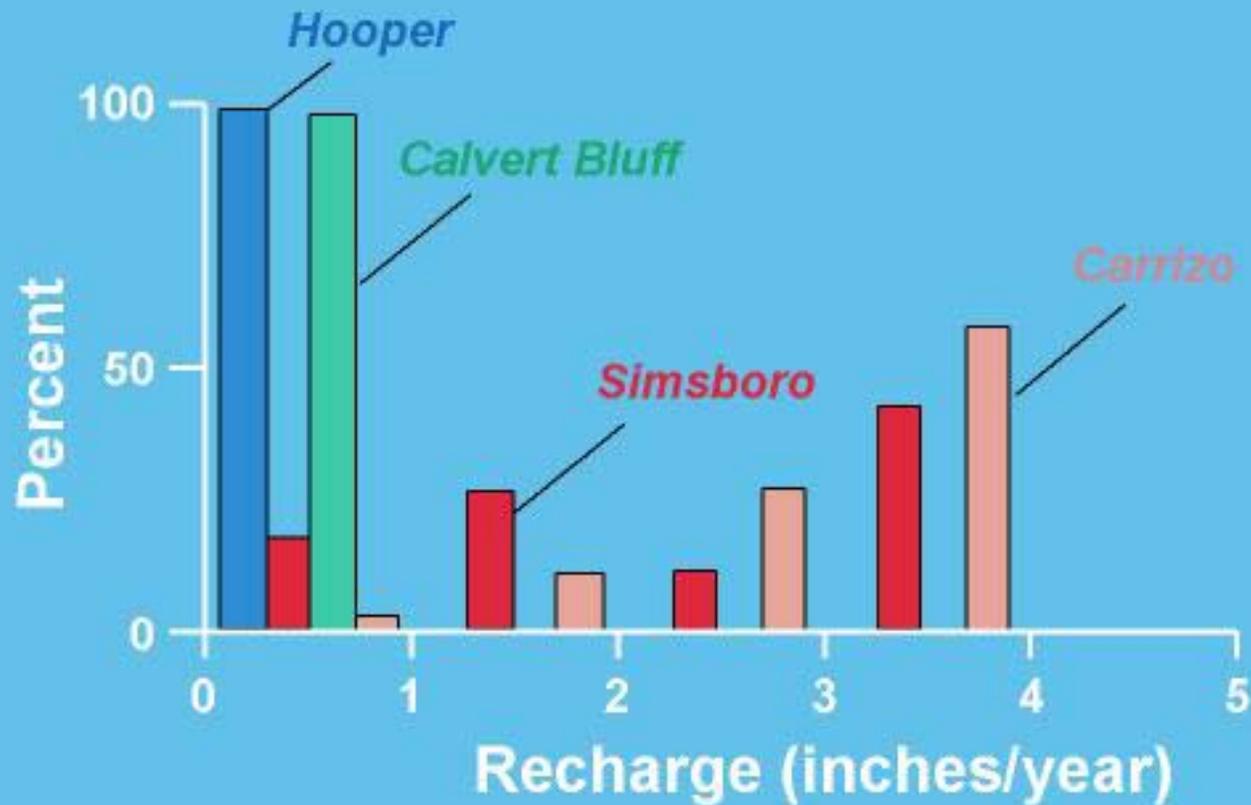
MODEL GRID



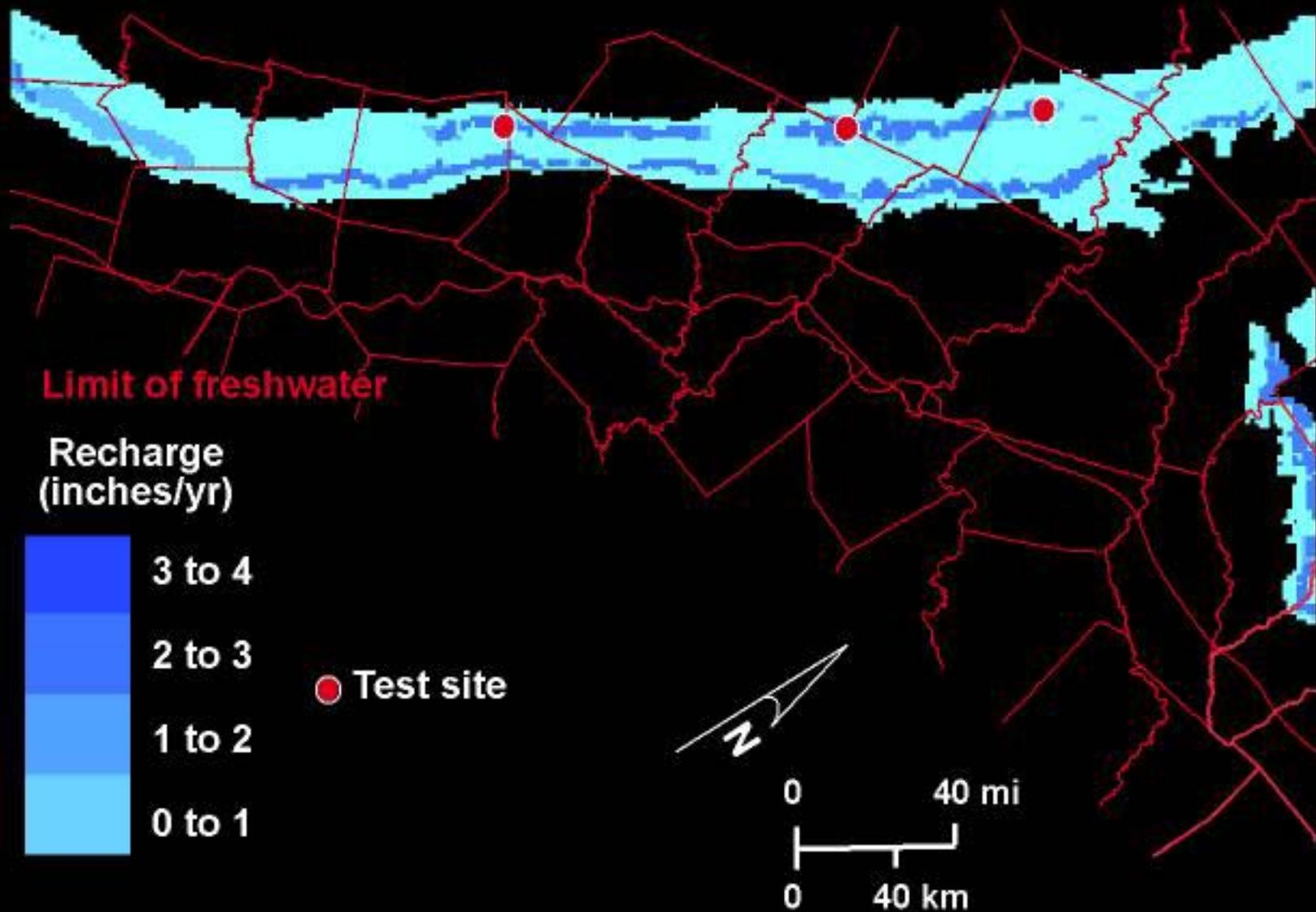
RECHARGE RATES

RECHARGE RATES

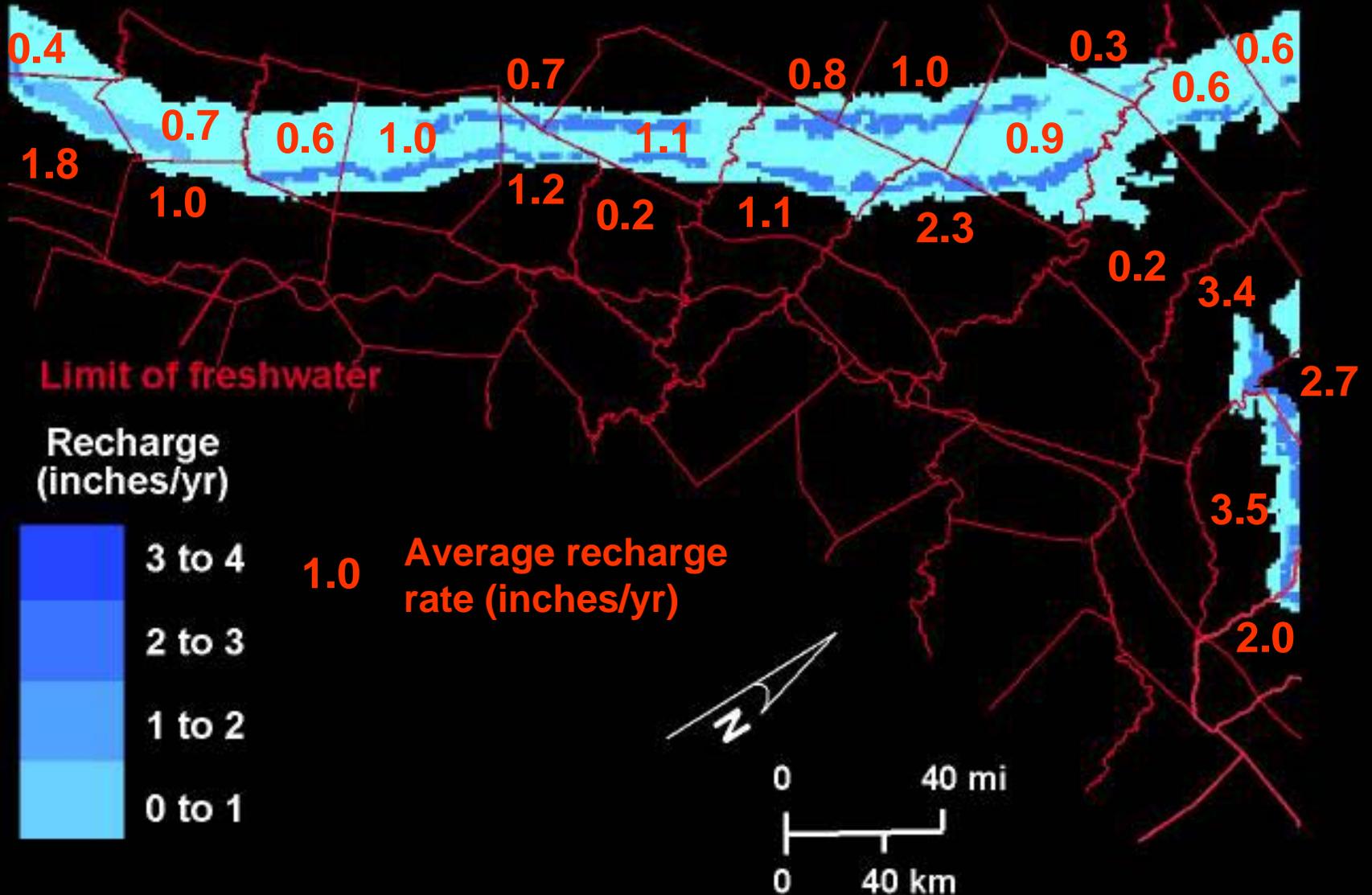
Applied in Central Carrizo-Wilcox GAM Model



RECHARGE RATES



AVERAGE RECHARGE RATE In Carrizo-Wilcox Aquifer By County



AVERAGE RECHARGE RATE

(inches/year)*

| | | | | | |
|-----------|-----|-------------|-----|---------------|-----|
| Anderson | 0.2 | Gonzales | 1.0 | Navarro | 0.3 |
| Bastrop | 1.0 | Guadalupe | 0.7 | Robertson | 1.1 |
| Bexar | 0.4 | Henderson | 0.6 | Rusk | 2.7 |
| Burleson | 0.2 | Lee | 1.2 | San Augustine | 2.0 |
| Caldwell | 0.6 | Leon | 2.3 | Van Zandt | 0.6 |
| Cherokee | 3.4 | Limestone | 1.0 | Williamson | 0.7 |
| Falls | 0.8 | Milam | 1.1 | Wilson | 1.8 |
| Freestone | 0.9 | Nacogdoches | 3.5 | | |

* *Applied to outcrop of central Carrizo-Wilcox aquifer in model area*

AVERAGE RECHARGE RATE

(1,000 acre-feet/year)*

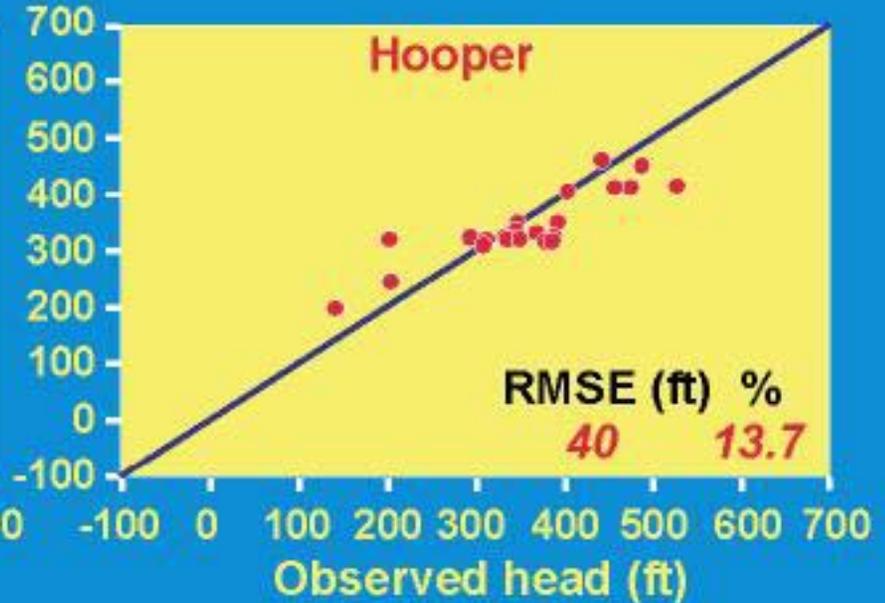
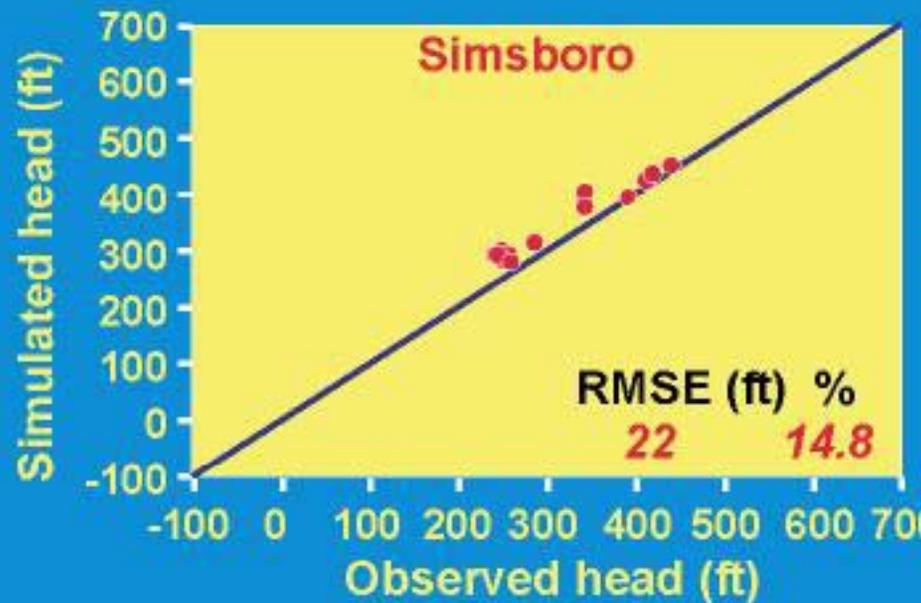
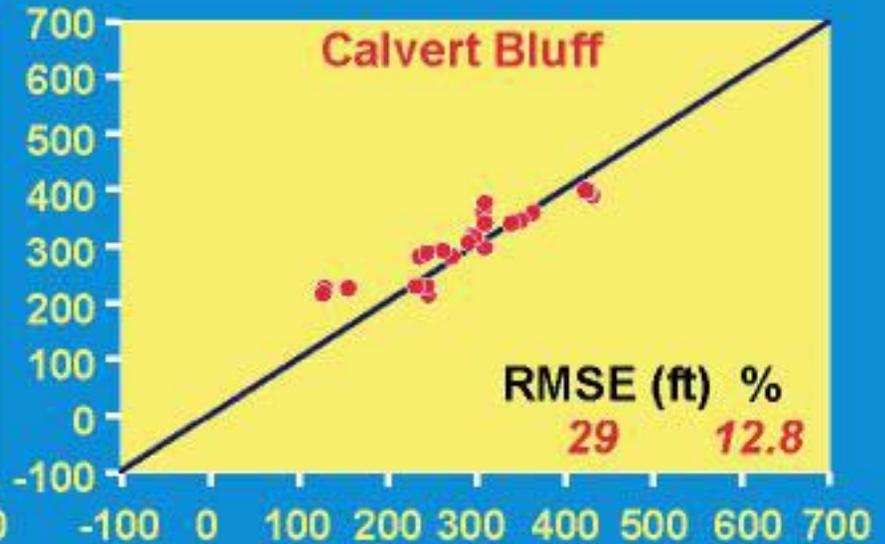
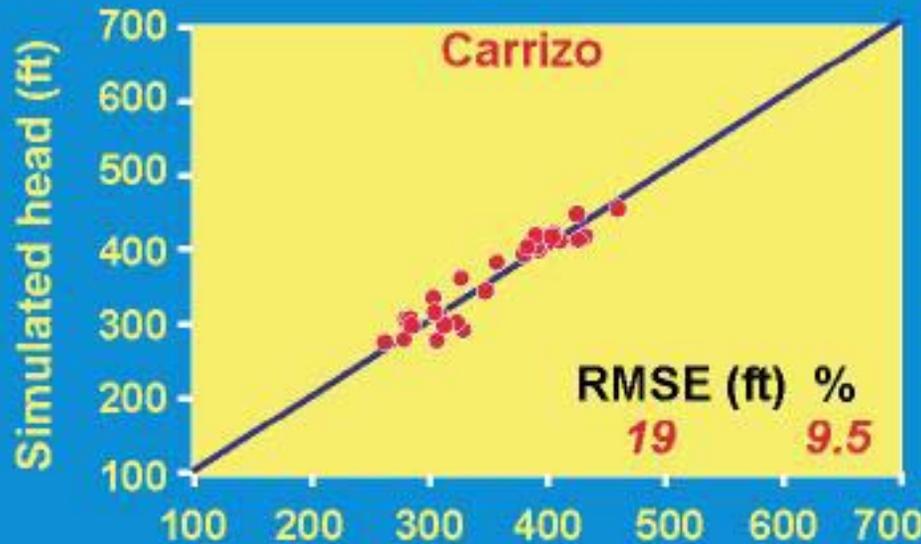
| | | | | | |
|------------------|-------------|--------------------|-------------|----------------------|-------------|
| Anderson | 0.6 | Gonzales | 0.9 | Navarro | 1.7 |
| Bastrop | 24.5 | Guadalupe | 13.7 | Robertson | 26.3 |
| Bexar | 5.2 | Henderson | 10.0 | Rusk | 3.9 |
| Burleson | 0.01 | Lee | 7.3 | San Augustine | 2.3 |
| Caldwell | 10.3 | Leon | 8.4 | Van Zandt | 6.0 |
| Cherokee | 7.8 | Limestone | 18.6 | Williamson | 1.5 |
| Falls | 1.9 | Milam | 25.5 | Wilson | 13.7 |
| Freestone | 33.6 | Nacogdoches | 15.3 | | |

** Applied to outcrop of central Carrizo-Wilcox aquifer in model area*

CALIBRATION

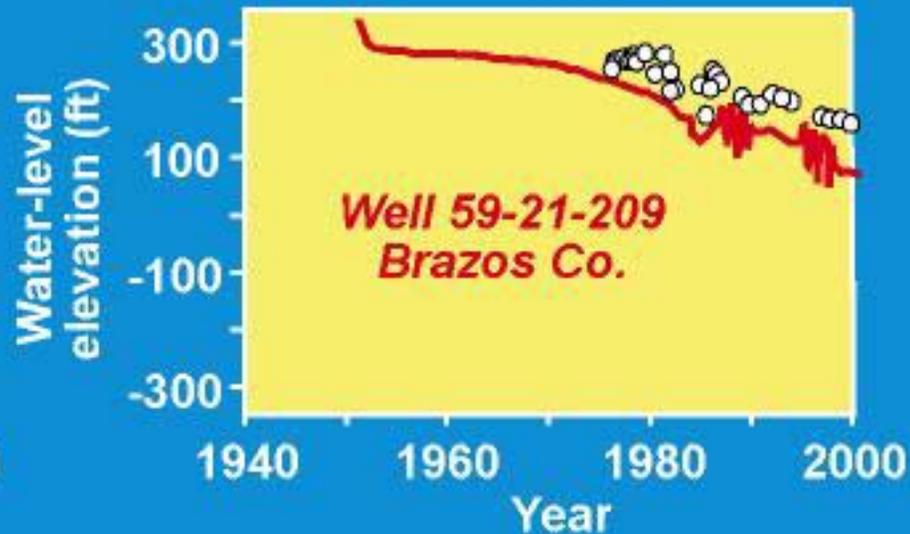
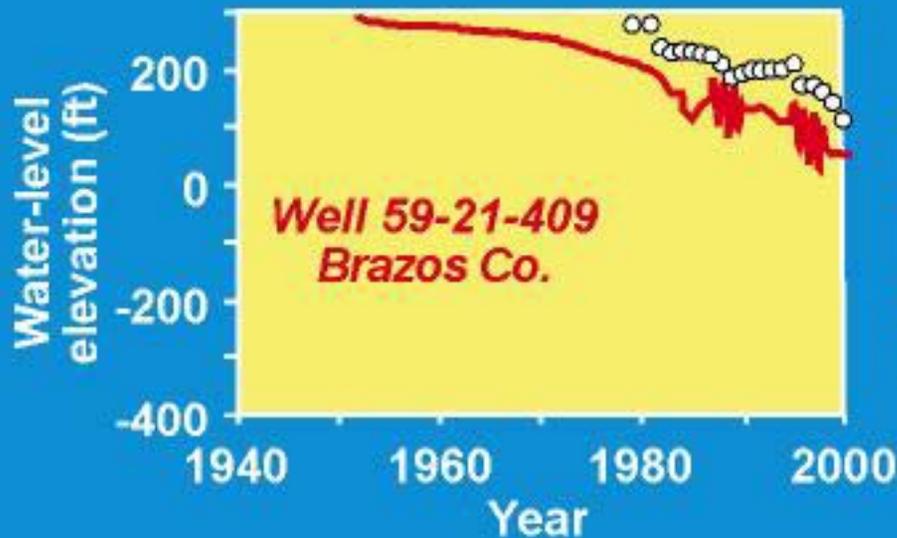
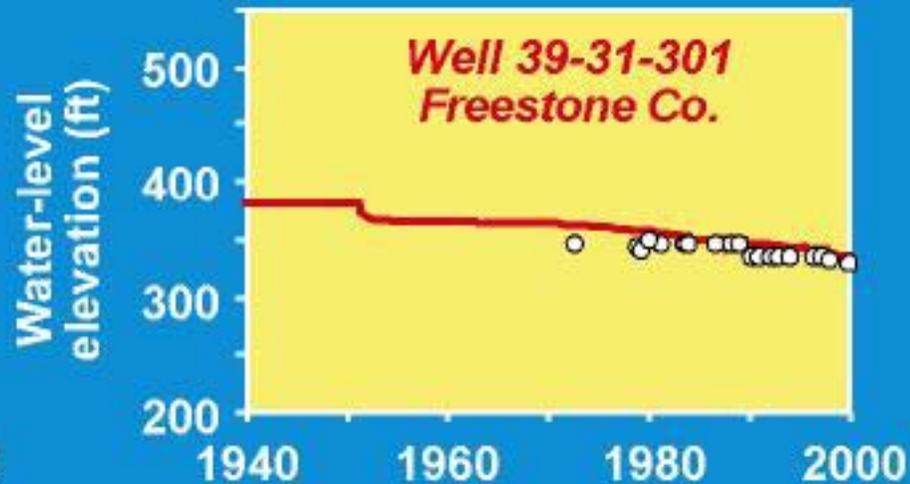
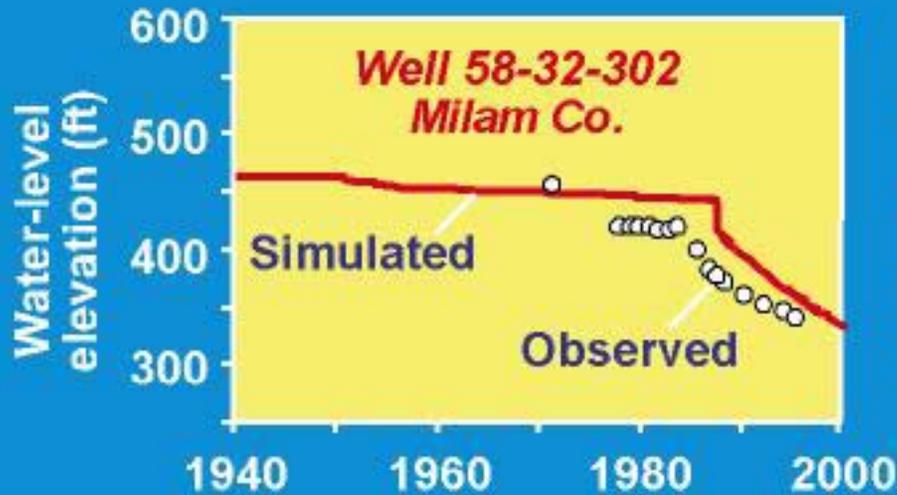
SIMULATED vs. OBSERVED WATER LEVELS

Steady State



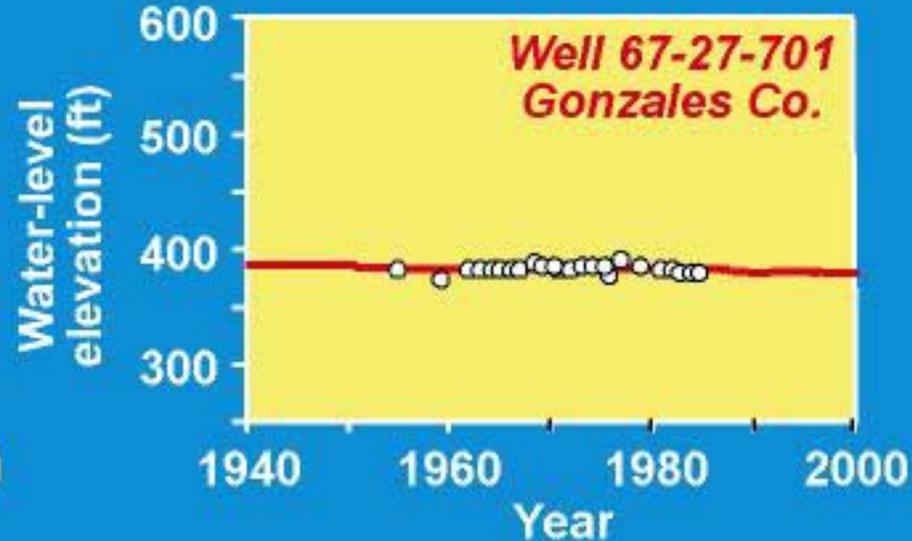
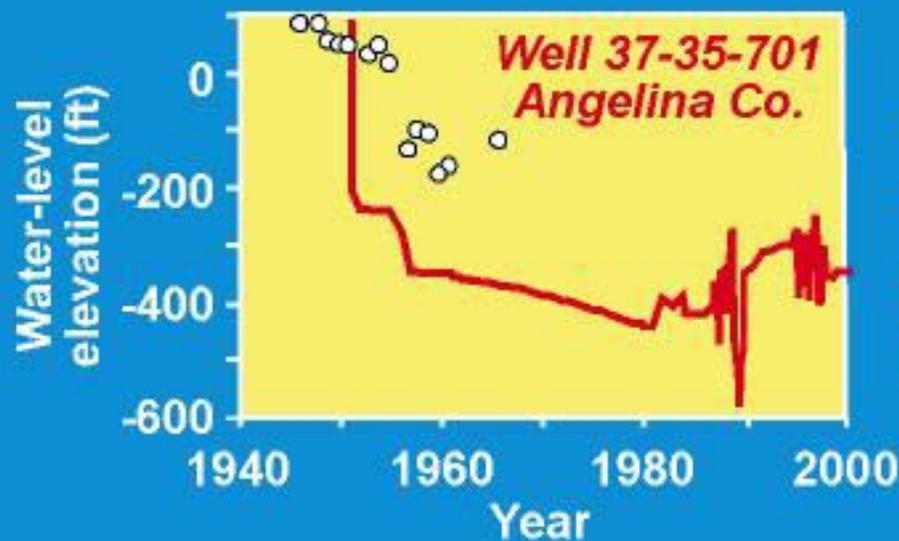
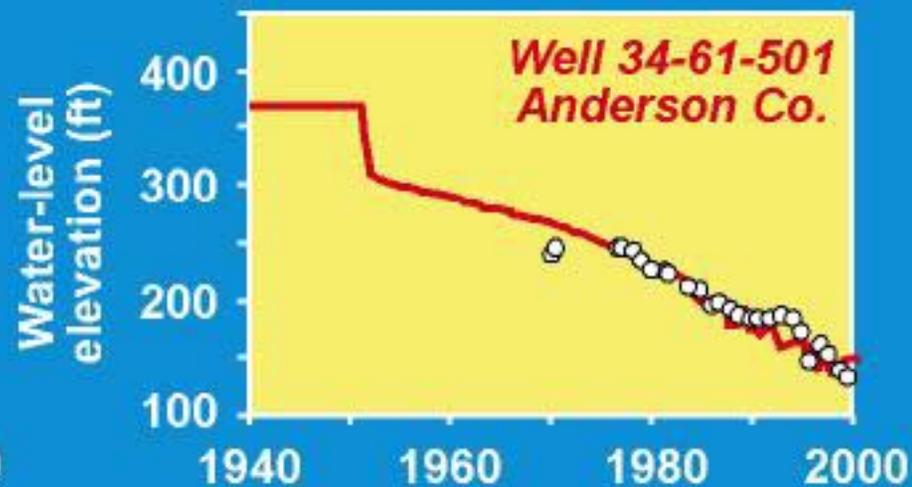
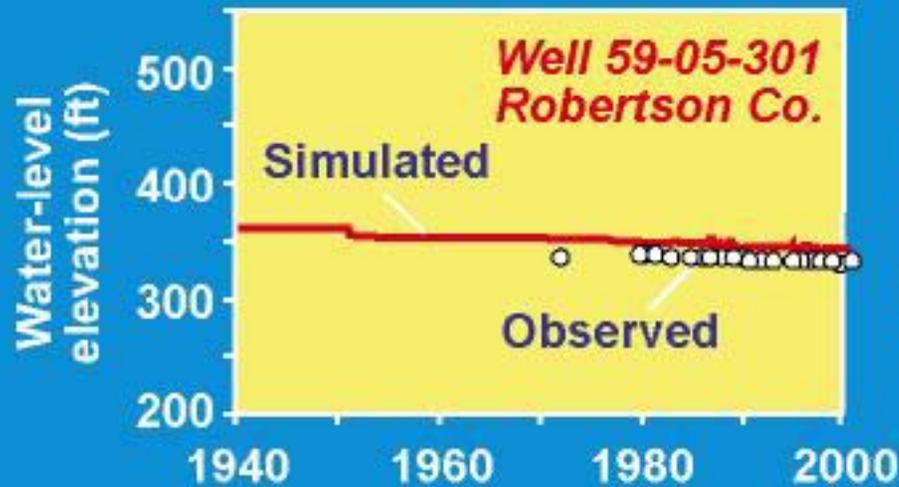
HYDROGRAPHS

Simsboro Aquifer

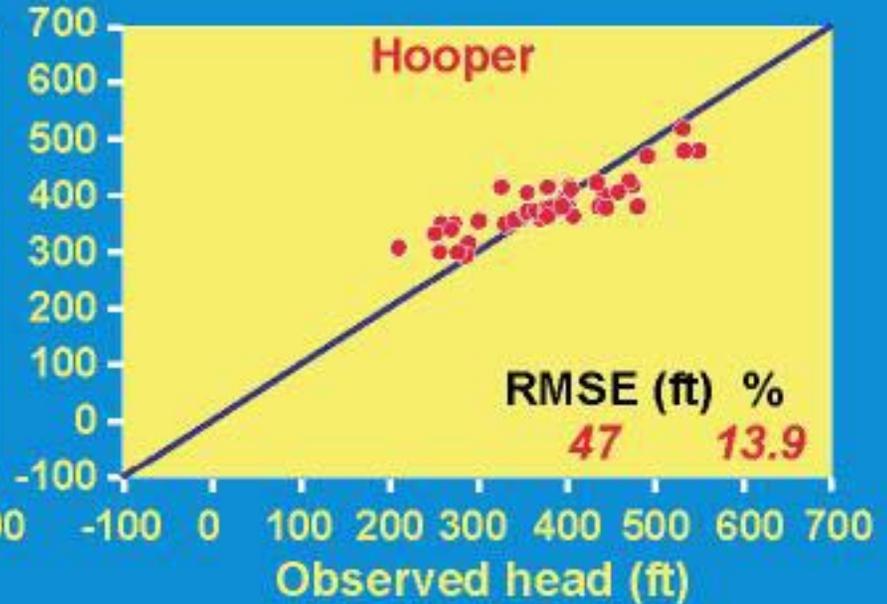
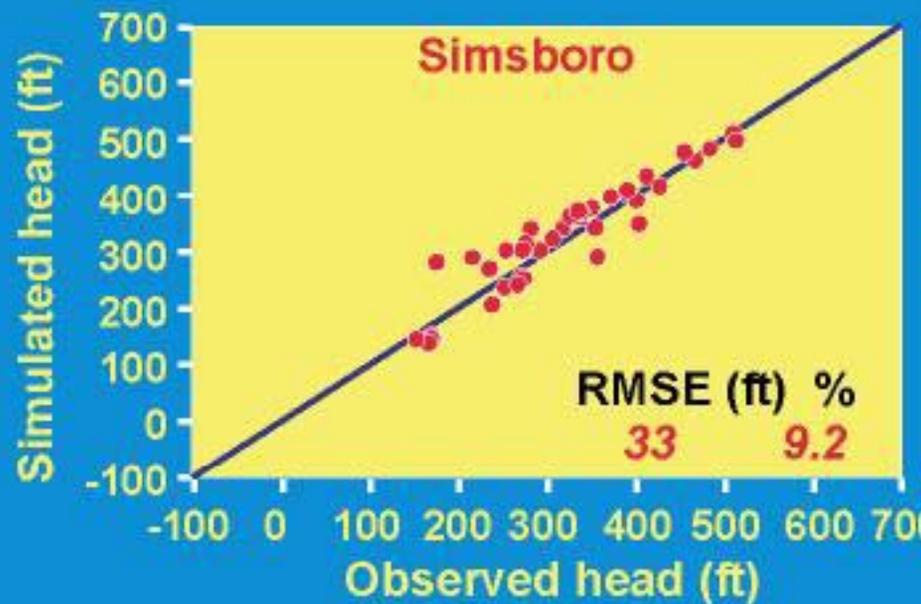
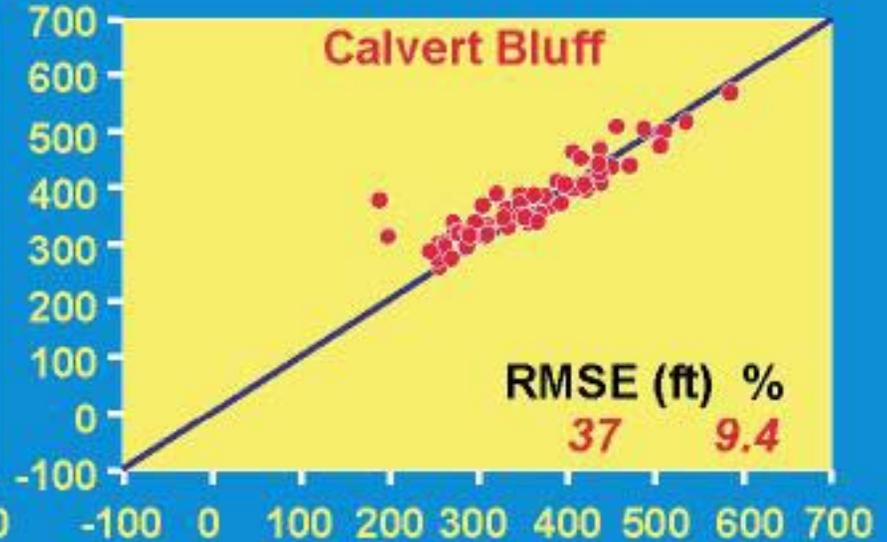
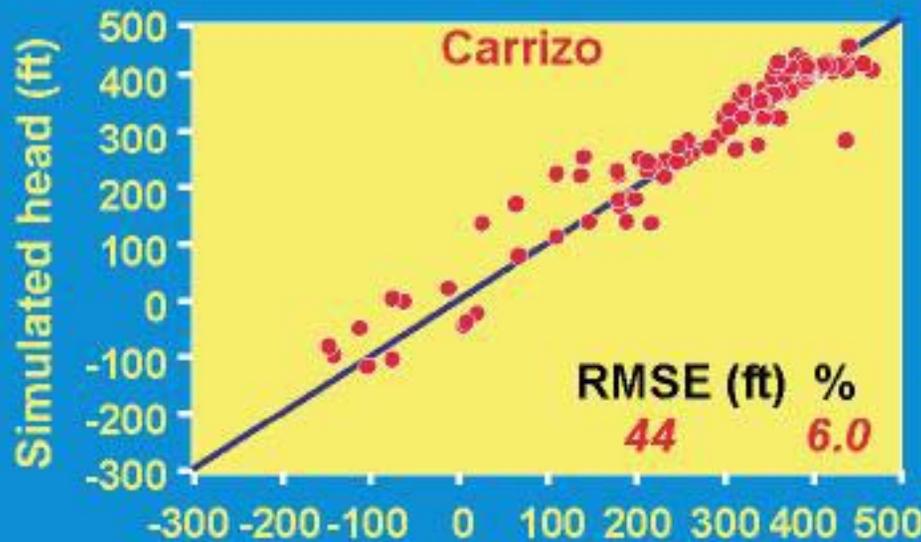


HYDROGRAPHS

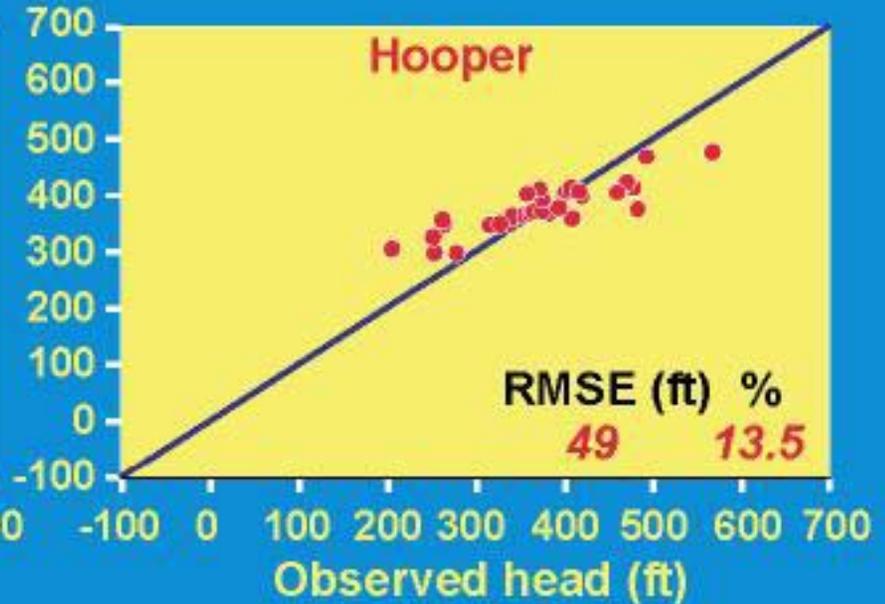
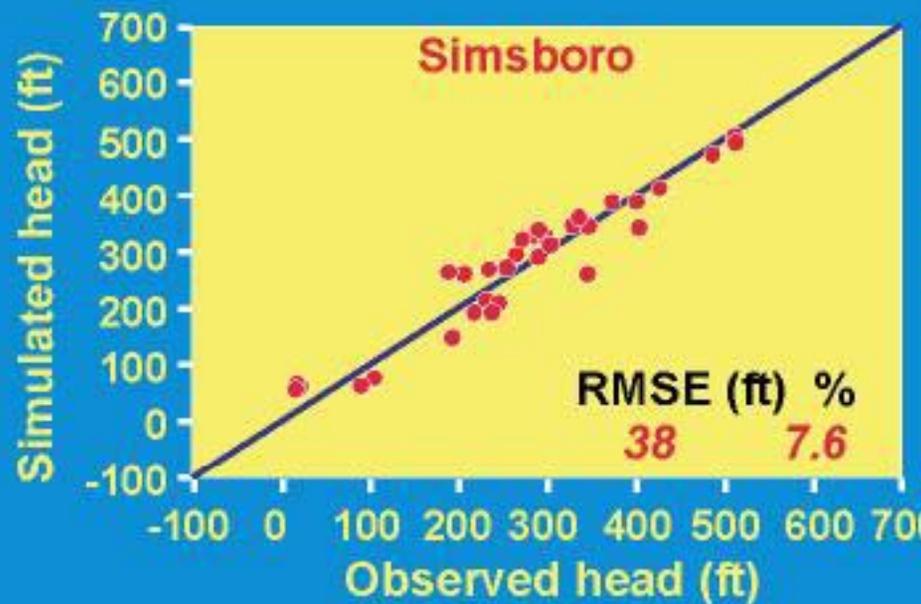
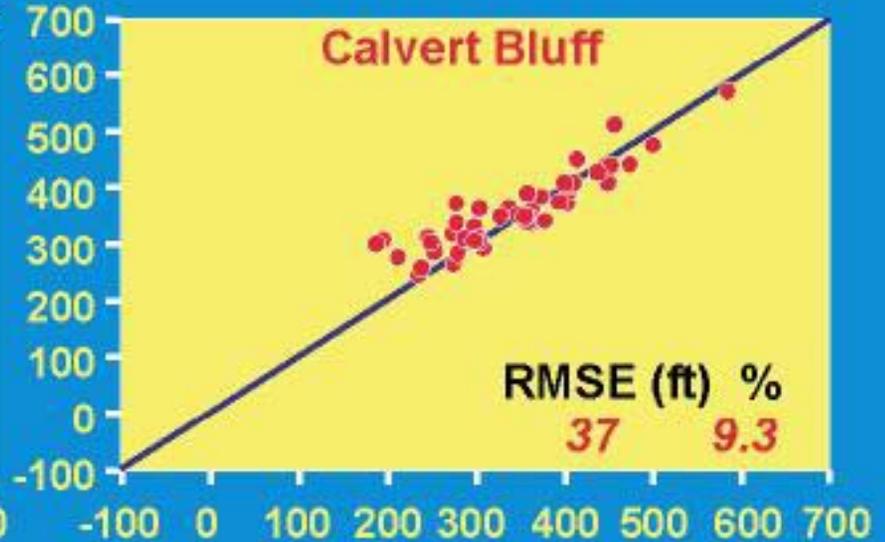
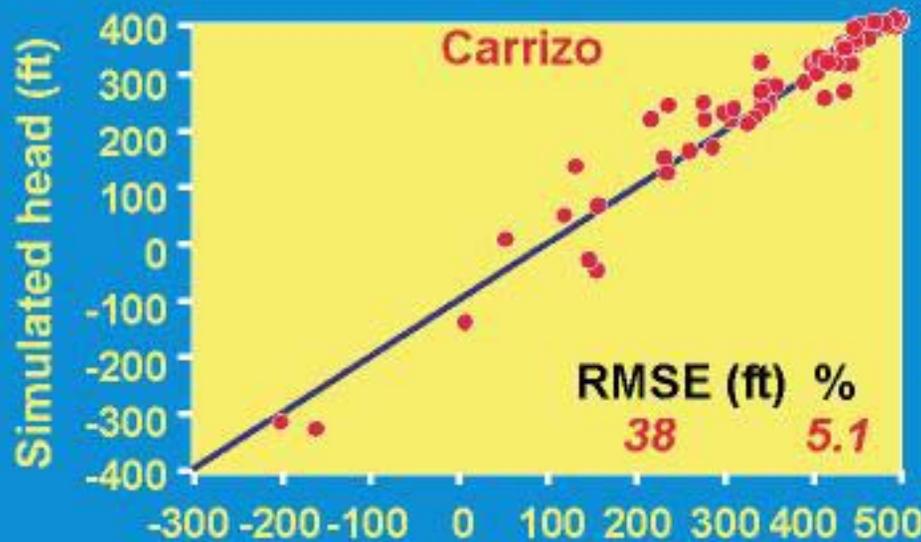
Carrizo Aquifer



SIMULATED vs. OBSERVED WATER LEVELS 1990



SIMULATED vs. OBSERVED WATER LEVELS 2000



**It's tough to make predictions,
especially about the future**

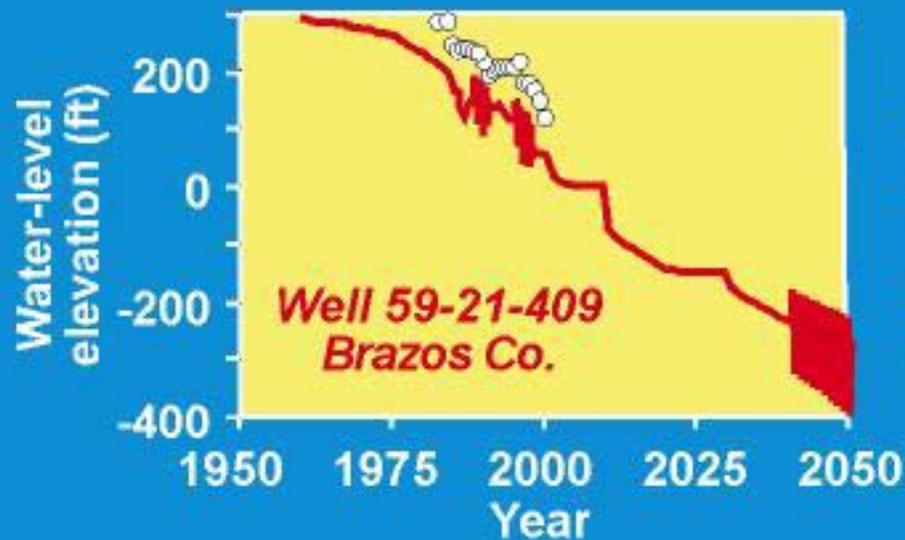
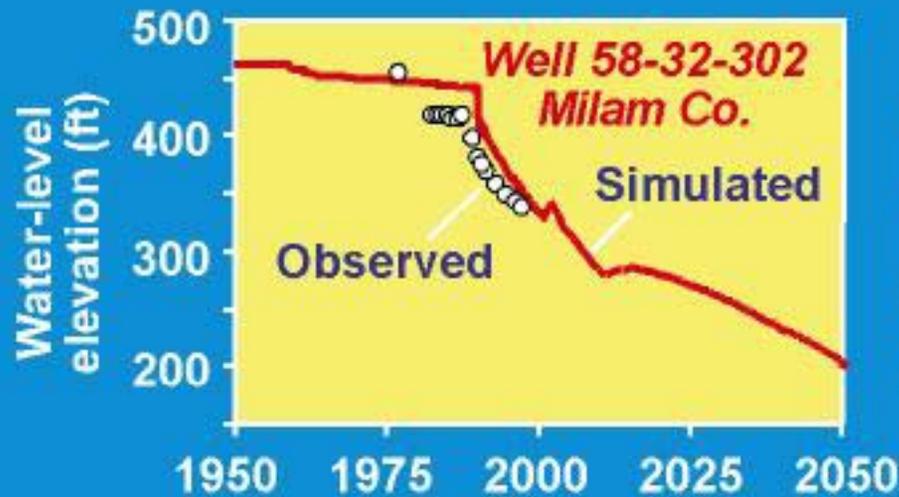
-Yogi Berra

PREDICTIVE MODEL SIMULATIONS

- **Regional Water Planning Group and State Water Plan (2002) water demand projections**
- **Average recharge rates except each simulation ends with a drought of record, representing 1954 through 1956**
 - **2000 through 2010**
 - **2000 through 2020**
 - **2000 through 2030**
 - **2000 through 2040**
 - **2000 through 2050**
- **Average recharge rates for 2000 through 2050**

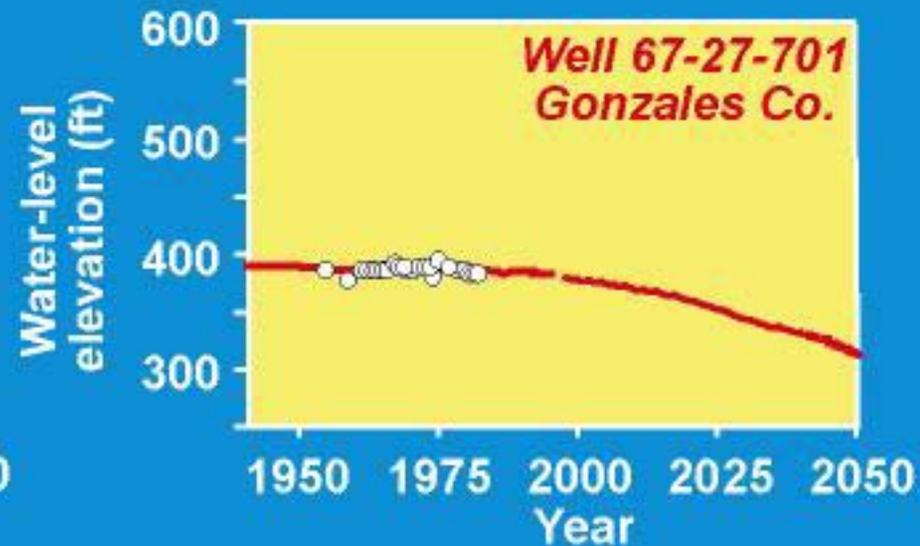
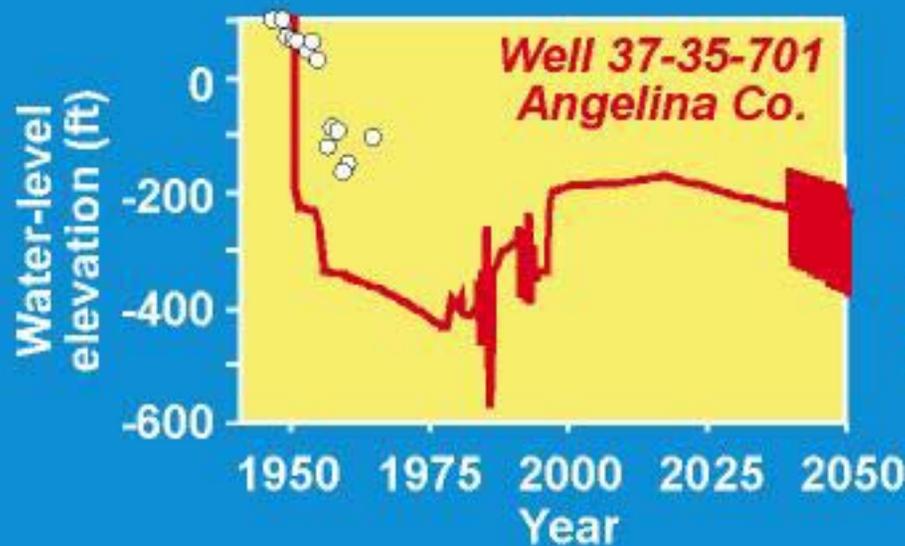
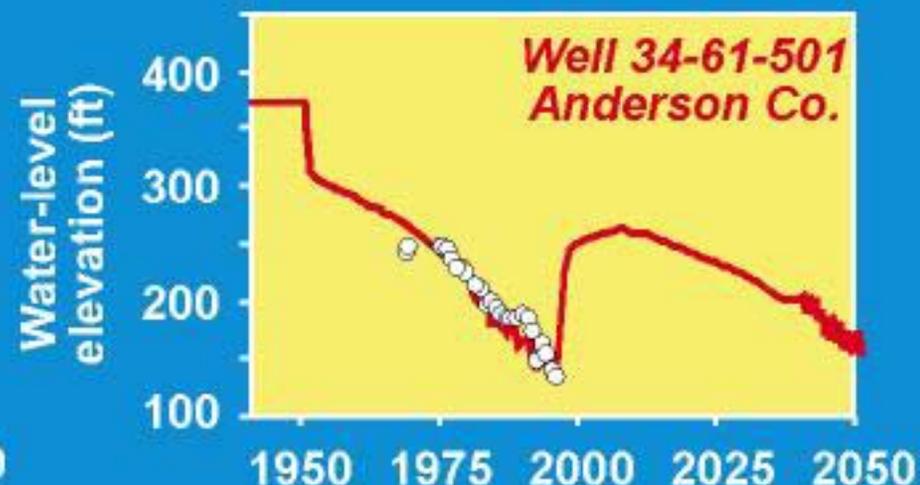
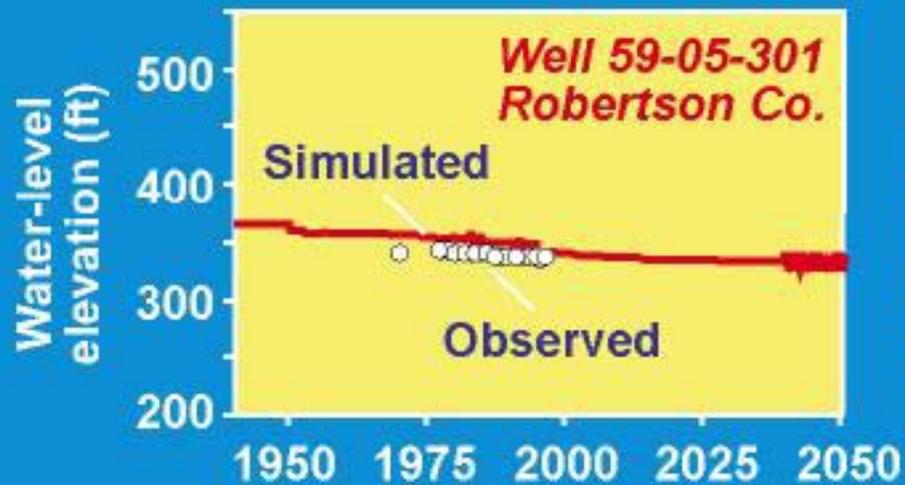
HYDROGRAPHS

Simsboro Aquifer 1950 through 2050

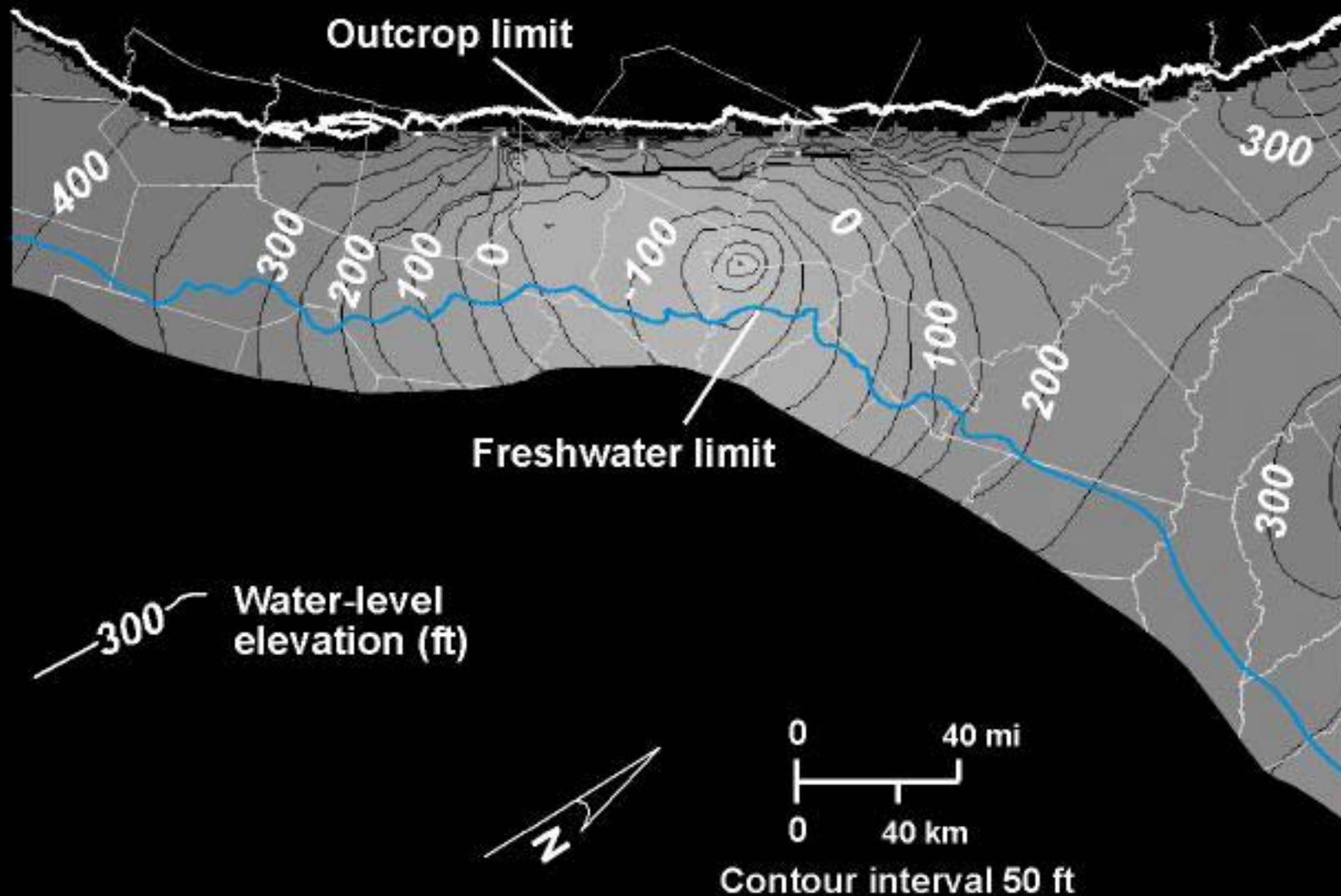


HYDROGRAPHS

Carrizo Aquifer 1950 through 2050

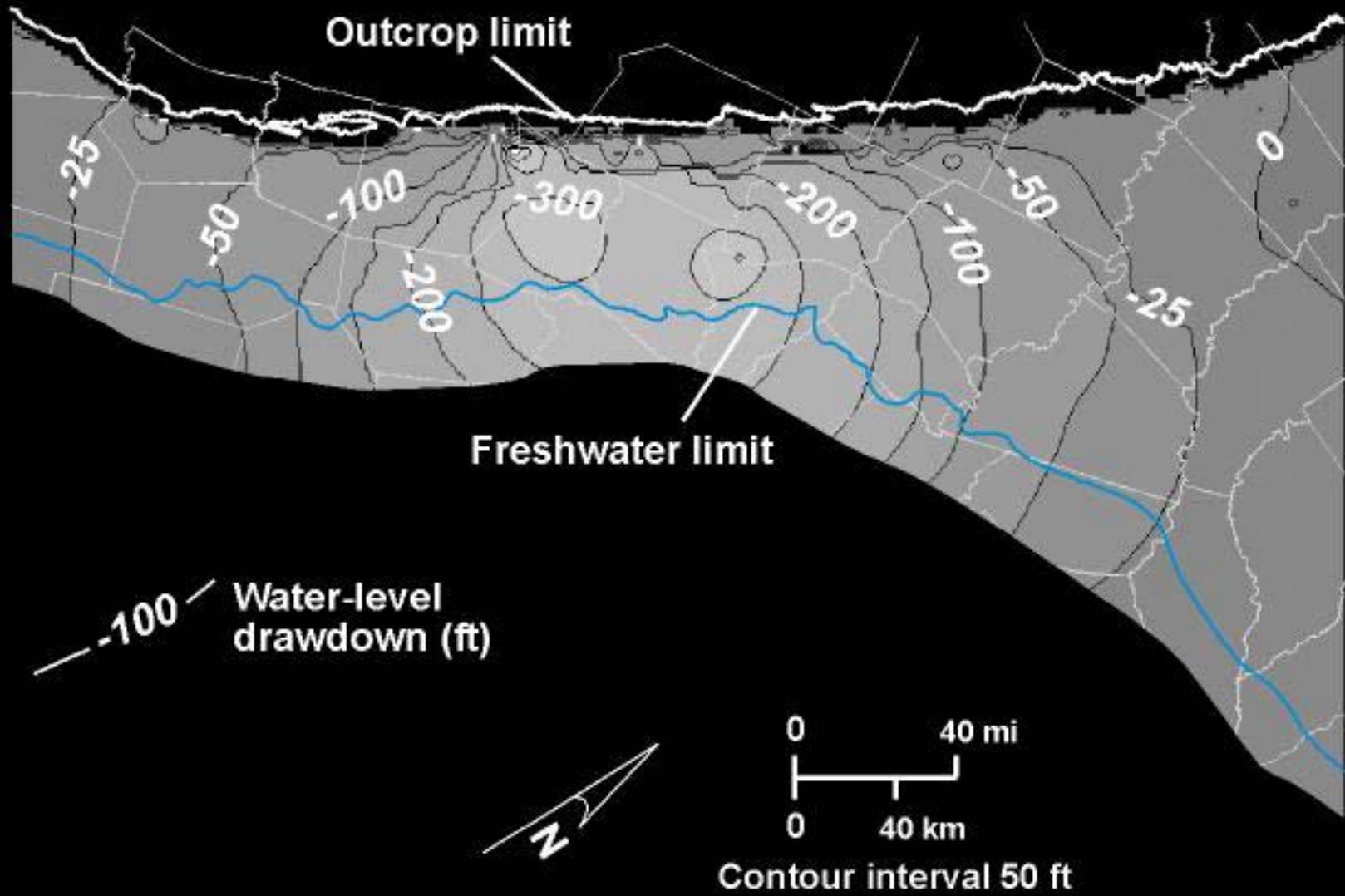


SIMULATED 2050 WATER LEVEL Simsboro Aquifer

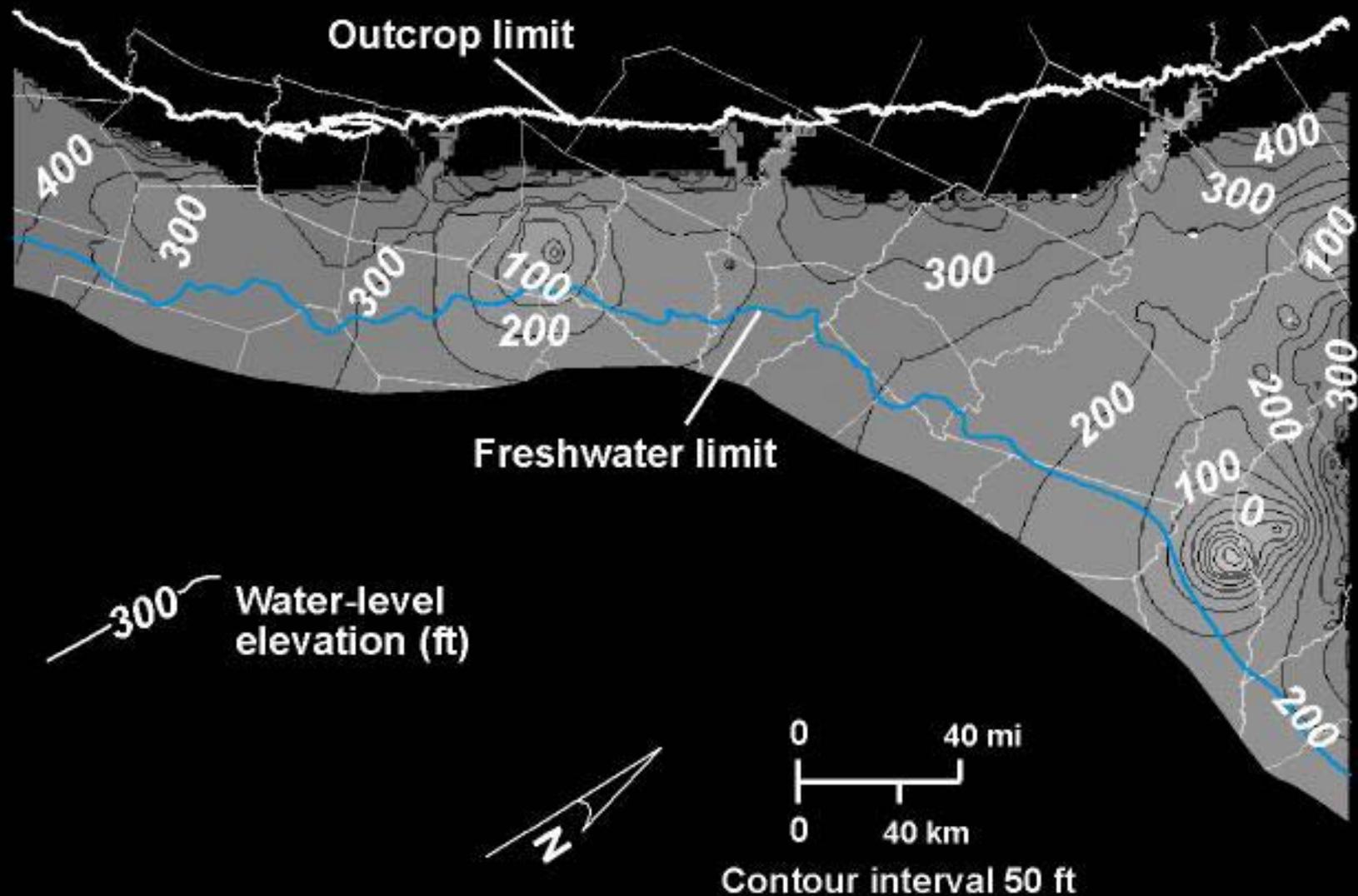


SIMULATED DRAWDOWN - 2000 THROUGH 2050

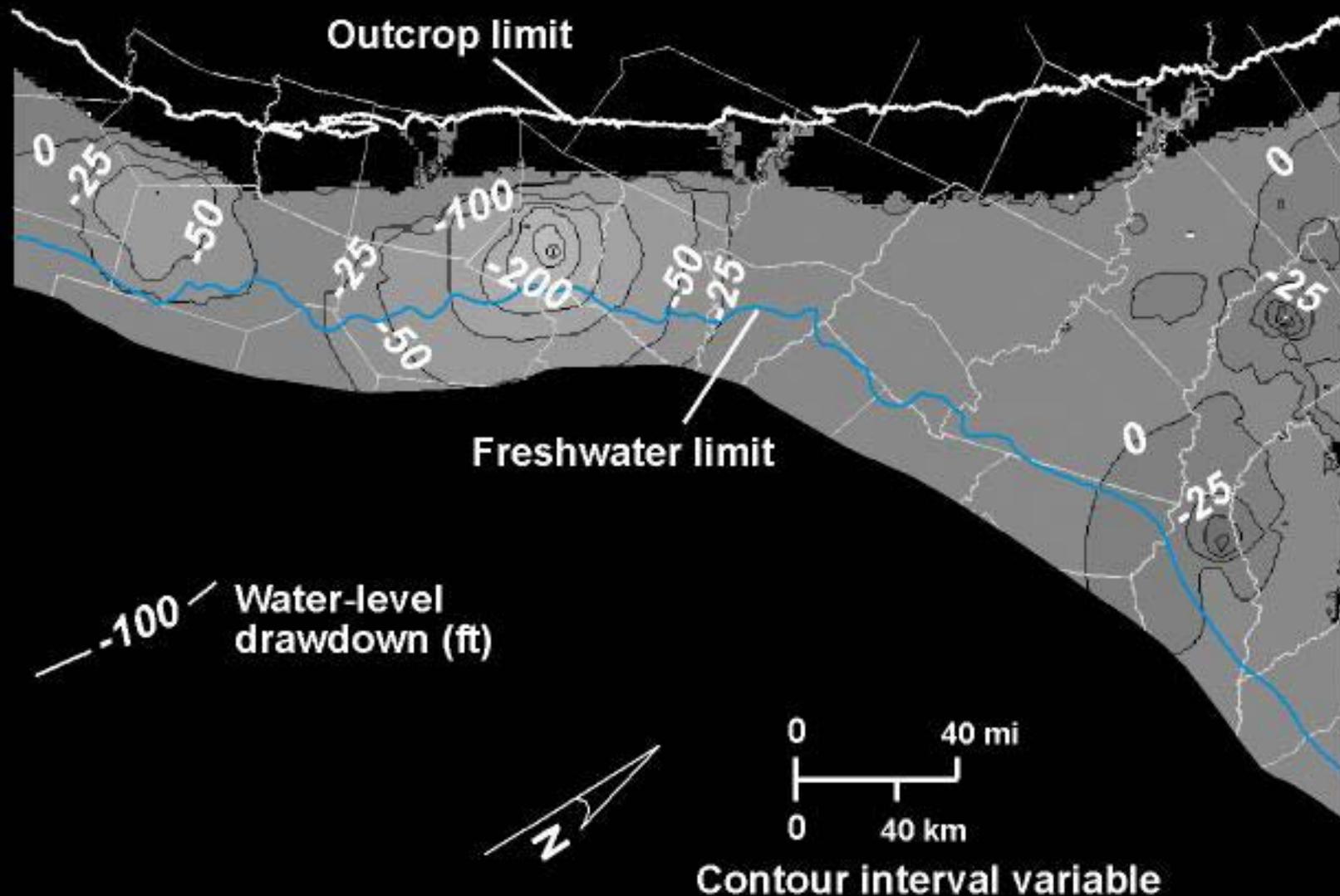
Simsboro Aquifer



SIMULATED 2050 WATER LEVEL Carrizo Aquifer

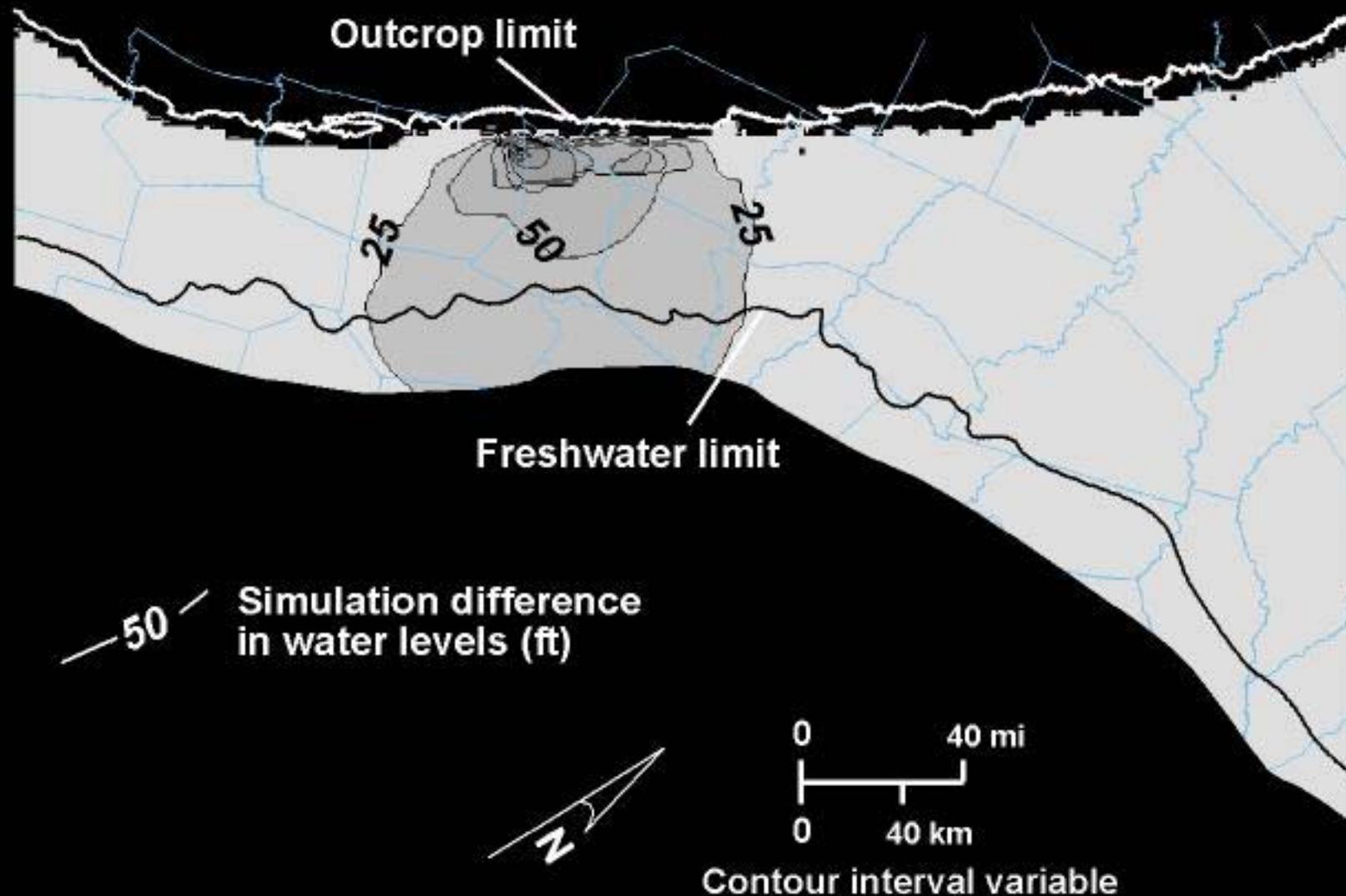


SIMULATED DRAWDOWN - 2000 THROUGH 2050 Carrizo Aquifer



EXAMPLE OF MODEL APPLICATION

Comparison of Scenarios for Simsboro Aquifer



**Stakeholder Advisory Forum (SAF)
Central Carrizo-Wilcox Aquifer Groundwater Availability Model**

**Forum Meeting No. 7
Tuesday, October 22, 10:00 a.m.
LCRA's McKinney Roughs Environmental Learning Center**

List of Attendees

| <u>Name</u> | <u>Affiliation</u> |
|---------------------|----------------------------------|
| Nathan Ausley | Post Oak Savanna GCD |
| Greg Barker | |
| Craig Bell | City of Austin |
| James Bene | RW Harden & Assoc |
| John Burke | Aqua WSC |
| Dick Burns | ALCOA |
| Joe Cooper | Lost Pines GCD |
| Reece deGraffenried | Twin Creek Water |
| Alan Dutton | BEG |
| Alan Hamilton | Ecologist |
| Bob Kier | Robert S. Kier Consulting |
| Katie Kier | BEG |
| Dan Kowalski | Walnut Creek Mining Co. |
| James Kowis | Alcoa |
| Robert Mace | TWDB |
| Mike Mahoney | Evergreen GWCD |
| Ann Mesrobian | Lost Pines GWCD |
| Barry Miller | Gonzales UWCD |
| David Nelson | Land Owner |
| Jean-Philippe Nicot | BEG |
| Joe Peters | TCEQ |
| Phil Savoy | Murfee Engineering Company, Inc. |
| Grant Snyder | URG |
| Shirley Wade | TWDB |

**Stakeholder Advisory Forum (SAF)
Central Carrizo-Wilcox Aquifer Groundwater Availability Model**

**Forum Meeting No. 7
Thursday, October 20, 2002, 10:00 a.m.
LCRA McKinney Roughs Conference Center**

The seventh Stakeholder Advisory Forum (SAF) for the Central Carrizo-Wilcox Aquifer Groundwater Availability Model (GAM) was held on August 28, 2002, from 10:00 to 11:30 a.m. at the LCRA McKinney Roughs Conference Center, Cedar Creek, Texas.

The purpose of the seventh SAF Forum was to review the steady-state and transient model calibrations and discuss results of predictive modeling. The presentation material (*SAF7_CW-c.pdf*) is available at www.twdb.state.tx.us/GAM/czwx_c/czwx_c.htm, the TWDB's GAM website. A list of attendees (*SAF7_CW-c_a.pdf*) is also posted at that website.

Introduction

Alan Dutton (Bureau of Economic Geology [BEG]) opened the Forum and introduced other modeling team members present, including James Bene (R. W. Harden and Associates, Inc.) and Jean-Philippe Nicot (BEG).

Dr. Robert Mace, project manager for the TWDB, summarized the process and schedule for the review of the draft report. BEG plans to submit the draft report within the week (submitted to TWDB on Monday October 28). TWDB will then post the report on the web (posting date of October 31, 2002). Stakeholders and interested parties will have three weeks (through November 21, 2002) to download the report and submit comments to Robert Mace at the TWDB. A SAF meeting will be scheduled for November for a discussion of review comments. Finally, in December there will be a model training workshop for anyone interested in learning more about the Central Carrizo-Wilcox GAM model.

Dr. Mace then noted that the contract for the GAM model of the Queen City and Sparta aquifers has been awarded to Intera, Inc. Both BEG and R. W. Harden and Associates, Inc., are subcontractors to Intera for the Queen City-Sparta GAM model, which is scheduled for completion in Summer 2004. The Queen City-Sparta GAM model will be divided into three models that correspond to the Carrizo-Wilcox models.

Presentation and Discussion

After the introductions, Alan Dutton made the presentation contained in the document *SAF7_CW-c.pdf*. During and following the presentation, questions were asked and discussed. Questions, answers, and comments are labeled in the following as Q, A, and C, respectively.

Model Calibration

- Q: When BEG determined recharge rates of the aquifer for each county, how was area determined? Did you divide the recharge for the county by the total county area or by only the area of the county covered by the aquifer?
- C: Stakeholder: It would be a good idea to remove the Reklaw Formation from the total recharge numbers. That way we can see the totals for specifically the Carrizo-Wilcox aquifer.
- A: We summed the recharge rates assigned to each model cell in a county and divided by the total number of recharge cells in that county. The average rate is therefore an area-weighted average for the Carrizo-Wilcox aquifer in the county, including the layers representing the Hooper, Simsboro, Calvert Bluff, and Carrizo. Recharge assigned to the Reklaw layer of the model has been removed from the numbers posted in *SAF7_CW-c.pdf*.

Predictive Model

- Q: What cities are associated with Anderson County in the model? Why do you show less pumping in the future in counties such as Anderson County?
- A: Anderson County cities with municipal pumping in the model include Palestine, Elkhart, and Frankston.
- C: [Robert Mace] The TWDB provided BEG with estimates of future pumping rates for each county. The estimates are largely based on the numbers in the various Regional Water Plans. Future pumping rates as included in the model are, of course, only one possible predictive run of what the future demands might be.
- Q: How much pumping is allocated to the Williamson Pumping Project in Lee County?
- A: The data base assigns approximately 17,000 acre feet/ year (2050 number, increasing from ~800 acre feet/ year in 2010) to Williamson County from the Carrizo-Wilcox aquifer. That total is from estimates of municipal and rural domestic needs from the TWDB predictive pumping numbers. We made the assumption that this is withdrawn from Lee County.
- C: [Robert Mace] Sometimes it is not clear in the regional water plans how much water will come from surface water sources and how much from groundwater sources. Also, exact locations of pumping might be ambiguous because the water planning groups simply provided a basin location, rather than an exact site for pumping. This is another reason why the future

pumping needs should only be interpreted as an estimate, not an exact number.

- C: [Stakeholder] One of the best uses of the GAM model is to find effects of certain pumping projects. The GAM model is great for the “what if” scenarios. As pumping demands change in the future, the GAM model can be used to look at scenarios of pumping from various locations to accommodate the changing water needs of the community.
- Q: How much is the estimated pumping for the ALCOA and SAWS sites? How is that pumping distributed between the Sandow mine and Lee County? Does the 38,700 acre feet/ year total include the mining demands of ALCOA, or is that number above and beyond that? The Sandow mine is about to close; did BEG take that change into account?
- A: The numbers in the TWDB *CityMunicipal_Master_Predictive.xls* file include a Bexar County water need of 38,700 acre feet/year by 2050 that is expected to be met by the ALCOA-SAWS transfer from the Carrizo-Wilcox aquifer. During the projected life of the Sandow and Three Oaks mines, some of the SAWS water need is assumed to be met by water produced as part of mining operations. We assumed that all but 10,000 acre-feet/year of groundwater pumping for mining operations at these two mines would be used as part of the ALCOA-SAWS transfer. The model at present has the 38,700 acre feet/year (by 2050) pumping allocated over about a 40 square mile area of Bastrop, Lee, and Milam Counties, in addition to the located scheduled pumping from the mines.
- Q: Have you run simulations of water levels for the Hooper Formation?
- A: Yes, there is pumping from the Hooper in the model and simulated water-level changes. The report has water-level maps for the Hooper for 1990, 2000, and 2050, and a predicted drawdown between 2000 and 2050 for the Hooper.