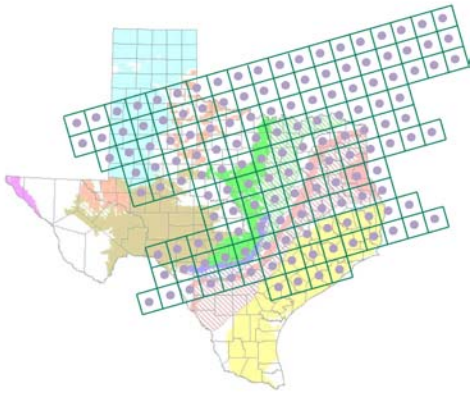
texas water development board

Groundwater Availability Modeling

Contract Manager

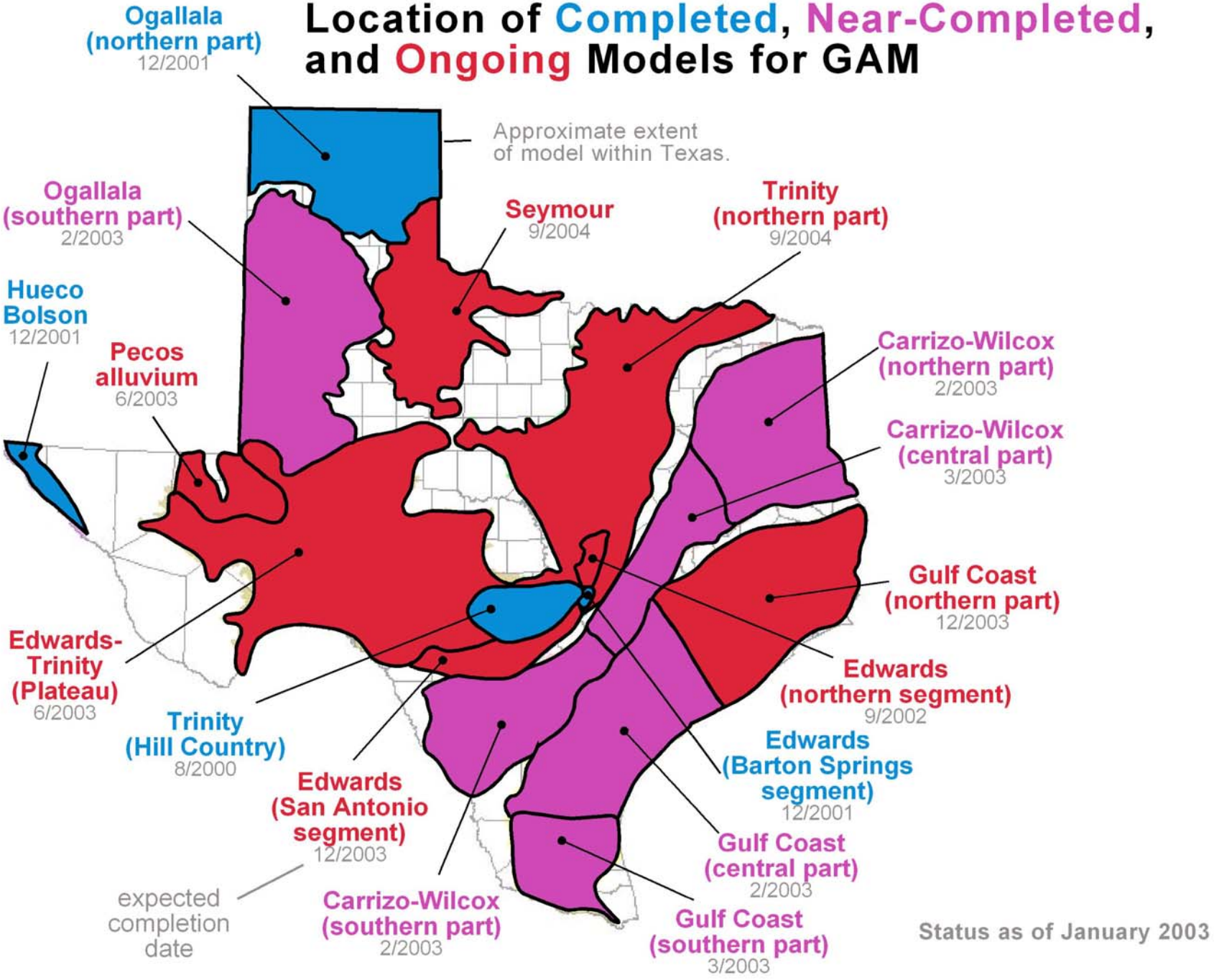
Texas Water Development Board

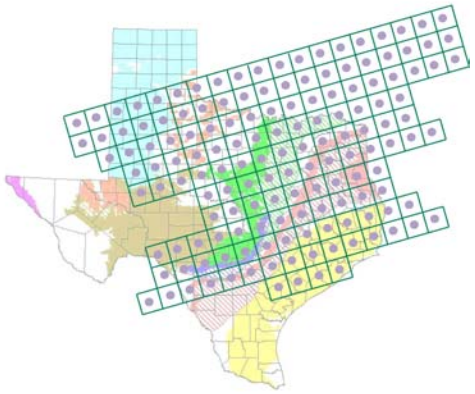


GAM

- Purpose: to develop the best possible groundwater availability model with the available time and money.
- Public process: you get to see how the model is put together.
- Freely available: standardized, thoroughly documented, and available over the internet.
- Living tools: periodically updated.

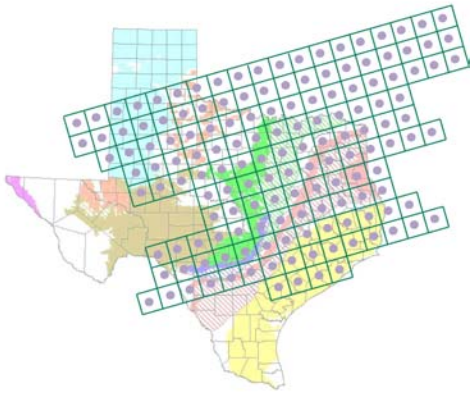
Location of Completed, Near-Completed, and Ongoing Models for GAM





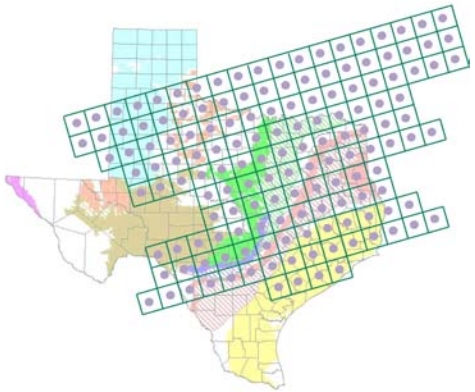
What is groundwater availability?

- …the amount of groundwater available for use.
- The State does not decide how much groundwater is available for use: GCDs and RWPGs decide
- A GAM is a tool that can be used to assess groundwater availability once GCDs and RWPGs decide how to define groundwater availability.



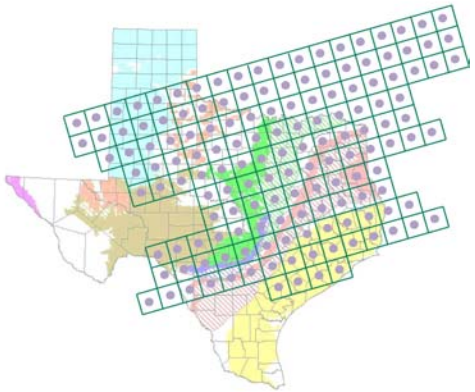
Do we have to use GAM?

- Water Code & TWDB rules require that GCDs use GAM information. Other information can be used in conjunction with GAM information.
- TWDB rules require that RWPGs use GAM information unless there is better site specific information available



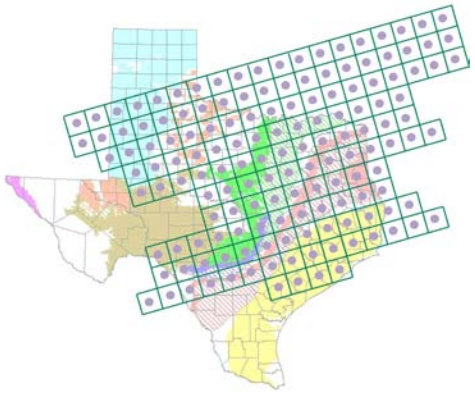
How do we use GAM?

- The model itself
  - predict water levels and flows in response to pumping and drought
  - effects of well fields
- Data in the model
  - water in storage
  - recharge estimates
  - hydraulic properties
- GCDs and RWPGs can request runs



Living tools

- GCDs, RWPGs, TWDB, and others collect new information on aquifer
- This information can enhance the current GAMs
- TWDB plans to update GAMs every five years with new info
- Please share information and ideas with TWDB on aquifers and GAMs



Participating in the GAM process

- SAF meetings
  - hear about progress on the model
  - comment on model assumptions
  - offer information (timing is important!)
- Report review
  - at end of project
- Contact TWDB
  - Robert Mace
  - Ted Angle

Comments:

Ted Angle

(512)936-2387

tangle@twdb.state.tx.us

www.twdb.state.tx.us/gam

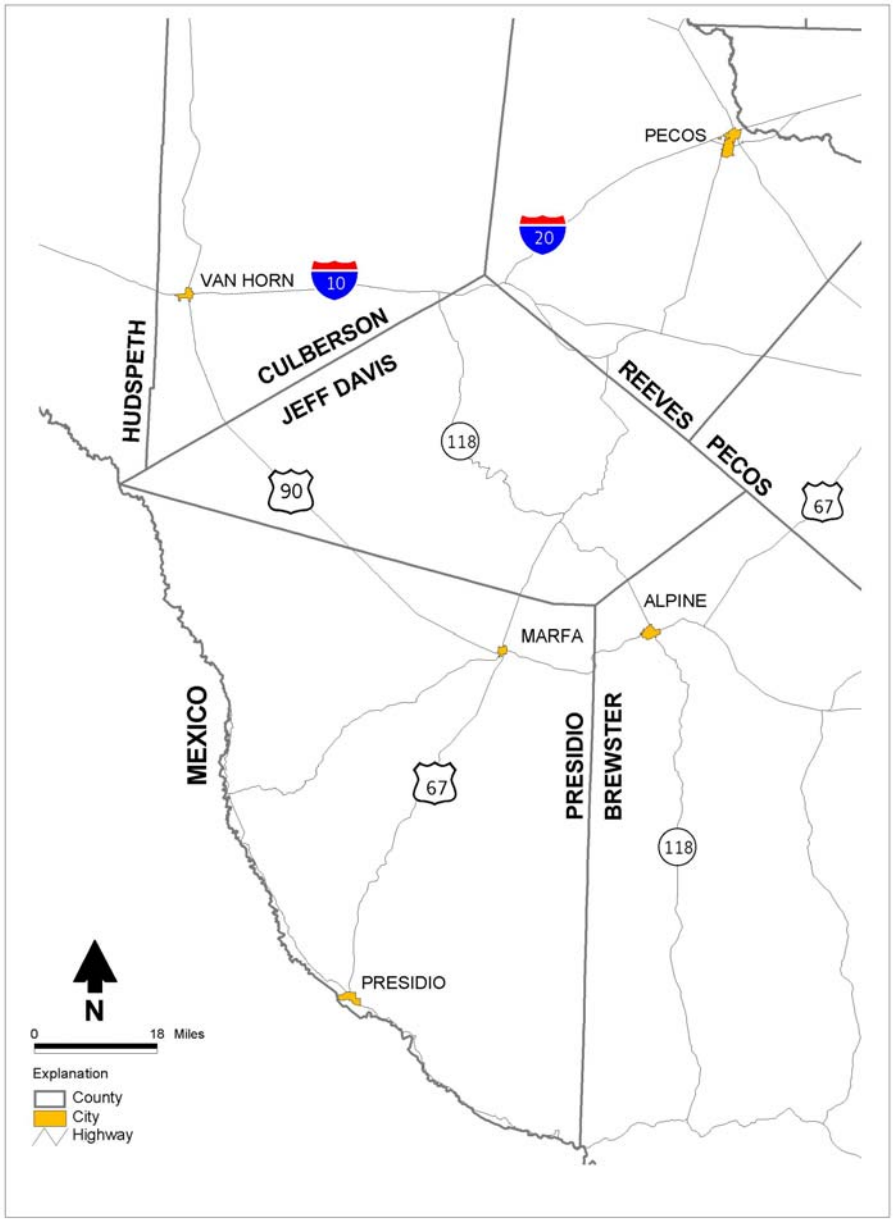
West Texas Igneous and Bolson GAM Team

- LBG-Guyton Associates
  - Water Prospecting and Resource Consulting, LLC
  - John Shomaker & Associates, Inc.
  - Daniel B. Stephens & Associates, Inc.
  - Senior Technical Advisors
    - Kevin Urbanczyk, Ph.D., Sul Ross State University
    - Jack Sharp, Ph.D., University of Texas at Austin

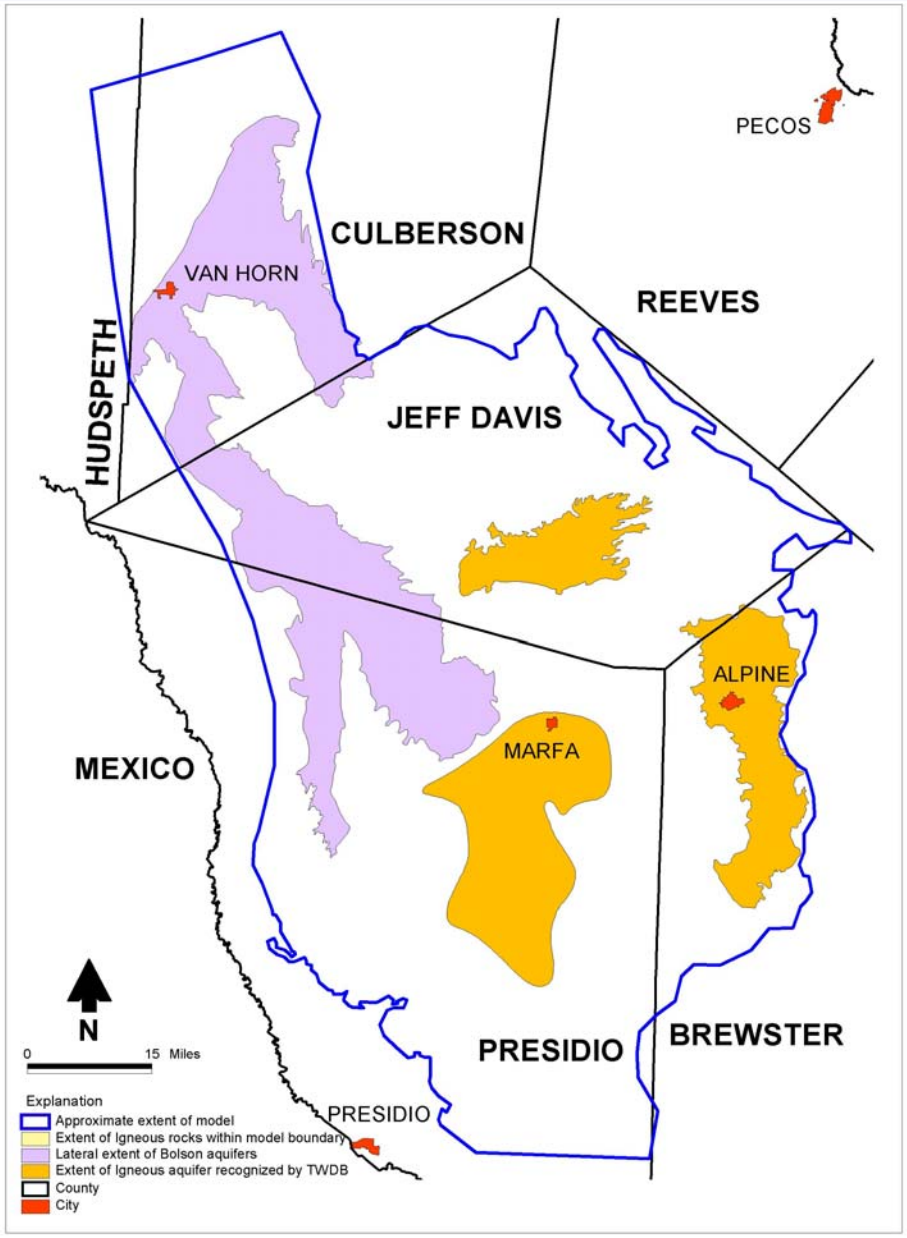
Agenda

- quick review of previous work on project
- status of data collection and assimilation associated with the project,
- status of pump tests being performed for the GAM effort,
- hydrogeologic cross-sections developed from existing data,
- conceptual model
- model boundaries

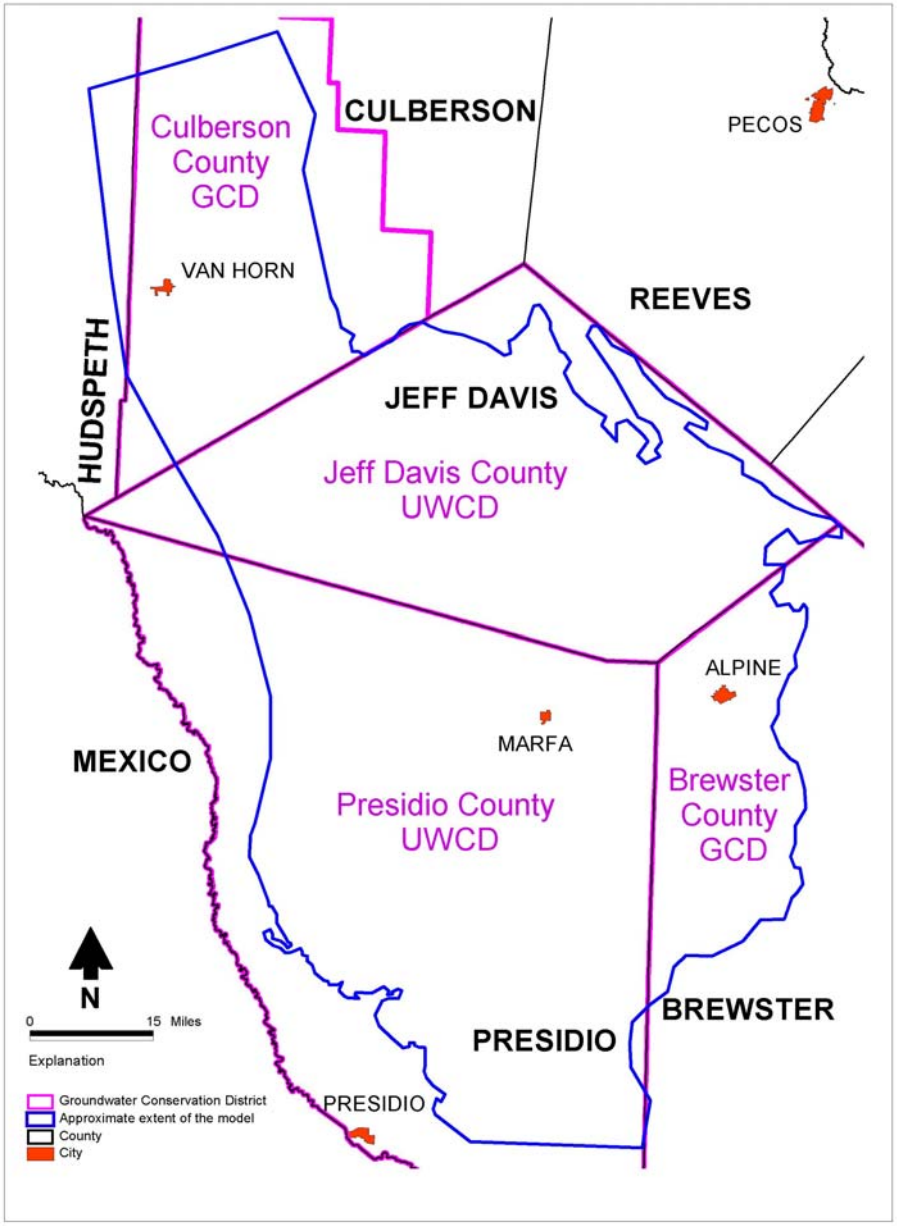
Review – General Study Area



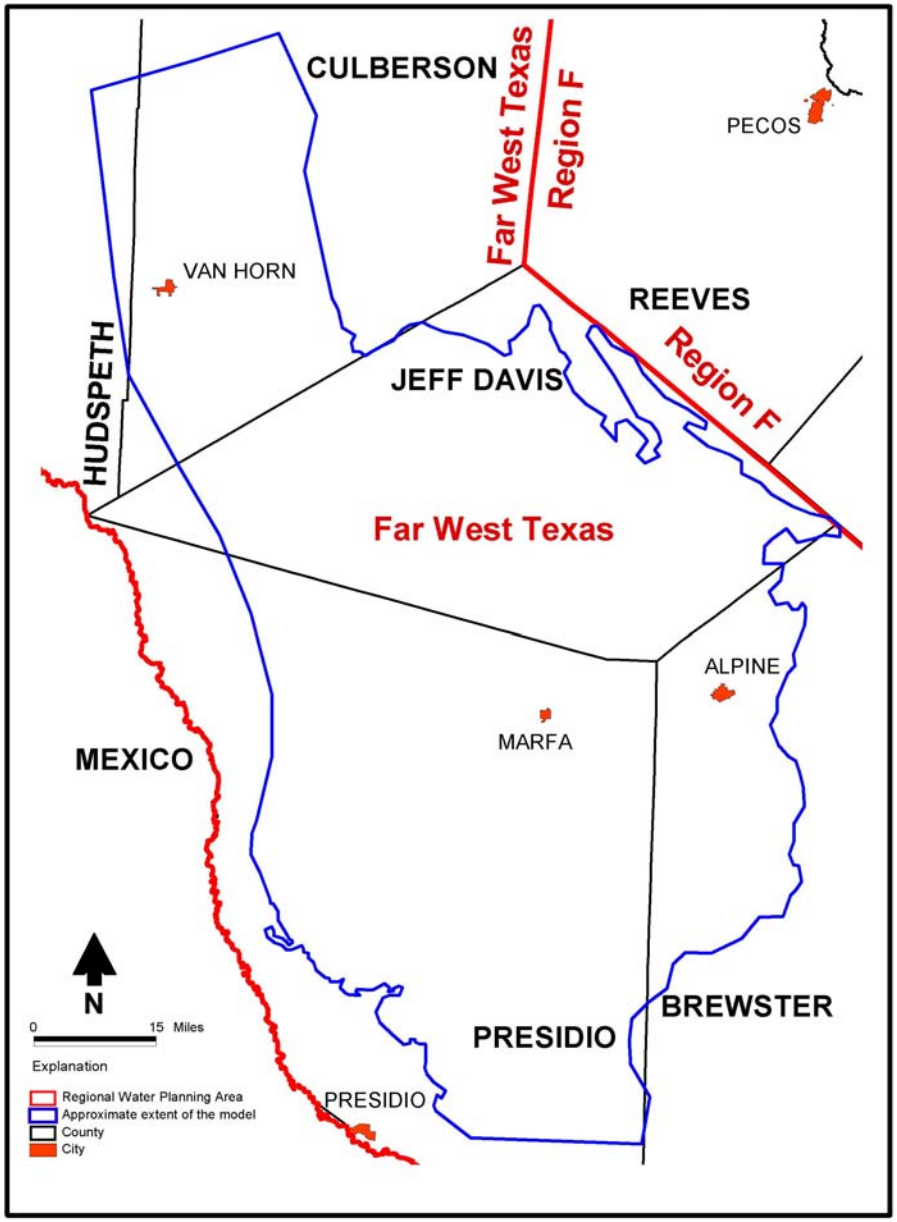
TWDB Aquifer Outlines



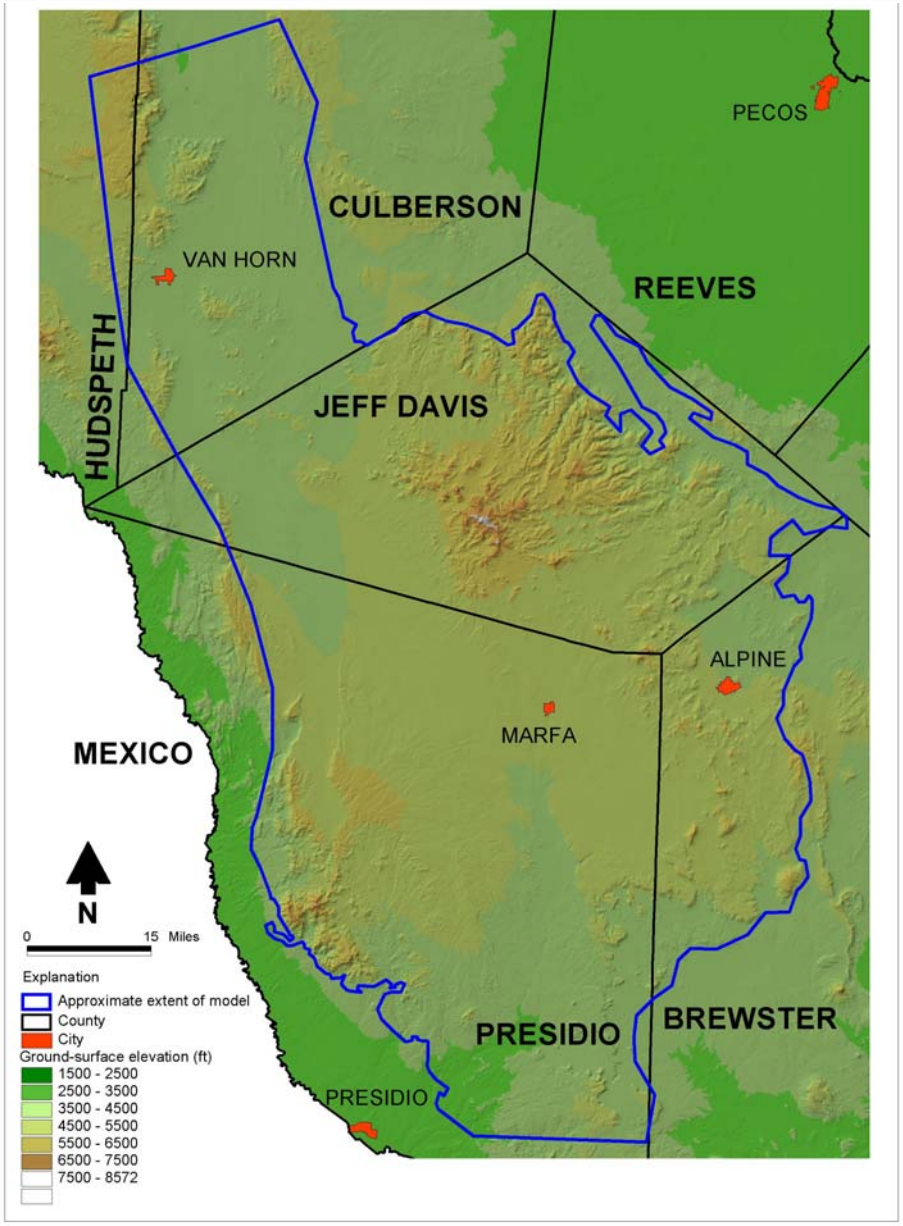
GCD Boundaries



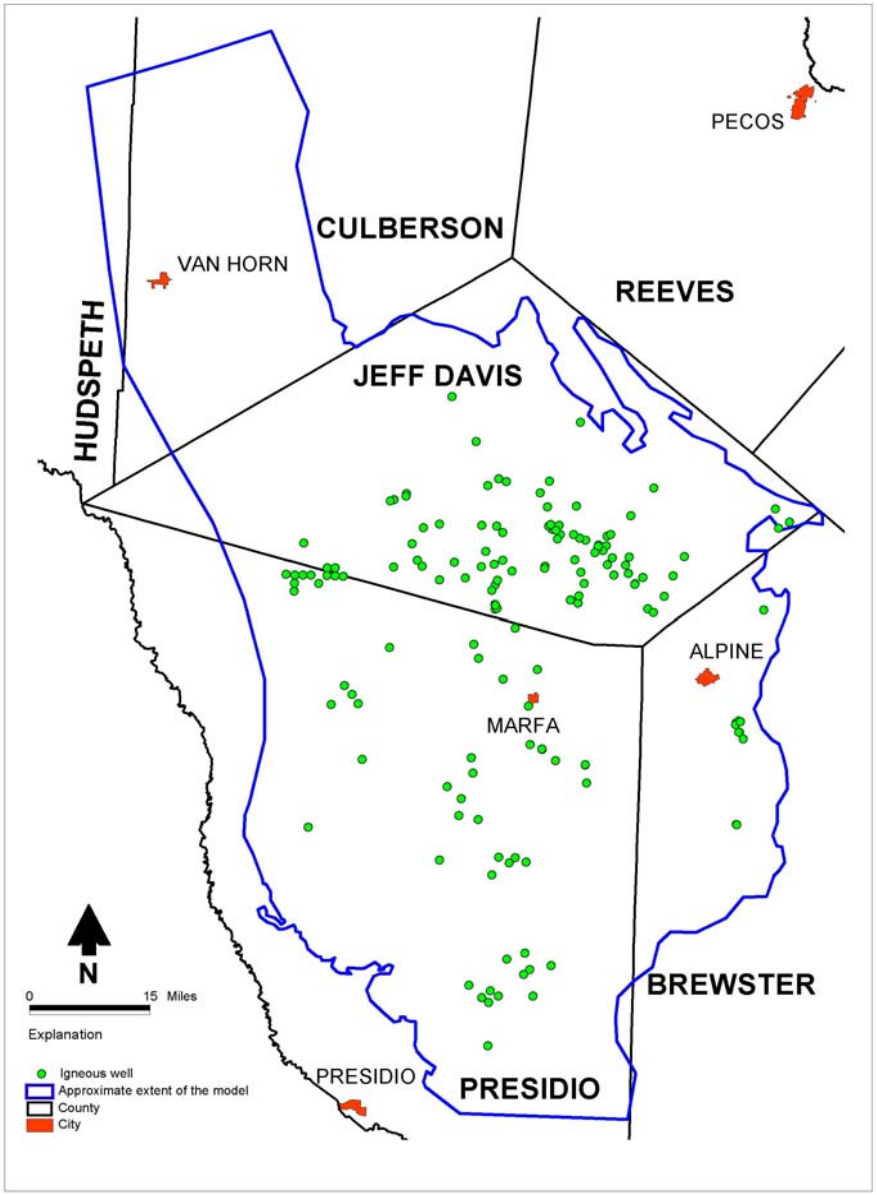
RWPG boundaries



Topography

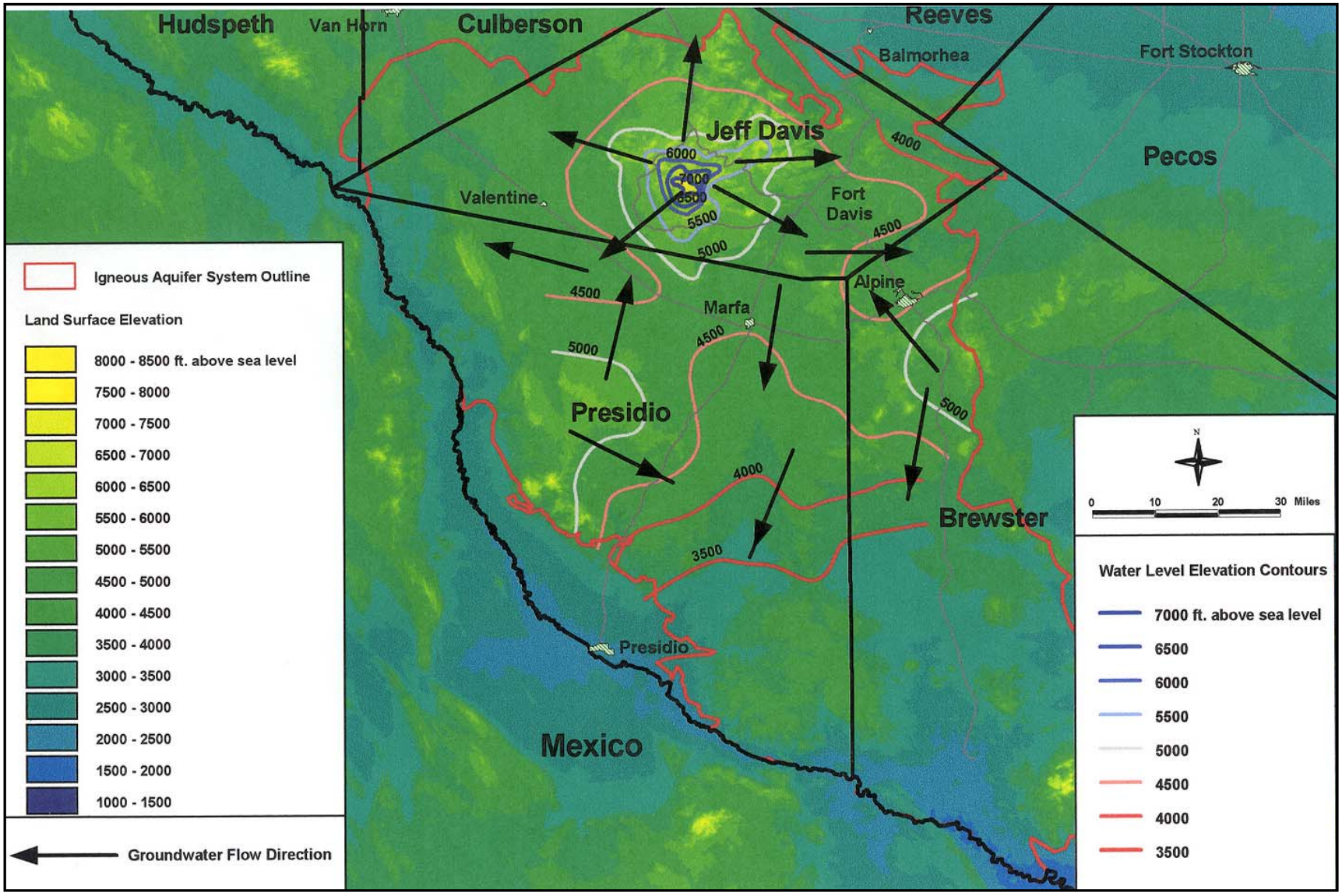

PECOS
CULBERSON
VAN HORN
REEVES
HUDSPETH
JEFF DAVIS
ALPINE
MARFA
MEXICO
N
0
15 Miles
Explanation
Approximate extent of model
County
City
Ground-surface elevation (ft)
1500 - 2500
2500 - 3500
3500 - 4500
4500 - 5500
5500 - 6500
6500 - 7500
7500 - 8572
PRESIDIO
BREWSTER
PRESIDIO

Igneous Aquifer Wells



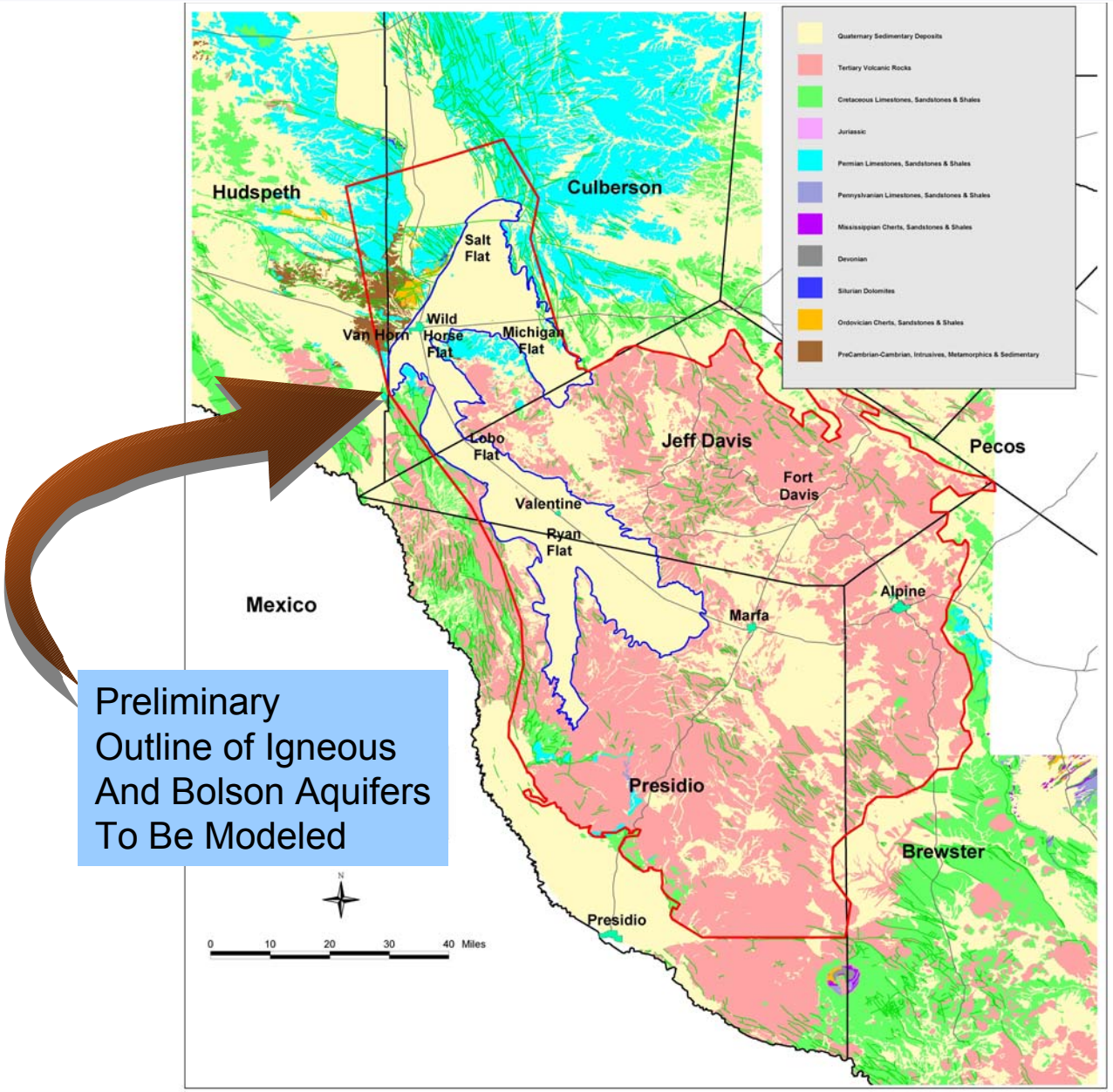
after LBG-Guyton (2001)

Igneous Aquifer Water Levels



from LBG-Guyton (2001)

Geology

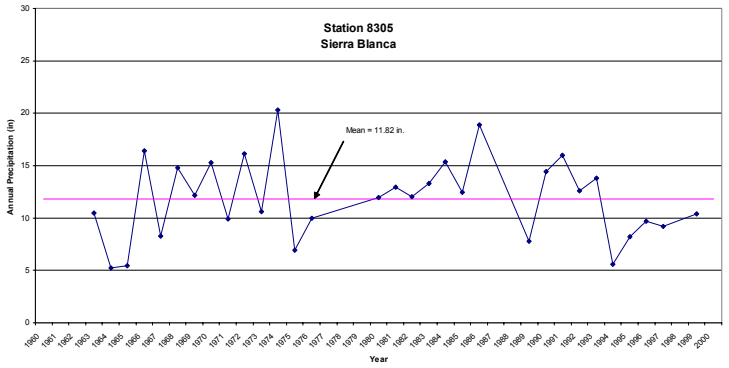


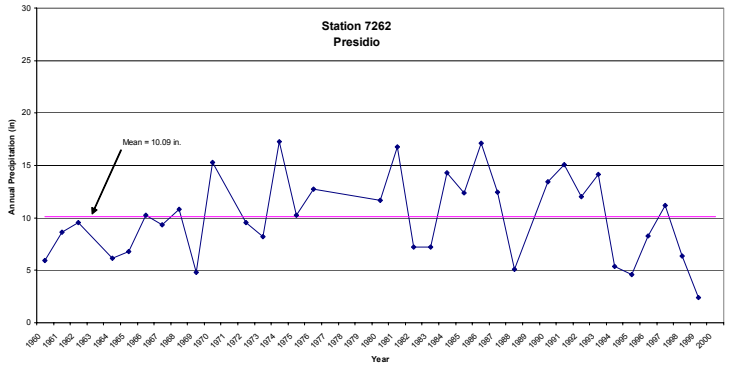
Preliminary Outline of Igneous And Bolson Aquifers To Be Modeled

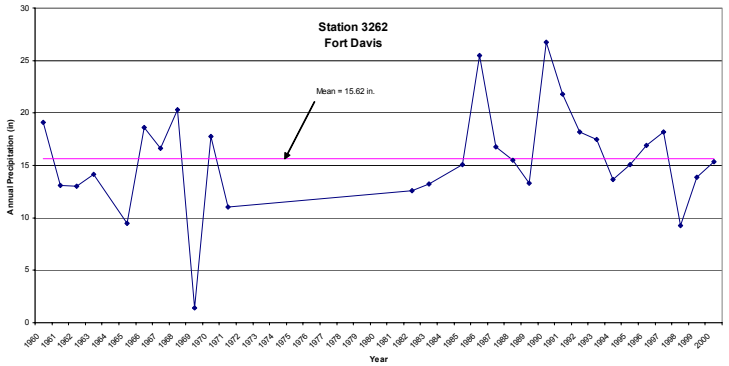
Summary of Data Compilation

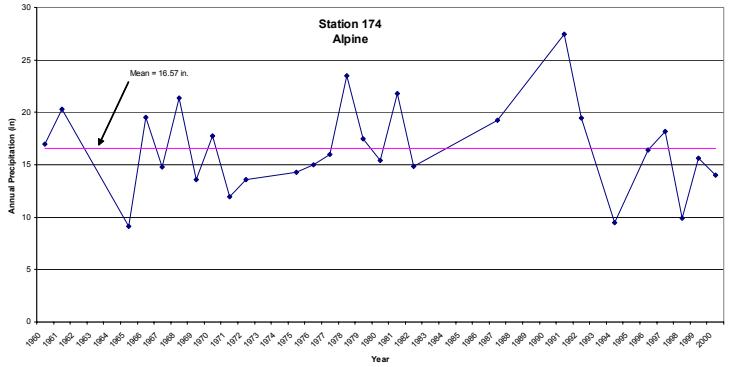
- Physiography and Climate
- Geology, Hydrostratigraphy, Structure
- Water Levels and Groundwater Flow
- Recharge
- Rivers, Streams, Springs, and Lakes
- Hydraulic Properties
- Discharge
- Water Quality

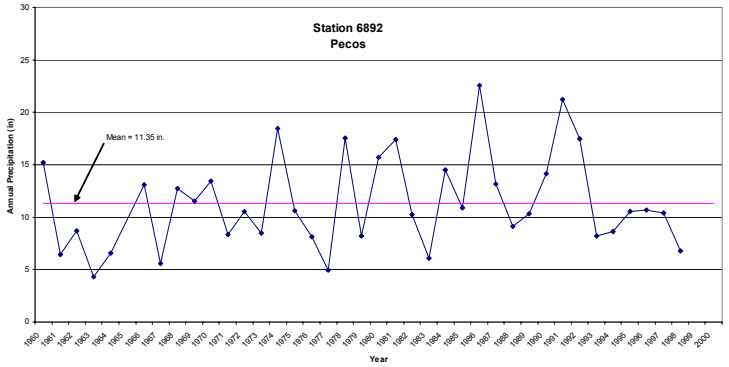
Precipitation

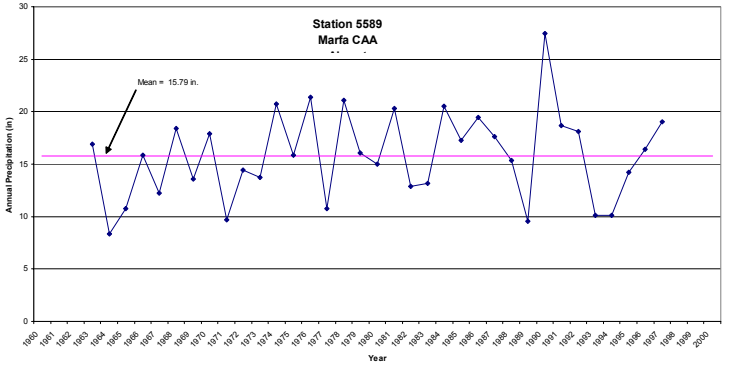




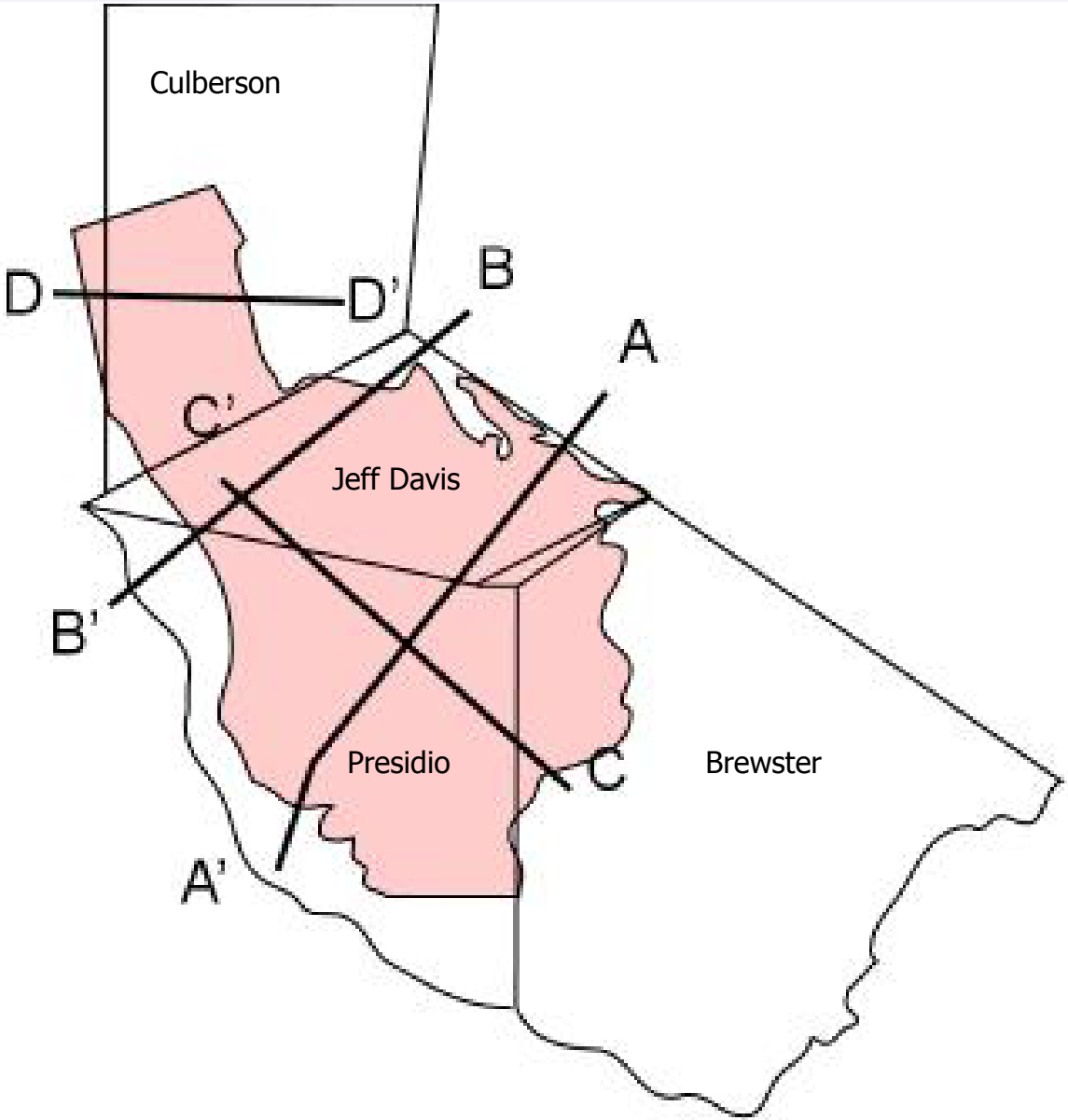




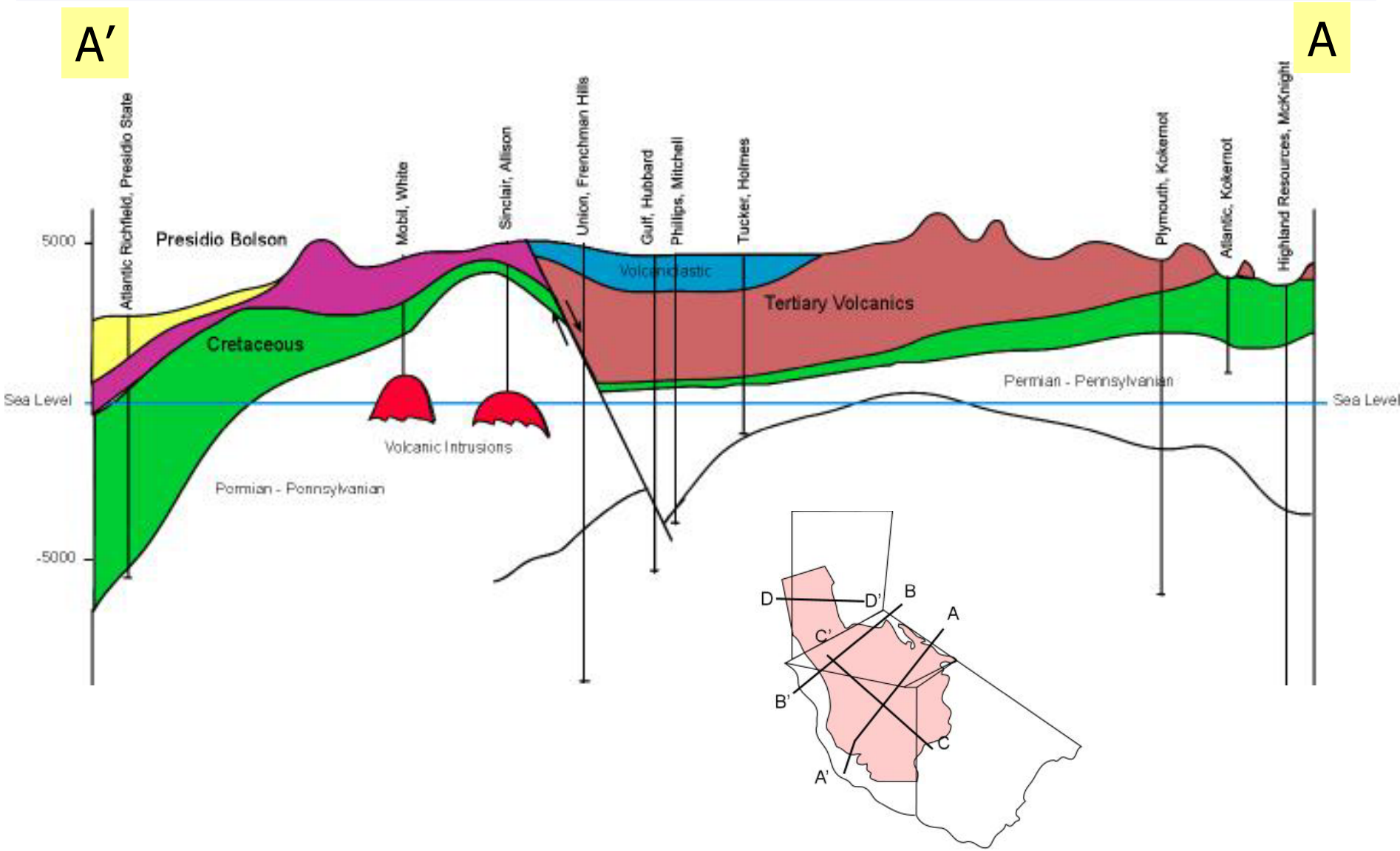




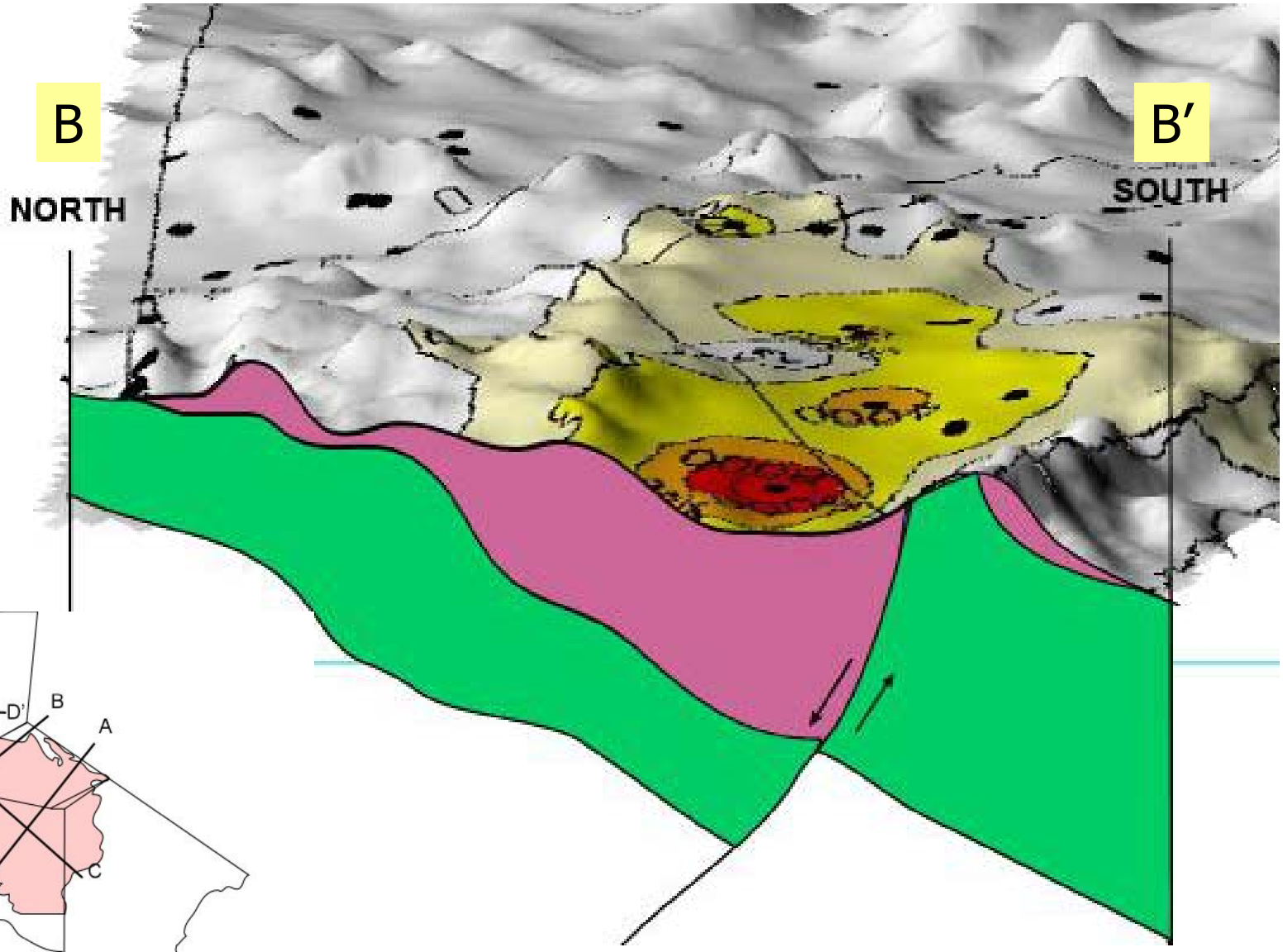
Igneous-Bolson Geologic Cross Sections



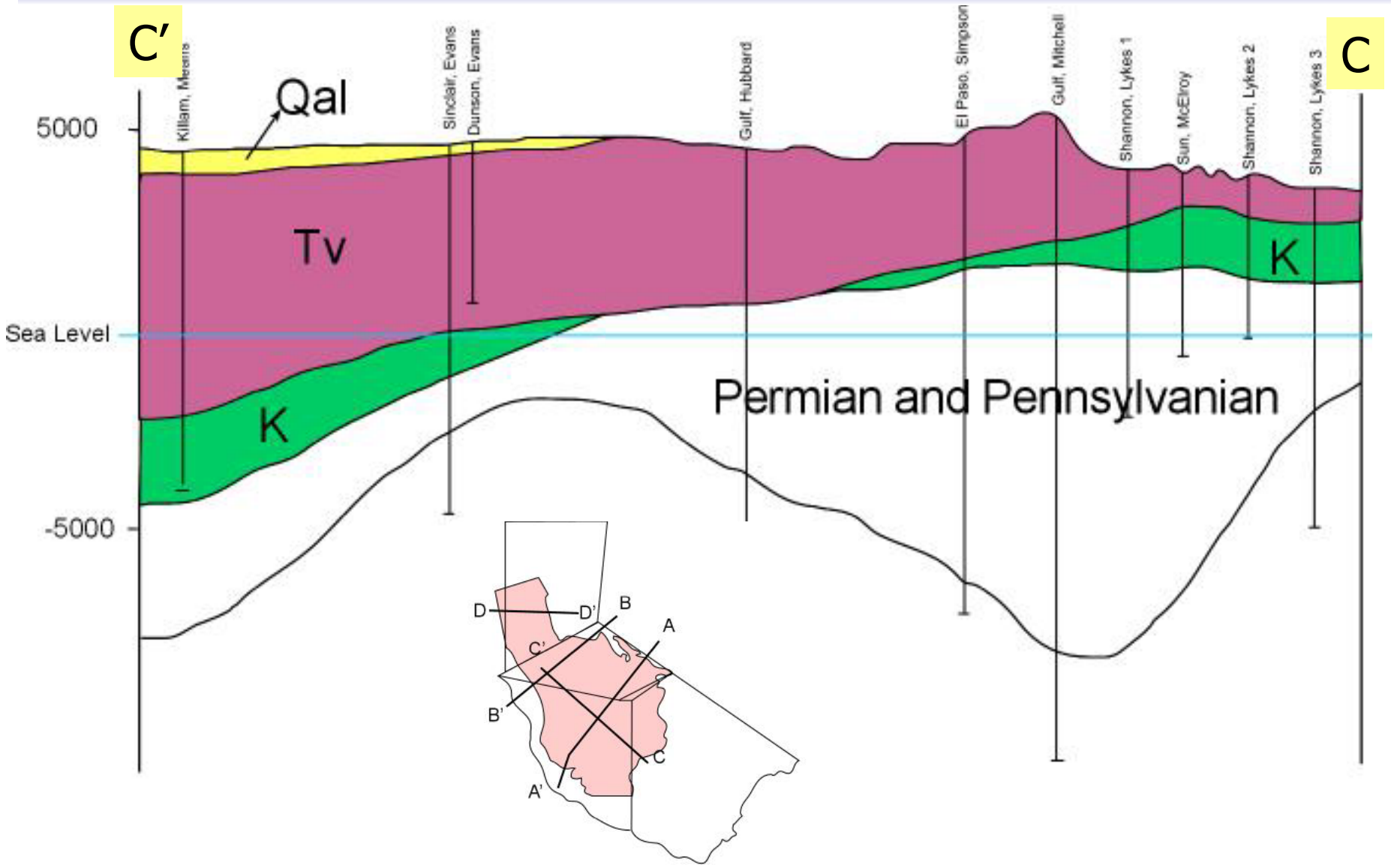
Geologic Cross-Section A-A’



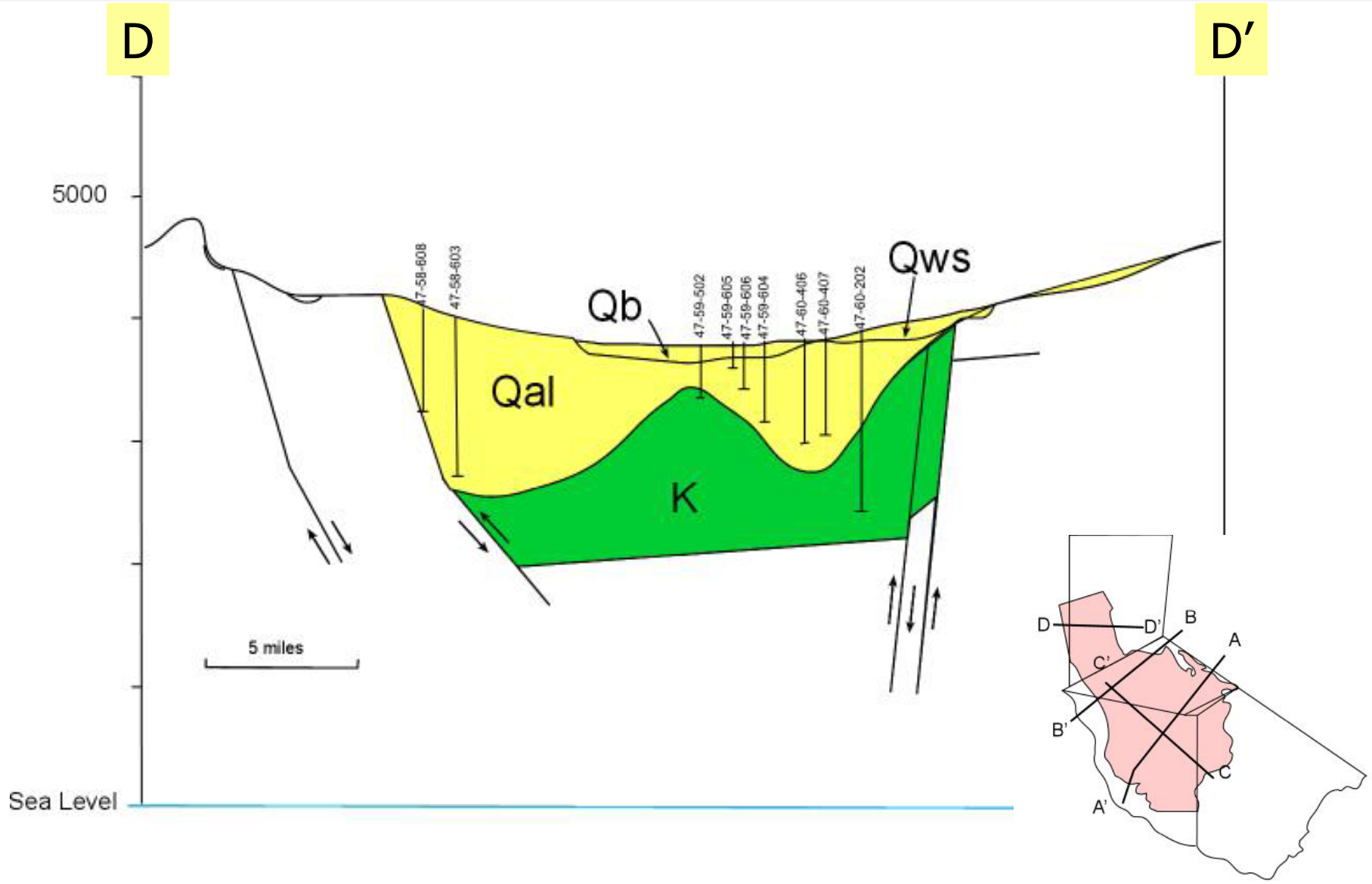
Geologic Cross-Section B-B′



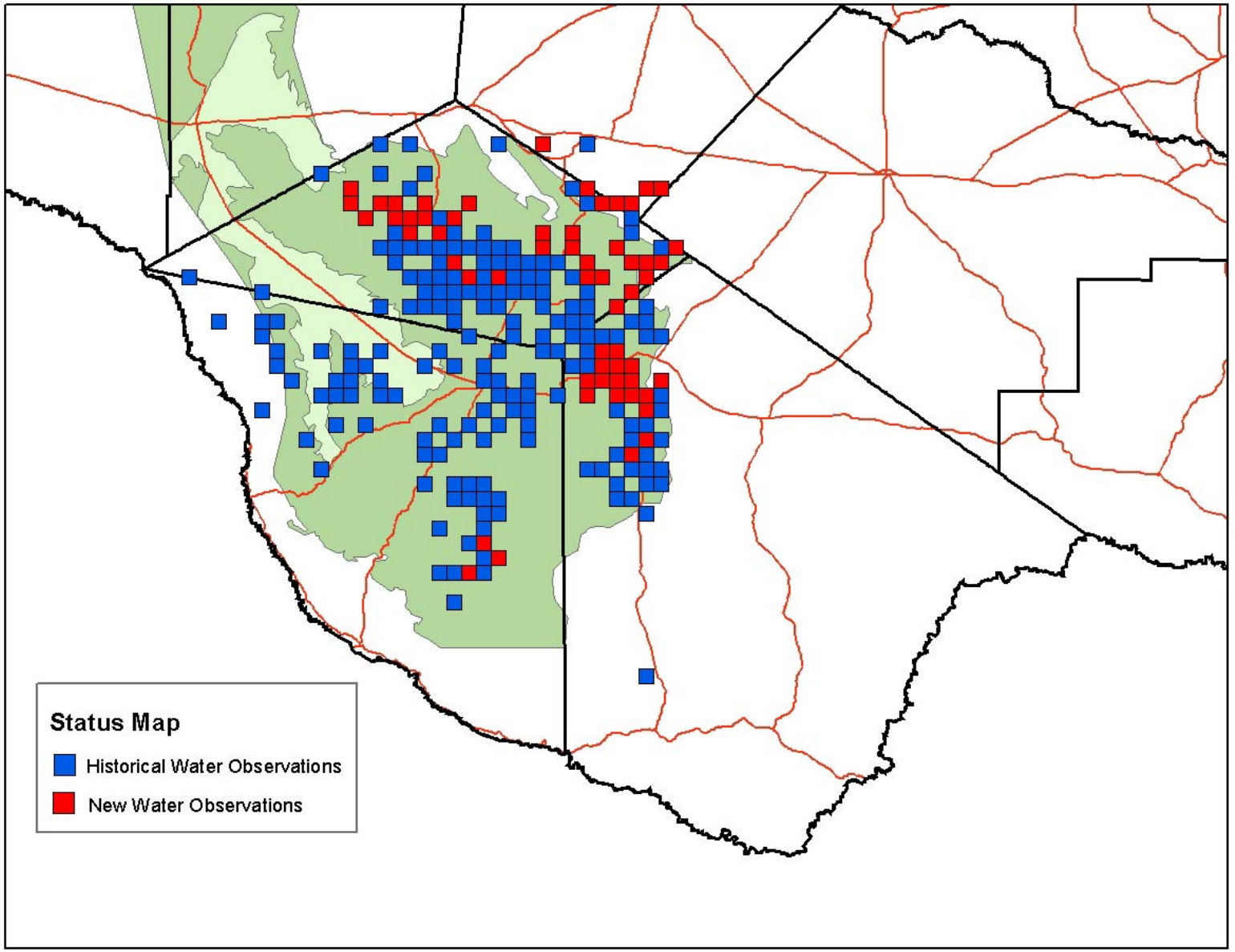
Geologic Cross-Section C-C’



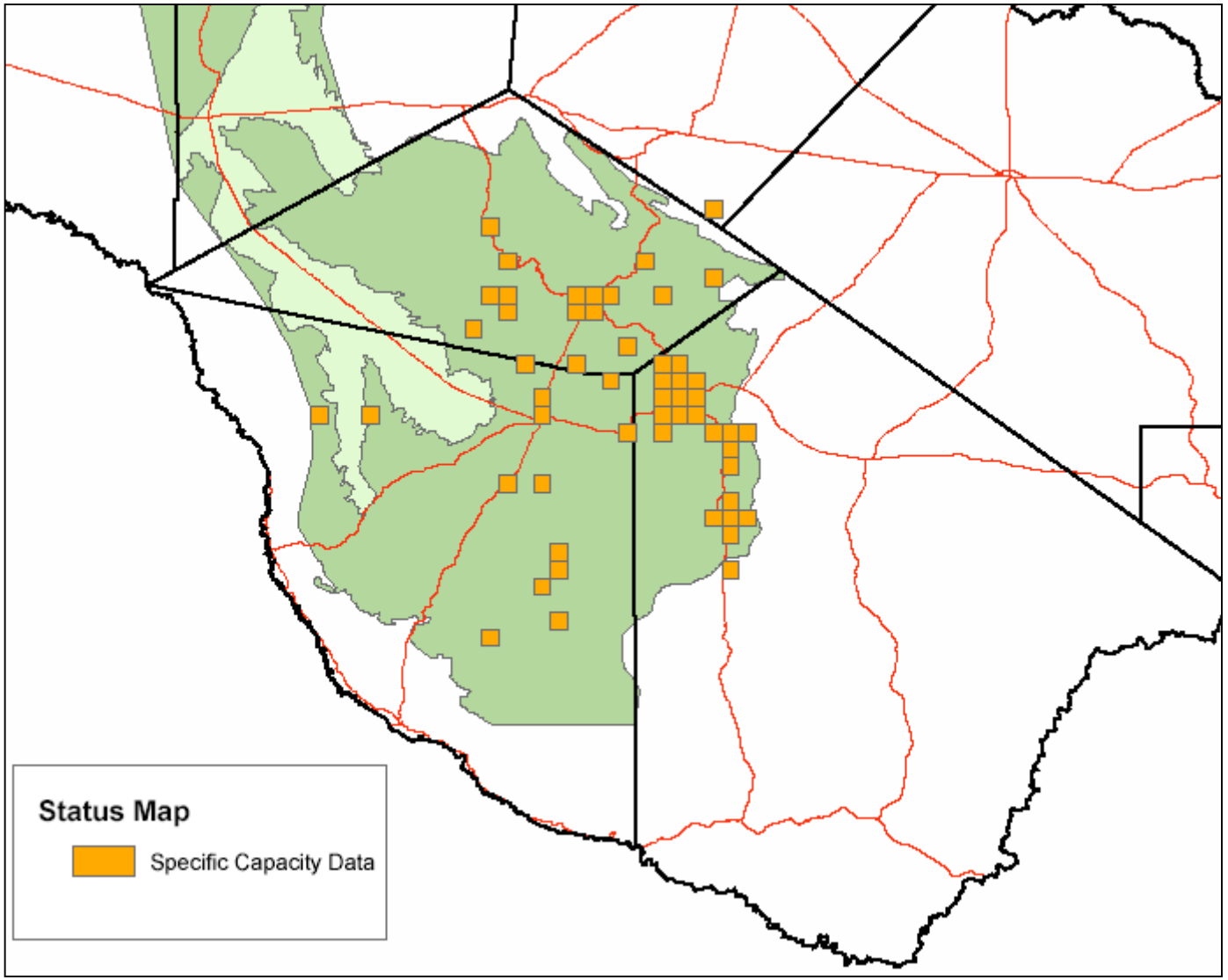
Geologic Cross-Section D-D’



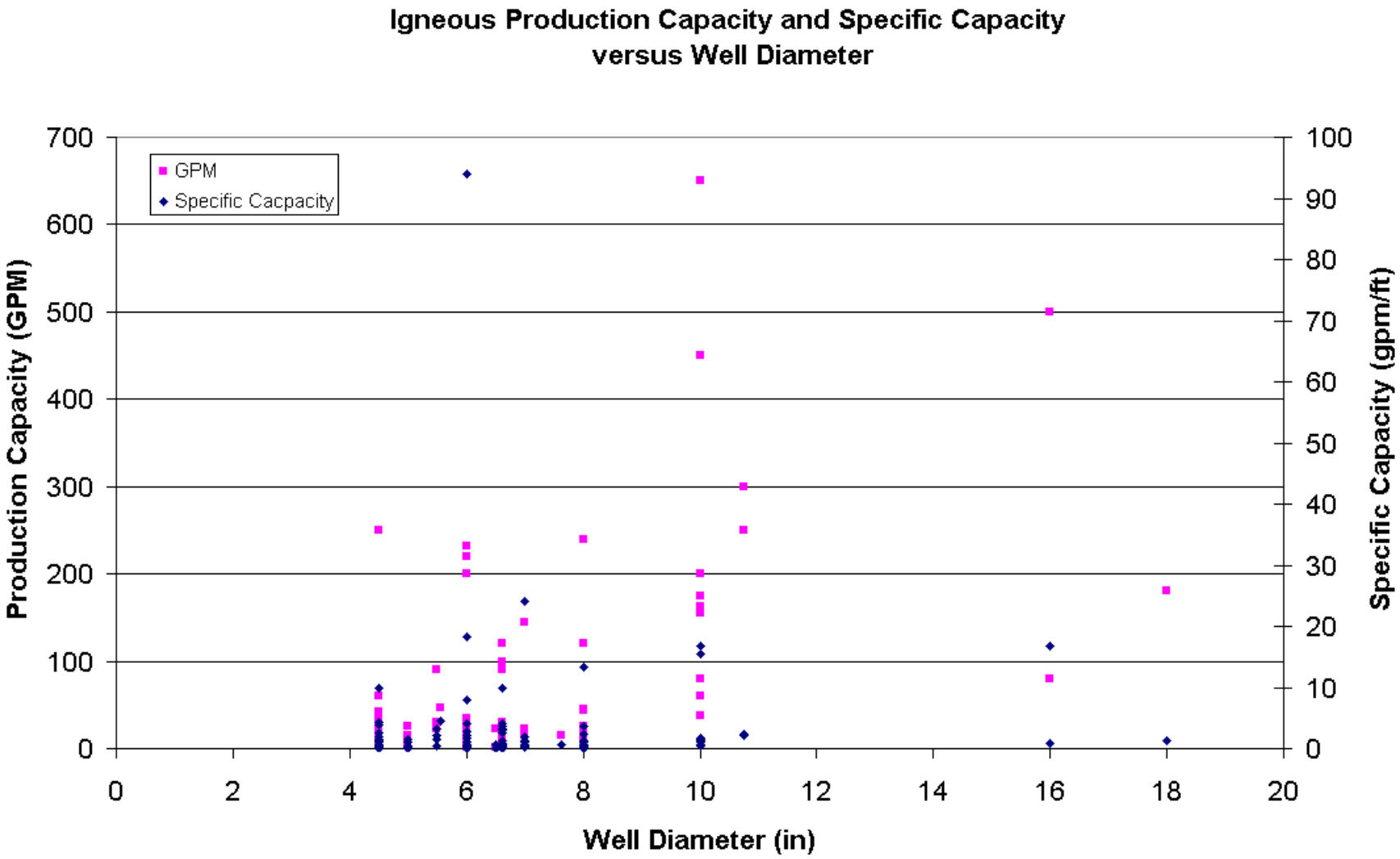
Igneous Water Levels



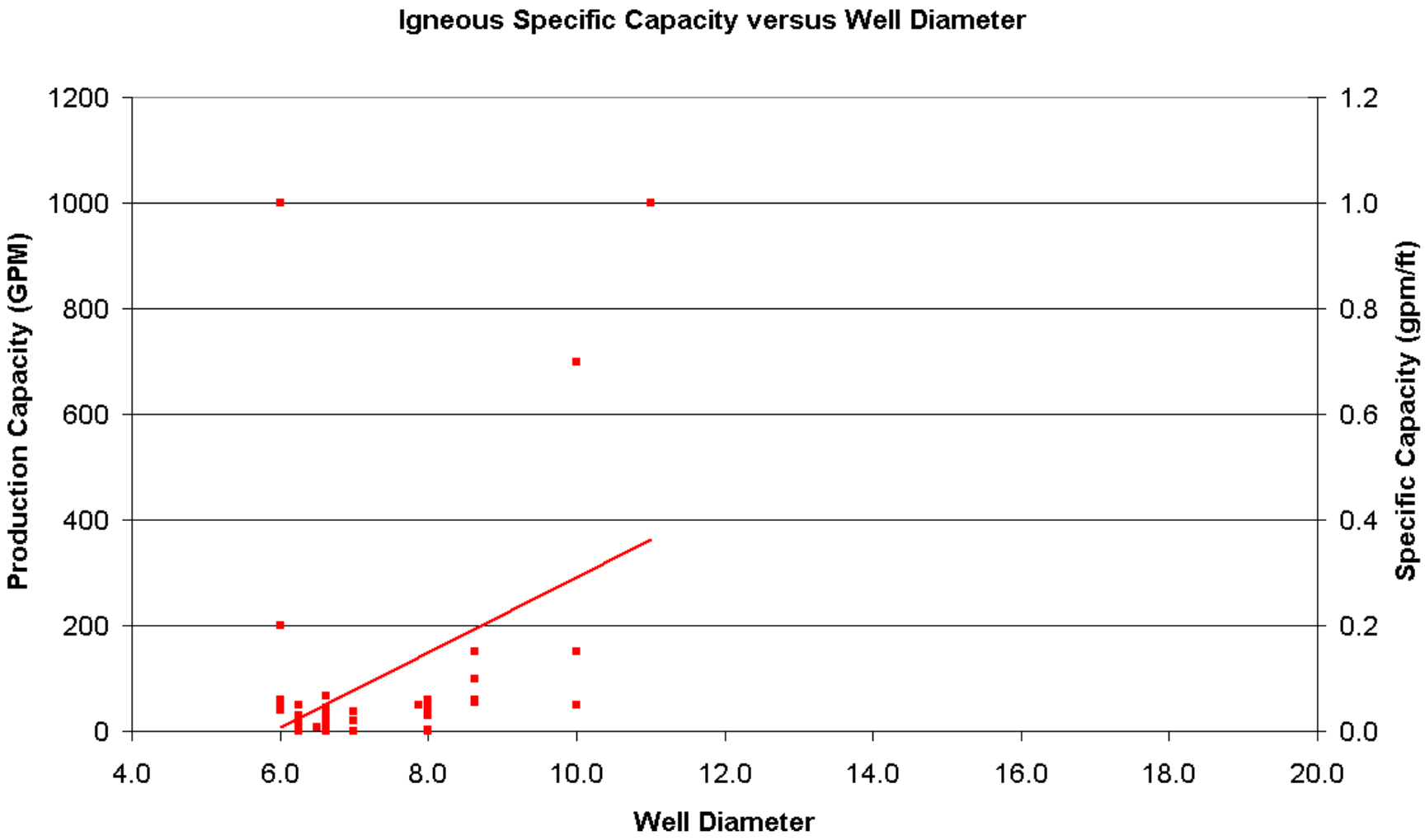
Igneous Hydraulic Properties



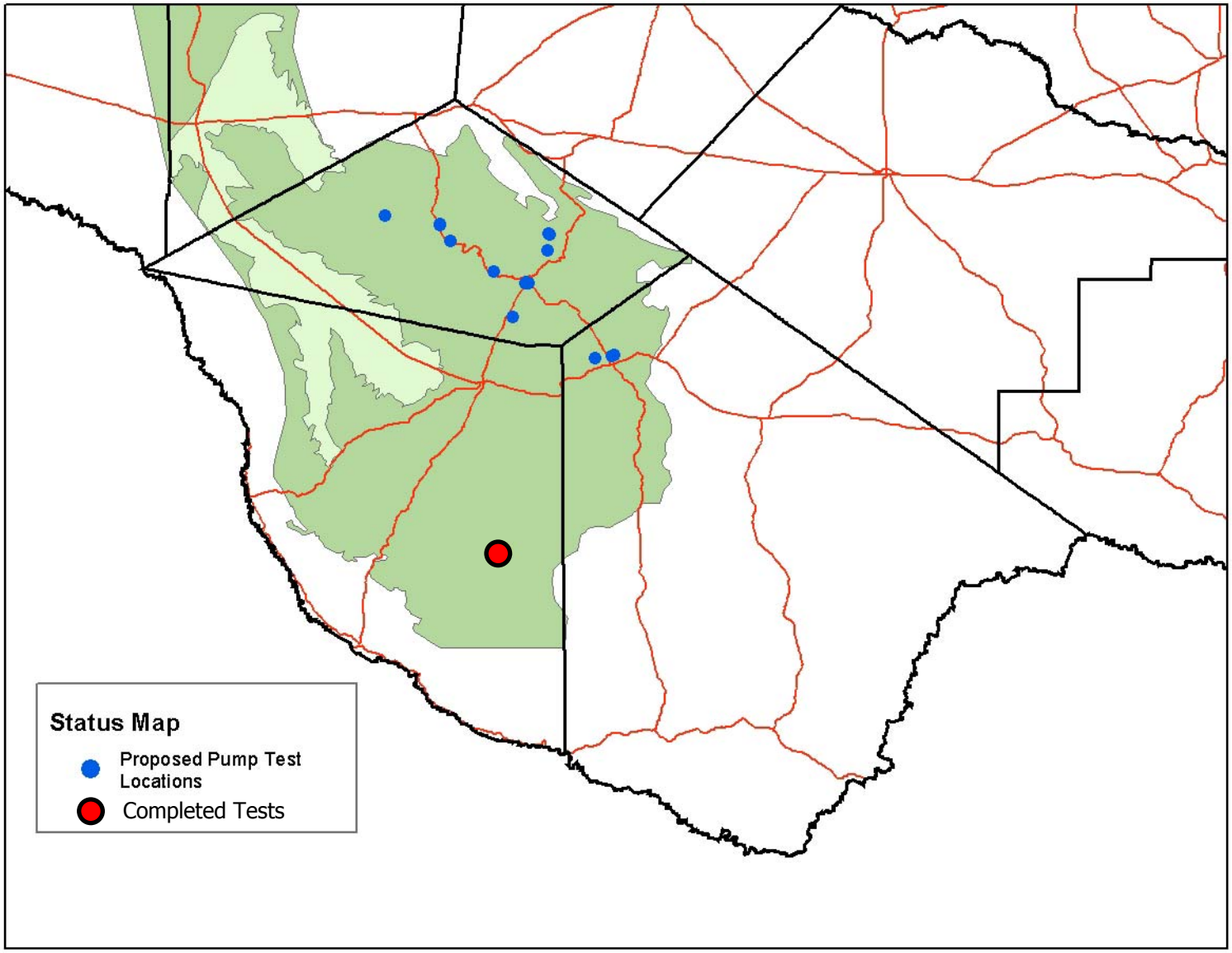
Igneous Hydraulic Properties



Igneous Hydraulic Properties



Pump Tests (sponsored by Region E RWPG)



Physiography of Model Area

Work completed to date

- Delineated watersheds for GAM area
- Performed detailed analysis of watershed characteristics
- Performed statistical analysis of precipitation data

Bolson Geology

Work completed to date

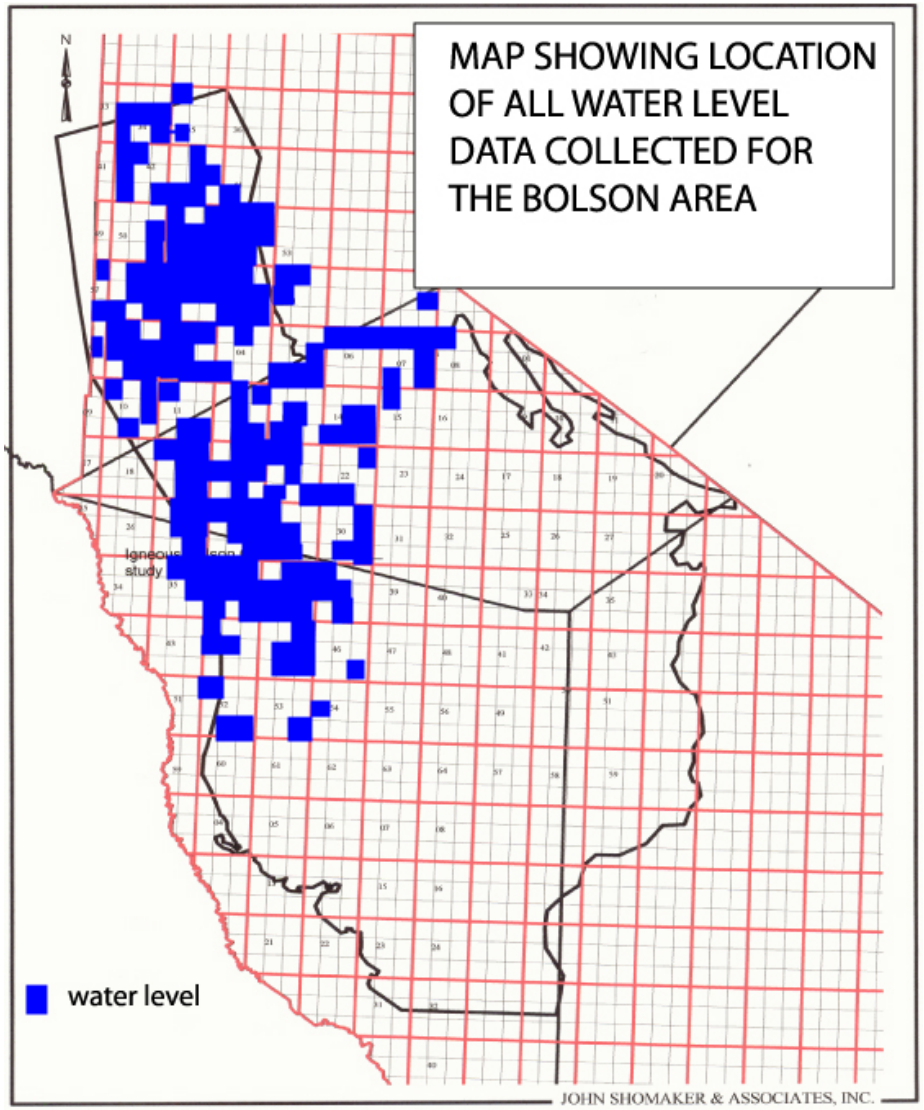
- Compilation of available geologic data into database
- Developed elevation contours for top of Cretaceous rocks beneath Wild Horse Flat
- Updated hydrogeologic cross-sections for the bolsons

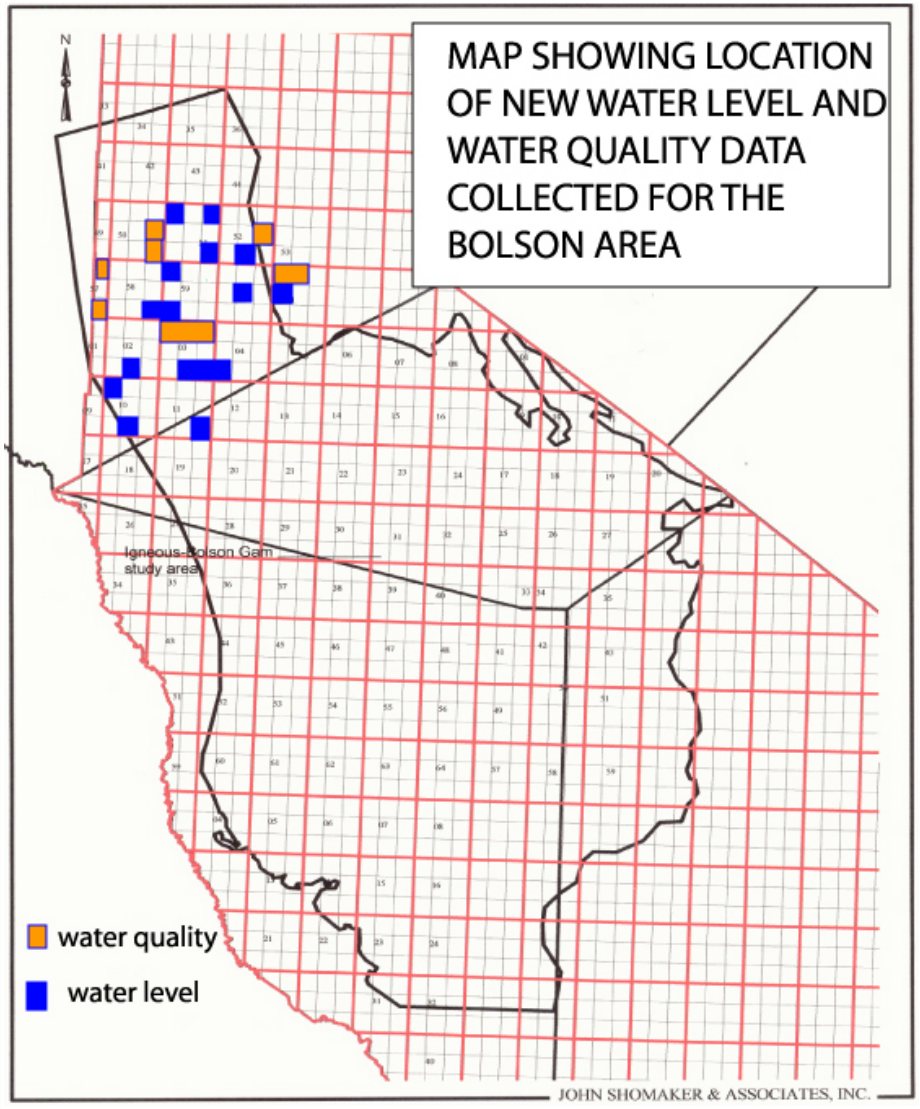
Bolson Water Levels and Quality

Work completed to date

- Data collection is 95% complete
- Visited 114 wells not in the TWDB database
- Measured water levels in 21 wells (filled previous data gaps)
- Measured specific conductance in 14 wells
- Additional well reports compiled from TCEQ to support interpretation (80% complete)
- Water level database for Bolson is complete

Bolson Water Levels and Quality





Surface Water

Work completed to date

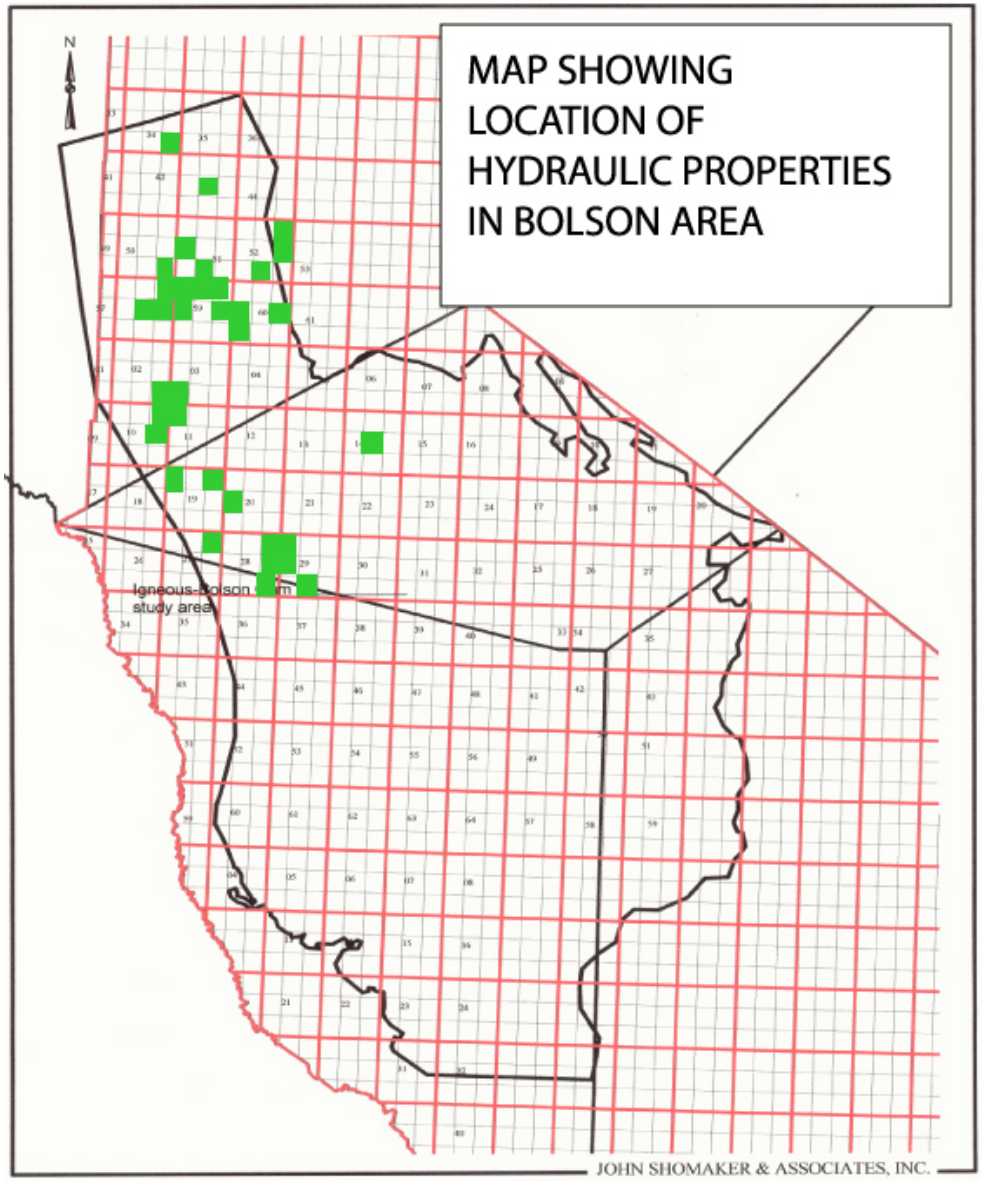
- Identified all springs in Bolson area and tabulated spring data
- Collected specific conductance measurements from selected springs
- Estimated runoff from watersheds as part of recharge study

Bolson Aquifer Characteristics

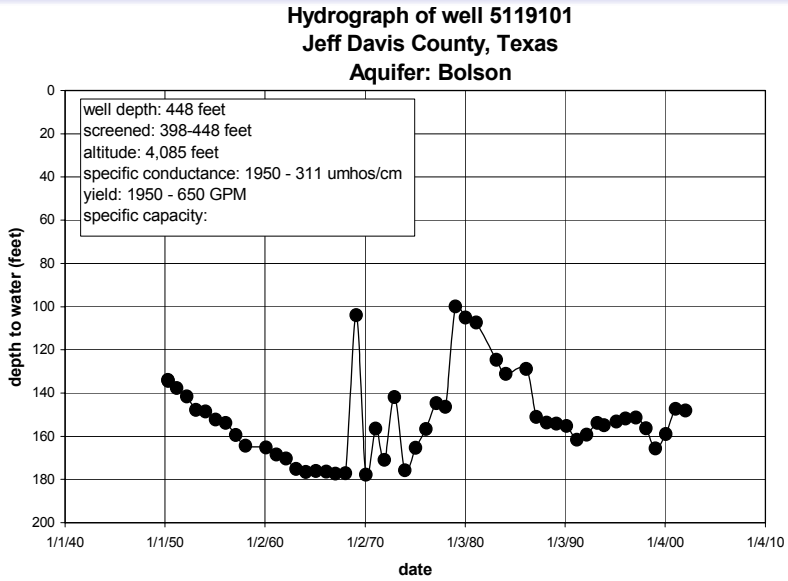
Work completed to date

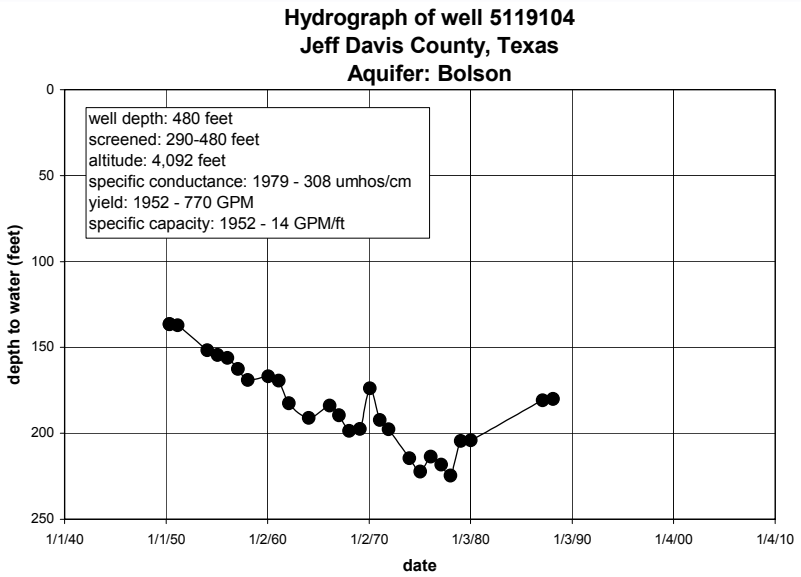
- Collected available specific capacity and pumping test data for the Bolson area
- Added aquifer characteristics data to geo-database, including well yield, water quality, specific capacity, and transmissivity

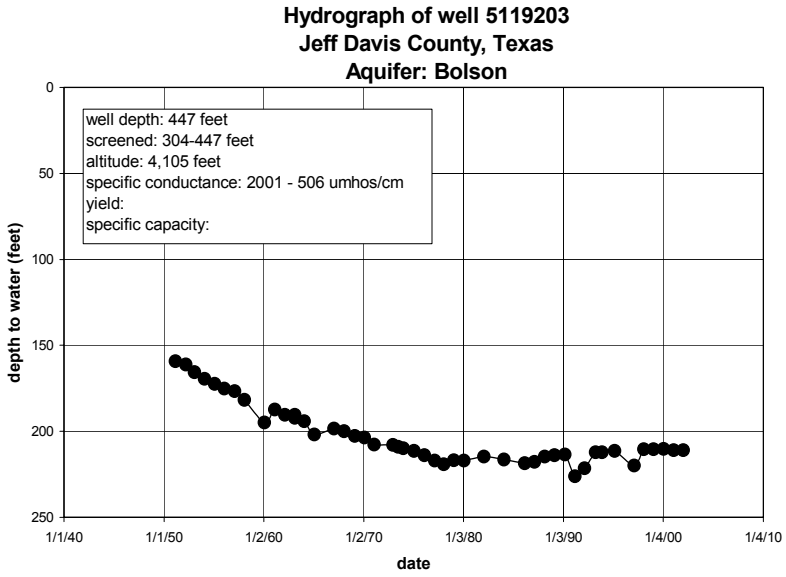
Bolson Aquifer Characteristics

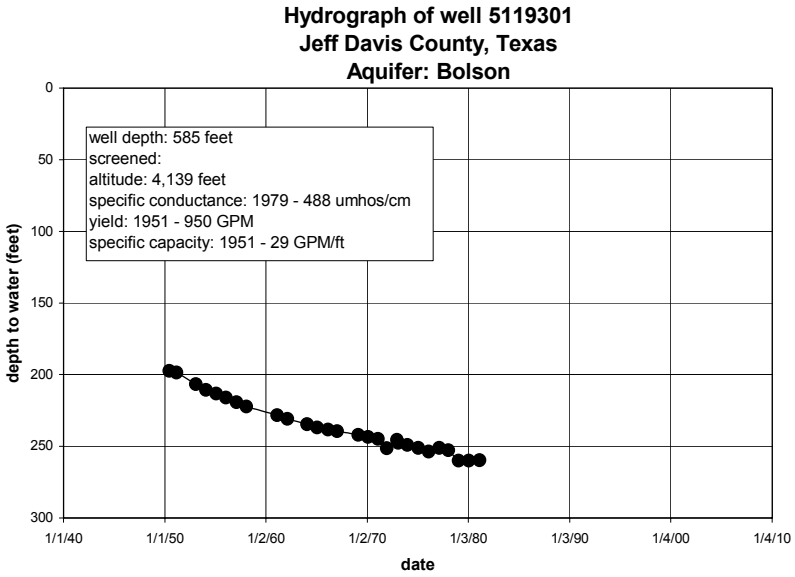


Bolson Hydrographs

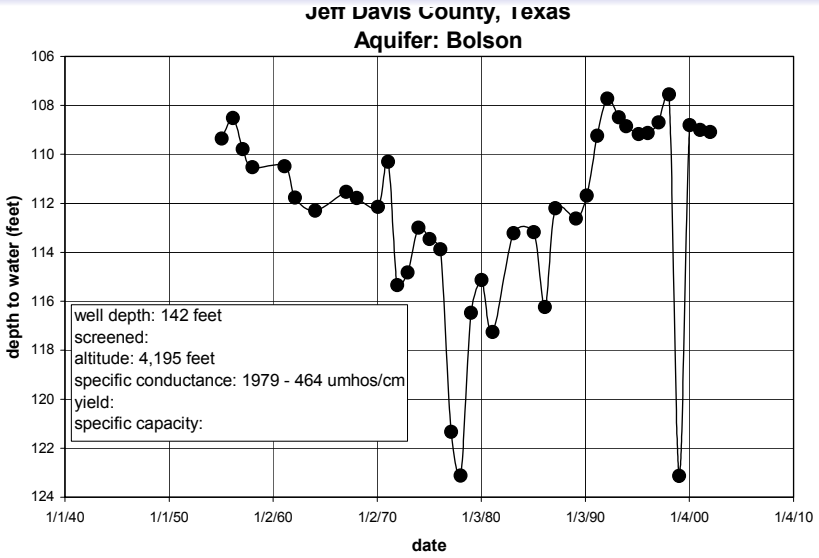


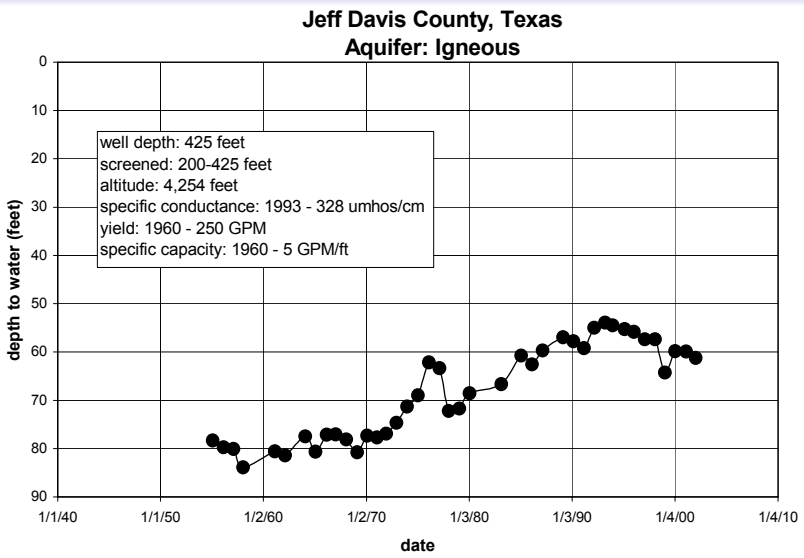


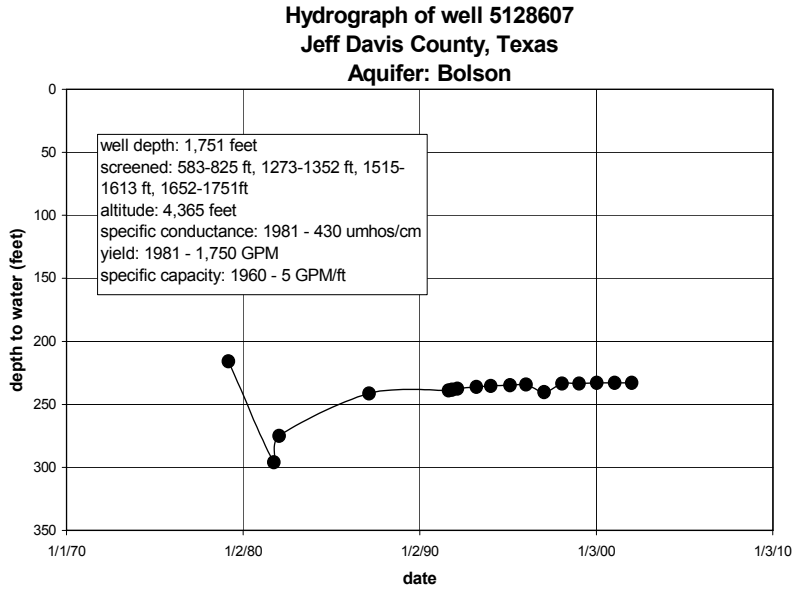


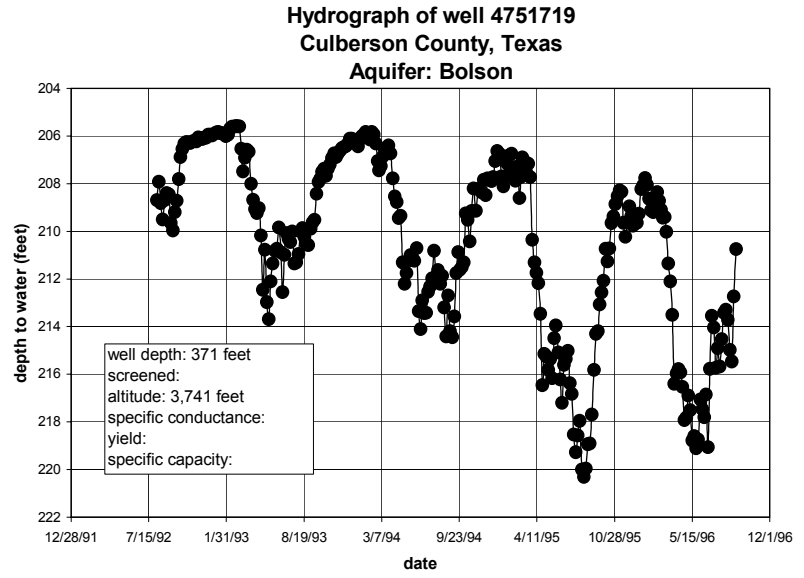


Bolson & Igneous Hydrographs









Recharge Methodology

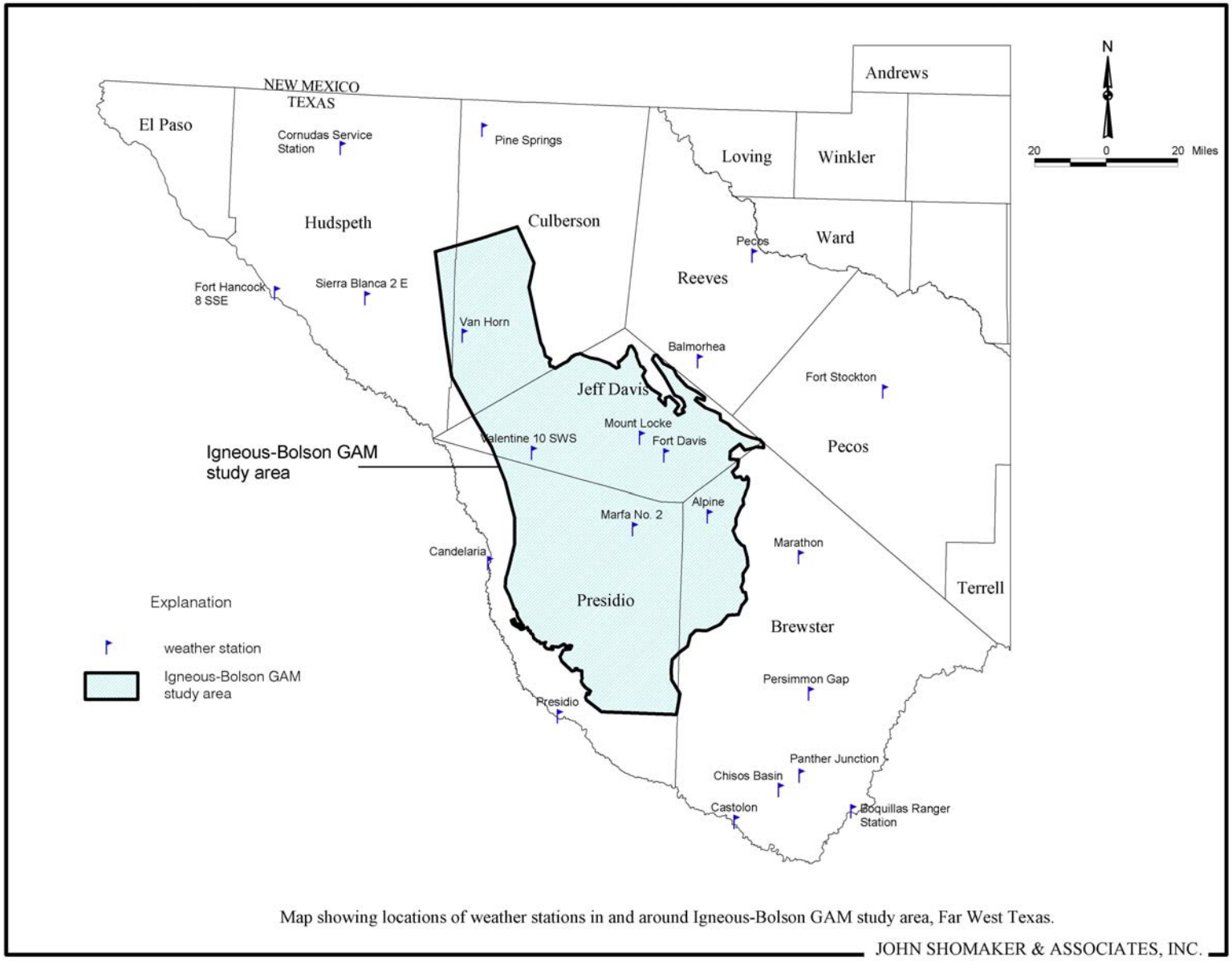
1. Delineate sub-basins within the study area, and their hydrologic characteristics
2. Calculate topographic statistics for the sub-basins
3. Estimate potential recharge (corrected for elevation zones and evaporation) for each sub-basin
4. Analyze the magnitude of precipitation events that result in runoff
5. Determine which sub-basins receive runoff (redistribution) and estimate recharge

Recharge Methodology Data

For each basin - define

1. sub-basins
2. sub-basin type (mountain or bolson)
3. geology
4. hydrologic soil group (A, B, C, or D)
5. curve number
6. curve number (dry conditions)
7. weather station
8. initial abstraction, (dry conditions)

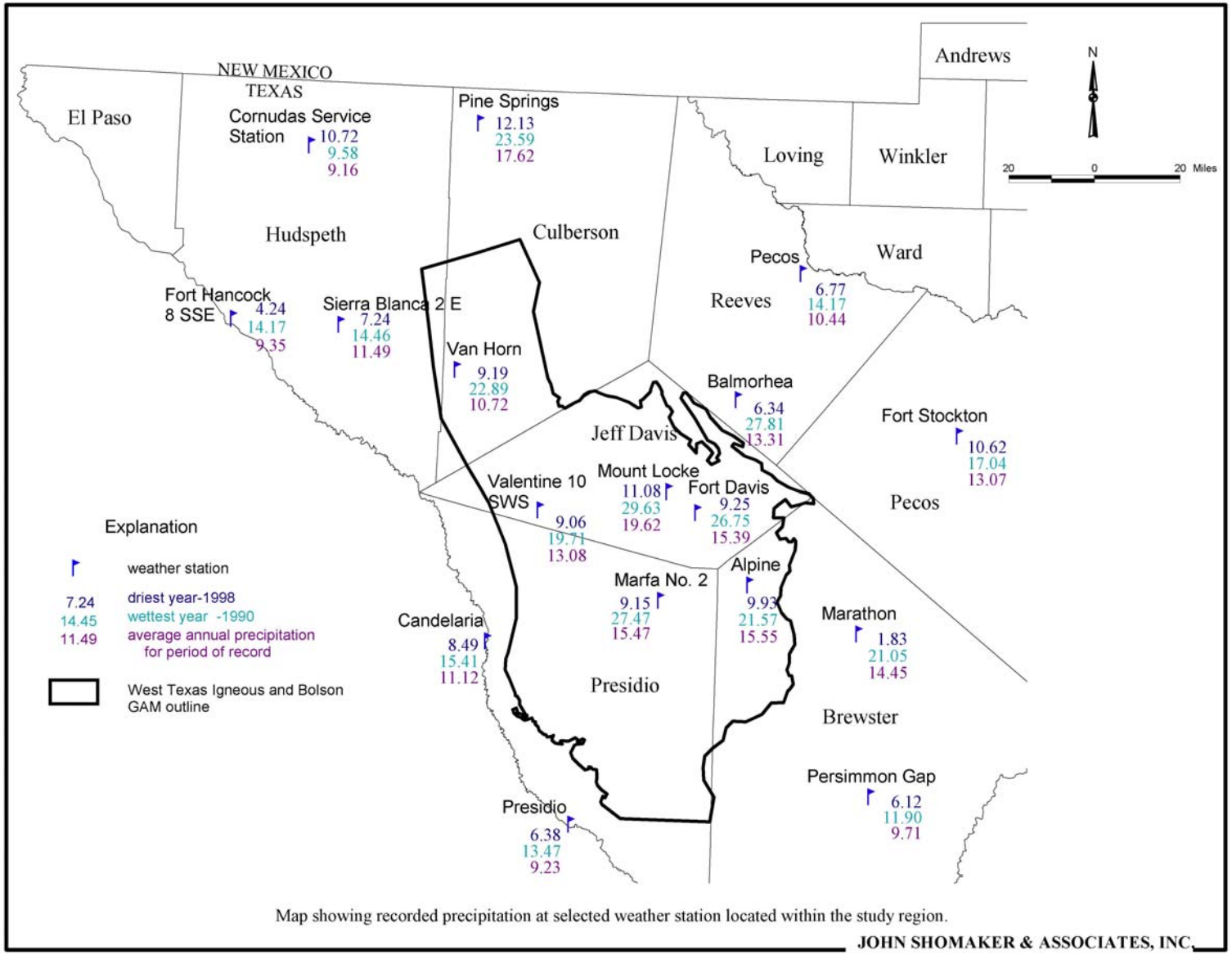
Precipitation Gages in GAM Area



Map showing locations of weather stations in and around Igneous-Bolson GAM study area, Far West Texas.

JOHN SHOMAKER & ASSOCIATES, INC.

Precipitation Data in GAM Area



Map showing recorded precipitation at selected weather station located within the study region.

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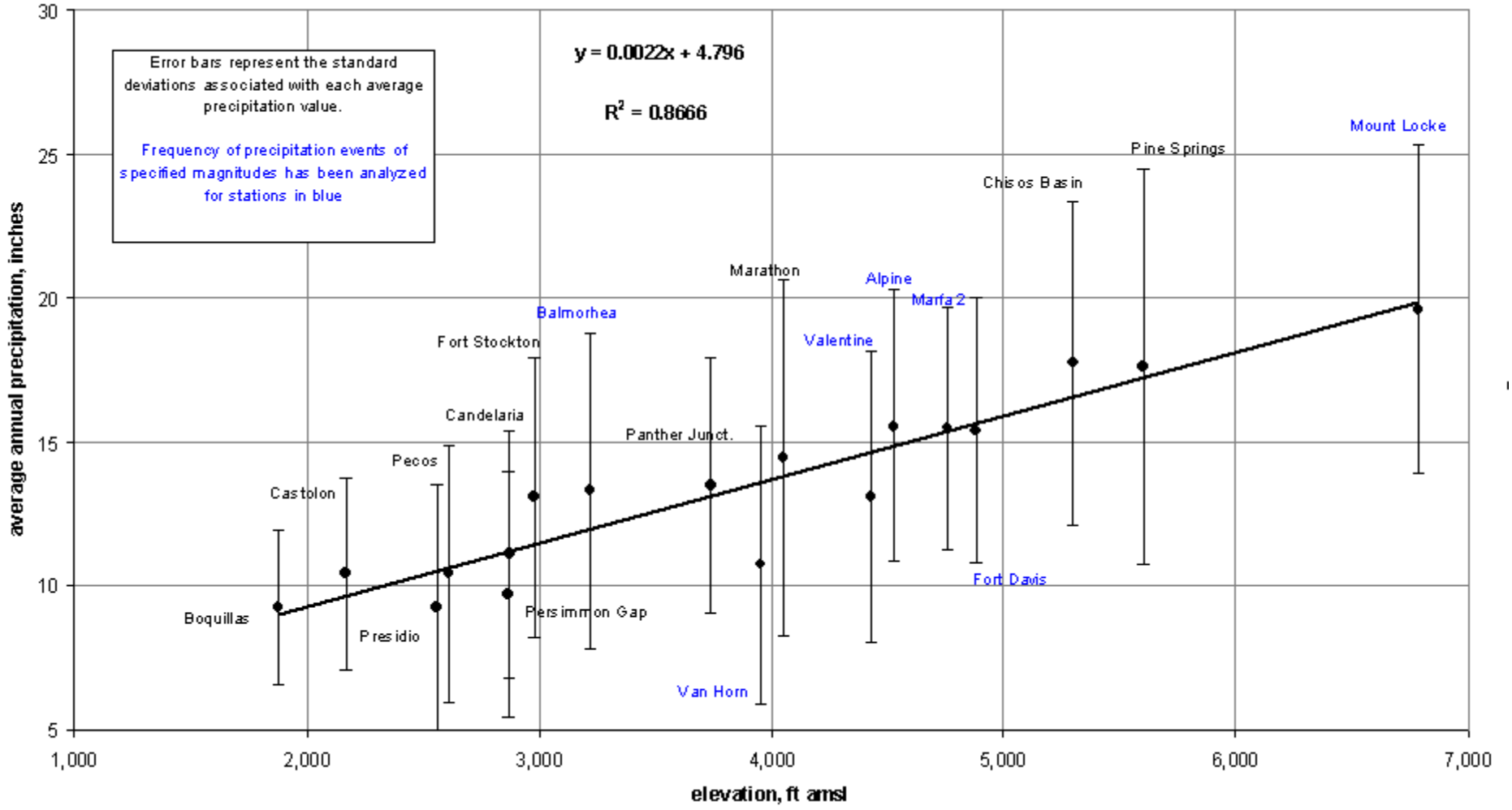
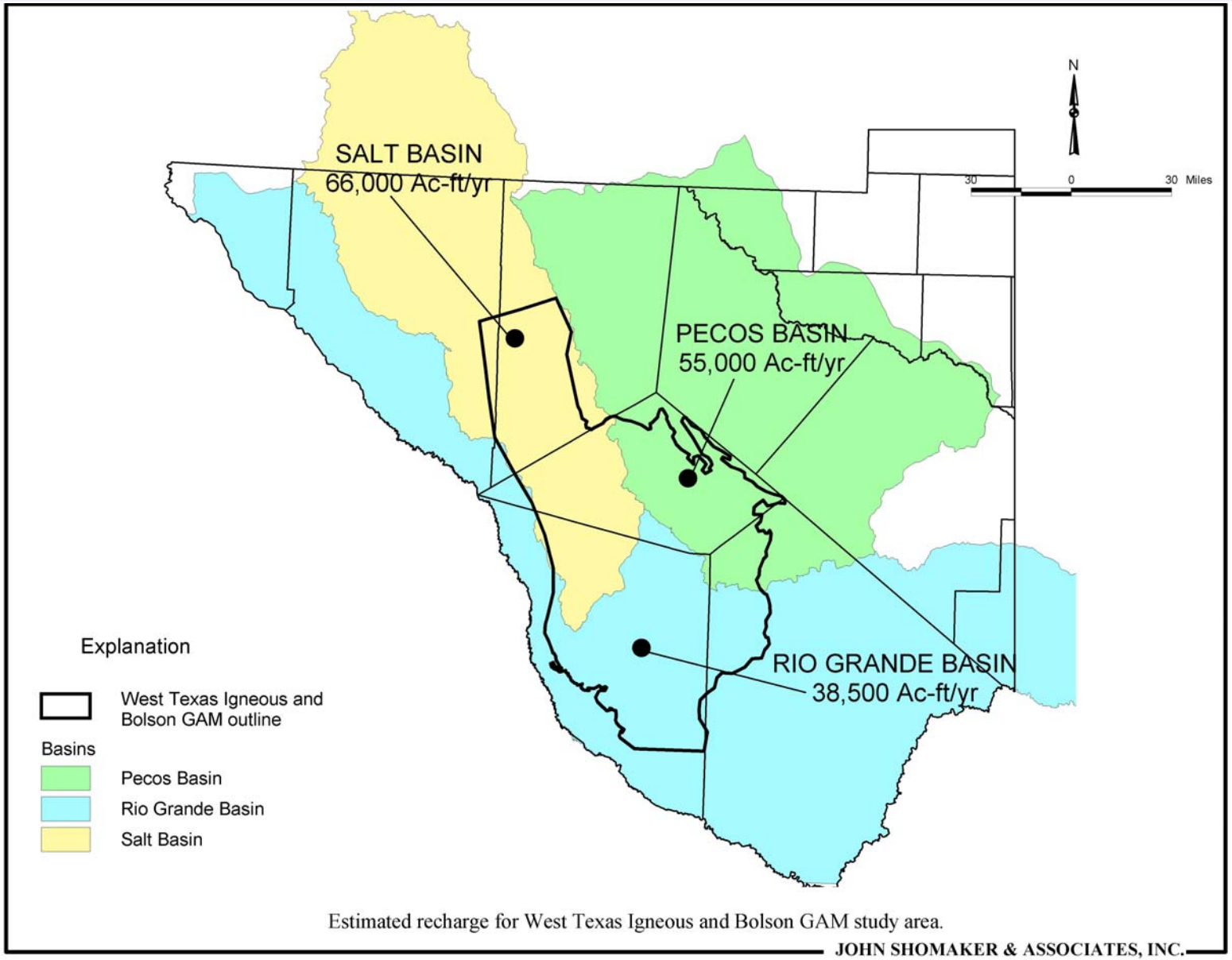
Precipitation versus Elevation



Recharge in Major Basins



Estimated recharge for West Texas Igneous and Bolson GAM study area.

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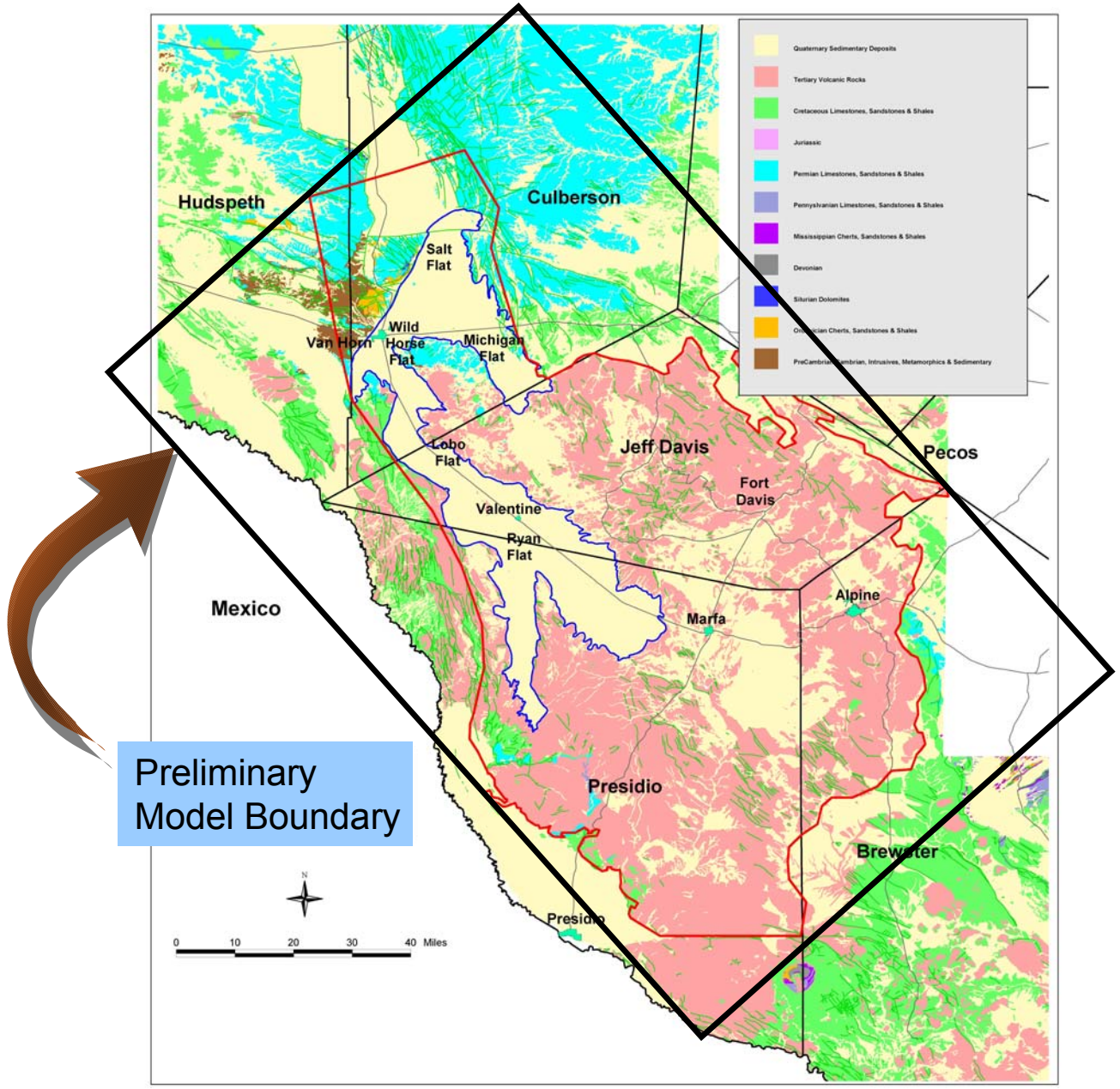
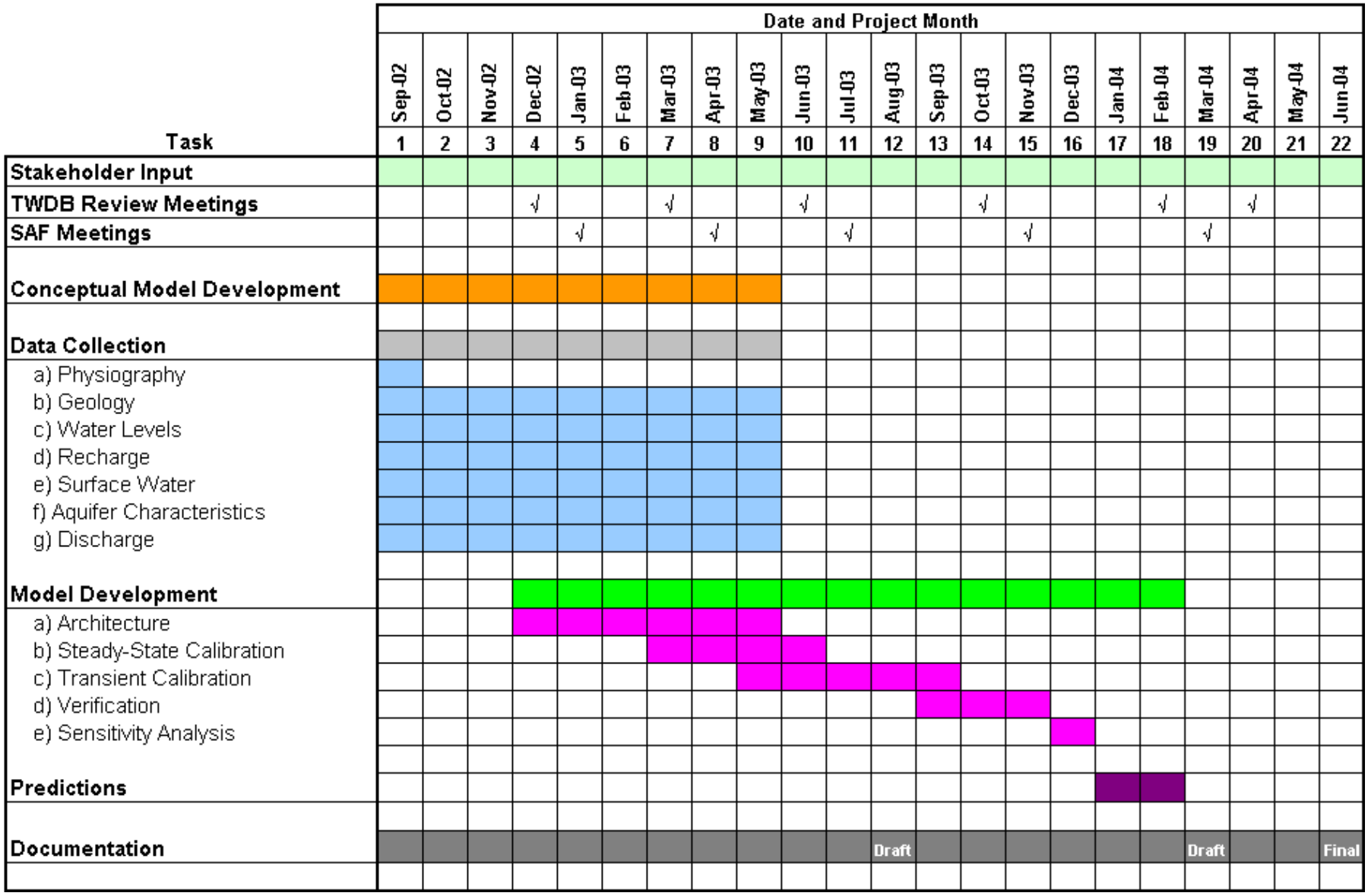
Prelimenary Recharge Results

Major drainage area	Area	Precipitation	estimated recharge	precipitation that becomes recharge
	(square miles)	(ac-ft/yr)	(ac-ft/yr)	%
Salt Basin	2,424	1,910,515	66,000	3.5
Pecos River	1,650	1,373,586	55,000	4.0
Rio Grande	2,138	1,707,982	38,500	2.3
Total	6,212	4,992,083	**159,500**	-

Preliminary Model Area



Project Schedule



SAF Schedule

SAF Meeting	Date	Topics
1	Jan 7, ’03	Introduction & Modeling Approach
2	April, ’03	Data Evaluation & Conceptual Model
3	July, ’03	Model Architecture & Steady-State Calibration
4	Nov, ’03	Transient Calibration & Sensitivity
5	March, ’04	Predictions and Final Presentation
Model Training	June, ’04	Hands-on Stakeholder Training Seminar
Final Report	June 30, ’04	Final Report Due to TWDB

Name	Affiliation
James Beach	LBG-Guyton Associates
John Ashworth	LBG-Guyton Associates
Curtis Schrider	City of Marfa
Van Robinson	
Mike Mecke	TX Cooperative Extension
Jeffrey Bennett	WPRC
Janet Adams	Jeff Davis County UWCD & Brewster Co. GCD
Laura Brock	Environmental Defense
Albert W. Miller	Jeff Davis County UWCD
Dave Hall	El Paso
Bill Hutchinson	El Paso Water Utilities
Bill Jenkins	20 Resources
Zhuiping Sheng	Texas A&M Unversity
Karl Mitchell	Presidio Co. UWCD
James King	The Nature Conservancy
Steven Bond	Bond Geological Service
Pat Goodson	Geoprojets
Gordon Erwin	Global Pump & Ex.
Scott King	L.R. French, Jr.
Kevin Urbanczyk	Sul Ross
Josclyn Fenstermaker	Alpine
Patricia Johnson	Rio Grande Council of Governments
Barbara Kauffman	Rio Grande Council of Governments
T. L. Hawkins	Ranch Owner
James W. Ward	Sul Ross
Andrew Chastain-Hawley	WPRC
Edward S. Angle	TWDB

Questions and Answers from SAF Meeting #2
Fort Davis April 16, 2003

Q: Are you assuming that elevation determines if recharge occurs directly from precipitation?

A: No, other factors such as soil characteristic, slope of land surface, vegetation, etc. are also factored into the formula used to estimate recharge at any specific location.

Q: Are you assuming that there is no recharge (return flow) from irrigation?

A: There are a few areas where irrigation return flow may be significant, such as Lobo Flat where pecan orchards are row irrigated. Return flows will not be considered in areas where only pivot irrigation has been used in the relatively recent past.

Q: Statement – Water-level hydrographs from some wells that are designated as being in the Bolson aquifer may also be partially completed in underlying volcanic units.

A: This may be true; we are attempting to identify any well designations that may be in error.

Q: What will be covered in the August report?

A: The "Conceptual Model" report due to be completed in August 2003 will contain a description of all geologic and hydrologic characteristics of the study area that will be encompassed in the development of the model. These characteristics will include such subjects as geologic formations, hydrologic units, thickness, water levels, and transmissivity of the aquifer.

Q: What is the schedule for completion of pumping tests?

A: The Far West Texas Regional Planning Group has provided additional funding to conduct pumping tests for the purpose of generating needed aquifer characterization where none currently exists. It is anticipated that tests will be completed in the next four to five weeks.

Q: How will you define the layers in the model?

A: The definition of hydrostratigraphic units will be consistent with the level of information that can be compiled for this complex geologic area. The hydrostratigraphy has not been finalized yet, but the geology, structure, stratigraphy, and hydraulic properties will all be used to define appropriate hydrostratigraphic units for the model.

Q: What springs will be included as discharge points and from what source did you derive these springs?

A: A 100% survey of springs will not be attempted in this project; however, a sampling of springs will be evaluated for their discharge characteristics and this information will be distributed over the area where springs are known to exist. It

should be noted that the MODFLOW model would probably not be a good predictive tool for many of the small springs at relatively high elevations that exist because of complex geologic structures. There are several reasons why the model will not be suitable for making predictions for some of these springs, including relatively large grid spacing and lack of information on geologic structure which control these local flow systems.

Q: *Are you doing water chemistry on the springs to fingerprint their source?*
A: No; however, large springs will be incorporated into the appropriate layers in the model, as we currently understand their distribution.

Q: *Are GAM models capable of incorporating water-quality issues at a later time?*
A: Available water quality data for parameters such as TDS will be mapped in the model area, however this modeling project does not include a water quality modeling. Future generations of the model may be developed to include water quality.