
GAM
Groundwater
Availability
Modeling
texas water development board

Agenda for Stakeholder Advisory Forum (SAF) Meeting No. 1 April 25, 2001

- Role of Groundwater Availability Models (GAMs) and the SAF
- Groundwater flow and groundwater modeling
- Modeling approach/project team
- Project schedule

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Purpose of the GAM is to...

"provide reliable, timely data on groundwater availability to the citizens of Texas to ensure adequacy of supplies or recognition of inadequacy of supplies throughout the 50-year planning horizon."

- Pederson, TWDB (1999)

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To accomplish this objective, we need a predictive tool- the tool is a groundwater flow model.

- The model must be as realistic and scientifically accurate as possible
- The model must be developed with stakeholder input
- The model must be thoroughly documented

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The model will be used by

- Underground Water Conservation Districts (UWCDs), Regional Water Planning Groups (RWPGs), TWDB and other entities to evaluate the effects of water use alternatives
- The model and the data will be available to the public

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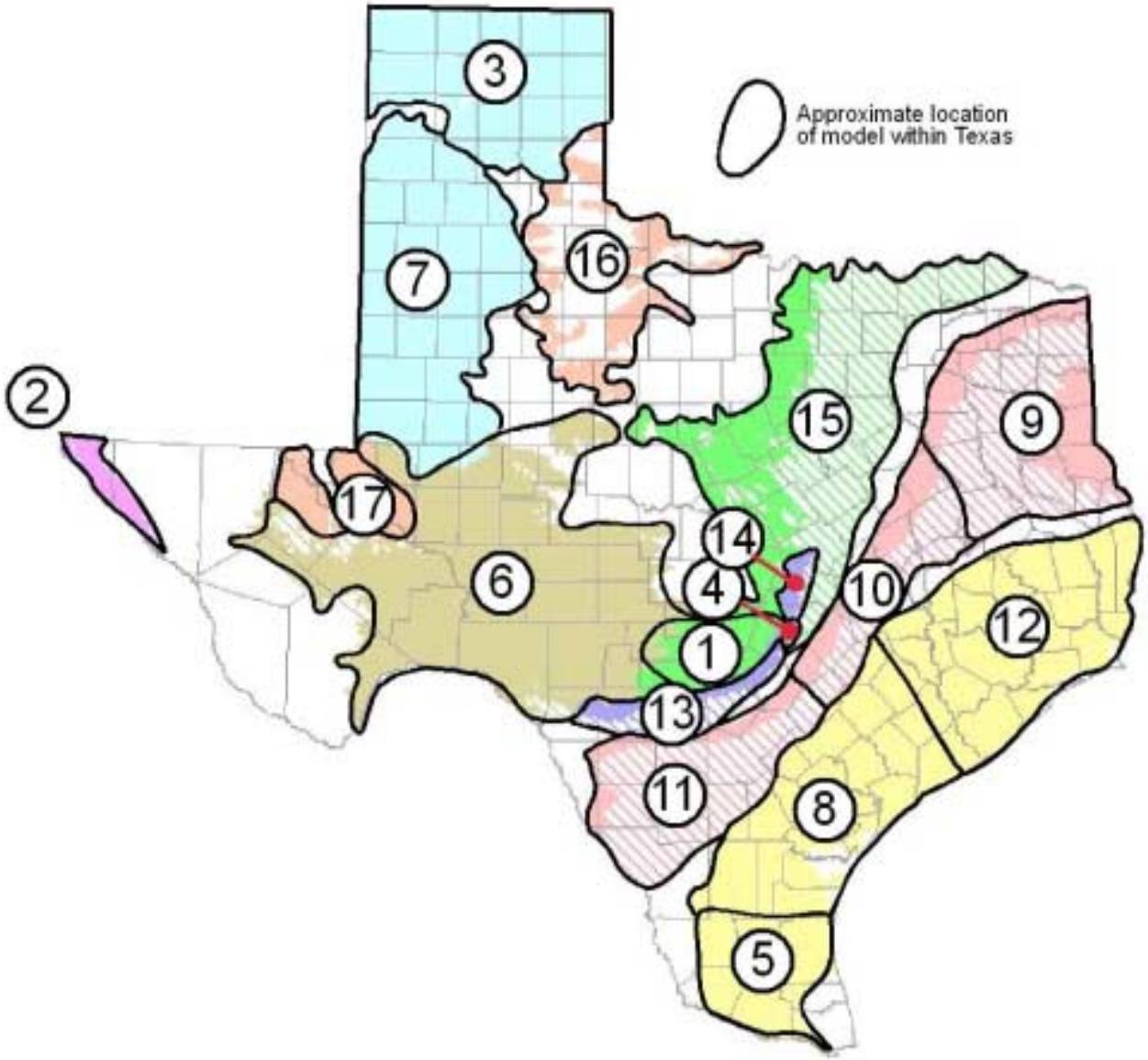
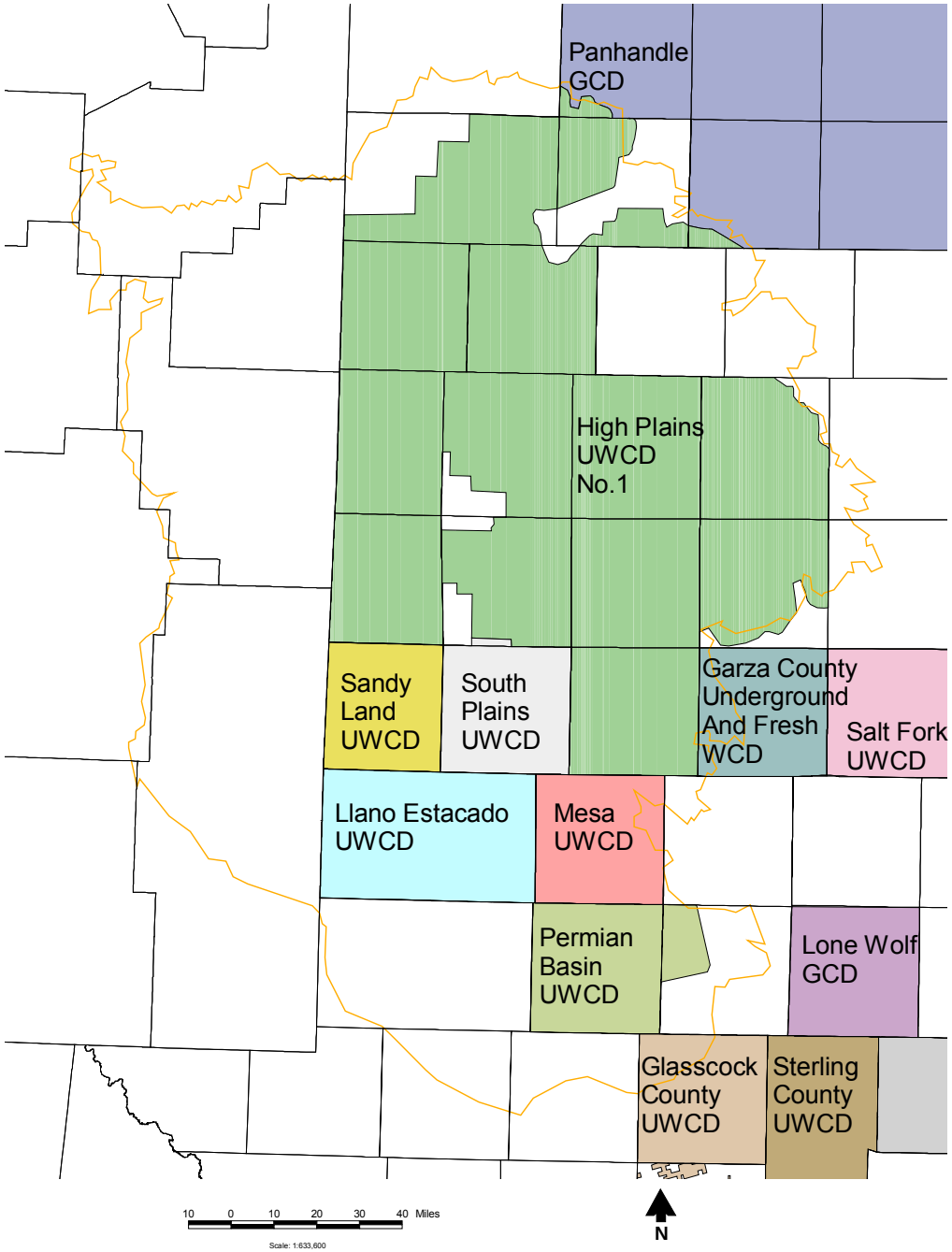
Location of Completed, Ongoing, and Proposed Models for GAM

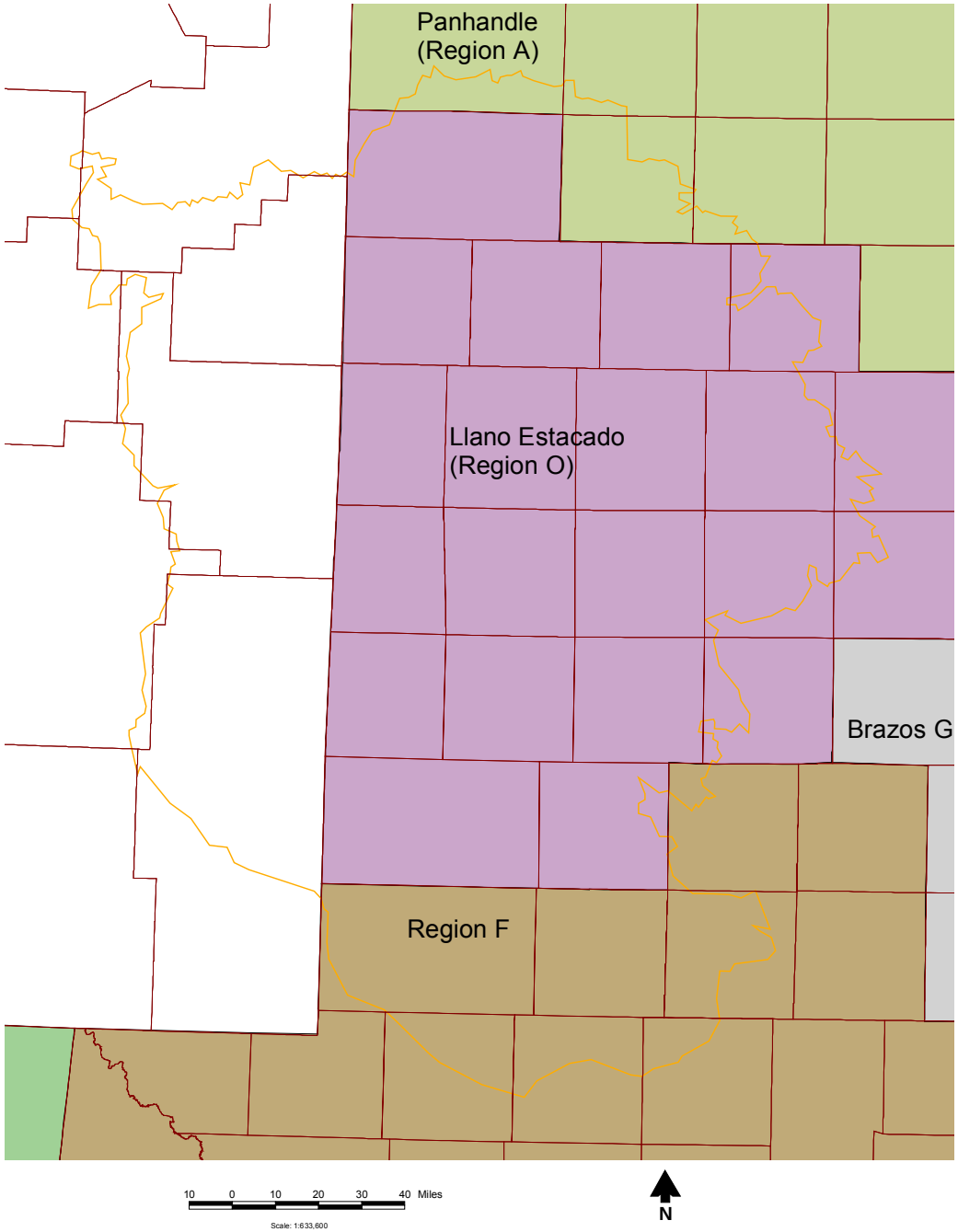


c = completed
o = ongoing
p = proposed

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

October 2000


Panhandle GCD
High Plains UWCD No.1
Sandy Land UWCD
South Plains UWCD
Garza County Underground And Fresh WCD
Salt Fork UWCD
Llano Estacado UWCD
Mesa UWCD
Permian Basin UWCD
Lone Wolf GCD
Glasscock County UWCD
Sterling County UWCD
10 0 10 20 30 40 Miles
Scale: 1:633,600
N


Panhandle
(Region A)
Llano Estacado
(Region O)
Brazos G
Region F
10 0 10 20 30 40 Miles
Scale: 1:633,600
N

Stakeholder Advisory Forum (SAF)

- Stakeholder participation is critical to the success of the GAM!
- SAF intended to be widely inclusive of interested participants
- Quarterly SAF meetings
  - Updates on progress of model development
  - Opportunity for you to raise issues related to modeling the aquifer
  - Identify information to help build a better model
- SAF memo reports and presentation materials will be posted on the TWDB web site (http://www.twdb.state.tx.us)

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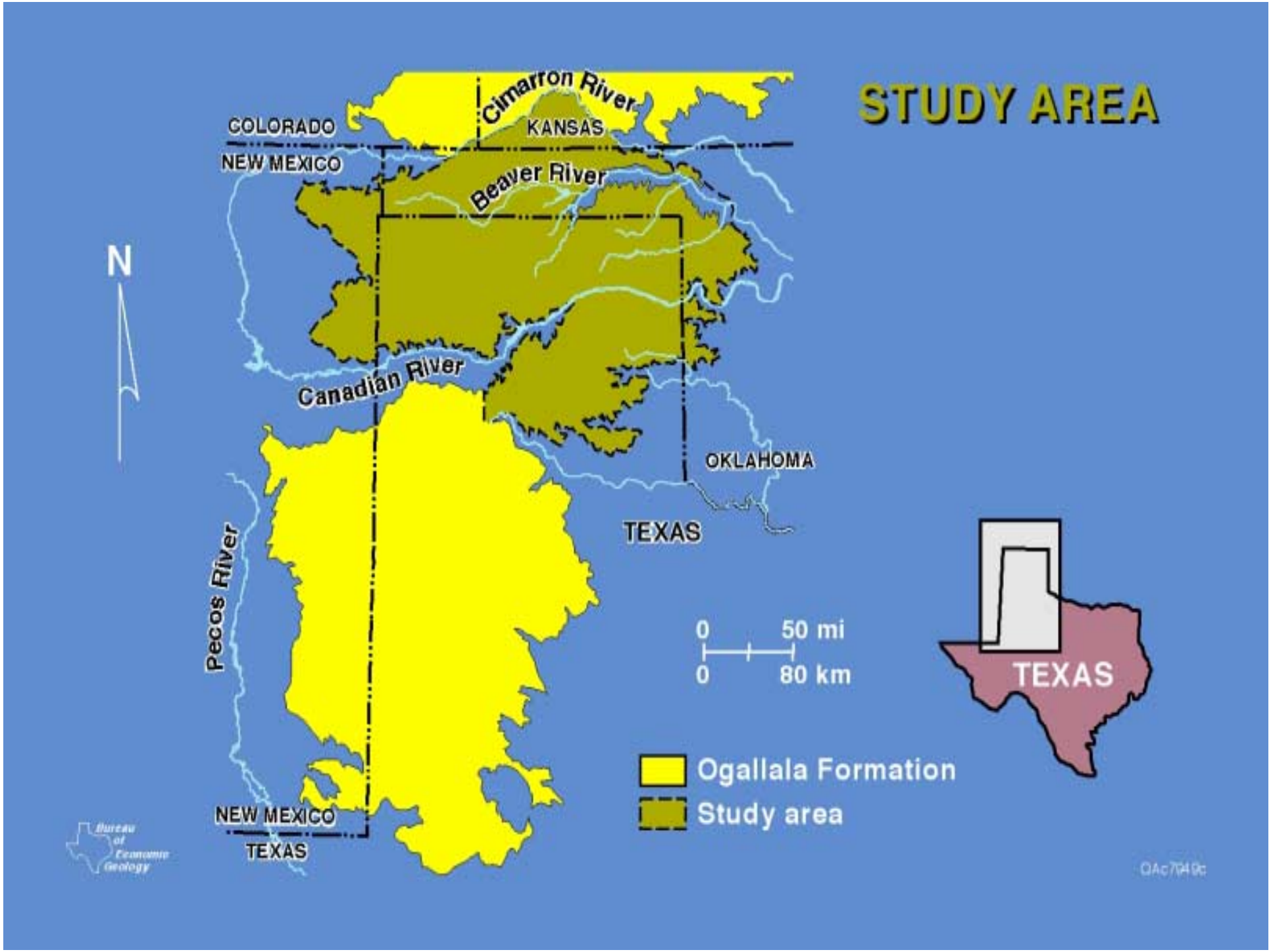
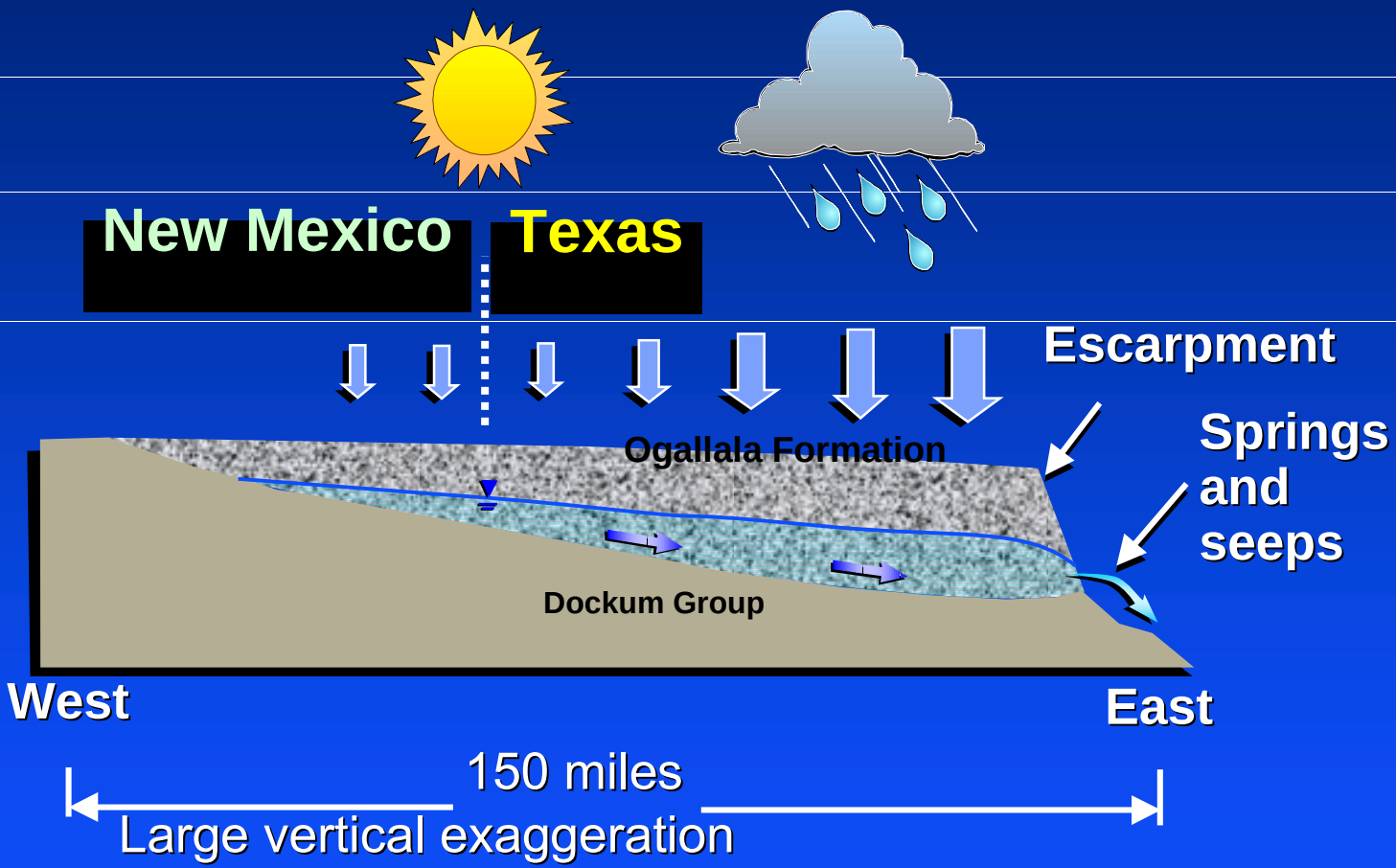

STUDY AREA
Cimarron River
COLORADO
KANSAS
NEW MEXICO
Beaver River
N
Canadian River
OKLAHOMA
TEXAS
Pecos River
0 50 mi
0 80 km
TEXAS
Ogallala Formation
Study area
NEW MEXICO
TEXAS
Bureau of Economic Geology

Southern Ogallala Aquifer Cross Section



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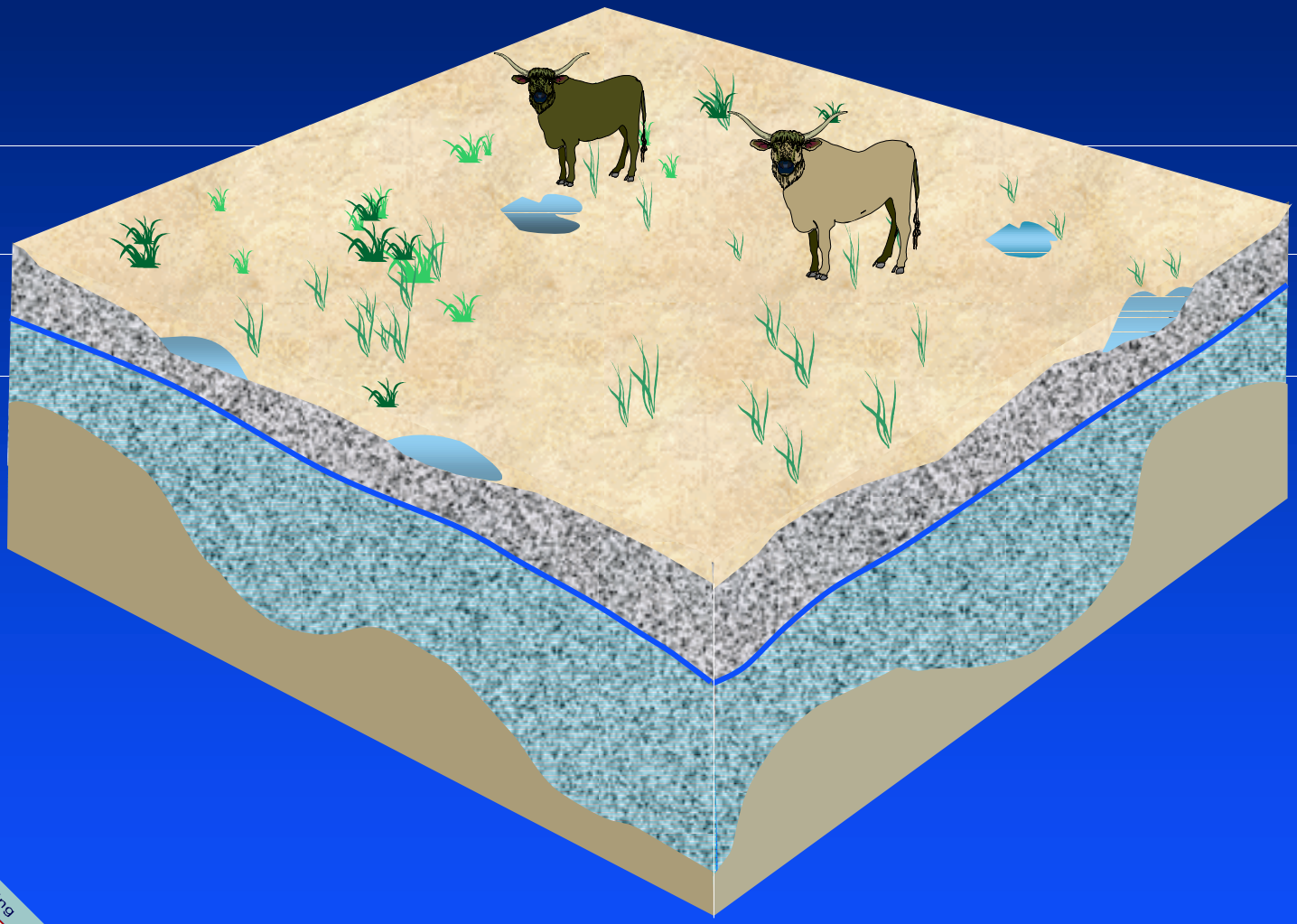
Pre-1940



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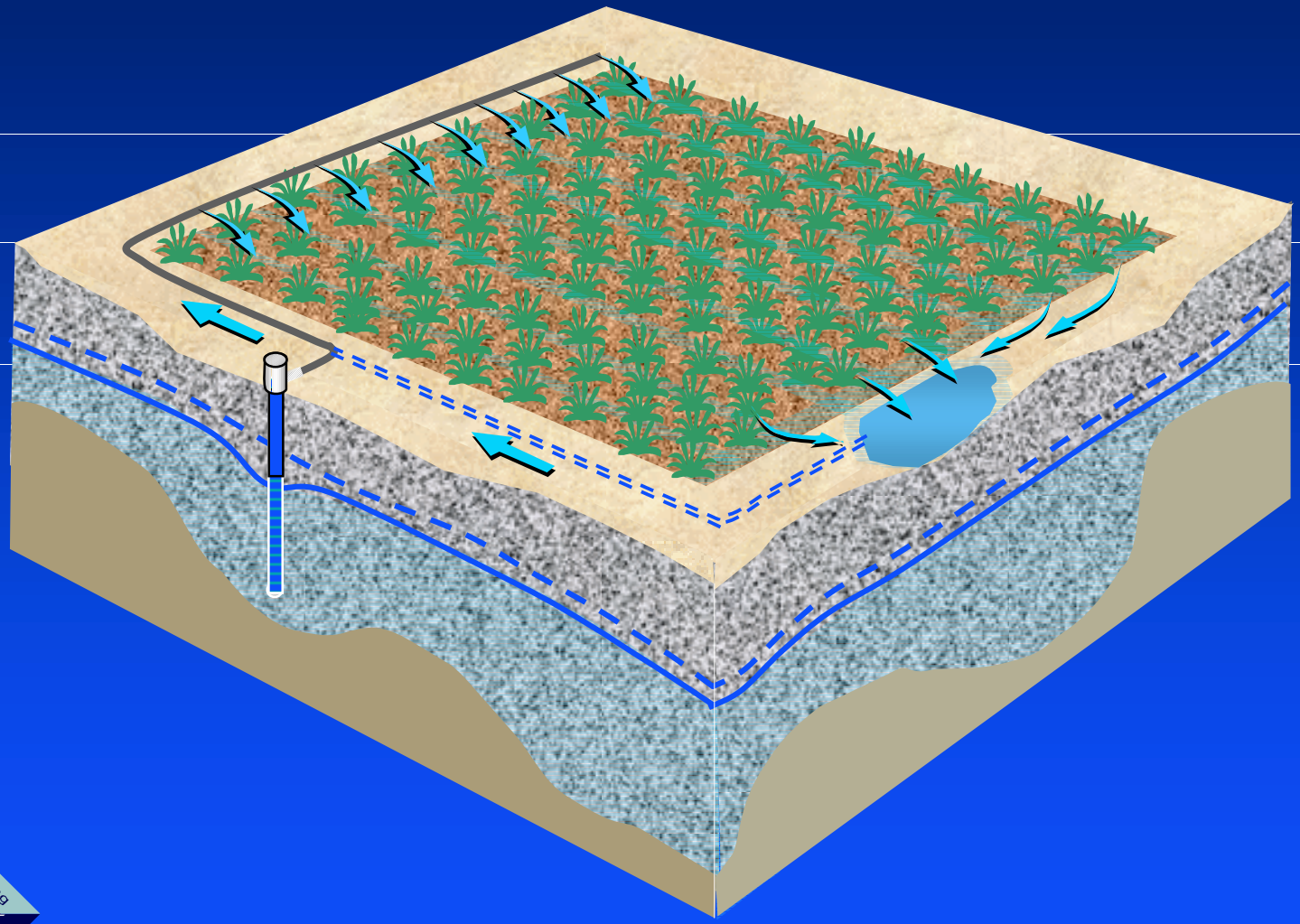
Early Irrigated Agriculture (1940s-1970s)



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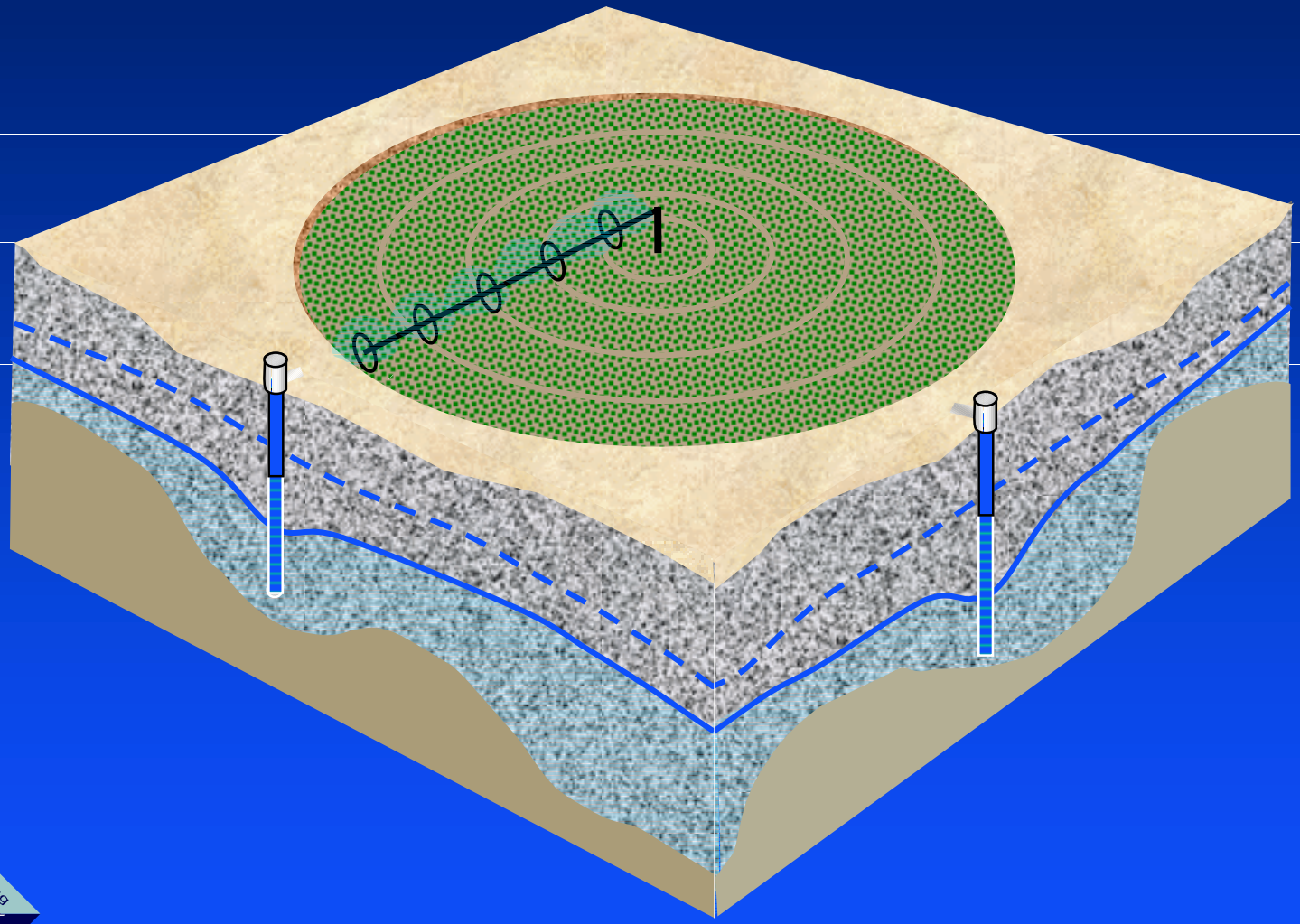
Recent Developments (1980s - 1990s)



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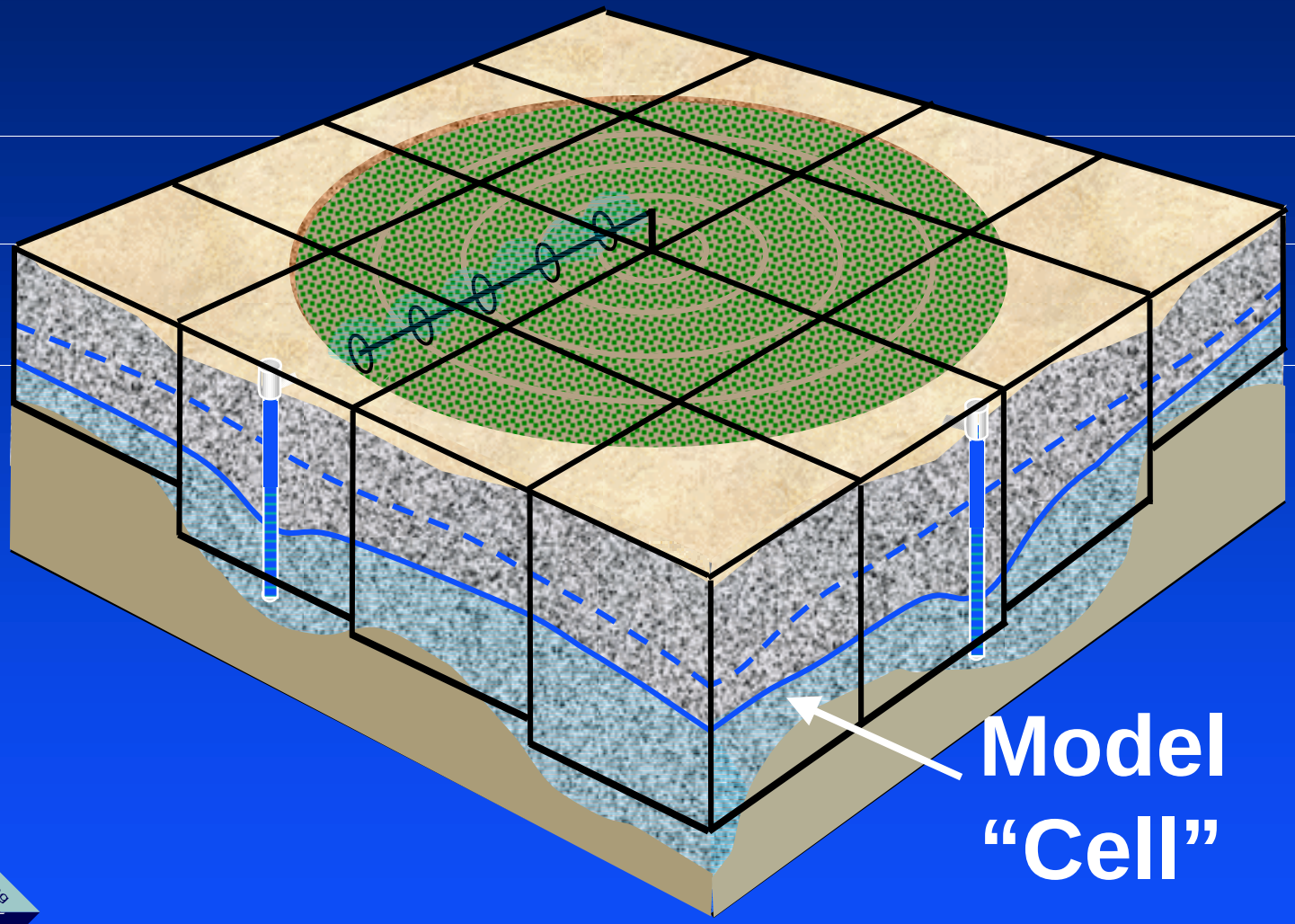
Groundwater Flow Modeling



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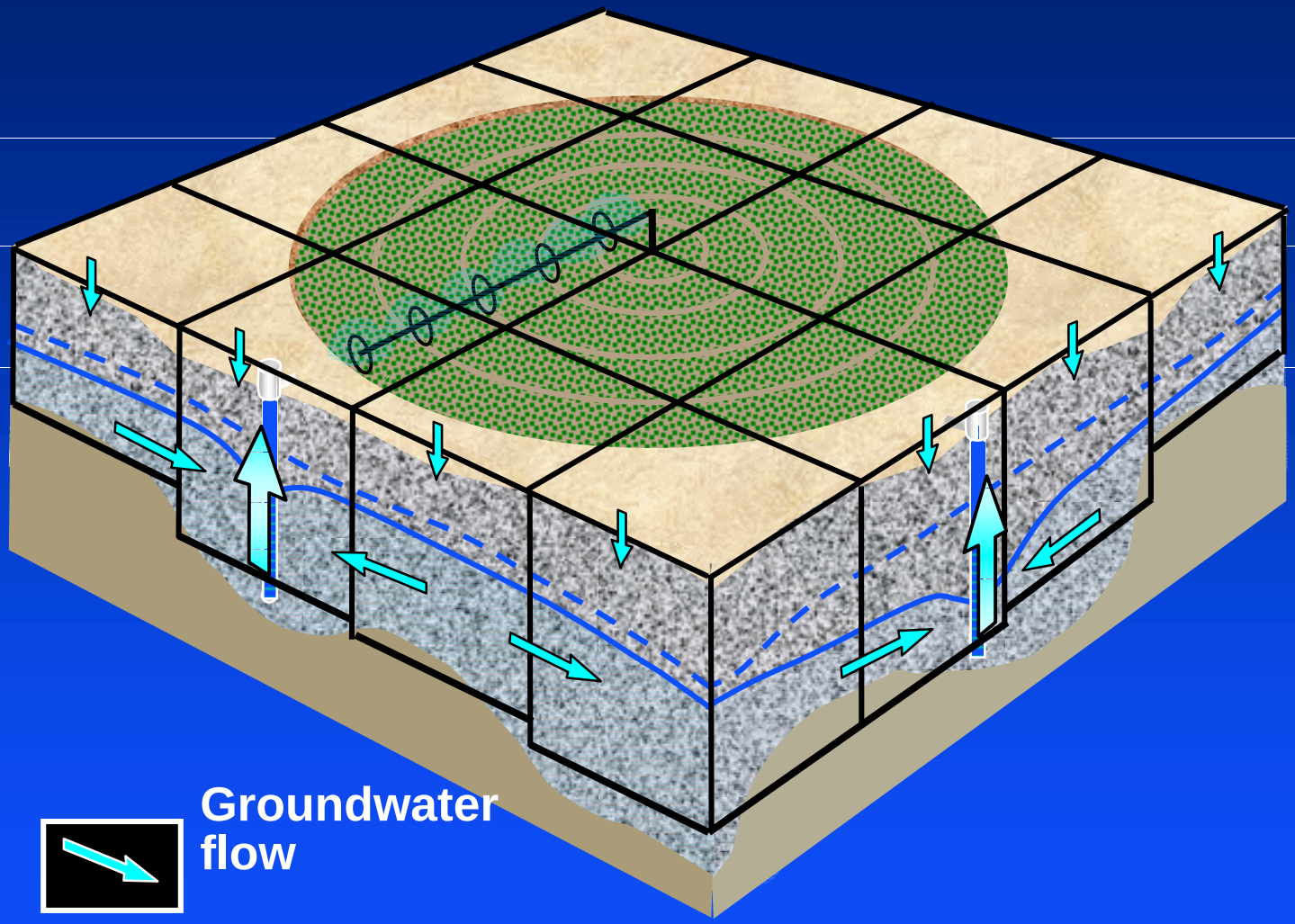
Cells "Communicate"

Their Language is Mathematics!



Groundwater flow

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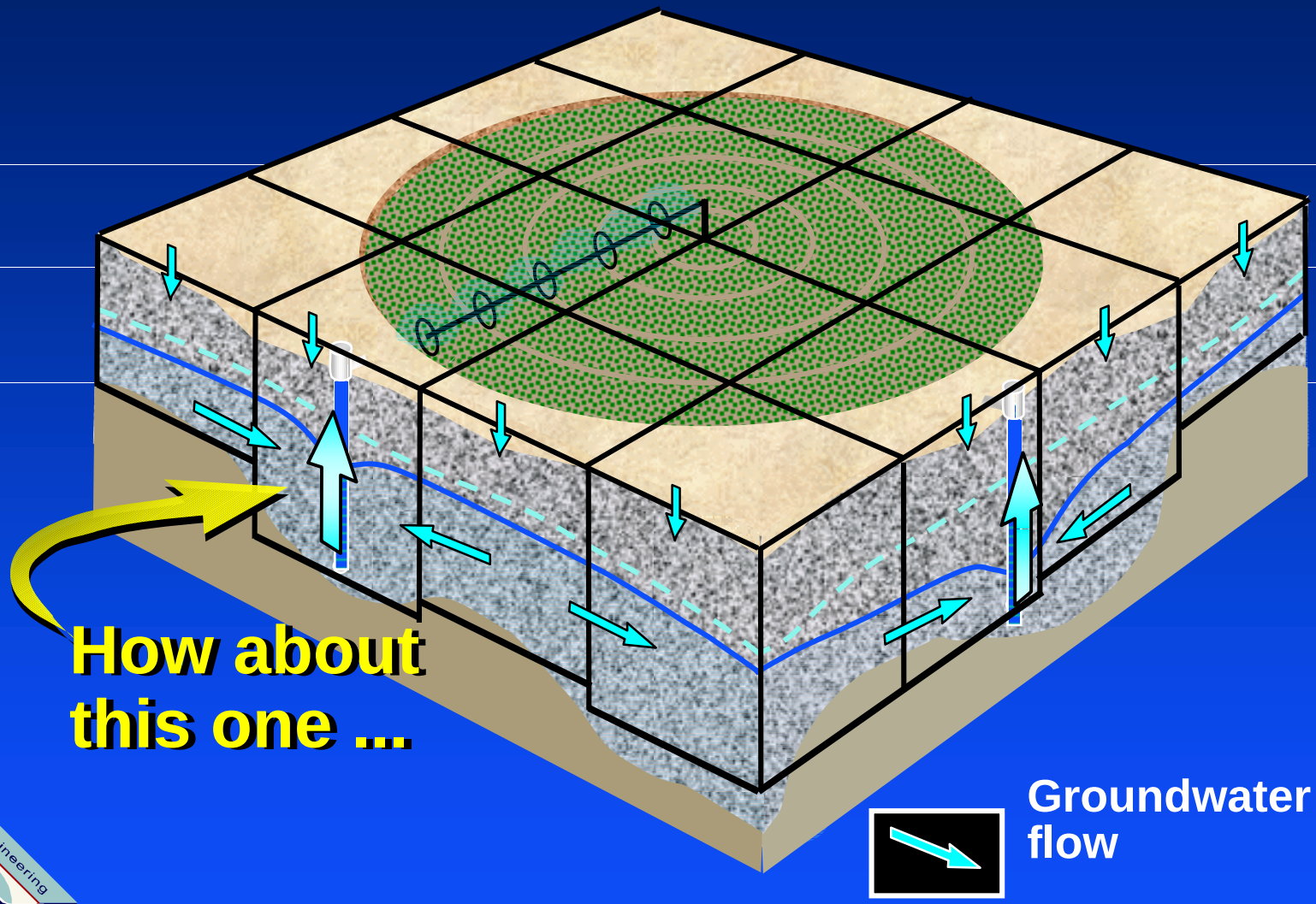
Let's Take a Look at One ...



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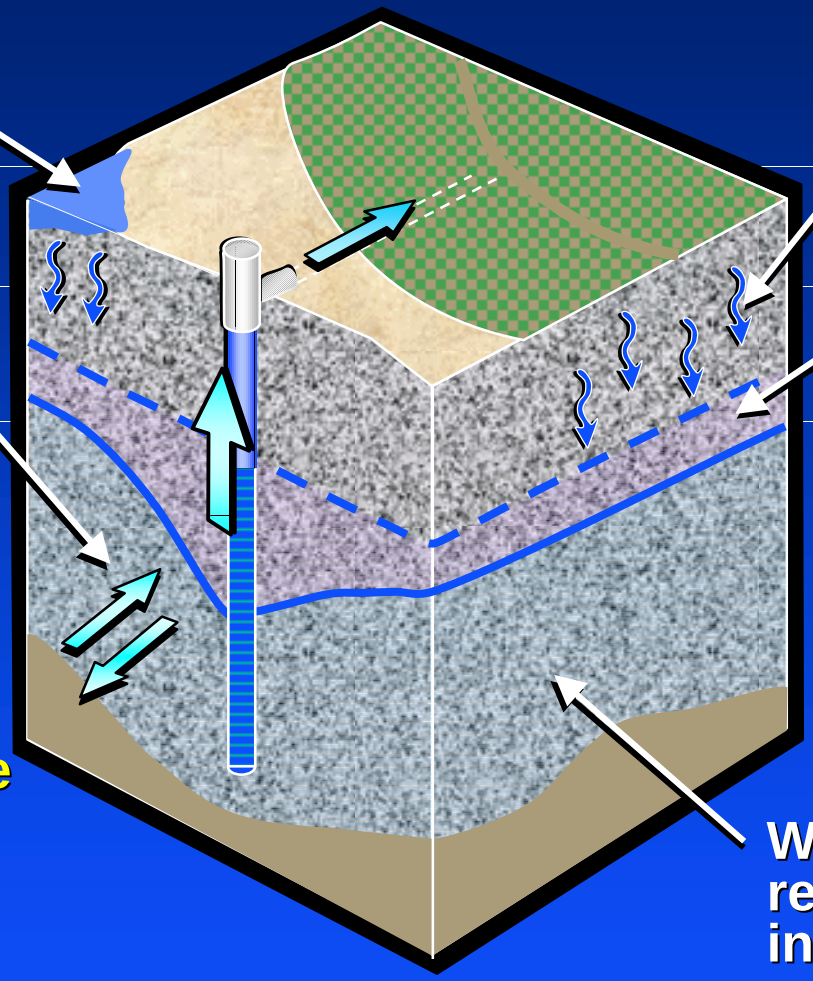
Major Influences in the Life of a Cell



Natural recharge

Irrigation return flow

Water removed from storage

Exchange of water with neighboring cells

- Permeability
- Storage value
- Thickness

Water remaining in storage

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Modeling Approach

- Quantify recharge terms separately
  - Natural (precipitation)
  - Irrigation return flow
- Refine estimates of agricultural water use
- Update aquifer parameters
  - Specific capacity data
  - Previous field investigations
  - Geostatistical and geological models
- All data sets available electronically

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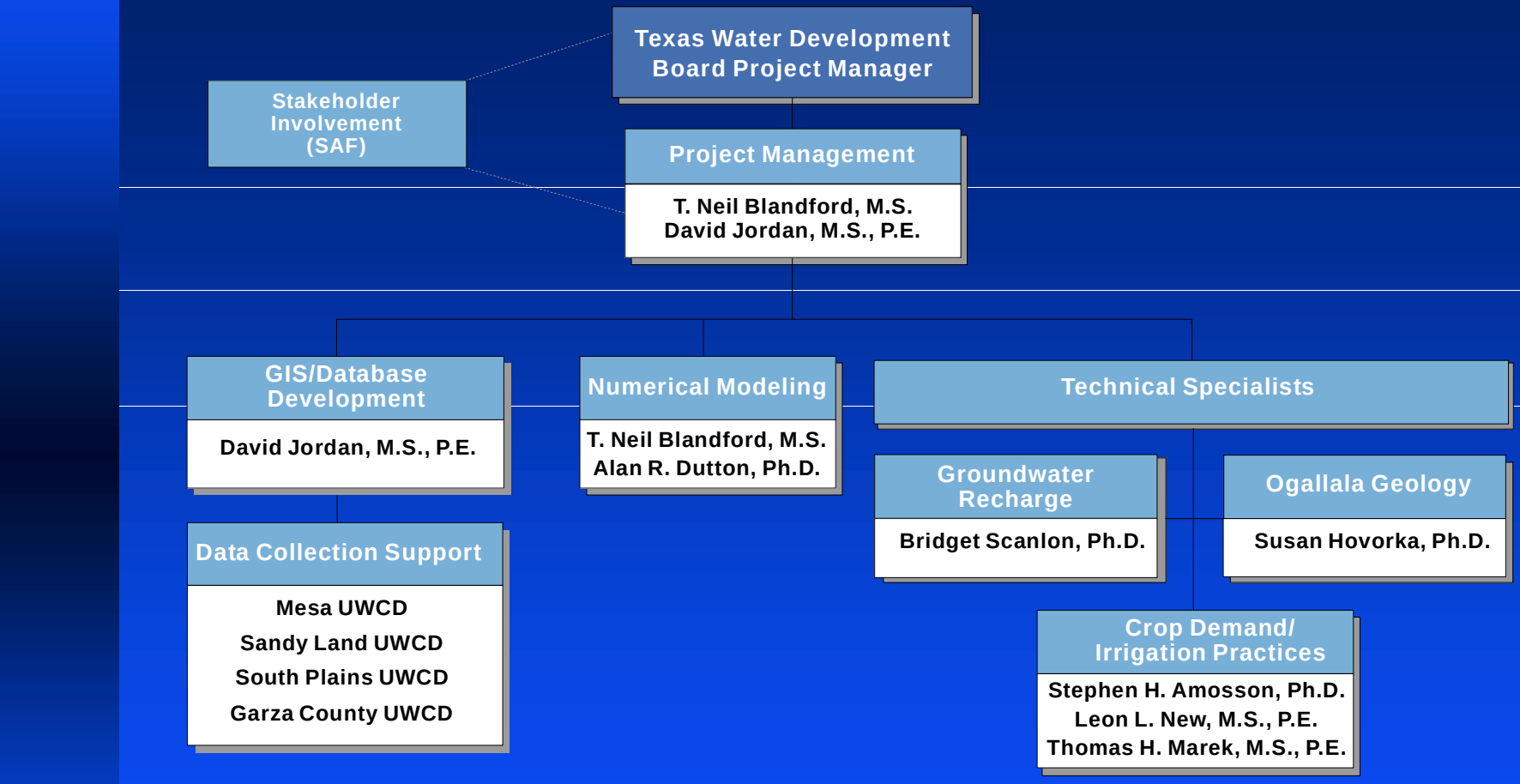

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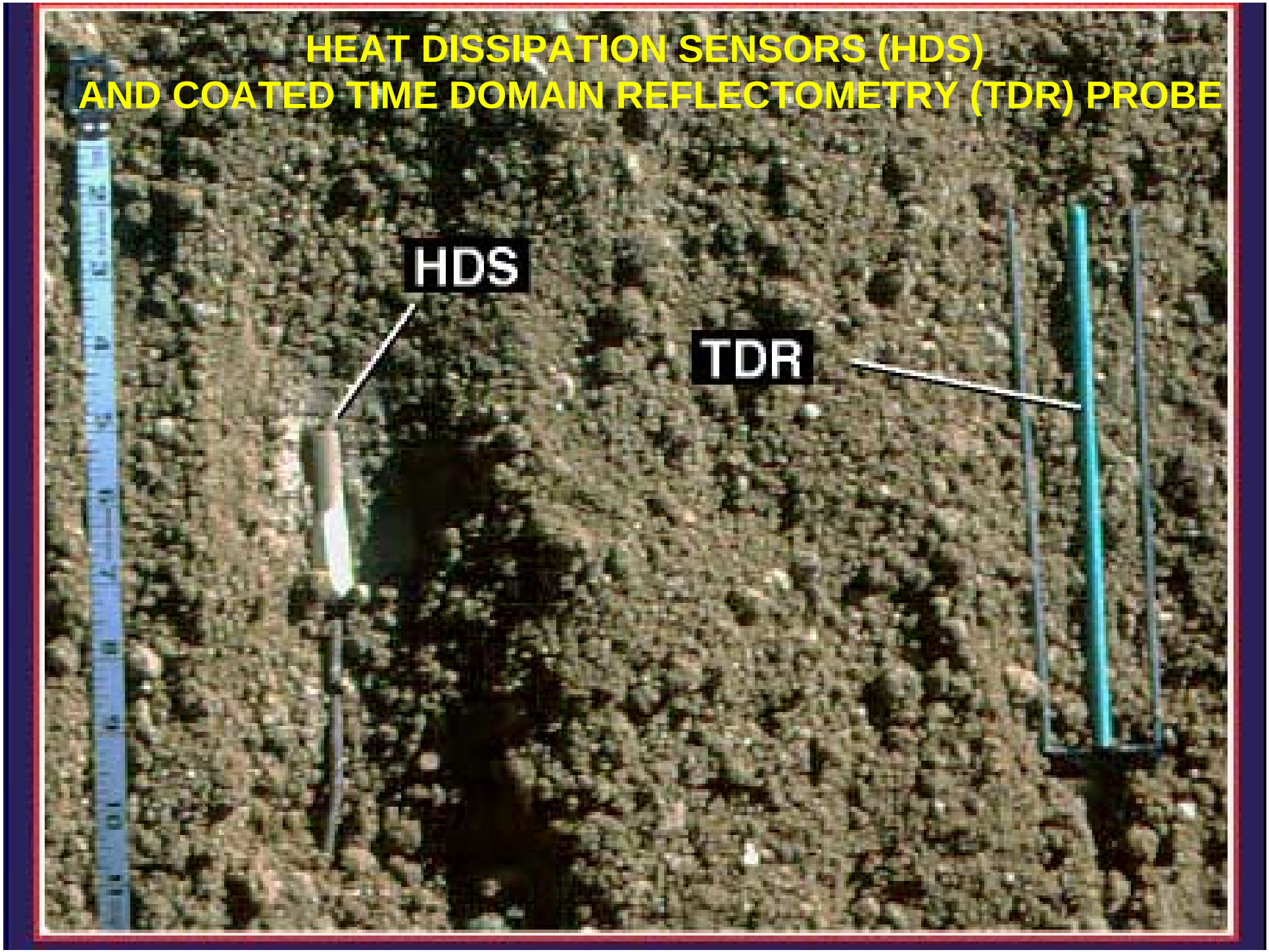
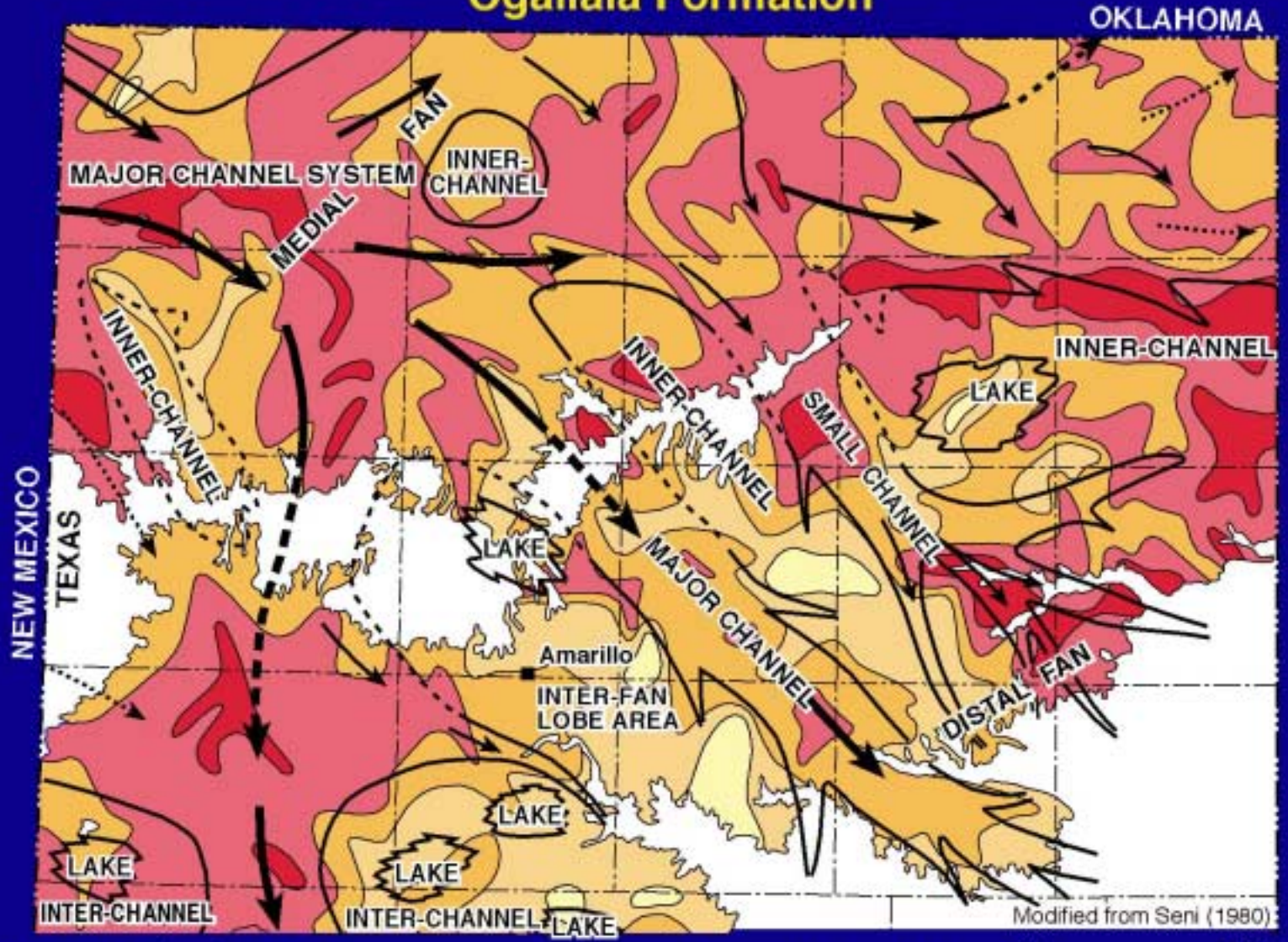

HEAT DISSIPATION SENSORS (HDS)
AND COATED TIME DOMAIN REFLECTOMETRY (TDR) PROBE
HDS
TDR

PERCENT SAND AND GRAVEL
Ogallala Formation

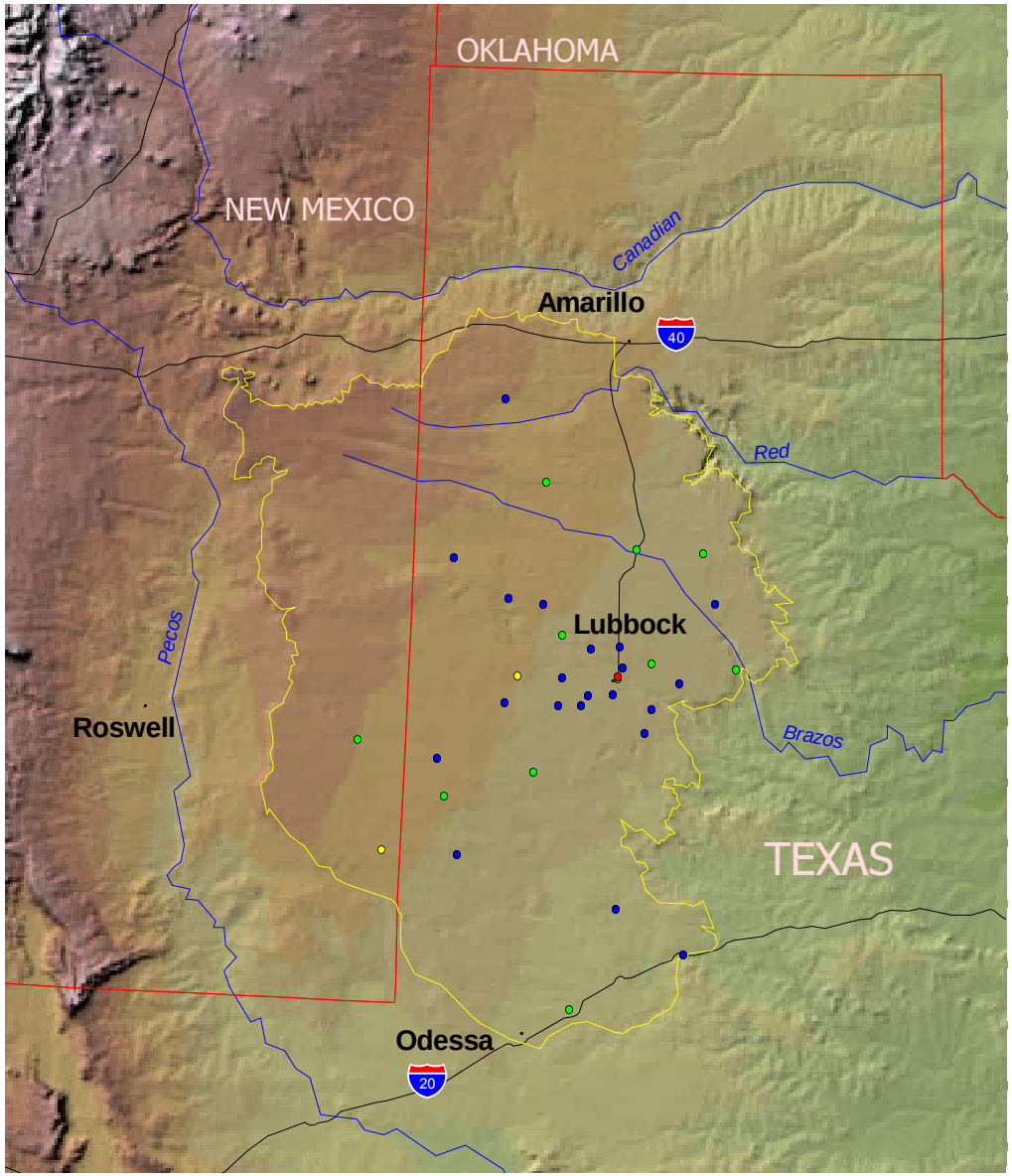


80 – 100
60 – 80
40 – 60
20 – 40
0 – 20
Ogallala not present

Lower Ogallala contact
dashed where covered
by younger deposits

0 40 mi
0 60 km
Contour interval
20 percent

QAc8432c


OKLAHOMA
NEW MEXICO
Canadian
Amarillo
40
Red
Lubbock
Pecos
Roswell
Brazos
TEXAS
Odessa
20
10 0 10 20 30 40 Miles
Scale: 1:633,600
N
DBS&A sites
1
2 - 10
11 - 100
101 - 200

Expectations of the Model

- Satisfactory calibration/validation
- Given projected future pumping rates, all else being unchanged, the model will predict for 1 square mile areas
  - Water levels
  - Groundwater in storage
  - Water budget inflows and outflows
- Regional scale model will not fully handle local features

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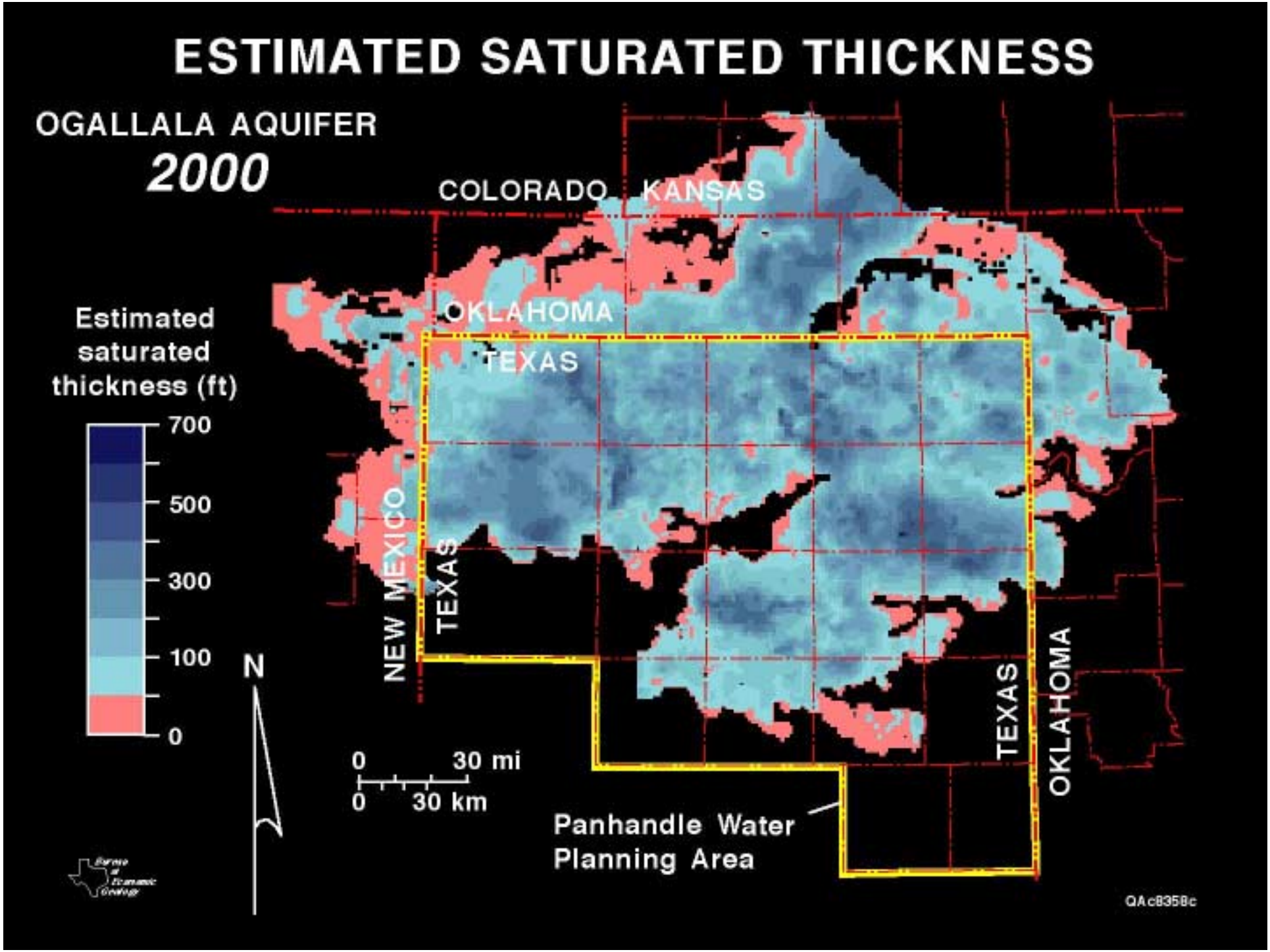
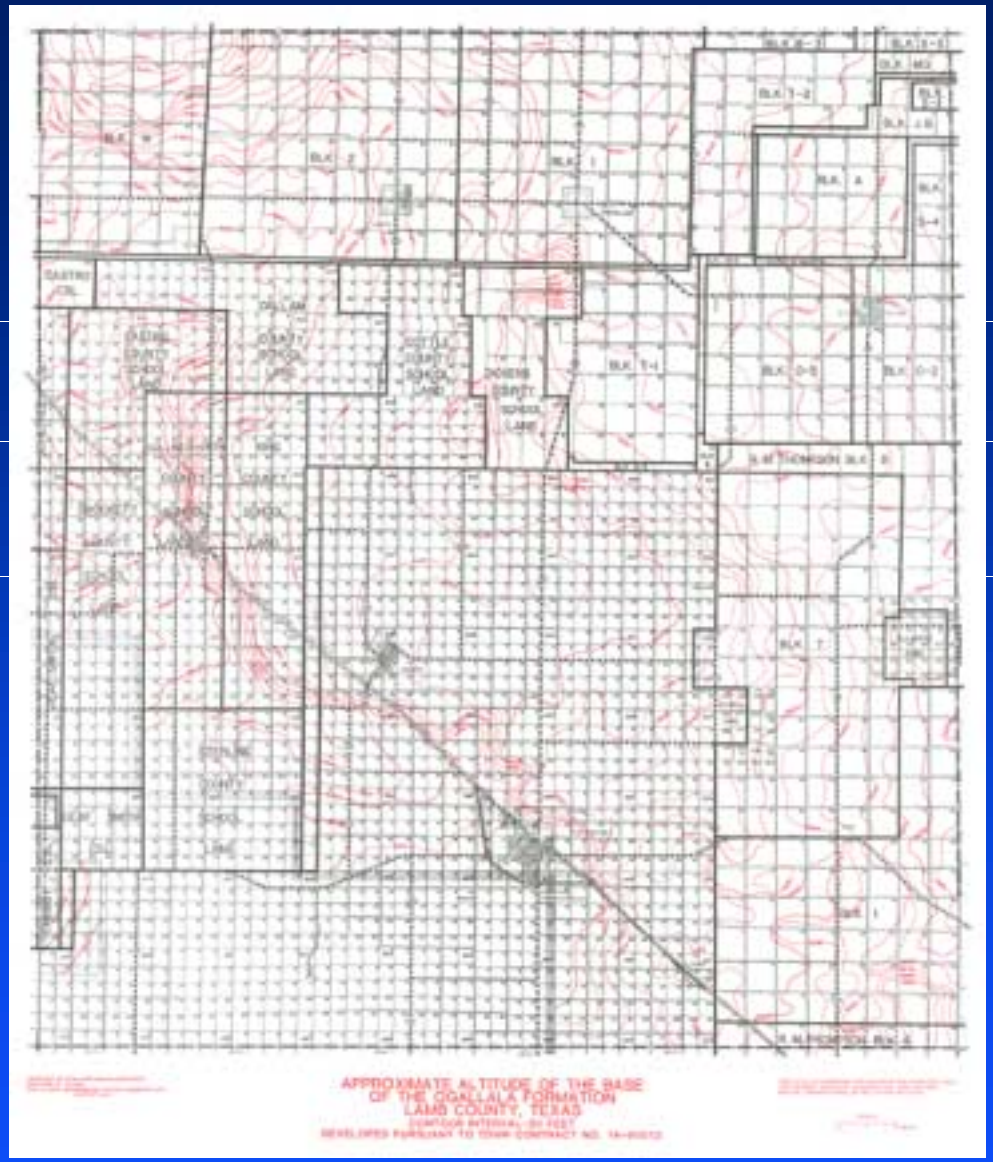

ESTIMATED SATURATED THICKNESS
OGALLALA AQUIFER
2000
COLORADO
KANSAS
OKLAHOMA
TEXAS
NEW MEXICO
TEXAS
TEXAS
OKLAHOMA
Estimated saturated thickness (ft)
700
500
300
100
0
N
0 30 mi
0 30 km
Panhandle Water Planning Area
QAc8358c

Approximate Altitude of the Base of the Ogallala Formation, Lamb County, Texas



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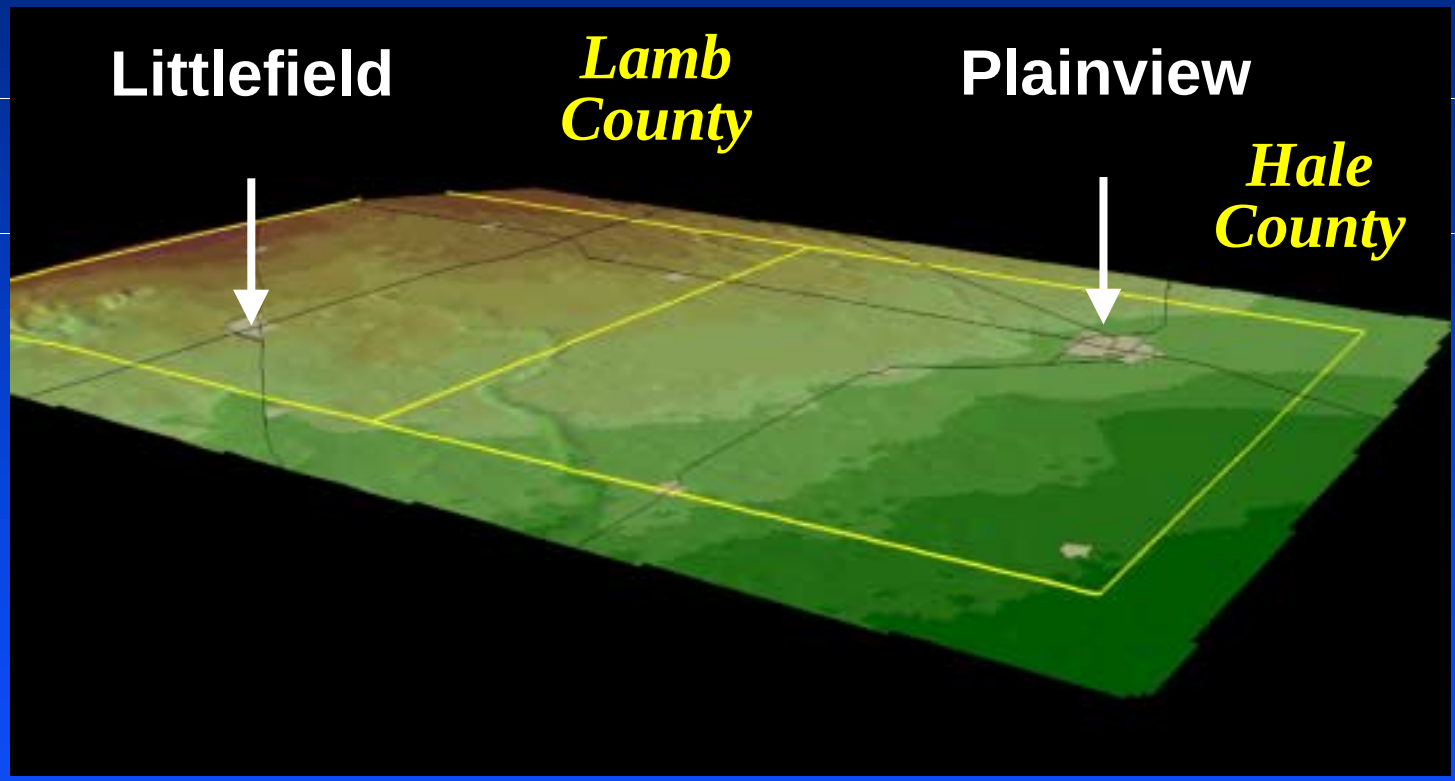
Lamb and Hale Counties



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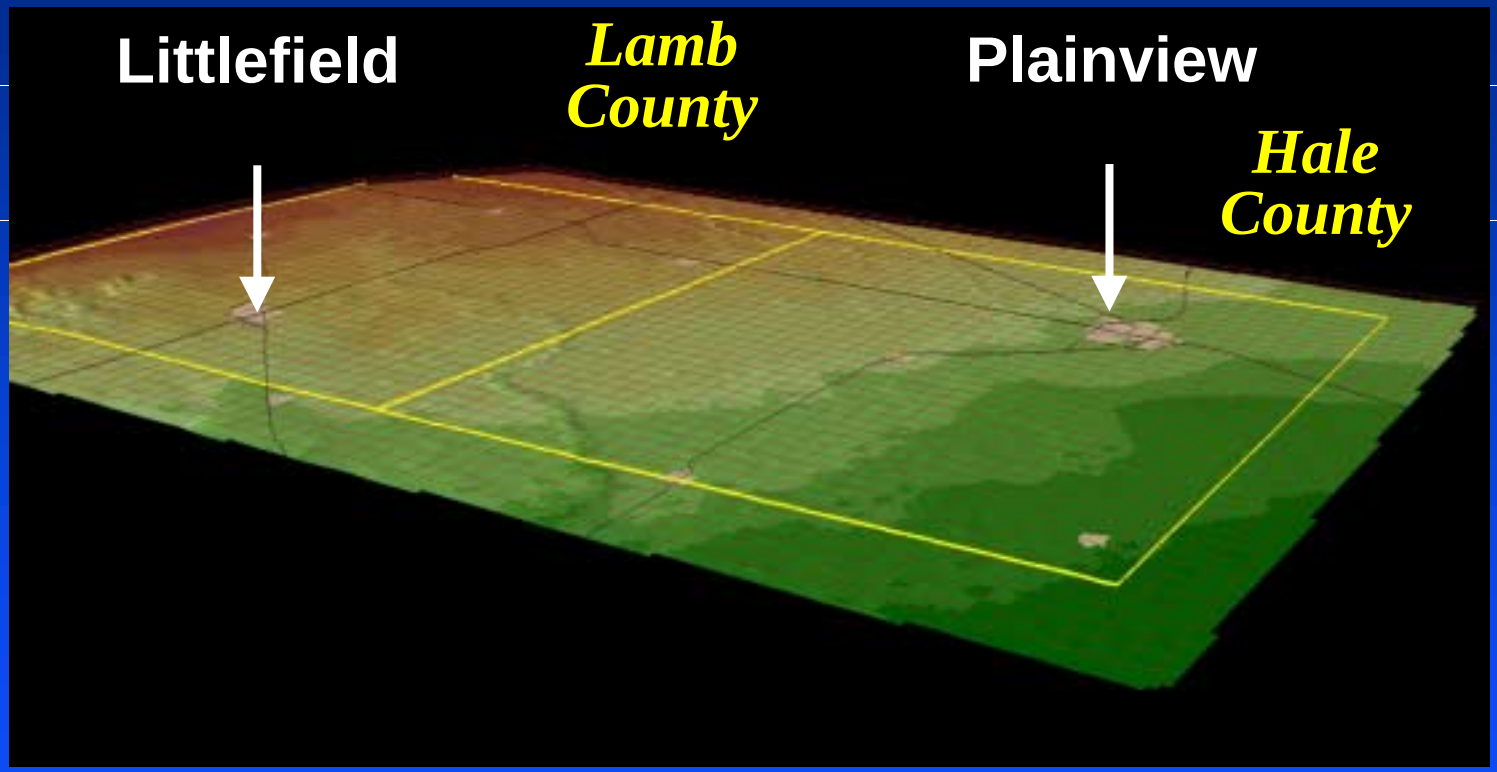
Lamb and Hale Counties with Model Grid



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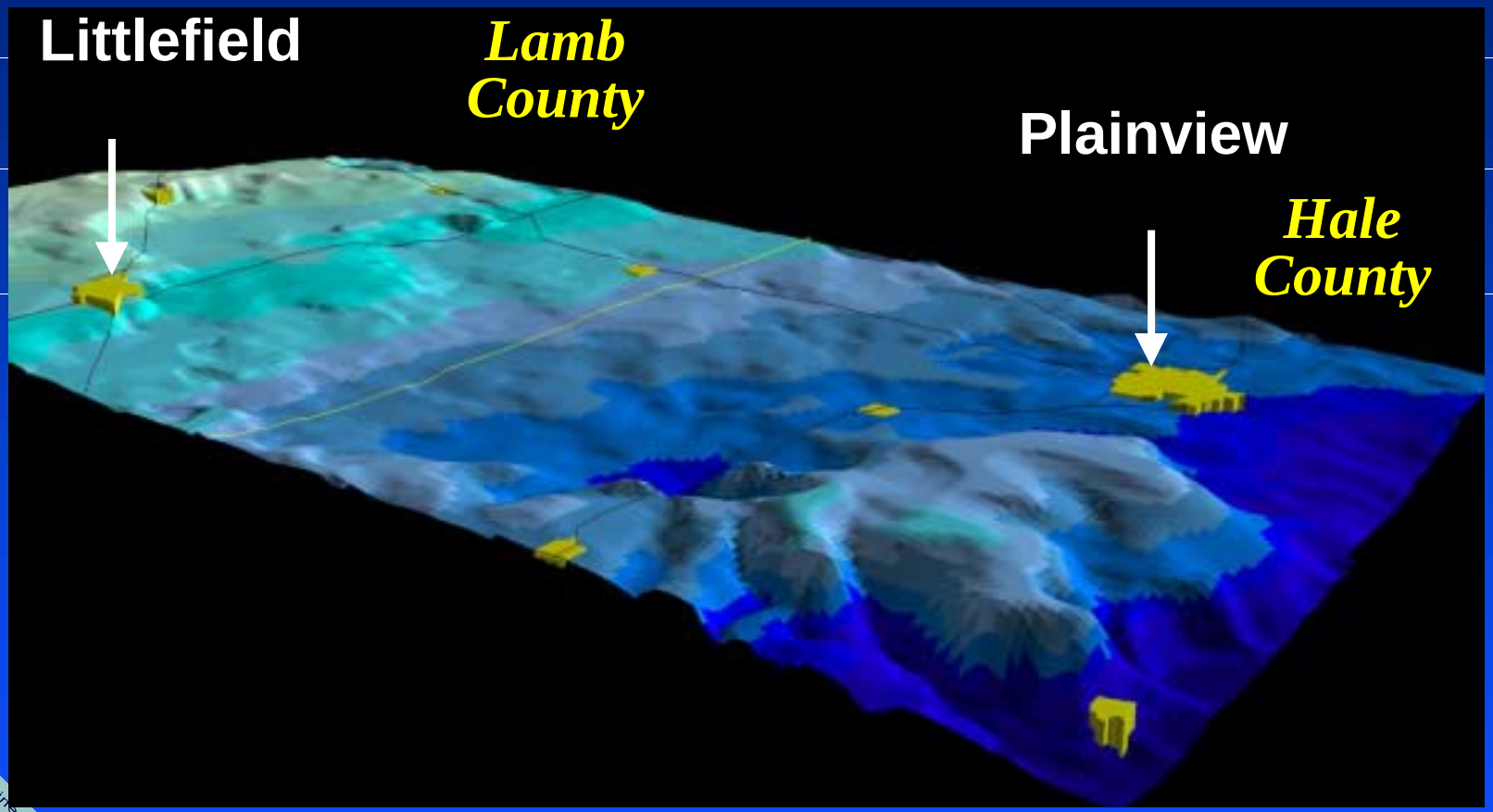
Approximate Altitude of the Base of the Ogallala Formation



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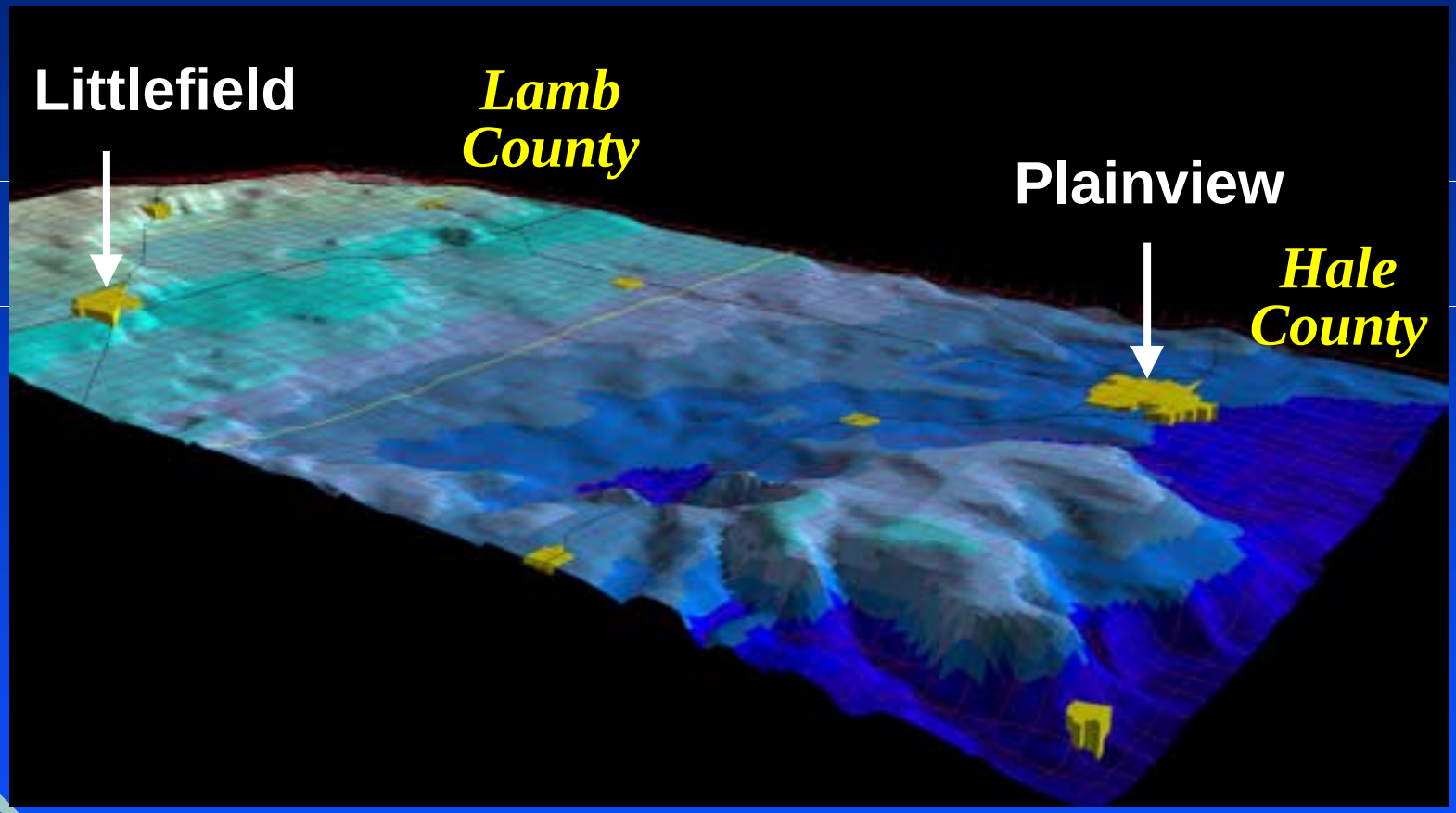
Approximate Altitude of the Base of the Ogallala Formation with Model Grid



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Project Schedule

Stakeholder Advisory Forum
April 25, 2001

List of Attendees

Name	Affiliation
Larry M. Sanders	Region F Water Planning Group
Comer Tuck, Jr.	High Plains Underground Water Conservation District No. 1
Ray Brady	Panhandle Groundwater Conservation District
John R. Abernathy	Texas Tech University
David Turnbough	Sandy Land Underground Water Conservation District
Ronald Bertrand	Texas Department of Agriculture
Chris Wingert	CRMWD
Ches Carthel	City of Lubbock
Lloyd Urban	Texas Tech University, Water Resources Center
Gene Montgomery	Oxy Permian
Kent Satterwhite	Canadian River Municipal Water Authority
Gene Henslee	Southwestern Public Service
Arland Schneider	USDA-ARS
Jason Coleman	South Plains Underground Water Conservation
Alan Dutton	Bureau of Economic Geology
Robert Mace	TWDB
Richard Smith	TWDB
Neil Blandford	Daniel B. Stephens & Associates, Inc. (presenter)

Stakeholder Advisory Forum No. 1
April 25, 2001
High Plains Underground Water Conservation District No. 1
Lubbock, Texas

Questions & Answers Concerning Groundwater Availability Modeling (GAM) of the Southern Ogallala

1. How will the GAMs be used by Regional Water Planning Groups and water districts?

Response: *There are proposed rules with the TWDB that would require these groups to use the model unless a better, more local model is available.*

2. When did the project start and what is the timeframe for completion?

Response: *The contracts were finalized mid-January 2001 and the project is expected to be completed with 2 years. The first year of the project will be mostly data collection and analysis. The actual modeling will begin during the first part of year two.*

3. What is the relationship between this model and the model developed by Texas Tech for the Region O Regional Water Planning Group?

Response: *There are several differences:*

1. *This model will extend to the portion of the Ogallala in New Mexico, and this portion of the aquifer will be simulated in greater detail than has previously been done. The Texas Tech model includes this region also, but focuses on Texas. The estimates of aquifer parameters and pumping rates in New Mexico are rough estimates and approximations taken from previous studies.*
2. *This model will try to quantify natural recharge versus irrigation return flow, and separate out explicitly these two processes. This will be based in part on field data and studies not available when Texas Tech developed their model.*
3. *The methodology for determining irrigation demand will be the same or similar to the methodology used in the Region A model.*
4. *The aquifer parameters (i.e. hydraulic conductivity) will be updated using specific capacity data available from the State and hydraulic testing data collected for contaminated sites in the region. This will give a broader picture and more detail of the permeability of the aquifer.*
5. *Because of the requirements of the GAM project, all data will be formatted electronically and publicly available on the TWDB's website.*

4. At how many locations will irrigation return flow be measured?

Response: *There will not be a lot of measurements. There will be two wells in irrigated areas that are highly instrumented to look at irrigation return flows.*

5. What will the spatial distribution of irrigation use be based on?

Response: *TWDB maps will probably be used. If there is a way to put detail into a county, as opposed to using withdrawal over the entire county, that detail will be used.*

6. Is the location of irrigation wells available?

Response: *We will rely on groundwater districts to help provide this information. The TWDB does not keep require that these wells be registered with them.*

7. Why are only four water districts listed on the project team?

Response: *The listed districts are those that agreed to be on the project team when we submitted our proposal. We will work with and rely on all of the districts for basic data and input.*

8. How is the calibration criteria determined?

Response: *This criteria was established in the TWDB's Request for Proposal (RFP). The RFP stated that the mean squared error of the difference between the simulated water levels and the observed water levels must be less than 10% of the total change in water levels across the basin.*

9. How many wells will be used in determining water levels?

Response: *A specific number of wells has not been determined.*

10. What software will you need to view and run the model?

Response: *The model can be run using MODFLOW, which is available at no (or minimal) charge through the USGS and other sources. If someone wanted to run the model, they would need a software package called PMWIN, which can be purchased.*

11. Will the Geographic Information System (GIS) files be available electronically?

Response: *Yes, however, you will need ArcView to run them.*

12. What files will be available electronically?

Response: All files will be available, including GIS files, input files, and maps.

13. What if a 10% model error cannot be reached?

Response: Once data is collected and put into a model, the model tends to "find" a natural error. Manipulating the data to force additional error reduction can produce false results due to model "overcalibration". we do not anticipate a problem in meeting the calibration criteria.

14. Will this model be historical or predictive?

Response: The model will be a "transient" model. The historical period to be modeled will begin sometime between 1940-1950 (pre-development) and run until 2000. The emphasis will be on the 1980's and 1990's, because we have better data during this time. The predictive modeling period will be from 2001 to 2050. This will give us a 100-year simulation.

15. Where will meeting announcements and other documents be posted?

Response: On the TWDB's GAM website: http://www.twdb.state.tx.us/gam