

## Groundwater Availability Modeling (GAM) for the Lipan Aquifer

Presented to  
Stakeholder Advisory Forum  
San Angelo, Texas  
January 14, 2003

## LBG-Guyton Responsibilities

- Project Management
- TWDB & Stakeholder Interaction
- Data Collection, Assimilation, and Interpretation
- Model Development, Calibration, Verification, Prediction
- Report and Documentation

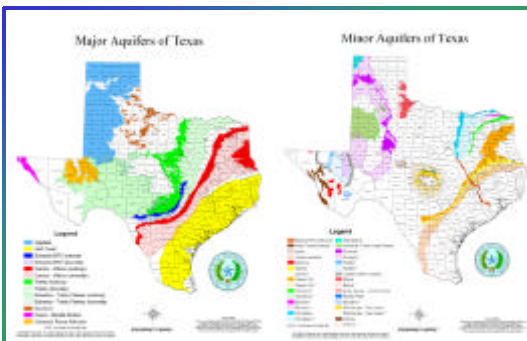
## Presentation Outline

- Review of GAM Objectives and Expectations
- Groundwater Modeling Concepts
- Overview of Lipan Aquifer
- Modeling Approach and Conceptual Model Issues

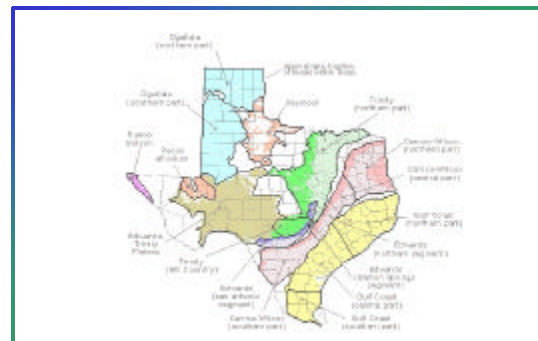
## GAM Objectives

- Provide reliable and timely information on GW availability to ensure adequate supplies or recognize inadequate supplies through 2050
- Develop realistic and scientifically accurate GW flow models representing the physical characteristics of the aquifer and incorporating the relevant processes
- The models are designed as tools to help assess GW availability through 2050 based on current projections of groundwater demands

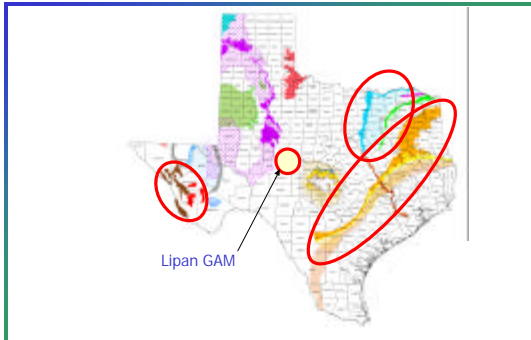
## Aquifers in Texas



## Major Aquifer GAMs



## Minor Aquifer GAMs



## GAM Expectations

- Result in standardized, thoroughly documented, and publicly available numerical groundwater flow models and supporting data
- Include substantial stakeholder input to insure the models address the relevant water-resources issues of each aquifer
- Provide an integrated tool for the assessment of water management strategies for GCDs, RWPGs, and state planners

## Why GAMs?

- A groundwater model provides a good way to integrate geologic information and measured data to predict groundwater flow.
- Best available technology.

## What a GAM IS.

- Tool to meet the TWDB GAM objectives as specified by Texas Legislature.
- Tool to perform regional evaluation for long-term water supply.
- Tool developed from an assimilation and interpretation of significant research and different types of data.

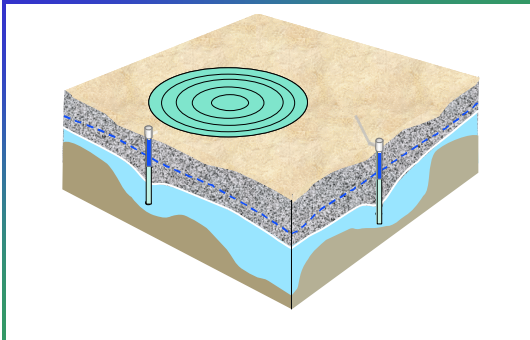
## What a GAM is NOT.

- Something that can tell you the water level in your backyard well to the nearest hundredth of a foot every minute of the day.
- Icon on a desktop computer that can be easily used and correctly interpreted by anyone.
- The definition of groundwater availability.

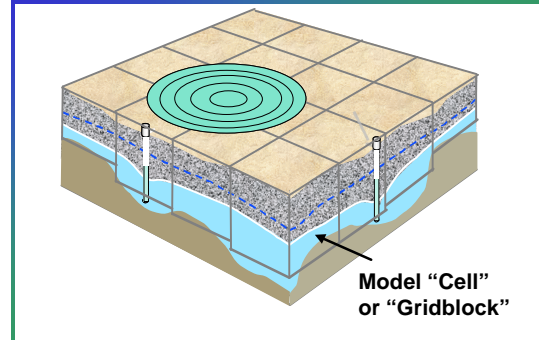
## Numerical GW Flow Modeling

- A numerical groundwater flow model is the mathematical representation of the physical aquifer
- A numerical model calculates the water level at specific locations based on aquifer characteristics, pumping, recharge, etc.
- Calculated water levels can be compared to measured water levels in wells

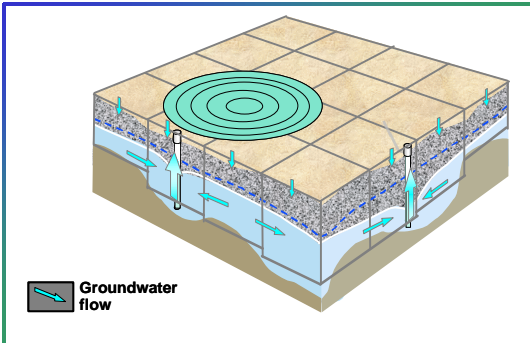
### Modeling Basics



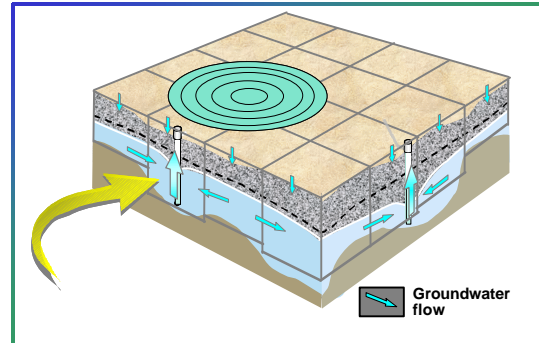
### Groundwater Flow Modeling



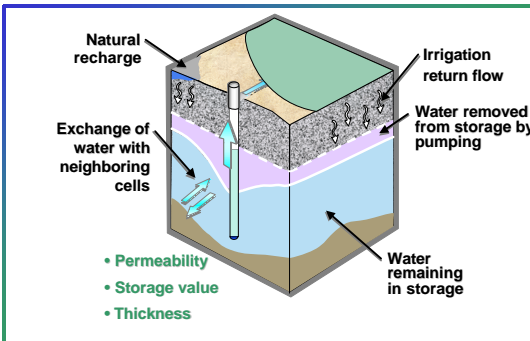
### Cells "Communicate"



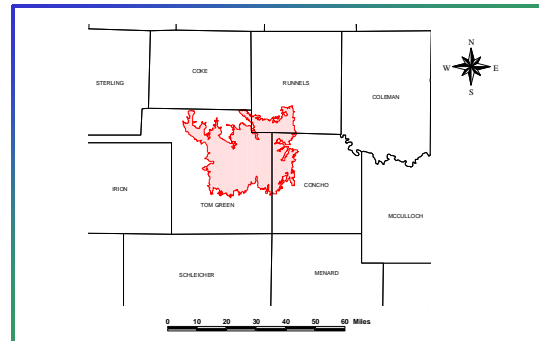
### What Goes On In A Gridblock?



### Gridblock Accounting



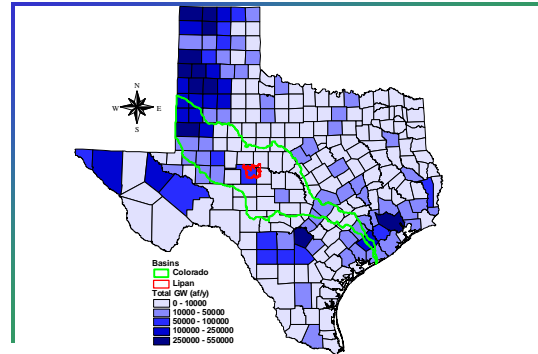
### TWDB Extent of Lipan Aquifer



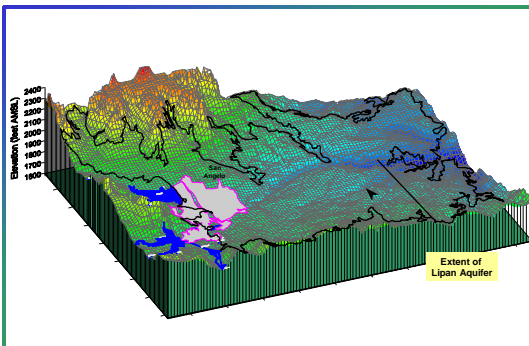
## Lipan Aquifer

- The Lipan Aquifer is categorized as a minor aquifer by the TWDB
- The Lipan is of critical importance in maintaining and further developing the potential of the region; uses include irrigation, livestock, and domestic
- Recent droughts and increased irrigation demand have caused some shortages
- Lipan-Kickapoo WCD has an excellent database

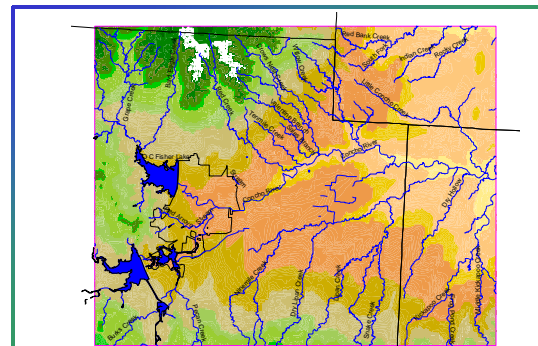
## 1997 Groundwater Usage



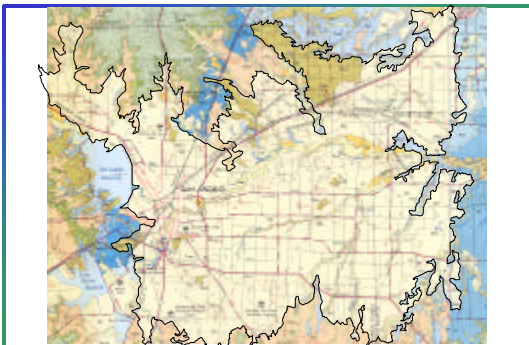
## Topography of Lipan Aquifer



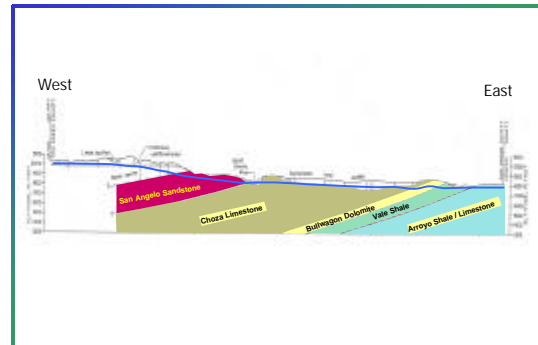
## Hydrology of Lipan Aquifer



## Lipan Aquifer Geology



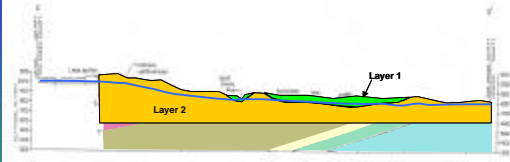
## Geologic Cross-Section



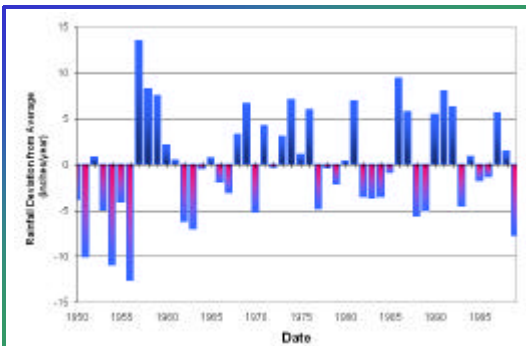
## Hydrogeologic Observations

- Most Lipan wells produce from the underlying Permian aquifers
- As expected, water quality generally deteriorates with depth
- Underlying karstic paleosurfaces influence the deposition of Leona gravels
- Distribution of high-yielding wells generally follow the strike of the underlying Permian formations

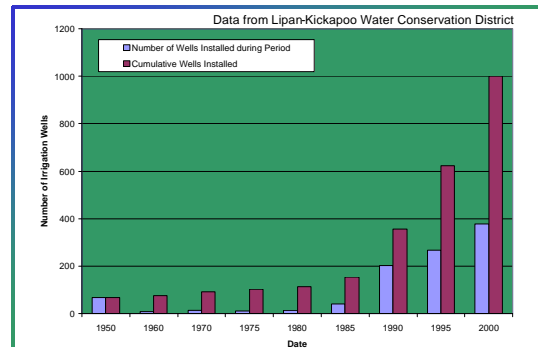
## Preliminary Conceptual Model for Lipan Aquifer



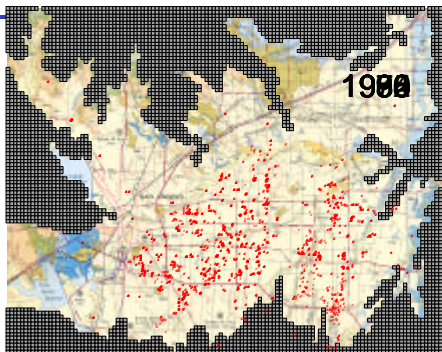
## Regional Precipitation



## Irrigation Wells

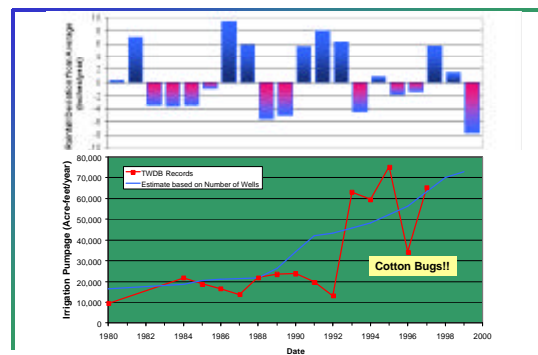


## Irrigation Well Distribution

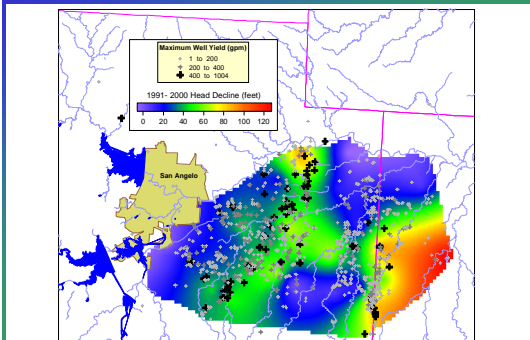


Data from Lipan-Kickapoo Water Conservation District

## Irrigation and Weather



### Observed Head Declines in LKWCD



### Observations from the Data

- Data indicate that demand from the Lipan Aquifer in the Lipan Flats area has increased 10-fold during the last decade (pivot systems)
- Water levels indicate that the aquifer has been relatively stable prior to 1990 but has experienced significant declines in the past decade

### Conceptual Model Issues

- Aquifer Characteristics
- Hydrostratigraphic layers
- Recharge (vertical and lateral)
- Pumping Allocation (Historical and Future)

### Project Schedule



### SAF Schedule

SAF Meeting	Date	Topics
1	Jan 14, '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

**LIPAN GAM STAKEHOLDER ADVISORY FORUM MEETING  
SIGN-IN SHEET**

**January 14, 2003**

<b>Name</b>	<b>Affiliation</b>
Will Wilde	City of San Angelo
James Beach	LBG-Guyton Associates
Richard Smith	TWDB

**Lipan Aquifer  
Groundwater Availability Model (GAM)**

**First Stakeholder Advisory Forum (SAF) Meeting**

**January 14, 2003  
San Angelo, Texas**

**Meeting Summary**

The first Stakeholder Advisory Forum (SAF) meeting for the Lipan Aquifer Groundwater Availability Model (GAM) was held on January 14<sup>th</sup> from 6:30 to 7:30 PM at the Texas A&M Research Center in San Angelo, Texas. Richard Smith of the TWDB introduced LBG-Guyton Associates as the consulting team that is contracted to perform the modeling project.

James Beach of LBG-Guyton made a presentation to an audience consisting of one attendee. The presentation, along with a list of participants who signed up at the meeting, is available at the TWDB GAM website ([www.twdb.state.tx.us/gam](http://www.twdb.state.tx.us/gam)). The presentation was structured according to the following outline:

- Review of GAM objectives and expectations
- Groundwater modeling concepts
- Lipan aquifer hydrogeology
- Modeling approach and conceptual model issues
- GAM and SAF schedule

The questions and answers from the SAF are presented below.

**Questions and Answers**

*Q: Will the model identify areas of recharge for the Lipan Aquifer?*

A: The model will help identify regional recharge areas in a general sense, but because of the scale and cell size of the GAM, it will not be appropriate for identifying local recharge areas in streams which may eventually contribute to Lipan recharge. Available precipitation and water level information will be used to calibrate the model.