Edwards Aquifer in the San Antonio Area: An interpretation of its Hydrogeology and Management*

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Abstract

The Edwards aquifer is the main source of water within the San Antonio area, Texas. A more comprehensive understanding of storage characteristics and flow patterns within the unconfined area is essential to characterize the potential of the Edwards aquifer to act as a water source, to sustain springflow, and to protect the resource from contamination. Future water management decisions undoubtedly will be dictated by social or political constraints; however, these decisions will be hopefully guided by our understanding of the hydrology of the system. Current management practices are based on knowledge derived from many previous investigations that determined the extent of the aquifer and hydrologic relationships among springflow, pumpage, and recharge. The most challenging management objective is to sustain discharge from Comal and San Marcos springs at or above the prescribed, mandatory rates. This objective is typically attained by controlling pumpage; however, this objective is becoming more elusive with increasing water demands. A refined concept of the groundwater flow paths within the Edwards Aquifer unconfined zone and estimates of how long water is retained before entering the confined zone are needed. Current data on the hydrogeology of the Edwards Aquifer are not adequate to refine our present conceptualizations. Needed data include mapping of the surface geology that identify hydrostratigrahic units, identifying karstic features including all known caves, better maps of water-level and the saturated thickness, more water chemistry data, and tracer tests to determine direction and rate of flow. These data need to be incorporated into new models so that the proposed plans can be evaluated with greater assurance of the success for their intended purposes.

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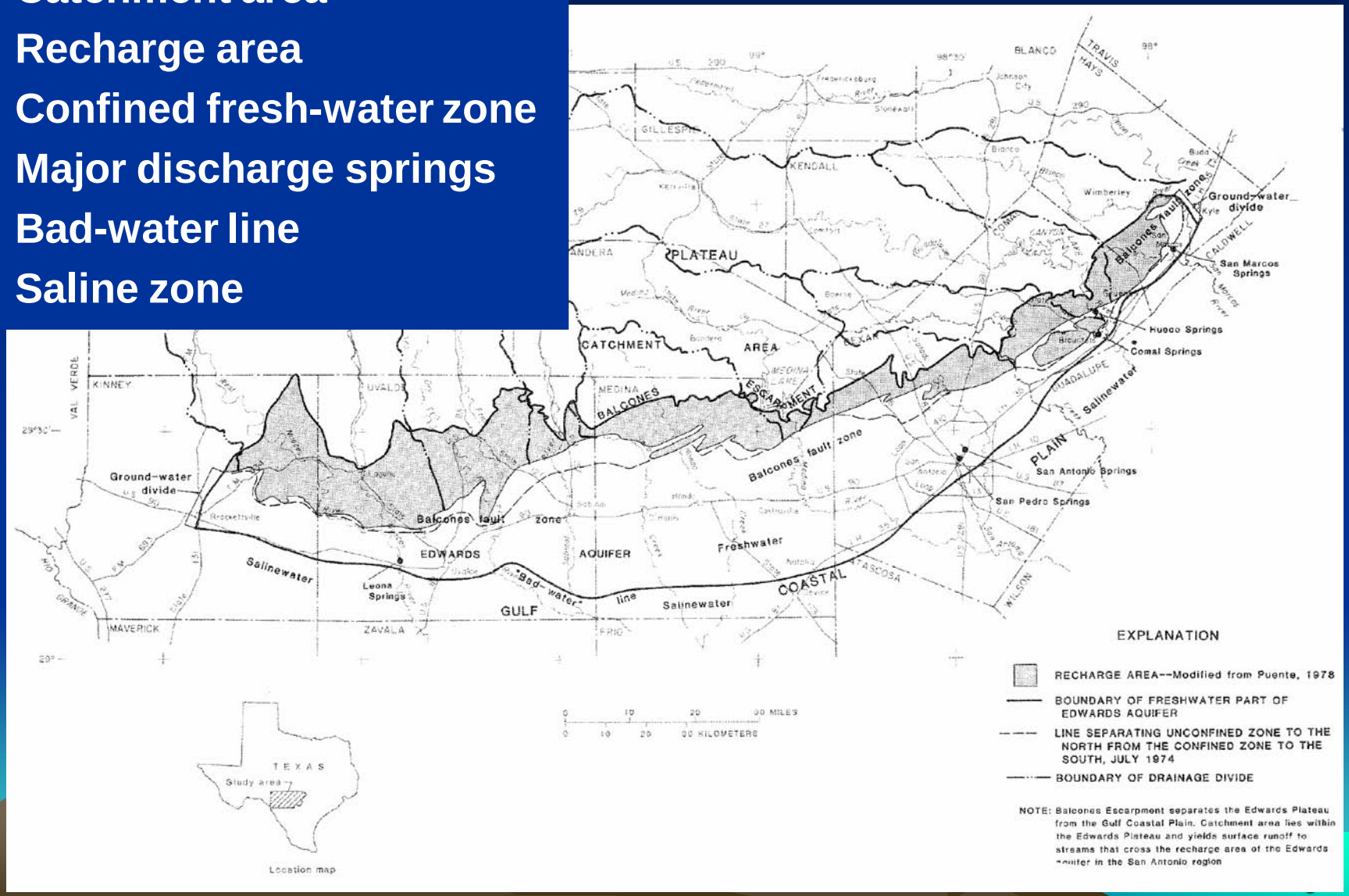
Objective of Presentation

- Describe hydrogeology of the Edwards aquifer
- Investigate groundwater flow in the Edwards aquifer
- Describe management of the Edwards aqufer and its constraints

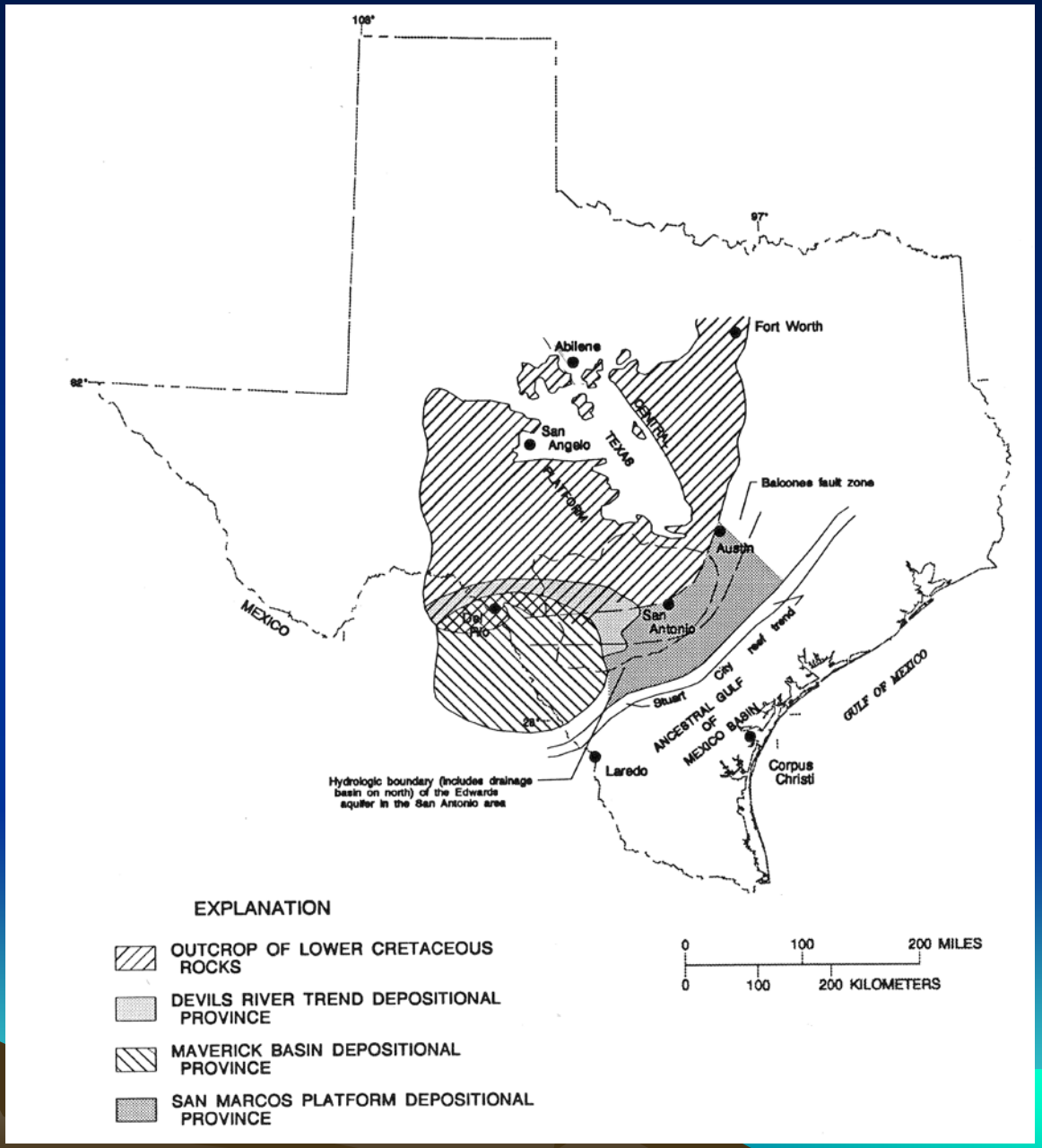
Regional Components of the Edwards Aquifer

- Catchment area
- Recharge area
- Confined fresh-water zone
- Major discharge springs
- Bad-water line
- Saline zone



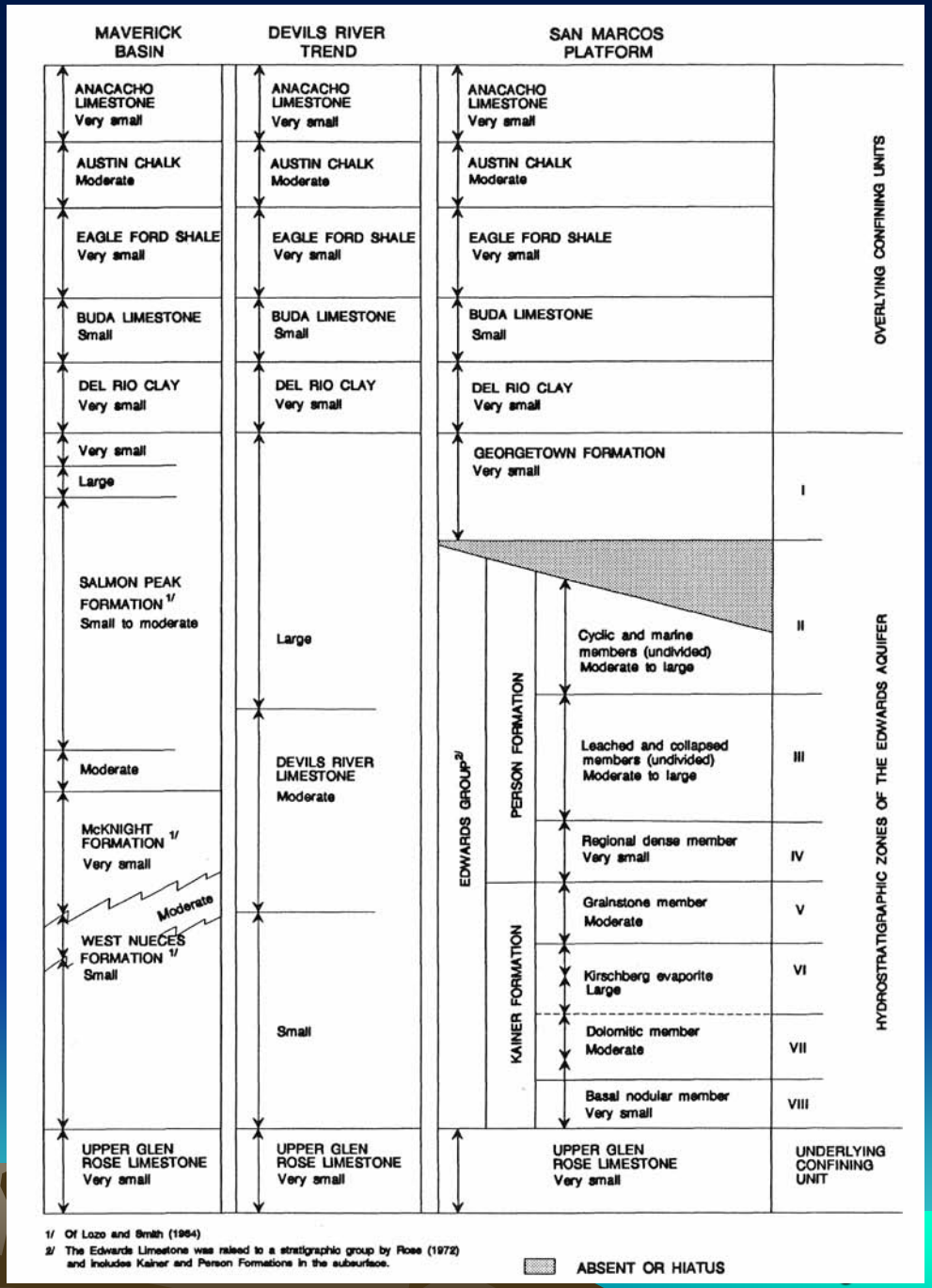
Depositional Provinces

- San Marcos Platform
- Devil's River Trend
- Maverick Basin



Hydrostratigraphy

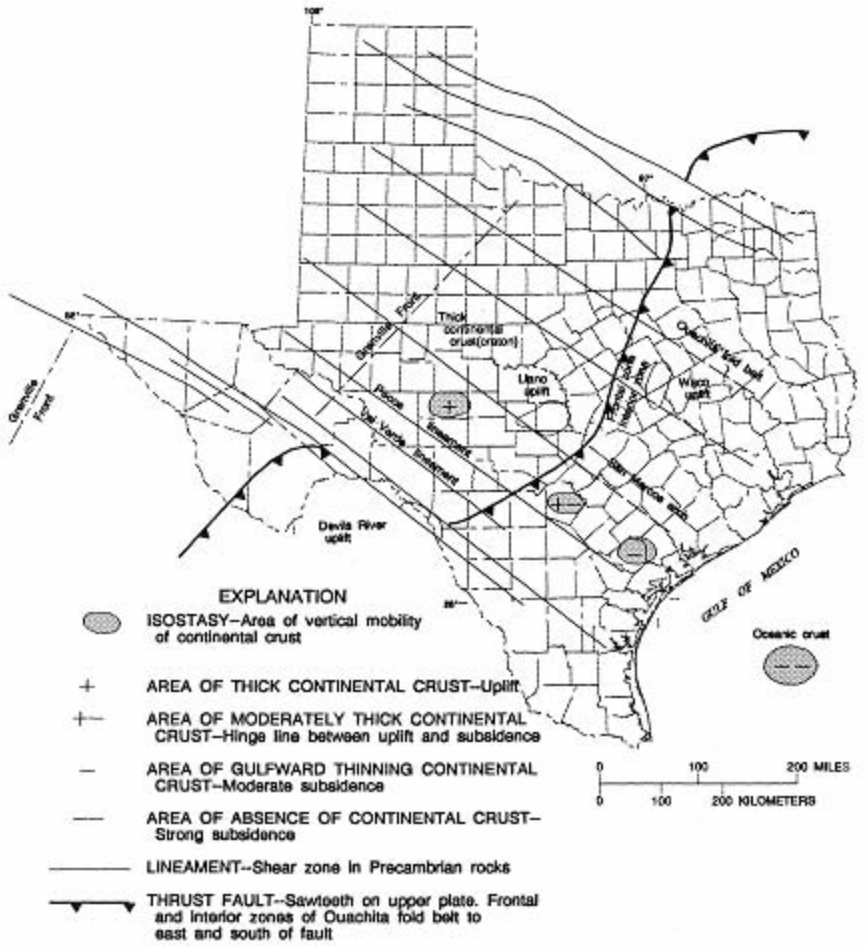
- Permeable units
- Low permeable units
- Regional stratigraphic correlation



Structure

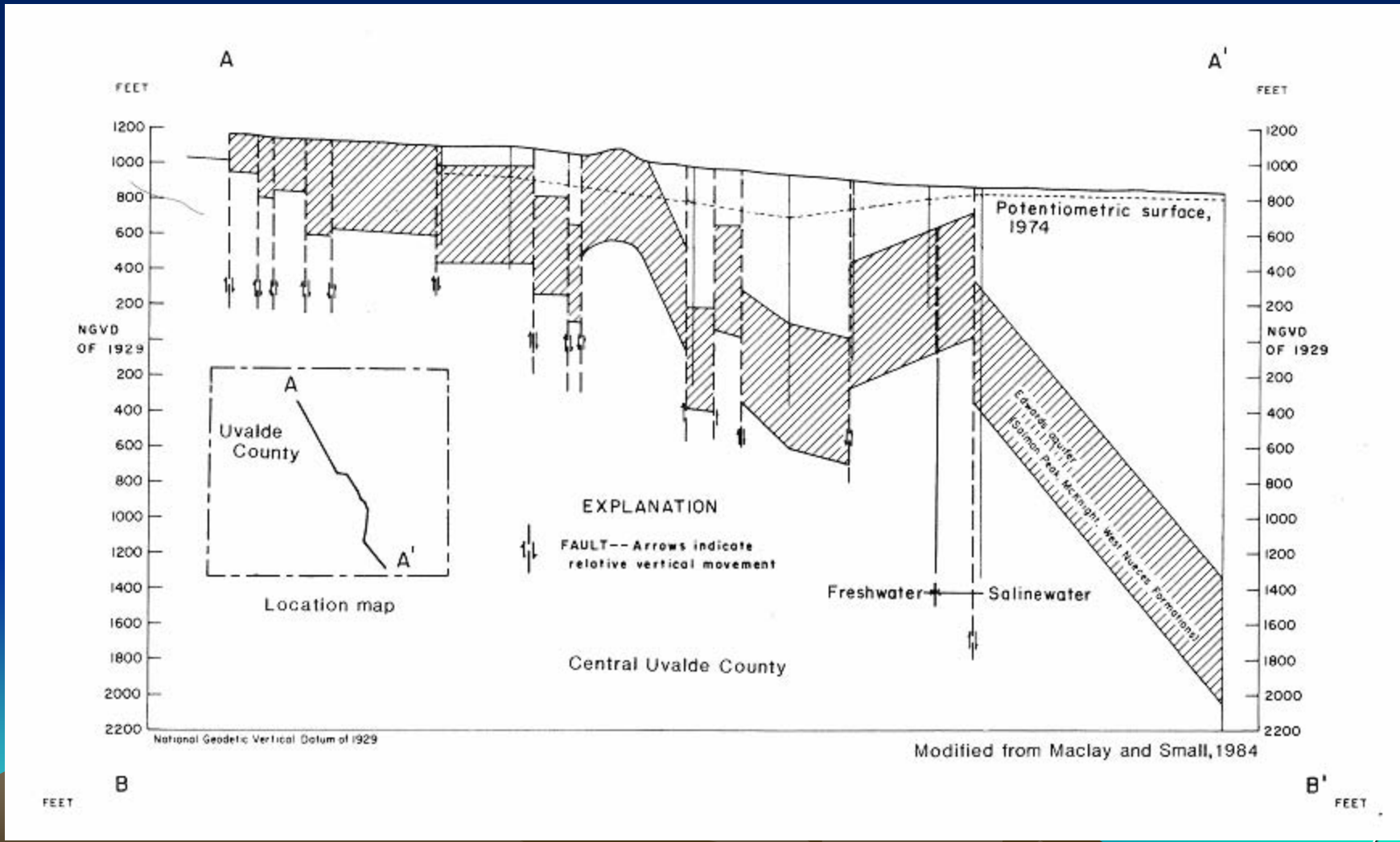
Balcones Fault Zone:

en echelon pattern of a series on northeast trending strike-slip fault that have been reactivated by uplift

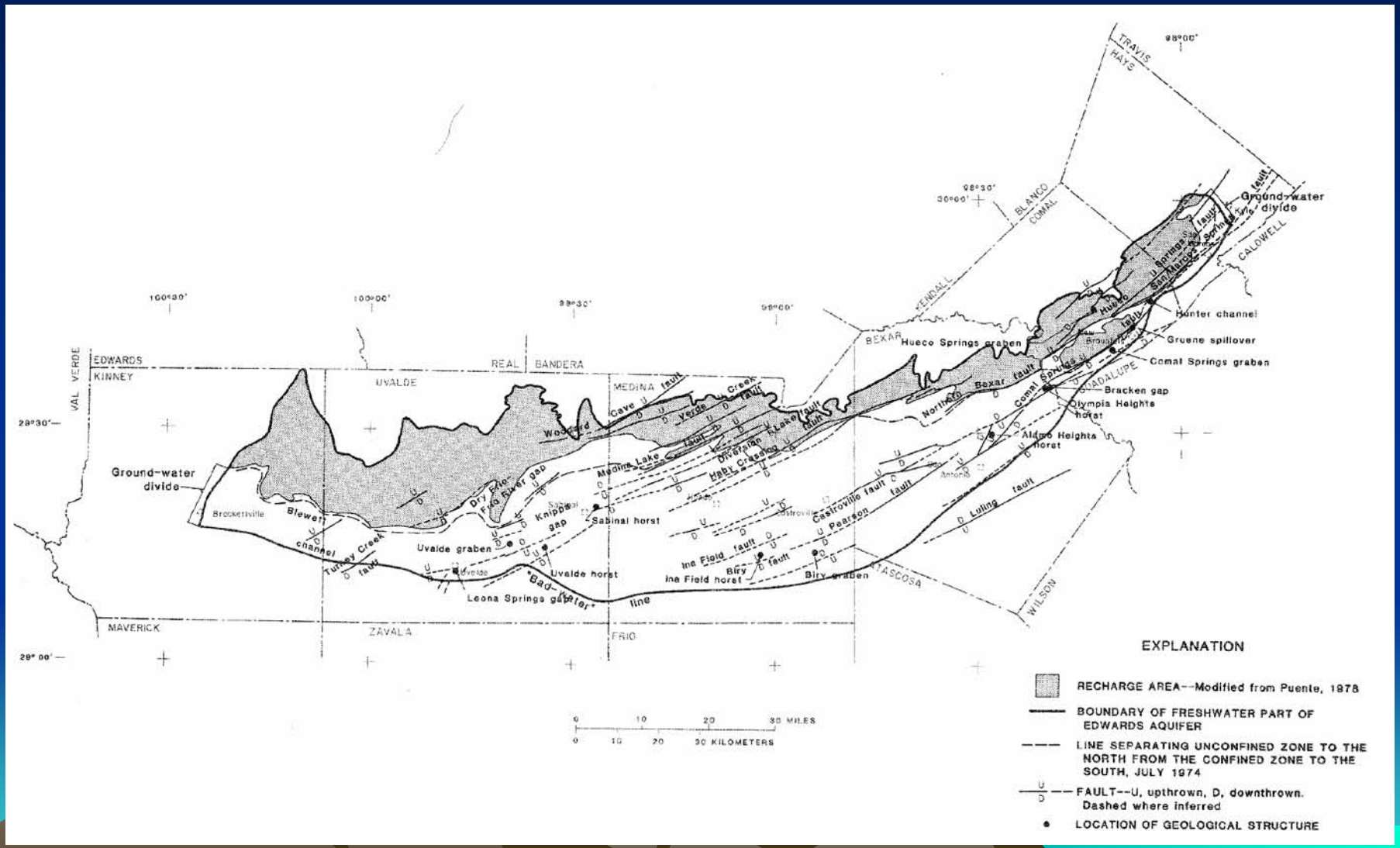


High-Angle Normal Faults

Ramp faulting near linements



Structures restricting ground-water flow

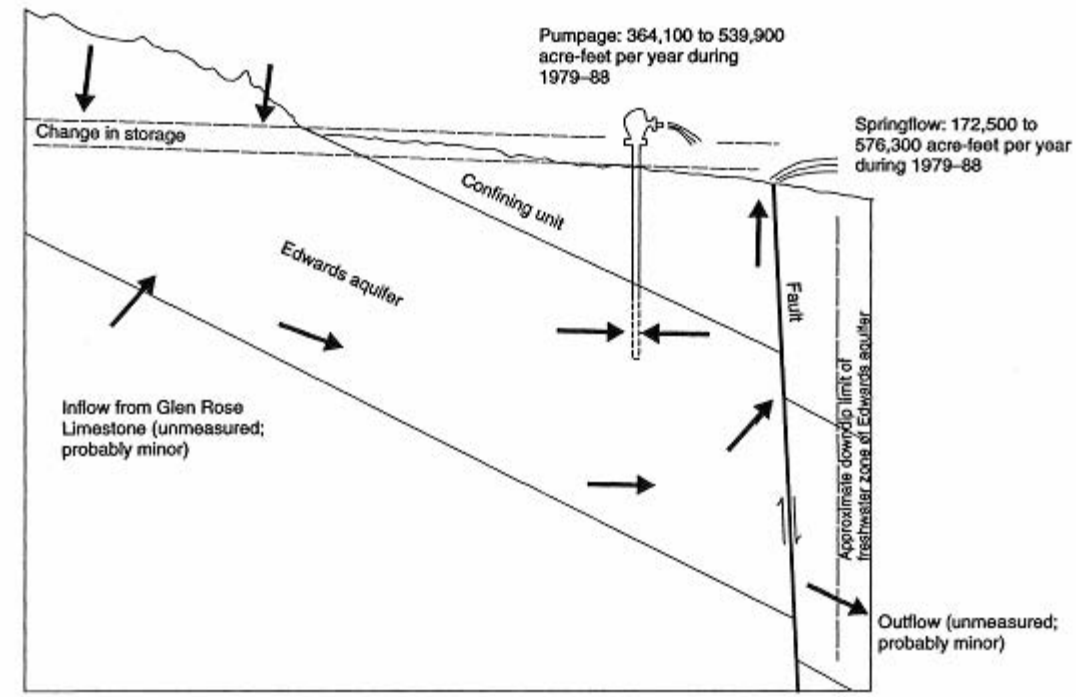


Hydrogeologic framework

- Diagenesis
- Paleokarst
- Uplift and erosion
- Karstification of exposed Edwards Limestone
- Dedolomization of rocks in fresh-water confined aquifer
- Well preserved textures in saline zone
- Lithology – fresh water zone-saline zone

Hydrology

- Water budget
- Groundwater flow
- Major fault barrier

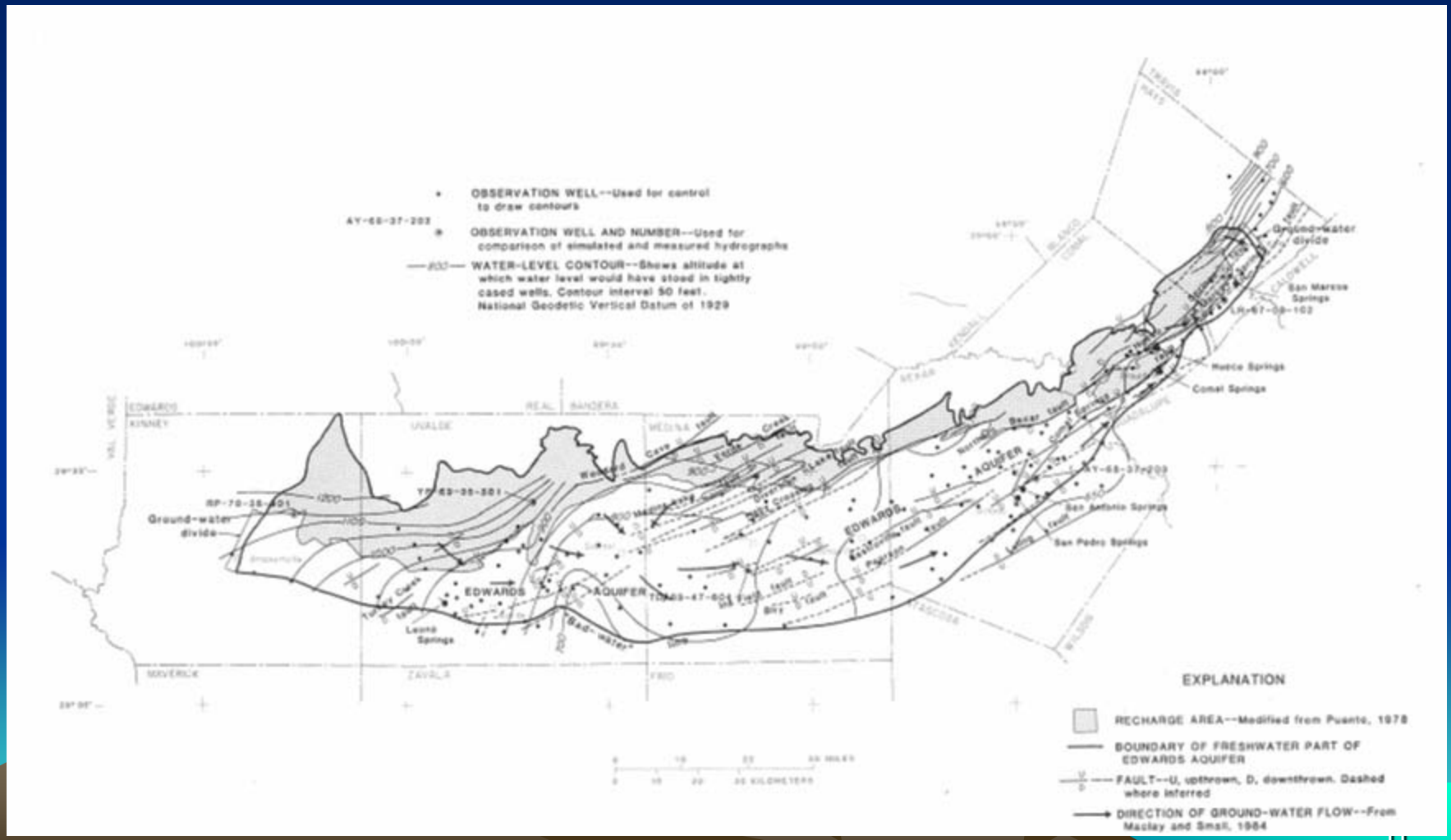


A. Variation of water-budget components during 1979–88

	Drought year (1956)	Wet year (1987)
Recharge (acre-feet)	43,700	2,003,600
Springflow (acre-feet)	69,800	576,300
Pumpage (acre-feet)	321,000	364,100
Change in storage (acre-feet) decrease (-), increase (+)	-347,200	+1,063,200

B. Water-budget components during a drought year and a wet year

Synoptic potentiometric map showing directions of ground-water flow

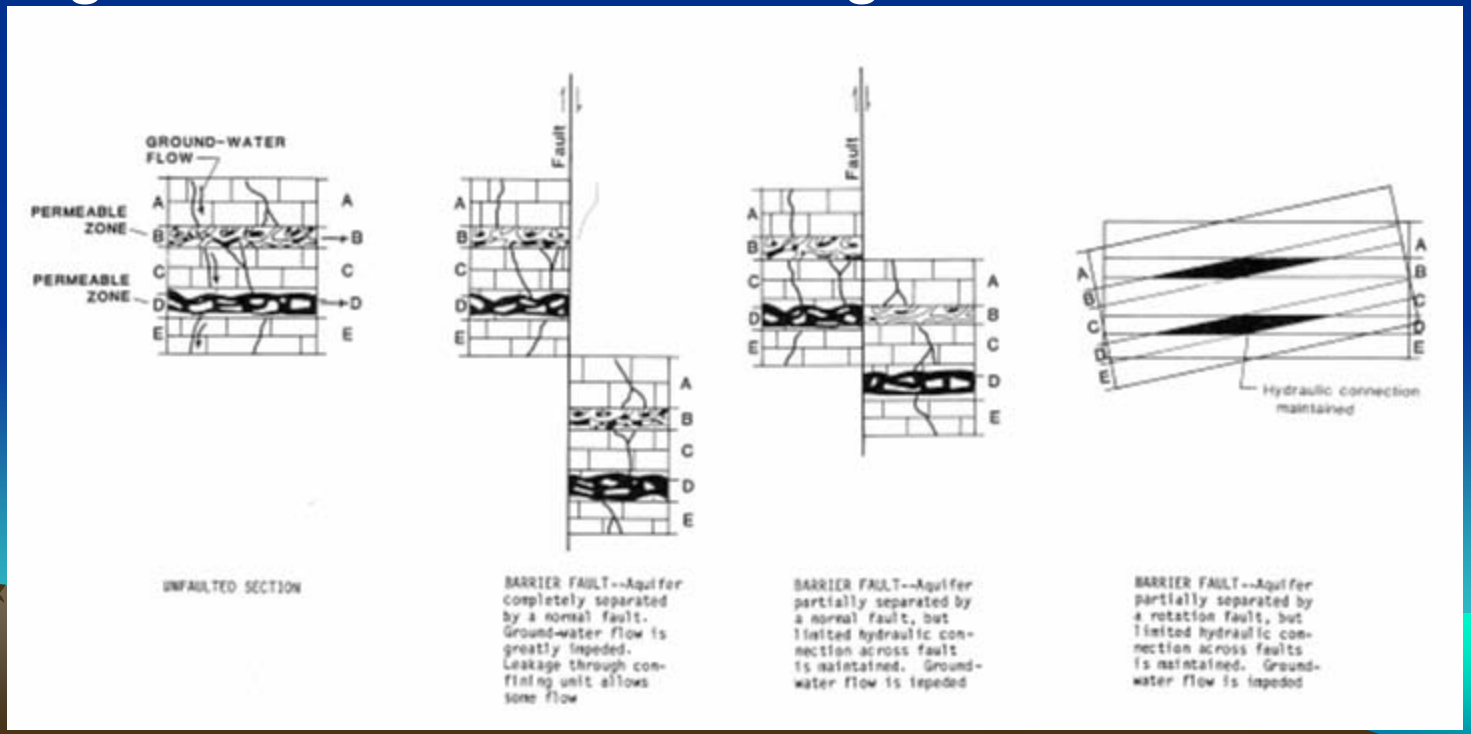


Management Models

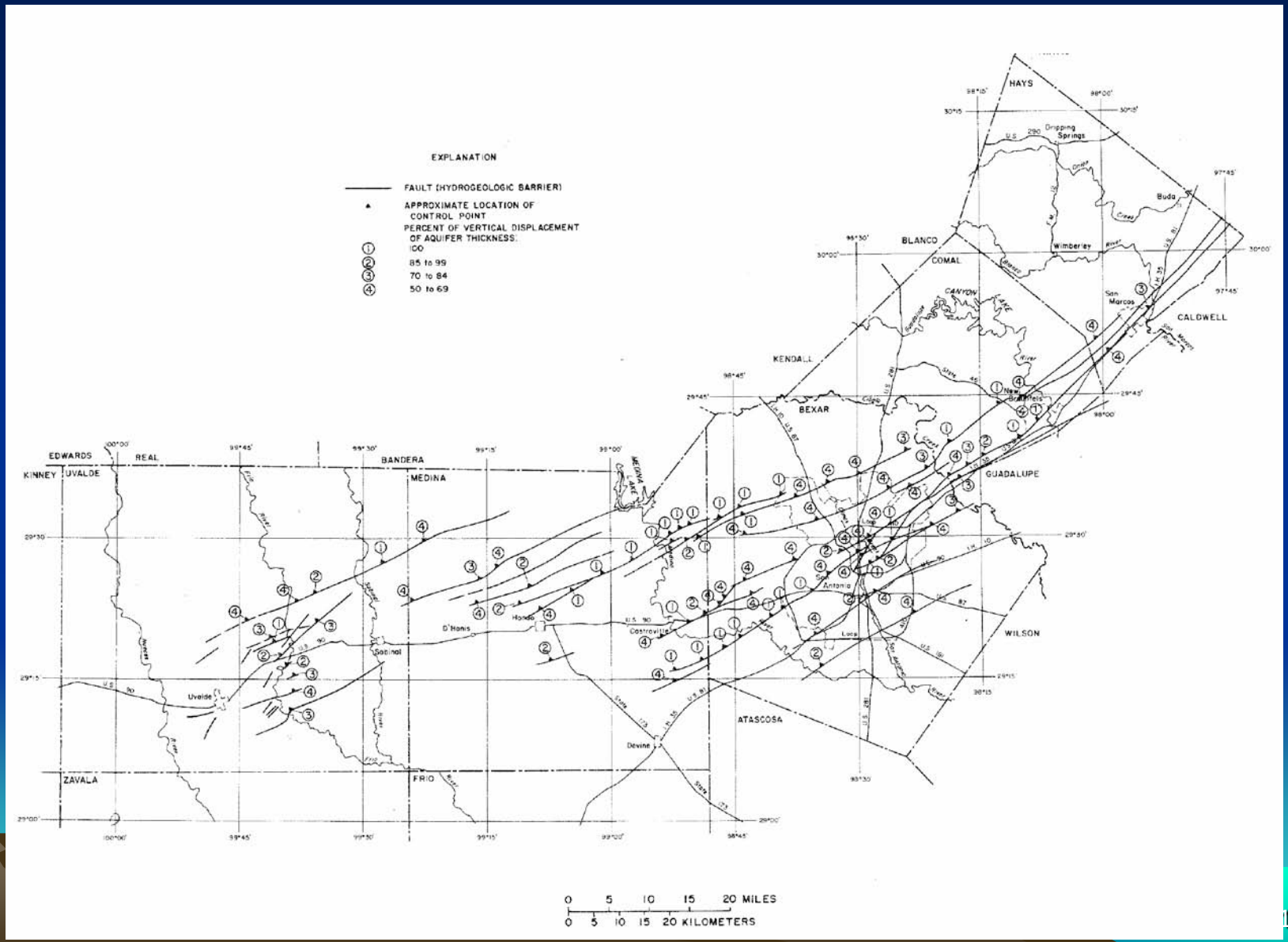
- Objectives
  - Provides a sustainable municipal supply
  - Sustain springflow at required rates
  - Protect water quality
- Applied regulation model
- Recharge=discharge change in storage
  - Annual basis

Conceptualization of Controls on Groundwater Flow

- Aquifer is non-homogeneous and anisotropic
- Groundwater flows along the path of least resistance
- Identify paths of least resistance
- Determine relatively permeable zones within the aquifer
- Identify structures that control direction of flow
- Investigation was based on a large and diverse database

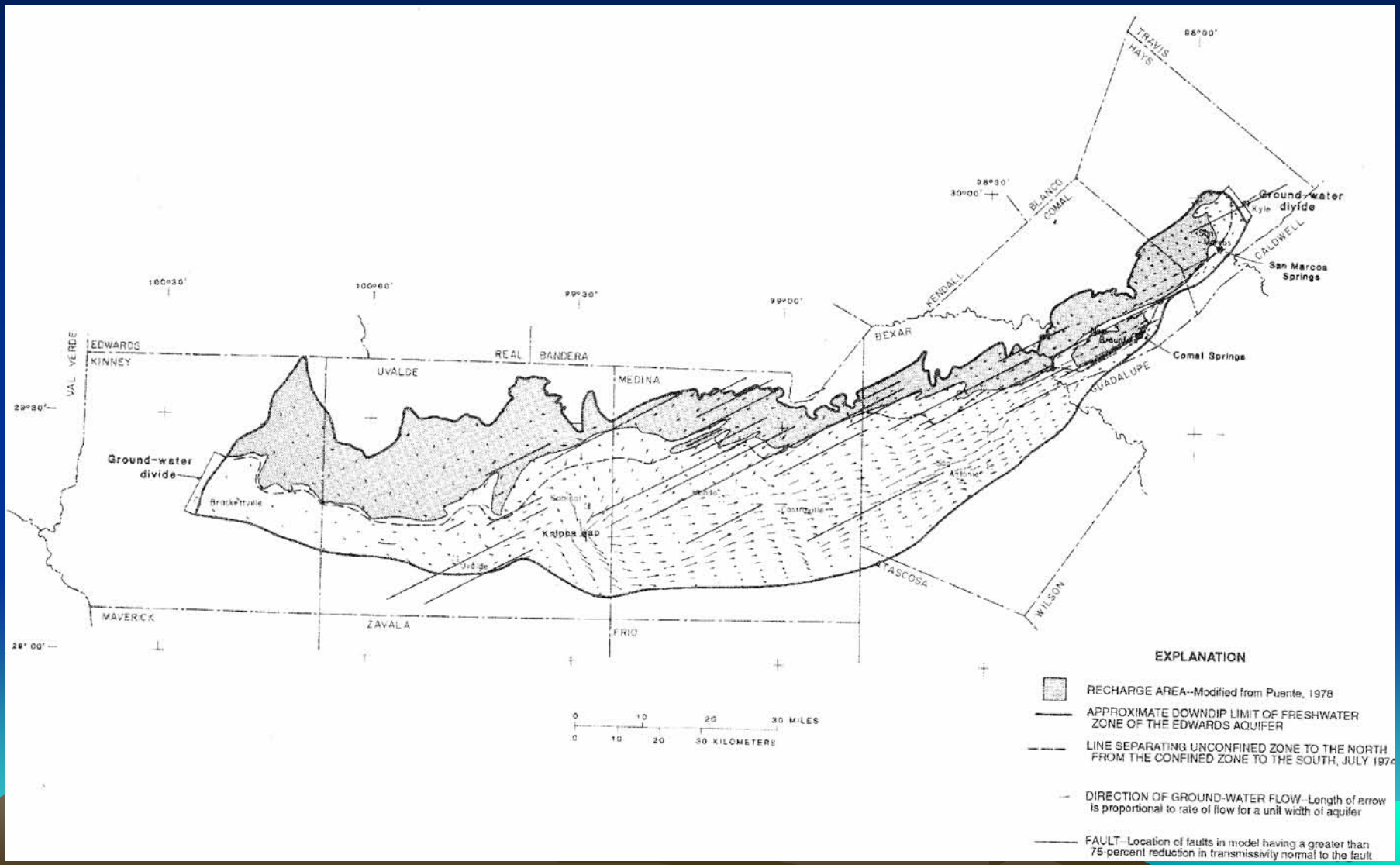


Research aquifer constraint – major barrier faults

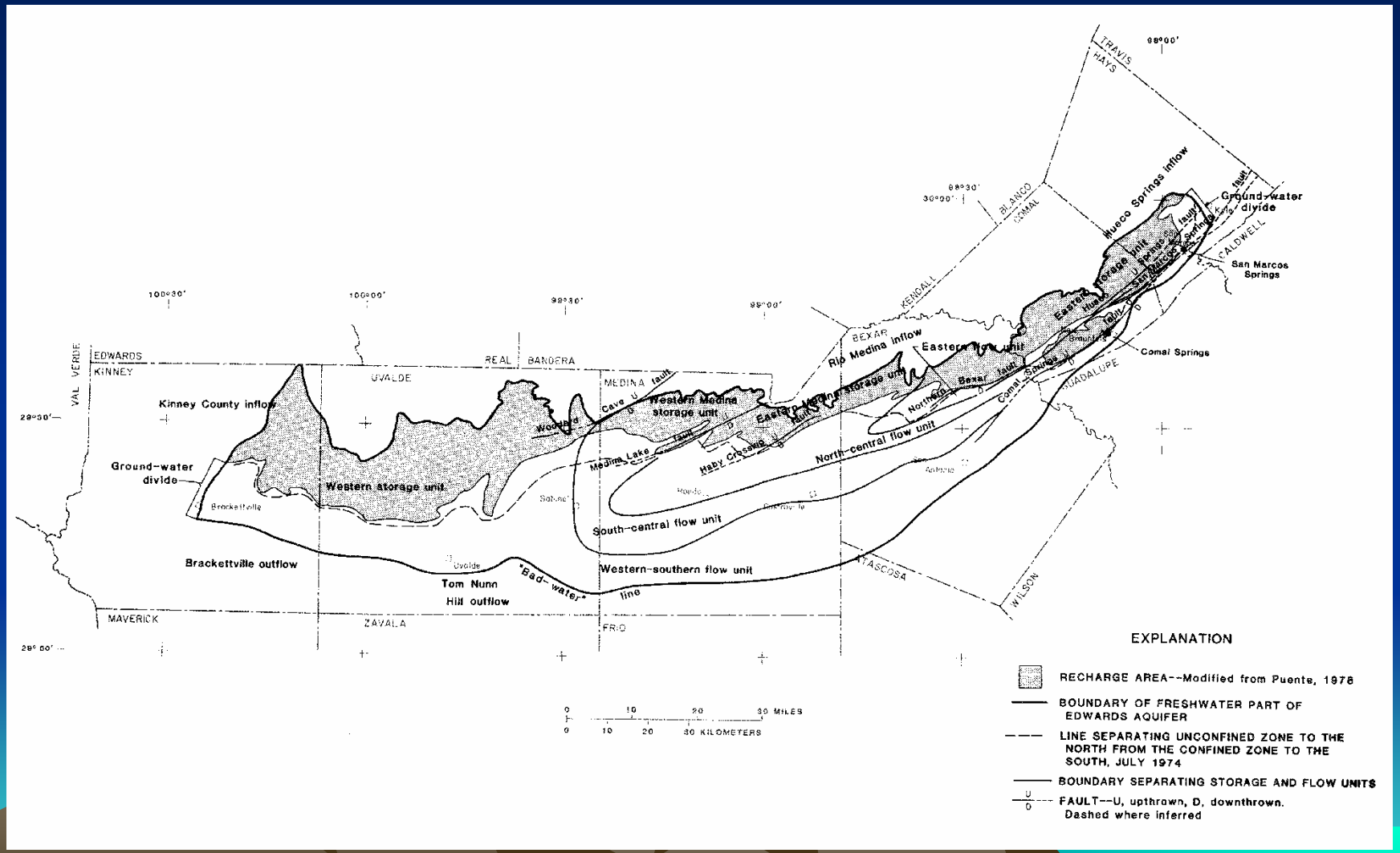


Investigative model-computer model

Cause and effect



Research aquifer constraints – fault boundaries, springflow, storage, flowpaths



Conclusions

- Faults control the direction of ground-water flow within the Edwards Aquifer in the Balcones Fault Zone
- Cavernous strata and fault conduits within the confined freshwater are highly transmissive
- More hydrologic information is needed to evaluate local pattern of ground-water flow and to understand storage retention within the recharge zone

Acknowledgements

- Ted Small – a friend, associate, and excellent field geologist
- Prepared many geologic cross sections
- Contoured the top of the Edwards Aquifer in the San Antonio area

References

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Puentes, C., 1978, Method of estimating natural recharge to the Edwards Aquifer in the San Antonio area, Texas, *in* U.S. Geological Survey Water-Resources Investigations 78-10, WRI, 34 p.