Hot Science Cool Talks

UT Environmental Science Institute

20

The Edwards Aquifer: Will There Be Water for Texas?

Dr. John M. Sharp

October 18, 2002

The Edwards Aquifer:
Will There be Water for Texas?

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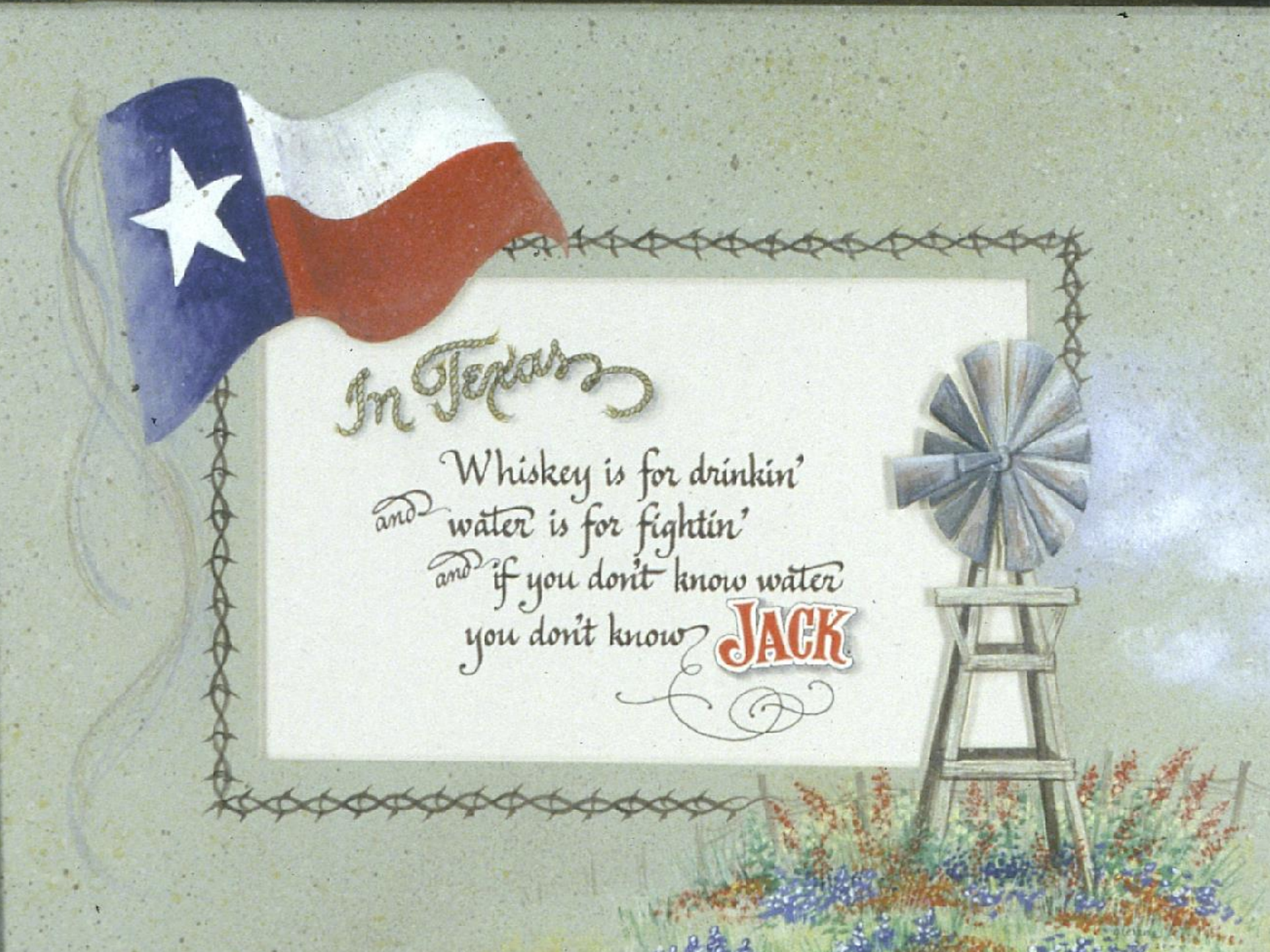
Department of Geological Sciences
University of Texas at Austin


In Texas
Whiskey is for drinkin'
and water is for fightin'
and if you don't know water
you don't know JACK

The Edwards Aquifer

- What is an aquifer?
- Geologic History
- How does water enter the aquifer?
- How does water leave the aquifer?
- Who uses water from the aquifer?
- Issues facing the aquifer

Headline News

Water is always making headlines in Texas. Locally, the Edwards aquifer always seems to be in the news. This is because water is vital to our society.

the playoff race. SPORTS 'Spy Kids' is a taste of moviemaking's future. LIFE & MOVIES

American-Statesman

statesman.com Friday, August 9, 2002

Barton findings hint at future health risks

Chemical in pool sediment not hazardous to humans yet

By Kevin Carmody
AMERICAN-STATESMAN STAFF

BACK TO SCHOOL

Studies in style

Join the fashion-smart set with back-to-school looks for every mood.

IN LIFE & ARTS

American-Statesman

statesman.com Thursday, August 8, 2002

Gus Garcia
Mayor says much is left to be done to protect Barton Springs.

Ten years later, Austin still working to save its springs

By Stephen Scheibal
AMERICAN-STATESMAN STAFF

The Save Our Springs ordinance survived an unlikely birth through a citizen's petition drive and a landslide election. It weathered a slew of attacks in the Texas Legislature and the courts. It established a new political order at City Hall and changed the way Austin grew.

But the ordinance

The Save Our Springs ordinance and its history, A10.

Pollution levels at Austin's iconic swimming hole are higher than they were in 1992, and the new suburbs that threaten the springs continue to grow further and further from Austin's regulatory reach.

For a decade, Austin's environmental

of dollars for preserve land.

Time is growing short. City scientists warn that toxic chemicals, including arsenic and copper, have reached alarming levels in the springs, threatening the endangered salamander that lives there.

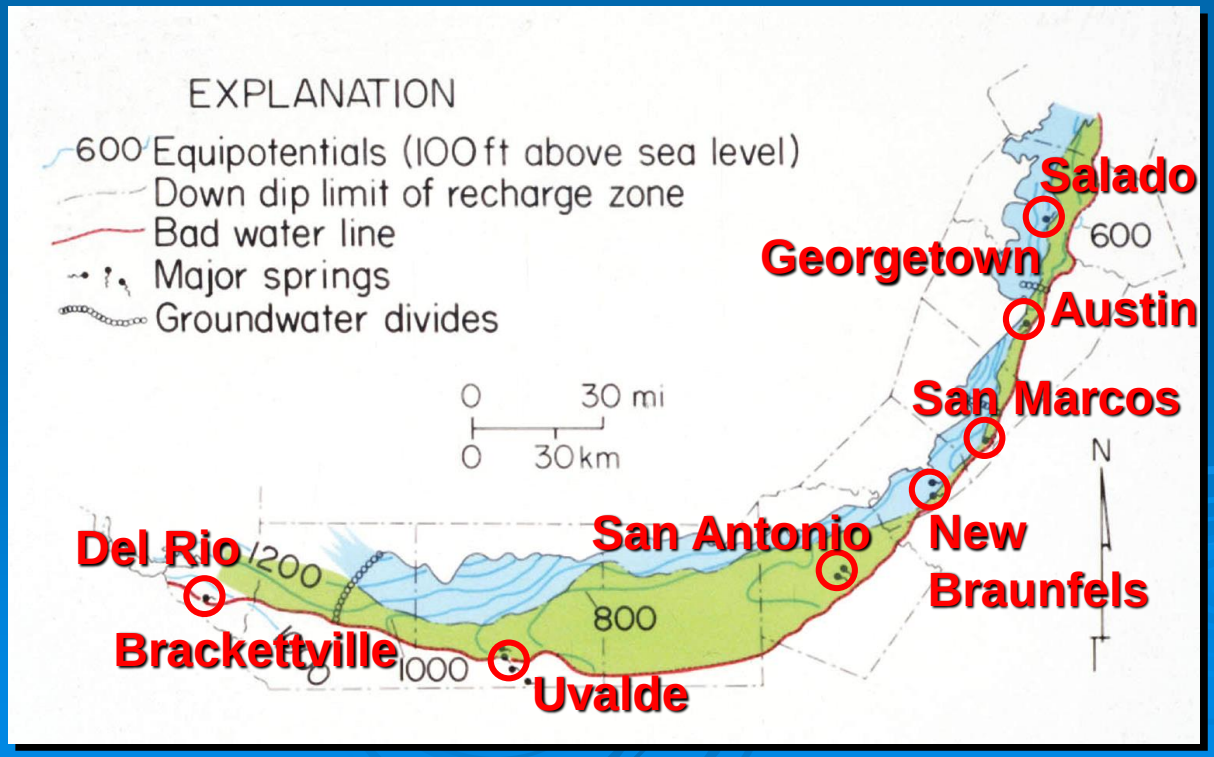
"There's no question that a lot of work needs to be done," Mayor Gus Garcia said.

Marking the day

The City of Austin and the Save Our Springs Alliance, an environmental group, will commemorate the 10th anniversary of the passage of the SOS water quality ordinance by opening Barton Springs Pool to free swimming today. The alliance also plans other activities today and Friday. For more information

It's Where We Live

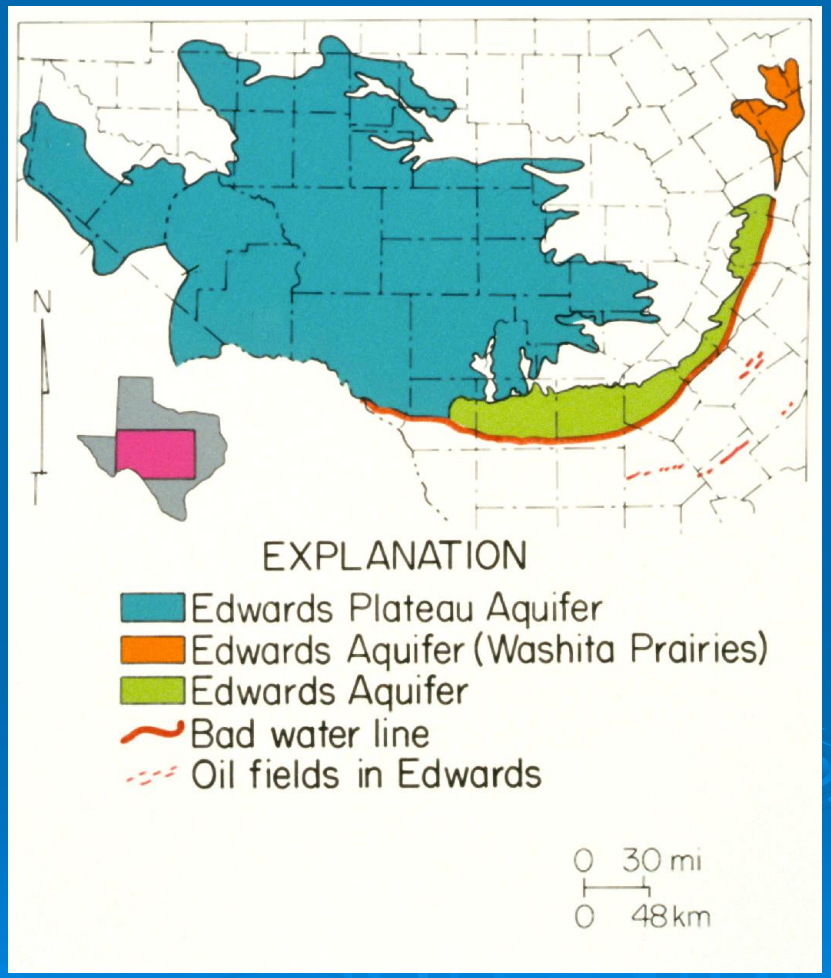
- These springs led to the development of major towns along the aquifer: Salado, Georgetown, Austin, San Marcos, New Braunfels, San Antonio, Uvalde, Brackettville, and Del Rio. All of these towns are sited where major springs discharge from the Edwards aquifer.



From Barton Springs to the Gulf

What is an aquifer?

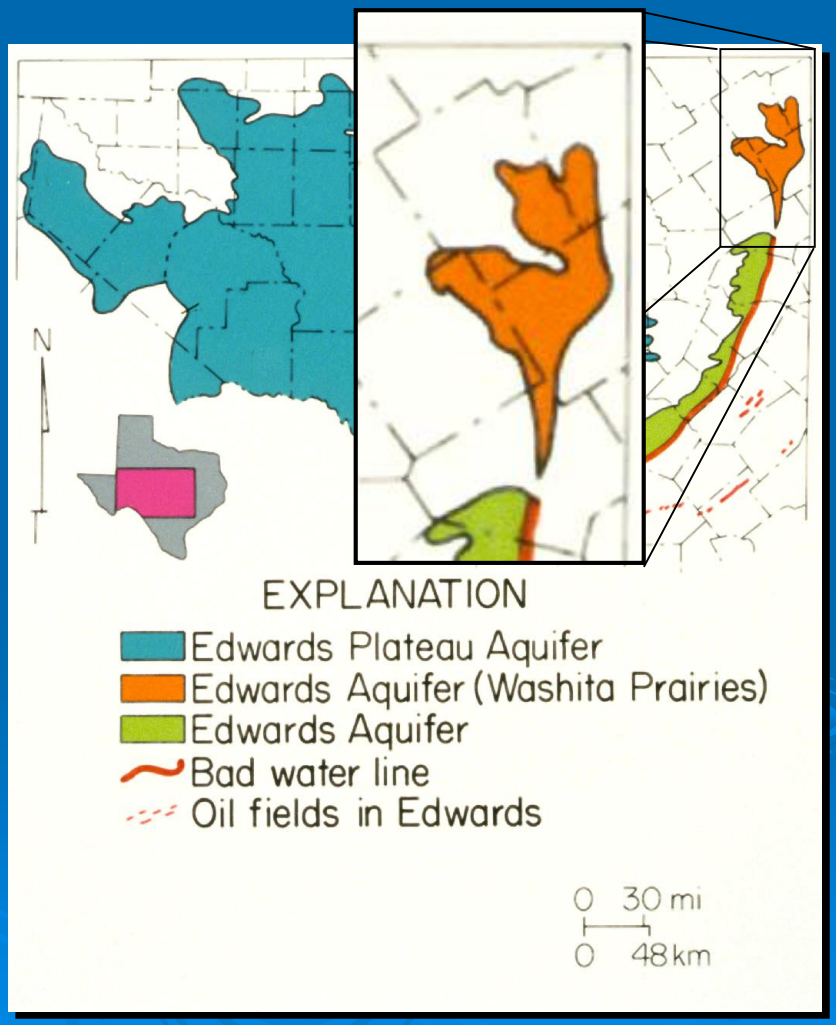
A body of rock, sediment, or soil that contains drinkable water and can transmit this water to wells or springs in economically usable quantities



Related Aquifers in Central and West Texas

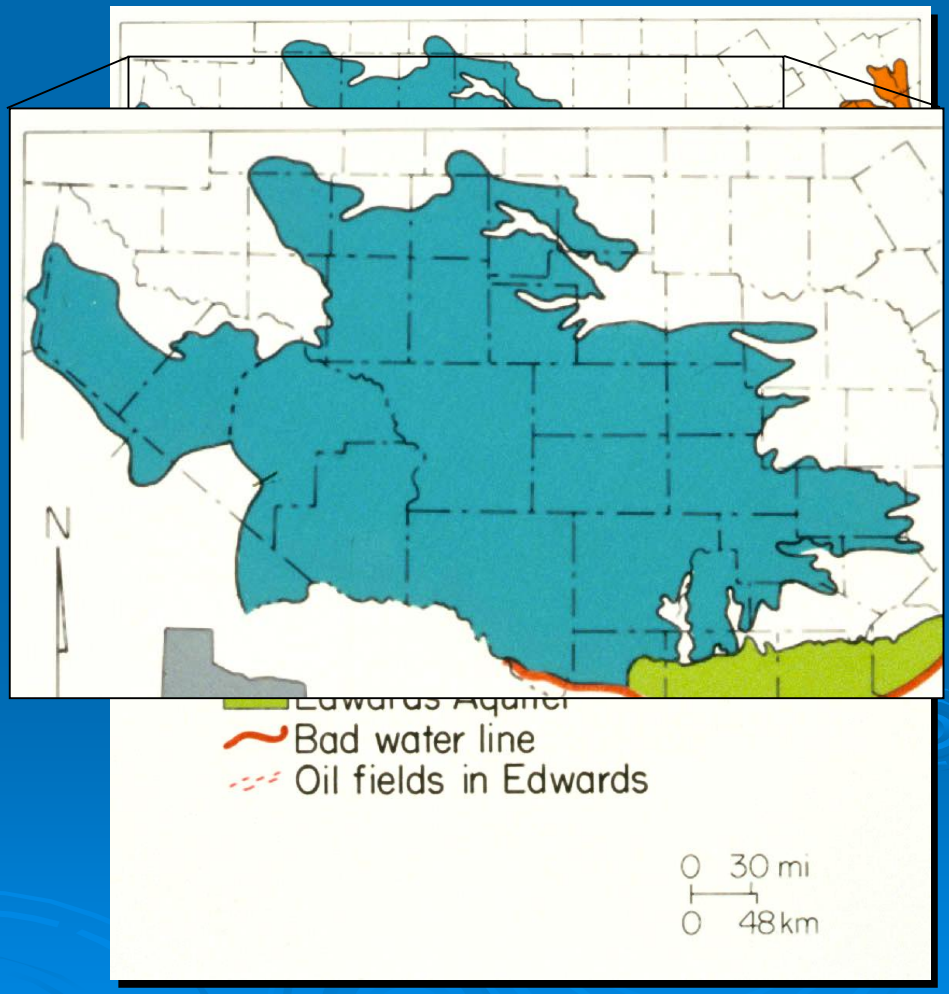
The carbonate rocks that hold the waters form several aquifers:

- The Washita Prairies aquifer near Waco



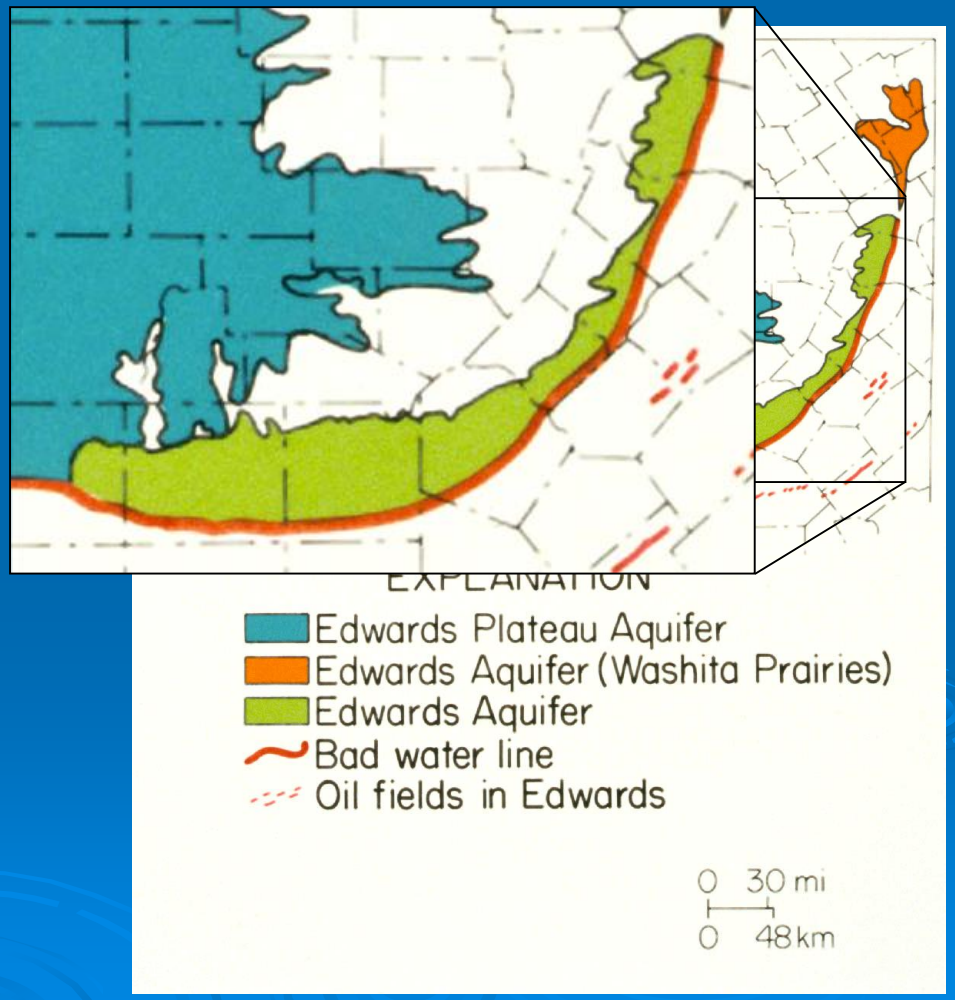
Related Aquifers in Central and West Texas

- The Edwards-Trinity Plateau aquifer (that long, flat stretch between Junction and Fort Stockton along I-10)



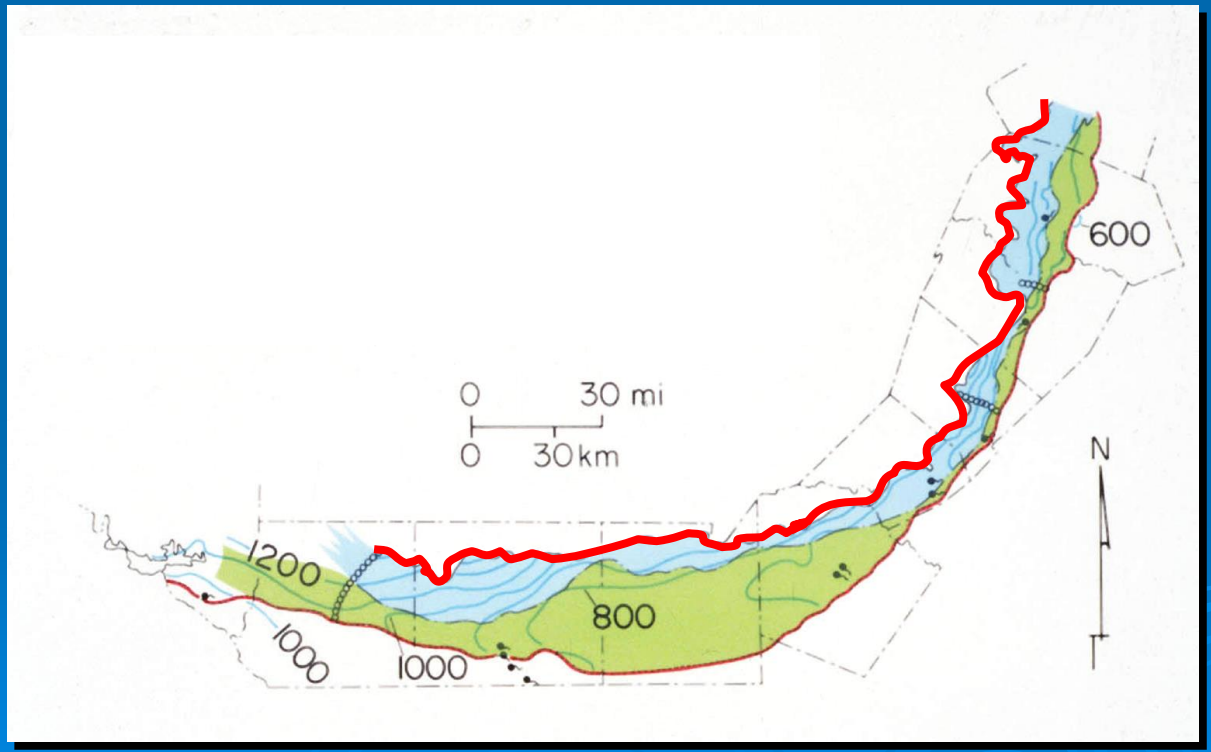
Related Aquifers in Central and West Texas

- The (Balcones Fault Zone) Edwards aquifer, what we refer to as the Edwards aquifer



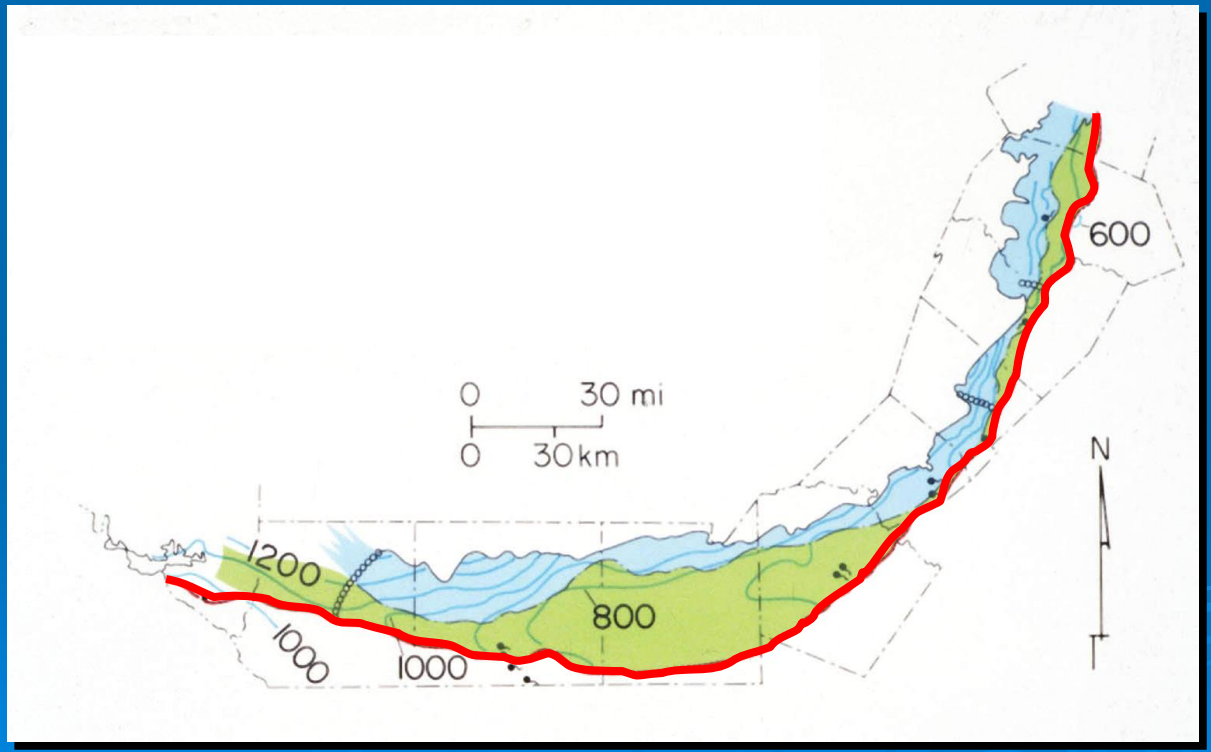
The Edwards aquifer

This narrow band of carbonate rocks extends from Del Rio to Salado, Texas. The boundary along the north and west is where the rocks have been eroded.



The Edwards aquifer

The boundary along the south and east is the badwater line. Waters pumped beyond this boundary are too salty for human consumption.



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The Rocks

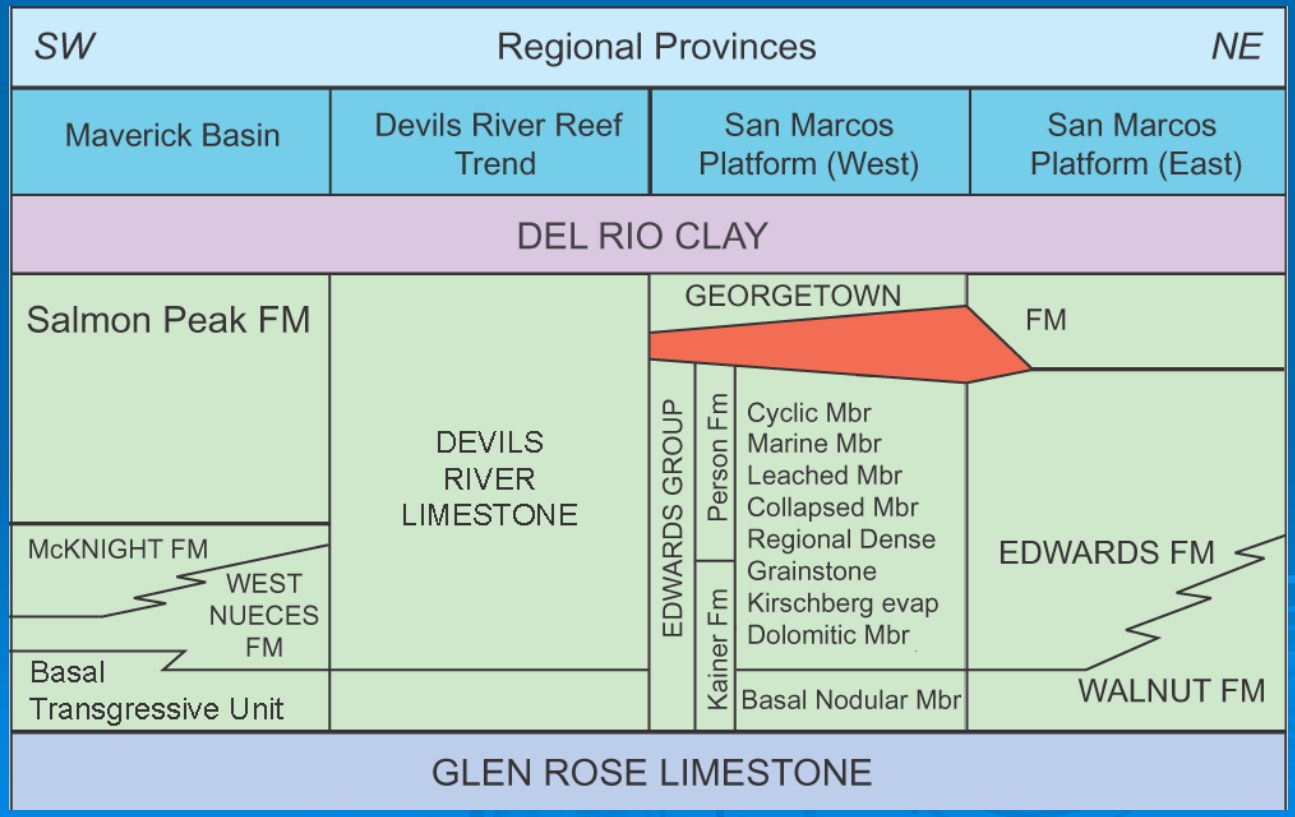
Edwards aquifer rocks formed during the days of the dinosaurs (the Cretaceous Period or between 62 million and 130 million years ago) in a series of reefs and lagoonal deposits.

The Rocks

A rudistid clam, one of the chief reef-building organisms of Cretaceous time.

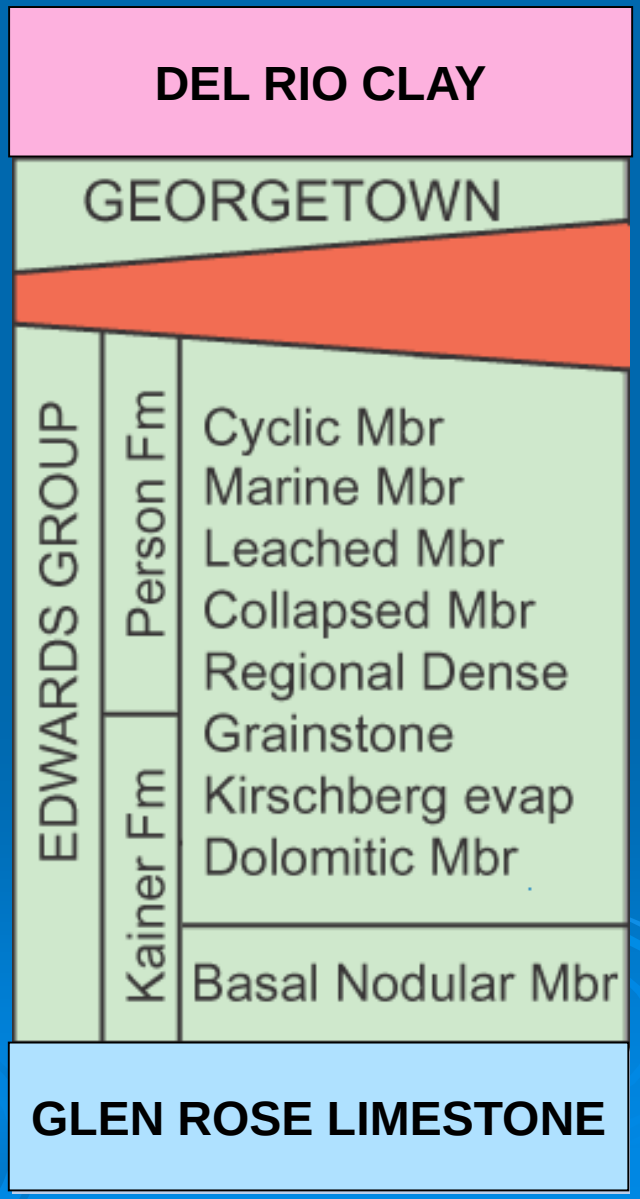
The Rocks

A number of different geological formations host the Edwards aquifer. In Austin, the aquifer rests in the Georgetown Formation and the Edwards Group.

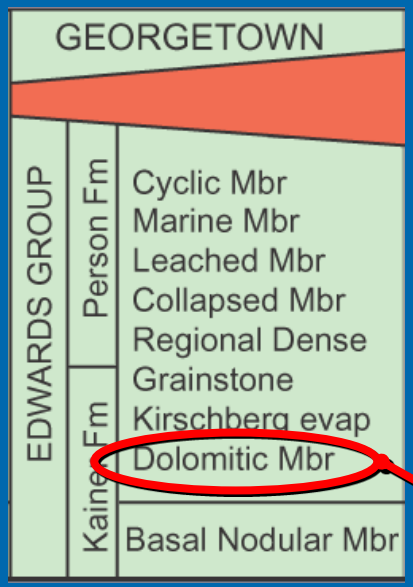


Where's the water?

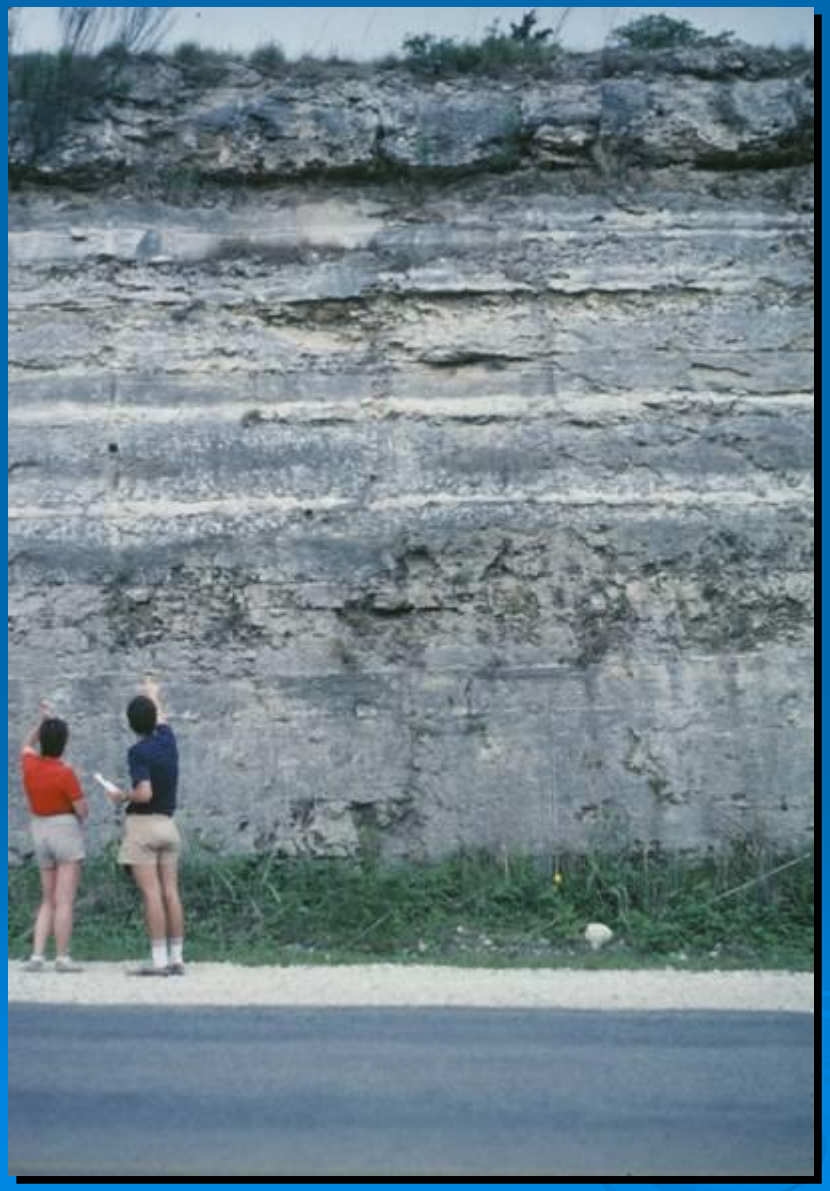
Water is held in rocks between the Glen Rose Limestone and the low permeability Del Rio Clay.

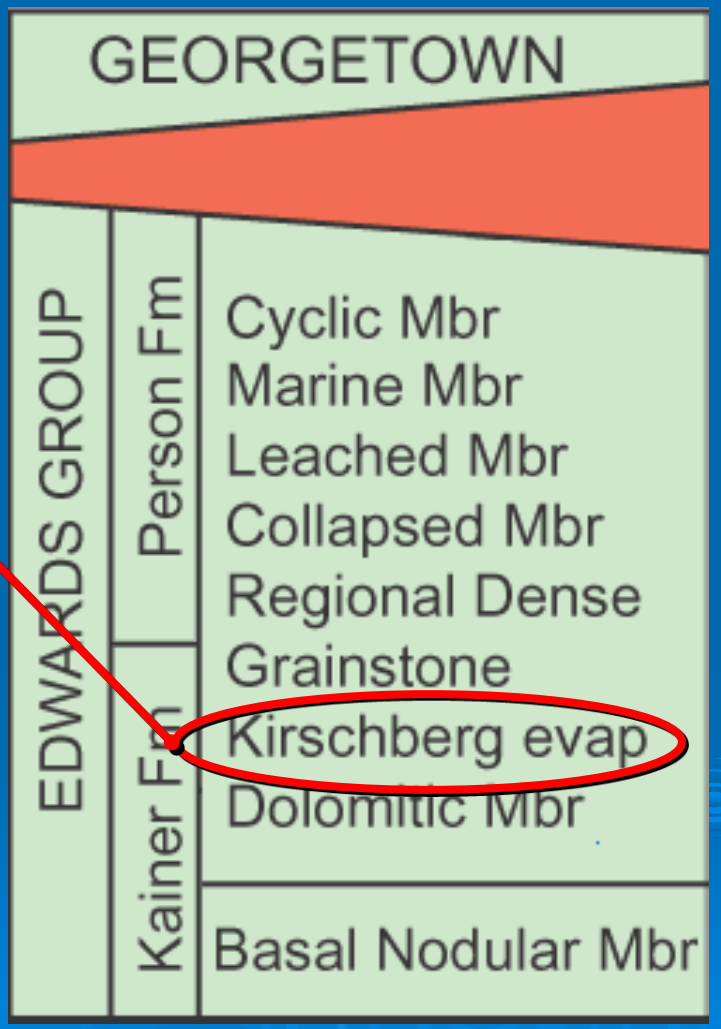


The Dolomitic Member

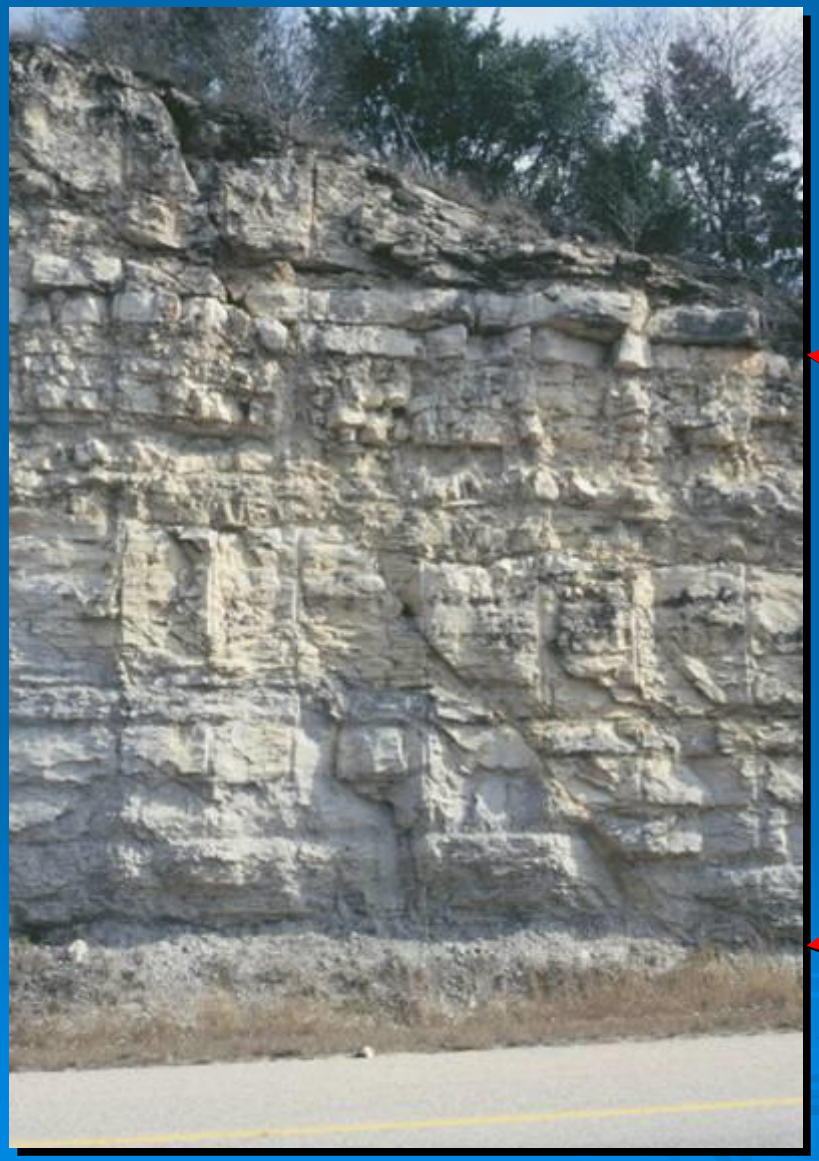


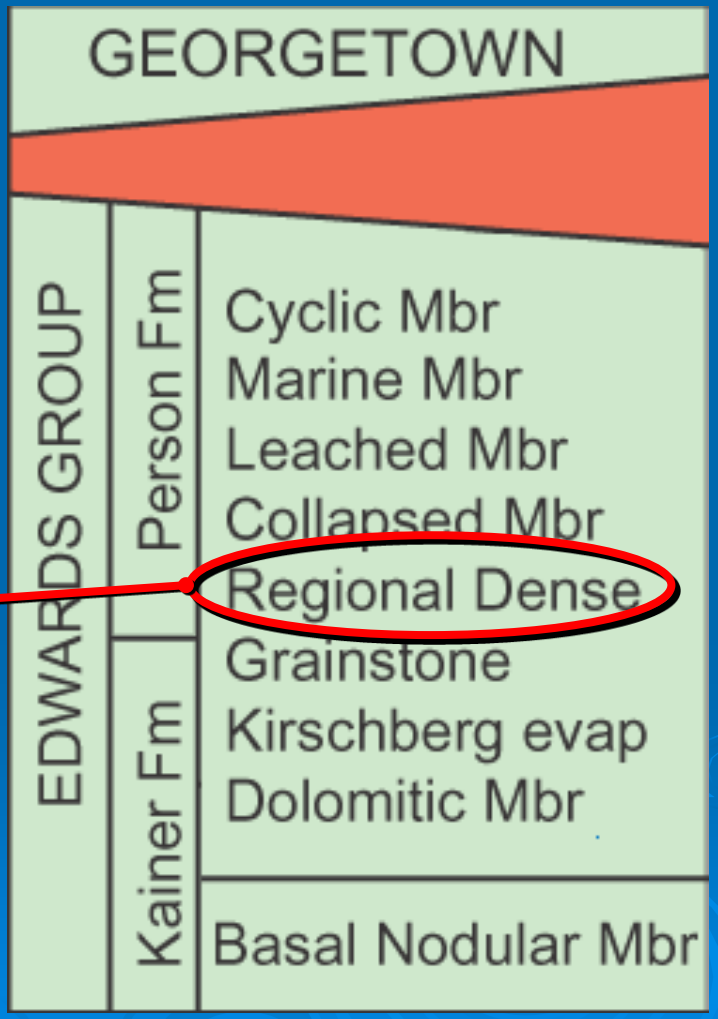
The Kirschberg Evaporite Member



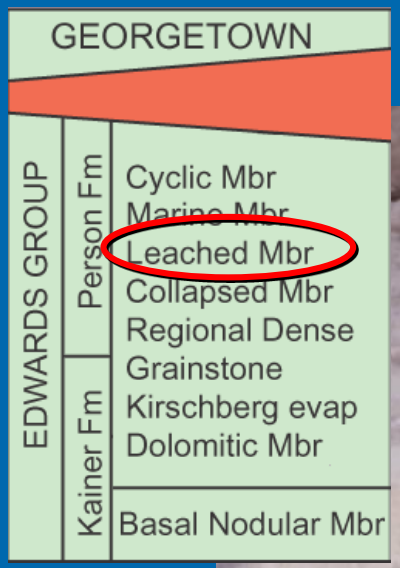


Regional Dense Member

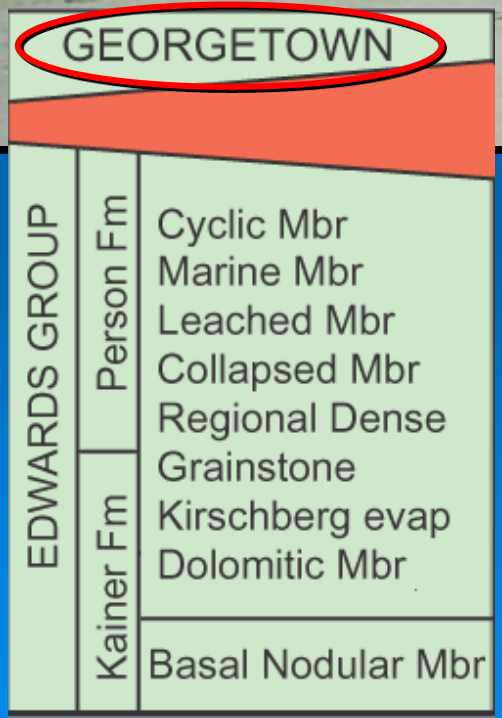


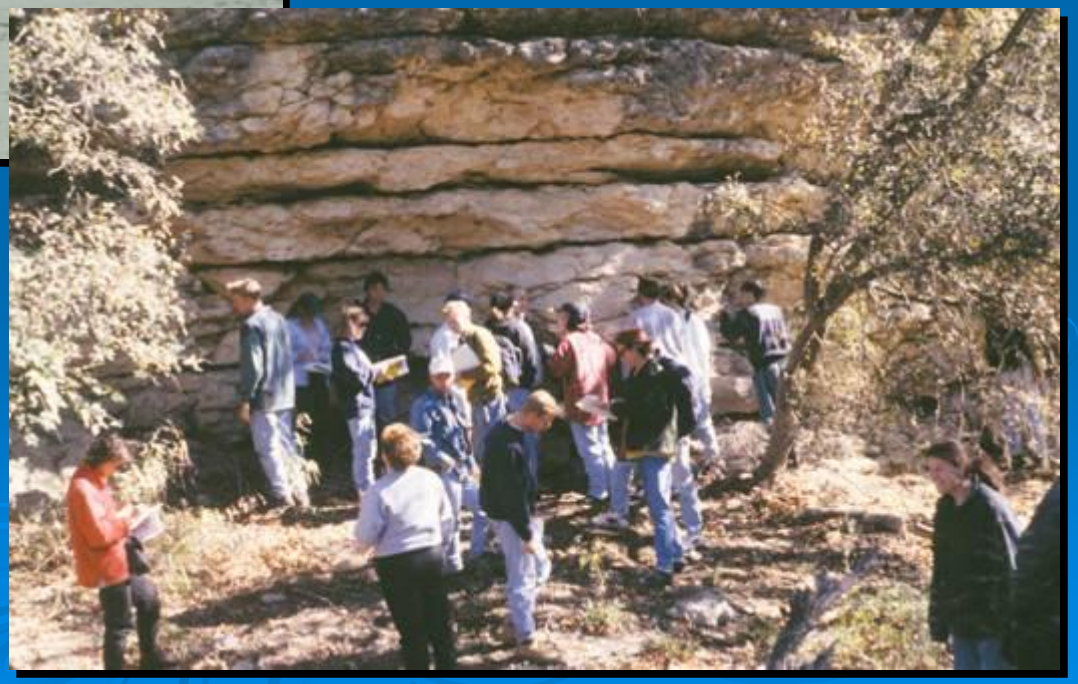


Conduits in the Leached and Collapsed Member

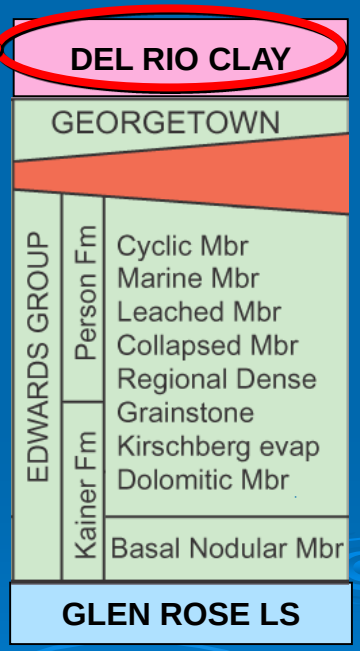


The Georgetown Formation





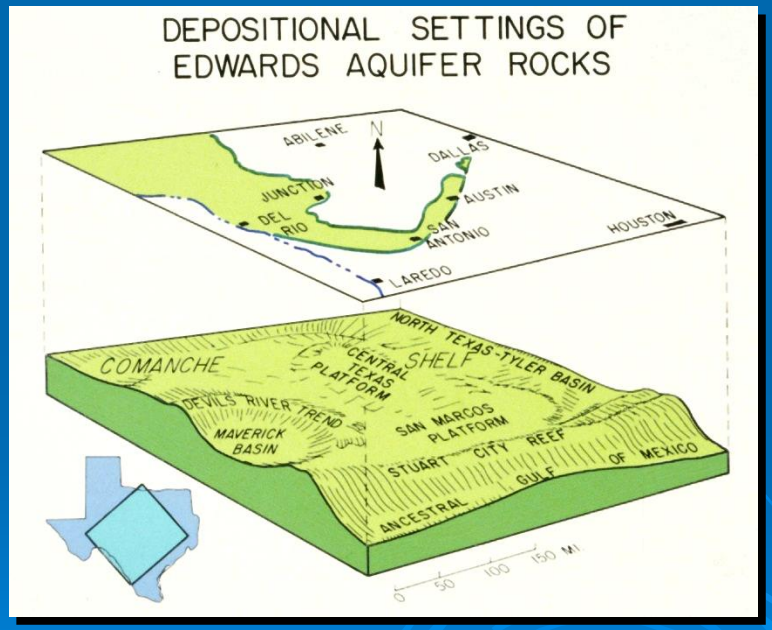
The Del Rio Clay and Overlying Sediments



A Little Geologic History

The Edwards aquifer rocks formed on a broad carbonate shelf, flanked by deeper basins in a setting similar to the modern Bahamas.

Crooked, Acklins Islands, Bahamas
Photo: NASA



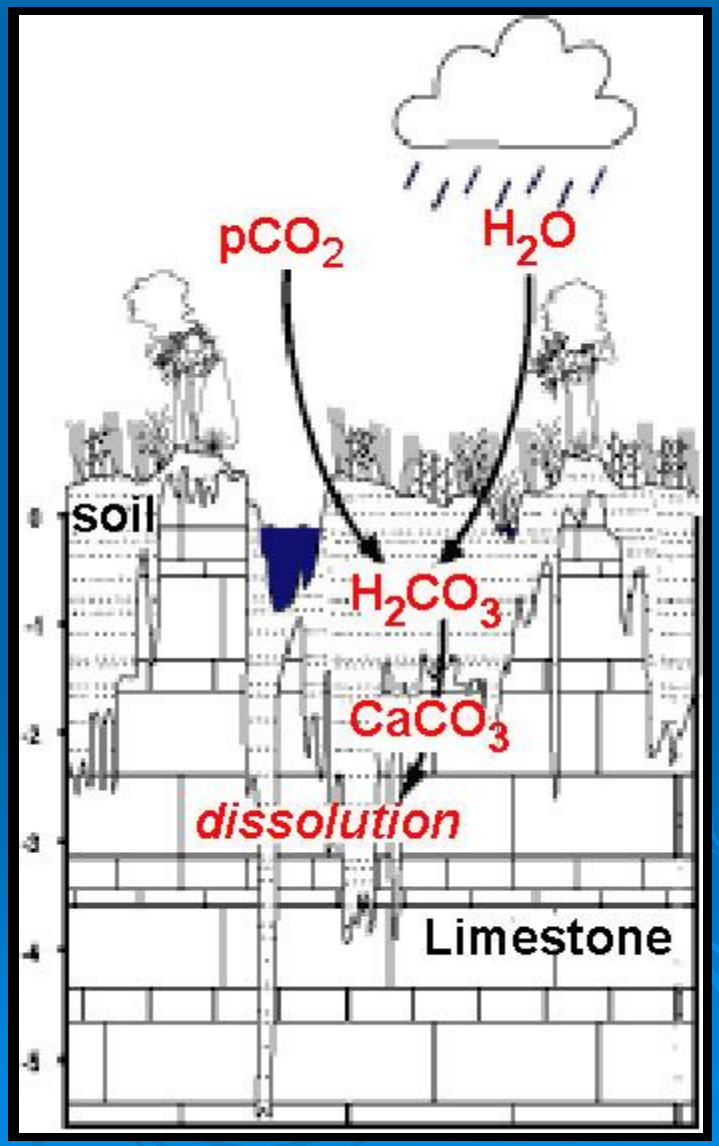
Geologic History

Dinosaurs living in the area left tracks in the emerged muddy tidal flats.

Dinosaur Valley State Park, Glen Rose, TX
Photo courtesy Texas Parks & Wildlife © 2002

Geologic History

Rainwater mixed with carbon dioxide in the air and soil, carving the landscape into caves and fissures.



Geologic History

The rocks sank again and more carbonates (the clayey Del Rio, and other rocks) were laid down above aquifer rocks. These include the Austin Chalk upon which much of Austin is built.

Geologic History

In the Miocene (about 17 million years ago), the aquifer rocks were uplifted and faulted (forming the Balcones Escarpment). They again became subject to erosion and dissolution.

Caves Associated With the Edwards

Inner Space Cavern
Austin, TX

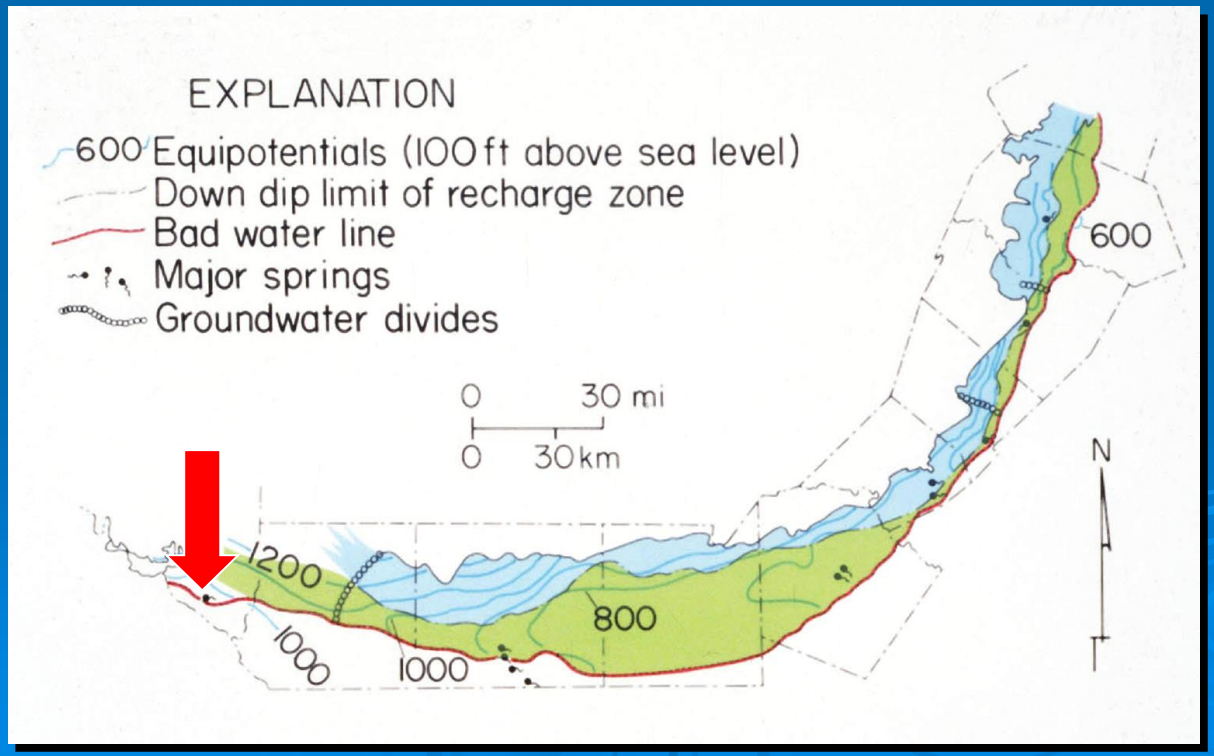
Devil's Sinkhole
State Natural Area
Rocksprings, TX

Natural Bridge Caverns
Natural Bridge Caverns, TX

Kickapoo Caverns State Park Brackettville, TX

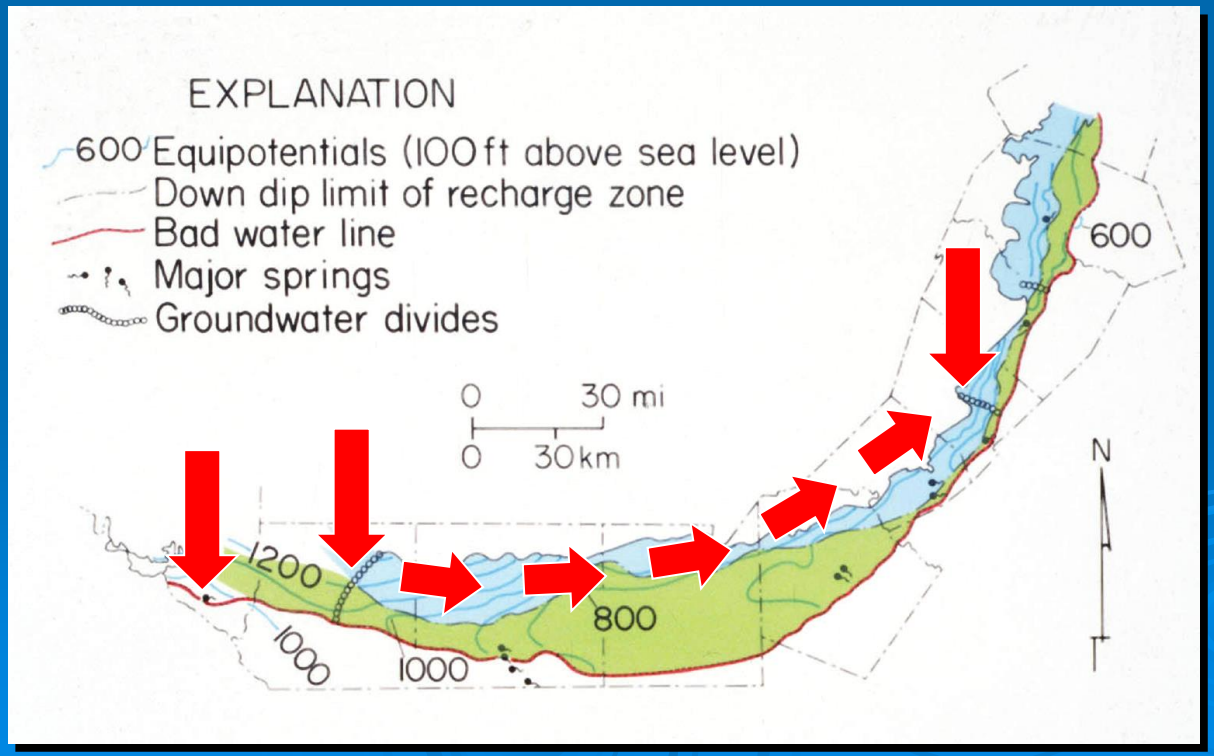
The Edwards Aquifer of Today

- The aquifer contains several flow systems – One occurs near Del Rio



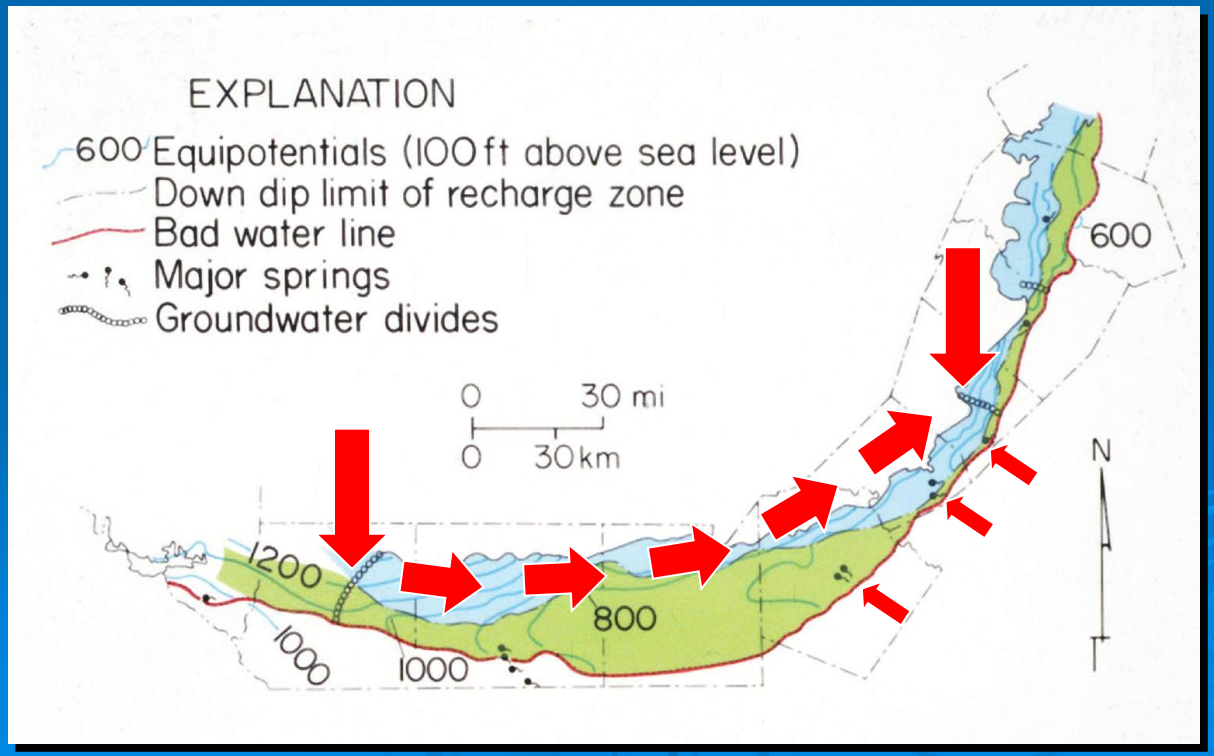
The Edwards Aquifer of Today

- The largest flow system runs from near Brackettville to near Kyle…



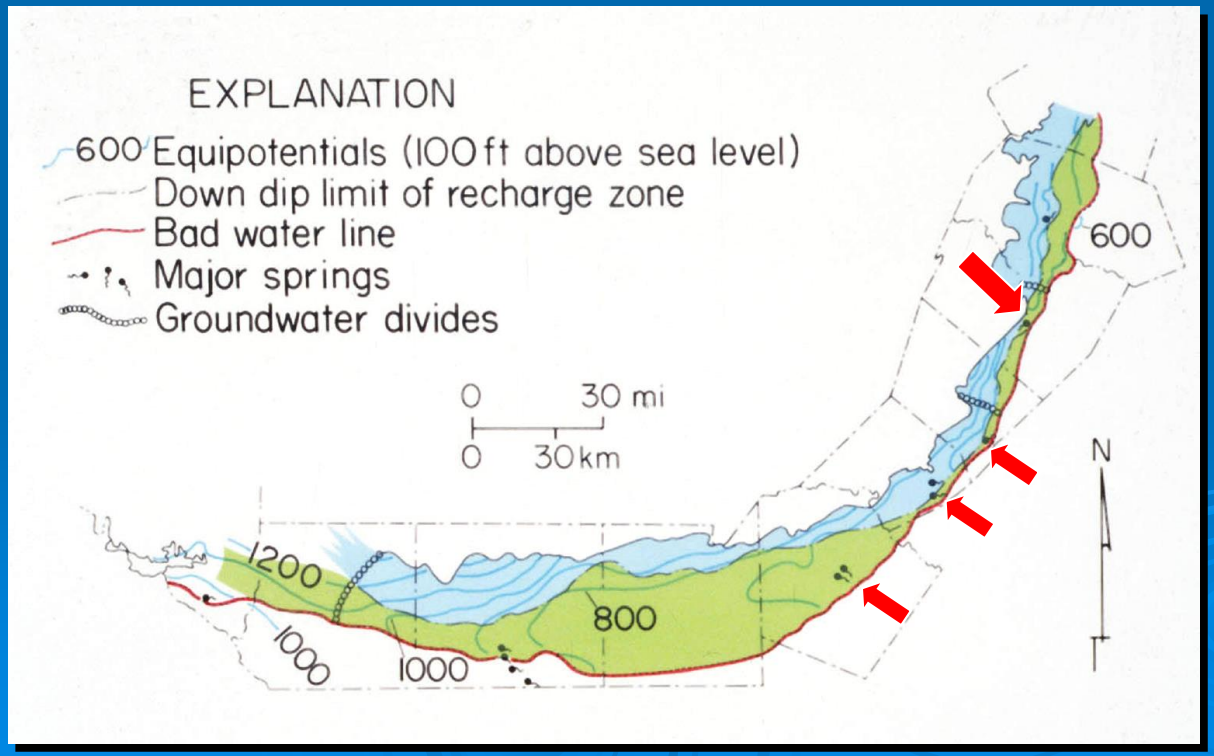
The Edwards Aquifer of Today

- … and supplies the major springs at San Marcos, New Braunfels, and San Antonio.



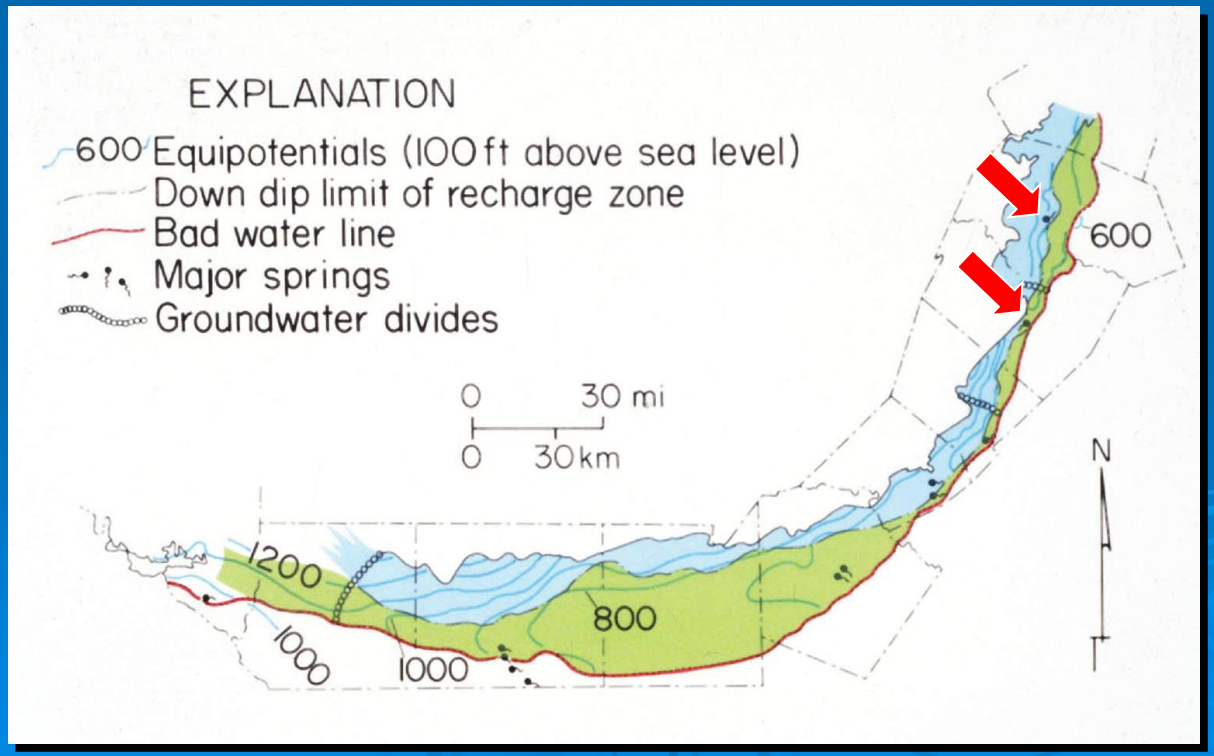
The Edwards Aquifer of Today

- Smaller flow systems include the Barton springs flow system…



The Edwards Aquifer of Today

- …and areas north of the Colorado River .



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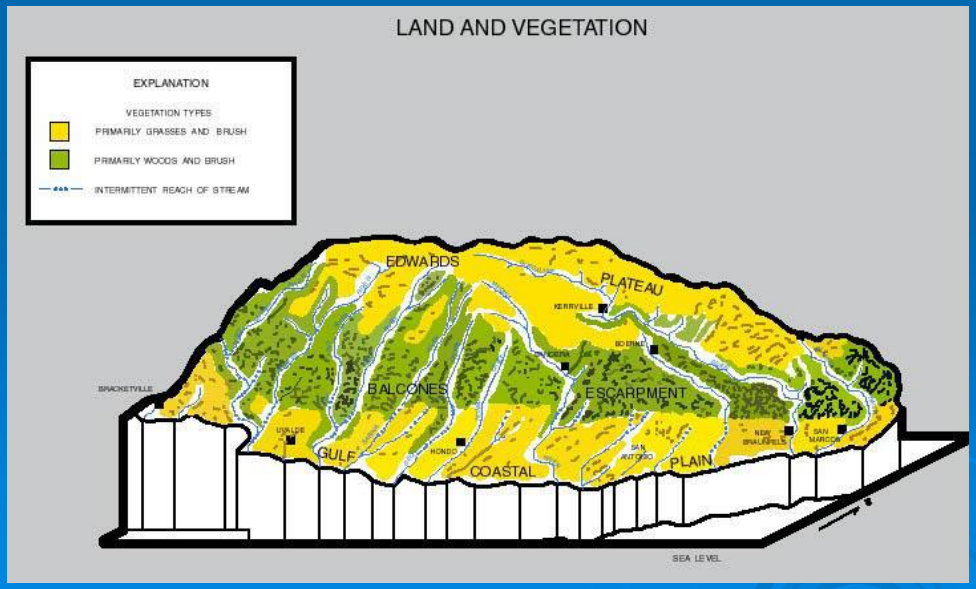
- Issues facing the aquifer

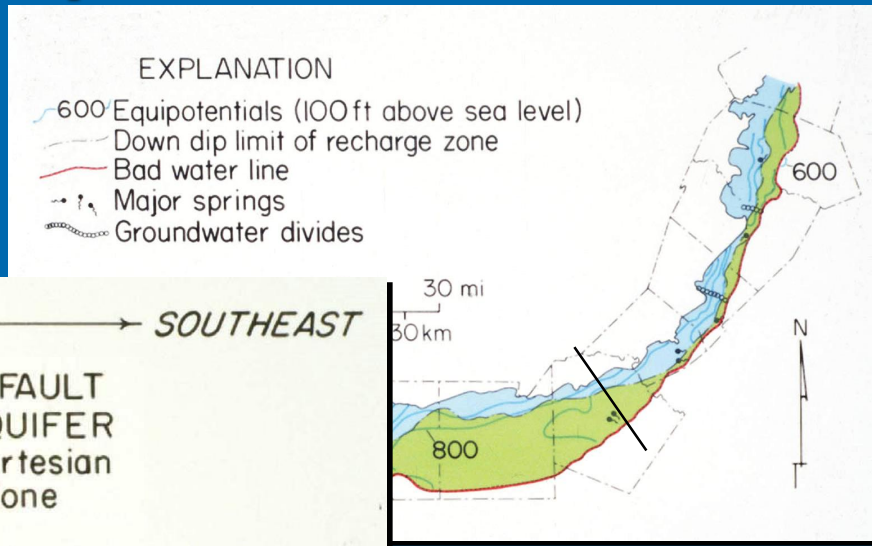
How does water get into the aquifer?

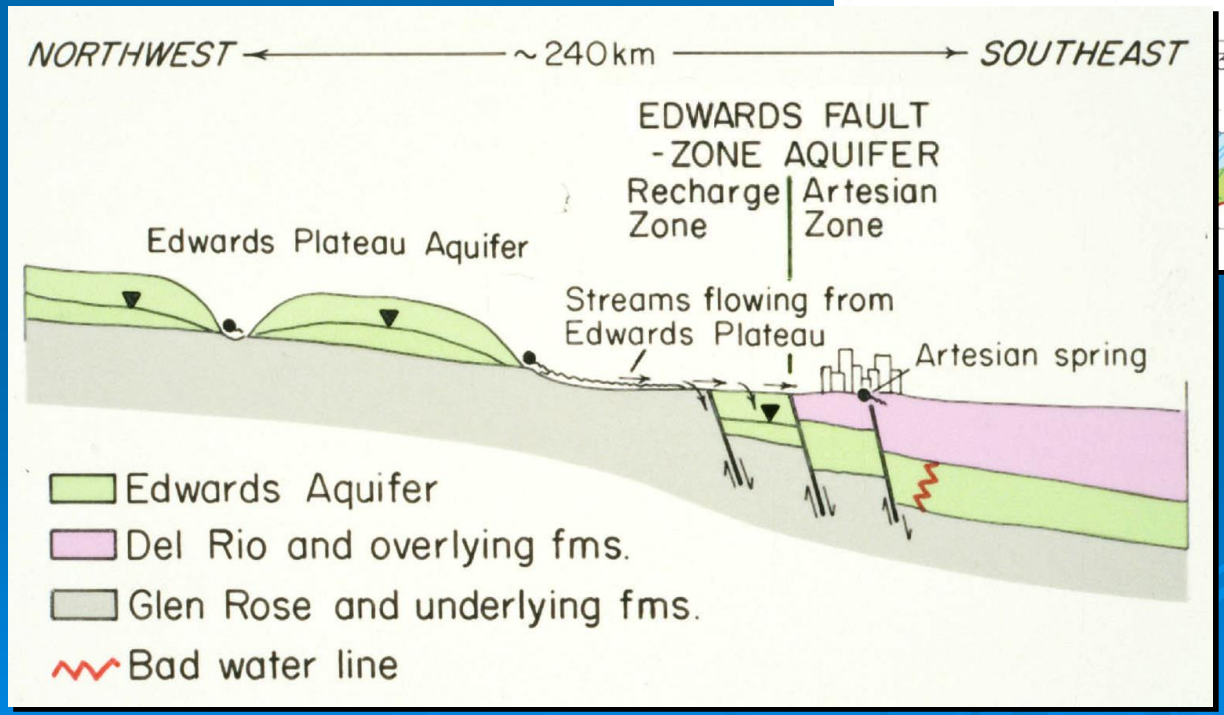
- Water enters the aquifer through faults, fractures, sinkholes, or percolation through the soil. This process is called ***recharge***.



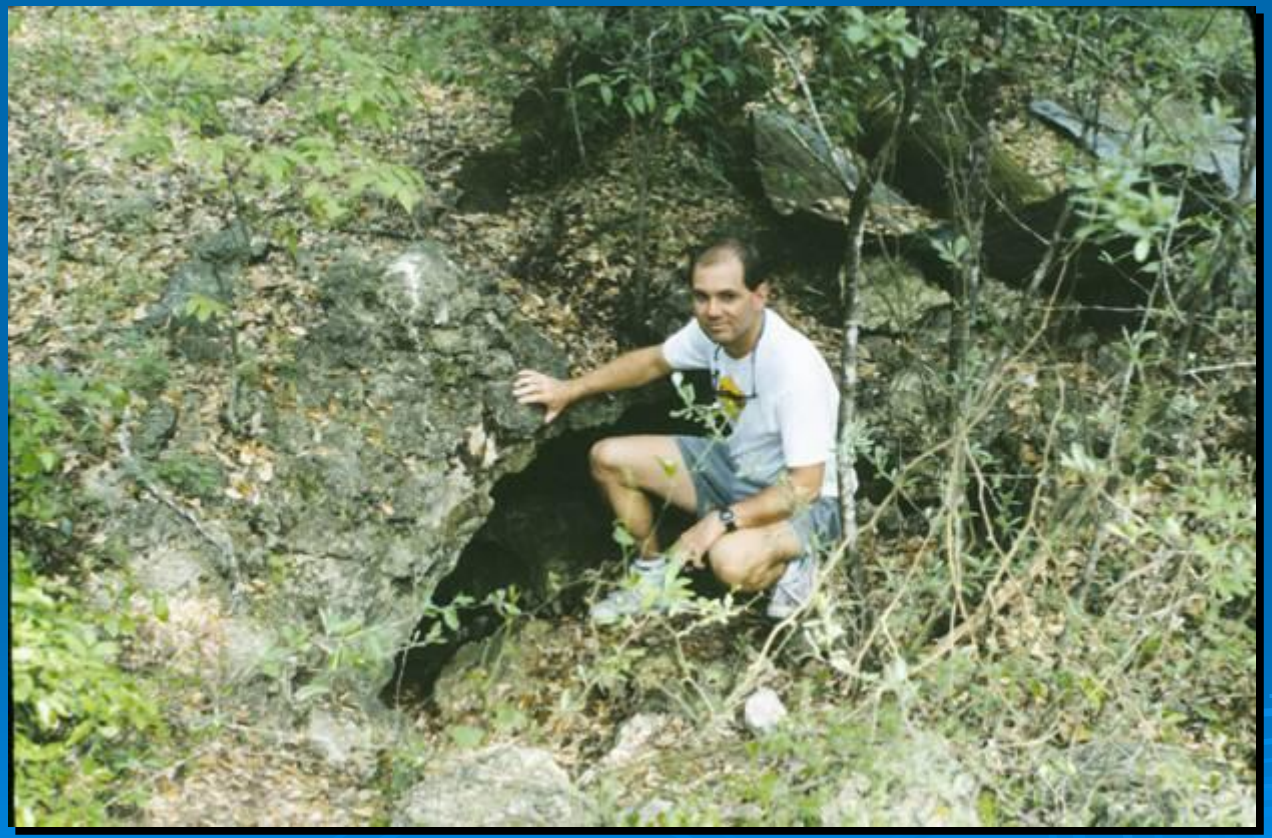
- The ***recharge zone*** is the area where water enters the aquifer.

Cross Section of the Edwards aquifer



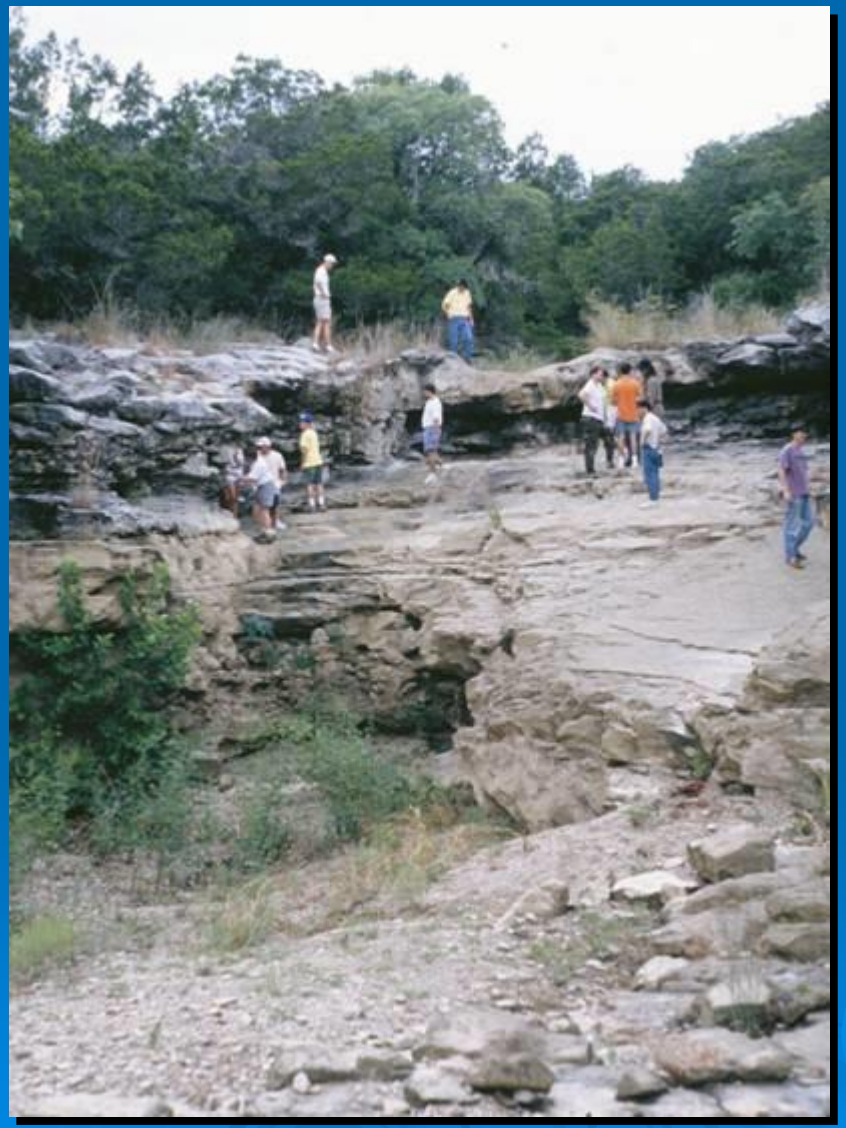


Recharge Feature in South Austin



Antioch Cave

Marbridge Ranch



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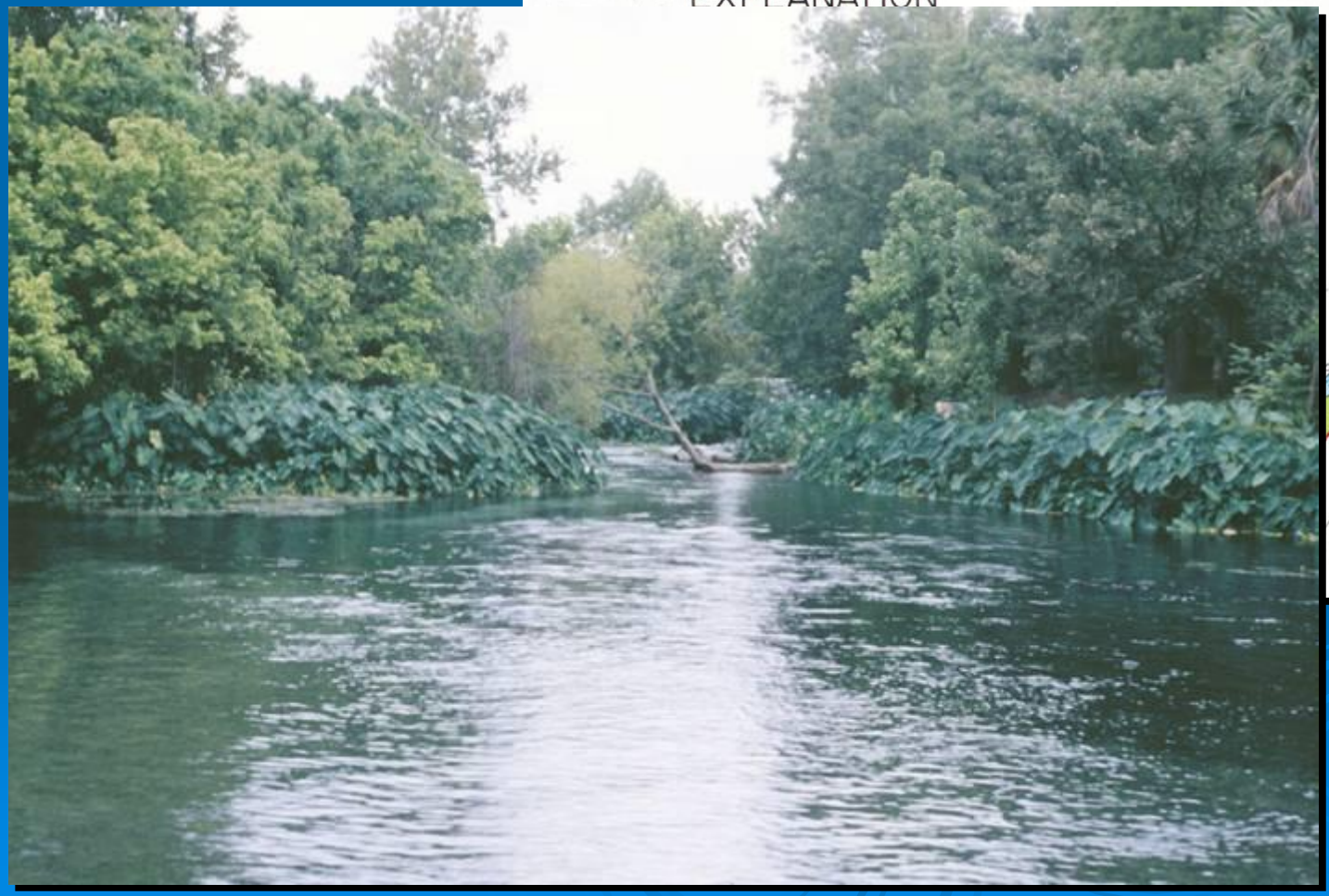
Big Boiling Springs
Salado, TX

Barton (main) Spring
Austin, TX

San Marcos Springs
San Marcos, TX

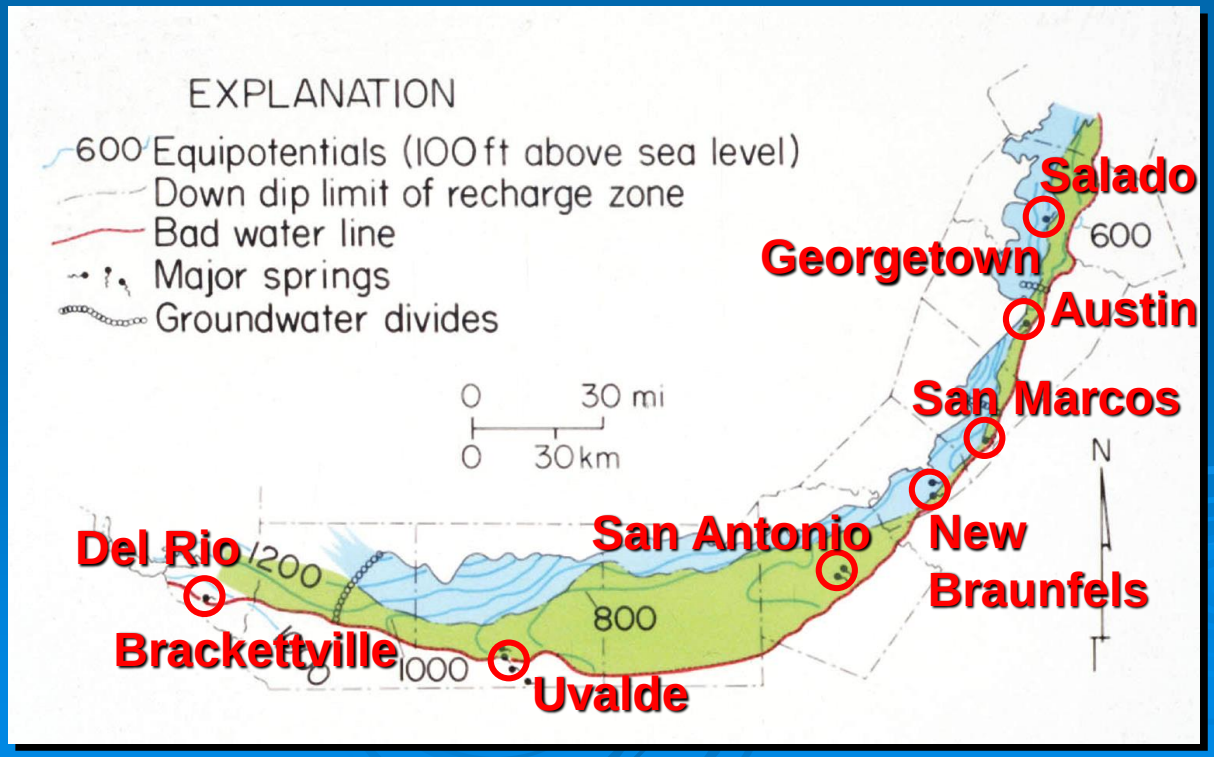


Comal Springs
New Braunfels, TX

San Felipe Springs
Del Rio, TX

It's Where We Live

- These springs led to the development of major towns along the aquifer: Salado, Georgetown, Austin, San Marcos, New Braunfels, San Antonio, Uvalde, Brackettville, and Del Rio. All of these towns are sited where major springs discharge from the Edwards aquifer.



Wells

Catfish Farms Well is a Texas-sized well. It was the greatest flowing well in the world. Over time aquifer discharge by wells has increased and spring flows have decreased.

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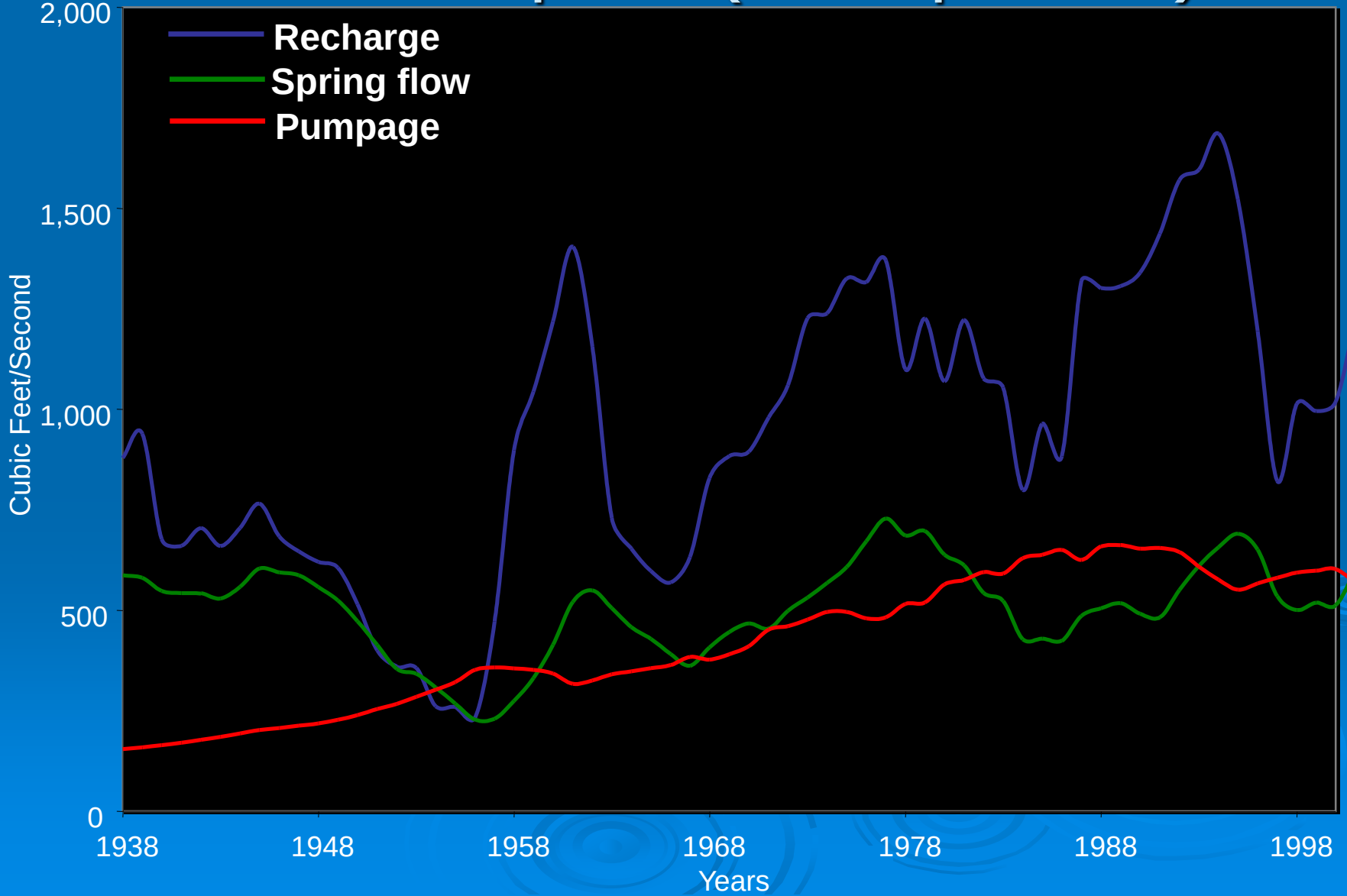
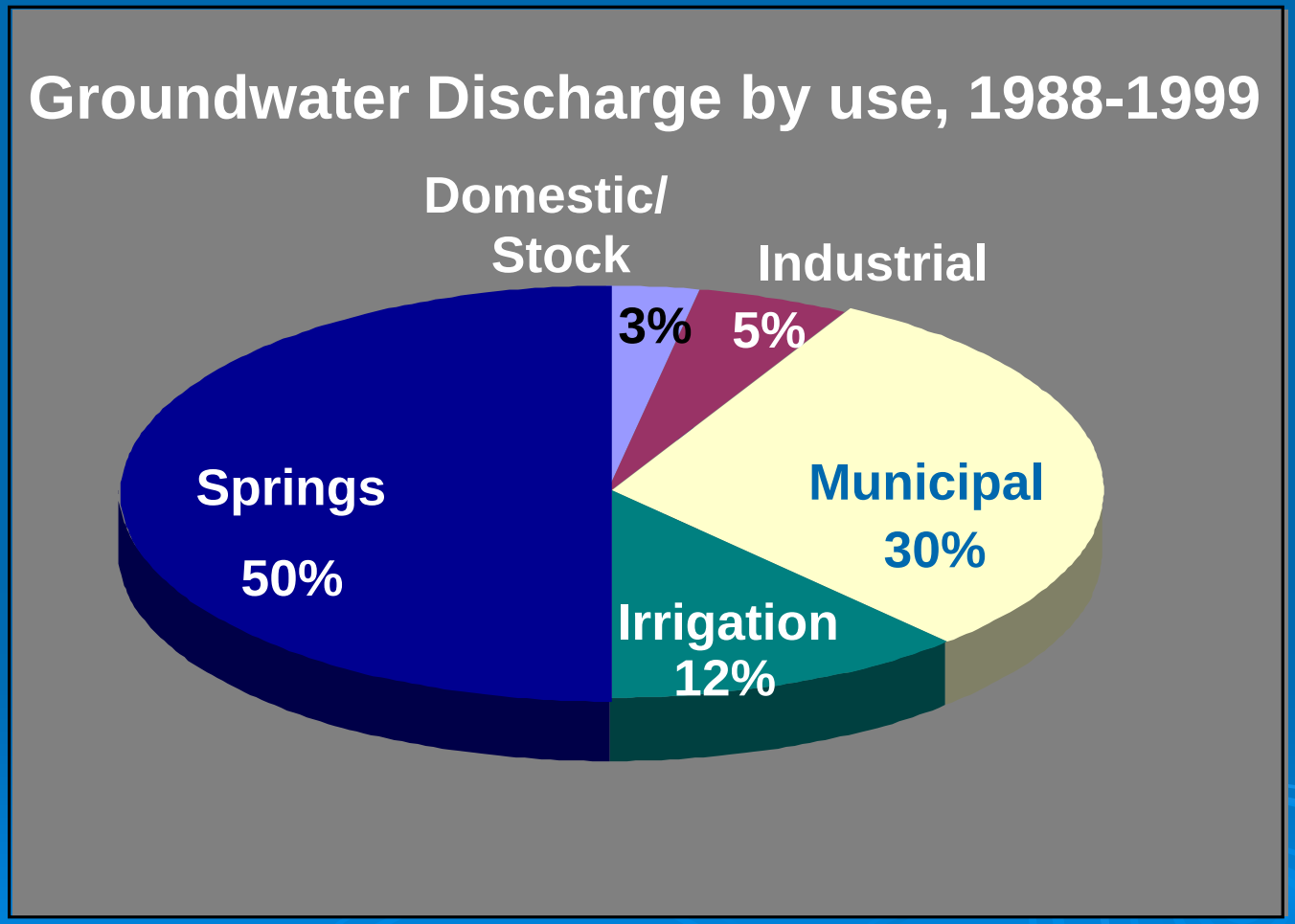
Historical Changes in the Edwards aquifer (1938-present)



Who uses the aquifer's waters?

- Municipal Users (San Antonio, San Marcos, etc.)
- Agriculture (irrigation)
- Industrial
- Recreational
- Fish and Wildlife
- Downstream Surface Water Users
  - Fisheries and flow to estuaries
  - Reservoirs for water supply
  - Irrigation
  - Recreation

Who uses the aquifer's waters?



Source: The Edwards Aquifer Authority

Municipal and Industrial Users

- Population growth and economic development require water (e.g. the exploding population along the I-35 corridor in San Antonio, New Braunfels, San Marcos, and Austin)
- Few suitable, affordable reservoir sites exist
- Excess storage in the aquifer could be mined during dry years, then recover during wet years

A growing megalopolis stretches from Salado to beyond San Antonio

Both the industries and

the people dwelling here now and in the future need water.

Agricultural Users

- Have been farming the land for generations
- Have legal rights to aquifer ground water by either riparian or appropriative doctrines
- Don’t want water metering!
- Dry land farming, stock raising less lucrative than irrigation farming

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Questions

- What is the best use of aquifer water?
- Is it possible to establish a market for water rights?
- Social costs?

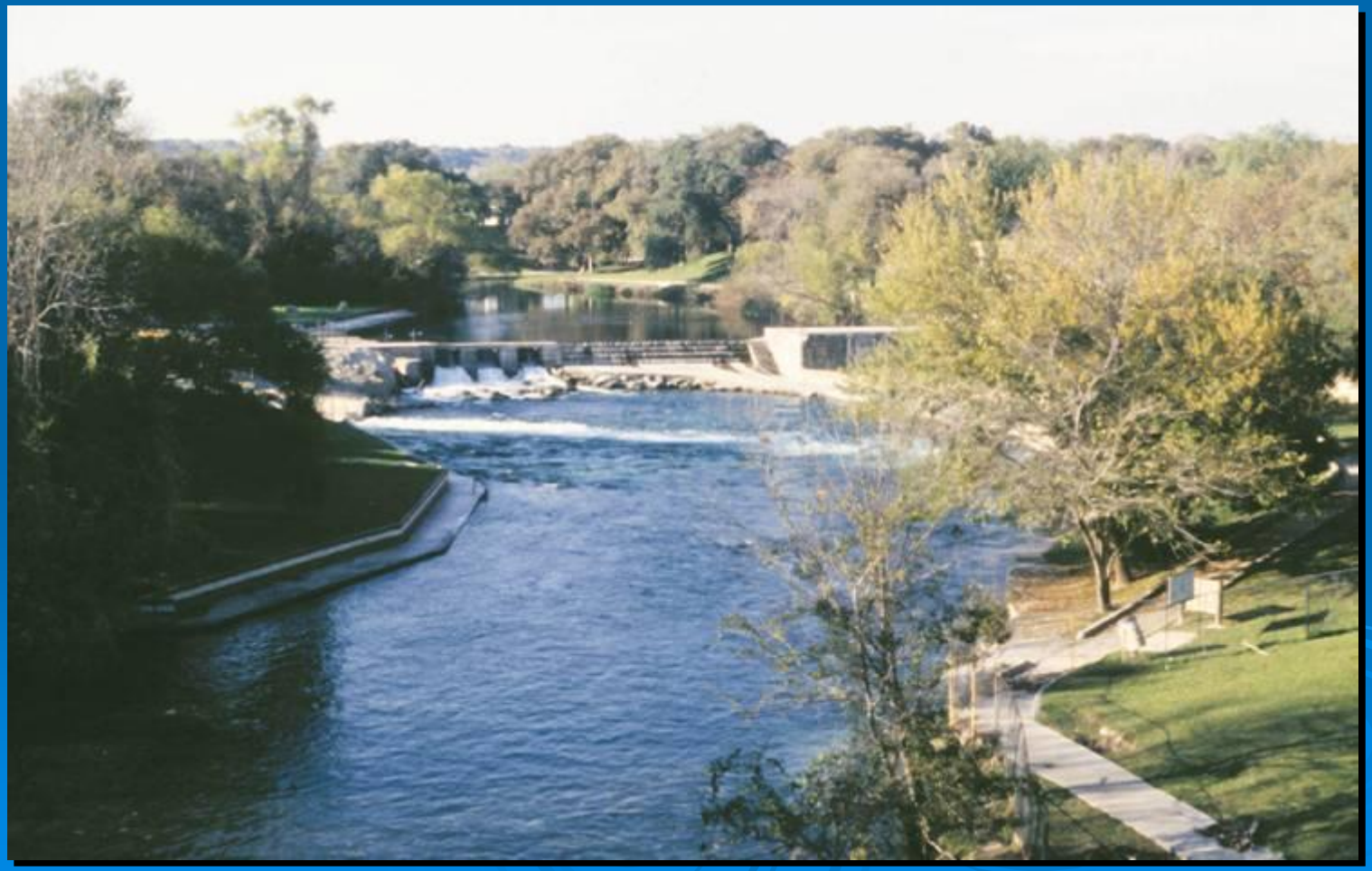
Answers?

- Irrigated fields in Texas can be very productive.

Austin Blind Salamander ***(Eurycea waterlooensis)***

- But heavy usage has reduced spring flows that are also important recreationally, esthetically, and for certain species native to the springs.

Comal Springs



Barton Springs

Goals of Springflow Users

- Protect endangered species at the Springs.
- Preserve recreational/esthetic and environmental aspects.
- Suggest that new/other users shift to surface waters.
- Maintain springflow.

Concerns

- Are there alternative means of saving endangered species?
- Who pays?
- Can springflow augmentation or enhanced recharge prevent or reduce negative consequences? Who pays for this?

Barton Springs

Barton Springs salamander
(Eurycea sosorum)

San Marcos Springs Orifice

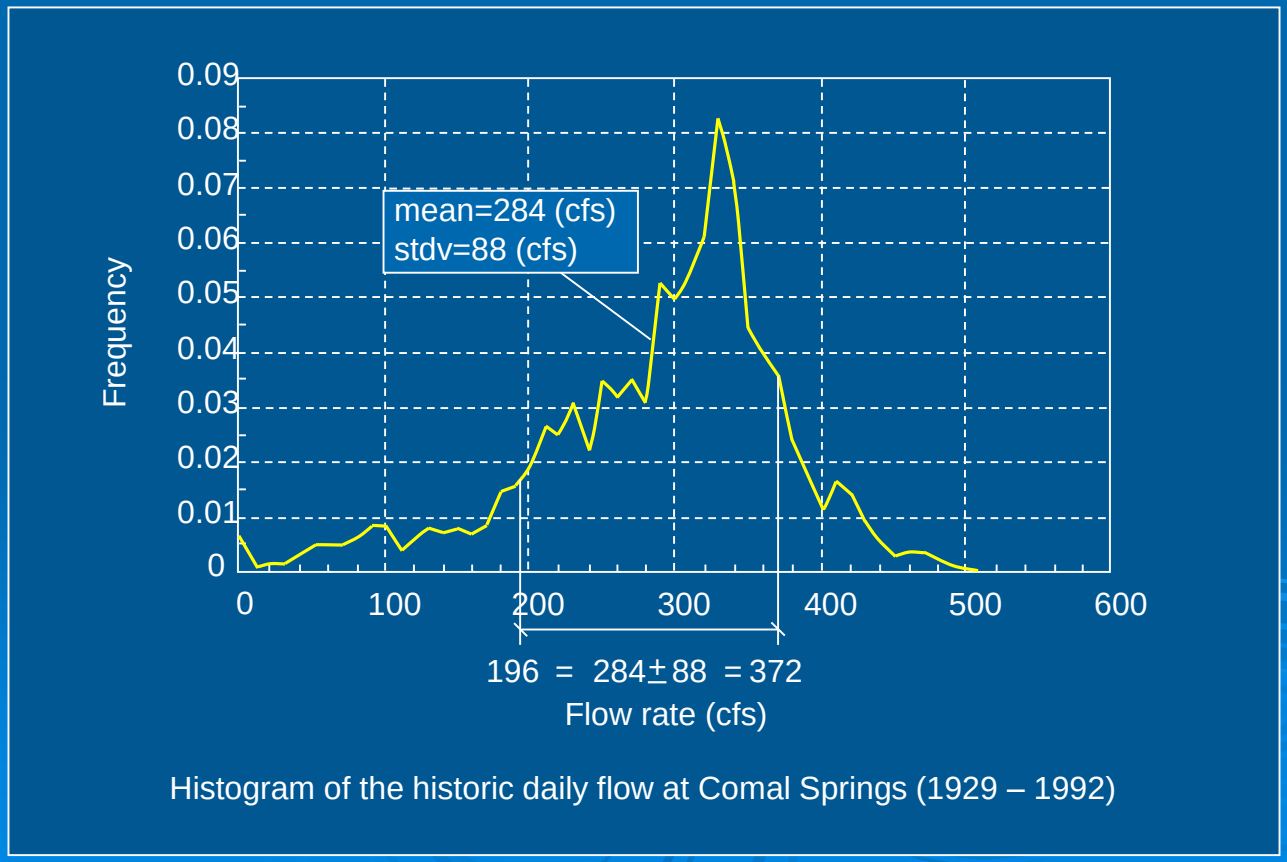
- How much water is required to preserve the species?

Take limit flows at San Marcos and Comal Springs

- San Marcos Springs
  - Fountain Darter – 100 cubic feet per second (cfs)
  - Texas Wild Rice – 100 cfs
  - San Marcos Salamander – 60 cfs (upwelling flow from orifices?)
- Comal Springs
  - Fountain Darter
    - 200 cfs
    - 150 cfs if the Ramshorn Snail can be controlled

Histogram of Comal Springs.

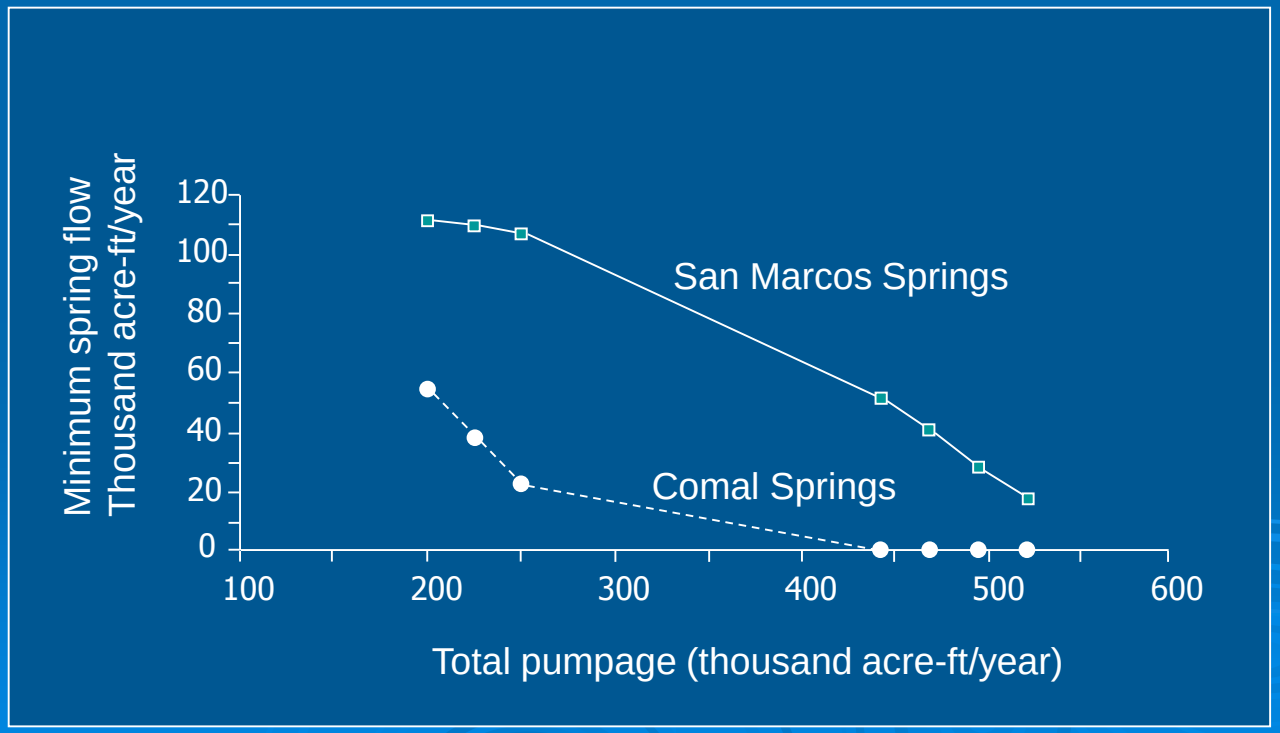
- We are already beneath the take limits for parts of the historical record.



Histogram of the historic daily flow at Comal Springs (1929 – 1992)

Springflow vs. Pumpage During Average Years.

- More pumpage for more people means lower springflows



Views of Downstream Users

Management of the Edwards aquifer is crucial to the development of Central and South Central Texas and is crucial to our environment. We don’t have all the facts.

Hydrogeological Unknowns

- What are the actual flow paths and travel times?
- How much cross-formational flow?
- Where precisely does recharge occur?
- What hydrogeological parameters must we ascertain for proper land use development?
- Can we extract (pump) waters in a more optimal manner?
  - Use more in times of drought?
  - Pump equivalent amounts with fewer detrimental effects?

Political Unknowns

- Will we still subsidize growth in Austin and San Antonio over growth in Beaumont and Port Arthur?
- Who will pay to provide water to Edwards users?
- Will growth restrictions be imposed?
- Will we market water rights (like Colorado)?
- Will the endangered species law continue to be the “biggest gun” in this water battle?
- Will the state (in its wisdom or lack thereof) allocate our waters?

Conclusions

- The aquifer has a long term balance (1934-2002) between recharge and discharge
- Periods of extended drought with present population or projected increases in use will create problems for aquifer users.
- New management policies and new, probably expensive, technologies will need to be implemented.

In other words…

We have to manage the Edwards aquifer and other Texas water resources to meet the needs or our society now and in the future.

TAP Statement

"…the greatest danger to the…aquifer would be a failure to effect prudent, conjunctive management while there is yet time to prevent a crisis from developing…because continued growth…increases the risk that effective [management] measures cannot be implemented rapidly enough in periods of drought to prevent…serious consequences. Regional management of the aquifer and associated river systems seems necessary if use and impacts are to be reconciled prudently."

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Barton Springs

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Dr. John M. Sharp

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