Brewster County Aquifers

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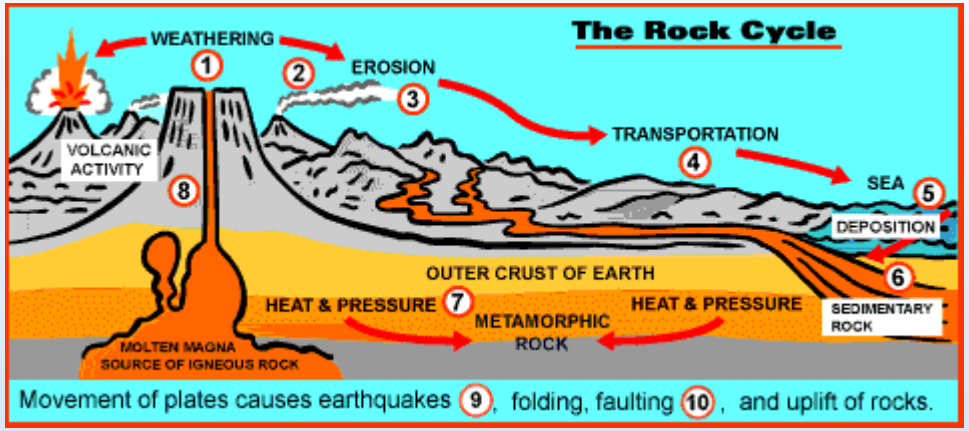
Aquifer

- Simple:
  - Rock or Sediment that can hold and transmit water
- More complex:
  - Rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs (Fetter, 1994)



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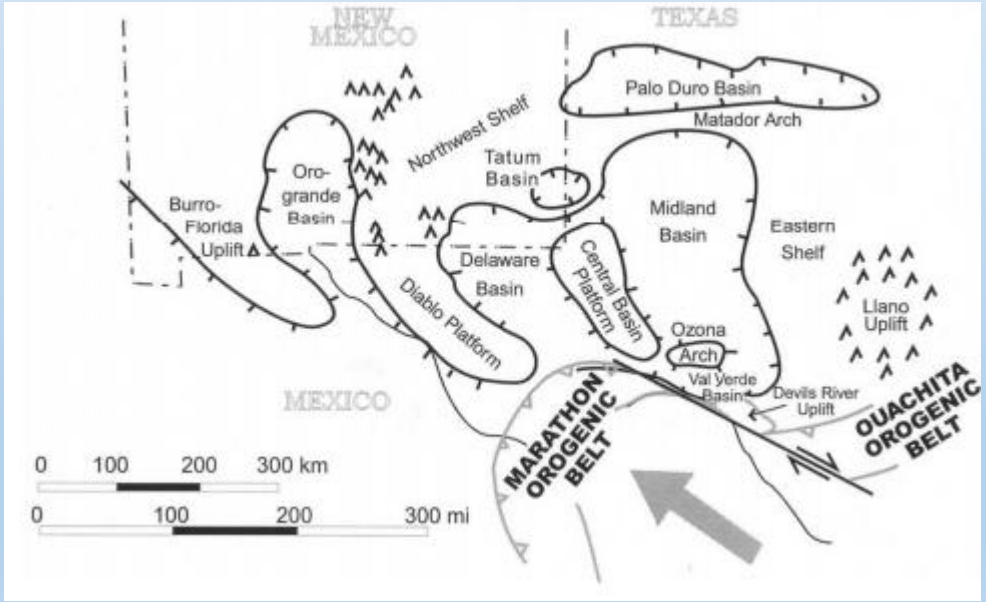
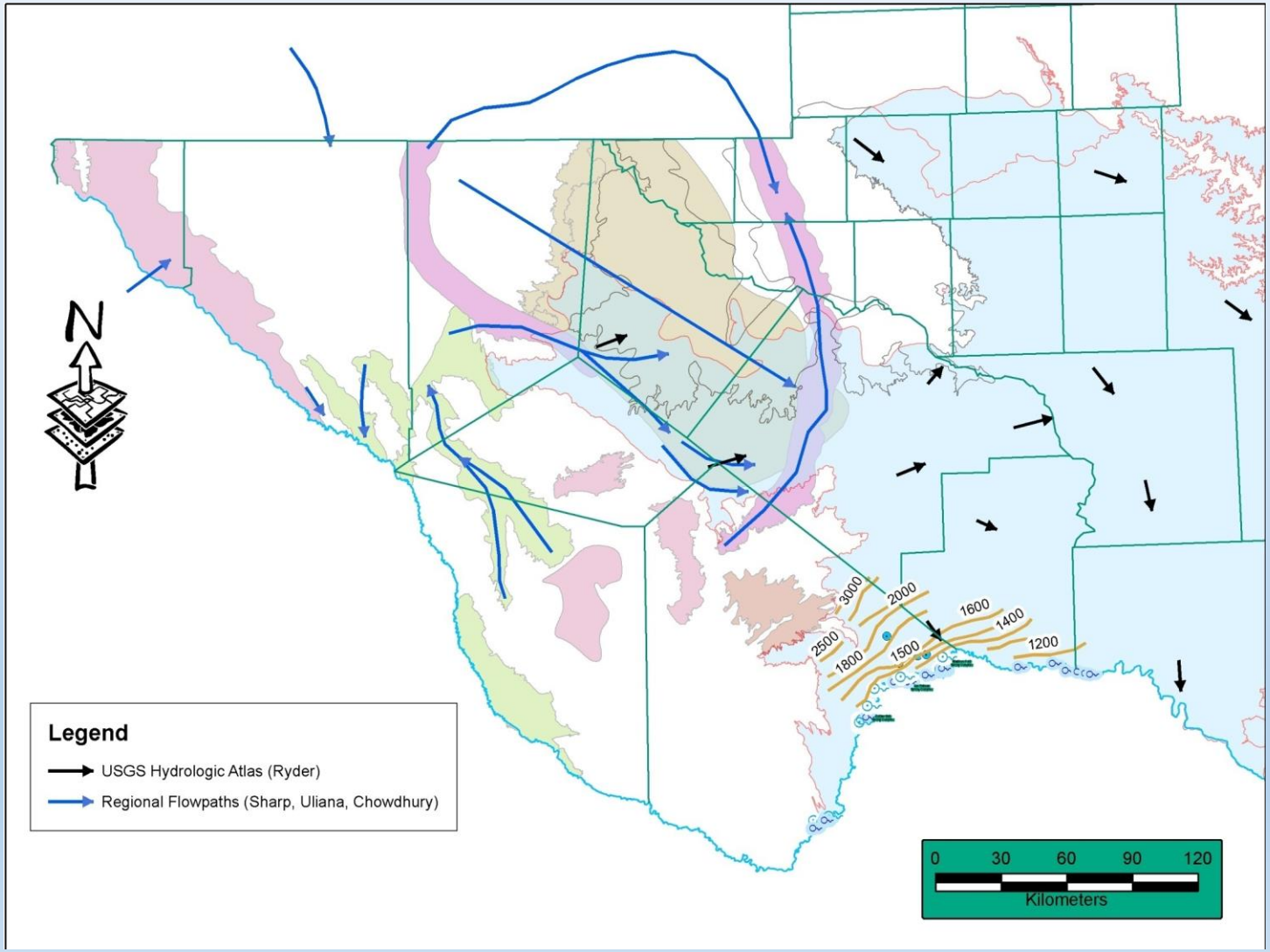


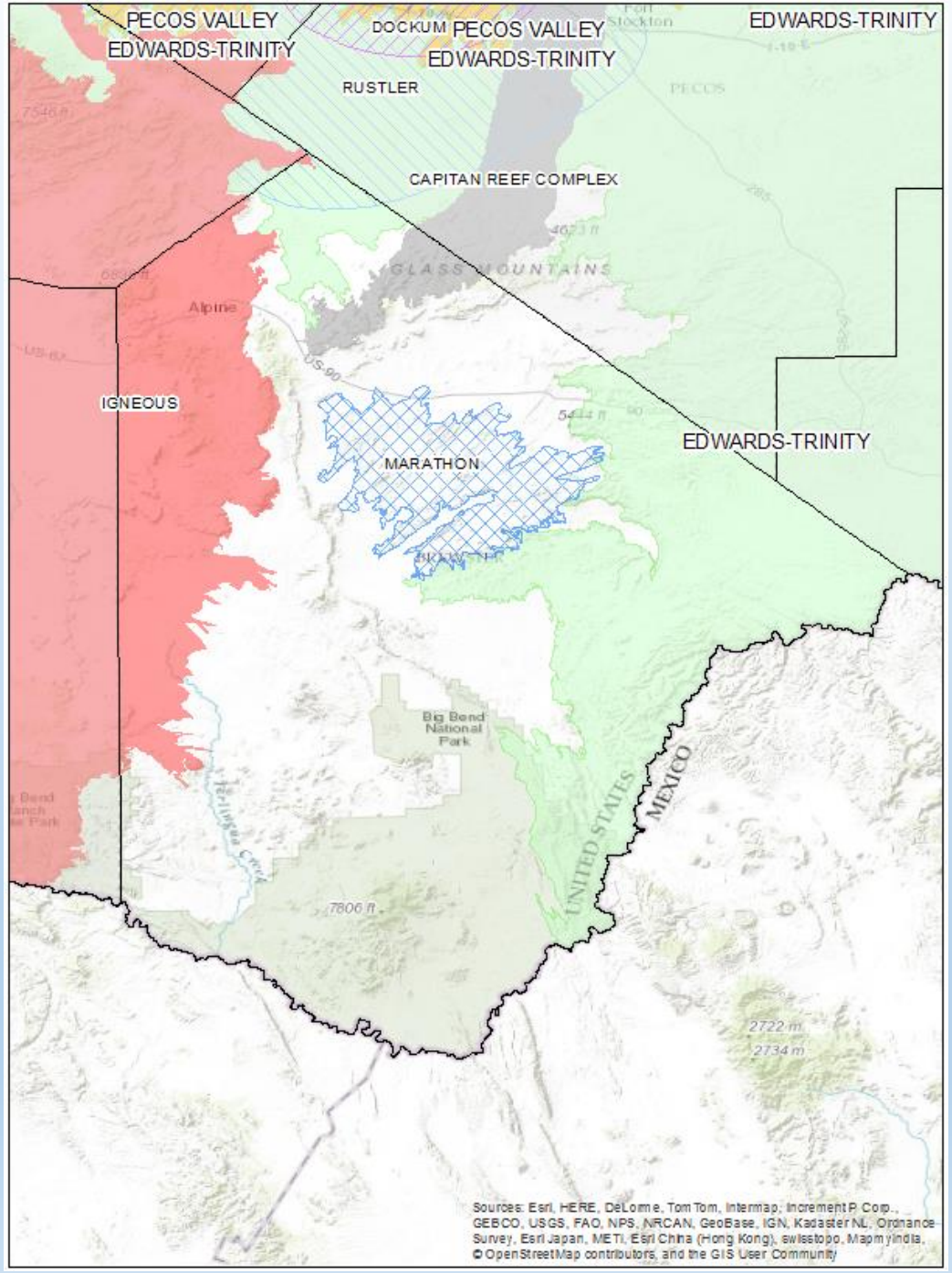
Aquifers of west Texas



Era	Period	Aquifer
Cenozoic	Quaternary	Cenozoic Pecos Alluvium Brazos River Alluvium West Texas Bolsons Seymour Lipan
	Tertiary	Gulf Coast Carrizo-Wilcox Hueco-Mesilla Bolson Ogallala Sparta Igneous Queen City
Mesozoic	Cretaceous	Woodbine Edwards-Trinity (Plateau) Edwards-Trinity (High Plains) Edwards (BFZ) Trinity Nacatoch Blossom Rita Blanca
	Jurassic	Rita Blanca
	Triassic	Dockum
Paleozoic	Permian	Blaine Bone Spring-Victorio Peak Capitan Reef Complex Rustler Lipan
	Pennsylvanian	Marble Falls Marathon
	Mississippian	Marathon
	Devonian	Marathon
	Silurian	Marathon
	Ordovician	Ellenburger-San Saba Marathon
	Cambrian	Ellenburger-San Saba Hickory
Precambrian		

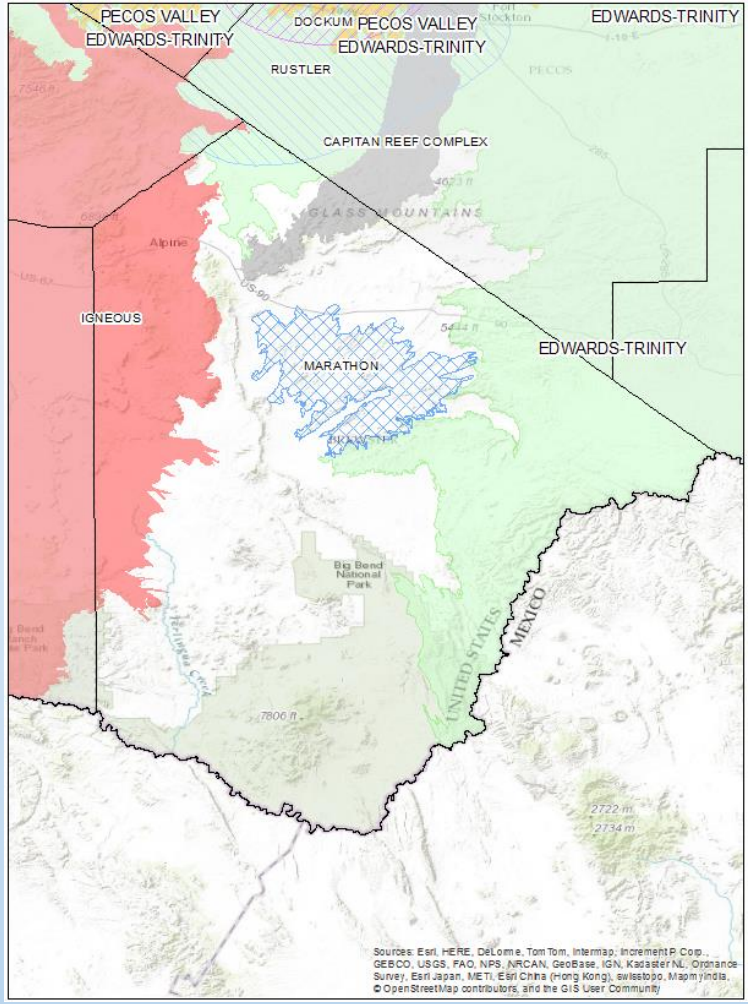
Brewster County Aquifers

- According to the Texas Water Development Board (TWDB):
  - Major aquifers:
    - Edwards-Trinity
  - Minor aquifers:
    - Igneous
    - Marathon
    - Capitan Reef Complex
    - Rustler



Aquifer Types

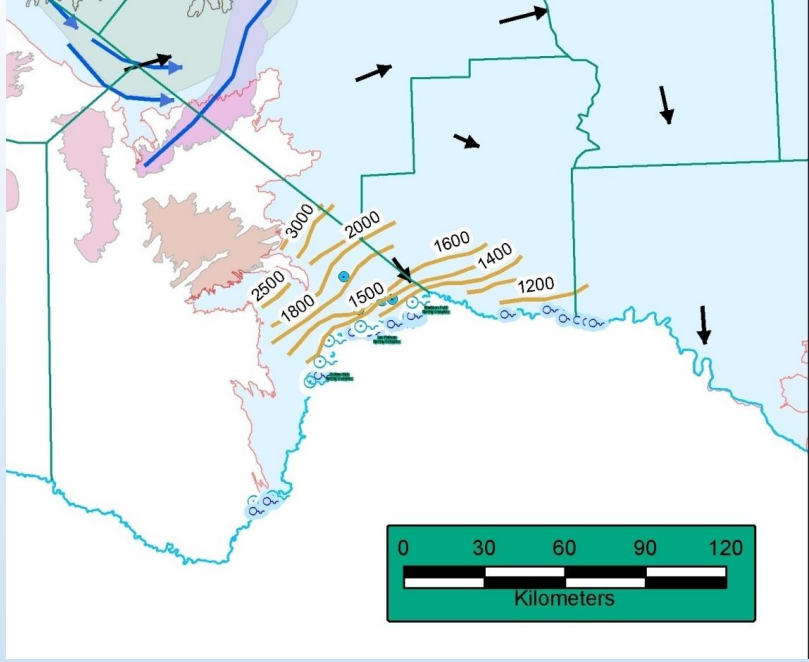
- “Igneous” – Paleogene/Neogene; various volcanic flows, intrusive bodies and sediment; makes a reasonable aquifer if fractured / faulted



From Ashworth and Hopkins (1995)

Aquifer Types

- “Edwards-Trinity Plateau” – Cretaceous marine sediments; limestone, dolomite and shale



From Ashworth and Hopkins (1995)

Aquifer Types

- “Rustler” – Permian; rock types include dolomite, limestone and gypsum, typically has high total dissolved solids

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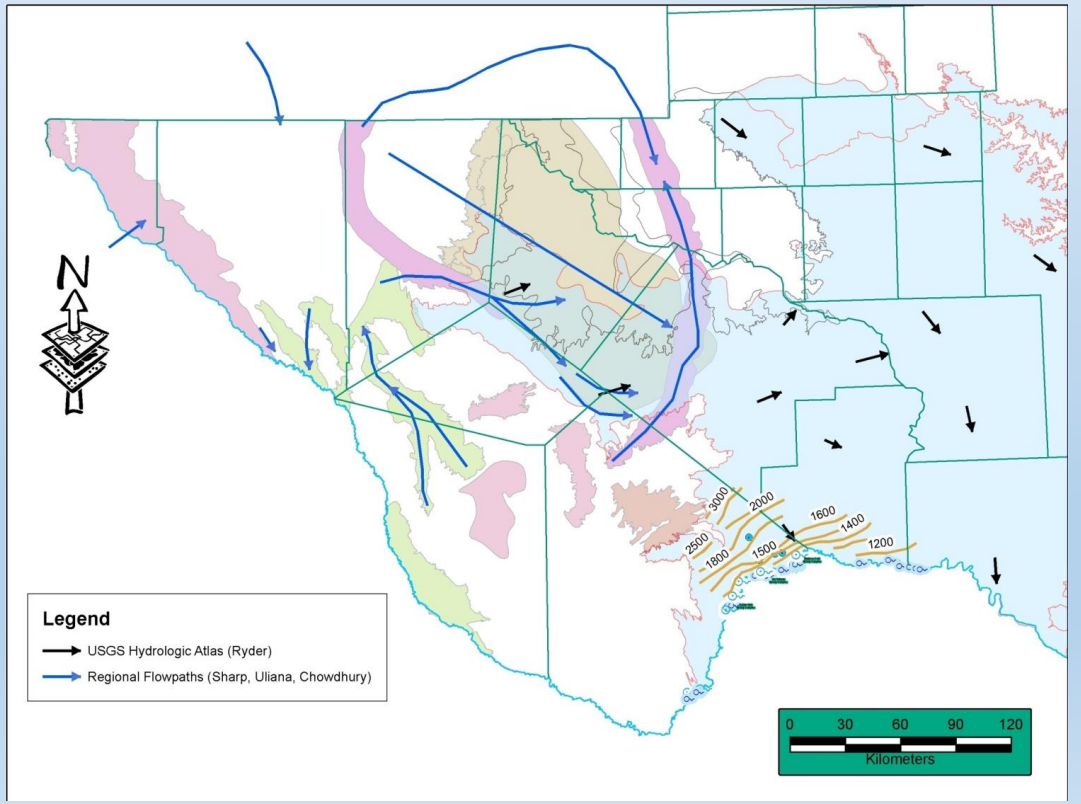
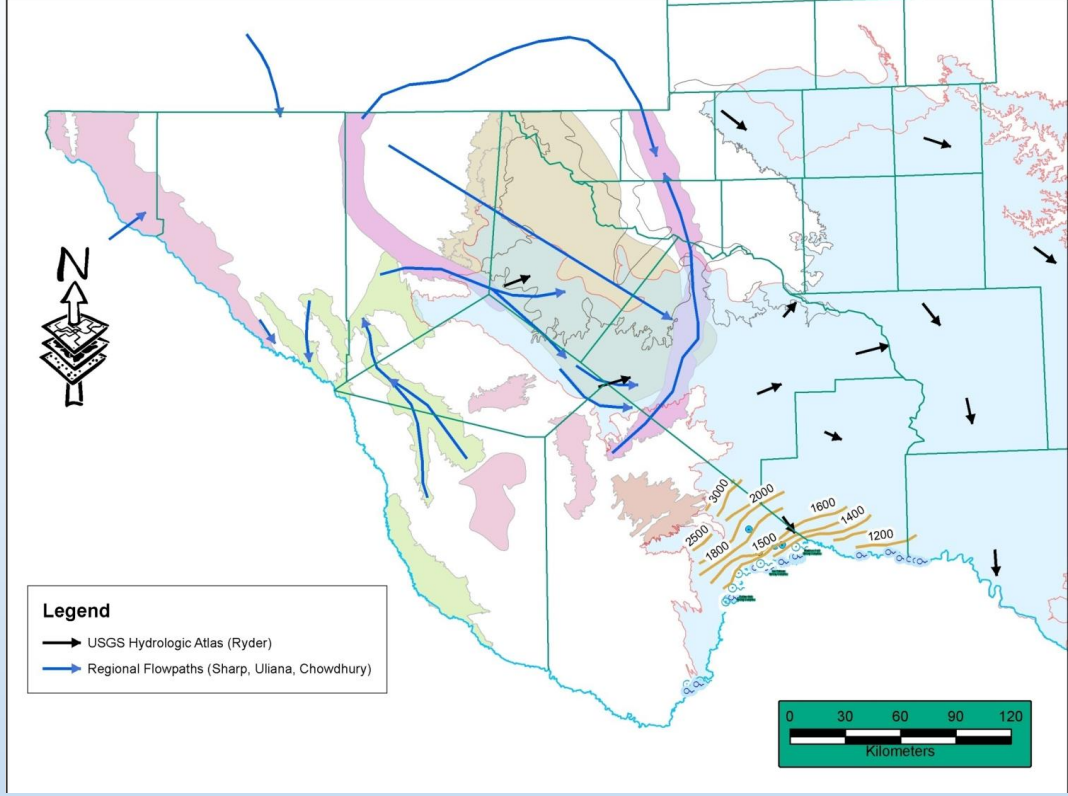
Precambrian		



From Ashworth and Hopkins (1995)

Aquifer Types

- “Capitan Reef Complex” – Permian, represents reef system that formed around the margins of the Delaware basin



From Ashworth and Hopkins (1995)

Aquifer Types

- Marathon – various Paleozoic marine sediments including the Marathon limestone

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Cenozoic	Quaternary	Cenozoic Pecos Alluvium Brazos River Alluvium West Texas Bolsons Seymour Lipan
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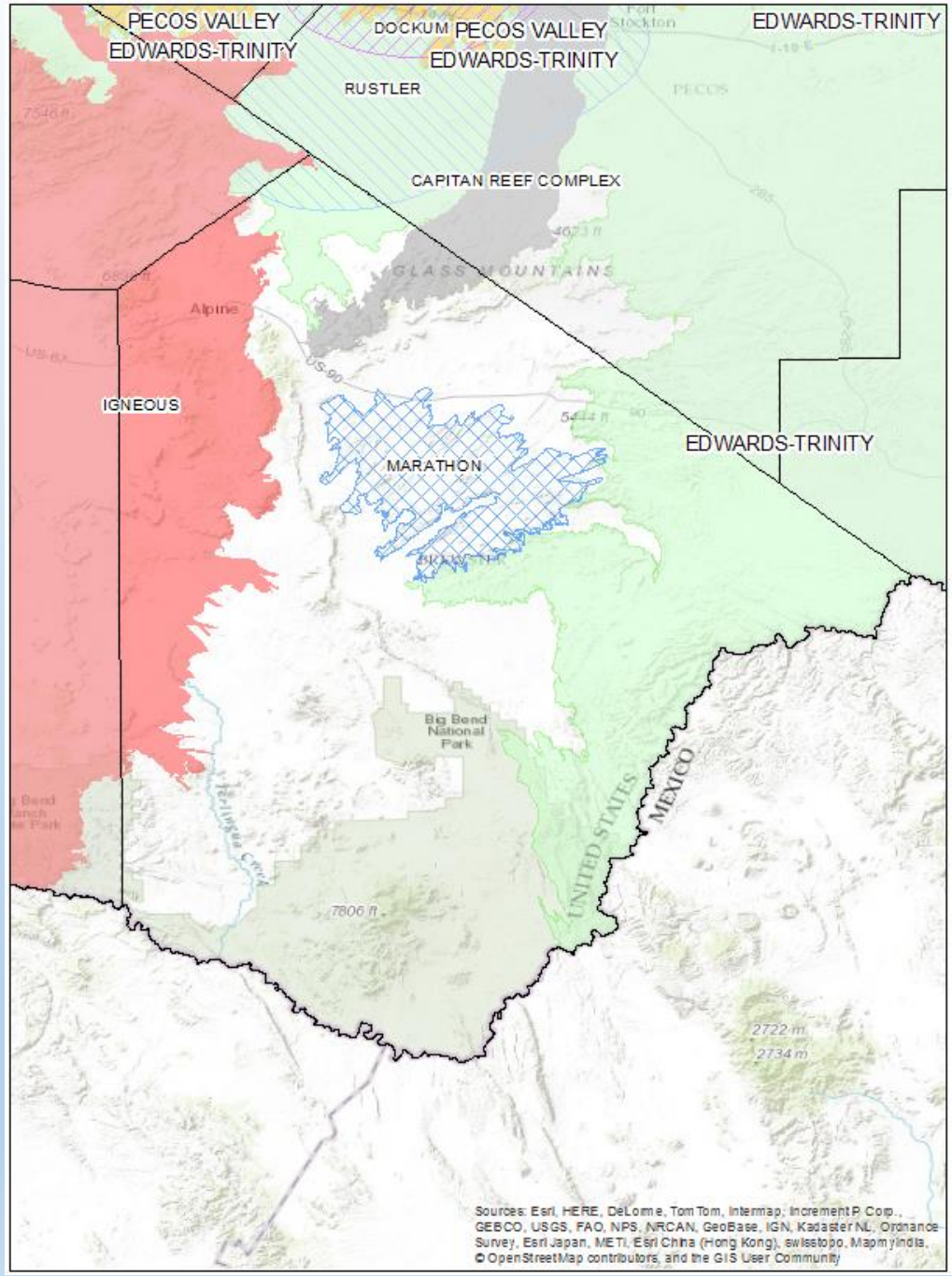


From Ashworth and Hopkins (1995)

Groundwater Availability Model (GAM)

- TWDB effort to provide water resource information for water planning purposes
- GAMs available:
  - Igneous and Bolson aquifer (Beach and others, 2004)
  - Edwards-Trinity Plateau and Pecos Valley aquifers (Anaya and Jones, 2009)
  - Capitan Reef Complex – eastern arm (Jones, 2016)
  - Rustler aquifer (Ewing and others, 2012)

Igneous Bolson Aquifer Conceptual Model

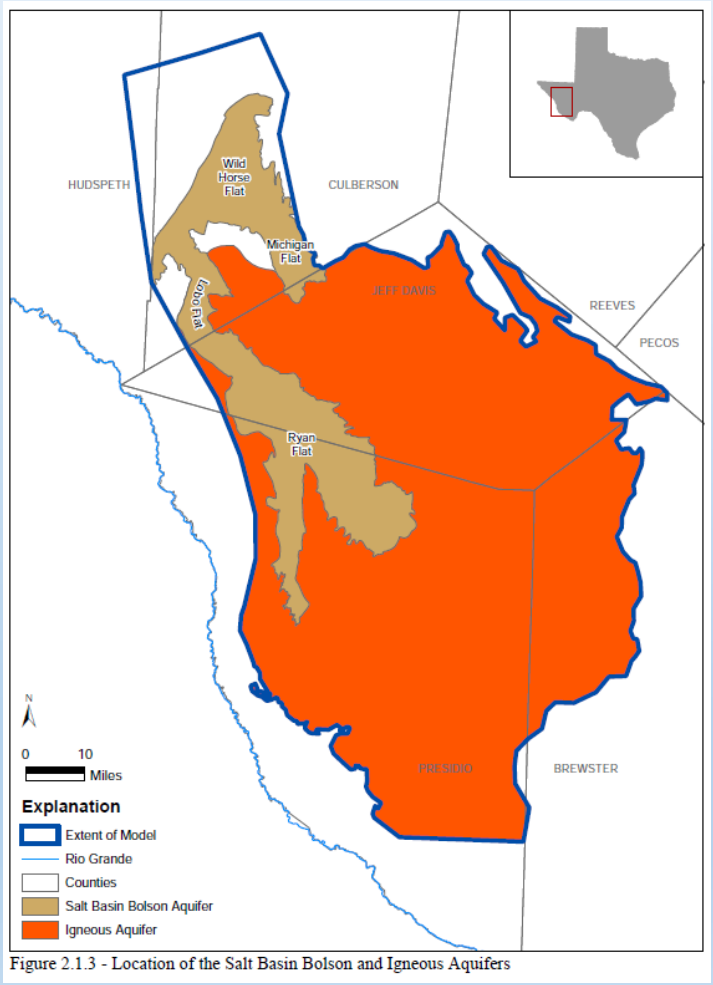


Figure 2.1.3 - Location of the Salt Basin Bolson and Igneous Aquifers

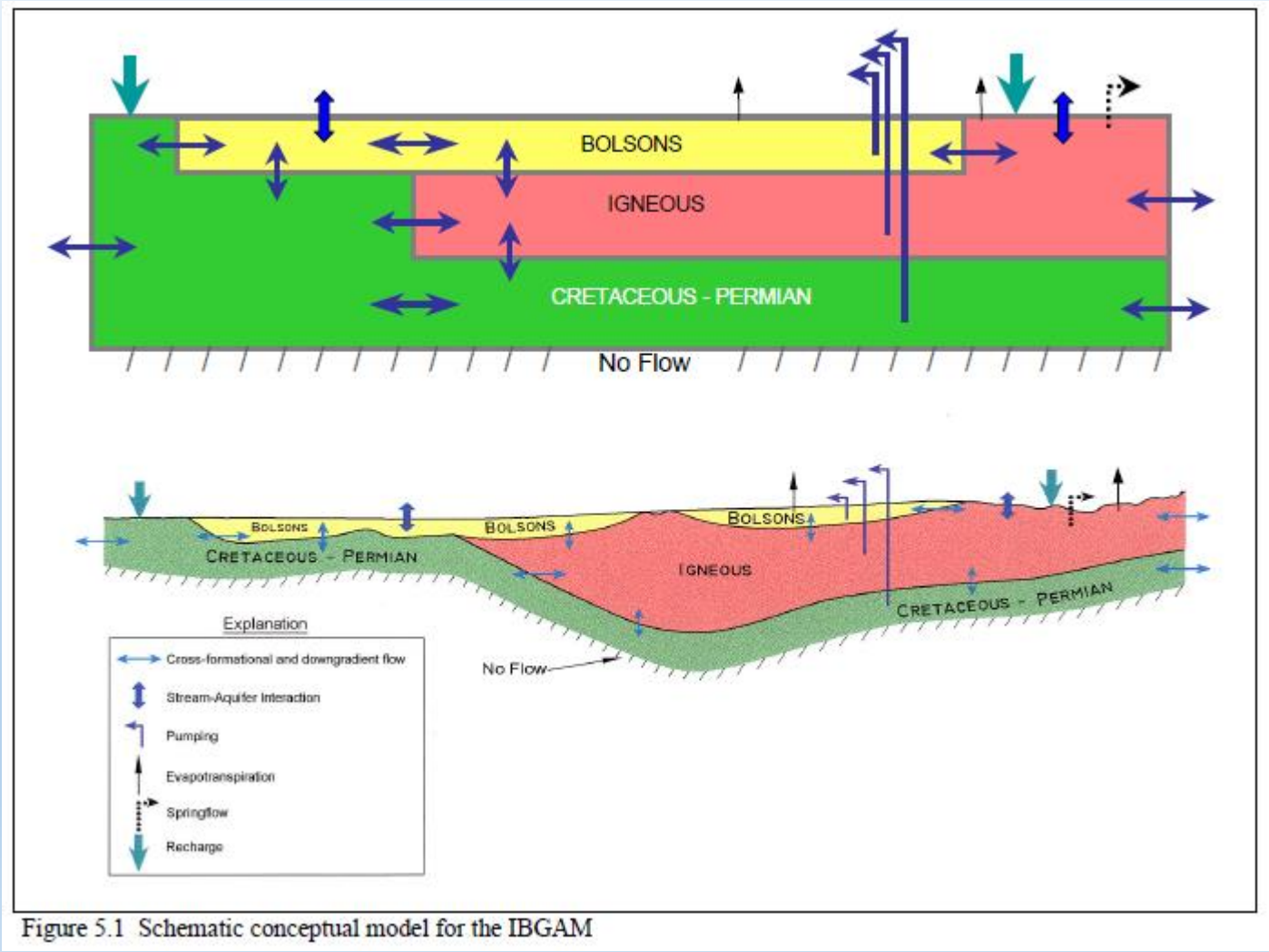


Figure 5.1 Schematic conceptual model for the IBGAM

Beach and others, 2004

Edwards-Trinity Plateau Aquifer Conceptual Model

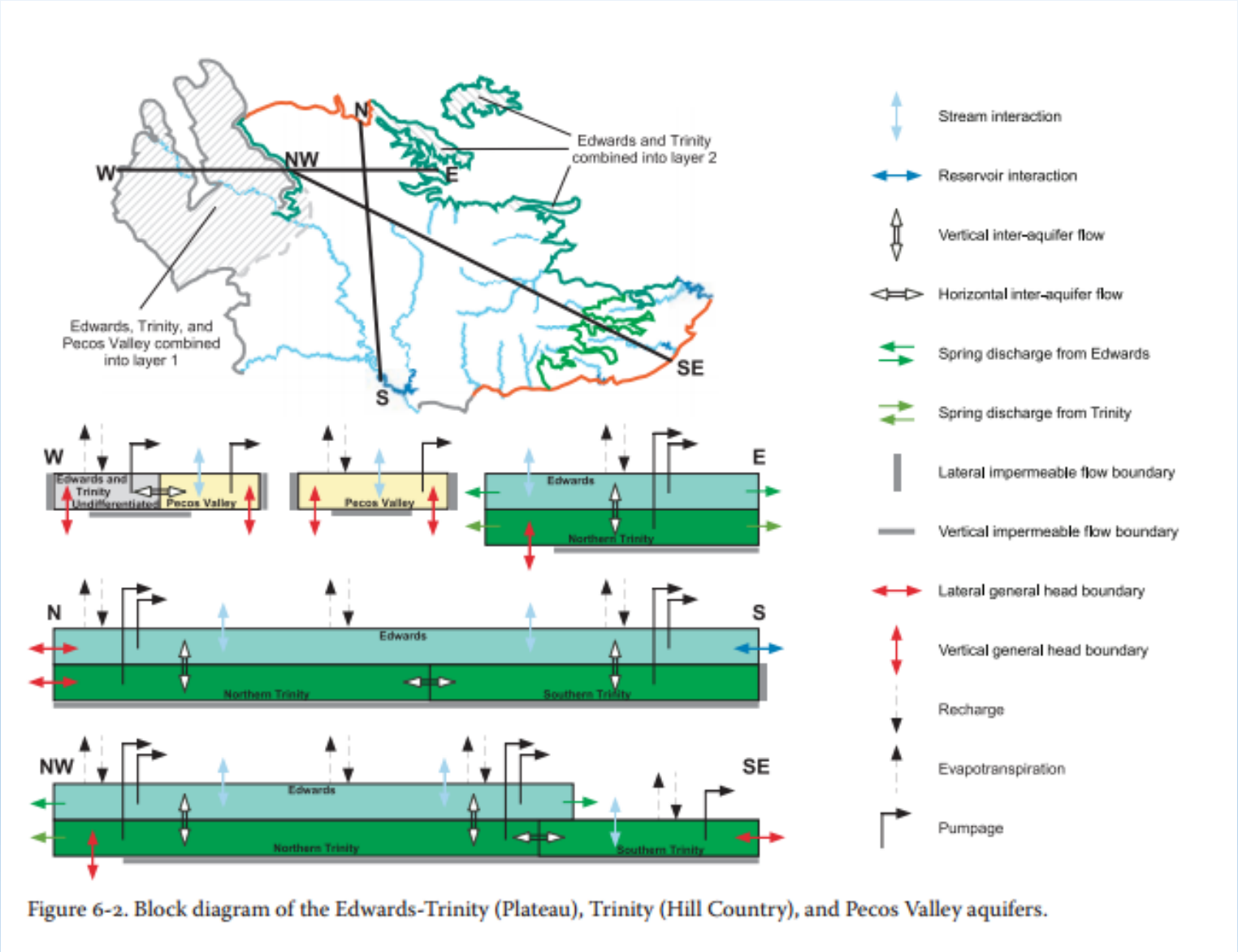


Figure 6-2. Block diagram of the Edwards-Trinity (Plateau), Trinity (Hill Country), and Pecos Valley aquifers.

Anaya and Jones, 2009

Capitan Reef Complex Aquifer Conceptual Model

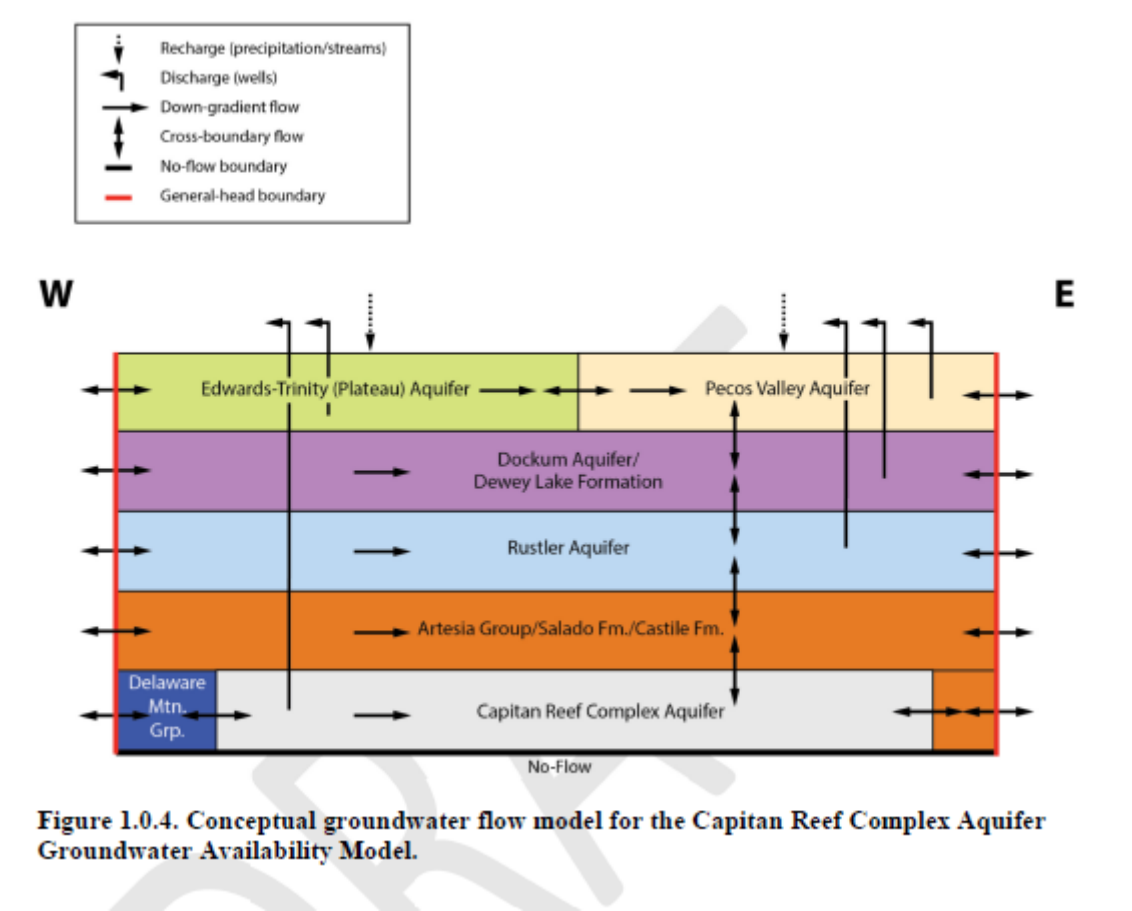
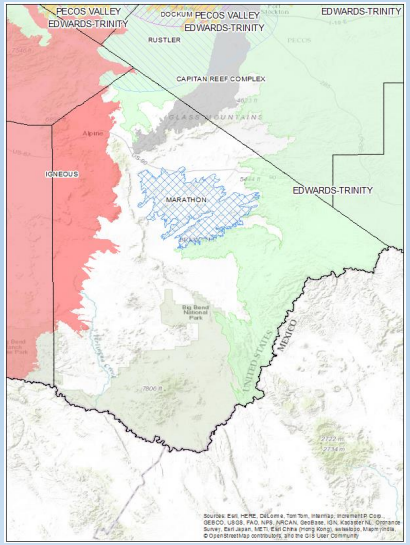


Figure 1.0.4. Conceptual groundwater flow model for the Capitan Reef Complex Aquifer Groundwater Availability Model.

Jones, 2016

TWDB Annual groundwater existing supplies*

Aquifer	Annual "supplies" (acre-feet)
Igneous	7,311
Marathon	127
Capitan Reef Complex	12,685
Edwards-Trinity (Plateau)	255,991
Rustler	2,521

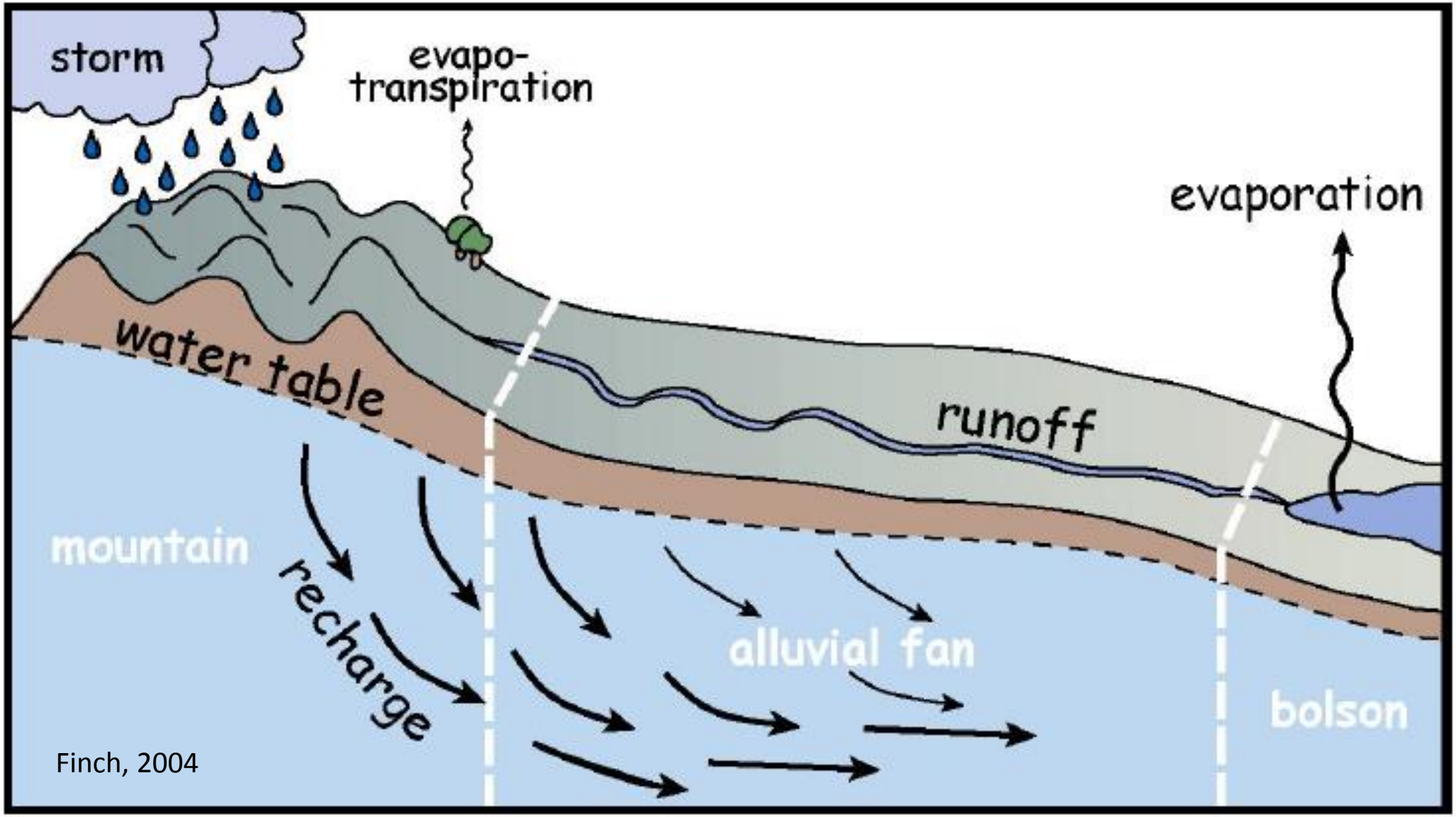


* From the 2017 Texas State Water Plan

- The estimates are per aquifer; excluding the Marathon aquifer, only parts of all of the aquifers are in Brewster county

Recharge

- The method by which water gets into an aquifer
- A few specific ways that this might happen:
  - Direct infiltration onto aquifer outcrops (Edwards-Trinity Plateau)
  - Diffuse infiltration across buried aquifer (various examples)
  - Mountain front recharge across buried faults (Diablo mountains)
  - Surface water redistribution (Igneous)
- Recharge is difficult to quantify, estimates are commonly less than 5 % of total precipitation

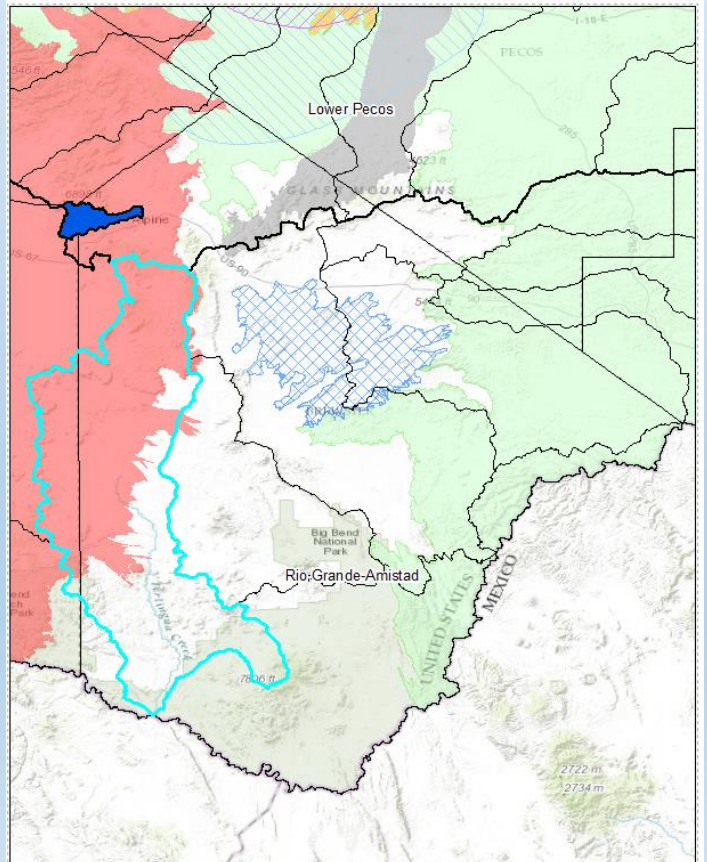

storm
evapo-
transpiration
evaporation
water table
runoff
mountain
recharge
alluvial fan
bolson

Finch, 2004

Diablo mountains north of Van Horn

Recharge, continued

- Catchments can be delineated from surface topography
- These help to predict the topographic controls on recharge
- Hydrologic Unit Codes (HUC) maps are available at various scales
  - Two digit: 13 = Rio Grande Basin
  - Four digit: 1307 = Lower Pecos
  - Eight digit: 13040204 = Terlingua creek
  - Twelve digit: 130700060105 = Ramirez Tank-Alpine Creek



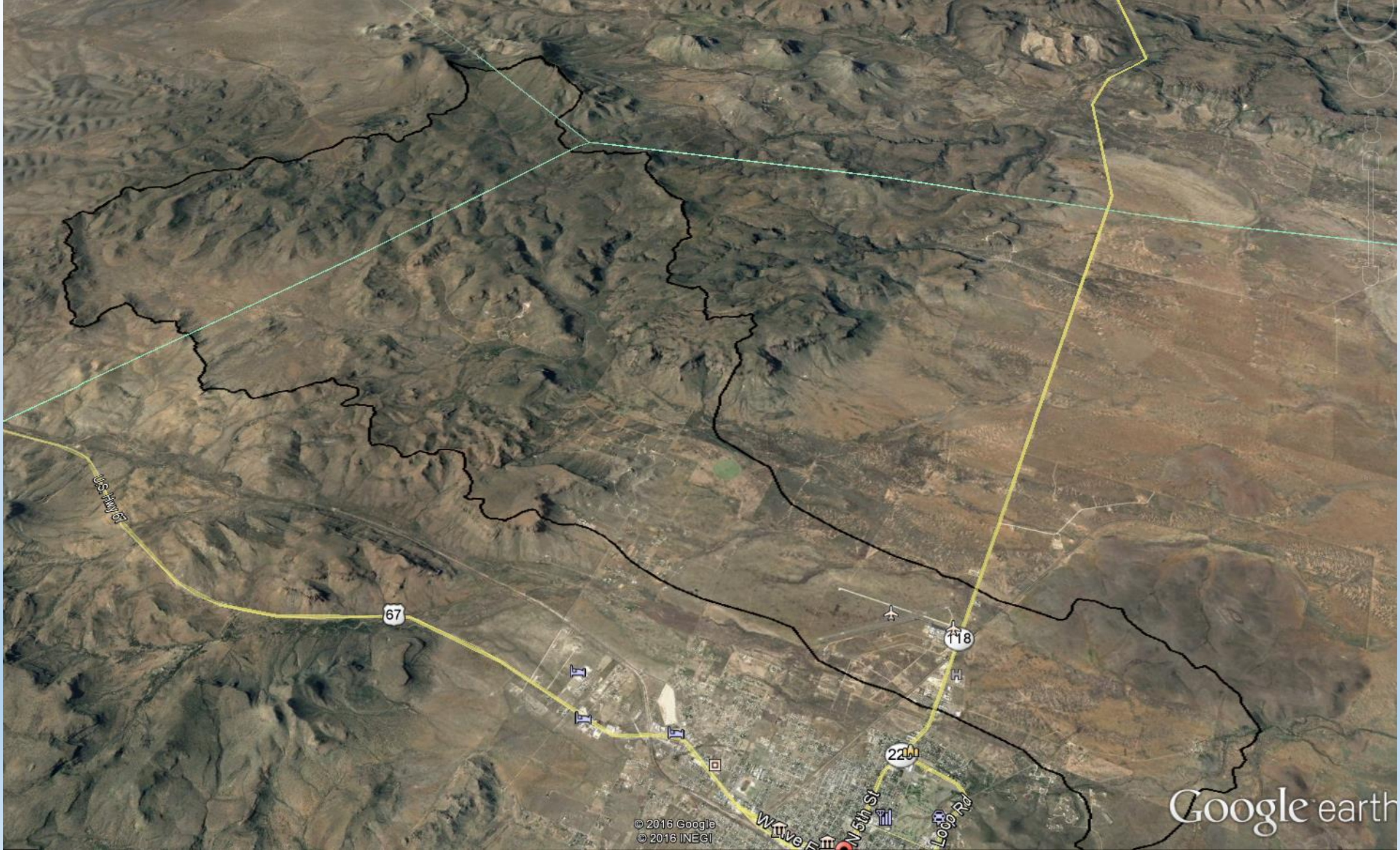
Sunny Glen recharge example

- Surface water redistribution:

sub-basin	sub-basin area, acres	Ia[1], inches	precipitation, ac-ft/yr	potential recharge, ac-ft/yr	runoff generated within sub-basin that leaves sub-basin, ac-ft/yr	runoff that enters sub-basin from up-gradient sub-basins, ac-ft/yr	estimated recharge, ac-ft/yr[a]
Upper Alpine Creek	33,829	0.67	47,882	2,090	1,123	0	967

2 % of precipitation on the area

Finch, 2004


US Hwy 67
67
118
22
N 5th St
Loop Rd
© 2016 Google
© 2016 INEGI
Google earth

Sunny Glen recharge example

sub-basin	sub-basin area, acres	Ia[1], inches	precipitation, ac-ft/yr	potential recharge, ac-ft/yr	runoff generated within sub-basin that leaves sub-basin, ac-ft/yr	runoff that enters sub-basin from up-gradient sub-basins, ac-ft/yr	estimated recharge, ac-ft/yr[a]
Upper Alpine Creek	33,829	0.67	47,882	2,090	1,123	0	967

My estimate for Sunny Glen:

Ramirez tank / Alpine Creek (HUC12)	**23,674**	**0.67**	**33,508**	**proportional**	**proportional**	**0**	**670**

670 ac-ft/yr = maximum number

Summary

- The complex geology results in complex aquifers
- Quantitative GAM models are very general and provide overall water resource information
- GAM models are typically not detailed enough for local resource evaluation
- We need to be able to understand how much groundwater we can use and have a sustainable groundwater supply for the future