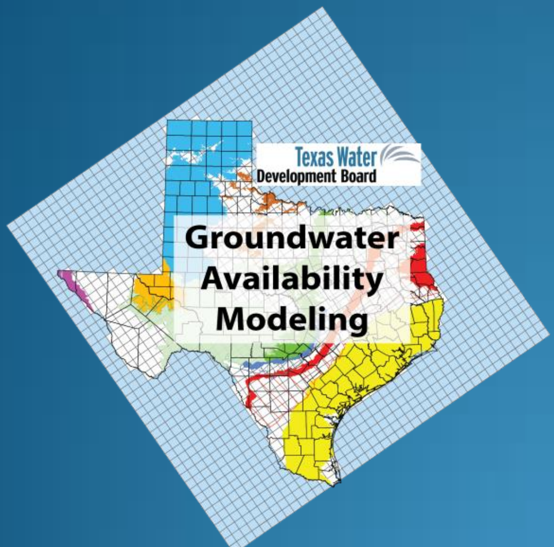
Capitan Reef Complex Aquifer GAM Stakeholder Advisory Forum Number 2



Fort Stockton, Texas

May 27, 2014

Ian C. Jones, Ph.D., P.G.

Texas Water Development Board

Disclaimer

The statements contained in this presentation are my professional views and opinions and are not intended to reflect the positions of, or information from, the three member Texas Water Development Board, nor is it an indication of any official policy position of the Board.

Outline

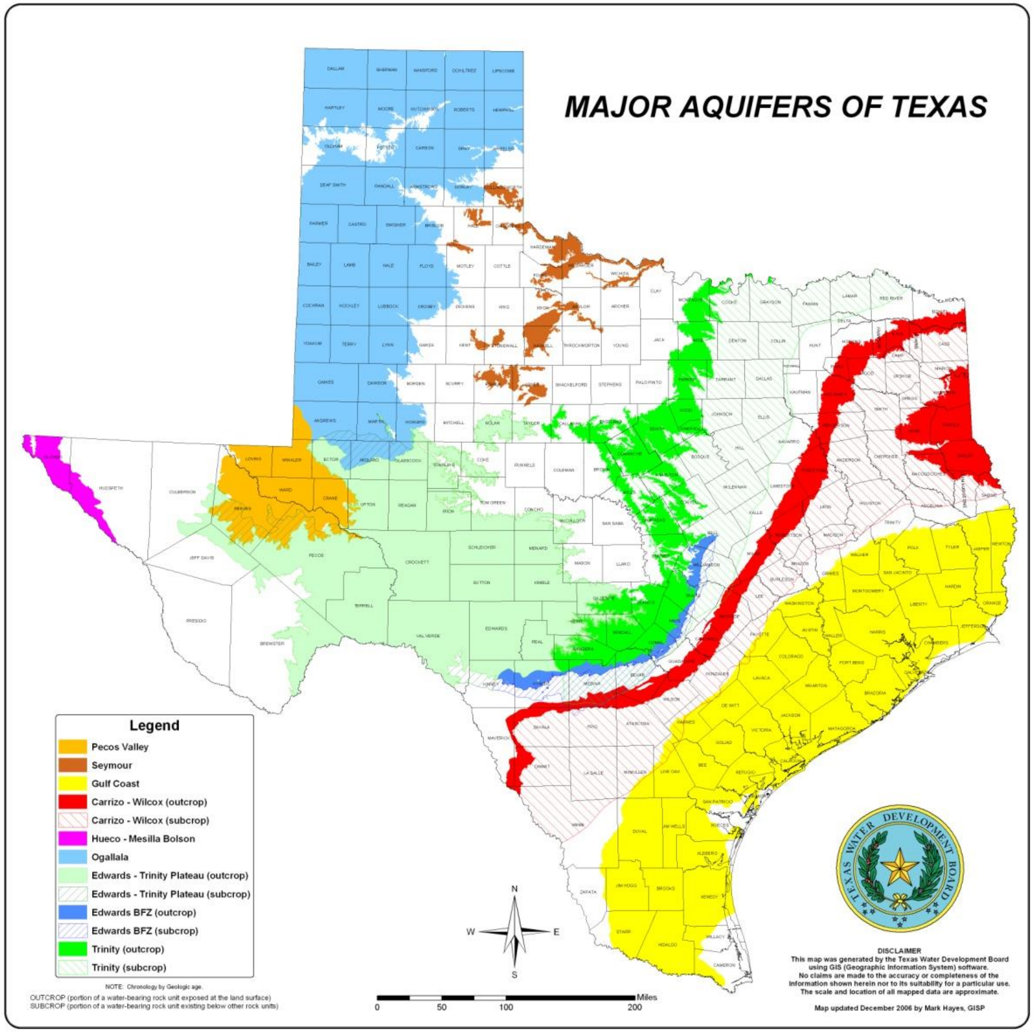
- Introduction
- Overview of Capitan Reef Complex Aquifer
- Conceptual model
- Revised project schedule

INTRODUCTION

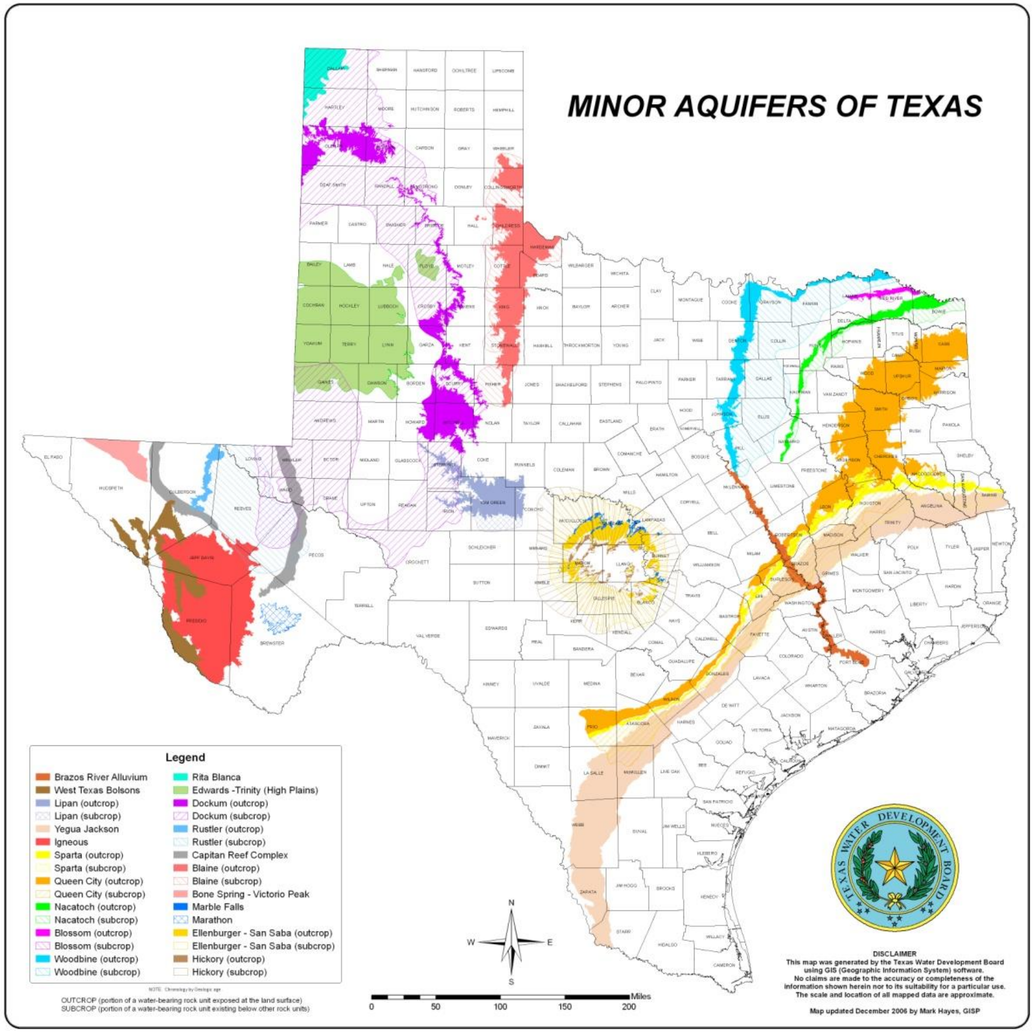
Groundwater Availability Modeling Program

- **Aim**: Develop groundwater flow models for the major and minor aquifers of Texas.
- **Purpose**: Tools that can be used to aid in groundwater resources management by stakeholders.
- **Public process**: Stakeholder involvement during model development process.
- **Models**: Freely available, standardized, thoroughly documented. Reports available over the internet.
- **Living tools**: Periodically updated.

Major Aquifers



Minor Aquifers



How we use Groundwater Models?

- Provide groundwater conservation districts with water budget data for their management plans.
- Assisting groundwater management areas in determining desired future conditions.
- Calculating Modeled Available Groundwater.
- Calculating Total Estimated Recoverable Storage.

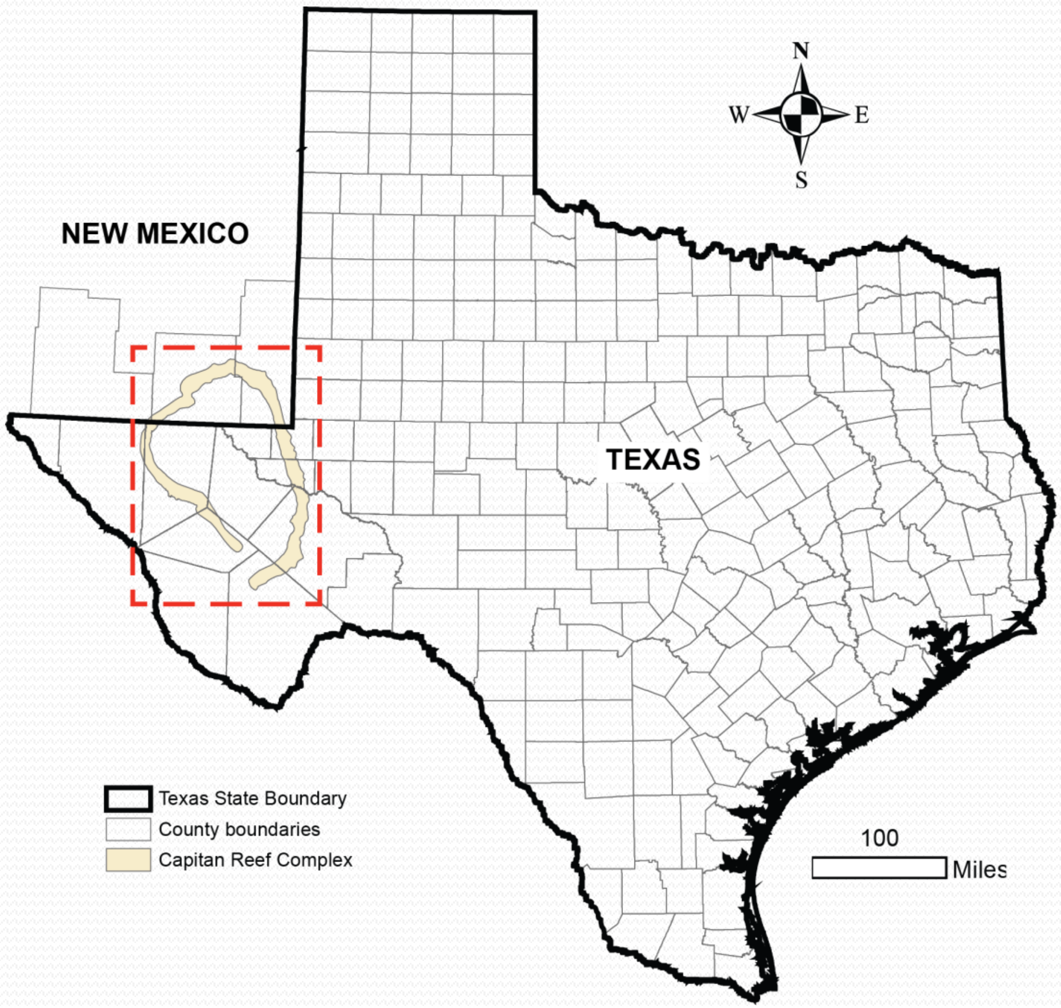
Stakeholder Advisory Forums

- Keep stakeholders updated about progress of the model
- Inform how the groundwater model can, should, and should not be used
- Provide stakeholders with the opportunity to provide input and data to assist with model development

CAPITAN REEF COMPLEX AQUIFER

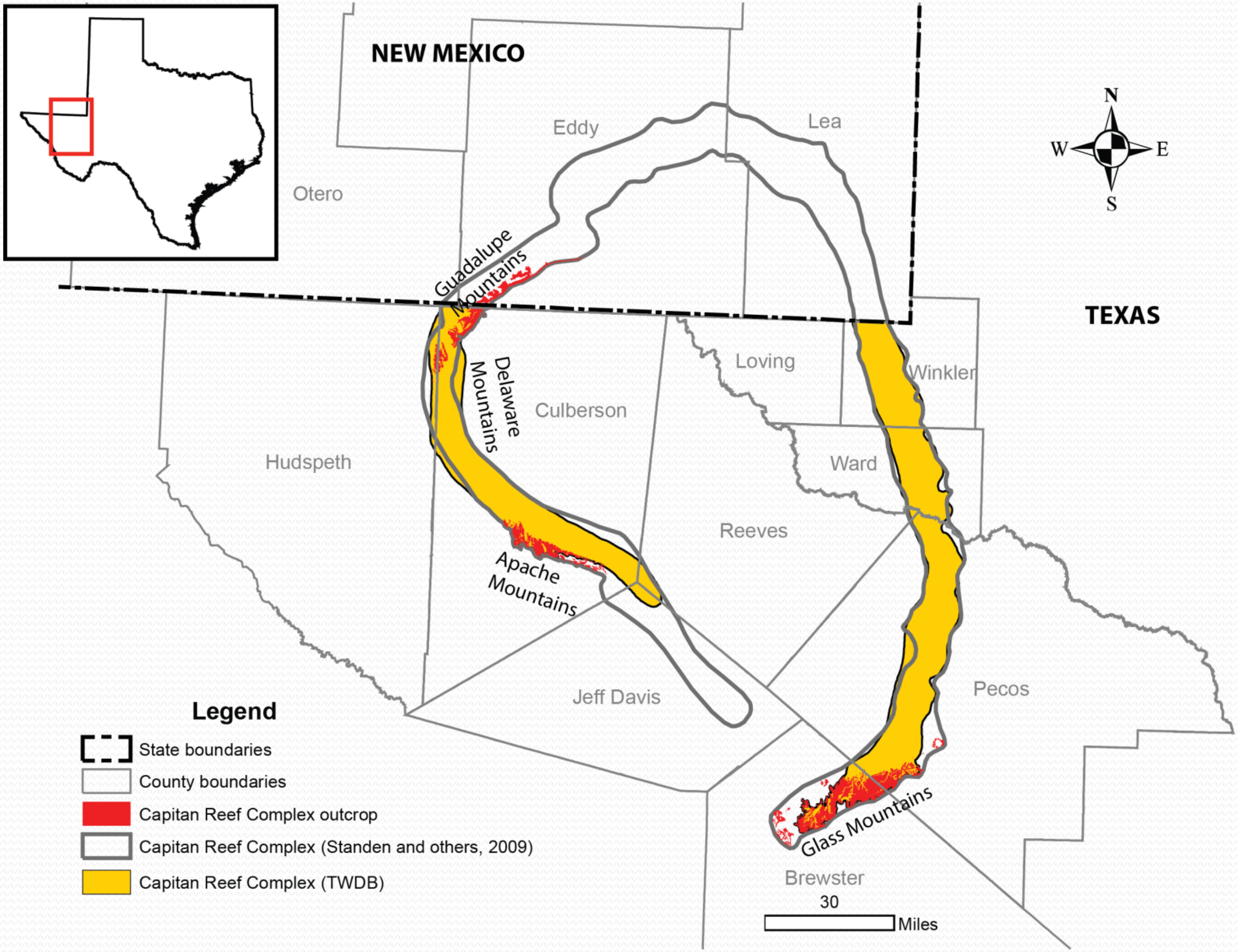
Study Area

Study Area

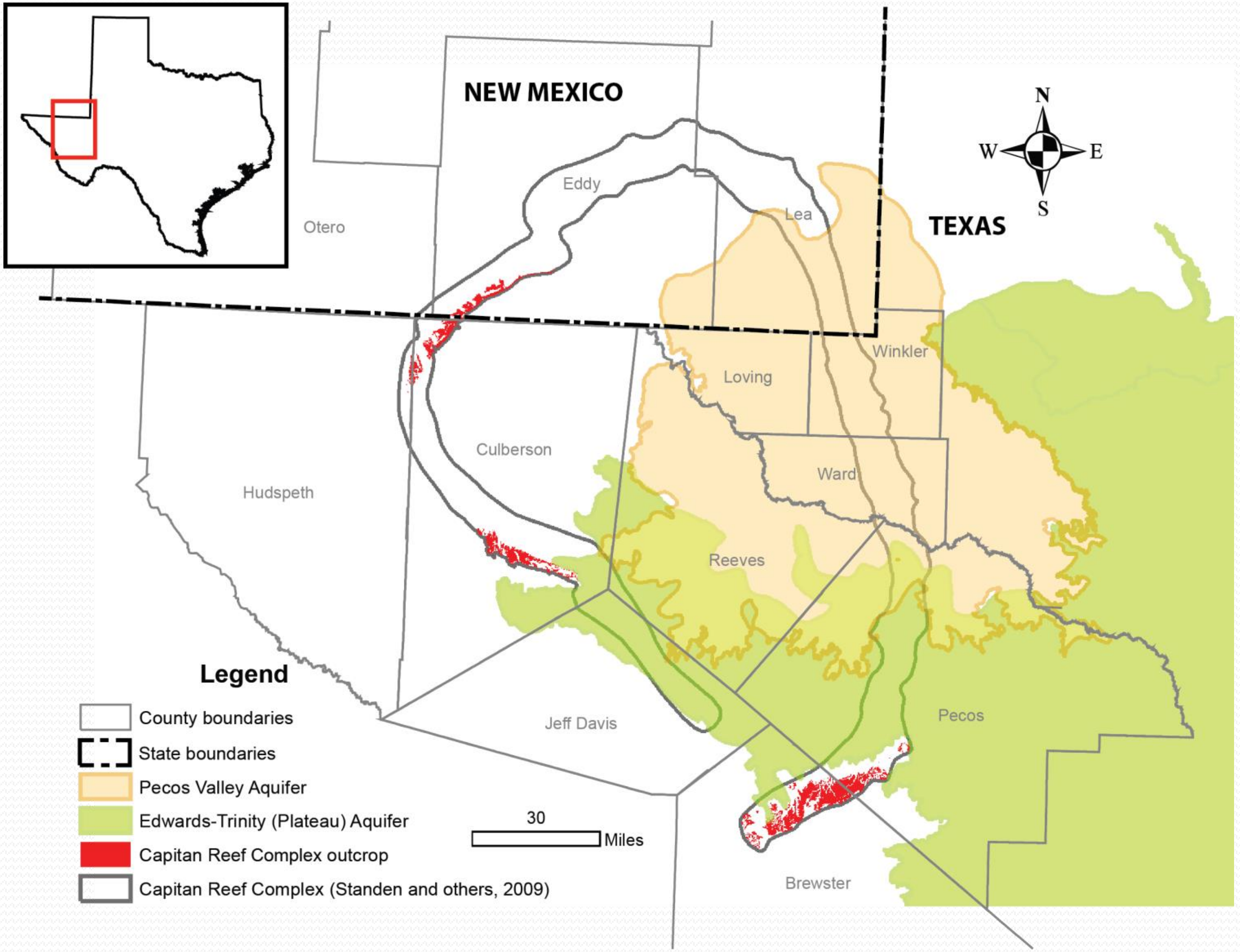


NEW MEXICO
TEXAS
N
W
E
S
100
Miles
Texas State Boundary
County boundaries
Capitan Reef Complex

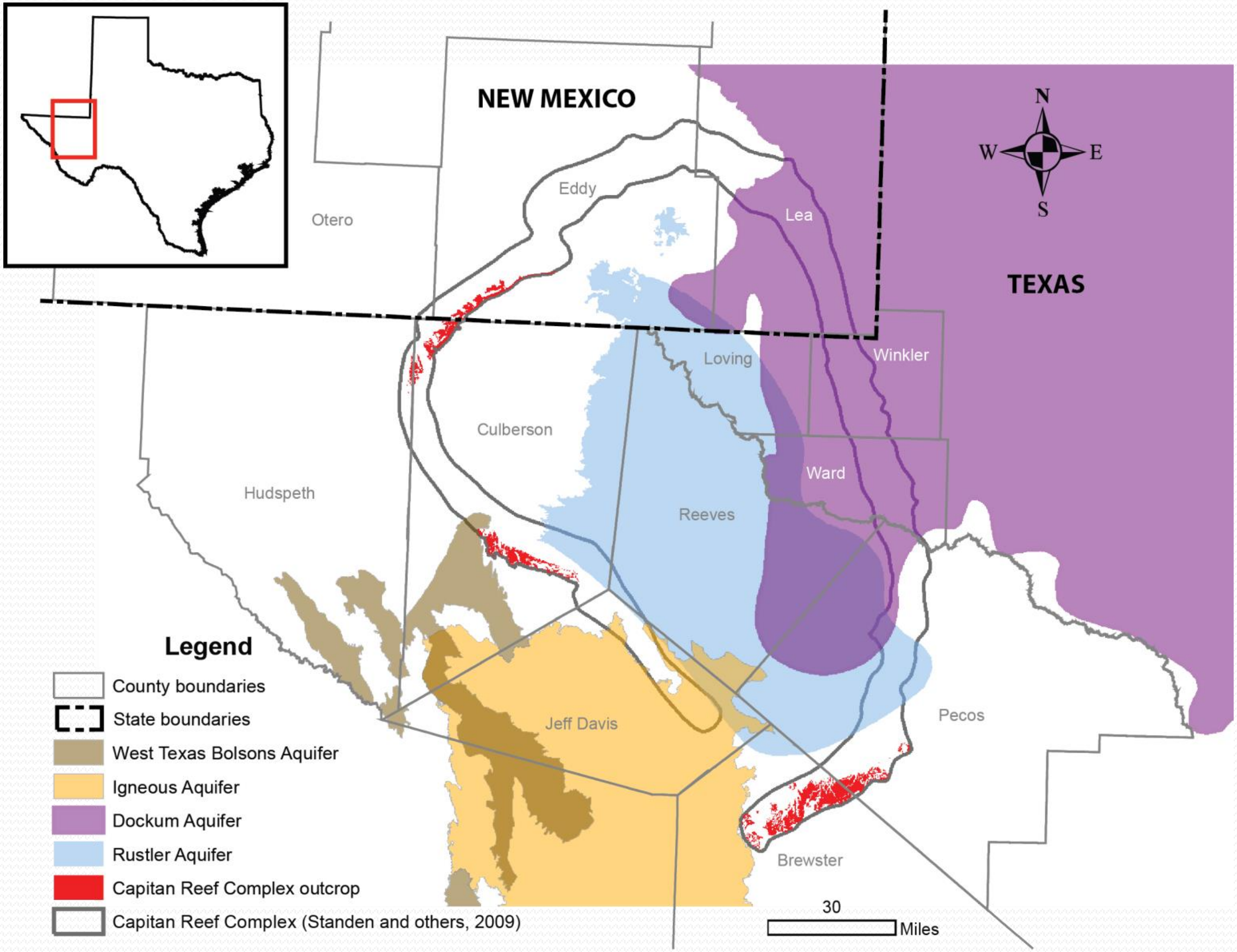
Aquifer Boundaries



Major Aquifers

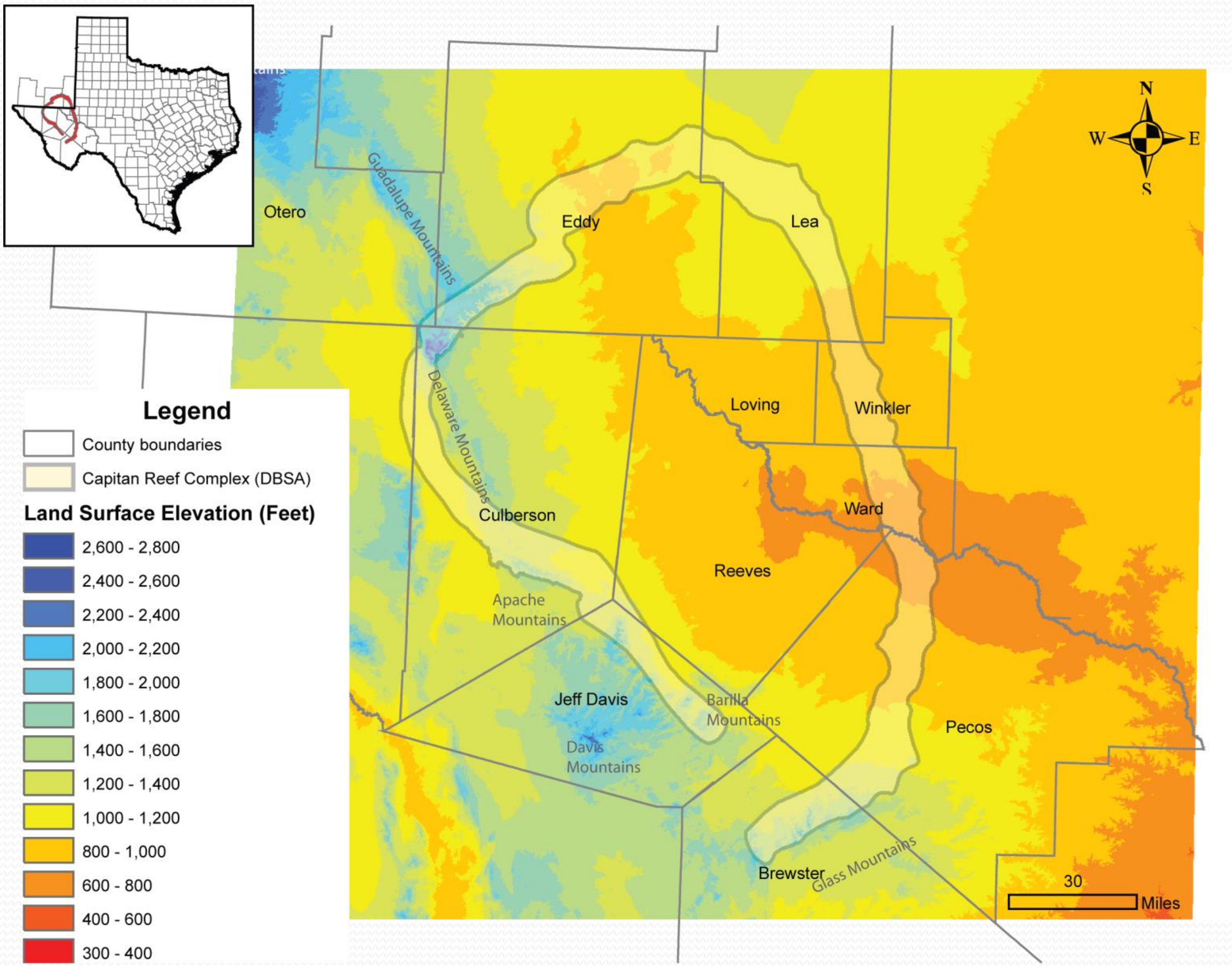


Minor Aquifers



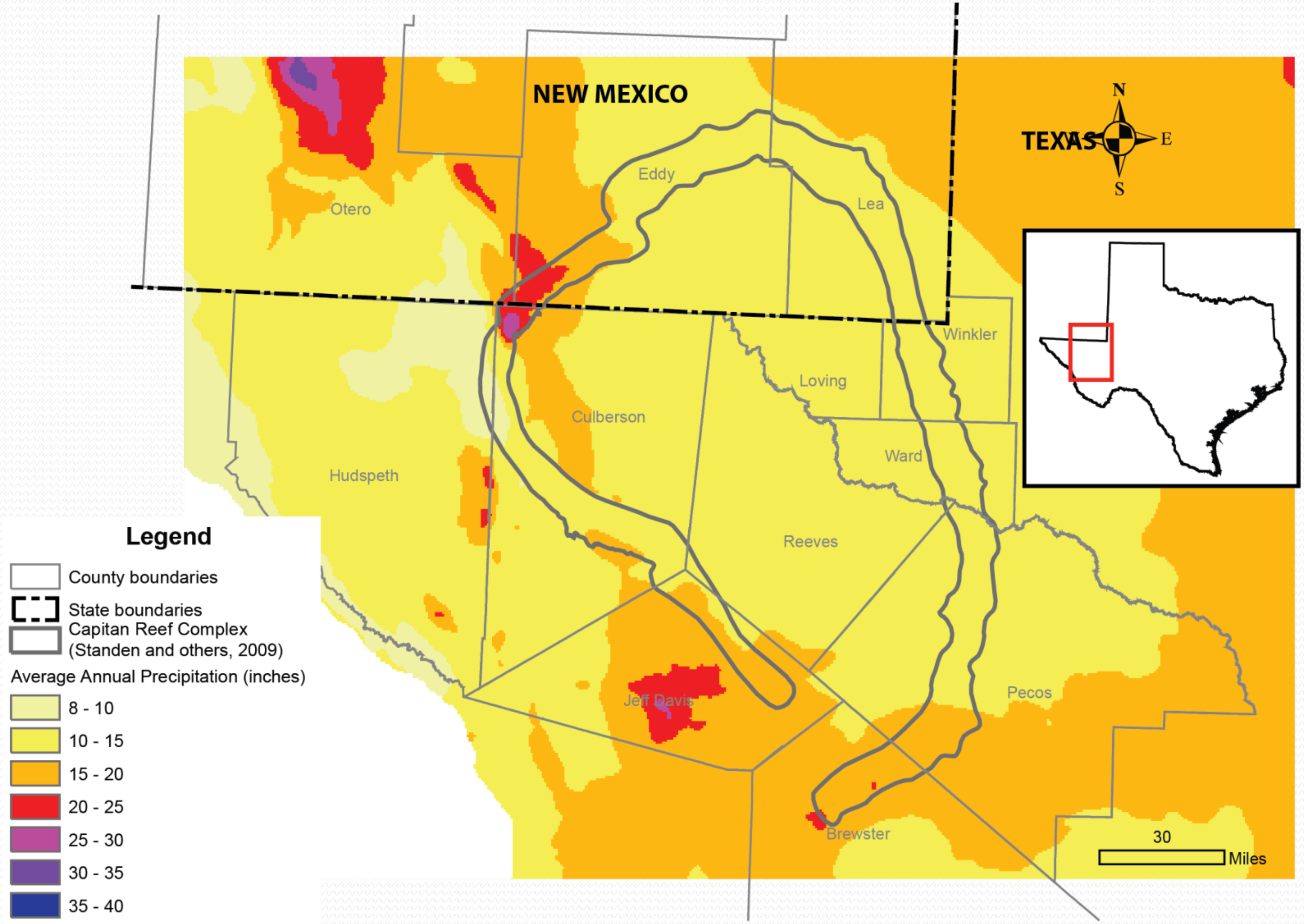
Climate

Land Surface Elevation



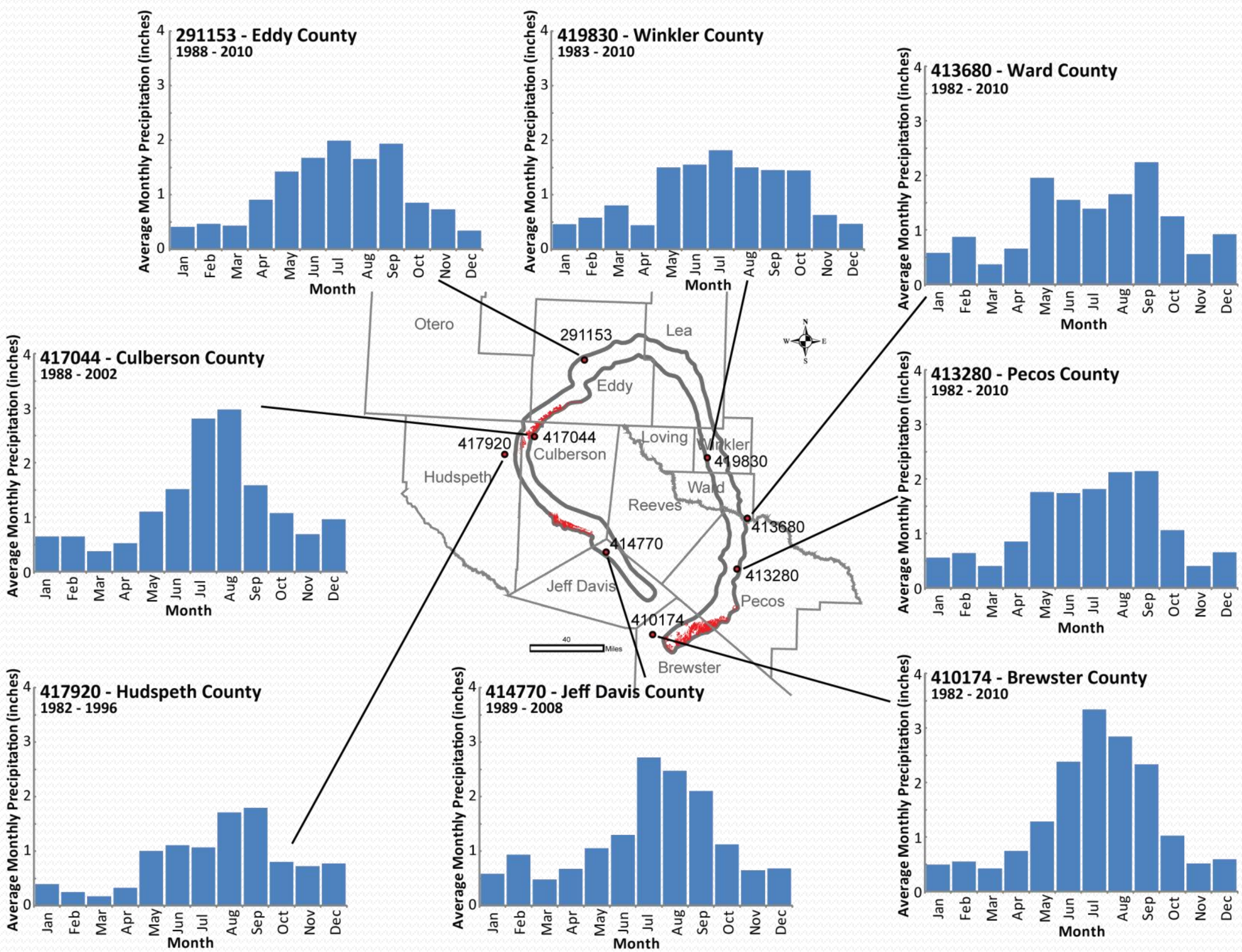
Based on data from Gesch and others (2002)

Average Annual Precipitation



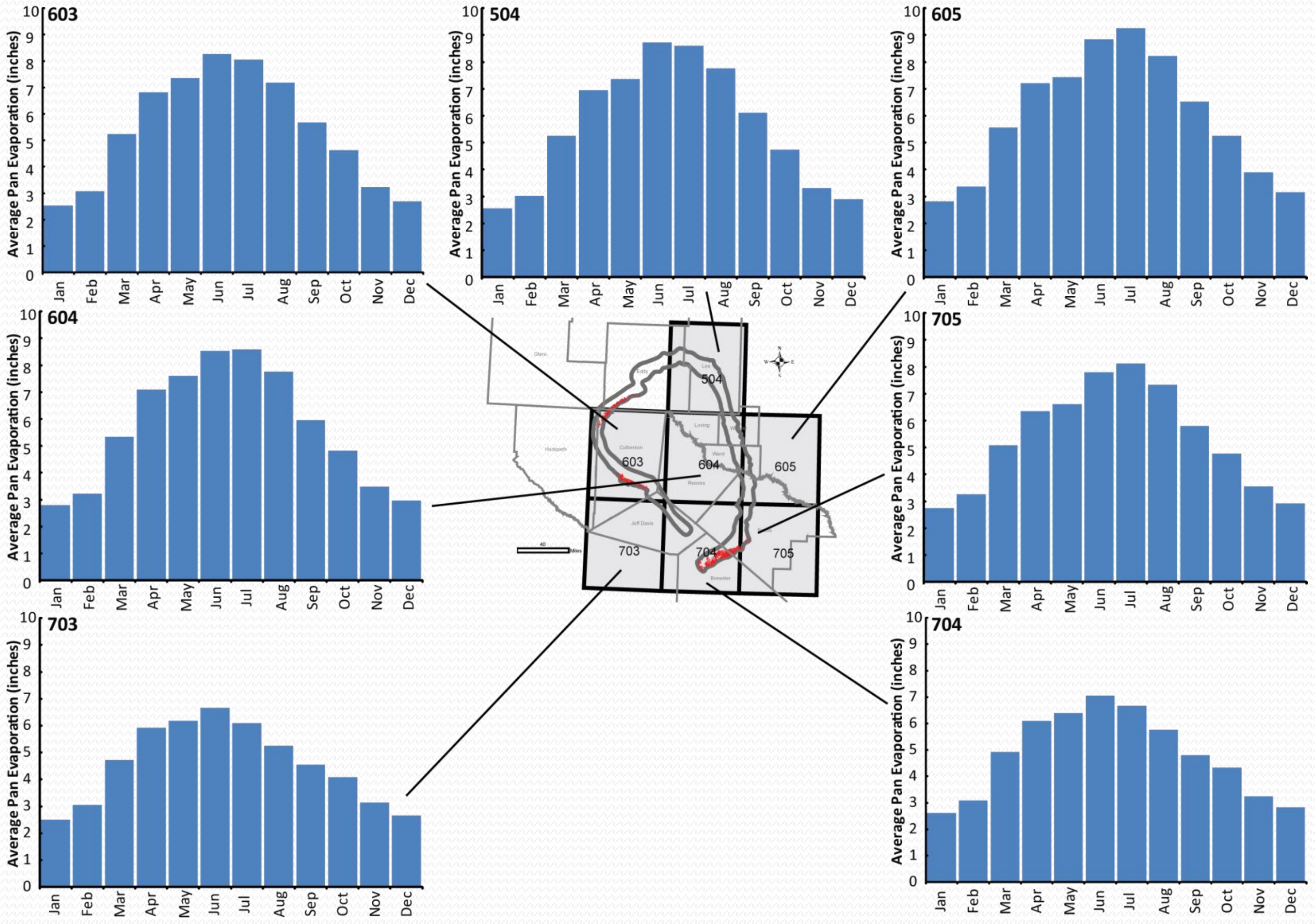
Based on data from Oregon State University (2006)

Average Monthly Precipitation



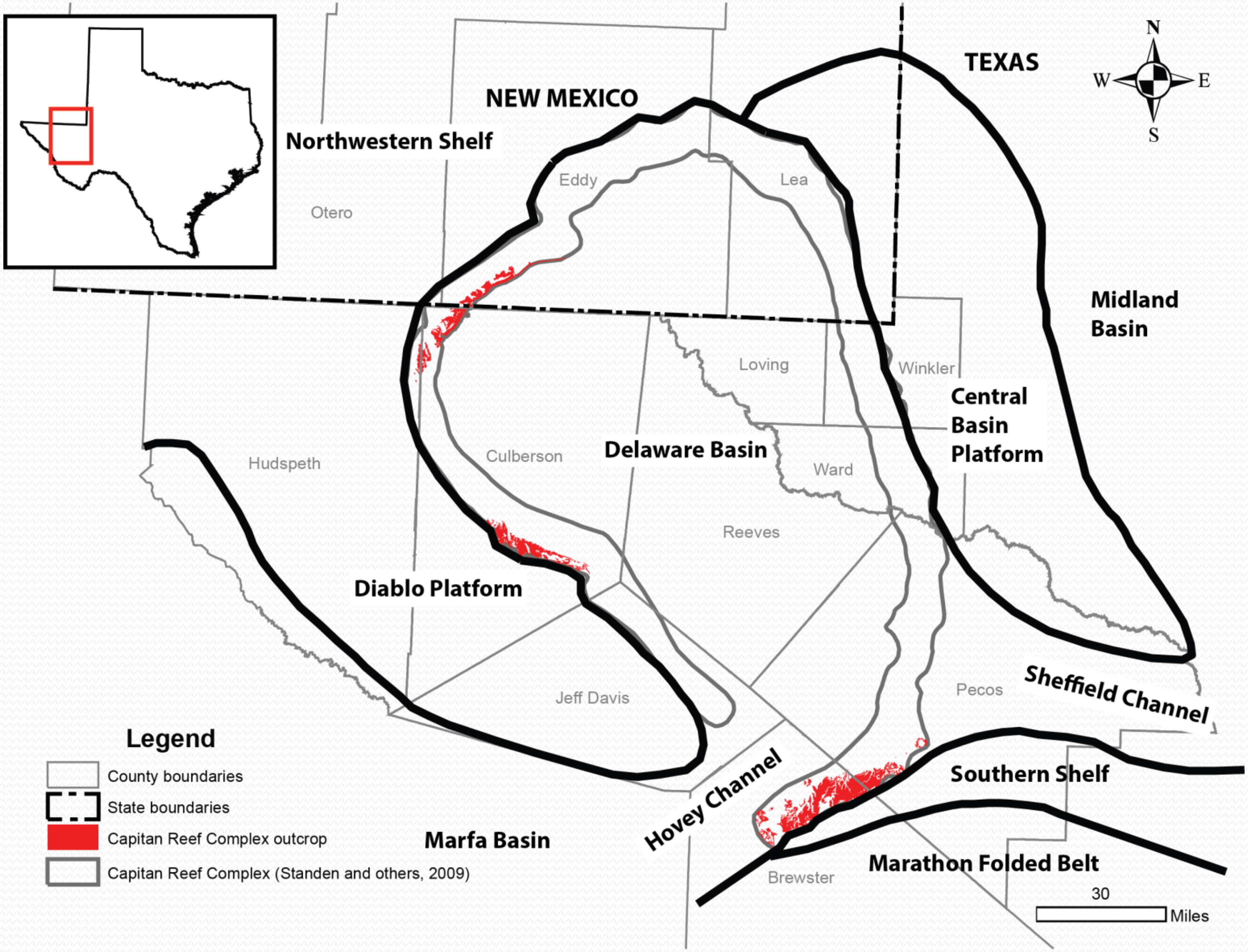
Based on data from National Climatic Data Center (2011)

Average Monthly Pan Evaporation



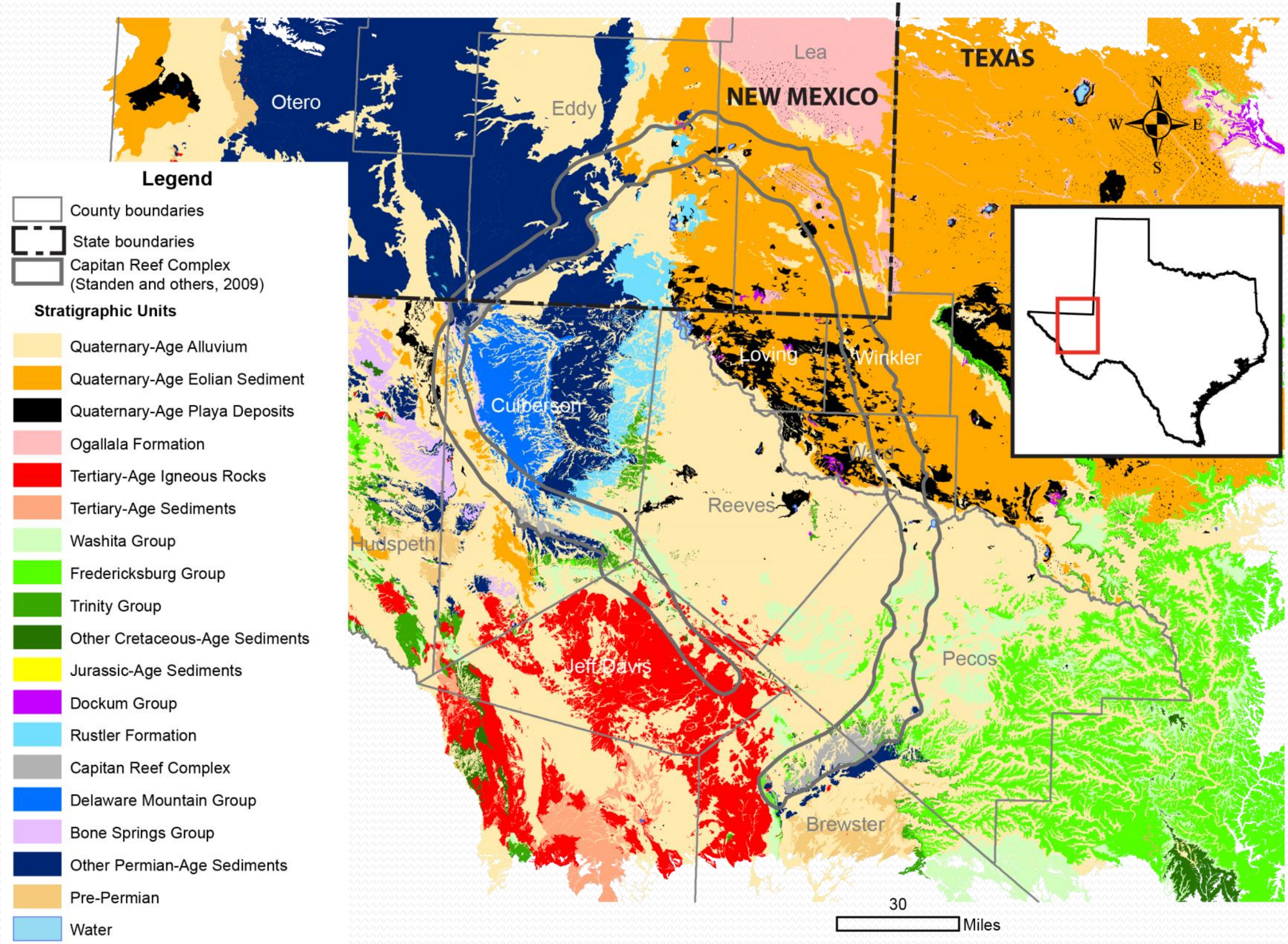
Geology

Structural Setting



Modified from Armstrong and McMillion (1961)

Surface Geology



Based on data from the Bureau of Economic Geology and New Mexico Bureau of Geology and Mineral Resources

Generalized Stratigraphy

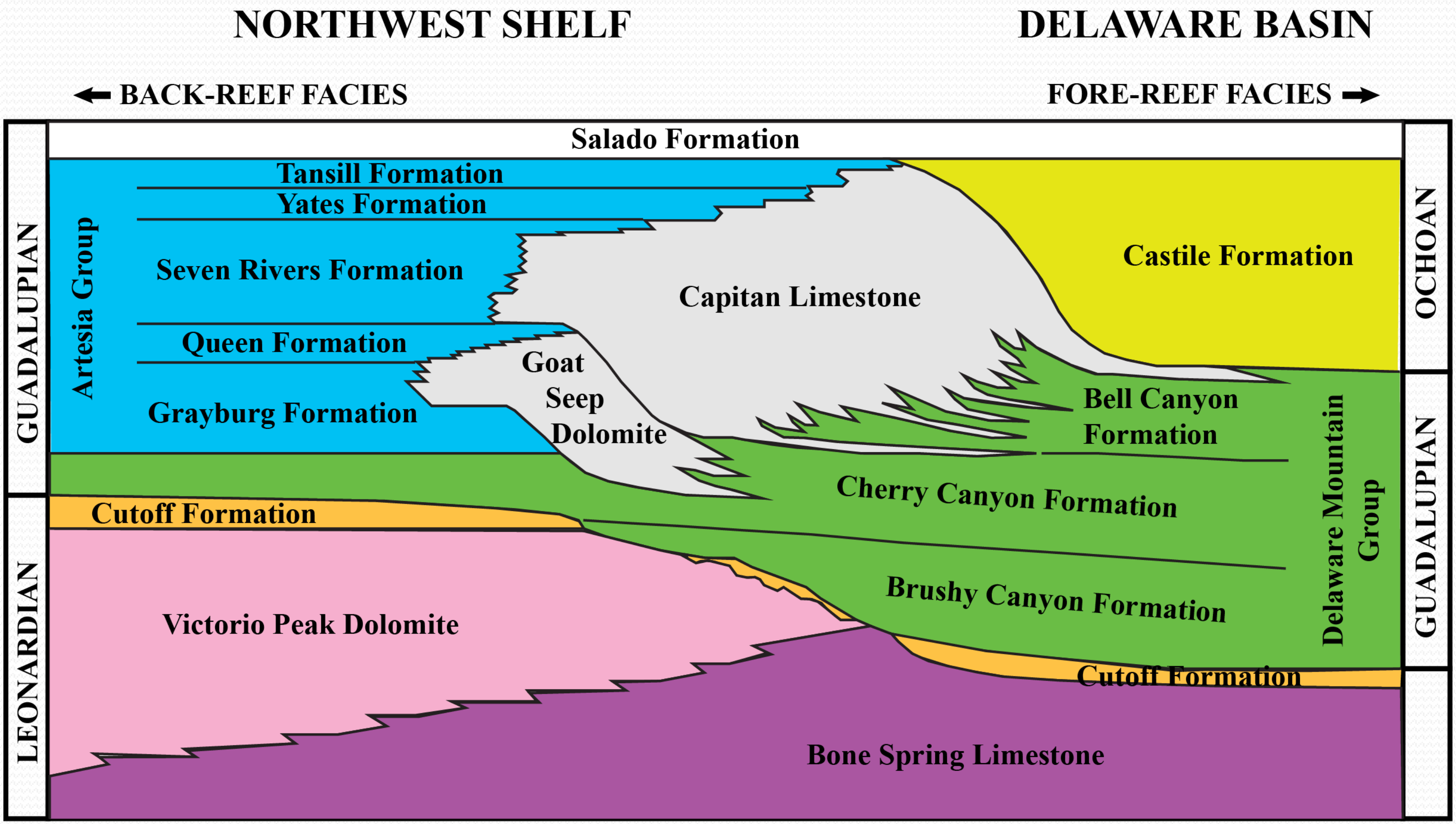
Summary of geologic formations and groups forming the Capitan Reef Complex and Delaware Basin

Period/Epoch or Series	Apache Mountains (Wood, 1968; Uliana, 2001)		Guadalupe Mountains (King, 1948; Hiss, 1975; Kerans and others, 1994; Kerans and Tinker, 1999)		Glass Mountains (King, 1930; Hill, 1999)		Delaware Basin
	Back Reef	Reef	Back Reef	Reef	Back Reef	Reef	
Quaternary to Tertiary	Quaternary Tertiary Deposits		Quaternary Tertiary Deposits		Quaternary Tertiary Deposits		Pecos Valley Alluvium
Cretaceous					Cretaceous		Edwards/Trinity Groups
Triassic					Bissett		Dockum Group
Permian/Ochoan				Rustler [a]			Rustler
				Salado [a]			Salado
				Castile [a]			Castile
Permian/Guadalupian	Artesia Group: Tansill	*Capitan Reef Complex*: Capitan Limestone	Artesia Group: Tansill	*Capitan Reef Complex*: Carlsbad and Capitan Limestones	Gilliam	*Capitan Reef Complex*: Tessey	Delaware Mountain Group: Bell Canyon
	Yates		Yates				
	Seven Rivers		Seven Rivers			Vidrio	Cherry Canyon
	Munn		Queen/Grayburg	Goat Seep Dolomite			
	Cherry Canyon		Upper San Andres; Lower San Andres (Brushy Canyon Equivalent)	Cherry Canyon	Word Formation (Cherry and Brushy Canyon Equivalent)		Brushy Canyon
	Cutoff Shale (Member of Bone Spring Limestone)						Pipeline Shale Member
Permian/Leonardian	Yeso	Victorio Peak (Member of the Bone Spring Limestone)			Leonard and Hess Member of Leonard Formation		Bone Spring Limestone

Sources: From Standen and others (2009): Modified after King, 1930, 1948; Wood, 1968; Hiss, 1975; Uliana, 2001; Hill, 1999; Kerans and others, 1994; Kerans and Tinker, 1999.

[a] Formations overlie Capitan Reef Complex between the Guadalupe and Glass Mountains

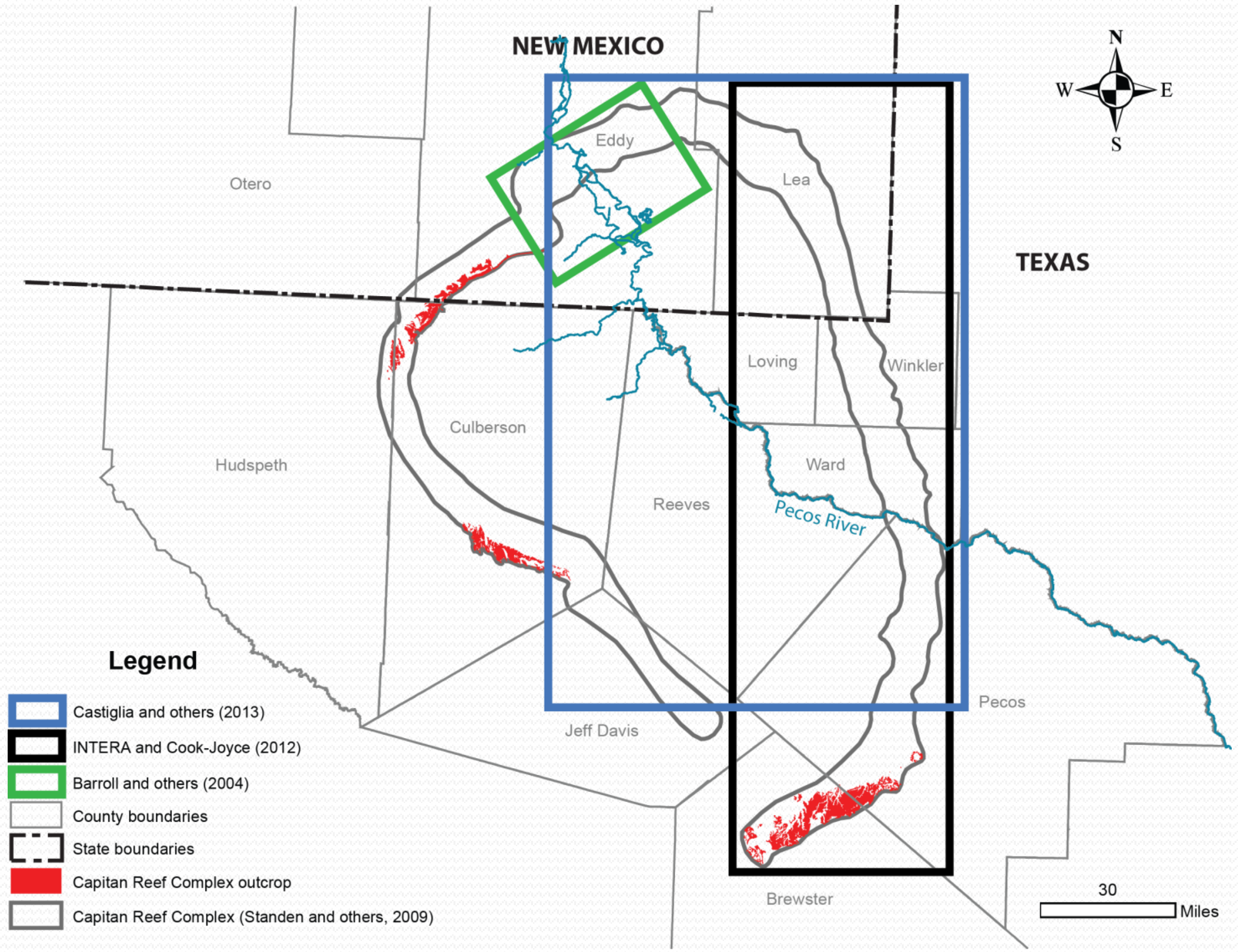
Generalized Cross-Section



Modified from Standen and others (2009); Melim and Scholle (1999)

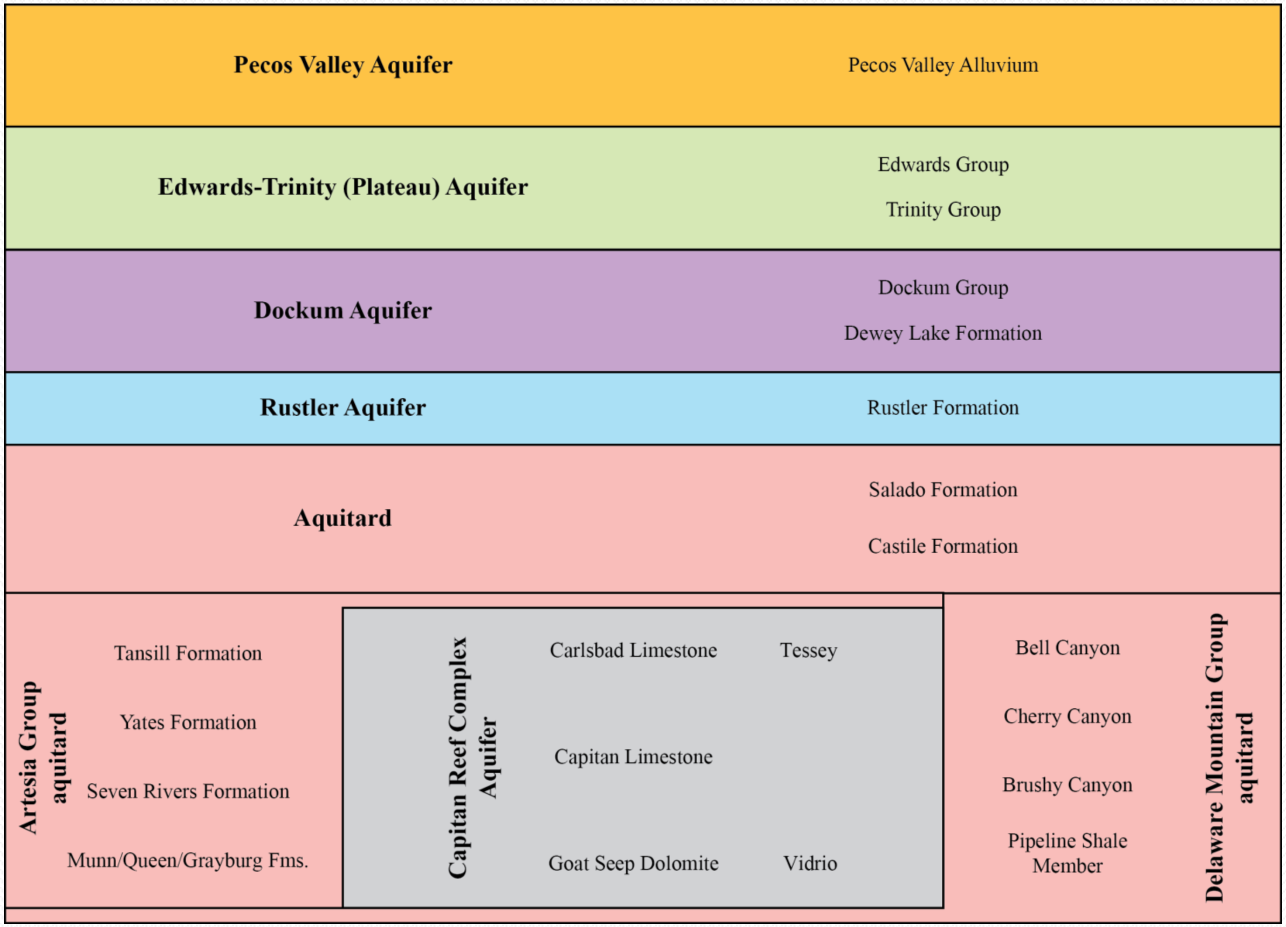
Previous Work

Previous Groundwater Models

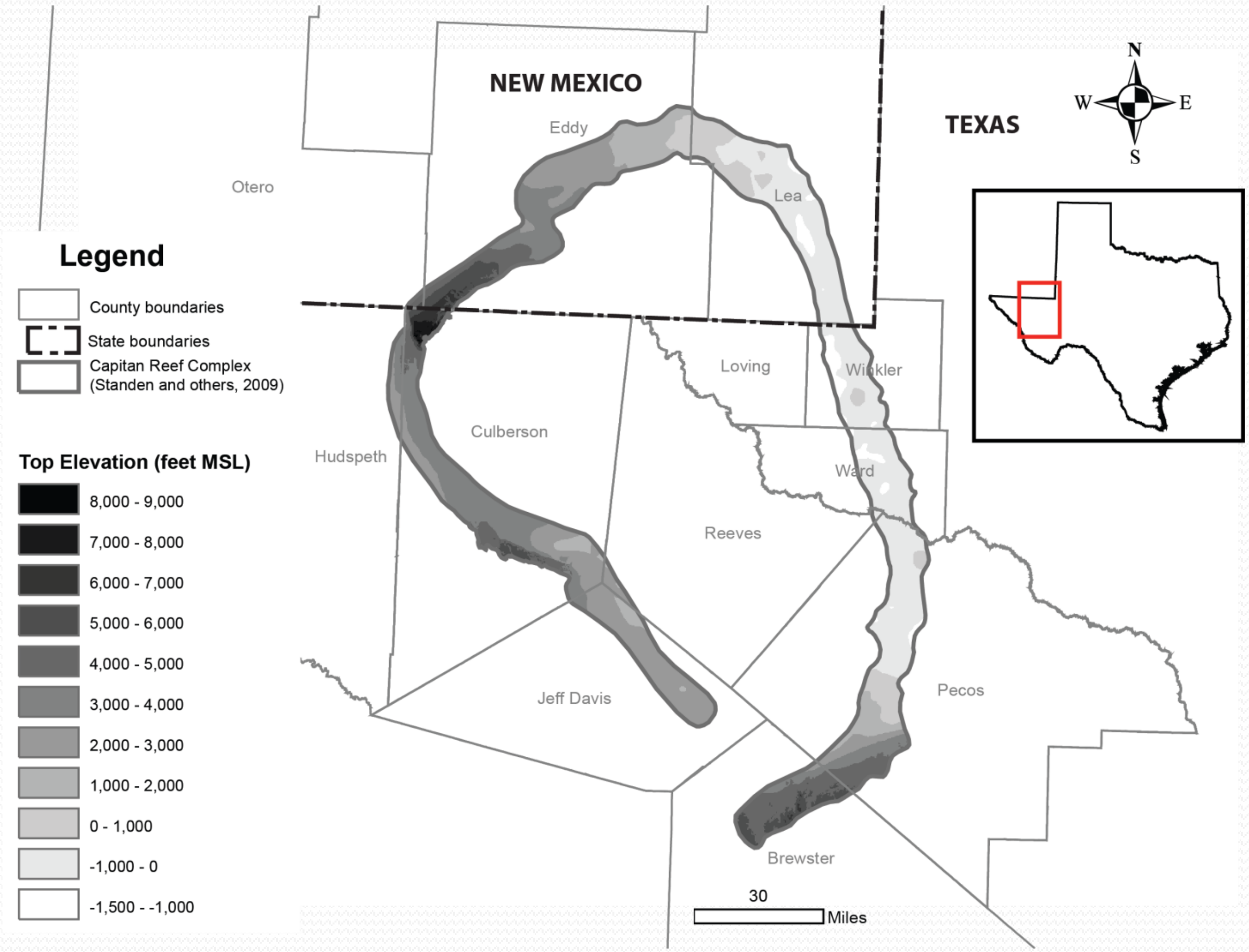


Hydrostratigraphy/Framework

Hydrostratigraphy

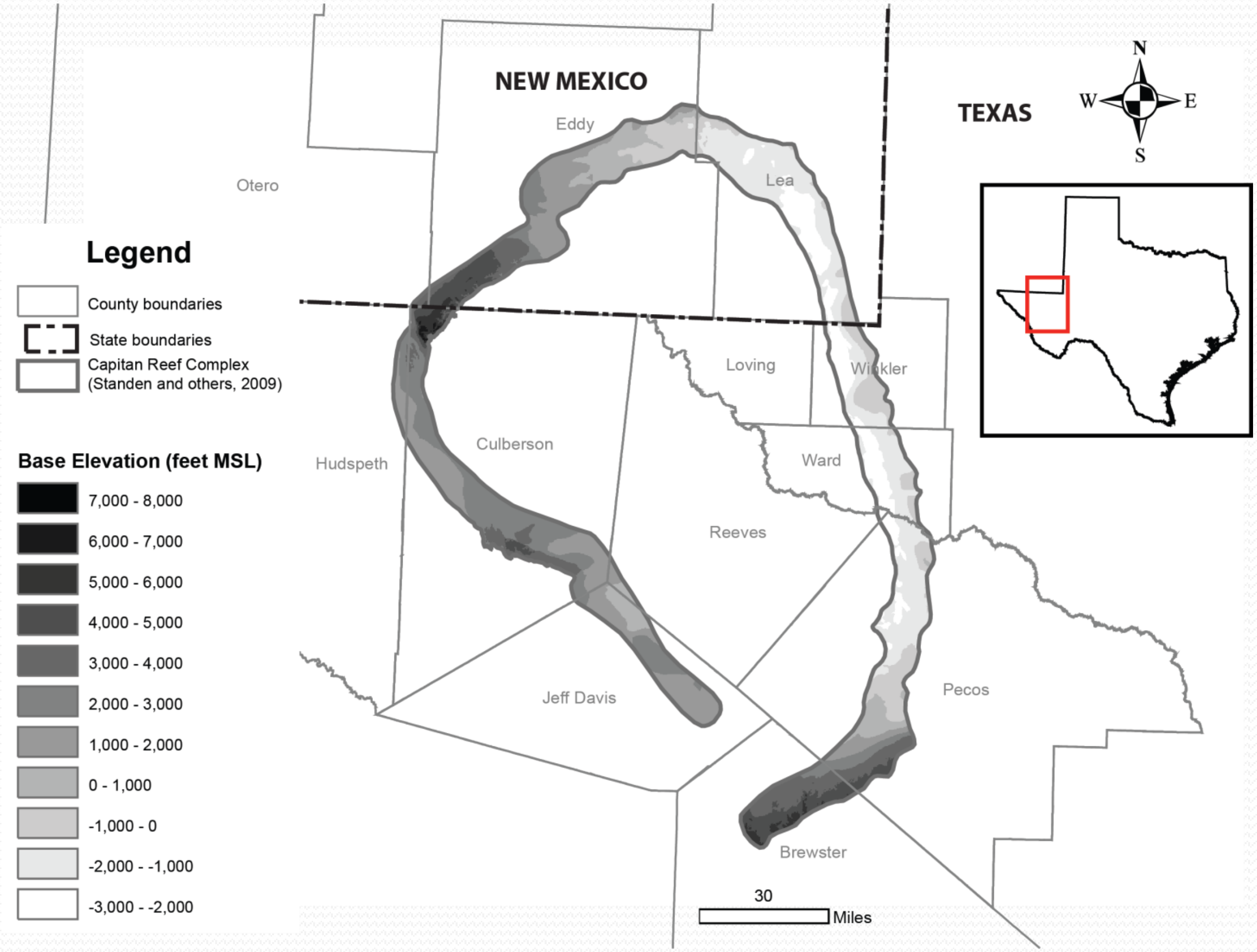


Capitan Aquifer Top Elevation



Modified from Standen and others (2009)

Capitan Aquifer Base Elevation



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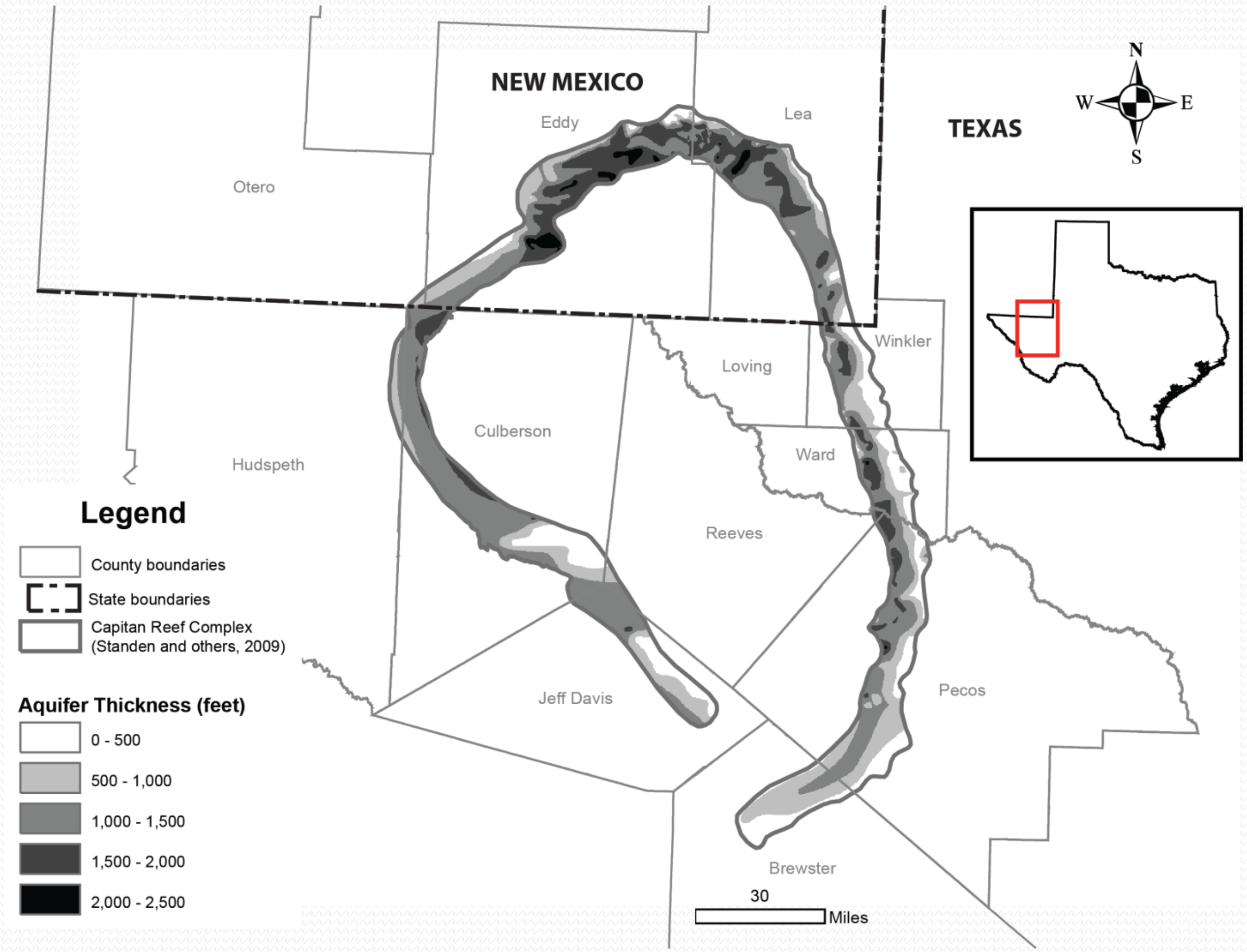
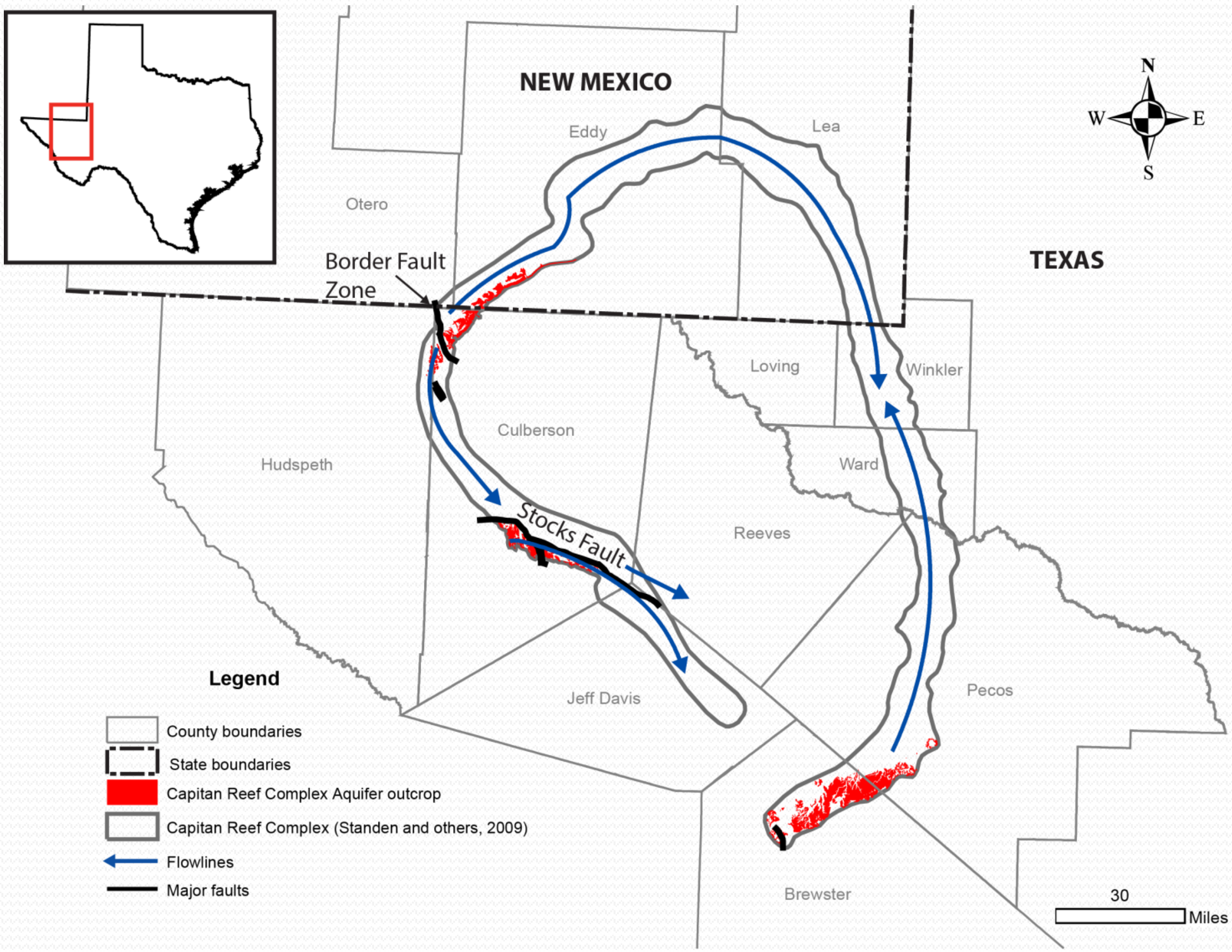
Capitan Aquifer Thickness



Modified from Standen and others (2009)

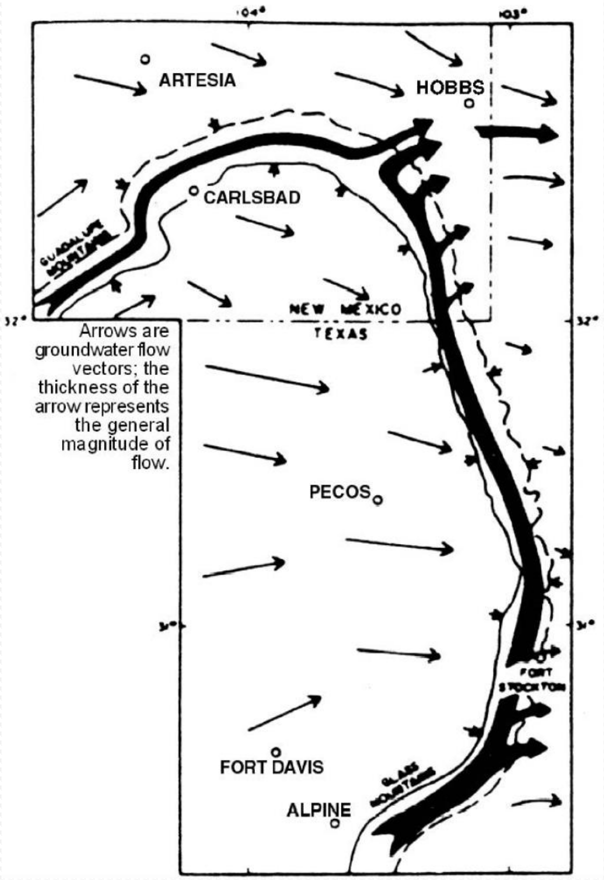
Water Levels/Regional Groundwater Flow

Conceptual Flow System

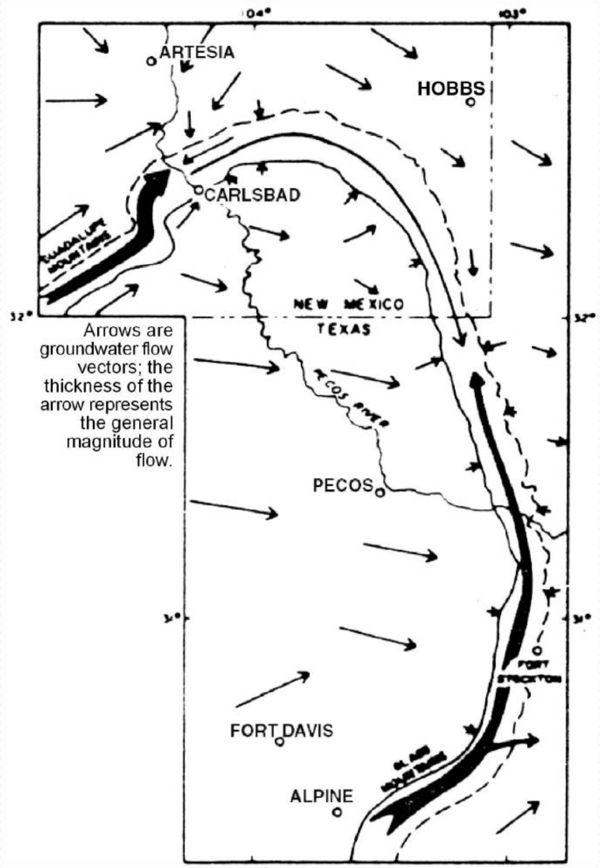


Modified from Hiss (1980) and Sharp (2001)

Conceptual Flow System



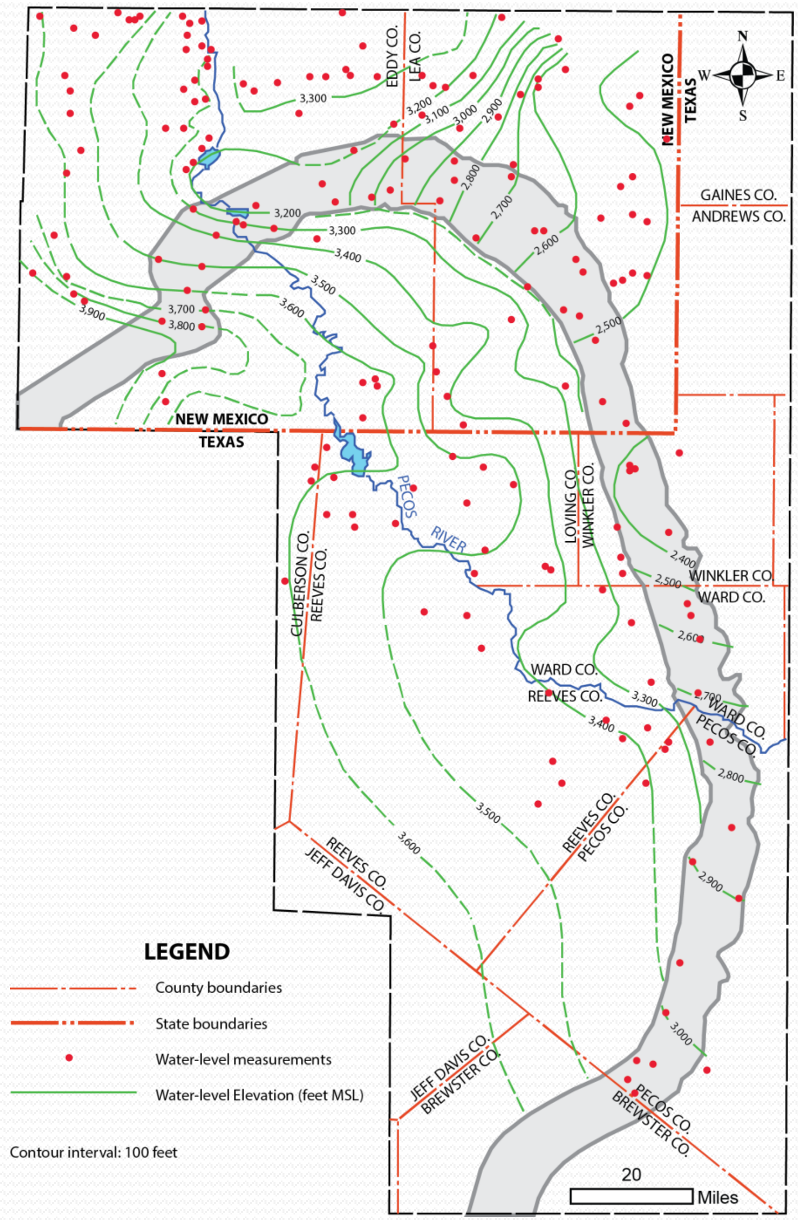
(a)



(b)

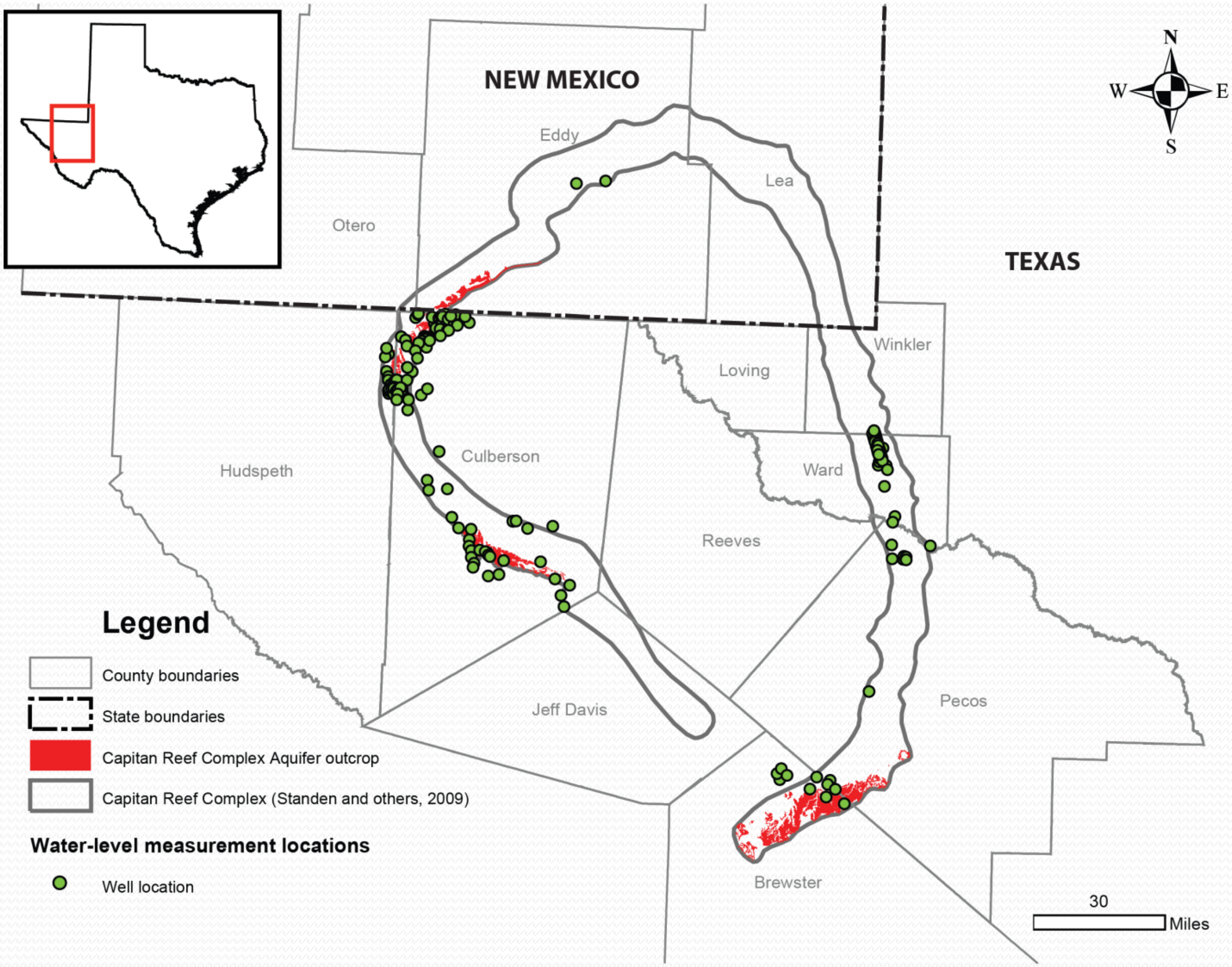
From Hiss (1980)

Conceptual Flow System

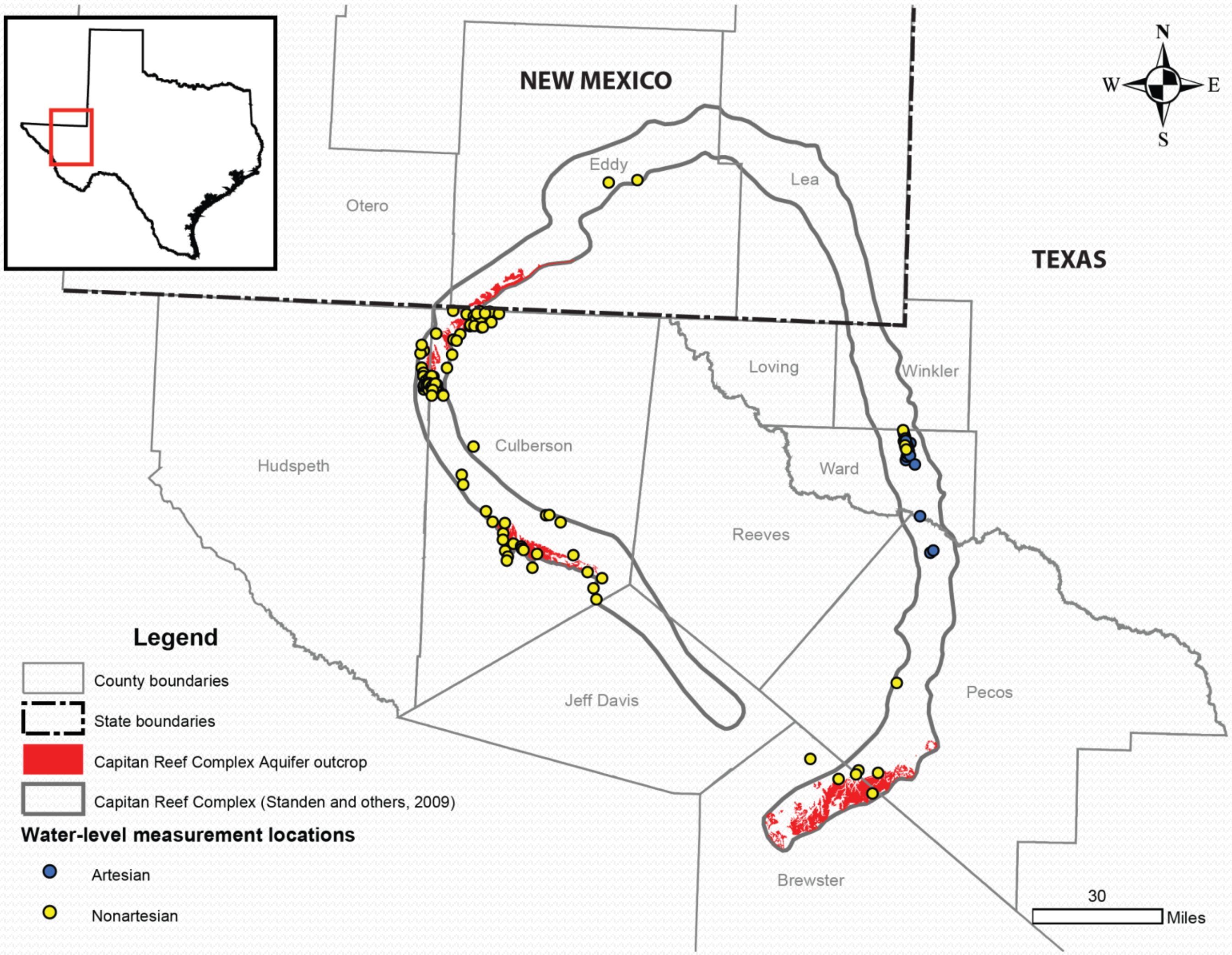


From Hiss (1980)

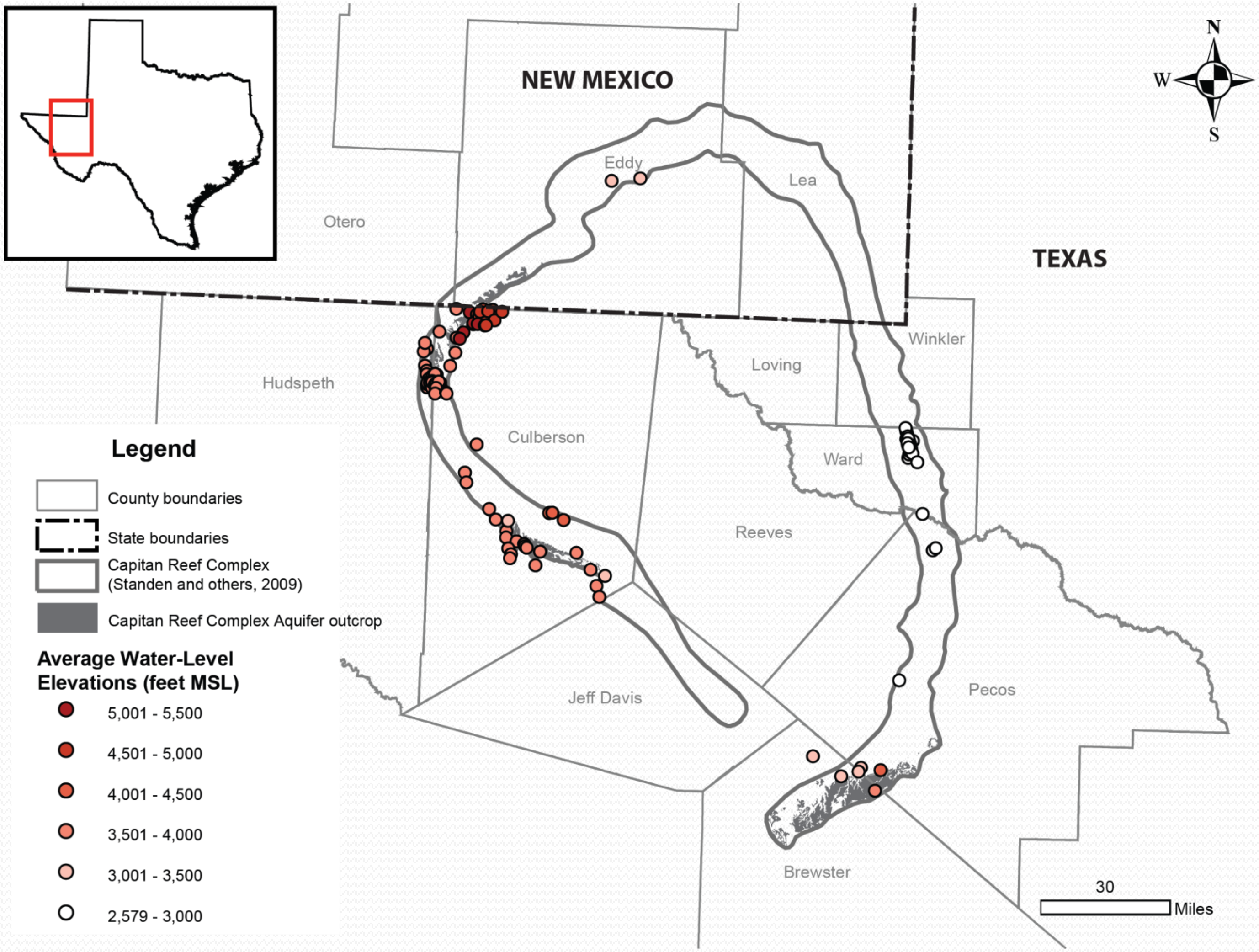
Water-Level Data



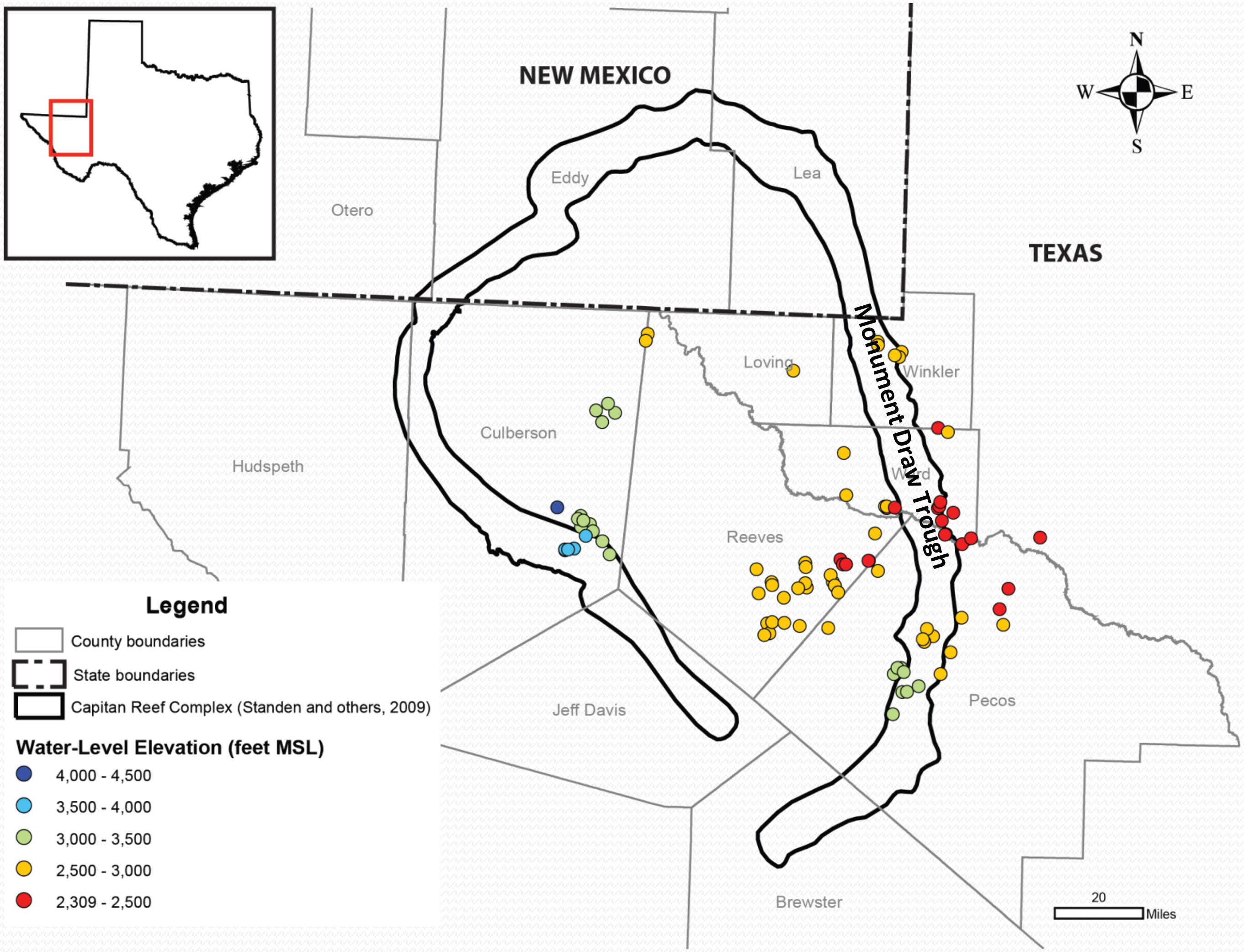
Artesian Wells



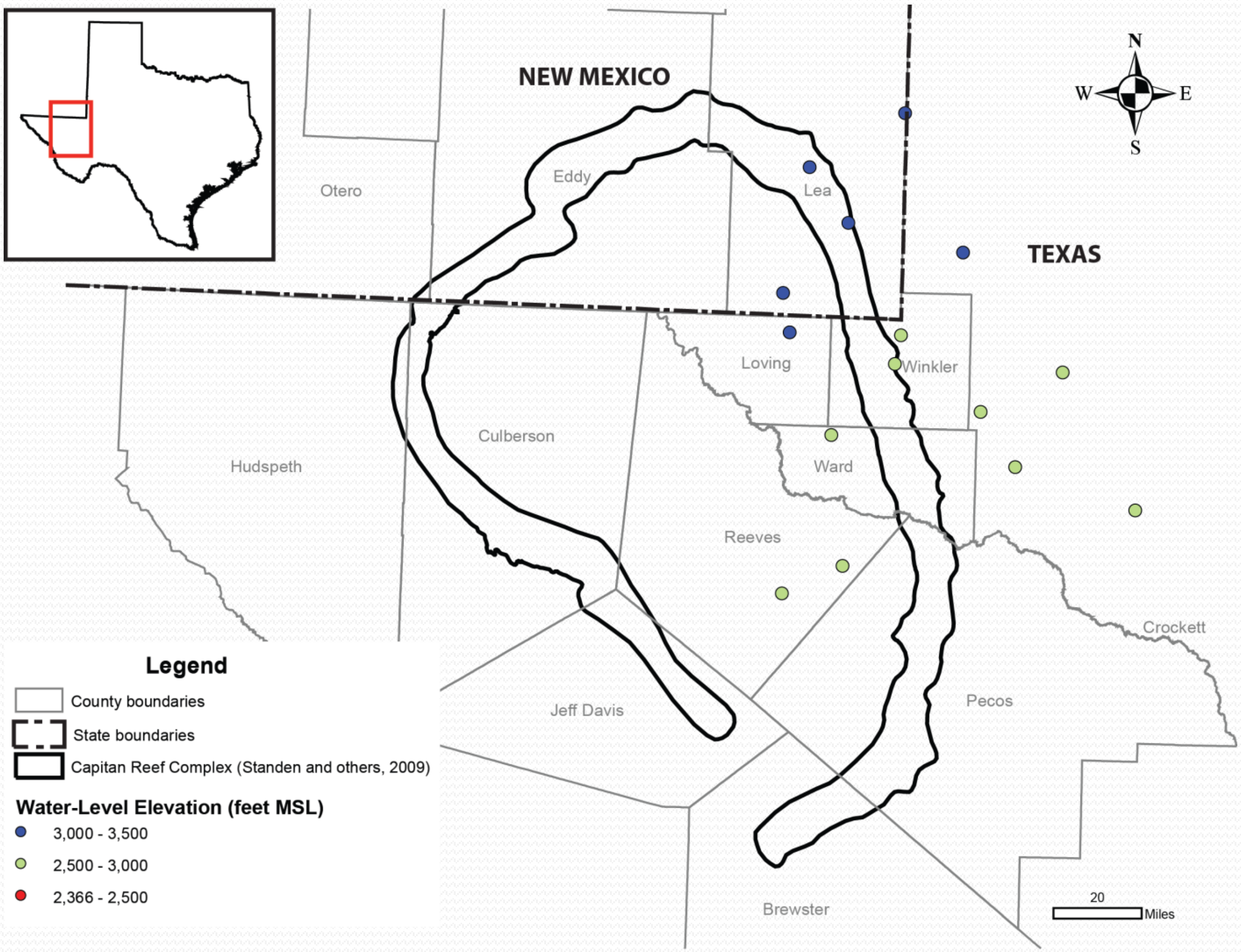
Capitan Aquifer Water-Level Data



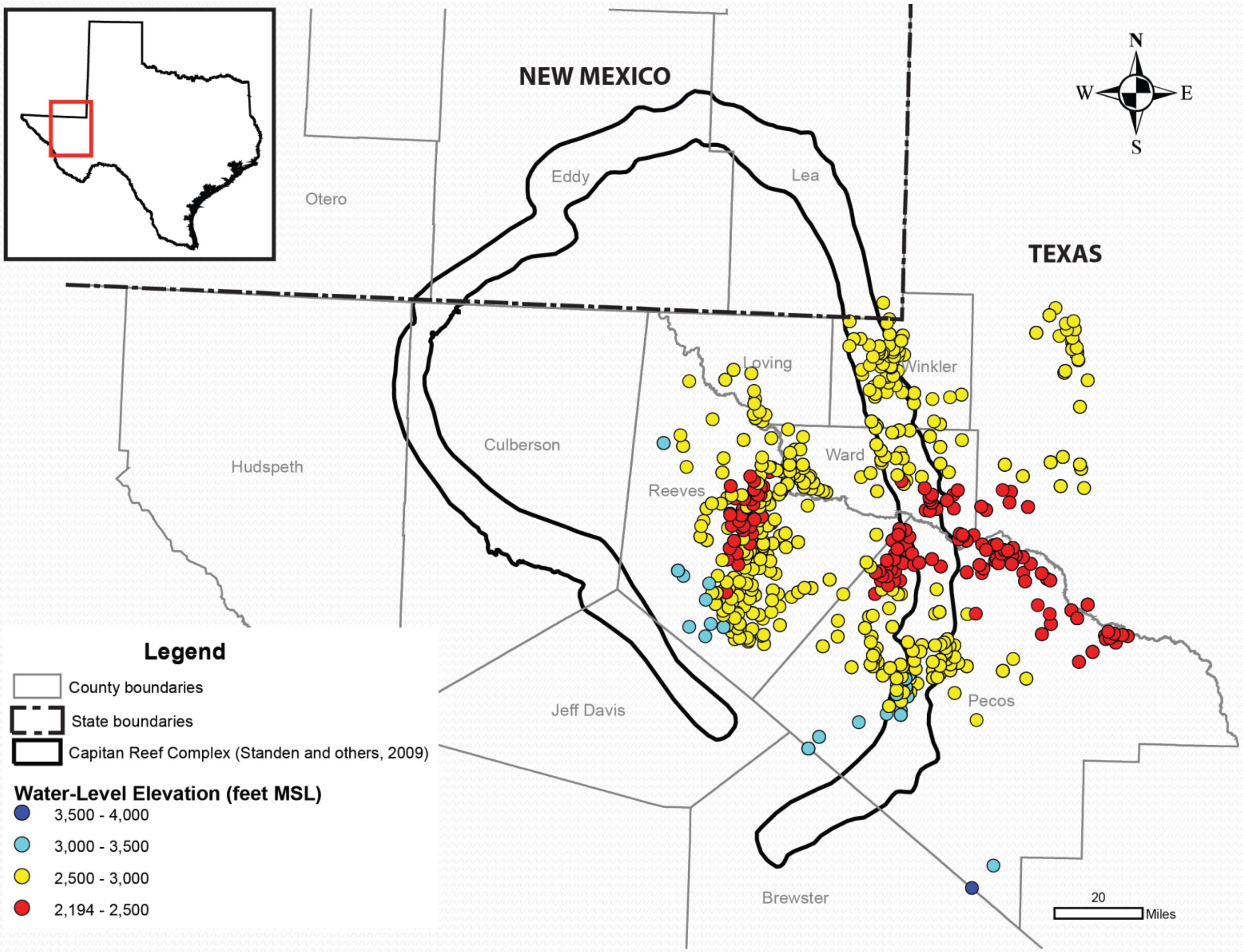
Rustler Aquifer Water-Level Data



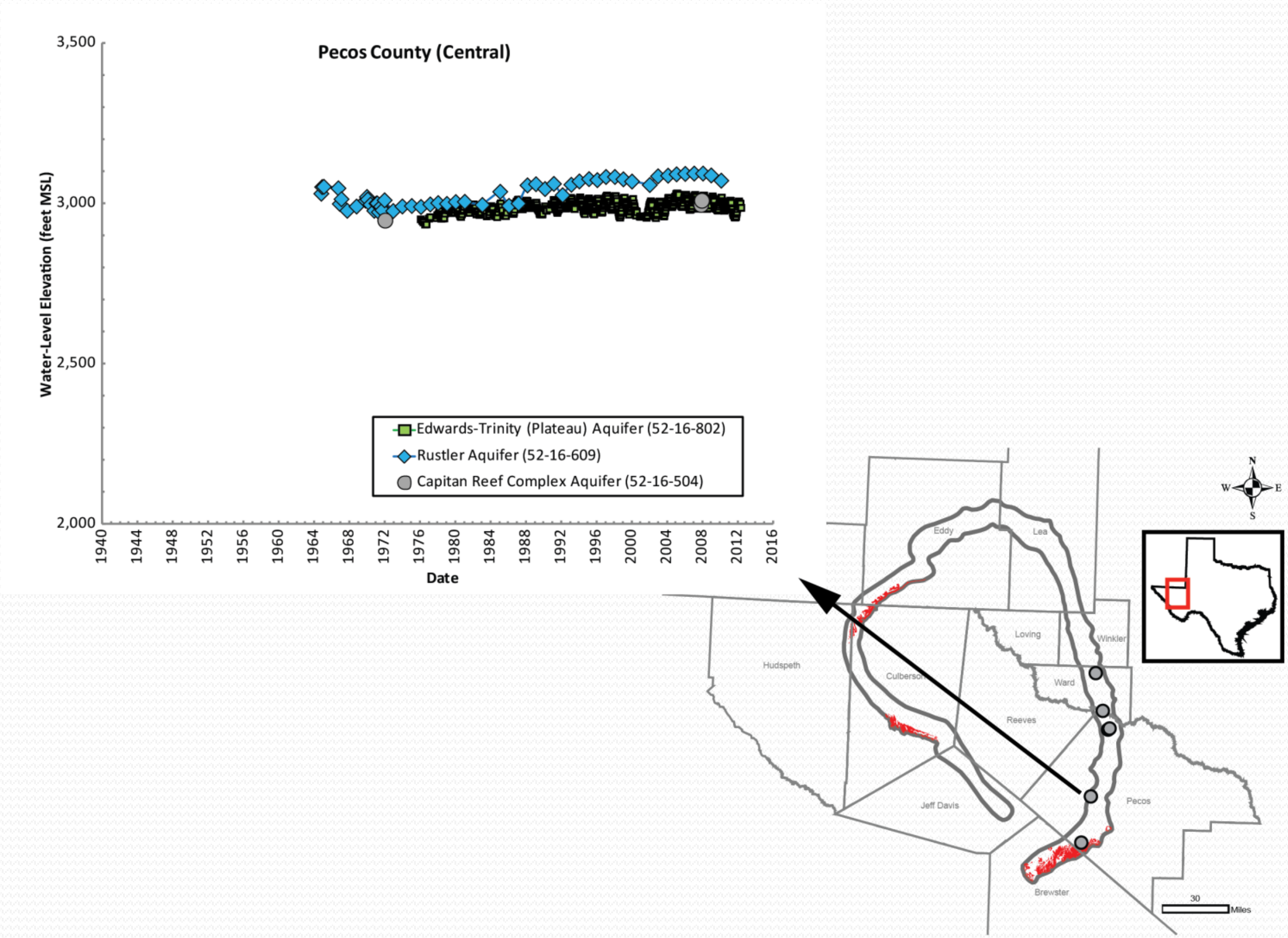
Dockum Aquifer Water-Level Data



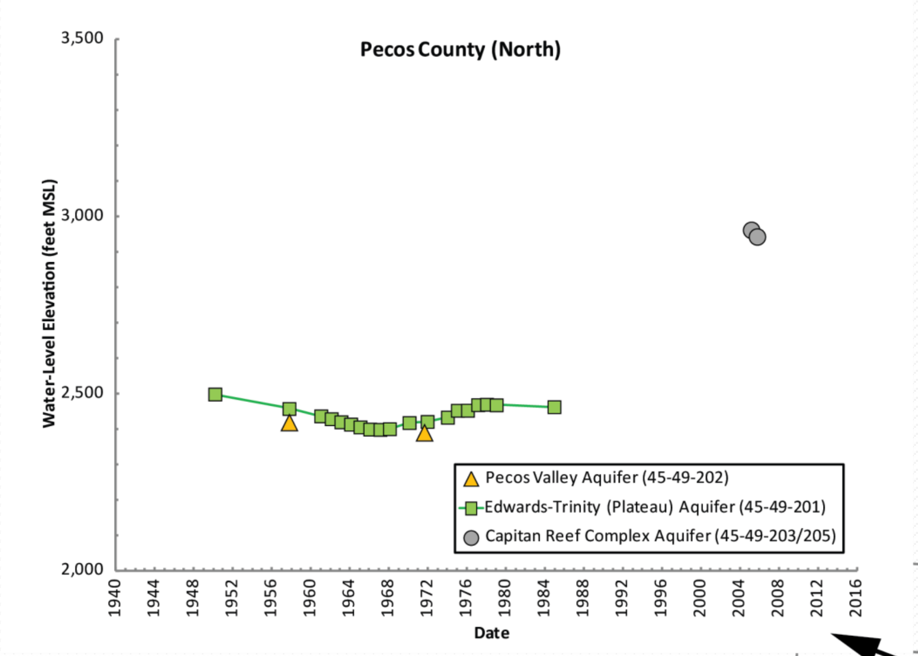
Edwards-Trinity/Pecos Valley Aquifer Water-Level Data

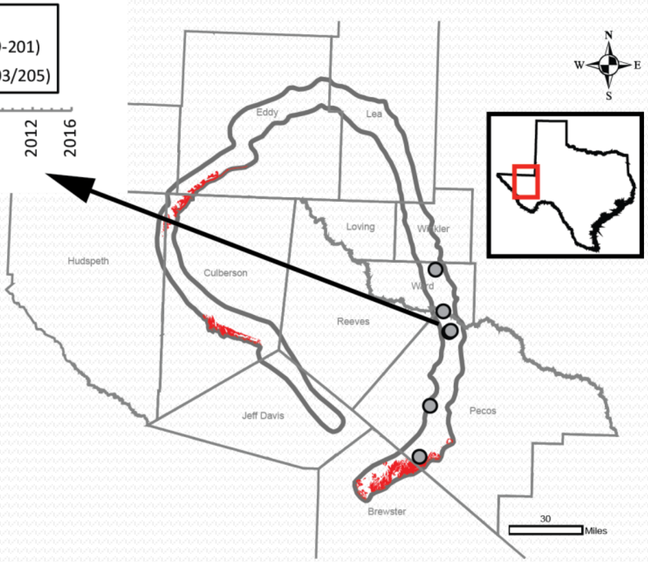


Water-Level Data

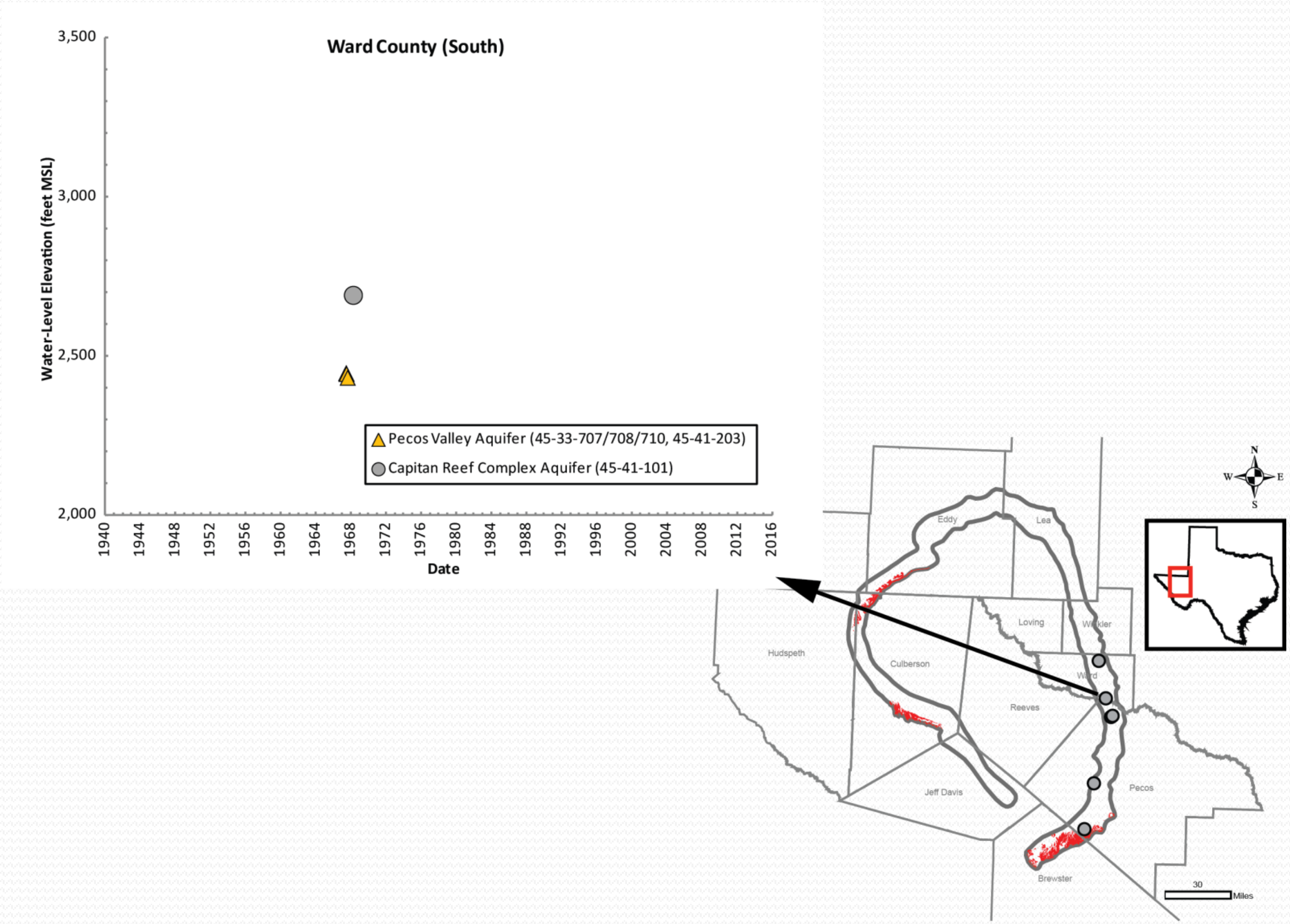


Water-Level Data

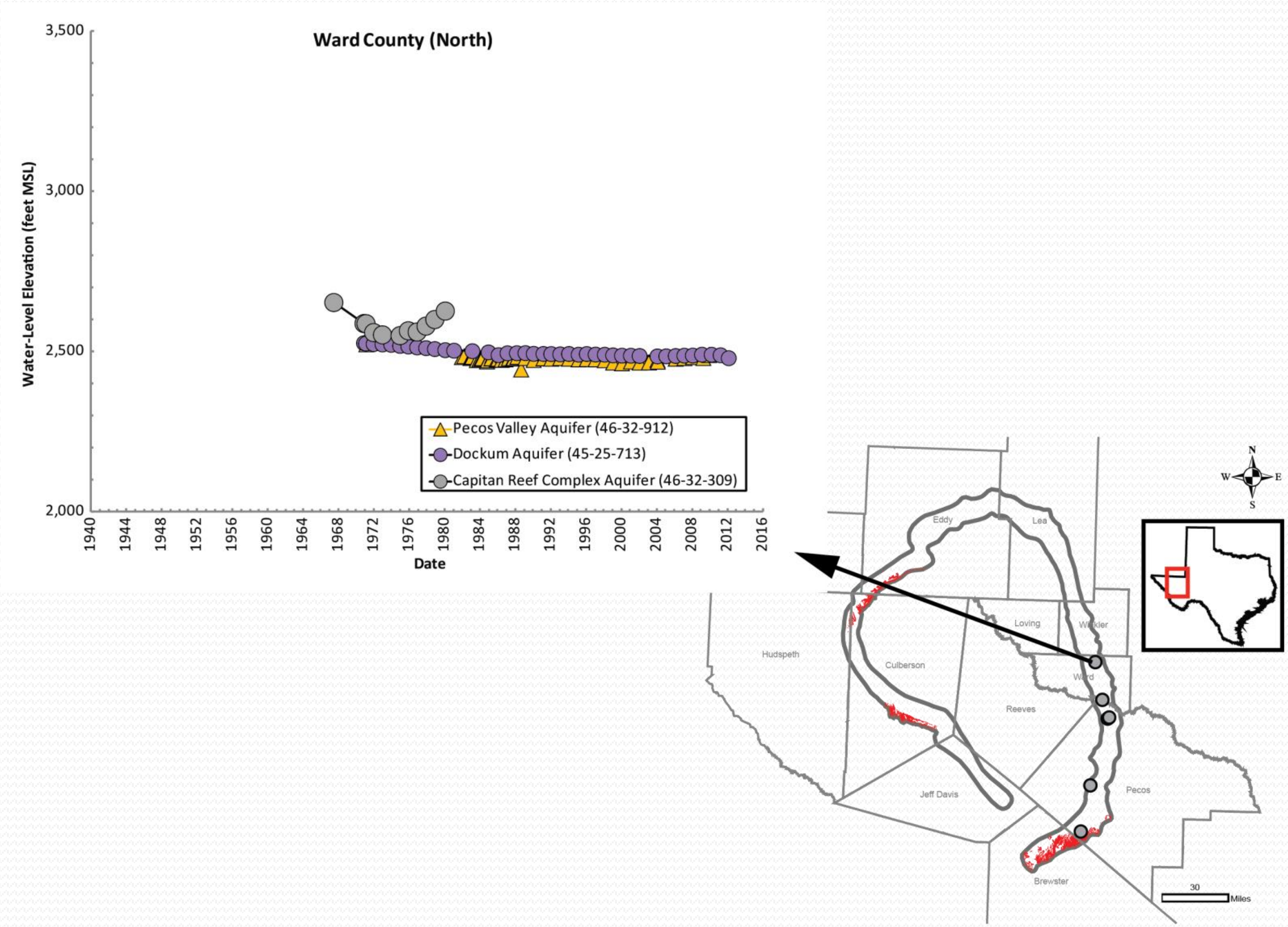




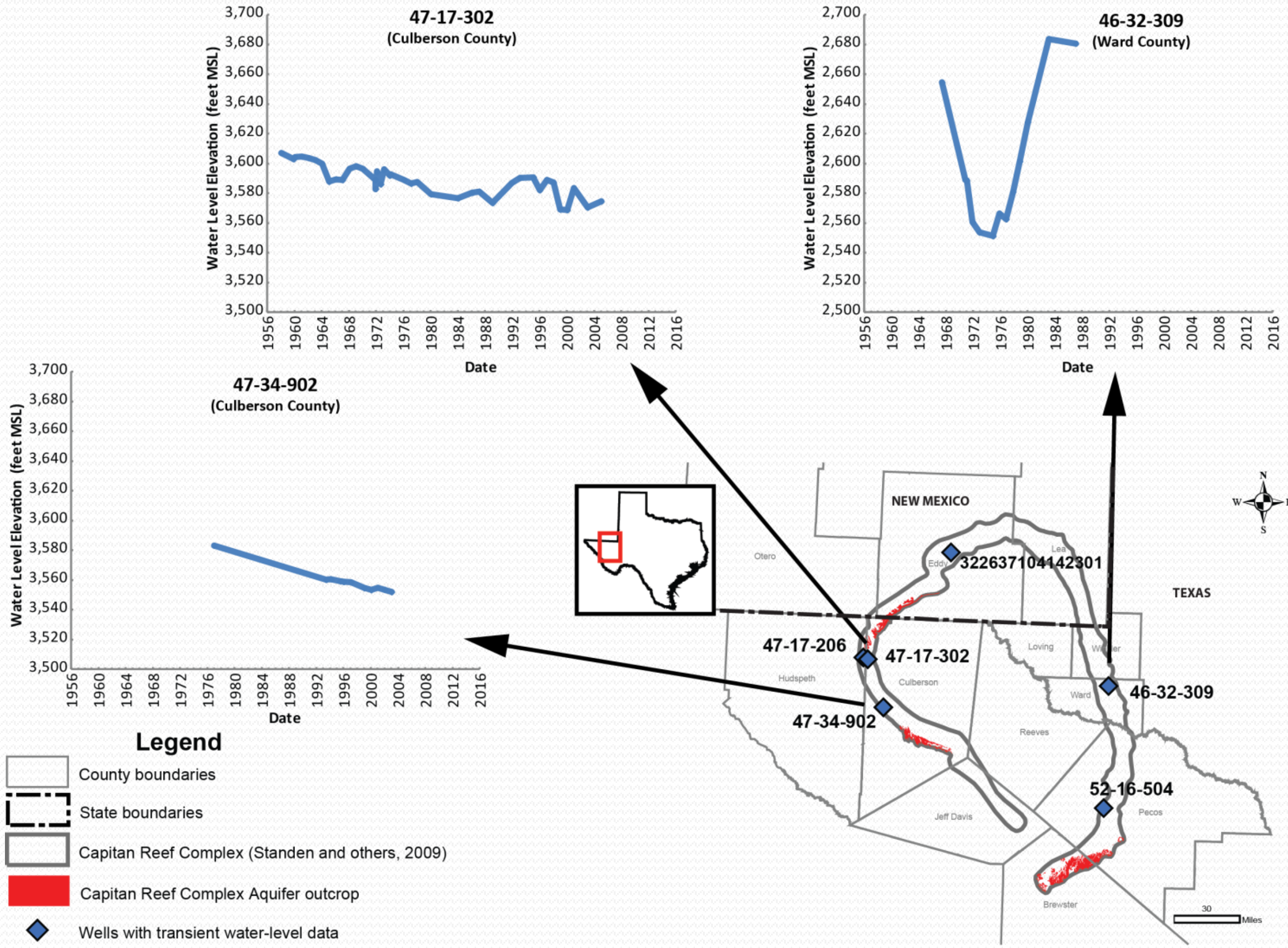
Water-Level Data



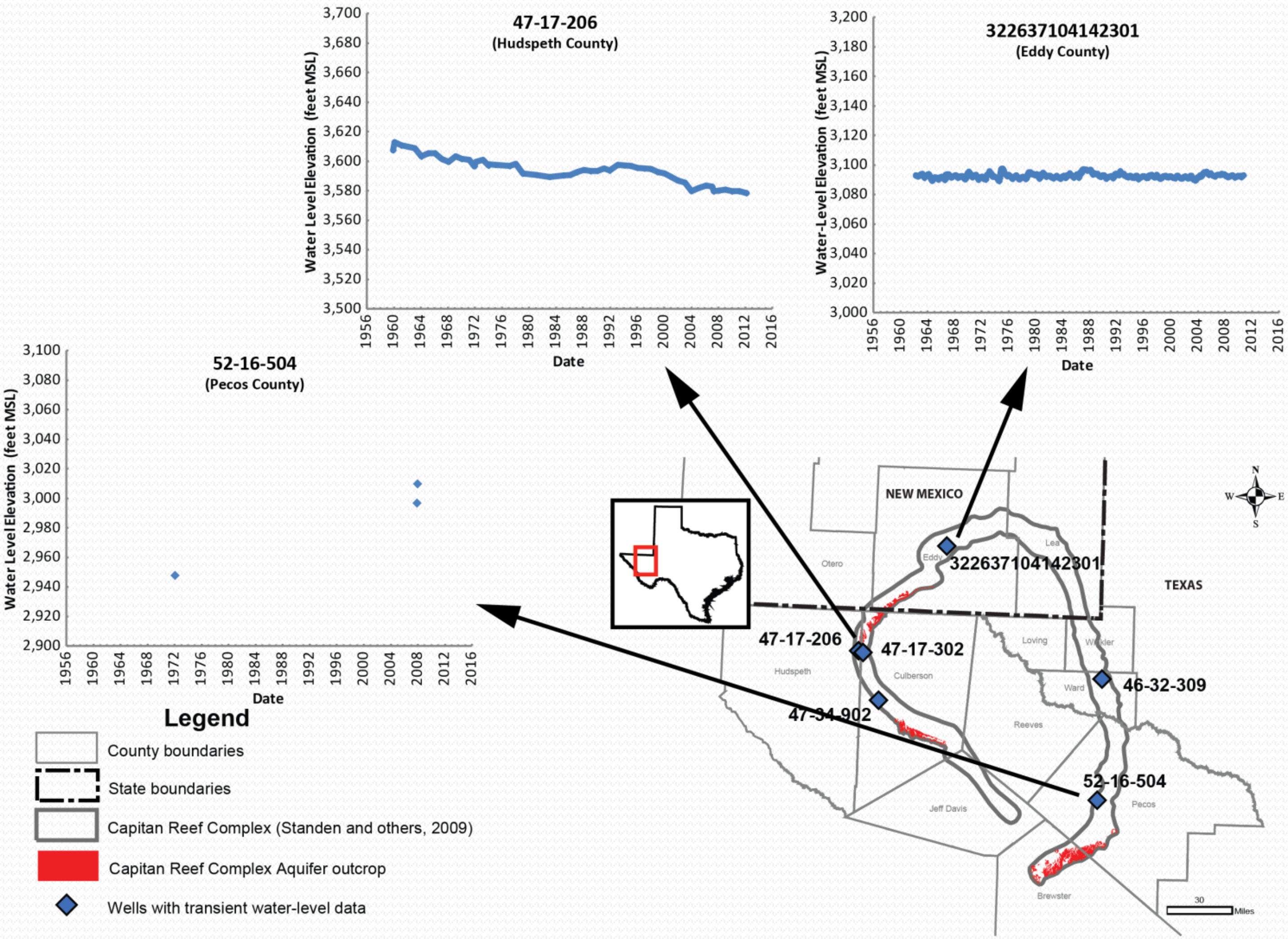
Water-Level Data



Water-Level Data

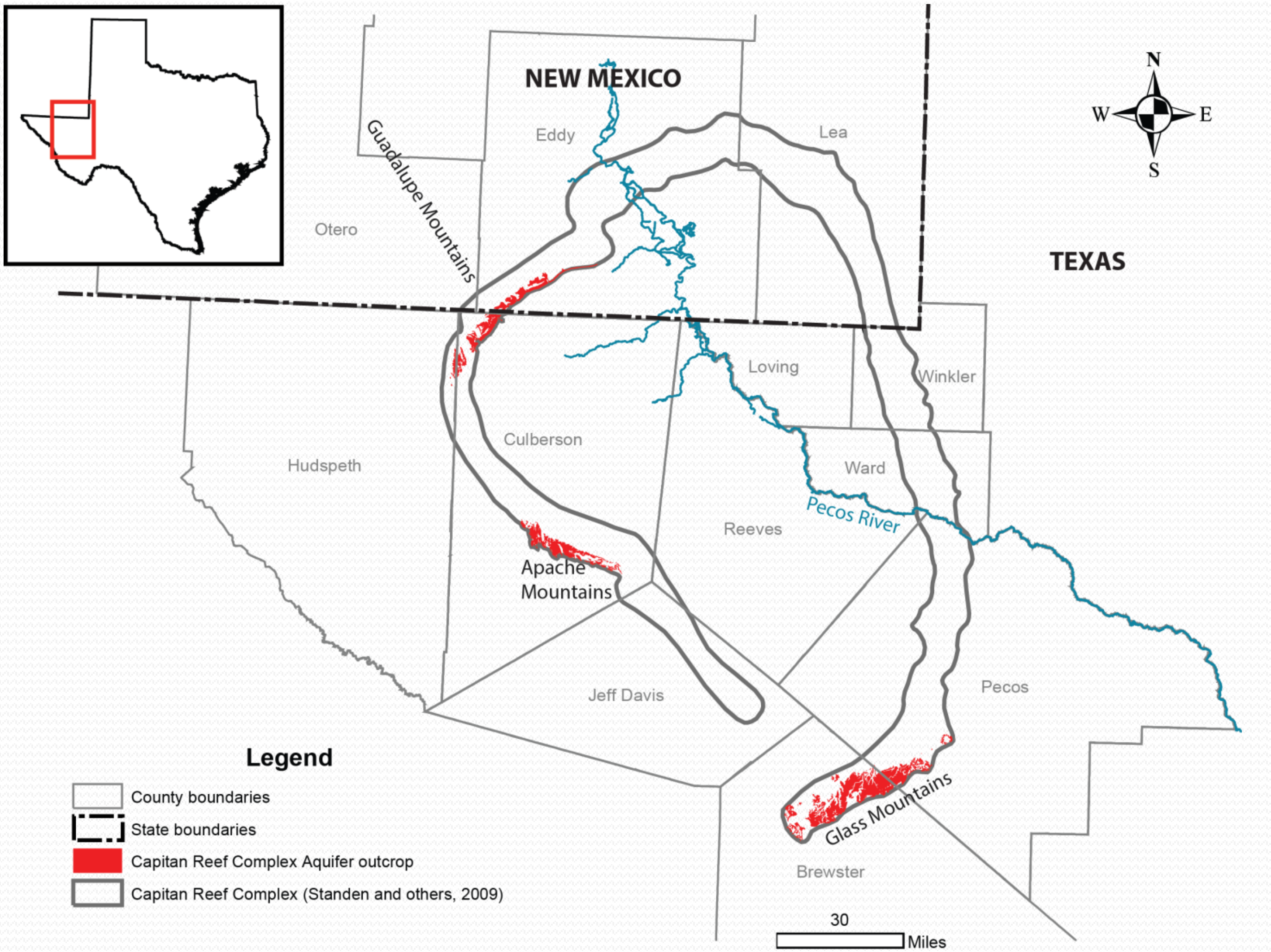


Water-Level Data



Recharge

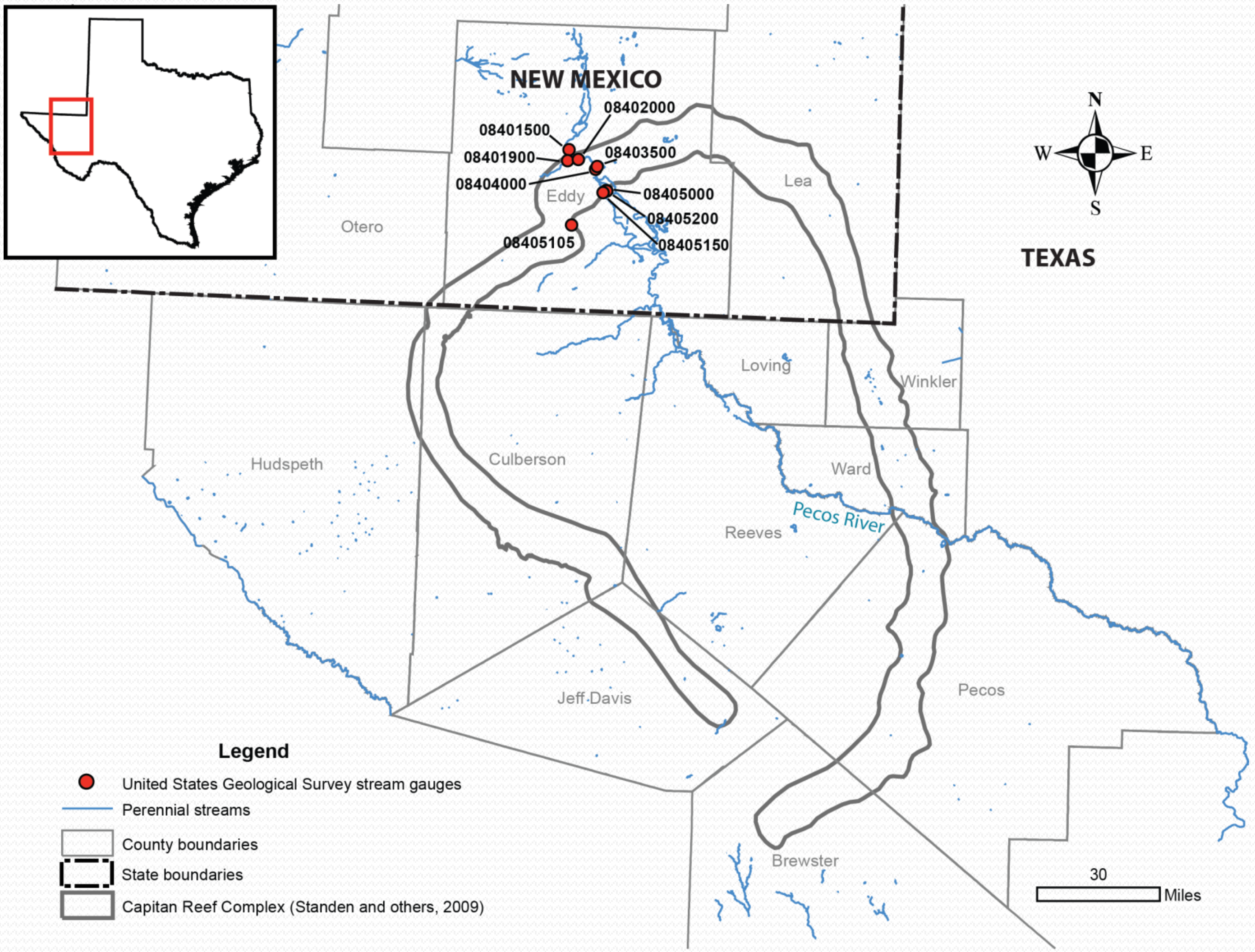
Recharge



NEW MEXICO
TEXAS
Eddy
Lea
Otero
Guadalupe Mountains
Loving
Winkler
Culberson
Hudspeth
Ward
Pecos River
Reeves
Apache Mountains
Jeff Davis
Pecos
Glass Mountains
Brewster
N
S
E
W
30
Miles
Legend
County boundaries
State boundaries
Capitan Reef Complex Aquifer outcrop
Capitan Reef Complex (Standen and others, 2009)

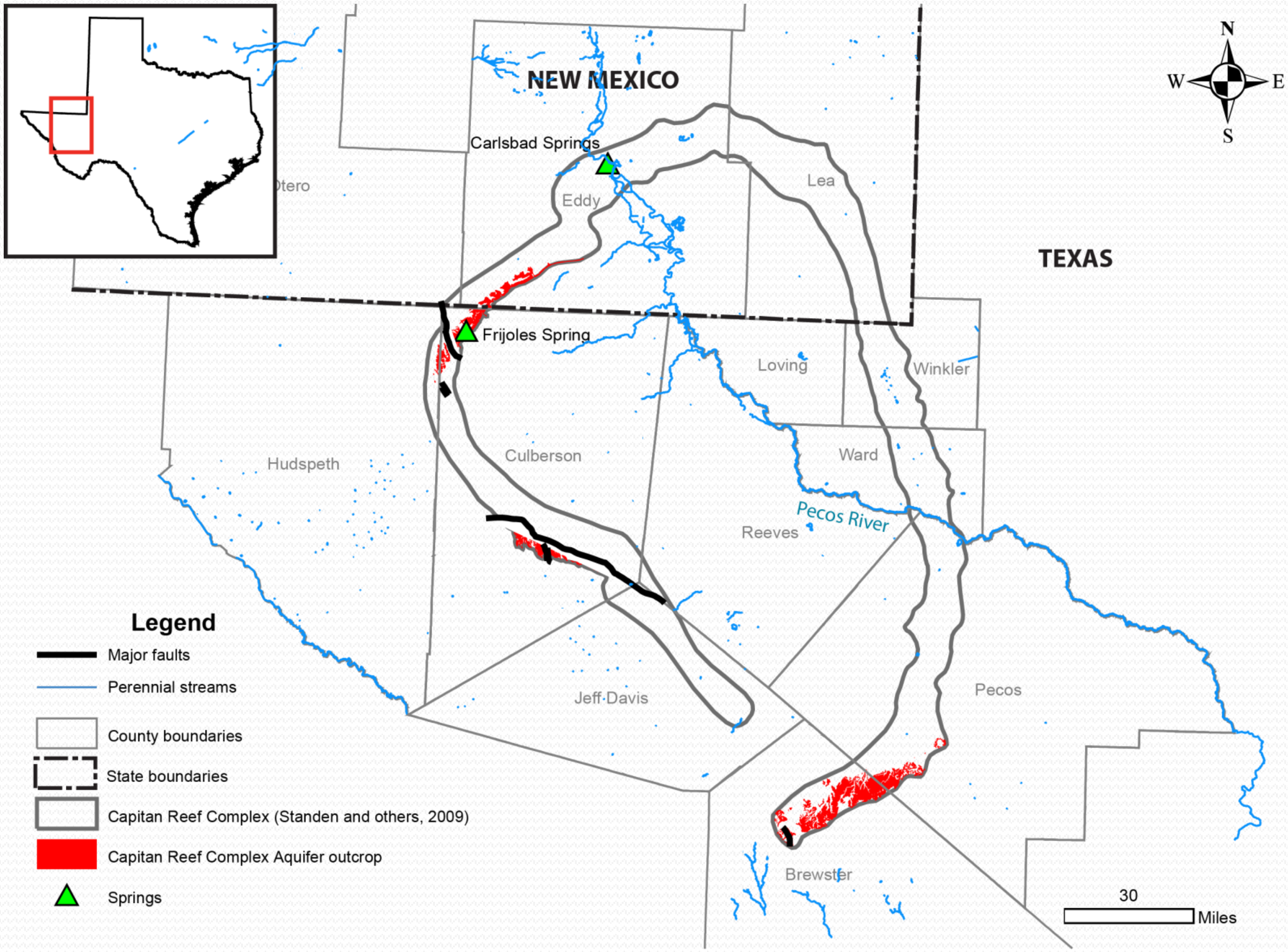
Discharge

Surface Water

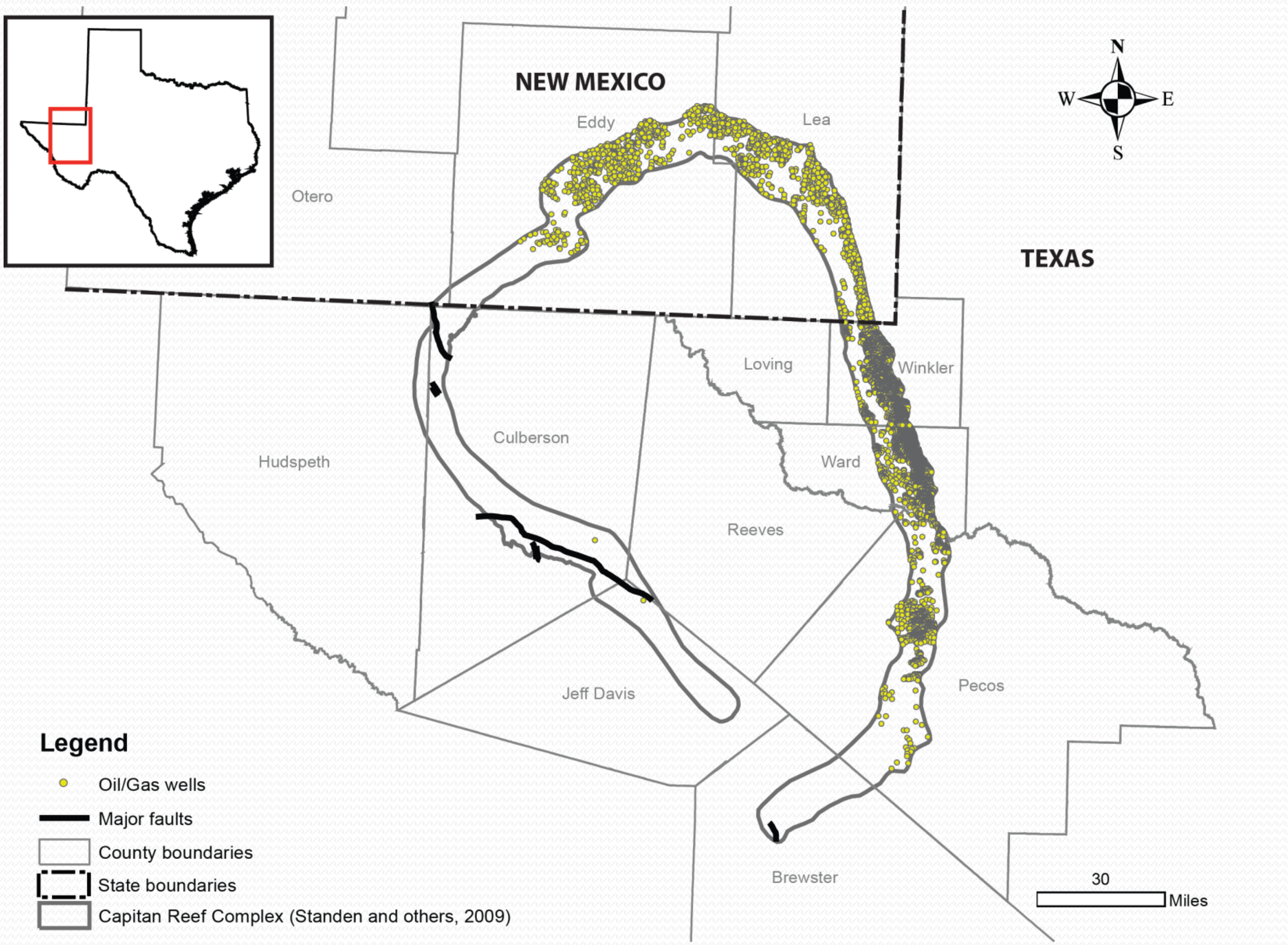


Data from U.S. Geological Survey

Springs

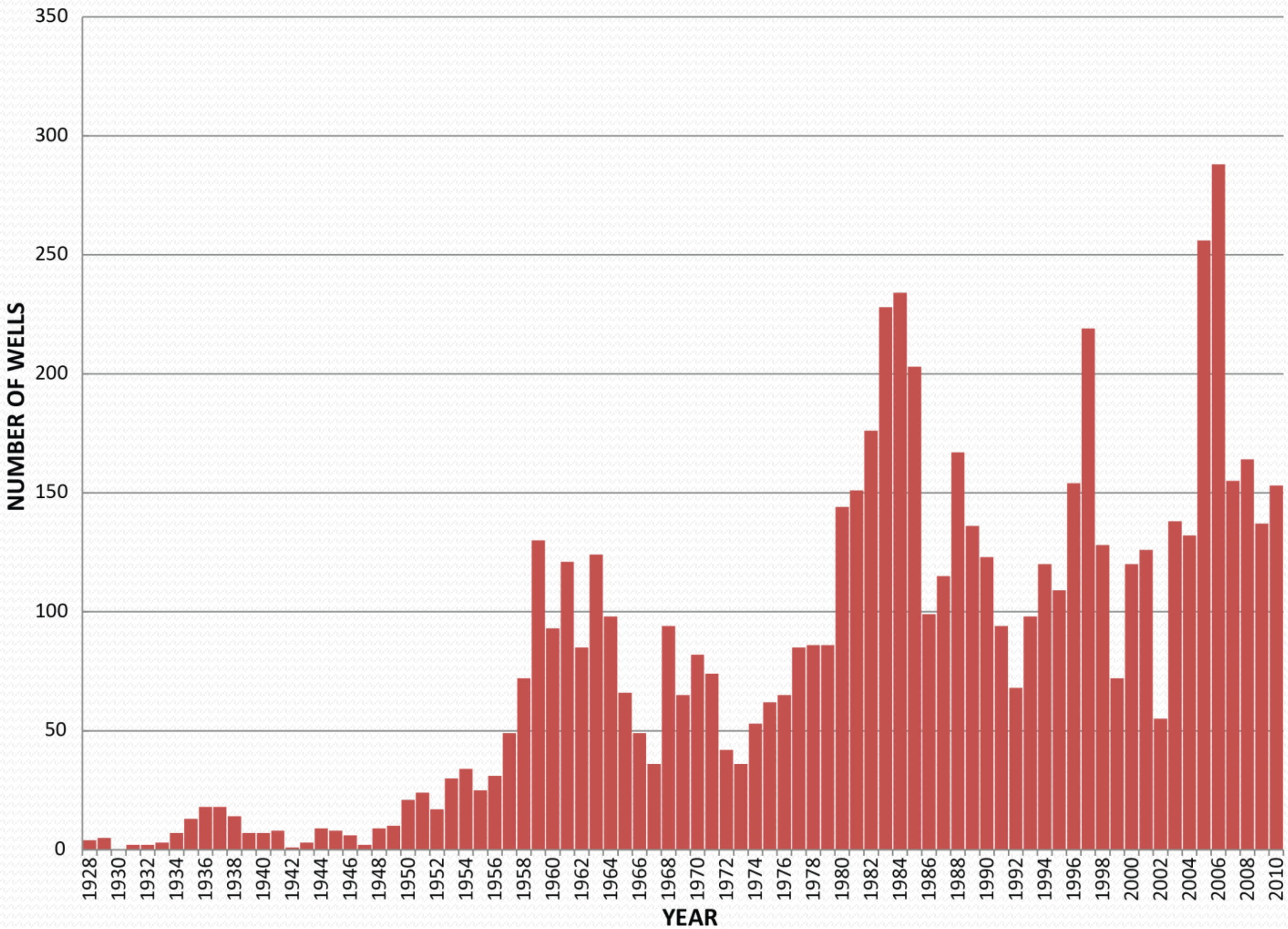

NEW MEXICO
TEXAS
Carlsbad Springs
Frijoles Spring
Eddy
Lea
Loving
Winkler
Ward
Culberson
Hudspeth
Reeves
Pecos River
Jeff Davis
Pecos
Brewster
N
W
E
S
30
Miles
Legend
Major faults
Perennial streams
County boundaries
State boundaries
Capitan Reef Complex (Standen and others, 2009)
Capitan Reef Complex Aquifer outcrop
Springs

Oil and Gas Wells



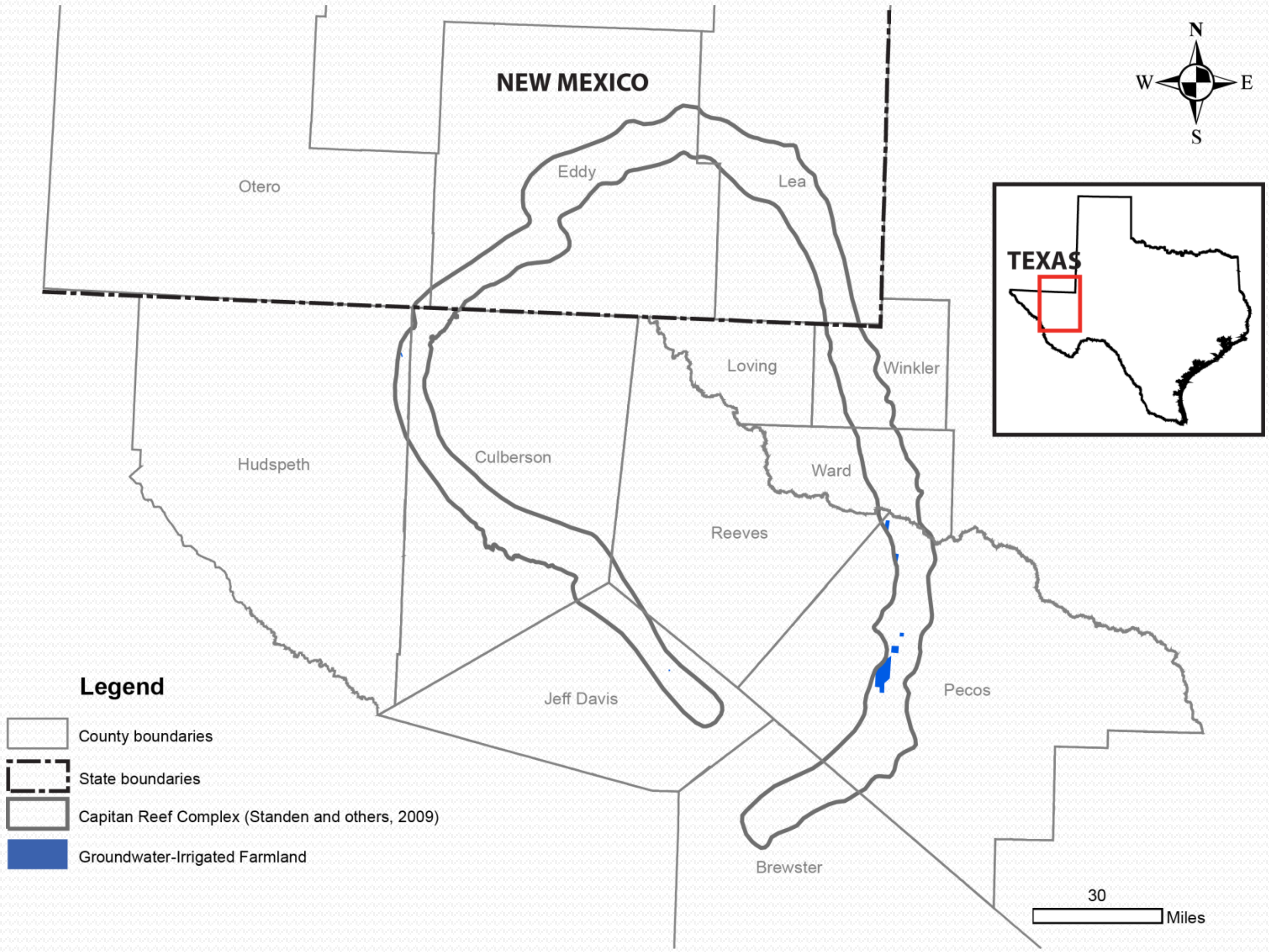
Data from Railroad Commission of Texas and
New Mexico Energy, Minerals and Natural Resources Department

Oil and Gas Wells

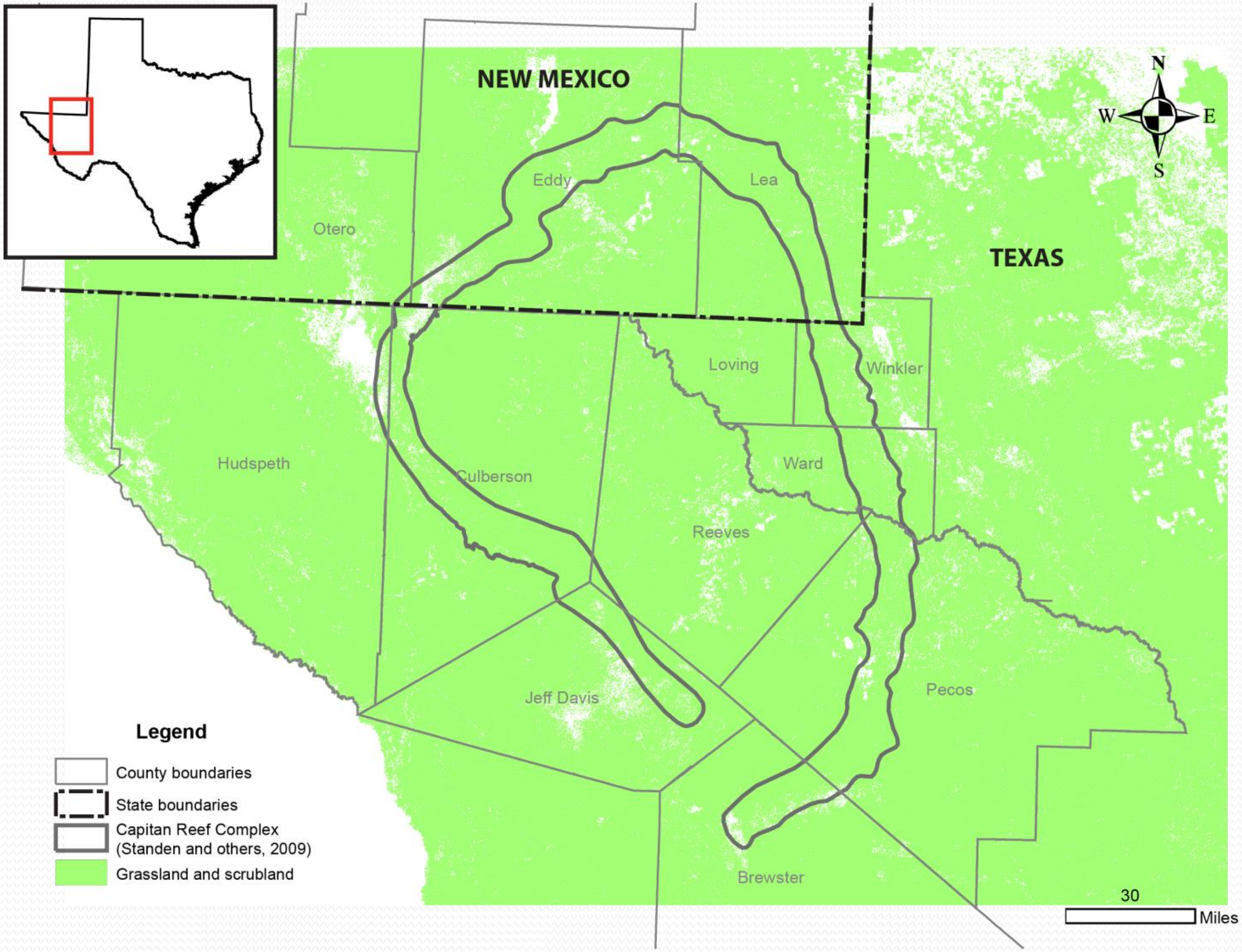


Data from Railroad Commission of Texas and
New Mexico Energy, Minerals and Natural Resources Department

Irrigated Farmland

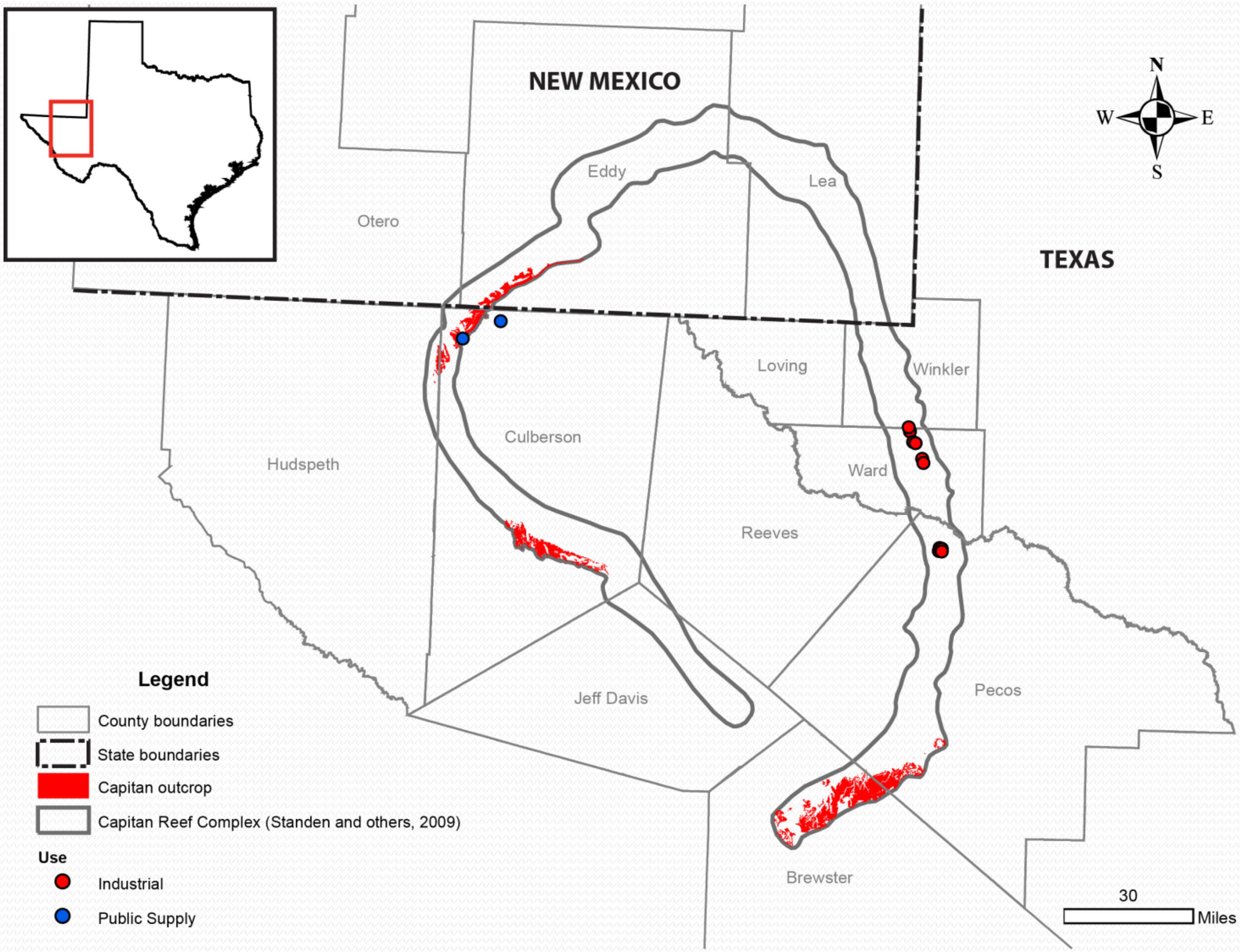


Grassland and Scrubland

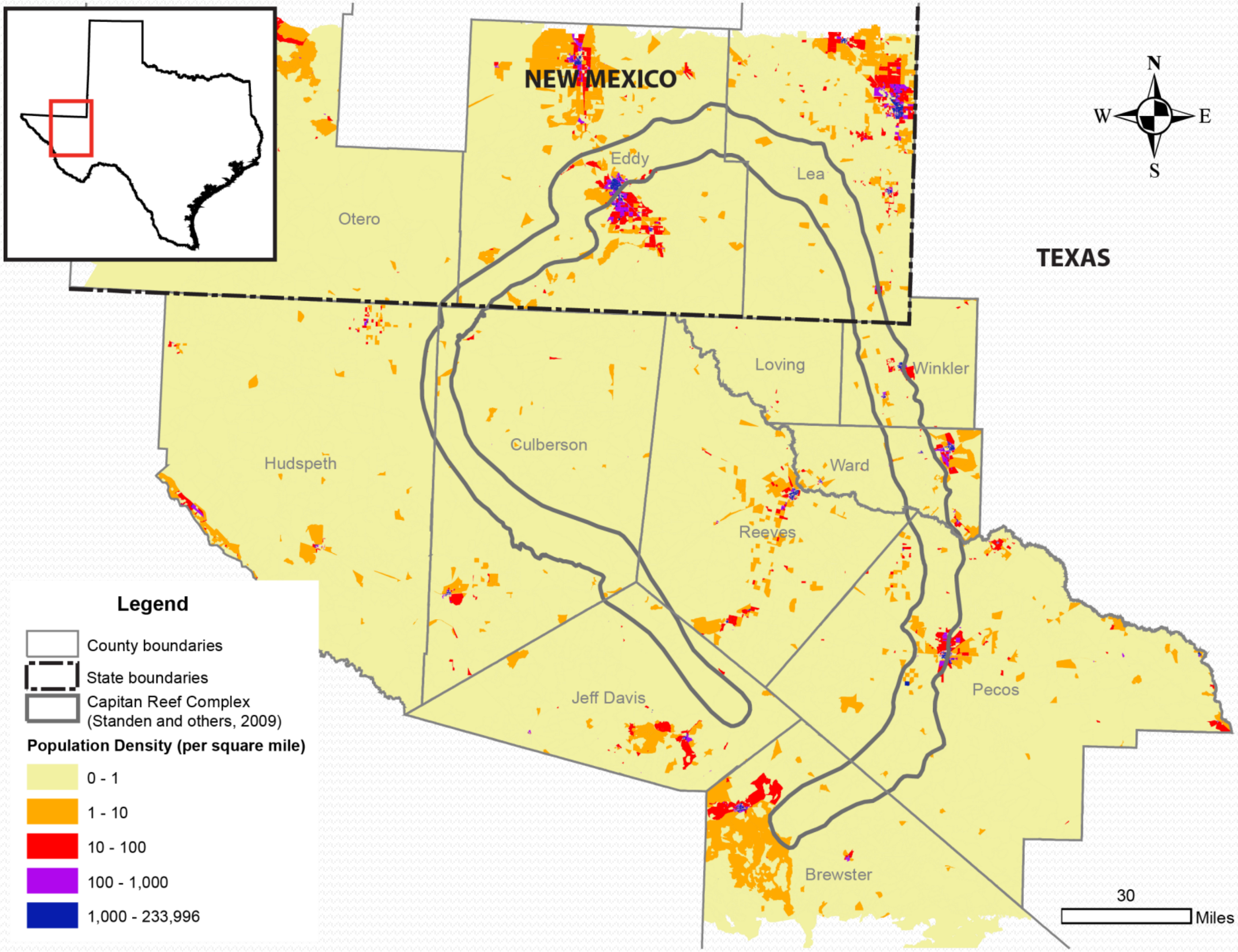


Data from National Land Cover Dataset

Industrial and Public Supply Wells



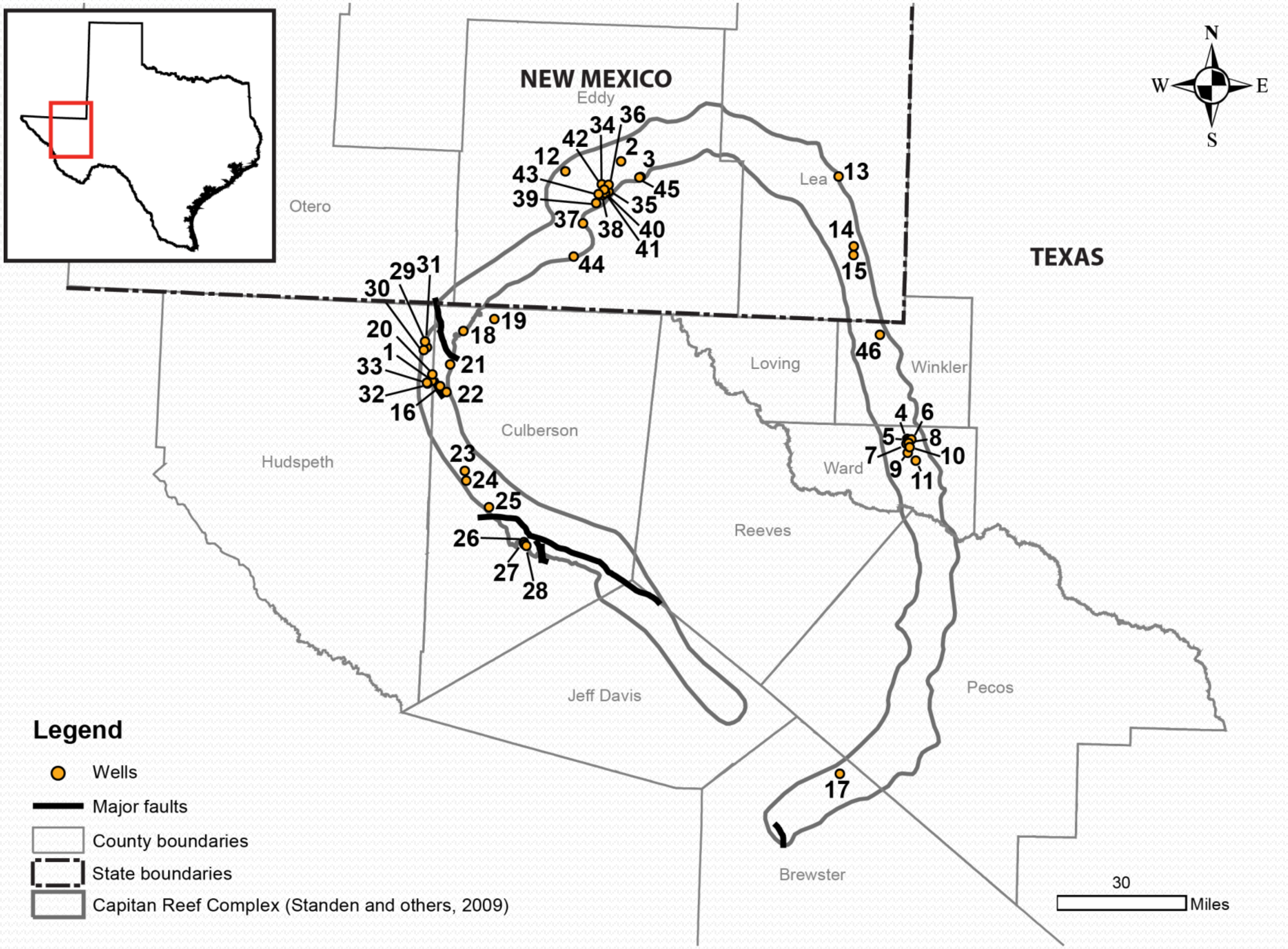
Population Density



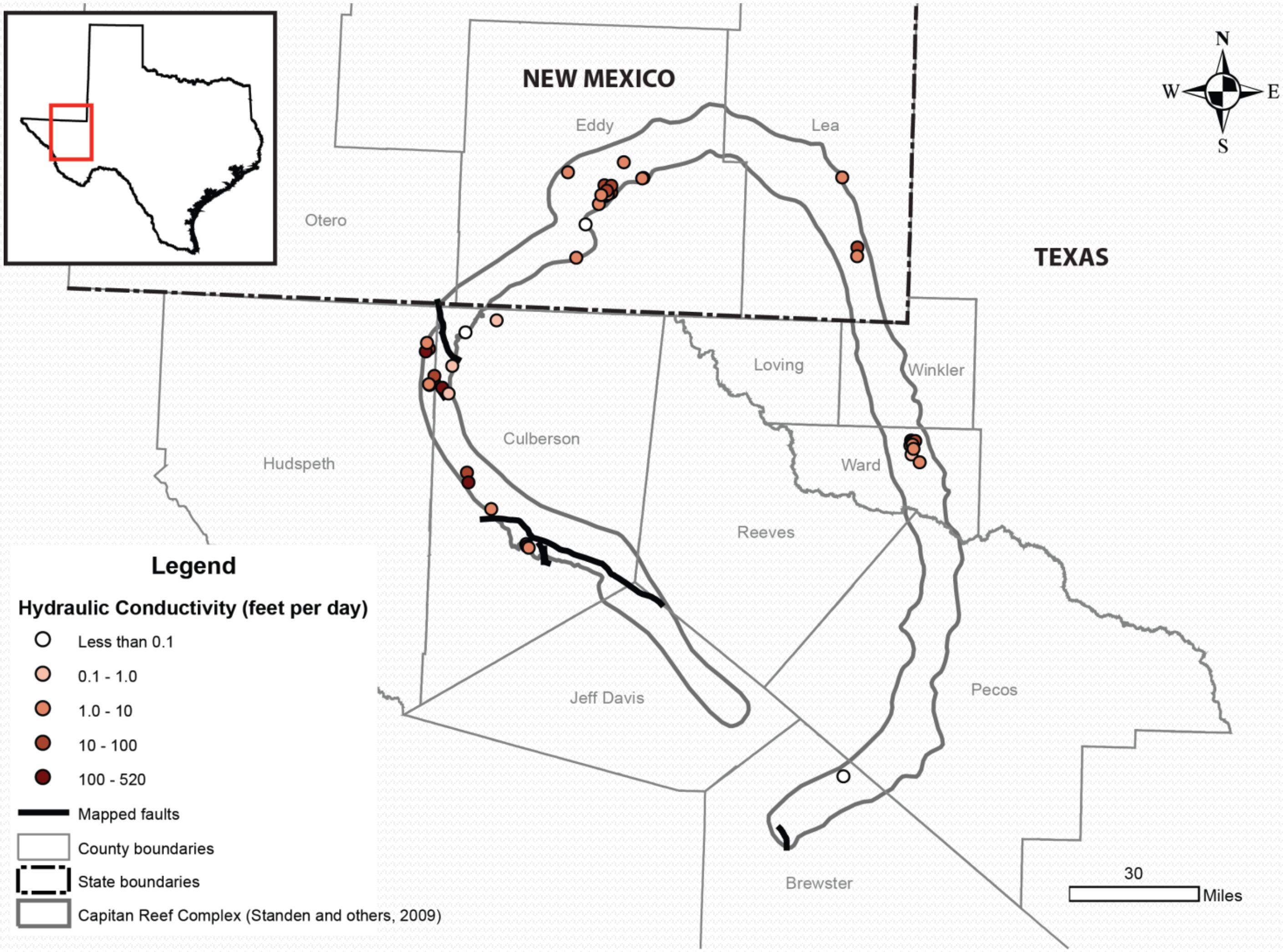
Data from U.S. Census Bureau

Hydraulic Properties

Hydraulic Properties



Hydraulic Properties

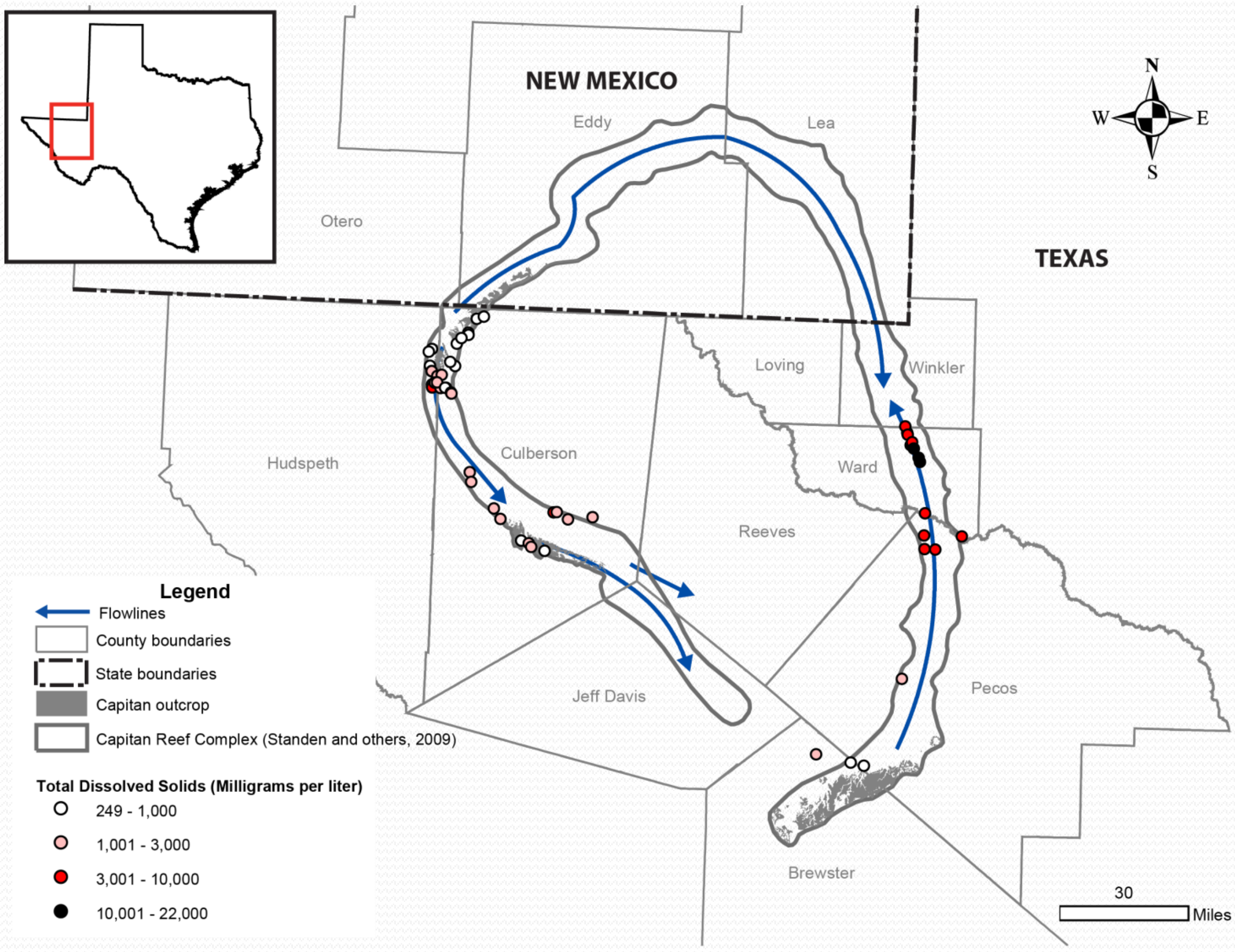


Hydraulic Properties

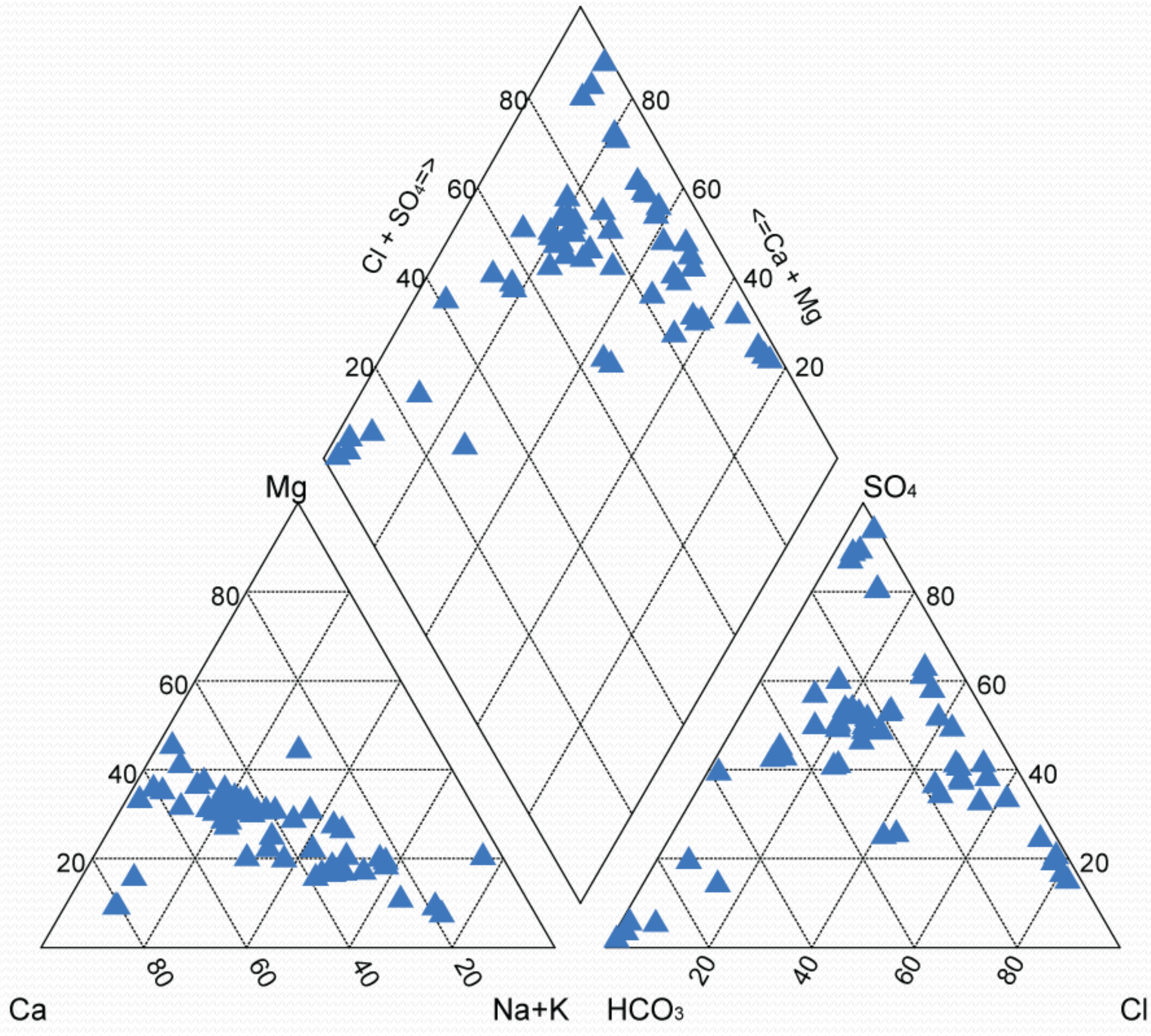
Aquifer	Minimum (feet/day)	Maximum (feet/day)	Median (feet/day)
Capitan Reef Complex Aquifer	0.009	517	2.8
Artesia Group	0.0003	0.9	0.006
Delaware Mountain Group			0.00000007
Castile Formation			0.05
Rustler Aquifer	0.001	100	
Dockum Aquifer	0.3	300	
Edwards-Trinity (Plateau) Aquifer	0.25	45	6.7
Pecos Valley Aquifer	4	25	8.6

Water Quality

Groundwater Quality



Groundwater Quality



Groundwater Isotopes

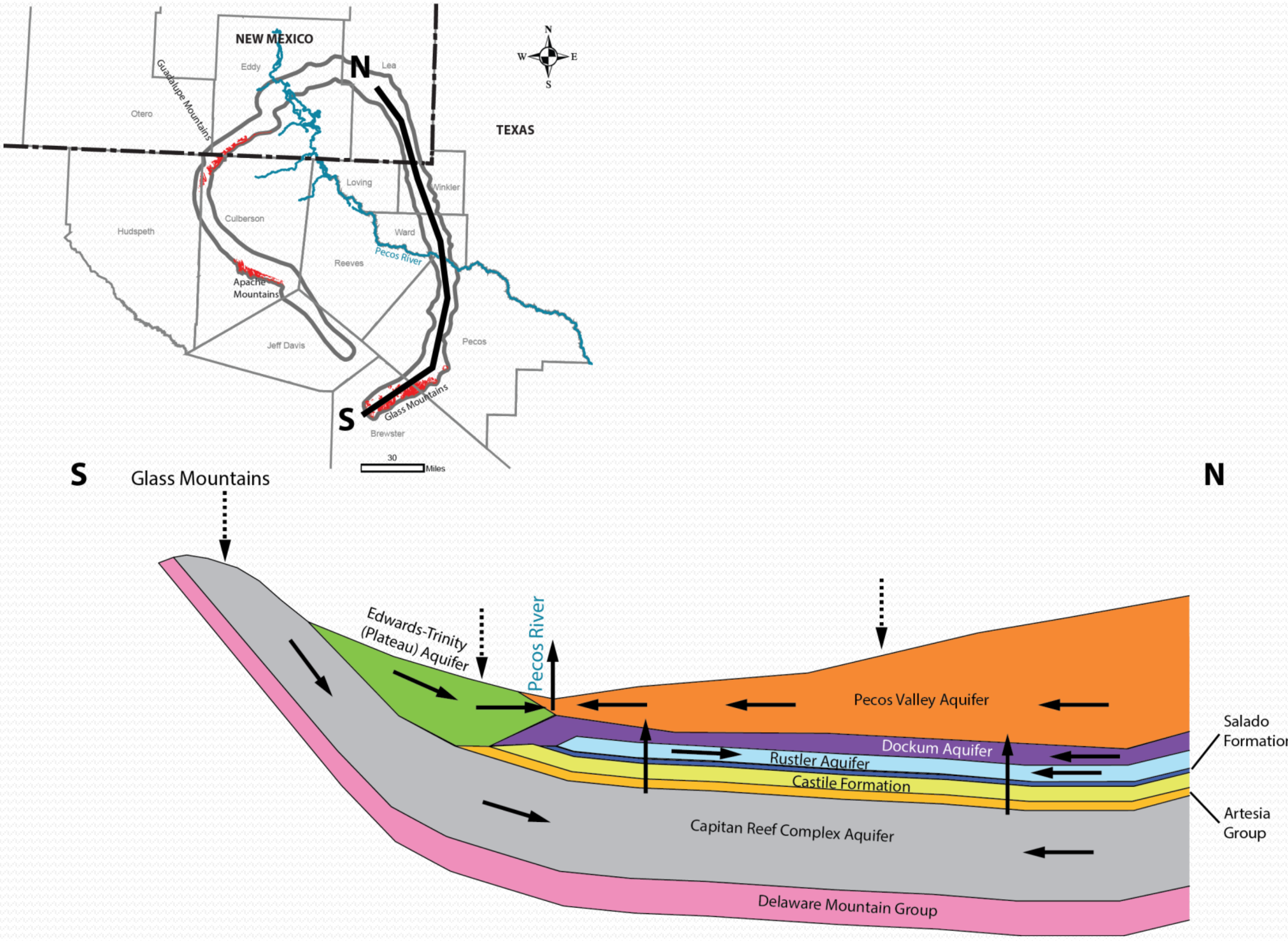
- Carbon-14 (^{14}C)
  - Relative age of groundwater
  - Indicates recent recharge
- Carbon-13 ($\delta^{13}C$)
  - Progressively changes from soil to rock compositions along flow paths
- Tritium (^{3}H)
  - Relative age of groundwater
  - Indicates recent recharge
- Stable Hydrogen ($\delta^{2}H$) and Oxygen ($\delta^{18}O$)
  - Seasonal and/or spatial distribution of recharge
  - Source of recharge water

Groundwater Isotopes

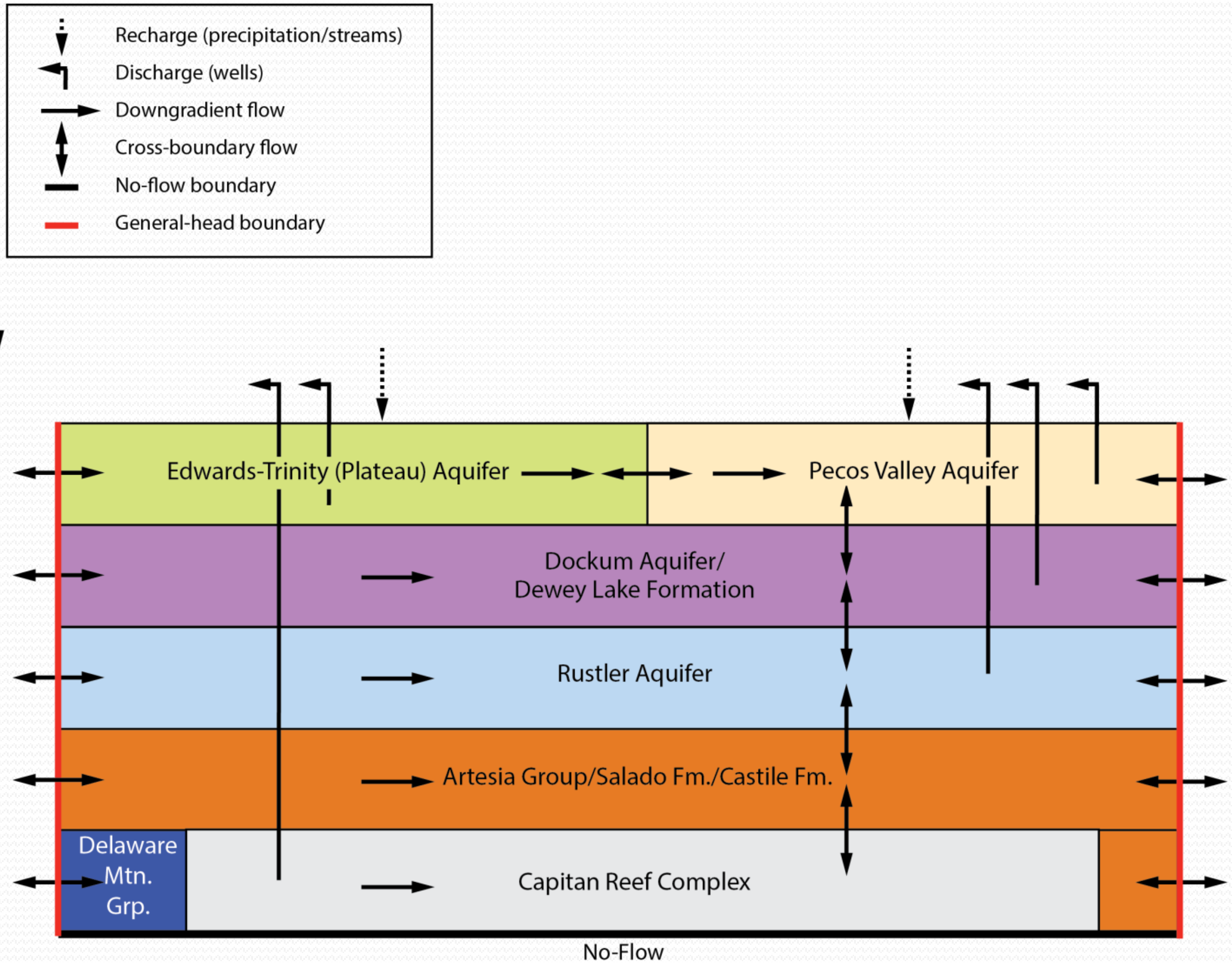
- Conclusions
  - Most recharge occurred in or near the aquifer outcrops
    - Guadalupe and Glass Mountains,
    - near southern margin of Delaware Mountains
  - Little recharge associated Apache Mountains
  - Most recharge during Pleistocene (10,000+ years ago)
    - Most recent recharge near the Delaware Mountains
  - Eastern arm of aquifer has relatively simple flow system
    - Single recharge zone in the Glass Mountains
  - Western arm of aquifer more complex
    - Range of recharge conditions

CONCEPTUAL MODEL

Conceptual Model



Conceptual Model



REVISED PROJECT SCHEDULE

Project Tasks and Proposed Schedule

Milestone	Completion Date
Stakeholder Advisory Forum #1	October 2012
Draft Conceptual Model Report	April 2014
Stakeholder Advisory Forum #2	May 2014
Final Conceptual Model Report	June 2014
Model construction & calibration/draft model report	May 2015
Stakeholder Advisory Forum # 3	June 2015
Final Report	August 2015

Contact Information

Ian C. Jones, Ph.D., P.G.

ian.jones@twdb.texas.gov

512-463-6641

Texas Water Development Board

P.O. Box 13231

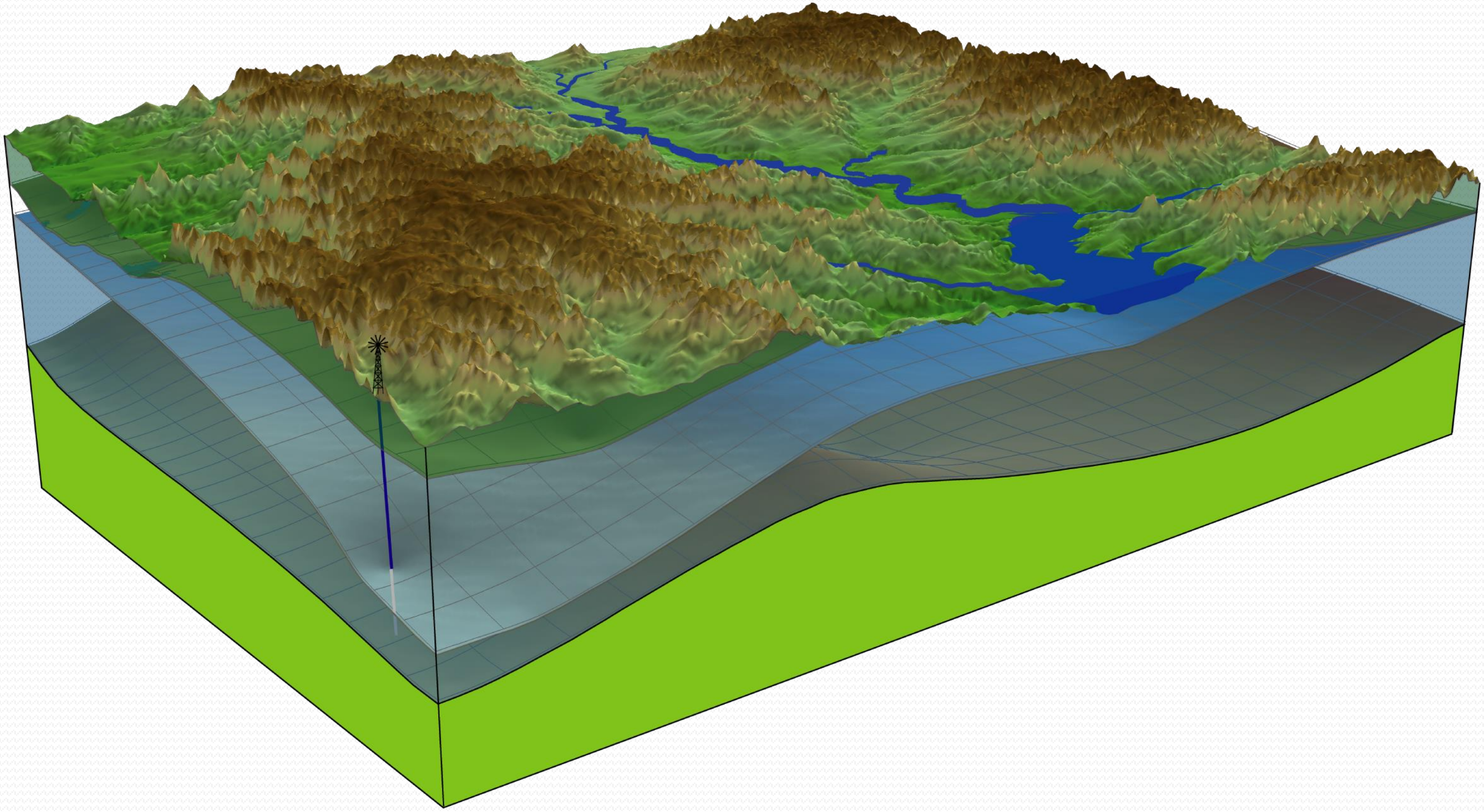
Austin, Texas 78711-3231

Web information:

www.twdb.texas.gov/groundwater

Texas Water Development Board

Groundwater Model



What is Groundwater Availability?

Science + Policy = Groundwater Availability

GAM or other tool + Desired Future Conditions = Managed Available Groundwater

Goal: informed decision-making

BASICS OF GROUNDWATER FLOW

Groundwater Flow: Definitions

- **Aquifer** — Geologic unit that can transmit useable amounts of water to a well
  - **Unconfined** — water table forms the upper boundary
  - **Confined** — upper boundary is low permeability layer
- **Water table** — boundary between saturated and unsaturated zones
- **Hydraulic head** — water level in a well expressed as an elevation

Groundwater Flow: Definitions

- **Hydraulic conductivity** — A measurement of the ability of material to transmit groundwater
- **Specific yield** – The volume of water that an unconfined aquifer releases from storage per unit surface area of aquifer per unit decline in water table elevation
- **Storativity** – The volume of water that a confined aquifer releases from storage per unit surface area of aquifer per unit decline of head

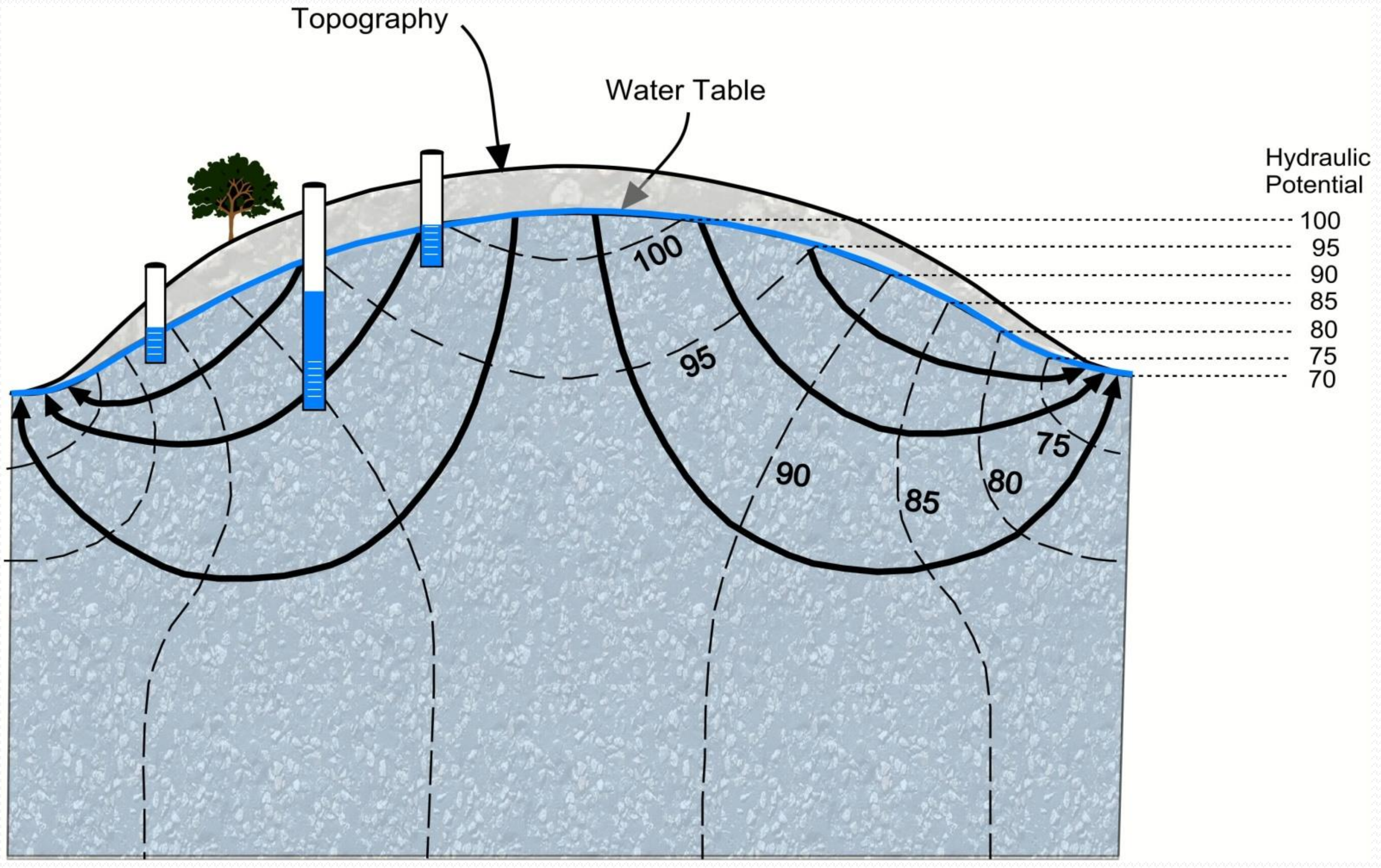
Groundwater Flow: Definitions

- **Recharge** — The processes involved in the addition of water to the saturated zone
- **Discharge** – The processes involved in water leaving an aquifer
- **Cross-formational flow** – Groundwater flow between geologic formations (aquifers)
- **Stream loss or gains** – The water that is lost or gained through the base of a stream due to interaction with an aquifer

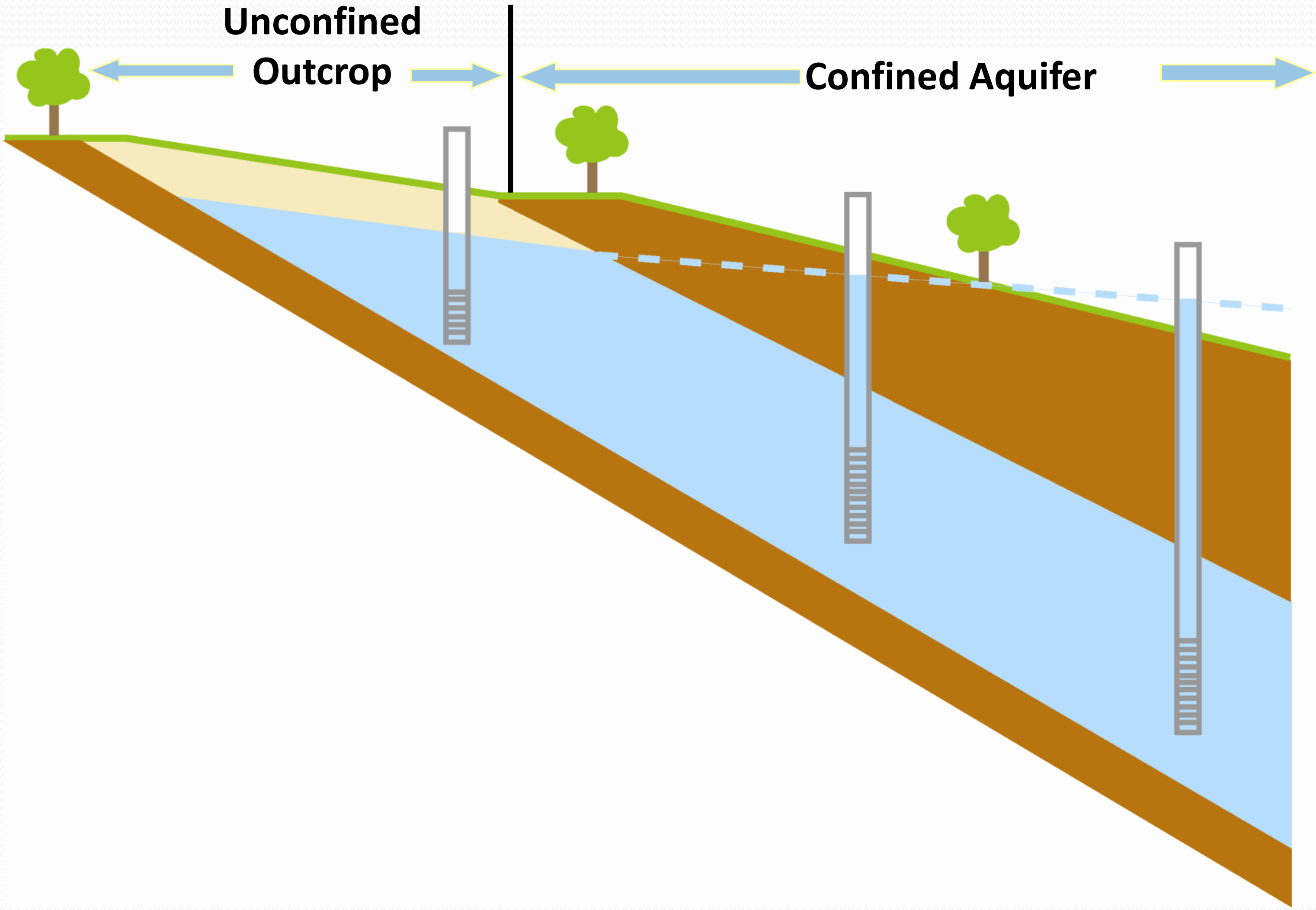
Basic Principles of Groundwater Flow

- The primary observable quantity describing groundwater flow is the hydraulic head as measured in a well
- The difference in hydraulic head between adjacent wells determines the direction of groundwater flow
  - From higher heads towards lower heads
- The water table is typically a subdued replica of the topography
- The thickness and hydraulic conductivity of the aquifer define volumetric flow rates
  - The larger the hydraulic conductivity and thickness, the greater the flow

Schematic Cross Section of Groundwater Flow



Confined/Unconfined Aquifer



GROUNDWATER MODELING

Definition

- A mathematical device that represents an approximation of an aquifer *(The Compendium of Hydrogeology)*
- Simulation of groundwater flow by means of a governing equation used to represent the physical processes that occur in the aquifer, together with equations that describe heads or flows along the boundaries of the model *(Anderson and Woessner, 2002)*

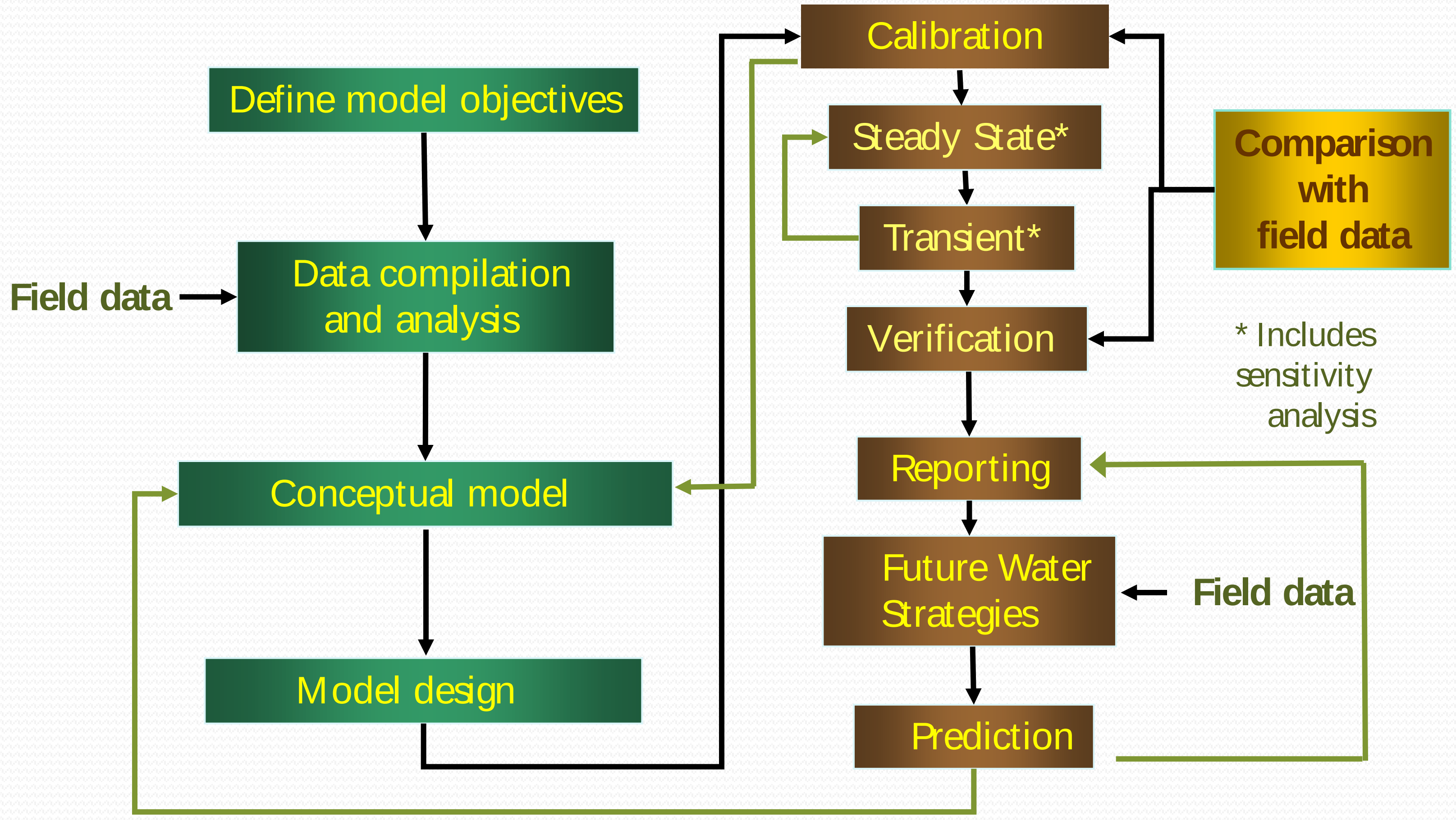
Why Groundwater Flow Models?

- In contrast to surface water, groundwater flow is difficult to observe
- Aquifers are typically complex in terms of spatial extent and hydrogeological characteristics
- A groundwater model provides the only means for integrating available data for the prediction of groundwater flow at the scale of interest

Numerical Flow Model

- A numerical groundwater flow model is the mathematical representation of an aquifer
- It uses basic laws of physics that govern groundwater flow
- In the model domain, the numerical model calculates the hydraulic head at discrete locations (determined by the grid)
- The calculated model heads can be compared to hydraulic heads measured in wells

Modeling Process



Model Specifications

- Three dimensional (MODFLOW-2005 or later)
- Regional scale (1000’s of square miles)
  - Eastern arm of the Capitan Reef Complex Aquifer
- Grid spacing
  - Uniform grid – ¼ miles proposed
- Implement
  - recharge
  - groundwater/surface water interaction
  - pumping
- Calibration to observed water levels/fluxes

MODFLOW

- Code developed by the U.S. Geological Survey (USGS)
- Selected by TWDB for all GAMs
- Handles the relevant processes
- Comprehensive documentation
- Public domain – non-proprietary
- Most widely used groundwater model
  - USGS had 12,261 downloads of MODFLOW computer code in 2000
- Supporting interface programs available
  - Groundwater Vistas to be used in all GAMs

DATA COLLECTION

Data Collection

- Heads, Discharge & Water Quality Data
  - County Reports (predevelopment)
    - Evidence of artesian wells
    - Evidence of flowing springs
  - TWDB groundwater database
  - GCDs
  - Thesis work
  - Other literature

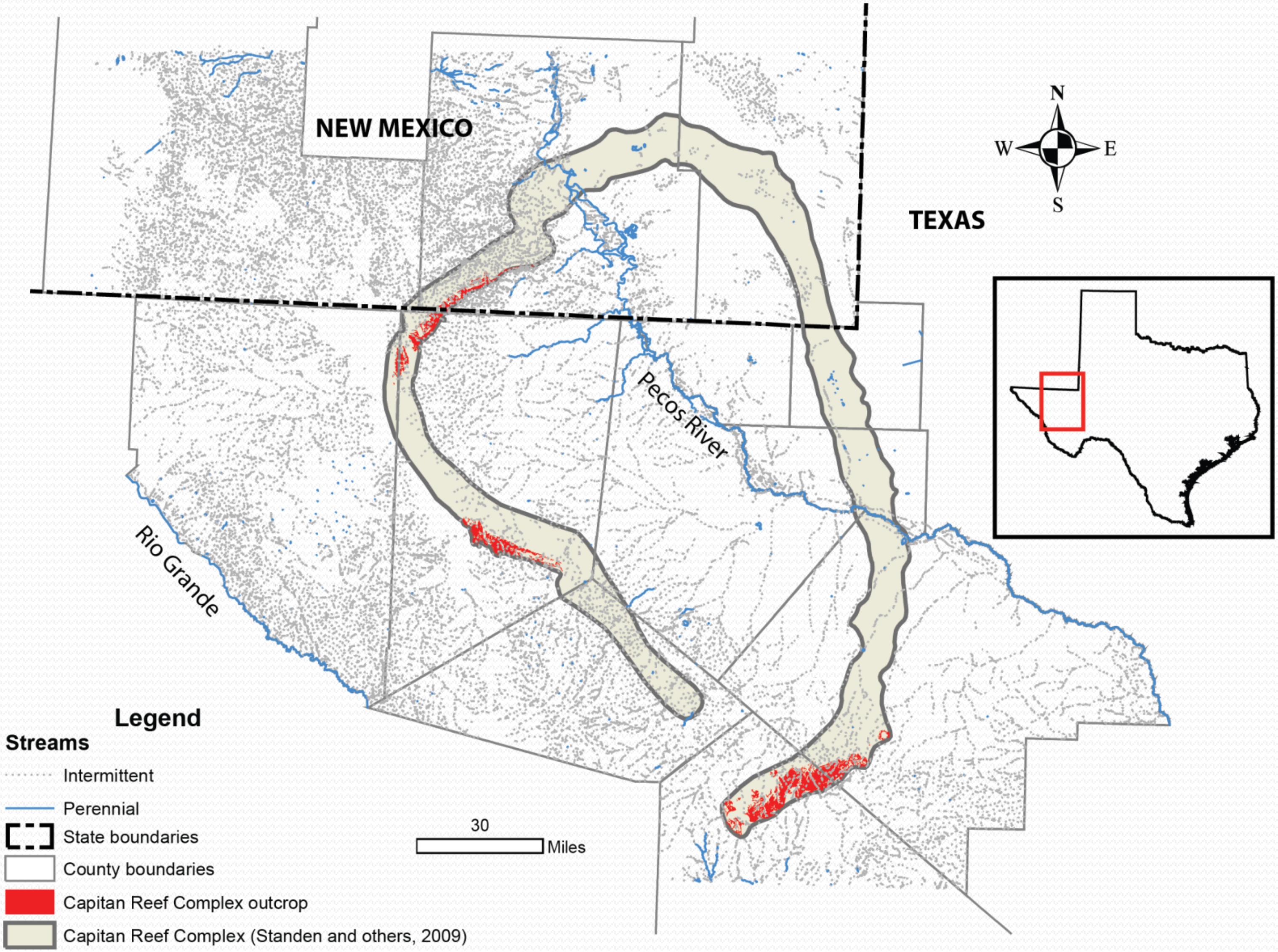
Data Collection

- Hydraulic Properties
  - County reports
  - Meyers
  - TCEQ Surface Casing Database
    - Typically specific capacity tests
  - GCD
  - Literature/Thesis
  - Stakeholders

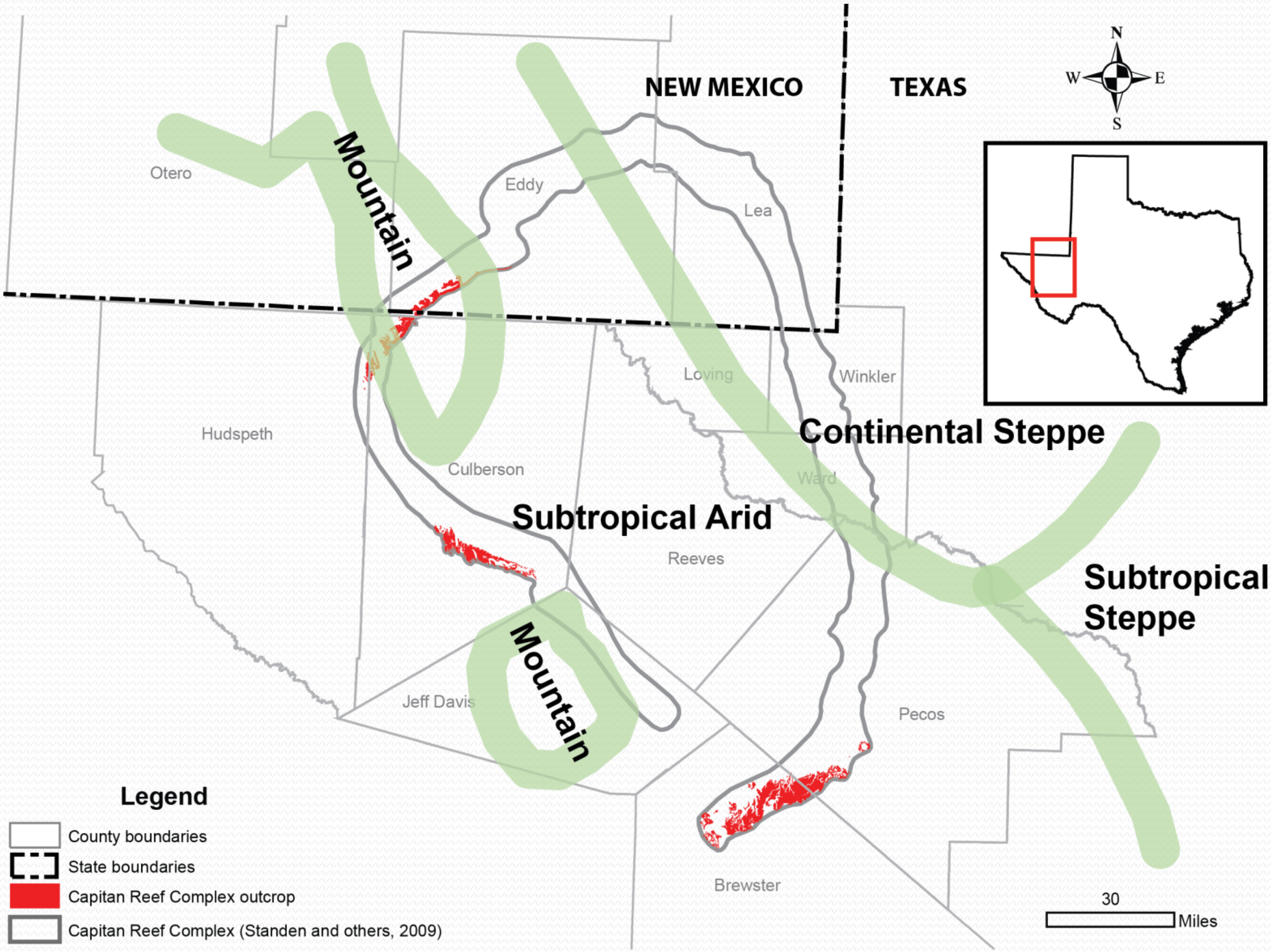
Data Request

- Request:
  - Unpublished data to support the model
    - Water levels
    - Pump test results
- Deadline:
  - February 2013

Surface Hydrology

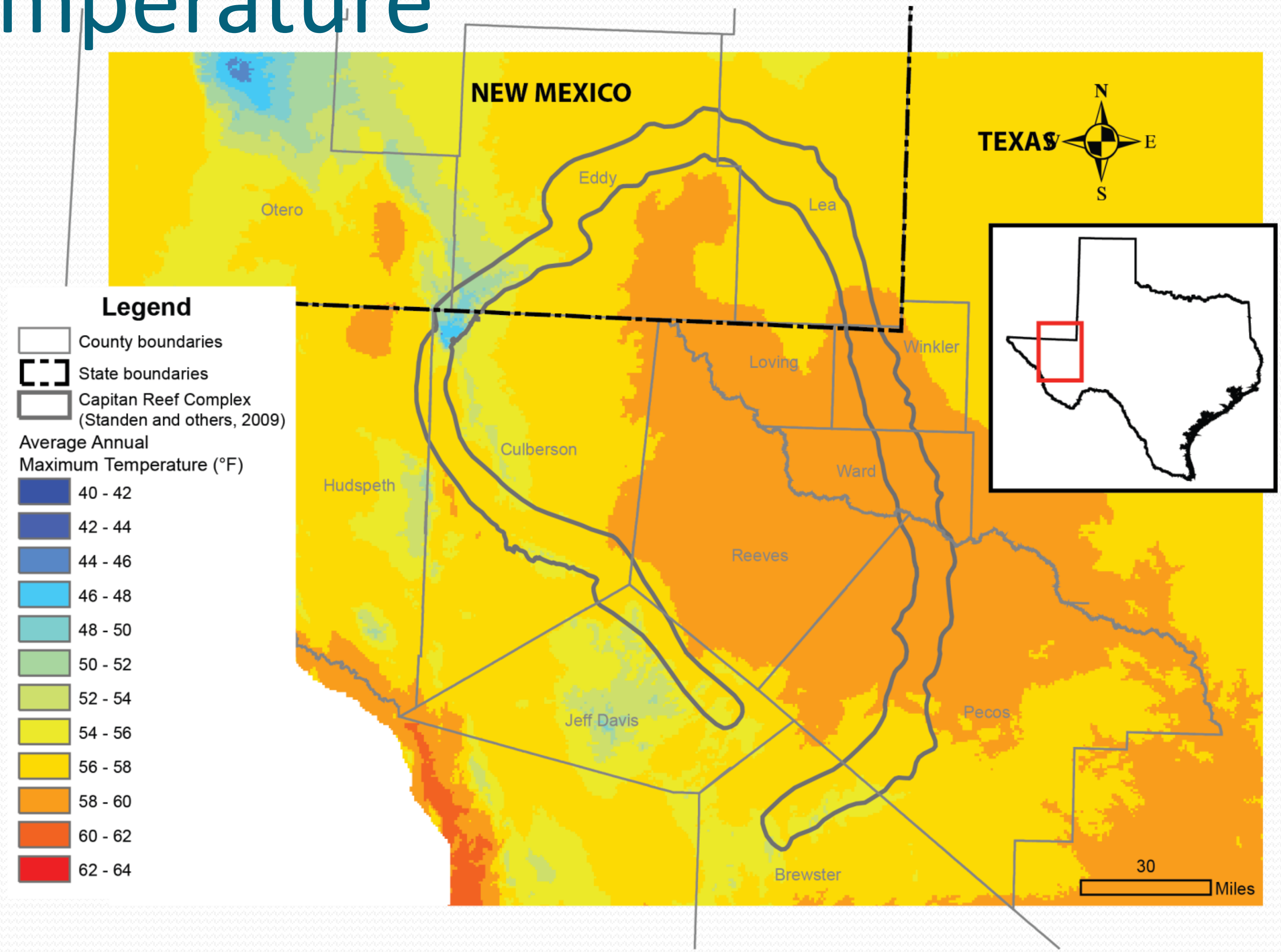


Climate Regions



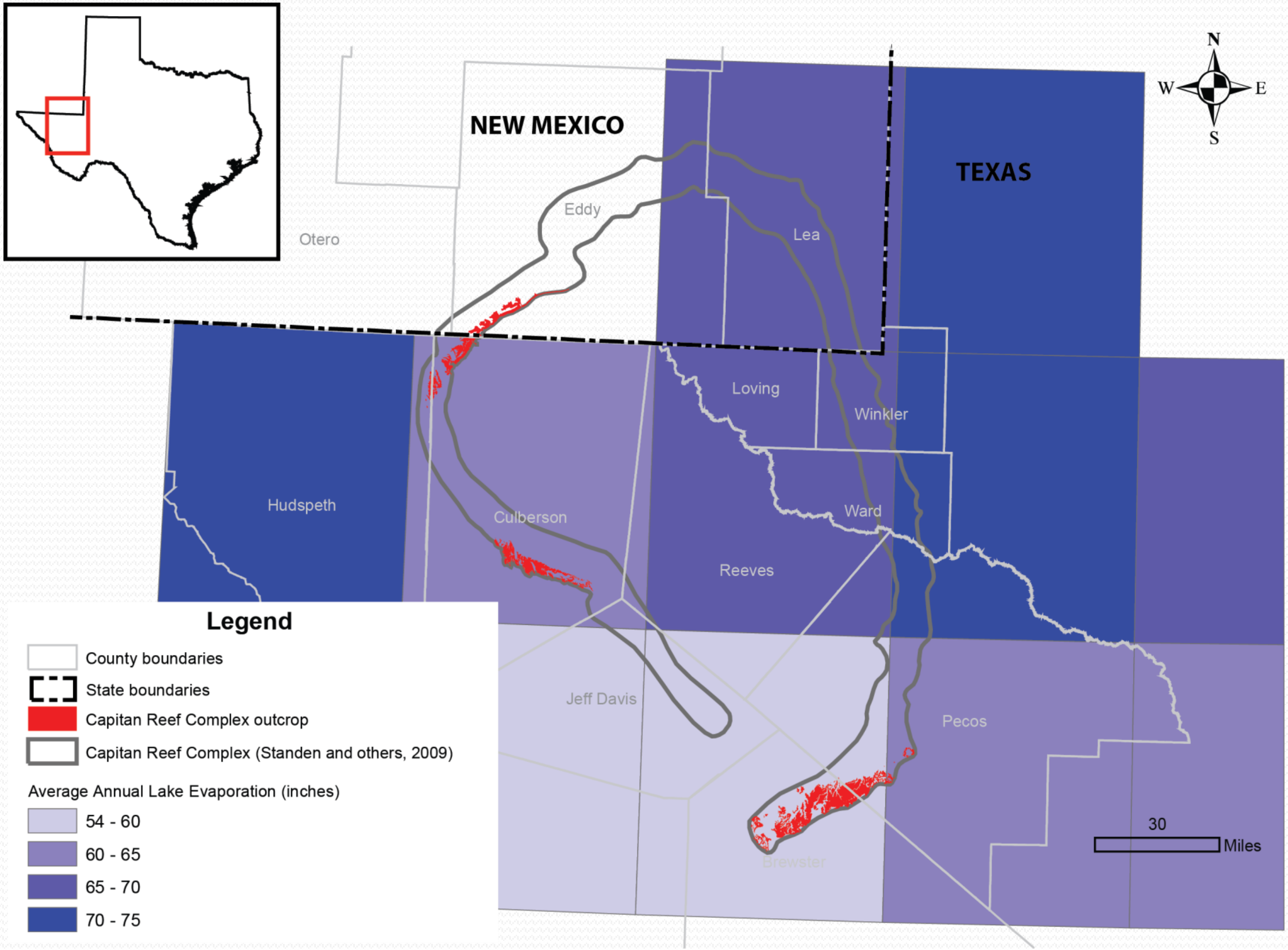
Modified from Larkin and Bomar (1983)

Average Annual Maximum Temperature

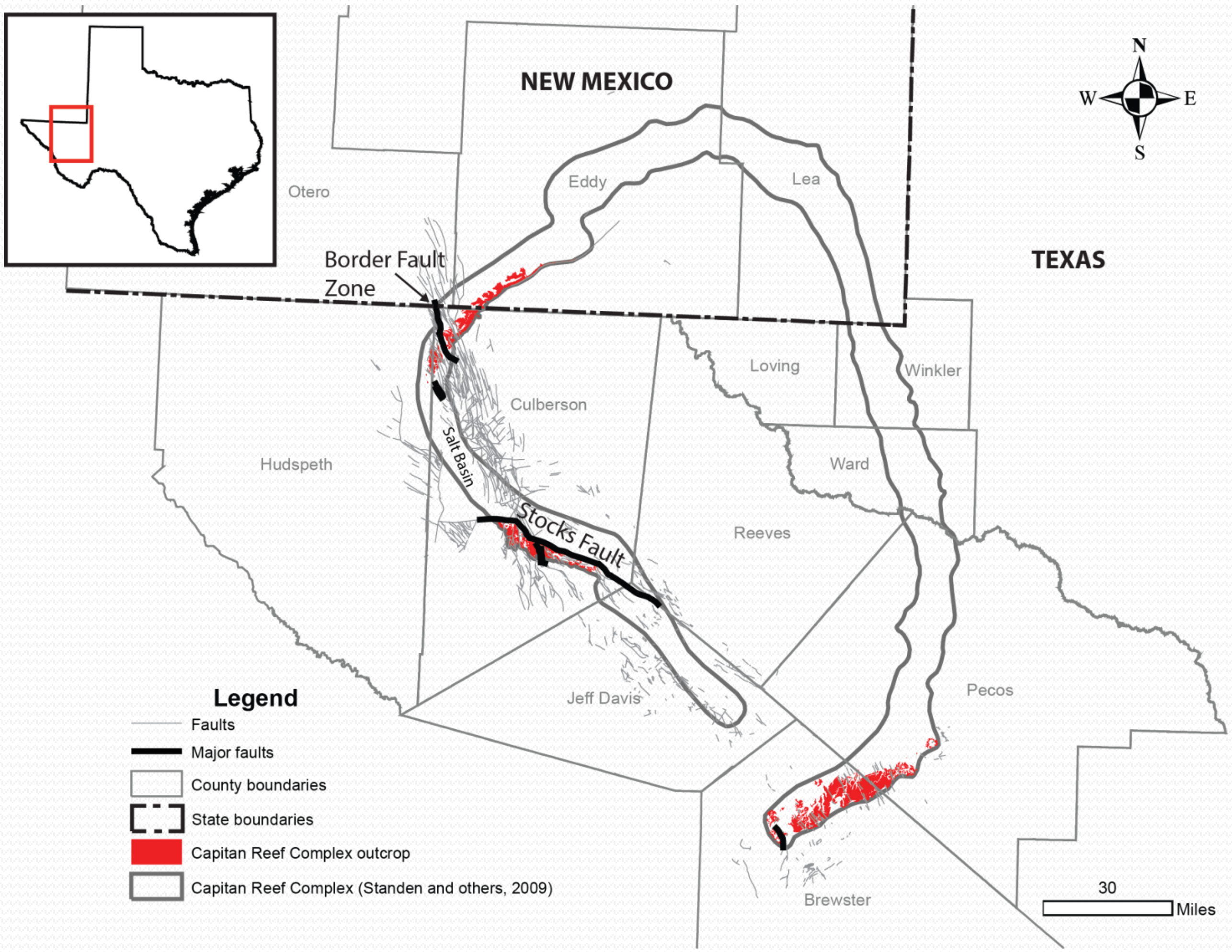


Based on data from Oregon State University (2006)

Average Annual Pan Evaporation

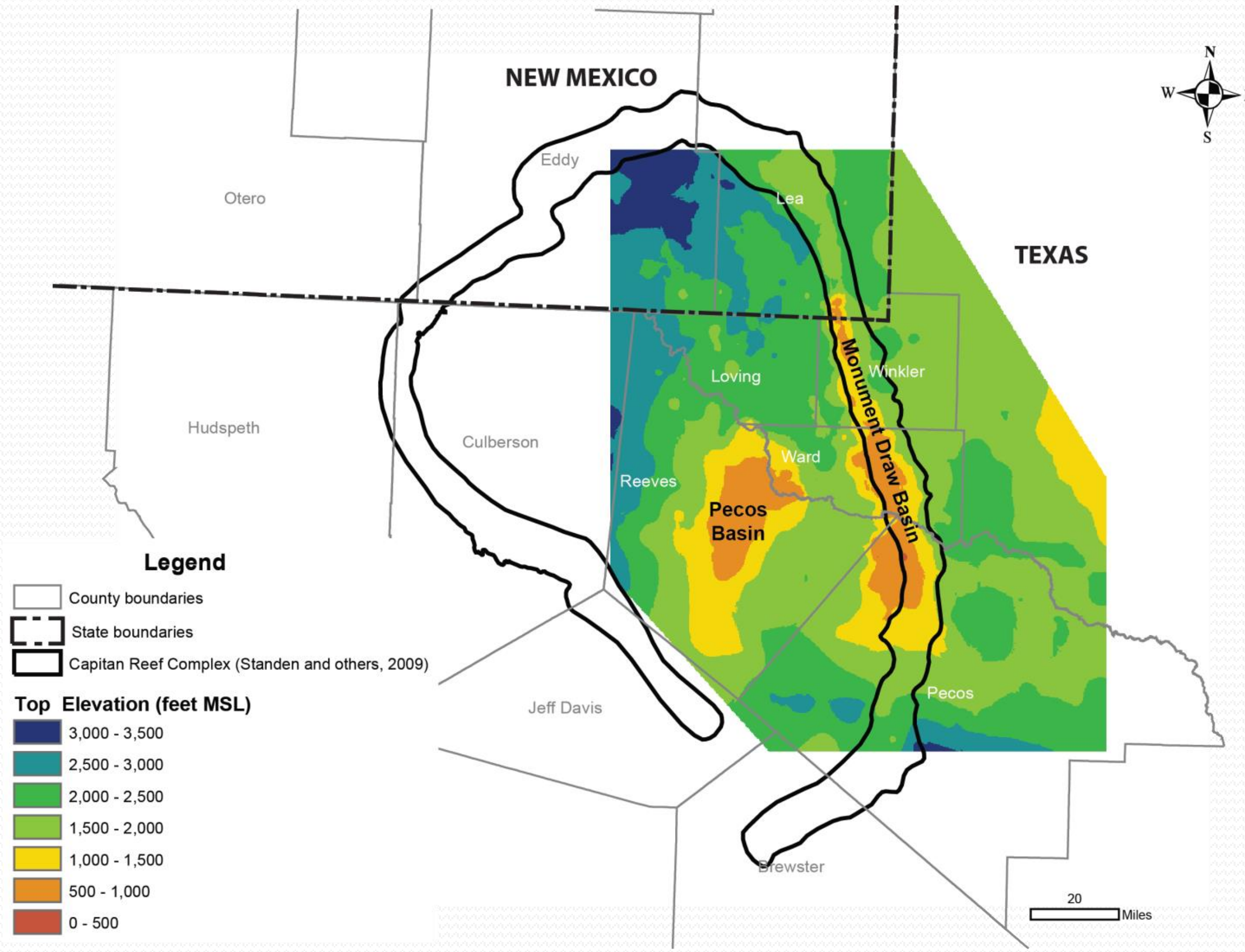


Fault System



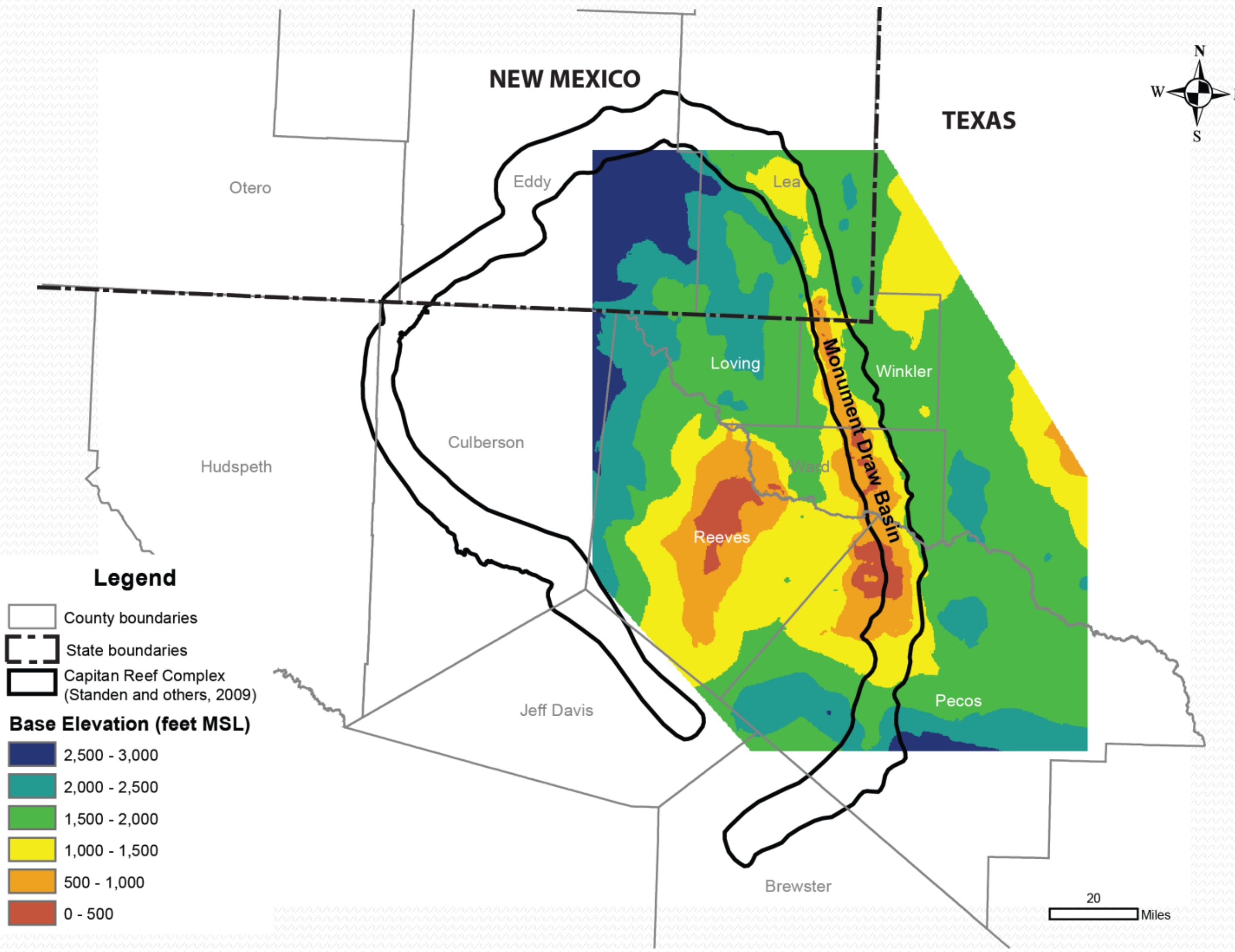
Based on data from the Bureau of Economic Geology and New Mexico Bureau of Geology and Mineral Resources

Rustler Aquifer Top Elevation



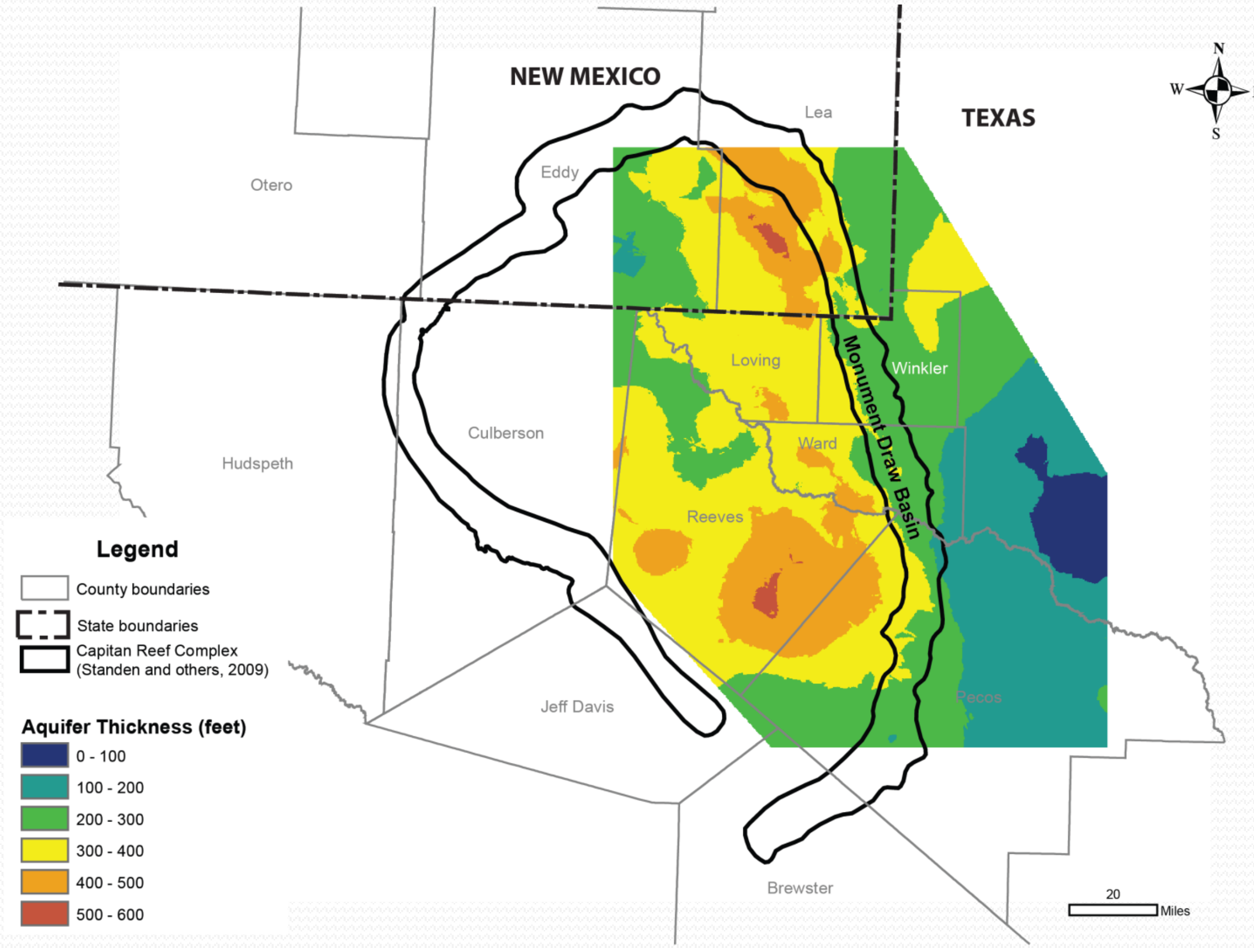
Based on data from Ewing and others (2012)

Rustler Aquifer Base Elevation



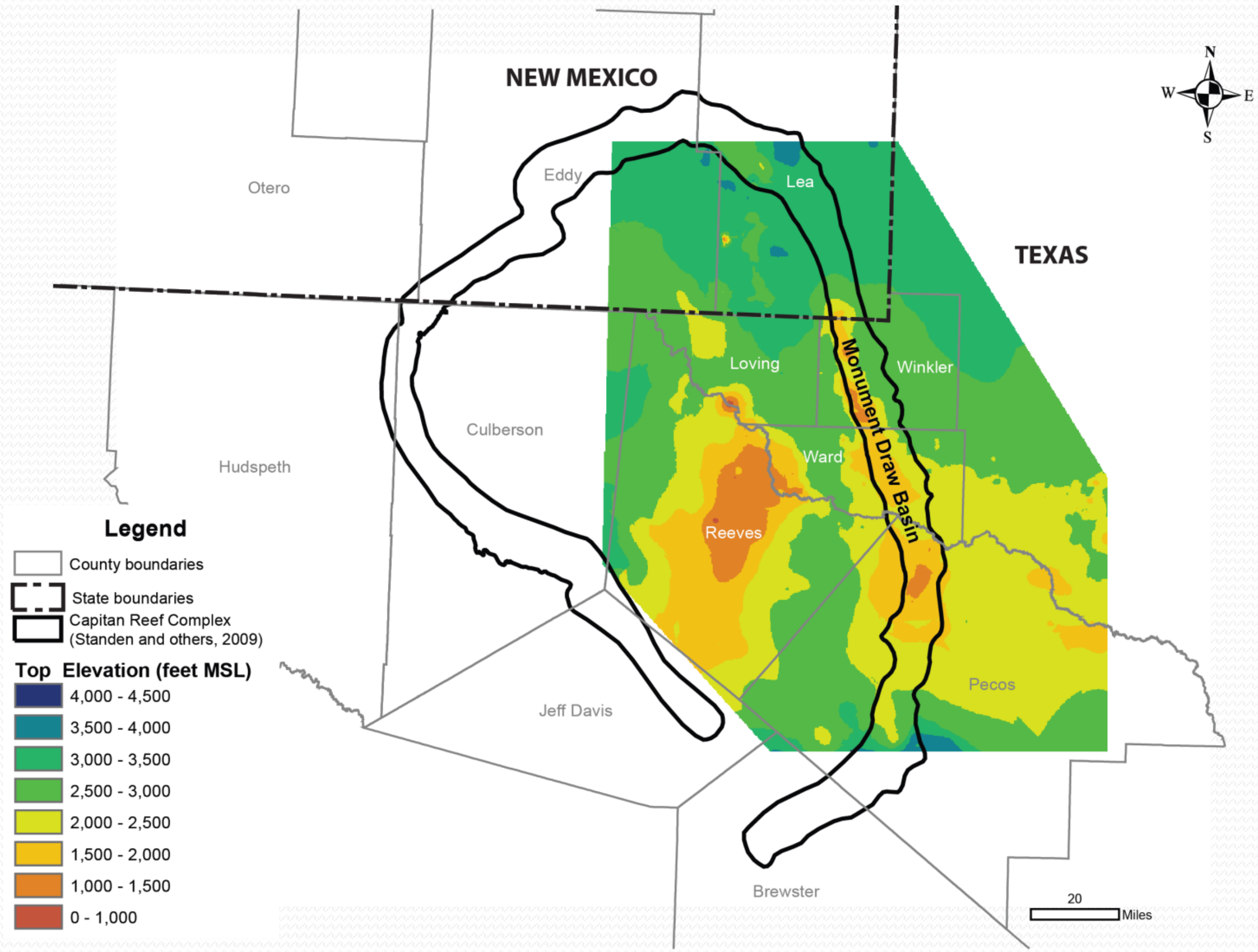
Based on data from Ewing and others (2012)

Rustler Aquifer Thickness



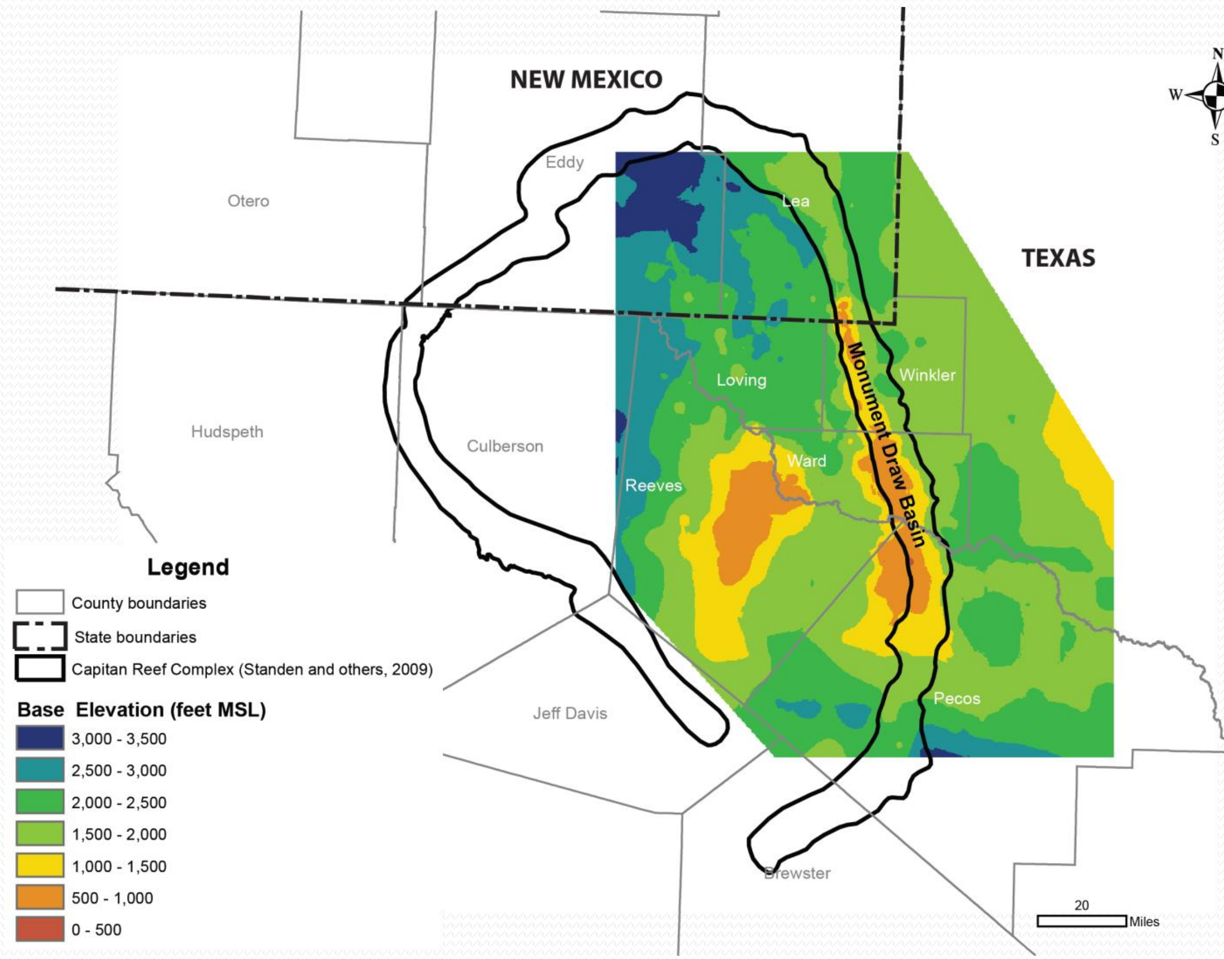
Based on data from Ewing and others (2012)

Dockum Aquifer Top Elevation



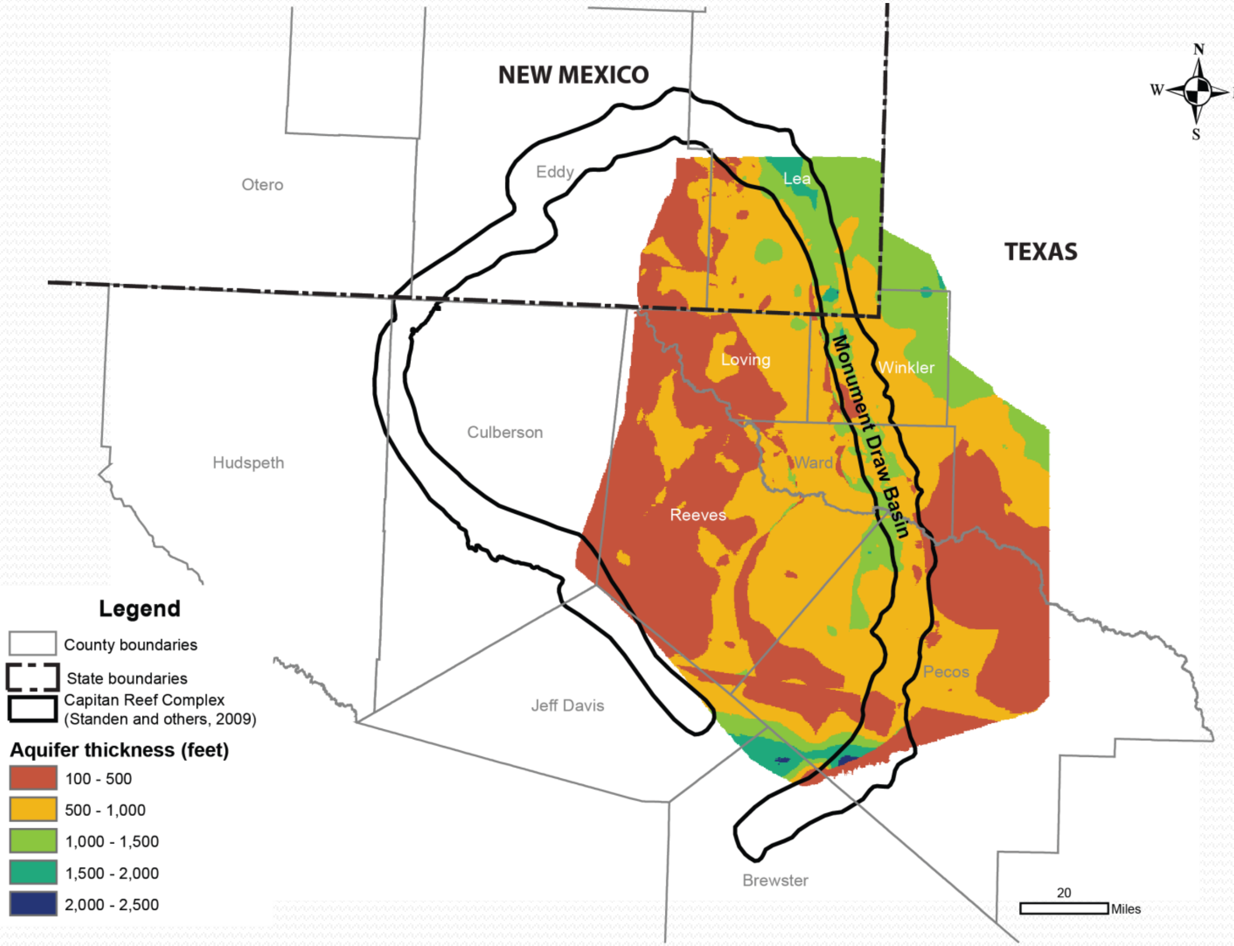
Based on data from Ewing and others (2008)

Dockum Aquifer Base Elevation



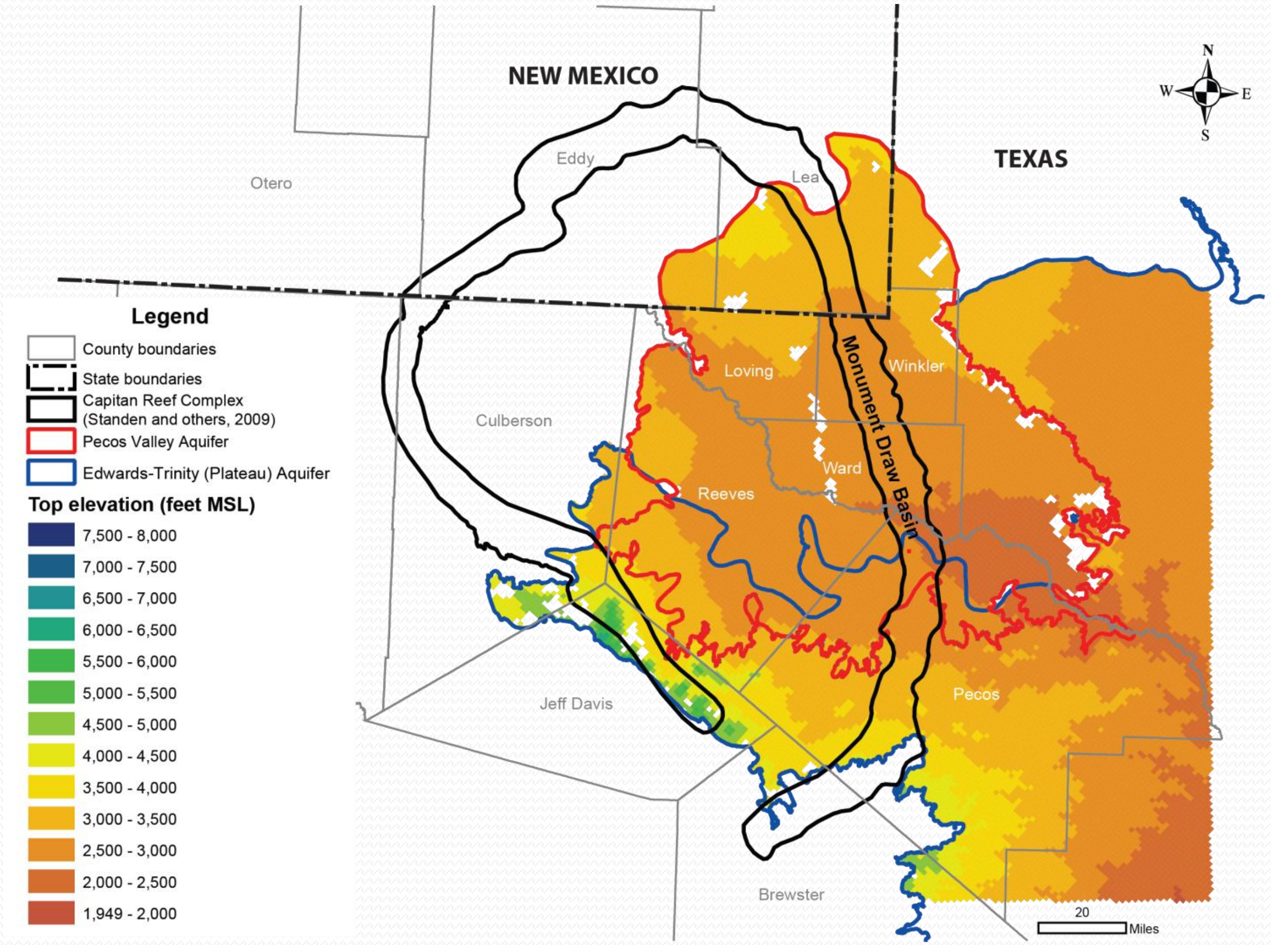
Based on data from Ewing and others (2008)

Dockum Aquifer Thickness



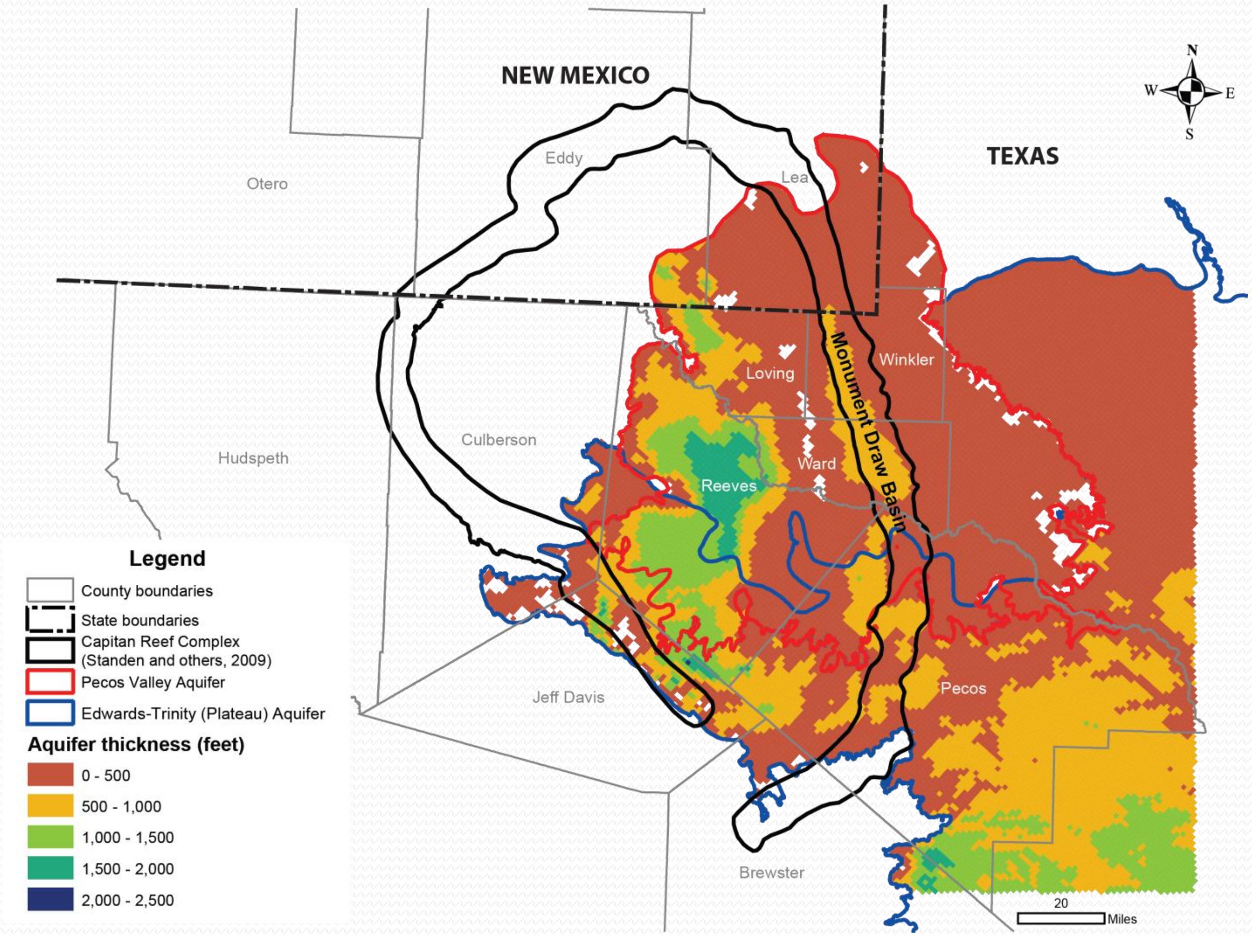
Based on data from Ewing and others (2008)

Edwards-Trinity/Pecos Valley Aquifer Top Elevation



Based on data from Hutchison and others (2011)

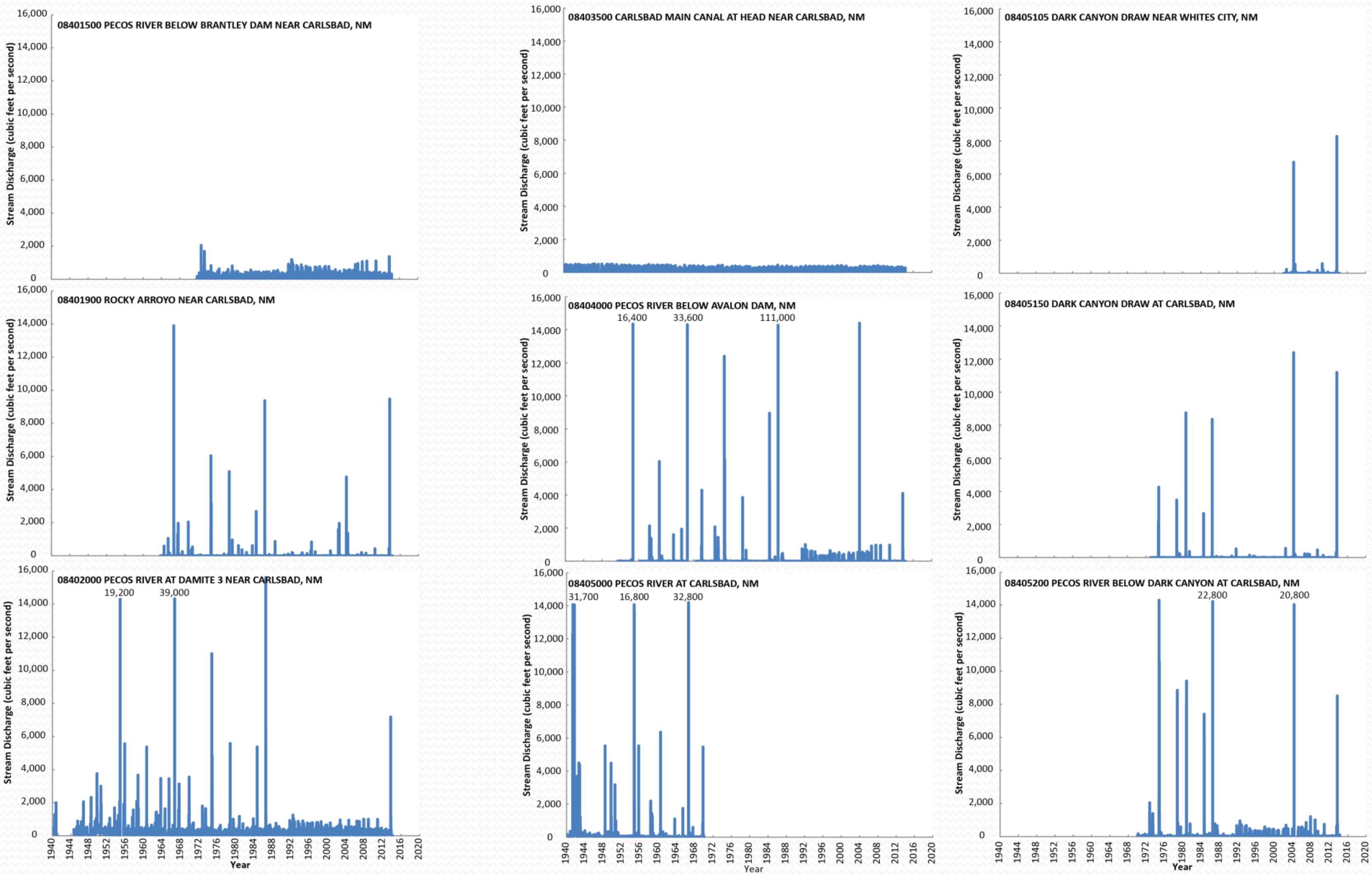
Edwards-Trinity/Pecos Valley Aquifer Thickness



Based on data from Hutchison and others (2011)

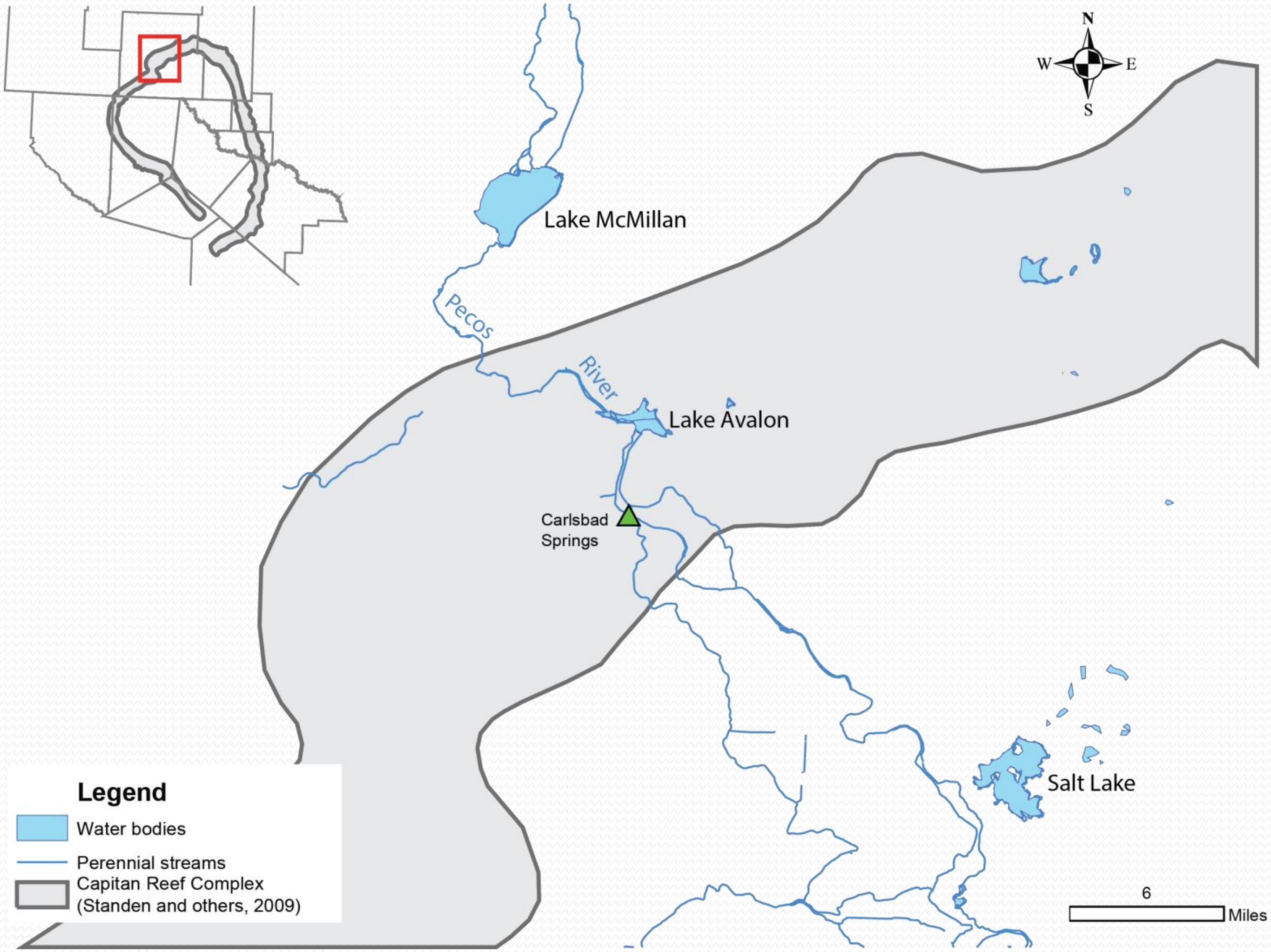
Surface Water Hydrology

Surface Water

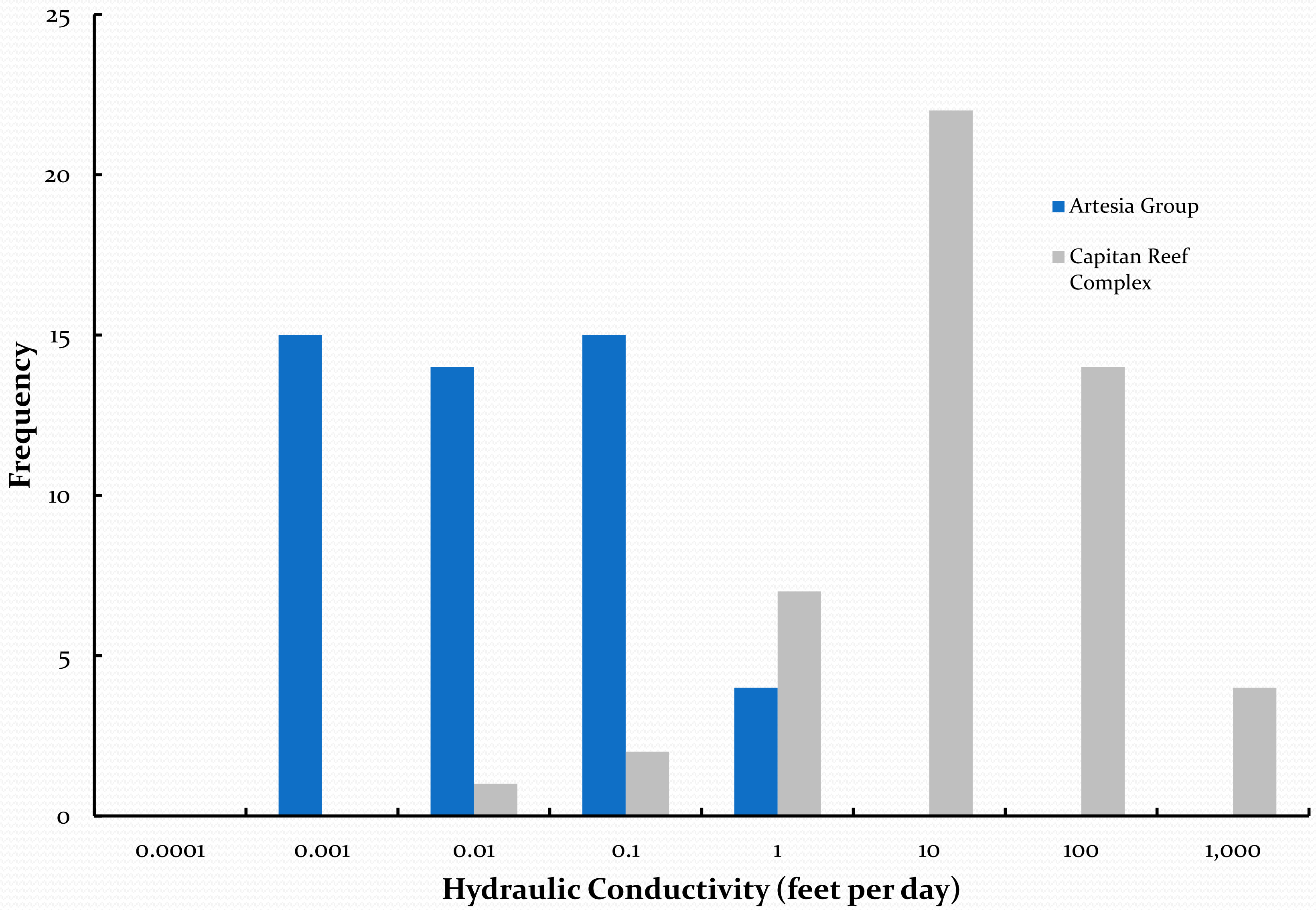


Data from U.S. Geological Survey

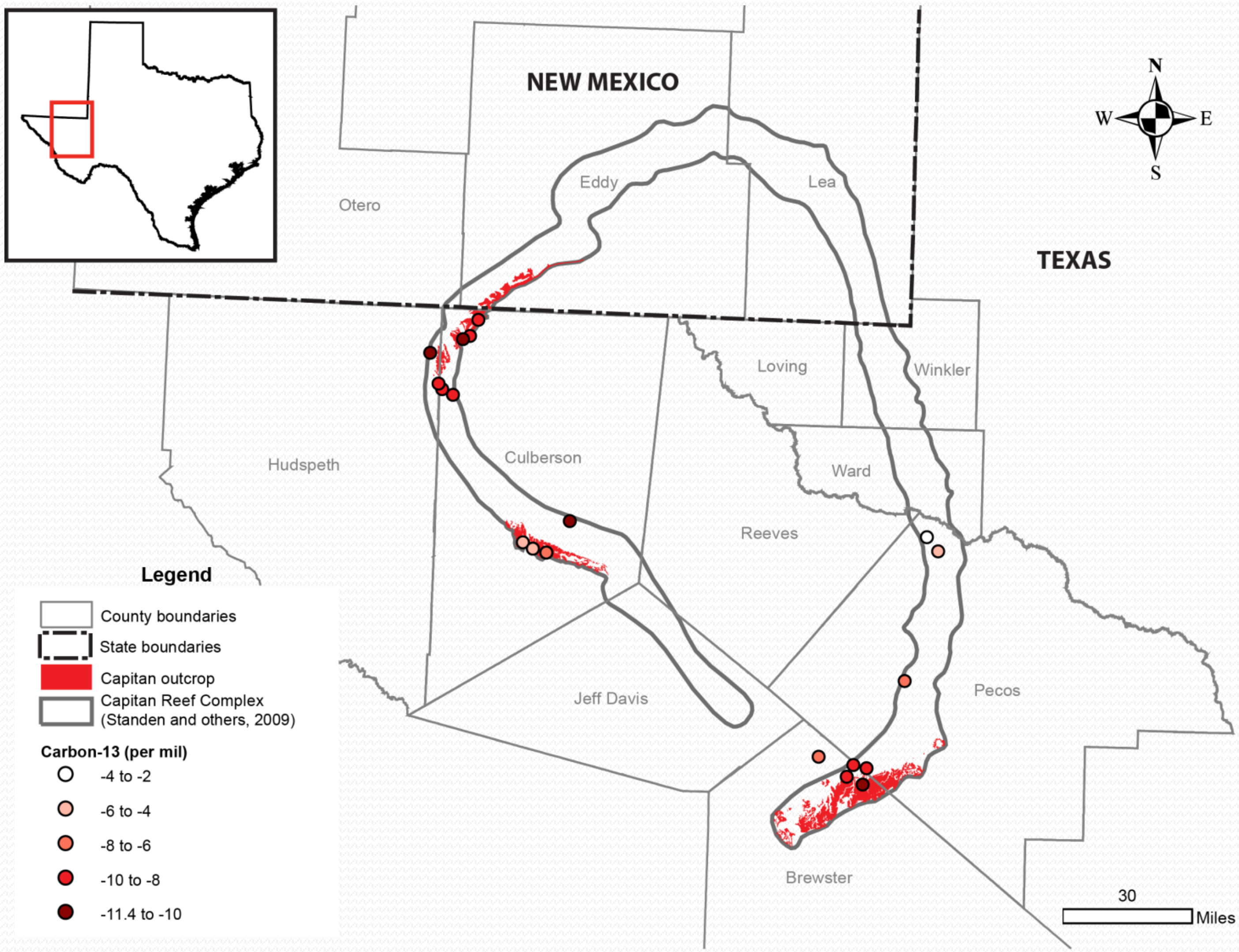
Springs


N
W
E
S
Lake McMillan
Pecos
River
Lake Avalon
Carlsbad
Springs
Salt Lake
Legend
Water bodies
Perennial streams
Capitan Reef Complex
(Standen and others, 2009)
6
Miles

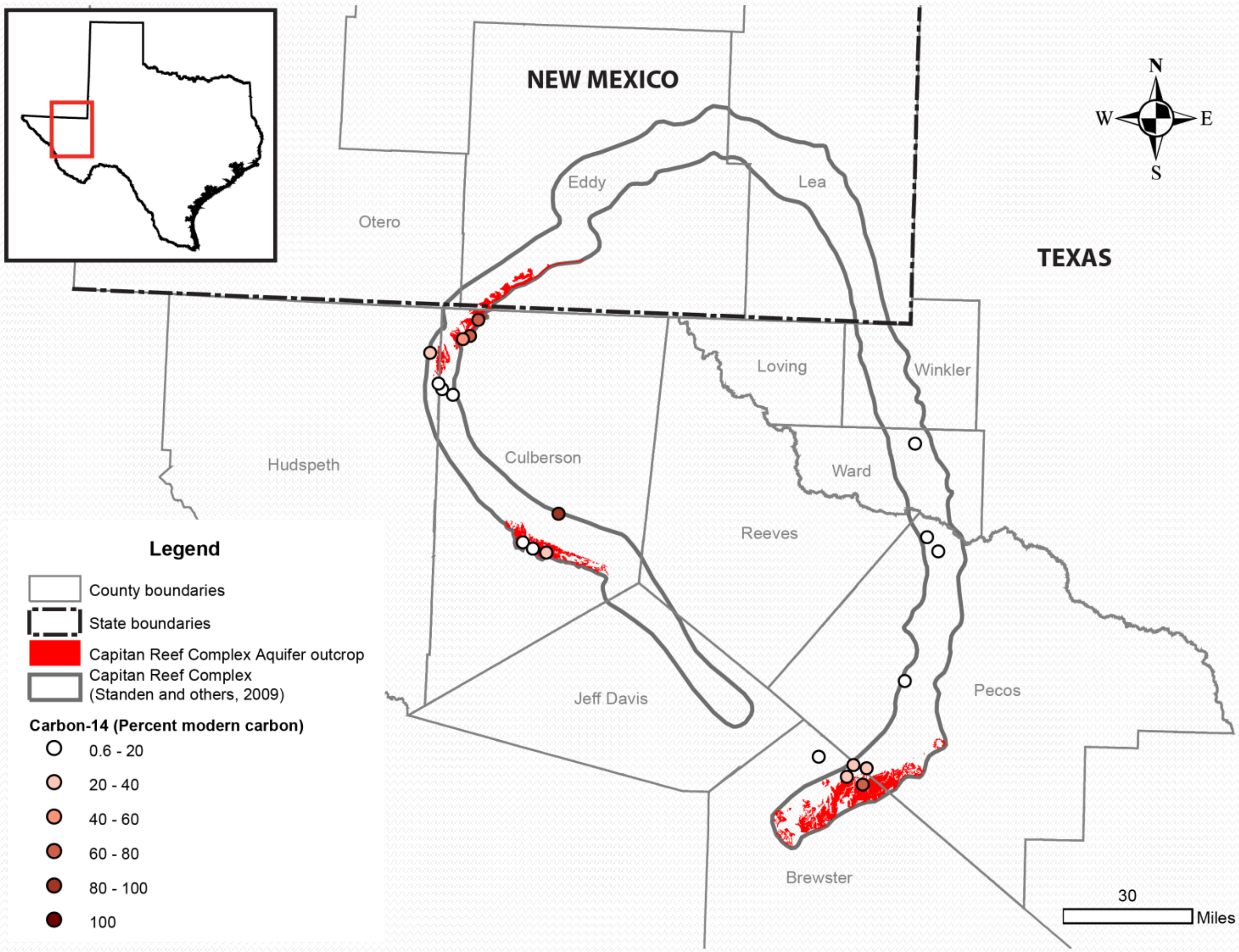
Hydraulic Properties



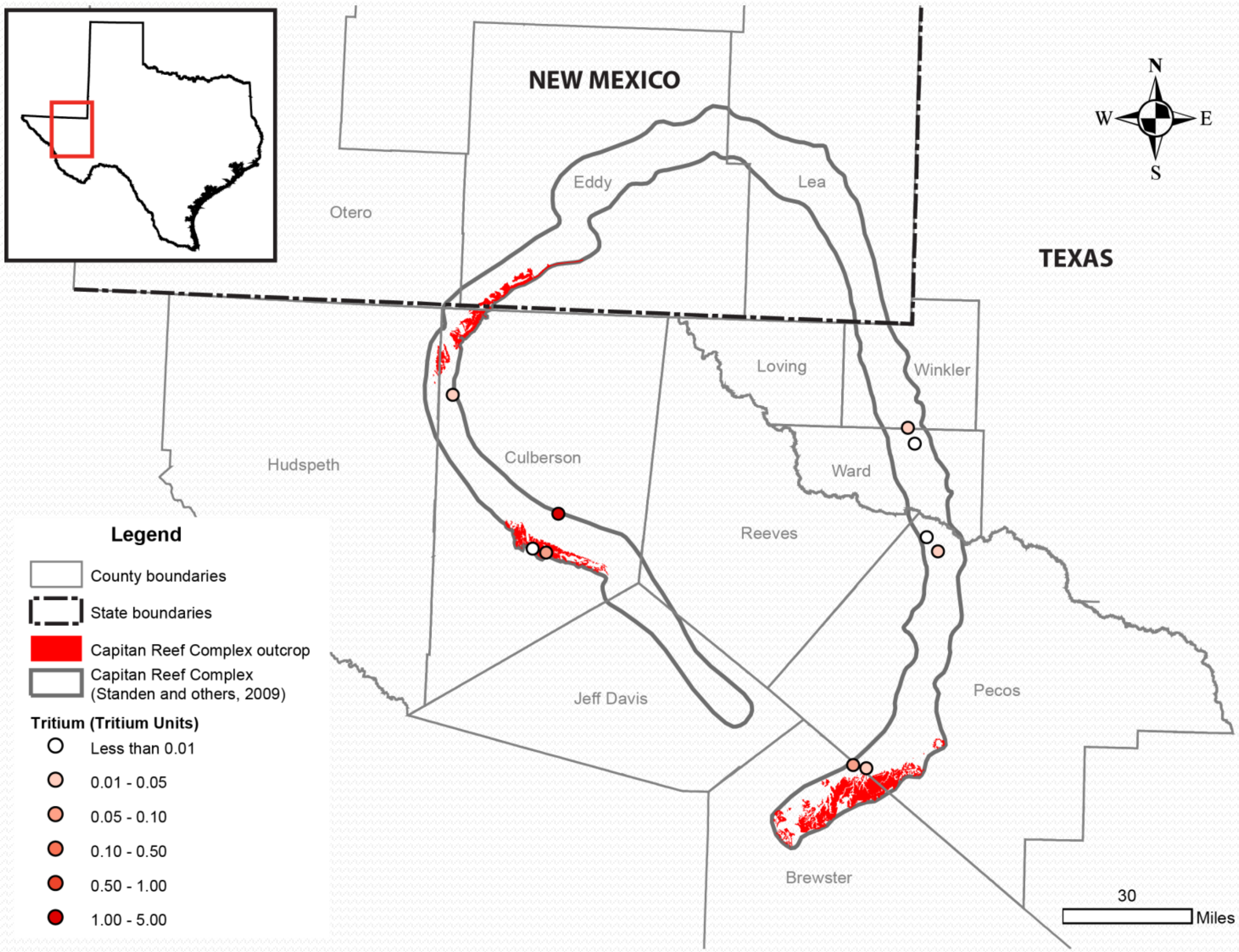
Groundwater Isotopes



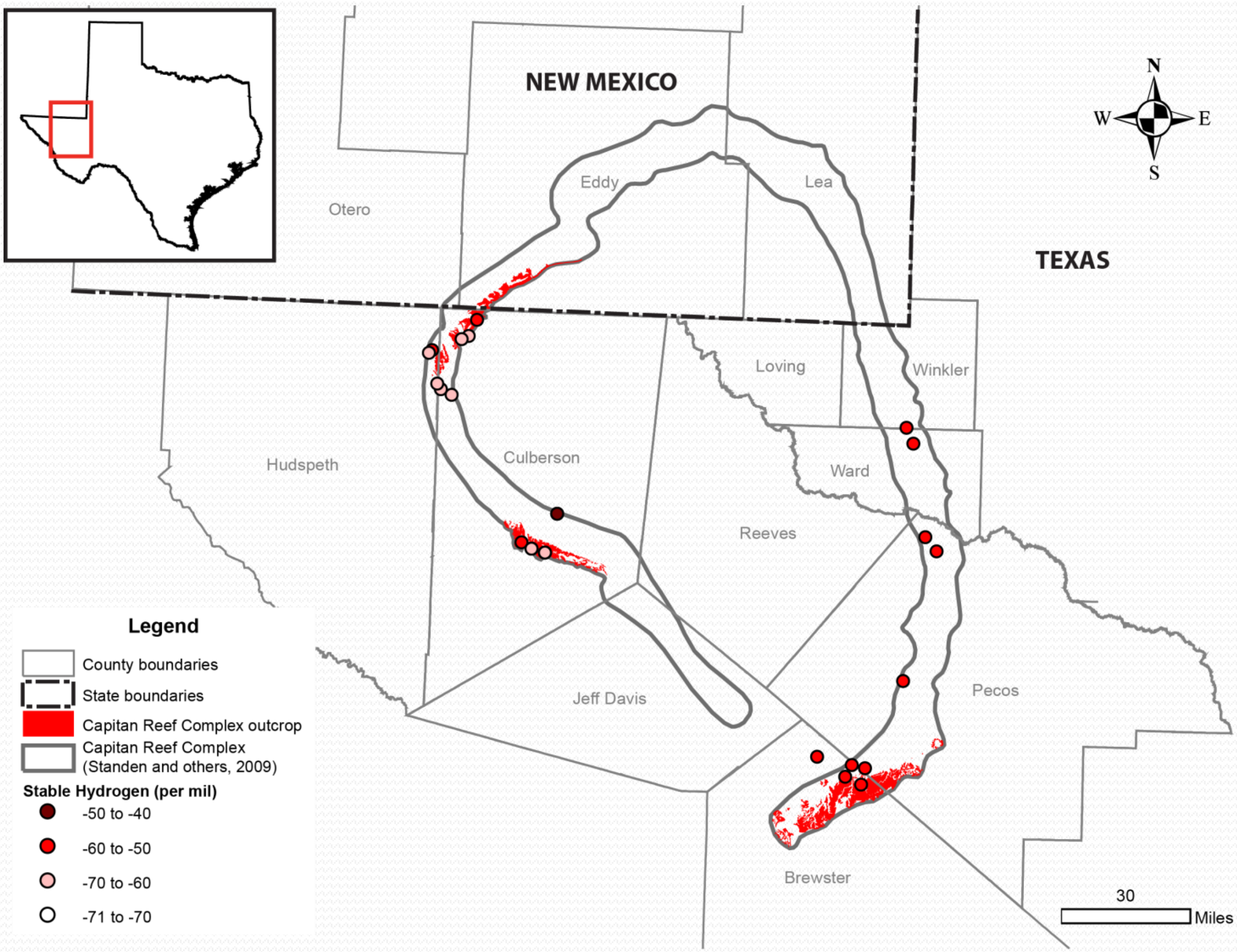
Groundwater Isotopes



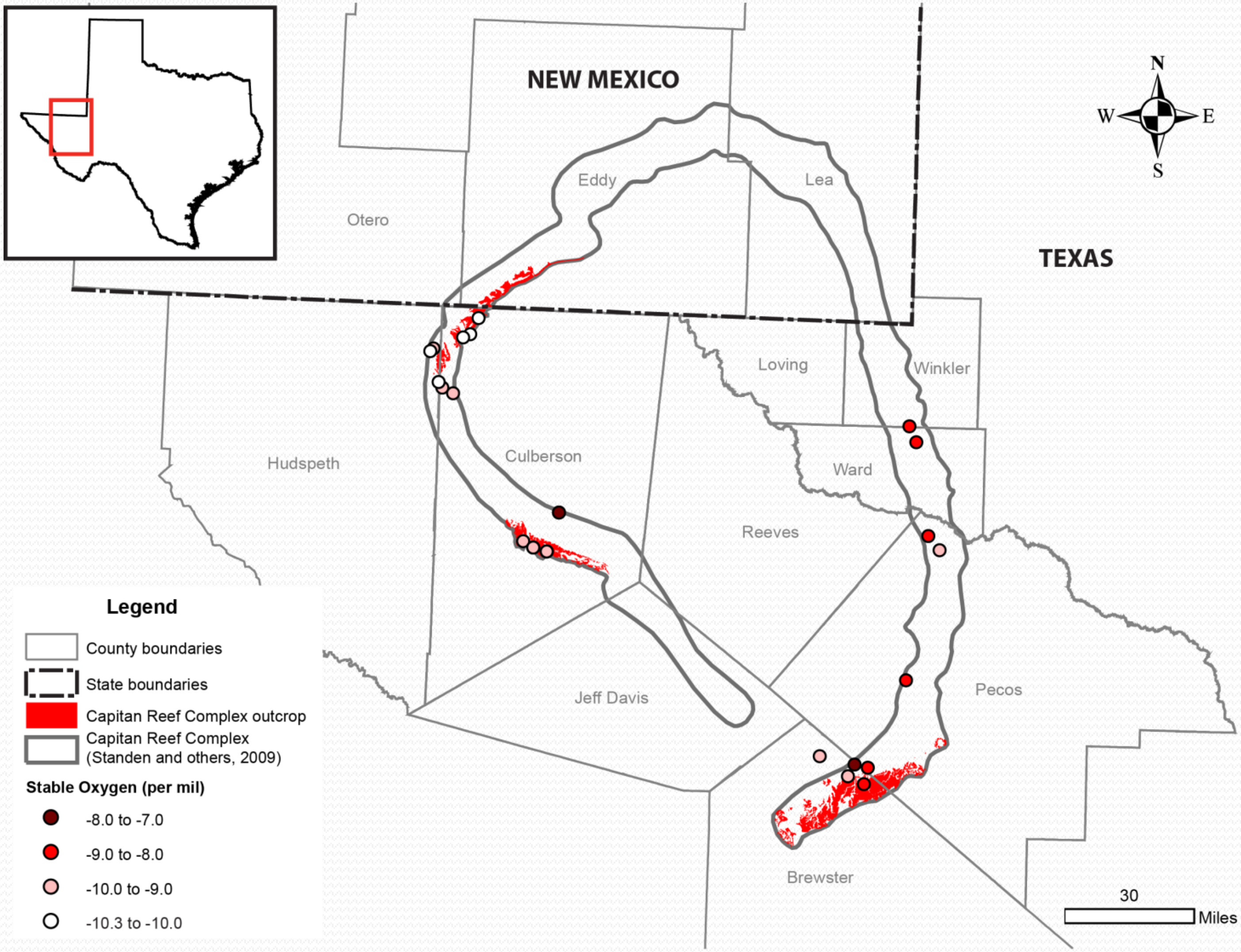
Groundwater Isotopes



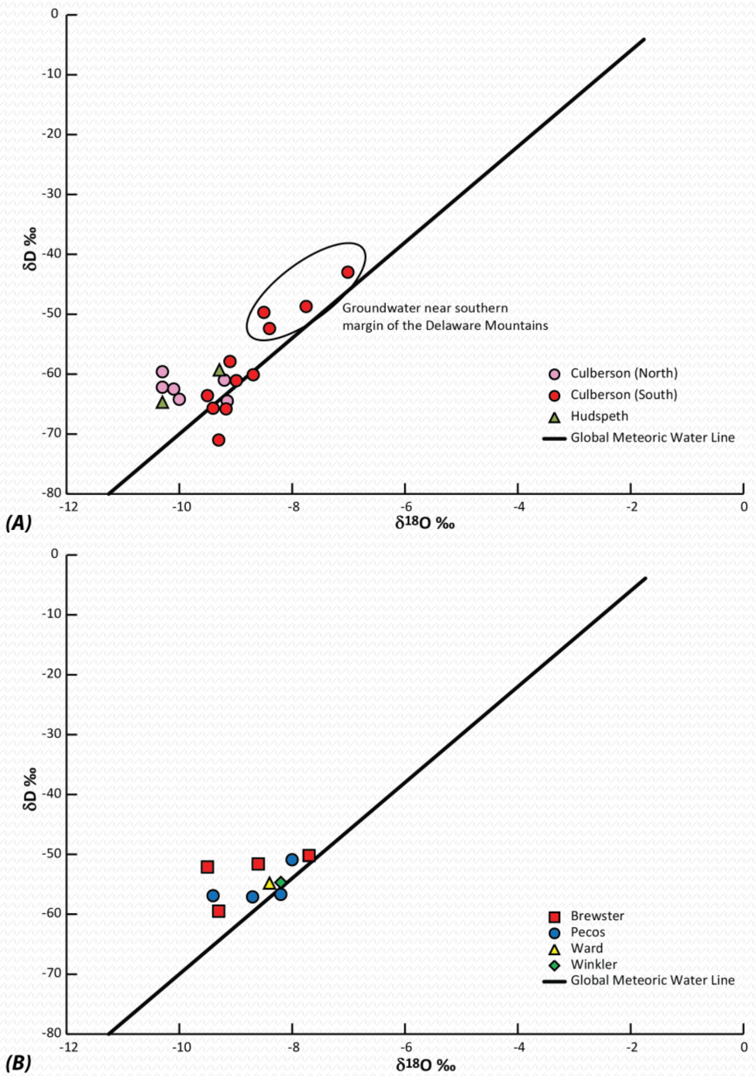
Groundwater Isotopes



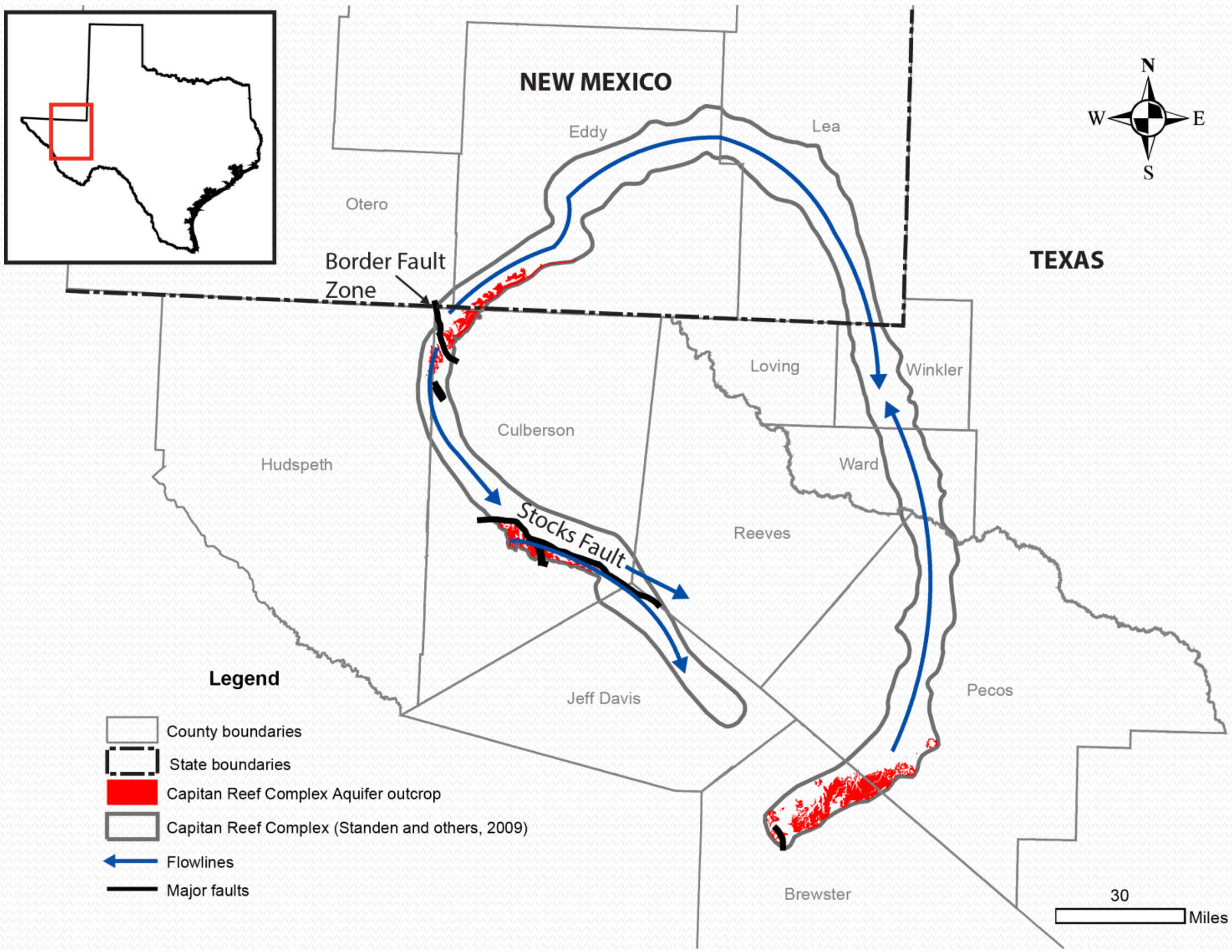
Groundwater Isotopes



Groundwater Isotopes

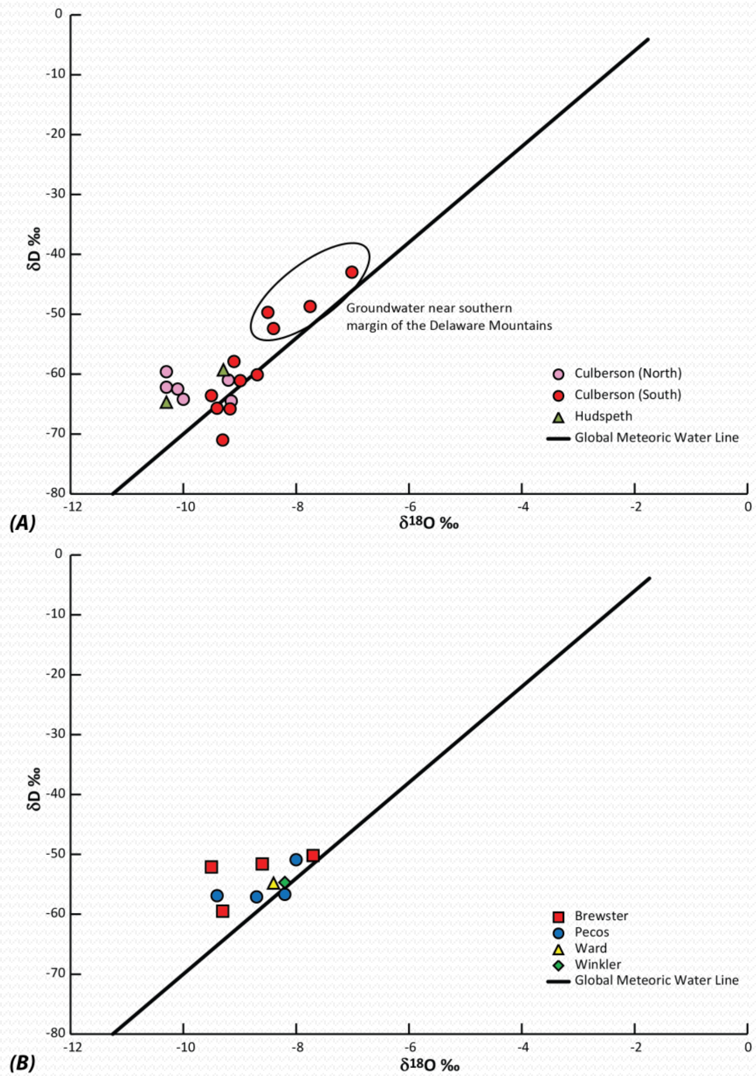


Groundwater Isotopes

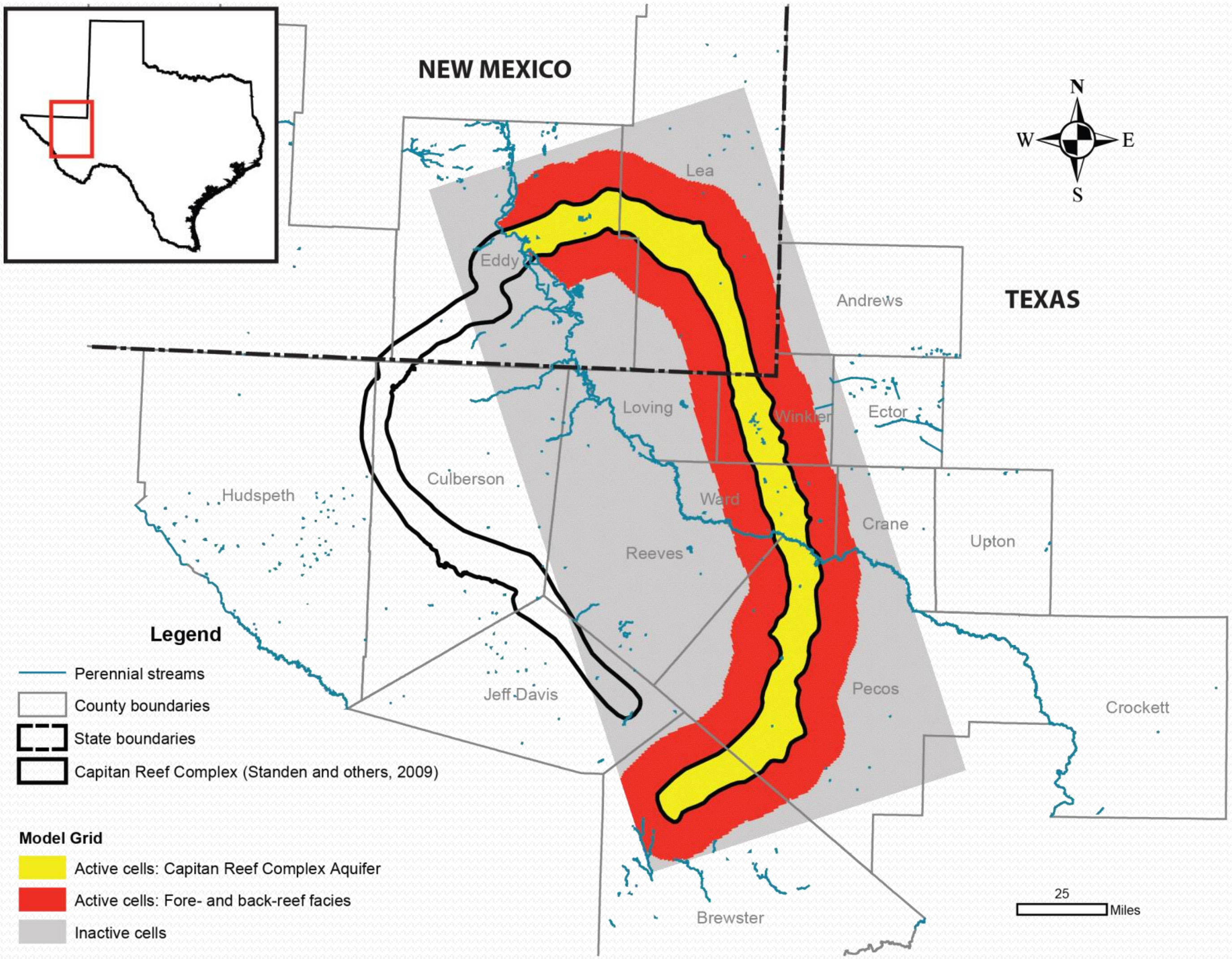


Modified from Hiss (1980) and Sharp (2001)

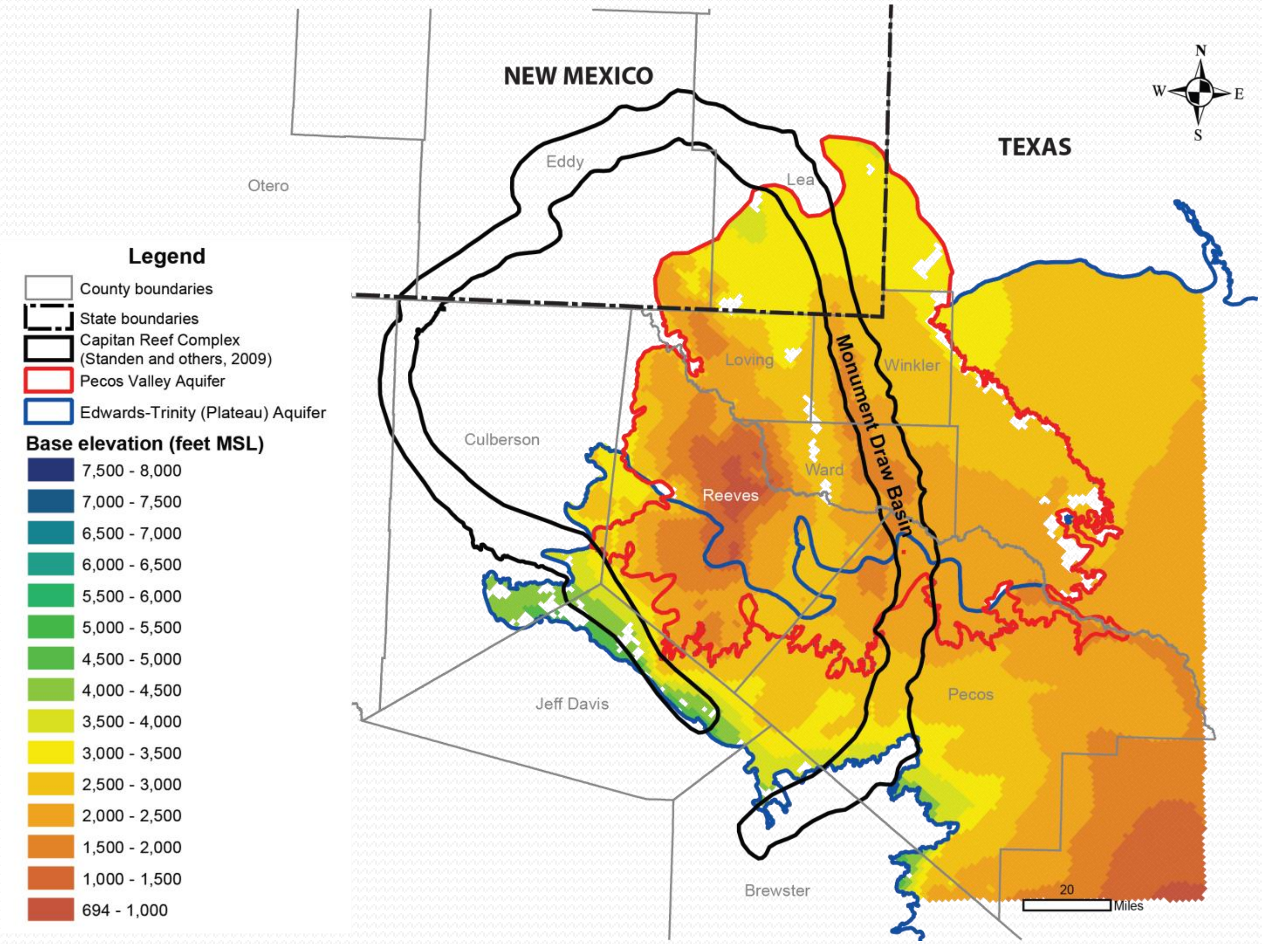
Groundwater Isotopes



Conceptual Model



Edwards-Trinity/Pecos Valley Aquifer Base Elevation



Based on data from Hutchison and others (2011)

MEETING MINUTES FOR THE SECOND CAPITAN REEF COMPLEX AQUIFER GROUNDWATER AVAILABILITY MODEL STAKEHOLDER ADVISORY FORUM

May 27, 2014

Pecos County Courthouse, Fort Stockton, Texas

The second Stakeholder Advisory Forum (SAF) for the Capitan Reef Complex Aquifer Groundwater Availability Model (GAM) was held on Tuesday, May 27, 2014 at 11:00 AM at the Pecos County Courthouse located at 103 West Callaghan Street in Fort Stockton. A list of meeting participants is provided at the end of this meeting note.

The purpose of the second SAF was to discuss the recently developed conceptual model which will be the basis for construction of the groundwater availability model. The meeting also provided a forum for discussing the revised project schedule and provided an opportunity for feedback from stakeholders.

SAF Presentation: Ian Jones, Ph.D., P.G., TWDB

Dr. Jones presented a prepared presentation structured according to the following outline:

1. Introduction
2. Overview of the Capitan Reef Complex Aquifer
3. Conceptual model
4. Revised project schedule

Questions and Answers:

Question: What do you think causes the fluctuations in the Capitan Reef Complex Aquifer water levels?

Answer: Possibly fluctuations in pumping -- industrial pumping was important in the 1970s.

Question: Does the Pecos River interact with the Capitan Reef Complex Aquifer in locations other than that near Carlsbad, New Mexico?

Answer: No, there [the Capitan] is thousands of feet below land surface. It has an effect, but not a direct effect, because there are lots of aquifers in between.

Question: Are these total number of [oil] wells?

Answer: Total number of wells per year.

Question: Wells that were drilled in the Capitan Reef Complex?

Answer: Wells that are actually penetrating the Capitan Reef Complex. These wells are specific to the footprint of the Capitan Reef Complex.

Question: But [they are] not producing from it?

Answer: Right, [the wells] just went through it.

Question: What do [the numeric labels on the hydraulic properties slide] mean?

Answer: In the report there's a table and these numbers help in matching up each point [on the map] with the data in the table.

Question: Why is not the western arm of the Capitan Reef Complex Aquifer included in this groundwater availability model?

Answer: Part of the western arm is already included in the Bone Spring–Victorio Peak Aquifer groundwater flow model, which we will be adopting as a groundwater availability model later this year.

Question: Is the Capitan Reef Complex Aquifer discharging into the other aquifers?

Answer: Yes, it's going all the way through overlying aquifers including the Rustler, Dockum, Pecos Valley, and Edwards-Trinity (Plateau) aquifers.

Question: Are you also considering cross-formational flow between the Capitan and the San Andres – shelf margin discharge.

Answer: We are including this as a buffer zone along the side of the Capitan Reef Complex Aquifer itself, and we assume there's no flow between the Capitan Reef Complex and anything underlying it.

Question: Will you continue with no-flow boundaries on the eastern side of the model?

Answer: We're not, at least for the beginning, assuming no flow between the Capitan Reef and the Delaware Mountain Group. Considering there is a huge difference in hydraulic conductive, there will be very limited flow between them.

Question: One thing I found while doing work on the Escalera Ranch, which is on the North side of Glass Mountains – the work that Hiss did, the hydrologic framework, did not include the Tessey Limestone, nor did the work by Allan Standen for Daniel B. Stephens & Associates. The Tessey Limestone is not part of the structure as presented here, so I think it would be appropriate to add in that formation, because it's a significant piece of the aquifer system south of [Ft. Stockton]. The vertical cross-formational flow bothers me, because you can't see any water quality in Winkler County that would imply vertical flow of that quality from the Capitan Reef Complex Aquifer. I can provide data on that.

Answer: In terms of isotopic groundwater composition, there is very little difference between the Capitan Reef Complex and overlying aquifers—the Rustler, Dockum and Pecos Valley aquifers.

Comment: I have, and will share with you, all the data on pumping that's been compiled by Hiss from the 1970s with the water-level data, which is the most robust thing to calibrate to.

Question: Water levels reconstructed starting water levels. Looks like you're looking at 1980, which are not really steady-state…

Answer: I haven't made a final decision yet. 1980s are the typical starting point for groundwater availability models, but we're not wedded to that.

Question: So, with the dataset available, will you be willing to go back in time a little bit?

Answer: Yes.

Question: There's not much discussion about recharge in [this presentation], but how do you plan on dealing with this? You have very limited hydraulic conductivity data, and no recharge analysis, just ranges of recharge of 1,000 to 16,000 acre-feet…

Answer: Typically we would calibrate to the recharge.

Comment: On the framework, there's a USGS report by Wilshire (Professional Paper 599H) that has the Tessey Limestone – I can provide that, too.

Question: There's mention of this being a karst aquifer, but no mention of this in the conceptual model. Seems kind of confusing.

Answer: There's a certain amount of karst effects on it.

Comment: Maybe [should give] consideration there, on how you'd treat the hydraulic conductivity there as opposed to the other areas.

Answer: Yes, in fact just the shape of the model, the aquifer itself, will restrict flow particular parallel to the reef trend.

Question: Are you going to post the presentation on the website?

Answer: Yes, with the comments, too.

Question: The slide of the hydrographs in the central Pecos County… Is it correct that water levels in the Rustler Aquifer are higher by 100 feet or so than the rest? So you would not expect the Capitan water to overcome that amount of head and move upward.

Answer: The general trend would seem to suggest, if anything, the Capitan Reef Complex Aquifer may receive water from the Rustler Aquifer at that location. Based on those three wells.

Question: Are you actively modeling all five layers, or are you using General-Head Boundaries to represent some of those layers?

Answer: The primary aim would be to model the Capitan Reef Complex Aquifer layer. The other layers will be based on data incorporated from existing groundwater availability models.

Question: The simulated layers will be General-Head Boundaries?

Answer: The question is, to what degree will I be recalibrating those layers? The emphasis will be on the Capitan Reef Complex Aquifer itself and its relationship to what's [adjacent] to it.

Question: Any idea on the thickness of Artesia Group between the Rustler and the Capitan? Somebody said there's a lot of communication between the Rustler and the Capitan Reef Complex aquifers, and then the USGS – there's communication between the Rustler and the Edwards-Trinity (Plateau) aquifers.

Answer: It varies, in some areas the Salado Formation may not be there at all.

Question: The water districts when they did their Desired Future Conditions, they include 11,000 acre-feet permitted water from the Capitan Reef Complex Aquifer, they did not have a lot of data. Will you be making recommendations for different sections of the aquifers when they redo the Desired Future Conditions in 2016, to either raise it or lower the Desired Future Conditions.

Answer: We calculate Modeled Available Groundwater based on Desired Future Conditions that are provided by the local planning group. In some instances a Desired Future Condition may not be possible, in terms of what the model shows.

Question: We did receive Total Estimated Recoverable Storage, and the numbers in Groundwater Management Area 7 are different than previously determined. They kind of increased.

Answer: Yes, the probably could be. A whole new process.

CAPITAN REEF COMPLEX AQUIFER GROUNDWATER AVAILABILITY MODEL STAKEHOLDER ADVISORY FORUM #2

May 27, 2014

Attendance

NAME	AFFILIATION
Steve Finch	John Shoemaker & Associates
Jeff Williams	Williams Ranch
Darrell Peckham	Water Quest, Inc.
Gil Van Deventer	Trident Environmental
Gerry Grisak	INTERA Inc.
Alyson McDonald	TAMU Extension
M.R. Gonzalez	Middle Pecos GCD
Gerald D. Lyda	La Escalera Ranch
Greg Stanton	USGS
Weldon Blackwelder	Middle Pecos GCD
Jerry McGuairt	Middle Pecos GCD
Harvey Gray	Middle Pecos GCD
Raymond Straub	Straub Corporation
Ty Edwards	Middle Pecos GCD
John Dorris	Middle Pecos GCD
Gladys Dorris	Middle Pecos GCD
James Craven	Pecos Pecan
Radu Boghici	Texas Water Development Board
Ian Jones	Texas Water Development Board