U.S. Geological Survey Studies in Texas
Recent Results and Selected Current Studies

Presented to

Canadian Advisory Committee Meeting

by

Mick Baldys

U.S. Geological Survey

March 17, 2015

Organization of the presentation

- Red River Basin Study
- Peak-Streamflow Frequency Curves
- Brazos Gain-Loss Study
- North Plains Groundwater District Study
- West Texas Geophysical Studies
- Zebra Mussel Study
- Emerging Contaminants Study

Red River Basin Study

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Project Background

- SECURE Water Act (2007)
  - National Science and Technology Council
    - Ongoing water census

water SMART

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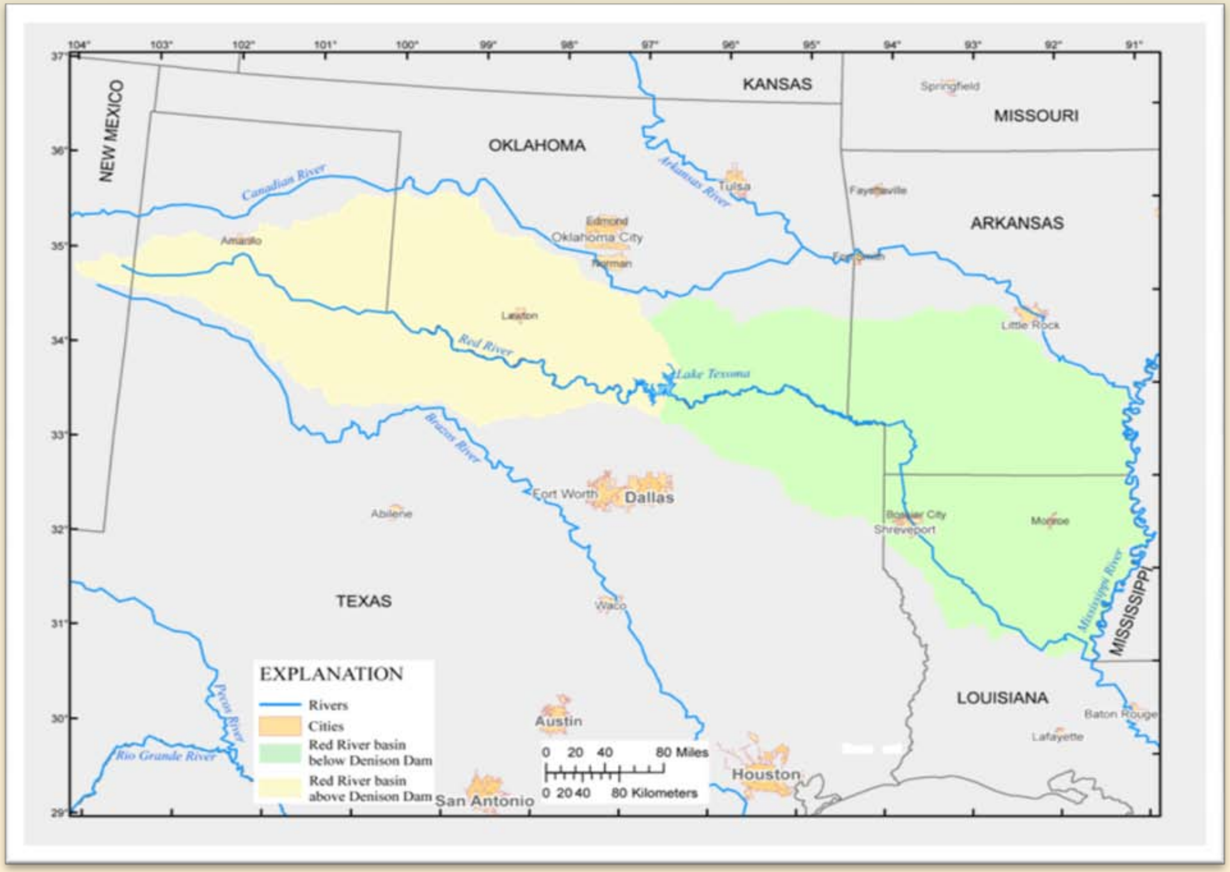
Study Area



Project Background

- USGS Water Science Centers Involved
  - Arkansas - 32
  - Louisiana - 50
  - Oklahoma - 25
  - Texas - 35

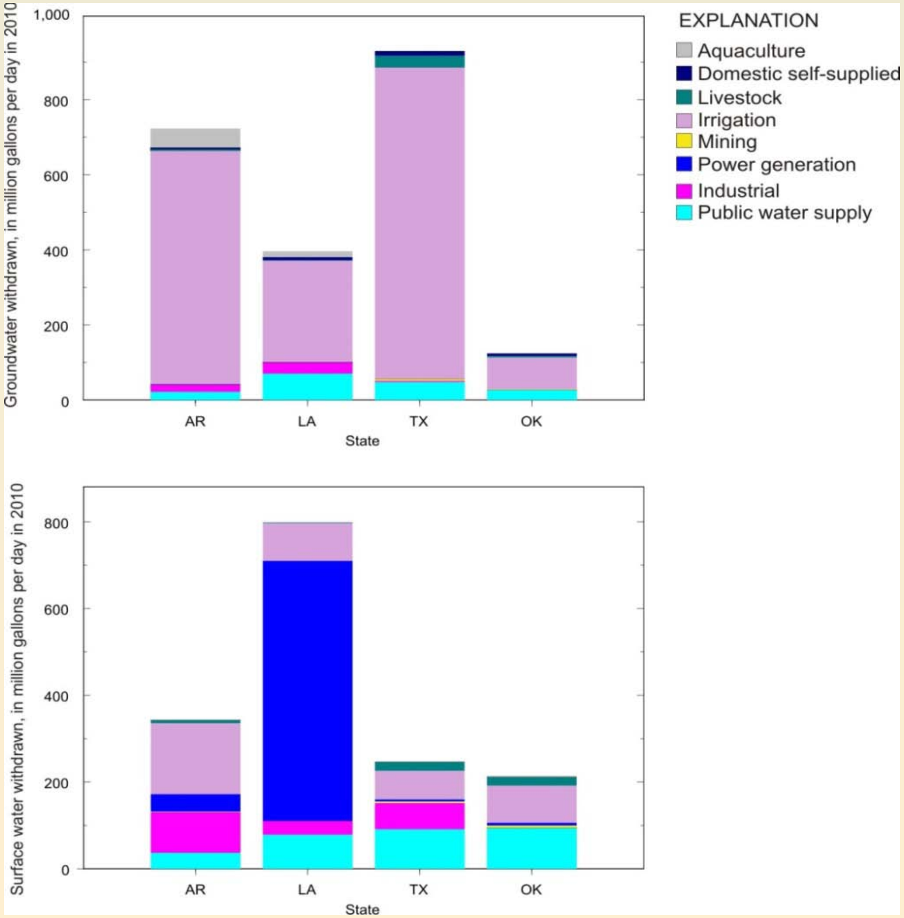
Study Goals

- One Strategy
- Focus on Water Availability
- Answer the Questions:
  - Is there adequate quantity of water, with sufficient quality and timing-characteristics, to meet both human and ecological needs?
  - Will this water be present to meet both existing and future needs?

Planned Activities

1 - Refine 2010 USGS Water-use Estimates

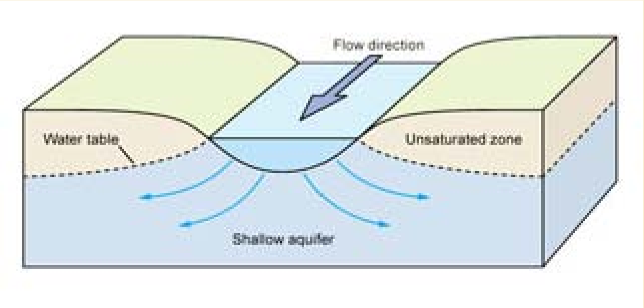
- Downscale
- Irrigation
- Interbasin
- Consumptive use



Planned Activities

2 - Groundwater/Surface Water Interaction

- Develop a model (MODFLOW)
  – Upstream of Denison Dam
  – Additional withdrawals
  – Climate



Planned Activities

3 - Estimate Daily Streamflows

- Precipitation Runoff Modeling System (PRMS)
  - Predict flows in ungaged area
  - Future projections
  - Couple with GW model

In cooperation with the Texas Department of Transportation

Summary of Data for the Texas Department of Transportation and U.S. Geological Survey Data-Collection Program—Report for Water Year 2014

Letter of Communication dated February 24, 2015

U.S. Department of the Interior
U.S. Geological Survey

Objective of the study

- Develop peak-streamflow frequency curves in central and western Texas
- Estimate storm hydrographs

Approach

- 51 crest-stage gages
- 10 flood hydrograph stations
- 3 real-time continuous streamflow stations
- Determine annual peak instantaneous streamflow at small to midsize basins

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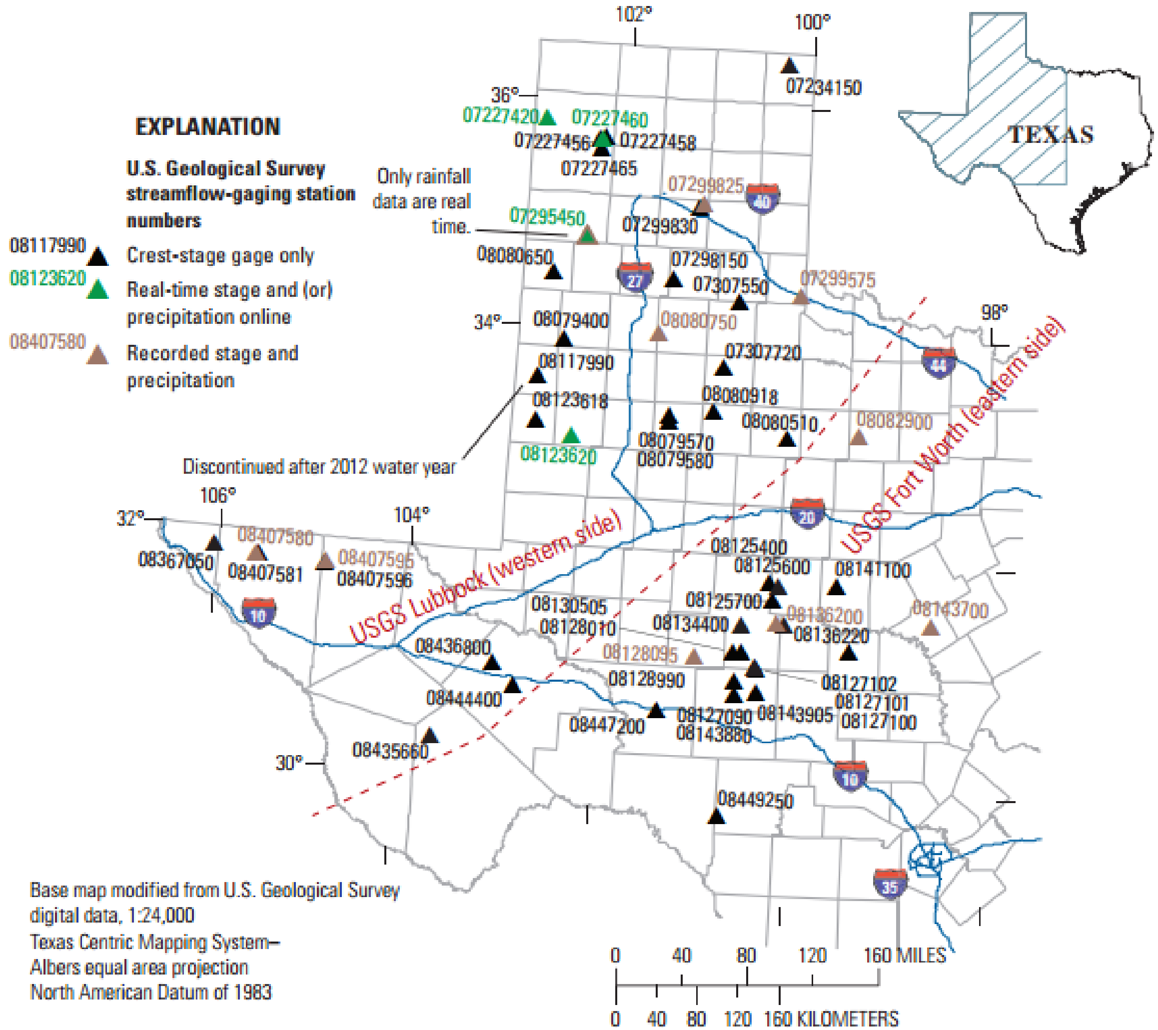

Figure 1. U.S. Geological Survey streamflow-gaging stations used to estimate annual- and quarterly-series peak streamflows and collect real-time stage and precipitation data in small- to medium-sized rural watersheds in central and western Texas as in operation circa February 2014 [modified from Harwell and Asquith (2011)].

Figure 10. U.S. Geological Survey streamflow-gaging station 07227420 Cramer Creek at US Highway 54 near Dalhart, Tex.

Figure 11. U.S. Geological Survey streamflow-gaging station 07227456 Middle Cheyenne Creek at State Highway 354 near Channing, Tex.

Figure 12. U.S. Geological Survey streamflow-gaging station 07227458 East Cheyenne Creek at State Highway 354 near Channing, Tex.

Figure 13. U.S. Geological Survey streamflow-gaging station 07227460 East Fork Cheyenne Creek tributary near Channing, Tex.

Figure 14. U.S. Geological Survey streamflow-gaging station 07227465 East Cheyenne Creek tributary at US Highway 385 near Boys Ranch, Tex.

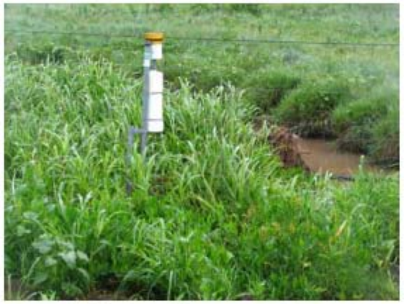

Figure 15. U.S. Geological Survey streamflow-gaging station 07234150 White Woman Creek tributary near Darrouzett, Tex.

Prepared in cooperation with the Texas Water Development Board

Base Flow (1966–2009) and Streamflow Gain and Loss (2010) of the Brazos River from the New Mexico–Texas State Line to Waco, Texas

Scientific Investigations Report 2011–5224

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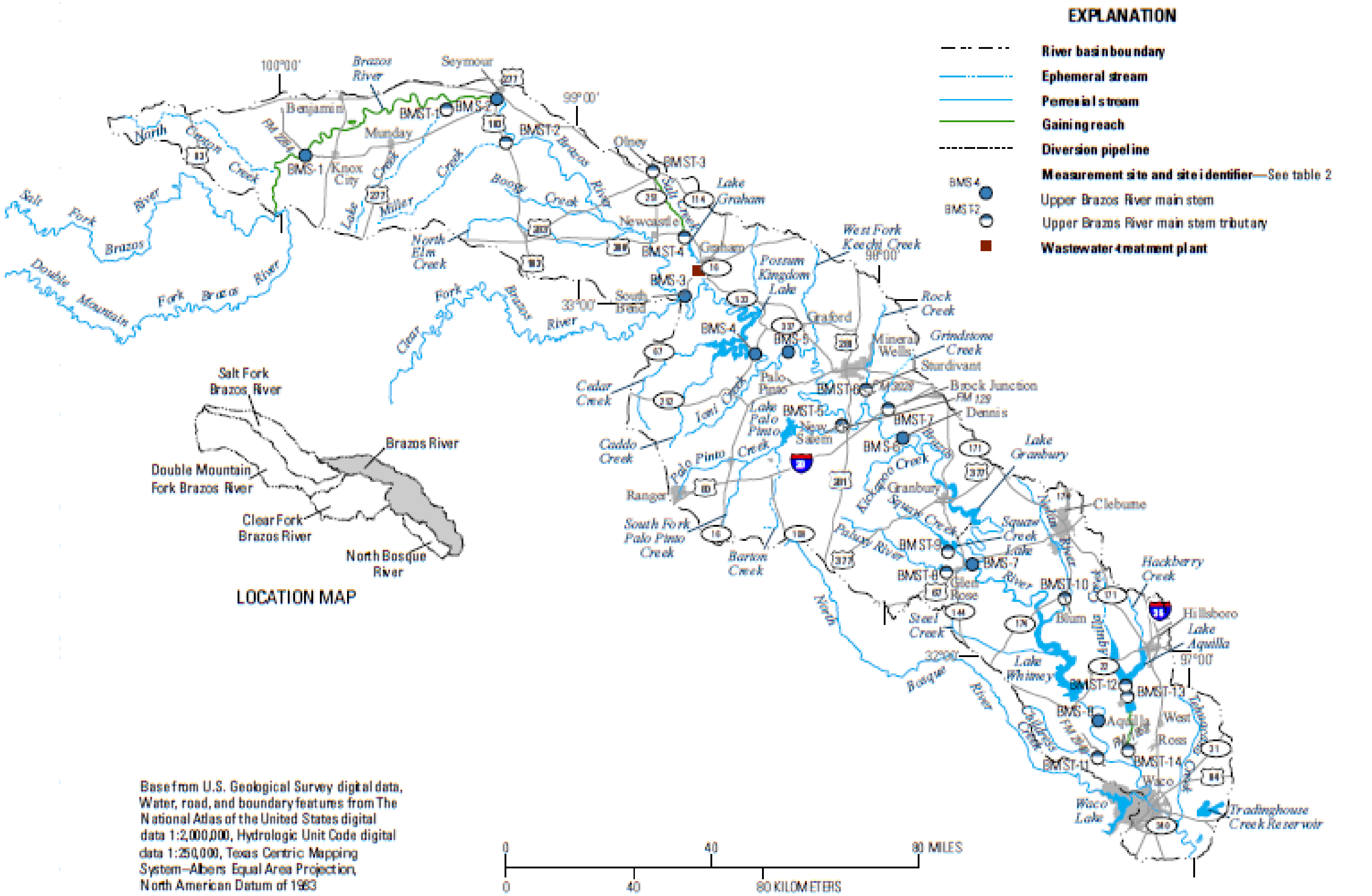

Figure 8. Sites where streamflow and specific conductance were measured in June and October 2010, main stem of the Brazos River and tributaries to the main stem, Texas.

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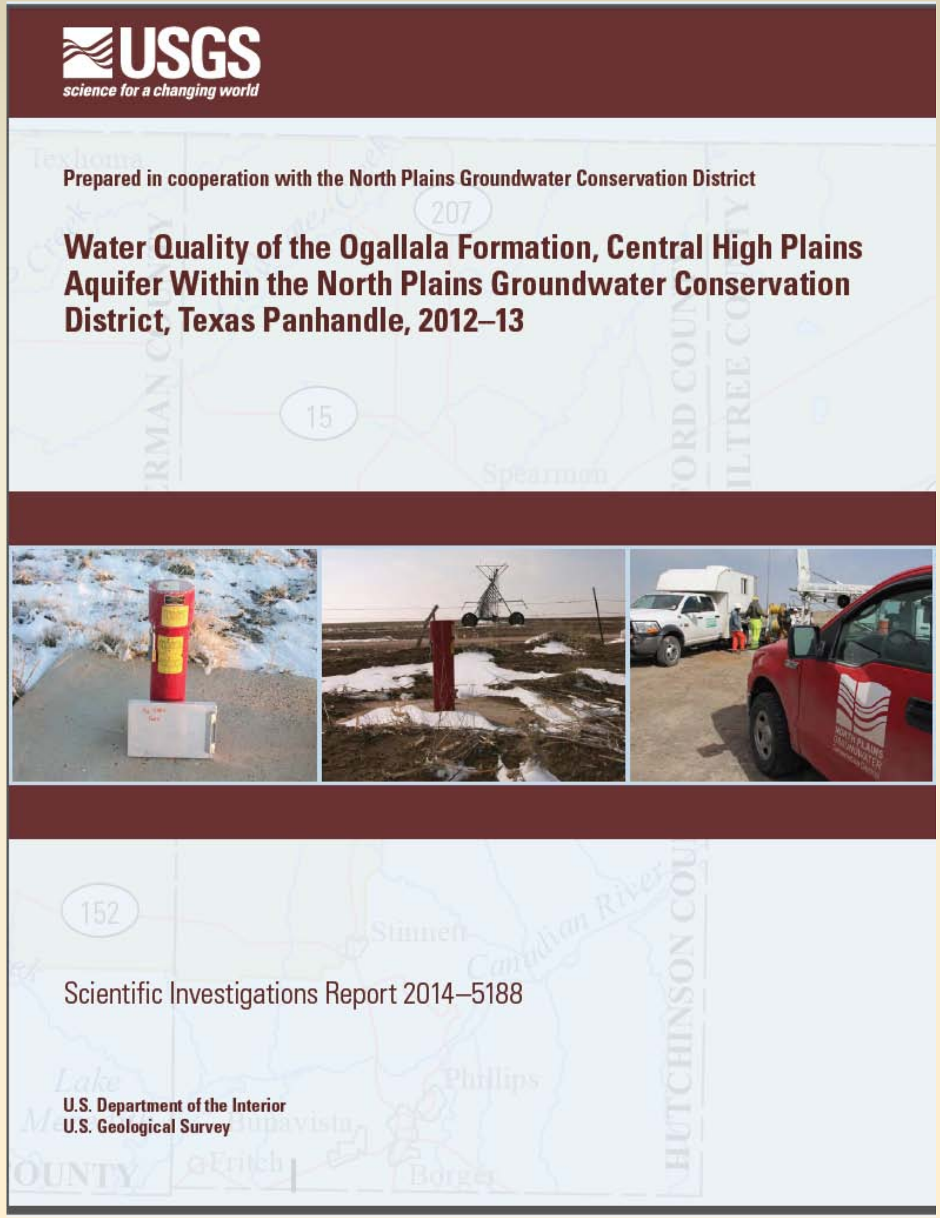
Prepared in cooperation with the North Plains Groundwater Conservation District

Water Quality of the Ogallala Formation, Central High Plains Aquifer Within the North Plains Groundwater Conservation District, Texas Panhandle, 2012–13

Scientific Investigations Report 2014–5188

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Study area

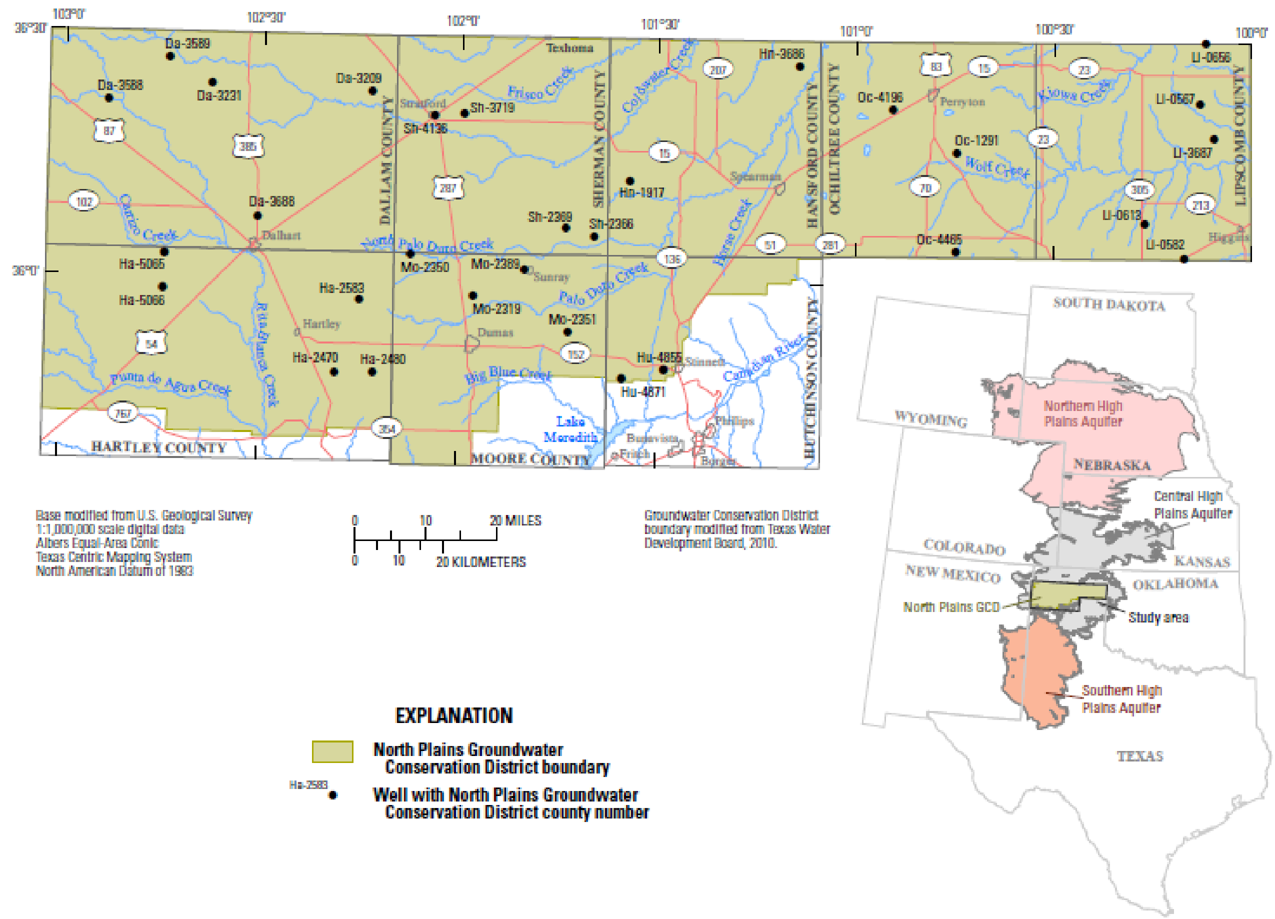
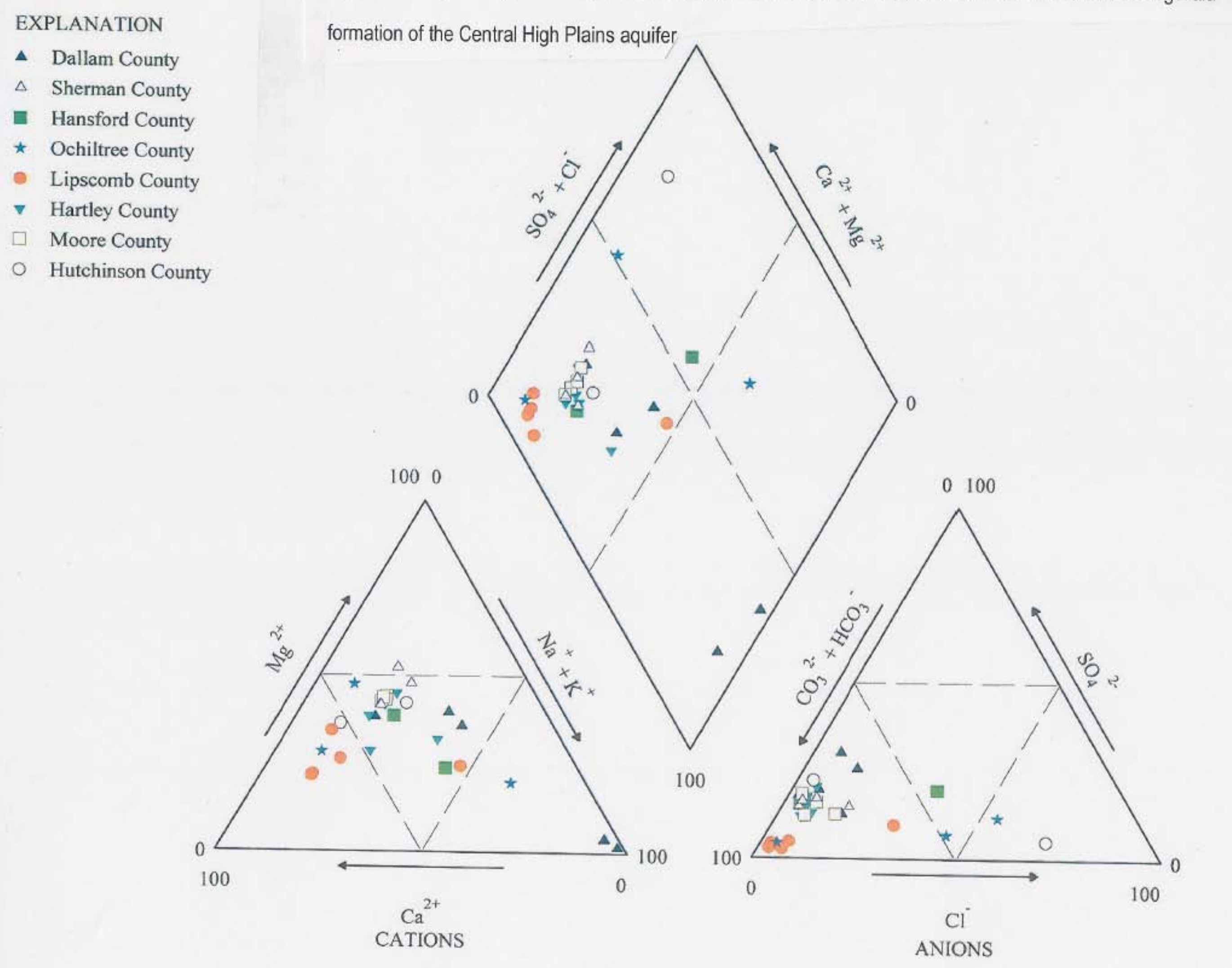


Figure 1.

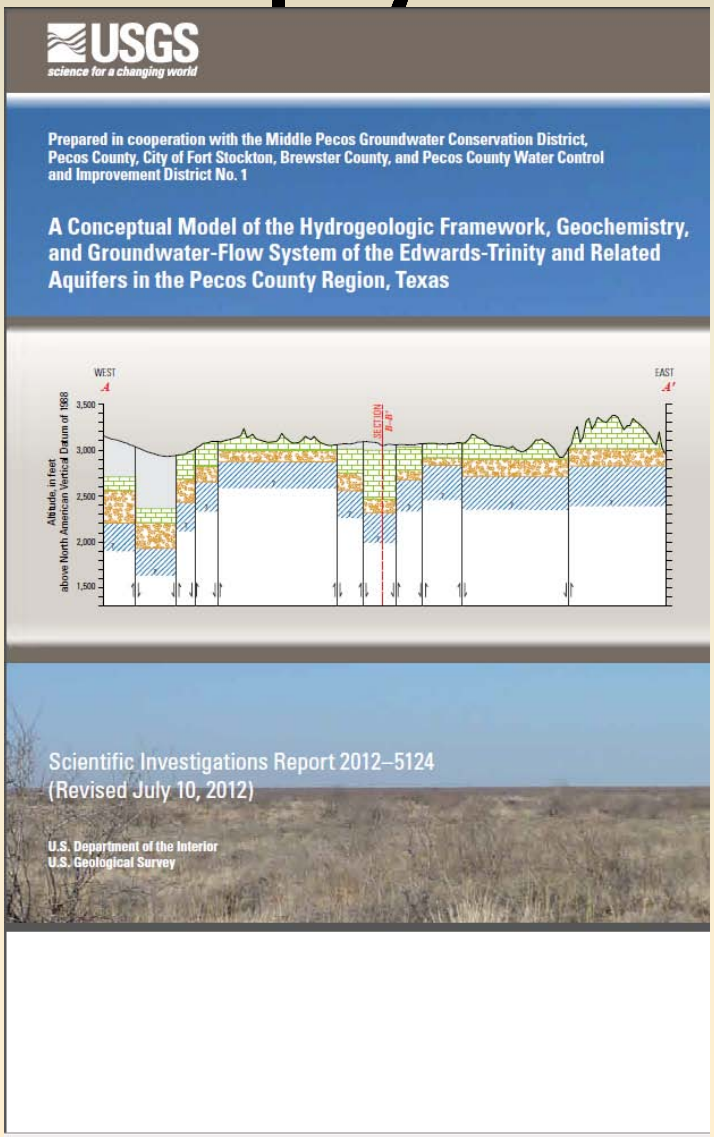
Purpose and Scope of Study

- Document water levels at 30 wells
- Document water-quality characteristics (30 wells)
  - Water properties
  - Major inorganic ions
  - Nutrients
  - Trace metals
  - Pesticides (6 wells)

Figure 5. Piper diagram of major ions for samples collected in 2012-13 from 30 monitor wells in the Ogallala formation of the Central High Plains aquifer



Geophysical Studies in West Texas



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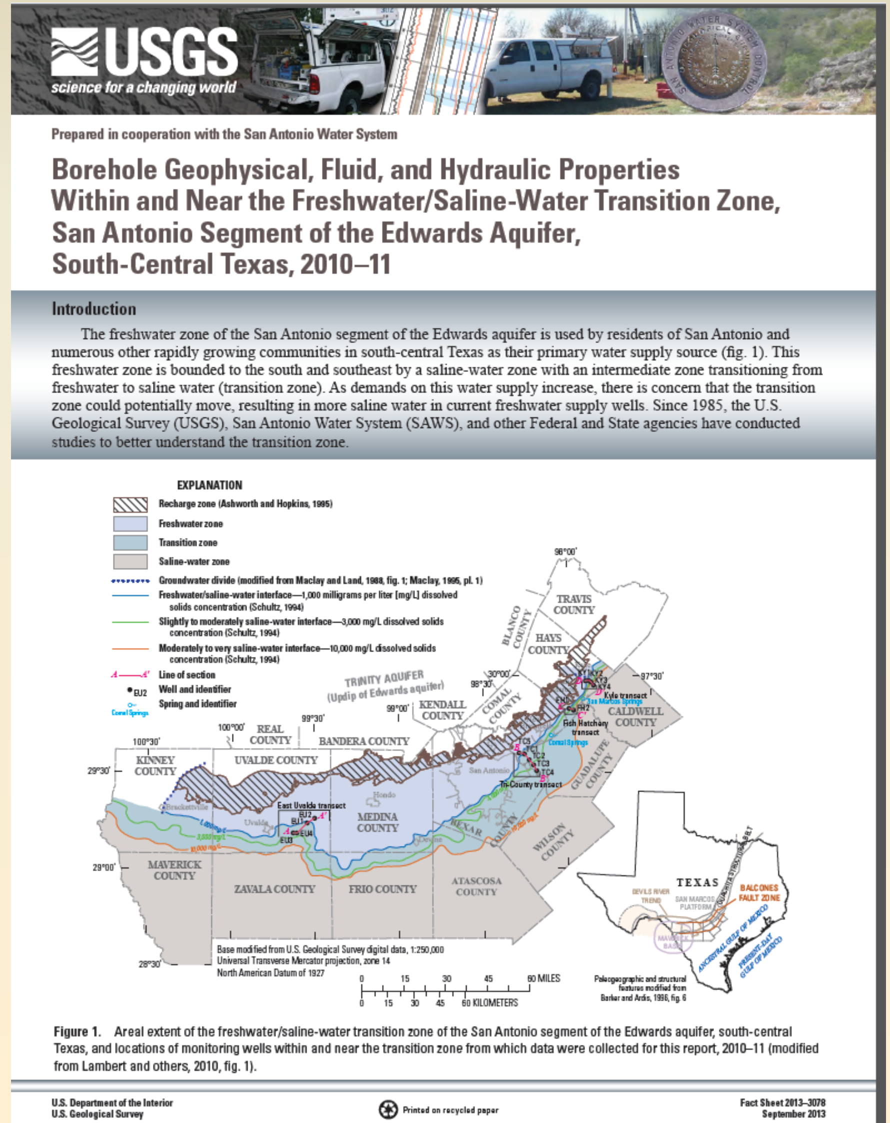
Prepared in cooperation with the Middle Pecos Groundwater Conservation District, Pecos County, City of Fort Stockton, Brewster County, and Pecos County Water Control and Improvement District No. 1

A Conceptual Model of the Hydrogeologic Framework, Geochemistry, and Groundwater-Flow System of the Edwards-Trinity and Related Aquifers in the Pecos County Region, Texas

Scientific Investigations Report 2012–5124
(Revised July 10, 2012)

U.S. Department of the Interior
U.S. Geological Survey



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Prepared in cooperation with the San Antonio Water System

Borehole Geophysical, Fluid, and Hydraulic Properties Within and Near the Freshwater/Saline-Water Transition Zone, San Antonio Segment of the Edwards Aquifer, South-Central Texas, 2010–11

Introduction

The freshwater zone of the San Antonio segment of the Edwards aquifer is used by residents of San Antonio and numerous other rapidly growing communities in south-central Texas as their primary water supply source (fig. 1). This freshwater zone is bounded to the south and southeast by a saline-water zone with an intermediate zone transitioning from freshwater to saline water (transition zone). As demands on this water supply increase, there is concern that the transition zone could potentially move, resulting in more saline water in current freshwater supply wells. Since 1985, the U.S. Geological Survey (USGS), San Antonio Water System (SAWS), and other Federal and State agencies have conducted studies to better understand the transition zone.

Figure 1. Areal extent of the freshwater/saline-water transition zone of the San Antonio segment of the Edwards aquifer, south-central Texas, and locations of monitoring wells within and near the transition zone from which data were collected for this report, 2010–11 (modified from Lambert and others, 2010, fig. 1).

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Fact Sheet 2013–3078
September 2013

Study Objective

- Understand the hydrogeological setting and processes that control the distribution, quality, and availability of water in the Edwards-Trinity aquifer in Pecos County

Approach

- Phase 1-collect groundwater, surface water, geochemical, geophysical and geologic data
- Phase 2-develop a conceptual model
- Phase 3-develop a numerical model

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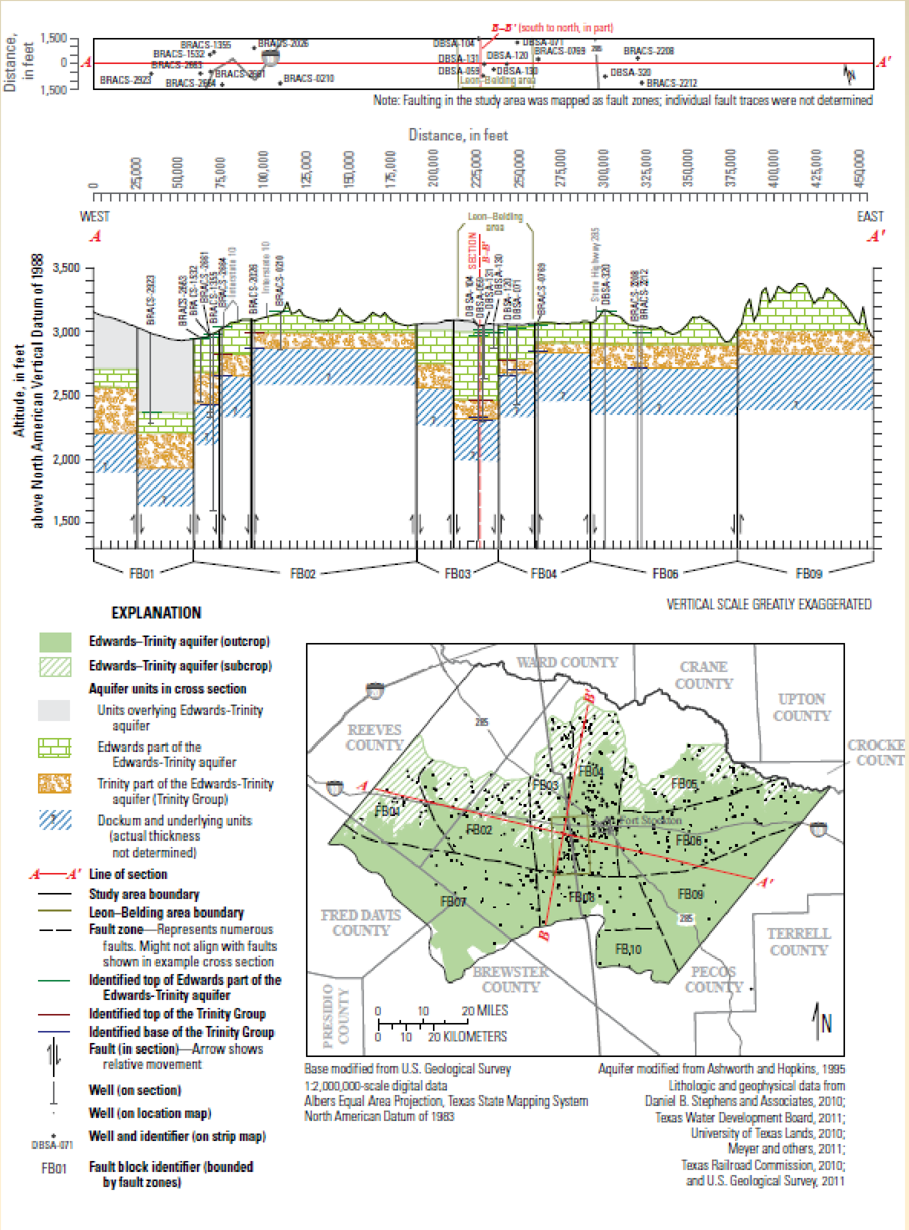
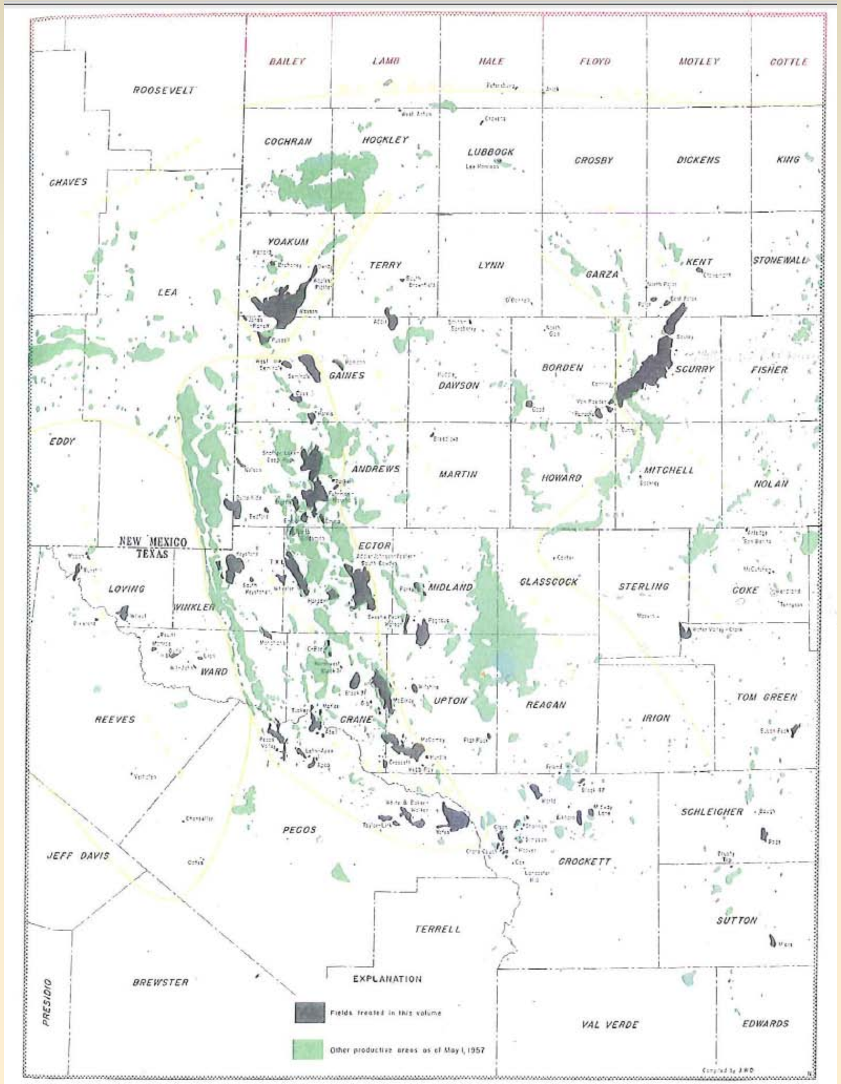




Ongoing work in 2015-17:

Yoakum, Terry, and Gaines Counties

for

Sandy Land UWCD

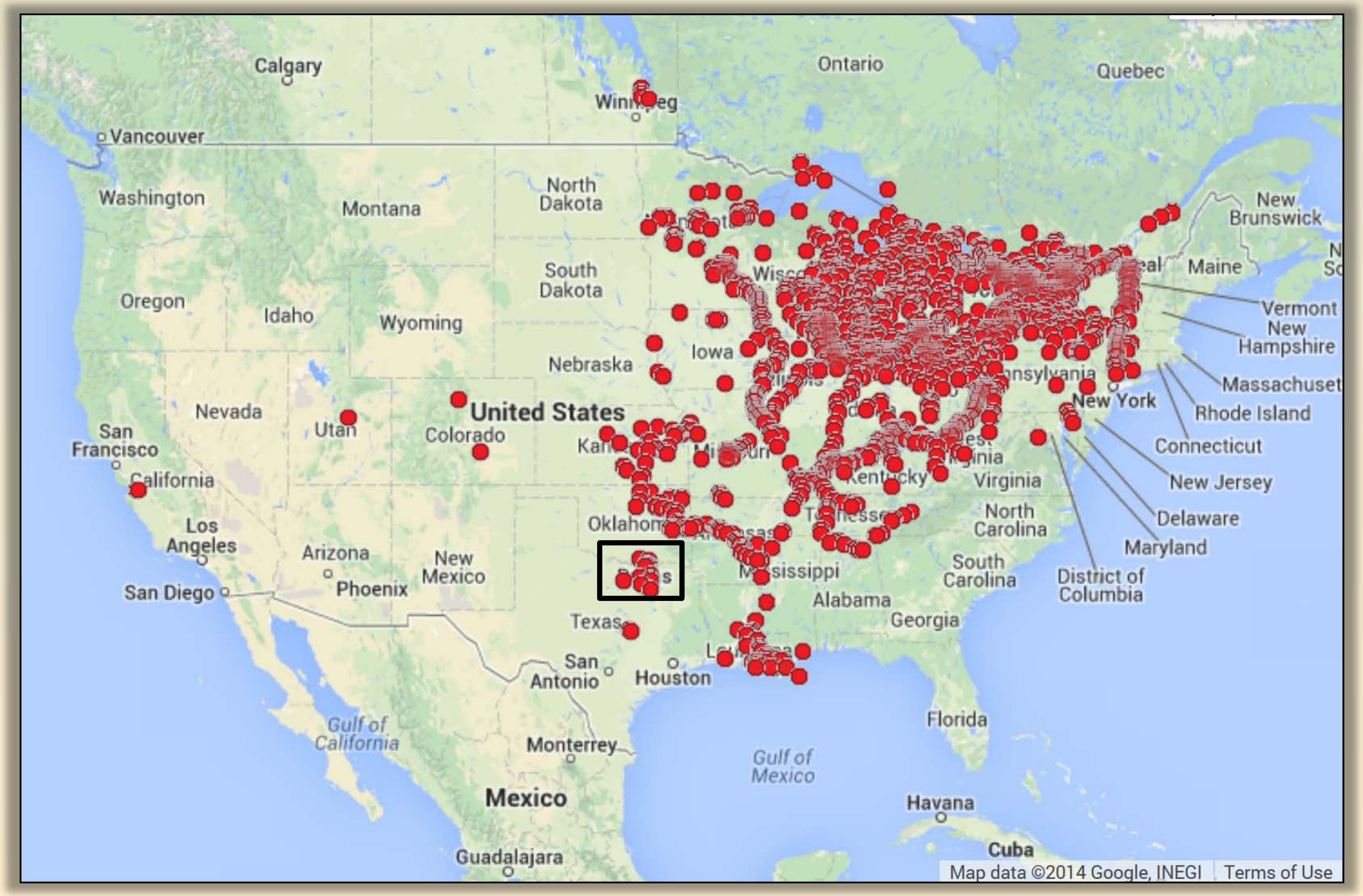
South Plains UWCD

Llano Estacado UWCD

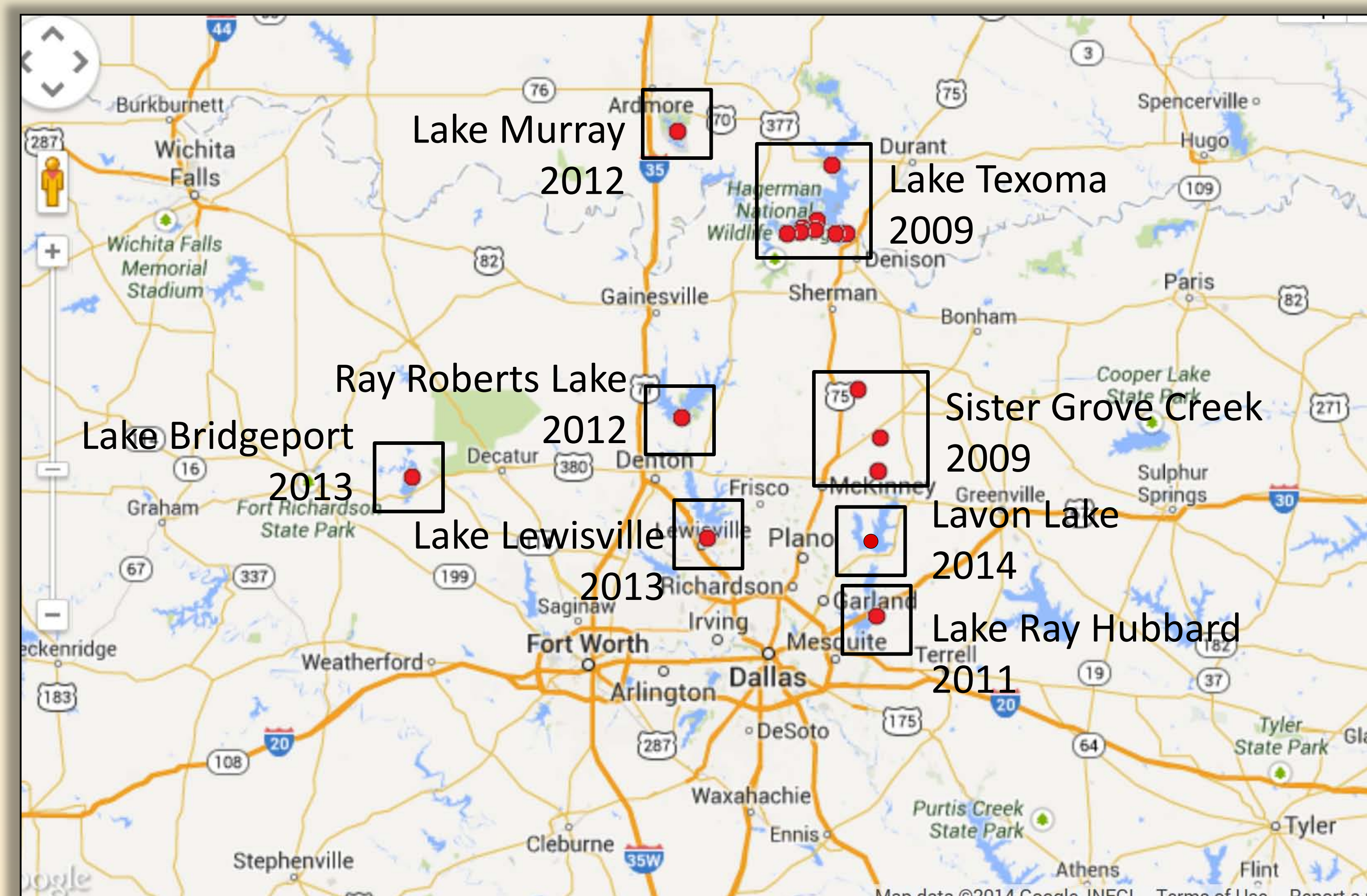
Zebra Mussel Study

Photo: Christopher Churchill, USGS

Zebra Mussel Distribution 2014



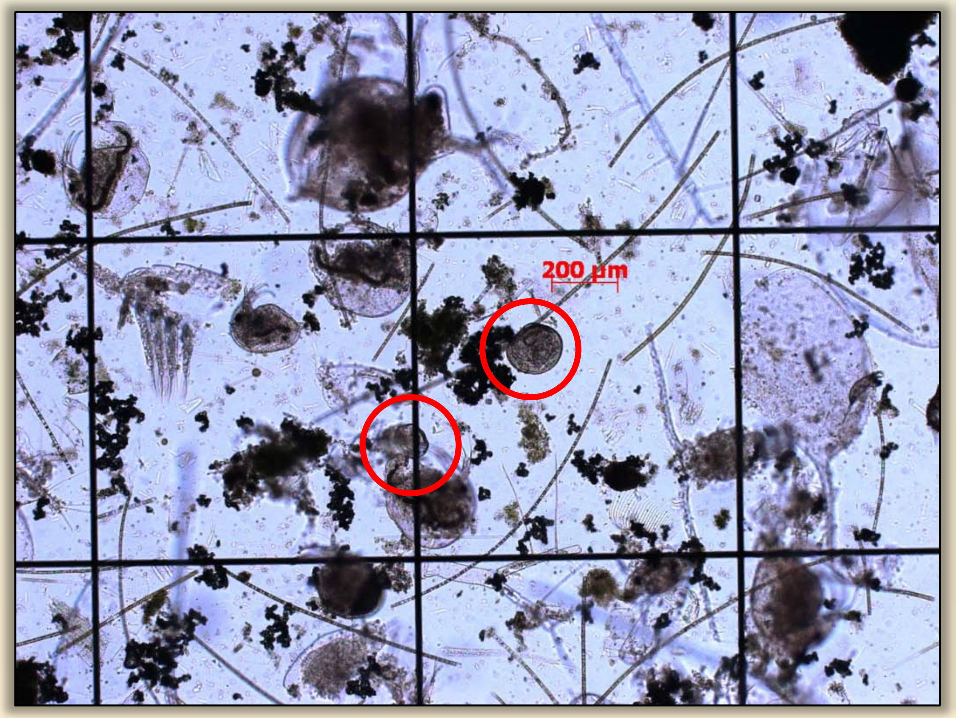
Zebra Mussel Distribution 2014

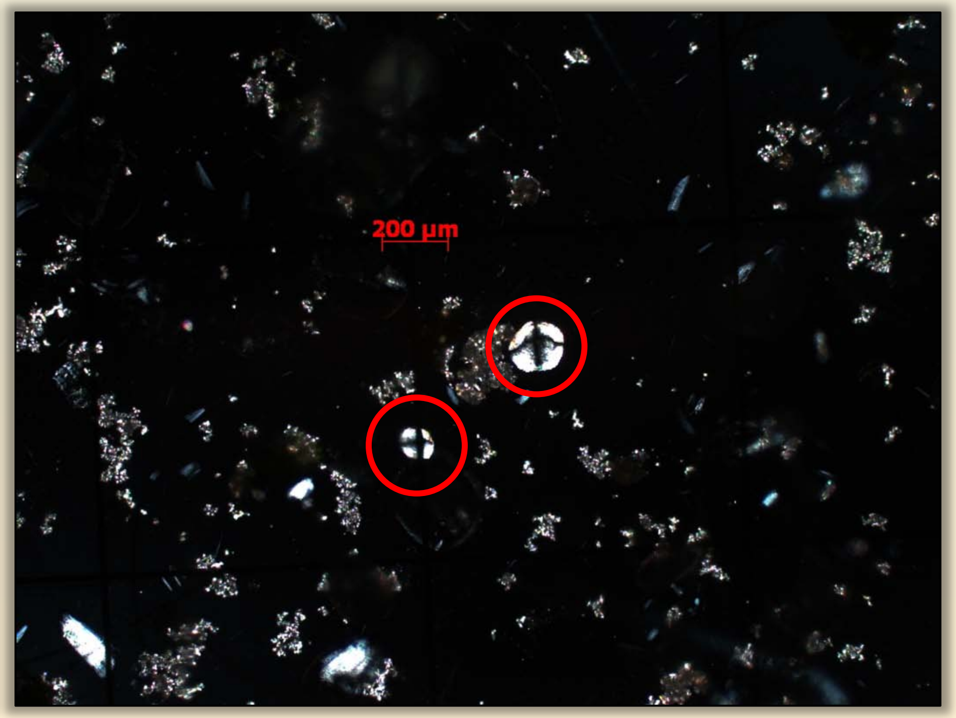


Zebra Mussel Monitoring Program

- Multiple lines of evidence to determine likelihood of established populations
- Target areas of likely introduction and water processing infrastructure
- Target periods of reproductive activity and settlement

Cross-polarized Light Microscopy



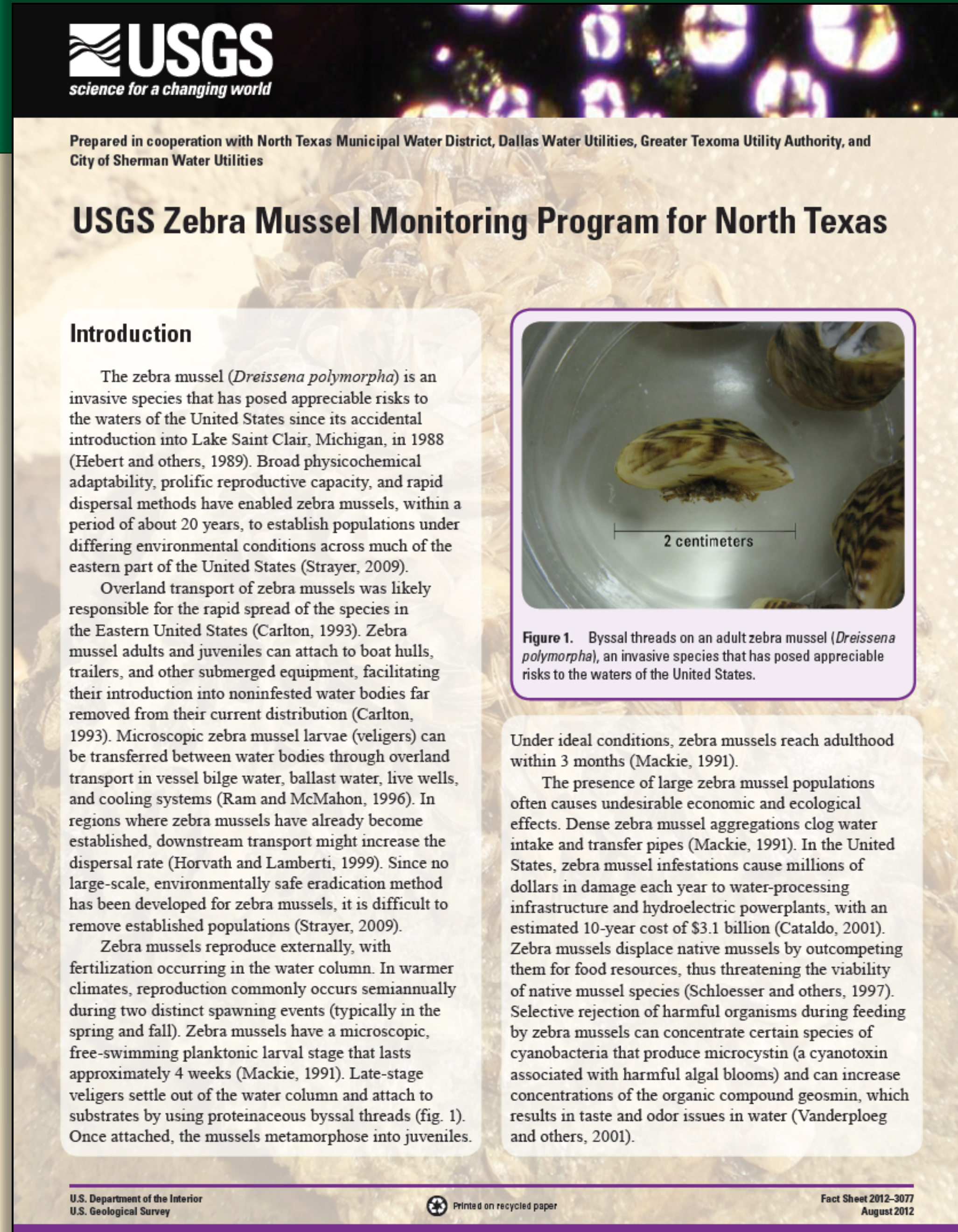


Plain light

Cross-polarized light

Photos: Christopher Churchill, USGS

Zebra Mussel Monitoring - Equipment and Methodology



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Prepared in cooperation with North Texas Municipal Water District, Dallas Water Utilities, Greater Texoma Utility Authority, and City of Sherman Water Utilities

USGS Zebra Mussel Monitoring Program for North Texas

Introduction

The zebra mussel (*Dreissena polymorpha*) is an invasive species that has posed appreciable risks to the waters of the United States since its accidental introduction into Lake Saint Clair, Michigan, in 1988 (Hebert and others, 1989). Broad physicochemical adaptability, prolific reproductive capacity, and rapid dispersal methods have enabled zebra mussels, within a period of about 20 years, to establish populations under differing environmental conditions across much of the eastern part of the United States (Strayer, 2009).

Overland transport of zebra mussels was likely responsible for the rapid spread of the species in the Eastern United States (Carlton, 1993). Zebra mussel adults and juveniles can attach to boat hulls, trailers, and other submerged equipment, facilitating their introduction into noninfested water bodies far removed from their current distribution (Carlton, 1993). Microscopic zebra mussel larvae (veligers) can be transferred between water bodies through overland transport in vessel bilge water, ballast water, live wells, and cooling systems (Ram and McMahon, 1996). In regions where zebra mussels have already become established, downstream transport might increase the dispersal rate (Horvath and Lamberti, 1999). Since no large-scale, environmentally safe eradication method has been developed for zebra mussels, it is difficult to remove established populations (Strayer, 2009).

Zebra mussels reproduce externally, with fertilization occurring in the water column. In warmer climates, reproduction commonly occurs semiannually during two distinct spawning events (typically in the spring and fall). Zebra mussels have a microscopic, free-swimming planktonic larval stage that lasts approximately 4 weeks (Mackie, 1991). Late-stage veligers settle out of the water column and attach to substrates by using proteinaceous byssal threads (fig. 1). Once attached, the mussels metamorphose into juveniles.

2 centimeters

Figure 1. Byssal threads on an adult zebra mussel (*Dreissena polymorpha*), an invasive species that has posed appreciable risks to the waters of the United States.

Under ideal conditions, zebra mussels reach adulthood within 3 months (Mackie, 1991).

The presence of large zebra mussel populations often causes undesirable economic and ecological effects. Dense zebra mussel aggregations clog water intake and transfer pipes (Mackie, 1991). In the United States, zebra mussel infestations cause millions of dollars in damage each year to water-processing infrastructure and hydroelectric powerplants, with an estimated 10-year cost of $3.1 billion (Cataldo, 2001). Zebra mussels displace native mussels by outcompeting them for food resources, thus threatening the viability of native mussel species (Schloesser and others, 1997). Selective rejection of harmful organisms during feeding by zebra mussels can concentrate certain species of cyanobacteria that produce microcystin (a cyanotoxin associated with harmful algal blooms) and can increase concentrations of the organic compound geosmin, which results in taste and odor issues in water (Vanderploeg and others, 2001).

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Fact Sheet 2012–3077
August 2012

USGS Fact Sheet 2012-3077 – Churchill and Baldys 2012

In Cooperation with the City Of Dallas Water Utilities

Compounds of Emerging Concern in Potable and Wastewater Treatment Plants in Dallas and downstream in the Trinity River, Texas, 2009-13

By Stanley Baldys III, Christopher J. Churchill, Cathina L. Gunn, Craig A. Mobley, and Daniel P. Quigley

Report Series ####-####

Objectives of the Study

- Summarize detections, concentrations, and distributions of compounds of emerging concern in:
  - Potable Water Treatment Plants
  - Wastewater Treatment Plants
  - Receiving water of the Trinity River

Compounds analyzed for:

- Human-health pharmaceuticals **(14)**
- Steroidal hormones **(19)**
- Organic compounds in wastewater **(57)**
- Antibiotics **(31)**
- Bottom sediments (Trinity River sites) **(57)**

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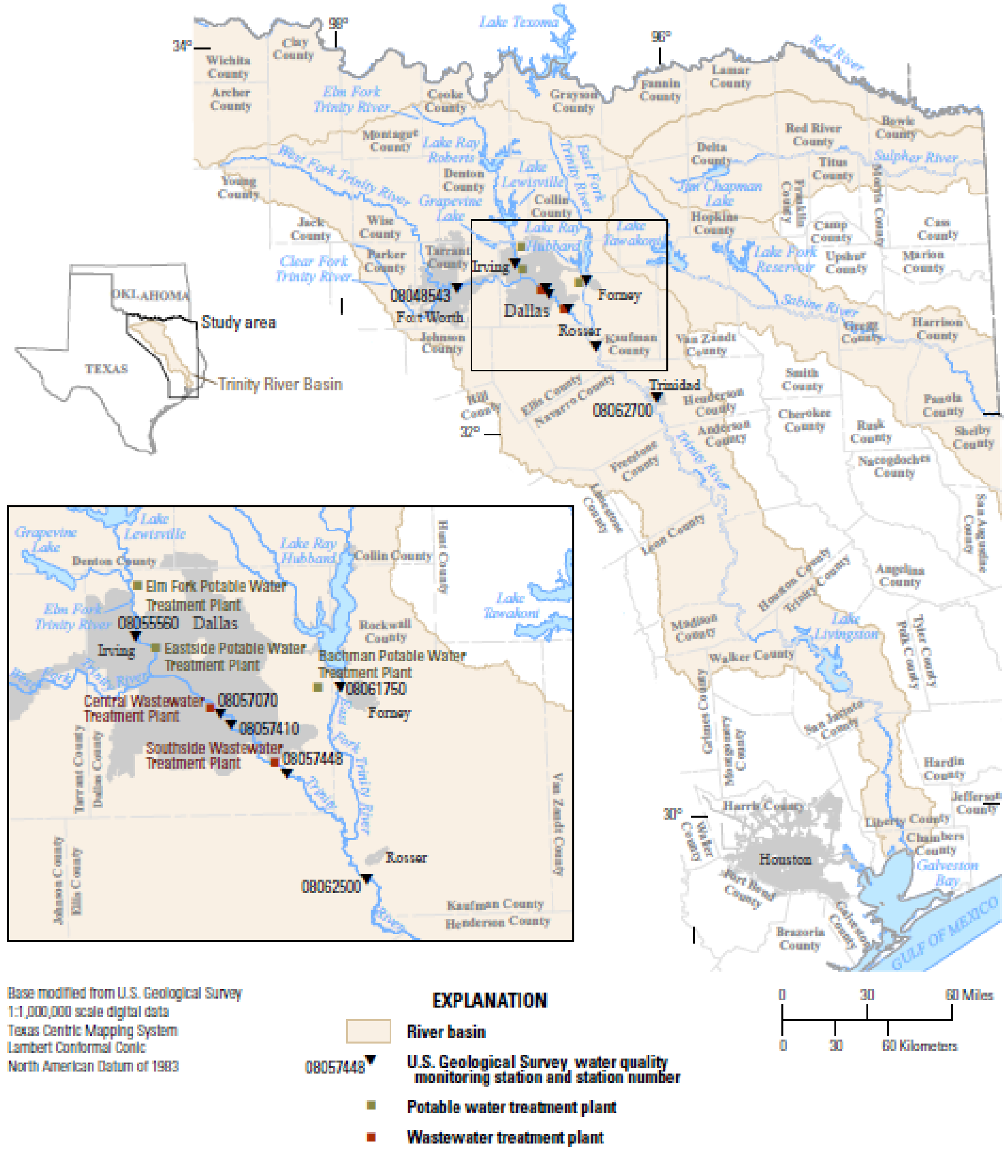

Summary

- Red River Basin Study
- Peak-Streamflow Frequency Curves
- Brazos Gain-Loss Study
- North Plains Groundwater District Study
- West Texas Geophysical Studies
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- Emerging Contaminants Study

Question and answer time

- Who is the oldest player on the current 40 man Texas Ranger Roster ?
  - Josh Hamilton
  - Nolan Ryan
  - Elvis Andrus
  - Colby Lewis
  - Adrian Beltre