# Western Travis County Hydrogeology Studies

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**Travis County:** Vicky Kennedy

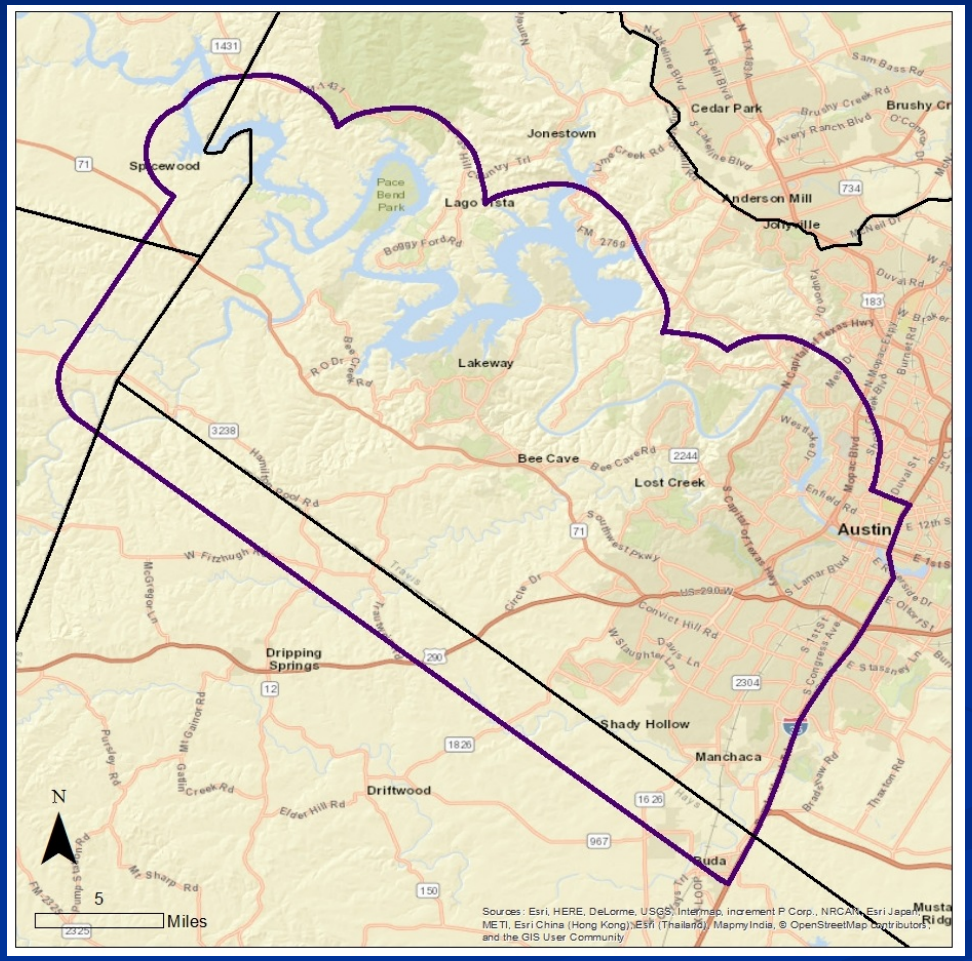
Barton Springs Edwards Aquifer CONSERVATION DISTRICT
30 years 1987-2017

*Southwest Travis County GCD*
*August 8, 2018*

# Scope of Study

- Characterize the groundwater resources in western Travis County.
  - Collect hydrogeologic data and well information
  - Sampling and mapping activities
- Provide educational and technical information for the public.
  - Digital databases of information
  - Publications and presentations

# Study Area

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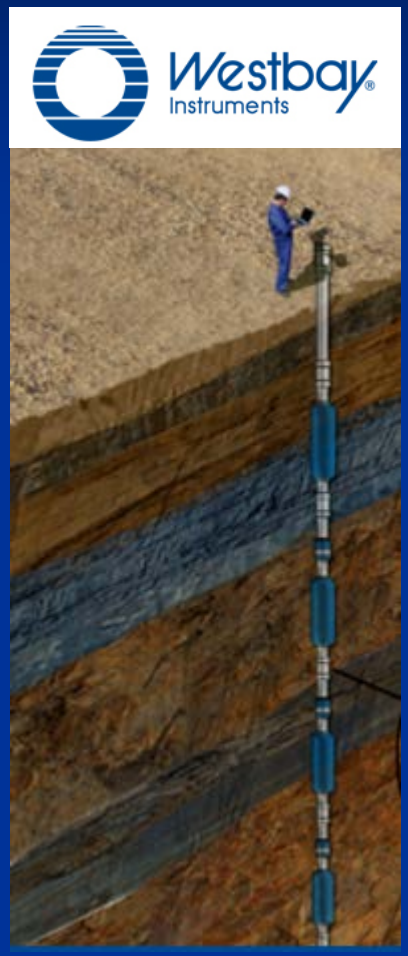
# Continuation of Collaborative studies with Travis County

- Multiport well
- Monitor wells
- Water sampling
- Geophysical logging
- Flow measurements

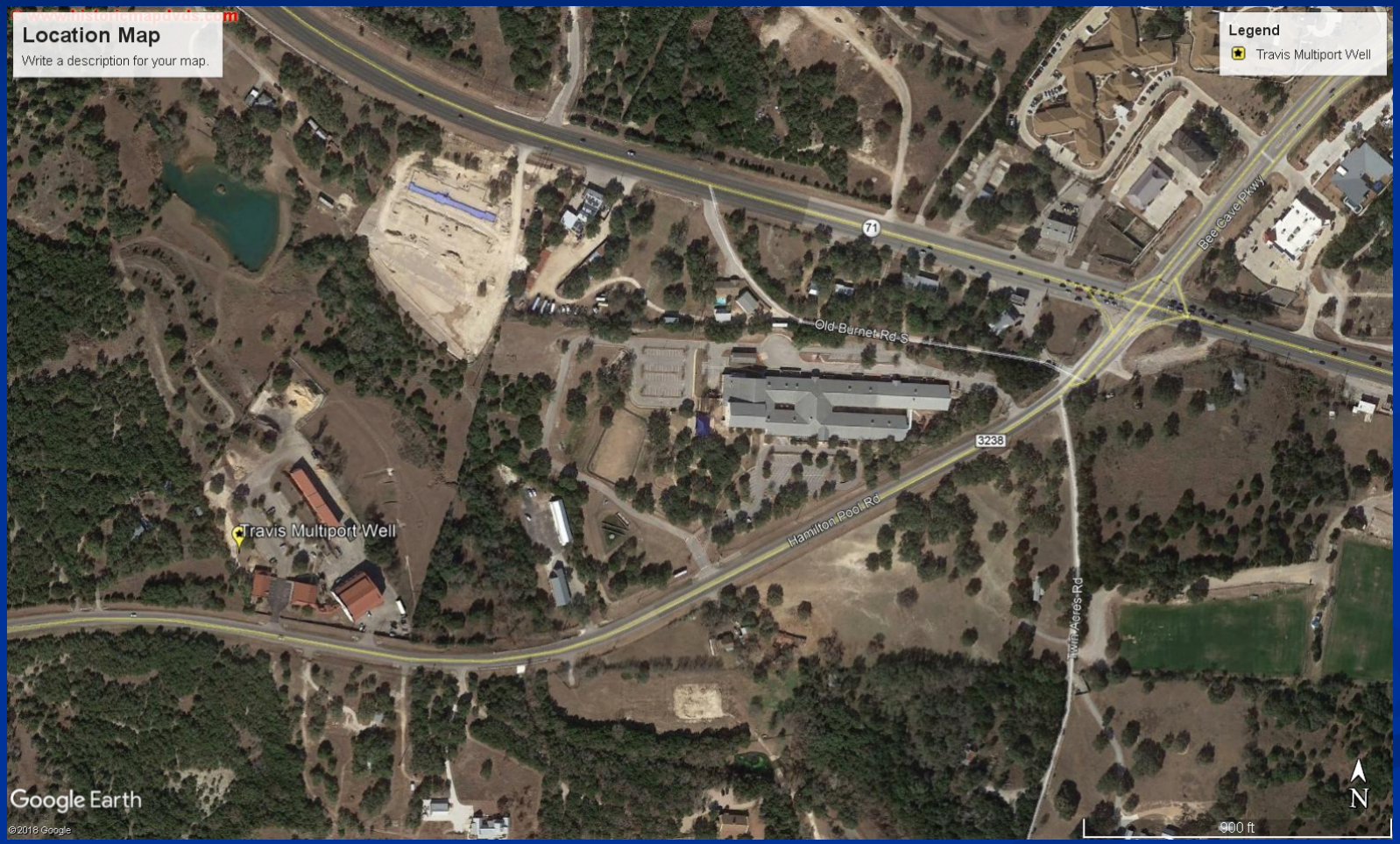
Travis County Multiport Monitor Well (2017)

# Multiport Monitor Well




Long-term data collection:

- Fluid pressure (water levels)
- Hydraulic conductivity (slug testing)
- Sampling (geochemistry)

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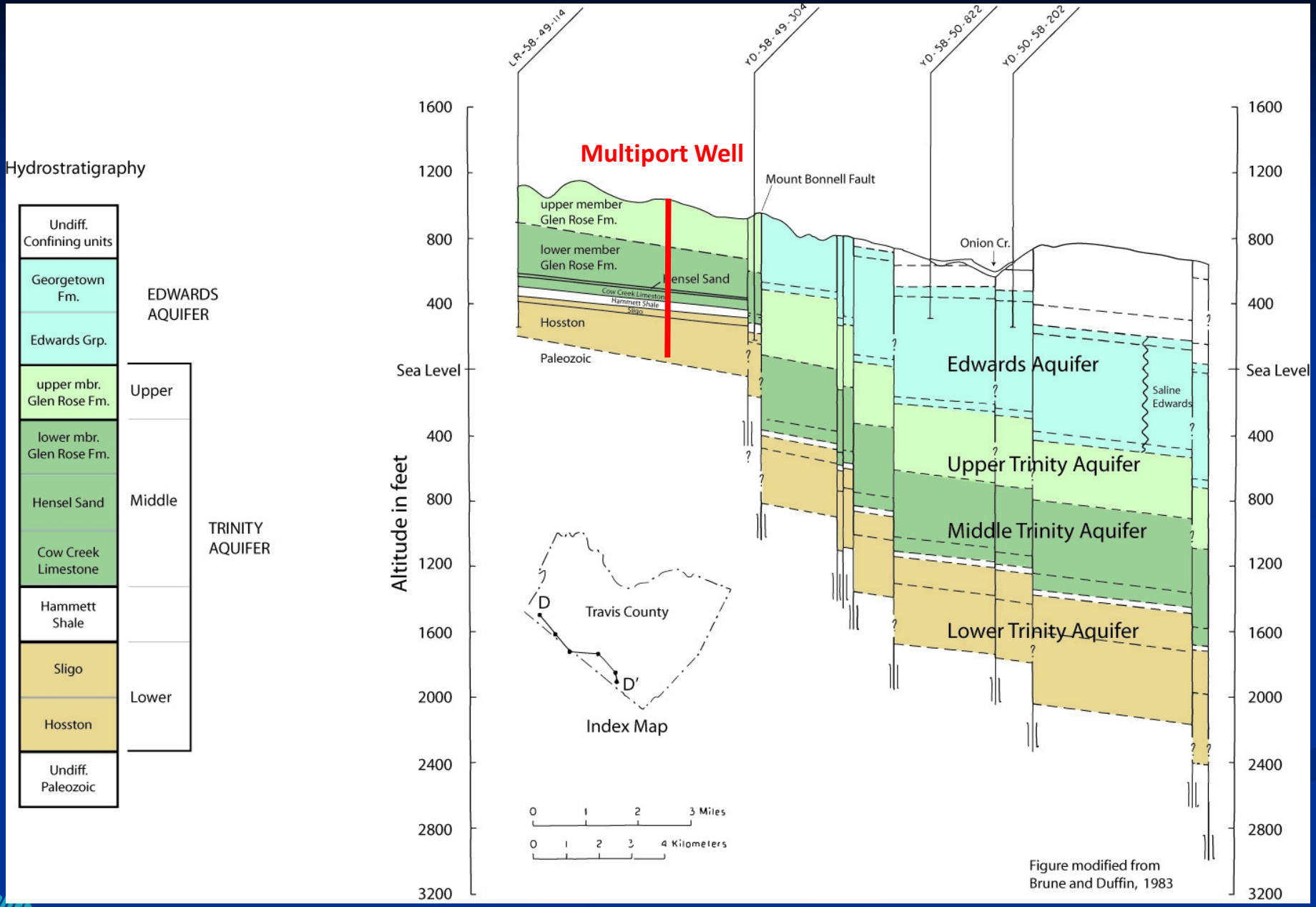

Hydrostratigraphy
Undiff. Confining units
Georgetown Fm.
Edwards Grp.
EDWARDS AQUIFER
upper mbr. Glen Rose Fm.
lower mbr. Glen Rose Fm.
Hensel Sand
Cow Creek Limestone
Hammett Shale
Sligo
Hosston
Upper
Middle
Lower
TRINITY AQUIFER
Undiff. Paleozoic
Multiport Well
LR-58-49-114
YD-58-49-304
YD-58-50-822
YD-50-58-202
Mount Bonnell Fault
Onion Cr.
upper member Glen Rose Fm.
lower member Glen Rose Fm.
Hensel Sand
Cow Creek Limestone
Hammett Shale
Sligo
Hosston
Paleozoic
Edwards Aquifer
Saline Edwards
Upper Trinity Aquifer
Middle Trinity Aquifer
Lower Trinity Aquifer
Altitude in feet
1600
1200
800
400
Sea Level
400
800
1200
1600
2000
2400
2800
3200
D
D'
Travis County
Index Map
0 1 2 3 Miles
0 1 2 3 4 Kilometers
Figure modified from Brune and Duffin, 1983

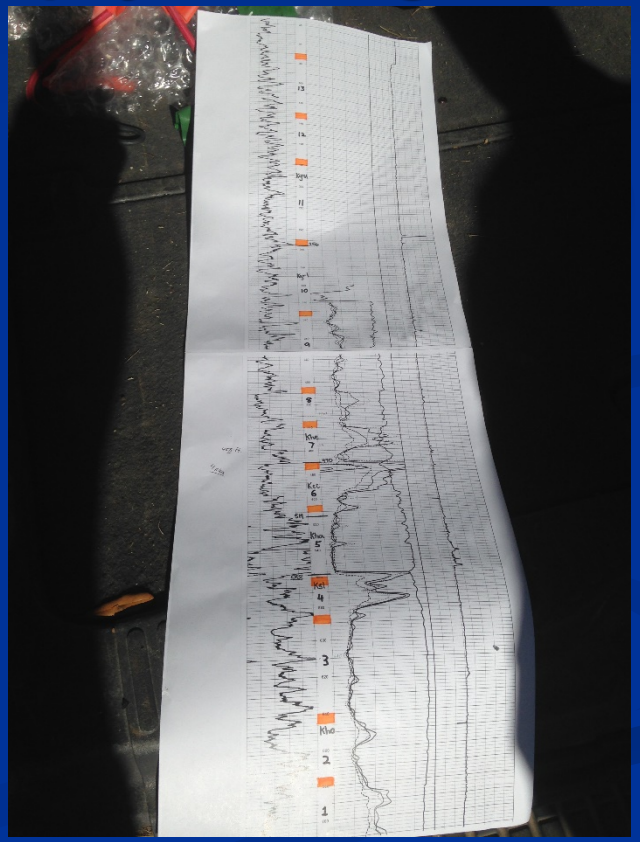
# Borehole Drilling

**Completed 2/16/2017**
**Total depth 717 ft**

# Multiport Well Design

## Drill cuttings

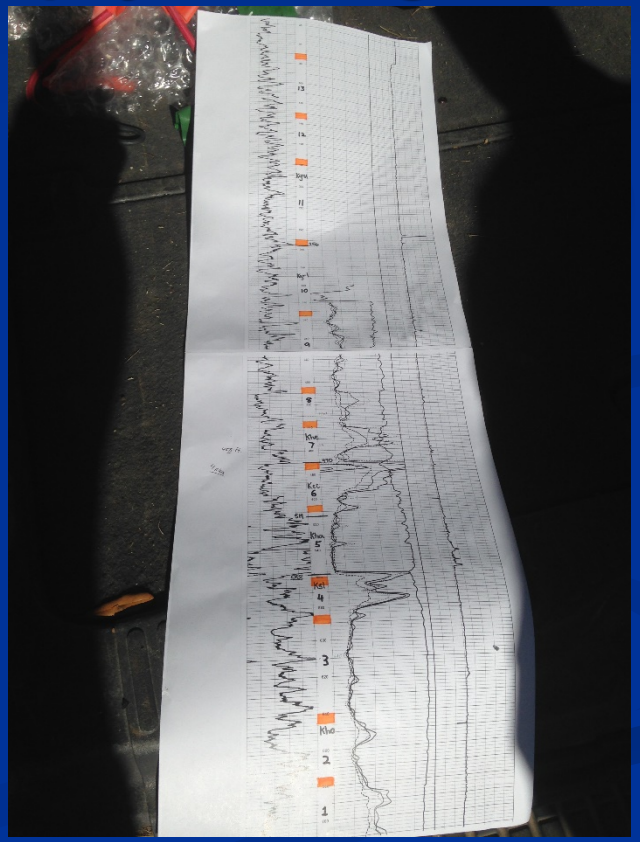
## Geophysical Log



# Multiport Well Design

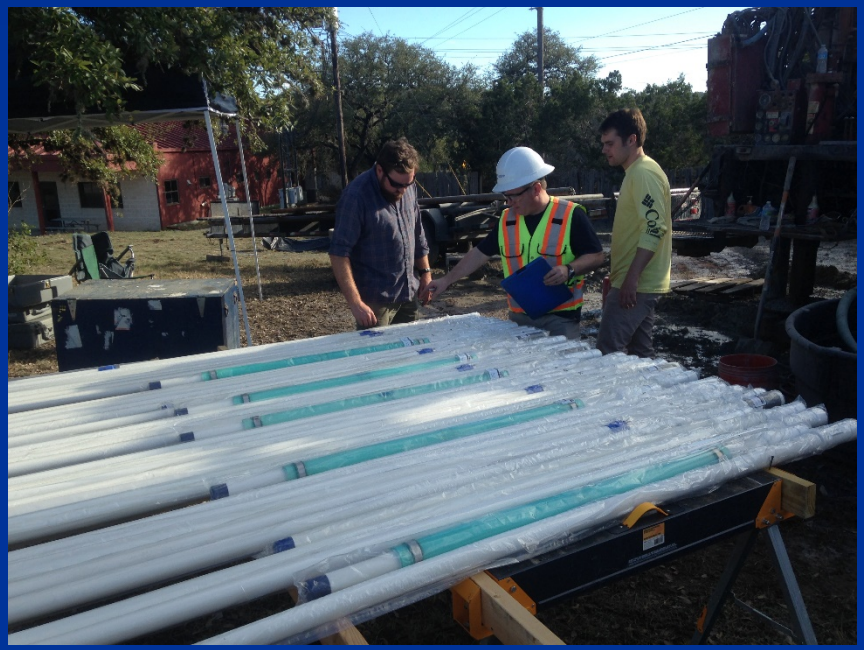
## Drill cuttings

## Geophysical Log



# Installation of Multiport System

## Multiport design



## Installing into borehole

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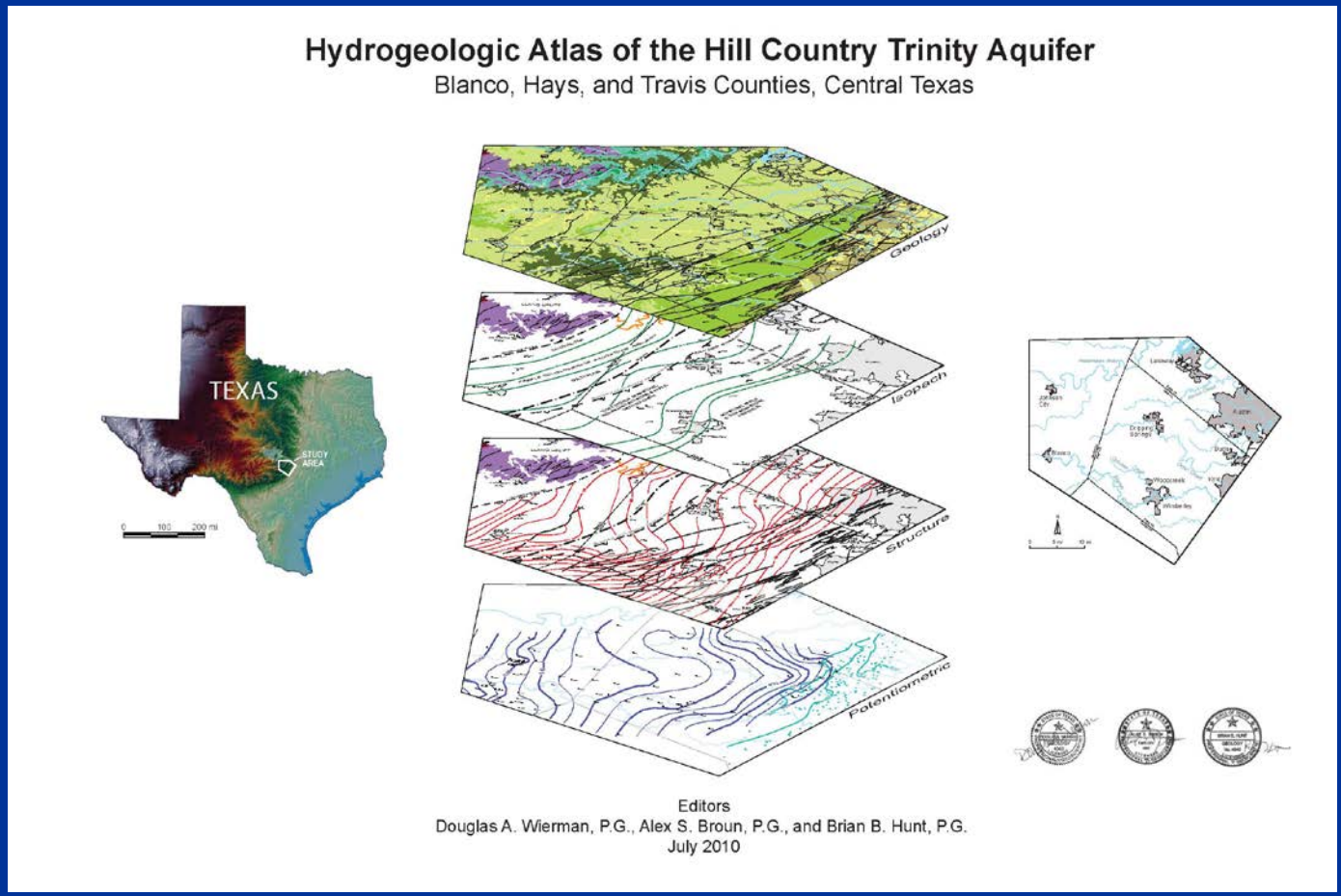
# Multiport Completed

February 23, 2017

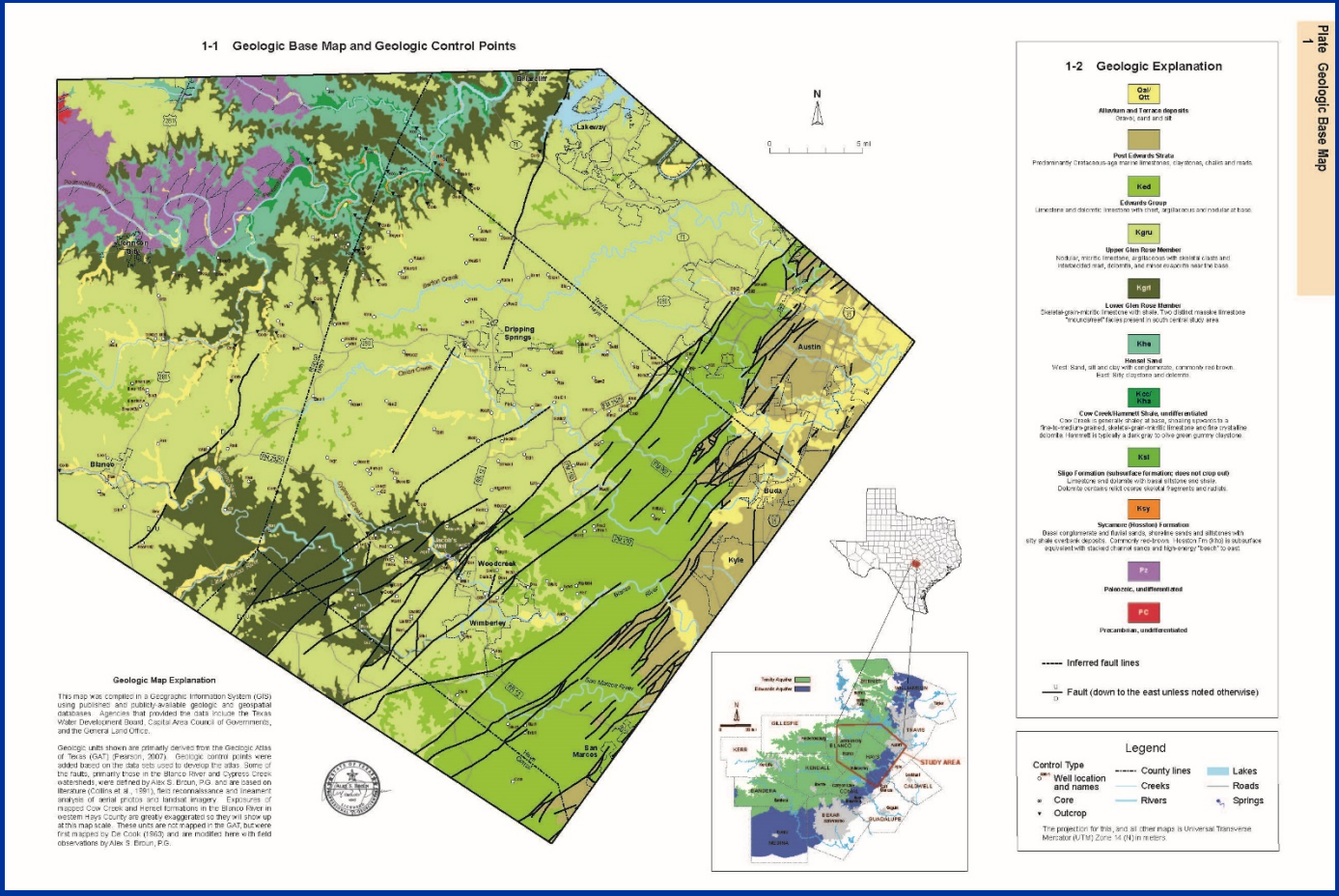
14 Zones: Upper, Middle, and Lower Trinity Aquifer units

# 2019 Project Deliverable: Hydrogeologic Atlas of Western Travis County

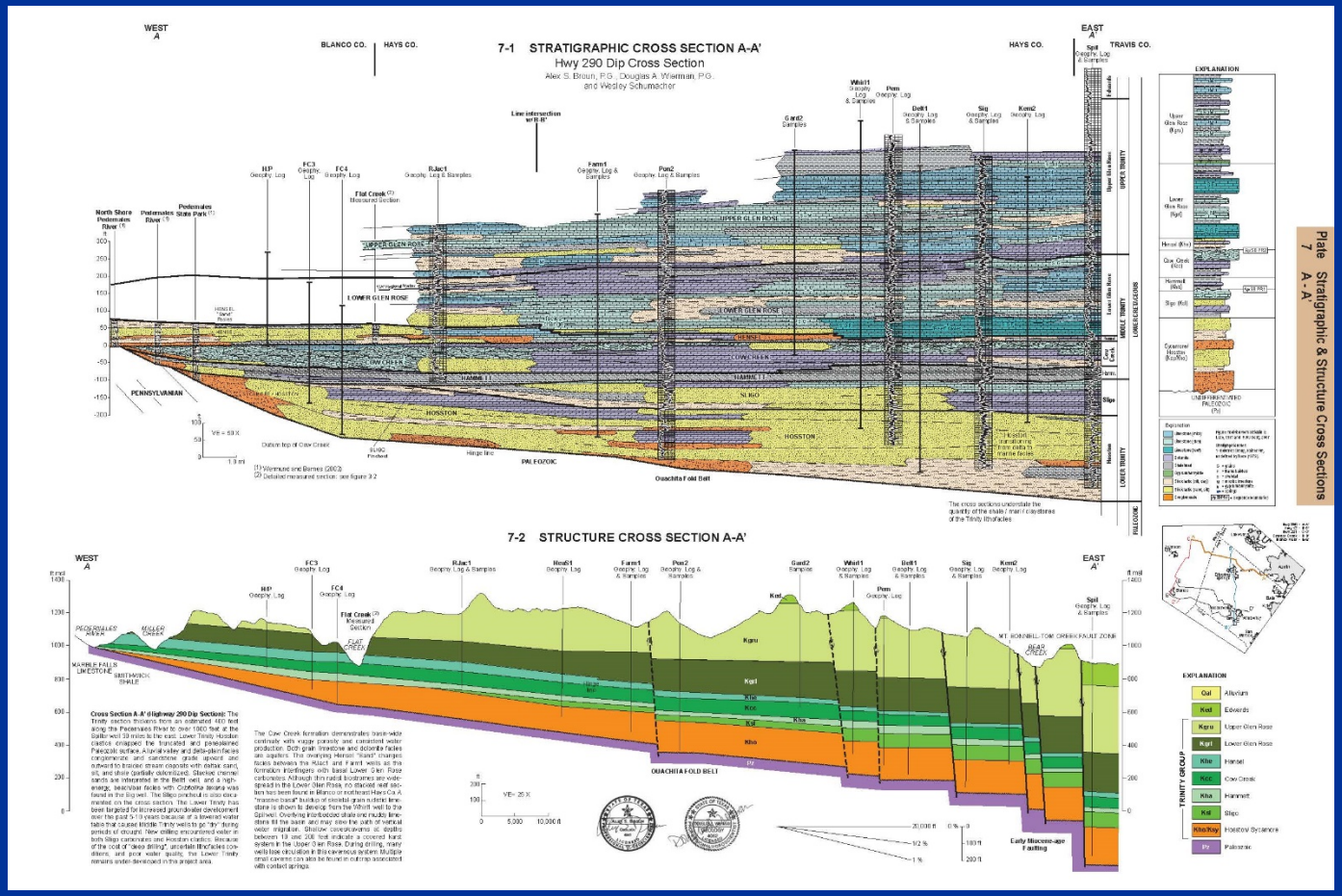



Model and example from 2010 Atlas

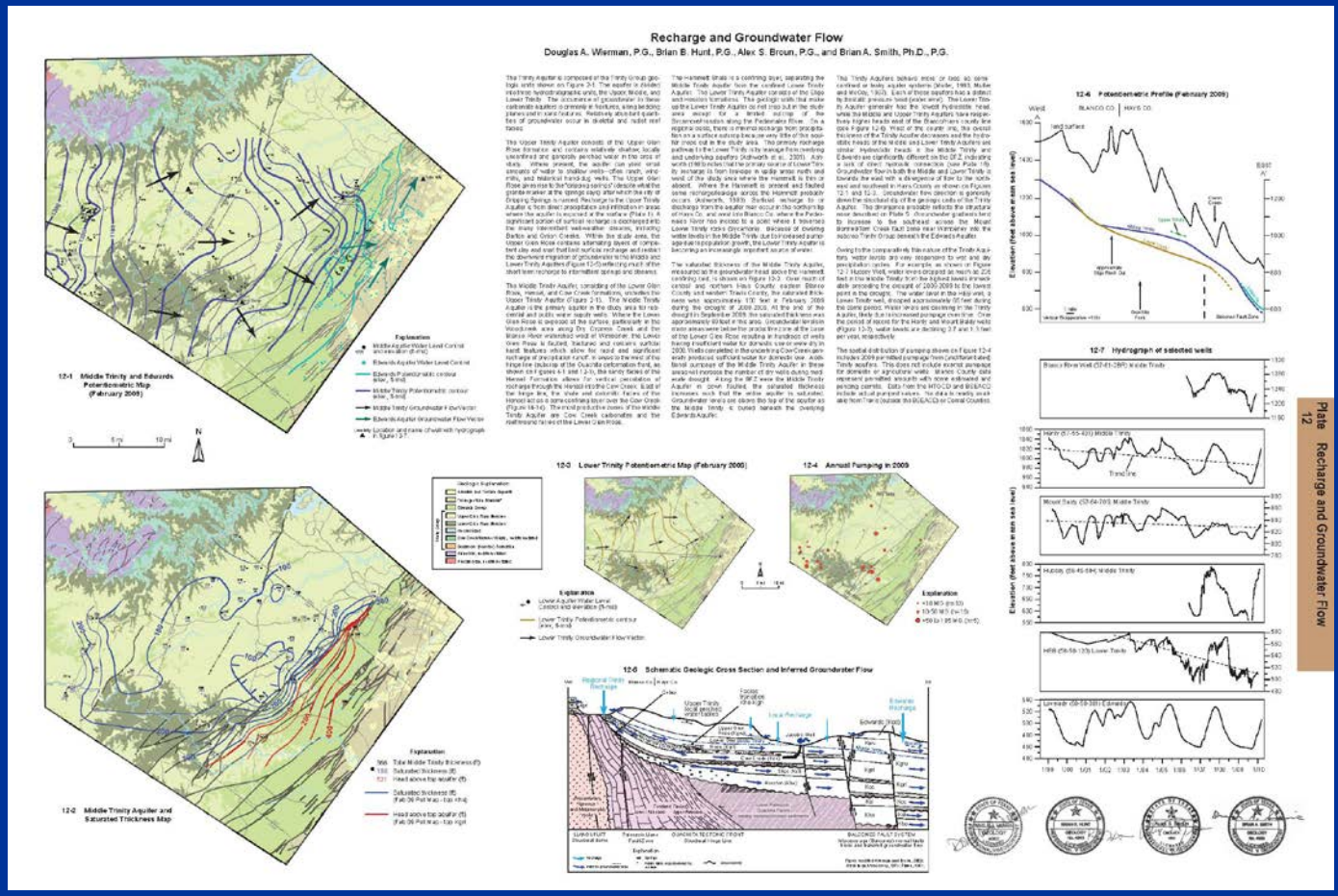
# Geologic Mapping



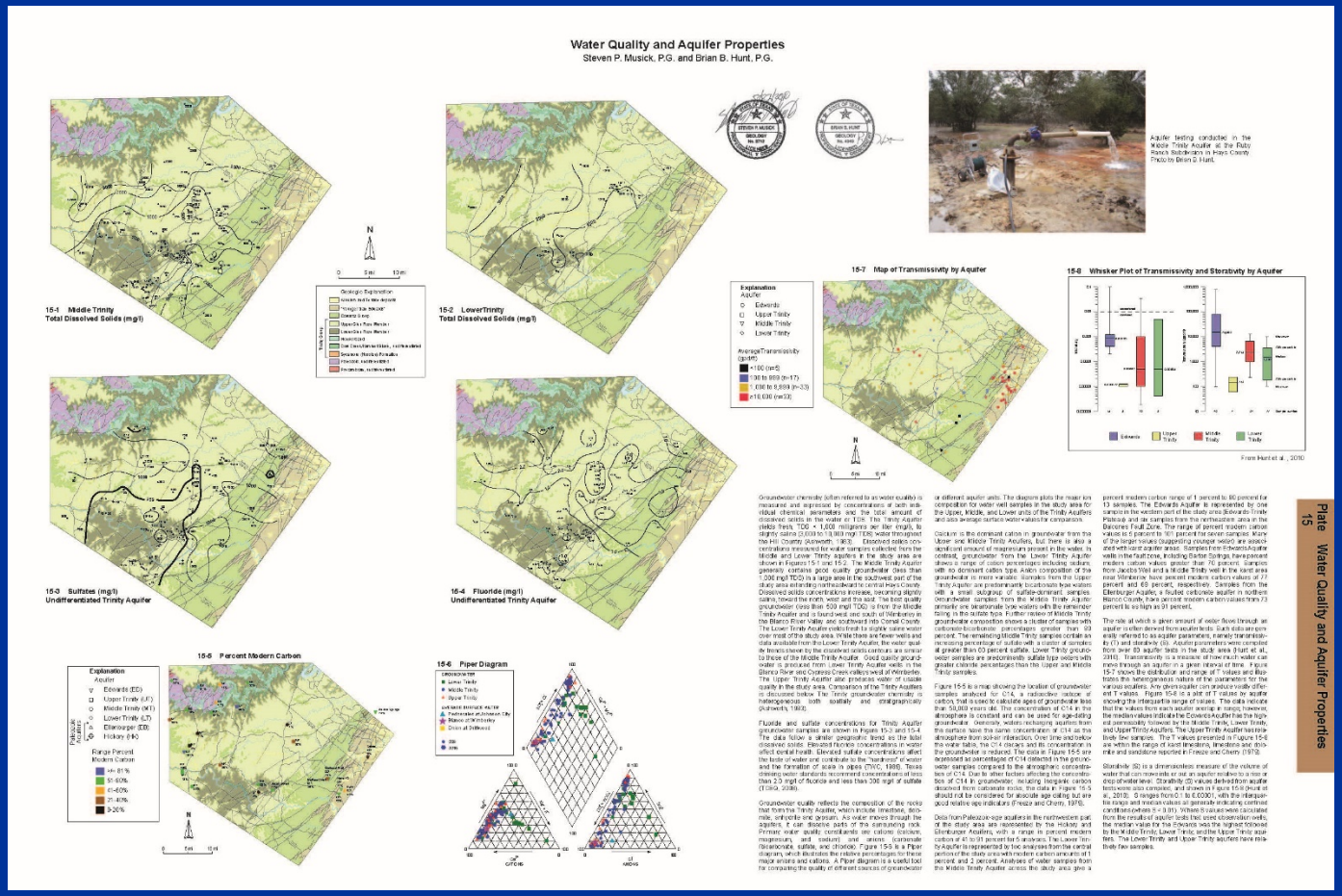
# Geologic Cross Sections



# Groundwater Flow



# Groundwater Quality



Water Quality and Aquifer Properties

Steven P. Musick, P.G. and Brian B. Hunt, P.G.

15-1 Middle Trinity Total Dissolved Solids (mg/l)

15-2 LowerTrinity Total Dissolved Solids (mg/l)

15-3 Sulfates (mg/l) Undifferentiated Trinity Aquifer

15-4 Fluoride (mg/l) Undifferentiated Trinity Aquifer

15-5 Percent Modern Carbon

15-6 Piper Diagram

15-7 Map of Transmissivity by Aquifer

15-8 Whisker Plot of Transmissivity and Storativity by Aquifer

From Hunt et al., 2010

Aquifer testing conducted in the Middle Trinity Aquifer at the Ruby Ranch Subdivision in Hays County. Photo by Brian B. Hunt.

Groundwater chemistry (often referred to as water quality) is measured and expressed by concentrations of both individual chemical parameters and the total amount of dissolved solids in the water or TDS. The Trinity Aquifer (HWS Tests, TDS < 1,000 milligrams per liter (mg/l)), is slightly saline (3,000 to 10,000 mg/l TDS) water throughout the Hill Country (Ashworth, 1983). Dissolved solids concentrations measured for water samples collected from the Middle and Lower Trinity aquifers in the study area are shown in Figures 15-1 and 15-2. The Middle Trinity Aquifer generally contains good quality groundwater (less than 1,000 mg/l TDS) in a large area in the southwest part of the study area extending northeastward to central Hays County. Dissolved solids concentrations increase, becoming slightly saline, toward the north, west and the east. The best quality groundwater (less than 500 mg/l TDS) is from the Middle Trinity Aquifer and is found west and south of Wimberley in the Blanco River Valley and southward into Comal County. The Lower Trinity Aquifer yields fresh to slightly saline water over most of the study area. While there are fewer wells and data available from the Lower Trinity Aquifer, the water quality trends shown by the dissolved solids values are similar to those of the Middle Trinity Aquifer. Good quality groundwater is produced from Lower Trinity Aquifer wells in the Blanco River and Cypress Creek valleys west of Wimberley. The Upper Trinity Aquifer also produces water of usable quality in the study area. Comparison of the Trinity Aquifers is discussed below. The Trinity groundwater chemistry is heterogeneous both spatially and stratigraphically (Ashworth, 1990).

Fluoride and sulfate concentrations for Trinity Aquifer groundwater samples are shown in Figures 15-3 and 15-4. The data follow a similar geographic trend as the total dissolved solids. Elevated fluoride concentrations in water affect dental health. Elevated sulfate concentrations affect the taste of water and contribute to the "hardness" of water and the formation of scale in pipes (TWC, 1995). Texas drinking water standards recommend concentrations of less than 2.0 mg/l of fluoride and less than 300 mg/l of sulfate (TDEQ, 2008).

Groundwater quality reflects the composition of the rocks that form the Trinity Aquifer, which include limestone, dolomite, anhydrite and gypsum. As water moves through the aquifers, it can dissolve parts of the surrounding rock. Primary water quality constituents are cations (calcium, magnesium, and sodium) and anions (carbonate/bicarbonate, sulfate, and chloride). Figure 15-5 is a Piper diagram, which illustrates the relative percentages for these major anions and cations. A Piper diagram is a useful tool for comparing the quality of different sources of groundwater or different aquifer units. The diagram plots the major ion composition for water well samples in the study area for the Upper, Middle, and Lower units of the Trinity Aquifers and also average surface water values for comparison.

Calcium is the dominant cation in groundwater from the Upper and Middle Trinity Aquifers, but there is also a significant amount of magnesium present in the water. In contrast, groundwater from the Lower Trinity Aquifer shows a range of cation percentages including sodium, with no dominant cation type. Anion composition of the groundwater is more variable. Samples from the Upper Trinity Aquifer are predominantly bicarbonate type waters with a small subgroup of sulfate-dominant samples. Groundwater samples from the Middle Trinity Aquifer primarily are bicarbonate type waters with the remainder falling in the sulfate type. Further review of Middle Trinity groundwater composition shows a cluster of samples with carbonate-bicarbonate percentages greater than 90 percent. The remaining Middle Trinity samples contain an increasing percentage of sulfate with a cluster of samples at greater than 60 percent sulfate. Lower Trinity groundwater samples are predominantly sulfate type waters with greater chloride percentages than the Upper and Middle Trinity samples.

Figure 15-5 is a map showing the location of groundwater samples analyzed for C14, a radioactive isotope of carbon, that is used to calculate ages of groundwater less than 50,000 years old. The concentration of C14 in the atmosphere is constant and can be used for age-dating groundwater. Generally, waters recharging aquifers from the surface have the same concentration of C14 as the atmosphere from soil-air interaction. Over time and below the water table, the C14 decays and its concentration in the groundwater is reduced. The data in Figure 15-5 are expressed as percentages of C14 detected in the groundwater samples compared to the atmospheric concentration of C14. Due to other factors affecting the concentration of C14 in groundwater, including inorganic carbon dissolved from carbonate rocks, the data in Figure 15-5 should not be considered for absolute age-dating but are good relative age indicators (Freeze and Cherry, 1979).

Data from Paleozoic-age aquifers in the northwestern part of the study area are represented by the Hickory and Ellenburger Aquifers, with a range in percent modern carbon of 47 to 91 percent for 5 analyses. The Lower Trinity Aquifer is represented by two analyses from the central portion of the study area with modern carbon amounts of 1 percent and 2 percent. Analyses of water samples from the Middle Trinity Aquifer across the study area give a percent modern carbon range of 1 percent to 86 percent for 13 samples. The Edwards Aquifer is represented by one sample in the western part of the study area (Edwards-Trinity Plateau) and six samples from the northeastern area in the Balcones Fault Zone. The range of percent modern carbon values is 6 percent to 101 percent for seven samples. Many of the larger values (suggesting younger water) are associated with karst aquifer areas. Samples from Edwards Aquifer wells in the fault zone, including Barton Springs, have percent modern carbon values greater than 76 percent. Samples from Jacobs Well and a Middle Trinity well in the karst area near Wimberley have percent modern carbon values of 77 percent and 65 percent, respectively. Samples from the Ellenburger Aquifer, a faulted carbonate aquifer in northern Blanco County, have percent modern carbon values from 73 percent to as high as 91 percent.

The rate at which a given amount of water flows through an aquifer is often derived from aquifer tests. Such data are generally referred to as aquifer parameters, namely transmissivity (T) and storativity (S). Aquifer parameters were compiled for over 80 aquifer tests in the study area (Hunt et al., 2010). Transmissivity is a measure of how much water can move through an aquifer in a given interval of time. Figure 15-7 shows the distribution and range of T values and illustrates the heterogeneous nature of the parameters for the various aquifers. Are given aquifer can produce vastly different T values. Figure 15-8 is a plot of T values by aquifer showing the interquartile range of values. The data indicate that the values from each aquifer overlap in range; however, the median values indicate the Edwards Aquifer has the highest permeability, followed by the Middle Trinity, Lower Trinity, and Upper Trinity Aquifers. The Upper Trinity Aquifer has relatively few samples. The T values presented in Figure 15-8 are within the range of karst limestone, limestone and chalk mile and sandstone reported in Freeze and Cherry (1979).

Storativity (S) is a dimensionless measure of the volume of water that can reasonably or not an aquifer relative to a loss or drop of water level. Storativity (S) values derived from aquifer tests were also compiled, and shown in Figure 15-8 (Hunt et al., 2010). S ranges from 0.1 to 6.E-0.001, with the interquartile range and median values all generally indicating confined conditions (where S < 0.01). Where S values were calculated from the results of aquifer tests that used observation wells, the median value for the Edwards was the highest followed by the Middle Trinity, Lower Trinity, and the Upper Trinity aquifers. The Lower Trinity and Upper Trinity aquifers have relatively few samples.

# Project Deliverable

Provide educational and technical information for the public (August 2019)

- Digital databases of information
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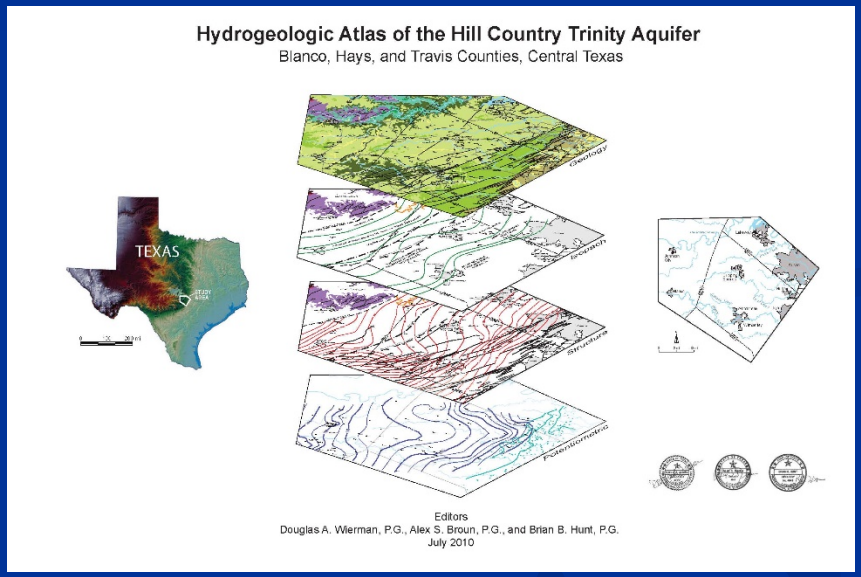


Model and example from 2010 Atlas

# Questions?

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30 years 1987-2017 Barton Springs Edwards Aquifer CONSERVATION DISTRICT