Recharge and Groundwater Flow

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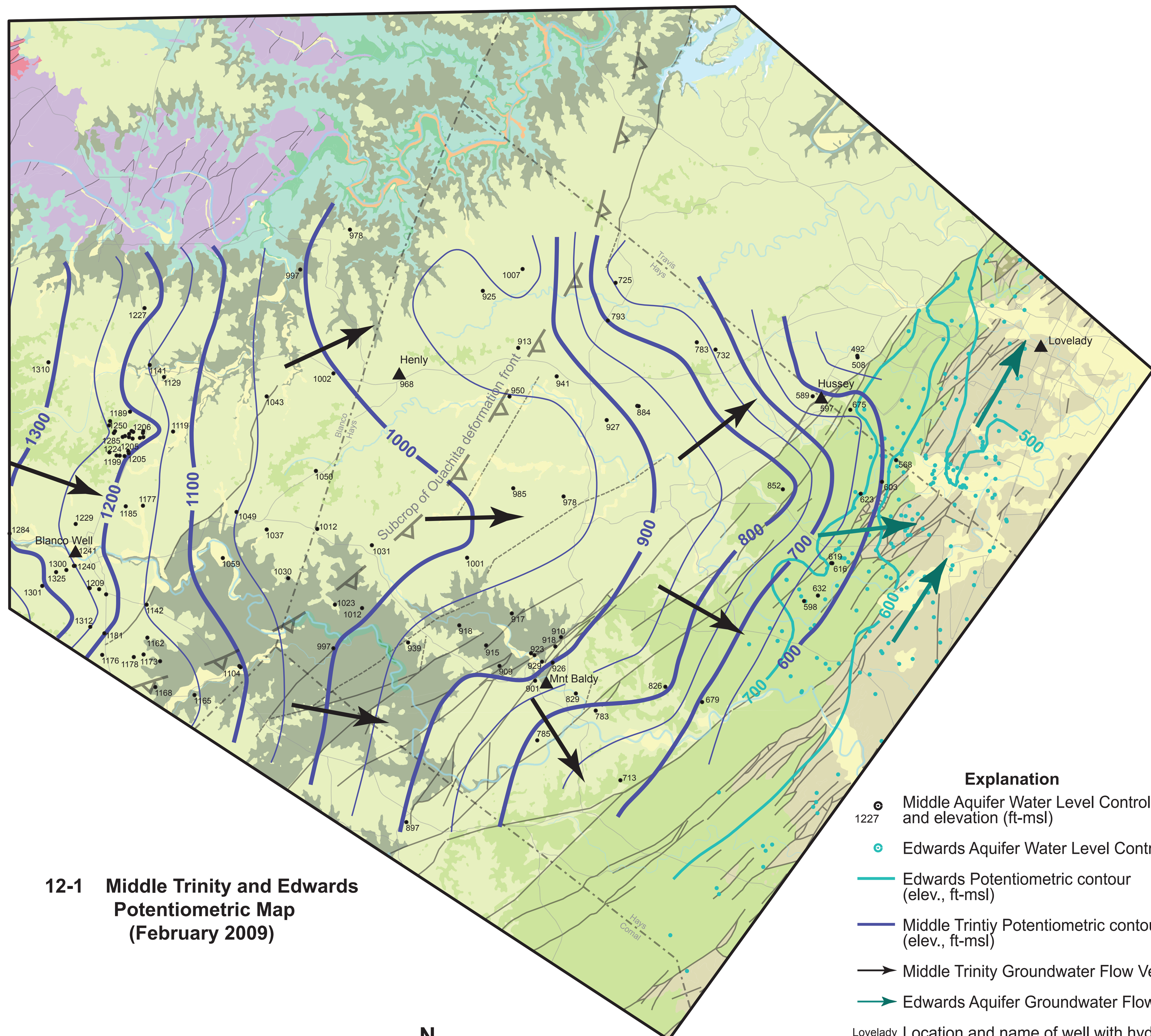


12-1 Middle Trinity and Edwards Potentiometric Map (February 2009)

The Trinity Aquifer is composed of the Trinity Group geologic units shown on Figure 2-1. The aquifer is divided into three hydrostratigraphic units, the Upper, Middle, and Lower Trinity. The occurrence of groundwater in these carbonate aquifers is primarily in fractures, along bedding planes and in karst features. Relatively abundant quantities of groundwater occur in skeletal and rudist reef facies.

The Upper Trinity Aquifer consists of the Upper Glen Rose formation and contains relatively shallow, locally unconfined and generally perched water in the area of study. Where present, the aquifer can yield small amounts of water to shallow wells—often ranch, windmills, and historical hand-dug wells. The Upper Glen Rose gives rise to the "dripping springs" (despite what the granite marker at the springs says) after which the city of Dripping Springs is named. Recharge to the Upper Trinity Aquifer is from direct precipitation and infiltration in areas where the aquifer is exposed at the surface (Plate 1). A significant portion of surficial recharge is discharged into the many intermittent wet-weather streams, including Barton and Onion Creeks. Within the study area, the Upper Glen Rose contains alternating layers of competent clay and marl that limit surficial recharge and restrict the downward migration of groundwater to the Middle and Lower Trinity Aquifers (Figure 12-5) reflecting much of the short-term recharge to intermittent springs and streams.

The Middle Trinity Aquifer, consisting of the Lower Glen Rose, Hensel, and Cow Creek formations, underlies the Upper Trinity Aquifer (Figure 2-1). The Middle Trinity Aquifer is the primary aquifer in the study area for residential and public water supply wells. Where the Lower Glen Rose is exposed at the surface, particularly in the Woodcreek area along Dry Cypress Creek and the Blanco River watershed west of Wimberley, the Lower Glen Rose is faulted, fractured and contains surficial karst features which allow for rapid and significant recharge of precipitation runoff. In areas to the west of the hinge line (subcrop of the Ouachita deformation front, as shown on Figures 4-1 and 12-1), the sandy facies of the Hensel Formation allows for vertical percolation of recharge through the Hensel into the Cow Creek. East of the hinge line, the shale and dolomitic facies of the Hensel act as a semi-confining layer over the Cow Creek (Figure 14-14). The most productive zones of the Middle Trinity Aquifer are Cow Creek carbonates and the reef/mound facies of the Lower Glen Rose.

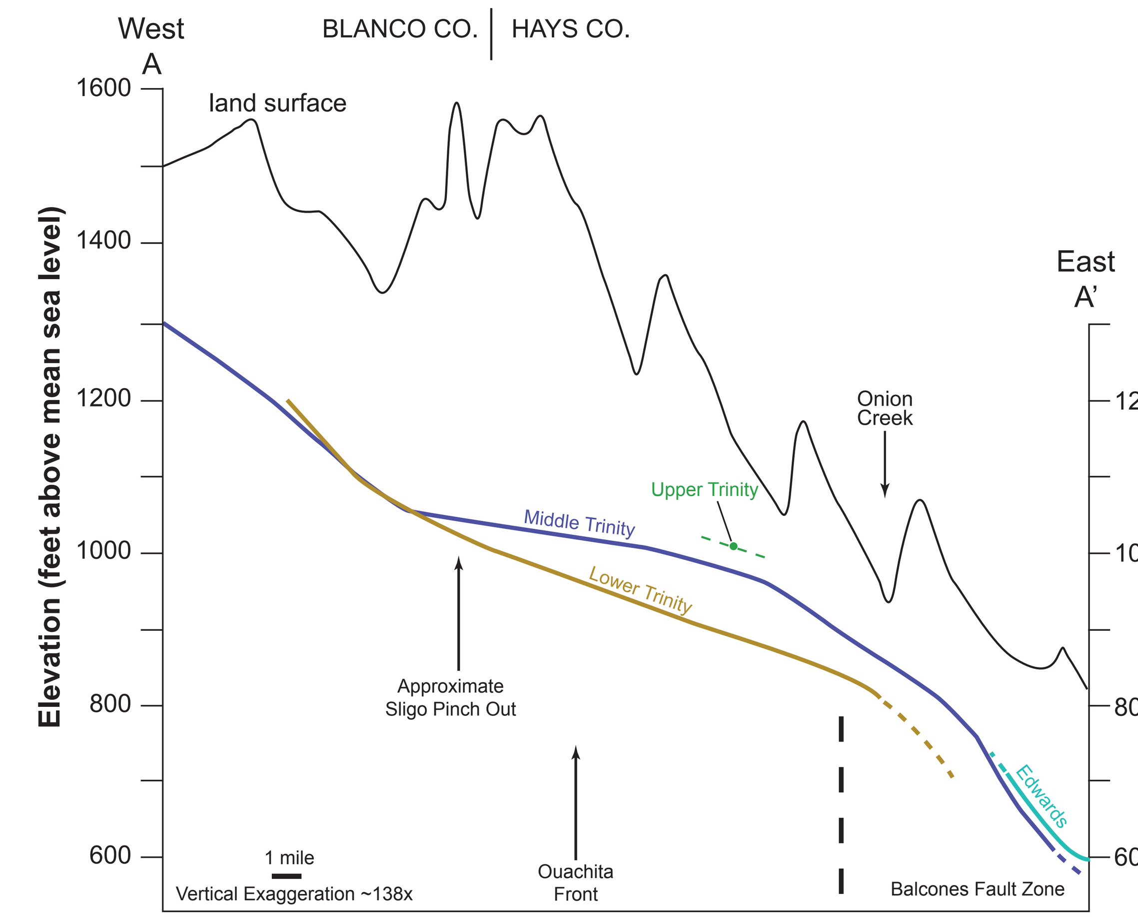
The Hammett Shale is a confining layer, separating the Middle Trinity Aquifer from the confined Lower Trinity Aquifer. The Lower Trinity Aquifer consists of the Sligo and Hosston formations. The geologic units that make up the Lower Trinity Aquifer do not crop out in the study area except for a limited outcrop of the Sycamore/Hosston along the Pedernales River. On a regional basis, there is minimal recharge from precipitation on a surface outcrop because very little of this aquifer crops out in the study area. The primary recharge pathway to the Lower Trinity is by leakage from overlying and underlying aquifers (Ashworth et al., 2001). Ashworth (1983) notes that the primary source of Lower Trinity recharge is from leakage in updip areas north and west of the study area where the Hammett is thin or absent. Where the Hammett is present and faulted some recharge/leakage across the Hammett probably occurs (Ashworth, 1983). Surficial recharge to or discharge from the aquifer may occur in the northern tip of Hays Co. and west into Blanco Co. where the Pedernales River has incised to a point where it traverses Lower Trinity rocks (Sycamore). Because of lowering water levels in the Middle Trinity due to increased pumpage due to population growth, the Lower Trinity Aquifer is becoming an increasingly important source of water.

The saturated thickness of the Middle Trinity Aquifer, measured as the groundwater head above the Hammett confining bed, is shown on Figure 12-2. Over much of central and northern Hays County, eastern Blanco County and western Travis County, the saturated thickness was approximately 100 feet in February 2009 during the drought of 2008-2009. At the end of the drought in September 2009, the saturated thickness was approximately 80 feet in this area. Groundwater levels in many areas were below the productive zone at the base of the Lower Glen Rose resulting in hundreds of wells having insufficient water for domestic use or were dry in 2009. Wells completed in the underlying Cow Creek generally produced sufficient water for domestic use. Additional pumpage of the Middle Trinity Aquifer in these areas will increase the number of dry wells during moderate drought. Along the BFZ were the Middle Trinity Aquifer in down faulted, the saturated thickness increases such that the entire aquifer is saturated. Groundwater levels are above the top of the aquifer as the Middle Trinity is buried beneath the overlying Edwards Aquifer.

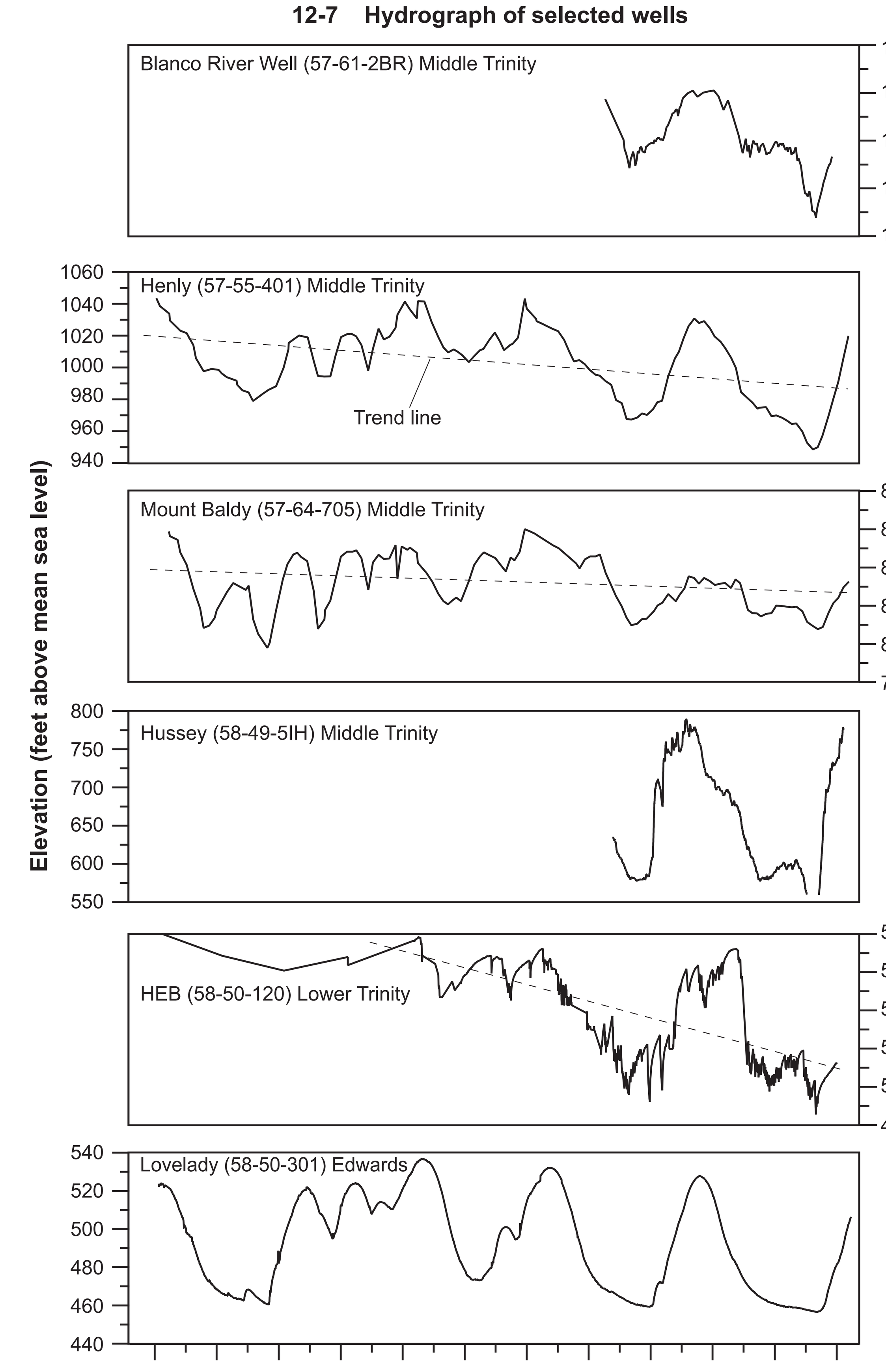
The Trinity Aquifers behave more or less as semi-confined or leaky aquifer systems (Muller, 1990; Muller and McCoy, 1987). Each of these aquifers has a distinct hydrostatic pressure head (water level). The Lower Trinity Aquifer generally has the lowest hydrostatic head, while the Middle and Upper Trinity Aquifers have respectively higher heads east of the Blanco/Hays county line (see Figure 12-6). West of the county line, the overall thickness of the Trinity Aquifer decreases and the hydrostatic heads of the Middle and Lower Trinity Aquifers are similar. Hydrostatic heads in the Middle Trinity and Edwards are significantly different sin the BFZ, indicating a lack of direct hydraulic connection (see Plate 16). Groundwater flow in both the Middle and Lower Trinity is towards the east with a divergence of flow to the northeast and southeast in Hays County as shown on Figures 12-1 and 12-3. Groundwater flow direction is generally down the structural dip of the geologic units of the Trinity Aquifer. The divergence probably reflects the structural nose described on Plate 5. Groundwater gradients tend to increase to the southeast across the Mount Bonnell/Tom Creek fault zone near Wimberley into the subcrop Trinity Group beneath the Edwards Aquifer.

Owing to the comparatively thin nature of the Trinity Aquifers, water levels are very responsive to wet and dry precipitation cycles. For example, as shown on Figure 12-7 Hussey Well, water levels dropped as much as 235 feet in the Middle Trinity from the highest levels immediately preceding the drought of 2008-2009 to the lowest point in the drought. The water level in the HEB well, a Lower Trinity well, dropped approximately 65 feet during the same period. Water levels are declining in the Trinity Aquifer, likely due to increased pumpage over time. Over the period of record for the Henly and Mount Baldy wells (Figure 12-7), water levels are declining 2.7 and 1.3 feet per year, respectively.

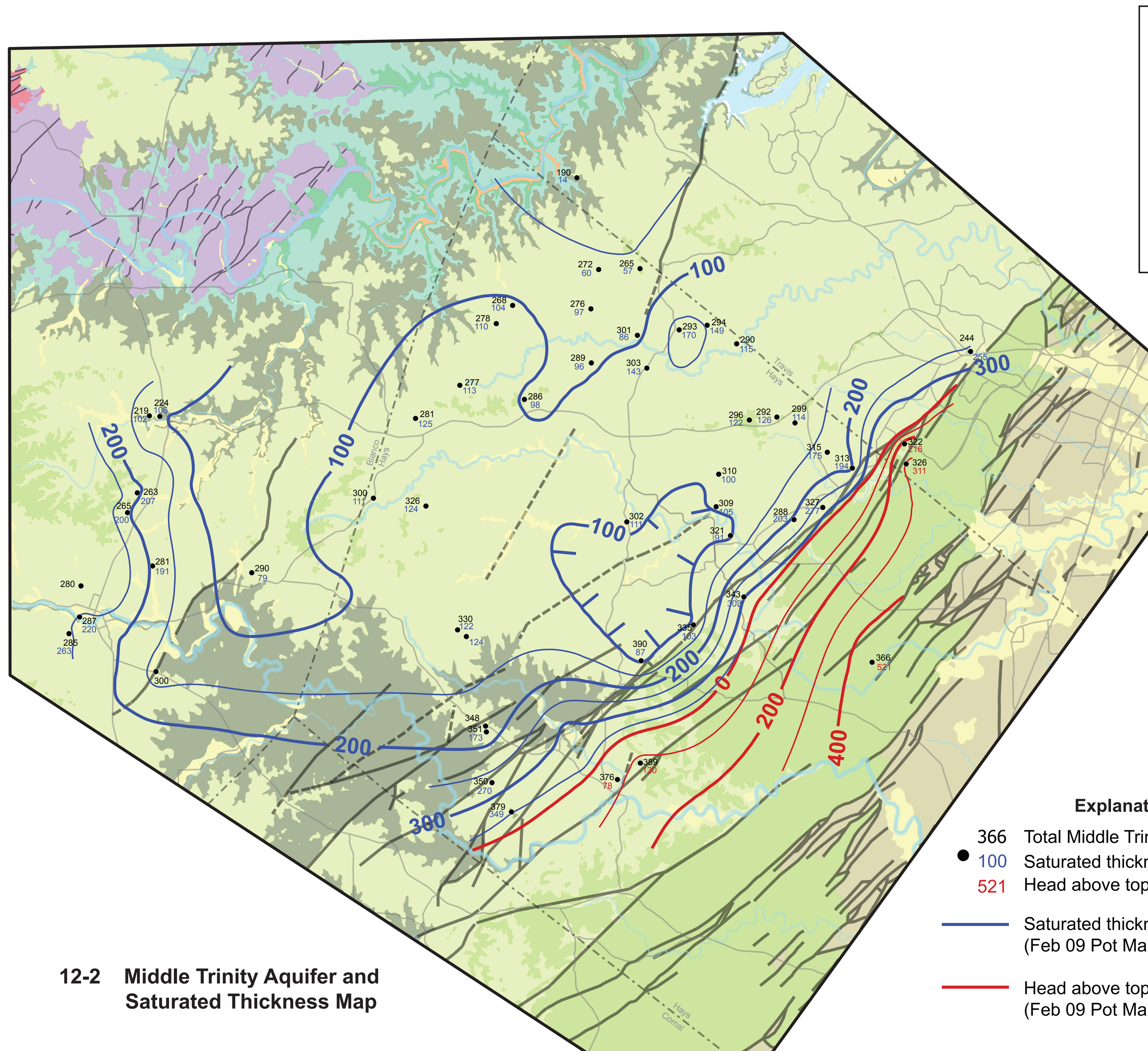
The spatial distribution of pumping shown on Figure 12-4 includes 2009 permitted pumpage from (undifferentiated) Trinity aquifers. This does not include exempt pumpage for domestic or agricultural wells. Blanco County data represent permitted amounts with some estimated and pending permits. Data from the HTGCD and BSEACD include actual pumped values. No data is readily available from Travis (outside the BSEACD) or Comal Counties.



12-6 Potentiometric Profile (February 2009)



12-7 Hydrograph of selected wells

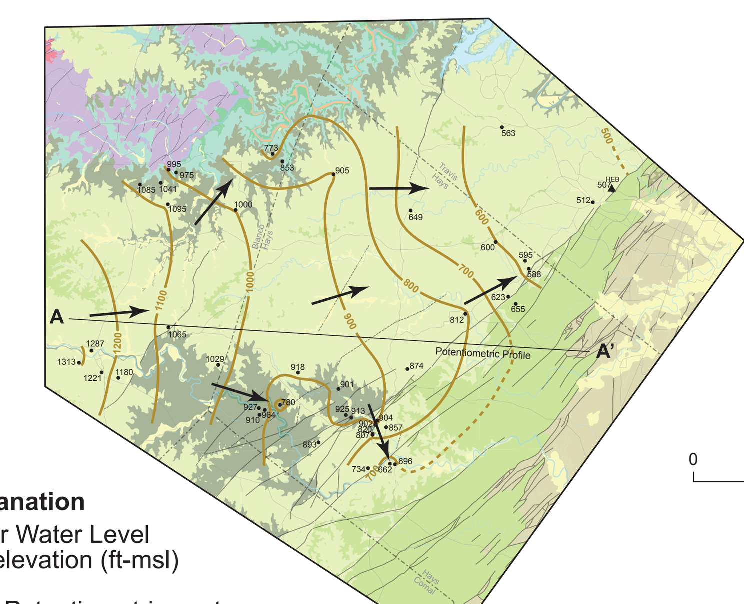


12-2 Middle Trinity Aquifer and Saturated Thickness Map

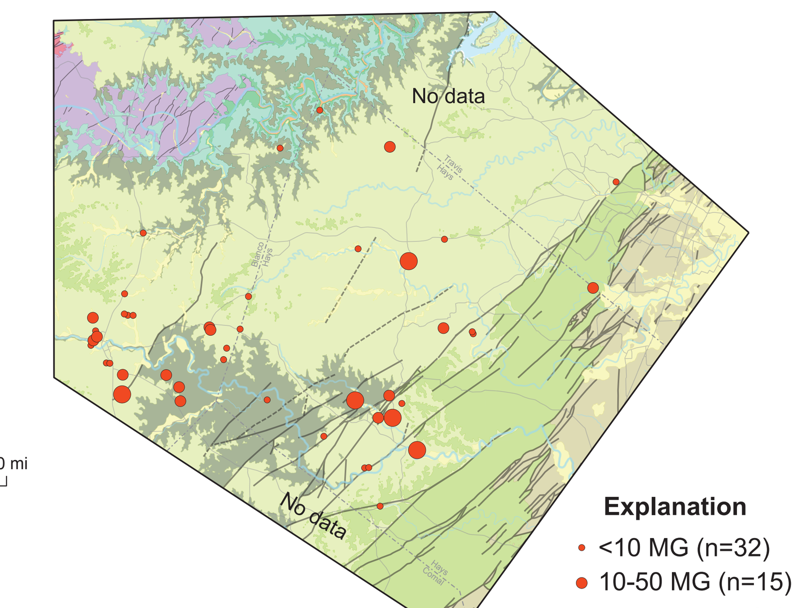
Geologic Explanation

- Alluvium and Terrace deposits
- "Younger than Edwards"
- Edwards Group
- Trinity Group:
  - Upper Glen Rose Member
  - Lower Glen Rose Member
  - Hensel Sand
  - Cow Creek/Hammet Shale, undifferentiated
  - Sycamore (Hosston) Formation
- Paleozoic, undifferentiated
- Precambrian, undifferentiated

12-3 Lower Trinity Potentiometric Map (February 2009)



12-4 Annual Pumping in 2009



12-5 Schematic Geologic Cross Section and Inferred Groundwater Flow