

Potentiometric Investigation of Two Large Springs Discharging From the Middle Trinity Aquifer, Western Hays County, Texas.



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Abstract

Pleasant Valley Spring (PVS) and Jacob's Well Spring (JWS) are large karst springs providing perennial baseflow to the Blanco River and Cypress Creek, respectively, which eventually recharges the Edwards Aquifer. In order to better understand groundwater flow and sources of recharge to these springs (springsheds), we created a potentiometric map of the area surrounding the springs from water level measurements (n=59) taken in July 2013. Results indicate that general groundwater flow is NW to SE in the study area, parallel to the direction of structural dip of Middle Trinity strata. Potentiometric gradients increase from 15ft/mi in recharge areas to 60ft/mi in the confined zone SE of the springs and major faults in the Balcones Fault Zone (BFZ). Potentiometric data suggest the Blanco River watershed, including and area of exposed Cow Creek Fm in the river, is a source of recharge for PVS. Potentiometric data suggest the source area for JWS could be limited to the Cypress Creek watershed, although contributions under differing hydrologic conditions could also include the Blanco River. We interpret a potentiometric trough, which represents a preferential flow path, surrounding the mapped JWS cave passage extending NW along Cypress Creek. A small potentiometric ridge is present between the Blanco River and Cypress Creek watersheds, suggesting a localized hydraulic separation between PVS and JWS. Additional evidence for hydrologic separation of the JWS and PVS springsheds was demonstrated by the differential springflow response to a large storm on May 25-26, 2013. PVS increased significantly in response to increased Blanco River flows, while JWS did not respond. These data help to define the source areas for PVS and JWS and suggest under drought conditions they may have independent springsheds. These data have implications for groundwater management and the preservation of springflows.

Research Questions

What patterns of groundwater flow are present in the Middle Trinity Aquifer over the study area? Are Jacob's Well Spring (JWS) and Pleasant Valley Spring (PVS) recharged from the same source(s) or do they have distinct "spring sheds"?

Methods

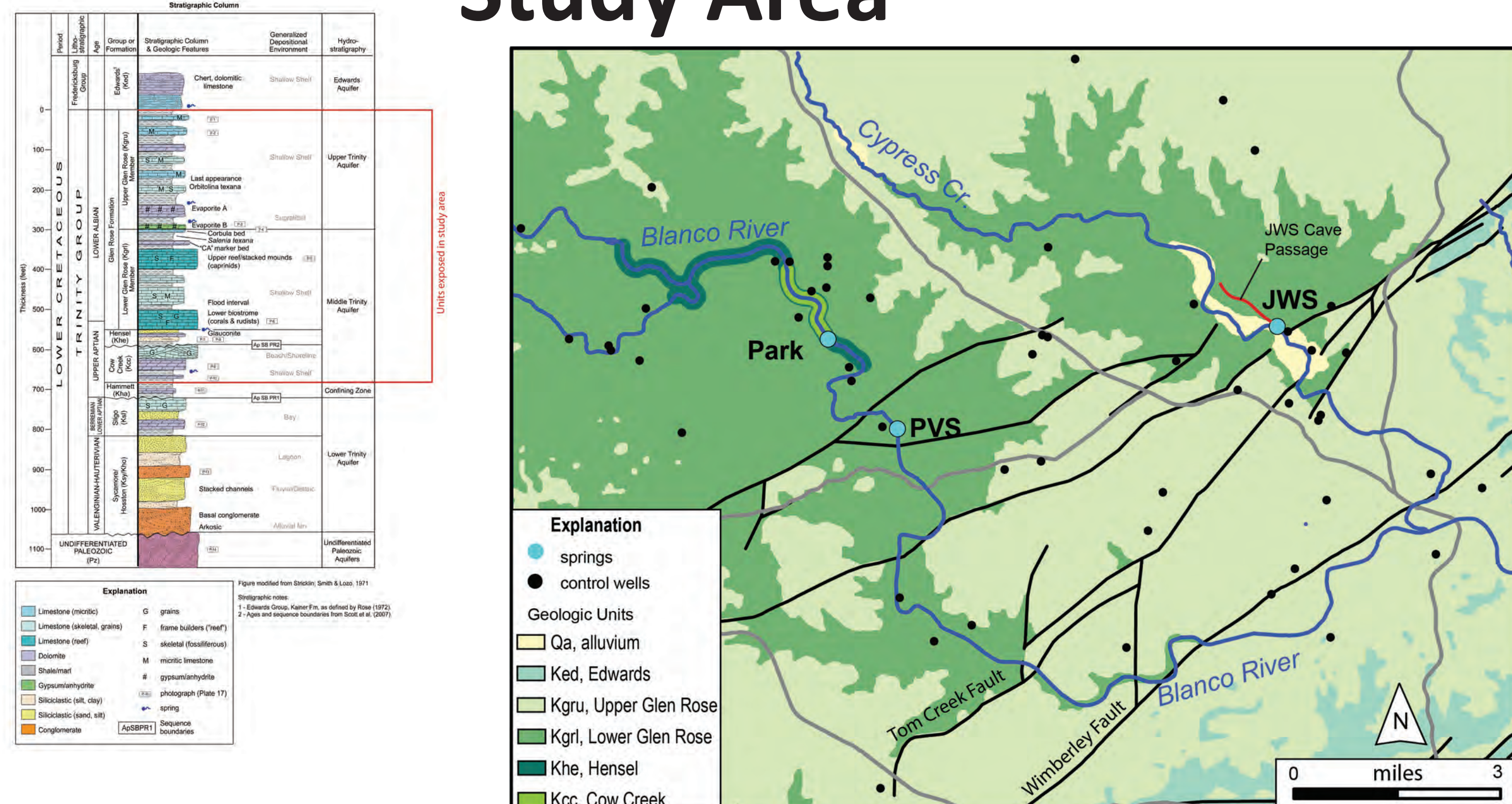
Water Level Measurements: Water levels measured from Middle Trinity Wells in July 2013 and used to construct a potentiometric map.

Well Completion: Well completion compiled from TWDB WIID driller's reports and compared to Middle Trinity structure data.

Qualitative Rainfall Distribution Analysis: NEXRAD precipitation data from May 24-May 26 2013 were overlaid onto Blanco River/Cypress Creek watershed shapefiles.

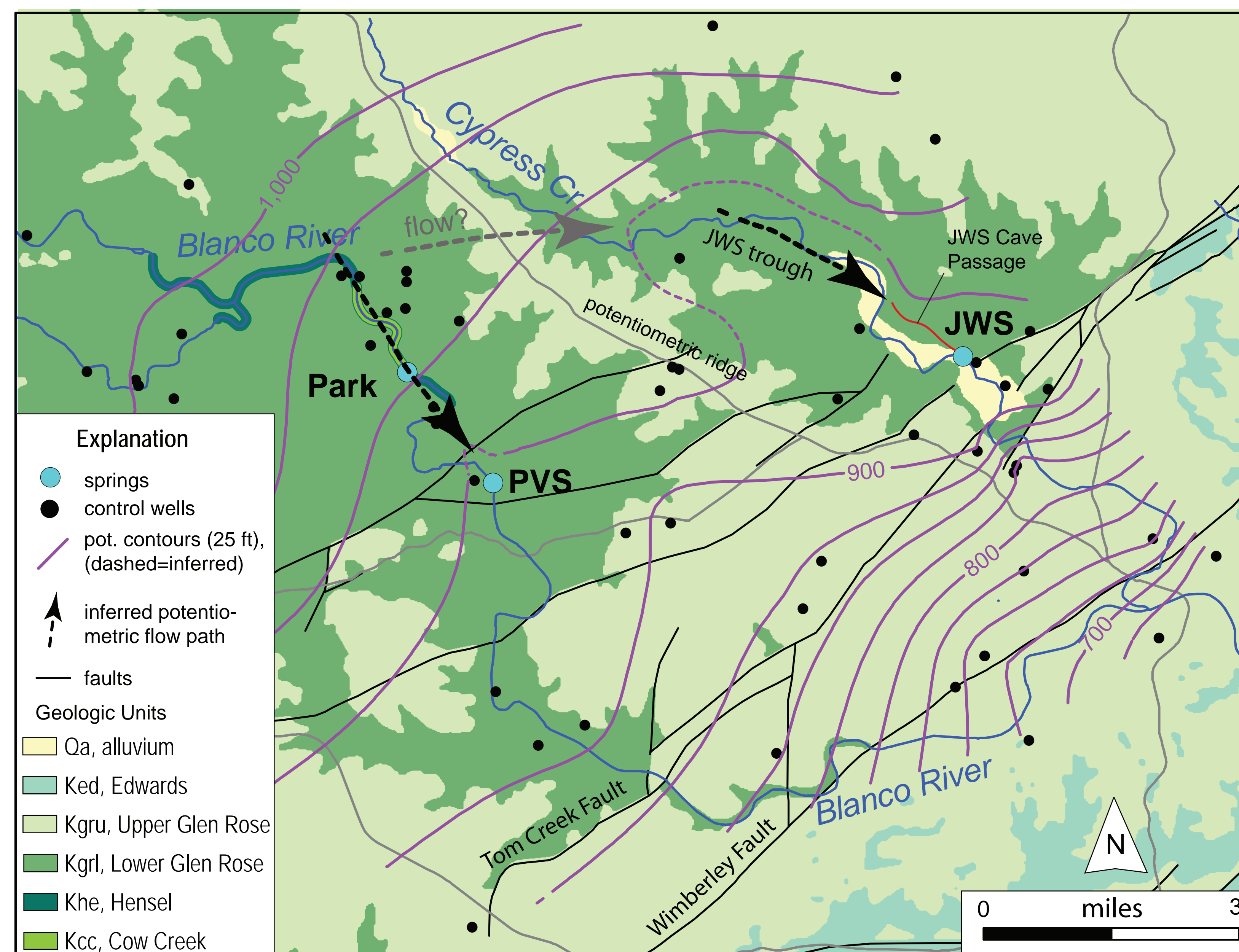
PVS Manual Discharge measurements: PVS discharge measured manually and compared to USGS streamflow data from JWS and the Blanco River Wimberly gages.

Study Area



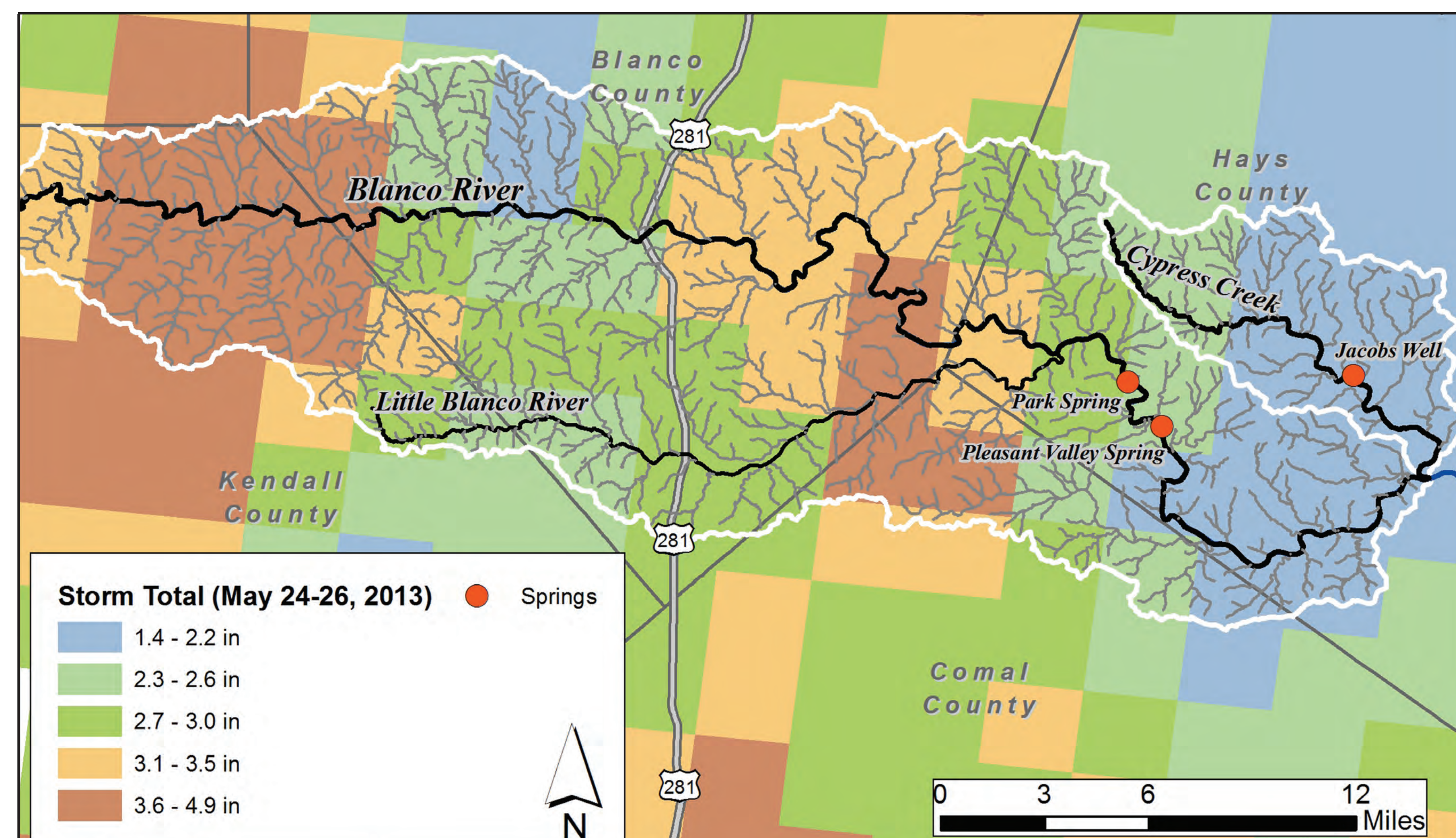
Left: Stratigraphy of the Middle Trinity Aquifer from Wierman et al. (2010). Right: Extent map of the study area. Basemap data from TWDB: Major Aquifers of Texas, Major Rivers; and -USGS: Geologic Atlas of Texas.

Potentiometric Mapping Results



Potentiometric surface map of the Middle Trinity Aquifer in the study area. Basemap data from TWDB: Major Aquifers of Texas, Major Rivers; and USGS: Geologic Atlas of Texas. Cow Creek and Hensel outcrops along Blanco river enlarged for visibility.

Rainfall Distribution Analysis

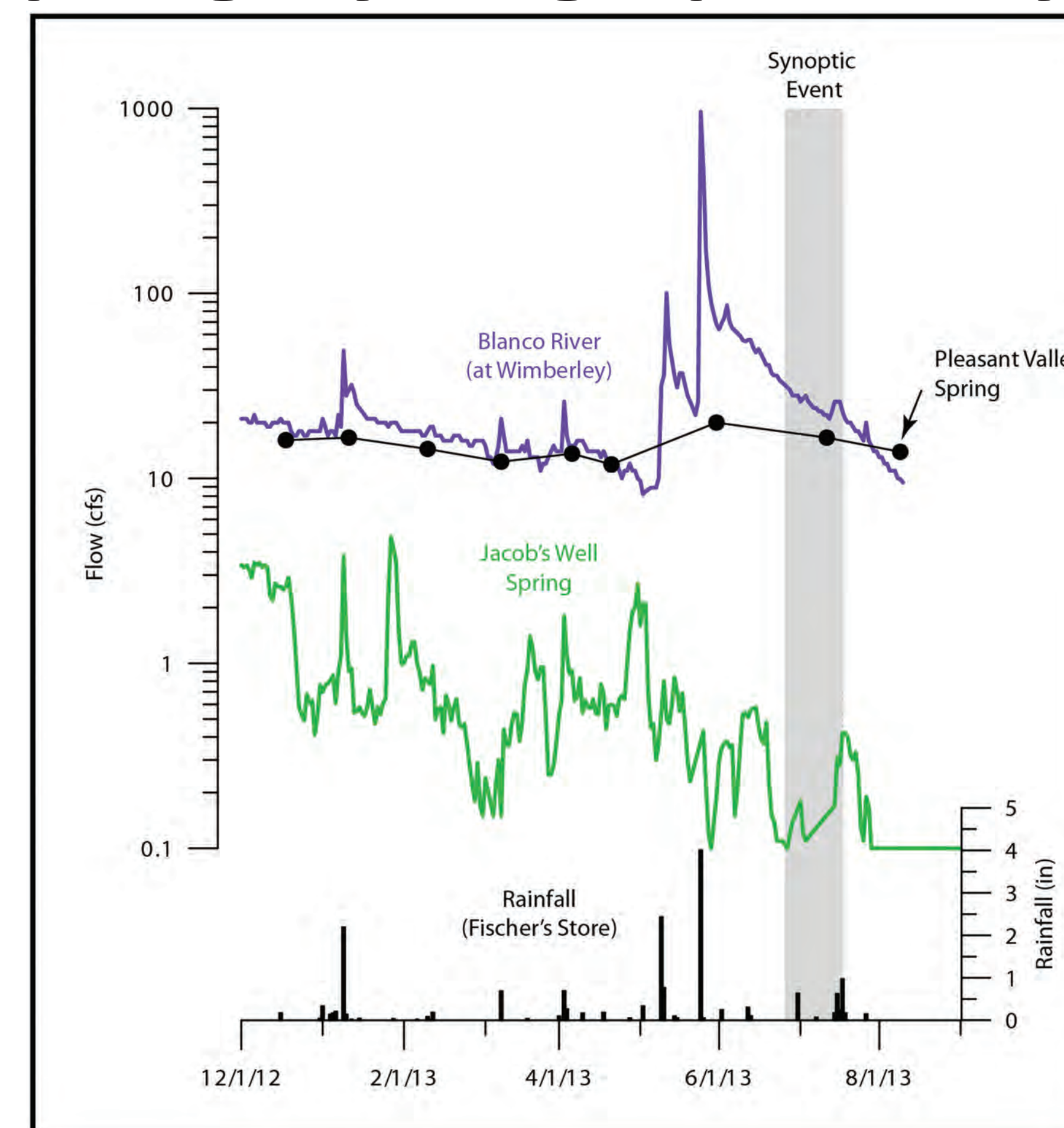


NEXRAD rainfall images from May 24-26, 2013 showing modelled rainfall coverage over the Cypress Creek and Blanco River watersheds during a major rainfall event. Data pulled by M. O. Gary, EAA.

Acknowledgements

A special thanks to the land owners in the Wimberly area who were gracious enough to give us access to their wells for water-level measurements. Monitoring data from the Hay Trinity Groundwater Conservation District (HTGCD) and Wimberly Water Supply Company (WWSC) was integrated into the potentiometric map. NEXRAD rainfall distribution data was provided by the Edwards Aquifer Authority (EAA) and the rainfall figure was created by Robin Gary.

Spring Hydrograph Analysis



Hydrographs of JWS, PVS and the Blanco River prior to the water level measurements (Streamflow and rainfall data from USGS (2013), and NOAA (2013). PVS springflow measured by J. Watson.

Conclusions

- Groundwater flows generally from NW to SE across the extent of the study area
- Potentiometric gradients steepen downgradient of major faults associated with the Balcones Fault Zone, suggesting that faults may be acting as barriers to groundwater flow.
- A small potentiometric ridge present between PVS and JWS suggests a localized groundwater divide between portions of the Blanco River and Cypress Creek watersheds.
- Increased flows at PVS in response to a storm event in the upper Blanco watershed suggests that the watershed is a major recharge source to PVS. Lack of JWS flow response to the same event suggests that the upper Blanco is not a recharge source for JWS under study conditions.

Future Work

Additional potentiometric maps reflecting times of higher and intermediate baseflow conditions are necessary to better understand how groundwater flow in the aquifer changes over time. Geophysical, geochemical, and dye-trace studies would also help to provide a more complete picture of the hydrogeologic setting of the area, as well as determine the extent to which JWS and PVS are connected (or disconnected).

References

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- USGS (U.S. Geological Survey), 2013, USGS Water Data For the Nation: Last accessed online 5 May, 2013 <<http://nwis.waterdata.usgs.gov/nwis>>.
- Wierman, D. A., Broun, A. S., Hunt, B. B., 2010, Hydrogeologic Atlas of the Hill Country Trinity Aquifer, Blanco, Hays, and Travis Counties, Central Texas. Hays-Trinity Groundwater Conservation District, United