



## **FLOW MEASUREMENTS AND GENERAL OBSERVATIONS IN RELATION TO THE PROPOSED DRIPPING SPRINGS WASTEWATER TREATMENT PLANT DIRECT DISCHARGE TO ONION CREEK**

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DR-14-02: March 2014

Staff from the City of Austin, Justin Camp and David Johns, measured flows and made general observations on the main stem of Onion Creek near Dripping Springs on Friday, February 28, 2014. We were escorted on the Kellar Ranch by foreman Andrew Venderlee. Unescorted access to Lucy Hibbert's Ranch was arranged by Dan Wheelus. We began downstream and generally worked upstream. Overall creek length covered was approximately 3.2 miles from just upstream of the westernmost 150 bridge to the upstream property boundary of Lucy Hibbert's Ranch (Figure 1).

### **Background**

A good geologic and groundwater overview report of this area is the Hydrogeologic Atlas of the Hill Country Trinity Aquifer: Blanco, Hays and Travis Counties, Central Texas published in 2010 (Wierman et al., 2010). Our study area along Onion Creek is underlain geologically by the Upper Glen Rose member of the Glen Rose formation of the Trinity Group with alluvial and terrace deposits adjacent to the creek channel (Wierman et al., 2010; Barnes, 1981). An inferred fault is shown (Wierman et al., 2010) crossing the downstream part of the study area where Onion rounds a broad bend and trends northeastward FM150. Staff did not examine the channel throughout this reach for evidence of a fault. The Upper Glen Rose is characterized by interbedded limestone, dolomite, and marl. The Trinity is an important aquifer west of Austin supplying many public and private water wells. Important information regarding the Trinity Aquifer from the Wierman et al. 2010 report includes:

- Groundwater occurs “primarily in fractures, along bedding planes, and in karst features.”
- “Recharge to the Upper Trinity Aquifer is from direct precipitation and infiltration in areas where the aquifer is exposed at the surface.”
- “A significant portion of surficial recharge is discharged into the many intermittent wet-weather streams, including Barton and Onion Creeks.”

Onion Creek as it flows eastward is an important source of recharge to the Barton Springs segment of the Edwards Aquifer (BSEA). The BSEA is tapped by numerous public and private water wells and discharges at Barton Springs, a significant spring containing two endangered species of salamanders. Barton Springs also supplies water to a regionally significant recreational facility (Barton Springs Pool) as well as providing baseflow to the Colorado River.

## **Methods**

Staff used a SonTek FlowTracker acoustic doppler flow meter and methods established by the U.S. Geological Survey (USGS) to manually measure the volume of flow in Onion Creek. Flow velocity (ft/sec) is combined with depth (ft) and width (ft) to calculate creek flow or discharge in cubic feet per second (cfs). Sites were selected based on general spacing along the study reach, access, water depth, and channel cross sections having reasonably uniform bottom conditions.

Conditions during the site visit were conducive for flow measurement with sunny skies and mild temperatures. Reported flow or discharge in Onion Creek at the U.S. Geological Survey operated gage at Driftwood was approximately 4 cfs, well below the long-term median flow of approximately 20 cfs. This site is several miles downstream of the study area but serves to indicate that creek flow conditions and general moisture conditions were below average.

[http://waterdata.usgs.gov/tx/nwis/uv/?site\\_no=08158700&PARAMeter\\_cd=00065,00060](http://waterdata.usgs.gov/tx/nwis/uv/?site_no=08158700&PARAMeter_cd=00065,00060)). As an additional indicator of general moisture conditions, rainfall at Camp Mabry in Austin for 12 and 6 months prior to February 2014 were 38.6 and 23.97 inches, respectively, compared to average annual rainfall of 33.75. The higher than average rainfall prior to February 2014 are skewed by the record rainfall in October 2013 but is not reflected in creek flows at the USGS gage. Two tributaries enter Onion Creek within the area surveyed: Gatlin Creek on the east end and Little Onion Creek on the west end. Flows in these tributaries were not measured.

Limestone bedrock is exposed commonly along the channel bottom and most flow measurements were made in bedrock reaches (Photo 1). Composition of the creek banks may be important in understanding flow measurement results as water may enter these bank deposits during storm events or at locations where the creek channel is partly obstructed by natural or man-made features. The banks were comprised of bedrock on both banks at two of the eight sites, or on one bank at four sites or were comprised of alluvium on both banks at two sites. Creek banks in most areas accessed are comprised of alluvial sediments of varying thickness, generally from a couple of feet to greater than 10 ft. Some possible discharge points were observed in alluvial banks as indicated by vegetation (Photo 2) but no measureable discharges were seen. There are at least five large gravel bars that probably backup creek flow and allow water to move as underflow through channel alluvium toward downstream. Measurement sites were located avoid flow problems from the gravel bars. There are five check dams, low water crossings without culverts or road crossings with culverts (Figure 1, Photo 3). These may influence movement of water into and out of the channel that is especially noticeable in low creek flow conditions.

### **Flow Measurement Results**

Flow measures show an overall gain of 2.7 cfs in creek flow from the upstream end of the study area to the downstream end (Figure 1). Wierman et al. (2010) also documented gaining creek flow in a longer reach of creek that included the current study area. The maximum flow measured was 8.3 cfs at site “On 5” with two measurements greater than 5 cfs further downstream. The most downstream site (On 1) had 3.1 cfs suggesting that there was a significant loss of water (approximately 2.2 cfs) over a one mile reach of creek between sites “On 2” and “On 1”, which is also the area where a fault is inferred from Wierman et al. (2010). Gatlin Creek also joins Onion Creek in this reach so flow losses may be higher than documented in this report if Gatlin was contributing water to Onion as well.

There is a discrepancy in flows from sites “On 4”, “On 5” and “On 3” which suggest an increase in creek flow over a relatively short length of channel (Figure 1). However, “On 5” had much greater flow than “On 3” located 1,100 feet downstream and much greater flow than “On 4” only 650 feet upstream. The gain in flow of 3.6 cfs between sites “On 4” and “On 3” appears valid but the flow at “On 5” appears anomalous at this time. Additional flow measurements should be made to verify these changes.

It is currently unclear where the additional water is entering the creek or where the specific flow losses are occurring and what influences, if any, there are with the locally thick bank alluvial deposits, the numerous faults and fractures and the low water road crossings and check dams. Between sites “On 7” and “On 8”, there is a reach of creek containing very prominent fractures in the bedrock bottom (Photos 4 and 5). These fractures trend N48E and N32W. The probable fault at the upper end of the study area trends N40E (Photo 6). Surface water recharge to the Trinity Aquifer may be locally greater through faults and fractures and these features may also discharge water to the creek under some conditions. A fault is inferred to cross or parallel the lowest reach of the study area (Wierman et al., 2010). Perhaps significantly, the two northwest/southeast trending channel reaches parallel the N32W fracture trends measured in the creek bedrock on Lucy Hibbert’s Ranch and two northeast/southwest trending channel reaches are subparallel to the N38E fracture trend measured on Lucy Hibbert’s Ranch. These suggest possible large-scale geologic structural influence on the creek channel orientation.

A check of historic aerial photos available on Google Earth (<http://www.google.com/earth/>) show several parts of the creek channel containing apparently pooled water. These are visible in aerial photos from April 2006 and February 2009, years with well below average rainfall in Austin. These pools during below-average rainfall periods may indicate sites of spring discharge into the channel or may simply represent deeper points of the channel not yet dry from drought conditions. Rainfall in Austin at Camp Mabry for 12 and 6 months prior to April 2006 was 23.8 and 12.53 inches, respectively, and prior to February 2009 was 15.99 and 6.28 inches, respectively. Average annual rainfall at Camp Mabry is 33.75 inches and is 15.02 inches

in the 6 months preceding April, and 16.12 inches in the 6 months preceding February. Areas of the creek containing water during both drought years include:

- At the creek bend upstream of Lucy Hibbert's road crossing
- Behind Lucy Hibbert's road crossing upstream of site "On 8" which is also where South Onion Creek joins Onion Creek,
- Downstream of the first Kellar road crossing
- Upstream of the second Kellar crossing at site "On 5"

There are several isolated pools in the long straight reach upstream of site "On 2" but the aeriels are not clear enough to show if the same areas contain water in both 2006 and 2009. However, both aeriels do show the channel dry from the confluence of Gatlin Creek to the FM 150 bridge.

One groundwater well was observed on the Kellar Ranch. The well was equipped with a solar-powered pump and a small solar panel array for power and appeared to be only used for supplying a small water trough. This well was probably the same one used in the Weirman et al. (2010) atlas and was referred to as the Flying L well. Specific data on the well is not currently available but based on cross sections in the Weirman et al. (2010) atlas it is completed into the Cow Creek Formation approximately 250-300 ft below ground. Other wells are probably present on both ranches.

### **Conclusions**

Flow measurements indicate an overall gain of 2.7 cfs of creek water from upstream to downstream within the study area. There is gain in flow of 1.5 cfs between sites "On 7" and "On 8" and 3.6 cfs between site "On 4" and "On 3". Creek flow of at least 2.2 cfs is lost between sites "On 1" and "On 2", which is also where a fault is inferred to cross the study area. Numerous faults and fractures visible in the channel may play a significant role in localizing groundwater flow into the creek channel or in recharging the underlying Trinity aquifer as well as influencing the orientation of the creek channel. The locally thick alluvial bank deposits may also contribute water to the creek, receive water backed up behind low water crossings and check dams, or locally route water around portions of the creek channel.

### **References**

Barnes, V.E., 1981. Geologic Atlas of Texas, Llano Sheet. Bureau of Economic Geology, The University of Texas at Austin.

Wierman, D.A., Broun, A.S., and Hunt, B. B. editors (2010), Hydrogeologic Atlas Of the Hill Country Trinity Aquifer, Blanco, Hays and Travis Countries, Central Texas.

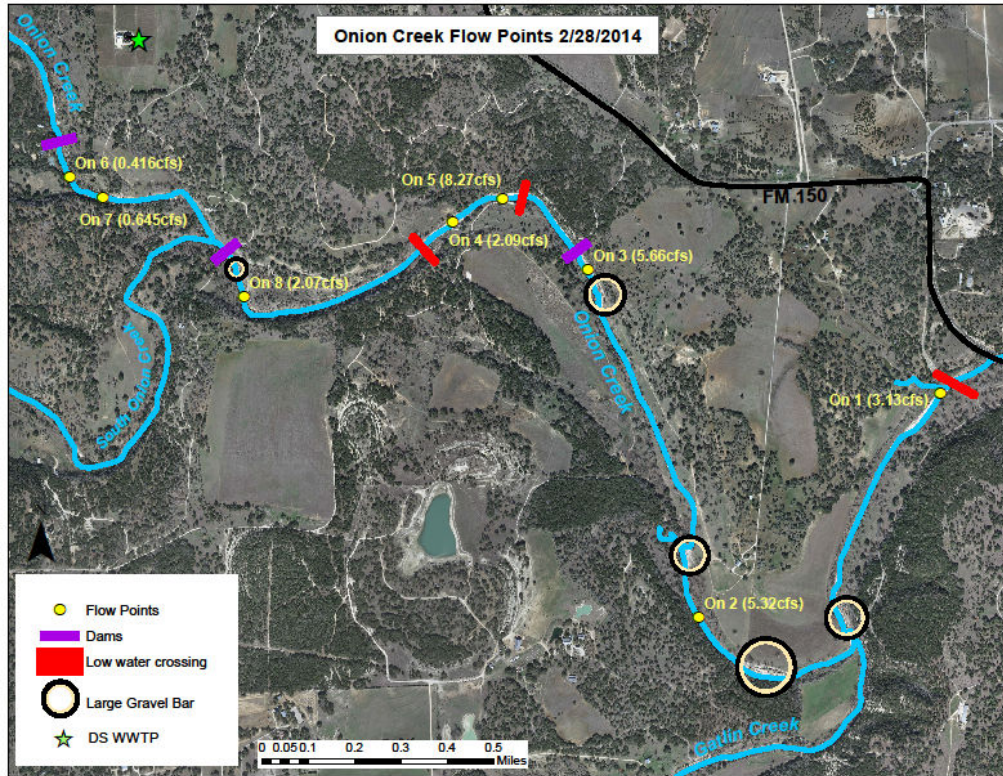


Figure 1. Aerial image of the study area showing results of manual creek flow measurements from February 28, 2014 as well as significant channel features such as road crossing, dams, and large gravel bars.



Photo 1. Site “On 1” showing limestone bedrock channel and banks.



Photo 2. Site “On 2” showing limestone channel bottom and a steep alluvial bank. The alluvial bank appears to have local vegetation that may indicate groundwater seepage to the creek.



Photo 3. Site “On 3” showing limestone bedrock channel bottom and bank. The check dam is approximately 4 ft high.



Photo 4. Limestone bedrock with prominent fractures trending N48E and N32W which are visible on aerial imagery in Photo 5.



Photo 5. Aerial image showing Onion Creek with clearly visible fractures in the limestone bedrock channel bottom on Lucy Hibbert's Ranch near the upstream end of the study area. Photo 4 was taken from the north bank in this creek reach.



Photo 6. Possible fault trending N40E crossing the Onion Creek channel near the upstream end of the study area. The amount of displacement was not determined. Several small faults exposed immediately downstream show displacement of less than one foot. The creek flows from left to right.