Geochemical Indicators of Urbanization in the Bull Creek Watershed

Balcones Canyonlands Preserve – Permit Report

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Introduction

In the Austin, TX area, it has been observed that $^{87}Sr/^{86}Sr$ correlates strongly with both physical and chemical indicators of urbanization (e.g. median structure age and F mg/L) when comparing average streamwater compositions from various watersheds in the Austin area. $^{87}Sr/^{86}Sr$ of streamwater in urbanized watersheds is reflective of the higher values found in Austin municipal water, whereas $^{87}Sr/^{86}Sr$ in streamwater from rural watersheds falls close to the lower values typical of the cretaceous limestone bedrock in Austin, indicating that municipal water influx to natural streamwater is a dominant process in the urbanized watersheds of Austin (Christian et al., 2011).

Current research is examining municipal water influx on the scale of a single watershed – the Bull Creek watershed – as the urbanization pattern within this watershed has created a pronounced gradient with respect to land use (*Figure 1)*. Tributaries within the BCP are sampled to provide contrast with the more heavily urbanized tributaries that drain to Bull Creek, as one of the BCP tributaries drains a relatively large area with few major roads.

Methods

Streamwater samples (~ 250 mL) are collected from two sites on the BCP (*Figure 1, Table 1)* on both March 7th, 2013, and June 20th, 2013. Samples are separated for analysis in the following categories: $^{87}Sr/^{86}Sr$ and cations (filtered, acidified), anions (filtered through Ca&Mg/Na exchange filters, stored at 4°C) & alkalinity (raw, collected with zero headspace, stored at 4°C). $^{87}Sr/^{86}Sr$ is measured via TIMS and analyzed in alongside NBS987, with typical standard error of 6×10^{-6} over 160 analyses. Cations are analyzed via ICP-Q-MS, anions Cl & SO_4 are analyzed via HPLC, and F measured via LaF_3 ISE, where standards are held to ±10% analytical agreement with analytical curve, and duplicates are held to ±5%. Spike recoveries for cation analyses are measured for matrix interference and held to a ±15% recovery. Alkalinity (reported as HCO_3 mg/L) samples are titrated with a 0.1 N H_2SO_4 solution to an endpoint of pH=4.5 ± 0.1. Field blanks are collected for each collection trip and held to be <5% of field samples for all cation and anion parameters.

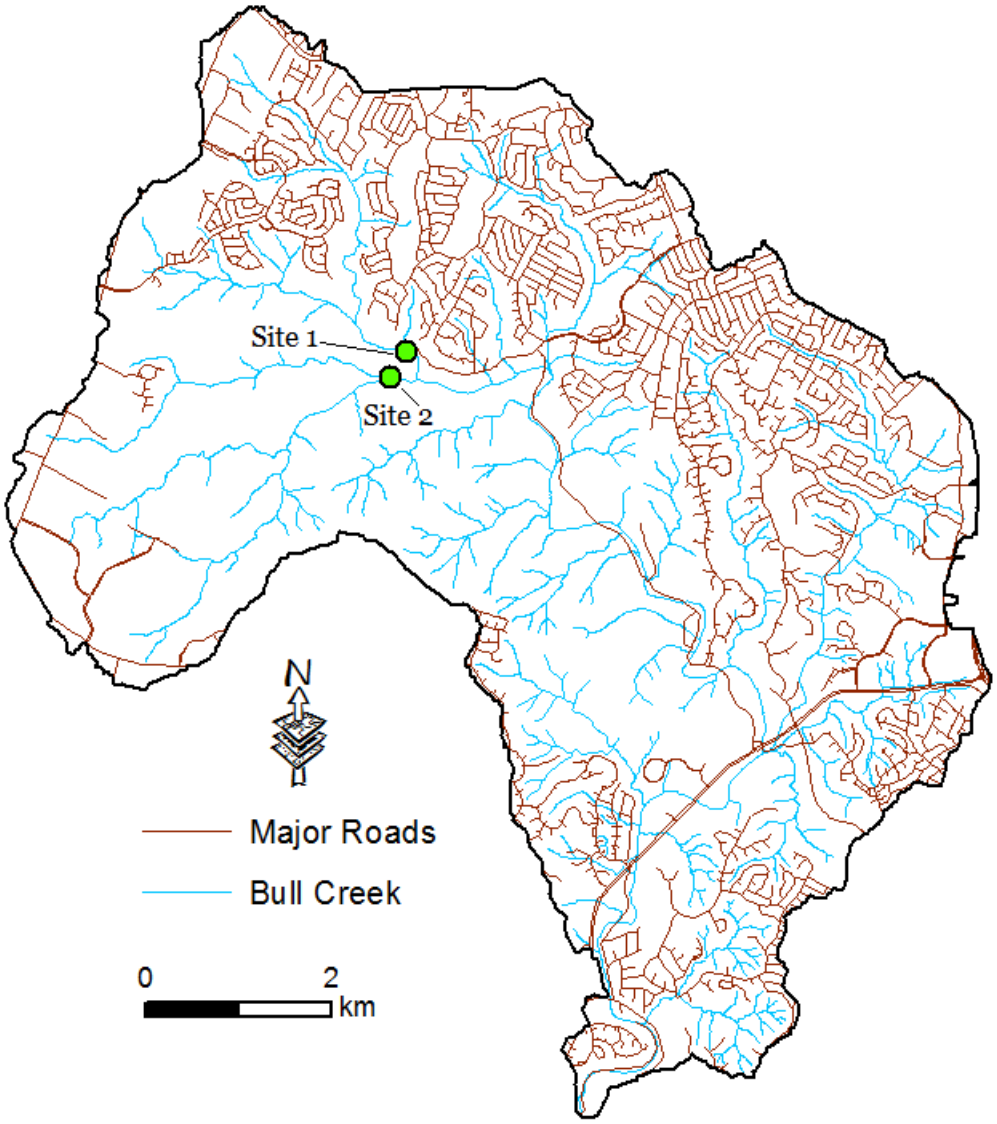

Figure 1. The Bull Creek watershed as delineated by local topographic maxima, including road lines and major creek segments. Sample sites are shown as green circles. GIS data comes from the City of Austin and the Capital Area Council of Governments.

Results

Site 1

Latitude	*Longitude*	*Date*	*Time*	*T (°C)*	*pH*	*sC (µS/cm)*	*HCO_3 (mg/L)*
30.4218	-97.8090	03.07.13	13:40	14.7	7.9	767	324
30.4218	-97.8090	06.20.13	08:47	n.m.*	7.9	854	333

Site 2

Latitude	*Longitude*	*Date*	*Time*	*T (°C)*	*pH*	*sC (µS/cm)*	*HCO_3 (mg/L)*
30.4193	-97.8109	03.07.13	13:30	17.2	7.6	547	312
30.4193	-97.8109	06.20.13	08:40	n.m.*	7.8	588	322

n.m.*-not measured

Table 1. Field data from both sites on the March and June collections of 2013.

Data Analysis

Site 2 offers 30% lower conductivity, yet only 5% lower bicarbonate among March and June samples when compared with site 1 (*Table 1*). Lab analysis of collected samples for outstanding parameters (listed in the methods section) will be complete and accessible with the publication of Jeff Senison's master's thesis in 2014.

Conclusions

The variation in conductivity between site 1 and site 2 does might not be explainable by limestone dissolution processes, based upon the minimal difference in bicarbonate between the two sites, among both March and June samples. This suggests another source for the excess ions found in site 1. The drainage basin for site 1 is roughly half-urbanized, whereas the watershed for site 2 exhibits a sparser pattern of development (*Figure 1*). Analysis of specific ions and isotope ratios from all sampled urban and rural tributaries along Bull Creek will help to identify the sources of the dissolved constituents in both BCP tributaries.

References

Christian, L.N., Banner, J.L., and Mack, L.E., 2011, Sr isotopes as tracers of anthropogenic influences on stream water in the Austin, Texas, area: Chemical Geology, v. 282, no. 3-4, p. 84–97, doi: 10.1016/j.chemgeo.2011.01.011.