High Frequency Sampling of Campus Creek RSC system

Affects of precipitation on water chemistry in the Campus Creek RSC system.

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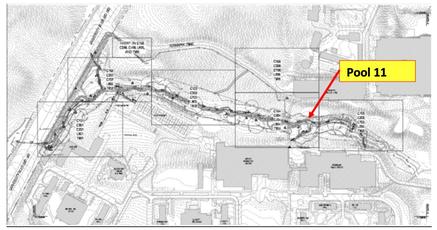
Introduction

Urban runoff has increased the concentrations of limiting nutrients, dissolved metals, and dissolved organic matter (DOM) in waterways that have created problems for watersheds and our health (Kaushal et al., 2014). Regenerative Stormwater Conveyance Systems can help reduce these concentrations but need to be better understood.

Figure 1: Schematic of the Campus Creek RSC system.
Samples were drawn from Pool 11. Its adjacent riffle weirs were also sampled (UMD Campus Creek Stream Restoration Design Build, Proj. No: 14-659-056-00 QC 14484). Samples were drawn in October 2020 and February 2021



The Campus Creek RSC system has 18 pools and is approximately 700m in length.

Motivations for this Study

i. Does the day and night cycle affect concentrations of P, Fe, Mn, and microbial activity?
ii. How effective is the Campus Creek RSC in immobilizing, retaining, and releasing nutrients, metals, and dissolved organic matter?
iii. How do rain and rain-on-snow (ROS) events affect water quality?

Methods

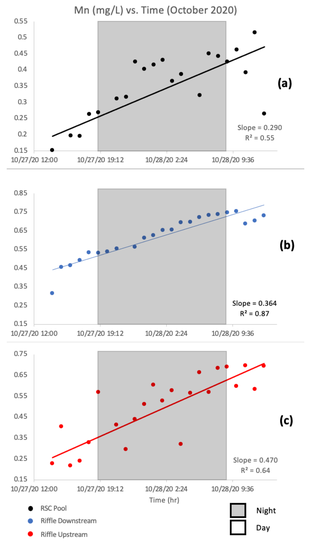
Water samples were collected from Campus Creek during October 2020 and February 2021. Samples were collected during the day and night with the help of automated sampler.

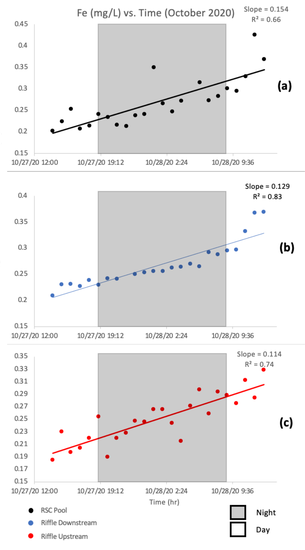
Table 1: Summary of times and equipment used for the October 2020 and February 2021 Data.

Date of Collection	October 2020	February 2021
Sample Location	Upstream, Downstream riffle weirs, & RSC Pool 11	Upstream Riffle Weir & RSC Pool 11
Time Between Samples Collection	1 hour	2, 3, and 4 hours
Equipment	Spectrofluorometer & ICP-OES	Oakton pHtestr Model 50 pH meter & Spectrofluorometer

Results

Figure 2: Concentrations (mg/L) of dissolved ions Fe^{2+} and Mn^{2+} vs time (October 27th, 2020). Dissolved Fe^{2+} (Left) and Dissolved Mn^{2+} (Right).





Concentrations of Fe^{2+} and Mn^{2+}

- A linear increase in concentrations Fe^{2+} and Mn^{2+} was observed over the 24-hour period in the upstream, downstream riffle weirs and RSC pool 11.
- Concentrations of Fe^{2+} and Mn^{2+} did not exceed 1 mg/L, which is a safe concentration.
- Concentrations of Mn^{2+} increased higher in the riffle weirs than the RSC pool (Left).
- Concentrations of Fe^{2+} increased higher in the RSC pool than the riffle weirs (Right).
- **No observable diurnal cycle in concentrations of biological redox sensitive elements (Fe^{2+} and Mn^{2+}).**
- **Dissolved Fe^{2+} and Mn^{2+} are being released after a rain event by urban runoff or microbes.**

Figure 3: FI, HIX, BIX, and PH for (Feb 11th – 15th 2021).

What Microbial Indices Tell Us!

FI: Is a measure of the source of DOM.
BIX: Indicator of how biologically fresh the DOM is
HIX: Provides information on the humifaction of the DOM.
PH: Ratio of protein-like to humic-like DOM.

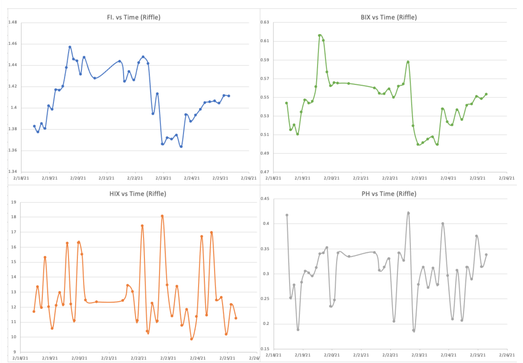


Figure 4: FI, HIX, BIX, and PH for (Feb 18th – 25th 2021).

How They Tell Us!

FI: Terrestrial (1.4), Microbial (1.9).
BIX: Terrestrial (<0.7), Algal (0.8-1.0), Aquatic Bacteria(>1.0).
HIX: Clean water (0.3), Sewage Impacted (2.0) (Ghervase et al., 2010).
PH: Less Protein-Like (<0.5), More Protein-Like (>0.5).

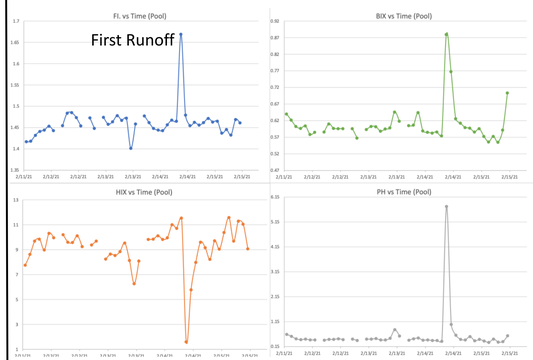
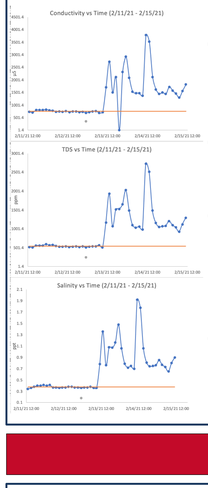
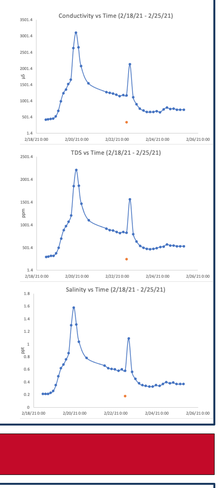


Figure 5: Conductivity (Top), TDS (Middle), Salinity (Bottom) in response to Snow events. February 11th, 2021 (Right) and February 18th, 2021 (Left).



Conductivity, TDS, and Salinity

- Peaks in Cond., TDS, and Salinity in response to road salt assisted snow melt.
- Conductivity, TDS, and Salinity are higher in Winter Months.
- 2-hour sample intervals (Left) when compared to 3 &4-hour intervals (right) has more variability.
- Does not return to baseline. **RSC take longer than 4 days to flush out salts (Return to Baseline).**



Conclusions

- No observable diurnal cycle in Mn^{2+}, Fe^{2+}, and microbial indices.
- Rain and snow events can create large changes in water chemistry. Concentrations of metal ions increase after rain events. Conductivity, TDS, and Salinity peaked during a snow event.
- Fe^{2+} and Mn^{2+} are released by runoff or microbial activity. Salts are retained for a minimum of 4 days. No immobilization of nutrients was observed.
- Analyze February 2021 data with ICP-OES and TOC for concentrations of trace elements, carbon, and nitrogen.

Acknowledgements and References

Kaushal, S.S., Mayer, P.M., Vidon, P.G., Smith, R.M., Penino, M.J., Newcomer, T.A., Duan, S., Welty, C., Belt, K.T. (2014). "Land use and Climate Variability Amplify Carbon, Nutrient, and Contaminant Pulses: A Review with Management Implications." *Journal of the American Water Resources Association.* 50 (3): 585-614.

University of Maryland Campus Creek Stream Restoration Design Build. Project No. 14-659-056- 00 QC 14484. April 25th , 2018.

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