WATER QUALITY MONITORING OF CAMPUS WATERSHEDS: SETTING A BASELINE FOR TANYARD CREEK, LILY BRANCH, AND LAKE HERRICK

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Abstract. Headwater streams are heavily influenced by their surrounding watersheds due to their small size. These small streams are also prone to low water quality and short hydrologic residence times. These problems can stem from combined sewage-stormwater systems leaking, historic septic systems, stream channelization, and impervious surface runoff. Our objective was to provide baseline monitoring data on two urban headwater streams on the University of Georgia campus: Tanyard Creek and Lily Branch. These two campus streams were monitored over the for approximately 7 months (August 2015 – December 2015, February 2016 - April 2016). Preliminary results from a shorter pilot monitoring study on Lake Herrick from August 2016 through October 2016 is also reported. The streams are both highly developed and have substantial buried reaches. Each week, temperature, specific conductivity, dissolved oxygen, pH, turbidity, and nutrient concentration (nitrate, nitrite, phosphate, and ammonium) were measured. Data collected from Tanyard Creek and Lily Branch had similar water quality, except for specific conductivity. In Lake Herrick, spikes in physical parameters were associated with spikes in nutrient parameters.

INTRODUCTION

A watershed is an area of land that captures water in any form, such as precipitation, snowmelt, or dew and drains it to a common body of water, like a stream, river, lake, or the ocean (DeBarry 2004). Watersheds have five primary functions: (1) collection of water, (2) storage of water in soil, streams vegetation, and wetlands, (3) discharge of water from the basin, (4) definition of the characteristics of the surrounding aquatic & terrestrial habitats, and (5) a medium for chemical reactions and buffer against the impacts of environmental changes (Black 1997).

In urban watersheds, headwater streams are often highly impacted and have low water quality. Leakage from combined sewage-storm water systems, historic septic systems, and impervious surface runoff pose threats to urban stream water quality (Platt 2006), this is especially evident in small headwaters, such as Lily Branch and Tanyard Creek in Athens, Georgia. Impacts are also observed in urban basins, such as Lake Herrick in Athens, GA. Our objective is to provide baseline monitoring data on these two urban headwater streams and one urban basin that as preliminary studies that may inform restoration of these waters at UGA.

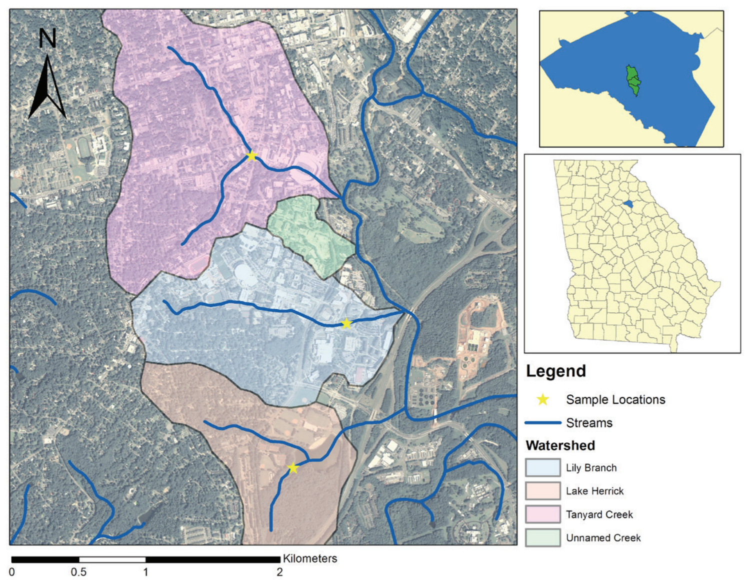

Figure 1. University of Georgia watersheds.

METHODS

Two small, highly impacted headwater streams, Lily Branch and Tanyard Creek, and one urban basin, Lake Herrick, were monitored for physical and chemical water quality (Figure 1). Samples from Lily Branch and Tanyard Creek were taken once a week from October 2015 to April 2016. Samples from Lake Herrick were taken once a week from August 2016 to October 2016. A quanta multi-probe was used to measure temperature, pH, dissolved oxygen, and specific conductivity in Lily Branch and Tanyard Creek. An Oakton multi-probe was used to measure specfic conductance and temperature in Lake Herrick. A LaMotte colorimeter was used to measure nitrate, nitrite, phosphate, and ammonia levels through colorimetric reaction methods in both studies. A La Motte turbidimeter was used to measure turbidity in both studies.

Water quality data was plotted and analyzed for the two streams using Matlab 2014a. Boxplots and t-tests were used to compare paramter values in the two streams. Time series of the Lake Herrick data were created in Microsoft Excel 2016.

RESULTS AND DISCUSSION

Tanyard Creek and Lily Branch had similar water quality except for specific conductivity (Figure 2). Both streams are in heavily urbanized watersheds which would mean that similar water quality is not unexpected. However, differing conductivity values is interesting and may be worth further study.

Lake Herrick was measured over a smaller timescale (one month versus 9 months) but slight changes in the parameters over time were seen (Figure 3). Nitrite and ammonia followed similar patterns while phosphate and nitrate had similar trends.

In Lily Branch, phosphate correlated with both turbidity and specific conductivity. In Tanyard Creek, both temperature and specific conductivity correlate with phosphate. Additionally, turbidity correlated with dissolved oxygen and pH correlated with specific conductivity. In Lake Herrick ammonia correlated with turbidity. Additionally, temperature was correlated with both phosphate and pH in Lake Herrick.

These analyses may indicate that rapidly measured physical parameters could be used to monitor nutrient and chemical parameters in Lake Herrick. Further investigation is needed but these preliminary results are promising. This will be particularly useful to future studies on Lake Herrick that are currently collecting these same parameters in real time as part of the Watershed UGA initiative.

CONCLUSIONS

Tanyard Creek, Lily Branch and Lake Herrick all contribute to the Oconee River and should be included in restoration goals for this watershed. Toward that goal, we provide baseline data on these water bodies that can be used as a preliminary dataset to inform further studies and small restoration projects within these watersheds.

Relationships among parameters were determined and showed that specific conductance, temperature and turbidity could have potential for use as monitoring targets. These physical parameters are simple to measure and each was correlated to one or more of the less easily measured target variables in each water body. Although we recommend further study.

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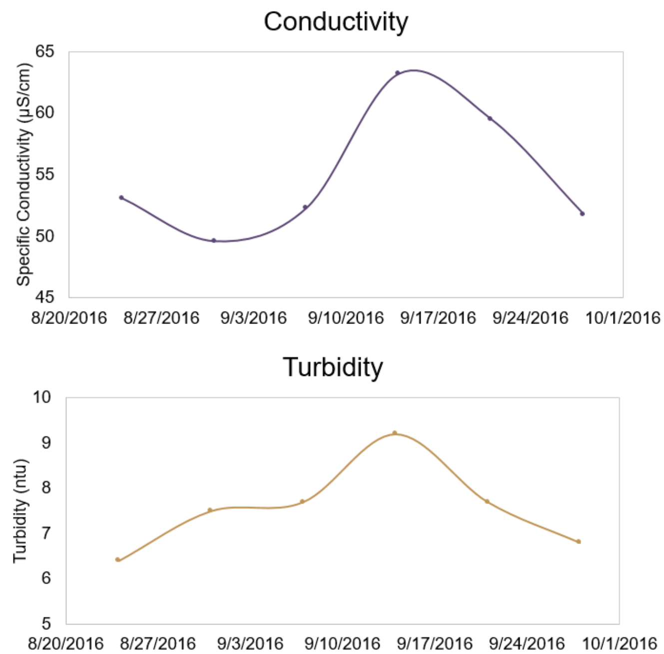
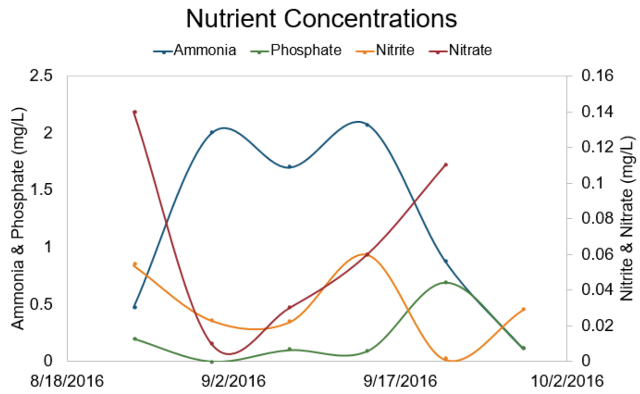


Figure 2. Conductivity was higher in Lily Branch than Tanyard Creek. All other parameters were similar despite the differences in variability for ammonium and nitrate. Similar variability was observed for most parameters.



Figures 3. Ammonia and nitrite followed similar patterns as well as phosphate and nitrate being similar in their trends. Conductivity and turbidity spiked at the same time during the October 2016.

Table 1. Parameter correlations for Lily Branch.

Parameter	Specific Conductivity		Turbidity		Temperature	
	r-value	p-value	r-value	p-value	r-value	p-value
Nitrite	0.197	0.501	-0.331	0.247	0.329	0.251
Nitrate	0.163	0.577	-0.373	0.189	-0.221	0.448
Ammonia	-0.545	0.054	0.638	0.019	-0.051	0.868
PO4	**-0.558**	**0.031**	**0.661**	**0.007**	0.336	0.220
DO	0.085	0.773	0.006	0.984	-0.359	0.207
pH	0.084	0.767	-0.074	0.794	-0.365	0.181

Table 2. Parameter correlations for Tanyard Creek.

Parameter	Specific Conductivity		Turbidity		Temperature	
	r-value	p-value	r-value	p-value	r-value	p-value
Nitrite	0.324	0.258	-0.291	0.335	0.337	0.238
Nitrate	0.440	0.115	-0.069	0.822	-0.145	0.621
Ammonia	0.143	0.641	0.507	0.077	-0.120	0.696
PO4	**-0.519**	**0.048**	-0.103	0.726	**0.563**	**0.029**
DO	0.016	0.958	**0.554**	**0.049**	-0.291	0.313
pH	**-0.578**	**0.024**	0.501	0.068	0.115	0.683

Table 3. Parameter correlations for Lake Herrick.

Parameter	Specific Conductivity		Turbidity		Temperature	
	r-value	p-value	r-value	p-value	r-value	p-value
Nitrite	0.231	0.660	0.164	0.755	0.449	0.371
Nitrate	0.116	0.827	-0.434	0.466	-0.650	0.162
Ammonia	0.531	0.279	**0.882**	**0.020**	0.168	0.750
PO4	0.441	0.322	-0.044	0.934	**-0.969**	**<0.001**
pH	-0.395	0.380	-0.552	0.256	**0.761**	**0.047**