Analyzing Daily Variability in *E. Coli* Concentrations in an Urban Stream

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Introduction

A critical issue in urban streams is increased levels of *E. coli* due to anthropogenic sources. In the city of Buffalo, NY these sources are due to an aging waste water infrastructure, which has a combined storm water and sewer system. One creek that is heavily impacted by increased *E. coli* due to combined-sewer overflows is Scajaquada Creek. In 1921, as development in the city increased, Scajaquada Creek was diverted underground. The creek now flows in a tunnel under Buffalo for four miles and then emerges again in Forest Lawn Cemetery. In this experiment, our goal was to determine the sources of *E.coli*, and mechanisms which might account for variability in *E.coli* within Forest Lawn Cemetery. Potential variability in these concentrations were thought to have come from photo degradation and dilution. These potential drivers were investigated over a 24 hour sampling period at locations with variable contributions of sun light and tributary sources of water.

Figure 1. Scajaquada Creek sampling locations A, B, and C under typical flow conditions

Methodology

Water samples were collected in Forest Lawn Cemetery along a 2-mile stretch of Scajaquada Creek, with background sampling conducted over four month period (May – Aug 2015). Fine scale sampling was taken every two hours over a 24 hour period. Escherichia coli (*E.coli*) water samples were taken in five different locations along the stream. After the samples were taken, Coliert was added to the samples, and the samples were placed in a Quanti-Tray for quantification of E.coli and fecal coliforms (ISO standard 9308-2:2012). Samples were incubated for 24 hours at 35°C. After 24 hours samples were placed under a florescent light; the cells that glowed were considered to have *E.coli.*

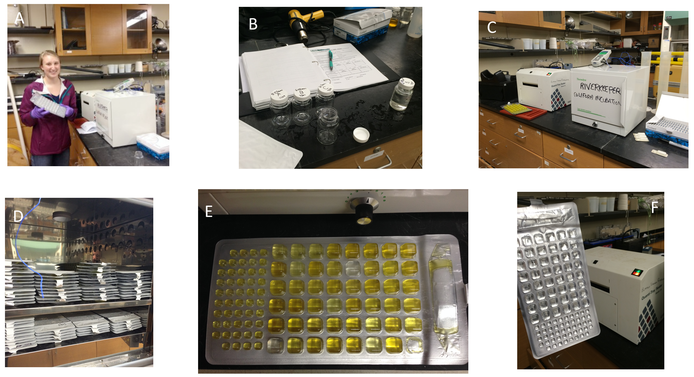


Figure 2. Equipment used for testing E. Coli (A): Sample bottles (B), Laminator and incubator (C), 24 hour samples in incubator (D), Positive count Quanti-tray (E), Field blank Quanti-tray (F).

Results

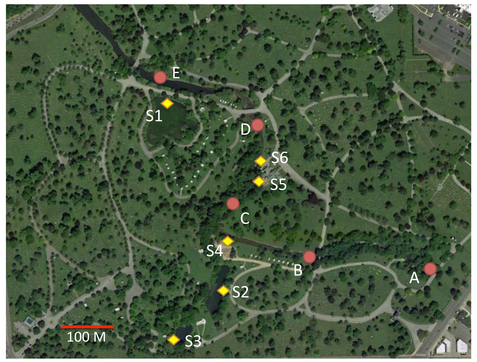


Figure 3. Site map of Scajaquada Creek. Red dots represent stream sampling locations. Yellow diamonds represent sampling locations of external drains and ponds.

Spatial Distribution of *E. coli*

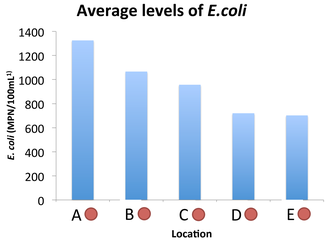


Figure 4. Spatial distribution of *E.coli* within Scajaquada Creek.

External Sources of Water Entering Stream

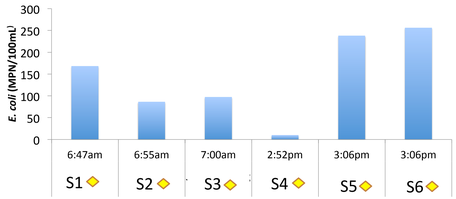


Figure 5. Levels of *E.coli* from external sources of water entering the stream show lower concentrations as compared to the main channel of the stream. The largest concentration appear to enter the stream along the eastern bank.

24-Hour Sampling Results

The results were highly variable at the outlet of the tunnel (location A) and there was no significant pattern in the changes of *E.coli* levels throughout the 24-hour period. Results show small diel fluctuation in *E.coli* concentrations only at the downstream sampling locations (D and E).

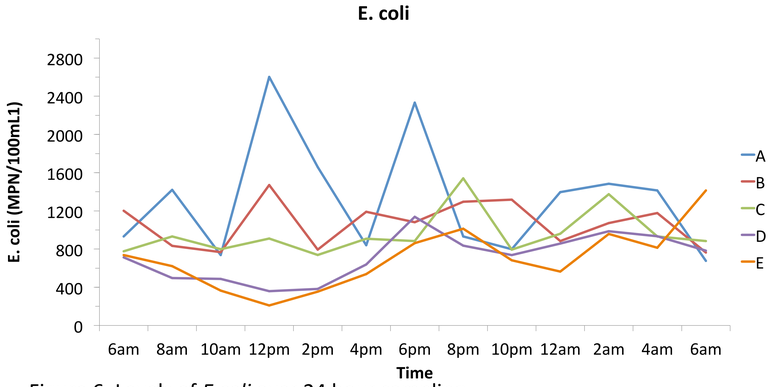


Figure 6. Levels of *E.coli* over 24 hour sampling.

Results, continued

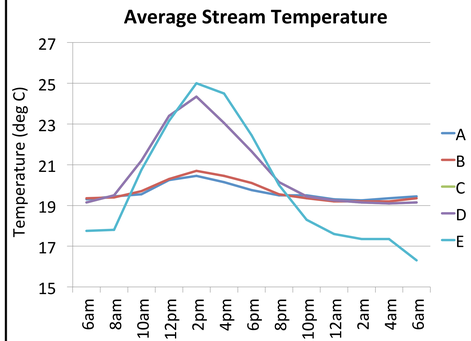
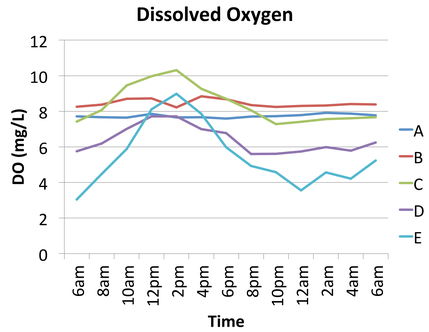


Figure 7. Temperatures rose during the day and were highest at around 2pm. Variability in stream temperature increased moving down stream from the culvert as surface water was more exposed to the sun.

Figure 8. Dissolved Oxygen is higher during the day because photosynthesis is needed to produce DO, and sunlight is required for photosynthesis to occur. Dissolved oxygen is consumed during the night by aquatic animal respiration in the creek, which is seen in the results.



Conclusions

Average levels of *E.coli* decrease moving downstream from the outlet of the culvert, indicating the source of *E.coli* is likely coming from inside the culvert. Levels of *E.coli* in tributary pipes and drains entering Scajaquada Creek were found to have lower concentrations, indicating that the water from these openings may dilute the *E.coli* concentrations in the main channel. These results may partially explain the lower levels of *E.coli* further down the stream. Results from the 24 hour sampling show small diel fluctuation in *E.coli* concentrations only at the down stream sampling locations. These diel trends support the idea of limited photo degradation, which resulted in a change of 800 MPN/ 100mL change in concentrations at the lower site (Site E). This photo degradation is superimposed on the dilution signal resulting in the observed reduction in *E.coli* along the stream reach.

Figure 9. Water samples taken at 12am

Acknowledgements

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References

Coliert Quanti-tray and presence/absence methods for total coliforms and *Escherichia Coli*- Appendix C3- Ohio Water Microbiology Laboratory (data collection sheet form).