Appendix C: Additional Water Quality Data

Water Quality Analysis for the Souhegan Watershed: A decade of *E. coli* Trends Measured by Citizen Scientists

An analysis of *E. coli* contamination levels across the Souhegan River watershed that focused on data collected by citizen scientists from the Souhegan Watershed Association (SWA) shows an effect of precipitation on *E. coli* presence. SWA data stretches back to 1998 and is a significant investment by local stakeholders in the health of the Souhegan River and shows a local focus on water quality. Even though data is available from 1998 this analysis was performed from 2012 to 2022 (months of June, July, August and September) limited to the years precipitation data was available, excluding 2020 due to COVID-19. Precipitation was measured in Greenville as a proxy for the watershed. Study includes 62 sampling days and 1,118 *E. coli* samples collected across multiple sites. Only data collected on days with available precipitation records or *E. coli* measurements were used. This study identifies patterns in contamination levels and correlations with precipitation events.

Methods

The Souhegan Watershed Association has its samples evaluated by Municipal Wastewater Treatment Plant (WWTP) Labs in the watershed. These labs monitor the wastewater effluent dumped into the river for some of the same parameters that SWA tracks for the river itself. The following labs have at one time or another performed SWA lab work: Milford, Nashua, Merrimack and Manchester.

The *E. coli* bacteria levels are quantified with the same toolset at all labs. They all use IDEXX Quanti-Tray systems. The human sample process effort takes a few minutes. After 24 hours incubation the system provides bacterial counts within 95% accuracy. The labs then digitally forward the data to SWA. This program is dependent on the labs providing quick-no-cost service.

Key Findings

1. Correlation Between Precipitation and *E. coli* Levels

    - Analysis shows a significant relationship between precipitation events and *E. coli* levels across many sites. This is reflected in mean *E. coli* value measured for each collection day at all the sites (Figure B-1). Many sites showed a positive correlation between precipitation and *E. coli* counts (Figure B-2, Figure B-3, Figure B-4), indicating a moderate to strong link between rainfall and elevated *E. coli* levels.

    - This pattern of higher *E. coli* counts due to rainfall events suggests stormwater runoff is a significant driver of non-point source contamination in the Souhegan River. Following rainfall, runoff likely transports contaminants from various sources such as septic overflows, agricultural areas, impervious surfaces, and disturbed landscapes into the river.

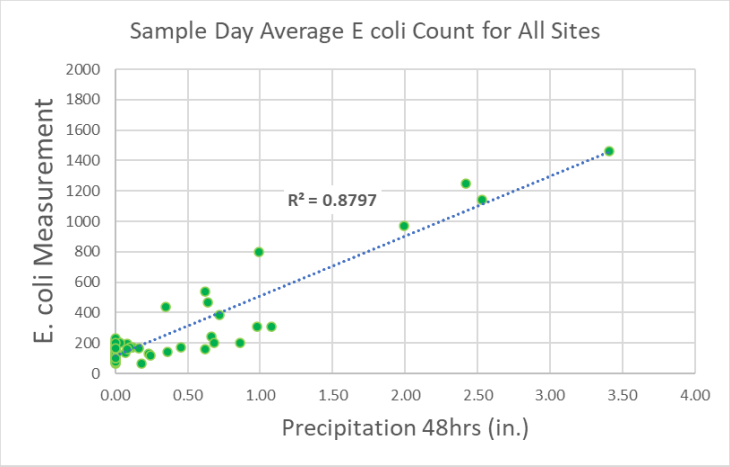

Figure B-1 Average *E. coli* value on day of collection for 20 Souhegan River sites

2. Site Variability

- Some sites along the river demonstrate unique contamination profiles that are less influenced by precipitation, indicated by their lower R-squared values. This suggests that other local factors, such as direct human activity, proximity to WWTPs, or wildlife, may play a more prominent role in these areas.

Implications for Corridor Management

1. Targeted Stormwater Management

- Based on the strong correlation between rainfall and *E. coli* levels, particularly at sites with high R-squared values, improving stormwater infrastructure near these areas could reduce contamination. Strategies could include septic remediation, controls for agricultural runoff, expanding riparian buffers, and promoting pervious surfaces to reduce runoff velocity and pollutant load.
- High-Risk Sites for Focused Intervention: Sites such as the Boston Post Road Canoeport and Beaver Brook in Amherst, and Watson Park in Merrimack could benefit from targeted investigations including DNA investigation to trace the sources of *E. coli* contamination. These areas have consistently high contamination levels that are exacerbated by rainfall, indicating that localized runoff controls could be effective.

2. Community Involvement and Education

- The engagement of SWA's citizen scientists has been important in gathering this extensive dataset, highlighting the need for public involvement in watershed health monitoring. It is recommended continuing and expanding community outreach to foster greater awareness and encourage best practices to prevent pollution.
- Outreach and engagement could also provide opportunities for public education, with material particularly focused on reducing runoff from residential and recreational areas during storm events.

Recommendations

1. Enhance Stormwater Management Measures

- Expand the use of green infrastructure at high-risk sites to mitigate contamination from runoff. For example, rain gardens and extended vegetated buffers could help intercept and filter pollutants before they reach the river.
- Investigate the feasibility of low-impact development practices for new or ongoing developments within the watershed to minimize impervious surfaces and reduce runoff-related contamination.

2. Continue Long-Term Monitoring and Expand Predictive Modeling

    - Long-term monitoring should continue with support from citizen scientists. Additional variables, such as flow rate or land use changes, could improve predictive accuracy.
    - The Negative Binomial model has shown to be a useful predictive tool for understanding contamination drivers. Estimates of rainfall could yield expected *E. coli* increases. Further model refinement, possibly incorporating other seasonal effects such as temperature and localized factors such as land use or contamination zones, could better inform management strategies and public health.

Conclusion

This citizen-scientist data-driven assessment underscores the importance of targeted watershed management interventions to address *E. coli* contamination, particularly during rainfall events. By implementing stormwater controls, continuing community-driven monitoring, and prioritizing high-risk sites, water quality in the Souhegan River can be better protected, supporting both environmental health and safe public enjoyment. Additionally, the data collected by SWA citizen scientists serves as a powerful foundation for these efforts and reflects the value of community involvement in preserving the Souhegan River's water quality.

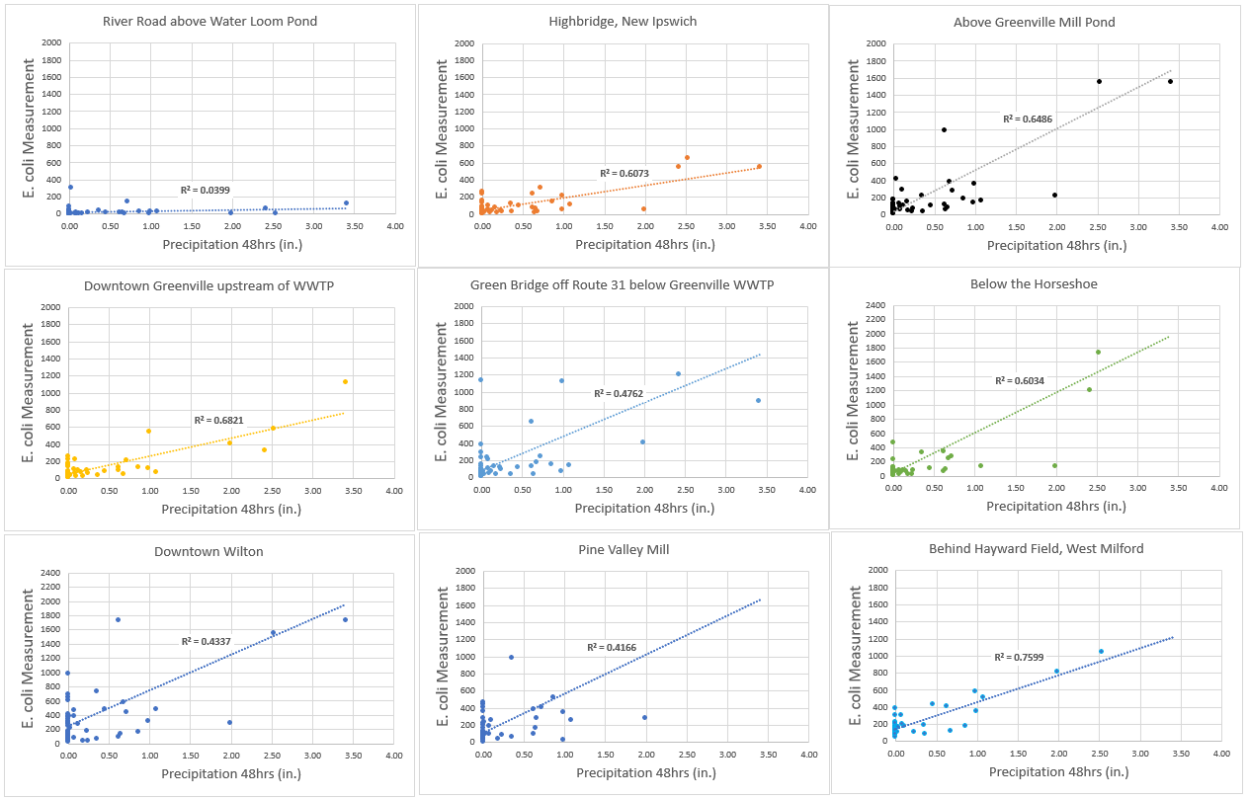

Figure B-2. *E. coli* and precipitation measurements for 9 sites in the Souhegan River watershed

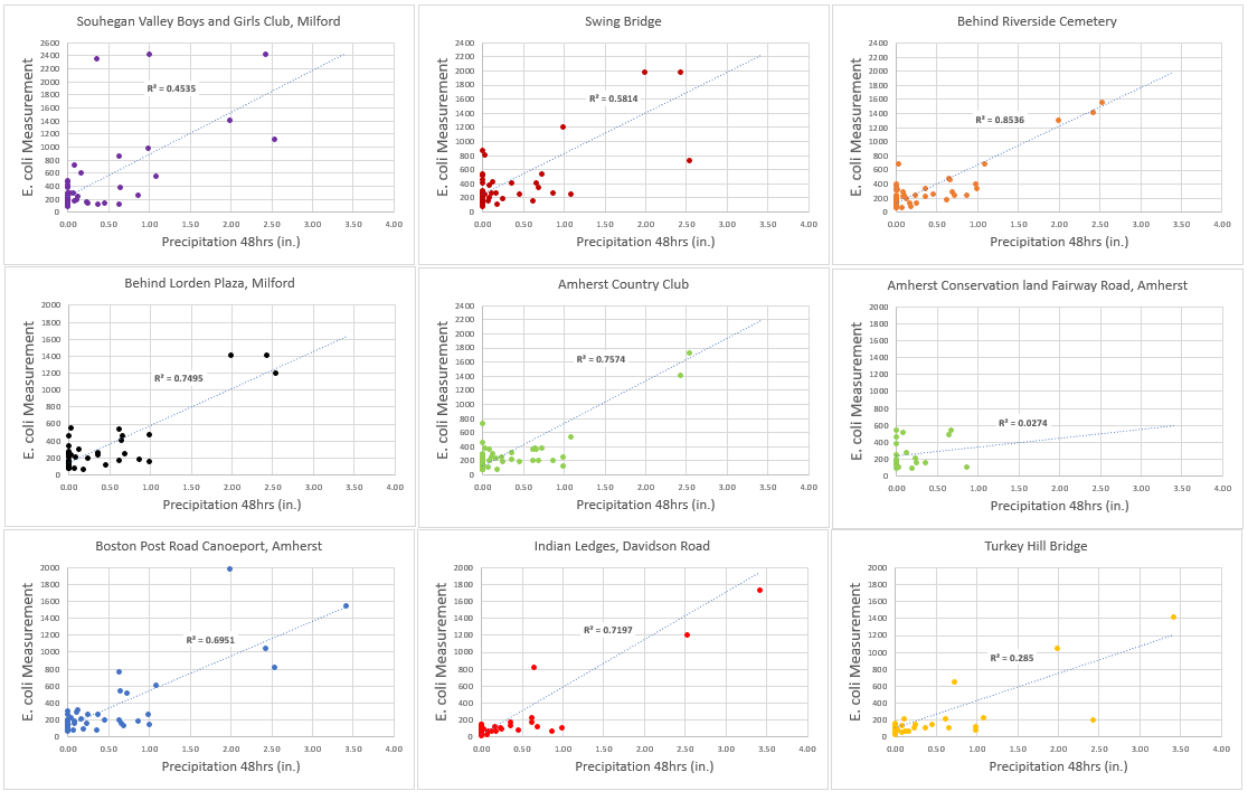

Figure B-3. *E. coli* and precipitation measurements for 9 sites in the Souhegan River watershed

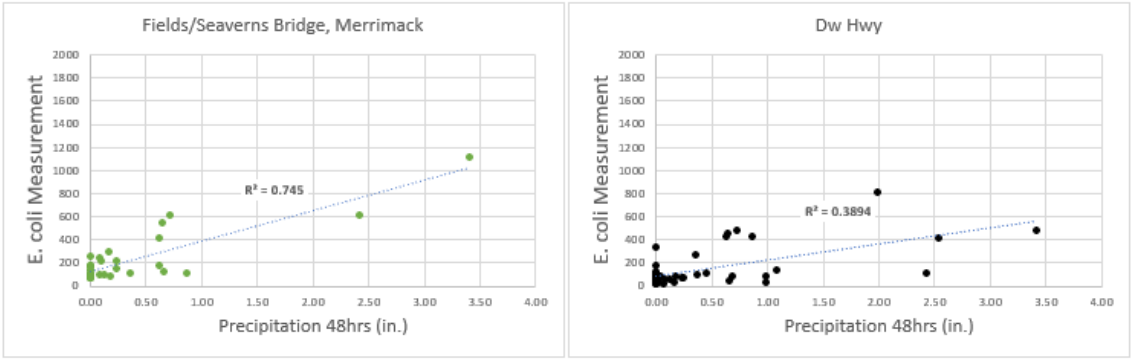

Figure B-4. *E. coli* and precipitation measurements for two sites in the Souhegan River watershed