

Development of a Citizen Science *E. coli* and Optical Brightener Monitoring Prototype as a Pollution Screening Tool

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OBJECTIVES

- Monitor *E. coli* bacteria to identify potential sources of contamination
- Conduct optical brightener “tamplng” monitoring as a pollution screening tool
- Develop a state-wide citizen science prototype to serve as a warning system for wastewater contamination.

KEY FINDINGS

Potential sources of *E. coli* bacteria to lower Cypress Creek include Mexican free-tailed bats and other wildlife, nonpoint source stormwater runoff, and failing or illicit discharges from on-site sewage facilities.

Detection of optical brightener fluorescence at all sites and for all treatments may indicate wastewater contamination, although additional research and fluorometric analysis is needed.

RESULTS



Optical brightener fluorescence was detected at all sites and treatments. Qualitatively, fluorescence was observed in low, medium, and high ranges. Organic matter such as algae, chlorophyll, and sediments fluoresce and can interfere with “tamplng” results. A protocol is currently being developed for fluorometric analysis of optical brighteners to quantify “tamplng” fluorescence and to develop a colorimetric scale to assist citizen scientists with interpretation of observed results.

NEXT STEPS

- Continue sampling eight sites bi-monthly
- Collect field parameters, observations, and *E. coli* bacteria colony counts
- Quantify fluorescence using a handheld fluorometer and reinstate “tamplng” monitoring to establish a relationship for colorimetric scale
- Investigate methods to discern bacteria sources including:
 - development of a mixing model,
 - conducting dye studies to identify failing septic systems,
 - track bat colony presence/absence,
 - delineate sub-watersheds for field reconnaissance to identify failing septic systems,
- As of May 2022, the City of Wimberley reported 71 completed sewer connections, 17 pending connections, and approximately 15 locations with extensions or plans to connect.

BACKGROUND

Lower Cypress Creek is an urban stream in Central Texas exhibiting signs of water quality degradation and often exceeds the contact recreational use *E. coli* bacteria water quality standard (126 MPN/100 ml). This is a concern due to the role ecotourism plays on the local economy and the recreational activities associated with Cypress Creek.

Mexican free-tailed bats reside under the bridge at Ranch Road 12 in Wimberley. Cattle access Cypress Creek as a drinking water source upstream of study area. Excrement from domestic pets and other wildlife including deer, racoons, and waterfowl are also potential sources of bacteria to Cypress Creek.

Saturated drain fields and malfunctioning septic systems are other potential sources of bacterial contamination. Commercial and residential developments in Wimberley have historically used on-site septic systems for sewage disposal. Recently, a centralized collection system was installed and hook ups to the system are beginning to take place.

What is *E. coli* Bacteria?

Escherichia coli bacteria originate in the digestive tract of endothermic organisms and are found in the feces of warm-blooded animals. It is used by state and federal agencies as freshwater indicators of potential pathogen contamination and as a water quality standard for the contact recreational use.

What are Optical Brighteners (OBs)?

OBs are chemical compounds or dyes added to laundry detergents, cleaning agents, textiles, synthetic fibers, and many kinds of paper including toilet paper. They adsorb to cotton and fluoresce under ultraviolet light. They are used as an indicator of wastewater contamination from illicit discharges in storm drains and failing septic systems. Where fecal contamination is known to occur, optical brighteners can assist in pollution screening and source identification.

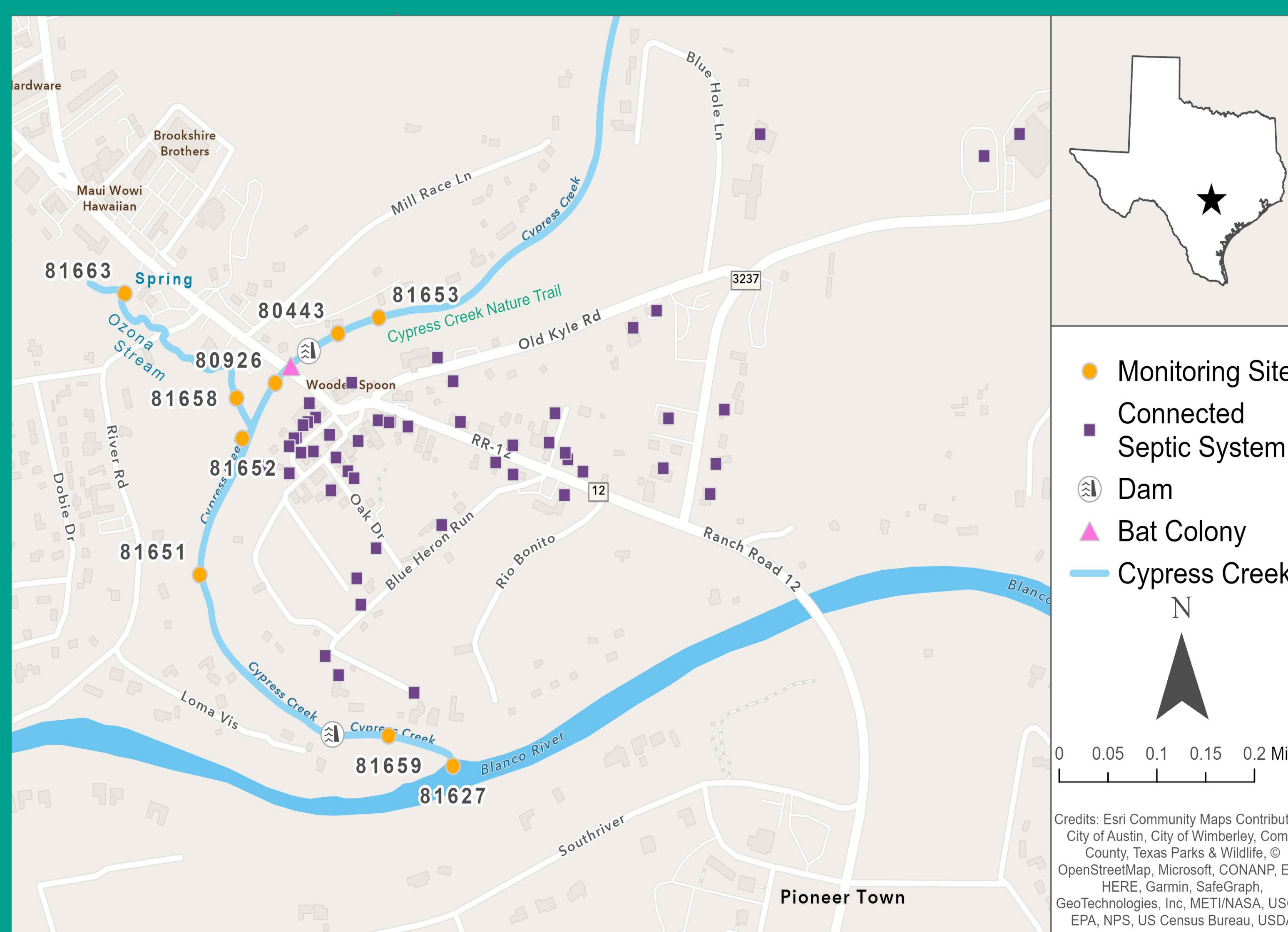


METHODS

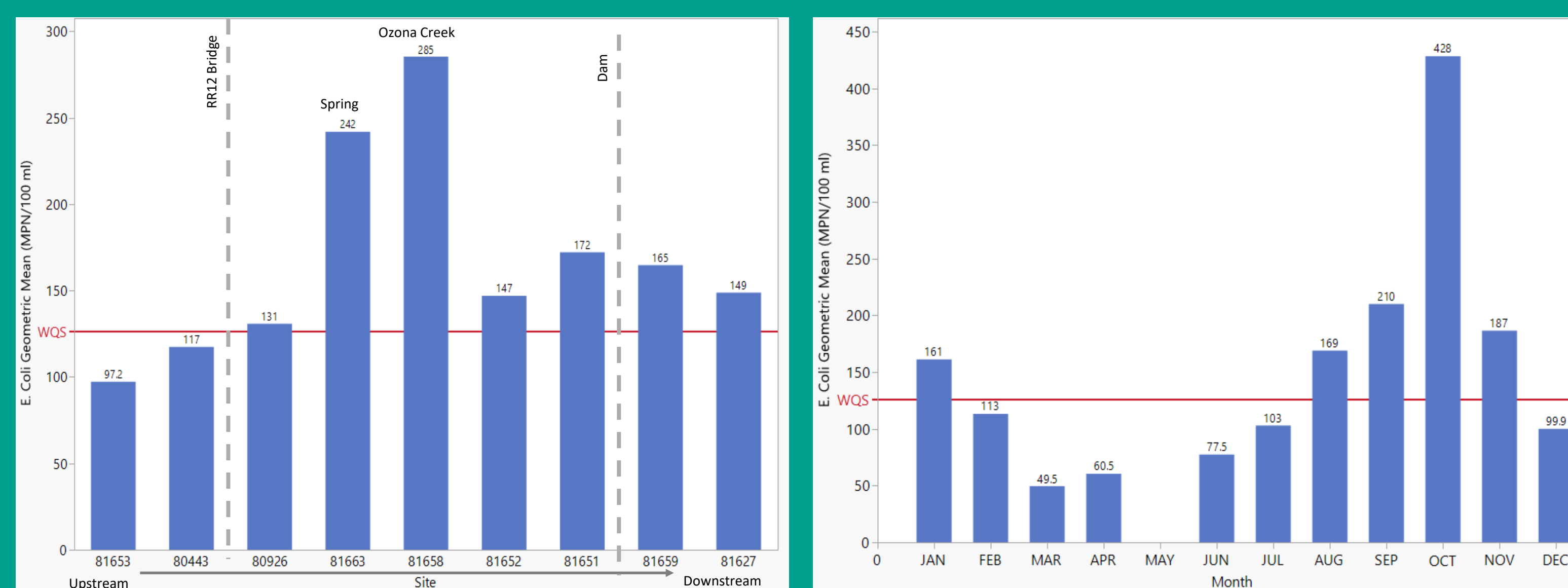
Project Duration: June 2021 to present
 Sampling Frequency: Eight sites, twice a week/weekly/bi-monthly
 Data types: Water-quality field parameters and observations
E. coli bacteria colony counts
 “Tamplng” presence/absence
 Sampling methods: Texas Stream Team and Albus 2021
 Field parameters: water temperature, dissolved oxygen, pH, and specific conductance
 Field observations: flow severity, algae cover, watercolor, water clarity, water surface, water conditions, water odor, days since last significant precipitation, and rainfall accumulation.

E. coli bacteria: Coliscan Easygel

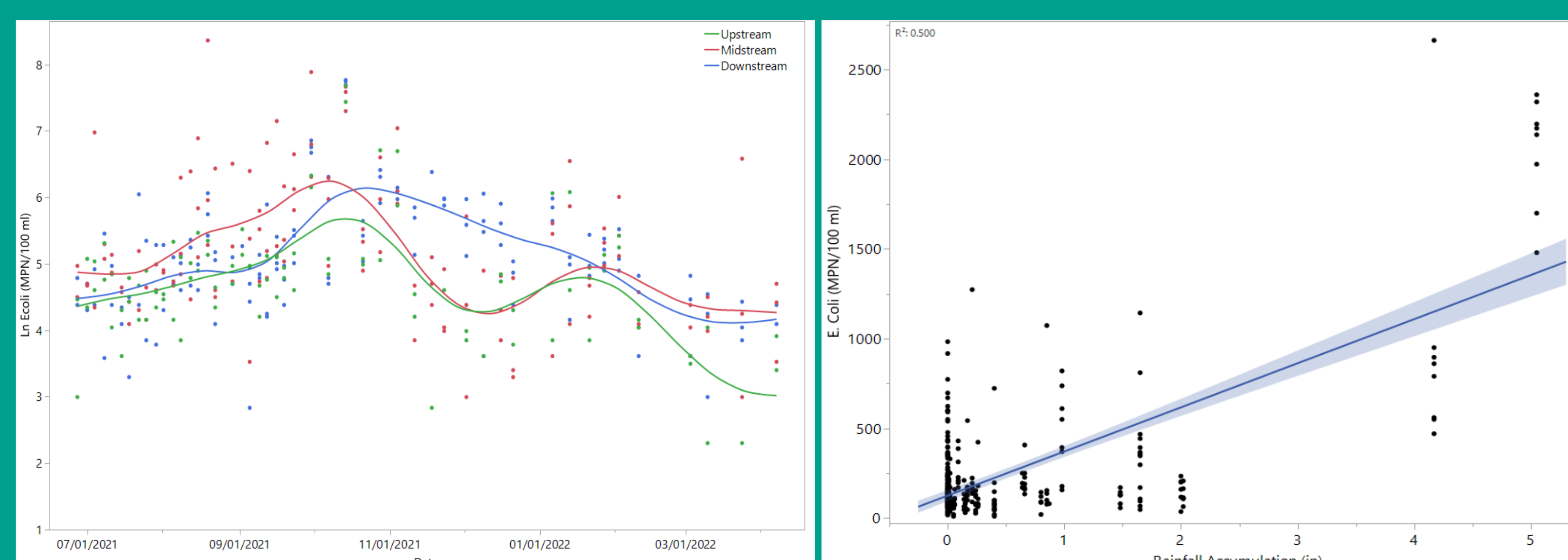
Optical brightener tamplng monitoring included placement of sterile organic cotton tampons in recycled water bottles placed in the centroid of stream flow and attached to a tree branch or kettle bell with monofilament line. Four deployment/retrieval treatments were applied: 3-day, 4-day, 1 week, and 2 weeks. Upon retrieval, samples were transported to the lab in a dark container for evaluation under UV light.



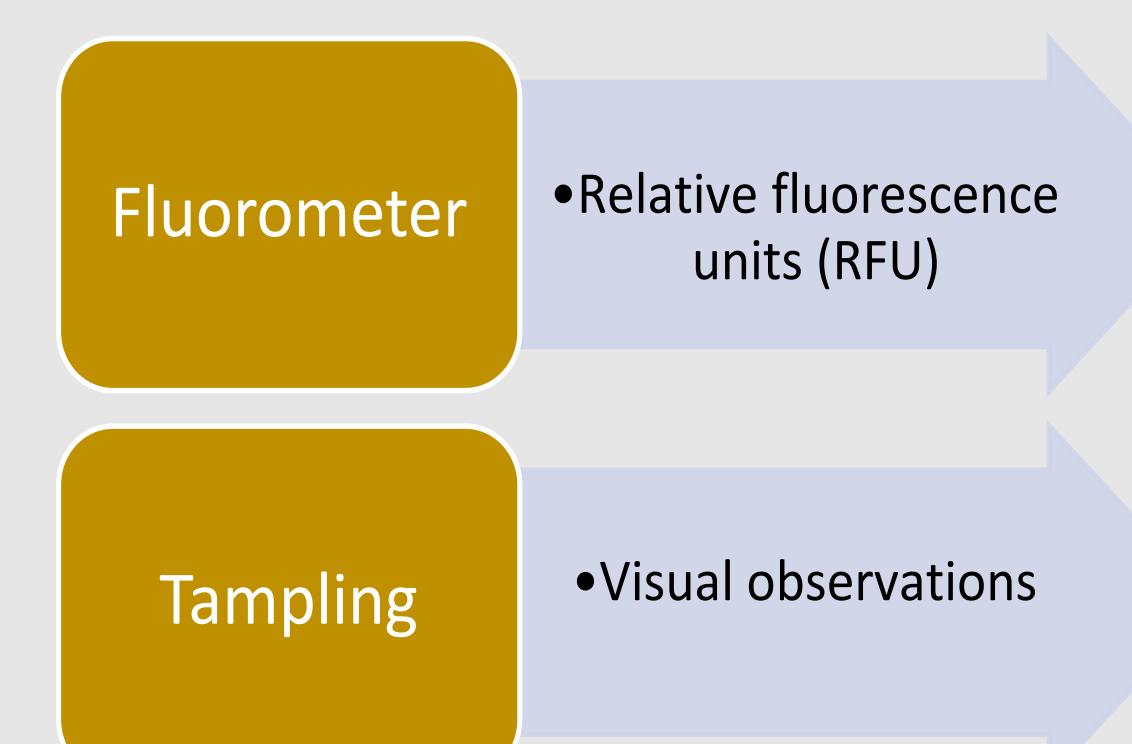
- Forty-eight sampling events occurred, and 355 *E. coli* samples were collected between June 2021 and April 2022. Eighteen samples were lost due to errors in plating or malfunctioning equipment.
- The highest *E. coli* geometric mean was at Ozona Creek (Site 81658) and the lowest was at the most upstream site (81653).
- The two sites upstream of the RR12 bridge had geometric means below (<126 MPN/100 ml) the water quality standard while all the remaining sites downstream of RR12 had geometric means above (>126 MPN/100 ml) the water quality standard.
- Monthly geometric means for all sites show seasonal fluctuations with higher values coinciding with high rainfall and lower values when rainfall was lower, and bats were absent.



- Sites were grouped into upstream, midstream and downstream. Midstream sites generally exhibited higher *E. coli* bacteria concentrations at the beginning of the study, but a shift to higher bacteria values was observed at the downstream sites after high rainfall events in October/November.
- Rainfall measurements from the U.S.G.S. gauge on the Blanco River at Fischer Store Road were compiled for three days leading up to a monitoring event and reported as rainfall accumulation (in).
- A correlation analysis between *E. coli* concentrations and rainfall yielded strong correlations ($r^2 > 0.50$) at all sites except at the spring and Ozona Stream. The strong correlation between *E. coli* bacteria and rainfall likely results from nonpoint source pollution during rainfall events.



CONCEPTUAL MODEL



Colorimetric Scale	RFU Value
5,000 - 10,000 ppm	
15,000 - 20,000 ppm	
25,000 - 30,000 ppm	

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