From spring to stream: water quality analysis in Trout Brook, Dakota County, MN

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Introduction

Trout Brook has some of the highest recorded nitrate levels from southeast Minnesota springs. The springs are in karst and fed by the Prairie du Chien aquifer. Spring water is a relatively constant temperature when it enters the stream, creating a favorable environment for trout. The spring contributions are supplemented by flushes of snowmelt and precipitation events on surrounding agricultural an undeveloped land.

Methods

- Collect in-situ measurements and field samples
- Analyze cations, anions, isotopes, alkalinity
- Compare results to historical data
- Interpret trends

Nitrate Levels are Highest in West Branch

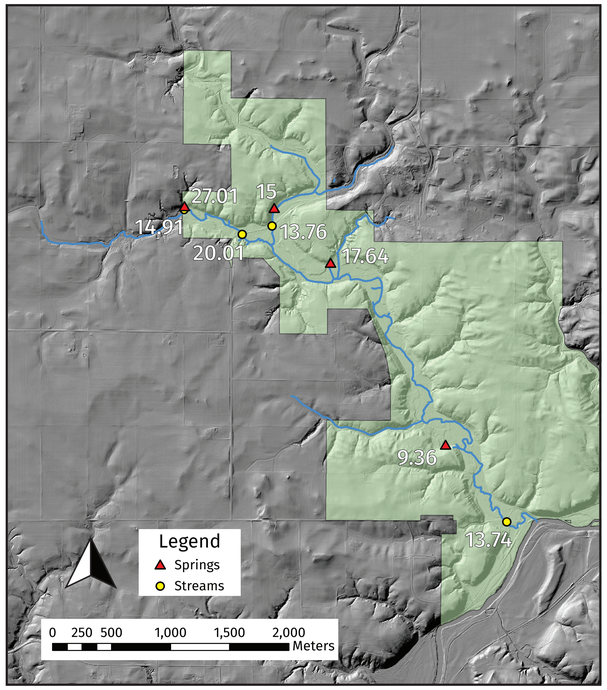

Figure 1: Nitrate-nitrogen concentrations in the springs and streams of Trout Brook. The numbers next to the symbols are the nitrate levels in the 3/17/18 sample event. The green shaded area is the Miesville Ravine Regional Park.

Low Data Collection Frequency Inhibits Actionable Results

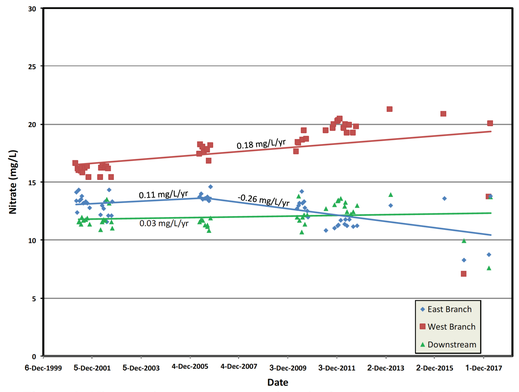

Figure 2: Nitrate-nitrogen concentrations in the East Branch (TB1), West Branch (TB2) and Downstream end (TB3) of Trout Brook - including the 2/13/17 and 2/23/18 Dakota Co. data sets.

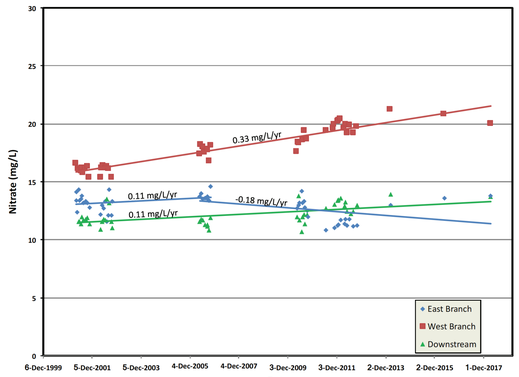

Figure 3: Nitrate-nitrogen concentrations in the East Branch (TB1), West Branch (TB2) and Downstream end (TB3) of Trout Brook - excluding the 2/13/17 and 2/23/18 Dakota Co. data sets.

Similar Data Variance Observed In Springs

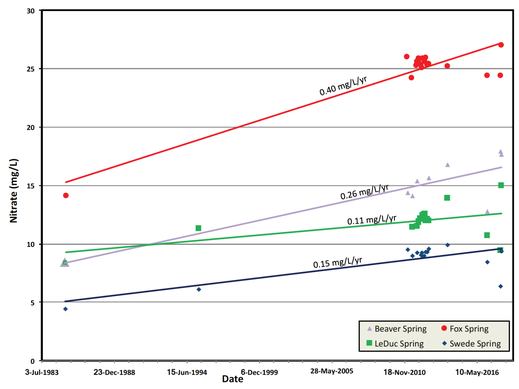

Figure 4: Nitrate-nitrogen concentrations in four Trout Brook Springs - including Ron Spong's measurements from the 1980s and 1990s and all more recent measurements.

Isotope Ratios Show Mixing of Meltwater & Baseflow

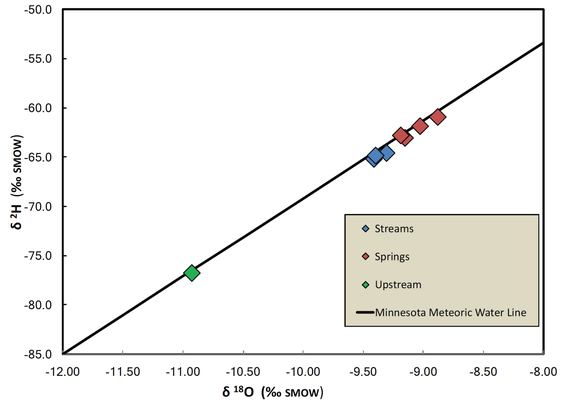

Figure 5. Stable isotope data from Trout Brook Springs and Streams. Sampled 3/17/18 during melting snow pack conditions.

Discussion

The nitrate levels in Trout Brook springs and streams remain high, and appear to trend upwards. However, Trout Brook stream and springs are very variable systems. The water quality parameters vary greatly on a day to day time scale. Year-on-year trends cannot be documented with the certainty needed for effective environmental management without continuous monitoring of critical parameters. Relative depletion in ^{2}H and ^{18}O from the upstream sample shows that meltwater had a higher contribution there than the springs, and stream samples were a mix of both ratios.

Recommendations

- Use dataloggers to understand spring responses to environmental conditions
- Determine age of water in samples to understand response time for changing practices & policies
- Use observation based hydrogeologic knowledge of the surface/groundwater dynamics to guide environmental management and remediation effort to improve the water quality in the Trout Brook surface and groundwater sheds.

Acknowledgements

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