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# Transport Contaminant in Flowing Water for Improving Water Quality

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## ABSTRACT

Clean freshwater is fundamental to sustain human activities and the aquatic life. However, cities, industries, and agriculture wastes deteriorate water quality. For example, released fertilizer induces excess algal growth. This leads to major ecological problems such as eutrophication of freshwater ecosystems which has not only a great environmental cost impact, but can also affect the health and sustenance living of the people. This project investigates the transport of nitrate, a major plant fertilizer, in flowing freshwater. Streams and rivers can transform nitrate, thus mitigating its impact. Most of the biogeochemical reactions involved in nitrate removal take place where microorganisms usually thrive, at the sediment or water interfaces. We propose to study how the riverbed sediment influences nitrate transport and transformation. At Notre Dame University, our group conducted tracer experiments in artificial streams at the Linked Ecosystem Experimental Facility (LEEF). The experiment was conducted by co-injecting a conservative tracer (NaCl) and a nitrate salt (KNO3) and measuring their concentration over time at a downstream station. The data shows how their behavior differs as a function of time. Because water flowing through the sediment is much slower than the surface flow, we can make a space for time substitution and attribute longer timescales to travel in the hyporheic zone. As a result, we can attribute reaction rates to specific reactive zones in the stream. Our results show that benthic and hyporheic nitrate uptakes were reflected in the shape of the nitrate breakthrough curves. The benthic zone induced an exponentially decreasing nitrate signal at early times, while the hyporheic uptake was reflected by the truncation of the late time power law tail. We suggest that our analysis should be useful to scientists and managers alike, as we provide a new, spatially explicit, understanding of nitrate fate in flowing systems.

## KEYWORDS

Surface water transport, ground water interaction, denitrification, tracer experiment, water quality, nitrate transport.