Potential impacts of wastewater discharge on nitrification and oxygen demand

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Introduction

Today, State of Utah, Division of Water Quality (DWQ) regulations for wastewater only limit ammonia levels in treated water. However, high ammonia levels are not the sole water quality issue. An over abundance of Phosphorus (P) and any form of Nitrogen (N) can contribute to a decline in watershed health. Wastewater treatment facilities are complying with DWQ standards by converting ammonia to nitrate.

Releasing treated wastewater with high nitrate concentrations may result in changes in ecosystem health and stability such as:

- Increases in algal and plant abundance
- Potential eutrophication and hypoxic zones
- Decrease in freshwater invertebrate populations
- Long term loss of biodiversity

The Silver Creek Wastewater Treatment Facility (WWTF) near Park City, UT was chosen as the site for this study because its treated discharge has no detectable ammonia but has nitrate levels ranging from 3 to over10 mg NO_3-N/L and suffers from low dissolved oxygen (DO) concentrations in Silver Creek downstream from the plant discharge.

Research Questions

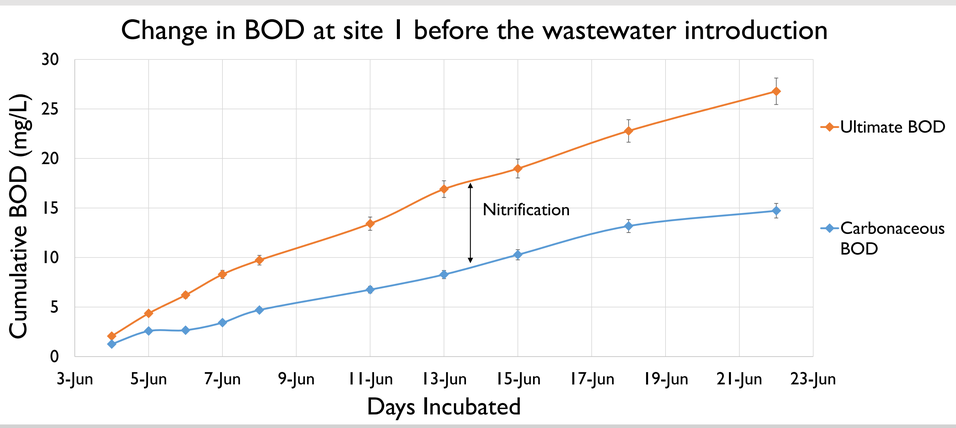
How has the release of nitrate saturated water into freshwater systems affected system services, health, and overall function?

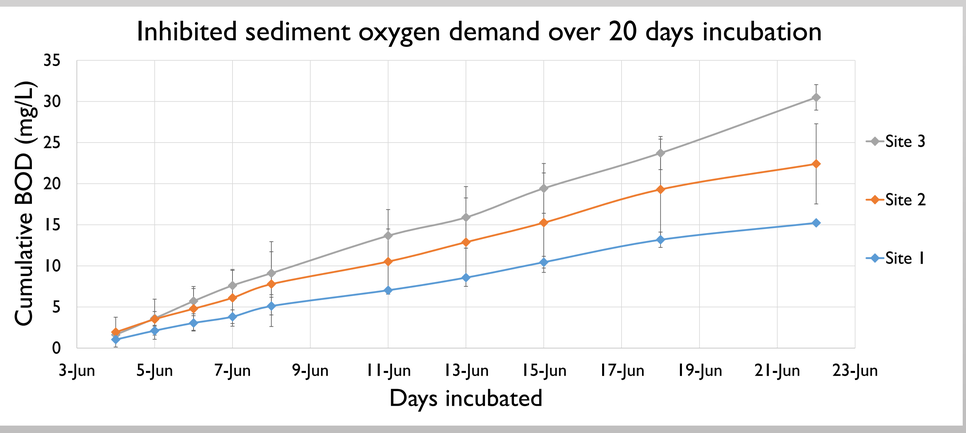
What are the significant nitrogen transformation processes taking place with Silver Creek upstream of plant discharge?

Is Silver Creek's oxygen demand caused by these nitrogen cycling processes or is there an oxygen demand from biological activity within the sediments and/or from plants that exist in the creek?

Sample Sites

Results





Methods

- Water and sediment samples were collected from three Silver Creek locations and tested in triplicate to determine the impact of nitrate loading from the treatment plant.
  - Site 1. Upstream of the wastewater discharge
  - Site 2. Directly downstream of the wastewater discharge
  - Site 3. Farther downstream of wastewater discharge
- A long-term biochemical oxygen demand (BOD) test was performed for 20 days to determine differences in oxygen demand among sites.
- Nitrapyrin was used to inhibit nitrification in ½ the samples to determine nitrification rates in uninhibited samples.

Conclusions

Biochemical oxygen demand in the creek's sediments show significant differences between the three testing sites. Additionally, sediments consumed six times more oxygen, on average, than the water column over the same test duration.

Data suggests that the sediment oxygen demand is naturally high but the addition of nitrate enriched wastewater promotes plant growth and creates an environment with a high oxygen demand.

Monitoring and regulating nitrate levels may be necessary to restore or maintain the biological integrity of Silver Creek.