

NITRATE REMOVAL FROM WASTEWATER EFFLUENT USING THE HYPORHEIC ZONE AS A BIOREACTOR

Michael Esteban

Mentors: Dr. Josh Sharp, Dr. John McCray, Zack Jones and Skuyler Herzog

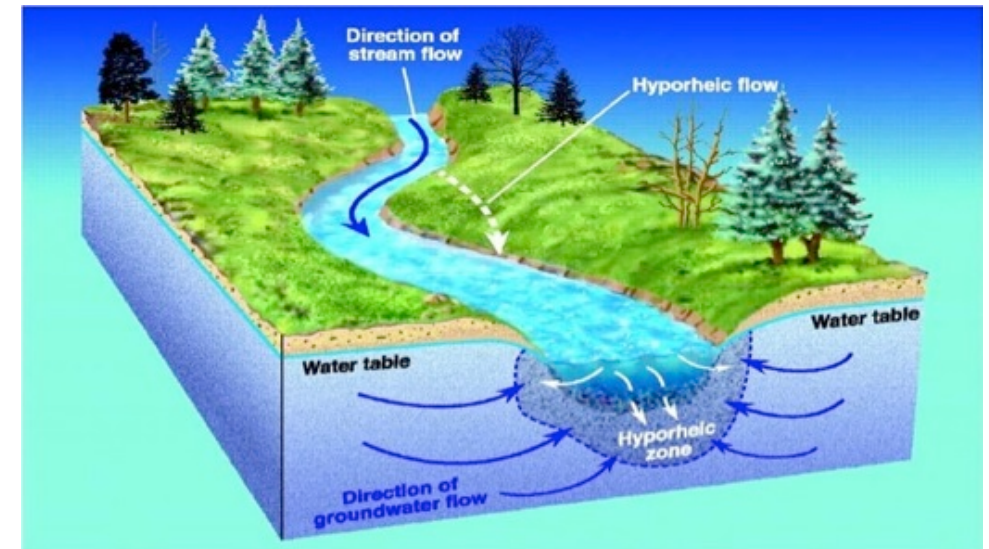


Background

- Impaired surface waters cause ecological and human health impacts
- Hyporheic Zone (HZ) provides natural treatment for streamwater. The HZ is the area of sediment with mixing of surface water and groundwater.
 - In natural systems exchange of streamwater with the HZ is not efficient

Project Goal and Methods

- To explore the treatment capabilities of hyporheic exchange enhancement structures using chemical and biological techniques.
 - Focused on denitrification within our bench scale simulation (shown right)
- Chemical techniques: Hach Kits testing for Ammonia, Nitrate, Nitrite and Total Nitrogen along 14 sample ports along flowlines in the system.
- Biological techniques: Quantitative PCR with primers for 16S gene (total bacteria) and the nirS and nirK genes (denitrification genes) in 4 sediment columns.



(Alley et al. 2002)



CONCLUSIONS

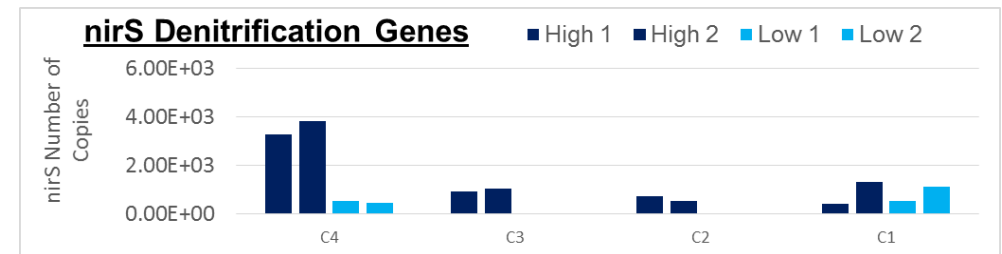
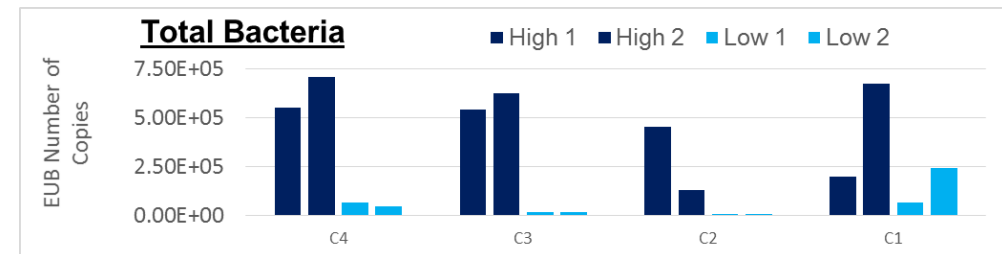
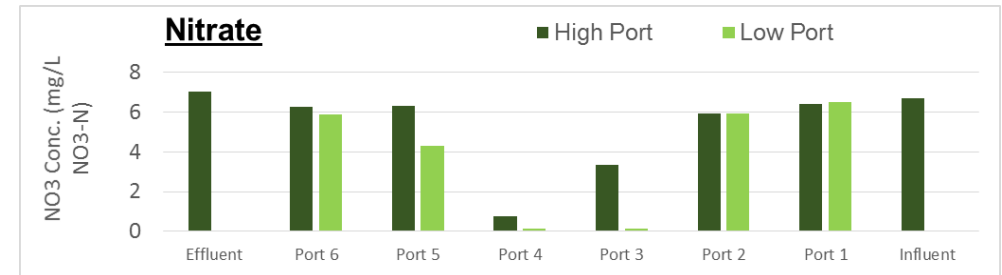


Results

- Denitrification occurring in the Modified Zone (Port 3 and 4)
- Greater density of bacteria in the upper 6cm of sediment
- Greater nirS gene concentration in Effluent Zone
- Confirms denitrification is occurring within the Modified Zone of the enhancement structure

Future Recommendations

- Reconfigure streambed simulation and run tests to investigate
 - Spatial distribution of microbes with depth
 - Potential fungal growth and denitrification
 - Denitrification rates



Nitrate, Total Bacteria and nirS profiles with respect to length and depth in the system. Flowing from right to left, the sample ports 3 and 4, and the sample columns C2 and C3 correspond to the area within the Modified Zone.