Physicochemical Processes Before and After RSC Construction

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Muddy Creek Restoration

Before...

Watershed, 226 ha
• 49% Forest
• 37% Agriculture
• 14% Residential

...During

RSC: Regenerative Stormwater Conveyance

Sand Plus Woodchips
Gravel
Research Goals

• Assess the effects of the RSC on:
  • The removal of suspended solids and nutrients from surface water; and...
  • The chemistry and flow of groundwater as they may impact removal of nutrients and precipitation of iron in the stream.
Automated Sampler and Sondes

Groundwater Sampling Transects

Automated Sampler and Sondes
Bluejay Branch = Control
Muddy Creek Watershed = Treatment
RSC
Comparing the inlet and outlet of the restored reach: Percentage of inflow retained increased after restoration

Statistics: Randomized Intervention Analysis

Comparing the treatment and control watersheds:
No statistically significant changes in loads could be attributed to the restoration. The effects may have been masked by the effects of beaver ponds downstream.
Transect of Wells and Piezometers
• Water levels measured weekly.

• Chemistry analyzed monthly for two years.
Horizontal Pressure Gradient

- Ground Level
- Water Table
- Well
- Flow
Before restoration, groundwater flow was mostly toward the stream.

After restoration, groundwater flow is mostly away from the stream.

Legend:
- < -0.01: Away from stream
- -0.01
- 0.00
- 0.01
- > 0.01: Toward stream
Before restoration, the eroded channel drained the banks.
After restoration, the water table elevation increased.

- Well
- Piezometers
- Sand & Woodchips
- Gravel

Saturated soil kills roots.

Evapotranspiration

Groundwater Flow

Water Table After

Clay Aquiclude
Vertical Pressure Gradients

- Ground Level
- Water Level
- Water Table
- Flow

Piezometer

Well

Piezometer

Well
Vertical pressure gradients in streambed groundwater: Negative values suggest infiltration

May-June 2018 data from SERC intern Christina Klein:

[Graph and diagram showing head difference in m for different locations labeled 1 to 15, with Iron Precip highlighted.]

[Diagram of ground level, water level, piezometer, and well showing flow direction.]
Sand Filter Concept:

- The gravel layer allows faster groundwater flow than the overlying sand.
- This pulls water downward through the sand.
- At the end of the restored reach groundwater carried through the gravel is released back into the surface flow.
Groundwater chemistry after restoration:
Statistically significant changes in dissolved concentrations

<table>
<thead>
<tr>
<th>Decreased:</th>
<th>Increased:</th>
<th>No change:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphate</td>
<td>Organic C</td>
<td>Nitrate</td>
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<tr>
<td>Ammonium</td>
<td>Iron</td>
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<td>Sulfate</td>
<td>Oxygen</td>
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<td>pH</td>
<td>Conductivity</td>
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Summary: Surface Water

• Comparing loads entering and leaving the restored reach before and after restoration:
  • Significant retentions of: phosphate, total P, ammonium, and total N.

• Comparing control and treatment watersheds:
  • No significant effects of restoration.
  • Effects may have been masked by retentions in beaver ponds downstream of the restored reach.
Summary: Groundwater

• The restoration altered the distribution and flow of groundwater around the restored reach.

• Groundwater chemistry changed after the restoration.

• Enhanced exchanges of surface water and groundwater may contribute to nutrient retention.
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