Federal Way S. 356th Street Project: Effectiveness of Retrofit and Expansion

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Did retrofit and expansion improve flow control and treatment?
S. 356th Street Detention Facility

• Built in 1997 to treat runoff from 189-acre basin
  • combined detention and stormwater treatment wetland (“wetland”)
• Expanded in 2014
• In-series “wetland” to increase treatment
• 2 bioretention facilities to treat previously untreated runoff from 22-acre basin
New “wetland”

- Increase capacity
- Unlined, but infiltration limited
New “wetland”

- Increase capacity
- Unlined, but infiltration limited

Bioretention facilities

- New capacity
- Underdrained
  - East: drains quickly
  - West: drains slowly
Untreated

- East bioretention facility
- West bioretention facility
- Wetland complex

Treated

In

Out
Receiving waters:
North Fork West Hylebos Creek
Sampling

• Flow at 7 locations
• 18 storms sampled for TSS, metals, nutrients, PAHs
• 10 storms for PCBs, fecal coliforms
• 6 storms for toxicity

• Pre- and post-retrofit turbidity and temperature data
Flow Monitoring Results

- Flow-weighted composite sampling successful
- Reduction in peak flows and delay in peak timing at all facilities

Rain = 0.78 inches
Flow Monitoring Results continued

• But, less certainty in flow volume estimates
• Unclear extent of groundwater intrusion and/or infiltration

• Results focus on concentration changes rather than mass loadings
Treatment?

Concentrations in effluent vs. influent:

Significantly reduced

Somewhat reduced

Somewhat increased

Significantly increased
Caveats

• Pollutant concentrations in bioretention influent were lower than in wetland complex influent

• Bioretention soil mix was standard 60% sand/40% compost mix but it was 30 inches deep

• 90% of total flow is through the wetland complex
<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Bioretention Facility</th>
<th>Wetland Complex</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>East</td>
<td>West</td>
</tr>
<tr>
<td>Fecal Coliform</td>
<td></td>
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<tr>
<td>TSS</td>
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<td>Turbidity</td>
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<td>Conductivity</td>
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Take Home:
- System reduced total suspended solids (TSS) loads
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<tr>
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<td>East</td>
<td>West</td>
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<tr>
<td>Zinc, total</td>
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<tr>
<td>Zinc, dissolved</td>
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<td>Copper, total</td>
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<tr>
<td>Copper, dissolved</td>
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<td>Lead, total</td>
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<tr>
<td>Lead, dissolved</td>
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<tr>
<td>Cadmium, total</td>
<td>NC</td>
<td>NC</td>
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<tr>
<td>Cadmium, dissolved</td>
<td>NC</td>
<td>NC</td>
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Take Home:
- **Mixed results**, but complicated by low influent concentrations in bioretention facilities
- System reduced loads of total metals
- System source of dissolved metals
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<tbody>
<tr>
<td></td>
<td>East</td>
<td>West</td>
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<tr>
<td>Total PAHs</td>
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<tr>
<td>Total PCBs</td>
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Take Home:
• System reduced loads of PAHs and PCBs
### Pollutant Distribution

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<tbody>
<tr>
<td></td>
<td>East</td>
<td>West</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td></td>
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<tr>
<td>Orthophosphate P</td>
<td></td>
<td></td>
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<tr>
<td>Total Nitrogen</td>
<td></td>
<td></td>
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<tr>
<td>Nitrate + Nitrite N</td>
<td></td>
<td></td>
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<tr>
<td>Ammonia N</td>
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**Take Home:**
- Bioretention facilities: large source of N & P (~80% of total phosphorus load)
- Overall system is a source of all nutrients except ammonia
Study Conclusions

• Overall, effectiveness determined by wetland complex (90% of flow)
• Bioretention facilities are large sources of phosphorus and nitrogen (these should not be built as is in basins with nutrient concerns)
• Pre- and post-retrofit data indicate treatment improved
Lessons Learned

• Flow monitoring is very challenging.

• Anticipate delays.

• Groundwater may complicate matters.

• Some questions may be answered with cheap(er) continuous data.

• Urban basins are subject to change.
Questions?

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Example: Storm #10 East bioretention facility

Rain = 0.78 inches
Example: Storm #10 East bioretention facility

- Inflow = 12200 cubic feet
- Outflow = 8300 cubic feet
- Rain = 0.78 inches
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- Inflow = 12200 cubic feet
- Outflow = 8300 cubic feet
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*Reduced peak flows*

*Infiltration*