Stormwater Sampling in Clarks Creek, Puyallup River Drainage (WRIA 10)

Measuring Oxygen-Demanding Sources

Presented by:

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GOALS AND OBJECTIVES

- Evaluate water quality in stormwater conveyances from storms of varying duration and intensity;
- Identify differences in upstream/downstream water quality conditions of each stormwater outfall monitored to Clarks Creek;
- Determine if specific water quality parameters are associated with a decline in dissolved oxygen concentrations;
- Identify the influence of sediment oxygen demand on surface water dissolved oxygen concentrations within Clarks Creek; and
- Describe location(s) where cumulative impacts may occur from upstream pollution sources.
STUDY DESIGN

Locations

Clarks Creek
Pioneer Avenue
Stormwater (SW-1)

Clarks Creek
7th Avenue
Stormwater (SW-2)

Meeker Ditch
Stormwater (SW-3)

Clarks Creek
12th Avenue
Stormwater (SW-4)
STUDY DESIGN

Images of the Sites

SW-4

SW-3

SW-2

SW-1
STUDY DESIGN
Water Quality Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Collection Points</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus</td>
<td></td>
<td>1) No. of storm events</td>
</tr>
<tr>
<td>Soluble Reactive Phosphorus</td>
<td></td>
<td>2) Time x Rainfall Volume</td>
</tr>
<tr>
<td>Total Kjeldahl Nitrogen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO3+NO2-N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia-N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Suspended Sediment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volatile Suspended Sediment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissolved Organic Carbon (DOC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biochemical Oxygen Demand (5-day)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fecal Coliform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissolved Oxygen (DO)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
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<tr>
<td>Conductivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOD Chamber</td>
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</tbody>
</table>

bField measurements
STUDY RESULTS
Rainfall Events

DEFINITION OF RAINFALL EVENTS: Duration and Intensity

1) Minimum of 0.2 inches in >24-hr period; November 11, 2011; 0.41 inches.
2) Minimum of 0.2 inches in <24-hr period; February 17, 2012; 0.69 inches.
3) Minimum of 0.6 inches in >24-hr period; March 13, 2012; 0.98 inches.
4) Minimum of 0.6 inches in <24-hr period; March 29, 2012; 1.12 inches.
STUDY RESULTS

Dissolved Oxygen Concentrations

November 16, 2011

(red line is the water quality standard; 9.5 mg/L)
STUDY RESULTS

Dissolved Oxygen Concentrations

February 17, 2012

(red line is the water quality standard; 9.5 mg/L)
STUDY RESULTS
Dissolved Oxygen Concentrations

Dissolved Oxygen

March 13, 2012
(red line is the water quality standard; 9.5 mg/L)
STUDY RESULTS
Dissolved Oxygen Concentrations
STUDY RESULTS

Dissolved Oxygen Concentrations

Saturated vs. Actual DO Concentrations
(difference shows DO deficit)
STUDY RESULTS
Total Suspended Sediments

November 16, 2011
### STUDY RESULTS
Cumulative Impacts

<table>
<thead>
<tr>
<th>Source (Site)</th>
<th>Water Quality Parameter</th>
<th>Type of Storm Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW-2, SW-1</td>
<td>Total Suspended Sediment</td>
<td>&gt;0.2 inches, &gt;24 hours (Feb 17, 2012)</td>
</tr>
<tr>
<td>SW-2, SW-1</td>
<td>Volatile Suspended Sediment</td>
<td>&gt;0.2 inches, &gt;24 hours (Feb 17, 2012)</td>
</tr>
<tr>
<td>SW-4, SW-2</td>
<td>Total Phosphorus</td>
<td>&gt;0.2 inches, &gt;24 hours (Feb 17, 2012)</td>
</tr>
<tr>
<td>SW-4, SW-2</td>
<td>Fecal Coliform</td>
<td>&gt;0.2 inches, &gt;24 hours (Feb 17, 2012)</td>
</tr>
<tr>
<td>SW-1</td>
<td>Volatile Suspended Sediment</td>
<td>&gt;0.6 inches, &gt;24 hours (Mar 13, 2012)</td>
</tr>
<tr>
<td>SW-2</td>
<td>Fecal Coliform</td>
<td>&gt;0.6 inches, &gt;24 hours (Mar 13, 2012)</td>
</tr>
</tbody>
</table>

Patterns in water quality parameters that showed increasing concentrations at downstream locations.
STUDY RESULTS
Sediment Oxygen Demand

September 2011 (Philip Murphy)
STUDY RESULTS

Sediment Oxygen Demand

**In situ** Sediment Oxygen Demand versus Community Sediment Oxygen Demand (September 19-21, 2011)

<table>
<thead>
<tr>
<th>Station</th>
<th>in situ SOD (gm O₂/m²/day)</th>
<th>CSOD (gm O₂/m²/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC-1</td>
<td>1.58</td>
<td>2.46</td>
</tr>
<tr>
<td>CC-2</td>
<td>1.99</td>
<td>4.71</td>
</tr>
<tr>
<td>CC-3</td>
<td>See Note below</td>
<td>3.73</td>
</tr>
</tbody>
</table>

Note: Submerged macrophytes and rocky bottom precluded and SOD estimate at this location.

1) Community Substrate Oxygen Demand (CSOD) increases at downstream locations.
2) Sediment Oxygen Demand (CSOD) increases at downstream locations.
CONCLUSIONS

- Dissolved oxygen (DO) concentrations highest near beginning of wet season (Nov. 2011);
- 25% of observations met core summer salmonid habitat criterion (9.5 mg/L);
- Incremental decline in DO concentrations at successive sampling events;
- Outfall DO concentrations at Meeker Creek and SW-1 (W. Pioneer Way) consistently low;
- General decline in DO concentrations at all sites during progressive monitoring events;
- Declining DO inversely related to increasing flow.