Portland Water Bureau’s One-Year Cryptosporidium Study in the Bull Run Watershed

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Long Term 2 Enhanced Surface Water Treatment Rule

- EPA LT2 Rule mandates removal or inactivation of the pathogenic protozoan *Cryptosporidium* (2006)
- Level of additional treatment based on average *Cryptosporidium* concentration calculated from 24 months of source water monitoring
- Unfiltered water systems must add treatment equivalent to filtered systems- minimum of 2-log removal regardless of monitoring results

Portland Water Bureau’s One Year Cryptosporidium Study in Bull Run
Bull Run Watershed

- Long history of source water protection
- BRWMU/Closure area
- No public entry
- No recreational use
- No development
- No timber harvest
Portland’s Rationale for a Variance from LT2 Rule Requirements

- Very good source water quality
- No Cryptosporidium had been detected since 2002
- Extremely low risk for human infectious Cryptosporidium
- No evidence in the community of cryptosporidiosis related to drinking water

Portland Water Bureau's One Year Cryptosporidium Study in Bull Run

Maximum fecal coliform for filtration exemption is 90% of samples <20 CFU/100 mL
Bull Run's 90% percentile fecal coliform is 1 CFU/100 mL
LT2 Variance Request
Sampling Plan and Study

- SDWA variance provision requires water quality data and other information on the quality of the source water.
- Portland had to demonstrate a Cryptosporidium concentration statistically equivalent to filtered systems under the LT2 Rule (<0.075 oocyst/1000 L).
- Sampling plan and study developed in consultation with EPA.
- Must demonstrate that due to the nature of the Bull Run source water additional treatment is not needed.
Dec. 14, 2009- Dec. 6, 2010
10,250 L with zero oocysts detected
50 L samples 4x/week
EPA Method 1623 for Cryptosporidium and Giardia
Method modification during seasonal low recovery
QA matrix spike samples at minimum frequency of 1 per 20 field samples
Scheduled and Event-Based Upstream Monitoring at Potential *Cryptosporidium* Hotspots
Sampling Frequency & Triggers

**Sampling Locations**
- **Site 1**: Main stem Bull Run River
- **Site 2**: North Fork Bull Run River
- **Site 3**: South Fork Bull Run River
- **Site 4**: Fir Creek
- **Site 5**: Boody Lake
- **Site 6**: Reservoir 1, deepest part
- **Site 7**: Reservoir 2, deepest part
- **Site 8**: Upper Reservoir 1, potential grazing area
- **Site 9**: Upper Reservoir 2, potential grazing area

**Scheduled Sampling Frequency**
- **Site 1**: 1 per week starting March 2010 (initially 1 per month) - sample throughout the year
- **Site 2**: 1 per month throughout the year
- **Site 3**: 1 per month when accessible (late spring through fall)
- **Site 4**: 1 per month when accessible (late spring through fall)
- **Site 5**: Not applicable - no identified events
- **Site 6**: Not applicable - additional discretionary sampling not necessary
- **Site 7**: Not applicable - additional discretionary sampling not necessary
- **Site 8**: 1 per month when areas are exposed during drawdown (Summer-Fall)
- **Site 9**: 1 per month when vegetation is established during reservoir drawdown when vegetation is established

**Event Sampling Triggers**
- Stream flow exceeding 95th percentile of historical flows for each of five seasons
- Turbidity > 2.0 NTU at intake
- Sample throughout the year when accessible
- >0.5" rain after at least 10 days of < 0.1" rain
- During reservoir drawdown when vegetation is established

**Seasonal Variation for Event Sampling**
- FIVE SEASONS
  1. November – February
  2. March – April
  3. May – June
  4. July – August
  5. September – October

**Additional Discretionary Event Sampling**
- Additional flow event sampling that may not be triggered

**Intensive Storm Event Sampling**
- Not applicable – site unsafe for storm sampling
- To capture rising and falling limb of storm hydrograph
- Not applicable – drains small subbasin

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Portland Water Bureau’s One Year Cryptosporidium Study in Bull Run
Intensive Storm-Event Sampling at Reservoir Tributary Site #1 & #3

- Bull Run dry period from approximately June through October
- First flush storms can mobilize pathogens accumulated over the dry period
- Multiple samples collected throughout the hydrograph
Wildlife Investigations

- Pathogen Catchment Budget Model
- Identified wildlife that are most abundant, produce largest fecal loads, and use aquatic & riparian habitats
- Scat monitoring for *Cryptosporidium* and Giardia
- Genotyping and DNA sequencing of positive samples

Portland Water Bureau’s One Year Cryptosporidium Study in Bull Run
Intake Cryptosporidium Results

| Number of field samples collected and analyzed | 449 |
| Volume of raw water collected and analyzed    | 10,271 L |
| Number of Cryptosporidium oocysts detected    | 0 |
| Mean Cryptosporidium concentration            | 0 oocysts/L |
Intake **Giardia** Results

### Giardia Results

<table>
<thead>
<tr>
<th>Month</th>
<th>Volume (L)</th>
<th>Cyst Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>951.2</td>
<td>3</td>
</tr>
<tr>
<td>Feb</td>
<td>800.8</td>
<td>2</td>
</tr>
<tr>
<td>Mar</td>
<td>950.9</td>
<td>7</td>
</tr>
<tr>
<td>Apr</td>
<td>801.1</td>
<td>8</td>
</tr>
<tr>
<td>May</td>
<td>900.9</td>
<td>9</td>
</tr>
<tr>
<td>Jun</td>
<td>900.9</td>
<td>6</td>
</tr>
<tr>
<td>Jul</td>
<td>800.1</td>
<td>0</td>
</tr>
<tr>
<td>Aug</td>
<td>956.6</td>
<td>1</td>
</tr>
<tr>
<td>Sept</td>
<td>852.2</td>
<td>3</td>
</tr>
<tr>
<td>Oct</td>
<td>853.1</td>
<td>4</td>
</tr>
<tr>
<td>Nov</td>
<td>903.6</td>
<td>2</td>
</tr>
<tr>
<td>Dec</td>
<td>600.9</td>
<td>13</td>
</tr>
</tbody>
</table>
Upstream Cryptosporidium Results

- No detections in 315 samples (3384 L)
- 39% of samples collected during event-based conditions

<table>
<thead>
<tr>
<th>Site and Description</th>
<th># of Field Samples</th>
<th>Volume (L)</th>
<th>Cryptosporidium Concentration (#oocysts/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Main stem Bull Run River</td>
<td>54</td>
<td>585.4</td>
<td>0</td>
</tr>
<tr>
<td>2. North Fork Bull Run River</td>
<td>82</td>
<td>883.4</td>
<td>0</td>
</tr>
<tr>
<td>3. South Fork Bull Run River</td>
<td>83</td>
<td>881.5</td>
<td>0</td>
</tr>
<tr>
<td>4. Fir Creek</td>
<td>55</td>
<td>592.3</td>
<td>0</td>
</tr>
<tr>
<td>5. Boody Lake</td>
<td>7</td>
<td>73.9</td>
<td>0</td>
</tr>
<tr>
<td>6. Reservoir 1, deepest part</td>
<td>11</td>
<td>120.5</td>
<td>0</td>
</tr>
<tr>
<td>7. Reservoir 2, deepest part</td>
<td>12</td>
<td>129.4</td>
<td>0</td>
</tr>
<tr>
<td>8. Upper Bull Run Reservoir 1, potential grazing area</td>
<td>6 65</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>9. Upper Bull Run Reservoir 2, potential grazing area</td>
<td>5 52.9</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
A Variety of Flow Conditions Captured at Reservoir Tributary Streams

Site #3 - South Fork

Portland Water Bureau’s One Year Cryptosporidium Study in Bull Run
**Giardia Results - Reservoir Tributary Streams**

<table>
<thead>
<tr>
<th>Month</th>
<th>Site #1</th>
<th>Site #2</th>
<th>Site #3</th>
<th>Site #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>11.2</td>
<td>11.2</td>
<td>10.8</td>
<td>10.8</td>
</tr>
<tr>
<td>Feb</td>
<td>9.4</td>
<td>10.9</td>
<td>10.5</td>
<td>10.8</td>
</tr>
<tr>
<td>Mar</td>
<td>66.4</td>
<td>66.0</td>
<td>65.1</td>
<td>65.3</td>
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<tr>
<td>Apr</td>
<td>43.8</td>
<td>42.8</td>
<td>43.8</td>
<td>43.2</td>
</tr>
<tr>
<td>May</td>
<td>43.4</td>
<td>43.8</td>
<td>54.1</td>
<td>43.9</td>
</tr>
<tr>
<td>Jun</td>
<td>65.8</td>
<td>66.0</td>
<td>64.3</td>
<td>65.7</td>
</tr>
<tr>
<td>Jul</td>
<td>54.7</td>
<td>54.1</td>
<td>53.1</td>
<td>53.6</td>
</tr>
<tr>
<td>Aug</td>
<td>54.4</td>
<td>54.5</td>
<td>53.6</td>
<td>54.0</td>
</tr>
<tr>
<td>Sep</td>
<td>119.1</td>
<td>76.5</td>
<td>116.1</td>
<td>74.8</td>
</tr>
<tr>
<td>Oct</td>
<td>267.6</td>
<td>64.2</td>
<td>263.1</td>
<td>63.9</td>
</tr>
<tr>
<td>Nov</td>
<td>52.8</td>
<td>42.3</td>
<td>51.9</td>
<td>53.5</td>
</tr>
<tr>
<td>Dec</td>
<td>94.6</td>
<td>52.8</td>
<td>95.1</td>
<td>52.7</td>
</tr>
</tbody>
</table>

**Giardia (cysts/L) vs. Volume (L)**

- Site #1
- Site #2
- Site #3
- Site #4

*Portland Water Bureau's One Year Cryptosporidium Study in Bull Run*
Intensive Storm-Event Sampling Results

South Fork: Intensive Event #1 (9/17-9/18/2010)

- Discharge (cfs)
- Sample Collected
- Cryptosporidium (#oocysts/10L)
- Giardia (#cysts/10L)
- E. coli Load (#E. coli/second)

Precipitation at South Fork SNOTEL
- 9/12: 0 in
- 9/13: 0 in
- 9/14: 0 in
- 9/15: 0.4 in
- 9/16: 0.4 in
- 9/17: 1.2 in
- 9/18: 0.8 in

Dates highlighted in yellow are intensive event sampling dates

South Fork: Intensive Event #2 (10/9-10/10/2010)

- Discharge (cfs)
- Sample Collected
- Cryptosporidium (#oocysts/10L)
- Giardia (#cysts/10L)
- E. coli Load (#E. coli/second)

Precipitation at South Fork SNOTEL
- 10/4: 0 in
- 10/5: 0 in
- 10/6: 0 in
- 10/7: 0.3 in
- 10/8: 0 in
- 10/9: 1.4 in
- 10/10: 1.2 in

Dates highlighted in yellow are intensive event sampling dates

South Fork: Intensive Event #3 (10/24-10/26/2010)

- Discharge (cfs)
- Sample Collected
- Cryptosporidium (#oocysts/10L)
- Giardia (#cysts/10L)
- E. coli Load (#E. coli/second)

Precipitation at South Fork SNOTEL
- 10/20: 0 in
- 10/21: 0 in
- 10/22: 0 in
- 10/23: 0.3 in
- 10/24: 0 in
- 10/25: 1.4 in
- 10/26: 1.2 in

Dates highlighted in yellow are intensive event sampling dates

South Fork: Intensive Event #4 (12/11-12/12/2010)

- Discharge (cfs)
- Sample Collected
- Cryptosporidium (#oocysts/10L)
- Giardia (#cysts/10L)
- E. coli Load (#E. coli/second)

Precipitation at South Fork SNOTEL
- 12/6: 0 in
- 12/7: 0 in
- 12/8: 0.9 in
- 12/9: 2 in
- 12/10: 1.1 in
- 12/11: 1.9 in
- 12/12: 1.9 in

Dates highlighted in yellow are intensive event sampling dates
Interim Monitoring - Turbidity Event

Portland Water Bureau's One Year Cryptosporidium Study in Bull Run

Bull Run Source Water Shut Down
1/16/2011 - 2/1/2011

- Turbidity (NTU)
- E. coli (MPN/100mL)
- Giardia (cysts/L)
- Cryptosporidium (oocysts/L)

Turbidity Event:
- Giardia (cysts/L): 0.02, 0.04
- Cryptosporidium (oocysts/L): 0.02

Sample Collected:
- 1/4, 1/7, 1/10, 1/13, 1/16, 1/19, 1/22, 1/25, 1/28, 1/31, 2/3, 2/6, 2/9, 2/12, 2/15, 2/18, 2/21
Interim Monitoring- Cryptosporidium Detections at Intake and Upstream Site #3

Bull Run Intake (2P)

- 1 Cryptosporidium oocyst and 1 Giardia cyst detected in a 50 L sample collected on 12/30/2011.
- Monitoring frequency at the intake increased to 4 times per week.

Turbidity spike caused when Powerhouse 2 tripped, opening the Howell Bunger Valves and stirring the diversion pool; spike lasted approximately 30 minutes.
OHA Grants Portland’s LT2 Variance Request

- LT2 Variance Request submitted to OHA June 6, 2011
- On November 29, 2011 OHA issued intent to grant the variance
- Public comment period
- Second public comment period in response to Cryptosporidium detections
- Final Order granting Portland a variance issued March 14, 2012
- Variance subject to specific conditions

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