WATER IN THE WATERSHED

Keeping our water clean is more important than ever! Nearly 400,000 people receive their drinking water from the Clackamas River every day. The Clackamas watershed provides a place for thousands of people to swim, boat, and play — not to mention a home for endangered fish and wildlife. It's one of the last remaining salmon strongholds, home to wild Coho, Chinook, and Steelhead. These reasons and much more emphasize the need to protect this vital resource by improving water quality.

One of the best ways to determine watershed health is through sampling of water quality. The Clackamas River Basin Council (CRBC), with funding from the Oregon Department of Environmental Quality (DEQ), spent the fall of 2013 doing just that! CRBC staff collected water quality data along with macroinvertebrate and habitat characteristics in the lower Clackamas watershed at eight tributary locations including Spring Creek, Clear Creek, Foster Creek, North Fork Deep Creek, and Eagle Creek. Sites sampled were chosen for their proximity to current restoration projects and also included locations previously sampled. By engaging in water quality monitoring, CRBC can gauge the relative health of the streams we are working on, fill geographic gaps in data, as well as help compile a baseline for future monitoring. Data will help inform CRBC and our partners in future decision making and activities that foster stream friendly practices such as water conservation, wise use of pesticides and chemicals, importance of vegetative buffers for stream shading, pollutant filtering, erosion control, and much more.

WATER QUALITY DATA

Using a Thermo Orion Star multi-meter and HACH turbidimeter, water quality parameters including temperature, pH, dissolved oxygen, conductivity, and turbidity were measured as seen in Figure 1. Interpretations were determined using Oregon's water quality standards provided in DEQ's 2009 Willamette Basin Rivers and Streams Assessment (Mulvey, Leferink, and Borisenko) and DEQ's 2006 Willamette Basin TMDL: Clackamas Subbasin chapter.

Temperature has a wide range of effects on stream function and can be affected by a variety of factors including human impacts to surrounding area (i.e. reduced riparian canopy cover, irrigation withdrawals, runoff from impervious surfaces, discharge from industrial wastewater facilities, etc.). Cool water temperatures are critical for both aquatic fish and wildlife. Outside of spawning season, 16.0°C or 60.8°F is considered the threshold identified for core cold water habitat needed throughout the Clackamas subbasin located above the confluence of Clear Creek with the Clackamas River. Salmon and steelhead spawning season which begins as early as September 1st and extends as late as June 15th, has a requirement of 13.0°C or 55.4°F. All sites sampled were during this time period and were below 13.0°C except the Lower Clear Creek at Carver site. Though it had the warmest water temperature, it was also the earliest sampled site, and is located right at the confluence with the mainstem. Clear Creek at Metzler Park, which is considered our control site based on its relatively unimpacted location, had the coolest water temperature.

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pH is a measure of acidity or alkalinity in a water sample, and impacts the growth and survival of aquatic life. All sites were well within good pH readings of the 6.5-8.5 benchmark.This indicates low nutrient inputs from human operations such as nurseries which often affect algae growth.

Dissolved oxygen is the measurable amount of oxygen in water and is essential to all life dependent on aquatic respiration. It is determined by many factors (i.e. barometric pressure, decomposition of organic materials, photosynthesis, etc.) but has an inverse relationship to water temperature. The lower the water temperature, the higher the amounts of oxygen that can be dissolved into water, which means happy salmon. However, only four of our sample sites remained above the 11 mg/L good benchmark.

Conductivity is the ability to conduct electricity based on the amount of dissolved salts present in a stream's water and can be absorbed through natural means or human activities. High conductivity can indicate inputs of fertilizers, pesticides, and other pollutants that contain charged particles. Measurements for Spring Creek at Mattoon Road, Foster Creek at its mouth, and North Fork Deep Creek were above the <93 good benchmark for conductivity indicating a fairer reading. These sites also had higher stream temperatures and can typically have lower water flow and more groundwater input, which can concentrate constituents and increase conductivity.

Turbidity is an optical measurement that can indicate the amount of suspended solids present in a body of water. The higher the turbidity reading, the higher the amount of solids in the water column which translates to unhealthy streams. Excess sediments (i.e. from bank erosion) are detrimental to juvenile salmon and other aquatic life, can adversely affect gill function and visibility and can smother fish and amphibian eggs. Foster Creek at Harding Road measured a turbidity of >22 which indicates a poor reading. Observations in the field suggested that Foster Creek was a more silty stream than others tested which had more cobble present. Upstream activities including beaver activity could also account for the higher turbidity reading. In addition, the low dissolved oxygen saturation score (<90%) could be due to a higher sediment oxygen demand. More turbidity leads to warmer water temperatures and less oxygen.

OVERALL FINDINGS

Clear Creek at Metzler Park, Clear Creek at Cedarhurst, and Eagle Creek at Bonnie Lure appear to be the healthiest streams, all within DEQ accepted limits. This was expected as these areas consist of mostly forested, highly shaded areas of the Clackamas River Basin. Other sites such as Foster Creek at mouth, Foster Creek at Harding Road, Lower Clear Creek at Carver, and North Fork Deep Creek which are known to reside on predominately agricultural lands that can cause increased nutrient levels, were surprisingly within more acceptable limits than anticipated. However, these areas still suggest further water quality improvements are needed.

Figure 1.

2013 Water Quality Data in the Clackamas River Basin

Sampling Site	Date	Temp °C	pH SU	DO mg/L	DO %sat	Cond µS/cm	Turb NTU
Spring Crk at Mattoon Rd	10/23/13	9.3	7.62	11.2	99	95.10	3.59
Clear Crk at Cedarhurst	10/16/13	8.4	7.59	12.1	104	57.89	2.19
Foster Crk at mouth	10/10/13	10.5	7.45	10.5	97	95.01	5.44
North Fork Deep Crk	10/21/13	10.8	7.27	10.8	100	94.22	4.49
Eagle Crk at Bonnie Lure	10/25/13	9.5	7.64	11.9	105	42.18	0.65
Foster Crk at Harding Rd	10/30/13	7.4	7.23	10.3	87	81.42	30.90
Lower Clear Crk at Carver	09/20/13	14.7	7.90	10.5	105	78.00	1.30
Clear Crk at Metzler Park	09/23/13	5.4	7.59	12.6	103	61.79	2.80

Benchmarks of tested parameters: Good, Fair, Poor - Interpretations determined using Oregon's water quality standards provided in DEQ's 2009 Willamette Basin Rivers and Streams Assessment (Mulvey, Leferink, and Borisenko).

Macroinvertebrates and Habitat Characteristics: Following EPA Environmental Monitoring and Assessment Protocols (EMAP), CRBC collected habitat measurements which consisted of pebble counts, channel cross sections, channel incision, stream flow and percent shade (see Figure 4) at each location. Macroinvertebrate samples were analyzed according to the PREDATOR Model by staff at Cole Ecological, Inc. and results can be seen in Figure 2.

2013 Macroinvertebrates	
Sampling Site	**Condition Class**
Spring Crk at Mattoon Rd	Least Disturbed
Clear Crk at Cedarhurst	Moderately Disturbed
Foster Crk at Mouth	Moderately Disturbed
North Fork Deep Crk	Most Disturbed
Eagle Crk at Bonnie Lure	Moderately Disturbed
Foster Crk at Harding Rd	Moderately Disturbed
Lower Clear Crk at Carver	Most Disturbed
Clear Crk at Metzler Park	Least Disturbed

Figure 2. Macroinvertebrate Condition Class based on O/E (P > 0.5) analyzed by Cole Ecological, Inc.

<u>Relative Bed Stability</u> - What is it and Why is it important?

Sediment load or Relative Bed Stability (RBS) is an important indicator of stream health and useful to measure excess sediment caused by human activities. RBS is the relationship between supply and transport in a stream. From the habitat measurements collected, RBS and Percent of Sands and Fines were calculated and used in Figure 3 to show Sediment Benchmarks. Natural factors that influence these benchmarks are stream power (slope & size), roughness (large woody debris and pools), and lithology (particle erodibility). Healthy streams with low human disturbance have RBS values near zero and are considered stable because they are transporting as much sediment as is being supplied. Streams that are disturbed have low RBS values (-1.5 to -3.0). Figure 3 reveals that Foster Creek at Harding Road is in the "exceedance zone" and has more fine particles than expected (also indicated by the turbidity reading). This suggests erodibility and human disturbances are impacting water quality at this site. Also of note, North Fork Deep Creek is considered fair while all other sites are considered good, suggesting that it too like Foster Creek is being affected by human activity and land uses.

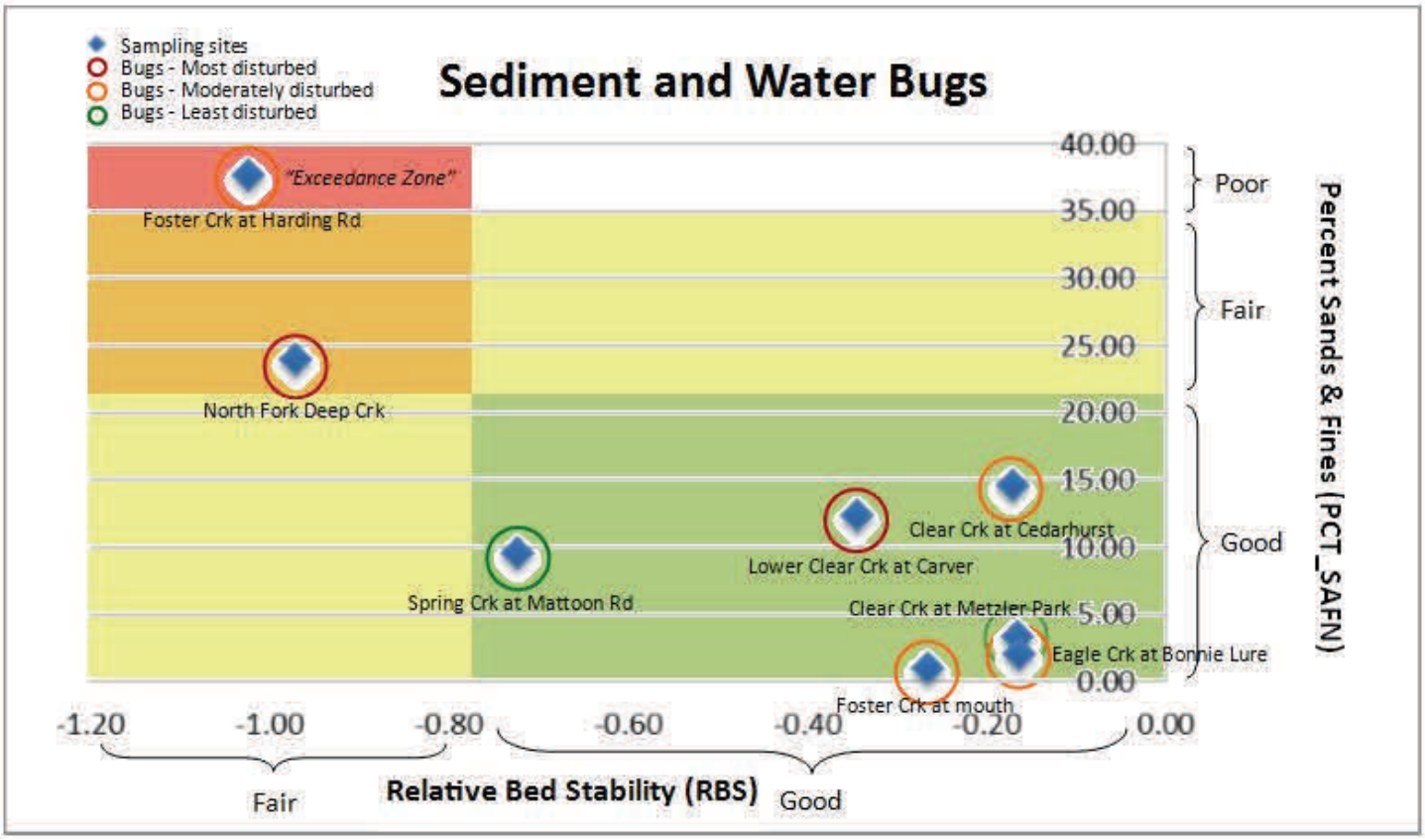

Figure 3. Based on Sediment Benchmarks for Oregon presented by Doug Drake and Phil Kaufmann.

"Any river is really the summation of the whole valley. To think of it as nothing but water is to ignore the greater part."
— (Hal Borland, *This Hill, This Valley*)

2013 Canopy Cover

Sampling Site	Status	Avg % Bank Shade
Spring Crk at Mattoon Rd	Previously sampled site	93%
Clear Crk at Cedarhurst	Previously sampled site	76%
Foster Crk at Mouth	Previously sampled site	86%
North Fork Deep Crk	Restoration site	87%
Eagle Crk at Bonnie Lure	Restoration site	30%
Foster Crk at Harding Rd	Restoration site	51%
Lower Clear Crk at Carver	Restoration site	79%
Clear Crk at Metzler Park	Control site	95%

Figure 4. Riparian canopy cover (% density) along bank using densiometer.

Photos: Examples of a healthy shaded riparian area (top) vs. unhealthy.

What can you do to improve water quality?

Everyone's actions make an impact on watershed health. Cleaner water is healthier to drink and healthier to play in! There are many easy steps you can take to make sure that the water flowing into our creeks is as clean as possible. Here are just a few:

Create more shade! Removing invasive weeds along streams and replacing them with native plants can have far reaching effects for you and the stream. A riparian buffer of native grasses, rushes, shrubs, and trees provide food and shelter that improve water quality and create better habitat for plants, animals, and fish. As trees mature, their leaves create shade that will cool water temperatures which is critical for both drinking water and the health of many temperature-sensitive native fish species. The shade provided by native plants also lowers water temperatures and reduces the risk of algae growth. Planting a variety of trees and shrubs creates a network of roots that hold soil in place and reduce bank erosion. In addition, these plants help filter dirty water running off surrounding lands by trapping sediments and chemicals , preventing them from reaching the stream.

Cut back on pesticides! With your help, we can cut back on the amount of chemicals used in our fields, lawns and gardens, which is a growing concern in the Clackamas watershed. Pesticides should be your last defense against pests. However, people frequently apply more pesticides than needed, resulting in excess chemicals in our lawns and streams. This can lead to pesticide-resistant weeds and insects which only makes your job more difficult. These chemicals often end up affecting plants and animals that aren't the intended target. Sensitive salmon are especially hard hit. If pesticide use is absolutely unavoidable, apply just enough to address the problem, no more. Do your research - buy the right pesticide for the right place. Make sure you follow the directions, read labels, apply the appropriate amount, and only apply during non-windy conditions to minimize drift. Taking these steps can be cost saving as well. A win-win for everyone!