

BUREAU OF ENVIRONMENTAL SERVICES • CITY OF PORTLAND

Portland Area Watershed Monitoring and Assessment Program

Executive Summary—First Year Data

YEAR

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ENVIRONMENTAL SERVICES
CITY OF PORTLAND

working for clean rivers

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OCTOBER 2015

EXECUTIVE SUMMARY

Portland Area Watershed Monitoring and Assessment Program FIRST YEAR DATA (FY 2010-2011)

PAWMAP gathers and analyzes data from these Portland-area watersheds:

- Columbia Slough
- Fanno Creek
- Johnson Creek
- Tryon Creek
- Tualatin River
- Willamette River tributaries only

The Portland Area Watershed Monitoring and Assessment Program (PAWMAP) redesigned the city's watershed monitoring to more directly support the 2005 Portland Watershed Management Plan.

The program:

- Coordinates and integrates watershed monitoring across all watersheds, to make results comparable.
- Collects all watershed measures at the same locations to support more powerful analysis of patterns in the data.
- Uses a strong statistical design that increases the accuracy and efficiency of data collection.
- Adopts an approach designed by national monitoring experts, providing information that is directly comparable to state and federal monitoring efforts.
- Supports regulatory compliance requirements under the Clean Water Act and the Endangered Species Act.

Portland watersheds are very diverse, including steep Forest Park streams, moderate-gradient streams like Tryon and Johnson creeks, and low-gradient waterbodies like the Columbia Slough and Columbia and Willamette Rivers. Stream sizes range from small seasonal streams to the fourth largest river in the country. Land cover ranges from the heavily forested Forest Park and Tryon Creek State Natural Area to the highly industrialized Portland Harbor.

PAWMAP samples the habitat, water quality and biological communities of Portland's watersheds¹. This document summarizes the results of the first year data sampling in each watershed.

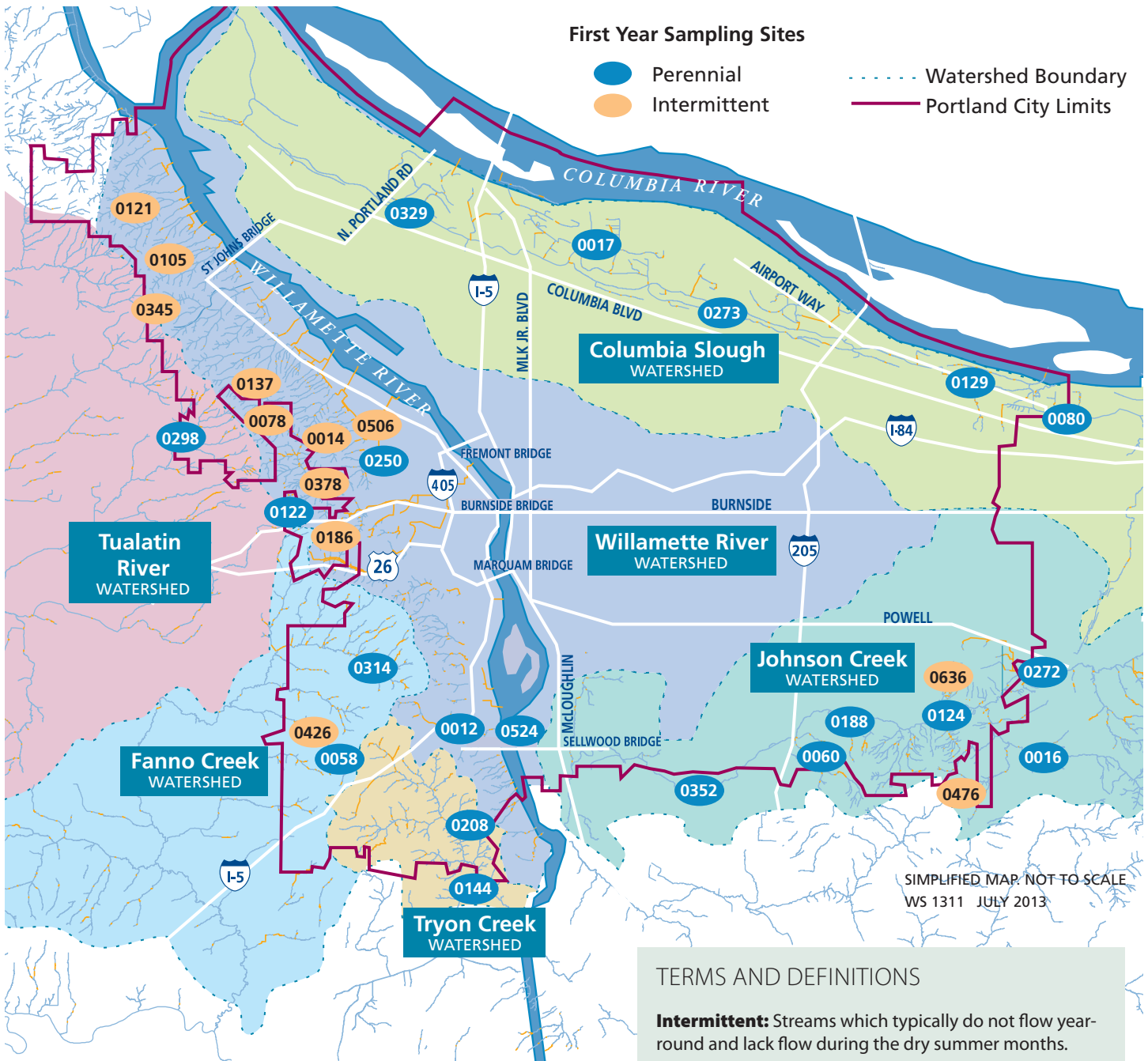
TERMS AND DEFINITIONS

Please refer to the Glossary starting on page 16 for definitions of the technical terms used throughout this summary.

¹ Monitoring in the major rivers—the Columbia and Willamette—has not been incorporated into PAWMAP yet due to the large amount of existing information and complexity of issues in Portland Harbor. Developing the approach for incorporating large river monitoring into PAWMAP is in progress.

Portland area watersheds with first year sampling sites

In the first sampling season (July 2010 – June 2011) BES Field Operations staff monitored 20 sites along perennial streams and 12 sites along intermittent streams.



TERMS AND DEFINITIONS

Intermittent: Streams which typically do not flow year-round and lack flow during the dry summer months.

Perennial: Streams which typically have water flowing year round.

Summary of First Year Sampling by Watershed



This Columbia Slough site (0129) is an example of a typical slough site. The slough is a naturally low-gradient, slow-flowing system which is very different from the other streams in Portland.

WATERSHED: COLUMBIA SLOUGH



The Columbia Slough at Whitaker Slough (site 0273) is an example of a "boatable" survey site, where deep water does not allow field staff to traverse the stream safely and sampling must be done from a boat.

The Columbia Slough begins at Fairview Lake and meanders west for 19 miles to Kelley Point Park where it empties into the Willamette River. Historically, the Columbia Slough waterway was a low-gradient collection of wetlands, lakes and streams that formed the Columbia and Willamette river floodplains. The slough is Portland's most altered watershed and waterway. Over the years, the area was heavily altered to accommodate industry, transportation and agriculture. Beginning in 1918, levees were built to provide flood protection. Wetlands and side channels were drained and filled to allow for development. The waterway was channelized, and dozens of streams were filled or diverted to underground pipes.



Field staff measuring a common carp, a non-native fish species common in the Columbia Slough. Non-native fish are abundant in the Columbia Slough. While most Portland streams typically have less than 1% non-native fish comprising their fish communities, the Columbia Slough has well over 35% non-native fish in its fish communities.

First year data summary—Columbia Slough

HABITAT	WATER QUALITY	BIOLOGICAL
WOOD Like most Portland watersheds, large wood is very scarce, in part because of limited riparian vegetation and the need to maintain flood control capacity.	TEMPERATURE² Most of the stations sampled in the first year exceeded temperature standards until fall. The one exception was Whitaker Slough, which never exceeded standards after the probes were placed in mid-July.	AQUATIC INSECTS The Columbia Slough had the lowest aquatic insect community scores of all the watersheds. It is important to note, however, that most metrics used to evaluate the health of aquatic insect communities are developed for pool-riffle stream systems. They are not as effective in addressing low gradient systems like the slough. Poor aquatic insect communities in the slough are likely a result of two factors: macroinvertebrate metrics are not designed for slough systems and watershed conditions are also poor.
	EUTROPHICATION The Columbia Slough is one of the few watersheds in which signs of eutrophication – excessive nutrients that lead to overproduction of algae and low dissolved oxygen – are present. The slough is naturally susceptible due to low gradient, slow flows and long residence times, but human alterations including removal of wetlands that process nutrients, segmentation by culverts, and discharges that increase nutrient loads have created the problem.	
SUBSTRATE The Columbia Slough substrates are naturally fine grained due to its low gradient, slow flows and floodplain deposits.	TOTAL SUSPENDED SOLIDS The slough had the highest median TSS of all the watersheds, but maximum TSS values were not as high as some other watersheds (e.g., Willamette Streams, Johnson Creek). The slough tended to have higher TSS than other watersheds during the seasonal (non-storm) sampling, but lower values during storms because of lower gradients and less flashy flows.	FISH Fish communities are dominated by invasive species in the slough whereas they are a minor component in other watersheds. While the most abundant species was the native three-spined stickleback, six of the ten most abundant species were non-native.
	E. COLI The slough was tied with the Willamette Streams for lowest overall median <i>E. coli</i> concentration (20 MPN), and had only one measurement above the single sample criterion of 406 MPN, the lowest of any watershed.	
RIPARIAN CONDITIONS The levee system precludes the presence of riparian vegetation along many parts of the slough, and this is reflected in percentages of riparian canopy far below the other watersheds.	METALS The slough had moderate levels in comparison to other watersheds for zinc and lead, and low values for copper and mercury. The slough was one of the only watersheds that did not have at least one exceedence of the copper criterion during storm flows.	RIPARIAN BIRDS Riparian bird communities typically had low integrity in the slough. This was likely due to the low percentage of riparian canopy, which was an important determinant of bird community health. However, a site in the Upper Slough near Big Four Corners had the highest number of Special Status and At-Risk bird species (7 species) of all the first year sites.
	PORTLAND WATER QUALITY INDEX Three of the five stations sampled in the first year were above the PWQI Properly Functioning Condition benchmark of 60. One station in the upper slough had a PWQI of 50 and in Elrod Slough had a PWQI of 34.	

² Because of the time required to secure access to sample stream reaches through private property, temperature probes were often not installed until mid- late-summer. This will be an issue in sampling the four rotating panels for the first time, but since access permissions have been acquired, will not be an issue for the second and subsequent rounds of sampling each panel.

Summary of First Year Sampling by Watershed



Riparian vegetation sampling location #0058 in Woods Creek includes western red cedar, vine maple and sword fern.

WATERSHED: FANNO CREEK

Fanno Creek is one of a series of streams that drain the west slope of the Tualatin Mountains to the Tualatin River, then flow to the Willamette River above Willamette Falls. Fanno Creek is a tributary to the Tualatin River Basin, which drains about 20,500 acres. Of that land area, 4,528 acres are within the City of Portland jurisdiction. Land use in the Fanno Creek Watershed is dominated by residential, industrial, and commercial activities.



Above: Water quality is sampled quarterly on the Fanno mainstem to capture seasonal changes, and once during storm flows at each site. Stormwater can be a major threat to the health of urban watersheds, and sampling during storm flows helps to understand how stormwater affects stream health.

Left: Fanno Creek sampling location #0314 is adjacent to the Beaverton-Hillsdale Highway. Culverts are common along urban streams and have major impacts. They can limit the ability of fish to move between different habitats seasonally, impact water quality, and alter natural stream flows.

First year data summary—Fanno Creek

HABITAT	WATER QUALITY	BIOLOGICAL
<p>WOOD</p> <p>Like most Portland watersheds, large wood is very scarce in Fanno Creek, and the three sites sampled in Fanno the first year were less than half the level considered “Not Properly Functioning.”</p>	<p>TEMPERATURE²</p> <p>Of the two perennial stations sampled for temperature, the station at Fanno mainstem had higher temperatures than the station in Woods Creek. The Fanno mainstem station exceeded standards from the time it was placed in early July until late Sept. In contrast, the station at Woods only exceeded standards for short periods in early July and mid-August.</p>	<p>AQUATIC INSECTS</p> <p>Two stations were sampled for aquatic insects in the first year. The results from Woods Creek were moderate when compared to other streams across the city, while the result from Fanno mainstem was very low in comparison to other stream stations – the second lowest of the 20 stations sampled across the city in Year 1.</p>
	<p>EUTROPHICATION</p> <p>While signs of eutrophication in Fanno Creek are less than in the Columbia Slough (chlorophyll <i>a</i> was never detected), nutrients and eutrophication are still a concern in this watershed because 1) it drains to the Tualatin River, where eutrophication is a problem being addressed through regulatory limits, and 2) it was one of the few watersheds where ammonia was detected regularly.</p>	
<p>SUBSTRATE</p> <p>One of the three sites sampled in the first year was a naturally fine grained site with low gradient and few riffles. The other two sites (both in Woods Creek) met benchmarks for gravel, but one of the sites had excessive levels of fines exceeding the benchmark.</p>	<p>TOTAL SUSPENDED SOLIDS</p> <p>Fanno Creek had a median TSS value that was moderate in comparison to other watersheds, and maximum values less than other watersheds.</p>	<p>FISH</p> <p>Fish communities were poor at the three stations sampled for fish in Fanno Creek in the first year. No fish were captured at the two stations in Woods Creek. No fish were captured in the station on Fanno mainstem in spring and fall, and only a single mosquitofish – a non-native species – was captured in summer.</p>
<p><i>E. COLI</i></p> <p>Fanno Creek had a median <i>E. coli</i> value in the middle of the range for all watersheds, and only two values exceeded the single sample criterion of 406 MPN.</p>		
<p>RIPARIAN CONDITIONS</p> <p>Fanno Creek had the lowest median value for riparian canopy of the westside watersheds and the second lowest overall in the first year.</p>	<p>METALS</p> <p>In comparison to other watersheds the median value for Fanno Creek was high for copper, lead and zinc, and low for mercury.</p>	<p>RIPARIAN BIRDS</p> <p>All the bird species observed at the three stations sampled in the first year were native. However, the Fanno mainstem site was the only station in the first year in which no special status bird species were observed, and only one was observed in Woods Creek. The station higher up in Woods Creek (0058) did have several Special Status bird species, and the highest number of At-Risk Bird species (2) at any site in the first year.</p>
	<p>PORTLAND WATER QUALITY INDEX</p> <p>Two of the three Fanno stations sampled in the first year were above the PWQI Properly Functioning Condition benchmark of 60. The third station in Fanno mainstem was just below this level (PWQI=54).</p>	

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Summary of First Year Sampling by Watershed



Sampling site #0124 is in middle Johnson Creek and shows trees in the riparian area along the banks. The riparian vegetation shades streams and moderates stream temperatures, controls erosion, and provides a source of organic matter and insects that support aquatic food chains.

WATERSHED: JOHNSON CREEK



In the 1930s, the Work Progress Administration (WPA), deepened, straightened, and armored the creek by installing large basalt rock lining along its banks and streambed. The WPA work eliminated aquatic habitat such as riffles, pools, and large wood and impaired the stream's ability to migrate and recruit gravels and large wood. It also disconnected the stream from its floodplain which previously absorbed, stored, and conveyed floodwater.

Johnson Creek originates in the hills east of Portland and flows westward approximately 25 miles to its confluence with the Willamette River. The stream receives water from several major tributaries, including Crystal Springs Creek, Kelley Creek, Mitchell Creek, Butler Creek, Hogan Creek, Sunshine Creek, and Badger Creek. Land use in the 34,310-acre watershed ranges from heavily developed urban and industrial areas to rural farm and nursery lands.



Sampling location #0352 in the lower mainstem—summer low flow conditions

During summer most Portland streams exceed temperature standards. Fish communities often cannot be sampled during these low flow periods if species listed under the Endangered Species Act (e.g., salmon) are present, because high temperatures and stress from sampling may be harmful to these sensitive species.

First year data summary—Johnson Creek

HABITAT	WATER QUALITY	BIOLOGICAL
<p>WOOD</p> <p>None of the sites sampled in Johnson Creek in the first year met benchmarks for wood. Most were well below the Properly Functioning Condition benchmarks. Stations at the Kelley Creek confluence and in Middle Johnson were noticeably higher in wood volume than other sites in the watershed.</p>	<p>TEMPERATURE²</p> <p>Of the six stations sampled in the first year, temperatures were highest on the mainstem stations in Middle and Lower Johnson. Stations in tributaries – Kelley and Veterans creeks – were typically lower and only exceeded standards for a few days.</p> <p>EUTROPHICATION</p> <p>First year monitoring data suggest that eutrophication is not a major issue in Johnson Creek.</p>	<p>AQUATIC INSECTS</p> <p>Stations in Johnson Creek tended to be in the upper half of aquatic insect community scores across the city. The best of the six stations sampled in the first year was in Veterans Creek, while the worst score in the watershed was in Middle Johnson.</p>
<p>SUBSTRATE</p> <p>Of the two reaches sampled in the first year in which more than half the habitat was riffles, one site in Veterans Creek met the Properly Functioning Condition benchmark for gravel and was just below the benchmark for fines. The site in Lower Johnson met the benchmark for fines but was very low in gravel.</p>	<p>TOTAL SUSPENDED SOLIDS</p> <p>Johnson Creek had a moderate median value for TSS in comparison to other watersheds, although high values were occasionally observed.</p> <p>E. COLI</p> <p>Johnson Creek was tied with the Tualatin tributaries for the second highest median <i>E. coli</i> value (130 MPN).</p>	<p>FISH</p> <p>Five stations were sampled for fish in Johnson Creek in the first year. The vast majority of fish were native, the only exception being four warmouth collected at Kelley Creek. Salmonids captured included cutthroat trout at Lower Johnson and Kelley Creek, and steelhead/rainbow trout in Middle and Lower Johnson.</p>
<p>RIPARIAN CONDITIONS</p> <p>Riparian canopy varied widely in the Johnson Creek stations sampled in the first year, and the overall average for the watershed was in the middle of the watershed averages. Well vegetated reaches included Veterans Creek, Mitchell Creek and Powell Butte.</p>	<p>METALS</p> <p>In comparison to other watersheds, median levels for Johnson Creek were low for copper, lead and zinc and moderate for mercury.</p> <p>PORTLAND WATER QUALITY INDEX</p> <p>A station in Johnson Creek had the highest PWQI of the stations sampled during the first year: 85 at Powell Butte. In addition, three other stations had PWQI scores above the Properly Functioning Condition benchmark of 60. Four stations had PWQI scores below the benchmark, with the lowest being a score of 27 in Lower Johnson.</p>	<p>RIPARIAN BIRDS</p> <p>Johnson Creek had the second lowest median Bird Integrity Index across the city. The best score was at Powell Butte, while the worst score in the watershed was in Lower Johnson. In addition, about half the species observed at the Kelley Creek station were non-native.</p>

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Summary of First Year Sampling by Watershed



Tryon Creek sampling location #0208, at the restoration project near 4th Ave. The creek had eroded its banks and exposed a sewer pipe. The restoration project protected and stabilized the sewer pipe, and enhanced aquatic habitat by redirecting the creek away from the pipe, adding large wood, creating pool and riffle habitats, and revegetating riparian and floodplain areas.

WATERSHED: TRYON CREEK



Sampling site 0144 is at Nettle Creek, a small tributary that flows from Lake Oswego into the lower mainstem of Tryon in the Tryon Creek State Natural Area.

Tryon Creek is a seven-mile long free-flowing stream that drains a roughly 4,200-acre watershed. The stream flows in a southeasterly direction from Mt. Sylvania in the Southwest Hills of Portland to the Willamette River near Lake Oswego. It is primarily a moderate gradient stream with steep slopes, which results in a high frequency of landslides and erosion. The upper watershed has suffered impacts commonly associated with urban development, including increased instream flow velocities and volumes following storm events and subsequent stream bank erosion.



A Pacific giant salamander, found at Tryon Creek sampling location #0208, is an amphibian that is often present in Pacific Northwest streams when habitat conditions are healthy.

First year data summary—Tryon Creek

HABITAT	WATER QUALITY	BIOLOGICAL
<p>WOOD</p> <p>Although both stations sampled in the first year were within the Tryon Creek State Natural Area, the amount of wood was dramatically different at the two locations. Nettle Creek had very low levels of wood while the second site, located at the 4th Avenue restoration site, was one of only two stations in the first year that met the “Properly Functioning Condition” benchmark for wood.</p>	<p>TEMPERATURE²</p> <p>The two stations sampled in the first year had similar patterns. Both stations had a small peak in temperature in late July and then reached their highest values in mid-late August. The mainstem site exceeded standards for short times during both peaks. The station in Nettle only exceeded standards during the second peak for 3 days.</p>	<p>AQUATIC INSECTS</p> <p>The two stations randomly sampled in the first year in Tryon both landed in well-vegetated stream reaches (Nettle Creek and Tryon Creek State Natural Area) and the two reaches had the second and third highest aquatic insect community scores across the 20 sites sampled in the first year.</p>
	<p>EUTROPHICATION</p> <p>First year monitoring data suggest that eutrophication is not a major issue in Tryon Creek.</p>	
<p>SUBSTRATE</p> <p>The station in Tryon Creek State Natural Area met Properly Functioning Condition benchmarks for fines and gravel. The station in Nettle Creek was higher in fines and lower in gravel in comparison to the benchmarks.</p>	<p>TOTAL SUSPENDED SOLIDS</p> <p>Tryon Creek had very low median and maximum TSS values in comparison to other watersheds</p>	<p>FISH</p> <p>Two sites were sampled over three seasons in the first year in Tryon. All fish were native fish. Reticulate sculpin were by far the most abundant species, but cutthroat trout, coho salmon and steelhead/rainbow trout were also present.</p>
	<p>E. COLI</p> <p>Tryon Creek had the highest median value for <i>E. coli</i> of all the watersheds (170 MPN/100 ml) in the first year.</p>	
<p>RIPARIAN CONDITIONS</p> <p>Because the two sites sampled in the first year were located in Tryon Creek State Natural Area, both had high percent riparian canopy in comparison to the other watersheds.</p>	<p>METALS</p> <p>In comparison to other watersheds, median levels for Tryon Creek were moderate for copper, lead and mercury and high for zinc.</p>	<p>RIPARIAN BIRDS</p> <p>No non-native species were observed at the two stations sampled in the first year. Tryon Creek had the second highest overall median Bird Integrity Index scores.</p>
	<p>PORTLAND WATER QUALITY INDEX</p> <p>The two stations sampled in the first year varied widely in their PWQI scores: The station in Tryon Creek State Natural Area was well above the “Properly Functioning Condition” benchmark of 60 (PWQI=71), while the station in Nettle Creek was well below the benchmark (PWQI=41).</p>	

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Summary of First Year Sampling by Watershed



Identifying and measuring fish at Cedar Mill Creek, which flows westward from the West Hills and eventually to the Tualatin River. The number, size and condition of each fish species is recorded to provide information on the health of fish communities in Portland streams. Fish are a barometer of the overall ecological health of a stream.

WATERSHED: TUALATIN RIVER

Over the crest of the West Hills (also known as the Tualatin Mountains) is a long range of streams that drain to the Tualatin River, then flow to the Willamette River above Willamette Falls. Fanno Creek is the most well known, though smaller streams such as Bronson and Cedar Mill creeks are located to the north. These streams range widely in land use from well-forested natural areas to residential and transportation land uses.



The Cedar Mill Creek site shows wood and boulders piling up at a culvert. Culverts often limit the passage of large wood and fish and wildlife and degrade stream flow and water quality, which adversely affects stream health.

First year data summary—Tualatin River

HABITAT	WATER QUALITY	BIOLOGICAL
<p>WOOD</p> <p>The three stations in the Tualatin Tributaries were all less than half the level considered “Not Properly Functioning” for volume of large wood in the Watershed Health index.</p>	<p>TEMPERATURE²</p> <p>Cedar Mill Creek was well above standards when the probes were placed in early July. It remained above standards – with the exception of one week in late Sept. – until early Oct. The probe in Golf Creek was not placed until early Sept., but the temperatures over this time period were considerably lower than in Cedar Mill.</p>	<p>AQUATIC INSECTS</p> <p>Two stations were sampled for aquatic insects in Tualatin Tributaries in the first year. The station in Golf Creek was in the upper 75th percentile of stations sampled across the city, while the station in Cedar Mill was in the lower third.</p>
	<p>EUTROPHICATION</p> <p>While signs of eutrophication in the Tualatin tributaries are less than in the Columbia Slough (chlorophyll <i>a</i> was only detected once), nutrients and eutrophication are still a concern in this watershed because 1) these streams drain to the Tualatin River, where eutrophication is a problem being addressed through TMDLs, and 2) it was one of the few watersheds where ammonia was detected regularly.</p>	
<p>SUBSTRATE</p> <p>Although Bronson and Golf creeks both met the Properly Functioning Condition benchmark for gravel, they greatly exceeded the Not Properly Functioning Condition for fines.</p>	<p>TOTAL SUSPENDED SOLIDS</p> <p>The Tualatin Tributaries had a comparatively high median TSS value (second highest behind the slough), some high individual values during storms, and over 25% of the values were above the watershed index benchmark value of 20 mg/l.</p>	<p>FISH</p> <p>The Tualatin tributaries were sampled once at Golf Creek (no fish were captured), and three times at Cedar Mill Creek. Two nonnative fish (fathead minnows) were captured in one survey, but they were well outnumbered by native reticulate sculpin and reddsides.</p>
	<p>E. COLI</p> <p>The Tualatin tributaries were tied with Johnson Creek for the second highest median <i>E. coli</i> value (130 MPN).</p>	
<p>RIPARIAN CONDITIONS</p> <p>The sites in Bronson and Golf creeks had comparatively high percentages of riparian canopy, whereas the site in Cedar Mill had very low percentages.</p>	<p>METALS</p> <p>The Tualatin River tributaries had high median values in all metals in comparison to other watersheds.</p>	<p>RIPARIAN BIRDS</p> <p>The Tualatin tributaries had the highest overall median for the Bird Index of Integrity, but also the widest range in the scores from the three sites sampled in the first year. It had the overall lowest BII at Cedar Mill, and the second highest BII at Bronson Creek. Bronson Creek was also tied for the highest abundance of Special Status species with a Forest Park site.</p>
	<p>PORTLAND WATER QUALITY INDEX</p> <p>All stations in Tualatin were well below the benchmark PWQI of 60. The lowest was a core of 23 in Bronson Creek. Tualatin streams had the second lowest median PWQI of all the watersheds at 37.</p>	

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Summary of First Year Sampling by Watershed



Stephens Creek sampling location #0012 shows a range of sizes in stream substrate. Substrate – the gravel, cobbles, sand and organic matter that form the stream bottom – are very important to stream health. Aquatic insects – which form the base of the stream food web – use substrate as habitat, and salmon form their nests within the substrate.

WATERSHED: WILLAMETTE STREAMS



Saltzman Creek at sampling site #0137 shows the steep slopes and mature vegetation present at many Forest Park streams.

The Willamette Streams are a diverse set of streams that range from the highly impacted and urbanized Stephens Creek to the well-vegetated and protected streams within Forest Park. These small watersheds all drain the West Hills before discharging to the Willamette River mainstem. They are therefore grouped together into a “watershed” termed the Willamette Streams. Because of their diverse land uses and characteristics, these streams typically had wide ranges in watershed metrics.



Field crew measure stream channel and riparian characteristics at site #0250 in Balch Creek. This information on instream habitat and riparian conditions helps identify the major factors threatening stream health.

First year data summary—Willamette Streams

HABITAT	WATER QUALITY	BIOLOGICAL
<p>WOOD</p> <p>Willamette Streams were one of only two watersheds with a site that met Properly Functioning Condition benchmarks for large wood in the first year, and this site – Balch Creek – was the only site that met the target naturally (i.e., the site was not a restoration project with added wood). Two sites – in Saltzman Creek and in an unnamed Forest Park tributary – were just below the target. The other eight sites were well below the target.</p>	<p>TEMPERATURE²</p> <p>The three perennial stations sampled in the first year – in Balch Creek and two in Stephens Creek – did not exceed standards, although the probes at the two Stephens Creek sites were not placed until late Aug. – early Sept.</p> <p>EUTROPHICATION</p> <p>First year monitoring data suggest that eutrophication is not a major issue in the Willamette Streams.</p>	<p>AQUATIC INSECTS</p> <p>The three stations sampled in Willamette Streams varied widely. The station in Balch Creek had the highest aquatic insect community score across the city in the first year, and the only score above DEQ’s criterion for a “most disturbed” insect community. The lowest score in the watershed was in Stephens Creek below Interstate 5.</p>
<p>SUBSTRATE</p> <p>In the first year two Willamette Streams stations had riffles over more than half their reaches and so could be evaluated against the substrate benchmark. Both were in Stephens Creek. The site in upper Stephens Creek below I-5 had by far the most degraded substrate of any riffle site sampled across the city. The site at the mouth of Stephens was just below the benchmark for gravels, but exceeded the Not Properly Functioning benchmark for fines. It is possible that some of this is due to natural conditions associated with deposition from the Willamette River.</p>	<p>TOTAL SUSPENDED SOLIDS</p> <p>The Willamette Streams had a moderate median TSS value in comparison to other watersheds, but some of the highest maximum values observed across all watersheds, and over 25% of the values were above the watershed index benchmark value of 20 mg/l.</p> <p>E. COLI</p> <p>The Willamette Streams were tied with the Columbia Slough for the lowest median <i>E. coli</i> value among the watersheds, but also had the widest variability and the highest single values overall.</p>	<p>FISH</p> <p>Three sites were sampled in Willamette Streams in the first year: Balch Creek, the mouth of Stephens Creek and a tributary to Stephens. The tributary had no fish. The mouth of Stephens – openly connected to the Willamette – had several salmonids including steelhead, Chinook and coho, but also had two non-native species. Balch only had cutthroat and had a large number of native fish on the two surveys conducted at that station.</p>
<p>RIPARIAN CONDITIONS</p> <p>The Willamette Streams varied widely in riparian canopy, but had four of the five stations with the highest percentages of riparian canopy, including sites in Forest Park, Balch Creek and Tanner Creek.</p>	<p>METALS</p> <p>The Willamette Streams were moderate in copper, zinc and lead (although high in dissolved lead) and high in mercury in comparison to other watersheds.</p> <p>PORTLAND WATER QUALITY INDEX</p> <p>The Willamette Streams had a wide range of PWQI scores. Three sites were above the Properly Functioning Condition benchmark value of 60, with the highest being 73 at the mouth of Stephens Creek. Eight stations were below the benchmark value, due primarily to low scores for mercury, suspended sediment and <i>E. coli</i>. The Willamette streams also had the lowest median PWQI of all the watersheds – 30.</p>	<p>RIPARIAN BIRDS</p> <p>The Willamette Streams had no non-native bird species at the stations sampled in the first year. The overall median Bird Index of Integrity was moderate in comparison to other watersheds, but the highest Index score across the city in the first year was observed in Balch Creek.</p>

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GLOSSARY

Bird Integrity Index: An index based off an index developed by Bryce et al. (2002) that uses bird communities as an index of riparian condition for streams in the Willamette Valley. (Bryce, S. A., R. M. Hughes, and P. R. Kaufman. 2002. Development of a bird integrity index: using bird assemblages as indicators of riparian condition. *Environmental Management* 30:294–310.)

Eutrophication: The process by which a body of water becomes enriched in dissolved nutrients (as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen.⁶

Fine sediments: Sediments <0.06 mm in size, although sometimes this can include sand which is < 2 mm in size.⁷

Gradient: The degree of inclination, or the rate of ascent or descent in a river or stream.⁴

Gravels: Loose rounded fragments of rock⁶, typically 2 – 64 mm in size (about the size of a ladybug to a tennis ball).

Levee: A natural or man-made earthen obstruction along the edge of a stream, lake, or river, usually built to restrain the flow of water out of a river bank and protect land from flooding.⁴

Macroinvertebrates: Macroinvertebrates are organisms that are large enough to be seen with the naked eye but do not have a back bone. Many types of macroinvertebrates live in or near the water. They are abundant in lakes, streams, ponds, marshes, and puddles.⁷ The types of macroinvertebrates present in a stream are often used to assess its health.

Metals: A dense, opaque element that is usually a lustrous solid and is a good conductor of heat or electricity.⁵ In high concentrations metals can be toxic to aquatic life.

Properly Functioning Condition: The sustained presence of natural habitat-forming processes that are necessary for the long-term survival of the species through the full range of environmental variation.⁵

Not Properly Functioning: The lack of the sustained presence of natural habitat-forming processes that are necessary for the long-term survival of the species through the full range of environmental variation.⁵

Portland Water Quality Index: An index comprised of eight measures that is designed to compile water quality data of importance in Portland's streams into a single value that can be tracked over time. The eight measures are temperature, dissolved oxygen, ammonia, phosphorus, total suspended solids, dissolved copper, total mercury and *E. coli*.

Riparian canopy: The canopy of the trees on the banks of a waterbody.³

Riparian conditions: The conditions on the banks of a waterbody.⁵

Riffles: Shallow rapids in an open stream, where the water surface is broken into waves by obstructions such as shoals or sandbars wholly or partly submerged beneath the water surface.⁴

Salmonids: Any of a family (Salmonidae) of elongate bony fishes (as a salmon or trout) that have the last three vertebrae upturned.⁶ Salmonids that are present in local Portland streams and rivers include coho and Chinook salmon, and cutthroat and steelhead trout. Chum salmon are present in the Columbia River and sockeye salmon are occasionally observed in the Willamette and Columbia rivers.

Substrate: The material underlying something, such as the soil beneath plants and animals, or the gravels and sediments composing a stream bottom.³

Suspended sediments: Particles of organic and inorganic matter that are suspended in or are carried by water.⁷

Total suspended solids: A measure of suspended sediments in water, obtained by filtering water and weighing the amount of sediment retained on a filter.⁷

Watershed: A topographically discrete unit or stream basin that includes the headwaters, main channel, slopes leading to the channel, tributaries and mouth area.³

3 Framework for Integrated Management of Watershed Health <http://www.portlandoregon.gov/bes/33528>

4 The Ecology Dictionary <http://www.ecologydictionary.org>

5 Oxford Dictionary of Environment and Conservation. <http://www.oxfordreference.com/view/10.1093/acref/9780198609957.001.0001/acref-9780198609957>

6 Merriam Webster <http://www.merriam-webster.com/dictionary>

7 Chris Prescott, Portland Bureau of Environmental Services, Personal Communication.

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