Statewide Water Quality Toxics Assessment Report

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DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

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Executive Summary

This is the first statewide assessment of toxics in water across Oregon. In 2008, the Oregon Department of Environmental Quality's Laboratory and Environmental Assessment Program began monitoring work to assess the presence and concentration of toxic chemicals in Oregon's waters. From 2008 to 2013, DEQ laboratory staff collected water samples from 177 sites across the state. These sites included coastal estuaries, large rivers and small streams. The laboratory analyzed these samples for more than 500 different chemicals.

Although some chemicals exceeded state criteria or benchmarks for human health and aquatic organisms, most did not. Samples from urban areas in the Willamette River Basin and agricultural areas in the Hood River Basin contained the largest variety of chemicals detected at least once and the largest frequency of samples with at least one chemical over a criteria or benchmark. DEQ's findings show that current-use pesticides, legacy or no-longer-used pesticides, polycyclic aromatic hydrocarbons and certain metals are of particular concern for human health and aquatic life impacts in Oregon and will require continued monitoring.

This study will serve as a baseline for future DEQ water quality monitoring studies.

Several key findings:

- 128 unique chemicals detected in water samples
- Most detected chemicals were at very low concentrations and within applicable criteria or benchmarks for environmental and human health
- Largest variety of chemicals detected in the Willamette Basin, followed by the Hood Basin
- Most samples with at least one chemical over a criteria or benchmark occurred in the Hood Basin
- Detections of current-use pesticides occurred in all basins, often as mixtures and at times at levels above acceptable EPA aquatic life benchmarks; diuron (herbicide) detected in all but one basin
- Legacy pesticides present in water; frequently above DEQ human health criteria
- Priority metals (such as copper and lead) present at levels above DEQ aquatic life criteria
- Arsenic and inorganic arsenic measured at levels of concern above DEQ human health criteria, mainly in Eastern Oregon and in Oregon's coastal estuaries
- Flame retardants detected around the state in urban and rural areas
- Polycyclic aromatic hydrocarbons (PAHs, which are combustion by-products from fires, vehicle combustion and waste incineration) detected above DEQ human health criteria at several locations

1. Introduction

1.1 Background/Justification

More than 80,000 different chemicals are in use in the United States. These chemicals include pesticides, pharmaceuticals, consumer products and industrial chemicals. Although they have intended beneficial uses, when they reach the environment, they may become pollutants potentially affecting aquatic life and human health. Recent national studies detected these pollutants across the United States in 80 percent of streams sampled (Kolpin, et al. 2002; Facazio, et al. 2008). Similar smaller-scale studies focused in Oregon detected similar chemicals in water, fish and streambed sediment (LCREP, 2007; Nilsen, 2007; Caton, 2012; Nilsen, et al., 2014).

Once in the environment some chemicals may have effects on aquatic organisms as well as humans. These effects may be acute (resulting in organism death as a direct result of exposure) or chronic (disrupting essential organism function) and can often occur as a result of very low concentrations of pollutants. Research indicates that low levels may affect a variety of behaviors in salmon and other aquatic organisms including disrupted feeding, reduced/disrupted reproduction, and difficulty with predator avoidance as well as reduced growth and physical abnormalities (LCREP, 2007). In addition, many chemicals may act together to increase these toxic effects. For many of these chemicals, the ones considered *emerging*, little is known about their effects and very few water quality criteria exist.

Sources of these chemicals to aquatic systems vary and include diffuse (non-point) and specific (point) sources. A survey of Oregon's major wastewater treatment facilities' effluent in 2010 detected 114 of 406 chemicals included in the monitoring (Hope, et al., 2012). Detections included similar chemicals to the ones found in Kolpin's study, including current-use pesticides, consumer products, pharmaceuticals, priority pollutant metals such as copper and lead, flame retardants and industrial chemicals. Additionally, a study focused on the Columbia River basin found similar pollutant groups in stormwater as well as wastewater effluent (Morace, 2012). Other possible pathways for these chemicals to reach aquatic ecosystems include industrial discharge, chemical spills, precipitation or irrigation-driven surface runoff, and atmospheric deposition.

In 2007 the Oregon Legislature funded the Oregon Department of Environmental Quality to begin the Statewide Water Quality Toxics Monitoring Program. Started in 2008, the program identified four main goals:

1. Gather information to characterize the presence and concentration of chemicals of concern in Oregon's waters.
2. Use this information to identify sources of these chemicals.
3. Present and make available information gathered for public benefit.
4. Work with DEQ internal groups, community groups and Oregon citizens to identify opportunities for reducing these pollutants.

To achieve these goals, the DEQ Laboratory and Environmental Assessment Program developed a five year monitoring plan. This plan (completed in 2013) used a rotating basin approach to conduct a reconnaissance sampling of the state's waters. The monitoring, sampling and analytical methods evolved over the course of the study. Initial sampling focused solely on water and fish tissue. However, by 2013, collections of water, sediment, fish and shellfish occurred and several state-of-the-art analytical methods were added. This report summarizes the water portion of the monitoring effort. Tissue and sediment data will be summarized in a subsequent report. The intent is to inform future water quality toxics monitoring by DEQ and its partners.

To accomplish project goals 2 through 4, laboratory and program staff are working closely not only with internal DEQ programs but also with Oregon communities, tribal nations, watershed groups, and other stakeholders. The data collected from this program support initiatives on the local level (restoration activities, community actions), basin level (DEQ Basin Assessment process, watershed councils), and state level (Integrated Report development, water quality criteria development). These data also inform DEQ's overall Toxics Reduction Strategy. The continuation of this monitoring program will support these efforts moving forward.

1.2 Sampling Design

The monitoring program's primary goal is to characterize the presence and concentration of chemicals of concern in Oregon's waters. To achieve this goal, DEQ chose sites in each of Oregon's main geographic basins (Figure 1). Following a rotating basin approach, sampling of all Oregon's basins spanned a time period from 2008 until 2013.

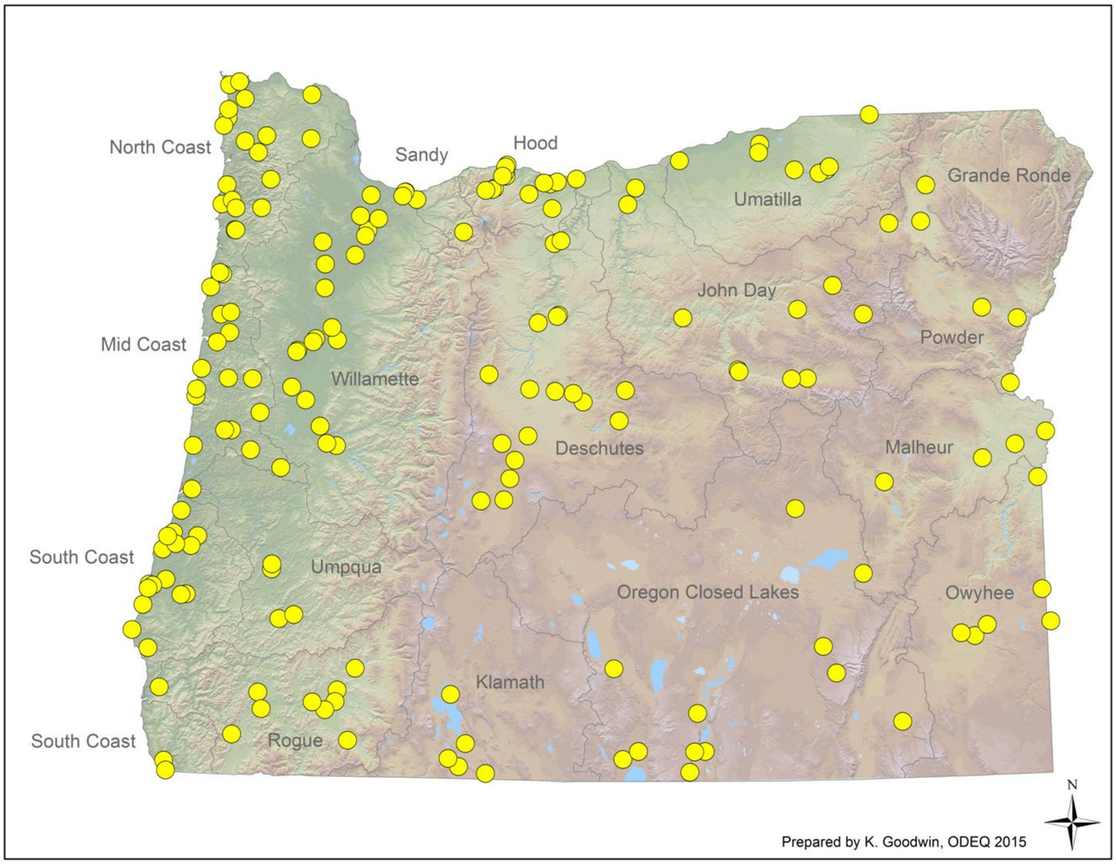

Figure 1: Water sampling sites (2008–2013).

DEQ used several criteria for sample site selection. Initially, DEQ selected sites to be integrator sites that receive water from the larger sub-watersheds within a basin. This was the main criterion for selection of sites within the Willamette (2008-2010), Umatilla (2011), Grande Ronde (2011), Powder (2011), Rogue (2011), Klamath (2011) and Umpqua (2011) basins (parentheses indicate year sampled). As the program developed and evolved, consideration and inclusion of additional criteria occurred to evaluate risks posed to smaller watersheds from chemicals of concern. These criteria included land use, point and non-point sources. Site selection in 2012 (John Day, Deschutes, Hood, and Sandy basins) and in 2013 (three coastal basins, Owyhee and southeast Oregon Closed Basins) considered these additional criteria, as well as input from local stakeholders.

1.3 Water Collection Methods

In order to characterize concentrations temporally, staff collected water grab samples in each basin three times a year. The exceptions were the Willamette, DEQ sampled six times over two years, and sites in southeast Oregon (Oregon Closed Lakes, Owyhee and Malheur Basins) which DEQ sampled once. These temporal samplings attempted to capture not only hydrologic differences in the watersheds but also potential seasonal use patterns for certain chemicals.

Lab staff member collecting water from a bridge monitoring site.

In general, sampling staff collected water directly into certified clean laboratory sample bottles. If not possible, staff used clean intermediate containers. In this case, transfer of samples to appropriate laboratory containers occurred at the site. Staff preserved or filtered samples in the field as necessary. The ODEQ (2012) Quality Assurance Project Plan (DEQ09-LAB-0029-QAPP) and the basin-specific Sampling and Analysis Plans contain a full description of sampling methods, sampling containers, holding times and preservation techniques.

1.4 Field Quality Assurance / Quality Control

To evaluate and monitor field sampling activities, DEQ collected field quality control samples. Sampling crews collected at least one field equipment blank and field duplicate on each sampling excursion. DEQ laboratory staff and the project manager evaluated these results and qualified or estimated the related data as outlined in the QAPP.

1.5 Analytical Methods

This study analyzed over 500 unique chemicals in water (Appendix A). Given the range of chemicals sampled, this effort required 21 different analytical methods. The water quality criteria or environmental benchmarks for many of these chemicals are in the nanogram per liter, or parts per trillion, level. Therefore, the laboratory employed best available technologies.

The DEQ laboratory completed all analyses with the following exceptions. The laboratory subcontracted analysis of total organic carbon and dissolved organic carbon to ESC Laboratories in Nashville, TN. Also, the laboratory subcontracted the first year of inorganic arsenic samples to ALS Laboratories in Kelso, WA. Each of these laboratories is accredited to perform these specific analyses through the National Environmental Laboratory Accreditation Program. Specific information on methods and complete analyte lists for each method is found in the project's quality assurance plan and yearly sampling and analysis plans and available upon request from the DEQ laboratory.

1.6 General parameters

Field staff measured general field parameters during each sampling event. These included water temperature, conductivity, dissolved oxygen, pH and turbidity. Staff collected water for analysis of total solids, total suspended solids and alkalinity.

1.7 Inorganic parameters

The DEQ laboratory analyzed more than 20 inorganic parameters during this study. The majority of these parameters included total and dissolved metals. In order to achieve the necessary detection limits, the laboratory used an Agilent ICPMS (inductively coupled plasma mass spectrometer) following EPA guidance (EPA Method 200.8). Analysis for total metals occurred in all study years. In 2011, the program added dissolved metals in response to revisions in the state's water quality criteria for some metals and in 2012, the DEQ laboratory began to analyze for inorganic arsenic (EPA Method 1632A).

1.8 Organic parameters

The organic laboratory analyzed water samples for more than 450 parameters using several analytical technologies, including liquid chromatography tandem mass spectrometry (LCMSMS), gas chromatography with an electron capture detector (GC-ECD), and gas chromatography high-resolution mass spectrometry (GC-HRMS) (Table 1).

Gas chromatograph high-resolution mass spectrometer (GC-HRMS) used to analyze water samples for chemicals at sub-nanogram per liter levels.

Table 1: Organic chemicals and associated analytical technologies.

Analytical Technology	Chemical Groups
Liquid chromatography tandem mass spectrometry	Pharmaceuticals and personal care products Current-use pesticides
Gas chromatography mass spectrometry	Current-use pesticides Combustion by-products (PAHs) Industrial chemicals
Gas chromatography with electron capture detector	Current-use pesticides (phenoxy herbicides)
Gas chromatography – high resolution mass spectrometry	Steroids and hormones Legacy pesticides PCBs PBDEs (Flame retardants) Dioxins and furans

DEQ lab staff extracted all samples by liquid-liquid extraction within appropriate holding times. If necessary, method-required cleanup of the extracts occurred.

1.9 Laboratory Quality Control

Each laboratory analytical batch included a method blank, laboratory control sample, matrix spike and either a sample duplicate or matrix spike duplicate. Laboratory analytical staff and the project manager evaluated the results of each quality control sample and estimated or qualified data as appropriate.

2. Results

2.1 Statewide Summary

Over the course of the sampling, the DEQ laboratory analyzed water samples from 177 sampling sites across the state (Figure 1). Appendix B shows the basins, major land use and watershed area for each water sampling location. Analytical methods developed and changed over the course of the sampling. In 2012, new methods brought online evaluated very low levels of chlorinated pesticides, flame retardants, PCBs, and dioxins and furans in water. During the last year of sampling in 2013, laboratory analyses encompassed more than 500 unique chemicals using 21 different analytical methods. For this report, DEQ groups these chemicals into 11 categories. Table 2 provides a brief description of these categories with a more thorough description in the Results: Chemical Group Summary section. Statewide, DEQ detected 128 unique chemicals. The most commonly detected groups were priority metals and sterols present at 100 percent of sites, followed by current-use pesticides, at just over 50 percent of sites (Figure 2). Appendix C summarizes the chemicals detected, number of detections, and maximum concentrations.

Sampling site in the Umatilla Basin

Table 2: Chemical groups of analytes as reported in this study.

Chemical Group	Description	Number of compounds analyzed
Current-use pesticides	Herbicides, insecticides and fungicides currently used in the U.S.	111
Legacy pesticides	Chlorinated insecticides banned in U.S. and many other countries. Many continue to be used in some parts of the world	31
Combustion by-products	Polycyclic aromatic hydrocarbons (PAHs), by-products of incomplete combustion of petroleum, wood products, incineration, etc. May also be present in sealants.	21
Industrial chemicals	Dyes, pigments and industrial intermediates	60
Consumer product constituents	Pharmaceuticals including hormones, and other consumer-related compounds such as caffeine, insect repellants, plasiticizers	28
Plant or animal sterols	Plant and animal sterols, may be the results of human waste as well as natural sources	10
Priority metals	Metals for which DEQ water quality criteria exist	17
Flame retardants	Brominated flame retardants (PBDEs) added to a variety of common products including furniture, laptops, cars, etc., to retard combustion	41
PCBs	Polychlorinated biphenyls (PCBs) used as electrical insulating fluid	194
Dioxins / Furans	Chemicals formed as by-products of industrial processes, wood pulp bleaching and incomplete combustion from forest fires, volcanoes and incineration processes	17
Ammonia	Industrial contaminant mostly through air deposition but may also be the result of fertilizer use. Naturally occurring at very low concentrations.	1

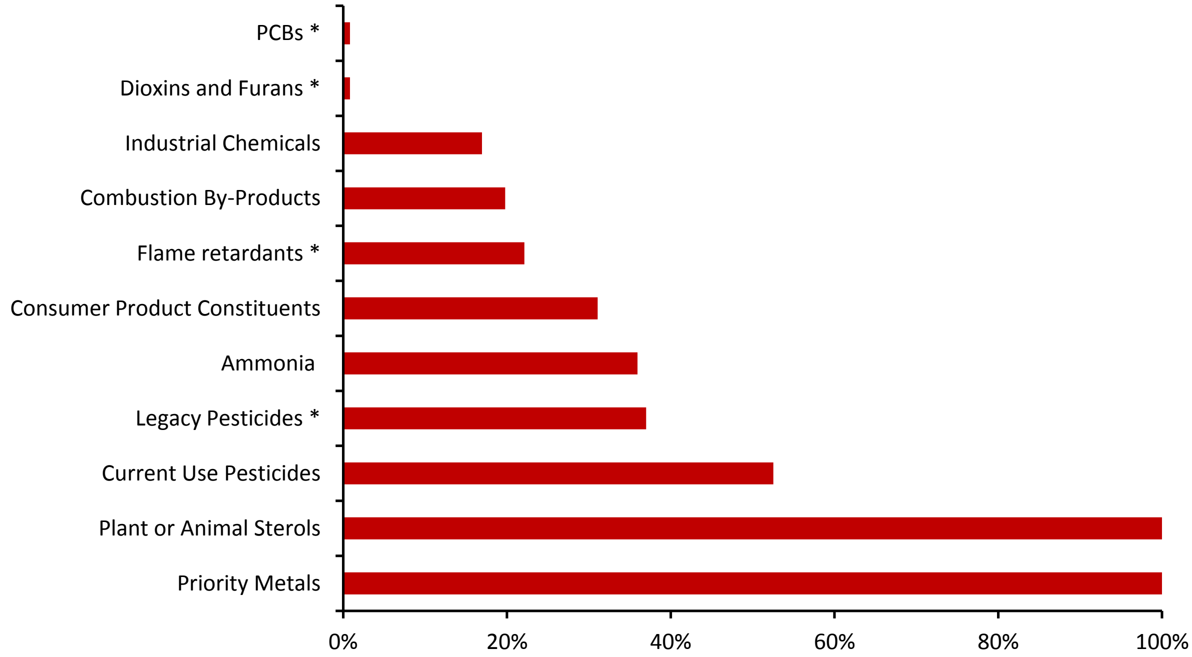

Figure 2: Percent of sites with detections by chemical group. Asterisks indicate chemical groups analyzed at sites sampled during 2012-2013.

The number of different chemicals detected varied geographically (Figure 3). Basins with the most intensive population centers and agricultural activity such as the Willamette and Hood Basins showed the greatest number and variety of chemicals detected. Although the number of unique chemicals varied across basins, detections of current-use pesticides, priority metals and sterols occurred in each basin. Consumer product constituents occurred in all but one basin and combustion by-products in 11 of 15 basins.

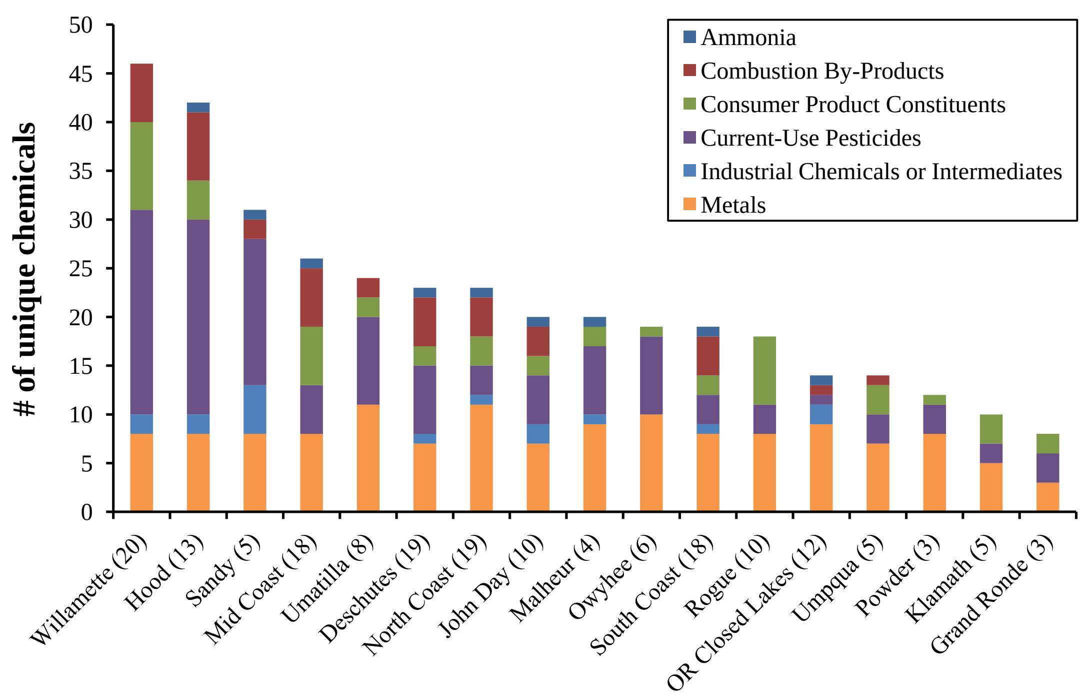

Figure 3: Number of unique chemicals detected by chemical group per basin (excludes new methods added in 2012, See Figure 4). Number of sites sampled in each basin listed in parentheses. Sterols excluded from excluded from this figure since the same four sterols were detected across all basins.

Since they were not measured in all basins, Figure 3 excludes the new methods added in 2012 for legacy pesticides, flame retardants, PCBs, and dioxins / furans. The chemicals in these methods tend to sequester to the sediment and bio-accumulate in tissue. For this reason their presence in the aquatic environment may pose health risks for certain populations. In 2011, DEQ adopted new toxics criteria based on a consumption rate to protect subsistence fishers (175 g/day) (ODEQ, 2011). This resulted in very low criteria for these chemicals in water. Therefore, in 2012 the DEQ laboratory added methods to evaluate their occurrence in water. The laboratory measured detectable levels of legacy pesticides in all basins in which they were analyzed (nine basins) and flame retardants in seven of these same nine basins (Figure 4). Detections of PCBs and dioxins and furans occurred in only one basin for each group. One site on the upper Siuslaw River at Siuslaw River Falls (Mid-Coast basin) showed an unusually high number of detections, especially for legacy pesticides and flame retardants. Reasons for this are unknown at this time. This area warrants follow-up during future monitoring activities. Also in 2012 and 2013, the laboratory added several additional current-use pesticides. Detections of one of these additions, 2,6 dichlorobenzamide (BAM), a breakdown product of the herbicide dichlobenil, occurred frequently in 2013.

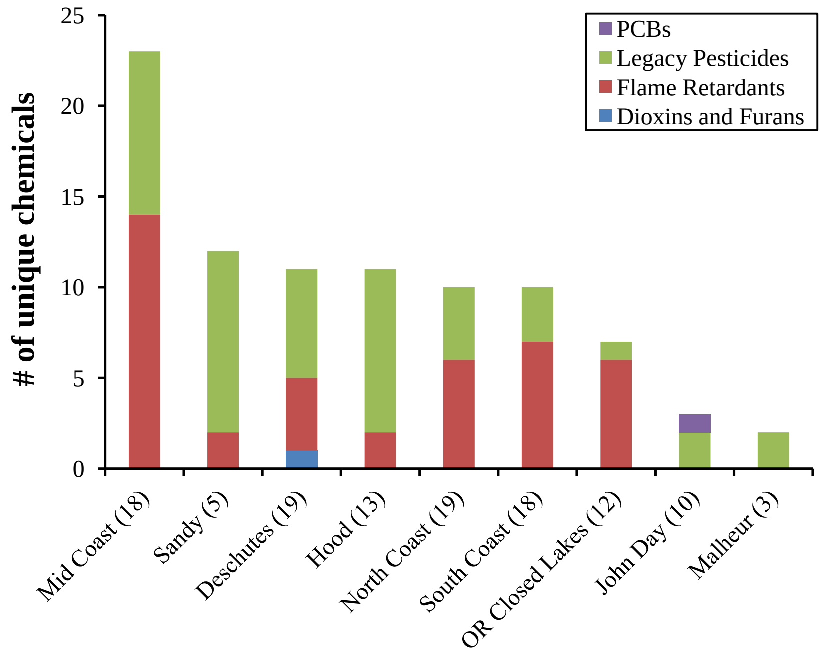

Figure 4: Number of unique chemicals detected by chemical group per basin for analytical methods added in 2012. Number of sites sampled in each basin listed in parentheses.

2.2 Chemical Group Summary

This section describes the chemicals in each group, the potential effects of these chemicals, and the results of this study.

2.2.1 Current-Use Pesticides

Current-use pesticides include insecticides, herbicides, fungicides and others. These products may move to surface waters through runoff or drift from agricultural lands, public right-of-ways, managed forest areas and residential properties and may move to surface waters through runoff or drift. Another source of pesticides to Oregon's waters is treated wastewater. A 2010 study in Oregon found current-use pesticides in the effluent of several major wastewater facilities (Hope et al., 2012). Some examples of current-use pesticides found in Oregon's waters are:

- Diuron (Karmex®, Direx®) – herbicide used for roadside weed control as well as on various agricultural lands
- Carbaryl (Sevin®) - insecticide used on forests, fields, homes and a variety of crops

- Propiconazole (Tilt®) – fungicide used on food crops and ornamental plants, as well as a wood preservative

Most current-use pesticides do not have established DEQ water quality criteria; however, EPA's Office of Pesticide Programs established aquatic life benchmarks (EPA, 2014). This report compares results to the lowest Oregon water quality criteria if available, and for pesticides without criteria, to the lowest EPA aquatic life benchmark. DEQ uses impact ratios (concentration detected in the sample divided by lowest criteria or aquatic life benchmark). These ratios allow for the comparison of potential risk from chemicals with different toxicities (aquatic life and/or human health). Figures 5 and 6 illustrate the impact ratios) for the detected current-use pesticides. Detections of most pesticides were at levels below aquatic life benchmarks or criteria. The exceptions to this are diuron, dichlorvos, fenvalerate/esfenvalerate and pentachlorophenol which occurred above their respective benchmarks or criteria.

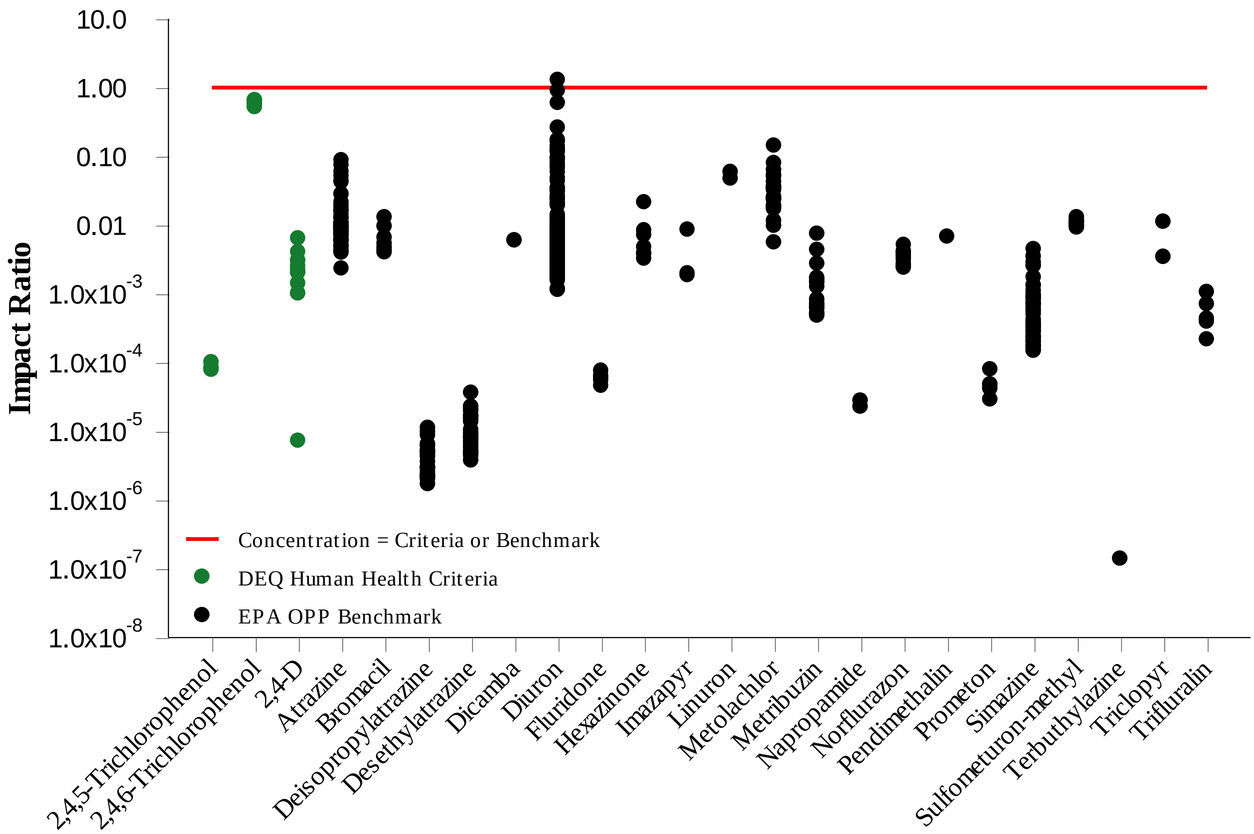

Figure 5: Impact ratio (log scale) for detected current-use herbicides. Values above the red line indicate a potential for impact to aquatic life or human health.

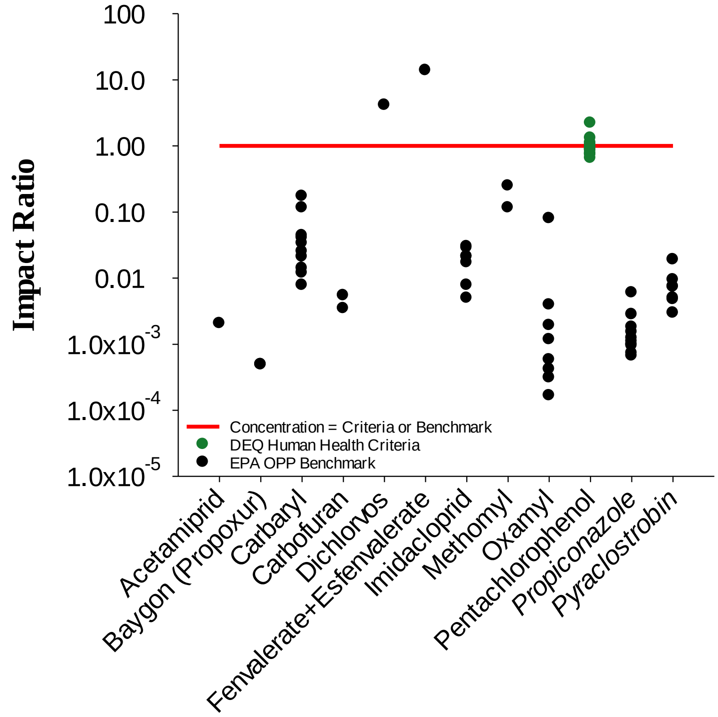

Figure 6: Impact ratio (log scale) for detected current use insecticides and fungicides (italics). Values above the red line indicate a potential for impact to aquatic life or human health.

Detected frequently, the herbicide atrazine, which is used on lawns and some agricultural crops, may be present at levels of concern for aquatic organisms. Research indicates atrazine may have feminization effects on amphibians (Hayes, et al., 2002) as well as effects on humans (Winchester, et al., 2009; Munger, et al., 1997). Atrazine and its degradate are detected extensively in groundwater across the United States including Oregon. The European Union banned the use of atrazine in 2003. In addition, as an outcome of their current registration review process for atrazine, the EPA recently lowered its aquatic life benchmark from 1 to 0.001 µg/L for vascular plants (EPA, 2014). During registration review, it is common for new studies to result in changes to benchmarks; however, such a significant change merits a thorough evaluation. At this time, multiple states, including those in the Pacific Northwest, are working through a national committee representing state agencies to better understand and evaluate the scientific justification for this 1,000-fold decrease in the atrazine benchmark before using at the state level.. Therefore, for the purpose of this report, figure 5 uses the previous benchmark of 1 µg/L. All detections of atrazine in this study exceed the revised EPA benchmark.

Detections of current-use pesticides occurred in all basins sampled, overall at 53 percent of sites. Figure 7 illustrates the concentrations of the most commonly detected pesticides, all of which are herbicides. Detections of diuron occurred in all basins except the Oregon Closed Lakes basin, located in southeastern Oregon. Concentrations ranged from very low to levels exceeding the chronic aquatic life benchmark. The chemical, 2,6-dichlorobenzamide is the degradate of the herbicide, dichlobenil. The DEQ laboratory added this compound to its analytical list in 2013. Therefore, analysis for dichlobenil and 2,6-dichlorobenzamide only occurred at a limited number of sites. The samples from 8 percent of those sites contained this degradate. Based on data from other DEQ monitoring programs including the Pesticide Stewardship Partnership Program, DEQ expects that this herbicide or its degradate would be found at more locations across the state if it were monitored.

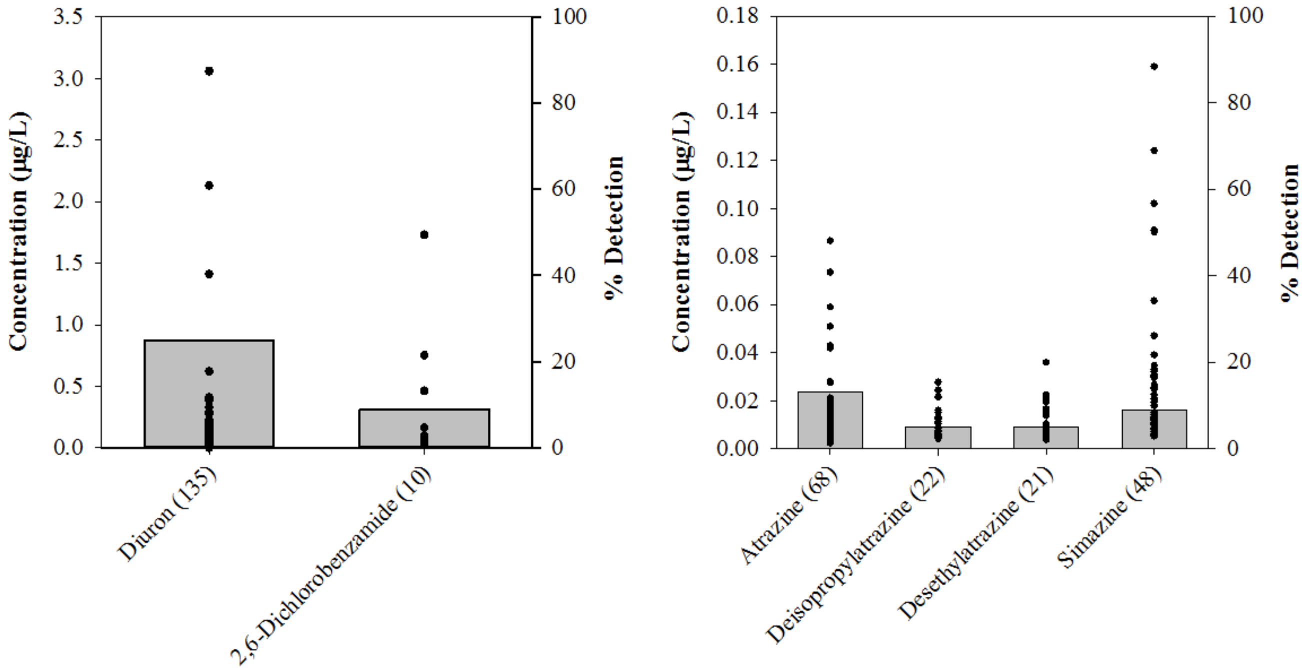

Figure 7: Most commonly detected pesticides, all herbicides. Dots represent concentration in samples (left axis). Bars represent percent detection across all samples (right axis). Total number of detections shown in parentheses.

Although individual pesticides are present at very low levels, these pesticides are often present as mixtures. The effects of these mixtures on aquatic life or human health are largely unknown; however, research indicates that combinations of pesticides may act additively, synergistically or antagonistically. Studies show that current-use pesticides may adversely affect salmon, amphibians and other aquatic species particularly when present as a mixture (Laetz, 2009; Langlois, 2009). Detections of more than one pesticide occurred in 19 percent of samples with three percent of samples having 6 to 10 pesticides (Figure 8).

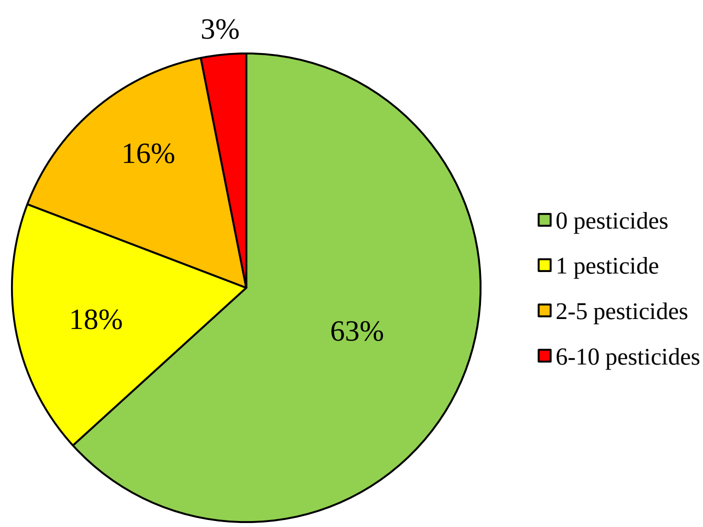

Figure 8: Number of unique pesticides detected per sample by percentage of samples.

2.2.2 Combustion by-products

This group includes the polycyclic aromatic hydrocarbons (PAHs). These combustion by-products make their way into the aquatic environment through a variety of routes. Since these chemicals are a product of automobile combustion, forest fires and incineration of industrial and municipal wastes, air deposition is a major route into the aquatic environment. Another source is stormwater runoff, especially from urban and impervious surfaces. The aquatic toxicity of these compounds varies based on molecular weight. Most are not water soluble and end up in the sediments. Human health impacts from this class of compounds are typically from air exposures.
The laboratory detected 14 PAHs in the basins across the state. Detected most frequently, fluoranthene and phenanthrene are components of incomplete combustion and diesel fuel. The state of Oregon has established water quality criteria for most of these chemicals (ODEQ, 2014). Figure 9 illustrates the concentration of the detected compounds versus their respective water quality criteria. Detected levels of five PAHs were above their respective criteria. These criteria represent potential human health impacts from these compounds through water and fish consumption.

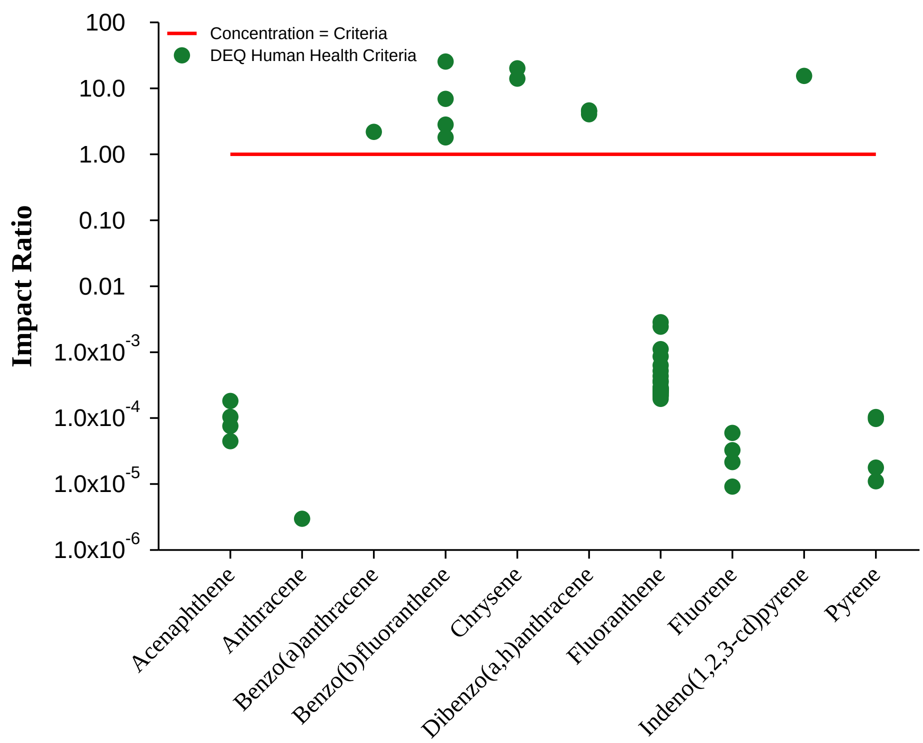

Figure 9: Impact ratio (log scale) for detected PAHs. Values above the red line indicate a potential for impact to human health.

2.2.3 Dioxins and Furans

Dioxins and furans include 17 different chemicals or cogeners that are similar in structure to each other but vary in their toxicity. These chemicals are not produced intentionally but rather are a by-product of industrial activities (paper bleaching, industrial production) and fossil fuel combustion from sources such as incineration, wood stoves and forest fires. These chemicals persist in the environment, bio-accumulate in organisms, and are toxic to humans and wildlife.

Given their chemical nature, these chemicals are not expected to be found in water samples. Due to their tendency to bio-accumulate in tissue, presence of these chemicals even at very low levels poses a risk to human health. Therefore, the DEQ water quality criteria for these chemicals are very low. During this study, a detection for one dioxin congener occurred at one site in the Deschutes Basin (Deschutes River at Shears Falls.

Octachlorodibenzodioxin (OCDD), the detected dioxin, is possibly a product of smoke from wood burning in the area. It is about 3,000 times less toxic than the most toxic dioxin congener, 2,3,7,8-tetrachlorodibenzodioxin (2,3,7,8-TCDD) and less bioaccumulative.

2.2.4 Flame retardants (brominated)

Flame retardants or polybrominated diphenyl ethers (PBDEs) are chemicals which are added to a variety of products such as laptops, automobiles, furniture and textiles. These chemicals release from these products and may enter the aquatic environment through air deposition, incineration, landfill leachate, and wastewater discharges. Commercially produced brominated flame retardants exist as three types of mixtures: pentaBDE, octaBDE, and decaBDE - each made up of several congeners. In the environment these chemicals degrade into individual congeners. Similar in structure to polychlorinated biphenyls (PCBs), they persist in the environment and tend to bio-accumulate in organisms. Studies found these compounds in osprey eggs and eagles in the Northwest United States (Henny et al., 2009; Spears and Isanhart, 2014), breast milk in Sweden (Hooper and McDonald, 2000) and in the Canadian Arctic in animal tissue (Ikonomou et al., 2002). Additionally, recent work by DEQ published in Hope, et al. (2012) detected these compounds in wastewater discharges to Oregon's waters. The presence of these compounds indicates a potential for not only aquatic system impacts but also human health impacts. Although Oregon does not have state water quality criteria for these compounds, concern over their potential toxicity prompted several states including Oregon (ORS 453, http://www.oregonlaws.org/ors/chapter/453) to pass legislation banning the manufacture and use of certain PBDE compounds. In Oregon, products put into commerce after Jan. 1, 2011 may not contain penta, octo, or deca brominated diphenyl ether (BDEs) formulations. In addition, based on their tendency to bio-accumulate in tissue, the Oregon Health Authority established screening values for four congeners (PBDE-47, PBDE-99, PBDE-153, PBDE-209) in fish tissue.

During this toxics monitoring study, the DEQ laboratory analyzed water samples for 40 congeners and detected 17. The laboratory added this method in 2012. Therefore, these chemicals were not analyzed in water samples from the Willamette and other basins sampled before 2012. Figure 10 shows the number of sites with detections of each congener. These detections are consistent with previous data on discharges to Oregon's waters (Hope et al., 2012) as well as consistent with the commercial formulation of pentaBDE and its photodegradates (Fang, et al., 2008). In addition, frequent detection of PBDE-209 (the primary component of decaBDE) indicates the potential presence of the decaBDE formulation, for which use increased upon the phase-out of the octa and penta formulations in 2004 (Spears and Isanhart, 2014; DHS, 2008).

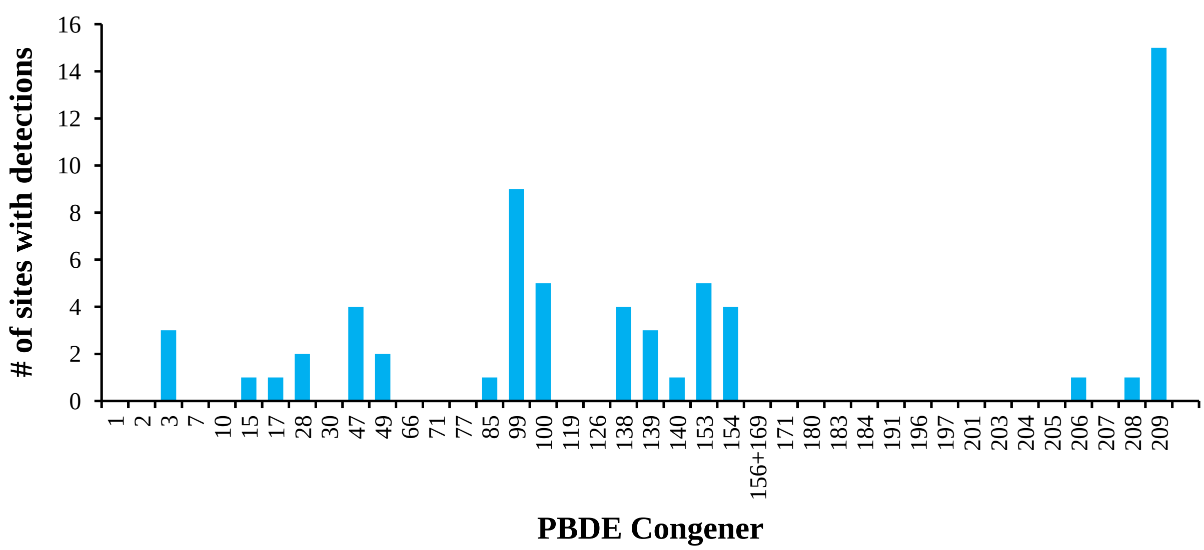

Figure 10: Number of sites with at least one detection of each PBDE congener analyzed.

Detected concentrations of these congeners were very low, ranging from a minimum of 0.08 ng/L (PBDE-15) to a maximum of 26.5 ng/L (PBDE-209). Contamination from flame retardants tends to be associated with urban and industrial areas, however, in other studies, detections occurred in the Arctic and other remote ecosystems, suggesting airborne transport (Ikonomou et al., 2002). Similarly in this study, detection of these chemicals occurred at urban sites as well as in rural, relatively unpopulated areas of southeast Oregon and the Coast range (Figure 11), supporting airborne transport as a potential source of PBDEs to Oregon's aquatic ecosystems. Several additional types of flame retardants (organophosphorus and nitrogen based) are currently in commercial use. Analysis for these compounds did not occur in this study, but will be considered for addition in future work.

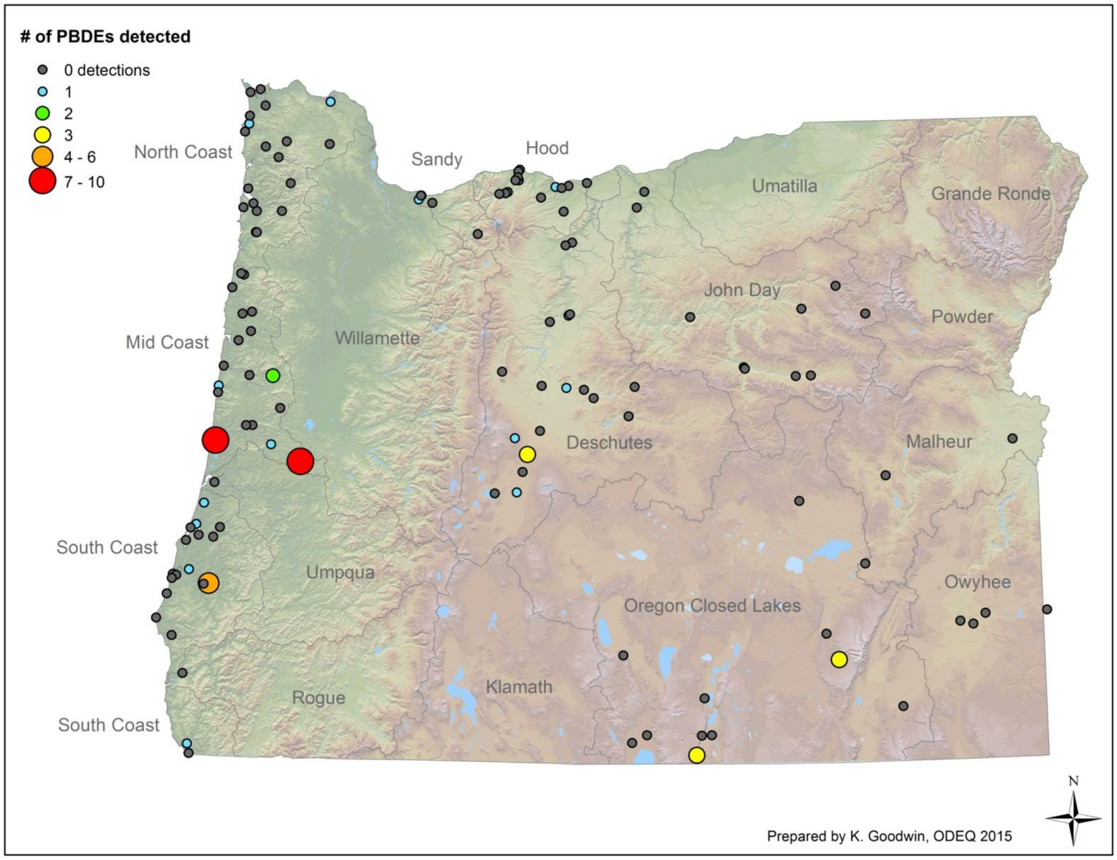

Figure 11: Number of PBDEs detected at sites across Oregon.

2.2.5 Legacy pesticides

Legacy pesticides include those pesticides banned from use in the United States. In some cases, these chemicals continue to be used in other parts of the world. Due to their environmental persistence (typically in sediment and soils), runoff from historically treated areas is a major source of these chemicals to aquatic systems. These compounds also bio-accumulate in organisms and pose risk throughout the food web and, ultimately, to human health. This study measured not only the parent compounds of these pesticides but also several of the breakdown products.

The DEQ laboratory analyzed samples for legacy pesticides during all sampling years. However, in 2012, the laboratory added a method for analysis of these chemicals by a gas chromatograph high-resolution mass spectrometer (GC-HRMS). This new methodology allowed the laboratory to measure these chemicals at the sub-nanogram per liter level. The following summarizes the data collected using this methodology during years 2012 – 2013 (Hood, Sandy, John Day, Deschutes, Coastal basins).

The Oregon water quality criteria for many of the pesticides in this group are very low (less than 1 ng/L) because of their tendency to bio-accumulate in organisms and potentially contribute to human health impacts. Therefore measured concentrations exceeded the applicable water quality criteria at several locations, particularly in the Hood and Sandy basins (Figures 12 and 13). DDT (and degradates), aldrin, chlordane, dieldrin, heptachlor, heptachlor epoxide, and hexachlorobenzene are all at levels of concern at several sampling sites. These sites include long-time agricultural lands but also rural and coastal areas, indicating a potential for airborne transport of these chemicals (Figure 13) (ASTDR, 2005; Genauldi, et al., 2009).

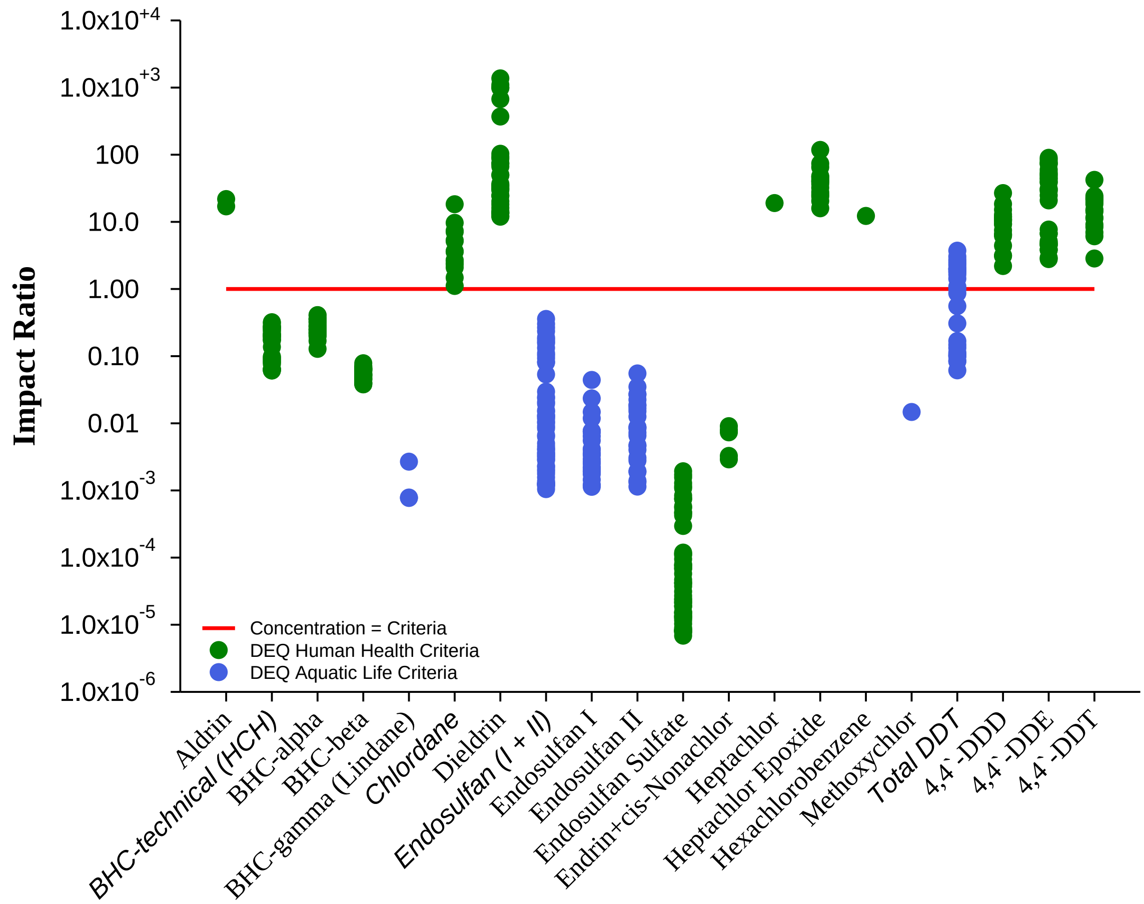

Figure 12: Impact ratio (log scale) for detected legacy pesticides. Values above the red line indicate a potential for impact to aquatic life or human health.

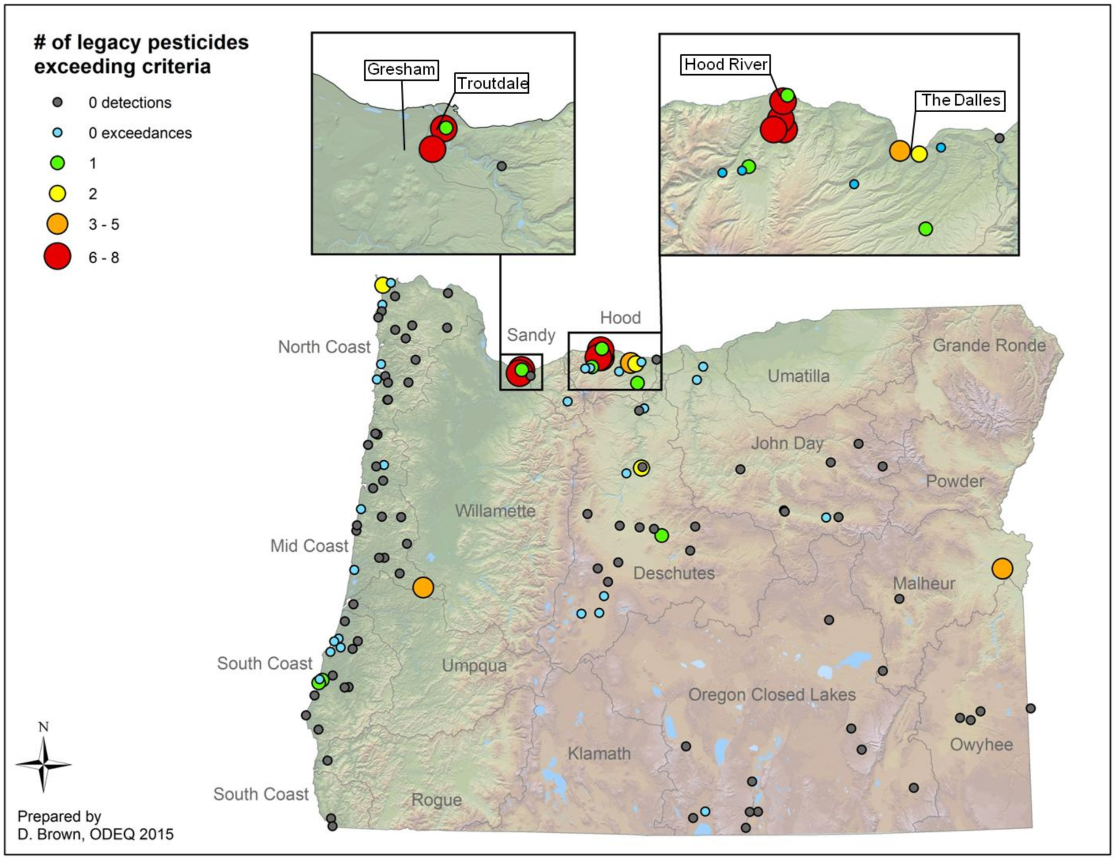

Figure 13: Geographic distribution of legacy pesticide exceedances of water quality criteria.

Water samples from 10 of 17 estuary locations contained measurable levels of alpha and beta BHC. These two legacy chemicals are isomers that were part of the technical formulation of BHC (also known as HCH (hexachlorocyclohexane)) as well as contaminants in the production of gamma- BHC (lindane). Although uses of technical BHC discontinued many years ago in the United States and lindane is being phased out, these chemicals persist in the environment. Several historic uses for technical BHC and lindane included agricultural seed treatments, livestock treatment and wood treatments by the timber industry on cut logs (Li, 1999). Additionally, airborne transport of these chemicals may also occur over great distances (ASTDR, 2005; Genauldi, et al., 2009). This may be a source of these chemicals to Oregon's estuarine waters. However, the presence of beta-BHC (beta-HCH) may also indicate localized sources (Li, 1999).

2.2.6 Industrial Chemicals

Industrial chemicals analyzed in this study include a selection of chemical intermediates used in the production of pesticides, pharmaceuticals, rubber, consumer products, etc. Detections of industrial chemicals occurred sporadically in this study. In total, water samples contained eight different industrial chemicals. The most commonly found chemical was 2,4-dimethylphenol, which is used in the manufacture of a variety of products including pesticides, pharmaceuticals, and consumer disinfection products. However, no water quality criterion exists for this compound. Of the other industrial chemicals detected, none exceeded established criteria.

Ammonia

Although ammonia is a pollutant commonly found in waste products, DEQ designated ammonia as an industrial chemical because of its use in fertilizers and dyes. Ammonia may be extremely toxic to aquatic organisms, such as freshwater bivalves and salmon (EPA, 2013). The toxicity of ammonia depends on the pH and temperature of the water. In general, higher pH and higher temperature lead to increased toxicity. In this study, detections of ammonia occurred at 28 percent of sites (where measured) with 11 of these samples (estuary sites) exceeding the applicable calculated aquatic life criteria. Note that in January 2015, DEQ adopted revised aquatic freshwater criteria for ammonia. The revised chronic criterion is generally less stringent than the criteria currently in effect and used for comparison purposes in this study. The new ammonia criteria become effective following EPA adoption.

Polychlorinated biphenyls (PCBs)

Polychlorinated biphenyls or PCBs are a class of industrial chemicals. Historically used as an electrical insulating fluid in transformers and capacitors, additional uses in adhesives, sealants and paints existed. Because of their persistence in the environment, toxicity to humans and possible links to cancer, the United States banned manufacture and use of these chemicals in products at levels above 50 parts per million (ppm). However, sources of PCBs still exist from products that remain in use, improper disposal practices, or as low-level (below 50 ppm) contaminants in other industrial chemicals or products. Similar to legacy pesticides and flame retardants, these chemicals persist in the sediment of aquatic systems and detections in water are not expected. Several fish consumption advisories exist in Oregon for PCBs because they bio-accumulate in organisms and thus pose a risk to wildlife and humans. During 2012 and 2013 monitoring, detection of PCB congeners in water only occurred at one site.

2.2.7 Priority Metals

This group includes all metals for which Oregon has existing water quality criteria, with the exception of mercury. This study only analyzed for mercury in fish tissue. DEQ will present a summary of these data in a separate report.

Stormwater runoff, industrial processes, pesticides and consumer products are all sources of metals to the environment. In addition, metals occur naturally in the earth’s crust and enrichment of certain metals in rocks varies based on geologic history and formation. Although metals occur naturally, they can be enriched in surface waters by human activities and disturbance. Metals such as copper and lead may reach the environment from cars and pesticides; silver, from x-rays and photography, jewelry and electronics; and arsenic from some legacy pesticides and semi-conductors.

High concentrations of metals can kill aquatic life but, more often, sub-lethal effects can be the result of very low concentrations of metals. Chronic effects may include decreased growth, reduced or inhibited reproduction, increased susceptibility to other diseases or environmental stressors such as low dissolved oxygen or high temperature. Very low levels of copper are linked to the disruption of the olfactory system in salmon, impairing their ability to feed, navigate and reproduce (LCREP, 2007).

State water quality criteria for some metals are calculated based on the hardness of the water. Hardness is a measure of in-water calcium and magnesium. The presence of calcium and magnesium inhibits the binding of the metal in the organism. Therefore, in general, the lower the hardness, the more toxic the metal is to aquatic life. In addition, several criteria are expressed as dissolved, representing the more bioavailable form of the metal. In this study, arsenic, copper, iron and lead exceeded their applicable water quality criteria (Figure 14).

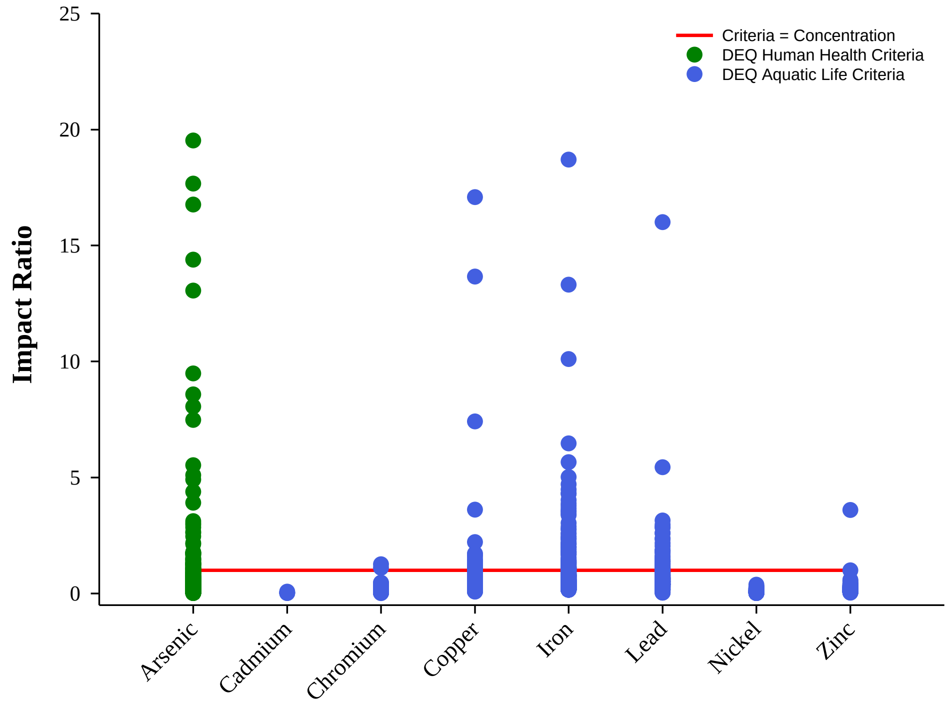

Figure 14: Impact ratio (log scale) for commonly detected priority metals. Criteria adjusted for sample specific hardness if applicable. Values above the red line indicate a potential to impact aquatic life or human health.

As a result of industrial activities, automobiles and pesticide use, several of these metals, such as cadmium, copper, chromium, lead and zinc, are associated with stormwater runoff. Concentrations and number of detections for these metals varied seasonally, with the fewest detections and lowest concentrations in the summer (Figure 15). Concentrations and detections of these metals were high in spring and fall, as would be expected with the onset of the rainy months.

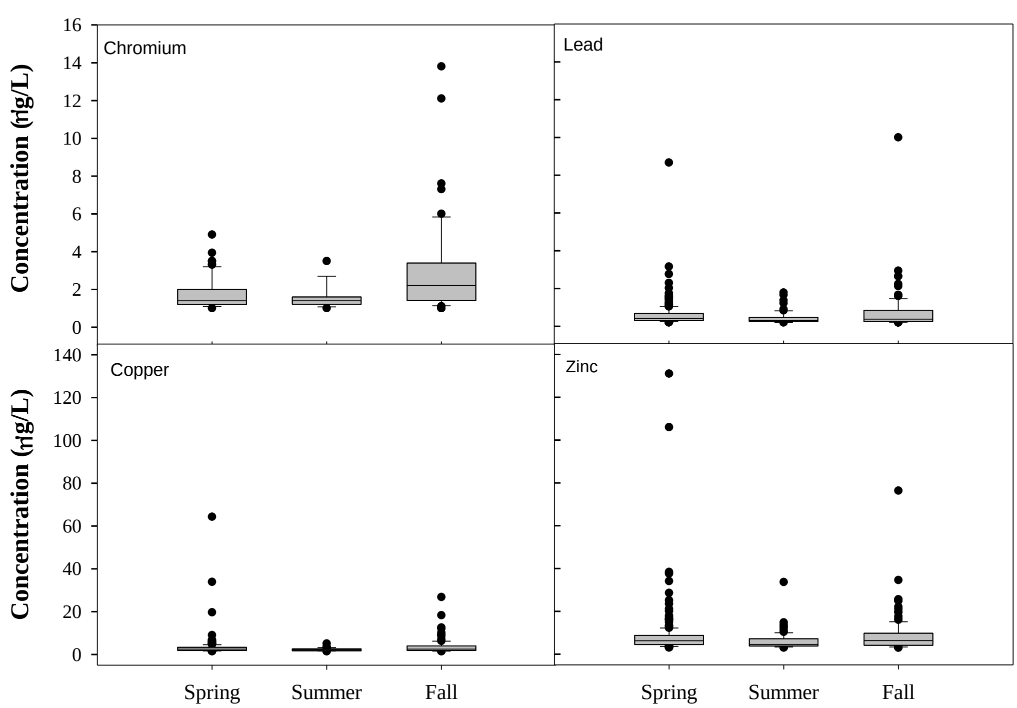

Figure 15: Concentration of stormwater associated metals across seasons, all sites.

Arsenic is a commonly occurring metal in Oregon's surface waters. Naturally present in Oregon geology, its concentration varies geographically (Figure 16). The average and maximum concentrations of total arsenic are highest on the state's east side, while the coast and western valleys tend to have lower concentrations. The toxic form of arsenic to humans and aquatic life is inorganic arsenic. Therefore, water quality criteria are expressed as total inorganic arsenic. In 2012, the laboratory added a method to measure inorganic arsenic. Where it was measured, inorganic arsenic levels exceeded the freshwater human health criterion (2.1 µg/L) at eight sites on the state's eastern side. Although low in concentration relative to eastern Oregon waters, several coastal estuaries exceeded the inorganic arsenic saltwater human health criterion (1.0 µg/L). Since the likely source for the majority of the arsenic in Oregon is natural, management of this risk is difficult.

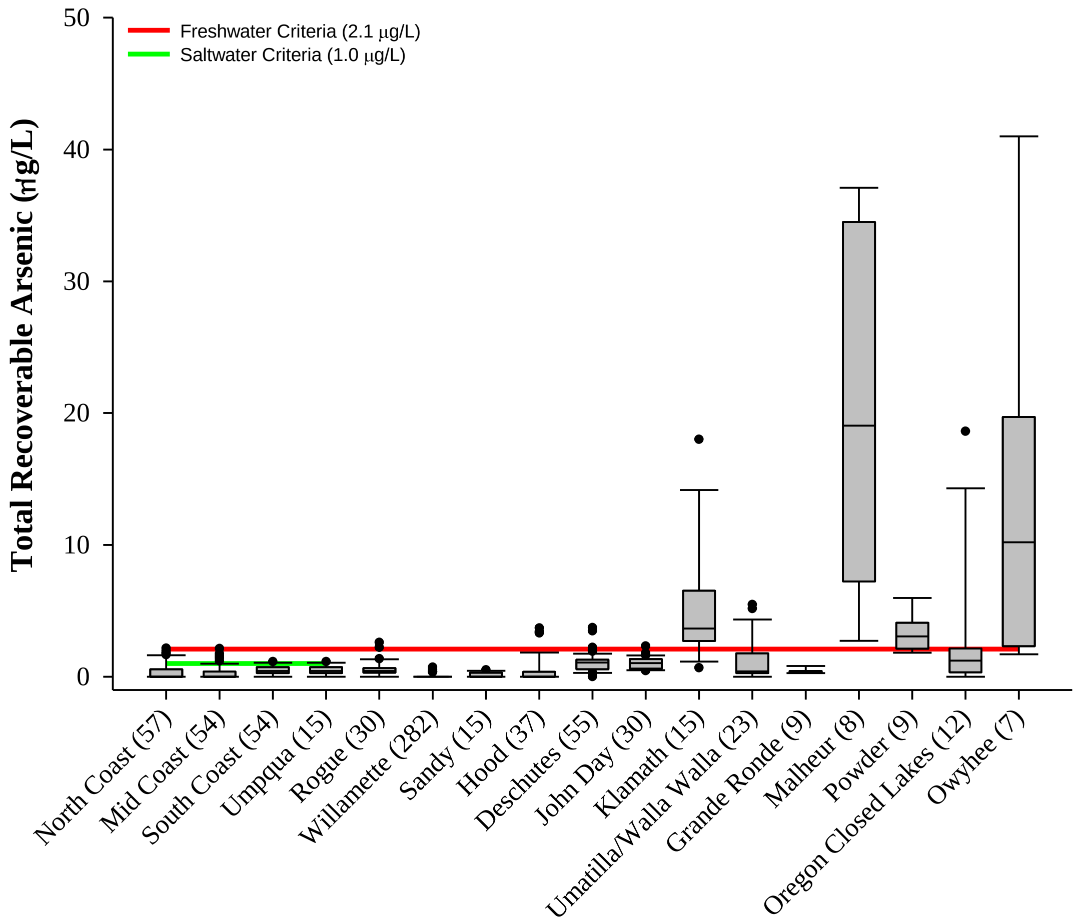

Figure 16: Total recoverable arsenic concentrations across Oregon. Basins are roughly arranged from west to east. Human health criteria are expressed as inorganic arsenic, therefore comparison to total arsenic may be conservative.

The measurement of inorganic arsenic in water is difficult and expensive. Therefore, for assessment purposes, total arsenic is often measured and used as a conservative surrogate where inorganic data is not available. In addition, use of an established inorganic to total arsenic ratio may aid when data is not available. This study measured both types of arsenic and allows for an evaluation of this approach. In general, our data do not support the application of a single ratio statewide. In this work, this ratio ranged from a low of 0.32 in the Hood basin to a high of 0.98 in the Oregon Closed Lakes basin. The ratio also varied seasonally at specific sites. DEQ will present a more detailed review of these data in a separate summary report.

2.2.8 Consumer Product Constituents including Pharmaceuticals

Consumer product constituents include fragrances, pharmaceuticals, insect repellants and other products found in everyday household chemicals, cleaning products, beauty products, clothing and medications. Examples of commonly detected consumer products in other studies include the insect repellant DEET, the stimulant caffeine, and the antibiotic sulfamethoxazole. These constituents likely make their way into the water through wastewater discharges and septic systems. Research confirms the use of some pharmaceuticals such as carbamazepine (anti-convulsant/seizure medication) and consumer products, such as caffeine as tracers of wastewater impacts to surface and groundwater (Seiler et al., 1999; Fram and Belitz, 2011; Rodriguez del Rey, et al., 2012). Although the detected levels are significantly lower than a human pharmaceutical dose, presence of these chemicals in aquatic systems may lead to aquatic life impacts (Gagne, et al., 2006). Currently, no water quality criteria or benchmarks exist for most of these compounds.

This study detected at least one compound from this group at 31 percent of sites. Detected in 13 percent of samples, sulfamethoxazole, a common antibiotic, was the most commonly detected compound in this group. Although detected frequently in other studies (Kolpin et al., 2002), this study did not commonly detect caffeine and DEET. Analysis of the compound, DEET, proved problematic due to ubiquitous low level (both laboratory method and field) blank issues. Over the course of the study, the laboratory increased the reporting limit for this compound to 30 ng/L. Therefore, this report only includes results greater than 30 ng/L.

2.2.9 Plant or Animal Sterols

Sterols

The laboratory measured four plant and animal sterols in the water. Sterols are a group of unsaturated solid alcohols of the steroid group, such as cholesterol, found in the fatty tissues of plants and animals. All four of these sterols occur naturally in the environment but may also be enriched by humans and human activities. The predominant source of the two plant sterols analyzed, beta-sitosterol and stigmastanol, is terrestrial plants (Tse, et al., 2014). Other sources of these sterols may be industrial processes (wood pulping, food oils) and modern pharmaceutical supplements. Beta-sitosterol is commonly used to treat heart disease and high cholesterol among other uses. Beta-sitosterol and stigmastanol were detected in nearly all samples (100 and 99 percent detection, respectively).

The laboratory also measured two animal sterols, cholesterol (100 percent detection) and coprostanol (94 percent detection). While cholesterol is ubiquitous and found in a variety of different species, coprostanol is specific to fecal matter from humans and higher mammals as it is formed during digestion from cholesterol (Grimalt, et al., 1990). Research suggests the ratio of coprostanol to cholesterol can be used to evaluate contamination by human sewage (Grimalt & Albaiges, 1990). Figure 17 shows the coprostanol / cholesterol ratios from each event. Ratios greater than 0.2 indicate a source from either humans (sewage) or higher mammals (biogenic). In conjunction, a ratio less than one indicates a biogenic source (livestock, higher animals) and greater than one a sewage or human source (Tse et al., 2014). Ratios measured at all sites in this study were less than one, indicating a biogenic source of coprostanol.

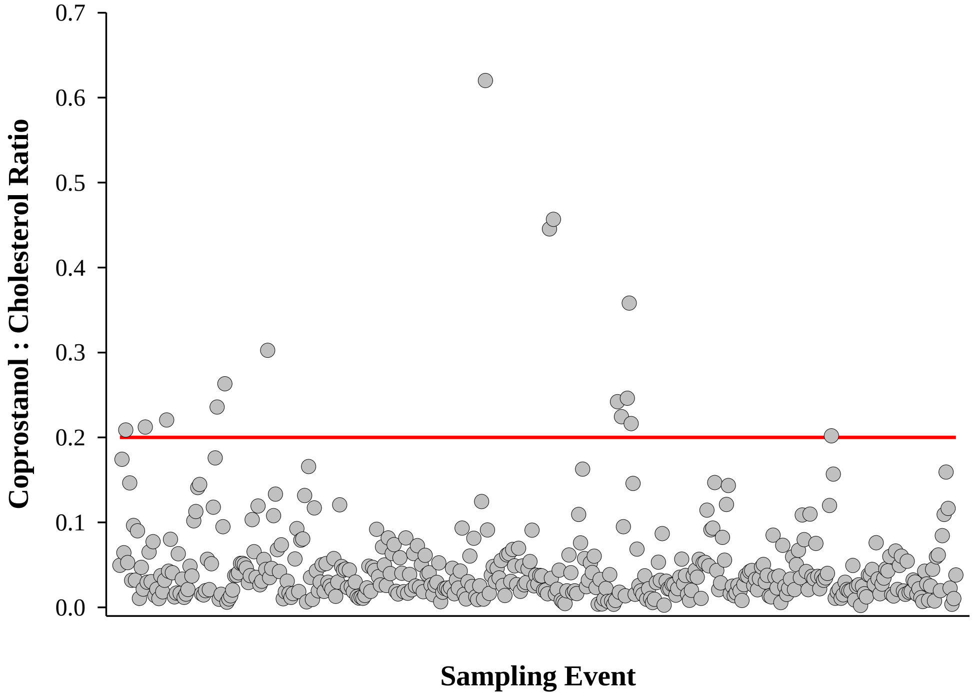

Figure 17: Ratio of coprostanol to cholesterol for each sample across all sampling dates and locations. Ratios above the red line may indicate fecal contribution from humans or higher mammals.

Hormones

Also included in this category are natural and synthetic hormones such as estriol and 17-ß estradiol. These may exhibit endocrine disrupting properties in aquatic organisms (Langdon, et al., 2010). In general, detections for these compounds occurred sporadically at only a limited number of sites. Detections of two natural estrogens, estrone and estriol, occurred most frequently, but only at three sites.

2.3 Land use summary

In order to evaluate sites based on risk associated with land use, DEQ staff assigned a dominant land use classification to each sampling site based on the land use (accounting for greater than 50 percent) in the watershed within five miles upstream (Figure 18). Depending on the size of the complete watershed, this five-mile upstream area may represent a small or large fraction of the contributing landscape. DEQ uses this land use assessment in other monitoring programs to identify the land use that may have the most direct impact on the sampling site. In general, the largest number of unique chemicals occurred in samples collected from agricultural land use locations (Figure 19), which accounted for 17 percent of sites. This study did not identify any correlations between detections or concentrations of specific contaminants and land use. Based on this data review, the five mile area may be inappropriate to evaluate sources for some pollutants or the sample size may be too small for each land use type to identify specific correlations. Also, the land use classifications used in this study are broad and a more refined approach may be needed in the evaluation of such a diverse set of pollutants across streams and rivers of different sizes.

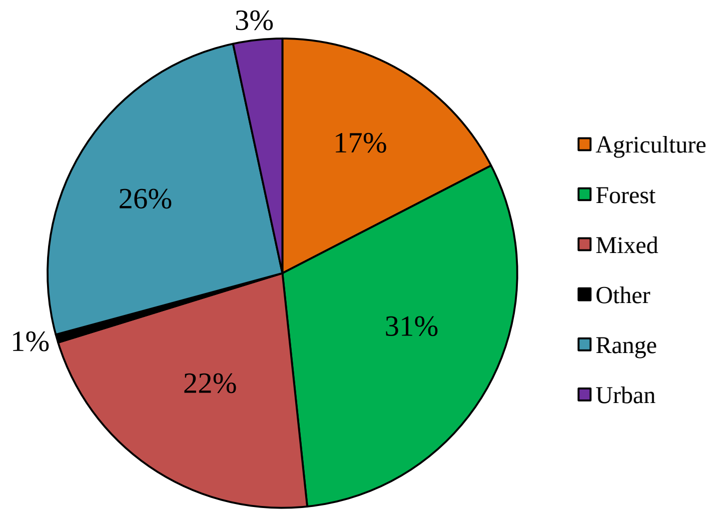

Figure 18: Percent of sampling sites in each land-use category.

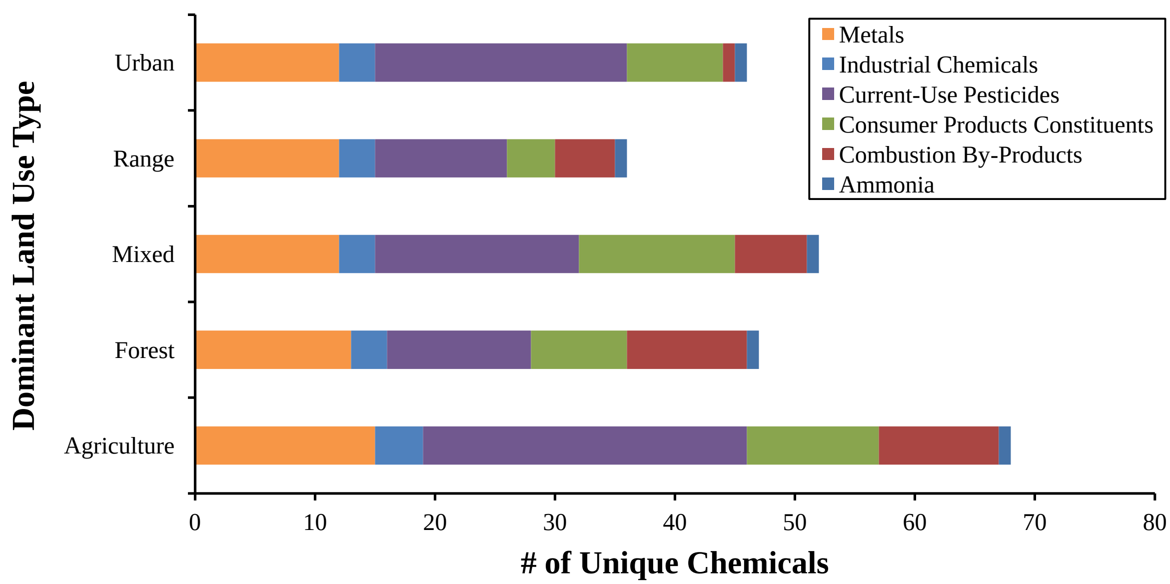

Figure 19: Number of unique chemicals detected by land use (based on station clipped land use).

3. Next Steps

DEQ will use data from this initial statewide assessment to inform and develop future monitoring efforts. These efforts will again employ a rotating basin approach to effectively cover the state over the course of the next five years. From 2015 through 2019, DEQ will conduct monitoring each year in specific geographic areas. Based on past data collected, land use and other risk factors, DEQ will revisit some previous monitoring sites and add new sites. In order to begin evaluating changes in toxic chemicals in aquatic systems over time, DEQ will revisit several sites. In addition, DEQ will add additional sites in each basin to provide better spatial resolution to the data in that basin. This effort is scheduled to begin in 2015 in the North Coast, Umpqua, Rogue, and Klamath basins.

In addition, several areas identified by this study require follow-up sampling. These areas may include:

- additional sampling in the Mid Coast and Hood basins
- investigation of the occurrence and source of inorganic arsenic and chlorinated pesticides in the coastal estuaries
- initial sampling for flame retardants and chlorinated pesticides in those basins not previously sampled for these chemicals including the Willamette Basin

Finally, DEQ is evaluating the potential of additional investigations in conjunction with the laboratory's bio-monitoring program and EPA's National Lakes Assessment. The bio-monitoring investigations will initially be limited in scope, but this monitoring may provide insight into effects on biological communities from low-level toxics in the environment. The National Lakes Assessment surveys lakes across the state for a variety of parameters. By including the evaluation of toxic chemicals in this survey, DEQ will gather information statewide on an aquatic resource not typically sampled for toxic chemicals.

DEQ expects to implement these monitoring programs over time as resources allow. DEQ will work with its partners and stakeholders to conduct additional monitoring to potentially identify sources of toxics in their watersheds as well as assist in planning management actions.

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Appendix A – Chemicals Analyzed

Pages A1 through A9

List contains all compounds analyzed during the sampling period.	
	(pink) Low level methods added in 2012
	(green) Methods added after 2010 sampling
	(blue) Methods added after 2011 sampling
	(purple) Methods added after 2012 sampling

Analyte group, *Analyte sub-group,* Analyte name	
Ammonia	**Consumer Product Constituents, cont'd**
Ammonia as N	Caffeine
Combustion By-Products	Carbamazepine
1-Methylphenanthrene	Codeine
1-Methylpyrene	Cotinine
Acenaphthene	DEET
Acenaphthylene	Diethylphthalate
Anthracene	Diethylstilbestrol
Benzo(a)anthracene	Dimethyl phthalate
Benzo(a)pyrene	Di-n-octyl phthalate
Benzo(b)fluoranthene	Diphenhydramine
Benzo(g,h,i)perylene	Estriol
Benzo(k)fluoranthene	Estrone
Chrysene	Ibuprofen
cis-1,2-Dichloroethene	N-Nitrosodiethylamine
cis-1,3-Dichloropropene	N-Nitrosodimethylamine
Dibenzo(a,h)anthracene	N-Nitroso-di-n-butylamine
Dibenzofuran	N-Nitrosopyrrolidine
Fluoranthene	Sulfamethoxazole
Fluorene	Triclosan
Indeno(1,2,3-cd)pyrene	Venlafaxine
Naphthalene	**Current Use Pesticides**
Phenanthrene	*Herbicides*
Pyrene	1,2-Dibromoethane (EDB)
Consumer Product Constituents	2,4,5-T
17a-Estradiol	2,4,5-Trichlorophenol (blue)
17a-Ethynyl estradiol	2,4,6-Trichlorophenol (blue)
17ß-Estradiol	2,4-D
4-Chloro-3-methylphenol	2,4-DB
Acetaminophen	2,6-Dichlorobenzamide (purple)
bis(2-ethylhexyl)adipate	Acetochlor
bis(2-ethylhexyl)phthalate	Acifluorfen
Butylbenzylphthalate	Acrolein

List contains all compounds analyzed during the sampling period.	
	Low level methods added in 2012
	Methods added after 2010 sampling
	Methods added after 2011 sampling
	Methods added after 2012 sampling

Analyte group, *Analyte sub-group,* Analyte name	
Current Use Pesticides, cont'd	**Current Use Pesticides, cont'd**
Herbicides	*Herbicides*
Alachlor	Neburon
Ametryn	Norflurazon
Aminocarb	Oxyfluorfen
Atrazine	Pebulate
Bentazon	Pendimethalin
Bromacil	Picloram
Butachlor	Prometon
Butylate	Prometryn
Chlorpropham	Pronamide
Cyanazine	Propachlor
Cycloate	Propazine
Dacthal (DCPA)	Siduron
DCPA acid metabolites	Simazine
Deisopropylatrazine	Simetryn
Desethylatrazine	Sulfometuron-methyl
Dichlobenil	Tebuthiuron
Dichloroprop	Terbacil
Dimethenamid	Terbutryn (Prebane)
Dinoseb	Terbutylazine
Diphenamid	Triclopyr
Diuron	Trifluralin
EPTC	Vernolate
Fluometuron	*Insecticides*
Fluridone	Acetamiprid
Hexazinone	Azinphos-methyl (Guthion)
Imazapyr	Baygon (Propoxur)
Linuron	Bifenthrin
MCPA	Carbaryl
MCPP	Carbofuran
Metolachlor	Chlorpyrifos
Metribuzin	Diazinon
Molinate	Dicamba
Napropamide	Dichlorvos

List contains all compounds analyzed during the sampling period.	**Low level methods added in 2012** **Methods added after 2010 sampling** **Methods added after 2011 sampling** **Methods added after 2012 sampling**
Analyte group, *Analyte sub-group,* Analyte name	
Current Use Pesticides, cont'd	**Current Use Pesticides, cont'd**
Insecticides	*Fungicides*
Dimethoate	Pentachlorophenol
Disulfoton	Propiconazole
Ethoprop	Pyraclostrobin
Fenamiphos	Triadimefon
Fenvalerate+Esfenvalerate	Tricyclazole
Imidacloprid	**Dioxins and Furans**
Malathion	1,2,3,4,6,7,8-HpCDD
Methiocarb	1,2,3,4,6,7,8-HpCDD as TEQ
Methomyl	1,2,3,4,6,7,8-HpCDF
Methyl paraoxon	1,2,3,4,6,7,8-HpCDF as TEQ
Mevinphos	1,2,3,4,7,8,9-HpCDF
Mexacarbate	1,2,3,4,7,8,9-HpCDF as TEQ
MGK 264	1,2,3,4,7,8-HxCDD
Oxamyl	1,2,3,4,7,8-HxCDD as TEQ
Parathion-ethyl	1,2,3,4,7,8-HxCDF
Parathion-methyl	1,2,3,4,7,8-HxCDF as TEQ
Insecticides	1,2,3,6,7,8-HxCDD
Permethrin	1,2,3,6,7,8-HxCDD as TEQ
Phosmet	1,2,3,6,7,8-HxCDF
Pyriproxyfen	1,2,3,6,7,8-HxCDF as TEQ
Terbufos	1,2,3,7,8,9-HxCDD
Tetrachlorvinphos (Stirophos)	1,2,3,7,8,9-HxCDD as TEQ
Fungicides	1,2,3,7,8,9-HxCDF
2,3,4,6-Tetrachlorophenol	1,2,3,7,8,9-HxCDF as TEQ
2,3,5,6-Tetrachlorophenol	1,2,3,7,8-PeCDD
bis(2-chloroisopropyl)ether	1,2,3,7,8-PeCDD as TEQ
Carboxin	1,2,3,7,8-PeCDF
Chloroneb	1,2,3,7,8-PeCDF as TEQ
Chlorothalonil	2,3,4,6,7,8-HxCDF
Etridiazole	2,3,4,6,7,8-HxCDF as TEQ
Fenarimol	2,3,4,7,8-PeCDF
Pentachlorobenzene	2,3,4,7,8-PeCDF as TEQ
Pentachloronitrobenzene	2,3,7,8-TCDD

List contains all compounds analyzed during the sampling period.	Low level methods added in 2012 Methods added after 2010 sampling Methods added after 2011 sampling Methods added after 2012 sampling
Analyte group, *Analyte sub-group,* Analyte name	
Dioxins and Furans, cont'd	**Flame retardants, cont'd**
2,3,7,8-TCDD as TEQ	PBDE-183
2,3,7,8-TCDF	PBDE-184
2,3,7,8-TCDF as TEQ	PBDE-191
OCDD	PBDE-196
OCDD as TEQ	PBDE-197
OCDF	PBDE-2
OCDF as TEQ	PBDE-201
Total 2378 Substituted Dioxins	PBDE-203
Total 2378 Substituted Furans	PBDE-204
Total 2378 Substituted HpCDFs	PBDE-205
Total 2378 Substituted HpCDFs as TEQ	PBDE-206
Total 2378 Substituted HxCDDs	PBDE-207
Total 2378 Substituted HxCDDs as TEQ	PBDE-208
Total 2378 Substituted HxCDFs	PBDE-209
Total 2378 Substituted HxCDFs as TEQ	PBDE-28
Total 2378 Substituted PeCDFs	PBDE-3
Total 2378 Substituted PeCDFs as TEQ	PBDE-30
Total 2378 Substituted TEQ	PBDE-47
Flame retardants	PBDE-49
PBDE-1	PBDE-66
PBDE-10	PBDE-7
PBDE-100	PBDE-71
PBDE-119	PBDE-77
PBDE-126	PBDE-85
PBDE-138	PBDE-99
PBDE-139	**Industrial Chemicals or Intermediates**
PBDE-140	1,1,1,2-Tetrachloroethane
PBDE-15	1,1,1-Trichloroethane
PBDE-153	1,1,2,2-Tetrachloroethane
PBDE-154	1,1,2-Trichloroethane
PBDE-156+169	1,1-Dichloroethane
PBDE-17	1,1-Dichloroethylene
PBDE-171	1,1-Dichloropropene
PBDE-180	1,2,4,5-Tetrachlorobenzene

List contains all compounds analyzed during the sampling period.	Low level methods added in 2012 Methods added after 2010 sampling Methods added after 2011 sampling Methods added after 2012 sampling
Analyte group, *Analyte sub-group,* Analyte name	
Industrial Chemicals or Intermediates, cont'd	**Industrial Chemicals or Intermediates, cont'd**
1,2,4-Trichlorobenzene	Bromodichloromethane
1,2-Dichlorobenzene	Bromoform
1,3-Dichlorobenzene	Bromomethane
1,4-Dichlorobenzene	Chloroform
2,4-Dichlorophenol	Chloromethane
2,4-Dimethylphenol	Dibromochloromethane
2,4-Dinitrophenol	Dibromomethane
2,4-Dinitrotoluene	Hexachloro-1,3-butadiene
2,6-Dichlorophenol	Hexachlorocyclopentadiene
2,6-Dinitrotoluene	Hexachloroethane
2-Butanone (MEK)	Isophorone
2-Chloroethyl vinyl ether	Nitrobenzene
2-Chloronaphthalene	N-Nitroso-di-n-propylamine
2-Chlorophenol	N-Nitrosodiphenylamine
2-Chlorotoluene	Phenol
2-Methylphenol	Styrene
2-Nitrophenol	Toluene
3,3´-Dichlorobenzidine	Vinyl chloride
3,5-Dichlorobenzoic acid	**Legacy Pesticides**
3-Methylphenol + 4-Methylphenol	2,4,5-TP (Silvex)
4,6-Dinitro-2-methylphenol	Aldrin
4-Bromophenyl phenyl ether	*BHC-technical (HCH)*
4-Chlorophenylphenylether	BHC-alpha
4-Chlorotoluene	BHC-beta
4-Isopropyltoluene	BHC-delta
4-Methyl-2-pentanone (MIBK)	BHC-gamma (Lindane)
4-Nitrophenol	*Chlordane*
Acetone	alpha-Chlordane
Azobenzene	cis-Chlordane
Benzene	trans-Chlordane
Benzidine	trans-Nonachlor
bis(2-chloroethoxy)methane	gamma-Chlordane+trans-Nonachlor
bis(2-chloroethyl)ether	Oxychlordane
Bromochloromethane	Chlorobenzilate

List contains all compounds analyzed during the sampling period.	Legend
	Low level methods added in 2012
	Methods added after 2010 sampling
	Methods added after 2011 sampling
	Methods added after 2012 sampling

Analyte group, *Analyte sub-group,* Analyte name	
Legacy Pesticides, cont'd	**PCBs, cont'd**
Dieldrin	PCB-112+119
Endosulfan (I + II)	PCB-114
Endosulfan I	PCB-115
Endosulfan II	PCB-118
Endosulfan sulfate	PCB-120
Endrin	PCB-122
Endrin aldehyde	PCB-124
Endrin ketone	PCB-125
Endrin+cis-Nonachlor	PCB-126
Heptachlor	PCB-127
Heptachlor epoxide	PCB-128
Hexachlorobenzene	PCB-129
Methoxychlor	PCB-130
Total DDT	PCB-131+133
2,4´-DDD	PCB-132+153
2,4´-DDE	PCB-134
2,4´-DDT	PCB-135
4,4´-DDD	PCB-136
4,4´-DDE	PCB-137
4,4´-DDT	PCB-138+163
PCBs	PCB-139
Total PCBs	PCB-140
PCB-1	PCB-141
PCB-100	PCB-142
PCB-101+113	PCB-143
PCB-102	PCB-144
PCB-103	PCB-145
PCB-104	PCB-146
PCB-105	PCB-147
PCB-106	PCB-148
PCB-107+123	PCB-149
PCB-108	PCB-150
PCB-109	PCB-151
PCB-110	PCB-152

List contains all compounds analyzed during the sampling period.	
	Low level methods added in 2012
	Methods added after 2010 sampling
	Methods added after 2011 sampling
	Methods added after 2012 sampling

Analyte group, *Analyte sub-group,* Analyte name	
PCBs, cont'd	**PCBs, cont'd**
PCB-154	PCB-188
PCB-155	PCB-189
PCB-156	PCB-19
PCB-157	PCB-190
PCB-158+160	PCB-191
PCB-159	PCB-192
PCB-16+32	PCB-194
PCB-161	PCB-195
PCB-162	PCB-196
PCB-164	PCB-197
PCB-165	PCB-198
PCB-166	PCB-199
PCB-167	PCB-20+21+33
PCB-168	PCB-200
PCB-169	PCB-201
PCB-17	PCB-202
PCB-170	PCB-203
PCB-171	PCB-204
PCB-172	PCB-205
PCB-173	PCB-206
PCB-174	PCB-207
PCB-175+182	PCB-208
PCB-176	PCB-209
PCB-177	PCB-22
PCB-178	PCB-23
PCB-179	PCB-24
PCB-18	PCB-25
PCB-180+193	PCB-26
PCB-181	PCB-27
PCB-183	PCB-28
PCB-184	PCB-29
PCB-185	PCB-30
PCB-186	PCB-31
PCB-187	PCB-34

List contains all compounds analyzed during the sampling period.	Low level methods added in 2012 Methods added after 2010 sampling Methods added after 2011 sampling Methods added after 2012 sampling
Analyte group, *Analyte sub-group,* Analyte name	
PCBs, cont'd	**PCBs, cont'd**
PCB-35	PCB-77
PCB-36	PCB-78
PCB-37	PCB-79
PCB-38	PCB-80
PCB-39	PCB-81
PCB-40	PCB-82
PCB-41+72	PCB-83
PCB-42	PCB-84
PCB-43+52	PCB-85
PCB-44	PCB-86
PCB-45	PCB-87+111+116+117
PCB-46	PCB-88
PCB-47	PCB-89
PCB-48	PCB-90
PCB-49	PCB-91
PCB-5	PCB-92
PCB-50	PCB-93
PCB-51	PCB-94
PCB-53	PCB-95+121
PCB-54	PCB-96
PCB-55	PCB-97
PCB-56	PCB-98
PCB-57	PCB-99
PCB-58+67	**Plant or animal sterols**
PCB-59	beta-Sitosterol
PCB-60	Cholesterol
PCB-61	Coprostanol
PCB-62	Stigmastanol
PCB-63	**Metals**
PCB-64+68	*Dissolved*
PCB-65+75	Antimony
PCB-66	Arsenic
PCB-69	Barium
PCB-74+76	Beryllium

List contains all compounds analyzed during the sampling period.	**Low level methods added in 2012** **Methods added after 2010 sampling** **Methods added after 2011 sampling** **Methods added after 2012 sampling**
Analyte group, *Analyte sub-group,* Analyte name	
Metals, cont'd	**Metals, cont'd**
Dissolved	*Total Recoverable*
Cadmium	Beryllium
Chromium	Cadmium
Copper	Chromium
Iron	Cobalt
Lead	Copper
Manganese	Iron
Nickel	Lead
Selenium	Manganese
Silver	Molybdenum
Thallium	Nickel
Zinc	Selenium
Total Inorganic	Silver
Arsenic	Thallium
Total Recoverable	Uranium
Antimony	Vanadium
Arsenic	Zinc
Barium	

Appendix B – Complete Site List

Pages B-1 through B-8

Station	Site Code	Basin Name	Site Description	Latitude	Longitude	Majority Land Use (5 mi)	Watershed Area (km^2)
10411	D01	Deschutes	Deschutes River at Deschutes River Park	45.6302	-120.91017	Mixed	27774
10506	D02	Deschutes	Deschutes River at Hwy 26 (Warm Springs)	44.7612	-121.22781	Range	20893
10508	D03	Deschutes	Deschutes River at Lower Bridge	44.3599	-121.29378	Range	5442
10517	D04	Deschutes	Crooked River at Lone Pine Road (Terrebonne)	44.3487	-121.08069	Range	11636
10684	D05	Deschutes	Deschutes River at Benham Falls Footbridge	43.9308	-121.41067	Forest	4522
10689	D06	Deschutes	Deschutes River at Wickiup Reservoir Gauge Station	43.6844	-121.68872	Forest	1061
10696	D07	Deschutes	Little Deschutes River at HWY 42 (Road 2114)	43.8204	-121.45130	Forest	2663
10697	D08	Deschutes	Little Deschutes River at Burgess Road	43.6923	-121.50017	Mixed	2301
11387	D09	Deschutes	White River at Tygh Valley State Park	45.2399	-121.09553	Range	1080
11477	D10	Deschutes	Crooked River at Conant Basin Road	44.1726	-120.54114	Range	6097
12561	D11	Deschutes	Deschutes River upstream of Riverhouse Hotel	44.0792	-121.30583	Urban	4810
25558	D12	Deschutes	Metolius River at Track C Bridge	44.4468	-121.63879	Forest	2
32475	D13	Deschutes	Crooked River at County Park	44.2861	-120.84337	Range	7151
32494	D14	Deschutes	Crooked River at Elliot Drive	44.3376	-120.92716	Mixed	8384
33093	D15	Deschutes	Ochoco Creek at mouth of Duncan Creek	44.3561	-120.48870	Forest	127
33939	D16	Deschutes	Trout Creek in lower canyon on Trout Creek Ranch	44.8088	-121.05418	Range	1486
36030	D17	Deschutes	Deschutes River at Shears Falls Fish Ladder	45.2570	-121.03957	Range	26762
36776	D18	Deschutes	Trout Creek downstream of Mud Springs Creek	44.8012	-121.06598	Range	1726
37106	D19	Deschutes	Tumalo Creek downstream of Bridge Creek at Skyliner Road (County Hwy 4601)	44.0319	-121.52080	Forest	77

Station	Site Code	Basin Name	Site Description	Latitude	Longitude	Majority Land Use (5 mi)	Watershed Area (km^2)
10719	GR01	Grande Ronde	Grande Ronde River at Hwy 82 (North Elgin)	45.5669	-117.90928	Mixed	3656
10720	GR02	Grande Ronde	Grande Ronde River at Hilgard Park	45.3421	-118.23556	Range	1411
11521	GR03	Grande Ronde	Grande Ronde River at Peach Lane (Island City)	45.3497	-117.96261	Agriculture	1889
11972	H01	Hood	Lenz Creek at mouth	45.6438	-121.51517	Agriculture	9
12012	H02	Hood	Hood River at footbridge downstream of I-84	45.7107	-121.50672	Agriculture	878
12550	H03	Hood	Fifteenmile Creek at Boyd Market Road at Dufur	45.4512	-121.11544	Range	220
13138	H04	Hood	East Fork Hood River at County Gravel Pit (River Mile 0.75)	45.5697	-121.61264	Mixed	274
13139	H05	Hood	Middle Fork Hood River at River Mile 1.0 (ODFW Smolt Trap)	45.5618	-121.63150	Forest	105
13140	H06	Hood	West Fork Hood River at Lost Lake Road (River Mile 4.7)	45.5570	-121.68642	Forest	178
13141	H07	Hood	Neal Creek at mouth (upstream of bridge)	45.6637	-121.52461	Mixed	86
13148	H08	Hood	Indian Creek at Union Avenue near Ppl power station	45.6991	-121.51897	Agriculture	17
13253	H09	Hood	Odell Creek at 200 feet downstream of Odell WWTP outfall	45.6432	-121.54410	Mixed	25
25204	H10	Hood	Threemile Creek at Hwy 197	45.5980	-121.13500	Agriculture	53
28333	H11	Hood	Fifteenmile Creek at Petersburg, OR	45.6110	-121.07400	Agriculture	642
28574	H12	Hood	Mill Creek at 2nd Street, The Dalles	45.6041	-121.18880	Mixed	163
32982	H13	Hood	South Fork Mill Creek upstream of Wicks Treatment Plant diversion (Mill Creek, Columbia River)	45.5375	-121.31693	Range	71
11016	JD01	John Day	John Day River downstream of South Fork John Day (Dayville)	44.4752	-119.54003	Range	4150
11020	JD02	John Day	South Fork John Day River at Dayville	44.4656	-119.53122	Range	1566
11386	JD03	John Day	John Day River at Hwy 206	45.4769	-120.46864	Range	17927
11478	JD04	John Day	John Day River at Service Creek	44.7924	-120.00269	Range	13289
24135	JD05	John Day	Clear Cr. (near Red Boy Mine)	44.7981	-118.47266	Forest	125

Station	Site Code	Basin Name	Site Description	Latitude	Longitude	Majority Land Use (5 mi)	Watershed Area (km^2)
31987	JD06	John Day	Canyon Creek at John Day City Park	44.4181	-118.95748	Range	299
31990	JD07	John Day	John Day River at Clyde Holliday State Park	44.4157	-119.08995	Range	1487
36787	JD08	John Day	Rock Creek at mouth	45.5764	-120.40152	Range	1319
37118	JD09	John Day	Middle Fork John Day River at Hwy 395 RM 25.4	44.8360	-119.03010	Range	1238
37135	JD10	John Day	North Fork John Day Basin at river mile 73.2 10 meters upstream of Oriental Cr	44.9754	-118.72690	Forest	972
10759	K01	Klamath	Lost River at Hwy 39 (Merrill)	42.0404	-121.62267	Agriculture	3478
10763	K02	Klamath	Klamath Strait at USBR Pump Station F	42.0799	-121.84072	Agriculture	53
10765	K03	Klamath	Klamath River at Hwy 66 (Keno)	42.1281	-121.92778	Mixed	18027
10768	K04	Klamath	Link River at mouth (Klamath Falls)	42.2188	-121.78836	Mixed	9788
10770	K05	Klamath	Williamson River at Williamson River Store	42.5146	-121.91619	Forest	7848
10407	MA01	Malheur	Malheur River at Hwy 201 (Ontario)	44.0568	-116.97222	Agriculture	12233
10728	MA02	Malheur	Willow Creek @ RR Crossing (Vale)	43.9882	-117.23070	Agriculture	1991
11047	MA03	Malheur	Malheur River at Hwy 20 (Drewsey)	43.7838	-118.33178	Range	2452
11480	MA04	Malheur	Malheur River near Little Valley	43.9103	-117.50758	Range	7826
10391	MC01	Mid Coast	Siletz R 5 miles DS of Siletz at RM 29.9	44.7643	-123.91350	Range	587
10582	MC02	Mid Coast	Schooner Creek at Highway 101 Bridge (Lincoln City)	44.9268	-124.01258	Forest	45
10990	MC03	Mid Coast	Wolf Creek @ MOUTH	43.9549	-123.62050	Forest	153
11263	MC04	Mid Coast	Alsea River at Thissell road	44.3827	-123.83100	Forest	857
11476	MC05	Mid Coast	Yaquina River at Trapp Rd.(Chitwood)	44.6577	-123.83478	Forest	183
13336	MC06	Mid Coast	Yaquina River at Marker #47	44.5975	-123.93806	Forest	566
20434	MC07	Mid Coast	Lake Creek at Deaddog Hole	44.0708	-123.78806	Forest	576
29900	MC08	Mid Coast	Cummins Creek	44.2673	-124.09786	Forest	21
33642	MC09	Mid Coast	Siuslaw River at Tide, boat ramp	44.0685	-123.84282	Forest	1511
34115	MC10	Mid Coast	Panther Creek at North Bank Road (Salmon River)	45.0087	-123.91510	Forest	6
34425	MC11	Mid Coast	Yachats River at RM 0.9	44.3091	-124.09380	Forest	109

Station	Site Code	Basin Name	Site Description	Latitude	Longitude	Majority Land Use (5 mi)	Watershed Area (km^2)
35486	MC12	Mid Coast	Salmon River at Hatchery Below Weir Approx. USGS RM 5.05	45.0165	-123.93830	Forest	153
36432	MC13	Mid Coast	Alsea at Mill Creek Boat Landing	44.3848	-123.62706	Forest	350
36803	MC14	Mid Coast	Lake Creek at Sumich Rd bridge	44.1839	-123.55357	Forest	104
37396	MC15	Mid Coast	Siletz River at Moonshine Park	44.7793	-123.83257	Forest	298
37397	MC16	Mid Coast	Alsea R at Port Docks (Waldport)	44.4346	-124.05820	Forest	1216
37398	MC17	Mid Coast	Siuslaw River Florence Boat Docks	43.9676	-124.10090	Mixed	1989
37400	MC18	Mid Coast	Siuslaw River at Siuslaw Falls Park	43.8547	-123.36403	Forest	211
10521	NC01	North Coast	Necanicum River at Forest Lake RV Camp (Seaside)	45.9520	-123.92510	Forest	143
10812	NC02	North Coast	Skipanon River at Hwy 101	46.1490	-123.92436	Mixed	33
11005	NC03	North Coast	Beaver Creek at Beaver	45.2774	-123.82567	Forest	75
11229	NC04	North Coast	Ecola CR at Cannon Beach Loop RD	45.9023	-123.95844	Forest	53
11849	NC05	North Coast	Salmonberry River at mouth	45.7504	-123.65178	Forest	184
12187	NC06	North Coast	Youngs River at Youngs River Loop Road	46.0696	-123.78558	Forest	89
12951	NC07	North Coast	Wilson River at Hwy 6 (Lee's Camp)	45.5902	-123.53489	Forest	154
12962	NC08	North Coast	South Fork Trask River downstream of Edwards Creek	45.4158	-123.60397	Forest	53
13308	NC09	North Coast	Tillamook Bay at Hobsonville Point	45.5469	-123.90917	Forest	1439
13311	NC10	North Coast	Netarts Bay at CNTY boat ramp	45.4294	-123.94611	Forest	36
13431	NC11	North Coast	Trask River at Netarts Road (Hwy. 6)	45.4564	-123.85853	Agriculture	437
13440	NC12	North Coast	Tillamook River at Bewley Creek Road	45.4086	-123.82472	Forest	93
13553	NC13	North Coast	Youngs Bay at Old Hwy 101 bridge	46.1700	-123.83694	Mixed	315
13654	NC14	North Coast	Necanicum River @ 12th St. approach	46.0015	-123.92260	Mixed	176
18802	NC15	North Coast	North Fork Nehalem River at Highway 53	45.8135	-123.76911	Forest	119
22394	NC16	North Coast	Nestucca River at first bridge ramp (upstream of Beaver)	45.2765	-123.81817	Forest	371
24299	NC17	North Coast	Nehalem River at Hwy 47 bridge, US of Vernonia	45.8437	-123.20160	Range	244

Station	Site Code	Basin Name	Site Description	Latitude	Longitude	Majority Land Use (5 mi)	Watershed Area (km^2)
32980	NC18	North Coast	Humbug Creek near mouth (Nehalem)	45.8512	-123.58465	Range	75
34165	NC19	North Coast	Clatskanie River above Fall Creek at Beaver boat ramp	46.1075	-123.20642	Forest	235
10741	OC01	Oregon Closed Lakes	Honey Creek at Plush	42.4071	-119.90106	Range	437
10748	OC02	Oregon Closed Lakes	Antelope Creek at Hwy 140 (Lakeview)	42.1307	-120.50903	Range	11
12264	OC03	Oregon Closed Lakes	Whitehorse Creek at Whitehorse Ranch Road	42.3376	-118.23411	Range	279
12265	OC04	Oregon Closed Lakes	Donner Und Blitzen River upstream of Page Springs Campground	42.8011	-118.86658	Range	541
12266	OC05	Oregon Closed Lakes	Twentymile Creek at Hwy 140	42.1761	-119.84194	Other	7
12267	OC06	Oregon Closed Lakes	Deep creek west of Adel	42.1744	-119.92667	Range	703
13014	OC07	Oregon Closed Lakes	South Fork Blitzen River at Blitzen Crossing	42.6388	-118.76317	Range	208
24158	OC08	Oregon Closed Lakes	Twentymile Creek at canyon/irrigation diversion	42.0529	-119.96831	Range	129
33929	OC09	Oregon Closed Lakes	Silvies River at West Loop Road	43.6341	-119.07709	Range	1178
33930	OC10	Oregon Closed Lakes	Chewaucan River, 2.4 miles upstream of Paisley	42.6779	-120.58383	Forest	667
36778	OC11	Oregon Closed Lakes	Thomas Creek at Stock Drive Road	42.1787	-120.38433	Agriculture	104
37573	OC12	Oregon Closed Lakes	Donner Und Blitzen River at Center Patrol Road	43.2354	-118.52434	Range	2116
10729	OW01	Owyhee	Owyhee River at Hwy 201 Bridge (Owyhee)	43.7839	-117.05433	Agriculture	28427
10730	OW02	Owyhee	Owyhee River at Rome (Hwy 95)	42.8407	-117.62281	Range	16579
11050	OW03	Owyhee	Jordan Creek at Arock Bridge	42.9049	-117.51856	Range	2945
12261	OW04	Owyhee	Jordan Creek u/s of Jordan Valley, OR at Pleasant Valley Road Bridge	42.9114	-116.99528	Range	1196
36783	OW05	Owyhee	Crooked Creek at Kiger Road	42.8605	-117.73315	Range	3468
37544	OW06	Owyhee	Cow Creek at Hwy 95	43.1078	-117.05730	Range	184
10724	P01	Powder	Powder River at Hwy 86 (east of Baker City)	44.8183	-117.46750	Range	3176
11494	P02	Powder	Burnt River at Snake River Road (Huntington)	44.3569	-117.25195	Range	2846
11857	P03	Powder	Powder River at Snake River Road (Richland)	44.7463	-117.17183	Range	3672

Station	Site Code	Basin Name	Site Description	Latitude	Longitude	Majority Land Use (5 mi)	Watershed Area (km^2)
10414	R01	Rogue	Rogue River at Lobster Creek Bridge	42.5037	-124.29217	Forest	13267
10418	R02	Rogue	Rogue River at Robertson Bridge (Merlin)	42.4968	-123.48728	Forest	8559
10423	R03	Rogue	Rogue River at Hwy 234 (Dodge Park)	42.5253	-122.84158	Range	3155
10428	R04	Rogue	Applegate River at Hwy 199 (near Wilderville)	42.3975	-123.45583	Forest	1990
10434	R05	Rogue	Bear Creek at Valley View Road (North of Ashland)	42.2244	-122.74494	Mixed	482
10602	R06	Rogue	Little Butte Creek at Agate Road (White City)	42.4554	-122.85503	Agriculture	971
11051	R07	Rogue	Bear Creek at Kirtland Road (Central Point)	42.4047	-122.93772	Mixed	936
11375	R08	Rogue	Rogue River at Casey State Park	42.6594	-122.69894	Mixed	2430
11482	R09	Rogue	Illinois River downstream of Kerby	42.2384	-123.68675	Range	1104
34860	R10	Rogue	Rogue River at RM 120.76, 200 yds upstream of City of Gold Hill PWS Intake	42.4486	-123.04210	Mixed	5388
10674	SA01	Sandy	Sandy River at Troutdale Bridge	45.5385	-122.37544	Mixed	1258
11025	SA02	Sandy	Gordon Creek	45.4934	-122.27728	Forest	46
26419	SA03	Sandy	Camp Creek at campground downstream of Bruin Run Creek (Zigzag River, Sandy River tributary)	45.3034	-121.87043	Forest	23
34102	SA04	Sandy	Beaver Creek at river mile 0.9 north of Otto Park (Sandy)	45.5376	-122.37920	Urban	32
37091	SA05	Sandy	Kelly Creek at Kane Rd Gresham upstream of Mt Hood Community College Pond	45.5124	-122.39816	Urban	12
11571	SC01	South Coast	NF Coquille River @ Cooper Bridge	43.0717	-124.10597	Forest	733
12607	SC02	South Coast	Tenmile Creek at Lakeside Marina (off Park Street)	43.5733	-124.17586	Mixed	183
13400	SC03	South Coast	Joe Ney Slough at east end of dock	43.3350	-124.31461	Forest	14
13405	SC04	South Coast	Coquille River at Riverton Boat Ramp	43.1540	-124.27728	Mixed	2542
13569	SC05	South Coast	West Fork Millicoma River at Allegany	43.4250	-124.03056	Forest	142
13574	SC06	South Coast	S Fork Coos River at Anson Rodgers bridge	43.3639	-124.08308	Mixed	603

Station	Site Code	Basin Name	Site Description	Latitude	Longitude	Majority Land Use (5 mi)	Watershed Area (km^2)
13587	SC07	South Coast	North Slough at mouth (Causeway Bridge)	43.4383	-124.23361	Mixed	38
13680	SC08	South Coast	Coquille Bay at Bandon Boat Launch-Conc. Pier	43.1208	-124.41294	Mixed	2733
25754	SC09	South Coast	SFC River @ RM 1, Myrtle Point Boat Ramp	43.0668	-124.14744	Mixed	1535
28303	SC10	South Coast	Elk Creek at ODFW Hatchery	42.7367	-124.39916	Forest	183
28803	SC11	South Coast	Ferry Creek D/S of ODFW Hatchery	43.1149	-124.38450	Forest	10
30670	SC12	South Coast	Chetco River below Jacks creek	42.0643	-124.22897	Forest	893
33476	SC13	South Coast	Coos Bay @ City Dock	43.3710	-124.20933	Mixed	87
34309	SC14	South Coast	Sixes River @ RM 1.1	42.8416	-124.53630	Mixed	344
36638	SC15	South Coast	New River Near Storm Ranch Boat Ramp	42.9966	-124.45743	Mixed	269
36750	SC16	South Coast	Winchuck River Estuary @ 101	42.0054	-124.21030	Forest	184
37405	SC17	South Coast	Johnson Creek upstream of golf course (Bandon)	43.0943	-124.42070	Mixed	11
37415	SC18	South Coast	Coos Bay at North Spit BLM Boat Ramp	43.4149	-124.27958	Mixed	1455
10404	UT01	Umatilla	Umatilla River at Yoakum Bridge	45.6774	-119.03539	Range	3303
10406	UT02	Umatilla	Umatilla River at Hwy 11 (Pendleton)	45.6748	-118.75850	Mixed	1148
10708	UT03	Umatilla	Willow Creek at Heppner Junction	45.7398	-120.02314	Range	2209
11489	UT04	Umatilla	Umatilla River at Westland Road (Hermiston)	45.8357	-119.33194	Agriculture	5891
12005	UT05	Umatilla	McKay Creek at Kirk Road (Pendleton)	45.6544	-118.82303	Mixed	513
12015	UT06	Umatilla	Butter Creek at Old Stanfield Road (Bucks Corner)	45.7848	-119.34128	Agriculture	1160
36445	UT07	Umatilla	Wildhorse Creek at McCormmach Rd	45.6923	-118.73502	Agriculture	495
10442	UQ01	Umpqua	South Umpqua at Melrose Road	43.2418	-123.41106	Mixed	4575
10451	UQ02	Umpqua	North Umpqua at Garden Valley Road (Roseburg)	43.2719	-123.40922	Mixed	3516
10997	UQ03	Umpqua	Cow Creek at mouth	42.9439	-123.33575	Mixed	1291
11484	UQ04	Umpqua	South Umpqua at Days Creek Cutoff Road (Canyonville)	42.9709	-123.21575	Forest	1778
37399	UQ05	Umpqua	Umpqua River at Discovery Center Docks	43.7048	-124.09438	Forest	11980

Station	Site Code	Basin Name	Site Description	Latitude	Longitude	Majority Land Use (5 mi)	Watershed Area (km^2)
23497	WA01	Walla Walla	Walla Walla River at OR/WA state line	46.0000	-118.37872	Agriculture	40
10339	WM01	Willamette	Willamette River at Canby Ferry	45.3003	-122.69072	Agriculture	24153
10344	WM02	Willamette	Willamette River at Wheatland Ferry	45.0906	-123.04431	Agriculture	20599
10350	WM03	Willamette	Willamette River at Albany (eastbound Hwy 20 bridge)	44.6397	-123.10578	Agriculture	12575
10352	WM04	Willamette	Willamette River at Old Hwy 34 Bridge (Corvallis)	44.5655	-123.25542	Agriculture	11438
10355	WM05	Willamette	Willamette River at Hwy 99E (Harrisburg)	44.2672	-123.17367	Agriculture	8895
10360	WM06	Willamette	Clackamas River at Hwy 99E (Gladstone)	45.3735	-122.60022	Urban	2444
10363	WM07	Willamette	Yamhill River at Dayton	45.2236	-123.07158	Agriculture	1905
10366	WM08	Willamette	South Santiam River Hwy 226 (Crabtree)	44.6362	-122.92356	Agriculture	1853
10373	WM09	Willamette	Mary's River at 99W (Corvallis)	44.5566	-123.26364	Mixed	781
10376	WM10	Willamette	McKenzie River at Coburg Road	44.1127	-123.04619	Mixed	3453
10386	WM11	Willamette	Middle Fork Willamette River at Jasper Bridge	43.9982	-122.90528	Mixed	3491
10456	WM12	Willamette	Tualatin River at Boones Ferry Road	45.3861	-122.75628	Urban	1792
10555	WM13	Willamette	Willamette River at Marion Street (Salem)	44.9461	-123.04153	Mixed	18772
10611	WM14	Willamette	Willamette River at Hawthorne Bridge	45.5133	-122.66989	Urban	28935
10637	WM15	Willamette	Molalla River at Knights Bridge Road (Canby)	45.2677	-122.70922	Agriculture	892
10640	WM16	Willamette	Pudding River at Hwy 211 (Woodburn)	45.1504	-122.79253	Agriculture	821
10792	WM17	Willamette	North Santiam River at Greens Bridge	44.7087	-122.97111	Agriculture	1895
11140	WM18	Willamette	Long Tom River at Stow Pit Road (Monroe)	44.3429	-123.29444	Agriculture	1049
11180	WM19	Willamette	Calapooia River at Queen Road	44.6202	-123.12747	Agriculture	963
11275	WM20	Willamette	Coast Fork Willamette at Mt. Pisgah Park	44.0100	-122.98511	Agriculture	1699

Appendix C – Detected Chemicals

Pages C-1 through C-9

Detected analytes	No. of detections	No. of samples	Percent detection	No. of samples over the screening value	Maximum value (µg/L)	ODEQ Water Quality Freshwater Standard (µg/L)	ODEQ Water Quality Saltwater Standard (µg/L)	EPA Office of Pesticide Programs Aquatic Life Benchmark (µg/L)	Reference	Primary use
Analyte group, *Analyte sub-group*, Analyte name										
Ammonia										
Ammonia as N	87	302	28.8	11	238	‡	‡	*nsv*	2	Fertilizer, intermediate for dyes
Combustion By-Products										
Acenaphthene	4	343	1.2	0	0.0171	95	99	*nsv*	1	Chemical intermediary
Acenaphthylene	3	544	0.6		0.0124	*nsv*	*nsv*	*nsv*		Component of coal tar products
Anthracene	1	544	0.2	0	0.00856	2900	4000	*nsv*	1	Component of tar, diesel, or crude oil
Benzo(a)anthracene	1	544	0.2	1	0.00283	0.0013	0.0018	*nsv*	1	None (combustion by-product)
Benzo(b)fluoranthene	4	544	0.7	4	0.033	0.0013	0.0018	*nsv*	1	None (combustion by-product)
Benzo(g,h,i)perylene	1	542	0.2		0.021	*nsv*	*nsv*	*nsv*		None (combustion by-product)
Chrysene	2	544	0.4	2	0.026	0.0013	0.0018	*nsv*	1	None (combustion by-product)
Dibenzo(a,h)anthracene	4	541	0.7	3	0.006	*nsv*	*nsv*	*nsv*		None (combustion by-product)
Fluoranthene	25	544	4.6	0	0.0396	14	14	*nsv*	1	None (combustion by-product)
Fluorene	4	544	0.7	0	0.023	390	530	*nsv*	1	None (combustion by-product)
Indeno(1,2,3-cd)pyrene	1	516	0.2	1	0.02	0.0013	0.0018	*nsv*	1	None (combustion by-product)
Naphthalene	5	317	1.6		0.105	*nsv*	*nsv*	*nsv*		Fumigant, component of gasoline
Phenanthrene	28	541	5.2		0.044	*nsv*	*nsv*	*nsv*		Explosives, component of tar and diesel fuel
Pyrene	4	544	0.7	0	0.0299	290	400	*nsv*	1	None (combustion by-product)
Consumer Product Constituents										
17a-Estradiol	1	468	0.2		0.01	*nsv*	*nsv*	*nsv*		Natural hormone
17a-Ethynyl estradiol	1	468	0.2		0.00436	*nsv*	*nsv*	*nsv*		Synthetic estrogen

Detected analytes	No. of detections	No. of samples	Percent detection	No. of samples over the screening value	Maximum value (µg/L)	ODEQ Water Quality Freshwater Standard (µg/L)	ODEQ Water Quality Saltwater Standard (µg/L)	EPA Office of Pesticide Programs Aquatic Life Benchmark (µg/L)	Reference	Primary use
Analyte group, *Analyte sub-group*, Analyte name										
Consumer Product Constituents, cont'd										
17ß-Estradiol	1	468	0.2		0.0025	*nsv*	*nsv*	*nsv*		Natural estrogen hormone
bis(2-ethylhexyl)adipate	3	396	0.8		0.573	*nsv*	*nsv*	*nsv*		Plasticizer for food wrappers
bis(2-ethylhexyl)phthalate	1	221	0.4	1	2.61	0.2	0.22	*nsv*	1	Plasticizer
Butylbenzylphthalate	1	536	0.2	1	0.261	190	190	*nsv*	1	Plasticizer
Caffeine	3	545	0.6		0.389	*nsv*	*nsv*	*nsv*		Stimulant
Carbamazepine	15	545	2.8		0.15	*nsv*	*nsv*	*nsv*		Antiepileptic
DEET	10	540	1.9		1.32	*nsv*	*nsv*	*nsv*		Insect repellant
Diethylphthalate	9	403	2.2	0	0.05	3800	4400	*nsv*	1	Plasticizer for polymers and resins
Diethylstilbestrol	1	428	0.2		0.0004	*nsv*	*nsv*	*nsv*		Synthetic estrogen
Diphenhydramine	5	517	1.0		0.034	*nsv*	*nsv*	*nsv*		Antihistimine
Estriol	3	468	0.6		0.0024	*nsv*	*nsv*	*nsv*		Natural estrogen hormone
Estrone	3	468	0.6		0.008	*nsv*	*nsv*	*nsv*		Natural estrogen hormone
Sulfamethoxazole	69	546	12.6		0.337	*nsv*	*nsv*	*nsv*		Antibiotic
Venlafaxine	13	543	2.4		0.091	*nsv*	*nsv*	*nsv*		Antidepressant
Current Use Pesticides										
Herbicides										
2,4-D	13	541	2.4	0	0.63	100	*nsv*	12500	1,5	Herbicide
2,4,5-Trichlorophenol	3	325	0.9		0.0329	330	*nsv*	*nsv*	1	Herbicide
2,4,6-Trichlorophenol	4	319	1.3	0	0.0149	0.023	*nsv*	*nsv*	1	Disinfectant
2,6-Dichlorobenzamide	10	114	8.8		1.73	*nsv*	*nsv*	*nsv*		None (dichlobenil degradate)
Atrazine	68	546	12.5	0	0.0865	*nsv*	*nsv*	1.0	7	Herbicide
Bromacil	7	547	1.3	0	0.087	*nsv*	*nsv*	6.8	7	Herbicide
Chlorpropham	1	547	0.2		0.578	*nsv*	*nsv*	*nsv*		Herbicide
Deisopropylatrazine	22	431	5.1	0	0.0277	*nsv*	*nsv*	2500	7	None (atrazine & simazine degradate)

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Analyte group, *Analyte sub-group*, Analyte name										
Current Use Pesticides										
Herbicides, cont'd										
Desethylatrazine	21	431	4.9	0	0.0359	*nsv*	*nsv*	1000	7	None (atrazine degradate)
Dicamba	1	546	0.2	0	0.36	*nsv*	*nsv*	61	7	Herbicide
Diuron	135	546	24.7	1	3.06	*nsv*	*nsv*	2.4	7	Herbicide
Fluridone	5	547	0.9	0	0.036	*nsv*	*nsv*	480	4	Herbicide
Hexazinone	7	547	1.3	0	0.148	*nsv*	*nsv*	7	7	Herbicide
Imazapyr	3	418	0.7	0	0.203	*nsv*	*nsv*	24	8	Herbicide
Linuron	2	546	0.4	0	0.00526	*nsv*	*nsv*	0.09	6	Herbicide
Metolachlor	20	546	3.7	0	0.141	*nsv*	*nsv*	1	6	Herbicide
Metribuzin	18	546	3.3	0	0.0639	*nsv*	*nsv*	8.7	7	Herbicide
Napropamide	2	547	0.4	0	0.0302	*nsv*	*nsv*	1100	4	Herbicide
Norflurazon	13	547	2.4	0	0.0492	*nsv*	*nsv*	9.7	7	Herbicide
Pendimethalin	1	547	0.2	0	0.0347	*nsv*	*nsv*	5.2	7	Herbicide
Prometon	5	531	0.9	0	0.00769	*nsv*	*nsv*	98	7	Herbicide
Simazine	48	546	8.8	0	0.159	*nsv*	*nsv*	36	7	Herbicide
Sulfometuron-methyl	9	431	2.1	0	0.00576	*nsv*	*nsv*	0.45	8	Herbicide
Terbuthylazine	1	546	0.2	0	0.0035	*nsv*	*nsv*	1700	3	Herbicide
Triclopyr	2	547	0.4	0	1.1	*nsv*	*nsv*	29800	7	Herbicide
Trifluralin	5	546	0.9	0	0.0012	*nsv*	*nsv*	1.14	4	Herbicide
Insecticides										
Acetamiprid	1	431	0.2	0	0.0043	*nsv*	*nsv*	2.1	6	Insecticide
Baygon (Propoxur)	2	546	0.4	0	0.0027	*nsv*	*nsv*	5.5	5	Insecticide
Carbaryl	10	546	1.8	0	0.0862	*nsv*	*nsv*	0.5	6	Insecticide
Carbofuran	2	546	0.4	0	0.0041	*nsv*	*nsv*	0.75	6	Insecticide

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Analyte group, *Analyte sub-group*, Analyte name										
Current Use Pesticides										
Insecticides, cont'd										
Dichlorvos	1	547	0.2	1	0.024	*nsv*	*nsv*	0.0058	6	Insecticide
Fenvalerate+Esfenvalerate	1	542	0.2	1	0.235	*nsv*	*nsv*	0.017	6	Insecticide
Imidacloprid	7	531	1.3	0	0.0314	*nsv*	*nsv*	1.05	6	Insecticide
Methomyl	2	546	0.4	0	0.173	*nsv*	*nsv*	0.7	6	Insecticide
Oxamyl	8	531	1.5	0	2.15	*nsv*	*nsv*	27	6	Insecticide, nemiticide
Fungicides										
2,3,4,6-Tetrachlorophenol	3	325	0.9		0.0859	*nsv*	*nsv*	*nsv*		Fungicide, wood preservative
2,3,5,6-Tetrachlorophenol	5	325	1.5		0.0939	*nsv*	*nsv*	*nsv*		Wood preservative
Chloroneb	3	547	0.5		0.068	*nsv*	*nsv*	*nsv*		Fungicide
Pentachlorophenol	16	758	2.1	5	0.33	0.15	0.3	25	1,5	Wood preservative
Propiconazole	10	546	1.8	0	0.126	*nsv*	*nsv*	21	7	Fungicide
Pyraclostrobin	7	546	1.3	0	0.0286	*nsv*	*nsv*	1.5	7	Fungicide
Dioxins and Furans										
OCDD	1	120	0.8		0.00014	*nsv*	*nsv*	*nsv*		None (Combustion/Industrial byproduct)
Flame retardants										
PBDE-3	3	118	2.5		0.00011	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-15	1	117	0.9		$8.1x10^{-05}$	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-17	1	158	0.6		0.00016	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-28	2	158	1.3		0.00027	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-47	4	146	2.7		0.00894	*nsv*	*nsv*	*nsv*		Flame retardant (banned)
PBDE-49	2	118	1.7		0.00017	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-85	1	159	0.6		0.0003	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-99	9	138	6.5		0.0083	*nsv*	*nsv*	*nsv*		Flame retardant (banned)

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Analyte group, *Analyte sub-group*, Analyte name										
Flame retardants, cont'd										
PBDE-100	5	155	3.2		0.00422	*nsv*	*nsv*	*nsv*		Flame retardant (banned)
PBDE-138	4	159	2.5		0.006	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-139	3	120	2.5		0.00036	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-140	1	120	0.8		0.00011	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-153	5	159	3.1		0.006	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-154	4	159	2.5		0.007	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-206	1	108	0.9		0.00066	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-208	1	108	0.9		0.00043	*nsv*	*nsv*	*nsv*		Flame retardant
PBDE-209	15	89	16.9		0.0265	*nsv*	*nsv*	*nsv*		Flame retardant
Industrial Chemicals or Intermediates										
1,2,4-Trichlorobenzene	2	364	0.5		0.0083	*nsv*	*nsv*	*nsv*		Chemical intermediary, solvent
2,4-Dimethylphenol	22	316	7.0		0.0227	*nsv*	*nsv*	*nsv*		Chemical intermediary, germicide
2,4-Dinitrotoluene	1	544	0.2	0	0.0258	0.084	0.34	*nsv*	1	Plasticizer
2,6-Dinitrotoluene	4	541	0.7		0.0758	*nsv*	*nsv*	*nsv*		Synthesis of explosives and foams
Chloroform	1	40	2.5	0	0.0015	260	1100	*nsv*	1	Chemical intermediary, solvent
Dibromochloromethane	1	40	2.5	0	0.0005	0.31	1.3	*nsv*	1	Chemical intermediary, reagent
Isophorone	2	440	0.5	0	0.176	27	96	*nsv*	1	Ink and coating solvent
Nitrobenzene	1	325	0.3	0	0.0058	14	69	*nsv*	1	Chemical intermediary, solvent
Legacy Pesticides										
Aldrin	2	547	0.4	6	0.00011	$5.0x10^{-06}$	$5.0x10^{-06}$	*nsv*	1	Insecticide
BHC-technical (HCH)	39	547	7.1	0	0.0032	0.0014	*nsv*	*nsv*	1	Insecticide
BHC-alpha	26	547	4.8	0	0.0002	0.0005	0.0005	*nsv*	1	Insecticide
BHC-beta	30	547	5.5	0	0.00013	0.0016	0.0017	*nsv*	1	Insecticide
BHC-gamma (Lindane)	3	547	0.5	0	0.00021	0.08	0.16	0.5	2,5	Insecticide

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Analyte group, *Analyte sub-group*, Analyte name										
Legacy Pesticides, cont/d										
Chlordane	15	328	4.6	15	0.00148	$8.0x10^{-05}$	*nsv*	*nsv*	1	Insecticide
alpha-Chlordane	6	328	1.8		0.00024	*nsv*	*nsv*	*nsv*		Insecticide
gamma-Chlordane+trans-Nonachlor	5	328	1.5		0.00034	*nsv*	*nsv*	*nsv*		Insecticide
Oxychlordane	9	328	2.7		0.00148	*nsv*	*nsv*	*nsv*		None (chlordane degradate)
Dieldrin	31	547	5.7	31	0.00723	$5.0x10^{-06}$	$5.0x10^{-06}$	*nsv*	1	Insecticide
Endosulfan (I + II)	33	543	6.1	0	0.00555	0.056	0.0087	*nsv*	2	Insecticide
Endosulfan I	28	535	5.2	0	0.00247	0.056	0.0087	*nsv*	2	Insecticide
Endosulfan II	25	530	4.7	0	0.00308	0.056	0.0087	*nsv*	2	Insecticide
Endosulfan sulfate	55	543	10.1	0	0.0162	8.5	8.9	150	1,5	None (endosulfan degradate)
Endrin+cis-Nonachlor	3	328	0.9		0.00022	*nsv*	*nsv*	*nsv*		Insecticide
Heptachlor	1	547	0.2	1	0.00015	$8.0x10^{-06}$	$8.0x10^{-06}$	*nsv*	1	Insecticide
Heptachlor epoxide	15	507	3.0	15	0.00046	$4.0x10^{-06}$	$4.0x10^{-06}$	*nsv*	1	None (heptachlor degradate)
Hexachlorobenzene	1	547	0.2	1	0.00036	$3.0x10^{-05}$	$3.0x10^{-05}$	*nsv*	1	Microbiocide, fungicide, insecticide
Methoxychlor	1	547	0.2	0	0.00044	0.03	0.03	0.7	2,5	Insecticide
Total DDT	30	547	5.5	15	0.00371	0.001	0.001	*nsv*	2	Insecticide
2,4´-DDD	14	328	4.3		0.00024	*nsv*	*nsv*	*nsv*		None (DDT degradate)
2,4´-DDT	6	328	1.8		0.00016	*nsv*	*nsv*	*nsv*		Insecticide
4,4´-DDD	20	547	3.7	20	0.00083	$3.0x10^{-05}$	$3.0x10^{-05}$	*nsv*	1	None (DDT degradate)
4,4´-DDE	30	545	5.5	30	0.00197	$2.0x10^{-05}$	$2.0x10^{-05}$	*nsv*	1	None (DDT degradate)
4,4´-DDT	18	547	3.3	18	0.00093	$2.0x10^{-05}$	$2.0x10^{-05}$	*nsv*	1	Insecticide
PCBs										
Total PCBs	1	340	0.3	0	0.00044	$6.0x10^{-06}$	nsv	nsv	1	Closed electrical equipment
PCB-209	1	121	0.8		0.00044	*nsv*	*nsv*	*nsv*		Closed electrical equipment

Detected analytes	No. of detections	No. of samples	Percent detection	No. of samples over the screening value	Maximum value (µg/L)	ODEQ Water Quality Freshwater Standard (µg/L)	ODEQ Water Quality Saltwater Standard (µg/L)	EPA Office of Pesticide Programs Aquatic Life Benchmark (µg/L)	Reference	Primary use
Analyte group, *Analyte sub-group*, Analyte name										
Plant or animal sterols										
beta-Sitosterol	428	428	100.0		4.53	*nsv*	*nsv*	*nsv*		Phytoestrogen
Cholesterol	463	463	100.0		9.26	*nsv*	*nsv*	*nsv*		None (biogenic sterol)
Coprostanol	435	464	93.8		1.06	*nsv*	*nsv*	*nsv*		None (fecal indicator)
Stigmastanol	422	427	98.8		0.956	*nsv*	*nsv*	*nsv*		Plant sterol
Priority Metals										
Dissolved										
Arsenic	268	421	63.7	68	40.9	2.1[†]	1.0[†]	*nsv*	1	Herbicide, Insecticide, naturally occuring
Antimony	4	421	1.0		0.48	*nsv*	*nsv*	*nsv*		Semi-conductor industry
Barium	341	421	81.0		91.3	*nsv*	*nsv*	*nsv*		Metal alloys, drilling fluids, fireworks
Cadmium	4	421	1.0	0	0.13	*[#]	8.8	*nsv*	2	Batteries, pigments, metals industries
Chromium	8	421	1.9	0	1.7	11	50	*nsv*	2	Metals industries, leather tanning, pigments
Copper	12	421	2.9	2	51.9	*[#]	3.1	*nsv*	2	Biocide, piping, electronics, brake pads
Iron	45	421	10.7	2	2130	1000[#]	*nsv*	*nsv*	2	Metal alloys, essential nutrient
Lead	1	421	0.2	0	0.41	*	8.1	*nsv*	2	Batteries, electronics, legacy fuels and paints
Manganese	337	420	80.2		327	*nsv*	*nsv*	*nsv*		Metals industries, pigments, essential nutrient
Nickel	58	421	13.8	0	12.2	*	8.2	*nsv*	2	Batteries, metals industries
Selenium	2	421	0.5	0	2.8	4.6	71	*nsv*	2	Glass industry, trace nutrient
Thallium	4	421	1.0		0.05	*nsv*	*nsv*	*nsv*		Rat & other poisons (historically)
Zinc	30	419	7.2	0	42.7	*	81	*nsv*		Metal alloys, pigments, galvanizing, nutrient
Total Inorganic										
Arsenic	268	281	95.4	20	30.2	2.1	1.0	*nsv*	1	Herbicide, Insecticide, naturally occuring

Detected analytes	No. of detections	No. of samples	Percent detection	No. of samples over the screening value	Maximum value (µg/L)	ODEQ Water Quality Freshwater Standard (µg/L)	ODEQ Water Quality Saltwater Standard (µg/L)	EPA Office of Pesticide Programs Aquatic Life Benchmark (µg/L)	Reference	Primary use
Analyte group, *Analyte sub-group*, Analyte name										
Total Recoverable										
Arsenic	268	281	95.4	75	41	2.1†	1.0†	*nsv*	1	Herbicide, insecticide, naturally occuring
Antimony	4	946	0.4	0	0.48	5.1	64	*nsv*	1	Semi-conductor industry
Barium	869	961	90.4	0	146	1000	*nsv*	*nsv*	1	Metal alloys, drilling fluids, fireworks
Beryllium	8	949	0.8		0.4	*nsv*	*nsv*	*nsv*		Aircraft & space industry
Cadmium	6	961	0.6	0	0.36	*	8.8§	*nsv*	2	Batteries, pigments, metals industries
Chromium	171	911	18.8	2	13.8	11§	50§	*nsv*	2	Metals industries, leather tanning, pigments
Cobalt	237	513	46.2		5.55	*nsv*	*nsv*	*nsv*		Metal alloys, electroplating
Copper	398	961	41.4	25	64.3	*	3.1§	*nsv*	2	Biocide, piping, electronics, brake pads
Iron	682	960	71.0	89	18700	1000	*nsv*	*nsv*	2	Metal alloys, essential nutrient
Lead	417	907	46.0	51	10	*§	8.1§	*nsv*	2	Batteries, electronics, legacy fuels and paints
Manganese	404	430	94.0		353	*nsv*	*nsv*	*nsv*		Metals industries, pigments, essential nutrient
Molybdenum	1	513	0.2		4.2	*nsv*	*nsv*	*nsv*		Metals industries, trace nutrient
Nickel	270	961	28.1	0	12.2	*§	8.2§	*nsv*	2	Batteries, metals industries
Selenium	2	961	0.2	0	2.8	4.6§	71§	*nsv*	2	Glass industry, trace nutrient
Silver	1	961	0.1	0	0.16	*§	1.9§	*nsv*	2	Photography, silverware, jewelry, electronics
Thallium	2	961	0.2	2	0.1	0.043	0.047	*nsv*	1	Rat & other poisons (historically)
Uranium	39	513	7.6		1	*nsv*	*nsv*	*nsv*		Nuclear energy
Vanadium	192	513	37.4		34	*nsv*	*nsv*	*nsv*		Steel production
Zinc	455	935	48.7	1	131	*§	81§	*nsv*	2	Metal alloys, pigments, galvanizing, nutrient

Appendix C Legend

nsv	no screening value has been assigned	
1	Human Health Criteria: Water + Organism	http://www.deq.state.or.us/wq/standards/docs/tables303140.pdf
2	Freshwater Chronic Criteria (CCC)	
3	Freshwater Fish Acute Criteria	http://www.epa.gov/oppefed1/ecorisk_ders/aquatic_life_benchmark.htm
4	Freshwater Fish Chronic Criteria	
5	Freshwater Invertebrates Acute Criteria	
6	Freshwater Invertebrates Chronic Criteria	
7	Freshwater Nonvascular Plants Acute Criteria	
8	Freshwater Vascular Plants Acute Criteria	
*	Hardness dependent criteria	
#	This criteria applies to the total recoverable metal.	
†	This criteria applies to total inorganic arsenic. These results are for (inorganic + organic) arsenic, dissolved and total recoverable.	
§	This criteria applies to the dissolved concentration, and is therefore a conservative comparison.	
‡	pH and temperature dependent criteria	