Oregon Public Water Systems

Surface Water Resource Guide

For Drinking Water Source Protection

February 2018 Version 1.0

Oregon Department of Environmental Quality
Environmental Solutions Division
Watershed Management

Oregon Health Authority
Center for Health Protection
Drinking Water Services

A Call to Action -
A Recommitment to Assessing and Protecting Sources of Drinking Water

"Our vision…Federal, state, and local actions reflect the high value of safe drinking water: the high value of drinking water is widely recognized at all levels of government and among the general public…"

(**Appendix 1,** Source Water Collaborative, 2014)

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NOTE: This document is "Version 1.0" and dated February 2018. It will be made available on DEQ's Drinking Water Protection website in February 2018. DEQ anticipates there will be frequent revisions and updates on this document. Please feel free to make suggestions for improvements so that we can make the document more valuable to the public water systems in Oregon.

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Surface Water Resource Guide
TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

PROJECT PURPOSE

Why is there a need for a "Surface Water Resource Guide"?

Oregon faces many challenges with water quantity, water quality, and ecosystem needs. Oregon's people rely upon water to drink, to irrigate and grow food, to supply livestock, to build products, to move goods, to recreate, to produce energy. Clean water is essential to Oregon's environmental health—for the trees, native plants, wetlands, aquatic life, and human health. Oregon's economy is also highly dependent upon a healthy environment and clean, reliable sources of water.

As Oregon's population grows, the importance of high quality drinking water sources to meet the demands of that population will increase. Ensuring high quality sources of water is essential for providing clean drinking water to agricultural growers/ranchers, rural homeowners, businesses, and urban communities of all sizes.

Today, and historically, **the public is concerned about the safety of its drinking water**. This project---developing a "Resource Guide" for public water systems---was initiated after several multi-agency meetings during 2013-14 regarding how to address community concerns about drinking water quality. Oregon DEQ developed the Resource Guides in response to these meetings. *It was clear that local government and community citizens needed more information to: a) understand the various authorities associated with water quality in their source area, and b) learn about the various tools and assistance available to reduce the risk of contamination of their drinking water.*

While the risk of intentional contamination is small, drinking water sources can become contaminated by a variety of human activities and natural causes. Most water resource work to date has focused on identifying pollutant impacts, then reducing the levels of pollutants and restoring impaired or polluted waters. While we will continue to do this as resources allow, it is also important to prevent problems from occurring. Pollution prevention does not depend on data showing there is an existing problem, but an understanding of factors that pose a risk of pollution. If there is already a pollution problem, it is too late to prevent it.

Pollution prevention is fundamentally different from pollutant removal or treatment. With regard to safe drinking water, many studies have shown that **it is more cost-effective to prevent pollution than to remove it through treatment or implement restoration**. Reducing or eliminating off-site releases of pollutants through protection and prevention activities can effectively lower treatment and maintenance costs, and improve long-term viability of surface water drinking water sources (Freeman et al 2008). Reducing pollutant loading to source water can reduce the need for equipment replacement or upgrades, as well as reduce risks associated with many contaminants (including ones known to be toxic, persistent, and/or bio-accumulative) where regulatory standards and/or monitoring requirements may be lacking. Long-term

assurances of a safe and adequate drinking water supply also helps to protect property values and preserve the local and regional economic potential for the area.

This Resource Guide provides the basic information necessary for Oregon's public water system officials and community partners to implement local place-based planning to prevent pollutant impacts that could affect their drinking water quality. **Pollution prevention can help protect public health, enhance public confidence in their drinking water, and reduce the need for expensive treatment in both surface water and groundwater.**

There have been many studies showing the cost-effectiveness of source water protection. One of the most recent comprehensive studies is from the Nature Conservancy's Global Water Program. The program just released a report titled "Beyond the Source: The environmental, economic, and community benefits of source water protection", which is paired with a companion decision tool mapping website. The report analyzes the source watersheds of more than 4000 large cities worldwide, and highlights how nature-based solutions can be scaled up and implemented to make a difference in biodiversity conservation, resilience, and public health. For example, the analysis shows that 4 out of 5 of the ~4000 cities studied could meaningfully reduce sediment and nutrient pollution in water they use through 3 source water protection activities: reforestation, forest protection, and planting cover crops. It also dedicates significant discussion to potential cost-saving repercussions of source water protection efforts. The report can be accessed here:
https://global.nature.org/content/beyond-the-source?src=r.global.beyondthesource

EXECUTIVE SUMMARY

In Oregon, there are currently 240 active intakes tapping into surface water for 163 individual public water systems. Section 1453 of the federal 1996 Safe Drinking Water Act Amendments (PL 104-182) required states to develop "Source Water Assessments" for all public water supplies within their state. Source Water Assessments identify watershed or aquifer conditions and potential sources of pollutants, and also prioritize areas for future protection. The Oregon Health Authority (OHA) and the Oregon Department of Environmental Quality (DEQ) completed Oregon's assessment reports in 2005. More advanced data and GIS capabilities are currently available, so the state agencies are now completing "Updated Source Water Assessments" for public water systems in Oregon. USWAs provide more detailed technical information on their drinking water source area. This Surface Water Resource Guide is a "toolbox" for using the Updated Source Water Assessment information on the source areas to support local drinking water source protection.

Drinking water sources, whether from a watershed or aquifer recharge area, are subject to a variety of potential point and nonpoint sources of pollution. Improving or maintaining the source water quality is a vital component of providing safe and clean drinking water to the public. This document will provide information to better understand existing protections for drinking water, provide guidance for overcoming barriers to protection, and provide a consistent framework for developing and implementing effective drinking water source protection projects.

DEQ recognizes the need to stabilize and create ecological and social resilience in municipal watersheds; this need will continue to increase as climate change brings more intense storms. It is clear that weather patterns are shifting, and Oregon communities are feeling more impacts of severe storms and intense rainfall events. Based on evaluation of drinking water data, it is clear that the most significant direct impact of intense storms to watersheds is an increase in turbidity levels – that is, an increase in materials in the water that decrease water clarity. Elevated turbidity often results in increased maintenance for drinking water treatment and costs to residents. Pollutants such as fuels or pesticides adsorbed to the surface of entrained particles in turbid water can also increase public health risks. Regardless of the source, high dissolved and/or fine particulate organic matter in streams often requires more chemicals to treat water, and can increase the levels of disinfection byproducts, a category of regulated carcinogenic compounds. Other impacts of climate change include an increase in temperatures of streams and lakes during the warmer summers, contributing to an increase in harmful algal blooms driven by higher levels of nitrates and phosphorus in stormwater and groundwater feeding into surface water.

The State of Oregon adopted an "Integrated Water Resources Strategy (IWRS)" in 2012 to serve as a blueprint for addressing statewide water resource challenges. The Water Resources Department led the effort in consultation with Oregon DEQ, Oregon Department of Fish and Wildlife, and the Oregon Department of Agriculture. Within Goals 1 and 2 of the IWRS, the strategy seeks to improve information about local water resources and help communities undertake place-based integrated planning to improve resiliency and any public health

challenges associated with water quantity and water quality. Meeting Oregon's water resource needs under the strategy includes "ensuring the safety of Oregon's drinking water", and "reducing the use of and exposure to toxics and other pollutants" (IWRS 2012, Recommended Actions 1C, 9A, 12A, and 12B). See WRD website for the 2012 IWRS, as well as a Draft 2017 IWRS: http://www.oregon.gov/owrd/Pages/law/integrated_water_supply_strategy.aspx

The primary purpose of the Resource Guide is to assist public water systems to prevent or reduce contamination from activities within their drinking water source area. **The approach for developing and implementing prevention plans will follow the IWRS model and recommendations.** Public water system officials/staff can rarely develop and implement strategic plans for pollutant reduction without assistance from partner organizations. To increase the opportunities for finding assistance, this document provides detailed information on potential partner organizations, resources available, and funding sources. To increase the likelihood that voluntary pollution reduction strategies will be successfully implemented, in-depth information is provided on various water quality protection tools and how to develop effective place-based plans through collaborative partnerships.

As a first step in preventing pollution, DEQ's Drinking Water Protection program collects and disseminates information, provides financial and technical assistance where possible, and implements other activities with other water quality programs to prevent pollution. All public water systems are required to perform monitoring tests that meet the Safe Drinking Water Act requirements, but in order to keep costs reasonable for the public water systems, these tests are performed at 3 (or more) year intervals, and not all pollutants are tested for. This is an important reason to work collaboratively on pollution prevention in the drinking water source areas.

Community place-based planning for drinking water protection allows citizens to take an active role and work together in protecting public health and reducing the costs of providing clean drinking water.

In preparation of this Surface Water Resource Guide, DEQ collaborated with a number of state, federal, and university partners to develop tools that are designed to help public water systems prevent or reduce contamination from sources within their watershed. Oregon state agencies' shared responsibilities for protecting water quality means that expertise representing a wide variety of land uses and activities help to develop screening tools and identify practices that could potentially affect source waters. The goal of having detailed information on the drinking water watershed characteristics is to promote a greater level of communication with upstream landowners who could potentially affect water quality. The Resource Guide also includes several tools that can be used for developing strategies to reduce pollutant loads.

This document provides data and information to encourage action on priority areas, mapping of natural features, susceptibility analysis, and identifying potential sources of pollutants; links to non-profit organizations that may be able to assist; and information for how to improve collaboration with upstream partners and landowners to protect and improve source water quality.

1.0 DRINKING WATER REGULATORY OVERVIEW

It is important to understand the regulatory context of water quality as it relates to drinking water source protection. We all depend on clean water. This section will highlight the federal regulations related directly to public drinking water. Many agencies administer different aspects of water quality regulations that are intended to protect public health and water resources in Oregon. An Interagency Agreement between the OHA and DEQ provides a framework to ensure the responsibilities and tasks for DEQ associated with the drinking water *protection* aspects of public water systems are clearly articulated.

Safe Drinking Water Act

The Oregon Health Authority (OHA) is the state agency responsible for the implementation of the federal Safe Drinking Water Act in Oregon. ORS 338.277 authorizes OHA to administer the federal Safe Drinking Water Act in Oregon as the Primacy Agency in agreement with the federal government. ORS 448.131 further authorizes the adoption of standards necessary to protect public health through insuring safe drinking water within a water system. Oregon Administrative Rules OAR 333-061 include requirements for systems to meet the Safe Drinking Water Act maximum contaminant levels (MCL), submit to periodic inspections, and meet enforcement requirements as administered by OHA.

As the primacy agency, OHA also approves drinking water treatment plans and sets construction standards, operator certification standards, and enforces rules to ensure safe drinking water. In order to assist systems in complying with standards, OHA also provides technical assistance and oversight of grants and loans for public water system operation and improvements.

The OHA website has extensive information on all drinking water regulatory requirements: http://healthoregon.org/dwp

The federal Safe Drinking Water Act currently regulates the 91 most commonly occurring pollutants in drinking water in the United States (USEPA, 2018). *There are many pollutants not regulated in treated drinking water —including pharmaceuticals, personal care products, and many pesticides used in Oregon.* For example, Community public water systems (places where people live) and Non-transient Non-community public water systems (places where people work or attend school) test for regulated synthetic organic contaminants every three years in treated drinking water, but there are many compounds used in Oregon that are not regulated under the current requirements. The testing requirements for Transient Non-community public water systems (places that don't serve the same people every day) are limited to bacteria and nitrate, pollutants that can have an acute illness risks.

Through extensive sampling and analysis by the U.S. Geological Survey, U.S. EPA, and others, we know that many pollutants found in drinking water sources cannot be fully removed through standard drinking water treatment technologies (Stackelberg et al 2004, Glassmeyer et al 2017).

The inability to remove pollutants from source water *places even more emphasis in reducing or preventing pollutants in source waters.*

Clean Water Act

The Safe Drinking Water Act does not provide authorities to prevent pollution in source waters. *Protecting water quality in source waters for public water systems requires implementation of federal Clean Water Act authorities and state law.* DEQ is responsible for implementation of the federal Clean Water Act and state water quality law in Oregon. Because of this authority, DEQ is responsible for addressing pollutants from point and nonpoint sources of pollution that affect the water quality throughout the state.

The federal Clean Water Act authorities apply to all surface waters in the United States. Oregon state statutes (ORS 468B.005(10)) expand upon the federal Clean Water Act to afford protection for all waters of the state, including groundwater. Oregon statues authorize DEQ to implement and enforce the federal Clean Water Act within Oregon. Pertinent Oregon statutes that provide the basis for prevention of contamination include:

ORS 468B.005 Definitions for water pollution control laws.

…(5) "Pollution" or "water pollution" means such alteration of the physical, chemical or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, silt or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state, which will or tends to, either by itself or in connection with any other substance, create a public nuisance or which will or tends to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational or other legitimate beneficial uses or to livestock, wildlife, fish or other aquatic life or the habitat thereof.

…(10) "Water" or "the waters of the state" include lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or effect a junction with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction.

ORS 468B.015 Policy.

Whereas pollution of the waters of the state constitutes a menace to public health and welfare, creates public nuisances, is harmful to wildlife, fish and aquatic life and impairs domestic, agricultural, industrial, recreational and other legitimate beneficial uses of water... it is hereby declared to be the public policy of the state:

*…(2**)** To protect, maintain and improve the quality of the waters of the state for public water supplies, for the propagation of wildlife, fish and aquatic life and for domestic, agricultural, industrial, municipal, recreational and other legitimate beneficial uses;*

…(5) To cooperate with other agencies of the state, agencies of other states and the federal government in carrying out these objectives.

DEQ has primary responsibility for implementing water quality protection in Oregon. DEQ has a suite of programs and responsibilities to help prevent contamination from point and non-point sources of pollution, to clean up pollution sources, and to monitor and assess water quality (see: http://www.oregon.gov/deq/wq/Pages/default.aspx). As part of its strategic plan, DEQ places high emphasis on protecting human health. Within the water quality program, this is achieved through work on watershed health, basin assessments, discharge permitting, nonpoint source controls, water quality standards and protecting beneficial uses. There is a high level of coordination to integrate the drinking water source area information and priorities into other agency programs, including toxics reduction, pesticide stewardship partnership implementation, emergency/spill response, hazardous waste cleanup, water quality permitting, and other programs that impact water resources. Many DEQ programs prioritize public drinking water source areas in their statewide strategic planning for implementation. For example, the DEQ underground storage tank cleanup program prioritized and addressed 99 leaking tanks in the source areas adjacent to public water system wells based on the 2005 Source Water Assessment data.

2.0 CLIMATE CHANGE

Climate change is already affecting the Pacific Northwest, and alterations to our regional as well as global climate are expected to continue for decades. Effects of climate change include more frequent and larger major storms, drier summers and wetter winters, increased wildfire severity in some places, increases in stream temperature, and reductions to summer and early autumn streamflow. Larger storms increase surface erosion (Lanini et al 2009) and are more likely to trigger landslides (Robison et al 1999, Turner et al 2010). In areas dependent on groundwater discharge into streams, there may be lower streamflows during the dry seasons that could create problems for fish and water supplies. Increases in stream temperatures can encourage algal blooms and impair fish and other aquatic life. Incidences of algal blooms can also be increased by storm runoff of nitrate- or phosphorus-rich waters. Climate change effects do not occur in isolation but will interact with the effects of human activities and other natural processes.

For Oregon, some specific examples of how climate change may impact surface water systems include:

- Potential less surface water available in summer months and this may cause water shortages for public water systems with newer or “junior” water rights,
- Potential increased competition with other water users such as agriculture,
- Potential increased costs for drinking water treatment due to increased algal blooms or bacteria where there are increased temperatures in streams, and
- Potential increased costs for drinking water treatment due to water quality effects of low flows causing concentration of nutrients.

In 2007, the Oregon State Legislature charged the Oregon Climate Change Research Institute with assessing the likely effects of climate change on the state, including specific biological, physical and social science aspects that relate to Oregon. An assessment report was developed in

2010 to act as a compendium of the relevant research on climate change and its impacts on Oregon (Dello 2010). The report stated that human activities are primarily responsible for the observed 1.5° F (0.83°C) increase in the 20th century temperatures in the Pacific Northwest.

Future predicted regional climate changes in Oregon include:

- Increases in temperature around 0.2-1°F (0.11-0.56°C) per decade
- Warmer and drier summers with a likely 14 percent decrease for summer precipitation by the 2080s
- Extreme precipitation events will likely increase in frequency and severity
- Sea levels will rise, possibly by two to four feet (0.6 to 1.2 meters) by 2100

Key findings from the report include:

- **Summer water supply will decrease due to reduced snowpack and summer precipitation**;
- Availability, quality, and cost of water will likely be the most limiting factor for agricultural production under a warmer climate
- Wildfire is projected to increase in all Oregon forest types in the coming decades
- Frequency and magnitude of coastal flooding events may continue to increase
- Many plant and animal species on land, in freshwater and in the sea have and will shift their distribution and become less or more abundant – invasive species and harmful algal blooms may become more abundant
- Changes to the marine environment including increasing water temperatures
- Oregon's economy, like many other states, is likely to be affected by a changing climate and by policies addressing projected changes
- The important drivers of greenhouse gas emissions are population, consumption, and the emission intensity of the economy.

In July 2010, the US Forest Service released the *National Roadmap for Responding to Climate Change* and the accompanying Climate Change Performance Scorecard. These actions were intended to help move USFS forward in responding to climate change, but the work on the vulnerability assessments may be useful for other applications associated with drinking water and climate change.

The purpose of developing vulnerability assessments, through research and management partnerships, includes:

- Assess the vulnerability of species, ecosystems, communities, and infrastructure and identify potential adaptation strategies.
- Assess the impacts of climate change and associated policies on tribes, rural communities, and other resource-dependent communities.
- Collaborate with the U.S. Fish and Wildlife Service and National Marine Fisheries Service to assess the vulnerability of threatened and endangered species and to develop potential adaptation measures.

To support their vulnerability assessments, Region 6 (Pacific Northwest) contracted with the Climate Impacts Group (CIG) at the University of Washington to develop a set of consistent historical and future downscaled climate and hydrologic projections for the western United States. Details on this project and the data produced by the team can be found here: http://www.cascadegis.com/CCVA_Project.html

In 2015, additional climate adaptation work was done as part of a project funded by the National Oceanic and Atmospheric Administration (Weber 2015). The project was developed by NOAA's Oregon Coastal Management Program and included the Oregon Sea Grant and Oregon Department of Land Conservation and Development. The project used the statewide climate impacts and produced strategies for implementation at the county level. The Clatsop and Tillamook County strategies are transferable and can be used in other counties.

For additional tools to address climate change, public water systems should review US EPA's resources (USEPA 2015).

3.0 SURFACE WATER CHARACTERIZATION AND RISKS

This section provides an introduction to the surface water resources in Oregon, an overview of what makes surface water susceptible to contamination, and highlights of important and/or unique surface water issues in Oregon.

Surface water is an essential Oregon resource. By law, all surface and groundwater in Oregon belongs to the public. To protect this valuable resource, the Oregon legislature passed state laws and delegated federal Clean Water Act implementation authorities to prevent surface water contamination, conserve and restore surface water, and maintain the high quality of Oregon's surface water resources for present and future uses. DEQ implements Oregon's surface water protection programs to monitor, assess, protect, and restore the quality of Oregon's water resources. Because the sources of water contamination and consumers of surface water cross all boundaries, DEQ also engages with other state agencies, federal agencies, private and public organizations and individuals to improve and protect surface water quality. The Oregon Water Resources Department (WRD) has significant water quantity authorities related to issuing and regulating water rights, oversight of the demands on the state's water resources, providing water resource data, and facilitating water supply solutions (especially necessary in drought conditions).

Surface water in Oregon has many valuable uses and functions:

- Surface water makes up of the most visible and sensitive of available freshwater resources.
- Surface water uses account for approximately 70 percent of all water used in Oregon.
- Approximately 10% of the Oregon public water systems get their drinking water from surface water, but those include large municipalities such as Portland, Salem, Eugene, Medford, Bend, and others.

- Oregon's businesses require clean water for industries such as food processing, breweries, dairies, manufacturing, and computer chip production.
- Surface water provides irrigation water for Oregon agriculture and water for livestock.

Geologic Framework

The entire Pacific Northwest is a dynamic natural environment. Understanding the geographic setting improves identification of risks and vulnerabilities to a drinking water source. Watershed protection in this geographic setting requires understanding the unique influences of geology, topography, climate and ecology.

Plate tectonics, a subducting ocean plate, volcanoes, and uplift have created (and continue to create) diverse geological conditions in the Oregon Coast Range, the Cascades, Blue, Wallowa, and Klamath Mountains. The Blue, Wallowa, and Klamath Mountains are remnants of historic coastlines and coastal ranges when the majority of the current Oregon land mass was underwater. The Cascade Mountains are primarily of volcanic origin and continue to be tectonically active with volcanoes and earthquakes as major forces that can drastically alter the landscape. Much of Oregon's landscape is covered with thick volcanic basalt deposits from historic eruptions and flood basalt flows.

Topographically, the younger terrain near the coast is mountainous. The Coast Range is the youngest of Oregon's mountains and is primarily interlayered oceanic sediment deposits and lava flows, pushed upward as a result of plate tectonics. This means there are large areas of highly erodible sedimentary rocks, including some of oceanic origin, with sections of harder igneous (volcanic) rocks. There are also large sea floor faults off the coast of Oregon that are active and can cause both earthquakes and tsunamis. Earthquake-driven tsunamis present a risk to coastal drinking water supplies due to the possibility of saltwater surges upstream and physical damage to the infrastructure of community water supplies.

Regional geology can be a factor in climate conditions as well. For example, the topography of the mountains and proximity of the ocean makes for a unique climate on the west side of the Cascade Mountains. Oregon's Coast Range is characterized by a dry summer season with high amounts of precipitation between October and April, including frequent large storms. Yearly average precipitation can regularly exceed 100 inches in many mountainous locations. In contrast, the high desert region of eastern Oregon is characterized by average precipitation of only 8-12 inches per year.

Oregon's geology has a very active and diverse history, and the conditions driving the movement and change continue today. The landscape is shaped by the erosion and sediment movement processes that vary locally due to site-specific rock types and differing degrees of consolidation. Steep slopes are prone to shallow, rapidly-moving landslides, and there are numerous large, deep-seated landslides as well. Understanding the geology and landscape conditions are an important first step in determining the characteristics of watersheds in Oregon.

Surface Water Susceptibility

An understanding of the fundamentals of surface water hydrology is essential for effective protection of waterbodies used for public water supplies. Surface water originates as precipitation (rain, fog, snow) and can move directly into waterbodies as surface runoff, be stored as snowpack and ice, or infiltrate into the soil, from there moving into aquifers and waterbodies. Streams and lakes are connected to groundwater (aquifers) with water moving between groundwater reservoirs and surface waterbodies. Timing, form, and intensity of precipitation affect surface water quantity, quality, and seasonal flow patterns. Peak flows occur during and directly after large storms and snowmelt events (winter and spring). Low flows typically occur at the end of the dry summer season (September or October, depending on when significant rainfall occurs). The basic hydrological structure of soils and stream channels in the region varies with geology, topography, elevation, and precipitation form. Stream channels themselves can be ephemeral (only flowing during and just after storms), intermittent (flowing during much of the year but typically ceasing to flow during parts of the summer), or perennial (flowing year round). Headwaters streams collect into larger channels in hierarchal fashion, with flow volume generally (but not always) increasing in a downstream direction. As water moves across the landscape, surface water is vulnerable to contamination from air- or water-transported pollutants.

Surface drinking water intakes in Oregon draw water from lakes, streams, and rivers. As part of OHA and DEQ's drinking water protection work, the "drinking water source area" for each public water system intake was delineated and mapped. An intake's source area is the area of the catchment upstream of the intake to either the catchment boundaries or the next upstream intake, whichever is closer. **Figure 1** provides a statewide view of the drinking water source areas for Oregon's approximately 2150 public water systems. Figure 1 includes the source areas for 240 intakes that are part of 163 surface water public water systems in Oregon. Many public water systems have more than one intake to serve their water supply needs. Individual maps can be accessed for each Oregon public water system on DEQ's Drinking Water Protection website (ODEQ 2018): http://www.oregon.gov/DEQ/Data-and-Reports/Pages/GIS.aspx

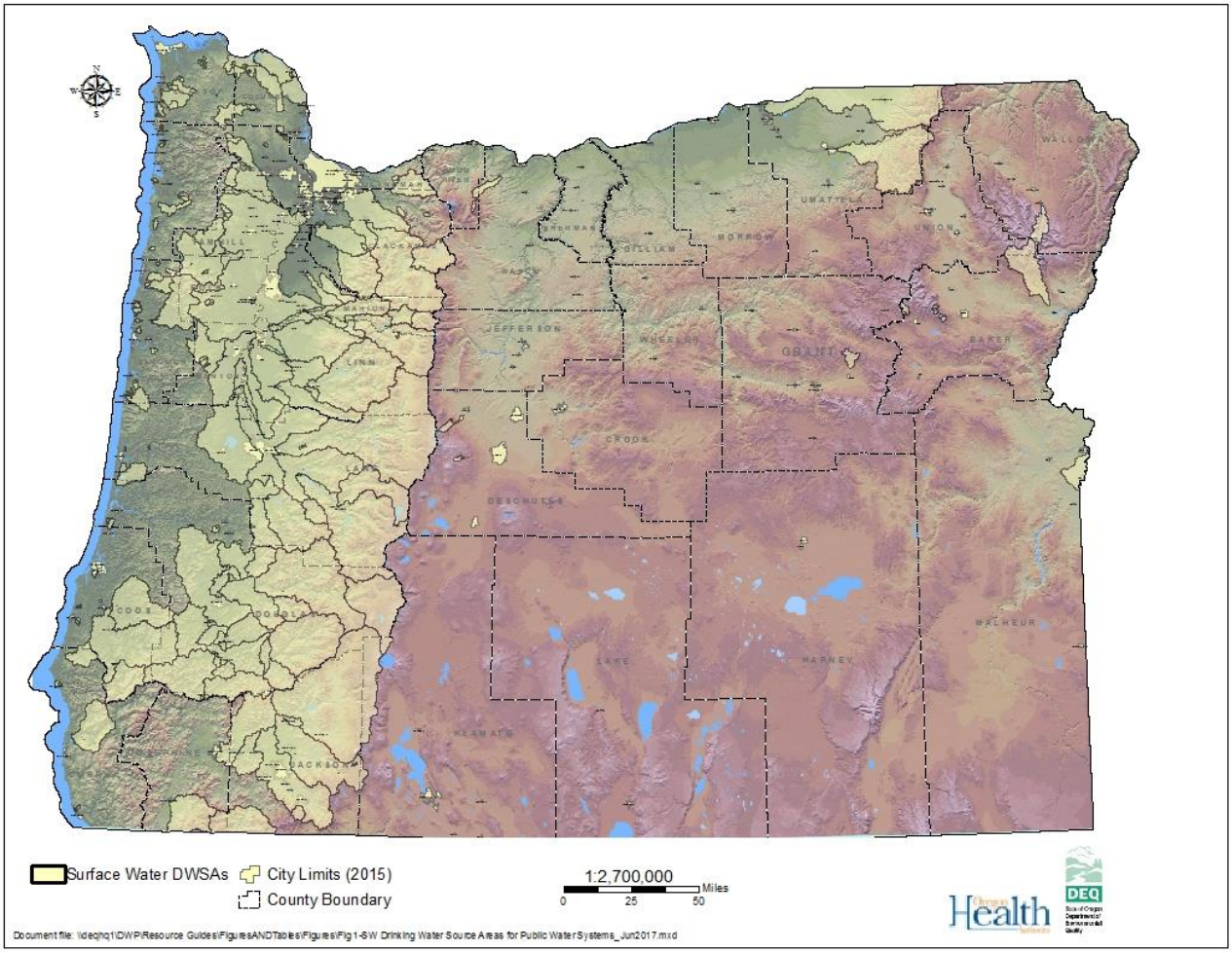


Figure 1. Drinking Water Source Areas for Public Water Systems Using Surface Water

As part of the U.S. Geological Survey National Water-Quality Assessment (NAWQA) Program, the USGS has studies examining the presence and concentrations of nutrients, pesticides, volatile organic compounds, and mercury in the nation's streams, as well as the ecological health of streams and the effects of urbanization on water quality (https://water.usgs.gov/nawqa/). These studies examine the physical, chemical, biological, and anthropogenic factors that create susceptibility to pollution and ecosystem degradation. These studies are national in scale with data from the Pacific Northwest included in the data collection and analysis and give insight into how contaminants can reach drinking water supplies and intakes.

The susceptibility of a drinking water intake to contamination depends on both waterbody and landscape characteristics and the land uses and activities in the vicinity of the waterbody. Natural conditions that may contribute to higher contamination risks include the amount of local precipitation, vegetation density and composition, natural disturbances, erodibility of soils and other geologic factors, ground surface slope/gradient, and other related factors.

Water quality in Oregon can vary due to natural and/or human influences. Fires periodically burn through forests and rangelands (see for example Coast Range history: Long et al 1998). In steep areas, landslides occur and can move large amounts of soil, rock and debris. Windstorms can blow over trees, and flooding periodically affects streamside areas and beyond. Erosion of streambanks and falling vegetation can add sediments and organic matter (biomass) to surface waters. These disturbances, large and small, are important ecological processes, rejuvenating and reorganizing ecosystems, and can at times interfere with beneficial uses of surface waters (Reeves et al 1995, Gomi et al 2005, Reeves et al 2006).

Anthropogenic activities and pollution sources can be a risk to a drinking water intake that serves as a private or public water system source. Surface water is susceptible to contamination from many different land uses and activities. Common potential sources of pollution within drinking water source areas include urban stormwater runoff, municipal and industrial wastewater, gravel quarries and other mining sites, animal management areas (including confined livestock or animal feeding operations), onsite wastewater systems (domestic or industrial), fuel and hazardous material storage/use locations, boat ramps and marinas, agricultural practices, forestry operations, and solid waste handling sites (landfills or transfer stations). As described in more detail below, the Source Water Assessment reports identified a broad range of these "potential contaminant sources" for each drinking water source area.

To summarize, causes of water quality impacts and risks can be roughly divided into natural and human (or anthropogenic) factors. *More specific information on each of these potential water quality impacts can be found in Appendix 2 in this document.*

Natural factors that can affect water quality include:

- Locations of steep slopes prone to shallow, rapidly-moving landslides (>70-85%), depending on geology and landform)
- Locations of earthflows and other deep-seated earth movements
- Eroding streambanks, inner gorges and cliffs, and other erosion-prone, stream-adjacent features
- Recently disturbed uplands and riparian areas (for example, fire or windstorm in the past 10 to 30 years)
- Naturally-occurring mineral deposits such as mercury, nickel, chromium, and arsenic

Human factors affecting water quality include:

- Human activities and facilities within riparian areas
- Road locations and conditions, especially stream crossings, roads near streams, roads on steep slopes, and roads with drainage systems connected to the stream network
- Actively used pastures and/or cropland that have flowing water adjacent
- Stormwater runoff from vulnerable areas (areas with high phosphorus or nitrogen content, for example)
- Recently managed forestland which has been harvested, replanted, treated with herbicides, etc.

- Quarries and associated infrastructure
- Construction sites
- Residential land (rural, suburban, urban) and infrastructure (for example, onsite/septic systems and stormwater discharge pipes)
- Hazardous material sites
- Industrial sites
- Solid waste landfill sites

Some locations on the landscape are more sensitive to disturbances, including:

- Riparian areas
- Springs, seeps and wetlands
- Steep slopes (>70-85%)
- Floodplains
- Areas with highly-erodible soil
- Any areas with disturbed or bare soil
- High water table areas

The costs associated with treating surface water sources can be directly related to raw water quality conditions (Brown 2000, Postel and Thompson 2005, Freeman et al 2008). The natural processes and human and natural disturbances listed above can affect water quality in ways that become problematic for drinking water treatment processes. Increased turbidity (cloudiness) and suspended sediment in source water can clog filters, require more water treatment chemical use, and carry pollutants and pathogenic microorganisms (Meschke and Sobsey 1998, Lick 2008). Dissolved organic matter is a necessary precursor to potentially carcinogenic disinfection byproducts, which are formed when commonly used disinfectants react with dissolved organic carbon compounds. All of these constituents can raise the cost of drinking water treatment, require treatment plant shutdowns, or result in finished drinking water that does not meet Safe Drinking Water Act maximum contaminant levels (MCL) or treatment technique standards. Providing reliable clean and safe drinking water to the public requires both water treatment technology and prevention of pollutants in source water (the "multiple barrier approach"). *Reducing the pollutant loading in source waters can avoid additional treatment costs and improve the reliability of treatment (US EPA 2001a, US EPA 2001b).* Reducing pollutant levels in source water can also reduce the production of harmful disinfection byproducts, which are a result of factors such as high chlorine demand and/or high organic matter content in source waters (Nikolaou et al 1999, US EPA 2002). Protection of watersheds is often more cost-effective than treatment (Gartner et al 2014).

Oregon Public Water Systems

Public water systems in Oregon are regulated by the Oregon Health Authority–Drinking Water Services. In Oregon, public water systems with 4 or more connections or serving more than 10 people for at least 60 days of the year are regulated. There are approximately 3400 public water systems in Oregon. The majority of these use groundwater wells or springs, and 163 of these use surface water from rivers, reservoirs, or *wells that have been determined to be under the direct*

influence of surface water. Surface water serves most of the larger municipalities in Oregon and they have more than one intake on their surface water sources. For the 163 surface water public water systems, there are 240 active intakes serving those systems as of August 2017.

Source Water Assessments

The individual drinking water source areas for public water systems in Oregon were mapped as required in the 1996 amendments to the federal Safe Drinking Water Act (USEPA 1996). These amendments required states to develop "source water assessments" for all public water supply systems. The work was funded through the Safe Drinking Water Act. Between 1999 and 2005, OHA and DEQ teamed up to complete the assessments for 2,656 public water systems (the total number of federally-regulated systems in Oregon at that time). Oregon's source water assessment procedures, including the development of the list of potential risks, were established by a statewide citizen's advisory committee (Feb 1998-June 1999) and approved by US EPA in July 1999.

The assessment reports for each public water system provide community officials with detailed information on the watershed or recharge area that supplies their well, spring, or surface water intake and identify potential risks within the source area. The potential risks to be identified in these reports were defined by EPA and included both point sources and nonpoint sources. A description of each type of land use/activity defined as a potential risk is provided in the assessment for each system, along with individual maps with locational data. The potential risks identified in the assessments were based upon a review of nine agency databases (DEQ, US EPA, State Fire Marshall, etc.) and other data sources (including some field assessments where necessary).

One of the most important aspects of the source water assessment process was determining the "susceptibility" of each system to contamination. Susceptibility in the assessment was defined as the potential for contamination in the source area to reach the public water system intake(s). Whether or not a particular drinking water source becomes contaminated depends on three major factors: 1) the occurrence of a land use/activity that releases contamination, 2) the location of the release, and 3) the hydrologic, ecological, and/or soil characteristics in the source area that allow the transport of the contaminants to the waterbody and thereby the intake. The assessments contained basic maps of susceptible areas within the source area for public water intakes.

The 2000-2005 assessment reports are still available for the public from DEQ and OHA. Reports for surface water sources are available on DEQ's website at:
http://www.deq.state.or.us/wq/dwp/swrpts.asp

Maps and downloadable statewide GIS shapefiles (ODEQ 2018) of drinking water source area data are available on DEQ's drinking water source protection website at:
http://www.oregon.gov/deq/wq/programs/Pages/DWP.aspx

Drinking water source areas, land use/activities, etc. are shown on DEQ's Interactive Map Viewer (IMV): http://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx

The IMV is a location-based system showing DEQ and OHA data and information. The drinking water source areas are also mapped on the Oregon State University–Institute for Natural Resources website, and are also available from the Oregon Geospatial Data Clearinghouse. The information provided within the original assessment reports served as a basis for communities to develop strategies to reduce the risks of pollution in their drinking water sources.

Updated Source Water Assessments

The level of information in databases and GIS mapping has significantly improved since Oregon's original assessments were completed between 2000 and 2005. DEQ and OHA are now able to generate "Updated Source Water Assessments (USWA)". DEQ is working to issue updated assessments for all surface water systems, including new systems, and OHA is updating the groundwater assessments with assistance from DEQ for GIS resources and mapping.

Accurate source area mapping and visual resources to share with the community residents and officials is one of the most important and valuable assets a public water system can have. Since the first source water assessments were completed, DEQ has expanded its GIS capabilities and, more importantly, the range of available data for analyzing potential pollutant sources. Our understanding of potential pollutant sources is improved by development or acquisition of new datasets (such as the hazardous material storage locations, linking water quality assessment results to pollution sources; better roadway and river networks; outfall locations for permitted pollution sources; underground injection control well locations; land use based on photo imagery; permitted sources' front door locations; historic landslide data; harmful algae blooms; confined animal feeding operations; mining activities; and many more). Currently the program has more than 40 GIS datasets to assist public water systems to identify new or previously unknown potential pollutant sources.

In the updated assessment reports, DEQ and OHA provide information to the public water systems on the locations of the potential sources of contamination. The location of each intake has been fixed with a precise GPS latitude and longitude location. The figures include a new regional map view of source area, aerial photo base map with the source area delineated, and maps with anthropogenic land uses, potential sources of pollutants, and historic landslides. Tables are provided that include a summary of the types of potential pollutant risks in their drinking water source area. The susceptibility of a public drinking water system source depends on both the natural conditions in the source area and the human land uses/activities in that area.

The updated assessment reports also include a variety of resources so that effective pollution prevention plans can be developed to prevent or reduce any surface water contamination. Appendices provide information for moving forward to develop and implement source water protection, lists of websites and resources available to public water systems and community members seeking technical assistance for work on watershed protection, and descriptions and contact information for grants and loans to fund both drinking water infrastructure and source

protection projects. Many of those same materials have been expanded with more information and detail in this Resource Guide.

More information on the groundwater USWA reports can be found on the OHA website: http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/SourceWater/Pages/swp.aspx

Surface water USWA reports completed to date can be found on the DEQ website: http://www.oregon.gov/deq/wq/programs/Pages/DWPAssessments.aspx

Using Oregon Data to Identify Priorities

Surface water contamination is a serious issue in some areas of Oregon. Many state and federal agencies have studied the quantity and quality of surface water in specific areas, but there are still significant gaps and data needs to fully characterize Oregon's water resources. This section will summarize some of the best sources of data that help DEQ to determine the priorities for surface water contaminant reduction work in drinking water source areas, based on priority contaminants identified by OHA.

Figure 1 (above) provides a statewide view of the drinking water source areas for Oregon's 163 public water systems using surface water. In terms of total land area, the drinking water source areas for public water system intakes are a significant proportion of the land area in the state west of the Cascade Mountain crest, but occupy a smaller proportion of the part of the state east of the Cascades. These areas are critical for Oregon's communities. Surface water is susceptible to contamination from many different land uses and activities within those source areas. Surface water may be susceptible to organic, inorganic, and pathogenic pollutants from both historical and existing land uses and natural features.

For purposes of providing statewide guidance to public water systems, drinking water protection priorities to focus on could be selected by either:

A) *Calculating the areas of predominant land uses within the public drinking water source areas that have a potential to impact water quality, or*
B) *Compiling monitoring data to determine the most significant contaminant or chemical in surface water at or near public water systems.*

As previously discussed, the source water assessment reports identified the geographical areas of drinking water source areas supplying the public water system intakes. Each assessment provided an inventory of the potential contaminant risks identified at the time of assessment completion. A review of all statewide source water assessment 2005 data within drinking water source areas found over 15,750 potential contaminant risks (in a total of 134 categories). For the public water systems served by surface water, the following were identified as the top 5 categories for higher risks:

- Managed Forests (harvests/pesticides)

  Cutting and yarding of trees may contribute to increased erosion, resulting in turbidity and chemical changes in drinking water supply. Application or improper

handling of pesticides or fertilizers may impact drinking water sources, depending on site conditions and procedures. Areas with a high density of roads can present risks.

- Crops – Irrigated

  Application or improper handling of pesticides or fertilizers may impact drinking water, depending on site conditions and procedures. Excessive irrigation may cause transport of contaminants or sediments to groundwater/surface water through runoff. NOTE: Drip-irrigated crops such as vineyards and some vegetables, are considered to be a low risk.
- Grazing Animals/confined livestock (>5 large /acre)

  Improper storage and management of animal wastes may impact drinking water supply. Concentrated livestock or wild animals may contribute to bacterial contamination, soil erosion, and increased turbidity in surface water bodies.
- Above Ground Tanks

  Spills, leaks, or improper handling of stored materials may impact the drinking water supply.
- Auto Repair

  Spills, leaks, or improper handling of automotive fluids, solvents, and repair materials during transportation, use, storage and disposal may impact the drinking water supply.
- Other significant potential risk categories include:
  - Wastewater Treatment Plants — permitted for discharge upstream of public drinking water intakes (47 locations, including collection stations)
  - Heavy Recreation — at least 6 reservoirs and lakes that serve as community drinking water sources are also used for recreation including human contact.

The assessment inventory results were an important summary of *potential* risks to Oregon public water systems. DEQ used this list as a first step in prioritizing drinking water protection planning and implementation after delivery of the original source water assessments. **Figure 2** is a graphic showing the approximate percentage of the land uses within drinking water source areas for public water systems using surface water.

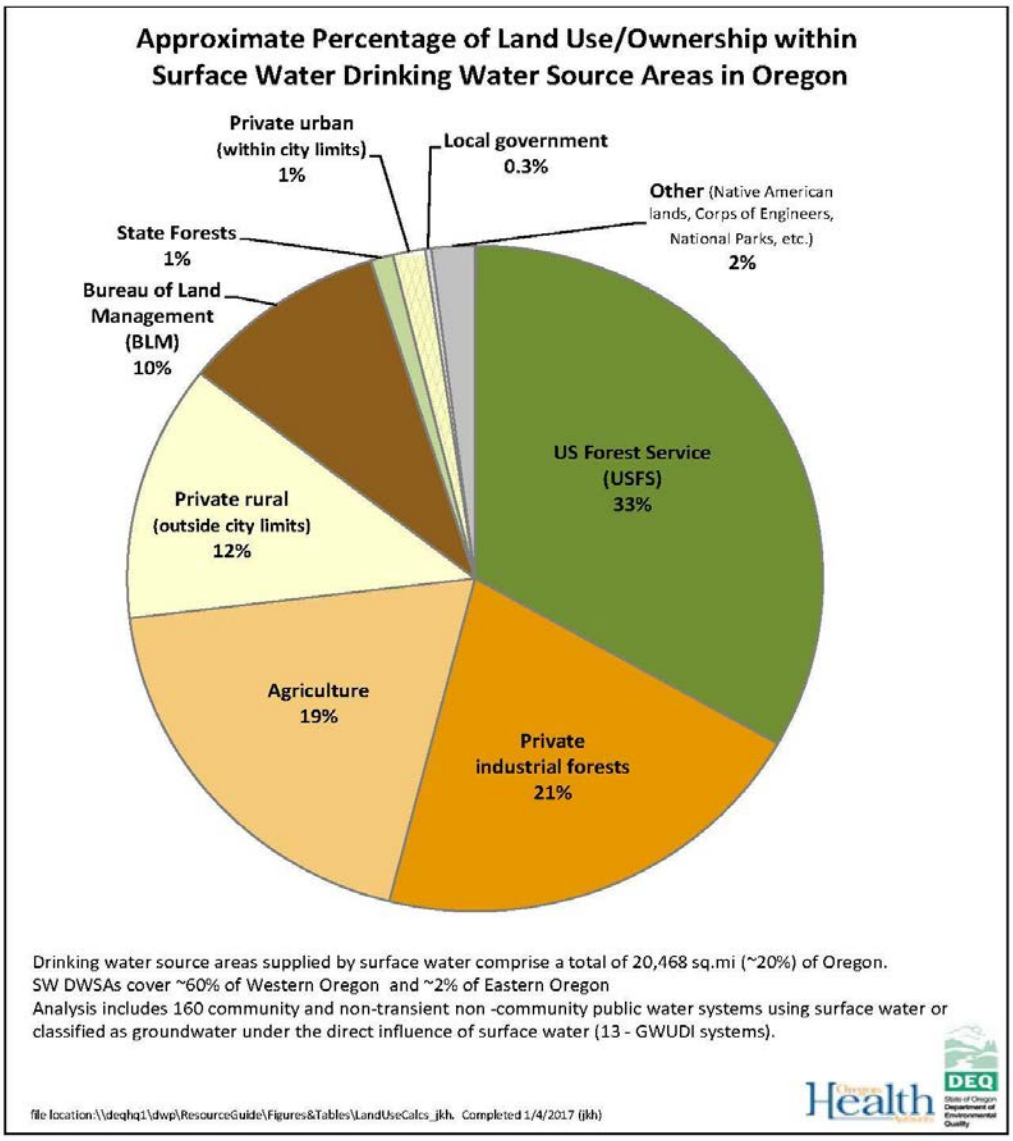


Figure 2. Approximate Percentage of Land Uses within Drinking Water Source Areas for Surface Water

The data on land uses is only approximate due to limitations within the GIS layers. Not all counties have data that is accurate for all types of land uses under statewide planning.
Public water systems in Oregon are subject to Safe Drinking Water Act (SDWA) regulations. OHA implements the SDWA regulations that require public water systems to test their finished or treated drinking water for particular substances before delivery to customers. This required data can be evaluated to determine drinking water priorities using the detections found in surface water systems. OHA does not routinely collect samples of source water prior to treatment. There are some data on surface water quality prior to treatment, but it is limited. The Safe Drinking Water Information System (SDWIS) data for treated surface water is still useful for prioritizing the contaminants since the public water systems must address these in the raw source water. Using

Oregon SDWIS data from 2006 to 2017, the *top contaminant detections in drinking water after treatment include nitrates, fuel constituents, pesticides, phthalates, arsenic, and volatile organic compounds such as tetrachloroethylene. For surface water systems detections of total coliform and detections of disinfection byproducts (TTHM, HAA5 and bromate) exceeding the MCL are also prevalent.* Detections of contaminants in regulatory monitoring are a clear indication that there is an existing pathway of contamination from the ground surface to the waterbody and intake.

Oregon DEQ's Laboratory collects data as part of the statewide monitoring and assessment program for surface and groundwater. The Laboratory monitors a network of 163 ambient water quality sites throughout the state six times a year. These sites represent the diverse land use coverage and geography within Oregon, and include major rivers and streams throughout the state. The ambient network and subsequent water quality index reporting is Oregon's only long-term, systematic, continuously funded statewide river water quality monitoring program. The DEQ began monitoring the oldest sites in the late 1940s and many sites in the network contain data going back more than 30 years, allowing for long-term trending in DEQ's progress toward meeting state water quality objectives. The size of the network periodically changes due to logistical and budgetary constraints. For example, 19 sites were added to the ambient network in 2011 with funding support from the Oregon Department of Agriculture.

The Oregon Water Quality Index (OWQI) is a statistical tool used to analyze a defined set of water quality variables and produce a score describing general water quality for a particular monitoring site. OWQI scores range from 10 (worst case) to 100 (ideal water quality). These scores allow the Oregon DEQ to communicate overall water quality information to the public, agency managers and the Oregon Legislature in an easy-to understand, non-technical manner. See background information and details on the OWQI here: http://www.oregon.gov/deq/FilterDocs/wqmreportingmethodsF.pdf

OWQI results for water years 2007-2016 show 50 percent of sites in excellent or good status, 16 percent in fair and 33 percent in poor or very poor status for the statewide ambient monitoring network of 163 sites. Of the 133 ambient monitoring network sample sites with sufficient data to calculate trends (30 or more scores), 24 percent show improving water quality, while 6 percent have declining water quality. Of the sites with improving trends, 41 percent are categorized as fair to very poor status. This is down from 53 percent last year, which is encouraging as continued upward trends may result in improved water quality status for these sites. On the other hand, three of the eight sites with declining water quality are in good status and should be evaluated further to avoid a decrease in water quality status. The remaining 70 percent of sites have no statistically significant trend.

OWQI monitoring sites with significantly improving water quality index scores in 2016 were spread across the state. Two sites in the Klamath basin had the greatest improvement in water quality, based on the magnitude of the trend, with both sites showing improving trends in the dissolved oxygen, nitrogen and phosphorus sub-indices. Many of the sites with improving water quality are in fair to very poor status (11 out of 32 sites; Table 1), indicating that the largest gains in water quality occurred at sites with the most room for improvement. Statewide, 14 of the 32

sites with improving OWQI scores in 2016 have had improving trends for three or more consecutive years While sites with significantly declining water quality index scores in 2016 are also spread across the state, they are less prevalent. Only one site, in the lower Deschutes Basin, showed a declining trend for three or more consecutive years. The declining trend at this location is ongoing and further investigation should be conducted. Three sites in the Willamette Basin, currently in good status, showed declining trends for the first time. These sites will be monitored to determine any further decline in status.

Trending analysis of the water years 2007-2016 data show a greater proportion of sites with improving trends for phosphorus than any other sub-index variable with 64 percent of the sites with improving trends, followed by temperature with 53 percent of the sites with improving trends (Figure 2). Dissolved oxygen had the greatest percentage of sites with declining trends (19 percent), followed by nitrogen and total solids, both close to 15 percent. With the exception of temperature and phosphorus, most sites showed no significant improving or declining 10-year trends for all other sub-indexes.

More information and data from the most recent OWQI report can be found here: http://www.oregon.gov/deq/FilterDocs/2016DataSumF.pdf

In 2015, Oregon DEQ also published a report describing the results of a 5-year sampling project through the state to survey toxic compounds in Oregon's waters. In 2008, DEQ'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 to assess the presence and concentration of toxic chemicals in Oregon's waters. 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 from the Statewide Water Quality Toxics Assessment:

- 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 [criterion] 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 (see the website for a breakdown)
- Some pesticides of high concern, such as chlorpyrifos, continue to be found in basins where land uses include both urban and rural
- 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 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

The results show basic information about toxic compound detections in Oregon's waters. The Statewide Water Quality Toxics Assessment was part of a larger evaluation of toxic substances in water and products, including a project to examine drinking water sources directly. The frequencies of toxic compound detections across the state serve to illustrate the potential value of a source water protection approach to prevent contamination at the source.
More information about the DEQ program can be found here:
http://www.oregon.gov/deq/wq/Pages/WQ-Monitoring-Statewide.aspx

In a collaborative project with the Oregon Health Authority initiated in 2008, DEQ implemented a Drinking Water Source Monitoring project that conducted water quality testing for chemicals in the *source water for public water intakes*. During the period of 2008 through 2014, Oregon DEQ tested the source waters prior to treatment at 35 surface water intakes. This provided a characterization of the waterbodies supplying public water intakes, as well as information on the influence from the drinking water source areas. The samples were analyzed at the DEQ Laboratory for over 250 Oregon-specific herbicides, insecticides, pharmaceuticals, VOCs (including cleaners), fire retardants, PAHs, personal care products, and plasticizers. The results showed very low concentrations of detected water pollutant impacts from the various land uses and activities in typical source areas. ***Of all surface water sources, 66% had wastewater constituents and 57% of the samples had pesticide detections.*** With the exception of three detections (aluminum), the levels of all parameters detected were very low and met available health standards.

As part of the Drinking Water Source Monitoring project's susceptibility analysis, DEQ also evaluated land uses/activities for source areas of each of the intakes and wells. Project staff conducted further evaluation of potential sources of contaminants on a site-by-site basis for each contaminant detected. These sources are likely from multiple land uses and activities in the watershed or source area for the wells. Since the levels were very low in this initial sampling project, OHA and DEQ will use the data analysis to determine potential associations with sources

and to provide technical assistance to public water systems to reduce concentrations of source water contaminants.

Key findings of the data analysis from the Source Monitoring project:

Potential Sources of Contaminants Identified in the Drinking Water Source Monitoring Project

- **Fecal bacteria (*E. coli*)/Pathogens** are human and animal waste byproducts and are potentially from upstream wastewater discharges, concentrated animal feeding operations, livestock grazing, wildlife, high-density onsite septic systems discharging to shallow groundwater and/or surface water, and heavy recreational uses.
- **Turbidity/Fine Sediment** refers to mineral and organic soil constituents and other particles which cause cloudiness (turbidity) when suspended in water. Fine sediment and turbidity-causing particles enter water from wastewater effluent, leaching of compounds from vegetation, and soil erosion due to natural and/or anthropogenic factors. Natural factors include precipitation, wind, slope gradient, and soil and bedrock type. Anthropogenic factors include agricultural and silvicultural practices, transportation, recreation, and construction.
- **Pesticides** can enter surface water from agricultural fields, forests, urban lawns, gardens, and roadside spraying. Results from this drinking water source monitoring suggest the primary sources are irrigated crops, orchards, and high-density housing. Household lawn applications of pesticides can contribute urban use pesticides to local surface water resources (and can occur at higher concentrations in those areas).
- **Harmful algal blooms** in freshwater are due to drastic population increases of certain algal (cyanobacteria) species. Harmful species produce toxins that can remain in the water even after the death of the organism. These blooms are enabled by slow-moving, warm water and increases in nitrogen and phosphorous concentrations, which may be due to nutrient pollution from onsite septic systems, wastewater treatment facilities, and agriculture.
- **Steroids and hormones** are very likely linked to human waste byproducts in wastewater released through sewage treatment facilities into surface water and through onsite septic systems into groundwater. The most common marker of these byproducts is coprostanol, found in human feces. Some hormones can also come from livestock wastes.
- **Pharmaceuticals** are commonly detected in surface water that is downstream of wastewater treatment facilities or high-density housing using onsite wastewater disposal. It is well documented that drugs are primarily found in human urine and can also come from improper disposal of unused drugs in toilets. Some pharmacueticals (for example, antibiotics) can come from livestock wastes—confined feeding or other operations.

Many of the low-level detections from the Drinking Water Source Monitoring are chemicals in drinking water sources that are not currently regulated. Many volatile organic compounds are regulated, so this is an example of chemicals not tested in this project. Sampling and analyzing for low levels of a broad range of chemicals in waters of the state is important for several reasons:

- Detections become important priorities for prevention because we lack health standards for many of them (e.g. Benotti et al 2009),
- Detections are priorities for prevention because many of the pollutants cannot be removed through standard treatment technologies (Stackelburg et al 2004, Carpenter et al 2008, Glassmeyer et al 2017)
- Additive or synergistic toxicity has not been included in developing MCLs or screening levels for chemicals that are present in finished drinking water (Hayes et al 2006)
- Data are used to prioritize future water quality monitoring,
- Detections provide DEQ and others the ability to prioritize pollutant reduction efforts on activities and land uses that potentially impact water quality.

Oregon DEQ uses monitoring data for both informational and regulatory purposes. Under the Clean Water Act, DEQ is required to assess the condition of waterbodies statewide in comparison to water quality standards using available data of sufficient quality. The Integrated Report ("Section 305(b)" report) evaluates waters of the state as to whether or not they attain the water quality standards which are meant to protect beneficial uses including drinking water. Part of this Report is the list of impaired waters needing Total Maximum Daily Loads (TMDLs) to calculate pollutant load reductions needed to meet standards, commonly known as the Section 303(d) list. The 303(d) list consists of waters listed as Category 5 (impaired and needing a TMDL) in the Integrated Report. Waters which are impaired but not in need of a TMDL (because a TMDL or other restoration plan is in place or because flow issues are causing impairment rather than a pollutant) are listed as Category 4. These waters still require action to bring them into compliance with standards and to fully support beneficial uses such as drinking water.

The most recent Oregon Integrated Report is for the 2012 assessment period. In addition to numerous stream segments in **Category 4 or 5 for fecal bacteria, *E. coli*, turbidity, or sedimentation standards exceedances**, there are several stream segments and waterbodies listed for **impairment of drinking water beneficial uses due to water quality degradation**.

For streams listed on the 303(d) list as Category 5, TMDLs are developed by DEQ and approved by the USEPA. TMDLs are a calculation of the maximum amount of a pollutant that a waterbody can have and still meet water quality standards. This calculation is used to set pollution limits: wasteload allocations and load allocations for point and nonpoint sources, respectively, along with a margin of safety and reserve capacity for future needs. The wasteload allocations are implemented through NPDES permits while load allocations are implemented through Designated Management Agencies such as Oregon Department of Forestry, Oregon Department of Agriculture, and county governments. Meeting TMDL allocations should, over time, result in waterbodies attaining water quality standards and fully supporting beneficial uses such as drinking water and fisheries.

Based on the sets of data presented in this section, DEQ will provide general water quality protection recommendations for all potential contaminants, but will *focus the more detailed recommendations and prevention tools in this Resource Guide on fecal bacteria, erosion (sediment/turbidity/organic carbon), and pesticides*.

Many surface water systems in Oregon have treatment limitations for removal of contaminants*. Filtration and chlorination is not an effective treatment for pesticides and has limits for removal of sediment and organic carbon compounds (which are precursors to disinfection by-products (DBPs); see below). This places even more emphasis in reducing or preventing pollutants in source waters.*

Bacteria Data and Susceptibility

Bacteria are a critical part of digestion processes in animals, and masses of living and dead bacteria are a component of feces. The term "bacteria" in this context refers to fecal bacteria such as *E. coli* or other fecal coliform bacteria from human and/or animal sources. Agencies like DEQ use some of these bacteria species as indicators of contamination of waterbodies by human and/or animal wastes as they are pathogens (disease-causing organisms) or co-occur with pathogenic bacteria, viruses, protozoa, and parasites from wastes. Bacteria sources include wildlife, domestic animals (pets and livestock), septic systems, recreation, and wastewater treatment facilities.

Bacteria can wash into streams and rivers from the land surface or be directly discharged there, causing elevated fecal bacteria levels in surface waters (Cabral 2010). Precipitation runoff can carry improperly handled human, pet, and livestock waste into surface water. Inadequate treatment of wastewater and failing onsite septic systems can release bacteria into waterbodies. Wildlife and grazing animals can defecate directly into surface water. Bacteria may also infiltrate into shallow groundwater from septic systems and animal agriculture operations and thereby be transported with subsurface water into surface waterbodies.

Fecal bacteria such as *E. coli* and other coliforms may or may not themselves be pathogenic. Regardless, they are useful indicators of contamination by human and/or animal waste and potential waste-borne pathogens. Consumption of infected water or food (known as the fecal-oral route of infection) introduces the pathogen into the human body, potentially leading to infection, sickness and disease, or even death. Feces-borne organisms include dangerous viruses (e.g. Hepatitis A virus, noroviruses, and poliovirus), bacteria (e.g. cholera, *Shigella*, and *Campylobacter*), protozoa (e.g. *Giardia*, *Cryptosporidium*, and *Toxoplasma gondii*), and parasites (e.g. tapeworms and hookworms). Depending on pathogen, infected persons can experience diarrhea, cramping, anemia, dehydration, malnutrition, nerve damage, and death. Effective use of prevention (e.g. sanitation and manure management) and treatment (e.g. filtration and disinfection) can prevent fecal-borne diseases.

While every community should ensure they reduce bacterial contamination of drinking water, small and rural communities may need to pay heightened attention due to the higher prevalence of agricultural activities and associated fertilizer (manure) applications, septic systems, and animal wastes. There are several sectors of development that contribute to the transport of bacteria to waterbodies. These sectors include agriculture (e.g. manure application, composting operations, animal waste from livestock) and residential (e.g. septic systems, pets, stormwater, breaks in sewer lines or inadequate treatment of sewage). By increasing the density of humans

and livestock near waterbodies, humans can increase the presence and infectiousness of fecal bacteria in surface waters used for drinking and contact recreation (Cabral 2010). Note that the larger Oregon confined animal operations are under permit that limit discharges to surface water.

Water samples collected from DEQ's laboratory and partners detected bacteria above water quality standards in water bodies throughout the state. In addition, required testing of finished (treated) drinking water sometimes detects bacteria, triggering alerts and violations of Safe Drinking Water Act MCLs. **Figure 3** illustrates a compilation of Oregon bacteria data showing some areas of surface water quality concern for fecal bacteria. This figure includes data from public water systems (alerts and violations in finished drinking water testing from SDWIS) and DEQ's database of streams which are water quality limited due to *E. coli* or fecal bacteria (2012 list of impaired waters (Categories 4 & 5)).

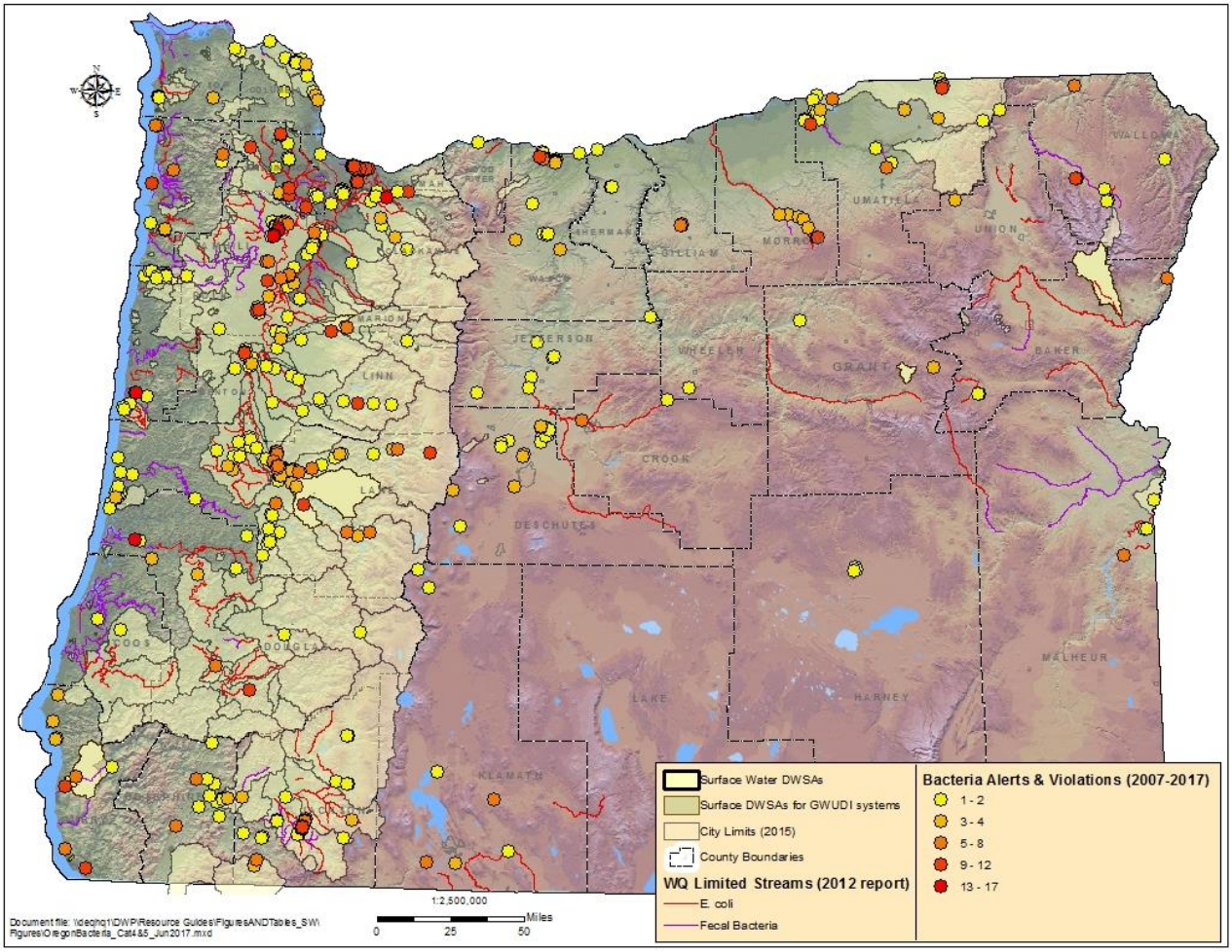


Figure 3. Oregon Data for Bacteria in Surface Water

Turbidity & Disinfection By-Product Data and Susceptibility

Turbidity is a measure of optical scattering by particulate matter and pigments in water. It is a useful measure of particulate matter of mineral and organic origin in water. One reason turbidity is regulated in public drinking water is because it can interfere with effective disinfection treatment to inactivate harmful microorganisms (LeChevallier et al 1981). Particulate matter shields infectious microorganisms from disinfection mechanisms like chlorine, ozone, and UV light. Particulates can also deplete the disinfectant dosage and residual concentration necessary to keep treated water safe. Some organisms (e.g. *Cryptosporidium*) form spores that are resistant to chlorine, so turbidity removal through both source water protection and filtration is important to prevent disease (Betancourt and Rose 2004). Accordingly, most public water systems must practice filtration treatment to remove particulate matter prior to disinfection. (There are a very few water systems with highly protected and unique surface water sources that are able to meet turbidity limits without filtration.)

Turbidity is also a strong indicator of filtration performance. Filtration treatment systems can be highly effective in removing turbidity, and thus microorganisms, but that effectiveness is dependent on a combination of the turbidity levels in the source water, treatment technology, and public water system resources and expertise. High turbidity episodes, such as those from heavy rainfall events, require increased application of coagulant chemicals and result in reduced filter run times and increased backwashing (Postel and Thompson 2005, Freeman et al 2008). High source water turbidity can also result in higher finished water turbidity in spite of treatment adjustments, reducing disinfection effectiveness (LeChevallier et al 1981, Betancourt and Rose 2004). Strategies to manage runoff and sediment production in watersheds and reduce the frequency, magnitude, and duration of high turbidity in water sources used for drinking water can help ensure safe drinking water, especially considering possible future impacts of climate change on storm intensity and frequency (Dalton et al 2013, Abatzoglou et al 2014, Mote et al 2014).

Disinfection is essential to inactivate harmful microorganisms. However, undesirable by-products can form. Disinfection By-Products (DBPs) are regulated in public drinking water systems because of chronic health effects including cancer risk. DBPs are formed in drinking water by reaction of organic matter present in source waters with chlorine- or bromine-based disinfectants, or by oxidation with ozone and subsequent reaction with naturally occurring halide atoms (US EPA 2001a). This organic matter comes from natural materials in the environment such as decaying plants, leaves, organic matter in eroded soil, and other vegetative materials and is measured and reported as total organic carbon (TOC) with the dissolved (and more chemically available) fraction known as DOC. High TOC/DOC may manifest as visible color or turbidity in water, especially in late fall when leaf drop impacts are high and water flows are low, but can also be invisible to the eye. Formation of DBPs is directly related to the quality of the source water and is also influenced by the configuration and operation of public water system infrastructure (US EPA 2001a). Source water quality factors that contribute to DBP formation include TOC/DOC content, pH, temperature, and halide (i.e. chlorine, bromine, iodine) ion

concentration. Infrastructure factors that contribute to DBP formation include chlorine dosage and application point, as well as residence time of treated water in distribution piping and storage tanks. The EPA requires public water systems with high source water TOC/DOC and using filtration treatment to practice enhanced coagulation to reduce TOC/DOC concentrations prior to disinfection. The public health objectives are to prevent acute illness by assuring that disinfection treatment inactivates microorganisms, while also limiting chronic exposure of water users to DBPs by minimizing their formation. Reducing source water TOC and DOC can be one of the strategies to assure safe drinking water.

Human land management activities can disturb watersheds and streamside areas with the potential to alter water quality and aquatic habitat. Farming, forest management, urban and residential development, roads, recreation and other activities can cause erosion, trigger landslides, add organic matter and pollutants, change flows and stream temperature, or alter stream structure. For example, clearcut timber harvesting is known to increase landslide rates on steep slopes and increase streamflows and erosion (Montgomery et al 2000). Narrow riparian buffers are subject to frequent windthrow (toppling of trees by wind), a fraction of which will become a source of fine sediment to the stream (Rashin et al 2006). Roads are a well-known source of fine sediment, petroleum products, and other pollutants (Christensen et al 1997, Trombulak & Frissell 2000). Bank disturbance by development, agricultural practices and grazing animals, and forest harvest can also contribute sediment and organic matter to stream systems, such as slash from forest harvests adjacent to unbuffered headwaters streams (Jackson et al 2001, Kibler et al 2013) or eroded soil, nutrients, or fecal bacteria-containing manure from cropland and grazing (Roni et al 2002, Durán-Zuazo and Rodríguez-Pleguezuelo 2008, Holz et al 2015). Land clearing and construction disturb the soil and create erosion if improperly managed or lacking in riparian protections (see DEQ 1200-C Construction Stormwater General Permit, 2015). Municipal and industrial stormwater can carry sediments, metals, nutrients, and other pollutants into waterbodies (Hughes et al 2014, Kolpin et al 2002). Eroded soil can transport soil-bound pesticides or other toxic substances into waterbodies (Gevao et al 2000, Ambachtsheer et al 2007). Effects of these sources may be apparent immediately or over time and may be only local in effect and/or cumulative across the landscape.

Figure 4 illustrates a compilation of Oregon turbidity, sedimentation, and disinfection by-product data showing some areas of surface water quality concern for turbidity and DBP-forming organic carbon concentrations. This figure includes data from public water systems (OHA 2018: Alerts and Violations in finished drinking water testing for turbidity and DBPs from SDWIS) and DEQ's database of streams which are water quality limited due to turbidity or sedimentation (2012 list of impaired waters (Categories 4 & 5)).

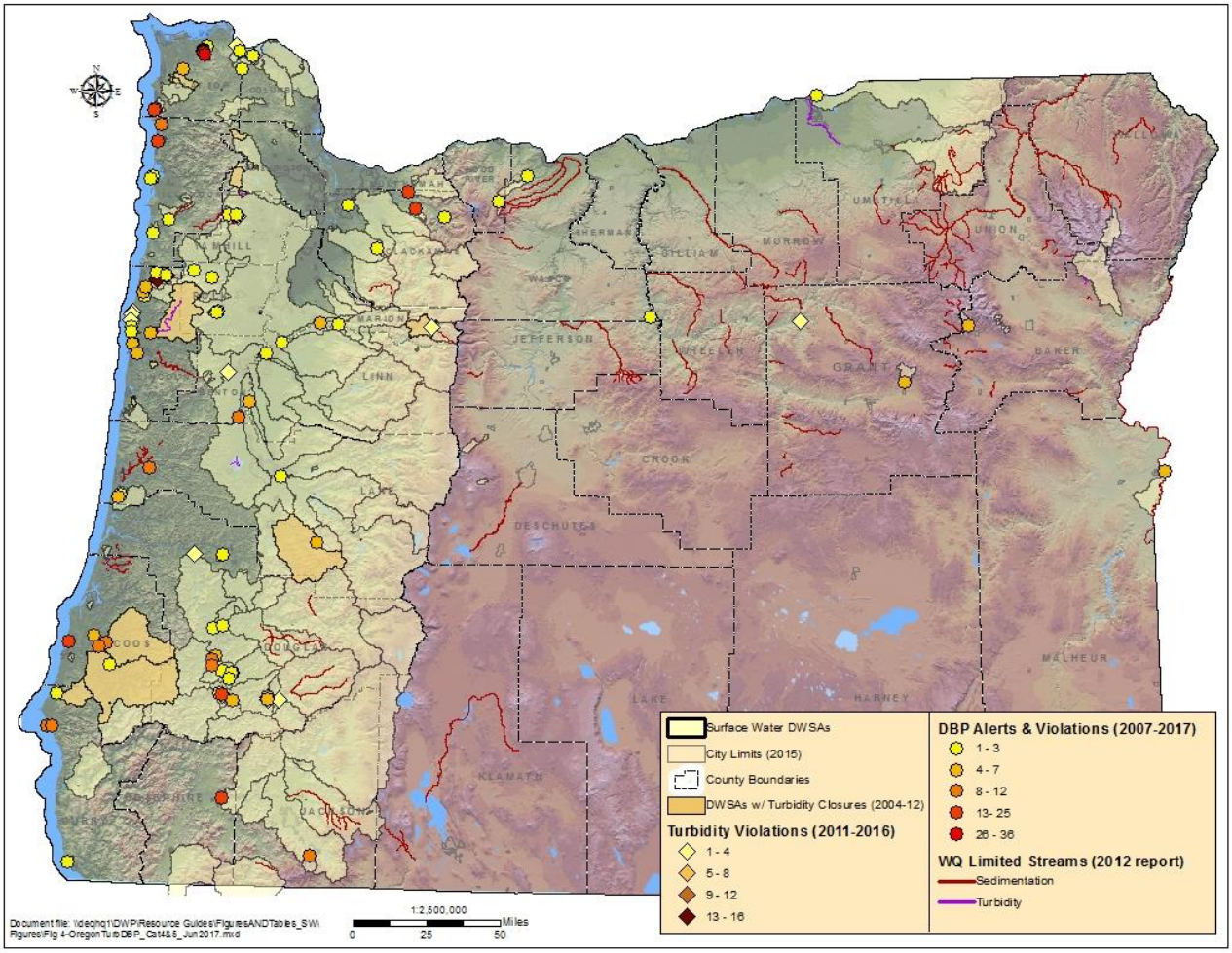


Figure 4. Oregon Data for Turbidity & Disinfection By-Products in Surface Water

For public water systems, DEQ consulted a variety of sources of information and technical data to find tools to identify areas that may be susceptible to streamside erosion. Determining the relative susceptibility to erosion within a drinking water source area will allow a public water system to focus technical assistance and resources on the highest priority sections of the drinking water source area. Three types of data from the USDA National Soil Information System (NASIS) are highlighted in this guide as potential tools for predicting relative susceptibilities to streamside erosion:

1) K_f-factor ≥0.25 (soil erodibility, rock-free) for slopes >30 %,
2) Erosion Hazard Ratings—Off-Road/Off-Trail (Slight, Moderate, Severe, or Very Severe),
3) Oregon Department of Agriculture's (ODA) Erosion Vulnerability Index.

Figures 5-7 illustrate the statewide data for each of these tools that can be used for predicting erosion susceptibilities near waterbodies used for drinking water.

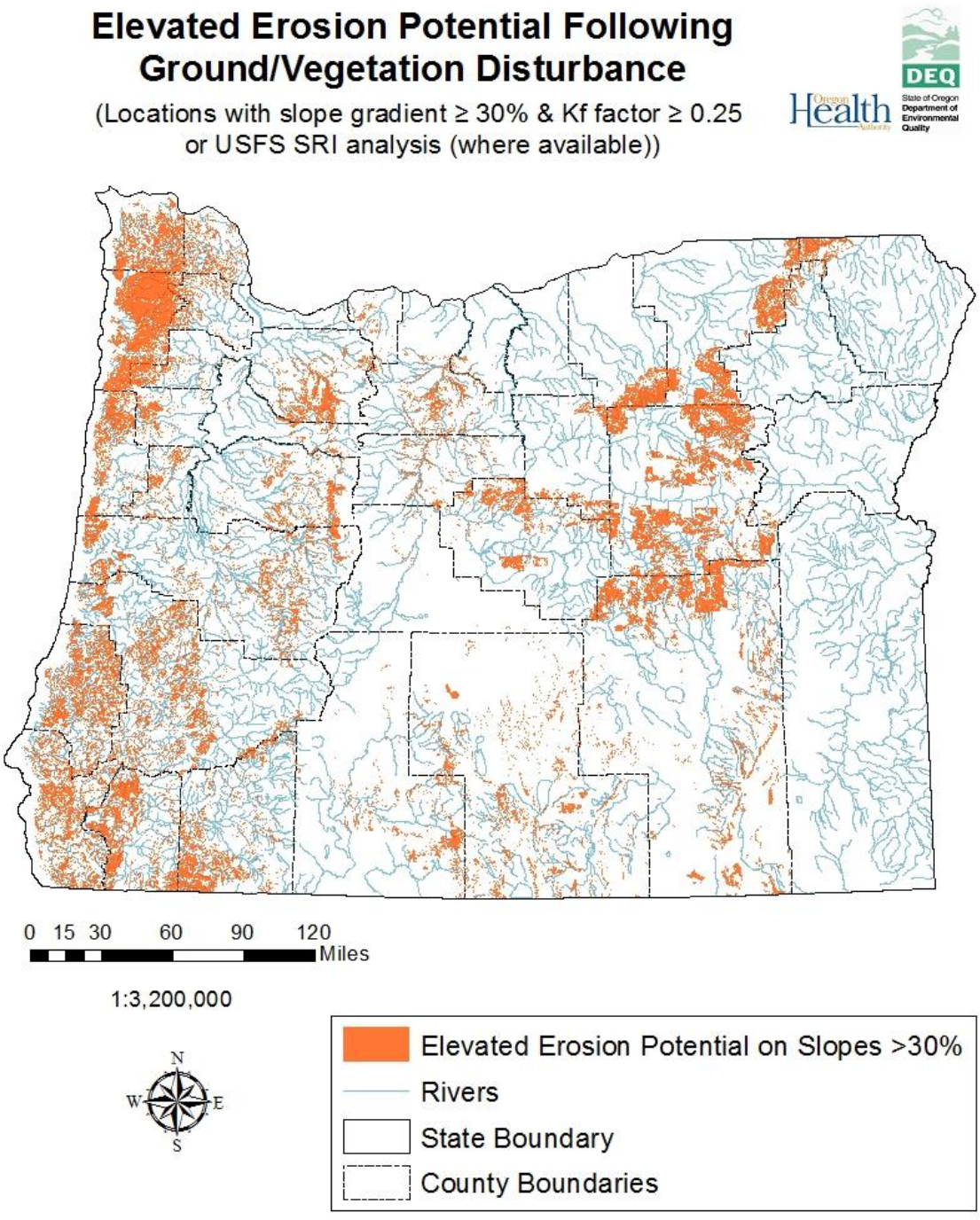


Figure 5. Predicted Susceptibility to Erosion from Moderate Ground Disturbance

The data shown in Figure 5 are an evaluation of the erosion susceptibility of bare and moderately-to-severely disturbed soils on moderate-to-steep slopes using the K_f-factor (rock-free

soil erodibility) from the Revised Universal Soil Loss Equation (RUSLE), which is used to predict erosion losses on agricultural and other managed lands where practices result in disrupted soil structure and loss of plant cover. This evaluation is focused on steeper landforms (>30% slope) and is a 2007 update of a method for identifying sensitive areas used in the original Source Water Assessments.

The data shown in Figure 6 are an evaluation by NRCS of the surface erosion hazard for non-road/trail soil disturbances where up to 75% of the soil surface is bare. The erosion hazard ratings are based upon inherent soil properties (K_w-factor (whole soil erodibility) and slope) and reflect management disturbances such as uncontrolled grazing, forestry, heavy equipment use, fire control, and mining. Gully erosion, plowing or other disturbances that "disturb up to nearly 100 percent of the area and change the character of the soil", and Histosol soils are not adequately characterized by this method and effects will be underestimated. This method does evaluate mobilization potential of soil through sheet and rill erosion, but does not evaluate delivery to surface waters. In the Updated Source Water Assessments, DEQ mapped only those locations where risk is Moderate or higher AND that are within 300 feet of surface water in order to estimate those places where delivery to water is possible.
According to NRCS, the ratings are:

Slight—Erosion is unlikely under ordinary climatic conditions.
Moderate—Some erosion is likely; control measures may be needed.
Severe—Erosion is very likely; control measures for vegetation re-establishment on bare areas and structural measures are advised.
Very Severe—Significant erosion is expected; loss of soil productivity and off-site damages are likely; control measures are costly and generally impractical.

The data from ODA's Erosion Vulnerability Index are shown in Figure 7, calculated statewide in 2001 utilizing the K_w-, R-, and LS-factors from NRCS's RUSLE with the C- and P-factors set at a value of 1. [These factors are whole soil erodibility, rainfall erosivity, length and gradient of slope, soil cover, and conservation practice factors, respectively.] Setting C and P to "1" illustrates a worst-case scenario where soil is uncovered and exposed directly to precipitation forces and where no conservation practices are in place. Therefore, this index reflects erosion risk from severe agricultural disturbance without mitigating measures in place. It does not evaluate delivery to surface waters. In Source Water Assessments, DEQ maps only those locations where RUSLE values are >5 AND that are within 300 feet of surface water in order to estimate those places where delivery to water is possible.

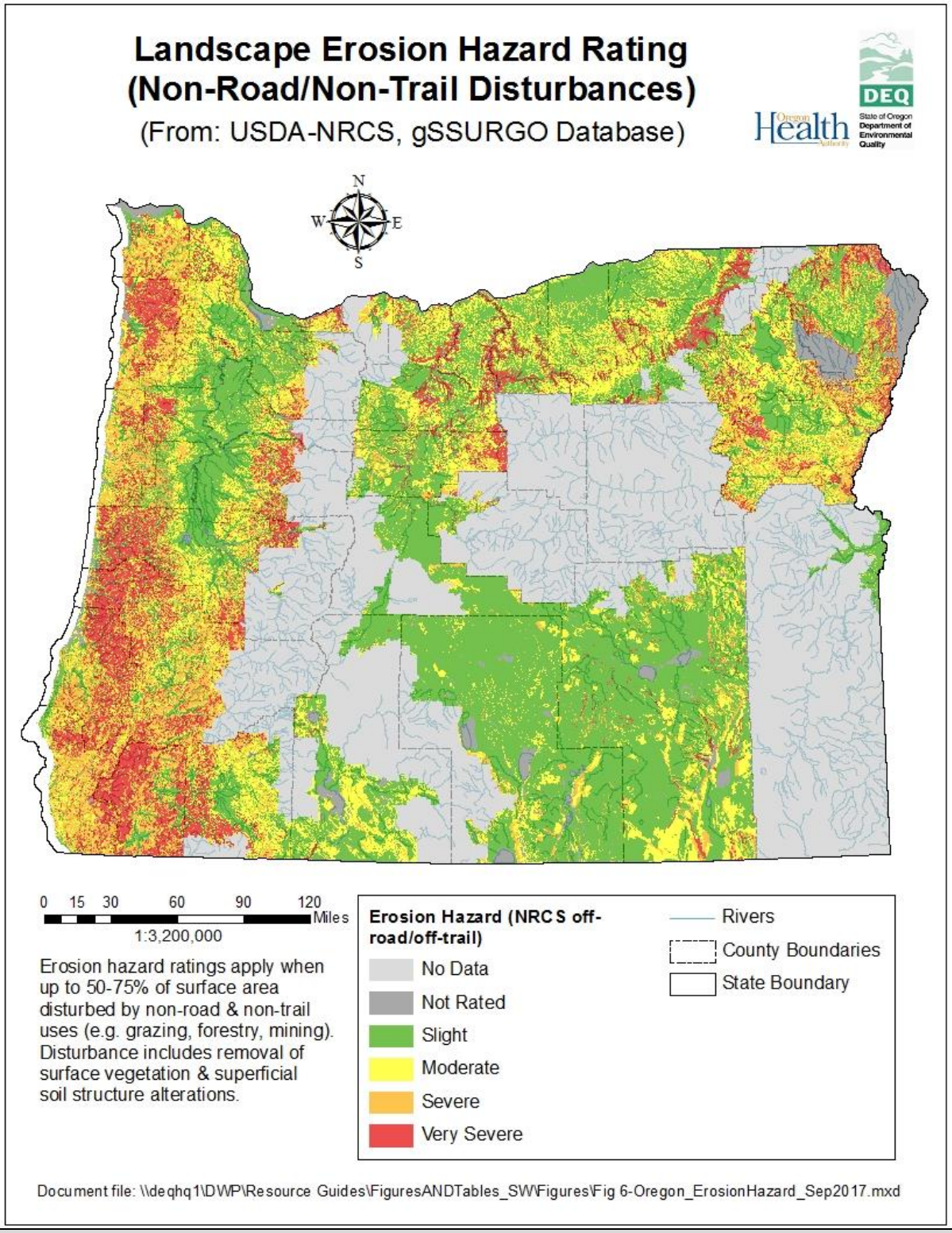


Figure 6. NRCS Erosion Hazard Ratings –Off-Road, Off-Trail

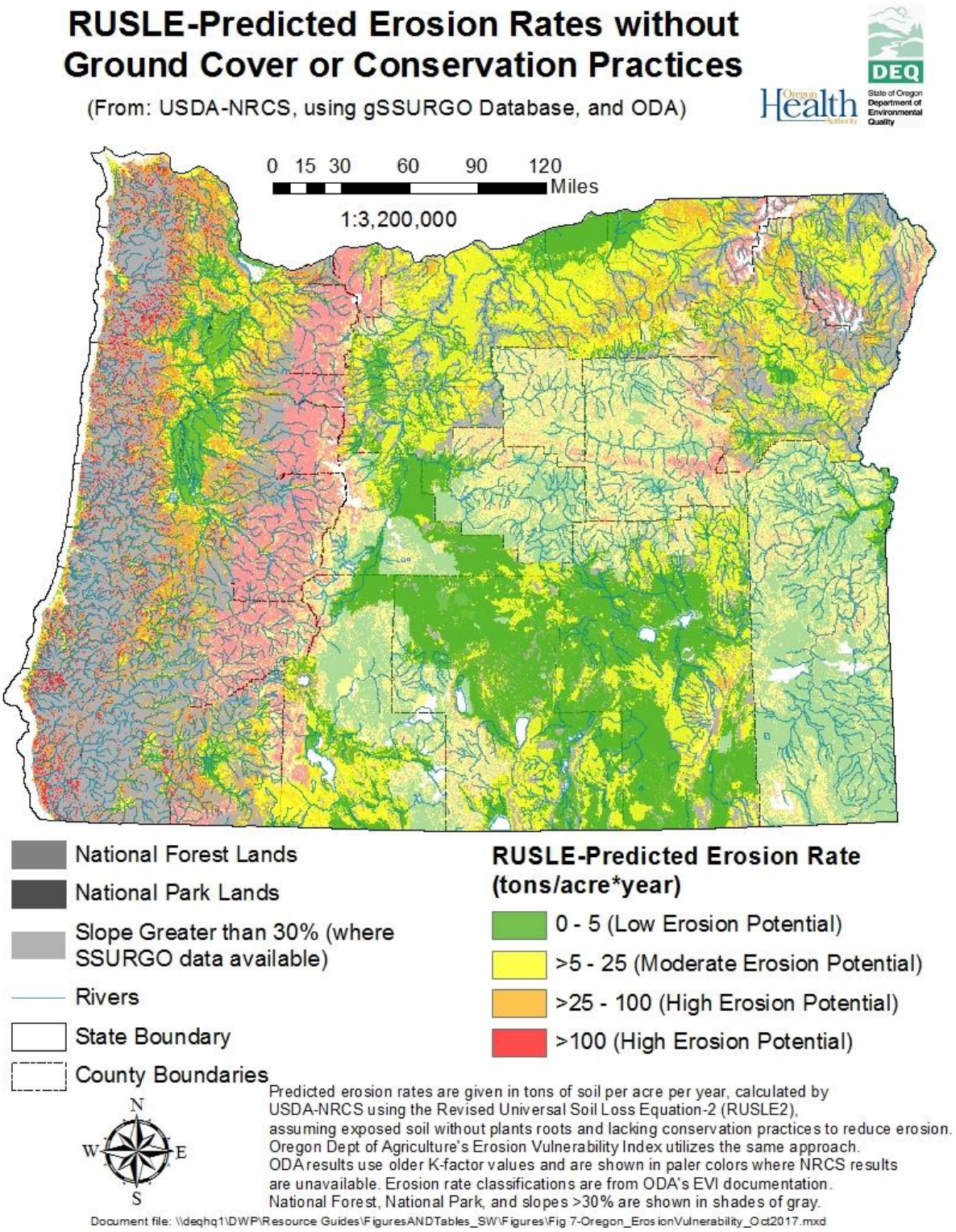


Figure 7. Statewide Erosion Vulnerability Index Ratings

Soil erosion and stormwater runoff and any resulting water pollution vary greatly among sites and management approaches. The development and implementation of strategic actions to reduce sediment and organic carbon pollution will likely require research and mapping of the site-specific susceptibility within each drinking water source area.

When using these site-specific soil maps, it is important to keep in mind that interpretations and planning of conservation practices based upon these maps should be done through the involvement of a partner organization that specializes in natural resource conservation. The organizations that can most likely assist with creating and using site-specific nitrate susceptibility maps include the local Soil and Water Conservation Districts, Watershed Councils, NRCS districts, the OSU Extension Service, or others. For a list of local county-level resources, see Partner Organizations in Section 4.0.

Pesticide Data and Susceptibility

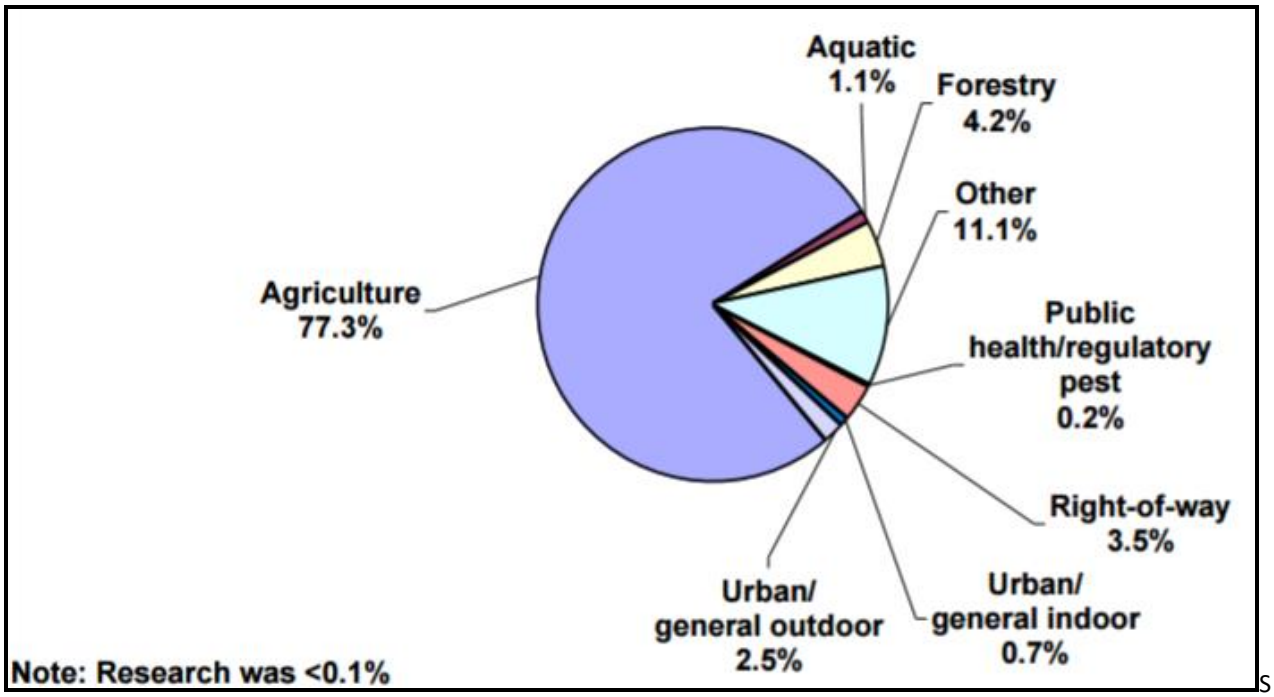
Pesticide contamination of surface water is a subject of national importance because surface water is used for drinking water by about 50 percent of the U.S. population. This especially concerns people living in the agricultural areas where pesticides are most often used, as about 95 percent of that population relies upon groundwater for drinking water, or in small communities using surface water with limited treatment capacity. Pesticides can reach surface waterbodies from applications to crops, drift and revolatilization movement by air, precipitation runoff and shallow groundwater transport, accidental spills and leaks, and improper disposal. The National Water-Quality Assessment (NAWQA) Program of the US Geological Survey provides the most comprehensive national-scale analysis to date of pesticide occurrence and concentrations in streams and ground water: https://water.usgs.gov/nawqa/pnsp/. The USGS's WARP tool (Watershed Regressions for Pesticides Models) can provide estimates of pesticide occurrence to help target monitoring resources (Stone et al 2013).

Through the Pesticide Stewardship Partnership program, the state currently monitors 64 surface water locations throughout the state for approximately 140 current and historically-used pesticides. This monitoring occurs in agriculture, forestry, industrial, and urban watersheds. For more information on the PSP program, see "Pesticide Regulations" below in Section 7.0 Land Uses and Regulatory Authorities.

The use of pesticides is prevalent in agricultural activities but also exists in municipalities, rural and urban properties, transportation rights-of-way, parks, forestlands, powerline corridors, golf courses, and other land uses. Pesticides can sometimes be transported by water and air from the area of application to off-site locations, where they may impact beneficial uses such as drinking water (see summary of DEQ toxic substance monitoring summary above). A summary paper of USGS pesticide sampling results showed that pesticides occur in streams and rivers in the U.S. frequently (>95% of samples; Stone et al 2014). Trends in exceedances of aquatic life criteria/benchmarks held relatively steady for agriculture and mixed use streams (61% and 46%, respectively for 1992-2001 and 2002-2011 time periods) but increased in urban streams (from 53% for 1992-2001 to 90% for 2002-2011), primarily due to use of recently registered

insecticides. Exceedance of human health benchmarks was rare. Changes in occurrence of particular pesticides appeared related to changes in pesticide regulations such as registration (allowed legal uses) of new compounds and loss of registration for some pesticides. Changes in pesticide uses can also be due to market-based decisions related to public demand, acceptance, and perception. For example, an increased awareness of neonics affecting bees has resulted in public pressure to switch back to chlorpyrifos (more toxic) as the most effective insecticide.

Oregon is the national agricultural leader in the production of hazelnuts, blackberries, Christmas trees, peppermint, orchard grass seed, and other seeds. Oregon exports $2.6 billion in raw agriculture products internationally (USDA Economic Research Service- 2013 data). Oregon's success as a leading agricultural producer may be partly due to the use of modern chemicals (pesticides) to control the insects, weeds, and other organisms that attack food and ornamental crops. Of the multiple land uses/activities that use pesticides in Oregon, agriculture ranks at the top of all of those for pesticide use. Oregon Department of Agriculture has an extensive program that works to prevent off-site movement of pesticides applied to agricultural operations (see Section 6.0 below). **Figure 8** provides the most recent pesticide use reporting data for Oregon by land use/activity. While these data are almost ten years old, we would expect that the breakdown would be similar today if the data were collected and made available.



Source: Pesticide Use Reporting System: 2008 Annual Report. Oregon Department of Agriculture. June 2009. (http://www.oregon.gov/ODA/programs/Pesticides/Pages/AboutPesticides.aspx, December 2016)

Figure 8. Percentage of Pesticide Active Ingredient by Land Use/Activity in Oregon

The effects of past and present land-use practices and pesticide applications may take decades to become apparent in groundwater, but any contamination of surface water is more immediate.

When weighing pollutant reduction strategies for protection of surface water quality, it is important to consider the means of transport and the effects of weather during and after application of pesticides (and any other chemicals) to the land and subsequent off-target movement of the chemicals into a waterbody. Movement can be immediate (drift) or delayed (runoff mobilization or revolatilization). There is also a time lag before arrival in groundwater which generally decreases with increasing aquifer permeability and with decreasing depth to water. In response to reductions in chemical applications to the land and/or use of practices which reduce off-target movement, the quality of surface water will improve relatively rapidly, excepting cases where contaminated groundwater is a major source.

Natural land conditions and land-management practices can affect pesticide distribution. Pesticide concentrations in surface water vary by season, with lengthy periods of low concentrations punctuated by seasonal pulses of much higher concentrations. Concentrations are sensitive to application amount and timing and seasonal wind movement, precipitation, and hydrology variations. Surface water is most vulnerable to contamination in areas with high stream densities, erodible and/or permeable soil (depending on pesticide characteristics), and frequent or intense precipitation. Applications near to waterbodies and/or with air currents moving towards waterbodies are more susceptible to off-target movement into water. Hot, dry conditions can cause some pesticides to revolatilize and then drift on air currents, even after successful deposition during application. The entire atmospheric-hydrologic system and its complexities need to be considered in evaluating the potential for pesticide contamination of waterbodies, as well as characteristics of pesticide formulations themselves. For example, some pesticides (e.g. atrazine and imazapyr) are more water soluble and move with water movement; others (e.g. glyphosate isopropylamine salt and permethrin) bind tightly to soil and organic matter and are more likely to move along with eroded soil (see National Pesticide Information Center database at http://npic.orst.edu/NPRO/). Seasonal patterns in pesticide concentrations are important to consider in managing the quality of drinking water withdrawn from surface water in agricultural, forestry, and urban settings (e.g. the first large storms after application can move pesticides into water bodies while later storms have less effect; NCASI 2013). Substantive cooperative efforts have been made in Oregon to reduce pesticide movement into waterbodies (see Pesticide Stewardship Partnership information in Section 7.0).

Understanding the correlations of pesticide occurrence with the amounts and characteristics of pesticides used can help land managers to anticipate and prioritize the pesticides most likely to affect water quality in different land-use settings. **Table 1** lists some of the pesticide transport factors and surface water vulnerability factors that make portions of the drinking water source area susceptible to pesticide impacts.

Pesticide Transport Factors					Water Vulnerability Factors	
Pesticide Parameters	**Soil Parameters**	**Crop Parameters**	**Climatological Parameters**	**Management Parameters**	**Site Transport Characteristics**	**WARP Watershed Characteristics**
Organic carbon-normalized sorption coefficient (K_{oc})	Dispersion coefficient	Root density distribution	Rainfall or irrigation rates	Pesticide application rate and timing	Surface/near-surface runoff	Rainfall Erosivity (R-factor from USLE)
Distribution coefficient (K_d)	Saturated water content	Maximum rooting depth	Pan evaporation rates	Pesticide application method and formulation	Soil erosion & transport - Wind & water	% of streamflow from saturation (Dunne) overland flow
Aqueous solubility	Field-capacity water content (θ_{FC})	Pesticide uptake rates	Daily maximum and minimum temperature	Crop production-system variables	Surface water proximity to application	Total precipitation in May & June (spring application period)
Henry's constant	Wilting-point water content		Snow melt	Soil-management variables	Vegetative cover/ disturbance	% of soils with restrictive layer w/in top 25cm
Saturated vapor density	Hydraulic properties		Hours of sunlight			
Gas phase diffusion coefficient	Bulk density (ρ_b)				Wind speed / direction	
Biological half-life	Organic carbon content (f_{oc})				Depletion of residues by previous storms	
Hydrolysis half-life	pH					
Oxidation half-life	Cation exchange capacity					
Foliar decay rate	Heat flow parameters					

Sources: ***Pesticide Transport Factors*** *adapted from the National Research Council (U.S.) Committee on Techniques for Assessing Ground Water Vulnerability. (1993). Ground water vulnerability assessment: Contamination potential under conditions of uncertainty. National Academy Press, Washington, D.C.* ***Water Vulnerability Factors: Site Transport Characteristics*** *from NRC Committee on Long-Range Soil and Water Conservation Policy. (1993). Soil and Water Quality: An Agenda for Agriculture, Chapter 8: Fate and Transport of Pesticides. National Academy Press, Washington, D.C.; Holvoet et al 2007; NCASI 2013; and National Association of State Departments of Agriculture. (2014). National Pesticide Applicator Certification Core Manual, 2nd edition. Arlington, VA.* ***Water Vulnerability Factors: Watershed Characteristics*** *"Watershed Regressions for Pesticides" model from Stone et al 2013.*

Table 1. Factors Influencing Pesticide Transport and Surface Water Vulnerability

Section 6.0 will provide several tools that may be useful for reducing off-site migration of pesticides, with the goal of reducing any potential impact to drinking water supplies.

Only a limited number of pesticides have a Safe Drinking Water Act "maximum contaminant level" for drinking water set by the U.S. EPA. Additive or synergistic toxicity has not been included in the development of these drinking water standards. There are currently a number of studies examining whether (or how) low levels of chemical mixtures in the environment may be combining to contribute to environmental carcinogenesis; that is, the cumulative effects of several individual chemicals may act on cancer pathways to synergistically produce carcinogenic effects at low exposure levels (Alavanja and Bonner 2005, Goodson et al 2015). Regarding the issue of chemical mixtures, US EPA states that although guidelines and detailed procedures for evaluating potential effects from exposure to chemical mixtures have been provided by US EPA

and other agencies, such as the Agency for Toxic Substances and Disease Registry (ATSDR), implementation has been difficult because of the complexity of mixtures that occur in the environment and the inadequacy of data on the toxicity of the mixtures. Most toxicological testing is performed on single chemicals—usually at high exposure levels—whereas most human and ecological exposures are to chemical mixtures at relatively low doses…" See:
https://www.epa.gov/pesticides
http://www.safewater.org/fact-sheets-1/2017/1/23/pesticides

Most drinking water treatment systems also do not effectively remove pesticides and other artificial compounds effectively, and even with technology such as granulated activate charcoal, removal is incomplete (Blomquist and Janet 2001, Carpenter et al 2008). This is the basis for why environmental health professionals tend to be cautious about the presence of pesticides in drinking water.

More information on the drinking water standards/benchmarks, and how Oregon regulates pesticides can be found in Section 7.0 under Pesticide Regulations.

Water Treatment Technologies

In addition to the watershed and water quality characteristics, the types of drinking water treatment technologies employed can be summarized for Oregon's 163 surface water public water systems. Only one public water system –Reedsport-- has a regulatory filtration treatment exemption and does not filter the raw water (disinfection only). Oregon Health Authority recently revoked Portland's exemption after repeated detections of *Cryptosporidium*. All other surface water systems in the state employ filtration treatment. Treatment systems used by the public water systems are varied and are summarized as follows, as of February 2011 (OHA *pers comm*):

Filtration Type	No. PWSs	Population Served
Conventional	65	1,152,980
Direct	40	350,296
Pressure/Rapid Sand	12	3,252
Membrane	23	236,960
Slow Sand	28	311,812
Cartridge	57	11,196
Diatomaceous Earth	3	1,700

Drinking water treatment is usually a combination of physical and chemical processes (see USEPA 1999, WADOH 2009). Mechanical straining removes some particles in raw water by trapping them between the grains of the filter medium (such as sand). Sand filters can also remove pathogens by abrasion. Coagulation (and flocculation) is a process by which suspended particles form a larger "floc" particle that allows for removal by sedimentation and/or filtration. This can also remove dissolved and organic carbon compounds. Other types of filtration processes can be used without coagulation, and include membrane and cartridge filtration, as well as diatomaceous earth, while biological processes predominate in slow sand filters. Filters are

periodically cleaned by backwashing (reversing the flow of water through the filter). Anthracite coal or activated carbon may also be included in addition to sand to improve the filtration process, especially for the removal of organic contaminants and taste and odor problems. Smaller communities with fewer resources typically have treatment that is less able to manage extensive chemical contamination, tastes and odors, and/or high turbidity, according to OHA.

In rapid sand filtration, the water is filtered through a bed of graded sand. Pressure filters are similar to rapid sand filters, except that the water enters the filter under pressure. Cartridge filtration uses a physical process—straining water through porous media. Cartridge filters are typically used for removing microbes and turbidity in small systems. The cartridge consists of ceramic or polypropylene filter elements fitted into pressurized housings. Cartridge filters cannot be cleaned by backwashing.

Slow sand filtration occurs at a much slower rate. Removal of particles and pathogens is predominantly dependent on biological processes. These filters form a filter skin or "schmutzdecke" containing microorganisms that trap and break down algae, bacteria, and other organic matter before the water reaches the filter medium itself, where contaminant removal includes biochemical and physical mechanisms. The filter consists of a bed of fine sand of approximately 3 to 4 feet deep supported by a 1-foot layer of gravel and an underdrain system.

Membrane systems utilize material capable of separating substances, depending upon the pore size of the material, when a driving force is applied across the membrane. Membrane filtration is effective for removal of microorganisms, particulate material, and some natural organic material that can impart taste and odor problems in drinking water. Membrane systems often employ coagulation to address disinfection by-product precursors like soluble total organic carbon that can more readily pass through micro and ultra-filtration systems.

Treatment systems have contaminant removal limits. As described, different system types have varying limitations for removal of solids and dissolved substances. Removal of pesticides, human waste products, petroleum and chemical contaminants, and so on is incomplete in most common treatment types, and expensive to treat with additional technology. Exceedances of capacities lead to exceedances of MCLs or shutdowns of water systems until conditions improve. Slow- and rapid-sand filters, for instance, have relatively low raw water turbidity upper limits (<5-10 NTU) for operation (WADOH 2009). Smaller systems in particular frequently rely on technologies which are more sensitive to declines in raw water quality (approximately 75% of Oregon surface water PWSs serve populations of 3,300 or fewer persons). For this reason, source water protection is the first barrier, and an important one for many contaminants. Prevention is often more effective and economically efficient than enhancing treatment facilities to remove contaminants after the fact.

4.0 PARTNERS, RESOURCES, AND FUNDS

Communities of sufficient size, resources, and other means may be able to develop drinking water source protection plans for their surface water source without the use of the tools provided in this Resource Guide. Many communities that fit this description have already taken steps to develop and utilize screening tools, resources, and strategies for reducing potential risks to their drinking water. For smaller communities, partner organizations may be able to assist with drinking water protection efforts that cannot be performed with existing staff and resources.

The tools provided in this Resource Guide are intended to be used by public water system staff/managers (where possible), and community leaders with assistance received from their regional or county partner organization. A partner organization for community-led drinking water protection efforts can be the local Soil and Water Conservation District (SWCD), Watershed Council, the University Extension Service staff (OSU), the US Department of Agriculture -Natural Resources Conservation Service district, and/or a contracted natural resources consultant. *Early involvement of a partner organization is critical in order to ensure that screening tools are accessible, used properly, and are effective.* Developing a strategic protection plan may require grant writing and additional funding when significant collaboration work is necessary.

This section provides brief descriptions and contact information for resources available to public water systems----including county contacts, more information on agency programs, grants, and loans to fund drinking water infrastructure and source protection projects.

TECHNICAL ASSISTANCE - PARTNER ORGANIZATIONS BY COUNTY

Baker County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
3990 Midway Lane Baker City, OR 97814-1453 (541) 523-4430	3990 Midway Lane Baker City, OR 97814 (541) 523-7121	2600 East Street Baker City, OR 97814 (541) 523-6418	2960 Broadway St Baker City, OR 97814 (541) 523-7288

Benton County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
456 SW Monroe Avenue, Suite 110 Corvallis, OR 97333-4400 (541) 753-7208	3415 NE Granger Avenue Corvallis, OR 97330-9620 (541) 757-4825	4077 SW Research Way Corvallis, OR 97333 541-766-6750	101 SW Western Blvd #105 Corvallis, OR 97339 (541) 758-7597

Clackamas County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
221 Molalla Avenue Street, Suite 102 OR City, OR 97045 (503) 210-6000	221 Molalla Avenue Street, Suite 120 OR City, OR 97045 (503) 655-3144	200 Warner Milne Rd OR City, OR 97045 503-655-8631	PO Box 927 OR City, OR 97045 (503) 427-0439

Clatsop County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
750 Commercial Street Room 207 Astoria, OR 97103 (503) 325-4571	750 Commercial Street, Room 207 Astoria, OR 97103 (503) 325-4571	2001 Marine Drive, Room 210 Astoria, OR 97103 (503) 325-8573	42 7th Street, Suite 102 C Astoria, OR 97103 503-468-0408

Columbia County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
35285 Millard Road St. Helens, OR 97051 (503) 397-4555	35285 Millard Road St. Helens, OR 97051 (503) 397-4555	505 N. Columbia River Hwy St. Helens, OR 97051 503-397-3462	57420-2 Old Portland Rd Warren, OR 97053 503-397-7904

Coos County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
382 North Central Coquille, OR 97423-1296 (541) 396-6879	382 North Central Coquille, OR 97423-1296 (541) 396-2841	631 Alder St. Myrtle Point, OR 97458 541-572-5263	223 N. Alder, Suite D Coquille, OR 97423 (541) 572-2541

Crook County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
498 S.E. Lynn Blvd Prineville, OR 97754 (541) 447-3548	498 S.E. Lynn Blvd Prineville, OR 97754 (541) 447-3548	498 S.E. Lynn Blvd Prineville, OR 97754 (541) 447-6228	498 S.E. Lynn Blvd Prineville, OR 97754 541-447-8567

Curry County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
P.O. Box 666 Gold Beach, OR 97444 (541) 247-2755	See SWCD	29390 Ellensburg Ave Gold Beach, Or 97444 541-247-6672	P.O. Box 666 Gold Beach, OR 97444 (541) 247-2755

Deschutes County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
625 SE Salmon Avenue, Suite 4 Redmond, OR 97756-9580 (541) 923-2204	625 SE Salmon Avenue, Suite 4 Redmond, OR 97756- 9580 (541) 923-4358	3893 SW Airport Way Redmond, OR 97756-8697 541-548-6088	700 NW Hill St #1 Bend, OR 97701 (541) 382-6102

Douglas County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
2741 West Harvard Ave Roseburg, OR 97471 (541) 957-5061	2593 NW Kline Street Roseburg, OR 97471 (541) 673-6071	1134 SE Douglas Ave. Roseburg, OR 97470 541-672-4461	P.O. Box 101 Roseburg, OR 97470 (541) 672-7065

Gilliam County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
333 S. Main Street	333 Main, Dunn Brothers Building	135 S. Main Street, Suite 219	333 S. Main St.
Condon, OR 97823-0106	Condon, OR 97823-0106	Condon, OR 97823-0707	Condon OR 97823
(541) 384-2281	(541) 384-2671	541-384-2271	(541) 384-2281 x 111

Grant County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
721 S Canyon Blvd	721 S Canyon Blvd	530 E. Main Street Ste. 10	P.O. Box 522
John Day, OR 97845-1084	John Day, OR 97845-1084	John Day, OR 97845	Mt. Vernon, OR 97865
(541) 575-0135	(541) 575-0135	(541) 575-2248	541-792-0435

Harney County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
530 Hwy 20 South	530 Hwy 20 South	450 N. Buena Vista #10	450 N Buena Vista Ave # 4
Hines OR 97738-0848	Hines OR 97738-0848	Burns, OR 97720	Burns, OR 97720
(541) 573-5010	(541) 573-6446	(541) 573-2506	(541) 573-8199

Hood River County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
3007 Experiment Station Drive	6780 Hwy 35	2990 Experiment Station Drive	3007 Experiment Station Rd
Hood River, OR 97031	Mt Hood, OR 97041	Hood River, OR 97031	Hood River OR 97031
(541) 386-4588	541-352-1037	541-386-3343	(541) 386-4588

Jefferson County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
625 SE Salmon Avenue, Suite 6	4223 Holiday Street	850 NW Dogwood Lane	625 SE Salmon Ave #6
Redmond, OR 97756-8696	Warm Springs, OR 97761	Madras OR, 97741-8988	Redmond OR 97756
(541) 923-4358 ext 101	(541) 553-2009	(541) 475-7107	(541) 923-4358 x139

Josephine County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
1440 Parkdale Drive	1590 SE N Street, Suite C	215 Ringuette St	P.O Box 1214
Grants Pass OR 97527	Grants Pass, OR 97526	Grants Pass, OR 97527	Medford, OR 97501
(541) 474-6840	(541) 450-9724	541-476-6613	541-414-9064

Lake County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
17612 Hwy. 395	17612 Hwy. 395	103 South E Street	17482 Tunnel Hill Rd
Lakeview, OR 97630	Lakeview, OR 97630	Lakeview OR 97630	Lakeview OR 97630
(541) 947-5855	(541) 947-2367	541-947-6054	(541) 219-0830

Lane County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
780 Bailey Hill Road, Suite 5 Eugene, OR 97402 (541) 465-6443	780 Bailey Hill Road, Suite 5 Eugene, OR 97402 (541) 465-6443	996 Jefferson Street Eugene, OR 97402 541-344-5859	751 S. Danebo Ave. Eugene, OR 97402 541-338-7055

Lincoln County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
23 North Coast Highway Newport, OR 97365 (541) 265-2631	23 North Coast Highway Newport, OR 97365 (541) 265-2631	1211 SE Bay Blvd Newport OR 97365 541-574-6534	23 N Coast Hwy Newport OR 97365 (541) 265-9195

Linn County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
33630 McFarland Road Tangent, OR 97389-9708 (541) 926-2483	31978 N. Lake Creek Dr. Tangent, OR 97389-9708 (541) 967-5925	33630 McFarland Rd Tangent, OR 97389 541-967-3871	PO Box 844 Brownsville OR 97327 (541) 466-3493

Malheur County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
2925 SW 6th Avenue, Ste 2 Ontario, OR 97914-2446 (541) 889-2588	2925 SW 6th Ave, Ste 2 Ontario, OR 97914-2446 (541) 889-9689	710 SW 5th Ave Ontario, OR 97914 541-881-1417	710 SW 5th Ave Ontario OR 97914 (541) 881-1417 x 105

Marion County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
650 Hawthorne Avenue SE, Ste 130 Salem, OR 97301 (503) 391-9927	650 Hawthorne Ave. SE, Suite 130 Salem, OR 97301 (503) 399-5741	1320 Capitol St NE, Ste 110 Salem, OR 97301 503-588-5301	4780 Brush College Rd NW Salem OR 97304 (503) 371-6552

Morrow County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
430 Heppner/Lexington Hwy Heppner, OR 97836-0127 (541) 676-5452	430 Heppner/Lexington Hwy Heppner, OR 97836-0127 (541) 676-5021	54173 Hwy 74 Heppner, OR 97836 541.676.9642	920 SW Frazer Ave # 210 Pendleton, OR 97801 (541) 276-2190

Polk County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
580 Main, Suite A Dallas, OR 97338-1911 (855) 651-8930	580 Main, Suite A Dallas, OR 97338-1911 (855) 651-8930	289 E Ellendale, Suite 301 Dallas, OR 97338 503-623-8395	580 Main St #A Dallas OR 97338 (503) 623-9680

Sherman County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
P.O. Box 405 Moro, OR 97039-0405 (541) 565-3551	P.O. Box 405 Moro, OR 97039-0405 (541) 565-3551	66365 Lonerock Road Moro 97039 541-565-3230	PO Box 405 302 Scott Street Moro, OR 97039 541-565-3216 X 109

Tillamook County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
4000 Blimp Blvd. Suite 200 Tillamook, OR 97141 (503) 842-2848 Ext 4	4000 Blimp Blvd. Ste 200 Tillamook, OR 97141 (503) 842-2848, Ext 3	2204 4th Street Tillamook, OR 97141 503-842-3433	4000 Blimp Blvd #440 Tillamook OR 97141 (503) 322-0002

Umatilla County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
1 SW Nye Ave Pendleton, OR 97801 (541) 278-8049 ext 134	1 SW Nye Ave, Ste 130 Pendleton, OR 97801 (541) 278-8049	PO Box 100 Pendleton, OR 97801 541-278-5403	920 SW Frazier Ave., Suite 210 Pendleton OR 97801 (541) 276-2190

Union County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
10507 N. McAlister Road, Room 7 La Grande, OR 97850-8705 (541) 963-1313	1901 Adams Avenue, Suite 6 La Grande, OR 97850 (541) 963-4178	10507 N McAlister Rd, Room 9 La Grande, OR 97850 (541) 963-1010	1114 J Ave La Grande, OR 97850 (541) 663-0570

Wallowa County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
401 NE First St., Suite E Enterprise, OR 97828 (541) 426-4521	401 NE First St., Suite E Enterprise, OR 97828 (541) 426-4521	668 NW 1st Enterprise OR 97828 541-426-3143	1114 J Ave La Grande, OR 97850 (541) 663-0570

Wasco County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
2325 River Road, #3 The Dalles, OR 97058 (541) 298-8559	2325 River Road, #3 The Dalles, OR 97058 (541) 298-8559	400 E Scenic Dr. The Dalles, OR 97058 (541) 296-5494	2325 River Road, Ste 3 The Dalles, OR 97058 (541) 296 - 6178 x102

Washington County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
1080 SW Baseline, Suite B-2 Hillsboro, OR 97123-3823 (503) 681-0953	1080 SW Baseline, Suite B-2 Hillsboro, OR 97123-3823 (503) 648-3174	1815 NW 169th Place, Bdlg 1, Ste 1000 Beaverton, OR 97006 503-821-1150	P.O. Box 338 Hillsboro, OR 97123 (503) 846-4810

Wheeler County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
40535 Highway 19 Fossil, OR 97830 (541) 468-2990	See SWCD	401 4th St Fossil OR 97830-0407 541-763-4115	40535 HWY 19 Fossil OR 97830 (541) 468-2990

Yamhill County			
SWCD	**NRCS**	**OSU Extension**	**Watershed Council**
2200 SW 2nd Street McMinnville, OR 97128-9185 (503) 472-1474	2200 SW 2nd Street McMinnville, OR 97128-9185 (503) 472-1474	2050 NE Lafayette Avenue McMinnville, OR 97128 503-434-7517	NE Ford Street, Suite 9 McMinnville, OR 97128 503 474-1047

Note: The watershed council that is listed is only one of the watershed councils within your service area. The contact information listed is the council that is located closest to the other partner organizations within the county. Upon contacting the partner organization listed, you may be redirected to the more appropriate partner organization.

RESOURCES AND FUNDS

PLEASE NOTE: The Internet URL Addresses listed in this section were included as a convenience for the users of this document. All URL Addresses were functional at the time this section was updated (October 2017), but many URLs are changing for state agencies, so these will be updated as necessary. For accessing active links, this list will be placed on DEQ's Water Quality and Drinking Water Protection web pages under "Funds and Resources". The location for drinking water protection is: http://www.oregon.gov/deq/wq/programs/Pages/DWP.aspx

Oregon Health Authority (OHA)

Drinking Water Services - **Phone:** 971-673-0405; **Website**:

http://www.oregon.gov/OHA/PH/HealthyEnvironments/DrinkingWater/pages/index.aspx

The Oregon Health Authority (OHA) is the primacy agency for the implementation of the federal Safe Drinking Water Act (SWDA) in Oregon. ORS 338.277 authorizes the OHA to administer the federal Safe Drinking Water Act in Oregon as the Primacy Agency in agreement with the federal government. ORS 448.131 further authorizes the adoption of standards necessary to protect public health through insuring safe drinking water within a water system. Standards in OAR 333-061 outlines requirements for systems to meet MCLs, submit to periodic inspections, and meet enforcement requirements as administered by OHA. As the primacy agency, OHA also approves drinking water treatment plans and sets construction standards, operator certification standards, and enforces rules to ensure safe drinking water. The OHA website above has extensive information on drinking water treatment requirements.

In order to assist systems in complying with standards, OHA also provides technical assistance and oversight of grants and loans from the Safe Drinking Water Act for public water system operation and improvements. *For those Safe Drinking Water Act loans and grant funds, the* ***Oregon Health Authority partners with Oregon Infrastructure Finance Authority to provide the financial services*** *(see below).*

Business Oregon - Infrastructure Finance Authority (IFA)

Phone: (503) 986-0123; **Website:** http://www.orinfrastructure.org/

IFA is a division of Business Oregon that provides funding for municipally owned infrastructure projects. IFA manages federal infrastructure funds for agencies such as Oregon Health Authority and Housing and Urban Development. IFA is not a regulatory agency but collaborates and supports our state and federal partners with financing programs and technical assistance. Available funding programs that are most applicable for drinking water source protection include: the Safe Drinking Water Revolving Loan Fund (SDWRLF), Drinking Water Source Protection Fund (DWSP), and Special Public Works Fund (SPWF).

Safe Drinking Water Revolving Loan Fund (SDWRLF)

This loan program funds drinking water system improvements needed to maintain compliance with the Federal Safe Drinking Water Act. The Safe Drinking Water Fund is funded by annual grants from the U.S. Environmental Protection Agency (EPA) and matched with funds from the state Water/Wastewater Financing Program. The program is managed by the Oregon Health Authority (OHA), Drinking Water Services. The loans are managed by the Oregon Infrastructure Finance Authority (IFA).

The Safe Drinking Water Revolving Loan Fund (SDWRLF) is designed for water source, treatment, distribution, storage and related infrastructure projects. Funding is available for all sizes of water systems, although 15 percent of the funds are reserved for systems serving a population of fewer than 10,000. Eligible applicants can be owners of water systems that provide service to at least 25 year-round residents or systems that have 15 or more connections (or a nonprofit with 25 or more regular users). Owners can be a nonprofit, private party or municipality, but systems cannot be federally owned or operated.

To be eligible for funding, a project must solve an existing or potential health hazard or noncompliance issue under federal/state water quality standards. The following are the main types of eligible activities:

- Engineering, design, upgrade, construction or installation of system improvements and equipment for water intake, filtration, treatment, storage, transmission
- Acquisitions of property or easements
- Planning, surveys, legal/technical support and environmental review
- Investments to enhance the physical security of drinking water systems, as well as water sources

SDWRLF loan amount: The program provides up to $6 million per project (more with additional approval) with the possibility of subsidized interest rate and principal forgiveness for a Disadvantaged Community. The standard loan term is 20 years or the useful life of project assets, whichever is less, and may be extended up to 30 years under SDWRLF for a Disadvantaged Community. Interest rates are 60-80 percent of state/local bond index rate.

To apply, the municipality should first submit a Letter of Interest to Oregon Health Authority where it will be rated and ranked. Call Oregon OHA Drinking Water Services at 971-673-0422 or go to the OHA website: **www.healthoregon.org/srf**

Projects placed on the Project Priority List will be invited to apply through IFA for funding. Contact your IFA Regional Coordinator for assistance and more information. Call IFA at 503-986-0123 or **http://www.orinfrastructure.org/ .**

Drinking Water Source Protection Fund (DWSP)

From the Safe Drinking Water Act, loans and grants are also available for drinking water protection projects: low interest *loans up to a maximum of $100,000 per project*, and *grant funds up to $30,000 per water system*. Eligible systems include any public and privately-owned Community and Nonprofit Non-Community water systems with a completed Source Water Assessment are able to demonstrate a direct link between the proposed project and maintaining or improving drinking water quality. Eligible activities include those that lead to risk reduction within the delineated source water area or would contribute to a reduction in contaminant concentration within the drinking water source. Projects can take either a local or regional approach. Local projects are defined as activities that concentrate on a public water system's source area(s). Regional projects are defined as activities that involve multiple communities and/or water systems attempting to address a common source water issue or group of issues.

The categories for eligible projects for DW Source Protection funding include the following:

Refined Delineation OHA and DEQ have completed delineations for most drinking water source areas (DWSA) for the community and non-community public water systems. DWSAs include aquifer recharge areas for groundwater sources and watershed areas for surface sources. DW Source Protection funding can be used to complete, update, or refine DWSA delineations using new or additional site-specific information as part of a more comprehensive protection strategy.

Updated Assessment

> ***Inventory*** – Projects that improve upon existing potential contaminant source inventories available from the DEQ database, Geographic Information System, and Assessment Reports prepared by OHA/DEQ. A project could involve expanding or updating the inventory of land uses or existing and potential point and non-point contaminant sources.
>
> ***Evaluation*** – Projects establishing a water quality monitoring project to evaluate existing and potential threats to water quality. This could include evaluating and prioritizing potential threats (or protection activities) based upon new or more detailed information.

Source Protection Planning

Projects designed to identify appropriate protection measures, including development of a comprehensive DW Source Protection plan, educational projects, projects to identify and ensure implementation of Best Management Practices (BMPs), development of local DW Source Protection ordinances, development of restoration or conservation plans for the source area for future easement or land acquisition.

Implementation

Funds can be used to implement many types of protection strategies in drinking water source areas. This can include implementation of any *eligible activities that will reduce risks within the source water area or would contribute to a reduction of contaminant concentration within the drinking water source(s)*.

Examples of the types of projects that can be funded include:

- Implementing drug-take-back projects in source areas
- Projects for reducing pesticide application rates and loadings in source area
- Implementing pesticide and household hazardous waste collection events
- Closure of high-risk abandoned or unused (private or irrigation) wells close to supply well
- Projects for reforestation or replanting in sensitive or riparian areas
- Installation of fencing to protect sensitive riparian source areas
- Installation of signs at boundaries of zones or protection areas
- Projects for assessing risks from onsite systems near supply wells, inspections, pump-outs, or decommissioning onsite systems.
- Secondary containment for high-risk ABOVE ground tanks
- Focused workshop events for household/business instruction for changing to alternative nonhazardous product usage ("green chemical" products)
- Seismic spill prevention or inspection project in proximate areas for high-risk sources
- Permanent abandonment (i.e. filling in) of inadequately constructed private wells within the source area
- Installation of fencing around the immediate intake or well area to provide protection
- Structures to divert contaminated stormwater runoff affecting the source area
- Set up ecosystem services (or similar) project in watershed to fund preservation areas
- Implementation of pollution prevention or waste reduction projects
- Restoration and/or conservation projects within the drinking water source area
- Implementation of water reuse and other conservation measures related to source protection
- Implementation of best management practice projects
- Implementation of conservation easements to protect sensitive source areas
- Implementation of a drinking water source protection ordinance
- Establishing management plans for easements or lands purchased within source areas
- Development of educational flyers/brochures for purposes of public education
- Purchase of lands within the drinking water source area (funded only via low interest loans)

Any *Public and Privately-owned Community and Nonprofit Non-Community water systems* with a completed *Source Water Assessment* are eligible for funds. A "community water system" is defined as a public water system that has 15 or more service connections used by year-round residents, or which regularly serves 25 or more year-round residents. This includes water systems that are owned privately, by non-profit or public entities such as a city, district, or port. A "nonprofit non-community water system" is a public water system that is not a community water system and that regularly serves at least 25 people (more than 6 months per year) and is legally recognized under Oregon law as a nonprofit entity.

For the source water protection funds, contact OHA regarding the letter of interest submittal schedule. Call Oregon OHA Drinking Water Services at 971-673-0422 or go to the OHA website: **www.healthoregon.org/srf** or contact IFA at 503-986-0123; **www.orinfrastructure.org**

Water/Wastewater Funding Program (WWFP)
This loan program funds the design and construction of public infrastructure needed to ensure compliance with the Safe Drinking Water Act or the Clean Water Act. The public entities that are eligible to apply for the program are cities, counties, county service districts, tribal councils, ports, and special districts as defined in ORS 198.010. Municipalities must either have a documented compliance issue or the potential of a compliance issue in the near future. Allowable funded project activities may include:

- Construction costs, including Right of Way and Easements, for improvement or expansion of drinking water, wastewater or stormwater systems
- Design and construction engineering
- Planning/technical assistance for small communities

WWFP Loans
The maximum loan term is 25 years or the useful life of the infrastructure financed, whichever is less. The maximum loan amount is $10 million per project (more with additional approval) through a combination of direct and/or bond funded loans. Loans are generally repaid with utility revenues or voter approved bond issues. A limited tax general obligation pledge also may be required. "Credit worthy" borrowers may be funded through the sale of state revenue bonds.

WWFP Grants
Grant awards up to $750,000 may be awarded based on a financial review. An applicant is not eligible for grant funds if the applicant's annual median household income is equal or greater than 100 percent of the state average median household income for the same year.

Funding for Technical Assistance
The Infrastructure Finance Authority offers technical assistance financing for municipalities with populations of less than 15,000. The funds may be used to finance preliminary planning, engineering studies and economic investigations. Technical assistance projects must be in preparation for a construction project that is eligible and meets the established criteria.

Grants up to $20,000 may be awarded per project.

Loans up to $60,000 may be awarded per project.

To apply, call IFA at 503-986-0123, then contact your IFA Regional Coordinator for assistance and more information. **http://www.orinfrastructure.org/**

Special Public Works Fund (SPWF)

The Special Public Works Fund (SPWF) provides funds for publicly owned facilities that support economic and community development in Oregon. Funds are available to public entities for planning, design, purchasing, improving and constructing publicly owned facilities, replacing publicly owned essential community facilities, emergency projects as a result of a disaster, and for planning. Public agencies that are eligible to apply for funding are cities, counties, county service districts (ORS 451), tribal councils, ports, districts as defined in ORS 198.010, and airport districts (ORS 838).

SPWF Loans

Loans for development (construction) projects range from less than $100,000 to $10 million (more with additional approval). The Infrastructure Finance Authority offers very attractive interest rates that reflect tax-exempt market rates for highly qualified borrowers. Initial loan terms can be up to 25 years or the useful life of the project, whichever is less.

SPWF Grants

Grants are available for construction projects that create or retain traded-sector jobs. They are limited to $500,000 or 85 percent of the project cost, whichever is less, and are based on up to $5,000 per eligible job created or retained. Limited grants are available to plan industrial site development for publicly owned sites and for feasibility studies.

To apply, call IFA at 503-986-0123, then contact your IFA Regional Coordinator for assistance and more information. **http://www.orinfrastructure.org/**

Community Development Block Grant (CDBG)

Grants and technical assistance are available to develop livable urban communities for persons of low and moderate incomes by expanding economic opportunities and providing housing and suitable living environments. Non-metropolitan cities and counties in rural Oregon can apply for and receive grants. *[Oregon tribes, urban cities (Albany, Ashland, Bend, Corvallis, Eugene, Gresham, Hillsboro, Medford, Portland, Salem and Springfield) and counties (Clackamas, Multnomah, Washington) receive funds directly from HUD.]* Funding amounts are based on the applicant's need, the availability of funds, and other restrictions defined in the program's guidelines. The maximum available grant for drinking water system projects is $3,000,000.

All projects must meet one of three national objectives:

- The proposed activities must benefit low- and moderate-income individuals.
- The activities must aid in the prevention or elimination of slums or blight.

- There must be an urgent need that poses a serious and immediate threat to the health or welfare of the community.

To apply, call IFA at 503-986-0123, then contact your IFA Regional Coordinator for assistance and more information. **http://www.orinfrastructure.org/**

Port Revolving Loan Fund (PRLF)

The Port Revolving Loan Fund (PRLF) is a loan program to assist Oregon ports in the planning and construction of facilities and infrastructure. Ports must be incorporated under ORS Chapter 777 or 778. The Fund may be used for port development projects (facilities or infrastructure) or to assist port-related private business development projects. The variety of eligible projects is very broad and may include water-oriented facilities, industrial parks, airports and commercial or industrial developments. Eligible project costs can include engineering, acquisition, improvement, rehabilitation, construction, operation, and maintenance or pre-project planning. Projects must be located within port district boundaries. The maximum loan amount is $3 million at any one time. The loan term can be as long as 25 years or the useful life of the project, whichever is less. Interest rates are set by the IFA at market rates, but not less than Treasury Notes of a similar term minus one percent.

Note: Flexible manufacturing space projects will not accrue interest until the building is at least 25 percent occupied or until three years after the date of the loan contract, whichever is earlier.

To apply, call IFA at 503-986-0123, then contact your IFA Regional Coordinator for assistance and more information. **http://www.orinfrastructure.org/**

Other IFA Funding Programs

IFA administers a number of other funding programs for communities that support the design and construction of public infrastructure and economic and community development. These funding programs include the Water/Wastewater Funding Program, the Special Public Works Fund (SPWF) Community Development Block Grant (CDBG), and the Port Revolving Loan Fund (PRLF). More information and allowable funded project activities are available on IFA's website.

Oregon Department of Environmental Quality (DEQ)

Clean Water State Revolving Fund: 503-229-6412

Website: http://www.oregon.gov/deq/wq/cwsrf/Pages/default.aspx

Clean Water State Revolving Fund (CWSRF)

Low-cost loans for planning, design, and construction projects to attain and maintain water quality standards, and necessary to protect beneficial uses such as drinking water sources, irrigation, and recreation. Eligible borrowers are public entities, such as cities and counties, Indian tribal governments, sanitary districts, soil and water conservation districts, irrigation districts, various special districts and some intergovernmental entities. Applications are accepted

year round with scheduled review and ranking in the first week of January, May and September. Contact DEQ for a list of CWSRF project officers:
http://www.oregon.gov/deq/wq/cwsrf/Pages/CWSRF-Contacts.aspx

Financial incentives make CWSRF loans worth exploring. Principle forgiveness is available for communities meeting affordability criteria, or for meeting green project criteria. Implement a non-planning nonpoint source project ***and*** a traditional point source wastewater treatment project through the same application to reduce your interest rate on the combined two projects to as low as 1%. This combined application is called a sponsorship option.

CWSRF Pollution Reduction Funding

The Clean Water State Revolving Fund loan program provides low-cost loans to public entities for the planning, design or construction of both point source and nonpoint source projects that *prevent or mitigate water pollution*. CWSRF offers a Local Community Loan, which allows the borrower to make loans to private entities like home owners and farmers. The Local Community Loans fund the repair and replacement of failing decentralized systems. This loan type can also fund nonpoint source agricultural best management practices and a variety of nonpoint source watershed improvement projects.

CWSRF loans fund development of nonpoint source water quality improvement plans, such as an integrated water resources plan and a regional or municipality-wide stormwater management plan. Planning loans can also fund the establishment of watershed partnerships, local ordinances to implement a stormwater master/management plan, engineering and development standards for new and redevelopment, permanent riparian buffers, floodplains, wetlands and other natural features.

CWSRF offers a Local Community Loan, which allows the borrower to make loans to private entities like home owners and farmers. The Local Community Loans fund the repair and replacement of failing decentralized systems. This loan type can also fund nonpoint source agricultural best management practices such as building manure containment structures, manure digesters, and fences to protect riparian resources capture and convert methane, and purchase calibrated application equipment.

CWSRF loans fund a variety of nonpoint source watershed improvement implementation projects such as establishing or restoring permanent riparian buffers and floodplains, and daylighting streams from pipes. Loans can fund protecting and restoring streamside areas, wetlands and floodplains, and to acquire riparian land, wetlands, conservation easements, and land to protect drinking water sources.

More information on DEQ's Clean Water State Revolving Fund program can be found here:
http://www.oregon.gov/deq/wq/cwsrf/Pages/default.aspx

For specific information on the Sponsorship Option, Planning Loans, Nonpoint Source Loans, or Local Community Loans, see the links on the above webpage. The application requirements for CWSRF loans may take some lead-time to develop and may require out-of-pocket expense to

prepare. Prospective CWSRF applicants should discuss any questions about the required content of these items with a regional DEQ CWSRF Project Officer at the earliest opportunity:

http://www.oregon.gov/deq/wq/cwsrf/Pages/CWSRF-Contacts.aspx

Supplemental Environmental Projects (SEPs)

Supplemental Environmental Projects are administered by DEQ's Office of Compliance and Enforcement. When DEQ assesses civil penalties for environmental law violations, violators can offset up to 80% of their monetary penalty by agreeing to pay for a Supplemental Environmental Project that improves Oregon's environment. SEPs can be for pollution prevention or reduction, public health protection, environmental restoration and protection as long as it is a project that the respondent is not already required to do by law or where the project would be financially self-serving for the respondent. The work can be completed by a third-party like a local government, watershed council, non-profit or private entity. Community organizations with proposed projects are also free to contact respondents on their own initiative. The enforcement case does not necessarily have to be in the same area (watershed/county, etc.) as the environmental project or even address the same media (i.e. air/water/land). Interested parties can sign up for DEQ's public notifications via email at: http://www.oregon.gov/deq/Get-Involved/Pages/Public-Notices.aspx

When signing up, select types of information (select "enforcement actions") and which counties or subbasins are of interest.

Oregon Water Resources Department (WRD)

Website: http://www.oregon.gov/OWRD/pages/index.aspx

The Water Resources Department is the state agency charged with administration of the laws governing surface and ground water resources. The Department's core functions are to protect existing water rights, facilitate voluntary streamflow restoration, increase the understanding of the demands on the state's water resources, provide accurate and accessible water resource data, and facilitate water supply solutions. WRD carries out the water management policies and rules set by the Water Resources Commission and oversees enforcement of Oregon's water laws. By law, all surface and ground water in Oregon belongs to the public.

WRD developed *Oregon's 2012 Integrated Water Resources Strategy* to help individuals and communities address instream and out-of-stream needs now and into the future, including water quantity, water quality and ecosystem needs. Funding to support water quality-related planning, feasibility studies, and implementation of water projects includes: Feasibility Study Grants, Water Project Grants and Loans (formerly Water Supply Development Grants and Loans), and Place-based Planning Grants. For more information on the criteria for these grants, visit:

http://www.oregon.gov/owrd/Pages/law/integrated_water_supply_strategy.aspx

Municipal Water Management and Conservation Planning

Municipal water management and conservation planning provides a process through which cities and other municipal water suppliers estimate long-range water supply needs and identify alternatives, including water conservation programs, to meet those needs. The Department requires many municipal water suppliers to prepare plans as conditions of their water use permits or permit extensions.

Water Rights

Oregon's water laws are based on the principle of prior appropriation. This means the first person to obtain a water right on a stream is the last to be shut off in times of low streamflows. In water-short times, the water right holder with the oldest date of priority can demand the water specified in their water right regardless of the needs of junior users. The date of application for a permit to use water usually becomes the priority date of the right. Watermasters respond to complaints from water users and determine in times of water shortage, which generally occur every year, who has the right to use water. Each summer as streamflows drop, watermasters regulate junior users to provide water to the more senior users. On many streams throughout the state, by the end of summer, there is only enough water to supply users who established their rights in the late 1800s. All of the more recently established rights will have been regulated off by the watermaster.

There are "watermaster" offices located around the state. The watermaster office is an excellent source of local information. Watermasters can research water rights for a particular stream reach and provide supporting maps. During critical flow periods, watermasters regulate water usage to enable senior water right holders to satisfy their water right. The watermaster may also provide information regarding instream leases, ground water rights, cancellations, transfers of water rights, streamflow data, and water right information in general. Here's the most recent list of Watermasters:

WRD Watermasters

District 1
Nikki Hendricks
c/o Port of Tillamook Bay
4000 Blimp Blvd Ste 400
Tillamook, Oregon 97141
Ph: 503-815-1967

District 2
Michael Mattick
125 East 8th Avenue
Eugene, OR 97401-2926
Ph: 541-682-3620

District 3
Robert Wood
2705 E 2nd St
The Dalles, Oregon 97058
Ph: 541-506-2652

District 4
Eric Julsrud
201 S Humbolt, Suite 180
Grant County Courthouse
Canyon City, Oregon 97820
Ph: 541-575-0119

District 5
Greg Silbernagel
116 SE Dorion Ave
Pendleton, OR 97801
Ph: 541-278-5456

District 6
Shad Hattan
10507 N McAlister Rd #6
La Grande, Oregon 97850
Ph: 541-963-1031

District 7
David Bates
401 NE First St., Suite 11
Enterprise, Oregon 97828
Ph: 541-426-4464

District 8
Rick Lusk
Baker County Courthouse
1995 3rd Street, Suite 180
Baker City, Oregon 97814
Ph: 541-523-8224 ext 231

District 9
Ron Jacobs
Malheur County Courthouse #4
251 B St W
Vale, Oregon 97918
Ph: 541-473-5130

District 10
JR Johnson
Harney County Courthouse
450 N Buena Vista #3
Burns, OR 97720
Ph: 541-573-2591

District 11
Jeremy Giffin
231 SW Scalehouse Loop,
Ste 103
Bend, Oregon 97702
Ph: 541-306-6885

District 12
Brian Mayer
513 Center St
Lakeview, Oregon 97630
Ph: 541-947-6038

District 13
Travis Kelly
10 S Oakdale, Rm 309A
Medford, Oregon 97501
Ph: 541-774-6880

District 14
Kathy Smith
700 NW Dimmick St.
Grants Pass, Oregon 97526
Ph: 541-479-2401

District 15
David Williams
Douglas County Courthouse, Room 306
Roseburg, Oregon 97470
Ph: 541-440-4255

District 16
Joel Plahn
725 Summer St NE, Ste A
Salem, Oregon 97301
Ph: 503-986-0889

District 17
Scott White
305 Main Street
Klamath Falls, Oregon 97601
Ph: 541-883-4182

District 18
Jake Constans
1400 SW Walnut St, Suite 240
Hillsboro, Oregon 97123
Ph: 503-846-7780

District 19
Greg Wacker
Physical Address:
225 N Adams
Coquille, Oregon 97423
Ph: 541-396-1905

District 20
Amy Kim
10722 SE Highway 212
Clackamas, Oregon 97015
Ph: 503-722-1410

District 21
Ken Thiemann
221 S Oregon St.
P.O. Box 427
Condon, OR 97823
Ph: 541-384-4207

Oregon Department of Forestry (ODF)

Website: http://www.oregon.gov/ODF/Pages/index.aspx

The Oregon Department of Forestry manages and regulates activities on non-federal forestland in Oregon. There are three main divisions under ODF-- Fire Protection, Private Forests, and State Forests. The Private Forests Division administers the Forest Practices Act and various forestry incentive programs and employs the use of about 50 Stewardship Foresters who work closely with landowners and operators. Private Forests also provides early detection and rapid response to forest health threats, family forestland incentive programs and technical assistance, Urban and Community forestry services, and monitors compliance and effectiveness of the Forest Practices Act. The State Forests Division is responsible for forest management to provide economic, environmental, and social benefits to Oregonians. The Fire Protection Division protects Oregon forestlands from fire through a complete and coordinated system with our landowner partners and cooperators, including fire prevention, suppression, investigation and cost collection. The over-arching goal is to minimize the cost of suppression and the loss of resource values through aggressive wildland fire initial attack, secondary only to the protection of human life.

Financial incentive programs are aimed at encouraging and assisting landowners in managing their resources and meeting their objectives. Typical forestry projects can be aimed at protecting the landowner's resources/investment from fire or insect and disease infestation, to increasing its monetary and environmental value in the future.

Information about all ODF and federal forestry-related grants and incentive programs can be found at:

http://www.oregon.gov/ODF/AboutODF/Pages/GrantsIncentives.aspx

Community Forest Program

The Community Forest and Open Space Conservation Program is a federal financial assistance program with grants available to local governments, Indian tribes, and qualified nonprofit organizations to establish community forests and sustainably manage them for many public benefits, including recreation, income, wildlife habitat, stewardship demonstration sites, and environmental education.

Conservation Stewardship Program

To help landowners and operators maintain existing stewardship and adopt additional conservation on privately-owned, non-industrial working forests and agricultural lands.

Forest Legacy Program

The Forest Legacy Program is a national program that addresses privately-owned forestlands that face threats of conversion to non-forest use by development pressures. The goal of the Forest Legacy Program is to promote stewardship and sustainable management of private forest lands by maintaining working forests that conserve important forest resource and conservation values. Forest Legacy provides funds for eligible private forestlands for the purchase of development rights through either conservation easement or fee-title acquisition into public ownership. All properties entered into Oregon's Forest Legacy Program – either through conservation easement, fee acquisition or donation – have their forest resources and conservation values protected and managed in accordance with a State Forester-approved Forest Stewardship Plan (see below).

Forest Stewardship Program

Oregon's Forest Management Planning System recognizes that forest management planning is a journey – Pathways to Stewardship -- involving several distinct steps. A landowner's initial interest may be related to a specific project or action that is pressing on their property – such as reducing hazardous wildfire fuels or combating an invasive weed. Landowner assistance organizations and agencies usually first cross paths through outreach efforts defined around mutual interests or resource concerns. Landowners who are just beginning the management planning process begin a more formal journey by taking the Woodland Discovery step. Woodland Discovery consists of gathering basic property information and solidifying management goals. The remaining steps for completing your forest management plan include organizing the planning elements into specific management planning modules: soil and water, forest vegetation, fish and wildlife, access and protection, scenery and enjoyment and tax and business. Every step completed along the way results in the identification of specific actions that a landowner can take to improve conditions of the forestland or otherwise meet goals in owning forestland. Completion of a forest management plan opens up formal types of engagement such as forest certification and the enrollment of lands into specialized conservation programs that define a long-term commitment to sustainable forestry.

Healthy Forests Reserve Program (HFRP)

The goal is to restore and enhance ecosystems and habitat for threatened and endangered species while promoting sustainable timber harvests on working forest lands.

Department of Agriculture - Natural Resources Program

Phone: 503-986-4700;

Website: *http://www.oregon.gov/ODA/programs/NaturalResources/Pages/Default.aspx*

The Oregon Department of Agriculture (ODA) is responsible for developing plans to prevent and control water pollution from agricultural activities and soil erosion on rural lands. Through the actions below, ODA's Natural Resources Program aims to conserve, protect, and develop natural resources on public and private lands to ensure that agriculture will continue to be productive and economically viable in Oregon:

- Address water quality and natural resource conservation on agricultural lands
- Ensure proper and legal sale, use, and distribution of pesticide products
- Assist local soil and water conservation districts as they help landowners properly manage Oregon's natural resources

More information on the Agricultural Plan Areas and Regulations can be found at:

http://www.oregon.gov/ODA/programs/NaturalResources/AgWQ/Pages/AgWQResources.aspx

Information on local management plans and your area's ODA Water Quality Specialist can be found at:
http://www.oregon.gov/ODA/programs/NaturalResources/AgWQ/Pages/AgWQPlans.aspx

More information on the regulation and use of pesticides can be found at:

http://www.oregon.gov/ODA/programs/Pesticides/Pages/default.aspx

Department of Agriculture Pesticide Analytical & Response Center (PARC)

Website: http://www.oregon.gov/ODA/programs/Pesticides/Pages/PARC.aspx

The Pesticide Analytical and Response Center (PARC) was created by executive order in 1978. The program was reauthorized under the Oregon Department of Agriculture (ODA) as ORS 634.550, in 1991.

PARC is mandated to perform the following activities with regard to pesticide-related incidents in Oregon that have suspected health or environmental effects: collect incident information,

mobilize expertise for investigations, identify trends and patterns of problems, make policy or other recommendations for action, report results of investigations, and prepare activity reports for each legislative session.

PARC does not have regulatory authority. Their primary function is to coordinate investigations to collect and analyze information about reported incidents.

To report a pesticide incident that has impacted people, animals, or the environment, contact:

Theodore Bunch Jr., PARC Coordination Team Leader at 503-986-6470 or toll-free at 844-688-7272, **PARC@oda.state.or.us** or Christina Higby, Citizen Advocate Liaison at 503-986-5105, **chigby@oda.state.or.us**

Department of Agriculture - Soil and Water Conservation Districts

Website: http://www.oregon.gov/oda/programs/naturalresources/swcd/pages/swcd.aspx

SWCD Program and Water Quality Program Manager: John Byers, 503-986-4718

The Soil and Water Conservation District (SWCD) Program provides services to the 45 Soil and Water Conservation Districts throughout Oregon (list current as of 6/16). SWCDs are local government entities that have authorities to address soil, erosion, and water quality issues.

Department of Agriculture – Pesticide Stewardship Partnership

Website:
http://www.oregon.gov/ODA/programs/Pesticides/Water/Pages/PesticideStewardship.aspx

The PSP Program is a cooperative, voluntary process that is designed to identify potential concerns regarding surface and groundwater affected by pesticide use. Its purpose is to reduce the occurrence of pesticide residues in the state's water bodies by working with local stakeholders and to provide a mechanism to share "lessons learned" with all citizens of the State of Oregon. The goal of the program is to achieve measurable environmental improvements, making Oregon waters safer for people and aquatic life.

In cooperation with PSP partners, 64 statewide surface water locations are monitored March – June and August- November for approximately 140 pesticides. These results are provided to local stakeholders and the general public. Additionally, funds are provided to local watershed councils and soil and water conservation districts to address pesticide residues that occur frequently or approach or exceed an aquatic life benchmark.

Source Water Collaborative – U.S. Environmental Protection Agency

Technical assistance and lists of resources and contacts are available from this national network that has worked to promote drinking water protection for several years. The Source Water Collaborative is a network of federal, state, and local organizations led by US EPA. Some of the key Source Water Collaborative members include the US EPA, US Department of Agriculture, AWWA, American Planning Association, ASDWA, ACWA, National Rural Water Association, Groundwater Protection Council, National Association of Counties, and The Trust for Public Land. See **Appendix 1** for a summary of their priorities. Resources can be found here: http://sourcewatercollaborative.org/

U.S. Environmental Protection Agency

Catalog of Federal Funding Sources for Watershed Protection

Website: https://ofmpub.epa.gov/apex/wfc/f?p=165:1::::::

This is an online, free searchable database of financial assistance sources (grants, loans, cost-sharing) available to fund a variety of watershed protection projects.

U.S. Environmental Protection Agency - Environmental Finance Centers

Website: https://www.epa.gov/envirofinance/tools

Free technical assistance is available through EPA's Environmental Finance Centers. There is currently no Environmental Finance Center for US EPA Region 10, but the resources are still available through the US EPA website. The program mission is to provide help to those facing the "how to pay" challenges of environmental protection. EFC is committed to helping the regulated community build and improve the technical, managerial, and financial capabilities needed to comply with federal and state environmental protection laws.

U.S. Department of Agriculture, Farm Service Agency Conservation Programs

Website: https://www.fsa.usda.gov/programs-and-services/conservation-programs/index

USDA Farm Service Agency oversees a number of voluntary conservation-related programs. These programs work to address a large number of farming and ranching related conservation issues including: drinking water protection, reducing soil erosion, wildlife habitat preservation,

preservation and restoration of forests and wetlands, and aiding farmers whose farms are damaged by natural disasters.

Source Water Protection Program (SWPP)

The SWPP is designed to protect surface and ground water used as drinking water by rural residents. Through a partnership with the National Rural Water Association, local teams are formed to develop plans to reduce pollutant impacts in rural areas.

https://www.fsa.usda.gov/programs-and-services/conservation-programs/source-water-protection/index

Conservation Reserve Program (CRP)

In exchange for a yearly rental payment, farmers enrolled in the program agree to remove sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index

Conservation Reserve Enhancement Program (CREP)

The CREP, an offshoot of CRP, targets high-priority conservation issues identified by local, state, or tribal governments or non-governmental organizations. In exchange for removing environmentally sensitive land from production and introducing conservation practices, farmers, ranchers, and agricultural land owners are paid an annual rental rate. Participation is voluntary, and the contract period is typically 10–15 years, along with other federal and state incentives as applicable per each CREP agreement.

https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-enhancement/index

Emergency Conservation Program (ECP)

The ECP provides funding and technical assistance for farmers and ranchers to restore farmland damaged by natural disasters and for emergency water conservation measures in severe droughts. helps farmers and ranchers to repair damage to farmlands caused by natural disasters and to help. The ECP also provides funding and assistance to help ranchers and farmers install water conservation measures during severe drought.

https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-enhancement/index

U.S. Department of Agriculture, Natural Resources Conservation Service

NRCS provides farmers, ranchers and forest managers with free technical assistance, or advice, for their land. Common technical assistance includes: resource assessment, practice design and resource monitoring. The conservation planner will help you determine if financial assistance is right for you. Technical assistance is also available online through Conservation Client Gateway. More information about NRCS can be found on their home page:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/about/

Environmental Quality Incentives Program (EQIP)
Grants are available for best management practices and conservation on private, non-industrial forestland and agricultural lands. Financial assistance is available to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland. In addition, EQIP can help producers meet Federal, State, Tribal and local environmental regulations.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
Eligible Applicants: Owners of land in agricultural or forest production or persons who are engaged in livestock, agricultural or forest production on eligible land and that have a natural resource concern on the land
Funding Available: Financial and technical assistance to agricultural and forestland producers through contracts up to 10 years. Not to exceed $300,000 for all EQIP contracts entered into during any six-year period. If NRCS determines project has special environmental significance the payment limitation is a maximum of $450,000.

Conservation Stewardship Program (CSP)
CSP helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns. Through CSP, participants take additional steps to improve resource condition including soil quality, water quality, water quantity, air quality, and habitat quality, as well as energy. Participants earn CSP payments for conservation performance - the higher the performance, the higher the payment.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/

Wetlands Reserve Easements (WRE)
WRE provides habitat for fish and wildlife, including threatened and endangered species, improve water quality by filtering sediments and chemicals, reduce flooding, recharge groundwater, protect biological diversity and provide opportunities for educational, scientific and limited recreational activities.

NRCS also provides technical and financial assistance directly to private landowners and Indian tribes to restore, protect, and enhance wetlands through the purchase of a wetland reserve easement.
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/home/?cid=stelprdb1249312

Agricultural Land Easements (ALE)
ALE is designed to protect the long-term viability of the nation's food supply by preventing conversion of productive working lands to non-agricultural uses. Land protected by agricultural land easements provides additional public benefits, including environmental quality, historic preservation, wildlife habitat and protection of open space.
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/home/?cid=stelprdb1249312

Emergency Watershed Protection (EWP)
The EWP program was set up by Congress to respond to emergencies created by natural disasters. The United States Department of Agriculture's Natural Resources Conservation Service is responsible for administering the program. EWP is designed to relieve imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. It is not necessary for a national emergency to be declared for an area to be eligible for assistance. Activities include providing financial and technical assistance to remove debris from streams, protect destabilized streambanks, establish cover on critically eroding lands, repairing conservation practices, and the purchase of flood plain easements. The purpose of EWP is to help groups of people with a common problem. EWP is generally not an individual assistance program. All projects undertaken must be sponsored by a political subdivision of the State, such as a city, county, general improvement district or conservation district, or by a tribal government.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/or/programs/financial/ewp/

Other NRCS Programs
There are other NRCS programs that are specific to Oregon geographic areas---Wildfire Rehabilitation Initiative, Organic Initiative, drought funding, and restoration funding---see the Oregon
NRCS link for more information on those:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/or/programs/financial/eqip/
Anyone applying for EQIP or any of the other NRCS grants for the first time should schedule a meeting with NRCS to discuss their options before moving forward.

Oregon Watershed Enhancement Board (OWEB)

775 Summer St. NE Suite 360 Salem, OR 97301
Phone: (503) 986-0178
Website: www.oregon.gov/OWEB

The Oregon Watershed Enhancement Board (OWEB) is a state agency that provides grants to help Oregonians take care of local streams, rivers, wetlands and natural areas. Community members and landowners use scientific criteria to decide jointly what needs to be done to conserve and improve rivers and natural habitat in the places where they live. OWEB grants are funded from the Oregon Lottery, federal dollars, and salmon license plate revenue. The agency is led by a 17 member citizen board drawn from the public at large, tribes, and federal and state natural resource agency boards and commissions.

OWEB provides grants to projects that contribute to the Oregon Plan for Salmon and Watersheds and the Oregon Conservation Strategy by protecting, restoring and improving clean water and fish and wildlife habitat. See the OWEB website for more information on grants:

http://www.oregon.gov/OWEB/GRANTS/pages/index.aspx

Oregon Sea Grant (OSG)

Oregon State University Corvallis, Oregon
Phone 541-737-2714
http://seagrant.oregonstate.edu/

Oregon Sea Grant serves Oregon coastal communities through integrated research, education and public engagement on ocean and coastal issues. Based at Oregon State University, OSG is part of the national network of NOAA Sea Grant College Programs, dedicated to promoting environmental stewardship, long-term economic development and responsible use of America's coastal, ocean and Great Lakes resources. OSG targets research on better defining the relationships between the many pressures that can degrade water quality: climate change, upland and coastal land use, fish and habitat restoration efforts, aquatic invasive species. OSG works with groups whose interests sometimes come in conflict - landowners, outdoor recreationists, farmers and woodland managers, local government, the general public - to seek solutions that will help sustain healthy watersheds and our precious water resources. OSG focuses on the question of resilience - the ability to plan, adapt and rebound in the face of change by supporting physical and social science research aimed at better understanding ocean

and coastal processes and the socio-economic barriers to hazard and climate change preparation. http://seagrant.oregonstate.edu/coastal-hazards-and-climate-change

OSG and OSU Extension produce textbooks and other publications on such topics as conservation-friendly gardening, sustainable living and low-impact development. OSG also partners with the Oregon State Marine Board to develop the Clean Vessel Act (CVA) Education Initiative. Funded by the Clean Vessel Act of 1992, the goal of the CVA Education Initiative is to improve boaters' awareness, accessibility and use of sewage pump-outs, dump stations, and floating toilets. Publications and resources available from OSG about watershed health can be found here:

http://seagrant.oregonstate.edu/sgpubs/collection/watersheds-and-wetlands

Every two years, OSG awards approximately $2 million in research grants addressing community preparedness for climate change, watershed health, other urgent or emerging regional needs with high relevance to coastal communities. For more information on grants, see: http://seagrant.oregonstate.edu/research

U.S. Department of Agriculture, Rural Development

Water and Waste Disposal Direct Loans and Grants

Eligible Projects: Pre-construction and construction associated with building, repairing, or improving drinking water, solid waste facilities and wastewater facilities

Eligible Applicants:

-Cities or towns with fewer than 10,000 population

-Counties, special purpose districts, non-profit corporations or tribes unable to get funds from other sources at reasonable rates and terms

Funding Available: Loans (40-year term), grants in some cases, interest rates vary (currently 2.125 – 3.5%)

How To Apply: Applications accepted year-round on a fund-available basis.

https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program

U.S. Environmental Protection Agency

Community Action for a Renewed Environment (CARE) Grants

Eligible Projects: Prevention of human exposure to harmful pollution; improve water quality. Form community-based collaborative partnerships; identifying and developing an understanding of the many local sources of risk from toxic pollutants and environmental concerns; and setting priorities for the reduction of the identified risks and concerns of the community

Eligible Applicants: Local, public non-profit institution/organizations, federally-recognized Indian tribal government, Native American organizations, private non-profit institution/organization, quasi-public nonprofit institution/organization both interstate and intrastate, local government, colleges, and universities

Funding Available: $75,000 to $100,000 with an average project funding of about $90,000

How To Apply: https://www.epa.gov/communityhealth/community-action-renewed-environment-care-resources

U.S. Department of Commerce -

Community Development Block Grant Planning Program

Phone: (206) 220-5101; Website:

https://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

Eligible Projects: Comprehensive plans, Infrastructure plans, Feasibility studies, Community action plans, Low-income housing assessments

Eligible Applicants: Projects must principally benefit low- to moderate-income people in non-entitlement cities (under 50,000 people) and counties (under 200,000 people).

Funding Available: Grants

· Up to $24,000 for a single jurisdiction

· Up to $35,000 for single jurisdiction projects that address urgent public health and safety needs

· Up to $40,000 for multiple jurisdictions/joint application

How To Apply: https://www.hudexchange.info/grantees/

Rural Community Assistance Corporation (RCAC)

Website: http://www.rcac.org/

National contact: Josh Griff, 720-951-2163, jgriff@rcac.org

Oregon contact: RosAnna Noval, Rural Development Specialist 503-308-0207; rnoval@rcac.org

At the national level, RCAC has a variety of loans for water and/or wastewater planning, environmental work, and other work to assist in developing an application for infrastructure improvements

Eligible Applicants: Non-profit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less, or 10,000 or less if guaranteed by USDA Rural Development financing.

Funding Available:

- Maximum $50,000 for feasibility loan
- Maximum $350,000 for pre-development loan
- 1 year term with 5.5% interest rate

How To Apply: Applications accepted anytime. www.rcac.org

Water Research Foundation –

Source Water Protection Cost-Benefit Tool

Website: http://www.swptool.org/index.cfm

This is a free, online suite of tools designed to assist in evaluating the triple bottom-line costs and benefits of different source water protection options. Cost/benefit calculations help evaluate, prioritize, justify, and ultimately implement source water protection initiatives.

LAND TRUSTS

Most land trusts are community based and deeply connected to local needs, so they are well-equipped to identify land that offers critical natural habitat as well as land offering recreational, agricultural and other conservation value. There are several categories of land trusts:

- Conservation land trusts: A land trust is a nonprofit organization that, as all or part of its mission, actively works to conserve land by undertaking or assisting in land or conservation easement acquisition, or by its stewardship of such land or easements.
- Alternative type of land trust: The legal title of the property in question is held by another person (a trustee) while the original owner retains all of the rights and privileges of property ownership.
- Community land trusts (CLTs): A community land trust is a private, non-profit corporation, created to acquire and hold land for the benefit of a community, and provide secure affordable access to land and housing for community residents. CLTs offer a balanced approach to ownership: the nonprofit trust owns the land and leases it for a nominal fee to individuals who own the buildings on the land. In particular, Community land trusts attempt to meet the needs of residents least served by the prevailing land market.

Resources to assist in locating a land trust: http://findalandtrust.org/states/oregon41

Coalition of Oregon Land Trusts

Phone: 503-719-4732 ***Website:*** http://oregonlandtrusts.org/

The Coalition of Oregon Land Trusts (COLT) is a newly formed nonprofit representing and serving Oregon's land trusts. Its mission is to serve and strengthen the land trust community in Oregon. Oregon's land trust community is working at local, regional, and statewide scales with landowners, communities, public agencies and other partners to maintain the state's natural heritage and the economies it supports. COLT will accomplish its mission by strengthening public policies and programs that are supportive of land conservation, helping to build capacity within and across land trusts, and communicating to key audiences about the role of land trusts in conserving Oregon's natural heritage and healthy human communities that depend on it. There are currently 18 land trusts that are members of COLT.

Land Trust Alliance

Phone: (971) 202-1483 ***Website:*** http://www.landtrustalliance.org/

The Land Trust Alliance is a national conservation organization that works preserve land through conservation and easements, so land and natural resources get protected. The Alliance is based in Washington, D.C., and has several regional offices.

Individual land trusts which may be of assistance include:

The Trust for Public Land https://www.tpl.org

The Nature Conservancy https://www.nature.org

5.0 PLACE-BASED PLANNING FOR SOURCE WATER

Drinking water protection involves identifying and working to reduce the highest risks that could potentially affect the public water system, rather than prohibiting specific uses in a watershed or groundwater recharge area. The prime benefit or incentive to local communities to voluntarily develop and implement drinking water protection strategies is reduction of risk to ensure a more secure source of high-quality water. This is important in light of the pace at which new chemicals are developed and the known gaps in water quality health-based standards. In addition, lands within most drinking water source areas across the state are not owned by public water systems, so voluntary commitment within the community to collaborate on water protection efforts is an essential aspect of long-term protection.

Developing pollutant reduction strategies to protect a public water system is a cost-effective use of resources, since it is expensive to treat contaminated drinking water or to acquire a replacement water supply should a supply become unusable due to contamination (see Gartner et al 2014). DEQ estimates the cost of developing drinking water protection strategies for a community of less than 500 in population to range from $100 (with staff or donated time) to $6,000 (with preparation by a consultant). This level of investment in drinking water protection stands in stark contrast with the typical costs to investigate and install treatment for contamination. Based on an actual event in 1992, a small groundwater-supplied public water system in Marion County spent at least $500,000 on contamination response. This example is consistent with a US EPA study that determined *the cost of contamination cleanup to be 5 to 200 times more expensive than basic pollution prevention efforts.*

There are several reasons why "place-based planning" is essential to the success of overcoming commonly encountered challenges for drinking water protection planning. The drinking water source area for most communities lies partially, if not entirely, outside of municipal jurisdictions. The jurisdiction of the source area may also be complicated by several different and overlapping governing agencies. The land uses and potential contaminant sources may correspond to a diverse mix of landowners, businesses and residents. When developing protection strategies, DEQ and OHA highly recommend that the water system and community involve potentially affected stakeholders early in the process to foster their awareness and trust in the resulting strategies. When source water protection efforts occur at the community level and involve key stakeholders, there is a greater likelihood of success. These efforts may comprise a focused strategy to address a specific issue, or broader "action plans" that address short-term and longer-term drinking water protection challenges. Regardless of the approach, all of this work is a valuable investment in protecting the quality of life and economic vitality of the local community.

In 2012 Oregon adopted an "Integrated Water Resources Strategy (IWRS)" that provides recommendations for how to follow a place-based and integrated approach to water resources planning (OWRD 2015). This approach helps communities achieve the level of coordination and collaboration to successfully address local water quality and water quantity challenges, such as developing and implementing strategies to protect their drinking water sources. The IWRS Place-Based Planning guidelines describe elements to consider for building a collaborative process, characterizing water-related issues, quantifying existing and future water needs, developing a suite of solutions, and adopting and implementing the plan. More information about the process can be found in this Water Resources Department document: http://www.oregon.gov/owrd/LAW/docs/IWRS/2015_February_Draft_Place_Based_Guidelines.pdf

Essentials of place-based planning include:

- Voluntary process, driven by local partners
- Involves and integrates diverse and representative perspectives
- Potentially addresses a broad array of common water quality challenges that include:
    - Water quality impairments and water supply limitations
    - Identifying data gaps and initiating projects to address these (e.g. water monitoring studies to assess water quality, hydrology, sources of potential or known pollutants, utilization, etc.)
    - Identifying water resource needs and partner to develop solutions
    - Lack of jurisdiction over lands in source area
    - Assessing cumulative effects of regional demands on waterbodies, including existing uses and new development
    - Increasing the visibility and awareness of water quality as a priority water resource issue

        - Connecting the health of source water to overall watershed health with decision makers and funders
        - Impacts on water resources, e.g. development and negative effects on aquifer recharge and streamflows; vulnerability of groundwater and surface water to contamination.
- Collaborative partners help implement place-based planning efforts:
    - SWCDs
    - USDA - NRCS
    - Oregon State University Extension Service
    - Watershed Councils
    - County and City jurisdictions
    - Other public water systems in area
    - WRD (Watermaster and Planning staff)
    - Other relevant agencies e.g.: DEQ, ODFW, ODF, ODA
    - Representative stakeholders:
        - Irrigation districts
        - Residential homeowners
        - Commercial, industrial landowners
        - Agricultural and forestry landowners

Planning Process for Protection

Many public water systems do not have the staff or resources necessary to develop comprehensive drinking water protection plans, or maintain communication and coordination with landowners in their source area. For communities with limited resources, it is critical to streamline the process for developing and implementing strategies for drinking water protection to ensure that protection efforts focus on the highest resource priorities. **Figure 9** provides a visual map or process for moving through the various steps for developing a pollutant reduction or drinking water protection plan.

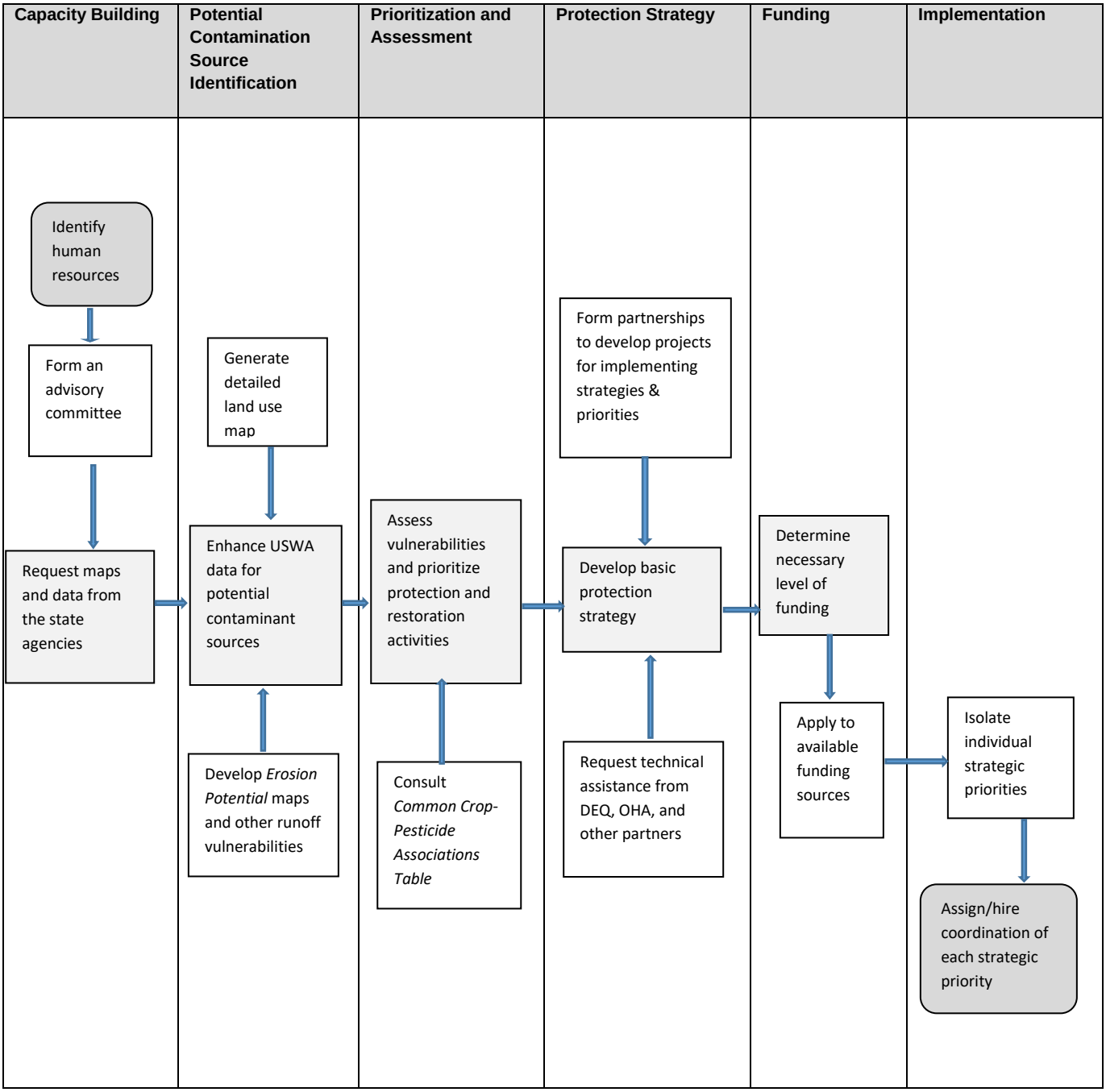


Figure 9. Process Diagram for Drinking Water Source Protection

The level of available resources, information and data will likely define the scope of the drinking water protection efforts. Initially, even a focused effort to address a few higher priority pollutants of concern is a concrete step towards pollutant reduction. Over time, as resources allow, water systems can build on their initial efforts to pursue a broader approach that engages more local and/or regional partners and diverse community perspectives. With place-based planning, the goal of collaborators could be to develop an aquifer protection plan (e.g. the City of Florence, Oregon's plan: *http://www.ci.florence.or.us/planning/drinking-water-protection*) or a comprehensive watershed management plan that integrates surface and groundwater protection measures for drinking water and other important water uses in the region.

The process diagram in Figure 10 summarizes a streamlined approach for drinking water protection planning. Protection planning may also include the following important steps:

1. Identify human resources to work on protection/restoration planning.
2. Solicit available technical experts, citizens, and landowners to form advisory committee (DEQ/OHA can provide technical assistance and/or participate).
3. Review Updated Source Water Assessment and identify potential stakeholders and partners within drinking water source area. This includes the water system and any other entities that have jurisdiction and/or regulatory authority, such as cities, counties, state, federal agencies, Tribes, or special districts. This is particularly important for locations where priority sources occur.
4. REQUEST STATE AGENCY ASSISTANCE to provide GIS and database information/maps, along with technical support, especially for broader place-based planning efforts. (see Section 4.0 for list of for contacts).
5. Develop enhanced potential contaminant source (PCS) inventory to identify and map any additional PCSs not already included in the USWA.
6. PRIORITIZE protection and restoration activities using all available information/maps; general criteria for prioritization include:
    a. Proximity to wells/springs
    b. Location within identified sensitive and/or susceptible areas in DWSA
    c. Land uses/activities that pose significant threat to water quality(e.g. use of toxic chemicals, application of pesticides, older septic systems, etc.).
7. Use available resources to develop basic protection strategies for high priority PCSs with input from stakeholders; if feasible pursue larger efforts such as a Place-based Planning approach (see details below), or a Drinking Water Protection Plan (which can be a component of Place-based Planning).
8. Establish a timeline for implementing strategies and identify individuals and/or organizations that will take the lead and/or assist (utilize technical assistance from DEQ and OHA).
9. Determine level of funding necessary to accomplish short-term and longer-term protection planning and identify potential funding sources.

10. Isolate individual strategic priorities and assign (or hire) a coordinator to implement each priority as resources and time permit.
11. If resources are limited for accomplishing proposed protection efforts, apply for grants or loans with assistance from partners who can implement the work.

Data Available to Support Surface Water Protection Efforts

Sources of data on watershed conditions and natural risks that could aid in developing plans and strategies for surface water protection include, but are not limited to, the following (see also agencies and organizations listed in Section 4.0):

- DEQ Drinking Water Source Area data layers
- Drinking water source area conditions and risks from Source Water Assessment Report
- National Land Cover Database (NLCD) for land use
- Aerial photography (current and past) from Google Earth
- Digital elevation models (DEMs) from Oregon Geospatial Enterprise Office
- Waterbody locations and flow paths from USGS (National Hydrology Dataset);USDA-NASS Cropland Data Layer (USDA 2015) for land use
- Groundwater levels, aquifers, water use, and water quality data from USGS and USEPA
- Disturbance data from USFS
- Soil contaminant leaching research data from Oregon State University
- National Soil Information System (NSIS) data from NRCS
- Water quality and quantity data from Oregon databases – DEQ, ODA's Pesticide Stewardship Partnership, WRD, others

Additional data on land uses, management, or potential risks due to human activities:

- Agricultural Water Quality Management Plan for your area (ODA)
- Source Water Assessments and Updated Assessments completed by DEQ and OHA contain information on potential contaminant sources, well construction, and susceptibility
- Site Assessment database at DEQ
- Land ownership category data from ODF and other agencies
- Most recent data on locations of hazardous material from DEQ and the State Fire Marshall
- More details on locations of county roads, forest roads (County, ODF)
- Forest practice notifications for harvest and application of pesticides (ODF)
- Update on locations of quarries and gas wells from DOGAMI

Appendix 2 is a compilation of information on the most common potential impacts to the drinking water sources in Oregon. Appendix 2 "Pollutant Reduction Strategies for Land Uses/Activities" lists the categories of land uses and activities that are identified in the Updated Source Water Assessments, then summarizes the potential impacts or risks from those

activities. *Contamination most commonly occurs when chemicals are improperly handled or best management practices are not followed. The purpose of developing strategies to "protect" a drinking water source area is to reduce the risks of spills, pollutant release, or off-site movement of chemicals.* The Appendix 2 table provides key pollutant reduction ideas and resources for implementing drinking water source protection strategies.

Local and statewide technical, financial, and labor resources may be available to assist in implementation of source water protection. For example, community members, volunteer labor, and the expertise of state agencies can be important sources of technical assistance and on-the-ground implementation of protection strategies. There are grants available from state and federal government agencies as well as foundations and non-profits (see Section 4.0). Local experts in water quality, conservation practices, restoration, forestry, fisheries, etc. may be willing to contribute their knowledge and time. Service organizations, schools (including colleges/universities), OSU County Extension offices, Soil and Water Conservation Districts, and Watershed Councils can be a source of knowledge, labor, and sometimes funds. Local landowners and residents are often valuable resources with important insights and understanding of area ecosystems and land management.

Working with landowners within delineated drinking water source areas for public water systems must be a top priority in conservation and protection. If all or part of the area is owned by entities other than the public water supplier, then engagement and cooperation (or at least permission) of the landowner is necessary. This could take the form of permission to evaluate and remedy degraded sites on the landowner's property, a cost-share agreement where the landowner does the work and the water system assists with the necessary expenses and resources, or simply encouraging the landowner to implement conservation practices on their own. Some landowners will be reluctant to allow access to their property for liability and other reasons. Therefore, developing a carefully negotiated agreement can address those concerns. An agreement may take the form of a "Memorandum of Agreement" (MOA) often used between municipal entities and private or public landowners. The discussions and agreements with landowners in the drinking water source area regarding management practices (including agreements with monetary compensation attached) are an important tool.

There are many technical resources available to producers that outline pesticide use practices to increase yields and reduce costs. However, comparatively few resources (such as materials on Integrated Pest Management and less-toxic options) are available to compare different pesticide management practices in terms of their impact on sustaining the quality of ground- or surface water for agricultural production and agricultural communities. Ensuring high quality ground- and surface water is essential for important agricultural purposes such as livestock watering and irrigation of crops, as well as for providing drinking water to rural and urban homeowners in communities of all sizes. The shared vision of protecting agricultural water quality necessitates availability of screening tools for identifying pesticide use practices and

their associated potentials for contaminating water resources. For these reasons this guide includes several crop-related tools that are intended to provide preliminary information regarding the effects of agricultural pesticide use within the vicinity of the drinking water source areas. This information may in turn encourage and bring about a greater level of discussion regarding community-led drinking water protection planning as it relates to the agricultural sector, urban pesticide usage, and other land uses that involve pesticide application.

In preparation of this resource guide, DEQ collaborated with a number of state partners to develop information that may help public water systems prevent or reduce contamination from sources within their recharge area.

6.0 POLLUTANT REDUCTION TOOLS

This section provides summaries and examples of tools that public water systems may find useful for implementing pollutant reduction within drinking water source areas for surface water intakes.

For the purposes of this guide, a "tool" is defined broadly as an organized collection of data and/or information that may be used in informing technical assistance and implementation of drinking water protection planning. A partial list of what can be considered a "tool" are maps, tables, diagrams, checklists, charts, online resources, scientific models and estimation methods, and other formats. The land cover-related tools provided and referenced within this guide range in complexity from simple tables to high-resolution geospatial information system (GIS) maps. Several of the tools display statewide data that may not be directly transferrable for use at the local level due to the lack of resolution. In such cases where a local, site-specific, or tailored map/tool is needed, please make these requests directly to DEQ Drinking Water Protection (Julie Harvey at 503-229-5664).

Communities of sufficient size, resources, and other means may be able to develop drinking water source protection plans for their water resources without the use of the tools provided in this section. Many communities that fit this description have already taken steps to develop and utilize screening tools, resources, and strategies for reducing potential risks to their drinking water. Other communities may lack the information or data to engage landowners or managers within the drinking water source area. These discussions may be aided through the use of the tools provided in this section.

The tools provided in this section are intended to be used by public water system staff, managers, and community leaders with assistance received from their regional or county *partner organization*. A partner organization for community-led drinking water protection efforts are most often the local Soil and Water Conservation District (SWCD), watershed

council, the university extension office (OSU), the USDA NRCS district, and/or possibly a contracted natural resources consultant. Early involvement of a partner organization is critical in order to ensure that screening tools are accessible, used properly, and are effective. Partner organizations may also be able to assist with follow-up efforts that may require grant writing and additional funding when in-depth investigation of natural resources may be deemed necessary. It is important that public water systems and community leaders involve their regional partner organization at the outset when using screening tools provided in this section. The consolidated list of potential partner organizations for Oregon counties can be found in Section 4.0.

The authors of this resource guide would like to stress that ***none of the tools provided in this section are regulatory***. Instead, the use of the tools are highly encouraged. A community's decision to put the screening tools into use represents a community effort towards the broader, long-term goal of drinking water source protection planning. The tools provided in this section do not attempt to model a watershed, an aquifer, or the transport or fate of contaminants. Rather, they are viewed more as screening tools for potential contaminant sources that provide preliminary information for informing community-led discussions aimed at drinking water source protection. Screening tools provide a cost-effective way to focus and prioritize limited resources where community planning efforts are expected to yield the greatest benefit to drinking water source protection. None of the tools in this section should be considered "definitive" analysis or a "risk analysis" for surface water vulnerability or bacteria, sediment, or pesticide transport to waterbodies.

Land Cover Maps

The Updated Source Water Assessments (sent to each public water system) include maps showing current land uses within the drinking water source areas. These land cover maps are a combination of multiple datasets developed by DEQ, most recently updated in March 2017. The primary dataset is from Bureau of Land Management BLM (OWNERSHIP_POLY.shp dated 06/20/2013) obtained from BLM: http://www.blm.gov/or/gis/data-details.php?id=425. (Publication date: 2013/07/18)

The dataset has been modified by grouping land owner categories in order to simplify data display on the map and using geospatial techniques to add additional data to capture the following land uses:

- Agricultural land using a combination of the National Agricultural Statistics Service (NASS) data from Natural Resource Conservation Service (2007 " cdl_awifs_r_or_2007.tif") and agricultural land zoning from Oregon Department of Land Conservation and Development (note that public water systems may obtain more detailed information on potential crop types using the US Department of Agriculture - National Agricultural Statistics Service "CropScape-cropland data layer" available at https://nassgeodata.gmu.edu/CropScape/),

- Private industrial forests using Oregon Department of Forestry's (ODF) Private_Industrial_2006_ ORLambert.shp" last updated in 2013,
- Local government land combined from BLM ownership, tax lot ownership information from local county tax lot data and "OR Map" on-line application: http://www.ormap.net/,
- Private urban lands based on private lands located within 2016 city limits, and
- All other categories (BLM, USFS, State, etc) from BLM 06202013 data. Note that Private urban lands may include residential, municipal, commercial, and industrial land uses. Private non-urban lands typically include rural residential land but may also include commercial and industrial land uses.

Because of the nature of combining multiple datasets, minor discrepancies will be seen in some maps especially at larger scales. Public water systems and communities could use tax lot data available from the counties or other datasets to further refine the analysis if higher accuracy is needed.

For the source water areas close to the intakes, public water systems may want to develop more detailed maps to prioritize pollutant reduction strategies. For those areas that are current productive agricultural lands, there are additional resources available for mapping and engaging local partners. **Table 2** provides a list of example land covers that can be identified through imagery. The methodology for the USDA National Agricultural Statistics (NASS) imagery is to identify one of over 240 unique agricultural land covers, referred as "Cropland Data Layers (CDL)". The metadata for generating the source CDL imagery is referenced in Section 8.0 (USDA 2015). After identifying the CDL covers, the tool then identifies each of the non-agricultural land covers as provided by National Land-Cover Database (NLCD). The NLCD is a result of work by a federal agency consortium. The two sources of data are combined within this recommended Land Cover Map tool.

National Land Cover Database Classifications (NLCD 2011)	Continental US Land Cover Classifications (CDL 2015)
Water/ Barren	**CDL Land Use Examples**
Open Water	**Alfalfa**
Perennial Ice/Snow	
Barren Land (Rock/Sand/Clay)	**Barley**
Developed	
Developed, Open Space- Impervious surfaces are 20%	**Cherries**
Developed, Low Intensity- Impervious surfaces are 20% to 49%	**Grapes**
Developed, Medium Intensity - Impervious surfaces are 50% to 79%	**Grassland/Pasture**
Developed High Intensity- Impervious surfaces are 80% to 100%	**Oats**
Forest	**Onions**
Deciduous Forest	
Evergreen Forest	**Pears**
Mixed Forest	
Shrubland	**Potatoes**
Shrub/Scrub	
Herbaceous	**Sod/Grass Seed**
Grassland/Herbaceous	
Wetlands	**Sweet corn**
Woody Wetlands	
Emergent Herbaceous Wetlands	**Winter wheat**
The classification system used by NLCD2011 is modified from the Anderson Land Cover Classification System*	The complete CDL Land Use listing can be retrieved at: https://www.nass.usda.gov/Research_and_Science/Cropland/sarsfaqs2.php#Section1_9.0

Table 2. Example Land Characteristics and Cover Identified through Imagery

Depending on data sources being updated on a regular basis, more detailed mapping may also be available from local agencies. Public water systems can also request tax-lot data from local city or county agencies. At present, when a public water system requests a more detailed land use map from DEQ for their drinking water source area(s), the community will receive the most updated imagery available from DEQ, including the *USDA National Agricultural Statistics and the National Land-Cover Database* (USDA 2015).

High Soil Erosion Potential

DEQ uses two different soil datasets for analyzing soil erodibility depending on the overall slope of the land surface. These two datasets are described as follows:

For areas with steeper slopes (>30%) - This information was developed in accordance with the methods detailed in Oregon's Source Water Assessment program to assist public water systems prioritize drinking water protection strategies within their source area and was updated in 2016 using Natural Resource Conservation Service (NRCS) 1:24,000 Soil Survey Geographic Database (SSURGO) and State Soil Geographic Database (STATSGO) data downloaded 25OCT2016. High Soil Erosion Potential for non-Forest Service lands with steeper slopes is determined by combining the effects of slope and the rock-free soil erodibility factor ("K_f-factor") using SSURGO and STATSGO data. The K_f-factor quantifies the susceptibility of soil particles to detachment and movement by water including the effects of rainfall, runoff, and infiltration. Soils with "high" soil erodibility ratings are considered sensitive to extensive ground disturbance such as some yarding methods and road building activities. Soils classified as "high" include soil with slopes of 30% (or greater) and K_f-factors (kffactor - rock free) of 0.25 (or greater). Soil Resource Inventory (SRI) information from the US Forest Service was used to determine erosion potential on National Forest lands. Erosion potential for soils represented in the SRI data is based on available representative data attributes such as sedimentation yield potential, sediment, or surface soil erosion potential. Specific information on the factors used for each National Forest to evaluate sensitivity is available from DEQ upon request.

For areas with lower slopes (generally <30% i.e. valleys and agricultural lands): This information is derived from two sources of information. Section 3.0 has additional details and a statewide example maps for both methods which use SSURGO data from USDA Natural Resources Conservation Service (NRCS).

The first is the Off-Road/Off-Trail Erosion Hazard Rating system developed by NRCS as shown in the Web Soil Survey online viewer (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx). Erosion hazard ratings group soils through a combination of K_w-factor (whole soil erodibility) and slope into Slight, Moderate, Severe and Very Severe classes. Higher slope and/or higher K_w-factor ratings result in higher ratings, and modifying conditions (incompetent rock, high rainfall erosivity, etc.) may necessitate assignment of a soil unit to a more severe rating. We selected those soil units with Severe or Very Severe ratings because significant erosion is possible or likely in these places. This method is suitable for up to 50-75% ground cover disturbance and sheet and rill erosion, including effects from machinery, grazing, and other ground and vegetation disturbing agricultural and silvicultural activities. It is not suitable for tillage, gully erosion, and other major disruptions of soil structure and vegetation cover.

The second method is Oregon Department of Agriculture's Erosion Vulnerability Index, which is based on NRCS' Revised Universal Soil Loss Equation (RUSLE). Data are available from DEQ and ODA; DEQ can assist with mapping upon request. This method uses the environmental variables from RUSLE (K_w-, R-, and LS-factors—whole soil erodibility, rainfall erosivity, length and gradient of slope, respectively) and sets the management variables (C- and P-factors—cropping and erosion control practices, respectively) to 1, representing a lack of ground cover and erosion control actions or structures. Therefore, the Erosion Vulnerability Index shows locations where erosion potential is higher and erosion control practices (e.g. cover crops, no till, etc.) are most beneficial. DEQ and ODA consider results EVI >5 tons lost per unit area in need of greater attention and caution. This method is suitable for all level of soil disturbance, especially more intensive management such as plowing and cultivation.

Landslide Risks

For mapping landslides, DEQ uses the Oregon Department of Geology and Mineral Industries (DOGAMI) Statewide Landslide Information Database of Oregon Release 3.2 (SLIDO-3.2). The data includes earth and debris slides, flows, slumps, falls and complex landslide types, but does not include rock material landslide deposits. The landslide data set is published to improve the understanding of landslide hazards in Oregon and to provide a statewide base level of landslide data. This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information. This publication cannot substitute for site-specific investigations by qualified practitioners. Site-specific data may give results that differ from the results shown in the publication. For more information see: http://www.oregongeology.org/sub/slido/

DEQ's Water Quality Program is currently working with DOGAMI to develop and provide a more detailed landslide potential analysis for public water systems. Contact Oregon DEQ's Environmental Solutions Division/Water Quality Program for further information on the analysis. If data is available for the specific area, DEQ will provide the more detailed landslide analysis to the public water system.

Urban Homeowners and Pesticides

At present, the use of pesticides in urban settings by homeowners are considerably more heterogenous and unpredictable than agricultural pesticide applications. In high density housing areas, if a good portion of the homeowners are applying pesticides liberally, this could cause a regional water quality problem. For these reasons we have chosen to provide a resource that consolidates the a wide range of best use practices for homeowners when attempting to manage pests.

Urban homeowners tend to apply relatively high rates of general use pesticides on a per area basis for the maintenance of lawns, home gardens, and ornamentals plants. Most homeowners apply pesticides with minimal or no training, and they usually apply pesticides without a pesticide applicator license (as general use pesticides do not require an applicator license). For these reasons there is a reasonable likelihood to expect that residential pesticide applications can readily result in off-target transport of pesticides. This means that residential pesticides that are applied near homes may end up traveling below the root zone of the targeted vegetation. These pesticides would be expected to travel on to contaminate the underlying aquifer or a nearby aquifer. Residential pesticide use is also likely to be washed off-site during storm events or through excessive watering, and thereby have the result of contaminating municipal stormwater (surface water pollution).

In recognition of this challenge, several larger municipalities in the Pacific Northwest created an online tool called Grow Smart, Grow Safe. The tool is both a website (desktop) tool as well as a smartphone/mobile application (http://www.growsmartgrowsafe.org/). The tool provides homeowners with non-chemical options as well as comparative hazard ratings for different products depending on their intended use and application. This is a free resource to the public that is intended to assist homeowners in making informed decisions and thereby lead to a reduction of negative environmental impacts that are commonly associated with pesticide use. Grow Smart Grow Safe organizes its information and ratings by whether the intended user is managing for insects, weeds, plant diseases, and animal pests. Additional information about less-toxic alternatives can be found at the National Pesticide Information Center (http://npic.orst.edu/ingred/lowrisk.html & http://npic.orst.edu/ingred/organic.html; see below).

Common Crop-Pesticide Associations

Gaining a better understanding of land use activities within a drinking water source area for public supply wells is an important step towards developing strategies for drinking water source protection. As discussed in Section 5.0 above, within the place-based planning approach for drinking water source protection, it is important to use every available data source to identify vulnerabilities and risks to be addressed in risk reduction. After identifying the land uses and activities in the drinking water source area, the next step is to prioritize the reduction work based on the particular chemicals or pesticides that may impact the drinking water system. In this section, tools are provided that enable the public water system staff to identify priority areas regarding potential risks from pesticides.

The association of pesticides with specific land management practices can vary over time based upon several factors. Today's producers must continually adapt to many factors when considering what to grow year to year. Some of these factors include: changing commodity

prices, climate change, available labor, cost of crop inputs (pesticides and fertilizers), and encroaching urbanization in some areas. For more information, see: www.oregon.gov/ODA/shared/Documents/Publications/Administration/BoardReport.pdf

However, county level statistics suggest that crop selections and their yield tend to be relatively stable over the past two decades. The stability in land management decisions is further supported by the consistency of USDA satellite imagery data (as shown in Figure 8). Proven pest management strategies tend to be carried forward from the previous year into the next. Where a crop-rotation plan is practiced, these operations typically rotate back through set grouping of crops as well as a corresponding set of pest management strategies. The possible variability in crops and pesticides can be addressed through precise mapping and working closely with the local agricultural partners.

Several resources or tools are described here that may be useful in identifying pesticides that are most commonly associated with specific land uses or crops.

Washington State University Cooperative Extension Service operates an extensive resource with information on crops and pesticides. The "Pesticide Information Center Online" (PICOL) can be found at: http://picol.cahe.wsu.edu/labels/backup/ViewOptions.php?SrchType=C.

The PICOL database of registered pesticides provides thousands of potential pesticide use associations. It is good resource for drinking water source planning efforts, but the sheer volume of pesticide registrations contained in PICOL means that it may not be the best tool for initiating the drinking water source protection efforts. After initial characterization, the PICOL database may be a secondary research tool for identifying more details of the crop-associated pest management strategies.

Table 3 provides a starting point or a preliminary identification of which pesticides are most commonly associated with specific land uses. Table 4 provides common crop application patterns for the pesticides that are typically applied to more common Oregon crops. The patterns or associations between land management and pesticides in Table 4 are a result of multiple producer/landowner survey data, pesticide registration information, and published regional strategies for managing pests (Pacific Northwest Pest Management Handbooks http://oregonstate.edu/dept/coarc/plant-disease-management-handbook). While most of the land uses are specific crops, nursery operations, Christmas trees, and other non-crop land uses are included in these tools as they are available. *Please note that this table is simplistic and may not be representative of crop pesticides in your drinking water source area.* The table is included for educational purposes only. Local partners (listed in Section 4.0) will be able to assist in identifying the actual crops and pesticides.

Table 3. Common Crop-Pesticide Associations in Oregon

DATA SOURCES: *The majority of the data in this table are survey data provided by the USDA-NASS Agricultural Chemical Use Program, with the additional data sources listed at the bottom of the table. The NASS program is USDA's official source of statistics about on-farm pesticide use and pest management practices. NASS collects information directly from growers, who participate voluntarily and on a confidential basis. The NASS data are empirical and report actual pesticide use. Estimates were subject to sampling variability; sampling variability was measured by the coefficient of variation (cv), expressed as a percent of the estimate.*

Crop	Type of Pesticide	Predominant	Estimate of % Acres Treated	Additional commonly-used chemicals	Data Source	Year
Alfalfa	Herbicide	Metribuzin	--	Diuron	2	1992 - 2013
Apples	Fungicide	Triflumizole	55	Penthiopyrad, Myclobutanil, Mancozeb, Streptomycin sulfate, Trifloxystrobin	1	2015
Apples	Herbicide	Glyphosate	49	--	1	2015
Apples	Insecticide	Chlorantraniliprole	58	Carbaryl, Methoxyfenozide, Spinetoram	1	2015
Blackberries	Fungicide	Cyprodinil; Fludioxonil	52	Azoxystrobin, Pyraclostrobin, Captan	1	2015
Blackberries	Herbicide	Carfentrazone-ethyl	54	Simazine, Paraquat, Diuron	1	2015
Blackberries	Insecticide	Zeta-	64	Bifenthrin	1	2015

		Cypermethrin				
Blueberries	Fungicide	Cyprodinil	54	Fludioxonil, Azoxystrobin, Captan, Fenhexamid, Boscalid, Pyraclostrobin, Fenbuconazole	1	2015
Blueberries	Herbicide	Simazine	35	Diuron, Flumioxazin	1	2015
Blueberries	Insecticide	Zeta-Cypermethrin	61	Malathion, Thiamethoxam, Bifenthrin	1	2015
Cherries, Sweet	Fungicide	Quinoxyfen	54	Triflumizole, Pyraclostrobin, Boscalid, Trifloxystrobin	1	2015
Cherries, Sweet	Herbicide	Glyphosate	25	--	1	2015
Cherries, Sweet	Insecticide	Imidacloprid	44	Fenpropathrin, Malathion, Lambda-Cyhalothrin	1	2015
Christmas Trees[1]	Fungicide	Chlorothalonil	--	--	1	2009
Christmas Trees[1]	Herbicide	Glyphosate Iso. Salt	--	--	1	2009
Christmas Trees[1]	Insecticide	Chlorpyrifos	--	--	1	2009
Corn, Sweet	Herbicide	Atrazine	95	Dimethenamid-P	1	2014
Grapes, Wine[2]	Fungicide	Quinoxyfen	70	Cyclufenamid, Boscalid, Pyraclostrobin, Fluopyram, Ebuconazole,	1	2015

				Triflumizole		
Grapes, Wine[2]	Herbicide	Glyphosate Iso-Salt	67	Paraquat, Glyphosate Amm. Salt, Carfentrazone-Ethyl	1	2015
Grapes, Wine[2]	Insecticide	Bifenthrin	26	Abamectin	1	2015
Hazelnuts	Fungicide	Chlorothalonil	--	--	7	2006
Hazelnuts	Herbicide	Paraquat	--	2,4-D	7	2006
Hazelnuts	Insecticide	Esfenvalerate	80	Chlorpyrifos, Permethrin, Pyriproxyfen	7	2006
Hops	Fungicide	Quinoxyfen	--	Pyraclostrobin, Boscalid	5	2013
Hops	Herbicide	Carfentrazone ethyl	--	Paraquat, Clethodim, 2,4-D	5	2014
Hops	Insecticide	Imidacloprid	--	Bifenthrin, abamectin (mite), spiridoclofen (mite), hexythiazox (mite)	5	2010, 2013
Mint	Herbicide	Bromoxynil	--	Bentazon	3	2011
Mint	Insecticide	Chlorpyrifos, Acephate	--	Chloranthraniliprole	4	2015
Nursery Stock[1]	Fungicide	Chlorothalonil	--	--	1	2009
Nursery Stock[1]	Herbicide	Glyphosate Iso. Salt	--	--	1	2009
Nursery Stock[1]	Insecticide	Petroleum Distillate	--	--	1	2009

Onions	Fungicide	Mancozeb	48	Pyraclostrobin, Mefenoxam, Chlorothalonil	1	2014
Onions	Herbicide	Pendimethalin	88	Bromoxynil Octanoate, Oxyfluorfen, Clethodim, Dimethenamid-P, Glyphosate	1	2014
Onions	Insecticide	Methomyl	90	Spirotetramat, Azadirachtin, Chlorpyrifos	1	2014
Pasture and Hay	Herbicide	2,4-D	--	MCPA, Diuron	2	1992 - 2013
Pears	Fungicide	Mancozeb	84	Penthiopyrad,Triflumizole, Pyraclostrobin, Boscalid	1	2015
Pears	Herbicide	Glyphosate	42	2,4-D	1	2015
Pears	Insecticide	Spirotetramat	82	Pyridaben, Pyriproxyfen, Abamectin, Chlorantraniliprole, Etoxazole, Lambda-Cyhalothrin	1	2015
Potatoes [2]	Fungicide	Chlorothalonil	78	Mancozeb, Mefenoxam, Fluazinam, Azoxystrobin, Boscalid, Fludioxonil, Cymoxanil, Famoxadone, Difenoconazole	1	2014
Potatoes [2]	Herbicide	Rimsulfuron	37	--	1	2014

Potatoes [2]	Insecticide	Novaluron	29	Flonicamid	1	2014
Raspberries	Fungicide	Cyprodinil	58	Fludioxonil, Boscalid, Pyraclostrobin, Azoxystrobin	1	2015
Raspberries	Herbicide	Simazine	42	Paraquat	1	2015
Raspberries	Insecticide	Zeta-Cypermethrin	58	Bifenthrin	1	2015
Ryegrass seed	Insecticide	Chlorpyrifos	--	--	6	2002
Strawberries	Fungicide	Boscalid, Pyraclostrobin	67	--	1	2014
Strawberries	Herbicide	Flumioxazin	54	--	1	2014
Winter Wheat	Herbicide	2,4-D	49	Imazamox, Metsulfuron-Methyl, Thifensulfuron, Tribenuron-Methyl	1	2015

Notes

1 -Cut Christmas tree and nursery survey data from the USDA chemical use program include data from multiple program states, of which Oregon was one of the participating program states.

2 -USDA surveys of Washington wine grape and potato producers were used since Oregon data of this type was not available at the time this table was compiled.

Table 3 (Continuation). Common Crop-Pesticide Associations in Oregon

References/ Data Sources

1 -[USDA-NASS] U.S. Department of Agriculture–National Agricultural Statistics Service. 2016. Agricultural Chemical Use Program. Washington, D.C.: USDA National Agricultural Statistics Service, Accessed Online October, 18, 2016: https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/index.php

2 -Pesticide use estimates are based upon USGS NAWQA project data. Nancy T. Baker, U.S. Geological Survey, 2016, written communication.

3 -Sbatella G and Twelker S, "Weed Control Programs in Mint Based Upon Spring Applied Herbicides to Minimize Rotational Restrictions," Central Oregon Agricultural Research Center, Oregon State University. Accessed online February 2017: http://oregonstate.edu/dept/coarc/sites/default/files/weed_control_programs_in_mint_based_on_spring_applied_herbicides.pdf

4 -Butler M, Walenta D, Sullivan C, Anderson N, Berry R, "Electronic Mint Pest Alert Newsletter to Promote Optimal Application of Coragen (R) to Control Mint Root Borer, Cutworms, Armyworms and Loopers." Central Oregon Agricultural Research Center, Oregon State University. Accessed online February 2017: http://oregonstate.edu/dept/coarc/sites/default/files/publication/07_herbicide_tea_leaves.pdf

5 -O'Neal S, "Pest Management Strategic Plan for U.S. Hops," Washington State University Irrigated Agriculture Research and Extension Center. Accessed online February 2017: https://ipmdata.ipmcenters.org/documents/pmsps/US-hops-PMSP2015.pdf

6 -USDA Integrated Pest Management Center, [Report], "Crop Profile for Ryegrass Seed in Oregon." Accessed online February 2017: https://ipmdata.ipmcenters.org/documents/cropprofiles/ORryegrass.pdf

7 -DeFrancesco J, Oregon State University, Workshop Summary, "Pest Management Strategic Plan for Hazelnuts in Oregon and Washington." Accessed online February 2017: http://www.ipmcenters.org/pmsp/pdf/ORWA_Hazelnut.pdf

The data in Table 3 provides a preliminary list for discussing pest management practices that are used within the drinking water source area. As indicated in the notes, there are limitations associated with the data. For example, the USDA surveys of Washington wine grape and potato producers were used since Oregon data of this type was not available at the time this table was

compiled. The data on the percentage of total acreage treated are for the first (predominant) pesticide listed by the survey, and the data are not always available. The table does not include common "organic-approved pesticides" that may be used in both organic and conventional agricultural systems. The PICOL Pesticide Database was accessed and cross-referenced for Oregon-registered products. Site-specific pesticide use practices should be confirmed through discussions with producers and landowners. These discussions benefit from guidance and assistance provided by the agricultural service partner organizations (see Section 4.0).

The US Geological Survey has done extensive research on pesticides in surface water and groundwater across the country. USGS data on pesticides in US waters can be found here: https://pubs.usgs.gov/fs/2006/3028/

As part of the USGS research, their National Water-Quality Assessment (NAWQA) Program not only does research in pesticide occurrence, but also how that data relates to land use and pesticide use. The NAWQA program is currently working to publish reports on new statistical models that can be used to estimate the concentrations or occurrence of some pesticides in streams and ground water where they have not yet been measured. The national NAWQA data are sufficiently extensive to support these statistical models. The spatial extrapolation allows NAWQA's data on detections, sources and factors that affect pesticide occurrence —such as pesticide use and land use, climate, and soil characteristics—to be used as a more comprehensive national assessment that includes unmonitored areas. The Watershed Regressions for Pesticides (WARP) Models give a means to predict probable pesticide concentrations in waterbodies, given several watershed characteristics, pesticide properties, and use practices.

USGS has developed pesticide-use maps that show the geographic distribution of estimated use on agricultural land in the conterminous United States for numerous pesticides. Maps were created by allocating county-level use estimates to agricultural land within each county. Graphs at the county level are available that show annual use by major crop for the mapped pesticides (Thelin et al 2013). These pesticide use estimates are suitable for evaluating national and regional patterns and trends of annual pesticide use (Baker et al 2015). USGS notes that the reliability of estimates generally decrease with scale and these maps are not intended for detailed evaluations, such as within or between specific individual counties. Details for how the pesticide-use maps are made, including data sources and methodologies, are available here:

https://water.usgs.gov/nawqa/pnsp/usage/maps/

For purposes of providing additional tools to be used within drinking water source areas, DEQ used the data from USGS and Oregon-specific data for pesticides in statewide water quality monitoring to create a "Categorical Crop to Pesticide Table". The table is attached as **Appendix 3.** It provides a broad association between common Oregon crops and pesticide use, potentially useful as another starting point in working to develop drinking water protection strategies.

Additional information on pesticides and for crop-pesticide association is the National Pesticide Information Center (NPIC). The NPIC is a cooperative agreement between Oregon State University and the U.S. EPA (#X8-83560101). This site is an important reference for pesticide related information, providing science-based information about pesticides and pesticide-related topics, including information on health/environmental impacts, pest identification, pesticide label and MSDS databases, manufacturers, statistics, and records of exposures, etc. The NPIC site can be accessed at the following location: http://npic.orst.edu/

It is important to state again that pesticide use practices may have variability with respect to geography, time/season, and landowner decisions. The site-specific data for chemical and pesticide usage should be verified at the field level. The specific land uses, cropping patterns, and associated pesticides chosen by landowners/producers can change from one year to the next. Agricultural producers may need to adapt new strategies to manage pests. The particular pest pressures will vary from year to year, and chemical companies formulate new pesticides for review and potential registered usage in Oregon. Agricultural service partners (Section 4.0) may be able to assist with the outreach necessary to work with the landowners and operators so that there is an understanding of their practices and product usage.

Conservation Practices

Drawing upon the extensive research available nationwide from USDA, universities, and other organizations, it is well known that some conservation practices are universally beneficial to reducing the potential for pesticides or other pollutants to reach to surface water. To provide background information on potential technical approaches, here are summaries of some of the leading conservation practices:

- Irrigation practices—restricting irrigation based on plant needs and soil water content can reduce the potential for pesticides to be moved off-target to contaminate groundwater or surface water. A selection of free-for-use desktop and mobile irrigation scheduler applications for multiple irrigation methods are available at the WSU Extension website: http://irrigation.wsu.edu/Content/Select-Calculators.php .
- Timing of pesticide applications—observing weather patterns and avoiding the application of pesticides preceding rain events considerably reduces the potential for off-target pesticide movement.
- Quantity of pesticide application—precision agriculture techniques are allowing producers to better utilize pesticides and their efficacy as a win-win for producers' profits and a way to reduce the potential for water quality impacts.
- Nutrient management—calculating the necessary nutrients using soil characteristics can maximize yields and protect water quality.
- Integrated Pest Management—developing non-chemical solutions (e.g. crop rotations, trap crops, beneficial insects, etc.)

- Conservation tillage—integrating crop residual through tillage and reduced tillage practices can provide increased returns in crop yield, enhanced soil health (increased nutrients and organic matter, better water infiltration and storage), and reduced erosion and water pollution (USDA 2016).
- Cover cropping—keep the soil surface covered and conserving nutrients by planting cover crops between market crops builds soil structure and health, retains nutrients, prevents erosion, and increases crop yields (USDA 2016).
- Organic farming---approved organic farms generally use natural pesticides or pesticides lower in toxicity and persistence.

The above points are a few of the key strategies that can lead to increased profits while at the same time reduce costs and risks of off-site movement of agricultural crop products. A sampling of current innovations in IPM can be accessed through the OSU Integrated Plant Protection Center website at: http://www.ipmnet.org/index.htm

Additional strategies for IPM can be found from local partner organizations in your county (Section 4.0). *These same resources should also be consulted for technical assistance when attempting to use or implement the tools provided in this section of the guide.*

Nutrient Management

Municipal stormwater contributes a considerable amount of nitrogen from fertilizers used on urban private and commercial properties. On a per area basis, a relatively high amount of nitrogen and other macronutrients are applied to lawns, gardens, and ornamental plants throughout cities. The high rate of application, when combined with large amounts of impervious surfaces in urban settings, presents a considerable challenge to manage nitrogen and other nutrients for city planners. Urban zoning laws and building codes are increasingly taking into account over time the influence of impervious surface effect and the corresponding need to construct bioswales, buffers, and constructed wetlands to mitigate these effects. In most cases these requirements are only placed upon new and larger-sized development projects and they do not apply to existing or previously completed projects. In 2014, DEQ issued "Oregon's Nutrient Management Program" guidance that discusses sources and source control for nutrients in Oregon:

http://www.oregon.gov/deq/FilterDocs/NutrientManageRep.pdf

Many tools for urban nutrient management can be found on this US EPA website:

https://www.epa.gov/nutrientpollution/what-you-can-do

In agricultural areas, the Oregon Department of Agriculture (ODA) addresses excessive nutrient runoff through implementation of its 38 Agricultural Water Quality Management Area plans and rules. Numerous financial incentives are available to encourage agricultural landowners to

reduce nutrient runoff and off-site movement, including programs through the state Soil and Water Conservation Districts, Oregon Watershed Enhancement Board, DEQ's Section 319 nonpoint grants, and federal grant programs. The Oregon Department of Forestry also addresses nutrients in its fertilizer application management program.

Cover crops and no till operations have the benefit of reducing or even eliminating the need for fertilizer application. They reduce the leaching of nutrients, and they are protective of our shared drinking water resources. ODA assists farmers and ranchers in Oregon to prevent and control nutrient pollution from agricultural activities on rural lands. More information on agricultural water quality plans and programs can be found here:

http://www.oregon.gov/ODA/programs/NaturalResources/AgWQ/Pages/AgWQPlans.aspx

Nutrient management within the agricultural sector is extremely important for maximizing yields and protecting water quality. Calculating the necessary nutrients for cultivating crops begins with obtaining soil samples from each field that have distinct soil characteristics and crop cultivation histories. Soil samples are best obtained in the fall so that the remaining fertility after harvest can be factored into the upcoming season's planned fertilization schedule. The OSU Extension cover crop calculator for regions both east and west of the Cascades Mountain can be found here: http://smallfarms.oregonstate.edu/calculator. The leftover nutrients after harvest can be carried over to the next seasons and the leaching of these nutrients during heavy winter rainfall events can be minimized through the use of winter cover crops.

Obtaining soil test data can allow producers to fine-tune fertilizer application with each consecutive crop cycle. An additional benefit of obtaining soil sample results is that they may influence a producer's decision for which cover crop to use. Soil sampling for nutrients is best done in the spring before planting and in the fall after harvest. The spring samples are useful for knowing the concentration of nutrients already present, so the fertilization can be adjusted. The fall sample is an effective measure of how much of the nutrient addition was not used by the crop, so the fertilization amount can be adjusted the next season.

When excessive nitrogen remains in the soil, a grass cover crop may effectively take up nitrogen and conserve it for spring planting as a "green manure." Legume cover crops fix additional nitrogen from the atmosphere. Legumes are best used when soils are deficient for this nitrogen. Legume cover crops are capable of fixing up to 150 pounds per acre—enough nitrogen for some of the most heavy nitrogen feeding crops (Hoorman et al 2009). The organic matter produced during the winter months provide a "soil building" benefit to the soil, effectively increasing tilth for present and future production. The use of cover crops have also been found to "jump start" the increase yields obtained from no-till or conservation tillage practices (Hoorman et al 2009). Where conversion to no-till operations have taken many as nine years to observe increased yields, combining cover crops with no-till practices have reduced or even eliminated this lag time to see increase yields.

Potential Goals and Outcomes for Using Tools

The tools in this section are provided to assist public water system officials in understanding some of the primary tools and best management practices to reduce off-site migration of pollutants such as nutrients, sediment (soil), or pesticides. The tools may be useful in the following practical ways:

- For prioritizing technical assistance and outreach efforts;
- To inform the creation and composition of an inclusive community-led drinking water protection planning committee;
- As a technical basis for submitting grant requests;
- As a basis for needing comprehensive modeling of local contaminant sources (e.g. follow-on grants, studies, and/or modeling efforts);
- As justification for new/renewed water quality monitoring/sampling activities.

Additional beneficial outcomes are expected to result from using the tools provided in this section. The use of these tools are best done through collaborative place-based planning approaches. *In practice, keep in mind that most of the coordination and collaboration of the agricultural community will be done through your local partners such as watershed councils, NRCS, and SWCDs.*

7.0 LAND USES AND REGULATORY AUTHORITIES

DEQ, along with the State Departments of Forestry, Agriculture, State Lands, Geology and Mineral Industries, Fish and Wildlife, Parks and Recreation, Land Conservation and Development, and Marine Board have regulatory authority or advisory roles associated with land use activities that potentially impact water quality. Two of the primary mechanisms for DEQ to regulate pollution is through the adoption of water quality standards and Total Maximum Daily Loads (TMDLs) and the related implementation plans. TMDLs and their implementation plans are designed to control source pollution to bring water bodies into attainment with the water quality standards adopted by the state for water bodies in Oregon. Water bodies meeting water quality standards should be readily useable as drinking water sources with standard treatment technology.

In DEQ's rules, a "source" is defined as any process, practice, activity or resulting condition that causes or may cause pollution or the introduction of pollutants to a waterbody (OAR 340-42-0025). Sources of pollutants can be point sources or nonpoint sources. Under ORS 468B.110 (1), DEQ has the specific authority to take the actions necessary to attain and maintain water quality standards and to implement load allocations established under a TMDL. Management

strategies to achieve wasteload and load allocations in a TMDL are implemented through water quality permits for those sources subject to permit requirements in ORS 468B.050 and through source-specific Water Quality Management Plans (WQMP) for other sources.

Nonpoint source pollution is pollution from a diffuse area as opposed to point sources from a discrete pipe, ditch, etc. At DEQ, nonpoint sources are addressed through the following programs: Water Quality Standards, Water Quality Assessment, Groundwater, TMDLs, §319 Nonpoint Source Planning and Grants, Drinking Water Protection, Clean Water State Revolving Fund, Pesticide Stewardship Partnerships, and Water Quality Monitoring. DEQ also coordinates with federal and state agencies that are responsible for nonpoint source issues and identifies them as Designated Management Agencies (DMAs). The WQMPs identify the source-specific implementation requirements and the persons, including DMAs, responsible for developing, implementing, and revising those plans.

There are two areas where DEQ's authority is limited under OAR 340-42-0080 for nonpoint source controls: in forested and agriculture land uses. Nonpoint source discharges of pollutants from forest operations on state or private lands are subject to best management practices and other control measures established by the Oregon Department of Forestry (ODF) under the ORS 527.610 to 527.992. Oregon DEQ may not impose or enforce effluent limits on nonpoint source discharges from forest operations subject to the State's Forest Practice Act, unless such limits are required by the CWA or other federal law.

The Oregon Department of Agriculture (ODA) regulates agricultural activities through Agricultural Water Quality Management Area rules. In areas subject to the Agricultural Water Quality Management Act under ORS 568.900, the Oregon Department of Agriculture (ODA) develops and implements agricultural water quality management area plans and rules to prevent and control water pollution from agricultural activities and soil erosion on agricultural and rural lands.

Regulatory responsibilities vary by land use and ownership type. It is important that public water systems and community citizens understand which agencies have authority for regulation of anthropogenic activities, the structure of those regulations, and the individual agency responsibilities. *The landowner is ultimately responsible for management activities and potential off-site impacts, so in addition to regulatory agencies, community engagement with landowners in a drinking water source area can be a critical component to implement strategies for improving water quality.*

Aggregate & Mineral Mining / Extraction Wells

Development, use, and reclamation of rock pits or quarries are regulated by the Department of Geology and Mining Industry (DOGAMI). DOGAMI acts as DEQ's agent for water quality permitting (under a *Memorandum of Understanding*) and adds permit conditions to the Operating Permit for each facility to ensure compliance with state regulations. Many quarries

contain process water and stormwater runoff on-site which minimizes the risks of groundwater or surface water pollution. Landowners are required to obtain the following permits if they discharge process water or otherwise discharge water from their site:

- DEQ WPCF 1000 General Permit--- for disposing of process water by evaporation or seepage in ponds or by irrigation (issued through DOGAMI);
- DEQ NPDES 1200-A General Permit--- for stormwater from the mining operation and haul roads that drains to surface waters (issued through DOGAMI);
- Individual DEQ NPDES or WPCF Permit--- for discharging process wastewater to surface water or groundwater (issued by DEQ).

Rock pits or quarries located on forestland and used for forest management are exempt from needing a DOGAMI mine operating permit but under the Forest Practices Act (OAR 629-625-0500), they "shall be conducted using practices which maintain stable slopes and protect water quality". On forestlands, the regulating agency for rock pits or quarries is the Department of Forestry.

DOGAMI is also the permitting agency for extraction wells, such as gas, oil, and geothermal wells. DOGAMI coordinates with DEQ to address NPDES or WPCF permitting to protect water quality. More information on the permits for surface mining, wells, or chemical process mining in Oregon can be found here:

http://www.oregongeology.org/mlrr/default.htm

Agricultural Lands

Oregon regulates agricultural activities through programs administered by the Oregon Department of Agriculture (ODA). The Confined Animal Feeding Operation (CAFO) Program regulates animal facilities such as dairies and large chicken and hog operations. CAFOs are point sources of pollution under Oregon and federal law, and many must have a permit to operate. The permits provide for zero effluent discharge limits. For more information, please go to: http://www.oregon.gov/ODA/programs/NaturalResources/Pages/CAFO.aspx

The Agricultural Water Quality Management (AgWQM) Program regulates animal production activities not regulated by the CAFO Program and all other agricultural activities that may impact water quality. The Agricultural Water Quality Management Act, formerly referred to as Senate Bill 1010, gives ODA the authority to establish management plans and adopt rules to prevent and control water pollution from agricultural lands. These areas include those where an agricultural water quality management plan is required by state or federal law, such as DEQ TMDLs and Oregon Groundwater Management Areas (ORS 568.909). ODA's AgWQM area plans and rules are the official TMDL implementation plans for agricultural nonpoint sectors.

There are 38 management areas throughout the state with area plans and the rules that regulate agricultural activities to prevent and control water pollution. **Appendix 4** is a compilation of riparian management widths and rules for agricultural land uses.

All 38 management areas have riparian rules requiring that agricultural activities allow the establishment and growth of stream-side vegetation to provide specific functions such as: moderation of solar heating (shade), filtration of overland flow, and stream bank stability. Further information can be found here: http://www.oregon.gov/ODA/programs/NaturalResources/AgWQ/Pages/AgWQPlans.aspx

ODA's Pesticide Program regulates the sale and use of pesticides in Oregon. Program staff conduct routine compliance monitoring, investigate complaints of alleged pesticide misuse, and administer enforcement actions when appropriate. Enforcement actions, including civil penalties, play a vital role in deterring unlawful use of pesticides. Additional responsibilities include communicating the laws and regulations to licensed pesticide applicators and the public. This is done through continuing education training resources, informational brochures, the ODA website, and one-on-one communication. For more information about ODA's regulatory authorities, see: http://www.oregon.gov/ODA/agriculture/Pages/Laws.aspx

Commercial and Industrial Lands

Oregon waters can be susceptible to contamination from many different commercial or industrial land uses. DEQ is responsible for waste reduction and management from commercial and industrial activities, air quality monitoring, spill preparedness and response, environmental assessment and cleanup, and underground storage tank compliance and cleanup. Oregon's Toxics Use Reduction and Hazardous Waste Reduction Act of 1989 was one of the first laws in the nation to mandate pollution prevention planning. The Act outlines a comprehensive approach to reduce or eliminate toxic chemical use and hazardous waste generation. In June 2005, the Oregon Legislature passed a law (Oregon Revised Statute 465.003 to 465.037) that streamlined and made other significant changes to the Toxics Use and Hazardous Waste Reduction Program.

Large toxics users, large quantity generators, and small quantity generators must prepare a Reduction Plan or an Environmental Management System. As part of the planning, a facility must evaluate options to reduce its toxics and hazardous wastes. Materials that must be in the plan include any toxic substance reported to the U.S. Environmental Protection Agency under the Toxics Release Inventory program.

Since the Act's adoption, businesses throughout Oregon have reduced their toxic chemicals and hazardous wastes. DEQ publishes pollution prevention stories to explain how businesses are reducing their toxics and hazardous waste. In the program's 21 years, businesses have voluntarily reported: reducing more than 31.5 million pounds of hazardous waste with savings

estimated at $5.25 million, and reducing more than 56.25 million pounds of toxic chemicals with savings at over $15 million.

For more information on toxics reduction, see:

http://www.oregon.gov/deq/Hazards-and-Cleanup/ToxicReduction/Pages/default.aspx

When there are spills or releases that contaminate groundwater or surface water, DEQ's Site Assessment program investigates hazardous substance sites that may require further action to protect health and the environment, ranks sites based on threat to human health and the environment, overseeing limited removal and remedial actions, and maintains DEQ's Environmental Cleanup Site Information database. When extensive investigation and appropriate cleanup of hazardous substance site is necessary to protect public health and the environment, the Site Response program works to investigate and clean up contaminated hazardous waste sites throughout Oregon.

Federal Lands

Federal lands in drinking water source areas are primarily forestlands and rangelands managed for multiple uses including watersheds and water quality, biodiversity and endangered species, recreation, and forest products. The US Forest Service and the Bureau of Land Management manage these lands in National Forests and Districts, respectively. Each National Forest and BLM District has a unique management plan, but all have common features. In the past, the federal agencies have entered into agreements with municipalities and water districts to ensure protection of drinking water sources on federal lands.

In August 2016, BLM approved new Resource Management Plans (RMPs) for western Oregon. The approval marked the end of a four-year effort by the BLM to use new science, policies, and technology to protect natural resources and support local communities. DEQ's drinking water protection staff evaluated the proposals to provide input to BLM so that those federal lands will continue to provide high quality water for ecosystems and domestic use.

These RMPs provide direction for the management of approximately 2.5 million acres of BLM-administered lands, and maintain strong protections for the northern spotted owl, listed fish species, and water resources while offering predictable and sustainable outcomes for local communities from tourism, recreation, and timber harvest. For more information on the BLM plan and implementation, see:

https://www.blm.gov/programs/planning-and-nepa/near-you/oregon-washington/rmps-westernoregon

Forest Lands

Forestry activities on state-owned and private lands are regulated by the Oregon Department of Forestry (ODF). The statutes and rules, referred to as the "Forest Practices Act", are implemented by ODF and address the overall maintenance of the following resources: (a) air

quality; (b) water resources, including but not limited to sources of domestic drinking water; (c) soil productivity; and (d) fish and wildlife (ORS 527.710(2)). The forest practice rules address chemical use, pesticides, and water protection provisions governing activities in or adjacent to water bodies, wetlands, and riparian areas (OAR 629-635-0000 to 629-660-0060). The overall goal of the water protection rules is to provide resource protection during operations adjacent to and within streams, lakes, wetlands and riparian management areas so that, while continuing to grow and harvest trees, the protection goals for fish, wildlife, and water quality are met. **Appendix 4** is a compilation of riparian management widths and rules for forestry.

Forest practice rules related to water quality (as prescribed in ORS 527.765) must ensure that, to the maximum extent practicable, non-point source discharges of pollutants resulting from forest operations do not impair the achievement and maintenance of the water quality standards (OAR 629-035-0100(7)(a)-(c)). Forestry rules specify harvest protections for riparian areas and some steep slopes, chemical use (including pesticides), reforestation requirements, and road construction and maintenance.

Rules for private forests can be found here: http://www.oregon.gov/ODF/Pages/lawsrules.aspx

An illustrated guide to the rules from the Oregon Forest Resources Institute can be found here: http://oregonforests.org/sites/default/files/publications/pdf/OR_For_Protect_Laws_2011.pdf

State-owned forestlands are referred to as “Board of Forestry lands”. Management plans (rules) for state-owned forests can be found here: http://www.oregon.gov/ODF/Working/Pages/StateForests.aspx

The overall goal of managing state-owned forestlands is stated as follows: “Oregon Revised Statutes direct that Board of Forestry Lands shall be managed by the State Forester to ‘secure the greatest permanent value of such lands to the state’.” The goals for state forestlands include maintaining healthy watershed conditions to support the beneficial uses of the waters of the state both in water quality and water quantity. Public water systems with state forestlands within their source area may consider contacting the District or State Forester to ensure that management of the forest to maintain the quality and quantity of public water supplies for community water systems is adequately considered when determining the greatest permanent value of these lands to the state. An economic analysis of the value of the land to provide long-term community drinking water may be helpful for demonstrating this.

Onsite Septic Systems

Approximately 30 percent of Oregon households rely on onsite septic systems to treat their sewage. Properly functioning septic systems treat sewage to minimize groundwater and surface water pollution. A malfunctioning system can be a health hazard and will harm natural resources.

Under state law, DEQ is responsible for ensuring that septic systems are sited, installed, and operated so that Oregon's land, water, and public health are protected. Improperly functioning septic systems can pollute streams and groundwater and be a public health hazard. Owners of onsite systems must operate and maintain their systems in compliance with all permit conditions and applicable requirements in this rule division and must not create a public health hazard or pollute public waters (*OAR 340-71-0130 General Standards, Prohibitions, and Requirements)*.

Many counties implement the onsite system regulations within their county on behalf of DEQ, and some counties have additional requirements beyond those in state rules. For more information on regulatory oversight and counties that administer state and local rules, please go to the DEQ Onsite web pages: http://www.oregon.gov/deq/Residential/Pages/Onsite.aspx

A new program was initiated in 2016 between DEQ and a regional nonprofit lender "Craft3" to make repairs more affordable for Oregonians in need. The new partnership provides funds to help Oregonians get their septic systems fixed.

The Clean Water Loans will allow homeowners to pay for all costs associated with the project, including:

- Septic system design,
- Relevant permits,
- Installation of the new septic system,
- Ongoing maintenance,
- Essential safety measures, such as those to prevent children from falling into septic tanks.

Special rates and deferred payment options may be available for homeowners with lower incomes. Homeowners, small businesses and onsite service providers can learn more about the Clean Water Loan program and apply for loans at www.Craft3.org/CleanWater. In addition, several public water systems have implemented cost-share programs for local homeowners conducting septic system inspections and repairs in areas that could impact drinking water quality if the septic system fails or is not functioning properly.

There are excellent resources available to assist homeowners with septic systems. The "Septic Smart" program discussed in Section 7.0 includes resources for septic system owners for the repair and maintenance of septic systems as this helps protect the quality of groundwater and downgradient surface water**.**

Pesticide Regulations

Pesticide use is governed by the Federal Insecticide, Fungicide, and Rodenticide Act and corresponding state law (ORS634.005-.992). Nearly 1,400 pesticides are currently registered and approved by the US EPA for agricultural and non-agricultural use (USDHHS 2010). Agencies

responsible for implementation in Oregon are the US EPA and ODA, DEQ, and ODF (for non-federal forestlands).

ODA's Pesticide Program regulates the sale and use of pesticides. Program staff conduct routine compliance monitoring, investigate complaints of alleged pesticide misuse, and administer enforcement actions when appropriate. Enforcement actions, including civil penalties, play a vital role in deterring unlawful use of pesticides. Additional responsibilities include communicating the laws and regulations to licensed pesticide applicators and the public. This is done through continuing education training resources, informational brochures, the ODA website, and one-on-one communication.

Here is a summary and website link for pertinent pesticide programs and resources:

Additional information about pesticide regulation can be found at:
http://www.oregon.gov/ODA/programs/Pesticides/Pages/default.aspx

Water Quality Pesticides Management Team – Collaboratively addresses challenges associated with detecting active pesticide ingredients in surface and groundwater sources for the protection of public health and environmental sustainability.
http://www.oregon.gov/ODA/PEST/Pages/water_quality.aspx

Pesticide Water Quality Program – Implements the Pesticide Water Quality Management Plan to protect waters from pesticide contamination. Prioritizes pesticides of concern, establishes water quality guidelines, performs watershed vulnerability assessments, designs and conducts monitoring, recommends management options, and develops communication strategies.

Pesticide Management Plan (2011):
http://www.oregon.gov/ODA/PEST/docs/pdf/wqpmtpmp.pdf

Pesticide Analytical and Response Center (PARC) – Coordinate investigations to collect and analyze information about reported pesticide incidents that have health or environmental impacts. Cooperating member agencies: ODEQ, ODF, ODFW, ODOT, OHA, OHSU, Poison Control, OSHA, State Fire Marshall, OSU http://www.oregon.gov/ODA/PEST/Pages/parc.aspx

Pesticide Exposure, Safety and Tracking Program - Tracks and investigates health effects reported by people exposed to pesticides.
http://www.oregon.gov/oha/ph/HealthyEnvironments/HealthyNeighborhoods/Pesticides/Pages/index.aspx

Human Health Benchmarks for Pesticides (HHBPs) in drinking water - US EPA recently revised this list for 363 compounds that have no drinking water health advisory or SDWA MCL. Public water systems can use this information to respond to detections of pesticides in drinking water. It will be useful to help determine the need for remedial action and assist in crafting

appropriate messages for the public about risk. To view the table and supporting information online, go to: http://www.epa.gov/pesticides/hhbp

As of 2016, the HHBP list includes 11 new benchmarks and 10 updates of existing numbers, with cancer effects added to 40 pesticides. Exposure to various pesticides has been linked to brain/central nervous system, breast, colon, lung, ovarian, pancreatic, kidney, testicular, and stomach cancers, as well as Hodgkins and non-Hodgkins lymphomas, multiple myeloma, and soft tissue sarcoma (Clapp 2007). Approximately 40 chemicals classified by the International Agency for Research on Cancer (IARC) as known, probable, or possible human carcinogens, are used in EPA-registered pesticides now on the market (IARC 2009).

The HHBPs or benchmarks indicate levels in water, below which no adverse health effects are anticipated. The benchmarks include values for short term and lifetime exposure and cover both cancer and non-cancer risks. The benchmarks are based on studies and data that EPA receives through the pesticide registration process.

Health advisories and MCLs for other pesticides can be found at: http://www.epa.gov/drink/standards/hascience.cfm.

Pesticide Data Program - Database provides national data on pesticide residues in food and water. http://www.ams.usda.gov/AMSv1.0/science

Pesticide Container and Containment - ODA agreement with USEPA to ensure proper management and disposal of pesticides. Minimizes risk of environmental release in the event of leaks or spills through inspection of pesticide containers and containment structures, inspection of refilling establishments, and label review to verify instruction on proper rinsing and disposal of pesticide residues. http://www.oregon.gov/ODA/PEST/Pages/disposal.aspx

For a summary of Oregon pesticide regulations with regard to drinking water sources, please see:
http://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf

Since 1999, Oregon has been using a voluntary, collaborative approach called Pesticide Stewardship Partnerships (PSPs) to identify problems and improve water quality associated with pesticide use at the local level. The PSP approach uses local expertise in combination with the water quality sampling and toxicology expertise of state agency partners to encourage and support voluntary changes that cause measurable environmental improvements. The key actions include: identifying local, pesticide-related water quality issues through targeted monitoring, sharing results early and often with local stakeholders, explaining data in relation to effects and water quality criteria, engaging the agricultural community for identifying and implementing solutions, and using ongoing effectiveness monitoring to measure success and provide feedback to support water quality management.

PSPs use both water quality and crop quality as measures of success. Pest management and water quality management must both be effective for long-term stewardship of natural resources. As DEQ and ODA implement the PSP projects, there has been a focus on agricultural and some urban areas to date, but DEQ is also working with ODF and urban stakeholders with the goal of increasing the PSPs reach into urban and forested landscapes.

Currently there are eight partnerships in seven watershed areas. The eight include Hood River; Mill Creek and Fifteenmile Creek (in Wasco County); the Walla Walla River; Clackamas River; Pudding River; Yamhill River (Yamhill Pesticide Stewardship Partnership for rural and urban areas, and South Yamhill River Pesticide Stewardship Partnership, for a forested area of the watershed); and the Amazon Creek watershed project in Eugene. These partnerships receive guidance from an inter-agency Water Quality Pesticide Management Team. This team developed a statewide plan to protect water quality from pesticide impacts. It also designates priority pesticides that could affect water quality, and helps evaluate monitoring data. In 2013, the Legislature allocated stable funding to ODA and DEQ to expand the program to additional watersheds.

In addition, DEQ and ODA work with many of the same partners to conduct pesticide waste collection events in watersheds where Pesticide Stewardship Projects are active, as well as other areas of the state. The purpose of these events is to reduce the risks of accidental releases of unwanted pesticides into surface or groundwater and provide a cost-effective disposal option for pesticide users.

DEQ's drinking water protection program provides information on public drinking water source areas and public water system partners to help prioritize areas for Pesticide Stewardship Partnership implementation. Several waste pesticide collection events benefiting drinking water source areas occurred in 2014, including a project in Milton-Freewater that collected more than 15,000 pounds. The collection area for the Milton-Freewater pesticide waste collection event included the drinking water source area for Milton-Freewater's public supply wells, serving over 7,000 people.

For more information on the PSP program, see:

http://www.oregon.gov/deq/wq/programs/Pages/Pesticide.aspx

Water Quality Permits

Construction stormwater, city stormwater in larger municipalities, and sewage treatment are regulated by DEQ through National Pollutant Discharge Elimination System (NPDES) permits. In urban areas, city governments are primarily responsible for regulations. In rural areas, counties are primarily responsible. Rural residential activities related to livestock and farming activities are regulated by ODA. Rules and ordinances vary among cities and counties, so restrictions on

residential land activities will be different depending on the location of a given drinking water source area.

DEQ regulates sewage treatment systems and industrial dischargers through the water quality permit program. NPDES-permitted facilities are those which discharge pollutants from any point source, such as a pipe, to state waters. If a facility discharges to the ground, it is a WPCF (Water Pollution Control Facility). Several of DEQ's general permits are administered by other agencies through Memoranda of Agreement or Understanding (MOA or MOU); these include the GEN800 for CAFOs (ODA), GEN1000 for gravel mining (Oregon Department of Geology and Mineral Industries; DOGAMI), NPDES 1200A for off-site discharge of storm and process water from gravel mining (DOGAMI), and 1200C and 1200CN for stormwater runoff from construction activities administered by various local government agencies. Other permits are administered directly by DEQ.

National Pollutant Discharge Elimination System (NPDES) permits from DEQ are required for stormwater and process discharges to surface waters from construction and industrial activities and larger municipalities if stormwater from rain or snow melt leaves a site through a "point source" and reaches surface waters either directly or through storm drainage. As a result, stormwater discharges from large and medium sized municipal storm sewer systems are required to have NPDES permits. Similarly, NPDES stormwater permits are required for most industrial properties and for construction affecting one acre or more of land, including projects that are less than one acre that are part of a larger common plan of development that ultimately disturbs one acre or more.

DEQ regulates Underground Injection Control (UIC) well discharges. DEQ issues permits for UIC systems under the Safe Drinking Water Act to protect water quality. Injection systems are any discharges below the ground or subsurface including geothermal systems, large capacity septic systems, and aquifer storage and recovery systems. DEQ maintains a database of Class V wells. For more information, see: http://www.oregon.gov/deq/wq/wqpermits/Pages/UIC.aspx

Runoff from rural communities and rural residential areas remains largely unregulated, except to the extent that it may be covered by an implementation plan developed by a local government or special district as a designated management agency identified under a TMDL. DEQ has clear legal authority to require local governments to address pollution that arises from proprietary-controlled activities. Small rural "farmsteads" are subject to regulation by ODA. Local governments operating as designated management agencies may develop TMDL implementation plans both for properties over which they have proprietary control (e.g. a street system or park) and for areas where they maintain regulatory authority (police power or land use planning) over private property.

8.0 RELATED WATER QUALITY ISSUES/PROJECTS

Total Maximum Daily Loads

DEQ prepares Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) documents for waterbodies in Oregon designated as water quality limited and on DEQ's 303(d) list of impaired waters. A TMDL uses scientific data collection and analysis to determine the amount and source of each pollutant entering streams. A TMDL is the maximum amount of pollutant that can be present in a waterbody while meeting water quality standards. These maximum allowable pollutant loads are assigned to contributing sources, typically to point sources (wasteload allocations) and land use authorities or nonpoint source sectors (load allocations). The WQMP provides the framework for management strategies to attain and maintain water quality standards. The framework is designed to work in conjunction with detailed plans and analyses provided in sector-specific or source-specific implementation plans. The plan designates organizations to prepare and carry out source-specific TMDL implementation plans including the U.S. Forest Service and Bureau of Land Management, the Oregon Departments of Agriculture and Forestry, counties, cities, and others. The implementation plans identify management measures that will be used to achieve and maintain water quality standards.

When TMDLs are developed, it is necessary to identify, assess, and implement control measures that limit the known and potential sources of pollutants entering the surface water that did not meet water quality standards. *Any pollutants entering the surface water from groundwater discharge is considered a nonpoint source.* These are evaluated as part of the allocation process when the TMDL is developed. Groundwater is generally a transport mechanism for pollutants entering surface waters and should be considered as part of the load allocations for pollutants. For more information on the TMDL program and status:

http://www.oregon.gov/deq/wq/tmdls/Pages/default.aspx

Statewide Toxics Monitoring and Assessment

In a program referred to as "Statewide Toxics Monitoring", the DEQ laboratory staff collect samples on a rotating basin schedule during spring, summer and fall around the state. The DEQ laboratory analyzes seven major categories of toxics, including consumer product constituents, current-use pesticides, legacy pesticides, flame retardants, combustion products, metals, and industrial intermediates. Access, site appropriateness, species availability and hydrology all determine the types of samples collected. In 2012-13 sampling, DEQ tested for more than 500 unique chemicals using 21 different analytical methods and 128 unique chemicals were

detected in that round of sampling. The most commonly detected groups were priority metals and sterols present at 100% of sites, followed by current-use pesticides, at just over 50% of sites sampled. In 2015, DEQ began its second round of monitoring for toxics around the state. The DEQ laboratory is currently collecting water and sediment samples from locations in the Klamath, North Coast, Rogue, and Umpqua basins.

For an update of the status of Statewide Toxics Monitoring, see: http://www.oregon.gov/deq/Hazards-and-Cleanup/ToxicReduction/Pages/Reducing-Toxics.aspx

Harmful Algae Blooms

State officials in Oregon expect that with climate change, algae blooms in streams and lakes will increase in number and severity. Algae blooms are associated with warmer temperatures in streams and lakes, increased sunlight, and increased runoff of nutrients during high-intensity storms. The floodwater and stormwater runoff carries additional pollutants into the streams and lakes, including phosphorus and nitrates that increase the risks of algae blooms. Algae blooms can cause many complications for drinking water, including toxic exposures, taste and odor issues, algal mats blocking the intakes, and changes in pH.

As noted in the *Climate Change* section above, HABs would likely become more abundant in Oregon with climate change. Changing conditions, both warmer and drier climate and lower flows (based both on shifts in precipitation and demand for water), would result in warmer water and more standing water which is more favorable to cyanobacteria growth. Therefore, it is likely that blooms would occur longer, in more places and perhaps with greater magnitude (Paerl et al 2011).

DEQ and OHA work with a variety of federal, state and local partners to coordinate monitoring and response related to HABs. OHA provides public education regarding the risks to human and animal health that HABs pose as part of their overall program. OHA developed HABs sampling guidelines and has been working with a number of labs to better standardize identification and enumeration techniques. OHA -Drinking Water Services has several resources for HABs and drinking water are available on their website and it is important to note that these are updated as necessary:
http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Operations/Treatment/Pages/algae.aspx OHA recreational HAB's program also has several resources on their website:
http://public.health.oregon.gov/HealthyEnvironments/Recreation/HarmfulAlgaeBlooms/Pages/index.aspx
Oregon's current HAB strategy (Schaedel 2011) relies primarily on monitoring by management agencies, or groups such as watershed councils, that are:

- Responsible for recreational sites, water access or water uses such as drinking water;
- Operate dams;

- Manage activities in the lake or reservoir and its watershed; or
- Have water quality responsibilities.

Partners include DEQ, USFS, US Army Corps of Engineers (USACE), USGS, ODFW, and a number of local watershed groups, health departments, parks and recreation agencies and drinking water providers. Through this effort, a limited surveillance program has been established, with monitoring occurring primarily at or near recreational facilities maintained by the USFS or the USACE. If there is no clear Designated Management Agency that would be responsible for monitoring the HAB, as resources allow, DEQ would collect, preserve and ship samples. An Interagency Agreement between OHA and DEQ defines and partially funds this activity (Oregon DHS 2010), and the IGA is updated as necessary.

While there is variation in monitoring protocols including the number, frequency and types of sample analysis (algal identification, enumeration, or toxin), it generally consists of the following:

- Observation of conditions in the lake or reservoir--- this is usually done by a partner agency with familiarity and knowledge of a waterbody's current conditions.
- When visible scums or blooms occur, samples are collected by the partner agency for algal identification and enumeration; secchi disk depths are often used to trigger the process.
- OHA issues an advisory if combined cell counts for toxigenic cyanobacteria are at or above 100,000 cells/ml, or less than 40,000 cells/ml of microcystis or planktothrix; typically advisories are posted on the OHA website, at the waterbody and are sent to media outlets.
- The advisory stays in effect and is lifted on the basis of no visible bloom and both cell counts and toxicity testing showing that both are below advisory values.

With regard to HAB monitoring, funding and resources may change from year-to-year, so public water providers and management agencies may depend more upon observation and inspection, and less upon active monitoring. DEQ and OHA are currently revising the HAB strategy to reflect ongoing funding changes and focused priorities.

DEQ's TMDLs are an effective approach for developing appropriate pollutant loads to address the causes of HABs. TMDLs are not only required under the Clean Water Act but they are a good tool for conducting the necessary studies to determine factors that are causing HABs and setting appropriate goals for addressing HABs. TMDLs can address coastal lakes already experiencing HABs, rather than preventing other lakes from developing HABs. DEQ's TMDL approach is currently being applied on a lake-by-lake basis -- TMDLs that set a target for each specific lake can ultimately address waters on the impaired waterbody list, but do not automatically address nearby lakes that may be declining or could be experiencing HABs. For example, the 2007 Umpqua TMDL addressed blooms in Diamond Lake and the South Umpqua

River but, in 2010, four other listings for HABs were added in the Umpqua (Lemolo and Fish Lakes, Elk Creek and the Umpqua River).

Tillamook Estuary Partnership

As part of a regional water quality assessment, the Tillamook Estuary Partnership and DEQ completed an analysis in 2014 of water samples collected from surface water sources in 5 North Coast drinking water watersheds. The samples were analyzed for over 120 different chemicals using 4 different laboratory methods. DEQ summarized the results and coordinated with OHA toxicologist to compare to health standards, and letters were sent to all of the public water systems where sampling occurred. The public water systems sampled were the City of Vernonia, Beaver Water District, Rockaway Beach, Tillamook Water District, and Neskowin Regional Water District. Low levels of pesticides were detected, including atrazine and its breakdown products, sulfometuron-methyl, DEET, and Glyphosate and its breakdown product. Concentrations were near the detection level, and well below any available health standards. DEQ drinking water staff continues to provide technical assistance to public water systems in the North Coast as part of this larger effort, including addressing issues surrounding gravel quarries within their source area, pesticide spraying, and forest harvests on private lands. Additional project planning and scoping is underway.

Basin Assessments

DEQ works to develop drinking water-specific sections and data input for the Basin Assessment Reports and during the biennial reviews of Agricultural Water Quality Management Plans (AgWQMP), including identifying drinking water sources, drinking water quality issues, potential contaminant sources and recommendations for action. The AgWQMPs are developed to prevent and control water pollution from agricultural activities and soil erosion on rural lands, and include pollution reduction strategies that protect sources of drinking water.

The basin (or watershed) assessments draw on the expertise of DEQ's 17 water quality sub-programs including recommendations for actions that DEQ (and others who are interested in these basins) can take to improve water quality. To date, drinking water input for the watershed assessments has been developed for the North Coast, South Coast, Deschutes, Rogue, Umpqua, and Willamette basins.

DEQ is also working directly with multiple public water systems in basins or subbasins to encourage protection strategies on a watershed scale basis. This includes coordinating with surface water providers in the Rogue River, Umpqua, and Siletz subbasins. In the Umpqua project, DEQ staff has worked with the Winston-Dillard Water District, Oregon Department of Agriculture, Douglas Soil and Water Conservation District (SWCD), and Partnership for the Umpqua Rivers to address high *E. coli* bacteria counts in untreated drinking water detected during Safe Drinking Water Act testing. The partners are providing technical assistance to

interested landowners, implementing on-the-ground restoration projects, and conducting effectiveness monitoring at project sites identified as high risk for bacteria contribution. In the Siletz watershed, Lincoln SWCD worked with the Cities of Toledo and Newport to conduct a bank erosion assessment in portions of the upper watershed, as well as a sediment delivery analysis for county roads within the drinking water source area. The work products identify priority areas for restoration/best management practices within the Siletz, setting the stage for on-the-ground implementation. In addition, the work serves as a model to employ within other basins and subbasins dealing with the impacts of bank erosion and sediment at drinking water treatment plants. Lincoln SWCD's work was funded through the OHA drinking water protection grant program (described in the *Funds and Resources* section above).

Turbidity and TMDLs

DEQ drinking water staff recently worked directly with 15 public water systems to research/document water quality problems with turbidity. Several systems are impacted so severely that the intake must be shut down regularly due to extremely high turbid water. Disinfection by-products are also problematic for many communities, and the organic matter precursors may be related to land management and nonpoint source pollution. Research and assessment included collection of raw water data, interviews with operators, GIS research on land uses, and field inspections. The report documenting data and findings (Seeds 2010) can be accessed on DEQ's drinking water protection website. DEQ continues to use the data from the report to promote further research, more active protection and awareness of potential violations to the turbidity or potable water standards in the public water supply watersheds. This includes conversations with citizens, city governments, watershed councils, and water utility boards to share information and source water protection strategies. In addition, data and analysis from the above-mentioned turbidity report were used to list three waterbodies on Oregon's 2010 List of Impaired Waters (303(d) list).

One of those waterbodies (the Siletz River upstream of the intake for the City of Siletz) has a TMDL for turbidity/sediment under development. DEQ is currently working on that TMDL as well as other sediment-based TMDLs, evaluating natural and human sources of sediment pollution to the listed waterbodies in the Oregon Mid-Coast Basin. The TMDLs will document known and potential sediment sources, set allowable limits of sediment inputs to the waterbodies, and detail management measures and monitoring needed. Information from the TMDLs may be used to inform changes to riparian and steep slope protections on forest- and agricultural lands.

Nonpoint Sources

Nonpoint source pollution (pollution from a diffuse area rather than a discrete pipe, ditch, etc.) is addressed through the following programs implemented by DEQ: Water Quality Standards, Water Quality Assessment, TMDLs, §319 Nonpoint Source Planning and Grants, Drinking Water

Protection, Groundwater, Clean Water State Revolving Fund, Pesticide Stewardship Partnerships, and Water Quality Monitoring. DEQ also coordinates with federal and state agencies that are responsible for nonpoint source issues and identifies them as Designated Management Agencies (DMAs). Under ORS 468B.110 (1), DEQ has the specific authority to take the actions necessary to attain and maintain water quality standards and to implement load allocations established under a TMDL. The only significant limitation on DEQ's authority is that it may not impose or enforce effluent limits on nonpoint source discharges from forest operations subject to the State's Forest Practice Act, unless such limits are required by the CWA or other federal law. The Oregon Department of Forestry (ODF) regulates commercial harvesting on private and state forest lands. The Oregon Department of Agriculture (ODA) regulates agricultural activities through Agricultural Water Quality Management Area rules.

The Nonpoint Source Program at DEQ coordinates with ODA and ODF to ensure that forestry and agriculture on nonfederal lands meets water quality standards and TMDL load allocations. The NPS Program also coordinates with other programs within DEQ (e.g. Drinking Water Protection, Water Quality Standards) and with outside partners to prevent and remediate nonpoint sources of pollution using cooperation, technical assistance, and federal pass-through (§319) grants. Federal land management agencies (e.g. USFS and BLM) work with the NPS Program to ensure management is consistent with state and federal water quality laws and regulations. An additional responsibility is creation, approval, and implementation of a Coastal Nonpoint Pollution Control Plan under the federal CZARA statute.

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APPENDICES

APPENDIX 1. **Source Water Collaborative -- Call to Action**

APPENDIX 2. **Pollutant Reduction Strategies for Land Uses/Activities**

APPENDIX 3. **Categorical Crop-to-Pesticide Table**

APPENDIX 4. **Riparian Management Widths: Forestry & Agriculture**

APPENDIX 5. **Drinking Water Protection Websites**

APPENDIX 1. Source Water Collaborative -- Call to Action

A CALL TO ACTION –
A RECOMMITMENT TO ASSESSING AND PROTECTING SOURCES OF DRINKING WATER

WHY A CALL TO ACTION NOW?

As a nation we face a host of water quality and quantity challenges that are both pressing and ongoing. Persistent threats and challenges, and disastrous chemical spills highlight the importance of safe drinking water to public health and local economies. The public and private costs of inaction can be extensive. Together, we must consider lessons learned over the past decade and apply newly available resources to prioritize threats and protect drinking water sources, both surface and ground water. A realistic assessment of recent events demonstrates that additional action by federal, state, and local partners can and must be taken to effectively protect drinking water sources.

Our Vision for the Future: The Nation's Source Waters are Protected

Our vision includes the following elements:

- Federal, State, and Local Actions Reflect the High Value of Safe Drinking Water: The high value of drinking water is widely recognized at all levels of government and among the general public, by regular and systematic actions to help ensure sufficient quantities of high quality water into the future.
- Source Water Protection is Embedded into Our Processes: Source water protection is "hard-wired" into everyday practice at federal, state, and local levels.
- All Stakeholders Work to Help Protect Drinking Water Sources: Stakeholders across multiple fields and sectors are invested in source water protection. We can achieve mutual benefits through government agencies, non-governmental organizations, water utilities, communities, emergency response personnel, and businesses/corporations working collaboratively.

To accomplish this vision, we recommend the following key actions:

1. Update/improve source water assessments and protection plans to prioritize risks and actions, by leveraging new data and tools.
2. Take priority actions to protect sources of drinking water, working with key partners.
3. Coordinate, plan, and communicate in advance with key "upstream" partners as well as within water utilities to help ensure that, in an event, rapid emergency notification is provided to facilitate activation of mitigation measures.

Our Vision

All drinking water sources are adequately protected. As a result, the nation gains profound public health advantages as well as economic benefits.

KEY ACTIONS FOR SOURCE WATER PROTECTION LEADERS AND STAKEHOLDERS

DRINKING WATER UTILITIES

Source water protection is part of an effective multiple-barrier approach to ensure the safety and quality of drinking water.

- Leverage new contaminant information resources to update source water assessments, source water protection plans, and emergency response plans.
- Work with local/state partners on priority actions that prevent and/or mitigate the potential for source water contamination.
- Build relationships with emergency responders and staff at sites storing priority contaminants.
- Develop communication plans to obtain early, actionable information from local and state agencies and potential contaminant sources.
- Identify funding strategies for priority measures that protect source water.
- Develop and exercise response and recovery plans for potential contamination events.

LOCAL GOVERNMENTS

Local entities are well situated to address specific local source water concerns through land use planning and collaboration with key stakeholders.

- Address potential impacts on drinking water quality and public health through land use planning (from plan development and implementation through capital investment), zoning, development regulations, and code enforcement.
- Disseminate educational information to community members on water quality issues.
- Coordinate with states and water utilities in developing source water assessments and implementing protective measures.

STATE DRINKING WATER AND OTHER PROGRAMS

Collaboration between state water programs and other influential agencies (agriculture, parks, fish & game, forestry, conservation, and others) provides multiple opportunities to protect drinking water sources.

- Where source water assessments are no longer current or sufficient for supporting source water protection efforts, encourage and engage in targeted updating of source water assessments in collaboration with drinking water systems, and other state, federal, and local officials.
- Leverage the Clean Water Act and other programs and authorities to protect water supplies.
- Communicate key information from source water assessments to stakeholders to guide priority actions and advance protection.
- Factor source water protection needs into land acquisition and management strategies.
- Partner with communities and other watershed and ground water stakeholders to implement priority actions.
- Facilitate community and state-level all-hazards planning.

A CALL TO ACTION TO DEFEND DRINKING WATER

Source water protection ultimately takes place at the local level and, those on the front lines of drinking water protection – drinking water utilities and local governments, supported by state, federal, and community-sponsored programs – have unique opportunities to defend drinking water. Federal agencies can provide tools and data, and leverage programs and authorities to protect drinking water sources. Other source water partners, including Source Water Collaborative (SWC) members and their constituents, also play vital roles. All SWC members and other stakeholders can seize opportunities to establish, participate in or support state and local collaboratives to protect drinking water sources. Defending drinking water is truly a shared responsibility among all concerned stakeholders -- as responses to recent contamination episodes have made abundantly clear.

FEDERAL GOVERNMENT

Land management, environmental, agriculture, scientific, and public health agencies have a role in protecting drinking water sources.

- Encourage and support collaborative approaches to source water protection between programs at the federal, state, and local levels, including USDA conservation and forestry programs, EPA programs, and all federal programs that support the quality of water resources.
- Assist state agencies and local communities to improve source water assessments and protection plans by providing information on the nature and quantity of potential contaminant sources, as well as modeling and analytical tools to characterize contaminant transport in surface and ground waters.
- Continue to expand electronic data sharing among federal offices and agencies to bring the most current and complete datasets possible to bear on source water assessments and protection plans.
- Identify opportunities to incentivize collaboration between the chemical emergency response community and state and local source water assessment and protection activities.
- Encourage upstream entities to take on shared responsibility for protecting source water, including enhancing rapid notification of contaminant spills to downstream drinking water utilities.
- Promote use of Clean Water and Safe Drinking Water State Revolving Fund (SRF) programs to support preparedness and source water protection priorities.

OTHER SOURCE WATER PARTNERS

- Engage in public participation processes under state and federal programs and local land use planning processes to protect sources of drinking water. In particular, take advantage of opportunities to engage in various Clean Water Act actions and projects to protect sources of drinking water [e.g., water quality standards, Total Maximum Daily Loads, point source discharge National Pollutant Discharge Elimination System (NPDES) permits, nonpoint source project development].
- Promote grassroots place-based initiatives to advance source water protection.
- Share data and information to help target source water protection and citizen scientist monitoring.
- Continue to plan and install soil health best management practices to obtain the multiple benefits of soil health, including improved water quality and drinking water protection.
- Inform and influence land use decisions that adequately consider potential impacts to drinking water sources.
- Encourage land conservation practitioners to prioritize working with landowners, drinking water suppliers, and other interested parties to protect undeveloped land that is critically important for protecting drinking water source areas, such as headwater streams, riparian areas, wetlands and intact forests.
- Communicate the importance of source water protection to local, state, and federal decision-makers.
- Understand local communities' emergency response procedures for chemical spill events.
- Adapt positive examples in contingency planning from local source water collaborations.

FOR A COMPLETE COPY OF THE CALL TO ACTION TO DEFEND DRINKING WATER INCLUDING SUPPORTING RESOURCES PLEASE VISIT THE SOURCE WATER COLLABORATIVE WEBSITE AT SOURCEWATERCOLLABORATIVE.ORG

WHAT IS THE SOURCE WATER COLLABORATIVE?

These national organizations have united to protect America's drinking water at the source – in the lakes, rivers, streams and aquifers we tap for drinking purposes. The Source Water Collaborative (SWC) was originally formed in 2006 with the goal to combine the strengths and tools of a diverse set of member organizations to act now, and protect drinking water sources for generations to come.

sourcewater COLLABORATIVE

Comprised of federal, state, and local partners, the SWC has come together to further the goals of protecting sources of drinking water – recognizing that resources are extremely limited, authorities are split, and the actors who can actually protect source waters are diffuse. Each national organization in the Collaborative understands and appreciates the importance of source water protection. Individually, each promotes implementation of source water protection in their overall mission. Each organization recognizes the synergy of coordinated actions and the need for leveraging each other's resources in order to increase the chances for success over each entity going it alone.

- American Planning Association
- American Water Works Association
- Association of Clean Water Administrators
- Association of Metropolitan Water Agencies
- Association of State and Territorial Health Officials
- Association of State Drinking Water Administrators
- Clean Water Action/Clean Water Fund
- Environmental Finance Center Network
- Ground Water Protection Council
- Groundwater Foundation
- National Association of Conservation Districts
- National Environmental Services Center
- National Ground Water Association
- National Rural Water Association
- North American Lake Management Society
- River Network
- Rural Community Assistance Partnership
- Smart Growth America
- U.S. Department of Agriculture - Natural Resources Conservation Service
- U.S. Environmental Protection Agency
- U.S. Forest Service (Northeastern Area)
- Water Systems Council

For a complete list of SWC members and available tools and resources, see www.sourcewatercollaborative.org.

Note: *All actions that EPA may take in furtherance of this statement are subject to the availability of appropriated funds and the parties to this agreement will not submit a claim to EPA for compensation for services rendered as part of this agreement. In signing this statement, none of the Source Water Collaborative member organizations, including the EPA, are obligating funds nor making a commitment to provide funding to any organization or individual in the future. Further, EPA cannot endorse the sale or purchase of products or services developed by the participating organizations.*

APPENDIX 2

Pollutant Reduction Strategies for Common Land Uses / Activities Within the Drinking Water Source Areas

This table is a compilation of information on the most common potential impacts to the drinking water sources in Oregon. Impacts from these land uses and activities will only occur when chemicals are improperly handled or best management practices are not followed. The pollutant reduction strategies are intended to reduce the risk of impacts to the drinking water source(s) downstream.

The Potential Pollutant Land Use/Activity categories included in this table:

Aboveground storage tanks
Agricultural activities - other than cropland
Automotive – washes, repair, gas stations
Boats – launches, marinas, river traffic
Chemicals – stored, areas of use
Commercial or industrial sites
Confined animal feeding operations
Cropland – irrigated, non-irrigated
Dams, reservoirs
Fire impacts - burned areas
Fish hatchery
Forest lands
Golf courses, parks, lawns
Grazing animals
Irrigation canal, ponds
Known contamination sites
Landfills, composting, transfer, recycling

Large capacity onsite septic systems
Mining activities, gravel pits
Onsite septic systems
Parking lots – large impervious areas
Pipelines – petroleum or other chemicals
Random dump sites
Residential lands
River recreation – heavy use areas
Schools, universities
Sewer lines
Stormwater runoff
Stream crossing
Transportation corridors
Underground injection control (UICs)
Underground storage tanks
Utility stations
Wastewater treatment, outfalls
Wells – private domestic, others

Potential Pollutant Type	***Potential Impact***	***Pollutant Reduction and Outreach Ideas***
Agricultural activities, other than cropland or animal management - includes farm machinery repair areas and equipment maintenance areas	Improper soil management or improper storage or management of cleaning solvents, fuels, petroleum products, pesticides, fertilizers, and irrigation water may impact drinking water	□ Work with the local SWCD, Oregon State University County Extension Agent, or Natural Resources Conservation Service to actively encourage management measures that protect water quality and develop farm plans when beneficial. Management measures may include: crop production practices, pesticide/fertilizer/petroleum product handling and storage, vehicle/equipment maintenance and repair, livestock waste storage and treatment, hazardous waste management, wastewater disposal/fill, and wells. **Agency Websites** Soil and Water Conservation Districts: http://oacd.org/conservation-districts/directory OSU Extension: http://extension.oregonstate.edu/find-us Natural Resources Conservation Service, Oregon: http://www.nrcs.usda.gov/wps/portal/nrcs/site/or/home/ Oregon Department of Agriculture: http://www.oregon.gov/ODA/Pages/default.aspx **Additional recommendations** □ If this land covers a large percentage of your drinking water source area, notify your local Soil and Water Conservation District (SWCD) of your drinking water intake. □ Identify and document any pesticides used to maintain site and the areas where applied.

		□ Set up or participate in a local material exchange program. http://www.oregon.gov/DEQ/mm/Pages/Material-Recovery-and-Recycling.aspx □ Other than crops, see DEQ factsheets *"Pesticide use in the vicinity of drinking water sources" for additional regulations and recommendations: https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf
Automotive – washes, repair shops, gas stations	Improper management of vehicle wash water may result in soaps, oils, greases, and metals impacting water quality. Spills, leaks, or improper handling of fuels and other materials during transportation, transfer, and storage may impact water quality.	□ Notify the car wash or repair shop of their location within your drinking water source area and send the following fact sheets: *Automotive Repair and Maintenance Tips for Drinking Water Protection: http://www.oregon.gov/deq/FilterDocs/dwpautomaint.pdf *Managing Vehicle Washing to Prevent Contamination of Drinking Water: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_VehicleWashing.pdf □ Implement best management practices to minimize potential impact from stormwater runoff. □ Implement best management practices for chemical and fuel storage, handling, and disposal, including spill response. □ Review "Drinking Water Protection Strategies for Commercial and Industrial Land Uses" and consider other general or business sector specific strategies for pollution risk reduction. http://www.oregon.gov/deq/FilterDocs/DWPStrategiesComInd.pdf □ Ensure all shallow/underground injection well issues are addressed so that surface water is not impacted from those (see other fact sheets in commercial/industrial section below)
Boats – launches, marinas, river traffic	Spills, leaks, or improper handling of fuels, grease, solvents, and other materials from boats, fueling, storage and parking areas may impact the drinking water supply.	See the Oregon State Marine Board website for helpful information on water quality protection: http://www.oregon.gov/osmb/Pages/index.aspx □ For in-water work on boats, see http://www.oregon.gov/OSMB/forms-library/Documents/Boating%20Facilities/boating_facility_operation_bmps.pdf □ Implement best management practices for chemical and fuel storage, handling, and disposal, including spill response; at boat launches, ensure that boats do not idle excessively if near drinking water intake(s). □ If appropriate, marinas may receive technical assistance from DEQ Toxics Use/Waste Reduction Assistance Program. □ For marinas, implement management practices for Clean Marina certification (administered by Oregon State Marine Board) http://www.oregon.gov/OSMB/boater-info/Pages/Environmental.aspx □ Implement best management practices to minimize potential impact from stormwater runoff. Check DEQ's permit webpage to learn more about permits to protect water quality: http://www.oregon.gov/deq/wq/wqpermits/Pages/All-Permits-Applications.aspx

Chemicals - stored or used in close proximity to intake	Chemicals, fuels, and equipment maintenance materials may impact surface water sources of drinking water.	□ Verify that no fuels, pesticides, fertilizers or other chemicals are used or stored within 100 feet (or a site-specific safe distance) of the surface water intake. □ Ensure all fuels and chemical vessels/tanks in sensitive upstream source areas have secondary containment to prevent leaks into groundwater or as runoff impacting surface water downstream. □ Consider increased setbacks based on sensitivity and degree of hazard from chemicals or pesticides within sensitive areas upstream of intake. For pesticide applications, see info on Integrated Pest Management (http://npic.orst.edu/pest/ipm.html) for alternative methods in sensitive areas; alternate methods for vegetation management in riparian or buffer areas may include mechanical removal, mowing, or non-chemical pre-emergent or post-emergent herbicide. □ Work with the local first responders to develop a spill response and/or communication strategy for any nearby upstream chemical storage areas. □ Correct any outstanding deficiencies at the intake structure that may increase risk of chemical impacts. □ Acquire adequate spill response equipment and any required training. **Fact Sheets/Resources** *Managing Small Quantity Chemical Use: http://www.oregon.gov/deq/FilterDocs/SQGHandbook.pdf http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_ChemUseSmallQ.pdf *Integrated Pest Management: http://npic.orst.edu/pest/ipm.html
Commercial or industrial sites – includes businesses that 1) do not require permits or 2) regulated facilities like dry cleaners, cleanup sites, hazardous waste/materials sites, underground storage tanks, wastewater and solid waste disposal	Spills, leaks, or improper handling of solvents, petroleum products, wastewater, or other chemicals and materials associated with commercial or industrial activities may impact the drinking water supply.	□ Work with the local first responders to develop a spill response and/or communication strategy in case of accident or environmental releases; make a plan for regular updates. □ Review "Drinking Water Protection Strategies for Commercial and Industrial Lane Uses" and consider other general or business sector specific strategies for pollution risk reduction. http://www.oregon.gov/deq/FilterDocs/DWPStrategiesComInd.pdf □ Check DEQ's permit webpage to learn more about permits to protect water quality from commercial or industrial sites: http://www.oregon.gov/deq/wq/wqpermits/Pages/All-Permits-Applications.aspx □ Notify the owner or manager of commercial/industrial sites about their location within your drinking water source area and send the following general fact sheets: *Basic Tips for Keeping Drinking Water Clean and Safe http://www.oregon.gov/deq/FilterDocs/BasicTips12WQ005.pdf *Business and Industry tips for reducing water quality impacts (DEQ) http://www.oregon.gov/deq/FilterDocs/dwpbusindtips.pdf *Pollution Prevention for Industry and the Environment: http://www.oregon.gov/deq/Hazards-and-Cleanup/ToxicReduction/Pages/Pollution-Prevention.aspx □ Contact owner/operator to verify that chemical or petroleum

		product storage are not high risks for impacting water quality. For example, chemicals could be stored and used inside, or have secondary containment. Encourage business to receive technical assistance from DEQ's non-regulatory Toxics Use/Waste Reduction Technical Assistance Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/hw/Pages/Technical-Assistance.aspx □ Implement relevant best management practices (BMPs) for stormwater and industrial wastewater: https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater#edu https://www.epa.gov/npdes/industrial-wastewater □ Work with Drinking Water Protection staff and permitting program staff to ensure permitted facilities are in compliance.
Confined animal feeding operations (CAFOs)	Improper storage and management of animal wastes and wastewater in areas of concentrated animals may impact drinking water	□ Verify that the owner or CAFO manager has the contact information for any nearby public water systems in the Emergency Response section of their Animal Waste/Nutrient Management Plan to ensure timely notification of spills or releases that may impact drinking water supply. □ Contact ODA's Livestock Water Quality specialist for your area to ensure that all CAFOs that are required to have a permit have one. Ensure the ODA specialist is aware of the public water system location and that the permit and associated Animal Waste Management Plan are protective of the drinking water supply; request that existing technical assistance resources and compliance inspections be prioritized for the drinking water source area. □ Note that all permitted CAFOs are regularly inspected on a 10-month rotation and water quality protection is part of the permit conditions. □ Get notification from ODA on permit modifications or renewals; review/comment as appropriate. **Fact Sheets/Resources** *Oregon Department of Agriculture CAFO program: http://www.oregon.gov/oda/programs/NaturalResources/Pages/CAFO.aspx US EPA Animal Feeding Operations: https://www.epa.gov/npdes/animal-feeding-operations-afos
Cropland -- **Irrigated** (includes orchards, vineyards, nurseries, greenhouses) **Non-irrigated** (includes Christmas trees, grains, grass seed, pasture)	Over-application or improper handling of pesticides and fertilizers may impact drinking water; excessive irrigation may transport contaminants to groundwater (impacting	□ Work with the local SWCD, Oregon State University County Extension Agent, or Natural Resources Conservation Service to actively encourage management measures that protect water quality and develop farm plans when beneficial; management measures may include: crop production practices, pesticide/fertilizer/petroleum product handling and storage, vehicle/equipment maintenance and repair, livestock waste storage and treatment, hazardous waste management, wastewater disposal/fill, and wells. □ If this land covers a large percentage of your Drinking Water Source Area, notify your local Soil and Water Conservation District (SWCD) of your source area location and ask for technical assistance

	nearby surface water), or surface water through runoff. Note: drip-irrigated and non-irrigated crops are considered to be lower risk.	to work with owner/operator. □ Work with owner/operator to identify and document any pesticides used and the areas where they are regularly applied. □ Participate in, or request assistance from, the Pesticide Stewardship or Integrated Pest Management Programs (or other efforts , such as pesticide collection events for unused and legacy pesticides) to reduce use of products that threaten water quality: http://www.oregon.gov/DEQ/wq/programs/Pages/Pesticide.aspx □ See DEQ factsheet "Pesticide use in the vicinity of drinking water sources" for additional regulations and recommendations: https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf **Agency Websites** Soil and Water Conservation Districts: http://oacd.org/conservation-districts/directory OSU Extension: http://extension.oregonstate.edu/find-us Natural Resources Conservation Service, Oregon: http://www.nrcs.usda.gov/wps/portal/nrcs/site/or/home/ Oregon Department of Agriculture: http://www.oregon.gov/ODA/Pages/default.aspx □ Also send relevant fact sheets and information below. **Fact Sheets/Resources** *Managing Agricultural Fertilizer Application (US EPA source): http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_AgFertilizer.pdf *Managing Large-Scale Application of Pesticides: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_PesticidesLargeScale.pdf *Irrigation System Maintenance and Improved Production: https://catalog.extension.oregonstate.edu/em8862 *Guidance for Evaluating Residual Pesticides on Lands Formerly Used for Agricultural Production http://www.oregon.gov/deq/FilterDocs/GuidanceEvalResidualPesticides.pdf **Additional recommendation** □ Set up or participate in a local material exchange program. http://www.oregon.gov/DEQ/mm/Pages/Material-Recovery-and-Recycling.aspx
Dams, reservoirs	During major storm events, reservoirs may contribute to prolonged turbidity for downstream intakes for drinking water. Construction, fluctuating water	□ Notify the dam owner or operator of their location within the drinking water source area and ensure that there is secondary containment for fuels or other chemicals stored; send the fact sheet: "Managing Small Quantity Chemical Use" http://www.oregon.gov/deq/FilterDocs/SQGHandbook.pdf http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_ChemUseSmallQ.pdf □ Work with the local first responders to develop a spill response and/or communication strategy in case of accident or dam release; make a plan for regular updates.

	levels, and heavy waterside use can increase erosion and turbidity in reservoir or drinking water source.	**Additional recommendations** □ Consult dam safety resources from FEMA. □ Consider restricting use of two-stroke engines on small reservoirs that serve drinking water intakes
Fire impacts, burned areas	Vegetation removal by fire may increase surface erosion and sediment delivery rates, resulting in high turbidity in surface water and drinking water intake; fire-fighting activities and application of retardants can impact downstream drinking water.	□ During fire prevention planning, work with the forest owner(s) or manager(s) so they know where the drinking water intake is located and the location of the drinking water source area boundaries; send the "Basic Tips for Keeping Drinking Water Clean and Safe": http://www.oregon.gov/deq/FilterDocs/BasicTips12WQ005.pdf □ On state-owned or regulated forest lands, learn more about the Oregon Department of Forestry's work regarding fires; work with ODF to identify and address potential impacts to drinking water intake(s): http://www.oregon.gov/ODF/Fire/pages/FireStats.aspx □ Work with land owners and managers to quickly assess potential water quality impacts after fire; support Forest Service and others to implement stabilization such as Burn Area Emergency Rehabilitation (BAER) for erosion control and/or other treatments to reduce the risk of runoff. See: https://www.fs.fed.us/eng/rsac/baer/ □ Post-fire, contact Oregon DEQ Laboratory (503-229-5630) to request water quality monitoring at the drinking water intake to evaluate chemical changes in levels of nitrogen, sulfates, pH, chlorides, turbidity, fire-fighting chemicals, etc. □ Contact Oregon Health Authority to find out about post-fire emergency drinking water source protection grant to help with watershed stabilization to reduce water quality impacts and risks: http://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/DRINKINGWATER/SRF/Pages/index.aspx
Fish hatchery	Some aquaculture practices may increase surface erosion and sediment delivery rates, resulting in turbidity in drinking water source; runoff or discharges containing nutrients, suspended solids, antibiotics and other chemicals may	□ Notify the owner or manager of their location within the drinking water source area and send the "Basic Tips for Keeping Drinking Water Clean and Safe": http://www.oregon.gov/deq/FilterDocs/BasicTips12WQ005.pdf □ Contact the owner or manager to verify that best management practices are being used for chemical or petroleum product storage (indoors or outdoors) to reduce potential impacts to water quality. □ Check DEQ's permit webpage to learn more about permits to protect water quality from aquaculture operrations: http://www.oregon.gov/deq/wq/wqpermits/Pages/All-Permits-Applications.aspx

	impact drinking water.	
Forest lands or forest management areas	Forest management activities including cutting and yarding of trees; improper management of pesticide and fertilizer applications; and road building/usage/ maintenance activities may impact drinking water	□ Notify forest landowner(s) or manager(s) of their location in your drinking water source area and send EPA fact sheets: *Managing Nonpoint Source Pollution from Forestry http://www.epa.gov/polluted-runoff-nonpoint-source-pollution/nonpoint-source-forestry and *Nonpoint Source Pollution from Forestry: National Management Measures to Control Nonpoint Source Pollution from Forestry http://www.epa.gov/polluted-runoff-nonpoint-source-pollution/forestry-additional-resources □ If there is private industrial forest land scheduled for harvest or chemical application within 2-year Time-of-Travel zone (or within short-term recharge area for a spring), work with landowner to set up direct communication, share maps, and provide notification on any chemical application. □ For details on pesticide use in Oregon forestry, please see: http://www.oregon.gov/ODF/AnalyticsReports/ForestryFacts_Herbicides_And_Forestry_01092017.pdf □ Work with Oregon Department of Forestry (ODF) Stewardship or District Forester to request that there is voluntarily no mixing, handling, or storage of bulk pesticides or fertilizers in the 2-year Time-of-Travel zone or Zone 1 for springs. ODF may be able to help facilitate communication with the land owners or managers to discuss site-specific concerns about protecting the groundwater or springs: http://www.oregon.gov/ODF/Working/Pages/FindAForester.aspx □ For harvested areas that use pesticides, refer to fact sheets in "Cropland" section above for additional information □ For assistance with drinking water source protection issues on federal forest lands, contact US Forest Service Region 6: https://hrm.gdcii.com/directory/R6.htm **Additional recommendations** □ Set up an agreement or MOU with landowner(s) or manager(s) that addresses handling and application of pesticides and fertilizers and best management practices for equipment fueling and spills. □ See DEQ factsheet on "Pesticide use in the vicinity of drinking water sources" for additional regulations and recommendations: https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf
Golf courses, parks (and any other highly-maintained areas, like cemeteries, concentrated residential lawns, ball fields, etc.)	Over-application or improper handling of pesticides or fertilizers may impact water quality; excessive irrigation may cause transport	□ Determine degree and type of chemicals used for lawns and landscaping maintenance. □ Share relevant fact sheets below. □ Work with landowners or operators to minimize (or eliminate in sensitive areas) pesticide and fertilizer application. □ Provide training/workshops to park staff on water quality protection. See: *Integrated Pest Management website (OSU): http://npic.orst.edu/pest/ipm.html □ Use products that are environmentally friendly.

	of contaminants through runoff and infiltration.	□ Minimize irrigation, or use water-efficient irrigation. □ Ensure pesticides are handled and stored safely. □ Ensure that a spill response plan is in place, a spill kit is available and employees are trained annually in spill response. □ For golf courses, distribute Integrated Pest Management (IPM) information: *Integrated Pest Management Info for Golf Courses: http://www.greengolfusa.com/tiki-index.php **Fact Sheets/Resources** *Healthy Lawn, Healthy Environment: https://www.epa.gov/sites/production/files/2014-04/documents/healthy_lawn_healthy_environment.pdf *EPA Source Water Protection Practice Bulletins: - Managing Small-Scale Application of Pesticides: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_PesticidesSmallScale.pdf - Managing Turfgrass and Garden Fertilizer Applications: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_TurfgrassGarden.pdf - Managing Small Quantity Chemical Use: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_ChemUseSmallQ.pdf
Grazing animals - (as a guideline, only those areas with >5 large animals or equivalent per acre over an extended time) Includes small rural farms, boarding stables, auction lots, fairgrounds	Improper storage and management of animal wastes and wastewater in areas of concentrated animals may impact water quality	□ Encourage farm operator to work with their local Soil and Water Conservation District (SWCD), Oregon State University County Extension Agent, or Natural Resources Conservation Service (NRCS) to actively encourage management measures that protect water quality; management measures can address livestock waste storage and treatment, wastewater disposal, etc. **Agency Websites:** Oregon Department of Agriculture: http://www.oregon.gov/ODA/Pages/default.aspx Soil and Water Conservation Districts: http://oacd.org/conservation-districts/directory OSU Extension: http://extension.oregonstate.edu/find-us Natural Resources Conservation Service, Oregon: http://www.nrcs.usda.gov/wps/portal/nrcs/site/or/home/ □ Share relevant fact sheets below. □ If this land covers a large percentage of your drinking water source area, notify your local SWCD of your source area location. □ Identify and document any pesticides used to maintain site and areas applied. **Fact Sheets/Resources** *For grazing animals, provide Oregon NRCS Fact Sheets from this link: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/?cid=nrcs142p2_046062 *Managing Pastures in Eastern Oregon (or Western Oregon)

		*Managing Stock Water in Pastures and Streamside Areas *Managing Weeds in Pasture and Managing Pastures. (Tips for Eastern Oregon Landowners) *Managing Pastures in Western Oregon (Tips for Western Oregon Landowners) *Providing Stock Water in Fields near Streams *Managing Weeds in Pasture Also, Manure Management in Small Farm Livestock Operations http://animalag.wsu.edu/water%20quality/Tab4em8649.pdf
Irrigation canal, ponds	Runoff or infiltration containing pesticides or fertilizers may impact drinking water	□ Determine from owner(s) or operator(s) whether fertilizer or pesticides are being used. See DEQ Factsheet: "Pesticide use in the vicinity of drinking water sources": https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf □ Check DEQ's permit webpage to learn more about permits to protect water quality from pesticide application areas: http://www.oregon.gov/deq/wq/wqpermits/Pages/All-Permits-Applications.aspx □ Work with land owner or manager to ensure that the pesticide/fertilizer/petroleum mixing and storage areas is located outside the 2 year Time-of-Travel zone or Zone 1 for springs. □ If irrigation canals are in close proximity to shallow wells, share guidance on integrated pest management approaches to control vegetation: http://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1010&context=centerforlakes_pub
Known contamination sites - spill sites or known downgradient plumes	Existing contamination from spills, leaks, or improper handling of used or stored materials may impact the drinking water supply	□ Verify cleanup site status by checking Environmental Cleanup Site Information (ECSI) database at: http://www.oregon.gov/deq/Hazards-and-Cleanup/env-cleanup/Pages/ecsi.aspx □ Contact DEQ Cleanup program or Drinking Water Protection staff (Julie Harvey, DEQ, 503-229-5664) for assistance in verifying that cleanup is protective of drinking water. □ Ensure DEQ cleanup program staff are aware of the drinking water source area location, and are working towards "No Further Action" status. For more information, go to: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/env-cleanup/Pages/default.aspx
Landfills, composting facility, historic waste dumps, waste transfer, waste recycling stations	Water coming into contact with waste material may transport contaminants to groundwater and/or as runoff affecting surface water	□ Notify the landowner or manager of their location within your drinking water source area □ Work with DEQ Drinking Water Protection staff or permitting program staff to review permits and ensure permitted facilities are in compliance. http://www.oregon.gov/DEQ/mm/swpermits/Pages/default.aspx □ For historic landfills, check with the DEQ Site Assessment program to verify status of site: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/env-

		cleanup/Pages/Site-Assessment.aspx □ Ensure DEQ cleanup program staff are aware of the drinking water source area location, and are working towards "No Further Action" status. For more information, go to: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/env-cleanup/Pages/default.aspx
Large capacity onsite septic systems (serves > 20 people)	If not properly sited, designed, installed, and maintained, septic systems can impact groundwater and downgradient surface water	□ Review and share technical information from: *Managing Septic Systems to Prevent Contamination of Drinking Water http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_SepticSystems.pdf □ Encourage/incentivize septic system upgrades and establish an ongoing septic system maintenance program. DEQ On-site permitting: http://www.oregon.gov/DEQ/Residential/Pages/Onsite.aspx □ Verify UIC registration and onsite permit with DEQ; sign up to get notifications from DEQ on any permit modifications □ See Residential lands for additional technical assistance (below) □ If applicable, ongoing education program for residents or businesses on household hazardous waste and proper disposal of pharmaceuticals. Household Hazardous Waste Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/hw/Pages/hhw.aspx Household Pharmaceutical Waste Disposal: http://www.oregon.gov/deq/Hazards-and-Cleanup/hw/Pages/Pharmaceuticals.aspx
Mining activities, gravel pits	Spills, leaks, or improper handling of chemicals and wastes generated in mining operations or from heavy equipment may impact the drinking water supply	□ Contact the site manager and verify that chemicals, petroleum products, and other materials are handled properly and share: *Business and Industry Tips for Drinking Water Protection http://www.oregon.gov/deq/FilterDocs/dwpbusindtips.pdf □ Contact Oregon Dept. of Geology and Mineral Resources for more information on best management practices: http://www.oregongeology.org/mlrr/surfacemining-faq.htm □ Check DEQ's permit webpage to learn more about permits to protect water quality: http://www.oregon.gov/deq/wq/wqpermits/Pages/All-Permits-Applications.aspx □ Verify Permit status with regional DEQ office; gravel mines may have a general WPCF permit 1000 for gravel mining activities and a General 1200-A permit for stormwater discharge; set up notification from DEQ on any permit modifications. **Additional recommendations** □ Review Recommended Best Management Practices for Storm Water Discharges and implement best management practices (See Section 2.1) http://www.oregon.gov/deq/FilterPermitsDocs/BMPManual.pdf

Onsite septic systems residential, farm, commercial onsite systems	If not properly sited, designed, installed, and maintained, septic systems can impact drinking water; use of drain cleaners and dumping household hazardous wastes or pharma-ceuticals can result in groundwater contamination affecting nearby surface water; for higher-density septic, cumulative effects of multiple systems in an area may impact groundwater and surface water quality	□ In addition to general residential lands (below), rural lands, commercial/industrial factsheets, share relevant information from list below: **Fact Sheets/Resources** *DEQ Septic Smart Program web-site: http://www.oregon.gov/DEQ/Residential/Pages/Septic-Smart.aspx *"Septic Smart for Homeowners - brochure": http://www.oregon.gov/deq/FilterDocs/septicowner.pdf *"Managing Septic Systems to Prevent Contamination of Drinking Water": http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_SepticSystems.pdf □ Refer local homeowners and small businesses to Oregon Onsite loan program that can help with septic system costs: http://www.oregon.gov/deq/Residential/Pages/Onsite-Loans.aspx Additional measures may include: □ Make "Septic Smart for Homebuyers" available at local permitting counter or to local realtors: https://www.oregon.gov/deq/FilterDocs/septicbuyer.pdf □ Develop ongoing education program on septic system operation, maintenance and upgrades □ Consider grants to partially fund inspection/repair program □ Implement required inspection program on property transfer
Parking lots, large impervious surfaces	Spills and leaks of automotive fluids and residues in parking lots may impact the drinking water supply.	□ Notify the owner or manager of their location within your drinking water source area and send fact sheets on "Use of Injection Control Systems and Groundwater Protection" and "Managing Storm Water Runoff"; work with municipality (permit holder) to ensure best management practices are in place to protect drinking water resources. □ Verify if the drinking water source area is covered under a Municipal Phase I or Phase II separate storm sewer system (MS4) permit; check DEQ's permit webpage to learn more about permits to protect water quality: http://www.oregon.gov/deq/wq/wqpermits/Pages/All-Permits-Applications.aspx □ Identify sensitive areas or locations where stormwater management enhancements would benefit drinking water; work with landowner to secure grants to implement best management practices.

Pipelines petroleum, chemicals	Spills, leaks, or improper handling of pipeline products may impact water quality; construction and corridor maintenance may contribute to increased erosion and turbidity in drinking water supply.	If a public water system is concerned about potential or known pipelines within their drinking water source area, please contact DEQ's drinking water GIS staff (503-229-5664) for mapping information. See: http://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx □ Contact the pipeline owner or contractor and ensure they are aware of their location within your drinking water source area; request direct immediate notification of the public water system in case of spills. □ Work with the local first responders to develop a spill response and/or communication strategy and plan for regular updates. □ Request pipeline owners or operators to eliminate or minimize pesticide applications and extensive soil disturbance in the source water area or upstream of the intake. □ During pipeline construction or maintenance work, request that the owner/operator take significant precautions to prevent soil erosion, especially during storm events.
Random dump sites	Illegal trash and debris containing chemicals and hazardous materials may generate runoff and cause contamination of drinking water sources	□ Notify the owner of the property of their location within your drinking water source area and send "Combating Illegal Dumping". http://www.oregon.gov/DEQ/mm/Pages/Illegal-Dumping-Clean-Up.aspx □ Implement appropriate community-based prevention strategies including an education campaign – install signs, newspaper releases and ads, utility inserts, cleanup events, collection events, install lights, use vehicle barriers, and/or public-private partnerships. □ If contamination is suspected, file a complaint online or call DEQ's complaint line (1-888-997-7888) for assistance. **Fact Sheets/Resources** DEQ Site Assessment Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/env-cleanup/Pages/Site-Assessment.aspx
Residential lands – private urban or private rural homes	Spills, leaks, or improper handling of chemicals, fuels, wastewater, and other materials may impact drinking water; infiltration containing pesticides or fertilizers may impact drinking water; see onsite septic systems (above)	□ Provide information to residents within your drinking water source area. See this example letter: http://www.oregon.gov/deq/FilterDocs/dwpExampleLettertoResidents.docx. Outreach can be done through local media or via utility bills. Send (or refer to) relevant fact sheets and web resources from list below. **Fact Sheets/Resources** *Healthy Lawn, Healthy Environment: https://www.epa.gov/sites/production/files/2014-04/documents/healthy_lawn_healthy_environment.pdf *What is Household Hazardous Waste?: http://www.oregon.gov/deq/FilterDocs/WhatisHHW.pdf *Household Hazardous Waste Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/hw/Pages/hhw.aspx *Household Pharmaceutical Waste Disposal: http://www.oregon.gov/deq/FilterDocs/HouseholdPharmaceuticalWasteDisposal.pdf

		*Stormwater runoff from residential lands: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_StormWater.pdf Additional measures may include: □ Establish partnerships with County Extension Service or SWCD to assist with educational program on household hazardous waste and proper disposal of pharmaceuticals, lawn and landscaping, septic system maintenance. □ Establish regular presence at local events, fairs, etc. with educational materials
River recreation and camping – heavy use areas	Inadequate disposal of human wastes may contribute bacteria, pathogens, and nutrients to the drinking water supply; heavy use may contribute to streambank erosion causing turbidity; fuel spills and emissions from boats may also contribute to contamination.	□ Notify the owner, operator, or land manager of their location within your drinking water source area. Check if there are septic systems and portable toilet disposal systems in close proximity to the stream or reservoir; verify maintenance and permits. (To verify the septic system permit status, contact DEQ regional office 503-229-5630) If applicable, post information about safe fueling, and waste disposal at marina/boat launch; see Oregon State Marine Board website: http://www.oregon.gov/OSMB/boater-info/Pages/Environmental.aspx □ Work with landowners and jurisdictions to address any significant water quality degradation in surface water; management options for reducing impacts include providing toilets, requiring waste collection and haul-out, prohibiting pets and pack animals, reducing vehicle traffic, minimizing streamside camping, targeted education to visitors on waste disposal techniques, etc. □ Share information from the Bureau of Land Management's summary of how to reduce impacts of river recreation and camping: https://www.blm.gov/or/districts/vale/recreation/files/vdo_rec_wallowaGRlowimpact070606.pdf
Schools, universities	Over-application or improper handling of cleaning products, lab chemicals, pesticides or fertilizers used on the school grounds may impact drinking water; parking lots, roadways, or vehicle maintenance may also contribute contaminants to runoff and infiltration	□ Notify the school of their location within your drinking water source area and send fact sheets (below) as appropriate. □ Verify that the school is complying with Oregon schools' Integrated Pest Management (IPM) law; contact Oregon Department of Agriculture with questions or assistance: http://www.ipmnet.org/tim/IPM_in_Schools/IPM_in_Schools-Main_Page.html Learn more about schools and drinking water: https://www.epa.gov/schools-air-water-quality/schools-water-quality □ Contact the school and find out if there is an onsite septic system, if there are aboveground storage tanks, underground injection wells, or vehicle maintenance and washing; if present, contact DEQ Drinking Water Protection staff (503-229-5664) so that DEQ may assist school with best management practices. **Fact Sheets** *DEQ's Household Hazardous Waste Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/hw/Pages/hhw.aspx

		*Healthy Lawn, Healthy Environment: https://www.epa.gov/sites/production/files/2014-04/documents/healthy_lawn_healthy_environment.pdf *Managing Septic Systems: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_SepticSystems.pdf *Septic Systems OSU Extension website: http://wellwater.oregonstate.edu/septic-systems-0 *Automotive Repair and Maintenance Tips for Drinking Water Protection: http://www.oregon.gov/deq/Filterdocs/automaint.pdf *Managing Vehicle Washing to Prevent Contamination of Drinking Water: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_VehicleWashing.pdf
Sewer lines – within close proximity to waterbody	If not properly designed, installed, and maintained, sewer lines can impact drinking water, especially adjacent to a waterbody	□ Contact jurisdiction for sewer/wastewater management and determine locations, status of sewer lines and sewer plan □ Identify broken or cracked lines in relation to drinking water intake(s), areas with inflow and infiltration; identify upgrade or replacement of lines as a high priority within the municipal sewer master planning. □ Work with jurisdiction to request maintenance, replacement, or double sleeve of sewer lines near surface water, especially immediately upstream of intakes
Stormwater runoff -- (focusing on impervious surfaces or high density housing (> 1 House/0.5 acre))	Stormwater runoff from land and impervious areas such as paved streets, parking lots, and building rooftops during rainfall and snow events often contain pollutants that could adversely affect water quality.	Check DEQ's permit webpage to learn more about permits to protect water quality: http://www.oregon.gov/deq/wq/wqpermits/Pages/All-Permits-Applications.aspx □ National Pollutant Discharge Elimination System (NPDES) permits are required for storm water discharges to surface waters from construction and industrial activities and municipalities if stormwater from rain or snow melt leaves a site through a "point source" and reaches surface waters either directly or through storm drainage. □ Identify underground injection wells and dry wells for stormwater disposal; verify permit status. □ Implement education program on stormwater issues; ongoing public education program on pesticide and fertilizer use, household hazardous waste, pet waste, and household pharmaceutical waste disposal. □ Host or facilitate ongoing household hazardous waste, collections; see: http://www.oregon.gov/deq/Hazards-and-Cleanup/hw/Pages/hhw.aspx □ Work with your municipality to increase emphasis on pre-treatment for stormwater runoff and best management practices for stormwater. □ Develop best management practices and maintenance plan for drywells and injection wells. http://www.oregon.gov/deq/wq/wqpermits/Pages/UIC-

		Guidance.aspx http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_StormWater.pdf □ Review Oregon's Water Quality Model Code and Guidebook or Portland's Stormwater Management Manual (or other stormwater management document), and develop program to address stormwater issues. □ Send applicable information from list below: **Fact Sheets/Resources** *Managing Stormwater to Prevent Contamination of Drinking Water: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_StormWater.pdf *Water Quality Model Code and Guidebook: http://www.oregon.gov/LCD/waterqualitygb.shtml *Portland's Stormwater Management Manual: http://www.portlandonline.com/bes/index.cfm?c=dfbbh *Best Management Practices (BMPs) for washing vehicles: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_VehicleWashing.pdf *Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_PetWaste.pdf *Disposal of Chlorinated Water from Swimming Pools and Hot Tubs: https://www.oregon.gov/deq/FilterDocs/bmpchlorwaterdisp.pdf *Household Hazardous Waste Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/hw/Pages/hhw.aspx *Underground Injection Control (UIC) Program: http://www.oregon.gov/DEQ/wq/wqpermits/Pages/UIC.aspx *Healthy Lawn, Healthy Environment: https://www.epa.gov/sites/production/files/2014-04/documents/healthy_lawn_healthy_environment.pdf
Stream crossings	Transported chemicals or fuels from trucks and cars can easily enter surface water when spilled at bridges or low-water crossings in stream beds; these can immediately impact downstream drinking water intakes.	□ Work with the local first responders to develop a spill response and/or communication strategy and plan for regular updates. □ Become familiar with the Office of Emergency Operations and their Assessment and Planning Tools (RAPTOR)---a web mapping application that allows users to display data from various agencies: http://www.oregon.gov/oem/emops/Pages/RAPTOR.aspx □ Verify that your public water system contact information is correct in the state emergency response programs □ Learn more about Oregon DEQ's work with other agencies and industry to prevent and respond to spills of oil and hazardous chemicals: http://www.oregon.gov/deq/Hazards-and-Cleanup/env-cleanup/Pages/Emergency-Response.aspx □ Become familiar with the role of the Oregon Emergency Response System (OERS); should a spill occur, this agency coordinates and manages state resources in response to natural and technological

		emergencies involving multi-jurisdictional cooperation between all levels of government and the private sector. **NOTE: the phone number to report spills to OERS is 800-452-0311**
Transportation corridors, right-of-ways, roads, railroads, transmission lines	Vehicle use increases risk for fuel and other chemical leaks, spills and emissions affecting drinking water; over-application or improper handling of pesticides or fertilizers may impact drinking water supply; construction and maintenance of roadways and corridors may contribute to increased erosion and turbidity in drinking water	□ Notify the owner (City, County, ODOT, railroad, transmission line, etc) and local first responders of the drinking water source area location to enable rapid spill response; consult the Oregon Emergency Response Program Local Emergency Managers List: https://www.oregon.gov/OMD/OEM/docs/plan_train/locals_list.pdf □ In areas where pesticides are used for weed suppression, share technical information on water quality and pesticides: Managing Small-Scale Application of Pesticides: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin_PesticidesSmallScale.pdf □ See DEQ factsheet "Pesticide use in the vicinity of drinking water sources" for additional regulations and recommendations: https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf □ Request elimination or minimization of herbicide application on right-of-ways that may contaminate groundwater and downgradient surface water. □ Recognize stormwater discharge issues from transportation sources: https://www.epa.gov/npdes/stormwater-discharges-transportation-sources □ Identify if stormwater injection wells are present. If they are present, verify the permit status by contacting Oregon DEQ's Underground Injection Control staff (503-229-5630). **Additional recommendations** □ Encourage proper use or elimination of any dry wells or sumps in your drinking water source area. □ Ask transportation officials to examine spill/runoff detention capacity to prevent contaminants entering the groundwater or surface water after an accident. □ Ask for notification of the public water system in case of spills □ Reroute transport of hazardous materials if possible □ Public water system may want to assume responsibility for non-chemical weed control near the intake
Underground injection control (UICs) – dry wells, stormwater sumps	Shallow injection wells may transport untreated water directly into groundwater and impact downgradient surface water	□ Notify the landowner or manager of their location within your drinking water source area. □ Work with Drinking Water Protection staff or UIC permitting program staff (503-229-5630) to ensure permitted facilities are in compliance. □ Share applicable information on UICs: *Oregon DEQ Underground Injection Control Program: http://www.oregon.gov/DEQ/wq/wqpermits/Pages/UIC.aspx Check DEQ's permit webpage to learn more about permits to protect water quality: http://www.oregon.gov/deq/wq/wqpermits/Pages/All-Permits-Applications.aspx

Underground storage tanks (USTs)	Existing or historic contamination from spills, leaks, or improper handling of stored materials may impact the drinking water supply; spills or improper handling during tank filling or product distribution may also impact groundwater and/or downgradient surface water	□ Notify owner or manager of their location within the drinking water source area; share technical information about protecting nearby drinking water resources: http://www.oregon.gov/deq/wq/programs/Pages/DWPAssessments.aspx *DEQ's Underground Storage Tank Program: http://www.oregon.gov/DEQ/tanks/Pages/default.aspx □ For Active Registered Tanks: Verify permit status at http://www.oregon.gov/DEQ/tanks/Pages/Tank-Lists.aspx Contact DEQ Tanks program with questions. □ For Leaking USTs, verify status at http://www.oregon.gov/deq/tanks/Pages/Leaking-Undergr-Tanks.aspx □ Contact DEQ Tanks program at: Underground Storage Tanks Helpline, 1-800-742-7878, 503-229-6652, tanks.info@deq.state.or.us or Drinking Water Protection staff (Julie Harvey, DEQ, 503-229-5664) for assistance in verifying that cleanup is protective of drinking water. □ For non-regulated tanks (<1,100 gals or large heating oil tanks) also send: *Frequently Asked Questions About Heating Oil Tanks http://www.oregon.gov/deq/tanks/Pages/hot.aspx
Utility stations, substations, maintenance, and transformer storage	Spills, leaks, or improper handling of chemicals and other materials including PCBs during transportation, use, storage and disposal may impact the drinking water supply	□ Notify the landowner or property manager of their location within the drinking water source area; identify and discuss pollution prevention activities at the site □ Work with DEQ Drinking Water Protection staff or permitting program staff to ensure permitted facilities are in compliance. □ Request elimination or minimization of herbicide application on utility station properties that may contaminate groundwater and downgradient surface water. □ In areas where pesticides are used for weed suppression, share technical information on pesticides and water quality: *Managing Small-Scale Application of Pesticides: http://www.oregon.gov/deq/FilterDocs/EPASWPPracticesBulletin PesticidesSmallScale.pdf □ See DEQ factsheet "Pesticide use in the vicinity of drinking water sources" for additional regulations and recommendations: https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf
Wastewater treatment, outfalls	Treatment chemicals and equipment maintenance materials may impact surface water quality; wastewater treatment effluent is	□ Consult DEQ's Interactive Map Viewer to verify locations of upstream wastewater treatment outfalls: http://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx □ Work with the local first responders to develop a spill response and/or communication strategy and plan for regular updates. □ If applicable, ongoing education program for residents or businesses on household hazardous waste and proper disposal of pharmaceuticals; obtain grants to implement household hazardous waste and pharmaceutical collection events to reduce waste input levels to wastewater treatment plant upstream of drinking water

	known to contain trace amounts of human, household, and chemical wastes	intakes
Wells – private domestic, municipal, commercial, industrial, irrigation, or unused wells	Improperly installed or maintained wells and abandoned (unused) wells may provide a direct conduit for contamination to groundwater and downgradient surface water	□ Notify well owners of closure requirements for unused wells and construction requirements for active wells. □ Ensure local cross-connection program protects public water supply. □ Offer educational programs to residential well owners on proper maintenance and drinking water protection. □ Verify proper well abandonment in sensitive areas that may impact surface water intake(s). □ Provide financial incentives for permanent well abandonment according to the Water Resources Department's (WRD) "Water Well Owner's Handbook". See: http://www.oregon.gov/owrd/pages/pubs/index.aspx (Provided well construction is adequate, temporary abandonment will be protective of groundwater---contact WRD Staff for assistance.) □ Adopt local ordinance or internal procedures to ensure compliance with WRD well abandonment requirements prior to development. □ Share applicable information from list below: **Fact Sheets/Resources** *Domestic Well Safety Program –Oregon Health Authority http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/SourceWater/DomesticWellSafety/Pages/index.aspx *Groundwater Basics: http://www.oregon.gov/deq/FilterDocs/GroundwaterBasics.pdf *Water Well Owner's Handbook & other related guidance documents (WRD): http://www.oregon.gov/owrd/pages/pubs/index.aspx *Groundwater Friendly Gardening Tips: http://wellwater.engr.oregonstate.edu/groundwater-friendly-gardening

Crop Application Table

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Based upon USGS Pesticide Synthesis Project using EPest Low method, for years 1992-2013. The below table is based upon the estimated kilograms of pesticde applied in Oregon by crop/crop category.

1. This table is comprised of selected pesticides ingredients as per their designation as an Oregon Pesticide of Concern (POC), Pesticide of Interest (POI), or as per water quality monitoring results.

2. The research/scientific basis for how color coding ratings for crop and pesticide application rates are explained below the table in the references and notes section.

KEY for crop and pesticide assocations

Orange - highly associated	[> 25% of kg estimated]
Yellow - moderately associated	[10-25% of kg estimated]
Green - less often associated	[2 - 10% of kg estimated]
Blue - weakly associated	[1 - 2 % of kg estimated]
Not listed - dataset did not support association	

Alfalfa	Metribuzin	Diuron	Chlorpyrifos	2,4-D	Malathion							
Pasture and Hay	2,4-D	MCPA	Diuron	Atrazine								
Wheat	2,4-D	MCPA	Diuron	Metribuzin	Propiconazole	Atrazine	Metolachlor					
Corn	Atrazine	Metolachlor	Chlorpyrifos	2,4-D	Ethoprop (Mocap)							
Orchards and grapes	2,4-D	Chlorpyrifos	Simazine	Azinphosmethyl (Guthion)	Malathion	Diuron	Carbaryl	Diazinon				
Vegetables and fruit	Metolachlor	Ethoprop (Mocap)	Chlorpyrifos	Atrazine	DCPA (Dacthal)	Carbaryl	Metribuzin	Diazinon	Malathion	Simazine	Diuron	MCPA
Other crops	2,4-D	MCPA	Atrazine	Chlorpyrifos	Carbaryl	Diuron						

REFERENCES & NOTES:

<> Orchard & grape crop group in Oregon principally include: hazlenuts, pears, wine grapes, cherries, apples, and other crops
<> Vegetable & Fruit crops group in Oregon principally include: Potatoes, onions, blueberries, other berries, snap beans, strawberries, garlic, green peas, cranberries, and others
<> Other crops group in Oregon principally include: Field and grass seeds, hops, and others

Pesticides selected on the basis of water quality **monitoring results** include: DCPA, diazinon, and MCPA. Source: DEQ december 2009 report for LASAR data: "Analysis of DEQ and DHS Pesticide Data in Oregon"

Pesticide use estimates are based upon USGS NAWQA project data. Source data: Nancy T. Baker, U.S. Geological Survey, 2016, written communication

Limitations: EPest values from this study are suitable for making national, regional, and watershed assessments of annual pesticide use. Although estimates are provided by county to facilitate estimation of watershed pesticide for a variety of watersheds, there is a greater degree of uncertainty in individual county-level estimates when compared to Crop Reporting District or state-level estimates because (1) EPest crop-use rates were developed on the basis of pesticide use on harvested acres in multi-county areas (Crop Reporting Districts) and then allocated to county harvested cropland; (2) pesticide-by-crop use rates were not available for all Crop Reporting Districts in the conterminous United States, and extrapolation methods were used to estimate pesticide use for some counties; and (3) it is possible that surveyed pesticide-by-crop use rates do not reflect all agricultural use on all crops grown. The methods developed in this study also are applicable to other agricultural pesticides and years.

Note 1: One POI, Sulfometuron, was not included in the table above due to the lack of sufficient available data.

Note 2: Bromacil was also considered as part of the analysis on the basis of water quality monitoring results, however the data did not support an assocation with a crop/crop category.

Note 3: Grass seed is included under "other crops" category

APPENDIX 3. Categorical Crop-to-Pesticide Table

APPENDIX 4.

Riparian Management Widths: Forestry & Agriculture

All distances are outside boundary of zone in feet from bankfull width (edge of typical high-water level).
[For example, Oregon Private RMA for Large F is 0-20 no cut, 21-100 limited entry.]

Stream Classification[C1]	Oregon Private Forests		Oregon State Forests			Federal Forests	Agriculture
	No Cut	**Limited Entry[P1]**	**No Cut**	**Mature Forest**	**Limited Entry**	**Aquatic Conservation Strategy**	**Site Capable Vegetation**
Large F	20	100 (230/100)	25	100[S3]	170[S6]	2 SPTH[F1] (300-400ft)	Undefined[A1]
Medium F	20	70 (120/74.7)	25	100 [S3]	170 [S6]	2 SPTH[F1] (300-400ft)	Undefined[A1]
Small F	20	50 (40/34.8)	25	100 [S3]	170 [S6]	2 SPTH[F1] (300-400ft)	Undefined[A1]
Medium SSBT	20	80	25	100 [S3]	170 [S6]	2 SPTH[F1] (300-400ft)	Undefined[A1]
Small SSBT	20	60	25	100 [S3]	170 [S6]	2 SPTH[F1] (300-400ft)	Undefined[A1]
Large D	20	70 (90/56.0)	See F	See F	See F	2 SPTH[F1] (300-400ft)	Undefined[A1]
Medium D	20	50 (50/43.6)	See F	See F	See F	2 SPTH[F1] (300-400ft)	Undefined[A1]
Small D	20	None	See F	See F	See F	2 SPTH[F1] (300-400ft)	Undefined[A1]
Large N	20	70 (90/56.0)	25	100 [S3]	170 [S7]	2 SPTH[F1] (300-400ft)	Undefined[A1]
Medium N	20	50 (50/43.6)	25	100 [S3]	170 [S7]	2 SPTH[F1] (300-400ft)	Undefined[A1]
Small Np	0	0/10[P2]	25[S1]	100[S4]	170 [S8]	2 SPTH[F1] (300-400ft)	Undefined[A1]
Small Ns	0	0/10[P2]	25/0[S2]	100[S5]	170 [S8]	1 SPTH[F1] (150-200ft)	Undefined[A1]

C1: Type F = Streams with anadromous or "game" fish (e.g. cutthroat trout)
Type D = Streams with qualifying fish that are used for domestic (drinking) water
Type N(p/s) = Stream with neither qualifying fish nor domestic use; (p/s) designates perennial or seasonal
Large = >10cfs (cubic feet per second) average annual flow
Medium = 2-10cfs (cubic feet per second) average annual flow
Small = <2cfs (cubic feet per second) average annual flow

P1: (ft^2 per 1000ft of stream/ft^2 per acre) = Coast Range and South Coast regions' standard target for required conifer basal area retention in square feet per 1000ft/square feet per acre *for clearcut harvests*. Lower basal area retention is allowed if active restoration (e.g. large wood placement) is part of the harvest

operation. Other regions may have slightly higher or lower retention (see OAR 629-640-0100 (6) (a) Table 1). **See ODF rules for SSBT stream details**.

P2: Understory vegetation and conifers less than 6 inches in diameter breast height retained within 10 feet in Eastern Cascades and Blue Mountain regions; retained within 10 feet in larger drainages in South Coast region (160 acres), Interior region (330 acres), and Siskiyou region (580 acres); and no retention in Coast Range and West Cascades regions (see OAR 629-640-0200 (6) Table 5).

S1: Applied to at least 75% of the reach including junctions with Type F streams.

S2: High Energy reaches and Potential Debris Flow Track reaches have 25ft no-cut buffer. Other small seasonal Type N reaches have no retention requirements.

S3: Manage for mature forest condition and retain at least 50 trees per acre.

S4: 15-25 conifer trees and snags per acre.

S5: 15-25 conifer trees and snags per acre on High Energy reaches, 10 conifer trees and snags per acre on other Type N seasonal streams.

S6: 10-45 conifer trees and snags per acre.

S7: At least 10 conifer trees and snags per acre.

S8: 0-10 conifer trees and snags per acre. Doesn't apply to seasonal streams other than High Energy reaches.

F1: SPTH= site potential tree height, the maximum height a mature conifer tree is expected to reach based on the productivity of the site. It ranges from 150-200 feet.
Federal forestlands are managed under the Northwest Forest Plan which requires management for ecological purposes only in the riparian reserves.
Bureau of Land Management lands in western Oregon are undergoing revisions to their management plans that are expected to reduce the size of riparian reserves while continuing to protect water quality.

A1: None of the ODA water quality rules specify distances for riparian management rule requirements. Specific rules vary by WQMA but generally require agricultural activities in the riparian area to allow for establishment, growth, and maintenance of vegetation consistent with "vegetative site capability", shade production, and sediment filtration. See here for details: http://www.oregon.gov/oda/programs/NaturalResources/Pages/AgWaterQuality.aspx .

APPENDIX 5. Drinking Water Protection Websites

Oregon Health Authority

Regulations for drinking water, health effects information, data, etc.:
http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Pages/index.aspx

Oregon DEQ's Drinking Water Protection

http://www.oregon.gov/deq/wq/programs/Pages/DWP.aspx
Technical resources, best management practices, fact sheets, etc.:
http://www.oregon.gov/deq/wq/programs/Pages/DWP-Pubs.aspx

Department of Geology and Mineral Industries

Information on landslides, mapping, 3D terrain, and LiDAR:
http://www.oregongeology.org/sub/projects/olc/default.htm

Oregon Geospatial Enterprise Office

For Oregon Geographic Information Systems (GIS) data layers:
http://www.oregon.gov/DAS/CIO/GEO/pages/index.aspx

Google Earth

For maps, satellite imagery, etc.:
https://earth.google.com/

US Geological Survey

Information on toxics, monitoring data, and human health benchmarks, etc.:
http://toxics.usgs.gov/regional/emc/index.html
http://health.usgs.gov/dw_contaminants/
Scientific information to identify, assess, and quantify the availability of water resources. Information on groundwater levels, aquifers, water use, and water quality.
http://water.usgs.gov/ogw/gwrp/

Multidisciplinary studies of regional drinking water availability across the United States to provide resource managers and policy makers with essential information needed for management of a limited resource in areas experiencing chronic water-supply issues and concerns.

http://water.usgs.gov/ogw/gwrp/activities/regional.html