Report

State of Oregon
Department of Environmental Quality

Drinking Water Source Monitoring Project Phase I 2008-2009

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Executive Summary

This multi-phase project examines drinking water source monitoring and associated contaminants. Oregon Department of Environmental Quality and Oregon Department of Human Services drinking water staff looked at whether there are potential human health risks beyond those routinely monitored by federal Safe Drinking Water Act regulations at 13 public water supply systems throughout Oregon. The two agencies also sought to determine priorities for technical assistance and contamination prevention efforts statewide.

During Phase 1 of this project (2008-09), DEQ and DHS collected surface water and groundwater samples from intakes and wells that have multiple land uses in the source areas and are considered high-risk sources, as identified through a state analysis of susceptible systems.

In 2008 and spring 2009, DEQ Laboratory staff collected samples above the surface water intakes serving the cities of Detroit, Gold Hill, Jefferson, Riddle, Seaside and Hillsboro. Samples were also collected at the supply wells for Independence, Oakridge, Keizer, Spray, Avion (Bend), Vale and Whispering Pines Mobile Lodge in Corvallis. Staff analyzed samples for several hundred compounds, including Oregon-specific herbicides, insecticides, pharmaceuticals, volatile organic compounds (including cleaners), fire retardants, polycyclic aromatic hydrocarbons (organic compounds produced as byproducts of fuel burning) and plasticizers.

DHS toxicologists reviewed and interpreted analytical results for the first round and sent the results to the individual public water systems. This report presents these results.

In general, data from this project show that very low levels of some contaminants are present in these drinking water source waters. The levels of these contaminants meet existing applicable standards and guidelines, however, coming in well within acceptable limits. Contaminants detected were consistent with other studies conducted in similar source areas across the country.

Funding for this project came through the federal Safe Drinking Water Act (Drinking Water Revolving Loan Fund Set-Asides for Local Assistance: drinking water protection).

Phase II of this project (2010-11) will involve sampling at approximately 10 groundwater wells and 10 intakes across the state and analyzing for the same parameters as in Phase I. The locations will be selected based upon the existing data at each system showing high levels of nitrates and other contaminants. The sampling will be done in June and October 2010.

Program Background and Scope

In Oregon, the Department of Human Services (DHS) is responsible for oversight of drinking water quality at public water systems. DHS is also responsible for administering and enforcing national drinking water regulations established by the U.S. Environmental Protection Agency (EPA) under the federal Safe Drinking Water Act (SDWA), through an arrangement with EPA called "Primacy." Under Primacy, DHS adopts state regulations that are no less stringent than federal regulations, and DHS enforces those regulations directly with public water suppliers. EPA oversees the DHS Primacy program.

SDWA regulations require public water systems to meet Maximum Contaminant Levels (MCLs), or in some cases, treatment technique requirements, for specific regulated contaminants in water delivered to users for drinking. EPA has established MCLs or treatment techniques for 91 contaminants, taking into account both protection of public health and the level of environmental protection that water systems can achieve using the best available water treatment technology.

About 2,700 public water systems in Oregon are subject to regulation under the federal Safe Drinking Water Act. Public water systems are defined as those serving 25 or more people at least 60 days per year. Community water systems have 15 or more service connections used by year-round residents. Currently, 882 community water systems serve an estimated 3.2 million Oregonians. Another 346 are non-transient, non-community water systems including schools or workplaces with independent water supply systems that serve the same people day after day. The remaining 1,471 are transient non-community water systems serving transient populations such as campgrounds, parks or restaurants with their own independent water supply systems. An additional 921 very small water systems, those serving 10 to 24 people each and representing approximately 16,000 Oregonians, are subject only to state regulations under the Oregon Drinking Water Quality Act. Not covered by either state or federal drinking water standards are an estimated 600,000 Oregonians who get their drinking water from individual home wells. For information on public water systems in Oregon, including monitoring data, status, and type of treatment technology, go to the DHS website at: http://170.104.63.9/search.htm

Amendments made to the Safe Drinking Water Act in 1996 directed and empowered state drinking water programs to begin or expand efforts to protect sources of drinking water. In Oregon, DHS partnered with DEQ to jointly carry out a statewide drinking water source protection effort. DHS secured available set-aside funds from Oregon's allocation of the Drinking Water State Revolving Fund, and the agencies began joint efforts to 1) conduct assessments of public drinking water sources, and 2) work with local communities to assist them in implementing local protection efforts.

Safe drinking water supplies are dependent upon well-maintained and operated treatment systems and distribution networks. However, it is widely recognized now that even new state-of-the-art treatment technologies can be challenged by the contaminants from diverse activities on land used as sources of drinking water, including the proliferation of new synthetic chemical compounds, strong microbial pathogens, and pharmaceuticals in the waste stream. Safe drinking water supplies will increasingly depend upon working to protect the source areas from contamination. Protecting the drinking water source areas in Oregon is vitally important for reducing the future costs of treatment, and perhaps more importantly, reducing the health risks associated with the contaminants that are not monitored and/or removed through existing regulatory requirements. This project is part of the drinking water protection work in Oregon.

The issue of "emerging contaminants" gained significant attention when national monitoring data results were released by the United States Geological Survey (USGS) in 2005. Several of their monitoring sites included Oregon waters. New chemical compounds were identified in local surface water and groundwater resources, similar to those found across the country. Scientists in Oregon questioned the potential for these pollutants to be in Oregon's drinking water sources.

SDWA does not require that the *source waters* supplying public drinking water systems be sampled---- only the finished or treated water gets sampled prior to delivery to customers. In order to learn more about the quality of the source waters serving public water systems, DEQ and DHS developed a sampling plan for the source waters upstream of surface water intakes and at groundwater extraction wells serving public water systems. Data previously collected as part of the Source Water Assessment project, as well as a Susceptibility Analysis project helped to determine the priorities for the first phase of the sampling plan. The chemical compounds selected for the sampling plan include those not addressed in the Safe Drinking Water Act requirements.

The next phase of monitoring will be initiated in Spring 2010 and will focus on systems with one primary type of risk/land use in the source area and those where community officials have requested state testing due to potential high risks.

Determining Susceptibility to Risks

In 2005, DEQ and DHS completed "Source Water Assessments" for all Oregon public water systems. These were mandated by the federal SDWA Amendments of 1996. For the assessment reports, the agencies used geologic data and geographic information system (GIS) technology to produce maps delineating the source areas for all ground water wells and surface water intakes. The agencies were also required to identify locations of potential risks from 98 separate land uses and activities. Over 15,500 of these potential contaminant risks were located in those source areas upstream and upgradient of public water systems. The top five potential contaminant risks identified for surface drinking water sources were: *managed/clearcut forests; irrigated crops; grazing animals (>5/acre); above ground fuel/chemical tanks; and auto repair shops*. The top five potential contaminant risks identified within ground water source areas were: *high density housing (includes onsite systems); transportation corridors; above ground* *fuel/chemical tanks; irrigated crops; and underground fuel storage tanks*. All of this data is compiled in a database and used frequently for research and strategic planning. More information on the source water assessments, including the report summaries, source area maps, methodology, and inventory results can be found on the DEQ website: http://www.deq.state.or.us/wq/dwp/results.htm

Using the data from the source water assessments, DEQ and DHS were able to identify the Oregon public water systems that have high susceptibility to risks of contamination. Details of the susceptibility analysis are included in *Appendix A*. Database queries and GIS were used to rank the systems in groups called Tier 1 through 4. Tier 1 systems are considered at highest risk due to the *number and proximity of the individual contamination risk sites, and the sensitivity of the source area* where those contaminant risks are located. The groundwater recharge or source areas considered "sensitive" included those within a 2-year time-of-travel zone from each well and have shallow depths, alluvial sediments or fractured bedrock in the recharge zone, and a high infiltration potential. The characteristics of the sensitive areas within surface water watersheds include 1000-foot setbacks from the stream banks, high-erosion soils, high slopes, and high-infiltration soils (especially those near the stream banks).

There were 211 total number of surface water intakes analyzed and ranked. For surface water, 47 systems fell within the Tier 1 ranking of high risk, 40 are within Tier 2, and 31 are in Tier 3. Out of 1827 groundwater sources analyzed, 569 were in Tier 1, 324 were in Tier 2, and 289 were in Tier 3.

The susceptibility analysis for the public water systems statewide has two important uses. The data allows DEQ and other natural resource agencies to prioritize technical assistance, grants, and to develop workplans for monitoring and potential research. The susceptibility analysis also provides the individual water systems with information on where their greatest risk occurs and where to focus available resources for protection. The identification of the high-risk systems has already served as an important tool for determining priorities for drinking water protection work.

Drinking Water Source Monitoring Plan

The goal of this Drinking Water (DW) Source Monitoring project is to determine future program priorities based on actual data. There were three primary objectives in this first phase (2008-09) of the study, including to:

- Collect and analyze samples from surface water and groundwater for a list of contaminants of interest,
- Utilize the results as screening-level data on whether there are potential human health risks beyond those routinely monitored under the SDWA regulations in the drinking water systems that were determined to be at higher risk (Tier 1) from the upstream potential sources of contamination, and,
- Utilize the study results to improve strategic planning and determine priorities for technical assistance and pollution prevention.

In order to select locations for sampling, database queries were first performed for existing water quality data. Most upstream and upgradient source areas do not have ambient monitoring stations for regulated drinking water parameters, so this step did not prove to be very useful. The Susceptibility Analysis results were then used to select priorities. Public water systems were selected from the Tier 1 group and those with a variety of land uses and activities in their source areas were ranked the highest. In the initial 2008-09 round of sampling, the DEQ/DHS team determined that it would be most useful to choose locations that represented a cross-section of land uses or activities. For the surface water systems, the sampling sites included Mackey Creek (City of Detroit), Rogue River (City of Gold Hill), Santiam River (City of Jefferson), Cow Creek (City of Riddle), Necanicum River (City of Seaside), and the Tualatin River (City of Hillsboro/Joint Water Commission). *Figure 1* shows the locations of the watersheds serving the intakes for these systems. *Table 1* provides a summary list of the communities served, intake stream, area of the watershed, and the primary land uses in the watershed. For groundwater systems, the wells were from the Independence Water System, City of Oakridge, City of Keizer, City of Spray, Avion Water Company, City of Vale, and Whispering Pines Mobile Lodge. *Figure 2* shows the locations of the groundwater source areas. *Table 2* provides a summary listing of those groundwater systems and characteristics.

In developing a priority "contaminants of interest" list of pollutants, the DHS/DEQ team used recent national USGS emerging contaminant data in drinking water source areas, an analysis of current unmonitored pollutants used in Oregon, other state source monitoring programs, and consultations with environmental toxicologists at Oregon State University and DHS that have public health/drinking water expertise. Data sources for prioritizing within each group of pollutant included USGS national detection data on pharmaceuticals (see http://toxics.usgs.gov/regional/emc/); cleaners; VOCs; fire retardants from a 2007 analysis of Oregon's highest risks from household chemicals (see http://www.deq.state.or.us/lq/sw/hhw/index.htm); pesticides used in Oregon forestry from Oregon Department of Forestry records; pesticides used in Oregon agriculture from a 2002 DEQ Willamette Valley study; and for other areas of the state, Pesticide Stewardship Partnership data based on past DEQ monitoring in agricultural areas. Other high-risk chemicals were added for review by DHS toxicologists based on recent public water system monitoring results and national data analysis from EPA's drinking water records.

After developing lists within each pollutant group, the final priorities were selected by the toxicologists based on determinations of potential risks to public health. Most of the chemical compounds that were analyzed for are not monitored under the Safe Drinking Water Act requirements. Over 50 compounds were identified as "contaminants of interest" for drinking water in Oregon, including:

- herbicides (total of 12 from agriculture/forestry/urban land uses or sources)
- insecticides (12 from agriculture/urban sources)
- fungicides (3 from agriculture/forestry sources)
- metals (copper, arsenic, mercury)
- bacteria/pathogens (coliform from human and animal wastes)
- drugs (5 from human waste discharge---onsite or wastewater treatment plants)

- cleaners/VOCs (7 from wastewater/industry sources)
- fire retardants (3 from wastewater/urban sources)
- PAHs (5 from combustion-air deposition/runoff from industrial or urban sources)
- plasticizers (1 from industry/urban sources)

Table 3 lists the 50 compounds that are considered drinking water "contaminants of concern" priorities, and indicates the potential land uses or activities where these can originate in the source areas. When the DEQ Laboratory analyzed for these compounds, the list significantly expanded in number as the methods were selected at the lab. For example, the method analysis for *Semi-Volatile Organic Compounds by Gas Chromatograph/Mass Spectrum* includes approximately 126 compounds. All of the data quality indicators and analytes for this project are listed in *Appendix B*. Field analytical methods can be found in the Watershed Assessment Mode of Operations Manual which is available on the DEQ Laboratory website at, deqlab3\SOP\Watershed Assessment\DEQ03-LAB-0036-SOP.pdf. Included in the expanded analysis were also 67 volatile organic compounds, 32 pesticides, and 16 metals. Additional analytes were reported and summarized as part of the chemical analysis results; the final lab report included 272 compounds.

Samples were taken in May/June of 2008, October 2008 (for all sites), and then in June 2009 (for re-testing 3 wells). The sampling locations included source water upstream of 6 individual public water system intakes and the wells serving 7 individual public water systems. For the surface water sites, samples were pulled from a point near the intake, then approximately 200' and 400' upstream of the intake. At one system, samples were pulled at both of the intakes, located on two separate reaches of stream segments (6 public water systems; 7 sites sampled). Actual field locations where samples were pulled depended on access to the river or stream. At the groundwater wells, sampled were pulled from a pre-selected well at the first access point after the water was pumped above ground. In 2 wells, there was no access prior to chlorination, so many of the organic compounds could not be analyzed with an adequate degree of confidence. Due to the access issues, only 5 of the groundwater wells had all analytes reported in the results.

Data Evaluation

The data from the 2008-09 testing revealed that there are *very low levels of contaminants present in the source waters sampled*. DHS toxicologists analyzed DEQ's lab results to provide interpretative information to the public water supplier and local community officials at each source water site. DHS compared the sample results to current Safe Drinking Water Act drinking water standards, secondary standards, or health guidance levels in scientific publications and toxicological research information. Most contaminant levels were orders of magnitude lower than any established standards or regulatory limits. Results of the 2008-09 source water sampling may be broadly summarized as follows:

- 28 percent of samples analyzed from surface water sources had at least one contaminant
- 22 percent of samples from wells had at least one contaminant

- Two groundwater samples (at one well) were found to have arsenic and manganese at levels above the secondary drinking water standards
- Eight surface water samples (at five intakes) were found to have aluminum at levels above the secondary drinking water standards
- The highest number of contaminant detections in surface water included microbes, steroids/hormones, metals, phthalates and pesticides
- The highest number of contaminant detections in groundwater included steroids/hormones (cholesterol), metals, and pesticides (Atrazine)
- One surface water source contained three pharmaceuticals at low levels: Sulfamethoxazole (an antibiotic), Carbamazepine (a mood stabilizer), and Diphenhydramine (an antihistamine)

For individual samples, the lab results are available from the DEQ LEAD website via the LASAR database. In this report, we will summarize the results of the analytes detected. In the surface water sources sampled, the insecticide DEET was found at 85 percent of the sites, the herbicides Atrazine and Diuron were found at 43 percent of the sites and Fluometuron was detected at 28 percent of the sites. Overall, pesticides were present in 29 percent of surface water source samples, but the highest concentrations were at levels below the state's water quality criteria for aquatic life, health-based levels, or drinking water standards (where available). Diethylphthalate and Bis(2-ethylhexyl)phthalate were found at 57 percent of the sites. Metal compounds were identified in almost half of the sites sampled. The highest number of detections included aluminum (at 100 percent), barium and manganese (at 57 percent). Since most metals in Oregon waters are from natural sources and attach to suspended clays in streams, it is not unusual to find high concentrations in source waters. Where the secondary maximum contaminant levels were exceeded for aluminum and manganese, the levels are likely significantly reduced by the drinking water treatment facility. Conventional treatment processes reduce turbidity and suspended solids from the source water with filtration. Finished drinking water samples at these public water systems met the established federal drinking water standards.

In the groundwater sources, the herbicide Atrazine was detected in 40 percent of the samples, but the levels never exceeded the drinking water standard. In the limited number of samples that were analyzed for steroids and hormones, all of them had coprostanol, considered a marker for human wastes. This can come from both onsite septic systems, as well as from wastewater treatment discharges upstream. Arsenic and manganese were also found in high concentrations at separate sample sites. Arsenic is a very common natural contaminant in Oregon's groundwater. The high levels of both arsenic and manganese are indicative of geologic formations supplying the well water. In many areas of Oregon, these metals are quite common and treatment is necessary to reduce those levels where the drinking water standards are routinely exceeded. Metals were found at about half of the well sites sampled, but most were well within acceptable drinking water standards.

As part of the 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 recharge area for the wells. Since the levels were very low in this initial sampling project, DHS 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 from the data analysis:

POTENTIAL SOURCES OF CONTAMINANTS TO SURFACE WATER SUPPLIES

- **Microbes (E. coli), steroids and hormones** are human waste byproducts and are likely from upstream wastewater discharge, high-density onsite septic systems discharging to groundwater, or heavy recreational uses.
- **Metals** can be from industrial or wastewater discharge, but most likely come from natural suspended clays in streams. In surface waters where metals were found, the concentrations were higher in the spring, which may be indicative of potential agricultural fertilizer sources.
- **Phthalates** are contaminants from plastics, perfumes, car care products, cosmetics and flooring. Phthalates in surface water can come from the breakdown of PVCs, plastics or flooring materials. Another very likely source is wastewater discharges and high-density housing with onsite septic systems, since the compounds are found in so many household products.
- **Pesticides** can enter surface waters from agricultural fields, forests, urban lawns, and roadside spraying. Results from this drinking water source monitoring suggest the primary sources are orchards, irrigated crops, harvested forests and high-density housing. The insect repellant DEET enters surface waters from swimmers or wastewater from baths/showers after application to skin. DEET is very persistent once it enters a water body.
- **Pharmaceuticals** were detected in source waters that have both multiple wastewater treatment discharges upstream, as well as 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.

POTENTIAL SOURCES OF CONTAMINANTS TO GROUNDWATER SUPPLIES

- **Steroids and hormones** are very likely linked to human waste byproducts released through onsite septic systems into groundwater. The most common marker of these byproducts is coprostanol, found in human feces.
- **Metals** are very common in Oregon’s groundwater resources from natural geologic formations but are also found in stormwater runoff/infiltration from urban areas and agricultural fertilizer applications.
- **Pesticides** are found at low levels in wells surrounded by agricultural activities and high-density housing. Household lawn applications of pesticides can contribute as many pesticides to local groundwater resources as large-scale crop irrigation and spraying.

Other Relevant Comparative Studies

Other studies conducted recently identify levels of concern in Oregon drinking water sources. For example, DEQ has conducted pesticide monitoring in the Clackamas River since 2005. This river serves as the source of drinking water for more than 380,000 citizens. DEQ sampling results showed two insecticides at levels that exceed state water quality criteria. DEQ is collaborating with USGS on this project, along with the local Soil and Water Conservation District, Clackamas River Basin Council, Oregon State University Extension Service and Oregon Department of Agriculture. DEQ and the other state agencies are working to develop benchmarks for pesticides of concern because the state does not have water quality standards for many of them. This will result in a statewide Pesticide Management Plan that will prioritize pesticides of concern and list a set of desired actions to deal with these pesticides. With this data, DEQ, the Oregon Department of Agriculture and Oregon Department of Forestry can work with pesticide producers and applicators in the basin to reduce pollutant loads to levels that do not pose public health risks.

The USGS also conducted extensive monitoring for other contaminants in the Clackamas River starting in 2002. Sample results found 63 pesticides in source water and 15 pesticides in treated water. Twelve of the pesticides in finished drinking water do not have maximum contaminant levels set by state or federal agencies. For the three pesticide contaminants that do have standards, the treated Clackamas River water meets federal standards for drinking water. USGS has developed health-based screening levels for most pesticides without drinking water standards. The pesticides and other detected concentrations in the raw drinking water sources were very low and did not exceed any of the screening levels established thus far by USGS. Other toxics of concern found in this drinking water supply included various plasticizers, disinfection byproducts and volatile organic compounds, including benzene and toluene (*"Concentration Data for Anthropogenic Organic Compounds in Ground Water, Surface Water, and Finished Water of Selected Community Water Systems in the United States, 2002-05." USGS: 2007*). This new data is particularly useful in identifying specific sources and land uses that are contributing toward pollutants. This will assist DEQ and other natural resource agencies in making better decisions about how to prevent contamination in source waters.

When Oregon's results are compared with national data from USGS and other researchers, DHS and DEQ find that *most of the Oregon percentages are lower for contaminant detections*. In a national reconnaissance study, USGS found that human waste byproducts, several nonprescription drugs, the insect repellent DEET and detergent metabolites were all found at detection frequencies above 75%. During 2008 and 2009, Underwriters Laboratories Inc. (UL) conducted analyses of more than 200 finished drinking water samples from across the United States. This data included samples from 145 public water systems in 29 states. UL conducts regulatory testing for Safe Drinking Water Act compounds, but in this project also tested for a broad range of pharmaceuticals. Cotinine, a nicotine metabolite, was found in 57 percent of the samples.

A synthetic fragrance, Galaxolide, was found in 53 percent of the samples. The most common prescription drug found was Carbamazapine, an anti-depressant, at 46 percent. DEET insect repellent was found in 41% of the samples. UL is quick to point out that this data is limited – of the top 120 drugs now prescribed in the United States, only a couple of those have lab standards currently available. The vast majority of prescription drugs cannot be measured in drinking water or source water.

There are many other research projects underway to test for emerging contaminants in drinking water sources and treated water. The majority of analytical results in drinking water tests reveal very low concentrations. Until recently, chemists did not even have the technology to measure the compounds at parts-per-billion or parts-per-trillion levels. It is clear now, however, that these personal care products and pesticides and drugs are found virtually in every stream tested in the country where humans reside or recreate. State agencies also recognize that drinking water treatment plants cannot completely eliminate toxic contaminants from source waters.

Using the Data

DHS and DEQ will use data from this Drinking Water Source Monitoring project to help prioritize the drinking water source areas for other partnership programs. These projects can be implemented with the help of DEQ and DHS drinking water protection staff within source areas for drinking water intakes or wells. The DW Source Monitoring project and drinking water protection efforts are closely linked to other current DEQ and DHS toxics monitoring and pollution prevention initiatives, especially the DEQ Toxics Reduction project (see http://www.deq.state.or.us/toxics/index.htm) and the Oregon Toxics Monitoring Program (see http://www.deq.state.or.us/lab/wqm/toxics.htm).

As part of DEQ's drinking water protection strategies, the agency has mapped on GIS the intakes of all public water systems and outfalls of all National Pollutant Discharge Elimination System permitted facilities. An estimated 208 publicly-owned wastewater collection/treatment systems serve the majority of Oregon's urban centers. There are 52 that process more than 10 million gallons per day. These 52 large wastewater treatment plants are part of a statewide project designed to reduce toxics discharged into Oregon waterways. DEQ's Priority Persistent Pollutant List process identified 118 toxic pollutants that persist in the environment and/or accumulate in animals. DEQ will require monitoring for these pollutants at these 52 treatment plants. These facilities must also develop toxics pollutant reduction plans those pollutants that exceed trigger levels set by DEQ. *Sixteen of these facilities are upstream of public water system intakes.* Pollutant reductions in treatment plant discharges will ultimately reduce the pollutants in the drinking water sources. Drinking water protection staff will be available to assist communities upstream of intakes as they seek to reduce the toxic compounds in discharges from wastewater treatment plants.

In its existing Pesticide Stewardship Partnership projects, DEQ and its partners work to identify streams with elevated levels of pesticides and to find ways to reduce contaminant drift and runoff in those streams, using a collaborative, voluntary approach. The goals include developing better monitoring of pesticides and improved pesticide management and reduction strategies. These projects have been successful in reducing both the levels of pesticides in streams, as well as the potential risks from stored pesticides picked up through collection events documented in five basins. Safe Drinking Water Act monitoring across Oregon shows 53 public water systems with consistent detections of pesticides. These are areas where the drinking water protection staff can focus small-scale Pesticide Stewardship Partnership projects using the existing successful strategy.

To address existing turbidity problems, DEQ is currently working with 15 public water systems to research and document water quality issues associated with nonpoint sources. Many of these systems have chronic problems with high turbidity – some so severely that public water system intakes must be shut down periodically due to extremely high turbid water. *High turbidity levels can also carry additional contaminants, such as nutrients and pesticides, into and through the water treatment facilities.* The DEQ turbidity research study included collection of raw water data, interviews with operators, GIS analysis of land uses, and field inspections. The final report, which is expected in early 2010, will provide an analysis of the turbidity impacts for public water systems. This data will also be used to develop climate change projections and identify strategies for protecting the most vulnerable systems from losses due to landslide-causing storms and land-use changes.

This data will be shared with other agencies and US EPA to assist in efforts to address the emerging contaminant issues in drinking water. Determining what is “safe” water for public health and aquatic health is difficult. The important first step is identifying the presence and concentrations of the emerging contaminants in the source waters. In terms of evaluating the risks, the primary challenge facing scientists at this time is that there are few standards to analyze the results. There are many toxic contaminants for which there are no drinking water or health-based standards. The synergistic and cumulative effects of the various compounds that have been detected in water are not known. DEQ and DHS will continue to track the new data and toxicological research and adjust work plans and priorities as necessary. Through the drinking water protection efforts, DEQ will continue to work to reduce the levels of contaminants in source waters to provide the highest quality waters to the public water system treatment plants.

Phase II Monitoring

In 2010, we will move into Phase II of the DW Source Monitoring. This will include sampling locations with more specific sources of potential contaminants. The DHS/DEQ team will evaluate several options for the next set of sampling locations. Current thinking is that it should be a combination of two criteria:

1) Source areas for public water systems that have requested monitoring and have verified susceptibility to contaminants, and those risks encompass large portions of the watershed or recharge area. About 25% of the Phase II monitoring can be dedicated to those systems that request monitoring based on known risks and concerns. This would address important strategic objectives----since 2003, the strategic plan has included the objective to address specific concerns from public water systems, environmental health officials, or local/county government.

2) Those public water system source areas with discreet risks of contamination in close proximity to the intakes or wells. This would include systems that have large-scale single land use risks or activities that are high priority Tier 1 and 2 systems. For example, intakes or wells would be sampled where source areas include all agriculture, all urban, an NPDES discharge just upstream, or all forests. This will enable DEQ and DHS to determine more about those individual sources and corresponding risks.

The DEQ and DHS drinking water team will continue to prioritize statewide program efforts and local technical assistance using new data from the DW Source Monitoring project and other important data collection projects in Oregon. The near-term strategy for addressing the new "emerging" micro contaminants includes collecting more specific data to assess risks, continuing to prioritize potential exposure risks based on scientific research, and actively minimizing the input of toxics from known sources (primarily, collection events and public education).

Figure 1.
Drinking Water Source Areas Sampled at Surface Water Systems

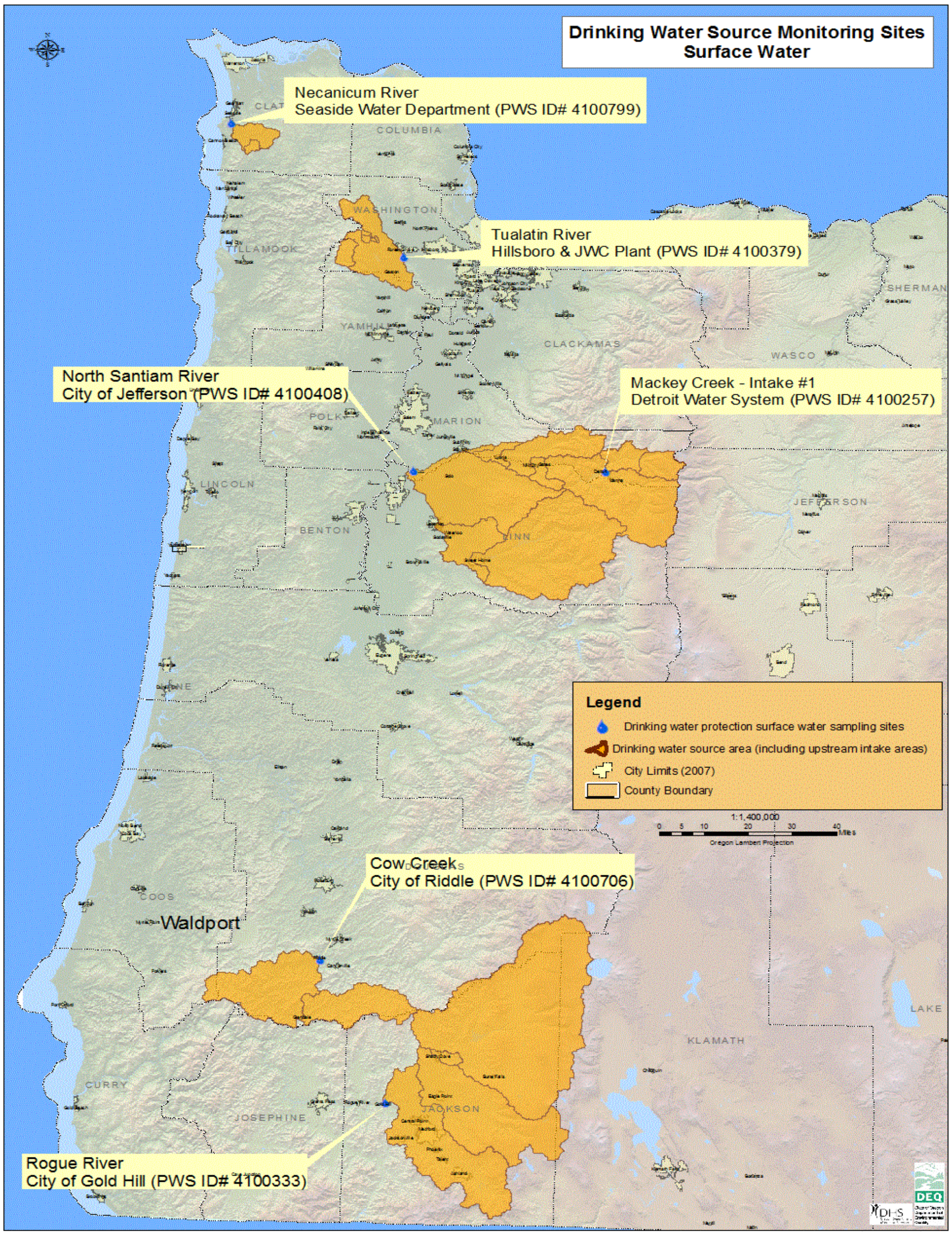

Figure 2.
Drinking Water Source Areas Sampled at Groundwater Systems

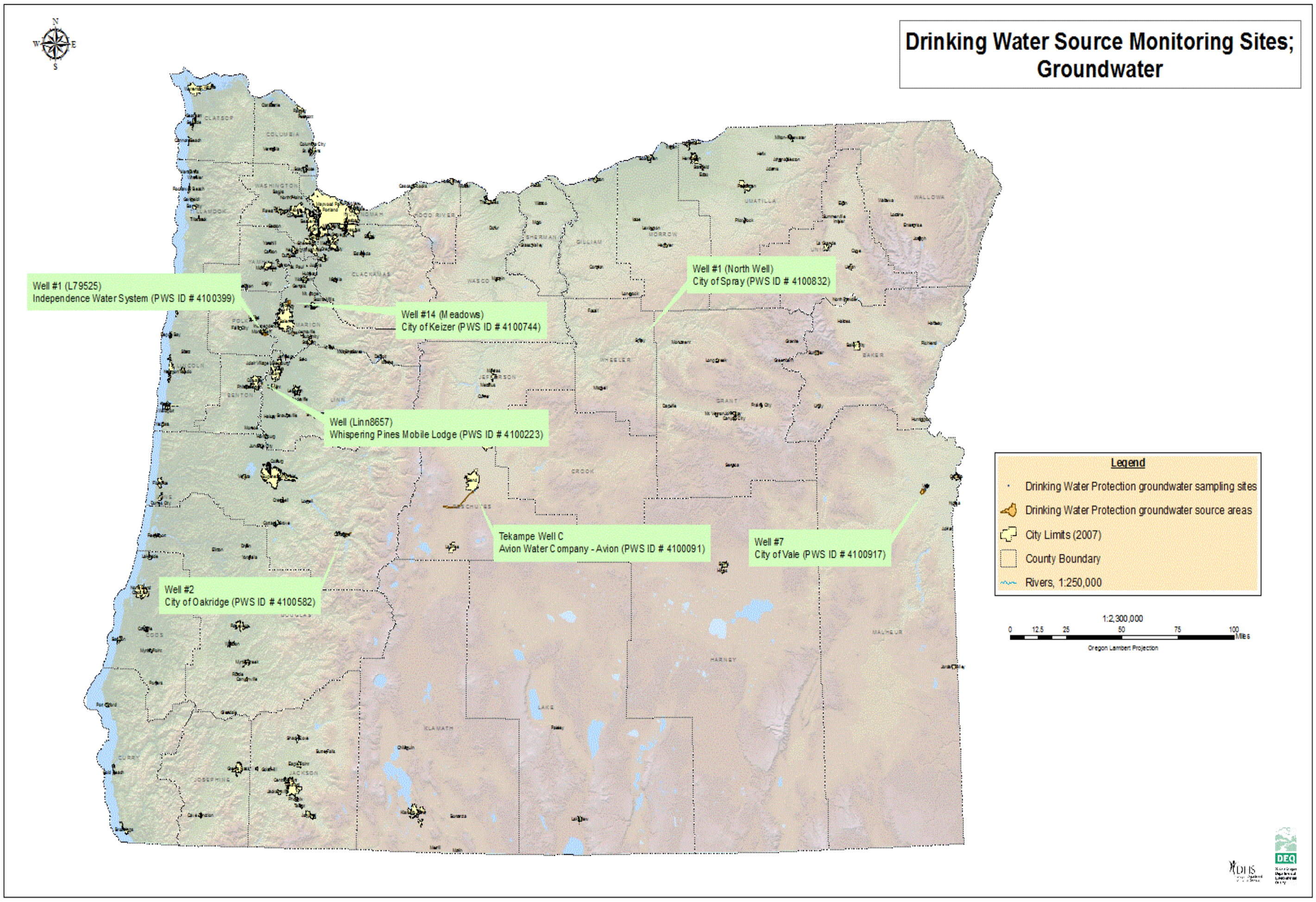

Table 1.

Drinking Water Source Monitoring
2008-09 Priority Surface Water Systems

Community and public water system	**Intake location**	**Size of watershed**	**Primary land uses or activities in watershed**
Seaside	Necanicum River	8.11 sq. miles	Managed forests Transportation corridors (Hwy 101 and 26) High density housing with onsite (septic) Nursery High capacity onsite (mobile home park)
Detroit	Mackey Creek	.287 sq. miles	Managed forests
Gold Hill	Rogue River	917 sq. miles	Commercial Industrial High density housing Wastewater treatment plant outfalls (2) Transportation corridors (I-5, highways, rail) Managed forests
Riddle	Cow Creek	487 sq. miles	Managed forests Irrigated crops Biosolids application area Commercial Industrial –hazardous waste cleanup site Wastewater treatment plant outfalls (3)
Jefferson	North Santiam	1712 sq. miles	Managed forests Agricultural—irrigated crops, nurseries Biosolids application area Industrial –timber mills, hatcheries High density housing with onsite areas Wastewater treatment plant outfalls (4)
Hillsboro	Tualatin River	543 sq. miles	Managed forests Agricultural—irrigated crops, nurseries, dairy Cemeteries (2)

Table 2.

Drinking Water Source Monitoring
2008-09 Priority Groundwater Systems

Community and PWS	**County**	**Size of recharge area**	**Primary land uses or activities in recharge area**
Avion Water Company-Avion	Deschutes	6.17 acres	High density housing with septic Golf course Grazing animals Wells/abandoned wells
Whispering Pines Mobile Lodge	Linn	.59 acres	High density housing with septic Irrigated crops Grazing animals
Independence Water System	Polk	2.06 acres	High density housing with septic Irrigated crops Nurseries Grazing animals
City of Oakridge	Lane	.72 acres	High density housing Managed forests Campground / RV park Park Sewer lines / septic
City of Keizer	Marion	1.38 acres	High density housing Park Sewer lines Irrigated crops Equestrian Center Irrigation ditch
City of Spray	Wheeler	.42 acres	Irrigated pastures Park High density housing on septic
City of Vale	Malheur	2.87 acres	Confined animal feeding lot Farmers co-op Irrigated crops Irrigation canal High density housing / rural on septic

Table 3.

Oregon Drinking Water Source Monitoring Priority Chemical Compounds

Chemical Compound	Potential Contaminant Source(s)	Is there a SDWA MCL for this compound?
HERBICIDES		
Trifluralin	Agriculture	No
Hexazinone	Forestry/agriculture	No
Triclopyr	Agriculture /forestry/residential	No
Metolachlor	Agriculture	No
Linuron	Agriculture	No
Napropamide	Agriculture	No
Pendimethalon	Agriculture	No
Diuron	Agriculture	No
2,4-D	Forestry/agriculture/residential	Yes
Atrazine	Forestry/agriculture	Yes
Imazapyr	Forestry	No
Dacthal	Agriculture	No
INSECTICIDES		
Ethoprop	Agriculture	No
Diazinon	Agriculture/urban runoff	No
Chlorpyrifos	Agriculture/urban runoff	No
Azinphos-methyl	Agriculture	No
Imidacloprid	Agriculture/urban runoff	No
Propoxur	Agriculture/urban runoff	No
Permethrin	Agriculture/urban runoff	No
N, N-diethyltoluamide (DEET)	Wastewater/urban runoff	No
Lindane	Wastewater/urban runoff	Yes
Carbaryl	Agriculture/some forestry	No
Malathion	Agriculture	No
Dieldrin	Agriculture (banned)	No
FUNGICIDES		
Chlorothalonil	Agriculture/residential/forestry	No
Propiconazole	Agriculture	No
Pyraclostrobin	Agriculture/golf courses	No
BACTERIA/PATHOGENS		
Coliform (E Coli)	Agriculture/ CAFOs/recreation	Yes

Chemical Compound	Potential Contaminant Source(s)	Is there a SDWA MCL for this compound?
METALS		
Copper	Natural/agriculture/ vineyards	Yes
Arsenic	Natural sources/wood treatment	Yes
Mercury	Commercial/industry/natural/ air deposition	Yes
DRUGS		
Carbamazepine	Wastewater –WWTP/onsite	No
Venlafaxine	Wastewater	No
Caffeine	(indicator)	No
CLEANERS & VOCs		
Tetrachloroethylene	Wastewater –housing/industry	Yes
Triclosan	Wastewater -housing	No
4-nonylphenol	Wastewater -housing	No
Trichloroethene	Industry	Yes
Benzene	Industry/vehicles– runoff & spills	Yes
Ethylbenzene	Industry/vehicles - runoff & spills	Yes
Toluene	Industry/vehicles - runoff & spills	Yes
FIRE RETARDANTS		
Decca-PBDE	Wastewater/urban runoff	No
Tri (2-chloroethyl) phosphate	Wastewater/urban runoff	No
Tri(dichlorisopropyl) Phosphate	Wastewater/urban runoff	No
PAHs		
Benzo (a) pyrene	Combustion – air dep & runoff	Yes
Chrysene	Combustion – air dep & runoff	No
Pyrene	Combustion – air dep & runoff	No
Anathracene	Combustion - air dep & runoff	No
Fluoranthene	Combustion - air dep & runoff	No
PLASTICIZERS		
Diethylphthalate	Industry/urban	No

NOTE: The listed potential contaminant sources are based on pertinent data from other studies for this parameter. Data sources for both chemical compounds and potential contaminant sources include:

- USGS frequency data on pharmaceuticals from Dana Kolpin, USGS (February 12, 2007 email).
- Cleaners, VOCs, fire retardants from a 2007 DEQ analysis of Oregon’s highest risks from household chemicals.
- List of pesticides used in forestry from ODF estimates (Knotts, January 2008 document).
- List of pesticides used in agriculture from DEQ 2002 Willamette Valley study, USGS data, and Pesticide Stewardship Partnership data based on past DEQ monitoring downstream of numerous agricultural areas.
- Other high-risk chemicals added by agency toxicologists based on PWS monitoring results and national data analysis.

Appendix A.

Description of Statewide Susceptibility Analysis and Prioritization for Drinking Water Source Areas

The DEQ Drinking Water Protection Program database and GIS layers contain information from the Source Water Assessments. This includes data on the occurrence and location of over 15,000 facilities or land uses that may release contamination to drinking water sources and the sensitivity of each well, spring, or intake to those potential sources of contamination that are located within the drinking water source area.

The overall susceptibility of each drinking water source (well, spring, or surface water intake) was evaluated based on the number and type of potential contaminant sources (PCSs) within the drinking water source area (DWSA) and the level of sensitivity of the DWSA. This analysis has already been used by the Drinking Water Protection Program as the foundation for evaluating how and where to provide active outreach and technical assistance. It also provided priority sampling locations for the Phase I DW Source Monitoring Project.

For Groundwater and Surface Water:
As part of the Assessments, the PCSs were identified between 2001 and 2005 based on a list of over 100 separate categories (covering commercial/industrial, residential/municipal, and agricultural/forestry land uses) that were developed by a statewide advisory committee. Based on the type of facility and the nature of the chemicals used, the potential sources of contamination identified represent a lower-, moderate-, or higher-relative risk to the drinking water source. PCSs were also classified as “area-wide” sources or “point” sources. The area-wide sources represent the approximate area where the land use or activity occurs and were marked at a point closest to the intake. The point sources represent the approximate point where the land use or activity occurs. In the susceptibility analysis, the PCSs were “weighted” following these general rules:

- PCSs in sensitive areas were given twice the weight of PCSs that were not located in sensitive areas. Sensitive areas for groundwater DWSAs included the 2-year time-of-travel zone for wells and short-term recharge area for spring sources. Sensitive areas for surface water included a 1000-foot setback from perennial water bodies, areas with high erosion or runoff potential, and high permeability areas.
- Area-wide PCSs were given twice the weight of point sources (since the database does not account for the total area within the DWSA that is potentially affected),
- High-risk PCSs were given twice the weight of moderate-risk PCSs, and
- PCSs with lower risks were not included in the susceptibility ranking.

For Surface Water DWSAs:
The surface water drinking water watersheds were ranked into Tiers 1-4 (Tier 1 = highest priority) based on either:

- NUMBER of weighted[1] potential contaminant sources in the entire drinking water protection area,

- Weighted[1] potential contaminant source DENSITY in the entire drinking water protection area (density calculations for sensitive areas only are not currently available),

1 As discussed in the general section on Groundwater and Surface Water, PCSs in sensitive areas or area-wide PCSs were weighted double due to their importance.

- Weighted[1] potential contaminant source DENSITY in the entire drinking water protection area PLUS the drinking water protection areas located UPSTREAM within the same sub-basin as defined by the US Geological Survey 4th field Hydrologic Unit (drinking water protection areas are delineated intake to intake)

Note: As discussed above, PCSs in sensitive areas or area-wide PCSs were weighted double due to their importance.

Summary of Surface Water Susceptibility[2]

Total number of SW drinking water sources (intakes)	211
Tier 1	47
Tier 2	40
Tier 3	31
Tier 4	83
No SWA Data at DEQ (unknown susceptibility)	10

(EWEB, SUB, Wilsonville, Salem Public Works, Berndt Creek Water Co-op in Columbia County, Anglers Cove in Jackson Co., Canby's Springs Gallery, Manzanita's Anderson Creek, Midland WA Springs and Unnamed Creek)

For Groundwater DWSAs:
Wells and springs are considered sensitive if they meet one of these criteria:

1. They draw from aquifers that were identified as sensitive in the source water assessments based on aquifer characteristics, vadose zone characteristics, or high infiltration potential (from precipitation and irrigation);
2. The entry point for the well or spring has had chemical detection(s) of a volatile organic compound (VOC) or synthetic organic compound (SOC) in the past as recorded in Department of Human Services' Safe Drinking Water Information System data as of November 2006;
3. The well or spring is classified by DHS as groundwater under the direct influence of surface water (GU) (evaluation protocol at http://oregon.gov/DHS/ph/dwp/gwater.shtml)

Wells and springs that did not meet any of these criteria are considered to have low sensitivity to potential sources of contamination.

Note: DWSAs that did not have adequate data entered in DHS's SWAP 97 database to determine if they were sensitive were labeled as "NR" for "Needs Review" and were included in this "sensitive" category which is a conservative approach – DHS will review the SWA reports to determine sensitivity and adjustments will be made at a later date. Currently, all springs, infiltration galleries, Ranney wells, and wells classified by DHS as groundwater in hydraulic connection with surface water (HC) are included in this "Needs Review" category.

The 1182 "sensitive" wells and springs were ranked into three tiers (Tier 1 = highest priority) by percentile rank based on either:

- NUMBER of weighted[1] potential contaminant sources in the entire drinking water source area; or
- Weighted[1] potential contaminant source DENSITY in the entire drinking water source area.

2 For surface water: Tier 1 includes intakes that fell in the upper 10% based on percentile rank in any of the three categories (percentile rank >= 90%). Tier 2 included the next 10% (percentile rank between 80% and 90%), Tier 3 included the next 10% (percentile rank between 70% and 80%) and Tier 4 included intakes with percentile rank less than 70%.

Summary of Groundwater Susceptibility[3]

Total number of GW drinking water sources		1,827
Number of “sensitive” GW sources		1,182
Tier 1	569	
Tier 2	324	
Tier 3	289	
Low Sensitivity GW DWSAs		562
Low Sens_Group1	280	
Low Sens_Group2	173	
Low Sens_Group3	109	

NoSWAData at DEQ[3] (unknown susceptibility) = 83

Some Source Water Assessments were completed by the PWS and DEQ does not have the data on potential contaminant sources to rank their overall susceptibility[4].

3 For groundwater: Tier 1 includes wells and springs classified as “sensitive” that fell in the upper third based on percentile rank in either of the two bulleted categories (percentile rank between 66% and 100%). Tier 2 included the middle third (percentile rank between 33% and 66%) and Tier 3 included the bottom third (percentile rank less than 33%). LowSens-Group 1 includes wells and springs that were NOT classified as “sensitive” and fell in the upper third based on percentile rank in either of the two categories (percentile rank between 66% and 100%). Group 2 included the middle third (percentile rank between 33% and 66%) and Group 3 included the bottom third (percentile rank less than 33%)

4 Information on the potential contaminant sources and/or the delineation for these PWSs may not be fully included in this data: 4100143 - Brightwood Water Works; 4100200 - City of Coburg; 4100287 - Eugene Water and Electric Board; 4100296 - City of Fairview Water Dept.; 4100394 - Idanha City Water; 4100418 - Junction City Water Utilities; 4100443- City of Klamath Falls Water Dept.; 4100513 - Medford Water Commission (Big Butte springs); 4100657 - Portland Bureau of Water Works; 4100666 - Powell Valley Road and Water District; 4100731- Salem Public Works; 4100837 - Springfield Utility Board; 4100839 - Rainbow Water District (Springfield); 4100954 - City of Wilsonville; 4101068 - Big Valley Woods RV Resort; 4101241 - Zig Zag Water Co-op; 4105581 - Weiss Estates Water System; 4193745 - Lebanon High School.

Appendix B.

2008-09 Drinking Water Source Monitoring Plan

DEQ Laboratory and Environmental Assessment Division
Analytical Methods, Compounds, and Detection Limits

DHS/DEQ Drinking Water Source Monitoring Project - 2008/2009
Analytical Methods, Compounds, and Detection Limits

*** = detected in at least one source water sample (surface water or groundwater)**

Parameter	LOQ (1)	Unit
Organic Compounds by LC/MS/MS Method 8321		
Oxyamyl	0.001	µg/L
Aminocarb	0.001	µg/L
Methomyl	0.001	µg/L
Imazapyr	0.020	µg/L
Imidacloprid	0.010	µg/L
Simazine	0.002	µg/L
Metribuzin	0.002	µg/L
Baygon	0.001	µg/L
Carbofuran	0.001	µg/L
Carbaryl *	0.003	µg/L
Fluometuron*	0.002	µg/L
Simetryn	0.002	µg/L
Atrazine*	0.002	µg/L
Diuron*	0.002	µg/L
Prometon	0.002	µg/L
DEET*	0.003	µg/L
Mexacarbate	0.001	µg/L
Ametryn	0.001	µg/L
Azinophos Methyl	0.010	µg/L
Siduron	0.001	µg/L
Methiocarb	0.002	µg/L
Propazine	0.002	µg/L
Linuron	0.002	µg/L
Terbutylazine	0.001	µg/L
Prometryn	0.001	µg/L
Terbutryne	0.001	µg/L
Acetochlor	0.005	µg/L
Alachlor	0.005	µg/L
Neburon	0.003	µg/L
Metolachlor*	0.005	µg/L
Propiconazole	0.010	µg/L
Pyraclostrobin	0.002	µg/L

Parameter	LOQ (1)	Unit
METALS by EPA Method 200.8 (except Mercury by Method 245.1)		
Mercury Digestion	NA	Date
Total Mercury*	0.02	µg/L
Total Recoverable Aluminum*	3	µg/L
Total Recoverable Antimony	0.5	µg/L
Total Recoverable Arsenic*	2	µg/L
Total Recoverable Barium*	2	µg/L
Total Recoverable Beryllium	0.3	µg/L
Total Recoverable Cadmium	0.3	µg/L
Total Recoverable Chromium*	0.5	µg/L
Total Recoverable Copper*	0.5	µg/L
Total Recoverable Lead*	0.2	µg/L
Total Recoverable Manganese*	5	µg/L
Total Recoverable Nickel*	1	µg/L
Total Recoverable Selenium	2	µg/L
Total Recoverable Silver	0.1	µg/L
Total Recoverable Thallium	0.1	µg/L
Total Recoverable Zinc*	2	µg/L
Phenoxy Herbicides by GC/ECD Method 6640B		
2,4,5-T	0.1	µg/L
2,4-D	0.1	µg/L
2,4-DB	0.7	µg/L
3,5-dichlorobenzoic acid	0.3	µg/L
4-Nitrophenol	0.7	µg/L
Acifluorfen	0.2	µg/L
Bentazon	0.7	µg/L
Dicamba	0.3	µg/L
Dichloroprop	0.3	µg/L
Dinoseb	0.3	µg/L
MCPA	21.7	µg/L
MCPP	54.2	µg/L
Pentachlorophenol	0.1	µg/L
Picloram	2	µg/L
Silvex	0.1	µg/L
Triclopyr	0.3	µg/L
Microbiology (Method 9223B by Oregon DHS)		
E. Coli*	1	MPN/ 100 ml

DHS/DEQ Drinking Water Source Monitoring Project - 2008/2009
Analytical Methods, Compounds, and Detection Limits

*** = detected in at least one source water sample (surface water or groundwater)**

Parameter	LOQ [1]	Unit	Parameter	LOQ [1]	Unit
Pharmaceuticals by LC/MS/MS Method 1694			**Steroids and Hormones by HRGC/HRMS by Method 1698 [2]**		
Acetaminophen	0.500	µg/L	17a-Estradiol	0.020	µg/L
Codeine	0.025	µg/L	Estrone	0.100	µg/L
Caffeine	0.125	µg/L	17ß-Estradiol	0.002	µg/L
Sulfamethoxazole *	0.010	µg/L	17a-Ethynyl Estradiol	0.005	µg/L
Venlafaxine	0.010	µg/L	Estriol	0.002	µg/L
Diphenhydramine *	0.010	µg/L	**Coprostanol***	0.005	µg/L
Carbamazepine *	0.010	µg/L	**Cholesterol***	0.075	µg/L
Volatile Organic Compounds by GC/MS Method 8260 B					
1,1,1,2-Tetrachloroethane	0.500	µg/L	**Bromodichloromethane ***	0.500	µg/L
1,1,1-Trichloroethane	0.500	µg/L	Bromoform	0.500	µg/L
1,1,2,2-Tetrachloroethane	0.500	µg/L	Bromomethane	0.500	µg/L
1,1,2,2-Tetrachloroethylene	0.500	µg/L	Carbon Tetrachloride	0.500	µg/L
1,1,2-Trichloroethane	0.500	µg/L	Chlorobenzene	0.500	µg/L
1,1-Dichloroethane	0.500	µg/L	Chloroethane	0.500	µg/L
1,1-Dichloroethylene	0.500	µg/L	**Chloroform ***	0.500	µg/L
1,1-Dichloropropene	0.500	µg/L	Chloromethane	0.500	µg/L
1,2,3-Trichlorobenzene	0.500	µg/L	cis-1,2-Dichloroethylene	0.500	µg/L
1,2,3-Trichloropropane (TCP)	2.000	µg/L	cis-1,3-Dichloropropene	0.500	µg/L
1,2,4-Trichlorobenzene	0.500	µg/L	**Dibromochloromethane ***	0.500	µg/L
1,2,4-Trimethylbenzene	0.500	µg/L	Dibromomethane	0.500	µg/L
1,2-Dibromo-3-chloropropane (DBCP)	8.000	µg/L	Dichlorodifluoromethane	0.500	µg/L
1,2-Dibromoethane (EDB)	0.500	µg/L	Ethyl Benzene	0.500	µg/L
1,2-Dichlorobenzene	0.500	µg/L	Hexachloro-1,3-Butadiene	0.500	µg/L
1,2-Dichloroethane	0.500	µg/L	Isopropylbenzene (Cumene)	0.500	µg/L
1,2-Dichloropropane	0.500	µg/L	Methylene Chloride	0.500	µg/L
1,2-Dimethylbenzene	0.500	µg/L	MtBE	0.500	µg/L
1,3,5-Trimethylbenzene	0.500	µg/L	Naphthalene	0.500	µg/L
1,3-Dichlorobenzene	0.500	µg/L	n-butylbenzene	0.500	µg/L
1,3-Dichloropropane	0.500	µg/L	n-Propylbenzene	0.500	µg/L
1,4/1,3-Dimethylbenzene	1.000	µg/L	sec-Butylbenzene	0.500	µg/L
1,4-Dichlorobenzene	0.500	µg/L	Styrene	0.500	µg/L
2-Butanone (MEK)	50.000	µg/L	tert-Butylbenzene	0.500	µg/L
2,2-Dichloropropane	0.500	µg/L	**Toluene ***	0.500	µg/L
2-Chloroethyl Vinyl Ether	2.000	µg/L	trans-1,2-Dichloroethylene	0.500	µg/L
2-Chlorotoluene	0.500	µg/L	trans-1,3-Dichloropropene	0.500	µg/L
4-Chlorotoluene	0.500	µg/L	Trichloroethylene	0.500	µg/L
4-isopropyltoluene	0.500	µg/L	Trichlorofluoromethane	0.500	µg/L
4-Methyl-2-Pentanone (MIBK)	1.000	µg/L	Vinyl Chloride	0.500	µg/L
Acrolein (2-Propenal)	6.000	µg/L	Acetone	1.000	µg/L
Benzene	0.500	µg/L	**Carbon Disulfide ***	0.500	µg/L
Bromobenzene	0.500	µg/L	Tentatively Identified Compound	5.000	µg/L
Bromochloromethane	0.500	µg/L			

DHS/DEQ Drinking Water Source Monitoring Project - 2008/2009
Analytical Methods, Compounds, and Detection Limits

*** = detected in at least one source water sample (surface water or groundwater)**

Parameter	LOQ [1]	Unit	Parameter	LOQ [1]	Unit
Semi-volatile Organic Compounds by GC/MS-Toxics by Method 525.2 [3]					
4,4-DDT	0.020	µg/L			
Pentachlorophenol	0.098	µg/L			
Semi-volatile Organic Compounds by GC/MS-SPE by Method 8270 C					
Dichlorvos	0.020	µg/L	Chlorothalonil	0.020	µg/L
EPTC (Eptam)	0.020	µg/L	delta-BHC	0.020	µg/L
Butylate	0.070	µg/L	Heptachlor	0.020	µg/L
Vernolate	0.020	µg/L	Aldrin	0.020	µg/L
Pebulate	0.020	µg/L	Dacthal	0.020	µg/L
Tebuthiuron	0.020	µg/L	Trans-Chlordane	0.020	µg/L
Molinate	0.020	µg/L	Endosulfan I	0.020	µg/L
DEET	0.020	µg/L	Cis-Chlordane	0.020	µg/L
Propachlor	0.020	µg/L	trans-Nonachlor	0.020	µg/L
Ethoprophos	0.020	µg/L	4,4`-DDE	0.020	µg/L
Cycloate	0.020	µg/L	Dieldrin	0.020	µg/L
Chlorpropham	0.020	µg/L	Endrin	0.080	µg/L
Trifluralin	0.020	µg/L	Endosulfan II	0.020	µg/L
Atraton	0.080	µg/L	Chlorobenzilate(a)	0.020	µg/L
Prometon	0.020	µg/L	4,4`-DDD	0.020	µg/L
Atrazine	0.080	µg/L	Endrin Aldehyde	0.040	µg/L
Propazine	0.020	µg/L	Endosulfan sulfate	0.020	µg/L
Terbufos	0.040	µg/L	4,4`-DDT	0.020	µg/L
Pronamide	0.020	µg/L	Methoxychlor	0.020	µg/L
Diazinon	0.020	µg/L	Permethrin	0.040	µg/L
Disulfoton	0.020	µg/L	Isophorone	0.040	µg/L
Methyl paraoxon	0.020	µg/L	Hexachlorocyclopentadiene	0.020	µg/L
Terbacil	0.020	µg/L	Dimethylphthalate	0.020	µg/L
Alachlor	0.020	µg/L	2,4-Dinitrotoluene	0.040	µg/L
Simetryn	0.020	µg/L	Acenaphthylene	0.020	µg/L
Ametryn	0.020	µg/L	Acenaphthene	0.020	µg/L
Prometryn	0.020	µg/L	PCB-1 (2-Chlorobiphenyl)	0.020	µg/L
Terbutryne	0.020	µg/L	2,6-Dinitrotoluene	0.020	µg/L
Bromacil	0.020	µg/L	**Diethylphthalate***	0.040	µg/L
Malathion	0.020	µg/L	Fluorene	0.020	µg/L
Metolachlor	0.020	µg/L	PCB-5 (2,3-Dichlorobiphenyl)	0.020	µg/L
Chlorpyriphos (Dursban)	0.020	µg/L	Hexachlorobenzene	0.020	µg/L
Cyanazine	0.020	µg/L	Pentachlorophenol	0.080	µg/L
Triadimefon	0.020	µg/L	**Phenanthrene ***	0.020	µg/L
Diphenamid	0.020	µg/L	Anthracene	0.020	µg/L
MGK-264	0.040	µg/L	PCB-29 (2,4,5-Trichlorobiphenyl)	0.020	µg/L
Pendimethalin	0.020	µg/L	PCB-47 (2,2`,4,4`-Tetrachlorobiphenyl)	0.020	µg/L
Tetrachlorvinphos	0.020	µg/L	PCB-98 (2,2',3',4,6-Pentachlorobiphenyl)	0.020	µg/L
Butachlor	0.020	µg/L	Fluoranthene	0.020	µg/L
Napropamide	0.020	µg/L	Pyrene	0.020	µg/L

DHS/DEQ Drinking Water Source Monitoring Project - 2008/2009
Analytical Methods, Compounds, and Detection Limits

*** = detected in at least one source water sample (surface water or groundwater)**

Parameter	LOQ [1]	Unit	Parameter	LOQ [1]	Unit
Semi-volatile Organic Compounds by GC/MS-SPE by Method 8270 C (continued)					
Fenamiphos	0.020	µg/L	PCB-154 (2,2',4,4',5,6'-Hexachlorobiphenyl)	0.020	µg/L
Tricyclazole	0.020	µg/L	Bis(2-ethylhexyl)adipate	0.100	µg/L
Carboxin	0.020	µg/L	Benzo(a)anthracene	0.020	µg/L
Norflurazon	0.020	µg/L	PCB-171 (2,2`,3,3`,4,4`,6-Heptachlorobiphenyl)	0.020	µg/L
Hexazinone	0.020	µg/L	Chrysene	0.020	µg/L
azinphos-methyl	0.020	µg/L	PCB-200 (2,2',3,3',4,5',6,6'-Octachlorobiphenyl)	0.020	µg/L
Fenarimol	0.020	µg/L	**Bis(2-ethylhexyl)phthalate ***	0.500	µg/L
Fluridone	0.020	µg/L	**Butylbenzylphthalate ***	0.200	µg/L
Etridiazole	0.020	µg/L	Benzo[b]fluoranthene	0.020	µg/L
Chloroneb	0.020	µg/L	Benzo[k]fluoranthene	0.020	µg/L
Simazine	0.040	µg/L	Benzo(a)pyrene	0.020	µg/L
alpha-BHC	0.020	µg/L	Indeno[1,2,3-cd]pyrene	0.020	µg/L
beta-BHC	0.040	µg/L	Dibenz[a,h]anthracene	0.020	µg/L
Lindane	0.040	µg/L	Benzo[g,h,i]perylene	0.020	µg/L
Semi-volatile Organic Compounds by GC/MS-SPE by Method 8270 C [2]					
Dimethoate	0.020	µg/L	2,3',4',6-Tetrabromodiphenyl ether (PBDE 71)	0.020	µg/L
Fenvalerate+Esfenvalerate	0.100	µg/L	2,2',3,4,4'-Pentabromodiphenyl ether (PBDE 85)	0.020	µg/L
Imidan (Phosmet)	0.020	µg/L	2,2',4,4',5-Pentabromodiphenyl ether (PBDE 99)	0.020	µg/L
Methyl Parathion	0.020	µg/L	2,2',4,4',6-Pentabromodiphenyl ether (PBDE 100)	0.020	µg/L
Pyriproxyfen	0.050	µg/L	2,2',3,4,4',5'-Hexabromodiphenyl ether (PBDE 138)	0.020	µg/L
2,2',4-Tribromodiphenyl ether (PBDE 17)	0.020	µg/L	2,2',4,4',5,5'-Hexabromodiphenyl ether (PBDE 153)	0.020	µg/L
2,4,4'-Tribromodiphenyl ether (PBDE 28)	0.020	µg/L	2,2',4,4',5,6'-Hexabromodiphenyl ether (PBDE 154)	0.020	µg/L
2,2',4,4'-Tetrabromodiphenyl ether (PBDE 47)	0.020	µg/L	2,2',3,4,4',5',6-Heptabromodiphenyl ether (PBDE 183)	0.020	µg/L
2,3',4,4'-Tetrabromodiphenyl ether (PBDE 66)	0.020	µg/L	Tentatively Identified Compound		

(1) LOQ = Limit of quantitation/method detection limit
(2) Compounds added to analysis in Fall 2008 Round
(3) Analytical Method for SVOCs in Spring 2009 Round