Report to the Environmental Quality Commission and Legislature

Groundwater Quality Protection In Oregon

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Department of
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Quality

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Groundwater Quality Protection in Oregon

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Executive Summary

Groundwater makes up approximately 95 percent of available freshwater resources in Oregon. Approximately 70 percent of all Oregon residents rely solely or in part on groundwater for drinking water. Over 90 percent of rural Oregonians rely on groundwater for drinking water. The goals of the Oregon Groundwater Quality Protection Act of 1989 (ORS 468B.150 – 468B.190) are to prevent contamination of groundwater resources, conserve and restore groundwater, and maintain the high quality of Oregon's groundwater resource for present and future uses. The Act established a policy that all state agencies' rules and programs are to be consistent with this goal of protecting drinking water resources and public health.

Groundwater is present beneath almost every land surface and is sometimes at very shallow depths. It is vulnerable to contamination from activities that take place on the land as well as from discharges of wastes and pollutants at or below the ground surface. Once groundwater becomes contaminated it is very difficult to clean up. Because groundwater moves very slowly, the contamination may persist for tens, hundreds, or even thousands of years. Likewise, groundwater that is currently being contaminated may not affect beneficial uses until some time far into the future. This contamination may impair groundwater for use as drinking water and may affect the quality of the surface waters where it comes to the surface.

DEQ has primary responsibility for implementing a groundwater protection program in Oregon that includes activities focused on assessment, monitoring and restoration, and protection. DEQ's Laboratory and Environmental Assessment Division continues to collect samples and perform the analysis for the state's three groundwater management areas (GWMAs). Two regional hydro geologists oversee monitoring and restoration activities in these groundwater management areas that include the Northern Malheur County, the Lower Umatilla Basin, and the Southern Willamette Valley. Action plans have been developed for the GWMAs that include maintaining groundwater quality monitoring networks, reviewing data to assess groundwater quality trends, and supporting local efforts to implement best management practices to maintain and restore groundwater quality. Due to changing water quality program priorities and reduced budget resources for DEQ's groundwater program, the groundwater coordinator position shifted from headquarters to the northwest regional office in August 2009 to address permitting backlog issues in the Underground Injection Control program. DEQ regional staff focus efforts on providing technical assistance and assisting with implementation activities in the three GWMAs.

DEQ uses a combination of water quality and land quality programs to help prevent groundwater contamination from point and non-point sources of pollution, clean up pollution sources, and monitor and assess groundwater and drinking water quality. These programs include the Water Pollution Control Facilities (WPCF) and National Pollutant Discharge Elimination System (NPDES) permitting, Onsite Wastewater Treatment, drinking water source water assessment and protection, Underground Injection Control, solid and hazardous waste management, Resource Conservation and Recovery Act, Underground Storage Tank, and the state environmental cleanup. DEQ also implements some programs though partnerships with the Oregon Department of Human Services (DHS), Oregon Water Resources Department (WRD), Oregon Department of Agriculture (ODA), Oregon Department of Geology and Mineral Industries (DOGAMI), Oregon State University, and other state, local, and private organizations, businesses, and individuals.

DEQ and ODA continue to fund groundwater projects through various grants and loans including a groundwater research grant, federal Clean Water Act 319 grants, and Clean Water State Revolving Fund loans. Since 2008, approximately $524,000 in grants was provided to Oregon State University, the Rogue Valley Council of Governments, and the Umatilla Soil and Water Conservation District for research and implementation of groundwater projects in the Lower Umatilla Basin and Southern Willamette Valley GWMAs. About $27 million has been provided since 2008 through loans to public agencies to address groundwater protection projects such as installing sanitary sewer collection systems to replace failing onsite disposal systems and decommissioning or modifying stormwater dry wells with green infrastructure facilities.

Groundwater Quality Protection in Oregon

Introduction

The Oregon Groundwater Quality Protection Act of 1989 (ORS 468B.150-190) sets a broad goal for the State of Oregon – to prevent contamination of the groundwater resource, to conserve and restore this resource, and to maintain the high quality of Oregon's groundwater resource for present and future uses. The Act established a policy that all state agencies' rules and programs are to be consistent with this goal of protecting drinking water resources and public health.

DEQ has primary responsibility for implementing groundwater protection in Oregon. However, because of dwindling budget resources and other water quality priorities, DEQ's groundwater quality protection efforts have decreased significantly in the last decade and have become increasingly fragmented among multiple programs administered out of multiple offices. In the early 1990s, DEQ had 12 staff dedicated to the Groundwater program, and by the early 2000s the program staff had been reduced to five. DEQ does not have the resources to provide a coordinated groundwater quality protection program or to provide ongoing groundwater monitoring and assessment. With this level of staffing, DEQ's groundwater program consists of technical assistance, minimal statewide coordination, and implementation of groundwater monitoring and restoration activities in the three GWMAs. DEQ uses a combination of water quality and land quality programs to help prevent groundwater contamination from point and non-point sources of pollution, clean up pollution sources, and monitor and assess groundwater and drinking water quality. These programs include the Water Pollution Control Facilities (WPCF) and National Pollutant Discharge Elimination System (NPDES) permitting, Onsite Wastewater Treatment, drinking water source water assessment and protection, Underground Injection Control, solid and hazardous waste management, Resource Conservation and Recovery Act, Underground Storage Tank, and the state environmental cleanup.

Based on the reduced amount of resources dedicated to the groundwater protection program over the last 20 years, DEQ strives to work with other state agencies that are also addressing groundwater activities. DEQ implements some programs though partnerships with the Oregon Department of Human Services (DHS), Oregon Water Resources Department (WRD), Oregon Department of Agriculture (ODA), Oregon Department of Geology and Mineral Industries (DOGAMI), Oregon State University, and other state, local, and private organizations, businesses, and individuals.

Groundwater in Oregon has many valuable uses and functions:

- Groundwater makes up approximately 95 percent of available freshwater resources.
- Groundwater is the primary source of drinking water and its use is increasing.
  - Approximately 70 percent of all Oregon residents rely solely or in part on groundwater for drinking water.
  - Over 90 percent of rural Oregonians rely on groundwater for drinking water.
  - There are over 350,000 individual private domestic wells.
- Oregon's businesses require clean groundwater for industries such as food processing, dairies, manufacturing, and computer chip production.
- Groundwater provides irrigation water for Oregon agriculture and water for livestock.
- Groundwater supplies base flow for most of the state's rivers, lakes, streams, and wetlands. In many streams, the inflow of cool groundwater may be essential to reduce stream temperatures to the range required by sensitive fish species.

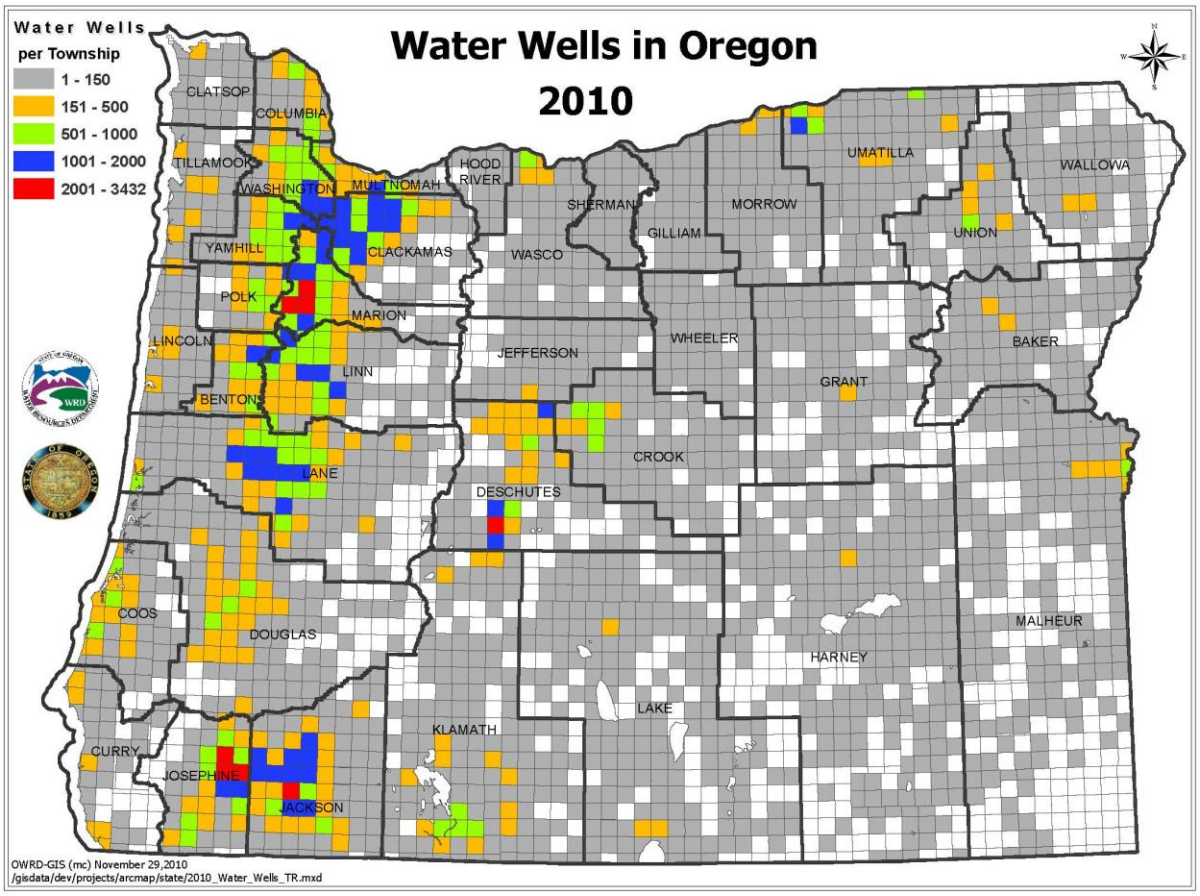
As surface water resources are used to capacity, Oregonians are becoming more dependent on groundwater resources and they expect those resources to remain clean, available and useable. As the population of Oregon grows, the importance of the groundwater resource to meet the demands of that population will increase. Figure 1 shows the distribution of water wells in the state that tap groundwater resources for drinking water, irrigation, and industrial uses.

Groundwater Quality Protection in Oregon

This report will present information on:

- Groundwater assessment and monitoring activities in Oregon
- Groundwater restoration activities in three GWMAs
- Groundwater protection activities by DEQ and other agencies
- Funding for groundwater quality projects in Oregon
- Future directions for groundwater quality protection

Figure 1. Distribution of Water Wells in Oregon



Groundwater Assessment in Oregon

DEQ's Groundwater Monitoring and Assessment Program

Oregon's Groundwater Quality Protection Act of 1989 requires DEQ to conduct an ongoing statewide monitoring and assessment program to identify and characterize the quality of Oregon's groundwater resources. Since DEQ does not have the resources to conduct a statewide groundwater assessment and monitoring program, on-going monitoring is conducted only within the three existing GWMAs – the Northern Malheur County, the Lower Umatilla Basin, and the Southern Willamette Valley. Specific monitoring and assessment requirements of the Act are to identify:

- Areas of the state that are especially vulnerable to contamination;
- Long-term trends in groundwater quality;
- Ambient quality of groundwater resources; and
- Emerging groundwater quality problems.

Groundwater Quality Protection in Oregon

DEQ's Laboratory and Environmental Assessment Division continues to collect samples and perform the analysis for the state's three groundwater management areas (Appendix 1). The areas are routinely sampled several times a year to track nitrate levels in the groundwater. Once each summer, DEQ laboratory staff collects an additional suite of analytes from the Lower Umatilla Basin and Northern Malheur County Groundwater Management Areas for pesticide analysis by the ODA laboratory; this pesticide sampling and analysis though was not completed in 2010 as the ODA laboratory focused on methods development and the need to save resources.

Past Groundwater Assessments

Between 1980 and 2000, DEQ conducted 45 groundwater quality assessments. These assessments covered approximately 6.4 percent of the total land area of the state, and 30.8 percent of the area in Oregon where groundwater is used. The assessment data provide a general rating of the overall quality of the groundwater resource available in Oregon for use as drinking water. The data show nitrate is the most commonly detected contaminant, followed by pesticides, volatile organic compounds, and bacteria. DEQ evaluates impairment by comparing the levels of detected contaminants to the federal drinking water standards. However, many organic chemicals, pesticides, and herbicides do not have drinking water standards and the detection of any level of these contaminants in groundwater indicates a potential concern. In 35 of the 45 studies completed, the assessment results show some impairment or reason for concern. In Oregon, the detection of contaminants in groundwater at one half the drinking water standard, or at 70 percent of the nitrate drinking water standard, can be the basis for declaring a Groundwater Management Area.

Drinking Water Source Monitoring

DEQ and DHS jointly implement a program designed to protect the discreet areas that supply public water wells. As part of this program, the DEQ Laboratory and Environmental Assessment Division sampled the source water serving wells at seven public water systems around the state in spring 2008 and at another eight systems in 2010. This project was funded by federal funds provided through the Safe Drinking Water Act. The source water samples were analyzed for contaminants commonly found in personal care products, domestic wastewater, new synthetic chemical compounds, strong microbial pathogens, and pharmaceuticals. Many of the parameters analyzed do not have federal drinking water standards and are not addressed in the Safe Drinking Water Act. The data shows low levels for many of these "emerging contaminants", although DEQ and DHS did not find contaminants in the 2008 sampling to be at levels of public health concern. The study results are providing state agencies with information on where to prioritize resources for preventing contamination of the source waters used for public systems.

Southern Willamette Valley Groundwater Management Area Synoptic Survey

In May and June 2009, DEQ tested over 100 wells in the Southern Willamette Valley GWMA. The work aimed to fill in data gaps and give stakeholders a better understanding of groundwater quality in the existing groundwater management area. The wells were tested for nitrate, sulfate, pH, specific conductance and temperature during a two week sampling event. Coordination for the project was a collaborative effort by DEQ and private well owners. DEQ analyzed the samples and released the results to internal DEQ stakeholders and ultimately to the individual well owners. The study provided valuable information to the public about their drinking water quality and potential health effects related to nitrate contaminants in groundwater.

The data showed that 45 sites, or 37 percent of the wells sampled exceeded the nitrate action level (7 mg/L) for declaring a Groundwater Management Area. Fourteen sites (11 percent of the wells sampled) were over the drinking water standard for nitrate (10 mg/L). DEQ notified the well owners of the results along with information on well head protection and potential nitrate treatment options.

Lower Umatilla Basin Groundwater Management Area Synoptic Survey

From September 2009 to January 2010, the DEQ laboratory collected samples at domestic and monitoring wells in the Lower Umatilla Basin GWMA to facilitate and enhance the understanding of groundwater quality by local stakeholders and DEQ hydrogeologists. Wells previously sampled during prior synoptic events were revisited and sampled to enhance the nitrate dataset.

The data showed that 63 sites (58 percent of the wells sampled) exceeded the nitrate action level (7 mg/L) for declaring a Groundwater Management Area. 49 sites (45 percent of the wells sampled) were over the drinking water standard for nitrate (10 mg/L). A trend analysis of nitrate concentrations indicates that the nitrate trend was increasing which could adversely impact groundwater quality.

Other Groundwater Activities

DEQ laboratory staff coordinated a groundwater meeting in April 2010 and gave presentations on current topics of interest to the groundwater community. The meeting included DEQ staff and presenters from outside the agency, including staff from the WRD, DHS, and the United States Geological Survey.

Other Groundwater Monitoring and Assessment Activities

Private drinking water supply wells are not routinely tested for water quality, although state law requires testing at the time of a real estate transaction. A home owner selling a property with a drinking water well must test the water for nitrate and total coliform bacteria. The 2009 Oregon legislature amended ORS 448.271(1) that now requires (effective January 1, 2010) a property owner to also test the well water for arsenic. The seller must submit the test results within 90 days to the real estate buyer and the DHS Drinking Water Program after the seller receives the test results. Between 1989 and 2003, about 24,633 nitrate tests were performed by home owners. This data is not routinely evaluated due to a lack of resources. However, in 2004, DEQ obtained a grant from the EPA to create a database and summarize the real estate transaction data received through December 2003. These data provided a broad overview of groundwater quality in the state. Most of the domestic well tests (82 percent) show nitrate levels below 2 mg/L and reflect background groundwater quality. Approximately 14 percent of the tests showed nitrate levels above background groundwater quality and about 1.7 percent of the wells tested exceeded the federal drinking water standard of 10 mg/L.

Groundwater Restoration in Oregon

Groundwater Management Areas

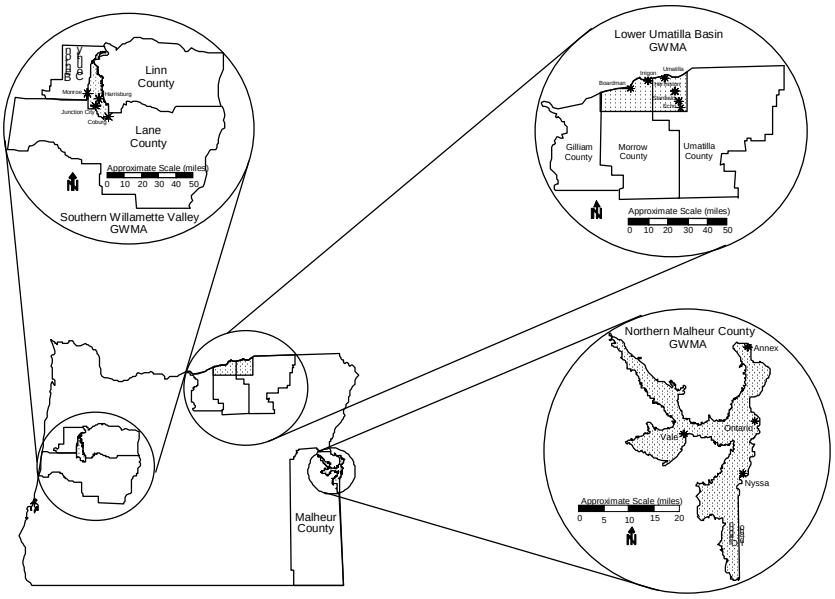
Data from past groundwater assessments were used to identify localized or area-wide groundwater contamination problems. If area-wide contamination is found at consistently high enough levels, an area shall be declared a GWMA under Oregon law[1]. When this situation occurs, the Groundwater Quality Protection Act requires the establishment of a local GWMA committee comprised of affected and interested parties. This committee works with state agencies to develop and implement an action plan to reduce groundwater contamination originating from point and non-point source activities in the area.

Oregon currently has three GWMAs (Figure 2) including the Northern Malheur County GWMA, the Lower Umatilla Basin GWMA, and the Southern Willamette Valley GWMA. All three GWMAs were declared for widespread nitrate contamination. In infants and developing fetuses, nitrate greater than 10 mg/L can interfere with the ability of blood to carry vital oxygen to body tissues resulting in methemoglobinemia or "blue baby" syndrome. There are other health risks also linked to high levels on nitrate in drinking water. DEQ is currently assisting with the implementation of the GWMA action plans which include maintaining groundwater quality monitoring networks, reviewing existing data to

[1] ORS 468B.180. The Department of Environmental Quality shall declare a ground water management area if, as a result of information provided to the department or from its statewide monitoring and assessment activities under ORS 468B.190, the department confirms that, as a result of suspected nonpoint source activities, there is present in the ground water:
(a) Nitrate contaminants at levels greater than 70 percent of the levels established pursuant to ORS 468B.165; or
(b) Any other contaminants at levels greater than 50 percent of the levels established pursuant to ORS 468B.165.

assess groundwater quality trends, and supporting local efforts to implement best management practices (BMPs) to maintain and restore groundwater quality.

Figure 2. Location of Oregon's Groundwater Management Areas



Northern Malheur County Groundwater Management Area

The Northern Malheur County (NMC) GWMA was declared in 1989 after significant groundwater contamination was identified in the northeastern portion of the county. ORS 468B.180 requires that DEQ declare a GWMA if nitrate concentrations exceed the Maximum Measureable Level of 7 mg/L. In 1985, DEQ sampled 107 wells in northern Malheur County. Thirty-four percent of the wells sampled had nitrate levels above the drinking water standard of 10 mg/L. The presence of the pesticide Dacthal was also an additional concern. Sampling confirmed that most of the contaminated groundwater is present in the shallow alluvial sand and gravel aquifer which receives a large proportion of its recharge from infiltration of irrigation canal leakage and irrigation water. Land use in the GWMA is dominated by agriculture.

The NMC Action Plan, dated December 1991, includes recommendations that allow farmers to customize BMPs to their farm's needs. The committee chose to implement the action plan on a voluntary basis recognizing that individuals, businesses, organizations, and governments will, if given adequate information and encouragement, take positive actions and adopt or modify practices and activities to reduce contaminant loading to groundwater. The success of the action plan is gauged by both the adoption of BMPs and improvement of water quality within the GWMA.

The Natural Resources Conservation Service and the local Soil and Water Conservation District are working with farmers to develop water quality plans to address groundwater concerns. Alternative irrigation and fertilization management practices have been designed and recommended for the area.

DEQ currently samples a network of approximately 35 wells every other month for analysis of nitrate and Dacthal and does a more complete analysis approximately once a year. A formal trend analysis of nitrate concentrations was conducted in 2010 using the 18 years of data since implementation of the action plan (1991 through 2009). The analysis indicated that the area-wide nitrate trend was slightly decreasing. Individual wells showed a mix of decreasing (58 percent), increasing (22 percent), and statistically insignificant (19 percent) trends across the area. Progress is being made on the land surface through the implementation of BMPs. However, it may take years or even decades for groundwater quality to return to natural background levels.

Lower Umatilla Basin Groundwater Management Area

The Lower Umatilla Basin (LUB) GWMA was declared in 1990 after nitrate contamination was identified in the northern portions of Umatilla and Morrow Counties. Between 1990 and 1993, DEQ sampled 252 wells in the LUB study area. Groundwater samples from private wells identified nitrate contamination above the 10 mg/L drinking water standard in 33 percent of the samples. DEQ worked together with WRD and DHS Drinking Water Program in the early 1990s on a comprehensive study of the area that identified five sources of nitrate loading to groundwater:

- Irrigated agriculture
- Land application of food processing water
- Septic systems (rural residential areas)
- Confined animal feeding operations
- Washout lagoons at the Umatilla Chemical Depot

The LUB Committee finalized the LUB Action Plan in December 1997. This voluntary plan focuses on education and outreach, identifying and encouraging adoption of appropriate BMPs and making soil sampling and groundwater nitrate testing equipment and supplies available for local use. In addition, over 90 percent of the total acres in the LUB GWMA are covered by individual farm-specific irrigation water management plans.

Similar to NMC, DEQ samples a network of approximately 33 wells every other month for analysis of nitrate. Approximately once a year, these wells are sampled for a larger list of contaminants including major ions, metals, and pesticides. These data are being used to evaluate changes in groundwater quality over time in response to adoption of BMPs. Implementation of the Action Plan also includes ongoing community outreach and education efforts highlighting groundwater quality concerns and solutions.

In October 2008, the LUB committee finalized the "Second Four-Year Evaluation of Action Plan Success and 2005/2006 Annual Progress Report." The report concludes that "because measurable progress has been made towards the Action Plan goal using the criteria set for the Action Plan, the voluntary nature will continue for now, but BMP efforts, particularly documentation, need to be increased."

The current Action Plan contains milestones and goals through December 2009. DEQ is currently evaluating groundwater nitrate concentrations from multiple sources to address the December 2009 goal of a downward trend in nitrate levels throughout most of the GWMA. The sources of groundwater nitrate data being evaluated include the bimonthly well network, 113 wells in and around food processor wastewater application sites sampled quarterly, and three large sampling events over the past two decades involving over 100 wells.

When this evaluation is complete, the LUB GWMA Committee will complete a "Third Four-Year Evaluation of Action Plan Success" and prepare a new Action Plan with milestones and goals for the future. Results from the "Third Four-Year Evaluation of Action Plan Success" and development of a new Action Plan should be available by June 2011.

Perchlorate in the LUB GWMA

Perchlorate is a chemical contaminant that is found nationwide at low levels in the environment including water, milk and some foods. It can be anthropogenic but is also naturally occurring. There currently is no federal or Oregon drinking water standard for perchlorate. EPA has adopted a reference dose that translates to 24.5 parts per billion (ppb), if all exposure comes through drinking water. However, if exposure also comes from food, the "safe" level in water would be lower.

Perchlorate was detected near military facilities in the LUB GWMA in 2001 and 2003. In fall 2003, perchlorate was included in a regional groundwater sampling event that was part of the ongoing nitrate investigation to see if perchlorate was localized or generally present in the area. Perchlorate was detected in about half of the 133 wells sampled.

DEQ, EPA, the United States Navy, and private companies have conducted multiple, subsequent sampling events. A total of 391 groundwater samples have been collected from 288 locations with perchlorate concentrations ranging from non-detect to 29.2 microgram per liter (ug/L) with an average of 3.3 ug/L. Concentrations were generally low and do not appear to represent a single contaminant plume. The full geographic extent of perchlorate in groundwater has not been determined although it is clear that it occurs at low levels over a wide area. The source(s) of perchlorate in the LUB GWMA remains unknown and additional research is needed to identify the specific source(s). It is possible that both naturally occurring and manufactured sources of perchlorate are contributors. Perchlorate concentrations typically decrease with depth, especially in the basalt wells. Wells with properly constructed seals may aid in reducing exposure to perchlorate.

In 2008, EPA Region 10 collected pasteurized milk samples from grocery stores in northern Morrow and northwestern Umatilla Counties to learn more about dietary exposure from perchlorate. The perchlorate levels found in the milk purchased by EPA in the LUB are similar to those found in the Food and Drug Administration's (FDA) national studies. The mean perchlorate concentration in the milk collected by EPA in the LUB is 4.8 ug/L, while the mean perchlorate concentrations in milk collected during FDA's 2004-2005 Exploratory Survey and FDA's 2005-2006 Total Diet Study were 5.8 ug/L and 7.0 ug/L, respectively.

In January 2009, EPA issued an Interim Health Advisory for perchlorate of 15 μg/L to assist state and local officials in addressing local contamination of perchlorate in drinking water while the Agency evaluates the opportunity to reduce risks through a national primary drinking water standard.

In August, 2009, EPA published a Supplemental Request for Comments Federal Register notice seeking input on additional ways to analyze data related to the regulatory determination of perchlorate. EPA is considering a broader range of alternatives for interpreting the available data on: the level of health concern, the frequency of perchlorate occurrence in drinking water, and the opportunity for health risk reduction through a national primary drinking water standard. A key focus is the re-evaluation of perchlorate exposure to sensitive life stages including infants and developing children, in addition to pregnant women and their developing fetuses. EPA will make a final regulatory determination for perchlorate after considering comments provided on this and previous notices related to the perchlorate regulatory determination. EPA's final decision may impact future management in the LUB GWMA.

In late 2009 and early 2010, DEQ performed the third synoptic sampling event. Perchlorate was one of the analytes quantified during the event. Perchlorate concentrations in the 104 wells sampled ranged from less than 1 ug/L to 24.6 ug/L, with a median value of 1.4 ug/L and an average value of 3.2 ug/L. Two wells exceeded 15 ug/L. Ninety-nine wells were sampled in both the 2003 and 2009 synoptic sampling events. Perchlorate concentrations increased in approximately twice as many wells as it decreased. The wells that showed the largest perchlorate increases also showed increased nitrate concentrations. The wells that showed the largest perchlorate decreases also showed decreased nitrate concentrations.

Southern Willamette Valley Groundwater Management Area

Over the last 20 years, many studies and sampling programs have focused on groundwater quality in the Southern Willamette Valley (SWV). Although low levels of nitrate may be naturally present, the probable causes of nitrate contamination in the SWV are from sources related to human activity such as use of fertilizers, industrial and municipal wastewater facilities, animal waste, and septic systems.

Over 20 percent of the 476 wells sampled by DEQ in 2000 and 2001 had nitrate concentrations in excess of 7 mg/L nitrate-N. The highest level detected within the study area was 23 mg/l. In 2002, DEQ resampled those wells that tested greater than 7 mg/L during the 2000-2001 study. In addition to the nitrate analyses, DEQ included testing for pesticides, bacteria and a variety of other geochemical parameters and potential contaminants. Nitrate was confirmed at levels significantly above 7 mg/L, with a maximum value of 28 mg/L. The nitrate data from this and previous groundwater studies in the area document a regional groundwater quality concern. The pesticide data did not provide adequate information to characterize the entire study area. However, the results were sufficient to conclude that pesticides are present although they are below any health advisory standard and below 30 percent of any applicable standard.

On May 10, 2004, the DEQ declared a GWMA for portions of the SWV (Figure 3). DEQ was designated as the "Lead Agency" and a GWMA Committee was appointed to develop an Action Plan. This committee met regularly and worked with many stakeholders for almost 20 months to produce a draft Action Plan. A final Action Plan was approved at the November 9, 2006 SWV GWMA Committee meeting. The voluntary Action Plan provides 60 strategy recommendations related to agriculture, residential, commercial/industrial/municipal, and public water system to reduce nitrate contributions and prevent further groundwater contamination.

In spring 2009, an Oregon State University graduate student completed a survey of residents who live in the SWV GWMA to assess their knowledge, awareness and attitude relative to groundwater issues and protection. The response rate was a remarkable 47 percent. This baseline assessment will be used to measure progress, and to design future outreach events.

Education and outreach are key components of the Action Plan. In 2010, the SWV GWMA was selected as the environmental concern issue for the *Oregon Envirothon*'s annual competition that involves 24 teams of high school students from around the state. For the second year, the GWMA Booth was a major hit at the *Kids Day for Conservation* event in Corvallis, where over 600 kids created an edible aquifer, polluted it with their land use of choice (fertilizer, manure, pet waste and/or pesticides – all edible replicates), added rain to the system, and then drilled a well (straw) to learn how easy groundwater (and their drinking water) can be polluted.

In February 2010, there was a joint DEQ and ODA workshop to explore the priority research ideas for the SWV GWMA. This was a very successful event with nearly 50 researchers, farmers, regulators, field staff, residents, districts and agency representatives present. A prioritized list of research projects was produced.

DEQ continues to monitor the 24 monitoring wells DEQ installed in the SWV, as well as the 17 domestic wells that are a part of the long term monitoring program. In 2009, a one-time "Synoptic Event' was conducted to gauge how well the long term monitoring program compares to the boarder sampling base. This event added just over 100 wells to the May 2009 sampling event. Synoptic events help to inform DEQ of potential contamination "hot spots" over a wider area and a longer time scale. Data analysis indicates that the area-wide nitrate trend was steady or slightly decreasing.

The SWV GWMA Committee continues to meet 3-4 times a year to address and assess ongoing issues. Further information can be found at: http://gwma.oregonstate.edu/ .

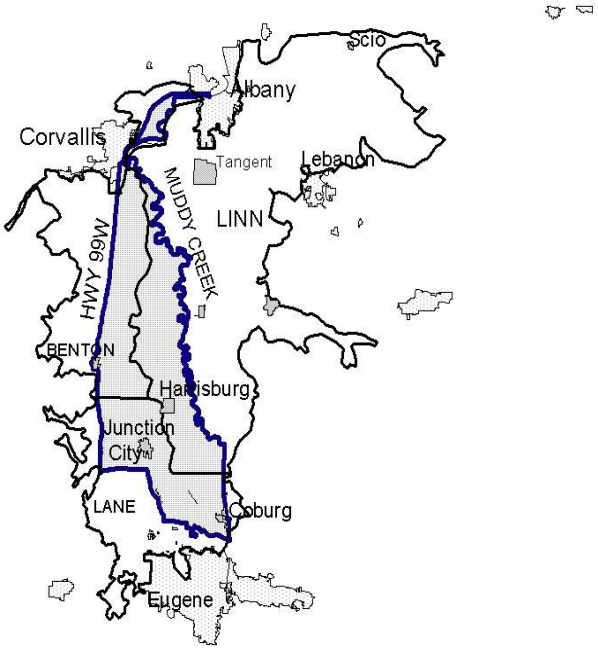


Figure 3. Southern Willamette Valley Groundwater Management Area

Groundwater Protection in Oregon

Groundwater is present beneath almost every land surface and is sometimes at very shallow depths. It is vulnerable to contamination from activities that take place on the land as well as from discharges of wastes and pollutants at or below the ground surface. Once groundwater becomes contaminated it is very difficult to clean up. Because groundwater moves very slowly, the contamination may persist for tens, hundreds, or even thousands of years. Likewise, groundwater that is currently being contaminated may not affect beneficial uses until sometime far into the future. This contamination may impair groundwater for use as drinking water and may affect the quality of the surface waters where it comes to the surface.

DEQ has primary responsibility for implementing groundwater protection in Oregon. DEQ uses a combination of programs to help prevent groundwater contamination from point and non-point sources of pollution, clean up pollution sources, and monitor and assess groundwater and drinking water quality. DEQ implements some programs though partnerships with DHS, WRD, ODA, DOGAMI, Oregon State University, and other state, local, and private organizations, businesses, and individuals. **Appendix 2** is a table summary of the various groundwater protection programs and identifies the primary responsible state agency. A few of the projects and programs are highlighted below.

La Pine National Demonstration Project

The La Pine area of central Oregon is a rural residential area that is experiencing rapid development and population growth. In the 1960s, large tracts of land were subdivided into 15,000 lots as small as one-half acre. The primary source of drinking water for the 12,000 residents of the area is shallow groundwater tapped by over 4,000 individual domestic wells that are typically less than 50 feet deep. In addition, there are about 100 community public water system wells serving small-scale subdivisions, schools and businesses in the region. Most homes in the area use individual onsite wastewater treatment systems (onsite septic systems). The porous and permeable pumice soils, shallow groundwater table, and relatively high development densities in the region created a threat to shallow groundwater.

Groundwater assessments in the 1990s found nitrate concentrations in drinking water wells that approached the drinking water standard (10 mg/L) in several of the oldest and most densely developed areas. The Deschutes and Little Deschutes Rivers, both listed as water-quality limited streams by DEQ, flow through the region and potentially receive discharge from the shallow aquifer. In the mid-1990s, Deschutes County and DEQ assessed the potential impact of residential development in the La Pine region on groundwater quality. Preliminary studies and 2-dimensional groundwater modeling at that time predicted that nitrate levels in groundwater would exceed 10 mg/L within 20 years. These preliminary findings were based on the best available information at the time on groundwater recharge and flow velocities.

In 1999, the United States Congress awarded a $5.5 million 5-year grant to DEQ, Deschutes County, and the U.S. Geological Survey as part of the National Decentralized Wastewater Treatment and Disposal Demonstration Project. The objective of the study is to protect the La Pine area groundwater quality because it is the sole source of drinking water for the region. The study evaluated innovative nitrogen reducing onsite septic system technologies, and developed and used a three-dimensional groundwater flow and contaminant transport model to determine a comprehensive groundwater protection strategy.

The La Pine Demonstration Project included elements to:

- Install and monitor (system effluent and monitoring well samples) up to 50 innovative nitrogen reducing systems;
- Initiate an onsite system maintenance program;
- Conduct 3-dimensional groundwater flow modeling and nitrogen contaminant fate and transport modeling and assess optimum lot density and treatment standards based on model results; and
- Establish a low-interest loan fund for septic system repair or replacement.

DEQ and Deschutes County Environmental Health Division staff conducted baseline groundwater sampling of 199 domestic and public water supply wells in 2000. Similar data collection and evaluation continued in 2001 and 2002. Results show 10 percent of the wells sampled had nitrate concentrations above background levels of nitrate. These results and other data from the study show that groundwater moves slowly in the area, and that nitrate from onsite septic systems are in the early stages of creating groundwater contamination. Onsite septic systems have been discharging nitrate for over 40 years, but contamination has only begun to reach the groundwater tapped for drinking water supplies in the past 10 to 15 years. The predicted quantity of nitrogen contributed to groundwater is high as contaminants continue to move into the groundwater from an ever increasing population of existing systems. The contaminant load to the aquifer will increase with the population as the remaining vacant buildable lots are developed.

In total, 15 types of innovative onsite septic systems and 3 types of control (standard, pressure distribution and sand filter systems) onsite systems have been installed. The La Pine project monitored a total of 49 onsite systems beginning in 2000 and ending in December 2004. The effect of these systems on groundwater quality was monitored through a network of nearly 200 shallow monitoring wells and several extensive sampling events involving public and private domestic water wells. Data from the shallow monitoring wells capturing the influence of onsite systems drainfields indicate significant impacts from those systems, particularly those systems that do not reduce nitrogen. Conventional systems, including standard tank and gravity drainfield, pressure distribution systems, and sand filters provide minimal nitrogen reduction, and therefore minimal protection for the groundwater in this area. Some data have been collected to evaluate groundwater and surface water interaction along the Deschutes and Little Deschutes Rivers within the study area, although a full evaluation was beyond the scope of this project. Several reports and papers have been published by the US Geological Survey based on research conducted during the demonstration project:

- Hinkle SR, Weick RJ, Johnson JM, Cahill JD, Smith SG, Rich BJ, 2005. *Organic Wastewater Compounds, Pharmaceuticals, and Coliphage in Ground Water Receiving Discharge from Onsite Wastewater Treatment*

Systems near La Pine, Oregon: Occurrence and Implications for Transport. US Geological Survey Scientific Investigations Report 05-5055, 98 p.

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In 2005, the EPA awarded a grant to Deschutes County to implement findings from the La Pine National Demonstration Project on a local level. The new project allowed the county to undertake creation of a Pollution Reduction Credit Program as one part of a financial assistance program to help pay for groundwater protection measures. The county also developed, as part of this project, a new county code to require the use of onsite wastewater treatment systems that provide increased protection for groundwater quality. This new code was adopted by the Board of County Commissioners on July 23, 2008. The effective date of the code was October 23, 2008; however, opponents of the code submitted a petition to refer the code to a county-wide vote. In a special election held on March 10, 2009 county voters overturned the local ordinance.

As result of the vote, in July 2009 Deschutes County Commissioners asked DEQ to take the lead in the efforts to resolve the issue. At the July 2009 meeting, the public raised many questions about how to best approach the issue and decried a lack of an effective public process. Many of the questions and comments made at the meeting touched on a variety of issues, and depending on the questions, different agencies in attendance responded. DEQ decided the first step in moving forward was to address the concerns for an effective public involvement process. In 2010 DEQ sent out over 10,500 notices to area property owners, held two public meetings and established a steering committee comprised of local citizens. The steering committee met three times in fall 2010 and plans to meet monthly until late 2011 or mid-2012.

Source Water Assessments and Drinking Water Protection Programs

In 1996, the Federal Safe Drinking Water Act required states to develop Source Water Assessments for public water supply systems (surface water and groundwater sources). DEQ and the DHS Drinking Water Program implement this program in Oregon. Between 2000 and 2005, DEQ and DHS completed the assessments for 2,460 public water systems using groundwater sources. The assessment report provided to every system gives the community officials detailed information on the watershed or recharge area that supplies the well, spring or surface water intake ("drinking water source area") and identifies potential risks within the source area.

In 2007, DEQ completed a statewide "susceptibility analysis" which used the results of the Source Water Assessments to determine the overall susceptibility of each drinking water source (well, spring, or surface water intake). Each public water system was evaluated based on the number and type of potential contaminant sources within the drinking water source area and the level of sensitivity of the source area. The analysis rankings are being used by DHS and DEQ to prioritize outreach and technical assistance, to evaluate cross-program opportunities, and to select toxic monitoring locations based on high potential risks.

The information in the source water assessments provides the basis for a community to voluntarily develop strategies or a plan to protect the source area that supplies their drinking water. Drinking water protection strategies generally focus on reducing the impact of one or two high-priority pollutants within the source area. The primary incentive for local communities to develop and implement drinking water protection is the benefit of a more secure source of high quality water. Other incentives may include a reduction in public water supply monitoring requirements and the reduced likelihood of costs for replacement and/or treatment of contaminated drinking water. DEQ and DHS provide direct technical assistance to communities as they develop and implement strategies to protect their local public drinking water sources.

The source water assessment data is readily accessible to others electronically and in hard copy. The assessment data is used by other DEQ programs to prioritize areas for permit modifications, inspections, technical assistance and cleanup. It has been provided to several other state and federal agencies including Oregon Emergency Response System, Oregon Department of Transportation, Oregon Department of Forestry, ODA, Department of Lands, Conservation and Development, U.S. Forest Service, and U.S. Bureau Land Management to facilitate incorporation of protection strategies into their respective programs. Maps and downloadable statewide GIS shapefiles of drinking water source area coverages and identified potential sources of contamination are available to the public on the DEQ Drinking Water Protection website at http://www.deq.state.or.us/wq/dwp/dwp.htm. The drinking water source areas can also be identified (and selected as a search criteria) for both DEQ's Facility Profiler (a location based system showing DEQ permit holders and cleanup sites) and LASAR (DEQ's Laboratory Analytical Storage and Recovery for air and water quality monitoring data).

The contaminant source inventories in the delineated wellhead protection areas provide useful information as the community or agencies evaluate the risks and prioritize protection strategies. Typical contaminant sources identified in groundwater source areas include high density housing, septic systems, auto repair shops (e.g., drywells, drill holes, floor drains and sumps), gas stations, irrigated crops, managed forest land, grazing animals, and transportation corridors. DEQ developed a database referencing best management practices for the 88 most common potential contaminant sources in Oregon (available under "technical assistance" in DEQ's Drinking Water Program website). The database lists activities ranging from educational outreach to regulatory approaches that public water systems or communities can take to reduce their risk. The database can be used to pull the best management practices for a public water system or geographic area from GIS layers into a format that communities can use to choose their drinking water protection strategies for groundwater.

DEQ initiated a technical analysis in 2010 for groundwater nitrate and toxic chemicals detected in public water systems. The project will include a soil nitrate sensitivity analysis involving 8-10 public water systems with high nitrate levels, and research for technical information on nitrate sources. The nitrate data for each well will be statistically analyzed and plans developed to reduce the loading within the 2 and 5-year times of travel to the individual wells. A final report and action plan are scheduled for completion in spring 2011.

DEQ has 1 FTE in the drinking water protection program dedicated to groundwater which is funded by the Safe Drinking Water Act through a Memorandum of Agreement between DEQ and DHS. This position provides technical assistance for groundwater protection for public water systems, and is funded to work only on public water system groundwater protection issues.

Other Groundwater Protection Efforts

DEQ administers several programs that contribute to groundwater protection through the implementation of regulations, standards and permitting activities. These programs include underground storage tanks (UST), solid waste landfills, remediation sites, underground injection control (UIC) systems, onsite wastewater treatment systems, and permitting of industrial, municipal and domestic wastewater treatment facilities that discharge wastewater to land. DEQ's laboratory provides sampling and logistical support for DEQ's UST program, and sampling support has also been provided DEQ's solid waste program through split sampling events at 26 landfills statewide.

The UST program helps to protect groundwater by managing issues related to regulated tank registration, testing, and compliance, and cleanup of releases of leaking petroleum tanks including releases from home heating oil tanks. Compliance and prevention requires the registration of tanks and specifies the technical requirements for new and existing UST systems. Service provider and supervisor licensing requires companies (service providers) and individuals (supervisors) to obtain a license before performing UST work. Cleanup activities within this program require the timely reporting of petroleum releases, and the investigation and remediation of soil and groundwater contamination resulting from leaks and spills of petroleum products. There are over 25,000 USTs that have been decommissioned in Oregon and thousands more operating under permits.

The Solid Waste program permits several different types of solid waste disposal facilities including municipal solid waste landfills, petroleum contaminated remediation facilities, and compost operations. These permitting activities help to protect groundwater resources by requiring liners and other standards to control liquids leaching from these facilities.

The Site Response program works to investigate and clean up contaminated hazardous waste sites throughout Oregon. Many of these sites have historically contributed to the contamination of groundwater. By cleaning up these sites future contamination of groundwater by chemicals or pollutants is prevented.

DEQ administers and implements Oregon's UIC program through delegation from the EPA. The UIC program is administered to protect groundwater through the approval and permitting of drywells, sumps, and other injection systems that discharge a variety of residential, commercial, and industrial fluids below the ground. Injection systems are required to be designed, installed, maintained, and, in many cases, monitored so that they are protective of groundwater resources. Federal regulation requires DEQ to keep an updated inventory of all injection wells and report them to the EPA. In Oregon the majority of injection systems are associated with storm water discharge and industrial process/wastewater. There are over 46,400 injection systems registered in Oregon (ranking 3rd highest in the nation based on inventory), most of which handle stormwater flow from streets, parking lots and businesses. The level of funding (1 FTE) for administering the statewide UIC program had been inadequate, so the 2007 legislature approved new fees under HB 2118 to allow the phase-in of new staff (5.5 FTE total). This staffing level would allow DEQ to deliver the basic elements of a statewide UIC program and retain primacy of the program. However, due to the down turn in the economy and housing development that began in 2008, DEQ is currently administering the program with 3 FTE and will phase in the remaining FTE when revenue is available.

The Onsite Wastewater Treatment System program administers the permitting of hundreds of thousands of onsite septic systems throughout Oregon. Approximately one-third of all Oregonians rely on onsite systems as a means to treat residential wastewater. This program helps to protect groundwater resources by requiring systems to be designed and installed according to state regulations that include prescriptive sitting and performance standards.

DEQ regulates domestic, municipal and industrial wastewater discharge activities (such as lagoons and land application systems) to protect groundwater resources through the use of Water Pollution Control Facility and National Pollutant Discharge Elimination permits. The Wastewater Permitting program regulates thousands of industrial, municipal and domestic wastewater treatment facilities in Oregon. Municipal and domestic facilities generally collect and treat sewage from residences and commercial facilities, while industrial facilities treat manufacturing and processing wastewater they generate.

Funding Groundwater Quality Projects in Oregon

The 1989 Groundwater Protection Act authorized DEQ to fund research and development projects related to groundwater quality, particularly in GWMAs. However, no dedicated funding source was established for this purpose. A fee on fertilizer products purchased in Oregon was instituted as part of the act to fund groundwater quality research associated with the interaction of pesticides or fertilizer and groundwater. The grant fund is administered by ODA. In previous biennia, the grant fund has been used for research projects in the first two declared GWMAs (NMC and LUB) in the state. Revisions to the fertilizer law in 2001 expanded the use of the fund to include research related to the interaction of fertilizer, agricultural mineral or agricultural amendment products and groundwater or surface water,

eliminated research on pesticides and groundwater, and established a committee to advise ODA on funding of research grants.

DEQ has allocated federal grants available through Clean Water Act Section 319 to groundwater projects in limited areas. Funding as low-interest loans to public agencies is also available through the Clean Water State Revolving Fund. A summary of groundwater related projects funded by DEQ and ODA from 2008 through 2012 is included in **Appendix 3**.

Future Direction

DEQ's objectives for groundwater quality protection in the 2011-2013 biennium include the following activities.

- Continue to implement the LUB and NMC GWMA Action Plans and evaluate the performance or success of the management plans in reducing groundwater contamination. Work with the LUB GWMA Committee to prepare a new Action Plan with goals and milestones for the future. Also, continue regional groundwater monitoring networks in the two GWMAs.
- Coordinate the SWV GWMA committee and implementation activities to reduce area-wide groundwater contamination.
- Continue monitoring 41 wells in the SWV GWMA to determine groundwater trends.
- Evaluate the effectiveness of conservation enhancement practices in reducing nitrate pollution to the groundwater in the SWV GWMA.
- Conduct focus groups to determine how to best incorporate groundwater protection into the daily life of GWMA residents.
- Evaluate the potential nitrate impact to a 'deeper' aquifer in the Linn County area of the SWV GWMA.
- Continue to work cooperatively with Deschutes County to implement groundwater protection programs in the La Pine area.
- Complete additional Drinking Water Source Water Assessments as new systems come online and provide technical assistance to communities developing drinking water protection plans; expand statewide analyses and collaborate with other agencies to reduce risks of contamination to public water system wells.
- Continue funding and support of research, education, and implementation of BMPs for groundwater protection, as funding allows.

Appendix 1 - Groundwater Quality Assessment Projects

Summary as of November 2010

Basin	Project Name	No. of Sample Events	No. of Wells Sampled	Groundwater Quality Rating[I]	Contaminants Of Concern	Contaminants Found [II]	Suspected Contaminant Sources	Date Last Monitored
Malheur	Northern Malheur County GWMA[III]	Ongoing	40	4	Nitrate, Pesticides	Nitrate, Dacthal	Agriculture	2010
Umatilla	Lower Umatilla Basin GWMA	Ongoing	32 (198 synoptic)	4	Nitrate, Pesticides	Nitrate, EDB, Atrazine, Dacthal, Dicamba, Picloram	Agriculture, Onsite Septic Systems, Industry	2010
Willamette	Southern Willamette Valley GWMA	Ongoing	40 (105 synoptic)	2	Nitrate, Pesticides	Nitrate, Pesticides	Agriculture, CAFOs, Onsite Septic Systems	2010
Umpqua	Sutherlin Arsenic Study	2	114	3	Nitrate, Arsenic	Arsenic	Naturally occurring	2008
Statewide	Drinking Water Source Monitoring	2	7	*[IV]	Pesticides/herbicides/ fungicides, pharmaceuticals, organics, metals, bacteria	*[IV]	Sewage treatment plants, agriculture, industry, urbanization, industry, naturally occurring	2008

Notes:

I. **Groundwater Quality Rating**:
1 = Means less than 10 percent of wells had a contaminant level over the drinking water standard.
2 = Means 25 percent or more of wells had nitrate levels between 5 to 10 mg/L, or any well had an organic compound detected.
3 = Means 10 percent to 25 percent of wells had a contaminant level over the drinking water standard.
4 = Means more than 25 percent of wells had a contaminant level over the drinking water standard.

II. **Contaminants:** 1,2 DCP = 1,2 dichloropropane; EDB = Ethylene dibromide; PCE = Perchloroethylene or tetrachloroethylene; PCP = Pentachlorophenol;
VOC = Volatile organic compound.

III. GWMA = Groundwater Management Area

IV. Pending analysis

Appendix 2 - Oregon Groundwater Protection Programs and Responsibilities

AGENCY	GROUNDWATER PROTECTION RESPONSIBILITIES
Department of Environmental Quality (**Due to lack of resources and staff, DEQ no longer, wholly or in part, performs these responsibilities.)	**Coordinates interagency management of groundwater to achieve state goal to prevent groundwater contamination.
	**Designs and conducts targeted groundwater quality investigations statewide.
	**Maintains a groundwater quality database and data repository.
	**Responds to area-wide groundwater contamination by working with agencies and local citizens to develop an action plan to address sources.
	**Promotes public education and community involvement in groundwater protection programs and citizen monitoring.
	**Establishes groundwater quality reference levels and concentration limits.
	Issues water quality and underground injection control Water Pollution Control Facilities (WPCF) permits that include groundwater protection requirements.
	Administers federal National Pollutant Discharge Elimination System (NPDES) program and issues wastewater discharge permits that include groundwater protection requirements.
	Administers onsite sewage system program, contracting with some counties.
	Shares implementation of the drinking water source water assessment and protection program with DHS.
	Certifies drinking water protection plans for public water supply systems.
	Administers federal Underground Injection Control program.
	Administers a federally funded (Clean Water Act 319) nonpoint source grant program.
	Administers solid waste and hazardous waste management programs.
	Administers and implements federal Resource Conservation and Recovery Act program.
	Administers Underground Storage Tank program.
	Administers state environmental cleanup program.
	Administers Oregon Dry Cleaner program.
Water Resources Department (WRD)	Characterizes aquifers and groundwater availability.
	Approves water right applications for withdrawals of groundwater.
	Implements regulations regarding well construction and decommissioning.
	Maintains database of location and construction of wells.
	Coordinates reviews issues permits for aquifer storage and recovery projects.

Groundwater Quality Protection in Oregon

AGENCY	GROUNDWATER PROTECTION RESPONSIBILITIES
Department of Human Services (DHS)	Administers public water system monitoring programs.
	Administers real estate transaction well-testing program.
	Administers and shares implementation of the drinking water source water assessment program with DEQ.
	Certifies delineation of wellhead protection areas.
	Provides technical assistance to public water systems on well construction issues.
Oregon Department of Agriculture (ODA)	Administers programs regulating farming practices to protect groundwater, wellhead protection, groundwater management areas, and areas of groundwater concern.
	Develops and implements water quality management plans for groundwater protection.
	Administers a fertilizer and groundwater research grant program funded by fee on fertilizer product distribution.
	Develops and implements a pesticide management program.
	Implements Confined Animal Feeding Operations regulations.
	Develops or assists in development of management plans for agricultural areas per ORS 468B.184.
	Provides pesticide analytical services for groundwater assessments.
Oregon State University (OSU), Agricultural Extension Service and Experimental Stations	Assists with identification of areas vulnerable to groundwater contamination and conducts nitrate testing of local wells.
	Conducts research regarding soil and groundwater contamination and BMPs to prevent contamination.
Department of Land Conservation & Development (DLCD)	Reviews comprehensive plans for communities to ensure they are consistent with goal of the Groundwater Quality Protection Act (ORS 468B.155).
Oregon Department of Transportation (ODOT)	Ensures that the goals of the Groundwater Protection Act are incorporated in all aspects of highway and road design and construction.
Department of Geology and Mineral Industries (DOGAMI)	Ensures that the goals of the Groundwater Protection Act are incorporated.
	Regulates drilling and permitting of geothermal wells.

Appendix 3 - Funding for Groundwater Projects

Date	Project	Amount	Description
Oregon Department of Agriculture – Groundwater Research Grant			
March 2008 – June 2011	Oregon State University Environmental & Molecular Toxicology Dept.	$74,595	Fate of Bioaccessible Metals from Prior Metal Rich Fertilizer Applications and Preserving Established Select Field Sites
Federal Clean Water Act 319 Grants			
2007-2010	Integration TMDL and GW priorities into Willamette Ag. Demo Project	$171,000	Implement agricultural water quality projects in priority watersheds and the correspondent GWMA. These efforts will be augmented with education and outreach efforts.
2008-2010	Southern Willamette Valley Groundwater Management Area Action Plan Implementation	$99,893	The project will address: a) need to develop a Land Management Action Kit; b) coordination of the Septic System Technical Group; c) coordination of the GWMA Committee; and d) outreach/education/communication actions.
2009	LUB GWMA Action Plan Effectiveness Monitoring & Outreach	$38,000	The 1997 LUB GWMA Action Plan identified five area activities contributing to nitrate contamination of groundwater. 1. Irrigated agriculture – approximately 180,000 acres 2. Confined Animal Feeding Operations (CAFOs) - seven major CAFOs in LUBGWMA 3. U.S. Army Umatilla Chemical Depot washout lagoons 4. Food processing water 5. Domestic sewage where septic systems are in high density To address the activities listed above, the Umatilla County SWCD developed the LUB GWMA Education and Outreach Plan in 1997 to increase public awareness of not only the economic importance of groundwater but also the associated health risks of high nitrate levels in the drinking water. Historically the education/outreach activities conducted by the SWCD included maintenance of a BMP library, land use workshops, water quality presentations at Outdoor School and Watershed Field Days with local schools, the development of an educational DVD specifically targeting the LUBGWMA, and community meetings addressing wells and septic systems.
2009-2011	Groundwater Protection Education to Promote Citizen Involvement in the Southern Willamette Valley	$67,985	Provide assistance to residents in the GWMA through education and promoting citizen involvement. Develop educational curriculum for school age children that focuses on groundwater principles and protection. Coordinate existing citizen volunteers to assist with outreach and education to the general public, including community groups.
2010-2012	Southern Willamette Valley Groundwater Management Area Action Plan Analysis, Marketing, and Implementation	$72,480	The six work tasks in this grant will build on the accomplishments from previous water resource work with federal, state, and local partners, thus accomplishing the goals and objectives described below.

Date	Project	Amount	Description
			• Identify and prioritize stressors, problems, or gaps preventing attainment of strategies outlined in the GWMA Action Plan. • Build individual and community awareness, readiness and motivation to change behaviors to improve groundwater quality and reduce nitrate contamination. • Build community capacity and momentum among project partners to spread the word in their communities about groundwater and nitrate contributions. • Reduce nitrate contributions in a comprehensive and stakeholder-based approach, working with residents, farmers, agencies, and organizations to consider and apply a variety of strategies that will protect and restore groundwater quality.
Clean Water State Revolving Fund Loans			
2008	Farmer's Irrigation District	$3,000,000	Replace open distribution ditches with piping in an area served by old onsite systems.
2008	Miles Crossing Sanitary District	$4,893,000	New sewage collection system to replace failing and marginal onsite disposal systems in area of high groundwater.
2009	City of Milwaukie	$4,000,000	Sanitary sewer collection extended to area of failing onsite systems and cesspools.
2009	Clackamas County Sewer District	$4,000,000	Sanitary sewer collection extended to area of failing onsite systems and cesspools.
2010	City of Gresham	$5,000,000	Stormwater drywells decommissioned or modified with green infrastructure facilities to reduce stormwater and groundwater impacts.
2010	City of Athena	$1,543,900	Construction of artificial wetland will reduce the level of effluent application to agronomic rates.
2010	Clackamas County Sewer District	$5,000,000	Extension of sanitary sewer collection to eliminate onsite and cesspool threatening groundwater.