Groundwater Quality Protection in Oregon

Submitted to:

Governor Kate Brown
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Oregon Environmental Quality Commission

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

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Executive Summary

Groundwater is an essential Oregon resource. It makes up 95 percent of Oregon's available fresh water. More than 70 percent of Oregon residents get their drinking water from groundwater, and over 90 percent of the state's public water systems get their drinking water from groundwater. To protect this valuable resource, Oregon passed laws to prevent groundwater contamination, conserve and restore groundwater, and maintain the high quality of Oregon's groundwater resource. The Oregon Department of Environmental Quality implements Oregon's groundwater protection program to monitor, assess, protect and restore Oregon's groundwater resources. Because sources of groundwater contamination and consumers of groundwater cross many boundaries, DEQ also works with other government entities (federal, state and local), as well as private and public organizations and individuals to improve and protect groundwater.

Oregon Revised Statute 468B.162(3) requires DEQ to prepare a biennial report to the Oregon Legislature. The report includes the status of groundwater in Oregon, efforts made in the preceding year to protect, conserve and restore Oregon's groundwater, and grants awarded under ORS 468B.169. This report also includes an overview of program history from the late 1980s to the present. Program highlights for 2016-2018 are noted below.

In 2016, DEQ conducted a groundwater study in the North Coast Basin to identify areas of groundwater contamination and provide information regarding potential risks to human health. Full summary reports of past and recent studies are published on DEQ's Groundwater Protection webpage. DEQ is currently analyzing groundwater data collected in the Walla Walla basin near Milton-Freewater in Eastern Oregon. That report will be published in early 2019. DEQ is also analyzing data collected in the Mid-Willamette Valley and in Harney County.

In 2018, DEQ helped to support a Water Resources Department groundwater study by collecting water level data at the same time that groundwater quality data were collected in wells in the Harney Basin. Isotope data were also collected from these wells to contribute to a hydrogeological understanding of those aquifers. The study area spanned Harney County, including the communities of Burns and Hines and smaller surrounding communities including southern Harney County. DEQ staff sampled 91 private wells, domestic and agricultural, in the spring and fall of 2018. The samples are analyzed for nitrate, arsenic, bacteria, pesticides, pharmaceuticals, metals and common ions. The data from this study are still being analyzed but will be shared with study participants, and be made publically available, by the fall of 2019.

The Pesticide Stewardship Partnership program continues to conduct watershed monitoring and present results to stakeholders. DEQ and the Oregon Department of Agriculture participate in multiple watershed-based events each year to create awareness about the Pesticide Stewardship Program and identify priorities for collaborative actions to improve water quality. A small amount of funding is available for technical assistance and conducting agricultural pesticide collection events which average about four collection events per year. Since 2015, nearly 197,000 pounds of pesticides have been collected – thereby preventing potential release and contamination to groundwater. DEQ designates groundwater management areas when groundwater in an area has elevated levels of contaminants. Oregon has three groundwater management areas: Northern Malheur County, Lower Umatilla Basin, and Southern Willamette Valley. In each area, DEQ monitors groundwater quality, provides technical assistance and engages communities to adopt best management practices to reduce groundwater contamination. In the Lower Umatilla Basin area, DEQ continues to engage the public in educational outreach and is currently finalizing a second Local Action Plan working with the local planning committee. In the Southern Willamette Valley, DEQ continues to work with the local planning committee while it collaborates with the various stakeholders to study fertilizer application and irrigation

methods that best limit nitrate infiltration into the groundwater. Highlights of recent groundwater management area activities are noted below:

- Northern Malheur County 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 developed for the area, and nitrate levels in groundwater have declined.

- Lower Umatilla Basin GWMA: DEQ continues to engage the public in educational outreach and the GWMA committee is currently updating its Action Plan, with an anticipated completion date of late 2018.

- Southern Willamette Valley GWMA: DEQ continues to work with the local planning committee while it collaborates with the various stakeholders and others to better understand constituents' needs, create the appropriate communication tools, and encourage beneficial practices.

DEQ continues to assist Deschutes County and work with local groups on the South Deschutes/North Klamath Groundwater Protection Project, an area with elevated nitrate concentrations, to identify and implement measures to protect groundwater quality.

DEQ and ODA fund groundwater projects through various grant and loan programs. In the past, DEQ has awarded Clean Water Act Section 319 grants to promote community involvement in groundwater protection. A 2018 Harney County planning grant was the most recent Section 319 grant funded activity. Since 2009, DEQ has provided a total of $49 million through Clean Water State Revolving Fund loans to public agencies for groundwater protection projects such as replacing failing onsite disposal systems with sanitary sewer collection systems and piping open irrigation canals. ODA's Fertilizer Grants Program funds studies of the interaction of fertilizers, agricultural amendments or agricultural minerals with groundwater. In the past, ODA has granted funding towards research on fertilizer management practices in the Southern Willamette Valley Groundwater Management Area and for an independent review of the monitoring program which was finalized in 2017 for the Lower Umatilla Basin Groundwater Management Area. In addition, in late 2018, several projects targeted for the Lower Umatilla Basin Groundwater Management Area were awarded funding for future research work.

Introduction

Groundwater in Oregon has many valuable uses and functions:

- Groundwater makes up about 95 percent of available freshwater resources.
- According to the 2017 Groundwater Resource Guide (https://www.oregon.gov/deq/FilterDocs/gwresguide.pdf), groundwater uses account for 30 percent of all water used in Oregon.
- Groundwater is the primary source of drinking water for Oregonians and its use is increasing.
    - Over 70 percent of Oregon residents rely solely or in part on groundwater for drinking water.
    - Over 90 percent of public water systems get their drinking water from groundwater.
    - An estimated 350,000 private drinking water wells exist in Oregon today.
- 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.

Groundwater is present beneath almost every land surface and sometimes occurs at very shallow depths. It is vulnerable to contamination from activities taking place on land as well as from discharges of wastes and pollutants at or below ground surface. Once groundwater becomes contaminated, it is very difficult to clean up. Because groundwater moves slowly, contamination may persist for tens, hundreds or even thousands of years. Likewise, groundwater 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 surface waters where it comes to the surface.

Contamination of groundwater resources can lead to severe negative human health consequences. In infants and developing fetuses, nitrate concentrations greater than 10 mg/L can interfere with the ability of blood to carry vital oxygen to body tissues resulting in methemoglobinemia (aka "blue baby") syndrome. The condition can progress rapidly to coma and death if not treated properly. There are other health risks linked to even lower levels of nitrate in drinking water and other contaminants such as pesticides, volatile organic compounds, and bacteria.

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

DEQ has primary responsibility for implementing groundwater quality protection in Oregon. DEQ has a suite of programs and responsibilities to help prevent groundwater contamination from point and non-point sources of pollution, to clean up pollution sources, and to monitor and assess groundwater quality.

DEQ coordinates groundwater protection and restoration efforts with other state agencies that have overlapping responsibilities for groundwater regulation, involvement, or oversight. DEQ also implements some programs through partnerships with the Oregon Health Authority, Oregon Water Resources Department, and the Oregon Department of Agriculture.

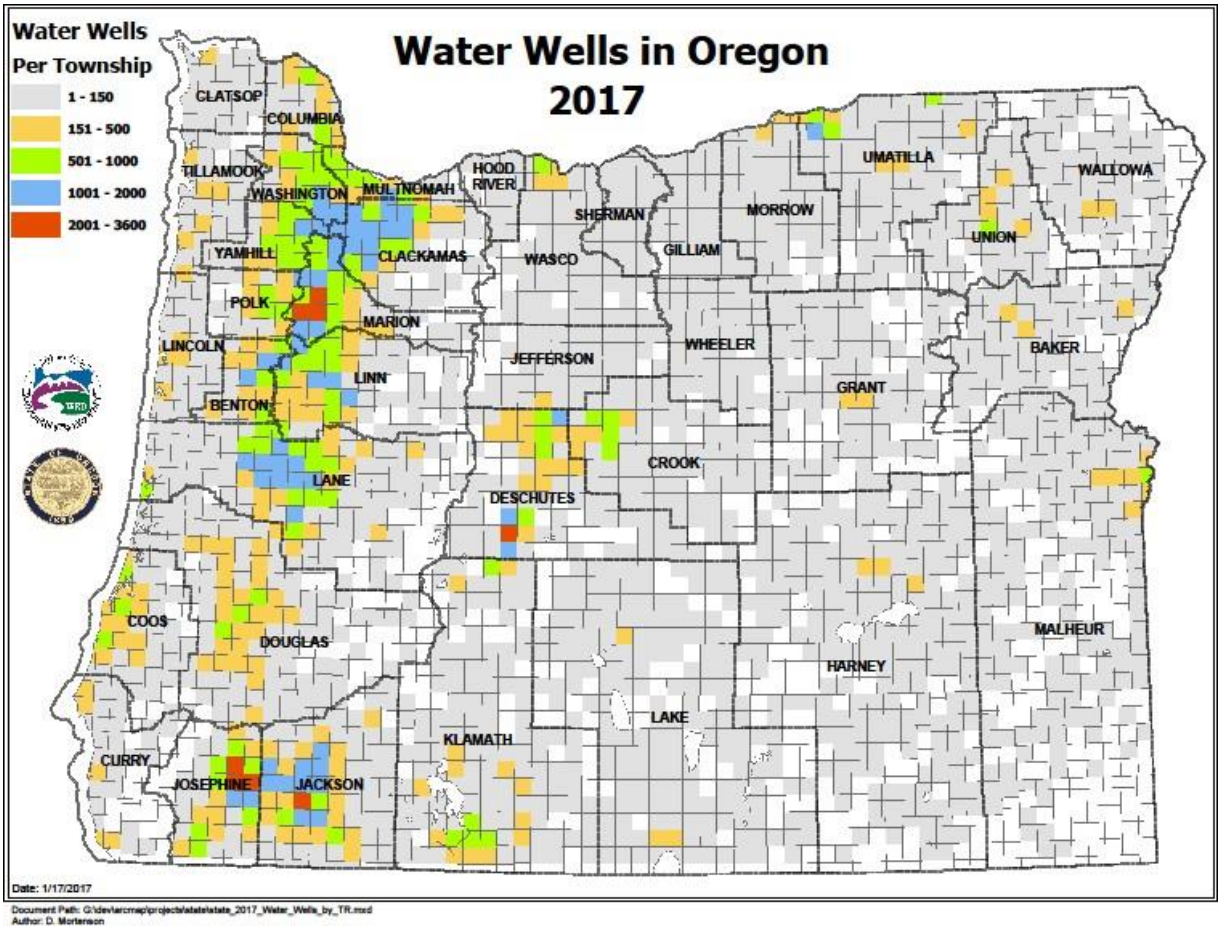
DEQ also works collaboratively with interested parties to assess the situation, share information, identify funding sources, and find common-ground solutions. Partners include state, local and private organizations, businesses and individuals.

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 usable. As Oregon's population grows, the importance of groundwater 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.

This report presents information on:

Section 2: Assessing aquifer health and threats
Section 3: Reducing potential contaminant sources
Section 4: Engaging communities on impaired aquifer recovery

Figure 1. Distribution of water wells in Oregon



Assessing Aquifer Health and Threats

Groundwater Monitoring and Assessment

Oregon's Groundwater Quality Protection Act of 1989 requires DEQ to conduct a statewide monitoring and assessment program to identify and characterize the quality of Oregon's groundwater resources. Specific monitoring and assessment requirements of the act include identifying:

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

DEQ's Laboratory and Environmental Assessment Program collects water quality data from water bodies across the state, including limited information on groundwater. Lab staff perform quality assurance, analysis, and quality checks on the data before entering the data into DEQ's water quality database. The water quality database is accessible to the public via DEQ's website: https://www.oregon.gov/deq/wq/Pages/WQdata.aspx.

DEQ evaluates water quality in aquifers by comparing levels of detected contaminants to federal drinking water standards. However, many organic chemicals, pesticides and herbicides do not have drinking water standards and the detection of contaminants in groundwater may indicate a potential concern. In Oregon, detection of contaminants in groundwater at one half the drinking water standard, or at 70 percent of the nitrate drinking water standard (7.0 mg/L), can be the basis for declaring a groundwater management area.

Between 1980 and 2000, DEQ conducted 45 groundwater quality assessments that covered 6.4 percent of the state's total land area and 30.8 percent of the area in Oregon where groundwater is used. The assessment data provided a general rating of the overall quality of the groundwater resource available in Oregon for use as drinking water. In 35 of the 45 studies completed, results showed some impairment or reason for concern. Nitrate was the most commonly detected contaminant, followed by pesticides, volatile organic compounds and bacteria.

The statewide ground water assessments revealed three impaired regional aquifers: Northern Malheur County, Lower Umatilla Basin and Southern Willamette Valley. DEQ designated these locations as groundwater management areas (GWMAs). These GWMAs are discussed in Chapter 4 of this report. DEQ conducts ongoing monitoring within the GWMAs to check for status and trends in impairments.

Recent Groundwater Monitoring Activities

DEQ's Statewide Groundwater Quality Monitoring Program began collecting samples again in 2015 after being inactive for about 10 years. The purpose is to identify areas where there are groundwater risks, detect emerging groundwater quality problems, establishing long-term data on groundwater conditions over time, and inform groundwater users of potential risks. While DEQ doesn't regulate drinking water wells, the testing can help DEQ understand the condition of aquifers and the information gathered can be a resource for public organizations and help owners learn more about their well water.

Between 2015 and 2017, DEQ conducted two regional groundwater study per year, rotating amongst different regions of the state. Funding for the 2017-19 biennium allowed DEQ to continue studies, but at a reduced rate of one study per year. Each study includes two sampling events to look into seasonal and climatic difference in groundwater quality. The study areas are selected based on a variety of screening criteria including past studies as well as nitrate data collected during real estate transactions. To date, study areas have included the Mid-Rogue Valley Basin in 2015, the North Coast Basin in 2015-2016, and the Walla Walla Basin in 2016. The Mid-Willamette Basin in 2017, and Harney County in 2018. Completed study reports are available on DEQ's website at: https://www.oregon.gov/deq/wq/programs/Pages/GWP.aspx. Reports from the Walla Walla, the Mid-Willamette Basins, and Harney County are expected in 2019 and 2020.

Public Drinking Water Source Assessment

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 OHA's Drinking Water Program jointly implement the Drinking Water Protection Program designed to protect distinct areas that supply public water wells. This program does not address private domestic wells.

DEQ has one full-time equivalent position in the drinking water protection program dedicated to groundwater; the Safe Drinking Water Act funds the position through an interagency agreement between DEQ and OHA. The position provides technical assistance for groundwater protection for public water systems, and is funded to work on public water system groundwater protection issues.

Program Activities
Source Water Assessments: Between 1999 and 2005, DEQ and OHA's Drinking Water Program assessed risks to 2,460 public water systems. The assessment report provided to every system gave community officials detailed information on the watershed or recharge area that supplies the well, spring or surface water intake ("drinking water source area") and identified potential risks within the source area. The public water systems use this information to develop and implement local drinking water protection strategies so that they can continue to have high quality sources of drinking water.

In 2016, DEQ and OHA began publishing updated assessments for all surface water sources for public water systems to incorporate information that was not previously available, including additional data that can be used to analyze watershed characteristics and potential pollutant sources. The agencies have prioritized reports for surface water sources in watersheds serving the coastal communities since these communities are at risk for potential climate change impacts. The updated assessments are available online at: https://www.oregon.gov/deq/wq/programs/Pages/DWPAssessments.aspx.

Source Water Sampling: Between 2008 and 2014, DEQ's laboratory staff sampled source water serving wells at 48 public water systems around the state. Funding for this work came from the federal Safe Drinking Water Act. Source water samples were analyzed for contaminants commonly found in personal care products and domestic wastewater, and also for 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 show low levels for many of these "emerging contaminants." DEQ and OHA did not find individual contaminants in either of the sampling projects at levels of public health concern.

Information Sharing: The source water assessment data are readily accessible electronically and in hard copy. Other DEQ programs use the assessment data to prioritize areas for permit modifications, inspections, technical assistance and cleanup. The data have been provided to several other state and federal agencies including Oregon Emergency Response System; Oregon Department of Transportation;

Oregon Department of Forestry; Oregon Department of Agriculture; 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 GIS shapefiles of drinking water source area coverages and identified potential sources of contamination are available to the public on DEQ's Drinking Water Protection webpage at : https://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx.

DEQ drinking water protection staff also continues to provide information on public water systems and water quality to the interagency Water Quality Pesticide Management Team to assist in prioritizing areas for Pesticide Stewardship Partnership implementation.

Source Water Protection Planning: Information in the source water assessments provides the basis for a community to voluntarily develop strategies or a plan to protect the source area supplying 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 OHA provide direct technical assistance and/or grant funding to communities as they develop and implement strategies to protect their local public drinking water sources. As of June 2016, 416 groundwater systems have achieved partial or substantial implementation of source water protection. This represents a total of 908,962 people served by public water systems that participate in active groundwater protection for drinking water.

Contaminant source inventories in the delineated source areas provide useful information as communities or agencies evaluate 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 at: https://www.oregon.gov/deq/wq/programs/Pages/DWP-Pubs.aspx).

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 is currently working with OHA to complete new "Updated Source Water Assessments" for groundwater systems in Oregon. To support place-based planning and the use of the Updated Source Water Assessments for public water systems, DEQ has also helped prepare Resource Guides for Drinking Water Source Protection. Two separate Resource Guides for statewide groundwater and surface waters are available. The initial draft of the Surface Water Resource Guide was sent to partner agencies for review in August 2017 and after comments from multiple reviewers, DEQ revised the draft and "Version 1.0" is now available for use by public water systems. The companion Groundwater Resource Guide was completed and reviewed by state agencies and other partners in 2017 and "Version 1.0" document is available for use by public water systems. The Guides are available at: https://www.oregon.gov/DEQ/wq/programs/Pages/DWP.aspx

Private Drinking Water Source Assessment

Private domestic wells used for drinking water are not routinely tested by DEQ for water quality. However, state law requires testing at the time of a real estate transaction (ORS 448.271). A homeowner selling a property with a private domestic well must test the water for arsenic, nitrate and total coliform bacteria, using an accredited laboratory, and provide those results to the Oregon Health Authority (OHA) Domestic Well Safety Program (DWSP) and the buyer within 90 days of receiving the test results. In 2014, the DWSP completed development of a database containing this information as well as other sources of domestic well data.

Between 1989 and now, more than 24,470 nitrate tests have been reported to OHA. These data provided a broad overview of groundwater quality in the state. Most of the domestic well tests (82.5 percent) show nitrate levels below 2 mg/L and reflect background groundwater quality. About 16 percent of the tests showed nitrate levels above background groundwater quality and about 1.6 percent of the wells tested were not within satisfactory levels (the federal drinking water standard of 10 mg/L).

In 2009, the Oregon Legislature amended the real estate transaction law (ORS 448.271(1)) to require property owners to test for arsenic in well water. Although arsenic testing was not required until 2009, OHA has received 2712 arsenic results from homeowners since 2001. Approximately 9.7% of arsenic test results exceed the federal standard (.010 mg/L), and about 2% could be considered to be very high concentrations (more than 0.050 mg/L).

As DEQ initiates new groundwater assessments around the state, these data help identify areas of groundwater contamination or risk, and focus monitoring resources. DEQ is working closely with OHA to communicate monitoring results to domestic well owners to ensure they understand any health risks to which they may be exposed.

Reducing Contaminant Sources

DEQ leads Oregon's groundwater quality protection and restoration efforts through its regulatory and funding programs. Many of Oregon's groundwater contaminant sources are point sources from piped discharges. These can be regulated through the registering, permitting, licensing, inspecting, and enforcement activities of DEQ's regulatory programs. Some of Oregon's groundwater contaminant sources are non-point sources from landscape-scale activities such as farming, transportation, and forestry. These can be addressed through other regulatory and non-regulatory programs.

Groundwater Regulatory Programs

DEQ administers several programs that contribute to groundwater protection through registering, permitting, licensing, inspecting, and enforcement activities. A few of the programs are highlighted here.

Appendix 2 summarizes the state's various groundwater protection programs and identifies the primary responsible agency.

Water Reuse: The reuse program prescribes treatment and monitoring requirements for the beneficial use of wastewater. DEQ currently administers 43 graywater permits. Recycled water and industrial process water reuse plans are incorporated into wastewater discharge permits issued by DEQ.

Biosolids Management: Almost all biosolids derived from domestic wastewater treatment facilities in Oregon are applied to the land for agricultural purposes. The biosolids program encourages the beneficial use of biosolids while protecting public health and the environment. Land application of biosolids is regulated through biosolids management plans that are reviewed and approved by DEQ, and through detailed site authorization letters issued by DEQ. There are approximately 300 sites in Oregon authorized to land apply biosolids.

Hazardous Waste: The hazardous waste program regulates and permits the generation, storage, transportation, treatment and disposal of hazardous waste. In 2018 there was a total of 487 regulated generators of hazardous waste in Oregon.

Underground Storage Tanks (UST): The underground storage tank program helps protect groundwater by managing issues related to petroleum and home heating oil tanks. The UST program regulates tank registration, permits registered tanks, licenses service providers and investigates and remediates petroleum leaks. To date, Oregon has decommissioned more than 27, 018 USTs with about 5, 034 operating under permits. Over 6, 827 regulated tank sites contaminated with petroleum have been cleaned up.

Solid Waste: DEQ's solid waste program permits several different types of solid waste disposal facilities including 27 municipal solid waste landfills, 16 petroleum-contaminated remediation facilities and 55 compost operations. These permitting activities help protect groundwater resources by requiring liners and adherence to other standards to control liquids leaching from these facilities. There are currently 287 permitted solid waste disposal facilities in Oregon.

Cleanup: The agency's cleanup program investigates and cleans up historical releases of hazardous substances at sites throughout Oregon. Many of these sites have historically contributed to groundwater contamination. Cleaning up these sites protects the current and future beneficial use of groundwater and prevents further release of chemicals or pollutants that would affect those uses. In fiscal year 2017, DEQ completed 105 cleanup actions and added 75 sites to the more than 6000 contaminated or potentially contaminated sites list in Oregon.

Underground Injection Control (UIC): DEQ administers and implements Oregon's UIC program through delegation from EPA. Underground injection controls include drywells, sumps and other injection systems that discharge a variety of residential, commercial and industrial fluids below the ground. Many UICs are not registered. Federal regulation requires DEQ to inventory UICs and report them to EPA. The UIC program protects groundwater by locating, registering, and permitting existing UICs, and permitting and approving UIC design, installation, maintenance, and monitoring plans for new UICs. Most injection systems receive stormwater flow from streets, parking lots and areas associated with commercial and industrial sites. There are approximately 45,035 registered UICs in Oregon.

State regulations require that drinking water wells be at least 500 feet away from UICs to minimize the potential for cross contamination, but it's been difficult to ensure compliance with this requirement because information about existing UICs has been difficult to find. As a result, owners of newly constructed drinking water wells unknowingly find themselves in conflict with injection systems, sometimes placing UIC owners out of compliance with state and federal regulations. There are also no provisions for well drillers to consider UICs that are known to be nearby when the driller is locating a well, nor are there requirements for UIC owners to be notified.

The greatest challenge to providing the public with the UIC coordinates has been that many UIC locations were submitted inaccurately with the applications. With DEQ's Facility Profiler, a user can enter an address or a latitude and longitude and immediately see if there are UICs nearby.

On-Site: DEQ's onsite wastewater treatment system program administers the permitting of hundreds of thousands of onsite septic systems throughout Oregon. About one-third of all Oregonians rely on onsite systems to treat residential wastewater. This program helps protect groundwater resources by requiring systems to be designed and installed according to state regulations that include prescriptive siting and performance standards.

Wastewater Permitting: Many domestic, municipal and industrial wastewater and stormwater facilities discharge wastewater to land using lagoons, land application, or other systems. Municipal and domestic facilities generally collect and treat sewage from residences and commercial facilities, while industrial facilities treat manufacturing and processing wastewater they generate. DEQ protects groundwater resources through the use of Water Pollution Control Facility (WPCF) permits. DEQ's wastewater permitting program issues permits, performs inspections, and assures compliance for wastewater treatment facilities that discharge wastewater to land. There are 241 WPCF individual domestic and industrial permits and 1649 WPCF general permits as of November 2018.

Groundwater Protection Funding Programs

DEQ and the Oregon Department of Agriculture have funding sources that can be used to provide grants or loans for projects that address groundwater contamination. Appendix 3 summarizes recent groundwater related protection projects funded by DEQ and ODA grants and loans.

Oregon Department of Agriculture (ODA)
The 1989 Groundwater Protection Act authorized DEQ to fund research and development projects related to groundwater quality. A fee on fertilizer products purchased in Oregon was implemented as part of the act to fund groundwater quality research associated with the interaction of pesticides or fertilizer and groundwater. ODA now administers the grant fund. In previous biennia, the grant fund was used for research projects in the first two declared groundwater management areas (Northern Malheur County and Lower Umatilla Basin) in the state. Revisions to the fertilizer law in 2001 expanded 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 research grant funding.

Clean Water State Revolving Fund
The Clean Water State Revolving Fund loan program provides below-market rate loans to public agencies for the planning, design and construction of projects that prevent or mitigate water pollution. Since 2010, DEQ has provided a total of $49 million in low-interest loans to public agencies through the Clean Water State Revolving Fund for groundwater protection projects such as replacing failing onsite disposal systems with sanitary sewer collection systems and replacing stormwater dry wells with green infrastructure facilities.

EPA 319 Pass-through Fund
DEQ's 319 grant program supports community driven planning and implementation projects that address water quality problems in surface and groundwater resources resulting from non-point source pollution. The program is wholly funded by EPA pass-through funds from Section 319 of the Clean Water Act.

Engaging Communities

On occasion, DEQ's regulatory programs and funding programs are unable to protect groundwater from significant non-point sources of contaminants. When this occurs, multi-stakeholder, collaborative solutions are needed.

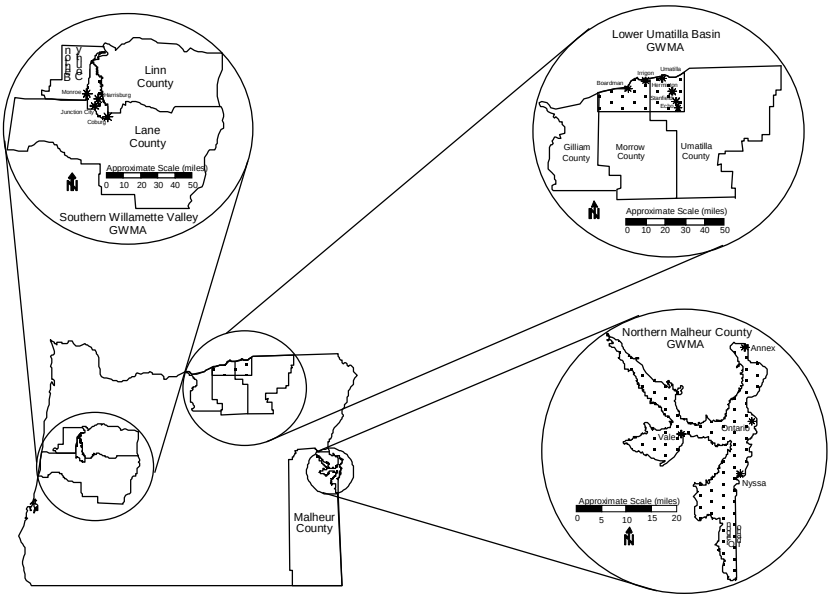
Groundwater Management Areas

Oregon revised statute 468B.180 requires DEQ to declare a Groundwater Management Area (GWMA) when DEQ groundwater assessments reveal area-wide groundwater contamination problems at consistently high levels. A GWMA declaration requires DEQ, Department of Agriculture, Water Resource Department, Oregon Health Authority and other state agencies to focus efforts to restore the groundwater quality. DEQ leads the effort by convening a local groundwater management area 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.

DEQ's role in GWMA committees includes participating on the groundwater management area committee; responding to questions regarding groundwater quality; sharing DEQ groundwater monitoring data; reaching out to stakeholders and interagency coordination; and educating the public; assisting with implementation of the management area action plans; maintaining groundwater quality monitoring networks; reviewing existing data to assess groundwater quality trends; helping to secure funding; and supporting local efforts to implement regulatory and best management practices to maintain and restore groundwater quality.

Oregon currently has three groundwater management areas (Figure 2): Northern Malheur County, Lower Umatilla Basin, and Southern Willamette Valley. All three areas were designated for widespread nitrate contamination. More information on the groundwater management areas can be found on DEQ's website at: https://www.oregon.gov/deq/wq/programs/Pages/GWP-Management-Areas.aspx.

Figure 2. Location of Oregon's Groundwater Management Areas



Northern Malheur County Groundwater Management Area

Declaration of Groundwater Management Area
The Northern Malheur County groundwater management area was declared in 1989 after DEQ identified significant groundwater contamination in the county's 115,000-acre northeastern portion. 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 raised additional concerns. 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. Agriculture dominates land use in this groundwater management area.

Formation of Committee and Action Plan
In August 1989, the Oregon Strategic Water Management Group selected the members of the Northern Malheur GWMA Committee from local organizations and private citizens and state agency representatives. After two years of meetings, DEQ finalized the NMC GWMA Action Plan, dated December 1991. The goal of the action plan is to:

- Identify and evaluate management practices that contribute to contamination
- Consider reasonable alternative practices to reduce contamination
- Recommend mandatory actions to reduce contamination
- Create an implementation schedule to stepwise reduce contaminants to below GWMA trigger levels
- Amend local comprehensive plans and land use plans to be consistent with the action plan

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 adoption of best management practices and improved water quality within the management area.

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

Progress Toward Action Plan Goals
DEQ currently samples a network of about 38 wells once per year for analysis of nitrate and Dacthal, and does a more complete analysis approximately once a year. DEQ conducted a formal trend analysis of nitrate concentrations in 2014 using 21 years of data since implementation of the action plan (1991 through 2012). The analysis indicated that the area-wide nitrate trend was slightly decreasing. Individual wells showed a mix of decreasing (53 percent), increasing (28 percent) and statistically insignificant (19 percent) trends across the area. Progress is being made on the land surface through implementation of best management practices. However, it may take years or even decades for groundwater quality to return to natural background levels.

DEQ will conduct another trend analysis in 2019 to determine if area-wide nitrate concentrations continue to decrease. More information is available at: http://www.cropinfo.net/water/Groundwater.php.

Lower Umatilla Basin Groundwater Management Area (LUB GWMA)

Declaration of Groundwater Management Area
DEQ declared the Lower Umatilla Basin groundwater management area 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 basin's study area and found that 33% of samples had nitrate concentrations above 10mg/L. DEQ worked with the Oregon Water Resources Department and Department of Human Services 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; and
- Washout lagoons at the Umatilla Chemical Depot.

Formation of Committee and Action Plan
The Lower Umatilla Basin Committee was convened in 1996 and finalized the first LUB GWMA Action Plan in December 1997. This voluntary plan focuses on education and outreach, identifying and encouraging adoption of appropriate best management practices 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 this basin's groundwater management area are covered by individual farm-specific irrigation water management plans.

Perchlorate in the Lower Umatilla Basin: In the early 2000s a second contaminant of concern was detected in the LUB GWMA. Perchlorate was detected near military facilities in the Lower Umatilla Basin in 2001 and 2003. Subsequently, DEQ, EPA, the U.S. Navy and private companies conducted multiple sampling events. Concentrations were generally low and widespread, and did not appear to represent a single contaminant plume. Perchlorate is a chemical contaminant found nationwide at low levels in the environment from human and natural sources. It is possible that both naturally occurring and manufactured sources of perchlorate are contributors. Currently there are neither federal nor Oregon drinking water standards for perchlorate.

Recent Collaborative Efforts
Well Monitoring: Working with interested landowners, DEQ samples a network of about 38 wells quarterly for analysis of nitrate. Approximately once a year, these wells are sampled for a larger list of contaminants including major ions, metals and pesticides. DEQ uses these data to evaluate changes in groundwater quality over time in response to adoption of best management practices.

Information Sharing: DEQ shared information on the status of the LUB GWMA and best management practices to a variety of audiences including the public, local growers and agricultural businesses, agencies, watershed councils, and environmental groups.

- February 2017: DEQ Legislative Update
- 2017: LUB GWMA Committee meetings, May, June, September, November, December
- December 2017: InterACTWEL Research Team meeting
- 2018: LUB GWMA Committee meetings, February, April, June, August, October, December
- July 2018: Morrow County Planning Commission

Outdoor School: DEQ conducted outreach to Outdoor Schools involving 902 students from nine school districts in May, and June 2017, and to 1421 students from nine school districts in May, June, September, and October in 2018. These presentations involved several communities within the LUB GWMA (Hermiston, Echo, and Stanfield) and several nearby communities (Heppner, Ione, Condon,

Arlington, Sherman County, Athena, Weston, Milton-Freewater, Pendleton, and Baker). DEQ staff used a groundwater model and a surface water model to describe how groundwater and surface water are related, the difference between point sources and non-point sources of contamination, and how to minimize water pollution.

*Classroom Visits***:** DEQ staff engaged over 56 fifth grade students in an Outdoor School-style presentation made in the classroom setting in June 2017 at McKay Elementary School in Pendleton, Oregon.

Wal-Mart Safety Day: DEQ staff, along with local fire, weather, and law enforcement officials participated in Wal-Mart Safety Day in June 2018 in Pendleton, Oregon. The purpose of the event is to engage the public with fun and interesting ways to promote safety. DEQ staff used the opportunity to build "Edible Aquifers". An edible aquifer is basically an ice cream float used to illustrate the geologic formation of an aquifer, how pollution can get into ground water, and how easily this pollution can end up in drinking water wells. Over 50 edible aquifers were built and eaten by the public at this event.

Progress Toward Action Plan Goals

Every four years, the LUB GWMA Committee evaluates Action Plan success. The third evaluation of Action Plan success was completed in January 2013. The evaluation included an assessment of both the 2009 goals and implementation of previous recommendations. Of the eight 2009 goals, three were met, two were partially met, and three were not met. Of the eighteen recommendations, five were implemented, seven were partially or largely implemented, and six were not implemented.

DEQ, in partnership with local stakeholders and ODA, OSU, OHA, OWRD, Morrow & Umatilla County SWCDs and City & County planning agencies is engaged in finalizing the Second Lower Umatilla Basin Groundwater Management Area Local Action Plan to replace the previous Action Plan and augment ongoing efforts to reduce nitrate concentrations in area groundwater. The updated Action Plan includes:

1. Recommendations of actions that, if and when implemented, will reduce the contamination to a level below that level requiring the declaration of a ground water management area;
2. Public and periodic review and update of the Action Plan;
3. Explore requirements Required for amendments of affected city or county comprehensive plans and land use regulations to address the identified ground water protection and management concerns; and
4. Establishment of programs to prevent ground water quality degradation through the use of best practicable management practices (BMPs).

DEQ in partnership with ODA and OSU Extension will look to develop and implement a voluntary BMP certification program for irrigated agriculture that will involve a suite of actions, including but not limited to, the following actions:

- The use of nutrient and irrigation water management guidelines for crops.
- Deep soil testing for tracking effectiveness of fertilizer and irrigation water management techniques.
- Development of pre-season nutrient and water management plans coupled with post-season evaluation.
- Crediting the different sources of nitrogen that crops may use beneficially.
- Develop tools and services that will provide data for irrigation water

management, including weather and soil moisture data collection and distribution.

- Conversion to more efficient irrigation systems.
- Recommendations regarding fertilizer source, rate, placement, timing of application, and realistic crop yield goals.
- Procedures for crediting the various sources of nitrate including inorganic fertilizers, organic sources, residual soil nitrogen, and irrigation water.
- Recommendations on soil and tissue sampling to reduce uncertainty about crop nutrient needs.
- Recommendations regarding the efficient use of irrigation systems and uniform application of irrigation water for all crops.
- Recommendations to manage for all crops in the rotation and not focus on one crop.
- Schedule maintenance leaching to minimize groundwater impact.
- Promote cropping systems to manage nitrate movement. These systems may include the use of second crops, cover crops, and deep-rooted crops to recover and/or store nitrogen that would otherwise pass the crop root zone
- Catalog and publish all agronomic BMPs that ensure groundwater protection.
- Create a Groundwater Protection and Agronomic Factor (GPAF) scoring system, that incorporates groundwater protection and agronomic viability, and apply a GPAF score to each cataloged BMP published by OSU.
- Update the BMP catalog and GPAF scoring on an annual basis.
- Utilizing the GPAF scores, create a standardized suite of BMPs that represent an economically achievable baseline of BMP implementation for growers across the Basin. Utilized this standard suite of BMP in a voluntary BMP certification program that involves active outreach to growers. Active outreach includes recognizing existing BMP performance and improving upon BMP performance.
- Monitor crop nitrogen removal, soil nitrate accumulation, and nitrate leaching for several years.
- Implement a lysimeter study project measuring nitrate losses from fields in areas with improved fertilizer management. Soil water samples from existing and newly placed lysimeters are collected once a month for 2 years, and analyzed by a laboratory to determine levels of nitrate and phosphorus leaching below the crop rooting zones in fields using precision agriculture and other innovative fertilizer management practices.
- Monitor soil moisture and soil nitrogen content pre-plant, during the cropping season and post-harvest to assess the potential for having pushed nitrate below the root zone.
- Document pre-plant soil test nitrogen, in season nitrogen fertilization and remaining post-harvest soil test nitrogen.
- Compare common methods of soil moisture monitoring to evaluate whether irrigation management effectiveness is influenced by the type and/or frequency of generated data.
- Update and unify all fertilizer rate application tables for the recommended agronomic rate of nitrogen addition to the soil that is needed to produce expected yield, while minimizing adverse environmental effects. The recommended agronomic rate must account for nitrogen available to the crop throughout the growing season from all sources such as mineralization of organic residues and soil organic matter, residual inorganic nitrogen in the rooting zone and nitrogen from irrigation water or other sources.

More information is available at: http://lubgwma.org.

Southern Willamette Valley Groundwater Management Area (SWV GWMA)

Declaration of Groundwater Management Area

In 2000 and 2001, DEQ's statewide monitoring and assessment program revealed groundwater contaminants in levels that exceeded state standards in the southern Willamette Valley. Nitrate concentrations in 20 percent of 476 wells sampled were found to be above 7 mg/L or 70 percent of the federal standard. Pesticide data were sufficient to conclude that pesticides were present. However, pesticide concentrations were below any health advisory standard and below 30 percent of any applicable standard. Also, pesticide data did not provide adequate information to characterize the entire study area. Other monitoring activities by DEQ, US Geological Survey, Oregon State University Extension and the Environmental Protection Agency have confirmed the elevated concentration of contaminants and documented the regional nature of the groundwater quality concern. Although low levels of nitrate may be naturally present, probable causes of nitrate contamination in this area are from sources related to human activity such as use of fertilizers, industrial and municipal wastewater facilities, animal waste, and septic systems.

In May 2004, DEQ declared the Southern Willamette Valley Groundwater Management Area. The GWMA encompasses a 230 square mile area of elevated nitrate contamination in the southern Willamette Valley including portions of Lane, Linn, and Benton counties and five cities (Corvallis, Harrisburg, Monroe, Junction City, and Coburg).

Formation of Committee and Action Plan

As the designated the lead agency, DEQ convened a groundwater management area committee to develop an action plan. The committee meets three to four times a year to assess and address groundwater issues. These meetings draw extensive public interest with an attendance of 35-40 people at each meeting in the last two years. In November 2006, after 20 months of regular meetings and the involvement of many stakeholders, the committee approved a final action plan. This voluntary plan outlines 60 recommendations to reduce nitrate contributions and prevent further groundwater contamination related to agricultural, residential, commercial, industrial and municipal land uses and public water systems. The plan is currently being updated in order to identify high priority work that can be accomplished despite a recent reduction in staff and lab resources. The program continues to educate residents in the GWMA about local contamination issues, and continues to work with partners to identify nitrate contamination sources and provide effective and focused methods of technical assistance to landowners to address these sources. More information is at: http://gwma.oregonstate.edu/.

Recent Collaborative Outreach and Education Efforts

Benton County Domestic Well Safety Grant Program: The 2018 Benton County Environmental Health (BCEH) Domestic Well Safety Program (DWSP) was funded in part by a grant from Oregon Health Authority's (OHA) DWSP. Benton County outreach efforts included one shared educational event with Oregon State University Extension Service (OSU Ext. Service), one presentation to the Benton County Environmental Issues Advisory Committee, several emails sent to email lists in rural areas of the county, and an article about the DWSP in the OSU Ext. Service newsletter. Additionally, BCEH launched a website describing the DWSP with links to well safety information. These outreach efforts resulted in 94 interested individuals contacting BCEH to participate in the program.

A total of 40 participants were selected using several criteria including self-identifying attributes associated with vulnerable populations. To address high interest in DWSP, applicants were further assessed using additional criteria: their well's testing history and, whether children live in their household. A total of 40 domestic wells were tested for arsenic, nitrate, and total coliform bacteria (Table 1). When total coliform bacteria was detected, an additional test for Escherichia coli (E.coli) was performed. Program participants received: free well water testing, an exterior well inspection, analysis of set-backs to septic drain field and septic tanks, identification of any hazards in the immediate vicinity of

the well, a review of Oregon Water Resource Department's (WRD) website for well logs/records associated with the homeowner's property, administration of a demographic survey, a letter summarizing test results and recommendations, and a resource packet (containing educational materials about health hazards associated with tested contaminants, discounted voucher for future water testing, local resources, and well safety information).

Table 1. Summary of well testing results for 2018

Contaminant	Contaminant Present at any level	Contaminant above MCL	Contaminant Absent
Arsenic	7.5% (3/40)	2.5% (1/40)	92.5% (37/40)
Nitrate	40% (16/40)	0% (0/40)	60% (24/40)
Total Coliform	20% (8/40)	N/A	80% (32/40)

Benton County has tested 189 wells since 2014 with this grant which is approximately two percent of the 10,000 estimated wells in Benton County (Table 2). Of those 189 wells, Benton County has only found one positive E. coli result. Although well testing is primarily for homeowners, renters may also get their water tested.

Table 2. Summary of well testing from 2014 - 2018

Contaminant	Contaminant Present at any level	Contaminant above MCL	Contaminant Absent
Arsenic	18% (34/189)	3% (6/189)	82% (155/189)
Nitrate	31% (58/189)	3% (5/189)	69% (131/189)
Total Coliform	19% (36/189)	N/A	81% (153/189)

Recent Collaborative Monitoring Efforts

Long-term Monitoring: Sampling at long-term monitoring wells was reduced from 160 samples to approximately 80 samples in 2016 due to budget constraints. DEQ continues to collect quarterly samples from 12 monitoring wells installed in the southern Willamette Valley, in addition to annual well sampling at 27 locations and six surface water locations. In addition to nitrate and chloride sampling, nitrogen isotope sampling was also conducted in order to help identify sources of nitrate contamination.

Surface Water - Groundwater Interaction: EPA continues to provide stable isotopic analyses on surface and groundwater samples collected by DEQ's laboratory. Data from nitrogen isotope ratios will assist in identifying nitrate contamination sources and help to focus efforts at reducing nitrate levels in the SWV GWMA.

Lysimeter Project: In 2013, the Oregon Department of Agriculture (ODA) Fertilizer Fund Grant and an EPA RARE grant funded a lysimeter which concluded four years of sampling in 2017. Soil data gathered from local farms, coupled with historical data provided by the university, will help the team determine best practices to minimize nitrate leaching while maintaining crop yields. In the Southern Willamette Valley, there are a number of options for improvement of nutrient management. Nitrate leaching occurs mainly during rainy seasons between October and March, so fertilizer should be applied cautiously during this time since it is washed away faster than the plant can use it. Recommendations for fertilizer application, particularly for grass seed, will be forthcoming, but a report was posted February 2017 on ODA's website at:
http://www.oregon.gov/ODA/programs/Pesticides/Fertilizers/Pages/WaterResearch.aspx

Lysimeter Project Farmer Interviews: The results of the lysimeter study indicate there is a relationship between farmers' current agricultural practices and nutrient leaching. These results and analyses were shared with the farmers that participated in the study. In addition, during the spring of 2018, several persons from the team that worked on the lysimeter project interviewed farmers to understand how they were using the nutrient data and how it has impacted their nutrient management practices. The results will help guide EPA and other agencies to determine the most effective ways to provide information to farmers to help them reap the economic and environmental benefits of improving nutrient management practices and maintaining the quality of their water.

Fertilizer Project: Portland State University and Oregon State University have been working with growers of grass seed crops (tall fescue) on optimizing grass seed production while protecting groundwater and air quality in the Southern Willamette Valley GWMA; this project recently completed its first year of field monitoring. Through an Oregon Department of Agriculture Fertilizer grant, one part of the study will measure how enhanced efficiency fertilizers (slow-release pellets) affect seed yield and nitrate leaching to groundwater. The other part of the study, supported by a USDA NRCS Oregon Conservation Innovation Grant, focuses on how water quality, air quality, and crop yield can change under different fertilizer rates. Four growers are participating in the study, and fertilizers are being applied in coordination with their schedules and requirements throughout the year. For two years, measurements of groundwater nitrogen and greenhouse gas emissions are being made every two weeks during the growing season, with crop yields determined at harvest time.

This project builds on ongoing efforts and pre-existing partnerships with industry, farmers, and local management districts to provide tools and information to reduce nitrate leaching below the root zone and greenhouse gas emissions from fields in the Southern Willamette Valley GWMA. Groundwater nitrate contamination affects thousands of households in the GWMA. Many factors affect the rate of nitrate leaching to groundwater and the rate of nitrous oxide emission to the atmosphere, including crop type, soil conditions, weather, fertilizer source and application. Atmospheric nitrous oxide is a powerful greenhouse gas that enhances the greenhouse effect and depletes the ozone layer. Agricultural fertilizer is a major source of nitrous oxide to the atmosphere. Effective timing, product choice, and application rate not only can save money and maximize yields, they can help reduce greenhouse gas emissions and harmful nitrate runoff into groundwater.

GWMA Monitoring Data Trend Study: An Oregon State University Masters student will be looking at nitrate trends in DEQ monitoring wells across the Southern Willamette Valley GWMA with data from 2006 to the present. In addition to the trend analysis the study will be using GIS to look at the potential causes of the nitrate fluctuations between wells by crop type, soil type, crop leaching rate/plant utilization, precipitation, well depth, septic system influence, influence of nearby nitrogen sources and known groundwater flow direction.

South Deschutes / North Klamath Groundwater Protection Project

In some situations, groundwater contaminant levels are elevated but do not yet meet the criteria for a groundwater management area declaration. Rather than wait until contamination exceeds the groundwater management area trigger levels, DEQ proactively identifies the area as a groundwater protection project. This identification allows DEQ to focus staff efforts and engage the community on protecting drinking water sources and reducing groundwater contamination in the area immediately.

Identification of the Problem
The southern Deschutes County and northern Klamath County area near La Pine in central Oregon has porous and permeable pumice soils, a shallow groundwater table, and little rainfall. This rural residential area of 12,000 residents relies on the shallow groundwater to supply water to more than 4,000 individual domestic wells that are typically less than 50 feet deep, and to about 100 community public water system wells serving small-scale subdivisions, schools and businesses in the region. Most homes in this rural area also discharge partially treated sewage to the shallow groundwater from their individual onsite wastewater treatment systems (onsite septic systems). Prior to adoption of current planning goals, large tracts of land were subdivided into 15,000 lots as small as one-half acre, resulting in areas of concentrated septic discharges. The distributed water supply demand and relatively high development densities in the region created a threat to public health.

Groundwater sampling in the late 1970s and early 1980s revealed very high concentrations of nitrate in the core area of the City of La Pine. This contamination resulted from onsite septic disposal and has diminished since a wastewater treatment system was constructed to serve the city. Groundwater assessments of the unincorporated residential areas of Southern Deschutes and Northern Klamath Counties in the 1990s found nitrate concentrations in drinking water wells that approached unsafe levels (10 mg/L) in several of the oldest and most densely developed areas. In the mid-1990s, Deschutes County and DEQ assessed the potential impact of new residential development in the La Pine region on groundwater quality. Preliminary studies predicted nitrate levels in groundwater would exceed 10 mg/L within 20 years. These preliminary findings were based on best available information at the time on groundwater recharge and flow velocities.

Collaborative Efforts
Baseline Groundwater Sampling: 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 was repeated in 2001 and 2002 and again in 2011. Results show 10 percent of the wells sampled had nitrate concentrations above background levels of nitrate and there has been a modest increase in overall concentrations during this period. 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 40 to 50 years, but contamination has only begun to reach the groundwater tapped for drinking water supplies in the past 15 to 20 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.

La Pine Demonstration Project: In 1999, the Environmental Protection Agency awarded a $5.5 million, five-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 grant funded a study to evaluate innovative nitrogen-reducing onsite septic system technologies, and develop a three-dimensional groundwater flow and contaminant transport model to inform a groundwater protection strategy. The project resulted in:

- Installing and monitoring fifty nitrogen reducing systems
- Initiating a septic system maintenance program
- Conducting 3D groundwater flow modeling and nitrogen contaminant fate and transport modeling
- Assessing optimum lot density and treatment standards based on model results
- Establishing a low-interest loan fund for septic system repair or replacement

Fifteen types of innovative onsite septic systems and three types of control (standard, pressure distribution and sand filter systems) onsite systems were installed. The La Pine project monitored a total of 49 onsite systems from 2000 through 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 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 groundwater in this area. The USGS published several reports and papers on research conducted during the demonstration project which can be found at the following web page: http://or.water.usgs.gov/proj/or186/index.html. Additional info can also be found at: https://www.deschutes.org/cd/page/la-pine-national-demonstration-project

Pollution Reduction Credit Program: In 2005, the EPA awarded Deschutes County a grant to implement findings from the La Pine National Demonstration Project on a local level. The new project allowed the county to create a Pollution Reduction Credit Program as 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 use of alternative treatment technology nitrogen-reducing onsite wastewater treatment systems that provide increased protection for groundwater quality. The Deschutes Board of County Commissioners adopted the new code in July 2008, and it went into effect in October 2008; however, opponents of the code submitted a petition to refer the code to a county-wide vote. In a special election in March 2009, county voters overturned the local ordinance.

South Deschutes / North Klamath Groundwater Protection Project: As result of the vote overturning the new county code requiring expensive onsite treatment systems, Deschutes County Commissioners asked DEQ to lead efforts to resolve the issue. DEQ hosted a public meeting in July 2009 with various agencies in attendance. Many questions were raised about how to best approach the contamination issue and how to create an effective public process. DEQ decided that the first step was to address concerns related to 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 completed a report of recommendations on groundwater protection for the project area in 2013. In the report, the committee recommended:

- Allowing an exception to Oregon's Statewide Planning Goal 11
- Continuing groundwater monitoring
- Creating a local sanitation authority
- Limiting the number of livestock per acre
- Investigating point sources and requiring permits
- Placing a moratorium on requiring alternative treatment technologies for at least 5 years
- Identifying disadvantaged community financing solutions
- Continuing outreach and community education
- Considering alternative "Green" solutions

Seeking an area wide exception to land use Goal 11 had unanimous support from the group. An exception would allow establishment of sewers within the area of concern and the development of a Sanitary Authority for the area. The Sanitary Authority that would be responsible for planning the development of these systems. The intention was to offer the greatest number of options for wastewater treatment and disposal that would go beyond individual onsite systems.

DEQ, the Oregon Department of Land Conservation and Development (DLCD), and Deschutes County Planning Department jointly prepared an application for consideration by the Deschutes County Planning Commission and the Deschutes County Board of Commissioners. The application made the case that groundwater was being contaminated by ongoing reliance on individual onsite wastewater systems that an exception to Goal 11 would allow various scales of wastewater treatment appropriate to the diverse nature of residential development in Southern Deschutes County. After public hearings held by both boards, both approved the application and concept.

On November 23, 2015 the Deschutes County Board of County Commissioners held a public hearing on Ordinance 2015-007, to amend the Deschutes County Comprehensive Plan to add an exception to Goal 11 to allow sewers in unincorporated lands in southern Deschutes County. On February 10, 2016 the Board of County Commissioners held the second reading of Ordinance 2016-007 and approved a Goal 11 exception. Ordinance 2016-007 was to take effect on May 10, 2016, unless appealed.

On March 1, 2016, Central Oregon LandWatch filed a Notice of Intent to Appeal the County's approval of the Goal 11 Exception for southern Deschutes County with the State of Oregon Land Use Board of Appeals (LUBA). On November 1, 2016, LUBA issued Final Opinion and Order 2016-020 remanding the application back to the Deschutes County Board of County Commissioners. Among the shortcomings in the exception were the large area proposed for the exception, the inclusion of areas that LUBA believed did not require higher treatment to protect groundwater, and that there was no requirement for construction of wastewater treatment facilities; rather this would be voluntary.

More information about the South Deschutes/North Klamath Groundwater Protection Project and the report can be found at the following web pages:
https://www.oregon.gov/deq/wq/programs/Pages/Deschutes-Klamath-Groundwater-Protection.aspx.
and:
https://www.deschutes.org/cd/page/south-deschutes-county-groundwater-protection-project

Pesticide Stewardship Partnership (PSP)

Groundwater management areas and groundwater protection projects are declared when contaminants are known to have reached an elevated level. Monitoring for pesticides, however, is not widespread and many pesticides do not have water quality standards to measure against. Yet, pesticides are known to be hazardous to human health. DEQ and other state agencies have formed a partnership to proactively reduce pesticide use and promote proper pesticide disposal to limit the amount of pesticide entering surface waters and groundwater. The Pesticide Stewardship Partnership (PSP) approach encourages local stakeholders to adopt best management practices in applying, storing, and disposing of agricultural chemicals; and provides opportunities for local citizens to safely discard unused agricultural chemicals.

The PSP program uses water quality monitoring data to inform voluntary, collaborative actions to reduce pesticides. These practices include Integrated Pest Management activities, pesticide spray efficiency measures, and use of less toxic pesticides. Thus far, PSPs have largely focused on reducing pesticides in surface water. However, the improved agricultural practices implemented as part of the program can benefit groundwater as well. The program is also planning to include some groundwater monitoring in PSP watersheds in the future to further inform collaborative actions and provide another measure of program effectiveness.

The state agencies involved in the PSP include DEQ, Oregon Health Authority, Oregon Department of Agriculture and Oregon Department of Forestry. Typical stakeholders involved include watershed councils, soil and water conservation districts, Oregon State University Extension Service, irrigation districts, tribal governments, agricultural chemical suppliers, and local citizens.

Collaborative Efforts

Groundwater Monitoring: Pesticide Stewardship Partnership staff are coordinating with watershed stakeholders on identifying possible groundwater monitoring locations.

Agricultural Pesticide Waste Collection Events: Since 2015, nearly 197,000 pounds of pesticides have been collected from agriculture pesticide collection events, in coordination with Pesticide Stewardship Partnership projects and other collaborative water quality improvement programs.

Outreach and Education: DEQ and ODA participate in multiple watershed-based events each year to create awareness about the PSP Program and present monitoring data findings. This outreach helps identify priorities for collaborative actions to improve water quality. Local partners, most notably watershed councils and soil and water conservation districts, also conduct similar outreach efforts to expand awareness about the data.

Technical Assistance: The PSP Program received funding from the Legislature in 2013 to support direct technical assistance to pesticide users. Some of these funds were used to purchase pesticide spray optimization equipment and new innovative spray application technology to reduce off-target drift that can impact water resources. The remaining funds are distributed to organizations (through a grant program administered by ODA) that will implement technical assistance activities in PSP watersheds.

Future Direction

DEQ groundwater program funding and staffing resources have declined in recent years. However, DEQ plans to implement the following more limited activities related to protecting Oregon groundwater quality during the 2019-21 biennium:

- DEQ will continue to implement the Lower Umatilla Basin, Northern Malheur County, and Southern Willamette groundwater management area action plans and evaluate the performance or success of the management plans in reducing groundwater contamination. This will include working with the Lower Umatilla Basin Groundwater Management Area Committee to implement a new updated action plan with future goals and milestones. DEQ will also continue to conduct routine groundwater monitoring of the well networks in these management areas.
- DEQ will continue to conduct drinking water source water assessments as new systems come online and provide technical assistance to communities developing drinking water protection plans. The program anticipates expanding state-wide analyses while collaborating with other agencies to reduce risks of contamination to public drinking water systems.
- Look to support local initiatives and solutions for areas on septic systems and shallow drinking water systems.
- Provide timely review of new Water Quality permits and renewals that have a chance to impact groundwater quality.
- DEQ will continue to look for and use new and existing funding sources to support research, education and implementation of best management practices for groundwater protection.
- DEQ will continue to plan, conduct, and report on monitoring of priority groundwater basins as part of our Statewide Groundwater Monitoring Program. Anticipated 2019 work in the Klamath Basin and the work of the DEQ Groundwater Technical Advisory Team will aim to help identify and inform on emerging groundwater problems in the future.
- DEQ will continue to look for joint opportunities to collaborate with federal, state, and local partners -including WRD, ODA, OHA, and USGS - to further the groundwater needs of Oregon including funding and prioritization of work including water quality, water quantity, farming and development needs, and evaluate potential climate change impacts.

Appendix 1 - Groundwater Quality Assessment Projects

Summary as of January 2019

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
Harney County	Statewide Program: Harney County Groundwater Study	2	91	2	Arsenic, Boron, Alkalinity, Pesticides	TBD	Naturally Occurring, Agriculture	2018
Mid-Willamette	Statewide Program: Mid-Willamette Groundwater Study	2	100	2	Nitrate, Arsenic, Pesticides and Pharmaceuticals, Volatile Organic Compounds	Arsenic, Manganese, Pesticides, Pharmaceuticals, Lead, VOCs, Bacteria	Agriculture, Industry, Naturally Occurring, Onsite Septic Systems	2017
Walla Walla	Statewide Program: Walla Walla Basin Groundwater Study	2	100	2	Nitrate, Arsenic, Pesticides, Perchlorate	Nitrate, Lead, Pesticides, Perchlorate, Bacteria	Agriculture, Naturally Occurring	2016
North Coast	Statewide Program: North Coast Groundwater Study	2	69	2	Nitrate, Pesticides and Pharmaceuticals	Nitrate, Arsenic, Lead, Manganese, Pesticides, Pharmaceuticals, Bacteria	Agriculture, Onsite Septic Systems, Naturally Occurring	2016
Rogue	Statewide Program: Mid-Rogue Basin Groundwater Study	2	107	2	Nitrate, Arsenic	Nitrate, Arsenic, Manganese, Pesticides, Pharmaceuticals, Bacteria	Agriculture, Naturally Occurring	2015

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	38 annually	4	Nitrate, Pesticides	Nitrate, Dacthal	Agriculture	2018
Umatilla	Lower Umatilla Basin GWMA	Ongoing	34 quarterly	4	Nitrate, Pesticides, and Perchlorate	Nitrate, EDB, Atrazine, Dacthal, Dicamba, Picloram	Agriculture, Onsite Septic Systems, Industry	2018
Willamette	Southern Willamette Valley GWMA	Ongoing	40 annually 12 quarterly	2	Nitrate, Pesticides	Nitrate, Pesticides	Agriculture, CAFOs, Onsite Septic Systems	2018

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.
Note: Bacteria levels detected in wells sampled in the Statewide Groundwater Monitoring Program often exceeded the percentages of other contaminates found and were not considered in the above ratings.

II. Contaminants: EDB = Ethylene dibromide; VOC = Volatile organic compound.

III. GWMA = Groundwater Management Area

Appendix 2 - Oregon Groundwater Protection Programs and Responsibilities

AGENCY	GROUNDWATER PROTECTION RESPONSIBILITIES
Department of Environmental Quality (DEQ)	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 WPCF permits that include groundwater protection requirements.
	Administers federal 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 OHA.
	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.

AGENCY	GROUNDWATER PROTECTION RESPONSIBILITIES
	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.
Oregon Health Authority (OHA)	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			
2012-2016	Benton Soil and Water Conservation District	$51,464	Making the case for implementing groundwater protection through fertilizer management (includes EPA matching funds)
2014-2017	GSI Water Solutions, Inc.	$100,000	Independent review of the Lower Umatilla Basin groundwater management area monitoring program
Federal Clean Water Act 319 Grants			
2017	Oregon Coast Community Forest Initiative	$9,000	DEQ funded Sustainable NW for groundwater/drinking water activities
2017-18	A Tiered Approach for Assessing Pesticide Use and GW Vulnerability for DWP in Oregon WS	$20,000	DEQ funded OSU Phase 1, 2, and 3 activities in the SWV GWMA.
Clean Water State Revolving Fund Loans			
2012	City of Adair Village	$150,000	Repairs and seals manholes, installs cured-in-place piping in select piping sections, and replaces others that are beyond rehabilitation. All address reduction of inflow and infiltration.
2009 to 2016	Farmers Irrigation District	$17,473,079	Continuance of the District's projects to remove irrigation water from open ditches and convey it through pipe.
2013	City of Cove	$1,523,300	Designs and constructs a treatment wetland, a disposal wetland and a pump station and pipeline to carry treated effluent from the treatment wetland to the disposal wetland.
2009 to 2017	Three Sisters Irrigation District	$5,034,662	Design and construction of the District's projects to remove irrigation water from open ditches and convey it through pipe.
2014	City of Ashland	$4,549,691	New oxidation ditch and pipeline improvements to provide sufficient treatment during high flows. This project includes a sponsorship option in the amount of $1,300,000 to partially replace an irrigation canal with a pipeline
2014	Central Oregon Irrigation District	$3,250,000	4500 feet of new pipeline to carry irrigation water currently in open canal.

2014	City of Newport	$8,906,800	The age and condition of existing collection lines is contributing to inflow and infiltration in this area of the system.
2014	City of Prineville	$1,888,464	Stormwater collection system improvements that include abandoning and/or retrofitting existing drywells close to drinking water wells and groundwater.
2015	City of Myrtle Point	$1,099,868	Overflows are much-reduced or eliminated, manholes have been replaced; and the location of the treatment plant has been moved to a higher location, thus removing it from a location subject to flooding.
2015	City of Gold Hill	$1,334,200	I&I correction work to include pipeline replacement and manholes repair.
2015	City of Dallas	$1,750,000	Land purchase for drinking water source protection.
2016	Clackamas Soil and Water Conservation District	$12,500	The District has a local community loan program that makes loans to private entities for the repair and replacement of failing septic systems impacting groundwater.
2017	City of Madras	$1,115,000	Municipal sewer extension to Herzberg Heights and Bel Air Estates with failing septic's and drill that contaminate the groundwater supply.
2014 and 2018	City of Columbia City	$876,000	Sewer improvements project, including upgrade of the RCE Pump Station, new telemetry, manhole lining and steel septic tank replacement or abandonment.