DEQ Water Quality Division

2000 Annual Progress Report For the Lower Umatilla Basin Groundwater Management Area

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State of Oregon
Department of
Environmental
Quality

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State of Oregon
Department of Environmental Quality

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1.0 INTRODUCTION

This report describes the progress made towards implementation of the Lower Umatilla Basin Groundwater Management Area Action Plan. Because this is the first progress report prepared since the Action Plan was approved in December 1997, the time frame covered by this report is 1998 through 2000. This report was prepared by the Oregon Department of Environmental Quality (DEQ) using information provided by the affected and interested parties involved in the Lower Umatilla Basin Groundwater Management Area. It should be noted that many of the parties contributing to this document are also doing other activities that are protective of groundwater both within and outside the GWMA. However, these "other activities" are not mentioned in this document because they are not directly applicable to implementation of the Action Plan.

This section of the report provides information on the establishment of the Lower Umatilla Basin Groundwater Management Area, the purpose of this report, important facts about nitrate, the goals of the Action Plan, and ways to measure success of the Action Plan.

1.1 Establishment of Lower Umatilla Basin Groundwater Management Area

Oregon's Groundwater Protection Act of 1989 requires the DEQ to declare a Groundwater Management Area (GWMA) if area-wide groundwater contamination, caused primarily by nonpoint source pollution, exceeds certain trigger levels.

Nonpoint source pollution of groundwater results from contaminants coming from diffuse land use practices, rather than from discrete sources such as a pipe or ditch. The contaminants of nonpoint source pollution can be the same as from point source pollution, and can include sediment, nutrients, pesticides, metals, and petroleum products. The sources of nonpoint source pollution can include construction sites, agricultural areas, forests, stream banks, roads, and residential areas.

The Groundwater Protection Act also requires the establishment of a local Groundwater Management Area Committee comprised of affected and interested parties. The committee works with and advises the state agencies who are required to develop an action plan that will reduce groundwater contamination in the area.

The Lower Umatilla Basin GWMA was declared in 1990 after nitrate contamination was identified in a 352,000-acre area in the northern portions of Umatilla and Morrow Counties. Groundwater samples from private wells identified nitrate contamination above the federal safe drinking water standard in many samples collected from the area. A four-year comprehensive study of the area was conducted in the early 1990s by the DEQ, the Oregon Water Resources Department, and the Oregon Health Division. The 1995 report titled "Hydrogeology, Groundwater Chemistry, & Land Use in the Lower Umatilla Basin Groundwater Management Area" identified five potential sources of nitrate loading to groundwater:

1. Irrigated Agriculture
2. Land Application of Food Processing Water
3. Septic Systems (rural residential areas)
4. Confined Animal Feeding Operations, and
5. The Umatilla Chemical Depot Washout Lagoons

The Lower Umatilla Basin Groundwater Management Area Action Plan was finalized in December 1997. The Action Plan details the activities to be conducted by the various agencies and organizations involved. The Umatilla and Morrow County Soil and Water Conservation Districts are the local agencies leading implementation of the Action Plan. The ODEQ and ODA have oversight responsibility. Local governments, private industry, and the US Army are also involved in implementation of the Action Plan. The Action Plan recommends general activities and specific tasks to be conducted by involved agencies and groups representing the five sources of nitrate loading. The Action Plan also identifies methods and a schedule for evaluation of the Action Plan progress. It was decided 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 ODEQ samples a network of 38 wells every other month for analysis of nitrate. Approximately once a year, these wells are sampled for a larger list of analytes including major ions, metals, and additional pesticides. These data are being used to evaluate changes in groundwater quality over time in response to adoption of BMPs. Progress is being made at land surface, but it may take years or even decades for groundwater quality to return to natural background levels.

1.2 Purpose Of This Report

The purpose of this report is to outline the activities undertaken by the various interested parties related to implementation of the Action Plan. This report is in accordance with Section VII, Item B.1 of the Action Plan. In addition, groundwater quality information collected from the bi-monthly monitoring well network is presented.

1.3 Important Facts About Nitrate

The following information is from the May 2001 Oregon Health Division's Technical Bulletin - Nitrate Health Effects Information. These facts are provided as background information to educate the reader and provide a context for the remainder of the report.

Nitrate Synonyms

There are no synonyms for nitrate but there are a number of nitrogen compounds that are important in nitrate effects including nitrites, amines and nitrosamines. All may be present along with nitrates in the environment and in the human body.

What Is Nitrate And What Are Its Uses

Nitrate is a naturally occurring oxide of nitrogen. Nitrogen is always present in the air and it reacts with oxygen and ozone to produce nitrogen oxides of which nitrate is one. Nitrogen oxidation also occurs in growing and decomposing biological systems. Oxides of nitrogen are present in smoke in significant quantities. Nitrate is an essential component of living things and is a major component of animal manure, human sewage waste and commercial fertilizers. Nitrates and nitrites have been used for centuries as fertilizers, in explosives and as food preservatives, especially in cured red meats. There are many other uses of nitrates, and the presence of nitrates in the environment is normal and necessary.

How Can I Be Exposed To Nitrates

Everyone is exposed regularly to nitrates because of their presence in foods, in water and because they are formed during digestion and metabolism in our bodies. Nitrates are not harmful unless our exposure to them is excessive. Very young infants, persons taking nitrogen-containing medications, persons who work with nitrates occupationally, and persons with genetic susceptibility to nitrates are harmed at lower exposure levels than others; but high nitrate exposures may be harmful to everyone.

Occurrence And Sources Of Nitrate In Water Supplies

Naturally occurring levels of nitrate in surface and groundwater do not generally exceed 2 milligrams per liter (mg/l). Sources of nitrate in water include fertilizers, septic systems, animal feedlots, industrial wastes, and food processing waste. It can also be naturally occurring in certain geological settings, and can result from decaying organic matter. Elevated levels of nitrate found in well water usually indicates improper well construction or location, overuse of chemical fertilizers or improper disposal of human and animal waste in the vicinity of the well. Water with less than 10 mg/l nitrate as nitrogen (NO_3-N) is generally safe for all household activities including use in foods and beverages.

Health Effects Of Drinking Nitrate Contaminated Water

The United States Environmental Protection Agency (USEPA) has set a maximum contaminant level (MCL) of 10 mg/l for nitrate (NO_3-N) in public water supplies. Nitrate levels above 10 mg/l may present a serious health concern for infants and pregnant or nursing women. Adults receive more nitrate exposure from food than from

water. Infants, however, receive the greatest exposure from drinking water because most of their food is in liquid form. Nitrate can interfere with the ability of the blood to carry oxygen to vital tissues of the body in infants of six months old or younger. The resulting illness is called methemoglobinemia, or "blue baby syndrome".

Pregnant women may be less able to tolerate nitrate, and nitrate in the milk of nursing mothers may affect infants directly. These persons should not consume water containing more than 10 mg/l nitrate directly, added to food products, or beverages (especially in baby formula). Other domestic uses of affected water such as irrigation, washing and bathing do not result in nitrate absorption.

The 10 mg/l standard for NO_3-N in public drinking water supplies has been devised to protect a select group of sensitive persons (infants, and pregnant and nursing women). Available health information suggests that non-sensitive persons, including healthy adults and children older than six months in age, may safely consume water containing up to 20 mg/l nitrate.

It has been suggested in preliminary studies that excessive nitrate ingestion may be linked to gastric or bladder cancer. This link, however, has not been firmly established and current exposure levels do not appear to put the population at risk. There is also some evidence that areas having elevated nitrate in drinking water may have increased incidence of spontaneous abortion.

Removing Nitrate From Drinking Water

Heating or boiling water containing nitrate will not remove the nitrate, but may actually concentrate it. Options to consider if the water supply is contaminated with nitrate above the 10 mg/l level, include using bottled water for drinking, and for food and beverage preparation, or installing a home water treatment unit. Mechanical filters or chemical disinfection, such as chlorination, do not remove nitrate from water. Nitrate may successfully be removed from water using treatment processes such as ion exchange, distillation, and reverse osmosis. These treatment techniques require careful maintenance and sampling to achieve and confirm effective operation. If a treatment system is to be used, one with National Sanitation Foundation (NSF) certification should be selected. For additional information on these options, contact the Drinking Water Section of the Oregon Health Division at (503) 731-4010.

1.4 Action Plan Goal

The ultimate goal of the Action Plan is to seek solutions to protect the area's groundwater. Recommended solutions should, within a reasonable time, bring the level of nitrate-nitrogen in the groundwater back below the 7 mg/l level triggering the declaration of a GWMA.

1.5 Action Plan Implementation

The Action Plan recommends general activities and specific tasks to be conducted by involved agencies and groups representing the five sources of nitrate loading. The Action Plan identifies methods and a schedule for evaluation of the Action Plan progress. The Action Plan is also voluntary. It was decided 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.

1.6 Measures of Action Plan Success

The Action Plan includes specific ways to gauge success that are focused on each sector. Assessments are primarily conducted on four-year cycles. The specific parties to conduct the assessment are also identified. For each of the five sectors, some benchmark information was to be obtained within 2 years. Other measurable goals for each sector are at 4, 8, 12, etc. years after Action Plan adoption.

2.0 EDUCATION / OUTREACH ASPECTS OF ACTION PLAN IMPLEMENTATION

This section of the report includes information on the educational / outreach activities conducted as part of the Action Plan implementation, a residential survey conducted to gauge public awareness, general cataloging of information, printed material available, information sources, and future needs in education / outreach.

2.1 Educational / Outreach Activities Conducted

General Information

The Umatilla County SWCD has performed educational and outreach activities focused on the irrigated agriculture and rural residential sectors of the LUB. The Umatilla County SWCD also assists and supports educational meetings held by county extension agents.

The Umatilla County SWCD developed a "Lower Umatilla Basin Groundwater Management Area Education and Outreach Plan" dated December 23, 1997. The plan set forth two goals, 1) Emphasize through education and outreach, the economic importance of groundwater to the citizens of the Lower Umatilla Basin; and 2) Develop steps or measures that increase awareness of groundwater problems and the need for protecting and improving the quality of the resource.

Examples of specific Umatilla County policies to address the educational aspect of the Action Plan implementation include:

1. Umatilla County will maintain a library of materials and contacts regarding BMPs to prevent water contamination.
2. Umatilla County may require video viewing or training regarding septic system maintenance as a condition of development approval.
3. Umatilla County may require video viewing or training regarding proper well placement, construction, and maintenance as a condition of development approval.
4. Umatilla County shall coordinate with other concerned entities to develop an outreach program regarding proper well and septic system maintenance, livestock containment, and lawn fertilization and irrigation.
5. Umatilla County will coordinate with the LUB GWMA committee in establishing an educational program regarding water contamination within the western portion of the County.

The Morrow County Planning Department regularly distributes written materials about groundwater quality, OSU Home-A-Syst information, etc. to landowners. The distribution of this groundwater quality information is made a condition of approval of many land use permits, including subdivisions and partitions in residential zones. In addition, a general disclaimer about the impact a proposed development may have on groundwater quality is included in almost every "Finding of Fact" report for land use actions.

Examples of specific Morrow County policies to address the educational aspect of the Action Plan implementation include:

1. Morrow County maintains a library of materials regarding BMPs to prevent water contamination.
2. Morrow County coordinates with the LUB GWMA committee in establishing an educational program regarding water contamination.

Groundwater Classes

The Umatilla County SWCD presented a *Groundwater* Class through the Blue Mountain Community College in 1998 and 1999 for interested members of the public. These classes involved speakers from local government organizations and state agencies. The speakers discussed topics such as urban growth, rural residential development, drinking water, wells, and septic systems as they relate to groundwater pollution.

The Umatilla County SWCD presented a *Groundwater* Class through the Blue Mountain Community College in 1998 and 1999 for realtors in the area. These classes involved speakers from local government organizations and

state agencies. The speakers discussed topics such as urban growth, rural residential development, drinking water, wells, and septic systems as they relate to groundwater pollution.

Other Classes

The Umatilla County SWCD, along with other partners, presented a *Lawns 98* class, a *Country Home* class, and a *Winterizing Your Yard* class. The classes focused on homes and home assistance for preventing pollution and protecting the environment from contaminants.

Public Schools and Civic Groups

The City of Boardman has had an active interest in groundwater education since the early 1990s. The City offers public education in a variety of subjects, including groundwater, to public schools of the area and interested civic groups. Classes have been taught to grades 2 through 12 in the public schools. The City has a groundwater model that is used in several of the classes to show how contamination in groundwater can affect this area. This activity has garnered press coverage in previous years, which further spread the information to the public.

The City of Boardman has developed and distributed flyers and handouts on the Wellhead Protection Area to schools, at civic functions, and other opportunities.

DEQ personnel periodically visit local schools to demonstrate ways to prevent pollution of groundwater and surface water by using a groundwater model and an Enviroscape® model.

Umatilla County Fair

The Umatilla County SWCD manned a booth at the Umatilla County Fair in 1997, 1998, and 1999. A static display was prepared for the booth in 1998. The display featured a poster of the Groundwater cycle and impacts both positive and negative that occur during the cycle. Identification of positive actions were indicated with 'smiley faces' and negative impacts were indicated with 'sad faces' connected by streamers on a narrative board. Appropriate literature was handed out with over 2,000 pieces given out. Total attendance at the fair was over 60,000 for the five day run.

The Umatilla County SWCD manned a booth at the 1999 Umatilla County fair focusing on groundwater protection. A display booth was presented with handout materials provided. The theme of the booth was "You Affect What Your Neighbor is Drinking!". The booth featured a static display of the groundwater cycle and impacts of human activities both positive and negative on the groundwater in the Lower Umatilla Basin. Attendance at the fair was over 60,000. It is estimated that attendees took over 2,000 pieces of literature.

Farm Fair

The Umatilla County SWCD participated in Farm Fair in 1997, 1999, and 2000. Details of the participation are summarized below.

1997 - The Umatilla County SWCD sponsored a speaker for the Farm Fair. Patrick Knight, former Resource Assistance for Rural Environments (RARE) Intern directed his presentation, "What's Happening in the Lower Umatilla Basin", toward the Irrigated Agriculture audience. Patrick's thirty-minute talk summarized the current activities in the LUB and discussed 10 Best Management Practices that may offer solutions to the contamination problem.

1999 - The Umatilla County SWCD prepared a booth focusing on the groundwater issue in the LUB. Using the slogan "Try this? Use varying root depth crops to take advantage of residual nutrients". It was an attempt to influence farmers to consider crop root depths as a management tool for nitrate retention. Half the booth focused on this idea and the other half of basic groundwater education. The booth was divided into two areas, an active groundwater module and another side for brochures. In addition there was a display provided by Desert Springs Bottled Water Company. Dessert Springs donated the water to supply those that stopped at the SWCD booth. Two

nitrate kits were available for free testing. Handout material included "Water Quality Protection Guide," "Groundwater, Pollute or Preserve.

2000 - The Umatilla County SWCD developed a booth focusing on groundwater and agricultural water quality management BMPs. The district conducted a survey of interested persons stopping by the booth. The survey asked questions related to knowledge of the critical groundwater area, cause of high nitrates in the groundwater, and best management practices that may reduce the problem. Over 300 surveys were completed during the three-day event. In addition there was a display provided by Desert Springs Bottled Water Company. Dessert Springs donated the water to supply those that stopped at the SWCD booth. Handout material included, "Understanding Groundwater the Hidden Resource", "Home A Syst, OSU Extension Service", Groundwater, "Pollute or Preserve DEQ", "Septic Tank Maintenance, DEQ", "Tips on Land & Water Management For Small Acreage's NRCS"," Water Quality Protection Guide ODA".

Tour With EPA Personnel

The Umatilla County SWCD Water Quality Coordinator conducted a tour of the LUB for staff members of the federal EPA Pesticides Division in August 1999. This tour focused on the complexity of the agricultural / environmental issue, what successes the agricultural community has realized, and expressing willingness to cooperate with environmental agendas within economic reason.

Public Service Announcements

A RARE intern, along with Umatilla County SWCD staff, developed radio Public Service Announcements (PSAs) targeted to the rural residential community. The PSAs aired in Umatilla County from July through September 2000. The PSAs were aired in both English and Spanish. A more detailed article about the spots can be found on page 3 of a July 2000 newsletter called the “LUB Letter”. Copies of the newsletter can be obtained by contacting Bev Kopperud with the Umatilla County SWCD at (541) 278-8049 or on the Internet at http://www.deq.state.or.us/er/newsletters/lubdoc1.doc

Envirothon

Envirothon is a problem-solving competition for high school students based on natural resources and the environment. It consists of four workshops, a presentation, and a competition day. Envirothon began in Pennsylvania in 1979 and has grown to be the largest high school environmental education competition in North America. In 2000, the Umatilla County SWCD organized the first Envirothon held in Umatilla County. Four teams of students participated in the event. The winning team attended the State Competition in Salem.

Water Wells

On a daily basis, Oregon Water Resources Department (WRD) staff answers questions from the public and well contractors on well construction issues. When a new or recently constructed well is found to be commingling water, the well is repaired or abandoned. When people contact the WRD staff with water quality problems, well construction and well placement are investigated as the possible cause of the problem. WRD staff educates the public on how poor well construction can lead to poor water quality.

On the second Monday of every quarter, the WRD gives its test for new water well drillers. A week prior to this test, a four hour class is offered to individuals wishing to take the test. In this class the State well construction rules and statutes are discussed. Heavy focus is placed on well location, sealing depth, areas of known nitrate contamination, alternative well construction methods, under reamer systems, and telescoping casing methods of construction. In addition to the new driller education, WRD staff works with SWCD and other agencies on workshops for realtors and other interested public. Some of the topics covered in these workshops include basic well construction, sand point wells, well location, well abandonment, and water rights.

Confined Animal Feeding Operations (CAFOs)

In cases where non-permitted CAFOs land-apply wastes, ODA offers educational reviews designed to assist operators in identifying potential pollution pathways associated with waste application. The CAFO program

encourages, and has required in several instances, development of an Agricultural Waste Management Plan. Through this process, appropriate BMPs are identified that are protective of waters of the state.

2.2 Residential Survey

In May 1999, the Umatilla County SWCD, in conjunction with the Blue Mountain Community College, conducted a telephone survey of 100 LUB residents to gauge their knowledge of water quality issues in the basin, including high nitrate levels in the groundwater. Results of the survey were presented in a June 30, 1999 final report. According to Jim Loiland, the Umatilla County SWCD Water Quality Coordinator at the time, "the survey results indicate we need to continue to remind residents of nitrate levels and other groundwater issues".

2.3 General Cataloging of Information

In April 1998, the Umatilla County SWCD staff completed a bibliography of groundwater information. The bibliography includes a wide range of information on topics related to groundwater issues. This information was reviewed and updated in July 2000. The bibliography is available at the Umatilla County SWCD office.

The Umatilla County SWCD has a list of information and people knowledgeable in groundwater protection management for different sectors. The list is available at the Umatilla County SWCD office.
The City of Boardman maintains an information library which includes the Lower Umatilla Basin Study, the LUB Action Plan, the Wellhead Protection Study, inventories of all well logs filed with the Water Resources Department in Township 4N / Range 25E, numerous materials on groundwater protection strategies for construction, storm water management and others. This information is available to the staff, decision-makers in the community, and the general public for review or research.

Umatilla County recognizes groundwater quality and quantity as a concern. Under the State-mandated Periodic Review process, Umatilla County included groundwater quality and quantity in its Periodic Review Work Program. Umatilla County staff has made an inventory of groundwater studies conducted in Umatilla County by various agencies. Specific areas having groundwater quality and quantity problems for the entire County were identified based on the studies inventoried.

2.4 Printed Material

Newspaper Articles

Several articles have appeared in local newspapers discussing the groundwater nitrate problem as well as other water quality concerns in the area. Examples include:

- "Lower Umatilla Basin Groundwater Survey, Many Residents not Aware of Groundwater Issues", By Jim Loiland December 10, 1999
- "Students put to the test on natural resources", East Oregonian, May 1, 2000. Article on Envirothon competition.
- "Groundwater nitrate levels affect health", East Oregonian by Eric Fetters, August 1999.
- "Solutions outlines area groundwater", East Oregonian by Shirley Wentworth, March 22, 1998.
- "Depot makes progress at cleaning groundwater", East Oregonian, May 28, 1998.
- "Voluntary approach key to local water management", Hermiston Herald by Frank Lockwood, December 9, 1997.
- "UCSWD official outlines 'Action Plan', Hermiston Herald by Frank Lockwood, December 9, 1997
- "Blue Babies, Brown Spots, And Green Lawns?. How to water
- "Hydraulic soil probe available to farmers", AgriTimes by Beth Mills, November 4, 1994.
- "Nitrogen in water worrisome", Agri-Times NW by Jerry George, February 26, 1993.
- "Studies under way on nitrogen level in NE Oregon groundwater" Capital Press by Jerry George, February 19, 1993
- "Getting the work out about groundwater", Inland Farmer, by Mike Wohld. 1992
- "Official hired to study nitrate problem, Groundwater coordinator will be funded by grant." East Oregonian, September 24, 1992

Newsletter

In February 2000, the LUB Citizens Committee requested a semi-annual newsletter be produced to inform citizens about local groundwater activities. The Umatilla County SWCD agreed to prepare the newsletter. The first issue of the newsletter, titled "*The LUB Letter*" was produced in July 2000. The newsletter was sent to the citizens committee and other interested agencies and members of the public. Copies of the newsletter can be obtained by contacting Bev Kopperud with the Umatilla County SWCD at (541) 278-8049 or on the Internet at http://www.deq.state.or.us/er/newsletters/lubdoc1.doc

Residential Survey

As indicated in Section 2.2, the Umatilla County SWCD, in conjunction with the Blue Mountain Community College, conducted a telephone survey of 100 LUB residents in May 1999 to gauge their knowledge of water quality issues in the basin, including high nitrate levels in the groundwater. Results of the survey were presented in a June 30, 1999 final report titled "Lower Umatilla Basin Groundwater Management Area Residential Survey - Final Report". This report is available at the Umatilla County SWCD for review by the general public.

Baseline Survey of Irrigated Agriculture

During the irrigation season of 1998, over 45 operators in the Umatilla Electric Co-op service area, representing over 160,000 acres, subscribed to and utilized the services of the Northwest Irrigation Network. IRZ Consulting, LLC directly contacted and surveyed 14 operators representing 48,044 acres in the basin to establish baseline information for use in implementing the Action Plan. Respondents indicated 66.4 % used pivot irrigation, 100% used some form of irrigation scheduling, 99.5% monitored soil moisture, 51.5% use OSU/WSU fertility guides, 78.3 % monitored soil fertility, and 49.4 % used cropping and/or tillage systems designed for wind/water erosion or nitrogen recovery. All survey results were presented in a March 1999 report prepared by IRZ Consulting, LLC for the LUB Citizens Committee and the Umatilla County SWCD. The report, titled "1998 Base Line Survey of Irrigated Agriculture", is available through either IRZ Consulting or the Umatilla County SWCD.

BMP Handbook

The Umatilla County SWCD staff created a draft Best Management Practices Handbook combining BMPs for air, surface water, and groundwater into one user-friendly document. The document was sent out for comment in June 1998 and finalized in November 1998. The handbook was created to make available to the farmer the BMPs for soil erosion and water quality protection (both groundwater and surface water) in the Umatilla Basin in an easy to use and practical format. The document is available at the Umatilla County SWCD office.

A Consumer's Guide to Water Well Construction, Maintenance, and Abandonment

The Oregon Water Resources Department updated the Consumer's Guide to Water Well Construction, Maintenance, and Abandonment in 1999. The document includes information on common well construction questions such as proper set back requirements, well abandonment, drilling your own well, and other well topics. This pamphlet is handed out to anyone inquiring about wells. This pamphlet is also made available to other agencies for their uses in dealing with the public. Individuals with Internet access can obtain a copy at www.wrd.state.or.us under the publication link.

Other Educational Printed Material

The following educational materials are available at the Umatilla County SWCD:
Tips on Land & Water Management for Small Acreages in Oregon
Blue Thumb Pamphlet, Water Conservation Tips
Basic Guide for Lawn Maintenance (Pendleton Public Works Pamphlet)
Home*A*Syst pamphlet and worksheets 1-11
Farm*A*Syst overview booklet titled "Twelve simple things you can do to protect well water"
Home*A*Syst pamphlet titled "Why do septic systems fail?"
Groundwater: Pollute or Preserve? It's Your Choice (OSU Extension Circular 1343)
LUB Groundwater Action Plan

Oregon Groundwater Community Involvement Program
"I Love Water" pamphlet

2.5 Information Sources

The following table contains contact information for various topics related to the GWMA.

Topic	Contact	Organization	Telephone #
Irrigated Agriculture BMP Implementation	Ray Denny Janet Greenup Don Horneck Bob Adelman	Umatilla County SWCD Morrow County SWCD OSU Extension NRCS	(541) 276-8170 (541) 676-5452 (541) 567-8321 (541) 278-8049
Health effects of nitrate and/or how to remove nitrate from your drinking water	Drinking Water Section	Oregon Health Division	(503) 731-4010
Protecting groundwater quality while developing property	Tamra Mabbott Patty Perry	Morrow Co. Planning Umatilla Co. Planning	(541) 922-4624 (541) 278-6252
Groundwater quality protection guidelines related to lawn and garden maintenance	Ray Denny Don Horneck	Umatilla County SWCD OSU Extension	(541) 276-8170 (541) 567-8321
Groundwater quality protection guidelines related to well construction and maintenance	Brian Mayer	Oregon Water Resources Department	(541) 278-5456
Groundwater quality protection guidelines related to animal density	Eric Moeggenberg	Oregon Department of Agriculture	(541) 475-7155
DEQ's bi-monthly monitoring well network	Phil Richerson	Oregon Department of Environmental Quality	(541) 278-4604
Properly siting, installing, and maintaining a septic system	Bernie Duffy or Bob Marshall	Oregon Department of Environmental Quality	(541) 276-4063

2.6 Future Needs in Education / Outreach

The following items have been identified that would assist in the education and outreach aspects of Action Plan implementation:

- Spanish version of health effects of nitrate and how to treat drinking water, and
- Wellness Seminar that involves the medical community in a discussion of the health effects of nitrate.

3.0 DETERMINATION AND IMPLEMENTATION OF BMPS

This section of the report includes discussions of various research projects for determining BMPs relevant to the Lower Umatilla Basin. Examples of specific BMPs implemented are also discussed.

3.1 Research into BMP Determination

Research into BMPs has occurred on several levels. Specific activities related to BMP determination for irrigated agriculture and rural residential development are discussed below.

Irrigated Agriculture

Most agri-chemicals, including nitrogen fertilizers, currently used in the LUB are applied through, or at least under, center pivot irrigation systems. If nutrients and irrigation water are not properly managed, nitrate can leach through the root zone and contaminate groundwater. The primary BMPs to minimize nitrate leaching, cited throughout the scientific literature, are proper irrigation management and the metering of fertilizer throughout the season.

Proper irrigation management involves the careful monitoring of the soil moisture in the root zone and scheduling irrigation to maintain soil moisture near field capacity. The goal of irrigation management is to prevent over-irrigation and under-irrigation.

Proper nutrient management involves knowing the type, amount, and timing of fertilizer application so that no more nutrients are applied than the crop needs so that excess nitrate is not available for leaching. As with soil moisture, knowing the amount of each nutrient in the soil and how much the crop needs allows the application of just the right amount of fertilizer. With the development of chemigation techniques, such metered application of fertilizer are possible through center pivot and drip irrigation systems.

Some of the research into determining BMPs for irrigated agriculture in the LUB has revolved around quantifying what constitutes proper irrigation and nutrient management for the local crops, soils, and climate. By quantifying nitrogen present below the root zone, a grower is able to adjust nutrient management practices by adjusting application timing and rates and/or elect to plant an appropriate deep-rooted crop to capture excessive levels of deep nitrogen thus averting nitrate leaching to groundwater. The primary goal of a series of projects partially funded through DEQ's Nonpoint Source Management Program (also known as the 319 program) and involving landowners, IRZ Consulting, and OSU Extension service, was to demonstrate to growers the direct benefits of using deep soil sampling and irrigation water analysis as part of their fertilizer and water management program.

Rural Residential Development

Umatilla County has incorporated groundwater quality concerns in their Comprehensive Plan Policies. Examples of Umatilla County's policies to address groundwater quality issues in the rural residential setting include:

1. Umatilla County recognizes that the development of performance standards will assist in protecting the quality of groundwater.
2. Umatilla County recognizes the Lower Umatilla Basin Groundwater Management Area and will take the actions requested within the Groundwater Management Area Action Plan.
3. Umatilla County will work in cooperation with DEQ and EPA to determine standards to lower nitrate concentrations in groundwater.
4. Umatilla County will work with DEQ and EPA to develop performance standards for land use development to maintain water quality at a sustainable level both within and outside of designated Critical Groundwater Areas.
5. Umatilla County shall work with DEQ to determine the effectiveness of alternative on-site septic systems in removing nitrates.
6. Umatilla County will consider several factors when creating solutions to the groundwater quality limitations on development. These solutions may include but are not limited to performance standards, alternative septic system technologies, transferable development credits, and sewer systems within cluster development sites.

7. Umatilla County will remain informed about the Source Water Assessments of public water systems and will take necessary steps to limit determined sources of contamination to public water systems.
8. Umatilla County shall encourage and assist managers of all public or community water systems to implement a well head protection program for their wells.

The City of Boardman is in the process of Comprehensive Plan Review and a review of the zoning and development ordinances to assess the need for changes. Incorporation of the Wellhead Protection Area into the Comprehensive Plan is part of the required work items under review. Additionally, groundwater protection in general is being looked at within this review. This process is expected to take until 2003 to complete; however, implementation of some of the concepts already identified is currently taking place. The Planning Commission and Boardman City Council have supported these efforts and expect them to be part of the Comprehensive Plan and the Ordinances when they are completed.

In March 1999 Marc Norton (a Hydrogeologist with the Oregon Water Resources Department) prepared a report titled "Minimum Taxlot Size Based on Water Availability for Basalt Aquifers in Morrow and Umatilla Counties". Mr. Norton attempted to determine the density of rural residential development that can be sustained by the groundwater resource in the vicinity of critical and classified groundwater areas. The least squares regression method was used to estimate the relationship between the annual water level change due to pumpage and the annual pumpage rate. This relationship was then used to estimate the minimum lot size required to maintain the groundwater resource. It was concluded that the minimum lot size for the Butter Creek and Stage Gulch critical areas ranged from 1.69 to 47.73 acres and averaged 7.18 acres. Based on this study, the Water Resources Department recommended (1) the Morrow and Umatilla County Planning Commissions move toward an average minimum lot size of seven acres, (2) counties develop a program, in partnership with WRD, to monitor groundwater levels in areas of rural residential development to observe the response of the aquifer to new stresses.

Curt Black (an Environmental Scientist with the EPA in Seattle) presented his draft report titled "Rural Residential Loading of Nitrate and It's Impact on Land Use Planning in Morrow and Umatilla Counties, Lower Umatilla Ground-Water Basin, Oregon" to an August 1999 LUB Citizens Advisory Committee meeting and to the Morrow and Umatilla County Planning Commissions. Mr. Black used a spreadsheet model to estimate the lot size required so that nitrate loading from a standard septic system would not cause groundwater concentrations to exceed 7 mg/l. Mr. Black's recommendations included:

- A range of large lot sizes was recommended, depending on the technology applied to the effluent,
- Carefully consider the application of sewage sludge and expansion of CAFOs,
- Consider alternate technologies for sewage treatment such as composting toilets and in-situ reactive walls,
- Implement education / outreach activities aimed at clinics, hospitals, and health care providers to make certain they are aware of the symptoms of methemoglobinemia (blue baby syndrome),
- Implement education / outreach activities to alert area residents to nitrate health risks and treatment technologies,
- Implement education / outreach activities focused on reducing excessive fertilization of lawns and gardens,
- Provide a means to help rural residents measure the nitrate concentration in their drinking water, and
- Re-evaluate the existing groundwater monitoring sampling network and frequency.

Mr. Black's report has not been finalized. Therefore, local citizen's questions and concerns regarding the report's assumptions, input variables, and recommendations have not yet been formally presented.

3.2 BMP Implementation

BMP implementation has occurred on several levels. Specific examples of BMP implementation are discussed below.

Irrigated Agriculture

The Umatilla County SWCD Water Quality Coordinator created a "Nutrient Management Worksheet" for use by NRCS planning staff working in the Lower Umatilla Basin.

Irrigation Management – Companies like IRZ Consulting and Simplot Soilbuilders play an important role in implementing irrigation management in the LUB.

IRZ's irrigation management service includes soil moisture monitoring, an on-line source of daily crop water use and evapotranspiration reports, the use of aerial infrared photography, the development of comprehensive water conservation plans, and irrigation scheduling software.

Simplot Soilbuilder's irrigation scheduling and crop water management services utilize crop ET rates, plant water uptake within the root zone and moisture movement through the soil profile.

Giddings Probe - In July 1999 and March 2000, the Umatilla County SWCD and the OSU Extension Service provided training and maintenance for a Giddings Probe housed at the OSU Experimental Station in Hermiston.

The Giddings Probe is used for deep soil sampling. This is of particular value following high nitrogen use, shallow rooted crops. Sampling after crops such as potatoes and onions to depths beyond two feet is difficult with hand probes. The Giddings probe was acquired to allow deeper sampling: to four feet, six feet, or even deeper (samples have been collected from nine feet where soil depth allows). The concept is to measure the amount of residual nitrogen, particularly in the three to five feet zone that might still be pulled back up and utilized by a "sponge crop" such as cereal, grass seed, or sudan grass. Although alfalfa leaves some residual nitrogen itself, this is generally deposited in the surface two feet and its deeper rooting habit (even to depths of six to seven feet) can be an effective way to move nitrogen back to the surface where it can then be removed with the harvested crop. This concept was very successfully used by a local grower when they were utilizing high nitrogen hog waste from their lagoon and is now being used by another grower utilizing municipal sludge. It could be appropriate for the incoming dairy waste utilization. An area-wide deep sampling study conducted by an OSU Master's student identified additional "hot spots" of nitrogen deposition such as swales.

CAFOs

Educational reviews were (and still are) offered by ODA to assist operators in identifying potential pollution pathways associated with waste application. The CAFO operator identifies and adopts BMPs through the Animal Waste Management Planning process. ODA reviews Animal Waste Management Plans (AWMPs) that are submitted as part of a CAFO's Water Pollution Control Facility (WPCF) permit. ODA offers courtesy reviews of AWMPs written for non-permitted operations.

Letters were written in an attempt to gain involvement from the non-permitted CAFOs in the LUB. A meeting was held between ODA, Extension, and the WQC. The ODA and the Umatilla County SWCD set up a demonstration of confined feeding areas (winter holding pastures) upstream on Butter Creek in 1999. A report documenting this demonstration project is on file at the Umatilla County SWCD.

Rural Residential

The City of Boardman includes groundwater protection and wellhead protection as integral parts of staff reports developed for land use decisions within the jurisdictional boundaries of the City, the Urban Growth Boundary, and the delineated Wellhead Protection Area. Although there is not a Wellhead Protection Ordinance, review of potential impacts of any development is accomplished through a process of staff review, Site Team review (bringing in other utilities and agencies for review), and Planning Commission approval (when use is not

outright). These reviews allow for the assessment of groundwater and other environmental impacts to be addressed or mitigated prior to development. The City of Boardman does not allow new septic systems within the City limits.

The City of Boardman has developed a Municipal Sewer System Plan that includes a requirement for developers to extend sewers to new developments within City limits, and that prohibits new septic systems within 300 feet of the municipal sewer system.

Morrow County was actively involved in Periodic Review until 1997 when the Oregon Legislature exempted counties with a population less than 15,000 (which included Morrow County) from the process. The one unresolved work program item was to study and develop policies with regard to development inside the critical groundwater and groundwater contaminated areas. Despite being exempt from the Periodic Review process, Morrow County continued working on the issue and concluded that rural residential development was the topic where the County may want to consider regulatory measures for development. The main concern related to groundwater contamination was septic tank density. A study conducted by EPA (and discussed in Section 3.1 of this document under the Rural Residential heading) concluded a large minimum lot size would be required to ensure zero negative impact to groundwater. The Planning Commission and County Court reviewed the study and concluded it was much to onerous and the County did not change the minimum lot size. The Oregon Land Conservation & Development Commission (LCDC), however, revised Oregon Administrative Rules for Goal 14 and, effective October 3, 2000, essentially imposed a 2-acre minimum lot size for existing residentially zoned lands outside of urban growth boundaries. This eliminated Morrow County's one-acre residential zone, and effectively reduced the potential future impact of nitrate contamination from on-site septic systems in rural areas. Another effect of the LCDC rule change was to limit the minimum lot size for newly zoned residential lands to ten acres. So, any zone changes to allow farm or other ground to be taken out of exclusive farm use and put into a residential zone would not allow two acre or four acre parcels; the minimum lot size would be ten acres. This change greatly limits the potential for widespread groundwater contamination from rural septic systems.

3.3 Future Needs Regarding BMP Determination and Implementation

No needs were identified regarding BMP determination and implementation.

4.0 GROUNDWATER QUALITY MONITORING

Following is a discussion of the results of DEQ's bi-monthly sampling, the upcoming water quality evaluation at food processor process water land application sites, and the ongoing groundwater cleanup at the US Army Umatilla Chemical Depot Washout Lagoons.

4.1 Results of DEQ's Bi-Monthly Monitoring

As indicated in Section 1.1, the ODEQ samples a network of 38 wells every other month for analysis of nitrate. The results of this monitoring are presented in Table 1. In addition to the 18 sampling events conducted since adoption of the Action Plan, results from two additional events are included in Table 1. These additional events include the first bimonthly event (October 1991) and the synoptic event (July 1992) conducted during the investigation phase of the project. It is important to note that the water quality discussion in this report is an informal evaluation of the three years of data collected since adoption of the Action Plan. The first formal trend analysis of the bi-monthly monitoring well network data is scheduled for 2009, and will include 12 years of data.

The maximum nitrate value observed between January 1998 and November 2000 at each well is identified in Table 1 with shading. The scattered distribution of the shaded cells indicates maximum nitrate values over the past three years occurred at different times at different locations. This suggests some wells may have increasing nitrate trends while other wells may have decreasing nitrate trends.

The maximum nitrate value observed at each sampling event is identified in Table 1 with large bold numbers. The large bold numbers indicate the maximum nitrate values during the past three years in the alluvial aquifer wells. The maximum values have most often been at well UMA085 (13 of 18 events) but have also occurred at well UMA096 (3 of 18 events), UMA156 (1 of 18 events), and UMA198 (1 of 18 events). The average nitrate concentration at well UMA085 is 32 ppm.

The large bold numbers also indicate the maximum nitrate value during the past three years in the basalt aquifer wells has always been at well UMA029. The average nitrate concentration at well UMA029 is 44 mg/l. Concentrations at this well seem anomalously high. Testing of irrigation water by landowners and irrigation consultants from numerous basalt wells throughout the LUB suggests nitrate concentrations in the basalt aquifer are generally less than 10 ppm.

An evaluation of wells exhibiting high nitrate concentrations will be conducted in 2001. The evaluation will consist of examining the well log to confirm adequate well construction followed by a site visit to evaluate potential contaminant sources and pathways.

Figure 1 is a graph of average and median nitrate concentrations in the Alluvial Aquifer and Basalt Aquifer during the three years since the Action Plan was adopted (1998 through 2000). Each data point represents either the average or median nitrate concentration of the wells sampled during that particular sampling event. The LOWESS lines[1] in Figure 1 suggest:

- the average concentration in the Alluvial Aquifer wells fluctuated slightly but remained fairly constant at about 10 ppm,
- the median concentration in the Alluvial Aquifer wells started at about 7 ppm and may be slightly declining,
- the average concentration in the Basalt Aquifer wells decreased slightly during 1998, then increased through 1999, then flattened back out at about 12.5 ppm in 2000, and
- the median concentration in the Basalt Aquifer wells started at about 3.5 ppm and increased about 1 ppm.

The larger difference between average and median values in Basalt Aquifer wells than in the Alluvial Aquifer wells reflects the high values observed in the Basalt Aquifer well UMA029. Average values are influenced by

[1] LOWESS stands for LOcally WEighted Scatterplot Smoothing and is a data smoothing technique used to illustrate the underlying structure of a data set. LOWESS is similar to a moving average.

every data point while median values reflect only the "middle" value. The LOWESS lines in Figure 1 provide an indication of how the average water quality data is changing through time but does not constitute a trend analysis.

The cyclic nature of the average nitrate values in the Alluvial Aquifer wells (e.g., the spikes at March of each year) suggests seasonality may be an important factor in water quality changes. The cyclic nature of the average nitrate values in the Basalt Aquifer wells is less obvious.

4.2 Monitoring at Food Processor Process Water Land Application Sites

Groundwater quality monitoring continues at the six food processor process water land application sites. The first evaluation of these data is scheduled to occur by December 2001.

4.3 Monitoring at the US Army Umatilla Chemical Depot Washout Lagoons

The following information appears in the "Annual Monitoring Report 08/20/99 – 08/10/00 Contaminated Groundwater Remediation Treatment System, Umatilla Chemical Depot, Hermiston, Oregon" by Remtech, Inc. The full report can be obtained from Kira Lynch with the US Army Corps of Engineers (206-764-6918).

- Groundwater samples from extraction wells and selected monitoring wells are analyzed quarterly. Semi-annual water quality samples are collected at the effluent sample port. The samples are analyzed for explosives[2], metals, anions, alkalinity, and TDS.
- Since the groundwater remediation plant began operation in December 1996, contaminant concentrations show a general decline over time at most of the wells.
- The explosive chemistry at several wells varies with seasonal water levels.
- The TNB, TNT, and 2,4-DNT plumes appear to be located well inside the capture zone of the treatment system. However, the eastern-most edge of the RDX plume extends beyond the capture zone. Additional monitoring wells need to be drilled to determine the extent of the RDX plume.
- Six wells show increases in the most mobile contaminant (RDX). These increases are attributed to the soil washing phase of operations, which transfers the contaminant from the soil to the groundwater so that it can be captured by the remediation system. RDX concentrations have peaked at 5 of these 6 wells and are beginning to show general declines.
- Other departures from the general trend of declining contaminant concentrations in the wells include some rebound in contaminant concentrations in the wells around the edge of the washout lagoon when soil washing was discontinued.

[2] Explosives include 1,3,5-Trinitrobenzene (TNB), 2,4,6-Trinitrotoluene (TNT), 2,4-Dinitrotoluene (2,4-DNT), and hyxahydro-1,3,5-trinitro-1,3,5-triazine (RDX).

5.0 DECEMBER 1999 GOALS

Five goals were identified in the Action Plan as having December 1999 deadlines. These five goals relate to the five contributors of nitrate, and are discussed below.

5.1 Irrigated Agriculture

Goal

By December 1999, 70% of the Lower Umatilla Basin's irrigated acres have requested and been assessed for the current adequacy of groundwater protection measures and have been inventoried for the current type of irrigation and fertilization management practices being used.

Accomplishments

Ray Wilson, NRCS Pendleton office Soil Conservationist, completed conservation plans covering 28,000+ acres in the LUB to Resource Management System levels. Resource Management System conservation plans address all resource concerns identified on the farm that do not meet the minimum quality criteria as identified by NRCS quality standards. The plans were completed in fall of 1999. Cooperators operating under conservation plans continue to utilize conservation practices developed in their plans.

IRZ Consulting conducted the first baseline survey of irrigated agriculture during the 1998 irrigation season. During that season, more than 45 of the 50 to 55 operators in the Umatilla Electric Co-op service area subscribed to and utilized the services of Northwest Irrigation Network. These subscriptions represented over 160,000 acres of the approximately 180,000 acres of irrigated agriculture in the GWMA. IRZ Consulting directly contacted and surveyed 14 operators representing 48,044 acres. Respondents indicated 66.4% used pivot irrigation, 100% used some form of irrigation scheduling, 99.5% monitored soil moisture, 51.5% used OSU/WSU fertility guides, 78.3% monitored soil fertility, and 49.4% used cropping and/or tillage systems designed for wind/water erosion or nitrogen recovery.

5.2 Rural Residential

Goal

By December 1999, a survey was to be completed of the Lower Umatilla Basin residents to determine the level of awareness of the groundwater nitrate problem, the causes, and what can they do about reducing the loading.

Accomplishments

The survey was completed by the Umatilla County SWCD and Blue Mountain Community College. It consisted of a telephone survey of 100 LUB residents in May 1999. Results of the survey were presented in a June 30, 1999 final report. The results indicate continued education and outreach efforts are needed to raise awareness in the area.

5.3 Food Processor Process Water

Goal

By December 1999, continue monitoring of existing monitoring wells as specified in facilities permits.

Accomplishments

Based on information from permitees and DEQ files, groundwater quality monitoring is continuing as specified in facilities permits.

5.4 CAFOs

Goal

By December 1999, 75% of the Lower Umatilla Basins CAFOs have requested and/or been assessed for the current adequacy of groundwater protection measures at their facilities

Accomplishments
ODA has conducted educational site visits to CAFOs within the LUB GWMA upon request. The requests for groundwater assessment are for new facilities currently being built (Sixmile Dairy, Willow Creek Dairy, Columbia River Dairy, and Stage Gulch Dairy). These new facilities, all permitted since declaration of the GWMA, have significant engineered upgrades and monitoring sufficient to allow assessment of groundwater protection. No other facilities have requested an evaluation of, or have been assessed for, the current adequacy of groundwater protection measures.

All six of the permitted CAFOs within the GWMA have been inspected within the last year. All six of these facilities have implemented or are developing an animal waste management plan consistent with ODA expectations. The inspection process is a good tool to assess proper agronomic application of wastes or identify operational waste management problems. Assessment of engineered structures and irrigation scheduling can be accomplished at the landowner's request.

Non-permitted CAFOs are not routinely inspected except in response to a citizen's complaint. Approximately twelve non-permitted CAFOs have been inspected since adoption of the Action Plan. Because no formal tracking mechanism (i.e., a permit) exists for these facilities, the exact number of non-permitted CAFOs within the GWMA is not known.

5.5 Umatilla Chemical Depot Washout Lagoon

Goal
By December 1999, continue to follow the Record of Decision and the Remedial Action Management Plan for Groundwater.

Accomplishments
From discussions with the US Army and DEQ personnel familiar with the groundwater remediation project, the referenced documents are being followed and groundwater remediation is proceeding as planned. In general, contaminant concentrations have shown a decline over time at most wells since the groundwater remediation plant began operation in December 1996. More specific information regarding the groundwater quality at the site is provided in Section 4.3 of this report.

6.0 DECEMBER 2001 GOALS

Section VIII.C.1 of the Action Plan states that after the first four years of implementation, the success of the Action Plan will be based on whether strategies and plans have been developed as outlined under the Implementation Tasks (Section VII). The evaluation will include documentation of information gathered and organized, whether the appropriate institutions have been put into place to promote the Action Plan recommendations and documentation of what activities, practices, and alternates have been adopted that reduce nitrate loading to groundwater.

Specific goals were identified in the Action Plan as having December 2001 deadlines. These goals relate to the five contributors of nitrate, and are reiterated below.

6.1 Irrigated Agriculture

Goal

By December of 2001, 75% of the irrigated acreage is implementing an accepted system of BMPs or are covered by an implementation plan and the recommendations are in place and being used. Responsible parties – SWCDs, NRCS, OSU Extension, and private agricultural service providers.

6.2 Rural Residential

Goal

By December of 2001, through a random survey, 50% of area residents are aware of the groundwater nitrate problem and know of at least one activity or practice that contributes to the problem. Responsible parties – SWCD and OSU Extension.

Goal

By December of 2001, procedures and methods to reduce the impact of septic system nitrate loading to the groundwater have been investigated and presented to all local area governments. Responsible parties – local governments and DEQ.

Goal

By December of 2001, evaluate the ability of the state to consider the cumulative impact of septic systems when issuing permits. Responsible party – DEQ

6.3 Food Processor Process Water

Goal

By December of 2001, monitoring data shows improving groundwater quality trends for nitrate and meeting permit conditions and objectives. Responsible parties – DEQ and food processor permitees.

6.4 CAFOs

Goal

By December of 2001, 50% of CAFOs are implementing an accepted system of BMPs or are covered by an implementation plan. Responsible parties – ODA, SWCDs, NRCS, OSU Extension, and private agricultural service providers.

6.5 Umatilla Chemical Depot Washout Lagoons

Goal

By December of 2001, monitoring data should show that the treatment system is working as expected and that reinjection water is not migrating beyond the capture zone of the treatment system. Responsible parties – US Army and DEQ.

7.0 RECOMMENDATIONS

This section of the report contains recommendations for the upcoming year and recommended changes to the Action Plan.

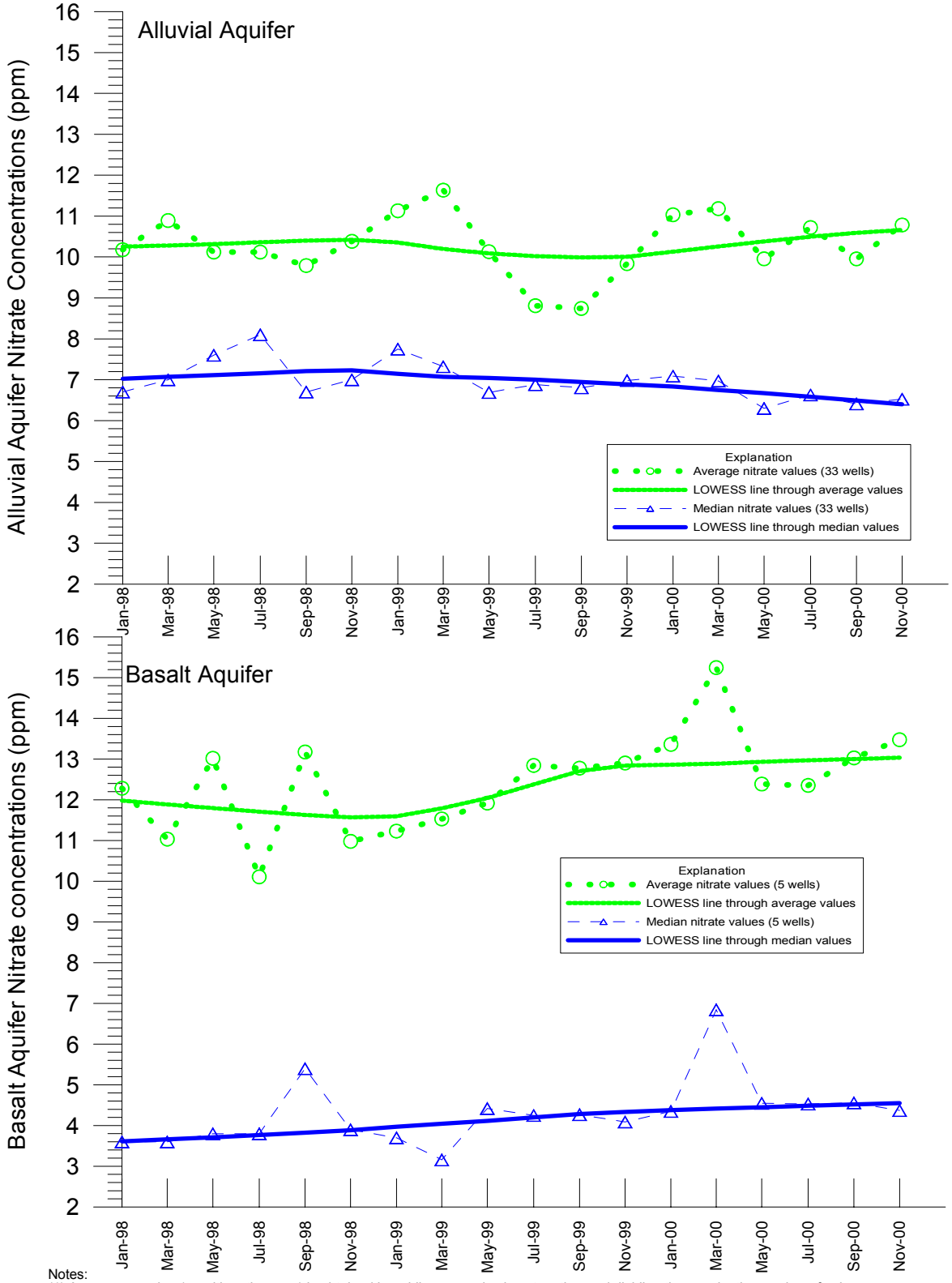
7.1 Recommendations for 2001

- DEQ should work towards implementing an economical alternative septic system demonstration project.
- DEQ should get educational materials produced in Spanish and make them available to the Spanish-speaking population within the GWMA.
- All interested and affected parties should work towards accomplishing the December 2001 goals.
- Explore the possibility of performing deep soil sampling at locations where high nitrates have been detected.
- DEQ and others should investigate the anomalously high nitrate values at several monitoring well network wells.
- DEQ and others should investigate the research needs for BMP determination and implementation as well as the hydrogeologic characterization of the GWMA.

7.2 Recommendations for Changes to the Action Plan

There are no recommended changes to the Action Plan at this time.

Figure 1
Summary of Nitrate Concentrations
Lower Umatilla Basin Groundwater Management Area



Notes:
(1) An average value (or arithmetic mean) is obtained by adding several values together and dividing the sum by the number of values.
(2) A median value is the middle number in a sequence of ranked values, or the average of the two middle numbers when a sequence has an even number of values.
(3) LOWESS is a data smoothing technique used to illustrate the general structure of a data set.

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Table 1
Comparison of Nitrate Values (in ppm) from Selected Sampling Events
Lower Umatilla Basin Groundwater Management Area

Alluvial Aquifer

Well ID	Oct-91 (1st bimonthly event)	Jul-92 (synoptic event)	Jan-98 (1st event after Action Plan adoption)	Mar-98	May-98	Jul-98	Sep-98	Nov-98	Jan-99	Mar-99	May-99	Jul-99	Sep-99	Nov-99	Jan-00	Mar-00	May-00	Jul-00	Sep-00	Nov-00	Minimum value per well; 1998 thru 2000	Maximum value per well; 1998 thru 2000	Median value per well; 1998 thru 2000	Average per well; 1998 thru 2000
UMA033	10	7.6	6.6	7.1	6.5	7.2	6.9	7	7.1	7.51	6.63	7.03	7.28	6.98	7.03	6.97	6.47	6.56	6.83	6.72	6.47	7.51	6.98	6.91
UMA034	2.5	2	5	6.8	3.5	6.3	5.5	4.6	4.9	7.32	7.37	4.1	3.64	3.46	3.72	5.16	4.83	3.94	3.32	3.01	3.01	7.37	4.72	4.80
UMA038	1.6	3	3.9	4.2	4.4	4.9	4.6	3	3	2.74	4.09	3.19	3.75	3.00	2.08	2.04	2.51	1.28	2.24	1.09	1.09	4.9	3.00	3.11
UMA039	2.1	1.3	3.5	2.4	3.1	ns	3.6	4	4.3	2.92	2.06	3.92	4.11	4.19	4.62	4.15	4.05	4.12	4.4	4.45	2.06	4.62	4.05	3.76
UMA046	1.4	0.47	0.56	1.2	0.49	0.5	0.67	0.54	0.51	0.912	0.507	0.83	0.872	0.406	0.459	0.782	0.474	0.533	0.776	0.473	0.406	1.2	0.54	0.64
UMA048	1.8	1.2	1.8	1.8	1.7	1.9	1.8	1.9	1.7	1.78	1.72	1.69	2.02	2.12	2.15	1.96	1.83	1.8	1.99	2.14	1.69	2.15	1.82	1.88
UMA056	6.4	6.6	6.8	6.9	6.8	6.5	6.5	6.5	6.8	7.32	6.75	6.73	6.86	6.69	6.46	7.02	4.56	6.76	6.41	6.33	4.56	7.32	6.74	6.59
UMA058	13	23	16	21	15	11	19	17	11	18.1	11.1	10.2	15.2	11.2	10.5	15.5	11	12.1	12.1	9.7	9.7	21	12.10	13.71
UMA066	4.8	6.5	8.5	8.3	8.8	8.4	8.6	8.8	8.8	9.38	9.07	7.6	6.75	8.05	8.76	9.1	8.18	6.7	7.5	8.07	6.7	9.38	8.45	8.30
UMA084	14	10	14	9.5	12	16	15	14	13	6.66	6.21	7.4	11.8	10.9	7.72	4.18	6.59	10.2	15.5	11.4	4.18	16	11.15	10.67
UMA085	20	22	**29**	29	29	28	**31**	**31**	**31**	31.5	**33.3**	**31.0**	**33.4**	**33.0**	**33.6**	**34.4**	**33.7**	**34.5**	**35.1**	35	28	35.1	32.25	32.03
UMA088	11	12	14	14	14	15	17	15	15	14.7	15.4	16.3	16.5	16.4	15.8	16.1	15.1	17.5	17.6	16.3	14	17.6	15.60	15.65
UMA094	13	10	11	9.3	8.5	8.1	9.5	8.4	8.4	8.17	7.41	7.44	7.59	7.14	7.15	6.99	6.49	6.56	7.42	7.04	6.49	11	7.52	7.92
UMA096	**25**	**31**	28	**32**	**31**	**31**	29	27	30	31.5	32.4	29.1	25.5	22.5	27.9	31.5	29.5	29.8	27.5	19.2	19.2	32.4	29.30	28.58
UMA103	17	21	20	18	18	18	18	16	18	18.4	18.8	17.4	18.2	17.0	20.8	21.7	20.9	22.4	22.5	20.7	16	22.5	18.30	19.16
UMA109	2.5	1.9	4.7	5.6	5.4	4.8	3.9	2.8	3.9	5.62	4.51	3.49	3.31	3.53	4.04	5.11	5.56	4.45	3.75	4.21	2.8	5.62	4.33	4.37
UMA110	6.8	5.9	5.7	3.8	8.4	9.3	9.3	6.8	5	3.93	5.69	7.51	8.34	4.72	3.81	4.39	6.13	7.26	8.27	5.69	3.8	9.3	5.92	6.34
UMA112	5	4.6	2.7	6.9	2.8	3.1	3.3	2.9	3.2	3.77	3.35	3.67	3.73	3.98	4.19	4.26	4.23	4.49	4.56	4.84	2.7	6.9	3.75	3.89
UMA116	3.1	3	4.3	4	4	4.2	4.3	4.3	4.5	4.57	4.27	4.26	4.49	4.92	5.08	4.98	4.25	4.3	4.85	4.89	4	5.08	4.30	4.47
UMA119	6.6	6.8	15	18	11	8.5	3.5	9.6	15	20.5	17.9	8.28	7.66	14.3	19	22.4	13.8	10.8	4.68	11.2	3.5	22.4	12.50	12.84
UMA122	8.1	9.7	14	22	26	21	15	13	17	24.4	31.3	21.6	11.9	14	19.4	17.8	20.9	34.4	24.4	22.2	11.9	34.4	20.95	20.57
UMA133	21	17	29	32	30	29	28	29	30	29.6	26	18.1	15.8	25.4	27.7	26.7	19.5	18.6	11.9	21.7	11.9	32	27.20	24.89
UMA144	2.9	4.9	18	20	13	12	12	17	19	19.7	17.4	4.33	1.46	11.2	15	17.6	12.4	10.5	9.69	10.5	1.46	20	12.70	13.38
UMA156	13	10	24	24	19	16	16	23	28	**32**	8	17.8	19.8	21.5	23.4	28.7	22.5	28.5	25.7	25.7	8	32	23.20	22.42
UMA160	0.06	0.02	0.02	0.02	0.02	0.4	0.67	6	<0.02	<0.004	0.0062	0.0063	3.03	0.0052	<0.0050	0.0054	0.006	<0.0050	2.61	0.0071	0.0052	6	0.02	0.91
UMA168	4.7	3.6	3.6	3.1	2.8	2.2	2.1	3.1	3.4	3.02	2.75	2.17	2.34	3.45	3.6	1.81	2.47	2.39	2.4	3.45	1.81	3.6	2.78	2.79
UMA180	0.14	0.7	1.3	1.7	1.6	2.2	2.7	ns	ns	3.99	4.12	5.00	5.41	ns	ns	ns	5.18	5.07	4.5	3.29	1.3	5.41	3.99	3.54
UMA185	0.13	0.11	0.14	0.13	0.15	0.15	0.15	0.12	0.14	0.135	0.138	0.139	0.143	0.143	0.149	0.139	0.143	0.148	0.149	0.147	0.12	0.150	0.14	0.14
UMA187	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.004	<0.004	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.004	<0.02	<0.0050	<0.02
UMA190	0.89	0.55	2.7	1.4	1.7	1.1	2.5	3.8	2.4	2.99	1.39	0.612	0.827	3.68	3.38	1.43	0.811	0.848	3.71	4.1	0.612	4.1	2.05	2.19
UMA191	0.37	0.87	0.9	1.4	1.2	1	1.2	0.73	0.87	1.22	1.14	0.909	1.15	0.793	0.679	0.958	2.22	1.7	1.13	1.14	0.679	2.22	1.14	1.13
UMA198	5.8	7.9	14	16	16	16	13	14	17	15.9	12	9.4	7.49	16.6	17.8	18.5	19.9	ns	ns	**41**	7.49	41	16.00	16.54
UMA201	12	11	17	17	18	20	19	21	21	20.4	21.4	20.7	19.4	23.7	25.01	24.3	22.4	23.4	25.1	29.4	17	29.4	21.00	21.57
Maximum per sampling event	**25**	**31.0**	**29.0**	**32.0**	**31.0**	**31.0**	**31.0**	**31.0**	**31.0**	**32.0**	**33.3**	**31.0**	**33.4**	**33.0**	**33.6**	**34.4**	**33.7**	**34.5**	**35.1**	**41.0**				
Median per sampling event	5.0	6.2	6.7	7.0	7.6	8.1	6.7	7.0	7.8	7.3	6.7	6.9	6.8	7.0	7.1	7.0	6.3	6.6	6.4	6.5				
Average per samping event	7.2	7.7	10.2	10.9	10.1	10.1	9.8	10.4	11.1	11.6	10.1	8.8	8.7	9.8	11.0	11.2	10.0	10.7	10.0	10.78				

Basalt Aquifer

Well ID	Oct-91 (1st bimonthly event)	Jul-92 (synoptic event)	Jan-98 (1st event after Action Plan adoption)	Mar-98	May-98	Jul-98	Sep-98	Nov-98	Jan-99	Mar-99	May-99	Jul-99	Sep-99	Nov-99	Jan-00	Mar-00	May-00	Jul-00	Sep-00	Nov-00	Minimum value per well; 1998 thru 2000	Maximum value per well; 1998 thru 2000	Median value per well; 1998 thru 2000	Average per well; 1998 thru 2000
UMA028	2.2	2.2	5.3	5.1	6.3	6.7	7.7	7.8	7.8	8.36	8.87	9.23	9.01	9.56	10.9	10.4	9.49	10	10.4	12.5	5.1	12.5	8.94	8.63
UMA029	**37.0**	**31.0**	**49.0**	**43.0**	**51.0**	**36.0**	**41.0**	**39.0**	**41.0**	**43.3**	**42.4**	**47.0**	**46.5**	**46.3**	**47.8**	**46.7**	**44.1**	**43.4**	**46.1**	**46.2**	36	51	45.10	44.43
UMA047	2.5	2.6	3	3	3.2	3.1	3.1	3	3	3.16	3.07	3.1	3.17	3.06	3.17	3.29	3.05	3.17	3.25	3.18	3	3.29	3.10	3.12
UMA106	0.8	0.75	0.52	0.47	0.8	0.94	0.9	1.2	0.66	0.792	0.834	0.644	0.938	1.51	0.584	0.601	0.747	0.67	0.837	1.13	0.47	1.51	0.80	0.82
UMA164	2.8	2.9	3.6	3.6	3.8	3.8	ns	3.9	3.7	2.04	4.42	4.25	4.27	4.09	4.35	ns	4.55	4.53	4.56	4.37	2.04	4.56	4.17	3.99
Maximum per sampling event	**37.0**	**31.0**	**49.0**	**43.0**	**51.0**	**36.0**	**41.0**	**39.0**	**41.0**	**43.3**	**42.4**	**47.0**	**46.5**	**46.3**	**47.8**	**46.7**	**44.1**	**43.4**	**46.1**	**46.2**				
Median per sampling event	2.5	2.6	3.6	3.6	3.8	3.8	5.4	3.9	3.7	3.2	4.4	4.3	4.3	4.1	4.4	6.8	4.6	4.5	4.6	4.37				
Average per samping event	9.1	7.9	12.3	11.0	13.0	10.1	13.2	11.0	11.2	11.5	11.9	12.8	12.8	12.9	13.4	15.2	12.4	12.4	13.0	13.5				

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