DEQ Water Quality Division

Second Four-Year Evaluation of Action Plan Success And 2005 / 2006 Annual Progress Report For the Lower Umatilla Basin Groundwater Management Area

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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 during 2005 and 2006. In addition, Section VIII, item B.2 of the Action Plan requires a review and evaluation of the effectiveness of the Plan be conducted as a joint effort between DEQ, ODA, the Committee, and the local lead organizations and local governments. As part of this review and evaluation, an assessment of the success of the Action Plan to date has been made.

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 that 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 (now known as the Department of Human Services). 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 DEQ samples a network of 33 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

In accordance with Section VIII, Item B.1 of the Action Plan, the purpose of this report is to outline the activities undertaken by the various interested parties related to implementation of the Action Plan during 2005 and 2006. In addition, this report gauges the success of Action Plan implementation during the second four years of implementation (i.e., 2002 through 2005) and provides an update to Section VII of the Action Plan. Finally, groundwater quality information collected from the bi-monthly monitoring well network is presented.

1.3 Important Facts About Nitrate

The following information is, in large part, from the June 2001 Oregon Health Division's Technical Bulletin - Nitrate Health Effects Information. Edits have been made to the "What is Nitrate and What Are Its Uses" section of the Technical Bulletin and a few comments on of blue baby syndrome have been included. This background information is provided 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 several nitrogen oxides of which nitrate is one. Nitrogen oxidation also occurs in aerobic growing and decomposing biological systems such as soils. Nitrogen is an essential component of living things and is a major component of animal manure, human sewage waste and many commercial fertilizers. Nitrogen in the environment occurs in organic and inorganic forms. There are two dominant inorganic forms: nitrate and ammonia. Most organic and inorganic nitrogen fertilizer sources are ammonia or organic based, not nitrate. Organic nitrogen converts to ammonia which gets oxidized to nitrate by the soil's microbiological system. Most plants take up nitrogen in the nitrate form. Nitrate must be present in the soil for adequate nitrogen uptake by plants. Nitrate has been used for centuries as fertilizers, in explosives and as a food preservative.

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 above the current MCL 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 indicate 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).

It has been suggested in human studies that 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.

It should be noted that some members of the LUB GWMA Committee believe that blue baby syndrome has not been shown to be a problem in the LUB GWMA. Their belief is based on the lack of reported cases of the illness in the area. Other members of the LUB GWMA Committee counter that argument by noting that the medical community is not required to report cases of blue baby syndrome. Regardless of the extent of the blue baby syndrome in the area, the LUB GWMA Committee is committed to reducing the level of nitrate contamination in groundwater.

Removing Nitrate From Drinking Water

Heating or boiling water containing nitrate will not remove the nitrate, the loss of water actually concentrates 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 Department of Human Services 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, 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, and is currently updating, a "Lower Umatilla Basin Groundwater Management Area Education and Outreach Plan". 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.

The following handouts are available in the Morrow County Planning Department and are provided upon request to local homeowners.

Water Handouts:

- LUB GWMA DEQ Fact Sheet
- Small Acre Conservation Toolbox
- Managing Small Acreage Horse Farms
- Disposal of Chlorinated Water
- Rural Domestic Water Supply and Conserving Water
- Keeping Your Well Water Well
- 12 Simple Things You Can Do To Protect Your Well Water
- Drinking Water and Health
- Sourcewater Collaborative: Advice Worth Drinking

Sewer Handouts:

- So…now you own a septic system
- The care and feeding of your septic system
- Groundwater protection and your septic system
- Interim Septage Storage Tanks
- Septic Tank Additives
- Septic System Management Landscaping and other Activities on Your Property
- Septic Systems & Stream Crossings Test Pit Preparation
- Septic Tank Maintenance (DEQ)
- Septic Tank Maintenance (OSU)
- Why Do Septic Systems Fail?
- Procedures and Criteria for Installing New Septic System

Home-A-Syst Handouts

- Worksheet 1: Drinking Water Condition
- Fact Sheet 1: Improving Drinking Water Well Condition
- Worksheet 2: Pesticide Storage and Handling
- Fact Sheet 2: Improving Pesticide Storage and Handling
- Worksheet 3: Fertilizer Storage and Handling
- Fact Sheet 3: Improving Fertilizer Storage and Handling
- Worksheet 4: Petroleum Product Storage
- Fact Sheet 4: Improving Petroleum Product Storage
- Worksheet 5: Hazardous Waste Management
- Fact Sheet 5: Improving Hazardous Waste Management
- Worksheet 6: Household Wastewater Treatment
- Fact Sheet 6: Improving Household Wastewater Treatment
- Worksheet 7: Livestock Waste Storage
- Fact Sheet 7: Improving Livestock Waste Storage
- Worksheet 8: Livestock Yards Management
- Fact Sheet 8: Improving Livestock Yards Management
- Worksheet 9: Milking Center Wastewater Handling
- Fact Sheet 9: Improving Milking Center Wastewater Handling
- Worksheet 10: Site Evaluation
- Worksheet 11: Overall Homestead Assessment

Forest Facts (from OSU)

- Forests and Drinking Water
- Landslides
- Reforestation
- Planting Tree Buffers
- Earthquakes
- Disposing of Woody Material
- Thinning
- Mechanical Fuels Reduction
- Pruning
- Carbon Storage in Forests

Also available upon request is the “Living with Umatilla and Morrow County Natural Resources” manual. 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.

E-notes, newsletters and website

The SWCD, through its' website http://www.umatillacountyswcd.com/, is maintaining a location for news about events and meetings of interest in Umatilla County and links to other newsletters and websites. Monthly, this information is sent out electronically to a growing number of recipients. Updates to groundwater information and programs will be regularly included. The periodic newsletter sent out both electronically and hard copy gives an accounting of events that the SWCD participates in and provides information about current programs.

Watershed Field Days

The Umatilla and Morrow SWCDs continue to participate in the annual Watershed Field Days sponsored by the Umatilla/Morrow Education Service District. Over the course of five days, approximately 800 fifth graders plus teachers and parents from Umatilla and Morrow County schools participate in the event which has seven stations with professional instructors covering natural resource topics. The Umatilla County SWCD and ODA staff cover water quality testing which includes testing and discussion of various water quality parameters including nitrate at 2 locations: one on McKay Creek between Pilot Rock and Pendleton, and the other at Oxbow Park in Hermiston. Students are given nitrate sampling strips to take home to test home well water.

Clean Water Neighborhood and PURE

With the assistance of funding through DEQ and OWEB, the Umatilla County SWCD RARE participant worked on developing the "Clean Water Neighborhood" project and assisted with creating PURE (Preserving Umatilla's Natural Resources through Education). The Umatilla County SWCD has applied for another RARE participant to continue with developing the Clean Water Neighborhood project.

It is envisioned that the Clean Water Neighborhood project include the following tasks:

- Identify interested persons/neighborhood to host neighborhood meetings to provide the rural residential community with information and alternatives on how to manage their property while protecting groundwater quality.
- Facilitate organization, discussion and presentations for neighborhood meetings
- Compile a "toolkit" of available resource materials and contact information to bring to the neighborhood meetings
- Produce a newsletter to report updated information and highlight accomplishments
- Follow up with neighborhood groups to assess progress of implementation
- Identify and reward individuals that have met their goals
- Organize informal workshops to provide information to larger audiences

The Preserving Umatilla's Resources through Education (PURE) program will be used to support an organized outreach effort to present a consistent message about groundwater protection and other relevant natural resource issues. Activities would include:

- Development and distribution of workbooks and informational packets
- Development and presentation of educational displays and demonstration models
- Organization and presentation of workshops about relevant natural resource topics such as small acreage management, pasture management, horse management
- Organization of annual seminars presenting updated information about precision agriculture and other relevant topics

- Participation in school related events such as Watershed Field Days, Outdoor School and classroom presentations

Precision Agriculture

In 2006, the Umatilla SWCD organized and presented the Precision Ag Seminar at the Pendleton Convention Center for 100+ local farmers and members of the public. The seminar featured educational programs on the Precision Agriculture Incentive Program. This seminar provided the latest information to agricultural producers about technical advancements in the field of precision agriculture. Additionally, they received funding from OWEB to fund an incentive program to provide monetary incentives for the implementation of variable rate fertilizer application to match the soil productivity. Soil testing and monitoring is required for participation in the program.

Public Schools and Civic Groups

In 2005 and 2006, the Umatilla SWCD participated in the 6th grade Outdoor School giving presentations on water quality testing and environmental protection using the Enviroscape model. In addition, they also gave presentations on groundwater quality to school kids at Sunridge Middle School in Pendleton.

In 2005 and 2006, DEQ personnel participated in several Outdoor School programs with kids from Stanfield, Hermiston, Echo, Arlington, Condon and Sherman County to demonstrate ways to prevent pollution of groundwater and surface water by using a groundwater model and an Enviroscape® model.

Hermiston OSU Extension faculty continue to discuss recommended practices to reduce nitrogen loading to the groundwater at Hermiston High School, local civic groups and to local Cub Scout Packs.

Morrow County Land Use Findings of Fact

All Findings of Fact for land use actions in Morrow County requiring a public hearing now identify if the subject property is located within the LUB GWMA and provide contacts for the applicant/landowner to obtain additional information.

Morrow County Water Use Committee

Morrow County established a Water Use Committee with one of its focuses being water quality. The intergovernmental Agreement (signed by Morrow County, Morrow County cities and towns, and the local irrigation district) specifically identifies the existence of the LUB GWMA.

Farm Fair

In 2005, a Groundwater Issues Forum was held with several presentations by Critical Groundwater Taskforce and Umatilla County Planning. Featured speaker was Dr. Todd Jarvis of the OSU/Institute for Natural Resources.

In 2006, the Critical Groundwater Taskforce held a visioning session to present an overview of the work done by the taskforce related to water quantity issues. The taskforce conducted a survey of Farm Fair attendees regarding knowledge of water quantity and quality issues.

In addition, there were general sessions on crop management for improving grower BMPs, some specifically targeting nitrogen use and efficiency.

Water Wells

On a regular 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)

ODA occasionally receives requests from CAFOs to assess the adequacy of their groundwater protection measures. When requested, ODA visits the site and provides recommendations.

In addition, ODA Technical Staff review scientific literature on a regular basis to keep up to date on CAFO issues.

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.

LUB Citizens Advisory Committee Meetings

The LUB Citizens Advisory Committee met on May 12, 2005. Agenda items included:

- a discussion of the 2005 Action Plan goals,
- a brief presentation of the first Food Processor Trend Analysis Report results,
- a discussion of appropriate follow up to the Trend Analysis Report by DEQ and the food processors,
- an update on the groundwater and surface water sampling for perchlorate,
- a request for information for the 2004 Progress Report, and
- a discussion of alternative onsite treatment technologies (i.e,, new septic system designs)

The LUB Citizens Advisory Committee met on February 23, 2006. Agenda items included:

- Finalization of 2004 LUBGWMA Progress Report
- Drafting of 2005 Evaluation of LUBGWMA Action Report and Progress Report
- The LUBGWMA Outreach and Survey Grant
    - The grant may receive funding from DEQ through the 319 Non Point Source Program. This grant will partially fund the completion of the three surveys required to evaluate Action Plan success.
- There will be a need for a meeting to discuss the 2005 Evaluation of LUBGWMA Action Plan Success Report, but no date has been set. It is anticipated to occur about one month after the three surveys are completed (Summer or Fall 2006).
- It was decided to combine the 2005 annual report and 4 year evaluation report into one report.
- The 2005 Goals for Lower Umatilla Basin Groundwater Management Area Action Plan were discussed.
- The 2003 Synoptic Sampling Event Report was discussed
- Perchlorate sampling results were discussed
- Recent grant proposals for the "Clean Water Neighborhood" project were discussed
    - The Umatilla County SWCD has applied for three grants to fund education and outreach in the LUBGWMA concentrating on both water quality and quantity.
    - Oregon Watershed Enhancement Board (OWEB) – "Community-Based Water Solutions"
        - Education and outreach project focused on water quality and quantity.
        - The project will be targeted at rural residents.

    - All information will be presented in English and Spanish.
    - This project was funded.
- DEQ 319 Grant – "LUBGWMA Outreach and Survey"
    - Education and outreach to cover none funding from OWEB.
    - Survey will include the CAFO, rural residential, and irrigation 2005 Action Plan Goals.
    - This project was funded.
- Environmental Protection Agency (EPA) – "Clean Water Neighborhood a Community-Based Water Solutions Approach"
    - Local community driven education and outreach.
    - Targeting rural residents for quality concerns.
    - This project was not funded.
- Additional grants will be pursued to funded outreach in the LUBGWMA.

Re-use Water Consortium Meetings

On June 22, 2005 a re-use water consortium meeting was held at the OSU Experiment Station in Hermiston to discuss appropriate follow up to the Trend Analysis Report. The bulk of the discussion revolved around trying to identify causes for water quality changes (both good and bad) that could be related to changes in land use. Little useful information was generated from the discussion.

As follow up on one of the recommendations of the draft document "Second Trend Analysis of Food Processor Land Application Sites in the Lower Umatilla Basin Groundwater Management Area", Phil Richerson (with DEQ) met with some of the food processors at a 5/25/07 Re-Use Consortium meeting.

The intent of the discussion was to attempt to identify the cause of the observed change in groundwater quality. Phil identified 30 wells from 8 sites whose time series plots show something interesting (usually a change in trend direction, but sometimes anomalously high or low values). Most of the wells selected show a change in trend direction towards lower nitrate concentrations, but some show a change towards higher nitrate concentrations.

The food processors discussed historic practices in the vicinity of these wells with emphasis on what might have happened to cause the changes observed at these wells.

Possible causes of improving water quality that can apply throughout the GWMA include:

- Following OSU fertilizer guide agronomic rates,
- Limiting and/or eliminating winter time irrigation,
- Improving winter time irrigation practices (e.g., drying fields out in the fall, more dispersion of water droplets through smaller nozzle sizes, using faster laps, and increased monitoring frequency (neutron probes) to twice a week during winter periods).
- Changing to crops that require less nitrogen and/or more efficiently utilize nitrogen,
- Reducing the amount of nitrogen applied,
- Using more freshwater,
- Practicing deficit irrigation, and
- Upgradient water quality improved.

Possible causes of improving water quality that are likely site specific include:

1. Dilution of groundwater nitrate concentrations resulting from implementation of Umatilla Project Phase II. The Phase II water exchange kept the Umatilla River water flowing longer in the year which likely increased the amount and duration of water going through Umatilla River flood plain sediments.

Possible causes of declining water quality include:

- Traditional irrigated agriculture practices,
- Over-application of wastewater (primarily in the past),

- Over-application of commercial fertilizer (primarily in the past),
- Pipeline breaks causing wastewater spills,
- Subsurface conditions switching from anaerobic to aerobic (causing ammonia to convert to nitrate and become mobile) when a pond dried out and cracked,
- Nitrate builds up in the vadose zone during dry years (when irrigators are more frugal with water) then flushes into the alluvial aquifer during wet years.

Presentations of "Water Quality Concerns in the Lower Umatilla Basin"

In 2006, DEQ staff gave a presentation discussing groundwater nitrate and perchlorate contamination in the Lower Umatilla Basin on 6 occasions to the following organizations:

- Oregon Water Coalition
- Umatilla/Morrow Head Start Policy Council
- Umatilla County SWCD
- Well Driller Continuing Education Workshop
- Hermiston Chamber of Commerce
- Morrow County SWCD

2.2 Residential Survey

The Umatilla County SWCD submitted an EPA/DEQ 319 grant application to conduct a survey that follows up on the 2001 survey. The survey, conducted in conjunction with the Blue Mountain Community College, involved 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. The survey (included in this document as Appendix 1) identified a lack of knowledge on how nitrate occurs and the potential effects of it.

2.3 General Cataloging of Information

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.

2.4 Printed Material

Living with Umatilla and Morrow County Natural Resources

In 2006, a manual was prepared that describes the natural resources of the Lower Umatilla Basin with emphasis on the fragile nature of the ecosystem and actions people can take to minimize their impact on the natural resources. The LUB GWMA is discussed in this booklet. This manual is designed to help the residents of Umatilla and Morrow Counties learn more about the natural resources of the region; as well as the benefits and issues associated with these resources. It includes contact and informational resources readers can utilize and success stories to get readers thinking about how they might better manage their little piece of the world. The booklet was prepared through the cooperation of the Morrow SWCD, Blue Mountain Resource Conservation & Development Council, EPA, Morrow County Planning Department, Umatilla County Planning Department, DEQ, and the Umatilla County Commissioners. It is available from the Columbia Blue Mt. Resource Conservation and Development office and can be requested by calling 541/278-8049, ext. 140.

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 August 2006. 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

Due to relocation of the Umatilla County SWCD office, their library will need cataloguing and reorganizing. Once that is complete, the following educational materials will be 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	Bev Kopperud Janet Greenup Don Horneck Loren Unruh	Umatilla County SWCD Morrow County SWCD OSU Extension NRCS	(541) 276-8131 (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	Carla McLane Tamra Mabbott	Morrow Co. Planning Umatilla Co. Planning	(541) 922-4624 (541) 278-6246
Groundwater quality protection guidelines related to lawn and garden maintenance	Bev Kopperud Don Horneck	Umatilla County SWCD OSU Extension	(541) 276-8131 (541) 567-8321
Groundwater quality protection guidelines related to well construction and maintenance		Oregon Water Resources Department	(541) 278-5456
Groundwater quality protection guidelines related to animal density	Eric Moeggenberg	Oregon Department of Agriculture	(541) 617-0055
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:

- Complete a Rural Residential Survey at the end of 2009.
- Translate additional educational materials into Spanish and make them available to the Spanish-speaking population within the GWMA.
- Pursue funding to implement the Clean Water Neighborhood and PURE projects.

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 since declaration of the GWMA. 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 applications of fertilizer are possible through center pivot and drip irrigation systems.

Some of the past 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.

During 2005/2006, ODA worked with one farm that had done extensive soil testing to determine statistically how many soil samples were needed per acre of land to determine nitrogen concentrations with a 95% confidence. Between 40 to 50 soil samples per 120 acre field were collected and analyzed. ODA staff then performed statistical analyses to determine the variability of the data with a confidence limit of 0.1 mg/kg N. By using this site-specific information, it was determined for this particular project that one sample per six acres was sufficient.

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.

No research regarding BMP determination for septic systems in rural residential development, CAFOs or the land application of food processing process water was conducted in the LUB GWMA in 2005 or 2006.

3.2 BMP Implementation

BMP implementation has occurred on several levels since declaration of the LUB GWMA. Specific examples of BMP implementation are discussed below.

Nutrient Management

ODA works with some of the permitted CAFOs in the LUB GWMA that also grow crops by reviewing their annual soil testing data. They then point out areas where excess nitrogen is present in the soil and require that this be accounted for agronomically in the next season's (or winter) crop.

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. The Northwest Irrigation Network is available to commercial growers and the community as a whole.

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.

Irrigation Conversions

The Umatilla County SWCD continues to apply for funding to convert small acreage farms from flood irrigation to a more efficient sprinkler or drip systems. These applications reportedly don't rank very high due to difficulty quantifying environmental benefits. However, the SWCD does have one approved project in the Diagonal Road area of Hermiston in which they assist Hermiston Irrigation District to complete a pipeline project that converts several rural residents from open ditch system to closed pipeline and sprinklers.

EQIP Projects

The Environmental Quality Incentives Program (EQIP) provides a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land. The program is implemented by NRCS.

In 2005, EQIP cost share dollars funded on 42 acres of irrigation water management and 107 acres of nutrient management in Umatilla County.

In 2005, EQIP cost share dollars were used on 435 acres in Morrow County where a variable speed pump controller allowed water use to be scheduled field by field.

In 2006, EQIP cost share dollars were used on 350 acres in Morrow County to install dual nozzle and low pressure drop tubes. This reduced water use from 800 gallons per minute down to 396 gallons per minute for most of the irrigation season.

Giddings Probe - OSU Extension Service provides maintenance and one-on-one training for a Giddings Probe used for deep soil sampling. It was checked out for 76 days for sampling in Umatilla and Morrow Counties between July and December 2006.

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.

Implementation of Recommended Management Practices – In addition to the specific goals specified for 2005 (discussed in Section 5.0), the Action Plan also lists several recommended practices for the irrigated agriculture community (Section VI, items A.2.c.1.a through p).

It should be noted that it is very difficult to quantify implementation of the recommended management practices. There were no new surveys of large commercial operations completed during this period that specifically address the management practices being implemented. Most of the recommended management practices are being implemented by commercial operations on an ongoing basis depending on crops grown, economic conditions, weather conditions and other variables. The information from the 1998 survey is still valid though probably understates the degree of implementation of some activities, primarily monitoring, soil testing and precision farming. Federal programs provide incentive payments and technical assistance for adoption of acceptable systems. The SWCD and OSU Extension actively promote adoption of BMPs for protection of groundwater. However, growers are not required to report any of their activities and surveys are very time consuming and intrusive into private business, therefore we have to extrapolate from what little existing data we have access to.

Analysis of the enrollment statistics for the USDA's Conservation Security Program reflects, to a large extent, the adoption of practices that meet at least the minimum NRCS standards for soil and water quality. Keep in mind that payment limitations prevent enrollment of all cropland in the basin though the same BMPs are likely used on many more acres. Refer to the "Lower Umatilla Basin Groundwater Management Area Irrigated Agriculture Survey Final Report" completed by the SWCD in 2006 for a more in depth analysis of CSP contracts along with data from irrigation districts and irrigation service providers. The conclusion of that analysis confirms that at least 85% of irrigated acres within the LUB GWMA are operating under BMPs.

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.

An amendment to the Morrow County Zoning Ordinance that restricted the number of animals on property zoned Rural Residential, Suburban Residential, and Farm Residential in 1998. Since adoption of the animal density requirements, several actions have been taken by the Morrow County Code Enforcement Officer to enforce those regulations. While there continue to be a few violations, often by the same landowners, general overall compliance has been achieved. Code enforcement actions will continue as necessary and needed.

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.

During the subdivision and partitioning of land in the LUB GWMA, Morrow County Planning require the seller to notify the buyer(s) of the potential for elevated nitrate levels in groundwater and encourage regular testing of well water.

Food Processor Process Water

Each of the food processors that land-apply water have a permit and an Operation, Monitoring, & Maintenance Plan (OM&M Plan) on file with DEQ. These documents detail various BMPs regarding nutrient management and water management, specific to their facility. An example of nutrient management that some facilities perform is post-harvest soil sampling (to help compare the amount of nitrogen applied to the amount of nitrogen removed). An example of water management that some facilities perform is soil moisture monitoring (to allow the control of deep percolation of process water).

3.3 Future Needs Regarding BMP Determination and Implementation

BMP research needs are discussed below. In accordance with the Action Plan, implementation of BMPs should be tracked to ensure that BMP implementation occurs. Currently this is not occurring in an organized fashion that will allow spatial analysis of BMP implementation relative to monitoring well nitrate concentrations. Tracking of BMP implementation in both time and space will allow evaluation of BMP effectiveness, and it will also allow success stories to be documented in a scientifically defensible manner.

Continued BMP development and implementation is also an important part of GWMA management. Since groundwater quality will change very slowly, performance of new and already existing BMPs should continue to be evaluated. Most BMPs have not been rigorously tested in a manner that ensures the target nitrate levels for groundwater will be achieved.

1. *BMP Implementation*
    a. *Develop and implement a survey of irrigated agriculture BMPs that are protective of groundwater quality.*

One recurring LUB GWMA Action Plan goal is to gauge the degree to which BMPs that are protective of groundwater are being implemented. To date, the methods used to estimate the extent of BMP implementation in the LUB GWMA have varied from survey to survey. It would be beneficial to develop a method of capturing BMP implementation information that allows periodic evaluation of the degree of BMP implementation. [Primary candidates for work are OSU Extension and the SWCDs].

b. *Document BMP implementation on the GWMA scale in a system that allows spatial analysis (e.g., GIS).*

It would be beneficial to track BMP implementation both temporally and spatially. This will allow quantification and documentation that action plan goals are being achieved and will also allow analysis of monitoring well water quality relative to BMP implementation. This provides the positive link between landowner activities and resultant water quality. It is anticipated that this is likely a very controversial and time-consuming task. Since privacy issues and perception of government priorities will be large drivers, those entities with higher credibility with the landowners will need to accomplish the work, and great pains will need to be taken to preserve landowner anonymity while still preserving scientific value. A very detailed work plan would be required for this item, but the results would be very valuable. [Primary candidates for work are OSU Ext, SWCDs, and OSU Geography (or other department with interest and GIS skill).]

c. *Field scale BMP performance evaluations.*

In some cases, it would be beneficial to perform evaluations of BMPs (both existing and experimental) at the field scale. Since the GWMA is highly variable, this process will provide case studies that show the viability of practices for production as well as environmental protection. Effectively, these studies will be demonstration projects and should have a strong outreach component. Proposed projects should have very well developed monitoring plans capable of documenting BMP performance. [Primary candidates for work are OSU Ext, Umatilla SWCD, OSU Bioresource Engineering, and OSU Crop and Soil Sciences.]

d. *Revise some of the fertilizer guides and recommended BMPs.*

Deficiencies were noted with various fertilizer guides. Several guides are approximately 20 years old, and they recommend rates and practices that are not consistent with present practices. On a case-by-case basis, fertilizer guides and BMP guidance documents should be revised. Plans to revise fertilizer guides should provide basic information that describes the deficiencies of the current document and the number of acres that will be affected by the revisions. Review and revision should also evaluate the environmental aspects of the document. Consideration should be given to adding a section giving environmental pointers (e.g., "To account for mineralization of nitrogen from organic sources, a mineralization N test can be used.", "Over-irrigation may result in leaching of nitrate.", etc.). [Primary candidates for work are OSU Ext and OSU Crop and Soil Sciences.]

e. *Mineralization N test.*

One particular BMP that should be evaluated is a mineralization N test. This test requires a digestion period (therefore, more lead time by the operator), but it provides information to the operator about how much nitrogen will become available to the plant during the growing season. A comparison of this test with other commonly used tests may encourage operators to use this test when applicable. This test may allow more accurate budgeting of nitrogen. [Primary candidates for work are OSU Ext and OSU Soil Sciences.]

f. Groundwater workshop for growers and certified crop advisors.

Reportedly, it is relatively difficult for certified crop advisors to satisfy their groundwater points requirement due to a general low number of workshops that qualify. For this reason, groundwater workshops in both GWMAs should be well attended. Sponsoring these workshops allows DEQ and ODA to ensure that the content is consistent with the intent of the action plans and with groundwater protection in general. [Primary candidates for work are OSU Ext, DEQ and the SWCDs.]

g. Develop outreach material/strategy for small acreage growers and/or lawn and garden care.

Small acreage growers and homeowners occupy a relatively small percentage of the GWMA. In those areas with higher density of residences, the effect of their practices on groundwater may be appreciable. Historically, these people have been very difficult to communicate with in an effective and efficient manner. Grants designed to effectively communicate environmentally protective practices to this demographic should be encouraged. Innovative approaches may be necessary to draw in these portions of the LUB Community. [Primary candidates for work are OSU Ext and the Umatilla SWCD.]

4.0 GROUNDWATER QUALITY MONITORING

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

4.1 Results of DEQ's Bi-Monthly Monitoring

As indicated in Section 1.1, the DEQ samples a network of 33 wells[1] every other month for analysis of nitrate. The results of this monitoring are presented in Table 4-1. Table 4-1 includes results from the 54 sampling events conducted since adoption of the Action Plan. In addition, results from two additional sampling events are included in Table 4-1: 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 involves the data collected since adoption of the Action Plan. The first trend analysis of the bi-monthly monitoring well network data required by the Action Plan is scheduled for early 2010, and will include a more thorough evaluation.

The maximum nitrate value observed between January 1998 and November 2006 at each well is identified in Table 4-1 with shading. The scattered distribution of the shaded cells indicates maximum nitrate values over the past nine 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 4-1 with large bold numbers. The maximum values in alluvial aquifer wells have most often been at well UMA085 (41 events) but have also occurred at well UMA096 (9 events), UMA198 (2 events), UMA156 (1 event), and UMA122 (1 event). The average nitrate concentration at well UMA085 is 36.2 ppm.

The large bold numbers also indicate the maximum nitrate value during the past nine years in the basalt aquifer wells has always been at well UMA029, if this well was sampled. Well UMA028 exhibited the highest nitrate concentration during the eight events well UMA029 was not sampled. The average nitrate concentration at well UMA029 is 47 mg/l. The average nitrate concentration at well UMA028 is 8 mg/l.

Figure 4-1 is a graph of all nitrate data from the bi-monthly well network from 1998 through 2006. The area-wide trend and a LOWESS line through all the data are also included. Figure 4-1 consists of many stacks of data points at 2 month intervals. Each of these stacks of data represents one sampling event and contains one data point for each well sampled that event. It is evident from Figure 4-1 that the highest concentrations detected have occurred in the latter portion of the dataset. It is also evident that most of the highest concentrations are from two wells: UMA029 and UMA085.

The area-wide trend is a statistically insignificant flat trend; meaning that with a low degree of confidence, it can be concluded that nitrate trends are staying essentially the same. In other words, the slope is zero (i.e, a flat trend) and the confidence level is low enough (i.e., 33%) that the trend is deemed statistically insignificant. The LOWESS line suggests nitrate concentrations have slightly declined from 1998 through 2006.

[1] The bi-monthly network originally consisted of 38 wells. Some well owners have since decided to discontinue their participation while other wells are no longer in use.

Table 4-1
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	Jan-01	Mar-01	May-01	Jul-01	Sep-01	Nov-01	Jan-02	Mar-02	May-02	Jul-02	Sep-02	Nov-02
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	6.8	6.82	6.73	6.84	6.88	6.98	7.22	7.26	7.28	7.01	7.28	7.2
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	3.76	5.04	3.47	3.39	2.95	2.82	3.73	4.49	4.22	2.26	2.55	2.35
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	2.38	3.51	1.69	0.983	2.96	4.23	2.88	2.76	*ns*	3.16	2.82	1.99
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	4.14	3.31	3.34	4.12	4.15	4.38	4.71	4.41	4.56	4.57	5.04	5.67
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	0.485	0.512	0.473	0.429	0.61	0.512	0.479	0.461	1.08	3.5	3.24	1.96
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	2.03	1.69	1.9	1.72	2.09	2.13	2.17	1.99	1.71	1.69	1.64	2.02
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	6.31	6.22	5.74	3.87	5.18	6.55	6.64	6.13	6.13	6.2	5.15	6.55
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	8.03	7.38	7.76	9.01	9.43	7.24	7.2	8.4	14.4	12.9	9.96	8.31
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	8.55	8.63	9.21	8.82	8.01	8.48	9.12	9.18	9.24	6.24	5.58	*ns*
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	8.32	5.23	6.19	10.8	12.5	9.16	6.75	4.36	3.94	3.35	5.68	7.61
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**	35.0	**34.4**	**34**	**35.1**	**36.6**	**36.3**	**36.9**	**37.9**	**37.0**	**38.3**	**37.8**	**38.1**	*ns*
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	15.2	14.9	14.9	16.4	17.9	16.3	16.4	15.8	16.5	18.5	17.9	17.5
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	6.57	6.17	6.32	6.78	7.09	6.98	7.16	6.79	6.78	7.16	7.56	8.01
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	28.4	30.5	33.2	30.2	18.8	26.6	31.4	32.8	34.0	29	19.7	12.8
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	21.6	20.5	19.3	19.4	18.7	20.1	22.6	22.2	23.3	20.4	13.9	20
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	4.6	4.86	6.43	5.80	5.33	4.96	5.32	5.02	5.71	4.15	3.88	4.43
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	5.72	5.27	3.22	4.45	5.5	3.48	3.09	2.63	2.95	4.64	5.63	4.85
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	4.49	4.44	4.19	4.68	4.63	4.78	4.28	4.32	4.51	4.12	4.01	3.73
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	4.38	3.99	4.56	4.49	4.26	4.18	4.85	4.75	4.81	4.07	3.23	3.43
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	8.27	21.2	19.9	11.4	5.58	12.4	16.1	19	16.1	9.16	8.05	13.3
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	25.9	25.2	30.8	32.2	23.5	26.1	25.9	29.7	30	31.8	26.9	**28.6**
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	22.9	21.7	15.8	17.3	16.1	19.0	20	18.8	16.4	14	15.8	16
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	13.6	16.2	11.6	10.0	9.36	9.88	12.5	14.8	14.3	10.5	8.30	7.74
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	26.4	26.0	17.8	14.4	10	22.0	27.3	27	17.4	14.9	12.0	17.3
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	<0.0050	<0.0050	0.0063	0.0077	0.151	9.67	<0.0050	8.46	5.84	7.99	15.4	13.6
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	3.44	2.94	3	2.92	2.99	3.45	3.62	2.1	3.55	3.2	3.36	3.95
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	3.19	3.36	5.53	8.56	7.32	4.37	3.86	3.48	5.52	5.37	5.24	2.75
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	ns	0.140	ns	0.149	ns	0.149	0.149	0.138	0.145	0.151	0.152	0.149
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	ns	<0.0050	0.0202	<0.0050	<0.0050	0.0059	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
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	3.31	6.23	2.03	1.17	1.77	7.80	5.3	2.39	1.88	1.73	0.655	5.21
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	1.1	1.27	3.14	1.37	0.954	1.00	0.712	1.42	1.19	2.07	0.160	0.523
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**	21	20.4	19	15.8	24.1	16.9	15.8	15.2	7.16	28.7	26.8	20.7
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	24.8	23.8	21.7	24.5	23.2	21.2	20.7	20.2	22.8	18.6	24.3	24.5
Maximum per sampling event	**25**	**31**	**29**	**32**	**31**	**31**	**31**	**31**	**31**	**32**	**33.3**	**31.0**	**33.4**	**33.0**	**33.6**	**34.4**	**33.7**	**34.5**	**35.1**	**41**	**34.4**	**34**	**35.1**	**36.6**	**36.3**	**36.9**	**37.9**	**37.0**	**38.3**	**37.8**	**38.1**	**28.6**
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	6.7	6.2	6.3	6.8	6.9	7.0	6.8	6.5	6.1	6.2	5.7	6.9
Average per sampling 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	11.0	11.0	10.1	10.0	9.6	10.0	10.8	10.7	10.7	10.3	9.7	9.1

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	Jan-01	Mar-01	May-01	Jul-01	Sep-01	Nov-01	Jan-02	Mar-02	May-02	Jul-02	Sep-02	Nov-02
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	**13.0**	**12.7**	12.3	10.3	9.38	11.7	**12.0**	**11.4**	10.6	8.31	7.59	8.15
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**	*ns*	*ns*	**45.2**	**46.6**	**33.7**	**45.7**	*ns*	*ns*	**49.6**	**48.6**	**49.2**	**49.3**
UMA047	2.5	2.6	3	3	3.2	3.1	3.1	3.0	3.0	3.16	3.07	3.1	3.17	3.06	3.17	3.29	3.05	3.17	3.25	3.18	3.08	2.99	3.07	3.24	3.22	3.24	3.31	3.19	3.38	3.43	3.4	3.31
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	0.489	1.40	0.759	0.83	0.861	1.49	0.743	0.469	0.595	0.894	0.552	1.25
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	4.27	*ns*	4.56	4.56	*na*	*ns*	*ns*	4.27	4.58	4.27	4.13	3.97
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**	**13.0**	**12.7**	**45.2**	**46.6**	**33.7**	**45.7**	**12.0**	**11.4**	**49.6**	**48.6**	**49.2**	**49.3**
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	3.7	3.0	4.6	4.6	6.3	7.5	3.3	3.7	4.6	4.3	4.1	4.0
Average per sampling 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	5.2	5.7	13.2	13.1	11.8	15.5	5.4	4.8	13.8	13.1	13.0	13.2

Table 4-1
Comparison of Nitrate Values (in ppm) from Selected Sampling Events
Lower Umatilla Basin Groundwater Management Area

Alluvial Aquifer

Well ID	Jan-03	Mar-03	May-03	Jul-03	Sep-03	Nov-03	Jan-04	Mar-04	May-04	Jul-04	Sep-04	Nov-04	Jan-05	Mar-05	May-05	Jul-05	Sep-05	Nov-05	Jan-06	Mar-06	May-06	Jul-06	Sep-06	Nov-06	Minimum value per well; 1998 thru 2006	Maximum value per well; 1998 thru 2006	Median value per well; 1998 thru 2006	Average per well; 1998 thru 2006
UMA033	7.57	7.08	7.39	7.18	6.97	6.98	7.28	7.08	7.22	6.95	6.92	6.93	7.09	6.89	6.92	6.97	7.15	6.85	6.83	6.76	6.63	7.08	7.04	6.69	6.47	7.57	6.98	6.98
UMA034	2.65	3.63	3.97	2.77	2.03	1.43	3.36	4.6	4.71	3.29	2.98	1.36	2.96	4.18	4.07	2.87	2.42	1.12	1.84	3.46	3.58	3.13	2.34	2.24	1.12	7.37	3.49	3.68
UMA038	*ns*	3.37	9.68	3.14	2.20	2.08	*ns*	2.53	5.02	2.66	3.2	2.23	1.33	2.28	2.71	1.92	*ns*	2.62	3.04	4	*ns*	4.04	3.1	1.46	0.983	9.68	2.88	3.02
UMA039	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	ns	1.08	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	1.08	5.67	4.13	3.91
UMA046	0.665	0.576	0.531	1.09	1.98	0.575	0.359	0.66	0.404	1.09	0.653	0.519	0.519	0.51	0.469	0.513	1.13	0.517	0.42	0.461	0.356	0.619	0.588	0.297	0.297	3.5	0.53	0.75
UMA048	1.88	2.02	1.83	1.73	1.65	2.18	2.22	1.92	2.06	1.88	2.05	2.09	2.19	1.92	1.55	1.78	1.9	2.02	1.69	1.49	1.4	1.51	1.98	1.45	1.4	2.22	1.89	1.87
UMA056	6.63	6.48	6.60	6.23	6.27	6.14	6.27	6.31	6.49	6.01	6.09	5.88	6.32	6.14	5.9	6.15	6.18	5.83	6.2	6.07	0.578	6.12	5.82	5.06	0.578	7.32	6.29	6.13
UMA058	7.2	8.28	8.4	9.22	9.55	8.30	8.11	7.91	9.63	9.31	7.89	7.01	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	7.01	21	9.7	10.89
UMA066	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	5.58	9.38	8.55	8.29
UMA084	4.23	3.68	7.66	9.06	11.8	10.0	6.91	4.54	10.7	13.7	15.1	12.5	*ns*	6.4	9.3	9.9	13.5	18.6	11.8	9.34	15.3	17.5	16.6	*ns*	3.35	18.6	9.7	9.89
UMA085	**40.2**	**38.8**	39.3	**39.2**	**37.9**	**38.7**	**39.2**	**37.7**	**40.2**	**39.9**	**40.1**	**39.7**	**41.6**	**41.2**	**42.1**	**41.6**	**43.2**	**42.5**	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	28	43.2	36.9	36.21
UMA088	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	14	18.5	16.20	16.00
UMA094	7.66	7.62	*ns*	4.24	7.3	6.84	6.45	6.12	6.13	6.03	7.95	8.51	8.9	8.52	7.99	8.35	*ns*	10.6	10.5	10.4	9.4	10.8	11.6	11.6	4.24	11.6	7.50	7.87
UMA096	25.5	31.5	32.4	30.3	19.9	18.5	29	31.9	33.1	31.8	21.1	19.6	31.9	33.2	37.1	35	36	35.6	**32.2**	**33.5**	**35**	**35.9**	**36.2**	**30.5**	12.8	37.1	30.5	29.23
UMA103	*ns*	*ns*	*ns*	26.6	23.3	18.7	29	27.5	ns	27	20.4	24.4	30.3	30.5	27.1	26.3	24.4	24.2	27.1	27.1	30.5	25.5	17.7	21.7	13.9	30.5	20.9	21.92
UMA109	4.53	4.79	4.51	3.19	3.16	3.72	3.75	3.9	3.74	3.08	3.03	2.84	3.55	3.82	3.25	3.46	3.23	3.04	3.21	3.96	4.79	4.77	3.84	*ns*	2.8	6.43	4.04	4.23
UMA110	4.41	3.74	4.40	5.45	5.17	4.68	3.8	3.27	2.68	3.48	4.07	3.01	2.83	2.46	1.89	2.4	4.42	3.03	2.24	2.59	2.9	4.41	5.65	4.51	1.89	9.3	4.42	4.68
UMA112	3.68	3.68	3.65	3.47	3.72	3.22	3.04	3.06	3.12	3.01	2.82	2.72	2.7	2.65	2.59	2.49	2.48	2.37	2.32	2.2	2.11	2.12	2.01	2.01	2.01	6.9	3.56	3.51
UMA116	4.58	4.61	4.43	3.97	3.29	3.61	4.67	4.11	4.55	3.93	3.22	3.32	4.98	4.62	4.12	3.92	3.4	3.51	4.87	5.12	4.44	4.14	3.38	3.02	3.02	5.12	4.30	4.25
UMA119	17.9	20.5	11.7	12.6	8.31	9.97	11.3	14.4	14.5	13.9	13.9	17.4	19.1	21.5	17.7	15.3	13.2	17.6	17.1	17.9	22	13.8	14.1	14.2	3.5	22.4	14.2	14.10
UMA122	28.1	29.0	32.0	32.8	28.7	27.8	27.7	24.3	31.5	30.9	25.1	24.5	25.7	31.4	29.8	31.5	32.9	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	11.9	34.4	26.0	25.54
UMA133	17.1	17.2	15.5	14.1	13.3	15.2	16.6	15.5	14.6	14.2	13.7	15.6	*ns*	16.9	15.4	13.9	13.9	15.9	16.8	16	15.5	15.2	13.8	*ns*	11.9	32	16.7	19.19
UMA144	8.59	12.1	9.85	9.34	9.81	9.16	14.5	16.2	12.5	13.5	14.6	12.1	12.2	18	13.9	10.9	18.4	17.6	14.6	10.8	14.6	11.8	7.52	7.55	1.46	20	12.2	12.59
UMA156	22.5	27.0	17.7	11.9	10.8	17.7	22.3	25.6	25.9	12.5	13.3	14.8	*ns*	20.9	21.4	12.8	12.6	20.2	18.7	26.6	25.4	15.5	21.8	*ns*	8	32	21.2	20.27
UMA160	2.74	1.52	0.0245	12.7	18.5	14.4	5.6	15.1	13.6	17	27.5	10.7	16.2	0.122	9.44	15.4	23.4	0.156	5.91	8.96	11.5	26.4	14.4	7.88	0.0052	27.5	5.91	7.51
UMA168	4.11	2.71	3.79	3.42	3.22	4.21	4.31	3.34	3.65	3.55	3.15	3.77	5.39	4.93	3.66	3.51	3.5	4.13	4.26	3.84	2.88	3.04	4.28	5.19	1.81	5.39	3.41	3.34
UMA180	3.58	3.70	3.88	3.88	3.81	2.82	3.28	3.4	3.65	4.05	4.11	4.33	4.09	4.34	4.57	4.89	0.224	6.78	7.91	6.87	4.26	8.93	7.45	6.23	0.224	8.93	4.11	4.40
UMA185	0.147	0.146	0.146	0.145	0.150	0.161	*ns*	0.143	0.143	0.147	0.152	0.152	0.157	0.146	0.151	0.147	0.153	*ns*	0.16	0.15	0.144	0.151	0.151	0.143	0.12	0.161	0.15	0.15
UMA187	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.005	0.0202	0.0059	0.01
UMA190	*ns*	2.43	4.92	2.41	1.5	5.30	4.95	3.01	2.35	2.27	1.86	5.46	1.98	3.06	2.84	1.16	1.6	1.89	3.15	1.8	2.18	2.67	2.17	0.695	0.612	7.80	2.35	2.65
UMA191	0.521	0.869	2.62	0.769	0.239	0.179	0.185	6.1	2.86	1.47	0.253	0.46	0.673	0.868	0.868	0.674	0.836	0.962	0.744	1.08	1.23	0.576	0.276	0.469	0.16	6.1	0.96	1.13
UMA198	16.6	16.5	**42.6**	36.1	32.6	32.6	9.18	20.1	12.3	14.1	35.9	19.4	22.1	13.5	7.42	7.21	7.35	18.6	15.5	16.2	*ns*	7.56	39.5	19.6	7.16	42.6	16.6	18.80
UMA201	23.9	21.6	22.1	20.4	16.2	18.2	19.5	19.2	20.6	13.7	25.5	26.7	28.8	27.1	25.5	25.1	20.9	23.7	23.1	23.9	25.2	7.4	11.2	23.8	7.4	29.4	21.9	21.70
Maximum per sampling event	**40.2**	**38.8**	**42.6**	**39.2**	**37.9**	**38.7**	**39.2**	**37.7**	**40.2**	**39.9**	**40.1**	**39.7**	**41.6**	**41.2**	**42.1**	**41.6**	**43.2**	**42.5**	**32.2**	**33.5**	**35.0**	**35.9**	**39.5**	**30.5**				
Median per sampling event	5.6	4.7	6.6	6.2	7.0	6.8	6.5	6.1	6.3	6.0	6.5	6.9	5.4	5.5	6.4	6.6	6.7	6.3	5.9	6.4	4.6	6.6	6.4	5.1				
Average per sampling event	10.3	10.2	11.2	10.9	10.1	10.1	10.8	11.0	10.6	10.5	10.9	10.3	11.3	11.4	11.1	10.6	11.5	11.2	9.0	9.6	10.1	9.3	9.8	8.0				

Basalt Aquifer

Well ID	Jan-03	Mar-03	May-03	Jul-03	Sep-03	Nov-03	Jan-04	Mar-04	May-04	Jul-04	Sep-04	Nov-04	Jan-05	Mar-05	May-05	Jul-05	Sep-05	Nov-05	Jan-06	Mar-06	May-06	Jul-06	Sep-06	Nov-06	Minimum value per well; 1998 thru 2006	Maximum value per well; 1998 thru 2006	Median value per well; 1998 thru 2006	Average per well; 1998 thru 2006
UMA028	8.48	**8.13**	7.54	6.54	5.8	**6.26**	**6.27**	**6.14**	5.71	4.74	5.46	5.62	6.26	6.25	6.17	5.85	5.93	6.2	4.49	6.66	6.32	5.74	5.84	4.68	4.49	13.0	7.65	7.96
UMA029	**52.1**	*ns*	**33.5**	**51.8**	**49.5**	*ns*	*ns*	*ns*	**36.8**	**35.4**	**52.7**	**53.2**	**54.2**	**52.9**	**53.3**	**52.8**	**54.5**	**54.6**	**52.3**	**44.8**	**43.8**	**49.4**	**53.6**	**61.3**	33.5	61.3	46.9	47.0
UMA047	3.29	3.44	3.41	3.50	3.49	*ns*	3.33	3.4	3.45	3.52	3.35	3.4	3.45	3.46	3.75	3.45	3.57	3.54	3.56	3.47	3.4	3.84	3.54	3.5	2.99	3.84	3.31	3.30
UMA106	*ns*	0.574	0.965	1.1	0.944	1.85	0.819	0.825	1.03	0.915	*ns*	1.79	1.24	0.554	0.758	0.805	0.987	1.38	*ns*	0.785	0.692	1.03	0.72	*ns*	0.469	1.85	0.83	0.90
UMA164	4.18	4.14	4.3	4.14	3.98	3.9	3.81	4.19	4.21	4.19	4.03	4.03	4.23	4.4	4.62	4.48	4.53	4.56	4.53	4.47	4.7	4.88	4.62	4.63	2.04	4.88	4.27	4.21
Maximum per sampling event	**52.1**	**8.13**	**33.5**	**51.8**	**49.5**	**6.26**	**6.27**	**6.14**	**36.8**	**35.4**	**52.7**	**53.2**	**54.2**	**52.9**	**53.3**	**52.8**	**54.5**	**54.6**	**52.3**	**44.8**	**43.8**	**49.4**	**53.6**	**61.3**				
Median per sampling event	6.3	3.8	4.3	4.1	4.0	3.9	3.6	3.8	4.2	4.2	4.7	4.0	4.2	4.4	4.6	4.5	4.5	4.6	4.5	4.5	4.7	4.9	4.6	4.7				
Average per sampling event	17.0	4.1	9.9	13.4	12.7	4.0	3.6	3.6	10.2	9.8	16.4	13.6	13.9	13.5	13.7	13.5	13.9	14.1	16.2	12.0	11.8	13.0	13.7	18.5				

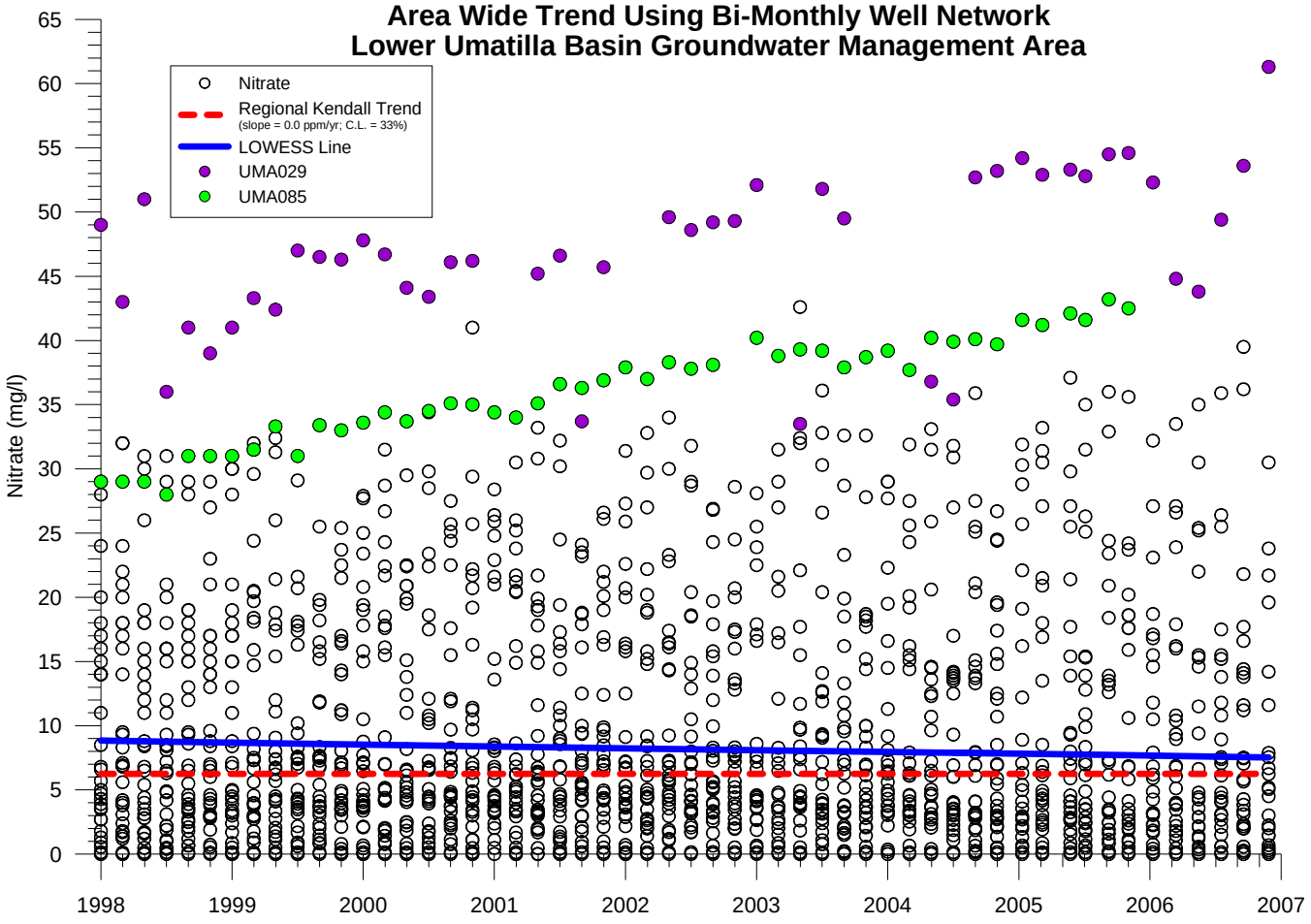
Notes:

na = not analyzed

ns = not sampled

E:\LUB\Annual Progress Report - 2002\[Lub Well Comparison.xls]

Figure 4-1
Area Wide Trend Using Bi-Monthly Well Network
Lower Umatilla Basin Groundwater Management Area



4.2 Monitoring at Food Processor Process Water Land Application Sites

The Action Plan requires that a trend analysis of groundwater monitoring data from food processor wastewater land application sites be conducted. Specifically, the goal of Section VIII, Item G.3.c is that by December 2005, "monitoring data shows improving groundwater quality trends for nitrate" and that permitees are "meeting permit conditions and objectives".

There are six facilities (consisting of 12 sites) within the LUB GWMA that land applied food processing water in 2005 and are thus targeted by this goal. The nitrate trends at 133 wells located at or near the 12 sites have been evaluated. Of the wells evaluated, approximately 58% have increasing trends, 20% have decreasing trends, and 22% have statistically insignificant trends. It should be noted that these wells are located upgradient, downgradient, cross gradient, and within these land application sites. Nitrate trends are increasing at most wells, and at most sites. One the whole, the rate of increase is slower than it was during the previous analysis. A report titled "Second Trend Analysis of Food Processor Land Application Sites in the LUB GWMA" which discusses the trend analysis and draws conclusions regarding upgradient and downgradient concentrations and trends is available at http://www.deq.state.or.us/wq/groundwater/lubgwma.htm.

4.3 Monitoring at the US Army Umatilla Chemical Depot Washout Lagoons

The following information appears in the 2005 Annual Report Umatilla Chemical Depot Explosives Washout Lagoons Groundwater Treatment System prepared by SCS Engineers.

- Data collected during this reporting period indicated that the treatment plant was performing adequately, and effectively treated the extracted groundwater prior to discharge. While the system is performing as designed, influent concentrations have declined substantially, thus reducing the rate of total contaminant mass removal. Groundwater monitoring data indicate that during system operation the plume appears to be contained.
- RDX, the most mobile of the contaminants, has the largest plume. RDX appears to have spread beyond the Explosives Washout Lagoons. The TNT plume extends over a smaller area as a result of TNT having lower transport mobility. The TNT plume is centered under the Explosive Washout Lagoons.

The first two statements seem to be inconsistent in that RDX is present in groundwater outside the washout lagoon area while the treatment plant is performing adequately. A lobe of RDX contamination exists beyond the capture zone of the groundwater extraction system. The system as currently designed and operating is not able to fully remove portions of the RDX plume, which is a significantly larger plume than the TNT plume. DEQ and the Army are discussing options to address the portion of the RDX plume that extends beyond the Explosives Washout Lagoons.

- All effluent samples remained below the Record of Decision (ROD) remediation requirement levels of 2.8 µg/l for TNT and 2.1 µg/l for RDX. *Authors note: the remediation system is not designed to remove nitrate.*
- During operation from March to December 2005, the treatment plant processed approximately 450 million gallons of explosives contaminated groundwater. To date, approximately 4.6 billion gallons of water have been treated. All treated groundwater was discharged back to the subsurface through infiltration fields.
- The amount of explosives removed from the contaminated groundwater during the operation period during the contract year was approximately 62 pounds. To date, approximately 12,806 pounds have been removed. The rate of contaminant mass removal has generally declined with time.
- Since the groundwater remediation plant began operation in December 1996, the levels of most explosives in the groundwater at most of the extraction and monitoring wells have been decreasing. The results from April, July, and October 2005 generally demonstrated the continuation of this downward trend.
- The April and October 2005 concentration contour maps demonstrate that the overall footprint of the most highly contaminated zones have continued to decrease in size since the system was restarted in March 2005 (after a five month shut down), and indicate the effectiveness of the groundwater extraction and treatment system. The infiltration modifications performed in 2002 appear to have had a positive influence on plume geometry.

4.4 Isotopic / Age Dating Project

In January and April 2004, groundwater samples were collected from 7 wells at the ConAgra North Farm (a food processing wastewater application site) and from 10 wells at the adjacent Umatilla Chemical Depot landfill. In August 2004, groundwater samples were collected from 9 wells at the Simplot Terrace site (a food processing wastewater application site) and 3 temporary wells installed downgradient of the Terrace site and the adjacent animal feed lot. Unsuccessful attempts were made to install temporary wells at a traditionally operated agricultural field near Irrigon.

Groundwater samples were analyzed for nitrate stable isotopes, nutrients, major ions, and age-dating constituents. The purpose of the sampling was to determine if nitrate from food processing wastewater could be distinguished from other sources of nitrate like animal and human waste, soil nitrate, and

commercial fertilizer. The study determined that it was not possible to differentiate between food processing wastewater and other nitrate sources. Efforts are underway to publish the results.

The apparent recharge ages derived from this project are of particular interest, and are discussed below. Some samples were analyzed for tritium (^3H) and its radioactive decay product helium-3 (^3He). The tritium/helium-3 ratio was used to calculate the apparent age of the water. The apparent age is defined as the time elapsed since the parcel of water was isolated from the atmosphere following recharge.

North Farm

Four of the samples (one from the North Farm and three from the Depot) were analyzed for age-dating constituents. The four wells tested include the North Farm well MW-10 and the Depot landfill wells 11-3, MW-33, and 11-7. The Depot landfill wells are located downgradient of MW-10 (approximately ⅜ to ⅞ mile west of MW-2). Apparent recharge age results were 5 years at the North Farm Site well and greater than 50 years at the 3 Depot landfill wells.

The young age of groundwater at MW-10 suggests groundwater impacts at the North Farm are, in large part, due to recent facility operations. The old age of groundwater at the Depot landfill wells suggests relatively minor effects from recent wastewater application at the North Farm Site are evident at the landfill.

Terrace Site

Six of the samples collected (four from the Terrace Site wells and two temporary wells north of the site) were analyzed for age-dating constituents. Apparent recharge age results ranged from 1.6 years (at MW-53) to 48.9 years (at MW-14). Other results included 1.9 years (at MW-39), 2.6 years (at MW-40), 7.8 years (at Terrace-1) and 8.2 years (at Terrace-2). The average of all six age dates is 11.8 years while the average of the four age dates from the Terrace Site is 13.8. The geometric mean (which is a useful way of characterizing the central tendency of such a highly skewed data set) of all six age dates is 5.4 years while the geometric mean of the four age dates from the Terrace Site is 4.4 years.

The young age of groundwater at the Site suggests groundwater impacts at the Terrace Site are, in large part, due to recent activities at land surface. It is unclear why the water at well MW-14 appears to be so much older than the other wells sampled. The boring that contains MW-14 is 30 feet deeper, and the well screen is 5 feet lower in elevation than the next deepest well dated. If water entering well MW-14 is from deeper in the aquifer, the older age may be due to mixing groundwater of differing ages.

5.0 DECEMBER 2005 GOALS

Section VIII.C.2 of the Action Plan states that after the eight years of implementation, the success of the Action Plan will be based on whether the protection strategies are still being promoted and whether a high enough proportion of the citizens and organizations are participating in adopting recommended practices, activities and strategies to protect groundwater quality (qualitative evaluation of adoption rates only).

Five goals were identified in Section VIII.G of the Action Plan as having December 2005 deadlines. These five goals relate to the five contributors of nitrate, and are discussed below.

5.1 Irrigated Agriculture

Goal

By December of 2005, 85% 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.

Accomplishments

As described below and in the survey included as Appendix 2, the Umatilla County SWCD has concluded that this goal has been met. An EPA/DEQ 319 grant was secured which, in part, funded the completion of a survey to gauge this goal. As explained in the document "Lower Umatilla Basin Groundwater Management Area Irrigated Agriculture Survey Final Report" the Umatilla County SWCD concluded that at least 85% of irrigated acres within the LUB GWMA are operating under BMPs.

The primary means for determining achievement of the goal was the amount of participation in the NRCS Conservation Security Program (CSP). Information from the Oregon Water Resources Department, local irrigation districts, and irrigation consultants was used to supplement the CSP information. Because not all of the acreage in the LUB GWMA was eligible for the Umatilla Basin CSP contracts, the information used to gauge success came from an area covering about one-third to one-half of the GWMA. It is not known if the level of participation in the Umatilla Basin CSP contracts is representative of the LUB GWMA as a whole.

5.2 Rural Residential

Goal

By December of 2005, through a random survey, 80% of area residents are aware of the groundwater nitrate problem and know of at least one activity or practice that contributes to the problem. 50% of those surveyed can cite at least one activity or practice they have changed because of their awareness of its impact on groundwater quality. Responsible parties – Local governments, SWCD and OSU Extension Service.

Accomplishments

As described below and in the survey included as Appendix 1, this goal was either not met or not specifically measured. An EPA/DEQ 319 grant was secured which, in part, funded the completion of a survey to gauge this goal. The document "Lower Umatilla Basin Groundwater Management Area Residential Survey Final Report May 1, 2007" makes the following conclusions from a telephone survey of 100 households in the GWMA regarding these goals:

- Regarding the goal that "80% of area residents are aware of the groundwater nitrate problem…", the following results are less than the goal of 80%.
    - A little over half (51%) of the individuals surveyed in 2007 had heard of concerns regarding the quality of groundwater. This result is similar to the 1999 results (57%) and higher than the 2001 results (37%). Of those who had heard of concerns in 2007, 19% were aware of high nitrate levels in the groundwater (as compared to 24% in 1999, and 13% in 2002).
- Regarding the goal that "80% of area residents know of at least one activity or practice that contributes to the problem", the following results are less than the goal of 80%.

  - When asked "closed-ended questions" about nitrate contributors (i.e., they were asked to answer yes or no if they knew a specific practice was a nitrate contributor), approximately three fourths of the respondents knew that improper fertilizing (76%), septic system location and density (72%) and improper storage of fertilizers and household chemicals (70%) were contributors to the buildup of nitrates in the groundwater. Additionally, more than half knew that concentrated animal manure piles (60%), improper well location (58%) and concentration of outdoor animals (55%) were also contributors. Approximately half knew that well leakage, age of well and improper watering were also of concern.
  - When asked "open-ended questions" about nitrate contributors (i.e., they were asked to name possible nitrate contributors), awareness was quite low and has decreased for agriculture, food processing plants, and animal feeding operations since 1999, while increasing slightly for the Umatilla Army Depot.
- Regarding the goal that "50% of those surveyed can cite at least one activity or practice they have changed because of their awareness of its impact on groundwater quality", the following results indicate a general awareness of protective measures but the survey did not specifically gauge their actions.
  - When respondents were told a list of steps or actions to reduce the buildup of nitrates in the groundwater, a majority of respondents knew about most all of the positive steps or actions the local community could take to reduce nitrate buildup".

Goal

By December of 2005, all local governments can cite procedures, requirements and/or practices they have instituted as a result of the declaration of the GWMA. Responsible parties – local governments.

Accomplishments

As indicated below, this goal was partially met. Some governments can cite specific practices they have done as a result of the GWMA declaration, some can cite specific practices they have done as a result of the groundwater nitrate contamination (but not necessarily the GWMA declaration), while other governments have not had the resources to implement changes.

Morrow County Planning Department has done the following as a result of the declaration of the GWMA:

- Amended the Morrow County Zoning Ordinance to restrict the number of animals on property zoned Rural Residential, Suburban Residential, and Farm Residential.
- During the subdivision and partitioning of land in the LUB GWMA, Planning staff indicates that the selling land owner is responsible for notifying buyers of the potential for elevated nitrate levels in groundwater and encourage regular testing.
- All Findings of Fact for land use actions requiring a public hearing now identify if the subject property is located within the LUB GWMA and provide contacts for additional information.
- Due in part to the declaration of the GWMA and in part due to groundwater quantity concerns, Morrow County established a Water Use Committee.

Umatilla County has done the following to implement the LUBGWMA Action Plan implementation:

- Staff usually address nitrate contamination when reviewing administrative land use applications in the GWMA. If a subject property is located in the GWMA a reference is included in the findings document with a recommendation to contact DEQ to learn more about the GWMA and nitrates.
- Any partitions with proposed parcel sizes less than four acres in size require a favorable site suitability report from DEQ prior to staff approving a partition. Please note that the favorable site suitability report is usually for a standard system which DEQ states does not minimize nitrate loading resulting from septic effluent. If DEQ were to require ATT's etc. in the GWMA staff could add a condition of approval that ATT's be installed.

- Large developments require the applicant to show, prior to approval, that they can meet DEQ standards and obtain the necessary waste water permits.
- The planning office has completed a lot of outreach associated with water quality and quantity. The Task Force has run numerous articles and adds that focus on both water quality and quantity. There are numerous brochures and a 14 page printed newspaper pamphlet that address quality and quantity at the front counter for people to read or take home.

The City of Echo applies only limited fertilizer on City facilities to minimize the potential for groundwater contamination. There are only five septic systems in Echo, and City ordinance requires connection to the municipal wastewater system if the home is within 200 feet of a sewer line.

The City of Umatilla has extended their wastewater system into three areas adjacent to the city limits. This will allow additional development to utilize the City's wastewater treatment system rather than individual septic systems.

The City of Hermiston has land use policies that are intended to prevent further groundwater nitrate contamination. For example:

- All failing septic systems with 300 feet of existing sewer lines must connect to the municipal wastewater system.
- No new septic systems are allowed inside the City limits.
- New development outside the City Limits but within the Urban Growth Boundary are encouraged to be annexed so that they can be connected to municipal water and wastewater systems.

The City of Boardman has implemented several different mechanisms which are complimentary to the LUB GWMA. Although these actions have not been in direct response to the criteria developed by the Committee for LUB GWMA , they are in responsive to potential contamination threats with new and, to a lesser extent, existing developments. Some of the actions taken include the following bulleted list:

► Through an EPA Wellhead Protection Demonstration Project Grant the delineation of the city's collector wells through numerical computer modeling techniques was completed in 1992. This delineation established 1, 5, 10 and 20 year times of travel to the city's horizontal collector well sites at maximum flow rates allowed under Oregon Water Resource Permit for the water source.

► The City established, during land use approval, a review of all new development within the Wellhead Protection delineation boundaries to assure contamination risk is addressed in a manner to prevent contamination of the city's drinking water source from land use activities. This review identifies potential contamination risks, solutions and existing state, federal or local regulations to be met.

► The City has established the wellhead protection area on the Natural Resources Map along with flood plain areas, and other natural resources to allow for protection of the resources under development code criteria.

► The City adopted a new Development Code, adapted from the State of Oregon Model Code, in 2002. This Development code has specific requirements for development throughout the city and has review processes identified which allow for the review of groundwater protection identified in the second bullet above.

► The City has established new storm water management techniques within the Development Code with a chapter on storm water management. Chapter 3.5 – Stormwater Management is available for review or copy on the city's website by following the link provided as follows: http://www.cityofboardman.com/dev_code/chap3_5.pdf

► The new storm water techniques are designed to allow for retention and infiltration of storm waters into the ground by using landscape areas to allow for mimicking natural areal recharge. The techniques have reduced the amount of storm water being collected and disposed of by the use of Type V Underground Injection Control wells (dry wells). In addition to not using dry wells, the techniques allow for conservation of water by using the rain events to supplement the irrigation needed for maintaining landscape areas in the local arid environment.

►The City has identified projects within the Capital Improvement Plans to provide sewerage to areas within the community which are not currently served by sewer services. Current Municipal Code does not allow for installation of new septic systems within the city; however, the existing septic systems are allowed to remain until sewer services can be extended to those areas as a course of development.

Goal

By December of 2005, areas in the lower basin have been identified where high densities of septic systems may impact groundwater quality. Responsible party – DEQ

Accomplishments

As described below, this goal has been met. Umatilla and Morrow County Planning Departments provided information to DEQ regarding the locations of units (e.g., homes, businesses, churches) outside sewer service areas. It is assumed that these units are active and use septic systems with drainfields. Figure 5-1 illustrates the density of homes and facilities using septic drainfields in the LUB GWMA using the Planning Department information. As indicated in Figure 5-1, the greatest density of septic systems occurs near Hermiston (especially northeast and southwest of town) and near Irrigon.

Figure 5-2 illustrates the density of septic systems installed from 1990 through 2005. The information used to generate Figure 5-2 was obtained from the DEQ Eastern Region Onsite Application Database. DEQ began construction of a database to document and track onsite wastewater treatment system (i.e., septic system) applications in 1990. The information entered into the database included some limited information on historical systems such as owner and location but little information regarding the type of system. Information entered into the database starting in 1990 includes such things as owner, location, system type, inspection dates, installer, and fees. The version of the database used to generate Figure 5-2 included information up through December 2005.

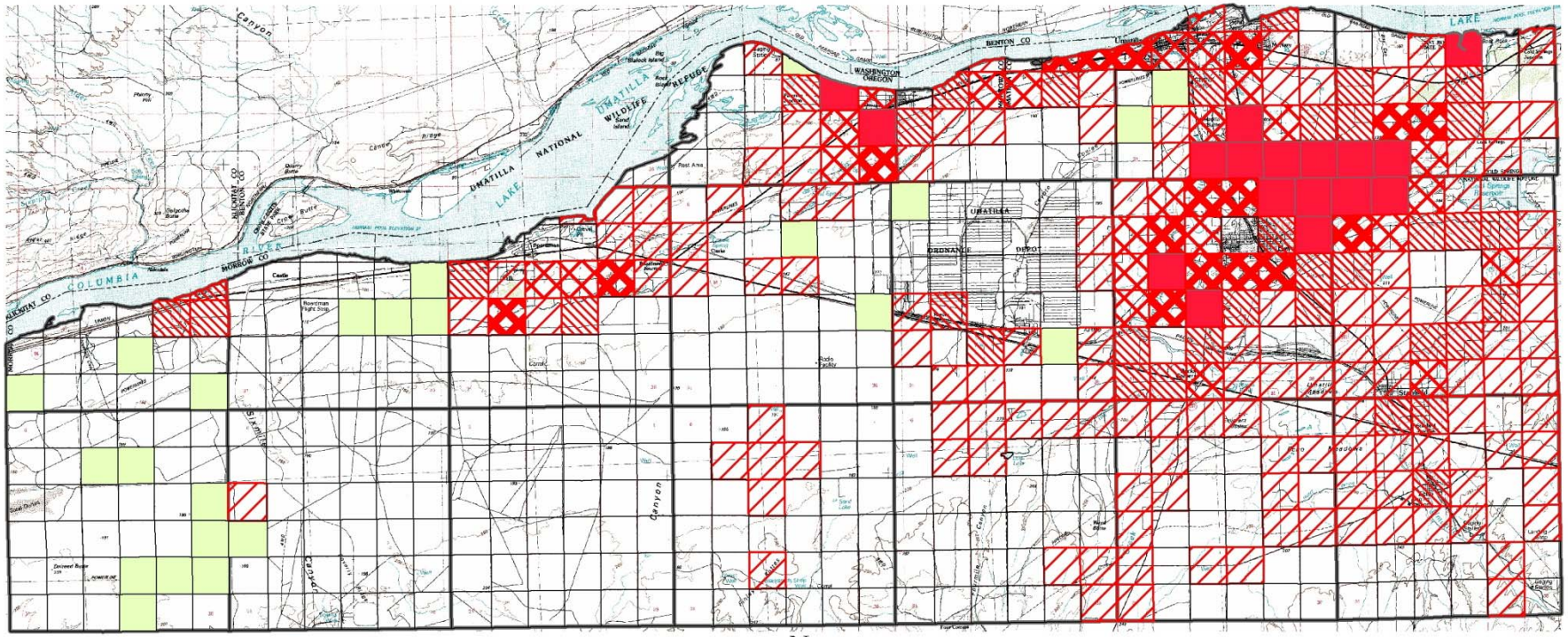
The process to extract the information used to generate Figure 5-2 was as follows:

- Begin with the entire database,
- Extract only the records within the GWMA,
- Delete records that did not pertain to installing a septic system (i.e., inspection records, denials, minor repairs, abandonments, installation of a holding tank)
- Identify whether the system was a standard or alternative system.
- Summarize the number of standard, alternative, and total number of systems installed in each Section.

Alternative systems are required at locations when a high water table, minimal soil depth, poor soil type, and/or small lot size prevent a standard system. Alternative systems include capping fill systems, pressure distribution systems, sandfilters, and seepage trenches. Most areas requiring alternative systems could be more vulnerable to groundwater contamination.

As indicated in Figure 5-2, the greatest density of septic systems installed from 1990 through 2005 are north and northeast of Hermiston and near Irrigon. Figure 5-2 also indicates the area with the greatest number of alternative systems is the area south of Boardman. The McNary area also had a large number of alternative systems installed during this period.

Figure 5-1
Density of Homes and Facilities Using Septic Drainfields
Lower Umatilla Basin Groundwater Management Area



Number per Section

- 0
- 1 to 10 (126 sections)
- 11 to 25 (36 sections)
- 26 to 50 (23 sections)
- 51 to 100 (17 sections)
- greater than 100 (17 sections)
- DEQ records show a system was installed but tax lot information lacks sufficient detail to precisely identify location.

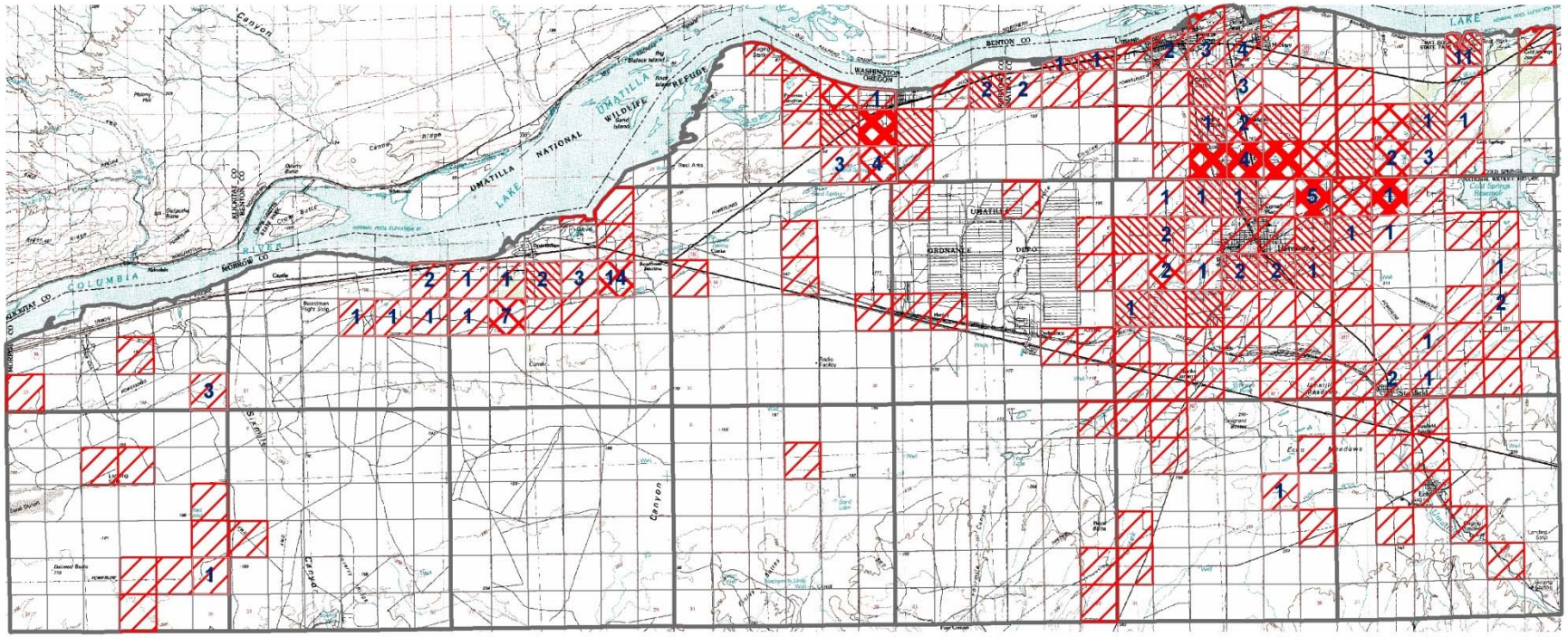
N

0 2 4 8 12 16 Miles

Note: This map shows the number of units outside sewer service areas. They are assumed to be active and use septic systems with drainfields.

Source: Umatilla and Morrow County Planning Offices

Figure 5-2
Density of Septic Systems Installed From 1990 through 2005
Lower Umatilla Basin Groundwater Management Area



Number of Systems Installed per Section

- 3 — Number of alternative systems
- 0
- 1 to 10 (127 sections)
- 11 to 25 (24 sections)
- 26 to 50 (10 sections)
- 51 to 85 (6 sections)

N

0 2 4 8 12 16 Miles

This map was created using information from the DEQ Eastern Region Onsite Application Database. Information entered into the database starting in 1990 includes such things as owner, location, system type, inspection dates, installer, and fees. This map contains information from January 1990 through December 2005.

Alternative systems are required at locations when a high water table, minimal soil depth, poor soil type, and/or small lot size prevent a standard system. Alternative systems include capping fill systems, pressure distribution systems, sandfilters, and seepage trenches. Most areas requiring alternative systems could be more vulnerable to groundwater contamination.

5.3 Food Processor Process Water

Goal

By December of 2005, monitoring data shows improving groundwater quality trends for nitrate and meeting permit conditions and objectives. Responsible parties – DEQ and food processor permitees.

Accomplishments

As discussed below, this goal was partially met.

Improving Groundwater Quality Trends for Nitrate

As discussed in section 4.2, there are six facilities (consisting of 12 sites) within the LUB GWMA that land applied food processing water in 2005 and are thus targeted by this goal.

The nitrate trends at 133 wells located at or near the 12 sites were evaluated. Of the wells evaluated, approximately 58% have increasing trends, 20% have decreasing trends, and 22% have statistically insignificant trends. It should be noted that these wells are located upgradient, downgradient, cross gradient, and within these land application sites. Nitrate trends are increasing at most wells, and at most sites. Therefore, the measure of Action Plan progress that states "monitoring data shows improving groundwater quality trends for nitrate" was not met. On the whole, the rate of increase is slower than it was during the previous analysis.

A report titled "Second Trend Analysis of Food Processor Land Application Sites in the LUB GWMA" which discusses the trend analysis and draws conclusions regarding upgradient and downgradient concentrations and trends is available at http://www.deq.state.or.us/wq/groundwater/lubgwma.htm.

Meeting Permit Conditions and Objectives

Significant improvements in food processor facility operation and application site management are reflected in the approved Operations, Monitoring and Management (OM&M) plans approved for crop year 2005. DEQ oversight has also improved as annual reports and OM&M plan changes are reviewed annually. New to the 2005 OM&M plans is a defined method of calculating available soil nitrogen and a list of approved crops and their designated agronomic loading rate. Food processors are also required to account for the nitrogen found in supplemental water sources. Many food processors operate within established permit limits, while others continue to struggle to comply with nitrogen and hydraulic load limitations. Nitrogen loading violations still occur, but improved understanding of process operations makes ultimate goals seem realistic.

5.4 CAFOs

Goal

By December of 2005, 75% 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.

Accomplishments

As described below and in the survey included as Appendix 3, the Umatilla County SWCD has concluded that this goal has been met.

Unregulated CAFOs

An EPA/DEQ 319 grant was secured which, in part, funded the completion of a survey to gauge this goal. Using landowner information from the Umatilla County Planning Department and some information from Morrow County, landowners with 2 or more acres of land were mailed a 15-question survey, largely focused on animal management practices. The intent of the survey was to gauge BMP implementation at non-regulated animal feeding operations. The SWCD considered responses regarding access to surface water, irrigation management, and pasture condition to assess fulfillment of this goal. Based on these factors, the SWCD concluded that over 75% of non-regulated animal feeding operations are implementing BMPs.

It should be noted that the Morrow County portion of the LUB GWMA was not well represented by the returned responses (1 out of 436). Therefore, it is not known how representative the responses are for that portion of the GWMA.

Regulated CAFOs

The following tables summarize the status of the regulated CAFOs within the LUB GWMA. The tables illustrate the number of active (i.e., permitted) and inactive (i.e., formerly permitted) CAFOs that have an approved Animal Waste Management Plan (AWMP) or are in the process of being reviewed for approval. As illustrated in the following tables, 16 of the 18 active regulated CAFOs have approved AWMPs, with the remaining 2 facilities have pending approval. ODA assumes that facilities with an approved AWMP are implementing an accepted system of BMPs. Site visits are used to verify compliance with an AWMP.

Active CAFO Category	Number of Operations Per Classification	Animal Waste Management Plan (AWMP) Status **Approved**	(AWMP) Status **Pending** Approval
Active Large Federal CAFOs (LFC), Standard Industrial Classification (SIC) 0211 Beef Feedlot, Fattening	11	10	1
Active LFC SIC 0241 Dairy	5	5	0
Active LFC, SIC 0214 Sheep/Goat	1	1	0
Active Medium Federal CAFO (MFC) SIC 0211 Beef Feedlot, Fattening	1		1
Total	**18**	**16**	**2**

Inactive CAFO Category	Number of Operations Per Classification	Animal Waste Management Plan (AWMP) Status **Approved**
INACTIVE Large Federal CAFOs (LFC), Standard Industrial Classification (SIC) 0211 Beef Feedlot, Fattening	2	0
INACTIVE LFC SIC 0241 Dairy	1	0
INACTIVE LFC, SIC 0214 Sheep/Goat	1	0
INACTIVE Medium Federal CAFO (MFC) SIC 0211 Beef Feedlot, Fattening		0
INACTIVE State CAFO SIC 0241 Dairy	0	0
Total	**4**	**0**

Based on the responses to the survey and the ODA information on regulated CAFOs, the Umatilla County SWCD has concluded that this goal has been met.

5.5 Umatilla Chemical Depot Washout Lagoon

Goal

By December of 2005, 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.

Accomplishments

This goal has been partially met, as described below. Based on review of the Annual Monitoring Report for the treatment system, contaminant concentrations have generally shown a decline over time at most wells since the groundwater remediation plant began operation in December 1996. However, the RDX plume has migrated beyond the capture zone to the east, presumably due to "soil washing" during the early stages of remediation. More specific information regarding the groundwater quality at the site is provided in Section 4.3 of this report.

6.0 RESEARCH NEEDS FOR HYDROGEOLOGIC CHARACTERIZATION

From July 30, 2001 to August 2, 2001, a field visit of the Lower Umatilla Basin Ground Water Management Area (LUB GWMA) was conducted to identify research needs related to nitrate pollution of the GWMA.

The field visit was conducted by Tom Straughan (ODA water quality planner), Ray Denny (program manager for Umatilla SWCD), Phil Richerson (DEQ nonpoint source hydrogeologist), and Erick Burns (ODA hydrogeologist). Sites visited include many of the monitoring well locations, permitted confined animal feeding operation (CAFOs), and the Hermiston Agricultural Research and Extension Center. Don Horneck and George Clough represented OSU Extension for a half-day meeting designed to identify research needs.

Those research needs identified fell into two broad categories: 1) hydrogeologic character of the GWMA, and 2) BMP implementation. The first category encompasses those research topics that will allow interpretation of nitrate trend data. This is critical since there currently are severe limitations to the ability to predict when and how observed nitrate data relate to improvement of water quality within the GWMA. The hydrogeologic research needs are discussed below. The second category is an important aspect of action plan implementation and will allow spatial analysis of management factors as they relate to water quality. The BMP research needs are discussed in Section 3.3. The research topics listed below may be used as an overall research plan. Each item will improve the utility of the other items, and in only rare instances will the research efforts be redundant at all. It is recommended that most of the items be accomplished, followed by re-assessment of the research plan.

A primary concern of both landowners and regulators was premature interpretation of BMP implementation effect on water quality change. In order to understand when, where, and how to look for water quality improvements, an adequate understanding of travel time through the groundwater system is necessary. Such information is currently not available for the GWMA.

This research topic focuses on hydrogeologic characterization of the groundwater management area. Travel time and geochemical character of the hydrogeologic system are critical pieces of information for making assessment of when water quality improvements are expected.

a. *Analyze current monitoring well network for additional analytes that will improve our understanding of the hydrogeologic system and potential nitrate sources (e.g., isotopic analysis, redox potential, etc.).*

   An increasing number of studies are utilizing geochemical indicators to evaluate travel time of groundwater. These indicators should be analyzed for potential usefulness in the current monitoring network. Since these wells are already sampled regularly, costs should be nominal (i.e., only for analyses).

   Isotopic analysis of various chemical constituents may allow estimation of groundwater age or of likely nitrate source (e.g., septic tanks, manure, and commercial fertilizer). An understanding of the age of the groundwater in various parts of the basin will allow estimates of time until BMP implementation will be detected at each well. Evaluation of likely sources of pollution will allow BMPs to be focused where they will do the most good.

   Other geochemical indicators may also prove useful (e.g., redox potential, Cl/N ratios, etc.) for detecting water quality improvements (resulting from BMP implementation) or for understanding why some wells are consistently lower in nitrate concentration. While nitrate is very mobile in groundwater, in some geochemical environments, it is likely not conservative. [Primary candidates for work are DEQ, OSU Ext, OSU Bioresource Engineering, OSU Forest Engineering, or other departments or universities exhibiting sufficient expertise.]

b. *Re-sample the 200+ wells sampled during the synoptic sampling round in 1992.*

   2009 will be the seventeenth year since the first synoptic sampling event, and six years since the second synoptic sampling event. Re-sampling of these wells in 2009 would aid in the first GWMA-wide quantitative evaluation of water quality required by the Action Plan. Having a large number of locations with a few data points over 17 years could augment the more statistically robust, but more

limited geographic coverage, of the analysis of trends using the 30+ wells in the bi-monthly well network. If additional analytes will prove beneficial (see *a.* above), then these should be added to the synoptic sampling round. For this reason, it may be beneficial to accomplish *a.* (above) first (i.e., it would minimize cost to know which additional analytes are most likely to succeed). [Primary candidate for work is DEQ.]

c. Vadose zone sampling.

Vadose zone sampling was accomplished early during the action plan implementation. Additional vadose zone sampling may prove beneficial, but research objectives need to be clearly identified. Reductions in amounts of applied irrigation and fertilizer have a synergistic effect that may provide misleading results. Also, vadose sampling will be expensive if the goal is to provide statistically relevant results to be applied at the basin scale. [Primary candidates for work are DEQ, OSU Ext, OSU Bioresource Engineering, and OSU Soil Sciences.]

d. Hydraulic aquifer testing (i.e., hydraulic conductivity determination).

Pump and slug testing are standard tools used in hydrogeology. Estimates of hydraulic conductivity would prove very beneficial in formulation of conceptual models of the flow in the GWMA. Further, this data can be used at future dates for development of numerical models. Unfortunately, there are a number of technical challenges associated with use of the existing monitoring network, and aquifer testing is relatively expensive (especially if the goal is to characterize the entire GWMA). [Primary candidates for work are DEQ or a contracted consultant.]

e. Development of new statistical tools for analysis of trend data.

Statistical analysis of Northern Malheur County GWMA data indicate Dacthal trends are decreasing faster than nitrate trends. This is likely due to the fact that Dacthal use essentially ended in the mid 1990s while nitrate continues to be added to the system.

If proper statistical methods can be developed, analysis of the Malheur nitrate and Dacthal data together may provide some method of estimating system response time to nitrate BMP implementation. If this proves to be the case, it may be beneficial to attempt to identify some chemical in the LUB GWMA that may also provide a temporal signature that coincides with BMP implementation. [Primary candidates for work are DEQ and OSU Mathematics (or others).]

f. Case-by-case evaluation of anomalously high nitrate concentrations.

A few wells were noted to have anomalously high nitrate levels (e.g., there is a basalt well that would normally be assumed to have high protection against agricultural or septic tank pollution). These wells might benefit from a more detailed inspection to ensure that there are no well construction or siting problems that invalidate their use as a GWMA monitoring well. It is anticipated that these additional inspection items will be low cost actions (e.g., sending a camera down the borehole to ensure there is no cross-connection of aquifers). Anomalous high pollutant levels may have large impacts on trend analyses depending on the types of statistics that are employed. [Primary candidate for work is DEQ.]

g. Spatial analysis of other vulnerability factors (e.g., soil type, septic density, distance from irrigation canals, etc.).

Site visits to wells indicated that many of the possible confounding factors for aquifer vulnerability were not easy to assess. In order to evaluate these factors, it may be desirable to be able to perform spatial analysis between high concentration wells and factors that may affect aquifer vulnerability. This item might best be accomplished following geochemical analysis of monitoring wells and documentation of BMP implementation. This will ensure the analysis of the other vulnerability factors occurs in the proper context. [Primary candidates for work are DEQ, OSU Ext, OSU Bioresource Engineering, and OSU Soil Sciences.]

h. Evaluation of groundwater / surface water interaction.

Although not identified during the field visit discussed above, an evaluation of the interaction of groundwater and surface water could be very useful. An increased knowledge of groundwater surface water interaction (throughout the basin as a whole and at specific locations) could shed light on issues where surface water issues and groundwater issues intersect (e.g., Total Maximum Daily Loads for surface water bodies versus GWMA needs, BMPs protective of surface water quality but detrimental to groundwater quality). A comprehensive groundwater study that will characterize the groundwater system (including surface water interaction) for the entire Umatilla River basin is desired. Funding partners are being pursued to allow this project to proceed. [OWRD and USGS are the agencies that will lead this investigation.]

7.0 EVALUATION OF SUCCESS

Item C.2 in Section VIII of the Action Plan requires the success of the Action Plan be evaluated after eight years of implementation (i.e., 1998 through 2005). The criteria for evaluating success are described as "whether the protection strategies are still being promoted and whether a high enough proportion of the citizens and organizations are participating in adopting recommended practices, activities and strategies to protect groundwater quality". Section 7.1 includes an evaluation of the success of each item listed in the 2001 version of Section VII of the Action Plan. Section 7.2 includes conclusions regarding the overall success of Action Plan Implementation.

In addition to the evaluation of overall success, item A.4 in Section VII of the Action Plan requires the Implementation Tasks section of the Action Plan (Section VII) be updated after each four year evaluation period. The updated Section VII is provided in Appendix 4.

7.1 Evaluation of Implementation of Individual Action Plan Tasks

Table 7-1 summarizes each item listed in the 2001 version of Section VII of the Action Plan and the progress made towards implementing each item.

Table 7-1
Summary of Action Plan Implementation

Action Plan Reference	Topic	Annual Progress Report Item	Lead Organizations	Progress Made Towards Implementation
VII.A.5.a.1	General – Education and Public Awareness	Develop Public Information and Education plans which emphasize groundwater quality protection in the LUB GWMA. Then, as resources allow, implement components of the plan.	SWCD and OSU Extension	Umatilla County SWCD is developing the "Clean Water Neighborhood (CWN)" outreach program
VII.A.5.a.2	General – Education and Public Awareness	Design presentations or workshops which could be used to present groundwater protection concepts to a variety of target audiences. Attempt to include groundwater protection presentations into various forums attended by targeted audiences.	SWCD, NRCS, and OSU Extension	Some efforts have been completed and others are ongoing. Examples include Umatilla County SWCD and DEQ showing a groundwater model to school kids.
VII.A.5.a.3	General – Education and Public Awareness	Prepare and/or encourage the development of articles addressing different aspects of groundwater quality protection. Attempt to have the articles printed in local publications and/or as a Groundwater Quality Newsletter.	SWCD and OSU Extension	Some efforts have been completed and others are ongoing. The CWN program will address some of these needs.
VII.A.5.b.1	General – Cataloging of Information	Maintain and update a groundwater quality management practices library and index. Organize and update the information and make the material available at appropriate locations.	SWCD, NRCS, and OSU Extension are the lead agencies but local governments and agencies, individuals, businesses, and organizations are encouraged to participate	The Umatilla County SWCD and the City of Boardman maintain groundwater quality libraries

Action Plan Reference	Topic	Annual Progress Report Item	Lead Organizations	Progress Made Towards Implementation
VII.A.5.b.2	General – Cataloging of Information	Keep an index of the location of pertinent information and people knowledgeable in groundwater protection management practices for the different sectors.	SWCD, NRCS, and OSU Extension are the lead agencies but local governments and agencies, individuals, businesses, and organizations are encouraged to participate	The Umatilla County SWCD maintains such an index
VII.A.5.c.1	General – Implementing Strategy	Identify accepted systems of BMPs or implementation plans which would be useful for those in the identified sectors to use for protection of groundwater quality. Encourage the development and adoption of strategic plans by individuals, business organizations, and governments to protect the groundwater quality	SWCD, NRCS, and OSU Extension are the lead agencies but local governments and agencies, individuals, businesses, and organizations are encouraged to participate	Some efforts have been completed and others are ongoing
VII.A.5.c.2	General – Implementing Strategy	Gather, organize, and make available existing relevant information pertaining to practices and strategies which will protect groundwater from contamination.	SWCD, NRCS, and OSU Extension are the lead agencies but local governments and agencies, individuals, businesses, and organizations are encouraged to participate	This information is part of the library maintained by the Umatilla County SWCD
VII.A.5.c.3	General – Implementing Strategy	Develop and implement specific plans which highlight the groundwater concerns to be addressed and the practices which will be promoted and encouraged to address those concerns.	SWCD, NRCS, and OSU Extension are the lead agencies but local governments and agencies, individuals, businesses, and organizations are encouraged to participate	Some efforts have been completed and others are ongoing. The CWN program will address some of these needs.
VII.A.5.c.4	General – Implementing Strategy	Identify gaps in knowledge and develop plans for obtaining the information or research needed to fill those gaps.	SWCD, NRCS, and OSU Extension are the lead agencies but local governments and agencies, individuals, businesses, and organizations are encouraged to participate	The CWN program will address some of these needs.
VII.A.5.d.1	General – Documentation of Results	Develop a plan to document how well activities, practices and alternative practices recommended in the Action Plan are being adopted. Include specifics on types of practices, aerial extent, location, time of adoption, continued use of recommendations and other factors relevant to document progress in implementing the action plan. This plan will be used to address the evaluation criteria in Section VIII.	SWCD, NRCS, and OSU Extension are the lead agencies but local governments and agencies, individuals, businesses, and organizations are encouraged to participate	
VIII.C.2	Irrigated Agriculture	To familiarize the agricultural sector in the reasoning and use of the recommended management practices, appropriate articles should be developed for publication in local media outlets. Additionally, presentations on groundwater quality protection should be developed and presented at local forums.	SWCD, NRCS, and OSU Extension	Some efforts have been completed and others are ongoing

Action Plan Reference	Topic	Annual Progress Report Item	Lead Organizations	Progress Made Towards Implementation
VII.C.3	Irrigated Agriculture	Survey local growers as to what practices they are now using to determine baseline practices. This can also be used as an educational tool to highlight what practices the GWMA Committee is recommending for use in the basin.	SWCD, NRCS, and OSU Extension	Completed
VII.C.4	Irrigated Agriculture	Develop inventories of reference materials, guidance documents and articles which recommend management practices and strategies to reduce nitrate loading for targeted crops and conditions in the LUB. Develop and maintain a bibliography of literature on BMPs.	SWCD with assistance from OSU Extension and private agricultural service sector companies	
VII.C.5	Irrigated Agriculture	Target grant applications and other assistance funds to implementing recommended management practices and strategies and developing practices which address reducing nitrate contamination of the groundwater.	None specified	Some efforts have been completed and others are ongoing. For example, the Umatilla SWCD pursues OWEB grants for these activities.
VII.C.6.a	Irrigated Agriculture	Coordinate and assist the agricultural community in identifying practices that reduce or eliminate nitrate loading to the groundwater.	All agencies	Some efforts have been completed and others are ongoing
VII.C.6.b	Irrigated Agriculture	Support funding activities to develop, compile information, or demonstrate the use of BMPs and strategies for protection of the basin's groundwater quality resources.	None specified	Some efforts have been completed and others are ongoing
VII.C.6.c	Irrigated Agriculture	Investigate and research which production practices are most appropriate for use in reducing the loading of nitrate to the groundwater. Determine whether the recommended practices are being used and applied correctly and at the proper time.	None specified	Some efforts have been completed and others are ongoing
VII.C.6.d	Irrigated Agriculture	Determine what the relationship is between various irrigation scheduling methods and nitrate losses for different crops and practices within the basin.	None specified	OSU Extension applied for a grant to do this but were denied
VII.C.6.e	Irrigated Agriculture	Determine the level of soil and tissue sampling to provide optimal information for the cost involved for the different crops grown in the basin.	None specified	OSU Extension is continually working on this; particularly for watermelons, onions, potatoes, and grass seed.

Action Plan Reference	Topic	Annual Progress Report Item	Lead Organizations	Progress Made Towards Implementation
VII.C.6.f	Irrigated Agriculture	Determine the levels and variances of nitrate at depth in the soil profile under agricultural fields in the area. Recommend appropriate methods and sample size for growers to use to account for variations in their fields. Promote an increased understanding of the variation in practices and nutrient requirements across agricultural fields.	None specified	OSU Extension has several publications that recommend a post-harvest sample to "see how well they did" but few growers do it.
VII.C.6.g	Irrigated Agriculture	Identify what are the sources and sinks of nitrogen in the soil profile and the transformation rates of nitrogen in the soil. Evaluate whether there are certain times of year when nutrients leach out of the soil profile. Develop a strategy which would account for and capture a majority of nitrate in the soil profile.	None specified	OSU Extension believes this is largely known; the difficulty in preventing leaching is that weather is not always the same. From irrigation information, spring and fall are the most likely time that N is lost.
VII.C.6.h	Irrigated Agriculture	Determine the nutrient requirements for each life stage of the major crops being grown in the basin and recommend optimum fertilizer rates. Add a "growth stage nitrogen component" for crops on the Northwest Irrigation Network.	None specified	OSU Extension believes we know when and how much N is used for many of the local crops.
VII.C.6.i	Irrigated Agriculture	Determine the specific nutrient requirements for a given yield on different crops grown in the area. Then develop recommendations and review and modify fertilizer guides, if needed, based on high yield requirements.	None specified	
VII.C.6.j	Irrigated Agriculture	Further study nitrogen uptake in potatoes to better develop an understanding of nitrogen requirements. Utilize Dr. Hodges work. This information would also help with the Northwest Irrigation Network project. Compile existing data on nitrogen-irrigation-variety work on potatoes in the basin to update and expanded "Fertilizer Guide".	None specified	Some efforts have been completed and others are ongoing. WSU and OSU are both working on the N part.
VII.C.6.k	Irrigated Agriculture	Determine fertilization needs of onions in the basin. This would help with the Northwest Irrigation Network project.	None specified	Some efforts have been completed and others are ongoing
VII.C.6.l	Irrigated Agriculture	Determine which plants would be most beneficial in reaching and utilizing nitrates deep in the soil profile. Develop recommendations for the use of deep rooted crops.	None specified	OSU Extension believes these crops are largely known. Irrigation practices may be more important than crop selection.

Action Plan Reference	Topic	Annual Progress Report Item	Lead Organizations	Progress Made Towards Implementation
VII.D.1.a	Rural Residential – General	Develop appropriate articles and newsletters for local publication and media outlets. Emphasize and encourage the adoption of recommended practices to reduce nitrogen loading to the groundwater. Submit a monthly press release to local newspapers, publish a biannual newsletter and submit articles to the Ruralite magazine (written by various agency personnel and active citizens)	SWCD and OSU Extension	Some efforts have been completed and others are ongoing. A weekly radio show on AM1360 helps with outreach
VII.D.1.b	Rural Residential – General	Develop and establish an educational / outreach program and material to provide the rural residential community with information and alternatives on how to develop property while protecting groundwater quality. Encourage local area libraries to house information for public checkout.	SWCD and OSU Extension	A weekly radio show on AM1360 helps with outreach
VII.D.1.c	Rural Residential - General	Integrate a groundwater quality component into the local area watershed curriculum initiative and other educational forums such as 4H, FFA, and Scouts.	SWCD and OSU Extension	Some efforts have been completed and others are ongoing
VII.D.1.d	Rural Residential – General	Conduct surveys of local residents to determine their awareness of the groundwater quality concerns and problems in the area. Do surveys at local community events or in conjunction with a free nitrate testing program.	SWCD and OSU Extension	1999, 2001, 2005, and 2009 goals
VII.D.1.e	Rural Residential – General	Offer workshops for realtors on groundwater quality concerns and provide continuing education credits.	SWCD and OSU Extension	Workshops conducted in 1998 and 1999
VII.D.1.f	Rural Residential – General	Develop bilingual outreach material for Hispanic community. Consider applying for an Environmental Justice grant to address this need.	None Specified	Spanish version of nitrate fact sheet completed
VII.D.2.a	Rural Residential – Septic Systems	Develop options and alternatives for county and city governments to use to address the cumulative impacts of septic systems	DEQ and County Planning Depts.	Completed
VII.D.2.b	Rural Residential – Septic Systems	Determine where in the basin septic system waste water loading could create a groundwater quality problem based on current development, hydrogeology and potential future development	DEQ and County Planning Depts.	Completed
VII.D.2.c	Rural Residential – Septic Systems	Once an understanding of where groundwater degradation from septic systems may occur, develop options and alternatives to assist county planning commissions, departments and the development community in addressing the groundwater quality impacts of development.	DEQ and County Planning Depts.	2009 goal
VII.D.2.d	Rural Residential – Septic Systems	Review Land Use Plans and Codes to determine how to incorporate groundwater concerns and incorporate groundwater quality as a criterion in land use review of development proposals. Develop a long term municipal sewer system plan. Where and when possible, connect residences to the municipal system	DEQ and City and County Governments and Planning Depts.	Some efforts have been completed and others are ongoing

Action Plan Reference	Topic	Annual Progress Report Item	Lead Organizations	Progress Made Towards Implementation
VII.D.2.e	Rural Residential – Septic Systems	Encourage routine maintenance of septic systems to extend the useful life of systems and minimize groundwater quality impacts.	DEQ, Counties, OSU Extension, and SWCD	Ongoing. The CWN program will address some of these needs.
VII.D.2.f	Rural Residential – Septic Systems	Encourage periodic inspections and replacement or upgrading of septic systems to meet current standards	DEQ, Counties, OSU Extension, and SWCD	Ongoing. The CWN program will address some of these needs.
VII.D.2.g.1	Rural Residential – Septic Systems	Investigate possible methods for determining where in the basin high densities of septic systems are likely to have an adverse impact on groundwater quality	None specified	Some efforts have been completed and others are ongoing
VII.D.2.g.2	Rural Residential – Septic Systems	Develop recommendations of methods for County Planning Commissions and planning departments to use in addressing present and future development issues with regards to groundwater contamination	None specified	Some efforts have been completed and others are ongoing
VII.D.3.a	Rural Residential – Landscape, Lawn, and Garden	Organize information and develop an educational/outreach program on methods and alternatives to properly maintain landscaping, lawns, and gardens to prevent leaching nutrients to the groundwater.	SWCD and OSU Extension	The CWN program will address some of these needs.
VII.D.4.a	Rural Residential - Wells	Develop and distribute information to well drillers about groundwater contamination concerns in the area.	SWCD and OSU Extension	
VII.D.4.b	Rural Residential – Wells	Outline the need to construct and repair wells to prevent possible contamination from the surface and the concern about the use of sand points.	SWCD and WRD	OWRD staff talk with well owners and drillers as opportunities arise. The CWN program will also address some of these needs.
VII.D.4.c	Rural Residential – Wells	Highlight the need to repair wells which are commingling alluvial and basalt aquifers so contamination in one aquifer does not contaminate another	SWCD and WRD	OWRD works with well owners to abandon or repair wells to prevent commingling.
VII.D.4.d	Rural Residential – Wells	Educate well drillers on the concerns of placement of wells too close to septic systems.	SWCD and WRD	Ongoing. OWRD gives periodic classes for well drillers discussing proper setbacks, geology, and commingling.
VII.D.5.a	Rural Residential – Animal Pastures	Develop comprehensive plan policies that encourage the implementation of guidelines establishing the number of animals allotted per acre as determined to be appropriate to prevent groundwater contamination.	County Planning Depts., ODA, NRCS, and OSU Extension	
VII.D.5.b	Rural Residential – Animal Pastures	Better enforce existing zoning code restrictions on allowable animal densities. Document and map if possible.	County Governments	

Action Plan Reference	Topic	Annual Progress Report Item	Lead Organizations	Progress Made Towards Implementation
VII.E.1	Food Processor Process Water	Strive to address the intent of the laws and regulations established for environmental protection. Continue to follow permit conditions and requirements and meet or exceed all requirements. Continue the use of the Operation, Monitoring and Management (OMM) Strategy.	DEQ and food processors	Ongoing
VII.F.1	CAFOS	Develop informational materials introducing BMPs for groundwater protection to CAFO operators	SWCD, NRCS and ODA	Completed by ODA
VII.F.2	CAFOS	Develop and maintain a bibliography of literature on CAFO BMPs	SWCD, NRCS and ODA	In ODA Library
VII.F.3	CAFOS	Develop and maintain a list of individuals and agencies with technical expertise in design, construction, and operation of CAFO BMPs	SWCD, NRCS and ODA	Ongoing; Partial list available from ODA
VII.F.4	CAFOS	Provide individual farm evaluations of CAFOs upon request to assess the adequacy of groundwater protection measures.	SWCD, NRCS and ODA	
VII.F.5	CAFOS	Develop a database characterizing CAFOs to support information / education efforts and to measure implementation of the action plan.	SWCD, NRCS and ODA	Ongoing effort by ODA
VII.F.6	CAFOS	Develop a prioritized list of information, research and demonstration needs relating to CAFO management and groundwater protection	SWCD, NRCS and ODA	
VII.F.7.a	CAFOS	Perform further analysis on different types of manure (i.e., fresh, dried, composted) to develop nutrient guidelines for the use of manure on crops.	None specified	
VII.F.7.b	CAFOS	Review scientific literature and studies regarding groundwater quality management of CAFO operations	None specified	Completed by ODA
VII.F.7.c	CAFOS	Review research and identify BMPs that will address waste management problems within CAFOs	None specified	Ongoing effort by ODA
VII.F.7.d	CAFOS	Develop educational materials which recommend BMPs for use by CAFO operators	None specified	
VII.F.7.e	CAFOS	Develop a plan for educating the public which will clarify the science in regards to groundwater quality and the management of CAFOs	None specified	
VII.F.7.f	CAFOS	Develop a forum for providing and disseminating information developed through this plan	None specified	
VII.F.7.g	CAFOS	Develop and implement a strategy to effectively deliver information and education to CAFO operators on BMPs for groundwater protection	None specified	
VII.G.1	US Army Umatilla Chemical Depot Washout Lagoons	Operation of the treatment system and continued monitoring of groundwater quality around the treatment system with the intent being to assure that nitrate contaminated water is not migrating away from the treatment system and into other parts of the aquifer.	DEQ and US Army	Ongoing

7.2 Evaluation of Overall Success of Action Plan Implementation

As shown in Table 7-1, progress has been made towards implementing many items. Several Action Plan items have been completed in full. Many Action Plan items have some aspects that have been completed while others are ongoing. Other Action Plan items have yet to be implemented. Some of these items could, and should, be implemented as soon as possible while others are scheduled for future implementation.

The City of Irrigon is concerned with the lack of progress being made towards toward reducing groundwater nitrate concentrations. Their position is that the voluntary program is not working, and that DEQ should regulate nonpoint sources. A letter describing the City of Irrigon's position is included as Appendix 5.

As indicated in Section 5.0 of this report and in Table 7-2, approximately half of the December 2005 goals have been met.

Table 7-2

Achievement of 2005 LUB GWMA Action Plan Goals

Sector	Goal	Goal Met	Goal Partially Met	Goal Not Met	Unknown if goal was met	Comment
Irrigated Ag	85% of irrigated ag is using BMPs	met				
Rural Residential	80% of area residents are aware of groundwater nitrate problem			not met		
Rural Residential	80% of area residents know of at least one activity or practice that contributes to the problem			not met		
Rural Residential	50% can cite at least one activity or practice they have changed				unknown	the survey did not specifically gauge their actions
Rural Residential	All local governments can cite procedures, requirements, and /or practices they have instituted as a result of the GWMA declaration		partially			
Rural Residential	Areas in the lower basin have been identified where high densities of septic systems may impact groundwater quality	met				
Food Processor Process Water	Monitoring data shows improving groundwater quality trends for nitrate		partially			
Food Processor Process Water	Food processors are meeting permit conditions and objectives		partially			
CAFOs	75% of CAFOs are implementing an accepted system of BMPs or are covered by an implementation plan	met				
Depot Bomb Washout Lagoon	Monitoring data show that the treatment system is working as expected and that reinjection water is not migrating beyond the capture zone of the treatment system		partially			

8.0 RECOMMENDATIONS

Regional groundwater quality improvement is not an Action Plan goal until December 2009. However, evaluations to date indicate nitrate concentrations are not yet decreasing. Considering historical groundwater concentrations and the generally slow nature of groundwater flow, it is likely that regional groundwater nitrate trends will not be decreasing by December 2009.

Based in part on the above statement, the following recommendations are made.

8.1 Recommendations for the Future

- Considering the incomplete achievement of the December 2005 Action Plan goals, DEQ should develop a list of potential mandatory activities for the potential nitrate sources which fall under DEQ oversight (i.e., food processors, rural residential septic systems, and the Depot). The potential mandatory activities will form a starting point for discussions to occur during the next evaluation of Action Plan success.
- Considering the incomplete achievement of the December 2005 Action Plan goals, it is recommended that ODA and DEQ should work with the LUBGWMA Irrigated Agriculture Sub-committee, CAFO Sub-committee and the local agricultural community to develop a list of action items that will be completed and documented and are likely to lead to groundwater quality improvements. These actions could include on-the-ground management activities for irrigated agriculture, CAFOs, and rural residential pastures to help assure fertilizer and irrigation water are being applied in a way that is protective of groundwater quality. These management activities should focus on mitigating agriculture's contribution as a potential nitrate source and provide flexibility to accommodate the diversity of agricultural practices. The list should also identify the mechanism(s) by which implementation of management activities will be assured. The identification, implementation, and documentation of these management activities will be used to evaluate of Action Plan success. The following Action Items are associated with this recommendation:

    1. ODA will work with the SWCDs and Extension to increase education and outreach efforts to rural residents on proper pasture management. This task will be completed by December 31, 2009.

    2. ODA, DEQ and the Agriculture Sub-Committees will develop a list of actions that are likely to lead to improvements in groundwater quality, that can be documented, and have mechanisms to assure actions are implemented. This task will be completed by December 31, 2008.

    3. ODA, DEQ and the Agriculture Sub-Committees will develop a method to document implementation of the recommended actions. This task will be completed by December 31, 2008.

    4. The recommended actions will be promoted by ODA, OSU Extension, SWCDs, DEQ, and NRCS staff. Possible promotions will include a web presence and field sized demonstrations to showcase recommended actions. Promotion may be done through Hermiston Farm Fair, HAREC field days, public school presentations, school organizations, public service or fraternal organizations, and other mechanisms as identified by ODA, DEQ, SWCD, and OSU. Education and promotion will continue through at least the next Action Plan Success Evaluation. A basic economic evaluation of the implementation of some of the recommended actions will be developed to emphasize additional benefits.

    5. Documentation of the implementation of the recommended actions will be completed by the agriculture sub-committees, ODA, and DEQ. This task will be completed by December 31, 2009.

- Develop a plan to document how activities, practices and alternative practices recommended in the Action Plan are being adopted. Include specifics on types of practices, aerial extent, location, time of adoption, continued use of recommendations and other factors relevant to document progress in implementing the action plan.
- All interested and affected parties shall work towards accomplishing the December 2009 goals.

- Perform deep soil sampling at locations where high nitrates have been detected in groundwater.
- DEQ and others shall further investigate the anomalously high nitrate values at several network wells with the goal of determining their representativeness.
- DEQ and others shall pursue funding for the research needs identified for BMP determination and implementation as well as the hydrogeologic characterization of the GWMA.
- Complete a Memorandum of Agreement between the SWCDs, ODA and DEQ along with a work plan for activities associated with this action plans implementation (Section VII, item A.3).
- DEQ shall implement an economical alternative septic system demonstration project.
- DEQ shall obtain additional educational materials in Spanish and make them available to the Spanish-speaking population within the GWMA.
- Through the Clean Water Neighborhood project, develop Public Information and Education plans which emphasize groundwater quality protection in the LUB GWMA.
- Through the Clean Water Neighborhood project, encourage routine maintenance of septic systems, encourage periodic inspections, and when necessary replacement or upgrade septic systems.
- Through the Clean Water Neighborhood project, address rural residential animal pastures per items VII.D.5a & b.
- DEQ shall review documents submitted by food processor facilities in a timely manner and provide comments that will assist the food processor facilities meet their permit conditions and objectives.
- Food processor facilities shall meet permit conditions and objectives.
- Direct more education to growers regarding nutrient management to help reduce over-fertilization and make more efficient irrigation. High fertilizer and power costs will encourage nutrient and water conservation. Precision ag seminar and grants will encourage more protective practices.
- Direct more general education on maintenance and management of wheel and permanent set irrigation systems.
- Define an “acceptable system of BMPs” for irrigated agriculture.

8.2 Recommendations for Changes to the Action Plan

Recommended changes to the Action Plan at this time include:

- Incorporation of the updated Section VII “Implementation Tasks” (included as Appendix 4) into the final version of the Action Plan.

9.0 ACTION PLAN SUPPORT AND APPROVAL

Section VIII, item C.5 of the Lower Umatilla Basin Groundwater Management Area Action Plan states it is the responsibility of the Lower Umatilla Basin Groundwater Management Area Committee, ODA, and DEQ to determine whether the Action Plan is addressing the groundwater contamination concerns adequately or whether modifications need to be made to the Action Plan to better enable it to succeed. The following statements address the adequacy of the Action Plan, and its success to date.

9.1 Statement by Committee Chair

On behalf of the Committee, I commend the efforts of those who have strived to implement the Action Plan over the past eight years. It is through the efforts of these affected parties, with support from local natural resource agencies, that progress has been made in education, outreach, best management practice development and implementation toward the goal of seeking solutions to protect the area's groundwater and, ultimately, reduce the nitrate-nitrogen concentration in the groundwater to below the 7 mg/l level that triggered the declaration of the Groundwater Management Area.

Because measurable progress has been made towards the Action Plan goal using the criteria set for the Action Plan, the voluntary nature will continue for now, but BMP efforts, particularly documentation, need to be increased. The next evaluation will include an assessment of both the 2009 Action Plan goals and implementation of the current recommendations

If the voluntary implementation of these efforts is to continue as recommended, regular progress towards all goals must occur at each evaluation interval. The positive actions of all who have contributed to the current progress will have to be supplemented and built upon to gain the interest and participation of additional members of our citizenry.

Furthermore, the Committee is dedicated to continued efforts to implement the Action Plan and any future amendments until the goal has been reached. A similar statement regarding Action Plan success will be prepared following the next four year evaluation period ending in 2009.

Ron Rickman, Committee Chair — Date: 10/14/08

9.2 Statement by ODA Director

I concur with the statement by the Committee Chair, acknowledge the progress of Action Plan implementation to date, and recognize the importance of ODA's support towards attaining the Action Plan goal.

Katy Coba, Director
Oregon Department of Agriculture — Date: 10-21-08

9.3 Statement by DEQ Director

I concur with the statement by the Committee Chair, acknowledge the progress of Action Plan implementation to date, and recognize the importance of DEQ's support towards attaining the Action Plan goal.

Dick Pederson, Director
Oregon Department of Environmental Quality — Date: 10-29-08

Appendices