DEQ Water Quality Division

2004 Progress Report For the Lower Umatilla Basin Groundwater Management Area

March 9, 2006

State of Oregon Department of Environmental Quality

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2004 Progress Report for the Lower Umatilla Basin GWMA

1.0 INTRODUCTION

This report describes the progress made towards implementation of the Lower Umatilla Basin Groundwater Management Area Action Plan during the year 2004. 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 composed 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 ODEQ samples a network of 35 wells[1] 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 VII, 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 the year 2002 and 2003. In addition, groundwater quality information collected from the bi-monthly monitoring well network is presented.

1.3 Important Facts About Nitrate

The following information is, 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 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.

[1] The well network originally included 38 wells. However, 3 wells were eliminated from the network in 2003 when written permission to continue sampling could not be obtained.

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 blue baby syndrome is often mis-diagnosed, and 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 Program of the Department of Human Services at (971) 673-0405.

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

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

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

Umatilla County Planning Department

The County's primary role in the voluntary Action Plan is to address groundwater quality issues influenced by land use, particularly rural residential. The 1995 Umatilla County Periodic Review Work Program contains several tasks related to the groundwater quality Statewide Planning Goal 6 and is available in the County Planning Department.

1. Umatilla County Planning has participated in the Hermiston Farm Fair each year providing presentations and working in conjunction with other Action Plan natural resource agencies regarding issues involving the LUBGWMA such as water quantity, flood plain, and water quality.

2. The Umatilla County Planning Department continues to have informational written material to present to citizens who inquire about development and natural resources.

3. The Umatilla County Planning Department has also participated, in conjunction with Columbia - Blue Mountain Resource Conservation and Development program, in the development of a natural resource information packet. This project is still in the development phase and will be printed to provide general resource information regarding the Umatilla/Morrow County area.

4. The Umatilla County Planning Department participated in a Umatilla County Soil and Water Conservation District (SWCD) sponsored class by making a presentation on water impacts to water quality and quantity.

Morrow County Planning Department

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

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

1. Morrow County maintains a library of materials regarding BMPs to prevent water contamination.
2. Morrow County coordinates with the LUB GWMA committee in establishing an educational program regarding water contamination.
3. The Morrow County Planning Department has also participated, in conjunction with Columbia - Blue Mountain Resource Conservation and Development program and others, in the development of a natural resource information packet for Morrow and Umatilla Counties.

LUB GWMA Citizens Advisory Committee Meetings

The LUB GWMA Citizens Advisory Committee held a meeting on February 26, 2004. The following is a summary of the meeting minutes.

Rebecca Ferge, (FFA student) presented a speech on water and used the Committee for practice while everyone was eating. The speech was regarding "Water, the world's greatest resource". Phil Richerson, DEQ, reviewed the Geographic Rule request made by the Umatilla County Board of County Commissioners. A letter to the Committee from Umatilla County Commissioners dated December 29, 2003 was reviewed and copies provided to members. Phil provided the background. He reminded the Committee that a Geographic Rule is mentioned in the Action Plan and reviewed the ways a Geographic Rule could be done. Phil also explained that the Committee should eventually make a recommendation to DEQ regarding their intent for the Rule.

A general discussion followed. Don Horneck, made a motion (MS Greg Williams) to not recommend EQC develop Geographic Rule-motion passed with Patty Perry abstaining.

Phil Richerson, DEQ, reviewed the 2005 Action Plan Goals. Ray Denny commented that the irrigated agriculture goal will most likely be met, i.e. 85% of the irrigated acreage is implementing an accepted system of BMPs or are covered by an implementation plan. However, although a list of BMPs has been established, no particular BMP has been designated as "an accepted system." There was a general discussion of the irrigated ag goal and how it was going to be met.

Rural residential goal: Bev Kopperud informed the Committee about septic classes that were held and surveys done by SWCD. Phil Richerson noted that he made a presentation to the Board of Realtor's Association and provided them with a hand out on proper septic system care. Phil also expressed his opinion that this goal may not be met, 80% awareness of groundwater nitrate problem. There was consensus that, overall, there has been a significant improvement of awareness.

A question was asked about what happens if the goal is not met by 2005. Phil explained that the progress report would say "no the goal has not been met." Mike Henderson also explained that there is a small window of opportunity to voluntarily meet the goals. The EQC may, in the future, place mandatory requirements to assure the goals are met.

Phil reported that well reconnaissance sampling has been ongoing, data is being evaluated and an isotopic analysis study is just getting started.

Ron Rickman returned to the Action Plan Goals, Section 7.0 in the Plan. This section was passed out in the form of a hand out. Topics in Table 2 were reviewed. The following is an update of actions/review of 2001-2003 actions by lead organizations on completion of voluntary action. These items will be included in the next Annual Progress Report.

Food processors consortium meets once a month on these topics: BMPs, catalogues information and improves process by which process water is managed. Outside experts and scientists were brought in and a continuing effort to improve practices. There is an education benefit to participants and attendees. The Giddings probe truck is being used consistently and $4,000 was spent upgrading and maintaining the truck. Don Horneck indicated that he also does presentations and attends conferences to keep informed.

The need for a second gathering to finish the progress report was discussed. Don Horneck said OSU has been doing the same things as in the past. Consensus was for Phil to send out another e-mail request for lead organizations to send in updates for him to incorporate into the progress report.

Bev Kopperud introduced Chris Kelly and Kathy Ferge and described a pilot project proposed in the area for demonstration septic systems. Target properties will be identified that have failing systems or contaminated well problems for the projects. The SWCD is not going to be able to provide low income loans as was hoped but as money becomes available as the word gets out and grant searches are successful. Well monitoring and total water management, pasture management and the whole property will be evaluated by the various agencies, i.e. DEQ, NRCS, etc.

Bev explained that this project will address a lot of the items on the list. She requested that this LUB Committee be the steering committee for this project to provide direction and assistance for grant opportunities, etc. A Newsletter is proposed and some innovative approaches to reaching out to people were proposed such as reaching the Hispanic community and "tupperware parties."

Ron Rickman summarized Bev's presentation and indicated that she is asking for input and help from the Committee members to develop the proposal, fine tune the project and assistance in obtaining funding. EPA has $14,000 to provide for education and will be used to get the project on the road.

To get started, Bev and Kathy requested people come forward to volunteer in writing the grant. Phil Richerson, Craig Williams, Mike Henderson, Don Horneck, and Christine Kelly volunteered to assist with the proposed project. Bev has started by developing a LUB page in the SWCD website. She asked for anyone that might have related LUB documents to put on the site to contact her. The project needs to be a cooperative effort.

Clinton Reeder, Umatilla County Critical Groundwater Task Force coordinator, provided an update to the Committee. He reported that there is a lot of information out there that needs to be organized all in one place where it can be conveniently updated and available to those who are looking. The web site set up should be downloadable, sortable and be made easily available and adaptable. Security issues were discussed.

The LUB GWMA Citizens Advisory Committee also held a meeting on June 15, 2004. The main agenda item was an update on the perchlorate investigation in the area. The discussion was led by Sheila Monroe of DEQ. In summary, low levels of perchlorate were detected in approximately half of the wells sampled during the fall 2003

Synoptic Sampling Event. Smaller sampling events completed to fill in data gaps since the large sampling event of fall 2003 show similar results: low levels of perchlorate distributed throughout the area with no obvious source area. The process that DEQ and EPA are following for the perchlorate investigation is similar to investigating a cleanup site. Information will be gathered regarding the source and extent of contamination, then exposure routes and risk will be assessed.

Phil Richerson then discussed the information submitted to him for inclusion in the 2002/2003 Progress Report. He requested any additional information to be included in the Report be sent to him.

The LUB GWMA Citizens Advisory Committee also held a meeting on November 3, 2004. Agenda items included (1) a discussion of comments on, and finalization of the 2002/2003 Progress Report, (2) an update on the EPA/USGS Isotope Study, (3) a discussion of potential 319 grant application projects, (4) and update on the education/outreach project, and (5) and update on the perchlorate sampling conducted to date.

WRD Groundwater Workshop

A public workshop was held in Pendleton in November 2004 that presented information and facilitated discussion about local groundwater issues. The event was organized by Oregon Water Resources Department and co-sponsored by local natural resource agencies including the SWCD.

E-notes, newsletters and website

The SWCD, through its' website, 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.

Public Schools and Civic Groups

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

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

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

OSU Extension staff in Hermiston gave several presentations at national, regional, state, and local venues. Most of these presentations involved soil testing, crop fertilization needs, nutrient management, and practices to reduce nitrogen loading to the groundwater. Local presentations were made at venues such as growers meetings, Farm Fair, Kiwanis Club meetings, workshops, training seminars, Hermiston High School and local Cub Scout troops.

Water Wells

In 2004, 152 water supply well reports were submitted to the OWRD for Umatilla and Morrow counties. Of the well reports submitted, 137 (90%) were for domestic or community use. Well logs and well construction information are some of the most requested information. On a daily basis, OWRD staff answer questions from the public and well contractors on well construction issues. OWRD publishes a Consumers Guide to well construction. In this publication general well construction questions are answered. These include well set back, household water needs, water right requirements, selecting a contractor, well abandonment, drilling your own well, and other well topics. This pamphlet is handed out to any one inquiring about wells. This is also made

available to other agencies for their uses in dealing with the public. Individuals with internet access can obtain a copy online at www.wrd.state.or.us under the publication link.

On a daily basis, OWRD staff deal with well contractors and the public on well construction issues. When a new or recently constructed well is found to be mis-constructed, OWRD requires the well to be repaired or abandoned. When people contact OWRD with water quality problems, well construction and well placement are investigated as the possible cause of the problem. OWRD staff educate the public on how poor well construction can lead to poor water quality.

On the second Monday of every quarter, the OWRD gives its test for new water well drillers. A week prior to this test, the North Central Region Office in Pendleton offers an informal four hour class to individuals wishing to take the drillers 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, OWRD staff work 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.

In 2001, the State legislature passed SB 579, which requires licensed drillers to attend classes in order to obtain Continuing Education Credits (CECs). Each driller is required to have 14 CECs per two-year licensing cycle and must show proof of CECs when licensing in and after 2005.

In November 2004, OWRD held a workshop at Blue Mountain Community College to help well constructors obtain the necessary CECs required by SB 579. Topics at the workshop included: Movement of Nitrate and Other Contaminants in Groundwater presented by DEQ, the Effects of Nitrates presented by the Drinking Water Program of the Oregon Health Department, and Basic Basalt and Sedimentary Geology of the Umatilla Basin.

Confined Animal Feeding Operations (CAFOs)

In cases where non-permitted CAFOs land-apply wastes, ODA offers educational reviews designed to assist operators in identifying potential pollution pathways associated with waste application. The CAFO program requires Agricultural Waste Management Plans for all CAFOs permitted under the National Pollutant Discharge Elimination System (NPDES). Through this process, appropriate BMPs are identified that are protective of waters of the state.

Assistance was given by the SWCD and ODA in filling out applications for new Confined Animal Feeding Operations permits and developing Animal Waste Management Plans. Routine inspections were conducted on operations. Upon request, ODA provides individual evaluations of CAFOs to assess the adequacy of groundwater protection measures. These evaluations include a discussion BMPs appropriate for the specific facility.

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 SWCD and ODA staff cover water quality testing which includes testing and discussion of various water quality parameters including nitrate. Students are given nitrate sampling strips to take home to test home well water.

Water Quality Testing Training

During August 2004, the Umatilla/Morrow Education Service District sponsored the Eastern Oregon Institute that provides training for educators in many subject areas. The Umatilla SWCD and ODA provided a two-hour course on water quality testing, similar to that done at Watershed Field Days. About 15 local teachers participated in the event.

Outdoor School

ODEQ participated in the annual Outdoor School activities sponsored by local schools. In 2004, ODEQ staff participated in 8 days of Outdoor School that included over 300 six graders from Hermiston, Stanfield, Condon, Arlington, and Ione. Outdoor School involves multiple stations with instructors discussing a variety of outdoor and natural resource topics. ODEQ presented a groundwater model and a surface water model. The hydrologic cycle was discussed as well as ways that water contamination occurs and how water contamination can be minimized.

2.2 General Cataloging of Information

A bibliography of groundwater information is maintained at the Umatilla County SWCD office. The bibliography includes a wide range of information on topics related to groundwater issues.

The Umatilla County SWCD has a list of information and people knowledgeable in groundwater protection management for different sectors. The list is available at the Umatilla County SWCD office.

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

2.3 Printed Material

BMP Handbook

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

Onsite Septic Systems

Information on septic system installation and maintenance is available on DEQ's Onsite Sewage Treatment and Disposal Program web page ***http://www.deq.state.or.us/wq/onsite/onsite.htm*** or (within the LUB GWMA) from DEQ's Pendleton office. Available information includes handouts on:

- Septic Tank Maintenance
- Procedures and Criteria for Installing a New Septic System
- Alternative Treatment Technologies
- Site Evaluation Guide for Septic Systems
- Construction/Installation Permit Guide for Septic Systems
- Existing System Evaluation Guide for Septic Systems
- Repair Permit Guide for Septic Systems
- Authorization Notice Guide for Septic Systems (generally required when connecting or re-connecting to any existing septic system, when replacing one residence with another, when rebuilding a structure, when adding bedrooms to a dwelling, when connecting additional dwellings, when changes to sewage flow or waste strength are proposed).

Other Educational Printed Material

The following educational materials are available at the Umatilla County SWCD:
Tips on Land & Water Management for Small Acreages in Oregon
Blue Thumb Pamphlet, Water Conservation Tips
Basic Guide for Lawn Maintenance (Pendleton Public Works Pamphlet)
Home*A*Syst pamphlet and worksheets 1-11

Farm*A*Syst overview booklet titled "Twelve simple things you can do to protect well water"
Home*A*Syst pamphlet titled "Why do septic systems fail?"
Groundwater: Pollute or Preserve? It's Your Choice (OSU Extension Circular 1343)
LUB Groundwater Action Plan
Oregon Groundwater Community Involvement Program
"I Love Water" pamphlet

2.4 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 Tom Straughan Janet Greenup Don Horneck Loren Unruh	Umatilla County SWCD ODA Morrow County SWCD OSU Extension NRCS	(541) 276-8131 (541) 278-6721 (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 Program	Oregon Department of Human Services	(971) 673-0405
Protecting groundwater quality while developing property	Carla McLane Patty Perry	Morrow Co. Planning Umatilla Co. Planning	(541) 922-4624 (541) 278-6252
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	Brian Mayer	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

2.5 Future Needs in Education / Outreach

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

- Translate additional educational materials into Spanish and make them available to the Spanish-speaking population within the GWMA.
- Conduct more proactive education/outreach activities such as neighborhood meetings, direct mailings, and information at gatherings specifically for the Spanish-speaking populations.

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

In 2004, the Conservation Security Program enrolled about 40 landowner/operators in the LUB with over 82,500 acres. Participants were rewarded for having adopted BMPs that meet or exceed NRCS quality standards for soil and water quality. All enrollees practice irrigation and nutrient management. Irrigation management includes utilizing sprinkler or drip systems and soil water monitoring. Nutrient management includes at least 2 or 3 soil samples during the growing season, adjusting nutrient applications according to the tests and applying nutrients through the irrigation system.

In 2004, only operators in the Umatilla watershed were eligible for the program. Willow Creek watershed will be included in the 2005 signup as well as new participants in the Umatilla watershed. The area between the Umatilla and Willow watersheds, Mid-Columbia-Lake Wallula watershed, which comprises a large portion of the LUB, will be included in a later sign-up.

The Environmental Quality Incentives Program (EQIP) funded 1 contract in Morrow County and 4 contracts in Umatilla County including 2 projects to convert flood-irrigated cropland to sprinklers on about 250 acres.

The Morrow County Water Use Committee, a county wide committee, began meeting in April 2004. The goal of the Committee is "to create and implement a comprehensive water plan addressing Morrow County water needs for the next 50 years".

OSU Experiment Station staff in Hermiston continue studying nitrogen uptake in potatoes and onions. The potato data is available in a WSU nutrient management guide and the onion information is available in a PNW onion publication. Kentucky bluegrass is currently being researched for nitrogen utilization and optimum fertilizer practices. The bluegrass work is in its final stages. The end goal is to have a new fertilizer guide.

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.
9. Umatilla County will create a ground water task force that will address groundwater quality. This task force is expected to create a water plan to address needs through 2050.

No research regarding BMP determination for septic systems in rural residential development was conducted in the LUB GWMA in 2004.

Land Application of Food Processing Water

An organization called the Re-Use Water Consortium develops and shares improving knowledge around the topic of environmentally sound reuse of vegetable processing wastewater. The organization includes leadership and expertise by OSU Hermiston Agricultural Resource Center and includes various local food processors, a Port, consultants and farmers.

CAFO Surveys

One of the 2001 Action Plan goals was that "50% of CAFOs are implementing an accepted system of BMPs or are covered by an implementation plan". The definition of CAFO used in the Action Plan includes both permitted and un-permitted facilities. Resources were not available until 2003 and 2004 to evaluate this goal. Efforts to evaluate this goal are discussed below.

In 2003 and 2004, ODA conducted a survey of permitted CAFOs and AFOs to identify new operations that required an operating permit. A total of fourteen CAFO operations in the LUB GWMA were issued a permit in 2004. All permitted CAFOs are required to follow an approved Animal Waste Management Plan. Each Plan incorporates the applicable BMPs as described in NRCS standards. Therefore, all permitted CAFOs are implementing an accepted system of BMPs.

In February and March 2004, the Umatilla County SWCD conducted a survey by mail of Umatilla and Morrow County landowners of 2 acres or more. The purpose of the survey was to gauge the implementation of BMPs by the rural residential community. The survey included a cover letter explaining the purpose of the survey along with a stamped survey reply card. Conducting the survey in this manner allowed collection of information without identifying the respondent. 2048 questionnaires were mailed out with 500 being returned which equates to a 24.4% return rate. Results of the survey are summarized in the following table and discussed below.

March 2004 Animal Feeding Operation Survey
Lower Umatilla Basin Groundwater Management Area

		Hermiston	Irrigon	Boardman	Stanfield	Echo	Umatilla	Not Reported	Total
1	Do you live near?	305	55	37	35	28	25	15	500
		61%	11%	7%	7%	6%	5%	3%	100%
2	How many acres do you own or manage?	2 to 5 acres	more than 40	6 to 10 acres	11 to 20 acres	21 to 40 acres		Not Reported	
		302	68	51	38	36		5	500
		60%	14%	10%	8%	7%		1%	100%
3	Are you pasturing animals?	Yes	No						
		334	166						500
		67%	33%						100%
4	Is you livestock confined to pens or stalls?	No	Yes						
		261	73						334
		78%	22%						100%
5	How long are your animals confined? (1)	Always	90 days	6 months	30 days				
		43	29	20	13				105
		41%	28%	19%	12%				100%
6	How do you manage manure?	Nothing	Spread	Compost	Drystack	Hauled Away		Not Reported	
		102	73	45	19	2		23	264
		39%	28%	17%	7%	1%		9%	100%
7	Do you rotate your pen/animal locations?	Yes	No						
		197	88						285
		69%	31%						100%
8	Do animals have access to streams, rivers or creeks?	Yes	No						
		15	318						333
		5%	95%						100%
9	Do you have buffers protecting your streams?	Yes	No						
		53	61						114
		46%	54%						100%
10	How many acres of pasture and irrigated land do you have? (2)	Irrigated	Pasture						
		0.25 to 1,800	1 to 9,000						
11	What is your irrigation method? (3)	Sprinklers	Flood	Drip				Not Reported	
		354	66	19				12	451
12	How would you rate your pasture condition?	Good	Excellent	Poor				Not Reported	
		218	85	46				12	361
		60%	24%	13%				3%	100%
13	Is you drinking water from a well?	Yes	No					Not Reported	
		475	15					10	500
		95%	3%					2%	100%
14	How far is your well from your livestock pens? (4)	>200 ft	100 to 200 ft	<100 ft				Not Reported	
		129	103	82				41	355
		36%	29%	23%				12%	100%
15	Is your well upslope or downslope from animal areas?	Upslope	Downslope	Level				Not Reported	
		201	71	42				44	358
		56%	20%	12%				12%	100%
16	Do you have your drinking water tested for nitrate or bacteria?	Yes	No					Not Reported	
		290	202					8	500
		58%	40%					2%	100%

Notes:
(1) 6 respondents reported confinement but no time while 30 respondents reported time but not confinement.
(2) 72% of respondents had some pasture while 84% of respondents had some irrigated land.
(3) Results from this questions were inconsistent in that 418 reported having irrigation, 25 reported multiple methods, 13 reported irrigation but no method, and 14 reported a method but no irrigation.
(4) Some respondents reported distances from neighbors animals.

As indicated in the table above, most respondents live near Hermiston on 2 to 5 acres, do not confine their livestock, have some type of manure management, rotate their animal locations, and rate their pasture in good condition. Most respondents also use sprinkler irrigation, get their drinking water from a well located more than 100 feet upslope from their animal areas and test their water for nitrate or bacteria.

Based on results of the survey, the SWCD concluded that over 50% of the farms and rural residences that have some livestock in the GWMA are implementing an acceptable system of BMPs.

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.

Irrigated Agriculture

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

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

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

Giddings Probe - OSU Extension Service provides maintenance and one-on-one training for a Giddings Probe used for deep soil sampling. It was checked out for 99 days in 2004 for sampling in Umatilla and Morrow Counties. The probe track sampling unit has been rebuilt and sampling parts updated.

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.

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 National Pollutant Discharge Elimination System (NPDES) permit. ODA offers courtesy reviews of AWMPs written for non-permitted operations.

As of October 2003, all permitted large CAFOs are required to take annual manure samples and analyze them for N, P, & K. ODA evaluates these results and crop needs to determine if manure is being applied at agronomic rates.

Rural Residential

The City of Boardman includes groundwater protection and wellhead protection as integral parts of staff reports developed for land use decisions within the jurisdictional boundaries of the City, the Urban Growth Boundary, and the delineated Wellhead Protection Area. Although there is not a Wellhead Protection Ordinance, review of potential impacts of any development is accomplished through a process of staff review, Site Team review (bringing in other utilities and agencies for review), and Planning Commission approval (when use is not outright). These reviews allow for the assessment of groundwater and other environmental impacts to be addressed or mitigated prior to development. The City of Boardman does not allow new septic systems within the City limits.

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

Morrow County was actively involved in Periodic Review until 1997 when the Oregon Legislature exempted counties with a population less than 15,000 (which included Morrow County) from the process. The one unresolved work program item was to study and develop policies with regard to development inside the critical groundwater and groundwater contaminated areas. Despite being exempt from the Periodic Review process, Morrow County continued working on the issue and concluded that rural residential development was the topic where the County may want to consider regulatory measures for development. The main concern related to groundwater contamination was septic tank density. A study conducted by EPA for the GWMA (including both Morrow and Umatilla Counties) concluded a large minimum lot size would be required to ensure attainment of the 7 mg/l goal for the GWMA. The Planning Commission and County Court reviewed the study and concluded the recommendations were much too onerous and the County did not change the minimum lot size. The Oregon Land Conservation & Development Commission (LCDC), however, revised Oregon Administrative Rules for Goal 14 and, effective October 3, 2000, essentially imposed a 2-acre minimum lot size for existing residentially zoned lands outside of urban growth boundaries. This eliminated Morrow County's one-acre residential zone, and effectively reduced the potential future impact of nitrate contamination from on-site septic systems in rural areas. Another effect of the LCDC rule change was to limit the minimum lot size for newly zoned residential lands to ten acres. So, any zone changes to allow farm or other ground to be taken out of exclusive farm use and put into a residential zone would not allow two acre or four acre parcels; the minimum lot size would be ten acres. This change greatly limits the potential for widespread groundwater contamination from rural septic systems.

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).

ConAgra Foods (formerly known as Lamb-Weston) contracted with a third party for soil moisture monitoring and analysis service to streamline the soil moisture monitoring process from data capture through expert review and feedback to controlling field irrigation. This has improved the management of soil moisture. ConAgra Foods also began monitoring soil nutrient concentrations at deeper depths than standard agricultural practice. ConAgra Foods now sample to five feet (or auger refusal) and include these additional data in crop management planning.

Simplot closed its Hermiston potato processing plant in November 2003. No potato wastewater was produced during 2004. The volume and nitrogen content of the remaining wastewater (primarily wastewater from the adjacent Calpine steam electric generation plant) was dramatically reduced.

The Port of Morrow has utilized a wastewater storage pond during winter months and during periods of higher than normal rainfall. The storage pond provides the irrigators better flexibility in managing both water and nutrients. The Port of Morrow has purchased more acres of irrigated farm land to facilitate expansion of the industrial part and to allow better distribution and timing of application of wastewater.

Artificial Recharge Projects

Artificial recharge projects (i.e., projects that add water to an aquifer) are consistent with the goal of the LUB GWMA Action Plan, and are specifically identified as something to encourage for the alluvial aquifer. The assumption is that artificial recharge will dilute groundwater nitrate concentrations and speed the flush of the alluvial aquifer. Artificial Recharge projects are permitted through the OWRD. DEQ provides comments to

OWRD on water quality aspects of these projects. The artificial recharge projects within the LUB GWMA that have progressed to the testing and/or implementation phase are:

- County Line Water Improvement District – This recharge project uses water diverted from the Umatilla River into a recharge canal located along the Umatilla/Morrow County line south of the Umatilla Chemical Depot. Water seeps from the canal into the shallow aquifer. The project owners can remove water from storage as needed to irrigate their crops. The project has been in operation since 1976.
- Butter Creek Artificial Recharge Project – The concept of the Butter Creek project is to divert Butter Creek water during high winter flows and flood some land within the Butter Creek flood plain to aid in local irrigation. The Butter Creek project obtained a limited license in March 2004 to conduct artificial recharge testing. Due to the limited amount of water available in Butter Creek, little recharge has occurred.
- Echo Meadows Winter Artificial Recharge Project – The concept of the Echo Meadows project is to divert water from the Umatilla River during high winter flows and flood some land near Echo, Oregon. The intent is to recharge the shallow aquifer so that the water would discharge to the Umatilla River during the summer months when river flow is low and river temperature is high. The Echo Meadows project obtained a limited license to conduct artificial recharge testing. Due to limited funding, the project was restricted to two days of diverting water during February 2002.

3.3 Future Needs Regarding BMP Determination and Implementation

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 in Section 6.0. 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 below.

In accordance with the Action Plan, implementation of BMPs will 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. *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, Umatilla SWCD, and OSU Geography (or other department with interest and GIS skill).]

b. 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 Soil Sciences.]

c. 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 Soil Sciences.]

d. 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.]

e. 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, ODA, DEQ and the SWCDs.]

f. 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, and the ongoing groundwater cleanup at the US Army Umatilla Chemical Depot Washout Lagoons.

4.1 Results of DEQ's Bi-Monthly Monitoring

As indicated in Section 1.1, the ODEQ samples a network of 35 wells every other month for analysis of nitrate. The results of this monitoring for the years 2001 through 2004 are presented in Table 1. Some of the pre-2001 data are presented in previous progress reports. It is important to note that the water quality discussion in this report is an informal evaluation of the seven years of data collected since adoption of the Action Plan. The first formal trend analysis of the bi-monthly monitoring well network data is scheduled for 2009, and will include 12 years of data.

The maximum nitrate value observed between January 1998 (the first sampling event after Action Plan finalization) and November 2004 at each well is identified in Table 1 with shading. Some wells (e.g., UMA034) exhibited maximum concentrations between 1998 and 2000 so no shaded cell is observable in Table 1 for these wells. The scattered distribution of the shaded cells indicates maximum nitrate values over the past seven years occurred at different times at different locations. This suggests some wells may have increasing nitrate trends while other wells may have decreasing nitrate trends.

The maximum nitrate value observed at each sampling event is identified in Table 1 with large bold numbers. The large bold numbers indicate the maximum nitrate values during the past four years. The maximum values in alluvial aquifer wells have most often been at well UMA085 (22 of 24 events) but have also occurred at well UMA122 (1 of 24 events), and UMA198 (1 of 24 events). The average nitrate concentration at well UMA085 is 40.2 ppm.

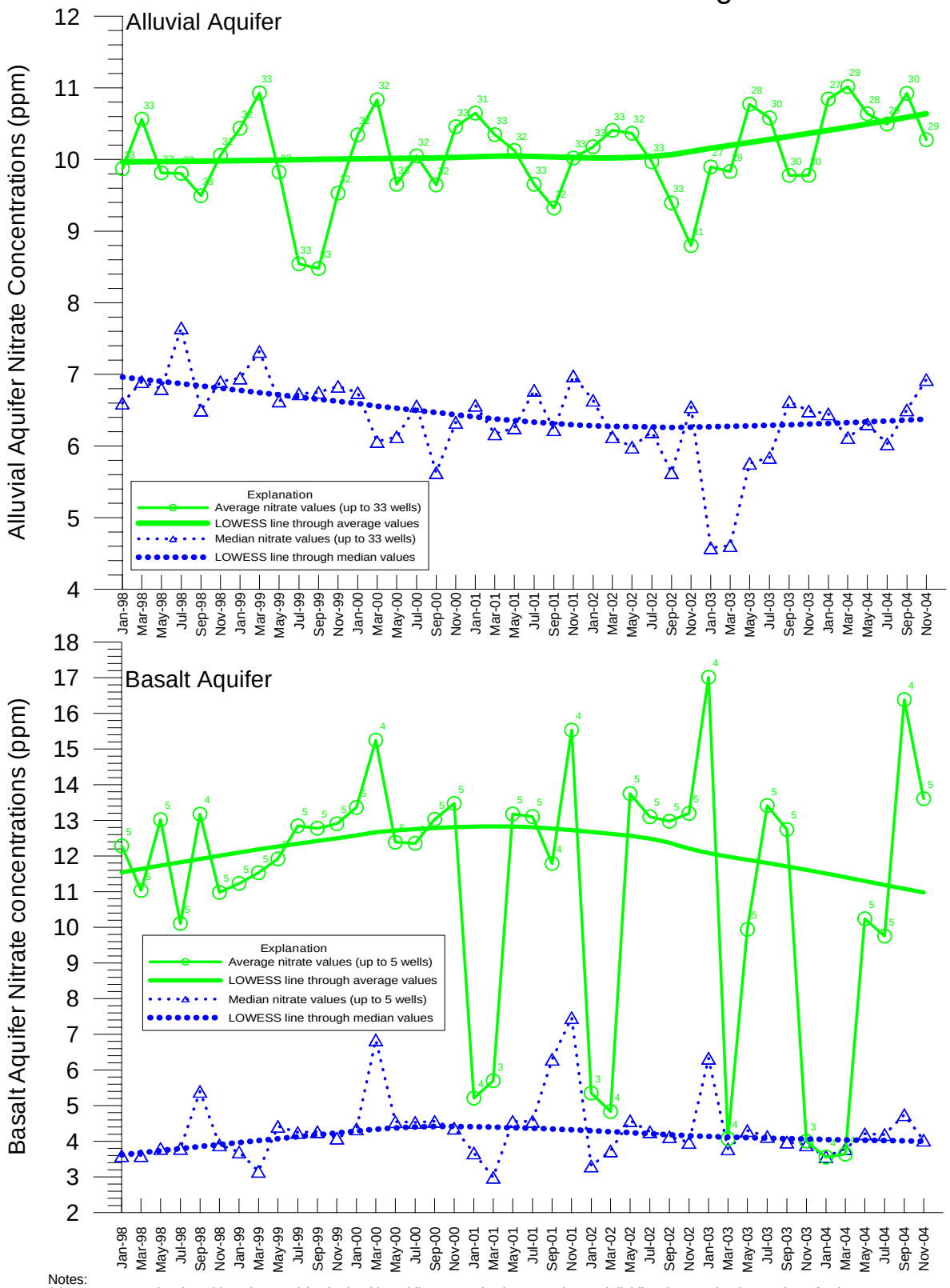
The large bold numbers also indicate the maximum nitrate value during the past four years in the basalt aquifer wells has always been at well UMA029, if this well was sampled. Well UMA028 exhibited the highest nitrate concentration during the eight events well UMA029 was not sampled. The average nitrate concentration at well UMA029 is 53.2 mg/l. The average nitrate concentration at well UMA028 is 13.0 mg/l.

Figure 1 is a graph of average and median nitrate concentrations in the Alluvial Aquifer and Basalt Aquifer during the seven years since the Action Plan was adopted (i.e., 1998 through 2004). Each of the 42 data point represents either the average or median nitrate concentration of the wells sampled during that particular sampling event. The purpose of graphing the average and median nitrate concentrations is to provide an indication of area-wide nitrate concentrations. It is important to note that these values represent the "middle" portion of the data set. Individual wells exhibit significantly higher and lower concentrations. The LOWESS lines[2] drawn through the 42 data points in Figure 1 suggest:

- the average nitrate concentration in the Alluvial Aquifer wells was basically flat through July 2002, and has slowly increased since then,
- the median nitrate concentration in the Alluvial Aquifer wells decreased through March 2002, was flat through November 2002, and has slowly increased since then,
- the average nitrate concentration in the Basalt Aquifer wells changes dramatically depending on whether or not well UMA029 is sampled but appears to have increased through 2000, and decreased since then, and
- the median nitrate concentration in the Basalt Aquifer wells is less dramatically affected by which wells are sampled but follows a similar pattern as the average nitrate concentrations.

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

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



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

e: lub annualreport 2004 Alluv&Bas.grf

The larger difference between average and median values in Basalt Aquifer wells than in the Alluvial Aquifer wells reflects the high values observed in the Basalt Aquifer well UMA029. Average values are influenced by every data point while median values reflect only the "middle" value. This difference is evident in the dip in average values of when well UMA029 was not sampled (e.g., January and March 2001).

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

Additional Data Evaluation

Because the LOWESS lines through the average and median Alluvial Aquifer nitrate concentrations do not suggest similar changes in water quality, additional evaluation of Alluvial Aquifer nitrate data was conducted. This evaluation consisted of using all Alluvial Aquifer nitrate data collected since Action Plan finalization for the calculation of (1) an area-wide trend and (2) drawing a LOWESS line through the data. Results of this evaluation are discussed below and illustrated in Figure 2.

The LOWESS lines through Alluvial Aquifer nitrate values in Figure 1 are also included in Figure 2. In addition, the dash-dot orange line represents the LOWESS line through all Alluvial Aquifer nitrate data. Finally, the dashed red line represents the area-wide trend of Alluvial Aquifer nitrate concentrations. The area-wide trend of Alluvial Aquifer nitrate concentrations was calculated using a variation of the Seasonal Kendall technique known as the Regional Kendall technique.

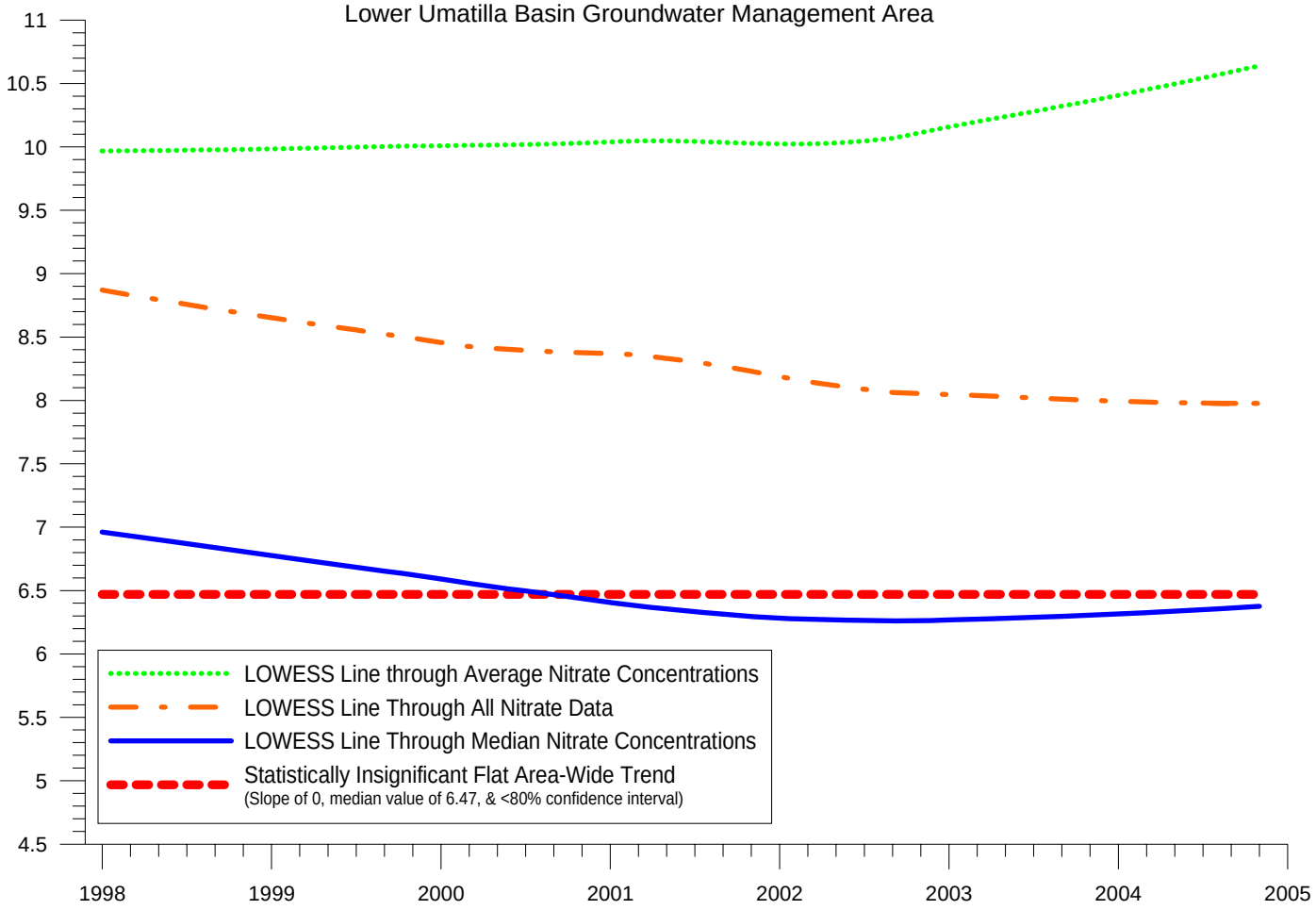
The area-wide trend is a statistically insignificant flat trend. In other words, the slope of the straight line drawn through the 1,327 data points is zero (i.e., the trend is "flat"). Furthermore, the confidence level of the flat straight line drawn through the data points is so low (<80%) that the trend is considered "statistically insignificant".

The LOWESS line drawn through all 1,327 data points suggests nitrate concentrations slightly declined through much of 2002, then leveled off through 2005.

As illustrated in the previous discussion, each type of data analysis (i.e., average nitrate concentrations, median nitrate concentrations, LOWESS line through all nitrate concentrations, and area-wide trend) produces a slightly different interpretation of water quality change. The most statistically robust technique, the area-wide trend, is believed to provide the best estimate. Again, the area-wide trend was estimated to be a statistically insignificant flat trend. The second best estimate is believed to be the LOWESS line drawn through all of the data. To reiterate, the LOWESS line through all nitrate data appears to decrease through much of 2002 before leveling off through 2004.

In conclusion, the Alluvial Aquifer nitrate concentrations have not changed sufficiently enough over the past seven years so that each method of data analysis identifies the same water quality change. The most statistically robust technique used suggests nitrate concentrations are not changing over time (i.e, a flat slope), but there is little confidence in that estimate (i.e, the "statistically insignificant" qualifier).

Figure 2
Estimates of Changes in Alluvial Nitrate Concentrations
Lower Umatilla Basin Groundwater Management Area



4.2 2003 Synoptic Sampling Event

One of the research needs identified in 2001 was the resampling of the 200+ wells used during the 1992 synoptic sampling event (which characterized the regional groundwater chemistry). With EPA's support (i.e., they analyzed the samples), DEQ conducted the 2003 Synoptic Sampling Event in September and October 2003. For a variety of reasons, only 135 of the 200+ wells could be sampled. Groundwater samples collected from the 135 wells were analyzed for nitrate, ammonia, bromide, calcium, chloride, fluoride, iron, magnesium, manganese, potassium, phosphorus, sodium, sulfate, and perchlorate.

Nitrate

When 1992 nitrate concentrations are compared to 2003 nitrate concentrations throughout the GWMA, most wells exhibited higher concentrations in 2003. However, due to the inherent variability of groundwater nitrate concentrations (including seasonal fluctuations), it would be inappropriate to draw conclusions regarding long term nitrate trends from two data points. For example, the fact that a September 2003 nitrate concentration is a few parts per million (ppm) higher than a June 1992 concentration does not necessarily mean that nitrate concentrations are increasing over time. It is possible that both concentrations are within the range of natural fluctuation and analytical precision. However, significant differences in the two nitrate concentrations (i.e., tens of ppm) are more likely to represent a significant change in water quality (e.g., a long term trend or response to a localized spill or discharge).

Of the 135 wells tested in 2003, 118 wells were also tested in 1992 and had detectable nitrate concentrations during both sampling events. Of these 118 wells, 78 wells showed an increase in nitrate concentrations. Nitrate

increases ranged from 0.03 to 32.4 ppm, and typically increased between 3 and 7 ppm. The other 40 wells showed a decrease in nitrate concentrations. Nitrate decreases ranged from 0.01 to 43.4 ppm, and typically decreased between 1 and 6 ppm.

Although far from conclusive, the comparison described above does hint at increasing nitrate trends in the GWMA. A more detailed discussion of the 1992 and 2003 nitrate concentrations will be provided in a separate document.

Perchlorate

Perchlorate was added to the 2003 sampling event because it had previously been detected at several locations in the region. Including perchlorate in such a regional sampling event was planned to help determine if the perchlorate is confined to specific locations or if it is a more regional problem. Sample results indicate that perchlorate was detected at over half of the wells sampled, which was unexpected. Due to the widespread nature of the perchlorate detections, and the health concerns associated with low levels of perchlorate, DEQ, Oregon Department of Human Services, and the United States Environmental Protection Agency (EPA) are working together to develop options for further study and potential necessary actions to address perchlorate in the area. A more detailed discussion of the 2003 Synoptic Sampling Event perchlorate concentrations will be provided in a separate document.

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

Alluvial Aquifer

Well ID	Jan-01	Mar-01	May-01	Jul-01	Sep-01	Nov-01	Jan-02	Mar-02	May-02	Jul-02	Sep-02	Nov-02	Jan-03	Mar-03	May-03	Jul-03	Sep-03	Nov-03	Jan-04	Mar-04	May-04	Jul-04	Sep-04	Nov-04	Minimum value per well; 1998 thru 2004	Maximum value per well; 1998 thru 2004	Median value per well; 1998 thru 2004	Average per well; 1998 thru 2004
UMA033	6.8	6.82	6.73	6.84	6.88	6.98	7.22	7.26	7.28	7.01	7.28	7.2	7.57	7.08	7.39	7.18	6.97	6.98	7.28	7.08	7.22	6.95	6.92	6.93	6.47	7.57	6.99	7.01
UMA034	3.76	5.04	3.47	3.39	2.95	2.82	3.73	4.49	4.22	2.26	2.55	2.35	2.65	3.63	3.97	2.77	2.03	1.43	3.36	4.6	4.71	3.29	2.98	1.36	1.36	7.37	3.68	3.91
UMA038	2.38	3.51	1.69	0.983	2.96	4.23	2.88	2.76	*ns*	3.16	2.82	1.99	*ns*	3.37	9.68	3.14	2.20	2.08	*ns*	2.53	5.02	2.66	3.2	2.23	0.983	9.68	2.96	3.11
UMA039	4.14	3.31	3.34	4.12	4.15	4.38	4.71	4.41	4.56	4.57	5.04	5.67	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	ns	1.08	*ns*	1.08	5.67	4.13	3.91
UMA046	0.485	0.512	0.473	0.429	0.61	0.512	0.479	0.461	1.08	3.5	3.24	1.96	0.665	0.576	0.531	1.09	1.98	0.575	0.359	0.66	0.404	1.09	0.653	0.519	0.359	3.5	0.55	0.82
UMA048	2.03	1.69	1.9	1.72	2.09	2.13	2.17	1.99	1.71	1.69	1.64	2.02	1.88	2.02	1.83	1.73	1.65	2.18	2.22	1.92	2.06	1.88	2.05	2.09	1.64	2.22	1.90	1.91
UMA056	6.31	6.22	5.74	3.87	5.18	6.55	6.64	6.13	6.13	6.2	5.15	6.55	6.63	6.48	6.60	6.23	6.27	6.14	6.27	6.31	6.49	6.01	6.09	5.88	3.87	7.32	6.47	6.30
UMA058	8.03	7.38	7.76	9.01	9.43	7.24	7.2	8.4	14.4	12.9	9.96	8.31	7.2	8.28	8.4	9.22	9.55	8.30	8.11	7.91	9.63	9.31	7.89	7.01	7.01	21	9.7	10.9
UMA066	8.55	8.63	9.21	8.82	8.01	8.48	9.12	9.18	9.24	6.24	5.58	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	5.58	9.38	8.55	8.29
UMA084	8.32	5.23	6.19	10.8	12.5	9.16	6.75	4.36	3.94	3.35	5.68	7.61	4.23	3.68	7.66	9.06	11.8	10.0	6.91	4.54	10.7	13.7	15.1	12.5	3.35	16	9.1	9.19
UMA085	**34.4**	**34**	**35.1**	**36.6**	**36.3**	**36.9**	**37.9**	**37.0**	**38.3**	**37.8**	**38.1**	*ns*	**40.2**	**38.8**	39.3	**39.2**	**37.9**	**38.7**	**39.2**	**37.7**	**40.2**	**39.9**	**40.1**	**39.7**	28	40.2	35.1	35.4
UMA088	15.2	14.9	14.9	16.4	17.9	16.3	16.4	15.8	16.5	18.5	17.9	17.5	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	14	18.5	16.20	16.0
UMA094	6.57	6.17	6.32	6.78	7.09	6.98	7.16	6.79	6.78	7.16	7.56	8.01	7.66	7.62	*ns*	4.24	7.3	6.84	6.45	6.12	6.13	6.03	7.95	8.51	4.24	11	7.16	7.34
UMA096	28.4	30.5	33.2	30.2	18.8	26.6	31.4	32.8	34.0	29	19.7	12.8	25.5	31.5	32.4	30.3	19.9	18.5	29	31.9	33.1	31.8	21.1	19.6	12.8	34.0	29.3	27.8
UMA103	21.6	20.5	19.3	19.4	18.7	20.1	22.6	22.2	23.3	20.4	13.9	20	*ns*	*ns*	*ns*	26.6	23.3	18.7	29	27.5	ns	27	20.4	24.4	13.9	29	20.3	20.6
UMA109	4.6	4.86	6.43	5.80	5.33	4.96	5.32	5.02	5.71	4.15	3.88	4.43	4.53	4.79	4.51	3.19	3.16	3.72	3.75	3.9	3.74	3.08	3.03	2.84	2.8	6.43	4.44	4.37
UMA110	5.72	5.27	3.22	4.45	5.5	3.48	3.09	2.63	2.95	4.64	5.63	4.85	4.41	3.74	4.40	5.45	5.17	4.68	3.8	3.27	2.68	3.48	4.07	3.01	2.63	9.3	4.70	5.09
UMA112	4.49	4.44	4.19	4.68	4.63	4.78	4.28	4.32	4.51	4.12	4.01	3.73	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	6.9	3.73	3.84
UMA116	4.38	3.99	4.56	4.49	4.26	4.18	4.85	4.75	4.81	4.07	3.23	3.43	4.58	4.61	4.43	3.97	3.29	3.61	4.67	4.11	4.55	3.93	3.22	3.32	3.22	5.08	4.30	4.28
UMA119	8.27	21.2	19.9	11.4	5.58	12.4	16.1	19	16.1	9.16	8.05	13.3	17.9	20.5	11.7	12.6	8.31	9.97	11.3	14.4	14.5	13.9	13.9	17.4	3.5	22.4	13.6	13.3
UMA122	25.9	25.2	30.8	32.2	23.5	26.1	25.9	29.7	30	31.8	26.9	**28.6**	28.1	29.0	32.0	32.8	28.7	27.8	27.7	24.3	31.5	30.9	25.1	24.5	11.9	34.4	25.9	25.0
UMA133	22.9	21.7	15.8	17.3	16.1	19.0	20	18.8	16.4	14	15.8	16	17.1	17.2	15.5	14.1	13.3	15.2	16.6	15.5	14.6	14.2	13.7	15.6	11.9	32	17.7	20.1
UMA144	13.6	16.2	11.6	10.0	9.36	9.88	12.5	14.8	14.3	10.5	8.30	7.74	8.59	12.1	9.85	9.34	9.81	9.16	14.5	16.2	12.5	13.5	14.6	12.1	1.46	20	12.1	12.4
UMA156	26.4	26.0	17.8	14.4	10	22.0	27.3	27	17.4	14.9	12.0	17.3	22.5	27.0	17.7	11.9	10.8	17.7	22.3	25.6	25.9	12.5	13.3	14.8	8	32	21.8	20.4
UMA160	<0.0050	<0.0050	0.0063	0.0077	0.151	9.67	<0.0050	8.46	5.84	7.99	15.4	13.6	2.74	1.52	0.0245	12.7	18.5	14.4	5.6	15.1	13.6	17	27.5	10.7	0.0052	27.5	2.74	6.09
UMA168	3.44	2.94	3	2.92	2.99	3.45	3.62	2.1	3.55	3.2	3.36	3.95	4.11	2.71	3.79	3.42	3.22	4.21	4.31	3.34	3.65	3.55	3.15	3.77	1.81	4.31	3.21	3.14
UMA180	3.19	3.36	5.53	8.56	7.32	4.37	3.86	3.48	5.52	5.37	5.24	2.75	3.58	3.70	3.88	3.88	3.81	2.82	3.28	3.4	3.65	4.05	4.11	4.33	1.3	8.56	3.88	4.03
UMA185	ns	0.140	ns	0.149	ns	0.149	0.149	0.138	0.145	0.151	0.152	0.149	0.147	0.146	0.146	0.145	0.150	0.161	*ns*	0.143	0.143	0.147	0.152	0.152	0.12	0.161	0.15	0.14
UMA187	ns	<0.0050	0.0202	<0.0050	<0.0050	0.0059	<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	0.0059	0.0202	0.01305	0.01
UMA190	3.31	6.23	2.03	1.17	1.77	7.80	5.3	2.39	1.88	1.73	0.655	5.21	*ns*	2.43	4.92	2.41	1.5	5.30	4.95	3.01	2.35	2.27	1.86	5.46	0.612	7.80	2.40	2.81
UMA191	1.1	1.27	3.14	1.37	0.954	1.00	0.712	1.42	1.19	2.07	0.160	0.523	0.521	0.869	2.62	0.769	0.239	0.179	0.185	6.1	2.86	1.47	0.253	0.46	0.16	6.1	1.05	1.23
UMA198	21	20.4	19	15.8	24.1	16.9	15.8	15.2	7.16	28.7	26.8	20.7	16.6	16.5	**42.6**	36.1	32.6	32.6	9.18	20.1	12.3	14.1	35.9	19.4	7.16	42.6	16.8	19.6
UMA201	24.8	23.8	21.7	24.5	23.2	21.2	20.7	20.2	22.8	18.6	24.3	24.5	23.9	21.6	22.1	20.4	16.2	18.2	19.5	19.2	20.6	13.7	25.5	26.7	13.7	29.4	21.3	21.6
Maximum per sampling event	**34.4**	**34**	**35.1**	**36.6**	**36.3**	**36.9**	**37.9**	**37.0**	**38.3**	**37.8**	**38.1**	**28.6**	**40.2**	**38.8**	**42.6**	**39.2**	**37.9**	**38.7**	**39.2**	**37.7**	**40.2**	**39.9**	**40.1**	**39.7**				
Median per sampling event	6.7	6.2	6.3	6.8	6.9	7.0	6.8	6.5	6.1	6.2	5.7	6.9	5.6	4.7	6.6	6.2	7.0	6.8	6.5	6.1	6.3	6.0	6.5	6.9				
Average per sampling event	11.0	11.0	10.1	10.0	9.6	10.0	10.8	10.7	10.7	10.3	9.7	9.1	10.3	10.2	11.2	10.9	10.1	10.1	10.8	11.0	10.6	10.5	10.9	10.3				

Basalt Aquifer

Well ID	Jan-01	Mar-01	May-01	Jul-01	Sep-01	Nov-01	Jan-02	Mar-02	May-02	Jul-02	Sep-02	Nov-02	Jan-03	Mar-03	May-03	Jul-03	Sep-03	Nov-03	Jan-04	Mar-04	May-04	Jul-04	Sep-04	Nov-04	Minimum value per well; 1998 thru 2004	Maximum value per well; 1998 thru 2004	Median value per well; 1998 thru 2004	Average per well; 1998 thru 2004
UMA028	**13.0**	**12.7**	12.3	10.3	9.38	11.7	**12.0**	**11.4**	10.6	8.31	7.59	8.15	8.48	**8.13**	7.54	6.54	5.8	**6.26**	**6.27**	**6.14**	5.71	4.74	5.46	5.62	4.74	13.0	8.34	8.56
UMA029	*ns*	*ns*	**45.2**	**46.6**	**33.7**	**45.7**	*ns*	*ns*	**49.6**	**48.6**	**49.2**	**49.3**	**52.1**	*ns*	**33.5**	**51.8**	**49.5**	*ns*	*ns*	*ns*	**36.8**	**35.4**	**52.7**	**53.2**	33.5	53.2	46.3	45.1
UMA047	3.08	2.99	3.07	3.24	3.22	3.24	3.31	3.19	3.38	3.43	3.4	3.31	3.29	3.44	3.41	3.50	3.49	*ns*	3.33	3.4	3.45	3.52	3.35	3.4	2.99	3.52	3.22	3.23
UMA106	0.489	1.40	0.759	0.83	0.861	1.49	0.743	0.469	0.595	0.894	0.552	1.25	*ns*	0.574	0.965	1.1	0.944	1.85	0.819	0.825	1.03	0.915	*ns*	1.79	0.469	1.85	0.83	0.90
UMA164	4.27	*ns*	4.56	4.56	*na*	*ns*	*ns*	4.27	4.58	4.27	4.13	3.97	4.18	4.14	4.3	4.14	3.98	3.9	3.81	4.19	4.21	4.19	4.03	4.03	2.04	4.58	4.19	4.10
Maximum per sampling event	**13.0**	**12.7**	**45.2**	**46.6**	**33.7**	**45.7**	**12.0**	**11.4**	**49.6**	**48.6**	**49.2**	**49.3**	**52.1**	**8.13**	**33.5**	**51.8**	**49.5**	**6.26**	**6.27**	**6.14**	**36.8**	**35.4**	**52.7**	**53.2**				
Median per sampling event	3.7	3.0	4.6	4.6	6.3	7.5	3.3	3.7	4.6	4.3	4.1	4.0	6.3	3.8	4.3	4.1	4.0	3.9	3.6	3.8	4.2	4.2	4.7	4.0				
Average per sampling event	5.2	5.7	13.2	13.1	11.8	15.5	5.4	4.8	13.8	13.1	13.0	13.2	17.0	4.1	9.9	13.4	12.7	4.0	3.6	3.6	10.2	9.8	16.4	13.6				

Notes:

na = not analyzed

ns = not sampled

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4.3 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 VII, Item G.3.b is that by December 2001, "monitoring data shows improving groundwater quality trends for nitrate" and that permitees are "meeting permit conditions and objectives". It should also be noted that Section VIII, Item A.3 states "since it is not anticipated that quantitative reductions in nitrate levels will take place early in the implementation phases of the plan, qualitative measures will also be established to evaluate the progress and success of the Action Plan."

There are six facilities (consisting of 10 sites) within the LUB GWMA that land applied food processing water in 2001, and are thus targeted by this goal. The nitrate trends at 113 wells located at the 10 sites were evaluated. Of the 113 wells evaluated, approximately 64% have increasing trends, 7% have decreasing trends, 3% have flat trends, and 27% have statistically insignificant trends. It should be noted that these wells are located upgradient, downgradient, cross gradient, and within these land application sites.

The hydrogeology at these sites was evaluated so that detailed comparisons can be made between upgradient and downgradient wells. Most sites have averages greater than the 7 mg/l Action Plan goal. Nitrate concentrations are increasing at most wells, and at most sites. There are, however, wells and sites where nitrate concentrations are decreasing. Identifying what combination of factors produces improving water quality trends, then applying those factors elsewhere, should result in improving water quality trends across the GWMA.

A report describing this trend analysis is available at http://www.deq.state.or.us/wq/groundwa/LUBGWMgmtArea3.htm. The Action Plan requires that a similar report will be prepared in early 2006 using data through December 2005.

4.4 Monitoring at the US Army Umatilla Chemical Depot Washout Lagoons

The following information, which generally summarizes the groundwater treatment system, appears in the March 15 and 16, 2005 Umatilla Chemical Depot BRAC Cleanup Team Meeting draft minutes for the Explosives Washout Lagoons groundwater pump and treat system.

Washout Lagoons: Groundwater Treatment Plant

- 4.3 billion gallons had been treated to date with 12,784 pounds of explosives removed.
- The RDX influent concentration had leveled out in the last 2 years at 20-30 µg/l at approximately 10 times the RDX cleanup level of 2.1 µg/l.
- The TNT levels had gone from 250 µg/l to less than the TNT detection limit of 0.03 µg/l by early 2004. TNT was still present in the influent from extraction wells EW-1 and EW-3, however the dilution of EW-4 had dropped the influent concentration to below the laboratory detection limit.
- The average rate of explosives removed had gone from 25 lb/day to 0.25 lb/day.
- RDX concentrations rebounded slightly in the extraction wells in January 2005 because of the pumps being turned off for approximately six months during maintenance and repair of pump EW-4.
- Infiltration gallery IF-1 was not used in 2004. More water being injected into infiltration galleries IF-2 and IF-3 caused the plume to retreat from the south.
- Electrical problems caused the circuit breaker to trip several times in June and July 2004 which shut the system off for unknown periods of time in between scheduled visits by the system operator. The treatment plant was kept shutdown while the electrical equipment was evaluated. The evaluation indicated the breaker tripping was not due to the treatment system but a circuit recloser on the Depot electrical system.
- The treatment plant was shut off in August 2004 and remained off the remainder of the year.

Washout Lagoons: Groundwater Contaminant Plume

- The overall trend of declining groundwater levels stopped by January 2005, but may be due to the treatment plant being shutdown since August 2004.

- RDX and TNT concentrations have decreased sharply since the treatment system was installed in 1996.
- Shutting off infiltration gallery IF-1 caused the plume to move in from the south and the explosives concentrations in the center of the plume to increase.
- The effect of shutting down the extraction wells in August 2004 was that the plume had expanded to the east but not by a great amount (RDS in the furthest east well increased from 2 µg/l to 3.1 µg/l).
- The RDX plume had not expanded to the north or northwest.
- The TNT plume, which is much smaller than the RDX plume, had remained fairly constant in size.
- Discussions were had regarding the technical practicability of reaching the RDX cleanup level because the mass removal rates had leveled off in the last two years.
- The data indicate diminishing returns were being achieved with the pump and treat system as the influent concentrations and % carbon loading reached asymptotic curves in the last two years. The treatment system operators suggest it is unlikely that the present system is capable of reaching the cleanup goals.
- It was pointed out that the April 2004 and January 2005 contaminant contours showed little advancement in the six months that the treatment system had been turned off.
- A new (more limited) monitoring strategy for sampling influent and effluent concentrations was discussed and approved.
- It was agreed that discussing potential changes to the treatment system was in order. Potential mechanisms for formal consideration of changes include a focused feasibility study or supplemental feasibility study. Potential changes include:
    - Continue pumping but change treatment technology (phytoremediation, UV oxidation, and chemical oxidation using a combination of hydrogen peroxide and ozone),
    - No pumping, reduced pumping, possibly combined with a technical impracticability waiver,
    - Pulse pumping, and
    - In-situ remediation using an injection oxidant and/or iron gel.

4.5 Isotopic / Age Dating Project

In November 2002, Curt Black of EPA Region X (in cooperation with DEQ, OWRD, and ODA) submitted a Regional Applied Research Effort proposal (an internal EPA program) requesting funds to develop and utilize isotopic and tracer tools to evaluate the source, timing, and movement of nitrate in areas like the LUB GWMA. The goals of this project include:

(1) ***Identify the source or sources of nitrate***. Determination of the origin of nitrate in a sample has been demonstrated in other areas using isotopic analysis. The identification of the principal source(s) of nitrate in the LUB GWMA should allow focusing of efforts aimed at changing management practices where they will have the greatest result.

(2) ***Distinguish between legacy problems and present nitrate sources.*** By identifying age, we can assess whether we're still monitoring the vadose zone legacy or we're measuring more recent sources. If the results show more recent sources, it will be an indication of the need to revisit the BMPs presently considered to be protective of groundwater quality.

Ultimately, the information gathered (i.e., water chemistry, isotopic signature, and age) would be used to gauge the source, timing, and movement of the contamination. Potential conclusions from the study could be along the lines of "This contamination is primarily from inorganic fertilizer applied 30 years ago", or "This contamination is primarily from septic systems discharging over the last 5 years".

In March 2003, the proposal was funded. In November 2003, a scoping meeting was held in Hermiston at which the local, state, and federal agencies involved (i.e., DEQ, ODA, SWCD, EPA, USGS) discussed the project with LUB GWMA committee members and other interested parties for the purpose if identifying potential sites for investigation. Three potential sites for investigation were identified at the scoping meeting.

Sampling was conducted at the two of the three sites in 2004. The drill rig was not capable of reaching groundwater at the third site. A formal report documenting results of the sampling is currently being prepared by the USGS but preliminary information suggests it is very difficult to distinguish nitrate sources at these sites. Additional information will be provided in the next progress report, once the USGS report is finalized.

5.0 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.

2002 will be the tenth year since the synoptic round of well sampling across the entire GWMA. Re-sampling of these wells in 2002 will allow a comparison of a large number of data points ten years later. The large number of data points will allow statistics to be applied to give an indication of whether the GWMA nitrate concentrations are generally higher or lower than they were ten years ago.

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.]

This task was completed in September and October 2003. Results are discussed in Section 4.2.

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.

Preliminary statistical analysis of Northern Malheur County GWMA data indicated that more advanced statistical tools need to be developed to assign numeric values to pollutant trends in the GWMAs. Confidence that current tools will allow evaluation of probable final nitrate concentrations in groundwater is very low.

If proper statistics can be developed, analysis of the Malheur nitrate and Dacthal data together may provide some method of estimating system response time to 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.]

6.0 December 2005 Goals

Section VIII of the Action Plan identifies qualitative and quantitative measures to be used to evaluate the progress and success of the Action Plan. Specific goals were identified in the Action Plan as having December 2005 deadlines. These goals relate to the five contributors of nitrate, and are reiterated below.

6.1 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.

6.2 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.

Goal

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

6.3 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.

6.4 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.

6.5 Umatilla Chemical Depot Washout Lagoons

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.

7.0 PAST AND CURRENT RECOMMENDATIONS

This section of the report identifies past recommendations that have been, at least partially, addressed as well as recommendations for the future. Some recommendations appear in both sections because they have been partially, but not completely, addressed.

7.1 Past Recommendations That Have Been Accomplished

- Completion of the follow up survey to the baseline rural residential survey conducted in 1999 (Section VIII, item G.2.b)
- DEQ and others should pursue funding for the research needs identified for BMP determination and implementation as well as the hydrogeologic characterization of the GWMA (partially completed).
- Consider a more proactive approach to education efforts such as a door-to-door information campaign, direct mailing, and/or meetings specific to the Spanish-speaking population. The proactive approach to education has been discussed and plans are being made to implement such a program.
- Begin efforts to encourage routine maintenance of septic systems and to encourage periodic inspections and replacement or upgrading of septic systems.
- Begin efforts to address rural residential animal pastures per items VII.D.5a & b.
- DEQ should do a better job at reviewing documents submitted by food processor facilities in a timely manner and providing comments that will assist the food processor facilities meet their permit conditions and objectives.
- Food processor facilities continue to strive to meet permit conditions and objectives.
- Develop an inventory of CAFOs in the LUB GWMA.

7.2 Recommendations for the Future

- DEQ and others should further investigate the anomalously high nitrate values at several network wells.
- All interested and affected parties should work towards accomplishing the December 2005 goals.
- DEQ and others should pursue funding for the research needs identified for BMP determination and implementation as well as the hydrogeologic characterization of the GWMA.
- DEQ should work towards implementing an economical alternative septic system demonstration project.
- Develop a plan to document how well activities, practices and alternative practices recommended in the Action Plan are being adopted. Include what is meant by an “accepted system of BMPs”. 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.
- Explore the possibility of performing deep soil sampling at locations where high nitrates have been detected.
- Completion of 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 should get additional educational materials produced in Spanish and make them available to the Spanish-speaking population within the GWMA.
- Develop Public Information and Education plans which emphasize groundwater quality protection in the LUB GWMA.
- Direct more education to growers regarding nutrient management to help reduce over-fertilization.
- Direct more general education on maintenance and management of wheel and permanent set irrigation systems.
- Either define an “acceptable system of BMPs” for irrigated agriculture or redefine the 2005 irrigated agriculture goal.
- Implement a more proactive approach to education efforts such as a door-to-door information campaign, direct mailing, and/or meetings specific to the Spanish-speaking population.
- Continue efforts to encourage routine maintenance of septic systems and to encourage periodic inspections and replacement or upgrading of septic systems.
- Continue efforts to address rural residential animal pastures per items VII.D.5a & b.

7.3 Recommendations for Changes to the Action Plan

It is recommended that the Action Plan be amended to:

- recognize the new EPA and ODA definitions of CAFOs and AFOs, and
- better define what acceptable systems of BMPs are for irrigated agriculture, rural residential properties, and CAFOs.