

# **APRIL 1999 MILTON-FREEWATER GROUNDWATER QUALITY STUDY**

## **AS PART OF THE STATEWIDE GROUNDWATER MONITORING PROGRAM**

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State of Oregon  
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## REGISTERED PROFESSIONAL GEOLOGIST SEAL

In accordance with Oregon Revised Statutes Chapter 672.505 to 672.705, specifically ORS 672.605 which states:

"All drawings, reports, or other geologic papers or documents, involving geologic work as defined in ORS 672.505 to 672.705 which shall have been prepared or approved by a registered geologist or a subordinate employee under the direction of a registered geologist for the use of or for delivery to any person or for public record within this state shall be signed by the registered geologist and impressed with the seal or the seal of a nonresident practicing under the provisions of ORS 672.505 to 672.705, either of which shall indicate responsibility for them.",

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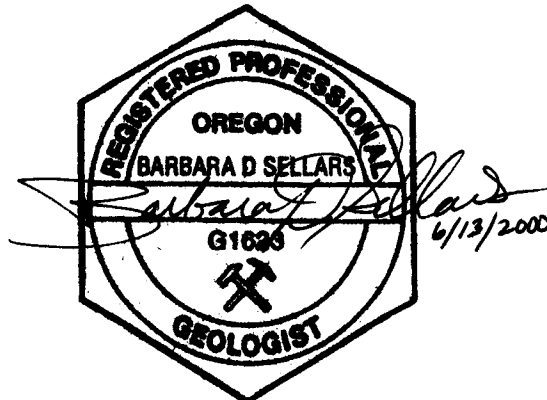
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## **1.0 PROJECT DESCRIPTION**

### **1.1 Introduction**

In October of 1989, the State of Oregon passed the Groundwater Protection Act. The goal of this Act is to "...prevent contamination of Oregon's groundwater resource while striving to conserve and restore this resource and to maintain the high quality of Oregon's groundwater resource for present and future uses." (State of Oregon, 1989).

Section 29 of the Act requires the Department of Environmental Quality (DEQ), the Oregon Water Resources Department (WRD), and Oregon State University (OSU) to cooperate in an "...ongoing statewide monitoring and assessment program of the quality of the groundwater resource of this state." (State of Oregon, 1989).

As part of this program, the DEQ has prioritized areas within the state for further evaluation, based on vulnerability to groundwater contamination, and whether or not a given area had known or suspected groundwater contamination. The prioritization process is outlined in the "Statewide Groundwater Monitoring Program - Master Plan" (ODEQ, 1993).

The Milton-Freewater area was identified as being in need of further groundwater assessment, based primarily on high profile water quantity and water quality issues, and to a lesser degree, on the factors outlined in the Master Plan.

This project was conducted in partial fulfillment of the 1989 Groundwater Protection Act, to satisfy the obligation to characterize the quality of the state's groundwater. The Milton-Freewater area was also identified as being at risk for anthropogenic (*i.e.*, caused by humans) contamination, due to (1) its near surface, coarse-grained aquifer (from which potable drinking water is withdrawn), and (2) the presence of various land uses, industrial activities, and commercial activities, which have a high potential for causing contamination. This study was intended to obtain a "snapshot" of water quality (*i.e.*, determine what kind of groundwater contamination was present in the area, and at what concentration).

The data were used to evaluate if there were any localized or area-wide groundwater contamination problems. If contaminants were found during the initial sampling that exceeded any drinking water standards, then resampling occurred only for those contaminants that exceeded a standard. If area-wide contamination was found, at consistently high enough levels, then the area could have been declared a groundwater area of concern, or a groundwater management area.

The State Health Division will use the water quality results of this sampling event to assist them in determining what, if any, health risks are posed to the residents of the area, who depend on the

groundwater for their potable water supplies.

## 1.2 Project Organization and Responsibilities

The following is a list of key project personnel and their responsibilities:

Project Officer:	Phil Richerson.
Responsibilities:	Project Supervision.
Field Operations:	David Cole.
Responsibilities:	Sampling Plan Development and Implementation.
Laboratory Operations:	Bob McCoy.
Responsibilities:	Sample Receiving and Tracking.
Data Quality (QA) Review:	Raeann Haynes/Chris Redman: LAB (503-229-5983).
Responsibilities:	Assure that Data Quality Objectives (DQO) are met.

## 1.3 Study Area and Well Network Selection

Previous groundwater sampling and testing in this area have shown that nitrate and bacteria are present in the groundwater. The presence of nitrate and bacteria indicate that the groundwater may be vulnerable to the presence of other pollutants, such as pesticides.

Additional factors which were used to establish this area as having high priority for groundwater sampling include:

- (1) more than 80% of the area is under irrigation (OWRD, 1992),
- (2) sensitive aquifers underlie the area (Sweet, 1980), and
- (3) land uses in these areas (agriculture, wood products, and manufacturing) are of concern.

The boundary of the study area was determined by evaluating the hydrogeology of the region, results of past water quality investigations, and land use practices. The study area was defined as the sixteen sections (16 square miles) north of the city of Milton-Freewater. The approximate location of the study area within the State of Oregon is indicated in Figure 1. Once the study area was defined, the wells comprising the sampling network were chosen.

The goal of establishing the monitoring well network was to include a sufficient number of wells to adequately represent the area's groundwater quality. To do this, properly constructed and maintained wells from the different land use areas were identified. Well logs on file with the Oregon Water Resources Department were used in determining which wells were properly

constructed and the aquifer depth tapped by each of these wells. Visual observations of the well head area were used to determine which of these wells were properly maintained. Wells were discounted from potential use if improper practices were observed near the well head which might produce results reflecting very local activities and not results typical of regional water quality.

Thirty wells were ultimately chosen as the sampling network. DEQ assigned a six character well identification for each well. The well identification contains the three letters "UMA" representing Umatilla County followed by a three digit number representing a sequential numbering of wells used in DEQ studies. The wells used in this study are designated UMA282 through UMA311. The locations of the wells comprising the sampling network are shown in Figure 2.

#### **1.4 Analyte List Selection**

Each sample was analyzed for a list of chemical constituents called the analyte list. The analyte list for this project includes the standard analyte list specified in the Statewide Groundwater Monitoring Program – Master Plan. In addition, specific pesticides were added based on the specific historical pesticide use in the area. Similarly, fecal coliform and *E. Coli* bacteria were added based on historical groundwater quality problems with bacteria. The final analyte list for this project included physical / chemical parameters, common ions, metals, nutrients, pesticides, bacteria, and volatile organic compounds.

## **2.0 BACKGROUND**

### **2.1 Site Location**

The Milton-Freewater study area is located in northern Umatilla County (Figure 1). At the demographic heart of the study area is the town of Milton-Freewater, which is located approximately 5 miles south of the Oregon-Washington border (Figure 2).

### **2.2 Geography**

The Milton-Freewater area is located in a rural agricultural and ranching setting, in the southern part of the Walla Walla River Valley. The population of Milton-Freewater is 6,055, with an additional 9,800 in the surrounding countryside, for a total population in the vicinity of the study area of approximately 15,855.

The study area consists of flat alluvial and lacustrine plains, at an elevation of about 1,100 feet above mean sea level. The principal land use in the study area is agricultural. Umatilla County, which contains the study area, ranks as Oregon's top county for wheat and grain production. Other crops include fruits (apples, plums, peaches, pears, apricots, and cherries), and vegetables

(asparagus). Some areas are used for pasture.

The climate in the study area is semiarid, with cold winters and warm, dry summers. The average annual precipitation in the area is 12 to 16 inches, with approximately 55% of that total falling between November and March. Much of the winter season's precipitation falls as snow.

### **2.3 Geology**

Well logs and geologic reports indicate that sedimentary deposits from 200 to 250 feet thick, unconformably overlie volcanic rocks of the Columbia River Basalt Group. The topmost unit consists of interbedded alluvial deposits of gravel, sand, silt, and clay. The thickness of this upper unit ranges from 80 to 100 feet. These deposits are the result of coalescing alluvial fan sediments, derived from Mill Creek and the Walla Walla River. Underlying these deposits are fine-grained lacustrine deposits, with local beds of coarser deposits, also known as the Touchet Beds. These lacustrine deposits overlie fine-grained wind blown loess deposits of the Palouse and Ringold Formations. Underlying the Palouse Formation are the rocks of the Columbia River Basalt Group (Newcomb, 1965).

The Walla Walla syncline, developed within the basalt bedrock, forms the basin structure. Bounding the basin on its flanks are anticlinal structures of the Blue Mountains, Horse Heaven Hills, and Divide (Newcomb, 1965).

### **2.4 Hydrogeology**

Because the soils are porous and permeable, drainage rates are high. The local area has an irrigation water distribution system consisting of unlined ditches. These factors combine to yield a large amount of groundwater recharge. In 1965, Newcomb stated that an estimated 60,000 acre-feet of water was taken from the Walla Walla River, mostly just below Milton-Freewater. Newcomb estimated that a large part of that irrigation water, probably half on the average, infiltrates into the shallow groundwater aquifer. These recharge characteristics imply a strong potential for movement of various contaminants into the groundwater.

MacNish et. al. (1973) described the shallow gravel aquifer that underlies the Walla Walla Valley, and that receives the recharge water. The gravel aquifer is coupled intimately with the network of streams, canals, and ditches that web the land surface. The aquifer receives recharge from precipitation, stream leakage, canal leakage, and from infiltration of excess irrigation water. In turn, water from the aquifer discharges to a number of springs and natural streams at lower elevations. The aquifer also contributes water by downward leakage through underlying clay to the basalt aquifer, and where water levels are close to the surface, the aquifer releases water to growing plants. Numerous irrigation and domestic wells draw water from the aquifer. The distribution of coarse and fine materials within the aquifer also influences the movement of groundwater. In the topographically higher locations in the northern part of the Walla Walla

basin, north and east of Walla Walla, Washington, and in the southern part of the Walla Walla basin, just to the north and west of Milton-Freewater the shallow aquifer is composed chiefly of coarse gravel which transmits water quite readily. In the areas where coarse gravels are common, water from the main streams and numerous canals percolates into the gravel aquifer. Downslope from these two areas, water is transmitted less readily because the materials become finer grained, and layers of clay and silt occur locally in the aquifer. As the water in the aquifer moves toward the center of the valley, into lower altitudes, it encounters these finer-grained materials which cannot transmit water as quickly as the coarse materials supplying them. In these areas, the water is forced to discharge from the aquifer as springs. MacNish estimated that the amount of water that flows into and through the aquifer in this manner is about 50,000 acre-feet per year. As of MacNish's report (1973), the estimated total amount of water flowing through the aquifer, including pumpage from all of the irrigation wells tapping this aquifer, and the total spring flow, was at least 75,000 acre-feet per year.

MacNish likened the gravel aquifer to a large surface reservoir that has been filled with rocks. He estimated that between the rocks are gaps or spaces that comprise about 20% of the total volume of the gravel aquifer. In the Walla Walla River Basin, the gravel aquifer is about 20 miles long, 10 miles wide, and averages more than 200 feet in thickness. Even though this reservoir is 80% rock materials, the remaining 20% will accommodate more than 5 million acre-feet of water. The aquifer's total storage capacity cannot be utilized, however, due to practical limitations which prevent the removal of all of the water from the aquifer. MacNish estimated that quantities which more likely approximate the manageable reservoir capacity of the gravel aquifer are perhaps as much as 1 million acre-feet.

Oregon Health Division (1991) summarized hydrogeologic evidence in the area and indicated that the Walla Walla River infiltrates into the subsurface, and although the alluvial aquifer is confined locally, the confining layer is not impermeable nor continuous throughout the region, which implies that conduits from the surface to the aquifer probably exist. Comparison of static water levels (SWLs) in the wells with the river bottom elevation shows that the SWLs are at lower elevations than the river. Additional evidence shows that SWLs decrease away from the river. Both of these observations indicate that groundwater does not support base flow of the Walla Walla River. The river is, in fact, a discharging, or losing, stream at this point.

Other evidence that supports the notion that the river is a losing stream is a conductivity study. The conductivity of a water sample is proportional to the amount of dissolved solids in the water. Generally, the greater the amount of dissolved solids in the water, the greater is the water's conductivity. When solids dissolve in water, they tend to become polarized; that is, they are charged ions, rather than neutral elements or compounds. Because of their charge, ions are able to conduct electricity, so the greater the number of ions in the water, the greater is that water's ability to conduct electricity, and hence its conductivity is high. The total dissolved solid (TDS) load of an aquifer is a function of various factors, including aquifer mineralogy, residence time (i.e., how long the water has been in contact with aquifer materials), and how fast the

groundwater is moving. In a given aquifer, waters with longer residence times, or with lower velocities, will have higher conductivity (TDS).

The conductivity of the Walla Walla River was measured at two locations, and both values were approximately the same (53  $\mu\text{Mhos/cm}$ ). Wells in close proximity to the river have conductivity values only slightly higher than the river (55 - 75  $\mu\text{Mhos/cm}$ ). Well water conductivities along lines perpendicular to the river show increasing conductivity away from the river. At a distance of about 2/3 mile west of the river, well water conductivities exceed 100  $\mu\text{Mhos/cm}$ , while at about 1/2 mile east of the river groundwater conductivities exceed 160  $\mu\text{Mhos/cm}$ .

There is no evidence to suggest that there is a systematic and significant difference in aquifer mineralogy that occurs in the shallow aquifer that could account for the observed variation in groundwater conductivity. Furthermore, if groundwater was providing base flow to the river, the groundwater closest to the river would have had the greatest residence time, and hence should show the highest conductivity. Such a scenario would imply that groundwater conductivity increases toward the river. Since this is not what is observed, the most probable explanation then is that the Walla Walla River water, with its relatively low TDS, is discharging into the alluvium. As the water migrates away from the river, the TDS of the water progressively increases, and this is what we see. In summary then, hydrogeological and geochemical data are consistent with the hypothesis that discharge from the Walla Walla River significantly influences the shallow aquifer in the Milton-Freewater area.

## **2.5 Previous Work**

In 1976 the Umatilla County Health Department required some public water systems to install chlorination treatment because of coliform bacteria problems.

In 1985 the City of Milton-Freewater conducted a study of well depths in the area, in which 288 wells were surveyed.

In 1988 the OSU Extension Service sampled 40 private wells, 70% of which tested positive for total coliform bacteria.

In a separate OSU 1988 pesticide study, 10 wells were sampled and found to contain nitrate levels ranging from 0.51 ppm to 1.20 ppm.

In 1990 the Health Division required a licensed restaurant to close several times because water quality did not meet standards. Despite a change in ownership and the drilling of a new well, the restaurant still could not operate because the subsurface sewage system was inadequate.

In 1991 the Health Division conducted a health hazard sanitary survey, in which 35 wells were sampled. Seventeen of the wells (49%) tested positive for total coliform bacteria. One of the

wells (3%) tested positive for E-coli bacteria. The study concluded that “Of the 28 wells that we judged to not be vulnerable to surface water contamination, 15 (54%) were positive for total coliform.” Another conclusion of the study was that there was no apparent correlation between well depth and the presence of coliform bacteria. Furthermore, the contaminants seemed to be distributed throughout the entire aquifer. According to the study, the aquifer in the region is predisposed to contamination due to the coarse grained nature of the soils, which allows for significant surface water influence, and the presence of confined animal feeding operations (CAFOs), plus individual septic systems. Although some of the wells were free from contamination during the study, it is deemed likely that these wells may be subject to contamination during other seasons of the year.

In 1991 Dennis Nelson of the Health Division summarized the geology of the area, and stated that the combined thickness of the lake derived and wind blown deposits is from 200 to 250 feet. He said that hydrogeologic evidence indicates that the Walla Walla River water infiltrates into the subsurface in the area, and that local confining layers in the area are not continuous, and are not impermeable.

In 1992 - 1993 the Health Division conducted a special microbe study for the EPA. Samples were taken from the Outwest Motel well before any treatment equipment. A sample was taken every month for a year. The results indicated:

- Every sample had coliform bacteria
- 5 showed fecal bacteria and viral indicators
- 6 positive tests for E-coli
- 9 positive tests for Somatic Coliphage
- 4 positive tests for Enterovirus (Reovirus and unknown)

In 1996 the OSU Extension Agents conducted a study titled “Nitrates and Bacteria in Groundwater: a Second Look.” Among the highlights pertinent to the Milton-Freewater area are the following:

- Of 29 wells sampled in June 1996, 23 (77%) tested positive for coliform bacteria, and 6 (20%) also tested positive for E-coli bacteria.
- Nitrate levels ranged from 0.80 ppm to 14.00 ppm, with an average of 3.90 ppm.
- Of 15 wells sampled in August 1996, 7 (47%) tested positive for coliform bacteria, while none tested positive for E-coli.

- 30 wells were tested for nitrates in August 1996, with a range of 0.70 ppm to 8.60 ppm, and an average of 4.14 ppm.
- Well depth had no clear influence on the presence of coliform bacteria or nitrates.
- Of 40 wells tested in May 1988, the average nitrate level was 1.00 ppm, and 28 (70%) of these wells tested positive for the presence of coliform bacteria.
- Of 24 wells tested in July 1996, average nitrate levels were 3.70 ppm, and 20 of these wells (83%) tested positive for the presence of coliform bacteria.
- Coliform bacteria appear in most of the wells on a regular basis, but its presence can be erratic.
- Potential sources of contamination in the area are fertilizers, human waste and septic systems, and livestock waste.

## **2.6 Oregon Health Division Real Estate Transaction Groundwater Testing**

Since 1989, the Oregon Groundwater Protection Act (Oregon Revised Statutes 468B.150 through 468B.185) has required that nitrate testing of groundwater from domestic wells during property transactions be conducted. This information is submitted to the OHD. Analytical results from 46 water well tests, sampled from 10/25/89 to 11/20/96, in and around the study area, show that 3 wells had nitrate values that were at or above the drinking water standard of 10 mg/l. Two wells had nitrate values between 5.0 mg/l and 10.0 mg/l. The nitrate values from the remaining 41 wells were below 5.00 mg/l. This data is summarized in Appendix 1.

## **2.7 Oregon Health Division Public Drinking Water Supply Testing**

The OHD requires that testing of public water supplies (PWS) be conducted. This includes restaurants, hotels, mobile home parks, and any drinking water supply that is regularly accessible to the general public. Water samples from 13 Public Water Supply facilities in and around the study area are periodically collected for nitrate and coliform bacteria testing. The nitrate and coliform bacteria discussed here are the data posted on the Oregon Health Division's Drinking Water Program web site. The highest nitrate value from the most recent sample from these PWS facilities was 7.1 mg/l, which is below the drinking water standard of 10.0 mg/l. No coliform bacteria were detected in the most recent sampling event from these 13 facilities. The data summarized above is presented in Appendix 2.

### **3.0 SAMPLING PROCEDURES**

The sampling procedures followed during this project were in accordance with the Oregon Department of Environmental Quality's standard operating procedures. These procedures are described in (ODEQ 1986), (ODEQ 1991), (ODEQ 1995), and (ODEQ 1997).

### **4.0 REPORTING OF DATA TO WELL OWNERS**

After analytical results were received and reviewed, DEQ sent letters to the well owners summarizing the entire sampling event and explaining the analytical results associated with their individual well. A copy of the analytical results for the sample collected from their well was attached to the letter. Examples of these letters are included in Appendix 3.

### **5.0 SAMPLE RESULTS**

#### **5.1 Overview**

The groundwater samples collected during the study were analyzed for a wide variety of constituents including physical / chemical parameters, common ions, metals, nutrients, pesticides, bacteria, and volatile organic compounds. Table 1 is a summary of the April 1999 groundwater quality data, grouped by analyte type, for each well tested. Table 2 is an overview of the April 1999 groundwater quality data where, for each constituent analyzed, the maximum value observed, the average of the observed values, the minimum value observed, and the number of times it was detected is indicated. In addition, concentrations (or concentration ranges) from various sources are presented in Table 2 so that comparisons to the observed concentrations can be made. The sources of these comparison values are discussed in the following section. Discussions of specific results are presented in subsequent sections.

Results from duplicate samples (i.e., two samples from one well) were averaged into one number for inclusion in Table 1. Results from duplicate samples were not averaged for inclusion in Table 2. Therefore, the maximum value reported for a parameter in Table 2 might not necessarily be the value reported in Table 1. For example, the maximum Dacthal & Metabolites value in Table 1 is 21.7 ug/l, which is the average of the two values reported for the duplicate samples (18.7 and 24.6 ug/l) while the maximum Dacthal & Metabolites value in Table 2 is 24.6 ug/l.

#### **5.2 Comparison Values**

The sources of comparison values presented in Table 2 include Federal Drinking Water Standards<sup>1</sup>, health advisory guidance levels<sup>2</sup>, OAR 340-40-020 Reference Levels<sup>3</sup>, Preliminary

<sup>1</sup> Either primary or secondary drinking water standards

<sup>2</sup> The concentration in drinking water that is not expected to cause adverse noncarcinogenic effects over a lifetime of exposure, with a safety margin.

Remediation Goals<sup>4</sup>, naturally occurring levels<sup>5</sup>, and water quality criteria protective of fish<sup>6</sup>. Only the Federal Primary Drinking Water Standards and the OAR Reference Levels are enforceable by law. However, not all parameters analyzed have federal drinking water standards or OAR Reference Levels. The other values are presented so that some evaluation of the detected concentrations can be made.

### 5.3 Physical / Chemical Properties

The physical /chemical properties analyzed included such things as temperature, pH, and hardness. Tables 1 and 2 provide a complete list of physical / chemical properties tested. Total dissolved solids (TDS) and pH are the only two physical / chemical properties analyzed that have water quality standards (Table 2). All of the observed TDS and pH values are within the water quality standards.

The distribution of TDS values detected in April 1999 is shown in Figure 3. As indicated in Figure 3, the lowest concentrations of TDS are located in the eastern and southern portion of the study area while the highest concentrations of TDS are located in the northwestern portion of the study area. As a general observation, lower TDS values were observed in areas close to the Walla Walla River and dominated by flood irrigation while higher TDS values were observed in areas farther from the River and dominated by sprinkler irrigation. A possible explanation for this distribution is a flushing of low TDS water (surface water is often lower in TDS than groundwater) down the soil column and through the aquifer by the relatively large amounts of water leaking from the unlined ditches associated with flood irrigation and the water percolating down from the River into the aquifer.

Other physical / chemical properties tested were either not detected, detected within naturally occurring levels, or detected but are not priority pollutants or carcinogenic (cancer causing). Therefore, no groundwater quality problems associated with physical / chemical properties were identified.

### 5.4 Common Ions

The common ions analyzed include such things as chloride, sodium, and sulfate. Tables 1 and 2 provide a complete list of common ions analyzed. Chloride, manganese, and sulfate are the only three common ions analyzed that have water quality standards (Table 2). All of the observed chloride, manganese, and sulfate concentrations are below the applicable standards. Other common ions were detected at naturally occurring levels. Therefore, no groundwater quality

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<sup>3</sup> Only presented if lower than federal standards

<sup>4</sup> EPA Region 9 established Preliminary Remediation Goals which are concentrations in water that are considered protective of humans, including sensitive groups, over a lifetime.

<sup>5</sup> Values cited in "Study of the Chemical Characteristics of Natural Water" by J.D. Hem, 1985. USGS Water Supply Paper 2254

<sup>6</sup> Water quality criteria protective of salmonid species of fish from "Quality Criteria for Water", EPA 440/5-86-001, 1986.

problems associated with common ions were identified.

## **5.5 Metals**

The metals analyzed include such things as arsenic, lead, and copper. Tables 1 and 2 provide a complete list of metals analyzed. Ten metals analyzed have primary drinking water standards (Table 2). Five metals analyzed have secondary drinking water standards (Table 2). With the exception of iron, no metals were detected above water quality standards. Iron was detected at one well (UMA301; Figure 2) at a concentration slightly above the secondary drinking water standard. Secondary drinking water standards are regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) rather than for health effects. Therefore, the iron concentration is not believed to represent a threat to human health or the environment.

With the exception of lanthanum, all other metals were either not detected, or detected at naturally occurring levels. A range of naturally occurring lanthanum in groundwater could not be identified. Because lanthanum is not a priority pollutant or a carcinogen, and because it was detected at relatively low levels, it is not believed to represent a problem to human health or the environment. Therefore, no groundwater quality problems associated with metals were identified.

It is interesting to note, however, that lanthanum was detected only in the 12 southern-most wells in the sampling network. These wells are closest to the location where the Walla Walla River exits the Blue Mountains and the alluvial fan is formed. Lanthanum is a rare-earth element most often found in nature in the mineral monazite. Monazite is an accessory mineral most often found in rocks such as granites, gneisses, and pegmatites. Monazite is often concentrated in the sands formed by erosion of the host rocks. The locations of the wells in which lanthanum was detected (i.e., on the Walla Walla River alluvial fan) suggests the source of lanthanum is naturally occurring and is located up the Walla Walla River valley.

## **5.6 Nutrients**

The nutrients analyzed include phosphate, total organic carbon (TOC), and portions of the nitrogen cycle (ammonia, total kjeldahl nitrogen (TKN), and nitrate / nitrite). Phosphate was detected in all samples at naturally occurring levels and is not believed to represent groundwater quality problems (Table 2). Both ammonia and TKN were detected at very low levels (near their detection limits) and are not believed to represent groundwater quality problems (Table 2). Nitrate is the only nutrient analyzed that has a water quality standard (Table 2). Nitrate was detected in all wells but at concentrations below the 10 milligram per liter (mg/l) drinking water standard. Sources of nitrate can include runoff from fertilizer use, leaching from septic tanks and drainfields, and erosion of natural deposits. The detection of nitrate in all wells tested supports the results of previous studies, which indicated the widespread occurrence of nitrate in

the study area.

The distribution of nitrate detected in April 1999 is shown in Figure 4. As indicated in Figure 4, the lowest concentrations of nitrate are located in the eastern and southern portion of the study area while the highest concentrations of nitrate are located in the northwestern portion of the study area. As a general observation, lower nitrate concentrations were observed in areas close to the Walla Walla River and dominated by flood irrigation while higher nitrate concentrations were observed in areas farther from the River and dominated by sprinkler irrigation. A possible explanation for this distribution is a flushing of nitrate down the soil column and through the aquifer, and/or dilution of nitrate within the aquifer, by the relatively large amounts of water leaking from the unlined ditches associated with flood irrigation and the water percolating down from the River into the aquifer.

## 5.7 Pesticides

A few pesticides were detected in a few samples but no groundwater quality problems associated with pesticides were identified. A discussion of the ways in which pesticides were analyzed and the associated results is provided below.

Pesticides were analyzed two different ways in this study. In addition to the traditional five pesticide screens, a relatively new method (known as solid phase extraction) was performed. The new method can provide lower detection limits than the traditional analysis and, therefore, can provide better information on the existence of pesticide contamination in the environment. Tables 1 and 2 provide a list of the pesticide screens performed and the specific pesticides detected. A complete list of the pesticides analyzed is provided on the analytical laboratory reports included as Appendix 4.

As indicated in Table 2, two of the pesticides analyzed have water quality standards. These two pesticides (atrazine and simazine) were detected in four samples but at concentrations much less than their standards. Desethyl atrazine (which has no water quality standard) was detected in five samples at concentrations similar to the detected atrazine concentrations. Because the toxicology data for desethyl atrazine are similar to toxicology data for atrazine, it is likely that a water quality standard for desethyl atrazine would be similar to the atrazine standard. Therefore, the concentrations of desethyl atrazine are not believed to represent problems to human health or the environment.

Dacthal and its metabolites<sup>7</sup> were detected in six samples as part of the phenoxyherbicide screen. The maximum concentration detected (24.6 micrograms per liter) was much less than the 4,000 micrograms per liter health advisory level (Table 2). Therefore, the concentration of dacthal and metabolites is not believed to represent problems to human health or the environment.

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<sup>7</sup> A metabolite is anything produced by the metabolism of dacthal (i.e., a breakdown product).  
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Three pesticides (chlorpyrifos, dacthal, and terbacil) analyzed by the solid phase extraction method were estimated to be present at very low levels, actually below the method detection limit. The trace amounts of these pesticides are not believed to represent problems to human health or the environment.

## **5.8 Bacteria**

Bacteria (specifically *E. Coli* and/or fecal coliform) were the only analytes detected at levels of concern in any of the wells sampled. Bacteria were detected in samples collected in April 1999 at the four wells indicated in Figure 5 (UMA285, UMA286, UMA287, and UMA297) at relatively low concentrations (Table 1). *E. Coli* and fecal coliform bacteria are associated with human and animal fecal waste. Therefore, sources of *E. Coli* could include sewage treatment plants, septic systems, agricultural and livestock operations, and wildlife. Based on the relatively low bacteria concentrations and the distribution of the affected wells, a single source of bacteria is not believed to have affected all four wells. Rather, it is more likely that multiple sources of bacteria affected these wells.

As indicated in Section 2.5, bacteria have historically been detected in groundwater in the study area. The locations and concentrations of bacteria have varied widely.

These four wells were resampled on October 28, 1999. Results of the resampling indicate all four samples contained no detectable *E. Coli* or fecal coliform bacteria. These four wells were not shock treated between April 1999 and October 1999. These results are consistent with results from the 1996 OSU study where the presence of coliform bacteria was erratic.

## **5.9 Volatile Organic Compounds**

The groundwater samples were analyzed for 63 volatile organic compounds (VOCs). The specific VOCs tested are indicated on the analytical laboratory reports included as Appendix 4 and include compounds found in petroleum products (*e.g.*, gasoline and diesel) and solvents (*e.g.*, degreasers and dry cleaning operations). No VOCs were detected in any of the samples (Table 2). Although low levels of some VOCs can be naturally occurring, the presence of VOCs in groundwater is usually indicative of contamination from factories, landfills, dry cleaning operations, petroleum storage tanks, etc. Therefore, no groundwater quality problems associated with VOCs were identified.

## **5.10 Evaluation of Water Quality Results With Respect To Well Construction Details**

The well logs for the study area wells were examined by WRD personnel. Based on this examination, three wells were identified which potentially have deficient seals. These wells include UMA285, UMA296, and UMA304. A complete well log for UMA310 was not available

for review. Therefore, it was not possible to evaluate the well seal for this well.

An evaluation of the water quality results was conducted to evaluate potential migration of contaminants along a potentially deficient well seal. A discussion of this evaluation is provided below. It is important to note that each well used in this study was visually inspected for evidence of faulty construction or maintenance prior to collecting groundwater samples, and none was found.

If agricultural land is located near a well, pesticides and nutrients (such as nitrate) are contaminants potentially found at land surface which could be transported to the subsurface along a deficient well seal. If livestock are located near a well, nitrates and bacteria are contaminants potentially found at land surface which could be transported to the subsurface along a deficient well seal.

The groundwater quality data from all wells were evaluated for the presence of the indicator parameters mentioned above. In addition, the well depths were evaluated with respect to presence of the indicator parameters. In summary, these indicator parameters were detected in both the “suspect” wells and the remaining “non-suspect” wells, and no water quality results were found which caused the conclusion that contaminants are being transported along a deficient seal. Details of the evaluation include:

- Pesticides were detected in the 4 suspect wells and 10 of the remaining 26 wells. Of the 7 pesticides detected, the maximum concentration of 3 pesticides was detected in one of the suspect wells.
- As previously mentioned, nitrate was detected in all study area wells. The maximum nitrate concentration detected was in one of the suspect wells. However, the pattern of nitrate distribution throughout the study appears natural and does not suggest the presence of poorly constructed or maintained wells.
- Of the 4 wells in which bacteria were detected, one of these wells is a suspect well. The maximum bacteria concentrations were not detected in a suspect well.
- The four suspect wells are not the shallowest or the deepest wells used in the study. The presence of the indicator parameters in deep wells but not in shallow wells could suggest contaminant migration along a deficient seal. The presence of indicator parameters in shallow wells but not in deep wells could suggest a natural contaminant migration through the subsurface.

## 6.0 CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Conclusions

Based on the information presented above, the following conclusions were made:

- Bacteria (specifically *E. Coli* and/or fecal coliform) were the only analytes detected at levels of concern in any of the wells sampled in April 1999.
- Bacteria were detected at low levels (< 15 cfu/100 ml) in 4 of 30 wells sampled in April 1999.
- When resampled in October 1999, no bacteria were detected in samples from the 4 wells.
- The presence of low levels of bacteria in April 1999 and absence of bacteria in October 1999 is consistent with the erratic bacteria occurrence noted in previous studies.
- Nitrate was detected in all wells but at concentrations below the 10 mg/l drinking water standard.
- The lowest concentrations of nitrate and TDS were located in the eastern and southern portion of the study area while the highest concentrations of nitrate and TDS were located in the northwestern portion of the study area.
- Lower nitrate and TDS concentrations were observed in areas close to the Walla Walla River and dominated by flood irrigation while higher nitrate and TDS concentrations (as high as 6.6 mg/l nitrate and 310 mg/l TDS) were observed in areas farther from the river and dominated by sprinkler irrigation.
- A possible explanation for the nitrate and TDS distribution is a flushing of low TDS water (surface water is often lower in TDS than groundwater) down the coarse-grained soil column and through the coarse-grained aquifer, and/or dilution of nitrate within the aquifer, by the relatively large amounts of water leaking from the unlined ditches associated with flood irrigation and the water percolating down from the River into the aquifer.
- Although examination of the study area well logs identified four wells with potentially deficient well seals, no water quality results were found which caused the conclusion that contaminants are being transported along a deficient seal.

## 6.2 Recommendations

Based on the conclusions presented above, the following recommendations were made:

- Due to the erratic occurrence of bacteria and the historical presence of nitrate and bacteria throughout the study area, periodic sampling and analysis of bacteria and nitrate from private drinking water sources is recommended.
- Citizens within the study area interested in learning about the health effects of nitrate and bacteria and/or available technology to treat nitrate and bacteria in their drinking water systems, should contact the Oregon Health Division.
- Citizens in the study area should be aware of, and attempt to minimize, materials and activities, which can contribute to groundwater contamination.

## 7.0 LIST OF REFERENCES

Darnell, Thomas, Montgomery, Marvin L., and Witt, James M., 1989, Pesticides in Groundwater, Milton-Freewater, Umatilla County, Oregon, Oregon State University.

MacNish, R.D., Mayers, D.A., and Barker, R.A., 1973, Appraisal of Groundwater Availability and Management Projections, Walla Walla River Basin, Washington and Oregon, Water Supply Paper Bulletin No. 37, Washington State Department of Ecology, in cooperation with the U.S. Geological Survey.

Newcomb, R.C., 1965, Geology and Groundwater Resources of the Walla Walla River Basin, Washington - Oregon, Water Supply Bulletin No. 21, Washington State Department of Conservation, Division of Water Resources in cooperation with the U.S. Geological Survey.

Oregon Department of Environmental Quality, Monitoring Section, Laboratory Division, Mode of Operations Manual, 1986.

Oregon Department of Environmental Quality, Quality Assurance Section, Laboratory Division, Field Sampling Reference Guide, June 20, 1991.

Oregon Department of Environmental Quality, Water Quality Division, 1993. Statewide Groundwater Monitoring Program-Master Plan.

Oregon Department of Environmental Quality, 1995. Groundwater Sampling Procedures.

Oregon Department of Environmental Quality, 1997. DEQ Laboratory Field Sampling Reference Guide, Revision 5.0.

Oregon Health Division, 1991. Sanitary Survey Report : Milton-Freewater Highway 11 Area

Oregon Water Resources Department, 1992. Percentage of Irrigated Land In Oregon map.

State of Oregon, 1989. Groundwater Protection Act of 1989. House Bill 3515, Sections 17 Through 66. (Oregon Revised Statutes 468B.150 through 468B.185).

Sweet, Randy H. et. al., 1980. Oregon Public Water Supply Wells and Sensitive Aquifers map, from Surface Impoundment Assessment for the State of Oregon, Sweet, Edwards and Associates.

Topielec, Rich, et. al., October 1996, Nitrates and Bacteria in Groundwater, A Second Look, Oregon State University Extension Service.