Idaho Department of Environmental Quality

Canyon County Ground Water Study along the Boise River Corridor, Canyon County, Idaho

Water Quality Status Report No. 119

Canyon County Ground Water Study of the Boise River Corridor, Canyon County, Idaho

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Abstract

In October 1992, the U.S. Geological Survey (USGS) and the Idaho Department of Environmental Quality (IDEQ) began a comprehensive study of ground water quality in and near Boise, Idaho. Objectives of this study were to compile information on historic land uses, water uses, and ground water quality; analyze water from major water yielding zones; assess the nature and extent of contamination; and report on the results of the investigation.

This study is a continuation of that ground water quality study within the Boise River drainage that began in October 1992 by the USGS and IDEQ Boise Regional Office. Three hundred and fourteen wells were sampled during 1996 and 1997 for this ground water study. From August 12, 1996 through September 5, 1996 150 wells were sampled in the Nampa area. From August 4, 1997 through October 23, 1997 164 wells were sampled from Middleton to the Snake River.

Field parameters were measured at each site, prior to collecting samples. Measured field parameters were pH, specific conductance, dissolved oxygen and temperature. All samples were analyzed for basic nutrients, volatile organic compounds, bacteria, and selected sites for metals and pesticides.

The volatile organic compound, tetrachloroethylene, was found in an area north of Nampa near I-84 and Franklin Road. Nitrate levels exceeded the Ground Water Standard of 10 mg/l in 24 of the 314 wells sampled. Total Coliform bacteria were detected in 41 of the 314 wells sampled. Atrazine, and atrazine breakdown constituents, were detected at very low levels in 31of the 37 wells sampled. Four of the 42 wells sampled for metals exceeded the current Ground Water Standard of 50 ug/l for arsenic. If the arsenic Ground Water Standard were lowered, to the proposed level of 5 ug/l, then 28 wells sampled would have exceeded the proposed standard.

Introduction

This is a continuation of the 1993-95 Department of Environmental Quality (DEQ) and U.S. Geological Survey (USGS) ground water study within the Boise River drainage. The results of the previous phases of the project can be found in the reports "Determination of Nature and Extent of Ground Water Contamination in Boise City and Boise Urban Planning Areas, Ada County, Idaho" (Boyle 1995), "Ground Water Study of the Lower Boise River Valley, Ada and Canyon Counties" (Boyle 1996), "Selected Well and Ground-Water Chemistry Data for the Boise River Valley, Southwestern, Idaho" (Parliman 1996), and "Ground-Water Quality in Northern Ada County, Lower Boise River Basin, Idaho, 1985-96" (Parliman 1998). Figure 1 shows the location of the study area and the location of all the wells sampled to date.

The focus of this phase of the study is on the ground water quality within the Boise River drainage in Canyon County. The project area in 1996 included Nampa and the surrounding area. The 1997 project area was along the Boise River from Middleton to the Snake River. The Nampa area is changing from rural land use to urban and suburban land use. The land use along the Boise River, from Middleton to the Snake River, is still mainly agricultural with some urban growth in the cities.

At least 90% of the drinking water in the Boise River drainage area is supplied from ground water sources (IDHW DEQ 1991). The urban, suburban, and rural areas have wells completed in a number of water-yielding zones (IDWR 1995). Ground water is present at varying depths in floodplain and terrace sediments. Layers of water-bearing zones are less than 30 feet to more than 1,000 feet below land surface, and wells throughout the area are open to one or several water-bearing zones. Water-bearing zones within a local ground-water system (floodplain and terrace sediments – depth to water near land surface to several hundred feet below land surface) overlie a regional ground water system (Parliman 1998).

Local water-bearing zones tend to be the most vulnerable to contamination from industrial solvents, petroleum products, septic tank drainfield leachate, animal waste, pesticides, fertilizers, and stormwater runoff. Leakage from unlined canals and ditches recharge the local water-bearing zones and can cause substantial seasonal changes to the level of the water table. Rising water levels flush contaminants from previously unsaturated soils. Contaminants related to land and water use include

nutrients, bacteria, pesticides, petroleum products, and solvents (Parliman 1993-1994).

Naturally occurring ground water contaminants include iron, manganese, methane, arsenic, sulfate, radon, alpha radiation, and beta radiation (Neely 1998). The regional cold water system is underlain by confined systems of geothermal water. Infiltration of geothermal water can elevate the levels of naturally occurring ground water contaminants (Parliman 1993-1995).

Objectives

The objectives of this study are:

1. Complete a retrospective analysis of existing hydrogeologic information and data on ground water quality.

2. Document historic and current land and water use practices.

3. Analyze ground water samples to determine the nature and extent of contaminants.

4. Publish a report on the results of the ground water study.

Project Area

The project boundaries for the 1996 Nampa area are from the corner of Ustick Road and Malt Road east on Ustick Road to the Ada/Canyon County line. Then south along the Ada/Canyon County line to Lewis Road. East on Lewis Road to Malt Road, then north on Malt Road back to Ustick Road.

The project boundaries for the 1997 corridor area are approximately 2 miles on each side of the Boise River from Middleton to the Snake River. See figure 2 for a diagram of the DEQ/USGS ground water study areas.

Historic and Current Land and Water Use Practices

Early farming was limited by the availability of water for the crops. By 1911 the valley had undergone significant changes. The construction of Diversion Dam and Arrowrock Reservoir, along with four major canals; the Ridenbaugh, Farmer's Union, New York and Phyllis canals carried water miles away from the Boise River for farm use. Anderson Ranch Reservoir was built later to provide an increase of irrigation water to the farms in the valley. The last dam to be built for irrigation storage was Lucky Peak Dam, which was constructed by 1952.

Surface water has not been the only source of irrigation water in the valley. Ground water pumped from irrigation wells is used to supplement surface irrigation water where surface water is limited or can not be utilized. Such large amounts of irrigation water, surface and well water, being used in a semi-arid desert has significantly altered the water table level in the local water-bearing zones of the aquifer in the valley. The use of surface water has raised the water table level in some areas considerably.

High water tables in some areas have created waterlogged soils, creating problems for farmers. Consequently, drains have been dug in these areas to allow drainage of the waterlogged soils.

During the 1950's there was a shift from septic fields to piping the waste to sewage treatment plants in and near the cities (Dion, 1972). This also increased the development of rural land into urban use. The change of farmland to residential and business use continues today.

Climate

The valley has a semi-arid, temperate climate characterized by cool, wet winters and warm, dry summers (Dion 1972). The mean annual temperature is 51 degrees Fahrenheit. The mean annual winter and summer temperature is 33 degrees Fahrenheit and 71 degrees Fahrenheit, respectively. The mean annual precipitation is 10 inches in the northeast part of Canyon County and as low as 6 inches in the southwest part of the county. The majority of the precipitation falls during the winter as snow.

Geology

The valley has a complex geologic history of erosion, sedimentation, and intrusion. Consequently, an accurate determination of age relationships between lithologic units, especially the younger sands and gravel, is often difficult. Rock units ranging in age from Miocene to Holocene underlie the area (Dion 1972).

The Idaho batholith is the oldest rock unit that is exposed. It is composed of gray granite that weathers into rounded slopes. Rocks of the Idaho batholith, probably, underlie the entire area at depth and form a structural troughlike basin in which younger rocks were deposited (Dion 1972).

Columbia River basalt of Miocene and Pliocene age can be found unconformably in the valley. Overlying the Columbia River basalt are basalts of the Snake River Plain. The Snake River Plain basalts are of late Pliocene and early Pleistocene age. There is abundant evidence of minor faulting and tilting within the formation (Dion 1972).

The basalts and granitic rocks have undergone extensive weathering and erosion. As the glaciers of the Pleistocene epoch melted, the valley saw torrential rivers until a basalt flow formed a dam causing the river to form a lake. The lakes lasted until a path through the basalt was created by the water. This repeated action of fast to slow moving water through the valley created from 0-5000 feet of sedimentary fill (Lindholm 1993). Finer sand and clay layers would be deposited in the slack waters of the lake conditions, then rock of sorted sizes were carried and deposited by the faster moving waters (Othberg 1994).

Larger rock deposits and isolated basalt remnants on the higher, outer edges of the moving water survived some or all the changes created by the water (Dion 1972). The rock deposits helped to build the terraces that can be found as one travels away from the Boise River floodplain.

Hydrogeology

The Boise River valley ground water system is primarily within unconsolidated deposits of silt, sand, clay and fine gravel (Graham and Campbell 1981). Water quality within the Boise River valley ground water system varies by the strata within the sedimentary layers that the water flows through. The zones of the aquifer are interrelated, with clay layers functioning as limited divisions to the water bearing zones (IDWR 1995). The overall general direction of the ground water movement is a westward direction toward the Boise River (on north side of Lake Lowell) as shown in the figure 3.

The regional cold water system is underlain by confined systems of geothermal water (Wood 1983). The emphasis of this report is only on the regional cold water system.

Soil Types

Soil maps are generated by the U.S. Department of Agriculture Soil Conservation Service (SCS) to identify the soil type to a depth of about 10 feet. The major purpose of the soil map is to maximize the land stewardship of agriculture to the soil type.

An additional benefit of using the SCS soil maps is to see how permeable the soils are for approximating the area ground water recharge in to the ground water system. The soils in the study area are predominately two types, Moulton-Bram-Baldock association and Greenleaf-Nyssaton-Garbutt association.

The Moulton-Bram-Baldock association are somewhat poorly drained and moderately well drained fine sandy loams to silt loams on lowlands. This soil type can be found along both sides of the Boise River.

The Greenleaf-Nyssaton-Garbutt association are well-drained silt loams
on lake terraces and alluvial fans. Where the Moulton-Bram-Baldock
association ends the Greenleaf-Nyssaton-Garbutt association
is the most common soil type to be found.

Methods and Materials

Collection of Historic Information and Data

A number of sites with impacted ground water were found during the previous stage of this project in Ada County by DEQ and USGS. Sites have also been identified by the Statewide Ground Water Quality Monitoring Program and remediation projects. The figure 4 shows the location of all sites found with historic data.

DEQ-Boise Regional Office remediation files contain information on ground water impacted by tetrachloroethylene and petroleum products. Seven areas have known tetrachloroethylene contamination, five in Boise, one in Garden City, and the other north of Nampa, all but one site have domestic wells that have been impacted. The petroleum contamination within the cities of the study area are site specific with contamination defined by monitoring wells installed for delineation and/or remediation purposes with ongoing remediation or monitoring taking place.

Selection of Wells for Sampling

Domestic and Irrigation wells were selected for this study. The wells were prioritized for the project objectives. First priority wells had historical data from previous sampling or studies. Second priority the wells had a well driller's log available from the Idaho Department of Water Resources. The final selection of wells was based on a thorough coverage of the sampling area, to eliminate clustering of wells. A map of well locations is shown in the figure 2.

A "permission letter" was sent to each owner of wells selected for sampling. Additional wells in a given area were chosen if the "permission letter" was not returned or permission was not granted.

Parameter Selection and Rational

Field Parameters

Specific conductance, pH, water temperature, and dissolved oxygen were utilized to determine when the well had been adequately purged prior to sampling; these measurements were taken approximately every five minutes. After all field parameters had stabilized for at least two measurements, the samples were collected.

Bacteriological Analyses

Bacteriological analyses are the principle tests used to assess the sanitary quality of water and the potential health risk from waterborne disease (Sylvester 1990). Total and fecal coliform can show a possible impact from changes made to the well and piping, land and water use, failing septic systems, and/or stormwater.

Volatile Organic Compounds

Volatile Organic Compounds (VOCs) analyses can show a potential impact to ground water from human made and human introduced compounds.

Nutrients

Nutrients are found naturally in ground water, different areas and zones of the aquifer have different concentrations of nutrient constituents. Increased levels can show human land and water use impact.

Metals

Metals are sampled in some of the wells in the project to address the possible differences of naturally occurring metal concentration in the different water-yielding zones of the aquifer. Samples are also taken where there is a suspected potential problem from human impact, such as at former landfill sites.

Ions

Ions are sampled in some of the wells in the project to address the possible differences of ionic concentration in the different zones of the aquifer.

Pesticides

Pesticides in ground water show an impact from human activities. Pesticides can be applied to control pests from agricultural and/or residential land.

Sampling and Collection Methods

At each site, the outside faucet or hydrant located closest to the well was chosen as the sampling location. A hose was connected to the faucet or hydrant with a splitter and a short section (approximately 5 feet) of hose placed at the end. The faucet or hydrant was then turned on the full amount possible. The longer or main hose was given the majority flow of

water with a controlled amount of water flowing into a bucket from the shorter hose.

A bucket was used to best imitate a flow-through chamber to represent the zone or zones of the aquifer in which the well was installed. The meters used to collect the field parameter data were placed in the bucket. The meters used were for measuring temperature, pH, specific conductance, and dissolved oxygen.

Measurements with the meters were taken about every five minutes and recorded on a field sheet. Sampling time was determined when the meters had stabilized for at least two measurements. The stabilized field parameter measurements indicate chemical stability of the ground water being pumped out. This was important in order to assess aquifer water quality versus the quality of the water that was allowed to sit in the well casing. Chemical characteristics of stagnant water in the well casing have the potential to be altered by exposure to the casing material or atmosphere.

After the chemical stability of the ground water the hoses were removed. The faucet or hydrant was allowed to run for 10-15 seconds prior to the samples being collected. Latex gloves were put on in order to eliminate cross contamination from the hands. An in-line filter, with 0.45-micron filter was attached to the faucet or hydrant. Water was allowed to run through the filter for 10-15 seconds. Then samples were collected for nutrients and ions, each in a separate triple field rinsed 125-milliliter (ml) polyethylene bottle filled to the neck of the bottle and tightly capped. The in-line filter was then removed in order to collect the remaining samples. A bacteria sample was collected in a sterile 125-ml polyethylene bottle; the bottle was filled to the neck and tightly capped. Care was taken to not touch the faucet or hydrant with the sample bottle for all samples collected.

A 500-ml polyethylene bottle was triple rinsed in the field and filled to the neck and tightly capped. This sample was used to run a HACH nitrate test at the USGS Laboratory.

Three 40-ml glass vials were used for collecting VOC samples. Two of the vials were preserved in the field with hydrochloric acid. The third vial was not preserved since it was analyzed with a portable gas chromatograph at the regional USGS Laboratory in Boise, Idaho. All vials were filled to the top, with meniscus at the lip of the vials and then tightly capped with a Teflon-lined cap.

All samples were labeled with a site identification number, project number, type of analysis, date, and time. Then the samples are placed in a cooler with ice, until arriving at the USGS Laboratory at the end of the day.

At the site, a clean beaker and graduated cylinder was triple rinsed with the flowing water. Then 50-ml of water was measured with the graduated cylinder and placed in the beaker. This water was then titrated with H2SO4 to calculate alkalinity and bicarbonate.

The field sheet was filled out to note all necessary information relative to the sampling procedure at every site. A chain of custody sheet was filled out for the VOC samples. All equipment used at each site was triple rinsed with de-ionized water then carefully packed to be re-used at the next site.

At the regional USGS Laboratory in Boise, Idaho, all samples, except the 500-ml and 125-ml polyethylene bottle and the unpreserved VOC sample, were placed in the sample refrigerator until they were packed on ice and shipped to the USGS Laboratory in Arvada, Colorado. The sample in the 500-ml polyethylene bottle was used to run the HACH NO2/NO3 at the USGS Laboratory. The sample collected in the 125-ml polyethylene bottle was sent to the Idaho State Bureau of Laboratories for the bacteria analyses. The unpreserved VOC bottle was analyzed with a Photovac 10-S Portable Gas Chromatograph to determine presence or absence of VOCs.

Frequency

The wells were sampled once during the sampling project. There were 150 wells sampled in 1996 in the Nampa area and 164 wells sampled in the corridor area in 1997.

Results

Well Depths

A total of 314 wells of varying depths and either domestic or irrigation use were sampled for this project. The well water use and percentages by their use are listed in the following Table.

• Table 1. Number of Wells Sampled and Their Use

	Number of Wells	Domestic Use	Irrigation Use
	314	285	29
percent by use		91%	9%

Field Parameters

Portable meters were used at every site the to measure temperature, specific conductance and pH. Alkalinity was calculated at every site by an acid titration method. The portable meters used were an Orion 810 Dissolved Oxygen, Orion 230A pH, and Orion 122 Conductivity. A list of the field parameter ranges found in the study area can be found in the following table.

- Table 2. Field Parameter Statistics

Field Parameter	Number of Samples	Median	Mean	Range	
				Minimum	Maximum
Temperature (°C)*	303	15	15	12.5	31
Specific Conductance (uS/cm at 25 °C)	305	525	556	101	2000
pH (standard Units)	301	7.7	7.4	6.8	9
Dissolved Oxygen (mg/l, >7 considered saturated)	281	3.3	3.7	0	>7
Alkalinity (mg/l as CaCO3)	296	243	189	105	850

*The MCL range for pH is between 6.5 to 8.5 (IDAPA 58 Title 01 Chapter 11, 1997).
There are no MCL for temperature, specific conductance or alkalinity.

Statistics on Individual Constituents

Statistics have been calculated on constituents collected. The following table shows the median, mean, and range values. The Maximum Contaminant Level (MCL), which is based upon protection of human health (IDAPA 58 Title 01 Chapter 11, 1997) is listed.

- Table 3. Selected Water Quality Statistics

| Constituent	Number of Samples	Median	Mean	Range		MCL
Nitrogen Compounds				Minimum	Maximum	
Nitrate (mg/l)	301	2.1	3.47	<0.01	18	10
Ammonia (mg/l)	301	<0.015	0.282	<0.015	4.12	none
Nutrients						
Phosphorus (mg/l)	301	0.03	0.054	<0.01	1.09	none
Calcium (mg/l)	30	44	43.9	7.8	100	none
Magnesium (mg/l)	30	12	13.6	0.6	38	none
Sodium (mg/l)	30	67	76.6	6.3	394	none
Potassium (mg/l)	30	3.1	3.7	0.81	16	none
Chloride (mg/l)	30	12	19.3	0.67	180	250
Sulfate (mg/l)	31	45	60.6	0.25	240	250
Fluoride (mg/l)	30	0.59	0.60	0.16	2.1	4
Metals						
Arsenic (ug/l)	42	9	14.6	<1	120	50
Iron (ug/l)	30	3.3	9.48	<3	77	300
Manganese (ug/l)	30	3.3	9.48	<3	77	300
Zinc (ug/l)	26	8	28.5	<3	230	5000
Pesticide						
Atrazine (ug/l)	37	0.03	0.038	<0.05	0.16	3

Piper Diagram

The piper diagram, or trilinear diagram, below shows the major ion chemistry in ground water. As ground water flows through the subsurface it assumes a chemical composition that is related to the lithology.

Each apex of a triangle represents a 100% concentration of one of the three constituents. If a sample has two constituent groups present, then the point representing the percentage of each would be plotted on the line between the apexes for those two groups. If all three constituent groups are present, the analyses would fall in the interior of the field. The diamond-shaped field between the two triangles is used to represent the composition of water with respect to both cations and anions (Fetter 1994).

Generally, the ground water in Canyon County is mixture of all three cation and anion groups. Where there is dominant water chemistry, it is calcium and bicarbonate or sodium and bicarbonate.

Figure 5. Piper Diagram
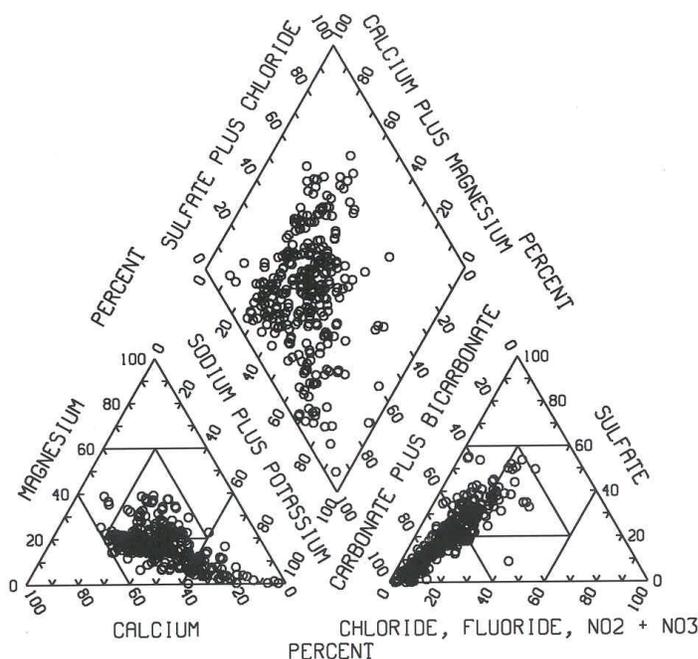
Nitrate

There is potential for nitrate to impact ground water from practices such as confined animal feeding operations and excessive fertilizer applications. Failing or improperly installed septic tanks, decaying organic matter, and storm water, also, have the potential to elevate the nitrate concentration in the ground water. The potential to impact the ground water depends on the excess of nitrate that can not be utilized by the natural system and/or available path to the ground water by pervious soils or manmade conduits.

Nitrate occurs naturally in a number of foods, particularly vegetables. Both nitrate and nitrite are added to meat products as preservatives. Nitrate can result in a blood condition in infants called methemoglobinemia or blue baby syndrome. The level of nitrate in drinking water that is considered safe for consumption is 10 milligrams per liter (mg/l). Current research shows a possible link with elevated nitrate in drinking water to miscarriages and non-Hodgkins lymphoma.

The ambient level of nitrate, as determined by Idaho Department of Water Resources is 2 mg/l or less. Forty-six percent of the wells sampled had nitrate concentrations at or below the ambient level. Twenty-six percent of the wells sampled had elevated nitrate up to 5 mg/l. Twenty percent of the wells sampled had nitrate levels greater than 5 mg/l but less than 10 mg/l. Nitrate concentrations greater than the ground water standard of 10 mg/l were found in 8% of the wells.

Table 3 displays the nitrate results by the number and percentage of wells. See the figure 6 for the location of the wells by nitrate level.

- Table 4. Nitrate Levels

• A Total of 285 Nitrate Samples Collected			
	• Ranges of Nitrate (mg/l)		
	• < 2 mg/l	• >2 - 5 mg/l	• >5 – 10 mg/l	• >10 mg/l
• # wells	• 131	• 73	• 57	• 24
• percentage	• 46%	• 26%	• 20%	• 8%

MCL for nitrate is 10 mg/l

Ammonia

Elevated levels of ammonia were found in the ground water from Notus area to the Snake River. The occurrence of elevated ammonia may be related to deposition of organic-rich fine sediments from the Lake Bonneville flood event (Othberg 1992 and 1994). Lakebed conditions, through geologic time, deposited the characteristic "blue clay" reported on copies of well driller's reports which are housed at the Idaho Department of Water Resources. These blue clays can act to confine individual water-bearing zones.

The results from some of these wells show elevated levels of ammonia and the absence, or low levels of nitrate. The ammonia is a natural

product in the nitrogen cycle. The ammonia in the ground water volatilizes to the atmosphere when it can, or mixes with oxygen to form nitrate. One predominate characteristic of the confined aquifer systems along the Snake River is the presence of ammonia in the ground water.

There is no regulatory level for ammonia. Human health research shows that human readily exhale ammonia at the levels found in this study.

The results showed the ammonia from <0.015 – 4.12 mg/l. Forty-seven percent of the wells sampled had ammonia above the detection level of 0.015 mg/l. Table 5 shows the number and percentage of wells in ammonia ranges. The ammonia levels found during this project can be found in C:\DATA\DEQUSGS\arcview\figure 7.jpg

- Table 5. Ammonia Levels

A total of 299 Ammonia Samples Collected					
	Ranges of Ammonia (mg/l)				
	<0.015	0.015-0.385	0.385-1.02	1.02-2.46	2.46-4.12
# of wells	159	79	31	17	13
percentage	53%	27%	10%	6%	4%

No MCL for ammonia

Arsenic

Arsenic is a naturally occuring element in rocks, soils, and the water in contact with them. The Environmental Protection Agency (EPA) is proposing to lower the MCL for arsenic from 50 ug/l to 5 ug/l. The statistics table below reflects arsenic levels commonly found in southwest Idaho. Many areas in southwest Idaho have naturally occurring arsenic in the ground water above the proposed 5 ug/l.

Arsenic has long been recognized as being toxic. It is a health concern because it can contribute to skin, bladder, and other cancers (National Research Council, 1999). There are technologies available to remove arsenic from the drinking water, with a variety of costs. It is important to get the information on arsenic to well owners so that they will know to test their water for arsenic and can make educated choices on home water treatment systems. arcview\figure 8.jpg shows the location of the wells sampled for arsenic.

• Table 6. Arsenic Results by Well Depth Groupings

A Total of 43 Arsenic Samples Collected					
	Ranges of Arsenic (ug/l)				
	0-2.5	2.5-5	5-25	25-50	>50
# of wells	10	6	15	9	3
percentage	23%	14%	35%	21%1	0

MCL for arsenic is currently 50 ug/l

Bacteria

Bacteria analyses assess the sanitary quality of water and the potential health risk from waterborne disease. Changes, or wear to the plumbing are the most common route of introducing bacteria in the system.

Forty-one wells, from the 282 sampled, had total coliform bacteria present. Five of the 41 wells with total coliform also had fecal coliform in the sampled well water (4 wells were used for domestic and 1 well for irrigation purposes). arcview\figure 9.jpg shows the location of the wells impacted by bacteria. The following table lists the wells with bacteria by depth and use:

• Table 7. Bacteria Results by Well Depth Groupings and Water Use

	Total Coliform	Fecal Coliform	Escherichia Coliform	Irrigation Use	Domestic Use
	282 Samples Collected	293 Samples Collected	138 Samples Collected		
Positive Results					
3 of wells	41	8	4	31	278
percentage	15%	3%	3%	10%	90%

MCL for total coliform bacteria is less than 1 colony, no MCL fecal or escherichia coliform

Discussion

Similar to the Boise and West Ada County ground water study areas (Boyle 1995 and 1996, Parliman 1996 and 1998), the emphasis of this study was on the ground water quality in the local water-bearing zone. The local water-bearing zone is from just below land surface to several hundred feet in unconfined aquifer conditions. Wells in the local water-bearing zone were more common to find in the area, compared to wells at the regional depths. The availability of water and the cost of installing a well to the deeper depth may be the limiting factor on the number of wells in the regional water-bearing zone.

The results from the 314 wells sampled show that there are wells with impacted ground water quality throughout the study area. Nitrate concentrations greater than the MCL of 10 mg/l were found in 8% of the wells sampled. Fifteen percent of the wells had total coliform results that were positive. Seven percent of the wells exceeded the current arsenic MCL of 50 ug/l.

Atrazine, and Atrazine breakdown constituents, were found at very low levels in majority of wells sampled for pesticides. The low detectable levels were found in 31 of the 37 wells sampled.

General knowledge of the ground water quality is valuable in this area of rapid population growth and land use changes. The data can be beneficial to anyone who needs or wants to know the general ground water quality where their well is located or to a land use planner for water supply purposes.

Every well owner who had their well sampled was sent a copy of their individual water quality results and a informational fact sheet(s) if their water quality was found to be impacted. If the well owner had any questions, technical assistance was available to answer any questions they may have had with their well and/or water quality.

Quality Assurance/Quality Control

All probes used for measuring field parameters were inspected every morning before leaving the office. Any necessary repairs or cleaning was conducted at the DEQ-Boise Regional Office laboratory or regional USGS laboratory in Boise, Idaho before going to the sampling sites. The condition and number of all necessary sample containers was checked before leaving for the sampling sites.

In the office each morning, the Orion model 810 dissolved oxygen meter was calibrated for the day of sampling. Once calibrated, the meter would remain on for the entire day of sampling to retain the same calibration for the day. The YSI dissolved oxygen meter was calibrated at each site.

At every site, the Orion model 230A pH meter was calibrated with fresh pH standards of 4 SU and 7 SU. If the ground water had a pH of greater than 7.8 SU, the pH meter was re-calibrated with pH standards of 7 SU and 10 SU.

Temperature was checked with three different instruments at each site with a non-mercury thermometer, the pH meter and the conductivity meter. The recorded ground water temperature for the field sheets were taken from the conductivity meter. The recorded air temperature on the field sheets was taken from the non-mercury thermometer.

The Orion model 122 conductivity meter was calibrated at each site with a conductivity standard as close as possible to the measurement at each site. A small plastic container of the fresh standard was placed in the bucket with the meter probes and allowed to equilibrate to the temperature of the ground water being sampled. After the samples were collected, the conductivity probe was placed into the conductivity standard to determine the correction factor.

The bucket, all hoses and splitters were kept (physically) clean. The hoses were drained at each site. The bucket, splitter and short hose were rinsed with deionized water at every site prior to packing back into the vehicle (Nielson 1991).

The in-line filter was triple rinsed with (liberal amounts of) deionized water after use at each site and then packaged into a clean zip lock bag. Latex gloves were worn, at all times, when handling the in-line filter.

Latex gloves were worn when collecting all samples. They were also worn at the regional USGS Laboratory in Boise, Idaho when running the

samples through the HACH kits and the portable gas chromatograph. Every sample was analyzed with the HACH kits for nitrate the same day the sample was collected. Every non-preserved VOC sample was analyzed with the portable gas chromatograph within seven days.

All sample containers were labeled with the site identification number, date, time of sample collection, project number, and type of analysis. This information was also recorded on the field sheets, along with the field parameters and notable site conditions. All necessary laboratory forms were filled out for all samples collected. Samples were packed in ice and promptly shipped to the USGS Laboratory in Arvada, Colorado within the necessary time frames.

This entire project followed the guidelines for the collection, treatment, and analysis of ground water samples as used by the USGS in the Statewide Monitoring Program.

Pesticide and metals results, included in this report, were collected by USGS for the Statewide Monitoring Program. Sample collection and HACH kit analyses were conducted by Deb Parliman, USGS; Sabrina Nicholls, USGS; and Linda Boyle, DEQ-Boise Regional Office. Laboratory VOC analyses with the portable gas chromatograph was conducted by Deb Parliman.

Acknowledgement

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