Idaho Department of Water Resources

Ground Water Quality Technical Brief
Statewide Ambient Ground Water Quality Monitoring Program
Arsenic Speciation Results (2002 & 2003)
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Introduction

Arsenic has recently become a concern for many ground water users in Idaho. In 2001, the U.S. Environmental Protection Agency (EPA) reduced the primary drinking water standard for total arsenic (As) from 50 micrograms per liter (μg/L) to 10 μg/L. Beginning January 23, 2006 public water systems must comply with the new standard (U.S. Environmental Protection Agency, 2004). The lower arsenic standard will have significant implications for public water systems in Idaho impacted by arsenic levels above 10 μg/L. Arsenic species have different chemical properties; therefore, knowing the particular species of arsenic in ground water is necessary for a public water system to design an effective treatment strategy.

Ground water samples from 119 wells in the Statewide Ground Water Quality Monitoring Program (Statewide Program) were analyzed for arsenic species to evaluate spatial distributions, geochemical influences, and lithologic associations. Samples were collected during the summers of 2002 and 2003. Testing for the two major inorganic arsenic species, arsenite [As(III)] and arsenate [As(V)], and organoarsenic compounds, monomethylarsonate (MMA) and dimethylarsinate (DMA), was conducted on ground water samples from sites previously containing arsenic levels above 8 μg/L. Ground water samples also were collected from new wells located in areas with high arsenic concentrations in ground water. Fifteen of the 119 sites were sampled both years.

Aquifers across the western United States contain elevated levels of naturally occurring arsenic because of geologic conditions (Welch et al, 1988). On a local scale, arsenic may be introduced into ground water through mining or industrial wastes or arsenical pesticides. Neely (2002) provides a comprehensive discussion of arsenic occurrence in Idaho ground water.

Background

Statewide Program Overview

The Statewide Program is designed to assess the current condition of ground water quality, to identify areas with water quality problems, and to detect water quality trends in the major aquifers of Idaho. The Statewide Program is a cooperative effort between the U.S. Geological Survey and Idaho Department of Water Resources (IDWR). Since the inception of the Statewide Program in 1990, over 1,900 monitoring sites (existing wells or springs) have been sampled for an extensive variety of ground water quality parameters, such as common ions (calcium, magnesium, etc.), trace elements (iron, copper, arsenic, etc.), bacteria, nutrients, radioactivity, volatile organic compounds, and pesticides. Most of the monitoring sites (67%) are wells used for domestic purposes; other well uses include irrigation, public supply, stock, commercial, and industrial. Prior to 2001, most monitoring sites were sampled once every four years. Since 2001, all monitoring sites, except 100 Annual Sites, are sampled once every five years. Annual Sites are sampled every year to allow trends to be examined.

Approximately 15% of the sites in the Statewide Program contain arsenic above the maximum contaminant level (MCL) of 10 μg/L. Maximum arsenic concentrations in water samples from the more than 1,900 Statewide Program sites range from 0.1 μg/L to 950 μg/L.

Arsenic levels above 10 μg/L are detected with the greatest frequency in ground water from sites in southwest Idaho. The counties with the highest percentage of Statewide Program wells containing an arsenic concentration above 10 μg/L include Owyhee County (72%), Washington County (50 percent), Twin Falls County (49%), Payette County (46%), Canyon County (42%) and Gem County (35%).

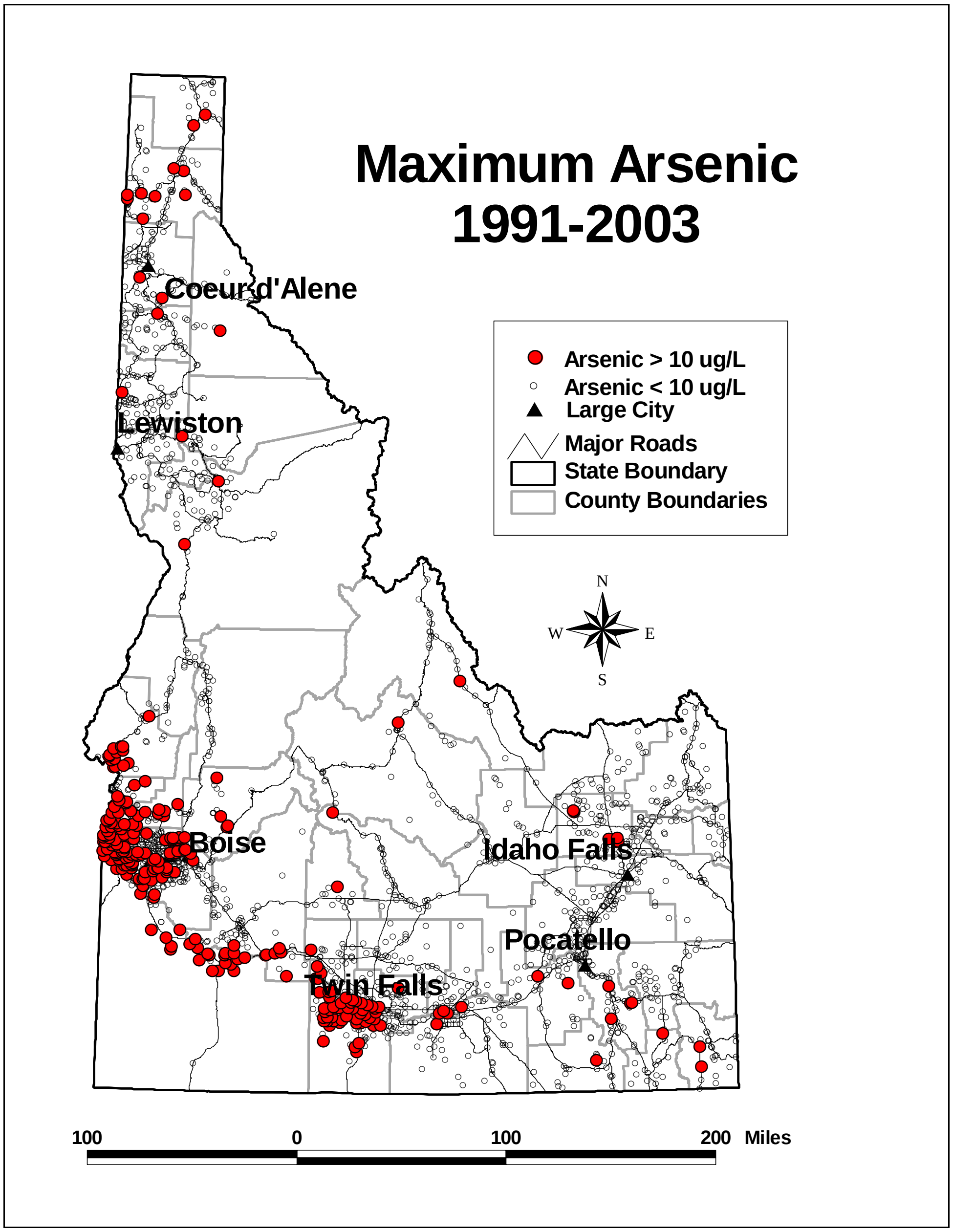

Figure 1. Arsenic concentrations in Statewide Program sites

Arsenic Species

The two predominant inorganic species of arsenic are differentiated by their valence state. Arsenite [As(III)] occurs as an uncharged molecule with a valence state of +3, while arsenate [As(V)] occurs as a negatively charged ion with a valence state of +5 (Hem, 1985). The lack of charge on the arsenite species enhances the mobility of arsenite relative to arsenate because it is less likely to adsorb onto aquifer materials. Additionally, arsenite is generally considered more toxic than arsenate.

The two arsenic species typically occur in different hydrogeologic environments. Arsenate is prevalent in aerobic (oxygen-rich) environments, whereas arsenite is more abundant in aquifers where anaerobic or reducing conditions exist.

RESULTS

Arsenic Species Identification

Samples were collected from 75 sites in 2002 and 59 sites in 2003. However, results are available from only 119 sites because fifteen of the sites were sampled both years. Table 1 summarizes the results from both years of sampling.

Table 1. Arsenic results summary

Year	2002	2003
No. of sites sampled	75	59
No. of sites w/As ≥ 9.5 μg/L	37	50
Total As conc. (mean)	14.1 μg/L	32.6 μg/L
Total As conc. (median)	8.7 μg/L	14.6 μg/L
As(V) conc. (median)	6.8 μg/L	11.5 μg/L
As(III) conc. (median)	0.2 μg/L	0.1 μg/L
As(V) conc. (mean)	11.6 μg/L	14.3 μg/L
As(III) conc. (mean)	1.94 μg/L	18.3 μg/L

The dominant arsenic species in each sample was determined to facilitate further evaluation. Samples were divided into three classifications (arsenate-dominant, arsenite-dominant, and mixed) based on a two-to-one ratio of one species to the other. For example, a sample containing an arsenate concentration of 10 μg/L and an arsenite concentration of 2 μg/L would be classified as an arsenate-dominant sample. Samples without a dominant species are classified as mixed.

The results of the arsenic species testing (Table 2) indicate arsenate [As(V)] is the dominant species in samples from approximately 70% of the sites, nearly 20% of samples have arsenite [As(III)] as the dominant species, and 10% of the samples contain approximately equal amounts of each species. The median and mean total arsenic values also were determined for classification (Table 2). No significant differences exist between the median total arsenic concentration in arsenate-dominant and arsenite-dominant samples at the 95% confidence level. However, the samples without a predominant arsenic species tended to have much lower levels of total arsenic (Table 2).

Table 2. Arsenic speciation results

Classification	Arsenate-dominant	Arsenite-dominant	Mixed
No. of samples	95	25	14
% of samples	70.9%	18.6%	10.5%
Median As	12.4 μg/L	13 μg/L	0.2 μg/L
Mean total As	18.2 μg/L	48.1 μg/L	4.0 μg/L

Samples with arsenic concentrations above 9.5 μg/L are of special interest because the drinking water standard is 10 μg/L. These sites are identified as sites above 10 μg/L for the remainder of this document. The distribution of arsenic species in samples with high arsenic levels is similar to the distribution for all speciation samples (Table 3). This suggests speciation is not associated with high arsenic levels.

Table 3. Elevated Arsenic Statistics (As >10 μg/L)

Classification	Arsenate-dominant	Arsenite-dominant	Mixed
Number of samples	67	16	4
% of samples	77%	18%	5%
Number of sites [1]	54	14	4
Median As conc.	17.4 μg/L	16.2 μg/L	11.4 μg/L
Mean As conc.	23.3 μγ/L	72.7 μg/L	12 μg/L
[1] – 15 annual sites sampled in both 2002 and 2003			

Spatial Distribution

The locations of sites with water samples containing arsenic species above 10 μg/l are plotted on Figure 2. More than 90% of the sites are located in southwest or south-central Idaho and draw water principally from alluvial or basalt aquifers. Two sites with arsenic above 10 μg/L are located in northern Idaho, and five sites are located in eastern and southeastern Idaho.

Arsenite and arsenate are found throughout Idaho. However, in areas with hydrogeologic consistency, arsenic is generally limited to one species. For example, in Twin Falls County, where basalt aquifers predominate, eighteen of the nineteen sites have arsenate-dominant well water. The nineteenth site was mixed in 2002 but arsenate-dominant in 2003.

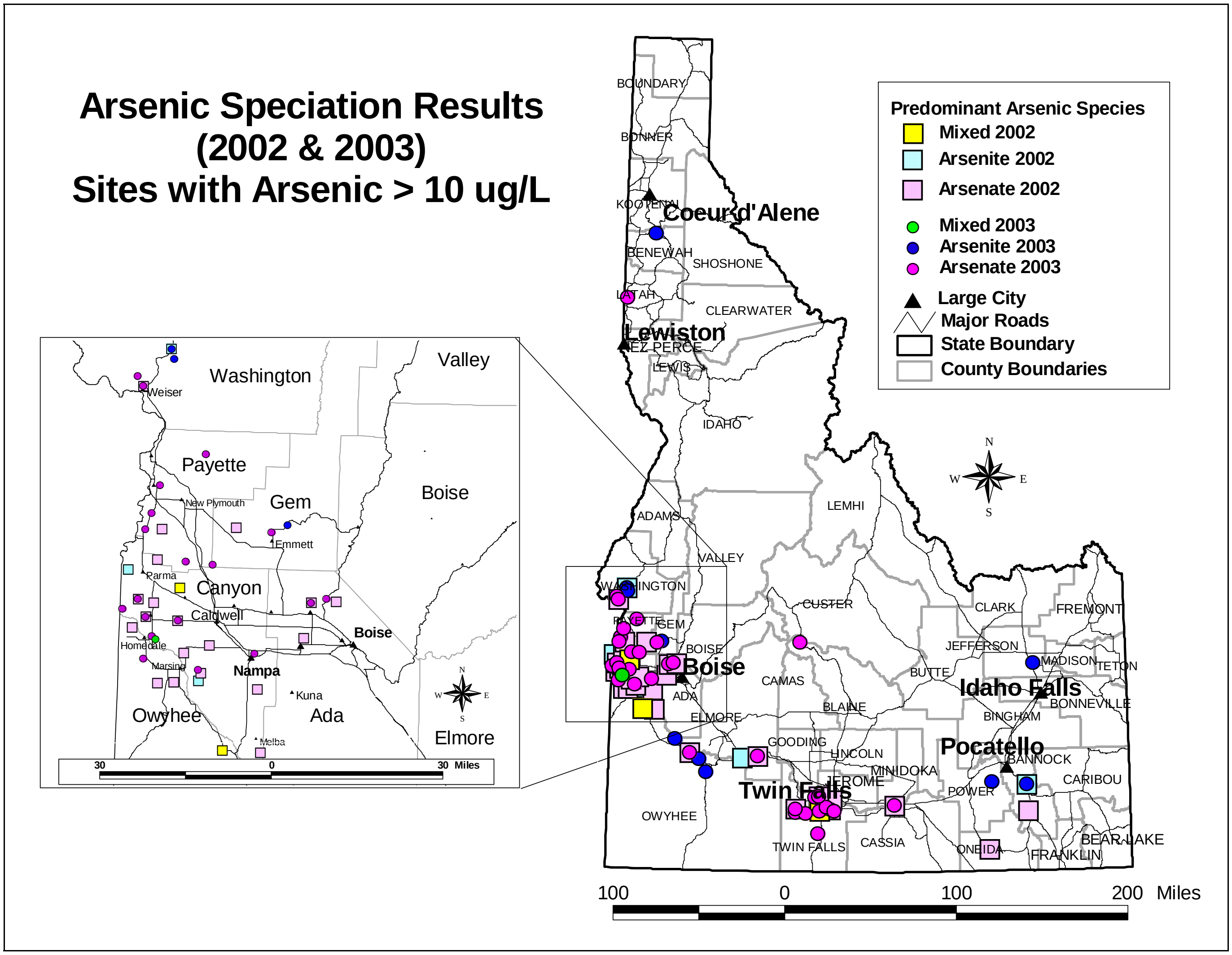

Figure 2. Arsenic speciation results for samples with arsenic over 10 μg/L

Geochemical Analyses

Statistical Analyses

Geochemical analyses were performed to ascertain if other dissolved constituents or field parameters are indicators of high total arsenic. The constituents and parameters include: sodium, potassium, magnesium, calcium, sulfate, chloride, hardness, bicarbonate, alkalinity, nitrate, ammonia, orthophosphate, dissolved oxygen, cadmium, barium, fluoride, iron, manganese, selenium, pH, temperature, specific conductance, and well depth.

The Spearman's rho rank-order correlation method (Spearman's) was applied to arsenic, common ions, trace elements, and well depth (Table 4). Spearman's correlation method is a nonparametric test that determines a correlation coefficient (the strength of the association) when the relationship between two variables is nonlinear (MINITAB Inc., 2000). The Spearman's method was applied because the data are not normally distributed with a skew toward the lower values. The probability (p) also was calculated for each correlation coefficient. When p is less than 0.05, the relationship between the two variables is significant at the 95% confidence level. Statistical analyses were conducted with MINITAB statistical software (MINITAB Inc., 2000). SYSTAT 9 statistical software (SPSS Inc., 1999) was used to confirm selected correlations.

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The results of the analysis show that in most instances, no correlation exists between total arsenic and another parameter. The correlations show evidence of relationships with arsenate or arsenite and numerous constituents. In addition, the arsenite species and arsenate species often have opposite correlations of similar magnitude. Constituents with a Spearman's correlation above ±0.5 and a p-value <0.05 are shown in Table 4.

The values in Table 4 identify constituents associated with a specific arsenic species. Additionally, the correlations reflect the influence of oxidizing/reducing conditions on the prevalence of arsenic species. For example, no statistically significant correlation was observed between total arsenic concentrations and dissolved oxygen. However, when the arsenic species concentrations are compared to dissolved oxygen concentrations statistically significant correlations are evident. As dissolved oxygen concentrations increase, arsenate concentrations tend to increase. On the other hand, when the dissolved oxygen concentrations increase the arsenite concentrations tend to decrease.

Table 4. Spearman's correlation values
(Samples with total As > 10 μg/L)

	Arsenic Species		
Constituent	**Total As**	**Arsenite**	**Arsenate**
Dissolved oxygen	N	-0.518	0.337
Nitrate	N	-0.465	0.545
Ammonia	N	0.650	-0.612
Selenium	0.278	-0.313	0.578
Iron	N	0.584	-0.404
Manganese	N	0.588	-0.427

N = no or poor correlation (p>0.05 or rho <±0.5)

<u>Bar Charts</u>

Bar charts comparing the median concentration of selected constituents in arsenate-dominant samples to the same constituents in arsenite-dominant samples are shown in Figures 3a through 3f. The constituents are grouped by median concentration ranges to better illustrate the differences between the species.

The charts show that arsenate-dominant samples tend to have higher concentrations of selenium (Figure 3a), zinc and gross alpha (Figure 3b), and nitrate and dissolved oxygen (Figure 3e). Arsenite-dominant samples tend to have higher concentrations of ammonia (Figure 3a) and iron and manganese (Figure 3f).

These relationships reflect the importance of oxidizing/reducing conditions on the speciation of arsenic. For example, the median dissolved iron and manganese concentrations in arsenite-dominant samples are 150 times and 250 times greater, respectively, than the concentrations in arsenate-dominant samples (Figure 3f). The high levels of dissolved iron and manganese, coupled with reducing conditions, suggest iron/manganese oxides may be undergoing dissolution and releasing arsenite (Hinkle and Polette, 1999). Correlation of arsenate with the oxyanions selenium and zinc may be evidence for competitive adsorption. (Robertson, 1989).

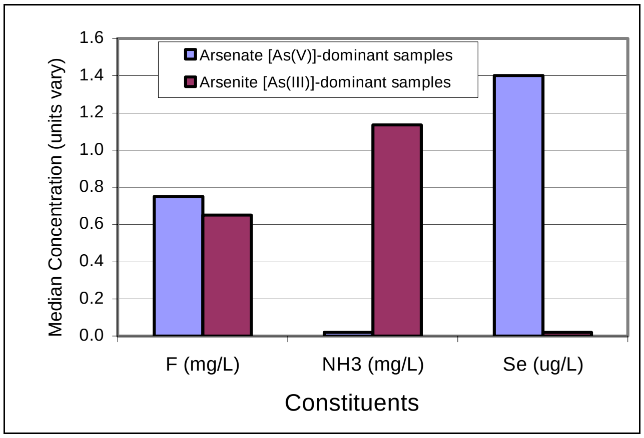

Figure 3a. Constituents grouped by arsenic species

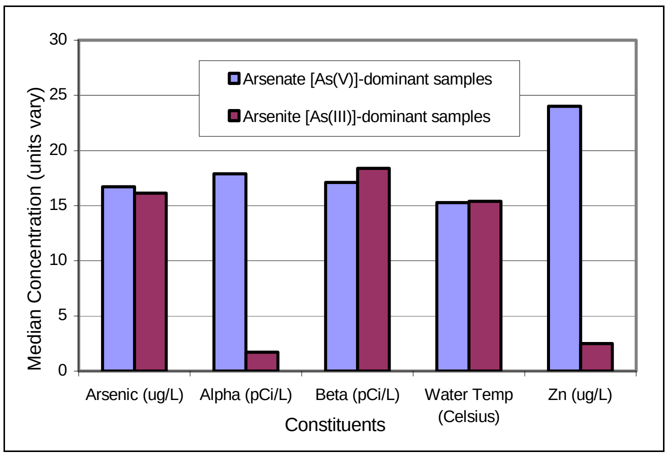

Figure 3b. Constituents grouped by arsenic species

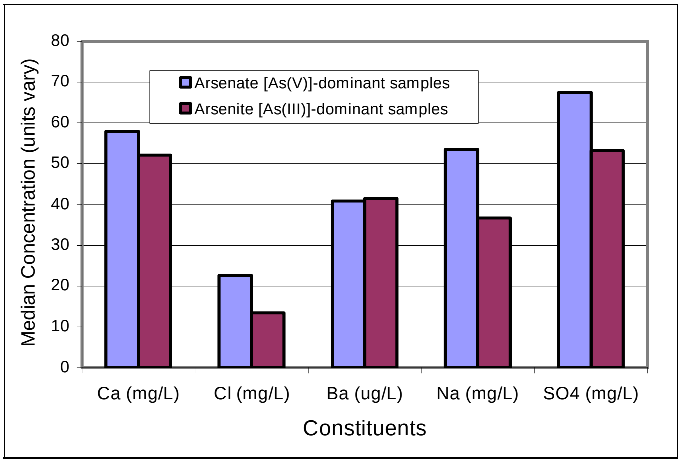

Figure 3c. Constituents grouped by arsenic species

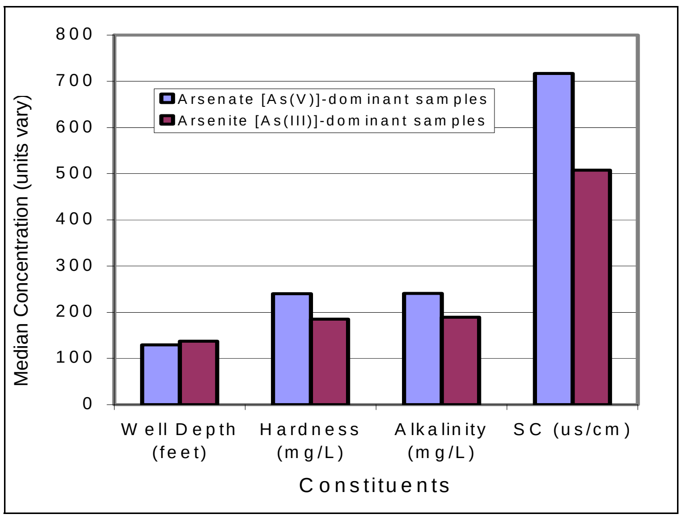

Figure 3d. Constituents grouped by arsenic species

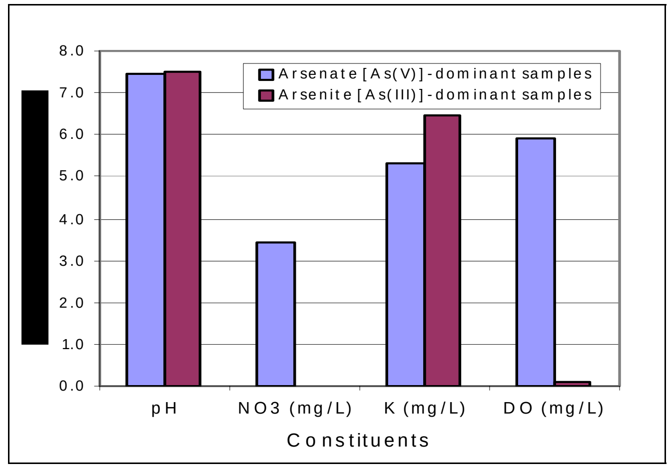

Figure 3e. Constituents grouped by arsenic species

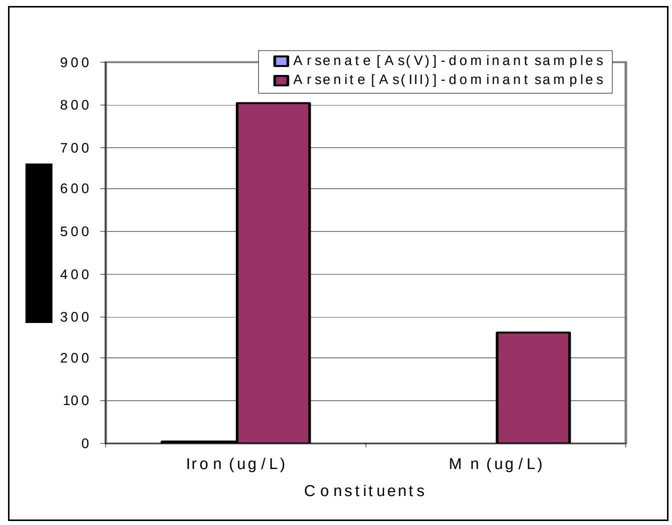

Figure 3f. Constituents grouped by arsenic species

Graphical Analyses

Major ion chemistry data from samples with arsenic concentrations greater than 10 µg/L were evaluated using the Piper trilinear diagram graphical technique (Figure 4). The Piper Diagram depicts the major ion composition of each sample on a single plot (Hem, 1985). Water samples with similar chemistry plot in the same area of the diagram. For the most part, the arsenic species are intermixed, suggesting that water type is not a good indicator of arsenic species. However, arsenite-dominant samples are not found in chloride and sulfate water types

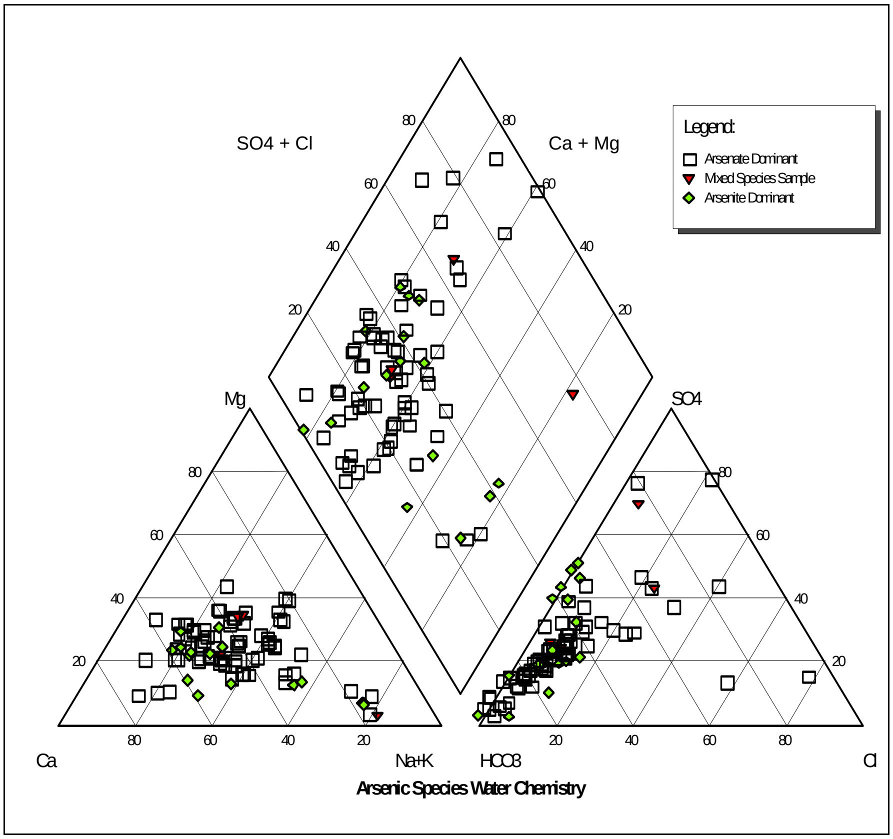

Figure 4. Arsenic species water chemistry

Aquifer Scale Constituent Correlations

Spearman's analyses were conducted to evaluate correlations in water from wells within distinct aquifers in Ada, Canyon, Owyhee, Payette, Washington, and Twin Falls counties. All samples with detectable arsenic levels were selected for analysis because some counties did not have enough samples with arsenic levels above 10 µg/L to ensure statistically valid correlations.

Samples in Ada County and Canyon County were separated into two aquifers – Treasure Valley Deep and Treasure Valley Shallow. Samples from Twin Falls County were from wells completed in basalt or rhyolite. Samples from Payette County and Washington County were from the shallow alluvial aquifer. In Owyhee County, eight samples from the Idaho Formation were analyzed. The number of samples from other aquifers in these counties was not sufficient to provide statistically valid results.

Aquifer-scale constituent correlations generally support the statewide scale results. If correlations existed, they typically were stronger than what was evident on a statewide scale. Correlations with the parameters or constituents shown on Table 7 were performed. However, only constituents with a Spearman's correlation above ±0.4 and a p-value <0.05 are shown in Table 5. Many of the correlations in Owyhee County are not reported because they were not significant at the 95% confidence level due to the small number of samples

Ammonia is the only constituent found to have a significant correlation with total arsenic or an arsenic species in four aquifers. In three of the aquifers, arsenate had a negative correlation with ammonia. In the Payette-Washington Shallow Aquifer, arsenite had a positive correlation with ammonia. Ammonia did not correlate in Twin Falls County because all values, except for one, were below the detection limit.

The predominance of one arsenic species is evident in many of the correlations. In the Twin Falls aquifer, total arsenic and arsenate, had almost identical correlations. This indicates arsenate is the dominant species in this aquifer.

Table 5. Aquifer-scale Spearman's rho correlation values

	Aquifers														
Constituent	TV - Shallow			TV - Deep			Twin Falls			Payette-Washington Shallow			Owyhee – ID Group		
	As	As(3)	As(5)	As	As(3)	As(5)	As	As(3)	As(5)	As	As(3)	As(5)	As	As(3)	As(5)
Ammonia	N	N	-0.42	N	N	-0.69	N	N	N	N	0.86	N	-0.90	N	-0.95
Barium	N	N	N	N	N	-0.50	-0.43	N	-0.53	N	0.72	N	N	N	N
Chloride	N	N	N	N	N	N	N	N	N	N	N	N	-0.79	*	*
Dissolved Oxygen	N	N	N	N	N	N	0.51	N	0.56	N	N	N	*	N	*
Fluoride	0.6	0.47	0.51	N	N	N	0.74	N	0.74	N	N	N	N	0.76	N
Iron	N	0.43	N	N	N	-0.76	N	N	N	N	0.76	N	*	N	*
Manganese	N	N	N	N	N	-0.64	N	N	N	N	0.70	N	N	N	-0.71
Nitrate	N	N	N	N	-0.52	N	0.50	N	0.40	N	N	N	*	N	N
pH	N	N	N	N	N	N	N	N	N	N	-0.61	N	N	*	N
Phosphorus	N	N	N	N	N	N	N	N	N	N	N	N	N	-0.80	N
Potassium	0.69	0.45	0.59	N	N	N	N	N	N	N	0.63	N	N	*	N
Selenium	0.42	N	0.49	N	-0.52	0.52	0.46	N	N	N	N	N	N	*	N
Temperature	N	0.41	N	N	N	N	-0.56	N	-0.50	N	N	N	N	N	N
Well Depth	-0.43	N	N	N	N	N	N	N	N	-0.64	N	-0.64	N	N	N

N = no or poor correlation, Spearman's correlation value < +/- 0.4

* = Correlation > +/- 0.5 but p value > 0.05

The strongest correlations (Spearman's correlation values > ±0.70) included ammonia, barium, chloride, fluoride, iron, manganese, and phosphorus. Most of the correlations reveal the influence of redox conditions. In general, if arsenate had a positive correlation with a constituent, then any correlation arsenite would have with that same constituent would be negative. However, two constituents, fluoride and potassium, had positive correlations with total arsenic, arsenite, and arsenate in the Treasure Valley Shallow Aquifer.

Spearman's correlations existing in more than one aquifer include: arsenate positively correlates with fluoride, and selenium, and negatively correlates with ammonia, barium, iron, and manganese. Arsenite positively correlates with fluoride. No other constituents correlated with arsenite in more than one aquifer. In the Payette-Washington Shallow Aquifer and the Treasure Valley Shallow Aquifer, the total arsenic concentration decreases as well depth increases.

Lithologic Relationships

More than 90% of the sites with arsenic over 10 μg/L are located in southwest or south-central Idaho and draw water principally from alluvial or basalt aquifers. Two sites are located in northern Idaho, and five sites are located in eastern and southeastern Idaho. According to the well driller's logs, one site in northern Idaho is completed in shale; the other site is completed in granite. Four of the wells in eastern/southeastern Idaho receive water from alluvial aquifers, while one draws water from cinders.

All arsenite-dominant samples with arsenic concentrations greater than 10 μg/l were collected from wells drawing water from confined aquifers overlain by gray or blue clays.

More than 90% of arsenate-dominant samples draw water from basalt or oxidized alluvial material as indicated by brown or tan color. Only five of the 61 sites with arsenate-dominant samples draw water from aquifers overlain by blue clays. All five of these wells encounter shallow ground water in oxidized sediments above the blue clay. Water from four of the wells contained dissolved oxygen concentrations of 1.8 mg/L or higher, suggesting water from the shallow unconfined aquifers may be entering the wells.

Organoarsenic Relationships

The organoarsenic compounds, monomethlyarsonate (MMA) and dimethylarsinate (DMA), were detected in 40% of the samples. Nine samples contained an organoarsenic concentration greater than 1.0 µg/L. In all samples, except for one in Twin Falls County, the organoarsenic concentrations comprised less than 10% of the total arsenic concentration. A sample in Twin Falls County with a total arsenic concentration of 0.5 µg/L was found to contain an organoarsenic concentration of 0.6 µg/L.

In samples where organic arsenic was detected, the organoarsenic comprised less than 2% of the arsenic in arsenate-dominant samples, and about 5% of the arsenic in arsenite-dominant samples. Samples with higher levels of arsenic generally contained a smaller percentage of organoarsenic (Figure 5). On a Statewide scale, organoarsenic does not appear to be a significant contributor of arsenic to ground water.

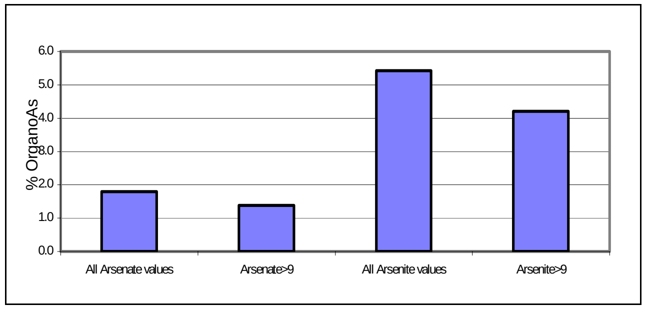

Figure 5. Organoarsenic fraction

Annual Sites

Arsenic concentrations in annual water samples with arsenic levels above 10 µg/L were plotted versus time to assess trends (Figure 6). The arsenic levels at the annual sites are relatively constant. However, Spearman's correlations indicate three sites (10S 16E 32DCD1, 10S 23E 14CCB1, and 12N 05W 24DCD1) have statistically significant trends at the 95% confidence level. Two sites (10S 23E 14CCB1 and 12N 05W 24DCD1) have decreasing trends, and 10S 16E 32DCD1 has an increasing trend. The magnitude of the arsenic changes at the three sites was less than 5 µg/L. The arsenic levels at the site with an increasing trend ranged from 10 µg/L to 11.1 µg/L.

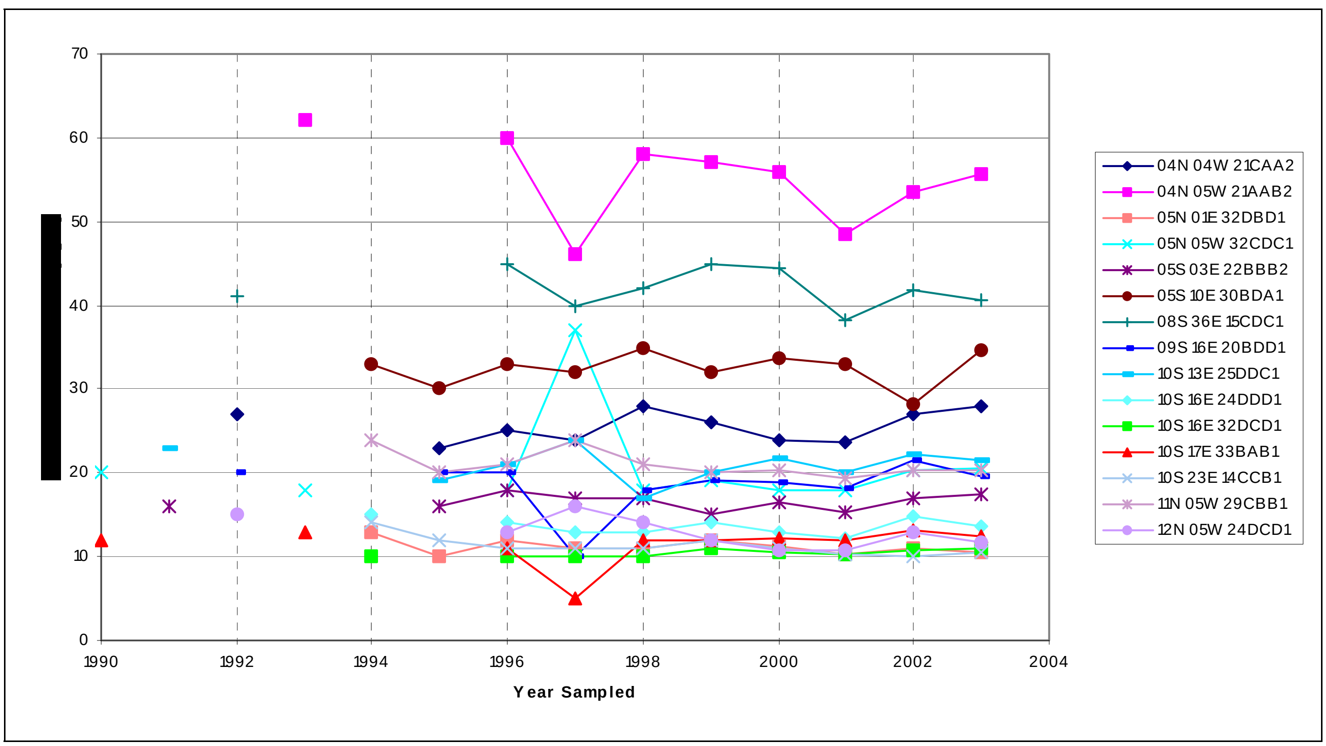

Figure 6. Arsenic trends – annual sites

The dominant arsenic species in ground water at the annual sites was unchanged at fourteen of the fifteen annual sites between from 2002 to 2003. The one annual site with an increasing trend, a site in Twin Falls County (10S 16E 32DCD1), changed from a mixed species in 2002 [As(III)=5.3 μg/L, As(V)=5.4 μg/L] to an arsenate-dominant species in 2003 [As(III)=0.1 μg/L, As(V)=10.4 μg/L]. The cause for the change is unknown. The arsenic levels at the site were similar, 10.8 μg/L in 2002 and 11.1 μg/L in 2003. No other water quality parameters exhibited more than a 1 ug/L change or more than 20% variation.

CONCLUSIONS

- Arsenate [As(V)] is the predominant arsenic species in 71% of the samples tested, arsenite is the predominant species in about 19% of samples, and about 10% of the samples contain similar amounts of both species.

- Hydrogeochemical analyses confirm redox conditions influence arsenic speciation. Spearman's rho correlations with arsenic species and dissolved constituents indicate arsenite and arsenate often have opposite correlations of similar magnitude. On a statewide scale, the constituents with the strongest correlations were ammonia, iron, manganese, dissolved oxygen, nitrate, and selenium. The data presented in the bar charts corroborate the effect of redox conditions on arsenic species.

- Major ion chemistry is a poor indicator of arsenic species. No difference was observed between arsenite-dominant samples and arsenate-dominant samples.

- Different aquifers appear to have unique chemical characteristics that may influence arsenic release and arsenic speciation. Correlations limited to results within an aquifer in many cases yielded very strong correlations that were not observed at the statewide scale.

- Lithology is a good indicator of arsenic species. All arsenite-dominant samples containing more than 10 μg/L of arsenic were from wells completed in confined aquifers overlain by blue or gray clays. More than 90% of arsenate-dominant samples with an arsenic concentration above 10 μg/L were from wells completed in basalt or brown or tan sediments.

- Organoarsenic comprises a very small component of the total arsenic in Idaho ground water.

- Total arsenic concentrations are generally stable. Statistical tests on 15 annual sites with arsenic levels above 10 μg/L indicate concentrations at 12 of the 15 have not changed since about 1990. Two of the sites had a decreasing trend and one site had an increasing trend.

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Table 6. 2002 Ground Water Chemistry Data

STATION	County	Date	Depth	As	As(3)	As(5)	Spec	DO	Ba	NH3	Ca	Cl	F	Hard	pH	K	Se	Na	SC	Temp	Alk	Fe	Mn	NO3	P	SO4	HCO3	Mg
01N 02W 05ADD1	Canyon	8/8/02	720	8.2	0.05	7.6	arsenate	4.8	27.4	<0.04	57.8	33.3	0.2	190	7.5	4.18	0.9	40.2	577	19.3	134	E9	6.0	1.57	<0.02	101	163	11.9
01S 02W 13ABBC2	Canyon	7/15/02	226	34.4	0.05	29.4	arsenate	1.3	3.7	<0.04	19.6	19.6	0.2	82	7.9	2.39	4.5	122	660	17.0	252	<10	4.1	2.48	0.02	56.2	307	7.91
01S 03W 11DDC1	Owyhee	9/3/02	170	12.0	5.40	7.5	mixed	0.4	0.7	0.5	26.6	19.6	3.5	79	8.1	4.46	E0.3	161	909	23.4	102	17	15.5	<0.05	<0.02	291	124	2.98
02N 01E 29CAD1	Ada	7/2/02	159	1.5	0.05	1.5	arsenate	5.7	35.6	<0.04	31.9	9.1	0.1	130	7.7	4.49	0.7	47.1	475	16.0	185	<10	<2	1.48	0.04	49.8	226	12.1
02N 02W 23ABD1	Canyon	7/8/02	110	11.8	0.05	11.8	arsenate	6.4	12.5	<0.04	48.0	12.2	0.5	190	7.7	4.59	1.0	56.9	600	15.3	210	<10	<2	5.00	0.03	66.6	256	16.4
02N 02W 32CDB1	Canyon	7/2/02	240	9.2	0.10	9.70	arsenate	6.3	30.5	<0.04	16.9	5.8	0.7	59	8.1	1.53	<0.3	28.4	241	15.6	90	<10	<2	0.82	E0.01	20.2	109	4.02
02N 03E 06AAB1	Ada	9/17/02	1001	3.2	0.10	3.10	arsenate	6.1	35.3	<0.04	16.1	4.5	0.4	44	7.9	1.06	0.4	18.2	173	20.7	68	<10	<2	1.50	0.02	8.3	83	0.94
02N 03W 06DBA1	Canyon	7/1/02	247	40.2	0.80	40.7	arsenate	3.3	33.0	<0.04	48.5	6.4	1.0	180	7.7	6.50	12.5	41.2	552	16.2	160	27	9.0	2.86	<0.02	106	196	13.8
02N 03W 07CDB1	Canyon	7/9/02	600	13.5	11.60	0.70	arsenite	0.8	63.9	1.2	76.0	7.6	0.4	260	7.5	16.9	<0.3	27.2	655	23.5	181	280	265	0.05	0.02	158	221	18.2
02N 04W 16BCB1	Owyhee	9/5/02	193	18.6	0.10	16.8	arsenate	3.6	28.6	<0.04	118	93.4	0.5	490	7.0	7.60	6.0	113	1390	15.0	250	80	7.6	8.10	0.03	323	305	48.4
02N 05W 13BCD1	Owyhee	8/27/02	190	167	1.80	170.	arsenate	3.8	33.7	<0.04	256	14.1	0.5	720	6.8	17.6	13.6	52.9	1440	15.4	177	10	2.5	2.29	0.11	627	216	19.6
03N 01E 01DBA1	Ada	8/7/02	268	3.5	0.50	3.10	arsenate	2.2	51.1	<0.04	62.4	10.0	0.5	210	7.2	1.93	0.5	39.2	553	14.8	243	71	19.0	2.09	0.03	27.1	296	12.4
03N 01E 13BDB1	Ada	7/3/02	97	8.3	0.05	7.20	arsenate	2.6	57.1	<0.04	54.4	43.3	0.7	200	7.3	2.03	<0.3	103	791	13.8	267	<10	<2	5.19	0.05	50.5	326	15.3
03N 01W 10DAAB1	Ada	7/3/02	210	0.6	0.05	0.50	arsenate	8.0	140	<0.04	63.3	23.0	0.2	210	7.3	1.88	0.9	21.5	498	14.7	152	12	<2	1.96	0.02	78.8	186	12.2
03N 02E 07ADCB2	Ada	7/2/02	265	2.2	0.10	2.00	arsenate	0.2	97.7	<0.04	50.1	7.8	0.6	180	7.2	2.35	E0.2	48.8	545	19.7	284	10	51.1	0.15	0.06	19.1	247	12.8
03N 02E 11CCDB2	Ada	6/25/02	445	5.1	6.50	0.60	arsenite	2.0	7.3	0.1	51.8	6.4	1.0	150	6.8	1.26	<0.3	34.7	465	22.0	87	2400	363	<0.05	<0.02	124	106	4.29
03N 02W 04DDAA2	Canyon	7/9/02	63	6.2	0.05	5.10	arsenate	3.4	108	<0.04	79.3	19.9	0.7	290	8.0	2.39	0.6	58.6	796	14.8	284	<10	<2	14.4	0.14	53.5	347	22.3
03N 02W 06DCC1	Canyon	8/6/02	530	5.5	1.90	5.10	arsenate	2.9	26.0	<0.04	13.7	5.0	0.6	41	7.9	1.15	0.3	26.1	188	24.3	74	<10	<2	0.29	0.02	9.7	91	1.59
03N 02W 13CBBC1	Canyon	6/13/02	266	2.1	0.05	0.80	arsenate	5.8	41.7	<0.04	81.3	20.0	0.3	240	7.7	1.84	1.2	88.7		14.9	251	<10	3.5	2.62	<0.02	125	306	9.72
03N 03W 09CBC1	Canyon	6/11/02	145	49.8	0.05	40.1	arsenate	2.7	16.0	<0.04	18.9	5.2	0.8	75	8.1	3.00	<0.3	81.0	470	12.7	174	<10	<2	1.44	0.02	32.8	212	6.79
03N 03W 10BAA1	Canyon	6/11/02	355	3.6	0.05	2.20	arsenate	4.1	93.6	<0.04	76.3	61.4	0.4	250	7.8	4.91	2.2	67.6	796	17.9	141	23	3.0	3.36	0.04	140	172	14.5
03N 04W 15DCC1	Canyon	7/17/02	79	75.2	0.30	68.5	arsenate	4.4	46.5	<0.04	48.4	25.8	0.9	190	7.6	7.56	6.4	92.4	747	16.9	237	<10	1.0	5.21	0.03	85.7	290	16
03N 05W 10CAA1	Owyhee	8/27/02	180	0.3	0.20	0.10	mixed	0.3	118	8.7	28.9	32.0	0.8	120	7.6	20.6	0.5	114	823	20.1	335	139	106	E0.02	0.12	48.0	408	12.8
04N 01E 31DCCD1	Ada	6/27/02	82	16.3	0.30	14.5	arsenate	0.5	98.6	<0.04	74.6	10.3	0.4	300	7.2	4.74	<0.3	41.3	739	13.8	348	40	5.4	4.22	0.29	27.2	425	26.7
04N 01E 36ADB1	Ada	6/26/02	105	7.2	0.05	6.8	arsenate	5.3	95.2	<0.04	66.6	9.2	0.5	270	7.1	2.54	0.8	29.9	626	13.9	268	<10	<2	5.48	0.16	31.3	326	24.2
04N 01W 25DCDD2	Ada	6/27/02	225	1.0	0.05	1.0	arsenate	3.6	123	0.1	68.8	7.9	0.2	220	7.2	2.42	<0.3	69.8	690	12.9	311	<10	<2	<0.05	<0.02	33.0	380	11
04N 02W 03AAAA1	Canyon	6/12/02	351	0.5	0.05	0.1	mixed	2.6	134	<0.04	57.7	7.6	0.1	180	7.0	1.85	<0.3	16.0	413	15.2	166	E7	1.9	2.25	<0.02	24.8	203	8.33
04N 03W 12BACC1	Canyon	7/16/02	102	1.3	0.10	0.8	arsenate	1.7	23.4	<0.04	11.1	1.1	0.3	39	7.0	1.01	<0.3	7.1	110	14.9	52	<10	4.1	0.10	0.04	2.7	63	2.62
04N 03W 21CDD1	Canyon	7/9/02	329	7.5	0.30	6.4	arsenate	1.1	3.5	<0.04	16.1	6.9	0.9	45	8.1	1.35	<0.3	41.4	260	25.0	120	<10	<2	0.19	E0.01	9.2	146	1.19
04N 04W 21CAA2	Canyon	7/16/02	36	27.1	2.30	23.3	arsenate	5.1	51.6	<0.04	42.4	9.6	0.7	240	7.8	2.83	2.1	79.2	764	14.7	314	15	<2	7.10	0.04	61.0	383	33.7
04N 05W 02CBB1	Canyon	7/22/02	90	17.7	0.10	15.3	arsenate	1.6	40.0	<0.04	117	44.8	0.6	440	7.5	8.23	7.2	204	1640	15.3	455	<10	<2	29.8	0.05	239	555	34.8
04N 05W 21AAB2	Canyon	7/17/02	220	53.5	0.40	44.7	arsenate	6.2	14.7	<0.04	41.5	6.1	1.0	150	7.7	9.34	0.9	21.1	401	17.4	157	<10	<2	3.89	0.02	26.6	191	10.9
04N 05W 31BAA1	Owyhee	9/3/02	155	19.4	4.20	15.0	arsenate	6.7	37.2	<0.04	45.4	11.8	0.9	220	7.4	5.51	3.3	43.1	585	15.8	235	<10	<2	3.37	0.04	52.2	287	25
05N 01E 31ACA2	Ada	9/4/02	205	7.3	0.10	7.3	arsenate	7.2	70.7	<0.04	37.1	5.2	0.4	120	7.0	1.91	0.3	21.5	300	16.5	146	<10	3.6	2.12	0.14	15.9	179	6.76
05N 01E 32DBD1	Ada	6/24/02	128	10.9	0.05	10.6	arsenate	6.9	50.5	<0.04	38.9	2.8	0.2	140	7.0	2.68	<0.3	28.0	376	14.0	182	<10	<2	1.72	0.15	5.9	223	9.6
05N 02E 31BCC1	Ada	9/26/02	270	12.2	0.10	12.6	arsenate	0.3	10.6	<0.04	47.1	3.3	0.4	140	7.4	2.29	0.6	14.5	311	18.3	133	<10	11.0	<0.05	<0.02	18.6	162	4.32
05N 05W 15DBB1	Canyon	7/22/02	273	0.7	0.80	0.10	arsenite	0.3	13.0	2.7	15.6	3.0	0.9	44	8.2	9.04	<0.3	36.7	289	16.3	148	745	113	<0.05	0.04	0.2	181	1.34
05N 05W 32CDC1	Canyon	7/24/02	58	20.4	0.20	19.3	arsenate	2.5	30.1	<0.04	34.8	15.8	0.8	160	7.7	7.79	0.8	51.0	538	17.7	196	<10	<2	2.49	0.03	54.2	239	16.6
05N 05W 34BCC1	Canyon	8/6/02	234	0.2	0.05	0.10	mixed	0.6	52.0	3.7	46.2	99.0	1.0	130	8.0	15.1	<0.3	79.2	717	18.9	156	258	122	<0.05	E0.02	44.0	190	3.72
05N 06W 01CDD1	Canyon	7/24/02	47	15.9	10.40	3.60	arsenite	0.4	99.5	2.1	65.4	41.0	1.0	230	7.5	10.1	0.5	122	985	12.8	368	2840	1350	<0.05	0.10	98.2	449	15.1
05S 03E 22BBB2	Owyhee	7/26/02	131	16.9	0.05	16.3	arsenate	6.7	74.9	<0.04	44.6	36.6	0.9	200	7.7	9.75	5.3	66.9	714	17.5	192	<10	<2	4.15	0.03	86.1	235	22.3
05S 08E 34DBA1	Elmore	7/24/02	75	9.9	9.30	0.30	arsenite	0.1	42.7	0.5	60.0	25.4	2.2	220	8.0	6.88	<0.3	48.7	651	16.1	227	367	312	<0.05	0.10	66.1	277	18.1
05S 10E 30BDA1	Elmore	7/24/02	91	28.2	0.10	28.3	arsenate	0.1	21.2	<0.04	32.3	29.1	0.9	230	7.8	7.04	3.5	74.0	765	18.2	268	30	119	0.73	0.08	81.2	327	36.2
06N 03W 10BAA1	Gem	7/25/02	88	7.7	0.90	6.10	arsenate	0.2	32.0	<0.04	14.2	1.9	0.4	47	7.4	1.98	<0.3	12.1	158	18.2	73	29	4.9	<0.05	0.06	5.7	89	2.84
06N 05E 26CBB1	Boise	7/11/02	128	4.7	2.60	1.40	mixed	0.3	106	0.1	10.9	6.8	0.4	36	7.0	2.83	<0.3	42.9	287	10.2	98	4290	352	<0.05	<0.02	24.0	119	2.05
06N 05W 26DCD1	Payette	9/12/02	455	10.1	0.30	11.2	arsenate	6.5	36.8	3.1	61.8	46.4	0.3	210	7.8	4.72	3.7	25.1	549	19.0	140	E5	<2	2.43	0.79	74.2	171	14.4
06N 05W 35BAC1	Canyon	7/22/02	322	8.7	0.10	8.40	arsenate	6.0	25.9	<0.04	41.8	10.0	0.2	150	7.9	3.94	3.8	15.8	354	19.0	143	E7	1.6	1.14	0.02	21.5	175	10.3
06S 05E 26BBB1	Owyhee	8/6/02	205	4.6	3.90	0.10	arsenite	0.1	14.6	2.8	196.	103	1.9	680	7.2	12.0	23.8	337	2410	19.8	210	84	341	1.75	<0.02	1050	256	47.4
07N 02W 30CCC1	Gem	8/21/02	85	13.2	0.20	13.6	arsenate	4.9	93.3	<0.04	52.4	3.4	0.6	210	6.8	3.34	E0.2	55.7	600	15.4	288	<10	<2	4.01	0.14	18.5	351	18
07N 05W 36CAC1	Payette	9/9/02	218	10.3	0.10	10.1	arsenate	10.1	72.1	<0.04	57.7	51.1	0.3	200	7.6	5.15	1.3	34.8	553	18.3	124	<10	<2	1.37	0.02	67.0	152	12.6
08S 12E 36BAA2	Twin Falls	6/17/02	460	8.0	0.05	7.40	arsenate	6.0	39.8	<0.04	29.3	12.6	0.8	95	7.8	5.59	1.0	28.3	332	22.9	107	<10	<2	2.06	E0.01	26.8	130	5.39
08S 36E 15CDC1	Bannock	7/25/02	233	41.7	39.80	2.10	arsenite	0.0	415	1.7	53.5	17.2	0.1	180	7.5	3.61	<0.3	28.9	485	14.0	226	911	13.1	<0.05	<0.02	0.1	276	12.3
09S 16E 20BDD1	Twin Falls	7/16/02	215	21.5	0.10	18.3	arsenate	6.4	34.7	<0.04	86.1	46.6	0.8	400	7.6	5.71	2.4	82.0	1100	14.0	352	<10	<2	5.34	E0.02	142	430	44.8
09S 17E 34CBA1	Twin Falls	8/23/02	220	12.4	0.70	11.0	arsenate	5.9	61.4	<0.04	102.	69.5	0.6	450	7.6	5.73	2.7	93.0	1250	13.9	359	<10	<2	6.64	E0.01	177	438	48.7
10S 13E 20DAB1	Twin Falls	7/17/02	253	0.7	0.50	0.10	arsenite	4.2	399	0.7	106	84.2	0.6	410	7.2	12.9	0.7	100	1260	17.8	419	<10	4340	E0.04	<0.02	128	511	34.9
10S 13E 25DDC1	Twin Falls	6/20/02	280	22.3	0.70	19.6	arsenate	7.0	33.7	<0.04	95.9	38.1	1.2	380	7.3	3.81	1.3	42.1	883	14.0	284	21	<2	6.13	0.06	104	347	34
10S 16E 19AAD1	Twin Falls	9/24/02	150	6.0	0.10	5.50	arsenate	3.0	39.2	<0.04	110	33.5	0.8	370	7.2	4.12	1.0	42.4	904	14.2	306	<10	<2	2.54	0.06	112	373	22.4
10S 16E 24DDD1	Twin Falls	7/17/02	100	14.7	0.05	12.3	arsenate	5.8	55.2	<0.04	108	52.8	1.0	420	7.3	6.64	1.6	56.7	1020	13.8	340	<10	<2	4.40	0.16	97.9	414	35.8
10S 16E 32DCD1	Twin Falls	6/25/02	275	10.8	5.30	5.40	mixed	5.6	108	<0.04	126	167	0.5	600	7.7	7.68	6.1	132	1680	15.4	279	<10	<2	5.74	E0.01	340	341	68
10S 17E 33BAB1	Twin Falls	9/24/02	630	13.1	0.30	12.9	arsenate	7.8	36.8	<0.04	62.5	35.4	0.8	290	7.6	3.90	1.3	48.3	786	14.6	263	<10	<2	2.31	0.02	86.5	320	32.5
10S 23E 14CCB1	Minidoka	10/2/02	57	10.1	0.20	10.2	arsenate	0.7	87.7	<0.04	81.4	29.6	0.9	320	7.4	7.94	<0.3	34.7	773	14.0	299	E9	153	0.89	0.07	62.7	365	29
11N 05W 29CBB1	Washington	9/9/02	80	20.3	0.20	21.4	arsenate	7.0	106	<0.04	74.3	21.6	0.4	240	7.3	9.28	1.7	79.5	710	14.1	294	<10	<2	8.47	0.10	63.6	359	14.2
11N 05W 35DCB1	Washington	9/13/02	85	7.9	6.90	0.60	arsenite	0.3	122	1.6	36.0	3.5	0.3	110	7.4	12.2	<0.3	29.1	379	19.0	151	567	249	<0.05	0.15	44.8	184	5.93
11N 06W 19AAB1	Washington	9/9/02	940	0.7	0.80	0.20	arsenite	2.3	3.0	0.6	25.6	28.8	1.7	64	9.7	0.51	0.9	173	899	24.6		<10	<2	<0.05	<0.02	347		0.03
11S 22E 14BAB1	Cassia	9/23/02	206	8.1	0.10	7.80	arsenate	8.8	89.7	<0.04	59.7	47.5	0.6	260	7.4	5.59	1.2	55.2	792	13.1	225	<10	<2	6.60	0.06	75.2	275	27.2
11S 36E 02ACD1	Bannock	6/25/02	200	10.8	0.50	10.1	arsenate	3.0	125	<0.04	164	309	0.3	630	7.6	8.58	2.9	34.9	1500	12.9	201	<10	<2	2.35	0.03	74.2	245	53.2
12N 05W 24DCD1	Washington	9/12/02	118	13.0	10.50	1.30	arsenite	0.5	19.2	2.1	15.5	4.2	0.2	47	7.1	6.06	<0.3	83.2	485	15.3	148	1070	261	<0.05	0.11	87.7	181	2.12
12S 18E 13CBA1	Twin Falls	6/27/02	275	0.5	0.40	0.70	mixed	5.2	61.2	<0.04	27.3	6.3	0.4	86	7.3	5.53	E0.2	14.8	226	15.2	95	<10	<2	0.39	E0.01	8.6	116	4.22
13N 03W 08CCC1	Washington	9/10/02	963	4.5	5.20	0.30	arsenite	0.3	30.2	0.1	8.5	2.9	0.7	25	8.2	23.8	<0.3	65.8	364	27.9	182	20	6.5	<0.05	0.02	9.3	222	0.81
13N 03W 17DBB1	Washington	9/10/02	147	0.1	0.30	0.30	mixed	0.4	197	0.7	6.5	3.8	0.6	28	7.2	10.1	<0.3	62.6	334	13.4	162	445	288	<0.05	0.28	8.1	198	2.71
14N 03W 24BCA1	Washington	9/12/02	189	7.6	5.20	1.90	arsenite	0.2	140	0.1	10.8	2.4	0.4	45	6.8	5.24	<0.3	31.3	209	16.3	103	721	338	<0.05	0.15	11.8	126	4.4
14S 32E 25BDA1	Oneida	8/20/02	107	9.7	0.40	8.40	arsenate	1.4	188	0.2	165	321	0.2	620	7.2	14.6	E0.2	101	1720	9.3	32	30	405	E0.22	0.13	67.9	39	49.8
55N 02W 20CCC1	Bonner	8/2/02	215	0.2	0.05	0.10	mixed	0.3	31.5	<0.04	12.1	1.0	0.1	69	7.4	1.51	<0.3	7.3	169	9.7	76	472	73.9	E0.03	E0.01	10.0	93	9.44
61N 04W 19BAB1	Bonner	8/1/02	51	0.3	0.05	0.10	mixed	8.6	21.0	<0.04	14.6	0.3	<0.1	53	6.5	1.32	<0.3	2.4	117	10.6	54	E6	2.7	0.46	E0.01	1.2	66	4.09
62N 02E 29BAD1	Boundary	7/30/02	150	0.3	0.05	0.10	mixed	6.7	44.5	<0.04	46.7	2.7	0.2	170	7.7	1.60	0.3	4.2	333	10.3	150	<10	<2	0.32	<0.02	15.9	182	12

Concentration units in mg/L for DO, NH3, Ca Cl, F, Hardness, K, Na, Alk, NO3, P, SO4, HCO3, Mg
Concentration units in μg/L for As, As(3), As(5), Ba, Se, Iron, Mn. Concentration units in microsiemens/cm for specific conductance (SC)

Table 7. 2003 Ground Water Chemistry Data

Station	County	Date	depth	As	As(3)	As(5)	Species	DO	Ba	NH3	Ca	Cl	F	Hard	pH	K	Se	Na	SC	Temp	Alk	Fe	Mn	NO3	P	SO4	HCO3	Mg
02N 03W 06BBA1	Canyon	7/02/03	140.0	28.0	0.1	26.4	arsenate	6.3	6.5	<0.04	59.5	11.7	0.8	240	7.3	5.7	3.6	53.5	665	17.9	215	<8	0.4	1.94	0.01	106.0	262	22.5
02N 03W 15BBC1	Canyon	9/04/03	280.0	12.2	0.1	11.9	arsenate	6.6	116.0	<0.04	99.5	93.6	0.4	340	7.6	5.2	2.5	34.8	887	16.5	130	4	0.5	5.42	0.01	152.0	159	21.0
03N 02W 15DDD1	Canyon	6/13/03	48.0	9.7	0.1	9.4	arsenate	3.9	74.0	<0.04	58.1	7.8	0.8	240	7.4	4.2	0.6	36.3	577	14.4	248	5	0.3	3.52	0.09	32.8	302	22.0
03N 05W 02DCB1	Canyon	6/11/03	230.0	14.4	8.5	5.2	mixed	0.4	62.6	1.34	96.0	16.9	0.9	350	7.2	20.7	<0.5	61.7	875	21.2	329	293	6120	<0.06	0.02	121.0	401	27.7
03N 05W 03ADA1	Canyon	6/11/03	55.0	45.0	0.1	44.1	arsenate	1.6	39.1	<0.04	39.6	11.0	0.9	180	7.5	12.7	2.6	84.6	692	15.4	255	<8	<0.4	4.86	0.08	65.3	311	20.8
03N 05W 28ACB1	Owyhee	6/27/03	30.0	62.1	0.9	54.8	arsenate	5.8	49.6	<0.04	106.0	35.4	1.7	380	7.3	3.0	3.4	80.2	1010	15.6	354	<8	0.2	5.24	0.03	126.0	431	27.7
04N 01E 06CCDB1	Ada	7/10/03	88.0	9.7	0.1	9.0	arsenate	7.0	97.7	<0.04	45.0	3.2	0.4	150	7.4	2.6	<0.5	39.4	450	14.2	211	8	0.4	1.41	0.18	13.4	257	8.4
04N 04W 21CAA2	Canyon	7/02/03	36.0	28.0	0.1	25.5	arsenate	6.5	47.6	<0.04	41.7	9.0	0.6	240	7.5	2.8	1.7	75.5	720	14.2	299	<8	0.7	7.38	<0.09	53.2	365	33.4
04N 05W 21AAB2	Canyon	7/03/03	220.0	55.6	0.1	52.2	arsenate	6.5	15.2	<0.04	44.3	6.4	0.9	160	7.2	10.0	1.0	23.5	417	17.2	155	8	1.0	4.39	0.02	28.9	189	11.3
04N 06W 11DCA1	Canyon	6/12/03	31.0	13.1	0.1	12.7	arsenate	9.2	49.0	<0.04	74.9	30.9	0.6	340	7.4	10.4	2.0	56.9	884	15.1	261	<8	0.4	16.30	0.06	78.6	318	36.3
04N 06W 12CAC1	Canyon	6/12/03	123.0	8.6	7.7	0.4	arsenite	0.9	108.0	2.62	34.9	26.2	0.7	120	7.7	13.9	<0.5	88.1	670	16.1	183	143	155	0.05	0.06	94.2	224	8.8
04N 06W 24BDA1	Owyhee	7/03/03	205.0	0.4	0.1	0.2	mixed	0.2	252.0	3.36	58.8	57.5	0.3	200	7.2	18.5	0.5	189.0	1140	18.2	542	396	280	<0.06	0.05	4.8	662	13.4
04S 02E 06CDA1	Owyhee	7/21/03	320.0	12.5	11.0	1.9	arsenite	0.1	35.9	0.64	69.4	21.1	2.7	250	7.7	7.6	<0.5	41.5	659	20.0	197	241	156	<0.06	<0.02	105.0	241	19.3
05N 01E 26CDDC1	Ada	7/11/03	59.8	22.0	0.1	20.8	arsenate	2.1	70.9	<0.04	86.9	14.8	1.0	290	6.9	4.8	1.1	32.5	725	15.9	188	5	1.4	1.25	0.22	157.0	229	18.8
05N 01E 32DBD1	Ada	8/13/03	128.0	10.6	0.1	11.0	arsenate	8.1	36.6	<0.04	30.6	3.5	0.2	110	7.2	2.3	<0.5	23.5	292	14.0	130	<8	<0.4	2.24	0.14	7.4	159	7.5
05N 01W 34ACAC1	Ada	7/07/03	85.0	9.3	0.1	8.1	arsenate	5.9	148.0	<0.04	62.9	12.2	0.4	220	7.0	3.7	0.4	33.0	550	15.0	190	6	2.1	12.90	0.25	27.5	232	14.3
05N 05W 03BCBC1	Canyon	6/12/03	60.0	16.0	14.6	0.8	arsenite	0.9	35.0	1.05	34.8	15.4	0.3	100	8.0	5.2	<0.5	18.3	300	17.8	90	35	139	<0.06	0.03	29.1	110	3.2
05N 05W 32CDC1	Canyon	7/08/03	58.0	20.5	0.1	18.4	arsenate	23.8	34.7	<0.04	40.3	19.5	0.8	180	7.2	8.8	0.6	53.5	572	17.1	194	<8	0.2	2.33	0.03	61.0	236	19.4
05N 37E 21CCC1	Jefferson	8/19/03	112.0	17.8	18.3	0.5	arsenite	0.1	146.0	0.21	63.6	22.9	1.1	220	8.4	6.1	<0.5	18.7	513	9.3	177	518	702	<0.06	0.04	50.2	216	15.5
05S 03E 22BBB2	Owyhee	7/21/03	131.0	17.4	0.1	16.8	arsenate	6.0	75.0	<0.04	47.3	36.9	1.0	220	7.8	9.7	5.6	66.0	700	17.6	205	<8	0.3	4.37	0.03	83.7	250	23.8
05S 10E 30BDA1	Elmore	7/25/03	91.0	34.6	0.4	36.8	arsenate		23.0	<0.04	32.7	29.8	0.9	240	7.7	7.6	4.1	79.0	763	17.4	271	51	164	0.89	0.10	79.4	330	37.5
05S 34E 20DCB1	Bannock	9/08/03	100.0	9.3	0.1	9.2	arsenate	3.2	60.6	<0.04	44.0	25.9	0.5	250	7.6	9.1	0.8	33.0	651	15.4	245	7	0.3	1.02	0.04	48.9	299	32.9
06N 03W 33CBA1	Gem	7/17/03	152.0	11.4	0.2	11.5	arsenate	6.6	119.0	<0.04	32.5	9.6	0.2	110	7.6	2.3	<0.5	38.7	385	16.1	136	<8	0.5	5.12	0.24	24.4	166	6.3
06N 04W 24ABB1	Payette	8/06/03	155.0	2.0	0.1	1.5	arsenate	9.8	57.0	<0.04	79.0	19.9	0.3	250	7.6	3.5	1.1	74.2	787	14.8	310	<8	2.0	2.96	0.05	71.1	379	13.8
06N 04W 34ACB1	Payette	8/28/03	311.0	10.3	0.1	10.4	arsenate	1.8	34.6	<0.04	25.8	7.7	0.3	91	7.4	2.8	0.6	12.9	227	19.0	80	4	0.5	0.32	0.04	17.7	97	6.5
06S 04E 04BDA1	Owyhee	7/23/03	380.0	13.7	13.7	0.5	arsenite		28.2	2.31	119.0	11.6	1.1	350	7.6	12.9	<0.5	63.3	906	20.7	231	332	552	<0.06	0.01	226.0	282	14.1
07N 01W 27BCB1	Gem	8/05/03	94.0	42.1	30.7	10.7	arsenite	0.5	16.6	<0.04	30.8	7.3	0.9	94	6.8	2.1	<0.5	29.9	329	16.5	89	1220	20	<0.06	0.06	56.2	109	4.1
07N 01W 31CAB1	Gem	7/25/03	80.0	20.0	0.1	18.8	arsenate	6.6	41.7	<0.04	55.4	3.7	0.6	190	7.3	4.1	<0.5	55.5	568	16.2	288	<8	<0.4	2.17	0.06	8.1	352	12.7
07N 05W 15CDC1	Payette	8/15/03	206.0	13.3	0.1	13.8	arsenate	3.0	68.2	<0.04	56.3	63.1	0.5	200	7.8	5.0	1.6	49.2	615	17.0	135	<8	0.7	0.78	0.02	78.3	165	14.0
07N 05W 33CDB1	Payette	8/23/03	120.0	22.4	0.1	22.8	arsenate	9.7	54.6	<0.04	55.6	12.2	0.3	200	7.6	6.8	2.1	69.0	634	15.8	217	5	0.3	8.40	0.05	49.6		16.0
07N 14E 17DDB1	Blaine	6/30/03	50.0	9.9	0.1	10.9	arsenate	9.6	2.4	<0.04	10.9	0.9	0.2	31	7.2	0.5	0.3	4.9	81	7.2	38	6	0.7	0.13	0.01	1.0	47	0.8
07S 05E 07DDC1	Owyhee	7/24/03	168.0	23.9	24.7	1.1	arsenite	0.5	25.3	0.19	9.8	8.1	8.4	30	8.7	4.7	<0.5	50.9	288	19.2	93	6	20.7	<0.06	0.02	19.4	113	1.5
07S 06E 16ABB2	Owyhee	7/23/03	190.0	24.3	0.1	25.7	arsenate		18.4	<0.04	11.2	9.6	7.2	29	8.5	10.7	0.6	59.3	341	21.0	100	10	0.8	0.33	<0.02	29.8	122	0.3
08N 05W 26ABB1	Payette	8/12/03	38.0	36.9	0.1	39.0	arsenate	3.1	68.7	<0.04	47.3	5.8	0.7	210	7.8	5.6	1.7	74.5	689	13.6	286	<8	<0.4	10.70	0.14	36.7	349	22.8
08N 34E 19AAA1	Jefferson	8/05/03	180.0	8.5	0.1	8.1	arsenate	3.4	24.2	<0.04	41.6	8.6	0.3	140	7.7	3.7	0.5	13.5	343	11.2	147	<8	0.4	0.34	0.02	18.8	180	9.6
08S 33E 05DCD1	Power	9/09/03	156.7	16.3	11.3	5.3	arsenite	0.0	40.3	0.13	46.1	31.8	0.8	190	7.5	10.4	<0.5	31.9	544	15.3	207	1050	42.1	<0.06	0.01	19.5	252	18.7
08S 36E 15CDC1	Bannock	9/02/03	233.0	40.6	38.2	2.5	arsenite	0.1	415.0	1.44	50.8	15.2	<0.2	180	7.5	3.1	<0.5	28.0	471	14.2	229	1330	14.3	<0.06	0.03	<0.2	280	13.9
09N 03W 30BAC1	Payette	8/15/03	65.0	16.5	0.1	16.8	arsenate	4.8	32.3	<0.04	63.5	6.2	0.3	230	7.3	1.3	<0.5	31.2	550	17.0	216	<8	1.0	8.98	0.51	31.3	263	18.1
09S 14E 07ABC1	Twin Falls	8/01/03	110.0	10.6	7.8	4.2	mixed	5.7	44.9	<0.04	86.9	51.9	0.8	420	7.3	4.9	1.3	100.0	1160	13.4	384	<8	0.6	8.26	0.02	121.0	468	50.5
09S 15E 09DCA1	Twin Falls	8/06/03	240.0	9.2	0.8	8.1	arsenate	3.7	43.5	<0.04	71.7	49.2	0.8	280	6.9	7.4	1.1	74.5	912	15.3	302	<8	0.6	2.77	0.02	86.6	368	24.8
09S 15E 25BAC1	Twin Falls	8/06/03	100.0	15.1	0.3	14.4	arsenate	3.7	39.9	<0.04	113.0	53.5	1.1	410	7.1	4.8	1.5	70.4	1080	13.8	345	<8	0.6	4.92	0.01	129.0	421	31.1
09S 16E 20BDD1	Twin Falls	8/06/03	215.0	19.5	0.5	18.6	arsenate	5.7	34.7	<0.04	81.8	48.4	0.8	380	7.5	6.0	2.0	80.5	1090	14.2	349	<8	1.0	5.44	0.02	141.0	426	42.3
09S 17E 29CCB1	Twin Falls	8/06/03	240.0	7.9	0.1	7.5	arsenate	6.7	25.6	<0.04	90.5	61.1	0.5	360	7.5	6.0	2.5	97.2	1120	14.2	331	<8	0.5	6.68	0.01	140.0	404	33.3
10S 13E 25DDC1	Twin Falls	7/22/03	280.0	21.5	0.2	21.2	arsenate	6.5	37.5	<0.04	98.9	40.4	1.3	390	7.3	3.9	1.1	38.6	876	14.0	272	64	0.7	7.14	0.07	93.4	332	34.0
10S 16E 24DDD1	Twin Falls	6/13/03	100.0	13.5	0.1	12.4	arsenate	5.8	57.4	<0.04	109.0	55.5	0.9	420	7.3	6.9	1.6	57.0	1040	14.4	339	<8	0.3	4.76	0.15	100.0	414	37.0
10S 16E 32DCD1	Twin Falls	6/26/03	275.0	11.1	0.1	10.4	arsenate	6.0	98.7	<0.04	113.0	154.0	0.6	570	7.8	8.2	5.4	132.0	1640	15.2	273	12	<0.4	5.54	<0.02	321.0	333	68.9
10S 17E 33BAB1	Twin Falls	7/08/03	630.0	12.5	0.1	11.0	arsenate	6.6	36.9	<0.04	68.5	39.2	0.9	320	7.5	4.3	1.2	50.4	805	15.2	264	<8	<0.4	2.38	<0.02	91.6	322	35.5
10S 23E 14CCB1	Minidoka	7/18/03	57.0	10.6	0.3	10.6	arsenate	0.5	86.5	<0.04	80.9	31.6	0.9	320	7.4	8.7	0.3	34.3	779	14.0	292	7	222	1.32	0.07	63.1	356	28.8
11N 05W 29CBB1	Washington	8/27/03	80.0	20.3	0.1	20.1	arsenate	7.2	107.0	<0.04	76.2	23.6	0.4	250	7.2	9.4	1.6	82.8	855	14.4	295	<8	0.2	10.00	0.10	68.9	360	14.7
11N 06W 13DDA1	Washington	8/27/03	60.0	18.6	0.1	18.0	arsenate	4.8	19.5	<0.04	74.3	12.2	0.3	300	7.2	3.5	0.9	77.7	889	13.8	248	5	<0.4	13.00	0.10	101.0	302	27.2
11S 13E 01DDD1	Twin Falls	8/04/03	145.0	11.7	0.1	11.7	arsenate	6.0	75.7	<0.04	84.6	33.2	1.0	310	7.1	4.4	0.6	34.5	764	13.8	261	26	2.6	2.95	0.07	66.2	319	25.2
11S 14E 12ADD1	Twin Falls	8/04/03	340.0	14.1	0.2	12.7	arsenate	6.8	24.9	<0.04	55.0	74.9	0.8	330	7.8	10.5	1.8	108.0	1140	16.0	289	26	2.3	3.35	0.01	162.0	353	46.7
11S 17E 02ABB1	Twin Falls	7/02/03	157.0	21.4	4.3	15.6	arsenate	6.3	39.3	<0.04	86.0	37.0	0.9	340	7.5	4.4	1.6	53.2	892	14.1	232	<8	<0.4	3.22	0.03	147.0	289	31.0
11S 17E 07BBA1	Twin Falls	7/08/03	320.0	8.3	0.1	8.0	arsenate	6.0	26.3	<0.04	46.2	39.5	0.7	250	7.8	4.3	1.2	49.7	676	16.9	209	<8	<0.4	1.34	0.01	75.3	254	32.4
12N 04W 31CAC1	Washington	8/26/03	75.0	858.0	852.0	21.8	arsenite	0.1	123.0	2.50	27.2	5.1	<0.2	92	6.8	7.6	<0.5	59.9	468	13.9	176	1780	339	<0.06	0.10	25.9	245	6.0
12N 05W 24DCD1	Washington	8/26/03	118.0	11.8	11.0	1.1	arsenite	0.1	19.5	2.37	14.5	4.4	0.2	45	7.1	6.0	<0.5	80.2	512	15.5	123	694	271	<0.06	0.14	86.3	150	2.2
13S 16E 08BBAC1	Twin Falls	7/21/03	140.0	27.2	0.2	27.1	arsenate	7.7	16.0	<0.04	146.0	339.0	1.4	660	7.7	5.2	7.2	217.0	2260	12.8	163	<8	0.3	7.40	0.01	435.0	199	71.2
40N 05W 20BBA1	Latah	7/29/03	350.0	14.6	0.5	14.9	arsenate	1.9	96.4	<0.04	42.5	1.1	1.2	130	7.4	1.1	<0.5	10.8	283	15.3	122	25	30.6	0.47	<0.02	8.2	149	6.9
46N 03W 12BCB1	Benewah	7/17/03	349.0	16.3	15.8	1.1	arsenite		230.0	0.74	56.6	2.9	0.5	210	7.5	7.1	<0.5	21.8	503	13.5	267	1140	1410	<0.06	0.14	0.7	325	17.5

Concentration units in mg/L for DO, NH3, Ca Cl, F, Hardness, K, Na, Alkalinity, NO3, P, SO4, HCO3, Mg
Concentration units in µg/L for As, As(3), As(5), Ba, Se, Iron, Mn
Concentration units in microsiemens/cm for specific conductance (SC)