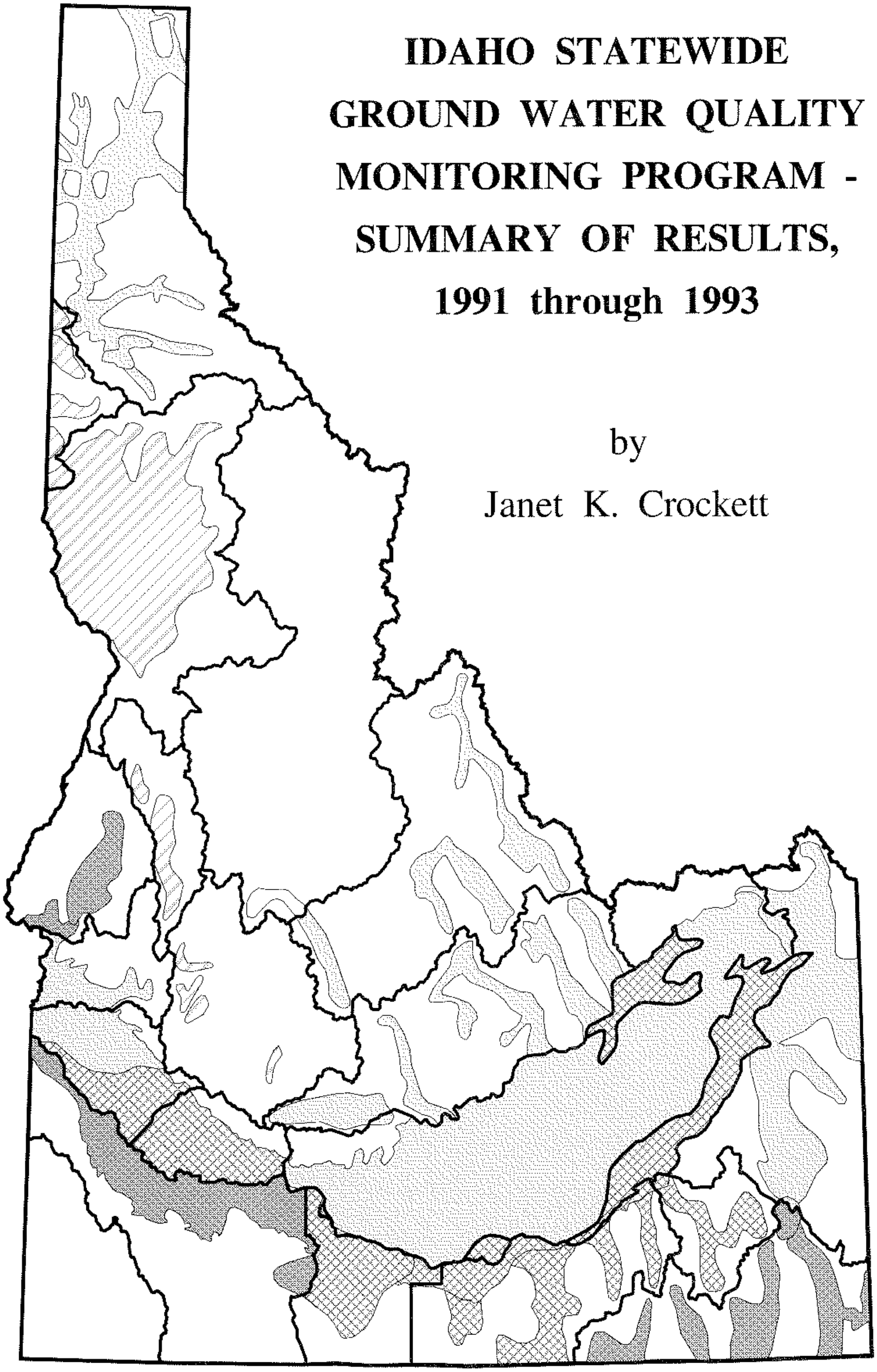
IDAHO STATEWIDE GROUND WATER QUALITY MONITORING PROGRAM - SUMMARY OF RESULTS, 1991 through 1993

by

Janet K. Crockett



IDAHO DEPARTMENT OF WATER RESOURCES
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Philip E. Batt,
Governor

R. Keith Higginson,
Director

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Water Information Bulletin No. 50, Part 2
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ABSTRACT

This Water Information Bulletin summarizes preliminary results from the Idaho Statewide Ground Water Quality Monitoring Program. It describes the objectives of the program and the subsequent network development and sample collection. Primarily, it assesses the ambient state of Idaho's ground water quality using the first three years of data.

The network for Idaho's Statewide Ground Water Quality Monitoring Program will be completed by the end of 1995 and will encompass approximately 1600 monitoring sites. The network was designed using stratified random site selection to satisfy the number one objective, to characterize the ambient water quality of the state's aquifers. The network is stratified by hydrogeologic subareas, units of similar aquifer systems.

Random site selection has also provided the means to begin addressing a second objective, to identify potential problems. Monitoring sites will be resampled and tested on a regular basis, every 4 years, to develop information on spatial and temporal trends, the third objective. A committee has been formed to develop the details of the trend monitoring network design. Trend monitoring will begin in 1995.

Preliminary results indicate that Idaho's ground water is generally acceptable for use as drinking water. Water quality problems that do exist are generally found in a crescent shaped swath from Weiser to Portneuf along the Snake River Plain. Total dissolved solids results indicate ground water south of the Snake River is generally higher in mineralization than ground water north of the river. Ground water in northern Idaho is much lower in mineralization than the rest of the state. Aesthetic concerns (taste, odor, staining, etc.) are associated with elevated sulfate, fluoride, chloride, sodium, iron and manganese.

Health concerns with natural ground water chemistry are associated with arsenic, uranium, and possibly sulfate in southwest Idaho and fluoride primarily in the central mountains, but also in southwest and southeast Idaho. Radon is also present in Idaho ground water, but the extent of its contribution to airborne radon, the primary route for radon health concern, is not clear.

Human-induced contaminants causing the greatest health concerns are nitrate, organics (volatile organic compounds and pesticides), trace elements (cadmium and selenium) and bacteria. The greatest impact from nitrate was to southwest and south central Idaho. The greatest impact from organics was to both urban and rural areas, particularly the Boise/Eagle area, Pocatello/Portneuf and Fort Hall. Cadmium contamination affected two different areas, the South Fork of the Coeur d'Alene River valley and a site just west of American Falls Reservoir.

INTRODUCTION

The Ground Water Protection Act of 1989 formed the Ground Water Quality Council to develop a Ground Water Quality Plan for Idaho. Based on Council recommendations, the 1990 Legislature funded the Idaho Department of Water Resources (IDWR) to begin a prototype statewide *ambient* ground water quality monitoring program. In April, 1990, IDWR, in cooperation with the Idaho Department of Health and Welfare,

> The Plan defines *ambient* as 'the water quality at a specific location at the time sampled'. Since data does not exist to determine *natural* background water quality prior to human impact, then ambient water quality is described as the quality of Idaho ground water as it currently exists.

Division of Environmental Quality (DEQ) and the Idaho Department of Agriculture (IDA), held a two-day technical workshop for Idaho ground water quality experts to design the prototype program. The attendees provided recommendations for monitoring network design, data requirements and information system design. A prototype program including 97 wells was implemented that summer.

The Idaho Ground Water Quality Plan (the Plan) was completed in 1991 and adopted by the legislature as law in 1992. The goals established first by the Act, then the Plan, embraced prevention, information, protection, education, monitoring, remediation and communication of results. Under 'monitoring', the Plan called for the development of a three part ground water quality monitoring program which included statewide ambient, regional and local monitoring. The three parts were designed to be interrelated, with knowledge gained from one enhancing or initiating another, differing in purpose, scale and duration. Statewide ambient monitoring is a long term, on-going program, covering the entire state. Regional monitoring focuses on areas of high vulnerability between 10 and 250 square miles. Local monitoring focuses on areas of contamination less than 10 square miles. The Plan assigns responsibility for statewide monitoring to IDWR with regional and local monitoring to DEQ.

This document summarizes the status and results of statewide ambient monitoring through the Idaho Statewide Ground Water Quality Monitoring Program (Statewide Program) from July 1, 1991 to June 30, 1994. To date, ground water quality samples have been collected from 1,165 monitoring sites (Figure 1). When the network is complete in 1995, it will include about 1,600 monitoring sites. This network will provide information about the general status of ground water quality in Idaho and lay the foundation for future trend monitoring.

OBJECTIVES

In the description of the three part monitoring program, the Ground Water Quality Plan charged that statewide ambient ground water quality monitoring answer the following five questions (Council, 1992, p. 51):

1) What is the general statewide ambient ground water quality?
2) What are background levels?
3) Are there problem areas that need more detailed monitoring?
4) What are the trends over time?
5) Is ground water generally suitable for drinking, agricultural and industrial purposes?

Three objectives were developed from these five questions. The first two questions were addressed through a single objective: *characterize the ground water quality of the state's aquifers*. This is the initial focus of the Statewide Program. The majority of this report describes the results obtained thus far in addressing this objective.

The third question also may be addressed through the focus on characterization, particularly through the random site selection, broad geographical coverage, and subsequent spatial and temporal trend analyses. To draw attention to problem areas through analysis, a second objective was developed: *identify potential problem areas*. (The Statewide Program is only one source of identifying potential problems).

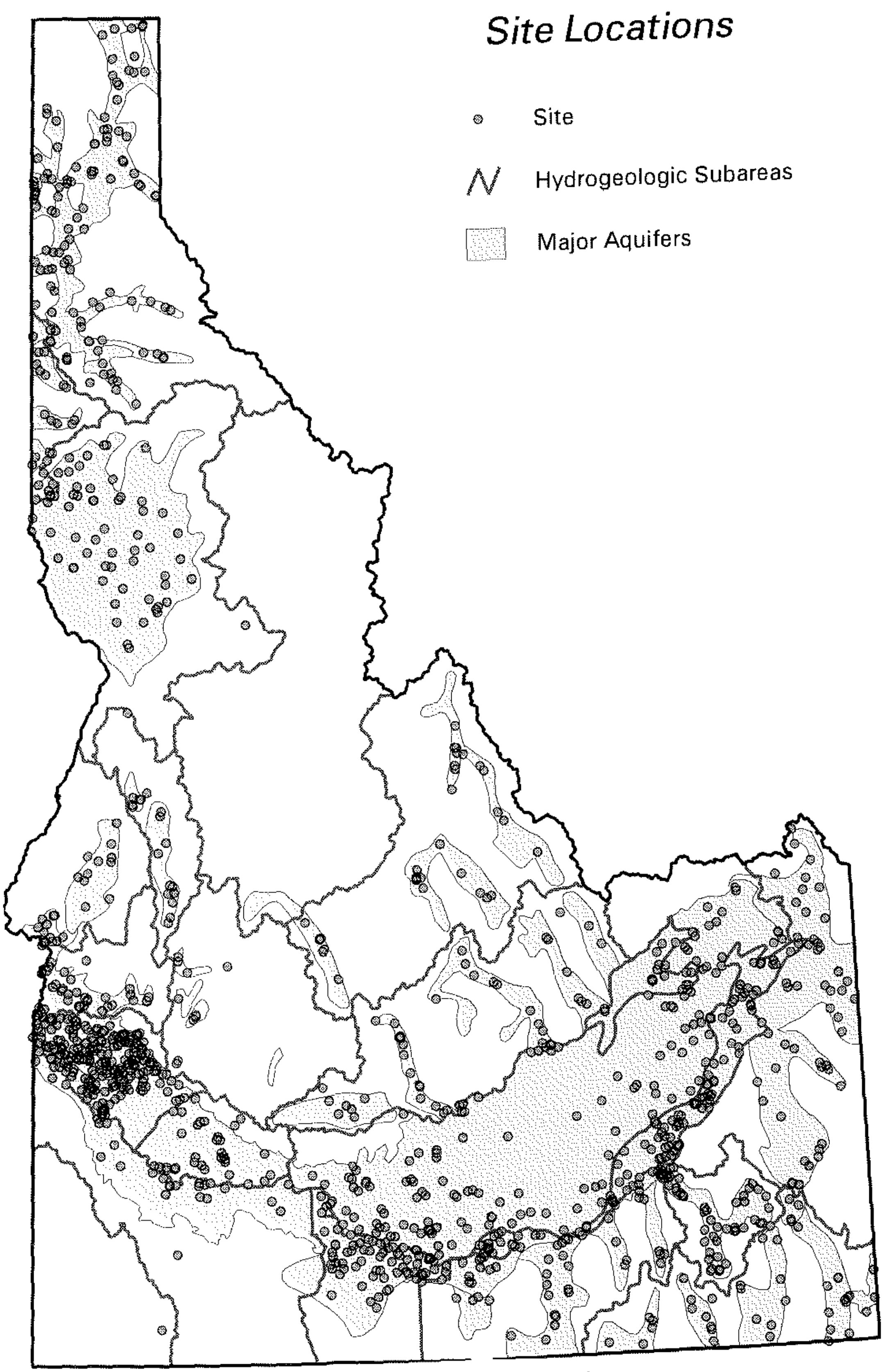

Figure 1. Site Locations

Question number four, regarding trends, depends upon establishing ambient water quality and existing problems through the first two objectives. The third objective established for the Statewide Program: *identify trends and changes in ground water quality within the state's aquifers*, began with a technical workshop in the fall of 1994, to outline the most important issues in an approach to measuring ground water quality trends in Idaho. Refer to 'Future Plans'.

Question five, general suitability, will be addressed by meeting all three objectives: characterizing the water quality and identifying trends and potential problems.

NETWORK DEVELOPMENT

Through the prototype monitoring done in 1990, it became clear certain network design elements were critical. In particular, the network design required a statistical framework so data could be used to describe characterization with confidence and without prejudice. Also through the 1990 monitoring, sample collection and quality assurance procedures were developed and refined. The 1991 legislature increased funding from $187,000 to $545,000 to enable full scale network development.

Network Design

The geology and ground water hydrology of Idaho are so diverse that a special approach was developed for the design of the monitoring network. Previously defined Idaho ground water basins (Graham and Campbell, 1981) were combined into geologically similar units called *hydrogeologic subareas*. Selection of monitoring sites was random within subareas in order to ensure objectivity for statistical evaluation. For a detailed discussion regarding the network design, refer to *Idaho Statewide Ground Water Quality Monitoring Program Network Design* (Neely, 1994).

Discussions of ambient water quality in this report refer to 20 different hydrogeologic subareas (Figure 2). Two additional subareas, Central Mountains and Southwest Owyhee, do not encompass aquifers significant enough in size to be included in this study. There is also some geographic overlap in two sets of subareas due to vertical separation between aquifer systems: the Boise Valley Shallow and Boise Valley Deep subareas, and the Snake River Plain Alluvium and Snake River Plain Basalt subareas.

Once the network is complete, wells along the fringes of the subareas will need further geologic evaluation to increase the confidence in the hydrogeologic subarea assignment. Some of the hydrogeologic subarea boundaries may be modified as a result of this evaluation. For example, the Snake River Plain Alluvium is shown as four separate areas. In the analyses for this report, those four separate areas have been treated as one subarea and may include alluvium that exists outside the boundaries as currently drawn.

Water Quality Constituents

Constituents and parameters included in the Statewide Program were the minimum recommended by the participants at the April, 1990 technical workshop: temperature, pH, specific conductance, alkalinity, fecal coliform bacteria, common ions, nutrients, selected trace elements, radioactivity

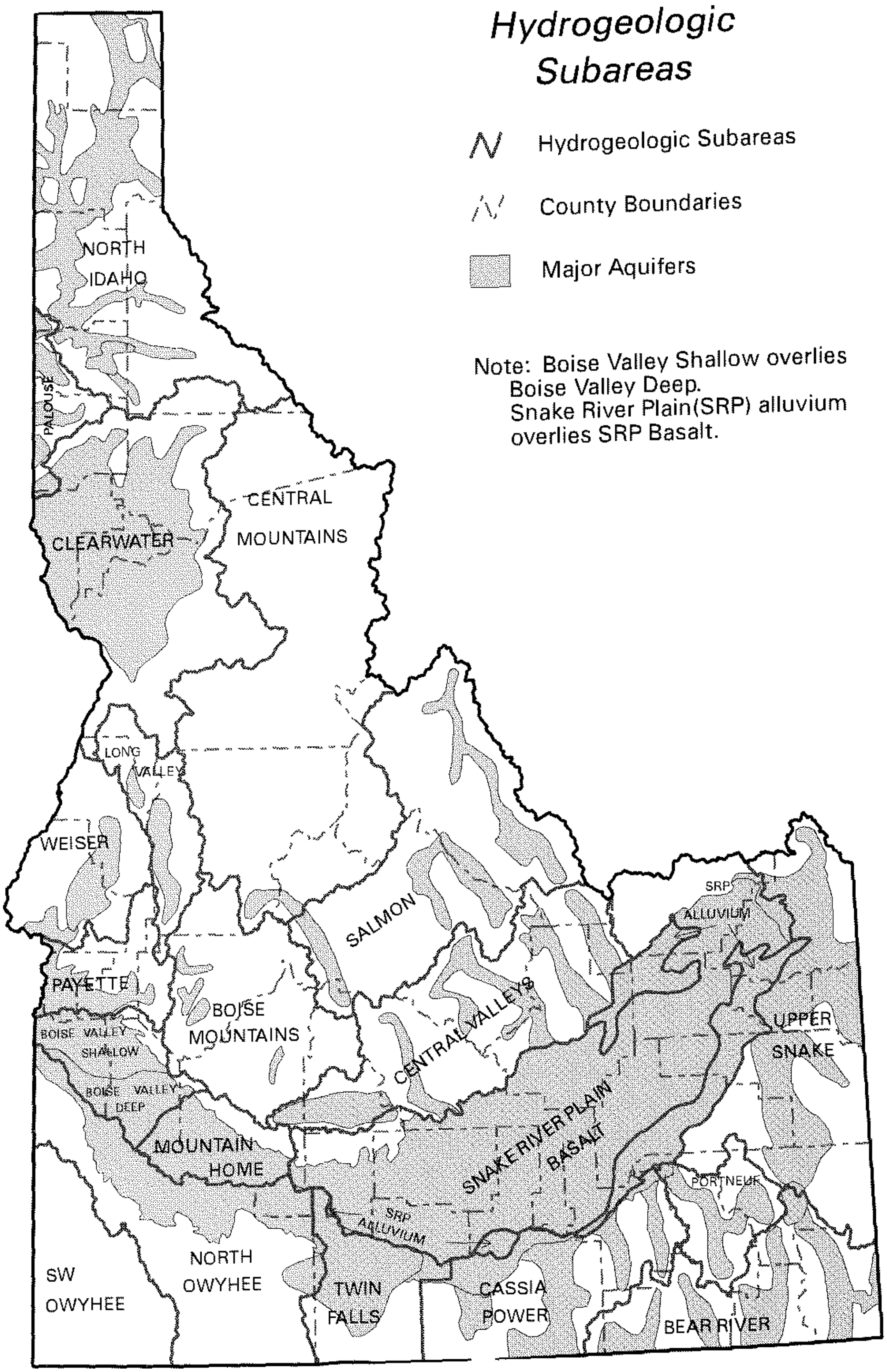

Figure 2. Hydrogeologic Subareas

screening, selected volatile organic compounds and pesticide screening. See Appendix B for a full list of constituents, methods and detection limits.

Sample Collection

Field data collection for the Statewide Program was done by the U.S. Geological Survey, Water Resources Division (USGS), through a matching funds agreement with IDWR. USGS field offices are located regionally, allowing technicians to cover the state with a minimum amount of travel time.

The work consisted of two phases, site inventory and sample collection. Both phases followed USGS and IDWR standard operating procedures. Site inventory was designed to locate, inspect, approve and acquire permission to sample sites in advance of sample collection. Sample collection was done once a year at the same time of year (July through September) to minimize seasonal variation. Sites were sampled once from 1991 through 1993. When the network is complete (1995), second round sampling will begin to address temporal trends.

Specific conductance, pH, temperature, bicarbonate, carbonate, alkalinity and fecal coliform bacteria were measured in the field. Common ion, nutrient and trace element samples were filtered and preserved on site. These samples were analyzed by the USGS National Water Quality Laboratory in Arvada, Colorado.

Samples for volatile organic compounds (VOCs), radiochemical and pesticide analyses were not filtered. VOCs were analyzed by a private state certified laboratory under contract to IDWR. Radiochemical samples were analyzed at the Idaho Department of Health and Welfare, Bureau of Laboratories (State Lab) in Boise, Idaho. Radiochemical samples requiring *speciation* (further analysis) were sent to a private laboratory. Analyses for pesticides were at IDWR using immunoassay techniques for all sites. Limited gas chromatography (GC) analysis for sites in selected subareas was done in 1993 (performed by the State Lab). In 1993, funding was provided by the IDA to increase both immunoassay and GC analyses.

Quality Assurance

Quality assurance (QA), in the field and laboratory, increased each year of the project. USGS field procedures were augmented by a QA Plan and Standard Operating Procedures (SOPs) developed jointly by IDWR and USGS. A training video and on-site visits to the field teams provided the opportunity to refine techniques and obtain feedback to help clarify SOPs, simplify logistics and improve subcontractor services. The visits also allowed opportunities to exchange ideas and information.

Quality control samples were taken at five percent of the sites and include: blanks and replicates for all common ions, trace elements and nutrients, splits for nitrate, trip and transfer blanks for VOCs and spikes for pesticides through gas chromatography. A second analysis was performed for all samples with concentrations viewed as extreme by either USGS or IDWR professional staff. Radiochemical analyses included five percent laboratory duplicates. Immunoassays include batch controls, duplicates and reruns for all positive detections.

In August of 1993, a special study was undertaken to resample sites where analyses had detected the presence of a regulated VOC. One or more samples were taken at each site where well owner permission was granted. Initial samples were sent to the private contract lab and splits were sent either to the USGS lab or the State Lab. Results confirmed the continued presence of the VOCs and established good correlation between laboratories.

In the spring of 1994, IDA conducted a study to resample all Statewide Program sites where pesticides had been detected through immunoassay. Split samples were taken for both GC and immunoassay analyses and the results compared. Comparability was particularly good for the most commonly detected pesticide, atrazine (Bahr, 1994).

GROUND WATER QUALITY CHARACTERIZATION

The initial focus for the Statewide Program is to characterize the ground water quality of the state's aquifers. This characterization will provide a general picture of Idaho's ground water quality as it exists in the early 1990s and lay the foundation for trend monitoring. Through the characterization process, some potential problem areas have also become apparent.

Assessing Ground Water Quality

Ground water quality results from the Statewide Program are assessed through comparison with the Federal Safe Drinking Water Standards established by the Environmental Protection Agency (EPA) for public drinking water supply systems. Statistics and graphics are used to describe the results.

Standards

In Idaho, EPA drinking water standards have been adopted and are enforced by DEQ. The standards consist of a *maximum contaminant level* (MCL) established for each constituent listed. *Primary* MCLs are established to protect against adverse health effects and are enforceable on public drinking water supplies. *Secondary* MCLs are established for aesthetic reasons such as taste, color or odor and are not enforceable on public drinking water supplies. An *action level* for selected constituents triggers the need for water or distribution treatment after the concentration of a percentage of samples exceeds the action level.

Samples used to comply with EPA drinking water standards must not be filtered, whereas Statewide Program common ion, trace element and nutrient samples are filtered to represent the dissolved state of these constituents. In the Statewide Program, these standards are used to assess the quality of ground water, not to measure compliance. To meet Statewide Program objectives, samples must represent ambient aquifer water quality, not local sediment conditions or distribution systems. Statewide Program sites include very few public water supply systems, but those systems may use radiochemical, VOC and some pesticide results from the Statewide Program for compliance purposes.

Statistics

Normally distributed data are dispersed over a symmetrical bell-shaped curve. Typically, water quality data are not normally distributed and the distribution curve is almost always *skewed* to the right. (Helsel and Hirsch, 1992). Thus, most of the analytical data were generally in the lower concentrations with some extreme values in the higher concentrations.
A *mean* is the average of all data results. A *median* is the middle value (or average of the two middle values) when all results are arranged in ascending order (also known as the 50th percentile). In normal data, the mean and the median are essentially equal. In skewed data, a mean will disproportionately reflect the influence of extreme values. Because Statewide Program data are skewed (Neely, 1994) the median value is used throughout this report to provide a consistent basis for comparison of results. It is one indication of the general impact of a constituent on the ground water of an entire subarea.

Appendix C contains general statistics for each constituent, by subarea. Appendix D contains boxplots of selected constituents by subarea.

Graphics

Graphics used in this report to portray existing water quality and comparisons are dot maps (site locations), choropleth (shade) maps and boxplots. Shade maps use different shade patterns to distinguish between calculated criteria for each hydrogeologic subarea. Note that all data within one subarea are included in the calculation with the intent to provide at a glance, the **overall** occurrence of a constituent(s) within a subarea. This does not mean that samples from all sites in the subarea fell within the range displayed.

The choropleth (shade) maps presented here show concentrations of constituents in a generalized way. Subareas with generally high concentrations also have sites with low concentrations of the same constituent. Subareas with generally low concentrations also have sites with high concentrations. Essentially what the maps say, are that one subarea is less or more likely than others to have elevated concentrations of certain constituents. Individual well owners should always have their well water tested prior to making any decisions on water treatment. Choose an independent qualified lab that performs drinking water analyses. Health districts can provide a list of qualified laboratories and information on various water treatment methods.

Ambient Water Quality

Currently, the network of sites (wells and springs) used to characterize ground water quality is not complete. A network of about 1,600 sites is anticipated to be complete by the end of 1995. This report summarizes the quality of Idaho ground water using the first three years of data.

Total Dissolved Solids

Total Dissolved Solids (TDS) may be defined as the total amount of solids left when a [filtered] ground water sample is evaporated to dryness (Drever, 1988) and is an indication of mineralization. In the Statewide Program, TDS is a calculated value, the sum of all dissolved constituents (See Glossary). The major contributors to TDS are common ions: calcium, magnesium, sodium, potassium, bicarbonate, carbonate, chloride, fluoride, sulfate and silica. These ions are often natural constituents of the ground water, though they can be elevated through human processes. Fluoride, sulfate and sodium are known or suspected to have negative health implications at higher levels (ATSDR, 1991d; U. of RI, 1990).

Boxplots provide graphical representation of sampling results and are valuable guides in differentiating central values, spread, symmetry and outliers among groups of data (in this case, hydrogeologic subareas) and do so in a relatively small space (Helsel and Hirsch, 1992). The *box* for each subarea represents the *interquartile range* (the middle 50 percent, from the 25th to the 75th percentile) of total dissolved solids data (Figure 3). For example, in the North Owyhee

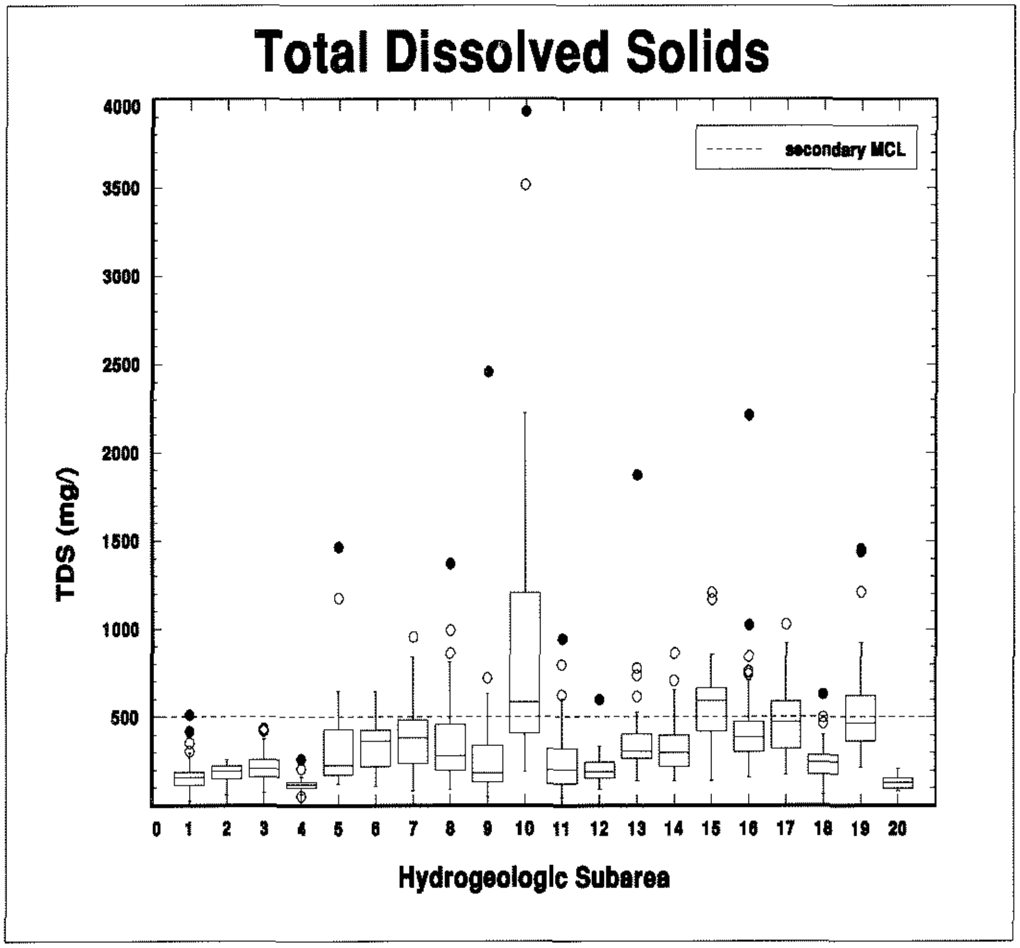

Figure 3. Total Dissolved Solids

subarea (#10), the interquartile range of all total dissolved solids data fell between 400 and 1200 milligrams per liter (mg/l). In contrast, the interquartile range in the Clearwater subarea (#3) fell between 150 and 250 mg/l. This shows not only that the North Owyhee ground water has a much greater mineral content than the ground water in the Clearwater subarea, but the *variation* in mineralization is also greater among sites in the North Owyhee subarea.

The horizontal line within the box represents the *median*. Although the interquartile ranges for Boise Valley Shallow subarea (#7) and Boise Valley Deep subarea (#8) are similar (200 to 500 mg/l), the median value is about 150 mg/l less in the Boise Valley Deep subarea, indicating mineralization is less overall in the deeper aquifer.

The *whiskers* of the boxplot extend to the largest (or smallest) value within one *step* (1.5 times the interquartile range) beyond the ends of the box. Asterisks represent *outside values*, single values that lie outside step one, but within step two (3 times the interquartile range). Circles represent *far-outside values*, single values that lie outside step two (Helsel and Hirsch, 1992).

The more elongated the box, the longer the whiskers and the presence of outside values, the greater the variation in the data. In Figure 3, data indicate that the mineralization of the aquifers in the Long Valley (#4) and Boise Mountains (#20) subareas is not only low, but varies little throughout the subareas. In contrast, the mineralization of the aquifers in the North Owyhee subarea (#10) is highly variant, from 191 mg/l TDS to 3931 mg/l TDS, the highest in the state.

Skewness is indicated by the symmetry of the box and whiskers in relationship to the median. A symmetrical box indicates normally distributed data. The lack of outside values and the near symmetry of the Palouse subarea (#2) boxplot indicates near-normal distribution for total dissolved solids data in that subarea. In contrast, the total dissolved solids data for the Weiser subarea (#5) is clearly skewed to the right.

The concentration of TDS is one indicator of how *potable*, or drinkable, water is. Water very low in TDS may taste bland; water very high in TDS may taste saline. A secondary MCL has been established for TDS at 500 milligrams per liter (mg/l) (USEPA, 1991a). The median values for the Twin Falls (592 mg/l) and North Owyhee (586 mg/l) subareas exceed the secondary MCL, followed closely by the Portneuf (476 mg/l) and Bear River (466 mg/l) subareas (Figure 3, Appendix C).

According to Drever, *fresh* waters contain less than 1000 mg/l TDS. Waters containing greater than 1000 mg/l and less than 20,000 mg/l TDS are referred to as *brackish* (Drever, 1988). The Statewide Program has not detected the presence of brackish waters in the northern and central portions of Idaho (Figure 4). However, mildly brackish water has been found in west, southwest and southeast Idaho (up to 3931 mg/l). In the North Owyhee subarea, nearly 30 percent of the wells tested would be considered mildly brackish.

Although there is a direct correlation between elevated TDS and elevated chloride, sulfate and/or sodium, there is no direct correlation between TDS and elevated fluoride (Figure 4). Fluoride levels are influenced by geothermal waters, which have been measured with fluoride concentrations as high as 30 mg/l in Idaho (Young and Mitchell, 1973). The Statewide Program includes non-geothermal waters and the highest fluoride concentration detected to date was 13 mg/l near Horseshoe Bend in the Payette subarea.

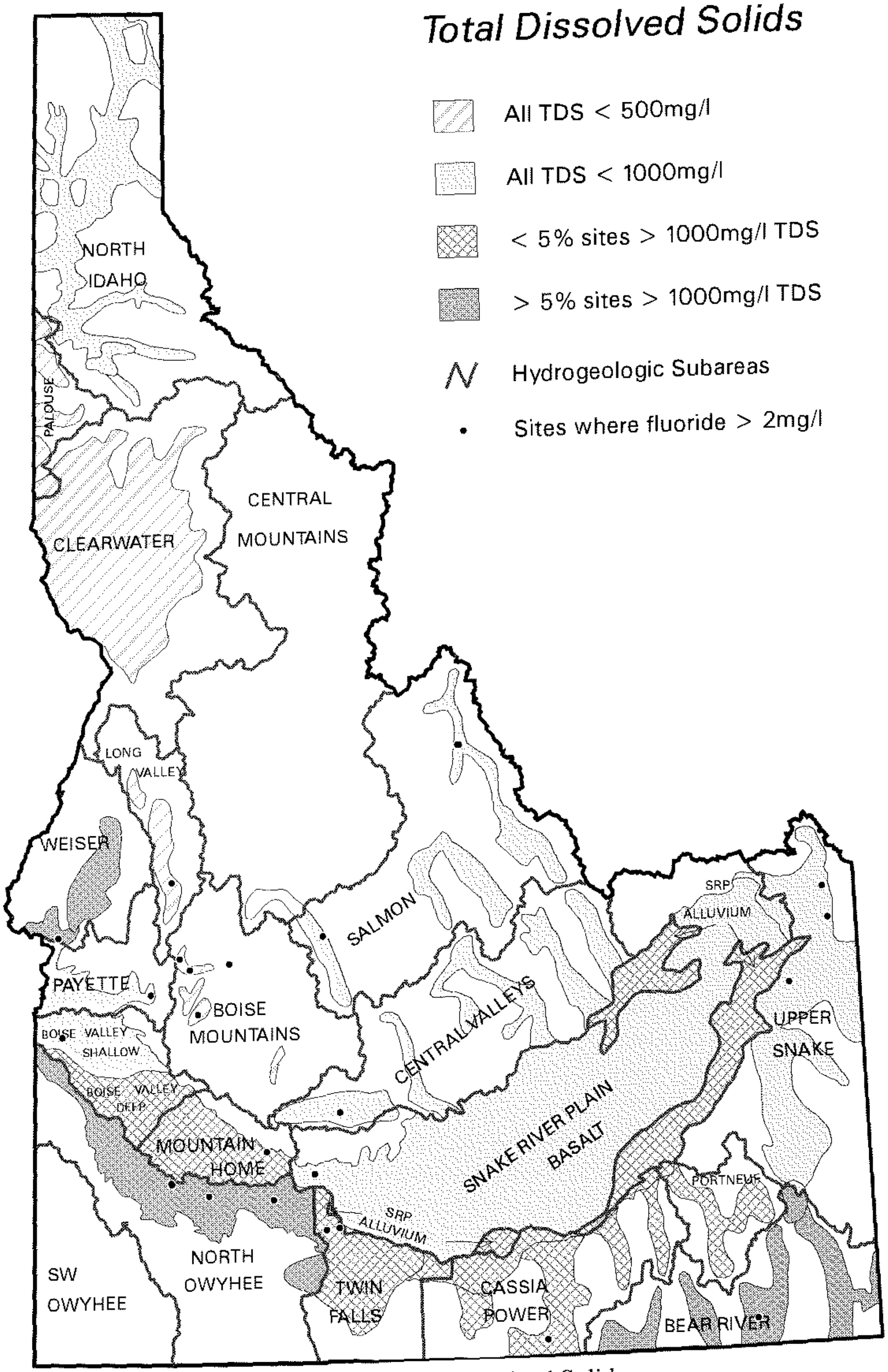

Figure 4. Total Dissolved Solids

Nutrients

Nutrients included in the Statewide Program are nitrate, nitrite, ammonia and orthophosphorus. In Idaho ground water, elevated nitrate is by far the most widespread of the preventable contaminants.

Nitrate is generated by decaying organic matter, fertilizers and both animal and human sewage, and is readily transported in ground water. Normally, concentrations of naturally occurring nitrate do not exceed 1 to 2 mg/l (USEPA, 1987). For the purposes of this study, concentrations greater than 2.0 mg/l (nitrite plus nitrate) are considered outside the range of naturally occurring and are referred to as *impacted* (elevated due to some form of land use).

Excessive nitrate is especially significant as it can cause an oxygen deficiency called methemoglobinemia (blue baby syndrome) that can cause illness and death in infants. (USEPA, 1987). Long term effects of nitrate on adults and children are unknown. Boiling the water will not get rid of nitrate, and in fact, will concentrate it (Hay, 1985). Because of the danger to infants, the EPA has established a primary MCL for nitrate in public drinking water at 10 mg/l. Of 1,151 total sites tested for nitrate, 40 (3.5 percent) exceeded the primary drinking standard.

Although nitrate impact was lower in north and central Idaho, there were no subareas in the state that were immune to nitrate impact on ground water quality (Figure 5). The subareas most affected by nitrate impact were North Owyhee, Twin Falls, Boise Valley Shallow and the eastern portion of Snake River Plain Alluvium.

Trace Elements

Trace elements in water are normally found in minor concentrations, measured in *micrograms* per liter (µg/l). However, trace element concentrations vary widely throughout Idaho and can have aesthetic or health implications.

Trace elements included in Statewide Program analyses were: arsenic, cadmium, chromium, copper, iron, lead, manganese, selenium and zinc. The compound cyanide was included and is measured in mg/l. Mercury was discontinued from the Statewide Program in 1994 because of sampling and analytical difficulties.

Data from the Statewide Program showed that the concentration of iron and manganese varied widely among hydrogeologic subareas (Figures 6 and 7). Iron and manganese are essential to life and are not harmful to health even at very high levels. However, they can cause aesthetic problems (staining on laundry, toilets and fixtures) and provide a food source for iron and manganese bacteria, which in turn cause discoloration, unpleasant odors, and corrosion and plugging of pipes.

Arsenic commonly occurs in Idaho ground water, varies widely in ambient concentrations among subareas and has health implications associated with higher concentrations. Arsenic occurs naturally in rock, volcanic gas and geothermal water. Elevated levels can be attributed to natural dissolution of rocks and soils, through the use of pesticides or the intrusion of industrial waste (ATDSR, 1989). Most forms of arsenic are toxic to humans, however, humans ingest small amounts naturally through food. The MCL for arsenic in public drinking water is currently 50 µg/l due to its effect on the dermal and nervous systems. The EPA is currently reviewing arsenic as a carcinogen (cancer causing) and may reduce the arsenic standard to between 2 and 5 µg/l (Pontius, 1993).

The ambient concentrations of arsenic in Idaho ground water was lowest in north and central Idaho (Figure 8). Elevated arsenic occurred most frequently in the ground water of southwest Idaho. The highest arsenic concentration was detected in the Weiser (#5) subarea, where the variability was also greatest (Figure 9). The highest medians were seen in the North Owyhee (#10) and Twin Falls (#15) subareas, which indicated generally higher concentrations of arsenic in those subareas.

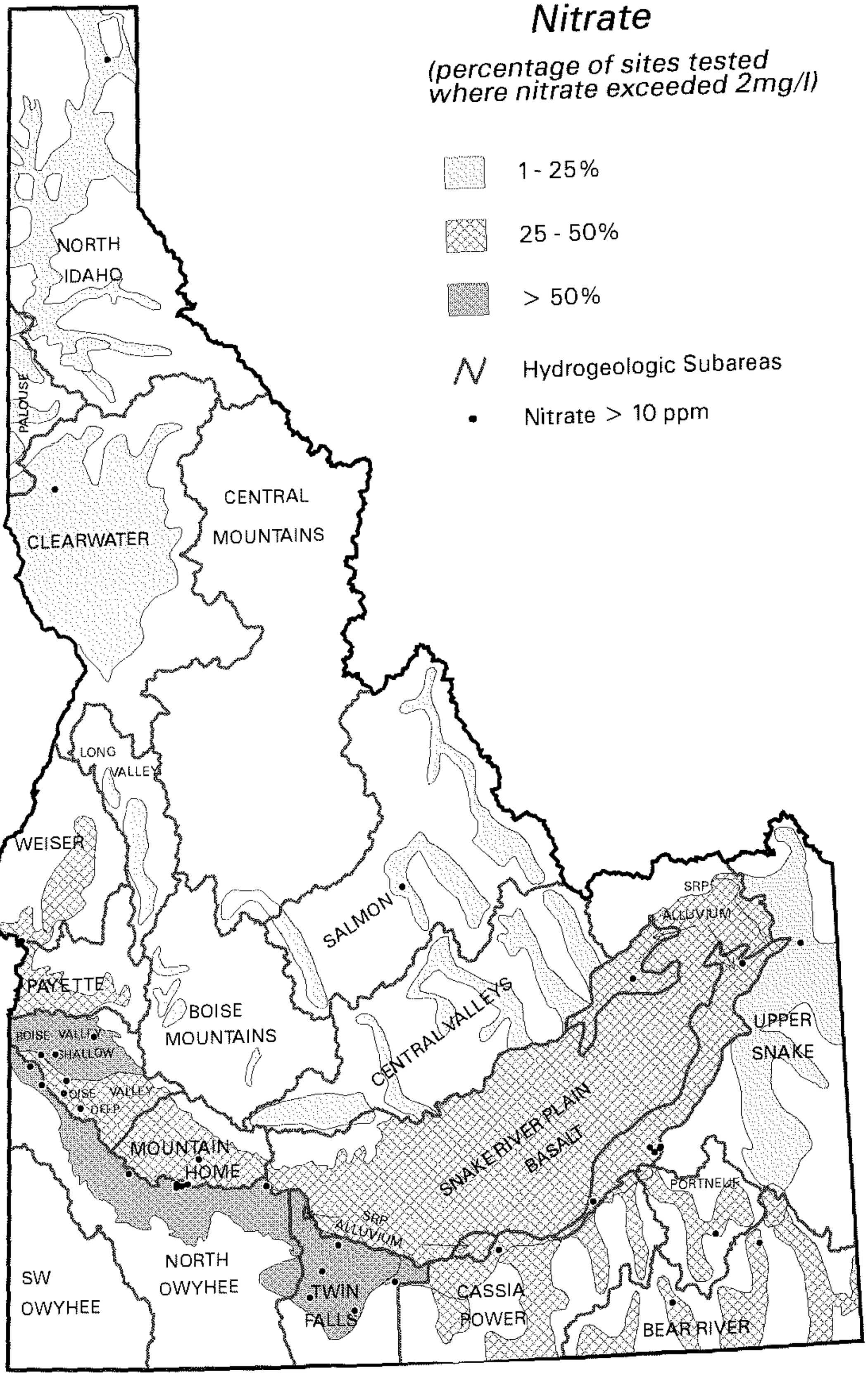

Figure 5. Nitrate

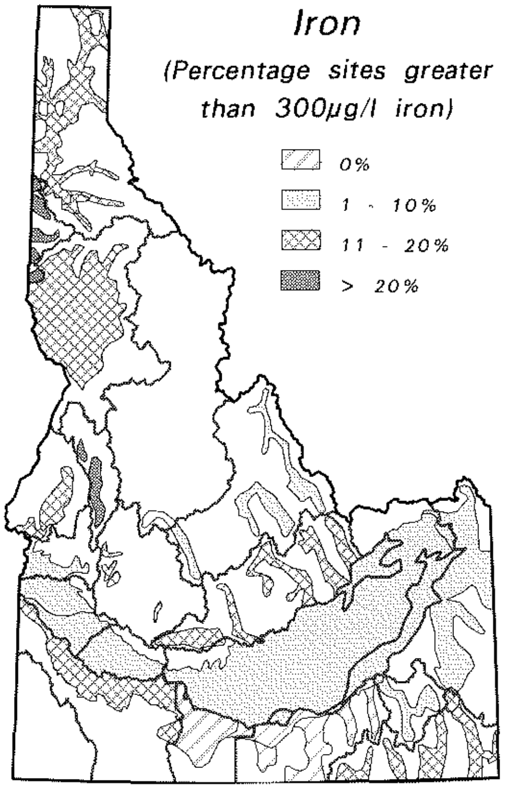

Figure 6. Dissolved Iron

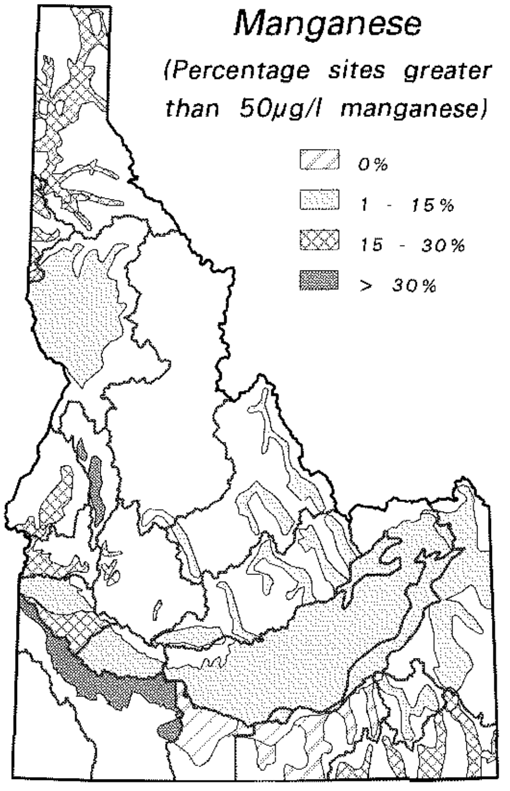

Figure 7. Dissolved Manganese

In addition to arsenic, trace elements that exceeded primary MCLs were cadmium and selenium.

* Cadmium exceeded the primary MCL of 5 µg/l at three wells in the South Fork of the Coeur d'Alene River valley. A portion of this valley is now a Superfund site due to prior contamination from hardrock mining and smelting. Cadmium also exceeded the MCL at one well in the Snake River Plain about 10 miles west of the northernmost portion of the American Falls Reservoir.

* Selenium was elevated (greater than previous primary MCL of 10 µg/l) at 12 sites, seven of which were located in the North Owyhee subarea. The remaining five sites were distributed in five different subareas. In 1992, the MCL was increased to 50 µg/l. Only one site exceeded the new primary MCL for selenium. That site is located in the North Owyhee subarea near Bruneau and the detection was associated with other extremes, including nitrate (110 mg/l) and sulfate (1500 mgl).

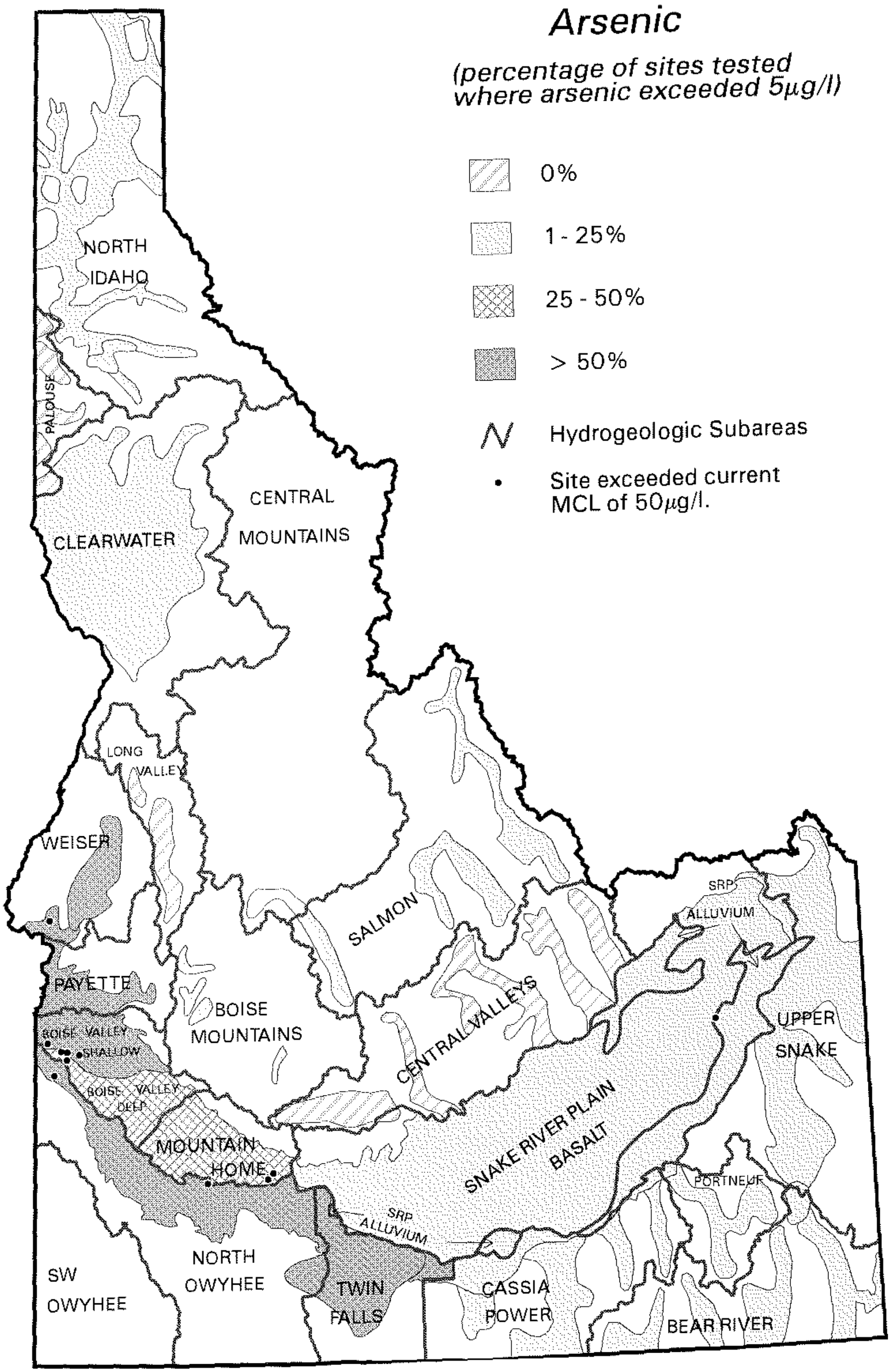

Figure 8. Arsenic

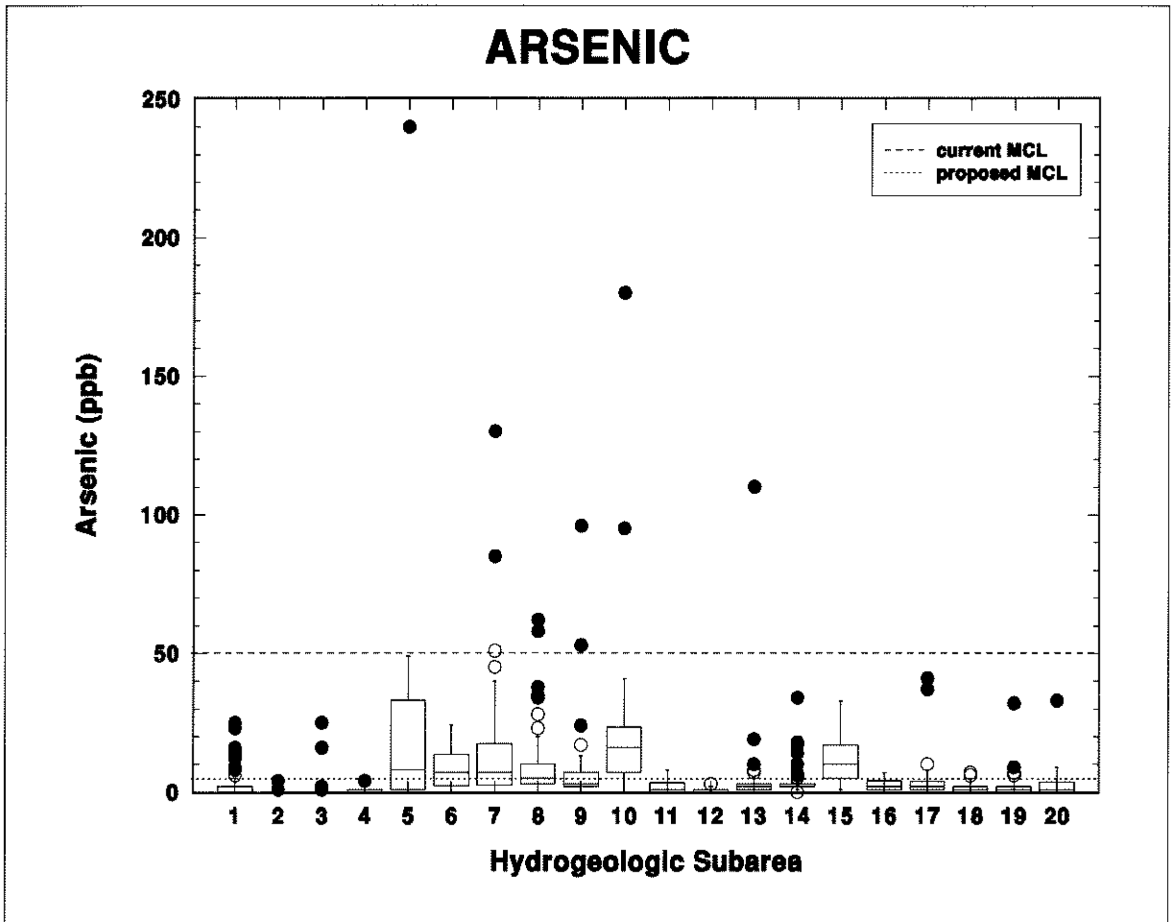

Figure 9. Arsenic

Radioactivity

Ground water samples were analyzed for gross alpha- and gross beta-particle *activity* and for radon-222. Activity for these radionuclides are recorded in picocuries per liter (pCi/l).

Gross alpha is a measurement of alpha radiation. Samples with high alpha activities were *speciated* to determine the source of alpha radiation. So far, all but one high gross alpha activities in Idaho have indicated the presence of elevated uranium. Uranium is naturally occurring in rocks and ground water, but can be redistributed through phosphate fertilizers, mining, milling, manufacturing and the improper disposal of waste containing uranium (USEPA, 1991e). The primary health concern with elevated uranium, as with other heavy metals, is kidney damage. Uranium also causes cancer, primarily bone tumors (USEPA, 1991e).

The primary MCL for gross alpha in public drinking water is 15 pCi/l. A primary MCL for uranium has been proposed at 20 µg/l. The subareas where alpha radiation is most likely to be elevated are illustrated in Figure 10. Southwest and southcentral Idaho show a higher percentage of sites with elevated alpha radiation and uranium.

Gross beta is a measurement of beta radiation. Sources of gross beta can be either man-made or natural (USEPA, 1991b). The primary MCL for gross beta in public drinking water is 50 pCi/l.

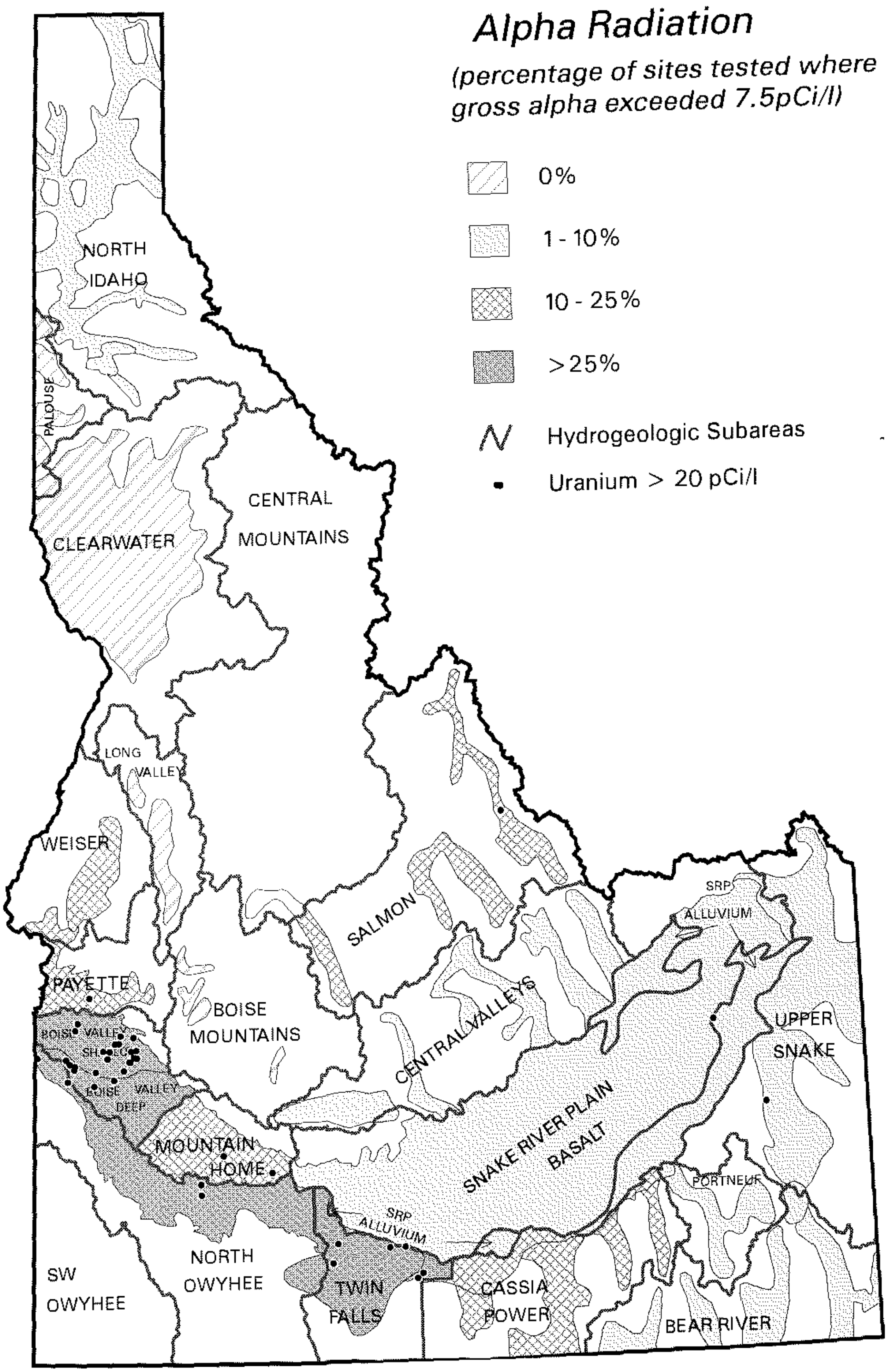

Figure 10. Alpha Radiation

There have been five sites where analysis showed gross beta exceeding the MCL: three in the North Owyhee subarea and one each in the Bear River and Mountain Home subareas. Speciation of samples high in beta activity have been inconclusive.

Radon-222 is a naturally occurring radioactive gas that is part of the uranium decay series (USEPA, 1991b). It is found in rocks, soil, water and air. Radon is a Group A carcinogen, known to cause cancer (USEPA, 1991a). Airborne radon that is inhaled may cause lung cancer (USEPA, 1992). Radon in ground water can be released into buildings by normal water uses such as showering and dish washing. In the average house, ground water contributes between 2 and 5 percent of the total indoor airborne radon (USEPA, 1987). The USEPA has considered proposing a primary MCL for radon in drinking water at 300 pCi/l (USEPA, 1991b).

The half life of radon is 3.82 days. Samples were shipped overnight and analyzed within 24 hours of lab receipt. Due to overnight shipping requirements and the remote nature of much of rural Idaho, radon samples were collected at about half of the locations and were clustered around major towns. Radon activities exceeded the proposed MCL of 300 pCi/l for 443 of 558 sites (79 percent) sampled.

Factors other than the concentration of radon in the ground water may have more influence on the concentration of airborne radon in buildings, such as the rock type, soil type, soil permeability and thickness, meteorological factors and particularly the construction and ventilation of the building (Gunderson and Wanty, 1991). The Office of Environmental Health (OEH) advises that all homes in Idaho be tested for airborne radon and that all homes be built using radon resistant construction techniques (OEH, 1992).

Organics

With the exception of naturally occurring petroleum deposits, organic compounds are man-made chemicals. The Statewide Program tests for volatile organic compounds (VOCs) and pesticides. VOCs are used as solvents, degreasers, fumigants and dry cleaning chemicals in industries and homes. They can easily percolate into the ground water, are persistent for long periods and are very difficult to clean up. Pesticides, as discussed in this report, are also organics and include insecticides, herbicides and fungicides used by commercial agriculture, homeowners, industry and government agencies.

None of these organics occur naturally in Idaho ground water. Therefore, the presence of any VOC or pesticide in the ground water indicates that human activity has affected the ground water quality. These organics may cause internal organ and nervous system damage, and cancer (USEPA, 1991c).

Volatile Organic Compounds

VOC contamination in Idaho occurs in both industrial and agricultural areas, as well as areas where neither influence is obvious (Figure 11). The most serious VOCs detected and confirmed, approximate locations, and their significance are found in Table 1. (All VOC detections are listed in Appendix C). Trihalomethanes (THMs) are displayed separately as they may be a byproduct of chlorination rather than direct contamination. Sites where field contamination may have contributed to a VOC detection are not shown. (Refrigeration may produce low freon concentrations (Scholl, 1993); trimethylbenzene appears to be an airborne contaminant). The presence of regulated VOCs was

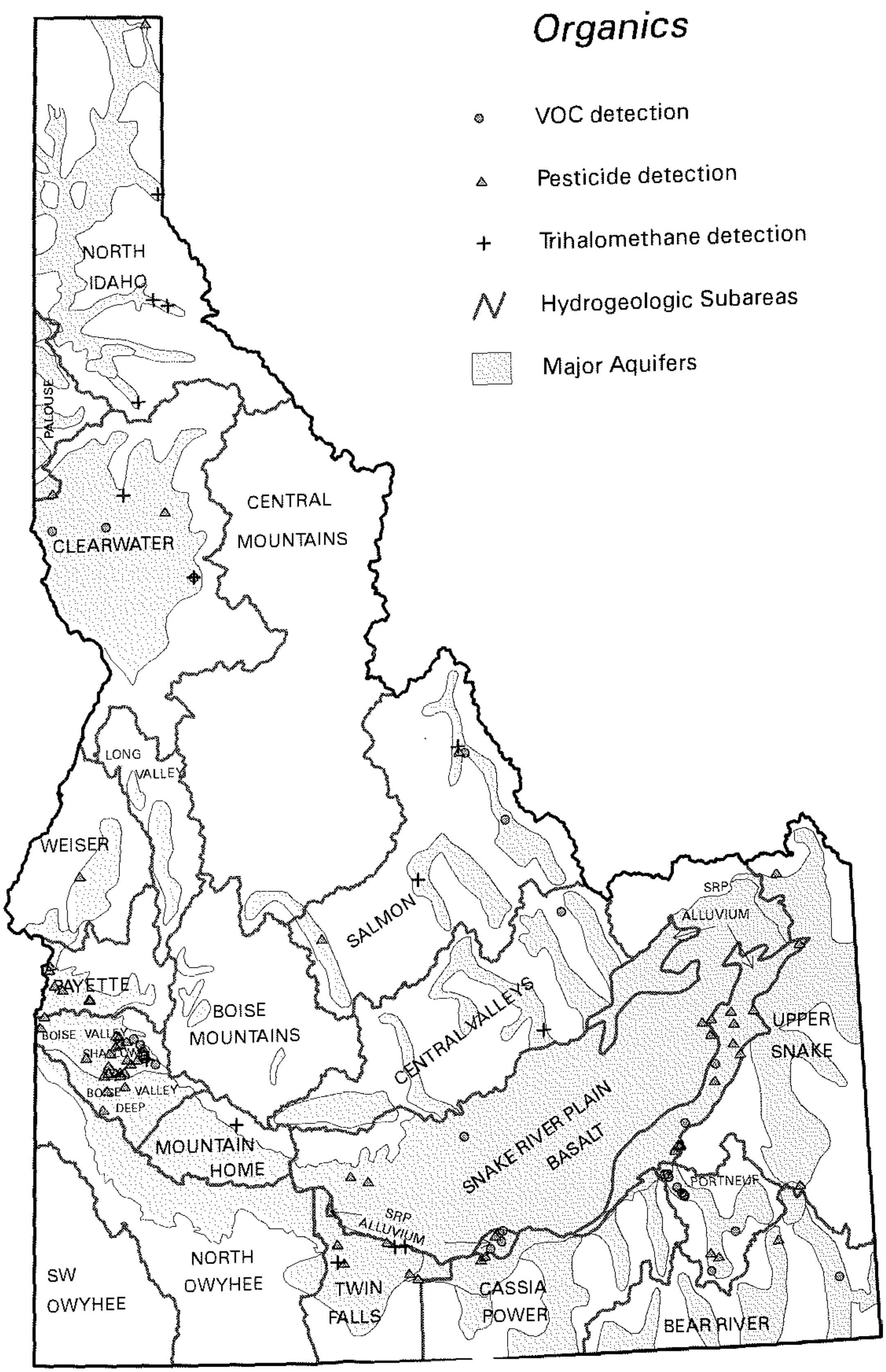

Figure 11. Organics

Table 1. Significant VOC Detections

Volatile Organic Compound	Confirmed Locations	Uses and Significance*
1,2-Dichloropropane (DCP) aka propylene dichloride	west of Eagle; Fort Hall Reservation	Intermediate for perc and carbon tetrachloride; lead scavenger for antiknock fluids; solvents for fats, oils, waxes, gums and resins; solvent mixture for cellulose esters and ethers; scouring compounds; spotting agents; metal degreasing agents; soil fumigant for nematodes. Causes damage to liver. Probable cancer causing.
Ethylene Dibromide (EDB) aka 1,2-dibromoethane	Fort Hall Reservation	Scavenger for lead in gasoline; grain, soil and fruit fumigant; general solvent; waterproofing preparations; organic synthesis; fumigant for tree crops. Major agricultural uses were canceled by 1984. Toxic by inhalation, ingestion and skin absorption. Causes damage to liver, kidney, testes, chromosomes. Causes genetic mutations. Probable cancer causing.
Perchloroethylene (Perc) aka tetrachloroethylene	Blackfoot Garden City Chubbuck Portneuf east of Eagle south of Lava Hot Springs	Dry cleaning solvent; vapor-degreasing solvent; drying agent for metals; vermifuge; heat-transfer medium; manufacture of fluorocarbons. Causes damage to liver, kidney, central nervous system. Probable cancer causing.
Trichloroethylene (TCE)	Portneuf south Pocatello	Metal degreasing; extraction solvent for oils, fats, waxes; solvent dyeing; dry cleaning; refrigerant and heat-exchange liquid; fumigant; cleaning and drying electronic parts; diluent in paints and adhesives; textile processing; chemical intermediate; aerospace operations. Solvent use not permitted in some states. Prohibited in foods, drugs and cosmetics. Causes damage to liver. Probable cancer causing.

* (Lewis, 1993; USEPA, 1991).
(Washington Dept. of Health, 1991).
(USEPA, 1991c).

confirmed at most sites through a special study conducted in 1993 (see Quality Assurance).

Although less populated areas had fewer VOC detections, they were not exempt from VOC contamination (Figure 11). Subareas most affected by VOC contamination were Boise Valley Shallow, Portneuf and the eastern portion of the Snake River Plain Alluvium. The Boise Valley Shallow subarea had the greatest number of different VOCs detected (Appendix C); perc and 1,2-dichloropropane exceeded MCLs at one well each. Sixteen percent of the sites in the Portneuf subarea were affected by VOC contamination, exceeding all other subareas. TCE exceeded MCLs at two wells south of Pocatello. VOC contamination in the Snake River Plain was most serious in the eastern portion with perc exceeding the MCL in Blackfoot, and EDB and DCP (See Pesticides, below) exceeding MCLs in the Fort Hall area. (Table 1 and Appendix C).

Pesticides

Factors affecting ground water contamination from pesticides include pesticide properties, soil properties, site conditions and land management practices (University of Rhode Island, 1991). Conventional laboratory methods for pesticide analyses are prohibitively expensive for the number of sites in the Statewide Program. Three different methods were used to test for the presence of pesticides: VOC analysis, immunoassay and gas chromatography (GC).

Pesticides detected through VOC analysis were: ethylene dibromide (EDB), 1,2-dichloropropane (DCP) and 1,2,3-trichloropropane (Table 1, Appendix C). EDB exceeded the MCL at four sites in the Fort Hall area (Snake River Plain Basalt and Alluvium). DCP exceeded the MCL at 1 site in the Fort Hall area and at 1 site west of Eagle (Boise Valley Shallow).

Immunoassays are enzyme specific tests developed for the medical field. The advantage of using immunoassays instead of GC laboratory methods is that numerous samples can be analyzed using very low detection limits, in short periods of time for little cost. The primary disadvantages are that tests are available for only a few pesticide families and they are not analyte specific. The Statewide Program has utilized immunoassay technology since 1990. The 1990 tests were non-quantitative, providing only "detect" or "non-detect" results. The four sites where detections occurred were resampled the following spring with samples for both immunoassay and GC analyses. Results were quantitative, confirmed the original detections and provided good correlation between GC and immunoassay. Immunoassay tests in 1991 through 1993 were quantitative.

In 1993, with additional funding from IDA, sites in several subareas were simultaneously sampled for pesticides through GC methods. Although two pesticides (for which there were no immunoassay tests available) were detected through GC, the detection limits of the immunoassay methods were so much lower than the GC methods that comparison between the methods was not reliable. Dual sampling, analyses and method comparisons are being continued through annual studies conducted by the IDA (Bahr, 1994). Some of these studies were conducted as follow up to the Statewide Program and have provided a process for verification of pesticide detections.

Pesticides detected through immunoassays and GC in 1993 were: triazines, carbamates, alachlor, dacthal and metribuzin. None of these exceeded MCLs. Triazines (atrazine) was the pesticide most commonly detected through the Statewide Program. The frequency with which triazines were detected was highest in the Boise Valley Shallow, Snake River Plain Basalt, Twin Falls and Payette subareas. Overall, the Payette and Twin Falls subareas were the most affected by pesticide detections (Figure 11).

Bacteria

Fecal coliform bacteria are an indicator of either human or animal fecal waste in the ground water. USGS field crews tested for fecal coliform bacteria at every site sampled.

When a field test produced a positive detection of fecal coliform bacteria at a domestic well, the well owner was notified. Well owners were advised to retest for coliform bacteria through local laboratories certified to conduct Drinking Water Analyses. Confirmation tests were paid for by the Statewide Program.

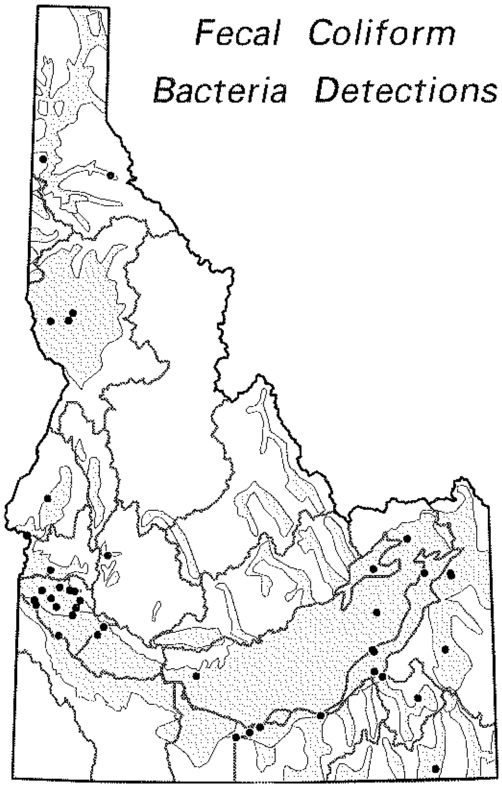

Figure 12. Fecal Coliform Bacteria

Tests showed that fecal coliform bacteria were detected throughout the state (Figure 12), particularly in the Boise Valley Shallow subarea. By comparing the percentage of sites tested where fecal coliform bacteria were detected, the highest occurrences of fecal coliform bacteria were in the Boise Mountains, Weiser, Boise Valley Shallow, Cassia/Power and Payette subareas (Appendix C). Bacteria is a significant ground water quality concern. Because bacteria do not travel far in ground water, this concern is best addressed at the local level.

GROUND WATER QUALITY CONCERNS

Characterization results are considered preliminary until data analysis is complete. Data collected thus far indicate that the majority of Idaho ground water appears to be both potable and safe for current beneficial uses. However, no subarea in Idaho has proven itself to be free of either concerns or the potential for contamination of the ground water.

Ground water quality concerns in Idaho are both natural and human induced. Of 1,165 monitoring sites where samples were collected from 1991 through 1993, 121 (ten percent) exceeded established primary MCLs, not including fecal coliform bacteria. The distribution of those detections is provided in Table 2. More information about the results and significance of selected constituents throughout the state is found in Table 3.

Naturally Occurring Constituents of Concern

To date, ground water quality data from the Statewide Program suggest that naturally occurring constituents elevated to the extent that they may cause health concerns include: fluoride, sulfate, arsenic, uranium and radon.

Fluoride

Elevated fluoride tends to occur in areas with geothermal influence. This program, however, does not sample geothermal wells over 26°Celsius). Health concerns with elevated fluoride involve the risk of skeletal fluorosis, including brittle bones and kidney damage (ATSDR, 1991). Fluoride is dispersed throughout southern Idaho, but concentrations exceeded the primary MCL of 4 mg/l in the Payette, Mountain Home, North Owyhee, Salmon, Bear River and Boise Mountain subareas. Concentrations were as high as 13 mg/l in the Payette subarea.

Sulfate

Although a primary MCL has not been established for sulfate, one has been proposed for 400 to 500 mg/l. Sulfate at higher levels may cause diarrhea, dehydration and gastroenteritis. It may also contribute to the accumulation of mineral salts around organ or duct tissue (USEPA, 1991d). Sulfate can impart a bitter taste to water, and because of that, may limit human exposure to elevated sulfate. However, elevated sulfate **may** have been a contributing factor to illness in dairy cattle at a failed dairy farm in the North Owyhee subarea, where an extremely high sulfate concentration (1900 mg/l) was detected. Sulfate concentrations exceeded 400 mg/l in the North Owyhee, Mountain Home, Bear River, Salmon, Weiser, Snake River Plain Alluvium, Boise Valley Deep, Twin Falls and Cassia/Power subareas.

Arsenic

Elevated arsenic is a concern in some areas of southwest and west-central Idaho. Health effects from arsenic include skin and nerve damage, and cancer (ATSDR, 1989). From 1991 through 1993, the highest arsenic concentration was 240 µg/l in the Weiser subarea. Concentrations of arsenic may fluctuate seasonally (Environmental Health Programs, 1991). Arsenic concentrations exceeded the current primary MCL 50 µg/l in the Weiser, North Owyhee, Boise Valley Shallow, Snake River Plain Alluvium, Mountain Home and Boise Valley Deep subareas.

Uranium

Elevated uranium is of greatest concern in southwest and southcentral Idaho. It occurs sporadically in eastern and central Idaho. A primary MCL of 20 µg/l for uranium has been proposed. The primary health concerns with uranium are kidney damage and bone tumors (USEPA, 1991e). Uranium concentrations exceeded 20 µg/l in 10 of the 20 subareas, but most often in Boise Valley Shallow, Boise Valley Deep and North Owyhee subareas.

Radon

Radon is a Group A carcinogen (known to cause cancer), when inhaled, may cause lung cancer (USEPA, 1991a). The activity level of radon in ground water is not necessarily indicative of the potential for harmful levels of airborne radon activity. A primary MCL of 300 pCi/l for radon has been proposed, but is currently in review. From 1991 through 1993, the highest radon activities

Table 2. Constituent Concentrations that Exceeded Primary MCLs.

Hydrogeologic Subarea	Sites Involved	Constituent	Detections > MCL	Hydrogeologic Subarea	Sites Involved	Constituent	Detections > MCL
North Idaho	4	Cadmium Nitrate	3 1	Salmon	4	Fluoride Nitrate Gross alpha	2 1 1
Palouse	none			Central Valleys	1	Gross alpha	1
Clearwater	1	Nitrate	1	Snake River Plain Alluvium	8	Nitrate EDB* DCP* Benzene Arsenic Gross alpha	6 3 1 1 1 1
Long Valley	none			Snake River Plain Basalt	6	Gross alpha EDB* Perc* Cadmium Nitrate	2 1 1 1 1
Weiser Basin	3	Nitrate Arsenic Gross alpha	2 1 1	Twin Falls	13	Gross alpha Nitrate	10 5
Payette	2	Nitrate Fluoride	1 1	Cassia/Power	2	Nitrate Gross alpha	1 1
Boise Valley, Shallow	27	Gross alpha Nitrate Arsenic Perc* DCP*	23 3 3 1 1	Portneuf	4	TCE* Nitrate Gross alpha	2 1 1
Boise Valley, Deep	21	Gross alpha Nitrate Arsenic	19 3 2	Upper Snake	3	Nitrate Gross alpha	2 1
Mountain Home	5	Nitrate Arsenic Gross alpha Gross beta Fluoride	2 2 2 1 1	Bear River Basin	4	Nitrate Fluoride Gross alpha Gross beta	2 1 1 1
North Owyhee	12	Nitrate Gross alpha Gross beta Arsenic Fluoride	8 4 3 2 2	Boise Mountains	2	Fluoride	2

Perc = Perchloroethylene DCP = 1,2-Dichloropropane
EDB = Ethylene Dibromide TCE = Trichloroethylene

Table 3. Summary of Selected Constituents

CONSTITUENTS WITH PRIMARY MCLS or EQUIVALENT								
Constituent	No. of Samples	No. of Detects	Median	Min (of detects)	Max	MCL {# exceed}	Potential Sources	Significance
INORGANICS								
Arsenic	1161	868	2.0 µg/l	1.0 µg/l	240 µg/l	50 µg/l (under review) {11}	Natural conditions, pesticides, industrial waste. Largest source of intake is food, esp. seafood.	Gastrointestinal problems, changes in nails, abnormal skin thickening or pigment. Skin cancer, nerve damage with long term exposure.
Cadmium	1161	7	<1.0 µg/l	1.0 µg/l	35 µg/l	5 µg/l {4}	Mineral deposits, corrosion of galvanized pipes, industrial/mining waste. More common from food and tobacco.	Accumulative. Causes kidney damage.
Chromium	1159	319	<1 µg/l	1 µg/l	31 µg/l	100 µg/l {0}	Mineral deposits, mine runoff, improper waste disposal from electroplating.	Causes liver and kidney damage, dermatitis and respiratory problems.
Cyanide	1114	4	<0.01 mg/l	0.01 mg/l	0.03 mg/l	0.2 mg/l proposed {0}	Waste from mining, steel, coking and electroplating.	Acutely toxic at high levels.
Fluoride	1162	1091	0.40 mg/l	0.10 mg/l	13.0 mg/l	4.0 mg/l primary {9} 2.0 mg/l secondary {31}	Natural conditions, manufacture of fertilizers, use of fertilizers, intrusion of industrial waste. As it is beneficial at low levels, public water supplies.	Concentrations > 2 mg/l may cause teeth mottling. Higher concentrations over long period may cause crippling skeletal fluorosis in adults.
Lead	1161	78	<1 µg/l	1 µg/l	12.0 µg/l	15 µg/l (Action Level, when taken at tap) {0}	Samples taken prior to inside tap. Natural conditions, lead dust fallout, leaching of soils, urban runoff, municipal, industrial and mining wastes, pipe corrosion.	In young children causes delays in physical, mental development, deficits in attention span, hearing and learning abilities; slight increase in blood pressure in adults.
Nitrate	1151	981	1.1 mg/l	0.05 mg/l	110 mg/l	10 mg/l {40} > 2 mg/l considered elevated {395}	Decaying organic matter, sewage and fertilizers. Encourages growth of algae, producing undesirable taste and odor. Boiling water will not get rid of nitrate.	Concentrations above 10 mg/l can cause illness & death in infants. Symptoms: blueness to skin, shortness of breath.
Selenium	1161	289	<1 µg/l	1 µg/l	150 µg/l	50 µg/l {1}	Natural in soils, feed additive. Elevated due to agricultural practices that concentrate salts at the surface.	Beneficial in trace amounts. Toxic at higher levels: numbness in limbs, gastrointestinal problems, dental damage. May cause cancer.
Sulfate	1162	1154	27.0 µg/l	0.10 µg/l	1900 µg/l	400 mg/l proposed {17} 250 mg/l secondary {36}	Natural conditions, liquid and atmospheric industrial waste.	Can impart bitter taste to water, scale in boilers. At higher levels may cause diarrhea, dehydration, and gastroenteritis.

Constituent	No. of Samples	No. of Detects	Median	Min (of detects)	Max	MCL {# exceed}	Potential Sources	Significance
VOLATILE ORGANIC COMPOUNDS								
1,2-Dichloropropane	1073	6	<0.2 μg/l	0.23 μg/l	19.1 μg/l	5.0 μg/l {2}	Solvent and pesticide.	Damage to liver. Probable cancer causing.
Ethylene Dibromide (EDB)	704	4	<0.2 μg/l	1.4 μg/l	20.2 μg/l	0.05 μg/l {4}	Once common pesticide.	Damage to liver, kidney, testes, chromosomes. Causes genetic mutations. Probable cancer causing.
Trichloroethylene (TCE)	1073	4	<0.2 μg/l	1.7 μg/l	30.0 μg/l	5.0 μg/l {2}	Metal cleaners and dry cleaning fluid.	Damage to liver. Probable cancer causing.
Tetrachloroethylene (Perc or PCE)	1073	14	<0.2 μg/l	0.12 μg/l	15.0 μg/l	5.0 μg/l {1}	Dry cleaning solvents.	Damage to liver, kidney, central nervous system. Probable cancer causing.
RADIONUCLIDES								
Gross Alpha	1163	567 *(at -2s)*	2.4 pCi/l	0.7 ± 0.5 pCi/l *(at -2s)*	83.0 ± 12.6 pCi/l	15 pCi/l {68}	Natural radioactive decay process.	High values may indicate presence of radiation that may cause cancer.
Uranium (238) - *only samples high in gross alpha were analyzed for uranium.*	52	51	-	8 μg/l	110 μg/l	20 μg/l (proposed) {40}	Natural conditions, producing phosphate fertilizers, improper waste disposal	Damage to kidneys most severe effect. Causes cancer, primarily bone tumors.
Gross Beta	1163	1060 *(at -2s)*	4.3 pCi/l	0.8 ± 0.7 pCi/l *(at -2s)*	115 ± 23.9 pCi/l	50 pCi/l {5}	Natural radioactive decay process.	High values may indicate presence of radiation that may cause cancer.
Radon-222	553	547	542 pCi/l	80 pCi/l	5700 pCi/l	300 pCi/l (proposed, but under review) {440}	Product of radioactive decay of Radium 226 through natural process.	Main concern is radon gas in soil entering home as airborne radon, which causes lung cancer. Radon in water may add to airborne radon.
CONSTITUENTS WITH SECONDARY MCLS or EQUIVALENTS								
Chloride	1162	1150	12.0 mg/l	0.10 mg/l	1400 mg/l	250 mg/l {15}	Natural, sewage, industrial wastes, water purification.	Produces undesirable taste in water. Increases corrosiveness of water.
Iron	1161	685	4.0 μg/l	3 μg/l	16000 μg/l	300 μg/l {75}	Natural, industrial wastes, corrosion of pipes, and other equipment.	Essential to life. At higher levels, produces undesirable color and taste, as well as plumbing problems. Iron bacteria.
Manganese	1161	419	<1 μg/l	1 μg/l	2300 μg/l	50 μg/l {162}	Natural. Most often found in acidic waters. Difficult to remove.	Essential to life. At higher levels, produces undesirable staining. Some bacterial problems.
Zinc	1161	1006	22 μg/l	3 μg/l	5900 μg/l	5000 μg/l {1}	Mineral deposits, urban runoff, industrial waste.	Essential to life. At higher levels, produces objectionable taste in water.

detected in Idaho ground water were in the Salmon, North Idaho, Boise Valley Shallow, Upper Snake and Central Valleys subareas. Highest median values were in the Salmon, Upper Snake, Central Valleys and North Idaho subareas.

Human Induced Constituents of Concern

The most significant human-induced ground water contamination were nitrate, organics, trace elements and bacteria.

Nitrate

Elevated nitrate occurs in ground water throughout Idaho, but is of greatest concern in southern Idaho. Nitrate concentrations higher than the primary MCL of 10 mg/l have been known to cause illness and death in infants (USEPA, 1987). Nitrate concentrations exceeded 10 mg/l in 16 of the 20 subareas. The highest percentage of sites that exceeded the MCL were in the North Owyhee, Snake River Plain Alluvium, Weiser and Twin Falls subareas.

Organics

Contamination from VOCs was seen in both urban and rural areas. Elevated organics may cause organ, nervous system and genetic damage and cancer (USEPA, 1991c). The most serious VOC contaminations from 1991 through 1993 data were:

* EDB in the Fort Hall area (eastern Snake River Plain Alluvium and Basalt)
* PERC in Garden City (Boise Valley Shallow and Deep), Blackfoot (eastern Snake River Plain Alluvium) and Chubbuck (Portneuf)
* TCE in South Pocatello (Portneuf)
* DCP near Eagle (Boise Valley Shallow and Deep) and in Fort Hall (eastern Snake River Plain Alluvium)

All sites either have been or are currently being studied by other agencies (EPA, DEQ, IDA and/or county or local government) and private consultants.

Trace Elements

Detectable levels of cadmium were rare; there were only 7 detections in 1161 sites tested for cadmium. Cadmium accumulates in the body causing kidney damage (USEPA, 1991d). Cadmium concentrations exceeded the primary MCL of 5 µg/l at three sites in the valley of the South Fork of the Coeur d'Alene River (North Idaho) and at one site just west of American Falls Reservoir (Snake River Plain Basalt). The former is associated with a Superfund site.

The primary MCL for selenium was increased from 10 µg/l to 50 µg/l in 1992. Selenium concentrations exceeded 10 µg/l in sporadic locations throughout Idaho, but most frequently in the North Owyhee subarea. At higher levels, selenium causes numbness in limbs, gastrointestinal problems and dental damage (USEPA, 1991d). The concentration of selenium exceeded 50 µg/l at one well near Bruneau (North Owyhee).

Bacteria

Fecal coliform bacteria are an indicator of either human or animal fecal waste, which can contribute pathogens to the ground water. Contamination with bacteria is among the most threatening to ground water because the potential health effects are both serious and immediate. The highest percentage of fecal coliform bacteria detections were in the Boise Mountains (low number of samples), Weiser, Boise Valley Shallow, Cassia/Power and Payette subareas.

FUTURE PLANS

An additional 370 sites were sampled in 1994 and will be added to the network when all data is received from laboratories performing the analyses. In 1995, sites will be added as needed to complete the first phase of the program, which is to establish a network to characterize the ground water quality of the state's aquifers. During 1995, analysis will begin in greater depth, evaluating results within each hydrogeologic subarea. One or more comprehensive reports will be issued, specifically addressing the objectives of characterizing the ground water quality and identifying potential problem areas.

Establishing ambient ground water quality through characterization will lay the foundation for the third objective, which is to identify trends and changes in the ground water quality of the state's aquifers. Trend monitoring activities began with a workshop in the fall of 1994. The workshop attendees recommended that trend monitoring encompass both temporal and spatial aspects, as well as identifying areas needing additional study. Another important recommendation from the workshop was to form a trend monitoring advisory committee, which is currently developing the details of the trend monitoring network design. Committee representation includes IDWR, DEQ, IDA, USGS and the Idaho National Engineering Laboratory (INEL) Oversight Program. Through the committee, the Statewide Program is able to tap into both state and national expertise.

Sample collection for trend monitoring will begin in the 1995 field season. Characterization of ground water quality and identification of potential problem areas will continue as the trend monitoring phase is implemented.

SUMMARY

With the development of the Idaho Ground Water Quality Plan, the state goal is to "protect ground water quality for use by the public", by outlining specific policies and implementation strategies. The Plan emphasized the importance of prevention, protection, education, monitoring, remediation and communication of results and information.

The Statewide Program is one key element of the Plan for achieving these goals. By the end of June, 1994, 1,165 monitoring sites were sampled and analyzed, towards a final goal of approximately 1,600 network monitoring sites. To date, adequate data have been gathered to analyze current progress in network design and ambient ground water quality, to identify possible areas of ground water quality concern and to develop tentative conclusions about the ambient ground water quality. The network should be complete by the end of 1995, followed by comprehensive interpretation and reporting. Trend monitoring, which is a major component of the program, will begin in 1995.

Results so far indicate that ground water quality in Idaho is generally acceptable for use as drinking water. Most of the water quality concerns occur in a crescent-shaped swath from the Weiser subarea, across the Snake River Plain and south through the Portneuf subarea. Health concerns with natural ground water chemistry are associated with arsenic, uranium and possibly sulfate in southwest Idaho, and fluoride primarily in the central mountains, but also in areas across southwest and southeast Idaho. Airborne radon is a potential health threat in Idaho, but ground water does not appear to be the primary source. Aesthetic concerns (taste, odor, staining, etc.) with natural ground water chemistry include: total dissolved solids across southern Idaho (including sulfate, chloride, sodium), iron and manganese in various areas and fluoride in areas influenced by geothermal water.

The greatest health concerns from human-induced contaminants are nitrate, organics (VOCs and pesticides), trace elements and bacteria. Nitrate impacted three subareas most severely: North Owyhee, Twin Falls, and Boise Valley Shallow. The greatest impact from organics was seen in subareas with either substantial industrial or agricultural commerce: Portneuf, Boise Valley Shallow and the southern and eastern portion of the Snake River Plain Alluvium.

One of the primary objectives of the Idaho Ground Water Quality Plan is to *maintain the existing high quality of the state's ground water and satisfy existing and projected future beneficial uses...* As the results of the Statewide Program portray, not all ground water quality concerns in Idaho are human-induced. However, the majority of Idaho ground water contamination has been caused by human activity.

GLOSSARY

Alluvium-Sediments laid down by physical processes in river channels, floodplains, and fans at the foot of mountain slopes.

Ambient-The Idaho Ground Water Quality Plan defines *ambient* as 'the water quality at a specific location at the time sampled'. As data does not exist to determine **natural** background water quality prior to human impact, the characterization objective of the Statewide Program will determine **ambient** ground water quality.

Aquifer-Any body of porous saturated material, such as rock, sand, gravel, etc., capable of transmitting ground water and yielding economically significant quantities of water to wells and springs.

Basalt-A fine grained igneous extrusive volcanic rock, commonly dark in color and composed mainly of minerals rich in magnesium and iron.

Boxplot-Boxplots are statistical graphs, providing information on data median, variation (interquartile range), skewness and anomalous values. Refer to the 'Total Dissolved Solids' discussion.

Common Ions-Commonly occurring charged atom or group of atoms. Examples are calcium, magnesium, chloride and sulfate.

Contaminant-Any chemical, ion, radionuclide, synthetic organic compound, microorganism, waste or other substance which does not occur naturally in ground water or which naturally occurs at a lower concentration.

Contamination-The direct or indirect introduction into ground water of any contaminant caused in whole or in part by human activities.

Detections-(or Detects, Table 3). *Detections* are sample analysis results where concentrations were greater than the laboratory detection limit for that constituent. *Non-detects* (<n) have undetermined concentrations less than detection limit *n*.

Drinking Water Standard-Drinking water standards are established by the EPA and have been adopted as Idaho State Standards for public drinking water by DEQ. In the Statewide Program they serve as a basis for appraising water quality. The standards consist of a *maximum contaminant level* (MCL) established for each constituent listed. *Primary* MCLs are established to protect against adverse health effects and are enforceable on public drinking water supplies. *Secondary* MCLs are established for aesthetic reasons such as taste, color or odor and are not enforceable on public drinking water supplies. An *action level* for selected constituents triggers the need for water or distribution treatment after the concentration of a percentage of samples exceeds the action level.

Elevated-Constituents other than nitrate that exceed 50 percent of an MCL, but less than the MCL. Nitrate levels above 20 percent are considered elevated (See Nitrate discussion).

Gross Alpha-Radioactivity given off as alpha particles during the radioactive decay process. Gross alpha is measured in *picocuries* per liter (pCi/l).

Gross Beta-Radioactivity given off as beta particles during the radioactive decay process. Gross beta is measured in *picocuries* per liter (pCi/l).

Ground Water-Any water of the state which occurs beneath the surface of the earth in a saturated geological formation of rock or soil.

Hardness-A measurement of ground water chemistry, calculated from calcium and magnesium concentrations *[(calcium times 2.5) plus (magnesium times 4.1)]*. Hardness is sometimes measured in *grains*. One grain of hardness per gallon is equal to 17.1 mg/l.

Hydrogeologic Subareas-Geologically similar units derived from previously defined Idaho ground water basins. These units are the primary basis for analysis of ground water quality data from the Statewide Program. Refer to *Idaho Statewide Ground Water Quality Monitoring Program Network Design* (Neely, 1994).

Immunoassay-An enzyme based field screening technique for detecting pesticides and other compounds in water and soil.

Impacted-A constituent with an elevated concentration, not naturally occurring and directly related to human activities.

MCL (Maximum Contaminant Level)-See *Drinking Water Standards*.

Mean-The average of all data results.

Median-The middle value (or average of the two middle values) when all results are arranged in ascending order. This is also called the 50th percentile, or the .5 quartile/quantile.

Micrograms per liter (ìg/l)-Unit of measurement equivalent to parts per billion.

Milligrams per liter (mg/l)-Unit of measurement equivalent to parts per million.

Monitoring Site-A specific point or location where air, water or soil samples are collected for analysis. In this study, monitoring sites are wells and springs.

Nitrate-A naturally occurring inorganic ion which can be generated by animal or human wastes, fertilizers, etc. In this study, nitrate refers to the concentration of nitrite plus nitrate ($NO^2 + NO^3$).

Pesticide-any substance or mixture of substances intended to: 1) prevent, destroy, repel, or mitigate any pest, and 2) use as a plant growth regulator, defoliant or desiccant. Insecticides, herbicides, fungicides, rodenticides, fumigants, disinfectants and plant growth regulators are all identified as pesticides.

Picocurie (pCi)-A unit of radioactivity. One picocurie equals 2.22 disintegrations per minute.

Radon-A naturally occurring radioactive gas that originates from decay of radium-226. Radon is measured in picocuries per liter (pCi/l).

Speciation-Laboratory analysis performed to further determine specific analytes present in a sample.

Subarea-See *Hydrogeologic Subareas.*

Total Dissolved Solids (TDS)-the total amount of solids left when a filtered ground water sample is evaporated to dryness (Drever). Statewide Program TDS results are calculated from the total major ions (mg/l): [(alkalinity * 0.6) + calcium + magnesium + sodium + potassium + chloride + sulfate + fluoride + silica + nitrate].

Trace Elements-Elements present in minor amounts in the earth's crust. Includes elements such as arsenic, cadmium, chromium, iron, lead, manganese, mercury, selenium, zinc and others.

Volatile Organic Compounds-Synthetic organic compounds with a tendency to volatilize (pass into the gaseous state) readily.

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APPENDIX A -
Data Storage and Availability

Statewide Program data is available through the Environmental Data Management System (EDMS), a public access database for ground water quality and surface water quality data. (EDMS is a receptacle for all Idaho water quality data; Statewide Program data only may be specified).

Data may be obtained for the entire state, by county, by latitude and longitude or by township and range. Lab analyses for approximately 35,000 samples covering a 50 year period are available from a number of contributing organizations. At present, there are more than 600,000 analytical results with more being added regularly. Inventory information exists on approximately 19,000 wells.

Access to EDMS is available through a dedicated workstation at IDWR, by modem, or in the near future, Internet. A state-of-the-art query generator and report writer are available to the EDMS user. A comprehensive user manual is provided to new accounts.

To request more information about EDMS or to get an account, contact:

EDMS
Idaho Department of Water Resources
1301 N. Orchard
Boise, ID 83706

Phone: 208-327-7900

APPENDIX B -

Constituent Listings

APPENDIX B - CONSTITUENT LISTS
Field Parameters, Common Ions, Nutrients, Trace Elements, Radioactivity

Method and detection limits were constant for all years, 1990 through 1993. Although 1990 data is available, it is not used for statistical analysis due to subjective selection of wells for that prototype year. All lab analyses for the following were performed at the USGS National Water Quality Lab with the exception of Gross Alpha and Gross Beta (State Lab), and Uranium (private lab). Method numbers are USGS, unless otherwise specified.

Constituent	Method	Detection Limit
FIELD PARAMETERS		
Temperature	nearest 0.5°C	
Specific Conductance	portable	1 μmho/cm3
pH	portable	0.1 units
Fecal Coliform Bacteria	incubation	1 colony
Bicarbonate	titration	1 mg/l
Carbonate	titration	1 mg/l
Alkalinity (field)	calculated	1 mg/l
COMMON IONS, dissolved		
Calcium	I115285	0.1 mg/l
Magnesium	I144785	0.1 mg/l
Potassium	I163085	0.1 mg/l
Sodium	I173585	0.1 mg/l
Alkalinity	I203085	1 mg/l
Sulfate	I205785	0.1 mg/l
Chloride	I205785	0.1 mg/l
Fluoride	I232778	0.1 mg/l
Silica	I270085	0.1 mg/l
Total Dissolved Solids	calculated	-
NUTRIENTS, dissolved		
Nitrate	I254590	0.05 mg/l
Nitrite	I254090	0.01 mg/l
Ammonia	I252290	0.01 mg/l
Orthophosphorus	I260190	0.01 mg/l

Constituent	Method	Detection Limit
TRACE ELEMENTS, dissolved		
Arsenic	I206285	1 μg/l
Cadmium	I213889	1 μg/l
Chromium	I123393	1 μg/l
Copper	I227489	1 μg/l
Iron	I138185	3 μg/l
Lead	I240389	1 μg/l
Manganese	I145485	1 μg/l
Mercury	I246285	0.1 μg/l
Selenium	I266785	1 μg/l
Zinc	I190085	3 μg/l
Cyanide	I232085	0.01 mg/l
RADIOACTIVITY		
Gross Alpha	EPA 401	-
Gross Beta	EPA 401	-
Radon 222	liquid scintilation	-
Uranium	EPA 908.0	5 μg/l

APPENDIX B - CONSTITUENT LISTS - Volatile Organic Compounds

VOLATILE ORGANIC COMPOUND	1990[a] Detection Limit	1991[a] Detection Limit	1992[b] Detection Limit	1993[c] Detection Limit
Benzene	0.10 µg/l	0.10 µg/l	0.2 µg/l	0.5 µg/l
Bromobenzene	0.14 µg/l	0.14 µg/l	-	0.5 µg/l
Bromochloromethane	0.01 µg/l	0.01 µg/l	-	0.5 µg/l
Bromodichloromethane (THM)	0.16 µg/l	0.16 µg/l	0.2 µg/l	0.5 µg/l
Bromoform (THM)	0.20 µg/l	0.20 µg/l	0.2 µg/l	0.5 µg/l
Bromomethane	0.19 µg/l	0.19 µg/l	-	0.5 µg/l
n_Butylbenzene	0.14 µg/l	0.14 µg/l	-	0.5 µg/l
sec_Butylbenzene	0.16 µg/l	0.16 µg/l	-	0.5 µg/l
tert_Butylbenezene	0.16 µg/l	0.16 µg/l	-	0.5 µg/l
Carbon Tetrachloride	0.17 µg/l	0.17 µg/l	0.2 µg/l	0.5 µg/l
Chlorobenzene	0.09 µg/l	0.09 µg/l	0.2 µg/l	0.5 µg/l
Chloroethane	0.13 µg/l	0.13 µg/l	-	0.5 µg/l
Chloroform (THM)	0.10 µg/l	0.10 µg/l	0.2 µg/l	0.5 µg/l
Chloromethane	0.1 µg/l	0.1 µg/l	-	0.5 µg/l
ortho-Chlorotoluene	0.04 µg/l	0.04 µg/l	-	0.5 µg/l
para-Chlorotoluene	0.07 µg/l	0.07 µg/l	-	0.5 µg/l
Dibromochloromethane (THM)	0.11 µg/l	0.11 µg/l	0.2 µg/l	0.5 µg/l
Dibromomethane	0.07 µg/l	0.07 µg/l	-	0.5 µg/l
1,2-Dibromo-3-Chloropropane (DBCP)	0.2 µg/l	0.2 µg/l	-	0.5 µg/l
1,2-Dichlorobenzene (ortho)	0.17 µg/l	0.17 µg/l	0.2 µg/l	0.5 µg/l
1,3-Dichlorobenzene (meta)	0.19 µg/l	0.19 µg/l	0.2 µg/l	0.5 µg/l
1,4-Dichlorobenzene (para)	0.21 µg/l	0.21 µg/l	0.2 µg/l	0.5 µg/l
Dichlorodifluoromethane (freon)	0.29 µg/l	0.29 µg/l	0.2 µg/l	0.5 µg/l
1,1-Dichloroethane	0.12 µg/l	0.12 µg/l	0.2 µg/l	0.5 µg/l
1,1-Dichloroethene	0.26 µg/l	0.26 µg/l	0.2 µg/l	0.5 µg/l
1,2-Dichloroethane	0.12 µg/l	0.12 µg/l	0.2 µg/l	0.5 µg/l
cis-1,2-Dichloroethene	0.05 µg/l	0.05 µg/l	0.2 µg/l	0.5 µg/l
trans-1,2-Dichloroethene	0.17 µg/l	0.17 µg/l	0.2 µg/l	0.5 µg/l
1,1-Dichloropropene	0.05 µg/l	0.05 µg/l	-	0.5 µg/l
1,2-Dichloropropane	0.12 µg/l	0.12 µg/l	0.2 µg/l	0.5 µg/l

[a] State Health Lab, EPA method 502.2. [b] USGS National Water Quality Lab, USGS equivalent to EPA method 524.2.
[c] Alpha Analytical, Inc., EPA method 524.2.

VOLATILE ORGANIC COMPOUND	1990[a] Detection Limit	1991[a] Detection Limit	1992[b] Detection Limit	1993[c] Detection Limit
1,3-Dichloropropane	0.02 μg/l	0.02 μg/l	-	0.5 μg/l
cis-1,3-Dichloropropene	0.15 μg/l	0.15 μg/l	-	0.5 μg/l
trans-1,3-Dichloropropene	0.20 μg/l	0.20 μg/l	-	0.5 μg/l
2,2-Dichloropropane	0.2 μg/l	0.2 μg/l	-	0.5 μg/l
Ethylbenzene	0.09 μg/l	0.09 μg/l	0.2 μg/l	0.5 μg/l
Ethylene Dibromide (EDB)	0.17 μg/l	0.17 μg/l	0.2 μg/l	0.2 μg/l
Hexachlorobutadiene	0.09 μg/l	0.09 μg/l	-	0.5 μg/l
Isopropylbenzene	0.14 μg/l	0.14 μg/l	-	0.5 μg/l
para-Isopropyltoluene	0.13 μg/l	0.13 μg/l	-	0.5 μg/l
Methylene Chloride	0.14 μg/l	0.14 μg/l	0.2 μg/l	0.5 μg/l
Napthalene	0.05 μg/l	0.05 μg/l	-	0.5 μg/l
n_Propylbenzene	0.15 μg/l	0.15 μg/l	-	0.5 μg/l
Styrene	0.08 μg/l	0.08 μg/l	0.2 μg/l	0.5 μg/l
Tetrachloroethene (Perc)	0.31 μg/l	0.31 μg/l	0.2 μg/l	0.5 μg/l
1,1,1,2-Tetrachloroethane	0.2 μg/l	0.2 μg/l	-	0.5 μg/l
1,1,2,2-Tetrachloroethane	0.28 μg/l	0.28 μg/l	-	0.5 μg/l
Toluene	0.05 μg/l	0.05 μg/l	0.2 μg/l	0.5 μg/l
1,2,3-Trichlorobenzene	0.06 μg/l	0.06 μg/l	-	0.5 μg/l
1,2,4-Trichlorobenzene	0.08 μg/l	0.08 μg/l	-	0.5 μg/l
Trichloroethene (TCE)	0.16 μg/l	0.16 μg/l	0.2 μg/l	0.5 μg/l
1,1,1-Trichloroethane	0.12 μg/l	0.12 μg/l	0.2 μg/l	0.5 μg/l
1,1,2-Trichloroethane	0.04 μg/l	0.04 μg/l	-	0.5 μg/l
Trichlorofluoromethane	0.34 μg/l	0.34 μg/l	0.2 μg/l	0.5 μg/l
1,2,3-Trichloropropane	0.02 μg/l	0.02 μg/l	-	0.5 μg/l
Trichlorotrifluoroethane (freon 113)	-	-	0.5 μg/l	0.5 μg/l
1,2,4-Trimethylbenzene	0.10 μg/l	0.10 μg/l	-	0.5 μg/l
1,3,5-Trimethylbenzene	0.11 μg/l	0.11 μg/l	-	0.5 μg/l
Vinyl Chloride	0.52 μg/l	0.52 μg/l	0.2 μg/l	0.5 μg/l
total Xylenes (Dimethylbenzene)	-	-	0.2 μg/l	0.5 μg/l
meta- & para-Xylene	0.22 μg/l	0.22 μg/l	-	-
ortho-Xylene	0.11 μg/l	0.11 μg/l	-	-

[a] State Health Lab, EPA method 502.2. [b] USGS National Water Quality Lab, USGS equivalent to EPA method 524.2.
[c] Alpha Analytical, Inc., EPA method 524.2.

APPENDIX B - CONSTITUENT LISTS
Pesticides by Immunoassay

1990 samples were non-quantitative, but followup sampling was done on detections with simultaneous GC analysis. 1990 and 1991 samples were performed in the USGS district lab. 1992 and 1993 samples were performed in the IDWR lab. Immunoassays are not analyte specific and the detection limit (least detectable dose, LDD) varies for each analyte. For example, the atrazine test is capable of detecting 11 different triazine compounds, each at a different LDD. Atrazine and propazine have the lowest LDDs (0.046 and 0.033 $\mu g/l$), but all 11 compounds have LDDs at or below 1.1 ppb.

PESTICIDE	1990	1991	1992	1993
2,4-D	all sites	all sites	all sites	all sites
Alachlor	-	all sites	-	all sites
Aldicarb	all sites	all sites	all sites	all sites
Atrazine	all sites	all sites	all sites	all sites
Carbofuran	-	-	-	all sites
Cyanazine	-	-	-	selected areas
Metholachlor	-	-	-	all sites

1992 and 1993 data are available in electronic format, but are not available in EDMS as immunoassay results are not analyte specific.

APPENDIX B - CONSTITUENT LISTS
Pesticides by Gas Chromatography

Through IDA funding, GC analyses were performed in 1993 on samples from selected subareas: All methods below for all wells in the Twin Falls and Shallow Boise Valley subareas; method 507 only for all wells in the Payette subarea and all shallow wells in the eastern Snake River Plain. Samples were extracted and analyzed by the State Lab.

PESTICIDE	EPA METHOD	DETECTION LIMIT (μg/l)
2,4-D	515.1	<0.2
Alachlor	507	<0.4
Aldicarb	531.1	<1.0
Atrazine	507	<0.2
Bromacil	507	<2.5
Carbofurn	531.1	<1.5
Dacthal	515.1	<0.2
Dicamba	515.1	<0.1
Diclofop	508	<1.0
Disulfoton	507	<0.3
EPTC	507	<0.3
Ethoprop	507	<0.2
Ethyl Parathion	8141	<0.2
Fonofos	507	<0.4
Lindane	508	<0.1
Methoxychlor	508	<0.1
Metolachlor	507	<0.8
Metribuzin	507	<0.2
PCP	515.5	<0.1
Pentachlorphenol	515.1	<0.2
Phorate	8141	<0.1
Picloram	515.1	<0.2
Terbufos	507	<0.5
Toxaphene	508	<1.0
Triallate	508	<0.2
Trifluralin	508	<0.1

APPENDIX C -

Data Statistical Tables

Idaho Statewide Ground Water Quality Monitoring Program
Hydrogeologic Subareas - Well Summary
1991 through 1993

Hydrogeologic Subarea	Number of Sites	Range of Well Depths (feet)	Major Lithologies
North Idaho	110	38 to 651	pleistocene alluvium and glacial outwash miocene Columbia River Basalt precambrian shield rock
Palouse	29	52 to 667	miocene Columbia River basalt cretaceous granite and granodiorite
Clearwater	55	70 to 758	miocene Columbia River basalt
Long Valley	18	34 to 610	quaternary and pleistocene alluviums glacial outwash
Weiser	23	25 to 398	miocene Columbia River basalt quaternary and/or pleistocene sediments
Payette	31	25 to 392	quaternary, holocene and pleistocene alluvium holocene terrace gravels pleistocene Idaho Group
Boise Valley Shallow	108	29 to 248	quaternary, holocene and pleistocene alluvium holocene and pleistocene terrace gravels a few quaternary Snake River Group
Boise Valley Deep	111	87 to 1000	pleistocene Idaho Group a few from Snake River Group
Mountain Home	36	19 to 1190	pleistocene Bruneau Formation some pleistocene Glenn's Ferry Formation and quaternary alluvium
North Owyhee	27	94 to 735	pleistocene Idaho Group, including the Glenn's Ferry and Bruneau Formations
Salmon	33	34 to 1020	quaternary alluvium
Central Valleys	39	34 to 490	quaternary and holocene alluvium

Hydrogeologic Subarea	Number of Sites	Range of Well Depths (feet)	Major Lithologies
Snake River Plain Alluvium	67	21 to 400	quaternary alluvium some contribution from holocene and pleistocene alluvium
Snake River Plain Basalt	198	45 to 1115	quaternary Snake River Plain basalt
Twin Falls	69	62 to 1285	pliocene Banbury basalt some Snake Plain basalt pleistocene Glenn's Ferry Formation
Cassia/Power	52	48 to 1210	quaternary and pleistocene alluvium Snake River Plain basalt niscellaneous pleistocene sediments and pliocene volcanics
Portneuf	51	48 to 360	pleistocene alluvium and pliocene Salt Lake Formation
Upper Snake	54	14 to 975	quaternary alluvium pleistocene volcanics, basalt and tuff
Bear River	43	38 to 485	quaternary and pleistocene alluvium minor pleistocene Salt Lake Formation
Boise Mountains	11	68 to 275	upper cretaceous Idaho batholith (granite) some alluvium, both quaternary and pleistocene
Total	1165	14 to 1285	

Idaho Statewide Ground Water Quality Monitoring Program
Hydrogeologic Subareas - Field Parameters and Cation Summary
1991 through 1993

Hydrogeologic Subarea	Specific Conductance range median	pH range median	Temperature °C range median	Fecal Coliform Bacteria # detects percent	Hardness mg/l range median	Calcium mg/l range median	Magnesium mg/l range median	Sodium mg/l range median	Potassium mg/l range median
North Idaho	23 to 821 234	6.0 to 8.5 7.5	6.5 to 16.2 9.4	2 2%	7 to 394 98	2.2 to 120 24.5	0.37 to 37 7.45	1.4 to 41 5.35	0.3 to 6.7 1.6
Palouse	93 to 416 263	6.5 to 8.4 7.5	8.2 to 23.3 11.8	0 0%	41 to 171 92	8.0 to 42 22	3.7 to 18 8.8	5.6 to 50 14	0.7 to 7.0 2.2
Clearwater	78 to 710 291	5.5 to 9.6 7.6	7.6 to 20.0 12.6	3 5%	8 to 260 100	3.0 to 58 22	0.09 to 33 10	3.4 to 130 16	0.1 to 8.9 2.4
Long Valley	46 to 370 145	5.9 to 8.7 7.3	8.5 to 19.5 10.2	0 0%	8 to 60 25	2.2 to 16 6.7	0.32 to 5.6 1.3	4.1 to 57 16	0.4 to 6.3 1.1
Weiser	119 to 2351 305	6.7 to 8.6 7.4	11.8 to 19.1 14.6	2 9%	28 to 577 95	10 to 170 26	0.91 to 42 7.1	5.6 to 340 29	0.5 to 43 4.3
Payette	159 to 1005 552	6.9 to 9.2 7.5	13.0 to 25.0 15.9	2 6%	7 to 277 138	2.6 to 75 37	0.08 to 25 11	9.0 to 190 48	0.4 to 16 2.7
Boise Valley Shallow	111 to 1532 585	6.4 to 8.6 7.6	11.0 to 24.9 14.6	7 7%	28 to 417 187.5	9.2 to 100 48	1.3 to 48 15	5.7 to 170 46	0.6 to 13 2.7
Boise Valley Deep	119 to 2030 409	6.9 to 8.7 7.8	12.9 to 26.2 17.8	5 4.5%	22 to 720 127	8.3 to 160 38	0.38 to 90 7.4	7.9 to 180 44	0.8 to 29 2.9
Mountain Home	45 to 3226 247	6.5 to 8.5 7.8	12.1 to 23.9 17.55	2 5%	11 to 572 73.5	3.1 to 150 21.5	0.78 to 76 5.85	2.9 to 550 19	0.7 to 30 4.2
North Owyhee	217 to 5050 844	6.9 to 8.8 7.6	13.5 to 24.4 18.4	0 0%	57 to 2531 293	20 to 420 81	1.2 to 360 23	13 to 790 82	2.6 to 70 11
Salmon	44 to 2244 350	6.3 to 9.7 7.45	5.7 to 15.4 10.5	0 0%	14 to 1000 117	4.5 to 300 33	0.22 to 65 12	1.7 to 180 11	0.3 to 16 1.4
Central Valleys	115 to 1062 322	6.6 to 8.4 7.7	5.6 to 21.0 10.3	0 0%	39 to 453 156	9.2 to 99 42	4.0 to 50 11	2.7 to 59 7.6	0.4 to 8.6 1.0
Snake River Plain Alluvium	181 to 2090 526	7.0 to 8.3 7.7	9.0 to 20.9 12.4	1 2%	56 to 929 235	15 to 250 66	4.5 to 74 16	5.1 to 270 16	1.3 to 16 3.4

Hydrogeologic Subarea	Specific Conductance range median	pH range median	Temperature °C range median	Fecal Coliform Bacteria # detects percent	Hardness mg/l range median	Calcium mg/l range median	Magnesium mg/l range median	Sodium mg/l range median	Potassium mg/l range median
Snake River Plain Basalt	187 to 1355 469	6.7 to 8.4 7.8	7.8 to 19.3 13.0	7 4%	76 to 481 194.5	19 to 130 52	5.9 to 38 16	5.7 to 140 17	1.3 to 16 3.4
Twin Falls	208 to 1978 894	7.3 to 10.4 7.7	11.8 to 25.6 15.0	1 1%	0.4 to 665 317	0.12 to 180 71.5	0.02 to 95 32	8.7 to 190 62.5	0.2 to 18 5.3
Cassia/Power	222 to 3830 641.5	6.7 to 8.2 7.6	5.9 to 25.2 14.0	3 6%	76 to 1145 245	24 to 320 66	3.9 to 84 17.5	7.2 to 290 24.5	1.2 to 15 6.7
Portneuf	312 to 1750 790	6.8 to 8.0 7.5	8.0 to 24.0 12.6	2 4%	74 to 709 318	20 to 190 77	5.8 to 100 30	6.4 to 190 31	0.5 to 35 5.7
Upper Snake	71 to 1040 373	6.8 to 8.9 7.6	6.0 to 23.3 9.35	3 5%	11 to 473 163.5	2.6 to 130 47	1.2 to 46 12	1.6 to 170 8.75	0.5 to 5.7 1.8
Bear River	385 to 5520 757	6.2 to 8.1 7.5	7.9 to 18.8 10.8	1 2%	30 to 2361 318	11 to 600 78	0.70 to 210 29	3.6 to 460 32	<0.10 to 71 4.2
Boise Mountains	82 to 312 198	6.5 to 8.8 7.6	8.3 to 20.6 13.6	1 10%	3 to 71 26	0.97 to 20 91	0.10 to 5.9 1.6	4.9 to 55 13	0.5 to 4.0 1.2
Overall	23 to 5520 447	5.5 to 10.4 7.65	5.6 to 26.2 13.4	42 4%	0.4 to 2531 176	0.12 to 600 46	0.02 to 360 14	1.4 to 790 21	<0.10 to 71 3.1

Idaho Statewide Ground Water Quality Monitoring Program
Hydrogeologic Subareas - Anion and TDS Summary
1991 through 1993

Hydrogeologic Subarea	Bicarbonate (mg/l) range median	Carbonate (mg/l) range median	Alkalinity (mg/l) range median	Sulfate (mg/l) range median	Chloride (mg/l) range median	Fluoride (mg/l) range median	Silica (mg/l) range median	Total Dissolved Solids (mg/l) range median
North Idaho	15 to 440 141	0	13 to 361 115.5	<0.1 to 120 6.3	<0.10 to 13 1.05	<0.1 to 0.9 0.1	6.8 to 55 18	24 to 510 158.5
Palouse	52 to 231 157	0 to 3 0	43 to 189 129	0.9 to 28 5.2	0.4 to 12 2.1	0.1 to 1.4 0.3	9.2 to 62 45	60 to 260 192.5
Clearwater	45 to 380 169.5	0 to 27 0	37 to 311 139	0.1 to 140 8.5	0.1 to 67 1.4	<0.1 to 2.0 0.3	0.2 to 71 48	73 to 434 209
Long Valley	25 to 123 70	0 to 4 0	21 to 101 58	<0.1 to 88 3	<0.10 to 12 0.9	<0.1 to 2.7 0.2	19 to 60 42.5	52 to 260 116.5
Weiser	76 to 1004 161	0	63 to 823 132	0.7 to 630 31	0.4 to 130 5.4	<0.1 to 2.4 0.3	30 to 65 56	121 to 1463 227
Payette	80 to 630 277	0 to 14 0	74 to 516 227	0.4 to 130 22	0.7 to 43 7.7	0.2 to 13 0.5	16 to 74 43	107 to 645 364
Boise Valley Shallow	63 to 497 269	0 to 1 0	52 to 407 221	<0.1 to 280 43.5	0.2 to 170 11	0.1 to 1.6 0.5	16 to 73 41.5	82 to 956 384
Boise Valley Deep	61 to 394 167	0 to 4 0	50 to 323 137	<0.1 to 570 45	0.4 to 180 14	<0.1 to 2.1 0.4	17 to 83 38	88 to 1370 280
Mountain Home	15 to 714 120	0 to 2 0	12 to 585 99	0.6 to 1100 19.5	0.7 to 180 10.05	<0.1 to 7.8 0.35	14 to 72 45.5	51 to 2455 182
North Owyhee	95 to 632 247	0 to 6 0	79 to 518 202	21 to 1900 210	3.9 to 560 31	0.2 to 6.1 0.6	29 to 78 59	191 to 3931 586
Salmon	29 to 441 183	0 to 28 0	24 to 361 150	0.6 to 760 20	0.3 to 250 7.5	<0.1 to 11 0.2	6.5 to 47 20	44 to 943 201.5
Central Valleys	68 to 312 178	0	55 to 256 146	0.2 to 82 18	0.4 to 130 4.1	<0.1 to 2.3 0.2	2.7 to 72 15	91 to 598 190.5
Snake River Plain Alluvium	65 to 606 237	0	53 to 497 195	<0.1 to 620 43	3.3 to 350 15	<0.1 to 1.7 0.4	12 to 60 30	141 to 1873 307

Hydrogeologic Subarea	Bicarbonate (mg/l) range median	Carbonate (mg/l) range median	Alkalinity (mg/l) range median	Sulfate (mg/l) range median	Chloride (mg/l) range median	Fluoride (mg/l) range median	Silica (mg/l) range median	Total Dissolved Solids (mg/l) range median
Snake River Plain Basalt	52 to 476 208	0 to 3 0	43 to 390 170.5	0.9 to 150 38.5	1.7 to 140 19	<0.1 to 3.7 0.4	14 to 60 32	138 to 862 299
Twin Falls	0 to 449 321	0 to 40 0	63 to 368 263	8.3 to 460 110	7.4 to 230 44.5	<0.1 to 3.0 0.7	6.5 to 71 51	140 to 1206 592
Cassia/Power	108 to 464 228	0	89 to 380 187	1.6 to 430 37.5	5.5 to 850 47	<0.1 to 2.2 0.3	16 to 71 44	159 to 2212 387
Portneuf	122 to 811 312	0	100 to 665 259	<0.1 to 160 40	<0.10 to 340 39	<0.1 to 2.0 0.2	0.5 to 77 27	172 to 1027 476
Upper Snake	42 to 497 199	0 to 13 0	34 to 407 163	1.0 to 150 8.85	<0.10 to 64 7.85	<0.1 to 2.7 0.25	6.5 to 58 26.5	63 to 629 243
Bear River	202 to 757 318	0	165 to 620 261	<0.1 to 900 42	2.6 to 1400 42	<0.1 to 6.4 0.2	8.9 to 75 27	217 to 1453 466
Boise Mountains	49 to 151 92	0 to 5 0	40 to 123 75	2 to 22 5.9	0.2 to 5.1 1.5	<0.1 to 8.8 0.3	19 to 60 37	81 to 210 130.5
Overall	0 to 1004 208	0 to 40 0	12 to 823 171	<0.1 to 1900 27	<0.1 to 1400 12	<0.1 to 13 0.4	0.2 to 83 35	24 to 3931 284

Idaho Statewide Ground Water Quality Monitoring Program
Hydrogeologic Subareas - Trace Elements and Metals Summary
1991 through 1993

Hydrogeologic Subarea	Arsenic (μg/l) MCL=50	Cadmium (μg/l) MCL=5	Chromium (μg/l) MCL=100	Copper (μg/l) AL=1300	Iron (μg/l) SMCL=300	Lead (μg/l) AL=15	Manganese (μg/l) SMCL=50	Selenium (μg/l) MCL=50	Zinc (μg/l) SMCL=5000	Cyanide (mg/l) MCL=200
	range median # >MCL	range median # >MCL	range median	range median	range median # > SMCL	range median	range median # > SMCL	range median # > MCL	range median # > SMCL	range median
North Idaho	<1 to 25 <1	<1 to 23 <1 3	<1 to 13 <1	<1 to 170 1	<3 to 16000 11.5 15	<1 to 5 <1	<1 to 750 5.5 33	<1 to 1 <1	<3 to 5900 37.5	no detections
Palouse	<1 to 4 <1	no detections	<1 to 2 <1	<1 to 40 <1	<3 to 1100 13.0 7	<1 to 1 <1	<1 to 140 18.0 7	<1 to 2 <1	<3 to 710 17	no detections
Clearwater	<1 to 25 <1	no detections	<1 to 2 <1	<1 to 64 <1	<3 to 1000 6.0 6	<1 to 4 <1	<1 to 480 2.0 5	<1 to 2 <1	<3 to 1900 73	no detections
Long Valley	<1 to 4 <1	no detections	<1 to 2 <1	<1 to 15 0.5	<3 to 2300 51.5 4	no detections	<1 to 410 52.5 9	no detections	<3 to 760 9.5	no detections
Weiser	<1 to 240 8 1	no detections	<1 to 2 <1	<1 to 75 1	<3 to 1900 5.0 4	<1 to 3 <1	<1 to 260 <1 6	<1 to 5 <1	<3 to 920 12	no detections
Payette	<1 to 24 7	no detections	<1 to 2 <1	<1 to 81 1	<3 to 2700 10.0 2	<1to 12 <1	<1 to 390 3.0 9	<1 to 3 <1	<3 to 170 13	no detections
Boise Valley Shallow	<1 to 130 7 3	no detections	<1 to 10 <1	<1 to 65 1	<3 to 4200 3.5 3	<1 to 2 <1	<1to 1300 <1 8	<1 to 7 <1	<3 to 390 18	no detections
Boise Valley Deep	<1 to 62 5 2	no detections	<1 to 21 <1	<1 to 29 <1	<3 to 1400 6.0 4	<1 to 4 <1	<1 to 920 1 24	<1 to 8 <1	<3 to 670 11	no detections
Mountain Home	<1 to 96 3 2	<1 to 1 <1	<1 to 8 2	<1 to 39 <1	<3 to 370 4.0 1	no detections	<1 to 340 <1 2	<1 to 4 <1	<3 to 120 18	no detections

Hydrogeologic Subarea	Arsenic (µg/l) MCL=50	Cadmium (µg/l) MCL=5	Chromium (µg/l) MCL=100	Copper (µg/l) AL=1300	Iron (µg/l) SMCL=300	Lead (µg/l) AL=15	Manganese (µg/l) SMCL=50	Selenium (µg/l) MCL=50	Zinc (µg/l) SMCL=5000	Cyanide (mg/l) MCL=200
	range median # >MCL	range median # >MCL	range median	range median	range median # > SMCL	range median	range median # > SMCL	range median # > MCL	range median # > SMCL	range median
North Owyhee	<1 to 180 16 2	no detections	<1 to 4 <1	<1 to 7 <1	<4 to 1600 23 3	<1 to 2 <1	<1 to 470 17 11	<1 to 150 1 1	<3 to 710 21	<0.01 to 0.03 <0.01
Salmon	<1 to 8 1	no detections	<1 to 3 <1	<1 to 35 2	<3 to 950 5.0 1	<1 to 2 <1	<1 to 64 <1 2	<1 to 17 <1	<3 to 1000 45	no detections
Central Valleys	<1 to 3 <1	no detections	<1 to 5 <1	<1 to 22 <1	<4 to 5900 <3 5	no detections	<1 to 500 <1 5	<1 to 4 <1	<3 to 230 23	no detections
Snake River Plain Alluvium	<1 to 110 2 1	no detections	<1 to 4 <1	<1 to 7 1	<3 to 870 3.0 2	<1 to 2 <1	<1 to 380 <1 6	<1 to 35 <1	<3 to 250 17	<0.01 to 0.03 <0.01
Snake River Plain Basalt	<1 to 34 2	<1 to 35 <1 1	<1 to 31 <1	<1 to 26 <1	<3 to 400 <3 2	<1 to 9 <1	<1to 2300 <1 7	<1 to 10 <1	<3 to 830 14.5	<0.01 to 0.02 <0.01
Twin Falls	1 to 33 10	no detections	<1 to 11 <1	<1 to 23 2	<3 to 220 <3 0	<1 to 2 <1	<1 to 49 <1 0	<1 to 6 1	<3 to 730 45	<0.01 to 0.01 <0.01
Cassia/Power	<1 to 7 2	no detections	<1 to 4 <1	<1 to 26 <1	<3 to 280 <3 0	<1 to 3 <1	<1 to 20 <1 0	<1 to 5 1	<3 to 380 9	no detections
Portneuf	<1 to 41 2	no detections	<1 to 12 <1	<1 to 7 <1	<3 to 1300 5.0 3	<1 to 1 <1	<1 to 470 <1 7	<1 to 4 <1	<3 to 450 23	no detections
Upper Snake	<1 to 7 1	no detections	<1 to 5 <1	<1 to 9 1	<3 to 600 5.0 2	<1to 10 <1	<1to 1300 <1 6	<1 to 11 <1	<3 to 570 90	no detections
Bear River	<1 to 32 1	no detections	<1 to 3 <1	<1 to 25 <1	<3 to 3900 5.0 8	no detections <1	<1to 1100 <1 11	<1 to 36 <1	<3 to 250 13	no detections

Hydrogeologic Subarea	Arsenic (µg/l) MCL=50	Cadmium (µg/l) MCL=5	Chromium (µg/l) MCL=100	Copper (µg/l) AL=1300	Iron (µg/l) SMCL=300	Lead (µg/l) AL=15	Manganese (µg/l) SMCL=50	Selenium (µg/l) MCL=50	Zinc (µg/l) SMCL=5000	Cyanide (mg/l) MCL=200
	range median # >MCL	range median # >MCL	range median	range median	range median # > SMCL	range median	range median # > SMCL	range median # > MCL	range median # > SMCL	range median
Boise Mountains	<1 to 33 1	no detections	<1 to 2 <1	<1 to 12 1	<3 to 2600 9.0 2	<1 to 2 <1	<1 to 240 2.0 3	no detections	<3 to 73 16	no detections
Overall	<1 to 240 2	<1 to 35 <1	<1 to 31 <1	<1 to 170 1	<3 to 16000 4	<1to 12 <1	<1to 2300 <1	<1 to 150 <1	<3 to 5900 22	<0.01 to 0.03 <0.01

Idaho Statewide Ground Water Quality Monitoring Program
Hydrogeologic Subareas - Nutrients Summary
1991 through 1993

Hydrogeologic Subarea	Nitrate (mg/l) range median 95% CI median # ≥ MCL, %	Nitrite (mg/l) range median	Ammonia (mg/l) range median	Phosphorus (mg/l) range median
North Idaho	<0.05 to 16 0.13 0.06 -> 0.19 1, 1%	<0.01 to 0.03 <0.01	<0.01 to 1.10 0.010	<0.01 to 0.29 <0.01
Palouse	<0.05 to 5.1 0.06 <0.05 -> 0.24 none	<0.01	<0.01 to 0.170 0.010	<0.01 to 0.17 0.055
Clearwater	<0.05 to 19 0.38 0.14 -> 0.71 1, 2%	<0.01 to 0.02 <0.01	<0.01 to 0.290 0.010	<0.01 to 0.28 0.05
Long Valley	<0.05 to 4.0 0.065 <0.05 -> 0.23 none	<0.01 to 0.02 <0.01	<0.01 to 0.76 0.020	0.01 to 0.97 0.06
Weiser	<0.05 to 19 0.44 0.07 -> 1.60 2, 9%	<0.01 to 0.02 <0.01	<0.01 to 2.40 0.020	<0.01 to 0.31 0.06
Payette	<0.05 to 12 0.77 0.06 -> 1.70 1, 3%	<0.01 to 0.04 <0.01	<0.01 to 8.0 0.030	<0.01 to 0.35 0.075
Boise Valley Shallow	<0.05 to 15 3.20 2.60 -> 3.70 3, 3%	<0.01 to 0.05 <0.01	<0.01 to 2.80 0.010	<0.01 to 1.6 0.04
Boise Valley Deep	<0.05 to 21 1.50 0.73 -> 1.90 3, 3%	<0.01 to 0.02 <0.01	<0.01 to 4.0 0.020	<0.01 to 0.19 0.02
Mountain Home	<0.05 to 16 1.40 0.79 -> 1.70 2, 5%	<0.01	<0.01 to 0.38 0.010	<0.01 to 1.10 0.02
North Owyhee	<0.05 to 110 2.40 <0.05 -> 4.3 8, 29%	<0.01 to 0.35 <0.01	<0.01 to 3.7 0.10	<0.01 to 0.10 0.02

Hydrogeologic Subarea	Nitrate (mg/l) range median 95% CI median # ≥ MCL, %	Nitrite (mg/l) range median	Ammonia (mg/l) range median	Phosphorus (mg/l) range median
Salmon	<0.05 to 11 0.550 0.32 -> 0.63 1, 3%	<0.01 to 0.02 <0.01	<0.01 to 0.07 0.010	<0.01 to 0.18 0.02
Central Valleys	<0.05 to 6.0 0.340 0.27 -> 0.61 none	<0.01 to 0.02 <0.01	<0.01 to 2.30 0.010	<0.01 to 0.44 0.02
Snake River Plain Alluvium	<0.05 to 35 1.70 1.00 -> 2.20 6, 9%	<0.01 to 0.12 <0.01	<0.01 to 0.43 0.010	<0.01 to 0.12 0.02
Snake River Plain Basalt	<0.05 to 35 1.45 1.20 -> 1.60 1, 0.5%	<0.01 to 0.04 <0.01	<0.01 to 1.20 0.010	<0.01 to 0.18 0.02
Twin Falls	<0.05 to 19 3.70 2.80 -> 4.10 5, 7%	<0.01	<0.01 to 0.49 0.010	<0.01 to 0.14 0.02
Cassia/Power	<0.05 to 12 0.905 0.59 -> 1.20 1, 2%	<0.01 to 0.03 <0.01	<0.01 to 0.16 0.010	<0.01 to 0.08 0.02
Portneuf	<0.05 to 11 1.60 1.10 -> 2.00 1, 2%	<0.01 to 0.02 <0.01	<0.01 to 1.60 0.020 0.01 -> 0.02	<0.01 to 0.49 0.03 0.02 -> 0.04
Upper Snake	<0.05 to 14 0.865 0.41 -> 1.40 2, 4%	<0.01 to 0.03 <0.01	<0.01 to 0.07 0.020	<0.01 to 0.15 0.02
Bear River	<0.05 to 17 0.940 0.40 -> 1.90 2, 5%	<0.01 to 0.07 <0.01	<0.01 to 2.90 0.020	<0.01 to 0.58 0.03
Boise Mountains	<0.05 to 2.60 0.230 <0.05 -> 1.50 none	<0.01	<0.01 to 0.22 0.010	<0.01 to 0.08 0.02
Overall	<0.05 to 110 1.10	<0.01 to 0.35 <0.01	<0.01 to 8.0 0.01	<0.01 to 1.6 0.02

Idaho Statewide Ground Water Quality Monitoring Program
Hydrogeologic Subareas - Radioactivity Summary
1991 through 1993

Hydrogeologic Subarea	Gross Alpha pCi/l MCL = 15 range median	Gross Beta pCi/l MCL = 50 range median	Uranium[1] µg/l # samples range	Radon pCi/l range median
North Idaho	0 to 12.2 0.8	0.4 to 10.5 2.3	-	150 to 3900 760
Palouse	0 to 3.9 0.5	0.4 to 8.7 3.0	-	100 to 1748 475
Clearwater	0 to 6.9 1.0	0.9 to 10.6 2.7	-	130 to 1300 455
Long Valley	0 to 1.7 0.45	0.3 to 6.1 2.2	-	180 to 642 320
Weiser	0 to 45.0 1.2	1.0 to 42.2 4.7	1 59	212 to 860 460
Payette	0 to 14.3 2.9	0.2 to 15.2 5.5	1 26	180 to 1200 640
Boise Valley Shallow	0 to 83.0 6.9	1.1 to 48.6 7.4	15 16 to 110	117 to 3700 640.5
Boise Valley Deep	0 to 52.9 3.5	0.6 to 27.7 5.6	13 9 to 59	80 to 1700 460
Mountain Home	0 to 78.0 1.0	1.1 to 56.8 4.65	2 47 to 100	410 to 1417 586
North Owyhee	0 to 78.5 1.6	3.3 to 115 14.0	5 11 to 110	400 to 1053 602.5
Salmon	0 to 41.5 1.7	0.3 to 40.8 2.3	1 56	380 to 5700 1300
Central Valleys	0 to 18.1 2.6	0.7 to 13.2 2.4	-	<80 to 2600 875
Snake River Plain Alluvium	0 to 40.0 1.8	0.6 to 23.6 4.3	1 33	180 to 1600 590
Snake River Plain Basalt	0 to 18.3 2.4	1.0 to 18.5 4.2	1 15	<80 to 1200 234
Twin Falls	0.1 to 43.9 7.3	0 to 25.4 8.0	9 16 to 45	90 to 848 280.5
Cassia/Power	0 to 15.8 4.55	2.3 to 26.2 8.0	1 8	120 to 870 475
Portneuf	0 to 17.9 3.7	0 to 46.8 7.0	1 <5 pCi/l	290 to 1400 479

Hydrogeologic Subarea	Gross Alpha pCi/l MCL = 15 range median	Gross Beta pCi/l MCL = 50 range median	Uranium[1] µg/l # samples range	Radon pCi/l range median
Upper Snake	0 to 29.2 1.3	0 to 16.7 2.6	1 22	176 to 2668 960
Bear River	0 to 22.2 3.6	0.7 to 77.5 6.5	-	330 to 610 525
Boise Mountains	0 to 3.3 0.7	0.8 to 4.7 1.7	-	180 to 1500 630
Overall	0 to 83.0 2.4	0 to 115 4.3	52 <5 to 110	<80 to 5700 542

1. Most samples exceeding 14 pCi/l gross alpha were speciated for total radium 226 and total uranium. A primary MCL has been proposed for uranium at 20 µg/l.

Idaho Statewide Ground Water Quality Monitoring Program
Hydrogeologic Subareas - Organics Summary
1991 through 1993

Hydrogeologic Subarea	Volatile Organic Compounds Compound - # detections # samples/# sites affected	Volatile Organic Compounds > MCLs Compound - #sites	Pesticides Detected by Immunoassay Compound - # detections # samples/# sites affected /percent sites affected	Pesticides Detected by GC methods Compound - # detections total # samples
North Idaho	Trihalomethanes[b] - 4 96 / 4	none	Triazine - 1 72 / 1 / 1%	no samples
Palouse	none found 27 / 0	none	Triazine - 1 20 / 1 / 5%	no samples
Clearwater	Trihalomethanes[b] - 2 Chloromethane -2 Napthalene - 1 54 / 5	none	none 39 / 0 / 0%	no samples
Long Valley	none found 17 / 0	none	none 10 / 0 / 0%	no samples
Weiser	*Dichlorodifluoromethane (freon[c]) - 1* 23 / 1	*none*	Triazine - 1 12 / 1 / 8%	no samples
Payette	none found 31 / 0	none	Triazine - 6 Alachlor - 1 20 / 6 / 30%	none found 9[+]
Boise Valley Shallow	1,2-Dichloropropane (DCP)[a] - 2 1,2,3-Trichloropropane[a] - 2 Perchloroethylene (Perc) - 3 Methylene Chloride - 3 Toluene - 1 Total Xylenes - 1 Trihalomethanes[b] - 1 1,1,1-Trichloroethane - 1 Trichlorotrifluoromethane (freon 113[c]) - 1 105 / 9	DCP - 1 Perc - 1	Triazine - 16 Alachlor - 1 Carbamate - 1 80 / 17 / 21%	Dacthal - 2 Metribuzin - 1 38[++]

[a] pesticide
[b] may be a biproduct of chlorination
[c] may represent airborne contamination of sample

+ tested for 9 pesticides
++ tested for 24 pesticides

Hydrogeologic Subarea	Volatile Organic Compounds Compound - # detections # samples/# sites affected	Volatile Organic Compounds > MCLs Compound - #sites	Pesticides Detected by Immunoassay Compound - # detections # samples/# sites affected /percent sites affected	Pesticides Detected by GC methods Compound - # detections total # samples
Boise Valley Deep	Perchloroethylene (Perc) - 1 1,2-Dichloropropane[a] - 1 1,2,3-Trichloropropane[a] - 1 103 / 2	none	Alachlor - 1 Carbamate - 1 71 / 2 / 3%	Dacthal - 1 14[++]
Mountain Home	Trihalomethanes[b] - 1 1,2,4-Trimethylbenzene[c] - 1 38 / 2	none	none 25 / 0 / 0%	none found 1[++]
North Owyhee	none found 27 / 0	none	none 19 / 0 / 0%	none found 1[++]
Salmon	Dichlorodifluoromethane (freon[c]) - 1 Chloromethane - 2 Trihalomethanes[b] - 2 27 / 5	none	Triazine - 1 Carbamate - 1 21 / 2 / 9.5%	no samples
Central Valleys	Trihalomethanes[b] - 1 Napthalene - 1 1,2,4-Trimethylbenzene[c] - 1 Chloromethane - 1 37 / 2	none	none 24 / 0 / 0%	no samples
Snake River Plain Alluvium	Ethylene Dibromide (EDB)[a] - 3 1,2,-Dichloropropane (DCP)[a] - 3 1,2,3-Trichloropropane[a] - 3 Chloromethane - 1 Benzene - 1 61 / 5	EDB - 3 DCP - 1 Benzene - 1	Triazine - 3 46 / 3 / 7%	none found 6[+]
Snake River Plain Basalt	Perchloroethylene (Perc) - 5 Ethylene Dibromide (EDB)[a] - 1 Chloromethane - 2 Total Xylenes - 1 1,2,4-Trimethylbenzene[c] - 1 180 / 9	Perc - 1 EDB - 1	Triazine - 8 132 / 8 / 6%	none found 26[+]

[a] pesticide
[b] may be a biproduct of chlorination
[c] may represent airborne contamination of sample

\+ tested for 9 pesticides
++ tested for 24 pesticides

Hydrogeologic Subarea	Volatile Organic Compounds Compound - # detections # samples/# sites affected	Volatile Organic Compounds > MCLs Compound - #sites	Pesticides Detected by Immunoassay Compound - # detections # samples/# sites affected /percent sites affected	Pesticides Detected by GC methods Compound - # detections total # samples
Twin Falls	Trihalomethanes[b] - 3 64 / 1	none	Triazine - 5 49 / 5 / 10%	Dacthal - 1 21[++]
Cassia/Power	none found 46 / 0	none	Triazine - 2 34 / 2 / 6%	none found 7[+]
Portneuf	Trichloroethylene (TCE) - 4 Perchloroethylene (Perc) - 5 1,1,1-Trichloroethane - 2 Toluene - 1 Dichlorodifluoromethane (freon[c]) - 1 48 / 8	TCE - 2	Carbamate - 2 37 / 2 / 5%	no samples
Upper Snake	none found 49 / 0	none	Triazine - 2 Carbamate - 2 37 / 3 / 8%	none found 6[+]
Bear River	Perchloroethylene (Perc) - 1 39 / 1	none	Triazine - 1 30 / 1 / 3%	no samples
Boise Mountains	none found 10 / 0	none	none 6 / 0 / 0%	no samples

[a] pesticide
[b] may be a biproduct of chlorination
[c] may represent airborne contamination of sample

+ tested for 9 pesticides
++ tested for 24 pesticides

APPENDIX D -

Selected Boxplots

Selected Boxplots

Selected boxplots have been included to assist in gaining additional insight. Refer to Table 3 for MCLs, potential sources and significance of most constituents.

1 - **Hardness**. *Hardness* measures the calcium and magnesium concentrations. High hardness can be a nuisance to laundry, dishes and plumbing fixtures, but has no negative health implications. Dashed lines represent limits between soft versus moderately hard (75 mg/l), moderately hard versus hard (150 mg/l), and hard versus very hard water (300 mg/l). By observing the median values, the hardest ground waters in the state are in the Portneuf, Bear River and Twin Falls subareas. The highest variability and greatest extremes were found in the North Owyhee subarea. Ground waters in the Long Valley and Boise Mountain subareas generally appear to be naturally soft.

2 - **Sodium**. Sodium concentrations appear to be variable throughout the state. The dashed line represents the USEPA caution limit for sodium-risk individuals to bring to the attention of their personal physician.

3 - **Chloride**. Some extremes are evident in southern Idaho, but only outside values exceed the secondary MCL of 250 mg/l (shown as a dashed line).

4 - **Fluoride**. Boise Mountains and North Owyhee subareas stand out for potential of elevated fluoride, though extremes exist in six different subareas. Dashed lines represent secondary (2 mg/l) and primary (4 mg/l) MCLs.

5 - **Sulfate**. Although extremes exist in eight different subareas, elevated sulfate appears to be common in the North Owyhee subarea. Dashed lines represent existing secondary MCL (250 mg/l) and proposed primary MCL (400 mg/l).

6 - **Nitrate (NO2+NO3, as N)**. Highest median values are in Twin Falls, Boise Valley Shallow and North Owyhee subareas. Greatest extremes are in North Owyhee subarea. Dashed lines represent impact level for this report (2 mg/l, refer to text under 'Nitrate') and primary MCL (10 mg/l).

7 - **Ammonia**. Interesting to compare to nitrate boxplot. North Owyhee subarea definitely impacted by ammonia (human or animal wastes), but not notably so in Twin Falls or Boise Valley Shallow subareas. The number of extremes in the Boise Valley Deep subarea seems worthy of further attention.

8 - **Iron**. Most values that exceed the secondary MCL of 300 pCi/l (dashed line) are outside and far-outside values. Iron rich ground waters are more prevalent in the northern Idaho subareas (North Idaho, Palouse, Long Valley, Weiser and Payette).

9 - **Manganese**. Manganese rich ground water follows the same pattern as iron, being more prevalent in northern Idaho. The secondary MCL for manganese is 50 pCi/l (dashed line). Other subareas where manganese is a common component of the water chemistry are North Owyhee, Bear River and Boise Mountains.

10 - **Gross Alpha**. Subareas most affected by elevated alpha radiation are clearly in southwest and south-central Idaho. The dashed line represents the primary MCL of 15 pCi/l.

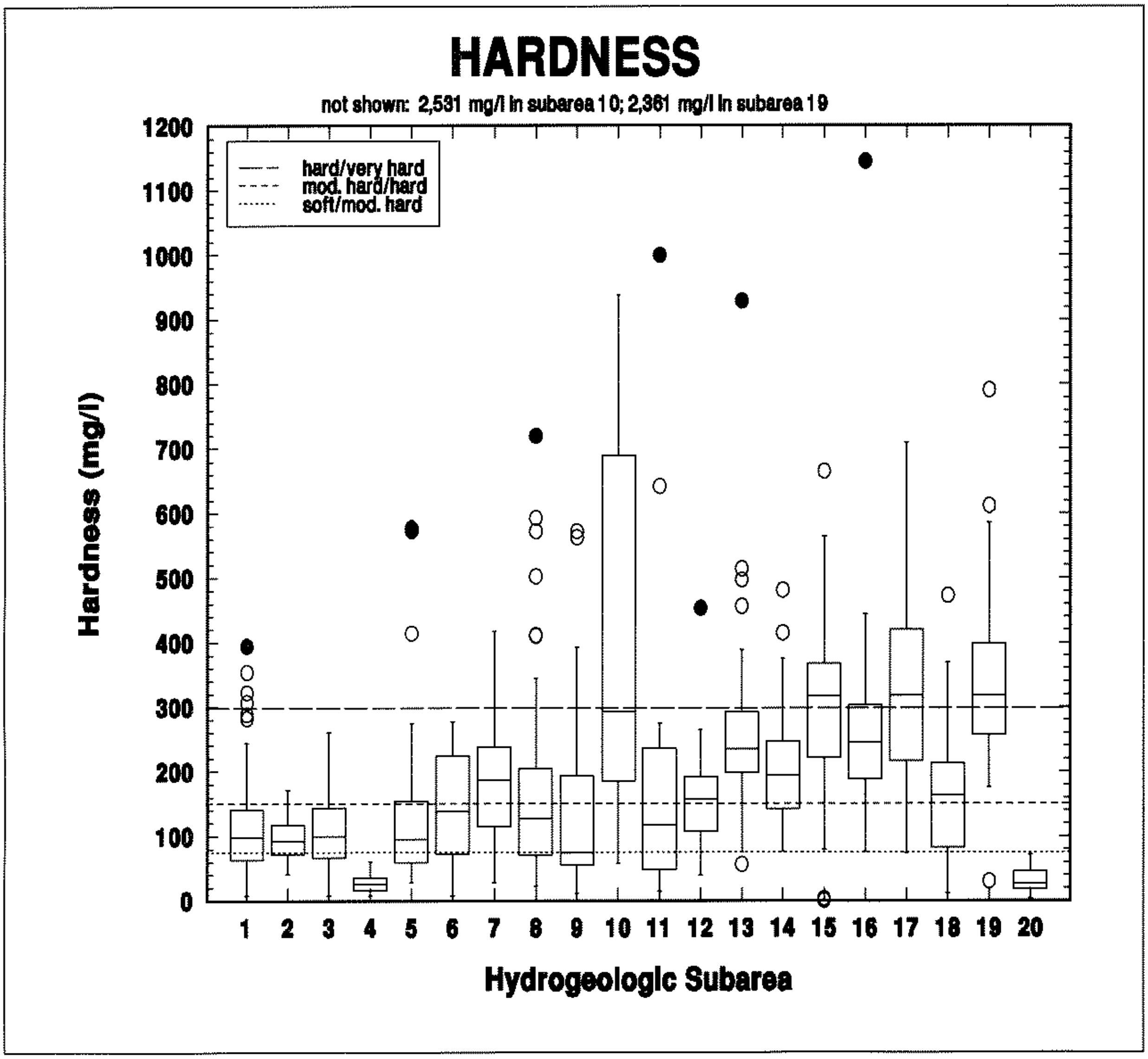
11 - **Gross Beta**. There exist few extremes. The dashed line represents the primary MCL of 50 pCi/l.

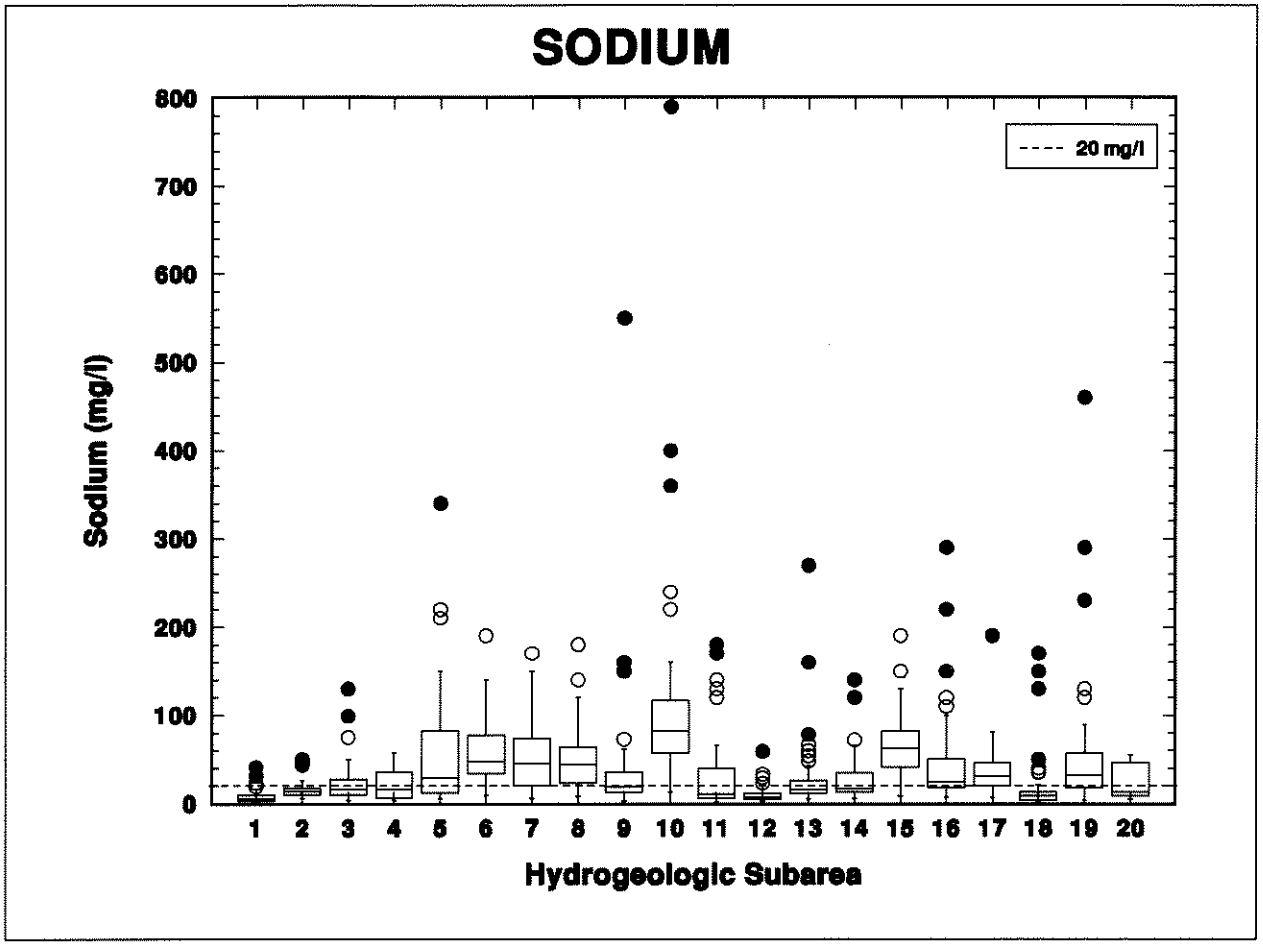
12 - **Radon**. Subareas with the highest median radon values are Salmon, Central Valleys, Bear River and North Idaho. The dashed line represents the USEPA proposed primary MCL of 300 pCi/l. The median value for all but two of the subareas (Snake River Plain Basalt and Twin Falls) exceed the proposed standard.

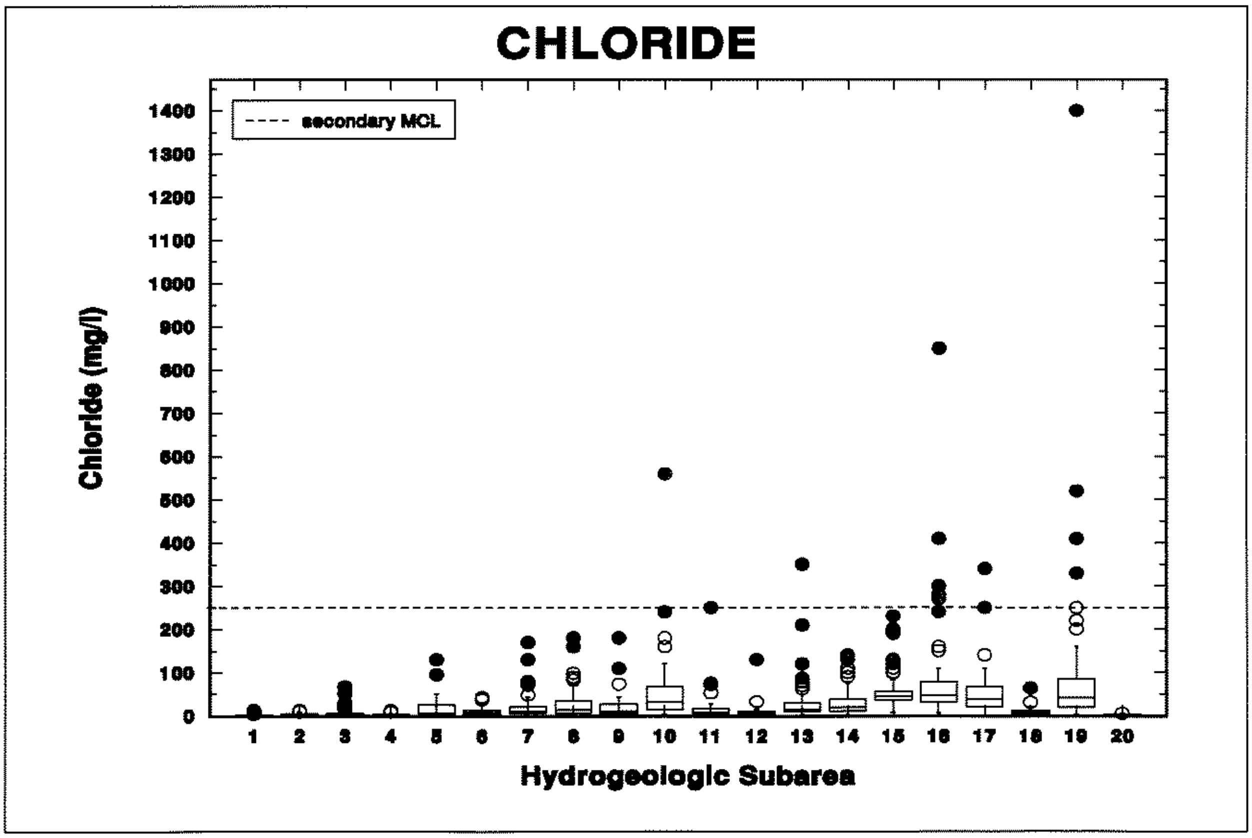
13 - **Silica**. It appears that there may be an inverse correlation between radon activity and silica content. Lowest silica concentrations occurred in Salmon, Central Valleys and North Idaho subareas.

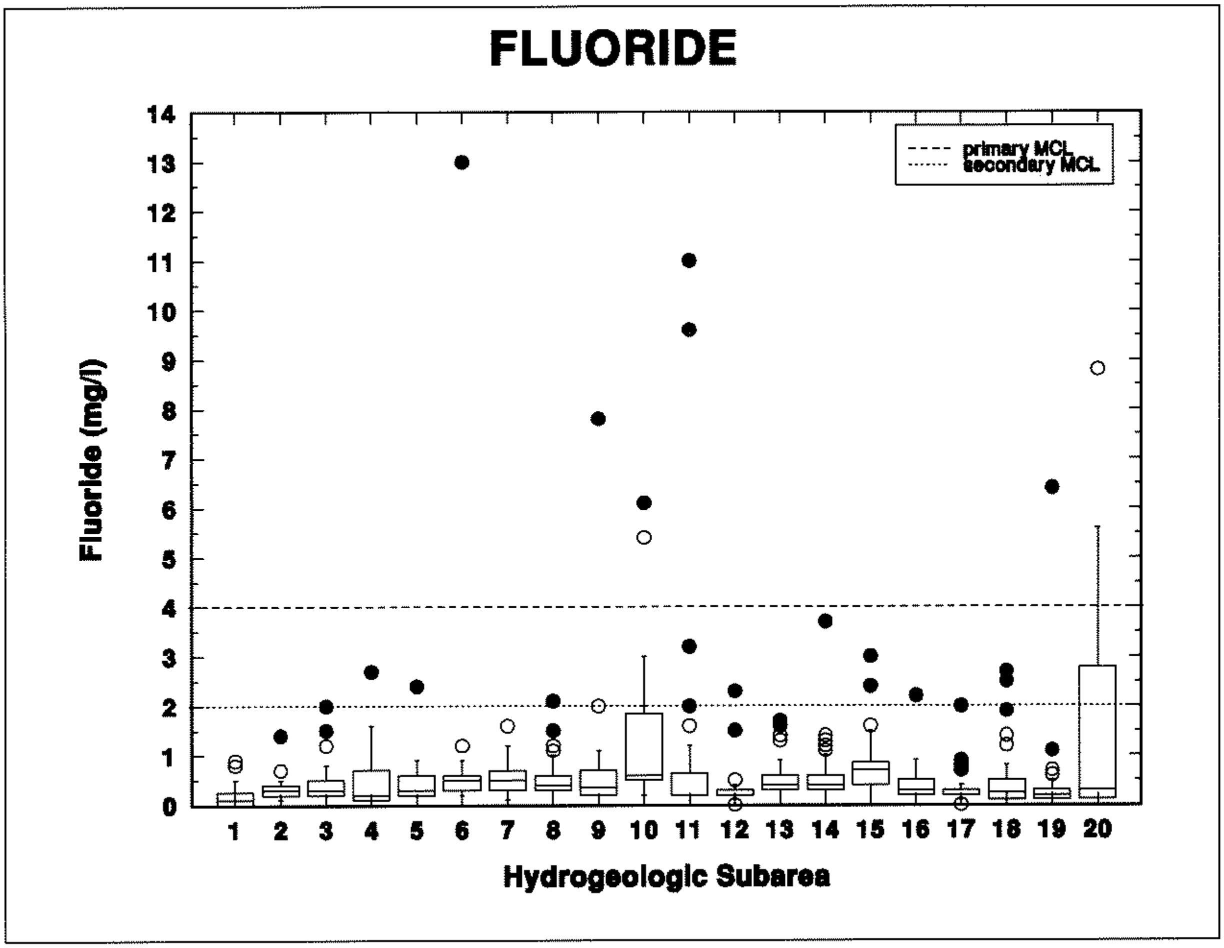
Hydrogeologic Subarea Key

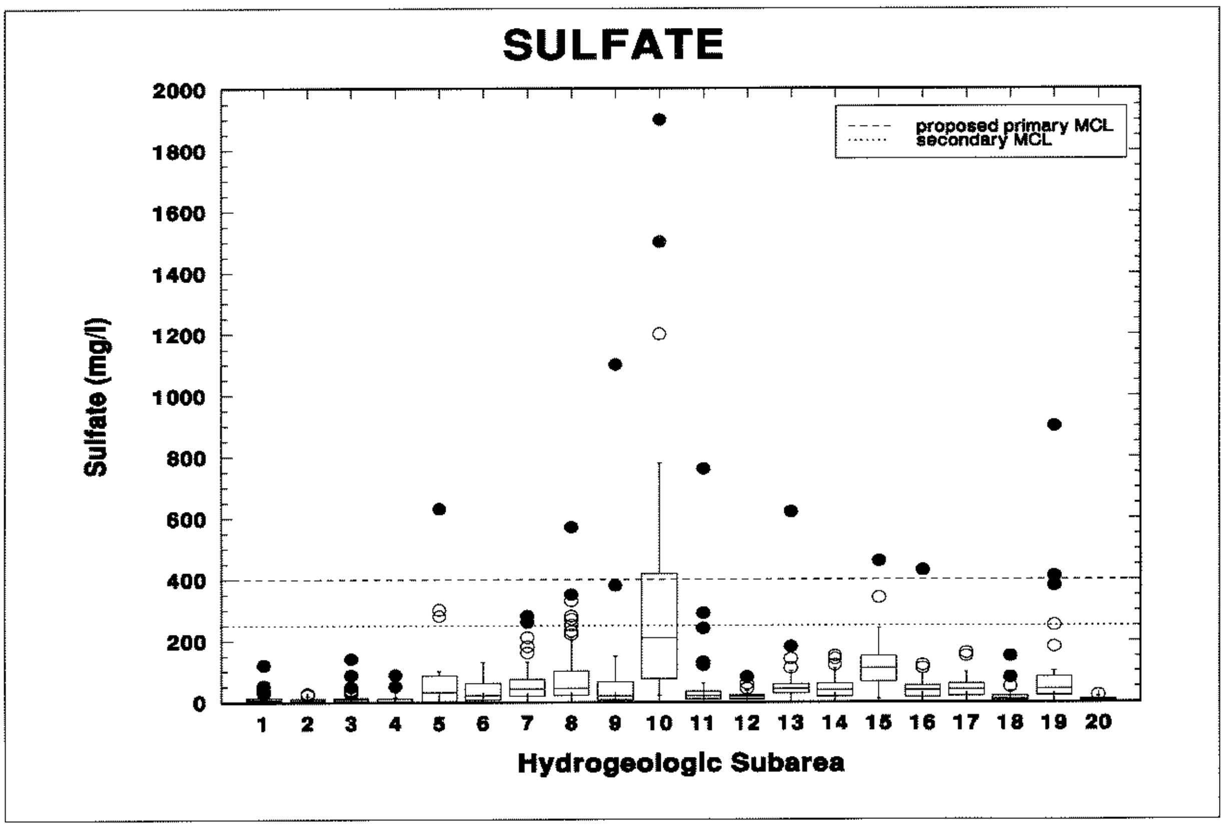
1 - North Idaho
2 - Palouse
3 - Clearwater
4 - Long Valley
5 - Weiser
6 - Payette
7 - Shallow Boise Valley
8 - Deep Boise Valley
9 - Mountain Home
10 - North Owyhee
11 - Salmon
12 - Central Valleys
13 - Snake River Plain Alluvium
14 - Snake River Plain Basalt
15 - Twin Falls
16 - Cassia/Power
17 - Portneuf
18 - Upper Snake
19 - Bear River
20 - Boise Mountains

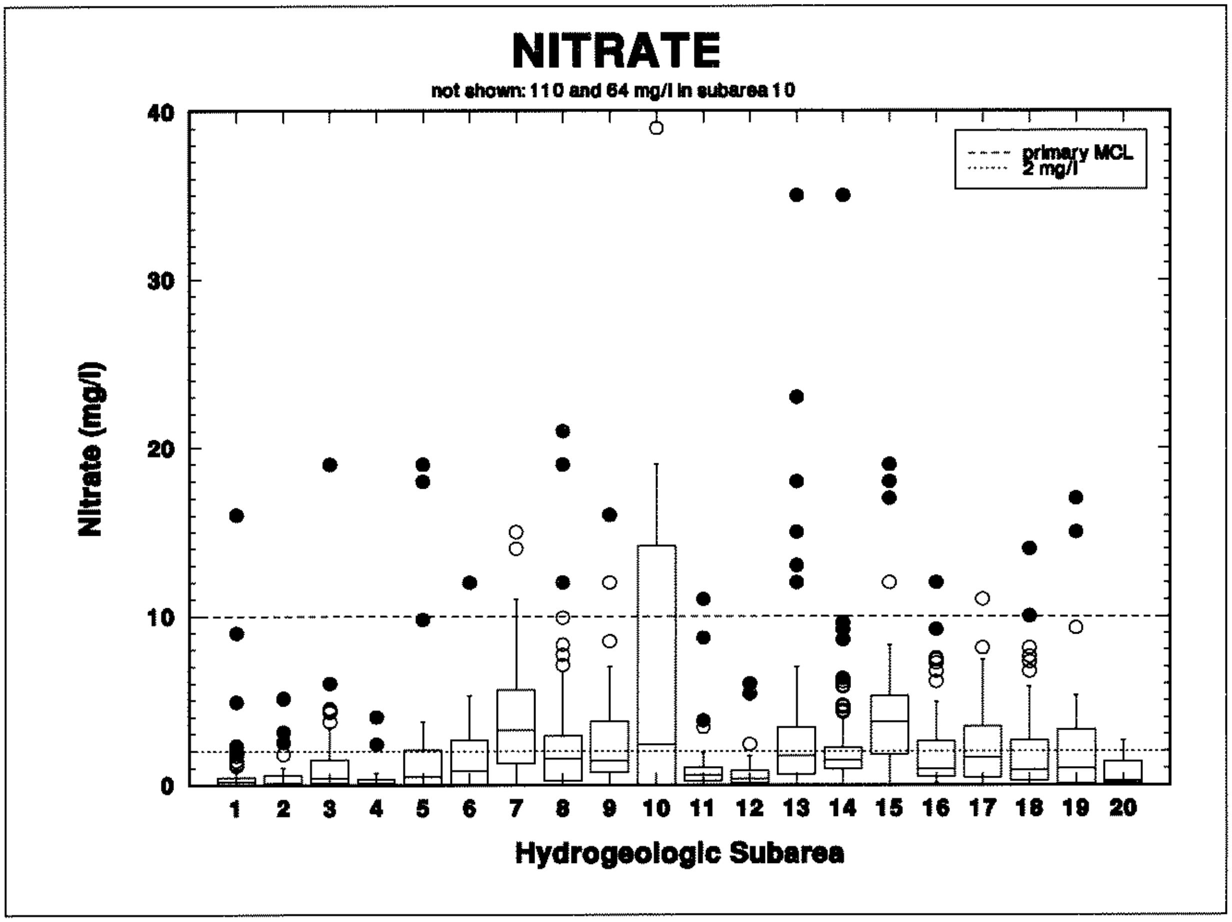



SODIUM
---- 20 mg/l
Sodium (mg/l)
0
100
200
300
400
500
600
700
800
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Hydrogeologic Subarea

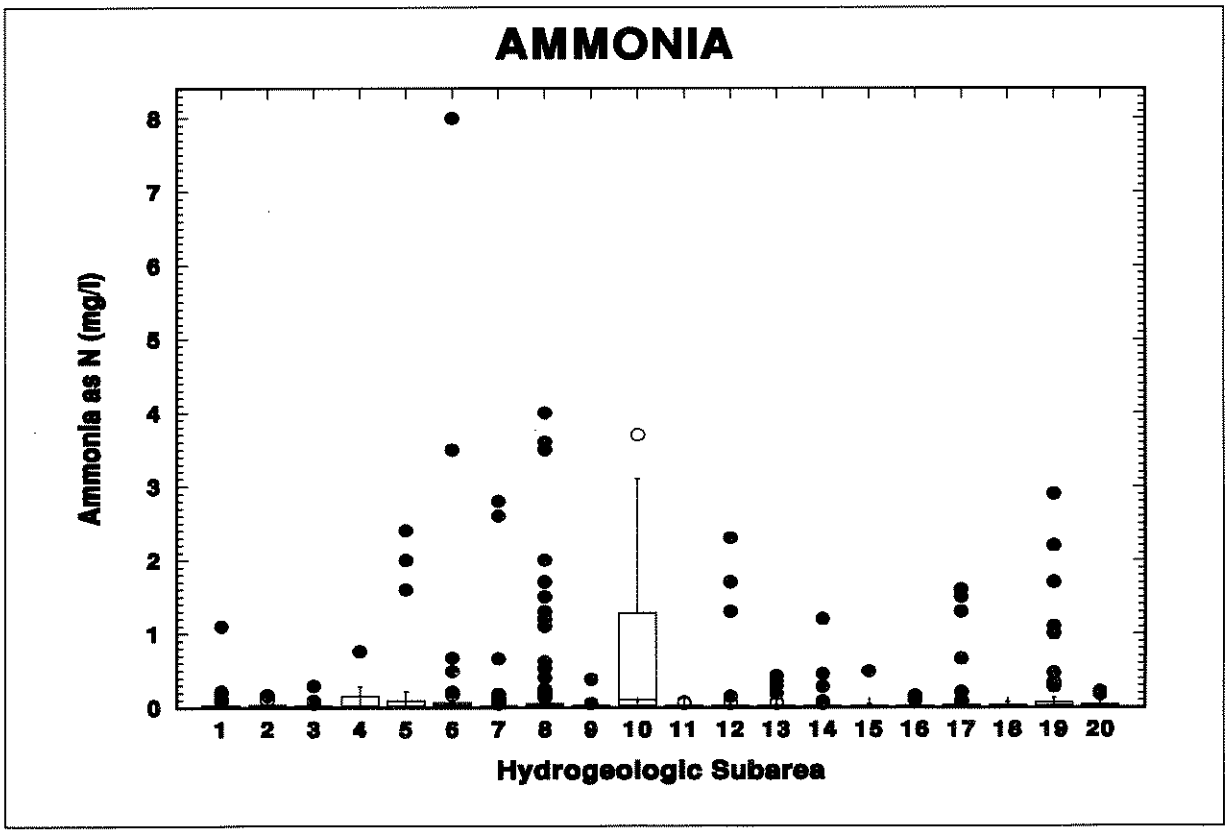

CHLORIDE
---- secondary MCL
Chloride (mg/l)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Hydrogeologic Subarea


FLUORIDE
Fluoride (mg/l)
Hydrogeologic Subarea
primary MCL
secondary MCL
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

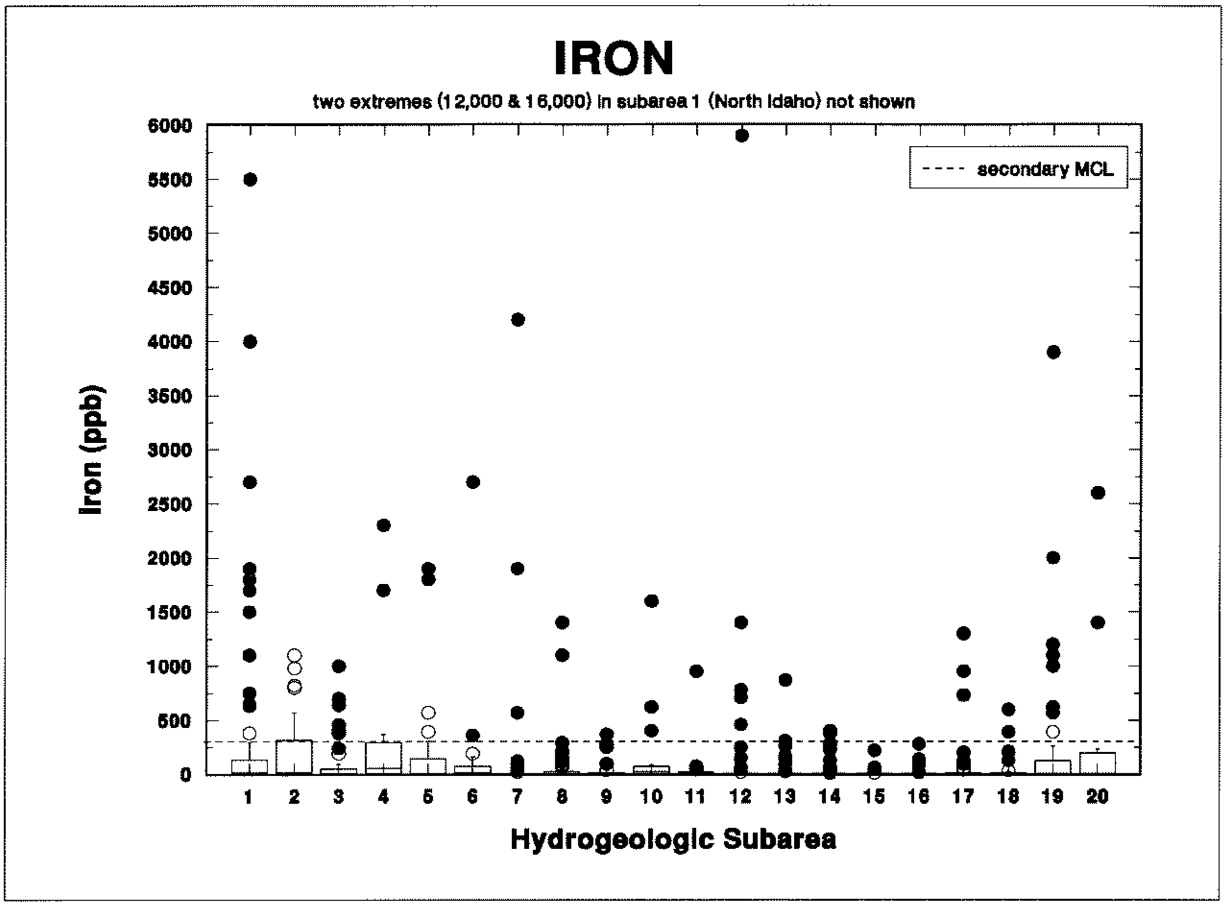

SULFATE
Sulfate (mg/l)
Hydrogeologic Subarea
proposed primary MCL
secondary MCL
0
200
400
600
800
1000
1200
1400
1600
1800
2000

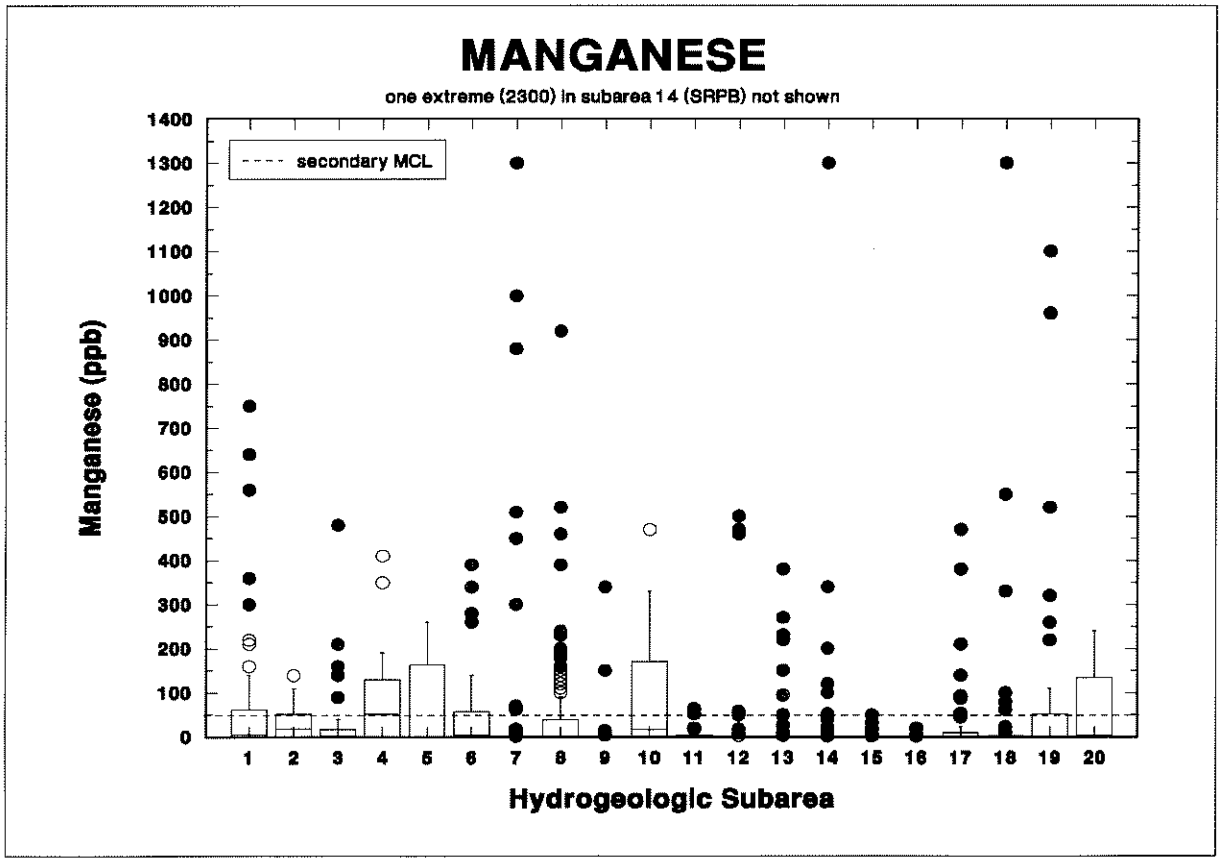


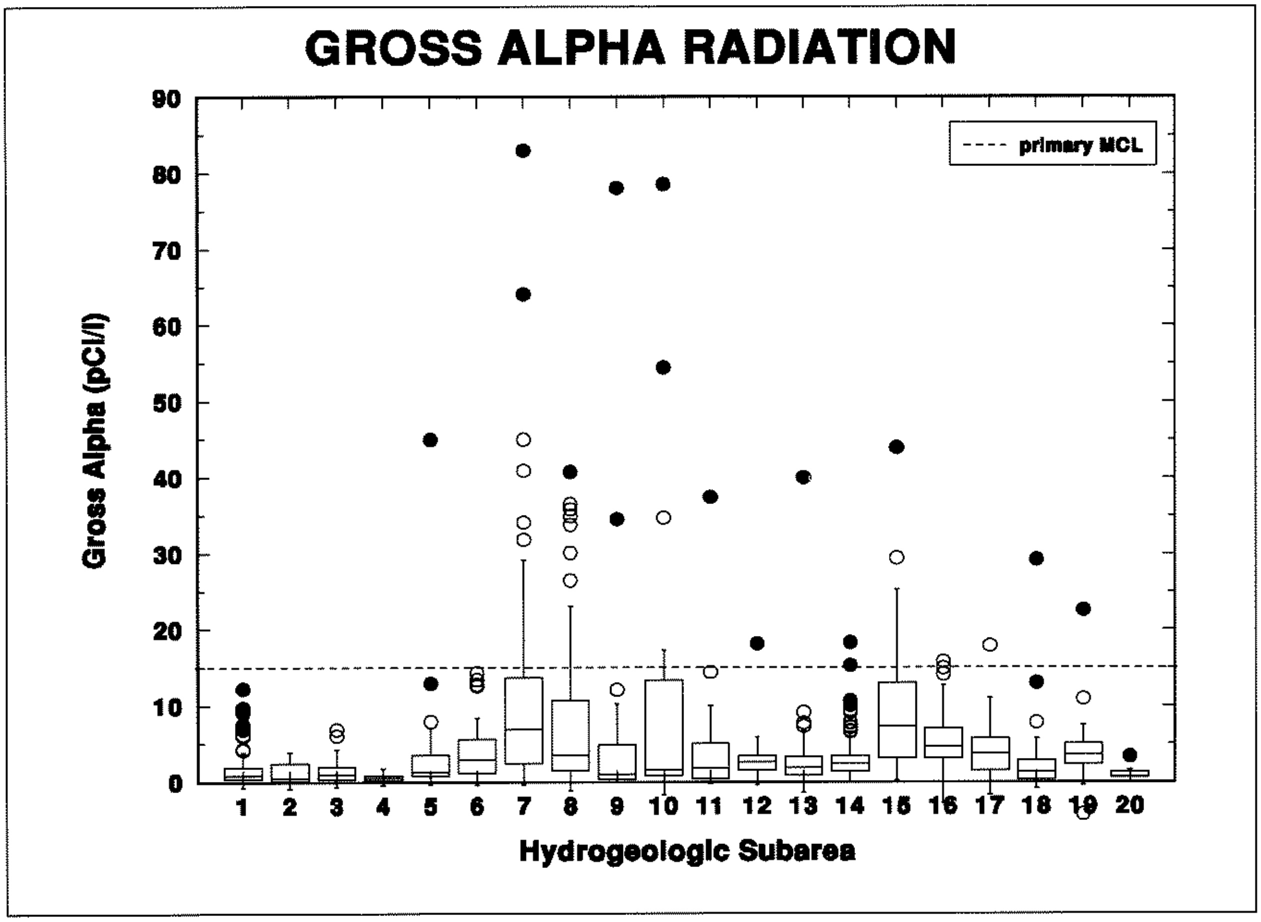
NITRATE
not shown: 110 and 64 mg/l in subarea 10
primary MCL
2 mg/l
Nitrate (mg/l)
0
10
20
30
40
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Hydrogeologic Subarea

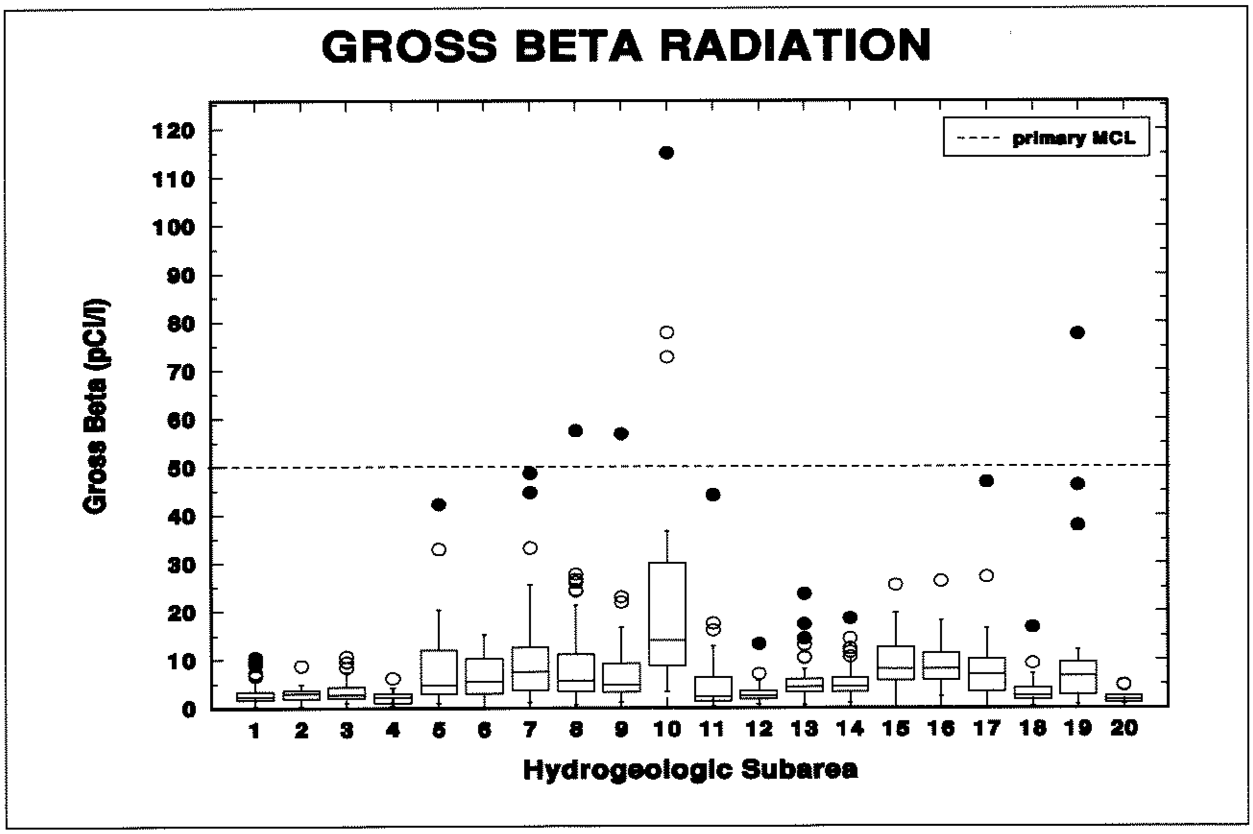


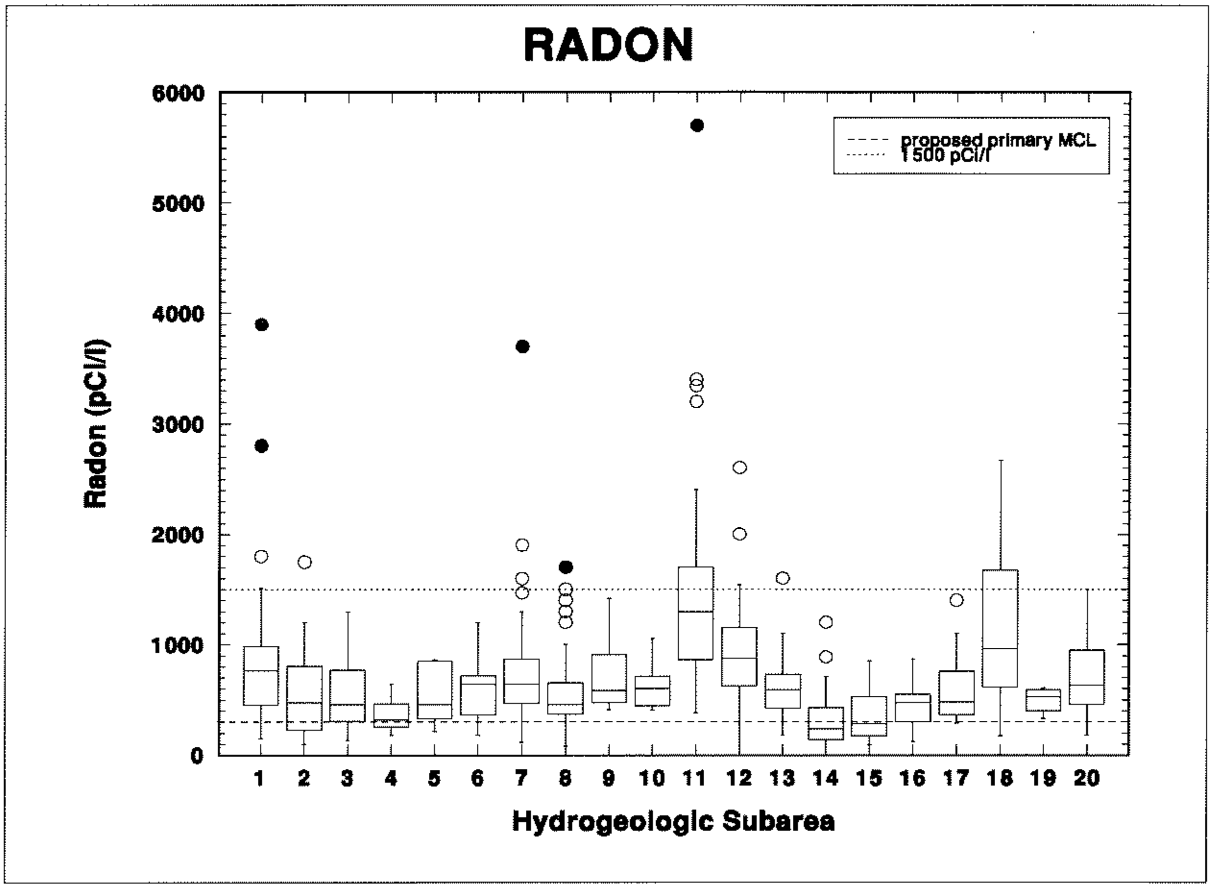
AMMONIA
Ammonia as N (mg/l)
0
1
2
3
4
5
6
7
8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Hydrogeologic Subarea

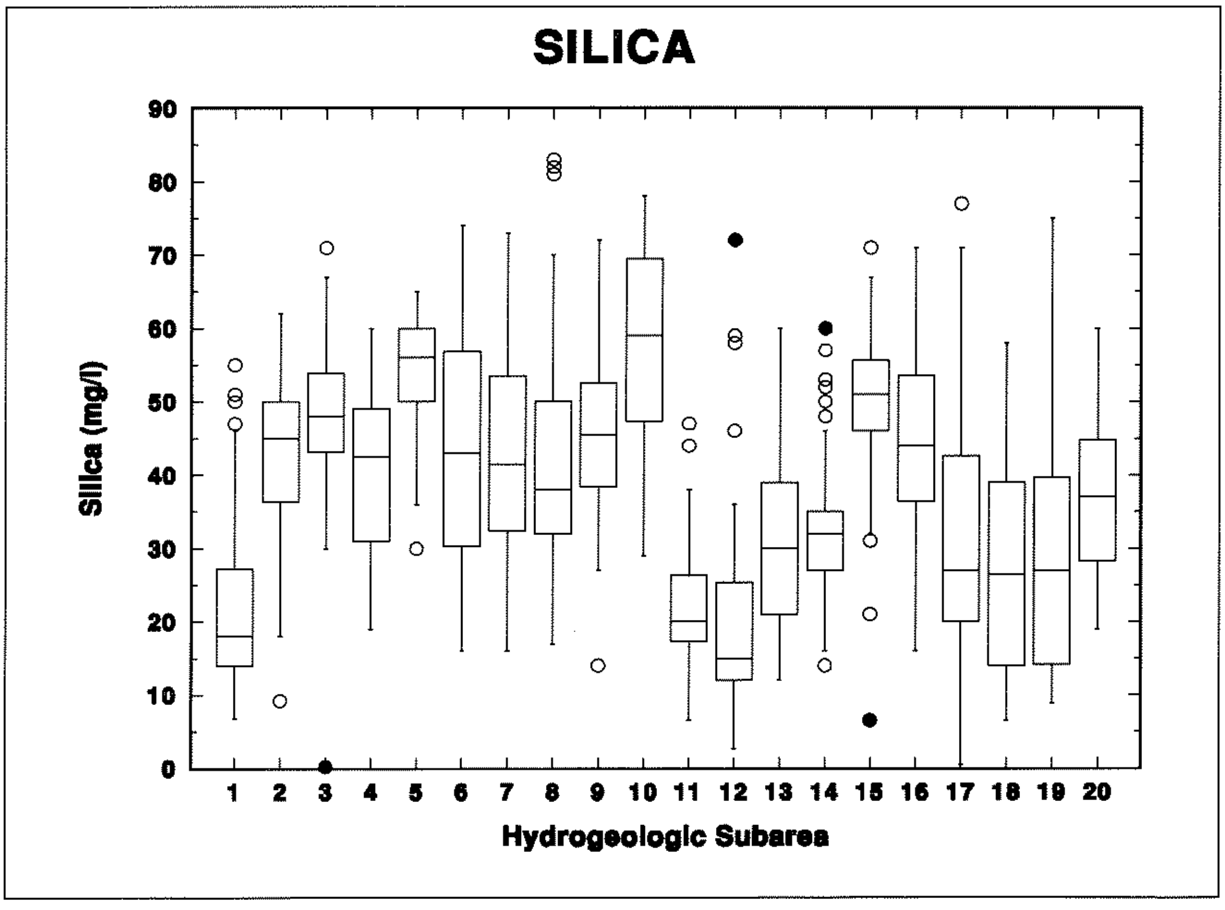

IRON
two extremes (12,000 & 16,000) in subarea 1 (North Idaho) not shown
secondary MCL
Iron (ppb)
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Hydrogeologic Subarea


MANGANESE
one extreme (2300) in subarea 14 (SRPB) not shown
secondary MCL
Manganese (ppb)
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Hydrogeologic Subarea


GROSS ALPHA RADIATION
primary MCL
Gross Alpha (pCi/l)
0
10
20
30
40
50
60
70
80
90
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Hydrogeologic Subarea


GROSS BETA RADIATION
primary MCL
Gross Beta (pCi/l)
0
10
20
30
40
50
60
70
80
90
100
110
120
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Hydrogeologic Subarea


RADON
6000
5000
4000
3000
2000
1000
0
Radon (pCi/l)
proposed primary MCL
1500 pCi/l
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Hydrogeologic Subarea


SILICA
90
80
70
60
50
40
30
20
10
0
Silica (mg/l)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Hydrogeologic Subarea