Field Methods and Quality-Assurance Plan for Quality-of-Water Activities, U.S. Geological Survey, Idaho National Engineering and Environmental Laboratory, Idaho

By Roy C. Bartholomay, LeRoy L. Knobel, and Joseph P. Rousseau

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INTRODUCTION

Water-quality activities at the Idaho National Engineering and Environmental Laboratory (INEEL) Project Office are part of the U.S. Geological Survey's (USGS) mission of appraising the quantity and quality of the Nation's water resources. The activities are conducted in cooperation with the U.S. Department of Energy's (DOE) Idaho Operations Office and the U.S. Environment Protection Agency, Region 10. Results of the water-quality investigations are presented in various USGS publications or in refereed scientific journals. The results of the studies are highly regarded and are used with confidence by researchers, regulatory and managerial agencies, and interested civic groups.

In its broadest sense, quality assurance refers to doing the job right, the first time. It includes the functions of planning for products, review and acceptance of the products, and an audit designed to evaluate the system that produces the product. Quality assurance and quality control differ in that quality control ensures that things are done correctly given the "state-of-the-art" technology, and quality assurance ensures that quality control is maintained within specified limits.

Purpose of and Responsibility for Maintaining the Quality-Assurance Plan

The purpose of the Quality Assurance Plan (QAP) for water-quality activities performed by the INEEL Project Office is to maintain and improve the quality of technical products and to provide a formal standardization, documentation, and review of the activities that lead to these products. The principles of this plan are as follows:

1. Water-quality programs will be planned in a competent manner and activities will be monitored for compliance with stated objectives and approaches. The objectives and approaches are defined in an annual project work plan.

2. Field, laboratory, and office activities will be performed in a conscientious and professional manner in accordance with specified Water Resources Discipline (WRD) practices and procedures by qualified and experienced employees who are well trained and supervised. If or when WRD practices and procedures are inadequate, data will be collected in a manner such that its quality will be documented.

3. All water-quality activities will be reviewed for completeness, reliability, credibility, and conformance to specified standards and guidelines.

4. A record of actions will be kept to document the activities and the assigned responsibilities.

5. Remedial action will be taken to correct activities that are deficient.

The overall responsibility for maintaining this QAP belongs to the Chief of the INEEL Project Office. The principal investigators for geochemistry and the lead personnel for the water-quality monitoring network, however, are directly responsible for the day-to-day maintenance of the QAP. The QAP will be formally revised and reprinted every 2 to 5 years; changes that take

place in the interim, however, will be communicated by memoranda to project-office personnel on an as-needed basis.

Scope

The QAP for water-quality activities at the INEEL defines procedures and tasks performed by project-office personnel that ensure the reliability of water-quality data. Virtually all of the principles of the plan have been in effect during past and current operations, but the QAP provides a method to formalize and communicate the plan to all employees of the project office and to users of the hydrologic data and interpretive reports. The plan was initially finalized in 1989. It was revised in March 1992 and again in 1996 (Mann, 1996). This report incorporates the revisions made to the program since 1996. A comprehensive list of references that contains guidelines used in data collection is given in the section entitled "Selected References." Tasks not described by the references owing to field conditions are detailed in the following sections.

Information on water-quality sampling schedules, data-quality objectives, and water-quality field equipment are included in attachments 1 through 5.

Monitoring Networks

The water-quality monitoring network for the INEEL consists of about 170 sites and includes production wells, wells dedicated to water-quality monitoring, and surface-water sites. The network originally was established to document the distribution and concentration of radionuclides and industrial chemicals contained in wastewater discharged at the INEEL, either to the Snake River Plain aquifer or to the overlying perched ground-water zones. Disposal has taken place through deep disposal wells and shallow infiltration ponds. Additional monitoring sites will be selected if and when they are needed to better document the distribution and migration of solutes.

The frequency of sampling wells and streams in the INEEL network varies depending on the proximity of a particular sample site to a disposal site, the historical concentration of the radioactive or chemical waste in the water, and the location of the sample site relative to other sites. In general, water samples routinely are collected at 6-month to annual intervals. The wells and streams at which water samples are collected, the method and frequency of sample collection, and the constituents routinely analyzed for are shown on attachment 1. In addition to the routine sampling, some wells periodically may be sampled for other constituents, including chlorine-36, iodine-129, trace metals, and purgeable organic compounds.

In addition to the 170 sites sampled for the routine program, the INEEL Project Office routinely collects water samples from 13 wells near the Naval Reactors Facility (NRF) approximately every 4 months. The purpose of this data-collection program is to provide the DOE's Pittsburgh Naval Reactors Office, Idaho Branch Office, with chemical and radiochemical data to evaluate the effect of NRF activities on the water quality of the Snake River Plain aquifer.

Also in addition to the routine program, the INEEL Project Office collects water samples from 41 wells and 5 springs between the southern boundary of the INEEL and the Hagerman area at 1- to 3-year intervals. This off-site water-quality network was established to monitor natural contaminants and anthropogenic pollutants in the aquifer that potentially could migrate from the INEEL to hydraulically downgradient populated and agricultural areas.

Data-Quality Objectives

Data-quality objectives are qualitative and quantitative criteria that describe the data needed by managers or regulators to support environmental decisions and actions or by scientists to study natural or induced chemical processes in the Snake River Plain aquifer. The first steps of the scientific method are somewhat analogous to and are supported by data-quality objectives. Identifying problems is followed by hypothesizing solutions. Unbiased and thorough scientific experiments are proposed and then conducted, analyzed, and reported in the literature for peer review and use by others.

Data-quality objectives for water samples analyzed by the USGS's National Water Quality Laboratory (NWQL) are included in attachment 2; objectives for radionuclides in water samples analyzed by the U.S. Department of Energy's Radiological and Environmental Sciences Laboratory (RESL) are in attachment 3; and objectives for water samples analyzed by the Department of Defense Environmental Conservation (DODEC) contract laboratory are in attachment 4.

Training Requirements and Site Safety

Training and site safety are important components of the INEEL Project Office's QAP. Employees are not assigned tasks for which they are not adequately trained, and all employees have a stop-work authority if they feel work conditions are not safe. The responsibility for ensuring that employees are adequately trained is shared jointly by the employee and the employee's supervisor. A more detailed description of USGS INEEL Project Office personnel training requirements and site safety requirements are given in the USGS INEEL Site Safety and Job Hazard Analysis Document (Mann, 1995, written commun.).

METHODS

Sample containers, sample preservation methods, field equipment, and well-head decontamination and sample-collection procedures are integral and crucial steps in assuring that data-quality objectives are achieved at the field level. Equally important are the analytical methods, and quality-control and quality-assurance activities exercised by the laboratories that analyze the samples.

Sample Containers and Preservation Methods

Sample containers and preservation methods differ depending on the chemistry of the constituents being analyzed. Samples analyzed by the NWQL are containerized and preserved in accordance with laboratory requirements specified by Timme (1995). Containers and chemical preservatives are supplied by the NWQL, where they undergo a rigorous quality control to ensure that they are free of contamination (Pritt, 1989, p. 75). Samples analyzed by the RESL are containerized and preserved in accordance with requirements specified by the laboratory's Analytical Chemistry Measurements Team; changes in procedures are documented in writing. Samples analyzed as part of the USGS DODEC program are containerized and preserved in accordance with requirements specified by the contract laboratory. Containers and preservatives for selected constituents are summarized on table 1.

Field Equipment

Analytical and other associated equipment used in the field include pH and specific-conductance meters, thermometers, multiparameter intruments, titrators for dissolved oxygen and alkalinity, a peristaltic pump, an in-line disposable filter capsule with a 0.45-micron filter that is certified to be analyte free, and associated glassware. The analytical equipment is housed and usually operated in mobile field laboratories. The purpose of the mobile laboratories is threefold: (1) they provide a relatively clean area to measure field parameters while minimizing the potential for contamination or degradation of the samples from the wind, dust, rain, snow, and sunlight; (2) they are used as storage for sample and shipping containers, chemical reagents and preservatives, analytical instrumentation, and deionized water used for decontaminating equipment in the field; and (3) they provide a place where samples can be containerized, preserved, and placed in shipping containers within minutes after withdrawal from a well or stream.

Instruments used to measure field water-quality parameters, such as pH and specific conductance, are maintained and calibrated in the field or in the laboratory in accordance with procedures specified by the instrument manufacturer. Instrument calibration is checked and, if necessary, instruments are recalibrated at each sampling site; calibration documentation is permanently recorded in a field logbook. A logbook that documents changes to equipment—for example, modifications to pH and conductivity meters—is kept with each meter. An inventory of field equipment is given in attachment 5.

Decontamination Procedures at the Well Head

Wells that are equipped with dedicated submersible or line-shaft turbine pumps do not require decontamination except for the equipment that is attached to the discharge pipe to accommodate the collection of a water sample. Additionally, at least three wellbore volumes of water are pumped from the well to remove stagnant water and to rinse and equilibrate the pump and delivery line. Production wells generally have a spigot at or near the well head; decontamination consists of thoroughly rinsing the spigot with pumped ground water to remove foreign materials.

Sample collection is facilitated and excess water is diverted away from the well head by fitting wells equipped with dedicated pumps with a portable discharge pipe about 2 ft long. The discharge pipe has a 1.5-in. I.D. (inside diameter) and is equipped with a gate valve to control the flow rate. A T-joint is inserted into the pipe between the well head and the control valve. A series of nipples, a valve to control the flow rate of the sampling port, and connectors are attached to the T-joint to reduce the diameter so that a 1/4-in. I.D. delivery line can be attached as a sampling point. The line is made up with two 1/4-in. I.D. nipples connected with a 90-degree elbow to facilitate sample collection. All fittings and pipes are stainless steel and are rinsed with deionized water before installation at the well head. Subsequent flushing with several hundred to thousands of gallons of purged well water further reduces the possibility of cross contamination with water from previously sampled wells. After sample collection, the fittings and pipes are rinsed with deionized water prior to storage to further reduce the chance of cross contamination between wells.

At wells that are not equipped with dedicated pumps, one of two methods is used to collect water samples, depending on the amount of water in the well and depth to water. A generator-powered portable pump is used to collect the sample from wells at which the depth to water is less than 200 ft. The portable pump and attendant hose are decontaminated by flushing many cycles of water and detergent through them and then rinsing the equipment with tap water and then deionized water; 1.5 gal of water is enough to flush the pump and hose one time. Before the pump is installed in a well, it is thoroughly flushed by pumping deionized water through pump and discharge hose. Samples of the deionized-water rinsate periodically are collected and analyzed to document whether the portable pump is contaminated by constituents of interest.

For wells without dedicated pumps and at which the depth to water exceeds 200 ft, and for wells with only a few feet of water in the well-bore or wells that do not produce much water, a bailer is used for collecting water samples. The bailer and that part of the bailer line that enters the well are washed with hot water and detergent and rinsed with deionized water prior to use; samples of the rinsate periodically are collected and analyzed to document whether the equipment is contaminated by constituents of interest. At some wells, bailers are dedicated to and stored in the well casing. This eliminates the possibility of cross contamination of samples from different wells.

Sample Collection

Sample collection by the USGS at the INEEL generally follows protocols established by Wilde and others (1998); however, protocols sometimes are modified to collect the best representative water sample possible. At wells equipped with a dedicated pump or at which a portable pump is used to ensure that water representative of the Snake River Plain aquifer or perched ground-water zone is sampled, a volume of water equivalent to a minimum of 3 wellbore volumes is pumped prior to collecting the samples; at many wells, 5 to 10 wellbore volumes are pumped. The diameter of the wellbore, rather than the volume of the casing is used to calculate the minimum volume because of the potentially large difference between the two. In addition, temperature, specific conductance, and pH are monitored periodically during pumping using methods described by Wood (1981) and Hardy and others (1989). Field measurements made immediately prior to sample collection are used to represent those for the sample. When these

measurements stabilize, indicating probable hydraulic and chemical stability, a water sample is collected using the following steps:

1. The field person responsible for collecting the water sample wears disposable gloves and stands in a position where neither the collector nor the sample can become contaminated.

2. The outside of the sample delivery line is thoroughly rinsed with water pumped from the well.

3. If appropriate, sample containers and filtration equipment are thoroughly rinsed with water pumped from the well or surface-water site before being used. A new, disposable capsule filter with a 0.45-micron membrane filter is used at each site. The capsule filter is inverted to clear trapped air bubbles and one liter of deionized water or water from the well is used to rinse the capsule filter prior to sample collection. This removes any surfactants that are adhered to the filter.

4. For ground-water samples from wells equipped with dedicated pumps, the capsule filter is connected to the sample port with precleaned Tygon tubing; unfiltered samples are collected directly from the sample port. For surface-water samples and bailer samples, a grab sample is collected in a pre-cleaned container and the inlet tubing of a peristaltic pump is placed into the container to supply sample water to the capsule filter. Unfiltered samples are collected by submersing the sample container into the surface-water body or drawing water from a precleaned container.

5. Samples are capped and moved into the mobile field laboratory where they are uncapped and preserved (if appropriate) as described in table 1. A new pair of gloves, safety glasses, and a lab apron are worn while preserving samples.

6. The bottles are capped and the caps are sealed with laboratory film. The bottles then are labeled (see fig. 1 for example of label). An alternate method for labeling containers is to record information directly on the sample container using a permanent marker. Recording the information both on a label and directly on the bottle is the preferable option.

LOCATION=	1 OF 1
STA NAME=	SPEC COND=
DATE=	TIME=
SAMP SIZE=	pH=
DISCHAGE=	TREATMENT=
W TEMP=	A TEMP=
SAMPLE TYPE=	SCHEDULE=

Figure 1. Label attached to each sample bottle.

7. Field measurements are made again after samples are collected. If the temperature differs by more than 0.5 °C, the pH differs by more than 0.1 units, or the conductance differs by more than 5 percent, the measurements are verified and a second set of samples are collected.

8. A laboratory request schedule is completed for use by each laboratory to which the sample(s) will be sent for analysis (see figs. 2-4 for examples). .

9. The water samples are chilled to 4 °C if necessary, and stored in the field laboratory until they can be transferred to a secured storage area. Samples are transported to the analyzing laboratory as soon as reasonably possible. Samples sent to the NWQL for analysis are transported in a sealed ice chest by a contract carrier; overnight delivery is stipulated for water samples for analyses of nutrients, total organic carbon, and purgeable organic compounds. Samples sent to the RESL for analysis are hand carried to the laboratory. Samples for the DODEC contract laboratory, with short holding times, are shipped by overnight delivery on the same day as the sampling.

10. All equipment is decontaminated with deionized water and, if necessary, organic-free water.

Some wells completed in the perched-water zones do not contain or produce enough water to be sampled with a portable pump. For these wells, either a 1,000-mL Teflon bailer or a 1,000-mL galvanized bailer normally is used for sample collection. The well is bailed until enough water is collected for all the samples required or until the well is bailed dry. When the bailer is retrieved, its

U.S. GEOLOGICAL SURVEY – NATIONAL WATER QUALITY LABORATORY
ANALYTICAL SERVICES REQUEST

THIS SECTION MANDATORY FOR SAMPLE LOGIN

NWIS RECORD NUMBER
SAMPLE TRACKING ID

User Code

Project Account

LAB USE ONLY
NWQL LABORATORY ID

STATION ID | 2 0 Begin Date (YYYYMMDD) | Begin Time | Medium Code | Sample Type

District Contact Phone Number | End Date (YYYYMMDD) | End Time | **District Contact Email**

SITE / SAMPLE / SPECIAL PROJECT INFORMATION (Optional)

State | County | Geologic Unit Code | Analysis Status* | Analysis Source* | Hydrologic Condition* | Hydrologic Event* | Chain of Custody | Sample Set

NWQL Proposal Number | NWQL Contact Name | NWQL Contact Email | Program/Project

Station Name: _____ Field ID: _____

Comments to NWQL: _____

Hazard (please explain): _____

ANALYTICAL WORK REQUESTS: SCHEDULES AND LAB CODES (CIRCLE A=add D=delete)

SCHED 1: _____ SCHED 2: _____ SCHED 3: _____ SCHED 4: _____ SCHED 5: _____ SCHED 6: _____

Lab Code: _____ A D Lab Code: _____ A D Lab Code: _____ A D Lab Code: _____ A D Lab Code: _____ A D
Lab Code: _____ A D Lab Code: _____ A D Lab Code: _____ A D Lab Code: _____ A D Lab Code: _____ A D
Lab Code: _____ A D Lab Code: _____ A D Lab Code: _____ A D Lab Code: _____ A D Lab Code: _____ A D

SHIPPING INFORMATION (Please fill in number of containers sent)

___ ALF	___ COD	___ FA	___ FCN	___ IQE	___ IRM	___ RA	___ RU	___ SUR	___ TPCN
___ BGC	___ CRB	___ FAM	___ FU	___ IQL	___ MBAS	___ RAM	___ RUR	___ SUSO	___ UAS
___ C18	___ CU	___ FAR	___ FUS	___ IQM	___ OAG	___ RAR	___ RURCT	___ TBI	___ WCA
___ CC	___ CUR	___ FCA	___ GCC	___ IRE	___ PHE	___ RCB	___ RURCV	___ TBY	___ _____
___ CHY	___ DOC	___ FCC	___ GCV	___ IRL	___ PIC	___ RCN	___ RUS	___ TOC	___ _____

NWQL Login Comments: _____

Collected by: _____ Phone No. _____ Date Shipped: _____

FIELD VALUES

Lab/P Code	Value	Remark	Lab/P Code	Value	Remark	Lab/P Code	Value	Remark
21/00095 Specific Conductance uS/cm @ 25 deg C			51/00400 pH Standard Units			2/39086 Alkalinity – IT mg/L as CaCO3		
/			/			/		

Field Comments: _____

*MANDATORY FOR NWIS

Form 9-3094
(August 2000)

Figure 2. Analytical services request form for the National Water Quality Laboratory.

UNITED STATES DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE
RADIOLOGICAL AND ENVIRONMENTAL SCIENCES LABORATORY
SAMPLE RECORD SHEET

ONSITE_____
OFFSITE_____

Routine_____ Urgent_____

Non-Routine____ Date Needed_____

Serial No._____

Sample From: _____

Collected By:_____ Date Sent: _____

Organization: _____

Sample Received: _____

Analysis Completed: _____

Notified: _____ Date: _____

Analyzed By: _____

Approved By: _____

SAMPLE NO.	Date	Hour	SAMPLE DESCRIPTION	Anal. for	Inst. Used	Quant Used	Date Cntc.	Count Time	Gross Count	BKGD.	Net Count		RESULTS ± 1S;O (attached)

Figure 3. Sample record sheet for the Radiological and Environmental Sciences Laboratory.

Chain of Custody Record

SEVERN TRENT **STL**

Severn Trent Laboratories, Inc.

STL Denver
4955 Yarrow Street
Arvada, CO 80002

STL-4124 (0901)

Client	Project Manager	Date	Chain of Custody Number 286125
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page _____ of _____
City / State / Zip Code	Site Contact / Lab Contact	Analysis (Attach list if more space is needed)	Special Instructions/ Conditions of Receipt
Project Name and Location (State)	Carrier/Waybill Number		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH		Analysis	Special Instructions/ Conditions of Receipt

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other_____

QC Requirements (Specify)

Relinquished By	Date	Time	Received By	Date	Time
1.			1.		
2.			2.		
3.			3.		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Figure 4. Sample request and chain-of-custody record for the Severn Trent Laboratory.

contents either are placed directly in bottles for raw samples or in a precleaned container as described in step 4. Field measurements are made on excess water from the bailer or in the precleaned container. After the sample bottle is filled with either raw or filtered water, samples are preserved appropriately and labeled, stored, and shipped as described in steps 6-9.

One perched-water well contains enough water to use a portable pump but because of a low recovery rate the well pumps dry before two or three wellbore volumes can be pumped. For this well, a sample is collected when temperature, pH, and specific conductance measurements stabilize. If the well pumps dry before measurements stabilize, the field person waits for the well to recover to collect a pumped or bailed sample or, if the well does not recover, a grab sample is collected from the prerinsed bucket into which water is discharged while pumping. Exceptions such as these to usual sample-collection procedures are described in the field logbook.

Wells inside the Test Reactor Area and the INEEL Comprehensive Environmental Response, Compensation and Liability Act Disposal Facility (ICDF) require containerization of all purge water. These wells are purged at slow rates to minimize the amount of purge water. After three stable readings of temperature, pH, and specific conductance are obtained, they are sampled.

An added precaution against cross contamination is used at wells that are sampled with a portable submersible pump or bailer. The concentrations of most contaminants are greatest in wells nearest disposal sites and decrease with increasing distance. Therefore, when conditions permit, the most distant wells are sampled first. This method of sampling minimizes the potential for cross contamination.

Conditions at the well during sample collection are recorded in a bound field logbook (fig. 5) and a chain-of-custody record (fig. 6) is used to track samples from the time of collection until delivery to the RESL or until mailing to the NWQL. These records are available for inspection at the USGS INEEL Project Office. The chain-of-custody record for the current DODEC contract laboratory, Severn Trent Laboratories, is shown in figure 4.

QUALITY ASSURANCE

The USGS's Quality-Assurance Program at the INEEL Project Office incorporates the previously described methods of sample collection and processing with several other elements: (1) analytical methods used by the laboratories; (2) quality-control samples; (3) review of analytical results of chemical constituents provided by the laboratories; (4) audits of performance in the field and in the laboratory; (5) corrective actions to resolve problems with field and laboratory methods; and (6) reporting of data. These elements effectively are performed to assure the following: (1) reliability of the water-quality data; (2) compatibility of the data with data collected by other organizations at the INEEL; and (3) the data meet the programmatic needs of the DOE and its contractors and the scientific and regulatory communities.

Analytical Methods and Quality-Control Samples

A detailed description of internal quality control and of the overall quality-assurance practices used by the NWQL is provided in reports by Friedman and Erdmann (1982) and Pritt and Raese (1995); quality-control practices at the laboratory are described by Jones (1987); and quality-assurance data for routine water analyses are presented in a report by Maloney and others (1993). Additional quality assurance instituted by the INEEL Project Office includes collection and analysis of the following: (1) duplicate samples—two or more samples collected concurrently or sequentially and sent to different laboratories; (2) blind replicates—duplicate samples with different sample identification numbers submitted to a laboratory; (3) blank samples—samples of deionized water sent to a laboratory and identified as routine samples; (4) equipment blanks—rinsate collected during decontamination procedures; (5) splits—large sample volumes divided into two or more equal volumes and sent to different laboratories for

Date:____/____/____ Time:_____ Weather conditions:_____

Site Id No:_____ Local Site Id_____

Purpose of Sampling:_____

Type of Sample (circle one): Ground water Surface water Other_____

Number of Containers:_____ Size of Containers/Method of Preservation:_____

_____

Laboratory Schedules Requested:_____

Descriptions of Sampling Point:(82398)_____

Equip. Serial Nos: pH_____ Specific Cond. _____ Other (specify)_____

Instrument Calibrations:

Specific Cond. Yes No Value of Standard Solution_____

pH Yes No Number of Buffers____Values of Buffers_____

Other (specify)_____

Equipment Maintenance:_____

Decontamination Procedures:_____

Field Measurements: Sampling Agency (00027) = USGS (1028)

Water Temp °C(00010) = _____ pH(00400) = _____ Sp.C. uS/cm(00095) = _____

Alk.as CaCO3(00410) = _____ DO(00300) = _____ Turb.(00076) = _____

Other(s)_____

References (maps, etc.):_____

Name and Affiliations of Observers:

1. _____ 2._____

Field Observations (notes, photos, drawings, pumping period and rate, etc.):

Pump on @ _____ TIME | T C pH | T C Sp.Cond. |

WL = _____ TD = _____ _____|_____| _____|_____

Dia = _____ Q = _____ _____|_____| _____|_____

Min/Vol = _____ _____|_____| _____|_____

RESL @ _____ _____|_____| _____|_____

Latitude_____ _____|_____| _____|_____

Longitude_____ _____|_____|_____|_____

Comments:_____

Collector's Names (please print), Signatures, and Date:

Name_____ Signature_____ Date_____

Name_____ Signature_____ Date_____

Name_____ Signature_____ Date_____

Figure 5. Sheet from Water-Quality Field Logbook.

U.S. Geological Survey
INEEL CF 690 Room 173
Scoville, IDAHO 83415

CHAIN OF CUSTODY RECORD

Page_____ of _____ pages

Proj. No.

Samplers: (Signatures)

Local I.D.	Date Collected	Time Collected	Type	Location			No. of containers										Remarks
				Lat.	Long.	Seq. no.											

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Lab by: (Signature)	Date/Time	Remarks	

Figure 6. Chain-of-custody record.

analysis; (6) trip blanks—laboratory supplied samples of boiled deionized water that travel with water samples from time of collection to time of analysis; and (7) spiked samples—samples to which a known concentration of a constituent is added. Analytical methods used by the NWQL are described by Faires (1992), Fishman (1993), Fishman and Friedman (1989), Goerlitz and Brown (1972), Rose and Schroeder (1995), Thatcher and others (1977), and Wershaw and others (1987). The type of analysis and analytical procedure are specified on the NWQL services request form (fig. 2).

A discussion of procedures used by the RESL for the analysis of radionuclides in water is provided in reports by Bodnar and Percival [eds.] (1982) and U.S. Department of Energy (1995). Additional quality assurance implemented by the INEEL Project Office for samples sent to the RESL is consistent with procedures used for samples sent to the NWQL. The type of analysis to be performed on a water sample is specified on the RESL sample record sheet (fig. 3).

A discussion of procedures used by the current DODEC contract laboratory, Severn Trent Laboratories, is provided in a report by Quanterra Environmental Services (1998). Quality-assurance samples for each NRF DODEC sampling round includes field-blank and replicate samples. A trip-blank sample for purgeable organic compound analysis is collected annually. The type of analysis to be performed on a water sample is specified on the contract laboratory sample request sheet (fig. 4).

In general, about 10 percent of the samples collected are dedicated to quality assurance. That is, for every 10 samples submitted to one of the laboratories for analysis, at least one is a blind replicate, a blank, a split, or another type of quality-assurance sample. For samples that are to be analyzed for non routine constituents, 15 to 20 percent of the samples are dedicated to quality assurance.

Comparative studies to determine agreement among analytical results for water-sample pairs analyzed by laboratories involved in the INEEL Project Office quality-assurance program are summarized by Wegner (1989), Williams (1996, 1997), and Williams and others (1998). Additional quality-assurance studies by personnel at the INEEL Project Office include an evaluation of field-sampling and preservation methods for strontium-90 (Cecil and others, 1989), a comparison of different pump types used for sampling purgeable organic compounds (Knobel and Mann, 1993), an analysis of tritium and strontium-90 concentrations in water from wells after purging different borehole volumes (Bartholomay, 1993), an analysis of the effect of different preservation methods on nutrient concentrations (Bartholomay and Williams, 1996), and an analysis of two analytical methods for the determination of gross alpha- and beta-particle radioactivity (Bartholomay and others, 1999).

Review of Analyses

After the analytical results are obtained from the analyzing laboratory, the concentration of each constituent of interest is reviewed by personnel at the INEEL Project Office for consistency, precision, and accuracy. Factors considered during the review are:

1. The historical concentration of the solute at the site where the sample was collected;

2. The concentration of the solute in replicate, split, blank, or other quality-assurance samples;

3. The concentration of the solute in nearby wells that obtain water from the same aquifer or perched-water zone;

4. A review of waste-disposal records and changes in disposal techniques, land use, and recharge that may influence the concentration of a solute(s);

5. Cation-anion balance of analyses for which common ions are analyzed; and

6. Other accepted tests for accuracy of analytical results, when appropriate (Hem, 1985, p. 163-165).

Constituents for which previous analyses have been made are reviewed for consistency with items 1, 2, and 3. If a constituent exceeds or is less than the historical data, if it differs markedly from the

concentration in water from nearby wells, or if an initial analysis for a solute exceeds 80 percent of the maximum contaminant level (MCL) for that constituent set by the Environmental Protection Agency, either a re-analysis by the laboratory is requested or a second sample is collected and analyzed to verify the concentration of the solute in the water. If resampling is necessary, replicates generally are collected to evaluate laboratory precision. Constituents for which MCLs have been proposed or established are shown on tables 2-8.

If analytical results indicate that concentrations in samples from one site vary by more than 50 percent for no obvious reason, the results are evaluated by replicate sampling. If the analytical results for the replicates do not agree, the analyzing laboratory is contacted to resolve the problem.

Performance Audits

Performance audits are conducted routinely at three levels: (1) at the field level, (2) at the laboratory level, and (3) through National Field Quality Assurance Tests. At the field level, the Project Chief or a designee routinely accompanies the field personnel to a selected number of sites to ascertain whether proper field techniques are used to collect and preserve the samples and to ensure safety procedures. The field auditor's checklist is given in attachment 6. Replicate and split samples are used to evaluate the precision of the field and laboratory methods; spikes and reference samples are used to measure accuracy.

The INEEL Project Office participates in the National Field Quality Assurance Program established by the USGS to evaluate the accuracy of water-quality field measurements. Quality-assurance samples are sent to field personnel for testing. The results are sent back to the water-quality service unit for evaluation. If field personnel or equipment do not pass the test, corrective action is taken. The program is described in detail by Erdmann and Thomas (1985).

In addition to the routine performance audits, water-quality activities at the INEEL Project Office periodically are monitored and reviewed by other USGS personnel; the Water-Quality Specialist for the Idaho District, Boise, Idaho; personnel at the Office of the Regional Hydrologist, Western Region, Menlo Park, Calif.; and personnel at the Office of Water Quality at Headquarters, Reston, Va. Reviews by personnel at the Idaho District take place at 1- to 2-year intervals and by the Western Region Office and Office of Water Quality at 2- to 3-year intervals. The reviews are summarized in writing and distributed to the Project Office, Regional Office, and the Office of Water Quality. If deficiencies are documented, a written reply outlining corrective action is required by the Project Office.

Corrective Actions

If the performance audits indicate inconsistencies or inadequacies in field methods or in analytical results by the laboratories, the problems are documented and the field personnel or laboratories are notified in writing of the inconsistencies or inadequacies. Training is provided to the field personnel as needed and the frequency of performance audits is increased until the performance is judged by the INEEL Project Office Chief as suitable and consistent with written guidelines.

Inconsistencies and inadequacies in laboratory analyses are discussed with or submitted in writing to the appropriate laboratory director, who is responsible for initiating the appropriate action to resolve the problem. To evaluate whether appropriate actions are taken, the frequency and numbers of replicate, blank, split, or other quality-assurance samples are increased until it is demonstrated that problems in the laboratory methods are resolved.

If project-office personnel discover a problem with sampling procedures, equipment calibration, or data review analysis and interpretation that cannot be resolved at the project level, the Idaho District Water-Quality Specialist is notified of the problem. If he or she cannot resolve the problem in consultation with the Regional Water-Quality Specialist, the problem may be referred to the Office of Water Quality or National Research Program, where research hydrologists and chemists will aid in resolving the problem.

Reporting of Data

All data collected by the USGS INEEL Project Office are publically available, after review, and most data are published in data reports and used in interpretive reports. Water-quality information, subsequent to its review, is entered into the National Water Information System (NWIS) and periodically merged with a nationally-accessible database. Data that suggest that there could be a human health or environmental problem are provided to managerial agencies such as the DOE and to regulatory agencies, such as the State of Idaho's Department of Health and Welfare and the U.S. Environmental Protection Agency, Region 10. After data have been reviewed and verified by resampling if necessary, they are available to the general public either upon request or through the USGS public web page at http://waterdata.usgs.gov/nwis.

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Table 1. Containers and preservatives used for water samples, Idaho National Engineering and Environmental Laboratory and vicinity

[Abbreviations: mL, milliliter; L, liter; N, normal. Symbols: HNO_3, nitric acid; H_2SO_4, sulfuric acid; HCl, hydrochloric acid; °C, degrees Celsius. Analyzing laboratory: NWQL—U.S. Geological Survey's National Water Quality Laboratory; DODEC—Department of Defense Environmental Conservation contract laboratory; RESL—U.S. Department of Energy's Radiological Environmental Sciences Laboratory]

Type of constituent	Container		Preservative		Other treatment	Analyzing laboratory
	Type	Size	Type	Volume		
Anions, dissolved	Polyethylene	250 mL	None	None	Filter	NWQL
Anions, dissolved	Polyethylene	1 L	None	None	Filter	DODEC
Cations, dissolved	Polyethylene, acid rinsed	250 mL	Ultrex HNO_3	2 ml	Filter	NWQL
Cations, total	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	DODEC
Metals, dissolved	Polyethylene, acid rinsed	250 mL	Ultrex HNO_3	2 ml	Filter	NWQL
Metals, total	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	DODEC
Mercury, dissolved	Glass, acid rinsed	250 mL	6N OmniTrace HCl	2 mL	Filter	NWQL
Mercury, total	Glass, acid rinsed	250 mL	6N OmniTrace HCl	2 mL	None	NWQL
Chromium, dissolved	Polyethylene, acid rinsed	250 mL	Ultrex HNO_3	2 ml	Filter	NWQL
Nutrients, dissolved	Polyethylene, brown	125 mL	None	None	Filter, chill 4°C	NWQL
Nutrients, total	Glass, baked	500 mL	H_2SO_4	2 mL	Chill, 4°C	DODEC
Purgeable organic compounds	Glass, baked	40 mL	None	None	Chill, 4°C	NWQL
Purgeable organic compounds	Glass	40 mL	HCl	4 drops	Chill, 4°C	DODEC
Semi-volatile organic compounds	Glass, baked	2 L	None	None	Chill, 4°C	DODEC
Total organic halogens	Glass, baked	250 mL	H_2SO_4	1 mL	Chill, 4°C	DODEC
Total organic carbon	Glass, baked	125 mL	None	None	Chill, 4°C	NWQL
Gross alpha- and beta-particle radioactivity	Polyethylene, acid-rinsed	2 L	HNO_3	4 mL/ bottle	Filter	NWQL
	Polyethylene, acid-rinsed	500 mL	HNO_3	2 mL	None	RESL
Pesticides	Glass, baked	1 L	None	None	Chill, 4°C	NWQL
Tritium	Polyethylene	500 mL	None	None	None	DODEC

Table 1. Containers and preservatives used for water samples, Idaho National Engineering and Environmental Laboratory and vicinity-Continued

Type of constituent	Container		Preservative		Other treatment	Analyzing laboratory
	Type	Size	Type	Volume		
Tritium (cont.)	Polyethylene	1 L	None	None	None	NWQL
	Polyethylene	125 mL	None	None	None	RESL
	Polyethylene	500 mL	None	None	None	RESL
Strontium-90	Polyethylene, acid-rinsed	1 L	HNO_3	4 mL	Filter	NWQL
	Polyethylene, acid-rinsed	500 mL	HNO_3	2 mL	None	RESL
Gamma spectroscopy	Polyethylene, acid-rinsed	2 L	HNO_3	4 mL/ bottle	Filter	NWQL
	Polyethylene, acid-rinsed	500 mL	HNO_3	2 mL	None	RESL
Transuranics	Polyethylene, acid-rinsed	1 L	HNO_3	4 mL	None	RESL

Table 2. Maximum contaminant levels of types of radioactivity and selected radionuclides in drinking water

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2000, p. 344) for community water systems and are included for comparison purposes only. The maximum contaminant level given for gross alpha-particle radioactivity includes radium-226 but excludes radon and uranium. The maximum contaminant level given for gross beta-particle and gamma radioactivity excludes radioactivity from natural sources and is included for comparison purposes only. Maximum contaminant levels given for strontium-90 and tritium are average annual concentrations assumed to produce a total body or organ dose of 4 millirem per year (mrem/yr) of beta-particle radiation. Abbreviation: pCi/L, picocurie per liter]

Radionuclide or type of radioactivity	Maximum contaminant level
Gross alpha-particle radioactivity	15 pCi/L
Gross beta-particle and gamma radioactivity	4 mrem/yr
Strontium-90	8 pCi/L
Tritium	20,000 pCi/L

Table 3. Maximum or secondary maximum contaminant levels and minimum reporting levels of selected trace elements in drinking water

[The maximum contaminant levels are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994b; 2000, p. 343, 421) for community water systems and are for comparison purposes only. Secondary maximum contaminant levels—in brackets—are from U.S. Environmental Protection Agency (2000, p. 613). Minimum reporting levels are given for all analytical methods used for the INEEL Project Office sample programs. Units are in micrograms per liter (µg/L). Symbols: #, arsenic has a new maximum contaminant level of 10 µg/L (U.S. Environmental Protection Agency, 2001, written commun.); ••, maximum contaminant level has not been established; *, lead has an action level of 15 µg/L]

Trace element	Maximum or secondary maximum contaminant level	Minimum reporting level
Aluminum	[50 to 200]	1, 15, 100
Arsenic#	10	0.9, 1, 1.9, 10
Antimony	6	0.048, 10
Barium	2,000	0.7, 0.9, 1, 10
Beryllium	4	0.06, 1.6, 2
Boron	••	13
Cadmium	5	0.037, 0.11, 5, 8
Chromium	100	0.8, 1, 5, 14
Cobalt	••	0.015, 13
Copper	[1,000]	0.23, 10, 20
Iron	[300]	10, 100
Lead	*	0.08, 1, 3, 100
Lithium	••	3.9
Manganese	[50]	0.1, 2.2, 3.2, 10
Mercury	2	0.01, 0.2, 0.23
Molybdenum	••	0.2, 34
Nickel	100	0.06, 40
Selenium	50	2.4, 2.6, 5
Silver	[100]	0.43, 1, 7, 10
Strontium	••	0.8, 1
Thallium	2	0.9, 10
Uranium	••	0.018
Vanadium	••	1, 10
Zinc	[5,000]	1, 20

Table 4. Maximum or secondary maximum contaminant levels and minimum reporting levels of selected common ions in drinking water

[The maximum contaminant levels are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2000, p. 343) for community water systems and are for comparison purposes only. Secondary maximum contaminant levels—in brackets—are from U.S. Environmental Protection Agency (2000, p. 613). Minimum reporting levels are given for all analytical methods used for the INEEL Project Office sample programs. Units are in milligrams per liter. Symbol: ••, maximum contaminant level has not been established]

Constituent	Maximum or secondary maximum contaminant level	Minimum reporting level
Bromide	••	0.01
Calcium	••	0.011, 0.2
Chloride	[250]	0.08, 3.0
	••	
Fluoride	4	0.16
	[2]	
Magnesium	••	0.008, 0.2
Potassium	••	0.09, 5.0
Silica	••	0.09, 0.48
Sodium	••	0.06, 5.0
Sulfate	[250]	0.11, 5.0
	••	

Table 5. Maximum contaminant levels and minimum reporting levels of selected nutrients, organic carbon, and total organic halogens in drinking water

[The maximum contaminant levels are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2000, p. 42) for community water systems and are for comparison purposes only. Minimum reporting levels are given for all analytical methods used for the INEEL Project Office sample programs. Units are in milligrams per liter. Symbol: ••, maximum contaminant level has not been established]

Constituent	Maximum contaminant level	Minimum reporting level
Ammonia (as nitrogen)	••	0.02
Nitrite (as nitrogen)	••	0.01, 0.5
Nitrite plus nitrate (as nitrogen)	10	0.05, 0.1
Orthophosphate (as phosphorus)	••	0.01, 0.05
Total kjeldahl nitrogen	••	0.5
Dissolved organic carbon	••	0.1
Total organic carbon	••	0.1, 1
Total organic halogens	••	0.03

Table 6. Maximum contaminant levels and minimum reporting levels of selected insecticides in drinking water

[Abbreviations: MCL, maximum contaminant level; MRL, minimum reporting level; MDL, method detection limit. MCLs were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2000, p. 420-421) for community water systems and are included for comparison purposes only. MRLs are from Timme (1995). MDLs are from Zaugg and others (1995). Units are in micrograms per liter. Symbols: ••, MCL has not been established or proposed; **, chlorthalonil is a fungicide, DNOC is considered an insecticide and herbicide]

Carbamate insecticides

Insecticide	MCL	MRL	Insecticide	MCL	MRL
Aldicarb	3	0.55	Methomyl	••	0.017
Aldicarb sulfone	2	.10	Oxamyl	200	.018
Aldicarb sulfoxide	4	.021	Propham	••	.035
Methiocarb	••	.026	Propoxur	••	.035

Additional insecticides

Insecticide	MCL	MRL	MDL	Insecticide	MCL	MRL	MDL
Azinphos methyl-	••	0.038	0.001	Fonofos	••	0 .008	0 .003
Carbaryl (Sevin)	••	.046	.003	HCH, alpha-	••	.007	.002
Carbofuran	40	.12	.003	HCH, gamma- (Lindane)	0.2	.011	.004
Chlorpyrifos	••	.005	.004	Hydroxycarbofuran, 3-	••	.014	.014
**Chlorthalonil	••	.48	.035	Malathion	••	.010	.005
DDE, p,p'-	••	.010	.006	Parathion, ethyl-	••	.022	.004
Diazinon	••	.008	.002	Parathion, methyl-	••	.035	.006
Dieldrin	••	.008	.001	Permethrine, cis-	••	.019	.005
Dinoseb	••	.035	.035	Phorate	••	.011	.002
Disulfoton	••	.028	.017	Propargite I & II	••	.006	.013
**DNOC	••	.42	.035	Terbufos	••	.012	.013
Ethoprop	••	.012	.003				

Table 7. Maximum contaminant levels and minimum reporting levels of chlorophenoxy-acid herbicides and other herbicides in drinking water

[Abbreviations: MCL, maximum contaminant level; MRL, minimum reporting level; MDL, method detection limit. MCLs were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2000, p. 420-421) for community water systems and are included for comparison purposes only. MRLs are from Timme (1995). MDLs are from Zaugg and others (1995). Units are in micrograms per liter. Symbols: ••, MCL has not been established or proposed; *, samples analyzed using two different laboratory schedules with different MRLs]

Chlorophenoxy-acid herbicides					
Herbicide	**MCL**	**MRL**	**Herbicide**	**MCL**	**MRL**
*2,4-D	70	0.01	*Silvex	50	0.01
(dissolved)	70	.15	(dissolved)	••	.021
2,4-DB	••	.24	*2,4,5-T	••	.01
2,4-DP	••	.01	(dissolved)	••	.035

Other herbicides							
Herbicide	**MCL**	**MRL**	**MDL**	**Herbicide**	**MCL**	**MRL**	**MDL**
Acetochlor	••	0.009	0.002	*Linuron	••	0.039	0.002
Acifluorfen	••	.035	.035	(dissolved)	••	.018	.018
Alachlor	2	.009	.002	MCPA	••	.17	.050
Atrazine	3	.017	.001	MCPB	••	.14	.035
Atrazine, desethyl-	••	.007	.002	Metolachlor	••	.009	.002
Benfluralin	••	.013	.002	Metribuzin	••	.012	.004
Bentazon	••	.014	.014	Molinate	••	.007	.004
Bromacil	••	.035	.035	Napropamide	••	.010	.003
Bromoxynil	••	.035	.035	Neburon	••	.015	.015
Butylate	••	.008	.002	Norflurazon	••	.024	.024
Chloramben	••	.42	.011	Oryzalin	••	.31	.019
Clopyralid	••	.23	.050	Pebulate	••	.009	.004
Cyanazine	••	.013	.004	Pendimethalin	••	.018	.004
*DCPA (Dacthal)	••	.004	.002	Picloram	500	.050	.050
(dissolved)	••	.017	.017	Prometon	••	.008	.018
Dicamba	••	.035	.035	Pronamide	••	.009	.003
Dichlobenil	••	1.2	.020	Propachlor	••	.015	.007
Dichlorprop	••	.032	.032	Propanil	••	.016	.004
Diethylaniline	••	.006	.003	Simazine	4	.008	.005
Diuron	••	.020	.020	Tebuthiuron	••	.015	.010
EPTC (Eptam)	••	.005	.002	Terbacil	••	.030	.007
Ethalfluralin	••	.013	.004	Thiobencarb	••	.008	.002
Fenuron	••	.013	.013	Triallate	••	.008	.001
Fluometuron	••	.035	.035	Triclopyr	••	.25	.050
				Trifluralin	••	.012	.002

Table 8. Maximum contaminant levels and minimum reporting levels of selected purgeable organic compounds in drinking water

[Analyses performed by the U.S. Geological Survey National Water Quality Laboratory use an analytical method equivalent to U.S. Environmental Protection Agency method 524.2. Abbreviations: MCL, maximum contaminant level; MRL, minimum reporting level. MCLs were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994b; 2000, p. 419) for community water systems and are included for comparison purposes only. MRLs are from Timme (1995). Units are in micrograms per liter (µg/L). Symbols: ••, MCL has not been established or proposed; *, total trihalomethanes—which include bromoform, chlorodibromomethane, chloroform, and dichlorobromomethane—in community water systems serving 10,000 or more persons cannot exceed 100 µg/L (U.S. Environmental Protection Agency, 2000, p. 343)]

Compound	MCL	MRL	Compound	MCL	MRL
Acrylonitrile	••	2.5	1,3-Dichloropropane	••	0.2
Benzene	5	.2	2,2-Dichloropropane	••	.2
Bromobenzene	••	.2	cis-1,3-Dichloropropene	••	.2
Bromochloromethane	••	.2	trans-1,3-Dichloropropene	••	.2
Bromoform	*	.2	1,1-Dichloropropene	••	.2
Bromomethane	••	.2	Ethylbenzene	700	.2
n-Butylbenzene	••	.2	Hexachlorobutadiene	••	.2
sec-Butylbenzene	••	.2	Isopropylbenzene	••	.2
tert-Butylbenzene	••	.2	p-Isopropyltoluene	••	.2
Carbon tetrachloride	5	.2	Methylene chloride	5	.2
Chlorobenzene	100	.2	Methyl tert-butylether	••	.2
Chlorodibromomethane	*	.2	Naphthalene	••	.2
Chloroethane	••	.2	n-Propylbenzene	••	.2
Chloroform	*	.2	Styrene	100	.2
Chloromethane	••	.2	1,1,1,2-Tetrachloroethane	••	.2
2-Chlorotoluene	••	.2	1,1,2,2-Tetrachloroethane	••	.2
4-Chlorotoluene	••	.2	Tetrachloroethylene	5	.2
1,2-Dibromo-3-chloropropane	.2	1	Toluene	1,000	.2
1,2-Dibromoethane	.05	.2	1,2,3-Trichlorobenzene	••	.2
Dibromomethane	••	.2	1,2,4-Trichlorobenzene	70	.2
1,2-Dichlorobenzene	600	.2	1,1,1-Trichloroethane	200	.2
1,3-Dichlorobenzene	600	.2	1,1,2-Trichloroethane	5	.2
1,4-Dichlorobenzene	75	.2	Trichloroethene	5	.2
Dichlorobromomethane	*	.2	Trichlorofluoromethane	••	.2
Dichlorodifluoromethane	••	.2	1,2,3-Trichloropropane	••	.2
1,1-Dichloroethane	••	.2	1,1,2-Trichloro 1,2,2-trifluoroethane	••	.2
1,2-Dichloroethane	5	.2	1,2,4-Trimethylbenzene	••	.2
cis-1,2-Dichloroethene	70	.2	1,3,5-Trimethylbenzene	••	.2
1,1-Dichloroethene	7	.2	Vinyl chloride	2	.2
trans-1,2-dichloroethene	100	.2	Xylenes, total ortho, meta, and para	10,000	.2
1,2-Dichloropropane	5	.2			

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ATTACHMENTS

TABLES 9–10

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Attachment 1—FIELD SCHEDULE SHOWING WELL AND PUMP INFORMATION AND SAMPLING SCHEDULES FOR SELECTED WELLS AND STREAMFLOW SITES

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)			RESL			NQWL	Field value		
						Apr	Jul	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper -ature	pH	SC
		ANP 6	Pump 45 gpm	12	305		14								
		ANP 9	Pump 20 gpm	12	322		35								
		Arbor Test	Pump 20 gpm	16	790		2								
		AREA II	Pump 18 gpm	16	877		14								
		Atomic City*	Spigot	8	639		9								
		Badging Facility	Pump 35 gpm	8	644		14								
		BLR (near Mackay)	Surface water			4		4							
		BLR (near Arco)	Surface water			4		4							
		BLR (INEL Div.)*	Surface water			4		4							
		BLR (Dairy Farm)*	Surface water			4		4							
		Birch Creek*	Surface water			1		1							
		CFA 1*	Pump 1000 gpm	16	685	13		14							
		CFA 2*	Pump 1400 gpm	20	681	13		14							
		CFA LF 2-10	Pump 8.3 gpm	6	765	26		27							
		CFA LF 3-9	Pump 7.5 gpm	4	500		23								
		CPP 1	Pump 3000 gpm	20	585	28		29							
		CPP 2	Pump 3000 gpm	16	605		43								
		CPP 4	Pump 400 gpm	16	700		43								
		CWP 1	Bail @65 feet	10	66.0		6								
		CWP 3	Bail @60 feet	10	60.5		6								
		CWP 8	Bail @65 feet	10	66.0		6								
		EBR-I	Pump 25 gpm	12	1075		38								

Attachment 1—FIELD SCHEDULE SHOWING WELL AND PUMP INFORMATION AND SAMPLING SCHEDULES FOR SELECTED WELLS AND STREAMFLOW SITES

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)			RESL			NQWL	Field value		
						Apr	Jul	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper -ature	pH	SC
		Highway 3*	Spigot	8	750		38								
		ICPP-MON-A-166	Pump 6 gpm	6	527	47		47							
		ICPP-MON-A-167	Pump 4 gpm	6	502	47		47							
		IET Disp	Pump 46 gpm	20	324		14								
		Leo Rogers 1	Pump 20 gpm	20	702		15								
		Little Lost River	Surface water			1		1							
		MTR Test	Pump 26 gpm	8	588	11		12							
		Mud Lake*	Surface			1		1							
		No Name 1 (Tan Expl.)	Pump 42 gpm	12	550		35								
		NRF 6***	Pump 30 gpm	8	417										
		NRF 7***	Pump 2.5 gpm#	10	417										
		NRF 8***	Pump 30 gpm	8	423										
		NRF 9***	Pump 30 gpm	8	422										
		NRF 10***	Pump 30 gpm	8	427										
		NRF 11***	Pump 30 gpm	8	417										
		NRF 12***	Pump 30 gpm	8	421										
		NRF 13***	Pump 1 gpm#	8	425										
		NPR Test	Pump 28 gpm	6	599		38								
		PSTF	Pump 44 gpm	16	322		35								
		P&W 2*	Pump 35 gpm	10	386		25								
		PW-1	Pump 3 gpm	10	117	5		13							
		PW-2	Bail @ 115 feet	10	131	5		13							
		PW-3	Bail @121 feet	10	125	5		13							

Attachment 1—FIELD SCHEDULE SHOWING WELL AND PUMP INFORMATION AND SAMPLING SCHEDULES FOR SELECTED WELLS AND STREAMFLOW SITES

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)			RESL			NQWL	Field value		
						Apr	Jul	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper -ature	pH	SC
		PW-4	Pump 6 gpm	10	136	5		13							
		PW-5	Bail @ 124	10	124	5		13							
		PW-6	Bail @125 feet	10	125	5		13							
		PW-8	Bail @ 90	10	166	7		17							
		PW-9	Pump 5 gpm	10	200	7		17							
		Rifle Range Well	Pump 25 gpm	6	620	6		18							
		RWMC M1SA	Pump 3.4 gpm	6	638		44								
		RWMC M3S	Pump 3.7 gpm	6	633		23								
		RWMC M7S	Pump 4.1 gpm	6	638		23								
		RWMC M11S	Pump 6 gpm	6	607		25								
		RWMC M12S	Pump 6 gpm	6	560		25								
		RWMC M13S	Pump 6 gpm	6	632		25								
		RWMC M14S	Pump 6 gpm	6	633		25								
		RWMC Production**	Pump 200 gpm	16	683	21	42	22							
		Site 4	Pump 500 gpm	15	496		11								
		Site 9	Pump 25 gpm	10	1057		14								
		Site 14*	Pump 40 gpm	8 >377 10 >340 12 <340	717		25								
		Site 17	Pump 25 gpm	20	600		14								
		Site 19	Pump 30 gpm	10 >576 18 <576	865		11								
		SPERT I	Pump 400 gpm	24	653		10								

Attachment 1—FIELD SCHEDULE SHOWING WELL AND PUMP INFORMATION AND SAMPLING SCHEDULES FOR SELECTED WELLS AND STREAMFLOW SITES

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)			RESL			NQWL	Field value		
						Apr	Jul	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper -ature	pH	SC
		SWP 8	Bail from bottom of well	2	26		16								
		TRA 1	Pump 3400 gpm	20	600		11								
		TRA 3	Pump 3800 gpm	20	602		11								
		TRA 4	Pump 2000 gpm	20	975		11								
		TRA A-13	Bail from bottom of well	2	59	7		18							
		TRA A-77	Bail from bottom of well	2	33	7		18							
		TRA Disp.	Pump 25 gpm	12	1267	7		19							
		W.S. for INEL-1	Pump 30 gpm	8	595		11								
		USGS 1	Pump 19 gpm	6	636		25								
		USGS 2	Pump 16 gpm	5	704		14								
		USGS 4	Pump 40 gpm	6	553		25								
		USGS 5	Pump 5 gpm#	6	500		38								
		USGS 6	Pump 25 gpm	6	620		14								
		USGS 7	Pump 45 gpm	4 >760 6 <760	1200		35								
		USGS 8*	Pump 16 gpm	6	812		25								
		USGS 9	Pump 19 gpm	8	655	1		25							
		USGS 11*	Pump 23 gpm	12	704	1		25							
		USGS 12***	Pump 32 gpm	10 >387 12 <387	560		31								
		USGS 14*	Pump 16 gpm	6	751	1		4							
		USGS 15	Pump 40 gpm	10 >480 16 <480	610		14								

Attachment 1—FIELD SCHEDULE SHOWING WELL AND PUMP INFORMATION AND SAMPLING SCHEDULES FOR SELECTED WELLS AND STREAMFLOW SITES

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)			RESL			NQWL	Field value		
						Apr	Jul	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper -ature	pH	SC
		USGS 17	Pump 32 gpm	6 >416 8 <416	498		25								
		USGS 18	Pump 30 gpm	4	329		14								
		USGS 19*	Pump 33 gpm	6	405		25								
		USGS 20	Pump 30 gpm	6	676	3		14							
		USGS 22	Pump 2.5 gpm#	6	657		9								
		USGS 23	Pump 25 gpm	6	467		25								
		USGS 26	Pump 40 gpm	8	266		35								
		USGS 27*	Pump 20 gpm#	8	312		25								
		USGS 29	Pump 32 gpm	6	422		14								
		USGS 31	Pump 40 gpm	8 >306 10 <306	428		14								
		USGS 32	Pump 28 gpm	6 >323 10 <323	392		14								
		USGS 34	Pump 30 gpm	10 >499 13 <499	700	28		29							
		USGS 35	Pump 25 gpm	7	578	3		14							
		USGS 36	Pump 25 gpm	6	567	3		14							
		USGS 37	Pump 25 gpm	8	573	3		20							
		USGS 38	Pump 4 gpm#	6 >505 8 <505	729	28		29							
		USGS 39	Pump 25 gpm	6 >507 8 <507	572	3		14							

Attachment 1—FIELD SCHEDULE SHOWING WELL AND PUMP INFORMATION AND SAMPLING SCHEDULES FOR SELECTED WELLS AND STREAMFLOW SITES

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)			RESL			NQWL	Field value		
						Apr	Jul	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper -ature	pH	SC
		USGS 40	Pump 8 gpm	6	483	8		20							
		USGS 41	Pump 25 gpm	6	674	3		14							
		USGS 42	Pump 25 gpm	6	678	3		14							
		USGS 43	Pump 6 gpm	6	676	5		20							
		USGS 44	Pump 25 gpm	6	650	5		16							
		USGS 45	Pump 25 gpm	6	651	3		14							
		USGS 46	Pump 25 gpm	6	651	5		16							
		USGS 47	Pump 8 gpm	6	652	5		20							
		USGS 48	Pump 29 gpm	6	750	3		14							
		USGS 50	Pump 0.5 gpm#	6	405	5		16							
		USGS 51	Pump 4 gpm	6	659	3		14							
		USGS 52	Pump 30 gpm	6	650	3		14							
		USGS 53	Bail	6	90	7		18							
		USGS 54	Pump 4 gpm	6	91	7		18							
		USGS 55	Pump 1 gpm	6	79	7		17							
		USGS 56	Pump 1 gpm	6	80	7		18							
		USGS 57	Pump 30 gpm	6	732	3		16							
		USGS 58	Pump 26 gpm	6	503	7		18							
		USGS 59	Pump 1 gpm	6	657	3		14							
		USGS 60	Pump 6 gpm	6	117	7		17							
		USGS 61	Pump 6 gpm	10	123	7		17							
		USGS 62	Pump 5 gpm	8	165	7		17							
		USGS 63	Pump 5 gpm	10	97	7		17							

Attachment 1—FIELD SCHEDULE SHOWING WELL AND PUMP INFORMATION AND SAMPLING SCHEDULES FOR SELECTED WELLS AND STREAMFLOW SITES

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)			RESL			NQWL	Field value		
						Apr	Jul	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper -ature	pH	SC
		USGS 65*	Pump 8 gpm	6	498	36		37							
		USGS 66	Bail @ 214 feet	6	475		17								
		USGS 67	Pump 8 gpm	6	698	3		14							
		USGS 68	Pump 1 gpm#	10	128	45		46							
		USGS 69	Pump 5 gpm	10	115		17								
		USGS 70	Pump 6 gpm	8	100	7		17							
		USGS 71	Bail @ 175 feet	8	184	7		17							
		USGS 72	Pump 1 gpm	6	177		46								
		USGS 73	Grundfos @100 ft; 1.5 gpm	6	127	7		17							
		USGS 76	Pump 29 gpm	6	718	7		19							
		USGS 77	Pump 25 gpm	6	610	28		29							
		USGS 78	Bail @ 160 feet	7	204		17								
		USGS 79	Pump 30 gpm	6	702	2		11							
		USGS 82	Pump 25 gpm	8	700	3		14							
		USGS 83	Pump 28 gpm	6	752		38								
		USGS 84	Pump 5 gpm	6	505	36		37							
		USGS 85*	Pump 23 gpm	6	637	3		14							
		USGS 86	Pump 19 gpm	8	691		25								
		USGS 87*	Pump 2 gpm	6	673	32		33							
		USGS 88	Pump 2 gpm	6	662	21		22							
		USGS 89	Pump 5 gpm	6	646	21		22							
		USGS 92	Bail @ 213 feet	6	214	21		8							
		USGS 97***	Pump 27 gpm	4	510		37								

Attachment 1—FIELD SCHEDULE SHOWING WELL AND PUMP INFORMATION AND SAMPLING SCHEDULES FOR SELECTED WELLS AND STREAMFLOW SITES

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)			RESL			NQWL	Field value		
						Apr	Jul	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper -ature	pH	SC
		USGS 98***	Pump 25 gpm	6	505		37								
		USGS 99***	Pump 25 gpm	6	450		11								
		USGS 100*	Pump 10 gpm#	6	750		11								
		USGS 101	Pump 13 gpm	6	865		25								
		USGS 102***	Pump 29 gpm	6	445		14								
		USGS 103*	Pump 21 gpm	8	760	24		25							
		USGS 104*	Pump 26 gpm	8	700	1		10							
		USGS 105	Pump 24 gpm	8	800	1		25							
		USGS 106	Pump 24 gpm	8	760	1		9							
		USGS 107	Pump 30 gpm	8	690		38								
		USGS 108*	Pump 24 gpm	8	760	1		25							
		USGS 109	Pump 22 gpm	6	800	1		25							
		USGS 110A	Pump 24 gpm	10	644		25								
		USGS 111	Pump 15 gpm#	8	595	3		14							
		USGS 112*	Pump 30 gpm	8	563	3		14							
		USGS 113	Pump 25 gpm	6	564	3		16							
		USGS 114	Pump 10 gpm#	6	562	3		14							
		USGS 115*	Pump 5 gpm	6	581	3		14							
		USGS 116	Pump 20 gpm	6	580	3		14							
		USGS 117	Pump 12 gpm#	8	655	21		22							
		USGS 119	Pump 3 gpm#	8	705	21		22							
		USGS 120*	Pump 27 gpm	8	705	32		33							
		USGS 121	Pump 8 gpm	8	475	3		14							

Attachment 1—FIELD SCHEDULE SHOWING WELL AND PUMP INFORMATION AND SAMPLING SCHEDULES FOR SELECTED WELLS AND STREAMFLOW SITES

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)			RESL			NQWL	Field value		
						Apr	Jul	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper -ature	pH	SC
		USGS 123	Pump 3 gpm	8	481	3		14							
		USGS 124*	Pump 19 gpm	4	800	1		10							
		USGS 125*	Pump 21 gpm	10	760	1		25							
		USGS 126A	Pump	5	648		25								
		USGS 126B	Pump	10	452		25								
		USGS 127	Pump 25 gpm	10	596	26		27							
		USGS 128	Pump 23 gpm	4.5>533 6.5<533	618	23		23							

*Well is sampled with someone from the State of Idaho's INEEL Oversight Program

**Well is sampled monthly for organics - SH1380

***Well is sampled 3 times a year for the NRF study—Mar, July, Nov.

# Indicates well needs to be cut back to pump rate indicated; all other pump rates are approximate.

Codes for types of analyses (number of bottles needed in parenthesis)

1. ^{3}H, Cl^{-} (2)
2. ^{3}H, Cl^{-}, Cr (3)
3. ^{3}H, ^{90}Sr, Cl^{-} (3)
4. ^{3}H, Cl^{-}, α, β, ϒ Spec (4)
5. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-} (3)
6. ^{3}H, ^{90}Sr, Cl^{-}, Cr, SO_4^{--} (4)
7. ^{3}H, ^{90}Sr, ϒ Spec, Cl_3^{-}, Cr (4)
8. ^{3}H, ^{90}Sr, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^{-} (3)
9. ^{3}H, Cl^{-}, Na^{+} (3)
10. ^{3}H, Cl^{-}, Na^{+}, NO_3^{-} (4)
11. ^{3}H, Cl^{-}, Cr, Na^{+},SO_4^{--} (3)
12. ^{3}H, Cl^{-}, Cr, Na^{+}, NO_3^{-}, SO_4^{--} (4)
13. ^{3}H, ^{90}Sr, Cl^{-}, Na^{+}, SO_4^{--} (4)
14. ^{3}H, ^{90}Sr, Cl^{-}, Na^{+}, NO_3^{-},SO_4^{--} (5)
15. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+}(5)
16. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Na^{+}, NO_3^{-}, SO_4^{--} (5)
17. ^{3}H, ^{90}Sr, Cl^{-}, Cr, Na^{+}, SO_4^{--} (4)
18. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Cr, Na^{+}, SO_4^{--} (4)
19. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Cr, Na^{+}, NO_3^{-}, SO_4^{--} (5)
20. ^{3}H, ^{90}Sr, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^{-}, Na^{+}, NO_3^{-}, SO_4^{--} (5)
21. ^{3}H, ^{90}Sr, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^{-}, POC's (6)
22. ^{3}H, ^{90}Sr, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^{-}, Na^{+}, NO_3^{-}, POC's, SO_4^{--} (8)
23. ^{3}H, ^{90}Sr, Cl^{-}, NO_3^{-} (4)
24. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, NO_3^{-} (6)
25. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, NO_3^{-}, TOC (7)
26. ^{3}H, ^{90}Sr, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, NO_3^{-} (6)
27. ^{3}H, ^{90}Sr, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, NO_3^{-}, TOC (7)
28. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^{-}, Na^{+}, Cr, NO_3^{-}, SO_4^{--}, F^{-}, POC's (9)
29. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^{-}, Na^{+}, Cr, NO_3^{-}, SO_4^{--}, F^{-}, POC's, TOC (10)
30. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, NO_3^{-}, SO_4^{--}, POC's (9)
31. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, NO_3^{-}, SO_4^{--}, POC's, TOC (10)
32. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^{-}, Na^{+}, Cr, NO_3^{-}, POC's (9)
33. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^{-}, Na^{+}, Cr, NO_3^{-}, POC's, TOC, SO_4^{--} (10)
34. ^{3}H, ^{90}Sr, α, β, ϒ Spec, Cl^{-}, Na^{+}, NO_3^{-}, POC's, Sb, Ar, Cr, Pb, Hg, Ni, Tl, Zn (12)
35. ^{3}H, ^{90}Sr, α, β, ϒ Spec, Cl^{-}, Na^{+}, NO_3^{-}, POC's, TOC, Sb, Ar, Cr, Pb, Hg, Ni, Tl, Zn (13)
36. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^{-}, Na^{+} Cr, NO_3^{-}, SO_4^{--}, POC's, Al, Ar, Ba, Cd, Pb, Mn, Ni, Hg, Se, Ag, Zn (12)
37. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^{-}, Na^{+}, Cr, NO_3^{-}, SO_4^{--}, POC's, TOC, Al, Ar, Ba, Cd, Pb, Mn, Ni, Hg, Se, Ag, Zn (13)
38. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, NO_3^{-}, TOC, POC's (10)
39. ^{3}H, ^{90}Sr, Cl^{-}, PCC'S (6)
40. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, NO_3^{-}, POC's, SH1254 metals + Ar, V, Mo, Hg, and Field alkalinity and D.O. (11)
41. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, NO_3^{-}, POC's, SH1254 metals + Ar, V, Mo, Hg, , TOC + D.O. and field alkalinity (12)
42. POC's (3)
43. ^{3}H, ^{90}Sr, Cl^{-}, Cr, Na^{+}, NO_3^{-} (5)
44. ^{241}Am, ^{238}Pu, $^{239,240}Pu$ (1)
45. ^{3}H, ^{90}Sr, α, β, ϒ Spec, Cl^{-}, Cr, + SH 1281 metals: Ar, Ba, Cd, Cr, Pb, Hg, Se, Ag (7)
46. ^{3}H, ^{90}Sr, α, β, ϒ Spec, Cl^{-}, Cr, Na^{+}, SO_4^{--}, + SH 1281 metals: Ar, Ba, Cd, Cr, Pb, Hg, Se, Ag (8)
47. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Cr, Na^{+}, SO_4^{--}, NO_3^{-}, TOC (6)

Constituent and type of sample

Type of analyses	Lab	Size of sample and schedule or lab code	Type of sample treatment
^{3}H (Ru)	RESL	500 mL (Apr, Jul); 125 mL (Oct)	Raw water, unacidified, rinse bottle
^{90}Sr (RA)	RESL	500 mL	Raw water, preserved with 2 mL HNO_3, no rinse
^{90}Sr, Υ Spec (RA)	RESL	500 mL	Raw water, preserved with 2 mL HNO_3, no rinse
α, β (RA)	RESL	500 mL	Raw water, preserved with 2 mL HNO_3, no rinse
^{241}Am, ^{238}Pu, $^{239,240}Pu$ (RA)	RESL	500 mL	Raw water, preserved with 2 mL HNO_3, no rinse
^{90}Sr, Υ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$ (RA)	RESL	1L	Raw water, preserved with 4 mL HNO_3, no rinse
Υ Spec (RA)	RESL	500 mL	Raw water, preserved with 2 mL HNO_3, no rinse
Cl^-** (FU)	NWQL	250 mL; LC 1571	Filtered, unacidified, rinse poly bottle
Cr* (FA)	NWQL	250 mL; LC 722	Filtered, preserved with 2mL Ultrex HNO_3, rinse poly bottle
Na^+* (FA)	NWQL	250 mL; LC 675	Filtered, preserved with 1 mL HNO_3, or 2 mL Ultrex HNO_3, rinse poly bottle
NO_3^- (FCC)	NWQL	125 mL; SH101	Filtered, chilled, brown poly bottle, rinse bottle
POC's (GCV)	NWQL	(3) 40 mL; SH1380	Raw water, chilled, unacidified, rinse glass bottle, amber
SO_4^{--}** (FU)	NWQL	250 mL; LC 1572	Filtered, unacidified, rinse poly bottle
F^-** (FU)	NWQL	250 mL; LC 31	Filtered, unacidified, rinse poly bottle
TOC (TOC)	NWQL	125 mL; LC 114	Raw water, chilled, unacidified, amber glass bottle, no rinse
Sb, Cr, Pb, Ni, Zn (FA) Ar, Tl (FA) Sp. cond. (RU)	NWQL	250 mL; SH 1050 and LC 2160 and 2508 250 mL; SH 1050	Filtered, preserved with 2 mL ultrex HNO_3, rinse poly bottle Raw water, unacidified, rinse poly bottle
Hg (FAM)	NWQL	250 mL; LC 2707	Filtered, preserved with 2 mL 6N HCL, rinse, clear glass bottle
Al, Ba, Cd, Cr, Pb, Mn, Ni, Ag, Zn (FA) Ar, Se (FA) Sp. cond. (RU)	NWQL	250 mL; SH 1050 and LC 2160 and 2161 250 mL; SH 1050	Filtered, preserved with 2 mL Ultrex HNO_3 rinse poly bottle Raw water, unacidified, rinse, poly bottle
^{129}I	EML	1 L	Filtered, chilled, unacidified, polyseal cap
^{36}Cl	EML	1 L	Raw water, unacidified, polyseal cap on bottle
SH 1254 metals (FU, FA, RU)	NWQL	250 mL; SH 1254 250 mL; SH 1254+LC 2503, 1794, + 2509 125 mL; SH 1254	Filtered, unacidified, rinse poly bottle Filtered, preserved with 2 ml Ultrex HNO_3, rinse poly bottle Raw water, unacidified, rinse poly bottle
SH 1281 TLCP metals (RA, RU, RAM)	NWQL	250 mL; SH 1281 125 mL; SH 1281 250 mL; SH 1281	Raw, preserved with 2 mL Ultrex HNO_3, rinse poly bottle Raw water, unacidified, rinse poly bottle Raw water, preserved with 2 ml 6N HCl, rinse clear glass bottle

*Analysis can be requested from the same bottle, use 2 ml Ultrex HNO_3 to preserve bottle
**Analysis can be requested from the same bottle.

Attachment 2—Data-Quality Objectives for Water Samples Analyzed by the National Water Quality Laboratory

Constituent	Minimum reporting level (micrograms per liter)	Precision (± percent)	Accuracy* (percent)	Lab code/schedule
I. Purgeable organic compounds	.2	30	70-130	SH 1380
II. Total organic carbon	100	10	90-110	LC 114
III. Inorganic compounds (dissolved)				
Aluminum	1	10	90-110	SH 1050
Antimony	.048	10	90-110	SH 1050
Arsenic	.8	10	90-110	LC 2160
Barium	1	10	90-110	SH 1050
Beryllium	.06	10	90-110	SH 1050
Cadmium	.037	10	90-110	SH 1050
Calcium	12	10	90-110	SH 1254
Chromium	10	10	90-110	LC 722
Cobalt	.015	10	90-110	SH 1050
Copper	.23	10	90-110	SH 1050
Fluoride	110	10	90-110	LC 31
Iron	10	10	90-110	SH 1254
Lead	.08	10	90-110	SH 1050
Magnesium	8	10	90-110	SH 1254
Manganese	.1	10	90-110	SH 1050
Molybdenum	.2	10	90-110	SH 1050
Nickel	.06	10	90-110	SH 1050
Potassium	110	10	90-110	SH 1254
Selenium	2	10	90-110	LC 2161
Silica	130	10	90-110	SH 1254
Silver	1	10	90-110	SH 1050
Sodium	90	10	90-110	LC 675
Thallium	.041	10	90-110	LC 2508
Uranium	.018	10	90-110	SH 1050
Zinc	1	10	90-110	SH 1050
Mercury	.011	10	90-110	LC 2707
Sulfate	110	10	90-110	LC 1572
Chloride	330	10	90-110	LC 1571
Nitrate (as N)	47	10	90-110	SH 101
Nitrite (as N)	8	10	90-110	SH 101
Phosphate	18	10	90-110	SH 101
Ammonia (as N)	41	40	60-140	SH 101
IV. Organic compounds				
Pesticides	variable	40	60-140	SH 2001

*Coefficient of variance measured by replicate analysis; precision at 10 percent level.

For each radionuclide concentration, an associated analytical uncertainty, **s**, is calculated such that there is a 67-percent probability that the true concentration of a radionuclide in a sample is in the range of the reported concentration plus or minus the analytical uncertainty. For example, given an analytical result of 1.0±0.2 pCi/L (picocuries per liter), there is a 67-percent probability that the true concentration is in the range of 0.8 to 1.2 pCi/L. Some laboratories report the analytical uncertainty as 2**s**, at which there is a 95-percent probability that the true concentration is in the range of 0.6 to 1.4 pCi/L. Therefore, unlike analyses for most inorganic or organic constituents, the analytical uncertainty is specified for each analysis for a specified radionuclide. The following guidelines for interpreting analytical results are based on an extension of the method described by Currie (1968).

In the analysis for a selected radionuclide, laboratory measurements are made on a target sample and a prepared blank. Instrument signals for the sample and the blank vary randomly. Therefore, it is essential to distinguish between two key aspects of the problem of detection: (1) the instrument signal for the sample must be greater than the signal observed for the blank to make the decision that a selected radionuclide was detected; and (2) an estimation must be made of the minimum radionuclide concentration that will yield a sufficiently large observed signal to make the correct decision of detection or nondetection of that radionuclide most of the time. The first aspect of the problem is a qualitative decision based on an observed signal and a definite criterion for detection. The second aspect of the problem is an intuitive estimation of the detection capabilities of a given measurement process.

In the laboratory, instrument signals must exceed a critical level to make the qualitative decision whether a selected radionuclide was detected. Radionuclide concentrations that equal 1.6**s** meet this criterion; at 1.6**s**, there is a 95-percent probability that the correct decision—not detected—will be made. Given a large number of samples, up to 5 percent of the samples with true concentrations greater than or equal to 1.6**s**, which were concluded as being detected, might not contain the selected radionuclide. These measurements are referred to as false positives and are errors of the first kind in hypothesis testing.

Once the critical level of 1.6**s** has been defined, the minimum detectable concentration may be established. Radionuclide concentrations that equal 3**s** represent a measurement of the minimum detectable concentration. For true concentrations of 3**s** or greater, there is a 95-percent-or-more probability of correctly concluding that a selected radionuclide was detected in a sample. Given a large number of samples, up to 5 percent of the samples with true concentrations greater than or equal to 3**s**, which were concluded as being nondetected, could contain the selected radionuclide at the minimum detectable concentration. These measurements are referred to as false negatives and are errors of the second kind in hypothesis testing. Inclusion of the 3**s** criterion reduces the probability of a false negative to 5 percent or less.

True radionuclide concentrations between 1.6**s** and 3**s** have larger errors of the second kind. That is, there is a greater-than-5-percent probability of false negative results for samples with true concentrations between 1.6**s** and 3**s**, and although the selected radionuclide might not have been detected, such nondetection may not be reliable; at 1.6**s**, the probability of false negative is about 50 percent.

These guidelines are based on counting statistics alone and do not include systematic or random errors inherent in laboratory procedures. The values 1.6**s** and 3**s** vary slightly with background or blank counts and with the number of gross counts for individual analyses and for different selected radionuclides. The use of the critical level and minimum detectable concentration aid in the interpretation of analytical results and do not represent absolute concentrations of radioactivity which may or may not have been detected. The minimum detectable concentration should not be confused with the detection limit, which is based on instrument sensitivity, sample volumes, analytical procedures and counting times used in the laboratory.

Bodnar and Percival (1982) summarized detection limits normally available from the RESL. Special arrangements can be made to achieve smaller detection limits for selected constituents. For example, by using a 5-fold counting time for tritium in water, that is, increasing the counting time from 20 to 100 minutes, the detection limit can be reduced from 0.5 to 0.2 pCi/mL.

Detection limits for selected types of radioactivity and nuclides as a function of sample size and detection method are shown on table 9; the limits are intended as guides to order-of-magnitude sensitivities and, in practice, can easily change by a factor of two or more even for the conditions specified.

Table 9—Detection limits for selected types of radioactivity and nuclides

[Abbreviation: bkgd, background]

Type of radioactivity or nuclide	Sample material	Size of sample (milliliter)	Counting time (minutes)	Detection method or instrument	Detection limit (picocuries per milliliter)
Gross alpha	Water	100	60	Scintillation	$3X10^{-3}$
Gross beta	Water	250	20	Low bkgd counter	$5X10^{-3}$
	Water	100	20	Low bkgd counter	$4X10^{-3}$
	Water	5	20	Low bkgd counter	0.1
Po-210	Water	100	60	Scintillation	$1X10^{-3}$
Sr-90	Water	400	50	Low bkgd counter	$5X10^{-3}$
Th-230	Water	500	60	Scintillation	$1X10^{-3}$
Tritium	Water	10	20	Liquid scintillation	0.5
U-234	Water	1,000	1,000	Alpha spectrometry	$4X10^{-5}$
Th-230	Water	1,000	1,000	Alpha spectrometry	$4X10^{-5}$
Pu-238	Water	1,000	1,000	Alpha spectrometry	$2X10^{-5}$
Am-241	Water	1,000	1,000	Alpha spectrometry	$3X10^{-5}$
Np-239	Water	400	60	Ge(Li)	0.4
Tc-99	Water	400	60	Ge(Li)	0.7
Te-132	Water	400	60	Ge(Li)	$6X10^{-2}$
Pb-212	Water	400	60	Ge(Li)	0.1
Se-75	Water	400	60	Ge(Li)	$8X10^{-2}$
Sb-125	Water	400	60	Ge(Li)	0.2
Ru-103	Water	400	60	Ge(Li)	$1X10^{-2}$
Tl-108	Water	400	60	Ge(Li)	0.2
Sb-124	Water	400	60	Ge(Li)	0.1
Ta-182	Water	400	60	Ge(Li)	0.2
Co-60	Water	400	60	Ge(Li)	$6X10^{-2}$
Na-22	Water	400	60	Ge(Li)	$9X10^{-2}$
K-40	Water	400	60	Ge(Li)	1
La-140	Water	400	60	Ge(Li)	$7X10^{-2}$
Co-56	Water	400	60	Ge(Li)	$5X10^{-2}$
Ce-144	Water	400	60	Ge(Li)	0.4
Ce-141	Water	400	60	Ge(Li)	$9X10^{-2}$
Cr-51	Water	400	60	Ge(Li)	0.6
I-131	Water	400	60	Ge(Li)	$6X10^{-2}$
Ba-140	Water	400	60	Ge(Li)	0.2
Ru-106	Water	400	60	Ge(Li)	0.5
Cs-137	Water	400	60	Ge(Li)	$6X10^{-2}$
Bi-212	Water	400	60	Ge(Li)	1.0
Nb-95	Water	400	60	Ge(Li)	$6X10^{-2}$
Cs-134	Water	400	60	Ge(Li)	$6X10^{-2}$
Mo-99	Water	400	60	Ge(Li)	$5X10^{-2}$
Hg-203	Water	400	60	Ge(Li)	$6X10^{-2}$
Kr-85	Water	400	60	Ge(Li)	21
Bi-214	Water	400	60	Ge(Li)	0.4
Zr-95	Water	400	60	Ge(Li)	$9X10^{-2}$
Co-58	Water	400	60	Ge(Li)	$6X10^{-2}$
Mn-54	Water	400	60	Ge(Li)	$5X10^{-2}$
Ag-110	Water	400	60	Ge(Li)	$7X10^{-2}$
Ac-228	Water	400	60	Ge(Li)	0.2
Fe-59	Water	400	60	Ge(Li)	0.1
Zn-65	Water	400	60	Ge(Li)	0.1

Attachment 4—Data-Quality Objectives for Water Samples Analyzed by Severn Trent Laboratories

The EPA (1994a) has established six primary analytical data-quality objectives for environmental studies. These objectives are precision, accuracy, representativeness, completeness, comparability, and detectability. Severn Trent Laboratories' (STL) approach to each data-quality objective is given in a report by Quanterra Environmental Services (1998, section 8). The method of analyses, minimum reporting levels, and method detection limits for constituents analyzed by STL for the USGS INEEL Project Office are given on Table 10.

Table 10. Methods for analyses, minimum reporting levels, and method detection limits for constituents analyzed by Severn Trent Laboratories

Constituent	Method for analyses	Minimum reporting level (micrograms per liter)	Method detection limits (micrograms per liter)
Volatile organic compounds	524.2	1.0	variable
Semi-volatile organic chemicals	525.2	variable	variable
Total organic carbon	415.1	1,000	220
Total organic halogens	9020B	30	7.5
	[Inorganic compounds]		
Aluminum	6010B	100	15
Antimony	6010B	10	2.3
Arsenic	6010B	10	5.63
Barium	6010B	10	7.4
Beryllium	6010B	2	.77
Cadmium	6010B	5	1.4
Calcium	6010B	200	41
Chloride	300.0A	3,000	100
Chromium	7191	5	.5
Copper	6010B	20	2.1
Iron	6010B	100	86
Lead	6010B	3	2
Magnesium	6010B	200	48
Manganese	6010B	10	2.6
Mercury	7470A	.2	.043
Nickel	6010B	40	7.6
Potassium	6010B	5,000	500
Selenium	6010B	5	4.55
Silver	6010B	10	2.8
Sodium	6010B	5,000	560
Sulfate	300.0A	5,000	100
Thallium	6010B	10	7.39
Zinc	6010B	20	14
Nitrite (as N)	354.1	10	2
Nitrite plus Nitrate (as N)	353.2	100	10
Phosphorous (as P)	365.3	50	15
Total kjeldahl nitrogen	351.2	500	71

Attachment 5—Inventory of Water-Quality Field Equipment

Type of meter	Model	Manufacturer	Serial number
pH	SA250	Orion	4154
pH	250A	Orion	004282
pH	250A+	Orion	014620
pH	250A+	Orion	015522
Specific conductance	122	Orion	0905040
Specific conductance	122	Orion	42556041
Specific conductance	130A	Orion	none
Specific conductance	128	Orion	83576051
Dissolved oxygen	810	Orion	003585
Multi parameter	Quanta	Hydrolab	QDO1427
Turbidity meter	2100P	Hach	971200016277

Attachment 6—Auditor's Checklist for Quality-Assurance Field Audits.

QUALITY-ASSURANCE FIELD AUDITS AUDITOR'S CHECKLIST

Auditor's name _____

1. Date _____ **Sampler's name** _____ **Site Name** _____

2. Vehicle:

Was the vehicle clean and well maintained?	Yes	No
Was the vehicle well stocked?	Yes	No
Were the field computer and printer working properly?	Yes	No

3. Site Inspection? Yes No Details _____

4. Water-level measurement? Yes No

Recorded on WL sheet? Yes No

Hold1 _____
Cut1 _____
Hold2 _____
Cut2 _____
MP _____

5. Portable discharge lines rinsed with DI water? Yes No

6. Generator:

Grounded?	Yes	No
Parked downwind from well?	Yes	No

7. Time pump started? _____

Discharge measured? Yes No Q = _____ gpm
Well-bore volume calculated? Yes No = _____ min/vol
Time readings stabilized? _____

8. Field safety equipment:

Shovel?	Yes	No	Site-safety Plan?	Yes	No
Bucket?	Yes	No	QA Plan?	Yes	No
First-Aid Kit?	Yes	No	Body-fluids Kit?	Yes	No
Fire Extinguisher?	Yes	No	Life Vest (If required)?	Yes	No
Eye-wash Kit?	Yes	No	Pager and Cell Phone?	Yes	No

9. Constituents? _____

Number of bottles and designations _____

10. Calibrations:

Specific Conductance?	Yes	No	
pH?	Yes	No	
Recorded in log books?	Yes	No	
Other?	Yes	No	Specify_____

11. Field Measurements:

Temperature, water?	Yes	No	Value = _____
Temperature, air?	Yes	No	Value = _____
Specific Conductance?	Yes	No	Value = _____
pH?	Yes	No	Value = _____
Other (Specify)?	Yes	No	Value = _____

12. Sample Collection:

Time started _____

Gloves			Yes	No
Filter rinsed with sample water or DI (Circle type of rinsate)?			Yes	No
Air purged from filter?			Yes	No
Bottles rinsed with sample if appropriate?			Yes	No
Order of Filling Bottles?	Correct	Incorrect	List _____	
Number of Rinses?			List _____	

13. Preservation:

Safety Equipment?

Eye Shielding?	Yes	No
Rubber Apron?	Yes	No
Protective Gloves?	Yes	No
Correct Preservatives Added?	Yes	No
Was the Correct Order Followed?	Yes	No

14. Sample Handling:

Were Sample Bottles Properly Sealed?	Yes	No
Were Sample Bottles Properly Labeled?	Yes	No
Were Sample Bottles Properly Stored?	Yes	No
Was Proper Security of Sample Bottles Maintained?	Yes	No

15. Decontamination:

Were Portable Discharge Lines Rinsed with DI Water Prior to Storage? Yes No

16. Site Clean-up and Security

Was the well properly secured after sampling?	Yes	No
Was the Site properly cleaned prior to departure?	Yes	No

17. Paperwork copies?

	Requested?		Delivered?	
Logbook sheet?	Yes	No	Yes	No
Custody forms?	Yes	No	Yes	No
Analytical request forms?	Yes	No	Yes	No
Water-level sheet ?	Yes	No	Yes	No
Calibration logbook sheets?	Yes	No	Yes	No
Other? (Specify _____)	Yes	No	Yes	No

18. Comments