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Stratigraphic and Geophysical Data for Wells in the Vicinity of the Radioactive Waste Management Complex

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Idaho Completion Project

Bechtel BWXT Idaho, LLC

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Assistant Secretary for Environmental Management
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ABSTRACT

This report provides a complete collection of geophysical logging results and well completion lithology figures for wells in the vicinity of the Subsurface Disposal Area, a radioactive waste landfill that is part of the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory. This report describes the logging processes and geophysical properties measured, and offers recommendations for appropriate use of the data and assistance in interpreting the conventions for naming the files.

The original data were used to support risk and contaminant transport models; the updated data will be used to support the remedial investigation and feasibility study for Waste Area Group 7, Operable Unit 7-13/14. These data form the basis for the geologic model that will be used in fate and transport modeling for Operable Unit 7-13/14.

The data provided through this report were used to make the updated stratigraphic selections presented in the companion report *Updated Stratigraphic Selections for Wells in the Vicinity of the Subsurface Disposal Area*.[a]

a Ansley, S. L. and C. M. Helm-Clark, 2004, "Updated Stratigraphic Selections for Wells in the Vicinity of the Subsurface Disposal Area (Draft)," ICP-EXT-04-00207, Rev. 0, Idaho Completion Project, June 2004.

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ACRONYMS

INEEL	Idaho National Engineering and Environmental Laboratory
OU	operable unit
RI/FS	remedial investigation/feasibility study
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
TRU	transuranic
USGS	U.S. Geological Survey
WAG	waste area group

Stratigraphic and Geophysical Data for Wells in the Vicinity of the Radioactive Waste Management Complex

1. INTRODUCTION

This report provides a complete collection of geophysical logging results and well completion lithology figures for wells in the vicinity of the Subsurface Disposal Area (SDA), a radioactive waste landfill that is part of the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering and Environmental Laboratory (INEEL). (See Figure 1 for the location of the INEEL and its major facilities.) The original data were used in the *Ancillary Basis for Risk Analysis of the Subsurface Disposal Area* (Holdren et al. 2002) to support risk and contaminant transport models. The updated data will be used to support the remedial investigation and feasibility study (RI/FS) for Waste Area Group (WAG) 7, Operable Unit (OU) 7-13/14.[b] The data provided through this report were used to make the updated stratigraphic selections presented in *Updated Stratigraphic Selections for Wells in the Vicinity of the Subsurface Disposal Area* (Ansley and Helm-Clark 2004).

1.1 Purpose

This report supports the OU 7-13/14 RI/FS evaluation by providing background information on geophysical logging performed on the INEEL, INEEL geophysical logs, and well completion diagrams containing lithologic logs that were used to review, verify, validate, and modify the stratigraphic database for surficial sediment and interbed elevations and thicknesses beneath the Subsurface Disposal Area. This information supports the geologic model that will be used in predictive modeling for environmental fate and transport of contaminants for OU 7-13/14. See companion report by Ansley and Helm-Clark (2004).

1.2 Scope

This report provides geophysical logging data and well completion diagrams for wells in the vicinity of the SDA. The data include all wells drilled to date in the RWMC area, including shallow wells that penetrate only the surficial sediments inside the SDA. This report also describes both the logging processes and the geophysical properties measured, and offers recommendations for appropriate use of the data and assistance in understanding the conventions for naming files. The data files are referenced in Appendix A.

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b. The Federal Facility Agreement and Consent Order lists 10 WAGs for the INEEL. Each WAG is subdivided into OUs. The RWMC is identified as WAG 7 and originally contained 14 OUs. Operable Unit 7-13 (transuranic [TRU] pits and trenches RI/FS) and OU 7-14 (WAG 7 comprehensive RI/FS) were ultimately combined into the OU 7-13/14 comprehensive RI/FS for WAG 7.

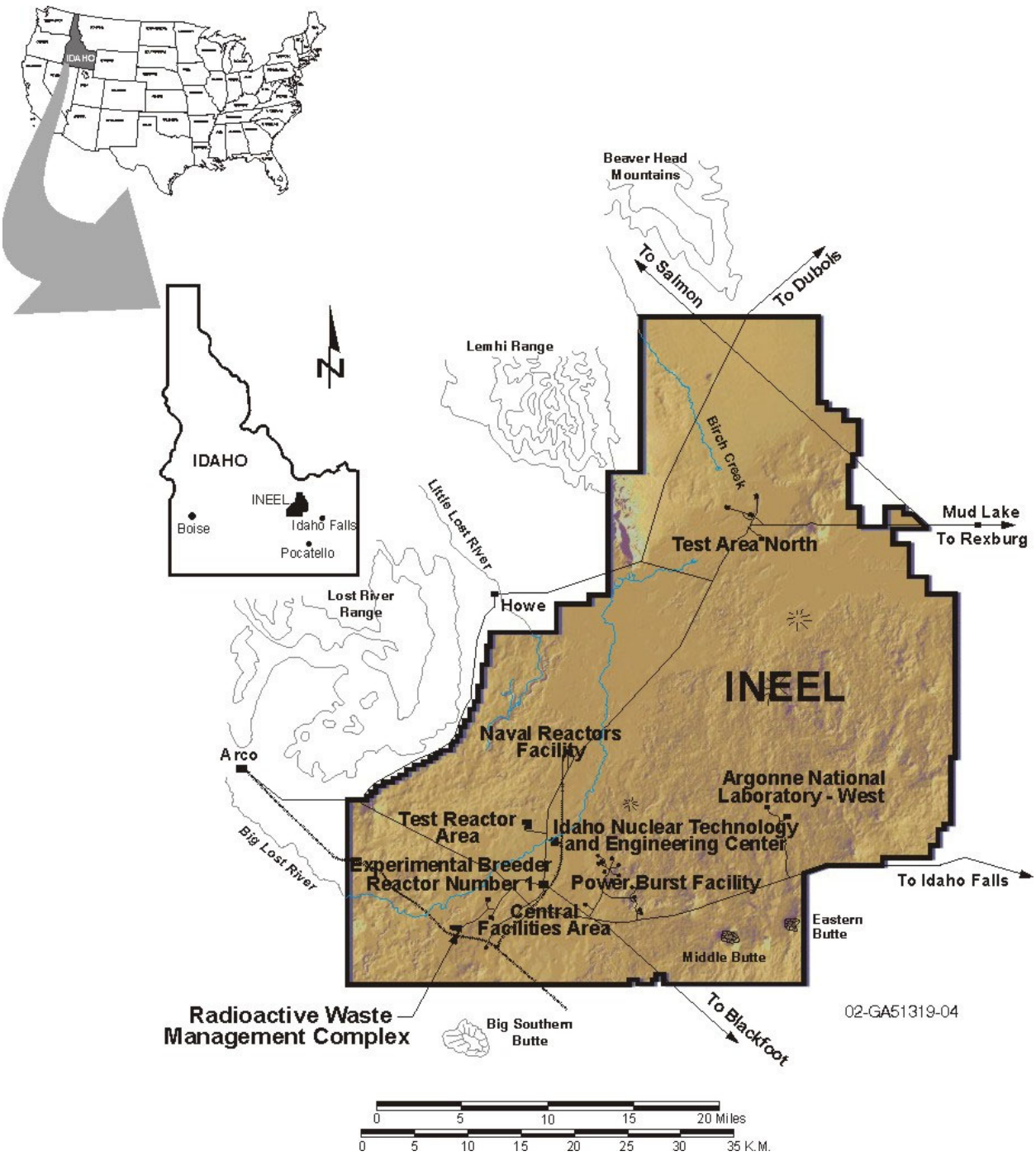

Figure 1. Map of the Idaho National Engineering and Environmental Laboratory showing the location of the Radioactive Waste Management Complex and other major facilities.

1.3 Document Organization

The following list briefly describes the remaining sections in this report:

- Section 2 provides a brief history and description of the SDA and the wells.
- Section 3 discusses selection of wells and describes the logging processes and geophysical properties measured.
- Section 4 lists the references cited throughout this report.
- Appendix A provides two tables summarizing the well data; Table A-1 lists wells by date completed and Table A-2 list wells by depth.
- Appendix B provides notes to help access INEEL geophysical logs and understand the conventions for naming the files.
- A compact disk (CD) is included. The CD contains completion diagrams and geophysical logs for wells included in Tables A-1 and A-2.

2. BACKGROUND INFORMATION

The following sections give a brief history and description of the SDA and the wells.

2.1 Brief History and Description of the Subsurface Disposal Area

The SDA, a radioactive waste landfill, is part of RWMC, a facility covering 72 ha (177 acres) in the southwestern quadrant of the INEEL, including the administration area of approximately 39 ha (97 acres), the SDA, and the Transuranic Storage Area (established in 1970 at 23 ha [58 acres]) (see Figure 2). Originally, the SDA was established at 5.2 ha (13 acres) in 1952 for disposal of solid radioactive waste. Defense waste with TRU elements began to arrive from the Rocky Flats Plant in 1954, and by 1957, the original 5.2-ha (13-acre) SDA was nearly full. In 1958, the SDA was expanded to 35.6 ha (88 acres), remaining the same until 1988 when the security fence was relocated outside the dike surrounding the SDA and the current size of 39 ha (97 acres) was established.

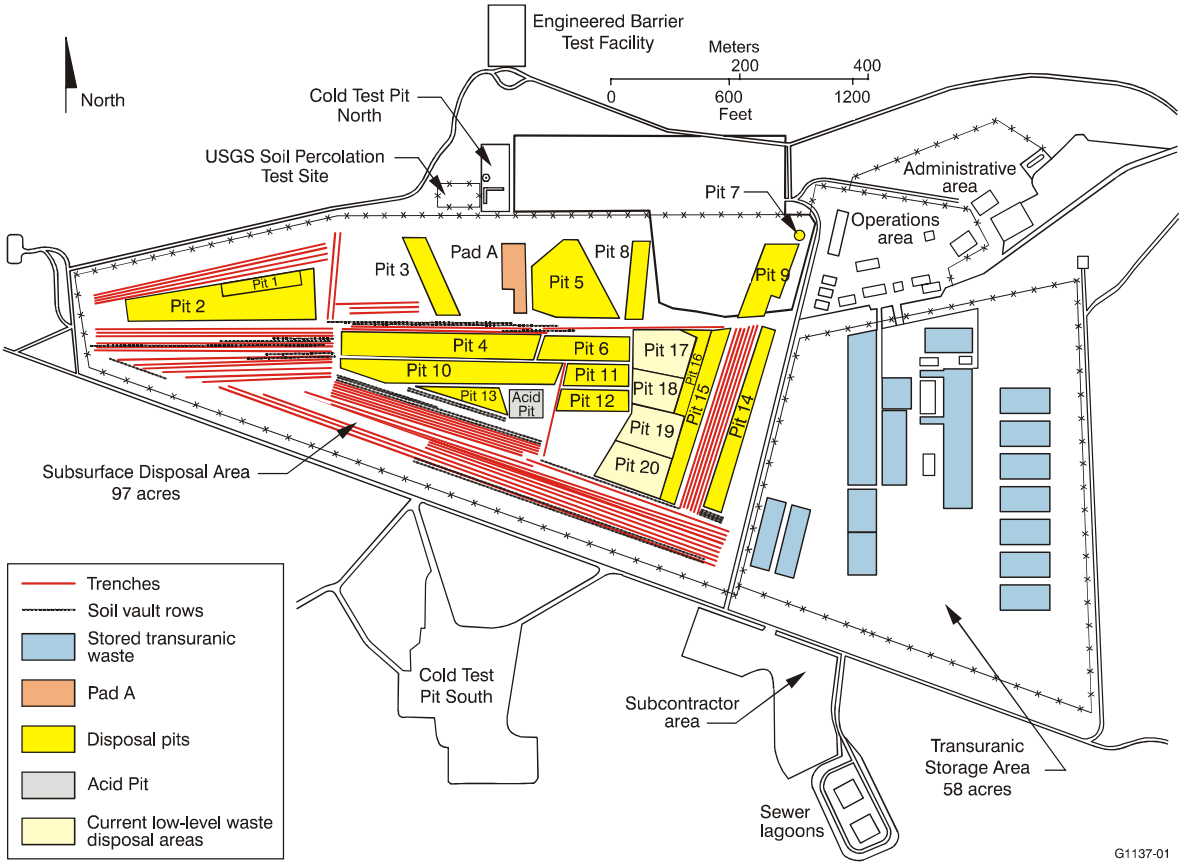

Figure 2. Map showing the Subsurface Disposal Area.

From 1952 to 1970, low-level and TRU waste was buried in pits, trenches, and soil vault rows excavated into a veneer of surficial sediment. This sediment is underlain by a thick series of basaltic lavas intercalated with sedimentary deposits. Waste containers may have been damaged by being compacted after sometimes random placement in pits and trenches. Since 1970, burial of low-level radioactive waste has continued and TRU waste has been stored on aboveground asphalt pads in retrievable containers. Between 1952 and 1997, approximately 215,000 m^3 of low-level and TRU waste containing about 12.6 million Ci of radioactivity was buried at the SDA (French and Taylor 1998). Of this 12.6 million Ci,

about 0.3 million Ci was TRU radioactive waste. An inventory of annual amounts of 38 radioactive buried contaminants (Becker et al. 1998) was updated for 25 radionuclides in Holdren et al. (2002).

Between 1960 and 1963, RWMC accepted radioactive waste from private sources such as universities, hospitals, and research institutes. This service stopped in September 1963, when commercial burial sites became available for contaminated waste from private industry. When the Transuranic Storage Area became operational, asphalt pads were constructed on which TRU waste was stacked and then covered with plywood, plastic sheeting, and 1 m (3 ft) of soil. From 1975 to 1996, air-support buildings were used to protect recently received waste containers during stacking operations. These support structures were emptied in 1996 and decommissioned in 1998 (Holdren et al. 2002).

Contaminants in the SDA radioactive waste landfill include radioactive elements resulting from weapons manufactured at the Rocky Flats Plant, fission and activation products resulting from on- and off-Site reactor operations, and hazardous chemicals associated with all waste sources.

2.2 Brief History of Well Drilling in the Vicinity of the Subsurface Disposal Area

Research activities, operations activities, the Rocky Flats Plant, and the Navy have generated liquid and solid radioactive waste that has been disposed of in soil vaults, unlined pits, and trenches at RWMC since 1952. Numerous characterization studies have been conducted during the last 50 years. The U.S. Geological Survey (USGS) initially investigated the geology and hydrology of the area in the 1950s to evaluate the area for waste disposal using soil borings and wells. Subsequent wells installed by the USGS in the 1960s through the 1990s further characterized the subsurface beneath RWMC. The U.S. Department of Energy, through its subcontractors, has also installed numerous wells since the 1980s.

Presently, the INEEL has a network of locations to monitor the Snake River Plain Aquifer, vadose zone, and perched water bodies beneath RWMC. These wells provide information about the distribution of contaminants and changes in contaminant concentrations that occur in response to natural processes of dispersion, attenuation, radioactive decay, and climate, and to changes in waste disposal and remediation activities. The wells distributed within an area of influence for RWMC are as follows:

- 23 aquifer wells (USGS is responsible for eight of these)
- 18 waste zone lysimeters (12 to 18 ft deep; one routinely yields water)
- 41 shallow lysimeters (0 to 35 ft deep; 18 routinely yield water)
- 16 intermediate depth lysimeters (35 to 140 ft deep; 14 routinely yield water)
- 23 deep lysimeters (greater than 140 ft deep; 8 routinely yield water)
- 2 deep perched water wells (approximately 220 ft; both routinely yield water).

3. WELL SELECTION AND WELL INFORMATION

The list of wells used in this report includes all wells in the immediate vicinity of the RWMC. Well information discussed in the following sections is presented in two categories: well completion diagrams and geophysical logs. Raw data from both USGS and the INEEL sources are included on the CD included in this report.

3.1 Well Completion Diagrams

Most recent well completion diagrams (i.e., "as-builts") are generated as part of well documentation. The diagrams contain information on construction, lithology, depth, instrument depths, casing size, geophysical logs, and other information in a common graphical format. Older wells may have completion diagrams generated by subcontractors or earlier sources. The formats and information on the diagrams vary considerably. The wells at the INEEL may be modified, abandoned, or require maintenance. The data and well configurations are updated as needed to reflect such changes in the wells.

3.2 Geophysical Logs

The USGS has been performing geophysical logging since at least the mid-1950s and has pioneered geophysical logging in groundwater studies. Logging by the USGS Idaho Operations Office represents some of the earliest caliper, fluid resistivity, temperature, and gamma logs. This early research was in conjunction with other USGS geophysical logging groups and was very active until 1964.

The following sections give a brief history of geophysical logging at the INEEL and describe the logging processes and geophysical properties measured.

3.2.1 Geophysical Log Processing at the Idaho National Engineering and Environmental Laboratory

The first comprehensive summaries of progress and results of well geophysical logging at the INEEL started in 1962. Many different logging methods were tested and some were discarded, e.g., magnetometer surveys. Source logging—including neutron-density logging that began about 1960 and many other logging studies that began in the mid-1960s—includes gamma-ray spectral logging, neutron-epithermal, neutron-gamma, and decentralized gamma-gamma.

Well information pertaining to INEEL wells includes geophysical logs run by the USGS Idaho Operations Office. The logging effort extends over more than 50 years, using different tools and recording technologies. Well names and geophysical logging naming conventions over this period have not been consistent. In using geophysical logs, note the following shortcomings:

- Temperature logs made by the USGS are not calibrated; therefore, they are not quantitative measurements
- Deviation logs may provide some qualitative level of interpretation, but when available, gyroscopic logs are recommended for interpretation.

Some logs made before 1989 were digitized in 1989 by Bartholomay (1990). Digitized logs have been archived in both processed and unprocessed format files. The unprocessed files were run through a program to put them in a two-column per row format (i.e., column one is depth and column two is tool measurement). The Bartholomay report also describes the procedures for digitizing the well logs

(originally in analog format) and includes printed copies of selected neutron, gamma-gamma (density), gamma (natural), and caliper logs developed from the digitized data for wells on or near the INEEL. The digitizing program was conducted by the USGS in cooperation with the Department of Energy. In 1991, the USGS purchased Century, the geophysical logging system now used.

See Figure 3 as an example for the following discussion of geophysical log types.

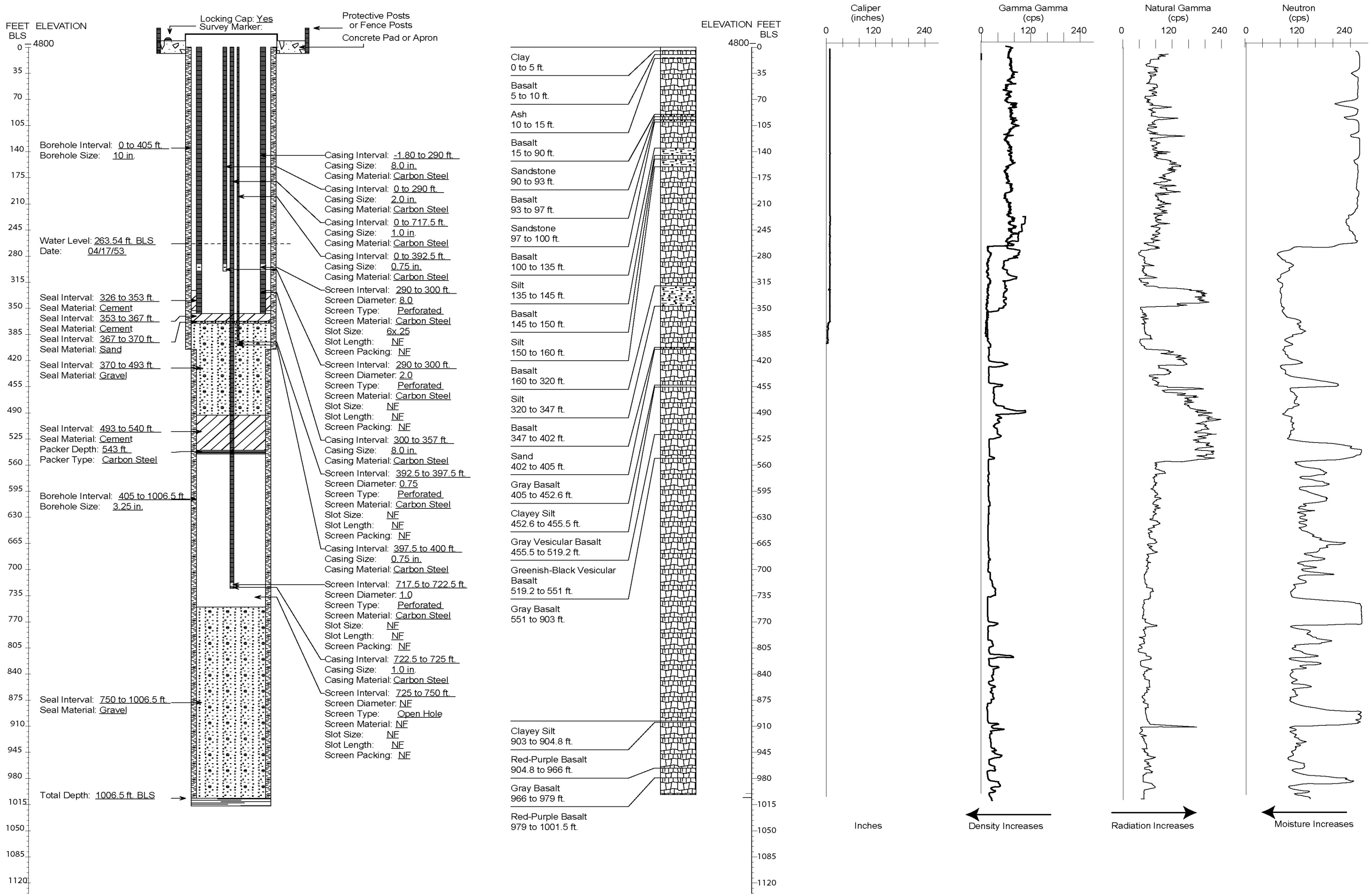

Figure 3. Example of well completion, lithology, and geophysical logs for Well 30 by the U.S. Geological Survey (after Goldstein and Weight 1982).

3.2.2 Description of Logging Processes and Geophysical Properties Measured

The following sections describe the processes for logging and the properties measured through caliper logs, gamma-gamma logs, natural gamma logs, neutron logs, deviation logs, and temperature logs.

3.2.2.1 Caliper Logs. Caliper logs record the drill-hole diameter in uncased parts of the well and the inside diameter of the casing. The logging tool contains three extendable feeler arms that trace the wall of the borehole. These logs are probably accurate to the nearest inch. Factors affecting hole size may include the drilling method used; rock type, permeability, and porosity; and washing out of saturated sediment zones.

Caliper logs are useful for locating fractures and cavernous zones, and aiding in interpreting other logs. During well construction, caliper logs may be used to determine where to set or cement casing, or place packing material.

3.2.2.2 Gamma-Gamma Logs. Gamma-gamma logs are a recorded measurement of gamma-radiation intensity from a source after it is backscattered or absorbed within a drill hole, the borehole fluid, or surrounding media (Chase et al. 1964). Cobalt-60 or cesium-137 are used as sources of gamma radiation. A source of cobalt-60, shielded from a sodium iodide detector, was used in the logging probe. In a sodium iodide, scintillation, gamma-radiation detector, a gamma ray impinging on a sodium iodide crystal causes a scintillation or emission of a flash of visible light. A photomultiplier tube detects each scintillation and transforms it into a pulse of electrical energy. A record of these electrical signals then forms a log of gamma-radiation responses.

The intensity of backscattered gamma energy is proportional to the electron density in the medium surrounding the probe. Although gamma-gamma logs are sometimes referred to as density logs, the logs are also influenced by other factors, including porosity, water saturation, changes in fluid type, hole diameter, cement grouting outside the casing, and the presence and thickness of casing. Because many factors influence gamma-gamma logs, their detailed interpretation requires considerable experience.

The following are general characteristics and principles applicable to interpreting gamma-gamma logs:

- Positive deflections, or deflections trending to the right, indicate increased gamma-ray backscatter because of increased porosity, decreased rock density, or increased hole diameter (see Figure 3)

- Negative deflections, or deflections trending to the left, indicate decreased porosity, increased rock density, or decreased hole diameter (see Figure 3).

The following are other significant factors affecting the percentage of scattering and absorption of gamma radiation:

- Size, type, and strength of source

- Distance between the source and detector

- Thickness of casing

- Fluid in the borehole.

The example log (see Figure 3) shows a marked negative deflection when the probe enters the groundwater. Water surrounding the probe greatly reduces the backscatter intensity recorded on the log. This effect is more pronounced in large diameter wells than in small diameter wells because the large diameter wells hold more water.

Another factor that causes general negative deflection below the water table is the increased bulk density of saturated rocks. Bulk-density studies of representative rock types at the INEEL show that bulk density increases markedly when dry rocks become saturated (Ansley and Helm-Clark 2004).

3.2.2.3 Natural Gamma Logs. A natural gamma log is a record of gamma radiation emitted by naturally occurring radioisotopes. The natural radioisotopes in the INEEL area are potassium-40, bismuth-214, lead-214, actinium-228, thorium-232, and uranium-238 (Barraclough et al. 1976). The gamma instrument measures total gamma radiation without distinguishing between individual contributions of the various radioisotopes.

The probe used for recording the gamma log contains a sodium iodide, scintillation, gamma radiation detector of the type described in Section 3.2.2.2. Higher levels of gamma radiation appear on the log as positive (or right) deflections; lower levels appear as negative (or left) deflections (see Figure 3).

The proximity effect also complicates the interpretation of natural gamma logs. The intensity of gamma radiation increases rapidly as a source is moved nearer to a detector (e.g., a quantity of material near the probe will display a higher gamma intensity than an equally intense quantity of similar material farther away). Considerations such as the type of fluid in the well, hole diameter, casing thickness, rock density, and the energy of emitted radiation are also important. These factors affect the range at which the probe can detect radioactivity (i.e., its radius of investigation).

Sediments have a greater concentration of naturally occurring radioisotopes than basalts (Chase et al. 1964) and exhibit positive deflections on the log, while basalts exhibit negative deflections (see Figure 3). Positive deflections can also be caused by sediment-filled voids and fractures in the basalt, accumulation of caved sediments downhole behind the casing, and radioisotopes discharged to the subsurface. The discharged radioisotopes accumulate in sediments, especially clays, by ion exchange and adsorption of radioactive ions on the sediment matrix (Goldstein and Weight 1982).

3.2.2.4 Neutron Logs. Neutron logs measure the moisture content above the water table and the total porosity below the water table. The source and the detector are arranged in the logging probe so that the recorded curve is a function of the hydrogen content in the borehole and the surrounding matrix (Keys and MacCary 1971).

A neutron is an electrically neutral atomic particle; high-energy neutrons are produced by collisions between alpha particles and beryllium nuclei. The instrument used for recording the logs depicted in the example log uses an alpha-emitting radioisotope, americium-241, mixed with beryllium and sealed to form a 3-curie neutron source. The high-energy neutrons emitted by the americium-beryllium source collide with atomic nuclei of fluids in a well, well casing, and rock materials. The neutrons are slowed by multiple collisions to velocities corresponding to an energy of 0.025 electron volts or less, called thermal neutrons, and can be captured and counted by the neutron detector (Keys and MacCary 1971). Hydrogen is the most effective element in slowing down neutrons because the nucleus of the hydrogen atom has approximately the same mass as a neutron. The velocity, and thus the energy of a neutron, is greatly reduced following a collision with a hydrogen nucleus. When colliding with a nucleus much larger and heavier than itself, a neutron rebounds with most of its original velocity and energy.

The radius of investigation of a neutron probe in saturated rocks ranges from about 6 in. in rocks of high porosity to 2 ft in rocks of little or no porosity. Neutron logs are less affected by well casing and mud or cemented casing than are other geophysical logs. Some factors that do affect neutron logs are water in the well, perched water bodies, well diameter, and the presence of hydrocarbons or other hydrogenous materials in the well.

A large negative deflection occurs as a neutron probe enters the water in a well (see Figure 3). This deflection indicates a decreased neutron count at the detector because more neutrons are absorbed by an aqueous environment than by an air environment. This negative deflection can be used to determine the water level at the time of logging. Negative deflections also occur when the neutron probe enters a perched water body and where the probe encounters hydrated material. Hydrated material may be erroneously interpreted as having high porosity.

3.2.2.5 Deviation Logs. Because deviation adds length to the distance that a measuring device registers to reach a reference depth, such as the aquifer water table, accurate measurement of borehole deviation is necessary. This is important for accurate waterlevel measurements and pump placements. The ideal undeviated borehole is both vertical (plumb) and straight (true). In some cases, the reported water table elevation has included error attributed to borehole deviation in aquifer wells (Wylie 1993). Because the deviated borehole does not follow a straight line or is not vertical, additional measuring line is required to reach the aquifer, giving the false impression of a lower water table at this location (see Figure 4). Inclination refers to the angle measured from vertical made by an off-plumb well. Inclination azimuth describes the twisting or corkscrewing of an untrue borehole (Rohe and Studley 2003).

The following two tools made by Century Geophysical Corporation have been routinely used by the USGS to log boreholes at the INEEL:

- Model 9055, a multiparameter logging tool used primarily by the USGS for neutron measurement of formation moisture content, but also produces magnetic data on borehole deviation

- Model 9095, a digital gyroscopic tool dedicated to detecting borehole deviation.

Model 9055 has a 3-axis magnetometer for inclination azimuth and a 2-axis inclinometer for inclination angle. The tool reads inclinations from vertical ranging from 0 to 45 degrees with $\pm$0.5-degree accuracy and has an inclination azimuth range of 0 to 360 $\pm$2 degrees (Peterson undated). The Model 9055 inclination data can be used to quantify water level correction factors for wells with borehole deviation. The inclination azimuth data from this tool should not be used as these are affected by carbon steel casings or magnetic properties of surrounding basalt. Preference should be given to results obtained with gyroscopic logging (Rohe and Studley 2003).

Model 9095, a digital gyroscopic tool, is fully dedicated to detecting borehole deviation. The digital solid state design incorporates a continuous-reading Humphrey gyroscope having a range and accuracy of 0 to 45 degrees from vertical $\pm$0.5 degree and an azimuth range of 0 to 360 $\pm$2 degrees according to Century Geophysical Corporation. Model 9095 is designed for logging within steel casings or open holes and therefore can be used among magnetic rock formations. Although dedicated to detecting borehole deviation, using Model 9095 is time-consuming because the tool requires long startup and shutdown times (Peterson undated).

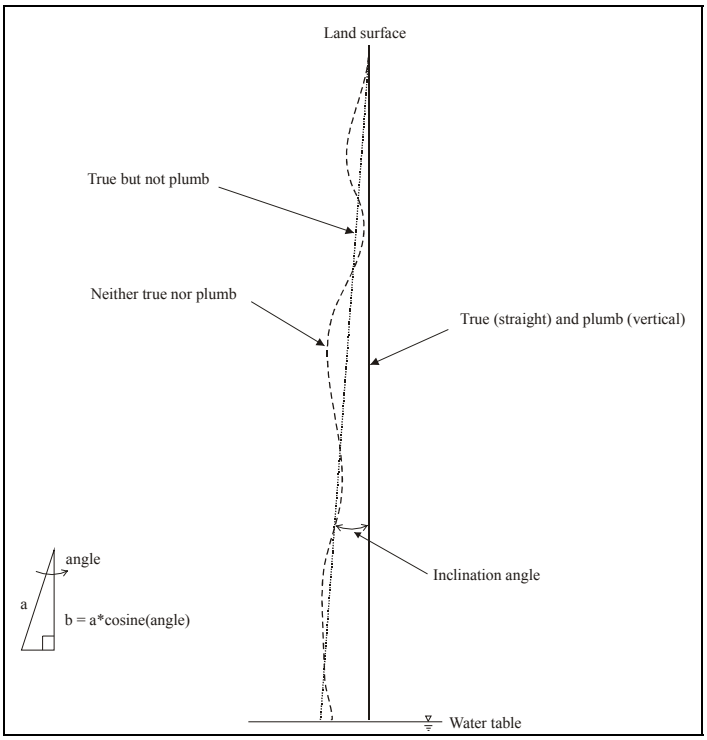

Figure 4. Borehole deviation description (after Driscoll 1987).

3.2.2.6 Temperature Logs. Temperature logging has been performed by both the USGS and David Blackwell of Southern Methodist University, whose work is a standard in temperature logging (Blackwell 1990).

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Appendix A

Tables Summarizing Well Data By Date and Zone

Appendix A

Tables Summarizing Well Data by Completion Date and Depth

Summary data are included in this report for all wells drilled to date in the SDA vicinity, including shallow wells that only penetrate the surficial sediments inside the SDA. Appendix A provides two tables summarizing the well data; Table A-1 is by date completed and Table A-2 is by depth.

In Table A-1, no shading indicates wells drilled before 1990; gray shading indicates wells drilled after 1990. In Table A-2, no color indicates a shallow well (less than 30 ft), gray shading indicates a mid-depth well (30–140 ft), and blue shading indicates a deep well (greater than 140 ft).

Table A-1. Radioactive Waste Management Complex area wells geophysical logs and completion diagram availability by date completed.

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	x	EBR-1	EBR-I	1949	149	8	Aquifer	1075
x	x	USGS-009	USGS-9	1951	458	7	Aquifer	654.14
x	x	USGS-086	USGS-86	1966	535	4	Aquifer	691
x	x	HIGHWAY 3	HWY-3	1967	184	5	Aquifer	750
x	x	USGS-088	USGS-88	1971	537	55	Aquifer	663
x	x	USGS-087	USGS-87	1971	536	27	Aquifer	673
x	x	USGS-096	USGS-96	1972	545	4	Vadose Zone	236.25
x	x	USGS-095	USGS-95	1972	544	5	Vadose Zone	246.25
x	x	USGS-094	USGS-94	1972	543	8	Vadose Zone	302.25
x	x	USGS-093A	USGS-93A	1972	49	4	Vadose Zone	233
x	x	USGS-093	USGS-93	1972	542	9	Vadose Zone	246.25
x	x	USGS-092	USGS-92	1972	541	15	Perched Water	247
x	x	USGS-091	USGS-91	1972	540	8	Vadose Zone	255.25
x	x	USGS-090	USGS-90	1972	539	17	Aquifer	626
x	x	USGS-089	USGS-89	1972	538	28	Aquifer	646
x	x	RWMC PRODUCTION WELL	RWMC	1974	268	11	Aquifer	685
x	x	USGS-096B	USGS-96B	1975	51	4	Vadose Zone	229
x	x	76-6	76-6	1976	9	4	Vadose Zone	243.8
x	x	76-5	76-5	1976	8	4	Perched Water	245
x	x	76-4A	76-4A	1976	7	3	Vadose Zone	254.3
x	x	76-4	76-4	1976	6	7	Vadose Zone	215
x	x	76-3	76-3	1976	5	4	Vadose Zone	240.4
x	x	76-2	76-2	1976	4	4	Vadose Zone	252.5

Table A-1. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	x	76-1	76-1	1976	3	4	Vadose Zone	228.3
x	x	77-2	77-2	1977	11	2	Perched Water	87.4
x	x	77-1	77-1	1977	10	4	Vadose Zone	600
x	x	78-5	78-5	1978	16	4	Vadose Zone	250
x	x	78-4	78-4	1978	15	7	Vadose Zone	350
x	x	78-3	78-3	1978	14	7	Vadose Zone	248
x	x	78-2	78-2	1978	13	7	Vadose Zone	252.6
x	x	78-1	78-1	1978	12	8	Perched Water	82
x	x	79-3	79-3	1979	20	4	Vadose Zone	262
x	x	79-2	79-2	1979	19	1	Perched Water	222.7
x	x	79-1	79-1	1979	18	4	Vadose Zone	244
x	x	USGS-109	USGS-109	1980	558	7	Aquifer	800
x	x	USGS-108	USGS-108	1980	557	10	Aquifer	760
x	x	USGS-106	USGS-106	1980	555	7	Aquifer	760
x	x	USGS-105	USGS-105	1980	554	10	Aquifer	800
x	x	WWW1	WWW#1	1983	598	2	Vadose Zone	258
x	NF	W-23	W23	1985	592	NF	Surface Sediments	19.83
x	NF	W-20	W20	1985	590	NF	Surface Sediments	7.5
x	NF	W-08	W08	1985	580	NF	Surface Sediments	22.17
x	NF	W-04	W04	1985	577	NF	Surface Sediments	24.9
x	NF	TH-04	TH04	1985	354	NF	Surface Sediments	11.17
x	NF	TH-02	TH02	1985	352	NF	Surface Sediments	6.125
x	NF	T-23	T23	1985	335	NF	Surface Sediments	19.92

Table A-1. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	NF	PA-02	PA02	1985	252	NF	Surface Sediments	9.17
x	NF	PA-01	PA01	1985	251	NF	Surface Sediments	14.67
x	NF	W-25	W25	1986	594	NF	Surface Sediments	15.5
x	NF	W-17	W17	1986	587	NF	Surface Sediments	20.42
x	NF	W-13	W13	1986	585	NF	Surface Sediments	18
x	NF	W-09	W09	1986	581	NF	Surface Sediments	14.96
x	NF	W-06	W06	1986	579	NF	Surface Sediments	11.83
x	NF	W-05	W05	1986	578	NF	Surface Sediments	15.92
x	NF	TH-05	TH05	1986	355	NF	Surface Sediments	15.6
x	x	D-06A	D-06A	1986	144	3	Perched Water	49.67
x	x	D-06	DO-6	1986	143	4	Vadose Zone	126.42
x	x	D-02	DO-2	1986	142	8	Vadose Zone	243
x	x	USGS-120	USGS-120	1987	569	8	Aquifer	705
x	x	USGS-119	USGS-119	1987	568	3	Aquifer	705
x	x	USGS-118	USGS-118	1987	567	15	Aquifer	622
x	x	USGS-117	USGS-117	1987	566	11	Aquifer	655
x	x	TW-1	TW-1	1987	448	5	Vadose Zone	237.5
x	NF	D-15	D-15	1987	146	NF	Vadose Zone	252
x	NF	D-10	D-10	1987	145	NF	Perched Water	238.5
x	x	VZT-01	VZT-1	1988	573	4	Vadose Zone	132
x	x	RIFLE RANGE WELL	RIFLE RANGE	1988	267	8	Aquifer	626
x	x	88-02D	88-02D	1988	46	8	Perched Water	221.1
x	x	88-01D	88-01D	1988	44	8	Vadose Zone	244.7

Table A-1. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	x	NA-89-3	NA89-3	1989	235	64	Vadose Zone	182
NF	x	NA-89-2	NA89-2	1989	234	65	Vadose Zone	235
x	x	NA-89-1	NA89-1	1989	233	68	Vadose Zone	238
x	x	89-01D	89-01D	1989	47	8	Vadose Zone	249
x	x	89-02D	89-02D	1990	48	NF	Vadose Zone	245
x	x	VVE 7	VVE 7	1992	1411	2	Vadose Zone	240.5
x	x	VVE 6A	VVE 6	1992	1410	4	Vadose Zone	323
x	x	VVE 4	VVE 4	1992	1409	2	Vadose Zone	275.2
x	x	VVE 3	VVE 3	1992	1408	5	Vadose Zone	233.4
x	x	VVE 10	VVE 10	1992	1412	5	Vadose Zone	265.5
x	x	VVE 1	VVE 1	1992	1407	1	Vadose Zone	247.5
x	x	M7S	M7S	1992	769	4	Aquifer	638
x	x	M6S	M6S	1992	768	4	Aquifer	696.5
x	x	M4D	M4D	1992	767	6	Aquifer	838
x	x	M3S	M3S	1992	766	8	Aquifer	660
x	x	M1SA	M1SA	1992	765	18	Aquifer	678
x	x	M10S	M10S	1992	770	4	Aquifer	678
x lith only	x	C1A	C-1A	1992	840	15	Beneath Aquifer	1805
x lith only	x	C1	C-1	1992	839	18	Aquifer	665
x	x	RWMC-PRO-A-064	RWMC TEST WELL	1993	1133	1	Aquifer	685
x	x	RWMC-MON-A-066	OW-2	1993	1132	46	Aquifer	10.25
x	x	RWMC-MON-A-065	OW-1	1993	1131	41	Aquifer	665
x	x	RWMC-MON-A-013	A11A31	1993	906	17	Aquifer	986

Table A-1. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	x	9302	93-02	1993	867	2	Vadose Zone	238
x	x	9301	93-01	1993	866	2	Vadose Zone	238
x	x	RWMC-VVE-V-071	5E	1994	1106	4	Vadose Zone	104
x	x	RWMC-VVE-V-070	4E	1994	1107	4	Vadose Zone	106
x	x	RWMC-VVE-V-069	3E	1994	1103	4	Vadose Zone	124
NF	x	RWMC-VVE-V-068	2E	1994	1102	4	Vadose Zone	101
x	x	RWMC-VVE-V-067	1E	1994	1105	5	Vadose Zone	108
x	NF	RWMC-NEU-S-110	NAT-17	1994	1204	NF	Surface Sediments	20.97
x	NF	RWMC-NEU-S-109	NAT-16	1994	1203	NF	Surface Sediments	18.97
x	NF	RWMC-NEU-S-108	NAT-15	1994	1202	NF	Surface Sediments	6.17
x	NF	RWMC-NEU-S-107	NAT-14	1994	1201	NF	Surface Sediments	6.34
x	NF	RWMC-NEU-S-106	NAT-13	1994	1200	NF	Surface Sediments	14.33
x	NF	RWMC-NEU-S-105	NAT-12	1994	1199	NF	Surface Sediments	18.25
x	NF	RWMC-NEU-S-104	NAT-11	1994	1198	NF	Surface Sediments	11.25
x	NF	RWMC-NEU-S-103	NAT-10	1994	1197	NF	Surface Sediments	10.92
x	NF	RWMC-NEU-S-102	NAT-9	1994	1196	NF	Surface Sediments	25.725
x	NF	RWMC-NEU-S-101	NAT-8	1994	1195	NF	Surface Sediments	19.87
x	NF	RWMC-NEU-S-100	NAT-7	1994	1194	NF	Surface Sediments	16.14
x	NF	RWMC-NEU-S-099	NAT-6	1994	1193	NF	Surface Sediments	10.5
x	NF	RWMC-NEU-S-098	NAT-5	1994	1192	NF	Surface Sediments	16.14
x	NF	RWMC-NEU-S-097	NAT-4	1994	1191	NF	Surface Sediments	0
x	NF	RWMC-NEU-S-096	NAT-3	1994	1190	NF	Surface Sediments	18.95
x	NF	RWMC-NEU-S-095	NAT-2	1994	1189	NF	Surface Sediments	9.3

Table A-1. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	NF	RWMC-NEU-S-094	NAT-1	1994	1188	NF	Surface Sediments	11.5
x	x	RWMC-GAS-V-081	10V	1994	1116	4	Vadose Zone	614
x	x	RWMC-GAS-V-080	9V	1994	1115	4	Vadose Zone	675
x	x	RWMC-GAS-V-079	8V	1994	1114	4	Vadose Zone	237
x	x	RWMC-GAS-V-078	7V	1994	1113	4	Vadose Zone	227
x	x	RWMC-GAS-V-077	6V	1994	1112	4	Vadose Zone	230
x	x	RWMC-GAS-V-076	5V	1994	1111	4	Vadose Zone	231
x	x	RWMC-GAS-V-075	4V	1994	1110	5	Vadose Zone	230
x	x	RWMC-GAS-V-074	3V	1994	1109	4	Vadose Zone	178
x	x	RWMC-GAS-V-073	2V	1994	1104	4	Vadose Zone	238
NF	x	RWMC-GAS-V-072	1V	1994	1108	6	Vadose Zone	228
x	NF	RWMC-SCI-S-115	LYS-1	1995	1209	NF	Surface Sediments	20
x	NF	PA-04	PA-04	1995	1793	NF	Surface Sediments	177
x	NF	PA-03	PA-03	1995	1792	NF	Surface Sediments	10
x	x	SOUTH-MON-A-004	M14S	1998	1215	7	Aquifer	645
x	x	SOUTH-MON-A-003	M13S	1998	1214	13	Aquifer	645.5
x	x	SOUTH-MON-A-002	M12S	1998	1213	13	Aquifer	585.5
x	x	SOUTH-MON-A-001	M11S	1998	1212	13	Aquifer	624
x	x	SOUTH-SCI-V-016	O-7	1999	1336	2	Vadose Zone	249
x	x	SOUTH-SCI-V-014	O-6	1999	1330	2	Vadose Zone	249
x	x	SOUTH-SCI-V-013	O-3	1999	1333	2	Vadose Zone	236.6
x	NF	SOUTH-SCI-V-011	O-1	1999	1331	NF	Vadose Zone	236
x	x	SOUTH-MON-A-009	M15S	1999	1338	1	Aquifer	653

Table A-1. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	NF	RWMC-SCI-V-160	I-1D	1999	1319	NF	Vadose Zone	245
x	NF	RWMC-SCI-V-156	I-3S	1999	1322	NF	Vadose Zone	116
x	NF	RWMC-SCI-V-154	I-2S	1999	1320	NF	Vadose Zone	116
x	NF	RWMC-SCI-V-153	I-1S	1999	1318	NF	Vadose Zone	116
x	x	SOUTH-SCI-V-018	O-4	2000	1334	2	Vadose Zone	244
x	x	SOUTH-SCI-V-015	O-5	2000	1335	2	Vadose Zone	260
x	NF	SOUTH-SCI-V-012	O-2	2000	1332	2	Vadose Zone	250.5
x	x	SOUTH-MON-A-010	M16S	2000	1337	3	Aquifer	663
x	NF	RWMC-VVE-V-205	6-E	2000	1371	NF	Vadose Zone	83
x	NF	RWMC-VVE-V-204	7-E	2000	1370	NF	Vadose Zone	82
x	NF	RWMC-VVE-V-163	DE-1	2000	1328	NF	Vadose Zone	435
x	NF	RWMC-SCI-V-203	O-8	2000	1329	NF	Vadose Zone	233
x	NF	RWMC-SCI-V-161	I-5S	2000	1326	NF	Vadose Zone	105.5
x	NF	RWMC-SCI-V-159	I-4D	2000	1325	NF	Vadose Zone	239
x	NF	RWMC-SCI-V-158	I-4S	2000	1324	NF	Vadose Zone	103
x	NF	RWMC-SCI-V-157	I-3D	2000	1323	NF	Vadose Zone	235.5
x	NF	RWMC-SCI-V-155	I-2D	2000	1321	NF	Vadose Zone	241
x	x	RWMC-MON-A-162	M17S	2000	1327	2	Aquifer	0
x	NF	RWMC-1820	SE-8	2002	1820	NF	Vadose Zone	448
x	x	SOUTH-1898	SOUTH-1898	2003	1898	1	Vadose Zone	585
x	x	SOUTH-1835	SOUTH-1823	2003	1835	4	Aquifer	648
x	x	RWMC-1822	DE-8	2003	1822	2	Vadose Zone	243
x	x	RWMC-1821	IE-8	2003	1821	2	Vadose Zone	107

Table A-1. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	x	RWMC-1819	DE-7	2003	1819	2	Vadose Zone	225
x	x	RWMC-1818	IE-7	2003	1818	1	Vadose Zone	136
x	x	RWMC-1817	SE-7	2003	1817	1	Vadose Zone	480
x	x	RWMC-1816	DE-6	2003	1816	3	Vadose Zone	232
x	x	RWMC-1815	IE-6	2003	1815	2	Vadose Zone	104
x	NF	RWMC-1814	SE-6	2003	1814	NF	Vadose Zone	459
x	x	RWMC-1813	DE-4	2003	1813	2	Vadose Zone	229
x	x	RWMC-1812	IE-4	2003	1812	2	Vadose Zone	102.5
x	x	RWMC-1810	DE-3	2003	1810	2	Vadose Zone	225
x	x	RWMC-1809	IE-3	2003	1809	2	Vadose Zone	484.6
x	x	RWMC-1808	SE-3	2003	1808	1	Vadose Zone	226.5

No color = Prior to 1990
Gray shading = After 1990
NF = none found

Table A-2. Radioactive Waste Management Complex area wells geophysical logs and completion diagram availability by depth.

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	NF	RWMC-NEU-S-107	NAT-14	1994	1201	NF	Surface Sediments	6.34
x	NF	W-20	W20	1985	590	NF	Surface Sediments	7.5
x	NF	PA-02	PA02	1985	252	NF	Surface Sediments	9.17
x	NF	RWMC-NEU-S-095	NAT-2	1994	1189	NF	Surface Sediments	9.3
x	NF	RWMC-NEU-S-097	NAT-4	1994	1191	NF	Surface Sediments	9.3
x	NF	PA-03	PA-03	1985	1792	NF	Surface Sediments	10
x	x	RWMC-MON-A-066	OW-2	1993	1132	46	Aquifer	10.25
x	NF	RWMC-NEU-S-099	NAT-6	1994	1193	NF	Surface Sediments	10.5
x	NF	RWMC-NEU-S-103	NAT-10	1994	1197	NF	Surface Sediments	10.92
x	NF	TH-04	TH04	1985	354	NF	Surface Sediments	11.17
x	NF	RWMC-NEU-S-104	NAT-11	1994	1198	NF	Surface Sediments	11.25
x	NF	RWMC-NEU-S-094	NAT-1	1994	1188	NF	Surface Sediments	11.5
x	NF	W-06	W06	1986	579	NF	Surface Sediments	11.83
x	NF	RWMC-NEU-S-106	NAT-13	1994	1200	NF	Surface Sediments	14.33
x	NF	PA-01	PA01	1985	251	NF	Surface Sediments	14.67
x	NF	W-09	W09	1986	581	NF	Surface Sediments	14.96
x	NF	W-25	W25	1986	594	NF	Surface Sediments	15.5
x	NF	TH-05	TH05	1986	355	NF	Surface Sediments	15.6
x	NF	W-05	W05	1986	578	NF	Surface Sediments	15.92
x	NF	RWMC-NEU-S-098	NAT-5	1994	1192	NF	Surface Sediments	16.14
x	NF	RWMC-NEU-S-100	NAT-7	1994	1194	NF	Surface Sediments	16.14
x	NF	W-13	W13	1986	585	NF	Surface Sediments	18

Table A-2. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	NF	RWMC-NEU-S-105	NAT-12	1994	1199	NF	Surface Sediments	18.25
x	NF	RWMC-NEU-S-096	NAT-3	1994	1190	NF	Surface Sediments	18.95
x	NF	RWMC-NEU-S-109	NAT-16	1994	1203	NF	Surface Sediments	18.97
x	NF	W-23	W23	1985	592	NF	Surface Sediments	19.83
x	NF	RWMC-NEU-S-101	NAT-8	1994	1195	NF	Surface Sediments	19.87
x	NF	T-23	T23	1985	335	NF	Surface Sediments	19.92
x	NF	RWMC-SCI-S-115	LYS-1	1985	1209	NF	Surface Sediments	20
x	NF	W-17	W17	1986	587	NF	Surface Sediments	20.42
x	NF	RWMC-NEU-S-110	NAT-17	1994	1204	NF	Surface Sediments	20.97
x	NF	W-08	W08	1985	580	NF	Surface Sediments	22.17
x	NF	W-04	W04	1985	577	NF	Surface Sediments	24.9
x	NF	RWMC-NEU-S-102	NAT-9	1994	1196	NF	Surface Sediments	25.725
x	x	D-06A	D-06A	1986	144	3	Perched Water	49.67
x	x	78-1	78-1	1978	12	8	Perched Water	82
x	NF	RWMC-VVE-V-204	7-E	2000	1370	NF	Vadose Zone	82
x	NF	RWMC-VVE-V-205	6-E	2000	1371	NF	Vadose Zone	83
x	x	77-2	77-2	1977	11	2	Perched Water	87.4
NF	x	RWMC-VVE-V-068	2E	1994	1102	4	Vadose Zone	101
x	x	RWMC-1812	IE-4	2003	1812	2	Vadose Zone	102.5
x	NF	RWMC-SCI-V-158	I-4S	2000	1324	NF	Vadose Zone	103
x	x	RWMC-1815	IE-6	2003	1815	2	Vadose Zone	104
x	x	RWMC-VVE-V-071	5E	1994	1106	4	Vadose Zone	104
x	NF	RWMC-SCI-V-161	I-5S	2000	1326	NF	Vadose Zone	105.5

Table A-2. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	x	RWMC-VVE-V-070	4E	1994	1107	4	Vadose Zone	106
x	x	RWMC-1821	IE-8	2003	1821	2	Vadose Zone	107
x	x	RWMC-VVE-V-067	1E	1994	1105	5	Vadose Zone	108
x	NF	RWMC-SCI-V-153	I-1S	1999	1318	NF	Vadose Zone	116
x	NF	RWMC-SCI-V-154	I-2S	1999	1320	NF	Vadose Zone	116
x	NF	RWMC-SCI-V-156	I-3S	1999	1322	NF	Vadose Zone	116
x	x	RWMC-VVE-V-069	3E	1994	1103	4	Vadose Zone	124
x	x	D-06	DO-6	1986	143	4	Vadose Zone	126.42
x	x	VZT-01	VZT-1	1988	573	4	Vadose Zone	132
x	x	RWMC-1818	IE-7	2003	1818	1	Vadose Zone	136
x	NF	PA-04	PA-04	1985	1793	NF	Surface Sediments	177
x	x	RWMC-GAS-V-074	3V	1994	1109	4	Vadose Zone	178
x	x	NA-89-3	NA89-3	1989	235	64	Vadose Zone	182
x	x	76-4	76-4	1976	6	7	Vadose Zone	215
x	x	88-02D	88-02D	1988	46	8	Perched Water	221.1
x	x	79-2	79-2	1979	19	1	Perched Water	222.7
x	x	RWMC-1810	DE-3	2003	1810	2	Vadose Zone	225
x	x	RWMC-1819	DE-7	2003	1819	2	Vadose Zone	225
x	x	RWMC-1808	SE-3	2003	1808	1	Vadose Zone	226.5
x	x	RWMC-GAS-V-078	7V	1994	1113	4	Vadose Zone	227
NF	x	RWMC-GAS-V-072	1V	1994	1108	6	Vadose Zone	228
x	x	76-1	76-1	1976	3	4	Vadose Zone	228.3
x	x	RWMC-1813	DE-4	2003	1813	2	Vadose Zone	229

Table A-2. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	x	USGS-096B	USGS-96B	1975	51	4	Vadose Zone	229
x	x	RWMC-GAS-V-075	4V	1994	1110	5	Vadose Zone	230
x	x	RWMC-GAS-V-077	6V	1994	1112	4	Vadose Zone	230
x	x	RWMC-GAS-V-076	5V	1994	1111	4	Vadose Zone	231
x	x	RWMC-1816	DE-6	2003	1816	3	Vadose Zone	232
x	NF	RWMC-SCI-V-203	O-8	2000	1329	NF	Vadose Zone	233
x	x	USGS-093A	USGS-93A	1972	49	4	Vadose Zone	233
x	x	VVE 3	VVE 3	1992	1408	5	Vadose Zone	233.4
NF	x	NA-89-2	NA89-2	1989	234	65	Vadose Zone	235
x	NF	RWMC-SCI-V-157	I-3D	2000	1323	NF	Vadose Zone	235.5
x	NF	SOUTH-SCI-V-011	O-1	1999	1331	NF	Vadose Zone	236
x	x	USGS-096	USGS-96	1972	545	4	Vadose Zone	236.25
x	x	SOUTH-SCI-V-013	O-3	1999	1333	2	Vadose Zone	236.6
x	x	RWMC-GAS-V-079	8V	1994	1114	4	Vadose Zone	237
x	x	TW-1	TW-1	1987	448	5	Vadose Zone	237.5
x	x	9301	93-01	1993	866	2	Vadose Zone	238
x	x	9302	93-02	1993	867	2	Vadose Zone	238
x	x	NA-89-1	NA89-1	1989	233	68	Vadose Zone	238
x	x	RWMC-GAS-V-073	2V	1994	1104	4	Vadose Zone	238
x	NF	D-10	D-10	1987	145	NF	Perched Water	238.5
x	NF	RWMC-SCI-V-159	I-4D	2000	1325	NF	Vadose Zone	239
x	x	76-3	76-3	1976	5	4	Vadose Zone	240.4
x	x	VVE 7	VVE 7	1992	1411	2	Vadose Zone	240.5

Table A-2. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	NF	RWMC-SCI-V-155	I-2D	2000	1321	NF	Vadose Zone	241
x	x	D-02	DO-2	1986	142	8	Vadose Zone	243
x	x	RWMC-1822	DE-8	2003	1822	2	Vadose Zone	243
x	x	76-6	76-6	1976	9	4	Vadose Zone	243.8
x	x	79-1	79-1	1979	18	4	Vadose Zone	244
x	x	SOUTH-SCI-V-018	O-4	2000	1334	2	Vadose Zone	244
x	x	88-01D	88-01D	1988	44	8	Vadose Zone	244.7
x	x	76-5	76-5	1976	8	4	Perched Water	245
x	x	89-02D	89-02D	1990	48	NF	Vadose Zone	245
x	NF	RWMC-SCI-V-160	I-1D	1999	1319	NF	Vadose Zone	245
x	x	USGS-093	USGS-93	1972	542	9	Vadose Zone	246.25
x	x	USGS-095	USGS-95	1972	544	5	Vadose Zone	246.25
x	x	USGS-092	USGS-92	1972	541	15	Perched Water	247
x	x	VVE 1	VVE 1	1992	1407	1	Vadose Zone	247.5
x	x	78-3	78-3	1978	14	7	Vadose Zone	248
x	x	89-01D	89-01D	1989	47	8	Vadose Zone	249
x	x	SOUTH-SCI-V-014	O-6	1999	1330	2	Vadose Zone	249
x	x	SOUTH-SCI-V-016	O-7	1999	1336	2	Vadose Zone	249
x	x	78-5	78-5	1978	16	4	Vadose Zone	250
x	NF	SOUTH-SCI-V-012	O-2	2000	1332	2	Vadose Zone	250.5
x	NF	D-15	D-15	1987	146	NF	Vadose Zone	252
x	x	76-2	76-2	1976	4	4	Vadose Zone	252.5
x	x	78-2	78-2	1978	13	7	Vadose Zone	252.6

Table A-2. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	x	76-4A	76-4A	1976	7	3	Vadose Zone	254.3
x	x	USGS-091	USGS-91	1972	540	8	Vadose Zone	255.25
x	x	WWW1	WWW#1	1983	598	2	Vadose Zone	258
x	x	SOUTH-SCI-V-015	O-5	2000	1335	2	Vadose Zone	260
x	x	79-3	79-3	1979	20	4	Vadose Zone	262
x	x	VVE 10	VVE 10	1992	1412	5	Vadose Zone	265.5
x	x	VVE 4	VVE 4	1992	1409	2	Vadose Zone	275.2
x	x	USGS-094	USGS-94	1972	543	8	Vadose Zone	302.25
x	x	VVE 6A	VVE 6	1992	1410	4	Vadose Zone	323
x	x	78-4	78-4	1978	15	7	Vadose Zone	350
x	NF	RWMC-VVE-V-163	DE-1	2000	1328	NF	Vadose Zone	435
x	NF	RWMC-1820	SE-8	2002	1820	NF	Vadose Zone	448
x	NF	RWMC-1814	SE-6	2003	1814	NF	Vadose Zone	459
x	x	RWMC-1817	SE-7	2003	1817	1	Vadose Zone	480
x	x	RWMC-1809	IE-3	2003	1809	2	Vadose Zone	484.6
x	x	SOUTH-1898	SOUTH-1898	2003	1898	1	Vadose Zone	585
x	x	SOUTH-MON-A-002	M12S	1998	1213	13	Aquifer	585.5
x	x	77-1	77-1	1977	10	4	Vadose Zone	600
x	x	RWMC-GAS-V-081	10V	1994	1116	4	Vadose Zone	614
x	x	USGS-118	USGS-118	1987	567	15	Aquifer	622
x	x	SOUTH-MON-A-001	M11S	1998	1212	13	Aquifer	624
x	x	RIFLE RANGE WELL	RIFLE RANGE	1988	267	8	Aquifer	626
x	x	USGS-090	USGS-90	1972	539	17	Aquifer	626

Table A-2. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	x	M7S	M7S	1992	769	4	Aquifer	638
x	x	SOUTH-MON-A-004	M14S	1998	1215	7	Aquifer	645
x	x	SOUTH-MON-A-003	M13S	1998	1214	13	Aquifer	645.5
x	x	USGS-089	USGS-89	1972	538	28	Aquifer	646
x	x	SOUTH-1835	SOUTH-1823	2003	1835	4	Aquifer	648
x	x	SOUTH-MON-A-009	M15S	1999	1338	1	Aquifer	653
x	x	USGS-009	USGS-9	1951	458	7	Aquifer	654.14
x	x	USGS-117	USGS-117	1987	566	11	Aquifer	655
x	x	M3S	M3S	1992	766	8	Aquifer	660
x	x	SOUTH-MON-A-010	M16S	2000	1337	3	Aquifer	663
x	x	USGS-088	USGS-88	1971	537	55	Aquifer	663
x lith only	x	C1	C-1	1992	839	18	Aquifer	665
x	x	RWMC-MON-A-065	OW-1	1993	1131	41	Aquifer	665
x	x	RWMC-MON-A-162	M17S	2000	1327	2	Aquifer	665
x	x	USGS-087	USGS-87	1971	536	27	Aquifer	673
x	x	RWMC-GAS-V-080	9V	1994	1115	4	Vadose Zone	675
x	x	M10S	M10S	1992	770	4	Aquifer	678
x	x	M1SA	M1SA	1992	765	18	Aquifer	678
x	x	RWMC PRODUCTION WELL	RWMC	1974	268	11	Aquifer	685
x	x	RWMC-PRO-A-064	RWMC TEST WELL	1993	1133	1	Aquifer	685
x	x	USGS-086	USGS-86	1966	535	4	Aquifer	691
x	x	M6S	M6S	1992	768	4	Aquifer	696.5
x	x	USGS-119	USGS-119	1987	568	3	Aquifer	705

Table A-2. (continued).

Completion Diagram	Geophysical Logs	Well Name	Well Alias	Date Completed	Well ID	Total Logs	Well Completion Zone	Well Depth (BLS)
x	x	USGS-120	USGS-120	1987	569	8	Aquifer	705
x	x	HIGHWAY 3	HWY-3	1967	184	5	Aquifer	750
x	x	USGS-106	USGS-106	1980	555	7	Aquifer	760
x	x	USGS-108	USGS-108	1980	557	10	Aquifer	760
x	x	USGS-105	USGS-105	1980	554	10	Aquifer	800
x	x	USGS-109	USGS-109	1980	558	7	Aquifer	800
x	x	M4D	M4D	1992	767	6	Aquifer	838
x	x	RWMC-MON-A-013	A11A31	1993	906	17	Aquifer	986
x	x	EBR-1	EBR-I	1949	149	8	Aquifer	1075
x lith only	x	C1A	C-1A	1992	840	15	Beneath Aquifer	1805

No color = shallow (i.e., less than 30 ft)
Gray shading = middle (i.e., 30 to 140 ft)
Blue shading = deep (i.e., greater than 140 ft)
NF = none found

Appendix B

Information for Interpreting Geophysical Logs

Appendix B

Information for Interpreting Geophysical Logs

Several different file-naming conventions are used for the geophysical logs, thus the file names and extensions are not consistent. The information below provides assistance with acronyms and file name extensions used over the 50 years of geophysical logging at the INEEL to enable recognition of the files and thus easier access.

.fix logs These logs were made before 1990, producing a single column of data. The logs were processed using a simple program to convert the single column to two columns: depth (bls) and measurement. The well name or a shortened version of the name is in the first position of the file name, before any file extensions (e.g., gs58…..fix)

Log Type Naming Conventions
The following are commonly used log type designations in the early logs. The log type appears after the well name or abbreviation (alias) (e.g., gs58ca..fix).

Ca = caliper log
Header info example: a:bgp_ca,"7-12-74","caliper_ca","inches","0","22","0","300"

Nga = natural gamma log
Header info example: a:bgp_ga,"10-7-74","gamma_nga","sc=.0025","0","40","0","558"

Gga = gamma gamma log
Header info example: a:bgp_gga,"5-20-4","gammagamma_gga","sc=.01","0","32","0","101"

Ga = natural gamma log
Header info example: a:bgp_ga,"10-7-74","gamma_nga","sc=.0025","0","40","0","558"

Na = neutron-na log
Header info example: a:bgp_na,"5-20-74","neutron_na","sc=.005","0","30","0","102"

Log Type Designations Using Geophysical Tool Number

Many of the logs use the geophysical logging tool number to designate type. The following columns are the columns in the logs of each type. Again, the file name itself begins with the well name or an abbreviation or alias and then the tool number that may be followed by a letter to indicate a sequence of logging efforts within that well. The asterisk before and after the tool number reflects its position in the file name.

***41* logs** Resistivity Log

DEPTH	GAM(NAT)	RES	TEMPRES(16N)	SP	RES(64N)	RESDEL	TEMP	LATERAL	TENSION	TIME
FT	API-GR	OHM	DEG F	MV	OHM-M	OHM	DEG F	OHM-M	POUNDS	MINUTES

***55* logs** Neutron Log

DEPTH	GAM(NAT)	RES	NEUTRON	SP	SANG	SANGB	TEMPDEL	TEMP	TENSION	TIME
FT	API-GR	OHM	API-N	MV	DEG	DEG	DEG F	DEG F	POUNDS	MINUTES

***65* logs** Short Arm Caliper, Long Arm Caliper

DEPTH	CALIPER	TENSION	TIME
FT	INCH	POUNDS	MINUTES

***69* logs** Gamma-Gamma (Ci Cs-137 source), Natural Gamma, Density

DEPTH	GAM(NAT)	DEN (LS)	DEN(SS)	TENSION	TIME
FT	API-GR	CPS	CPS	POUNDS	MINUTES

Processed Logs (in ascii format) using tool number as type designation

The naming convention for these logs is as follows:

Well name, alias or abbreviation_(underscore)date_tool number_measurement interval (i.e., .10 is tenth of a foot)_beginning depth_ending depth_processed or original.las
The following columns are as they appear in the log.

9057 .LAS Logs Neutron-Neutron (Ci Am-240 Be Source), Magnetic Deviation, Natural Gamma, Spontaneous Potential, Single Point Resistance, Temperature, Lateral Resistivity
Data columns are as follows:

GAM(NAT)	TEMP	RES(16N)	RES(64N)	RES	LATERAL	NEUTRON	POR(NEU)	SANGB	DEL TEMP	SANG	SP	TENSION	TIME
API-GR	DEG F	OHM-M	OHM-M	OHM	OHM-M	API-N	PERCENT	DEG	DEG F	DEG	MV	POUNDS	MINUTES

9095 .LAS Logs Gyro Deviation, Natural Gamma
Data columns are as follows:

DEPTH	SANG	SANGB	TOOL FACE	DELT TF	GYRO	PAD1-AZ	GAM(NAT)	COS-GYRO	SIN-GYRO	XINCL	YINCL	CAGE	MAG-VECT	MSANGB	TENSION	TIME
FT	DEG	DEG	DEG	DEG	VOLTS	DEG	API-GR	AMPL	AMPL	AMPL	AMPL	VOLTS	AMPL	DEG	POUNDS	MINUTES

9055N .LAS Logs Neutron-Neutron (Ci Am-240 Be Source), Magnetic Deviation, Natural Gamma, Spontaneous Potential, Single Point Resistance
Data columns are as follows:

DEPTH	GAM(N)	POR(NEU)	RES	NEUTRON	SP	SANG	SANGB	TEMP	DEL TEMP	TENSION	TIME
FT	API-GR	PERCENT	OHM	API-N	MV	DEG	DEG	DEG F	DEG F	POUNDS	MINUTES

9069 .LAS Logs Gamma-Gamma (Ci Cs-137 source), Natural Gamma, Density
Data columns are as follows:

DEPTH	GAM(NAT)	DEN(LS)	DEN(SS)	TENSION	TIME
FT	API-GR	CPS	CPS	POUNDS	MINUTES

Cal.* Logs Caliper Logs
Data Columns are as follows:

DEPTH	CALIPER
FT	INCH

Dev.* Logs Deviation Logs
Data Columns are as follows:

DEPTH	SANG	SANGB
FT	DEG	DEG

Gga.* Logs Density Logs
Data Columns as follows:

DEPTH	DEN(LS)	DEN(SS)
FT	CPS	CPS

Nga.* Logs Natural Gamma Logs
Data Columns are as follows:

DEPTH	GAM(NAT)
FT	API-GR

Neu.* Logs Neutron Logs
Data Columns are as follows:

DEPTH	NEUTRON
FT	API-N