Site Characterization and Monitoring Data from the Area 5 Pilot Wells

Prepared by

Bechtel Nevada
Geotechnical Sciences
Las Vegas, Nevada

Prepared for

U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Las Vegas, Nevada

September 2005

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DOE/NV/11718--1067

PREFACE

The Special Projects Section of Reynolds Electrical & Engineering Co., Inc. (REECo), a predecessor to Bechtel Nevada, was responsible for characterizing the subsurface hydrogeology of the Area 5 Radioactive Waste Management Site (RWMS) at the Nevada Test Site for the U.S. Department of Energy, Nevada Operations Office in the early 1990s. Some of this work was documented in a series of unpublished data reports. As part of Bechtel Nevada's current scope for closure planning for the Area 5 RWMS, two of these REECo data reports, *Hydrologic Characterization Data from the Area 5 Shallow Soil Trenches* (DOE/NV/11718--1060) and this report on the pilot wells, have been updated to current editorial standards for approval for public release so they will be accessible for public review and for citation in future documents.

This data report for the Area 5 pilot wells was originally prepared under the same title in February 1994, and assigned the document number, DOE/NV/11432--74. The report has been updated by revising it to conform to current editorial standards of Bechtel Nevada and of the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. In addition, some errors in the original unreviewed and unpublished report have been corrected.

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ABSTRACT

Three exploratory boreholes were drilled and completed to the uppermost alluvial aquifer in Area 5 of the Nevada Test Site, Nye County, Nevada, in 1992. The boreholes and associated investigations were part of the Area 5 Site Characterization Program developed to meet data needs associated with regulatory requirements applicable to the disposal of low-level, mixed, and high-specific-activity waste at this site. This series of boreholes was specifically designed to characterize the hydrogeology of the thick vadose zone and to help define the water quality and hydraulic properties of the uppermost aquifer.

Wells UE5PW-1, UE5PW-2, and UE5PW-3 are located in a triangular array near the southeast, northeast, and northwest corners, respectively, of the approximately 2.6-square-kilometer Area 5 Radioactive Waste Management Site to give reasonable spatial coverage for sampling and characterization, and to help define the nearly horizontal water table. Two of the wells, UE5PW-1 and UE5PW-2, penetrated only unconsolidated alluvial materials. The third well, located closer to the margin of the basin, penetrated both alluvium and underlying ash-flow and bedded tuff units. The water table was encountered at the elevation of approximately 734 meters.

The results of laboratory testing of core and drill cuttings samples indicate that the mineralogical, material, and hydrologic properties of the alluvium are very similar within and between boreholes. Additional tests on the same core and drill cuttings samples indicate that hydrologic conditions within the alluvium are also similar between pilot wells. Both core and drill cuttings samples are dry (less than 10 percent water content by weight) throughout the entire unsaturated section of alluvium, and water content increases slightly with depth in each borehole. Water potential measurements on core samples show a large positive potential gradient (water tends to move upward, rather than downward) to a depth of approximately 30.5 meters in each borehole, and a nearly zero potential gradient throughout the remaining portion of the vadose zone.

These hydrologic condition data and hydrologic property data indicate that little net downward liquid flow is occurring (if any) through the thick vadose zone. Conversely, gas flow by diffusion, and possibly by advection, may be an important transport mechanism. Environmental tracer measurements made on water extracted from geologic samples suggest that water vapor in the upper portion of the vadose zone is moving upward in response to evaporative demand of the present arid climate.

Preliminary water quality data indicate that the key hazardous and radioactive constituents do not exceed appropriate standards.

Monitoring instruments and equipment were installed in each pilot well for making in-situ measurements of key hydrologic and pneumatic parameters and to monitor change in these parameters over time.

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Table of Contents

Preface	iii
Abstract	v
List of Figures	x
List of Tables	xii
List of Appendices	xiii
List of Acronyms and Abbreviations	xviii
1.0 Introduction	1-1
1.1 Background Information	1-1
1.2 Project Description	1-1
1.3 Purpose and Justification	1-1
1.4 Scope of Report	1-3
1.5 Overview of Activities	1-4
1.6 Objectives	1-5
1.7 Site Description	1-6
1.8 Pilot Well Locations	1-7
1.9 Site Climatology and Meteorology	1-7
2.0 Drilling, Coring, and Completion	2-1
2.1 Drilling and Casing	2-1
2.2 Collection of Geologic Samples	2-4
2.2.1 Collection of Core Samples	2-5
2.2.2 Collection of Drill Cuttings Samples	2-8
2.3 Geologic Description and Disposition of Samples	2-8
2.3.1 Handling, Description, and Disposition of Core Samples	2-8
2.3.2 Handling, Description, and Disposition of Drill Cuttings Samples	2-11
2.4 Field Tests on Core and Drill Cuttings	2-11
2.4.1 Tracer Tests for Estimating Disturbance from Air Drilling Fluid	2-11
2.4.2 Radiological Surveys of Geologic Samples	2-12
2.5 Pilot Well Completion	2-12
2.5.1 Subsurface Completion Design	2-13
2.5.2 Subsurface Completion Operations	2-17
2.5.3 Surface Facilities and Wellhead Completion	2-18

Table of Contents *(Continued)*

2.6	Well Development	2-18
3.0	Laboratory Testing Methods and Results	3-1
3.1	General Geologic Description, Lithology, Stratigraphy, Mineralogy, and Organic Matter	3-14
3.1.1	General Geologic, Lithologic, and Stratigraphic Data for Alluvium	3-14
3.1.2	Tuff Lithology and Stratigraphy	3-17
3.1.3	Elemental and Oxide Composition	3-18
3.1.4	Secondary Mineralogy and Organic Matter	3-25
3.2	Physical Properties	3-27
3.2.1	Particle Size Distribution	3-27
3.2.2	Bulk Density and Porosity	3-31
3.3	Hydrologic Properties	3-36
3.3.1	Saturated Hydraulic Conductivity	3-36
3.3.2	Moisture Retention Relations	3-38
3.3.3	Unsaturated Hydraulic Conductivity	3-40
3.4	Hydrologic Conditions	3-43
3.4.1	Water Content	3-43
3.4.2	Water Potential	3-47
3.5	Environmental Tracers	3-51
3.5.1	Chloride/Bromide Profiles	3-51
3.5.2	Stable Isotope Profiles	3-60
3.5.3	Cosmogenic Chlorine-36 Data	3-60
3.5.4	Soluble Sulfate	3-63
3.6	Sampling and Analysis of Core Samples for Hazardous and Radiological Parameters	3-66
4.0	Field Testing Methods and Results	4-1
4.1	Preliminary Surface Surveys of Potential Contaminants at Drill Sites	4-1
4.1.1	Surface Soil Sampling, Analysis, and Results	4-1
4.1.2	Near-Surface Radon and Tritium Gas Sampling, Analysis, and Results	4-2
4.1.2.1	Radon Soil Gas Surveys	4-2
4.1.2.2	Tritium Soil Gas Surveys	4-3

Table of Contents (Continued)

4.2	Surface Geophysical Surveys	4-3
4.2.1	Resistivity Surveys	4-4
4.2.2	Magnetometer Surveys	4-6
4.3	Borehole Geophysical Logging Surveys	4-7
4.3.1	Description of Borehole Logging Activities	4-7
4.3.2	Summary of Nuclear Logging Results	4-9
4.3.3	Summary of Borehole Deviation Logs	4-10
4.4	In-Situ Air Permeability Testing	4-10
4.4.1	Air (Injection) Permeability Tests Below Drill Casing	4-11
4.4.2	Post-Drilling Air (Injection) Permeability Testing	4-12
4.5	Upper Aquifer Hydraulic Parameter Testing	4-13
4.5.1	Water Table Elevations and Gradient	4-13
4.5.2	Hydraulic Conductivity Recovery Tests	4-15
4.6	Neutron Logging Calibration Boreholes	4-17
5.0	Upper Aquifer Water Quality	5-1
5.1	RCRA Groundwater Sampling and Analysis	5-1
5.2	Preliminary Comparison of General Water Chemistry	5-3
6.0	Preliminary Vadose Zone Monitoring Data	6-1
6.1	Temperature Profile Data	6-1
6.2	Formation Air Pressure Profile Data	6-1
6.3	Water Potential Profile Data	6-3
7.0	Summary	7-1
8.0	References	8-1

Distribution List

List of Figures

Number	Title	Page
1-1	Location of the Area 5 Radioactive Waste Management Site	1-2
1-2	Location of the Area 5 Pilot Wells	1-8
2-1	Completion Configuration for Well UE5PW-1	2-14
2-2	Completion Configuration for Well UE5PW-2	2-15
2-3	Completion Configuration for Well UE5PW-3	2-16
2-4	Area 5 Pilot Well Surface Facilities and Wellhead Completion Diagram	2-19
3-1	Depth Profiles of Element and Oxide Composition Data by X-Ray Fluorescence (XRF) for Core Samples from Well UE5PW-1	3-19
3-2	Depth Profiles of Element and Oxide Composition Data by Instrumental Neutron Activation Analysis (INAA) for Core Samples from Well UE5PW-1	3-22
3-3	Depth Profiles of Inorganic Carbon for Drill Cuttings Samples from the Pilot Wells	3-26
3-4	Depth Profiles of Dry Sieve Analyses for Core and Drill Cuttings Samples from Well UE5PW-1	3-28
3-5	Depth Profiles of Dry Sieve Analyses for Core and Drill Cuttings Samples from Well UE5PW-2	3-29
3-6	Depth Profiles of Dry Sieve Analyses for Core and Drill Cuttings Samples from Well UE5PW-3	3-30
3-7	Depth Profiles of Dry Bulk Density for Core Samples from the Pilot Wells	3-32
3-8	Depth Profiles of Calculated (calc) and Water-Saturated (sat) Porosity for Core Samples from Well UE5PW-1	3-33
3-9	Depth Profiles of Calculated (calc) and Water-Saturated (sat) Porosity for Core Samples from Well UE5PW-2	3-34
3-10	Depth Profiles of Calculated (calc) and Water-Saturated (sat) Porosity for Core Samples from Well UE5PW-3	3-35
3-11	Depth Profiles of Saturated Hydraulic Conductivity for Core Samples from the Pilot Wells	3-37
3-12	Composite Moisture Retention Data for Core Samples from Well UE5PW-1	3-39
3-13	Composite Moisture Retention Data for Core Samples from Well UE5PW-2	3-39
3-14	Composite Moisture Retention Data for Core Samples from Well UE5PW-3	3-40
3-15	Fitted Unsaturated Hydraulic Conductivity Functions for Core Samples from Well UE5PW-1	3-42
3-16	Fitted Unsaturated Hydraulic Conductivity Functions for Core Samples from Well UE5PW-2	3-42

List of Figures (Continued)

Number	Title	Page
3-17	Fitted Unsaturated Hydraulic Conductivity Functions for Core Samples from Well UE5PW-1	3-43
3-18	Depth Profiles of Gravimetric Water Content for Core and Drill Cuttings Samples from Well UE5PW-1	3-44
3-19	Depth Profiles of Gravimetric Water Content for Core and Drill Cuttings Samples from Well UE5PW-2	3-45
3-20	Depth Profiles of Gravimetric Water Content for Core and Drill Cuttings Samples from Well UE5PW-3	3-46
3-21	Depth Profiles of Volumetric Water Content for Core Samples from the Pilot Wells	3-48
3-22	Depth Profiles of Water Potential for Core Samples from the Pilot Wells	3-50
3-23	Depth Profiles of Dry Soil Chloride Concentrations for Drill Cuttings Samples from the Pilot Wells	3-53
3-24	Depth Profiles of Dry Soil Chloride Concentrations for Core Samples from the Pilot Wells	3-54
3-25	Depth Profiles of Dry Soil Bromide Concentrations for Drill Cuttings Samples from the Pilot Wells	3-55
3-26	Depth Profiles of Dry Soil Bromide Concentrations for Core Samples from the Pilot Wells	3-56
3-27	Depth Profiles of Dry Soil Chloride/Bromide Ratios for Core and Drill Cuttings Samples from Pilot Well UE5PW-1	3-57
3-28	Depth Profiles of Dry Soil Chloride/Bromide Ratios for Core and Drill Cuttings Samples from Pilot Well UE5PW-2	3-58
3-29	Depth Profiles of Dry Soil Chloride/Bromide Ratios for Core and Drill Cuttings Samples from Pilot Well UE5PW-3	3-59
3-30	Depth Profiles of Stable Isotope Data for Core Samples from the Pilot Wells	3-61
3-31	Comparison of Measured Stable Isotopes for Core and Water Samples from the Pilot Wells with Stable Isotope Data for the Global Meteoric Water Line	3-62
3-32	Depth Profile of $^{36}\text{Cl}/\text{Cl}$ Ratios for Core Samples from Well UE5PW-1	3-64
3-33	Depth Profiles of Soluble Sulfate for Drill Cuttings Samples from the Pilot Wells	3-65
4-1	Resistivity Soundings at the Area 5 Pilot Well Locations	4-5
6-1	Depth Profiles of In-Situ Temperatures from the Pilot Wells	6-2
6-2	Depth Profiles of In-Situ Psychrometer Data from the Pilot Wells	6-4

List of Tables

<i>Number</i>	<i>Title</i>	<i>Page</i>
1-1	Regulatory Drivers for Site Characterization and Monitoring	1-4
1-2	Location Data for the Area 5 Pilot Wells	1-8
2-1	REEC Co Standard Operating Procedures and Test Plans Applicable to the Pilot Well Project	2-2
2-2	Summary of Pilot Well Drilling and Lithology Information	2-3
2-3	Core Record for Well UE5PW-1	2-6
2-4	Core Record for Well UE5PW-2	2-7
2-5	Core Record for Well UE5PW-3	2-7
2-6	Definitions of Core and Drill Cuttings Sample Labels	2-10
2-7	Pilot Well Development Data	2-21
3-1	Summary of Laboratory Methods	3-2
3-2	Summary of Tests Performed on Samples from the Pilot Wells	3-5
3-3	Summary of Descriptive Statistics for Alluvium Samples from the Pilot Wells	3-6
3-4	Summary of Descriptive Statistics for Tuff Samples from Well UE5PW-3	3-13
3-5	Summary of USCS Assignments for Core and Drill Cuttings Samples from the Pilot Wells	3-15
3-6	Summary of Descriptive Statistics of Moisture Retention Curves for Core Samples from the Pilot Wells	3-41
4-1	Borehole Geophysical Logging Episodes in the Area 5 Pilot Wells	4-8
4-2	Uncorrected Water Table Elevation Data	4-14
5-1	Testing Laboratories, Chemical Parameters, and Analytical Methods	5-2

List of Appendices

- A. Drilling Information
 - A.1 Chronological Drilling Summary for UE5PW-1
 - A.2 Chronological Drilling Summary for UE5PW-2
 - A.3 Chronological Drilling Summary for UE5PW-3
 - A.4 Drilling Penetration Rate Data for Pilot Wells
- B. Core and Drill Cuttings Sample Description Data
 - B.1 Borehole Log Sheets for UE5PW-1
 - B.2 Borehole Log Sheets for UE5PW-2
 - B.3 Borehole Log Sheets for UE5PW-3
 - B.4 Drill Cuttings Log Data for UE5PW-1
 - B.5 Drill Cuttings Log Data for UE5PW-2
 - B.6 Drill Cuttings Log Data for UE5PW-3
- C. Tracer (SF_6) Test Data
 - C.1 UE5PW-1 SF_6 Data from Core Samples and Compressor Air Lines
 - C.2 Formation SF_6 Tracer Gas Concentrations
- D. Completion Data
 - D.1 Pilot Well Completion
 - D.1.1 Annular Materials
 - D.1.2 Preparation for Completion
 - D.1.3 Casing and Instrumentation Installation Detail
 - D.1.4 Stemming Detail
 - D.1.5 Completion Operations Safety
 - D.2 Pilot Well Stemming Summaries
 - D.2.1 UE5PW-1 Stemming Summary
 - D.2.2 UE5PW-2 Stemming Summary
 - D.2.3 UE5PW-3 Stemming Summary
 - D.3 Pilot Well Casing Tallies
 - D.3.1 UE5PW-1 Casing Tally
 - D.3.2 UE5PW-2 Casing Tally
 - D.3.3 UE5PW-3 Casing Tally

List of Appendices (Continued)

- D.4 Pilot Well Daily Activities
 - D.4.1 UE5PW-1 Daily Activity
 - D.4.2 UE5PW-2 Daily Activity
 - D.4.3 UE5PW-3 Daily Activity
- E Laboratory Testing Data of Geologic Samples
 - E.1 Stratigraphy and Mineralogy Data
 - E.1.1 Profiles of USCS Textural Classes
 - E.1.2 XRF and INAA Data
 - E.1.2.1 Oxide Composition Data Determined by Major Elements XRF and INAA Methods for Core Samples from UE5PW-1
 - E.1.2.2 Elemental Composition Data Determined by INAA and Trace Element XRF Methods for Core Samples from UE5PW-1
 - E.1.2.3 Oxide Composition Data Determined by Major Elements XRF and INAA Methods for Core Samples from UE5PW-2
 - E.1.2.4 Elemental Composition Data Determined by INAA and Trace Element XRF Methods for Core Samples from UE5PW-2
 - E.1.2.5 Oxide Composition Data Determined by Major Elements XRF and INAA Methods for Core Samples from UE5PW-3
 - E.1.2.6 Elemental Composition Data Determined by INAA and Trace Element XRF Methods for Core Samples from UE5PW-3
 - E.2 Material, Hydrologic, and Geochemical Parameter Data for Alluvial Samples
 - E.2.1 Results of Laboratory Tests for Core Samples from UE5PW-1
 - E.2.2 Results of Laboratory Tests for Core Samples from UE5PW-2
 - E.2.3 Results of Laboratory Tests for Core Samples from UE5PW-3
 - E.2.4 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-1
 - E.2.5 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2
 - E.2.6 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-3
 - E.2.7 Moisture Retention Data for Core Samples from UE5PW-1
 - E.2.8 Moisture Retention Data for Core Samples from UE5PW-2
 - E.2.9 Moisture Retention Data for Core Samples from UE5PW-3

List of Appendices *(Continued)*

- E.2.10 Parameters Required to Calculate Unsaturated Hydraulic Conductivities for Core Samples
- E.3 Material, Hydrologic, and Geochemical Parameter Data for Tuff Samples
 - E.3.1 Results of Laboratory Tests for Tuff Core Samples from UE5PW-3
 - E.3.2 Results of Laboratory Tests for Tuff Drill Cuttings Samples from UE5PW-3
- E.4 Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples
- F Field Test Data
 - F.1 Near-Surface Soil Gas Surveys
 - F.1.1 Surface Soil Sampling, Analysis, and Results
 - F.1.2 Near-Surface Radon and Tritium Gas Sampling, Analysis, and Results
 - F.2 Surface Geophysical Surveys
 - F.2.1 Resistivity Survey Data
 - F.2.2 Magnetic Survey Data
 - F.3 Borehole Geophysical Surveys
 - F.3.1 Description of Borehole Geophysical Logging Tools Used
 - F.3.2 Borehole Geophysical Logs Run in UE5PW-1 on 4/20/1992
 - F.3.3 Borehole Geophysical Logs Run in UE5PW-1 on 6/16/1992
 - F.3.4 Borehole Deviation Logs Run in UE5PW-1 on 2/24/1993
 - F.3.5 Borehole Geophysical Logs Run in UE5PW-2 on 7/20/1992
 - F.3.6 Borehole Geophysical Logs Run in UE5PW-2 on 9/28/1992 and 9/29/1992
 - F.3.7 Borehole Deviation Logs Run in UE5PW-2 on 2/25/1993
 - F.3.8 Borehole Geophysical Logs Run in UE5PW-3 on 9/28/1992
 - F.3.9 Borehole Geophysical Logs Run in UE5PW-3 on 11/18/1992
 - F.3.10 Borehole Deviation Logs Run in UE5PW-3 on 2/25/1993
 - F.4 In-Situ Air Permeability Testing Data
 - F.4.1 Dimensions of Air Permeability Testing Interval for the Pilot Wells
 - F.4.2 In-Situ Air Permeability Testing Data
 - F.4.3 Effective Air Permeabilities and Inertial Coefficients for Field Testing in the Pilot Wells
 - F.5 Upper Aquifer Hydraulic Parameter Testing
 - F.5.1 Estimating the Water Table Slope under the Area 5 RWMS
 - F.5.2 Results of Hydraulic Conductivity Recovery Tests

List of Appendices (Continued)

G Data from Neutron Logging Calibration Boreholes

G.1 Drilling Information

- G.1.1 Chronological Drilling Summary for UE5PW-2A, 2B, and 2C
- G.1.2 Core Record for UE5PW-2A, 2B, and 2C
- G.1.3 Nevada State Central Zone Coordinates for Neutron Logging Calibration Boreholes

G.2 Core and Drill Cuttings Sample Description Data

- G.2.1 Borehole Log Sheets for UE5PW-2A
- G.2.2 Borehole Log Sheets for UE5PW-2B
- G.2.3 Borehole Log Sheets for UE5PW-2C
- G.2.4 Drill Cuttings Log Data for UE5PWW-2A
- G.2.5 Drill Cuttings Log Data for UE5PWW-2B
- G.2.6 Drill Cuttings Log Data for UE5PWW-2C

G.3 Laboratory Testing Data of Geologic Samples

G.3.1 Stratigraphy and Mineralogy Data

- G.3.1.1 Summary of USCS Group Names for Core and Drill Cuttings Samples from Calibration Boreholes
- G.3.1.2 Results from XRF and INAA for Core Samples from UE5PW-2A
- G.3.1.3 Results from XRF and INAA for Core Samples from UE5PW-2B
- G.3.1.4 Results from XRF and INAA for Core Samples from UE5PW-2C

G.3.2 Material, Hydrologic, and Geochemical Parameter Data

- G.3.2.1 Results of Laboratory Tests for Core Samples from UE5PW-2A
- G.3.2.2 Results of Laboratory Tests for Core Samples from UE5PW-2B
- G.3.2.3 Results of Laboratory Tests for Core Samples from UE5PW-2C
- G.3.2.4 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2A
- G.3.2.5 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2B
- G.3.2.6 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2C
- G.3.2.7 Summary of Descriptive Statistics of Alluvial Samples from UE5PW-2A, UE5PW-2B, and UE5PW-2C

List of Appendices (Continued)

G.4 Field Test Data

G.4.1 Site Preparation Information

G.4.2 Neutron-Moisture Meter Data

G.4.2.1 Neutron-Moisture Meter Data for UE5PW-2A

G.4.2.2 Neutron-Moisture Meter Data for UE5PW-2B

G.4.2.3 Neutron-Moisture Meter Data for UE5PW-2C

G.4.3 Calibration of the Neutron-Moisture Meter in the Calibration Boreholes

H Upper Aquifer Water Quality Data

H.1 RCRA Groundwater Sampling and Analysis Methods and Results

H.2 Preliminary General Water Chemistry

I Vadose Zone Calibration and Monitoring Data

I.1 Thermistor Calibration Data

I.2 Preliminary Temperature Monitoring Data

I.3 Pressure Transducer Calibration Data

I.4 Preliminary Pressure Monitoring Data

I.5 In Situ Thermocouple Psychrometer Calibration Data

I.6 Thermocouple Psychrometer Monitoring Data

List of Acronyms and Abbreviations

"C	degrees Celsius
"F	degrees Fahrenheit
³⁶ Cl	chlorine-36
²²² Rn	radon-222
ASTM	American Society for Testing and Materials
BN	Bechtel Nevada
Bq/m ³	Becquerels per cubic meter
CAU	casing advance underreaming
CFR	Code of Federal Regulations
cm	centimeter(s)
cm/s	centimeters per second
D	darcy
DOE/NV	U.S. Department of Energy, Nevada Operations Office
DRI	Desert Research Institute
Eh	reduction-oxidation potential
EPA	Environmental Protection Agency
ft	foot (feet)
g/cm ³	grams per cubic centimeter
gal/min	gallons per minute
GCD	Great Confinement Disposal
I.D.	inside diameter
in.	inch(es)
in./hr	inches per hour
INAA	Instrumental Neutron Activation Analysis
K(S)	unsaturated hydraulic conductivity
km	kilometer(s)
km ²	square kilometer(s)
kPa	kiloPascal(s)
KUT	potassium, uranium, thorium
L/min	liters per minute
LANL	Los Alamos National Laboratory
lb/ft ³	pounds per cubic foot
LDR	Land Disposal Restricted
LLNL	Lawrence Livermore National Laboratory

List of Acronyms and Abbreviations *(continued)*

LLW	low-level waste
m	meter(s)
mi	mile(s)
mi ²	square mile(s)
mm	millimeter(s)
MW	mixed waste
MWL	Meteoric Water Line
NEUT(F)	neutron tool (far spacing)
NEUT(S)	neutron tool (short spacing)
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
No.	number
NTS	Nevada Test Site
O.D.	outside diameter
pCi/m ³	picoCuries per cubic meter
psi	pounds per square inch
QA	Quality Assurance
RCRA	Resource Conservation and Recovery Act
REEC _o	Reynolds Electrical & Engineering Co., Inc.
RWMS	Radioactive Waste Management Site
SF ₆	sulfur hexafluoride
SI	le System International d'Unites
SPS	Special Projects Section
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TOX	total organic halogens
TPH	total petroleum hydrocarbons
TRU	transuranic waste
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
XRF	X-ray fluorescence

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1.0 Introduction

1.1 Background Information

The Special Projects Section (SPS) of Reynolds Electrical and Engineering Co., Inc. (REECo) was responsible for characterizing the subsurface hydrogeology of the Area 5 Radioactive Waste Management Site (RWMS) (Figure 1-1) at the Nevada Test Site (NTS) for the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO; formerly U.S. Department of Energy [DOE], Nevada Operations Office) Waste Management Division. REECo was a predecessor to Bechtel Nevada (BN) at the NTS. This report was originally prepared under the same title in February 1994, and was assigned the document number, DOE/NV/11432--74. The original report has been updated to conform to current editorial standards of BN and of the NNSA/NSO, and to facilitate public distribution of the data contained herein. The original data appendices are included unchanged from the original report. No new data have been added to this report, though additional relevant studies of the area have been conducted in the intervening years.

1.2 Project Description

The pilot well project was one of a series of hydrogeologic site characterization projects conducted for the Area 5 RWMS, designed to determine its suitability for disposal of low-level waste (LLW), mixed waste (MW), and transuranic waste (TRU). The other projects in the series are the existing excavations project (REECo, 1993a), the science trench boreholes project (REECo, 1993b), and the shallow soil trenches project (also updated and reissued as BN, 2005). The pilot well project produced important geologic and hydrologic data for the upper 256 to 291 meters (m) (839 to 955 feet [ft]) of the alluvium in which the RWMS is constructed.

1.3 Purpose and Justification

The primary purpose of the pilot well project was two-fold: first, to characterize important water quality and hydrologic properties of the uppermost aquifer; and second, to characterize the lithologic, stratigraphic, and hydrologic conditions that influence infiltration, redistribution, percolation, and chemical transport through the thick vadose zone in the vicinity of the Area 5 RWMS.

Figure 1-1
Location of the Area 5 Radioactive Waste Management Site

The justification for this work came from the review by the State of Nevada of the original NNSA/NSO Resource Conservation and Recovery Act (RCRA) Part B Permit application submitted in 1988 for disposal of MW at the Area 5 RWMS. The State of Nevada determined that the permit was deficient in characterization data concerning the hydrogeology of the vadose zone and the water quality and hydraulic properties of the uppermost aquifer. The NNSA/NSO agreed with the state and proposed the pilot well project to satisfy these important site characterization data requirements. In addition, NNSA/NSO proposed to install and monitor vadose zone instruments to obtain baseline unsaturated hydraulic parameter data in the three pilot wells.

A number of federal regulations and DOE orders provided additional justification for the site characterization and baseline monitoring data collection activities incorporated in the pilot well project. These regulations include specific RCRA requirements for the land disposal of hazardous waste, requirements for obtaining waivers relating to the land disposal of hazardous waste, as well as DOE Order 5820.2A, "Radioactive Waste Management," (now DOE Order 435.1) and requirements in 40 Code of Federal Regulations (CFR) 191 for land disposal of radioactive waste. Regulatory requirements for characterization and baseline monitoring are summarized in Table 1-1 for different waste types that NNSA/NSO is currently disposing at the Area 5 RWMS.

1.4 Scope of Report

This report describes pilot well drilling and coring, geophysical logging, instrumentation and stemming, laboratory testing, and in-situ testing and monitoring activities. In addition, this report summarizes all data obtained from these activities up to April 23, 1993. Later sampling data from these wells are typically compiled in the NTS Annual Site Environmental Report (see for example, DOE, 2002).

Note that this report presents the data in *le System International d'Unites* (SI) system of units; however, the data in the appendices were not converted to SI units, but are presented in the units in which they were measured in the field or laboratory.

Table 1-1
Regulatory Drivers for Site Characterization and Monitoring

Requirement	Waste and Facility Category		
	Low-Level Waste	Mixed Waste (existing cells)	TRU & Orphan Mixed Waste (existing GCD cells)
DOE Order 435.1			
Performance assessment	Characterization and Monitoring	Characterization and Monitoring	Characterization and Monitoring
RCRA (Part B Permit)			
Groundwater monitoring waiver (40 CFR 264.90 [b][2]) ^a	N/A	Characterization	Monitoring
No migration variance (40 CFR 268.6[a]) ^b	N/A	N/A	Characterization and Monitoring
40 CFR 193^c			
Groundwater protection	Characterization and Monitoring	N/A	N/A
40 CFR 191^d (vacated and remanded)			
Performance assessment	N/A	N/A	Characterization and Monitoring

- a 40 CFR 264 - Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
- b 40 CFR 268 - Land Disposal Restrictions
- c 40 CFR 193 - Environmental Standards for the Management, Storage, and Land Disposal of Low-Level Radioactive Waste and Naturally Occurring and Accelerator-produced Waste
- d 40 CFR 191 - Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes

1.5 Overview of Activities

Three wells were drilled and cored from the ground surface to approximately 21.3 m (70 ft) below the water table. Total depths of the wells ranged from approximately 256 to 292 m (840 to 955 ft). The drilling was accomplished using a casing-advance under-reaming (CAU) system to preserve in-situ hydraulic conditions (water content and water potential) of the formation and the drill cuttings. Core samples were collected in alluvium by driving a solid tube (containing segmented Lexan[®] liners) into the formation ahead of the casing with an air-percussion hammer. Standard air-rotary coring methods were used to core the underlying tuff formation in Well UE5PW-3.

Cuttings were collected at 0.76-m (2.5-ft) intervals and cores were taken at selected intervals. The lithology of the drill cuttings and core was rapidly determined in the field before the samples were packaged to maintain their physical integrity and to minimize water loss by evaporation. Samples were then shipped to various testing laboratories or stored for future use. Laboratory tests were conducted on both drill cuttings and core samples to quantify the distribution with depth of hydrologic, geochemical, environmental tracer, and mineralogic parameters. These laboratory data will provide estimates of input parameters required to model liquid, vapor, and heat flow, and some of the parameters required to model solute transport both in the vadose zone and the upper regions of the deep alluvial aquifer. Finally, both environmental tracer and unsaturated hydrologic parameters will be used to calculate recharge and travel times to the water table.

Borehole geophysical logging was performed during selected stages of drilling to attempt to make in-situ measurements of key physical and hydrologic parameters. These logs were intended to support and possibly augment the data obtained from geologic cuttings samples.

Upon completion of drilling, monitoring well casing and vadose zone instruments were installed and stemmed in place. In-situ hydrologic tests were conducted in the completed boreholes to characterize medium permeability to air and liquid. In addition, monitoring the vadose zone with instruments (including thermocouple psychrometers, thermistors, and air pressure transducers) was initiated. Finally, each pilot well was developed and purged, and water quality samples were collected to measure general water quality parameters and concentrations of hazardous chemical and radioactive constituents.

1.6 Objectives

The specific objective of the pilot well project was to collect sufficient samples required to meet geologic, hydrologic, geochemical, and hazardous constituent characterizations as specified below.

- Determine the stratigraphic, lithologic, mineralogic, physical, and magnetic characteristics of geologic samples to define vadose zone and groundwater flow paths.
- Determine the hydrologic characteristics (hydrologic properties and conditions) in geologic core samples and in-situ formation materials to help delineate both vadose zone and groundwater flow paths.
- Measure environmental tracer concentrations and hydraulic parameters in geologic samples necessary to estimate recharge.

- Characterize the geochemical properties of geologic samples required to model the transport of contaminants.
- Measure concentrations of potential source term radionuclide and RCRA hazardous constituents in both geologic and groundwater samples to establish baseline conditions.
- Delineate the general background chemical composition of the uppermost aquifer to establish baseline conditions.
- Determine the extent to which drilling fluids invaded geologic core samples and in-situ formation materials.

1.7 Site Description

The NTS is a DOE facility occupying approximately 3,561 square kilometers (km²) (1,375 square miles [mi²]) in southern Nevada, approximately 104 kilometers (km) (65 miles [mi]) northwest of Las Vegas (Figure 1-1). The site is bordered to the north, west, and east by the Nellis Air Force Test and Training Range, a government-owned, restricted-access area. Activities at the NTS include a variety of nuclear and non-nuclear projects and experiments.

The Area 5 RWMS encompasses 300 hectares (740 acres) north of Frenchman Lake playa, and is located near the junction of three alluvial fans within the Frenchman Lake drainage basin (RSN, 1991). The Low-Level Waste Management Unit is a 37-hectare (92-acre) facility located in the southeast section of the Area 5 RWMS. It was established in 1978 for the purpose of disposing of LLW generated at the NTS and other DOE facilities.

The Area 5 RWMS currently accepts low-level radioactive waste for shallow land burial. The Area 5 RWMS also currently accepts onsite-generated low-level waste containing hazardous constituents (mixed waste) that are not land-disposal restricted (LDR). Most wastes are disposed in steel drums, steel boxes, or wooden boxes. Plans are being made to accept mixed waste from both onsite and offsite generators in the near future. In the past, high-specific-activity wastes were disposed in 36.6-m (120-ft) deep boreholes called the Greater Confinement Disposal (GCD) boreholes.

1.8 Pilot Well Locations

The locations of the three pilot wells are outside past, current, and future waste disposal areas, and are shown on Figure 1-2. In plan view, the wells are located approximately at the apexes of an equilateral triangle, with sides approximately 1.5 km (1 mi) in length. These locations were selected to facilitate measurement of the expected very small water table gradient. Wells UE5PW-2 and UE5PW-3 were positioned on the presumed up-gradient side of the Area 5 RWMS to attempt to resolve questions concerning the effect of Massachusetts Mountain on the uppermost aquifer groundwater gradient.

Wells UE5PW-1 and UE5PW-2 were both located on older pediment surfaces where early stages of desert pavement have developed. Well UE5PW-3 is located on a much younger alluvial fan. The Nevada State Central Zone coordinates of the boreholes and elevations above sea level are given in Table 1-2.

1.9 Site Climatology and Meteorology

The climate and meteorology of the region are typical of the upper Mojave Desert province. Two major air movement patterns affect this area: from fall through spring, the effects of the Pacific high-pressure area moving over the Sierra Nevada are dominant; in summer, this high-pressure area dissipates, and the warm moist air mass in the Gulf of Mexico exerts its influence. Average daily temperatures range from 2 degrees Celsius ("C) (36 degrees Fahrenheit ["F]) in January to 24 "C (75 "F) in August. Precipitation is highly variable in the desert. The summer months have intense, isolated thunderstorms, but the winter storms are of longer duration and lower intensity. The average precipitation is approximately 100 millimeters (mm) (4 inches [in.]) per year, and the estimated evapotranspiration rate is 2,200 mm (87 in.) per year (EG&G/SAIC, 1991).

Figure 1-2
Location of the Area 5 Pilot Wells

Table 1-2
Location Data for the Area 5 Pilot Wells

Borehole	Elevation above Sea Level ^a meters (feet)	Nevada State Central Zone Coordinates ^b	
		North (meters [feet])	East (meters [feet])
UE5PW-1	969.37 (3,180.35)	223,386.48 (765,702.19)	216,357.08 (709,831.57)
UE5PW-2	990.12 (3,248.42)	234,817.13 (770,395.90)	216,376.00 (709,893.63)
UE5PW-3	1,005.22 (3,297.97)	235,089.93 (771,290.92)	214,415.04 (703,460.07)

a Measured from top of monitor well casing. 1929 National Geodetic Vertical Datum.

b 1927 North American Datum

2.0 Drilling, Coring, and Completion

This section describes the drilling procedures used and data obtained; the collection of alluvial deposits, rock, and groundwater samples; and the installation and stemming of monitoring well casing/screen and vadose zone instruments. Detailed procedures used to accomplish these activities were given in REECO Quality Assurance (QA) standard operating procedures and test plans listed in Table 2-1. In addition to following these formal procedures and recording data in procedure-specific forms, information on drilling, sampling, and completion activities was recorded daily in a log book.

2.1 Drilling and Casing

All three pilot wells were drilled by Tonto Drilling Company with an Ingersol-Rand T-4W rig, using telescoping (successively smaller diameter) CAU drilling systems. Air was the only drilling fluid used. This drilling method has been described in detail by Hammermeister et al. (1986), so only a brief description is included here. In this method, a down-hole percussion hammer is used to drill and ream below the bottom joint of the casing. A pilot bit, in conjunction with an eccentric reamer, drills a hole slightly larger than the outside diameter (O.D.) of the casing. The percussion hammer forces the casing down the borehole by impacting on a shoe attached to the bottom joint of the casing. Thus the casing is advanced downward as the borehole is drilled deeper. Drill cuttings are brought to the land surface through the casing, thereby minimizing the disturbance to the formation. The casing is moved downward until the desired depth for coring is reached. The interval is cored and then enlarged (reamed), and the casing is advanced to the bottom of the cored interval. This sequence of drilling, coring, reaming, and casing is repeated until the total depth of the borehole is reached.

The CAU drilling system is ideally suited for vadose zone characterization studies because it minimizes the disturbance of properties related to in-situ water content in the drill cuttings, core, and formation. It works well with air as a drilling fluid. The CAU drilling system cases (seals off) the formation from the drying effects of air immediately above the drill bit, and minimizes the exposure of drill cuttings to the air by moving them rapidly to the land surface.

The drilling start and end dates, total depth, borehole diameters, and lithologies are summarized for all three pilot wells in Table 2-2. Related drilling information can also be found in the *Nevada Test Site Drilling and Mining Summary* compiled by Raytheon Services Nevada

Table 2-1
REECo Standard Operating Procedures and Test Plans
Applicable to the Pilot Well Project

Test Plans and Procedures	Title	Date	Revision
AADzD.T.01.00	Surface Radiometric Survey Site Characterization Borehole	08/21/1991	0
AADzD.T.02.00	Borehole Water Level Monitoring	10/27/1991	0
AADzD.T.03.00	Drawdown and Recovery Aquifer Test Plan	10/27/1991	0
AADzD.T.04.00	Surface Resistivity Survey Site Characterization Borehole	10/17/1991	0
AADzD.T.05.00	Surface Magnetic Survey Site Characterization Borehole	10/15/1991	0
AADzD.T.06.00	Geologic Logging of Core and Drill Cuttings	02/21/1991	0
AADzD.T.07.00	Measurement of Tritium Oxide in Soil Pore Gas	08/31/1991	0
AADzD.T.10.00	Drilling, Coring, and Well Installation Project Plan	12/10/1991	0
AADzD.T.13.00	Determination of Mineralogic and Geologic Characteristics of Alluvial Samples	01/13/1992	0
WMD-T16	Science Trench Sampling for Determining Characteristics of Geologic Samples	02/20/1992	0
WMD-T17	Quality Assurance Project Plan for Pilot Well Project	04/24/1992	0
WMD-T18	Pilot Well Geophysical Logging	04/03/1992	0
WMD-T19	Pilot Well Core Sampling and Analysis for Hazardous and Radiological Constituents	05/01/1992	0
WMD-T20	Pilot Well Groundwater Sampling and Analysis	05/12/1992	0
AADzD.D.04.00	Handling, Division, Preparation, Control, and Transport of Characterization Samples	02/13/1992	0
AADzD.D.08.00	Calibration of the Organic Vapor Monitor	01/31/1990	0
WMD-D11	Handling In-Progress Data Records for Special Projects Section Activities	02/20/1992	0
WMD-D12	Calculation Check Sheet	05/07/1992	0
WMD-D13	Use of Tracers to Determine Core and Groundwater Contamination from Drilling	05/18/1992	0
WMD-D15	Gross Gamma Analysis of Pilot Well Core Samples	04/03/1992	0
WMD-D17	Pilot Well Abandonment	05/18/1992	0

Table 2-2
Summary of Pilot Well Drilling and Lithology Information

Borehole	Start Date	End Date	Borehole Diameter millimeters (inches)								Borehole Total Depth ^a meters (feet)	Lithology ^{a, b}
			305.97 (12.046)		237.31 (9.343)		211.99 (8.346)		200.03 (7.875)			
			from	to	from	to	from	to	from	to		
			Depth ^a meters (feet)									
UE5PW-1	03/19/1992	06/16/1992	0	116 (380)	116 (380)	256 (839)	--	--	--	--	256 (839.0)	Alluvium 0-256 m (0-839 ft)
UE5PW-2	06/18/1992	09/04/1992	0	122 (400)	122 (400)	280 (919.5)	--	--	--	--	280 919.5)	Alluvium 0-280 m (0-919.5 ft)
UE5PW-3	09/16/1992	11/09/1992	0	137 (450)	137 (450)	235 (770)	235 (770)	251 (822.5)	251 (822.5)	291 (955)	291 (955.0)	Alluvium 0-188 m (0-617.5 ft) Welded tuff 188-280 m (617.5-917.5 ft) Bedded tuff 280-291 m (917.5-955 ft)

a Measured from estimated ground surface.

b m = meters; ft = feet

(RSN, 1990). Detailed chronological drilling summaries of each well, including problems and their resolution, are presented in Appendices A.1, A.2, and A.3.

Drilling penetration rates are presented in graphical form in Appendix A.4. Penetration rates are related to rock formation properties, drilling equipment condition and performance, and the particular techniques used by the drillers. The penetration rate graphs, together with the drilling chronology summaries, show that numerous drilling problems were encountered and overcome during drilling of these holes. In almost all cases, these difficulties were related to the combined effects of formation materials and the use of air as the drilling fluid. The formation materials were primarily very dry, unconsolidated, coarse-grained alluvium. The use of air as the drilling fluid (required to prevent introduction of water or other fluids to the formation) further destabilized the already unstable borehole walls, resulting in “wash-out” zones in some regions of the borehole. However, the profiles of borehole diameter versus depth calculated from volumes of stemming materials required to fill the boreholes (Section 2.5) show that extensive hole erosion was confined to relatively small intervals of the boreholes. Borehole geophysical density logs confirm that hole erosion was restricted to specific depth intervals (Section 4.3). Hole caving occurred in other depth intervals, creating a great deal of friction between the casing and formation, and limiting the depth that a particular diameter CAU drilling system could be advanced. In summary, drilling activities never became routine, as different drilling problems were encountered in each borehole.

2.2 *Collection of Geologic Samples*

The CAU drilling system discussed above was selected in part because it produces drill cuttings samples that are representative of the formation. The system, when operated as designed, rapidly and nearly completely moves drill cuttings from the interval being drilled to the ground surface, ensuring that drill cuttings samples collected at the ground surface are in fact from the interval being drilled. Further, the rapid transport of drill cuttings to the surface minimizes the disturbance of the water content of the samples. Finally, the drilling action of the percussion hammer system minimizes the disturbance of the particle size distribution of unconsolidated alluvial materials penetrated. For these reasons, and because of the difficulty and high cost of coring unconsolidated alluvial materials, emphasis was placed on collection of drill cuttings samples during this project.

Certain important laboratory tests are not valid unless performed on samples with pore size distributions and water contents that are representative of the formation. Hence, coring unconsolidated alluvial materials, even though difficult and expensive, was necessary. The coring method described below is the only known method capable of producing this type of core sample from unconsolidated, relatively

dry, coarse-grained alluvial deposits. Because this coring method is standard in the drilling industry, it is only briefly described in Section 2.2.1.

Air-rotary coring was employed for coring the tuff formation that underlies the alluvium in Well UE5PW-3. This coring method was also attempted unsuccessfully in several of the more consolidated alluvium intervals in Wells UE5PW-1 and UE5PW-2.

2.2.1 Collection of Core Samples

Core samples were collected from the alluvium at selected intervals (Tables 2-3, 2-4, and 2-5) using drive core methods. An air-percussion hammer was used to drive a 0.76-m (2.5-ft) long by 114.3-mm (3.5-in.) O.D. solid-tube core barrel containing clear Lexan[®] (polycarbonate) liner segments to hold the sample material. The Lexan[®] segments were 76.2 mm (3 in.) long by 88.9 mm (3.5 in.) O.D. In several cases a longer core barrel (1.5-m [5.0-ft] long by 114.3 mm [3.5-in.] O.D.) was substituted for the standard core barrel.

Past experience demonstrated that the drive core method can provide good core recovery and minimize the disturbance of hydrologic conditions and physical properties of relatively dry, coarse-grained, unconsolidated alluvial samples (Hammermeister et al., 1986). Actual core recovery using these methods was generally excellent. Core loss or less than maximum recovery was mainly due to blockage of the solid-tube sample barrel with large rocks, fall-back of the cuttings (usually no more than 150 mm [6 in.]), or loss of core from the core barrel while removing the core barrel from the borehole.

The process of drive coring unconsolidated alluvium could conceivably alter the pore size distribution of samples in several ways. Visual observation of core samples as they were removed from the core barrel indicated that the samples were generally very tightly packed into the liners. Visual inspection also showed fines accumulating along the outer edge of the core, suggesting some minor disturbance of the core along the outer circumference. This suggests that the drive coring process probably did not significantly decrease the compaction of the samples compared to in-situ conditions. At the same time, it is hard to imagine that the coring process could significantly increase the compaction of relatively dry, sandy alluvial materials which have in some cases been under as much as 275 m (900 ft) of overburden for many thousands of years. The possible effects of the coring process on the values of parameters that are sensitive to pore size distribution are discussed further in Section 3.0.

Table 2-3
Core Record For Well UE5PW-1

Date	Run	Core Interval				Core Recovery			Coring Rate		Laboratory Test
		from (m)	to	from (ft)	to	(m)	(ft)	(percent)	(m/min)	(ft/min)	
03/17/92	1	8.08	8.84	26.50	29.00	0.52	1.7	68	0.15	0.50	A,B,D,E,F,G,ARCH
03/18/92	2	14.48	15.24	47.50	50.00	0.52	1.7	68	0.17	0.56	A,C,D,F,G,ARCH
03/18/92	3	15.24	16.00	50.00	52.50	0.61	2.0	80	0.18	0.58	HC&R
03/18/92	4	17.53	18.29	57.50	60.00	0.76	2.5	100	0.10	0.34	A,B,C,D,F,G,HC&R,ARCH
03/19/92	5	20.57	21.34	67.50	70.00	0.76	2.5	100	0.09	0.28	A,B,C,D,E,F,G
03/19/92	6	23.62	24.38	77.50	80.00	0.30	1.0	40	0.30	1.00	A,B,D,G
03/19/92	7	26.67	27.43	87.50	90.00	0.00	0.0	0	0.12	0.38	
03/20/92	8	29.72	30.48	97.50	100.00	0.55	1.8	72	0.17	0.56	B,C,D,F,G
03/20/92	9	35.81	36.06	117.50	118.30	0.24	0.8	0	0.05	0.18	
03/20/92	10	36.58	36.73	120.00	120.50	0.00	0.0	0	0.01	0.04	
03/20/92	11	38.86	39.20	127.50	128.60	0.00	0.0	0	0.04	0.12	
03/24/92	12	38.86	39.62	127.50	130.00	0.61	2.0	80	0.06	0.19	A,B,C,D,F,G
04/06/92	13	41.91	42.52	137.50	139.50	0.49	1.6	80	0.02	0.08	A,B,C,D,F,G
04/07/92	14	44.96	45.54	147.50	149.40	0.00	0.0	0	0.05	0.15	
04/07/92	15a	45.72	47.24	150.00	155.00	0.00	0.0	0	0.00	NA	
04/08/92	16	47.85	48.62	157.00	159.50	0.76	2.5	100	0.05	0.16	A,B,C,D,E,F,G,ARCH
04/08/92	17	50.90	51.66	167.00	169.50	0.76	2.5	100	0.11	0.36	A,B,C,D,E,F,G,ARCH
04/09/92	18	53.95	54.71	177.00	179.50	0.76	2.5	100	0.08	0.25	A,B,C,D,E,F,G,ARCH
04/09/92	19	60.05	60.81	197.00	199.50	0.76	2.5	100	0.09	0.29	A,B,C,D,E,F,G,ARCH
04/10/92	20	66.29	67.06	217.50	220.00	0.76	2.5	100	0.13	0.42	A,B,C,D,E,F,G,ARCH
04/10/92	21	72.39	73.24	237.50	240.30	0.00	0.0	0	0.24	0.80	ARCH
04/13/92	22	78.49	79.25	257.50	260.00	0.76	2.5	100	0.11	0.36	A,B,C,D,E,F,G
04/13/92	23	84.31	85.07	276.60	279.10	0.76	2.5	100	0.08	0.27	A,B,D,E,F,G
04/14/92	24	90.68	91.44	297.50	300.00	0.76	2.5	100	0.08	0.28	A,B,C,D,F,G
04/15/92	25	96.74	97.51	317.40	319.90	0.76	2.5	100	0.15	0.48	A,B,C,D,E,G,ARCH
04/15/92	26	102.87	104.40	337.50	342.50	0.00	0.0	0	0.13	0.42	
04/16/92	27	108.88	109.64	357.20	359.70	0.76	2.5	100	0.06	0.18	A,B,C,D,E,F,G
04/17/92	28	112.02	112.78	367.50	370.00	0.76	2.5	100	0.08	0.25	A,B,C,D,E,F,G,ARCH
04/22/92	29	121.46	122.23	398.50	401.00	0.76	2.5	100	0.15	0.50	A,B,C,D,E,F,G,ARCH
05/01/92	30	139.68	140.44	458.25	460.75	0.76	2.5	100	0.15	0.50	A,B,C,D,F,G,ARCH
05/04/92	31	151.72	152.48	497.75	500.25	0.76	2.5	100	0.15	0.50	A,B,C,D,E,F,G,ARCH
05/06/92	32	164.14	164.90	538.50	541.00	0.76	2.5	100	0.19	0.63	A,B,C,D,E,F,G,ARCH
05/07/92	33	176.51	177.27	579.10	581.60	0.76	2.5	100	0.19	0.63	A,B,D,E,F,G,ARCH
05/27/92	34	188.09	188.86	617.10	619.60	0.76	2.5	100	0.22	0.71	A,B,C,D,E,F,G,ARCH
05/28/92	35	200.53	201.29	657.90	660.40	0.76	2.5	100	0.22	0.71	A,B,D,E,F,G,ARCH
05/29/92	36	213.09	213.85	699.10	701.60	0.76	2.5	100	0.15	0.50	A,B,C,D,E,F,G,ARCH
06/06/92	37	219.09	219.85	718.80	721.30	0.76	2.5	100	0.15	0.50	A,B,C,D,E,F,G,ARCH
06/06/92	38	220.68	222.20	724.00	729.00	1.52	5.0	100	0.06	0.20	A,B,C,D,E,F,G,ARCH
06/08/92	39	224.79	225.55	737.50	740.00	0.76	2.5	100	0.22	0.71	A,B,C,D,E,F,G,ARCH
06/09/92	40	231.04	231.80	758.00	760.50	0.76	2.5	100	0.38	1.25	A,B,C,D,E,F,G,ARCH
06/10/92	41	234.01	234.78	767.75	770.25	0.76	2.5	100	0.19	0.63	A,D,E,HC&R,ARCH
06/11/92	42	234.24	235.00	768.50	771.00	0.76	2.5	100	0.38	1.25	A,D,F
06/12/92	43	240.11	240.87	787.75	790.25	0.76	2.5	100	0.15	0.50	A,B,D,E,F,G

a: Rotary core
A: Physical and hydraulic properties
B: Particle size analysis, water content
C: Chlorine-36
D: Water potential, water content, bulk density
E: Clay mineralogy
F: Stable isotopes, tritium, bulk density, water content
G: Chloride, bromide, sulfate, carbon, elemental mineralogy
HC&R: Hazardous constituents and radionuclides
ARCH: Archived sample

Table 2-4
Core Record for Well UE5PW-2

Date	Run	Core Interval				Core Recovery			Coring Rate		Laboratory Test
		from	to	from	to	(m)	(ft)	(percent)	(m/min)	(ft/min)	
		(m)		(ft)							
06/18/92	1	0.00	1.49	0.00	4.90	0.91	3.0	61	0.10	0.33	A,B,D,E,F,G,ARCH
06/22/92	2	8.63	9.97	28.30	32.70	0.91	3.0	68	0.12	0.40	A,B,C,D,E,F,G,ARCH
06/22/92	3	11.61	13.14	38.10	43.10	1.07	3.5	70	0.19	0.63	A,B,C,D,E,F,G,ARCH
06/24/92	4	20.50	21.40	67.25	70.20	0.76	2.5	85	0.36	1.18	A,C,D,F,HC&R,ARCH
06/24/92	5	29.87	30.63	98.00	100.50	0.76	2.5	100	0.30	1.00	A,B,C,D,E,F,G,ARCH
06/25/92	6	35.74	36.50	117.25	119.75	0.76	2.5	100	0.25	0.83	A,B,C,D,E,F,G,ARCH
06/25/92	7	38.80	39.56	127.30	129.80	0.76	2.5	100	0.19	0.63	A,B,C,D,E,F,G,ARCH
06/27/92	8	60.41	61.17	198.20	200.70	0.76	2.5	100	0.16	0.52	A,B,C,D,E,F,G,ARCH
06/29/92	9	75.67	76.43	248.25	250.75	0.70	2.3	92	0.07	0.23	A,B,C,D,E,F,G,ARCH
06/30/92	10	94.12	94.92	308.80	311.40	0.76	2.5	96	0.05	0.18	A,B,C,D,E,F,G,ARCH
07/09/92	11	121.25	121.98	397.80	400.20	0.70	2.3	96	0.04	0.13	A,D,E,F,ARCH
07/15/92	12	145.60	146.00	477.67	479.00	0.38	1.3	94	0.03	0.11	C,D,F,G,ARCH
07/15/92	13	151.56	152.33	497.25	499.75	0.76	2.5	100	0.11	0.36	A,D,F,G,ARCH
07/17/92	14	167.01	167.31	547.92	548.92	0.15	0.5	50	0.03	0.10	ARCH
07/17/92	15	197.51	197.79	648.00	648.90	0.25	0.8	90	0.01	0.05	D,F,ARCH
07/27/92	16	213.36	214.89	700.00	705.00	0.15	0.5	10	0.16	0.53	ARCH
08/05/92	17	218.87	219.23	718.08	719.25	0.36	1.2	100	0.01	0.05	A,D,F
08/06/92	18	227.99	228.40	748.00	749.33	0.41	1.3	100	0.02	0.06	A,E,G
08/10/92	19	249.20	249.51	817.58	818.58	0.30	1.0	100	0.02	0.06	A,D,E,F
08/11/92	20	252.48	252.83	828.33	829.50	0.30	1.0	85	0.02	0.07	F
08/11/92	21	252.68	254.26	829.00	834.17	0.00	0.0	0	0.08	0.26	
08/12/92	22	255.73	256.42	839.00	841.25	0.00	0.0	0	0.02	0.08	

Table 2-5
Core Record for Well UE5PW-3

Date	Run	Core interval				Core recovery			Coring rate		Laboratory test
		from	to	from	to	(m)	(ft)	(percent)	(m/min)	(ft/min)	
		(m)		(ft)							
09/16/92	1	0.00	0.76	0.00	2.50	0.53	1.8	70	0.59	1.92	A,B,C,D,F,G,ARCH
09/16/92	2	0.48	1.17	1.58	3.83	0.53	1.8	78	0.53	1.73	A,B,D,F,G,ARCH
09/17/92	3	14.78	16.21	48.50	53.17	1.30	4.3	91	1.09	3.59	A,B,C,D,E,F,G,ARCH
09/17/92	4	29.87	30.89	98.00	101.33	0.69	2.3	68	0.78	2.56	A,B,C,D,E,F,G,ARCH
09/17/92	5	39.32	40.44	129.00	132.67	0.84	2.8	75	0.86	2.82	A,B,C,D,E,F,G,ARCH
09/21/92	6	60.35	61.88	198.00	203.00	1.22	4.0	80	1.17	3.85	A,B,C,D,E,F,G,ARCH
09/22/92	7	75.84	76.91	248.83	252.33	0.99	3.3	93	0.82	2.69	A,B,C,D,E,F,G
09/24/92	8	106.30	106.78	348.75	350.33	0.41	1.3	84	0.37	1.22	A,D,E,F,ARCH
09/25/92	9	121.46	121.90	398.50	399.92	0.30	1.0	70	0.33	1.09	A,D,E,F
09/29/92	10	137.47	137.95	451.00	452.60	0.49	1.6	100	0.04	0.12	A,D,E,F,G,ARCH
09/30/92	11	151.77	152.53	497.92	500.42	0.76	2.5	100	0.07	0.22	A,B,C,D,E,F,G,ARCH
10/01/92	12	167.34	167.91	549.00	550.88	0.53	1.8	93	0.04	0.14	A,B,C,D,F,G,ARCH
10/02/92	13	188.50	188.70	618.42	619.08	0.08	0.3	38	0.02	0.08	ARCH
10/06/92	14a	194.54	196.14	638.25	643.50	0.30	1.0	19	0.03	0.11	A,B,D,F
10/21/92	15a	209.86	210.87	688.50	691.83	0.32	1.0	31	0.03	0.09	A,B,D,G

- a: Rotary core
- A: Physical and hydraulic properties
- B: Particle size analysis, water content
- C: Chlorine-36
- D: Water potential, water content, bulk density
- E: Clay mineralogy
- F: Stable isotopes, tritium, bulk density, water content
- G: Chloride, bromide, sulfate, carbon, elemental mineralogy
- HC&R: Hazardous constituents and radionuclides
- ARCH: Archived sample

Air-rotary core sampling methods were attempted in Wells UE5PW-1 and UE5PW-2 in the more consolidated (though still poorly consolidated) intervals of alluvium using “HX” core barrels (split inner tubes) with less success than drive core methods. In all cases, air-rotary core recovery was very poor in alluvial material. Air-rotary coring generally requires significant consolidation and/or cementation of the formation to yield reasonable recovery. Poor recovery in the two air-rotary core runs in welded tuff at Well UE5PW-3 was probably due to a combination of factors, including the fractured nature of the formation and problems with stabilizing the core barrel and core rod while drilling within the relatively large diameter borehole.

In all cases, the core barrels were transported to a temperature-controlled field laboratory for geologic description and disposition as soon as possible after removal from the borehole.

2.2.2 Collection of Drill Cuttings Samples

Drill cuttings samples were collected at 0.76-m (2.5-ft) depth intervals from a cyclone separator. Drill cuttings samples were not collected during hole cleaning activities. Sample collection procedures were designed to minimize the loss of water by evaporation. Immediately after drilling each 0.76-m (2.5-ft) interval, a valve on the bottom of the cyclone separator was opened and a representative sample was collected in a bucket as the cuttings fell into a large dumpster. A sample splitter was then used to obtain four sub-samples from the bucket. These sub-samples were placed in jars, which were capped, labeled with appropriate sample identification information, stored in plastic coolers, and taken to a temperature-controlled field laboratory as soon as logistically feasible.

2.3 Geologic Description and Disposition of Samples

Both drill cuttings and core samples were handled, in the field laboratory and during subsequent storage and transport, in a manner designed to minimize evaporative water loss, ensuring that the water content of samples was as close to in-situ formation conditions as possible. Procedures and plans were developed for the Pilot Well project (Table 2-1) to standardize sample collection and handling.

2.3.1 Handling, Description, and Disposition of Core Samples

Liner segments containing core samples were removed from the solid-tube drive core samplers by a pneumatic core extruder. A geologic description of the core was then made by examining the open ends of each 76.2-mm (3-in.) long liner segment. This geologic description was recorded on field data forms, which are presented in Appendices B.1, B.2, and B.3. The description of the alluvial samples

was based on methods from the American Society for Testing and Materials (ASTM), and the description of the tuff samples was based on procedures developed specifically for the NTS (Section 3.0).

Apparent magnetic susceptibility measurements were made on both core and drill cuttings samples. Changes in magnetic susceptibility may be related to changes in lithology as well as other factors such as rate of drill bit wear and the mixing of fine metal particles into the drill cuttings. These measurements were made on the flat ends of core segments and on the base of drill cuttings samples bottles using a Model KT-5 Exploranium meter. Individual sample measurements should not be compared because they were made under different measurement conditions, including geometry, density, and type of container.

Following geologic description and measurement of magnetic susceptibility, each 76.2-mm (3-in.) long core segment was capped, taped, and labeled with appropriate sample-identification and intended-use information. Core segments were further sealed in Protec-Core® (a tubular aluminized mylar laminate which protects the core from tampering and damage when correctly sealed) and labeled again with the same information. Most of the core segments were specified for particular types of laboratory tests, and the remainder were stored for future use. Tables 2-3, 2-4, and 2-5 summarize the uses specified for each core run. The intended use of each 76.2-mm (3-in.) core segment was summarized on detailed borehole log sheets. Because core recovery was not always 100 percent, and further, because some core segments were more disturbed than others (e.g., disturbance of water content, porosity, and aggregation), the assignment of core segments for various tests was based on a priority system. This system took into account the relative importance of various laboratory tests, as well as the degree of sample disturbance acceptable for each test, and is described in detail in the applicable procedures and plans listed in Table 2-1. The core assignment procedure was altered when a core run contained a stratigraphic contact. In this case, cores on both sides of the stratigraphic contact were assigned to the same high priority hydrologic parameter tests.

The labeling system used in the field to assign core segments and drill cuttings samples for different laboratory tests is summarized in Table 2-6. A particular sample label defined the laboratory testing required, the priority of these tests, and the laboratory responsible for conducting the analyses. In this report these labels are used to distinguish samples and responsible testing laboratories in tables of summary descriptive statistics of testing results, in figures of selected testing results in Section 3.0, and in tables of individual test results in Appendix E.

Table 2-6
Definitions of Core and Drill Cuttings Sample Labels

Sample Type	Sample Label	Sample Priority	Laboratory Testing Specified	Testing Laboratory
Core	DB1	1	Saturated hydraulic conductivity, moisture retention curves ^a , volumetric water content, dry bulk density, particle size distribution	Daniel B. Stephens & Associates, Albuquerque, NM
	HYD1	2	Gravimetric water content	Daniel B. Stephens & Associates, Albuquerque, NM
			Chloride, bromide, sulfate, inorganic carbon, organic carbon	New Mexico Institute of Mining and Technology, Dr. D. Branvold, Socorro, NM
			Mineral element and oxide composition ^a	New Mexico Institute of Mining and Technology, Dr. P. Kyle, Socorro, NM
	DRI1	3	Stable isotopes of hydrogen and oxygen ^a	Desert Research Institute, Dr. S. Tyler, Reno, NV
	DRI2	4	Water potential, volumetric water content, dry bulk density	Desert Research Institute, Dr. S. Tyler, Reno, NV
	DB2	5	Particle size distribution, gravimetric water content	Daniel B. Stephens & Associates, Albuquerque, NM
	HYD2	6	Chlorine-36 ^a	Hydro GeoChem, Inc., Tucson, AZ and Lawrence Livermore National Laboratory, Dr. M. Caffee, Livermore, CA
	SNL	7	Clay mineralogy ^a	Sandia National Laboratories, Dr. H. Stockman, Albuquerque, NM
	ARCH	8	None	None
Drill Cuttings	DB2	1	Particle size distribution, gravimetric water content	Daniel B. Stephens & Associates, Albuquerque, NM
	HYD1	1	Gravimetric water content	Daniel B. Stephens & Associates, Albuquerque, NM
			Chloride, bromide, sulfate, inorganic carbon, organic carbon	New Mexico Institute of Mining and Technology, Dr. D. Branvold, Socorro, NM
	HYD2	1	Chlorine-36 ^b	Hydro GeoChem, Inc., Tucson, AZ and Lawrence Livermore National Laboratory, Dr. M. Caffee, Livermore, CA
	ARCH	1	None	None

a Tests conducted on selected samples.

b Chlorine-36 samples stored for future testing.

2.3.2 Handling, Description, and Disposition of Drill Cuttings Samples

Geologic descriptions of drill cuttings samples were made after the samples were transported to the temperature-controlled field laboratory (Appendices B.4, B.5, and B.6). Sample jars containing drill cuttings were briefly opened and the same geologic description and magnetic survey procedures described in Section 2.3.2 for core samples were followed. Sample jars were then taped shut, sealed in Protec-Core[®], and labeled once again with appropriate sample- identification and intended-use information. Because these samples were more disturbed than core samples, fewer laboratory tests were specified. Four replicate drill cuttings samples were collected for these tests and other uses from each 0.76-m (2.5-ft) depth interval. The labels assigned to drill cuttings samples, which specified the tests to be conducted as well as the testing laboratories, are summarized in Table 2-6.

2.4 Field Tests on Core and Drill Cuttings

2.4.1 Tracer Tests for Estimating Disturbance from Air Drilling Fluid

Every effort was made to insure that air-percussion hammer-drive core samples were representative of in-situ formation conditions. For example, drilling and air-percussion coring procedures in alluvium were designed and implemented so that drive core samples were collected from the bottom of the borehole in formation materials where density, porosity, and pore size distribution had not been previously disturbed. However, the degree of intrusion of the drilling fluid (air) into the formation ahead of the drill bit, and consequently into core samples collected from these formation materials, could not be accurately estimated prior to this drilling program. Even more difficult to estimate were the potentially disturbing effects of the drilling air on hydrologic conditions such as water content and water potential.

With this in mind, a program was implemented to estimate the extent to which the drilling fluid (air) penetrated into the formation (and core samples) directly ahead of the drill bit. A tracer gas (sulfur hexafluoride, SF₆) was injected via a mass flow controller into the airstream originating from the air compressor during drilling and coring operations at Well UE5PW-1. Failure of the mass flow controller prevented similar injections during drilling and coring in Well UE5PW-2 and UE5PW-3. However, SF₆ was injected into the uncased bottom portion of Well UE5PW-3 in the interval 235 to 291 m (770 to 955 ft) for 15 minutes during final reaming/cleaning of the borehole. This injection was accomplished by setting the SF₆ tank pressure at 689 kiloPascals (kPa) (100 pounds per square inch [psi]) above the compressor airstream pressure.

Concentrations of SF₆ were measured in air sub-samples collected from the airstream, from the entire 0.76-m (2.5-ft) long core barrel, and from 76.2-mm (3-in.) long individual core segments. The results of these analyses are presented in Appendix C.1. The results show that SF₆ invaded all core samples to some extent, even segments located in the bottom of the core barrel which originated 0.76 m (2.5 ft) from the bottom of the original borehole. Large fluctuations in airstream line pressure resulted in large fluctuations in SF₆ concentrations in the airstream. This in turn prevented any quantitative analyses on the replacement of natural soil gases by air drilling fluid.

Analyses were conducted on extracted gases from 20.7-mm (0.814-in.) inside diameter (I.D.) nylon access tubes leading to five instrument stations in Well UE5PW-1 and one instrument station in Well UE5PW-3. These analyses indicated that significant quantities of SF₆ were still in the formation adjacent to these stations several months after drilling and coring activities were completed (Appendix C.2).

2.4.2 Radiological Surveys of Geologic Samples

Gamma radiation levels from drill cuttings were monitored continuously with an energy-compensated Geiger-Mueller detector mounted directly on the cyclone separator. In addition, radiation protection personnel analyzed drill cuttings samples and drilling and logging equipment via gamma spectroscopy, and collected swipe samples to analyze for removable alpha and beta radiation contamination on a daily basis. Swipe samples were also collected from core barrels after each core run. All radiological monitoring results were consistent with natural levels of background radiation.

2.5 Pilot Well Completion

This section briefly describes the materials, methods, and design followed to complete the three pilot wells. The completion involved installation and stemming of monitoring well casing/screen and vadose zone instruments in each well. Further details of all components of the completion design and operations are given in Appendix D.

Completion objectives for the pilot well program were:

- Install monitoring well casing/screen to provide access for sampling and hydraulic testing of the uppermost aquifer.
- Install instrumentation for measuring pressure, temperature, and humidity at selected intervals.

- Install delivery tubing for air permeability tests and tubing for remote pressure sensing and gas sampling at selected intervals.
- Emplace annular sand pack to enhance filter pack/well screen effectiveness.
- Emplace permeable sand at instrument stations to enhance air movement between instrument stations and the vadose zone formation.
- Emplace low-permeability annular seal materials between instrument stations to restrict preferential flow (short circuiting) of fluids between instrument stations in the borehole annulus.

2.5.1 Subsurface Completion Design

The 3 pilot wells were completed according to the same basic design (Figures 2-1, 2-2, and 2-3). Each design includes a centralized stainless-steel casing with an approximate I.D. of 63.5 mm (2.5-in.). An 18.3-m (60-ft) long dual-screen prefabricated filter pack (Pre-Pack[®]) was attached to the bottom of the central casing. Attached to the outside of the casing were 34 instruments with associated cables and tubing running to 10 different depths in the borehole. Three major groups (stations) of instruments were located at selected depths. Instrument stations and the associated instruments were installed as follows:

- Water level monitoring stations consist of 1 submersible pressure transducer located approximately 12.2 m (40 ft) below the water table.
- Type A instrument stations consist of 2 thermistors for temperature measurements, 2 psychrometers for humidity measurements, and 1 air pressure transducer, located at depths of approximately 30.5, 61.0, 91.4, 152.4, and 213.4 m (100, 200, 300, 500, and 700 ft).
- Type B instrument stations consist of screened air piezometers attached to 20.7-mm (0.814-in.) I.D. nylon tubing and 4.6-mm (0.18 in.) I.D. stainless-steel tubing for air permeability testing and gas sampling, located at depths of approximately 45.7, 76.2, 106.7, and 182.9 m (150, 250, 350, and 600 ft).

Figure 2-1
Completion Configuration for Well UE5PW-1

Figure 2-2
Completion Configuration for Well UE5PW-2

Figure 2-3
Completion Configuration for Well UE5PW-3

Note that some changes to the depths of several instrument stations were made to avoid “washed out” areas of the borehole or to correspond with core sample intervals. The actual depth of each instrument station is shown on the completion diagram for each pilot well.

The annular space around each station was stemmed with coarse-grained sand to facilitate pneumatic communication with the surrounding formation. The intervals between each station were stemmed with a low permeability mixture of bentonite, silica flour, and sand to eliminate preferential flow paths between the central casing and the formation. The air permeability of the dry, low permeability mixture was found to be approximately 9.0×10^{14} square meters (m^2) (90 millidarcy) in laboratory tests. This value is at least two orders of magnitude less than the air permeability of the alluvial formation (Section 4.4.2).

2.5.2 Subsurface Completion Operations

After drilling was completed at each pilot well site, the drill rig was moved off the location, leaving the borehole with two strings of steel casing in place: 219.1-mm (8.625-in.) O.D. casing, telescoped inside of 273.0-mm (10.75-in.) O.D. casing. An Ingersoll-Rand TH-60 drill rig with a two-man crew was then moved in to complete each pilot well as described in the following paragraphs. Details concerning materials used, preparation of the central casing and attachment of instruments, casing and instrument installation into the borehole, and stemming and cementing of the borehole are given in Appendix D.

The completion drill rig was used to run the centralized monitoring well casing/screen with attached instruments and associated cables and tubes inside the inner 219.1-mm (8.625-in.) casing to the required depth. The completion rig was then used to pull (with hydraulic jacks) the inner drill casing from the borehole in 3.0- or 6.1-m (10- or 20-ft) stages. As this casing was pulled from the borehole, dry stemming materials were added to fill the annular space between the formation and the centralized casing and attached instruments. The low permeability mixture was pumped down a steel “tremmie” pipe (1-in. Schedule 80) to the depth interval of interest with a shotcrete injector. The coarse-grained sand was simply poured into the tremmie line and allowed to fall by gravity to the interval being stemmed. Frequent measurements of the level of stemming materials in the borehole demonstrated that these materials did not settle downward during the stemming operation. To minimize future settling and provide strain relief for instrument cables and tubes, a gypsum grout interval was placed midway in each borehole.

When the 219.1-mm (8.625-in.) inner casing was pulled up and the borehole stemmed to the depth of the 273.0-mm (10.75-in.) casing, the smaller casing was pulled completely from the hole. The larger

casing was then pulled up in stages and stemming materials added as described above for the smaller casing. When the 273.0-mm (10.75-in.) casing was pulled up to approximately 24.4 m (80 ft) below ground surface, cement grout was poured into the casing. The casing was then pulled completely out of the hole while grout was added as required, leaving a cement surface seal from a depth of approximately 24.4 m (80 ft) to the ground surface.

2.5.3 Surface Facilities and Wellhead Completion

Figure 2-4 shows the surface facilities constructed at each pilot well site. Two buildings were originally positioned at each location: a wellhead building and an instrument building. The instrument buildings housed the data acquisition systems and related equipment, but have since been removed from the well sites.

The wellhead buildings, in conjunction with 3- by 3-m [10- by 10-ft] concrete pads at each site, provide weather protection, surface seal, and lockable access to the wells in accordance with RCRA requirements. Each wellhead building consists of a 2.4- by 6.1-m (8- by 10-ft) transportainer positioned over the casing. Each building houses the Bennett sample pump and other equipment and tools needed for groundwater sampling. A steel floor plate with a 0.6- by 0.6-m (2- by 2-ft) trapdoor provides access to the 1.8-m (6-ft) diameter by 1.2-m (4-ft) deep well cellar.

2.6 Well Development

The 3 pilot wells were developed to help insure that hydraulic and other testing conducted in these wells will yield results that are as representative as possible of the uppermost aquifer, and are not indicative of disturbed conditions caused by drilling and coring activities. The small diameter of the monitoring well tubing (63.5 mm [2.5 in.] I.D.) and screen (60.3 mm [2.375 in.] I.D.), combined with the great depth to the water table (greater than 235 m [770 ft]) restricted the choice of development methods to bailing and low-flow-rate pumping.

Initial development was conducted by bailing with a polyvinyl chloride bailer, approximately 38.1-mm (1.5-in.) O.D. by 6.1 m (20 ft) long, attached to a wireline system. During each bailing episode the bailer was run up and down between the water table surface and the bottom of the well screen several times before removing the bailer from the well. The turbidity of the water removed from the borehole decreased significantly with bailing. However, in all 3 wells the water never cleared completely. Bailing was discontinued when it began to appear that this activity had little or no noticeable effect on turbidity.

Figure 2-4
Area 5 Pilot Well Surface Facilities and Wellhead Completion Diagram
(not to scale)

Further development with a low-flow-rate sample pump (Bennett pump) was not started until at least several days after bailing was completed, to allow suspended sediment to settle to the bottom of the well screen. The sample pump was then lowered into the well screen to a pre-determined depth and the well was pumped at the maximum sample rate of approximately 2 liters per minute (L/min) (0.5 gallons per minute [gal/min]). In all cases the pump was positioned at least 6.1 m (20 ft) above the bottom of the screen. The outlet line of the pump was connected to a flow-through cell and the general water quality parameters of pH, temperature, conductivity, and reduction-oxidation potential (Eh) of the pumped water were monitored, together with the flow rate. Pumping generally continued at a particular depth until at least three well-bore volumes of water were removed and the general water quality parameters stabilized. If the schedule for development and sampling permitted, the above described procedure was repeated at several 1.5-m (5-ft) intervals. The volumes of water bailed and pumped, as well as final values of water quality parameters for each development episode, are summarized in Table 2-7.

**Table 2-7
Pilot Well Development Data**

Borehole	Date(s) Developed	Type of Development	Volume Removed L/well-bores (gal/well-bores)	Pump Depth Below Static Water Level m (ft)	Average pH	Average Eh (mv)	Average Conductivity (mmhos/cm)	Average Temperature ("C)
UE5PW-1	08/31/1992 09/01/1992 09/05/1992 09/11/1992	Bail	454/10.3 (120/10.3)	N/A	N/M	N/M	N/M	N/M
	09/16/1992	Pump	23/0.5 (6/0.5)	6.1 (20)	8.59	N/M	0.330	22.5
	09/11/1992	Pump	246/5.6 (65/5.6)	6.1 (20)	8.49	N/M	0.370	22.7
UE5PW-2	02/16/1993 02/17/1993 02/18/1993 02/19/1993	Bail	1,170/27.2 (309/27.2)	N/A	N/M	N/M	N/M	N/M
	03/09/1993	Pump	712/16.6 (188/16.6)	4.6 (15)	7.77	177	0.385	20.3
	03/11/1993	Pump	612/14.2 (162/14.2)	N/A	7.77	177	0.385	20.3
	03/15/1993	Pump	746/17.4 (197/17.4)	4.6-6.1 (15-20)	7.95	192	0.315	20.1
	03/16/1993	Pump	780/18.2 (206/18.2)	6.1-7.6 (20-25)	7.96	176	0.375	19.8
	03/17/1993	Pump	791/18.4 (209/18.4)	7.6 (25)	7.99	171	0.368	20.5
	03/18/1993	Pump	678/15.7 (179/15.7)	7.6-9.1 (25-30)	8.02	180	0.368	20.1
	03/30/1993	Pump	757/17.2 (200/17.2)	1.5-9.1 (5-30)	8.10	157	0.404	20.0
	01/04/1993 01/06/1993 01/07/1993 01/08/1993	Bail	1,071/23.5 (283/23.5)	N/A	N/M	N/M	N/M	N/M
	04/07/1993	Pump	254/5.5 (67/5.5)	1.5-3.0 (5-10)	8.31	1.71	0.399	20.4
UE5PW-3	04/12/1993	Pump	935/20.5 (247/20.5)	3.0-4.6 (10-15)	8.43	166	0.391	19.8
	03/13/1993	Pump	1,128/24.8 (298/24.8)	6.1 (20)	8.18	192	0.384	19.3

NOTES

L/Well bores = liters/boreholes

gal/well bores = gallons/borehole

m = meters

ft = feet

mv = millivolts

mmhos/cm = millimhos/centimeter

"C = degrees Celsius

N/A = not applicable

N/M = parameter not measured

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3.0 Laboratory Testing Methods and Results

A summary of laboratory tests and testing methods is given in Table 3-1, and specific details are contained in the cited references. In addition, descriptions of all laboratory testing methods used in the pilot well project are given in the data report for the science trench borehole (REECo, 1993a).

As described in Section 2.3 and Table 2-6, drill cuttings and core samples were sent to selected testing laboratories for measurement of material, hydrologic, mineralogic, and geochemical properties. In most cases, a testing laboratory conducted a number of related tests on the same core segment. For example, initial water content, bulk density, porosity, hydraulic conductivity, moisture retention, and particle size distribution measurements were conducted on the same core segment. A number of samples were placed in storage (archived) but have now been disposed of.

REECo audited and approved the QA programs of the following laboratories involved in the pilot well project. Daniel B. Stephens & Associates, Inc., Albuquerque, New Mexico, was responsible for review and approval of the QA programs for the laboratories of Dr. B. Branvold and Dr. P. Kyle, New Mexico Institute of Mining and Technology, Socorro, New Mexico. REECo reviewed and approved the QA program of Hydro GeoChem, Inc., Tucson, Arizona. Sandia National Laboratories, Albuquerque, New Mexico, was responsible for review and approval of the QA programs for the laboratories of Dr. S. Tyler, Desert Research Institute (DRI), Reno, Nevada, and Dr. M. Caffee, Lawrence Livermore National Laboratory (LLNL), Livermore, California.

The types and numbers of tests conducted on core and drill cuttings samples for each pilot well are summarized in Table 3-2. The tabular results from these laboratory tests for both core and drill cuttings samples are summarized in Appendix E. Summary statistics for laboratory measurements, where appropriate, are presented in Table 3-3 for samples from the alluvium, and in Table 3-4 for tuff samples. Plots of laboratory testing results for specific tests are presented in the appropriate sections that follow.

Table 3-1
Summary of Laboratory Methods

Method Description	Reference
Geologic Description <ul style="list-style-type: none"> • Unconsolidated Alluvium • Consolidated Rock 	<p>ASTM D 2488-90, 1990. Standard Recommended Practice for the Description of Soils - Visual Manual Procedure. <u>In</u>: 1990 Annual Book of ASTM Standards, Vol. 04.08, American Society for Testing and Material. Philadelphia, PA.</p> <p>Fenix & Scisson, Inc., 1987. Lithologic Descriptions of Volcanic Rocks, Memorandum GEO-0237, dated May 26, 1987.</p> <p>Fenix & Scisson, Inc., 1990. The Description of Rock Samples - Geology/Hydrology Division Procedure GP-003, Revision 1.</p>
Moisture Content	ASTM D 2216-80, 1980. Method for laboratory determination of water (moisture) content of soil, rock, and soil-aggregate moisture. <u>In</u> : 1987 Annual Book of ASTM Standards, Vol. 04.08, American Society for Testing and Material. Philadelphia, PA.
Bulk Density	Blake, G. R., and K. H. Hartge, 1986. Bulk Density. <u>In</u> : Klute, A. L. (ed.), Methods of Soil Analysis, Part I, Physical and Mineralogical Methods, 2 nd Edition, American Society of Agronomy, Madison, WI. Chapter 13, pages 363-367.
Porosity	Danielson, R. E., and P. L. Sutherland, 1986. Total Porosity. <u>In</u> : Klute, A. L. (ed.), Methods of Soil Analysis, Part I, Physical and Mineralogical Methods, 2 nd Edition, American Society of Agronomy, Madison, WI. Chapter 18, pages 444-445.
Saturated Hydraulic Conductivity <ul style="list-style-type: none"> • Constant Head • Falling Head 	<p>ASTM D 2434-68, 1974. Test method for permeability of granular soils (constant head). <u>In</u>: 1987 Annual Book of ASTM Standards, Vol. 04.08, American Society for Testing and Material. Philadelphia, PA.</p> <p>Klute, A. L., and C. Dirksen, 1986. Hydraulic conductivity and diffusivity: Laboratory methods - Falling head method. <u>In</u>: Klute, A. L. (ed.), Methods of Soil Analysis, Part I, Physical and Mineralogical Methods, 2nd Edition, American Society of Agronomy, Madison, WI. Chapter 28, pages 700-703.</p>

Table 3-1
Summary of Laboratory Methods (continued)

Method Description	Reference
Moisture Retention Curves <ul style="list-style-type: none"> • Pressure Plate Extractor • Hanging Column 	<p>ASTM D 2325-68, 1981. Test Method for Capillary Moisture Relationships for Coarse- and Medium-Textured Soils by Pressure-Plate Apparatus. <u>In</u>: 1987 Annual Book of ASTM Standards, Vol. 04.08, American Society for Testing and Material. Philadelphia, PA.</p> <p>Klute, A. L., 1986. Water Retention: Laboratory methods - Falling head method. <u>In</u>: Klute, A. L. (ed.), Methods of Soil Analysis, Part I, Physical and Mineralogical Methods, 2nd Edition, American Society of Agronomy, Madison, WI. Chapter 26, pages 635-641.</p>
Particle Size Characteristics, Dry Sieve	ASTM D 422-63, 1972. Method for particle size analysis of soils. <u>In</u> : 1987 Annual Book of ASTM Standards, Vol. 04.08, American Society for Testing and Material. Philadelphia, PA.
Water Potential	<p>Gee, G. W., M. D. Campbell, G. S. Campbell, and J. H. Campbell, 1992. Rapid Measurement of Low Soil Water Potential Using a Water Activity Meter. Soil Science Society of America Journal, Vol. 56, Pages 1,068-1,071.</p> <p>Campbell, G. S., and G. W. Gee, 1986. Water Potential Measurement Using the Filter Paper Technique. <u>In</u>: Klute, A. L. (ed.), Methods of Soil Analysis, Part I, Physical and Mineralogical Methods, 2nd Edition, American Society of Agronomy, Madison, WI. Chapter 25, pages 628-630.</p>
Chloride and Bromide <ul style="list-style-type: none"> • Extraction from Soil • Ion Chromatography 	<p>Los Alamos National Laboratory, 1992. Sample Leaching to Extract Soluble Chloride and Bromide. LANL-INC-DP-92.R0. Pages 3-15.</p> <p>Los Alamos National Laboratory, 1991. Draft Procedure for Using Ion Chromatography to Determine Chloride and Bromide Concentrations. LANL-INC-DP-94.R0. Pages 3-25.</p>
Total Organic Carbon	<p>USEPA Method 9060, September 1986. Total Organic Carbon. Test Methods for Evaluating Solid Waste (SW-846), Chapter 5, Miscellaneous Test Methods. 5 pages.</p> <p>ASTM D 2579-85, 1990. Test Method for Determining Total Organic Carbon. <u>In</u>: 1990 Annual Book of ASTM Standards, Vol. 11.02, American Society for Testing and Material. Philadelphia, PA.</p>
Inorganic Carbon	Nelson, R. E., 1982. Carbonate and gypsum: Pressure-calculator method. <u>In</u> : Page, A., R. H. Miller, and D. R. Keeney (eds.), Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties, 2 nd Edition, American Society of Agronomy, Madison, WI, Chapter 11, pages 188-192.

Table 3-1
Summary of Laboratory Methods (continued)

Method Description	Reference
<p>Chlorine-36</p> <ul style="list-style-type: none"> • Extraction from Soil • Mass Spectrometry Analysis 	<p>Los Alamos National Laboratory - Internal Document. Draft Procedure, March 16, 1993. Preparation of samples for chlorine-36 analysis. LANL-INC-DP-95.R1, pages 3-14.</p> <p>Davis, J. C., I. D. Proctor, J. R. Southon, M. W. Caffee, D. W. Heikkinen, M. L. Roberts, K. W. Turteltaub, D. E. Nelson, D. H. Lloyd, and J. S. Vogel, 1990. LLNL/UC AMS Facility and Research Program. Nuclear Instruments and Methods in Physics Research, Vol. B52, pages 269-272.</p>
<p>Stable Isotopes</p> <ul style="list-style-type: none"> • Toluene Extraction • Mass Spectroscopy Analysis 	<p>Ingraham, N. L. and C. Shadel, 1992. A Comparison of the Toluene Distillation and Vacuum/Heat Methods for Extracting Soil Water for Stable Isotope Analysis. Journal of Hydrology, Vol. 140, pages 371-387.</p> <p>Davis, J. C., I. D. Proctor, J. R. Southon, M. W. Caffee, D. W. Heikkinen, M. L. Roberts, K. W. Turteltaub, D. E. Nelson, D. H. Lloyd, and J. S. Vogel, 1990. LLNL/UC AMS Facility and Research Program. Nuclear Instruments and Methods in Physics Research, Vol. B52, pages 269-272.</p>
Water Soluble and Adsorbed Sulfate	<p>Tabatabai, M. A., 1982. Sulfur: Inorganic Sulfate. <u>In</u>: Page, A. L., R. H. Miller, and D. R. Keeney (eds.), Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties, 2nd Edition, American Society of Agronomy, Madison, WI, Chapter 28, pages 518-522.</p>
Sample Preparation and Analysis by X-Ray Fluorescence (XRF)	<p>Norrish, K. and B. W. Chappell, 1977. X-Ray Fluorescence Spectrometry. <u>In</u>: Zussman, J. (ed.), Physical Methods in Determinative Mineralogy, 2nd Edition, Academic Press, New York, Pages 210-272.</p> <p>Norrish, K. and J. T. Hutton, 1969. An Accurate X-Ray Spectrographic Method for the Analysis of a Wide Range of Geochemical Samples. Geochim. Cosmochim. Acta, v. 33, Pages 431-453.</p>
Sample Preparation and Instrumental Neutron Activation Analysis (INAA)	<p>Jacobs, J. W., R. L. Korotev, D. P. Blanchard, and L. A. Haskins, 1977. A Well-Tested Procedure for Instrumental Neutron Activation Analysis of Silicate Rocks and Minerals. Journal of Radioanalytical Chemistry, Vol. 40, pages 93-114.</p>

Table 3-2
Summary of Tests Performed on Samples from the Pilot Wells

Borehole		UE5PW-1		UE5PW-2		UE5PW-3				UE5PW-2A		UE5PW-2B		UE5PW-2C	
Sample Type	Alluvium	X	X	X	X	X	X			X	X	X	X	X	X
	Tuff							X	X						
	Core	X		X		X		X		X		X		X	
	Cuttings		X		X		X		X		X		X		X
Hydrologic Properties	Hydraulic Conductivity	34	--	16	--	10	--	3	--	--	--	--	--	--	--
	Air Permeability	--	--	--	--	--	--	3	--	--	--	--	--	--	--
	Moisture Retention	24	--	16	--	9	--	--	--	--	--	--	--	--	-
	Gravimetric Water Content	146	595	58	706	50	488	5	79	15	26	5	15	12	30
	Volumetric Water Content	76	--	34	--	23	--	3	--	14	--	5	--	12	--
	Water Potential	59	--	25	--	18	--	2	19	4	--	1	--	3	--
Material Properties	Hydrometer	5	11	15	96	12	--	--	--	3	--	1	--	1	--
	Dry Sieve	56	299	26	355	25	244	--	--	7	13	2	8	5	15
	Bulk Density	76	--	34	--	23	--	3	--	14	--	5	--	12	--
	Grain Density	--	--	--	--	--	--	3	--	--	--	--	--	--	--
	Calculated Porosity	76	--	34	--	23	--	3	--	14	--	5	--	12	--
	Saturated Porosity	24	--	16	--	9	--	--	--	--	--	--	--	--	--
	Mineralogy	34	--	13	--	13	--	3	--	4	--	2	--	4	--
Environmental Tracers	Carbon	38	288	13	355	12	246	2	134	--	13	--	7	--	15
	Chloride	38	287	14	353	12	246	--	134	4	13	2	7	4	15
	Bromide	26	234	14	324	12	246	--	129	4	13	2	7	4	15
	Sulfate	1	15	14	353	12	246	--	134	4	13	2	7	4	15
	Chlorine-36	9	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stable Isotopes	22	--	16	--	14	--	1	--	--	--	--	--	--	--

NOTE:

Wells UE5PW-2A, 2B, and 2C are neutron-moisture meter calibration holes drilled near the pilot wells. See Section 4.6.

34 = number of tests conducted

-- = test not conducted

Table 3-3
Summary of Descriptive Statistics for Alluvium Samples from the Pilot Wells

Hydrologic Properties		Core										Cuttings				Coefficient of Variation (percent)		Standard Deviation (percent)		Coefficient of Variation (percent)	
		Sample ID	Number of samples	Range		Mean	Standard Deviation	Variation (percent)	Number of samples	Range		Mean	Standard Deviation	Variation (percent)							
				Minimum	Maximum					Minimum	Maximum										
Saturated conductivity (cm/s)	UESPW-1	DB1	34	1.4x10 ⁻⁸	5.8x10 ⁻³	1.7x10 ⁻³	1.6x10 ⁻³	97.74													
		16	2.1x10 ⁻⁶	4.0x10 ⁻³	5.7x10 ⁻⁴	1.1x10 ⁻³	187.27														
		10	5.6x10 ⁻⁶	3.2x10 ⁻³	1.1x10 ⁻³	1.2x10 ⁻³	103.99														
		DB1	34	4.2	16.0	7.6	2.6	34.60													
		DB2	32	2.6	13.2	6.3	2.3	36.35													
Gravimetric water content (percent)	UESPW-1	DB12	42	3.7	15.8	7.1	2.7	37.53													
		DB1	38	3.0	13.9	6.9	2.6	37.58													
		Total	146	2.6	16.0	7.0	2.6	36.80													
		DB1	16	4.3	12.2	6.8	2.1	30.82													
		DB2	10	3.0	10.4	6.3	2.4	37.30													
UESPW-2	DB12	18	4.3	11.5	6.7	2.1	31.18														
	DB1	14	2.0	11.6	6.3	2.5	40.38														
	Total	58	2.0	12.2	6.5	2.2	33.57														
	DB1	10	3.0	7.9	5.0	1.4	28.59														
	DB2	15	2.8	8.4	5.2	1.6	30.49														
UESPW-3	DB12	13	1.5	6.6	4.6	1.5	32.33														
	DB1	12	2.8	6.4	4.6	1.0	22.37														
	Total	50	1.5	8.4	4.9	1.4	28.78														
	DB1	10	3.0	7.9	5.0	1.4	28.59														
	DB2	15	2.8	8.4	5.2	1.6	30.49														
Gravimetric water content (percent)	Vadose Zone UESPW-1	DB1	31	4.2	11.2	6.9	1.6	23.59													
		DB2	31	2.6	11.6	6.0	1.9	31.94													
		DB12	40	3.7	13.9	6.7	2.1	30.84													
		DB1	36	3.0	11.2	6.5	2.1	32.80													
		Total	138	2.6	13.9	6.6	2.0	30.05													
UESPW-2	DB1	16	4.3	12.2	6.8	2.1	30.82														
	DB2	10	3.0	10.4	6.3	2.4	37.30														
	DB12	18	4.3	11.5	6.7	2.1	31.18														
	DB1	14	2.0	11.6	6.3	2.5	40.38														
	Total	58	2.0	12.2	6.5	2.2	33.57														
UESPW-3	DB1	10	3.0	7.9	5.0	1.4	28.59														
	DB2	15	2.8	8.4	5.2	1.6	30.49														
	DB12	13	1.5	6.6	4.6	1.5	32.33														
	DB1	12	2.8	6.4	4.6	1.0	22.37														
	Total	50	1.5	8.4	4.9	1.4	28.78														

Table 3-3
Summary of Descriptive Statistics for Alluvium Samples from the Pilot Wells (continued)

Hydrologic Properties	Sample ID	Number of samples	Core				Cuttings			
			Range		Coefficient of Variation (percent)	Number of samples	Range		Coefficient of Variation (percent)	
			Minimum	Maximum			Minimum	Maximum		
Volumetric water content (percent)										
UESPW-1	DB1	34	6.5	26.8	12.4	4.6			36.93	
	DR12	42	5.6	28.6	11.7	4.9			41.53	
	Total	76	5.6	28.6	12.0	4.7			39.27	
UESPW-2	DB1	16	7.5	21.0	11.2	3.5			31.45	
	DR12	18	7.3	15.9	10.6	2.5			23.35	
	Total	34	7.3	21.0	10.9	3.0			27.37	
UESPW-3	DB1	10	4.9	13.2	8.4	2.5			29.06	
	DR12	13	2.6	10.7	7.5	2.3			30.37	
	Total	23	2.6	13.2	7.9	2.3			29.73	
Volumetric water content (percent)										
Vadoso Zone										
UESPW-1	DB1	31	6.5	16.4	11.2	2.5			22.41	
	DR12	40	5.6	23.0	11.0	3.6			33.17	
	Total	71	5.6	23.0	11.1	3.2			28.69	
UESPW-2	DB1	16	7.5	21.0	11.2	3.5			31.45	
	DR12	18	7.3	15.9	10.6	2.5			23.35	
	Total	34	7.3	21.0	10.9	3.0			27.37	
UESPW-3	DB1	10	4.9	13.2	8.4	2.5			29.06	
	DR12	13	2.6	10.7	7.5	2.3			30.37	
	Total	23	2.6	13.2	7.9	2.3			29.73	

Table 3-3
Summary of Descriptive Statistics for Alluvium Samples from the Pilot Wells (continued)

	Sample ID	Core					Cuttings				
		Number of samples	Range		Mean	Standard Deviation	Coefficient of Variation (percent)	Number of samples	Range		Coefficient of Variation (percent)
			Minimum	Maximum					Minimum	Maximum	
Hydrologic Properties	DR12										
Water potential (bars)											
UESPW-1		26	-21.8	-0.03	-5.5	14.1	98.92				
Filter paper method		34	-81.5	-0.7	-11.6	15.1	129.72				
Chilled mirror method	Total	60	-81.5	-0.03	-9.0	12.2	136.03				
UESPW-2		13	-28.0	-0.3	-13.9	9.8	70.50				
Filter paper method		12	-86.6	-1.4	-15.2	23.6	155.06				
Chilled mirror method	Total	25	-86.6	-0.3	-14.5	17.4	119.99				
UESPW-3		4	-19.3	-10.9	-16.2	3.7	22.84				
Filter paper method		14	-374.8	-6.8	-45.6	96.6	211.92				
Chilled mirror method	Total	18	-374.8	-6.8	-39.1	85.4	218.65				
UESPW-1 (below 45 m (150 ft))		26	-21.8	-0.03	-5.5	5.5	98.92				
Filter paper method		26	-12.2	-0.7	-5.7	3.1	55.05				
Chilled mirror method	Total	52	-21.8	-0.03	-5.6	4.4	78.74				
UESPW-2 (below 45 m (150 ft))		9	-24.0	-0.3	-10.5	8.4	80.05				
Filter paper method		3	-7.5	-1.4	-4.3	3.0	70.28				
Chilled mirror method	Total	12	-24.0	-0.3	-9.0	7.8	87.16				
UESPW-3 (below 30 m (100 ft))		4	-19.3	-10.9	-16.2	3.7	22.84				
Filter paper method		10	-19.8	-6.8	-12.2	4.7	38.75				
Chilled mirror method	Total	14	-19.8	-6.8	-13.3	4.7	35.35				

Table 3-3
Summary of Descriptive Statistics for Alluvium Samples from the Pilot Wells (continued)

Material Properties Sieve analysis (percent passing) No. 4 mesh screen	Sample ID	Core					Cuttings				
		Number of samples	Range			Coefficient of Variation (percent)	Number of samples	Range			Coefficient of Variation (percent)
			Minimum	Maximum	Mean			Minimum	Maximum	Mean	
UE5PU-1	DB1	24	52.68	98.02	79.26	11.83	299	37.26	98.72	81.55	12.32
	DB2	32	38.92	93.53	73.46	14.63					
	Total	56	38.92	98.02	75.94	13.70					
UE5PU-2	DB1	16	61.29	95.02	77.46	10.55	355	27.90	99.79	77.63	16.20
	DB2	10	57.56	92.35	78.24	11.38					
	Total	26	57.56	95.02	77.76	10.65					
UE5PU-3	DB1	10	58.69	80.04	69.15	6.21	244	26.05	96.16	76.13	16.09
	DB2	15	57.48	90.71	79.42	10.39					
	Total	25	57.48	90.71	75.31	10.19					
No. 200 mesh screen UE5PU-1	DB1	24	2.63	14.20	7.78	3.10	299	1.24	29.39	7.24	46.34
	DB2	32	1.10	13.32	5.86	3.27					
	Total	56	1.10	14.20	6.68	3.32					
UE5PU-2	DB1	16	5.20	16.30	11.18	3.66	355	0.87	34.78	12.82	36.35
	DB2	10	2.72	18.91	10.91	4.83					
	Total	26	2.72	18.91	11.08	4.05					
UE5PU-3	DB1	10	2.51	16.98	10.77	5.62	244	2.34	22.32	10.04	37.44
	DB2	15	2.72	16.66	8.96	3.66					
	Total	25	2.51	16.98	9.69	4.53					
Dry Bulk Density (g/cm ³) UE5PU-1	DB1	34	1.43	1.92	1.64	0.12					
	DB12	42	1.17	1.92	1.65	0.17					
	Total	76	1.17	1.92	1.64	0.15					
UE5PU-2	DB1	16	1.45	1.78	1.66	0.11					
	DB12	18	1.22	1.86	1.63	0.17					
	Total	34	1.22	1.86	1.64	0.14					
UE5PU-3	DB1	10	1.58	1.80	1.68	0.08					
	DB12	13	1.30	1.96	1.65	0.20					
	Total	23	1.30	1.96	1.66	0.16					

Table 3-3
Summary of Descriptive Statistics for Alluvium Samples from the Pilot Wells (continued)

	Core						Cuttings					
	Sample ID	Number of samples	Range			Coefficient of Variation (percent)	Number of samples	Range			Coefficient of Variation (percent)	
			Minimum	Maximum	Mean			Minimum	Maximum	Mean		
Material Properties												
Porosity, calculated (percent)												
UESPW-1												
	DB1	34	27.53	45.87	38.07	4.45						
	DB12	42	27.55	55.85	37.81	6.40						
	Total	76	27.53	55.85	37.93	5.58						
UESPW-2												
	DB1	16	32.91	45.36	37.36	3.94						
	DB12	18	29.81	56.60	40.06	7.27						
	Total	34	29.81	56.60	38.79	6.01						
UESPW-3												
	DB1	10	32.15	40.26	36.51	2.90						
	DB12	13	26.04	50.94	37.85	7.66						
	Total	23	26.04	50.94	37.27	5.99						
Porosity, saturated (percent)												
UESPW-1												
	DB1	24	27.50	39.20	33.50	3.39						
UESPW-2												
	DB1	16	27.93	39.77	32.70	3.41						
UESPW-3												
	DB1	9	26.88	35.87	30.31	2.72						
Magnetic susceptibility												
UESPW-1												
		195	0.5	5.0	2.1	1.0		0.7	4.5	2.1	0.6	28.97
UESPW-2												
		139	0.2	3.7	1.2	0.6		0.4	4.7	1.2	0.5	41.23
UESPW-3												
		112	0.6	3.6	1.7	0.7		0.6	3.9	1.6	0.6	34.80

Table 3-3
Summary of Descriptive Statistics for Alluvium Samples from the Pilot Wells (continued)

	Sample ID	Core					Cuttings				
		Number of samples	Range			Coefficient of Variation (percent)	Number of samples	Range			Coefficient of Variation (percent)
			Minimum	Maximum	Mean			Minimum	Maximum	Mean	
Environmental Tracers	HYD1										
Carbon in soil (percent)											
Inorganic											
UESPW-1		38	0.10	1.88	0.47	83.97	288	0.09	0.92	0.41	45.48
UESPW-2		13	0.17	0.93	0.56	39.02	355	0.09	1.53	0.58	35.24
UESPW-3		12	0.02	0.91	0.38	75.96	246	0.10	1.40	0.71	46.35
Organic											
UESPW-1		38	0.01	0.07	0.03	60.57	288	0.01	0.12	0.02	69.78
UESPW-2		13	0.01	0.08	0.03	70.90	355	0.01	0.08	0.02	55.78
UESPW-3		12	0.01	0.14	0.03	121.68	246	0.01	0.10	0.02	68.79
Total											
UESPW-1		38	0.11	1.93	0.50	81.11	288	0.10	0.97	0.44	45.24
UESPW-2		13	0.19	0.99	0.59	37.99	355	0.10	1.57	0.60	35.24
UESPW-3		12	0.03	0.93	0.41	71.04	246	0.11	1.43	0.73	45.81
Soluble carbon (ppm)											
UESPW-1		1	5.90				15	1.40	5.30	3.21	39.05
UESPW-2							25	2.20	62.00	28.90	70.23
UESPW-3		2	5.20	8.60	6.90	34.84	21	2.90	9.20	5.93	32.11
Chloride in soil (ppm)											
UESPW-1		38	0.40	201.00	34.06	162.52	287	0.40	179.00	22.13	181.97
UESPW-2		14	0.40	350.00	36.22	254.55	353	0.30	227.00	7.35	346.30
UESPW-3		12	1.00	93.00	39.88	81.35	246	0.40	240.00	35.82	100.28
Bromide in soil (ppm)											
UESPW-1		26	0.001	1.29	0.31	126.51	234	0.001	1.16	0.17	164.01
UESPW-2		14	0.01	1.90	0.22	229.70	324	0.001	1.20	0.05	324.69
UESPW-3		12	0.02	0.48	0.20	77.57	246	0.003	1.65	0.19	114.14
Chloride in water (ppm)											
UESPW-1							6	12.20	19.00	14.40	17.22
UESPW-2							4	13.00	16.00	14.25	8.83
UESPW-3											
Bromide in water (ppm)											
UESPW-1							6	0.09	0.13	0.11	12.10
UESPW-2							4	0.09	0.100	0.10	6.08
UESPW-3											
Soluble sulfate (ppm)											
UESPW-1		1	4.0				15	2.30	17.00	5.43	71.81
UESPW-2		14	2.7	7900.0	629.0	333.90	353	1.80	400.00	14.13	296.70
UESPW-3		12	2.1	230.0	103.8	87.03	246	1.80	770.00	68.78	132.98

Table 3-3
Summary of Descriptive Statistics for Alluvium Samples from the Pilot Wells (continued)

Environmental Tracers			Core										Cuttings					Coefficient of Variation	
			Sample ID	Number of samples	Range		Mean	Standard Deviation	Coefficient of Variation (percent)	Number of samples	Range		Mean	Standard Deviation	Coefficient of Variation (percent)				
Minimum	Maximum	Minimum			Maximum														
HYD1																			
Carbon in soil (percent)																			
Inorganic																			
UE5PW-1 (below 75 m (250 ft))		25	0.10	1.81	0.37	0.33	89.29			0.09	0.84	0.40	0.10			39.21			
UE5PW-2 (below 30 m (100 ft))		8	0.40	0.86	0.58	0.19	32.69			0.09	1.23	0.55	0.17			30.29			
UE5PW-3 (below 120 m (400 ft))		2	0.83	0.91	0.87	0.06	6.50			0.50	1.40	0.99	0.21			21.55			
Organic																			
UE5PW-1 (below 75 m (250 ft))		25	0.01	0.05	0.02	0.01	53.14			0.01	0.07	0.02	0.01			53.18			
UE5PW-2 (below 30 m (100 ft))		8	0.01	0.03	0.02	0.01	38.69			0.01	0.05	0.02	0.01			34.57			
UE5PW-3 (below 120 m (400 ft))		2	0.01	0.02	0.01	0.002	14.63			0.01	0.04	0.02	0.01			30.40			
Total																			
UE5PW-1 (below 75 m (250 ft))		25	0.11	1.85	0.40	0.34	85.26			0.10	0.87	0.37	0.14			37.65			
UE5PW-2 (below 30 m (100 ft))		8	0.42	0.89	0.60	0.19	32.28			0.10	1.27	0.56	0.17			29.85			
UE5PW-3 (below 120 m (400 ft))		2	0.84	0.93	0.88	0.06	6.64			0.51	1.43	1.01	0.22			21.44			
Soluble carbon (ppm)																			
UE5PW-1 (below 75 m (250 ft))		10	1.40	4.80	2.97	1.14	38.42			1.40	4.80	2.97	1.14			38.42			
UE5PW-2 (below 30 m (100 ft))		17	2.20	62.00	28.73	23.93	83.28			2.20	62.00	28.73	23.93			83.28			
UE5PW-3 (below 120 m (400 ft))		3	3.60	6.70	5.17	1.55	30.01			3.60	6.70	5.17	1.55			30.01			
Chloride in soil (ppm)																			
UE5PW-1 (below 75 m (250 ft))		25	0.40	4.10	1.01	0.82	81.45			0.40	8.60	1.15	0.93			81.03			
UE5PW-2 (below 30 m (100 ft))		9	0.40	15.00	3.20	4.64	145.08			0.30	93.00	1.88	6.10			325.04			
UE5PW-3 (below 120 m (400 ft))		2	1.00	1.00	1.00	0.00	0.00			0.40	9.80	2.15	2.41			111.78			
Bromide in soil (ppm)																			
UE5PW-1 (below 75 m (250 ft))		13	0.001	0.014	0.006	0.003	54.87			0.001	0.07	0.01	0.01			98.01			
UE5PW-2 (below 30 m (100 ft))		9	0.01	0.06	0.02	0.02	100.19			0.001	0.50	0.01	0.03			334.42			
UE5PW-3 (below 120 m (400 ft))		2	0.02	0.02	0.02	0.0	0.0			0.003	0.06	0.02	0.01			44.44			
Soluble sulfate (ppm)																			
UE5PW-1 (below 75 m (250 ft))		10	2.30	17.00	4.80	4.41	91.90			2.30	17.00	4.80	4.41			91.90			
UE5PW-2 (below 30 m (100 ft))		315	1.80	310.00	6.76	19.75	292.10			1.80	310.00	6.76	19.75			292.10			
UE5PW-3 (below 120 m (400 ft))		86	1.80	9.20	2.82	0.85	30.01			1.80	9.20	2.82	0.85			30.01			
UE5PW-1δ ¹⁸ O																			
UE5PW-2δ ¹⁸ O																			
UE5PW-3δ ¹⁸ O																			
UE5PW-1δD																			
UE5PW-2δD																			
UE5PW-3δD																			

Table 3-4
Summary of Descriptive Statistics for Tuff Samples from Well UE5PW-3

Properties	Sample ID	Number of Samples	Range		Mean	Standard Deviation	Coefficient of Variation (percent)
			Minimum	Maximum			
Core							
Saturated Conductivity (cm/s)	DB1	3	6.0 x 10 ⁻⁷	2.7 x 10 ⁻⁵	1.4 x 10 ⁻⁶	1.3 x 10 ⁻⁵	93.09
Air Permeability (cm/s)	DB1	3	2.0 x 10 ⁻⁶	3.8 x 10 ⁻⁵	2.8 x 10 ⁻⁵	9.0 x 10 ⁻⁶	32.44
Gravimetric Water Content (percent)	DB1	3	7.5	7.6	7.6	0.01	0.13
	DRI2	2	0.8	1.6	1.2	0.57	47.14
	Total	5	0.8	7.6	5.0	3.5	69.65
Volumetric Water Content (percent)	DB1	3	14.9	15.1	15.0	0.09	0.59
Water Potential (bars)	DRI2	2	-23.2	-16.3	-19.8	4.90	24.56
Dry Bulk Density (g/cm ³)	DB1	3	1.98	2.00	1.99	0.01	0.58
Grain Density (g/cm ³)	DB1	3	2.57	2.58	2.57	0.01	0.22
Calculated Porosity (percent)	DB1	3	21.90	23.10	22.40	0.62	2.79
Pore Volume (percent)	DB1	3	70.00	74.90	72.80	2.52	3.47
Magnetic Susceptibility		5	0.04	2.83	0.75	1.17	156.57
Drill Cuttings							
Gravimetric Water Content (percent)	DRI2	19	0.6	18.1	3.4	4.53	131.84
	HYD1	60	0.3	3.6	1.3	0.81	60.45
	Total	79	0.3	18.1	1.8	2.46	133.52
Water Potential (bars)	DRI2	19	-381.9	-2.7	-102.7	98.61	96.01
Magnetic Susceptibility		135	0.5	4.4	1.9	0.9	46.05
Inorganic Carbon (percent)	HYD1	66	0.01	1.19	0.34	0.33	96.17
Organic Carbon (percent)	HYD1	131	0.002	0.04	.01	0.01	67.60
Total Carbon (percent)	HYD1	66	0.013	1.20	0.35	0.33	94.31
Soluble Organic Carbon (ppm)	HYD1	3	2.8	20.60	10.30	9.24	90.00
Chloride in Soil (ppm)	HYD1	134	0.30	6.30	2.00	1.37	68.06
Bromide in Soil (ppm)	HYD1	129	0.001	0.05	0.01	0.01	82.74
Soluble Sulfate (ppm)	HYD1	134	0.7	17.40	2.80	2.86	102.44

NOTES

cm/s = centimeters per second
g/cm³ = grams per cubic centimeters
ppm = parts per million

3.1 General Geologic Description, Lithology, Stratigraphy, Mineralogy, and Organic Matter

General geologic descriptive information, as well as specific lithologic and stratigraphic information, is useful in identifying layers with possibly distinctive physical and hydrogeologic properties and potentially important flow paths, and understanding the overall geometry of the hydrogeologic flow system. This information is necessary to understand and model important processes under the existing arid climate, as well as for possible future climatic scenarios.

3.1.1 General Geologic, Lithologic, and Stratigraphic Data for Alluvium

Visual geologic descriptions were made on both core and drill cuttings samples (Sections 2.3.1 and 2.3.2) and recorded on borehole log sheets (Appendices B.1, B.2, and B.3) and in field notebooks. The descriptions included a field description of lithology, texture, color, cementation, and reaction to hydrochloric acid. Field descriptions of texture (particle size distribution) were not as accurate as the textural classifications based on laboratory dry sieve analyses. Therefore, the laboratory textural classifications were added to the edited versions of the borehole log sheets. This geologic descriptive information is summarized below.

Clasts recovered in the alluvial core and drill cuttings were primarily tuff with occasional quartzite and limestone. Basalt clasts were even rarer and only identified in several samples. The degree of welding in the tuff clasts (observable only in large clasts) ranged from welded to nonwelded. The alluvium samples were generally weakly cemented to uncemented and exhibited a weak to strong reaction to dilute hydrochloric acid. The poorly graded gravel and coarse-sand fractions were more sub-angular than the well-graded fractions of similar particle size. Cobbles were generally sub-rounded. The general color of the alluvial samples was predominantly very pale brown to light yellowish brown. Gravels, when separated from the other size fractions, were pink and gray in color.

The Unified Soil Classification System (USCS) textural data are summarized in Table 3-5 for all alluvial core and drill cuttings samples. Note that Table 3-5 includes particle size distribution data from each drill cuttings interval, and from two core segments (DB1 and DB2 samples) in every core run. The justification for combining particle size distribution data for core and drill cuttings is given in Section 3.2. These textural classes are composed primarily of sand with silt, some gravel, and no clay. The predominant textural group found in all three pilot wells is well-graded sand with silt (SW-SM). The second most frequently occurring group is silty sand (SM) in Wells UE5PW-2 and UE5PW-3, and well-graded sand (SW).

Table 3-5
Summary of USCS Assignments for Core and Drill Cuttings Samples from the Pilot Wells

Borehole	Sample Type	Number and Percent () of Samples with Given USCS Group Names ^a									Total
		SM	SP-SM	SW-SM	SP	SW	GM	GP	GW	GW-GM	
UE5PW-1	Drill Cuttings	24 (8)	10 (3.3)	193 (64.5)	2 (0.7)	66 (22.1)	--	--	2 (0.7)	2 (0.7)	299
UE5PW-1	Core	5 (8.9)	5 (8.9)	24 (42.8)	1 (1.8)	19 (34.0)	--	--	2 (3.6)	--	56
UE5PW-2	Drill Cuttings	192 (54.1)	3 (0.8)	131 (36.9)	1 (0.3)	10 (2.8)	1 (0.3)	1 (0.3)	--	16 (4.5)	355
UE5PW-2	Core	10 (38.5)	--	15 (57.5)	1 (3.8)	--	--	--	--	--	26
UE5PW-3	Drill Cuttings	71 (29)	--	149 (61)	--	11 (4.5)	--	2 (1)	2 (1)	9 (3.5)	244
UE5PW-3	Core	9 (36)	--	12 (48)	--	4 (16)	--	--	--	--	25
TOTAL		311 (31.0)	18 (1.8)	524 (52.1)	5 (0.5)	110 (10.9)	1 (0.2)	3 (0.3)	6 (0.6)	27 (2.7)	1,000

- a USCS = Unified Soil Classification System
SM: Silty sand (>12 %silt)	SW: Well graded sand (<5 % silt)
SP-SM: Poorly graded sand with silt (5 to 12 % silt)	GM: Silty gravel (> 12 % silt)
SW-SM: Well graded sand with silt (5 to 12 %silt)	GP: Poorly graded gravel (<5 % silt)
SP: Poorly graded sand (<5 % silt)	GW: Well graded gravel (<5 % silt)
GW-GM: Well graded gravel with silt (5 to 12 % silt)	
-- No samples in this USCS group	

Preliminary stratigraphic columns (Appendix E.1.1) were prepared for each pilot well using particle size distribution data from each drill cuttings interval and one core segment (DB2) from each core run. In general these columns show, for all three wells, that the thickest layers consist of sand with silt (SW-SM) and silty sand (SM). These layers alternate with thinner layers of poorly graded sand (SP), poorly graded sand with silt (SP-SM), well graded sand (SW), and gravel zones. Some subtle differences in textural groups between each pilot well are briefly outlined below.

In Well UE5PW-1 textural units consist predominantly of well graded sand with silt (SW-SM) with a maximum thickness of 8.2 m (27 ft); numerous layers of well graded sand with gravel (SW) with a maximum thickness of 5.2 m (17 ft), but more commonly 0.76 to 1.5 m (2.5 to 5 ft) thick; and less numerous and thinner layers of poorly graded sand (SP) and silty sand (SM). Textural units in Well UE5PW-2 are composed primarily of silty sand (SM) with a maximum thickness of 12.2 m (40 ft), with numerous inter-bedded gravel zones and layers of well graded sand with silt (SW-SM). In the depth

intervals 42.7 to 122.0 m (140 to 400 ft) and 171 to 256 m (560 to 840 ft) the silty sand unit (SM) is fairly massive, less gravelly, and has fewer inter-bedded layers of well graded sand (SW). Finally, the alluvial section in Well UE5PW-3 is composed mainly of well graded sand with silt (SW-SM) with a maximum thickness of 27.4 m (90 ft). In the interval 38.1 to 115.8 m (125 to 380 ft) the SW-SM unit is fairly massive, but in the interval 115.8 to 170.7 m (380 to 560 ft) there is an increase in the number of silty sand (SM) zones. Below 170.7 m (560 ft) the silty sand layer is quite massive with scattered zones of cobbles and boulders.

It is not surprising that these preliminary stratigraphic columns show no correlation between textural units in boreholes separated by approximately 1.5 km (1 mi). The various depositional processes that contribute to the formation of alluvial fans often interact to produce highly variable and discontinuous lithologic sequences both in the lateral and vertical directions. This makes it difficult to correlate deposits between even closely spaced boreholes. For example, attempts to correlate deposits in the science trench boreholes, located only 15.2 m (50 ft) apart (and in some cases only 1.5 m [5 ft] apart) based solely on particle size distribution were unsuccessful (REECo, 1993a).

Through observations of existing excavations within the Area 5 RWMS, lithologic units (based on a visual description of texture and a field interpretation of the depositional process involved) have been identified to extend laterally up to several hundreds of meters (RSN, 1991). However, a detailed comparison of the physical and hydrologic properties of these units indicated that the differences between units were neither distinct nor statistically significant in most cases. Each unit is made up of textural groups that are nearly identical; the only difference is that one unit is slightly finer in texture than the other.

It should be emphasized that the inability to correlate textural units between the pilot wells and the science trench boreholes is not a significant problem in terms of understanding and simulating the movement of fluids in the regions between these boreholes. Sully et al. (1993), quantitatively demonstrate that the physical and hydrologic properties of these textural units (required to simulate fluid flow) are very similar. Therefore, the subsurface penetrated by both the science trench boreholes and the pilot wells can be approximated as a homogenous hydrogeologic system. Data and more qualitative arguments supporting this conclusion are presented in Sections 3.2 and 3.3. Similar data and qualitative arguments were presented for the science trench boreholes (REECo, 1993a).

3.1.2 Tuff Lithology and Stratigraphy

Lithologic and stratigraphic descriptive data for the tuff units in Well UE5PW-3 were obtained by examining a complete record of drill cuttings samples collected over consecutive 0.76-m (2.5-ft) depth intervals from the alluvium-tuff contact at 188.2 m (617.5 ft) to the total borehole depth at 291.1 m (955.0 ft). The detailed descriptive information presented below was obtained from an in-depth laboratory examination of the complete set of drill cuttings samples. Some general descriptive lithologic and stratigraphic information collected during drilling is presented in drill cuttings log sheets (Appendix B.6).

Two major lithologic and stratigraphic tuff units were penetrated in Well UE5PW-3. A rhyolitic ash-flow tuff was encountered in the interval 188.2 to 279.7 m (617.6 to 917.5 ft). Underlying this unit is a bedded tuff that extends at least to the total borehole depth. The ash-flow tuff unit was identified as the Ammonia Tanks Tuff (Poole, 1965; Byers et al., 1976). This unit is of Tertiary age and grades from moderately welded at the alluvium-tuff contact to nonwelded at the bedded tuff contact. This gradation in welding character is also visible on the natural gamma logs presented in Section 4.3.2. The core samples from the tuff interval 194.54 to 196.14 m (638.25 to 643.50 ft) and from 209.86 to 210.87 m (688.50 to 691.83 ft) (Table 2-5) sampled the moderately welded and partially welded section of this unit, respectively.

The ash-flow unit is fairly uniformly gray in color, with a matrix that is glassy to devitrified. Abundant phenocrysts are present (20 to 25 percent by volume), consisting of bronze and black biotite, sanidine, sphene, and plagioclase feldspar minerals. Structural features were not observed in either the core or drill cuttings samples. Nearby outcrops of this unit at Massachusetts Mountain indicate that this unit dips approximately 15 to 25 degrees to the southeast. This significant dip may extend beneath Well UE5PW-3, which would cause the unit thickness in the borehole (91.4 m [300 ft]) to be greater than the true thickness. Where a nearby drill hole, UE11a, penetrated this unit, the bedding dip was reported to be 28 degrees to the southeast (Fernald et al., 1965).

The underlying bedded tuff unit was reworked by water (soon after deposition), is vitric and weakly calcareous, and contains abundant phenocrysts. The colors in the tuff include shades of red, orange, brown, and white. Overall, the bedded tuff is expected to exhibit a higher matrix porosity and hydraulic conductivity than the overlying moderately welded to nonwelded ash-flow tuff (Winograd and Thordarson, 1975).

3.1.3 Elemental and Oxide Composition

Characterization of the gross elemental and oxide composition is helpful in identifying the source(s) of sediments and understanding the age and stability of pediments, and the potential for future erosion at the Area 5 RWMS. With this in mind, selected core samples were pulverized, sub-sampled, and analyzed by X-ray fluorescence (XRF) for major elements:

- silicon dioxide (SiO_2)
- titanium dioxide (TiO_2)
- aluminum oxide (Al_2O_3)
- iron oxide (Fe_2O_3)
- manganese oxide (MnO)
- magnesium oxide (MgO)
- calcium oxide (CaO)
- sodium oxide (Na_2O)
- potassium oxide (K_2O)
- phosphorous oxide (P_2O_5)

and for trace elements :

- rubidium (Rb)
- strontium (Sr)
- zirconium (Zr)
- yttrium (Y)
- niobium (Nb)
- lead (Pb)
- thorium (Th)

The weight loss on ignition was also determined for each sample as a check on the quality of the analyses. Selected core samples were also analyzed for the following elements by instrumental neutron activation analysis (INAA):

- iron oxide (FeO)
- sodium dioxide (Na_2O)
- scandium (Sc)
- chromium (Cr)
- zinc (Zn)
- arsenic (As)
- bromine (Br)
- tin (Sb)
- barium (Ba)
- cesium (Cs)
- lanthanum (La)
- cerium (Ce)
- neodymium (Nd)
- samarium (Sm)
- europium (Eu)
- terbium (Tb)
- ytterbium (Yb)
- lutetium (Lu)
- hafnium (Hf)
- tantalum (Ta)
- thorium, (Th)
- uranium (U)

The completed results of element and oxide composition analyses for core samples from the pilot wells are given in Appendix E.1.2. Figures 3-1 and 3-2 illustrate the variation of elemental and oxide composition with depth in Well UE5PW-1. Overall, the elemental and oxide composition of minerals remains fairly constant with depth. The results from the other two pilot wells also show that the mineralogy profiles are similar to Well UE5PW-1. The variation of the data with depth is not significantly different from the variability noted in several science trench boreholes located some 20 to 30 m (65 to 100 ft) to the southeast of Well UE5PW-1 (REEC_o, 1993a).

Figure 3-1
Depth Profiles of Element and Oxide Composition Data by X-Ray Fluorescence (XRF) for Core Samples from Well UE5PW-1

Figure 3-1
Depth Profiles of Element and Oxide Composition Data by XRF for Core Samples
from Well UE5PW-1 (continued)

Figure 3-1
Depth Profiles of Element and Oxide Composition Data by XRF for Core Samples
from Well UE5PW-1 (continued)

Figure 3-2
Depth Profiles of Element and Oxide Composition Data by Instrumental Neutron
Activation Analysis (INAA) for Core Samples from Well UE5PW-1

Figure 3-2
Depth Profiles of Element and Oxide Composition Data by INAA for Core Samples
from Well UE5PW-1 (continued)

Figure 3-2
Depth Profiles of Element and Oxide Composition Data by INAA for Core Samples
from Well UE5PW-1 (continued)

These analyses further indicate that the samples from the pilot wells and the science trench boreholes have the same general composition as the source rock for the alluvium at the Area 5 RWMS, that is primarily Tertiary volcanic rocks (Ammonia Tanks Tuff) from the Massachusetts Mountain area. These results are consistent with visual lithologic descriptions presented in Section 3.1.2. The Tertiary volcanic rocks, and thus the alluvium, have a rhyolitic composition of approximately 65 percent SiO_2 and 13 percent Al_2O_3 ; all other major elements total less than 5 percent.

3.1.4 Secondary Mineralogy and Organic Matter

Depth profiles of inorganic carbon in alluvial drill cuttings samples for all three pilot wells are illustrated in Figure 3-3. Tabular values of inorganic and organic carbon measurements, as well as calculated values of total carbon for core and drill cuttings samples, are presented in Appendix E.2 for samples from the alluvium, and Appendix E.3 for tuff; descriptive statistics for these data are summarized in Tables 3-3 and 3-4, respectively.

The data show that inorganic carbon concentrations are very low (mean values are less than 1 percent by weight) and nearly constant throughout the entire thickness of alluvium penetrated. The only noticeable interval of elevated inorganic carbon is in Well UE5PW-2, from approximately 168 to 171 m (550 to 560 ft). Elevated levels of chloride, bromide, and sulfate were also measured in this thin interval, further indicating that this is a layer of secondary mineral accumulation that could possibly be called a caliche layer. However, there was no visible evidence in the core or drill cuttings samples of secondary mineral accumulation at this or any other depth interval in the pilot wells. Finally, the consistency in depth profiles of inorganic carbon concentrations also suggests that the source rock for the entire thickness of alluvium penetrated contained remarkably similar percentages of carbonates. This in turn suggests that the alluvial deposits originated from the same source rock.

Organic carbon values are generally an order of magnitude lower and equally as constant, demonstrating the absence of humus accumulation. The absence of caliche and humus layers helps support the argument (which is expanded in the following sections of this report) that the hydrogeologic system can be treated as a homogenous alluvial unit.

Figure 3-3
Depth Profiles of Inorganic Carbon for Drill Cuttings Samples from the Pilot Wells

3.2 *Physical Properties*

Several physical properties are relatively easy and inexpensive to measure, and provide valuable insight into understanding the hydrogeologic system beneath the Area 5 RWMS. These physical properties include particle size distribution, bulk density, and porosity. Bulk density and porosity measurements are dependent on the arrangement and degree of packing of unconsolidated alluvial particles, and therefore were made only on intact core samples. Particle size distributions of alluvial samples are independent of arrangement or packing, and were determined on both intact core and drill cuttings samples. However, particle size distribution measurements are not appropriate for consolidated rock samples, and therefore were not conducted on tuff from Well UE5PW-3.

3.2.1 *Particle Size Distribution*

Particle size distribution analyses were conducted on all alluvial drill cuttings samples collected at 0.76-m (2.5-ft) intervals and on two 76.2-mm (3-in.) core segments from each core run (if available), using a dry sieve method. Previous analyses (REECo, 1993b) indicated only small differences between dry sieve and the much more expensive wet sieve methods on these relatively coarse-grained alluvial materials.

Because the sieve process destroys the physical integrity of the core samples, this test always followed a series of non-destructive physical and hydrologic tests on the same core sample. These precursor tests included saturated porosity, saturated hydraulic conductivity, and moisture retention measurements.

The results of particle size distribution analyses are presented in tabular form in Appendix E.2. Data from the Number (No.) 4 and No. 200 sieve screens (percent of material passing) for alluvial drill cuttings and core samples from Wells UE5PW-1, UE5PW-2, and UE5PW-3 are plotted versus depth in Figures 3-4, 3-5, and 3-6, respectively. These figures illustrate the relative percent of materials falling into the gravel, sand, and silt/clay fractions at each depth. They show that the particle size distribution of alluvial materials is remarkably similar with depth. These materials are composed predominantly of sand-size particles with considerable amounts

Figure 3-4
Depth Profiles of Dry Sieve Analyses for Core and Drill Cuttings Samples from
Well UE5PW-1
 (Percent Passing Number 4 and Number 200 Mesh Screens)

Figure 3-5
Depth Profiles of Dry Sieve Analyses for Core and Drill Cuttings Samples from
Well UE5PW-2
 (Percent Passing Number 4 and Number 200 Mesh Screens)

Figure 3-6
Depth Profiles of Dry Sieve Analyses for Core and Drill Cuttings Samples from
Well UE5PW-3
 (Percent Passing Number 4 and Number 200 Mesh Screens)

of gravel, and typically contain less than 10 percent silt/clay. The small differences between profiles for core and drill cuttings may be due to a number of factors related to geology, drilling, or sampling. Apparently the different sample sizes (volumes) for core and drill cuttings is a factor.

Descriptive statistics for No. 4 and No. 200 sieve screen data for both core and drill cuttings from all three pilot wells are summarized in Table 3-3. These statistics were calculated separately for different sample types as well as for the combined pool of samples from each borehole (Table 2-6). Mean values of percent silt/clay material in Well UE5PW-2 appear to be significantly different from those for Wells UE5PW-1 and UE5PW-3. However, mean values of this size fraction are very similar within each borehole. Mean values of the gravel fraction (material held on the No. 4 screen) are very similar between holes for core samples but appear to significantly decrease from Well UE5PW-1 to Well UE5PW-3 for drill cuttings samples. This latter difference may be related to the ease and speed with which each borehole was drilled. The most drilling difficulty was encountered in Well UE5PW-1 and the least was encountered in Well UE5PW-3. This may suggest that air-percussion hammer drilling reduces the amount of gravel-size particle particles under different drilling conditions.

3.2.2 Bulk Density and Porosity

Dry bulk densities were determined on two 76.2-mm (3-in.) long core segments from each core run in alluvium and on 25.4- by 25.4-mm (1- by 1-in.) plug sub-samples from core in moderately welded tuff from Well UE5PW-3. These data are presented in tabular form in Appendix E.2. Plots of alluvial bulk densities versus depth are presented in Figure 3-7. There appear to be no consistent trends in bulk density with depth in the pilot wells. This may be due in part to the similarity of the particle size distribution (Section 3.2.1), consistency in lithology and mineralogy (Sections 3.1.2 and 3.1.3), and the near absence of secondary mineral cementing agents (Section 3.1.4).

Alluvial core porosities were calculated from dry bulk densities and using a particle density of approximately 2.65 grams per cubic centimeter (g/cm^3) (165 pounds per cubic foot [lb/ft^3]). In addition, water-saturated porosities were measured on alluvial core segments from all pilot wells following measurement of saturated hydraulic conductivity on the same core segment (Section 3.3.1). Both calculated and water-saturated porosities of samples from Wells UE5PW-1, UE5PW-2, and UE5PW-3 are plotted versus depth on Figures 3-8, 3-9, and 3-10, respectively. Water-saturated porosities are considerably lower than calculated porosities.

Figure 3-7
Depth Profiles of Dry Bulk Density for Core Samples from the Pilot Wells

Figure 3-8
Depth Profiles of Calculated (calc) and Water Saturated (sat) Porosity for Core
Samples from Well UE5PW-1

Figure 3-9
Depth Profiles of Calculated (calc) and Water Saturated (sat) Porosity for Core
Samples from Well UE5PW-2

Figure 3-10
Depth Profiles of Calculated (calc) and Water Saturated (sat) Porosity for Core Samples from Well UE5PW-3

Discussions with the testing laboratory indicated that the water-saturated porosity values are in error resulting from unavoidable water loss (drainage) that occurs from the coarse-grained samples just prior to the measurement.

Descriptive statistics for dry bulk densities and porosities of alluvium samples are summarized in Table 3-3. Mean values and coefficients of variation of dry bulk densities and calculated porosities (by definition) for each pilot well are nearly identical. Dry bulk densities range from 1.17 to 1.96 g/cm³ (73 to 122 lb/ft³). Bulk densities near both the lower and higher ends of the range may reflect sampling disturbance rather than in-situ conditions.

The mean bulk density and calculated porosity of three partially welded tuff core samples are 1.99 g/cm³ (124 lb/ft³) and 22.40 percent, respectively (Table 3-4). These values fall into the range of values found for the same parameters on other partially welded tuff core samples from the NTS (Fernald et al., 1965).

3.3 Hydrologic Properties

Hydrologic properties are required, together with information about hydrologic conditions, to estimate rates of water movement and potential travel times. Hydrologic property measurements include saturated hydraulic conductivities and moisture retention curves. Unsaturated hydraulic conductivities were calculated from the above-mentioned parameters in this study, as they are very difficult, if not impossible, to measure in the laboratory at the very dry in-situ conditions (Section 3.4.1) found in the vadose zone beneath the Area 5 RWMS.

3.3.1 Saturated Hydraulic Conductivity

Saturated hydraulic conductivity measurements, like measurements of dry bulk density, were conducted on one 76.2-mm (3-in.) long core segment from each alluvial core run in each pilot well, and on 25.4- by 25.4-mm (1- by 1-in.) plug sub-samples from tuff from Well UE5PW-3. Saturated hydraulic conductivity profiles for the three pilot wells are presented in Figure 3-11 and tabular data are listed in Appendix E.2. Descriptive statistics are summarized in Table 3-3 (possible outliers were retained in computation of the descriptive statistics). These data show that hydraulic conductivities range from 1.4×10^{-6} to 5.8×10^{-3} cm/s (centimeters per second) (0.002 to 8.2 inches per hour [in./hr]) for all the pilot wells. Mean values for each well range from 5.7×10^{-4} to 1.1×10^{-3} cm/s (0.81 to 1.6 in./hr). There are no obvious trends as a function of depth, and these values are typical of silty sand alluvial deposits (Freeze and Cherry, 1979.)

Figure 3-11
Depth Profiles of Saturated Hydraulic Conductivity for Core Samples
from the Pilot Wells

Statistical analyses have indicated that hydraulic conductivity might be lognormally distributed. A case could be made for presenting the geometric means and standard deviations, rather than arithmetic means and standard deviations. Means and standard deviations were used to facilitate comparison with other values reported in the literature.

3.3.2 Moisture Retention Relations

Following saturated hydraulic conductivity measurements, core samples were subjected to moisture retention measurements. These measurements (curves) for Wells UE5PW-1, UE5PW-2, and UE5PW-3 are presented in graphical form in Figures 3-12, 3-13, and 3-14, respectively; tabular data are listed in Appendices E.2.7, E.2.8, and E.2.9. Core interval depths for each curve are not identified in these plots. The general shape of these moisture retention curves is, without exception, typical of coarse-grained deposits (Hillel, 1980).

Moisture retention data were fit to the van Genuchten (1978, 1980) parameterization of the water retention curve described by:

$$\theta = \theta_r + (\theta_s - \theta_r) [1 + (-\alpha h)^n]^{-m}$$

where θ is volumetric water content (cm^3/cm^3), θ_s is the saturated volumetric water content, θ_r is the residual volumetric water content, h is matric potential (cm), α (cm^{-1}) and n (dimensionless) are curve fitting parameters, and m is $1-1/n$.

A nonlinear least squares computer code is used to calculate the curve-fitting parameters α and n , and residual saturation, θ_r . These parameters are tabulated in Appendix E.2.10 for all pilot well core samples, and summary descriptive statistics are given in Table 3-6. There is some evidence that α is lognormally distributed, indicating that the geometric mean and standard deviation would be more appropriate data summaries than the arithmetic mean and standard deviation. The latter are presented to facilitate comparison with other values reported in the literature. Observed values of α are consistent with values calculated for a number of coarse-grained materials (van Genuchten, 1978).

Figure 3-12
Composite Moisture Retention Data for Core Samples from Well UE5PW-1

Figure 3-13
Composite Moisture Retention Data for Core Samples from Well UE5PW-2

Figure 3-14
Composite Moisture Retention Data for Core Samples from Well UE5PW-3

3.3.3 Unsaturated Hydraulic Conductivity

Unsaturated hydraulic conductivity, $K(S)$, of core samples is generally calculated from moisture retention data and saturated hydraulic conductivity, rather than being experimentally measured. This is primarily because experimental measurements, especially at low water content, are extremely difficult, if not impossible to obtain. The equation used to calculate $K(S)$ in this program (van Genuchten, 1978, 1980) is derived by substituting the van Genuchten moisture retention curve-fitting parameters into the Mualem (1976) model of unsaturated hydraulic conductivity to obtain the following:

$$K(S) = K_s S^{1/2} [1 - (1 - S^{1/m})^m]^2 \quad (1)$$

where K_s is the saturated hydraulic conductivity, m is as in the van Genuchten water retention curve, and S is effective saturation as defined by:

$$S = (\theta - \theta_r) (\theta_s - \theta_r)^{-1} \quad (2)$$

The resulting $K(S)$ data, which have been converted to $K(\theta)$ through Equation 2, are illustrated for Wells UE5PW-1, UE5PW-2, and UE5PW-3 in Figures 3-15, 3-16, and 3-17, respectively.

The resulting $K(S)$ data, which have been converted to $K(\theta)$ through Equation 2, are illustrated for Wells UE5PW-1, UE5PW-2, and UE5PW-3 in Figures 3-15, 3-16, and 3-17, respectively.

These plots illustrate that unsaturated hydraulic conductivity decreases rapidly with decreasing water content. At these low in-situ formation water contents (Section 3.4.1) the unsaturated hydraulic conductivities are many orders of magnitude less than saturated hydraulic conductivities.

Table 3-6
Summary of Descriptive Statistics of Moisture Retention Curves
for Core Samples from the Pilot Wells

Borehole	Statistic	θ_r (cm ³ /cm ³)	θ_s (cm ³ /cm ³)	α cm ⁻¹	n
UE5PW-1 (s = 24)	Minimum	0.0	0.275	0.010	1.16
	Maximum	0.108	0.392	0.037	1.82
	Mean	0.061	0.335	0.090	1.49
	Standard Deviation	0.030	0.034	0.100	0.22
	CV (percent)	49.8	10.1	114.5	14.6
UE5PW-2 (s = 16)	Minimum	0.00	0.279	0.010	1.16
	Maximum	0.105	0.398	0.060	1.97
	Mean	0.052	0.327	0.020	1.39
	Standard Deviation	0.031	0.034	0.010	0.20
	CV (percent)	59.8	10.4	52.0	14.6
UE5PW-3 (s = 9)	Minimum	0.017	0.269	0.010	1.14
	Maximum	0.086	0.359	2.31	1.48
	Mean	0.045	0.303	0.028	1.38
	Standard Deviation	0.022	0.027	0.76	0.11
	CV (percent)	48.7	9.0	276.9	7.8

NOTES

θ = volumetric water content
 θ_s = saturated water content
 θ_r = residual volumetric water content

n = curve fitting parameter
s = the number of samples
CV = coefficient of variation

Figure 3-15
Fitted Unsaturated Hydraulic Conductivity Functions for Core Samples
from Well UE5PW-1

Figure 3-16
Fitted Unsaturated Hydraulic Conductivity Functions for Core Samples
from Well UE5PW-2

Figure 3-17
Fitted Unsaturated Hydraulic Conductivity Functions for Core Samples
from Well UE5PW-3

3.4 Hydrologic Conditions

Hydrologic conditions are parameters that vary over time. These include water content and water potential, where the latter is dependent on the former. The gradient of water potential values (i.e, the difference in value between two points divided by the distance separating these points) is one of the primary forces that drive the movement of liquid water.

3.4.1 Water Content

Water content on a weight basis (gravimetric water content) was determined for both drill cuttings and core samples. Water content on a volume basis (volumetric water content) was determined only for core samples. These data are summarized in tabular form in Appendix E.2, and descriptive statistics are presented in Tables 3-3 and 3-4 for alluvium and tuff, respectively. Gravimetric water content for both core and drill cuttings samples from the alluvium are plotted versus depth for Wells UE5PW-1, UE5PW-2, and UE5PW-3 in Figures 3-18, 3-19, and 3-20, respectively.

Figure 3-18
Depth Profiles of Gravimetric Water Content for Core and Drill Cuttings Samples
From Well UE5PW-1

Figure 3-20
Depth Profiles of Gravimetric Water Content for Core and Drill Cuttings Samples
From Well UE5PW-3

The mean gravimetric water content of alluvial drill cuttings samples was generally several percent lower than the gravimetric water content of core samples. This is because the drill cuttings samples were subjected to drying by the air drilling fluid as they were lifted out of the borehole. The limited data available for comparing tuff core and drill cuttings samples suggest that this drying occurs even more when drilling the tuff formation. Less drying occurred with the coarse cuttings fragments than with the mixture of fine and coarse fragments that came directly out of the collection separator. The smaller surface area-to-volume ratio of coarse fragments is expected to be responsible for these effects. Moreover, based on only three core samples from one core run, the water content of the tuff is higher than that of the overlying alluvial core samples. However, these differences in water content are consistent with neutron geophysical logs described in Section 4.3.2.

A comparison of the alluvial volumetric water content profiles from all three pilot wells (Figure 3-21) illustrates that water content values are remarkably low and constant throughout the entire zone of the unsaturated alluvium. The only noticeable trend is a possible slight increase in water content from the ground surface to a depth of approximately 40 m (130 ft). The constancy in water content suggests that little, if any, water is presently draining from the system. Both the unsaturated hydraulic conductivity data discussed previously (Section 3.3.3) and the water potential data discussed in the next section support this picture of the system.

3.4.2 *Water Potential*

Depth profiles of water potential data from geologic samples are summarized in tabular form in Appendix E.2, and descriptive statistics are given in Tables 3-3 and 3-4. Water potential measurements were made on nearly every alluvial core sample, on two tuff core samples from Well UE5PW-3, and on coarse drill cuttings fragments of tuff to supplement data from tuff core samples. Coarse drill cuttings were separated from composite drill cuttings obtained from the cyclone separator by sieving on a No. 4 mesh screen. It was thought that the smaller surface area-to-volume ratio of these coarse drill cuttings, compared to a composite sample of drill cuttings, would make them less susceptible to disturbance (e.g., drying) by the air drilling fluid.

It was expected that in-situ water potentials would be nearly equal in the alluvial and underlying tuff formations penetrated in Well UE5PW-3, assuming quasi-steady-state conditions exist, as suggested in Section 3.4.1. This is true for alluvium and tuff core samples, however, the water potentials of coarse tuff fragments (sieved drill cuttings) were generally more than an order of magnitude less than alluvium core values. This suggests that measured water potentials for drill

Figure 3-21
Depth Profiles of Volumetric Water Content for Core Samples
from the Pilot Wells

cuttings samples from the tuff were not representative of in-situ conditions. Because of the highly non-linear relationship between water potential and water content (Figures 3-12, 3-13, and 3-14), a small decrease in water content of coarse tuff drill cuttings resulting from the drying effects of the air drilling fluids could easily be responsible for the large order-of-magnitude decreases in water potential.

Water potential depth profile data (Figure 3-22; distance is positive downward), show a positive gradient (upward flow) to at least a depth of 30.5 m (100 ft) in each borehole. These data, coupled with unsaturated hydraulic conductivity data, indicate that liquid water is probably moving upward very slowly in this region. The water potential gradient is the principal driving force moving liquid water, because other potential gradients affecting water movement are small compared to the water potential gradient. For example, the water potential gradient near the ground surface is very large, the osmotic component of this potential has a value near zero (based on dissolved salt data), and the gravitational potential gradient is equal to unity (1.0) by definition. The hydraulic potential gradient, which is the total driving force, can be defined as the gravitational potential gradient plus the water potential gradient minus the osmotic potential gradient.

Environmental tracer data from the pilot wells suggest that the upward movement of liquid water, indicated by water potential measurements, results from evaporation, at least in the upper 30.5 m (100 ft). These data are presented in Section 3.5.

At greater depths the water potential gradient appears to be nearly zero. This is illustrated in Figure 3-22 and is supported by descriptive statistics for alluvium below 45.7 m (150 ft). Based on these data and on unsaturated hydraulic conductivity data, it is possible to make an order-of-magnitude calculation of the rate of liquid water movement. The nearly zero water potential gradient at depth implies that the unit gravitational gradient is the main driver of liquid water movement and is equal to the hydraulic gradient. It follows then (from Darcy's law and assuming one-dimensional flow) that the flux of water is equal to the unsaturated hydraulic conductivity at the water content of interest. On Figure 3-15, for example, at the mean water content of 11.2 percent in Well UE5PW-1, the unsaturated hydraulic conductivity (also water flux) is in all cases less than 1×10^{-7} cm/s (1×10^{-4} in./hr). For the median unsaturated hydraulic conductivity curve it is approximately 1×10^{-9} cm/s (1×10^{-6} in./hr). Assuming a water-filled porosity of 10 percent, this average flux value is equivalent to a travel velocity of approximately

Figure 3-22
Depth Profiles of Water Potential for Core Samples from the Pilot Wells

3×10^{-3} meters per year (1×10^{-2} feet per year). In other words, on the average it would take 1,000 years for water to travel 3 m (10 ft).

These calculations suggest that liquid water flow is not very important beneath the Area 5 RWMS, and that hazardous constituents (e.g., most metals) that move primarily with water will be essentially immobile if the disposal unit design does not significantly disturb the natural hydrologic setting. At the same time, the very low water content and liquid flux beneath the Area 5 RWMS imply that gas flow and transport are very important.

3.5 Environmental Tracers

Environmental tracers provide another method, independent of the hydraulic parameters mentioned above, for estimating water movement in the vadose zone, travel times, and recharge. The basic premise of this method is that infiltrating water (from precipitation and runoff) contains dissolved natural and man-made tracers that travel with the water as it moves into and through the vadose zone. Further, it is assumed that formation materials do not contribute to the concentrations of these tracers. The concentrations of these tracers were measured with depth in materials from the three pilot wells, and analysis of the profiles plotted from these data yields information concerning the history of water movement through the unsaturated zone. In the following sections only general observations are made concerning the tracer profile data.

3.5.1 Chloride/Bromide Profiles

Chloride and bromide ions can serve as tracers because their negative charge discourages sorption with negatively charged mineral surfaces at solution pH values commonly found in soils and alluvium. The chloride mass balance method for estimating recharge (Allison and Hughes, 1983) is based on the assumption that concentrations of chloride are relatively constant with precipitation, and as water evaporates from the soil, leaving this ion behind, the concentration of chloride increases in the soil water. A mass balance approach using bromide has not been used, primarily because of the low concentrations of bromide in precipitation and the related absence of bromide concentration data.

Chloride and bromide concentrations were measured on all drill cuttings and core samples. Tabular data are summarized in Appendix E.2. Descriptive statistics were calculated for chloride and bromide concentration data below the depths of 76.2, 30.5, and 121.9 m (250, 100, and 400 ft) in Wells UE5PW-1, UE5PW-2, and UE5PW-3, respectively (Table 3-3). Below these depths the concentrations of chloride and bromide are very low and approximately constant.

Depth profiles of chloride concentrations (per unit dry weight of soil) for drill cuttings samples from all three boreholes are illustrated in Figure 3-23, and similar profiles from core samples are presented in Figure 3-24. These concentration data will be converted to a per-unit-volume basis when quantitative analysis of the data is conducted. Depth profiles of bromide concentrations for core and drill cuttings samples (Figures 3-25 and 3-26, respectively) are virtually identical in shape to the chloride profiles.

Depth profiles of chloride/bromide ratios in both drill cuttings and core samples for each well are presented in Figures 3-27, 3-28, and 3-29. The high variability in these ratios is most likely due to errors in bromide concentration measurements, which increase greatly near the detection level of the instrument/method.

The relatively high concentrations of chloride in the shallow subsurface suggest that evaporation rates are high compared to the downward movement of water under the present climate. The very low concentrations of chloride at depth suggest that this water entered the system under a much wetter climate, where recharge rates compared to evaporation rates were much higher than present rates (Conrad, 1993). These data support the general conclusions made previously from hydraulic data (Section 3.4.2): that is, the net downward movement of water under the present climate is very low, and in fact there may be a net upward movement of water.

The large differences in the shapes of the chloride (and bromide) profiles in the upper portions of each pilot well may be due to a number of factors. Differences in the amount of surface water runoff at each well site (which is in turn related to proximity to upland mountains and to the size of the drainage basin) will definitely affect the amount of infiltration, and ultimately, the accumulation of chloride and bromide. Variations in plant communities and their rooting habits affect relative amounts of evapotranspiration and infiltration, and therefore chloride and bromide concentrations. Finally, the relative rates of aggradation and erosion may play an important role in affecting the concentration profiles.

Figure 3-23
Depth Profiles of Dry Soil Chloride Concentrations for
Drill Cuttings Samples from the Pilot Wells

Figure 3-24
Depth Profiles of Dry Soil Chloride Concentrations for Core Samples
from the Pilot Wells

Figure 3-25
Depth Profiles of Dry Soil Bromide Concentrations for Drill Cuttings Samples from the Pilot Wells

Figure 3-26
Depth Profiles of Dry Soil Bromide Concentrations for Core Samples from the
Pilot Wells

Figure 3-27
Depth Profiles of Dry Soil Chloride/Bromide Ratios for Core and Drill Cuttings
Samples from Pilot Well UE5PW-1

Figure 3-28
Depth Profiles of Dry Soil Chloride/Bromide Ratios for Core and Drill Cuttings
Samples from Pilot Well UE5PW-2

Figure 3-29
Depth Profiles of Dry Soil Chloride/Bromide Ratios for Core and Drill Cuttings
Samples from Pilot Well UE5PW-3

3.5.2 Stable Isotope Profiles

The stable isotopes of hydrogen (hydrogen and deuterium) and oxygen (^{16}O and ^{18}O) are excellent tracers of water movement because they are components of the water molecule itself. Stable isotopes are used in studies of the unsaturated zone to infer the source of soil water and determine if evaporation has occurred. Results are reported as a ratio of light to heavy isotopes (hydrogen/deuterium and $^{16}\text{O}/^{18}\text{O}$) in delta notation (δ) relative to Standard Mean Ocean Water. Fractionation (a change in the ratio) occurs during phase change processes. Therefore, condensation and evaporation processes are both reflected in the isotopic ratios. The condensation of precipitation from the atmosphere occurs under very nearly thermodynamic equilibrium conditions, resulting in a linear relationship between hydrogen and oxygen isotopes in worldwide precipitation, known as the meteoric water line (MWL). Evaporation of water generally occurs under non-equilibrium conditions and fractionation of oxygen isotopes is greater than that of hydrogen isotopes. The water remaining behind in the evaporation process thus develops an isotopic composition that plots to the right of the MWL.

Stable isotope data from selected core samples from all the pilot wells are presented in Appendix E.2. Depth profiles for these wells are presented in Figure 3-30. In general, these profiles show more enrichment of heavy isotopes in the upper vadose zone, suggesting that shallow water has been subjected to more evaporation. A plot of oxygen isotopic ratios from selected core samples, with the MWL for reference, is shown in Figure 3-31. The shallow samples plot to the right of the MWL on a line with a slope between 3.5 and 4. This slope is consistent with the range found by Allison (1982) in experiments of water evaporating from sand columns, and strongly supports the hypothesis (Section 3.4.2) that evaporation rates are high relative to the downward rate of water movement in the upper vadose zone under the present climate (Chapman, 1993).

3.5.3 Cosmogenic Chlorine-36 Data

The radioisotope chlorine-36 (^{36}Cl) is continually produced in the upper atmosphere. This isotope, together with the stable isotope, Cl (Section 3.5.1) is dissolved in ionic form in precipitation and enters the ground via infiltration. During periods of geomagnetic field fluctuations, increased production of ^{36}Cl is thought to occur (Blinov, 1988). Further, these field fluctuations and associated changes in ^{36}Cl production rates can possibly be dated. The relative magnitude of the ratios of these isotopes in the profiles provides information about the age of the soil water.

Figure 3-30
Depth Profiles of Stable Isotope Data for Core Samples from the Pilot Wells

Figure 3-31
Comparison of Measured Stable Isotopes for Core and Water Samples from the Pilot Wells with Stable Isotope Data for the Global Meteoric Water Line (MWL)

The depth profile of $^{36}\text{Cl}/\text{Cl}$ ratios from selected core samples from Well UE5PW-1 is plotted in Figure 3-32. These data are presented in tabular form in Appendix E.2. Present-day precipitation yields $^{36}\text{Cl}/\text{Cl}$ ratios in the range of 450 to 550 $\times 10^{-15}$. The ratios found at depths up to 30.5 m (100 ft) are elevated above present-day conditions, suggesting that they were produced during the most recent period of geomagnetic field fluctuation (Conrad, 1993). Since this last period of fluctuations is thought to have occurred approximately 15,000 years ago, it has taken at least this amount of time for water to reach a depth of 30.5 m (100 ft). These elevated ratios have also been found in pack rat middens that have tentatively been dated to be approximately 21,000 years old by carbon-14 dating methods (Phillips et al., 1988). These data are consistent with both the hydraulic parameter data and the previously discussed environmental tracer data, which indicate that the downward rate of liquid water movement is extremely slow, if not zero.

3.5.4 Soluble Sulfate

Sulfate is not generally considered an environmental tracer because it is far less mobile than chloride and bromide for a number of reasons, including the lower solubility of sulfate salts. Moreover, there are many potentially important sources of sulfate, in addition to rainfall and runoff, which complicate the interpretation of depth concentration profile data. These sources include a number of common secondary minerals (e.g., gypsum) that occur in soils, alluvium and source rock. Even with these complicating factors, sulfate depth profile data provide useful additional information concerning the relative importance of evaporation and infiltration processes under the present arid climate, as well as under a previous, more humid climate. These data are discussed in the following paragraphs.

Measurements of soluble sulfate were made on all core and drill cuttings samples from Wells UE5PW-2 and UE5PW-3. Only a few samples from Well UE5PW-1 were analyzed for soluble sulfate because the decision to add this measurement to the suite of wet chemical analyses (which included inorganic and organic carbon, chloride, and bromide) was made near the completion of testing on Well UE5PW-1. Depth profiles of sulfate data from drill cuttings samples are presented for all three pilot wells in Figure 3-33, tabular data for both core and drill cuttings samples are presented in Appendix E.2, and descriptive statistics for the data in the lower vadose zone are presented in Table 3-3.

Figure 3-32
Depth Profile of $^{36}\text{Cl}/\text{Cl}$ Ratios for Core Samples from Well UE5PW-1

Figure 3-33
Depth Profiles of Soluble Sulfate for Drill Cuttings Samples from the Pilot Wells

The data from drill cuttings samples for both Wells UE5PW-2 and UE5PW-3 show relatively high and variable concentrations of sulfate in the upper portion of the profile and much lower and less variable concentrations in the lower portion of the profile. These profiles are somewhat similar in shape to the chloride and bromide profiles (Section 3.5.1), however, the depth at which these concentrations decrease to lower values is much shallower for sulfate. These differences are probably due to the lower mobility of the sulfate anion, resulting (at least in part) from the generally lower solubility of sulfate salts compared to chloride and bromide salts.

In summary, these sulfate concentration profiles support the picture of water movement in the vadose zone suggested by the analyses of the other environmental tracers. In particular, these profiles imply that under the present arid climate, the liquid water that moves into the upper vadose zone, moves out of the vadose zone primarily by vapor flow in response to a high evaporative demand, and that the water that is presently in the lower vadose zone infiltrated under a more humid climate under which evaporation was not an important process.

3.6 *Sampling and Analysis of Core Samples for Hazardous and Radiological Parameters*

Alluvium samples were periodically collected during drilling and analyzed for selected hazardous and radiological parameters. The purpose of these analyses was to determine if core samples and the borehole were being contaminated by drilling and/or if the borehole had penetrated any contaminated regions.

Intact core samples were collected for analysis of volatile and semi-volatile organic compounds. Drill cuttings samples were collected for analysis of Total Kjeldahl Nitrogen (TKN), total metals, (As, Ba, Cd, Cr, Pb, Se, Ag, and Hg), and photon-emitting radionuclides. Sample collection and field quality assurance procedures are described in a test procedure for sampling and analysis (Table 2-1). In addition, these procedures contain additional information concerning sampling and analytical methods. The results of these analyses are tabulated in Appendix E.4.

The analytical results indicate that the concentrations of these constituents measured in core and drill cuttings samples are consistent with expected background levels. That is, elevated levels were not encountered while penetrating the thick vadose zone sediments and the upper portion of the alluvial aquifer.

Low levels of several volatile organic compounds, known to be common laboratory contaminants, were sporadically detected in alluvium samples. The presence of these

compounds is likely attributable to laboratory contamination. Semi-volatile organic compounds were not detected. Total metals analyses and TKN analyses were characteristic of uncontaminated soils. The only radionuclides detected were naturally occurring primordial radionuclides.

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4.0 Field Testing Methods and Results

4.1 Preliminary Surface Surveys of Potential Contaminants at Drill Sites

Frenchman Flat and the Area 5 RWMS have been the site of numerous activities that could potentially have contaminated surface soils with hazardous constituents and radionuclides. From 1951 to 1961 Frenchman Flat, and Yucca Flat to the north, were the site of numerous atmospheric nuclear weapons tests. After 1961, seven underground nuclear tests were conducted 4.4 km (2.4 mi) to the north and three were conducted at locations to the south of the Area 5 RWMS. Several safety tests were also conducted in the vicinity of the Area 5 RWMS. Safety tests involve chemical detonation of nuclear weapons components and could result in the dispersion of actinide contamination. Also, Area 5 is the site of a facility used for controlled chemical spill tests. Finally, all three pilot well sites had been disturbed to some extent by vehicle traffic.

Prior to initiating drilling operations, surface soil and near-surface gas samples were collected from the pilot well sites and analyzed to insure that the ground surfaces at these sites were free of elevated levels of contaminants that could be spread downward during drilling. The results of these sampling and analysis activities are described in the following paragraphs.

4.1.1 Surface Soil Sampling, Analysis, and Results

Surface soil samples were collected at each drill site prior to preparation and after grading and compaction. The purpose of these surveys was to determine if contamination existed at any of the drill sites at concentrations that could potentially result in contamination of the borehole through drilling activities. Samples from unprepared sites were analyzed for oil and grease, Total Petroleum Hydrocarbons (TPH), and photon-emitting radionuclides. Samples from prepared drill sites were analyzed for all the above parameters plus plutonium isotopes.

Samples were collected from 200- by 200-mm (7.9-in.) by 20-mm (0.8-in.) deep cells selected randomly from a 30- by 30-m (98-ft) grid centered at each borehole. Four random samples were collected from each of the unprepared and prepared sites, the only exception being the unprepared site at Well UE5PW-1. The Well UE5PW-1 site was disturbed by vehicle traffic prior to sampling for TPH and oil and grease. Due to the extent of the disturbance it was impossible to collect samples from this site using a randomized design. Therefore, 3 TPH and oil and grease samples were collected 15.2 m (50 ft) east, west, and north of the borehole. Finally, an additional grab sample was collected from a dark stained area southeast of the borehole location at the unprepared site for Well UE5PW-2.

Details of sample collection and analytical methods, together with the tabular testing results, are given in Appendix F.1.1. No analyte was detected at concentrations that would have presented potential contamination problems during drilling operations.

4.1.2 Near-Surface Radon and Tritium Gas Sampling, Analysis, and Results

Soil gas surveys for tritium oxide and radon-222 (^{222}Rn) were conducted in the near-surface soils at each of the pilot well locations prior to drilling operations. Samples for tritium analysis were obtained as water vapor (tritium oxide) and analyzed to insure that the pilot well sites were free of elevated levels of tritium near the ground surface that could be harmful to human health, and/or could be carried downward by the drilling operations and contaminate the groundwater. Samples were collected and analyzed for ^{222}Rn to establish background concentrations, which are dependent on site-specific lithologies. In addition, ^{222}Rn samples were collected over time as part of a preliminary study of the effects of barometric pumping on the movement of gases in the near surface.

Soil gas samples for analysis for both tritium oxide and ^{222}Rn were collected from the same stainless-steel sampling lines driven to depths of approximately 0.9, 2.7, and 6.4 m (3, 9, and 21 ft) at each of the locations using a hydraulically driven probe. At the Well UE5PW-3 location the hydraulic probe used to install sample lines met refusal at 5.2 m (17 ft) rather than the target depth of 6.4 m (21 ft) for the deepest sampling point. After the hydraulic probe was driven to the depth of interest, a sample line with a filter tip was run to the bottom of the probe hole, sand was then emplaced around the tip, and finally, the annulus between the sample line and the borehole wall was stemmed with bentonite to the ground surface to prevent preferential annular flow.

4.1.2.1 Radon Soil Gas Surveys

Details of ^{222}Rn sample collection and counting measurement methods, together with radon concentration data, are summarized in Appendix F.1.2. Soil gas concentrations of ^{222}Rn sampled at each pilot well location show increasing concentration and decreasing temporal variability with depth. The wider range of variability in the near-surface samples can probably be attributed to barometric pumping, while the trend of decreasing concentrations towards the surface is likely due to a combination of barometric pumping and the diffusion process across the zero-concentration soil/atmosphere boundary.

At the Well UE5PW-3 site, located near Massachusetts Mountain, the ^{222}Rn concentrations were approximately three times those found at the Well UE5PW-1 and UE5PW-2 sites. The higher concentration of ^{222}Rn in the soils at the Well UE5PW-3 site is probably due to a change in lithology (e.g., tuff units closer to the ground surface) with a higher uranium content.

4.1.2.2 Tritium Soil Gas Surveys

Descriptions of tritium oxide sample collection and analysis methods, as well as analytical results for all three pilot well sites, are given in Appendix F.1.2. With the exception of the 0.9-m (3-ft) depth at Well UE5PW-1, all sample activities were below detection limits. Detection limits ranged between 592 and 1,776 Becquerels per cubic meter (Bq/m^3 [0.127 picoCuries per milliliter (pCi/ml)]), depending on sample size and counting time.

Samples from the Well UE5PW-1 site were collected on October 24, 1991, and counted for 100 minutes. This count of the sample from the 0.9-m (3-ft) depth gave a sample activity of $1,850 \text{ Bq/m}^3$ (0.500 pCi/ml), with a sample error of 825 Bq/m^3 (0.223 pCi/ml) and a minimum detectable amount of $1,306 \text{ Bq/m}^3$ (0.353 pCi/ml). The other samples were below the minimum detectable amount. The samples were then recounted using a 300-minute count time, resulting in a sample activity of $1,550 \text{ Bq/m}^3$ (0.419 pCi/ml) and a sample error of 470 Bq/m^3 (0.127 pCi/ml) for the sample from the 0.9-m (3-ft) depth. The other samples were again found to be below the minimum detectable amount of 725 Bq/m^3 (0.196 pCi/ml) using a single background count.

In order to firmly establish whether these results were due to laboratory contamination or actual sample activity, a second sample was obtained from the Well UE5PW-1 site on October 30, 1991. The results confirmed the original sampling, indicating very low environmental levels of tritium oxide at the 0.9-m (3-ft) depth, and less than detection limits at the 2.7- and 6.4-m (9- and 21-ft) depths.

It should be emphasized that tritium oxide levels were in all cases below or very near to both detection levels and environmental background levels (even the 0.9-m [3-ft] depth sample in Well UE5PW-1). Based on these results, all sites were considered to be essentially free of elevated tritium oxide levels and were considered acceptable sites for drilling.

4.2 Surface Geophysical Surveys

A set of Schlumberger resistivity soundings, as well as total field and gradiometer magnetic field data were obtained at each of the pilot well locations. These data were collected prior to drilling activities in order to establish background control data before the sites were disturbed by the cultural effects of drilling operations. The primary purpose of these surveys was to attempt to obtain preliminary information about any subsurface lithologic/hydrologic feature that could be used to help design and focus future sampling and analysis activities. These surveys would also provide the opportunity to determine if in fact these geophysical tools could be used to help define lithologic/hydrologic features (as determined from analysis of core and drill cuttings samples) in thick unsaturated alluvium. If a positive correlation were found between

geophysical tool response and lithology, these geophysical methods would be useful in delineating the lithology at other sites (where borehole data do not exist) with thick unsaturated alluvium. The resistivity and magnetic surveys were conducted under the applicable procedures and plans listed in Table 2-1.

4.2.1 Resistivity Surveys

The resistivity soundings were performed with a Schlumberger array and were taken using an ABEM SAS 300C Terrameter with an SAS 2000 booster capable of operating up to 500 milliamperes transmitted current. The soundings were centered over each borehole location and oriented in a manner that would minimize cultural effects from pipelines, power lines, fences, and other structures. Current electrode separations (AB/2) were positioned logarithmically, ranging from 0.6 to 853.4 m (2 to 2,800 ft). The receiver dipole (mn/2) length ranged from 0.3 to 45.7 m (1 to 150 ft) as required by signal strength. The resistivity sounding data and log plots of these data locations are found in Appendix F.2.1.

Apparent resistivity, ρ , in ohm-meters, was calculated by:

$$\rho = V/I [(AB/2)^2 - (mn/2)^2] \pi/mn$$

where V is the received voltage, I is the transmitted current, AB is the current electrode separation in meters, and mn is the receiver separation in meters.

The resistivity soundings (Figure 4-1) at Wells UE5PW-1 and UE5PW-2 are similar, showing high resistivity in the near-surface, and decreasing with depth. The water table is evident on each sounding, as the low resistivity bottom layer visible to the right of the 304.8-m (1,000-ft) AB/2 separation. Overall resistivities are slightly higher at Well UE5PW-2 than at Well UE5PW-1, with the exception of the very near-surface reading.

Figure 4-1
Resistivity Soundings at the Area 5 Pilot Well Locations

Orthogonal Schlumberger arrays were used at Well UE5PW-2 to determine anisotropic and three-dimensional effects. Both soundings are remarkably similar, indicating that alluvium is both isotropic and lacking any three-dimensional effects in this area. Low resistivity was observed on both of these crossed arrays at an AB/2 of 170.7 and 405.4 m (560 and 1,330 ft). It is thought that these features are artifacts caused by interference arising from man-made structures.

The sounding data obtained at Well UE5PW-3 are clearly different from those seen at the other pilot well locations. It should be noted that the receiver-dipole porous-pot contact on this resistivity line became as high as 20,000 ohms, and the data may be somewhat noisy due to this. The layering seen on this line is a low-moderate-low-high-low sequence, whereas the other pilot wells show a high-low-low layering. Finally, the deep high resistivity response at Well UE5PW-3 is probably due to the presence of the volcanic tuff that was encountered during drilling at 188.2 m (617.5 ft) below the ground surface, and the low resistivity bottom layer is probably the water table, which was measured at approximately 271 m (888 ft).

4.2.2 Magnetometer Surveys

The magnetometer surveys were centered at the well locations, with 304.8-m (1,000-ft) profiles oriented north-south and east-west, and a station spacing of 15.2 m (50 ft). Total field magnetic data, as well as the vertical gradient, were obtained using a GEM Systems GSM-19 Overhauser magnetometer/gradiometer. Three-station in-phase and out-of-phase VLF data were also obtained while conducting the survey, but due to the lack of any significant response, the data are not reported here. A GEM systems recording base station was used to correct for diurnal variations and to monitor for magnetic storms during conduct of the survey. The base station and survey magnetometer clocks were synchronized, which allowed discrete time corrections to be made for the reduction of the diurnal data. Magnetic survey data are found in Appendix F.2.2

The total field and gradient data collected at each pilot well location are uniform and well behaved, which would be expected in homogeneous sedimentary alluvial basin fill. The total field intensities at Wells UE5PW-1, UE5PW-2, and UE5PW-3 are 50,975, 50,967, and 50,969 nanoteslas, respectively. Vertical gradients typically ranged between -2 and -6 nanoteslas per meter. It is thought that these local disturbances of the gradient and total field are artifacts caused by interference arising from the same man-made cultural effects mentioned above in relation to the resistivity surveys. Additional surveys in Frenchman Flat of the lithologic inhomogeneity are required to determine if magnetic surveys are useful tools to help delineate lithologies in alluvial basins with thick unsaturated zones.

4.3 Borehole Geophysical Logging Surveys

Borehole geophysical logging was conducted in each pilot well during different stages of drilling to attempt to obtain additional stratigraphic, mineralogic, hydrologic, and borehole condition information. This logging was conducted by Century Geophysical Corporation, Chino Valley, Arizona, under the direction of REEC Co SPS personnel, according to the applicable QA procedures listed in Table 2-1.

4.3.1 Description of Borehole Logging Activities

Borehole logs were conducted in each pilot well upon completion of three different stages of drilling and stemming activities. Each logging episode was conducted, at least in part, inside cased portions of each well. The only uncased borehole segment logged was the lower part of the tuff interval in Well UE5PW-3. Table 4-1 summarizes logging episodes for each well, including casing diameters and depths, type of log conducted, and logging tool model number.

The first logging episode was conducted after driving the 273.0-mm (10.75-in.) O.D. casing to about half the total planned depth of each well. In Well UE5PW-2, a second 219.1-mm (8.625-in.) O.D. casing was advanced inside the 273.0-mm (10.75-in.) O.D. casing from 121.9 to 167.9 m (400 to 551 ft) before the first episode of logging could be conducted. Therefore logs in this borehole from the ground surface to 121.9 m (0 to 400 ft) were conducted inside telescoped 273.0- and 219.1-mm (10.75- and 8.625-in.) casings, and logs were run from 121.9 to 167.9 m (400 to 551 ft) inside the 219.1-mm (8.625-in.) casing only.

The second logging episode was conducted after drilling the remaining lower portion of each borehole with 219-mm (8.625-in.) casing. This casing was run inside (telescoped) the 273.0-mm (10.75-in.) casing, so the second-episode logs in the approximate upper half of each borehole were run inside two casings.

The final logging episode was conducted after the 273.0- and 219.1-mm (10.75- and 8.625-in.) casings were removed, and the wells were completed with stainless-steel monitoring well tubing of approximately 73.0-mm (2.875-in.) O.D. Vadose zone instruments were stemmed at different depths on the outside of this tubing.

The first two logging episodes included neutron, density, natural gamma, spectral gamma (potassium, uranium, and thorium [KUT]), and caliper logs. The caliper log data were obtained as part of the natural gamma and density tool output, and are of use only in the uncased portion of the tuff in Well UE5PW-3.

Table 4-1
Borehole Geophysical Logging Episodes in the Area 5 Pilot Wells

Borehole	Episode Number	Date	Casing Outside Diameter mm (in.)	Casing Depth m (ft)	Log Type and Tool Model Number					
					Gamma Ray (Natural Gamma)	Gamma Density	Caliper	Spectral Gamma (KUT)	Neutron	Deviation
UE5PW-1	1	04/20/1992	273.0 (10.750)	112.0 (367.5)	9030	9030	9030	9080	9055	--
	2	06/16/1992	273.0 (10.750) 219.1 (8.625)	112.0 (367.5) 255.1 (837.0)	9035	9035	9035	9080	9071	--
	3	02/24/1993	73.0 (2.875)	250.5 (822.0)	--	--	--	--	--	9095
UE5PW-2	1	07/20/1992	273.0 (10.750) 219.1 (8.625)	121.9 (400.0) 167.9 (551.0)	9035*	9035	9035	9080	9055	--
	2	09/29/1992	273.0 (10.750) 219.1 (8.625)	167.9 (551.0) 259.1 (850.0)	9035	9035	9035	9080	9071	--
	3	02/25/1993	73.0 (2.875)	271.3 (890.0)	--	--	--	--	--	9095
UE5PW-3	1	09/28/1992	273.0 (10.750)	137.2 (450.0)	9035	9035	9035	9010	9071	--
	2	11/12/1992	273.0 (10.750) 219.1 (8.625)	137.2 (450.0) 213.4 (700.0)	9035	9035	9035	9080	9071	--
	3	02/25/12993	73.0 (2.875)	289.6 (950.0)	--	--	--	--	--	9095

NOTES

mm = millimeters

in. = inches

m = meters

ft = feet

KUT = potassium, uranium, thorium

-- = Logs not run during this logging episode

* Problems were encountered with the density tool response during this episode.

The final logging episode included borehole deviation logging (inclinometer-gyro tool) only. More detailed equipment information, as well as graphs of the results from each borehole logging episode, are presented for each pilot well in Appendix F.3.

4.3.2 Summary of Nuclear Logging Results

Borehole geophysical log results in alluvium (Appendix F.3) are not discussed in detail in this report because they provided little if any useful stratigraphic, mineralogic, and hydrologic information, other than to confirm the homogeneity of the geophysical response. This homogeneous response was not surprising, considering that the laboratory tests conducted on core and drill cuttings samples indicated that the alluvial deposits penetrated by the pilot wells were relatively homogeneous with respect to mineralogical, material, and hydrologic properties (Section 3.0). In addition, the fact that the logs in alluvium were conducted inside at least one steel casing further limited their potential usefulness. Steel casing dampens the response of most logs and greatly limits the usefulness of logging calibration curves, which are usually generated in uncased boreholes. It should be noted that unstable borehole wall conditions in the alluvium required that all logs be conducted inside the casing.

Several logs provided borehole condition information that was helpful in designing plans for instrumenting and stemming the vadose zone portion of each pilot well (Section 2.5). Both neutron and density logs identified regions in each borehole that were “washed out” (regions where borehole diameters were much larger than bit diameter). Density logs (including both short and long source/detector spacing) decreased significantly in these washed out regions, indicating the presence of void spaces behind the casing. Neutron logs, which are also dependent on formation (and casing) density, responded to these same washed out regions. As expected, the short neutron source/detector-spacing logs (NEUT [S]) responded similarly to density logs, and the long neutron source/detector-spacing logs (NEUT [F]) responded in the opposite direction. Specific intervals of boreholes where washed out regions were significant included:

<u>Well UE5PW-1</u>	<u>Well UE5PW-2</u>	<u>Well UE5PW-3</u>
112.8 to 173.7 m (370 to 570 ft)	121.9 to 167.6 m (400 to 550 ft)	109.7 to 137.2 m (360 to 450 ft)
213.4 to 231.6 m (700 to 760 ft)	210.3 to 216.4 m (690 to 710 ft)	

Finally, it should be noted that problems were encountered with density log outputs (both short and long source/detector spacings) from Well UE5PW-2 on July 20, 1992. The resulting logs should not be considered representative of either formation or borehole conditions.

The Ammonia Tanks ash-flow tuff was encountered at approximately 188.2 m (617.5 ft) in Well UE5PW-3. When logs were conducted in the lower portion of this borehole on November 18, 1992, the 219.1-mm (8.625-in.) casing extended to the depth of approximately 213.4 m (700 ft). The natural gamma log results show a gradual increase in counts with depth in both the cased (188.2 to 213.4 m [617.5 to 700 ft]) and uncased regions (213.4 to 291.0 m [700 to 955 ft]) of the borehole. This response may be due to changes in lithology and/or degree of welding (Section 3.1.2).

While the natural gamma log shows a significant response in the uncased tuff region of Well UE5PW-3, neutron and density logs show little variability in this region of the borehole down to a depth of approximately 3.0 m (10 ft) above the water table (approximately 270.7 m [888 ft]). This indicates that depth profiles of moisture content and density were relatively constant until approximately 3.0 m (10 ft) above the water table, where the logs exhibit a response indicative of increasing water content.

Similar responses to increasing water content beginning approximately 3.0 m (10 ft) above the water table were noted in neutron and density logs in alluvium for Well UE5PW-1 and UE5PW-2. These responses are consistent with water content data from analysis of drill cuttings samples and cores.

4.3.3 Summary of Borehole Deviation Logs

Borehole deviation logs were conducted after the 73.0-mm (2.875-in.) O.D. monitoring well tubing was installed in each well. The tool used collects both angle (inclinometer) and direction (gyro) data to correct actual logging cable length to true vertical depth. True vertical depth is required to obtain accurate water table elevation measurements.

The borehole deviation log data for Wells UE5PW-1, UE5PW-2, and UE5PW-3 are provided in Appendices F.3.4, F.3.7, and F.3.10, respectively, along with plan-view graphs of borehole deviation. An error analysis was conducted on individual depth correction measurements, and error bars were developed for the total depth correction. This information is discussed in detail in relation to water table elevation measurements in Section 4.5.1 and Appendix F.5.1.

4.4 In-Situ Air Permeability Testing

Air permeability tests were performed to address some of the data requirements for modeling the transport of water vapor, hazardous gases, and radioactive gases in the unsaturated alluvial materials found throughout Area 5. In-situ measurements provide estimates of both the magnitude and variability of the permeability of the gases of concern, as well as a means of

determining whether laboratory-measured saturated hydraulic conductivities from 76.2-mm (3-in.) core samples are representative of permeabilities measured on a field scale.

In-situ air permeability measurements in Well UE5PW-1, using two different air-injection methods, are described in the following paragraphs.

4.4.1 Air (Injection) Permeability Tests Below Drill Casing

Single flow-rate air injection permeability measurements were made during the drilling of Well UE5PW-1 by using the steel drill casing as an air conduit. These injection tests were conducted at two depths, 8.4 and 45.7 m (27.5 and 150 ft), but experimental difficulties prevented collection of data suitable for analysis from the test at 45.7 m (150 ft).

Prior to beginning these tests, the drill rods, air-percussion hammer, and drill bits were removed from the borehole. Air was then injected into an uncased portion of the borehole approximately 304.8 mm (12 in.) in diameter and 152.4 mm (6 in.) long. This cylindrical cavity, created by the pilot and reamer bits during drilling, was located at the base of the outer 273.0-mm (10.75-in.) casing. It was assumed that the annular space between the drill casing and formation did not provide a preferential flow path. Air pressure was monitored in two 25.4-mm (1.0-in.) O.D. by 12.7-mm (0.5-in.) I.D. monitoring holes installed using the Geoprobe hydraulic punch at horizontal distances of 4.6 and 9.1 m (15 and 30 ft) from the Well UE5PW-1 collar. The Geoprobe holes were installed to a depth of 9.1 m (30 ft).

Data were analyzed using the extended Darcy equation. The air permeability for the injection test at 8.4 m (27.5 ft) was found to $7.8 \times 10^{-12} \text{ m}^2$ (7.8 darcy [D]) using data from both the 4.6- and 9.1-m (15- and 30-ft) Geoprobe holes, which demonstrated good experimental reproducibility using this method. This value agrees well with field measurements of air permeability of NTS alluvium reported in the literature (Pasternak and McMullen, 1970; Morris et al., 1971; Snoeberger et al., 1974; Rozsa et al., 1975).

These tests were not repeated at additional depths in Well UE5PW-1 or the other pilot wells for several reasons. Among the key reasons for not repeating the tests were: the expense of the drill rig for standby time while conducting these tests; the additional disturbance of in-situ gas composition and possibly the hydrologic conditions of the formation by the injection of large volumes of air into the formation; and numerous experimental difficulties encountered during the in-situ testing.

4.4.2 Post-Drilling Air (Injection) Permeability Testing

Injection tests were conducted in the type B instrument stations, which consisted of one 20.7-mm (0.814-in.) I.D. nylon injection tube and one 4.6-mm (0.18-in.) I.D. stainless-steel piezometer tube. Test intervals consisted of screened sections, approximately 0.9 m (3 ft) in height filled with coarse sand. The annular space above and below the screened section was sealed with a low permeability mixture of bentonite and sand. The depths and dimensions of the air permeability stations in the pilot wells are listed in Appendix F.4.1. Most of the test intervals were located in unsaturated alluvial deposits. Laboratory analysis of cores taken during drilling indicated that the hydraulic properties of these deposits were remarkably constant with depth. The only interval not located within alluvium was the 210-m (689-ft) testing interval in Well UE5PW-3, located in the rhyolitic ash-flow tuff unit (Section 3.1.2).

The tests consisted of injecting air into the screened interval (through the 20.7-mm [0.814-in.] nylon tube) at a constant flow rate until the pressure in the interval (measured at the ground surface in the stainless-steel piezometer tube) reached a steady value (less than 0.7 kPa [0.1 psi] change in 10 minutes). In most cases this occurred within 15 minutes. The injection flow rate was then increased and a new steady-state pressure was obtained. A minimum of 4 steady-state pressures corresponding to four constant flow rates were measured for each screen interval.

In Well UE5PW-1, tests were successfully conducted in the test intervals at the depths of 45.7, 73.2, and 107.0 m (150, 240, and 350 ft). Application of 552 kPa (80 psi) air pressure to the interval at 183 m (600 ft) resulted in a flow rate of only 3.4 cubic meters per hour (2 cubic feet per minute) with no detectable pressure increase in the interval. The lack of flow and pressure response indicated that this injection line possibly became plugged during stemming, and no further testing was conducted in this interval. In Well UE5PW-2, tests were completed in the intervals at 45.7, 76.2, 122.0, and 183.0 m (150, 250, 400, and 600 ft). In Well UE5PW-3, tests were successfully completed in the intervals at 76.2, 107.0, and 210.0 m (250, 350, and 689 ft). Flow and pressure testing from the 168-m (550-ft) testing interval in Well UE5PW-3 resulted in an atypically low permeability estimate that may have been due to contamination of the testing interval with stemming material. The test data are summarized in Appendix F.4.2. Test results were analyzed using a form of Darcy's law modified for compressible flow. If inertial effects were observed, an integrated form of the Forchheimer equation was used (Katz et al., 1959).

The estimates of apparent permeability and inertial coefficients obtained from the pilot wells are found in Appendix F.4.3. Permeabilities range from 0.9×10^{-12} to $47 \times 10^{-12} \text{ m}^2$ (0.9 to 47 D).

These values are consistent with both the permeability values measured below the drill casing described in Section 4.4.1, and with the previous NTS studies cited above.

Permeabilities to water were determined on 60 core samples. The mean value of liquid permeability for these samples was $1.1 \times 10^{-12} \text{ m}^2$ (1.1 D). The mean value for air permeability for the tested intervals, excluding the test in the tuff unit, was $12 \times 10^{-12} \text{ m}^2$ (12 D). Permeability to air and water differed by approximately an order of magnitude. This was expected, as permeability to air of geologic materials generally exceeds permeability to water, due to interactions of water and matrix materials. Air permeability was determined in the laboratory on three unfractured core samples of the tuff. The mean permeability from these laboratory measurements was $4.3 \times 10^{-12} \text{ m}^2$ (4.3 D). The air permeability obtained from injection tests in the tuff unit at 210 m (689 ft) in Well UE5PW-3 was $18 \times 10^{-12} \text{ m}^2$ (18 D). This larger value from the in-situ tests suggests that the tuff unit is fractured at depth.

Because the stress induced in the formation by an air injection test is rapidly dissipated, the air permeability stations in the pilot wells can be tested repeatedly. Since the permeability is a strong, highly non-linear function of water content, these tests could potentially be used to monitor changes in water content. For example, an observed decrease in permeability would suggest an increase in water content.

4.5 Upper Aquifer Hydraulic Parameter Testing

4.5.1 Water Table Elevations and Gradient

The three pilot wells have defined an almost horizontal water table below the Area 5 RWMS. Water level measurements were made from the top of the monitoring well casing in each pilot well by REEC Co SPS personnel using an Solonist E-tape. The recorded depth and calculated water level elevations (not corrected for borehole deviation) are presented in Table 4-2. These measurements indicate little variation in the water table, and the changes that are seen are probably within the precision and accuracy of the instrument. U.S. Geological Survey (USGS) personnel also made water level measurements in each pilot well with a Solonist E-tape (an older instrument than the REEC Co E-tape), and these are also presented in Table 4-2. The USGS measurements indicated a slightly deeper water table than the REEC Co measurements taken on the same day. The USGS also used a calibrated steel tape (accurate to $\pm 0.003 \text{ m}$ [$\pm 0.01 \text{ ft}$]) to measure the depth to water.

Table 4-2
Uncorrected Water Table Elevation Data

Date	Depth to water from TOC ¹ m (ft)			Water table elevation m (ft)		
	UE5PW-1	UE5PW-2	UE5PW-3	UE5PW-1	UE5PW-2	UE5PW-3
2-28-93	235.702 (773.30)	256.632 (841.97)	271.778 (891.66)	733.669 (2407.05)	733.486 (2406.45)	733.443 (2406.31)
3-02-93	235.677 (773.22)	256.672 (842.10)	271.805 (891.75)	733.693 (2407.13)	733.446 (2406.32)	733.416 (2406.22)
3-02-93 ²	235.729 (773.39)	256.742 (842.33)	271.775 (891.65)	733.641 (2406.96)	733.376 (2406.09)	733.446 (2406.32)
3-04-93	235.726 (773.38)	256.739 (842.32)	271.802 (891.74)	733.644 (2406.97)	733.379 (2406.10)	733.419 (2406.23)
3-08-93	235.613 (773.01)	256.626 (841.95)	271.711 (891.44)	733.757 (2407.34)	733.492 (2406.47)	733.510 (2406.53)
3-22-93	235.635 (773.08)	256.587 (841.82)	271.708 (891.43)	733.736 (2407.27)	733.532 (2406.60)	733.513 (2406.54)
3-23-93	235.607 (772.99)	256.681 (842.13)	271.699 (891.40)	733.763 (2407.36)	733.437 (2406.29)	733.523 (2406.57)
3-24-93	235.610 (773.00)	256.565 (841.75)	271.708 (891.43)	733.760 (2407.35)	733.553 (2406.67)	733.513 (2406.54)
3-25-93	235.607 (772.99)	256.556 (841.72)	271.708 (891.43)	733.763 (2407.36)	733.562 (2406.70)	733.513 (2406.54)
3-29-93	235.671 (773.20)	256.559 (841.73)	271.747 (891.56)	733.699 (2407.15)	733.559 (2406.69)	733.474 (2406.41)
3-29-93 ²	235.711 (773.33)	256.629 (841.96)	271.738 (891.53)	733.660 (2407.02)	733.489 (2406.46)	733.483 (2406.44)
3-29-93 ³	235.641 (773.10)	256.535 (841.65)	271.683 (891.35)	733.730 (2407.25)	733.583 (2406.77)	733.538 (2406.62)
3-29-93 ³	235.609 (773.06)	256.541 (841.67)	271.693 (891.38)	733.742 (2407.29)	733.577 (2406.75)	733.529 (2406.59)
3-30-93	235.705 (773.31)	256.636 (841.98)	271.772 (891.64)	733.666 (2407.04)	733.483 (2406.44)	733.449 (2406.33)
4-01-93	235.620 (773.03)	256.578 (841.79)	271.708 (891.43)	733.751 (2407.32)	733.541 (2406.63)	733.513 (2406.54)
4-05-93	235.589 (772.93)	256.553 (841.71)	271.693 (891.38)	733.782 (2407.42)	733.565 (2406.71)	733.529 (2406.59)
4-06-93	235.671 (773.20)	256.611 (841.90)	271.769 (891.63)	733.699 (2407.15)	733.507 (2406.52)	733.452 (2406.34)

- 1 TOC = Top of monitor well casing
2 USGS E-tape measurements
3 USGS Calibrated steel tape measurements

A borehole geophysical deviation survey log was run in each borehole (Section 4.3.3) to attempt to correct for borehole deviations from a vertical straight line. It should be emphasized that the error in the deviation logs may be equal to or greater than the differences in the uncorrected water table elevations. For example, data from the manufacturer and operator of the deviation tool (Century Geophysics Corporation) indicate that the error in the corrected depth provided by this tool is ± 0.15 m (± 0.5 ft). This error is as large as the difference observed between water table elevations. In addition, estimated errors arising from the use of a water level measurement tape are on the order of ± 0.03 m (± 0.1 ft), and the error associated with surveying of casing elevations is probably somewhat less. Because of these uncertainties, it is only reasonable to conclude that differences in water table elevations are within the error of the measurement. The correction factors for Well UE5PW-1, UE5PW-2, and UE5PW-3 are -0.08, -0.21, and -0.02 m (-0.27, -0.68, and -0.06 ft), respectively. The elevations and coordinates of the top of each monitoring well casing were surveyed by REEC Co Engineering personnel and are listed in Table 2-2.

Various methods were employed to determine the shape of the water table below the Area 5 RWMS utilizing available water table elevations. The shape of the water table must be known to estimate the gradient and the direction of groundwater flow. These methods include a planar approximation and a statistical analysis that incorporates uncertainties in measurements (Appendix F.5.1). The conclusion reached from these analyses are similar: the water table below the Area 5 RWMS is approximately horizontal. Without elevation differences, the gradient is nearly zero and there will be essentially no horizontal movement in the uppermost aquifer.

4.5.2 Hydraulic Conductivity Recovery Tests

In-situ hydraulic conductivity tests were conducted in the pilot wells following standard slug test techniques (Table 2-1). Standard single-well pump test methods that would provide more reliable estimates of the uppermost aquifer hydraulic properties could not be conducted in the pilot wells primarily because of the small diameter of the monitoring well tubing and the great depth to water. The high volume, multi-stage pumps required to stress the permeable, relatively coarse-grained uppermost aquifer, approximately 243.8 m (800 ft) below the ground surface, are not available in small enough size to fit inside the 63.5-mm (2.5-in.) I.D. monitoring well tubing. Pumps that do fit in this tubing and are capable of lifting at least 243.8 m (800 ft) (e.g., Bennett sample pumps) are, without exception, not capable of the high flow rates required to create drawdowns in the alluvial aquifer.

Following well development (Section 2.6), in-situ hydraulic conductivity tests were conducted according to procedures in ASTM D 4044-91 (1992). A 38.1-mm (1.5-in.) O.D. by 6.1-m (20-ft) long mechanical slug was submerged in the screened interval of each pilot well. The water level was allowed to stabilize, then the slug was rapidly removed and the recovery of the aquifer versus time was monitored. Hydraulic conductivity values were calculated from a plot of the recovery data (log of water levels) versus time. Data were analyzed assuming the aquifer was partially penetrated, unconfined (or leaky confined), and incompressible. The average conductivities for Wells UE5PW1, UE5PW-2, and UE5PW-3 were 1.3×10^{-3} , 3.4×10^{-4} , and 1.4×10^{-3} cm/s (1.8, 0.5, and 2.0 in./hr), respectively. The results of the individual slug tests are presented in Appendix F.5.2. The mean in-situ hydraulic conductivity values calculated for the upper portion of the alluvial aquifer in Wells UE5PW-1 and UE5PW-2 were nearly identical to the mean hydraulic conductivities calculated from core samples collected over the entire depth of each borehole. The mean in-situ hydraulic conductivity calculated for the upper portion of the tuff aquifer (Well UE5PW-3) is within the range of hydraulic conductivities previously measured on bedded tuff core samples collected at the NTS (Winograd and Thordarson, 1975).

In addition, a separate slug test was conducted during the final stages of drilling Well UE5PW-1 in an uncased portion of the borehole (occupied by the drill and reamer bits during drilling) located directly below the casing. Prior to the test, the drill string was removed from the borehole, leaving an uncased cylindrical cavity measuring approximately 304.8 mm (12 in.) in diameter by 152.4 mm (6 in.) long available for testing. The mechanical slug was rapidly lowered into the water, and the aquifer recovery rate was monitored. The same assumptions (described above) were made in analyzing the recovery data. The hydraulic conductivity value calculated from these data (5×10^{-8} cm/s [7×10^{-5} in./hr]) is many order of magnitude less than the mean conductivities calculated by the recovery test method described above and mean values from laboratory tests on core samples. The reason for the differences in these values may be that the exposed walls of the formation in the small cylindrical cavity might have been smeared with fine materials during drilling, which in turn greatly reduced the hydraulic conductivity.

Alternatively, the slug tests in the 63.5-mm (2.5-in.) monitoring well tubing described previously, did not stress the aquifer enough to provide recovery data representative of the formation. However, comparisons of saturated hydraulic conductivity from core samples (Section 3.3.1) indicate that this slug test was anomalous.

4.6 Neutron Logging Calibration Boreholes

Three shallow boreholes planned for calibration of the neutron-moisture meter were drilled and cased with the three different-size CAU drilling systems used in the pilot well project. These boreholes were installed when the drill casing became stuck during the drilling of Well UE5PW-2. The drilling operations at Well UE5PW-2 could not continue for about a week until equipment could be brought onsite to free the casing. Rather than put the drilling rig and crew on “standby time,” it was decided to drill and sample three 12.2-m (40-ft) deep boreholes approximately 61 m (200 ft) from Well UE5PW-2 that could be used as calibration holes for a neutron-moisture meter and other borehole geophysical logging tools.

Neutron-moisture meter logging through large diameter steel casing has been proven to be a valuable method of monitoring changes in water content in alluvium at the NTS (Tyler, 1986). It was determined that this type of logging would prove useful during and after drilling of future vadose zone exploratory and monitoring wells with the CAU drilling system at the Area 5 RWMS. REEC Co SPS operated a CPN Model 503DR neutron-moisture meter for vadose zone monitoring of a mixed-waste storage facility, and the meter was readily available for logging in CAU drilling system boreholes.

The calibration boreholes, UE5PW-2A, UE5PW-2B, and UE5PW-2C, were drilled with 219.1-mm (8.625-in.) O.D., 193.7-mm (7.625-in.) O.D., and 273.0-mm (10.75-in.) O.D. CAU drilling system casing, respectively. The threaded connections on these casing sections had been damaged slightly during previous drilling activities and were not suited for deep drilling, which made these casings ideal for use in the shallow calibration holes.

A shallow trench was excavated and filled with water for several days to create a wetting front with depth. The boreholes were then drilled in the trench, and core and drill cuttings samples were collected. The geologic samples collected from these boreholes were subjected to the same laboratory tests as samples from the pilot wells (Table 3-2). Neutron-moisture logs were conducted immediately after completing each cased borehole, and were conducted periodically after completion. Depth profiles of neutron-moisture meter counts measured just after borehole completion are correlated with the volumetric water content from core samples to obtain calibration curves (relating counts to water content) for these different sized casings. Appendix G contains all data pertinent to drilling, sampling, laboratory results, neutron-moisture meter logs, and calibrations for these shallow test holes.

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5.0 Upper Aquifer Water Quality

5.1 RCRA Groundwater Sampling and Analysis

A primary objective of the pilot well project was to characterize the water quality of the uppermost aquifer under the Area 5 RWMS. With this in mind, a test plan was developed that was consistent with the detection and monitoring requirements of 40 CFR 264 (Table 2-1), and initial samples were collected from Well UE5PW-1 and analyzed. Based on this initial sampling and analysis activity, a standard operating procedure was developed to implement a groundwater characterization program at all three pilot wells. Field and laboratory testing results from the initial samples collected at Well UE5PW-1 are presented and discussed in the following paragraphs.

Groundwater samples were collected with a submersible stainless-steel, double-action piston pump operating at a flow rate of approximately 2 L/min (0.5 gal/min). Three wellbore volumes were purged prior to sample collection. Water temperature, pH, specific conductance, and eH were monitored during purging and sample collection. Standard QA procedures (Table 2-1) were followed for sample collection and analysis (e.g., procedures identifying standard containers, preservatives, filtration, holding times, blanks, replicates, chain of custody, accuracy, and precision). See Appendix H.1 for descriptions of sample collection methods and a brief discussion of these results.

The chemical parameters analyzed and methods used are summarized in Table 5-1. All analyses were performed by the REEC Co Analytical Services Department, with the exception of total organic carbon (TOC), total organic halogens (TOX), and herbicides, for which samples were sent to subcontracted testing laboratories.

In summary, the concentrations of all parameters, including those required to assess the suitability of groundwater as drinking water, and parameters to establish groundwater quality, are below applicable standards. The only exceptions were manganese and possibly chromium. Manganese exceeds the state of Nevada secondary standards for drinking water. Chromium was not detected, but the detection limit was slightly higher than the state of Nevada primary standards for drinking water. The mean value of the pH (8.13) and specific conductance (0.0389 Siemens per meter [0.389 mmhos per centimeter]) were indicative of good quality drinking water.

Table 5-1
Testing Laboratories, Chemical Parameters, and Analytical Methods

Laboratory	Sample Parameters	Method
REECo ASD ^a	Volatile Organics	8240 ^b
DataChem Laboratories	Total Organic Halogen	9020 ^b
DataChem Laboratories	Total Organic Carbon	9060 ^b
REECo ASD	Oil and Grease	413.2 ^c
REECo ASD	Pesticides/PCBs: Toxaphene, Lindane, Methoxychlor, Endrine	8080 ^b
DataChem Laboratories	Herbicides	8150 ^b
REECo ASD	Semi-volatile Organics	8270 ^b
REECo ASD	Total Metals: As, Ba, Cd, Cr, Fe, Hg, Mn, Na, Pb, Se	6010 ^b
REECo ASD	Total Silver	6010 ^b
REECo ASD	Cyanide	335.2 ^c
REECo ASD	Chloride, Sulfate, Fluoride, Nitrate	300 ^c
REECo ASD	Total Gross Alpha/Beta Gamma Spectroscopy	AABAB.D.04.30 ^d
REECo ASD	⁹⁰ Strontium	AABAB.D.04.40 ^d
REECo ASD	⁹⁹ Technetium	AAHCD.D.04.40 ^d
REECo ASD	Total Uranium	AABAB.D.04.20 ^d
REECo ASD	¹³¹ Iodine	AABAB.D.04.55 ^d
REECo ASD	^{238, 239, 240} Plutonium	AABAB.D.04.10 ^d
REECo ASD	^{226, 228} Radium	AAHCD.D.04.07 ^d
REECo ASD	Dissolved Metals: As, Ba, Cd, Cr, Fe, Hg, Mn, Na, Pb, Se	6010 ^b
REECo ASD	Dissolved Silver	6010 ^b
REECo ASD	Dissolved Gross Alpha/Beta Gamma Spectroscopy	AABAB.D.04.30 ^d
REECo ASD	Total Dissolved Solids	160.1 ^c
REECo ASD	Tritium	AABAB.D.04.70 ^d (Electrolyte Enrichment)

a Reynolds Electrical and Engineering Company, Analytical Services Department

b Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, U.S. Environmental Protection Agency (USEPA), SW-846

c Methods for Chemical Analysis of Water and Wastes, USEPA, EPA-600/4-82-055, 1982

d REECo ASD Standard Operating Procedure

Finally, organic contamination indicator parameters (TOC and TOX) were below or near detection levels. In conclusion, the initial sampling and analyses of groundwater from Well UE5PW-1 indicate that it is of high quality and meets all standards concerning hazardous and radioactive constituents.

5.2 Preliminary Comparison of General Water Chemistry

A preliminary general chemical analysis of groundwater samples collected from the pilot wells and several existing wells in the northern part of Frenchman Flat was conducted by DRI. The general chemical parameters analyzed included pH, conductivity, major cations, anions, and several other indicator parameters. The purpose of this activity was to compare the general chemistries of the pilot wells and surrounding wells, to begin to characterize the variability in the water chemistry of the uppermost alluvial aquifer, and to obtain geochemical information relating to the possible sources(s) of these waters and therefore possible directions of flow. Details of the methods used, together with the results from this preliminary general water chemistry survey, are presented in Appendix H.2. A summary is presented in the following paragraphs.

Results discussed here are preliminary. For example, groundwater samples were collected from undeveloped pilot wells and the results may not be representative of in-situ water. Samples from a number of the surrounding wells were collected from screened intervals that are significantly below the uppermost zone sampled in the pilot wells.

Water quality data from Wells UE5PW-1 and UE5PW-3, UE5n, and six nearby wells, all located in the Frenchman Flat area, were collected and analyzed by DRI. Water samples from the two pilot wells and Well UE5n were collected in January and February of 1993, and submitted for gross chemical analysis, stable isotope analysis, and enriched tritium counting. Water chemistry data for the six nearby wells were obtained from data sets archived by DRI from past analyses. The conclusions are:

- The gross chemical analyses for Wells UE5PW-1 and UE5PW-3 are very similar.
- These pilot well waters can be characterized as sodium bicarbonate waters with a total dissolved solid content of approximately 360 milligrams per liter.
- All of the samples from the pilot wells were saturated with respect to calcite, dolomite, and several forms of silica and calcium-magnesium sulfates.
- Pilot well water chemistry was most similar to that of Water Well 4, located to the northwest, but presumably hydraulically separated from the pilot wells by the Cane Spring fault.

- Analysis of the data with Stiff diagrams and tri-linear plots reveals that the pilot wells are higher in calcium and magnesium, relative to sodium, than most other wells.

DRI concluded that the groundwater from the pilot well area has had more contact with the carbonate material than water sampled elsewhere in Frenchman Flat. The report states that this is most likely to have occurred by percolation through alluvium derived from carbonate rocks from the CP Hills area north of Water Well 4 and from Nye Canyon, located east of the Area 5 RWMS. Further, DRI reported that water samples from Well UE5n, located in the west-central part of Frenchman Flat, were relatively calcium-poor, while still saturated with calcite. These findings were interpreted to mean that water from this well originated in volcanic terrain found to the west, or alternatively, that the water originated from downward percolation through carbonate-poor alluvial material in this area.

6.0 Preliminary Vadose Zone Monitoring Data

The installation and stemming of thermistors, air pressure transmitters, and thermocouple psychrometers at type A instrument stations were described in Section 2.5.1. Calibration procedures, together with preliminary data collected to date, are briefly described in the following paragraphs. Delays in electric power distribution to each pilot well site has limited the data collection activities, but portable data loggers/controllers demonstrated that the instruments are in working order.

6.1 Temperature Profile Data

The thermistors were calibrated for each mode of operation (resistance and voltage drop) following the methods developed by the USGS (J. Rousseau, 1993) for the Yucca Mountain Project (USGS, 1990). These methods were made available through a Department of Energy technology transfer program. Summary calibration data are presented in Appendix I.1.

To date, thermistor temperatures (voltage drop method) have been measured at type A instrument stations in all three pilot wells. Temperature data were collected for Wells UE5PW-1 and UE5PW-3 in mid-April 1993. Due to instrumentation problems, data were not collected from Well UE5PW-2 until mid-July 1993. Preliminary temperature profile data are plotted in Figure 6-1 and tabular temperature data are presented in Appendix I.2. A high temperature measured at the 30.5-m (100-ft) level in Well UE5PW-3 is not plotted because it is probably an anomaly resulting from heat being generated from the nearby cement plug (Section 2.5.2) which had recently been poured. A similar anomaly was detected at the 30.5-m (100-ft) level in Well UE5PW-2, and likewise was not plotted. Thermal gradients, per 304.8 m (1,000 ft), of 2.06, 4.30, and 3.83 °C (35.7, 39.7, and 38.9 °F) in Wells UE5PW-1, UE5PW-2, and UE5PW-3, respectively, were calculated from these temperature profiles. Additional monitoring data are needed to determine if instrument stations are in thermal equilibrium with the formation and whether the observed differences in thermal gradients between boreholes are significant.

6.2 Formation Air Pressure Profile Data

Factory calibrations supplied with Druck PTX pressure transmitters are summarized in Appendix I.3 for the instruments installed in the three pilot wells. These pressure transmitters

Figure 6-1
Depth Profiles of In-Situ Temperatures from the Pilot Wells

were also independently calibrated by the Physical Standards and Calibration Laboratory operated by REEC Co. However, problems identified with the calibration methods used by REEC Co have prevented the use of these calibration data.

Preliminary formation air pressure measurements made at type B instrument stations in Wells UE5PW-1 and UE5PW-3 are summarized in Appendix I.4. It is difficult to determine if these measurements accurately reflect formation air pressures without monitoring these instruments as well as atmospheric air pressure over a period of time to observe at least several high and low pressure waves. However, these preliminary data indicate that nearly all transmitters are operational and produce readings that appear to be within a reasonable range.

6.3 *Water Potential Profile Data*

Thermocouple psychrometer design, calibration equipment and methods, and field data acquisition systems developed by the USGS for the Yucca Mountain Project (USGS, 1993) were adopted for the pilot well project. The USGS (Rousseau, 1993) shared both calibration equipment and expertise. Tables of the calibration coefficients are in Appendix I.5.

A portable rack-mounted data acquisition system was built to perform baseline monitoring of the in-situ thermocouple psychrometers. Preliminary in-situ psychrometer data obtained are presented in Appendix I.6 and in Figure 6-2. Water potential profile data (distance is positive downwards) show a positive gradient (upward flow) in the upper 61 m (200 ft). At greater depths the potential gradient becomes nearly zero and constant. These preliminary in-situ psychrometer data compare favorably with the water potentials measured in the laboratory for core samples (Section 3.4.2).

Figure 6-2
Depth Profiles of In-Situ Psychrometer Data from the Pilot Wells

7.0 Summary

Three pilot wells were drilled and completed to the uppermost aquifer in the vicinity of the Area 5 RWMS in Frenchman Flat to meet data needs mandated by regulatory requirements applicable to the disposal of low-level, mixed, and high-specific-activity waste at this site. This series of boreholes was specifically designed to characterize the hydrogeology of the thick vadose zone and to help define the water quality and hydraulic characteristics of the uppermost aquifer.

This report describes the methods and results of the following activities:

- Pilot well borehole drilling
- Geologic sample collection
- Field geologic descriptions
- Laboratory testing of geologic samples
- Well and vadose zone monitoring system completion
- Geophysical logging and other in-situ testing
- Well development and in-situ aquifer testing
- Preliminary groundwater sampling and analyses
- Preliminary vadose zone monitoring

These results (data) are required to understand and model flow and transport processes both in the vadose zone and uppermost aquifer. This report provides only qualitative analyses and preliminary interpretations.

Some of the important findings are:

- The thick alluvial deposits penetrated by each pilot well are lithologically homogeneous and do not contain layers of secondary carbonate.
- The alluvial deposits are virtually homogeneous with respect to particle size distributions and are primarily composed of sands with some gravel and small amounts of fines.
- Hydrologic properties, including porosity, saturated hydraulic conductivity, moisture retention relations, and unsaturated hydraulic conductivity are typical of coarse-grained materials.
- Alluvial deposits are very dry near the surface and moisture increases only slightly with depth until a capillary fringe is reached approximately 3 m (10 ft) above the water table.
- Water potential measurements on core samples show a large positive potential gradient (water tends to move upward, rather than downward) in the upper 30.5 m (100 ft) in each borehole, and a nearly zero potential gradient throughout the remaining portion of the vadose zone.

- Unsaturated hydraulic conductivity data, together with water potential data, indicate that very little liquid flow is occurring (if any) throughout the thick alluvial deposits, and the direction of liquid flow is upward in the upper portion of the vadose zone.
- Because liquid water movement is virtually negligible in the upper vadose zone, vapor movement is probably the dominant mechanism of water movement in this region.
- Environmental tracer measurements of chloride, bromide, sulfate, hydrogen and oxygen stable isotopes, and cosmogenic chlorine-36 concentrations in soil water versus depth provide strong evidence that the direction of movement for both liquid water and vapor in the upper vadose zone is upward in response to the evaporative demand of the present arid climate.
- Further, environmental tracer data suggest that water which is presently in the lower vadose zone infiltrated under a more humid climate, when evaporation was not an important process.
- The limited data collected from the tuff units underlying the alluvium below 188.2 m (617.5 ft) in Well UE5PW-3 indicate that they have properties similar to those previously reported for these units.
- A variety of geophysical and in-situ hydrologic and pneumatic tests support results from core and drill cuttings data which suggest that vadose zone and uppermost aquifer alluvial deposits can be considered a homogeneous hydrogeologic system.
- Preliminary water quality data from each pilot well indicate that hazardous and radioactive constituents do not exceed appropriate standards in the uppermost aquifer.
- The uppermost water table gradient is nearly horizontal, with essentially a zero slope and no horizontal movement.
- Vadose zone monitoring instruments and equipment, which were stemmed in place around the central monitoring well casing in each pilot well, are being used to make in-situ measurements of important hydrologic and pneumatic parameters and to monitor changes in these parameters over time.

8.0 References

- Allison, G. B., 1982. *The Relationship Between ^{18}O and Deuterium in Water in Sand Columns Undergoing Evaporation*. Journal of Hydrology, v. 55, pp. 163-169.
- Allison, G. B., and M. W. Hughes, 1983. *The Use of Natural Tracers as Indicators of Soil-Water Movement in a Temperate Semi-Arid Region*. Journal of Hydrology, v. 60, pp. 157-173.
- ASTM D 2216-80, 1980. "Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Moisture." In: *1987 Annual Book of ASTM Standards*, Vol. 04.08, American Society for Testing and Material. Philadelphia, PA.
- ASTM D 2434-68, 1974. "Test Method for Permeability of Granular Soils (Constant Head)." In: *1987 Annual Book of ASTM Standards*, Vol. 04.08, American Society for Testing and Material. Philadelphia, PA.
- ASTM D 2325-68, 1981. "Test Method for Capillary Moisture Relationships for Coarse- and Medium-Textured Soils by Pressure-Plate Apparatus." In: *1987 Annual Book of ASTM Standards*, Vol. 04.08, American Society for Testing and Material. Philadelphia, PA.
- ASTM D 422-63, 1972. "Method for Particle Size Analysis of Soils." In: *1987 Annual Book of ASTM Standards*, Vol. 04.08, American Society for Testing and Material. Philadelphia, PA.
- ASTM D 2579-85, 1990. "Test Method for Determining Total Organic Carbon." In: *1990 Annual Book of ASTM Standards*, Vol. 11.02, American Society for Testing and Material. Philadelphia, PA.
- ASTM D 2488-90, 1990. "Standard Recommended Practice for the Description of Soils - Visual Manual Procedure." In: *1990 Annual Book of ASTM Standards*, Vol. 04.08, American Society for Testing and Material. Philadelphia, PA.
- ASTM D 4044-91, 1992. "Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug Test) for Determining Hydraulic Properties of Aquifers." In: *ASTM Standards on Groundwater and Vadose Zone Investigations (PCN: 03-418192-38)*, American Society for Testing and Material. Philadelphia, PA.
- Bechtel Nevada, 2005. *Hydrogeologic Characterization Data from the Area 5 Shallow Soil Trenches, Revision 1*. DOE/NV/11718--1060.
- Blake, G. R., and K. H. Hartge, 1986. "Bulk Density." In: Klute, A. L. (ed.), *Methods of Soil Analysis, Part I, Physical and Mineralogical Methods, 2nd Edition*, American Society of Agronomy, Madison, WI. Chapter 13, pp. 363-367.

- Blinov, A., 1988. *The Dependence of Cosmogenic Isotopic Production Rate on Solar Activity and Geomagnetic Field Variations*. In: Stephenson, F. R., and A. W. Wolfendale, eds., Secular Solar and Geomagnetic Variations in the Last 10,000 Years. Kluwer Academic Publishing Co., Dordrecht, Netherlands, pp. 329-340.
- BN, see Bechtel Nevada.
- Byers, F. M., Jr., P. P. Orkild, W. D. Quinlivan, and K. A. Sargent, 1976. *Volcanic Suites and Related Cauldrons of the Timber Mountain-Oasis Valley Caldera Complex, Southern Nevada*. U.S. Geological Survey Professional Paper 919.
- Campbell, G. S., and G. W. Gee, 1986. "Water Potential Measurement Using the Filter Paper Technique." In: Klute, A. L. (ed.), *Methods of Soil Analysis, Part I, Physical and Mineralogical Methods, 2nd Edition*, American Society of Agronomy, Madison, WI. Chapter 25, pp. 628-630.
- Chapman, J., Desert Research Institute, 1993. Personal communication regarding evaporation rates in the upper vadose zone.
- Conrad, S. H., 1993. *Using Environmental Tracers to Estimate Recharge Through an Arid Basin*. 1993 International High-Level Radioactive Waste Management Conference, Las Vegas, NV. April 26-30, 1993.
- Davis, J. C., I. D. Proctor, J. R. Southon, M. W. Caffee, D. W. Heikkinen, M. L. Roberts, K. W. Turteltaub, D. E. Nelson, D. H. Lloyd, and J. S. Vogel, 1990. *LLNL/UC AMS Facility and Research Program*. Nuclear Instruments and Methods in Physics Research, v. B52, pp. 269-272.
- DOE, see U.S. Department of Energy.
- Donaldson, R. E., and P. L. Sutherland, 1986. "Total Porosity." In: Klute, A. L. (ed.), *Methods of Soil Analysis, Part I, Physical and Mineralogical Methods, 2nd Edition*, American Society of Agronomy, Madison, WI. Chapter 18, pp. 444-445.
- EG&G/SAIC, 1991. *Radiological Performance Assessment for the Area 5 Radioactive Waste Management Site at the Nevada Test Site*, EG&G Idaho, Inc., and Science Applications International Corporation (SAIC), Idaho Falls, ID.
- Fenix & Scisson, Inc., 1987. *Lithologic Descriptions of Volcanic Rocks*, Memorandum GEO-0237, dated May 26, 1987.
- Fenix & Scisson, Inc., 1990. *The Description of Rock Samples* - Geology/Hydrology Division Procedure GP-003, Revision 1.
- Fernald, A. T., G. L. Dixon, W. J. Carr, and F. M. Byers, Jr., 1965. *Geologic Report on Drill Hole UE11a, Nevada Test Site*. U.S. Geological Survey Technical Letter NTS-160.
- Freeze, R. A., and J. A. Cherry, 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, NJ.

- Gee, G. W., M. D. Campbell, G. S. Campbell, and J. H. Campbell, 1992. *Rapid Measurement of Low Soil Water Potential Using a Water Activity Meter*. Soil Science Society of America Journal, v. 56, pp. 1,068-1,071.
- Hammermeister, D. P., D. O. Blout, and J. C. McDaniel, 1986. "Drilling and Coring Methods that Minimize the Disturbance of Cuttings, Core, and Rock Formations in the Unsaturated Zone, Yucca Mountain, Nevada." *In: Proceedings of the NWWA Conference on Characterization and Monitoring of the Vadose (Unsaturated) Zone, Denver, CO, 1985*, pp. 506-541. National Water Well Association, Worthington, OH.
- Hillel, D., 1980. Fundamentals of Soil Physics. Academic Press, New York, NY.
- Ingraham, N. L. and C. Shadel, 1992. *A Comparison of the Toluene Distillation and Vacuum/Heat Methods for Extracting Soil Water for Stable Isotope Analysis*. Journal of Hydrology, v. 140, pp. 371-387.
- Jacobs, J. W., R. L. Korotev, D. P. Blanchard, and L. A. Haskins, 1977. *A Well-Tested Procedure for Instrumental Neutron Activation Analysis of Silicate Rocks and Minerals*. Journal of Radioanalytical Chemistry, v. 40, pp. 93-114.
- Katz, D. L., D. Cornell, R. Kobayashi, F. H. Poettmann, J. A. Vary, J. R. Elenbaas, and C. F. Weinug, 1959. Handbook of Natural Gas Engineering. McGraw-Hill, New York, NY.
- Klute, A. L., 1986. "Water Retention: Laboratory Methods - Falling Head Method." *In: Klute, A. L. (ed.), Methods of Soil Analysis, Part I, Physical and Mineralogical Methods, 2nd Edition*, American Society of Agronomy, Madison, WI. Chapter 26, pp. 635-641.
- Klute, A. L., and C. Dirksen, 1986. "Hydraulic Conductivity and Diffusivity: Laboratory Methods - Falling Head Method." *In: Klute, A. L. (ed.), Methods of Soil Analysis, Part I, Physical and Mineralogical Methods, 2nd Edition*, American Society of Agronomy, Madison, WI. Chapter 28, pp. 700-703.
- Los Alamos National Laboratory, 1991. *Draft Procedure for Using Ion Chromatography to Determine Chloride and Bromide Concentrations*. Los Alamos National Laboratory Internal Report, LANL-INC-DP-94.R0, pp. 3-25.
- Los Alamos National Laboratory, 1992. *Sample Leaching to Extract Soluble Chloride and Bromide*. Los Alamos National Laboratory Internal Report, LANL-INC-DP-92.R0, pp. 3-15.
- Los Alamos National Laboratory, 1993. *Draft Procedure for Preparation of Samples for Chlorine-36 Analysis*. Los Alamos National Laboratory Internal Report, March 16, 1993. LANL-INC-DP-95.R1, pp. 3-14.
- Morris, G. A., D. Snoeberger, C. Morris, and V. Du Val, 1971. *Field Measurements of Permeability of NTS Alluvium in Area 10*. Lawrence Radiation Laboratory Report UCID-15919.

- Mualem, Y., 1976. *A New Model for Predicting the Hydraulic Conductivity of Unsaturated Porous Media*. Water Resources Research, v. 12, pp. 513-522.
- Nelson, R. E., 1982. "Carbonate and Gypsum: Pressure-Calcimeter Method." In: Page, A., R. H. Miller, and D. R. Keeney (eds.), *Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties, 2nd Edition*, American Society of Agronomy, Madison, WI. Chapter 11, pp. 188-192.
- Norrish, K., and B. W. Chappell, 1977. "X-Ray Fluorescence Spectrometry." In: Zussman, J. (ed.), *Physical Methods in Determinative Mineralogy, 2nd Edition*, Academic Press, New York, pp. 210-272.
- Norrish, K. and J. T. Hutton, 1969. *An Accurate X-Ray Spectrographic Method for the Analysis of a Wide Range of Geochemical Samples*. Geochimica et Cosmochimica Acta Journal, v. 33, pp. 431-453.
- Pasternak, A., and E. T. McMullen, 1970. *Field Measurement of the Permeability of NTS Alluvium*. Lawrence Radiation Laboratory Report UCID-15727.
- Phillips, F. M., J. L. Mattick, T. A. Duval, D. Elmore, and P. W. Kubick, 1988. *Chlorine-36 and Tritium from Nuclear Weapons Fallout as Tracers for Long-Term Liquid and Vapor Movement in Desert Soils*. Water Resources Research, v. 24, pp. 877-891.
- Poole, F. G., 1965. *Geologic Map of the Frenchman Flat Quadrangle, Nye, Lincoln, and Clark Counties, Nevada*. U.S. Geological Survey Map GQ-456.
- Raytheon Services Nevada, 1990. *Nevada Test Site Drilling and Mining Summary*. Available from Bechtel Nevada, Mercury, NV.
- Raytheon Services Nevada, 1991. Written communication. Subject: *Surficial Geology of the Area 5 Radioactive Waste Management Site, Interim Report*. Prepared for U.S. Department of Energy Nevada Operations Office. Las Vegas, NV.
- REEC Co, see Reynolds Electrical and Engineering Co.
- Reynolds Electrical and Engineering Co., Inc., 1993a. *Hydrogeologic Data for Science Trench Boreholes at the Area 5 Radioactive Waste Management Site, Nevada Test Site, Nye County, Nevada*. Special Projects Section, Environmental Management Division. Las Vegas, NV.
- Reynolds Electrical and Engineering Co., Inc., 1993b *Hydrogeologic Data for Existing Excavations at the Area 5 Radioactive Waste Management Site, Nevada Test Site*. Special Projects Section, Environmental Management Division. Las Vegas
- Rousseau, J., U.S. Geological Survey, 1993. Personnel communication regarding calibration and operation of thermistors at Yucca Mountain.

Rozsa, R. B., D. F. Snoeberger, and J. Baker, 1975. *Permeability of a Nuclear Chimney and Surface Alluvium, Area 2, ERDA, NTS*. Lawrence Livermore Laboratory Report UCID-16722.

RSN, see Raytheon Services Nevada.

Snoeberger, D. F., J. Baker, C. J. Morris, and R. B. Rozsa, 1974. *Permeability of a Nuclear Chimney and Surface Alluvium at the AEC Nevada Test Site*. Lawrence Livermore Laboratory Report UCID-16479.

Sully, M. J., D. E. Cawfield, D. O. Blout, L. E. Barker, B. L. Dozier, and D. P. Hammermeister, 1993. *Characterization of the Spatial Variability of Hydraulic Properties of an Arid Region Vadose Zone*, EOS Trans., American Geophysical Union, 74 (43), Fall Meeting, Supplement 286.

Tabatabai, M. A., 1982. "Sulfur: Inorganic Sulfate." In: Page, A. L., R. H. Miller, and D. R. Keeney (eds.), *Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties, 2nd Edition*, American Society of Agronomy, Madison, WI. Chapter 28, pp. 518-522.

Tyler, S., 1986. "Moisture Monitoring in Large Diameter Boreholes." In: *Proceedings of the NWWA Conference on Characterization and Monitoring of the Vadose (Unsaturated) Zone*, Denver, CO, 1985, pp. 97-106. National Water Well Association, Worthington, OH.

USEPA, see U.S. Environmental Protection Agency.

USGS, see U.S. Geological Survey.

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office, 2002. *Nevada Test Site Annual Site Environmental Report for Calendar Year 2001*. Prepared by Bechtel Nevada. Report DOE/NV/11718--747. Las Vegas, NV.

U.S. Environmental Protection Agency, 1982. *Methods for Chemical Analysis of Water and Wastes*. EPA-600/4-82-055.

U.S. Environmental Protection Agency, 1986. *USEPA Method 9060, Total Organic Carbon*. Test Methods for Evaluating Solid Waste (SW-846), Chapter 5, Miscellaneous Test Methods. 5 pp.

U.S. Geological Survey, 1990. *Method for Thermistor Calibration and Testing in a USGS Controlled Temperature Environment Laboratory*. USGS Technical Procedure NWM-USGS-HP-162, R0, Draft, 9/10/90.

U.S. Geological Survey, 1993. *Method for Calibrating Peltier-Type Thermocouple Psychrometers for Measuring Water Potentials of Partially Saturated Media*. USGS Technical Procedure NWM-USGS-HP-14, R2.

van Genuchten, M. Th., 1978. *Calculating the Unsaturated Hydraulic Conductivity with a New Closed-Form Analytical Model*. Water Resources Program, Dept. of Civil Engineering, Princeton Univ., Princeton, NJ Res. Rpt. 78-WR-8, 63p.

van Genuchten, M. Th., 1980. *A Closed-Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils*. Soil Science Society of America Journal, v. 45, pp. 892-898.

Winograd, I. J., and W. Thordarson, 1975. *Hydrogeologic and Hydrochemical Framework, South-Central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site*. U.S. Geological Survey Professional Paper 712-C.

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**Site Characterization and Monitoring Data from
Area 5 Pilot Wells**

Appendices A Through I

Errata to the Pilot Well Report Appendix

APPENDIX

All	Correct borehole designations: UE5PW-1, UE5PW-2, and UE5PW-3.
Table	F.2.1 Magnetic Survey Data should be F.2.2.
Table	Add: F.5.2 Results of Hydraulic Conductivity Recovery Tests.
Table	Appendix I title is "Vadose Zone Calibration and Monitoring Data".
D.1.3	Para. 5, line 4, should be "...a centralizer...".
E.1.2.2	Heading should be "Elemental...".
E.2.4	Heading should be "E.2.4".
G.3.1.1	Should contain the USCS profiles for the Calibration Boreholes found in Appendix E.1.1.
H.1	Section "Samples Collection and Preservation Methods", new first paragraph: Groundwater samples were collected with a submersible stainless-steel gas-operated double-action pump operated at a flow rate of approximately 2 l/min. Static water level was measured prior to well evacuation. The well was prepared for sampling by purging three wellbore volumes from the well casing. Water temperature, pH, specific conductance, and redox potential were monitored during purging and sample collection.
H.1	Section "Sample Collection and Preservation Methods", Para. 2, line 4, should be "...filtered...".
H.1	Section "Groundwater Analytical Results", para. 2, delete sentences 6 and 7, replace with "The 0.009 mg/l Pb value is less than the primary standard of 0.05 mg/l. Dissolved Pb was detected in a single sample at a concentration of 0.009 mg/l and found to be less than the detection limit in the duplicate."
H.1	Section "Groundwater Analytical Results", para. 2, line 10, delete "...also...".
H.1	Section "Groundwater Analytical Results", para. 3, Add last sentence: High levels of manganese can affect drinking water taste and stain laundry.
H.1	Section "Groundwater Analytical Results", para. 10, line 2, delete "...uncertainties..." and replace with "...a measurement uncertainty...".
H.1	"Table 1 Groundwater Sample Containers and Preservation", Dissolved Silver Volume should be "500 ml".
I.3	Para. 6, line 2 should be "...a straight line....".

List of Appendices

A. Drilling Information

- A.1 Chronological Drilling Summary for UE5PW-1
- A.2 Chronological Drilling Summary for UE5PW-2
- A.3 Chronological Drilling Summary for UE5PW-3
- A.4 Drilling Penetration Rate Data for Pilot Wells

B. Core and Drill Cuttings Sample Description Data

- B.1 Borehole Log Sheets for UE5PW-1
- B.2 Borehole Log Sheets for UE5PW-2
- B.3 Borehole Log Sheets for UE5PW-3
- B.4 Drill Cuttings Log Data for UE5PW-1
- B.5 Drill Cuttings Log Data for UE5PW-2
- B.6 Drill Cuttings Log Data for UE5PW-3

C Tracer (SF_6) Test Data

- C.1 UE5PW-1 SF_6 Data from Core Samples and Compressor Air Lines
- C.2 Formation SF_6 Tracer Gas Concentrations

D Completion Data

D.1 Pilot Well Completion

- D.1.1 Annular Materials
- D.1.2 Preparation for Completion
- D.1.3 Casing and Instrumentation Installation Detail
- D.1.4 Stemming Detail
- D.1.5 Completion Operations Safety

D.2 Pilot Well Stemming Summaries

- D.2.1 UE5PW-1 Stemming Summary
- D.2.2 UE5PW-2 Stemming Summary
- D.2.3 UE5PW-3 Stemming Summary

D.3 Pilot Well Casing Tallies

- D.3.1 UE5PW-1 Casing Tally
- D.3.2 UE5PW-2 Casing Tally
- D.3.3 UE5PW-3 Casing Tally

List of Appendices *(Continued)*

D.4 Pilot Well Daily Activities

D.4.1 UE5PW-1 Daily Activity

D.4.2 UE5PW-2 Daily Activity

D.4.3 UE5PW-3 Daily Activity

E Laboratory Testing Data of Geologic Samples

E.1 Stratigraphy and Mineralogy Data

E.1.1 Profiles of USCS Textural Classes

E.1.2 XRF and INAA Data

E.1.2.1 Oxide Composition Data Determined by Major Elements XRF and INAA Methods for Core Samples from UE5PW-1

E.1.2.2 Elemental Composition Data Determined by INAA and Trace Element XRF Methods for Core Samples from UE5PW-1

E.1.2.3 Oxide Composition Data Determined by Major Elements XRF and INAA Methods for Core Samples from UE5PW-2

E.1.2.4 Elemental Composition Data Determined by INAA and Trace Element XRF Methods for Core Samples from UE5PW-2

E.1.2.5 Oxide Composition Data Determined by Major Elements XRF and INAA Methods for Core Samples from UE5PW-3

E.1.2.6 Elemental Composition Data Determined by INAA and Trace Element XRF Methods for Core Samples from UE5PW-3

E.2 Material, Hydrologic, and Geochemical Parameter Data for Alluvial Samples

E.2.1 Results of Laboratory Tests for Core Samples from UE5PW-1

E.2.2 Results of Laboratory Tests for Core Samples from UE5PW-2

E.2.3 Results of Laboratory Tests for Core Samples from UE5PW-3

E.2.4 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-1

E.2.5 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2

E.2.6 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-3

E.2.7 Moisture Retention Data for Core Samples from UE5PW-1

E.2.8 Moisture Retention Data for Core Samples from UE5PW-2

E.2.9 Moisture Retention Data for Core Samples from UE5PW-3

E.2.10 Parameters Required to Calculate Unsaturated Hydraulic Conductivities for Core Samples

List of Appendices (Continued)

- E.3 Material, Hydrologic, and Geochemical Parameter Data for Tuff Samples
 - E.3.1 Results of Laboratory Tests for Tuff Core Samples from UE5PW-3
 - E.3.2 Results of Laboratory Tests for Tuff Drill Cuttings Samples from UE5PW-3
- E.4 Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples

F Field Test Data

- F.1 Near-Surface Soil Gas Surveys
 - F.1.1 Surface Soil Sampling, Analysis, and Results
 - F.1.2 Near-Surface Radon and Tritium Gas Sampling, Analysis, and Results
- F.2 Surface Geophysical Surveys
 - F.2.1 Resistivity Survey Data
 - F.2.2 Magnetic Survey Data
- F.3 Borehole Geophysical Surveys
 - F.3.1 Description of Borehole Geophysical Logging Tools Used
 - F.3.2 Borehole Geophysical Logs Run in UE5PW-1 on 4/20/1992
 - F.3.3 Borehole Geophysical Logs Run in UE5PW-1 on 6/16/1992
 - F.3.4 Borehole Deviation Logs Run in UE5PW-1 on 2/24/1993
 - F.3.5 Borehole Geophysical Logs Run in UE5PW-2 on 7/20/1992
 - F.3.6 Borehole Geophysical Logs Run in UE5PW-2 on 9/28/1992 and 9/29/1992
 - F.3.7 Borehole Deviation Logs Run in UE5PW-2 on 2/25/1993
 - F.3.8 Borehole Geophysical Logs Run in UE5PW-3 on 9/28/1992
 - F.3.9 Borehole Geophysical Logs Run in UE5PW-3 on 11/18/1992
 - F.3.10 Borehole Deviation Logs Run in UE5PW-3 on 2/25/1993
- F.4 In-Situ Air Permeability Testing Data
 - F.4.1 Dimensions of Air Permeability Testing Interval for the Pilot Wells
 - F.4.2 In-Situ Air Permeability Testing Data
 - F.4.3 Effective Air Permeabilities and Inertial Coefficients for Field Testing in the Pilot Wells
- F.5 Upper Aquifer Hydraulic Parameter Testing
 - F.5.1 Estimating the Water Table Slope under the Area 5 RWMS
 - F.5.2 Results of Hydraulic Conductivity Recovery Tests

List of Appendices (Continued)

G Data from Neutron Logging Calibration Boreholes

G.1 Drilling Information

- G.1.1 Chronological Drilling Summary for UE5PW-2A, 2B, and 2C
- G.1.2 Core Record for UE5PW-2A, 2B, and 2C
- G.1.3 Nevada State Central Zone Coordinates for Neutron Logging Calibration Boreholes

G.2 Core and Drill Cuttings Sample Description Data

- G.2.1 Borehole Log Sheets for UE5PW-2A
- G.2.2 Borehole Log Sheets for UE5PW-2B
- G.2.3 Borehole Log Sheets for UE5PW-2C
- G.2.4 Drill Cuttings Log Data for UE5PWW-2A
- G.2.5 Drill Cuttings Log Data for UE5PWW-2B
- G.2.6 Drill Cuttings Log Data for UE5PWW-2C

G.3 Laboratory Testing Data of Geologic Samples

G.3.1 Stratigraphy and Mineralogy Data

- G.3.1.1 Summary of USCS Group Names for Core and Drill Cuttings Samples from Calibration Boreholes
- G.3.1.2 Results from XRF and INAA for Core Samples from UE5PW-2A
- G.3.1.3 Results from XRF and INAA for Core Samples from UE5PW-2B
- G.3.1.4 Results from XRF and INAA for Core Samples from UE5PW-2C

G.3.2 Material, Hydrologic, and Geochemical Parameter Data

- G.3.2.1 Results of Laboratory Tests for Core Samples from UE5PW-2A
- G.3.2.2 Results of Laboratory Tests for Core Samples from UE5PW-2B
- G.3.2.3 Results of Laboratory Tests for Core Samples from UE5PW-2C
- G.3.2.4 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2A
- G.3.2.5 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2B
- G.3.2.6 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2C
- G.3.2.7 Summary of Descriptive Statistics of Alluvial Samples from UE5PW-2A, UE5PW-2B, and UE5PW-2C

G.4 Field Test Data

- G.4.1 Site Preparation Information

List of Appendices (Continued)

G.4.2 Neutron-Moisture Meter Data

G.4.2.1 Neutron-Moisture Meter Data for UE5PW-2A

G.4.2.2 Neutron-Moisture Meter Data for UE5PW-2B

G.4.2.3 Neutron-Moisture Meter Data for UE5PW-2C

G.4.3 Calibration of the Neutron-Moisture Meter in the Calibration Boreholes

H Upper Aquifer Water Quality Data

H.1 RCRA Groundwater Sampling and Analysis Methods and Results

H.2 Preliminary General Water Chemistry

I Vadose Zone Calibration and Monitoring Data

I.1 Thermistor Calibration Data

I.2 Preliminary Temperature Monitoring Data

I.3 Pressure Transducer Calibration Data

I.4 Preliminary Pressure Monitoring Data

I.5 Thermocouple Psychrometer Calibration Data

I.6 In Situ Thermocouple Psychrometer Monitoring Data

Area 5 Pilot Wells

APPENDIX A Drilling Information

- A.1 Chronological Drilling Summary for UE5PW-1
- A.2 Chronological Drilling Summary for UE5PW-2
- A.3 Chronological Drilling Summary for UE5PW-3
- A.4 Drilling Penetration Rate Data for Pilot Wells

Appendix A.1 Chronological Drilling Summary for Ue5PW-1

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
3-2				Mobilized from Mesquite, NV to Mercury and processed in.
3-3				Set up accounts in Las Vegas. Checked site and set trailer.
3-4				Met with REEC Co for Turtle Training & Safety Meetings. Went to Las Vegas for under-reamer and steam cleaner.
3-5				Set up steam cleaner and cleaned rods and subs.
3-6				Steam cleaned equipment and rigged up. Under reamer defective.
3-9				John Eddy interviewed drill helpers. Helpers not qualified. Built dump for cyclone. Put Odex together.
3-10				John Eddy interviewed drill helpers.
3-11				Picked up parts and helper in Las Vegas.
3-12				Machined 10 3/4" casing shoe & anvil. Inventoried casing.
3-13	27.5	10.75		Odex bit wouldn't unlock. Hammer was not firing. Plugged "blooie" line. Made T-line to cyclone. Wrong core barrel threads. Very loose ground. No core recovery in three attempts.
3-14				Worked on rig. Built second sling and worked on leaks.
3-15				Cut down sub for sampler, but it still wouldn't work. Picked up parts in Las Vegas.
3-16				Waited on sub for drive sampler.
3-17	37.5	10.75	1	Had to drive sampler w/rig hydraulics. Ran air perm tests. Need 2nd air compressor.
3-18	57.5	10.75	2, 3, 4	Hooked up second air compressor and changed return system. Casing sinking into hole @ 42.5'.

Appendix A.1 Chronological Drilling Summary for Ue5PW-1 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
3-19	97.5	10.75	5, 6, 7	Rigged casing to cyclone return. No recovery 87.5-90'. Broke threads on core barrel & shoe. Switched to rope threads. Pressed sampler w/hydraulics.
3-20	117.5	10.75	8	Casing turning in hole. Hammer was difficult to remove. Ran air perm tests at bottom of core run.
3-23				Re-routed air to hammer. Cleaned out hole. Tripped in with sampler.
3-24	137.5	10.75	9,10,11,12	No recovery 127.5-130'. Welded seat valve in core sub. Upper part of core barrel (fill material) had some oil contamination.
3-25				Had Tonto/REEC Co meeting.
3-26				Proposed changeover to 7" dual wall R. C. Rods.
3-27				Unloaded 7" dual wall R. C. rods. Started changeover to 7 rods."
3-28				Went to Las Vegas for parts.
3-29				Installed 4" king swivel, broke down Odex hammer and rigged boom truck.
3-30				Steam cleaned rods and equipment.
3-31				Changed over to 7" dual wall R. C. rods.
4-1				Changed over to 7" dual wall R. C. rods.
4-2				Changed over to 7" dual wall R. C. rods. Drove to Las Vegas for supplies.
4-3				Completed changeover. Tested equipment. Surveyed hole with camera.
4-4				Cleaned up site. Steam cleaned and tested equipment.
4-6	147.5	10.75	13, 14	No recovery 147.5-149.9' w/mobile sampler.

Appendix A.1 Chronological Drilling Summary for Ue5PW-1 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
4-7	157.5	10.75	15, 16	Ran air perm tests before core runs. High compressor flow rate (>1000 C.F.M.) melted wire for air perm test. Rotary core 150-155'. Oil contamination in upper core barrel in Run 15.
4-8	177.5	10.75	17, 18	
4-9	217.5	10.75	19	Replaced dust hose.
4-10	257.5	10.75	20, 21	
4-11				Drove to Las Vegas for parts.
4-12				Built line guide for wireline.
4-13	277.5	10.75	22, 23	Surveyed hole with camera.
4-14	317.5	10.75	24	40,000 Lbs. required to pull out sampler. Sampler became oblonged.
4-15	337.5	10.75	25, 26	Rotary core 337.5-342.5'. No recovery.
4-16	357.5	10.75	27	Fished hammer out of hole.
4-17	370	10.75	28	Hammered through casing shoe (casing shoe wore out.) Started changeover to 8".
4-18				Ran for parts. Cleaned 4 x 4 truck.
4-20				Century Geophysical ran deviation, density, K.U.T. neutron and induction logs. Changed over to 8 5/8" casing.
4-21				Century Geophysical ran K.U.T. and neutron logs. Ran 8 5/8" casing in hole. Shut down due to lightning.
4-22	417.5	8.625	29	
4-27	420	8.625		Odex modifications. Prepared and ran 4" casing with centralizers to 320'.
4-28				Ran HMQ rods to 424.5'. Odex modifications & securing casing.

Appendix A.1 Chronological Drilling Summary for Ue5PW-1 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
4-29	427.5	8.625	2 Unnumbered	Rigged dust head and hose to cyclone. Rotary core w/no recovery. Core runs were not numbered due to no recovery. Air was leaking through split barrel. Casing unscrewed. Casing locked in core rods.
4-30				Pulled out casing and rods. Had to cut casing with torch.
5-1	457.5	8.625	30	Had trouble getting Odex loose.
5-2				Performed service and maintenance on rig.
5-4	497.5	8.625	31	Hydraulic pump needed repairs.
5-5				Hydraulics repaired and lines bled.
5-6	537.5	8.625	32	Shutdown due to lightning.
5-7	612.5	8.625	33	Some oil in cuttings. Drilled through casing shoe.
5-8				Repaired leaking hydraulic hoses. Casing stuck.
5-9				Move filter for air system. Repair 4 x 4 truck. Drove to Reno for casing pulling hammer.
5-10				Returned from Reno with casing puller.
5-11				Casing stuck. Shoe wore out in last 70'. Pulled on casing. 4" stretch on casing.
5-12				Waiting for casing jacks.
5-13				Waiting and rigging up for casing spear, grapple and jacks. Pulled top 10' of casing.
5-14				Ran camera survey at 580'. Pulled rods. Built dust head and hoist plug.
5-15				Steam cleaned 7" casing. Set and hooked up jacks.

Appendix A.1 Chronological Drilling Summary for Ue5PW-1 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
5-16				Assembled Bowens spear. Began pulling casing w/114K lbs. on jacks and 60K lbs. on rods. Cracked HUSCO hydraulic valve. Casing wedged. Pulled 20' of casing.
5-17				Serviced and washed 4 x 4 truck.
5-18				Pulled out 460' of casing.
5-19				Finished pulling out casing. Shoe broken. Casing grade too soft for formation and joints didn't butt. Bottom tagged at 500'. Repaired hydraulic high speed gear box.
5-20				Repaired rig.
5-21				Met w/Tonto, REEC Co SPS & REEC Co Contracts Administration to discuss repairs and changes.
5-22				Replaced hoses and fittings. Ran casing to 490'.
5-26				Rigged and changed side air routing. Geograph to be installed. Welded casing head. Run 8 1/2" casing in to 600'. Reamed casing from 490-600'.
5-27	627.5	8.625	34	Reamed fan casing to 617.5'. Cleaned hole. Some oil contamination was in core.
5-28	657.5	8.625	35	Serviced rig.
5-29	697.5	8.625	36	Steam cleaned system. Some oil contamination was in core.
5-30				Steam cleaned rods. Mounted geograph. Cleaned air system.
5-31				Mounted 8" dumpgate on cyclone.
6-1	717.5	8.625	37	Steam cleaned rods for 8" Odex. Drilling was shut down until oil can be removed from "fill" in core runs.

Appendix A.1 Chronological Drilling Summary for Ue5PW-1 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
6-2				Made conference call: Tonto and REECe, re: compressor and line filters and misters on radiators. Drove to Las Vegas for parts.
6-3				Ran Tricone bit to 724.5'. Waiting on solid tube samplers. Changed separator filters and compressor oil filters. Rigged cat pump.
6-4			38	Rigged 5' core sampler. Core barrel broke off at back head in hole.
6-5	727.5	8.625		Drilled over core barrel w/4 7/8" x 5' barrel to retrieve. Retrieved sampler.
6-8	757.5	8.625	39	Replaced casing hoist cable.
6-9	767.5	8.625	40	Changed filters.
6-10			41	Re-designed cross bar for side air. Was shut down due to drill helper injury.
6-11	778.5	8.625	42	Had safety meeting. Very moist cuttings.
6-12	830	8.625	43	Water level at 778.25'. Bailed water for sample. Cleaned hole.
6-13				Serviced drill rig and 4 x 4 truck. Repaired hydraulic leaks.
6-14				Drove to Las Vegas for parts.
6-15				Water level at 771.7'. Bailed water for sample. Sand heaved in hole to 823' (7' of sand)
6-16	839	8.625		T.D. hole. Bailed hole for water sample. Ran recovery test. Moved rig off hole. Hole caved to 825' according to Century Geophysical. Ran gamma, neutron and density logs. Moved drill rig off hole.
6-17				Century Geophysical ran deviation, gamma, neutron density and K.U.T. logs.
7-13				Stemming rig set up on hole.
11-19				Century Geophysical ran neutron log.

Appendix A.2 Chronological Drilling Summary for Ue5PW-2

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
6-17				Moved rig, trailer and casing to site.
6-18	17.5	10.75	1	Spuded hole.
6-19				Eight hours standby without crew.
6-22	47.5	10.75	2, 3	Casing parted in hole. Stripped threads in core barrel. Pulled casing.
6-23				Reamed casing back in hole. Surveyed hole with camera.
6-24	97.5	10.75	4, 5	
6-25	157.5	10.75	6, 7	
6-26	197.5	10.75	8	Sampler broke off in hole. Retrieved sampler. Generator leaking oil.
6-27				Changed filter location and dust bag. Rig maintenance.
6-29	247.5	10.75	9	Unable to unscrew sampler off sub. Had to cut off sampler sub with torch.
6-30	307.5	10.75	10	
7-1	357.5	10.75		Cleaned hole. Steam cleaned rods for 8" Odex system. Waited for casings to arrive.
7-2				Rig on standby due to running out of 10" casing.
7-7				Steam cleaned rods and replaced discs on interchange of 8" Odex system. 15-10 $\frac{3}{4}$ " x 10' sections of casing arrived. Seven were damaged.
7-8				Steam cleaned 4 $\frac{1}{2}$ " rods and casing. Tonto/REEC; met in Las Vegas.
7-9	397.5	10.75	11	Casing shoe wearing out. Shoe 1.5-1.75". Had to cut off sampler shoe. Broke hydraulic line.
7-10	400	10.75		Drove through shoe. Standby waiting for shoe joint. Will telescope to 8 $\frac{5}{8}$ " casing.
7-13				Tripped in hole w/8 $\frac{5}{8}$ " casing. Inventoried equipment.
7-14	477.5	8.625		Generator problems. Was producing 300 volts.

Appendix A.2 Chronological Drilling Summary for Ue5PW-2 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
7-15	497.5	8.625	12, 13	Core barrel unthreaded in hole. Tripped in rotary core barrel to retrieve.
7-16	547.5	8.625		Pulled 8 $\frac{1}{2}$ " casing to loosen. Ran in fishing tool.
7-17			14	Moved off hole.
7-20				Century Geophysical ran K.U.T. log.
7-21				Moved back on hole. Steam cleaned pipe.
7-22	617.5	8.625		Continued drilling PW-2. Had to pull up casing at 587.5, 597.5 & 607.5' to loosen. Many boulders and cobbles.
7-23	647.5	8.625	15	Pulled up casing to loosen at 647.5'.
7-24	700.0	8.625		Pulled up casing to loosen at 657.5, 667.5, 687.5 and 697.5.
7-25				Repaired sprockets on chain pull down.
7-27	707.5	8.625	16	Rotary core 700-705'. Pulled up casing to loosen.
7-28	717.5	8.625		Casing shoe parted in hole.
7-29				Broke hydraulic line while pulling out casing.
7-30				Replaced hydraulic hose. Dug cellar for jacks.
7-31				Set jacks over 10" casing. Pulled casing back 10'. Blew another hoist hose. Pulled 70,000 lbs. on top and on bottom to move casing. Replaced all hoses with 6000 psi rating.
8-1				Pulled and replaced sprockets and adjusted chains. Replaced hydraulic fittings and gauges. Repaired hydraulic cooler. Changed hydraulic and compressor filters.
8-3				Tripped out w/8 $\frac{1}{2}$ " casing. Tripped in w/120' of casing.
8-4				Casing down to 660'. 60' of "cave" in hole. Replaced casing hoist system w/R. C. side air. Reamed casing to 680'.

Appendix A.2 Chronological Drilling Summary for Ue5PW-2 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
8-5	717.5	8.625	17	Cleaned out hole.
8-6	747.5	8.625	18	Changed compressor filters.
8-7	817.5	8.625		Moist below 797.5'. Pulled casing up to loosen.
8-8				Pulled and replaced sprockets and adjusted chains. Replaced hydraulic fittings and gauges. Repaired hydraulic cooler. Changed hydraulic and compressor filters.
8-10	828.5	8.625	19	
8-11	839.0	8.625	20, 21	Had to cut off sampler shoe to remove a core run #20.
8-12			22	160' of drill rod and sampler unscrewed and fell down hole. Was unsuccessful at spearing attempts.
8-13				Drill string fell 120'. Tripped in w/Sandia video camera. Drill R.C. rod pushed into drill pipe. Tripped in w/wall hook and overshot. Unable to pull.
8-14				Pulled on fishing tool.
8-15				Rigged and ran "jars." Ran at 50K-70K lbs., but nothing moved.
8-17				John Eddy went to Fontana, CA for casing puller.
8-18				Rigged jacks. Jacked casing and jarring rods. Casing jacked 3.5', but rods still stuck.
8-19				Jarring rods at 70K-80K lbs. Broke pull-down chains. Repaired chains. Rigged to jack casing and rods at same time. Jacked at 90K-190K lbs. with grapple in overshot. Broke loose. Pulled overshot.
8-20				Ran rods open ended and screwed into fish. Worked rods and jacked rods and casing. Rods moved 8" then became stuck. Top head froze up.

Appendix A.2 Chronological Drilling Summary for Ue5PW-2 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
8-21				Pulled off top head motor and took to Las Vegas for repairs. Motor beyond repair. Driller reports that failure caused by jarring.
8-24				Installed new rotation motor. Cleaned out metal from hydraulic system.
8-25				Flushed and drained system. Jacked casing and pulled rods at 210K PSI. No success. Broke inserts in dog collars.
8-26				Jacked casing to 210,000 lbs. Casing moved 1.5". Added 50 gal., of KBr, 60ppm, tracer solution to hole.
8-27				Was unsuccessful at retrieving w/spear, overshot and sinker bar. Everything behind hammer, backhead was retrieved.
8-28				Photo taken of hole bottom. Drilled over top of sampler, but couldn't retrieve. Ordered larger drillover.
8-31				Was unsuccessful at retrieving w/5" diameter core (PWC) barrel. Retrieved hammer and sampler w/SWC casing overshot by coring to 848.2' and pouring sand down rods to "sand lock" sampler and hammer.
9-1				Removed hammer from SWC drillover. Tripped in w/Odex. Couldn't pull up casing. Top threads dented.
9-2	867.5	8.625		Made up casing spear for top. Pulled back casing.
9-3	888.5 ±	8.625		Hole yielded water overnight at 848' ±. Took water sample.
9-4	911 T.D.	8.625		Drilled to T.D. Blew out hole and ran recovery test. Pulled out jacks.
9-8				Water level at 840.4'.
9-9				Tore down and rebuilt XL-4 hammer.
9-10				Tripped out w/Odex. Water level at 840.7'. Bottom of hole "tagged" at 910.2'. Bailed hole w/bailer.

Appendix A.2 Chronological Drilling Summary for Ue5PW-2 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
9-11				Steam cleaned rods and rig. Rigged down. Loaded rods and equipment with crane.
9-12				John Eddy went over inventory and equipment list for REECo.
9-14				Moved rig off hole.
9-29				Century Geophysical ran neutron and gamma logs.
10-5				Stemming rig set up on hole.
11-13				John Eddy moves T4W rig back on hole to free casing.
11-14				Ran Odex in hole and freed casing. Casing broke.
11-15				Replaced hydraulic cooler fan motor.
11-16				Waiting on logging truck to log casing break.
11-17				Worked Odex loose and pulled rods. Century Geophysical ran caliper log.
11-18				Ran in hole with spear. Century Geophysical ran compensated density and neutron, K.U.T., E-log, induction, resistivity short guard and deviation logs.
11-19				Worked bottom casing joint free. Pulled up and attempted to hook top piece, but spear wouldn't grab. Need new grapple.
11-20				Ran spear to 400'. Lost hydraulic pump.
11-21				Replaced pump. Ran spear and speared casing #1 and pulled back 20'. Speared casing #2 and pulled back 20' but casing stopped. Unhooked and pulled back into casing #1. Grapple wouldn't grab. Pulled out spear.
11-22				Returned w/new grapple. Pulled casing back 5', but casing stuck again.
11-23				Spear wouldn't work. Ordered new spear.

Appendix A.2 Chronological Drilling Summary for Ue5PW-2 (Continued)

[illegible]

Appendix A.3 Chronological Drilling Summary for Ue5PW-3

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
9-14				Mobilized and setup rig.
9-15				Most equipment on site. Fork lift dropped pipe and casing.
9-16	47.5	10.75	1, 2, 3	Rigged Odex hammer and casing with floor plate. Revised pipe damage list.
9-17	127.5	10.75	4, 5	
9-18	197.5	10.75		Extensive coarse-grained alluvium with <5% silt.
9-21	247.5	10.75	6, 7	Surveyed hole with camera.
9-22	327.5	10.75		Hooked up SF ₆ gas to air system. Meter doesn't work.
9-24	377.5	10.75	8	
9-25	450.0	10.75	9	Surveyed hole with camera. Extensive fine SM debris flows 387.5-417.5'. Shoe worn.
9-26				Serviced rig and 4 x 4 truck.
9-28				Century geophysical ran neutron density and K.U.T. logs. Steam cleaned 8" casing.
9-29	455	8.625	10	Tripped in with 8½" casing and Odex.
9-30	497.5	8.625	11	
10-1	557.5	8.625	12	
10-2	617.5	8.625	13	Slow drilling due to scattered boulders <2.5' diam.
10-5	637.5	8.625		Surveyed hole with camera. Ammonia Tanks welded tuff at 617.5' ±
10-6			14	HQ rotary core 638.25-643.5'. Set jacks.
10-7				Broke pull-down chain. Down until next week while custom chain being made.
10-13				Replaced chain and sprockets. Pulled casing up 25' to loosen.
10-14	663.0	8.625		Pulled casing back to 577'. Reamed back to bottom. Drove through casing.

Appendix A.3 Chronological Drilling Summary for Ue5PW-3 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
10-15				Tripped in casing spear and pulled out casing.
10-16				Extracted spear from casing and loaded for shipping.
10-19				No drilling — waiting on new casing shoe.
10-20				Tripped in w/8 $\frac{1}{2}$ " casing to 625' (top of cave).
10-21	687.5	8.625	15	Built up Odex.
10-22				No drilling. Tonto/REEC Co meeting, re: payment.
10-23	727.5	8.625		Scattered thin fractured, Mafic and Ash zones in cuttings. Repaired antifreeze and hydraulic leaks. Changed under reamer bit. Pulled back every 10' to keep casing free.
10-26	767.5	8.625		Hard drilling. Casing tight.
10-27	770.0	8.625		Milled out casing shoe w/casing reamer. 400 gallons of water were injected and 200 gallons were recovered.
10-28				Tripped out w/reamer. Built casing brake and seal for 7 $\frac{1}{2}$ " casing.
10-29				Tripped in w/7 $\frac{1}{2}$ " casing and Odex.
10-30	795.0	7.625		Difficult to get 7 $\frac{1}{2}$ " casing started in hole. Had to rotate casing while drilling.
11-2	822.5	7.625		Odex reamer was worn out. Pulled back 8 $\frac{1}{2}$ " casing. Stuck casing. Rigged for jacks.
11-3				Obtained jacks, slips and under reamer bit. No drilling activities. Set jacks.
11-4				Worked casing (7 $\frac{1}{2}$ ") free w/jacks and Odex. Started tripping out w/7 $\frac{1}{2}$ " casing.
11-5				Tripped out w/7 $\frac{1}{2}$ " casing and Odex.
11-6				Drilled to 905' w/IR-380 and 7 $\frac{1}{2}$ " button bit open hole.

Appendix A.3 Chronological Drilling Summary for Ue5PW-3 (Continued)

DATE 1992	CASING DEPTH (FT.)	CASING SIZE (IN.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
11-9				Drilled to 955' T.D. w/7 $\frac{1}{8}$ " button bit open hole. Bedded tuff from 917.5' $\pm$ to 955' T.D. Surveyed hole w/camera.
11-10				Water level 887.83'. Ran recovery test. Injected SF ₆ gas. Pulled rods. Jack 8 $\frac{1}{2}$ " casing loose.
11-12				Tripped in casing spear. Started pulling up 8 $\frac{1}{2}$ " casing. Pulled and jacked casing up 17'.
11-13				Pulled casing back to 700'. Moved off hole.
11-16				Stemming rig moved on hole.
11-18				Century Geophysical ran caliper, compensated neutron, K.U.T., induction, resistivity short guard, E-Log, compensated density, deviation and temperature logs.

Appendix A.4 Drilling penetration rate data for Ue5PW-1

Appendix A.4 Drilling penetration rate data for Ue5PW-2 (Continued)

Appendix A.4 Drilling penetration rate data for Ue5PW-3 (Continued)

Area 5 Pilot Wells

APPENDIX B

Core and Drill Cuttings Sample Description Data

- B.1 Borehole Log Sheets for UE5PW-1
- B.2 Borehole Log Sheets for UE5PW-2
- B.3 Borehole Log Sheets for UE5PW-3
- B.4 Drill Cuttings Log Data for UE5PW-1
- B.5 Drill Cuttings Log Data for UE5PW-2
- B.6 Drill Cuttings Log Data for UE5PW-3

Borehole Log Sheet

1) Hole Designation: Ue5PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 5.0 MIN/2.5 FT. Interval: 26.5-29.0 FT. Recovery: 1.7 FT./68%										
Run Number: 1		Rig Type: I.R. T4W										
Time out of Hole: 0905, 3-17-92		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
26.75	10YR 7/3	Dry	Cobbles 0	Silt Clay 1	Well	Poor	None	Weak	SP-SM			1 DB 1
27.0	VERY PALE		Gravel 2	Sand 94		Angular	Weak	Weak	SM			2 HYD 1
27.25	PALE		Gravel 2	Sand 97		Subangular	Weak	Weak	SM			3 DRI 1
27.5	BROWN		Gravel 11	Sand 83		Subrounded	Weak	Weak	SP-SM			4 DRI 2
27.75			Gravel 5	Sand 97		Angular	Weak	Weak				5 DB 2
28.0			Gravel 5	Sand 97		Subangular	Weak	Weak				6 DB 2
28.25			Gravel 5	Sand 97		Subrounded	Weak	Weak				7 SNL
												8 MTL
												9 ARCHIVE
												10

16) Comments: PARTICLE SIZE FOR 27.5-27.75' BASED ON LAB ANALYSIS, PREDOMINANTLY FINE SAND.
 0 - 5 FT. CUTTINGS : 2-3% GRAVEL
 17.5 ≈ 2.5 FT CUTTINGS @ BLOODE LINE: 2% QUARTZITE, 1% CARBONATES, 97% VOLCANICS
 INTACT GRAVEL: HAMMER NOT FIRING - NO CUTTINGS.
 TROUBLE REMOVING LINERS - SOME LOSS. 2 DISTURBANCE OF SAMPLES 26.5-27.5' PROBABLY FILL, 27.75-28.25' FROM
 27.5-27.75 FT 6200 COUNTS/2 MIN. FOR 556.9 GRAMS
 18) VOC's in ppm 0.0 FOR 27.5-27.75 FT.

17) Radiometric Data MAG. SUSC. 0.051
 EDITED BY: KEN DOWNERSON

19) Logged By: DANIEL BLOUT
 20) Date and Time Log Completed: 3-17-92, 0930
 21) Checked by:

Borehole Log Sheet

Page 2 of 41

1) Hole Designation: Ue 5 PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 4.5 MIN./2.5 FT. Interval: 47.5-50.0 FT. Recovery: 1.7 FT./68%									
Run Number: 2		Rig Type: I.R. T4W									
Time out of Hole: 1119, 3-18-92											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
47.75	10YR 7/3	Moist	Cobbles	0	Well	Poor	None	Weak	SM		1 DB 1
48.0	VERY	Dry	Gravel	3	Other	Angular	Weak	Weak			2 HYD 1
48.25	PALE		Sand	96	Carbonates	Subangular	Strong	None			3 DRI 1
48.5	BROWN		Silt-Clay	1	Volcanics	Rounded	Weak	Strong			4 DRI 2
48.75											5 DB 2
49.0											6 HYD 2
49.25											7 SNL
											8 MTL
											9 ARCHIVE
											10
16) Comments: SOME LOSS OF CORE WHEN BREAKING CORE BARREL FROM DRILL STRING & BREAKING OFF SHOE.											
17) Radiometric Data 6690 COUNTS/2 MIN. 49.0-49.25 FT FOR 647.4 GRAMS											
18) VOC's in ppm D.O FOR 49.0-49.25 FT.											
19) Logged By: DANIEL BLOUT											
20) Date and Time Log Completed: 11SO, 3-18-92											
21) Checked by:											

Borehole Log Sheet

Page 5 of 41

1) Hole Designation: Ue5PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 8.83 MIN/2.5 FT Interval: 67.5-70.0 FT Recovery: 2.5 FT./100%									
Run Number: 5		Rig Type: I.R. T4 W									
Time out of Hole: 1030, 3-19-92											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
67.75	10YR 5/4	Dry	Cobbles	0	3	96	1	98	2	SM	1 DB 1
68.0	YELLOWISH										2 HYD 1
68.25	BROWN										3 DRI 1
68.5											4 DRI 2
68.75											5 DB 2
69.0											6 HYD 2
69.25											7 SNL
69.5											8 MTL
69.75											9 ARCHIVE
70.0											10

16) Comments: CORE BARREL AT SHOE END OUT-OF-ROUND, CAN'T EXTRUDE LINERS, SAMPLES BEATEN & POURED INTO LINERS & HAND PACKED.
 SAMPLE FROM SHOE IS FOR METALS ANALYSIS.
 PARTICLE SIZE FOR 69.0-69.25 FT BASED ON LAB ANALYSIS, PREDOMINANTLY FINE SAND.
 HAMMER @ 150 PSI DURING DRIVE.

17) Radiometric Data

18) VOC's in ppm

19) Logged By: DANIEL BLOUT

20) Date and Time Log Completed: 3-19-92, 1130

21) Checked by:

Borehole Log Sheet

Page 8 of 41

1) Hole Designation: Ue S PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 4.5 MIN/12.5 FT Interval: 97.5 - 100.0 FT Recovery: 1.8 FT / 72%									
Run Number: 8		Rig Type: I R. T4W									
Time out of Hole: 0942		3-20-92									
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
97.75	10YR 7/4	Dry	Cobbles	Volcanics	Well	Angular	None	Strong	SM		1 DB 1
98.0	VERY PALE	Moist	Gravel	Silt-Clay	Moderate	Subangular	Weak	Weak			2 HYD 1
98.25	BROWN		Sand	Carbonates	Other	Rounded	Moderate	Moderate			3 DRI 1
98.5											4 DRI 2
98.75											5 DB 2
99.0											6 HYD 2
99.25											7 SNL
99.5											8 MTL
99.75											9 ARCHIVE
100.0											10

16) Comments: OVERDRIVE CORE BY 4 INCHES.
PARTICLE SIZE FOR 98.0 - 98.25 FT. BASED ON LAB ANALYSIS, PREDOMINANTLY FINE SAND.
HAMMER AT 120 - 200 PSI DURING DRIVE.

17) Radiometric Data

18) VOC's in ppm

19) Edited By: KEN DONNELSON
Logged By: DANIEL BLAUT

20) Date and Time Log Completed: 3-20-92, 1007 21) Checked by:

Borehole Log Sheet

Page 11 of 41

1) Hole Designation: Ue5 RW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer																													
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 20 MIN./1.6 FT Interval: 137.5 - 139.1 Recovery: 1.6 FT/100%?																													
Run Number: 13		Rig Type: I.R. T4W																													
Time out of Hole: 1010, 4-6-92																															
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content Dry Moist	7) Particle Size Distribution Cobbles Gravel Sand Silt-Clay	8) Major Minerals Volcanics Carbonates Other	9) Sorting Well Moderate Poor	10) Grain Shape Angular Subangular Rounded	11) Cementation None Weak Moderate Strong	12) HCL Reaction None Weak Moderate Strong	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation																				
137.75	10YR 6/4		0 28 45 6	97 2 1					SM-SW		1	DB 1	2	HYD 1	3	DRI 1	4	DRI 2	5	DB 2	6	HYD 2	7	SNL	8	MTL	9	ARCHIVE	10		
138.0	LIGHT																														
138.25	YELLOWISH																														
138.5	BROWN																														
138.75																															
139.0																															
139.25																															
139.5																															
16) Comments: CORE LOSS WHEN EXTRUDING LINERS. CORE AT TOP & BOTTOM WERE COMPETENT SAMPLES. EXCESS CORE POSSIBLY FROM NOT TAGGING BOTTOM BEFORE CORING. HAMMER AT 100PSI DURING DRIVE. PARTICLE SIZE FOR 137.5 - 137.75 FT. FROM LMS ANALYSIS.																															
17) Radiometric Data										18) VOC's in ppm 0.0																					
EDITED BY: KEN DONNELSON										20) Date and Time Log Completed: 4-6-92, 1040																					
19) Logged By: DANIEL BLOUT										21) Checked by:																					

Borehole Log Sheet

Page 12 of 41

1) Hole Designation: Ue 5 PW - 1		2) Drilling Method: Casing Advance/Percussion Air Hammer																		
3) Sampling Data Type: SEE BELOW		Penetration Rate: SEE BELOW Interval: SEE BELOW Recovery: 0																		
Run Number: 14 & 15		Rig Type: I.R. T4W																		
Time out of Hole: 1352, 4-6-92																				
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content Wet Dry	7) Particle Size Distribution Cobbles Gravel Sand Silt-Clay	8) Major Minerals Volcanics Carbonates Other	9) Sorting Well Moderate Poor	10) Grain Shape Angular Subangular Subrounded Rounded	11) Cementation None Weak Moderate Strong	12) HCL Reaction None Weak Moderate Strong	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation									
											Magnetic Susceptibility	1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE
		RUN No. 14: 147.5 - 149.4 FT., MOBILE SAMPLER, CORING RATE 6.58 MIN/FT., 120 PSI @ HAMMER & 3000 - 1000 PSI DOWNHOLE. RUN No. 15: 150.0 - 155.0 FT., ROTARY CORE, STARTED WITH 3000 PSI AT START OF RUN THEN REDUCE TO 1000 PSI AT END OF RUN, 4-7-92																		
16) Comments:																				
17) Radiometric Data																				
18) VOC's in ppm																				
19) Logged By: DANIEL BLOUT 20) Date and Time Log Completed: 4-6-92, 1400 21) Checked by:																				

Borehole Log Sheet

Page 13 of 41

1) Hole Designation: <u>JeSPW-1</u>		2) Drilling Method: <u>Casing Advance/Percussion Air Hammer</u>																			
3) Sampling Data Type: <u>DRIVE CORE</u>		Penetration Rate: <u>16 MIN/2 FT.</u> Interval: <u>157.5-159.5' Recovery: 2.5 FT/100%</u>																			
Run Number: <u>16</u>		Rig Type: <u>I. R. T4W</u>																			
Time out of Hole: <u>0800, 4-8-92</u>																					
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content Wet Dry	7) Particle Size Distribution Cobbles Gravel Sand Silt Clay	8) Major Minerals Volcanics Carbonates Other	9) Sorting Well Moderate Poor	10) Grain Shape Angular Subangular Rounded	11) Cementation None Weak Moderate Strong	12) HCL Reaction None Weak Moderate Strong	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation										
												1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10
157.75	10YR 6/4		0 4 95 1	97 2 1					SM												
158.0	LIGHT																				
158.25	YELLOWISH																				
158.5	BROWN																				
158.75																					
159.0																					
159.25																					
159.5																					
159.75																					
160.0																					
16) Comments: 1000 PSI/4 MIN. & 6000 PSI/12 MIN. CORED ON 4-7-92 @ ~1630. LEFT SAMPLER DOWN-HOLE OVERNIGHT. TROUBLE EXTRUDING LINERS - LOSS OF MATERIAL IN SOME SEGMENTS. SPENT 1 1/2 HOURS USING GEOPROBE TRYING TO EXTRUDE SAMPLER WITH CATCHER. THE SAMPLES FROM THE MIDDLE INTERVAL WERE VERY CONSOLIDATED. PARTICLE SIZE FOR 159.5-159.75 FT BASED ON LAB ANALYSIS.																					
17) Radiometric Data EDITED BY: <u>KEN DONNELSON</u>										18) VOC's in ppm 0.0 MAGNETIC SUSC.: 0.03											
19) Logged By: <u>DANIEL BLOUT</u>										20) Date and Time Log Completed: <u>4-8-92, 1000</u> 21) Checked by:											

Borehole Log Sheet

1) Hole Designation: Ue 5PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE		7 MIN/2 FT Penetration Rate: 3.5 MIN/FT. Interval: 167.5-169.5' Recovery: 2.5 FT/100 %?									
Run Number: 17		Rig Type: I.R. T4W									
Timeout of Hole: 1124, 4-8-92		15) Sample Designation									
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
167.75	10YR 6/4	Dry	Cobbles	0	5	94	1	SP-SM	→	→	→
168.0	LIGHT	→	→	→	→	→	→	→	→	→	
168.25	YELLOWISH	→	→	→	→	→	→	→	→	→	
168.5	BROWN	→	→	→	→	→	→	→	→	→	
168.75	→	→	→	→	→	→	→	→	→	→	
169.0	→	→	→	→	→	→	→	→	→	→	
169.25	→	→	→	→	→	→	→	→	→	→	
169.5	→	→	→	→	→	→	→	→	→	→	
169.75	→	→	→	→	→	→	→	→	→	→	
170.0	→	→	→	→	→	→	→	→	→	→	
16) Comments: CLEANER SANDS OVER ENTIRE INTERVAL. MUCH BETTER EXTRUSION OF LINERS & GOOD INTACT SAMPLES. 200PSI AT HAMMER DURING DRIVE & 2000 PSI PULL DOWN. PARTICLE SIZE FOR 169.75 - 170.0 FT. BASED ON LAB ANALYSIS.											
17) Radiometric Data										18) VOC's in ppm 0.0	
EDITED BY: KEN DONNELSON										MAG. SUSC. = 0.05	
19) Logged By: DANIEL BLOUT										20) Date and Time Log Completed: 4-8-92, 1145	
										21) Checked by:	

Borehole Log Sheet

Page 15 of 41

1) Hole Designation: Ue SPW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer																			
3) Sampling Data Type: DRIVE CORE (MOBILE SAMPLER)		Penetration Rate: 10 MIN/2 FT. Interval: 177.5-179.5 Recovery: 2.5 FT/100%?																			
Run Number: 18		Rig Type: I.R. T4W																			
Time out of Hole: 1538, 4-9-92																					
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation										
		Dry Moisture Content	Cobbles Gravel Sand Silt-Clay	Volcanics Carbonates Other	Well Moderate Poor	Angular Subangular Rounded	None Weak Moderate Strong	None Weak Moderate Strong	SM SP SM SW-SM		Magnetic Susceptibility	1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10
177.75			0 5 9 4 1	97 2 1					SM		2.0									X	
178.0											2.0										
178.25			4 9 5						SP		5.0										
178.5									SM		5.0										
178.75			5 9 4								2.5										
179.0											1.5										
179.25											1.5										
179.5											2.0										
179.75			42 53 +5						SW-SM												
180.0																					
16) Comments: 180 PSI AT HAMMER & 1000 PSI PULL-DOWN DURING CORING. PARTICLE SIZE FOR 179.5-179.75 FT. FROM LAB ANALYSIS.																					
17) Radiometric Data											18) VOC's in ppm										
EDITED BY: KEN DONNELSON																					
19) Logged By: DANIEL BLOUT											20) Date and Time Log Completed: 4-9-92, 1600 21) Checked by:										

Borehole Log Sheet

1) Hole Designation: Ue 5PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer																				
3) Sampling Data		Type: DRIVE CORE (MOBILE SAMPLER) Penetration Rate: 8.5 MIN./2 FT Interval: 197.5 - 199.5' Recovery: 2.5 FT/100%																				
Run Number: 19		Rig Type: I.R. T4W																				
Time out of Hole: 1015, 4-9-92																						
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation											
		Dry Moist	Cobbles Gravel Sand Silt/Clay	Volcanics Minerals Carbonates Other	Well Moderate Poor	Angular Subangular Rounded	None Weak Moderate Strong	None Weak Moderate Strong			Magnetic Susceptibility	1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10	
197.75	10YR 6/4		0 4 95 1	97 2 1					SP													
198.0	LIGHT																					
198.25	YELLOWISH																					
198.5	BROWN																					
198.75																						
199.0																						
199.25																						
199.5																						
199.75																						
200.0																						
16) Comments: <1% OF GRAVELS ARE OF VERY LARGE SIZE. 180 PSI AT HAMMER & 1000 LBS DOWN HOLE DURING CORING. PARTICLE SIZE FOR 199.5 - 199.75 FT FROM LAB ANALYSIS.																						
17) Radiometric Data EDITED BY: KEN DONNELSON											18) VOC's in ppm 0.0											
19) Logged By: DANIEL BLOUT 20) Date and Time Log Completed: 4-9-92, 1045 21) Checked by:																						

Borehole Log Sheet

1) Hole Designation: UeSPW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer											
3) Sampling Data Type: DRIVE CORE (MOBILE SAMPLE)		6.0 MIN / 2.5 FT Penetration Rate: 2.4 MIN/FT Interval: 217.5 - 220.0 Recovery: 2.5 FT / 100%											
Run Number: 20		Rig Type: I.R. T4W											
Time out of Hole: 0823, 4-10-92		15) Sample Designation											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation	
217.75		Dry	Cobbles	0	4	95	1	97	2	1	SM	1	DB 1
218.0		Moist	Gravel	4	95	1	97	2	1	SM	2	HYD 1	
218.25			Sand	5	94	1	97	2	1	SP-SM	3	DRI 1	
218.5			Silt-Clay	4	95	1	97	2	1	SM	4	DRI 2	
218.75				25	72	3				SW	5	DB 2	
219.0											6	HYD 2	
219.25											7	SNL	
219.5											8	MTL	
219.75											9	ARCHIVE	
220.0											10		

16) Comments: 180 PSI AT HAMMER & 1000 LBS PULL DOWN DURING CORING.
PARTICLE SIZE FOR 219.75 - 220.0 FT FROM LAB ANALYSIS.

17) Radiometric Data
EDITED BY: KEN DONNELSON
19) Logged By: DANIEL BLOUT

18) VOC's in ppm

20) Date and Time Log Completed: 4-10-92, 0855 21) Checked by:

Borehole Log Sheet

Page 18 of 41

1) Hole Designation: Ue 5PW-1										2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE (MOBILE SAMPLER)										3.5 MIN/2.8 FT Interval: 237.5 - 240.3 FT Recovery: 0%									
Run Number: 21										Rig Type: I.R. T 4 W									
Time out of Hole: 1330, 4-19-92																			
15) Sample Designation																			
Magnetic Susceptibility																			
1 DB 1										1 DB 1									
2 HYD 1										3 DRI 1									
3 DRI 1										4 DRI 2									
5 DB 2										6 HYD 2									
7 SNL										8 MTL									
9 ARCHIVE										10									
4) Depth in Feet																			
5) Color (Munsell Chart)																			
6) Moisture Content																			
7) Particle Size Distribution																			
Cobbles																			
Gravel																			
Sand																			
Silt-Clay																			
8) Major Minerals																			
Volcanics																			
Carbonates																			
Other																			
9) Sorting																			
Well																			
Moderate																			
Poor																			
10) Grain Shape																			
Angular																			
Subangular																			
Rounded																			
11) Cementation																			
None																			
Weak																			
Moderate																			
Strong																			
12) HCL Reaction																			
None																			
Weak																			
Moderate																			
Strong																			
13) USCS Group Name																			
14) Alluvial Unit																			
16) Comments: 160 PSI AT ODEX HAMMER 80 LBS. PULLDOWN WHILE CORING. * PENETRATION RATE: 2 MIN/2.5 FT. & 1.5 MIN. TO OVERCORE 0.3 FT. NO RECOVERY.																			
17) Radiometric Data										18) VOC's in ppm									
EDITED BY: REN BONNE LSON																			
19) Logged By: DANIEL BLUNT										20) Date and Time Log Completed: 4-10-92, 1330 21) Checked by:									

Borehole Log Sheet

Page 19 of 41

1) Hole Designation: Ue SPW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer																														
3) Sampling Data Type: DRIVE CORE (MOBILE SAMPLER) Penetration Rate: 7 MIN./2.5 FT		Interval: 257.5-260.0 Recovery: 2.5 FT./100%																														
Run Number: 22		Rig Type: I.R. T4W																														
Time out of Hole: 10:13, 4-13-92		2.8 MIN/FT.																														
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation																					
		Dry Moisture Content	Cobbles	Gravel	Sand	Silt-Clay	Volcanics	Carbonates	Other	Well	Poor	Angular	Subangular	Rounded	None	Weak	Moderate	Strong	SW-SM		1	2	3	4	5	6	7	8	9	10		
257.75	10YR 6/4	0	0	20	75	5	97	2	1																							
258.0	LIGHT																															
258.25	YELLOWISH																															
258.5	BROWN																															
258.75																																
259.0																																
259.25																																
259.5																																
259.75																																
260.0																																
16) Comments: 180 PSI AT ODEX HAMMER & 1000 LBS. PULLDOWN DURING CORING. LEXAN LINERS FOR SAMPLE FROM 259.75-260.0 FT ARE CRACKED FULL LENGTH. PARTICLE SIZE FOR 259.75-260.0 FT. FROM LAB ANALYSIS.																																
17) Radiometric Data										18) VOC's in ppm 0.0																						
EDITED BY: KEN DONNELSON										20) Date and Time Log Completed: 4-13-92, 1040 21) Checked by:																						
19) Logged By: DANIEL BLAUT																																

Borehole Log Sheet

1) Hole Designation: Ue 5PW-1										2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE										Penetration Rate: 6 MIN./2.5 FT. Interval: 277.5-279.1' Recovery: 2.5 FT/100%									
Run Number: 23										Rig Type: I.R. T4W									
15) Sample Designation										Time out of Hole: 1541, 4-13-92									
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation	16) Comments							
		Dry Moist	Cobbles Gravel Sand Silt/Clay	Volcanics Carbonates Other	Well Moderate Poor	Angular Subangular Rounded	Weak Moderate Strong	None Weak Moderate Strong	SW		1 DB 1 2 HYD 1 3 DRI 1 4 DRI 2 5 DB 2 6 HYD 2 7 SNL 8 MTL 9 ARCHIVE 10								
277.75	10YR 6/4		0 9 89 2 97 2 1								2.1								
278.0	LIGHT										1.9								
278.25	YELLOWISH										1.8								
278.5	BROWN										1.9								
278.75											2.0								
279.0											2.8								
279.25	10YR 7/3										1.9								
279.5	VERY PALE										1.6								
279.75	BROWN										3.8								
280.0											2.4								
16) Comments: VERY GOOD & INTACT CORE SAMPLES. PARTICLE SIZE FOR 277.5 - 277.75 FT. FROM LAB ANALYSIS. 180 PSI AT ODEX HAMMER & 2000 LBS PULL DOWN DURING CORING.																			
17) Radiometric Data										18) VOC's in ppm									
EDITED BY: KEN DONNELSON										20) Date and Time Log Completed: 4-13-92, 1615			21) Checked by:						
19) Logged By: DANIEL BLOUT																			

Borehole Log Sheet

Page 21 of 41

1) Hole Designation: UG 5 PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer																			
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 9 MIN./2.5 FT. Interval: 297.5-300.0' Recovery: 2.5 FT./100%																			
Run Number: 24		Rig Type: I.R. T4W																			
Time out of Hole: 1248, 4-14-92																					
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation										
		Dry Wet	Cobbles Gravel Sand Silt-Clay	Volcanics Carbonates Other	Well Moderate Poor	Angular Subangular Rounded	Weak Moderate Strong	None Weak Moderate Strong	SP SW-SM		Magnetic Susceptibility	1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10
297.75	10YR 6/4 LIGHT YELLOWISH BROWN		0 5 94 1 97 2 1								1.2										
298.0			21 73 6								1.5										
298.25	10YR 7/3 VERY PALE BROWN										1.8										
298.5											1.7										
298.75											1.3										
299.0											1.2										
299.25											0.8										
299.5											1.0										
299.75											0.6										
300.0											1.3										
16) Comments: 180 PSI AT ODEX HAMMER & 1000 LBS PULL DOWN DURING CORING. GOOD CORE. LARGE GRAVEL PIECE WITH MORE PRONOUNCED CALICHE ON UNDERSIDE AT 299.75 FT. PARTICLE SIZE FOR 299.75 - 300.0 FT. FROM LAB ANALYSIS.																					
17) Radiometric Data											18) VOC's in ppm										
EDITED BY: KEN DONNELSON																					
19) Logged By: DANIEL BLOUT											20) Date and Time Log Completed: 4-14-92, 1310 21) Checked by:										

Borehole Log Sheet

1) Hole Designation: Ue SPW-1										2) Drilling Method: Casing Advance/Percussion Air Hammer																													
3) Sampling Data Type: DRIVE CORE (MOBILE SAMPLER) Penetration Rate: 12 MIN./2.2 FT. Interval: 357.5-359.7 Recovery: 2.5 FT./100%										4) Run Number: 27 Rig Type: I. R. T4W																													
5) Color (Munsell Chart)										6) Moisture Content																													
7) Particle Size Distribution										8) Major Minerals																													
9) Sorting										10) Grain Shape																													
11) Cementation										12) IICL Reaction																													
13) USCS Group Name										14) Alluvial Unit																													
15) Sample Designation										16) Comments: PARTICLE SIZE FOR 358.5-358.75 FT & OTHERS CLASSIFIED AS "SW" FROM LAB ANALYSIS OF CORE. PARTICLE SIZE FOR INTERVALS CLASSIFIED AS "SW-SM" FROM LAB ANALYSIS OF CUTTINGS. 180 PSI AT ODEX HAMMER & 1000 LBS PULL DOWN WHILE CORING.																													
357.75	10YR 6/4 LIGHT YELLOWISH BROWN	0	23	76	1	97	2	1	Well	Moderate	Poor	Angular	Subangular	Rounded	None	Weak	Moderate	Strong	SW	2.5	1 DB 1	2	HYD 1	3	DRI 1	4	DRI 2	5	DB 2	6	HYD 2	7	SNL	8	MTL	9	ARCHIVE	10	
358.0	10YR 7/3 VERY PALE	3	88	9					Other	Carbonates									SW-SM	2.8																			
358.25	8YR 6/4 PALE	3	88	9					Other	Carbonates									SW-SM	2.9																			
358.5	8YR 6/4 BROWN	3	88	9					Other	Carbonates									SW-SM	3.0																			
358.75		3	88	9					Other	Carbonates									SW-SM	2.5																			
359.0		3	88	9					Other	Carbonates									SW-SM	2.1																			
359.25		3	88	9					Other	Carbonates									SW-SM	2.2																			
359.5		3	88	9					Other	Carbonates									SW-SM	2.0																			
359.75		3	88	9					Other	Carbonates									SW-SM	1.8																			
360.0		3	88	9					Other	Carbonates									SW-SM	2.0																			

17) Radiometric Data

EDITED BY: KEN DONNELSON

18) VOC's in ppm

19) Logged By: DANIEL BLOUT

20) Date and Time Log Completed: 4-16-92, 1530 21) Checked by:

Borehole Log Sheet

Page 26 of 41

1) Hole Designation: Ue 5PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 5 MIN./2.5 FT. Interval: 398.5 - 401.0 Recovery: 2.5 FT/100%										
Run Number: 29		Rig Type: I.R. T4W										
Time out of Hole: 1310, 4-22-92		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
398.75	10YR 4/4 DARK YELLOWISH	Dry	Cobbles	Volcanics	Well	Angular	None	Weak	SW	FILL	2.0	10
399.0	BROWN	Moist	Gravel	Carbonates	Moderate	Subangular	Weak	Strong	SP		3.7	9
399.25	10YR 6/4		Sand	Other	Well	Rounded	None	Weak			2.4	8
399.5	LIGHT										3.0	7
399.75	YELLOWISH										2.7	6
400.0	BROWN										2.2	5
400.25											2.0	4
400.5											1.9	3
400.75											1.9	2
401.0											2.1	1
16) Comments: 180 PSI AT ODEX HAMMER & 0 PULLDOWN WHILE CORING. ONLY SMELL & COLORATION FROM 398.5 - 399.0 FT PROBABLY DUE TO NEW OVER OILED HAMMER. PARTICLE SIZE FOR 399.0-399.25 FT. FROM LAB ANALYSIS FOR CORE. PARTICLE SIZE FOR SAMPLES CLASSIFIED AS "SP-SM" FROM LAB ANALYSIS FOR CUTTINGS.												
17) Radiometric Data												
18) VOC's in ppm												
19) Logged By: DANIEL BLOUT												
20) Date and Time Log Completed: 4-22-92, 1330												
21) Checked by:												

Borehole Log Sheet

Page 27 of 41

1) Hole Designation: Ue 5PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer											
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 5 MIN./2.5 FT. Interval: 458.25-460.75 Recovery: 2.5 FT/100%											
Run Number: 30		Rtg Type: I.R. T4W											
15) Sample Designation		Time out of Hole: 1555, 5-1-92											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content Dry Moist Wet	7) Particle Size Distribution Cobbles Gravel Sand Silt Clay	8) Major Minerals in % Volcanics Carbonates Other	9) Sorting Well Moderate Poor	10) Grain Shape Angular Subangular Rounded	11) Cementation None Weak Moderate Strong	12) HCL Reaction None Weak Moderate Strong	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation	
458.5	10YR 7/1 LIGHT GRAY		0 10 89 1	97 2 1				?	SP	FILL	1.4?	10	
458.75											2.8	9	
459.0											1.2	8	
459.25											1.1	7	
459.5	10YR 6/6 BROWNISH		27 68 54						SW-SM		1.3	6	
459.75	YELLOW										1.9	5	
460.0											2.4	4	
460.25											1.95	3	
460.5											1.85	2	
460.75											2.2	1	
16) Comments: 175 PSI ON ODEX HAMMER DURING CORING. PARTICLE SIZE FOR 460.5-460.75 FT. FROM LAB ANALYSIS. 3" OF FILL AT TOP OF CORE RUN. CASING WAS DRIVEN DOWN TO 458.5 FT. WHILE ATTEMPTING TO UNLATCH ODEX BIT. CORE BARREL HIT FILL AT 458.25 FT. GRAVEL LENS FROM 459.0-459.25 FT.													
17) Radiometric Data												18) VOC's in ppm	
EDITED BY: KEN DOWNELSON													
19) Logged By: HEATHER H. GANG												20) Date and Time Log Completed: 5-1-92, 1630	21) Checked by:

Borehole Log Sheet

Page 29 of 41

1) Hole Designation: Ue SPW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 4 MIN./2.5 FT									
Run Number: 32		Interval: 538.5-541.0 Recovery: 2.5 FT./100%									
Rig Type: T.R. T4-W		Time out of Hole: 1435, 5-C-92									
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
538.75	10YR 6/4 LIGHT	Dry	0 26 72 2	Silt-Clay	Well	Angular	None	Weak	SW	Fill?	1 DB 1
539.0	YELLOWISH	Moist	→	Sand	Other	Subangular	Weak	Moderate	→	1.7	2 HYD 1
539.25	BROWN		→	Gravel	Carbonates	Rounded	Moderate	Strong	→	1.6	3 DRI 1
539.5	→		→	Cobbles	Volcanics	Subangular	Strong	None	→	1.0	4 DRI 2
539.75	10YR 7/3 VERY PALE BROWN		22 71 7			Angular	None	Weak	SW-SM	1.2	5 DB 2
540.0	→		→			Subangular	Weak	Moderate	→	0.8	6 HYD 2
540.25	→		→			Rounded	Moderate	Strong	→	1.1	7 SNL
540.5	→		→			Angular	None	Weak	→	1.3	8 MTL
540.75	→		→			Subangular	Weak	Moderate	→	1.8	9 ARCHIVE
541.0	→		→			Rounded	Strong	None	→	1.9	10

16) Comments: POSSIBLE FILL WITH TRACE OF OIL? OR MOIST SANDY ZONE.
180 PSI AT ODEX HAMMER DURING CORING.
PARTICLE SIZE FOR 539.25-539.5 FT. FROM LAB ANALYSIS FOR CORE.
PARTICLE SIZE FOR INTERVAL CLASSIFIED AS "SW-SM" FROM LAB ANALYSIS FOR CUTTINGS.

17) Radiometric Data
EDITED BY: KEN DONNELSON
18) VOC in ppm
31 FOR 538.5-538.75, 2.9 FOR 538.75-539.0 FT,
20.1 FOR 539.0-539.25, 19.1 FOR 539.25-539.5 FT.

19) Logged By: DANIEL BLOUT
20) Date and Time Log Completed: 5-6-92, 1500
21) Checked by:

Borehole Log Sheet

Page 30 of 41

1) Hole Designation: Ue 5PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data Type: DRIVE CORE		4) Penetration Rate: 1.6 MINS./FT. Interval: 579.1 - 581.6 FT. Recovery: 2.5 FT/100%										
Run Number: 33		Time out of Hole: 134.5, 5-7-92										
Fig Type: I.R. T4W		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
579.35	10YR 6/4	Dry	Cobbles	Silt Clay	Volcanics	Angular	None	Weak	GW	FILL	3.1	1 DB 1
579.6	LIGHT	Wet	Gravel	Sand	Carbonates	Subangular	Strong	Moderate	SW		1.9	2 HYD 1
579.85	YELLOWISH					Rounded	Weak	None	SW		4.7	3 DRI 1
580.1	Brown						Strong	None	SW-SM		2.3	4 DRI 2
580.35											2.5	5 DB 2
580.6											1.3	6 HYD 2
580.85											0.2	7 SNL
581.1											0.3	8 MTL
581.35											0.2	9 ARCHIVE
581.6											3.2	10

16) Comments: 180 PSI AT ODEX HAMMER DURING CORING.
 PARTICLE SIZE FOR 579.6 - 579.85 FT. FROM LAB ANALYSIS FOR CORE
 PARTICLE SIZE FOR INTERVALS CLASSIFIED AS "SW" & "SW-SM" FROM LAB ANALYSIS FOR CUTTINGS.

17) Radiometric Data
 EDITED BY: KEN DOBNEUSON
 18) VOC's in ppm 2.0 FOR 581.35 - 581.6'

19) Logged By: DANIEL BLOUT
 20) Date and Time Log Completed: 5-7-92
 21) Checked by:

Borehole Log Sheet

Page 32 of 41

1) Hole Designation: Ue SPW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 3.5 MIN./2.1 FT Interval: 658.3 - 660.4' Recovery: 2.1 FT / 100%										
Run Number: 35		Rig Type: I. R. T4 W										
Time out of Hole: 1450, 5-28-92		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
658.25	10YR 3/3 DARK BROWN	Moist	0 40 47 13 97	Volcanics	Well	Angular	None	Strong	SM	FILL & OIL	3.6	10
658.5											2.8	9 ARCHIVE
658.75											4.2	8 MTL
659.0											1.4	7 SNL
659.25											1.2	6 HYD 2
659.5	10YR 6/4 LIGHT YELLOWISH BROWN		3 83 14								2.1	5 DB 2
659.75												4 DBI 2
660.0												3 DBI 1
660.25											2.2	2 HYD 1
660.5											2.2	1 DB 1
16) Comments: 180 PSI AT ODEX HAMMER DURING CORING. LOST SAMPLES FROM 659.5 - 660.0 FT. WHILE BREAKING CORE BARREL APART. PARTICLE SIZE FOR 658.75 - 659.0 FT. FROM LAB ANALYSIS OF CORE. PARTICLE SIZE FOR 659.25 - 660.5 FT. FROM LAB ANALYSIS OF CUTTING-1.												
17) Radiometric Data EDITED BY: KEN DEWILSON 19) Logged By: DANIEL BLOUT												
20) Date and Time Log Completed: 5-28-92, 1320? 21) Checked by: 5.8 FOR 658.5 - 658.75', 10.6 FOR 660.0 - 660.25' 18) VOC's in ppm												

Borehole Log Sheet

1) Hole Designation: Ue 5 PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 5 MIN./1.8 FT Interval: 699.8 - 701.6 FT Recovery: 1.8 FT./100%									
Run Number: 36		Rig Type: I.R. T4W									
Time out of Hole: 14:45, 5-29-92											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
699.25	?	Dry	Cobbles	Volcanics	Well	Angular	None	Strong		oily	1 DB 1
699.5		Wet	Gravel	Carbonates	Moderate	Subangular	Weak	Weak		FLU	2 HYD 1
699.75			Sand	Other	Good	Rounded	Moderate	None			3 DRI 1
700.0											4 DRI 2
700.25											5 DB 2
700.5											6 HYD 2
700.75											7 SNL
701.0											8 MTL
701.25											9 ARCHIVE
701.5											10

16) Comments: 180 PSI AT ODEX HAMMER DURING CORING.
PARTICLE SIZE FOR 700.5 - 700.75 FT. FROM LAB ANALYSIS.

17) Radiometric Data
EDITED BY: KEV DOWNELSON

18) VOC's in ppm
7.1 For 699.5-699.75, 7.0 For 700.25-700.5,
10.5 For 701.0 - 701.25.

19) Logged By: DANIEL BLAUT

20) Date and Time Log Completed: 5-29-92, 1500 21) Checked by:

Borehole Log Sheet

Page 35 of 41

1) Hole Designation: Ue 5PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer	
3) Sampling Data		Type: DRIVE CORE, SFT. BARREL	
Run Number: 38		Rig Type: I.R. TAW.	
4) Depth in Feet		5) Color (Munsell Chart)	
6) Moisture Content		7) Particle Size Distribution	
8) Major Minerals in %		9) Sorting	
10) Grain Shape		11) Cementation	
12) HCL Reaction		13) USCS Group Name	
14) Alluvial Unit		15) Sample Designation	
Magnetic Susceptibility		10	
724.75			1 DB 1
725.0	10YR 6/6		2 HYD 1
725.25	BROWNISH		3 DRI 1
725.5	YELLOW		4 DRI 2
725.75			5 DB 2
726.0			6 HYD 2
726.25			7 SNL
726.5			8 MTL
726.75			9 ARCHIVE
727.0			10

16) Comments: * CORED ON 6-4-92 BUT CORE BARREL BROKE OFF AT BACKHEAD IN HOLE & WAS RETRIEVED ON 6-5-92. 0.5 FT± OF SAMPLE FELL OUT OF BARREL (FILL). IN-SITU ALTERATION (ZEOLITIZATION?) OF CLASTS FROM 725.5 - 726.0 FT. PARTICLE SIZE FOR 725.5 - 725.75 FT. FROM LAB ANALYSIS.

17) Radiometric Data

18) VOC's in ppm

19) Logged By: HEATHER H. GAN

20) Date and Time Log Completed: 6-4-92, 14:28

21) Checked by:

Borehole Log Sheet

Page 36 of 41

1) Hole Designation: U ₆ SPW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer	
3) Sampling Data		Type: DRIVE CORE, 5 FT. BARREL Penetration Rate: 22 MIN./4.5 FT Interval: 724.5-729.0 Recovery: 4.5 FT/100%	
Run Number: 38		Rig Type: I.R. T4W	
4) Depth in Feet		5) Color (Munsell Chart)	
6) Moisture Content		7) Particle Size Distribution	
8) Major Minerals in %		9) Sorting	
10) Grain Shape		11) Cementation	
12) HCL Reaction		13) USCS Group Name	
14) Alluvial Unit		15) Sample Designation	
Magnetic Susceptibility			
727.25	10YR 6/6	0	2.8
727.5	BROWNISH	8	2.95
727.75	YELLOW	9	2.4
728.0		10	3.0
728.25		1	2.8
728.5		2	2.4
728.75		3	3.2
729.0		4	2.8
		5	
		6	
		7	
		8	
		9	
		10	

16) Comments: PARTICLE SIZE FOR 728.0-728.25 FT. FROM LAB ANALYSIS.

17) Radiometric Data

18) VOC's in ppm

19) Logged By: HEATHER H. GANGL

20) Date and Time Log Completed: 6-5-92, 1428

21) Checked by:

3.9 For 728. - 728.75 FT.

Borehole Log Sheet

Page 38 of 41

1) Hole Designation: Ue SPW-1										2) Drilling Method: Casing Advance/Percussion Air Hammer											
3) Sampling Data Type: DRIVE CORE										Penetration Rate: 2 MIN./2.5 FT. Interval: 757.6-760.5' Recovery: 2.5 FT/100%											
Run Number: 40										Rig Type: I.R. T4W											
15) Sample Designation										Time out of Hole: 1140, 6-9-92											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	1	2	3	4	5	6	7	8	9	10
758.25	10YR 4/2 DARK	0	0 1 86 13	97 2 1	Well	Poor	None	Weak	SM	FILL	3.4	DB 1	HYD 1	DRI 1	DRI 2	DB 2	HYD 2	SNL	MTL	ARCHIVE	
758.5	GRAYISH BROWN										2.4										
758.75	BROWN										1.0										
759.0											2.9										
759.25	10YR 7/3		17 78 - 5						SW		2.1										
759.5	VERY PALE BROWN										2.2										
759.75											2.0										
760.0											2.3										
760.25											1.6										
760.5											1.9										

16) Comments: 170 PSI AT ODEX HAMMER DURING CORING.
 PARTICLE SIZE FOR 759.25-759.5 FT. FROM LAB ANALYSIS FOR CORE.
 PARTICLE SIZE FOR INTERVAL CLASSIFIED AS "SM" FROM LAB ANALYSIS FOR CUTTINGS.

17) Radiometric Data
 EDITED BY: KEN DONNELSON
 19) Logged By: DANIEL BLOUT

20) Date and Time Log Completed: 6-9-92, 1200 21) Checked by:

20 For 758.25-758.5 FT.
 18) VOC's in ppm

Borehole Log Sheet

1) Hole Designation: <u>Ue5PW-1</u>		2) Drilling Method: <u>Casing Advance/Percussion Air Hammer</u>																			
3) Sampling Data Type: <u>DRIVE CORE</u>		Penetration Rate: <u>4 MIN./2.5 FT.</u>																			
Run Number: <u>41</u>		Interval: <u>767.5-770.25 Recovery: 2.5 FT./100%</u>																			
Rig Type: <u>I.R. T4W</u>		Time out of Hole: <u>0950, 6-10-92</u>																			
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation										
		Dry Moist	Cobbles Gravel Sand Silt-Clay	Volcanics Carbonates Other	Well Moderate Poor	Angular Subangular Rounded	None Weak Moderate Strong	None Weak Moderate Strong				1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10 H.C.R.
768.0	10YR 7/2		0 7 92 1	97 2 1						FILL											
768.25	LIGHT GRAY																				
768.5																					
768.75	10YR 4/3		3 85 12																		
769.0	BROWN-DARK																				
769.25	BROWN		5 89 6																		
769.5																					
769.75																					
770.0			3 85 12																		
770.25																					
16) Comments: 170 PSI AT ODEX HAMMER DURING CORING. HCR: HAZARDOUS CONSTITUENTS & RADIONUCLIDES. ENTIRE CORE RUN FITTED WITH BRASS LINERS. LOWER ONE FOOT CONSISTS OF TUFF FRAGMENTS THAT ARE ALTERED (CLAYEY?), BALLS UP IN FIST. PARTICLE SIZE FOR INTERVALS CLASSIFIED AS "SM" & "SM-SW" FROM LAB ANALYSIS FOR CUTTINGS.											6.4 FOR 768.0-768.25'; 344 FOR 769.75-770.0';										
17) Radiometric Data											18) VOC's in ppm										
EDITED BY: KEN DONNELSON											20) Date and Time Log Completed: 6-10-92, 1015										
19) Logged By: DANIEL BLOUT											21) Checked by:										

Borehole Log Sheet

1) Hole Designation: Ue SPW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 2 MIN./2.5 FT Interval: 768.5-771.0' Recovery: 2.5 FT./100%									
Run Number: 42		Rig Type: I.R.T.A.W									
Time out of Hole: 1220, 6-11-92		= 0.8 MIN./FT.									
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
768.75											1 DB 1
769.0											2 HYD 1
769.25											3 DRI 1
769.5											4 DRI 2
769.75											5 DB 2
770.0											6 HYD 2
770.25											7 SNL
770.5	10YR 4/6										8 MTL
770.75	DARK										9 ARCHIVE
771.0	YELLOWISH BROWN										10
16) Comments: 170 PSI AT ODEX HAMMER DURING CORING. CORED 1 FT. OF NEW GROUND. PARTICLE SIZE FOR INTERVAL CLASSIFIED AS "SM" FROM LAB ANALYSIS OF CUTTINGS.											
17) Radiometric Data EDITED BY: KEN DOWNES 18) VOC's in ppm											
19) Logged By: DANIEL BLOUT 20) Date and Time Log Completed: 6-11-92, 1420 21) Checked by:											
27 FOR 768.75-769.0 FT; 217 FOR 770.5-770.75'											

Borehole Log Sheet

1) Hole Designation: Ue 5PW-1		2) Drilling Method: Casing Advance/Percussion Air Hammer																		
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 5 MIN./2.5 FT.																		
Run Number: 43		Rig Type: T. R. T. 4 W																		
Time out of Hole: 1220, 6-12-92		Interval: 787.75-790.25' Recovery: 2.5 FT./100%																		
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation									
		Dry Moist	Cobbles Gravel Sand Silt-Clay	Volcanics Carbonates Other	Well Moderate Poor	Angular Subangular Rounded	Weak Moderate Strong None	Weak Moderate Strong None	SP SW-SH		1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10
788.0	10YR 7/4		0 5 94 1	97 2 1																
788.25	VERY PALE BROWN																			
788.5																				
788.75																				
789.0																				
789.25																				
789.5	10YR 4/3		14 79 7																	
789.75	BROWN-DARK BROWN																			
790.0																				
790.25																				
16) Comments: 170PSI AT ODEX HAMMER DURING CORING. SAMPLES FROM SATURATED ZONE. WATER LEVEL AT 778.25 FT. NO FILL MATERIAL IN CORE. USE BRASS SAMPLE LINERS FROM 789.25-790.25 FT. PARTICLE SIZE FOR 789.25-789.5 FT. FROM LAB ANALYSIS.																				
17) Radiometric Data ENTERED BY: KEN DONNELSON										18) VOC's in ppm										
19) Logged By: DANIEL BLOUT										20) Date and Time Log Completed: 6-12-92, 12:50										
										21) Checked by:										

Borehole Log Sheet

Page 1 of 25

1) Hole Designation: Ue5PW-2		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 15 MIN./4.9 FT. = 3.06 MIN./FT. Interval: 0 - 4.9 FT. Recovery: 3? FT/61%										
Run Number: 1		Rig Type: I.R. TAW										
Time out of Hole: 1053, 6-18-92		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chan)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
0.25	10YR7/3	Dry	Cobbles	0 13 78 9 90 10	Well	Angular	None	Strong	SW-SM	disturbed	1.5	9 ARCHIVE
0.5	VERY PALE	Moist	Gravel		Moderate	Subangular	Weak	Moderate			1.3	8 MTL
0.75	BROWN		Sand		Other	Subrounded	None	Weak			0.8	7 SNL
1.0			Silt-Clay		Volcanics		Strong	Strong			1.5	6 HYD 2
1.25							Weak	Weak			1.7	5 DB 2
1.5							Moderate	Moderate			1.1	4 DB 2
1.75							None	None			2.3	3 DB 1
2.0	7.5YR7/3										1.6	2 DB 1
2.25	PINK										1.1	1 DB 1
2.5	(LOG CONTINUED ON PAGE 2)										1.7	

16) Comments: STAGE II - III CARBONATE 1.75 - 3.25 FT.
0 - 1 FT. ROOTLETS. MOIST FROM PAD WETTING.
PARTICLE SIZE FOR 1.5 - 1.75 FT FROM LAB ANALYSIS.
DRILL RIG AT 70 PSI, 1100 RPM

17) Radiometric Data
EDITED BY: KEN DONNELSON
19) Logged By: KENNETH DONNELSON
20) Date and Time Log Completed: 6-18-92, 1147
21) Checked by:

18) VOC's in ppm

Borehole Log Sheet

1) Hole Designation: Ue 5PW-2		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 3.06 MIN./FT. Interval: 0 - 4.9 FT. Recovery: 3 FT./61%										
Run Number: 1		Rig Type: I.R. T4W										
Time out of Hole: 1053, 6-18-92		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
2.75	7.5YR8/3	Dry	Cobbles	Volcanics	Well	Angular	None	Weak	GM		1.6	1 DB 1
3.0	PINK	Wet	Gravel	Silt-Clay	Moderate	Subangular	Weak	Moderate			0.9	2 HYD 1
3.25			Sand	Carbonates	Poor	Founded	Strong	Strong			0.8	3 DRI 1
												4 DRI 2
												5 DB 2
												6 HYD 2
												7 SNL
												8 MTL
												9 ARCHIVE
												10

(LOG CONTINUED FROM PAGE 1)

16) Comments:

17) Radiometric Data

18) VOC's in ppm

19) Logged By: KENNETH DONNELSON

20) Date and Time Log Completed: 6-18-92, 1147

21) Checked by:

Borehole Log Sheet

1) Hole Designation: Ue 5W-2		2) Drilling Method: Casing Advance/Percussion Air Hammer																				
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 8 MIN. / 3.5 FT. Interval: 38.08 - 43.08' Recovery: 3.5 FT / 70%																				
Run Number: 3		Rtg Type: T, R, T & W																				
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content Dry Moist	7) Particle Size Distribution Cobbles Gravel Sand Silt-Clay	8) Major Minerals Volcanics Carbonates Other	9) Sorting Well Moderate Poor	10) Grain Shape Angular Subangular Rounded	11) Cementation None Weak Moderate Strong	12) HCL Reaction Weak Moderate Strong	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation											
											Magnetic Susceptibility	1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10	
38.25	10YR 7/4	↓	0 30 55 15 90 10	↓	↓	↓	↓	↓	SM	FILL?	2.0											
38.5	VERY	↓	↓	↓	↓	↓	↓	↓		↓	1.8											
38.75	PALE	↓	↓	↓	↓	↓	↓	↓		↓	1.7											
39.0	BROWN	↓	↓	↓	↓	↓	↓	↓		↓	1.8											
39.25	↓	↓	26 56 18	↓	↓	↓	↓	↓		↓	1.2											
39.5	↓	↓	↓	↓	↓	↓	↓	↓		↓	0.8											
39.75	↓	↓	↓	↓	↓	↓	↓	↓		↓	1.4											
40.0	↓	↓	↓	↓	↓	↓	↓	↓		↓	1.4											
40.25	↓	↓	↓	↓	↓	↓	↓	↓		↓	1.3											
40.5	↓	↓	↓	↓	↓	↓	↓	↓		↓	0.7											
(LOG CONTINUED ON PAGE 6)																						
16) Comments: PREDOMINANTLY FINE SAND WITH -3/8" GRAVELS. 2.5" ANGULAR GRAVEL AT 40.5 FT.																						
17) Radiometric Data										18) VOC's in ppm												
EDITED BY: KEN DONNELSON																						
19) Logged By: KENNETH DONNELSON																						
20) Date and Time Log Completed: 6-22-92, 1400																						
21) Checked by:																						

Borehole Log Sheet

Page 8 of 25

1) Hole Designation: Ue5PW-2		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data Type: DRIVE CORE		Penetration Rate: 2.5 MIN./2.5 FT. Interval: 97.72 ~ 100.42' Recovery: 2.5 FT./100%										
Run Number: 5		Rig Type: IR T4W										
Time out of Hole: 1610, 6-24-92		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
98.25	10YR 7/3	Dry	Cobbles 50 36 15 5 90 10	Volcanics	Well	Angular	None	Weak	GP	FILL	1.5	1 DB 1
98.5	VERY	Wet	↓ 23 ↓ 12	Carbonates	Other	Subangular	Weak	Weak	GM		1.7	8 MTL
98.75	PALE		0 23 68 9			Rounded	Strong		SW-SM		0.9	6 DB 2
99.0	BROWN										0.7	7 SNL
99.25											1.2	5 DB 2
99.5											0.9	4 DRI 2
99.75											1.2	3 DRI 1
100.0											1.0	2 HYD 1
100.25			25 63 12						SM		1.1	1 DB 1
100.5											1.0	9 ARCHIVE
												10

16) Comments: COBBLE FILLED AT TOP OF SAMPLE AT 98.25 FT.
SAND IS PREDOMINANTLY FINE-MEDIUM FROM 98.5-100.0 FT.
SAND IS PREDOMINANTLY FINE-MEDIUM WITH SOME COARSE SAND FROM 100.0-100.5 FT.
PARTICLE SIZE FOR 99.75 100.0 FT. FROM LAB ANALYSIS.

17) Radiometric Data
EDITED BY: KEN DONNELSON
18) VOC's in ppm

19) Logged By: KENNETH DONNELSON 20) Date and Time Log Completed: 6-24-92, 1643 21) Checked by:

Borehole Log Sheet

Page 9 of 25

2) Drilling Method: Casing Advance/Percussion Air Hammer											
1) Hole Designation: Ue SPW-2											
3) Sampling Data Type: DRIVE CORE											
Run Number: 6											
Rig Type: IR T4W											
Penetration Rate: 2.7 MIN./2.33 FT. Interval: 117.42-119.75' Recovery: 2.33'/100%											
Time out of Hole: 110.8, 6-25-92											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
117.5	10YR 6/3	Dry	Cobbles 0 60 35 5	Volcanics 90 10	Well	Angular	None	Weak	GP	FILL	1 DB 1
117.75	PALE	Wet	Gravel 18 70 12	Carbonates	Moderate	Subangular	Weak	Weak	SW-SM		2 HYD 1
118.0	BROWN				Other	Subrounded	Strong	Strong			3 DRI 1
118.25						Angular	None	None			4 DRI 2
118.5						Subangular	Weak	Weak			5 DB 2
118.75						Subangular	Moderate	Moderate			6 HYD 2
119.0						Angular	Strong	Strong			7 SNL
119.25						Subangular	None	None			8 MTL
119.5						Subangular	None	None			9 ARCHIVE
119.75						Angular	None	None			10

16) Comments: GRAVELS PREDOMINANTLY - 3/8", OCCASIONAL 1" GRAVEL. SAND PREDOMINANTLY FINE. MEDIUM GRAINED. SOME CALCITE COATED GRAVELS AT 119.5 FT. PARTICLE SIZE FOR 117.75-118.0 FT FROM LAB ANALYSIS.

17) Radiometric Data

18) VOC's in ppm

19) Logged By: KENNETH DONNELSON

20) Date and Time Log Completed: 6-25-92, 12 PM

21) Checked by:

Borehole Log Sheet

1) Hole Designation: <u>Ue5PW-2</u>										2) Drilling Method: <u>Casing Advance/Percussion Air Hammer</u>											
3) Sampling Data Type: <u>DRIVE CORE</u>										Penetration Rate: <u>3.2 MIN/2 FT.</u> Interval: <u>127.83-129.83</u> Recovery: <u>2 FT/100%</u>											
Run Number: <u>7</u>										Time out of Hole: <u>14:18, 6-25-92</u>											
Rig Type: <u>IR TAW</u>										15) Sample Designation											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10
127.5	10YR 7/3	→	0 10 78 12 90 10	Volcanics	Well	→	→	→	SM	FLU?	1.5										
127.75	VERY PALE	→	→	→	→	→	→	→	→	→	1.0										
128.0	PALE	→	→	→	→	→	→	→	→	→	1.4										
128.25	BROWN	→	→	→	→	→	→	→	→	→	0.3										
128.5		→	→	→	→	→	→	→	→	→	0.7										
128.75		→	→	→	→	→	→	→	→	→	0.8										
129.0		→	→	→	→	→	→	→	→	→	1.3										
129.25		→	→	→	→	→	→	→	→	→	0.7										
129.5		→	→	→	→	→	→	→	→	→	0.6										
129.75		→	→	→	→	→	→	→	→	→	0.8										
16) Comments: PARTICLE SIZE FOR 129.0-129.25' FROM LAB ANALYSIS.																					
17) Radiometric Data										18) VOC's in ppm											
19) Logged By: <u>KENNETH DONNELSON</u> 20) Date and Time Log Completed: <u>6-25-92, 1540</u> 21) Checked by:																					

Borehole Log Sheet

Page 11 of 25

1) Hole Designation: Ue 5PW-2		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data Type: Drive		4.6 MIN/2.12 FT Penetration Rate: = 1.89 MIN/FT Interval: 198.58-200.71 Recovery: 2.12 FT./100%										
Run Number: 8		Rig Type: I R TAW										
Time out of Hole: 1659 ⁺ , 6.26-92		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content Dry Wet	7) Particle Size Distribution Cobbles Gravel Sand Silt Clay	8) Major Minerals Volcanics Carbonates Other	9) Sorting Well Moderate Poor	10) Grain Shape Angular Subangular Rounded	11) Cementation None Weak Moderate Strong	12) HCL Reaction None Weak Moderate Strong	13) USCS Group Name SM	14) Alluvial Unit FILL	Magnetic Susceptibility	15) Sample Designation
198.5	10YR 7/3										0.9	1 DB 1
198.75	VERY										0.3	2 HYD 1
199.0	PALE										0.6	3 DRI 1
199.25	BROWN										0.9	4 DRI 2
199.5											1.4	5 DB 2
199.75											1.3	6 HYD 2
200.0											0.8	7 SNL
200.25											1.0	8 MTL
200.5											1.5	9 ARCHIVE
200.75											1.3	10

16) Comments: X CORE BARREL BROKE OFF AT TOP & WAS IN HOLE FROM 1501-1659. PARTICLE SIZE FOR 200.0-200.25 FROM LAB ANALYSIS. SAND FOR ALL INTERVALS IS PREDOMINANTLY FINE WITH SOME MEDIUM GRAINED.
 ① GRAVELS - 3/8"
 ② GRAVELS - 1/4", SOME 1-2" AT 198.75'
 ③ GRAVELS - 1/2" ANGULAR & TABULAR.
 ④ GRAVELS - 3/8", 2" AT 199'
 ⑤ GRAVELS - 1/4"
 ⑥ TRACE OF WHITE CARBONATES.
 ⑦ & ⑧ GRAVELS 1"-1.5" AT 200.25'
 ⑨ & ⑩ GRAVELS - 1/4"

17) Radiometric Data
 EDITED BY: KENNETH DONNELSON
 18) VOC's in ppm

19) Logged By: KENNETH DONNELSON
 20) Date and Time Log Completed: 6-27-92, 1551
 21) Checked by:

Borehole Log Sheet

Page 13 of 25

1) Hole Designation: Ue 5PW-2		2) Drilling Method: Casing Advance/Percussion Air Hammer																			
3) Sampling Data Type: DRIVE CORE, 4.5' BARREL.		Penetration Rate: 14.5 MIN./2.58' Interval: 308.83-311.42, Recovery: 2.5 FT./97%																			
Run Number: 10		Rig Type: I.R. T4W																			
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation										
		Dry Moist	Cobbles Gravel Sand Silt/Clay	Volcanics Carbonates Other	Well Moderate Poor	Angular Subangular Rounded	None Weak Moderate Strong	None Weak Moderate Strong	GP- SM-SP SM	FILL FILL	Magnetic Susceptibility	1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10
309.25	5YR 5/2 10YR 5/4 YELLOWISH	→	0 90 10 5	90 10	→	→	→	→	GP- SM-SP SM	→	0.5										
309.5	YELLOWISH	→	30 65	→	→	→	→	→	→	→	1.0										
309.75	BROWN	→	8 73 19	→	→	→	→	→	→	→	0.8										
310.0	10YR 6/4 LIGHT	→	→	→	→	→	→	→	→	→	0.8										
310.25	YELLOWISH	→	→	→	→	→	→	→	→	→	1.2										
310.5	BROWN	→	→	→	→	→	→	→	→	→	0.7										
310.75	→	→	→	→	→	→	→	→	→	→	1.3										
311.0	10YR 7/3 VERY PALE BROWN	→	→	→	→	→	→	→	→	→	1.3										
311.25	→	→	→	→	→	→	→	→	→	→	1.1										
311.5	→	→	→	→	→	→	→	→	→	→	1.4										
16) Comments: PARTICLE SIZE FOR 310.75 - 311.0 FT. FROM LAB ANALYSIS. ① GRAVELS - 1/4", OILY SMELL. ② PREDOMINANTLY FINE - MEDIUM SAND. GRAVELS WELL-GRADED, OILY SMELL. ③ PREDOMINANTLY FINE SAND WITH SOME COARSE SAND. SLIGHT CARBONATE "VEINING" BELOW 310 FT.											SLIGHT AMOUNT OF CLAY FROM 311.25 - 311.5 FT.										
17) Radiometric Data EDITED BY: KEN DONNELSON											18) VOC's in ppm										
19) Logged By: KENNETH DONNELSON 20) Date and Time Log Completed: 6-30-92, 1700 21) Checked by:																					

Borehole Log Sheet

2) Drilling Method: Casing Advance/Percussion Air Hammer											
1) Hole Designation: Ue 5PW-2											
3) Sampling Data Type: DRIVE CORE, 3.94 FT BARREL Penetration Rate: 20 MIN./0.92 FT Interval: 648.0-648.92, Recovery: 0.83 FT/91%											
Run Number: 15 Rig Type: I.R. T4W Time out of Hole: 1646, 7-23-92											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
648.25		Dry	Cobbles	Volcanics	Well	Angular	None	Weak	GP	FILL	1 DB 1
648.5			Gravel	Carbonates	Moderate	Subangular	Weak	Weak			2 HYD 1
648.75			Sand		Other	Rounded	Strong	Strong			3 DRI 1
649.0	10YR 7/3 VERY PALE BROWN		Silt Clay								4 DRI 2
											5 DB 2
											6 HYD 2
											7 SNL
											8 MTL
											9 ARCHIVE
											10

16) Comments:
 ① FILL, PREDOMINANTLY $\frac{3}{8}$ " GRAVELS, OILY SMELL
 ② SILTY GRAVELLY SAND, PREDOMINANTLY FINE-MEDIUM SAND, $\frac{3}{8}$ " GRAVELS. CALCAREOUS CEMENT & COATED GRAVELS. INDURATED ZONE.

17) Radiometric Data
 EDITED BY: KEN DONNELSON
 18) VOC's in ppm

19) Logged By: KENNETH DONNELSON 20) Date and Time Log Completed: 7-23-92, 1711 21) Checked by:

Borehole Log Sheet

Page 19 of 25

1) Hole Designation: Ue 5PW-2		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data		Type: ROTARY CORE, 5 FT. HQ CORE BARREL Penetration Rate: 9.5 MIN/5 FT Interval: 700.0 - 705.0 Recovery: 0.5 FT/10%									
Run Number: 16		Rig Type: I.R. T4W									
15) Sample Designation		Time out of Hole: 1339, 7-27-92									
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
700.25		Wet	Cobbles	Volcanics	Well	Angular	None	Weak	GP?		1 DB 1
700.5		Dry	Gravel	Carbonates	Other	Subangular	Weak	Weak			2 HYD 1
			Sand			Rounded	Strong	None			3 DRI 1
			Silt/Clay				Strong	Weak			4 DRI 2
											5 DB 2
											6 HYD 2
											7 SNL
											8 MTL
											9 ARCHIVE
											10

* DRILLER REPORTS THAT CORE RECOVERY IS FROM THE TOP 3" & BOTTOM 3" OF RUN OR 700.0 - 700.25 FT & 704.75 - 705.0 FT., RESPECTIVELY.

16) Comments:
 ① CORED COBBLE.
 ② GRAVEL 1" - 2 1/2" & SUBROUNDED, FINE - MEDIUM SAND. SLIGHT CARBONATE RIND ON GRAVELS.

17) Radiometric Data
 EDITED BY: KEN DONNELSON
 18) VOC's in ppm

19) Logged By: KENNETH DONNELSON
 20) Date and Time Log Completed: 7-27-92, 1400
 21) Checked by:

1) Hole Designation: Ue 5 PW-2		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data		Type: DRIVE CORE, 3.94 FT SOLID BORE, PENETRATION RATE: 24 MIN./1.17 FT. Interval: 718.08-719.25' Recovery: 1.17 FT./100%										
Run Number: 17		Rig Type: I.R. T4W										
Time out of Hole: 1527, 8-5-92		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
		Dry Wet	Cobbles Gravel Sand Silt-Clay	Volcanics Carbonates Other	Well Moderate Poor	Angular Subangular Rounded	None Weak Moderate Strong	None Weak Moderate Strong	GP SM-SP			1 DB 1 2 HYD 1 3 DRI 1 4 DRI 2 5 DB 2 6 HYD 2 7 SNL 8 MTL 9 ARCHIVE 10
718.25			0 100 0 0	95 5					GP	FILL		
718.5												
718.75	10YR 2.5/3		10 84 6								1.3	
719.0	Brown										1.0	
719.25	10YR 7/2		25 69								0.9	
	LIGHT GRAY											

16) Comments:

- PREDOMINANTLY 3/8" - 1/2" GRAVEL. FILL SAMPLE NOT RETAINED
- FINE SAND & FINE GRAVEL
- FINE - MEDIUM SAND, GRAVELS 1" - 2". CENTER OF SAMPLE IS MOIST, BUT OUTER 1/4" IS DRY.

17) Radiometric Data

EDITED BY: KEN DONNELSON

18) VOC's in ppm

19) Logged By: KENNETH DONNELSON 20) Date and Time Log Completed: 8-5-92, 1600 21) Checked by:

Borehole Log Sheet

Page 22 of 25

1) Hole Designation: Ue 5 PW-2		2) Drilling Method: Casing Advance/Percussion Air Hammer			
3) Sampling Data		Type: DRIVE CORE 2.5' BARREL 0.001" Penetration Rate: 18 MIN./1 FT. Interval: 817.58-818.58' Recovery: 1 FT./100%			
Run Number: 19		Time out of Hole: 1047, 8-10-92			
4) Depth in Feet		5) Color (Munsell Chart)			
6) Moisture Content		7) Particle Size Distribution			
8) Major Minerals		9) Sorting			
10) Grain Shape		11) Cementation			
12) HCL Reaction		13) USCS Group Name			
14) Alluvial Unit		15) Sample Designation			
Magnetic Susceptibility		16) Comments: DRILL & MTL ARE PARTIAL SAMPLE.			
817.25	10YR 3/6 DARK YELLOW BROWN	0 100 0 0	GP	1.3	1 DB 1
817.5	10YR 3/6 DARK YELLOW BROWN	20 70 10	SM-SP	1.0	2 HYD 1
817.75	10YR 3/6 BROWN	20 70 10	SM	1.4	3 DRI 1
818.0	10YR 3/6 BROWN	20 70 10	SM	2.1	4 DRI 2
818.25	10YR 6/3 PALE BROWN	15 65 20	SM	1.8	5 DB 2
818.5	10YR 6/3 PALE BROWN	15 65 20	SM		6 HYD 2
					7 SNL
					8 MTL
					9 ARCHIVE
					10

17) Radiometric Data

18) VOC's in ppm

19) Logged By: KENNETH DONNELSON

20) Date and Time Log Completed: 8-10-92, 1120

21) Checked by:

Borehole Log Sheet

1) Hole Designation: <u>Ve 5PW-2</u>		2) Drilling Method: <u>Casing Advance/Percussion Air Hammer</u>										
3) Sampling Data Type: <u>DRIVE CORE, 2.5 FT. BARREL</u>		Penetration Rate: <u>17.5 MIN. / 1.17' Interval: 828.33 - 829.5 FT. Recovery: 1 FT / 85%</u>										
Run Number: <u>20</u>		Rig Type: <u>T.R. T4W</u>										
Time out of Hole: <u>0910, 8-11-92</u>		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
828.5		Dry	Cobbles	Volcanics	Well	Angular	None	Strong	GP	FILL		1 DB 1
828.75		Moist	Gravel	Silt-Clay	Moderate	Subangular	Weak	Moderate				2 HYD 1
829.0			Sand	Other	Well	Subrounded	None	Strong				3 DRI 1
829.25	10YR 5/2		Gravel	Volcanics	Moderate	Angular	Weak	Moderate				4 DRI 2
829.5	LIGHT YELLOWISH BROWN		Sand	Other	Moderate	Subangular	None	Strong	GM?		1.4	5 DB 2
			Gravel	Volcanics	Well	Angular	Weak	Moderate				6 HYD 2
			Sand	Other	Moderate	Subangular	None	Strong				7 SNL
			Gravel	Volcanics	Well	Angular	Weak	Moderate				8 MTL
			Sand	Other	Moderate	Subangular	None	Strong				9 ARCHIVE
			Gravel	Volcanics	Well	Angular	Weak	Moderate				10

16) Comments:
 ① FILL, PREDOMINANTLY - 1/2" GRAVEL, SAMPLES NOT RETAINED.
 ② PREDOMINANTLY - 1" GRAVELS, FINE - MEDIUM SAND.

17) Radiometric Data
 EDITED BY: KEN DONNELSON
 19) Logged By: KENNETH DONNELSON 20) Date and Time Log Completed: 8-11-92, 0936 21) Checked by:

18) VOC's in ppm

Borehole Log Sheet

1) Hole Designation: Ue5 PW-2		2) Drilling Method: Casing Advance/Percussion Air Hammer																						
3) Sampling Data Type: HQ ROTARY CORE, 5' BARREL		20 MIN / 5.17 FT. Interval: 829.0-834.17 Recovery: 0 FT / 0%																						
Run Number: 21		Rig Type: I.R. T4W																						
Time out of Hole: 1430, 8-11-92																								
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation													
											Magnetic Susceptibility	1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10			
829.0	10YR 6/4	Moist	Cobbles	Volcanics	Well	Angular	Rounded	None	Weak	Strong	None	Weak	Moderate	Strong	SP?									
	LIGHT		Gravel	Silt-Clay	Other	Subangular	Subrounded	None	Weak	Strong	None	Weak	Moderate	Strong										
	YELLOWISH		Sand																					
	BROWN																							
834.17																								
16) Comments: NO RECOVERY OTHER THAN A FEW TEASPOONS OF PREDOMINANTLY FINE-MEDIUM SAND.																								
17) Radiometric Data												18) VOC's in ppm												
EDITED BY: KEN DONNELSON																								
19) Logged By: KENNETH DONNELSON												20) Date and Time Log Completed: 8-11-92, 1430												
21) Checked by:																								

Borehole Log Sheet

1) Hole Designation: Ue 5 PW-2		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data		Type: DRIVE CORE, 3.94 FT. BARREL									
Run Number: 22		Rig Type: I.R. T4W									
Run Number: 22		Penetration Rate: 29 MIN./2.25 FT.									
Run Number: 22		Interval: 839.0-841.25 Recovery: 0/0%									
Run Number: 22		Time out of Hole: 1735, 8-31-92									
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
		Dry	Cobbles	Volcanics	Well	Angular	Weak	Strong			1 DB 1
		Moist	Gravel	Silt-Clay	Other	Subangular	None	Weak			2 HYD 1
			Sand			Rounded	Moderate	Moderate			3 DRI 1
							Strong	Strong			4 DRI 2
							None	Weak			5 DB 2
								Weak			6 HYD 2
								Strong			7 SNL
								None			8 MTL
								Moderate			9 ARCHIVE
								Strong			10

16) Comments: CORED ON 8-12-92. SAMPLER LOST IN HOLE WHEN 160 FT. OF DRILL STRING FELL 120 FT. & BECAME WEDGED IN CASING ON 8-12-92. RETRIEVED SAMPLER ON 8-31-92. SAMPLER WAS SMASHED & SPLIT LENGTHWISE BY HAMMER ODEX. SAMPLER RETRIEVED BY OVERCORING WITH "SW" CASING & BIT TO 848.17 FT & POURING SAND DOWN DRILL STRING TO "SAND LOCK" SAMPLER. A SMALL AMOUNT OF SAMPLE COLLECTED FROM 847-848 FT. CONSISTED OF SILTY SAND, FINE-MEDIUM GRAINED WITH SOME COARSE SAND & 4% CLAY WITH LOW PLASTICITY. VERY MOIST, WEAK HCL REACTION, 7.5 YRS/2. HIGH DRY STRENGTH FOR DRIED SAMPLE BALL.

17) Radiometric Data

18) VOC's in ppm

19) Logged By: KENNETH DONNELSON

20) Date and Time Log Completed: 9-1-92, 0800

21) Checked by:

Appendix B.3 Borehole Log Sheets for Ue5PW-3
Borehole Log Sheet

1) Hole Designation: Ue5PW-3										2) Drilling Method: Casing Advance/Percussion Air Hammer												
3) Sampling Data Type: DRIVE CORE, 2.5' SPLIT BARREL Penetration Rate: 1.3 MIN./2.5' Interval: 0.0-2.5 FT Recovery: 1.75 FT./70%										4) Sampling Data Type: DRIVE CORE, 2.5' SPLIT BARREL Penetration Rate: 1.3 MIN./2.5' Interval: 0.0-2.5 FT Recovery: 1.75 FT./70%												
Run Number: 1										Rig Type: I.R. T4W												
15) Sample Designation										16) Comments:												
17) Radiometric Data										18) VOC's in ppm												
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	1	2	3	4	5	6	7	8	9	10	
0.25	10YR 7/3										1.77											
0.5	VERY PALE										1.98											
0.75	BROWN										1.08											
1.0											1.06											
1.25											1.25											
1.5											1.35											
1.75											1.56											
16) Comments: ① PREDOMINANTLY FINE SAND. GRAVEL PREDOMINANTLY - 3/8", ONE PIECE 1.5", SOME ROOT LETS. ② PREDOMINANTLY FINE SAND. GRAVEL PREDOMINANTLY - 1/4". SOME ROOT LETS. ③ GRAVELS PREDOMINANTLY - 1/4". SOME ROOT LETS. ④ GRAVELS PREDOMINANTLY - 1/4". FINE SAND. PARTICLE SIZE FOR 1.25 - 1.5 FT. FROM LAB ANALYSIS.																						
17) Radiometric Data										18) VOC's in ppm												
19) Logged By: KENNETH D. DONNELSON																						
20) Date and Time Log Completed: 9-16-92																						
21) Checked by:																						

3) Sampling Data	Type: DRIVE CORE, 2.5' SPLIT BARREL Penetration Rate: 1.1 MIN/2.5' Interval: 1.58 - 3.83', Recovery: 1.75 FT./78%
Run Number: 2	Rig Type: I.R. T4W = 0.44 MIN/FT. Time out of Hole: 08 4 9-16-92

4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
2.25	7.5 YR 7/3	Dry	Cobbles 0, Gravel 22, Sand 63, Silt-Clay 15	Volcanics 100, Other 0	Well	Angular	Weak	None	SM	FILL?	1 DB 1
2.5	PINK	Wet	Cobbles 0, Gravel 22, Sand 63, Silt-Clay 15	Volcanics 100, Other 0	Moderate	Subangular	Weak	Weak	SM	↓	8 MTL
2.75			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0	↓	Subrounded	Weak	None	SM-SW		7 SNL
3.0			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		6 HYD 2
3.25			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		5 DB 2
3.5			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		4 DRI 2
3.75			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subrounded	Weak	None	SM		3 DRI 1
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		2 HYD 1
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		1 DB 1
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		Magnetic Susceptibility
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subrounded	Weak	None	SM		9 ARCHIVE
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		8 MTL
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		7 SNL
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subrounded	Weak	None	SM		6 HYD 2
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		5 DB 2
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		4 DRI 2
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		3 DRI 1
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		2 HYD 1
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		1 DB 1
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		Magnetic Susceptibility
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		9 ARCHIVE
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		8 MTL
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		7 SNL
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		6 HYD 2
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		5 DB 2
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		4 DRI 2
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		3 DRI 1
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		2 HYD 1
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		1 DB 1
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		Magnetic Susceptibility
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		9 ARCHIVE
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Subangular	Weak	None	SM		8 MTL
			Cobbles 0, Gravel 15, Sand 80, Silt-Clay 5	Volcanics 100, Other 0		Angular	Weak	None	SM		7 SNL
			Cobbles								

16)Comments: PREDOMINANTLY FINE SAND. GRAVEL - $\frac{3}{8}$ ", SOME ROOTLETS. PARTICLE SIZE FOR 2.25 - 2.5 FT. FROM LAB ANALYSIS.

17) Radiometric Data

17/NAUIONMETRIC DATA
EDITED BY: REN DONNELSON

19) Edited By: KEN DONNELSON
20) Date and Time Log Completed: 9-16-92, 0936
21) Checked by: KENNETH B. DONNELSON

18)VOC's in ppm

Borehole Log Sheet

1) Hole Designation: Ue 5PW-3										2) Drilling Method: Casing Advance/Percussion Air Hammer											
3) Sampling Data										3) Sampling Data											
Type: DRIVE CORE, 5 FT SOLID BARREL Penetration Rate: 8.2 MIN/4.67' Interval: 48.5-53.17' Recovery: 4.25 FT/91%										Type: DRIVE CORE, 5 FT SOLID BARREL Penetration Rate: 8.2 MIN/4.67' Interval: 48.5-53.17' Recovery: 4.25 FT/91%											
Run Number: 3										Run Number: 3											
Rig Type: I.R. T4W										Rig Type: I.R. T4W											
Time out of Hole: 1646, 9-16-92										Time out of Hole: 1646, 9-16-92											
4) Depth in Feet	5) Color (Munsell Chan)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation										
48.75	10YR7/3								GM-GP Fill?		1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10	
49.0	VERY																				
49.25	PALE																				
49.5	BROWN																				
49.75																					
50.0																					
50.25																					
50.5																					
50.75																					
51.0																					
16) Comments: ① PREDOMINANTLY -3/8" GRAVEL & WELL GRADED SAND. ② PREDOMINANTLY -1/4" GRAVEL & WELL GRADED SAND. ③ PREDOMINANTLY FINE SAND. GRAVELS PREDOMINANTLY -1/4". ④ PREDOMINANTLY -3/8" GRAVEL & WELL GRADED SAND. PARTICLE SIZE FOR 49.75 - 50.0 FT FROM LAB ANALYSIS.																					
17) Radiometric Data										18) VOC's in ppm											
19) Logged By: KENNETH D. DONNELSON 20) Date and Time Log Completed: 9-17-92, 0700 21) Checked by:																					

Borehole Log Sheet

1) Hole Designation: Ue 5 PW - 3		2) Drilling Method: Casing Advance/Percussion Air Hammer	
3) Sampling Data Type: DRIVE CORE, 5 FT SOLID BARREL Penetration Rate: 1.76 MIN/FT. Interval: 4.8. 5-53.17 Recovery: 4.25 FT./91%		4) Depth in Feet	
Run Number: 3		Rig Type: I.R. T4W	
Time out of Hole: 1646, 9-16-92		15) Sample Designation	
		Magnetic Susceptibility	
		10	
		9 ARCHIVE	
		8 MTL	
		7 SNL	
		6 HYD 2	
		5 DB 2	
		4 DRI 2	
		3 DRI 1	
		2 HYD 1	
		1 DB 1	
5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %
51.25 10Y R 7/3	Dry	Cobbles	Volcanics
51.5 VERY	Wet	Gravel	Silt-Clay
51.75 PALE		Sand	
52.0 BROWN		Gravel	
52.25		Gravel	
52.5		Gravel	
52.75		Gravel	
(LOG CONTINUED FROM PAGE 3.)			
16) Comments: ⑤ STAGE I CARBONATE DEVELOPMENT WELL GRADED SAND. PREDOMINANTLY -1/4" GRAVEL. ⑥ GRAVELS PREDOMINANTLY -1/2" & CARBONATE COATED. PARTICLE SIZE FOR 52.5 - 52.75 FT. FROM LAB ANALYSIS.			
17) Radiometric Data		18) VOC's in ppm	
EDITED BY: KEN DONNELSON			
19) Logged By: KENNETH D. DONNELSON		20) Date and Time Log Completed: 9-17-92, 0700	
		21) Checked by:	

Borehole Log Sheet

1) Hole Designation: Ue 5PW-3										2) Drilling Method: Casing Advance/Percussion Air Hammer												
3) Sampling Data Type: DRIVE CORE, 5 FT SOLID BARREL Penetration Rate: 13 MIN./3.33' Interval: 98.0 - 101.33' Recovery: 2.25'/68%										4) Run Number: 4												
5) Color (Munsell Chart)										6) Moisture Content												
7) Particle Size Distribution										8) Major Minerals												
9) Sorting										10) Grain Shape												
11) Cementation										12) HCL Reaction												
13) USCS Group Name										14) Alluvial Unit												
15) Sample Designation										Magnetic Susceptibility												
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation	Magnetic Susceptibility	1	2	3	4	5	6	7	8	9	10
99.25	10YR 7/4	1	0 95 5 0 100	Volcanics	Well	Poor	None	Weak	GP	FILL		1.3										
99.5	10YR 7/3	1	37 53 10	Sh. Clay	Moderate	Angular	Weak	Weak	SW-SM			1.2										
99.75	10YR 7/3	1	20 70	Volcanics	Moderate	Subangular	Weak	Weak	SP-SM			0.6										
100.0	VERY PALE BROWN	1	15 15	Volcanics	Moderate	Angular	Weak	Weak	SM			1.2										
100.25	10YR 7/4	1	40 50 10	Volcanics	Moderate	Angular	Weak	Weak	SM-SW			0.9										
100.5		1		Volcanics	Moderate	Angular	Weak	Weak				1.0										
100.75		1		Volcanics	Moderate	Angular	Weak	Weak				1.0										
101.0		1		Volcanics	Moderate	Angular	Weak	Weak				1.2										
101.25		1		Volcanics	Moderate	Angular	Weak	Weak				1.2										
16) Comments:																						
① PREDOMINANTLY - 3/4" GRAVEL.																						
② PREDOMINANTLY WELL-GRADED SAND & - 1/4" GRAVEL. * PIECE OF CORE CATCHER IN SIDE OF SAMPLE.																						
③ PREDOMINANTLY FINE SAND & - 3/8" GRAVEL. PARTICLE SIZE FOR 99.25 - 99.5 FT. FROM LAB ANALYSIS.																						
④ SOME CARBONATE COATING ON GRAVELS.																						
⑤ GRAVELS PREDOMINANTLY - 1/4" WITH SOME 1" GRAVELS.																						
17) Radiometric Data										18) VOC's in ppm												
19) Logged By: KENNETH D. DONNELSON																						
20) Date and Time Log Completed: 9-17-92, 12:57																						
21) Checked by:																						

Borehole Log Sheet

1) Hole Designation: Ue 5 PW-3		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data		Type: DRIVE CORE, 5 FT. SOLID BARREL Penetration Rate: 10.7 MIN./3.67 FT. Interval: 129.0 - 132.67 Recovery: 2.75 FT./75%										
Run Number: 5		Rig Type: I.R. T-4 W										
Time out of Hole: 16:38, 9-17-92		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content Wet Dry	7) Particle Size Distribution Cobbles Gravel Sand Silt-Clay	8) Major Minerals in % Carbonates Volcanics	9) Sorting Well Moderate Poor	10) Grain Shape Angular Subangular Subrounded Rounded	11) Cementation None Weak Moderate Strong	12) HCL Reaction None Weak Moderate Strong	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
129.25	7.5 YR 7/4		0 15 83 2	100					SW		1.28	1 DB 1
129.5	PINK		20 77 3								3.0%	2 HYD 1
129.75											2.0%	3 DRI 1
130.0											0.81	4 DRI 2
130.25											1.55	5 DB 2
130.5											1.34	6 HYD 2
130.75											0.97	7 SNL
131.0											1.39	8 MTL
131.25											1.26	9 ARCHIVE
131.5	10 YR 6/4 LIGHT YELLOW		25 73 2						SP		1.75	
131.75	BROWN		43 52 5						SM-SW		1.71	

16) Comments:
 ① WELL GRADED SAND. GRAVELS PREDOMINANTLY $\frac{3}{8}$ " WITH ABUNDANT CARBONATES.
 ② PREDOMINANTLY COARSE SAND WITH GRAVELS $\frac{1}{4}$ " WITH SOME CARBONATE COATING. ANALYSIS.
 ③ GRAVELS $\frac{3}{8}$ " WITH SOME CARBONATE COATING.
 ④ RARE AMOUNT OF CLAY.

PARTICLE SIZE FOR 130.5-130.75 FT & 131.5-131.75 FT. FROM LAB

17) Radiometric Data
 EDITED BY: KEN DONNELSON
 19) Logged By: KENNETH O. DONNELSON 20) Date and Time Log Completed: 1742, 9-17-92 21) Checked by:

18) VOC's in ppm

Borehole Log Sheet

1) Hole Designation: Ue5PW-3		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE, 5 FT SOLID BARREL Penetration Rate: 11.9 MIN/5 FT		4) Recovery: 4.0 FT/80%									
Run Number: 6		Rig Type: I.R. T4W									
Time out of Hole: 1026, 9-21-92											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
198.25	10YR 6/4										
198.5	LIGHT										
198.75	YELLOW										
199.0	BROWN										
199.25											
199.5											
199.75											
200.0											
200.25											
200.5											
(LOG CONTINUED ON PAGE 8)											
16) Comments: PARTICLE SIZE FOR 198.75 - 199.0 FT. FROM LAB ANALYSIS. ① PREDOMINANTLY COARSE SAND GRAVELS - 1/4". ② GRAVELS UP TO 2 1/2". ③ GRAVELS UP TO 1 1/2", GRAVELS HAVE WHITE CARBONATE COATING. ④ GRAVELS - 3/4".											
17) Radiometric Data										18) VOC's in ppm	
19) Logged By: KENNETH DONNELSON 20) Date and Time Log Completed: 9-21-92, 1526 21) Checked by:											

Borehole Log Sheet

1) Hole Designation: Ue5 PW-3										2) Drilling Method: Casing Advance/Percussion Air Hammer											
3) Sampling Data Type: DRIVE CORE, 5 FT SOLID BARREL Penetration Rate: 11.9 MIN./5 FT.										4) Recovery: 4.0 FT / 80%											
Run Number: 6										Time out of Hole: 1026, 9-21-92											
Rig Type: I.R. T4W										15) Sample Designation											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10
200.75	10YR 6/4	Dry	Cobbles 0, Gravel 20, Sand 80, Silt-Clay 0	Volcanics 100	Well	Angular	None	Weak	SW		1.46										
201.0	VERY PALE								SW-SM		1.29										
201.25	BROWN								SP		1.31										
201.5	10YR 6/4										1.67										
201.75	LIGHT YELLOW										1.28										
202.0	BROWN										2.03										
(LOG CONTINUED FROM PAGE 7)																					
16) Comments: ⑤ PREDOMINANTLY FINE SAND . ⑥ PREDOMINANTLY MEDIUM SAND. PARTICLE SIZE FOR 200.5 - 200.75 FT. FROM LAB ANALYSIS.																					
17) Radiometric Data										18) VOC's in ppm											
EDITED BY: KENNETH DONNELSON										20) Date and Time Log Completed: 9-21-92, 1526											
19) Logged By: KENNETH DONNELSON										21) Checked by:											

Borehole Log Sheet

1) Hole Designation: Ue5PW-3										2) Drilling Method: Casing Advance/Percussion Air Hammer												
3) Sampling Data Type: DRIVE CORE, SPT, SOLID BARREL Penetration Rate: 4.43 MIN/FT. Interval: 248.83-252.33 Recovery: 3.25FT/93%										4) Run Number: 7 Rig Type: I.R. T4W Time out of Hole: 0730, 9-22-92												
4) Depth in Feet	5) Color (Munsell Chart)		6) Moisture Content		7) Particle Size Distribution		8) Major Minerals in %		9) Sorting		10) Grain Shape		11) Cementation		12) HCL Reaction		13) USCS Group Name		14) Alluvial Unit		15) Sample Designation	
	10R5/4 LIGHT YELLOW BROWN		Dry Moist		Cobbles Gravel Sand Silt-Clay		Volcanics Carbonates Other		Well Moderate Poor		Angular Subangular Rounded		None Weak Moderate Strong		None Weak Moderate Strong		SP ↓ SW-SM		2.63 1.78 2.03		1 DB 1 2 HYD 1 3 DRI 1 4 DRI 2 5 DB 2 6 HYD 2 7 SNL 8 MTL 9 ARCHIVE 10	
	251.75		↓		0 5 91 4 100		↓		↓		↓		↓		↓		↓		↓		X	
	252.0		↓		15 81		↓		↓		↓		↓		↓		↓		↓		X	
252.25		↓		12 7		↓		↓		↓		↓		↓		↓		↓		X		
C LOG CONTINUED FROM PAGE 9																						
16) Comments: ③ FINE SAND. ④ GRAVELS - 3/8". PARTICLE SIZE FOR 252.0-252.25 FT. FROM LAB ANALYSIS.																						
17) Radiometric Data EDITED BY: KEN DONNELSON										18) VOC's in ppm												
19) Logged By: KENNETH DOWNELSON										20) Date and Time Log Completed: 9-22-92, 0830 21) Checked by:												

Borehole Log Sheet

1) Hole Designation: Ue SPW-3		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE, 2.5 FT BARREL		Penetration Rate: 13.4 MIN/1.42 FT									
Run Number: 10		Rig Type: I.R. T4W									
Time out of Hole: 0744, 9-29-92		Recovery: 1.42 FT/100%									
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
451.25	10YR 7/3	Moist	Cobbles	Volcanics	Well	Angular	None	Weak	SM		1 DB 1
451.5	VERY PALE		Gravel	Silt-Clay	Moderate	Subangular	Weak	→			2 HYD 1
451.75	BROWN		Sand	Carbonates	Poor	Rounded	Strong	→			3 DRI 1
452.0											4 DRI 2
452.25											5 DB 2
452.5											6 HYD 2
											7 SNL
											8 MTL
											9 ARCHIVE
											10
16) Comments: PREDOMINANTLY FINE - MEDIUM SAND. GRAVELS PREDOMINANTLY - 1/4" WITH SLIGHT CARBONATE RIND. NOTE: NO INTACT SAMPLES. HAD TO "BEAT OUT" SAMPLE. UNABLE TO EXTRUDE DUE TO STUCK LINERS. PARTICLE SIZE FOR 451.75 - 452.0 FT. FROM LAB ANALYSIS.											
17) Radiometric Data										18) VOC's in ppm	
19) Logged By: KENNETH DONNELSON 20) Date and Time Log Completed: 9-29-92 0845 21) Checked by:											

Borehole Log Sheet

Page 14 of 18

1) Hole Designation: Ue 5PW-3										2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data Type: DRIVE CORE, 2.5 FT. BARREL										Penetration Rate: 10.2 MIN/2.25 FT Interval: 498.17 - 500.42' Recovery: 2.5 FT/100 %										
Run Number: 11										Rig Type: I. R. T4-W										
4) Depth in Feet										5) Color (Munsell Chart)										
6) Moisture Content										7) Particle Size Distribution										
8) Major Minerals										9) Sorting										
10) Grain Shape										11) Cementation										
12) HCL Reaction										13) USCS Group Name										
14) Alluvial Unit										15) Sample Designation										
Magnetic Susceptibility										10										
498.25	10YR 6/4	0	10	85	5	100	Other	Well	Good	Angular	Subangular	Rounded	None	Weak	Moderate	Strong	SP	1.61	1	DB 1
498.5	LIGHT	↓	↓	↓	↓	↓	Volcanics	↓	↓	↓	↓	↓	None	Weak	Moderate	Strong	↓	1.67	2	HYD 1
498.75	YELLOW	↓	↓	↓	↓	↓	Carbonates	↓	↓	↓	↓	↓	None	Weak	Moderate	Strong	↓	1.63	3	DRI 1
499.0	BROWN	↓	↓	↓	↓	↓	Other	↓	↓	↓	↓	↓	None	Weak	Moderate	Strong	↓	1.81	4	DRI 2
499.25		↓	↓	↓	↓	↓	Volcanics	↓	↓	↓	↓	↓	None	Weak	Moderate	Strong	↓	0.99	5	DB 2
499.5		↓	↓	↓	↓	↓	Volcanics	↓	↓	↓	↓	↓	None	Weak	Moderate	Strong	↓	1.16	6	HYD 2
499.75		↓	↓	↓	↓	↓	Volcanics	↓	↓	↓	↓	↓	None	Weak	Moderate	Strong	↓	1.02	7	SNL
500.0		↓	↓	↓	↓	↓	Volcanics	↓	↓	↓	↓	↓	None	Weak	Moderate	Strong	↓	1.17	8	MTL
500.25		↓	↓	↓	↓	↓	Volcanics	↓	↓	↓	↓	↓	None	Weak	Moderate	Strong	↓	0.98	9	ARCHIVE
500.5		↓	↓	↓	↓	↓	Volcanics	↓	↓	↓	↓	↓	None	Weak	Moderate	Strong	↓	3.50	10	

16) Comments: ① PREDOMINANTLY FINE-MEDIUM SAND WITH -1/4" GRAVELS.
 ② PREDOMINANTLY FINE-MEDIUM SAND.
 ③ PREDOMINANTLY WELL-GRADED SAND. GRAVELS PREDOMINANTLY -1/4" TO -3/8" WITH SLIGHT CARBONATE BIND.
 PARTICLE SIZE FOR 498.75 - 499.0 FT AND 500.25 - 500.5 FT FROM LAB ANALYSIS.

17) Radiometric Data

18) VOC's in ppm

19) Logged By: KENNETH DONNELSON 20) Date and Time Log Completed: 9-30-92, 1700 21) Checked by:

Appendix B.4 Drill Cuttings Log Data for Ue5PW-1

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
0.0-5.0	SP-SM	Sand	8	10	1	1.2	Moderate- Strong	V. Pale Yellow	V. Pale Yellow- White	
5.0-17.5	?				5-7					No recovery
17.5-20.0	SW	Sand	12	5	1.9					
20.0-22.5	?				1.9					No recovery
22.5-25.0	?				1.9	4.5	Moderate			No recovery?
25.0-27.5	SP	Sand	4	4	1.9					Medium sand
27.5-29.0	SP-SM	Sand	11	6			Weak			Fine sand
29.0-35.0	SW	Sand	10-33	2-4	2.7	2.1	Moderate		V. Pale Yellow	
35.0-37.5	?				2.7					No recovery
37.5-40.00	SP-SM	Sand	8	7	6.0					Fine sand
40.0-67.5	SW-SM	Sand	6-37	7-9	0.4-0.8	0.9-1.3	Strong			
67.5-72.5	SP-SM	Sand	7-11	8	0.6					Fine sand
72.5-80.0	SW-SM	Sand	11-29	5-7	0.6-0.8	0.9	Strong			
80.0-82.5	SP-SM	Sand	8	10	0.8	1.2	Strong			Fine sand
82.5-102.5	SW-SM	Sand	2-29	6-11	0.8	0.9-1.3	Strong			
102.5-107.5	SP-SM	Sand	8-10	6-7	0.7	1.2	Strong			Fine sand
107.5-115.0	SW-SM	Sand	12	7-12	1.6	1.2-1.3	Moderate- Strong			
115.0-117.5	SM	Silty sand	3	14	1.6	1.3	Strong			Fine sand
117.5-120.0	SW	Sand	48	3		0.7	Moderate			
120.0-127.5	SW-SM	Sand	7-20	7-10	1.7	1.1-1.4	Strong			Thin ash at 120'?

Appendix B.4 Drill Cuttings Log Data for Ue5PW-1 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
127.5-130.0	SW	Sand	8	5		1.3	Moderate	V. Pale Yellow Green	Very Pale Yellow White	
130.0-132.5	GW-GM	Gravel	50	8		1.2	Strong	V. Pale Yellow Green	Very Pale Yellow White	
132.5-147.5	SW-SM	Sand	16-45	5-10		1-1.7	Weak-Strong			
147.5-150.0	SW	Sand	47	5	1.2	1.8	Strong			
150.0-160.0	SW-SM	Sand	28-36	6-7	1.2-2.8	1.4-1.7	Moderate- Strong			
160.0-162.5	SW	Sand	44	4	1.2	1.0	Moderate			
162.5-180.0	SW-SM	Sand	19-32	5-8	1.2-3.6	1-1.8	Moderate- Strong			
180.0-182.5	SW	Sand	49	3	2.4	1.5	Moderate			
182.5-195.0	SW-SM	Sand	15-22	5-8	2.4-2.8	1.7-2.6	Weak-Strong		V. Pale Yellow Orange	
195.0-202.5	SW	Sand	15-34	2-5	2.2-2.8	1.9	Strong-Weak		V. Pale Yellow Orange	
202.5-205.0	SW-SM	Sand	20	6	4	1.4	Weak- Moderate			
205.0-210.0	SW	Sand	25	2-5	2.8-4	1.6	Weak-Strong			
210.0-215.0	SW-SM	Sand	22	5-6	2.8-4.4	1.4-1.7	Moderate- Weak			
215.0-217.5	SW	Sand	39	5	4.4	2	Weak			

Appendix B.4 Drill Cuttings Log Data for Ue5PW-1 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
217.5-227.5	SW-SM	Sand	8-19	8-9	2.4-4.4	1.2-2.1	Moderate- Strong			
227.5-232.5	SM	Silty Sand	18	12	2.4-2.8	1.5-1.7	Moderate- Strong			
232.5-242.5	SW-SM	Sand	10-33	6-9	1.6-2.4	1.5-2	Moderate- Strong	V. Pale Yellow Green	V. Pale Yellow	
242.5-245.0	SW	Sand	13	5	1.6	1.9	Moderate	V. Pale Yellow Green	V. Pale Yellow	
245.0-247.5	SW-SM	Sand	21	6	?	2.4	Weak	V. Pale Yellow Green	V. Pale Yellow	
247.5-250.0	SM	Silty Sand	12	13	2	2.2	Moderate			Medium Sand
250.0-252.5	SW-SM	Sand	16	8	3.4	2	Moderate			
252.5-255.0	SW	Sand	33	4	2.4	1.9	Weak- Moderate			
255.0-257.5	GW	Gravel	50	4	2	1.5	Weak			
257.5-267.5	SW-SM	Sand	13-19	7	1.6-3.2	1.3-2	Moderate- Strong			
267.5-270.0	SW	Sand	14	5	4	1.5	Weak		V. Pale Yellow Orange	
270.0-275.0	SW-SM	Sand	17-25	6	10.8-2.8	1.9-1.7	Weak- Moderate		V. Pale Yellow Orange	

Appendix B.4 Drill Cuttings Log Data for Ue5PW-1 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
275.0-277.5	SW	Sand	21	4	4	1.8	Weak		V.Pale Yellow Orange	
277.5-287.5	SW-SM	Sand	8-23	5-6	1.6-2	2	Weak- Moderate			
282.5-292.5	SW	Sand	14-33	1-4	1.2-3.2	2-2.3	Weak- Moderate			
292.5-307.5	SW-SM	Sand	10-26	8	1.2-5.2	1.4-2.6	Weak- Moderate			
307.5-312.5	SW	Sand	23-25	2-4	1.2-3.6	1.4-1.5	Moderate- Strong			
312.5-315.0	SM	Silty Sand	16	13	1.6	1.4	Strong			Medium Sand
315.0-320.0	SW-SM	Sand	10-28	8-11	1.2-2.4	1.9-2.9	Strong			
320.0-322.5	SW	Sand	14	2	2.4	2.6	Weak			
322.5-325.0	SW-SM	Sand	15	6	7.2	3.1	Weak			
325.0-327.5	SW	Sand	14	4	3.2	2.6	Strong			
327.5-330.0	SW-SM	Sand	14	5	5.2	2.9	Weak			
330.0-335.0	SW	Sand	10-24	3-5	2.8-3.6	2.6-3.2	Weak		V.Pale Yellow Orange	
335.0-347.5	SW-SM	Sand	7-18	5-8	2.8-4	2.6-2.9	Weak-None	Bright Green		
347.5-352.5	SW	Sand	6-8	4-5	3.6-4	1.9	None			
352.5-365.0	SW-SM	Sand	3-27	5-11	2-4.8	2.1-3.2	Weak- Moderate	Bright Green		

Appendix B.4 Drill Cuttings Log Data for Ue5PW-1 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
365.0-375.0	SM	Silty Sand	4-5	13-14	5.67	3.4	Moderate- Strong		Pale Orange	Fine Sand
375.0-377.5	SP-SM	Sand	4	10	?	2.7	Moderate			
377.5-385.0	SW-SM	Sand	6-25	8-9	0.4-2	2.9-3.2	Moderate			
385.0-387.5	SW	Sand	20	4	1.2	2.2	Weak			
387.5-392.5	SW-SM	Sand	10-15	5-8	1.6-3.2	2.3-2.4	Moderate- Strong			
392.5-395.0	SW	Sand	19	4	1.6	2.3	Moderate			
395.0-397.5	SW-SM	Sand	10	6	0.8	2.5	Weak			
397.5-402.5	SP-SM	Sand	13	7	0.4	2.6	Moderate			Medium Sand
402.5-407.5	SW-SM	Sand	25	9	0.8					
407.5-410.0	SW	Sand	19	5	0.6					
410.0-415.0	SW-SM	Sand	22-31	5-9	0.6					
415.0-417.5	SW	Sand	23	3	0.8					
417.5-420.0	SW-SM	Sand	5	6						
420.0-437.5	SW	Sand	21-29	3	0.8	1.0	Moderate			
437.5-440.0	SW-SM	Sand	24	9	0.8	2.1	Moderate			
440.0-442.5	SM	Silty Sand	14	13	0.8	2.4	Strong			Fine Sand
442.5-447.5	SW-SM	Sand	15	11	0.8	2.1	Strong			
447.5-450.0	SM	Silty Sand	8	13	0.8	2.6	Moderate- Strong			Medium Sand
450.0-467.5	SW-SM	Sand	9-37	6-12	0.8	2.2-2.9	Strong-Weak		V. Pale Orange	Fluorescence @ 465'

Appendix B.4 Drill Cuttings Log Data for Ue5PW-1 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
467.5-472.5	SW	Sand	32-37	3	0.8	2.1-2.5	Weak	Bright Green		Fluorescence @ 465'
472.5-487.5	SW-SM	Sand	16-29	5-9	0.8	2.2-2.7	Strong-Weak			
487.5-490.0	SM	Silty Sand	8	19	0.8	2.4	Moderate			Fine Sand
490.0-505.0	SW-SM	Sand	15-26	5-8	0.8-1.2	1.9-2.5	Moderate			
505.0-507.5	SW	Sand	24	5	1.6	2.1	Moderate			
507.5-512.5	SW-SM	Sand	17-29	6-10	0.8-1.2	1.5-2.4	Strong			
512.2-525.0	SW	Sand	18-36	3-4	0.8-1.4	1.8-2.6	Weak- Moderate	Bright Green		Fluorescence @ 520'
525.0-537.5	SW-SM	Sand	8-26	6-10	1-2	1.5-2.4	Strong			
537.5-540.0	SW	Sand	22	5	1.2	2.2	Weak			
540.0-545.0	SW-SM	Sand	22-32	6-7	1.2	2.2-2.4	Strong		V. Pale Yellow	
545.0-547.5	SW	Sand	39	5	1.2	3.1	Moderate			
547.5-567.5	SW-SM	Sand	9-23	6-12	1.2-2	1.9-2.8	Weak-Strong			
567.5-570.0	SM	Silty Sand	9	17	2	3.2	Moderate- Strong			Medium Sand
570.0-577.5	SW-SM	Sand	11-16	6-7	2	2.3-2.6	Moderate			
577.5-582.5	SW	Sand	46	1	1.6-2	2.4	Weak		V. Pale Yellow	
582.5-600.0	SW-SM	Sand	14-30	5-9	0.8-1.8	1.8-2.3	Moderate- Strong			
600.0-605.0	SW	Sand	17-18	3-5	1.4-1.6	2	Weak- Moderate	Pale Green	V. Pale Orange	

Appendix B.4 Drill Cuttings Log Data for Ue5PW-1 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
605.0-607.5	GW	Gravel	63	2	1.6	1.7	Weak- Moderate	Pale Green	V. Pale Orange	
607.5-610.0	SW	Sand	22	2	2	2.2	None	Pale Green	V. Pale Orange	
610.0-620.0	SW-SM	Sand	11-19	5-12	1.8-2.8	2.1-2.6	Moderate			
620.0-625.0	SW	Sand	16-22	3-4	1.2-2	1.7-2.1	Moderate			
625.0-627.5	SM	Silty Sand	11	13	2.4	2	Strong			Medium Sand
627.5-630.0	SW-SM	Sand	23	6	0.8	1.9	Moderate			
630.0-632.5	SW	Sand	17	4	2	2	Weak			
632.5-640.0	SW-SM	Sand	11-21	6-9	1.6-2.4	2-2.3	Strong- Moderate			
640.0-642.5	SW	Sand	12	4	1.6	2.2	Weak- Moderate	Bright Green		
642.5-645.0	SW-SM	Sand	11	6	2	2.2	Weak- Moderate			
645.0-647.5	SM	Silty Sand	7	12	2.8	2.5	Moderate			Medium Sand
647.5-650.0	SW-SM	Sand	10	6	2.4	2.8	Weak			
650.0-657.5	SW	Sand	11-21	3-4	2.8-4	2.1-2.3	Weak- Moderate			
657.5-660.0	SM	Silty Sand	3	14	2	3.6	Moderate	V. Pale Green	V. Pale Orange	Fine Sand
660.0-662.5	SW-SM	Sand	4	7	1.6	2.6	Moderate			
662.5-665.0	SM	Silty Sand	8	15	2.4	2.2	Strong			Fine Sand
665.0-629.5	SW-SM	Sand	2-27	5-10	0.8-2.4	2.1-2.8	Moderate- Strong			

Appendix B.5 Drill Cuttings Log Data for Ue5PW-2

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
0.0-12.5	SW-SM	Sand	6-39	5-9	0.4-2.8	1.3-4.7	Strong-Moderate	V.Pale Yellow	V.Pale Yellow	Bright Green Fluorescence @ 10'
12.5-15.0	SW	Sand	45	3	8.8	0.6	Weak	V.Pale Yellow	V.Pale Yellow	
15.0-17.5	GP	Gravel	65	1	3.2	0.6	Weak	V.Pale Yellow	V.Pale Yellow	
17.5-20.0	SW	Sand	20	4	2.8	1.4	Strong			
20.0-22.5	SW-SM	Sand	16	8	2.0	2.7	Strong			
22.5-27.5	SW	Sand	33	4	2-2.4	1.8-2.4	Moderate	Pale Yellow	V.Pale Yellow	
27.5-30.0	SW-SM	Sand	25	10	2.8	2.1	Strong			
30.0-32.5	SM	Silty Sand	11	17	1.6	1.2	Strong			Fine Sand
32.5-35.0	GW-GM	Gravel	51	8	2.0	1.0	Strong			
35.0-40.0	SW-SM	Sand	31-35	6-9	1.6	0.8-1.2	Moderate			
40.0-42.5	GW-GM	Gravel	53	8	1.6	1.0	Strong			
42.5-45.0	SW-SM	Sand	36	12	1.2	1.1	Moderate			
45.0-47.5	GW-GM	Gravel	54	5	1.6	1.2	Strong			
47.5-50.0	SW-SM	Sand	29	9	2.4	2.1	Strong			
50.0-52.5	GW-GM	Gravel	49	5	3.6	0.9	Strong			
52.5-77.5	SW-SM	Sand	20-35	7-12	2-3.2	0.9-1.3	Strong		Pale Orange	Fluorescence @ 60'
77.5-80.0	SM	Silty Sand	12	13	2.4	1.3	Moderate		V.Pale Yellow Orange	Fine Sand

Appendix B.5 Drill Cuttings Log Data for Ue5PW-2 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCI REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
80.0-82.5	SP-SM	Sand	11	10	1.2	0.9	Moderate		V. Pale Yellow Orange	Fine Sand
82.5-87.5	SW-SM	Sand	27-34	5-10	2-2.4	0.8-1	Strong			
87.5-92.5	SM	Silty Sand	18-24	13-17	2.4-5.2	1.4-2.1	Strong			Medium Sand
92.5-105.0	SW-SM	Sand	19-35	5-10	1.6-3.2	0.8-1.2	Strong-Moderate			
105.0-107.5	SM	Silty Sand	13	13	2.8	0.7	Moderate			Medium Sand
107.5-110.0	SW-SM	Sand	21	11	2.4	1.2	Moderate			
110.0-115.0	GW-GM	Gravel	50-52	6-8	2.4-3.2	0.8	Strong			
115.0-117.5	SM	Silty Sand	23	14	3.6	0.9	Strong			Medium Sand
117.5-120.0	SW-SM	Sand	30	8	2.4	0.8	Strong			
120.0-122.5	SM	Silty Sand	27	16	3.2	0.9	Strong			Medium Sand
122.5-125.0	SW-SM	Sand	34	12	2.8	0.9	Strong			
125.0-127.5	SM	Silty Sand	22	15	3.2	1.0	Strong			Medium Sand
127.5-130.0	SW-SM	Sand	32	9	3.2	0.9	Strong			
130.0-132.5	SM	Silty Sand	13	20	2.4	1.4	Strong			Fine Sand
132.5-135.0	SW-SM	Sand	38	10	2.0	0.8	Strong			
135.0-145.0	SM	Silty Sand	10-35	12-16	1.6-3.2	0.9-1.1	Strong			Fine-Coarse Sand
145.0-147.5	SW-SM	Sand	44	11	1.6	1.0	Strong			
147.5-157.5	SM	Silty Sand	14-30	14-20	1.6-3.2	0.9-1.1	Strong			Fine-Medium Sand
157.5-162.5	SW-SM	Sand	9-26	11-12	1.8-2.4	0.8-0.9	Strong-Moderate			

Appendix B.5 Drill Cuttings Log Data for Ue5PW-2 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
162.5-200.0	SM	Silty Sand	4-27	13-30	0.8-3.6	0.8-1.8	Strong			Fine-Medium Sand
200.0-202.5	SW-SM	Sand	23	10	2.8	0.7	Strong			
202.5-212.5	SM	Silty Sand	4-17	14-27	1.2-2.8	0.8-1.3	Moderate-Strong			Fine Sand
212.5-222.5	SW-SM	Sand	11-36	8-10	2.4-3.6	1.1-1.6	Strong			
222.5-225.0	SP-SM	Sand	28	10	1.6	1.4	Moderate			Medium Sand
225.0-230.0	SM	Silty Sand	10-13	18-20	2.4-2.8	1-1.3	Strong			Medium Sand
230.0-232.5	SW-SM	Sand	9	8	2.8	1.4	Weak-Moderate			
232.5-235.0	SM	Silty Sand	23	12	2.0	1.4	Strong			Medium Sand
235.0-285.0	SW-SM	Sand	6-30	5-12	1.2-3.6	0.8-2.5	Strong-Weak			
285.0-287.5	SW	Sand	6	4	4.8	1.8	None			
287.5-290.0	SP-SM	Sand	1	7	3.2	2.2	None			Fine Sand
290.0-292.5	SP	Sand	6	5	4.0	1.8	None			Medium Sand
292.5-307.5	SM	Silty Sand	6-22	13-22	1.8-3.6	1.0-1.6	Weak-Moderate	Bright Green		Fine-Medium Sand
307.5-335.0	SW-SM	Sand	7-35	6-10	1.2-6.6	1.1-2.0	Strong-Weak			
335.0-337.5	SM	Silty Sand	7	17	2.8	1.1	Strong			Fine Sand
337.5-355.0	SW-SM	Sand	11-39	6-12	1.6-2.8	1.0-1.4	Moderate-Strong			
355.0-360.0	SM	Silty Sand	10-14	15	1.6-3.2	1.0-1.1	Strong			Fine Sand
360.0-367.5	SW-SM	Sand	8-36	11-12	2.8-3.6	0.7-1.0	Moderate-Strong			
367.5-400.0	SM	Silty Sand	5-21	12-23	1.6-4.4	1.0-1.7	Strong-Moderate			Fine Sand
400.0-405.0	GW-GM	Gravel	60	11	5.8	1.1	Strong			

Appendix B.5 Drill Cuttings Log Data for Ue5PW-2 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
480.0-485.0	SM	Silty Sand	38	12-13	2.0-2.4	0.7-1.0	Moderate-Strong	Pale Green	V. Pale Yellow Orange	Coarse Sand
485.0-487.5	SW-SM	Sand	45	9	1.6	1.1	Moderate			
487.5-490.0	SM	Silty Sand	27	13	1.8	1.0	Strong			Medium Sand
490.0-495.0	SW-SM	Sand	42-45	9-10	1.6	0.5-0.7	Strong	V. Pale Green	V. Pale Yellow Orange	
495.0-500.0	SM	Silty Sand	3-32	14-20	2.2-2.4	0.9	Strong-Moderate	V. Pale Green	V. Pale Yellow Orange	Fine-Medium Sand
500.0-502.5	SW-SM	Sand	32	12	3.2	0.5	Strong-Moderate			
502.5-505.0	SM	Silty Sand	31	15	2.0	0.7	Strong-Moderate			Medium Sand
505.0-510.0	SW-SM	Sand	34-39	10-11	1.4-1.6	0.9-1.0	Moderate			
510.0-512.5	SM	Silty Sand	43	13	1.0	1.2	Moderate			Coarse Sand
512.5-515.0	GW-GM	Gravel	58	8	1.2	0.6	Strong			
515.0-522.5	SW-SM	Sand	25-36	9-11	1.6-2.0	0.7-1.0	Strong			
522.5-525.0	SM	Silty Sand	20	13	2.4	1.1	Strong			Medium Sand
525.0-527.5	SW-SM	Sand	36	11	2.2	0.7	Strong			
527.5-532.5	SM	Silty Sand	26-33	13	2.4-9.4	0.9-1.1	Moderate			Medium Sand
532.5-537.5	SW-SM	Sand	28-30	10-11	2.6-3.2	1.2-1.3	Strong	Pale Green	V. Pale Yellow Orange	
537.5-547.5	SM	Silty Sand	10-40	13-20	1.6-3.0	0.6-1.1	Moderate	Pale Green	V. Pale Orange	Fine-Medium Sand

Appendix B.5 Drill Cuttings Log Data for Ue5PW-2 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
547.5-550.0	SW-SM	Sand	30	11	0.8	1.2	Strong			
550.0-552.5	GW-GM	Gravel	46	11	2.0	0.8	Moderate			
552.5-555.0	SW-SM	Sand	44	9	1.6	0.6	Strong			
555.0-557.5	GW-GM	Gravel	48	10	2.0	0.7	Strong			
557.5-560.0	SW-SM	Sand	23	12	1.6	0.9	Strong			
560.0-570.0	SM	Silty Sand	18-34	12-15	2.0-3.2	0.8-1.1	Strong-Moderate			Medium Sand
570.0-572.5	SW-SM	Sand	38	11	2.8	1.0	Moderate			
572.5-575.0	SM	Silty Sand	31	13	4.4	0.7	Strong			Coarse Sand
575.0-577.5	SW-SM	Sand	36	12	3.2	0.8	Strong			
577.5-590.0	SM	Silty Sand	14-28	13-19	3.2-4.0	1.2-1.6	Strong-Moderate		V.Pale Yellow Orange	Medium Sand
590.0-592.5	SW-SM	Sand	35	12	3.2	0.88	Strong			
592.5-595.0	SM	Silty Sand	13	16	4.6	1.2	Moderate			Medium Sand
595.0-597.5	SW-SM	Sand	28	8	8.4	0.6	Moderate			
597.5-602.5	SM	Silty Sand	15-28	14-17	3.4	1.0-1.2	Moderate			Medium Sand
602.5-605.0	SW-SM	Sand	44	9	3.6	1.2	Moderate			
605.0-610.0	SM	Silty Sand	22-43	13-14	2.0-3.6	1.1-1.2	Strong			Coarse- Medium Sand
610.0-612.5	SW-SM	Sand	41	10	1.6	1.1	Strong			
612.5-620.0	SM	Silty Sand	21-38	13-18	1.6-2.2	0.9-1.1	V.Strong			Medium Sand
620.0-622.5	GM	Silty Gravel	44	14	1.8	0.8	V.Strong			

Appendix B.5 Drill Cuttings Log Data for Ue5PW-2 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCI REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
405.0-407.5	SW-SM	Sand	42	11	3.6	0.9	Strong			
407.5-415.0	SM	Silty Sand	10-42	11-35	2.4-4.0	1.0-1.4	Moderate-Strong		V. Pale Yellow Orange	Fine Sand
415.0-417.5	GW-GM	Gravel	72	6	1.6	0.4	Strong			
417.5-420.0	SW-SM	Sand	44	10	3.0	0.8	Strong	V. Pale Yellow	V. Pale Yellow Orange	
420.0-422.5	GW-GM	Gravel	69	5	1.8	0.6	Strong			
422.5-427.5	SW-SM	Sand	29-35	10-11	1.6-2.0	0.7-0.8	Strong			
427.5-430.0	GW-GM	Gravel	49	9	2.0	1.0	Strong			
430.0-455.0	SM	Silty Sand	19-42	12-17	1.2-2.0	0.8-1.2	Moderate-Strong			Fine-Medium Sand
455.0-475.5	GW-GM	Gravel	47	12	1.2	1.0	Strong			
457.5-462.5	SW-SM	Sand	30-36	10-11	2.0	1.1	Strong-Moderate			
462.5-467.5	SM	Silty Sand	35-37	12	1.6-2.0	0.8-1.0	Strong-Moderate			Coarse Sand
467.5-470.0	SW-SM	Sand	19	11	6.8	1.2	Strong			
470.0-472.5	SM	Silty Sand	21	17	1.2	0.9	Moderate			Medium Sand
472.5-475.0	GW-GM	Gravel	51	10	2.4	0.7	Moderate			
475.0-477.5	SM	Silty Sand	22	16	2.0	0.9	Strong			Fine Sand
477.5-480.0	SW-SM	Sand	40	8	1.6	1.4	Moderate	Pale Green	V. Pale Yellow Orange	

Appendix B.5 Drill Cuttings Log Data for Ue5PW-2 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
787.5-797.5	SM	Silty Sand	10-18	13-19	2.8-4.0	1.1-1.4	Strong			Medium Sand
797.5-800.0	SW-SM	Sand	12	7	3.2	1.0	Strong			
800.0-847.5	SM	Silty Sand	0.2-2.0	13-23	2.0-6.3	0.8-4.3	Moderate-Strong	Bright Green	V. Pale Orange	Medium-Fine Sand. Fluorescence @ 812'
847.5-850.0	SW-SM	Sand	28	8	6.6	1.7	Moderate			
850.0-855.0	SM	Silty Sand	17	12	7-10	1.4-2.0	Strong			Medium Sand
855.0-857.5	SW-SM	Sand	16	12	9.2	1.4	Strong			
857.5-865.0	SM	Silty Sand	10-18	16-19	3.6-16.6	1.8-3.6	Moderate-Weak			Medium Sand
865.0-867.5	SW-SM	Sand	17	12	21.0	2.3	Moderate			
867.5-870.0	SW	Sand	16	3	4.4	2.7	Weak		Pale Yellow	
870.0-872.5	SW-SM	Sand	14	12	8.4	1.1	Moderate			
872.5-875.0	SM	Silty Sand	16	13	5.4	1.4	Strong			Medium Sand
875.0-885.0	SW-SM	Sand	9-16	8-12	8.8-19.4	1.1-2.2	Moderate			
885.0-887.5	SM	Silty Sand	8	14	28.0	1.4	Moderate	Bright Green		Medium Sand
887.5-890.0	SW-SM	Sand	16	10	33.2	1.3	Moderate		Pale Yellow	
890.0-892.5	SW	Sand	21	4	4.4	1.6	Weak		Pale Yellow	
892.5-895.0	SW-SM	Sand	22	10	9.2	1.1	Weak		Pale Yellow	
895.0-902.5	SW	Sand	28-30	3-4	3.6-4.0	0.5-1.1	Weak			
902.5-911.0	SW-SM	Sand	7-42	9	5.1-8.0	1.1-1.7	Weak-Strong			

Appendix B.5 Drill Cuttings Log Data for Ue5PW-2 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCI REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
622.5-625.0	SM	Silty Sand	29	14	2.6	0.7	V.Strong			Medium Sand
625.0-627.5	SW-SM	Sand	43	11	4.0	1.2	Strong			
627.5-635.0	SM	Silty Sand	11-35	13-16	1.4-2.2	0.9-1.3	Strong			Medium- Coarse Sand
635.0-637.5	SW-SM	Sand	33	12	3.6	1.0	Strong			
637.5-642.5	SM	Silty Sand	23-24	12-15	1.8-2.0	1.0	Strong			Medium Sand
642.5-645.0	SW-SM	Suint	36	11	2.2	0.9	V.Strong			
645.0-657.5	SM	Silty Sand	11-28	12-19	2.2-3.2	1.1-1.6	Strong-Moderate		V.Pale Yellow	Medium Sand
657.5-660.0	SW-SM	Sand	29	11	2.0	1.1	Moderate			
660.0-680.0	SM	Silty Sand	12-27	12-20	1.4-2.8	0.8-1.3	Moderate-Strong		Pale Orange	Medium Sand. Fluorescence @ 660'
680.0-682.5	SW-SM	Sand	18	10	2.0	1.4	Moderate		V.Pale Orange	
682.5-715.0	SM	Silty Sand	8-37	12-20	1.4-6.0	0.9-1.6	Moderate-Strong		V.Pale Orange	Medium Sand
715.0-717.5	GW-GM	Gravel	52	10	1.6	1.0	Strong			
717.5-750.0	SM	Silty Sand	9-34	12-31	1.4-3.2	1.2-2.2	Strong-Moderate		V.Pale Orange	Medium Sand
750.0-752.5	SW-SM	Sand	18	10	2.4	2.1	Moderate			
752.5-785.0	SM	Silty Sand	7-23	14-21	1.2-4.0	1.0-1.5	Moderate-Strong	Pale Orange	V.Pale Yellow	Medium Sand
785.0-787.5	SW-SM	Sand	26	12	2.0	1.2	Strong			

Appendix B.5 Drill Cuttings Log Data for Ue5PW-2 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
911.0-919.5	—	—	—	—	—	1.5-3.4	Weak-Strong			

Appendix B.6 Drill Cuttings Log Data for Ue5PW-3

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
0.0-7.5	SW-SM	Sand	17-34	5-11	1-2	1.2-1.3	Strong	V. Pale Green	V. Pale Yellow	
7.5-10.0	GW	Gravel	74	3	2.8	1.2	Moderate	V. Pale Green	V. Pale Yellow	
10.0-12.5	GW-GM	Gravel	47	7	1.2	1.1	Moderate	V. Pale Green	V. Pale Yellow	
12.5-15.0	SM	Silty Sand	35	13	2.2	1.0	Strong	V. Pale Green	V. Pale Yellow	Coarse Sand
15.0-17.5	GW-GM	Gravel	50	7	2.6	1.0	Strong	V. Pale Green	V. Pale Yellow	
17.5-20.0	GP	Gravel	71	3	1.6	1.0	Strong	V. Pale Green	V. Pale Yellow	
20.0-22.5	GW-GM	Gravel	52	10	2.6	1.1	Strong	V. Pale Green	V. Pale Yellow	
22.5-25.0	SW-SM	Sand	25	12	1.6	0.8	Strong	V. Pale Green	V. Pale Yellow	
25.0-27.5	GW-GM	Gravel	60	5	4.2	1.4	Strong	—	V. Pale Yellow	
27.5-37.5	SW-SM	Sand	35-46	6-11	0.8-4	0.8-1.2	Strong	—	V. Pale Yellow	
37.5-42.5	SM	Silty Sand	9-26	12-13	1.2-1.6	0.8-1.3	Strong	—	V. Pale Yellow	Fine Sand (Aeolian?)
42.5-45.0	SW-SM	Sand	40	9	0.8	1.3	Strong	—	V. Pale Yellow	
45.0-50.0	SM	Silty Sand	20-30	12-13	1.2-1.6	1-1.1	Strong	—	V. Pale Yellow	Coarse Sand
50.0-52.5	GW-GM	Gravel	49	7	1.6	0.9	Moderate			
52.5-55.0	SW-SM	Sand	19	8	2.6	1.0	Moderate			

Appendix B.6 Drill Cuttings Log Data for UeSPW-3 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
55.0-57.5	SM	Silty Sand	7	18	1.4	1.1	Strong			Fine Sand
57.5-60.0	SW-SM	Sand	32	8	2.2	1.0	Strong			
60.0-62.5	SM	Silty Sand	23	14	2.4	1.0	Strong		V. Pale Yellow	Coarse Sand
62.5-67.5	GW-GM	Gravel	49-53	7-8	2.2-2.6	0.7-0.9	Strong		V. Pale Yellow	
67.5-72.5	SW-SM	Sand	27-39	8-11	3.6-4.8	1.1	Moderate-Strong		V. Pale Yellow	
72.5-75.0	SM	Silty Sand	43	14	2.2	0.9	Moderate		V. Pale Orange	Coarse Sand
75.0-77.5	GW-GM	Gravel	53	8	1.4	1.1	Moderate			
77.5-80.0	SW-SM	Sand	38	10	2.0	0.9	Moderate			
80.0-85.0	SM	Silty Sand	19-30	13-17	1.4-1.6	0.8-1.0	Strong			Medium- Coarse Sand
85.0-90.0	SW-SM	Sand	32-40	9-11	0.6-3.6	0.6-0.9	Moderate			
90-92.5	GW-GM	Gravel	50	10	2.8	1.1	Moderate			
92.5-107.5	SM	Silty Sand	14-31	15-18	1.6-4.0	1.0-1.3	Moderate-Strong			Medium- Coarse Sand
107.5-112.5	SW-SM	Sand	24-36	9-11	2-3.2	1.5-1.8	Strong			
112.5-115.0	SW	Sand	32	4	1.6	2.8	Moderate			
115.0-120.0	SW-SM	Sand	29-31	7-8	1.4-1.6	1.6-2.0	Weak-Moderate			Rust Stained
120.0-125.0	SM	Silty Sand	22-31	12-15	1.4-1.8	1.1	Strong			Coarse Sand
125.0-130.0	SW-SM	Sand	14-33	8-11	1.4-1.6	0.9-1.2	Strong			

Appendix B.6 Drill Cuttings Log Data for Ue5PW-3 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
130.0-135.0	SW	Sand	23-43	4	1.6-2.4	0.9-1.4	Moderate-Strong			
135.0-140.0	SW-SM	Sand	24-42	7-9	3.0	1.5-1.6	Strong			
140.0-142.5	SW	Sand	40	3	1.6	1.9	Weak			
142.5-155.0	SW-SM	Sand	23-36	6-8	1.0-2.2	1.4-2.1	Moderate-Strong			
155.0-157.5	GW	Gravel	59	5	1.2	1.5	Strong			
157.5-172.5	SW-SM	Sand	7-36	6-10	1.0-2.8	1.5-2.4	Strong			
172.5-175.0	SW	Sand	16	5	2.0	2.4	Weak			
175.0-190.0	SW-SM	Sand	15-36	6-8	1.6-2.4	1.4-3.3	Weak			Some Black Gravel @ 190'
190.0-192.5	SW	Sand	40	5	2.4	1.8	Weak			
192.5-210.0	SW-SM	Sand	9-41	5-10	2.0-4.6	1.8-3.9	Weak-Moderate		V. Pale Yellow	Fluorescence @ 205'
210.0-212.5	SW	Sand	37	5	2.0	2.2	Moderate			
212.5-217.5	SW-SM	Sand	24-37	7-10	1.6-2.4	1.8-1.9	Strong			
217.5-220.0	SM	Silty Sand	10	13	1.4	1.8	Strong			Moist, Medium Sand
220.0-310.0	SW-SM	Sand	5-39	5-11	1.2-5.4	1.5-3.4	Strong-Weak	Bright Green	V. Pale Yellow	Fluorescence @ 230', 240' & 285'
310.0-312.5	SW	Sand	17	5	5.4	3.0	Weak			
312.5-315.0	GW	Gravel	50	4	1.6	1.3	Moderate			
315.0-330.0	SW-SM	Sand	9-38	6-9	1.4-4.4	1.1-1.8	Strong		V. Pale Yellow	

Appendix B.6 Drill Cuttings Log Data for Ue5PW-3 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCI REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
330.0-335.0	SW	Sand	33-36	2-4	2.3-4.8	1.3	Moderate	Bright Green		
335.0-347.5	SW-SM	Sand	12-35	6-9	2.0-3.6	1.0-1.5	Strong		V. Pale Yellow	
347.5-350.0	SM	Silty Sand	5	15	2.8	1.4	Strong			Fine Sand
350.0-365.0	SW-SM	Sand	13-29	5-9	1.4-3.6	1.4-2.4	Weak		V. Pale Yellow	Fluorescence @ 360'
365.0-367.5	SW	Sand	23	4	2.6	1.7	Weak			
367.5-382.5	SW-SM	Sand	15-33	9-11	1.6-3.0	1.1-1.4	Strong			
382.5-385.0	SM	Silty Sand	22	13	2.6	1.4	Strong			Medium Sand
385.0-387.5	SW-SM	Sand	18	10	2.2	1.5	Moderate			
387.5-392.5	SM	Silty Sand	12	13-16	1.2-2.2	1.4-1.8	Strong			Fine Sand
392.5-397.5	SW-SM	Sand	25-39	9-10	1.4-2.0	0.8-1.2	Strong			
397.5-402.5	SM	Silty Sand	14	13	2.4-3.0	1.4-1.6	Strong			Medium Sand
402.5-407.5	SW-SM	Sand	40-42	8-9	1.6-2.0	1.3-1.5	Strong			
407.5-410.0	SM	Silty Sand	10	14	3.2	1.4	Moderate			Fine Sand
410.0-425.0	SW-SM	Sand	13-29	9-12	1.2-3.2	1.1-1.6	Strong			
425.0-427.5	SM	Silty Sand	12	13	2.2	1.6	Strong			Medium Sand
427.5-447.5	SW-SM	Sand	11-35	8-11	1.6-3.4	1.1-1.7	Moderate-Strong	V. Pale Green	V. Pale Yellow	
447.5-457.5	SM	Silty Sand	4-12	13-22	1.2-2.8	1.5-2.4	Strong			Fine Sand
457.5-475.0	SM-SW	Sand	5-35	6-12	1.8-4.8	0.8-1.6	Strong		V. Pale Yellow	
475.0-482.5	SM	Silty Sand	7-24	12-16	2.4-4.4	1.5-1.9	Strong			Medium Sand

Appendix B.6 Drill Cuttings Log Data for Ue5PW-3 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
482.5-485.0	SW-SM	Sand	17	12	1.0	1.4	Strong			
485.0-487.5	SM	Silty Sand	14	14	1.4	1.1	Strong			Medium Sand
487.5-490.0	SW-SM	Sand	32	12	0.8	1.4	Strong			
490.0-497.5	SM	Silty Sand	11-18	14-16	0.8-2.2	1.4-1.5	Strong		V. Pale Yellow	Medium Sand
497.5-505.0	SW-SM	Sand	20-33	8-12	1.0-2.0	1.0-1.9	Strong			
505.0-510.0	SM	Silty Sand	14-20	14-18	1.6-3.6	1.6	Strong			Medium Sand
510.0-512.5	SW-SM	Sand	34	9	1.2	1.4	Strong			
512.5-515.0	SM	Silty Sand	15	15	1.2	1.6	Strong			Medium Sand
515.0-525.0	SW-SM	Sand	12-25	8-12	0.8-2.4	1.3-1.5	Strong			
525.0-532.5	SM	Silty Sand	5-17	13-17	1.6	1.2-1.9	Strong			Medium Sand
532.5-535.0	SW-SM	Sand	14	12	1.6	1.6	Strong			
535.0-542.5	SM	Silty Sand	5-12	14-18	1.6-2.4	1.6-1.8	Strong			Medium Sand
542.5-545.0	SW-SM	Sand	21	11	1.6	1.6	Strong			
545.0-557.5	SM	Silty Sand	8-22	12-17	1.6-4.8	1.5-2.1	Strong			Medium Sand. Boulder 555.5- 557'
557.5-560.0	SW-SM	Sand	17	11	1.2	1.4	Strong			
560.0-570.0	SM	Silty Sand	5-23	12-20	2-3.4	1.4-2.1	Strong			Fine-Medium Sand. Boulder 562-563'
570.0-572.5	SW-SM	Sand	24	11	2	1.6	Strong			

Appendix B.6 Drill Cuttings Log Data for Ue5PW-3 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
572.5-580.0	SM	Silty Sand	13-22	13-14	3.2-4.0	1.6-1.9	Strong		Pale Orange	Medium Sand. Boulder 573- 574'
580.0-585.0	SW-SM	Sand	20	9	1.2-2.8	1.0-1.1	Strong		Pale Orange	
585.0-617.5	SM	Silty Sand	9-25	13-19	1.4-18.8	1.4-2.9	Strong-Moderate			Medium-Fine Sand. Boulder 610-612.5'
617.5-662.5	—	Welded Tuff			1.4-26.0	1.2-3.6	Strong	V. Pale Yellow	V. Pale Yellow	Gray-Pale Brown
662.5-682.5	—	Welded Tuff			1.8-6.6	0.9-3.4	Moderate	V. Pale Yellow	V. Pale Yellow	Gray-Pale Brown
682.5-705.0	—	Welded Tuff			1.4-5.0	0.5-1.7	None			Gray-Pale Brown
705.0-710.0	—	Welded Tuff			6-10.6	2.8-4	None			Dark Brown, Biotitic
710.0-720.0	—	Welded Tuff			1.4-2.6	1.2-1.8	None			Gray-Pale Brown
720.0-737.5	—	Welded Tuff			1.2-4.6	0.9-1.4	Moderate-Strong	Bright Green	Pale Orange	Ash?
737.5-750.0	—	Welded Tuff			3.4-12.8	1.1-1.5	Moderate-Weak		Pale Orange	Gray-Pale Brown
750.0-760	—	Welded Tuff			10.6-16.6	2.0-3.5	None			Dark Brown, Biotitic
760.0-822.5	—	Welded Tuff			3.2-13.2	1.2-2.4	None			Gray
822.5-905.0	—	Welded Tuff			2.6-8.8	2.2-4.4	None			Light Gray
905.0-917.5	—	Welded Tuff			2.2-7.8	1.7-1.8	None			Tan-Gray

Appendix B.6 Drill Cuttings Log Data for Ue5PW-3 (Continued)

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
917.5-925.0	—	Bedded Tuff			1.8-4.0	0.9-1.8	None			Light Brown
925.0-942.5	—	Bedded Tuff			2.6-4.8	0.7-1.9	None	Bright Green		Orange Brown, Wet
942.5-955.0	—	Bedded Tuff			1.2-5.8	0.6-2.0	None			Brown. Ash Bed? Wet

Area 5 Pilot Wells

APPENDIX C **Tracer (SF₆) Test Data**

- C.1 UE5PW-1 SF₆ Data from Core Samples and Compressor Air Lines
- C.2 Formation SF₆ Tracer Gas Concentrations

Appendix C.1 Ue5PW-1 SF₆ data from core samples and compressor air line

Date	Type	Depth (ft)	SF ₆ Concentration (ppb) ¹	SF ₆ Flow Rate (cm ³ /min)	Compressors On Line
3/17/92	core	27.5	26gb, 8s	500	2
3/17/92	line	37.5	30s	500	2
3/18/92	line	49.0	160s, 63gb, 66gb, 60v, 67s	450	2
3/18/92	core	49.0-49.25	64gb, 242v	450	2
3/18/92	core	48.25-48.5	331gb, 803v	450	2
3/18/92	core	51.25-51.5	44s, 94v, 28gb	450	2
3/18/92	core	57.5-60.0	10gb, 10v, 12.6v	490	2
3/18/92	core	58.25-58.5	60v, 26gb	495	2
3/18/92	core	59.5-59.75	12s, 21v, 11gb	495	2
3/19/92	core	67.5-70.0	11v, 12gb, 13v, 14v, 23v	468	1
3/19/92	line	77.5-80.0	19v	470	1
3/19/92	core	77.5-77.75	778v, 1193v,	470	1
3/19/92	line	80.0	76v, 74v, 67gb	470	2
3/20/92	line	97.5-100.0	131v, 40v, 96gb	470	1
3/20/92	core	98.0-98.25	9v	470	2
3/20/92	line	100.0	39v	470	2
3/24/92	line	127.5-130	10v, 192v, 17v	470	1

Appendix C.1 Ue5PW-1 (SF₆) data from core samples and compressor air line (Continued)

Date	Type	Depth (ft)	SF ₆ Concentration (ppb) ¹	SF ₆ Flow Rate (cm ³ /min)	Compressors On Line
3/24/92	core	127.5-130.0	3.8v	470	1
3/24/92	core	128.0-128.25	39v	470	1
3/24/92	core	127.5-130.0	738v, 110v	470	1
4/5/92	core	128.25-128.5	0.97gb, 0.84gb, 0.64v	0	1
4/5/92	line	147.5-150.0	8.3v, 8.0v	470	1
4/7/92	line	150.0-157.5	117v, 75v	470	1
4/8/92	core	157.5-159.5	9.2v, 10gb(in hole overnite)	470	1
4/8/92	core	158.5-159.0	119gb, 77v	470	1
4/8/92	core	169.0-169.25	10gb	470	1
4/9/92	line	177.5-197.5	16068v, 12896v tightened fittings	470	1
4/10/92	line	220	> 40000v saturated detector	200	1
4/10/92	line	220	66800v, 46316v	200	1
4/10/92	core	218.0-218.25	230v	200	1
4/10/92	core	219.25-219.5	529v, 428gb	200	1
4/10/92	line	237.0	6544v, 7112v, 8915v	12	1
4/15/92	line	317.2-317.5	35140v, 621v	12	1

Appendix C.1 Ue5PW-1 (SF₆) data from core samples and compressor air line (Continued)

Date	Type	Depth (ft)	SF ₆ Concentration (ppb) ¹	SF ₆ Flow Rate (cm ³ /min)	Compressors On Line
4/15/92	core	319.25-319.5	377v	12	1
4/15/92	core	317.45-318.0	299v	12	1
4/15/92	line	335.0-337.5	7897v	13	1
4/16/92	line	347.5-357.5	11117v	12	1
4/16/92	line	357.5-359.7	9193v	12	1
4/16/92	core	359.25-359.5	494gb	14	1
4/17/92	line	370.0-372.0	16021v	12	1
4/17/92	core	379.5-379.75	228gb	12	1
5/27/92	core	617.5-617.75	144v	24	1
5/27/92	core	618.75-619.0	113v	24	1
5/28/92	core	659.0-659.25	2v flow problems	0	1
6/8/92	core	739.0-739.25	0gb, 0v caps leaking	20	1
6/9/92	core	759.75-760.0	262v, 120gb	40	1
6/9/92	line	760.0	2200v	40	1
6/10/92	line	767.5	6487v	10	1
6/10/92	core	769.5-769.75	23v, 12gb	10	1

Appendix C.1 Ue5PW-1 (SF₆) data from core samples and compressor air line (Continued)

Date	Type	Depth (ft)	SF ₆ Concentration (ppb) ¹	SF ₆ Flow Rate (cm ³ /min)	Compressors On Line
6/10/92	line	772.0	7465v	20	1
6/10/92	core	770.75-771.0	4v, 5gb	20	1

¹ gb = gas bulb, s = syringe, v = vacutainer

Appendix C.2 Formation SF₆ Tracer Gas Concentrations

WELL NUMBER	DEPTH (ft)	STATIC VOLUME (liters)	VOLUME PUMPED (liters)	CONCENTRATION (ppm)
Ue5PW-1				
	150	15	4	1.03
	150	15	20	1.63
	150	15	60	1.35
	150	15	120	1.47
	240	24	12	0
	240	24	40	0.207
	240	24	80	1.12
	340	34.5	40	0
	340	34.5	80	0.799
	340	34.5	120	0.941
Ue5PW-3				
	686	70	80	0.003
	686	70	120	0.004

Area 5 Pilot Wells

APPENDIX D Completion Data

- D.1 Pilot Well Completion
 - D.1.1 Annular Materials
 - D.1.2 Preparation for Completion
 - D.1.3 Casing and Instrumentation Installation Detail
 - D.1.4 Stemming Detail
 - D.1.5 Completion Operations Safety
- D.2 Pilot Well Stemming Summaries
 - D.2.1 UE5PW-1 Stemming Summary
 - D.2.2 UE5PW-2 Stemming Summary
 - D.2.3 UE5PW-3 Stemming Summary
- D.3 Pilot Well Casing Tallies
 - D.3.1 UE5PW-1 Casing Tally
 - D.3.2 UE5PW-2 Casing Tally
 - D.3.3 UE5PW-3 Casing Tally
- D.4 Pilot Well Daily Activities
 - D.4.1 UE5PW-1 Daily Activity
 - D.4.2 UE5PW-2 Daily Activity
 - D.4.3 UE5PW-3 Daily Activity

D.1.1 Annular Materials:

Annular sand pack and seal materials were emplaced as follows:

6/12 coarse-mesh "Colorado Silica Sand" (grain size 0.132 to 0.0661 in) from the bottom of the hole to 10 ft above the screen (approximately 20 ft above water the table). This was installed to improve the performance of the pre-pack screen.

6/12 sand at the instrument stations: 20-ft interval at Station A installations and 3-ft intervals at Station B installations. The stations are located at the midpoint of the sand interval. In Ue5PW-2 and Ue5PW-3 Stations A, the sand was pre-wetted to approximately 0.1 percent by weight in order to bring the water potential of the sand closer to that of the formation. This was done in order to reduce the time for the psychrometers to equilibrate.

A low-permeability dry mixture was placed between instrument stations. This material consisted of 60 percent Overton sand (approximately 80 mesh sand), 25 percent Bentonite powder (200 mesh), and 15 percent silica flour (325 mesh). The dry mixture was blended (by weight) at REEC Co Cement Services, by blowing the material back and forth between two silos until uniform consistency was obtained.

A cement-based grout ("DR-1") was placed as a surface seal interval from approximately 80 ft to the ground surface. This grout was selected for its non-shrinking and low set-temperature characteristics to avoid overheating and possibly damaging the cables and tubing. The grout was blended as follows:

<u>Material</u>	<u>Slurry (lb/ft³)</u>
Type II cement	30
W-60 Gypsum	2.3
Barite	54
Gel (bentonite)	3.8
D-19 (friction reducer)	0.256
Water	37.72

The slurry density was calculated to be 17.12 lb/gal (128.076 lb/ft³).

A gypsum grout interval, approximately 8 to 10-ft long, was placed to relieve cable strain which was usually between a depth of 350 to 460 ft. The W-60 gypsum cement was blended with approximately 5.5 gal of water per 100-lb sack. This low viscosity mixture was able to be pumped through a small diameter line.

D.1.2 Preparation for Completion

Once the rig was mobilized onto the location, the equipment for running casing, screen, and the instruments was organized. A heavy plastic sheet with a "pig blanket" absorptive pad was placed under the rig and generator to contain any diesel, oil, or other spills. It was desirable, although not necessary, to install the casing jacks at this time. The casing jacks

used had 4-ea hydraulic cylinders with a total cross-sectional area of 78.5 in². Separate sets of casing slips were used for 10.75-in and 8.625-in casing. It was necessary to dig a well cellar approximately 4 ft deep to set the jacks properly.

Before running the casing and tremie pipes into the hole, these items were thoroughly steam cleaned, washed with Alconox (highly soluble laboratory detergent), and rinsed with distilled water. The couplings were removed from the casing to ensure a complete cleaning of threads. Once cleaned, the couplings were attached to the casing while on the pipe racks. Based on results from leak tests performed on the stainless steel casing during June 1992, it was determined that five wraps with 0.75-in width PTFE tape plus a thin coating of Jet-Lube "TFW" (Teflon-based environmental pipe joint sealant) would be used on casing joints to ensure airtight connections.

D.1.3 Casing and Instrumentation Installation Detail

The first item run in the hole was the dual string of tremie pipes. One tremie pipe was intended to deliver the materials downhole. The other tremie pipe was used as an access tube for a depth tagging device which would prevent entanglement with the instrumentation. The 20-ft long tremie joints were constructed of 1-in schedule 80, carbon steel pipe with 4-thread/inch flush-joint connections. The tremies were run close to the screened interval on bottom, typically from 750 to 850 ft to approximately 20 to 30 ft above the water level. Once at the intended depth, the tremies were attached to a simple slotted device allowing them to be hung on the side of the 8.625-in casing.

Next, six 10-ft long 'pre-pack' well screen joints were run into the hole. The first joint had a 304 sst plate welded on the bottom, effectively sealing the bottom of the screen. A simple "bullet nose" assembly (304 sst) extends approximately 1.75 in below the bottom plate to reduce the chance of hanging on any obstructions. Screen joints No. 1, No. 3, and No. 5 (numbered from the bottom up) have centralizer fins welded to the upper box (female) end of the joint (four 1/4-in thick sst fins welded at 90° spacing around the screen). All screen and casing joints were measured for effective length after being made up. The joint lengths were recorded on a casing tally sheet, and the cumulative length of the string was used to determine instrument locations. A "dog collar" clamp was used to hold the screen from the rig table while picking up the next screen joint.

The first instrument (pressure transducer) was attached to the top of screen joint No. 1 with a "Band-It" stainless steel band. This instrument was protected by the centralizer fins at that location. The cable for this instrument came off of a spool located on the series of spooling racks. The instrument cable was secured to the screen and casing using a series of heavy-duty (125-lb strength) nylon cable ties located every 3 to 5 ft.

Once the 60-ft screen was in the hole, the 2.875-in casing was then lowered down into the borehole. Because the casing has conventional (external-upset) couplings, a simple floorplate was used to support the casing in the hole while picking up the next piece of casing. Typically at 20 to 40 ft intervals, centralizers were placed on the casing. These centralizers (type 304 sst) were constructed from 3.375-in long by 3-in inside diameter tubing with four

0.25-in fins welded on. The centralizer was secured to the casing by 4-ea 1/4-20 sst socket-drive setscrews. In most cases, the centralizer was located immediately under the casing coupling. However, additional resistance from sliding was obtained in some cases by driving a stainless wedge between the centralizer and the casing.

The casing was run into the hole to the next lowest instrument station location. Preparations were made to attach the specific instruments to the casing from the spooling racks. Multiple checks were made to confirm and document instrument serial numbers and calibration coefficients. Before making up the threads on a casing joint, it was necessary to put on an centralizer. These centralizers were designed to provide protection for the instruments and tubing terminations. Station B centralizers were identical to the centralizers described above. Station A centralizers were fabricated with a cutout on two opposite sides to accommodate a 0.5-in thick Teflon insert. This insert was used to keep the thermistors thermally isolated from the casing, so that actual formation temperature is preferentially observed.

As the quantity of cables and tubing accumulated, extreme care was taken to ensure an organized arrangement. A major cable tie attached the cables to the casing approximately every 5 ft, with a minor cable tie every 2.5 ft. Extra-large, 0.5-in, wide 300 lb capacity cable ties were used to secure the 1-in nylon tubing without pinching. Approximately 1500 cable ties were used to complete a single well.

After all instruments and casing were in the hole, the top of the casing was hung at the appropriate height above ground level (as calculated from the casing tally) in order to place all instruments at the correct depth.

D.1.4 Stemming Detail

When the entire screen/casing/instrument assembly was in the hole, arrangements were made to convert the operation to stemming the borehole. All spooling racks were removed, and the stemming equipment was moved into place and connected to air and power supplies. The primary equipment used for delivery of material was a Shotcrete injector. This unit is designed to deliver dry materials continuously under pressure. The air supply for the Shotcrete unit was run through an air-dryer and supplied to the unit at approximately 3 to 5 psig. The dry mix was delivered to the location in a dry bulk tanker and blown with air into the material hopper.

The first interval to stem was the filter pack sand interval. The 6/12 coarse silica sand was fed into one of the two tremies using a funnel. The 8.625-in casing was typically retracted to immediately above the bottom of the tremies, just above the water level. Sand was poured until the material tagging device in the other tremie indicated that the desired level had been reached. Instrument station sand (also 6/12 silica sand) was dropped the same way, that is, gravity fed through one tremie while tagging the depth through the other tremie.

The material tagging device used was simply an electric tape with depth markings commonly used to measure depth-to-water. The bottom of the tape was modified by adding a push-button switch protected by a heavy rubber sheath. When the switch on the bottom of the tool came in contact with the material, it would close the circuit and sound an audible alarm. The depth was then read directly from the tape. At shallower depths, typically above 400 ft,

it became possible to "feel" the material depth without relying solely on the electric circuit.

While delivering the dry mixture, the level of material was tagged frequently and documented along with the amount of material delivered. Using these tools and techniques, developed specifically for the Pilot Well completions, material intervals were typically placed to within 1 to 2 inches of the desired depth, depending on the particular material's characteristic angle of repose.

After several hundred feet of the borehole had been stemmed, there would have been a risk of collapsing the screen from the weight of the entire screen/casing/instrument assembly. Using a lifting tool and techniques developed for this project, full tension was maintained on the casing from the surface while jacking and removing the 8.625-in casing. Once there was sufficient material emplaced above the screen, the tension could be released. At that point, the casing string would "relax" approximately 2 in.

Typically, the tremie pipes extended immediately below the temporary casing shoe, and material was placed up to the tremies. At that point, another section of tremie pipes and casing could be removed. Certain intervals of the Pilot Well Boreholes had a tendency to cave easily. To minimize such caving, the tremies were retracted within the casing, and the dry mixture was placed inside the temporary casing, sometimes up to 6 ft or more. The casing was then pulled up while the material spilled out the bottom, thus filling the borehole. A review of the density logs prior to stemming often identified the areas prone to caving. Starting at a depth of 80 ft, the surface seal was placed. The "DR-1" Bentonite-cement was mixed by REECo Cement Services using cold water and ice to keep the set-temperature at a minimum. The cement slurry was poured down the remaining temporary casing until full. The final joints of casing were then removed from the borehole. After each 20-ft joint was removed, the depth to the cement slurry was measured. If the level fell more than 20 ft below the ground surface, more slurry was added to bring the level back to near-surface. When the last joint of pipe was out of the hole, the casing jacks and support timbers were removed from the well cellar, and slurry was added until several inches of cement had accumulated in the floor of the well cellar.

D.1.5 Completion Operations Safety

After moving the completion rig onto the hole, but prior to conducting any operations, a safety inspection by a REECo safety representative was conducted to determine compliance with all applicable REECo, NTS, OSHA, and other safety regulations. At no time during completion operations were any incidents of rig noncompliance noted or reported by the REECo safety representative. Regular, unscheduled safety inspections were also conducted during the completion work. Also, frequent jobsite "tailgate" safety meetings were held to address general safety considerations and specifics of the job.

Appendix D.2.1 Stemming summary for UE5PW-1

PW-1 Stemming Summary					
All depths in ft., ref: Ground Level		Interval Depths			Mean Hole
Interval	Type of Matl.	Top	Bottom	Lbs Mat'l	Size, Inches
Surface seal	Bentonite-Cement	4.0	69.4	13716	17.6
Annular Seal	60/25/15 Dry Mix	69.4	89.7	440	6.9
Station A-100	Silica Sand	89.7	110.1	1151	10.8
Annular Seal	60/25/15 Dry Mix	110.1	148.2	1986	10.2
Station B-150	Silica Sand	148.2	151.3	159	10.3
Annular Seal	60/25/15 Dry Mix	151.3	189.5	1340	8.5
Station A-200	Silica Sand	189.5	210.0	1800	13.3
Annular Seal	60/25/15 Dry Mix	210.0	238.3	1092	8.9
Station B-240	Silica Sand	238.3	241.6	188	10.8
Annular Seal	60/25/15 Dry Mix	241.6	289.8	2720	10.6
Station A-300	Silica Sand	289.8	310.0	1100	10.6
Annular Seal	60/25/15 Dry Mix	310.0	348.3	2440	11.2
Station B-350	Silica Sand	348.3	351.8	213	11.2
Annular Seal	60/25/15 Dry Mix	351.8	369.7	1600	13.1
Strain Relief	Gypsum grout	369.7	377.8	874	13.4
Annular Seal	60/25/15 Dry Mix	377.8	495.0	9360	12.4
Station A-500	Silica Sand	495.0	510.0	700	9.9
Annular Seal	60/25/15 Dry Mix	510.0	598.5	3160	8.6
Station B-600	Silica Sand	598.5	601.5	150	10.2
Annular Seal	60/25/15 Dry Mix	601.5	690.0	3413	8.9
Station A-700	Silica Sand	690.0	710.0	900	9.7
Annular Seal	60/25/15 Dry Mix	710.0	752.0	3264	12.3
Filter Pack	Coarse Silica Sand	752.0	839.0	3500	9.7
Total Lbs of Bentonite-Cement:				13,716	
Total Lbs of Dry Mix:				30,815	
Total Lbs of Instrument Station Silica Sand				6,362	
Total Lbs of Gypsum grout:				874	
Total Lbs of Filter Pack Silica Sand:				3,500	
Total Lbs of Material Placed in Hole:				55,267	
Material Notes:					
Surface Seal: Portland Type II-based cement w/4.6% bentonite; total of 13,716 Lbs placed					
Dry Mix: 60% Overton (fine) sand, 25% Bentonite powder, 15% Silica Flour;					
Mix permeability: 90 millidarcies; total of 30,815 Lbs placed					
Instrument Stations: 6/12 mesh washed Silica Sand w/layer of 16/40 mesh sand top/bottom;					
Total of 6362 Lbs sand placed at stations					
Strain Relief Interval: 15.5 Lb/gal neat gypsum grout; total of 874 Lbs placed					
Filter Pack: 6/12 mesh washed Silica Sand; total of 3500 Lbs placed					
					JCH 10/6/92

Appendix D.2.2 Stemming summary for UE5PW-2

PW-2 Stemming Summary					
All depths in ft., ref: Ground Level		Interval Depths			Mean Hole
Interval	Type of Matl.	Top	Bottom	Lbs Mat'l	Size, Inches
Surface seal	Bentonite-Cement	4.0	79.9	17280	18.3
Annular Seal	60/25/15 Dry Mix	79.9	90.5	400	8.8
Station A-100	Silica Sand	90.5	110.3	1150	10.7
Annular Seal	60/25/15 Dry Mix	110.3	148.4	1840	9.8
Station B-150	Silica Sand	148.4	151.8	164	9.8
Annular Seal	60/25/15 Dry Mix	151.8	191.0	1120	7.8
Station A-200	Silica Sand	191.0	209.9	900	9.8
Annular Seal	60/25/15 Dry Mix	209.9	248.3	1840	9.8
Station B-250	Silica Sand	248.3	251.4	114	8.7
Annular Seal	60/25/15 Dry Mix	251.4	289.5	2280	10.9
Station A-300	Silica Sand	289.5	304.4	800	10.3
Annular Seal	60/25/15 Dry Mix	304.4	398.5	4280	9.6
Station B-400	Silica Sand	398.5	401.3	134	9.8
Annular Seal	60/25/15 Dry Mix	401.3	435.7	1580	9.6
Strain Relief	Gypsum Grout	435.7	456.0	1457	11.8
Annular Seal	60/25/15 Dry Mix	456.0	490.0	1520	9.5
Station A-500	Silica Sand	490.0	510.4	1131	10.5
Annular Seal	60/25/15 Dry Mix	510.4	598.3	3120	8.6
Station B-600	Silica Sand	598.3	600.8	117	9.7
Annular Seal	60/25/15 Dry Mix	600.8	690.3	3460	8.9
Station A-700	Silica Sand	690.3	710.3	1083	10.4
Annular Seal	60/25/15 Dry Mix	710.3	820.1	4120	8.8
Filter Pack	Coarse Silica Sand	820.1	906.0*	4133	10.0
Total Lbs of Bentonite-Cement:				17,280	
Total Lbs of Dry Mix:				25,560	
Total Lbs of Instrument Station Silica Sand				5,594	
Total Lbs of Gypsum grout:				1,457	
Total Lbs of Filter Pack Silica Sand:				4,133	
Total Lbs of Material Placed in Hole:				54,024	
Material Notes:					
Surface Seal: Portland Type II-based cement w/4.6% bentonite; total of 17,280 Lbs placed					
Dry Mix: 60% Overton (fine) sand, 25% Bentonite powder, 15% Silica Flour;					
Mix permeability: 90 millidarcies; total of 25,560 Lbs placed					
Instrument Stations: 6/12 mesh washed Silica Sand w/layer of 16/40 mesh sand top/bottom;					
Total of 5,594 Lbs sand placed at stations					
Strain Relief Interval: 15.5 Lb/gal neat gypsum grout; total of 1,457 Lbs placed					
Filter Pack: 6/12 mesh washed Silica Sand; total of 4,133 Lbs placed					
*Hole caved from TD of 919.9 Ft to 906 prior to stemming filter pack					
					JCH 3/19/93

Appendix D.2.3 Stemming summary for UE5PW-3

PW-3 Stemming Summary					
All depths in ft., ref: Ground Level		Interval Depths			Mean Hole
Interval	Type of Matl.	Top	Bottom	Lbs Mat'l	Size, Inches
Surface seal	Bentonite-Cement	4.0	80.1	12103	15.4
Annular Seal	60/25/15 Dry Mix	80.1	90.5	640	11.0
Station A-100	Silica Sand	90.5	109.9	1063	10.6
Annular Seal	60/25/15 Dry Mix	109.9	189.9	4480	10.7
Station A-200	Silica Sand	189.9	209.6	950	10.0
Annular Seal	60/25/15 Dry Mix	209.6	248.2	2440	11.4
Station B-250	Silica Sand	248.2	251.5	163	10.1
Annular Seal	60/25/15 Dry Mix	251.5	288.6	2640	12.0
Station A-300	Silica Sand	288.6	310.4	900	9.3
Annular Seal	60/25/15 Dry Mix	310.4	348.5	2400	11.3
Station B-350	Silica Sand	348.5	352.8	273	11.4
Annular Seal	60/25/15 Dry Mix	352.8	447.5	8800	13.6
Strain Relief	Gypsum Grout	447.5	454.4	1165	18.2
Annular Seal	60/25/15 Dry Mix	454.4	490.1	1680	9.9
Station A-500	Silica Sand	490.1	509.7	1263	11.5
Annular Seal	60/25/15 Dry Mix	509.7	548.5	1840	9.9
Station B-550	Silica Sand	548.5	551.4	113	9.1
Annular Seal	60/25/15 Dry Mix	551.4	628.4	3480	9.7
Station A-639	Silica Sand	628.4	649.1	713	8.6
Annular Seal	60/25/15 Dry Mix	649.1	687.0	1440	9.0
Station B-689	Silica Sand	687.0	691.8	126	7.6
Annular Seal	60/25/15 Dry Mix	691.8	868.0	6560	8.9
Filter Pack	Coarse Silica Sand	868.0	955.0	2500	7.9
Total Lbs of Bentonite-Cement:				12,103	
Total Lbs of Dry Mix:				36,400	
Total Lbs of Instrument Station Silica Sand				5,563	
Total Lbs of Gypsum grout:				1,165	
Total Lbs of Filter Pack Silica Sand:				2,500	
Total Lbs of Material Placed in Hole:				57,731	
Material Notes:					
Surface Seal: Portland Type II-based cement w/4.6% bentonite; total of 12,103 Lbs placed					
Dry Mix: 60% Overton (fine) sand, 25% Bentonite powder, 15% Silica Flour;					
Mix permeability: 90 millidarcies; total of 36,400 Lbs placed					
Instrument Stations: 6/12 mesh washed Silica Sand w/layer of 16/40 mesh sand top/bottom;					
Total of 5563 Lbs sand placed at stations					
Strain Relief Interval: 15.5 Lb/gal neat gypsum grout; total of 1,165 Lbs placed					
Filter Pack: 6/12 mesh washed Silica Sand; total of 2500 Lbs placed					
					JCH 3/19/93

Appendix D.3.1 Casing tally for UE5PW-1

Pilot Well PW-1 Casing Tally			
All lengths measured "as made up"			
Joint #	Length, in.	Cum. length, in.	Comments
Screen jts 1-6			
1	125.5	125.5	Screen jt.1 has 1.75" nose below 0 ref.
2	124.875	250.375	Druck-812 located between screen jts.#1-2
3	125	375.375	
4	124.75	500.125	
5	124.75	624.875	
6	124.875	749.75	
Casing jts 1-38			
1	241.75	991.5	
2	241.625	1233.125	
3	240.25	1473.375	Station A-700 9.375" below top of jt.#3
4	239.25	1712.625	
5	239.5	1952.125	
6	239.875	2192	
7	239.75	2431.75	
8	239.5	2671.25	Station B-600 7.25" below top of jt.#8
9	239.75	2911	
10	239.25	3150.25	
11	239.5	3389.75	
12	239.75	3629.5	
13	240.25	3869.75	Station A-500 5.75" below top of jt.#13
14	239.5	4109.25	
15	239.5	4348.75	
16	240.25	4589	
17	241.5	4830.5	
18	240.25	5070.75	
19	242	5312.75	
20	242.25	5555	
21	241.75	5796.75	Station B-350 132.75" below top of jt.#21
22	241.75	6038.5	
23	241.5	6280	Station A-300 16" from top of jt.#23
24	241.5	6521.5	
25	241.25	6762.75	
26	242.125	7004.875	Station B-240 20.875" below top of jt.#26
27	238.875	7243.75	
28	240.5	7484.25	Station A-200 20.5" below top of jt.#28
29	239.5	7723.75	
30	240	7963.75	
31	240.25	8204	Station B-150 140.25" below top of jt.#31
32	241.5	8445.5	
33	241.5	8687	Station A-100 23" below top of jt. #33
34	240.5	8927.5	
35	240.625	9168.125	
36	241.5	9409.625	
37	241.75	9651.375	
38	241.5	9892.875	GL=28.875" below top of jt. #38

Appendix D.3.2 Casing tally for UE5PW-2

Pilot Well PW-2 Casing Tally			PW-2.2 Final JCH 1/27/93
All lengths measured "as made up"			
Joint #	Length, in.	Cum. length, in.	Comments
Screen jts 1-6			
1	125.25	125.25	Centralizer on cplg; Bullet nose +1.625" below
2	124.75	250	Druck 880 on top of screen jt. #1
3	124.5	374.5	Centralizer on coupling
4	124.75	499.25	
5	124.25	623.5	Centralizer on coupling
6	124.75	748.25	
Casing jts 1-41			
1	240.5	988.75	Centralizer on coupling
2	242	1230.75	
3	242	1472.75	Centralizer on coupling
4	242	1714.75	
5	240	1954.75	Centralizer on coupling
6	241.875	2196.625	
7	240.5	2437.125	Station A-700 156.875" below top of joint
8	241	2678.125	
9	240	2918.125	Centralizer on coupling
10	242.5	3160.625	
11	240.5	3401.125	Centralizer on coupling
12	242	3643.125	Station B-600 163.125" below top of joint
13	242	3885.125	Centralizer on coupling
14	242	4127.125	
15	240.5	4367.625	Centralizer on coupling
16	241.75	4609.375	
17	242	4851.375	Station A-500 171.375" below top of joint
18	242.5	5093.875	Centralizer on coupling
19	242	5335.875	
20	241.75	5577.625	Centralizer on coupling
21	242.5	5820.125	
22	242.5	6062.625	Station B-400 182.625" below TO jt. 22
23	242.25	6304.875	Centralizer on coupling
24	239.875	6544.75	
25	240	6784.75	Centralizer on coupling
26	242.5	7027.25	
27	242	7269.25	Station A-300 189.25 below TO jt. 27
28	242	7511.25	Centralizer on coupling
29	242.25	7753.5	Station B-250 73.5" below TO jt. 29
30	254.5	8008	Centralizer on coupling
31	254.25	8262.25	
32	254.25	8516.5	Station A-200 236.5" below TO jt. 32
33	254.5	8771	Centralizer on coupling
34	254.25	9025.25	Station B-150 145.25" below TO jt. 34
35	255.25	9280.5	Centralizer on coupling
36	254.5	9535	Station A-100 55" below TO jt. 36
37	254	9789	Centralizer on coupling
38	254.5	10043.5	
39	254	10297.5	Centralizer on coupling
40	254	10551.5	Centralizer on coupling
41	155.25	10706.75	Jt. #41 located 26.75" above ground level

Appendix D.3.3 Casing tally for UE5PW-3

Pilot Well PW-3 Casing Tally			JCH rev. 3/15/93
All lengths measured "as made up"			
Joint #	Length, in.	Cum. length, in.	Comments
Screen jts 1-6			
1	125.5625	125.5625	Centralizer on cplg; Bullet nose +1.75" below
2	124.75	250.3125	
3	124.625	374.9375	Centralizer on cplg.
4	124.625	499.5625	
5	124.75	624.3125	Centralizer on cplg.
6	124.875	749.1875	
Casing jts 1-44			
1	242	991.1875	Centralizer on top of joint
2	241.625	1232.8125	
3	241.5	1474.3125	Centralizer on top of joint
4	241.25	1715.5625	
5	241.625	1957.1875	Centralizer on top of joint
6	241.25	2198.4375	
7	239.625	2438.0625	Centralizer on top of joint
8	239.5	2677.5625	
9	235.25	2912.8125	Centralizer on top of joint
10	241.4375	3154.25	Station B-689 168.25" below top of joint
11	239.16	3393.41	Centralizer on top of joint
12	243.3	3636.71	Station A-639 48.75" below top of joint
13	241.5	3878.21	
14	240.5	4118.71	Centralizer on top of joint
15	233.25	4351.96	
16	235.25	4587.21	Centralizer on top of joint
17	239.25	4826.46	Station B-550 170.5" below top of joint
18	241.54	5068	
19	240	5308	Station A-500 52" below top of joint
20	241.5	5549.5	Centralizer on top of joint
21	241.75	5791.25	
22	241.25	6032.5	Centralizer on top of joint
23	239.75	6272.25	
24	235.25	6507.5	Centralizer on top of joint
25	240.125	6747.625	
26	241.5	6989.125	Centralizer on top of joint
27	241.5	7230.625	Station B-350 174.625" below top of joint
28	241.75	7472.375	Centralizer on top of joint
29	241.5	7713.875	Station A-300 57.875" below top of joint
30	241.5	7955.375	Centralizer on top of joint
31	241	8196.375	
32	241.625	8438	Station B-250 182" below top of joint
33	241.875	8679.875	Centralizer on top of joint
34	241.5	8921.375	Station A-200 65.375" below top of joint
35	241.25	9162.625	Centralizer on top of joint
36	241.5	9404.125	
37	241.625	9645.75	Centralizer on top of joint
38	241.625	9887.375	
39	235.25	10122.625	Station A-100 66.625" below top of joint
40	241.625	10364.25	Centralizer on top of joint
41	241.5	10605.75	
42	237.5	10843.25	
43	235.5	11078.75	Centralizer on top of joint
44	207.125	11285.875	Top of joint #44 is 29.875" above GL

Appendix D.4.1 Daily activities for UE5PW-1

PW-1 Daily Activity				
Day	Hours	Date	Depth	Activity
1	7	7/13/92	0	Rig up, badging
2	8	7/14/92	0	Slug testing, steam cleaning SST casing
3	8	7/15/92	60	Ran 60' screen, steam clean 720' tremies
4	8	7/16/92	60	Complete steam clean tremies, total 88 jts; spool 375' and 647' of 1" tubing
5	8	7/17/92	143	Ran csg jts #1-4, Station A-700
6	8	7/20/92	282	Ran csg jts #5-11, Station B-600
7	8	7/21/92	362	Ran csg jts #12-15, Station A-500
8	8	7/22/92	483	Ran csg jts #16-21, Station B-350
9	8	7/23/92	543	Ran csg jts #22-24, Station A-300
10	8	7/24/92	624	Ran csg jts #25-28, Station B-240
11	8	7/27/92	684	Ran csg jts #29-31, Station A-200
12	8	7/28/92	724	Ran csg jts #32-33, Station B-150
13	8	7/29/92	784	Ran csg jts #24-36, Station A-100
14	8	7/30/92	804	Ran csg jt #37
15	8	7/31/92	822	Ran csg jt #38 (final), cutoff 10" csg, terminated cables, hoses, move spooling racks
16	8	8/3/92	822	Set hydraulic jacks in cellar
17	8	8/4/92	822	Fabricate lift sub, RU to pull 8-5/8"
18	8	8/5/92	822	RU casing/tremie lift mechanism, work stuck csg, free w/102Klb, pull 20'
19	8	8/6/92	822	Pull 60 ft 8-5/8" csg @ 600 psi hyd
20	8	8/7/92	752	Placed 35 sx 6/12 sand, pull 20 ft. 8-5/8
21	8	8/10/92	740	RU shotcrete inj., stem
22	8	8/11/92	730	Stem to 710, pull 10' 8"
23	8	8/12/92	700	Start Stem A-700, 4 sx 6/12
24	8	8/13/92	630	Complete stem A-700, 5 sx 6/12, pulled 60' 8" to 640
25	8	8/14/92	595	Pull 40' 8", stem
26	8	8/17/92	595	De-stem 595-602, work on tagging tool
27	8	8/18/92	562	Pull 40 8", 1.5 sx 6/12 598.5-601.5, stem up to 562
28	8	8/19/92	510	Pull 50' 8", stem to 510, re-design tagging tool, RU vibrator
29	8	8/20/92	495	Vibrator trip 500-600, pull 30' 8", 7 sx 6/12 station A-500, (495-510) hole caved 483-495
30	8	8/21/92	469	Stem 479-469, hole caving
31	8	8/24/92	450	Pull 50' 8", stem to 455

Appendix D.4.1 Daily activities for UE5PW-1 (Continued)

32	8	8/25/92	434	Vibrator trip to 500, stem 450-434
33	8	8/26/92	421	Pull 20' 8", stemming large hole to 414
34	8	8/27/92	379	Pull 40' 8", stem to 373
35	8	8/28/92	373	Vibrator trip 450-370, pull 370' 8"
36	8	8/31/92	373	Move jacks, clean cellar, welded 10" pup, RU bailer, bail
37	8	9/1/92	373	Config jacks for 10", pull 1000 psi/2 hrs, 1300/3 hrs, pull 4'-10", bail
38	8	9/2/92	366	Pumped ~15.1 ppg gypsum W-60 slurry, 6 sx, bail
39	8	9/3/92	348	Stem to 351.5, 6/12 sand 351.5-348.5 2 sx, pull 10' 10"
40	8	9/10/92	315	Pulled 20' 10", stem to 315
41	9	9/11/92	290	Bail, stem to 310, 11 sx 6/12, 1 sk 16/40 station A-300
42	10	9/14/92	238	Pull 10' 10", stem 290-241.5, 2 gal 16/40 + 1.5 sx 6/12 + 3 gal 16/40, to 238.5
43	10	9/15/92	238	Bail, neutron logging, RU Bennett pump #1
44	10	9/16/92	238	Run Bennett pump #1 in hole, pump, bail
45	10	9/17/92	238	Run Bennett pump #2 in hole, sampling all day
46	9	9/18/92	211	Stem 238-211, pull 20' 10"
47	10	9/21/92	169	Stem 211-169, 17 sx 6/12 sand + 6" 16/40 Sta. A-200
48	10	9/22/92	144	Stem 169-144, 1.33 sx 6/12, 6# 16/40 St. B-150
49	{8}	9/23/92	144	Standby w/o crew (event)
50	10	9/24/92	106	Stem 144-110, 3 sx 6/12 110-106
51	9	9/25/92	80	Complete St. A-100 8sx 6/12 + 12 # 16/40, stem 90-80 ft
52	8	9/28/92	69	Pull 20' 10"; lost 60' tremie; hole sluffed 80-69 ft
53	10	9/29/92	0	RU for cementing; place 4 yds low-set-temperature cement; LD all remaining pipe
54	10	9/30/92	0	Neutron logging; Rigdown/move to PW-2 Activity
55	8	10/1/92	0	Continue logging
56	8	10/2/92	0	Complete logging; Rig off hole 1200 hrs

Appendix D.4.2 Daily activities for UE5PW-2

PW-2 Daily Activity				JCH/MAB 2/18/93
Day	Hours	Date	Depth	Activity
1	8	1/11/93	0	Move rig on location; set spooling equipment; spool instruments/tubing
2	8	1/12/93	0	Continue rigup; steam clean tremie; spool tubing
3	8	1/13/93	0	Run 83 jts tremie (820 ft/840 ft); steam clean 29 jts stainless casing; tag TD 906 ft
4	8	1/14/93	0	Continue steam clean stainless casing; makeup casing couplings
5	8	1/15/93	183	Run screen joints #1-6 (60 ft); run Druck 880; run casing jts. 1-6 (120 ft)
6	10	1/19/93	384	Run casing joints #7-16; set stations A-700 and B-600
7	10	1/20/93	545	Run casing joints #17-24; set stations A-500 and B-400
8	10	1/21/93	689	Run casing joints #25-31; set stations A-300 and B-250
9	9	1/22/93	773	Run casing joints #32-35; set stations A-200 and B-150
10	10	1/25/93	837	Run casing joints #36-38; set station A-100; bundle excess psychrometer cable
11	10	1/26/93	890	Run casing joints #39-41; label/terminate cables
12	10	1/27/93	840	Cont. terminate cables; move out spools; rigup stemming equip; drop 25 sx 6/12 sand TD-840
13	10	1/28/93	751	Drop 6/12 sand 840-820; Stem 820-751
14	10	1/29/93	646	Stem 751-646; Station A-700
15	10	2/1/93	553	Stem 646-553; Station B-600
16	10	2/2/93	476	Stem 553-476; Station A-500
17	10	2/3/93	456	Stem 476-456; pull 170 ft 8-5/8 in casing
18	10	2/4/93	456	Pull 320 ft 8-5/8 in casing; weld on 10-3/4 in casing extension; reset jacks
19	10	2/5/93	413	Stem 456-413
20	2.5	2/8/93	413	Heavy rain; crew released 0930 hrs
21	10	2/9/93	355	Stem 413-355; Station B-400
22	10	2/10/93	279	Stem 355-279; Station A-300
23	10	2/11/93	209	Stem 279-209; Station B-250
24	10	2/12/93	143	Stem 209-143; Station A-200
25	10	2/16/93	80	Stem 143-80; Station B-150 and A-100; Bailing trips #1-13
26	10	2/17/93	80	Bailing trips #14-81
27	10	2/18/93	80	Bailing trips #82-129
28	10	2/19/93	0	RU for cmt; place 5 yds low-set-temp cement; LD all remaining pipe; Bailing trips #130-160

Appendix D.4.3 Daily activities for UE5PW-3

PW-3 Daily Activity				
Day	Hours	Date	Depth	Activity
1	8	11/16/92	0	Move rig onto PW-3 location, setup cable spools, cut tubing/hoses
2	8	11/17/92	0	Log 690-440 w/SPS neutron logger
3	8	11/18/92	0	Log w/Century Geophysical Logging (Ray Federwisch)
4	8	11/19/92	200	Run 83 jts. tremie; run screen jts 1-6; run csg jts 1-7; set Druck 940
5	8	11/20/92	300	Ran csg jts 8-12; set stations B-689, and A-639
6	8	11/23/92	560	Ran csg jts 13-25; set stations A-639, B-550, A-500
7	9	11/24/92	740	Ran csg jts 26-34; set stations B-350, A-300
8	10	11/25/92	860	Ran csg jts 35-40; set stations B-250, A-200
9	10	11/30/92	920	Ran csg jts 41-43; set station A-100; splice cable on Druck 639
10	10	12/1/92	940	Ran csg jt 44; terminate cables at WH
11	10	12/2/92	837	Rig down cable spooling equip; rig up shotcrete unit, hopper, etc. Stem 955-837
12	9	12/3/92	778	Stem 837-778
13	9	12/4/92	687	Stem 778-687, Station B-689
14	10	12/5/92	548	Stem 687-548, Station A-639, B-550
5	2	12/7/92	548	Heavy rain; crew released 0900 hrs
16	10	12/8/92	455	Stem 548-455; Station A-500
17	10	12/9/92	455	Pull 450 ft. 8-5/8" casing; Pull jacks, weld on 10-3/4", reset jacks
18	10	12/10/92	455	Continue changeover to 10-3/4" casing; Pull on 10-3/4 casing
19	10	12/11/92	403	Mix/pump 8 sx W-60 gypsum grout; mixed 5.5 gal/100 lb sk; Gypsum interval 6'-11" stem to 403
20	2	12/12/92	403	Generator down; crew released 0900 hrs
21	10	12/14/92	348	Stem 403-348; Station B-350
22	10	12/15/92	268	Stem 348-268; Station A-300
23	10	12/16/92	198	Stem 268-198; Stations B-250, A-200
24	10	12/17/92	110	Stem 198-110
25	10	12/18/92	80	Stem 110-80, Station A-100
26	10	1/4/93	80	Pull remaining tremie; Bailing trips #1-23
27	10.5	1/5/93	0	RU for cementing; place 3.5 yds low-set-temperature cement; LD all remaining pipe
28	10	1/6/93	0	Bailing trips #24-55
29	8	1/7/93	0	Bailing trips #56-85; move jacks to PW-2
30	8	1/8/93	0	Bailing trips #86-125

Area 5 Pilot Wells

APPENDIX E

Laboratory Testing Data of Geologic Samples

- E.1 Stratigraphy and Mineralogy Data
 - E.1.1 Profiles of USCS Textural Classes
 - E.1.2 XRF and INAA Data
 - E.1.2.1 Oxide Composition Data Determined by Major Elements XRF and INAA Methods for Core Samples from UE5PW-1
 - E.1.2.2 Elemental Composition Data Determined by INAA and Trace Element XRF Methods for Core Samples from UE5PW-1
 - E.1.2.3 Oxide Composition Data Determined by Major Elements XRF and INAA Methods for Core Samples from UE5PW-2
 - E.1.2.4 Elemental Composition Data Determined by INAA and Trace Element XRF Methods for Core Samples from UE5PW-2
 - E.1.2.5 Oxide Composition Data Determined by Major Elements XRF and INAA Methods for Core Samples from UE5PW-3
 - E.1.2.6 Elemental Composition Data Determined by INAA and Trace Element XRF Methods for Core Samples from UE5PW-3
- E.2 Material, Hydrologic, and Geochemical Parameter Data for Alluvial Samples
 - E.2.1 Results of Laboratory Tests for Core Samples from UE5PW-1
 - E.2.2 Results of Laboratory Tests for Core Samples from UE5PW-2
 - E.2.3 Results of Laboratory Tests for Core Samples from UE5PW-3
 - E.2.4 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-1
 - E.2.5 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2
 - E.2.6 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-3
 - E.2.7 Moisture Retention Data for Core Samples from UE5PW-1
 - E.2.8 Moisture Retention Data for Core Samples from UE5PW-2
 - E.2.9 Moisture Retention Data for Core Samples from UE5PW-3
 - E.2.10 Parameters Required to Calculate Unsaturated Hydraulic Conductivities for Core Samples
- E.3 Material, Hydrologic, and Geochemical Parameter Data for Tuff Samples
 - E.3.1 Results of Laboratory Tests for Tuff Core Samples from UE5PW-3
 - E.3.2 Results of Laboratory Tests for Tuff Drill Cuttings Samples from UE5PW-3
- E.4 Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples

Appendix E.1.1 Profile of USCS Textural Classes

Appendix E.1.1 Profile of USCS Textural Classes (Continued)

Appendix E.1.1 Profile of USCS Textural Classes (Continued)

E.1.2.1.1 Oxide composition data determined by major element XRF and INAA methods for core samples from Ue5PW-1.

Depth interval from (ft)	to	percent composition by weight											LOI ¹	FeO ²	Na2O ²
		SiO	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5				
47.75	48.00	66.21	0.28	12.89	2.04	0.06	1.27	4.59	2.67	3.84	0.04	6.41	1.84	2.81	
58.25	58.50	63.13	0.29	12.54	2.22	0.06	1.51	6.21	2.42	3.46	0.05	8.21	2.10	2.58	
67.50	67.75	65.29	0.29	12.89	2.09	0.06	1.26	5.14	2.71	3.69	0.04	6.80	1.93	2.86	
77.75	78.00	67.35	0.27	13.25	1.98	0.06	1.01	3.80	2.98	3.96	0.04	5.56	1.75	3.15	
128.50	128.75	65.33	0.30	13.32	2.38	0.06	1.65	4.08	2.46	3.81	0.07	6.59	2.11	2.69	
139.00	139.25	53.34	0.35	11.48	2.69	0.05	2.25	12.23	1.67	2.96	0.06	13.10	2.50	1.82	
258.25	258.50	67.62	0.44	13.82	2.94	0.07	1.38	2.88	2.56	3.86	0.07	4.47	2.75	2.69	
278.50	278.75	68.63	0.41	13.60	2.86	0.08	1.15	2.98	2.58	3.95	0.12	3.62	2.55	2.73	
279.75	280.00	64.29	0.59	13.93	4.22	0.09	1.62	3.90	2.28	3.53	0.12	5.14	3.98	2.52	
297.75	298.00	69.27	0.39	13.61	2.60	0.07	1.26	2.26	2.48	4.07	0.08	3.82	2.28	2.67	
298.25	298.50	66.39	0.45	13.90	3.09	0.08	1.68	3.18	2.29	3.80	0.08	5.29	2.90	2.46	
318.50	318.75	69.52	0.45	13.36	3.06	0.06	1.03	2.72	2.54	3.99	0.10	3.16	2.70	2.75	
358.00	358.25	68.22	0.44	13.98	3.16	0.07	1.18	2.75	2.54	3.90	0.13	3.36	2.89	2.79	
400.75	401.00	69.14	0.43	14.11	2.68	0.06	1.04	2.64	2.59	4.00	0.11	3.29	2.50	2.74	
460.25	460.50	65.79	0.45	13.96	3.11	0.07	1.42	4.19	2.39	3.62	0.13	5.13	2.88	2.54	
499.50	499.75	64.89	0.47	13.85	3.40	0.07	1.88	3.74	2.23	3.46	0.09	5.47	3.07	2.36	
540.75	541.00	59.47	0.40	12.93	3.02	0.07	1.75	7.50	2.03	3.40	0.08	9.14	2.71	2.08	
579.85	580.10	66.57	0.57	13.22	4.36	0.12	1.69	3.78	2.71	3.46	0.15	3.05	3.94	2.76	
580.35	580.60	67.83	0.40	13.08	2.71	0.06	1.13	3.71	2.67	3.85	0.12	4.16	2.45	2.69	
619.00	619.25	66.44	0.42	13.33	2.91	0.07	1.42	3.95	2.54	3.66	0.09	4.83	2.61	2.58	
659.00	659.25	64.49	0.45	13.58	3.17	0.08	1.52	4.44	2.54	3.56	0.14	5.53	2.81	2.63	
700.00	700.25	64.19	0.50	14.02	3.43	0.08	1.61	4.50	2.46	3.44	0.14	5.29	2.99	2.47	
720.25	720.50	61.00	0.44	13.65	3.21	0.08	2.03	6.03	2.11	3.41	0.13	7.69	2.89	2.19	
725.00	725.25	65.78	0.48	14.15	3.39	0.08	1.50	3.68	2.67	3.58	0.13	4.06	2.96	2.65	
726.50	726.75	66.39	0.43	13.46	2.82	0.07	1.38	4.09	2.61	3.84	0.15	4.40	2.63	2.69	
727.25	727.50	64.98	0.46	14.29	3.22	0.08	1.67	4.19	2.63	3.56	0.13	4.51	2.78	2.63	
739.50	739.75	66.75	0.49	14.57	3.18	0.07	1.34	3.34	2.80	3.73	0.14	3.28	2.79	2.88	
760.00	760.25	64.25	0.47	13.86	3.25	0.08	1.56	4.71	2.51	3.57	0.13	5.29	3.02	2.57	
790.00	792.50	66.99	0.45	13.34	3.00	0.07	1.31	4.24	2.86	3.86	0.16	3.69	2.66	2.90	
800.00	802.50	67.45	0.40	12.68	2.37	0.06	1.16	4.30	2.66	3.91	0.14	4.73	2.19	2.75	
812.50	815.00	65.32	0.43	13.63	2.99	0.08	1.48	4.43	2.62	3.74	0.13	4.96	2.56	2.65	
817.50	820.00	66.78	0.46	13.86	3.06	0.07	1.35	3.69	2.82	3.88	0.17	3.64	2.73	2.77	
822.50	825.00	68.35	0.44	13.42	2.91	0.07	1.30	3.59	2.74	3.75	0.14	3.15	2.68	2.77	
827.50	830.00	66.27	0.48	13.77	3.09	0.07	1.36	3.95	2.74	3.84	0.16	3.77	2.92	2.80	

¹LOI means "loss on ignition"

²Analyzed by INAA methods

E.1.2.2 Elemental composition data determined by INAA and trace element XRF methods for core samples from Ue5PW-1.

Depth interval from to (ft)	Composition (ppm)												Ba
	Sc	Cr	Zn	As	Br	Rb ¹	Sr ¹	Y ¹	Zr ¹	Nb ¹	Sb	Cs	
47.75	48.00	4.26	15	4.60	2.20	111	112	23	193	17	0.4	3.38	689
58.25	58.50	4.79	15	5.10	2.00	111	111	23	195	17	0.5	3.94	619
67.50	67.75	4.45	16	5.10	2.10	109	109	23	191	16	0.5	3.56	644
77.75	78.00	3.92	11	3.20	1.60	110	111	24	173	17	0.4	3.13	725
128.50	128.75	5.42	18	5.30	1.90	136	134	25	161	20	0.6	5.02	646
139.00	139.25	6.34	23	6.70	3.40	111	114	22	172	16	0.8	5.23	673
258.25	258.50	6.61	24	6.30	0.50	126	121	25	211	19	0.8	4.06	884
278.50	278.75	5.69	20	6.20	0.40	123	118	26	172	17	0.5	3.08	896
279.75	280.00	8.13	31	6.20	0.30	119	116	26	248	17	0.6	3.86	838
297.75	298.00	5.35	18	5.30	0.30	131	125	27	206	19	0.6	3.67	744
298.25	298.50	6.59	26	6.60	0.40	130	123	26	229	20	0.9	4.88	816
318.50	318.75	6.26	23	4.80	0.40	128	120	27	200	18	0.5	3.20	912
358.00	358.25	6.46	25	5.00	0.30	126	122	24	172	17	0.5	3.24	931
400.75	401.00	6.04	18	5.40	0.10	126	129	24	175	16	0.5	3.09	1006
460.25	460.50	6.90	23	5.60	0.40	118	116	26	205	16	0.6	3.54	957
499.50	499.75	7.71	29	6.60	0.70	121	122	25	210	17	0.7	4.40	748
540.75	541.00	6.72	24	7.00	1.10	120	119	25	201	18	0.7	4.80	647
579.85	580.10	8.90	32	5.80	0.60	105	103	29	216	17	0.6	2.60	842
580.35	580.60	5.78	21	5.20	0.60	123	121	27	178	18	0.5	3.00	826
619.00	619.25	6.29	21	5.70	0.07	121	118	25	201	17	0.6	3.40	791
659.00	659.25	6.91	24	5.40	0.70	120	116	28	238	18	0.6	3.60	745
700.00	700.25	7.53	25	6.20	0.50	114	118	26	203	16	0.6	3.90	914
720.25	720.50	7.56	27	6.40	0.60	125	117	25	202	17	0.7	5.10	718
725.00	725.25	7.12	23	5.70	0.50	115	115	27	203	16	0.6	3.30	860
726.50	726.75	6.86	22	6.30	0.60	130	130	29	184	18	0.6	3.40	865
727.25	727.50	7.30	24	5.30	0.50	115	118	26	205	17	0.6	3.70	837
739.50	739.75	7.03	22	5.00	0.60	116	108	25	188	15	0.6	3.00	973
760.00	760.25	7.45	28	5.90	0.40	118	116	26	197	17	0.6	3.90	891
790.00	792.50	6.77	22	6.40	0.60	132	126	28	189	18	0.6	3.10	867
800.00	802.50	5.88	21	4.40	0.60	132	134	27	172	20	0.4	3.10	784
812.50	815.00	6.60	23	5.20	0.70	125	130	26	188	19	0.5	3.80	824
817.50	820.00	7.06	23	4.50	0.70	127	120	27	178	18	0.5	3.00	916
822.50	825.00	6.93	26	4.70	0.50	126	127	27	193	17	0.4	3.20	815
827.50	830.00	7.06	22	4.50	0.50	126	126	27	187	17	0.5	3.20	889

E.1.1.2.2 Elemental composition data determined by INAA and trace element XRF methods for core samples from Ue5PW-1.

Depth interval from (ft)	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Pb'	Th'	ThI	U
47.75	48.00	38.3	74.2	5.32	0.91	0.58	2.26	0.28	7.06	1.34	22	14	13.1	3.3
58.25	58.50	39.1	76.0	5.06	0.92	0.59	2.09	0.31	6.90	1.17	20	14	13.1	3.2
67.50	67.75	41.8	75.9	4.89	0.90	0.51	2.00	0.30	7.11	1.20	20	12	14.2	3.0
77.75	78.00	48.4	90.3	5.42	0.90	0.57	1.98	0.31	5.59	1.30	23	15	14.6	3.0
128.50	128.75	37.5	76.1	4.98	0.81	0.61	2.29	0.33	5.86	1.40	24	17	16.4	3.9
139.00	139.25	34.9	68.4	4.89	0.86	0.56	2.02	0.33	5.32	1.10	19	12	13.0	3.6
258.25	258.50	46.9	90.8	5.68	1.01	0.61	2.29	0.36	8.09	1.28	24	16	15.4	3.6
278.50	278.75	52.1	97.5	6.40	1.11	0.67	2.26	0.30	5.39	1.24	24	16	15.5	3.5
279.75	280.00	60.3	112.7	6.78	1.28	0.68	2.42	0.34	8.09	1.14	24	17	16.5	3.1
297.75	298.00	52.6	97.5	6.03	1.00	0.64	2.37	0.34	6.07	1.30	25	18	17.0	3.2
298.25	298.50	49.8	100.0	6.17	1.05	0.71	2.47	0.41	7.94	1.30	24	17	16.4	3.3
318.50	318.75	53.0	97.0	6.24	1.15	0.68	2.20	0.31	7.11	1.25	23	18	16.6	3.7
358.00	358.25	59.0	107.2	6.37	1.23	0.66	2.10	0.32	6.25	1.15	26	18	16.0	3.3
400.75	401.00	53.5	100.5	6.26	1.22	0.63	2.27	0.31	5.66	1.17	23	16	15.8	3.8
460.25	460.50	50.6	93.9	6.41	1.24	0.68	2.52	0.30	5.94	1.16	24	17	14.6	3.0
499.50	499.75	49.2	91.1	6.25	1.11	0.72	2.20	0.34	6.59	1.12	22	15	15.4	3.3
540.75	541.00	43.0	82.3	5.60	0.94	0.64	2.20	0.33	6.33	1.19	22	14	14.9	3.3
579.85	580.10	75.7	140.8	8.41	1.32	0.92	2.28	0.37	6.68	1.17	24	16	16.0	2.5
580.35	580.60	53.5	97.4	6.50	1.09	0.71	2.42	0.34	5.75	1.28	22	18	16.7	3.6
619.00	619.25	57.0	102.2	6.64	1.12	0.74	2.39	0.32	6.29	1.16	22	16	15.9	3.2
659.00	659.25	54.6	102.2	6.41	1.13	0.76	2.36	0.35	7.25	1.26	26	16	15.9	3.5
700.00	700.25	49.3	91.8	5.91	1.24	0.71	2.07	0.32	6.19	1.02	22	15	14.0	2.8
720.25	720.50	46.4	88.2	5.76	1.08	0.68	2.35	0.35	6.31	1.10	24	16	14.8	3.3
725.00	725.25	50.2	91.0	6.58	1.26	0.73	2.25	0.36	6.50	1.08	23	16	14.6	2.8
726.50	726.75	50.5	93.5	6.70	1.14	0.74	2.47	0.37	5.45	1.17	25	17	17.0	3.5
727.25	727.50	51.9	95.4	6.34	1.21	0.71	2.07	0.36	6.52	1.06	23	16	15.0	2.8
739.50	739.75	52.1	92.9	6.08	1.30	0.68	1.93	0.31	6.21	1.02	24	17	14.9	3.2
760.00	760.25	53.6	97.8	6.75	1.20	0.73	2.37	0.37	6.69	1.12	22	16	15.3	3.1
790.00	792.50	50.5	94.5	7.27	1.10	0.86	2.71	0.38	5.90	1.28	22	17	16.8	3.7
800.00	802.50	49.8	89.6	6.41	0.99	0.74	2.43	0.38	6.13	1.26	22	18	18.5	4.1
812.50	815.00	47.9	87.1	6.17	1.06	0.77	2.34	0.39	6.60	1.18	22	19	16.2	3.4
817.50	820.00	54.0	98.2	6.84	1.18	0.78	2.36	0.40	5.67	1.21	23	18	16.0	3.5
822.50	825.00	51.9	93.9	6.52	1.15	0.69	2.29	0.38	5.87	1.10	21	16	16.5	3.3
827.50	830.00	53.3	93.6	6.51	1.19	0.73	2.36	0.35	6.48	1.12	23	18	17.6	3.6

^aAnalyzed by trace element XRF method

Appendix E.1.2.3 Oxide composition data determined by major element XRF and INAA methods for core samples from UE5PW-2

Depth interval from (ft)	to	percent composition by weight												
		SiO	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	LOI ¹	FeO ²	Na ₂ O ²
0.25	0.50	67.31	0.35	12.56	2.28	0.07	1.14	3.92	2.77	3.75	0.05	5.97	1.88	2.71
2.50	2.75	65.46	0.27	12.03	2.01	0.07	1.08	5.47	2.59	3.80	0.06	7.14	2.04	2.44
29.75	30.00	66.26	0.38	12.80	2.39	0.06	1.43	4.25	2.60	3.86	0.06	5.79	2.38	2.63
38.50	38.75	66.64	0.31	12.49	2.03	0.06	1.15	4.19	2.72	4.15	0.06	6.13	2.21	2.77
39.75	40.00	65.47	0.39	12.83	2.61	0.06	1.66	4.44	2.37	3.83	0.04	6.37	2.42	2.38
100.25	100.50	68.64	0.22	12.75	1.56	0.06	0.92	3.67	3.06	4.10	0.05	4.91	1.38	3.09
119.50	119.75	67.97	0.32	12.93	2.17	0.06	1.39	2.74	2.78	4.06	0.05	5.00	2.16	2.83
129.50	129.75	68.81	0.26	12.72	1.75	0.06	0.98	2.65	2.95	4.33	0.05	5.56	1.74	3.03
200.50	200.75	64.74	0.29	12.50	2.14	0.06	1.43	5.55	2.72	3.81	0.04	6.78	1.93	2.73
250.50	250.75	62.94	0.41	13.19	2.92	0.07	1.53	5.91	2.44	3.49	0.10	6.72	2.58	2.50
311.00	311.25	63.92	0.40	13.47	2.85	0.06	1.83	4.81	2.23	3.64	0.10	6.62	2.57	2.29
478.00	478.25	73.30	0.09	11.90	0.73	0.06	1.03	1.97	3.34	4.73	0.05	2.38	0.61	3.44
748.50	748.75	67.65	0.28	12.40	2.15	0.07	0.99	4.29	2.98	4.14	0.06	4.50	1.83	3.11

¹LOI means "loss on ignition"

²Analyzed by INAA methods

Appendix E.1.2.4 Elemental composition data determined by INAA and trace element methods for core samples from UE5PW-2

Depth interval from (ft)	to	Composition (ppm)													
		Sc	Cr	Zn	As	Br	Rb ¹	Rb	Sr ¹	Y ¹	Zr ¹	Nb ¹	Sb	Cs	Ba
0.25	0.50	4.71	16	33	5.0	2.3	120	120	367	26	220	19	0.5	3.5	701
2.50	2.75	4.50	13	66	4.5	4.5	126	115	334	25	162	18	0.5	4.0	723
29.75	30.00	6.03	20	56	5.5	1.8	123	116	348	25	236	18	0.7	4.2	723
38.50	38.75	6.08	16	92	5.3	1.5	133	120	298	27	211	19	0.6	3.7	651
39.75	40.00	6.40	22	83	6.0	1.5	126	125	367	24	246	19	0.7	4.7	621
100.25	100.50	3.53	7	43	5.1	1.1	127	128	316	23	148	18	0.4	3.9	506
119.50	119.75	5.50	18	44	6.1	0.5	136	140	338	26	222	19	0.8	5.1	643
129.50	129.75	4.50	9	52	5.5	0.6	144	138	363	27	171	21	0.5	4.3	561
200.50	200.75	5.13	16	47	7.1	1.3	136	132	349	25	175	20	0.7	4.8	558
250.50	250.75	6.31	22	109	7.5	1.0	123	127	376	26	190	18	0.6	4.8	663
311.00	311.25	6.79	21	63	23.6	0.8	132	123	372	25	195	18	0.9	5.2	720
478.00	478.25	2.79	0	36	4.0	0.4	207	197	37	30	99	27	0.3	3.6	85
748.50	748.75	3.81	10	70	5.7	0.6	131	126	243	26	226	22	0.5	3.3	540

Depth interval from (ft)	to	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Pb ¹	Th ¹	Th	U
0.25	0.50	36.1	69.7	30.3	5.25	0.91	0.60	2.14	0.32	6.70	4.00	28	14	14.2	3.3
2.50	2.75	34.9	68.9	25.2	4.84	0.77	0.57	2.11	0.32	6.30	1.00	23	17	14.1	3.3
29.75	30.00	44.3	83.5	27.6	6.02	0.95	0.66	2.30	0.35	6.80	1.10	22	15	14.1	3.0
38.50	38.75	48.7	91.4	32.6	5.87	0.94	0.62	2.30	0.36	8.40	1.00	22	16	14.3	3.3
39.75	40.00	47.5	91.7	26.9	5.90	0.94	0.68	2.33	0.34	7.90	1.10	23	16	16.0	3.3
100.25	100.50	54.1	93.9	28.1	5.48	0.67	0.58	2.18	0.31	5.80	1.10	25	16	17.2	3.7
119.50	119.75	41.8	83.5	30.4	5.50	0.86	0.65	2.46	0.36	7.90	1.30	24	17	16.0	3.8
129.50	129.75	44.3	84.9	31.7	5.46	0.68	0.65	2.40	0.35	6.20	1.50	27	18	17.9	3.9
200.50	200.75	41.7	80.0	29.0	5.61	0.80	0.75	2.46	0.37	5.80	1.40	23	16	15.3	4.2
250.50	250.75	43.7	80.4	25.1	5.45	1.02	0.48	2.23	0.33	5.80	1.00	23	17	15.3	4.4
311.00	311.25	44.6	84.2	32.5	5.79	0.99	0.65	2.22	0.32	5.20	0.90	22	15	15.8	4.0
478.00	478.25	28.1	56.3	18.5	4.23	0.23	0.68	2.64	0.38	3.76	2.03	26	23	20.9	5.4
748.50	748.75	54.2	102.0	34.4	6.57	0.78	0.75	2.55	0.40	8.58	1.43	24	19	18.2	3.8

¹Analyzed by trace element XRF method

Appendix E.1.2.5 Oxide composition data determined by major element XRF and INAA methods for core samples from UE5PW-3

Depth interval from (ft)	to	SiO ₂	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MnO	percent composition by weight					LOI ¹	FeO ²	Na ₂ O ²
							MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅			
0.50	0.75	64.90	0.37	12.48	2.50	0.07	1.37	5.13	2.68	3.78	0.05	6.20	2.10	2.71
2.75	3.00	68.67	0.34	12.95	2.28	0.07	1.08	3.10	2.96	4.13	0.04	4.00	1.89	2.69
50.25	50.50	66.56	0.35	13.03	2.45	0.06	1.54	4.00	2.93	3.94	0.04	5.11	2.23	3.00
52.25	52.50	65.59	0.37	12.26	2.25	0.07	1.44	4.98	2.92	3.97	0.05	5.71	1.97	3.03
99.75	100.00	67.53	0.40	13.34	2.82	0.07	1.61	2.86	2.88	3.96	0.05	4.12	2.35	2.96
129.50	129.75	69.25	0.60	12.97	2.88	0.07	0.99	2.75	2.87	3.93	0.07	3.40	2.42	2.90
199.25	199.50	67.67	0.43	13.59	3.35	0.07	1.19	3.04	2.77	3.71	0.12	3.68	2.74	2.85
199.75	200.00	69.32	0.39	13.80	2.99	0.07	1.07	2.60	2.94	3.86	0.12	3.11	2.47	2.97
249.50	249.75	67.17	0.50	14.52	3.56	0.07	1.27	3.08	2.76	3.59	0.13	3.23	2.97	2.77
250.75	251.00	67.63	0.47	14.78	3.37	0.07	1.34	2.82	2.78	3.59	0.14	2.93	2.83	2.80
499.00	499.25	61.59	0.30	12.29	2.13	0.07	1.46	7.68	2.88	3.80	0.08	7.45	1.80	2.85
499.50	499.75	72.11	0.11	12.11	0.90	0.06	0.75	2.92	3.49	4.73	0.08	2.99	0.74	3.36
549.25	549.50	67.16	0.33	13.27	2.59	0.08	1.24	3.92	3.10	4.01	0.06	4.28	2.11	3.16
638.50	638.75	70.64	0.18	12.45	1.20	0.07	0.40	3.29	3.83	4.80	0.04	2.93	0.92	3.78
638.75	639.00	68.02	0.25	12.69	1.50	0.07	0.57	4.40	3.72	4.82	0.07	3.44	1.26	3.74
688.50	688.75	73.35	0.26	13.75	1.67	0.08	0.32	0.88	4.09	5.15	0.07	0.35	1.32	4.09

¹LOI means "loss on ignition"

²Analyzed by INAA methods

Appendix E.1.1.2.6 Elemental composition data determined INAA and trace element methods for core samples from UE5PW-3

Depth interval from (ft) to		Composition (ppm)																		
		Sc	Cr	Zn	As	Br	Rb ¹	Rb	Sr ¹	Y ¹	Zr ¹	Nb ¹	Sb	Cs	Ba					
0.50	0.75	5.14	17	51	4.7	3.5	122	118	317	25	245	20	0.7	3.64	614					
2.75	3.00	4.56	16	46	4.9	3.0	130	121	286	25	248	20	0.6	3.43	635					
50.25	50.50	5.45	23	62	5.8	1.2	130	121	398	26	250	20	0.7	4.42	654					
52.25	52.50	4.44	20	56	4.7	1.9	132	125	315	25	213	21	0.6	3.95	572					
99.75	100.00	5.75	26	64	6.5	1.2	132	125	360	26	313	22	0.7	4.28	662					
129.50	129.75	5.23	27	55	5.6	0.9	129	118	368	26	193	19	0.6	3.04	707					
199.25	199.50	6.08	28	74	6.3	0.6	123	112	414	26	202	18	0.6	3.03	909					
199.75	200.00	5.74	22	68	5.8	0.2	124	115	421	26	188	18	0.6	3.02	912					
249.50	249.75	7.16	23	87	6.3	0.7	116	109	493	24	232	16	0.6	3.23	894					
250.75	251.00	6.94	22	54	6.2	0.5	116	111	497	25	215	15	0.6	3.30	986					
499.00	499.25	4.15	12	43	5.5	0.7	122	114	317	25	245	21	0.5	3.35	744					
499.50	499.75	2.81	2	40	4.2	0.5	196	185	71	32	109	27	0.4	3.37	164					
549.25	549.50	4.76	14	61	4.8	0.3	130	123	350	27	254	22	0.5	3.46	684					
638.50	638.75	1.92	1	45	3.0	0.5	169	162	81	33	221	29	0.3	2.80	330					
638.75	639.00	2.49	2	53	3.9	0.2	153	146	149	30	290	26	0.4	1.66	789					
688.50	688.75	2.74	2	42	2.4	0.6	173	162	129	33	318	28	0.3	2.92	779					

		La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Pb ¹	Th ¹	Th	U
0.50	0.75	48.4	90.0	32.9	5.51	0.85	0.69	2.24	0.32	7.10	1.35	23	17	15.69	3.2
2.75	3.00	51.9	96.4	35.7	6.13	0.90	0.77	2.56	0.36	7.64	1.38	23	17	16.24	3.7
50.25	50.50	47.5	89.6	24.2	5.48	0.78	0.70	2.51	0.38	8.71	1.38	26	18	16.75	4.0
52.25	52.50	53.9	97.5	34.8	5.57	0.78	0.66	2.36	0.35	7.12	1.39	25	20	17.64	3.9
99.75	100.00	49.9	96.6	31.1	5.86	0.86	0.67	2.53	0.38	9.49	1.48	24	19	17.64	3.7
129.50	129.75	46.8	82.2	33.3	5.78	0.93	0.73	2.37	0.34	6.36	1.24	25	17	15.22	3.4
199.25	199.50	55.1	97.4	37.8	6.29	1.07	0.68	2.32	0.34	5.94	1.22	26	17	16.17	3.4
199.75	200.00	50.7	90.3	33.8	5.80	1.08	0.69	2.23	0.32	5.12	1.17	27	19	15.37	3.4
249.50	249.75	52.3	96.1	37.8	6.11	1.29	0.65	2.13	0.32	6.73	1.03	28	16	14.51	3.4
250.75	251.00	49.5	89.5	30.0	6.00	1.24	0.68	2.04	0.30	5.17	0.99	25	15	13.92	3.3
499.00	499.25	49.0	90.0	31.5	5.83	0.91	0.74	2.46	0.34	6.74	1.32	26	18	15.72	4.0
499.50	499.75	34.7	67.0	21.9	4.91	0.34	0.71	2.71	0.39	4.04	1.98	28	24	21.59	5.2
549.25	549.50	57.7	106.1	35.8	6.21	0.94	0.73	2.53	0.37	7.25	1.45	22	19	17.49	4.2
638.50	638.75	55.8	101.6	36.5	5.84	0.59	0.77	2.87	0.42	6.42	2.00	24	27	22.68	4.2
638.75	639.00	64.3	116.2	37.5	6.56	0.91	0.81	2.90	0.42	7.98	1.83	25	23	21.05	4.3
688.50	688.75	69.3	125.5	44.7	6.89	0.92	0.86	3.12	0.45	8.61	2.53	21	27	22.89	4.7

¹Analyzed by trace element XRF method

Appendix E-2.1 Results of laboratory tests in core samples from UesPM-1.

HYDROLOGIC PROPERTIES										MATERIAL PROPERTIES					ENVIRONMENTAL TRACER PROPERTIES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Interval (ft)	Saturated Hydraulic Conductivity					Water Content (percent)					Particle Size Distribution					Dry Bulk Density (g/cm3)	Porosity (%)	Aspenic Density (g/cm3)	Carbon (Percent)					Chloride Bromide Infiltration					Stable Isotopes Ratio (d10/d15) Lower																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	D15	D30	D60	U15	U30	D15	D30	D60	U15	U30	D15	D30	D60	U15	U30				D15	D30	D60	U15	U30	D15	D30	D60	U15	U30		D15	D30	D60	U15	U30																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
26.75	27.00	27.25	27.50	27.75	28.00	5.6	3.0	9.1	-81.5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

Appendix E.2.1 Results of laboratory tests in core samples from UeSPW-1 (continued).

HYDROLOGIC PROPERTIES										MATERIAL PROPERTIES				ENVIRONMENTAL TRACER PROPERTIES				
Interval from to (ft)	Saturated Hydraulic Conductivity (cm/sec)	Water Content (percent)		Water Potential Pressure Head (cm H ₂ O)	Particle Size Distribution (Percent passing sieve)		Dry Bulk Density (g/cm ³)	Porosity (%)	Apparent Specific Gravity (ρ_a/ρ_w)	Carbon (percent)	Chloride Bromide Ratio (X10E5)	C/ ρ_w 36Cl/35Cl Ratio (X1E13)	Stable Isotopes $\delta^{18}O$ (‰), $\delta^{13}C$ (‰)					
		W _u (%)	W _t (%)		D ₆₀	D ₃₀								Org	Inorg	Org (‰)	Inorg (‰)	
726.75 - 727.00	22.50	7.7	7.7	13.3	-2.5			1.72	35.09	2.8								
727.00 - 727.25	22.50									0.29	0.02	0.31	0.5					
727.25 - 727.50	22.50												384.62					
4.1E-05 727.50 - 727.75	22.50	8.1	8.1	13.9		92.24 13.32	1.73	34.81										
727.75 - 728.00	22.50																	
728.00 - 728.25	22.50																	
728.25 - 728.50	22.50																	
728.50 - 728.75	22.50																	
4.9E-04 728.75 - 729.00	22.50	6.6		10.8			1.63	38.35										
729.00 - 729.25	22.50																	
729.25 - 729.50	22.50																	
729.50 - 729.75	22.50																	
729.75 - 730.00	22.50																	
730.00 - 730.25	22.50	4.9				71.14 3.44												
730.25 - 730.50	22.50																	
730.50 - 730.75	22.50																	
730.75 - 731.00	22.50																	
731.00 - 731.25	22.50																	
731.25 - 731.50	22.50																	
731.50 - 731.75	22.50																	
731.75 - 732.00	22.50																	
732.00 - 732.25	22.50																	
732.25 - 732.50	22.50																	
732.50 - 732.75	22.50																	
732.75 - 733.00	22.50																	
733.00 - 733.25	22.50																	
733.25 - 733.50	22.50																	
733.50 - 733.75	22.50																	
733.75 - 734.00	22.50																	
734.00 - 734.25	22.50																	
734.25 - 734.50	22.50																	
734.50 - 734.75	22.50																	
734.75 - 735.00	22.50																	
735.00 - 735.25	22.50																	
735.25 - 735.50	22.50																	
735.50 - 735.75	22.50																	
735.75 - 736.00	22.50																	
736.00 - 736.25	22.50																	
736.25 - 736.50	22.50																	
736.50 - 736.75	22.50																	
736.75 - 737.00	22.50																	
737.00 - 737.25	22.50																	
737.25 - 737.50	22.50																	
737.50 - 737.75	22.50																	
737.75 - 738.00	22.50																	
738.00 - 738.25	22.50																	
738.25 - 738.50	22.50																	
738.50 - 738.75	22.50																	
738.75 - 739.00	22.50																	
739.00 - 739.25	22.50																	
739.25 - 739.50	22.50																	
739.50 - 739.75	22.50																	
739.75 - 740.00	22.50																	
740.00 - 740.25	22.50																	
740.25 - 740.50	22.50																	
740.50 - 740.75	22.50																	
740.75 - 741.00	22.50																	
741.00 - 741.25	22.50																	
741.25 - 741.50	22.50																	
741.50 - 741.75	22.50																	
741.75 - 742.00	22.50																	
742.00 - 742.25	22.50																	
742.25 - 742.50	22.50																	
742.50 - 742.75	22.50																	
742.75 - 743.00	22.50																	
743.00 - 743.25	22.50																	
743.25 - 743.50	22.50																	
743.50 - 743.75	22.50																	
743.75 - 744.00	22.50																	
744.00 - 744.25	22.50																	
744.25 - 744.50	22.50																	
744.50 - 744.75	22.50																	
744.75 - 745.00	22.50																	
745.00 - 745.25	22.50																	
745.25 - 745.50	22.50																	
745.50 - 745.75	22.50																	
745.75 - 746.00	22.50																	
746.00 - 746.25	22.50																	
746.25 - 746.50	22.50																	
746.50 - 746.75	22.50																	
746.75 - 747.00	22.50																	
747.00 - 747.25	22.50																	
747.25 - 747.50	22.50																	
747.50 - 747.75	22.50																	
747.75 - 748.00	22.50																	
748.00 - 748.25	22.50																	
748.25 - 748.50	22.50																	
748.50 - 748.75	22.50																	
748.75 - 749.00	22.50																	
749.00 - 749.25	22.50																	
749.25 - 749.50	22.50																	
749.50 - 749.75	22.50																	
749.75 - 750.00	22.50																	
750.00 - 750.25	22.50																	
750.25 - 750.50	22.50																	
750.50 - 750.75	22.50																	
750.75 - 751.00	22.50																	
751.00 - 751.25	22.50																	
751.25 - 751.50	22.50																	
751.50 - 751.75	22.50																	
751.75 - 752.00	22.50																	
752.00 - 752.25	22.50																	
752.25 - 752.50	22.50																	
752.50 - 752.75	22.50																	
752.75 - 753.00	22.50																	
753.00 - 753.25	22.50																	
753.25 - 753.50	22.50																	
753.50 - 753.75	22.50																	
753.75 - 754.00	22.50																	
754.00 - 754.25	22.50																	
754.25 - 754.50	22.50																	
754.50 - 754.75	22.50																	
754.75 - 755.00	22.50																	
755.00 - 755.25	22.50																	
755.25 - 755.50	22.50																	
755.50 - 755.75	22.50																	
755.75 - 756.00	22.50																	
756.00 - 756.25	22.50																	
756.25 - 756.50	22.50																	
756.50 - 756.75	22.50																	
756.75 - 757.00	22.50																	
757.00 - 757.25	22.50																	
757.25 - 757.50	22.50																	
757.50 - 757.75	22.50																	
757.75 - 758.00	22.50																	
758.00 - 758.25	22.50																	
758.25 - 758.50	22.50																	
758.50 - 758.75	22.50																	
758.75 - 759.00	22.50																	
759.00 - 759.25	22.50																	
759.25 - 759.50	22.50																	
759.50 - 759.75	22.50																	
759.75 - 760.00	22.50																	
760.00 - 760.25	22.50																	
760.25 - 760.50	22.50																	
760.50 - 760.75	22.50																	
760.75 - 761.00	22.50																	

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES				ENVIRONMENTAL TRACER PROPERTIES			
Interval (m)	Hydraulic Conductivity (cm/sec)	Water Content (percent)	Water Potential (cm H ₂ O)	Specific Surface Area (cm ² /g)	Porosity (percent)	Density (g/cm ³)	Moisture Content (percent)	Carbon (percent)	Chloride (percent)	Sulfate (percent)	Cl/Br Ratio
0-10	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
10-20	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
20-30	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
30-40	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
40-50	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
50-60	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
60-70	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
70-80	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
80-90	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
90-100	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
100-110	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
110-120	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
120-130	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
130-140	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
140-150	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
150-160	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
160-170	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
170-180	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
180-190	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
190-200	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
200-210	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
210-220	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
220-230	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
230-240	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
240-250	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
250-260	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
260-270	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
270-280	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
280-290	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
290-300	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0	0
300-310	7.5E-04	7.3	10.6	95.02	16.30	1.45	1.62	38.87	0	0</	

Addenda

Appendix E.2.1 Results of laboratory tests for core samples from UE5PW-1.

Interval from to (ft)		³⁶ Cl/Cl (x10 ⁻¹⁵)
299.00	299.25	184
499.00	499.25	531
699.00	699.25	539

Appendix E.2.2 Results of laboratory tests for core samples from UE5PW-2.

Interval from to (ft)		Stable Isotopes $\delta^{18}\text{O}$ δD (per mil)		³⁶ Cl/Cl (x10 ⁻¹⁵)
2.00	2.25	-1.5	-66	
28.75	29.00			882
29.50	29.75	-6.6	-87	
38.75	39.00			906
40.25	40.50	-8.2	-45	
41.25	41.50	-8.4	-95	
68.00	68.25			716
68.75	69.00	-12.7	-112	
99.50	99.75	-14.2	-119	
119.00	119.25	-13.9	-120	
128.75	129.00	-15.6	-124	
199.75	200.00	-15.7	-127	
249.75	250.00	-14.1	-118	
310.50	310.75	-14.6	-119	
399.50	399.75	-14.4	-115	
478.75	479.00	-11.8	-101	
499.00	499.25	-13.8	-112	
718.50	718.75	-9.6	-78	
817.75	818.00	-11.2	-95	

Appendix E.2.3 Results of laboratory tests for core samples from UE5PW-3.

Interval from to (ft)		Stable Isotopes $\delta^{18}\text{O}$ δD (per mil)		³⁶ Cl/Cl (x10 ⁻¹⁵)
0.25	0.50	+4.8	-53	
3.00	3.25	+2.3	-57	
49.25	49.50			708
50.00	50.25	-8.4	-94	
52.00	52.25	-7.9	-100	
99.50	99.75			623
100.00	100.25	-13.1	-115	
130.75	131.00	-13.9	-119	
131.00	131.25			653
199.00	199.25	-14.0	-119	
200.00	200.25	-14.2	-119	
200.75	201.00			657
249.75	250.00	-14.1	-119	
250.00	250.25			642
250.50	250.75	-14.6	-122	
349.50	349.75	-14.3		
399.75	400.00	-13.3		
452.25	452.50	-12.7	-110	
499.25	499.50	-13.5	-112	
549.75	550.00	-12.9	-110	
638.25	638.50	-10.8		

Appendix 2.4 Results of laboratory tests in cuttings samples from UeSPW-1.

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES									
Interval from (ft)	to (ft)	Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride	Bromide	Cl/Br Ratio	Chloride	Bromide	Soluble Sulfate (ppm)
		DB2	HYD1	No. 4	No. 200		Inorganic	Organic	Total		in soil (ppm)	in water (ppm)				
0.0	5.0	4.4	4.4	91.96	10.07	1.2	0.66	0.09	0.75		84.0	0.65	129.2			
17.5	20.0	1.9	1.7	87.69	4.69		0.85	0.12	0.97		137.0	1.03	133.0			
22.5	25.0					4.5										
25.0	27.5	3.2	2.9	96.53	4.54		0.69	0.05	0.74		94.0	0.56	167.9			
29.0	32.5	1.5	1.3	90.54	2.26	2.1	0.82	0.06	0.88		113.0	0.75	150.7			
32.5	35.0	3.8	3.7	67.34	3.81		0.83	0.06	0.89		124.0	0.77	161.0			
37.5	40.0	2.0	1.9	91.95	7.10		0.57	0.06	0.63		112.0	0.75	149.3			
40.0	42.5		3.1				0.76	0.11	0.87		131.0	0.84	156.0			
42.5	45.0	3.6		90.99	8.23											
55.0	57.5	5.7	5.7	81.39	7.56		0.90	0.05	0.95		113.0	0.80	141.3			
60.0	62.5	5.4	5.3	93.85	8.41	1.3	0.71	0.05	0.76		91.0	0.65	140.0			
62.5	65.0	4.5	4.6	89.79	7.36		0.79	0.06	0.85		77.0	0.55	140.0			
65.0	67.5	4.5	4.6	75.00	8.96	0.9	0.80	0.05	0.85		85.0	0.59	144.1			
70.0	72.5	4.7	5.2	92.92	7.52		0.83	0.05	0.88		83.0	0.56	148.2			
72.5	75.0	5.9	5.9	74.35	5.85	0.9	0.92	0.05	0.97		95.0	0.66	143.9			
75.0	77.5	5.1	5.5	82.34	7.10		0.80	0.05	0.85		80.0	0.54	148.1			
77.5	80.0	5.5	4.6	89.48	5.29	1.0	0.65	0.05	0.70		88.0	0.64	137.5			
80.0	82.5	6.0	5.6	91.86	9.49	1.2	0.76	0.05	0.81		106.0	0.76	139.5			
82.5	85.0	5.5	4.9	89.14	9.70	1.0	0.89	0.06	0.95		95.0	0.69	137.7			
85.0	87.5	4.4	4.0	96.07	9.51		0.68	0.06	0.74		68.0	0.50	136.0			
87.5	90.0	2.8	2.8	98.07	10.76	1.3	0.68	0.05	0.73		86.0	0.63	136.5			
90.0	92.5	4.3	4.4	80.46	6.50	0.9	0.68	0.05	0.73		84.0	0.59	142.4			
92.5	95.0	4.8	4.6	75.04	6.98	1.1	0.65	0.04	0.69		88.0	0.61	144.3			
95.0	97.5	5.0	4.4	71.36	8.04		0.53	0.05	0.58		82.0	0.58	141.4			
97.5	100.0	5.6	5.5	98.18	7.47	1.1	0.74	0.05	0.79		118.0	0.78	151.3			
100.0	102.5	5.7	5.8	90.08	8.25		0.63	0.05	0.68		121.0	0.80	151.3			
102.5	105.0	5.2	5.2	90.38	5.81	1.2	0.52	0.04	0.56		100.0	0.69	144.9			
105.0	107.5	5.7	5.6	92.47	6.68		0.73	0.05	0.78		111.0	0.74	150.0			
107.5	110.0	5.2	5.7	86.70	6.89	1.2	0.71	0.05	0.76		103.0	0.67	153.7			
110.0	112.5	5.1	5.2	88.54	11.86	1.3	0.71	0.04	0.75		117.0	0.76	153.9			
112.5	115.0	5.1	5.2	87.94	11.85	1.2	0.53	0.04	0.57		115.0	0.78	147.4			
115.0	117.5	4.1	4.3	97.16	13.79	1.3	0.79	0.05	0.84		108.0	0.73	147.9			
117.5	120.0	4.5	4.6	52.11	2.74	0.7	0.55	0.03	0.58		179.0	1.16	154.3			
120.0	122.5	5.2	5.0	93.31	6.82	1.4	0.77	0.03	0.80		126.0	0.83	151.8			
122.5	125.0	6.0	6.0	79.90	7.41	1.1	0.78	0.04	0.82		108.0	0.90	120.0			
125.0	127.5	5.1	5.1	90.17	10.31	1.3	0.60	0.04	0.64		139.0	0.90	154.4			
127.5	130.0	4.8	4.8	92.33	4.07	1.3	0.80	0.04	0.84		139.0	0.88	158.0			
130.0	132.5	4.8	4.7	46.96	8.51	1.2	0.50	0.04	0.54		115.0	0.75	153.3			
132.5	135.0	4.4	4.6	70.71	8.26	1.0	0.42	0.03	0.45		103.0	0.61	168.9			
135.0	137.5	4.0	4.0	83.81	9.92	1.3	0.41	0.03	0.44		95.0	0.61	155.7			
137.5	140.0	3.3	3.2	81.69	5.22	1.7	0.48	0.04	0.52		84.0	0.50	168.0			
140.0	142.5	3.9	3.6	68.97	5.47	1.4	0.79	0.04	0.83		103.0	0.64	160.9			
142.5	145.0	4.0	4.0	81.10	6.06	1.2	0.70	0.04	0.74		119.0	0.76	156.6			
145.0	147.5	4.0	3.9	55.28	6.05	1.5	0.91	0.04	0.95		105.0	0.67	156.7			
147.5	150.0	4.1	4.0	53.36	4.88	1.8	0.75	0.05	0.80		104.0	0.67	155.2			
150.0	152.5	3.4	3.6	72.41	7.38	1.6	0.79	0.05	0.84		91.0	0.57	159.6			
152.5	155.0	3.1	3.2	64.24	5.52	1.5	0.63	0.04	0.67		73.0	0.45	162.2			
155.0	157.5	4.0	3.9	65.73	5.95	1.7	0.62	0.04	0.66		87.0	0.49	177.6			
157.5	160.0	4.3	4.5	63.96	5.46	1.4	0.53	0.12	0.65		99.0	0.46	215.2			
160.0	162.5	4.6	4.4	56.19	5.26	1.1	0.60	0.04	0.64		125.0	0.78	160.3			
162.5	165.0	4.8	4.5	71.99	7.40	1.2	0.66	0.04	0.70		85.0	0.57	149.1			
165.0	167.5	4.6	4.8	75.19	5.03	1.2	0.64	0.05	0.69	5.2	95.0	0.51	186.3			
167.5	170.0	3.9	3.9	80.65	8.45	1.8	0.48	0.05	0.53	5.3	70.0	0.37	189.2			5.9
170.0	172.5	4.1	4.2	77.61	7.27	1.0	0.47	0.03	0.50	2.7	97.0	0.55	176.4			6.5
172.5	175.0	3.9	3.7	67.58	7.11	1.1	0.48	0.05	0.53		71.0	0.39	182.1			
175.0	177.5	3.8	3.8	75.13	8.14	1.8	0.40	0.03	0.43		57.0	0.32	178.1			
177.5	180.0	4.3	4.4	68.05	7.27	1.9	0.23	0.03	0.26		63.0	0.31	203.2			
180.0	182.5	3.8	3.7	51.03	3.06	1.5	0.27	0.02	0.29		58.0	0.29	200.0			
182.5	185.0	4.5	4.3	84.78	8.62	2.2	0.46	0.03	0.49		53.0	0.30	176.7			
185.0	187.5	3.7	3.6	77.59	6.50	2.6	0.20	0.02	0.22		35.0	0.20	175.0			
187.5	190.0	4.1	4.2	79.27	5.24	1.9	0.25	0.02	0.27		48.0	0.25	192.0			
190.0	192.5	4.6	4.5	78.80	8.47	1.7	0.63	0.04	0.67		49.0	0.29	169.0			
192.5	195.0	3.6	3.7	85.28	7.63	1.8	0.36	0.03	0.39	2.2	34.0	0.18	188.9			4.4
195.0	197.5	4.3	3.9	67.03	1.46	1.4	0.53	0.02	0.55	3.0	36.0	0.20	180.0			5.6
197.5	200.0	2.6	2.5	85.37	4.86	3.0	0.23	0.02	0.25		22.0	0.12	183.3			
200.0	202.5	3.3	3.4	66.00	3.73	1.9	0.27	0.02	0.29		27.0	0.14	192.9			
202.5	205.0	2.8	3.0	79.48	6.00	1.4	0.35	0.03	0.38		23.0	0.12	191.7			
205.0	207.5	2.9	2.9	76.18	4.73	1.5	0.26	0.02	0.28		20.0	0.10	200.0			
207.5	210.0	3.9	3.7	74.80	2.19	1.6	0.37	0.03	0.40		25.0	0.15	166.7			
210.0	212.5	3.6	3.4	78.21	5.36	1.4	0.34	0.03	0.37		19.0	0.11	172.7			
212.5	215.0	3.0	2.6	77.62	5.60	1.7	0.31	0.02	0.33		13.0	0.08	162.5			
215.0	217.5	3.1	2.8	61.31	4.76	2.0	0.55	0.02	0.57		12.0	0.09	133.3			
217.5	220.0	3.8	3.9	92.28	8.33	2.0	0.17	0.03	0.20		13.0	0.08	162.5			
220.0	222.5	3.1	3.2	90.90	7.53	2.0	0.24	0.03	0.27		11.0	0.08	137.5			

Appendix E.2.4 Results of laboratory tests in cuttings samples from UeSPW-1 (continued).

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES									
Interval from to (ft)		Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide in water (ppm)	Cl/Br Ratio	Chloride in water (ppm)	Bromide in water (ppm)	Soluble Sulfate (ppm)
		DB2	HYD1	No.4	No.200		Inorganic	Organic	Total							
280.0	282.5	4.1	4.4	77.30	5.00	2.0	0.26	0.02	0.28		0.7					
282.5	285.0	4.3	4.4	66.73	3.94	2.3	0.26	0.02	0.28		0.7					
285.0	287.5	6.7	4.2	83.77	4.66	2.3	0.25	0.02	0.27		0.8					
287.5	290.0	4.1	4.3	86.43	1.33	2.2	0.22	0.02	0.24		1.2					
290.0	292.5	3.7	3.6	81.21	2.00	2.0	0.24	0.02	0.26		1.1					
292.5	295.0	3.7	3.5	89.72	8.12	2.6	0.15	0.02	0.17		1.1					
295.0	297.5	3.6	3.7	84.98	7.57	2.4	0.09	0.01	0.10		1.3					
297.5	300.0	4.6	4.6	82.00	7.50	1.9	0.21	0.03	0.24		2.5					
300.0	302.5	4.7	4.7	75.69	7.60	1.4	0.51	0.02	0.53		1.2					
302.5	305.0	3.4	3.3	74.22	7.70	1.9	0.31	0.02	0.33		0.9					
305.0	307.5	2.6	2.8	83.51	7.94	2.3	0.18	0.02	0.20		0.9					
307.5	310.0	3.2	3.1	77.05	4.17	1.4	0.38	0.03	0.41	2.6	0.9					3.1
310.0	312.5	5.0	4.9	75.23	2.81	1.5	0.43	0.04	0.47		0.8	0.012	66.7			
312.5	315.0	7.1	6.7	84.10	12.60	1.4	0.72	0.04	0.76		1.0	0.012	83.3			
315.0	317.5	5.2	4.8	71.96	7.69	1.9	0.27	0.03	0.30		0.8	0.011	72.7			
317.5	320.0	4.4	4.4	90.10	11.00	2.9	0.47	0.05	0.52		1.7					
320.0	322.5	3.2	3.5	85.50	2.33	2.6	0.19	0.02	0.21		0.7					
322.5	325.0	3.0	2.7	84.87	6.10	3.1	0.12	0.01	0.13		0.5	0.005	100.0			
325.0	327.5	2.9	3.2	85.86	3.61	2.6	0.28	0.02	0.30		0.7	0.006	116.7			
327.5	330.0	2.8	2.8	85.93	5.32	2.9	0.23	0.02	0.25		1.0					
330.0	332.5	3.2	3.2	75.96	4.55	3.3	0.17	0.02	0.19		0.8					
332.5	335.0	3.4	3.1	90.25	3.09	2.6	0.13	0.02	0.15		0.7					
335.0	337.5	3.3	2.8	82.30	5.30	2.6	0.11	0.02	0.13		0.7	0.070	10.0			
337.5	340.0	3.5	3.5	93.46	5.85	2.8	0.13	0.02	0.15		1.7					
340.0	342.5	3.1	2.9	85.77	5.88	2.9	0.17	0.02	0.19		0.7					
342.5	345.0	3.0	3.0	83.50	5.60	2.9	0.16	0.01	0.17		0.5	0.040	12.5			
345.0	347.5	3.3	3.3	91.80	7.90	2.9	0.12	0.02	0.14	1.8	0.7					3.1
347.5	350.0	3.1	3.1	91.65	4.92	1.9	0.11	0.02	0.13		2.7					
350.0	352.5	3.1	2.8	93.62	4.10	1.9	0.14	0.01	0.15		0.9					
352.5	355.0	3.9	3.9	87.05	11.22	2.1	0.24	0.03	0.27		1.1					
355.0	357.5	4.1	3.8	72.78	5.29	2.2	0.18	0.02	0.20		0.8					
357.5	360.0	2.8	3.0	97.09	9.42	2.8	0.14	0.04	0.18		1.9					
360.0	362.5	3.1	3.1	92.00	8.60	3.2	0.18	0.03	0.21		0.9					
362.5	365.0	3.5	3.1	90.30	6.20	2.7	0.25	0.02	0.27		2.9	0.009	322.2			
365.0	367.5	2.5	2.2	95.40	13.40	3.1	0.20	0.02	0.22		0.9					
367.5	370.0	3.5	3.5	96.00	14.00	3.4	0.50	0.03	0.53		8.6	0.022	390.9			
370.0	372.5	3.8	3.7	96.50	10.00	3.4	0.55	0.04	0.59		4.9	0.014	350.0			
372.5	375.0	3.6	3.4	93.72	9.46	3.0	0.34	0.04	0.38		5.8	0.011	527.3			
375.0	377.5	4.2	4.0	84.82	9.39	3.2	0.31	0.04	0.35		4.1	0.008	512.5			
377.5	380.0	4.0	4.1	74.90	8.00	2.9	0.16	0.02	0.18		2.1					
380.0	382.5	4.0	3.8	80.10	3.66	2.3	0.13	0.02	0.15		1.6	0.006	266.7			
382.5	385.0	4.2	4.1	84.84	5.05	2.3	0.22	0.03	0.25		1.8					
385.0	387.5	3.9	3.9	89.50	8.40	2.5	0.28	0.03	0.31		1.8					
387.5	390.0	3.9	3.7	81.03	3.80	2.3	0.21	0.02	0.23		1.4	0.004	350.0			
390.0	392.5	3.9	4.3	90.29	5.57	2.5	0.21	0.02	0.23		1.2					
392.5	395.0	3.7	3.6	86.70	6.50	2.7	0.23	0.03	0.26	4.8	1.8	0.008	225.0			5.5
395.0	397.5	4.3	4.8	74.80	8.90		0.49	0.02	0.51		1.6	0.010	160.0			
397.5	400.0	4.9	4.6	75.10	9.30		0.49	0.03	0.52		1.4	0.008	175.0			
400.0	402.5	4.5	4.4	81.00	4.82		0.23	0.02	0.25		1.3	0.007	185.7			
402.5	405.0	6.1	5.8	78.20	10.40		0.57	0.04	0.61		1.0	0.009	111.1			
405.0	407.5	5.5	5.3	69.20	5.40		0.45	0.04	0.49		0.9	0.006	150.0			
407.5	410.0	5.4	4.8	76.80	2.77		0.27	0.02	0.29		0.8	0.005	160.0			
410.0	412.5	2.7	2.4	94.79	5.60		0.21	0.02	0.23		1.3					
412.5	415.0	2.6	2.7	78.61	2.86		0.19	0.07	0.26		3.4	0.008	425.0			
415.0	417.5	3.2	3.1	71.11	3.47	1.1	0.27	0.03	0.30		1.1	0.005	220.0			
417.5	420.0	4.4	3.9	75.54	8.83	2.1	0.40	0.02	0.42		1.3	0.006	216.7			
420.0	422.5	4.3	4.1	86.46	12.84	2.4	0.56	0.04	0.60		1.1	0.007	157.1			
422.5	425.0	4.8	4.8	84.82	11.24	2.1	0.67	0.03	0.70		1.0	0.005	200.0			
425.0	427.5	3.8	3.8	91.73	13.11	2.6	0.54	0.04	0.58	3.1	3.1	0.009	344.4			17.0
427.5	430.0	4.8	4.6	87.60	11.63	2.4	0.50	0.03	0.53		1.2	0.005	240.0			
430.0	432.5	4.4	4.1	90.67	5.57	2.5	0.24	0.01	0.25		0.8	0.004	200.0			
432.5	435.0	4.3	4.5	84.05	11.47	2.7	0.21	0.02	0.23		0.9					
435.0	437.5	2.8	2.4	84.39	6.40		0.37	0.03	0.40		2.9	0.009	322.2			
437.5	440.0	3.9	3.7			2.2	0.56	0.03	0.59		1.9	0.008	237.5			
440.0	442.5	3.9	3.9	63.25	7.33	2.9	0.38	0.03	0.41		1.3	0.003	433.3			
442.5	445.0	3.5	3.5	90.82	6.17	2.3	0.19	0.01	0.20		1.0	0.006	166.7			
445.0	447.5	3.6	3.3	67.94	3.10	2.5	0.14	0.01	0.15		0.7	0.003	233.3			
447.5	450.0	3.8	4.1	63.44	2.55	2.1	0.14	0.01	0.15		0.8	0.004	200.0			
450.0	452.5	4.1	4.1	71.28	5.34	2.3	0.20	0.01	0.21		0.8	0.005	160.0			
452.5	455.0	5.0	4.8	77.30	7.61	2.3	0.42	0.01	0.43		0.8	0.005	160.0			
455.0	457.5	3.6	3.2	84.48	9.40	2.7	0.31	0.01	0.32		0.7	0.003	233.3			
457.5	460.0	5.0	4.6	78.22	6.39	2.2	0.27	0.01	0.28		0.6	0.004	150.0			
460.0	462.5	4.4	4.4	82.72	5.31	2.7	0.19	0.01	0.20		0.6	0.004	150.0			
462.5	465.0	4.0	3.9	78.36	5.52	2.4	0.16	0.01	0.17		0.5	0.003	166.7			
465.0	467.5	3.8	3.7	91.19	18.86	2.4	0.3									

Appendix E.2.4 Results of laboratory tests in cuttings samples from Ue5PW-1 (continued).

		HYDROLOGIC PROPERTIES		MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES									
Interval from	to	Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide	Cl/Br Ratio	Chloride in water (ppm)	Bromide	Soluble Sulfate (ppm)
		DB2	HYD1	No. 4	No. 200		Inorganic	Organic	Total							
545.0	547.5	3.8	4.0	61.41	4.89	3.1	0.35	0.01	0.36			0.7				
547.5	550.0	4.8		88.22	6.31	2.3										
550.0	552.5	5.0	5.2	89.63	8.69	2.4	0.42	0.01	0.43			0.9	0.004	225.0		
552.5	555.0	4.2		83.58	6.44	2.3										
555.0	557.5		3.7	91.19	11.76	2.8	0.29	0.01	0.30			0.7	0.002	350.0		
557.5	560.0	3.7	3.6	91.15	7.31	2.7	0.38	0.01	0.39			0.7	0.003	233.3		
560.0	562.5	4.9	4.2	77.06	5.88	1.9	0.38	0.01	0.39			0.7	0.003	233.3		
562.5	565.0	4.5	4.6	76.76	9.75	2.2	0.54	0.01	0.55			0.8	0.004	200.0		
565.0	567.5	4.1	4.0	87.04	11.51	2.3	0.40	0.01	0.41			1.4	0.004	350.0		
567.5	570.0	3.2	3.7	90.59	16.74	3.2	0.40	0.01	0.41			0.7	0.004	175.0		
570.0	572.5	4.3	4.6	83.50	6.66	2.3	0.42	0.01	0.43			0.8	0.003	266.7		
572.5	575.0	4.2	4.2	84.23	5.86	2.6	0.37	0.01	0.38			0.7				
575.0	577.5	3.7	3.6	89.37	6.47	2.5	0.40	0.01	0.41			1.2	0.002	600.0		
580.0	582.5	1.5	1.2	54.50	1.24	2.4	0.31	0.02	0.33			0.6				
582.5	585.0	3.0	3.1	86.01	7.79	2.0	0.34	0.01	0.35			0.5				
585.0	587.5	3.2	3.6	78.07	7.25	2.1	0.65	0.01	0.66			0.7	0.003	233.3		
587.5	590.0	3.5	3.4	84.77	6.49	2.0	0.39	0.02	0.41			1.4	0.003	466.7		
590.0	592.5	4.5	4.9	69.49	5.22	1.8	0.49	0.01	0.50			1.0	0.004	250.0		
592.5	595.0	3.7	3.9	82.84	7.73	2.3	0.49	0.01	0.50			0.8	0.002	400.0		
595.0	597.5	4.7	4.2	82.46	8.83	2.2	0.57	0.01	0.58			0.7	0.003	233.3		
597.5	600.0	3.0	3.3	80.58	6.02	1.8	0.45	0.01	0.46	1.4		0.5	0.002	250.0		2.3
600.0	602.5	3.5	3.9	81.70	3.44	2.0	0.48	0.01	0.49			0.6	0.002	300.0		
602.5	605.0	3.2	3.2	82.65	4.72	2.0	0.43	0.01	0.44			1.5	0.003	500.0		
605.0	607.5	3.0	2.8	37.26	1.76	1.7	0.43	0.01	0.44			0.6				
607.5	610.0	3.3	3.2	78.31	2.22	2.1	0.29	0.01	0.30			0.6	0.001	600.0		
610.0	612.5	3.2	3.2	80.68	5.00	2.1	0.29	0.01	0.30			0.5	0.002	250.0		
615.0	617.5	3.7	3.8	86.03	6.83	2.2	0.42	0.01	0.43			0.8	0.006	133.3		
617.5	620.0	2.2	2.3	89.10	11.90	2.6	0.48	0.02	0.50			0.8	0.006	133.3		
620.0	622.5	4.1	4.1	78.03	3.16	2.1	0.59	0.01	0.60			0.8	0.005	160.0		
622.5	625.0	4.0	3.9	84.18	4.10	1.7	0.36	0.01	0.37			0.7	0.005	140.0		
625.0	627.5	2.9	3.4	89.20	13.34	2.0	0.52	0.01	0.53			0.7	0.007	100.0		
627.5	630.0	4.4	4.5	76.65	6.01	1.9	0.39	0.01	0.40			1.0				
630.0	632.5	4.5	4.6	83.11	3.95	2.0	0.29	0.01	0.30			0.8	0.006	133.3		
632.5	635.0	5.1	5.0	79.21	9.06	2.0	0.41	0.01	0.42			0.8	0.007	114.3		
635.0	637.5	4.2	4.3	88.05	8.14	2.3	0.38	0.01	0.39			0.6	0.006	100.0		
637.5	640.0	4.6	4.7	88.81	6.35	2.3	0.37	0.02	0.39			2.6	0.012	216.7		
640.0	642.5	4.0	4.8	88.19	4.16	2.3	0.29	0.01	0.30			0.9	0.005	180.0		
642.5	645.0	4.0	4.0	88.58	6.06	2.2	0.37	0.01	0.38			0.8	0.004	200.0		
645.0	647.5	3.3	3.9	93.34	12.47	2.5	0.51	0.01	0.52			0.9	0.005	180.0		
647.5	650.0	3.3	3.6	90.36	5.77	2.8	0.36	0.01	0.37	3.9		0.7	0.006	116.7		2.4
650.0	652.5	3.4	3.6	89.05	3.45	2.3	0.26	0.01	0.27			0.6	0.004	150.0		
652.5	655.0	4.0	4.3	81.98	4.11	2.1	0.24	0.01	0.25			0.6	0.005	120.0		
655.0	657.5	4.0	4.1	78.79	4.06	2.1	0.23	0.01	0.24			0.6	0.005	120.0		
657.5	660.0	2.6	2.8	97.42	14.06	3.6	0.44	0.04	0.48			4.1				
660.0	662.5	3.9	3.5	96.33	6.85	2.6	0.52	0.02	0.54			1.2	0.006	200.0		
662.5	665.0	3.1	3.2	92.47	15.04	2.2	0.56	0.01	0.57			0.8	0.005	160.0		
665.0	667.5	4.1	3.7	77.48	6.81	2.1	0.57	0.01	0.58			0.7	0.006	116.7		
667.5	670.0	2.6	3.2	98.00	10.16	2.3	0.40	0.01	0.41			0.9	0.005	180.0		
670.0	672.5	3.6	4.0	72.92	7.21	2.5	0.42	0.01	0.43			0.7	0.004	175.0		
672.5	675.0	4.4	4.9	76.08	9.11	2.4	0.50	0.01	0.51			0.6	0.006	100.0		
675.0	677.5	4.5	4.4	88.61	8.60	2.4	0.34	0.01	0.35			0.8	0.007	114.3		
677.5	680.0	4.3	4.3	79.10	5.46	2.5	0.36	0.01	0.37			0.7	0.006	116.7		
680.0	682.5	4.1	4.4	85.12	9.31	2.4	0.43	0.01	0.44			1.2	0.008	150.0		
682.5	685.0	4.1	4.0	80.23	7.32	2.3	0.24	0.01	0.25			1.0	0.007	142.9		
685.0	687.5	3.6	3.5	86.94	7.04	2.7	0.38	0.01	0.39			0.6	0.007	85.7		
687.5	690.0	3.7	3.7	88.87	9.61	2.8	0.27	0.01	0.28			0.7	0.005	140.0		
690.0	692.5	3.7	3.6	85.10	7.90	2.6	0.27	0.01	0.28			0.6	0.005	120.0		
692.5	695.0	3.0	2.8	89.54	15.44	2.9	0.43	0.01	0.44			0.6	0.004	150.0		
695.0	697.5	3.7	4.4	74.25	12.11	2.9	0.43	0.01	0.44	3.3		0.6	0.005	120.0		3.1
700.0	702.5	2.6	2.7	91.44	10.68	3.4	0.35	0.02	0.37			1.1	0.004	275.0		
702.5	705.0	3.5	3.2	79.51	5.20	3.3	0.25	0.02	0.27			0.7	0.004	175.0		
705.0	707.5	3.0	2.9	88.39	8.93	2.8	0.33	0.03	0.36			0.5	0.003	166.7		
707.5	710.0	2.8	2.6	81.81	5.39	2.8	0.38	0.03	0.41			0.7	0.005	140.0		
710.0	712.5	3.0	3.2	67.39	3.99	2.4	0.41	0.02	0.43			0.5	0.003	166.7		
712.5	715.0	2.2	2.7	91.90	6.54	3.1	0.30	0.02	0.32			0.4	0.004	100.0		
715.0	717.5	1.8	1.8	97.64	8.94	2.8	0.26	0.03	0.29			0.4	0.003	133.3		
730.0	732.5	2.2	2.1	82.22	7.68	2.4	0.38	0.02	0.40			0.9	0.007	128.6		
732.5	735.0	1.9	1.7	81.79	6.34	2.4	0.36	0.01	0.37			0.6	0.005	120.0		
735.0	737.5	2.9	2.8	65.37	2.72	2.3	0.36	0.02	0.38			0.5	0.004	125.0		
737.5	740.0	3.0	2.9	86.49	6.89	3.4	0.22	0.02	0.24			1.0	0.006	166.7		
740.0	742.5		4.5			2.6	0.42	0.02	0.44			0.7	0.005	140.0		
742.5	745.0	3.0	3.3	93.05	9.25	3.2	0.34	0.02	0.36			0.5	0.004	125.0		
745.0	747.5	3.3	2.9	74.57	5.56	3.0	0.33	0.01	0.34			0.5	0.004	125.0		
747.5	750.0	3.2	3.2	75.83	5.95	3.0	0.29	0.01								

Appendix E.2.4 Results of laboratory tests in cuttings samples from UeSPW-1 (continued).

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES									
Interval from (ft)	to (ft)	Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride	Bromide	Cl/Br Ratio	Chloride	Bromide	Soluble Sulfate (ppm)
		DB2	HYD1	No. 4	No. 200		Inorganic	Organic	Total		in soil (ppm)	in water (ppm)				
807.5	810.0	23.2		85.24	18.26	1.7	0.36	0.01	0.37							
810.0	812.5	11.3	13.5	69.56	5.50	1.0	0.36	0.01	0.37		1.9	0.015	126.7			
812.5	815.0	32.3		95.07	29.39	1.8								14.5	0.11	
815.0	817.5	23.7		80.63	17.78	2.2										
817.5	820.0	24.8		93.22	6.66	2.6								12.2	0.09	
820.0	822.5	23.5		89.25	11.56	2.8										
822.5	825.0	25.3		79.25	6.79	2.8								12.4	0.095	
825.0	827.5	23.4		80.99	7.83	3.4										
827.5	830.0	32.4		88.63	14.43	2.7								14.7	0.115	
830.0	832.5	20.9	19.9	90.70	4.05	2.5	0.21	0.01	0.22		2.1	0.012	175.0			
832.5	835.0	14.3	14.7	79.13	2.40	1.2	0.64	0.02	0.66		1.7	0.013	130.8			
835.0	837.5	15.3	29.6	74.44	2.67	0.9	0.84	0.03	0.87		1.8	0.014	128.6			
837.5	839.0	8.3	8.1	86.20	5.80	1.5	0.45	0.02	0.47		1.4	0.011	127.3			

Appendix E.2.5 Results of laboratory tests in cuttings samples from Ue5PW-2.

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES									
Interval from to (ft)		Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride	Bromide	Cl/Br Ratio	Chloride	Bromide	Soluble Sulfate (ppm)
		DB2	HYD1	No.4	No.200		Inorganic	Organic	Total		in soil (ppm)	in water (ppm)				
2.5	5.0	2.9	2.7	89.46	8.00	1.3	0.78	0.07	0.85	26	204.0	1.10	185.45			400
5.0	7.5	2.4	2.2	61.29	5.10	1.6	1.06	0.07	1.13		182.0	0.98	185.71			200
7.5	10.0	1.6	1.6	87.38	6.49	4.7	0.88	0.05	0.93		144.0	0.81	177.78			79
10.0	12.5	1.5	1.6	93.63	9.09	4.2	1.08	0.08	1.16	17	128.0	0.72	177.78			135
12.5	15.0	1.6	1.6	55.34	2.58	0.6					227.0	1.20	189.17			300
15.0	17.5	1.6	1.5	34.92	0.87	0.7					152.0	0.87	174.71			260
17.5	20.0	1.6	1.7	79.99	4.20	1.4	1.49	0.06	1.55		93.0	0.56	166.07			310
20.0	22.5	2.0	2.1	83.76	7.85	2.7	1.03	0.05	1.08	21	68.0	0.42	161.90			140
22.5	25.0	2.4	2.2	66.10	4.33	2.4	1.53	0.04	1.57		60.0	0.40	150.00			79
25.0	27.5	2.5	2.3	66.85	4.21	1.8	1.18	0.05	1.23		44.0	0.27	162.96			64
27.5	30.0	2.1	1.9	74.83	10.47	2.1	0.91	0.04	0.95		63.0	0.41	153.66			74
30.0	32.5	2.6	2.6	88.56	17.40	1.2	0.79	0.04	0.83		66.0	0.44	150.00			90
32.5	35.0	3.7	3.7	49.01	7.74	1.0	1.05	0.05	1.10		75.0	0.50	150.00			79
35.0	37.5	3.6	3.7	69.16	9.34	0.8	0.55	0.04	0.59		42.0	0.29	144.83			35
37.5	40.0	2.6	2.4	65.41	5.73	1.2	0.78	0.04	0.82		41.0	0.28	146.43			47
40.0	42.5	3.4	3.0	46.59	7.68	1.0	1.03	0.04	1.07	44	26.0	0.18	144.44			27
42.5	45.0	3.6	3.1	64.21	11.85	1.1	0.52	0.03	0.55		14.0	0.12	116.67			15
45.0	47.5	3.5	3.5	46.22	5.26	1.2	0.86	0.04	0.90		17.0	0.12	141.67			22
47.5	50.0	2.2	2.0	71.04	8.56	2.1	1.39	0.05	1.44		57.0	0.32	178.13			82
50.0	52.5	3.6		50.79	5.17	0.9	0.77	0.05	0.82		16.0	0.12	133.33			20
52.5	55.0	3.3	3.0	70.58	11.17	1.2	0.49	0.03	0.52	26	12.0	0.08	150.00			17
55.0	57.5	4.1	4.0	70.15	9.02	1.0	0.55	0.03	0.58		12.0	0.10	120.00			15
57.5	60.0	3.6	3.7	73.64	10.06	1.1	0.98	0.05	1.03		45.0	0.28	160.71			43
60.0	62.5	4.2	4.5	80.06	11.13	1.1	0.63	0.03	0.66	30	12.0	0.10	120.00			16
62.5	65.0	5.5	5.0	78.62	10.25	1.0	1.24	0.05	1.29		7.8	0.08	97.50			13
65.0	67.5	4.3	4.6	78.09	11.54	1.0	0.98	0.07	1.05		4.2	0.04	105.00			11
67.5	70.0	3.6	3.6	71.26	7.60	1.3	0.63	0.04	0.67		19.0	0.12	158.33			37
70.0	72.5	4.2	4.0	64.53	10.40	1.0	0.61	0.04	0.65		22.0	0.14	157.14			37
72.5	75.0	4.6	4.4	79.72	7.34	0.9	0.77	0.04	0.81		6.3	0.06	105.00			13
75.0	77.5	4.2	3.9	66.23	7.85	1.0	0.74	0.04	0.78		6.6	0.06	110.00			12
77.5	80.0	3.6	3.6	88.43	13.34	1.3	0.61	0.02	0.63		32.0	0.17	188.24			42
80.0	82.5	3.6	3.7	89.33	9.90	0.9	0.45	0.01	0.46	25	13.0	0.07	185.71			16
82.5	85.0	9.2	4.8	65.95	5.07	0.8	0.67	0.02	0.69		19.0	0.13	146.15			16
85.0	87.5	5.3	5.1	73.39	9.91	1.0	0.95	0.03	0.98		13.0	0.09	144.44			14
87.5	90.0	2.8	3.0	82.43	12.87	2.1	0.87	0.03	0.90		37.0	0.19	194.74			60
90.0	92.5	3.8	3.9	76.36	16.63	1.4	0.56	0.02	0.58		11.0	0.06	183.33			21
92.5	95.0	4.8	4.9	72.98	10.12	0.9	1.07	0.02	1.09		7.4	0.05	148.00			11
95.0	97.5	4.3	4.3	79.30	10.44	1.2	0.93	0.02	0.95	45	4.1	0.03	136.67			7.3
97.5	100.0	14.4	4.4			0.8	0.82	0.02	0.84		1.4	0.01	100.00			5.0
100.0	102.5	4.6	4.2	65.54	5.02	0.8	0.60	0.01	0.61		1.0	0.01	83.33			3.7
102.5	105.0	5.1	5.2	80.92	8.44	1.0	0.59	0.02	0.61		1.2	0.01	85.71			5.2
105.0	107.5	13.2	5.7	86.83	13.04	0.7	0.81	0.02	0.83	56	1.3	0.02	56.52			5.1
107.5	110.0		5.0	79.90	10.95	1.2	0.63	0.02	0.65		1.3	0.02	86.67			4.2
110.0	112.5	5.0	5.3	50.24	7.77	0.9	0.74	0.02	0.76		1.6	0.02	100.00			8.9
112.5	115.0	5.2	4.7	48.05	5.97	0.8	0.65	0.02	0.67		1.4	0.02	87.50			4.9
115.0	117.5	5.1	4.1	77.01	13.57	0.9	0.57	0.02	0.59	50	1.3	0.02	86.67			4.4
117.5	120.0	5.6	5.3	69.93	8.13	0.8	0.67	0.02	0.69		1.7	0.02	100.00			6.3
120.0	122.5	5.0	4.8	72.60	15.53	0.9	0.86	0.03	0.89		1.1	0.02	73.33			4.6
122.5	125.0	5.1	5.0	66.38	11.58	0.9	0.81	0.02	0.83		1.0	0.02	62.50			4.4
125.0	127.5	4.8	4.7	78.37	15.49	1.0	0.82	0.02	0.84		1.1	0.01	100.00			4.1
127.5	130.0	4.7	4.3	68.38	9.17	0.9	0.69	0.02	0.71	62	0.8	0.01	66.67			4.2
130.0	132.5	4.0	3.7	86.96	19.92	1.4	0.66	0.02	0.68		0.8	0.01	100.00			4.0
132.5	135.0	4.8	4.8	62.46	10.06	0.8	0.80	0.02	0.82		0.9	0.01	69.23			4.8
135.0	137.5	5.8	5.8	79.67	16.15	1.0	0.78	0.02	0.80		1.2	0.01	85.71			4.9
137.5	140.0	6.2	6.0	89.71	16.11	1.1	0.81	0.02	0.83		0.9	0.02	60.00			4.7
140.0	142.5	5.1	5.3	70.42	12.99	0.9	0.84	0.02	0.86		1.3	0.02	86.67			4.3
142.5	145.0	5.8	4.6	65.14	12.28	1.0	0.80	0.01	0.81		0.8	0.01	66.67			3.9
145.0	147.5	5.1	4.5	56.13	11.05	1.0	0.84	0.01	0.85	54	0.6	0.01	60.00			3.5
147.5	150.0	6.8	6.6	86.42	14.17	1.0	0.71	0.01	0.72		1.1	0.02	73.33			9.4
150.0	152.5	5.0	4.9	84.01	19.72	1.1	0.85	0.01	0.86		1.0	0.01	71.43			6.4
152.5	155.0	5.3	5.0	70.08	16.72	0.9	0.80	0.01	0.81		1.1	0.01	84.62			6.1
155.0	157.5	5.0	5.5	80.74	15.48	1.0	0.75	0.01	0.76		0.8	0.01	61.54			4.4
157.5	160.0	6.1	6.4	73.52	11.80	0.9	0.65	0.02	0.67		0.7	0.01	100.00			4.4
160.0	162.5	7.3	7.4	90.76	10.92	0.9	0.59	0.02	0.61	45	0.5	0.01	50.00			3.5
162.5	165.0	5.9	6.2	84.06	17.40	1.0	0.80	0.03	0.83		0.6	0.01	50.00			3.6
165.0	167.5	6.0	6.2	75.02	16.39	0.9	0.71	0.03	0.74		0.6	0.01	85.71			3.7
167.5	170.0	8.1	8.1	86.02	15.95	0.9	0.79	0.03	0.82		1.7	0.01	121.43			7.8
170.0	172.5	4.3	4.6	80.16	13.64	1.8	0.57	0.02	0.59		0.5					3.3
172.5	175.0	4.4	4.5	89.08	19.08	1.6	0.59	0.02	0.61	46	0.5	0.01	83.33			3.2
175.0	177.5	6.4	6.5	72.70	14.98	1.0	0.55	0.02	0.57		0.6	0.01	75.00			3.8
177.5	180.0	7.0	7.1	84.22	12.88	0.9	0.43	0.02	0.45		1.0	0.01	166.67			

Appendix E.2.5 Results of laboratory tests in cuttings samples from Ue5PW-2 (continued).

		HYDROLOGIC PROPERTIES		MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES									
Interval from to (ft)		Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide	Cl/Br Ratio	Chloride in water (ppm)	Bromide	Soluble Sulfate (ppm)
		DB2	HYD1	No. 4	No. 200		Inorganic	Organic	Total							
245.0	247.5	5.8	6.0	84.03	11.19	1.4	0.41	0.02	0.43	43	1.0	0.00	250.00			3.5
247.5	250.0	4.7	4.6	84.98	10.34	1.9	0.44	0.02	0.46		2.2	0.01	366.67			4.1
250.0	252.5	3.7	3.8	83.61	6.32	1.7	0.20	0.01	0.21		0.6	0.00	150.00			2.7
252.5	255.0	5.7	5.7	69.98	9.89	1.1	0.43	0.02	0.45		1.6	0.01	266.67			3.9
255.0	257.5	6.5	7.0	73.93	11.70	0.8	0.46	0.02	0.48		1.5	0.01	136.36			5.0
257.5	260.0	8.5	8.7	87.50	9.14	1.0	0.58	0.03	0.61		1.9	0.01	172.73			9.0
260.0	262.5	9.5	9.5	80.55	8.84	0.8	0.41	0.02	0.43		1.6	0.01	145.45			6.5
262.5	265.0	9.4	9.8	86.77	11.01	0.8	0.55	0.02	0.57		1.7	0.01	170.00			6.3
265.0	267.5	6.3	6.5	82.64	10.36	1.1	0.89	0.03	0.92		4.0	0.02	210.53			6.2
267.5	270.0	5.7	6.2	88.23	10.38	1.3	0.70	0.02	0.72		2.2	0.01	244.44			5.5
270.0	272.5	5.6	5.2	78.17	6.40	1.4	0.43	0.02	0.45		1.9	0.01	271.43			5.3
272.5	275.0	3.8	3.9	90.85	5.96	2.4	0.22	0.01	0.23		0.7	0.01	140.00			3.7
275.0	277.5	3.6	3.7	88.37	10.11	2.5	0.21	0.01	0.22		1.7	0.00	425.00			3.7
277.5	280.0	4.0	4.1	90.29	6.65	2.0	0.20	0.02	0.22		0.9	0.01	180.00			3.7
280.0	282.5	2.8	3.1	93.48	5.08	2.2	0.17	0.01	0.18		0.9	0.00	300.00			2.8
282.5	285.0	3.4	3.2	83.04	6.10	2.3	0.13	0.01	0.14		1.2	0.00	600.00			2.3
285.0	287.5	2.6	2.6	93.65	4.43	1.8	0.12	0.01	0.13		0.4	0.00	133.33			1.8
287.5	290.0	2.2	2.3	99.08	7.40	2.2	0.15	0.01	0.16		1.3	0.00	650.00			2.5
290.0	292.5	2.7	2.5	93.78	4.69	1.8	0.11	0.01	0.12		1.6	0.00	1600.00			2.0
292.5	295.0	4.0	4.0	77.86	14.13	1.6	0.48	0.02	0.50		3.7	0.00	1233.33			2.4
295.0	297.5	5.7	5.6	87.59	21.79	1.2	0.23	0.01	0.24		2.1	0.00	525.00			2.8
297.5	300.0	6.4	6.0	94.41	13.41	1.2	0.29	0.01	0.30		2.0	0.00	666.67			2.7
300.0	302.5	7.3	7.3	88.56	17.38	1.0	0.52	0.02	0.54		1.3	0.01	144.44			3.5
302.5	305.0	6.2	6.4	89.67	16.42	1.1	0.42	0.02	0.44		1.2	0.01	150.00			3.5
305.0	307.5	6.6	6.7	93.42	13.94	1.3	0.34	0.02	0.36		1.3	0.01	185.71			4.4
307.5	310.0	6.8	7.3	79.55	10.48	1.1	0.48	0.02	0.50		1.6	0.01	145.45			6.7
310.0	312.5	5.9	5.9	68.78	10.39	1.3	0.53	0.02	0.55		1.4	0.01	233.33			4.2
312.5	315.0	5.4	5.5	80.81	8.87	1.1	0.52	0.02	0.54		1.1	0.01	183.33			3.6
315.0	317.5	5.1	5.2	64.73	7.57	1.3	0.65	0.03	0.68		1.3	0.01	185.71			4.1
317.5	320.0	4.2	4.6	83.21	6.68	1.7	0.40	0.02	0.42		0.9	0.00	300.00			3.4
320.0	322.5	3.3	3.7	89.99	7.13	1.7	0.20	0.02	0.22		0.8	0.00	266.67			2.5
322.5	325.0	3.7	4.1	84.70	9.35	2.0	0.12	0.01	0.13		0.7	0.00	233.33			2.8
325.0	327.5	3.9	4.2	86.73	7.02	2.0	0.09	0.01	0.10		0.8	0.00	266.67			2.7
327.5	330.0	3.2	3.4	94.25	7.35	1.8	0.20	0.01	0.21		0.9	0.00				3.5
330.0	332.5	2.9	3.3	87.30	7.53	1.9	0.25	0.01	0.26		0.5	0.01	100.00			2.8
332.5	335.0	2.7	3.0	93.31	5.66	1.9	0.22	0.01	0.23		0.5	0.00	166.67			2.9
335.0	337.5	4.3	4.6	92.57	16.80	1.1	0.64	0.02	0.66		0.6	0.01	120.00			2.9
337.5	340.0	4.6	5.0	80.78	7.41	1.2	0.48	0.01	0.49		2.1	0.00	700.00			3.0
340.0	342.5	5.6	5.5	60.78	8.96	1.3	0.46	0.02	0.48		1.5	0.00	375.00			3.0
342.5	345.0	4.5	4.9	86.86	10.17	1.4	0.47	0.01	0.48		1.6	0.00	533.33			3.0
345.0	347.5	5.2	4.9	64.87	6.37	1.4	0.46	0.02	0.48		2.9	0.00	725.00			3.9
347.5	350.0	4.6	4.7	88.73	9.79	1.4	0.33	0.01	0.34		1.4	0.00	466.67			3.5
350.0	352.5	6.2	6.1	83.91	10.40	1.1	0.47	0.02	0.49		2.1	0.00	525.00			2.9
352.5	355.0	6.1	6.0	84.48	11.60	1.2	0.57	0.02	0.59		1.6	0.01	320.00			2.9
355.0	357.5	6.8	7.2	89.79	14.63	1.0	0.65	0.02	0.67		1.7	0.01	212.50			2.9
357.5	360.0	5.3	5.5	86.07	15.10	1.1	0.51	0.01	0.52		1.1	0.01	220.00			4.3
360.0	362.5	6.2	10.7	91.65	11.88	1.0	0.35	0.01	0.36		0.9	0.00	225.00			3.6
362.5	365.0	7.5	7.6	63.52	10.52	0.9	0.58	0.02	0.60		2.3	0.01	191.67			8.1
365.0	367.5	8.3	8.4	74.74	11.02	0.7	0.72	0.02	0.74		2.2	0.01	169.23			7.8
367.5	370.0	6.9	7.3	91.45	14.00	1.0	0.65	0.02	0.67		2.0	0.01	200.00			7.0
370.0	372.5	7.5	6.6	86.52	19.30	1.1	0.57	0.01	0.58		1.9	0.01	271.43			10.9
372.5	375.0	5.0	5.4	95.08	19.20	1.6	0.34	0.01	0.35		0.8	0.00	400.00			3.8
375.0	377.5	5.4	5.5	82.80	14.70	1.7	0.39	0.02	0.41		1.1	0.00	366.67			4.1
377.5	380.0	5.5	5.3	89.62	17.73	1.0	0.48	0.02	0.50	20	1.0	0.00	250.00			3.8
380.0	382.5	5.0	5.1	79.07	15.37	1.0	0.50	0.02	0.52		0.9	0.00	300.00			2.9
382.5	385.0	7.4		81.39	12.55	1.1	0.37	0.01	0.38		1.0	0.00	500.00			2.8
385.0	387.5	7.5	6.0	84.87	13.18	1.1	0.56	0.01	0.57		0.8	0.00	200.00			3.4
387.5	390.0	9.1	8.4	93.37	19.19	1.0	0.55	0.02	0.57		1.0	0.01	166.67			3.7
390.0	392.5	5.8	5.6	94.31	23.01	1.1	0.45	0.01	0.46		0.8	0.00	800.00			2.6
392.5	395.0	5.6	5.4	90.10	22.35	1.0	0.56	0.02	0.58		0.6	0.00	600.00			2.9
395.0	397.5	4.9	4.5	82.55	13.70	1.2	0.39	0.02	0.41		0.5	0.00	500.00			2.1
397.5	400.0	4.8	4.5	87.90	12.50	1.2	0.37	0.02	0.39		0.8	0.00	266.67			3.3
400.0	402.5															
402.5	405.0	6.7	5.1	39.89	11.03	1.1	0.68	0.04	0.72	2.2	4.3	0.01	430.00			15.2
405.0	407.5	9.7	8.8	57.85	10.55	0.9	0.76	0.03	0.79		4.9	0.01	408.33			16.4
407.5	410.0	3.9	4.1	65.87	16.13	1.0	0.66	0.02	0.68		1.8	0.01	360.00			7.5
410.0	412.5	2.3	2.5	89.68	34.78	1.4	0.46	0.02	0.48		1.1					5.4
412.5	415.0	2.1	2.2	85.58	28.91	1.3	0.74	0.02	0.76		1.5	0.00	750.00			7.9
415.0	417.5	4.7	3.6	27.90	5.68	0.4	0.75	0.02	0.77		1.2	0.00	600.00			4.4
417.5	420.0	4.8	4.6	55.76	10.43	0.8	0.70	0.02	0.72		1.5	0.00	500.00			5.2
420.0	422.5	5.4	4.9	31.14	5.26	0.6	0.94	0.02	0.96		1.3	0.00	433.33			4.4
422.5	425.0	4.8	5.2	65.43	10.22	0.8	0.56	0.01	0.57		1.2	0.00	600.00			4.0
425.0	427.5	4.9	5.6	71.35	11.23	0.7	0.73	0.02	0.75		1.3	0.00	433.33			5.0
427.5	430.0	5.2	4.4	51.13	9.28	1.0	0.75	0.02	0.77		1.2	0.00	1200.00			3.7
430.0	432.5	4.6	2.9	72.91	14.48	1.0	0.67	0.02	0.69		1.2	0.00	1200.00			3.6
432.5	435.0	3.9	4.4	75.49	14.70	1.0	0.62	0.01	0.63	1.0	0.00	1000.00			3.3	
435.0	437.5	4.1	4.2	76.81	16.73	0.9	0.45	0.01	0.46							

Appendix E.2.5 Results of laboratory tests in cuttings samples from UeSPW-2 (continued).

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES									
Interval from to (ft)		Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide in soil (ppm)	Cl/Br Ratio	Chloride in water (ppm)	Bromide in water (ppm)	Soluble Sulfate (ppm)
				No.4	No.200		Inorganic	Organic	Total							
		DB2	HYD1													
487.5	490.0	4.4	5.2	72.62	12.62	1.0	0.63	0.01	0.64		1.3	0.01	185.71			4.4
490.0	492.5	4.8	4.2	55.04	9.66	0.7	0.79	0.02	0.81		0.7	0.00	175.00			3.5
492.5	495.0	4.2	4.5	57.96	9.16	0.5	0.63	0.01	0.64		0.9	0.01	180.00			4.0
495.0	497.5	3.4	3.1	68.10	14.33	0.9	0.49	0.01	0.50		0.5	0.00	166.67			2.0
497.5	500.0	1.7	1.5	96.96	19.52		0.34	0.02	0.36		1.4	0.00	350.00			34.0
500.0	502.5	3.1	3.0	67.53	11.97	0.5	0.60	0.02	0.62		0.5	0.00	166.67			5.6
502.5	505.0	3.2	3.1	68.64	14.66	0.7	0.36	0.01	0.37		0.8					3.7
505.0	507.5	3.9	4.3	66.45	11.03	1.0	0.72	0.01	0.73		0.9	0.00	450.00			4.7
507.5	510.0	4.1	3.8	60.78	9.53	0.9	0.60	0.02	0.62		1.2	0.00	400.00			4.0
510.0	512.5	3.9	4.4	57.00	12.95	1.3	0.44	0.01	0.45		0.6	0.00	300.00			2.4
512.5	515.0	4.4	3.4	42.39	8.39	0.6	0.43	0.01	0.44		0.3	0.00	150.00			1.9
515.0	517.5	4.0	3.7	63.91	10.80	0.9	0.65	0.01	0.66		0.4	0.00	100.00			3.5
517.5	520.0	4.3	4.8	73.80	9.01	1.0	0.53	0.02	0.55		0.9					5.1
520.0	522.5	4.3	4.5	74.87	10.83	0.7	0.56	0.01	0.57		0.7	0.00	175.00			4.7
522.5	525.0	3.9	3.6	80.13	13.10	1.1	0.57	0.01	0.58		0.4	0.00	100.00			5.0
525.0	527.5	4.0	4.0	64.49	10.69	0.7	0.56	0.01	0.57		0.4	0.00	133.33			2.7
527.5	530.0	3.8	4.0	74.51	13.31	1.1	0.56	0.01	0.57		0.5	0.00	125.00			2.5
530.0	532.5	3.5	2.9	67.26	12.56	1.0	0.58	0.02	0.60		0.7	0.00	233.33			2.6
532.5	535.0	3.9	3.3	69.50	10.82	1.3	0.44	0.01	0.45		0.4	0.00	133.33			2.2
535.0	537.5	4.1	4.0	71.83	10.38	1.2	0.46	0.02	0.48		0.4	0.00	133.33			2.4
537.5	540.0	2.4	3.2	89.79	17.79	1.0	0.40	0.01	0.41		0.4	0.00	133.33			2.4
540.0	542.5	3.0	3.4	83.09	19.75	1.1	0.52	0.01	0.53		0.5	0.00	250.00			2.5
542.5	545.0	4.0	3.4	60.10	13.24	0.6	0.42	0.01	0.43		0.4	0.00	133.33			2.2
545.0	547.5	3.2	4.0	83.94	16.57	0.9	0.41	0.02	0.43	2.4	0.5	0.00	166.67			3.2
547.5	550.0	3.3	3.9	69.84	11.21	1.2	0.68	0.05	0.73	3.1	93.0	0.50	186.00			310.0
550.0	552.5	4.2	4.0	54.50	10.88	0.8	0.76	0.03	0.79		50.0	0.25	200.00			140.0
552.5	555.0	4.1	4.3	56.35	9.14	0.6	0.80	0.03	0.83		15.0	0.07	214.29			40.0
555.0	557.5	4.0	3.8	51.54	10.27	0.7	0.68	0.02	0.70		16.0	0.08	205.13			52.0
557.5	560.0	3.2	3.2	76.59	11.94	0.9	0.60	0.02	0.62		14.0	0.06	229.51			54.0
560.0	562.5	3.7	3.8	81.74	12.54	0.8	0.64	0.03	0.67		4.5	0.02	236.84			13.0
562.5	565.0	3.7	3.6	78.76	13.48	0.8	0.69	0.02	0.71		14.0	0.07	208.96			51.0
565.0	567.5	3.3	3.3	76.67	15.40	1.0	0.80	0.02	0.82		9.3	0.05	197.87			33.0
567.5	570.0	3.4	3.0	65.61	15.18	1.1	0.64	0.02	0.66		8.2	0.04	205.00			29.0
570.0	572.5	3.8	3.6	62.39	10.81	1.0	0.57	0.01	0.58		1.2	0.01	200.00			6.3
572.5	575.0	3.8	3.1	69.04	12.77	0.7	0.69	0.02	0.71		0.4	0.00	133.33			2.8
575.0	577.5	4.1	3.8	63.97	11.52	0.8	0.59	0.01	0.60		0.8	0.00	266.67			2.8
577.5	580.0	3.5	3.8	82.54	18.23	1.4	0.55	0.02	0.57		0.7	0.00	175.00			2.7
580.0	582.5	3.0	3.0	72.80	15.84	1.2	0.55	0.02	0.57		0.5	0.00	250.00			2.5
582.5	585.0	3.4	3.0	72.02	13.56	1.6	0.50	0.02	0.52		0.5	0.00	250.00			1.9
585.0	587.5	3.2	3.1	86.10	13.17	1.3	0.53	0.02	0.55		0.7	0.00	233.33			2.8
587.5	590.0	2.9	3.0	82.92	18.75	1.2	0.53	0.02	0.55		0.7	0.00	233.33			3.5
590.0	592.5	4.5	4.3	64.70	11.48	0.9	0.65	0.02	0.67		0.7	0.01	140.00			3.5
592.5	595.0	3.1	3.3	86.67	15.59	1.2	0.55	0.02	0.57		0.6	0.01	120.00			3.5
595.0	597.5	8.2	8.1	72.48	8.52	0.6	0.53	0.02	0.55		3.0	0.02	157.89			14.0
597.5	600.0	2.7	2.8	84.70	17.17	1.0	0.47	0.01	0.48		0.7	0.00	175.00			8.4
600.0	602.5	3.1	3.1	71.92	14.42	1.3	0.42	0.01	0.43		0.6					2.5
602.5	605.0	3.7	3.8	56.14	9.08	1.2	0.48	0.01	0.49		1.2					2.8
605.0	607.5	4.1	3.7	57.44	13.03	1.2	0.67	0.01	0.68		1.4					3.0
607.5	610.0	3.4	3.8	78.15	13.76	1.1	0.62	0.01	0.63		1.5					3.1
610.0	612.5	4.1	3.9	59.20	10.40	1.1	0.59	0.01	0.60		0.8					3.4
612.5	615.0	4.0	3.7	62.42	14.35	0.9	0.58	0.01	0.59		1.4					3.5
615.0	617.5	3.3	3.9	78.73	13.12	1.1	0.45	0.01	0.46		0.7					3.0
617.5	620.0	2.7	2.7	75.81	18.11	1.0	0.63	0.01	0.64		1.3					3.9
620.0	622.5	4.7	4.2	56.09	14.01	0.8	0.98	0.02	1.00		1.5					7.5
622.5	625.0	3.1	3.3	71.44	13.95	0.7	0.71	0.01	0.72		0.6	0.00	300.00			2.3
625.0	627.5	3.6	2.8	57.13	10.94	1.2	0.54	0.01	0.55		0.6	0.00	200.00			2.5
627.5	630.0	2.7	3.0	89.38	15.87	1.3	0.56	0.01	0.57		0.7	0.00	175.00			2.8
630.0	632.5	3.6	3.4	67.88	13.69	0.9	0.45	0.01	0.46		0.6	0.00	150.00			2.7
632.5	635.0	3.6	3.1	65.26	14.57	1.0	0.45	0.02	0.47		1.3	0.00	325.00			2.8
635.0	637.5	3.5	3.9	67.00	11.54	1.0	0.71	0.02	0.73		1.7	0.01	340.00			3.5
637.5	640.0	4.7	4.9	77.24	12.14	1.0	0.38	0.01	0.39		1.3	0.01	216.67			4.1
640.0	642.5	4.0	3.9	76.52	15.12	1.0	0.48	0.01	0.49		0.7	0.00	175.00			3.2
642.5	645.0	4.7	4.3	63.97	11.30	0.9	0.66	0.01	0.67		0.6	0.00	200.00			3.0
645.0	647.5	3.5	3.5	79.19	15.62	1.1	0.62	0.01	0.63		0.5	0.00	125.00			3.1
647.5	650.0	2.9	3.1	72.07	14.99	1.6	0.50	0.02	0.52		1.6	0.00	533.33			5.1
650.0	652.5	3.4	3.6	84.71	12.07	1.2	0.62	0.01	0.63		1.8	0.00	450.00			3.2
652.5	655.0	3.3	3.3	86.80	18.78	1.1	0.61	0.01	0.62		2.9	0.02	152.63			6.3
655.0	657.5	2.4	2.5	89.34	14.50	1.6	0.33	0.01	0.34		1.1	0.00	275.00			2.4
657.5	660.0	3.5	3.2	70.60	11.41	1.1	0.37	0.01	0.38		1.3	0.01	260.00			3.4
660.0	662.5	3.4	3.4	79.51	12.07	1.2	0.63	0.01	0.64		1.2	0.01	240.00			2.9
662.5	665.0	2.5	2.5	85.69	20.40	1.3	0.49	0.01	0.50	</						

Appendix E.2.5 Results of laboratory tests in cuttings samples from Ue5PW-2 (continued).

Interval from to (ft)			HYDROLOGIC PROPERTIES		MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES								
			Gravimetric Water Content (percent)	Particle Size Distribution (percent passing sieve)	Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide in soil (ppm)	Cl/Br Ratio	Chloride in water (ppm)	Bromide in water (ppm)	Soluble Sulfate (ppm)	
						Inorganic	Organic	Total								
DB2	HYD1	No. 4	No. 200													
730.0	732.5	4.7	4.5	71.88	12.30	1.4	0.64	0.01	0.65	2.5	1.2	0.01	171.43			9.6
732.5	735.0	4.0	15.6	81.67	15.14	1.7	0.55	0.01	0.56		1.0	0.01	125.00			3.9
735.0	737.5	5.0	5.1	77.51	18.62	1.3	0.50	0.02	0.52		1.2	0.01	200.00			9.6
737.5	740.0	5.9	5.8	89.92	16.66	1.9	0.89	0.02	0.91		1.6	0.01	133.33			16.0
740.0	742.5	4.2	4.2	65.84	13.40	1.5	0.78	0.02	0.80		0.9	0.01	128.57			4.8
742.5	745.0	4.1	4.1	87.25	13.57	1.5	0.75	0.01	0.76		0.8	0.01	133.33			3.8
745.0	747.5	3.5	4.1	89.30	18.75	1.4	0.75	0.01	0.76		0.7	0.01	100.00			4.1
747.5	750.0	2.7	3.3	90.62	14.12	2.3	0.62	0.02	0.64		1.4	0.01	155.56			8.0
750.0	752.5	3.6	3.5	81.92	10.52	2.1	0.55	0.01	0.56		0.9	0.01	128.57			4.9
752.5	755.0	3.3	3.5	85.05	17.60	1.3	0.54	0.01	0.55		0.8	0.01	133.33			3.4
755.0	757.5	4.0	4.5	77.04	13.53	1.2	0.68	0.01	0.69	0.9	0.01	128.57			4.2	
757.5	760.0	3.6	3.4	84.20	17.27	1.4	0.57	0.01	0.58	0.9	0.01	150.00			3.5	
760.0	762.5	3.1	3.0	92.16	19.49	1.0	0.71	0.01	0.72	0.9	0.01	150.00			3.5	
762.5	765.0	3.4	3.9	90.31	18.43	1.0	0.52	0.01	0.53	1.0	0.01	166.67			3.5	
765.0	767.5	3.6	3.6	84.25	18.96	1.4	0.47	0.01	0.48	0.9	0.01	180.00			3.3	
767.5	770.0	3.1	3.4	91.01	21.11	1.3	0.51	0.01	0.52	0.8	0.01	133.33			3.3	
770.0	772.5	4.4	4.7	86.51	19.74	1.2	0.39	0.01	0.40	0.9	0.01	128.57			3.6	
772.5	775.0	4.0	4.0	84.73	20.53	1.2	0.45	0.01	0.46	0.8	0.01	133.33			3.4	
775.0	777.5	4.1	4.3	86.55	18.12	1.3	0.51	0.01	0.52	0.7	0.01	146.67			3.4	
777.5	780.0	3.6	3.5	87.44	16.06	1.4	0.53	0.01	0.54	0.9	0.01	150.00			4.2	
780.0	782.5	3.7	3.9	92.67	20.66	1.5	0.46	0.01	0.47	0.8	0.01	133.33			3.2	
782.5	785.0	3.3	3.2	91.69	17.33		0.46	0.01	0.47	0.8	0.01	160.00			3.0	
785.0	787.5	4.5	4.0	73.99	11.76	1.2	0.50	0.01	0.51	0.8	0.01	133.33			3.3	
787.5	790.0	4.7	5.0	86.92	12.72	1.2	0.62	0.01	0.63	0.9	0.01	128.57			3.9	
790.0	792.5	2.9	2.9	89.32	18.59	1.5	0.54	0.01	0.55	0.7	0.01	140.00			2.8	
792.5	795.0	3.5	3.7	89.59	18.59	1.4	0.41	0.01	0.42	0.8	0.01	160.00			3.0	
795.0	797.5	4.5	3.9	82.26	17.77	1.1	0.52	0.01	0.53	0.7	0.00	175.00			3.0	
797.5	800.0	5.3	5.8	87.47	7.11	1.0	0.44	0.01	0.45	1.7	0.01	154.55			6.3	
800.0	802.5	4.3	4.4	87.67	17.19	1.0	0.58	0.02	0.60	1.4	0.01	280.00			6.6	
802.5	805.0	3.1	3.2	90.37	20.23	1.2	0.51	0.02	0.53	0.9	0.00	225.00			5.9	
805.0	807.5	4.2	4.4	86.92	18.39	1.3	0.47	0.02	0.49	1.0	0.00	250.00			5.6	
807.5	810.0	4.9	5.3	83.25	12.94	1.2	0.46	0.01	0.47	1.1	0.01	220.00			7.9	
810.0	812.5	3.3	3.2	94.80	14.57	1.5	0.34	0.01	0.35	0.8	0.00	266.67			4.7	
812.5	815.0	3.8	3.9	88.99	15.04	1.4	0.36	0.01	0.37	1.0	0.01	200.00			3.0	
815.0	817.5	3.4	3.9	92.19	12.93	1.2	0.34	0.01	0.35	1.1	0.00	275.00			2.8	
817.5	820.0	2.7	2.6	92.69	18.55	2.0	0.44	0.02	0.46	1.1	0.00	275.00			4.5	
820.0	822.5	3.2	3.1	93.81	20.65	1.3	0.52	0.02	0.54	1.6	0.01	320.00			8.1	
822.5	825.0	2.2	2.2	93.89	23.27	1.3	0.28	0.02	0.30	1.3	0.00	325.00			3.4	
825.0	827.5	3.2	3.4	93.04	16.31	1.5	0.34	0.01	0.35	0.9	0.01	180.00			2.8	
827.5	830.0	0.7	0.8	99.79	20.69	4.3	0.30	0.03	0.33	2.0					4.6	
830.0	832.5	3.3	3.5	87.15	19.50	1.3	0.59	0.02	0.61	1.0					4.1	
832.5	835.0	5.2	5.2	80.10	14.04	0.8	0.41	0.01	0.42	1.0	0.01	200.00			3.9	
835.0	837.5	3.7	3.9	88.07	15.22	1.5	0.32	0.01	0.33	1.1	0.00	275.00			3.5	
837.5	840.0															
840.0	842.5															
842.5	845.0															
845.0	847.5															
847.5	850.0	5.7	9.7	71.79	8.37	1.7	0.54	0.02	0.56	1.5	0.02	78.95			6.1	
850.0	852.5	4.5	4.9	83.06	12.01	2.0	0.53	0.02	0.55	2.5					7.6	
852.5	855.0	5.1	5.3	83.27	12.32	1.4	0.45	0.02	0.47	2.8	0.02	133.33			7.8	
855.0	857.5	7.0	7.2	84.27	11.82	1.4	0.46	0.02	0.48	3.8	0.03	146.15			15.0	
857.5	860.0	6.2	6.5	81.57	18.58	2.0	0.43	0.02	0.45	2.3					8.4	
860.0	862.5	4.7	4.3	90.40	16.30	1.8	0.35	0.01	0.36	1.8					5.8	
862.5	865.0	3.7	4.2	87.67	18.86	3.6	0.36	0.02	0.38	1.7					5.2	
865.0	867.5	3.8	4.0	83.06	11.95	2.3	0.43	0.02	0.45	2.6	1.8				4.4	
867.5	870.0	27.3		84.21	2.73	2.7	0.37	0.01	0.38				14	0.1		
870.0	872.5	6.9	6.7	86.26	11.95	1.1	0.42	0.01	0.43	2.6					7.3	
872.5	875.0	5.3	5.4	83.92	13.39	1.4	0.72	0.03	0.75	2.2					5.6	
875.0	877.5	4.2	4.3	84.00	11.57	2.2	0.56	0.02	0.58	1.6	0.01	266.67			5.5	
877.5	880.0	16.8	17.8	91.25	9.13	1.1	0.54	0.03	0.57	3.7					16.0	
880.0	882.5	10.5	9.6	87.19	9.75	2.0	0.47	0.02	0.49	4.0	0.03	142.86			13.0	
882.5	885.0	6.4	5.6	87.82	7.92	1.6	0.36	0.01	0.37	3.4	0.01	283.33			8.7	
885.0	887.5	3.7	4.1	91.61	14.28	1.4	0.39	0.01	0.40	1.4					5.0	
887.5	890.0	16.2	16.4	84.18	9.75	1.3	0.51	0.02	0.53	2.2					7.8	
890.0	892.5	25.5	20.2	78.76	4.25	1.6	0.52	0.01	0.53	2.0	0.02	133.33			8.4	
892.5	895.0	18.3		78.07	10.21	1.1	0.58	0.01	0.59				16	0.1		
895.0	897.5	18.2	22.0	72.15	3.27	1.1	0.75	0.02	0.77	2.4	0.02	126.32			12.0	
897.5	900.0	23.7		69.80	4.54	1.1	0.50	0.01	0.51				13	0.09		
900.0	902.5	11.7	11.4	71.20	3.07	0.5	0.48	0.01	0.49	2.3	0.02	153.33			8.5	
902.5	905.0	7.4	7.8	90.09	8.59	1.2	0.45	0.01	0.46	2.6	0.01	216.67			6.8	
905.0	907.5	5.8	5.7	93.17	8.79	1.7	0.43	0.02	0.45	2.0	0.01	222.22			5.1	
907.5	911.0	23.3		58.31	8.64	1.1	0.52	0.02	0.54				14	0.09		
911.0	912.5					3.4										
912.5	915.0					1.5										
915.0	917.5					1.7										
917.5	919.5					1.9										

Appendix E.2.6 Results of laboratory tests in cuttings samples from Ue5PW-3.

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES							
Interval from to (ft)	Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)	Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide Cl/Br Ratio	Soluble Sulfate (ppm)			
	DB2	HYD1			No.4	No.200	Inorganic					Organic	Total	
0.0	2.5	2.6	2.5	66.44	5.47	1.2	0.29	0.09	0.38	8.9	4.6	0.07	65.71	12
2.5	5.0	3.0	2.9	83.20	10.91	1.2	0.37	0.07	0.44		31	0.27	114.81	150
5.0	7.5	3.1	3.2	83.10	10.65	1.3	0.84	0.10	0.94		160	1.21	132.23	770
7.5	10.0	2.1	2.1	26.05	2.82	1.2	0.63	0.05	0.68		160	1.08	148.15	300
10.0	12.5	2.8	2.7	52.63	7.30	1.1	0.84	0.06	0.90	240	1.65	145.45	330	
12.5	15.0	2.6	2.5	64.95	12.77	1.0	0.91	0.07	0.98	170	1.19	142.86	200	
15.0	17.5	2.6	2.7	49.66	7.08	1.0	1.00	0.06	1.06	160	1.11	144.14	150	
17.5	20.0	2.5	2.4	28.97	3.11	1.0	1.10	0.07	1.17	140	0.97	144.33	150	
20.0	22.5	2.7	2.4	47.62	10.06	1.1	0.96	0.05	1.01	120	0.81	148.15	120	
22.5	25.0	2.5	2.5	75.18	11.61	0.8	0.77	0.04	0.81	87	0.58	150.00	120	
25.0	27.5	2.0	2.2	40.27	5.03	1.4	0.56	0.03	0.59	75	0.46	163.04	120	
27.5	30.0	1.9	1.9			1.1	0.82	0.05	0.87	85	0.54	157.41	160	
30.0	32.5	3.4	3.4	65.52	10.82	0.8	0.91	0.05	0.96	100	0.62	161.29	200	
32.5	35.0	3.0	3.0	70.80	11.49	1.1	0.92	0.05	0.97	4.8	86	0.50	172.00	190
35.0	37.5	2.5	2.4	53.73	5.73	1.2	0.92	0.04	0.96		60	0.34	176.47	140
37.5	40.0	3.0	3.0	74.41	12.49	0.8	0.88	0.05	0.93	100	0.58	172.41	220	
40.0	42.5	2.6	2.6	91.30	12.57	1.3	0.60	0.03	0.63	4.5	78	0.45	173.33	170
42.5	45.0	2.5	2.5	60.26	8.56	1.3	0.86	0.05	0.91		70	0.36	194.44	200
45.0	47.5	2.6	2.5	70.23	12.80	1.0	0.69	0.03	0.72	59	0.29	203.45	180	
47.5	50.0	2.6	2.5	80.34	12.41	1.1	0.85	0.04	0.89	66	0.31	212.90	210	
50.0	52.5	2.6	2.6	51.20	6.99	0.9	0.77	0.04	0.81	63	0.31	203.23	190	
52.5	55.0	2.7	2.7	81.00	7.56	1.0	0.79	0.03	0.82	66	0.34	194.12	160	
55.0	57.5	2.9	2.7	92.81	18.08	1.1	0.77	0.03	0.80	4.8	63	0.31	203.23	190
57.5	60.0	2.5	2.7	67.88	7.94	1.0	0.74	0.03	0.77		47	0.22	213.64	120
60.0	62.5	2.4	2.4	76.76	13.64	1.0	0.82	0.03	0.85	54	0.25	216.00	140	
62.5	65.0	2.9	2.7	50.80	7.81	0.7	0.96	0.04	1.00	70	0.35	200.00	150	
65.0	67.5	2.8	2.9	46.62	7.18	0.9	0.91	0.04	0.95	3.8	58	0.27	214.81	150
67.5	70.0	2.3	2.5	72.85	8.41	1.1	0.83	0.04	0.87		60	0.33	181.82	130
70.0	72.5	2.3	2.3	60.73	10.59	1.1	0.89	0.04	0.93	42	0.20	210.00	130	
72.5	75.0	2.6	2.7	57.11	13.86	0.9	0.75	0.04	0.79	49	0.25	196.00	140	
75.0	77.5	3.2	3.2	47.00	7.94	1.1	0.81	0.03	0.84	56	0.29	193.10	150	
77.5	80.0	2.7	3.0	62.38	9.92	0.9	0.94	0.04	0.98	62	0.33	187.88	170	
80.0	82.5	3.6	3.7	69.79	13.41	1.0	0.82	0.03	0.85	69	0.37	186.49	180	
82.5	85.0	3.4	3.3	81.53	17.42	0.9	0.88	0.04	0.92	5.2	56	0.30	186.67	170
85.0	87.5	3.4	3.5	60.41	8.55	0.6	0.88	0.03	0.91		49	0.25	196.00	160
87.5	90.0	3.1	5.5	68.21	11.38	0.9	0.83	0.03	0.86	57	0.30	190.00	180	
90.0	92.5	3.4	3.5	50.07	9.55	1.1	0.82	0.03	0.85	66	0.36	183.33	190	
92.5	95.0	3.8	3.9	79.74	15.10	1.2	0.67	0.02	0.69	5.5	44	0.23	191.30	160
95.0	97.5	3.7	3.5	72.26	15.45	1.3	0.61	0.02	0.63		41	0.22	186.36	160
97.5	100.0	2.1	2.1	85.82	15.04	1.3	0.79	0.03	0.82	49	0.29	168.97	150	
100.0	102.5	3.5	3.4	70.92	18.29	1.3	0.71	0.03	0.74	58	0.34	170.59	190	
102.5	105.0	4.7	4.8	68.90	14.59	1.0	1.00	0.03	1.03	56	0.32	175.00	240	
105.0	107.5	4.6	4.6	76.35	17.39	1.1	0.89	0.02	0.91	43	0.22	195.45	220	
107.5	110.0	3.7	3.9	63.76	11.09	1.5	0.75	0.02	0.77	6.9	40	0.22	181.82	180
110.0	112.5	3.2	3.7	76.18	8.60	1.8	0.59	0.02	0.61		33	0.18	183.33	150
112.5	115.0	3.4	3.1	68.41	4.32	2.8	0.22	0.01	0.23	20	0.10	200.00	110	
115.0	117.5	3.7	3.8	68.91	6.77	2.0	0.18	0.01	0.19	39	0.19	205.26	200	
117.5	120.0	3.6	3.6	71.12	7.79	1.6	0.21	0.01	0.22	34	0.17	200.00	180	
120.0	122.5	4.0	3.9	77.75	12.23	1.1	0.83	0.02	0.85	49	0.24	204.17	240	
122.5	125.0	4.5	4.5	68.82	15.21	1.1	0.77	0.02	0.79	7.1	48	0.23	208.70	220
125.0	127.5	4.0	4.1	67.43	10.69	0.9	0.76	0.02	0.78		53	0.27	196.30	240
127.5	130.0	3.8	3.5	85.91	7.84	1.2	0.58	0.02	0.60	43	0.22	195.45	190	
130.0	132.5	4.2	4.0	77.21	4.31	1.4	0.27	0.01	0.28	9.2	33	0.16	206.25	150
132.5	135.0	4.4	4.3	57.45	4.13	0.9	0.82	0.02	0.84		46	0.24	191.67	210
135.0	137.5	4.6	4.4	57.95	7.38	1.5	0.95	0.03	0.98	52	0.26	200.00	220	
137.5	140.0	4.6	4.4	75.77	8.79	1.6	0.78	0.03	0.81	40	0.20	200.00	180	
140.0	142.5	3.9	4.0	59.71	3.38	1.9	0.38	0.01	0.39	35	0.18	194.44	160	

Appendix E.2.6 Results of laboratory tests in cuttings samples from Ue5PW-3 (continued).

		HYDROLOGIC PROPERTIES		MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES							
Interval from to (ft)		Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Suscepti- bility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide Cl/Br Ratio	Soluble Sulfate (ppm)	
		DB2	HYD1	No.4	No.200		Inorganic	Organic	Total					
142.5	145.0	4.1	3.9	70.37	6.25	2.1	0.28	0.01	0.29		32	0.16	200.00	150
145.0	147.5	4.5	4.1	66.84	6.02	2.0	0.38	0.01	0.39		39	0.20	195.00	170
147.5	150.0	4.0	3.9	77.08	7.38	2.1	0.41	0.01	0.42		36	0.17	211.76	150
150.0	152.5	5.3	4.9	63.83	8.46	1.5	0.52	0.02	0.54	7.3	52	0.27	192.59	210
152.5	155.0	5.0	4.8	69.00	7.41	1.4	0.54	0.02	0.56		46	0.23	200.00	190
155.0	157.5	4.4	4.7	41.20	4.57	1.5	0.71	0.02	0.73		45	0.23	195.65	200
157.5	160.0	4.3	4.3	77.73	7.51	1.6	0.42	0.01	0.43	6.6	43	0.22	195.45	170
160.0	162.5	5.2	5.2	64.03	6.41	1.5	0.63	0.02	0.65		46	0.21	219.05	200
162.5	165.0	4.7	4.9	75.86	8.33	1.7	0.45	0.01	0.46		46	0.21	219.05	180
165.0	167.5	5.6	5.6	80.20	9.84	1.8	0.49	0.01	0.50		46	0.21	219.05	180
167.5	170.0	4.3	4.4	81.06	7.45	2.5	0.29	0.01	0.30	4.8	34	0.15	226.67	140
170.0	172.5	3.1	3.1	92.68	5.51	2.4	0.17	0.01	0.18		24	0.13	184.62	96
172.5	175.0	3.1	3.3	83.70	4.71	2.4	0.14	0.01	0.15		25	0.13	192.31	92
175.0	177.5	4.7	4.5	64.65	7.25	1.4	0.95	0.03	0.98		54	0.25	216.00	200
177.5	180.0	4.4	4.6	64.18	7.83	1.9	1.10	0.03	1.13	8.3	45	0.22	204.55	170
180.0	182.5	4.1	4.0	69.15	6.92	2.8	0.76	0.03	0.79		37	0.18	205.56	140
182.5	185.0	3.4	3.4	70.68	6.17	3.3	0.41	0.01	0.42		28	0.14	200.00	110
185.0	187.5	3.2	2.8	77.42	8.34	3.2	0.17	0.01	0.18		22	0.11	200.00	85
187.5	190.0	2.4	2.5	85.02	5.68	3.3	0.11	0.01	0.12		18	0.08	225.00	72
190.0	192.5	3.2	3.0	59.89	4.66	1.8	0.18	0.01	0.19		25	0.12	208.33	96
192.5	195.0	3.3	3.0	59.37	5.42	3.9	0.13	0.01	0.14		27	0.13	207.69	99
195.0	197.5	3.3	3.0	74.04	6.42	3.2	0.14	0.01	0.15		31	0.14	221.43	110
197.5	200.0	2.2	2.0	91.30	9.05	2.8	0.17	0.02	0.19	9.2	32	0.16	200.00	110
200.0	202.5	2.9	2.9	63.66	6.06	1.8	0.16	0.01	0.17		33	0.14	235.71	110
202.5	205.0	2.9	2.7	73.75	7.06	1.9	0.18	0.02	0.20		27	0.12	225.00	89
205.0	207.5	2.8	2.6	73.16	6.64	2.1	0.21	0.01	0.22		28	0.12	233.33	91
207.5	210.0	3.4	3.2	70.67	9.10	2.0	0.26	0.01	0.27		39	0.17	229.41	120
210.0	212.5	3.6	3.6	63.22	4.97	2.2	0.25	0.01	0.26		42	0.19	221.05	120
212.5	215.0	4.4	4.3	63.08	7.37	1.9	0.31	0.01	0.32		54	0.23	234.78	150
215.0	217.5	5.3	5.1	76.42	10.32	1.8	0.37	0.02	0.39		64	0.29	220.69	170
217.5	220.0	5.1	4.9	89.85	12.51	1.8	0.50	0.02	0.52		62	0.27	229.63	160
220.0	222.5	6.2	6.3	64.32	5.94	1.5	0.52	0.02	0.54		74	0.32	231.25	190
222.5	225.0	4.0	4.0	84.87	7.76	2.2	0.36	0.01	0.37		46	0.21	219.05	120
225.0	227.5	3.7	3.7	65.58	6.73	2.7	0.30	0.02	0.32		40	0.18	222.22	100
227.5	230.0	3.1	3.1	76.50	5.87	2.7	0.19	0.01	0.20		30	0.13	230.77	74
230.0	232.5	2.7	2.8	82.44	7.57	2.9	0.10	0.01	0.11		28	0.13	215.38	63
232.5	235.0	3.8	3.8	60.90	6.71	2.2	0.32	0.01	0.33		52	0.21	247.62	93
235.0	237.5	3.4	3.4	69.29	7.81	2.5	0.19	0.01	0.20		43	0.21	204.76	74
237.5	240.0	2.7	2.9	87.47	9.27	2.5	0.19	0.01	0.20		35	0.16	218.75	60
240.0	242.5	3.9	3.8	61.79	8.37	2.0	0.50	0.01	0.51		55	0.24	229.17	79
242.5	245.0	4.8	4.6	73.90	9.09	1.8	0.65	0.01	0.66		80	0.35	228.57	100
245.0	247.5	5.7	5.3	78.31	8.95	1.4	0.57	0.01	0.58		79	0.36	219.44	92
247.5	250.0	3.7	3.7	82.59	8.91	2.3	0.28	0.01	0.29		44	0.19	231.58	54
250.0	252.5	3.8	3.7	95.40	10.32	2.2	0.17	0.01	0.18		43	0.19	226.32	44
252.5	255.0	4.9	4.9	80.41	7.31	1.9	0.43	0.01	0.44		65	0.28	232.14	56
255.0	257.5	4.2	4.5	84.51	6.87	2.1	0.36	0.01	0.37		60	0.27	222.22	51
257.5	260.0	2.8	3.1	91.53	8.34	2.1	0.33	0.01	0.34		48	0.20	240.00	40
260.0	262.5	3.0	2.8	76.33	6.59	2.3	0.29	0.01	0.30		41	0.18	227.78	32
262.5	265.0	3.5	3.8	77.44	6.18	1.8	0.30	0.01	0.31		71	0.31	229.03	36
265.0	267.5	4.1	3.9	78.69	7.08	1.8	0.28	0.01	0.29		61	0.26	234.62	31
267.5	270.0	3.7	3.7	85.72	6.69	1.8	0.32	0.01	0.33		66	0.28	235.71	27
270.0	272.5	6.1	6.1	89.25	10.82	1.5	0.89	0.02	0.91		120	0.53	226.42	41
272.5	275.0	5.5	5.8	88.61	9.87	1.8	0.86	0.01	0.87		85	0.39	217.95	31
275.0	277.5	4.3	4.3	82.58	8.37	2.4	0.60	0.01	0.61		74	0.31	238.71	29
277.5	280.0	3.5	3.4	84.05	5.94	2.7	0.33	0.01	0.34		48	0.21	228.57	21
280.0	282.5	2.5	2.5	82.96	6.39	3.0	0.14	0.01	0.15		33	0.17	194.12	9.3
282.5	285.0	2.7	2.6	84.30	8.08	2.4	0.11	0.01	0.12		37	0.16	231.25	9.2

Appendix E.2.6 Results of laboratory tests in cuttings samples from Ue5PW-3 (continued).

		HYDROLOGIC PROPERTIES		MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES						
Interval from (ft)	to (ft)	Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide (ppm)	Soluble Sulfate (ppm)
		DB2	HYD1	No.4	No.200		Inorganic	Organic	Total				
285.0	287.5	3.3	3.0	62.96	5.83	2.3	0.20	0.01	0.21		42	0.17	247.06
287.5	290.0	2.9	3.1	82.99	6.26	2.5	0.26	0.01	0.27		49	0.21	233.33
290.0	292.5	3.7	3.6	79.18	9.14	2.1	0.40	0.01	0.41		71	0.29	244.83
292.5	295.0	3.5	3.6	86.10	6.61	2.3	0.22	0.01	0.23		66	0.28	235.71
295.0	297.5	5.3	5.3	85.03	11.46	1.7	0.70	0.01	0.71	2.9	110	0.46	239.13
297.5	300.0	4.4	4.4	81.83	8.81	2.2	0.50	0.01	0.51		87	0.38	228.95
300.0	302.5	2.5	3.2	85.04	7.27	3.4	0.27	0.01	0.28		44	0.16	275.00
302.5	305.0	2.4	2.5	89.91	6.40	2.9	0.19	0.01	0.20		32	0.14	228.57
305.0	307.5	2.8	3.0	71.10	5.28	2.6	0.13	0.01	0.14		40	0.17	235.29
307.5	310.0	2.2	2.1	94.07	5.88	2.2	0.12	0.01	0.13	3.7	36	0.14	257.14
310.0	312.5	2.1	2.0	83.28	4.52	3.0	0.14	0.01	0.15		39	0.16	243.75
312.5	315.0	3.2	3.3	50.03	3.80	1.3	0.33	0.01	0.34		67	0.25	268.00
315.0	317.5	3.5	3.5	61.99	6.86	1.2	0.56	0.02	0.58		62	0.28	221.43
317.5	320.0	3.6	3.7	81.71	6.67	1.5	0.46	0.01	0.47		64	0.27	237.04
320.0	322.5	4.4	4.4	76.35	7.72	1.2	0.47	0.01	0.48		86	0.34	252.94
322.5	325.0	5.1	5.1	80.69	9.44	1.1	0.66	0.02	0.68		110	0.47	234.04
325.0	327.5	5.0	7.2	64.00	7.63	1.4	0.65	0.01	0.66		83	0.36	230.56
327.5	330.0	3.4	3.2	87.29	5.95	1.8	0.41	0.01	0.42		44	0.18	244.44
330.0	332.5	3.0	2.9	66.89	2.34	1.3	0.41	0.01	0.42		42	0.15	280.00
332.5	335.0	3.1	3.1	64.10	4.45	1.3	0.92	0.02	0.94		44	0.20	220.00
335.0	337.5	3.5	3.5	64.84	8.43	1.0	0.95	0.02	0.97		66	0.29	227.59
337.5	340.0	4.8	5.1	76.07	8.97	1.3	0.75	0.02	0.77		70	0.33	212.12
340.0	342.5	3.8	3.7	87.88	8.83	1.5	0.51	0.01	0.52		48	0.25	192.00
342.5	345.0	4.5	4.0	67.14	6.38	1.3	0.66	0.01	0.67		53	0.27	196.30
345.0	347.5	5.1	5.0	83.41	8.41	1.4	0.56	0.01	0.57		60	0.29	206.90
347.5	350.0	4.5	4.3	95.06	14.51	1.4	0.65	0.02	0.67		60	0.29	206.90
350.0	352.5	4.2	4.1	78.56	8.96	1.4	0.46	0.01	0.47		48	0.25	192.00
352.5	355.0	5.0	4.8	72.87	7.73	1.4	0.55	0.01	0.56		57	0.29	196.55
355.0	357.5	5.2	5.0	75.13	8.12	1.5	0.47	0.01	0.48		54	0.27	200.00
357.5	360.0	4.4	4.0	70.95	5.45	1.9	0.40	0.01	0.41		43	0.21	204.76
360.0	362.5	2.8	2.7	70.64	5.98	2.4	0.26	0.01	0.27		23	0.13	176.92
362.5	365.0	2.8	2.6	86.79	8.01	2.2	0.27	0.01	0.28		21	0.11	190.91
365.0	367.5	2.9	2.8	77.03	3.90	1.7	0.23	0.01	0.24		18	0.091	197.80
367.5	370.0	3.4	3.1	80.55	9.25	1.4	0.68	0.01	0.69		27	0.15	180.00
370.0	372.5	4.0	4.1	67.05	9.02	1.1	0.80	0.02	0.82		30	0.15	200.00
372.5	375.0	3.7	3.6	84.27	10.86	1.1	0.76	0.01	0.77		25	0.13	192.31
375.0	377.5	3.9	3.8	84.75	10.29	1.2	0.77	0.01	0.78		26	0.14	185.71
377.5	380.0	3.7	3.7	73.35	8.77	1.2	0.91	0.02	0.93		21	0.10	210.00
380.0	382.5	4.5	4.5	75.05	9.45	1.1	0.86	0.01	0.87		23	0.12	191.67
382.5	385.0	4.0	3.9	77.82	12.57	1.4	0.92	0.01	0.93		20	0.10	200.00
385.0	387.5	4.0	4.0	81.79	9.82	1.5	0.87	0.01	0.88		16	0.092	173.91
387.5	390.0	2.9	2.8	87.75	16.50	1.8	0.76	0.01	0.77	5.5	12	0.061	196.72
390.0	392.5	3.7	3.8	88.41	12.87	1.5	0.81	0.01	0.82		13	0.069	188.41
392.5	395.0	3.8	3.6	61.36	9.03	0.8	0.86	0.01	0.87		14	0.075	186.67
395.0	397.5	4.2	4.1	75.45	10.32	1.2	0.91	0.01	0.92		15	0.089	168.54
397.5	400.0	2.7	2.6	86.37	12.36	1.6	0.95	0.02	0.97		11	0.064	171.88
400.0	402.5	2.9	2.9	86.09	12.84	1.5	0.98	0.01	0.99		9.8	0.061	160.66
402.5	405.0	3.4	3.0	58.49	8.68	1.5	1.10	0.02	1.12		8.2	0.052	157.69
405.0	407.5	3.6	3.4	59.59	8.09	1.3	0.94	0.02	0.96		9.5	0.055	172.73
407.5	410.0	3.8	3.5	90.44	13.65	1.4	0.74	0.01	0.75	3.6	9.4	0.058	162.07
410.0	412.5	4.0	3.7	86.96	11.33	1.3	0.79	0.01	0.80		8.4	0.046	182.61
412.5	415.0	4.1	3.4	71.43	11.04	1.5	0.76	0.01	0.77		7.4	0.049	151.02
415.0	417.5	4.2	4.1	72.66	9.98	1.7	0.88	0.01	0.89		7.3	0.048	152.08
417.5	420.0	4.6	4.6	86.96	11.02	1.1	0.89	0.01	0.90		7.4	0.047	157.45
420.0	422.5	2.9	2.8	76.09	9.36	1.4	0.93	0.02	0.95		3.7	0.024	154.17
422.5	425.0	3.5	3.4	83.35	11.70	1.3	0.83	0.01	0.84		4.2	0.029	144.83
425.0	427.5	3.6	3.5	87.63	12.56	1.6	1.10	0.02	1.12		4.8	0.026	184.62

Appendix E.2.6 Results of laboratory tests in cuttings samples from Ue5PW-3 (continued).

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES							
Interval from to (ft)	Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide (ppm)	Cl/Br Ratio	Soluble Sulfate (ppm)	
	DB2	HYD1	No.4	No.200		Inorganic	Organic	Total						
427.5	430.0	3.5	3.6	87.59	11.15	1.4	0.86	0.01	0.87		4.6	0.027	170.37	3.1
430.0	432.5	2.9	2.9	73.15	8.47	1.7	0.93	0.02	0.95		3.8	0.029	131.03	2.9
432.5	435.0	3.3	3.2	76.67	10.86	1.4	0.94	0.01	0.95		2.9	0.021	138.10	2.4
435.0	437.5	3.4		74.27	9.29	1.1	0.97	0.02	0.99		3.1	0.020	155.00	2.6
437.5	440.0	3.8	3.6	89.33	9.89	1.4	0.97	0.01	0.98		3.0	0.028	107.14	2.6
440.0	442.5	3.2	3.1	81.45	8.84	1.6	0.91	0.01	0.92		2.2	0.02	110.00	2.2
442.5	445.0	2.7	2.6	65.07	8.58	1.3	1.00	0.02	1.02		1.4	0.02	70.00	2.3
445.0	447.5	2.8	2.8	69.33	8.24	1.2	0.89	0.01	0.90		1.7	0.02	85.00	2.3
447.5	450.0	3.4	3.2	87.79	13.13	1.5	0.88	0.01	0.89		1.9	0.02	95.00	2.7
450.0	452.5													
452.5	455.0	2.0	1.9	96.16	22.32	1.9	0.85	0.04	0.89		9.0	0.042	214.29	9.2
455.0	457.5	2.0	2.0	95.20	15.18	2.4	1.00	0.02	1.02		3.4	0.02	170.00	5.6
457.5	460.0	2.6	2.6	89.03	11.70	1.5	0.89	0.02	0.91		3.2	0.02	160.00	3.6
460.0	462.5	3.3		65.22	6.06	0.8	1.20	0.02	1.22		1.7	0.02	85.00	2.7
462.5	465.0	2.5		74.00	9.01	1.3	0.86	0.02	0.88	6.7	1.1	0.02	55.00	2.7
465.0	467.5	3.2	3.1	67.16	8.02	1.5	1.00	0.03	1.03		1.8	0.02	90.00	3.4
467.5	470.0	2.7	2.7	80.14	10.73	1.6	1.10	0.02	1.12		1.7	0.02	85.00	2.8
470.0	472.5	2.7	2.6	77.71	8.89	1.4	1.10	0.02	1.12		1.0	0.02	50.00	2.5
472.5	475.0	2.6	2.6	81.59	10.56	1.3	1.10	0.02	1.12		0.7	0.02	35.00	2.8
475.0	477.5	2.7	2.8	84.31	12.49	1.5	1.10	0.02	1.12		0.7	0.02	35.00	2.6
477.5	480.0	2.2	2.1	92.95	16.32	1.9	1.00	0.02	1.02		0.8	0.02	40.00	2.5
480.0	482.5	3.3	3.2	75.63	13.10	1.6	1.20	0.02	1.22		2.1	0.02	105.00	2.8
482.5	485.0	3.6	3.7	83.05	11.66	1.5	1.20	0.02	1.22		1.0	0.02	50.00	2.9
485.0	487.5	3.3	3.3	85.83	14.04	1.1	1.10	0.02	1.12		0.6	0.02	30.00	3.0
487.5	490.0	3.9	3.6	68.02	11.66	1.4	1.10	0.02	1.12		0.9	0.02	45.00	2.8
490.0	492.5	3.4	3.4	82.38	13.92	1.5	1.10	0.01	1.11		0.7	0.02	35.00	2.7
492.5	495.0	4.0	3.9	89.07	14.33	1.4	1.00	0.02	1.02		0.8	0.02	40.00	2.9
495.0	497.5	2.9	3.2	83.41	16.50	1.5	1.10	0.02	1.12		0.6	0.02	30.00	2.8
497.5	500.0	3.2	3.1	80.09	11.76	1.7	1.10	0.04	1.14		3.1	0.02	155.00	3.7
500.0	502.5	3.9	4.0	79.11	8.02	1.9	1.30	0.03	1.33		1.9	0.02	95.00	2.8
502.5	505.0	4.3	4.2	66.96	9.33	1.0	1.10	0.02	1.12		2.0	0.02	100.00	2.9
505.0	507.5	3.0	2.9	80.61	13.65	1.6	1.20	0.02	1.22		0.8	0.02	40.00	2.6
507.5	510.0	2.5	2.4	86.49	17.81	1.7	1.00	0.03	1.03		0.9	0.02	45.00	2.9
510.0	512.5	3.8	3.7	66.42	8.57	1.4	1.40	0.02	1.42		2.0	0.02	100.00	2.7
512.5	515.0	3.5	3.5	85.13	14.78	1.7	1.30	0.02	1.32		0.7	0.02	35.00	2.8
515.0	517.5	3.4	3.2	75.30	8.49	1.5	1.30	0.02	1.32		1.0	0.02	50.00	2.5
517.5	520.0	3.2	3.2	88.49	10.10	1.4	1.40	0.02	1.42		0.7	0.02	35.00	2.7
520.0	522.5	3.2	3.3	77.95	11.52	1.5	1.30	0.02	1.32		0.7	0.02	35.00	2.5
522.5	525.0	3.9	4.0	79.91	10.34	1.3	1.10	0.02	1.12		0.5	0.02	25.00	2.7
525.0	527.5	3.6	3.5	83.32	12.69	1.5	1.10	0.02	1.12		0.6	0.02	30.00	2.6
527.5	530.0	3.1	3.0	94.88	17.28	1.9	1.00	0.02	1.02		0.6	0.02	30.00	2.7
530.0	532.5	3.6	3.6	91.65	13.41	1.2	1.30	0.02	1.32		0.6	0.02	30.00	2.9
532.5	535.0	3.3	3.3	85.81	11.70	1.6	1.10	0.02	1.12		0.5	0.02	25.00	3.1
535.0	537.5	2.6	2.6	88.44	15.78	1.8	1.20	0.02	1.22		0.5	0.02	25.00	3.1
537.5	540.0	3.7	3.5	94.08	14.37	1.6	1.00	0.03	1.03		0.6	0.02	30.00	2.7
540.0	542.5	2.4	2.5	94.58	18.32	1.8	0.92	0.02	0.94		0.6	0.02	30.00	2.7
542.5	545.0	2.9	2.8	78.92	11.25	1.6	0.97	0.02	0.99		0.5	0.02	25.00	2.4
545.0	547.5	2.6	2.7	77.66	12.77	1.6	0.80	0.02	0.82		0.5	0.02	25.00	2.2
547.5	550.0	1.7	1.8	87.34	12.57	2.1	0.85	0.02	0.87		1.6	0.02	80.00	3.5
550.0	552.5	2.7	2.7	90.13	13.57	1.5	1.10	0.02	1.12		0.6	0.02	30.00	2.8
552.5	555.0	2.5	2.5	92.19	17.03	1.6	1.30	0.02	1.32		0.4	0.02	20.00	2.8
555.0	557.5	2.3	2.3	91.76	16.27	1.5	1.40	0.03	1.43		0.8	0.02	40.00	3.5
557.5	560.0	3.5	3.6	83.15	10.67	1.4	0.99	0.02	1.01		1.2	0.02	60.00	2.7
560.0	562.5	3.3	3.3	85.83	12.53	1.4	1.10	0.02	1.12		1.4	0.02	70.00	2.8
562.5	565.0	2.6	2.4	86.23	19.75	1.6	0.92	0.02	0.94	5.2	1.2	0.02	60.00	2.7
565.0	567.5	3.2	2.9	76.83	13.08	1.4	0.95	0.02	0.97		2.0	0.02	100.00	3.0
567.5	570.0	2.9	2.9	95.18	14.43	2.1	1.00	0.02	1.02		1.1	0.02	55.00	2.4

Appendix E.2.6 Results of laboratory tests in cuttings samples from Ue5PW-3 (continued).

		HYDROLOGIC PROPERTIES		MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES							
Interval from to (ft)		Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Suscepti- bility	Carbon (percent)			Soluble Carbon (ppm)	Chloride	Bromide	Soluble Cl/Br Sulfate Ratio (ppm)	
		DB2	HYD1	No.4	No.200		Inorganic	Organic	Total		in soil (ppm)			
570.0	572.5	3.0	2.9	76.21	10.93	1.6	1.10	0.02	1.12		1.2	0.02	60.00	2.8
572.5	575.0	2.6	2.5	77.73	13.91	1.9	0.74	0.02	0.76		1.1	0.02	55.00	2.3
575.0	577.5	2.5	2.4	87.09	13.12	1.7	0.75	0.01	0.76		1.0	0.02	50.00	2.3
577.5	580.0	2.3	2.4	84.02	13.59	1.6	1.20	0.02	1.22		1.2	0.02	60.00	2.5
580.0	582.5	3.0	2.8	80.30	8.71	1.1	1.20	0.02	1.22		1.3	0.02	65.00	2.6
582.5	585.0		3.0			1.0	0.67	0.02	0.69		1.0	0.02	50.00	2.5
585.0	587.5	2.5	2.7	90.21	17.65	1.8	0.90	0.02	0.92		1.0	0.02	50.00	2.5
587.5	590.0	3.2	3.0	79.15	16.15	1.3	1.00	0.02	1.02		1.1	0.02	55.00	3.4
590.0	592.5	3.3	3.3	81.96	15.92	1.4	1.40	0.03	1.43		1.4	0.02	70.00	2.9
592.5	595.0	2.1	2.2	91.26	15.67	2.0	0.71	0.02	0.73		0.8	0.02	40.00	2.6
595.0	597.5	2.6	2.6	74.76	12.86	2.3	0.50	0.01	0.51		0.8	0.02	40.00	2.0
597.5	600.0	2.5	2.9	89.13	13.98	1.7	0.57	0.02	0.59		1.2	0.02	60.00	3.1
600.0	602.5	2.5	2.4	77.56	13.28	2.5	0.56	0.02	0.58		0.9	0.02	45.00	1.9
602.5	605.0	3.0	3.1	83.29	18.40	2.9	0.62	0.01	0.63		1.2	0.02	60.00	2.2
605.0	607.5	3.3	3.3	87.34	16.70	2.5	0.61	0.01	0.62		0.8	0.02	40.00	2.2
607.5	610.0	3.0	2.9	90.37	13.96	2.1	0.82	0.02	0.84		0.9	0.02	45.00	2.5
610.0	612.5	2.3	2.4	90.12	17.06	2.2	0.53	0.01	0.54		0.9	0.004	225.00	3.9
612.5	615.0	4.2	3.7	87.34	18.62	2.3	0.61	0.01	0.62		0.9	0.007	128.57	2.9
615.0	617.5	2.8	3.1	87.41	18.20	2.4	0.64	0.01	0.65		0.4	0.003	133.33	1.8

Appendix E.2.7 Moisture retention data in core samples from Ue5PW-1.

Sample Depth (ft)	Volumetric Water Content (percent)	Water Potential (bars)	Sample Depth (ft)	Volumetric Water Content (percent)	Water Potential (bars)
48	7.7	18.448	179	7.1	14.389
	11.0	3.182		8.5	4.344
	14.8	0.433		11.9	0.515
	20.8	0.102		16.1	0.102
	30.2	0.051		19.2	0.051
	33.6	0.020		22.1	0.020
	36.3	0.000		27.5	0.000
59	7.0	25.505	199	7.5	16.521
	10.7	3.600		9.2	4.212
	15.6	0.433		11.5	0.433
	22.7	0.102		13.5	0.102
	31.0	0.051		15.7	0.051
	33.8	0.020		19.2	0.020
	37.1	0.000		30.7	0.000
78	7.0	19.080	219	6.7	28.361
	10.3	2.488		10.0	2.651
	13.6	0.433		13.2	0.433
	17.7	0.102		16.9	0.102
	26.5	0.051		19.6	0.051
	33.4	0.020		21.4	0.020
	37.2	0.000		29.6	0.000
129	9.5	17.857	259	7.6	15.654
	12.6	2.998		9.6	3.325
	18.3	0.433		13.0	0.433
	22.9	0.102		18.3	0.102
	27.7	0.051		23.5	0.051
	30.2	0.020		25.9	0.020
	36.6	0.000		34.1	0.000
139	10.8	15.266	300	8.6	24.322
	14.3	3.049		12.1	2.825
	19.1	0.433		15.9	0.515
	24.2	0.102		21.9	0.102
	28.0	0.051		25.4	0.051
	30.6	0.020		29.8	0.020
	38.9	0.000		36.6	0.000
159	7.5	18.683	320	5.6	21.069
	10.0	4.120		6.6	5.905
	13.3	0.515		9.0	0.433
	19.3	0.102		11.3	0.102
	24.0	0.051		14.2	0.051
	27.3	0.020		18.0	0.020
	30.8	0.000		30.0	0.000

Appendix E.2.7 Moisture retention data in core samples from Ue5PW-1
(Continued)

Sample Depth (ft)	Volumetric Water Content (percent)	Water Potential (bars)	Sample Depth (ft)	Volumetric Water Content (percent)	Water Potential (bars)
360	10.5	16.041	619	8.1	13.441
	12.2	5.690		10.7	2.804
	16.3	0.515		13.8	0.515
	22.9	0.102		20.0	0.102
	26.9	0.051		25.8	0.051
	27.5	0.020		32.4	0.020
	30.4	0.000		35.3	0.000
400	7.1	24.496	660	7.1	15.736
	9.1	4.926		10.0	2.784
	12.0	0.433		13.0	0.515
	15.5	0.102		18.8	0.102
	20.6	0.051		24.5	0.051
	28.1	0.020		29.9	0.020
	34.4	0.000		32.4	0.000
460	8.9	21.783	700	6.0	23.425
	13.2	3.427		7.7	5.069
	17.4	0.433		10.8	0.515
	25.3	0.102		19.0	0.102
	31.3	0.051		26.0	0.051
	32.8	0.020		30.6	0.020
	34.4	0.000		32.5	0.000
499	12.1	21.783	740	5.7	16.194
	15.6	2.794		7.3	4.457
	19.7	0.515		9.8	0.515
	26.5	0.102		14.1	0.102
	31.0	0.051		19.3	0.051
	35.6	0.020		27.7	0.020
	37.1	0.000		32.3	0.000
541	9.1	13.778	760	6.1	22.701
	11.4	3.977		8.3	3.610
	16.2	0.515		11.5	0.515
	26.3	0.102		15.5	0.102
	34.1	0.051		20.3	0.051
	37.4	0.020		29.3	0.020
	39.2	0.000		32.1	0.000
581	7.0	16.867	798	7.0	13.767
	8.8	2.519		8.5	3.681
	12.1	0.515		14.0	0.433
	18.0	0.102		16.7	0.102
	22.8	0.051		19.5	0.051
	27.6	0.020		23.0	0.020
	28.9	0.000		29.5	0.000

Appendix E.2.8 Moisture retention data in core samples from Ue5PW-2.

Sample Depth (ft)	Volumetric Water Content (percent)	Water Potential (bars)	Sample Depth (ft)	Volumetric Water Content (percent)	Water Potential (bars)
0.5	11.0	18.866	69	9.0	14.553
	11.8	2.713		11.5	4.038
	16.2	0.583		15.4	0.583
	23.2	0.102		21.1	0.102
	28.3	0.061		25.8	0.061
	31.1	0.032		28.6	0.032
	33.2	0.000		30.3	0.000
3	10.5	13.961	100	9.0	20.896
	14.3	2.978		11.5	2.845
	19.0	0.583		15.0	0.583
	25.5	0.102		18.4	0.102
	28.7	0.061		21.6	0.061
	29.8	0.032		26.3	0.032
	31.7	0.000		31.1	0.000
30	9.0	19.478	119	13.0	15.511
	12.2	4.049		13.6	3.681
	17.5	0.583		18.3	0.583
	26.6	0.102		26.2	0.102
	29.9	0.061		32.0	0.061
	31.0	0.032		33.0	0.032
	34.7	0.000		34.4	0.000
31	12.2	21.538	129	10.0	16.103
	15.1	3.569		12.4	2.631
	17.0	0.583		16.2	0.583
	22.8	0.102		22.3	0.102
	25.4	0.061		26.6	0.061
	26.3	0.032		28.0	0.032
	29.8	0.000		29.8	0.000
40	9.5	14.838	200	14.0	15.338
	12.6	3.121		14.3	3.008
	18.1	0.583		20.7	0.583
	27.4	0.102		29.2	0.102
	30.3	0.061		34.6	0.061
	31.6	0.032		35.8	0.032
	34.0	0.000		37.5	0.000
41	8.0	20.886	250	9.0	22.711
	10.9	3.059		9.8	3.579
	14.9	0.583		12.7	0.583
	20.9	0.102		16.7	0.102
	24.4	0.061		20.7	0.061
	26.7	0.032		29.7	0.032
	29.4	0.000		37.8	0.000

Appendix E.2.8 Moisture retention data in core samples from Ue5PW-2
(Continued)

Sample Depth (ft)	Volumetric Water Content (percent)	Water Potential (bars)
311	16.0	14.063
	16.0	3.008
	21.3	0.500
	26.8	0.102
	28.3	0.056
	29.1	0.031
	31.0	0.000
499	11.0	14.940
	11.0	2.947
	16.1	0.510
	23.2	0.135
	34.3	0.071
	37.6	0.038
	39.8	0.000
719	14.0	14.430
	14.0	5.293
	17.8	0.505
	21.5	0.102
	24.1	0.051
	27.9	0.000
817	21.0	15.287
	21.0	4.395
	21.1	0.505
	24.6	0.102
	27.4	0.051
	30.8	0.000

Appendix E.2.9 Moisture retention data in core samples from Ue5PW-3.

Sample Depth (ft)	Volumetric Water Content (percent)	Water Potential (bars)	Sample Depth (ft)	Volumetric Water Content (percent)	Water Potential (bars)
1	5.7	14.777	130	7.4	16.786
	8.0	3.916		9.6	4.161
	15.3	0.505		14.1	0.505
	25.7	0.102		17.7	0.102
	27.9	0.051		21.2	0.051
	29.3	0.027		27.8	0.027
	31.4	0.000		32.2	0.000
3	5.5	15.246	200	7.3	14.410
	8.3	2.988		9.1	2.906
	14.8	0.505		11.3	0.510
	24.2	0.102		13.8	0.099
	27.1	0.051		15.1	0.057
	28.8	0.027		16.4	0.020
	30.5	0.000		27.8	0.000
51	7.2	15.042	500	7.1	11.942
	9.3	4.691		9.4	3.110
	15.2	0.505		14.3	0.505
	23.0	0.102		18.5	0.133
	24.4	0.051		24.1	0.046
	25.3	0.027		30.0	0.000
	26.9	0.000	550	6.8	14.899
52	8.1	12.462		8.9	3.896
	9.7	3.427		13.5	0.505
	16.4	0.515		17.6	0.133
	25.1	0.102		23.5	0.046
	26.9	0.051		28.1	0.000
	28.1	0.031			
	30.1	0.000			
101	12.1	15.093			
	15.8	2.651			
	20.6	0.505			
	30.0	0.102			
	31.9	0.051			
	33.8	0.027			
	35.9	0.000			

Appendix E.2.10 Parameters required to calculate unsaturated hydraulic conductivity.

Borehole	Sample Depth (ft)	Saturated Hydraulic Conductivity (cm/sec)	Residual Volumetric Water Content (percent)	α	n
Ue5PW-1	48	1.1E-03	8.6	0.0211	1.73
	59	6.2E-04	6.7	0.0237	1.53
	78	2.3E-03	8.3	0.0305	1.77
	129	2.2E-03	2.0	0.0939	1.21
	139	4.4E-04	0.0	0.1657	1.16
	159	7.7E-04	6.3	0.0376	1.42
	179	2.9E-03	3.9	0.1038	1.28
	199	4.3E-03	6.6	0.3740	1.33
	219	4.1E-04	0.0	0.3093	1.16
	259	4.4E-03	4.8	0.0899	1.33
	300	5.4E-04	4.7	0.0957	1.27
	320	5.0E-03	5.2	0.2168	1.43
	360	9.8E-05	9.1	0.0197	1.44
	400	1.5E-03	7.8	0.0494	1.68
	460	6.5E-04	8.8	0.0146	1.55
	499	3.3E-03	10.8	0.0246	1.43
	541	5.5E-04	9.2	0.0160	1.71
	581	4.9E-04	6.8	0.0241	1.61
	619	1.0E-03	8.4	0.0295	1.63
	660	5.8E-03	7.3	0.0280	1.58
	700	2.4E-03	6.4	0.0213	1.77
	740	3.0E-03	6.5	0.0382	1.82
	760	2.9E-03	7.3	0.0344	1.78
	789	5.6E-05	0.0	0.1834	1.19
Ue5PW-2	1	5.2E-04	5.4	0.0185	1.40
	3	3.0E-05	3.6	0.0180	1.25
	30	5.3E-05	4.8	0.0209	1.33
	31	8.5E-05	10.5	0.0320	1.34
	40	1.1E-04	7.4	0.0204	1.40
	41	1.4E-04	3.8	0.0226	1.32
	69	1.7E-04	6.1	0.0191	1.39
	100	5.3E-04	4.9	0.0603	1.29
	119	1.1E-04	8.8	0.0116	1.50
	129	1.0E-04	3.8	0.0187	1.31
	200	1.3E-04	6.8	0.0140	1.39
	250	4.0E-03	9.0	0.0344	1.97
	311	2.1E-05	1.1	0.0134	1.21
	499	7.5E-04	7.1	0.0141	1.73
	719	1.2E-04	0.0	0.0249	1.20
	817	2.3E-03	0.0	0.0199	1.20
Ue5PW-3	1	7.2E-04	3.1	0.0103	1.47
	3	3.2E-04	3.2	0.0107	1.48
	51	3.2E-04	4.1	0.0115	1.38
	52	5.6E-05	4.9	0.0114	1.43
	101	6.0E-05	8.6	0.0153	1.37
	130	4.4E-04	7.2	0.0450	1.48
	200	3.2E-03	1.6	2.3097	1.14
	500	2.4E-03	3.0	0.0383	1.30
	550	1.1E-03	4.7	0.0274	1.38

Appendix E.3.1 Results of laboratory tests on core samples from the tuff from Ue5PW-3.

Interval from to (ft)	Saturated Hydraulic Conductivity (cm/sec)	Air Permeability		Water Content (percent)		Water Potential (bars)	Dry Bulk		Grain Density (g/cm)	Porosity (percent)	Relative Saturation (percent)	Apparent Magnetic Suscepti- bility
		Horizontal (cm/sec)	Vertical (cm/sec)	DBI	DRI		Gravimetric DBI	Density (g/cm)				
618.25 618.50												2.8
638.25 638.50												0.1
638.50 638.75												0.3
638.75 639.00												0.1
639.00 639.25												0.5
688.50 688.75					1.6		-16.3					
688.75 689.00	6.0E-07	2.5E-05		7.5		15.1		2.00	2.58	22.2	73.5	
689.00 689.25	2.7E-05	2.0E-05		7.6	0.8	15.1	-23.2	2.00	2.57	23.1	70.0	
689.25 689.50	1.5E-05	3.8E-05		7.6		14.9		1.98	2.57	21.9	74.9	

Appendix E.3.2 Results of laboratory test on cuttings samples from the tuff from Ue5PW-3.

HYDROLOGIC PROPERTIES					MATERIAL PROPERTIES	ENVIRONMENTAL TRACER PROPERTIES							
Interval from to (ft)	Gravimetric Water Content (percent)		Water Potential (bars)	Apparent Magnetic Susceptibility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide Cl/Br Ratio	Soluble Sulfate (ppm)		
	DB2	HYD1			Inorganic	Organic	Total						
617.5	620.0	1.9		3.6	0.93	0.02	0.95	7.4	2.7	0.011	245.5	4.3	
620.0	622.5	1.6	2.1	-51.7	1.7	1.09	0.02	1.11	0.8	0.007	114.3	3.8	
622.5	625.0	1.8		1.6	0.63	0.01	0.64		0.5	0.005	100.0	3.2	
625.0	627.5	2.3		1.6	0.61	0.01	0.62		0.5	0.004	125.0	2.2	
627.5	630.0	0.7		1.9	0.22	0.01	0.23		2.1	0.009	233.3	3.5	
630.0	632.5	1.2		1.6	0.60	0.01	0.61		1.2	0.005	240.0	3.0	
632.5	635.0	0.8		1.8	0.46	0.01	0.47		1.4	0.007	200.0	3.4	
635.0	637.5	2.0	2.0	-60.2	1.9	0.44	0.01	0.45	0.8	0.005	160.0	2.5	
637.5	640.0	1.9		2.2	0.92	0.02	0.94		0.8	0.007	114.3	3.6	
640.0	642.5	1.7	1.6	-190.7	1.9	0.72	0.01	0.73	0.9	0.006	150.0	3.8	
642.5	645.0	1.5		2.0	0.56	0.01	0.57		0.6	0.004	150.0	2.9	
645.0	647.5	2.3		1.5	1.19	0.01	1.20		0.7	0.006	116.7	3.9	
647.5	650.0	0.7		1.9	0.44	0.01	0.45		1.6	0.007	228.6	3.4	
650.0	652.5	1.3	1.2	-293.4	1.6	0.48	0.01	0.49	0.7	0.004	175.0	3.0	
652.5	655.0	1.2		1.6	0.60	0.01	0.61		0.8	0.006	133.3	4.5	
655.0	657.5	0.3		1.2	0.50	0.01	0.51		0.9	0.005	180.0	3.7	
657.5	660.0	0.4		1.2	0.39	0.02	0.41		0.7	0.006	116.7	2.6	
660.0	662.5	1.0	1.1	-381.9	1.2	0.60	0.01	0.61	0.7	0.005	140.0	2.8	
662.5	665.0	1.7		3.4	0.59	0.02	0.61		1.4			4.1	
665.0	667.5	1.3		1.9	0.66	0.01	0.67		1.2			3.2	
667.5	670.0	1.9		0.9	0.67	0.01	0.68		0.4	0.003	133.3	1.9	
670.0	672.5	1.6		1.7	0.64	0.01	0.65		0.5	0.003	166.7	2.4	
672.5	675.0	2.1		1.0	0.69	0.01	0.70		0.5	0.002	250.0	2.0	
675.0	677.5	1.3		1.1	0.64	0.01	0.65		0.4	0.002	200.0	2.0	
677.5	680.0	1.2		1.7	0.58	0.01	0.59		0.8	0.005	160.0	2.4	
680.0	682.5	0.9	1.2	-75.1	1.0	0.19	0.01	0.20	0.6	0.003	200.0	1.7	
682.5	685.0	0.5		1.2	0.04	0.01	0.05		0.5	0.003	166.7	1.2	
685.0	687.5	0.6		1.2		0.01			0.4	0.002	200.0	1.2	
687.5	690.0			1.2									
690.0	692.5	0.4		1.3	0.01	0.01	0.02		0.3	0.003	100.0	1.2	
692.5	695.0	0.9		0.5		0.00			0.3	0.001	300.0	0.7	
695.0	697.5	1.0		0.8	0.01	0.00	0.01		0.4	0.002	200.0	0.7	
697.5	700.0	0.9		1.2	0.06	0.01	0.07		0.5	0.005	100.0	1.4	
700.0	702.5	0.5	0.6	-89.5	1.2	0.10	0.01	0.11	0.8	0.005	160.0	1.4	
702.5	705.0	0.9		1.7	0.02	0.00	0.02		0.9	0.006	150.0	1.0	
705.0	707.5	1.0		4.0	0.04	0.00	0.04		0.9	0.004	225.0	1.0	
707.5	710.0	1.1		2.8	0.04	0.01	0.05		1.1	0.005	220.0	1.1	
710.0	712.5	1.7		1.4	0.03	0.00	0.03		0.6	0.003	200.0	1.0	
712.5	715.0	1.3		1.9	0.02	0.01	0.03		0.8	0.004	200.0	1.0	
715.0	717.5	2.0		1.2	0.08	0.01	0.09		0.7	0.004	175.0	1.1	
717.5	720.0	1.9		1.5	0.03	0.01	0.04		0.8	0.004	200.0	1.1	
720.0	722.5	1.9	3.0	-27.3	1.4	0.09	0.01	0.10	0.8	0.004	200.0	1.6	
722.5	725.0	3.0		1.4	0.36	0.01	0.37		0.9	0.005	180.0	3.6	
725.0	727.5	1.9		1.4	0.55	0.01	0.56		0.9	0.004	225.0	2.9	
727.5	730.0	3.1		1.3	0.57	0.01	0.58		1.0	0.007	142.9	3.3	
730.0	732.5	3.6		0.9	0.32	0.01	0.33		0.8	0.004	200.0	3.1	
732.5	735.0	3.5		1.2	0.99	0.01	1.00		0.8	0.006	133.3	3.3	
735.0	737.5	2.6		1.1	0.74	0.01	0.75		0.7	0.004	175.0	3.0	
737.5	740.0	1.8		1.5	0.55	0.01	0.56		1.1	0.006	183.3	2.8	
740.0	742.5	1.8	1.3	-52.4	1.1	0.67	0.01	0.68		0.7	0.004	175.0	2.8
742.5	745.0	0.8		1.1	0.28	0.01	0.29	2.8	0.7	0.004	175.0	2.6	
745.0	747.5	0.8		1.1	0.10	0.01	0.11		0.5	0.003	166.7	2.2	
747.5	750.0	0.7		1.1	0.05	0.01	0.06		0.7	0.004	175.0	2.4	
750.0	752.5	0.5		2.6	0.01	0.01	0.02		1.6	0.008	200.0	3.0	
752.5	755.0	0.5		3.5	0.01	0.01	0.02		1.9	0.006	316.7	2.2	
755.0	757.5	0.5		2.3	0.01	0.01	0.02		1.4	0.005	280.0	1.6	
757.5	760.0	0.4		2.0	0.01	0.01	0.02		1.8	0.007	257.1	1.8	

Appendix E.3.2 Results of laboratory test on cuttings samples from the tuff from Ue5PW-3 (continued).

HYDROLOGIC PROPERTIES			MATERIAL PROPERTIES	ENVIRONMENTAL TRACER PROPERTIES							
Gravimetric			Apparent Magnetic Suscepti- bility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide Cl/Br Ratio	Soluble Sulfate (ppm)	
Interval from (ft)	to (ft)	Water Content (percent) DB2 HYD1 Potential (bars)		Inorganic	Organic	Total					
760.0	762.5	0.3	1.4	0.01	0.01	0.02		1.7	0.007	242.9	1.4
762.5	765.0	0.3	1.3					1.7	0.006	283.3	1.1
765.0	767.5	0.3	1.2					1.9	0.007	271.4	1.4
767.5	770.0	0.6	1.3	0.01	0.01	0.02		1.5	0.007	214.3	1.0
770.0	772.5		1.2		0.04			5.5	0.028	196.4	7.5
772.5	775.0		1.2		0.01			3.5	0.015	233.3	2.9
775.0	777.5		1.5		0.01			3.8			2.8
777.5	780.0		1.4		0.01			3.1	0.013	238.5	3.3
780.0	782.5		1.4		0.01			4.1	0.017	241.2	3.3
782.5	785.0		1.5		0.02			6.3	0.021	300.0	3.2
785.0	787.5		1.4		0.01			5.1	0.020	255.0	2.7
787.5	790.0		1.3		0.01			3.8	0.015	253.3	2.4
790.0	792.5		1.4		0.01			3.3	0.016	206.2	2.6
792.5	795.0		1.5		0.01			3.3	0.017	194.1	2.6
795.0	797.5		1.6		0.01			3.5	0.016	218.8	2.5
797.5	800.0		1.4		0.01			3.5	0.013	269.2	1.4
800.0	802.5		1.5		0.01			3.2	0.013	246.2	1.2
802.5	805.0		2.4		0.02			4.6	0.015	306.7	2.9
805.0	807.5		1.5		0.01			3.6	0.011	327.3	1.3
807.5	810.0		1.4		0.01			3.1	0.011	281.8	1.1
810.0	812.5		1.5		0.01			3.3	0.013	253.8	1.2
812.5	815.0		2.1		0.01			2.6	0.010	260.0	1.7
815.0	817.5		1.4	0.01	0.00	0.01		1.6	0.011	145.5	1.0
817.5	820.0		1.8		0.00			2.3	0.010	230.0	1.0
820.0	822.5		1.8		0.01			2.1	0.009	233.3	0.9
822.5	825.0		2.2		0.03		20.6	2.0			3.1
825.0	827.5		2.2		0.02			2.1			2.3
827.5	830.0		2.4	0.01	0.01	0.02		2.7	0.012	225.0	1.3
830.0	832.5		2.4		0.01			2.8	0.013	215.4	1.1
832.5	835.0		2.7		0.01			2.2	0.009	244.4	0.9
835.0	837.5		2.7		0.01			2.2	0.008	275.0	1.0
837.5	840.0		2.6		0.01			0.9	0.007	128.6	0.7
840.0	842.5	1.0	3.5		0.01			1.0	0.008	125.0	0.8
842.5	845.0		3.3		0.01			1.7	0.007	242.9	0.8
845.0	847.5		3.3		0.01			1.7	0.009	188.9	1.0
847.5	850.0		3.2		0.01			1.0	0.007	142.9	0.7
850.0	852.5		2.6		0.01			1.2	0.007	171.4	0.7
852.5	855.0		2.9		0.01			2.3	0.009	255.6	0.9
855.0	857.5		2.3		0.01			2.0	0.008	250.0	0.8
857.5	860.0		2.5		0.01			1.1	0.007	157.1	0.8
860.0	862.5	8.1	2.7	0.01	0.00	0.01		1.6	0.008	200.0	0.8
862.5	865.0		3.2	0.03	0.01	0.04		2.0	0.006	333.3	1.1
865.0	867.5		2.5		0.02			3.0	0.008	375.0	1.6
867.5	870.0		2.7		0.01			3.5	0.009	388.9	1.1
870.0	872.5		2.8		0.01			2.7	0.008	337.5	1.1
872.5	875.0	5.1	2.9	0.03	0.01	0.04		2.3	0.007	328.6	1.1
875.0	877.5		3.2	0.08	0.01	0.09		2.5	0.006	416.7	1.2
877.5	880.0	1.0	4.4		0.01			2.5	0.008	312.5	1.1
880.0	882.5		4.1		0.01			3.2	0.008	400.0	1.1
882.5	885.0	1.3	4.1		0.01			2.7	0.007	385.7	1.1
885.0	887.5		3.9		0.01			2.3	0.007	328.6	1.1
887.5	890.0	1.8	3.0		0.01			1.8	0.005	360.0	1.1
890.0	892.5		4.1		0.01			1.6	0.006	266.7	1.1
892.5	895.0	1.6	3.6		0.01			2.1	0.005	420.0	1.1
895.0	897.5		3.5		0.01			3.7	0.010	370.0	1.5
897.5	900.0	1.5	3.3		0.01			3.3	0.009	366.7	1.1
900.0	902.5		3.6		0.01			3.9	0.011	354.5	1.4

Appendix E.3.2 Results of laboratory test on cuttings samples from the tuff from Ue5PW-3 (continued).

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES	ENVIRONMENTAL TRACER PROPERTIES							
Interval from to (ft)	Gravimetric Water Content (percent)		Water Potential (bars)	Apparent Magnetic Suscepti-bility	Carbon (percent)			Soluble Carbon (ppm)	Chloride in soil (ppm)	Bromide Cl/Br Ratio	Soluble Sulfate (ppm)	
	DB2	HYD1			Inorganic	Organic	Total					
902.5	905.0			2.7		0.01			3.4	0.009	377.8	1.3
905.0	907.5			1.8		0.01			5.2	0.017	305.9	3.2
907.5	910.0			1.7		0.01			2.9	0.010	290.0	1.4
910.0	912.5			1.8		0.01			2.7	0.009	300.0	1.2
912.5	915.0			1.8		0.01			2.3	0.007	328.6	1.2
915.0	917.5			1.8		0.01			1.8	0.007	257.1	1.4
917.5	920.0			1.2		0.01			0.9	0.005	180.0	1.8
920.0	922.5	11.7	-16.3	0.9		0.01			1.1	0.010	110.0	3.6
922.5	925.0			1.0		0.01			1.7	0.010	170.0	4.2
925.0	927.5	18.1	-2.7	0.7		0.01			3.0	0.024	125.0	10.7
927.5	930.0			1.3		0.01			2.2	0.018	122.2	7.5
930.0	932.5			1.9		0.01			1.5	0.012	125.0	4.5
932.5	935.0			1.5		0.00			5.0	0.033	151.5	9.6
935.0	937.5			1.3		0.00			4.5	0.036	125.0	12.4
937.5	940.0			1.2		0.01			4.3	0.035	122.9	12.5
940.0	942.5			1.0		0.00			2.2	0.019	115.8	6.7
942.5	945.0			1.4	0.09	0.04	0.13		4.0	0.020	200.0	11.1
945.0	947.5			1.0	0.20	0.00	0.20		3.9	0.027	144.4	9.3
947.5	950.0			0.6		0.01			4.1	0.038	107.9	13.6
950.0	952.5			1.0	0.05	0.01	0.06		6.0	0.048	125.0	17.4
952.5	955.0			2.0	0.02	0.00	0.02		4.0	0.034	117.6	11.9

Appendix E.4

Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples

Intact core samples and rotary air cuttings samples were collected periodically during pilot well drilling to determine if radiological or chemical contamination was present. Core and cuttings samples were not found to be contaminated with hazardous constituents or radioactivity.

Sampling locations were selected in advance and modified to accommodate drilling conditions and schedules. Samples from Ue5PW-1 were collected at higher frequencies near the surface and water table because of the expected greater potential for contamination at these locations. Sample frequencies were reduced for Ue5PW-2 and Ue5PW-3 because of the accelerated drilling schedule and the lack of detection of contamination in Ue5PW-1.

Sampling procedures and field quality assurance were conducted as described in WMD-T19 (Table 2.1). Alluvium samples analyzed for volatile organics, EPA method 8240 (EPA 1982), and semi-volatile organics, EPA method 8270 (EPA 1982), were collected as intact cores with a split spoon coring tool. Samples from Ue5PW-1 at a depth of 70 ft (21 m) were collected in polycarbonate liners with plastic end caps. All subsequent samples were collected in brass liners with plastic end caps. In each case, the end caps were taped and the cores were placed in a cooler at 4°C and transported to the laboratory.

Alluvium samples analyzed for photon emitting radionuclides, total kehl Dahl nitrogen and total metals (As, Ba, Cd, Cr, Pb, Hg, Se and Ag) were collected as rotary air cuttings at the cyclone separator. Samples for analysis of photon emitting radionuclides and total metals were collected in precleaned 500 ml high density polyethylene bottles. Total kehl Dahl nitrogen samples were collected in 500 ml glass jars.

Photon emitting samples were measured by gamma spectrometry of wet non-homogenized samples. The total kehl Dahl nitrogen analysis was performed using EPA method 351.5 (EPA 1982). Samples for total metals were prepared by EPA method 3050 (EPA 1982) and analyzed by inductively coupled plasma using EPA method 6010 (EPA 1982). In some instances total metals samples were prepared using the TCLP method.

Co-located samples (i.e. adjacent core samples) were periodically collected as duplicates for analysis of volatile organics and semi-volatile organics. Field blanks were prepared by filling sample containers with laboratory pure water at the drill site. Equipment or rinsate blanks were prepared by rinsing the coring tool with laboratory pure water. Trip blanks for analysis of volatile organics were prepared at the laboratory and transported into the field and returned for analysis.

Field quality assurance samples were prepared for photon emitting radionuclides, total metals and total kehl Dahl nitrogen. Duplicates were prepared by passing alluvium samples through a sample splitter. Field blanks were prepared from laboratory pure water in the field. Equipment or rinsate blanks were prepared by rinsing the coring tool with laboratory pure water.

Appendix E.4 Results of sampling and analysis for hazardous and radiological
parameters in core samples (Continued)

References

EPA, 1982. Methods for Chemical Analysis of Water and Waste, EPA-600/4-82-005

EPA, 1986. Test Methods for Evaluating Solid Waste, Physical /Chemical Methods, SW-846.

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples

Site: Area 5 RWMS Pilot Well 1/Ue5PW-1

Analysis: Gamma Spectrometry

Method: 901.1

Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	K-40 pCi/g	2s %	MDC	Cr-51 pCi/g	2s %	MDC	Mn-54 pCi/g	2s %	MDC
PW1-058-02-01	18-Mar-92	18-Mar-92	58	21	21		<MDC		2	<MDC		0.3
PW1-130-02-01	24-Mar-92	27-Mar-92	130	28.9	8.8		<MDC		2	<MDC		0.2
PW1-130-02-02	24-Mar-92	27-Mar-92	130	29.1	8.6		<MDC		2	<MDC		0.2
PW1-150-02-01	07-Apr-92	20-Apr-92	150	31.1	8.6		<MDC		1	<MDC		0.2
PW1-200-02-01	09-Apr-92	11-Apr-92	200	31.5	8.6		<MDC		1	<MDC		0.2
PW1-302-02-01	14-Apr-92	16-Apr-92	302	33	18		<MDC		1	<MDC		0.2
PW1-402-02-01	22-Apr-92	27-Apr-92	402	28	19		<MDC		1	<MDC		0.2
PW1-507-02-01	06-May-92	12-May-92	507	28	19		<MDC		1	<MDC		0.2
PW1-507-02-02	06-May-92	12-May-92	507	32	18		<MDC		1	<MDC		0.2
PW1-597-02-01	07-May-92	18-Jun-92	597	28	19		<MDC		1	<MDC		0.2
PW1-652-02-01	28-May-92	18-Jun-92	652	33	17		<MDC		1	<MDC		0.2
PW1-702-02-01	01-Jun-92	18-Jun-92	702	28	18		<MDC		1	<MDC		0.2
PW1-765-02-01	09-Jun-92	15-Jun-92	765	32	18		<MDC		1	<MDC		0.2
PW1-765-02-02	09-Jun-92	15-Jun-92	765	28	19		<MDC		1	<MDC		0.2
PW1-050-02-03	17-Mar-92	18-Mar-92	Equip. Blank	<MDC			<MDC		2	<MDC		0.3
PW1-050-02-04	17-Mar-92	18-Mar-92	Field Blank	<MDC			<MDC		2	<MDC		0.3
PW1-507-02-03	06-May-92	12-May-92	Field Blank	<MDC			<MDC		2	<MDC		0.3
PW1-765-02-03	09-Jun-92	11-Jun-92	Field Blank	<MDC			<MDC		2	<MDC		0.3

MDC - Minimum Detectable Concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW-1

Analysis: Gamma Spectrometry

Method: 901.1

Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Fe-59 pCi/g	2s %	MDC	Co-57 pCi/g	2s %	MDC	Co-60 pCi/g	2s %	MDC
PW1-058-02-01	18-Mar-92	18-Mar-92	58	<MDC		0.4	<MDC		0.3	<MDC		0.3
PW1-130-02-01	24-Mar-92	27-Mar-92	130	<MDC		0.4	<MDC		0.2	<MDC		0.2
PW1-130-02-02	24-Mar-92	27-Mar-92	130	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-150-02-01	07-Apr-92	20-Apr-92	150	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-200-02-01	09-Apr-92	11-Apr-92	200	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-302-02-01	14-Apr-92	16-Apr-92	302	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-402-02-01	22-Apr-92	27-Apr-92	402	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-507-02-01	06-May-92	12-May-92	507	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-507-02-02	06-May-92	12-May-92	507	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-597-02-01	07-May-92	18-Jun-92	597	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-652-02-01	28-May-92	18-Jun-92	652	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-702-02-01	01-Jun-92	18-Jun-92	702	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-765-02-01	09-Jun-92	15-Jun-92	765	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-765-02-02	09-Jun-92	15-Jun-92	765	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW1-050-02-03	17-Mar-92	18-Mar-92	Equip. Blank	<MDC		0.5	<MDC		0.3	<MDC		0.3
PW1-050-02-04	17-Mar-92	18-Mar-92	Field Blank	<MDC		0.5	<MDC		0.3	<MDC		0.3
PW1-507-02-03	06-May-92	12-May-92	Field Blank	<MDC		0.5	<MDC		0.3	<MDC		0.3
PW1-765-02-03	09-Jun-92	11-Jun-92	Field Blank	<MDC		0.5	<MDC		0.3	<MDC		0.3

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW-1

Analysis: Gamma Spectrometry

Method: 901.1

Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Zn-65 pCi/g	2s %	MDC	Zr-95 pCi/g	2s %	MDC	Nb-95 pCi/g	2s %	MDC
PW1-058-02-01	18-Mar-92	18-Mar-92	58	<MDC		0.5	<MDC		0.4	<MDC		0.2
PW1-130-02-01	24-Mar-92	27-Mar-92	130	<MDC		0.5	<MDC		0.4	<MDC		0.2
PW1-130-02-02	24-Mar-92	27-Mar-92	130	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW1-150-02-01	07-Apr-92	20-Apr-92	150	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW1-200-02-01	09-Apr-92	11-Apr-92	200	<MDC		0.3	<MDC		0.3	<MDC		0.2
PW1-302-02-01	14-Apr-92	16-Apr-92	302	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW1-402-02-01	22-Apr-92	27-Apr-92	402	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW1-507-02-01	06-May-92	12-May-92	507	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW1-507-02-02	06-May-92	12-May-92	507	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW1-597-02-01	07-May-92	18-Jun-92	597	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW1-652-02-01	28-May-92	18-Jun-92	652	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW1-702-02-01	01-Jun-92	18-Jun-92	702	<MDC		0.3	<MDC		0.3	<MDC		0.1
PW1-765-02-01	09-Jun-92	15-Jun-92	765	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW1-765-02-02	09-Jun-92	15-Jun-92	765	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW1-050-02-03	17-Mar-92	18-Mar-92	Equip. Blank	<MDC		0.6	<MDC		0.5	<MDC		0.3
PW1-050-02-04	17-Mar-92	18-Mar-92	Field Blank	<MDC		0.6	<MDC		0.5	<MDC		0.3
PW1-507-02-03	06-May-92	12-May-92	Field Blank	<MDC		0.6	<MDC		0.5	<MDC		0.3
PW1-765-02-03	09-Jun-92	11-Jun-92	Field Blank	<MDC		0.6	<MDC		0.5	<MDC		0.3

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW-1

Analysis: Gamma Spectrometry

Method: 901.1

Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Ru-106 pCi/g	2s %	MDC	Sb-124 pCi/g	2s %	MDC	Sb-125 pCi/g	2s %	MDC
PW1-058-02-01	18-Mar-92	18-Mar-92	58	<MDC		2.0	<MDC		0.2	<MDC		0.6
PW1-130-02-01	24-Mar-92	27-Mar-92	130	<MDC		1.7	<MDC		0.2	<MDC		0.5
PW1-130-02-02	24-Mar-92	27-Mar-92	130	<MDC		1.6	<MDC		0.2	<MDC		0.5
PW1-150-02-01	07-Apr-92	20-Apr-92	150	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW1-200-02-01	09-Apr-92	11-Apr-92	200	<MDC		1.3	<MDC		0.1	<MDC		0.4
PW1-302-02-01	14-Apr-92	16-Apr-92	302	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW1-402-02-01	22-Apr-92	27-Apr-92	402	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW1-507-02-01	06-May-92	12-May-92	507	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW1-507-02-02	06-May-92	12-May-92	507	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW1-597-02-01	07-May-92	18-Jun-92	597	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW1-652-02-01	28-May-92	18-Jun-92	652	<MDC		1.3	<MDC		0.1	<MDC		0.4
PW1-702-02-01	01-Jun-92	18-Jun-92	702	<MDC		1.3	<MDC		0.1	<MDC		0.4
PW1-765-02-01	09-Jun-92	15-Jun-92	765	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW1-765-02-02	09-Jun-92	15-Jun-92	765	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW1-050-02-03	17-Mar-92	18-Mar-92	Equip. Blank	<MDC		2.2	<MDC		0.2	<MDC		0.7
PW1-050-02-04	17-Mar-92	18-Mar-92	Field Blank	<MDC		2.2	<MDC		0.2	<MDC		0.7
PW1-507-02-03	06-May-92	12-May-92	Field Blank	<MDC		2.2	<MDC		0.2	<MDC		0.7
PW1-765-02-03	09-Jun-92	11-Jun-92	Field Blank	<MDC		2.2	<MDC		0.2	<MDC		0.7

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW-1

Analysis: Gamma Spectrometry

Method: 901.1

Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Cs-134 pCi/g	2s %	MDC	Cs-137 pCi/g	2s %	MDC	Ba-140 pCi/g	2s %	MDC
PW1-058-02-01	18-Mar-92	18-Mar-92	58	<MDC		0.2	<MDC		0.3	<MDC		0.7
PW1-130-02-01	24-Mar-92	27-Mar-92	130	<MDC		0.2	<MDC		0.3	<MDC		0.6
PW1-130-02-02	24-Mar-92	27-Mar-92	130	<MDC		0.2	<MDC		0.2	<MDC		0.6
PW1-150-02-01	07-Apr-92	20-Apr-92	150	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW1-200-02-01	09-Apr-92	11-Apr-92	200	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW1-302-02-01	14-Apr-92	16-Apr-92	302	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW1-402-02-01	22-Apr-92	27-Apr-92	402	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW1-507-02-01	06-May-92	12-May-92	507	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW1-507-02-02	06-May-92	12-May-92	507	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW1-597-02-01	07-May-92	18-Jun-92	597	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW1-652-02-01	28-May-92	18-Jun-92	652	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW1-702-02-01	01-Jun-92	18-Jun-92	702	<MDC		0.1	<MDC		0.2	<MDC		0.4
PW1-765-02-01	09-Jun-92	15-Jun-92	765	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW1-765-02-02	09-Jun-92	15-Jun-92	765	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW1-050-02-03	17-Mar-92	18-Mar-92	Equip. Blank	<MDC		0.2	<MDC		0.3	<MDC		0.8
PW1-050-02-04	17-Mar-92	18-Mar-92	Field Blank	<MDC		0.2	<MDC		0.3	<MDC		0.8
PW1-507-02-03	06-May-92	12-May-92	Field Blank	<MDC		0.2	<MDC		0.3	<MDC		0.8
PW1-765-02-03	09-Jun-92	11-Jun-92	Field Blank	<MDC		0.2	<MDC		0.3	<MDC		0.8

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW-1

Analysis: Gamma Spectrometry

Method: 901.1

Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	La-140 pCi/g	2s %	MDC	Eu-152 pCi/g	2s %	MDC	Ra-226 pCi/g	2s %	MDC
PW1-058-02-01	18-Mar-92	18-Mar-92	58	<MDC		0.3	<MDC		0.8	0.5	32	
PW1-130-02-01	24-Mar-92	27-Mar-92	130	<MDC		0.2	<MDC		0.7	1	11	
PW1-130-02-02	24-Mar-92	27-Mar-92	130	<MDC		0.2	<MDC		0.6	1	11	
PW1-150-02-01	07-Apr-92	20-Apr-92	150	<MDC		0.2	<MDC		0.6	1	10	
PW1-200-02-01	09-Apr-92	11-Apr-92	200	<MDC		0.2	<MDC		0.5	1	10	
PW1-302-02-01	14-Apr-92	16-Apr-92	302	<MDC		0.2	<MDC		0.5	2	26	
PW1-402-02-01	22-Apr-92	27-Apr-92	402	<MDC		0.2	<MDC		0.6	1	31	
PW1-507-02-01	06-May-92	12-May-92	507	<MDC		0.2	<MDC		0.6	2	28	
PW1-507-02-02	06-May-92	12-May-92	507	<MDC		0.2	<MDC		0.6	2	25	
PW1-597-02-01	07-May-92	18-Jun-92	597	<MDC		0.2	<MDC		0.6	1	34	
PW1-652-02-01	28-May-92	18-Jun-92	652	<MDC		0.2	<MDC		0.5	1	40	
PW1-702-02-01	01-Jun-92	18-Jun-92	702	<MDC		0.2	<MDC		0.5	1	29	
PW1-765-02-01	09-Jun-92	15-Jun-92	765	<MDC		0.2	<MDC		0.5	1	30	
PW1-765-02-02	09-Jun-92	15-Jun-92	765	<MDC		0.2	<MDC		0.5	1	29	
PW1-050-02-03	17-Mar-92	18-Mar-92	Equip. Blank	<MDC		0.3	<MDC		0.9	<MDC		
PW1-050-02-04	17-Mar-92	18-Mar-92	Field Blank	<MDC		0.3	<MDC		0.9	<MDC		
PW1-507-02-03	06-May-92	12-May-92	Field Blank	<MDC		0.3	<MDC		0.9	<MDC		
PW1-765-02-03	09-Jun-92	11-Jun-92	Field Blank	<MDC		0.3	<MDC		0.9	<MDC		

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW-1

Analysis: Gamma Spectrometry

Method: 901.1

Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Th-228 pCi/g	2s %	MDC	Th-232 pCi/g	2s %	MDC	Am-241 pCi/g	2s %	MDC
PW1-058-02-01	18-Mar-92	18-Mar-92	58	2	22		4	46		<MDC		1.3
PW1-130-02-01	24-Mar-92	27-Mar-92	130	2	8.9		2	11		<MDC		1.1
PW1-130-02-02	24-Mar-92	27-Mar-92	130	3	8.9		2	11		<MDC		1.0
PW1-150-02-01	07-Apr-92	20-Apr-92	150	3	9		3	11		<MDC		0.9
PW1-200-02-01	09-Apr-92	11-Apr-92	200	3	9		2	11		<MDC		0.8
PW1-302-02-01	14-Apr-92	16-Apr-92	302	2	21		3	28		<MDC		0.9
PW1-402-02-01	22-Apr-92	27-Apr-92	402	3	19		3	32		<MDC		0.9
PW1-507-02-01	06-May-92	12-May-92	507	3	19		2	36		<MDC		0.9
PW1-507-02-02	06-May-92	12-May-92	507	3	18		2	30		<MDC		0.9
PW1-597-02-01	07-May-92	18-Jun-92	597	3	21		3	30		<MDC		0.9
PW1-652-02-01	28-May-92	18-Jun-92	652	3	19		2	36		<MDC		0.9
PW1-702-02-01	01-Jun-92	18-Jun-92	702	3	21		2	41		<MDC		0.8
PW1-765-02-01	09-Jun-92	15-Jun-92	765	3	21		2	36		<MDC		0.9
PW1-765-02-02	09-Jun-92	15-Jun-92	765	2	22		3	31		<MDC		0.9
PW1-050-02-03	17-Mar-92	18-Mar-92	Equip. Blank	<MDC			<MDC			<MDC		1.4
PW1-050-02-04	17-Mar-92	18-Mar-92	Field Blank	<MDC			<MDC			<MDC		1.4
PW1-507-02-03	06-May-92	12-May-92	Field Blank	<MDC			<MDC			<MDC		1.4
PW1-765-02-03	09-Jun-92	11-Jun-92	Field Blank	<MDC			<MDC			<MDC		1.4

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
Site: Area 5 RWMS Pilot Well 2/Ue5PW-2
Analysis: Gamma Spectrometry
Method: 901.1
Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	K-40 pCi/g	2s %	MDC	Cr-51 pCi/g	2s %	MDC	Mn-54 pCi/g	2s %	MDC
PW2-075-02-01	24-Jun-92	25-Jun-92	75	32	18		<MDC		2	<MDC		0.2
PW2-075-02-02	24-Jun-92	25-Jun-92	75	31	18		<MDC		1	<MDC		0.2
PW2-097-02-01	24-Jun-92	25-Jun-92	97	29	18		<MDC		1	<MDC		0.2
PW2-152-02-01	25-Jun-92	25-Jun-92	152	31	18		<MDC		2	<MDC		0.2
PW2-202-02-01	29-Jun-92	30-Jun-92	202	28	19		<MDC		2	<MDC		0.2
PW2-305-02-01	30-Jun-92	22-Jul-92	305	30	18		<MDC		1	<MDC		0.2
PW2-407-02-01	14-Jul-92	14-Jul-92	407	32	18		<MDC		2	<MDC		0.2
PW2-407-02-02	14-Jul-92	14-Jul-92	407	26	19		<MDC		1	<MDC		0.2
PW2-597-02-01	22-Jul-92	04-Aug-92	597	33	18		<MDC		2	<MDC		0.2
PW2-825-02-01	10-Aug-92	11-Aug-92	825	31	18		<MDC		1	<MDC		0.2
PW2-825-02-02	10-Aug-92	11-Aug-92	825	34	18		<MDC		1	<MDC		0.2
PW2-075-02-03	24-Jun-92	25-Jun-92	Field Blan	<MDC			<MDC		2	<MDC		0.3
PW2-407-02-03	14-Jul-92	14-Jul-92	Field Blan	<MDC			<MDC		2	<MDC		0.3
PW2-825-02-03	10-Aug-92	10-Aug-92	Field Blan	<MDC			<MDC		2	<MDC		0.3

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
Site: Area 5 RWMS Pilot Well 2/Ue5PW-2
Analysis: Gamma Spectrometry
Method: 901.1
Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Fe-59 pCi/g	2s %	MDC	Co-57 pCi/g	2s %	MDC	Co-60 pCi/g	2s %	MDC
PW2-075-02-01	24-Jun-92	25-Jun-92	75	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW2-075-02-02	24-Jun-92	25-Jun-92	75	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW2-097-02-01	24-Jun-92	25-Jun-92	97	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW2-152-02-01	25-Jun-92	25-Jun-92	152	<MDC		0.4	<MDC		0.2	<MDC		0.2
PW2-202-02-01	29-Jun-92	30-Jun-92	202	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW2-305-02-01	30-Jun-92	22-Jul-92	305	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW2-407-02-01	14-Jul-92	14-Jul-92	407	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW2-407-02-02	14-Jul-92	14-Jul-92	407	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW2-597-02-01	22-Jul-92	04-Aug-92	597	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW2-825-02-01	10-Aug-92	11-Aug-92	825	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW2-825-02-02	10-Aug-92	11-Aug-92	825	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW2-075-02-03	24-Jun-92	25-Jun-92	Field Blank	<MDC		0.5	<MDC		0.3	<MDC		0.3
PW2-407-02-03	14-Jul-92	14-Jul-92	Field Blank	<MDC		0.5	<MDC		0.3	<MDC		0.3
PW2-825-02-03	10-Aug-92	10-Aug-92	Field Blank	<MDC		0.5	<MDC		0.3	<MDC		0.3

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
 Site: Area 5 RWMS Pilot Well 2/Ue5PW-2
 Analysis: Gamma Spectrometry
 Method: 901.1
 Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Zn-65 pCi/g	2s %	MDC	Zr-95 pCi/g	2s %	MDC	Nb-95 pCi/g	2s %	MDC
PW2-075-02-01	24-Jun-92	25-Jun-92	75	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW2-075-02-02	24-Jun-92	25-Jun-92	75	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW2-097-02-01	24-Jun-92	25-Jun-92	97	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW2-152-02-01	25-Jun-92	25-Jun-92	152	<MDC		0.5	<MDC		0.4	<MDC		0.2
PW2-202-02-01	29-Jun-92	30-Jun-92	202	<MDC		0.4	<MDC		0.4	<MDC		0.2
PW2-305-02-01	30-Jun-92	22-Jul-92	305	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW2-407-02-01	14-Jul-92	14-Jul-92	407	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW2-407-02-02	14-Jul-92	14-Jul-92	407	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW2-597-02-01	22-Jul-92	04-Aug-92	597	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW2-825-02-01	10-Aug-92	11-Aug-92	825	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW2-825-02-02	10-Aug-92	11-Aug-92	825	<MDC		0.4	<MDC		0.3	<MDC		0.2
PW2-075-02-03	24-Jun-92	25-Jun-92	Field Blank	<MDC		0.6	<MDC		0.5	<MDC		0.3
PW2-407-02-03	14-Jul-92	14-Jul-92	Field Blank	<MDC		0.6	<MDC		0.5	<MDC		0.3
PW2-825-02-03	10-Aug-92	10-Aug-92	Field Blank	<MDC		0.6	<MDC		0.5	<MDC		0.3

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
 Site: Area 5 RWMS Pilot Well 2/Ue5PW-2
 Analysis: Gamma Spectrometry
 Method: 901.1
 Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Ru-106 pCi/g	2s %	MDC	Sb-124 pCi/g	2s %	MDC	Sb-125 pCi/g	2s %	MDC
PW2-075-02-01	24-Jun-92	25-Jun-92	75	<MDC		1.5	<MDC		0.2	<MDC		0.5
PW2-075-02-02	24-Jun-92	25-Jun-92	75	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW2-097-02-01	24-Jun-92	25-Jun-92	97	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW2-152-02-01	25-Jun-92	25-Jun-92	152	<MDC		1.7	<MDC		0.2	<MDC		0.5
PW2-202-02-01	29-Jun-92	30-Jun-92	202	<MDC		1.6	<MDC		0.2	<MDC		0.5
PW2-305-02-01	30-Jun-92	22-Jul-92	305	<MDC		1.5	<MDC		0.1	<MDC		0.5
PW2-407-02-01	14-Jul-92	14-Jul-92	407	<MDC		1.6	<MDC		0.2	<MDC		0.5
PW2-407-02-02	14-Jul-92	14-Jul-92	407	<MDC		1.5	<MDC		0.1	<MDC		0.5
PW2-597-02-01	22-Jul-92	04-Aug-92	597	<MDC		1.6	<MDC		0.2	<MDC		0.5
PW2-825-02-01	10-Aug-92	11-Aug-92	825	<MDC		1.5	<MDC		0.1	<MDC		0.5
PW2-825-02-02	10-Aug-92	11-Aug-92	825	<MDC		1.5	<MDC		0.1	<MDC		0.5
PW2-075-02-03	24-Jun-92	25-Jun-92	Field Blank	<MDC		2.2	<MDC		0.2	<MDC		0.7
PW2-407-02-03	14-Jul-92	14-Jul-92	Field Blank	<MDC		2.2	<MDC		0.2	<MDC		0.7
PW2-825-02-03	10-Aug-92	10-Aug-92	Field Blank	<MDC		2.2	<MDC		0.2	<MDC		0.7

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
Site: Area 5 RWMS Pilot Well 2/Ue5PW-2
Analysis: Gamma Spectrometry
Method: 901.1
Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Cs-134 pCi/g	2s %	MDC	Cs-137 pCi/g	2s %	MDC	Ba-140 pCi/g	2s %	MDC
PW2-075-02-01	24-Jun-92	25-Jun-92	75	<MDC		0.2	<MDC		0.2	<MDC		0.5
PW2-075-02-02	24-Jun-92	25-Jun-92	75	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW2-097-02-01	24-Jun-92	25-Jun-92	97	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW2-152-02-01	25-Jun-92	25-Jun-92	152	<MDC		0.2	<MDC		0.3	<MDC		0.6
PW2-202-02-01	29-Jun-92	30-Jun-92	202	<MDC		0.2	<MDC		0.2	<MDC		0.6
PW2-305-02-01	30-Jun-92	22-Jul-92	305	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW2-407-02-01	14-Jul-92	14-Jul-92	407	<MDC		0.2	<MDC		0.2	<MDC		0.6
PW2-407-02-02	14-Jul-92	14-Jul-92	407	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW2-597-02-01	22-Jul-92	04-Aug-92	597	<MDC		0.2	<MDC		0.2	<MDC		0.6
PW2-825-02-01	10-Aug-92	11-Aug-92	825	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW2-825-02-02	10-Aug-92	11-Aug-92	825	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW2-075-02-03	24-Jun-92	25-Jun-92	Field Blank	<MDC		0.2	<MDC		0.3	<MDC		0.8
PW2-407-02-03	14-Jul-92	14-Jul-92	Field Blank	<MDC		0.2	<MDC		0.3	<MDC		0.8
PW2-825-02-03	10-Aug-92	10-Aug-92	Field Blank	<MDC		0.2	<MDC		0.3	<MDC		0.8

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
Site: Area 5 RWMS Pilot Well 2/Ue5PW-2
Analysis: Gamma Spectrometry
Method: 901.1
Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	La-140 pCi/g	2s %	MDC	Eu-152 pCi/g	2s %	MDC	Ra-226 pCi/g	2s %	MDC
PW2-075-02-01	24-Jun-92	25-Jun-92	75	<MDC		0.2	<MDC		0.6	1	31	
PW2-075-02-02	24-Jun-92	25-Jun-92	75	<MDC		0.2	<MDC		0.6	1	32	
PW2-097-02-01	24-Jun-92	25-Jun-92	97	<MDC		0.2	<MDC		0.5	1	29	
PW2-152-02-01	25-Jun-92	25-Jun-92	152	<MDC		0.2	<MDC		0.7	1	28	
PW2-202-02-01	29-Jun-92	30-Jun-92	202	<MDC		0.2	<MDC		0.7	2	26	
PW2-305-02-01	30-Jun-92	22-Jul-92	305	<MDC		0.2	<MDC		0.6	1	31	
PW2-407-02-01	14-Jul-92	14-Jul-92	407	<MDC		0.2	<MDC		0.6	1	30	
PW2-407-02-02	14-Jul-92	14-Jul-92	407	<MDC		0.2	<MDC		0.6	2	27	
PW2-597-02-01	22-Jul-92	04-Aug-92	597	<MDC		0.2	<MDC		0.6	1	29	
PW2-825-02-01	10-Aug-92	11-Aug-92	825	<MDC		0.2	<MDC		0.6	2	27	
PW2-825-02-02	10-Aug-92	11-Aug-92	825	<MDC		0.2	<MDC		0.6	1	34	
PW2-075-02-03	24-Jun-92	25-Jun-92	Field Blank	<MDC		0.3	<MDC		0.9	<MDC		
PW2-407-02-03	14-Jul-92	14-Jul-92	Field Blank	<MDC		0.3	<MDC		0.9	<MDC		
PW2-825-02-03	10-Aug-92	10-Aug-92	Field Blank	<MDC		0.3	<MDC		0.9	<MDC		

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
Site: Area 5 RWMS Pilot Well 2/Ue5PW-2
Analysis: Gamma Spectrometry
Method: 901.1
Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Th-228 pCi/g	2s %	MDC	Th-232 pCi/g	2s %	MDC	Am-241 pCi/g	2s %	MDC
PW2-075-02-01	24-Jun-92	25-Jun-92	75	3	19		3	29		<MDC		1.0
PW2-075-02-02	24-Jun-92	25-Jun-92	75	3	21		2	31		<MDC		0.9
PW2-097-02-01	24-Jun-92	25-Jun-92	97	3	20		2	35		<MDC		0.9
PW2-152-02-01	25-Jun-92	25-Jun-92	152	3	19		2	32		<MDC		1.1
PW2-202-02-01	29-Jun-92	30-Jun-92	202	3	20		2	37		<MDC		1.1
PW2-305-02-01	30-Jun-92	22-Jul-92	305	3	20		2	33		<MDC		1.0
PW2-407-02-01	14-Jul-92	14-Jul-92	407	3	20		3	31		<MDC		1.0
PW2-407-02-02	14-Jul-92	14-Jul-92	407	3	19		2	35		<MDC		1.0
PW2-597-02-01	22-Jul-92	04-Aug-92	597	3	18		3	30		<MDC		1.0
PW2-825-02-01	10-Aug-92	11-Aug-92	825	3	18		3	28		<MDC		1.0
PW2-825-02-02	10-Aug-92	11-Aug-92	825	4	18		3	30		<MDC		0.9
PW2-075-02-03	24-Jun-92	25-Jun-92	Field Blank	<MDC			<MDC			<MDC		1.4
PW2-407-02-03	14-Jul-92	14-Jul-92	Field Blank	<MDC			<MDC			<MDC		1.4
PW2-825-02-03	10-Aug-92	10-Aug-92	Field Blank	<MDC			<MDC			<MDC		1.4

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
 Site: Area 5 RWMS Pilot Well 3/Ue5PW-3
 Analysis: Gamma Spectrometry
 Method: 901.1
 Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	K-40 pCi/g	2s %	MDC	Cr-51 pCi/g	2s %	MDC	Mn-54 pCi/g	2s %	MDC
PW3-300-02-01	22-Sep-92	22-Sep-92	300	36	17		<MDC		1	<MDC		0.2
PW3-300-02-02	22-Sep-92	22-Sep-92	300	34	17		<MDC		1	<MDC		0.2
PW3-400-02-01	25-Sep-92	25-Sep-92	400	27	19		<MDC		1	<MDC		0.2
PW3-400-02-02	25-Sep-92	25-Sep-92	400	31	18		<MDC		1	<MDC		0.2
PW3-500-02-01	30-Sep-92	02-Oct-92	500	33	18		<MDC		1	<MDC		0.2
PW3-500-02-02	30-Sep-92	02-Oct-92	500	29	18		<MDC		1	<MDC		0.2
PW3-620-02-01	05-Oct-92	05-Oct-92	620	24	17		<MDC		1	<MDC		0.2
PW3-620-02-02	05-Oct-92	05-Oct-92	620	25	17		<MDC		1	<MDC		0.2

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
 Site: Area 5 RWMS Pilot Well 3/Ue5PW-3
 Analysis: Gamma Spectrometry
 Method: 901.1
 Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Fe-59 pCi/g	2s %	MDC	Co-57 pCi/g	2s %	MDC	Co-60 pCi/g	2s %	MDC
PW3-300-02-01	22-Sep-92	22-Sep-92	300	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW3-300-02-02	22-Sep-92	22-Sep-92	300	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW3-400-02-01	25-Sep-92	25-Sep-92	400	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW3-400-02-02	25-Sep-92	25-Sep-92	400	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW3-500-02-01	30-Sep-92	02-Oct-92	500	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW3-500-02-02	30-Sep-92	02-Oct-92	500	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW3-620-02-01	05-Oct-92	05-Oct-92	620	<MDC		0.3	<MDC		0.2	<MDC		0.2
PW3-620-02-02	05-Oct-92	05-Oct-92	620	<MDC		0.3	<MDC		0.2	<MDC		0.2

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
 Site: Area 5 RWMS Pilot Well 3/Ue5PW-3
 Analysis: Gamma Spectrometry
 Method: 901.1
 Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Zn-65 pCi/g	2s %	MDC	Zr-95 pCi/g	2s %	MDC	Nb-95 pCi/g	2s %	MDC
PW3-300-02-01	22-Sep-92	22-Sep-92	300	<MDC	0.4	0.3	<MDC	0.3	0.3	<MDC	0.2	0.2
PW3-300-02-02	22-Sep-92	22-Sep-92	300	<MDC	0.3	0.3	<MDC	0.3	0.3	<MDC	0.1	0.1
PW3-400-02-01	25-Sep-92	25-Sep-92	400	<MDC	0.4	0.4	<MDC	0.3	0.3	<MDC	0.2	0.2
PW3-400-02-02	25-Sep-92	25-Sep-92	400	<MDC	0.4	0.4	<MDC	0.3	0.3	<MDC	0.2	0.2
PW3-500-02-01	30-Sep-92	02-Oct-92	500	<MDC	0.4	0.4	<MDC	0.3	0.3	<MDC	0.2	0.2
PW3-500-02-02	30-Sep-92	02-Oct-92	500	<MDC	0.4	0.4	<MDC	0.3	0.3	<MDC	0.2	0.2
PW3-620-02-01	05-Oct-92	05-Oct-92	620	<MDC	0.4	0.4	<MDC	0.3	0.3	<MDC	0.2	0.2
PW3-620-02-02	05-Oct-92	05-Oct-92	620	<MDC	0.3	0.3	<MDC	0.3	0.3	<MDC	0.1	0.1

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
 Site: Area 5 RWMS Pilot Well 3/Ue5PW-3
 Analysis: Gamma Spectrometry
 Method: 901.1
 Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Ru-106 pCi/g	2s %	MDC	Sb-124 pCi/g	2s %	MDC	Sb-125 pCi/g	2s %	MDC
PW3-300-02-01	22-Sep-92	22-Sep-92	300	<MDC		1.3	<MDC		0.1	<MDC		0.4
PW3-300-02-02	22-Sep-92	22-Sep-92	300	<MDC		1.2	<MDC		0.1	<MDC		0.4
PW3-400-02-01	25-Sep-92	25-Sep-92	400	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW3-400-02-02	25-Sep-92	25-Sep-92	400	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW3-500-02-01	30-Sep-92	02-Oct-92	500	<MDC		1.5	<MDC		0.1	<MDC		0.5
PW3-500-02-02	30-Sep-92	02-Oct-92	500	<MDC		1.4	<MDC		0.1	<MDC		0.4
PW3-620-02-01	05-Oct-92	05-Oct-92	620	<MDC		1.3	<MDC		0.1	<MDC		0.4
PW3-620-02-02	05-Oct-92	05-Oct-92	620	<MDC		1.2	<MDC		0.1	<MDC		0.4

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
 Site: Area 5 RWMS Pilot Well 3/Ue5PW-3
 Analysis: Gamma Spectrometry
 Method: 901.1
 Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Cs-134 pCi/g	2s %	MDC	Cs-137 pCi/g	2s %	MDC	Ba-140 pCi/g	2s %	MDC
PW3-300-02-01	22-Sep-92	22-Sep-92	300	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW3-300-02-02	22-Sep-92	22-Sep-92	300	<MDC		0.1	<MDC		0.2	<MDC		0.4
PW3-400-02-01	25-Sep-92	25-Sep-92	400	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW3-400-02-02	25-Sep-92	25-Sep-92	400	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW3-500-02-01	30-Sep-92	02-Oct-92	500	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW3-500-02-02	30-Sep-92	02-Oct-92	500	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW3-620-02-01	05-Oct-92	05-Oct-92	620	<MDC		0.1	<MDC		0.2	<MDC		0.5
PW3-620-02-02	05-Oct-92	05-Oct-92	620	<MDC		0.1	<MDC		0.2	<MDC		0.4

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
 Site: Area 5 RWMS Pilot Well 3/Ju5PW-3
 Analysis: Gamma Spectrometry
 Method: 901.1
 Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	La-140 pCi/g	2s %	MDC	Eu-152 pCi/g	2s %	MDC	Ra-226 pCi/g	2s %	MDC
PW3-300-02-01	22-Sep-92	22-Sep-92	300	<MDC		0.2	<MDC		0.5	1	27	
PW3-300-02-02	22-Sep-92	22-Sep-92	300	<MDC		0.2	<MDC		0.5	1	26	
PW3-400-02-01	25-Sep-92	25-Sep-92	400	<MDC		0.2	<MDC		0.6	1	29	
PW3-400-02-02	25-Sep-92	25-Sep-92	400	<MDC		0.2	<MDC		0.6	2	24	
PW3-500-02-01	30-Sep-92	02-Oct-92	500	<MDC		0.2	<MDC		0.6	1	29	
PW3-500-02-02	30-Sep-92	02-Oct-92	500	<MDC		0.2	<MDC		0.6	1	26	
PW3-620-02-01	05-Oct-92	05-Oct-92	620	<MDC		0.2	<MDC		0.5	1	27	
PW3-620-02-02	05-Oct-92	05-Oct-92	620	<MDC		0.2	<MDC		0.5	1	27	

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters in Core Samples (Continued)

Gamma Spectrometry
 Site: Area 5 RWMS Pilot Well 3/Ue5PW-3
 Analysis: Gamma Spectrometry
 Method: 901.1
 Sample Matrix: Soil

Field ID	Collection Date	Analysis Date	Depth (ft.)	Th-228 pCi/g	2s %	MDC	Th-232 pCi/g	2s %	MDC	Am-241 pCi/g	2s %	MDC
PW3-300-02-01	22-Sep-92	22-Sep-92	300	3	20		2	35		<MDC		0.8
PW3-300-02-02	22-Sep-92	22-Sep-92	300	3	18		3	32		<MDC		0.8
PW3-400-02-01	25-Sep-92	25-Sep-92	400	3	20		2	35		<MDC		0.9
PW3-400-02-02	25-Sep-92	25-Sep-92	400	3	20		2	31		<MDC		0.9
PW3-500-02-01	30-Sep-92	02-Oct-92	500	3	20		3	33		<MDC		0.9
PW3-500-02-02	30-Sep-92	02-Oct-92	500	3	21		3	28		<MDC		0.9
PW3-620-02-01	05-Oct-92	05-Oct-92	620	3	17		3	34		<MDC		0.9
PW3-620-02-02	05-Oct-92	05-Oct-92	620	2	17		2	32		<MDC		0.8

MDC - Minimum detectable concentration

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW1

Analysis: Total Keldahl Nitrogen

Method: 351.5

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW1-058-02-01	18-Mar-92	58	20	20	28
PW1-130-02-01	24-Mar-92	130	40	20	22
PW1-130-02-02	24-Mar-92	130	20	20	22
PW1-200-02-01	09-Apr-92	200	30	20	21
PW1-402-02-01	22-Apr-92	402	40	10	20
PW1-507-02-01	06-May-92	507	22	2	21
PW1-507-02-01	06-May-92	507	51	2	21
PW1-765-02-01	09-Jun-92	765	20	10	30
PW1-765-02-02	09-Jun-92	765	10	10	30
PW1-050-02-03	17-Mar-92	Field Blank	0.11	0.05	13
PW1-050-02-04	17-Mar-92	Equip. Blank	0.06	0.05	13
PW1-507-02-03	06-May-92	Field Blank	0.03	0.01	19
PW1-765-02-03	09-Jun-92	Field Blank	0.22	0.05	30

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 2/Ue5PW-2

Analysis: Total Keldahl Nitrogen

Method: 351.5

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW2-075-02-01	24-Jun-92	75	50	10	14
PW2-075-02-02	24-Jun-92	75	20	10	14
PW2-097-02-01	24-Jun-92	97	20	10	14
PW2-202-02-01	29-Jun-92	202	20	10	22
PW2-407-02-01	14-Jul-92	407	20	10	7
PW2-407-02-02	14-Jul-92	407	10	10	7
PW2-825-02-01	10-Aug-92	825	8	4	21
PW2-825-02-02	10-Aug-92	825	8	4	21
PW2-075-02-03	24-Jun-92	Field Blank	<DL	0.05	14
PW2-407-02-03	14-Jul-92	Field Blank	<DL	0.05	7
PW2-825-02-03	10-Aug-92	Field Blank	<DL	0.1	21

<DL - Less than detection limit

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 3/Ue5PW-3

Analysis: Total Keldahl Nitrogen

Method: 351.5

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW3-300-02-01	22-Sep-92	300	90	10	16
PW3-300-02-02	22-Sep-92	300	50	10	16
PW3-400-02-01	25-Sep-92	400	30	10	18
PW3-400-02-02	25-Sep-92	400	20	10	18
PW3-500-02-01	30-Sep-92	500	20	10	12
PW3-500-02-02	30-Sep-92	500	<DL	10	12
PW3-620-02-01	05-Oct-92	620	70	10	8
PW3-620-02-02	05-Oct-92	620	<DL	10	8

<DL - Less than detection limit

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW1

Analysis: Total Metals

Method: Arsenic 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW1-058-02-01	18-Mar-92	58	ND	6	14
PW1-130-02-01	24-Mar-92	130	ND	5	8
PW1-130-02-02	24-Mar-92	130	<15	4	8
PW1-200-02-01	09-Apr-92	200	ND	6	12
PW1-402-02-01	22-Apr-92	402	ND	6	19
PW1-507-02-01	06-May-92	507	<18	5	14
PW1-507-02-02	06-May-92	507	ND	5	14
PW1-765-02-01	09-Jun-92	765	ND	4	13
PW1-765-02-02	09-Jun-92	765	ND	4	13
PW1-050-02-03	17-Mar-92	Field Blank	ND	0.06	14
PW1-050-02-04	17-Mar-92	Equip. Blank	ND	0.06	14
PW1-507-02-03	06-May-92	Field Blank	ND	0.06	14
PW1-765-02-03	09-Jun-92	Field Blank	ND	0.06	13

ND - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW1

Analysis: Total Metals

Method: Barium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW1-058-02-01	18-Mar-92	58	140	0.09	14
PW1-130-02-01	24-Mar-92	130	120	0.08	8
PW1-130-02-02	24-Mar-92	130	140	0.07	8
PW1-200-02-01	09-Apr-92	200	130	0.09	12
PW1-402-02-01	22-Apr-92	402	130	0.1	19
PW1-507-02-01	06-May-92	507	110	0.09	14
PW1-507-02-02	06-May-92	507	140	0.09	14
PW1-765-02-01	09-Jun-92	765	150	0.07	13
PW1-765-02-02	09-Jun-92	765	150	0.07	13
PW1-050-02-03	17-Mar-92	Field Blank	0.02	0.001	14
PW1-050-02-04	17-Mar-92	Equip. Blank	0.004	0.001	14
PW1-507-02-03	06-May-92	Field Blank	ND	0.001	14
PW1-765-02-03	09-Jun-92	Field Blank	<0.003	0.001	13

ND - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW1

Analysis: Total Metals

Method: Cadmium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW1-058-02-01	18-Mar-92	58	ND	0.3	14
PW1-130-02-01	24-Mar-92	130	ND	0.2	8
PW1-130-02-02	24-Mar-92	130	ND	0.2	8
PW1-200-02-01	09-Apr-92	200	ND	0.3	12
PW1-402-02-01	22-Apr-92	402	ND	0.3	19
PW1-507-02-01	06-May-92	507	ND	0.3	14
PW1-507-02-02	06-May-92	507	ND	0.3	14
PW1-765-02-01	09-Jun-92	765	<0.07	0.2	13
PW1-765-02-02	09-Jun-92	765	ND	0.2	13
PW1-050-02-03	17-Mar-92	Field Blank	ND	0.003	14
PW1-050-02-04	17-Mar-92	Equip. Blank	ND	0.003	14
PW1-507-02-03	06-May-92	Field Blank	ND	0.003	14
PW1-765-02-03	09-Jun-92	Field Blank	ND	0.003	13

ND - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW1

Analysis: Total Metals

Method: Chromium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW1-058-02-01	18-Mar-92	58	4.2	0.4	14
PW1-130-02-01	24-Mar-92	130	4.4	0.3	8
PW1-130-02-02	24-Mar-92	130	5.0	0.3	8
PW1-200-02-01	09-Apr-92	200	5.1	0.4	12
PW1-402-02-01	22-Apr-92	402	5.7	0.4	19
PW1-507-02-01	06-May-92	507	4.3	0.4	14
PW1-507-02-02	06-May-92	507	4.3	0.4	14
PW1-765-02-01	09-Jun-92	765	5.0	0.3	13
PW1-765-02-02	09-Jun-92	765	5.0	0.3	13
PW1-050-02-03	17-Mar-92	Field Blank	ND	0.003	14
PW1-050-02-04	17-Mar-92	Equip. Blank	ND	0.004	14
PW1-507-02-03	06-May-92	Field Blank	ND	0.004	14
PW1-765-02-03	09-Jun-92	Field Blank	ND	0.004	13

ND - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW1

Analysis: Total Metals

Method: Lead 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW1-058-02-01	18-Mar-92	58	10	3	14
PW1-130-02-01	24-Mar-92	130	8	2	8
PW1-130-02-02	24-Mar-92	130	11	2	8
PW1-200-02-01	09-Apr-92	200	6	3	12
PW1-402-02-01	22-Apr-92	402	<9	3	19
PW1-507-02-01	06-May-92	507	<8	2	14
PW1-507-02-02	06-May-92	507	9	2	14
PW1-765-02-01	09-Jun-92	765	7	2	13
PW1-765-02-02	09-Jun-92	765	<6	2	13
PW1-050-02-03	17-Mar-92	Field Blank	ND	0.03	14
PW1-050-02-04	17-Mar-92	Equip. Blank	ND	0.03	14
PW1-507-02-03	06-May-92	Field Blank	ND	0.03	14
PW1-765-02-03	09-Jun-92	Field Blank	ND	0.03	13

ND - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW1

Analysis: Total Metals

Method: Mercury 3050, 7470

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW1-058-02-01	18-Mar-92	58	ND	0.05	14
PW1-130-02-01	24-Mar-92	130	ND	0.05	8
PW1-130-02-02	24-Mar-92	130	ND	0.05	8
PW1-200-02-01	09-Apr-92	200	ND	0.01	12
PW1-402-02-01	22-Apr-92	402	ND	0.02	14
PW1-507-02-01	06-May-92	507	ND	0.03	15
PW1-507-02-02	06-May-92	507	ND	0.03	15
PW1-765-02-01	09-Jun-92	765	ND	0.03	13
PW1-765-02-02	09-Jun-92	765	ND	0.03	13
PW1-050-02-03	17-Mar-92	Field Blank	ND	0.0001	14
PW1-050-02-04	17-Mar-92	Equip. Blank	ND	0.0001	14
PW1-507-02-03	06-May-92	Field Blank	ND	6E-05	15
PW1-765-02-03	09-Jun-92	Field Blank	ND	6E-05	13

ND - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW1

Analysis: Total Metals

Method: Selenium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW1-058-02-01	18-Mar-92	58	ND	8	14
PW1-130-02-01	24-Mar-92	130	ND	7	8
PW1-130-02-02	24-Mar-92	130	ND	6	8
PW1-200-02-01	09-Apr-92	200	ND	8	12
PW1-402-02-01	22-Apr-92	402	ND	9	19
PW1-507-02-01	06-May-92	507	11	8	14
PW1-507-02-02	06-May-92	507	11	8	14
PW1-765-02-01	09-Jun-92	765	<22	6	13
PW1-765-02-02	09-Jun-92	765	<22	6	13
PW1-050-02-03	17-Mar-92	Field Blank	ND	0.09	14
PW1-050-02-04	17-Mar-92	Equip. Blank	ND	0.09	14
PW1-507-02-03	06-May-92	Field Blank	ND	0.09	14
PW1-765-02-03	09-Jun-92	Field Blank	ND	0.09	13

ND - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 1/Ue5PW1

Analysis: Total Methods

Method: Silver 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW1-058-02-01	18-Mar-92	58	ND	0.2	14
PW1-130-02-01	24-Mar-92	130	ND	0.2	8
PW1-130-02-02	24-Mar-92	130	ND	0.2	8
PW1-200-02-01	09-Apr-92	200	ND	0.2	12
PW1-402-02-01	22-Apr-92	402	ND	0.3	19
PW1-507-02-01	06-May-92	507	ND	0.2	14
PW1-507-02-02	06-May-92	507	ND	0.2	14
PW1-765-02-01	09-Jun-92	765	ND	0.2	13
PW1-765-02-02	09-Jun-92	765	ND	0.2	13
PW1-050-02-03	17-Mar-92	Field Blank	0.009	0.003	14
PW1-050-02-04	17-Mar-92	Equip. Blank	ND	0.003	14
PW1-507-02-03	06-May-92	Field Blank	ND	0.003	14
PW1-765-02-03	09-Jun-92	Field Blank	ND	0.003	13

ND - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 2/Ue5PW2

Analysis: Total Metals

Method: Arsenic 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW2-075-02-01*	24-Jun-92	75	n.d.	0.06	8
PW2-075-02-02*	24-Jun-92	75	n.d.	0.06	8
PW2-097-02-01*	24-Jun-92	97	n.d.	0.06	8
PW2-202-02-01	29-Jun-92	202	n.d.	3	25
PW2-407-02-01	14-Jul-92	407	<9.9	3	14
PW2-407-02-02	14-Jul-92	407	<9.9	3	14
PW2-825-02-01	10-Aug-92	825	n.d.	3	3
PW2-825-02-02	10-Aug-92	825	n.d.	3	3
PW2-075-02-03*	24-Jun-92	Field Blank	n.d.	0.06	8
PW2-407-02-03	14-Jul-92	Field Blank	n.d.	0.03	14
PW2-825-02-03	10-Aug-92	Field Blank	n.d.	0.03	3

n.d. - Not detected

* - TCLP analysis

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 2/Ue5PW2

Analysis: Total Metals

Method: Barium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW2-075-02-01*	24-Jun-92	75	0.17	0.001	8
PW2-075-02-02*	24-Jun-92	75	0.15	0.001	8
PW2-097-02-01*	24-Jun-92	97	0.11	0.001	8
PW2-202-02-01	29-Jun-92	202	120	0.04	25
PW2-407-02-01	14-Jul-92	407	120	0.04	14
PW2-407-02-02	14-Jul-92	407	99	0.04	14
PW2-825-02-01	10-Aug-92	825	71	0.08	3
PW2-825-02-02	10-Aug-92	825	71	0.09	3
PW2-075-02-03	24-Jun-92	Field Blank	n.d.	0.001	8
PW2-407-02-03	14-Jul-92	Field Blank	n.d.	0.0004	14
PW2-825-02-03	10-Aug-92	Field Blank	n.d.	0.0009	3

n.d. - Not detected

* - TCLP analysis

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 2/Ue5PW2

Analysis: Total Metals

Method: Cadmium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW2-075-02-01*	24-Jun-92	75	n.d.	0.003	8
PW2-075-02-02*	24-Jun-92	75	n.d.	0.003	8
PW2-097-02-01*	24-Jun-92	97	<0.01	0.003	8
PW2-202-02-01	29-Jun-92	202	n.d.	0.3	25
PW2-407-02-01	14-Jul-92	407	n.d.	0.3	14
PW2-407-02-02	14-Jul-92	407	n.d.	0.3	14
PW2-825-02-01	10-Aug-92	825	n.d.	0.4	3
PW2-825-02-02	10-Aug-92	825	n.d.	0.4	3
PW2-075-02-03*	24-Jun-92	Field Blank	n.d.	0.003	8
PW2-407-02-03	14-Jul-92	Field Blank	n.d.	0.003	14
PW2-825-02-03	10-Aug-92	Field Blank	n.d.	0.004	3

n.d. - Not detected

* - TCLP analysis

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 2/Ue5PW2

Analysis: Total Metals

Method: Chromium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW2-075-02-01*	24-Jun-92	75	n.d.	0.004	8
PW2-075-02-02*	24-Jun-92	75	n.d.	0.004	8
PW2-097-02-01*	24-Jun-92	97	n.d.	0.004	8
PW2-202-02-01	29-Jun-92	202	3.0	0.2	25
PW2-407-02-01	14-Jul-92	407	5.0	0.2	14
PW2-407-02-02	14-Jul-92	407	5.7	0.2	14
PW2-825-02-01	10-Aug-92	825	2.2	0.6	3
PW2-825-02-02	10-Aug-92	825	2.4	0.6	3
PW2-075-02-03*	24-Jun-92	Field Blank	n.d.	0.004	8
PW2-407-02-03	14-Jul-92	Field Blank	n.d.	0.002	14
PW2-825-02-03	10-Aug-92	Field Blank	n.d.	0.006	3

n.d. - Not detected

* - TCLP analysis

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 2/Ue5PW2

Analysis: Total Metals

Method: Lead 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW2-075-02-01*	24-Jun-92	75	n.d.	0.03	8
PW2-075-02-02*	24-Jun-92	75	n.d.	0.03	8
PW2-097-02-01*	24-Jun-92	97	n.d.	0.03	8
PW2-202-02-01	29-Jun-92	202	7.7	1.5	25
PW2-407-02-01	14-Jul-92	407	5.7	1.5	14
PW2-407-02-02	14-Jul-92	407	6.7	1.5	14
PW2-825-02-01	10-Aug-92	825	<9.4	2.9	3
PW2-825-02-02	10-Aug-92	825	<9.7	3	3
PW2-075-02-03*	24-Jun-92	Field Blank	n.d.	0.03	8
PW2-407-02-03	14-Jul-92	Field Blank	n.d.	0.01	14
PW2-825-02-03	10-Aug-92	Field Blank	n.d.	0.03	3

n.d. - Not detected

* - TCLP analysis

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 2/Ue5PW2

Analysis: Total Metals

Method: Mercury 3050, 7470

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW2-075-02-01*	24-Jun-92	75	n.d.	6E-05	8
PW2-075-02-02*	24-Jun-92	75	n.d.	6E-05	8
PW2-097-02-01*	24-Jun-92	97	n.d.	6E-05	8
PW2-202-02-01	29-Jun-92	202	n.d.	0.06	22
PW2-407-02-01	14-Jul-92	407	n.d.	0.06	14
PW2-407-02-02	14-Jul-92	407	n.d.	0.06	14
PW2-825-02-01	10-Aug-92	825	n.d.	0.06	10
PW2-825-02-02	10-Aug-92	825	n.d.	0.06	10
PW2-075-02-03*	24-Jun-92	Field Blank	n.d.	6E-05	8
PW2-407-02-03	14-Jul-92	Field Blank	n.d.	0.0001	14
PW2-825-02-03	10-Aug-92	Field Blank	n.d.	0.0001	10

n.d. - Not detected

* - TCLP analysis

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 2/Ue5PW2

Analysis: Total Metals

Method: Selenium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW2-075-02-01*	24-Jun-92	75	n.d.	0.09	8
PW2-075-02-02*	24-Jun-92	75	n.d.	0.09	8
PW2-097-02-01*	24-Jun-92	97	n.d.	0.09	8
PW2-202-02-01	29-Jun-92	202	n.d.	5	25
PW2-407-02-01	14-Jul-92	407	n.d.	5	14
PW2-407-02-02	14-Jul-92	407	n.d.	5	14
PW2-825-02-01	10-Aug-92	825	n.d.	6	3
PW2-825-02-02	10-Aug-92	825	n.d.	6	3
PW2-075-02-03*	24-Jun-92	Field Blank	n.d.	0.09	8
PW2-407-02-03	14-Jul-92	Field Blank	n.d.	0.05	14
PW2-825-02-03	10-Aug-92	Field Blank	n.d.	0.07	3

n.d. - Not detected

* - TCLP analysis

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 2/Ue5PW2

Analysis: Total Methods

Method: Silver 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW2-075-02-01*	24-Jun-92	75	n.d.	0.003	8
PW2-075-02-02*	24-Jun-92	75	n.d.	0.003	8
PW2-097-02-01*	24-Jun-92	97	n.d.	0.003	8
PW2-202-02-01	29-Jun-92	202	n.d.	0.3	25
PW2-407-02-01	14-Jul-92	407	n.d.	0.3	14
PW2-407-02-02	14-Jul-92	407	n.d.	0.3	14
PW2-825-02-01	10-Aug-92	825	<1.5	0.4	3
PW2-825-02-02	10-Aug-92	825	n.d.	0.5	3
PW2-075-02-03*	24-Jun-92	Field Blank	n.d.	0.003	8
PW2-407-02-03	14-Jul-92	Field Blank	n.d.	0.003	14
PW2-825-02-03	10-Aug-92	Field Blank	n.d.	0.005	3

n.d. - Not detected

* - TCLP analysis

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 3/Ue5PW-3

Analysis: Total Metals

Method: Selenium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW3-300-02-01	22-Sep-92	300	n.d.	6	7
PW3-300-02-02	22-Sep-92	300	n.d.	6	7
PW3-400-02-01	25-Sep-92	400	n.d.	6	12
PW3-400-02-02	25-Sep-92	400	n.d.	6	12
PW3-500-02-01	30-Sep-92	500	n.d.	6	5
PW3-500-02-02	30-Sep-92	500	n.d.	6	5
PW3-620-02-01	05-Oct-92	620	n.d.	6	2
PW3-620-02-02	05-Oct-92	620	n.d.	6	2

n.d. - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 3/Ue5PW-3

Analysis: Total Metals

Method: Arsenic 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW3-300-02-01	22-Sep-92	300	19	3	7
PW3-300-02-02	22-Sep-92	300	20	3	7
PW3-400-02-01	25-Sep-92	400	n.d.	3	12
PW3-400-02-02	25-Sep-92	400	n.d.	3	12
PW3-500-02-01	30-Sep-92	500	<9	3	5
PW3-500-02-02	30-Sep-92	500	<9	3	5
PW3-620-02-01	05-Oct-92	620	n.d.	3	2
PW3-620-02-02	05-Oct-92	620	<9	3	2

n.d. - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 3/Ue5PW-3

Analysis: Total Metals

Method: Barium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW3-300-02-01	22-Sep-92	300	140	0.08	7
PW3-300-02-02	22-Sep-92	300	139	0.08	7
PW3-400-02-01	25-Sep-92	400	140	0.09	12
PW3-400-02-02	25-Sep-92	400	140	0.09	12
PW3-500-02-01	30-Sep-92	500	140	0.09	5
PW3-500-02-02	30-Sep-92	500	130	0.09	5
PW3-620-02-01	05-Oct-92	620	83	0.09	2
PW3-620-02-02	05-Oct-92	620	75	0.09	2

n.d. - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 3/Ue5PW-3

Analysis: Total Metals

Method: Cadmium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW3-300-02-01	22-Sep-92	300	n.d.	0.4	7
PW3-300-02-02	22-Sep-92	300	n.d.	0.4	7
PW3-400-02-01	25-Sep-92	400	n.d.	0.4	12
PW3-400-02-02	25-Sep-92	400	n.d.	0.4	12
PW3-500-02-01	30-Sep-92	500	n.d.	0.4	5
PW3-500-02-02	30-Sep-92	500	n.d.	0.4	5
PW3-620-02-01	05-Oct-92	620	n.d.	0.4	2
PW3-620-02-02	05-Oct-92	620	n.d.	0.4	2

n.d. - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 3/Ue5PW-3

Analysis: Total Metals

Method: Chromium 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW3-300-02-01	22-Sep-92	300	5.9	0.6	7
PW3-300-02-02	22-Sep-92	300	5.6	0.6	7
PW3-400-02-01	25-Sep-92	400	5.4	0.6	12
PW3-400-02-02	25-Sep-92	400	6.0	0.6	12
PW3-500-02-01	30-Sep-92	500	6.8	0.6	5
PW3-500-02-02	30-Sep-92	500	6.9	0.6	5
PW3-620-02-01	05-Oct-92	620	6.8	0.6	2
PW3-620-02-02	05-Oct-92	620	7.1	0.6	2

n.d. - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 3/Ue5PW-3

Analysis: Total Metals

Method: Lead 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW3-300-02-01	22-Sep-92	300	<9.5	2.9	7
PW3-300-02-02	22-Sep-92	300	<9.3	2.9	7
PW3-400-02-01	25-Sep-92	400	<9.8	3	12
PW3-400-02-02	25-Sep-92	400	<9.8	3	12
PW3-500-02-01	30-Sep-92	500	<9.7	3	5
PW3-500-02-02	30-Sep-92	500	<9.7	3	5
PW3-620-02-01	05-Oct-92	620	<9.7	3	2
PW3-620-02-02	05-Oct-92	620	<9.7	3	2

n.d. - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 3/Ue5PW-3

Analysis: Total Metals

Method: Mercury 3050, 7470

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW3-300-02-01	22-Sep-92	300	n.d.	0.06	7
PW3-300-02-02	22-Sep-92	300	n.d.	0.06	7
PW3-400-02-01	25-Sep-92	400	n.d.	0.06	12
PW3-400-02-02	25-Sep-92	400	n.d.	0.06	12
PW3-500-02-01	30-Sep-92	500	n.d.	0.06	5
PW3-500-02-02	30-Sep-92	500	n.d.	0.06	5
PW3-620-02-01	05-Oct-92	620	n.d.	0.06	2
PW3-620-02-02	05-Oct-92	620	n.d.	0.06	2

n.d. - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 RWMS Pilot Well 3/Ue5PW-3

Analysis: Total Methods

Method: Silver 3050, 6010

Sample Matrix: Soil

Field ID	Collection Date	Depth (ft.)	Concentration (mg/kg)	Detection Limit	Holding Time (days)
PW3-300-02-01	22-Sep-92	300	n.d.	0.5	7
PW3-300-02-02	22-Sep-92	300	n.d.	0.5	7
PW3-400-02-01	25-Sep-92	400	n.d.	0.5	12
PW3-400-02-02	25-Sep-92	400	n.d.	0.5	12
PW3-500-02-01	30-Sep-92	500	n.d.	0.5	5
PW3-500-02-02	30-Sep-92	500	n.d.	0.5	5
PW3-620-02-01	05-Oct-92	620	n.d.	0.5	2
PW3-620-02-02	05-Oct-92	620	n.d.	0.5	2

n.d. - Not detected

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Pilot Well 1/Ue5PW-1

Analysis: Volatile Organics

Method: 8240

Collection Date: 18-Mar-92

Analysis Date: 26-Mar-92, 1-Apr-92

Matrix: Soil

Depth: 51 ft.

Compound	CAS Number	Sample	Duplicate	Trip Blank	Field Blank	Equipment Blank	Detection Limit	Units
Chloromethane	74-87-3	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Bromomethane	74-83-9	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Vinyl Chloride	75-01-4	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Chloroethane	75-00-3	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Methylene Chloride	75-09-2	5.B	4.JB	5	9	15	5	ug/kg
Acetone	67-64-1	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Carbon Disulfide	75-15-0	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,1-Dichloroethene	75-35-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,2-Dichloroethane	75-34-3	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,2-Dichloroethane(Total)	540-59-0	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
trans-1,2-Dichloroethene	540-59-0	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Chloroform	67-66-3	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,2-Dichloroethane	107-02-2	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
2-Butanone	78-93-3	40	30	n.d.	n.d.	n.d.	10	ug/kg
1,1,1-Trichloroethane	71-55-6	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Carbon Tetrachloride	56-23-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Vinyl Acetate	108-05-4	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Bromodichloromethane	75-27-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,2-Dichloropropane	78-87-5	n.d.	n.d.	3.J	3.J	3.J	5	ug/kg
cis-1,3-Dichloropropene	10061-01-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Trichloroethene	79-01-6	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Dibromochloromethane	124-48-1	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,1,2-Trichloroethane	79-00-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Benzene	71-43-2	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
trans-1,3-Dichloropropene	10061-02-6	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Bromoform	75-25-2	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
4-Methyl-2-pentanone	108-10-1	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
2-Hexanone	591-78-6	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Tetrachloroethene	127-18-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,1,2,2-Tetrachloroethane	79-34-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Toluene	108-88-3	4.J	2.J	n.d.	n.d.	n.d.	5	ug/kg
Chlorobenzene	108-90-7	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Ethylbenzene	100-41-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Styrene	100-42-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
m,p-Xylene	133-02-7	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Xylene(Total)	133-02-7	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Pilot Well 1/Ue5PW-1
Analysis: Volatile Organics
Method: 8240
Collection Date: 10-Jun-92
Analysis Date: 23-Jun-92
Matrix: Soil, Alluvium
Depth: 770 ft.

Compound	CAS Number	Sample	Duplicate	Trip Blank	Field Blank	Equipment Blank	Detection Limit	Units
Chloromethane	74-87-3	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Bromomethane	74-83-9	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Vinyl Chloride	75-01-4	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Chloroethane	75-00-3	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Methylene Chloride	75-09-2	24.B	29.B	13.B	36.B	35.B	5	ug/kg
Acetone	67-64-1	11	27	n.d.	n.d.	n.d.	10	ug/kg
Carbon Disulfide	75-15-0	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,1-Dichloroethene	75-35-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,2-Dichloroethane	75-34-3	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,2-Dichloroethene(Total)	540-59-0	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
trans-1,2-Dichloroethene	540-59-0	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Chloroform	67-66-3	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,2-Dichloroethane	107-02-2	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
2-Butanone	78-93-3	130	64	n.d.	n.d.	26	10	ug/kg
1,1,1-Trichloroethane	71-55-6	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Carbon Tetrachloride	56-23-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Vinyl Acetate	108-05-4	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Bromodichloromethane	75-27-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,2-Dichloropropane	78-87-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
cis-1,3-Dichloropropene	10061-01-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Trichloroethene	79-01-6	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Dibromochloromethane	124-48-1	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,1,2-Trichloroethane	79-00-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Benzene	71-43-2	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
trans-1,3-Dichloropropene	10061-02-6	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Bromoform	75-25-2	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
4-Methyl-2-pentanone	108-10-1	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
2-Hexanone	591-78-6	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Tetrachloroethene	127-18-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
1,1,2,2-Tetrachloroethane	79-34-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Toluene	108-88-3	6	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Chlorobenzene	108-90-7	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Ethylbenzene	100-41-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Styrene	100-42-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
m,p-Xylene	133-02-7	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg
Xylene(Total)	133-02-7	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/kg

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Pilot Well 2/UeSPW-2
Analysis: Volatile Organics
Method: 8240
Collection Date: 24-Jun-92
Analysis Date: 7-July-92
Matrix: Soil
Depth: 70 ft.

Compound	CAS Number	Sample	Duplicate	Trip Blank	Field Blank	Equipment Blank	Detection Limit	Units
Chloromethane	74-87-3	n.d.	n.d.	n.d.	n.d.	n.a.	10	ug/kg
Bromomethane	74-83-9	n.d.	n.d.	n.d.	n.d.	n.a.	10	ug/kg
Vinyl Chloride	75-01-4	n.d.	n.d.	n.d.	n.d.	n.a.	10	ug/kg
Chloroethane	75-00-3	n.d.	n.d.	n.d.	n.d.	n.a.	10	ug/kg
Methylene Chloride	75-09-2	27.B	6.B	n.d.	51.B	n.a.	5	ug/kg
Acetone	67-64-1	n.d.	17	n.d.	n.d.	n.a.	10	ug/kg
Carbon Disulfide	75-15-0	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
1,1-Dichloroethene	75-35-4	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
1,2-Dichloroethane	75-34-3	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
1,2-Dichloroethene(Total)	540-59-0	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
trans-1,2-Dichloroethene	540-59-0	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Chloroform	67-66-3	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
1,2-Dichloroethane	107-02-2	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
2-Butanone	78-93-3	180	180	n.d.	n.d.	n.a.	10	ug/kg
1,1,1-Trichloroethane	71-55-6	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Carbon Tetrachloride	56-23-5	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Vinyl Acetate	108-05-4	n.d.	n.d.	n.d.	n.d.	n.a.	10	ug/kg
Bromodichloromethane	75-27-4	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
1,2-Dichloropropane	78-87-5	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
cis-1,3-Dichloropropene	10061-01-5	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Trichloroethene	79-01-6	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Dibromochloromethane	124-48-1	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
1,1,2-Trichloroethane	79-00-5	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Benzene	71-43-2	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
trans-1,3-Dichloropropene	10061-02-6	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Bromoform	75-25-2	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
4-Methyl-2-pentanone	108-10-1	n.d.	n.d.	n.d.	n.d.	n.a.	10	ug/kg
2-Hexanone	591-78-6	n.d.	n.d.	n.d.	n.d.	n.a.	10	ug/kg
Tetrachloroethene	127-18-4	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
1,1,2,2-Tetrachloroethane	79-34-5	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Toluene	108-88-3	9	6	n.d.	n.d.	n.a.	5	ug/kg
Chlorobenzene	108-90-7	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Ethylbenzene	100-41-4	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Styrene	100-42-5	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
m,p-Xylene	133-02-7	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg
Xylene(Total)	133-02-7	n.d.	n.d.	n.d.	n.d.	n.a.	5	ug/kg

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

n.a. - Not analyzed

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 Pilot Well 1/Ue5PW-1

Analysis: Semi-Volatile Organics

Method: 8270

Collection Date: 18-Mar-92

Extraction Date: 19-Mar-92, 23-Mar-92

Analysis Date: 13-Apr-92

Matrix: Soil

Depth: 51 ft.

Compound	CAS Number	Sample	Duplicate	Field Blank	Equipment Blank	Detection Limit	Units
Phenol	108-95-2	n.d.	n.d.	n.d.	n.d.	670	ug/kg
bis(2-Chloroethyl)ether	111-44-4	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2-Chlorophenol	95-57-8	n.d.	n.d.	n.d.	n.d.	670	ug/kg
1,3-Dichlorobenzene	541-73-1	n.d.	n.d.	n.d.	n.d.	670	ug/kg
1,4-Dichlorobenzene	106-46-7	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Benzyl alcohol	100-51-6	n.d.	n.d.	n.d.	n.d.	670	ug/kg
1,2-Dichlorobenzene	95-50-1	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2-Methylphenol	95-48-7	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2,2'-oxybis(1-Chloropropane)	108-60-1	n.d.	n.d.	n.d.	n.d.	670	ug/kg
bis(2-Chloroisopropyl)ether	39638-32-9	n.d.	n.d.	n.d.	n.d.	670	ug/kg
4-Methylphenol	106-44-5	n.d.	n.d.	n.d.	n.d.	670	ug/kg
N-Nitroso-di-n-propylamine	621-64-7	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Hexachloroethane	67-72-1	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Nitrobenzene	98-95-3	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Isophorone	78-59-1	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2-Nitrophenol	88-75-5	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2,4-Dimethylphenol	105-67-9	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Benzoic acid	65-85-0	n.d.	n.d.	n.d.	n.d.	3400	ug/kg
bis(2-Chloroethoxy)methane	111-91-1	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2,4-Dichlorophenol	120-83-2	n.d.	n.d.	n.d.	n.d.	670	ug/kg
1,2,4-Trichlorobenzene	120-82-1	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Naphthalene	91-20-3	n.d.	n.d.	n.d.	n.d.	670	ug/kg
4-Chloroaniline	106-47-8	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Hexachlorobutadiene	87-68-3	n.d.	n.d.	n.d.	n.d.	670	ug/kg
4-Chloro-3-methylphenol	59-50-7	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2-Methylnaphthalene	91-57-6	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Hexachlorocyclopentadiene	77-47-4	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2,4,6-Trichlorophenol	88-06-2	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2,4,5-Trichlorophenol	95-95-4	n.d.	n.d.	n.d.	n.d.	3400	ug/kg
2-Chloronaphthalene	91-58-7	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2-Nitroaniline	88-74-4	n.d.	n.d.	n.d.	n.d.	3400	ug/kg
Dimethylphthalate	131-11-3	n.d.	n.d.	n.d.	n.d.	670	ug/kg

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 Pilot Well 1/Ue5PW-1

Analysis: Semi-Volatile Organics

Method: 8270

Collection Date: 18-Mar-92

Extraction Date: 19-Mar-92, 23-Mar-92

Analysis Date: 13-Apr-92

Matrix: Soil

Depth: 51 ft.

Compound	CAS Number	Sample	Duplicate	Field Blank	Equipment Blank	Detection Limit	Units
Acenaphthylene	208-96-8	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2,6-Dinitrotoluene	606-20-2	n.d.	n.d.	n.d.	n.d.	670	ug/kg
3-Nitroaniline	99-09-2	n.d.	n.d.	n.d.	n.d.	3400	ug/kg
Acenaphthene	83-32-9	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2,4-Dinitrophenol	51-28-5	n.d.	n.d.	n.d.	n.d.	3400	ug/kg
4-Nitrophenol	100-02-7	n.d.	n.d.	n.d.	n.d.	3400	ug/kg
Dibenzofuran	132-64-9	n.d.	n.d.	n.d.	n.d.	670	ug/kg
2,4-Dinitrotoluene	121-14-2	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Diethylphthalate	84-66-2	n.d.	n.d.	n.d.	n.d.	670	ug/kg
4-Chlorophenyl-phenylether	7005-72-3	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Fluorene	86-73-7	n.d.	n.d.	n.d.	n.d.	670	ug/kg
4-Nitroaniline	100-01-6	n.d.	n.d.	n.d.	n.d.	3400	ug/kg
4,6-Dinitro-2-methylphenol	534-52-1	n.d.	n.d.	n.d.	n.d.	3400	ug/kg
N-Nitrosodiphenylamine	86-30-6	n.d.	n.d.	n.d.	n.d.	670	ug/kg
4-Bromophenyl-phenylether	101-55-3	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Hexachlorobenzene	118-74-1	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Pentachlorophenol	87-86-5	n.d.	n.d.	n.d.	n.d.	3400	ug/kg
Phenanthrene	85-01-8	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Anthracene	120-12-7	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Carbazole	86-74-8	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Di-n-butylphthalate	84-74-2	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Fluoranthene	206-44-0	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Pyrene	129-00-0	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Butylbenzylphthalate	85-68-7	n.d.	n.d.	n.d.	n.d.	670	ug/kg
3,3'-Dichlorobenzidine	91-94-1	n.d.	n.d.	n.d.	n.d.	1300	ug/kg
Benzo(a)anthracene	56-55-3	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Chrysene	218-01-9	n.d.	n.d.	n.d.	n.d.	670	ug/kg
bis(2-Ethylhexyl)phthalate	117-81-7	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Di-n-octylphthalate	117-84-0	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Benzo(b)fluoranthene	205-99-2	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Benzo(k)fluoranthene	207-08-9	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Benzo(a)pyrene	50-32-8	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Indeno(1,2,3-cd)pyrene	193-39-5	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Dibenzo(a,h)anthracene	53-70-3	n.d.	n.d.	n.d.	n.d.	670	ug/kg
Benzo(g,h,i)perylene	191-24-2	n.d.	n.d.	n.d.	n.d.	670	ug/kg

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 Pilot Well 1/Ue5PW-1

Analysis: Semi-Volatile Organics

Method: 8270

Collection Date: 10-Jun-92

Extraction Date: 10-Jun-92, 11-Jun-92

Analysis Date: 29-Jun-92

Matrix: Soil

Depth: 770 ft.

Compound	CAS Number	Sample	Duplicate	Field Blank	Equipment Blank	Detection Limit	Units
Phenol	108-95-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
bis(2-Chloroethyl)ether	111-44-4	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2-Chlorophenol	95-57-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
1,3-Dichlorobenzene	541-73-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
1,4-Dichlorobenzene	106-46-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzyl alcohol	100-51-6	n.d.	n.d.	n.d.	n.d.	330	ug/kg
1,2-Dichlorobenzene	95-50-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2-Methylphenol	95-48-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,2'-oxybis(1-Chloropropane)	108-60-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
bis(2-Chloroisopropyl)ether	39638-32-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Methylphenol	106-44-5	n.d.	n.d.	n.d.	n.d.	330	ug/kg
N-Nitroso-di-n-propylamine	621-64-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Hexachloroethane	67-72-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Nitrobenzene	98-95-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Isophorone	78-59-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2-Nitrophenol	88-75-5	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4-Dimethylphenol	105-67-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzoic acid	65-85-0	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
bis(2-Chloroethoxy)methane	111-91-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4-Dichlorophenol	120-83-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
1,2,4-Trichlorobenzene	120-82-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Naphthalene	91-20-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Chloroaniline	106-47-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Hexachlorobutadiene	87-68-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Chloro-3-methylphenol	59-50-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2-Methylnaphthalene	91-57-6	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Hexachlorocyclopentadiene	77-47-4	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4,6-Trichlorophenol	88-06-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4,5-Trichlorophenol	95-95-4	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
2-Chloronaphthalene	91-58-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2-Nitroaniline	88-74-4	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
Dimethylphthalate	131-11-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 Pilot Well 1/Ue5PW-1

Analysis: Semi-Volatile Organics

Method: 8270

Collection Date: 10-Jun-92

Extraction Date: 10-Jun-92, 11-Jun-92

Analysis Date: 29-Jun-92

Matrix: Soil

Depth: 770 ft.

Compound	CAS Number	Sample	Duplicate	Field Blank	Equipment Blank	Detection Limit	Units
Acenaphthylene	208-96-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,6-Dinitrotoluene	606-20-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
3-Nitroaniline	99-09-2	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
Acenaphthene	83-32-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4-Dinitrophenol	51-28-5	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
4-Nitrophenol	100-02-7	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
Dibenzofuran	132-64-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4-Dinitrotoluene	121-14-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Diethylphthalate	84-66-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Chlorophenyl-phenylether	7005-72-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Fluorene	86-73-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Nitroaniline	100-01-6	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
4,6-Dinitro-2-methylphenol	534-52-1	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
N-Nitrosodiphenylamine	86-30-6	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Bromophenyl-phenylether	101-55-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Hexachlorobenzene	118-74-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Pentachlorophenol	87-86-5	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
Phenanthrene	85-01-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Anthracene	120-12-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Carbazole	86-74-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Di-n-butylphthalate	84-74-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Fluoranthene	206-44-0	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Pyrene	129-00-0	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Butylbenzylphthalate	85-68-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
3,3'-Dichlorobenzidine	91-94-1	n.d.	n.d.	n.d.	n.d.	660	ug/kg
Benzo(a)anthracene	56-55-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Chrysene	218-01-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
bis(2-Ethylhexyl)phthalate	117-81-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Di-n-octylphthalate	117-84-0	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzo(b)fluoranthene	205-99-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzo(k)fluoranthene	207-08-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzo(a)pyrene	50-32-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Indeno(1,2,3-cd)pyrene	193-39-5	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Dibenzo(a,h)anthracene	53-70-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzo(g,h,i)perylene	191-24-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 Pilot Well 2/Ue5PW-2

Analysis: Semi-Volatile Organics

Method: 8270

Collection Date: 24-Jun-92

Extraction Date: 29-Jun-92

Analysis Date: 28-Jul-92

Matrix: Soil

Depth: 70 ft.

Compound	CAS Number	Sample	Duplicate	Field Blank	Equipment Blank	Detection Limit	Units
Phenol	108-95-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
bis(2-Chloroethyl)ether	111-44-4	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2-Chlorophenol	95-57-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
1,3-Dichlorobenzene	541-73-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
1,4-Dichlorobenzene	106-46-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzyl alcohol	100-51-6	n.d.	n.d.	n.d.	n.d.	330	ug/kg
1,2-Dichlorobenzene	95-50-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2-Methylphenol	95-48-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,2'-oxybis(1-Chloropropane)	108-60-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
bis(2-Chloroisopropyl)ether	39638-32-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Methylphenol	106-44-5	n.d.	n.d.	n.d.	n.d.	330	ug/kg
N-Nitroso-di-n-propylamine	621-64-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Hexachloroethane	67-72-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Nitrobenzene	98-95-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Isophorone	78-59-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2-Nitrophenol	88-75-5	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4-Dimethylphenol	105-67-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzoic acid	65-85-0	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
bis(2-Chloroethoxy)methane	111-91-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4-Dichlorophenol	120-83-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
1,2,4-Trichlorobenzene	120-82-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Naphthalene	91-20-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Chloroaniline	106-47-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Hexachlorobutadiene	87-68-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Chloro-3-methylphenol	59-50-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2-Methylnaphthalene	91-57-6	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Hexachlorocyclopentadiene	77-47-4	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4,6-Trichlorophenol	88-06-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4,5-Trichlorophenol	95-95-4	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
2-Chloronaphthalene	91-58-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2-Nitroaniline	88-74-4	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
Dimethylphthalate	131-11-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Appendix E.4. Results of Sampling and Analysis for Hazardous and Radiological Parameters
in Core Samples (Continued)

Site: Area 5 Pilot Well 2/Ue5PW-2

Analysis: Semi-Volatile Organics

Method: 8270

Collection Date: 24-Jun-92

Extraction Date: 29-Jun-92

Analysis Date: 28-Jul-92

Matrix: Soil

Depth: 70 ft.

Compound	CAS Number	Sample	Duplicate	Field Blank	Equipment Blank	Detection Limit	Units
Acenaphthylene	208-96-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,6-Dinitrotoluene	606-20-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
3-Nitroaniline	99-09-2	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
Acenaphthene	83-32-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4-Dinitrophenol	51-28-5	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
4-Nitrophenol	100-02-7	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
Dibenzofuran	132-64-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
2,4-Dinitrotoluene	121-14-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Diethylphthalate	84-66-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Chlorophenyl-phenylether	7005-72-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Fluorene	86-73-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Nitroaniline	100-01-6	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
4,6-Dinitro-2-methylphenol	534-52-1	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
N-Nitrosodiphenylamine	86-30-6	n.d.	n.d.	n.d.	n.d.	330	ug/kg
4-Bromophenyl-phenylether	101-55-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Hexachlorobenzene	118-74-1	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Pentachlorophenol	87-86-5	n.d.	n.d.	n.d.	n.d.	1700	ug/kg
Phenanthrene	85-01-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Anthracene	120-12-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Carbazole	86-74-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Di-n-butylphthalate	84-74-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Fluoranthene	206-44-0	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Pyrene	129-00-0	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Butylbenzylphthalate	85-68-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
3,3'-Dichlorobenzidine	91-94-1	n.d.	n.d.	n.d.	n.d.	660	ug/kg
Benzo(a)anthracene	56-55-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Chrysene	218-01-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
bis(2-Ethylhexyl)phthalate	117-81-7	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Di-n-octylphthalate	117-84-0	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzo(b)fluoranthene	205-99-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzo(k)fluoranthene	207-08-9	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzo(a)pyrene	50-32-8	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Indeno(1,2,3-cd)pyrene	193-39-5	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Dibenzo(a,h)anthracene	53-70-3	n.d.	n.d.	n.d.	n.d.	330	ug/kg
Benzo(g,h,i)perylene	191-24-2	n.d.	n.d.	n.d.	n.d.	330	ug/kg

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Area 5 Pilot Wells

APPENDIX F

Field Test Data

- F.1 Near-Surface Soil Gas Surveys
 - F.1.1 Surface Soil Sampling, Analysis, and Results
 - F.1.2 Near-Surface Radon and Tritium Gas Sampling, Analysis, and Results
- F.2 Surface Geophysical Surveys
 - F.2.1 Resistivity Survey Data
 - F.2.2 Magnetic Survey Data
- F.3 Borehole Geophysical Surveys
 - F.3.1 Description of Borehole Geophysical Logging Tools Used
 - F.3.2 Borehole Geophysical Logs Run in UE5PW-1 on 4/20/1992
 - F.3.3 Borehole Geophysical Logs Run in UE5PW-1 on 6/16/1992
 - F.3.4 Borehole Deviation Logs Run in UE5PW-1 on 2/24/1993
 - F.3.5 Borehole Geophysical Logs Run in UE5PW-2 on 7/20/1992
 - F.3.6 Borehole Geophysical Logs Run in UE5PW-2 on 9/28/1992 and 9/29/1992
 - F.3.7 Borehole Deviation Logs Run in UE5PW-2 on 2/25/1993
 - F.3.8 Borehole Geophysical Logs Run in UE5PW-3 on 9/28/1992
 - F.3.9 Borehole Geophysical Logs Run in UE5PW-3 on 11/18/1992
 - F.3.10 Borehole Deviation Logs Run in UE5PW-3 on 2/25/1993
- F.4 In-Situ Air Permeability Testing Data
 - F.4.1 Dimensions of Air Permeability Testing Interval for the Pilot Wells
 - F.4.2 In-Situ Air Permeability Testing Data
 - F.4.3 Effective Air Permeabilities and Inertial Coefficients for Field Testing in the Pilot Wells
- F.5 Upper Aquifer Hydraulic Parameter Testing
 - F.5.1 Estimating the Water Table Slope under the Area 5 RWMS
 - F.5.2 Results of Hydraulic Conductivity Recovery Tests

Appendix F.1.1 Surface Soil Sampling, Analysis, and Results

Soil Sampling and Analysis Methods

Samples were collected from 20 cm by 20 cm by 2 cm deep cells selected randomly from a 30 m by 30 m grid centered at the borehole. Four random samples were collected from each of the unprepared and prepared sites, the only exception being the unprepared site at Ue5PW-1. The Ue5PW-1 site was disturbed by vehicle traffic prior to sampling for TPH and oil and grease. Due to the extent of the disturbance it was impossible to collect samples from this site using a randomized design. Therefore, three TPH and oil and grease samples were collected at 50 ft east, west and north of the borehole. Finally an additional grab sample was collected from a dark stained area southeast of the borehole location at the unprepared Ue5PW-2 site.

Oil and grease and TPH samples were collected in precleaned 500 ml glass jars. Samples for analysis of photon emitting radionuclides and plutonium were collected in 500 ml polyethylene bottles. Aliquots which were taken for analysis were not dried to constant mass or homogenized. Concentrations are expressed on a wet mass basis.

TPH samples were analyzed using EPA method 8015 (EPA 1986). Oil and grease samples were analyzed using a modification of EPA method 413.2 (EPA 1982). Photon emitting radionuclides and plutonium isotopes were analyzed using REECO Analytical Services Department (ASD) procedures. Analyses for photon emitting radionuclides were conducted with a high purity germanium detector. Soil samples for plutonium analysis were prepared by NaCO_3 fusion. Plutonium was separated from the dissolved sample by ion exchange and prepared for counting by electro-deposition. Plutonium isotopes were identified and quantified by alpha spectrometry.

Results for Ue5PW-1

The concentrations of chemical and radiological parameters found in soils from the unprepared and prepared Ue5PW-1 drill site do not indicate that this site was significantly contaminated. TPH was not detected in undisturbed soils. Oil was detected by TPH analysis in a single soil sample from the prepared drill site. The oil in this sample is most likely due to contamination from equipment used to grade and compact the site. The oil concentration, 44 mg/kg, was unlikely to have presented significant contamination concerns to drilling operations. Concentrations of oil and grease were low and unchanged by site preparation. These low concentrations may be due to naturally occurring organic matter in the soil.

The concentration of naturally occurring primordial radionuclides were unchanged by site preparation. The activity concentrations of ^{137}Cs in soil were low and reduced by site preparation to levels that posed little contamination concerns. The mean activity concentration of ^{137}Cs for the undisturbed site was 0.5 pCi/g. McArthur and Miller (1989) have reported that the activity concentration of ^{137}Cs in off-site surface soils in southern Nevada ranges from 0.3 pCi/g to 1.2 pCi/g. After preparation of the site, the mean ^{137}Cs activity concentration decreased to 0.1 pCi/g. ^{238}Pu plutonium activity concentrations were

Appendix F.1.1 Surface Soil Sampling, Analysis, and Results (Continued)

less than the detection limit in all samples. Low concentrations of $^{239,240}\text{Pu}$ were detected in two out of four samples.

Results for Ue5PW-2

The concentrations of chemical and radiological parameters in soils from undisturbed soils and the prepared drill site do not indicate that the Ue5PW-2 drill site was contaminated. Low concentrations of TPH as oil were detected in all samples from the undisturbed site. At a single site where used oil filters were present, a TPH(oil) concentration of 4200 mg/kg was found in a grab sample. The total area stained with oil was small, less than 1 m², and was removed during site preparation. After preparation of the site, TPH concentrations were less than the detection limit for all samples. Low concentrations of oil and grease were detected in a single random sample from the undisturbed site and from two samples in the prepared site. The mean oil and grease concentration was not changed by site preparation.

The activity concentrations of radionuclides at Ue5PW-2 were not different from that found in off-site soils for southern Nevada (McArthur and Miller 1989). The activity concentration of primordial radionuclides was unaffected by site preparation. Site preparation decreased the mean activity concentration of ^{137}Cs from 0.7 pCi/g to less than 0.06 pCi/g. $^{238}\text{Plutonium}$ and $^{239,240}\text{Pu}$ were detected in a single soil sample. The highest concentration of $^{239,240}\text{Pu}$ detected, 0.004 pCi/g, is within the range of concentrations expected for fallout in southern Nevada.

Results for Ue5PW-3

The concentrations of chemical and radiological parameters in soils from undisturbed soils and the prepared drill site do not indicate that the Ue5PW-3 drill site was contaminated. Low concentrations of TPH as oil were detected in undisturbed soils at Ue5PW-3. All TPH samples from the prepared site were less than the detection limit. Oil and grease concentration were low and unchanged by site preparation.

The activity concentrations of radionuclides at Ue5PW-3 were similar to those found in off-site soils for southern Nevada (McArthur and Miller 1989). The activity concentration of primordial radionuclides was unaffected by site preparation. The mean activity concentration of ^{137}Cs in undisturbed soil was 0.5 pCi/g and was not detected in any samples from the prepared site. The mean activity concentration of $^{239,240}\text{Pu}$, 0.032 pCi/g, was within the range of off-site soils. $^{238}\text{Plutonium}$ was not detected in any sample.

References

EPA, 1982. Methods for Chemical Analysis of Water and Waste, EPA-600/4-82-005.

EPA, 1986. Test Methods for Evaluating Solid Waste, Physical /Chemical Methods, SW-846.

Appendix F.1.1 Surface Soil Sampling, Analysis, and Results (Continued)

McArther, R.D., F.L. Miller, 1989. Off-Site Radiation Review Project Phase II, Soils Program, Desert Research Institute, Univ. of Nevada.

Appendix F.1.2 Near Surface Radon and Tritium Gas Sampling, Analysis, and Results

Appendix F.1.1 Surface Soil Sampling, Analysis, and Results (Continued)

Appendix F.1.1. Surface Soil Sampling, Analysis and Results

Area 5 Pilot Well 1/Ue5PW1

Undisturbed Drill Site/Simple Random Surface Samples

Sample Identification	Parameter	Method	Collection Date	Analysis Date	Concentration	% Uncertainty (2.0s)	Detection Limit	Units
N765,702.33	TPH(Total)	8015	28-Jan-92	30-Jan-92	<DL		20	mg/kg
E709,881.50	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
(SE-50W)	TPH(Oil)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	Oil and Grease	413.2	28-Jan-92	19-Mar-92	<DL		0.7	mg/kg
N 765,723.26	K-40	901.1	09-Jan-92	06-Feb-92	24	21	2	pCi/g
E 709,856.17	Cs-137	901.1	09-Jan-92	06-Feb-92	0.4	42	0.1	pCi/g
(SE-578-10-60)	Ra-226	901.1	09-Jan-92	06-Feb-92	1	31	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	39	0.4	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	2	25	0.2	pCi/g
N765,702.33	TPH(Total)	8015	28-Jan-92	30-Jan-92	<DL		20	mg/kg
E709,831.50	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
(SE-50N)	TPH(Oil)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	Oil and Grease	413.2	28-Jan-92	19-Mar-92	5.6		0.7	mg/kg
N765,720.05	K-40	901.1	09-Jan-92	06-Feb-92	22	22	2	pCi/g
E709,811.81	Cs-137	901.1	09-Jan-92	06-Feb-92	0.4	38	0.1	pCi/g
(SE-592-50-40)	Ra-226	901.1	09-Jan-92	06-Feb-92	1	30	0.1	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	36	0.4	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	2	25	0.2	pCi/g
N765,702.33	TPH(Total)	8015	28-Jan-92	30-Jan-92	<DL		20	mg/kg
E709,781.50	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
(SE-50E)	TPH(Oil)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	Oil and Grease	413.2	28-Jan-92	19-Mar-92	<DL		0.7	mg/kg
N765,665.91	K-40	901.1	09-Jan-92	06-Feb-92	25	20	1	pCi/g
E709,788.85	Cs-137	901.1	09-Jan-92	06-Feb-92	0.6	32	0.1	pCi/g
(SE-89-40-90)	Ra-226	901.1	09-Jan-92	06-Feb-92	1	29	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	37	0.4	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	2	22	0.2	pCi/g
N765,665.54	K-40	901.1	09-Jan-92	06-Feb-92	22	22	1	pCi/g
E709,788.19	Cs-137	901.1	09-Jan-92	06-Feb-92	0.4	39	0.1	pCi/g
(SE-119-19-70)	Ra-226	901.1	09-Jan-92	06-Feb-92	0.9	34	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	38	0.4	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	2	24	0.2	pCi/g
Mean Pilot Well 1	TPH(Total)				<DL			mg/kg
Concentrations	TPH(Diesel)				<DL			mg/kg
	TPH(Oil)				<DL			mg/kg
	Oil and Grease				1.9 - 2.3			mg/kg
	K-40				23	11		pCi/g
	Cs-137				0.5	38		pCi/g
	Ra-226				1	8.9		pCi/g
	Th-232				2	0.0		pCi/g
	Th-228				2	0.0		pCi/g

Appendix F.1.1 Surface Soil Sampling, Analysis, and Results (Continued)

Area 5 Pilot Well 1/Ue5PW-1

Prepared Drill Sites/Simple Random Surface Samples

Sample Identification	Parameter	Method	Collection Date	Analysis Date	Concentration	% Uncertainty (2s)	Detection Limit	Units
N765,680.02	TPH(Total)	8015	27-Feb-92	16-Mar-92	<DL		20	mg/kg
E709,836.09	TPH(Diesel)	8015	27-Feb-92	16-Mar-92	<DL		10	mg/kg
	TPH(Oil)	8015	27-Feb-92	16-Mar-92	<DL		10	mg/kg
(SE-6.8-1.4)	Oil and Grease	413.2	27-Feb-92	28-Mar-92	3.9		0.7	mg/kg
	K-40	901.1	27-Feb-92	13-Mar-92	24	8.9		pCi/g
	Cs-137	901.1	27-Feb-92	13-Mar-92	0.1	23		pCi/g
	Ra-226	901.1	27-Feb-92	13-Mar-92	0.8	12		pCi/g
	Th-232	901.1	27-Feb-92	13-Mar-92	1.4	13		pCi/g
	Th-228	901.1	27-Feb-92	13-Mar-92	1.6	9.5		pCi/g
	Pu-238	AABAB D.04.1	27-Feb-92	08-Jun-92	0.002	445		pCi/g
	Pu-239,240	AABAB D.04.1	27-Feb-92	08-Jun-92	0.003	105		pCi/g
N765,666.90	TPH(Total)	8015	27-Feb-92	16-Mar-92	<DL		20	mg/kg
E709,821.66	TPH(Diesel)	8015	27-Feb-92	16-Mar-92	<DL		10	mg/kg
	TPH(Oil)	8015	27-Feb-92	16-Mar-92	<DL		10	mg/kg
(SE-10.8-3)	Oil and Grease	413.2	27-Feb-92	28-Mar-92	1.4		0.7	mg/kg
	K-40	901.1	27-Feb-92	14-Mar-92	24.1	8.9		pCi/g
	Cs-137	901.1	27-Feb-92	14-Mar-92	0.05	40		pCi/g
	Ra-226	901.1	27-Feb-92	14-Mar-92	0.8	12		pCi/g
	Th-232	901.1	27-Feb-92	14-Mar-92	1.4	13		pCi/g
	Th-228	901.1	27-Feb-92	14-Mar-92	1.5	9.6		pCi/g
	Pu-238	AABAB D.04.1	27-Feb-92	08-Jun-92	0.004	283		pCi/g
	Pu-239,240	AABAB D.04.1	27-Feb-92	08-Jun-92	0.06	44		pCi/g
N765,707.58	TPH(Total)	8015	27-Feb-92	16-Mar-92	<DL		20	mg/kg
E709,856.11	TPH(Diesel)	8015	27-Feb-92	16-Mar-92	<DL		10	mg/kg
	TPH(Oil)	8015	27-Feb-92	16-Mar-92	<DL		10	mg/kg
(SE-1.6-7)	Oil and Grease	413.2	27-Feb-92	28-Mar-92	<DL		0.7	mg/kg
	K-40	901.1	27-Feb-92	20-Mar-92	23.6	8.9		pCi/g
	Cs-137	901.1	27-Feb-92	20-Mar-92	0.04	48		pCi/g
	Ra-226	901.1	27-Feb-92	20-Mar-92	0.8	13		pCi/g
	Th-232	901.1	27-Feb-92	20-Mar-92	1.4	13		pCi/g
	Th-228	901.1	27-Feb-92	20-Mar-92	1.6	9.5		pCi/g
	Pu-238	AABAB D.04.1	27-Feb-92	08-Jun-92	0.006	202		pCi/g
	Pu-239,240	AABAB D.04.1	27-Feb-92	08-Jun-92	0.006	92		pCi/g
N765,721.36	TPH(Total)	8015	27-Feb-92	16-Mar-92	44.2		20	mg/kg
E709,828.22	TPH(Diesel)	8015	27-Feb-92	16-Mar-92	<DL		10	mg/kg
	TPH(Oil)	8015	27-Feb-92	16-Mar-92	44.2		10	mg/kg
(SE-5.8-1)	Oil and Grease	413.2	27-Feb-92	28-Mar-92	<DL		0.7	mg/kg
	K-40	901.1	27-Feb-92	21-Mar-92	25.0	8.8		pCi/g
	Cs-137	901.1	27-Feb-92	21-Mar-92	0.1	20		pCi/g
	Ra-226	901.1	27-Feb-92	21-Mar-92	0.9	12		pCi/g
	Th-232	901.1	27-Feb-92	21-Mar-92	1.6	12		pCi/g
	Th-228	901.1	27-Feb-92	21-Mar-92	1.7	9.4		pCi/g
	Pu-238	AABAB D.04.1	27-Feb-92	08-Jun-92	-0.007	96		pCi/g
	Pu-239,240	AABAB D.04.1	27-Feb-92	08-Jun-92	0.020	59		pCi/g
Mean Pilot Well 1 Concentrations	TPH(Total)				11 - 26			mg/kg
	TPH(Diesel)				<DL			mg/kg
	TPH(Oil)				11 - 21			mg/kg
	Oil and Grease				2.6			mg/kg
	K-40				24.2	4.2		pCi/g
	Cs-137				0.1	76.5		pCi/g
	Ra-226				0.8	10.5		pCi/g
	Th-232				1	11.9		pCi/g
	Th-228				2	8.8		pCi/g
	Pu-238				0.001	795.0		pCi/g
	Pu-239,240				0.022	204.2		pCi/g

Appendix F.1.1 Surface Soil Sampling, Analysis, and Results (Continued)

Area 5 Pilot Well 2/Ue5PW2
Undisturbed Sites/Random Surface Soil Samples

Sample Identification	Parameter	Method	Collection Date	Analysis Date	Concentration	% Uncertainty (2.0s)	Detection Limit	Units
N 770,395.89	TPH(Total)	8015	28-Jan-92	30-Jan-92	21.2		10	mg/kg
E 709,831.47	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	TPH(Oil)	8015	28-Jan-92	30-Jan-92	21.2		10	mg/kg
(NE-409-20-90)	Oil and Grease	413.2	28-Jan-92	19-Mar-92	<DL		0.7	mg/kg
	K-40	901.1	09-Jan-92	06-Feb-92	25	20	1	pCi/g
	Cs-137	901.1	09-Jan-92	06-Feb-92	0.5	38	0.1	pCi/g
	Ra-226	901.1	09-Jan-92	06-Feb-92	1	32	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	34	0.4	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	2	21	0.2	pCi/g
N 770,367.35	TPH(Total)	8015	28-Jan-92	30-Jan-92	20		10	mg/kg
E 709,887.90	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	TPH(Oil)	8015	28-Jan-92	30-Jan-92	20		10	mg/kg
(NE-167-70-20)	Oil and Grease	413.2	28-Jan-92	19-Mar-92	<DL		0.7	mg/kg
	K-40	901.1	09-Jan-92	06-Feb-92	25	20	1	pCi/g
	Cs-137	901.1	09-Jan-92	06-Feb-92	0.6	32	0.1	pCi/g
	Ra-226	901.1	09-Jan-92	06-Feb-92	1	33	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	36	0.4	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	2	22	0.2	pCi/g
N 770,350.61	TPH(Total)	8015	28-Jan-92	30-Jan-92	21.8		10	mg/kg
E 709,889.21	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	TPH(Oil)	8015	28-Jan-92	30-Jan-92	21.8		10	mg/kg
(NE-16-30-10)	Oil and Grease	413.2	28-Jan-92	19-Mar-92	5.6		0.7	mg/kg
	K-40	901.1	09-Jan-92	06-Feb-92	29	19	1	pCi/g
	Cs-137	901.1	09-Jan-92	06-Feb-92	0.6	31	0.1	pCi/g
	Ra-226	901.1	09-Jan-92	06-Feb-92	1	30	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	37	0.4	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	2	21	0.2	pCi/g
N 770,413.93	TPH(Total)	8015	28-Jan-92	30-Jan-92	22.2		10	mg/kg
E 709,857.39	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	TPH(Oil)	8015	28-Jan-92	30-Jan-92	22.2		10	mg/kg
(NE-597-40-0)	Oil and Grease	413.2	28-Jan-92	19-Mar-92	<DL		0.7	mg/kg
	K-40	901.1	09-Jan-92	06-Feb-92	25	20	1	pCi/g
	Cs-137	901.1	09-Jan-92	06-Feb-92	0.9	27	0.1	pCi/g
	Ra-226	901.1	09-Jan-92	06-Feb-92	0.9	37	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	39	0.4	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	2	23	0.2	pCi/g
Pilot Well 2 Site	TPH(Total)	8015	27-Jan-02	04-Feb-92	4200		10	mg/kg
Soil Grab Sample	TPH(Diesel)	8015	27-Jan-02	04-Feb-92	<DL		10	mg/kg
from	TPH(Oil)	8015	27-Jan-02	04-Feb-92	4200		10	mg/kg
Discarded Oil Filters	Oil and Grease	413.2	27-Jan-02	11-Feb-92	1435		0.7	mg/kg
Mean Pilot Well 2	TPH(Total)				21.3	7.8		mg/kg
Concentration	TPH(Diesel)				<DL			mg/kg
	TPH(Oil)				21.3	7.8		mg/kg
	Oil and Grease				1.4 - 1.9			mg/kg
	K-40				26	13.3		pCi/g
	Cs-137				0.7	46.2		pCi/g
	Ra-226				1.0	8.9		pCi/g
	Th-232				2	0.0		pCi/g
	Th-228				2	0.0		pCi/g

Appendix F.1.1 Surface Soil Sampling, Analysis, and Results (Continued)

Area 5 Pilot Well 2/Ue5PW2

Prepared Drill Site/Simple Random Surface Sample

Sample Identification	Parameter	Method	Collection Date	Analysis Date	Concentration	% Uncertainty (2s)	Detection Limit	Units
N 770,369.70	TPH(Total)	8015	07-May-92	16-May-92	<DL		10	mg/kg
E 709,913.82	TPH(Diesel)	8015	07-May-92	16-May-92	<DL		10	mg/kg
	TPH(Oil)	8015	07-May-92	16-May-92	<DL		10	mg/kg
(PW2-620-1080)	Oil and Grease	413.2	07-May-92	27-May-92	<DL		1.4	mg/kg
	K-40	901.1	07-May-92	18-Jun-92	30.8	11.9	0.4	pCi/g
	Cs-137	901.1	07-May-92	18-Jun-92	<DL			pCi/g
	Ra-226	901.1	07-May-92	18-Jun-92	1	17	0.08	pCi/g
	Th-232	901.1	07-May-92	18-Jun-92	2	20	0.1	pCi/g
	Th-228	901.1	07-May-92	18-Jun-92	2	14	0.1	pCi/g
	Pu-238	AABAB.D.04	07-May-92	07-Jul-92	0.01	86	0.008	pCi/g
	Pu-239,240	AABAB.D.04	07-May-92	07-Jul-92	0.002	106	0.003	pCi/g
N 770,354.22	TPH(Total)	8015	07-May-92	16-May-92	<DL		10	mg/kg
E 709,941.38	TPH(Diesel)	8015	07-May-92	16-May-92	<DL		10	mg/kg
	TPH(Oil)	8015	07-May-92	16-May-92	<DL		10	mg/kg
(PW2-1460-1280)	Oil and Grease	413.2	07-May-92	27-May-92	<DL		1.4	mg/kg
	K-40	901.1	07-May-92	18-Jun-92	28.7	12	0.3	pCi/g
	Cs-137	901.1	07-May-92	18-Jun-92	0.06	81	0.04	pCi/g
	Ra-226	901.1	07-May-92	18-Jun-92	1	17	0.1	pCi/g
	Th-232	901.1	07-May-92	18-Jun-92	2	21	0.2	pCi/g
	Th-228	901.1	07-May-92	18-Jun-92	2	14	0.1	pCi/g
	Pu-238	AABAB.D.04	07-May-92	07-Jul-92	0.005	135	0.01	pCi/g
	Pu-239,240	AABAB.D.04	07-May-92	07-Jul-92	0.002	152	0.003	pCi/g
N 770,364.72	TPH(Total)	8015	07-May-92	16-May-92	<DL		10	mg/kg
E 709850.82	TPH(Diesel)	8015	07-May-92	16-May-92	<DL		10	mg/kg
	TPH(Oil)	8015	07-May-92	16-May-92	<DL		10	mg/kg
(PW2-1300-960)	Oil and Grease	413.2	07-May-92	27-May-92	2		0.7	mg/kg
	K-40	901.1	07-May-92	18-Jun-92	26.6	12	0.4	pCi/g
	Cs-137	901.1	07-May-92	18-Jun-92	<DL			pCi/g
	Ra-226	901.1	07-May-92	18-Jun-92	<DL			pCi/g
	Th-232	901.1	07-May-92	18-Jun-92	2	20	0.2	pCi/g
	Th-228	901.1	07-May-92	18-Jun-92	2	15	0.1	pCi/g
	Pu-238	AABAB.D.04	07-May-92	07-Jul-92	0.004	141	0.007	pCi/g
	Pu-239,240	AABAB.D.04	07-May-92	07-Jul-92	0.004	81	0.003	pCi/g
N 770,432.31	TPH(Total)	8015	07-May-92	16-May-92	<DL		10	mg/kg
E 709,926.94	TPH(Diesel)	8015	07-May-92	16-May-92	<DL		10	mg/kg
	TPH(Oil)	8015	07-May-92	16-May-92	<DL		10	mg/kg
(PW2-1020-1100)	Oil and Grease	413.2	07-May-92	27-May-92	2		0.7	mg/kg
	K-40	901.1	07-May-92	18-Jun-92	27.6	12	0.3	pCi/g
	Cs-137	901.1	07-May-92	18-Jun-92	<DL			pCi/g
	Ra-226	901.1	07-May-92	18-Jun-92	1	19	0.1	pCi/g
	Th-232	901.1	07-May-92	18-Jun-92	2	21	0.2	pCi/g
	Th-228	901.1	07-May-92	18-Jun-92	2	15	0.1	pCi/g
	Pu-238	AABAB.D.04	07-May-92	07-Jul-92	0.001	397	0.006	pCi/g
	Pu-239,240	AABAB.D.04	07-May-92	07-Jul-92	0.002	117	0.002	pCi/g
Mean Pilot Well 2 Concentrations	TPH(Total)				<DL			mg/kg
	TPH(Diesel)				<DL			mg/kg
	TPH(Oil)				<DL			mg/kg
	Oil and Grease				1.5			mg/kg
	K-40				28	42		pCi/g
	Cs-137				0.01 - 0.06			pCi/g
	Ra-226				0.3			pCi/g
	Th-232				2.0	22		pCi/g
	Th-228				2.0	0		pCi/g
	Pu-238				0.001	1187		pCi/g
	Pu-239,240				0.003	137		pCi/g

Appendix F.1.1 Surface Soil Sampling, Analysis, and Results (Continued)

Area 5 Pilot Well 3/Ue5PW3
Undisturbed Sites/Random Surface Soil Samples

Sample Identification	Parameter	Method	Collection Date	Analysis Date	Concentration	% Uncertainty (2.0s)	Detection Limit	Units
N767194.61	TPH(Total)	8015	28-Jan-92	30-Jan-92	15.7		10	mg/kg
E707032.86	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	TPH(Oil)	8015	28-Jan-92	30-Jan-92	15.7		10	mg/kg
(NW-10-20-30)	Oil and Grease	413.2	28-Jan-92	19-Mar-92	3.4		0.7	mg/kg
	K-40	901.1	09-Jan-92	06-Feb-92	25	21	2	pCi/g
	Cs-137	901.1	09-Jan-92	06-Feb-92	0.6	33	0.1	pCi/g
	Ra-226	901.1	09-Jan-92	06-Feb-92	0.8	39	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	34	0.4	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	2	22	0.2	pCi/g
N767247.10	TPH(Total)	8015	28-Jan-92	30-Jan-92	21.5		10	mg/kg
E707051.89	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	TPH(Oil)	8015	28-Jan-92	30-Jan-92	21.5		10	mg/kg
(NW-125-60-90)	Oil and Grease	413.2	28-Jan-92	19-Mar-92	<DL		0.7	mg/kg
	K-40	901.1	09-Jan-92	06-Feb-92	30	19	1	pCi/g
	Cs-137	901.1	09-Jan-92	06-Feb-92	0.3	45	0.1	pCi/g
	Ra-226	901.1	09-Jan-92	06-Feb-92	1	31	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	35	0.5	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	3	20	0.2	pCi/g
N767155.89	TPH(Total)	8015	28-Jan-92	30-Jan-92	20.6		10	mg/kg
E706970.85	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	TPH(Oil)	8015	28-Jan-92	30-Jan-92	20.6		10	mg/kg
(NW-300-20-20)	Oil and Grease	413.2	28-Jan-92	19-Mar-92	<DL		0.7	mg/kg
	K-40	901.1	09-Jan-92	06-Feb-92	31	18	1	pCi/g
	Cs-137	901.1	09-Jan-92	06-Feb-92	0.5	41	0.1	pCi/g
	Ra-226	901.1	09-Jan-92	06-Feb-92	1	31	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	2	32	0.4	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	3	19	0.2	pCi/g
N767173.61	TPH(Total)	8015	28-Jan-92	30-Jan-92	<DL		20	mg/kg
E707052.21	TPH(Diesel)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
	TPH(Oil)	8015	28-Jan-92	30-Jan-92	<DL		10	mg/kg
(NW-545-40-30)	Oil and Grease	413.2	28-Jan-92	19-Mar-92	<DL		0.7	mg/kg
	K-40	901.1	09-Jan-92	06-Feb-92	32	18	1	pCi/g
	Cs-137	901.1	09-Jan-92	06-Feb-92	0.5	38	0.5	pCi/g
	Ra-226	901.1	09-Jan-92	06-Feb-92	1	31	0.2	pCi/g
	Th-232	901.1	09-Jan-92	06-Feb-92	3	26	0.04	pCi/g
	Th-228	901.1	09-Jan-92	06-Feb-92	3	19	0.2	pCi/g
Mean Pilot Well 3 Concentrations	TPH(Total)				16.7			mg/kg
	TPH(Diesel)				<DL			mg/kg
	TPH(Oil)				13.6			mg/kg
	Oil and Grease				0.8 - 1.4			mg/kg
	K-40				30	18		pCi/g
	Cs-137				0.5	46		pCi/g
	Ra-226				1.0	18		pCi/g
	Th-232				2	38		pCi/g
	Th-228				3	31		pCi/g

Appendix F.1.1 Surface Soil Sampling, Analysis, and Results (Continued)

Area 5 Pilot Well 3/Ue5PW3
Prepared Drill Site/Simple Random Surface Sample

Sample Identification	Parameter	Method	Collection Date	Analysis Date	Concentration	% Uncertainty (2s)	Detection Limit	Units
N767195.14	TPH(Total)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
E707011.82	TPH(Diesel)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
	TPH(Oil)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
(PW3-168-22)	Oil and Grease	413.2	08-Sep-92	01-Oct-92	2.7		1.4	mg/kg
	K-40	901.1	08-Sep-92	09-Sep-92	15	24		pCi/g
	Cs-137	901.1	08-Sep-92	09-Sep-92	<DL			pCi/g
	Ra-226	901.1	08-Sep-92	09-Sep-92	0.9	32		pCi/g
	Th-232	901.1	08-Sep-92	09-Sep-92	1	41		pCi/g
	Th-228	901.1	08-Sep-92	09-Sep-92	1	27		pCi/g
	Pu-238	AABAB.D.04	08-Sep-92	29-Sep-92	0.0005	116		pCi/g
	Pu-239,240	AABAB.D.04	08-Sep-92	29-Sep-92	0.009	29		pCi/g
N767247.64	TPH(Total)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
E707006.31	TPH(Diesel)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
	TPH(Oil)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
(PW3-0-138)	Oil and Grease	413.2	08-Sep-92	01-Oct-92	<DL		1.4	mg/kg
	K-40	901.1	08-Sep-92	09-Sep-92	32	18		pCi/g
	Cs-137	901.1	08-Sep-92	09-Sep-92	<DL			pCi/g
	Ra-226	901.1	08-Sep-92	09-Sep-92	2	29		pCi/g
	Th-232	901.1	08-Sep-92	09-Sep-92	3	27		pCi/g
	Th-228	901.1	08-Sep-92	09-Sep-92	3	19		pCi/g
	Pu-238	AABAB.D.04	08-Sep-92	29-Sep-92	0.0007	201		pCi/g
	Pu-239,240	AABAB.D.04	08-Sep-92	29-Sep-92	0.08	26		pCi/g
N767156.43	TPH(Total)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
E707048.96	TPH(Diesel)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
	TPH(Oil)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
(PW3-13-14)	Oil and Grease	413.2	08-Sep-92	01-Oct-92	<DL		1.4	mg/kg
	K-40	901.1	08-Sep-92	09-Sep-92	18	22		pCi/g
	Cs-137	901.1	08-Sep-92	09-Sep-92	<DL			pCi/g
	Ra-226	901.1	08-Sep-92	09-Sep-92	1	28		pCi/g
	Th-232	901.1	08-Sep-92	09-Sep-92	1	34		pCi/g
	Th-228	901.1	08-Sep-92	09-Sep-92	1	20		pCi/g
	Pu-238	AABAB.D.04	08-Sep-92	29-Sep-92	0.0004	142		pCi/g
	Pu-239,240	AABAB.D.04	08-Sep-92	29-Sep-92	0.02	24		pCi/g
N767174.14	TPH(Total)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
E706980.39	TPH(Diesel)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
	TPH(Oil)	8015	08-Sep-92	17-Sep-92	<DL		10	mg/kg
(PW3-79-86)	Oil and Grease	413.2	08-Sep-92	01-Oct-92	<DL		1.4	mg/kg
	K-40	901.1	08-Sep-92	09-Sep-92	30	18		pCi/g
	Cs-137	901.1	08-Sep-92	09-Sep-92	<DL			pCi/g
	Ra-226	901.1	08-Sep-92	09-Sep-92	1	28		pCi/g
	Th-232	901.1	08-Sep-92	09-Sep-92	2	34		pCi/g
	Th-228	901.1	08-Sep-92	09-Sep-92	3	20		pCi/g
	Pu-238	AABAB.D.04	08-Sep-92	29-Sep-92	0.0004	142		pCi/g
	Pu-239,240	AABAB.D.04	08-Sep-92	29-Sep-92	0.02	24		pCi/g
Mean Pilot Well 3 Concentrations	TPH(Total)				<DL			mg/kg
	TPH(Diesel)				<DL			mg/kg
	TPH(Oil)				<DL			mg/kg
	Oil and Grease				0.7 - 1.7			mg/kg
	K-40				24	54		pCi/g
	Cs-137				<DL			pCi/g
	Ra-226				1	58		pCi/g
	Th-232				2	40		pCi/g
	Th-228				2	43		pCi/g
	Pu-238				0.001	24		pCi/g
	Pu-239,240				0.032	92		pCi/g

Appendix F.1.2 Near Surface Radon and Tritium Gas Sampling, Analysis, and Results

Radon Soil Gas Surveys

Gas samples were obtained by connecting the appropriate sample line through a 0.8 micron filter to a 175 cm³ Lucas cell. The Lucas cell and sample lines were purged by pumping at least 10 exchange volumes at a 3 liter per minute rate. The Lucas cell was then sealed. The samples were then allowed to decay for approximately 4 hours and counted by a photomultiplier for 10 to 30 minutes in order to obtain a minimum of 1000 counts. Specific Lucas cells were assigned to each sample depth so that the same cell would be used for each specific depth at any particular location, as well as for repeat measurements.

The radon counting system used was an RDA-200 manufactured by EDA Instruments in Toronto, Canada. Calibration of the Lucas cells was performed at the Environmental Protection Agency's Radon Calibration Facility in Las Vegas, Nevada on April 22, 1992. Cell calibration factors and assignments are detailed in Table 1. Sampling, operation, calibration, and calculation procedures followed are found in the EDA-200 Operators Manual and REECO Standard Operating Procedures Manual - Radon Sampling Procedures, 3/11/91, AADzA.D.06.00. Radon-222 activity levels in the soils at the three Pilot Well sites is summarized in Tables 2, Table 3, and Table 4 in the following.

Table 1. Lucas Cell Assignments

Cell number	Cell Volume (L)	Depth (ft)	Calibration CPM/pCi
2	0.170	3	3.00
5	0.170	9	3.30
3	0.170	21	3.53

Appendix F.1.2 Near Surface Radon and Tritium Gas Sampling, Analysis, and Results
(Continued)

Table 2. Pilot Well Ue5PW-1 Radon-222 Soil Gas Survey Data

Date	Counts	Count time (min)	Count time delay (hr)	Decay correction	Concentration pCi/L		
					3 ft	9 ft	21 ft
10/17/91	1162	10	4.00	.9702	232		
	4377	30	6.05	.9554		270	
	4463	30	5.10	.9622			255
10/23/91	1867	30	3.33	.9752	122		
	4019	30	3.78	.9719		243	
	4573	30	5.63	.9584			263
10/30/91	211	10	6.73	.9504	44		
	940	10	6.93	.9490		177	
	1262	10	7.06	.9481			222

Appendix F.1.2 Near Surface Radon and Tritium Gas Sampling, Analysis, and Results
(Continued)

Table 3 Pilot Well Ue5PW-2 Radon-222 Soil Gas Survey Data

Date	Counts	Count time (min)	Count time delay (hr)	Decay correction	Concentration pCi/L		
					3 ft	9 ft	17 ft
1/23/92	967	10	3.58	0.9733	192		
	2260	10	2.47	0.9815		385	
	2172	10	2.02	0.9849			366
1/28/92	1217	10	4.70	0.9651	245		
	2068	10	5.05	0.9626		380	
	2132	10	5.53	0.9591			369
2/4/92	750	10	4.37	0.9675	147		
	985	10	4.67	0.9654		179	
	1266	10	4.95	0.9633			217
2/5/92	656	10	5.57	0.9588	132		
	1127	10	5.28	0.9609		207	
	1164	10	5.68	0.9580			201
2/19/92	675	10	4.48	0.9667	135		
	1041	10	4.93	0.9635		190	
	1261	10	5.27	0.9610			217

Appendix F.1.2 Near Surface Radon and Tritium Gas Sampling, Analysis, and Results
(Continued)

Table 4 Pilot Well Ue5PW-3 Radon-222 Soil Gas Survey Data

Date	Counts	Count time (min)	Count time delay (hr)	Decay correction	Concentration pCi/L		
					3 ft	9 ft	21 ft
7/28/92	1966	10	7.68	0.9501	403		
	4520	10	6.17	0.9545		842	
	6044	10	5.41	0.9600			1047
7/29/92	2316	10	8.65	0.9368	482		
	4261	10	8.43	0.9383		807	
	5112	10	7.40	0.9457			899
7/30/92	7048	30	6.56	0.9517	482		
	14431	30	6.15	0.9546		897	
	15913	30	6.97	0.9488			930
8/3/92	2259	10	4.28	0.9682	455		
	4837	10	4.50	0.9666		889	
	4927	10	5.16	0.9618			852
8/4/92	2558	10	6.18	0.9544	523		
	5067	10	6.42	0.9527		946	
	4950	10	6.80	0.9500			867
8/11/92	6328	30	6.35	0.9532	431		
	13309	30	6.83	0.9497		830	
	14016	30	7.76	0.9431			824

Appendix F.1.2 Near Surface Radon and Tritium Gas Sampling, Analysis, and Results (Continued)

Tritium Soil Gas Surveys

Soil gas samples of water vapor were obtained from each of the pilot well locations for screening purposes to insure that drill sites were free of elevated levels of tritium that could cause health and safety and/or environmental problems. Possible sources of tritium could be expected to occur from world-wide fallout and local fallout of pre-1963 above ground nuclear weapons testing as well as from waste disposal operations.

The soil gas samples were obtained by driving a soil gas probe to selected depths and extracting a sufficient volume of pore gas (water vapor) through two series connected cold traps to condense and extract approximately 5 ml of liquid sample. The cold traps were inserted into a dewar flask containing dry ice and alcohol which condensed and extracted the water vapor. Flow rates were set at approximately 3 liters per minute so that all of the moisture was condensed within the first trap. The second trap was used to provide an indication of break-through from the first trap if flow rates were set too high. In all cases the first cold trap was sufficient to extract all the water vapor.

Tritium was analyzed as tritium oxide using REECO Analytical Service's low background liquid scintillation counter. This system is capable of detection limits near environmental levels without using enrichment techniques. Count times of 300 minutes were used with the minimum detectable amount ranging between 0.16 to 0.48 pCi/ml. Sampling methodologies and counting procedures are found in REECO Special Projects Section Standard Operating Procedures Manual - Measurement of Tritium Oxide in Soil Pore Gas, 8/13/91, AADzD.T.07.00. Tables 5,6,and 7 detail the results of the tritium soil gas survey for Pilot Wells sites Ue5PW-1, Ue5PW-2 and Ue5Pw-3, respectively.

Appendix F.1.2 Near Surface Radon and Tritium Gas Sampling, Analysis, and Results
(Continued)

Table 5 Pilot Well Ue5PW-1 Tritium Oxide Soil Gas Survey Data

Sample ID / Lab ID	Sample Date	Minimum Detectable Amount pCi/ml	Sample Activity ¹ pCi/ml		
			3 ft	9 ft	21 ft
T7SE 3FT / 77502	10/24/91	0.353	0.500		
T6SE 9FT / 77501	10/24/91	0.353		(0.042)	
T3SE 21FT / 77500	10/24/91	0.353			(0.152)
T7SE 3FT / 77513	10/24/91	0.196	0.419		
T6SE 9FT / 77512	10/24/91	0.196		(-0.090)	
T3SE 21FT / 77511	10/24/91	0.196			(-0.090)
3BT5 3FT / 77507	10/30/91	0.248	0.536		
2BT5 9FT / 77506	10/30/91	0.248		(0.082)	
4BT6 21FT / 77508	10/30/91	0.248			(0.053)

Appendix F.1.2 Near Surface Radon and Tritium Gas Sampling, Analysis, and Results
(Continued)

Table 6 Pilot Well Ue5PW-2 Tritium Oxide Soil Gas Survey Data

Sample ID / Lab ID	Sample Date	Minimum Detectable Amount pCi/ml	Sample Activity ¹ pCi/ml		
			3 ft	9 ft	17 ft
T6 3' PWNE / 77533	1/28/92	0.283	(0.129)		
T8 9' PWNE / 77530	1/28/92	0.480		(-0.379)	
T5 17' PWNE / 77534	1/28/92	0.283			(-0.250)
T6 3' PWNEB / 77535	2/04/92	0.283	(0.151)		
T8 9' PWNEB / 77538	2/04/92	0.197		(0.017)	
T5 17' PWNE / 77539	2/04/92	0.197			(-0.088)

Appendix F.1.2 Near Surface Radon and Tritium Gas Sampling, Analysis, and Results
(Continued)

Table 7 Pilot Well Ue5PW-3 Tritium Oxide Soil Gas Survey Data

Sample ID / Lab ID	Sample Date	Minimum Detectable Amount pCi/ml	Sample Activity ¹ pCi/ml		
			3 ft	9 ft	21 ft
PW3 T5 3' / 77614	7/30/92	0.161	(0.093)		
PW3 T7 9' / 77615	7/30/92	0.161		(0.023)	
PW3 T6 21' / 77616	7/30/92	0.161			(-0.031)

¹ () Denotes less than Minimum Detectable Amount

Appendix F.2.1 Resistivity survey data

----- SEBORE -----

PAGE 1

DATA SET: SEBORE

CLIENT: REECO
 LOCATION: AREA 5 NTS UE-5PW-1
 COUNTY: NYE COUNTY, NEVADA
 PROJECT: SOUTH EAST PILOT WELL STUDY
 ELEVATION: 3180.35
 SOUNDING COORDINATES: X: 709831.5620 Y: 765702.1870

DATE: 1/15/92
 SOUNDING: 1
 AZIMUTH: EAST - WEST
 EQUIPMENT: SAS 300C/2000

Schlumberger Configuration

L #	RESISTIVITY (ohm-m)	THICKNESS (feet)	ELEVATION (feet)	LONG. COND. (Siemens)	TRANS. RES. (Ohm-m ²)
			3180.3		
1	10.00				

ALL PARAMETERS ARE FREE

No.	SPACING (ft)	RHO-A (ohm-m) DATA	DIFFERENCE (percent)
1	10.00	837.0	
2	13.00	670.2	
3	18.00	452.6	
4	24.00	352.6	
5	32.00	327.1	
6	42.00	317.5	
7	56.00	310.1	
8	56.00	312.3	
9	75.00	287.1	
10	75.00	285.5	
11	100.0	274.3	
12	100.0	266.2	
13	133.0	255.7	
14	180.0	270.7	
15	240.0	260.7	
16	320.0	218.3	
17	420.0	167.7	
18	420.0	173.7	
19	560.0	155.1	
20	560.0	162.8	
21	750.0	150.3	
22	1000.0	150.8	
23	1330.0	121.1	
24	1800.0	110.4	
25	1800.0	115.0	

Appendix F.2.1 Resistivity survey data (Continued)

----- SEBORE -----

----- PAGE 2 -----

No.	SPACING (ft)	RHO-A (ohm-m) DATA	SYNTHETIC	DIFFERENCE (percent)
26	2400.0	79.19		
27	2400.0	81.92		
28	2867.0	66.77		

CURRENT RESOLUTION MATRIX NOT AVAILABLE

Appendix F.2.1 Resistivity survey data (Continued)

Appendix F.2.1 Resistivity survey data (Continued)

----- PWNE

----- PAGE 1

DATA SET: PWNE

CLIENT: REECO
 LOCATION: AREA 5 NTS UE-5PW-2
 COUNTY: NYE COUNTY, NEVADA
 PROJECT: North East Pilot Well
 ELEVATION: 3248.42
 SOUNDING COORDINATES: X: 709893.6250 Y: 770395.8750

DATE: 4/8/92

SOUNDING: 1

AZIMUTH: N 45 W

EQUIPMENT: SAS 300C/2000

Schlumberger Configuration

L #	RESISTIVITY (ohm-m)	THICKNESS (feet)	ELEVATION (feet)	LONG. COND. (Siemens)	TRANS. RES. (Ohm-m ²)
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1	10.00		3248.4		
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ALL PARAMETERS ARE FREE

No.	SPACING (ft)	RHO-A (ohm-m) DATA	SYNTHETIC	DIFFERENCE (percent)
1	2.50	377.3		
2	5.00	611.5		
3	10.00	649.0		
4	13.00	631.5		
5	18.00	594.0		
6	24.00	564.5		
7	32.00	510.0		
8	42.00	483.7		
9	56.00	454.8		
10	56.00	491.6		
11	75.00	406.7		
12	75.00	434.5		
13	100.0	383.7		
14	100.0	408.7		
15	133.0	387.5		
16	180.0	359.5		
17	240.0	347.2		
18	320.0	311.1		
19	420.0	260.7		
20	420.0	239.8		
21	560.0	247.1		
22	560.0	227.1		
23	750.0	241.8		
24	1000.0	246.5		
25	1330.0	230.8		

* Reynolds Electrical & Engineering Co *

Appendix F.2.1 Resistivity survey data (Continued)

----- PWNE

----- PAGE 2

No.	SPACING (ft)	RHO-A (ohm-m) DATA	SYNTHETIC	DIFFERENCE (percent)
26	1330.0	223.6		
27	1800.0	218.5		
28	1800.0	211.1		
29	2400.0	165.3		
30	2804.0	148.3		

CURRENT RESOLUTION MATRIX NOT AVAILABLE

Appendix F.2.1 Resistivity survey data (Continued)

Appendix F.2.1 Resistivity survey data (Continued)

PWXNE

PAGE 1

DATA SET: PWXNE

CLIENT: REECO
 LOCATION: AREA 5 NTS UE-5PW-2
 COUNTY: NYE COUNTY, NEVADA
 PROJECT: North East Pilot Well
 ELEVATION: 3248.42
 SOUNDING COORDINATES: X: 709893.6250 Y: 770395.8750

DATE: 4/27/92
 SOUNDING: 2
 AZIMUTH: N 50 E
 EQUIPMENT: SAS 300C/2000

Schlumberger Configuration

L #	RESISTIVITY (ohm-m)	THICKNESS (feet)	ELEVATION (feet)	LONG. COND. (Siemens)	TRANS. RES. (Ohm-m ²)
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3248.4

1 10.00

ALL PARAMETERS ARE FREE

No.	SPACING (ft)	RHO-A (ohm-m)		DIFFERENCE (percent)
		DATA	SYNTHETIC	
1	5.00	623.0		
2	10.00	684.0		
3	13.00	634.7		
4	18.00	577.0		
5	24.00	536.2		
6	32.00	497.2		
7	42.00	451.2		
8	56.00	415.8		
9	56.00	462.7		
10	75.00	422.3		
11	100.0	385.1		
12	133.0	371.8		
13	180.0	346.2		
14	240.0	322.6		
15	320.0	311.5		
16	420.0	252.5		
17	420.0	261.0		
18	560.0	233.8		
19	780.0	241.3		
20	1000.0	245.0		
21	1330.0	240.8		
22	1330.0	239.2		
23	1800.0	205.2		

CURRENT RESOLUTION MATRIX NOT AVAILABLE

* Reynolds Electrical & Engineering Co *

Appendix F.2.1 Resistivity survey data (Continued)

Appendix F.2.1 Resistivity survey data (Continued)

PW3NW

PAGE 1

DATA SET: PW3NW

CLIENT: Reynolds Electrical & Eng. DATE: 7/30/92
 LOCATION: Pilot Well #3 N.W. UE-5PW-3 SOUNDING: 1
 COUNTY: Nye AZIMUTH: N 50 E
 PROJECT: Pilot Well EQUIPMENT: SAS 300
 ELEVATION: 3297.97
 SOUNDING COORDINATES: X: 703460.0620 Y: 771290.9370

Schlumberger Configuration

L #	RESISTIVITY (ohm-m)	THICKNESS (feet)	ELEVATION (feet)	LONG. COND. (Siemens)	TRANS. RES. (Ohm-m ²)
-----	------------------------	---------------------	---------------------	--------------------------	--------------------------------------

3297.9

1 10.00

ALL PARAMETERS ARE FREE

No.	SPACING (ft)	RHO-A (ohm-m)		DIFFERENCE (percent)
		DATA	SYNTHETIC	
1	10.00	312.0		
2	13.00	272.7		
3	18.00	284.5		
4	24.00	331.5		
5	32.00	348.2		
6	42.00	366.3		
7	56.00	355.7		
8	56.00	395.0		
9	75.00	318.6		
10	75.00	358.6		
11	100.0	316.0		
12	100.0	359.5		
13	133.0	332.0		
14	180.0	279.3		
15	240.0	230.3		
16	320.0	189.5		
17	420.0	189.6		
18	420.0	178.8		
19	560.0	206.1		
20	560.0	196.7		
21	750.0	220.8		
22	1000.0	275.0		
23	1330.0	374.7		
24	1330.0	332.2		
25	1800.0	342.1		

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Appendix F.2.1 Resistivity survey data (Continued)

----- PW3NW ----- PAGE 2

No.	SPACING (ft)	RHO-A (ohm-m)		DIFFERENCE (percent)
		DATA	SYNTHETIC	
26	2400.0	306.6		
27	2800.0	301.7		

CURRENT RESOLUTION MATRIX NOT AVAILABLE

Appendix F.2.1 Resistivity survey data (Continued)

Appendix F.2.2 Magnetic survey data

Ue-5PW-1

Gem Systems GSM-19 13 IX 90 ID 000000001

05 XII91

141426 se borehole bkg survey

Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)	
142236	0001E	000550W	050927.02	-007.69	050922.85	
142309	0001E	000500W	050926.64	-008.13	050922.45	
142336	0001E	000500W	050926.73	-008.37	050922.59	
142415	0001E	000450W	050896.89	-031.00	050892.51	
142445	0001E	000450W	050897.04	-030.83	050892.63	
142524	0001E	000400W	050963.86	-001.47	050959.37	
142548	0001E	000400W	050964.58	-001.03	050959.85	
142621	0001E	000350W	050968.87	-002.53	050964.39	
142642	0001E	000350W	050969.40	-001.82	050964.82	
142715	0001E	000300W	050965.64	-004.16	050961.14	
142739	0001E	000300W	050965.90	-003.85	050961.37	
142815	0001E	000250W	050968.96	-004.42	050964.30	
142836	0001E	000250W	050968.69	-004.61	050964.03	
142912	0001E	000200W	050978.92	-003.34	050973.98	
142936	0001E	000200W	050978.97	-003.46	050974.01	
143009	0001E	000150W	050977.82	-005.07	050973.05	
143030	0001E	000150W	050978.22	-004.45	050973.39	
143103	0001E	000100W	050979.81	-002.81	050975.05	
143121	0001E	000100W	050979.88	-002.81	050974.98	
143151	0001E	000050W	050980.16	-004.07	050975.28	
143212	0001E	000050W	050979.05	-004.10	050974.35	
143418	0001E	000050W	050979.00	-005.39	050973.89	
143442	0001E	000050W	050980.64	-003.89	050975.36	
143503	0001E	000050W	050978.70	-005.99	050973.45	
143521	0001E	000050W	050979.11	-005.54	050973.93	
143545	0001E	000050W	050980.03	-004.69	050974.64	
143603	0001E	000050W	050979.89	-004.91	050974.46	
143739	0001E	000000W	050980.92	-005.36	050975.02	
143803	0001E	000000E	050981.27	-005.10	050975.18	
143824	0001E	000000E	050981.41	-004.94	050975.41	
143845	0001E	000000E	050981.55	-004.81	050975.38	Pilot Well
143903	0001E	000000E	050981.76	-004.71	050975.58	
143924	0001E	000000E	050981.62	-004.82	050975.38	
143945	0001E	000000E	050982.02	-004.63	050975.59	
144021	0001E	000050E	050978.32	-007.00	050971.89	
144042	0001E	000050E	050978.64	-006.87	050972.09	

Appendix F.2.2 Magnetic survey data (Continued)

Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)
144103	0001E	000050E	050978.75	-006.59	050972.37
144133	0001E	000100E	050986.82	-004.29	050980.29
144151	0001E	000100E	050987.46	-003.76	050980.77
144209	0001E	000100E	050987.72	-003.65	050980.86
144242	0001E	000150E	050987.82	-002.96	050980.89
144300	0001E	000150E	050987.90	-002.71	050980.96
144321	0001E	000150E	050987.80	-003.00	050980.72
144354	0001E	000200E	050981.32	-006.51	050974.12
144412	0001E	000200E	050983.60	-004.06	050976.45
144433	0001E	000200E	050984.53	-003.25	050977.18
144457	0001E	000200E	050984.75	-002.90	050977.51
144518	0001E	000200E	050984.63	-002.94	050977.32
144551	0001E	000250E	050987.04	-003.51	050980.00
144612	0001E	000250E	050987.01	-003.52	050979.99
144645	0001E	000300E	050992.87	-000.63	050985.90
144709	0001E	000300E	050993.09	-000.47	050986.08
144757	0001E	000350E	050988.70	-004.10	050981.63
144821	0001E	000350E	050991.89	-000.25	050984.86
144842	0001E	000350E	050988.72	-004.22	050981.58
144906	0001E	000350E	050988.91	-003.96	050981.78
144927	0001E	000350E	050991.98	-000.61	050984.64
145015	0001E	000350E	050993.58	001.82	050986.24
145242	0001E	000350E	050995.09	-003.57	050987.44
145303	0001E	000400E	050994.95	-003.46	050987.15
145333	0001E	000400E	050995.68	-002.99	050987.88
145357	0001E	000400E	050995.55	-003.07	050987.84
145445	0001E	000450E	050831.29	-218.67	050823.54
145509	0001E	000450E	050836.59	-214.13	050828.74
145545	0001E	000500E	050986.27	-004.32	050978.12
145606	0001E	000500E	050986.37	-004.17	050978.32
145627	0001E	000500E	050986.52	-004.08	050978.28
150412	0002N	000450S	050985.28	-008.94	050976.92
150451	0002N	000500S	050986.05	-008.02	050977.67
150509	0002N	000500S	050986.57	-008.26	050978.02
150818	0002N	000450S	050983.77	-008.52	050974.84
150839	0002N	000450S	050983.99	-008.66	050975.23
150912	0002N	000400S	050995.28	-004.40	050986.30
150933	0002N	000400S	050994.82	-004.96	050985.88
151006	0002N	000350S	050990.77	-005.53	050981.74
151036	0002N	000350S	050990.59	-006.21	050981.28

Appendix F.2.2 Magnetic survey data (Continued)

Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)	
151115	0002N	000300S	050985.42	-007.97	050975.93	
151136	0002N	000300S	050986.98	-006.41	050977.37	
151154	0002N	000300S	050987.56	-006.49	050977.48	
151227	0002N	000250S	050986.23	-007.03	050975.92	
151245	0002N	000250S	050986.37	-006.96	050976.06	
151306	0002N	000250S	050986.03	-006.99	050975.99	
151336	0002N	000200S	050986.78	-006.52	050976.33	
151357	0002N	000200S	050987.31	-006.28	050976.67	
151436	0002N	000150S	050986.45	-006.18	050976.50	
151457	0002N	000150S	050985.58	-007.58	050975.47	
151518	0002N	000150S	050985.47	-007.60	050975.37	
151551	0002N	000100S	050980.78	-008.43	050970.56	
151609	0002N	000100S	050980.00	-009.06	050969.97	
151633	0002N	000100S	050980.26	-008.83	050970.29	
151706	0002N	000050S	050982.78	-008.39	050972.41	
151727	0002N	000050S	050981.80	-009.18	050971.81	
151748	0002N	000050S	050981.79	-009.04	050971.99	
151824	0002N	000000S	050984.27	-006.46	050974.22	
151845	0002N	000000N	050984.65	-006.39	050974.39	
151909	0002N	000000N	050985.13	-006.20	050974.69	
151936	0002N	000000N	050986.89	-003.68	050976.48	Pilot Well
152000	0002N	000000N	050987.25	-003.62	050976.74	
152024	0002N	000000N	050984.35	-007.18	050973.70	
152106	0002N	000050N	050984.18	-007.05	050973.84	
152130	0002N	000050N	050984.21	-007.26	050973.68	
152154	0002N	000050N	050984.08	-007.59	050973.42	
152230	0002N	000100N	050983.63	-007.29	050972.75	
152251	0002N	000100N	050983.73	-007.67	050972.72	
152327	0002N	000150N	050982.40	-007.32	050971.09	
152348	0002N	000150N	050982.58	-007.40	050970.94	
152427	0002N	000200N	050982.81	-006.20	050970.84	
152451	0002N	000200N	050982.79	-006.56	050970.71	
152527	0002N	000250N	050980.10	-008.77	050968.07	
152548	0002N	000250N	050980.01	-009.10	050967.97	
152624	0002N	000300N	050984.50	-006.10	050972.29	
152648	0002N	000300N	050983.77	-006.63	050971.65	
152736	0002N	000350N	050947.36	-061.59	050935.39	
152803	0002N	000350N	050947.35	-061.51	050935.39	
152842	0002N	000400N	050977.53	-009.03	050965.73	
152903	0002N	000400N	050979.02	-007.39	050967.08	
152927	0002N	000400N	050977.18	-009.50	050965.15	

Appendix F.2.2 Magnetic survey data (Continued)

Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)
153012	0002N	000450N	050981.04	-006.18	050968.65
153039	0002N	000450N	050981.26	-006.02	050968.94
153112	0002N	000500N	050973.12	-005.94	050960.73
153142	0002N	000500N	050972.87	-006.56	050960.32
153221	0002N	000500N	050946.59	-008.74	050933.97
153254	0002N	000550N	050890.12	-009.25	050877.53
153324	0002N	000600N	050889.94	-009.72	050877.19
153354	0002N	000650N	051490.51	920.71	051477.78
153415	0002N	000650N	051409.38	708.45	051396.58

Appendix F.2.2 Magnetic survey data (Continued)

Ue-5PW-2

Gem Systems GSM-19 13 IX 90 ID 000000001

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Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)	
144733	0000N	000750E	050954.34	-007.86	050954.34	
145042	0000N	000750E	050954.83	-007.44	050954.59	
145127	0000N	000700E	050955.13	-006.85	050955.48	
145245	0000N	000700E	050947.36	-008.74	050948.51	
145327	0000N	000650E	050947.25	-009.36	050948.26	
145406	0000N	000650E	050947.73	-008.82	050948.83	
145509	0000N	000600E	050964.09	-004.86	050965.43	
145536	0000N	000600E	050963.88	-004.88	050965.17	
145618	0000N	000550E	050970.59	-002.73	050972.04	
145642	0000N	000550E	050970.49	-002.90	050972.19	
145721	0000N	000500E	050953.04	-010.87	050954.24	
145803	0000N	000500E	050952.91	-010.74	050954.42	
145845	0000N	000450E	050959.85	-007.09	050961.16	
145915	0000N	000450E	050959.68	-007.97	050960.63	
150003	0000N	000400E	050975.76	-002.10	050976.02	
150045	0000N	000400E	050975.34	-001.81	050976.13	
150124	0000N	000350E	050957.98	-006.67	050958.60	
150151	0000N	000350E	050958.38	-006.90	050958.88	
150236	0000N	000300E	050959.72	-006.33	050959.54	
150306	0000N	000300E	050960.42	-006.33	050959.81	
150439	0000N	000250E	050963.10	-004.23	050961.85	
150506	0000N	000250E	050963.13	-004.39	050961.62	
150539	0000N	000200E	050966.43	-004.75	050964.71	
150621	0000N	000150E	050971.69	004.84	050971.12	
150645	0000N	000150E	050971.22	004.07	050970.59	
150727	0000N	000100E	050969.03	-002.12	050968.46	
150821	0000N	000050E	050975.35	-001.09	050974.81	
150848	0000N	000050E	050975.47	-001.21	050974.97	
151021	0000N	000000E	050966.80	-004.86	050967.18	Pilot Well
151057	0000N	000000W	050966.85	-004.64	050967.36	
151139	0000N	000050W	050959.16	-005.15	050959.41	
151206	0000N	000050W	050959.32	-005.10	050959.57	
151242	0000N	000100W	050966.60	-002.96	050966.52	
151324	0000N	000150W	050958.84	-006.24	050957.98	
151651	0000N	000150W	050962.29	-006.76	050957.53	
151812	0000N	000150W	050962.47	-007.20	050956.96	
151836	0000N	000150W	050962.30	-007.44	050956.79	

Appendix F.2.2 Magnetic survey data (Continued)

Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)	
151912	0000N	000200W	050964.54	-004.19	050959.05	
151954	0000N	000250W	050963.71	-004.52	050958.17	
152036	0000N	000300W	050960.92	-006.36	050955.22	
152124	0000N	000350W	050998.61	013.91	050992.87	
152157	0000N	000350W	050998.91	013.97	050993.21	
152300	0000N	000350W	050999.38	013.60	050993.01	
152348	0000N	000400W	050970.65	-001.34	050964.07	
152433	0000N	000400W	050971.04	-001.12	050964.52	
152518	0000N	000450W	050967.45	-005.26	050960.74	
152609	0000N	000500W	050970.99	-001.34	050964.52	
152648	0000N	000500W	050971.16	-001.56	050964.94	
153345	0000E	000500S	050965.46	-004.37	050956.54	
153415	0000E	000500S	050965.41	-004.60	050956.59	
153500	0000E	000450S	050967.41	-004.02	050958.39	
153542	0000E	000400S	050962.19	-004.95	050953.96	
153624	0000E	000350S	050965.67	-003.16	050957.73	
153712	0000E	000300S	050971.70	-002.36	050964.31	
153757	0000E	000250S	050970.41	-002.54	050963.18	
153839	0000E	000200S	050968.58	-004.76	050961.39	
153915	0000E	000150S	050968.22	-002.05	050961.39	
154003	0000E	000100S	050975.68	-000.15	050968.81	
154051	0000E	000100S	050974.45	-000.66	050968.36	
154127	0000E	000050S	050970.50	-003.15	050964.45	
154200	0000E	000050S	050970.18	-003.16	050964.44	
154257	0000E	000050S	050966.76	-002.21	050961.61	
154551	0000E	000000S	050972.24	-001.44	050970.08	
154618	0000E	000000N	050971.72	-001.65	050969.90	Pilot Well
154651	0000E	000000N	050971.11	-002.55	050969.34	
154754	0000E	000050N	050961.25	-004.36	050959.81	
154924	0000E	000050N	050960.18	-004.69	050958.75	
154957	0000E	000100N	050963.12	-004.80	050962.09	
155033	0000E	000100N	050962.76	-005.20	050961.56	
155106	0000E	000150N	050968.85	-004.05	050967.70	
155142	0000E	000200N	050962.32	-003.36	050961.18	
155215	0000E	000200N	050961.76	-003.84	050960.74	
155251	0000E	000250N	050951.59	-005.99	050950.38	
155342	0000E	000300N	050991.04	008.53	050989.70	
155418	0000E	000300N	050990.76	008.38	050989.63	
155509	0000E	000350N	050964.74	-003.86	050963.85	
155557	0000E	000400N	050966.64	-002.16	050965.79	

Appendix F.2.2 Magnetic survey data (Continued)

Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)
155709	0000E	000450N	050953.42	-007.71	050952.82
155742	0000E	000450N	050953.07	-007.46	050952.59
155821	0000E	000500N	050957.02	-004.23	050956.86

Appendix F.2.2 Magnetic survey data (Continued)

Ue-5PW-3

Gem Systems GSM-19 13 IX 90 ID 000000001

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Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)	
105245	0001E	000500N	050838.90	-001.23	050964.03	
105445	0001E	000450N	050837.55	-002.57	050963.07	
105533	0001E	000400N	050835.79	-005.91	050961.44	
105600	0001E	000400N	050834.87	-006.60	050960.61	
105651	0001E	000350N	050837.66	-004.09	050963.37	
105742	0001E	000300N	050836.95	-004.38	050962.51	
105827	0001E	000250N	050839.52	-003.62	050965.47	
105909	0001E	000200N	050839.97	-002.95	050966.35	
110015	0001E	000150N	050840.75	-002.99	050967.62	
110042	0001E	000150N	050839.90	-003.41	050967.22	
110121	0001E	000100N	050840.03	-002.34	050967.56	
110206	0001E	000050N	050840.63	-002.04	050968.61	
110233	0001E	000050N	050840.34	-002.23	050968.35	
110303	0001E	000050N	050840.04	-002.38	050968.21	
110345	0001E	000000N	050841.31	-001.86	050969.64	
110412	0001E	000000S	050840.69	-002.39	050968.95	Pilot Well
110439	0001E	000000S	050839.80	-002.97	050968.43	
110545	0001E	000050S	050834.42	-005.31	050963.34	
110621	0001E	000050S	050833.25	-006.56	050962.35	
110712	0001E	000100S	050836.36	-004.95	050965.31	
110739	0001E	000100S	050835.95	-005.78	050964.56	
110821	0001E	000150S	050835.51	-004.74	050963.78	
110851	0001E	000150S	050834.75	-005.40	050962.97	
110927	0001E	000200S	050836.60	-004.07	050964.75	
111015	0001E	000250S	050837.74	-003.23	050966.17	
111057	0001E	000300S	050839.44	-000.90	050968.13	
111124	0001E	000300S	050839.22	-001.06	050967.92	
111212	0001E	000350S	050842.06	-000.90	050970.71	
111257	0001E	000400S	050833.57	-005.46	050962.13	
Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)	
111324	0001E	000400S	050833.14	-006.19	050961.36	
111403	0001E	000450S	050839.32	-003.15	050967.41	
111442	0001E	000500S	050837.62	-004.33	050965.58	
111506	0001E	000500S	050837.17	-005.12	050965.00	

Appendix F.2.2 Magnetic survey data (Continued)

Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)	
112315	0001N	000500W	050830.31	001.98	050956.69	
112348	0001N	000500W	050830.43	001.95	050956.65	
112424	0001N	000500W	050825.95	-003.21	050951.96	
112454	0001N	000500W	050825.91	-003.54	050951.90	
112600	0001N	000500W	050832.65	003.33	050958.02	
112642	0001N	000500W	050827.19	-002.36	050952.59	
112739	0001N	000500W	050832.14	003.02	050957.80	
112930	0001N	000500W	050828.81	-001.25	050953.92	
112957	0001N	000500W	050828.69	-001.30	050953.93	
113027	0001N	000500W	050828.77	-000.78	050954.36	
113103	0001N	000500W	050829.53	-000.02	050955.09	
113148	0001N	000500W	050829.30	-000.51	050954.75	
113554	0001N	000450W	050827.70	-004.01	050952.72	
113642	0001N	000400W	050828.80	-002.40	050953.71	
113730	0001N	000350W	050830.62	-006.25	050954.95	
113757	0001N	000350W	050829.49	-007.44	050953.95	
113824	0001N	000350W	050829.77	-007.30	050954.06	
113906	0001N	000300W	050832.07	-005.23	050956.46	
113954	0001N	000250W	050833.75	-003.42	050958.00	
114033	0001N	000200W	050838.65	-002.29	050962.71	
114121	0001N	000150W	050843.03	-003.71	050967.13	
114145	0001N	000150W	050842.05	-004.55	050966.37	
114227	0001N	000100W	050839.30	-004.41	050963.31	
114254	0001N	000100W	050838.85	-004.74	050963.06	
114348	0001N	000050W	050839.91	-002.31	050964.03	
114415	0001N	000050W	050839.83	-002.53	050963.94	
114506	0001N	000000W	050846.03	-000.95	050970.34	
114533	0001N	000000E	050846.15	-001.07	050970.48	Pilot Well
114733	0001N	000050E	050843.00	-002.96	050966.54	
114800	0001N	000050E	050843.39	-002.47	050966.70	
114951	0001N	000100E	050847.68	-002.99	050970.92	
115015	0001N	000100E	050847.61	-003.02	050970.63	
115054	0001N	000150E	050847.40	-001.89	050970.43	
115139	0001N	000200E	050847.15	-004.29	050970.20	
115227	0001N	000250E	050849.94	-000.65	050973.10	
115315	0001N	000300E	050853.70	-003.03	050976.78	
Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)	
115415	0001N	000350E	050855.26	-003.31	050978.01	
115500	0001N	000400E	050851.24	-004.12	050973.95	

Appendix F.2.2 Magnetic survey data (Continued)

Time	Line	Station (ft)	Total Fld (nT)	Gradient (nT/m)	Corrected Total Fld (nT)
115527	0001N	000400E	050850.59	-004.78	050973.39
115612	0001N	000450E	050857.85	-002.80	050980.06
115700	0001N	000500E	050855.53	-002.73	050977.74
115745	0001N	000500E	050855.56	-002.75	050977.64
115812	0001N	000500E	050855.49	-002.72	050977.77

Appendix F.3.1 Description of borehole geophysical logging tools used

9035 TOOL CONFIGURATION, SENSORS, AND OFFSETS (Not to Scale)

TOOL SPECIFICATIONS:

Length: 119.2 Inches (299.7 cm) Temperature: 185 F (85 C) Diameter:
2.8 Inches (7.1 cm) Pressure: 2500 PSI (175 kg/cc)
Weight: 78 Pounds (35.3 kg) Logging Speed: 30 FPM (9 M/M)

SENSOR RESPONSE RANGES

Sensor	Response Limits	Accuracy
Natural Gamma	0 to 10,000 api units	+/- 5%
Long Arm Caliper	0 to 14 inches	+/- .25 inches
Near Density	.5 to 3.5 g/cc	+/- .05 g/cc
Far Density	.5 to 3.5 g/cc	+/- .05 g/cc
Resistivity	0 to 60,000 ohm meters	+/- 5%

Appendix F.3.1 Description of borehole geophysical logging tools used (Continued)

9030 TOOL CONFIGURATION, SENSORS, AND OFFSETS

SENSOR OFFSETS

NATURAL GAMMA
18 INCHES (45.7 CM)

GUARD RESISTIVITY
28 INCHES (71.1 CM)

CALIPER
102 INCHES (259 CM)

DENSITY DETECTOR
111.6 INCHES (283.5 CM)

SOURCE TO DETECTOR SPACING
8.0 INCHES (20.3 CM)

TOOL LENGTH
121 INCHES (307.3 CM)

TOOL SPECIFICATIONS:

Length: 121 Inches (307.3 cm) Temperature: 185 F (85 C)
Diameter: 2.2 Inches (5.6 cm) Pressure: 2500 PSI (175 KG/Cm²)
Weight: 62 Pounds (28.1 kg) Logging Speed 30 FPM (9 M/M)

SENSOR RESPONSE RANGES

Sensor	Response Limits	Accuracy
Natural Gamma	0 to 10,000 api units	+/- 5%
Short Arm Caliper	0 to 8 inches	+/- .25"
Long Arm Caliper	0 to 12 inches	+/- .25"
Density	.5 to 3.5 g/cc	+/- .05
Resistivity	0 to 60,000 ohm meters	+/- 5%

Appendix F.3.1 Description of borehole geophysical logging tools used (Continued)

9071 TOOL CONFIGURATION, SENSORS, AND OFFSETS (Not to Scale)

TOOL SPECIFICATIONS:

Length: 105 Inches (266.7 cm)	Temperature: 221 F (105 C)
Diameter: 2.9 Inches (7.4 cm)	Pressure: 3300 PSI (232 kg/cc)
Weight: 57 Pounds (26 kg)	Logging Speed: 30 FPM (9 M/M)

SENSOR RESPONSE RANGES

Sensor	Response Limits	Accuracy
Natural Gamma	0 to 10,000 api units	+/- 5%
Near Neutron CPS	0 to 20,000	+/- 5% cps
Far Neutron CPS	0 to 5,000	+/- 5% cps
Neutron Porosity	-10 to 100 % Porosity	+/- 2% to 60%
Resistivity	0 to 2,000 ohm meters	+/- 5%
SP	-400 to 400 mv	+/- 10 mv

Appendix F.3.1 Description of borehole geophysical logging tools used (Continued)

9080 TOOL CONFIGURATION, SENSORS, AND OFFSETS (Not to Scale)

SENSOR OFFSETS

SPECTRAL GAMMA RAY
68 INCHES (172.7 CM)

TOOL LENGTH
80.5 INCHES (204.5 CM)

TOOL SPECIFICATIONS:

Length: 80.5 Inches (204.5 cm)	Temperature: 221 F (105 C)
Diameter: 2.5 Inches (6.35 cm)	Pressure: 3300 PSI (232 kg/cm ²)
Weight: 47 Pounds (21.3 kg)	Logging Speed: 10 FPM (3 M/M)

SENSOR RESPONSE RANGES

Sensor	Response Limits	Accuracy
Total Gamma	0 to 100,000 cps	+/- 5%
Potassium	0 to 40 percent	+/- .5% from K*
Uranium	0 to 1000 ppm	+/- 15ppm from U*
Thorium	0 to 1000 ppm	+/- 30ppm from T*

* Accuracy from Technical Report Number 174.

Appendix F.3.1 Description of borehole geophysical logging tools used (Continued)

9095 TOOL CONFIGURATION, SENSORS, AND OFFSETS (Not to Scale)

SENSOR OFFSETS

NATURAL GAMMA
6.3 INCHES (16 CM)

ALIGNMENT ASSY.
AND SCOPE MOUNT

X-Y INCLINOMETER

X-Y INCLINOMETER
70.9 INCHES (180 CM)

1.5 " HUMPHREY
MECHANICAL GYRO

GYRO
80.6 INCHES (204.7 CM)

OPTIONAL
WEIGHTED SECTION

TOOL LENGTH (WITHOUT WEIGHT)
95.5 INCHES (242.6 CM)

TOOL SPECIFICATIONS:

Length: 95.5 Inches (246.6 cm)
Diameter: 1.75 Inches (4.4 cm)
Weight: 29.5 Pounds (13.4 kg)

Temperature: 185 F (85 C)
Pressure: 3300 PSI (232 kg/cm²)
Logging Speed: 50 FPM (15 M/M)

SENSOR RESPONSE RANGES

Sensor	Response Limits	Accuracy
Natural Gamma	0 to 10,000 api units	+/- 5%
Inclination	0 to 45 degrees	+/- .5 degrees
Direction	0 to 360 degrees	+/- 2.0 degrees

Appendix F.3.1 Description of borehole geophysical logging tools used (Continued)

9510 TOOL CONFIGURATION, SENSORS, AND OFFSETS (Not to Scale)

SENSOR OFFSETS

NATURAL GAMMA
6.9 INCHES (17.5 CM)

4 COIL CONDUCTIVITY ELECTRODE
59.9 INCHES (152.2CM)

TOOL LENGTH
89 INCHES (226 CM)

TOOL SPECIFICATIONS:

Length: 89.0 Inches (226. cm)
Diameter: 1.625 Inches (4.1 cm)
Weight: 16 Pounds (7.2 kg)

Temperature: 176 F (80 C)
Pressure: 3000 PSI (210 kg/cm²)
Logging Speed: 60 FPM (18 M/M)

SENSOR RESPONSE RANGES

Sensor	Response Limits	Accuracy
Natural Gamma	0 to 10,000 api units	+/- 5%
Conductivity	0 to 1000 mmho/meter	+/- 5 @ 50 mmho/m

Appendix F.3.2 Borehole geophysical logs run in Ue5PW-1 on 4/20/92

EQUIPMENT DATA SHEET			
WELL # Ue5PW-1 DATE: 4-20-92	GAMMA RAY	DENSITY/NEUTRON	
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DISTANCE TO SOURCE DETECTOR TYPE DETECTOR OFFSET (FROM 0) LENGTH & DIAMETER (Near) LENGTH & DIAMETER (Far) LOGGING SPEED CENTRALIZER GAMMA RAY API CONVERSION MANUFACTURER	Three 9030 2.2" na Scintln. 18.0" 4.5 x 1.25" 30 fpm sidewall .618 Century	Three 9030 2.2" 119.6" 1-Scctl 111.6" 1.5x0.5" 30 fpm sidewall Century	Two 9055 1.8" 111.8" 1-He3 97.8" 6.0x1.0" 30 fpm free hang 1.0176 Century
RADIOACTIVE SOURCES SOURCE TYPE SOURCE SPACING SOURCE STRENGTH SOURCE SERIAL NO.		Cs 137 8" 125 mCi VL-1-278	AmBe 14" 1.0 Ci 71-1-404
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DETECTOR OFFSET (FROM 0) LOGGING SPEED TYPE	RESISTIVITY Four 9510 1.625 59.9" 60 FPM Single Indct.	CALIPER Three 9030 2.2" 102" 30 FPM Single Arm	
OTHER TOOL INFORMATION Detector Type and Size Tool Type Offset Run Number	SPECTRAL GAMMA NaI 1.5 x 12" 9080 68" One		
GENERAL INFORMATION TRUCK NO. 9103 SOFTWARE LEVEL Compulog III Version 7.03 OPERATOR Federwisch LOCATION N. 765702.19 E. 709831.57			
BOREHOLE RECORD RUN NO. 1 BIT SIZE NA - CASING IS DRIVEN RUN NO. 2 BIT SIZE RUN NO. 3 BIT SIZE			
CASING RECORD RUN NO. 1 SIZE 10" FROM 0 TO 367.5 RUN NO. 2 SIZE FROM TO RUN NO. 3 SIZE FROM TO			
REMARKS: Run 1 of this well. Induction Resistivity in not Valid in Steel Casing.			

Appendix F.3.2 Borehole geophysical logs run in Ue5PW-1 on 4/20/92 (Continued)

<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">GAMMA</td> <td style="padding: 5px;">CALIPER</td> </tr> <tr> <td style="padding: 5px;">NEUTRON</td> <td style="padding: 5px;">DENSITY</td> </tr> </table>		GAMMA	CALIPER	NEUTRON	DENSITY	
GAMMA	CALIPER					
NEUTRON	DENSITY					
COMPANY : REECO WELL : UE-5PW-1 LOCATION/FIELD : NEVADA TEST SITE COUNTY : NVE STATE : NEVADA SECTION : TOWNSHIP : RANGE :		OTHER SERVICES: <div style="border: 1px solid black; height: 40px; width: 100%;"></div>				
DATE : 04/20/92 PERMANENT DATUM : G.L. ELEVATIONS DEPTH DRILLER : 367.5 ELEV. PERM. DATUM: 3180.35 KB : LOG BOTTOM : 373.49 LOG MEASURED FROM: G.L. DF : LOG TOP : 2.29 BRL MEASURED FROM: TABLE GL : 3180.						
CASING DRILLER : 367.5 LOGGING UNIT : 9103 CASING TYPE : STEEL FIELD OFFICE : CHINO VALLEY CASING THICKNESS: .365 RECORDED BY : R.FEDERMISCH						
BIT SIZE : 10.5 BOREHOLE FLUID : AIR FILE : PROCE MAGNETIC DECL. : 12.5 RH : TYPE : 9055A MATRIX DENSITY : RH TEMPERATURE : LOG : 2 FLUID DENSITY : MATRIX DELTA T : PLOT : TS1 NEUTRON MATRIX : SANDSTONE FLUID DELTA T : THRESH: REMARKS :						
LOCATION N.765702.19, E.769031.57						
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS						

Appendix F.3.2 Borehole geophysical logs run in Ue5PW-1 on 4/20/92 (Continued)

UE-5PW-1 04/20/92 80

Appendix F.3.2 Borehole geophysical logs run in Ue5PW-1 on 4/20/92 (Continued)

N. U. T.			
COMPANY : REECO WELL : UE-5PW-1 LOCATION/FIELD : NEVADA TEST SITE COUNTY : NYE STATE : NEVADA SECTION : TOWNSHIP : RANGE :		OTHER SERVICES:	
DATE : 04/29/92 DEPTH DRILLER : 367.5 LOG BOTTOM : 373.40 LOG TOP : 8.00		PERMANENT DATUM : G.L. ELEV. PERM. DATUM: 3180.35 LOG MEASURED FROM: G.L. DRL MEASURED FROM: TABLE	
CASING DRILLER : 367.5 CASING TYPE : STEEL CASING THICKNESS: .363		ELEVATIONS KB : BF : GL : 3180. LOGGING UNIT : 9103 FIELD OFFICE : CHINO VALLEY RECORDED BY : R.FEDERWISCH	
BIT SIZE : 10.5 MAGNETIC DECL. : 12.5 MATRIX DENSITY : FLUID DENSITY : NEUTRON MATRIX : SANDSTONE FLUID		BOREHOLE FLUID : AIR RH : RH TEMPERATURE : MATRIX DELTA T : DELTA T :	
REMARKS : LOCATION N.765702.19, E.709831.57 WATER LEVEL 773.39		FILE : PROCE TYPE : 9080A LOG : 5 PLOT : TS1 THRESH:	
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS			

Appendix F.3.2 Borehole geophysical logs run in Ue5PW-1 on 4/20/92 (Continued)

UE-5PW-1 04/20/92 270

Appendix F.3.3 Borehole geophysical logs run in Ue5PW-1 on 6/16/92

EQUIPMENT DATA SHEET			
WELL # UESPW-1 DATE: 6-16-92	GAMMA RAY	DENSITY/NEUTRON	
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DISTANCE TO SOURCE DETECTOR TYPE DETECTOR OFFSET (FROM 0) LENGTH & DIAMETER (Near) LENGTH & DIAMETER (Far) LOGGING SPEED CENTRALIZER GAMMA RAY API CONVERSION MANUFACTURER	Three 9035 2.8" na Scintln. 6.6" 4.0 x .875" 30 fpm sidewall .658 Century	Three 9035 2.8" 114.7" 2-Sctln 101/107" 4.0x.875 1.2x.875 30 fpm sidewall Century	Two 9071 2.9" 99.0" 2-He3 75/88.2" 4.0x1.125 10.0x2.0 30 fpm free hang Century
RADIOACTIVE SOURCES SOURCE TYPE SOURCE SPACING SOURCE STRENGTH SOURCE SERIAL NO.		Cs 137 6 & 12" 125 mCi VL-1-278	AmBe 10.8&24" 5.0 Ci 71-1-399B
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DETECTOR OFFSET (FROM 0) LOGGING SPEED TYPE	RESISTIVITY	CALIPER Three 9035 2.8" 92" 30 FPM Single Arm	
OTHER TOOL INFORMATION Detector Type and Size Tool Type Offset Run Number	Spectral Gamma NaI 1.5 x 12" 9080 68" One		
GENERAL INFORMATION TRUCK NO. 9010 SOFTWARE LEVEL Compulog III Version 7.03 OPERATOR Federwisch LOCATION N. 765702.19 E. 709831.57			
BOREHOLE RECORD RUN NO. 1 BIT SIZE NA - CASING IS DRIVEN RUN NO. 2 BIT SIZE RUN NO. 3 BIT SIZE			
CASING RECORD RUN NO. 1 SIZE 10" FROM 0 TO 367.5 RUN NO. 2 SIZE 8" FROM 0 TO 837.0 RUN NO. 3 SIZE FROM TO			
REMARKS: Run 2 of this well.			

Appendix F.3.3 Borehole geophysical logs run in Ue5PW-1 on 6/16/92 (Continued)

<table border="1" style="margin: auto;"> <tr> <td style="padding: 5px;">GAMMA</td> <td style="padding: 5px;">CALIPER</td> </tr> <tr> <td style="padding: 5px;">NEUTRON</td> <td style="padding: 5px;">DENSITY</td> </tr> </table>		GAMMA	CALIPER	NEUTRON	DENSITY		
GAMMA	CALIPER						
NEUTRON	DENSITY						
COMPANY : REECO WELL : UE-5PW-1 LOCATION/FIELD : NEVADA TEST SITE COUNTY : NYE STATE : NEVADA SECTION :		OTHER SERVICES : <div style="border: 1px solid black; height: 40px; width: 100%;"></div>					
		TOWNSHIP : RANGE :					
DATE : 06/16/92 DEPTH DRILLER : 837 LOG BOTTOM : 949.00 LOG TOP : -3.00		PERMANENT DATUM : G.L. ELEV. PERM. DATUM : 3180.35 LOG MEASURED FROM : T.O.C. BRL MEASURED FROM : G.L.					
		ELEVATIONS KB : DF : GL : 3180.					
CASING DRILLER : 837 CASING TYPE : STEEL CASING THICKNESS : .375		LOGGING UNIT : 9010 FIELD OFFICE : CHINO VALLEY RECORDED BY : R.FEDERWISCH					
BIT SIZE : 6 MAGNETIC DECL. : 13 MATRIX DENSITY : FLUID DENSITY : NEUTRON MATRIX : SANDSTONE REMARKS :		BOREHOLE FLUID : AIR/H2O RH : 0 RH TEMPERATURE : 0 MATRIX DELTA T : FLUID DELTA T : SANDSTONE FLUID DELTA T :					
		FILE : PROCE TYPE : 9035A LOG : 1 PLOT : TS1 THRESH:					
LOCATION N.765702.19, E.799031.57 T.O.C. 2' 11" ABOVE GROUND LEVEL WATER LEVEL 773.39 ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS							

Appendix F.3.3 Borehole geophysical logs run in Ue5PW-1 on 6/16/92 (Continued)

UE-5PW-1 06/16/92 820

Appendix F.3.3 Borehole geophysical logs run in Ue5PW-1 on 6/16/92 (Continued)

<div style="border: 1px solid black; padding: 5px; display: inline-block;"> M. U. T. </div>					
COMPANY	: REECO	OTHER SERVICES:			
WELL	: UE-5PW-1				
LOCATION/FIELD	: NEVADA TEST SITE				
COUNTY	: NYE				
STATE	: NEVADA				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 06/17/92	PERMANENT DATUM	: G.L.	ELEVATIONS	
DEPTH DRILLER	: 937	ELEV. PERM. DATUM	: 3180.35	KB	:
LOG BOTTOM	: 837.60	LOG MEASURED FROM	: T.O.C	DF	:
LOG TOP	: 0.90	BRL MEASURED FROM	: G.L.	GL	: 3180.
CASING DRILLER	: 937	LOGGING UNIT	: 9010		
CASING TYPE	: STEEL	FIELD OFFICE	: CHINO VALLEY		
CASING THICKNESS	: .365	RECORDED BY	: R.FEDERWISCH		
BIT SIZE	: 8	BOREHOLE FLUID	: AIR, H2O	FILE	: ORIGI
MAGNETIC DECL.	: 13	RH	: 0	TYPE	: 9080A
MATRIX DENSITY	:	RH TEMPERATURE	: 0	LOG	: 4
FLUID DENSITY	:	MATRIX DELTA T	:	PLOT	: TS1
NEUTRON MATRIX	: SANDSTONE FLUID	DELTA T	:	THRESH:	
REMARKS	:				
LOCATION N.765702.19, E.769831.57					
WATER LEVEL 773.39					
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS					

Appendix F.3.3 Borehole geophysical logs run in Ue5PW-1 on 6/16/92 (Continued)

UE-5PW-1 06/17/92 270

F.3.4 Borehole deviation logs run in UE5PW-1 on 2/24/93 (replaces previous Equipment Data Sheet)

EQUIPMENT DATA SHEET			
WELL # UE5PW-1 DATE: 2-24-93	GAMMA RAY		DENSITY/NEUTRON
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DISTANCE TO SOURCE DETECTOR TYPE DETECTOR OFFSET (FROM 0) LENGTH & DIAMETER (Near) LENGTH & DIAMETER (Far) LOGGING SPEED CENTRALIZER GAMMA RAY API CONVERSION MANUFACTURER			
RADIOACTIVE SOURCES SOURCE TYPE SOURCE SPACING SOURCE STRENGTH SOURCE SERIAL NO.			
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DETECTOR OFFSET (FROM 0) LOGGING SPEED TYPE	RESISTIVITY	CALIPER	
OTHER TOOL INFORMATION Detector Type and Size Tool Type Offset Run Number	DEVIATION Incl/Gyro 9095 70.9/80.6 One	Manufacturer CGC/Humphrey	
GENERAL INFORMATION TRUCK NO. 9101 SOFTWARE LEVEL Compulog III Version 7.03 OPERATOR T. Knarr LOCATION N. 765702.19 E. 709831.57			
BOREHOLE RECORD RUN NO. 1 BIT SIZE 10" 0-367.5 RUN NO. 2 BIT SIZE 8" 367.5-839 RUN NO. 3 BIT SIZE			
CASING RECORD RUN NO. 1 SIZE 2-7/8" FROM 0 TO 839 RUN NO. 2 SIZE FROM RUN NO. 3 SIZE FROM			
REMARKS: Client supplied sighting stake direction. Bottom log depth 823.			

Appendix F.3.4 Borehole deviation logs run in Ue5PW-1 on 2/24/93 (Continued)

DEVIATION SURVEY			
COMPANY : NEVADA TEST SITE WELL : Ue5PW-1 (C) LOCATION/FIELD : NEVADA TEST SITE COUNTY : NVE STATE : NEVADA SECTION :		OTHER SERVICES: <div style="border: 1px solid black; height: 40px; width: 100%;"></div>	
		TOWNSHIP : RANGE :	
DATE : 02/24/93 DEPTH DRILLER : 039 LOG BOTTOM : 022.00 LOG TOP : -0.10		PERMANENT DATUM : ELEV. PERM. DATUM: KB : LOG MEASURED FROM: GL DF : DEL MEASURED FROM: GL GL : 3177.	
CASING DRILLER : 0 CASING TYPE : S STEEL CASING THICKNESS: 0		LOGGING UNIT : 9101 FIELD OFFICE : ELKO RECORDED BY : KHARR	
BIT SIZE : 2.875 MAGNETIC DECL. : 14.200 MATRIX DENSITY : FLUID DENSITY : NEUTRON MATRIX : REMARKS :		BOREHOLE FLUID : NONE RM : EM TEMPERATURE : MATRIX DELTA T : FLUID DELTA T : FILE : PROCE TYPE : GYRO LOG : 0 PLOT : TS 6 THRESH: 50000	
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS			

Appendix F.3.4 Borehole deviation logs run in Ue5PW-1 on 2/24/93 (Continued)

PLAN VIEW
COMPU-LOG DEVIATION

CLIENT: NEVADA TEST SITE
LOCATION: NEVADA TEST SITE
HOLE ID: Ue5PW-1 #2
DATE OF LOG: 02/24/93
PROBE: GYRO 1201

SCALE: 10 FT/IN
TRUE DEPTH: 822.47 FT
AZIMUTH: 158.1
DISTANCE: 18.8 FT
+ = 100 FT INCR
○ = BOTTOM OF HOLE

Appendix F.3.4 Borehole deviation logs run in Ue5PW-1 on 2/24/93 (Continued)

* * * * * COMPU-LOG -- VERTICAL DEVIATION * * * * *

CLIENT : NEVADA TEST SITE HOLE ID. : Ue5PW-1 #2
 FIELD OFFICE : ELKO DATE OF LOG : 02/24/93
 DATA FROM : PROBE : GYRO , 1201
 MAG. DECL. : 14.200 DEPTH UNITS : FEET LOG 0

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
0.2	0.20	0.00	0.00	0.0	43.2	0.6	43.2
5.0	5.00	0.04	0.04	0.1	46.4	0.6	55.5
10.0	10.00	0.06	0.08	0.1	52.2	0.6	62.7
15.0	15.00	0.08	0.13	0.2	56.5	0.5	68.9
20.0	20.00	0.09	0.17	0.2	62.8	0.4	123.5
25.0	25.00	0.07	0.19	0.2	69.3	0.2	146.5
30.0	30.00	0.05	0.21	0.2	75.9	0.4	144.9
35.0	35.00	0.03	0.23	0.2	82.9	0.4	151.1
40.0	40.00	0.00	0.25	0.2	89.9	0.4	155.1
45.0	45.00	-0.03	0.26	0.3	95.9	0.3	164.6
50.0	50.00	-0.06	0.26	0.3	102.1	0.4	180.0
55.0	55.00	-0.09	0.26	0.3	108.5	0.4	175.5
60.0	60.00	-0.12	0.26	0.3	114.5	0.4	193.0
65.0	65.00	-0.15	0.25	0.3	121.6	0.4	208.3
70.0	70.00	-0.19	0.22	0.3	130.6	0.6	212.6
75.0	75.00	-0.24	0.20	0.3	140.1	0.6	199.1
80.0	80.00	-0.30	0.19	0.4	148.0	0.8	184.4
85.0	85.00	-0.37	0.19	0.4	153.5	0.8	186.0
90.0	90.00	-0.44	0.18	0.5	158.1	0.8	187.3
95.0	95.00	-0.52	0.16	0.5	162.5	0.7	197.1
100.0	99.99	-0.61	0.15	0.6	166.2	1.1	186.4
105.0	104.99	-0.71	0.14	0.7	168.5	1.1	177.6
110.0	109.99	-0.80	0.15	0.8	169.5	1.0	173.6
115.0	114.99	-0.88	0.17	0.9	168.9	1.1	153.6
120.0	119.99	-0.96	0.22	1.0	167.3	1.0	143.2
125.0	124.99	-1.03	0.27	1.1	165.1	1.0	136.8
130.0	129.99	-1.08	0.34	1.1	162.4	1.1	124.4
135.0	134.99	-1.12	0.42	1.2	159.4	0.8	113.9
140.0	139.99	-1.14	0.48	1.2	157.4	0.5	111.0
145.0	144.99	-1.15	0.51	1.3	156.2	0.2	97.4
150.0	149.99	-1.15	0.53	1.3	155.3	0.2	90.0
155.0	154.99	-1.16	0.55	1.3	154.6	0.2	118.5
160.0	159.99	-1.17	0.55	1.3	154.7	0.4	196.1
165.0	164.99	-1.21	0.55	1.3	155.7	0.3	195.6
170.0	169.99	-1.25	0.54	1.4	156.8	0.5	189.7
175.0	174.99	-1.31	0.52	1.4	158.2	0.8	194.1
180.0	179.99	-1.37	0.51	1.5	159.7	0.7	195.4
185.0	184.99	-1.43	0.48	1.5	161.3	0.7	199.2
190.0	189.99	-1.50	0.46	1.6	162.9	0.9	198.6
195.0	194.99	-1.56	0.44	1.6	164.4	0.7	200.9
200.0	199.98	-1.60	0.42	1.7	165.4	0.3	211.4
205.0	204.98	-1.62	0.41	1.7	166.0	0.2	206.4
210.0	209.98	-1.65	0.40	1.7	166.2	0.4	173.9
215.0	214.98	-1.69	0.42	1.7	166.1	0.9	156.1
220.0	219.98	-1.78	0.46	1.8	165.4	1.4	152.5
225.0	224.98	-1.90	0.52	2.0	164.8	1.5	156.6
230.0	229.98	-2.04	0.58	2.1	164.2	1.9	158.6
235.0	234.98	-2.20	0.64	2.3	163.7	2.0	159.4
240.0	239.97	-2.35	0.70	2.4	163.3	1.8	159.1
245.0	244.97	-2.48	0.75	2.6	163.2	1.4	169.3
250.0	249.97	-2.58	0.76	2.7	163.6	0.9	195.4
255.0	254.97	-2.63	0.72	2.7	164.6	0.7	228.5

Appendix F.3.4 Borehole deviation logs run in UeSPW-1 on 2/24/93 (Continued)

* * * * * COMPU-LOG - VERTICAL DEVIATION * * * * *

CLIENT : NEVADA TEST SITE HOLE ID. : UeSPW-1 #2
 FIELD OFFICE : ELKO DATE OF LOG : 02/24/93
 DATA FROM : PROBE : GYRO , 1201
 MAG. DECL. : 14.200 DEPTH UNITS : FEET LOG 0

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
260.0	259.97	-2.64	0.67	2.7	165.8	0.6	278.4
265.0	264.97	-2.63	0.62	2.7	166.8	0.4	279.5
270.0	269.97	-2.63	0.59	2.7	167.4	0.3	277.0
275.0	274.97	-2.62	0.57	2.7	167.7	0.1	93.4
280.0	279.97	-2.64	0.59	2.7	167.4	0.5	125.8
285.0	284.97	-2.68	0.63	2.8	166.9	0.6	145.3
290.0	289.97	-2.75	0.66	2.8	166.5	1.0	154.3
295.0	294.97	-2.85	0.70	2.9	166.3	1.5	168.4
300.0	299.96	-3.00	0.71	3.1	166.7	1.9	179.7
305.0	304.96	-3.18	0.71	3.3	167.4	2.0	183.4
310.0	309.96	-3.35	0.70	3.4	168.3	2.0	187.6
315.0	314.96	-3.52	0.67	3.6	169.2	1.9	190.2
320.0	319.95	-3.66	0.65	3.7	170.0	1.4	186.2
325.0	324.95	-3.77	0.63	3.8	170.5	1.1	192.0
330.0	329.95	-3.84	0.61	3.9	171.0	0.7	201.6
335.0	334.95	-3.89	0.60	3.9	171.3	0.4	203.3
340.0	339.95	-3.90	0.61	3.9	171.1	0.4	59.1
345.0	344.95	-3.87	0.64	3.9	170.6	0.6	63.0
350.0	349.95	-3.85	0.68	3.9	170.0	0.5	64.6
355.0	354.95	-3.83	0.72	3.9	169.3	0.4	99.5
360.0	359.95	-3.88	0.77	4.0	168.8	0.9	161.5
365.0	364.95	-3.98	0.78	4.1	168.9	1.3	178.0
370.0	369.95	-4.12	0.77	4.2	169.4	1.9	183.8
375.0	374.94	-4.30	0.76	4.4	170.0	2.3	184.5
380.0	379.94	-4.53	0.75	4.6	170.6	2.9	182.8
385.0	384.93	-4.77	0.72	4.8	171.4	2.8	186.5
390.0	389.93	-5.00	0.70	5.1	172.0	2.4	184.0
395.0	394.92	-5.19	0.70	5.2	172.3	2.2	181.1
400.0	399.92	-5.35	0.72	5.4	172.4	1.8	175.5
405.0	404.92	-5.49	0.74	5.5	172.4	1.3	167.4
410.0	409.92	-5.59	0.77	5.6	172.2	1.0	163.1
415.0	414.92	-5.65	0.80	5.7	171.9	1.0	140.7
420.0	419.92	-5.70	0.86	5.8	171.5	0.9	123.9
425.0	424.92	-5.74	0.92	5.8	170.9	0.9	115.7
430.0	429.92	-5.79	1.00	5.9	170.2	1.2	123.6
435.0	434.91	-5.86	1.07	6.0	169.6	1.3	136.4
440.0	439.91	-5.96	1.15	6.1	169.1	1.4	147.4
445.0	444.91	-6.08	1.20	6.2	168.9	1.6	166.1
450.0	449.91	-6.22	1.21	6.3	169.0	1.7	177.6
455.0	454.91	-6.38	1.21	6.5	169.2	1.8	180.0
460.0	459.90	-6.53	1.20	6.6	169.6	1.6	190.0
465.0	464.90	-6.66	1.18	6.8	170.0	1.3	188.2
470.0	469.90	-6.77	1.16	6.9	170.2	1.3	190.0
475.0	474.90	-6.88	1.15	7.0	170.5	1.1	180.9
480.0	479.90	-7.02	1.20	7.1	170.3	1.9	154.5
485.0	484.90	-7.17	1.28	7.3	169.9	2.0	150.5
490.0	489.89	-7.32	1.36	7.4	169.4	1.9	151.9
495.0	494.89	-7.47	1.44	7.6	169.1	1.9	156.8
500.0	499.89	-7.63	1.50	7.8	168.9	1.8	162.9
505.0	504.88	-7.77	1.53	7.9	168.8	1.6	166.4
510.0	509.88	-7.89	1.56	8.0	168.8	1.4	168.1
515.0	514.88	-8.00	1.59	8.2	168.8	1.2	164.9

Appendix F.3.4 Borehole deviation logs run in Ue5PW-1 on 2/24/93 (Continued)

* * * * * COMPU-LOG - VERTICAL DEVIATION * * * * *

CLIENT : NEVADA TEST SITE HOLE ID. : Ue5PW-1 #2
 FIELD OFFICE : ELKO DATE OF LOG : 02/24/93
 DATA FROM : PROBE : GYRO , 1201
 MAG. DECL. : 14.200 DEPTH UNITS : FEET LOG 0

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
520.0	519.88	-8.09	1.62	8.3	168.7	1.0	163.3
525.0	524.88	-8.18	1.64	8.3	168.6	1.1	164.5
530.0	529.88	-8.27	1.68	8.4	168.5	1.3	158.0
535.0	534.88	-8.38	1.73	8.6	168.3	1.5	159.6
540.0	539.88	-8.50	1.77	8.7	168.2	1.6	163.8
545.0	544.87	-8.64	1.81	8.8	168.2	1.7	163.7
550.0	549.87	-8.78	1.85	9.0	168.1	1.7	164.4
555.0	554.87	-8.91	1.89	9.1	168.0	1.5	167.2
560.0	559.87	-9.03	1.91	9.2	168.1	1.3	176.6
565.0	564.87	-9.14	1.92	9.3	168.1	1.3	168.5
570.0	569.87	-9.24	1.94	9.4	168.2	1.1	171.2
575.0	574.86	-9.34	1.97	9.5	168.1	1.4	158.8
580.0	579.86	-9.45	2.03	9.7	167.9	1.5	143.3
585.0	584.86	-9.55	2.11	9.8	167.6	1.5	142.2
590.0	589.86	-9.66	2.19	9.9	167.2	1.6	143.7
595.0	594.86	-9.77	2.27	10.0	166.9	1.7	144.9
600.0	599.86	-9.90	2.36	10.2	166.6	1.9	147.7
605.0	604.85	-10.03	2.44	10.3	166.4	1.7	149.5
610.0	609.85	-10.15	2.50	10.5	166.1	1.5	149.1
615.0	614.85	-10.26	2.58	10.6	165.9	1.5	144.2
620.0	619.85	-10.37	2.66	10.7	165.6	1.7	145.0
625.0	624.84	-10.50	2.75	10.9	165.3	1.8	146.7
630.0	629.84	-10.63	2.82	11.0	165.1	1.7	150.5
635.0	634.84	-10.76	2.89	11.1	165.0	1.7	152.2
640.0	639.84	-10.90	2.95	11.3	164.9	1.7	156.1
645.0	644.84	-11.05	3.01	11.4	164.8	1.9	157.5
650.0	649.83	-11.20	3.07	11.6	164.7	2.0	156.1
655.0	654.83	-11.37	3.15	11.8	164.5	2.1	154.2
660.0	659.83	-11.52	3.24	12.0	164.3	1.9	145.7
665.0	664.82	-11.65	3.34	12.1	164.0	1.9	136.4
670.0	669.82	-11.79	3.46	12.3	163.6	2.2	139.8
675.0	674.82	-11.95	3.59	12.5	163.3	2.5	148.1
680.0	679.81	-12.13	3.70	12.7	163.1	2.5	149.3
685.0	684.81	-12.32	3.80	12.9	162.9	2.4	150.2
690.0	689.80	-12.50	3.90	13.1	162.7	2.4	152.3
695.0	694.80	-12.67	4.01	13.3	162.5	2.3	148.7
700.0	699.79	-12.85	4.12	13.5	162.2	2.4	149.6
705.0	704.79	-13.03	4.23	13.7	162.0	2.5	149.5
710.0	709.78	-13.23	4.34	13.9	161.8	2.5	150.9
715.0	714.78	-13.42	4.47	14.1	161.6	2.5	147.8
720.0	719.77	-13.60	4.58	14.4	161.4	2.5	148.4
725.0	724.77	-13.78	4.70	14.6	161.2	2.5	146.3
730.0	729.77	-13.95	4.81	14.8	161.0	2.3	147.2
735.0	734.76	-14.11	4.90	14.9	160.8	2.2	150.3
740.0	739.76	-14.28	5.00	15.1	160.7	2.4	154.3
745.0	744.75	-14.47	5.10	15.3	160.6	2.5	150.0
750.0	749.75	-14.66	5.21	15.6	160.4	2.6	149.4
755.0	754.74	-14.85	5.33	15.8	160.3	2.7	147.2
760.0	759.74	-15.04	5.44	16.0	160.1	2.4	146.9
765.0	764.73	-15.22	5.56	16.2	159.9	2.6	143.3
770.0	769.73	-15.40	5.68	16.4	159.8	2.4	153.0
775.0	774.72	-15.59	5.77	16.6	159.7	2.6	152.2

Appendix F.3.4 Borehole deviation logs run in Ue5PW-1 on 2/24/93 (Continued)

* * * * * COMPU-LOG - VERTICAL DEVIATION * * * * *

CLIENT : NEVADA TEST SITE HOLE ID. : Ue5PW-1 #2
 FIELD OFFICE : ELKO DATE OF LOG : 02/24/93
 DATA FROM : PROBE : GYRO , 1201
 MAG. DECL. : 14.200 DEPTH UNITS : FEET LOG 0

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
780.0	779.72	-15.78	5.89	16.8	159.5	2.7	147.6
785.0	784.71	-15.97	6.02	17.1	159.3	2.8	144.7
790.0	789.71	-16.16	6.14	17.3	159.2	2.4	147.5
795.0	794.70	-16.33	6.25	17.5	159.1	2.4	148.3
800.0	799.70	-16.52	6.36	17.7	158.9	2.5	151.3
805.0	804.69	-16.72	6.46	17.9	158.9	2.7	151.2
810.0	809.69	-16.93	6.59	18.2	158.7	2.8	143.0
815.0	814.68	-17.13	6.74	18.4	158.5	3.1	140.9
820.0	819.67	-17.34	6.91	18.7	158.3	3.1	141.4
822.8	822.47	-17.46	7.00	18.8	158.1	3.1	141.6

Appendix F.3.5 Borehole geophysical logs run in Ue5PW-2 on 7/20/92

EQUIPMENT DATA SHEET			
WELL # Ue5PW-2 DATE: 7-20-92	GAMMA RAY		DENSITY/NEUTRON
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DISTANCE TO SOURCE DETECTOR TYPE DETECTOR OFFSET (FROM 0) LENGTH & DIAMETER (Near) LENGTH & DIAMETER (Far) LOGGING SPEED CENTRALIZER GAMMA RAY API CONVERSION MANUFACTURER	Three 9035 2.8" na Scintln. 6.6" 4.0 x .875" 30 fpm sidewall .658 Century	Three 9035 2.8" 114.7" 2-Sctln 101/107" 4.0x.875 1.2x.875 30 fpm sidewall Century	Two 9071 2.9" 99.0" 2-He3 75/88.2" 4.0x1.125 10.0x2.0 30 fpm free hang Century
RADIOACTIVE SOURCES SOURCE TYPE SOURCE SPACING SOURCE STRENGTH SOURCE SERIAL NO.		Cs 137 6 & 12" 125 mCi VL-1-278	AmBe 10.8&24" 5.0 Ci 71-1-399B
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DETECTOR OFFSET (FROM 0) LOGGING SPEED TYPE	RESISTIVITY		CALIPER Three 9035 2.8" 92" 30 FPM Single Arm
OTHER TOOL INFORMATION Detector Type and Size Tool Type Offset Run Number	Spectral Gamma NaI 1.5 x 12" 9080 68" One		
GENERAL INFORMATION TRUCK NO. 9103 SOFTWARE LEVEL Compulog III Version 7.03 OPERATOR Federwisch LOCATION N. 770395.90 E. 709893.63			
BOREHOLE RECORD RUN NO. 1 BIT SIZE NA - CASING IS DRIVEN RUN NO. 2 BIT SIZE RUN NO. 3 BIT SIZE			
CASING RECORD RUN NO. 1 SIZE 10" FROM 0 TO 551.0 RUN NO. 2 SIZE FROM TO RUN NO. 3 SIZE FROM TO			
REMARKS: Run 1 of this well.			

Appendix F.3.5 Borehole geophysical logs run in Ue5PW-2 on 7/20/92 (Continued)

GAMMA		CALIPER	
NEUTRON		DENSITY	

COMPANY	: REECO		
WELL	: UE-5PW-2		
LOCATION/FIELD	: NEVADA TEST SITE		
COUNTY	: NVE		
STATE	: NEVADA		
SECTION	:	TOWNSHIP	: RANGE :

OTHER SERVICES:

DATE	: 07/20/92	PERMANENT DATUM	:	ELEVATIONS
DEPTH DRILLER	: 559	ELEV. PERM. DATUM	: 3249.42	KB :
LOG BOTTOM	: 551.69	LOG MEASURED FROM	: T.O.C.	DF :
LOG TOP	: -0.00	URL MEASURED FROM	: G.L.	GL : 3248.

CASING DRILLER	: 551	LOGGING UNIT	: 9103
CASING TYPE	: STEEL	FIELD OFFICE	: CHINO VALLEY
CASING THICKNESS	: .365	RECORDED BY	: R.FEDERMISCH

BIT SIZE	: 8.75	BOREHOLE FLUID	: AIR	FILE	: PROCE
MAGNETIC DECL.	: 12	RH	: 0.0	TYPE	: 9055A
MATRIX DENSITY	: 0	RH TEMPERATURE	: 0	LOG	: 0
FLUID DENSITY	: 1.0	MATRIX DELTA T	: 0	PLOT	: TS1
NEUTRON MATRIX	: SANDSTONE FLUID	DELTA T	: 0	THRESH	: 50000

REMARKS :

LOCATION N.776395.29, E.709093.63

WATER LEVEL 842.33

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

Appendix F.3.5 Borehole geophysical logs run in Ue5PW-2 on 7/20/92 (Continued)

UE-5PW-2 07/20/92 245

Appendix F.3.5 Borehole geophysical logs run in Ue5PW-2 on 7/20/92 (Continued)

<div style="border: 1px solid black; padding: 5px; display: inline-block;"> N. U. T. </div>			
COMPANY : REECO WELL : UE-5PW-2 LOCATION/FIELD : NEVADA TEST SITE COUNTY : Nye STATE : NEVADA SECTION :		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> OTHER SERVICES: </div>	
		TOWNSHIP : RANGE :	
DATE : 07/20/92		PERMANENT DATUM : 3248.42 ELEVATIONS	
DEPTH DRILLER : 559		ELEV. PERM. DATUM : KB :	
LOG BOTTOM : 347.00		LOG MEASURED FROM : T.O.C. : DF :	
LOG TOP : 0.00		DEL MEASURED FROM : G.L. : GL : 3248.	
CASING DRILLER : 700		LOGGING UNIT : 9103	
CASING TYPE : STEEL		FIELD OFFICE : CHINO VALLEY	
CASING THICKNESS : .065		RECORDED BY : R.FEDERMISCH	
BIT SIZE : 0.75		BOREHOLE FLUID : AIR	
MAGNETIC DECL. : 12		RM : 0.0	
MATRIX DENSITY : 0		RM TEMPERATURE : 0	
FLUID DENSITY : 1.0		MATRIX DELTA T : 0	
NEUTRON MATRIX : SANDSTONE		FLUID DELTA T : 0	
REMARKS :		FILE : ORIGI TYPE : 9080A LOG : 1 PLOT : TS1 THRESH : 50000	
LOCATION N.770395.89 E.709030.63			
WATER LEVEL 842.33			
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS			

Appendix F.3.5 Borehole geophysical logs run in Ue5PW-2 on 7/20/92 (Continued)

UE-5PW-2 07/20/92 270

Appendix F.3.6 Borehole geophysical logs run in Ue5PW-2 on 9/28/92

EQUIPMENT DATA SHEET			
WELL # Ue5PW-2 DATE: 9-29-92	GAMMA RAY	DENSITY/NEUTRON	
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DISTANCE TO SOURCE DETECTOR TYPE DETECTOR OFFSET (FROM 0) LENGTH & DIAMETER (Near) LENGTH & DIAMETER (Far) LOGGING SPEED CENTRALIZER GAMMA RAY API CONVERSION MANUFACTURER	Three 9035 2.8" na Scintln. 6.6" 4.0 x .875" 30 fpm sidewall .658 Century	Three 9035 2.8" 114.7" 2-Sctln 101/107" 4.0x.875 1.2x.875 30 fpm sidewall Century	Two 9071 2.9" 99.0" 2-He3 75/88.2" 4.0x1.125 10.0x2.0 30 fpm free hang Century
RADIOACTIVE SOURCES SOURCE TYPE SOURCE SPACING SOURCE STRENGTH SOURCE SERIAL NO.		Cs 137 6 & 12" 125 mCi VL-1-278	AmBe 10.8&24" 5.0 Ci 71-1-399B
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DETECTOR OFFSET (FROM 0) LOGGING SPEED TYPE	RESISTIVITY	CALIPER Three 9035 2.8" 92" 30 FPM Single Arm	
OTHER TOOL INFORMATION Detector Type and Size Tool Type Offset Run Number	Spectral Gamma NaI 1.5 x 12" 9080 68" One		
GENERAL INFORMATION TRUCK NO. 9103 SOFTWARE LEVEL Compulog III Version 7.03 OPERATOR Federwisch LOCATION N. 770395.90 E. 709893.63			
BOREHOLE RECORD RUN NO. 1 BIT SIZE NA - CASING IS DRIVEN RUN NO. 2 BIT SIZE RUN NO. 3 BIT SIZE			
CASING RECORD RUN NO. 1 SIZE 10" FROM 0 TO 551.0 RUN NO. 2 SIZE 8" FROM 0 TO 850.0 RUN NO. 3 SIZE FROM TO			
REMARKS: Run 2 of this well.			

Appendix F.3.6 Borehole geophysical logs run in Ue5PW-2 on 9/28/92 (Continued)

<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">GAMMA</td> <td style="padding: 5px;">CALIPER</td> </tr> <tr> <td style="padding: 5px;">NEUTRON</td> <td style="padding: 5px;">DENSITY</td> </tr> </table>		GAMMA	CALIPER	NEUTRON	DENSITY		
GAMMA	CALIPER						
NEUTRON	DENSITY						
COMPANY : REECO WELL : UE-5PM-2 LOCATION/FIELD : NEVADA TEST SITE COUNTY : Nye STATE : NEVADA SECTION : TOWNSHIP : RANGE :		OTHER SERVICES : <div style="border: 1px solid black; height: 50px; width: 100%;"></div>					
DATE : 09/29/92 DEPTH DRILLER : 917 LOG BOTTOM : 917.00 LOG TOP : -6.00		PERMANENT DATUM : 3248.42 ELEVATIONS ELEV. PERM. DATUM: 3248.42 KB : LOG MEASURED FROM: T.O.C. DF : LOG MEASURED FROM: G.L. GL : 3248.					
CASING DRILLER : 958 CASING TYPE : STEEL BH CASING THICKNESS: .065		LOGGING UNIT : 9193 FIELD OFFICE : CHINO VALLEY RECORDED BY : R.FEDERMISCH					
BIT SIZE : 10.75 MAGNETIC DECL. : 10 MATRIX DENSITY : 1.9 FLUID DENSITY : NEUTRON MATRIX : SANDSTONE FLUID DELTA T : REMARKS :		BOREHOLE FLUID : AIR H2O BH : BH TEMPERATURE : MATRIX DELTA T : DELTA T : FILE : PROCE TYPE : 9035A LOG : 1 PLOT : TS1 THRESH: 50000					
LOCATION N.779395.90, U.704003.63 WATER LEVEL 842.33 ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS							

Appendix F.3.6 Borehole geophysical logs run in Ue5PW-2 on 9/28/92 (Continued)

Appendix F.3.6 Borehole geophysical logs run in Ue5PW-2 on 9/28/92 (Continued)

<div style="border: 1px solid black; padding: 5px; display: inline-block;"> M. U. T. </div>			
COMPANY : REUCO WELL : UE-5PW-2 LOCATION/FIELD : NEVADA TEST SITE COUNTY : NVE STATE : NEVADA SECTION :		<div style="border: 1px solid black; padding: 5px; min-height: 50px;"> OTHER SERVICES: </div>	
		TOWNSHIP :	RANGE :
DATE :	09/28/92	PERMANENT DATUM :	G.L. ELEVATIONS
DEPTH DRILLER :	859	ELEV. PERM. DATUM:	3248.42 KB :
LOG BOTTOM :	917.00	LOG MEASURED FROM:	T.O.C. DF :
LOG TOP :	0.20	BRL MEASURED FROM:	G.L. GL : 3248.
CASING DRILLER :	859	LOGGING UNIT :	9183
CASING TYPE :	STEEL BH	FIELD OFFICE :	CHINO VALLEY
CASING THICKNESS:	.265	RECORDED BY :	R.FEDERWISCH
BIT SIZE :	10.75	BOREHOLE FLUID :	AIR, 420 FILE : ORIGI
MAGNETIC DECL. :	14	RH :	TYPE : 9080A
MATRIX DENSITY :	1.8	PH TEMPERATURE :	LOG : 0
FLUID DENSITY :		MATRIX DELTA T :	PLOT : TS1
NEUTRON MATRIX :	SANDSTONE FLUID	DELTA T :	THRESH: 50000
REMARKS :			
LOCATION N.776395.99, E.789893.63			
WATER LEVEL 842.33			
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS			

Appendix F.3.6 Borehole geophysical logs run in Ue5PW-2 on 9/28/92 (Continued)

UE-5PW-2 09/28/92 270

Appendix F.3.7

Borehole deviation log run in UE5PW-2 on 2/24/93 (replaces previous Equipment Data Sheet).

EQUIPMENT DATA SHEET			
WELL # UE5PW-2 DATE: 2-25-93	GAMMA RAY	DENSITY/NEUTRON	
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DISTANCE TO SOURCE DETECTOR TYPE DETECTOR OFFSET (FROM 0) LENGTH & DIAMETER (Near) LENGTH & DIAMETER (Far) LOGGING SPEED CENTRALIZER GAMMA RAY API CONVERSION MANUFACTURER			
RADIOACTIVE SOURCES SOURCE TYPE SOURCE SPACING SOURCE STRENGTH SOURCE SERIAL NO.			
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DETECTOR OFFSET (FROM 0) LOGGING SPEED TYPE	RESISTIVITY	CALIPER	
OTHER TOOL INFORMATION Detector Type and Size Tool Type Offset Run Number	DEVIATION Incl/Gyro 9095 70.9/80.6 One	Manufacturer CGC/Humphrey	
GENERAL INFORMATION TRUCK NO. 9101 SOFTWARE LEVEL Compulog III Version 7.03 OPERATOR T. Knarr LOCATION N. 770395.90 E. 709893.63			
BOREHOLE RECORD RUN NO. 1 BIT SIZE 10" 0 - 551 RUN NO. 2 BIT SIZE 8" 551 - 919.5 RUN NO. 3 BIT SIZE			
CASING RECORD RUN NO. 1 SIZE 2 - 7/8" FROM 0 TO 919.5 RUN NO. 2 SIZE FROM RUN NO. 3 SIZE FROM			
REMARKS: Client supplied sighting stake direction. Bottom log depth 894 run 1, and 878 run 2			

Appendix F.3.7 Borehole deviation logs run in Ue5PW-2 on 2/25/93 (Continued)

DEVIATION SURVEY			
COMPANY : NEVADA TEST SITE WELL : Ue5PW-2 #2 LOCATION/FIELD : NEVADA TEST SITE COUNTY : NYE STATE : NEVADA SECTION :		TOWNSHIP : RANGE :	
		OTHER SERVICES :	
DATE : 02/25/93 DEPTH DRILLER : 919.5 LOG BOTTOM : 878.49 LOG TOP : -0.10		PERMANENT DATUM : ELEV. PERM. DATUM: KB : LOG MEASURED FROM: GL DF : DRL MEASURED FROM: GL GL :	
CASING DRILLER : 0 CASING TYPE : CASING THICKNESS: 0		LOGGING UNIT : 9101 FIELD OFFICE : ELKO RECORDED BY : KNARR	
BIT SIZE : 2.875 MAGNETIC DECL. : 0.000 MATRIX DENSITY : FLUID DENSITY : NEUTRON MATRIX :		BOREHOLE FLUID : NONE RM : RM TEMPERATURE : MATRIX DELTA T : FLUID DELTA T :	
REMARKS : STAKE IS TRUE NORTH		FILE : PROCE TYPE : GYRO LOG : 0 PLOT : TS 6 THRESH: 50000	
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS			

Appendix F.3.7 Borehole deviation logs run in Ue5PW-2 on 2/25/93 (Continued)

PLAN VIEW
COMPU-LOG DEVIATION

CLIENT: NEVADA TEST SITE
LOCATION: NEVADA TEST SITE
HOLE ID: Ue5PW-2 #2
DATE OF LOG: 02/25/93
PROBE: GYRO 1201

MAG DECL: 0.0

SCALE: 25 FT/IN
TRUE DEPTH: 877.65 FT
AZIMUTH: 104.1
DISTANCE: 32.3 FT
+ = 150 FT INCR
○ = BOTTOM OF HOLE

Appendix F.3.7 Borehole deviation logs run in Ue5PW-2 on 2/25/93 (Continued)

* * * * * COMPU-LOG - VERTICAL DEVIATION * * * * *

CLIENT : NEVADA TEST SITE HOLE ID. : Ue5PW-2 #2
 FIELD OFFICE : ELKO DATE OF LOG : 02/25/93
 DATA FROM : PROBE : GYRO , 1201
 MAG. DECL. : 0.000 DEPTH UNITS : FEET LOG 0

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
0.2	0.20	-0.00	0.00	0.0	138.7	0.6	138.7
5.0	5.00	-0.03	0.04	0.1	131.1	0.6	134.6
10.0	10.00	-0.07	0.08	0.1	131.0	0.6	132.4
15.0	15.00	-0.11	0.13	0.2	129.7	0.6	123.6
20.0	20.00	-0.13	0.16	0.2	129.0	0.4	126.4
25.0	25.00	-0.14	0.18	0.2	129.0	0.3	59.3
30.0	30.00	-0.16	0.20	0.3	129.6	0.3	132.3
35.0	35.00	-0.18	0.22	0.3	129.5	0.4	126.9
40.0	40.00	-0.21	0.26	0.3	129.6	0.7	131.0
45.0	45.00	-0.26	0.31	0.4	129.7	0.9	127.7
50.0	50.00	-0.30	0.36	0.5	129.6	0.8	128.9
55.0	55.00	-0.34	0.42	0.5	129.4	1.0	128.2
60.0	60.00	-0.39	0.48	0.6	129.1	0.9	125.2
65.0	64.99	-0.43	0.54	0.7	128.5	1.0	118.9
70.0	69.99	-0.48	0.62	0.8	127.7	0.9	107.5
75.0	74.99	-0.52	0.71	0.9	126.3	1.2	113.2
80.0	79.99	-0.56	0.80	1.0	125.0	1.1	112.4
85.0	84.99	-0.61	0.90	1.1	124.1	1.3	117.5
90.0	89.99	-0.66	0.99	1.2	123.6	1.3	121.1
95.0	94.99	-0.72	1.09	1.3	123.4	1.4	122.2
100.0	99.99	-0.77	1.19	1.4	123.1	1.4	121.1
105.0	104.99	-0.84	1.29	1.5	123.1	1.4	129.1
110.0	109.98	-0.92	1.38	1.7	123.7	1.7	132.5
115.0	114.98	-1.01	1.49	1.8	124.3	1.8	130.3
120.0	119.98	-1.12	1.61	2.0	124.7	1.9	128.2
125.0	124.98	-1.22	1.74	2.1	125.0	2.0	127.1
130.0	129.97	-1.30	1.87	2.3	124.8	1.8	117.8
135.0	134.97	-1.36	2.00	2.4	124.2	1.4	105.5
140.0	139.97	-1.40	2.13	2.5	123.3	1.4	100.3
145.0	144.97	-1.41	2.24	2.6	122.2	1.3	90.1
150.0	149.97	-1.41	2.34	2.7	121.0	1.2	86.1
155.0	154.97	-1.40	2.45	2.8	119.7	1.3	86.3
160.0	159.97	-1.40	2.56	2.9	118.6	1.3	89.8
165.0	164.96	-1.40	2.68	3.0	117.6	1.3	97.0
170.0	169.96	-1.42	2.79	3.1	116.9	1.4	99.7
175.0	174.96	-1.45	2.92	3.3	116.5	1.6	107.2
180.0	179.96	-1.50	3.05	3.4	116.2	1.8	112.9
185.0	184.96	-1.57	3.21	3.6	116.1	1.9	116.3
190.0	189.95	-1.65	3.37	3.7	116.1	2.1	118.8
195.0	194.95	-1.74	3.52	3.9	116.2	1.7	126.6
200.0	199.95	-1.83	3.69	4.1	116.3	1.8	114.7
205.0	204.94	-1.91	3.85	4.3	116.4	2.0	117.8
210.0	209.94	-1.99	4.00	4.5	116.4	1.8	115.2
215.0	214.94	-2.04	4.13	4.6	116.3	1.5	112.7
220.0	219.94	-2.08	4.24	4.7	116.1	1.5	103.6
225.0	224.94	-2.10	4.37	4.8	115.7	1.5	94.9
230.0	229.93	-2.12	4.50	5.0	115.2	1.6	96.0
235.0	234.93	-2.13	4.65	5.1	114.6	1.8	93.6
240.0	239.93	-2.15	4.82	5.3	114.0	2.1	96.3
245.0	244.92	-2.18	5.01	5.5	113.5	2.3	101.7
250.0	249.92	-2.22	5.22	5.7	113.0	2.4	100.7
255.0	254.92	-2.26	5.43	5.9	112.6	2.4	102.4

Appendix F.3.7 Borehole deviation logs run in Ue5PW-2 on 2/25/93 (Continued)

* * * * * COMPU-LOG -- VERTICAL DEVIATION * * * * *

CLIENT : NEVADA TEST SITE HOLE ID. : Ue5PW-2 #2
 FIELD OFFICE : ELKO DATE OF LOG : 02/25/93
 DATA FROM : PROBE : GYRO , 1201
 MAG. DECL. : 0.000 DEPTH UNITS : FEET LOG 0

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
260.0	259.91	-2.32	5.63	6.1	112.4	2.6	104.4
265.0	264.91	-2.39	5.83	6.3	112.2	2.3	111.5
270.0	269.90	-2.47	6.02	6.5	112.3	2.3	117.2
275.0	274.90	-2.56	6.18	6.7	112.5	2.1	121.8
280.0	279.90	-2.65	6.32	6.9	112.8	2.1	121.2
285.0	284.89	-2.74	6.45	7.0	113.0	1.6	123.7
290.0	289.89	-2.81	6.55	7.1	113.3	0.9	132.5
295.0	294.89	-2.86	6.61	7.2	113.4	0.6	117.3
300.0	299.89	-2.89	6.65	7.2	113.4	0.4	96.1
305.0	304.89	-2.98	6.71	7.3	113.2	0.9	80.9
310.0	309.89	-2.86	6.81	7.4	112.8	1.5	81.1
315.0	314.89	-2.84	6.97	7.5	112.2	2.0	81.9
320.0	319.88	-2.82	7.16	7.7	111.5	2.4	84.7
325.0	324.98	-2.91	7.38	7.9	110.8	2.8	87.0
330.0	329.87	-2.81	7.63	8.1	110.2	2.9	88.4
335.0	334.87	-2.83	7.88	8.4	109.8	2.8	95.6
340.0	339.86	-2.87	8.11	8.6	109.5	2.6	100.3
345.0	344.86	-2.91	8.30	8.8	109.3	1.8	102.8
350.0	349.85	-2.94	8.43	8.9	109.2	1.5	107.4
355.0	354.85	-2.97	8.53	9.0	109.2	1.0	111.2
360.0	359.85	-3.01	8.61	9.1	109.3	0.8	124.4
365.0	364.85	-3.05	8.66	9.2	109.4	0.8	135.7
370.0	369.85	-3.12	8.72	9.3	109.7	1.2	135.6
375.0	374.85	-3.21	8.81	9.4	110.0	1.7	136.1
380.0	379.85	-3.33	8.92	9.5	110.4	2.1	135.3
385.0	384.84	-3.47	9.06	9.7	111.0	2.5	138.9
390.0	389.84	-3.64	9.21	9.9	111.5	2.6	137.5
395.0	394.83	-3.80	9.37	10.1	112.1	2.7	136.8
400.0	399.83	-3.94	9.53	10.3	112.5	2.2	125.2
405.0	404.83	-4.03	9.68	10.5	112.6	1.8	109.1
410.0	409.82	-4.06	9.84	10.6	112.4	1.8	92.5
415.0	414.82	-4.04	10.01	10.8	112.0	2.1	80.1
420.0	419.82	-4.01	10.20	11.0	111.4	2.5	86.8
425.0	424.81	-3.99	10.41	11.1	111.0	2.4	90.1
430.0	429.81	-4.02	10.61	11.3	110.8	2.4	109.5
435.0	434.80	-4.13	10.80	11.6	110.9	2.6	125.0
440.0	439.80	-4.28	10.96	11.8	111.3	2.1	144.1
445.0	444.79	-4.45	11.09	11.9	111.9	2.2	147.9
450.0	449.79	-4.60	11.19	12.1	112.4	1.9	138.6
455.0	454.79	-4.71	11.28	12.2	112.7	1.3	129.7
460.0	459.79	-4.78	11.39	12.4	112.8	1.4	112.1
465.0	464.78	-4.82	11.50	12.5	112.7	1.3	109.2
470.0	469.78	-4.97	11.60	12.6	112.8	1.1	116.7
475.0	474.78	-4.94	11.69	12.7	112.9	1.5	137.3
480.0	479.78	-5.04	11.79	12.8	113.2	1.8	135.6
485.0	484.78	-5.15	11.89	13.0	113.4	1.8	140.1
490.0	489.77	-5.26	12.00	13.1	113.7	1.9	139.9
495.0	494.77	-5.38	12.12	13.3	113.9	2.0	132.1
500.0	499.77	-5.49	12.26	13.4	114.1	2.1	127.6
505.0	504.77	-5.59	12.39	13.6	114.3	1.9	116.2
510.0	509.76	-5.62	12.53	13.7	114.1	1.8	95.9
515.0	514.76	-5.61	12.70	13.9	113.9	2.0	86.4

Appendix F.3.7 Borehole deviation logs run in Ue5PW-2 on 2/25/93 (Continued)

***** COMPU-LOG -- VERTICAL DEVIATION *****

CLIENT : NEVADA TEST SITE HOLE ID. : Ue5PW-2 #2
FIELD OFFICE : ELKO DATE OF LOG : 02/25/93
DATA FROM : PROBE : GYRO , 1201
MAG. DECL. : 0.000 DEPTH UNITS : FEET LOG 0

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
520.0	519.76	-5.60	12.89	14.1	113.5	2.3	86.1
525.0	524.75	-5.59	13.11	14.2	113.1	2.7	92.1
530.0	529.75	-5.61	13.35	14.5	112.8	2.9	96.9
535.0	534.74	-5.67	13.59	14.7	112.6	2.9	109.7
540.0	539.73	-5.77	13.81	15.0	112.7	2.8	120.7
545.0	544.73	-5.91	14.03	15.2	112.9	2.9	125.2
550.0	549.72	-6.06	14.22	15.5	113.1	2.5	127.8
555.0	554.72	-6.18	14.39	15.7	113.2	2.4	124.7
560.0	559.71	-6.28	14.54	15.8	113.4	2.6	116.0
565.0	564.71	-6.35	14.67	16.0	113.4	1.5	120.3
570.0	569.71	-6.38	14.77	16.1	113.4	1.3	95.7
575.0	574.71	-6.39	14.90	16.2	113.2	1.8	96.0
580.0	579.71	-6.42	15.08	16.4	113.1	2.4	97.6
585.0	584.70	-6.45	15.31	16.6	112.9	2.8	99.3
590.0	589.69	-6.50	15.57	16.9	112.7	3.2	99.1
595.0	594.69	-6.54	15.85	17.1	112.4	3.3	100.1
600.0	599.68	-6.59	16.11	17.4	112.2	2.9	99.8
605.0	604.67	-6.63	16.37	17.7	112.1	3.1	98.8
610.0	609.66	-6.67	16.63	17.9	111.9	3.0	96.0
615.0	614.66	-6.70	16.90	18.2	111.6	3.1	97.0
620.0	619.65	-6.74	17.16	18.4	111.4	3.1	97.7
625.0	624.64	-6.78	17.42	18.7	111.3	2.6	102.1
630.0	629.64	-6.82	17.63	18.9	111.1	2.5	101.6
635.0	634.63	-6.85	17.85	19.1	111.0	2.5	97.2
640.0	639.63	-6.88	18.09	19.4	110.8	2.7	97.3
645.0	644.62	-6.92	18.32	19.6	110.7	2.8	98.5
650.0	649.62	-6.96	18.56	19.8	110.6	2.8	101.6
655.0	654.61	-7.01	18.80	20.1	110.5	3.0	103.6
660.0	659.60	-7.07	19.06	20.3	110.4	3.1	101.6
665.0	664.60	-7.12	19.33	20.6	110.2	3.3	95.7
670.0	669.59	-7.15	19.62	20.9	110.0	3.3	96.5
675.0	674.58	-7.18	19.91	21.2	109.8	3.4	96.5
680.0	679.57	-7.21	20.20	21.5	109.7	3.3	96.8
685.0	684.56	-7.25	20.49	21.7	109.5	3.1	96.6
690.0	689.55	-7.29	20.78	22.0	109.3	3.3	96.2
695.0	694.55	-7.32	21.05	22.3	109.2	3.0	96.6
700.0	699.54	-7.34	21.32	22.5	109.0	2.9	99.0
705.0	704.53	-7.37	21.58	22.8	108.9	3.1	100.4
710.0	709.53	-7.41	21.82	23.0	108.8	2.9	97.3
715.0	714.52	-7.45	22.05	23.3	108.7	2.6	100.8
720.0	719.51	-7.49	22.28	23.5	108.6	2.6	97.7
725.0	724.51	-7.53	22.51	23.7	108.5	2.8	101.8
730.0	729.50	-7.57	22.76	24.0	108.4	2.9	99.0
735.0	734.50	-7.60	23.02	24.2	108.3	3.0	99.5
740.0	739.49	-7.63	23.28	24.5	108.1	3.0	96.1
745.0	744.48	-7.65	23.53	24.7	108.0	2.8	90.5
750.0	749.48	-7.66	23.77	25.0	107.9	2.8	91.8
755.0	754.47	-7.67	24.02	25.2	107.7	2.8	91.9
760.0	759.46	-7.67	24.27	25.5	107.5	2.9	91.6
765.0	764.46	-7.68	24.52	25.7	107.4	2.8	88.8
770.0	769.45	-7.67	24.77	25.9	107.2	3.0	88.7
775.0	774.44	-7.67	25.04	26.2	107.0	3.1	90.3

Appendix F.3.7 Borehole deviation logs run in Ue5PW-2 on 2/25/93 (Continued)

* * * * * COMPU-LOG - VERTICAL DEVIATION * * * * *

CLIENT : NEVADA TEST SITE HOLE ID. : Ue5PW-2 #2
 FIELD OFFICE : ELKO DATE OF LOG : 02/25/93
 DATA FROM : PROBE : GYRO , 1201
 MAG. DECL. : 0.000 DEPTH UNITS : FEET LOG 0

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
780.0	779.44	-7.67	25.32	26.5	106.8	3.0	76.0
785.0	784.43	-7.66	25.61	26.7	106.7	3.5	89.5
790.0	789.42	-7.66	25.92	27.0	106.5	3.6	91.2
795.0	794.41	-7.66	26.24	27.3	106.3	3.7	89.5
800.0	799.40	-7.65	26.57	27.6	106.1	3.8	86.8
805.0	804.39	-7.64	26.89	28.0	105.9	3.4	90.0
810.0	809.38	-7.63	27.18	28.2	105.7	3.3	87.5
815.0	814.37	-7.62	27.48	28.5	105.5	3.4	91.3
820.0	819.36	-7.64	27.78	28.8	105.4	3.4	93.6
825.0	824.35	-7.66	28.08	29.1	105.3	3.6	92.3
830.0	829.34	-7.67	28.38	29.4	105.1	3.4	94.3
835.0	834.33	-7.70	28.67	29.7	105.0	3.3	95.1
840.0	839.32	-7.72	28.96	30.0	104.9	3.5	91.1
845.0	844.32	-7.72	29.27	30.3	104.8	3.5	89.4
850.0	849.31	-7.72	29.58	30.6	104.6	3.6	90.7
855.0	854.30	-7.73	29.90	30.9	104.5	3.7	93.1
860.0	859.28	-7.75	30.23	31.2	104.4	3.8	96.0
865.0	864.27	-7.79	30.58	31.6	104.3	3.9	94.0
870.0	869.26	-7.81	30.87	31.8	104.2	3.3	97.4
875.0	874.25	-7.85	31.17	32.1	104.1	3.4	95.7
878.4	877.65	-7.87	31.35	32.3	104.1	2.8	99.2

Appendix F.3.8 Borehole geophysical logs run in Ue5PW-3 on 9/28/92

EQUIPMENT DATA SHEET			
WELL # Ue5PW-3 DATE: 9-28-92	GAMMA RAY	DENSITY/NEUTRON	
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DISTANCE TO SOURCE DETECTOR TYPE DETECTOR OFFSET (FROM 0) LENGTH & DIAMETER (Near) LENGTH & DIAMETER (Far) LOGGING SPEED CENTRALIZER GAMMA RAY API CONVERSION MANUFACTURER	Three 9035 2.8" na Scintln. 6.6" 4.0 x .875" 30 fpm sidewall .658 Century	Three 9035 2.8" 114.7" 2-Sctln 101/107" 4.0x.875 1.2x.875 30 fpm sidewall Century	Two 9071 2.9" 99.0" 2-He3 75/88.2" 4.0x1.125 10.0x2.0 30 fpm free hang Century
RADIOACTIVE SOURCES SOURCE TYPE SOURCE SPACING SOURCE STRENGTH SOURCE SERIAL NO.		Cs 137 6 & 12" 125 mCi VL-1-278	AmBe 10.8&24" 5.0 Ci 71-1-399B
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DETECTOR OFFSET (FROM 0) LOGGING SPEED TYPE	RESISTIVITY	CALIPER Three 9035 2.8" 92" 30 FPM Single Arm	
OTHER TOOL INFORMATION Detector Type and Size Tool Type Offset Run Number	Spectral Gamma NaI 1.5 x 12" 9080 68" One		
GENERAL INFORMATION TRUCK NO. 9103 SOFTWARE LEVEL Compulog III Version 7.03 OPERATOR Federwisch LOCATION N. 767202.36 E. 707006.31			
BOREHOLE RECORD RUN NO. 1 BIT SIZE NA - CASING IS DRIVEN RUN NO. 2 BIT SIZE RUN NO. 3 BIT SIZE			
CASING RECORD RUN NO. 1 SIZE 10" FROM 0 TO 450.0 RUN NO. 2 SIZE FROM TO RUN NO. 3 SIZE FROM TO			
REMARKS: Run 1 of this well.			

Appendix F.3.8 Borehole geophysical logs run in Ue5PW-3 on 9/28/92 (Continued)

GAMMA		CALIPER	
NEUTRON		DENSITY	

COMPANY : REECO WELL : UE-5PW-3 LOCATION/FIELD : NEVADA TEST SITE COUNTY : NYE STATE : NEVADA SECTION : TOWNSHIP : RANGE :	OTHER SERVICES: <div style="border: 1px solid black; height: 60px; margin-top: 5px;"></div>
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DATE : 09/28/92	PERMANENT DATUM : G.L.	ELEVATIONS
DEPTH DRILLER : 450	ELEV. PERM. DATUM: 3300.87	KB :
LOG BOTTOM : 451.10	LOG MEASURED FROM: T.O.C.	DF :
LOG TOP : -9.30	DRL MEASURED FROM: G.L.	GL : 3300.

CASING DRILLER : 450	LOGGING UNIT : 9103	
CASING TYPE : STEEL	FIELD OFFICE : CHINO VALLEY	
CASING THICKNESS: .365	RECORDED BY : R.FEDERWISCH	

BIT SIZE : 10.75	BOREHOLE FLUID : AIR, H2O	FILE : PROCE
MAGNETIC DECL. : 14	RM :	TYPE : 9035A
MATRIX DENSITY : 1.0	RM TEMPERATURE :	LOG : 4
FLUID DENSITY :	MATRIX DELTA T :	PLOT : TS1
NEUTRON MATRIX : SANDSTONE FLUID	DELTA T :	THRESH: 50000

REMARKS :

LOCATION N.767202.36, E.707006.31

WATER LEVEL 894.65

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

Appendix F.3.8 Borehole geophysical logs run in Ue5PW-3 on 9/28/92 (Continued)

UE-5PH-3 09/28/92 820

Appendix F.3.8 Borehole geophysical logs run in Ue5PW-3 on 9/28/92 (Continued)

<div style="border: 1px solid black; padding: 5px; display: inline-block;">K. U. T.</div>					
COMPANY	: REECO	<div style="border: 1px solid black; padding: 5px;">OTHER SERVICES:</div>			
WELL	: UE-5PW-3				
LOCATION/FIELD	: NEVADA TEST SITE				
COUNTY	: NVE				
STATE	: NEVADA				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 09/28/92	PERMANENT DATUM	: G.L.	ELEVATIONS	
DEPTH DRILLER	: 450	ELEV. PERM. DATUM	: 3300.87	KB	:
LOG BOTTOM	: 449.80	LOG MEASURED FROM	: T.O.C.	DF	:
LOG TOP	: -1.70	DRL MEASURED FROM	: G.L.	GL	: 3300.
CASING DRILLER	: 450	LOGGING UNIT	: 9103		
CASING TYPE	: STEEL	FIELD OFFICE	: CHINO VALLEY		
CASING THICKNESS	: .365	RECORDED BY	: R.FEDERWISCH		
BIT SIZE	: 10.75	BOREHOLE FLUID	: AIR, H2O	FILE	: ORIGI
MAGNETIC DECL.	: 14	RM	:	TYPE	: 9080A
MATRIX DENSITY	: 1.0	RM TEMPERATURE	:	LOG	: 3
FLUID DENSITY	:	MATRIX DELTA T	:	PLOT	: TS1
NEUTRON MATRIX	: SANDSTONE FLUID	DELTA T	:	THRESH	: 50000
REMARKS	:				
LOCATION N.767202.36, E.707006.31					
WATER LEVEL 894.65					
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS					

Appendix F.3.8 Borehole geophysical logs run in Ue5PW-3 on 9/28/92 (Continued)

UE-5PW-3 09/28/92 270

Appendix F.3.9 Borehole geophysical logs run in Ue5PW-3 on 11/18/92

EQUIPMENT DATA SHEET			
WELL # Ue5PW-3 DATE: 11-18-92	GAMMA RAY	DENSITY/NEUTRON	
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DISTANCE TO SOURCE DETECTOR TYPE DETECTOR OFFSET (FROM 0) LENGTH & DIAMETER (Near) LENGTH & DIAMETER (Far) LOGGING SPEED CENTRALIZER GAMMA RAY API CONVERSION MANUFACTURER	Three 9035 2.8" na Scintln. 6.6" 4.0 x .875" 30 fpm sidewall .658 Century	Three 9035 2.8" 114.7" 2-Sctln 101/107" 4.0x.875 1.2x.875 30 fpm sidewall Century	Two 9071 2.9" 99.0" 2-He3 75/88.2" 4.0x1.125 10.0x2.0 30 fpm free hang Century
RADIOACTIVE SOURCES SOURCE TYPE SOURCE SPACING SOURCE STRENGTH SOURCE SERIAL NO.		Cs 137 6 & 12" 125 mCi VL-1-278	AmBe 10.8&24" 5.0 Ci 71-1-399B
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DETECTOR OFFSET (FROM 0) LOGGING SPEED TYPE	RESISTIVITY	CALIPER Three 9035 2.8" 92" 30 FPM Single Arm	
OTHER TOOL INFORMATION Detector Type and Size Tool Type Offset Run Number	Spectral Gamma NaI 1.5 x 12" 9080 68" One		
GENERAL INFORMATION TRUCK NO. 9103 SOFTWARE LEVEL Compulog III Version 7.03 OPERATOR Federwisch LOCATION N. 767202.36 E. 707006.31			
BOREHOLE RECORD RUN NO. 1 BIT SIZE NA - CASING IS DRIVEN RUN NO. 2 BIT SIZE RUN NO. 3 BIT SIZE			
CASING RECORD RUN NO. 1 SIZE 10" FROM 0 TO 450.0 RUN NO. 2 SIZE 8" FROM 0 TO 700.0 RUN NO. 3 SIZE FROM TO			
REMARKS: Run 2 of this well.			

Appendix F.3.9 Borehole geophysical logs run in Ue5PW-3 on 11/18/92 (Continued)

<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">GAMMA</td> <td style="padding: 5px;">CALIPER</td> </tr> <tr> <td style="padding: 5px;">NEUTRON</td> <td style="padding: 5px;">DENSITY</td> </tr> </table>		GAMMA	CALIPER	NEUTRON	DENSITY		
GAMMA	CALIPER						
NEUTRON	DENSITY						
<p>COMPANY : REECO</p> <p>WELL : UE-5PW-3</p> <p>LOCATION/FIELD : NEVADA TEST SITE</p> <p>COUNTY : NYE</p> <p>STATE : NEVADA</p> <p>SECTION : TOWNSHIP : RANGE :</p>		<div style="border: 1px solid black; padding: 5px; min-height: 50px;"> <p>OTHER SERVICES:</p> </div>					
<p>DATE : 11/18/92</p> <p>DEPTH DRILLER : 959</p> <p>LOG BOTTOM : 955.89</p> <p>LOG TOP : -6.89</p>		<p>PERMANENT DATUM : G.L.</p> <p>ELEV. PERM. DATUM: 3300.87</p> <p>LOG MEASURED FROM: G.L.</p> <p>DRL MEASURED FROM: G.L.</p>					
		<p>ELEVATIONS</p> <p>KB : DF : GL : 3300.</p>					
<p>CASING DRILLER : 709</p> <p>CASING TYPE : STEEL</p> <p>CASING THICKNESS: .365</p>		<p>LOGGING UNIT : 9103</p> <p>FIELD OFFICE : CHINO VALLEY</p> <p>RECORDED BY : R. FEDERWISCH</p>					
<p>BIT SIZE : 8.7</p> <p>MAGNETIC DECL. : 12.5</p> <p>MATRIX DENSITY : 1.8</p> <p>FLUID DENSITY :</p> <p>NEUTRON MATRIX : SANDSTONE</p> <p>REMARKS :</p>		<p>BOREHOLE FLUID : AIR, H2O</p> <p>RH : RH TEMPERATURE :</p> <p>MATRIX DELTA T : PLOT : TS1</p> <p>FLUID DELTA T : THRESH: 50000</p>					
<p>LOCATION N.767202.36, E.787006.31</p> <p>WATER LEVEL 894.65</p> <p>ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS</p>							

Appendix F.3.9 Borehole geophysical logs run in Ue5PW-3 on 11/18/92 (Continued)

UE-5PW-3 11/18/92 620

Appendix F.3.9 Borehole geophysical logs run in Ue5PW-3 on 11/18/92 (Continued)

<div style="border: 1px solid black; display: inline-block; padding: 5px 20px; font-weight: bold; font-family: sans-serif;">K. U. T.</div>					
COMPANY	: REECO	<div style="border: 1px solid black; padding: 5px;">OTHER SERVICES:</div>			
WELL	: UE-5PW-3				
LOCATION/FIELD	: NEVADA TEST SITE				
COUNTY	: NYE				
STATE	: NEVADA				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 11/18/92	PERMANENT DATUM	: G.L.	ELEVATIONS	
DEPTH DRILLER	: 950	ELEV. PERM. DATUM	: 3300.87	KB	:
LOG BOTTOM	: 951.50	LOG MEASURED FROM	: G.L.	DF	:
LOG TOP	: 1.60	DRL MEASURED FROM	: G.L.	GL	: 3300.
CASING DRILLER	: 700	LOGGING UNIT	: 9103		
CASING TYPE	: STEEL	FIELD OFFICE	: CHINO VALLEY		
CASING THICKNESS	: .365	RECORDED BY	: R.FEDERWISCH		
BIT SIZE	: 8.7	BOREHOLE FLUID	: AIR, H2O	FILE	: ORIGI
MAGNETIC DECL.	: 12.5	RM	:	TYPE	: 9080A
MATRIX DENSITY	: 1.0	RM TEMPERATURE	:	LOG	: 2
FLUID DENSITY	:	MATRIX DELTA T	:	PLOT	: TS1
NEUTRON MATRIX	: SANDSTONE FLUID	DELTA T	:	THRESH	: 50000
REMARKS	:				
LOCATION N.767202.36, E.707006.31					
WATER LEVEL 894.65					
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS					

Appendix F.3.9 Borehole geophysical logs run in Ue5PW-3 on 11/18/92 (Continued)

UE-5PW-3 11/18/92 270

Appendix F.3.10 Borehole deviation log run in UE5PW-3 on 2/24/93 (replaces previous Equipment Data Sheet).

EQUIPMENT DATA SHEET			
WELL # UE5PW-3 DATE: 2-25-93	GAMMA RAY	DENSITY/NEUTRON	
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DISTANCE TO SOURCE DETECTOR TYPE DETECTOR OFFSET (FROM 0) LENGTH & DIAMETER (Near) LENGTH & DIAMETER (Far) LOGGING SPEED CENTRALIZER GAMMA RAY API CONVERSION MANUFACTURER			
RADIOACTIVE SOURCES SOURCE TYPE SOURCE SPACING SOURCE STRENGTH SOURCE SERIAL NO.			
TOOL INFORMATION RUN NO. MODEL NO. TOOL DIAMETER DETECTOR OFFSET (FROM 0) LOGGING SPEED TYPE	RESISTIVITY	CALIPER	
OTHER TOOL INFORMATION Detector Type and Size Tool Type Offset Run Number	DEVIATION Incl/Gyro 9095 70.9/80.6 One	Manufacturer CGC/Humphrey	
GENERAL INFORMATION TRUCK NO. 9101 SOFTWARE LEVEL Compulog III Version 7.03 OPERATOR T. Knarr LOCATION N. 767202.36 E. 707006.31			
BOREHOLE RECORD RUN NO. 1 BIT SIZE 10" 0 to 450 RUN NO. 2 BIT SIZE 8" 450 to 955 RUN NO. 3 BIT SIZE			
CASING RECORD RUN NO. 1 SIZE 2-7/8" FROM 0 TO 955.0 RUN NO. 2 SIZE FROM RUN NO. 3 SIZE FROM			
REMARKS: Client supplied sighting stake direction. Bottom log depth 923 run 1 and 924 run 2.			

Appendix F.3.10 Borehole deviation logs run in Ue5PW-3 on 2/25/93 (Continued)

Century
GEOPHYSICAL CORP.

DEVIATION SURVEY

COMPANY : NEVADA TEST SITE
WELL : Ue5PW-3 #2
LOCATION/FIELD : NEVADA TEST SITE
COUNTY : RYE
STATE : NEVADA
SECTION :

OTHER SERVICES:

TOWNSHIP : RANGE :

DATE : 02/25/93 PERMANENT DATUM : ELEVATIONS
DEPTH DRILLER : 955 ELEV. PERM. DATUM: KB :
LOG BOTTOM : 924.00 LOG MEASURED FROM: GL DF :
LOG TOP : 4.00 BRL MEASURED FROM: GL GL :

CASING DRILLER : 0 LOGGING UNIT : 9101
CASING TYPE : FIELD OFFICE : ELKO
CASING THICKNESS: 0 RECORDED BY : KNARR

BIT SIZE : 2.875 BOREHOLE FLUID : NONE FILE : PROCE
MAGNETIC DECL. : 0.000 RM : TYPE : GYRO
MATRIX DENSITY : RM TEMPERATURE : LOG : 2
FLUID DENSITY : MATRIX DELTA T : PLOT : TS 6
NEUTRON MATRIX : FLUID DELTA T : THRESH: 50000

REMARKS :
STAKE IS TRUE NORTH

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

Appendix F.3.10 Borehole deviation logs run in Ue5PW-3 on 2/25/93 (Continued)

PLAN VIEW
COMPU-LOG DEVIATION

CLIENT: NEVADA TEST SITE
LOCATION: NEVADA TEST SITE
HOLE ID: Ue5PW-3 #2
DATE OF LOG: 02/25/93
PROBE: GYRO 1201

↑
↑
↑
MAG DECL: 0.0

SCALE: 2 FT/IN
TRUE DEPTH: 923.84 FT
AZIMUTH: 243.3
DISTANCE: 4.0 FT
+ = 100 FT INCR
○ = BOTTOM OF HOLE

Appendix F.3.10 Borehole deviation logs run in Ue5PW-3 on 2/25/93 (Continued)

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
5.0	5.00	0.00	0.00	0.0	0.0	0.0	0.0
10.0	10.00	0.01	0.03	0.0	75.0	0.4	68.1
15.0	15.00	0.02	0.06	0.1	72.3	0.3	62.9
20.0	20.00	0.02	0.07	0.1	70.4	0.1	36.7
25.0	25.00	0.02	0.07	0.1	70.2	0.0	31.0
30.0	30.00	0.02	0.07	0.1	74.2	1.5	186.3
35.0	35.00	0.01	0.06	0.1	82.9	0.2	156.2
40.0	40.00	-0.02	0.06	0.1	105.0	0.5	188.7
45.0	45.00	-0.06	0.05	0.1	139.7	0.6	208.8
50.0	50.00	-0.10	0.02	0.1	166.4	0.5	218.8
55.0	55.00	-0.14	-0.00	0.1	180.3	0.6	218.2
60.0	60.00	-0.18	-0.03	0.2	189.8	0.6	216.7
65.0	65.00	-0.22	-0.05	0.2	194.1	0.4	207.5
70.0	70.00	-0.25	-0.07	0.3	195.7	0.3	50.1
75.0	75.00	-0.27	-0.08	0.3	195.6	0.3	186.4
80.0	80.00	-0.30	-0.07	0.3	193.7	0.3	159.4
85.0	85.00	-0.33	-0.06	0.3	191.0	0.4	185.4
90.0	90.00	-0.36	-0.07	0.4	190.6	0.4	195.8
95.0	95.00	-0.40	-0.08	0.4	191.0	0.5	189.3
100.0	100.00	-0.45	-0.08	0.5	190.0	0.6	179.1
105.0	105.00	-0.49	-0.06	0.5	187.0	0.6	149.5
110.0	110.00	-0.53	-0.03	0.5	183.4	0.5	139.2
115.0	115.00	-0.54	-0.00	0.5	180.3	0.2	76.0
120.0	120.00	-0.53	0.01	0.5	178.8	0.1	27.8
125.0	125.00	-0.52	0.01	0.5	178.6	0.2	343.5
130.0	130.00	-0.50	0.00	0.5	179.5	0.3	321.6
135.0	135.00	-0.48	-0.02	0.5	182.0	0.3	295.6
140.0	140.00	-0.47	-0.05	0.5	185.6	0.4	282.2
145.0	145.00	-0.47	-0.08	0.5	190.0	0.5	267.8
150.0	150.00	-0.47	-0.13	0.5	195.1	0.6	273.4
155.0	155.00	-0.48	-0.17	0.5	199.5	0.3	259.0
160.0	160.00	-0.49	-0.20	0.5	201.6	0.4	236.8
165.0	165.00	-0.51	-0.22	0.6	203.0	0.3	219.5
170.0	170.00	-0.54	-0.23	0.6	203.0	0.3	196.5
175.0	175.00	-0.56	-0.24	0.6	202.8	0.3	196.2
180.0	180.00	-0.58	-0.25	0.6	203.3	0.3	222.6
185.0	185.00	-0.60	-0.27	0.7	204.2	0.4	224.3
190.0	190.00	-0.63	-0.29	0.7	205.1	0.3	227.7
195.0	195.00	-0.65	-0.32	0.7	205.9	0.4	220.9
200.0	200.00	-0.69	-0.34	0.8	206.2	0.5	205.6
205.0	204.99	-0.74	-0.36	0.8	205.7	0.8	193.8
210.0	209.99	-0.82	-0.37	0.9	204.0	1.0	182.5
215.0	214.99	-0.90	-0.36	1.0	202.0	0.8	177.5
220.0	219.99	-0.97	-0.36	1.0	200.2	0.7	165.7
225.0	224.99	-1.03	-0.34	1.1	198.4	0.6	170.6
230.0	229.99	-1.06	-0.33	1.1	197.1	0.5	134.3
235.0	234.99	-1.08	-0.32	1.1	196.3	0.1	121.5
240.0	239.99	-1.09	-0.31	1.1	195.9	0.2	182.0
245.0	244.99	-1.09	-0.31	1.1	195.9	0.2	3.2
250.0	249.99	-1.05	-0.32	1.1	196.9	0.5	344.6
255.0	254.99	-1.01	-0.33	1.1	198.4	0.5	344.1
260.0	259.99	-0.97	-0.36	1.0	200.2	0.5	318.8
265.0	264.99	-0.94	-0.39	1.0	202.5	0.6	285.6
270.0	269.99	-0.94	-0.44	1.0	205.1	0.6	262.4
275.0	274.99	-0.97	-0.51	1.1	207.6	0.9	241.5
280.0	279.99	-1.01	-0.58	1.2	209.8	1.1	236.2
285.0	284.99	-1.07	-0.65	1.2	211.3	0.9	224.2
290.0	289.99	-1.12	-0.69	1.3	211.7	0.7	212.2
295.0	294.99	-1.17	-0.71	1.4	211.2	0.6	178.1

Appendix F.3.10 Borehole deviation logs run in Ue5PW-3 on 2/25/93 (Continued)

***** COMPU-LOG - VERTICAL DEVIATION *****

CLIENT : NEVADA TEST SITE HOLE ID. : Ue5PW-3 #2
FIELD OFFICE : ELKO DATE OF LOG : 02/25/93
DATA FROM : PROBE : GYRO , 1201
MAG. DECL. : 0.000 DEPTH UNITS : FEET LOG 2

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
300.0	299.99	-1.22	-0.70	1.4	209.8	0.5	158.5
305.0	304.99	-1.26	-0.68	1.4	208.3	0.4	158.5
310.0	309.99	-1.29	-0.66	1.4	207.0	0.3	143.7
315.0	314.99	-1.32	-0.64	1.5	206.0	0.4	147.7
320.0	319.99	-1.34	-0.63	1.5	205.0	0.4	154.4
325.0	324.99	-1.37	-0.62	1.5	204.4	0.3	189.3
330.0	329.99	-1.40	-0.64	1.5	204.5	0.5	230.8
335.0	334.99	-1.42	-0.68	1.6	205.5	0.7	238.7
340.0	339.99	-1.45	-0.74	1.6	206.9	0.7	238.0
345.0	344.99	-1.48	-0.79	1.7	207.9	0.6	240.8
350.0	349.99	-1.51	-0.82	1.7	208.5	0.4	227.5
355.0	354.99	-1.53	-0.83	1.7	208.6	0.1	195.4
360.0	359.99	-1.53	-0.83	1.7	208.5	0.2	34.4
365.0	364.99	-1.49	-0.81	1.7	208.4	0.7	31.6
370.0	369.99	-1.43	-0.77	1.6	209.4	1.1	24.6
375.0	374.98	-1.35	-0.74	1.5	208.7	0.9	30.9
380.0	379.98	-1.28	-0.72	1.5	209.5	0.6	340.0
385.0	384.98	-1.25	-0.76	1.5	211.3	0.7	286.0
390.0	389.98	-1.25	-0.84	1.5	213.9	1.1	259.8
395.0	394.98	-1.28	-0.96	1.6	216.7	1.6	253.7
400.0	399.98	-1.32	-1.09	1.7	219.6	1.6	252.9
405.0	404.98	-1.36	-1.23	1.8	221.9	1.5	252.5
410.0	409.98	-1.42	-1.31	1.9	222.9	1.3	204.3
415.0	414.98	-1.46	-1.34	2.0	222.5	0.5	178.3
420.0	419.98	-1.51	-1.32	2.0	221.3	0.7	138.1
425.0	424.98	-1.55	-1.28	2.0	219.5	0.8	120.9
430.0	429.97	-1.59	-1.22	2.0	217.4	0.8	119.9
435.0	434.97	-1.61	-1.15	2.0	215.4	0.8	96.4
440.0	439.97	-1.61	-1.09	1.9	214.2	0.6	55.7
445.0	444.97	-1.57	-1.06	1.9	214.0	0.5	13.7
450.0	449.97	-1.52	-1.06	1.9	215.0	0.7	340.8
455.0	454.97	-1.47	-1.10	1.8	216.9	0.8	315.0
460.0	459.97	-1.43	-1.17	1.8	219.3	1.0	289.1
465.0	464.97	-1.40	-1.26	1.9	221.9	1.2	286.0
470.0	469.97	-1.37	-1.36	1.9	224.7	1.1	283.5
475.0	474.97	-1.35	-1.46	2.0	227.2	1.0	282.0
480.0	479.97	-1.33	-1.54	2.0	229.3	0.9	293.2
485.0	484.97	-1.29	-1.60	2.1	231.2	0.7	302.5
490.0	489.97	-1.26	-1.65	2.1	232.5	0.5	302.9
495.0	494.97	-1.27	-1.66	2.1	232.6	0.4	155.6
500.0	499.97	-1.33	-1.62	2.1	230.7	1.0	148.0
505.0	504.97	-1.40	-1.58	2.1	228.5	0.8	157.2
510.0	509.97	-1.46	-1.55	2.1	226.7	0.8	155.3
515.0	514.97	-1.50	-1.53	2.1	225.5	0.2	154.4
520.0	519.97	-1.49	-1.53	2.1	225.7	0.5	356.4
525.0	524.97	-1.44	-1.54	2.1	227.0	0.8	336.9
530.0	529.96	-1.37	-1.58	2.1	229.1	1.1	327.9
535.0	534.96	-1.29	-1.64	2.1	231.7	1.0	316.7
540.0	539.96	-1.26	-1.71	2.1	233.7	0.8	280.2
545.0	544.96	-1.27	-1.78	2.2	234.6	0.8	250.5
550.0	549.96	-1.32	-1.84	2.3	234.3	0.9	213.6
555.0	554.96	-1.40	-1.88	2.3	233.2	1.2	197.9

Appendix F.3.10 Borehole deviation logs run in Ue5PW-3 on 2/25/93 (Continued)

* * * * * COMPU-LOG - VERTICAL DEVIATION * * * * *

CLIENT : NEVADA TEST SITE HOLE ID. : Ue5PW-3 #2
 FIELD OFFICE : ELKO DATE OF LOG : 02/25/93
 DATA FROM : PROBE : GYRO , 1201
 MAG. DECL. : 0.000 DEPTH UNITS : FEET LOG 2

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
560.0	559.96	-1.50	-1.91	2.4	231.9	1.1	201.5
565.0	564.96	-1.53	-1.94	2.5	230.7	0.9	188.9
570.0	569.96	-1.65	-1.94	2.5	229.7	0.6	180.4
575.0	574.96	-1.68	-1.94	2.6	229.1	0.2	183.2
580.0	579.96	-1.69	-1.94	2.6	228.8	0.1	275.6
585.0	584.96	-1.69	-1.95	2.6	229.1	0.4	308.4
590.0	589.96	-1.66	-1.98	2.6	230.0	0.8	303.9
595.0	594.96	-1.60	-2.05	2.6	232.0	1.4	313.4
600.0	599.96	-1.52	-2.14	2.6	234.7	1.4	314.0
605.0	604.95	-1.44	-2.22	2.6	237.1	1.2	314.3
610.0	609.95	-1.37	-2.29	2.7	239.0	1.0	307.0
615.0	614.95	-1.34	-2.34	2.7	240.3	0.5	303.4
620.0	619.95	-1.33	-2.37	2.7	240.8	0.4	271.6
625.0	624.95	-1.35	-2.40	2.8	240.8	0.6	221.7
630.0	629.95	-1.39	-2.44	2.8	240.4	0.7	222.5
635.0	634.95	-1.45	-2.49	2.9	239.8	1.1	212.3
640.0	639.95	-1.54	-2.53	3.0	238.8	1.2	208.5
645.0	644.95	-1.62	-2.58	3.0	237.9	0.9	209.0
650.0	649.95	-1.67	-2.61	3.1	237.3	0.4	207.4
655.0	654.95	-1.69	-2.61	3.1	237.1	0.2	78.7
660.0	659.95	-1.67	-2.58	3.1	237.1	0.5	59.8
665.0	664.95	-1.65	-2.55	3.0	237.1	0.3	54.0
670.0	669.95	-1.63	-2.52	3.0	237.1	0.3	49.1
675.0	674.95	-1.62	-2.52	3.0	237.3	0.3	262.4
680.0	679.95	-1.63	-2.58	3.1	237.7	0.9	264.4
685.0	684.95	-1.64	-2.67	3.1	238.4	1.1	263.1
690.0	689.95	-1.65	-2.76	3.2	239.1	1.0	266.7
695.0	694.95	-1.66	-2.84	3.3	239.8	0.7	264.3
700.0	699.95	-1.65	-2.90	3.3	240.3	0.6	276.1
705.0	704.95	-1.65	-2.95	3.4	240.7	0.4	262.5
710.0	709.95	-1.66	-2.99	3.4	241.0	0.6	266.7
715.0	714.95	-1.66	-3.05	3.5	241.5	0.7	264.9
720.0	719.95	-1.66	-3.10	3.5	241.8	0.3	265.4
725.0	724.95	-1.66	-3.12	3.5	242.0	0.3	264.4
730.0	729.95	-1.66	-3.13	3.5	242.0	0.1	295.0
735.0	734.95	-1.66	-3.14	3.6	242.2	0.3	286.7
740.0	739.95	-1.65	-3.17	3.6	242.5	0.4	300.7
745.0	744.95	-1.63	-3.20	3.6	243.0	0.4	300.6
750.0	749.95	-1.62	-3.23	3.6	243.3	0.3	294.7
755.0	754.94	-1.60	-3.25	3.6	243.7	0.3	311.3
760.0	759.94	-1.59	-3.27	3.6	244.1	0.4	303.8
765.0	764.94	-1.58	-3.30	3.7	244.5	0.4	298.4
770.0	769.94	-1.56	-3.33	3.7	244.8	0.3	289.1
775.0	774.94	-1.55	-3.35	3.7	245.1	0.3	260.6
780.0	779.94	-1.55	-3.37	3.7	245.3	0.3	270.0
785.0	784.94	-1.55	-3.40	3.7	245.5	0.3	284.3
790.0	789.94	-1.55	-3.43	3.8	245.6	0.2	274.0
795.0	794.94	-1.55	-3.45	3.8	245.8	0.3	284.6
800.0	799.94	-1.54	-3.47	3.8	246.0	0.3	299.9
805.0	804.94	-1.53	-3.49	3.8	246.4	0.3	316.6
810.0	809.94	-1.51	-3.52	3.8	246.8	0.4	290.9
815.0	814.94	-1.50	-3.55	3.9	247.1	0.3	283.6

Appendix F.3.10 Borehole deviation logs run in Ue5PW-3 on 2/25/93 (Continued)

* * * * * COMPU-LOG - VERTICAL DEVIATION * * * * *

CLIENT : NEVADA TEST SITE HOLE ID. : Ue5PW-3 #2
 FIELD OFFICE : ELKO DATE OF LOG : 02/25/93
 DATA FROM : PROBE : GYRO , 1201
 MAG. DECL. : 0.000 DEPTH UNITS : FEET LOG 2

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
820.0	819.94	-1.49	-3.57	3.9	247.4	0.3	290.0
825.0	824.94	-1.48	-3.60	3.9	247.6	0.3	282.7
830.0	829.94	-1.48	-3.62	3.9	247.8	0.3	263.1
835.0	834.94	-1.48	-3.64	3.9	247.9	0.2	263.9
840.0	839.94	-1.48	-3.65	3.9	247.9	0.1	223.2
845.0	844.94	-1.49	-3.65	3.9	247.8	0.1	147.7
850.0	849.94	-1.49	-3.65	3.9	247.7	0.1	40.1
855.0	854.94	-1.49	-3.64	3.9	247.8	0.1	50.6
860.0	859.94	-1.48	-3.63	3.9	247.9	0.1	40.4
865.0	864.94	-1.47	-3.63	3.9	248.0	0.2	34.3
870.0	869.94	-1.46	-3.63	3.9	248.1	0.2	343.8
875.0	874.94	-1.45	-3.63	3.9	248.2	0.1	274.2
880.0	879.94	-1.46	-3.64	3.9	248.1	0.2	182.1
885.0	884.94	-1.48	-3.64	3.9	247.8	0.3	171.0
890.0	889.94	-1.51	-3.63	3.9	247.5	0.4	140.0
895.0	894.94	-1.53	-3.61	3.9	247.0	0.3	164.7
900.0	899.94	-1.56	-3.60	3.9	246.6	0.4	171.3
905.0	904.94	-1.60	-3.60	3.9	246.0	0.6	170.6
910.0	909.94	-1.66	-3.59	4.0	245.2	0.7	177.2
915.0	914.94	-1.72	-3.59	4.0	244.4	0.7	180.2
920.0	919.94	-1.77	-3.59	4.0	243.7	0.6	196.7
923.9	923.84	-1.81	-3.61	4.0	243.3	0.6	196.2

Appendix F.4.1 Depths and Dimensions of Air Permeability Testing Intervals for the Pilot Wells.

Borehole	Station Depth (m)	Interval Length (m)	Interval Radius (m)
UE5PW-1	45.7	0.95	0.13
	73.2	1.01	0.14
	107	1.07	0.14
	183	0.91	0.13
UE5PW-2	45.7	1.04	0.12
	76.2	0.95	0.11
	122	0.85	0.12
	183	0.76	0.12
UE5PW-3	76.2	1.01	0.13
	107	1.31	0.15
	168	0.88	0.12
	210	1.46	0.10

Appendix F.4.2 In situ air permeability testing data for UE5PW-1, UE5PW-2, and UE5PW-3.

UE5PW-1

Station Depth (m)	Flow Rate ($\times 10^{-2} \text{ m}^3 \text{ s}^{-1}$)	Barometric Pressure (kPa)	Interval Pressure (kPa)	Temperature (K)
45.7	0.906	91.6	98.8	292
45.7	1.18	91.5	101	294
45.7	1.42	91.6	103	300
45.7	1.68	91.5	105	302
45.7	1.91	91.5	107	305
45.7	2.16	91.5	109	308
45.7	2.55	91.4	112	314
73.2	0.916	92.1	95.5	299
73.2	1.45	92.1	98.2	300
73.2	1.89	92.1	101	305
73.2	2.45	92.1	104	311
107	0.911	92.4	93.4	297
107	1.41	92.3	95.0	299
107	1.94	92.3	97.5	303
107	2.43	92.4	100	306
107	3.04	92.4	104	308

Appendix F.4.2 Continued

UE5PW-2

Station Depth (m)	Flow Rate ($\times 10^{-2} \text{ m}^3\text{s}^{-1}$)	Barometric Pressure (kPa)	Interval Presssure (kPa)	Temperature (K)
45.7	0.392	89.9	94.6	307
45.7	0.935	89.9	100.3	309
45.7	1.49	89.9	105.2	310
45.7	2.08	89.9	111.7	312
45.7	2.71	89.9	119.8	315
45.7	3.39	89.9	128.7	317
76.2	0.518	90.2	92.7	305
76.2	0.932	90.2	94.7	307
76.2	1.37	90.2	96.5	309
76.2	1.86	90.2	98.8	313
76.2	2.34	90.2	101.5	315
76.2	3.02	90.1	105.6	316
122	0.944	90.1	97.3	310
122	1.33	90.1	99.6	312
122	1.97	90.1	104.7	310
122	2.38	90.1	108.0	316
122	2.85	90.1	112.1	317
122	3.56	90.1	120.1	317
183	0.395	90.0	102.7	307
183	0.510	90.0	106.9	309
183	0.717	90.0	112.5	310
183	0.920	90.0	118.7	312
183	1.04	89.9	121.5	312
183	1.26	90.0	127.1	311

Appendix F.4.2 Continued

UE5PW-3

Station Depth (m)	Flow Rate ($\times 10^{-2} \text{ m}^3 \text{ s}^{-1}$)	Barometric Pressure (kPa)	Interval Presssure (kPa)	Temperature (K)
76.2	0.396	89.8	92.7	307
76.2	0.508	89.7	93.1	308
76.2	0.622	89.7	94.5	311
76.2	0.741	89.7	95.2	312
76.2	0.845	89.7	96.1	311
76.2	0.949	89.7	96.6	312
76.2	1.04	89.7	97.2	313
76.2	1.18	89.6	98.2	314
76.2	1.28	89.6	98.9	314
76.2	1.38	89.6	99.7	314
76.2	1.50	89.6	100.5	315
76.2	1.60	89.6	100.4	316
107	0.399	89.5	95.0	313
107	0.539	89.4	98.4	314
107	0.740	89.4	101.3	315
107	0.847	89.4	102.8	315
107	0.959	89.4	105.1	315
107	1.09	89.4	107.3	315
107	1.17	89.4	108.4	315
107	1.37	89.4	111.6	315
168	0.076	89.6	96.2	302
168	0.113	89.6	99.1	302
168	0.165	89.6	102.4	303
168	0.217	89.6	105.3	304

Appendix F.4.2 Continued

UE5PW-3 (Continued)

Station Depth (m)	Flow Rate ($\times 10^{-2} \text{ m}^3\text{s}^{-1}$)	Barometric Pressure (kPa)	Interval Presssure (kPa)	Temperature (K)
210	0.480	89.6	91.8	307
210	0.569	89.6	92.3	308
210	0.658	89.6	92.8	309
210	0.755	89.6	93.5	310
210	0.847	89.6	94.3	312
210	0.942	89.6	94.9	313
210	1.02	89.6	95.5	313
210	1.13	89.6	96.3	314

Appendix F.4.3 Effective air permeabilities and inertial coefficients for field testing in UE5PW-1, UE5PW-2, and UE5PW-3.

Pilot Well	Depth (m)	Permeability ($\times 10^{-12} \text{ m}^2$)	Inertial Coefficient ($\times 10^{+7} \text{ m}^{-1}$)
UE5PW-1	45.7	8.1	†
	73.2	13	†
	107	47	5.4
	183	*	†
UE5PW-2	45.7	8.0	5.9
	76.2	16	†
	122	12	2.7
	183	2.3	†
UE5PW-3	76.2	9.2	†
	107	3.4	†
	168	0.9	†
	210	18	14

† Inertial effects not significant

* No pressure response observed for this station

Appendix F.5.1 Estimating the water table slope under the Area 5 RWMS

1.0 Introduction

After an extensive literature search, a rather sophisticated mathematical model, based upon the Dupuit-Forcheimer approximation, was proposed by Lindstrom, et al. (1992) as a means of estimating the character (inclination, warping, torsion, etc.) of the water table under the Radioactive waste management site (RWMS) in Area 5 of NTS. This model requires knowledge of the elevation of the water table at eight distinct geographical locations ringing the RWMS. The required data, which has any credibility, is currently lacking. Lindstrom et al. (1992) demonstrated the feasibility of the model by using uncertain USGS data from eight Frenchman basin widely spaced drill holes and water wells. Their conclusion was that the water table was statistically “flat” (zero gradient) with essentially no horizontal motion. Some of the calibration wells were over 25,000 feet apart. One foot uncertainties in some of the water table elevation readings easily translated into 10 foot mounds of water under RWMS, a clearly infeasible situation.

Lacking the five additional wells circumscribing RWMS and required to use the Dupuit-Forcheimer model of Lindstrom et al. (1992), a simple three-point interpolating plane approximation to the water table under RWMS was constructed. By knowing the elevations of the water table at each of the pilot well locations allows estimates of this plane (three dimensional) to be made. The model does not satisfy the simple Dupuit-Forcheimer approximation run under isotropic conductivity conditions. However, it can serve as a first order approximation with a more accurate analysis to be done if and when more characterization well data becomes available in the vicinity of RWMS.

2.0 Three-Dimensional Plane Approximation

Figure 1 shows a sketch of the simple three-dimensional plane approximation to the water table under RWMS. Equation 1 defines the plane

$$H(x,y) = \alpha + \beta(x-x_1) + \gamma(y-y_1) \quad (1)$$

where H is the water table elevation head in feet above mean sea level, x is the easting coordinate in feet (Nevada Coordinate System), y is the northing coordinate in feet, and α , β , and γ are parameters to be determined from the three calibration water table estimates (pilot wells 1, 2, and 3). The ordered pair (x_1, y_1) represents the (easting, northing) coordinates, chosen for pilot well 1, as a convenient reference point. The three pilot wells are used as calibration wells. The water table at PW-1 is characterized by the ordered triple (3-tuple), (x_1, y_1, H_1) . In like fashion we have (x_2, y_2, H_2) and (x_3, y_3, H_3) for PW-2 and PW-3, respectively. Hence, the three equations in three unknowns

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

Figure 1 PLANE SURFACE APPROXIMATION TO WATER TABLE

$$H_1 = \alpha$$

$$H_2 = \alpha + \beta (x_2 - x_1) + \gamma (y_2 - y_1) \quad (2)$$

$$H_3 = \alpha + \beta (x_3 - x_1) + \gamma (y_3 - y_1)$$

yield the unique solution

$$\alpha = H_1$$

$$\beta = \frac{(H_2 - H_1)(y_3 - y_1) - (H_3 - H_1)(y_2 - y_1)}{(x_2 - x_1)(y_3 - y_1) - (x_3 - x_1)(y_2 - y_1)} \quad (3)$$

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

$$\gamma = \frac{(H_3 - H_1)(x_2 - x_1) - (H_2 - H_1)(x_3 - x_1)}{(x_2 - x_1)(y_3 - y_1) - (x_3 - x_1)(y_2 - y_1)} \quad (4)$$

whenever the three points are not collinear in space.

The Darcy components (horizontal only here!) are defined as

$$q_x = -K_{xx} \frac{\partial H}{\partial x} - K_{xy} \frac{\partial H}{\partial y} = \epsilon u_x \quad (5)$$

and

$$q_y = -K_{xy} \frac{\partial H}{\partial x} - K_{yy} \frac{\partial H}{\partial y} = \epsilon u_y \quad (6)$$

where

q_x = easting component of Darcy velocity (ft/day),

q_y = northing component of Darcy velocity (ft/day),

K_{xx} = easting-easting component of saturated hydraulic conductivity (ft/day),

K_{xy} = easting-northing component of saturated hydraulic conductivity (ft/day),

K_{yy} = northing-northing component at saturated hydraulic conductivity (ft/day),

ϵ = porosity of alluvium (ft³/ft³),

u_x = easting component at seepage velocity (ft/day),

u_y = northing component of seepage velocity (ft/day).

For horizontally isotropic alluvial conditions, $K_{xy} = 0$. Also, $K_{xx} = K_{yy} = K_{sath}$, where K_{sath} is the saturated horizontal component of the conductivity tensor.

The positive orientation of movement towards increasing easting numbers and movement towards increasing northing numbers has been chosen for this model.

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

Recall from equations 4 and 5 that we need estimates of K_{sath} and ϵ . From the latest characterization of the Area 5 alluvium we find that reasonable estimates of the mean values of K_{sath} and ϵ from all three pilot wells are $K_{sath} = 2.8313$ ft/day and $\epsilon = 0.375$ ft³/ft³., respectively. Thus, using equations 1, 4, and 5, we find that

$$q_x = -K_{sath} \frac{\partial H}{\partial x} = -K_{sath} \beta = \epsilon u_x \quad (7)$$

and

$$q_y = -K_{sath} \frac{\partial H}{\partial y} = -K_{sath} \gamma = \epsilon u_y. \quad (8)$$

Table 1 summarizes the location and elevation of the water table in each of the pilot wells. All measurements were conducted by the U.S. Geological Survey (USGS).

Table 1. Pilot Well Data.

Pilot Well Number	Date of measurement	N o r t h i n g	E a s t i n g	Water level measurement (feet)	Elevation of surface casing (feet)	Uncorrected Water table elevation (feet)
Ue5PW-1	3-2-93	765,702.19	709,831.57	773.39	3180.35	2406.96
Ue5PW-2	3-2-93	770,395.90	709,893.63	842.33	3248.42	2406.09
Ue5PW-3	3-2-93	771,290.92	703,460.07	894.65	3300.87	2406.22

The results of running the program WT3DPAI (Attachment A) with the above characterization data is given in Table 2. The program is a computer code of the above equations.

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

Table 2 Three-dimensional plane approximation results.

$\alpha = 2406.96 \text{ feet}, \beta = -4.59 \times 10^{-5}, \gamma = -1.85 \times 10^{-4}$
$\frac{\partial H}{\partial x} = -4.59 \times 10^{-5} \text{ (ft/ft)}, \frac{\partial H}{\partial y} = -1.85 \times 10^{-4} \text{ (ft/ft)}$
$q_x = 1.30 \times 10^{-4} \text{ (ft/day)}, q_y = 5.23 \times 10^{-4} \text{ (ft/day)}$
$u_x = 3.47 \times 10^{-4} \text{ (ft/day)}, u_y = 1.39 \times 10^{-3} \text{ (ft/day)}$

Magnitude of seepage velocity is 1.44×10^{-3} (ft/day) in the direction 14° East of North.

3.0 Uncertainty Analysis

An uncertainty analysis for the water table is now given. Rather than go through the usual Monte Carlo simulation process, we seize on the simplicity of the water table formula, together with a few assumptions on the water table elevation random variable associated with each pilot well, to obtain a simple closed form expression for the mean water table formula and the associated variance envelope. The assumptions are:

$$\underline{H} = \underline{\alpha} + \underline{\beta} (x - x_1) + \underline{\alpha} (y - y_1) \quad (9)$$

where

$$\underline{\alpha} = \underline{H}_1 \quad (10)$$

$$\underline{\beta} = (\underline{H}_2 - \underline{H}_1) \phi_{1\beta} + (\underline{H}_3 - \underline{H}_1) \phi_{2\beta} \quad (11)$$

$$\underline{\gamma} = (\underline{H}_3 - \underline{H}_1) \phi_{1\gamma} + (\underline{H}_2 - \underline{H}_1) \phi_{2\gamma} \quad (12)$$

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

The geometric factors $\phi_{1\beta}$, $\phi_{2\beta}$, $\phi_{1\gamma}$, and $\phi_{2\gamma}$ are obtained from equations (3) and (4). These factors are rational functions of the products of differences of the coordinates (hence well pattern) locating the pilot wells.

Suppose that

$$\underline{H}_1 \sim NIID(\mu_1, \sigma_1^2) \quad (13)$$

$$\underline{H}_2 \sim NIID(\mu_2, \sigma_2^2) \quad (14)$$

$$\underline{H}_3 \sim NIID(\mu_3, \sigma_3^2) \quad (15)$$

$$Cov(\underline{H}_1, \underline{H}_2) = Cov(\underline{H}_1, \underline{H}_3) = Cov(\underline{H}_2, \underline{H}_3) = 0 \quad (16)$$

Assumption (15) should make sense physically since the pilot wells are located at least 4,000 feet apart.

Then, since the moment generating function for $\underline{H}(x, y)$ is defined in Moody et al., (1974) as

$$\begin{aligned} M_{gf}(t) &= \mathcal{E}(e^{t\underline{H}}) = \mathcal{E}(e^{t(\underline{g} + \underline{\beta}(x-x_1) + \underline{\gamma}(y-y_1))}) \\ &= \mathcal{E}(e^{t(\underline{H}_1 + ((\underline{H}_2 - \underline{H}_1)\phi_{1\beta} + (\underline{H}_3 - \underline{H}_1)\phi_{2\beta})(x-x_1) + ((\underline{H}_3 - \underline{H}_1)\phi_{1\gamma} + (\underline{H}_2 - \underline{H}_1)\phi_{2\gamma})(y-y_1))}) \\ &= \mathcal{E}(e^{t\underline{H}_1(1 - (\phi_{1\beta} + \phi_{2\beta})(x-x_1) - (\phi_{1\gamma} + \phi_{2\gamma})(y-y_1))}) \\ &\quad \bullet \mathcal{E}(e^{t\underline{H}_2(\phi_{1\gamma}(x-x_1) + \phi_{2\gamma}(y-y_1))}) \\ &\quad \bullet \mathcal{E}(e^{t\underline{H}_3(\phi_{2\beta}(x-x_1) + \phi_{1\beta}(y-y_1))}) \end{aligned} \quad (17)$$

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

Carrying out the indicated integrations in the expectation operator yields

$$M_{gf}(t) = e^{t(\mu_1 + (\mu_2 - \mu_1)\phi_{1\beta} + (\mu_3 - \mu_1)\phi_{2\beta})(x-x_1) + ((\mu_3 - \mu_1)\phi_{1\gamma} + (\mu_2 - \mu_1)\phi_{2\gamma})(y-y_1)}$$

$$\bullet e^{\frac{t^2}{2}(\sigma_1^2(1 - (\phi_{1\beta} + \phi_{2\beta})(x-x_1) - (\phi_{1\gamma} + \phi_{2\gamma})(y-y_1))^2 + \sigma_2^2(\phi_{1\beta}(x-x_1) + \phi_{2\gamma}(y-y_1))^2 + \sigma_3^2(\phi_{2\beta}(x-x_1) + \phi_{1\gamma}(y-y_1))^2)}$$
(18)

This formula indicates that $\underline{H}(x,y)$ is also normally distributed; however, its mean and variance are non trivial functions of x and y, a result to be expected. The “mean plane” is obtained from

$$\mu_H^{(1)} = \left. \frac{\partial M_{gf}}{\partial t} \right|_{t=0} = \mathcal{E}(\underline{H})$$

So that

$$\mathcal{E}(\underline{H}) = \mu_H^{(1)}(x,y) = \mu_1 + ((\mu_2 - \mu_1)\phi_{1\beta} + (\mu_3 - \mu_1)\phi_{2\beta})(x-x_1) + ((\mu_3 - \mu_1)\phi_{1\gamma} + (\mu_2 - \mu_1)\phi_{2\gamma})(y-y_1)$$
(19)

The second moment of $\underline{H}$, defined as

$$\mu_H^{(2)} = \left. \frac{\partial^2 M_{gf}}{\partial t^2} \right|_{t=0} = \mathcal{E}(\underline{H}^2)$$
(20)

is needed in computing the variance of $\underline{H}$. The variance of $\underline{H}$ is defined as

$$Var(\underline{H}) = \mathcal{E}((\underline{H}) - \mathcal{E}(\underline{H}))^2 = \mathcal{E}(\underline{H}^2) - (\mu_H^{(1)})^2$$
(21)

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

Computing the second partial derivative of $M_{gf}(t)$ and evaluation at $t=0$ together with substitution into (20) obtains the formula

$$\begin{aligned}\sigma_{\underline{H}}^2 = Var(\underline{H}) = & \sigma_1^2 + ((\sigma_2^2 + \sigma_1^2) \phi_{1\beta}^2 + 2\sigma_1^2 \phi_{1\beta} \phi_{2\beta} + (\sigma_3^2 + \sigma_1^2) \phi_{2\beta}^2) (x-x_1)^2 \\ & + ((\sigma_3^2 + \sigma_1^2) \phi_{1\gamma}^2 + 2\sigma_1^2 \phi_{1\gamma} \phi_{2\gamma} + (\sigma_2^2 + \sigma_1^2) \phi_{2\gamma}^2) (y-y_1)^2 \\ & - 2\sigma_1^2 (\phi_{1\beta} + \phi_{2\beta}) (x-x_1) - 2\sigma_1^2 (\phi_{1\gamma} + \phi_{2\gamma}) (y-y_1) \\ & + 2(\sigma_1^2 \phi_{1\beta} \phi_{1\gamma} + (\sigma_3^2 + \sigma_1^2) \phi_{2\beta} \phi_{1\gamma} + (\sigma_2^2 + \sigma_1^2) \phi_{1\beta} \phi_{2\gamma} + \sigma_1^2 \phi_{2\beta} \phi_{2\gamma}) (y-y_1)(x-x_1)\end{aligned}\quad (22)$$

for the variance of $\underline{H}$. A 95% uncertainty envelope is generated by defining the hyper planes

$$\begin{aligned}& (.975) \\ \mathcal{H}(x,y) = & \mu_{\underline{H}}^{(1)}(x,y) + 1.96\sigma_{\underline{H}}\end{aligned}\quad (23)$$

and

$$\begin{aligned}& (0.025) \\ \mathcal{H}(x,y) = & \mu_{\underline{H}}^{(1)}(x,y) - 1.96\sigma_{\underline{H}}.\end{aligned}\quad (24)$$

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

Table 3 summarizes the mean and uncertainty values currently used for the three pilot wells in generating the lower and upper hyper planes.

Index i	Well Name	Easting (ft)	Northing (ft)	Mean Elevation μ_i (ft)	Uncertainty σ_i (ft)
1	UE5PW1	709,831.57	765,702.19	2,406.96	0.5
2	UE5PW2	709,893.63	770,395.90	2,406.09	0.5
3	UE5PW3	703,460.07	771,290.92	2,406.22	0.5

Figure 2 shows a three-dimensional plot of the theoretical or “mean plane” elevated at the three water table calibration valves. The 97.5% and 2.5% and 2.5% uncertainty hyper planes, obtained by choosing $\sigma_1 = \sigma_2 = \sigma_3 = 0.5\text{ft}$, are also shown as bounding the theoretical plane. The ± 0.5 ft uncertainties in the water table readings are simply “currently best available guesses.” As time progresses and many more water table “taggings” by the USGS and REEC Co SPS personnel become available these individual uncertainty values will be refined and the 97.5% and 2.5% uncertainty envelopes will be recalculated.

Figures 3 and 4 show vertical slices of the uncertainty envelopes projected onto the vertical-northing plane and vertical-easting plane, respectively. The region covered by the RWMS lies just inside the overall ranges in Easting and Northing used to make the uncertainty envelopes.

Observe that a great many other three-dimensional plane approximations to the water table under RWMS will nicely fit inside the bounding uncertainty envelope. Thus, it is possible to have the “real, but unknown” water table plane approximation tilting slightly in almost any direction. However, with more observational data available the uncertainty envelopes are exchanged for confidence envelopes which move toward each other and force the totality of admissible approximating planes toward a smaller population. The ideal limit of course is that as the number of repeated observations on each well goes to infinity that the uncertainty envelope converges to zero in probability (measure), thereby “pinning down” the approximating plane.

Clearly from Table 2 the horizontal seepage velocity components are small, giving an average NNE flow of about 0.53 ft/yr. This estimate means that water at the water table currently under Ue5PW-1 will be in the vicinity of Ue5PW-2 in about 8,500 years.

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

References

- Lindstrom, F. T., L. E. Barker, D. E. Cawfield, D. D. Daffern, B. L. Dozier, D. F. Emer, and W. R. Strong (1992) "*Estimating the Water Table Under the Radioactive Waste Management Site in Area 5 of the Nevada Test Site: The Dupuit-Forcheimer Approximation*" in *Interdisciplinary Approaches in Hydrology and Hydrogeology*, M. E. Jones and A. Laenen eds., American Institute of Hydrology, pp. 146-171.
- Mood, A. M., F. A. Graybill, and D. C. Boes (1974). *Introduction to the Theory of Statistics*. MacGraw-Hill, New York, 564pp.

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

ATTACHMENT A

```

* Model name: WT3DPA1
* Version number: 1.0
* Date last worked on: APR. 19, 1993
* Key descriptors: 3-dimensional plane approximation for the water
*                  table under RWMS in Area 5 of the Nevada Test
*                  Site - three points required.
*
C*****
C    This model is the joint effort of: F. T. Lindstrom
C    and David E. Cawlfeld.
C
C    Special Projects Group.
C    Environmental Restoration & Technology Development
C    Department. M/S 738.
C    Reynolds Electrical and Engineering Co., Inc.
C    P O Box 98521 M/S 738 Las Vegas, NV 89193-8521
C*****
C
C    PROGRAM WT3DPA1
C
C    DOUBLE PRECISION X,Y,H,HEST
C    DOUBLE PRECISION KXX,KXY,KYY,PI,PHI,MAGN
C    DOUBLE PRECISION QX,QY,EPS,VX,VY,GRADX,GRADY
C    DOUBLE PRECISION XNUM1,XNUM2,DENOM,DENOMT
C    DOUBLE PRECISION ALPHA,BETA,GAMMA
C    DOUBLE PRECISION XIN,YIN,XINO,YINO,DXIN,DYIN
C
C    INTEGER I,J,NXEVAL,NYEVAL
C
C    COMMON/DATA1/X(3),Y(3),H(3),HEST
C    COMMON/DATA2/KXX,KXY,KYY,PI,PHI,MAGN
C    COMMON/DATA3/QX,QY,EPS,VX,VY,GRADX,GRADY
C    COMMON/DATA4/XNUM1,XNUM2,DENOM,DENOMT
C    COMMON/DATA5/ALPHA,BETA,GAMMA
C    COMMON/DATA6/XIN,YIN,XINO,YINO,DXIN,DYIN
C
C    OPEN(UNIT=20,FILE='          ',STATUS='OLD')
C    OPEN(UNIT=30,FILE='          ',STATUS='NEW')
C
C    READ IN ALL SYSTEM AND RUN CONTROL DATA
C
C    WRITE(30,*)
C 20 FORMAT(5X,' READ INPUT DATA IN FREE FORM ',/)
C    WRITE(*,*)
C    WRITE(30,*) ' INPUT KXX,KXY,KYY, AND EPS VALUES '
C    READ(20,*) KXX,KXY,KYY,EPS
C    WRITE(30,*) KXX,KXY,KYY,EPS
C    WRITE(30,*)
C    WRITE(*,*)
C    WRITE(30,*) ' INPUT X,Y, AND H VALUES '
C    WRITE(30,*)
C    DO 100 I=1,3
C    READ(20,*) X(I),Y(I),H(I)
C    WRITE(30,*) X(I),Y(I),H(I)
C    WRITE(30,*)
C 100 CONTINUE
C    WRITE(30,*)
C    3 FORMAT(1X,A,\)
C
C    CALCULATE CONSTANTS AND SYSTEM GROUP PARAMETERS

```


Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

ATTACHMENT A (Continued)

```

C      WRITE(*,21)
21  FORMAT(5X,'CALCULATING CONSTANTS AND SYSTEM GROUP PARAMETERS')
C
      PI=3.1415926D0
      ALPHA=H(1)
      XNUM1=(H(2)-H(1))*(Y(3)-Y(1))-(H(3)-H(1))*(Y(2)-Y(1))
      XNUM2=(H(3)-H(1))*(X(2)-X(1))-(H(2)-H(1))*(X(3)-X(1))
      DENOM=(X(2)-X(1))*(Y(3)-Y(1))-(X(3)-X(1))*(Y(2)-Y(1))
      DENOMT=DABS(DENOM)
      IF(DENOMT.LT.1.0D-50) GO TO 500
      BETA=XNUM1/DENOM
      GAMMA=XNUM2/DENOM
      GRADX=BETA
      GRADY=GAMMA
      QX=-GRADX*KXX
      QY=-GRADY*KYY
      VX=QX/EPS
      VY=QY/EPS
      MAGN=DSQRT(VX*VX+VY*VY)
      PHI=DATAN2(VY,VX)
      PHI=PHI*180.0D0/PI
C
      WRITE(30,22)' ALPHA is ',ALPHA
      WRITE(30,22)' XNUM1 is ',XNUM1
      WRITE(30,22)' XNUM2 is ',XNUM2
      WRITE(30,22)' DENOM is ',DENOM
      WRITE(30,22)' BETA is ',BETA
      WRITE(30,22)' GAMMA is ',GAMMA
      WRITE(30,22)' GRADX is ',BETA
      WRITE(30,22)' GRADY is ',GAMMA
      WRITE(30,22)' KXX is ',KXX
      WRITE(30,22)' KXY is ',KXY
      WRITE(30,22)' KYY is ',KYY
      WRITE(30,22)' QX is ',QX
      WRITE(30,22)' QY is ',QY
      WRITE(30,22)' VX is ',VX
      WRITE(30,22)' VY is ',VY
      WRITE(30,22)' MAGN is ',MAGN
      WRITE(30,22)' PHI is ',PHI
22  FORMAT(5X,A,E12.6)
      WRITE(30,*)
      WRITE(30,*)
C
      BEGIN EVALUATION LOOP
C
      WRITE(*,*)
      WRITE(*,*)
C
      WRITE(*,*)' You next need to evaluate the elevation head
      WRITE(*,*)' over a user defined rectangular sub region. First
      WRITE(*,*)' read in the number (integer) NXEVAL of x-coordinate
      WRITE(*,*)' evaluations desired and then read in the number
      WRITE(*,*)' NYEVAL of y-coordinate evaluations desired. This,
      WRITE(*,*)' is done as an ordered pair of integers.
C
      WRITE(*,3)' Input the ordered pair: NXEVAL,NYEVAL
      READ(*,*) NXEVAL,NYEVAL
C
      WRITE(*,*)' Secondly, read in the base point ordered pair

```

Appendix F.5.1 Estimation of water table slope under the Area 5 RWMS (Continued)

ATTACHMENT A (Continued)

```
      WRITE(*,*)' coordinate XIN,YIN as free form floating point form. '
C
      WRITE(*,3)' Input the ordered pair: XIN,YIN
      READ(*,*) XIN,YIN
C
      WRITE(*,*)' Lastly, read in the ordered pair increments
      WRITE(*,*)' DXIN,DYIN. These may be either positive or negative.'
      WRITE(*,*)' NOTE!! ALL INPUTS ARE IN FREE FORM READ FORMAT
C
      WRITE(*,3)' Input the ordered pair: DXIN,DYIN
      READ(*,*) DXIN,DYIN
C
      XINO=XIN
      YINO=YIN
      DO 213 J=1,NYEVAL
        YIN=YINO+DYIN*FLOAT(J-1)
        DO 214 I=1,NXEVAL
          XIN=XINO+DXIN*FLOAT(I-1)
          HEST=ALPHA+BETA*(XIN-X(1))+GAMMA*(YIN-Y(1))
          QX=-KXX*GRADX-KXY*GRADY
          QY=-KXY*GRADX-KYY*GRADY
          WRITE(30,101)XIN,YIN,HEST,QX,QY
101    FORMAT(1X,F10.2,1X,F10.2,1X,3(E12.6,1X))
214    CONTINUE
213    CONTINUE
      GO TO 2000
500  WRITE(*,*)' COLINEAR POINTS - CHECK THE COORDINATES AGAIN '
C
C  NORMAL TERMINATION OF FORTRAN EXECUTION
C
2000 STOP 'Normal Fortran termination'
      END
```

Figure 2 Theoretical plane water table elevated at the elevations shown in Table 3 together with the 0.975 and 0.025 uncertainty envelopes.

Figure 3. Sequence of vertical slices through the Easting coordinate and parallel to the vertical-Northing coordinate showing the uncertainty envelope.

Figure 4. Sequence of vertical slices through the Northing coordinate and parallel to the vertical-Easting coordinate showing the uncertainty envelope.

Appendix F.5.2 Results of hydraulic conductivity recovery tests

Borehole	Slug Test Number	Time Lag (s)	Hydraulic Conductivity (cm/s)
UE5PW-1	1	38	1.2×10^{-3}
	2	31	1.4×10^{-3}
	3	48	9.1×10^{-4}
	4	46	9.5×10^{-4}
	5	23	1.9×10^{-3}
	Average	24	1.3×10^{-3}
UE5PW-2	1	166	2.4×10^{-4}
	2	101	3.9×10^{-4}
	3	112	3.5×10^{-4}
	4	119	3.3×10^{-4}
	5	108	3.7×10^{-4}
	Average	121	3.4×10^{-4}
UE5PW-3	1	29	1.2×10^{-3}
	2	23	1.5×10^{-3}
	3	25	1.4×10^{-3}
	4	22	1.6×10^{-3}
	Average	25	1.4×10^{-3}

Area 5 Pilot Wells

APPENDIX G

Data from Neutron Logging Calibration Boreholes

- G.1 Drilling Information
 - G.1.1 Chronological Drilling Summary for UE5PW-2A, 2B, and 2C
 - G.1.2 Core Record for UE5PW-2A, 2B, and 2C
 - G.1.3 Nevada State Central Zone Coordinates for Neutron Logging Calibration Boreholes
- G.2 Core and Drill Cuttings Sample Description Data
 - G.2.1 Borehole Log Sheets for UE5PW-2A
 - G.2.2 Borehole Log Sheets for UE5PW-2B
 - G.2.3 Borehole Log Sheets for UE5PW-2C
 - G.2.4 Drill Cuttings Log Data for UE5PWW-2A
 - G.2.5 Drill Cuttings Log Data for UE5PWW-2B
 - G.2.6 Drill Cuttings Log Data for UE5PWW-2C
- G.3 Laboratory Testing Data of Geologic Samples
 - G.3.1 Stratigraphy and Mineralogy Data
 - G.3.1.1 Summary of USCS Group Names for Core and Drill Cuttings Samples from Calibration Boreholes
 - G.3.1.2 Results from XRF and INAA for Core Samples from UE5PW-2A
 - G.3.1.3 Results from XRF and INAA for Core Samples from UE5PW-2B
 - G.3.1.4 Results from XRF and INAA for Core Samples from UE5PW-2C
 - G.3.2 Material, Hydrologic, and Geochemical Parameter Data
 - G.3.2.1 Results of Laboratory Tests for Core Samples from UE5PW-2A
 - G.3.2.2 Results of Laboratory Tests for Core Samples from UE5PW-2B
 - G.3.2.3 Results of Laboratory Tests for Core Samples from UE5PW-2C
 - G.3.2.4 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2A
 - G.3.2.5 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2B
 - G.3.2.6 Results of Laboratory Tests for Drill Cuttings Samples from UE5PW-2C
 - G.3.2.7 Summary of Descriptive Statistics of Alluvial Samples from UE5PW-2A, UE5PW-2B, and UE5PW-2C
- G.4 Field Test Data
 - G.4.1 Site Preparation Information
 - G.4.2 Neutron-Moisture Meter Data
 - G.4.2.1 Neutron-Moisture Meter Data for UE5PW-2A
 - G.4.2.2 Neutron-Moisture Meter Data for UE5PW-2B
 - G.4.2.3 Neutron-Moisture Meter Data for UE5PW-2C
 - G.4.3 Calibration of the Neutron-Moisture Meter in the Calibration Boreholes

Appendix G.1.1 Chronological Drilling Summary for Ue5PW-2A, 2B, and 2C

DATE 1992	CASING DEPTH (ft.)	CASING SIZE (in.)	CORE RUN NO.	ACTIVITIES & PROBLEMS
7-17	37.5	8.625	1,2,3	Moved onto PW-2A calibration hole & spuded. Welded hammer closed.
7-20			4	Took core sample in PW-2A @ T.D. and moved off hole.
7-20	22.5	7.625	1	Moved to PW-2B. Can't get Odex back through casing due to "mill reject" tolerance. Cut sampler sub. Casing pulled and reset at 13.5 ft.
7-20			1	Moved to PW-2C.
7-21	37.5	10.75	2, 3	Completed PW-2C. Moved off hole.

Appendix G.1.2 Core record for the Ue5PW-2A, 2B, and 2C.

Calibration Borehole	Date	Run Number	Core Interval		Core Recovery		Coring Rate (ft/m)	Laboratory Tests
			from (ft)	to	(ft)	(percent)		
Ue5PW-2A	07/17/92	1	0.0	2.3	2.20	94	1.17	A,B,D,E,F,G,ARCH
	07/17/92	2	2.5	5.0	2.25	90	1.47	A,B,D,E,F,G
	07/17/92	3	17.8	20.3	2.50	99	0.63	ARCH
	07/20/92	4	40.1	42.6	2.20	88	0.11	A,B,C,D,E,F,G,ARCH
Ue5PW-2B	07/20/92	1	0.0	2.5	2.30	92	1.47	A,C,D,E,F,G,ARCH
Ue5PW-2C	07/21/92	1	0.0	2.3	2.10	91	0.77	A,B,C,D,E,F,G,ARCH
	07/21/92	2	18.1	20.3	2.25	100	0.42	A,B,D,E,F,G,ARCH
	07/21/92	3	40.8	43.2	2.00	82	0.17	A,C,D,E,F,G,ARCH

A: PHYSICAL AND HYDRAULIC PROPERTIES					E: XRF, MINERALOGY AND GEOCHEMISTRY			
B: PARTICLE SIZE ANALYSIS					F: STABLE ISOTOPES AND TRITIUM			
C: CHLORIDE EXTRATION					G: CHLORIDE, BROMIDE AND CARBON			
D: WATER POTENTIAL					ARCH: ARCHIVAL			

Table G.1.3 Nevada state central zone coordinates for neutron logging calibration boreholes

Well No.	Elevation Above Sea Level (ft)	Nevada State Central Zone Coordinates	
		North (ft)	East (ft)
Ue5PW-2A	3,245.60	770,291.49	709,974.51
Ue5PW-2B	3,244.66	770,273.57	709,965.90
Ue5PW-2C	3,245.59	770,308.96	709,981.24

Borehole Log Sheet

Page 1 of 4

1) Hole Designation: Ue5PW-2A										2) Drilling Method: Casing Advance/Percussion Air Hammer											
3) Sampling Data Type: DRIVE CORE, 2.33' BARREL										2 MIN./2.33 FT. Penetration Rate: = 0.86 MIN/FT. Interval: 0 - 2.33 FT. Recovery: 2.17 FT/93%											
Run Number: 1										Rig Type: I. R. T4W											
Time out of Hole: 1327, 7-17-92										15) Sample Designation											
4) Depth in Feet	5) Color (Munsell Chan)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	1	2	3	4	5	6	7	8	9	10
0.25	7.5 YR 5/4		0 30 50 10	Volcanics	Well	Angular	Weak	Strong	SM-SP	DISTURBED	1.9										
0.5	Brown		25 55 20 70		Moderate	Subangular	Weak	Weak	SW-SM		1.2										
0.75					Poor	Rounded	Moderate	Moderate			1.0										
1.0							Strong	Strong			0.6										
1.25			28 65 7								1.2										
1.5											1.1										
1.75			30 70 10								1.3										
2.0											2.0										
2.25											1.5										
NOTE: PARTICLE SIZE FOR 1.25 - 1.5 FT. FROM LAB ANALYSIS.																					
16) Comments: ① GRAVELLY SILTY SAND, FINE SAND, GRAVELS < 1", SOME ROOTLETS, DISTURBED BY EXCAVATING. ② GRAVELLY SILTY SAND, FINE SAND, GRAVELS < 3/8", DISTURBED BY EXCAVATING. ③ GRAVELLY SILTY SAND, FINE SAND, GRAVELS < 1/4", SOME ROOTLETS, 2 CALCAREOUS STRINGERS. ④ GRAVELLY SILTY SAND, GRAVELS < 1/4", SOME ROOTLETS & CALCAREOUS STRINGERS, SOME 1/2" GRAVELS. ⑤ GRAVELLY SILTY SAND, FINE SAND, GRAVELS < 3/4", RARE CALCAREOUS STRINGERS, SOME ROOTLETS.																					
17) Radiometric Data										18) VOC's in ppm											
EDITED BY: KEN DONNELSON										20) Date and Time Log Completed: 7-18-92, 1317											
19) Logged By: KENNETH DONNELSON										21) Checked by: <i>[Signature]</i>											

Borehole Log Sheet

Page 2 of 4

1) Hole Designation: Ue 5PW-2A		2) Drilling Method: Casing Advance/Percussion Air Hammer																			
3) Sampling Data Type: DRIVE CORE		1.7 MIN / 2.5 FT. Penetration Rate: = 0.68 MIN/FT. Interval: 2.5 - 5.0 FT Recovery: 2.25 FT/90%																			
Run Number: 2		Rig Type: I. R. T4W																			
Time out of Hole: 1351, 7-17-92																					
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation										
		Dry Moisture Content	Cobbles Gravel Sand Silt-Clay	Volcanics Carbonates Other	Well Moderate Poor	Angular Subangular Rounded	None Weak Moderate Strong	None Weak Moderate Strong			Magnetic Susceptibility	1 DB 1	2 HYD 1	3 DRI 1	4 DRI 2	5 DB 2	6 HYD 2	7 SNL	8 MTL	9 ARCHIVE	10
2.15	7.5YR 5/4								SM-SP		1.4										
3.0	BROWN										1.0										
3.25											1.9										
3.5											1.4										
3.75											1.4										
4.0											2.3										
4.25											1.8										
4.5											1.8										
4.75											3.2										
5.0																					
16) Comments:																					
① GRAVELLY SILTY SAND, FINE SAND, GRAVELS < 1/2", TRACE OF ROOTLETS & CALCAREOUS COATINGS DOWN TO 3.25 FT. INCREASED AMOUNT OF + 4 MESH GRAVELS FROM 3.25 - 3.7 FT. < 1" GRAVELS FROM 3.7 - 4.5 FT.																					
② GRAVELLY SAND, GRAVELS < 1/4" PARTICLE SIZE FOR 4.25 - 4.5 FT FROM LAB ANALYSIS.																					
17) Radiometric Data										18) VOC's in ppm											
EDITED BY: KEN DONNELSON										20) Date and Time Log Completed: 7-18-92, 1420											
19) Logged By: KENNETH DONNELSON										21) Checked by: <i>David J. Blum</i>											

①

②

Borehole Log Sheet

1) Hole Designation: Ue 5 PW-2A		2) Drilling Method: Casing Advance/Percussion Air Hammer									
3) Sampling Data Type: DRIVE CORE, 2.5 FT. BARREL		4 MIN./2.5 FT. PENETRATION RATE: = 1.6 MIN./FT. INTERVAL: 17.83 - 20.33 RECOVERY: 1.5 FT. / 60%									
Run Number: 3		Rig Type: I.R. T4W									
Time out of Hole: 1538, 7-17-92											
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	15) Sample Designation
18.0	7.5YR 7/3	Dry	Cobbles	Volcanics	Well	Angular	None	Weak	GM-GW		1 DB 1
18.25	PINK	Wet	Gravel	Carbonates	Moderate	Subangular	Weak	Weak			2 HYD 1
18.5			Sand	Other		Rounded	Strong	Strong			3 DRI 1
18.75			Silt Clay								4 DRI 2
19.0											5 DB 2
19.25											6 HYD 2
19.5											7 SNL
19.75											8 MTL
20.0											9 ARCHIVE
20.25											10
16) Comments: * SAMPLE DROPPED OUT OF SAMPLER AT SURFACE. MADE COMPOSITE SAMPLE. 3 1/2" MAXIMUM COBBLE SIZE. SAND & GRAVELS ARE WELL GRADED.											
17) Radiometric Data											
18) VOC's in ppm											
19) Logged By: KENNETH DONNELSON 20) Date and Time Log Completed: 7-18-92, 0943											
21) Checked by: David D. B. H. A.											

Borehole Log Sheet

1) Hole Designation: Ue 5 PW-2C		2) Drilling Method: Casing Advance/Percussion Air Hammer										
3) Sampling Data Type: DRIVE CORE, 2.33' SPLIT BARREL Penetration Rate: 14.7 MIN./2.42 FT.		14.7 MIN./2.42 FT.										
Run Number: 3		Time out of Hole: 14.40, 7-21-92										
Rig Type: I.R. TAW		15) Sample Designation										
4) Depth in Feet	5) Color (Munsell Chart)	6) Moisture Content	7) Particle Size Distribution	8) Major Minerals in %	9) Sorting	10) Grain Shape	11) Cementation	12) HCL Reaction	13) USCS Group Name	14) Alluvial Unit	Magnetic Susceptibility	15) Sample Designation
① 41.0	10YR 6/3	Moist	Cobbles 0	Silt Clay 0	Volcanics 90	Well	None	None	GP	FILL	1.1	DB 1
② 41.25	PALE	↓	↓	↓	↓	↓	↓	↓	SM-SP FILL?	↓	1.3	DB 1
③ 41.5	BROWN	↓	↓	↓	↓	↓	↓	↓	↓	↓	0.6	DB 1
④ 41.75	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1.0	DB 1
⑤ 42.0	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1.1	DB 1
⑥ 42.25	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1.0	DB 1
⑦ 42.5	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1.3	DB 1
⑧ 42.75	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0.7	DB 1
16) Comments: ① PREDOMINANTLY - 1/2" GRAVEL. ② FINE - MEDIUM SAND, PREDOMINANTLY - 1/2" GRAVELS. ③ FINE - MEDIUM SAND, PREDOMINANTLY - 1/4" GRAVELS. ④ FINE - COARSE SAND, PREDOMINANTLY - 1/4" GRAVELS. STAGE I-II CARBONATES 41.75 - 42.5 FT.												
17) Radiometric Data EDITED BY: KEN DONNELSON 19) Logged By: KENNETH DONNELSON 20) Date and Time Log Completed: 7-21-92, 1520 21) Checked by: <i>Michael P. Blum</i>												
18) VOC's in ppm												

NOTE: LEXAN LINERS FROM 42.25 - 42.75 FT. ARE CRACKED.

Appendix G.2.4 Drill Cuttings Log Data for Ue5PW-2A

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
0.0-5.0	SW-SM	Sand	22-28	7-9	1.2					
5.0-10.0	SW	Sand	13-37	5	1.2-1.4	2.0-2.2	Moderate			
10.0-12.5	SW-SM	Sand	15	5	1.4	4.1	Moderate	Pale White	V. Pale Yellow	
12.5-15.0	SW	Sand	22	5	1.2	3.5	Strong	Pale White	V. Pale Yellow	
15.0-20.0	SW-SM	Sand	9-28	9-8	1.4-1.6	2.0-4.4	Strong- Moderate		V. Pale Yellow	
20.0-22.5	SW	Sand	48	4	0.8	2.3	Strong		V. Pale Yellow Orange	
22.5-27.5	SW-SM	Sand	20-24	5-6	1.2-1.6	2.6-6.8	Moderate		V. Pale Yellow Orange	
27.5-37.5	SM	Silty Sand	18-29	16-20	0.4-1.2	1.1-1.2	Moderate		V. Pale Yellow Orange	Fine- Medium Sand

Appendix G.2.5 Drill Cuttings Log Data for Ue5PW-2B

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMAR KS
								SW	LW	
0.0-2.5	SM	Silty Sand	14	17	0.6					Fine Sand
2.5-5.0	SW-SM	Sand	26	7	1.4	1.9	Strong	V. Pale Yellow Green	Pale Yellow Orange	
5.0-7.5	SP-SM	Sand	0.1	6	1.8				Pale Yellow Orange	Medium Sand
7.5-10.0	SW-SM	Sand	11	8	3.0	5.3	Moderate		Pale Yellow Orange	
10.0-20.0	SW	Sand	24-41	3-5	0.4-0.8	1.7-5.5	Weak-Moderate	Pale Green	Pale Yellow Orange	
20.0-22.5	SW-SM	Sand	22	5	1.2	3.5	Moderate		Pale Yellow Orange	

Appendix G.2.6 Drill Cuttings Log Data for Ue5PW-2C

DEPTH INTERVAL (FT)	U.S.C.S.	GROUP NAME	% + 4 MESH	% - 200 MESH	DRILL RATE (MIN./FT.)	MAGNETIC SUSCEPT- IBILITY	10% HCl REACTIONS	U. V. LIGHT		REMARKS
								SW	LW	
0.0-7.5	SW-SM	Sand	11-20	6-9	1.6-4.0	1.2-1.9	Strong	V.Pale Yellow	V.Pale Yellow	
7.5-10.0	SM	Silty Sand	9	14	8.0	3.3	Strong	V.Pale Yellow	V.Pale Yellow	Medium Sand
10.0-30.0	SW-SM	Sand	16-32	6-10	1.4-3.8	1.2-3.2	Strong	V.Pale Yellow	V.Pale Yellow	
30.0-32.5	GW-GM	Gravel	47	7	2.4	0.9	Strong	V.Pale Yellow	V.Pale Yellow	
32.5-37.5	SW-SM	Sand	37-46	7-9	1.2-3.2	0.8-1.0	Strong	V.Pale Yellow	V.Pale Yellow	

Appendix G.3.1.1. Summary of USCS group names for core and drill cuttings samples from calibration boreholes

Borehole	Sample Type	SM	SW	SW-SM	SP-SM	GW-GM	TOTAL
Ue5PW-2A	Cuttings & core	6 30%	4 20%	9 45%		1 5%	20
Ue5PW-2B	Cuttings & core	1 10%	4 40%	3 30%	1 10%	1 10%	10
Ue5PW-2C	Cuttings & core	1 5%	2 10%	15 75%		2 10%	20
TOTAL		8 16%	10 20%	27 54%	1 2%	4 8%	50

SM: Silty sand, > 12% silt.

SW: Well graded sand, < 5% silt.

SW-SM: Well graded sand with silt, 5-12% silt.

SP-SM: Poorly graded sand with silt, 5-12% silt.

GW-GM: Well graded gravel with silt, 5-12% silt.

Appendix G.3.1.1 Profiles of USCS Textural Classes (Continued).

Appendix G.3.1.2 Results from XRF and INAA for core samples from Ue5PW-2A

Depth interval from to (ft)		SiO	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	LOI ¹	FeO ²	Na ₂ O ²		
1.75	2.00	64.78	0.33	12.63	2.43	0.06	1.31	5.35	2.81	3.62	0.05	6.48	2.25	2.67		
4.00	4.25	61.58	0.33	11.59	2.48	0.06	1.84	7.54	2.45	3.26	0.04	8.54	2.24	2.44		
4.50	4.75	64.70	0.32	12.27	2.46	0.06	1.32	5.70	2.75	3.47	0.04	6.68	2.04	2.75		
41.75	42.00	64.67	0.39	12.71	2.62	0.06	1.61	4.87	2.33	3.88	0.05	6.43	2.35	2.32		
from to (ft)		Sc	Cr	Zn	As	Br	Composition (pppm)				Y ²	Zr ²	Nb ²	Sb	Cs	Ba
1.75	2.00	5.19	21	56	5.7	2.7	112	103	409	25	186	16	0.6	3.9	689	
4.00	4.25	4.85	16	64	6.4	4.3	104	101	378	21	182	16	0.6	3.7	628	
4.50	4.75	4.25	16	40	5.4	2.9	103	106	404	22	182	16	0.5	3.2	768	
41.75	42.00	6.06	27	56	6.2	2.0	131	124	360	26	257	19	0.8	5.0	558	
from to (ft)		La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Pb ²	Th ²	ThI	U	
1.75	2.00	49.7	93.6	28.0	5.70	0.95	0.61	2.08	0.30	5.2	0.9	24	14	13.8	3.2	
4.00	4.25	43.2	79.8	25.8	5.24	0.63	0.57	2.26	0.36	6.1	1.0	22	13	15.8	3.7	
4.50	4.75	39.4	74.5	23.1	5.02	0.84	0.65	2.05	0.30	5.7	1.1	19	13	12.3	3.3	
41.75	42.00	47.5	91.5	28.3	5.94	0.83	0.74	2.33	0.36	8.7	1.2	23	15	16.6	3.6	

¹LOI means "loss on ignition"

²Analyzed by INAA methods

Appendix G.3.1.3 Results from XRF and INAA for core samples from Ue5PW-2B

Depth interval from to (ft)		SiO ₂	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	LOI ¹	FeO ²	Na ₂ O ²
		(percent composition by weight)												
0.25	0.50	65.91	0.41	12.79	2.58	0.07	1.38	4.41	2.56	3.74	0.06	5.95	2.02	2.57
2.25	2.50	60.91	0.29	11.35	2.04	0.05	1.24	8.44	2.44	3.21	0.05	9.59	1.87	2.49
from to (ft)		Sc	Cr	Zn	As	Br	Rb ²	RbI	Sr ²	Y ²	Zr ²	Nb ²	Sb	Cs
		Composition (pppm)												
0.25	0.50	5.53	18	57	4.7	4.7	114	116	379	24	241	17	0.6	3.8
2.25	2.50	4.12	10	62	6.1	6.8	104	100	375	20	173	16	0.5	3.1
from to (ft)		La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Pb ²	Th ²	ThI
		Composition (ppm)												
0.25	0.50	50.7	94.5	29.0	6.32	0.93	0.72	2.48	0.38	9.2	1.1	21	14	15.4
2.25	2.50	41.9	77.9	22.5	5.20	0.73	0.67	2.01	0.32	4.7	1.0	21	14	13.5
														3.3
														3.8

¹LOI means "loss on ignition"

²Analyzed by INAA methods

Appendix G.3.1.4 Results from XRF and INAA for core samples from Ue5PW-2C

Depth interval from to (ft)		SiO ₂	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	LOI ¹	FeO ²	Na ₂ O ²	
(percent composition by weight)															
2.00	2.25	65.85	0.31	12.68	2.11	0.06	1.18	4.79	2.77	3.59	0.04	6.03	2.18	2.80	
18.50	18.75	62.12	0.37	11.72	2.82	0.07	0.98	7.61	2.82	3.35	0.05	7.46	2.45	2.81	
20.00	20.25	64.21	0.44	12.17	3.80	0.10	1.05	5.89	2.97	3.37	0.06	5.48	3.11	2.92	
41.25	41.50	65.46	0.22	11.68	1.50	0.06	1.42	5.60	2.79	4.26	0.08	7.05	1.38	3.00	
from to (ft)		Sc	Cr	Zn	As	Br	Composition (pppm)			Y ²	Zr ²	Nb ²	Sb	Cs	Ba
Rb ² RbI Sr ²															
2.00	2.25	4.39	14	41	5.0	2.3	114	110	424	23	180	17	0.6	3.6	725
18.50	18.75	4.00	11	73	5.1	3.1	99	95	344	24	185	17	0.4	2.9	641
20.00	20.25	4.79	20	82	4.9	2.1	87	86	379	22	170	15	0.4	2.3	720
41.25	41.50	4.26	8	59	5.8	3.0	150	155	196	27	163	21	0.5	4.1	278
from to (ft)		La	Ce	Nd	Sm	Eu	Composition (ppm)			Hf	Ta	Pb ²	Th ²	ThI	U
Tb Yb Lu															
2.00	2.25	39.8	75.8	24.0	4.97	0.80	0.66	2.13	0.32	5.9	1.1	21	14	14.3	3.4
18.50	18.75	47.1	86.3	28.0	5.45	0.84	0.58	1.96	0.29	5.8	1.0	24	17	12.9	3.0
20.00	20.25	90.0	177.3	43.1	7.41	0.89	0.70	1.96	0.31	5.0	1.0	21	11	15.3	2.4
41.25	41.50	47.2	91.2	30.6	6.27	0.53	0.72	2.65	0.41	5.6	1.5	21	16	19.4	4.2

¹LOI means "loss on ignition"

²Analyzed by INAA methods

ENVIRONMENTAL TRACER PROPERTIES

MATERIAL PROPERTIES

ENVIRONMENTAL TRACER PROPERTIES

Appendix G.3.2.2 Results of laboratory tests for core samples from Ue5PW-2B.

HYDROLOGIC PROPERTIES										MATERIAL PROPERTIES						ENVIRONMENTAL TRACER PROPERTIES		
Interval from to (ft)	Water Content (percent)					Water Potential (bars)	Particle Size Distribution (percent passing sieve)		Dry Bulk Density (g/cm3)		Calculated Porosity (percent)		Apparent Magnetic Susceptibility	Chloride in soil (ppm)	Bromide in soil (ppm)	Soluble Sulfate Ratio (ppm)		
	Gravimetric		Volumetric				No. 4	No. 200	DB1	DR12	HYD1	DB1					DR12	HYD1
	DB1	DR12	HYD1	DB1	DR12													
0.00 0.25																		
0.25 0.50			11.87		15.83		43.22	6.92	1.47			1.33		49.69	14	0.21	66.67	
0.50 0.75		10.22		15.07								44.37					50	
0.75 1.00																		
1.00 1.25		13.10			20.70	-0.048	85.80	17.47	1.38		1.59		40.00					
1.25 1.50		14.46		20.01								47.78						
1.50 1.75																		
1.75 2.00																		
2.00 2.25																		
2.25 2.50			12.17		16.43							1.35		49.05	31	0.26	119.23	

ENVIRONMENTAL TRACER PROPERTIES

[illegible]

Appendix G.3.2.4 Results of laboratory tests for cuttings samples from Ue5PW-2A.

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES						
Interval from to (ft)		Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility				Chloride		Bromide	Soluble Sulfate
				No. 4	No. 200					in soil		Cl/Br	
		DB2	HYD1				No. 4	No. 200	Inorganic	Organic	Total	(ppm)	
5.0	7.5	11.0	11.5	87.11	4.85	2.0	0.83	0.10	0.93	130	0.8	162.50	190
7.5	10.0	7.0	7.5	63.08	4.70	2.2	0.89	0.05	0.94	620	3.8	163.16	320
10.0	12.5	4.2	35.4	85.72	5.18	4.1	0.94	0.05	0.99	360	2.3	156.52	230
12.5	15.0	2.3	2.5	77.86	4.74	3.5	1.25	0.06	1.31	170	1.0	170.00	240
15.0	17.5	2.2	2.4	71.98	8.00	2.0	1.09	0.07	1.16	160	0.9	175.82	1400
17.5	20.0	1.6	1.8	90.87	9.08	4.4	0.88	0.06	0.94	120	0.7	171.43	2400
20.0	22.5	2.5	2.5	52.15	4.03	2.3	1.31	0.07	1.38	130	0.8	173.33	1800
22.5	25.0	2.1	2.5	80.46	5.02	6.8	1.06	0.06	1.12	100	0.6	163.93	590
25.0	27.5	2.4	2.1	75.79	5.57	2.6	0.93	0.05	0.98	89	0.5	174.51	970
27.5	30.0	3.2	2.9	76.93	15.60	1.1	0.89	0.07	0.96	140	0.8	181.82	1600
30.0	32.5	4.0	3.9	74.71	18.08	1.2	0.78	0.06	0.84	180	1.0	181.82	750
32.5	35.0	4.4	4.3	77.39	19.50	1.1	0.69	0.05	0.74	150	0.8	185.19	430
35.0	37.5	3.7	3.7	82.05	19.40	1.2	0.50	0.03	0.53	110	0.6	180.33	350

Appendix G.3.2.5 Results of laboratory tests for cuttings samples from Ue5PW-2B.

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES						
Gravimetric Water Content (percent)				Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Chloride	Bromide	Soluble Sulfate	
				DB2	HYD1					No.4	No.200		Inorganic
Interval from to (ft)													
2.5	5.0	11.6	11.2	73.52	6.56	1.9	1.03	0.10	1.13	74	0.5	160.87	910
5.0	7.5	8.8		99.90	6.23								
7.5	10.0	5.5	5.8	89.20	7.77	5.3	0.88	0.05	0.93	50	0.3	156.25	150
10.0	12.5	7.4	7.6	71.02	3.40	7.3	0.77	0.04	0.81	110	0.6	171.88	330
12.5	15.0	6.5	6.3	76.47	2.62	5.5	0.89	0.04	0.93	120	0.7	169.01	830
15.0	17.5	7.9	7.7	59.21	4.58	2.4	0.86	0.05	0.91	230	1.4	164.29	1400
17.5	20.0	7.8	7.4	68.02	3.01	1.7	0.92	0.05	0.97	490	3.0	163.33	3600
20.0	22.5	4.4	3.8	78.26	5.15	3.5	0.86	0.03	0.89	170	1.1	154.55	2600

Appendix G.3.2.6 Results of laboratory tests for cuttings samples from Ue5PW-2C.

HYDROLOGIC PROPERTIES				MATERIAL PROPERTIES			ENVIRONMENTAL TRACER PROPERTIES						
Interval from to (ft)		Gravimetric Water Content (percent)		Particle Size Distribution (percent passing sieve)		Apparent Magnetic Susceptibility	Carbon (percent)			Chloride	Bromide	Soluble Sulfate	
				No.4	No.200					in soil (ppm)	Cl/Br ratio		
		DB2	HYD1			Inorganic	Organic	Total					
0.0	2.5	11.0	11.5	84.63	8.12	1.2	0.89	0.12	1.01	40	0.3	137.93	550
2.5	5.0	10.6	11.2	88.89	6.27	1.7	1.03	0.11	1.14	94	0.6	159.32	1600
5.0	7.5	11.2	11.8	80.42	9.39	1.9	1.07	0.08	1.15	340	2.0	170.00	630
7.5	10.0	5.3	5.6	91.48	13.72	3.3	1.16	0.09	1.25	340	2.1	161.90	510
10.0	12.5	4.7	4.7	73.26	7.20	3.2	1.01	0.05	1.06	390	2.4	162.50	460
12.5	15.0	2.1	2.1	67.73	5.61	3.0	1.16	0.06	1.22	210	1.3	161.54	870
15.0	17.5	2.6	2.2	76.87	6.24	1.9	0.94	0.05	0.99	150	1.0	156.25	550
17.5	20.0	2.3	1.8	78.36	6.64	1.6	1.21	0.04	1.25	140	0.9	162.79	1500
20.0	22.5	2.1	2.1	81.78	6.78	3.0	1.25	0.05	1.30	130	0.8	168.83	890
22.5	25.0	1.9	2.0	83.70	7.05	2.7	1.24	0.04	1.28	100	0.6	175.44	600
25.0	27.5	2.1	2.1	75.01	10.43	1.3	1.21	0.05	1.26	120	0.6	187.50	950
27.5	30.0	2.1	2.1	74.24	10.27	1.4	0.89	0.05	0.94	110	0.7	164.18	890
30.0	32.5	2.8	2.6	52.83	7.13	0.9	0.98	0.06	1.04	130	0.7	180.56	1200
32.5	35.0	3.4	2.1	54.11	6.74	0.9	0.79	0.04	0.83	120	0.7	176.47	1100
35.0	37.5	3.4	3.3	63.15	9.46	1.0	0.53	0.04	0.57	100	0.6	169.49	260

Appendix G.3.2.7 Summary of descriptive statistics of alluvium samples from Ue5PW-2A, 2B, and 2C.

		CORE							CUTTINGS						
Sample ID	Number of samples	Range			Mean	Standard Deviation	Coefficient of Variation	Number of samples	Range		Mean	Standard Deviation	Coefficient of Variation		
		Minimum	Maximum	Minimum					Maximum						
HYDROLOGIC PROPERTIES															
Gravimetric water content (percent)															
Ue5PW-2A															
DB1	4	6.0	17.6	12.1	5.6	46.57		13	1.6	11.0	3.9	2.6	65.53		
DB2	3	5.4	15.4	11.6	5.4	46.58									
DB12	4	5.3	16.2	11.0	4.5	41.16									
HYD1	4	6.4	16.9	13.1	4.8	36.34		13	1.8	35.4	6.4	9.1	142.98		
Total	15	5.3	17.6	12.0	4.6	38.19		26	1.6	35.4	5.1	6.7	130.18		
Ue5PW-2B															
DB1	2	10.2	14.5	12.3	3.0	24.30		8	4.4	11.6	7.5	2.2	29.52		
DB2															
DB12	1	13.1													
HYD1	2	11.9	12.2	12.0	0.2	1.76		7	3.8	11.2	7.1	2.3	32.00		
Total	5	10.2	14.5	12.4	1.6			15	3.8	11.6	7.3	2.2	29.65		
Ue5PW-2C															
DB1	3	2.0	8.9	5.7	3.5	61.37		15	1.9	11.2	4.5	3.5	77.37		
DB2	2	2.8	14.3	8.6	8.2	94.94									
DB12	3	2.6	8.2	5.4	2.8	52.19									
HYD1	4	2.3	10.6	5.6	4.0	71.11		15	1.8	11.8	4.5	3.8	84.62		
Total	12	2.0	14.3	6.1	3.9	64.78		30	1.8	11.8	4.5	3.6	79.66		
Volumetric water content (percent)															
Ue5PW-2A															
DB1	3	9.2	27.0	20.9	10.1	48.40									
DB2	3	9.1	24.7	18.3	8.2	44.81									
DB12	4	8.7	25.0	18.3	7.0	38.24									
HYD1	4	9.8	26.5	20.6	7.4	36.07									
Total	14	8.7	27.0	19.5	7.2	36.87									
Ue5PW-2B															
DB1	2	15.1	20.0	17.5	3.5	19.92									
DB12	1	20.7													
Total	3	15.1	20.7	17.6	2.6	14.57									
Ue5PW-2C															
DB1	3	3.3	14.7	9.1	5.7	62.29									
DB2	2	4.6	23.5	14.1	13.4	94.95									
DB12	3	3.9	15.2	9.5	5.7	59.70									
HYD1	4	4.1	15.8	8.9	5.7	63.36									
Total	12	3.3	23.5	10.0	6.4	63.70									
Water potential (bars)															
Ue5PW-2A															
Filter paper method	4	-28.9	-0.04	-7.3	14.4	-198.90									
Ue5PW-2B															
Filter paper method	1	-0.05													
Ue5PW-2C															
Filter paper method	1	-0.04													
Chilled mirror method	2	-37.7	-12.2	-25.0	18.0	-72.20									
Total	3	-37.7	-0.04	-16.7	19.2	-115.41									

Appendix G.3.2.7 Summary of descriptive statistics of alluvium samples from Ue5PW-2A, 2B, and 2C (continued).

MATERIAL PROPERTIES			CORE							CUTTINGS						
			Sample ID	Number of samples	Range		Mean	Standard Deviation	Coefficient of Variation	Number of samples	Range		Mean	Standard Deviation	Coefficient of Variation	
Minimum	Maximum	Minimum			Maximum											
Sieve analysis (percent passing) No. 4 mesh screen Ue5PW-2A			DB1	4	34.74	84.92	67.43	23.21	34.43	13	52.15	90.87	76.62	10.21	13.32	
			DB2	3	72.32	80.79	77.11	4.34	5.63							
			Total	7	34.74	84.92	71.58	17.39	24.30							
Ue5PW-2B			DB1	2	43.22	85.80	64.51	30.11	46.67	8	59.21	99.90	76.95	12.65	16.44	
			DB2													
Ue5PW-2C			DB1	2	54.82	79.23	67.03	17.26	25.75	15	52.83	91.48	75.10	11.49	15.30	
			DB2	3	43.30	78.77	62.64	17.95	28.66							
			Total	5	43.30	79.23	64.39	15.54	24.13							
No. 200 mesh screen Ue5PW-2A			DB1	4	6.37	13.69	10.55	3.06	29.05	13	4.03	19.50	9.52	6.21	65.23	
			DB2	3	6.81	17.81	11.29	5.78	51.17							
			Total	7	6.37	17.81	10.86	4.00	36.79							
Ue5PW-2B			DB1	2	6.92	17.47	12.20	7.46	61.17	8	2.62	7.77	4.92	1.85	37.63	
			DB2													
Ue5PW-2C			DB1	2	2.06	11.83	6.95	6.91	99.47	15	5.61	13.72	8.07	2.18	27.07	
			DB2	3	2.68	7.75	5.21	2.54	48.69							
			Total	5	2.06	11.83	5.90	4.01	67.88							
Dry Bulk Density (g/cm³) Ue5PW-2A			DB1	3	1.53	1.63	1.57	0.06	3.52	15	5.61	13.72	8.07	2.18	27.07	
			DB2	3	1.51	1.67	1.60	0.08	5.06							
			DB12	4	1.54	1.75	1.68	0.10	5.94							
			HYD1	4	1.51	1.68	1.58	0.07	4.71							
			Total	14	1.51	1.75	1.61	0.08	5.27							
Ue5PW-2B			DB1	2	1.38	1.47	1.43	0.06	4.47	15	5.61	13.72	8.07	2.18	27.07	
			DB12	1	1.59											
			HYD1	2	1.33	1.35	1.34	0.01	1.06							
			Total	5	1.33	1.59	1.42	0.11	7.52							
Ue5PW-2C			DB1	3	1.55	1.66	1.62	0.06	3.75	15	5.61	13.72	8.07	2.18	27.07	
			DB2	2	1.64	1.64	1.64	0.00	0.00							
			DB12	3	1.52	1.87	1.71	0.18	10.35							
			HYD1	4	1.49	1.82	1.67	0.16	9.49							
			Total	12	1.49	1.87	1.66	0.12	7.22							

Appendix G.3.2.7 Summary of descriptive statistics of alluvium samples from Ue5PW-2A, 2B, and 2C (continued).

MATERIAL PROPERTIES		CORE							CUTTINGS				
Sample ID	Porosity, calculated (percent)	Number of samples	Range		Mean	Standard Deviation	Coefficient of Variation	Number of samples	Range		Mean	Standard Deviation	Coefficient of Variation
			Minimum	Maximum					Minimum	Maximum			
Ue5PW-2A													
DB1		3	38.54	42.25	40.92	2.07	5.05						
DB2		3	36.81	42.84	39.66	3.03	7.64						
DR12		4	33.96	41.89	36.79	3.75	10.20						
HYD1		4	36.77	42.90	40.63	2.71	6.67						
Total		14	33.96	42.90	39.39	3.18	8.08						
Ue5PW-2B													
DB1		2	44.37	47.78	46.08	2.41	5.23						
DR12		1	40.00										
HYD1		2	49.05	49.69	49.37	0.45	0.92						
Total		5	40.00	49.69	46.18	4.02	8.70						
Ue5PW-2C													
DB1		3	37.27	41.51	38.83	2.33	6.00						
DB2		2	38.16	38.30	38.23	0.10	0.26						
DR12		3	29.43	42.64	35.47	6.68	18.82						
HYD1		4	31.25	43.71	36.97	5.99	16.20						
Total		12	29.43	43.71	37.27	4.54	12.19						
Magnetic susceptibility													
Ue5PW-2A		27	0.6	3.2	1.5	0.5	34.98	13	1.1	6.8	2.7	1.7	62.79
Ue5PW-2B		10	0.9	1.9	1.4	0.3	21.88	7	1.7	7.3	3.9	2.1	54.12
Ue5PW-2C		25	0.6	14.0	3.1	3.6	116.20	15	0.9	3.3	1.9	0.9	45.29

Appendix G.4.1 Site Preparation Information

DATE 1992	ACTIVITIES
7-13	Calibration trench excavated 8-12" deep x 10' wide x 66' long. Filled w/≈4500 gal. water.
7-14	Calibration trench excavated 8-12" deep x 16' wide x 66' long. Filled w/≈4500 gal. water.
7-15	Trench filled w/≈3000 gal. water.
7-16	Trench filled w/≈3000 gal. water. Trench covered w/plastic.

Appendix G.4.2.1 Neutron moisture-meter data for Ue5PW-2A.

Depth (ft)	07/20/92	07/22/92	07/23/92	07/30/92	08/04/92	08/12/92	08/27/92	10/21/92	12/01/92
0.5	2148	1489	2213	1411	1509	1337	1731	1534	1393
1.5	2010	1981	2033	2001	1948	1983	1895	1708	1657
2.5	2000	1849	2070	1942	1983	1913	1937	1692	1732
3.5	2091	2075	2197	2113	1991	2008	1938	1869	1866
4.5	2195	2044	2239	2182	1968	2046	2042	1982	1923
5.5	2085	1993	2064	2139	2047	2106	2039	2056	1962
6.5	2155	2125	2107	2195	2130	2200	2119	2017	2041
7.5	2110	1907	2000	1987	2135	2005	2030	1967	1806
8.5	1892	1768	1797	1960	1871	1898	1773	1725	1721
9.5	1847	1742	1784	1798	1861	1816	1781	1715	1705
10.5	1613	1635	1562	1592	1589	1600	1503	1439	1409
11.5	1435	1471	1489	1528	1461	1433	1395	1429	1319
12.5	1351	1506	1590	1552	1559	1598	1607	1500	1478
13.5	1274	1512	1636	1793	1915	1929	1960	1802	1800
14.5	1251	1238	1276	1733	1891	1957	1938	1785	1717
15.5	1239	1264	1262	1324	1406	1627	1687	1724	1727
16.5	1198	1204	1243	1274	1278	1299	1262	1519	1601
17.5	1231	1273	1310	1281	1280	1243	1357	1373	1427
18.5	1403	1270	1271	1340	1291	1372	1289	1353	1418
19.5	1380	1347	1336	1360	1303	1296	1337	1387	1349
20.5	1367	1333	1453	1355	1377	1340	1397	1397	1401
21.5	1375	1386	1420	1411	1448	1467	1416	1442	1496
22.5	1283	1331	1299	1363	1357	1367	1268	1317	1358
23.5	1304	1276	1285	1303	1291	1325	1337	1283	1304
24.5	1277	1220	1252	1268	1267	1272	1251	1317	1290
25.5	1326	1247	1390	1275	1277	1240	1356	1269	1292
26.5	1539	1429	1485	1409	1398	1363	1493	1518	1427
27.5	1539	1497	1454	1469	1544	1481	1489	1543	1491
28.5	1542	1527	1542	1410	1438	1522	1515	1488	1567
29.5	1547	1516	1597	1627	1517	1582	1585	1581	1558
30.5	1544	1558	1609	1558	1500	1590	1577	1595	1589
31.5	1561	1641	1651	1637	1629	1739	1670	1557	1666
32.5	1639	1659	1566	1646	1598	1704	1635	1620	1585
33.5	1539	1497	1506	1517	1585	1539	1543	1565	1560
34.5	1408	1446	1465	1491	1448	1456	1474	1534	1436
35.5	1422	1383	1476	1462	1479	1433	1519	1443	1359
36.5	1322	1302	1309	1320	1342	1415	1235	1301	1306
37.5	1365	1327	1353	1333	1318	1341	1318	1323	1366
38.5	1431	1374	1410	1445	1383	1402	1449		
39.5		2165	2220	2099	1996	2112	2170	1436	

Appendix G.4.2.2 Neutron moisture-meter data for Ue5PW-2B.

Depth (ft)	07/22/92	07/30/92	08/04/92	08/12/92	08/27/92	10/21/92	12/01/92
0.5		399	440	300	803	653	638
1.5	2167	1994	2122	1986	2197	2060	2101
2.5	2428	2362	2249	2309	2307	2165	2193
3.5	2283	2225	2215	2195	2236	2172	2128
4.5	2248	2355	2165	2320	2268	2192	2133
5.5	2319	2334	2382	2363	2354	2251	2266
6.5	2274	2311	2353	2390	2266	2254	2295
7.5	2299	2321	2326	2317	2164	2159	2201
8.5	2063	2194	2186	2233	2083	1872	2039
9.5	2147	2228	2213	2195	2229	2138	2098
10.5	2440	2388	2364	2445	2310	2333	2258
11.5	2344	2194	2232	2187	2295	2123	2122
12.5	2342	2225	2233	2228	2335	2202	2211

Appendix G.4.2.3 Neutron moisture-meter data for Ue5PW-2C.

Depth (ft)	07/22/92	07/30/92	08/04/92	08/12/92	08/27/92	10/21/92	12/01/92
0.5	1320	1433	1352	1401	1453	1423	1402
1.5	1283	1397	1349	1417	1388	1322	1343
2.5	1235	1397	1380	1381	1392	1418	1393
3.5	1368	1423	1430	1404	1442	1359	1387
4.5	1307	1508	1469	1507	1444	1388	1435
5.5	1239	1361	1405	1345	1309	1321	1303
6.5	1196	1330	1391	1325	1356	1317	1366
7.5	1236	1393	1367	1459	1354	1302	1280
8.5	1246	1310	1303	1276	1273	1200	1211
9.5	986	1083	1080	1121	1030	997	984
10.5	769	903	940	993	935	879	881
11.5	690	732	867	892	875	951	883
12.5	826	810	886	899	928	1073	1077
13.5	907	885	897	937	939	1004	998
14.5	911	923	944	898	1035	934	978
15.5	880	898	896	916	938	951	1007
16.5	894	922	957	923	920	996	988
17.5	858	928	934	968	906	962	972
18.5	944	972	1017	997	978	1053	938
19.5	950	1016	1029	940	1022	1056	1016
20.5	972	1107	1056	1094	1089	1158	1099
21.5	1024	1133	1092	1168	1147	1106	1094
22.5	953	973	985	1024	1033	1028	1101
23.5	966	1039	1017	994	1011	996	1069
24.5	963	1054	1057	1048	1063	1040	1051
25.5	983	1081	1123	1040	1187	1103	1163
26.5	1038	1076	1034	1012	1082	1113	1039
27.5	940	974	955	981	955	965	987
28.5	871	869	926	868	909	945	951
29.5	902	908	914	909	856	932	896
30.5	909	951	929	984	898	961	990
31.5	931	933	944	995	950	989	978
32.5	955	987	946	972	1055	1079	1006
33.5	1050	966	1068	1046	1034	1017	1012
34.5	1013	1001	1014	1054	959	990	1007
35.5	976	976	895	971	940	955	881
36.5	885	871	841	873	829	861	828
37.5	850	850	853	843	859	803	768
38.5	871	869	862	799	814	826	825

Appendix G.4.3 Calibration of the neutron-moisture meter in the calibration boreholes.

- UE5PW-2A ODEX 8-5/8 in O.D. A calibration cannot be made due to the following: Core was taken at the top of the borehole (wet); core from the middle (dry) was significantly disturbed providing no samples; although core was taken at the bottom of the borehole, the casing was not advanced through the cored interval and thus can not be logged.
- UE5PW-2B ODEX 7-5/8 in O.D. A calibration cannot be made due to the following: Core was take at the top of the borehole (wet); due to drilling problems the hole was abandoned at 22.5 ft and no other core samples were taken.
- UE5PW-2C ODEX 10-3/4 in O.D. A calibration can be made for this borehole. Data were used from core samples from the top (wet) and middle (dry) of the borehole. Although core was taken at the bottom of the borehole, the casing was not advanced through the cored interval and thus can not be logged.

The calibration equation is:

$$\text{Volumetric water content} = \text{Counts} \times 4.4 \times 10^{-2} + 37.9$$

Area 5 Pilot Wells

APPENDIX H

Upper Aquifer Water Quality Data

- H.1 RCRA Groundwater Sampling and Analysis Methods and Results
- H.2 Preliminary General Water Chemistry

Appendix H.1 RCRA Groundwater Sampling and Analysis Methods and Results

Sample Collection and Preservation Methods

Groundwater samples were preserved in the field and containerized as described Table 1. The samples were collected in the same order as they appear in this table. Sample containers were precleaned and rinsed with sample before use. Samples designated for dissolved metal analyses were filter with a 0.45 μm in-line teflon filter.

Each sample was collected in duplicate except for the contamination indicating parameters. These parameters were sampled in quadruplicate. A field blank was prepared for each sample by filling a precleaned container in the field and preserving it as a sample. An equipment or rinsate blank was prepared by passing distilled water through a precleaned sampling pump and preserving.

At the time of sample collection a chain of custody form was completed and custody seals were attached to each sample container. Chain of custody was maintained throughout sample transport, processing and analysis. The samples were promptly transported in coolers to REECo laboratories.

Groundwater Analytical Results

The results from the initial sampling of Ue5PW-1 are presented in Appendix H.1. Total organic carbon, TOX, specific conductance and pH were measured in quadruplicate as indicators of contamination. The mean pH was found to be 8.13 and the mean specific conductance was 0.389 mmhos/cm. TOC was less than the detection limit of 1 mg/l. TOX was detected in a single sample at the detection limit of 10 $\mu\text{g/l}$.

Total and dissolved As, Ba, Cd, Cr, Pb, Se, Ag and Hg were measured to assess the suitability of groundwater as drinking water. Arsenic, Cd, Se, Hg and Ag were not detected in the dissolved or total fraction. In each case the detection limit was less than the State of Nevada primary standard for drinking water (Nevada Administrative Code, Chapter 445, 1980). Chromium was not detected but the detection limit was slightly greater than the primary standard. Total and dissolved Ba was found to be present at mean concentrations of 0.026 mg/l and 0.023 mg/l, which are significantly less than the drinking water primary standard of 1 mg/l. Dissolved Pb was detected in a single sample. The concentration of 0.009 mg/l was less than the primary standard of 0.05 mg/l and was less than the 0.002 mg/l found in the duplicate sample. Total Pb was also less than the detection limit in all cases. Since total Pb and the duplicate for dissolved Pb were all less than the detection limit, the 0.009 mg/l concentration is believed to be anomalous.

Total and dissolved Fe, Mn and Na were measured to establish groundwater quality. As expected for an oxygenated groundwater, iron was found to be detectable in the total fraction

Appendix H.1 RCRA groundwater sampling and analysis methods and results (Continued)

only. Manganese was present in the total and dissolved fractions at mean concentrations of 0.19 mg/l and 0.18 mg/l, respectively. The manganese concentrations exceed the State of Nevada secondary standard for drinking water of 0.05 mg/l.

Pesticides, herbicides, fluoride, and nitrate were measured to determine the suitability of groundwater as drinking water. Fluoride and nitrate were both found to be present at concentrations less than the drinking water primary standard. The pesticides endrin, methoxychlor and toxaphene were not detected. In each case the detection limit was less than the primary standard. Lindane was detected in both the sample and the field duplicate at approximately 5% of the drinking water primary standard concentration. Lindane was not detected in the field blank and the equipment blank. The herbicides 2,4-D and 2,4,5-TP Silvex were not detected. The detection limits were less than the primary standard limit.

Chloride and sulfate were measured to establish groundwater quality. Chloride and sulfate were both found to be present at concentrations significantly less than the drinking water secondary standard.

Total dissolved solids, cyanide, and oil and grease were measured to characterize background for these parameters. The mean value for total dissolved solids was 272 mg/l. Cyanide and oil and grease were not detected.

Radiological parameters were measured to determine the suitability of groundwater as drinking water and to comply with the requirements of DOE Order 5820.2A. The mean total and dissolved gross alpha activity concentration was 7.3 pCi/l and 5.4 pCi/l, respectively. The EPA (1985) has reported a mean gross alpha activity concentration for Nevada drinking water of 3.6 pCi/l. The Ue5PW-1 values do not exceed the 15 pCi/l gross alpha drinking water limit, but does exceed the 5 pCi/l limit that requires ²²⁶Ra and ²²⁸Ra analysis. ²²⁶Radium and ²²⁸Ra were both found to be less than the respective detection limits of 0.8 pCi/l and 0.6 pCi/l.

Total uranium was found at a mean concentration of 5 µg/l. Assuming a natural isotopic abundance of uranium, the uranium concentration expressed as an activity concentration would be 3.4 pCi/l as total uranium. Although gross alpha activity concentrations can not be equated to the activity concentration of specific radionuclides, it appears that most of the gross alpha activity can be attributed to uranium.

The mean total and dissolved gross beta activity concentrations were 6.2 pCi/l and 4.6 pCi/l, respectively. The EPA (1985) has reported a mean gross beta value for Nevada drinking water of 4.9 pCi/l.

Tritium samples were enriched by alkaline electrolysis and found to be less than the detection limit of 15 pCi/l. Tritium is the most mobile radionuclide in Area 5 and occurs in significant quantities in the RWMS and in underground test debris. The observation that tritium is not present strongly suggests that no other contaminating radionuclides are present

Appendix H.1 RCRA groundwater sampling and analysis methods and results (Continued)

in the groundwater. ^{90}Sr , ^{99}Tc , ^{131}I , ^{238}Pu and $^{239,240}\text{Pu}$ were all found to be either less than the detection limit or to have uncertainties greater than 100%. The only photon emitting radionuclides detected were ^{214}Pb and ^{214}Bi . These radionuclides are progeny of the naturally occurring radionuclide ^{222}Rn . The EPA (1985) found that the average ^{222}Rn activity concentration in Nevada drinking water was 448 pCi/l. The concentrations of ^{214}Pb and ^{214}Bi are close to this value.

Volatile and semi-volatile organic compounds were measured to obtain a background characterization for these parameters. No volatile or semi-volatile target compounds were detected.

Appendix H.1 RCRA groundwater sampling and analysis methods and results (Continued)

Table 1 Groundwater Sample Containers and Preservation.

Parameter	Number per Sample	Volume	Container	Preservation
Volatile Organics (8240)	2	40 ml	Amber glass vial with teflon lined silicone septum	Add 4 drops conc. HCl, Cool to 4°C
Total Organic Halogen (9020)	4	500 ml	Amber glass bottle with teflon lined cap	Acidify to pH < 2 with conc. H ₂ SO ₄ , Cool to 4 °C
Total Organic Carbon (9060)	4	250 ml	Amber glass bottle with teflon lined cap	Acidify to pH < 2 with conc. HCl, Cool to 4 °C
Oil and Grease (413.2)	2	1 liter	Glass Bottle	Acidify to pH < 2 with 10 ml of conc. HCl, Cool to 4°C
Pesticides (8080)	1	1 gal.	Amber glass bottle with teflon lined cap	Cool to 4 °C, Adjust pH between 6 and 8 with NaOH or H ₂ SO ₄
Herbicides (8150)	1	1 gal.	Amber glass bottle with teflon lined cap	Cool to 4 °C, Adjust pH between 6 and 8 with NaOH or H ₂ SO ₄
Semivolatile Organics (8270)	1	1 gal.	Amber glass bottle with teflon lined cap	Cool to 4 °C
Total Metals (6010) As, Ba, Cd, Cr, Fe, Hg, Mn, Na, Pb, Se	1	1 liter	Polyethylene bottle	Acidify pH < 2 with conc. HNO ₃
Total silver (6010)	1	500 ml	Amber glass bottle with teflon cap	Acidify pH < 2 with conc. HNO ₃
Cyanide (335.2)	1	1 liter	Polyethylene	Add 10M NaOH to pH > 12, Cool to 4°C
Chloride, Sulfate, Fluoride, Nitrate (300)	1	500 ml	Polyethylene	Cool to 4°C

Appendix H.1 RCRA groundwater sampling and analysis methods and results (Continued)

Parameter	Number per Sample	Volume	Container	Preservation
Gross Alpha/Beta Gamma Spectroscopy	1	1 gal.	Polyethylene	Acidify to pH < 2 with HNO ₃ , Cool to 4°C
⁹⁰ Strontium	1	1 liter	Polyethylene	Acidify to pH < 2 with HNO ₃ , Cool to 4°C
⁹⁹ Technetium	1	1 liter	Polyethylene	Acidify to pH < 2 with HNO ₃ , Cool to 4°C
Total Uranium	1	1 liter	Polyethylene	Acidify to pH < 2 with HNO ₃ , Cool to 4°C
¹³¹ Iodine	1	1 liter	Polyethylene	None
Plutonium	1	1 gal.	Polyethylene	Acidify to pH < 2 with HNO ₃
Radium	1	1 gal.	Polyethylene	Acidify to pH < 2 with HNO ₃
Dissolved Metals (6010) As, Ba, Cd, Cr, Fe, Hg, Mn, Na, Pb, Se	1	1 liter	Polyethylene	Acidify pH < 2 with conc. HNO ₃
Dissolved Silver (6010)	1	500 mlo	Amber glass bottle with teflon cap	Acidify pH < 2 with conc. HNO ₃
Dissolved Gross Alpha/Beta Gamma Spectroscopy	1	1 gal.	Polyethylene	Acidify to pH < 2 with HNO ₃ , Cool to 4°C
Total Dissolved Solids (160.1)	1	500 ml	Polyethylene	Cool to 4°C
Tritium	1	1 liter	Glass Bottle	None

Appendix H.1 RCRA groundwater sampling and analysis methods and results (Continued)

References

- DOE, 1988. Radioactive Waste Management, DOE Order 5820.2A.
- EPA, 1982. Methods for Chemical Analysis of Water and Waste, EPA-600/4-82-005.
- EPA, 1985. Nationwide Occurrence of Radon and Other Natural Radioactivity in Public Water Supplies, EPA 520/5-85-008.
- EPA, 1986. Test Methods for Evaluating Solid Waste, Physical /Chemical Methods, SW-846.
- McArther, R.D., F.L. Miller, 1989. Off-Site Radiation Review Project Phase II, Soils Program, Desert Research Institute, Univ. of Nevada.
- State of Nevada, 1980. Public Water Systems, Nevada Administrative Code, Chapter 445.

Appendix H.1. Upper Aquifer Water Quality Data

Site: Ue5PW-1

Depth of Water Table(Estimated): 2408.51 ft

Indicators of Groundwater Contamination

Parameter	Collection Date	1	2	Replicate	3	4	Mean	Field Blank	Equipment Blank	Holding Time(days)	Detection Limit	Units
pH	17-Sep-92	8.20	8.19	8.12	8.04	8.13				(1)		mmhos/cm
Specific Conductance	17-Sep-92	0.373	0.394	0.390	0.400	0.389				(1)		ug/l
Total Organic Carbon	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	3 - 10	n.d.	n.d.	(2)	1000	ug/l
Total Organic Halogen	17-Sep-92	n.d.	10	n.d.	n.d.	n.d.					10	ug/l

(1) - Parameters determined in the field

(2) - Sample not analyzed

n.d. - not detected

Total and Dissolved Metals

Parameter	Collection Date	Sample	Duplicate	Mean	Field Blank	Equipment Blank	Holding Time(days)	Detection Limit	Units
Total Arsenic	17-Sep-92	<0.008	<0.008	<0.008	n.d.	n.d.	20	0.002	mg/l
Dissolved Arsenic	17-Sep-92	<0.008	<0.008	<0.008	n.d.	n.d.	20	0.002	mg/l
Total Barium	17-Sep-92	0.028	0.028	0.028	<0.005	0.017	20	0.001	mg/l
Dissolved Barium	17-Sep-92	0.023	0.024	0.023	<0.005	0.004	20	0.001	mg/l
Total Cadmium	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	20	0.005	mg/l
Dissolved Cadmium	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	20	0.005	mg/l
Total Chromium	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	20	0.09	mg/l
Dissolved Chromium	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	20	0.09	mg/l
Total Lead	17-Sep-92	<0.002	<0.002	<0.002	n.d.	<0.002	17	0.0007	mg/l
Dissolved Lead	17-Sep-92	<0.002	0.009	0.005	n.d.	n.d.	17	0.0007	mg/l
Total Selenium	17-Sep-92	n.d.	n.d.	n.d.	n.d.	<0.007	18	0.002	mg/l
Dissolved Selenium	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	18	0.002	mg/l
Total Silver	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	20	0.006	mg/l
Dissolved Silver	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	20	0.006	mg/l
Total Mercury	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	16	0.0001	mg/l
Dissolved Mercury	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	16	0.0001	mg/l
Total Iron	17-Sep-92	0.037	0.037	0.037	n.d.	0.013	20	0.008	mg/l
Dissolved Iron	17-Sep-92	n.d.	<0.021	0.010 - 0.013	n.d.	0.013	20	0.008	mg/l
Total Manganese	17-Sep-92	0.20	0.19	0.19	n.d.	n.d.	20	0.003	mg/l
Dissolved Manganese	17-Sep-92	0.18	0.18	0.18	n.d.	n.d.	20	0.003	mg/l
Total Sodium	17-Sep-92	56	57	56	0.8	0.1	20	0.06	mg/l
Dissolved Sodium	17-Sep-92	56	56	56	0.9	<0.1	20	0.06	mg/l

Appendix H.1. Upper Aquifer Water Quality Data (Continued)

Total Dissolved Solids, Anions, Oil and Grease, Pesticides and Herbicides

Parameter	Collection Date	Sample	Duplicate	Mean	Field Blank	Equipment Blank	Analysis		Detection Limit	Units
							Holding Time(days)	Extraction Holding Time(days)		
Total Dissolved Solids	17-Sep-92	337	207	272	191	n.d.	22	NA		mg/l
Fluoride	17-Sep-92	0.9	1	0.9	<0.6	<0.6	22	NA		mg/l
Nitrate (as Nitrate)	17-Sep-92	6.9	7.3	7.1	<0.3	n.d.	22	NA	0.1	mg/l
Chloride	17-Sep-92	10.9	11.1	11.0	<0.9	<1.0	22	NA		mg/l
Sulfate (as Sulfate)	17-Sep-92	34.3	35.6	34.9	<0.5	3.9	22	NA		mg/l
Cyanide	17-Sep-92	<0.004	<0.004	<0.004	<0.004	<0.003	22	NA	0.002	mg/l
Oil and Grease	17-Sep-92	<0.7	<0.7	<0.7	<0.7	<0.7	22	NA	0.7	mg/l
Pesticides										
Endrin	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	11	4	0.1	ug/l
Lindane	17-Sep-92	0.23	0.21	0.22	n.d.	n.d.	11	4	0.05	ug/l
Methoxychlor	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	11	4	0.5	ug/l
Toxaphene	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.a.	11	4	1	ug/l
Herbicides										
2,4-D	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	14	NA	0.5	ug/l
2,4,5-TP Silvex	17-Sep-92	n.d.	n.d.	n.d.	n.d.	n.d.	14	NA	0.25	ug/l

n.d. - not detected

NA - not applicable

Appendix H.1. Upper Aquifer Water Quality Data (Continued)

Radiological Parameters

Parameter	Collection Date	Sample	Uncertainty (2s)	Duplicate	Uncertainty (2s)	Mean	Uncertainty (2s)	Field Blank	Uncertainty (2s)	Equipment Blank	Uncertainty (2s)	Holding Time (days)	Minimum Detectable Concentration	Units
Total Gross Alpha	17-Sep-92	8.3	18	6.3	33	7.3	17	0.1	139	0.1	139	6	0.7	pCi/l
Dissolved Gross Alpha	17-Sep-92	7.0	20	3.9	25	5.4	16	0.1	174	0.1	154	6	0.7	pCi/l
Total Gross Beta	17-Sep-92	6.4	12	6.0	12	6.2	8.5	0.1	422	0.1	1340	6	0.8	pCi/l
Dissolved Gross Beta	17-Sep-92	5.0	14	4.3	16	4.6	11	0.1	747	0.2	338	6	0.8	pCi/l
Tritium	17-Sep-92	-128	93	-129	8.2	-128	7.5	-133	8.8	6.8	146	52	15	pCi/l
Strontium-90	17-Sep-92	0.1	132	0.1	108	0.1	85	0.04	98	0.18	109	74	0.09	pCi/l
Technetium-99	17-Sep-92	1.2	1510	0.01	14000	0.61	135	2.6	4550	(1)	(1)	95	2.7	pCi/l
Iodine-131	17-Sep-92	1.4	150	1.8	182	1.6	112	0.1	917	(1)	(1)	15	1.4	pCi/l
Radium-226	17-Sep-92	0.4	61	0.7	38	0.5	36	0.4	71	3.5	129	118	0.8	pCi/l
Radium-228	17-Sep-92	-0.1	106	0.0		-0.05		-0.2	79	1.3	262	118	0.6	pCi/l
Total Uranium	17-Sep-92	6	26	4	26	5	19	0	26	0.0	0	55	3	ug/l
Plutonium-238	17-Sep-92	0.002	200	0.002	200	0.002	141	0.001	200	0.0	0	39	0.007	pCi/l
Plutonium-239,240	17-Sep-92	0.002	200	0.002	200	0.002	141	0.0		0.004	142	39	0.007	pCi/l

(1) - Sample not analyzed

Appendix H.1. Upper Aquifer Water Quality Data (Continued)

Gamma Spectrometry

Parameter	Collection Date	Sample	% Uncertainty (2s)	Duplicate	% Uncertainty (2s)	Mean	% Uncertainty (2s)	Field Blank	% Uncertainty Equipment Blank (2s)	% Uncertainty (2s)	Holding Time (days)	Minimum Detectable Concentration	Units
Total Potassium-40	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	180	pCi/l
Dissolved Potassium-40	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	180	pCi/l
Total Chromium-51	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	26	pCi/l
Dissolved Chromium-51	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	26	pCi/l
Total Manganese-54	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	14	pCi/l
Dissolved Manganese-54	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	14	pCi/l
Total Iron-59	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	26	pCi/l
Dissolved Iron-59	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	26	pCi/l
Total Cobalt-57	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	12	pCi/l
Dissolved Cobalt-57	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	12	pCi/l
Total Cobalt-60	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	15	pCi/l
Dissolved Cobalt-60	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	15	pCi/l
Total Zinc-65	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	28	pCi/l
Dissolved Zinc-65	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	28	pCi/l
Total Zirconium-95	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	23	pCi/l
Dissolved Zirconium-95	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	23	pCi/l
Total Niobium-95	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	14	pCi/l
Dissolved Niobium-95	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	14	pCi/l
Total Ruthenium-106	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	130	pCi/l
Dissolved Ruthenium-106	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	130	pCi/l
Total Antimony-124	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	16	pCi/l
Dissolved Antimony-124	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	16	pCi/l
Total Antimony-125	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	41	pCi/l
Dissolved Antimony-125	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	41	pCi/l
Total Cesium-134	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	16	pCi/l
Dissolved Cesium-134	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	16	pCi/l
Total Cesium-137	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	14	pCi/l
Dissolved Cesium-137	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	14	pCi/l
Total Barium-140	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	46	pCi/l
Dissolved Barium-140	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	46	pCi/l
Total Lanthanum-140	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	15	pCi/l
Dissolved Lanthanum-140	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	15	pCi/l
Total Europium-152	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	37	pCi/l
Dissolved Europium-152	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	37	pCi/l
Total Lead-212	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	6	pCi/l
Dissolved Lead-212	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	6	pCi/l
Total Bismuth-212	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	6	pCi/l
Dissolved Bismuth-212	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	6	pCi/l
Total Lead-214	17-Sep-92	488	64	<MDC		0 - 488		<MDC			6	6	pCi/l
Dissolved Lead-214	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	6	pCi/l
Total Bismuth-214	17-Sep-92	761	64	425	90	593	52	<MDC			6	6	pCi/l
Dissolved Bismuth-214	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	6	pCi/l
Total Americium-241	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	98	pCi/l
Dissolved Americium-241	17-Sep-92	<MDC		<MDC		<MDC		<MDC			6	98	pCi/l

Appendix H.1. Upper Aquifer Water Quality Data (Continued)

Site: Pilot Well 1/Ue5PW1

Analysis: Volatile Organics

EPA Method: 8240

Collection Date: 17-Sep-92

Analysis Date: 25-Sep-92

Water Table Elevation(Estimated): 2408.51 ft

Compound	CAS Number	Sample	Duplicate	Trip Blank	Field Blank	Equipment Blank	Detection Limit	Units
Chloromethane	74-87-3	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/l
Bromomethane	74-83-9	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/l
Vinyl Chloride	75-01-4	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/l
Chloroethane	75-00-3	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/l
Methylene Chloride	75-09-2	6.B	7.B	7.B	6.B	7.B	5	ug/l
Acetone	67-64-1	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/l
Carbon Disulfide	75-15-0	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
1,1-Dichloroethene	75-35-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
1,2-Dichloroethane	75-34-3	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
1,2-Dichloroethene(Total)	540-59-0	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
trans-1,2-Dichloroethene	540-59-0	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Chloroform	67-66-3	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
1,2-Dichloroethane	107-02-2	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
2-Butanone	78-93-3	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/l
1,1,1-Trichloroethane	71-55-6	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Carbon Tetrachloride	56-23-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Vinyl Acetate	108-05-4	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/l
Bromodichloromethane	75-27-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
1,2-Dichloropropane	78-87-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
cis-1,3-Dichloropropene	10061-01-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Trichloroethene	79-01-6	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Dibromochloromethane	124-48-1	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
1,1,2-Trichloroethane	79-00-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Benzene	71-43-2	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
trans-1,3-Dichloropropene	10061-02-6	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Bromoform	75-25-2	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
4-Methyl-2-pentanone	108-10-1	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/l
2-Hexanone	591-78-6	n.d.	n.d.	n.d.	n.d.	n.d.	10	ug/l
Tetrachloroethene	127-18-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
1,1,2,2-Tetrachloroethane	79-34-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Toluene	108-88-3	n.d.	n.d.	n.d.	n.d.	28	5	ug/l
Chlorobenzene	108-90-7	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Ethylbenzene	100-41-4	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Styrene	100-42-5	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
m,p-Xylene	133-02-7	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l
Xylene(Total)	133-02-7	n.d.	n.d.	n.d.	n.d.	n.d.	5	ug/l

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Appendix H.1. Upper Aquifer Water Quality Data (Continued)

Site: Area 5 Pilot Well 1/Ue5PW1

Analysis: Semi-Volatile Organics

Method: 8270

Collection Date: 17-Sep-92

Extraction Date: 22-Sep-92

Analysis Date: 12-Oct-92

Depth to the Water Table(Estimated): 777 ft. 0.34 in.

Compound	CAS Number	Sample	Duplicate	Field Blank	Equipment Blank	Detection Limit	Units
Phenol	108-95-2	n.d.	n.d.	n.d.	n.d.	10	ug/l
bis(2-Chloroethyl)ether	111-44-4	n.d.	n.d.	n.d.	n.d.	10	ug/l
2-Chlorophenol	95-57-8	n.d.	n.d.	n.d.	n.d.	10	ug/l
1,3-Dichlorobenzene	541-73-1	n.d.	n.d.	n.d.	n.d.	10	ug/l
1,4-Dichlorobenzene	106-46-7	n.d.	n.d.	n.d.	n.d.	10	ug/l
Benzyl alcohol	100-51-6	n.d.	n.d.	n.d.	n.d.	10	ug/l
1,2-Dichlorobenzene	95-50-1	n.d.	n.d.	n.d.	n.d.	10	ug/l
2-Methylphenol	95-48-7	n.d.	n.d.	n.d.	n.d.	10	ug/l
2,2'-oxybis(1-Chloropropane)	108-60-1	n.d.	n.d.	n.d.	n.d.	10	ug/l
bis(2-Chloroisopropyl)ether	39638-32-9	n.d.	n.d.	n.d.	n.d.	10	ug/l
4-Methylphenol	106-44-5	n.d.	n.d.	n.d.	n.d.	10	ug/l
N-Nitroso-di-n-propylamine	621-64-7	n.d.	n.d.	n.d.	n.d.	10	ug/l
Hexachloroethane	67-72-1	n.d.	n.d.	n.d.	n.d.	10	ug/l
Nitrobenzene	98-95-3	n.d.	n.d.	n.d.	n.d.	10	ug/l
Isophorone	78-59-1	n.d.	n.d.	n.d.	n.d.	10	ug/l
2-Nitrophenol	88-75-5	n.d.	n.d.	n.d.	n.d.	10	ug/l
2,4-Dimethylphenol	105-67-9	n.d.	n.d.	n.d.	n.d.	10	ug/l
Benzoic acid	65-85-0	n.d.	n.d.	n.d.	n.d.	50	ug/l
bis(2-Chloroethoxy)methane	111-91-1	n.d.	n.d.	n.d.	n.d.	10	ug/l
2,4-Dichlorophenol	120-83-2	n.d.	n.d.	n.d.	n.d.	10	ug/l
1,2,4-Trichlorobenzene	120-82-1	n.d.	n.d.	n.d.	n.d.	10	ug/l
Naphthalene	91-20-3	n.d.	n.d.	n.d.	n.d.	10	ug/l
4-Chloroaniline	106-47-8	n.d.	n.d.	n.d.	n.d.	10	ug/l
Hexachlorobutadiene	87-68-3	n.d.	n.d.	n.d.	n.d.	10	ug/l
4-Chloro-3-methylphenol	59-50-7	n.d.	n.d.	n.d.	n.d.	10	ug/l
2-Methylnaphthalene	91-57-6	n.d.	n.d.	n.d.	n.d.	10	ug/l
Hexachlorocyclopentadiene	77-47-4	n.d.	n.d.	n.d.	n.d.	10	ug/l
2,4,6-Trichlorophenol	88-06-2	n.d.	n.d.	n.d.	n.d.	10	ug/l
2,4,5-Trichlorophenol	95-95-4	n.d.	n.d.	n.d.	n.d.	50	ug/l
2-Chloronaphthalene	91-58-7	n.d.	n.d.	n.d.	n.d.	10	ug/l
2-Nitroaniline	88-74-4	n.d.	n.d.	n.d.	n.d.	50	ug/l
Dimethylphthalate	131-11-3	n.d.	n.d.	n.d.	n.d.	10	ug/l

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Appendix H.1. Upper Aquifer Water Quality Data (Continued)

Site: Area 5 Pilot Well 1/Ue5PW1

Analysis: Semi-Volatile Organics

Method: 8270

Collection Date: 17-Sep-92

Extraction Date: 22-Sep-92

Analysis Date: 12-Oct-92

Depth to the Water Table(Estimated): 777 ft. 0.34 in.

Compound	CAS Number	Sample	Duplicate	Field Blank	Equipment Blank	Detection Limit	Units
Acenaphthylene	208-96-8	n.d.	n.d.	n.d.	n.d.	10	ug/kg
2,6-Dinitrotoluene	606-20-2	n.d.	n.d.	n.d.	n.d.	10	ug/kg
3-Nitroaniline	99-09-2	n.d.	n.d.	n.d.	n.d.	50	ug/kg
Acenaphthene	83-32-9	n.d.	n.d.	n.d.	n.d.	10	ug/kg
2,4-Dinitrophenol	51-28-5	n.d.	n.d.	n.d.	n.d.	50	ug/kg
4-Nitrophenol	100-02-7	n.d.	n.d.	n.d.	n.d.	50	ug/kg
Dibenzofuran	132-64-9	n.d.	n.d.	n.d.	n.d.	10	ug/kg
2,4-Dinitrotoluene	121-14-2	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Diethylphthalate	84-66-2	n.d.	n.d.	n.d.	n.d.	10	ug/kg
4-Chlorophenyl-phenylether	7005-72-3	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Fluorene	86-73-7	n.d.	n.d.	n.d.	n.d.	10	ug/kg
4-Nitroaniline	100-01-6	n.d.	n.d.	n.d.	n.d.	50	ug/kg
4,6-Dinitro-2-methylphenol	534-52-1	n.d.	n.d.	n.d.	n.d.	50	ug/kg
N-Nitrosodiphenylamine	86-30-6	n.d.	n.d.	n.d.	n.d.	10	ug/kg
4-Bromophenyl-phenylether	101-55-3	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Hexachlorobenzene	118-74-1	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Pentachlorophenol	87-86-5	n.d.	n.d.	n.d.	n.d.	50	ug/kg
Phenanthrene	85-01-8	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Anthracene	120-12-7	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Carbazole	86-74-8	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Di-n-butylphthalate	84-74-2	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Fluoranthene	206-44-0	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Pyrene	129-00-0	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Butylbenzylphthalate	85-68-7	n.d.	n.d.	n.d.	n.d.	10	ug/kg
3,3'-Dichlorobenzidine	91-94-1	n.d.	n.d.	n.d.	n.d.	20	ug/kg
Benzo(a)anthracene	56-55-3	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Chrysene	218-01-9	n.d.	n.d.	n.d.	n.d.	10	ug/kg
bis(2-Ethylhexyl)phthalate	117-81-7	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Di-n-octylphthalate	117-84-0	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Benzo(b)fluoranthene	205-99-2	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Benzo(k)fluoranthene	207-08-9	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Benzo(a)pyrene	50-32-8	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Indeno(1,2,3-cd)pyrene	193-39-5	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Dibenzo(a,h)anthracene	53-70-3	n.d.	n.d.	n.d.	n.d.	10	ug/kg
Benzo(g,h,i)perylene	191-24-2	n.d.	n.d.	n.d.	n.d.	10	ug/kg

n.d. - Not detected

J - Estimated value, less than sample quantitation limit

B - Analyte detected in blank

Appendix H.2 Preliminary General Water Chemistry

Groundwater Investigation Near the RWMS

Jenny B. Chapman
Desert Research Institute
March 16, 1993

The shallow groundwater zone beneath the Radioactive Waste Management Site (RWMS) was studied by collecting groundwater samples from two wells and logging the screened interval of one well. Samples were collected from UE-5c PW-1 and UE-5e PW-3 on January 20, 1993 and PW-1 was logged for temperature and electrical conductivity on the same day. A water sample was also collected from UE-5n, located south of the RWMS, near the Cambrian test site, on February 10, 1993, to investigate infiltration from the Cambrian ditch to the water table. All water samples were submitted for a gross chemical analysis, stable isotopic analysis, and enriched tritium counting. The gross analyses and stable isotopic analyses from the Pilot Wells and gross analysis from UE-5n are presented in this report, the other analyses have not been completed.

Logging and Sample Collection

Logging was performed in PW-1 to determine if there were any variations in temperature and electrical conductivity (EC) with depth that would dictate an optimum sample collection depth or need for multiple samples. The location of the water table is clearly defined by the sharp jump in both temperature and EC on the logs (Figure 1a). Small increases in EC are present both at the top of the water column and bottom of the well (Figure 1b), but otherwise the profile is constant. The increase at the top could be related to minor evaporation at the water surface in the well bore, while the presence of loose fill in the bottom of the well may be contributing dissolved ions to the water at the bottom. The temperature profile is constant throughout the water column (Figure 1b), with the exception of minor cooling at the top, presumably due to heat losses to the cooler atmosphere above the water table. The logging results indicated that one sample from the middle of the water column would be sufficient to characterize water in the wellbore.

Samples were collected from the middle of the saturated screened intervals in PW-1 and PW-3 using a discrete two-liter bailer. This bailer is sealed on the surface and sent downhole closed, only to be opened at the desired sampling horizon. At PW-1, the screen was reported to intercept the saturated zone between 771.6 and 822 ft below land surface (bls). The sample was therefore collected at 800 ft bls, measured from the well stick-up. At PW-3, the screen between 888 and 938 ft bls is in the saturated zone, and the sample was collected 918 ft bls, measured from well stick-up. Field parameters measured on the samples are given in Table 1.

The primary purpose of the sample from UE-5n was to collect water from the top of the saturated zone to determine if tritium from the Cambrian Ditch had infiltrated to the water table. The sample from UE-5n was collected at 720 ft bls. The water level in this well was measured by DRI as 703.9

Appendix H.2 Preliminary General Water Chemistry (Continued)

ft bls, but records show the perforated casing to be between 720 and 730 ft bls, thus the sample was collected at the top of the perforated interval. Samples from all three wells were collected as follows: one liter in a glass bottle with a poly-seal cap for enriched tritium analysis, 125 ml in a glass bottle with a poly-seal cap for carbon-13 analysis, 30 ml in a glass bottle with a poly-seal cap for stable isotopic analysis of hydrogen and oxygen, 500 ml in a plastic bottle for anion analysis, and 250 ml filtered through a 0.45 μ filter and preserved with nitric acid to a pH less than 2.0 for cation analysis.

Table 1. Field Parameters Measured at RWMS Wells

well name	UE-5e PW-1	UE-5e PW-3
sample depth, feet	800	918
collection date, MM-DD-YY	1-20-93	1-20-93
collection time	15:00	18:00
water temperature, °C	18	17
electrical conductivity, μ mhos/cm @ 25°C	394	378
pH, standard units	8.3	8.4
HCO ₃ , mg/L	128	140

Discussion of Analytical Results

The chemical analyses for PW-1 and PW-3 are shown on Tables 2 and 3 and the results from UE-5n are on Table 4. The PW-1 and PW-3 samples are virtually identical in terms of their gross chemistry and can be characterized as sodium bicarbonate waters with a total dissolved solids content of approximately 360 mg/L. All of the samples are saturated with respect to calcite, and several forms of silica and calcium-magnesium silicates. The Pilot Well samples are also saturated with respect to dolomite.

The water chemistry of these samples can be compared to that of nearby groundwater using trilinear plots and Stiff diagrams. The trilinear plot (Figure 2) represents the relative percentages of cations (left triangle) and anions (right triangle) and a combined representation in the middle diamond. The Pilot Well samples clearly have a different ion distribution than the other samples from Area 5. The major difference is a higher proportion of calcium and magnesium, relative to sodium, than most of the other samples. The only wells with greater proportions of calcium and magnesium than the Pilot wells are HTH-3 (completed in carbonates on the east side of Frenchman Flat) and Water Well 4. The Stiff diagrams (Figures 3 and 4), which incorporate the absolute ion concentrations in graphical form, also show the greatest similarity between the chemistry of PW-1, PW-3, and Water Well 4. The other wells, including UE-5n, have a more exclusively sodium bicarbonate composition that evolves from contact with volcanic-derived material.

Appendix H.2 Preliminary General Water Chemistry (Continued)

PW-1, PW-3 and Water Well 4 are located in the northern part of Frenchman Flat (Figure 5), but a sharp change in potentiometric levels between the subbasin containing Water Well 4 and the rest of Frenchman Flat suggests that the Cane Spring Fault hydraulically separates the regions. The chemical similarity between the Water Well 4 and Pilot Well areas may therefore be primarily related to a similarity in alluvial material. Specifically, the chemistry indicates that the water intersected by Water Well 4 and the Pilot Wells has had more contact with carbonate material than water sampled elsewhere in Frenchman Flat. This is most likely to have occurred by percolation through alluvium derived from carbonate rocks: from the CP Hills area north of Water Well 4 and from Nye Canyon east of the RWMS. Though calcium poor, the water in wells from UE-5C south is also at, or close to, saturation with respect to calcite. These waters apparently developed elevated pH values and bicarbonate levels prior to contacting carbonate material, allowing for little calcite dissolution before reaching saturation. Either carbonate material is poorly represented in alluvial material in the west-central part of Frenchman Flat, or the water sampled in this area originated in volcanic terrain to the west rather than by downward percolation.

The stable hydrogen and oxygen isotopic composition of the Pilot Wells (Table 5) is consistent with the deep soil water sampled during the drilling of PW-1. However, it is slightly more enriched than water analyzed previously from Water Well 5B ($\delta D = -110\text{‰}$, $\delta^{18}O = -14.1\text{‰}$), further supporting a difference between the history of water in the saturated zone in the RWMS area and groundwater to the south.

Appendix H.2 Preliminary General Water Chemistry (Continued)

Table 2. Chemical analyses for PW-1 and PW-3

WRC Waterlab

Requested by: Tyler, Scott
Project: DOE Area 5 Soils

Date submitted: 26-Jan-93
File name: 27879ST.dat

Sample #:	27879		27880					
Sample Date:	20-Jan-93		20-Jan-93					
Sample Name:	PW-1 RWMS 800'		PW-3 RWMS 918'					
EC	387		384					
SiO ₂	49.1		39.1					
pH	8.34		8.25					
	mg/l	cpm	mg/l	cpm	mg/l	cpm	mg/l	cpm
HCO ₃	169	2.770	171	2.803				
CO ₃	1.3	0.043						
Cl	10.0	0.282	9.2	0.259				
SO ₄	38.5	0.802	35.3	0.735				
NO ₃	11.0	0.178	14.7	0.237				
Total Anions		4.075		4.034				
Na	56.9	2.475	56.7	2.466				
K	6.62	0.169	6.15	0.157				
Ca	17.6	0.878	18.3	0.913				
Mg	5.83	0.479	5.58	0.459				
Total Cations		4.002		3.996				
Anions/Cations		1.018		1.010				

Appendix H.2 Preliminary General Water Chemistry (Continued)

Table 3. Additional analyses for PW-1 and PW-3

WRC Waterlab

Requested by: Tyler, Scott
Project: DOE Area 5 Soils

Date submitted: 26-Jan-93
File name: 27879ST.dat

Lab # Date	Description	NO ₃ mg/l as N	Br mg/l				
27879 20-Jan-93	PW-1 RWMS 800'	2.49	<0.1				
27880 20-Jan-93	PW-3 RWMS 918'	3.32	<0.1				

Appendix H.2 Preliminary General Water Chemistry (Continued)

Table 4. Chemical analysis for UE-5n

WRC Waterlab

Requested by: Tyler, Scott
Project: DOE Area 5 Soils

Date submitted: 12-Feb-93
File name: 28065ST.dat

Sample #:	28065							
Sample Date:	10-Feb-93							
Sample Name:	UE-5n							
EC	365							
SiO2	41.8							
pH	9.03							
	mg/l	cpm	mg/l	cpm	mg/l	cpm	mg/l	cpm
HCO3	144	2.360						
CO3	24.8	0.827						
Cl	11.4	0.321						
SO4	26.7	0.556						
NO3	1.20	0.019						
Total Anions		4.083						
Na	78.4	3.410						
K	8.96	0.229						
Ca	5.59	0.279						
Mg	1.27	0.104						
Total Cations		4.023						
Anions/Cations		1.015						

Appendix H.2 Preliminary General Water Chemistry (Continued)

Figure 1a. Full logs from PW-1

Figure 1b. Logs in PW-1 saturated zone

Appendix H.2 Preliminary General Water Chemistry (Continued)

- a PW-1 20-Jan-93 (alluvium)
- b PW-3 20-Jan-93 (volcanic)
- c UE-5n 10-Feb-93 (alluvium)
- d Water Well 5B (alluvium)
- e Water Well 5C (alluvium)
- f Well 5A (volcanic)
- g UE-5C Water Well (volcanic)
- h Water Well 4 (volcanic)
- i HTH #3 (carbonate)

Figure 2. Trilinear diagram showing ionic composition of Area 5 groundwater

Appendix H.2 Preliminary General Water Chemistry (Continued)

Figure 3. Stiff diagrams for PW-1, PW-3, UE-5n, and Well 5B

Appendix H.2 Preliminary General Water Chemistry (Continued)

Figure 4. Stiff diagrams for Water Well 4, UE-5c, Well 5A, and Well 5C

Appendix H.2 Preliminary General Water Chemistry (Continued)

Figure 5. Location map for Area 5 wells mentioned in text, and nearby outcrops differentiated by lithology

Appendix H.2 Preliminary General Water Chemistry (Continued)

Table 5. Stable isotopic analysis for PW-1 and PW-3

DRI ISOTOPE LAB

Project: AREA 5

Collaborators: J. CHAPMAN

Request No. 404

Completed: 2/16/93

Account: AREA 5 / AREA 5 CARBON

[illegible][illegible]

Area 5 Pilot Wells

APPENDIX I

Vadose Zone Calibration and Monitoring Data

- I.1 Thermistor Calibration Data
- I.2 Preliminary Temperature Monitoring Data
- I.3 Pressure Transducer Calibration Data
- I.4 Preliminary Pressure Monitoring Data
- I.5 Thermocouple Psychrometer Calibration Data
- I.6 In Situ Thermocouple Psychrometer Monitoring Data

Appendix I.1 Thermistor Calibration Data

The down-hole temperature measurement system and methods used in the Pilot Wells were developed by the U.S. Geological Survey (USGS) for the Department of Energy Yucca Mountain Project (YMP). The USGS approach requires that the thermistors be previously calibrated in a calibration station designed specifically to provide stable temperatures and accurate voltage inputs and outputs. During this calibration, the thermistors are exposed to a known range of temperatures. A multiple regression analysis is then performed on the raw data taken during this calibration process. During the regression analysis, three variables are generated that are specific to each thermistor. After the thermistor is installed in the field and raw data is acquired from them these variables are then applied to the Steinhart and Hart equation:

$$\frac{1}{T} = A + B(\ln R) + C(\ln R)^3$$

where T is the temperature in °K, R the resistance of the thermistor in ohms, and A, B and C are the thermistor-specific coefficients derived from calibration measurements. These coefficients are contained in the following tables. Coefficients of determination (r^2) for each equation/thermistor are summarized in the last column of these tables.

Ue5PW-1 Thermistor Coefficients

Thermistor	A	B	C	r^2
R0011	0.0014718608	0.0002378195	0.0000001043	.99999996
R0012	0.0014713196	0.0002379707	0.0000001034	.99999998
R0013	0.0014700013	0.0002379992	0.0000001025	.99999999
R0014	0.0014694040	0.0002383432	0.0000001010	.99999998
R0015	0.0014705912	0.0002380617	0.0000001028	.99999998
R0016	0.0014722276	0.0002377905	0.0000001023	.99999991
R0017	0.0013037612	0.0002704978	-0.0000000756	.99930399
R0019	0.0014718374	0.0002378550	0.0000001035	.99999984
R0021	0.0014615199	0.0002396920	0.0000000941	.99999997
R0022	0.0014654298	0.0002389685	0.0000000971	.99999993

Appendix I.1 Vadose Zone Monitoring Calibration Data (Continued)

Ue5PW-2 Thermistor Coefficients

Thermistor	A	B	C	r ²
R0033	0.0014193909	0.0002392307	0.0000000925	.99999680
R0034	0.0014598625	0.0002397175	0.0000000956	.99999877
R0035	0.0014651988	0.0002388323	0.0000000997	.99999995
R0036	0.0014634672	0.0002388244	0.0000001008	.99999995
R0037	0.0014645647	0.0002387517	0.0000001006	.99999985
R0038	0.0014641670	0.0002386864	0.0000001006	.99999992
R0039	0.0014660518	0.0002385872	0.0000001009	.99999983
R0040	0.0014636269	0.0002390765	0.0000000965	.99999955
R0041	0.0014651500	0.0002388875	0.0000000990	.99999875
R0042	0.0014562796	0.0002405315	0.0000000890	.99999691

Ue5PW-3 Thermistor Coefficients

Thermistor	A	B	C	r ²
R0023	0.0018368436	0.0001654200	0.0000005210	.99729803
R0024	0.0038278002	-0.0000561224	0.0000000797	.02616878
R0025	0.0017654394	0.0001787222	0.0000004542	.99628745
R0026	0.0019819824	0.0001364998	0.9999996899	.99618157
R0027	0.0017847121	0.0001750307	0.0000004733	.99589254
R0028	0.0018371921	0.0001647015	0.0000005322	.99576966
R0029	0.0018284713	0.0001665486	0.0000005199	.99608363
R0030	0.0017566154	0.0001810695	0.0000004342	.99706751
R0031	0.0018352190	0.0001655690	0.0000005227	.99698065
R0032	0.0017657583	0.0001790292	0.0000004475	.99662401

Appendix I.2 Preliminary Temperature Monitoring Data.

Borehole	Thermistor	Depth (ft)	Ohms	Temperature (°C)
UE5PW-1	R022	100	3018	18.43
	R021	100	3013	18.46
	R019	200	2987	18.65
	R017	200	2981	18.70
	R016	300	*	*
	R015	300	2941	19.00
	R014	500	2826	19.88
	R013	500	2842	19.75
	R012	700	*	*
	R011	700	2719	20.74
UE5PW-2	R033	100	-	-
	R034	100	-	-
	R035	200	3067	18.15
	R036	200	3234	16.92
	R037	300	3017	18.43
	R038	300	3035	18.30
	R039	500	2907	19.25
	R040	500	2916	19.18
	R041	700	2874	19.51
	R042	700	2833	19.83
UE5PW-3	R023	100	2811	20.00
	R024	100	2813	19.98
	R025	200	2844	19.74
	R026	200	2845	19.73
	R027	300	2825	19.89
	R028	300	2825	19.89
	R029	500	2761	20.40
	R030	500	2753	20.47
	R031	689	2716	20.77
	R032	689	2717	20.76

* Thermistor damaged during stemming operations and not operational.

Appendix I.3 Pressure Transducer Calibration Data

Each of the Area 5 RWMS Site Characterization Pilot Wells is instrumented in the vadose zone with five Druck PTX 620 pressure transmitters with ranges of 0-15 psia. One Druck PTX 164 pressure transmitter with a range of 0-100 feet of water is submerged in the water table.

All of the pressure transmitters emplaced in the three Area 5 Pilot Wells were submitted to the REECO Physical Standards and Calibration Facility for calibration. However, the calibration information was not released in what was considered a timely manner. In fact, in some cases calibration sheets were not received until months after the calibration date. As a result, the instruments were irretrievably emplaced in the wells on the calibration technician's word that they were calibrated.

There were numerous discrepancies and errors in the calibration reports from the REECO Physical Standards and Calibration Facility. One calibration sheet was missing, and after contacting the Calibration Lab, they were unable to supply a duplicate. One Calibration Report stated the transmitter model number as "unknown". Another Calibration Report either had the wrong model number, or was calibrated over the wrong pressure range.

As a result, it was decided to rely on the factory certification of the instruments instead of the REECO Physical Standards and Calibration Facility calibration data. The following is a description of the method used to obtain pressure data from the Area 5 RWMS Pilot Well down hole pressure transmitters.

The Druck pressure transmitters use an industry-standard method to transmit pressure data, known as a 4 to 20 milliamp current loop, with a linear output. Basically, the device is provided with a power supply voltage. The device then varies its internal resistance until the current passing through the device is proportional to the pressure the transmitter is exposed to. For example, a 0 to 10 psi transmitter will pass 4 milliamps of current when exposed to 0 psi; and will pass 20 milliamps when exposed to 10 psi. By placing a low resistance resistor in series with the circuit, a voltage drop can be measured across the resistor. Using Ohm's Law, where I is current, E is voltage, and R is resistance, the current passed by the transmitter is calculated.

The transmitter manufacturer, Druck Incorporated, certifies that the instrument leaves their facility with a maximum error of $\pm 0.1\%$ "best straight line" over the full range of the instrument's rated span. The net span of the instruments is 16 milliamps (from 4 to 20). After the current in the loop is determined, a simple proportional calculation will be used to determine the pressure the device is seeing.

Appendix I.4 Preliminary Pressure Monitoring Data

Transmitter	Depth	Volts	Pressure	
			psi	kPa
Ue5PW-1				
382357DJ	100	9.1237	13.36	92.12
308674DJ	200	9.0720	13.26	91.43
397287DK	300	9.0706	13.26	91.43
382368DJ	500	9.1251	13.36	92.12
396624DK	700	*	*	*
393449	submersed	5.2530	40.6 feet of water	
Ue5PW-3				
382375DJ	100	*	*	*
409496DJ	200	9.0374	13.20	91.04
382358DJ	300	9.1382	13.38	92.26
396623DK	500	9.1232	13.36	92.12
397298DK	689	9.1634	13.40	92.39
393447	submersed	5.1095	38.9 feet of water	

* transmitter damaged during stemming operations and not operational.

Appendix I.5 Thermocouple Psychrometer Calibration Data

The thermocouple psychrometry measurement system and methods used in the Pilot Wells were developed by the U.S. Geological Survey (USGS) for the Department of Energy Yucca Mountain Project (YMP). The USGS approach requires that psychrometers be previously calibrated in a calibration station designed specifically to provide stable temperatures and humidities with accurate voltage inputs and outputs. During this calibration, the psychrometers are exposed to a known range of temperatures and humidities. A multiple regression analysis is then performed on the raw data taken during this calibration process. During the regression analysis, six variables are generated that are specific to each psychrometer. After the psychrometer is installed in the field and raw data is acquired from them, these variables are then applied to the following equation to calculate soil water potential:

$$\Psi = A + BV + CV + DVT + ET^2 + FVT^2$$

where Ψ is the soil water potential in bars, V is the delta intercept voltage in microvolts, T is the temperature in $^{\circ}\text{C}$, and A , B , C , D , E and F are the psychrometer-specific coefficients. These coefficients are contained in the following tables. Coefficients of determination (r^2) for each equation/psychrometer are summarized in the last columns of these tables.

Appendix I.5 Thermocouple Psychrometer Calibration Data (Continued)

Ue5PW-1 Thermocouple Psychrometer Coefficients

Psychrometer	A	B	C	D	E	F	r ²
PSY001	0.330131	4.710410	-0.012957	-0.142780	-0.001310	0.001447	.99911305
PSY002	0.410103	4.758865	-0.013675	-0.142876	-0.001372	0.001436	.99930211
PSY003	0.590434	5.330468	-0.009903	-0.173041	-0.001425	0.001902	.99902538
PSY004	0.353170	4.865572	-0.010786	-0.148906	-0.001275	0.001558	.99926720
PSY005	0.085940	4.779917	-0.014293	-0.143423	-0.001234	0.001400	.99934352
PSY006	0.038869	4.771062	-0.003179	-0.133908	-0.000538	0.001395	.99941944
PSY007	0.000224	4.545606	-0.008290	-0.122408	-0.000782	0.001162	.99907334
PSY008	-0.038359	4.998648	-0.015059	-0.156213	-0.001034	0.001682	.99919845
PSY009	0.728378	4.940456	-0.014253	-0.152360	-0.001541	0.001577	.99927610
PSY010	0.185605	4.777737	-0.008086	-0.138769	-0.000821	0.001421	.99928171

Appendix I.5 Thermocouple Psychrometer Calibration Data (Continued)

Ue5PW-2 Thermocouple Psychrometer Coefficients

Psychrometer	A	B	C	D	E	F	r ²
PSY021	-1.443316	4.803186	-0.000094	-0.145245	0.000114	0.001798	.98099766
PSY022	-0.342791	4.764793	-0.010522	-0.153244	-0.001108	0.001789	.99931004
PSY023	0.029991	4.861583	-0.011130	-0.153242	-0.001057	0.001739	.99939553
PSY024	-0.082971	4.637020	-0.009415	-0.142095	-0.000282	0.001618	.99882113
PSY025	-1.336749	4.480305	-0.010469	-0.136911	0.000108	0.001517	.99847585
PSY026	-0.718588	4.988295	-0.007555	-0.161800	-0.000390	0.001942	.99943577
PSY027	0.421188	4.700282	-0.011179	-0.145756	-0.001388	0.001607	.99964693
PSY028	-19.78956	-8.576278	-0.000660	0.839062	0.028180	-0.016000	.77056254
PSY029	0.376722	4.906742	-0.011167	-0.160602	-0.001054	0.001893	.99948773
PSY030	0.188621	4.961155	-0.005726	-0.154976	-0.000545	0.001801	.99952361

Appendix I.5 Thermocouple Psychrometer Calibration Data (Continued)

Ue5PW-3 Thermocouple Psychrometer Coefficients

Psychrometer	A	B	C	D	E	F	r ²
PSY011	-0.391529	5.882157	0.009156	-0.213078	0.000737	0.003040	.98814300
PSY012	-0.251059	4.713352	0.013213	-0.118221	0.000625	0.001314	.99966618
PSY013	0.204857	4.770086	0.007832	-0.123563	0.000120	0.001308	.99953987
PSY014	-0.046448	4.596541	0.005275	-0.119039	-0.000116	0.001251	.99959234
PSY015	0.166865	4.923081	0.013358	-0.127036	0.000175	0.001385	.99918207
PSY016	-0.101569	4.877790	0.000016	-0.140858	-0.000258	0.001562	.99925708
PSY017	-0.474741	4.731203	-0.000737	-0.135140	-0.000140	0.001493	.99901976
PSY018	0.204354	4.689757	0.000719	-0.130063	-0.000383	0.001384	.99912745
PSY019	-0.786761	5.096368	0.006464	-0.145671	0.000831	0.001698	.99895660
PSY020	0.411186	4.921624	0.002790	-0.135104	-0.001132	0.001441	.99949366

Appendix I.6 In situ thermocouple psychrometer monitoring data.

Depth (ft)	Water Potential (bars)		
	UE5PW-1	UE5PW-2	UE5PW-3
100	-17.98	-14.19	-21.80
200	-8.39	-6.75	-10.75
300	-5.18	-4.68	-6.42
500	-3.91	-4.66	-6.27
700	-2.38	-	-