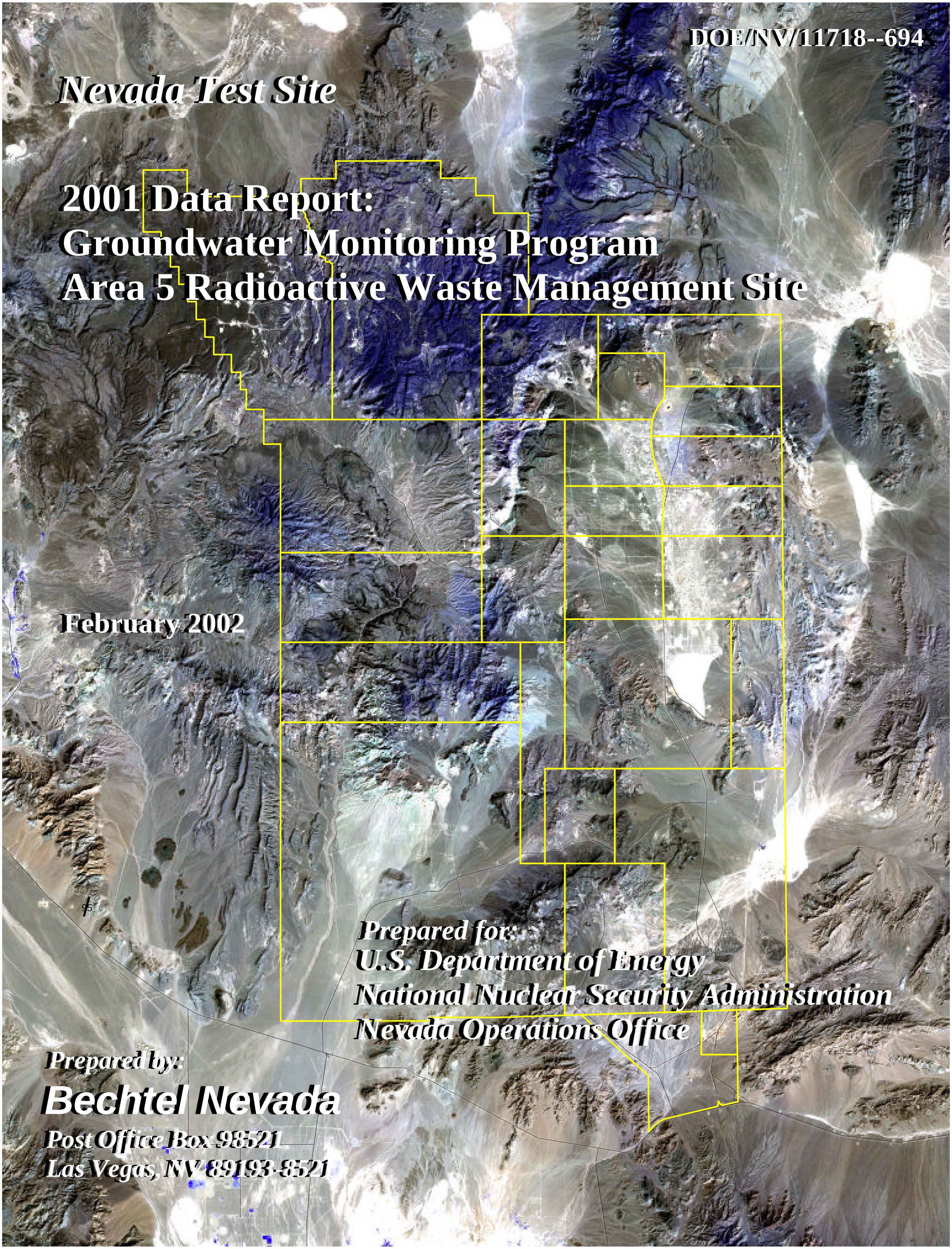

DOE/NV/11718--694

Nevada Test Site

2001 Data Report:
Groundwater Monitoring Program
Area 5 Radioactive Waste Management Site

February 2002

Prepared for:
U.S. Department of Energy
National Nuclear Security Administration
Nevada Operations Office

Prepared by:
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NEVADA TEST SITE

2001 DATA REPORT: GROUNDWATER MONITORING PROGRAM AREA 5 RADIOACTIVE WASTE MANAGEMENT SITE

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Worked Performed Under
Contract No. DE-AC08-96NV11718

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LIST OF ACRONYMS

CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
ERA	Environmental Resource Associates
GEL	General Engineering Laboratories
GW	Groundwater
IL	Investigation Level
MDL	Method Detection Limit
MWDU	Mixed Waste Disposal Unit
NDEP	Nevada Division of Environmental Protection
NTS	Nevada Test Site
RCRA	Resource Conservation and Recovery Act
RWMS	Radioactive Waste Management Site
TOC	Total Organic Carbon
TOX	Total Organic Halogen
VOA	Volatile Analysis

EXECUTIVE SUMMARY

This report is a compilation of the calendar year 2001 groundwater sampling results from the Area 5 Radioactive Waste Management Site (RWMS). Contamination indicator data are presented in control chart and tabular form with investigation levels (ILs) indicated. Gross water chemistry data are presented in graphical and tabular form.

Other information in the report includes, the Cumulative Chronology for Area 5 RWMS Groundwater Monitoring Program, a brief description of the site hydrogeology, and the groundwater sampling procedure.

Wells Ue5PW-1, Ue5PW-2, and Ue5PW-3 were sampled semiannually for the required analytes: pH, specific conductance, major cations/anions, metals, tritium, total organic carbon (TOC), and total organic halogen (TOX). Due to detections of TOC and TOX in some samples collected in 2000, a plan, as approved by the Nevada Division of Environmental Protection (NDEP), was executed to collect an increased number and type of samples in 2001. Results from all samples collected in 2001 were below ILs. These data indicate that there has been no measurable impact to the uppermost aquifer from the Resource Conservation and Recovery Act (RCRA) regulated unit within the Area 5 RWMS and confirm that the detections of TOC and TOX in 2000 were false positives.

There were no major changes noted in the monitored groundwater elevation. There continues to be an extremely small gradient to the northeast with an average flow velocity of less than one foot per year.

Cumulative Chronology for Area 5 RWMS Groundwater (GW) Monitoring Program

Ue5PW-1		Ue5PW-2		Ue5PW-3	
03/20/1990	U.S. Department of Energy (DOE) letter requesting installation of monitoring wells near the Area 5 RWMS.				
03/13/1992	Drilling begins	06/18/1992	Drilling begins	09/16/1992	Drilling begins
06/16/1992	Drilling ends	09/04/1992	Drilling ends	11/09/1992	Drilling ends
09/11/1992	Well Developed				
03/31/1993	GW Sampling	03/24/1993	GW Sampling	04/04/1993	Well Developed
07/06/1993	GW Sampling	03/30/1993	Well Developed	04/14/1993	GW Sampling
		06/22/1993	GW Sampling	06/02/1993	GW Sampling
09/01/1993	GW Sampling	11/15/1993	GW Sampling	10/12/1993	GW Sampling
12/07/1993	GW Sampling			12/20/1993	GW Sampling
12/17/1993	DOE letter to the NDEP requesting to establish pilot wells located in Area 5 as RCRA groundwater monitoring wells.				
		01/19/1994	GW Sampling		
02/24/1994	NDEP letter to DOE stating that the pilot wells appear to meet the applicable design, construction, and development criteria for RCRA groundwater monitoring wells.				
06/15/1994	GW Sampling	06/07/1994	GW Sampling	05/24/1994	GW Sampling
08/01/1994	GW Sampling	11/29/1994	GW Sampling	08/08/1994	GW Sampling
09/30/1994	Submitted to the NDEP the 1993 groundwater monitoring results from quarterly sampling effort.				
01/18/1995	GW Sampling	01/18/1995	GW Sampling	01/18/1995	GW Sampling
02/23/1995	DOE letter to NDEP transmitting Groundwater Monitoring Program Outline.				
03/01/1995	1994 Groundwater Monitoring Report submitted to the NDEP.				
04/04/1995	GW Sampling	04/04/1995	GW Sampling	04/04/1995	GW Sampling
11/09/1995	GW Sampling	11/20/1995	GW Sampling	11/09/1995	GW Sampling
11/09/1995	Ue5PW-1 pump snagged in hole and pulled reel from floor; this resulted in a bent shaft on the reel.				
01/22/1996	Ue5PW-1, 2, and 3 Bennet pump seals replaced.				
03/01/1996	1995 Groundwater Monitoring Report submitted to the NDEP.				
10/25/1996	NDEP letter to DOE requesting clarifications/changes in the GW Monitoring				

Cumulative Chronology for Area 5 RWMS GW Monitoring Program (cont.)

Ue5PW-1		Ue5PW-2		Ue5PW-3	
03/01/1997	Submitted to the NDEP 1996 GW Monitoring Report and revised GW Monitoring Program Outline.				
04/16/1997	GW Sampling	04/16/1997	GW Sampling	04/16/1997	GW Sampling
08/12/1997	NDEP letter to DOE commenting on 1996 GW Monitoring Report/Proposed Outline.				
10/22/1997	The Ue5PW-1 Bennet pump and water level meter while operating simultaneously were lodged in the well casing. Retrieved 10/23/1997.				
10/22/1997	Ue5PW-1, 2, and 3 larger-diameter air lines were installed.				
11/05/1997	GW Sampling	11/05/1997	GW Sampling	11/05/1997	GW Sampling
02/19/1998	1997 GW Monitoring Report submitted to DOE.				
03/01/1998	1997 GW Monitoring Report and new “outline” submitted to NDEP.				
03/31/1998	NDEP letter to DOE stating that they concur on the indicator parameters and ILs submitted in the groundwater monitoring outline.				
05/13/1998	GW Sampling	05/13/1998	GW Sampling	05/13/1998	GW Sampling
06/22/1998	TOX detected in the 05/13/1998 samples and blanks from Ue5PW-1, 2, and 3. Results reported to DOE.				
07/10/1998	A verbal agreement between DOE and NDEP permitted sampling of one well (Ue5PW-1) to confirm no TOX.				
07/29/1998	GW resampling for 5/13/1998 TOX hits.				
09/10/1998	Results from the 07/29/1998 sampling event are nondetect for TOX; therefore the TOX results from the 05/13/1998 sampling event are determined to be false positives.				
09/10/1998	Ue5PW-1, 2, 3 and spare Bennett pumps returned to manufacture for refurbishing.				
09/12/1998	Ue5PW-1, 2, and 3 reels returned to manufacture for new tubing bundles.				
10/28/1998	GW Sampling	10/28/1998	GW Sampling	10/28/1998	GW Sampling
09/12/1998	Ue5PW-1 reel returned to manufacture for repair of exhaust tube. Spare pump returned to manufacture for the repair of a leaky seal.				
02/12/1999	1998 GW Monitoring Report submitted to DOE.				
03/01/1999	1998 Groundwater Monitoring Report submitted to NDEP.				
03/31/1999	Letter from NDEP to DOE requesting statistical analysis of data. Letter also stated that values determined to be false positives through resampling do not need to be presented graphically.				
05/19/1999	GW Sampling	05/19/1999	GW Sampling	05/19/1999	GW Sampling
10/27/1999	GW Sampling	10/27/1999	GW Sampling	10/27/1999	GW Sampling
		12/13/1999	GW resampling for 10/27/1999 TOC hit.		

Cumulative Chronology for Area 5 RWMS GW Monitoring Program (cont.)

Ue5PW-1		Ue5PW-2		Ue5PW-3	
12/27/1999	Results from the 12/13/1999 sampling event at Ue5PW-2 are nondetect for TOC therefore the TOC result from the 10/27/1999 sampling event is determined to be a false positive.				
04/17/2000	Letter from NDEP to DOE stating that future reports do not need to include statistical analyses.				
04/26/2000	GW Sampling	04/26/2000	GW Sampling	04/26/2000	GW Sampling
06/28/2000	Verbally contacted the state to report TOX/TOC hits from April sampling event and agreed that the wells would be resampled in August which would also constituted as the Fall sampling event.				
08/09/2000	GW Sampling	08/09/2000	GW Sampling	08/09/2000	GW Sampling
09/20/2000	DOE contacted NDEP to report TOX hits from August sampling.				
11/07/2000	Letter from NDEP to DOE stating that DOE does not have a valid data set for TOX and possibly TOC and requests a plan to address contamination concerns prior to next sampling event.				
11/20/2000	video log borehole	11/20/2000	video log borehole	11/27/2000	video log borehole
12/20/2000	Transmittal of proposed plan to address contamination issues to NDEP				
01/31/2001	Letter from NDEP to DOE stating that NDEP generally concurs that the plan submitted to determine the cause of elevated TOX and TOC levels is sound.				
03/14/2001	Letter from NDEP to DOE stating that the 2000 Groundwater Monitoring report was received in a timely manner and contains all the data required by 40 CFR 265.94; letter also requests information regarding appendix A data.				
04/19/2001	Letter from DOE responding to NDEP's 3/14/2001 request for information regarding presentation of TOX/TOC data in the 2001 annual report.				
04/30/2001	Letter from NDEP to DOE concurring with the approach to data presentation as outlined by DOE in the 4/19/01 correspondence.				
05/29/2001	GW Sampling	05/29/2001	GW Sampling	05/29/2001	GW Sampling
10/03/2001	GW Sampling	10/03/2000	GW Sampling	10/03/2000	GW Sampling

I. INTRODUCTION

A. Purpose and Scope

This report is a compilation of the calendar year 2001 groundwater sampling results for the Nevada Test Site (NTS) (see Appendix A, Figure A.1 for location) Area 5 Radioactive Waste Management Site (RWMS) as required by Title 40 Code of Federal Regulations (CFR) 265 (CFR, 1999) (see Appendix A, Figures A.2 and A.3 [DOE, 1997; Gonzales, verbal communication] for locations). The Resource Conservation and Recovery Act (RCRA) regulated unit within Area 5 is P03U (see Appendix A, Figure A.4), referred to as Pit 3 Mixed Waste Disposal Unit (MWDU). The Pit 3 MWDU is operated in accordance with RCRA Interim Status standards for the disposal of mixed low-level waste. In addition to providing groundwater monitoring results, this report also includes information regarding site hydrogeology, well construction, and sample collection.

The format of this report was requested by the Nevada Division of Environmental Protection (NDEP) in a letter dated August 12, 1997. The appearance and arrangement of this document has been modified slightly since that date to give the reader additional information and to make the document easier to read. Specifically, the following changes have been made: (1) the "<" notation is used in the raw data tables to indicate a value was less than the method detection limit (MDL); (2) gradient and velocity calculations are presented; (3) data plots are presented in portrait fashion; (4) for the purposes of plotting data, non-detect values are assumed to be equal to one-half of their MDL; and (5) due to the lack of providing meaningful information, summary statistics for parameters dominated by non-detect values are not presented.

B. Objective

The objective of this report is to satisfy the reporting requirements of Title 40 CFR 265.94, as well as the agreements made between the U.S. Department of Energy (DOE) and the NDEP.

C. Site Hydrogeology

The Area 5 RWMS is located in northern Frenchman Flat in the southeast corner of the NTS. Thick, unsaturated alluvial deposits separate the facility from the uppermost aquifer. The alluvial aquifer is present beneath the Area 5 facility and is believed to extend throughout much of the Frenchman Flat basin (International Technology, 1998). Monitoring wells (referred to as pilot wells) Ue5PW-1 and Ue5PW-2 are completed in the alluvial aquifer, while Ue5PW-3 is completed in the Timber Mountain Tuff Aquifer in the northwest corner of the facility. The alluvial and Tertiary Tuff contact occurs at a depth of 600 feet at Ue5PW-3. Well construction details are provided in Appendix A, Figures A.5, A.6, and A.7.

The water from all three monitoring wells is characterized as sodium bicarbonate type waters. The alluvial and tuff aquifers have similar hydrochemistry and groundwater elevation and are believed to be connected, but the connection of these aquifers is an area of current study. Area 5 RWMS hydraulic parameters are presented in Appendix B, Table B.1. Saturated hydraulic conductivity and effective porosity values presented are the mean values from laboratory analysis of the alluvium cores taken from the three pilot wells. Hydraulic conductivity values calculated from slug tests are also in close agreement with values presented in Table B.1. Although Ue5PW-3 is completed in the tuff aquifer, the higher alluvial hydraulic properties are assumed in the groundwater velocity calculation.

Using the hydraulic properties listed in Appendix B, Table B.1, the groundwater flow direction and velocity were calculated. The hydraulic gradient, velocity, and direction values presented in Appendix B, Table B.1 correspond to groundwater elevation measurements made on May 21, 2001. The calculated mean horizontal groundwater flow velocity is less than one foot per year and flows to the northeast (57.6° east of north) in the uppermost aquifer. Details of velocity and direction calculations are given in Appendix C.

Some amount of vertical groundwater flow is thought to occur from the Alluvial Aquifer and Timber Mountain Aquifer to the Lower Carbonate Aquifer; however, this is an area of current study. The Lower Carbonate Aquifer is the regional aquifer that flows from central NTS to the south, where it discharges into Death Valley, California, and into smaller depressions (Amargosa Valley and Ash Meadows) in southwest Nevada (see Appendix A, Figure A.8 [Source of data: Rehfelt, 2001; written communication]). For a more detailed description of the site characteristics, refer to “Revised Area 5 Radioactive Waste Management Site Outline of a Comprehensive Groundwater Monitoring Program,” February 1998 (Bechtel Nevada, 1998).

Appendix A, Figure A.9 presents the monthly precipitation measured at the Area 5 RWMS meteorological tower.

II. MONITORING CRITERIA

The Area 5 RWMS pilot wells have been monitored for compliance since 1993 under Title 40 CFR 265. The groundwater monitoring program has transitioned from monitoring all parameters required by Title 40 CFR 265 to a program that monitors parameters applicable to this particular site. The current program is modeled after the Title 40 CFR 264 detection monitoring program. The analytes listed below were agreed upon by DOE and NDEP to be sampled semi-annually and are divided into groups representing indicators of contamination and general water chemistry parameters. Due to detections of TOC and TOX in some samples collected in 2000, a plan, as approved by the NDEP, was executed to collect an increased number and type of samples in 2001 (Liebendorfer, 2001).

The groundwater sampling procedure is presented in Appendix D. Radiological analyses for 2001 were performed by General Engineering Laboratories (GEL) for the May sampling event, and Sanford Cohen and Associates Southern Environmental

Laboratory for the October event. Non-radiological samples for 2001 were sent to RECRA Environmental, Inc., laboratory in May and October, while GEL was used only in May as a secondary laboratory.

Indicators of Contamination

- pH
- specific conductance
- total organic carbon (TOC)
- total organic halogen (TOX)
- tritium

General Water Chemistry Parameters

- total Ca, Fe, Mg, Mn, K, Na, Si
- total SO_4, Cl, F
- alkalinity

Control charts have been developed for each of the indicator parameters. These charts show the relationship of the results from the groundwater analysis to the investigation level (IL). ILs denote the values which, if exceeded, trigger a monitoring well resampling for that parameter. The intent of using an IL was to replace the need for rigorous statistical analyses, which attempt to identify if contamination has occurred. Statistical analyses are not presented in this year's report, as agreed upon by NDEP in a letter dated April 17, 2000, (Liebendorfer, 2000). ILs for each indicator parameter were negotiated between the DOE and NDEP in 1998 and are listed in Appendix B, Table B.2. The ILs for pH and specific conductance are based on the statistics of data collected from 1993 through 1996. Historic analyses for TOX, TOC, and tritium have reported concentration levels less than the MDL, and therefore statistical methods are not appropriate for determining their ILs. The ILs for TOX and TOC have been set slightly above their MDLs. The tritium IL has been set at 10 percent of the drinking water standard (20,000 pCi/L).

A. pH

Appendix A, Figure A.10 is a time series plot of the mean pH values for wells Ue5PW-1, Ue5PW-2, and Ue5PW-3. All pH values are well within upper and lower ILs and are hydrologically similar. The pH values for Ue5PW-2 and Ue5PW-3 reached a peak in 1994 and then declined over the next two years. Since that time, the pH values have remained relatively constant. A plot of the last two years of data is displayed in Appendix A, Figure A.11. Appendix B, Table B.3 contains actual pH values.

B. Specific Conductance

Appendix A, Figure A.12 presents a time series plot of the mean specific conductance values for wells Ue5PW-1, Ue5PW-2, and Ue5PW-3. All conductance values were below the IL. The plot shows a decrease in conductance from 1993 to 1995 and then an increase to 1996 for all wells. Since 1996, the specific conductance in all wells has remained relatively constant. The last two years of data are plotted in Appendix A, Figure A.13. Appendix B, Table B.4 contains actual specific conductance values.

C. Total Organic Carbon

Prior to calendar year 2001, there have been several instances of reported TOC concentrations above the IL. These occurred in years 1994, 1996, 1999, and 2000. All of these detections had duplicate analyses, which had concentrations less than the IL or MDL. All detections are likely a product of laboratory/field contamination, as subsequent resamplings had reported concentrations less than the IL. Although the April 1996 TOC result is likely a product of laboratory/field contamination, it is presented graphically because the well was not resampled specifically to confirm the result (resampling procedure was established in 1998).

To assess analytical precision and accuracy, performance evaluation samples were prepared by Environmental Resource Associates (ERA) and submitted for analysis along with the field samples collected in 2001. The results of these samples indicate that the recovery ranged from 97-124 percent for spiked samples, while all blank samples were reported as all non-detects. Results for these, as well as other performance evaluation samples submitted during 2001, are presented in Appendix E.

To aid in describing this year’s sampling events, results from calendar year 2001 field samples are presented in Table 1.0 below. Four replicate samples were collected and sent to both RECRA Laboratory and GEL for the May event. All results were below ILs. Three replicates were collected in October and sent only to RCRA Laboratory, with all results less than the IL and MDL. These results are consistent with the data received

Table 1.0 TOC Results (mg/L) - 2001

Sample IL= 1 mg/L	May RECRA MDL = 0.5	May GEL MDL = 0.04	October RECRA MDL = 0.5
Ue5PW-1	<0.5	0.54	<0.5
Ue5PW-1 field dup	<0.5	0.48	<0.5
Ue5PW-1 field dup	0.52	0.47	<0.5
Ue5PW-1 field dup	<0.5	0.48	n/a
Ue5PW-2	<0.5	0.58	<0.5
Ue5PW-2 field dup	<0.5	0.44	<0.5
Ue5PW-2 field dup	<0.5	0.47	<0.5
Ue5PW-2 field dup	<0.5	0.36	n/a
Ue5PW-3	0.6	0.47	<0.5
Ue5PW-3 field dup	<0.5	0.67	<0.5
Ue5PW-3 field dup	<0.5	0.46	<0.5
Ue5PW-3 field dup	<0.5	0.52	n/a

from samples collected for volatile and semi-volatile analyses and indicate that prior detections of TOC are false positives and that TOC is not present in the uppermost aquifer above ILs.

Appendix A, Figure A.14 presents a time series plot of the mean TOC values (note that non-detect values are presented as being equal to one-half of their MDL). Results confirmed as false positives by resampling are not displayed graphically per NDEP request (Liebendorfer, 1999). Appendix A, Figure A.15 presents TOC values over the last two years. Appendix B, Table B.5 contains actual TOC values.

D. Total Organic Halogen

Detections of TOX have been reported in samples collected in 1998 and 2000. The May 1998 sampling event had six samples with reported concentrations above the IL. A verbal agreement between DOE and NDEP on July 10, 1998, resulted in the resampling of one well (Ue5PW-1) to ensure that TOX was not present. Results from the resampling of Ue5PW-1 were below the MDL for TOX, confirming the May 1998 results as false positives. Detections above the IL in 2000 were reported by the RECRA Laboratory in both the April and August sampling events, which served as the resampling of April and second semi-annual 2000 sampling as negotiated verbally with NDEP. However, Barringer Laboratories was used as a secondary laboratory in August and reported all TOX values below the IL and many below the MDL. To investigate these discrepancies, a plan was submitted to and approved by NDEP (Leibendorfer, 2001) outlining DOE’s course of action. This plan included the use of spiked and blank samples to assess analytical precision and accuracy. These samples were prepared by ERA and submitted for analysis along with the field samples collected in 2001. The results of these samples indicate that the recovery ranged from 48-81 percent for spiked samples, while all but one of the blank samples were reported as non-detects. Results for these, as well as other performance evaluation samples submitted during 2001, are presented in Appendix E.

To aid in describing this year’s events, results from calendar year 2001 field samples are presented below in Table 2.0. Four replicate samples were collected and sent to both RECRA Laboratory and GEL for the May event. All results were below the IL and MDL. Three replicates were collected in October and sent only to RECRA Laboratory, with all results less than the IL and MDL. These results are consistent with the data received from samples collected for volatile and semi-volatile analyses and indicate that prior detections of TOX are false positives and that TOX is not present in the uppermost aquifer above ILs.

Appendix A, Figure A.16 presents a time series plot of the mean TOX values (note that non-detect values are presented as being equal to one-half of their MDL). The false positives (above the IL) discussed above are not displayed graphically per NDEP request (Liebendorfer, 1999). Appendix A, Figure A.17 presents data collected over the last two years. Appendix B, Table B.6 contains actual TOX values.

Table 2.0 TOX Results (ug/L) - 2001

	May		October
Sample IL = 50 ug/L	**RECRA** MDL = 12	**GEL** MDL = 2.9	**RECRA** MDL = 5.2
Ue5PW-1	<12	<10[1]	<5.2
Ue5PW-1 field dup	<13.3	<10[1]	<7.4
Ue5PW-1 field dup	<13.3	<10[1]	<5.8
Ue5PW-1 field dup	<12	<10[1]	n/a
Ue5PW-2	<12	<10[1]	<5.8
Ue5PW-2 field dup	<12	<10[1]	<5.8
Ue5PW-2 field dup	<12	<10[1]	<5.8
Ue5PW-2 field dup	<12	<10[1]	n/a
Ue5PW-3	<12	<10[1]	<5.2
Ue5PW-3 field dup	<12	<10[1]	<5.2
Ue5PW-3 field dup	<12	<10[1]	<5.2
Ue5PW-3 field dup	<12	<10[1]	n/a

[1] Laboratory reported result as less than required detection level of 10µg/L; the actual MDL achieved for the analyses was 2.9 µg/L.

E. Tritium

A time series plot of the mean sample values for tritium is presented in Appendix A, Figure A.18. To plot these data on the vertical log scale requested by NDEP, all negative values were set at 0.001 pCi/L. All tritium results are below the IL and most are below the MDL. The November 1993 sample for Ue5PW-2 is not presented on the graph because the standard, not the enriched analysis was performed. The variability over time, in Appendix A, Figure A.18, may be attributed to the variability of the analytical method (counting statistics and activity of background subtraction) and the enrichment process. Appendix A, Figure A.19 presents data collected over the last two years. Appendix B, Table B.7 contains actual tritium values.

F. General Water Chemistry Parameters

General water chemistry measurements were made to assess the water's gross chemistry, suitability for human consumption, and to evaluate aquifer characteristics such as aquifer continuity and hydraulic connection between wells. Due to the laboratory erroneously acidifying the anion samples for the May sampling, there are no anion data presented for this sampling event. Cl, F, Fe, Mn, and SO_4 concentrations were all below National Secondary Drinking Water Standards. A piper diagram showing the concentrations of the major cations and anions from the last two year's sampling events is included as Appendix A, Figure A.20 and indicates that the water from all three wells is sodium bicarbonate type waters. Stiff diagrams from each sampling event, from the last two years, are also included as Appendix A, Figure A.21, to illustrate water composition differences and similarities. Additionally, a charge balance error of less than ±9 percent was achieved at each well for the August 2001 sampling event. Groundwater temperature at the time of sample collection ranged from

19.2 - 21.9 °C at all three wells, for the May and August sampling events. Temperature data were collected at the ground surface in a flow-through cell and may have been influenced slightly by the ambient air. Raw data with summary statistics are presented in Appendix B, Tables B.8, B.9, and B.10. Visual inspection of graphical data indicate that the water geochemistry from the three wells is similar, and there is no significant change of the gross groundwater chemistry over time.

G. Groundwater Elevation

Water table elevations were measured with an electronic water level tape three times and once with a submersible transducer during calendar year 2001 to determine the hydraulic gradient. The water level tape measurements are subject to a total error of 0.16 feet (Bechtel Nevada, 1998). The approximate depth to groundwater at Ue5PW-1, Ue5PW-2, and Ue5PW-3 is 772 feet, 842 feet, and 891 feet, respectively. Plots of groundwater elevation corrected for borehole deviation, with time, are presented in Appendix A, Figure A.22. Appendix B, Table B.11 lists all of the groundwater elevation data from the three wells. Appendix A, Figure A.23 presents a time series plot of mean groundwater velocity and flow direction. This plot suggests the flow velocity has remained constant, while the flow direction has become slightly more easterly with time. Additionally, due to the flatness of the water table, small changes in elevation produced large changes in the calculated flow direction. Details for the gradient and velocity calculations are given in Appendix C.

H. Other Parameters

As part of the Nevada Test Site Routine Radiological Environmental Monitoring Plan activities, Ue5PW-1, Ue5PW-2, and Ue5PW-1 were sampled for gross alpha, gross beta, gamma emitters, and isotopic plutonium. Gross alpha and gross beta results were below National Primary Drinking Water Standards. Gamma spectroscopy and isotopic plutonium results were all within the 2 sigma counting error of their MDLs.

III. SUMMARY

There have been no significant changes detected in the chemistry of the uppermost aquifer. Indicator parameters were well within established ILs. Due to the detection of TOC and TOX in some samples collected in 2000, an increased number and type of samples were collected in 2001. All data collected indicate that the detections of TOC and TOX in field samples during 2000 were false positives. Hydrologic conditions within the uppermost aquifer below the Area 5 RWMS were stable, with groundwater flow continuing to the northeast at a velocity of less than one foot per year.

IV. CONCLUSION

There has been no measurable impact to the uppermost aquifer from the RCRA regulated unit within the Area 5 RWMS.

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VI. DISTRIBUTION

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Appendix A

Figures

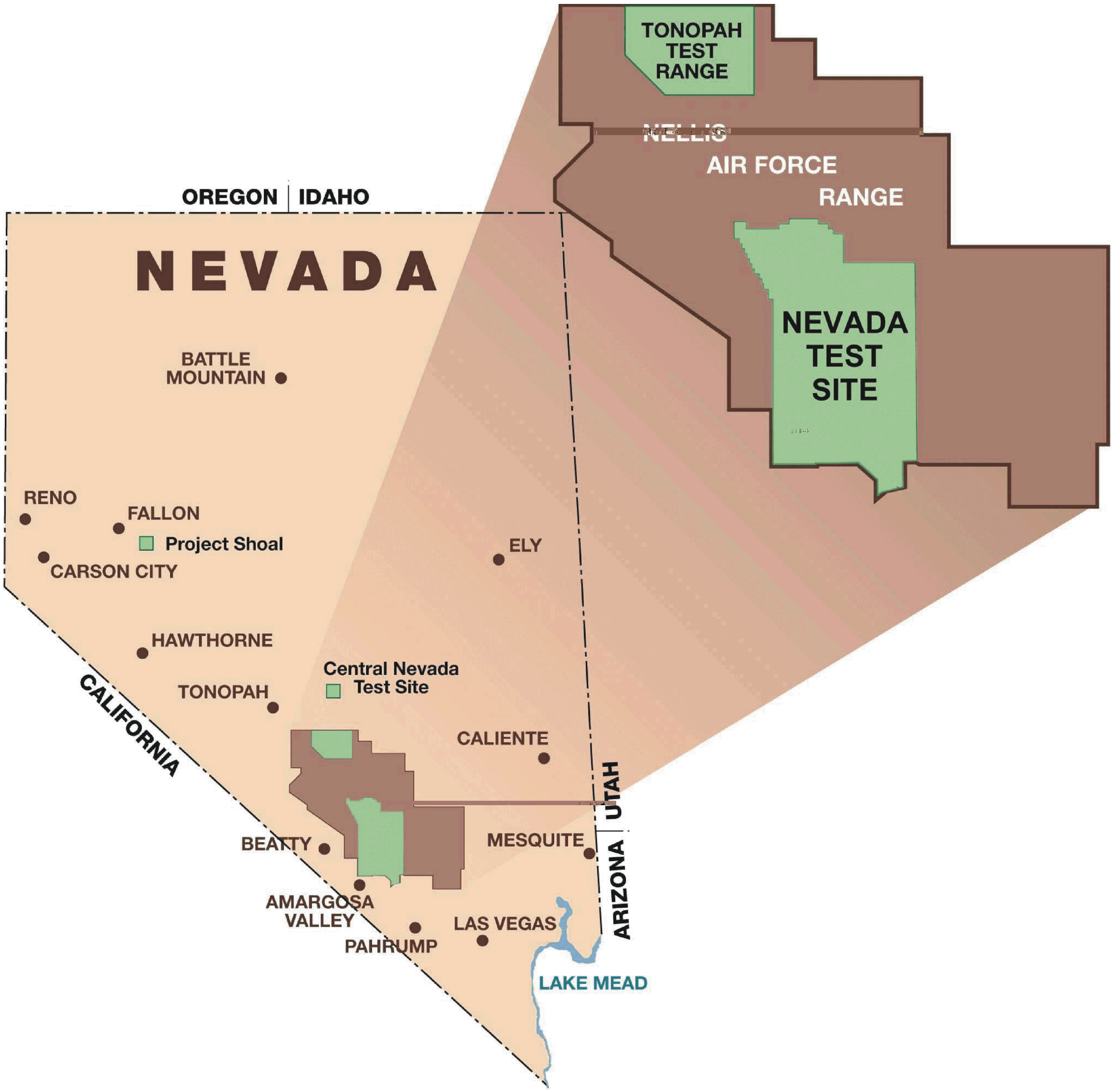

Figure A.1 Location of the Nevada Test Site within Nevada

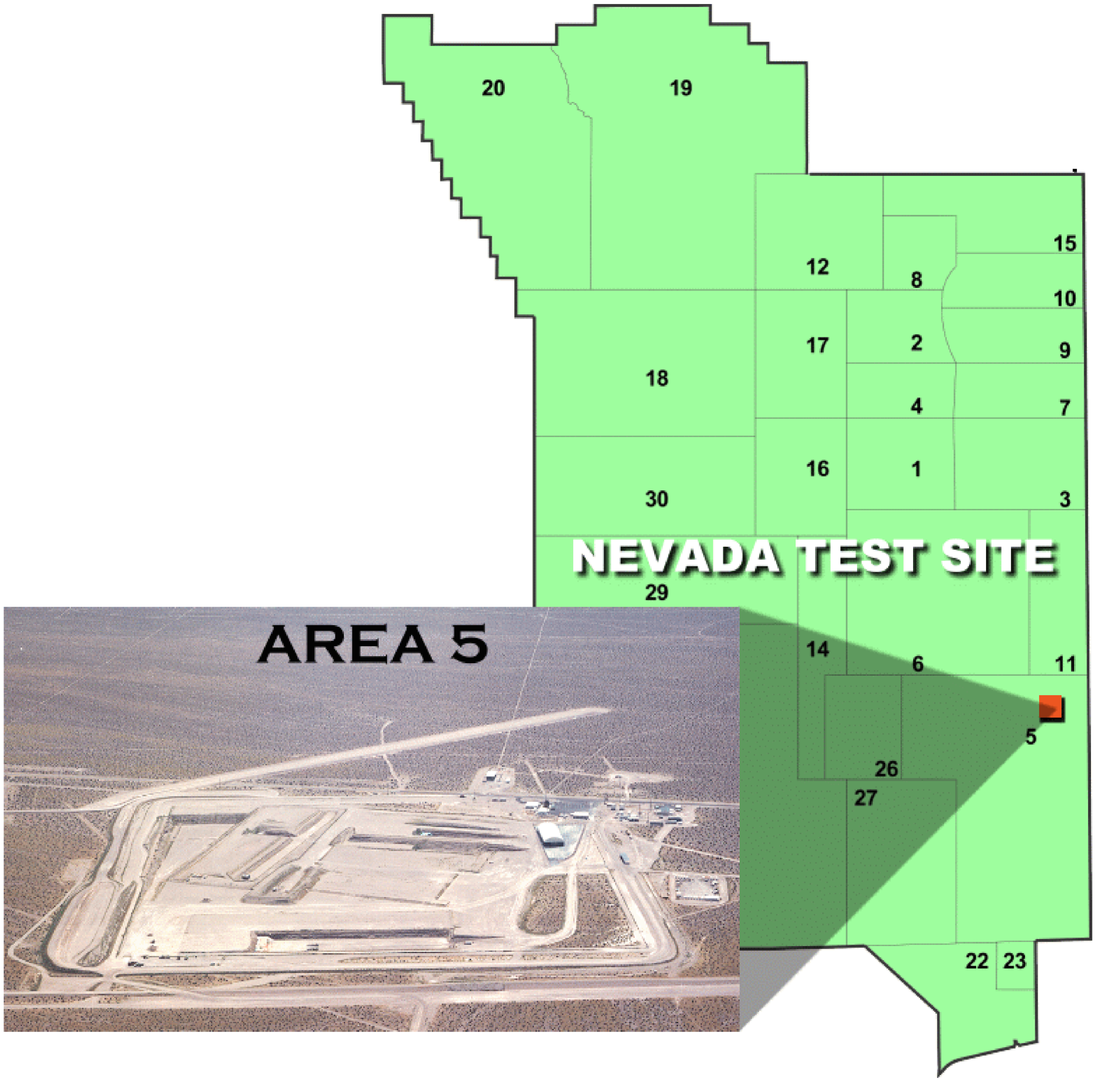

Figure A.2 Location of the Area 5 RWMS within the Nevada Test Site

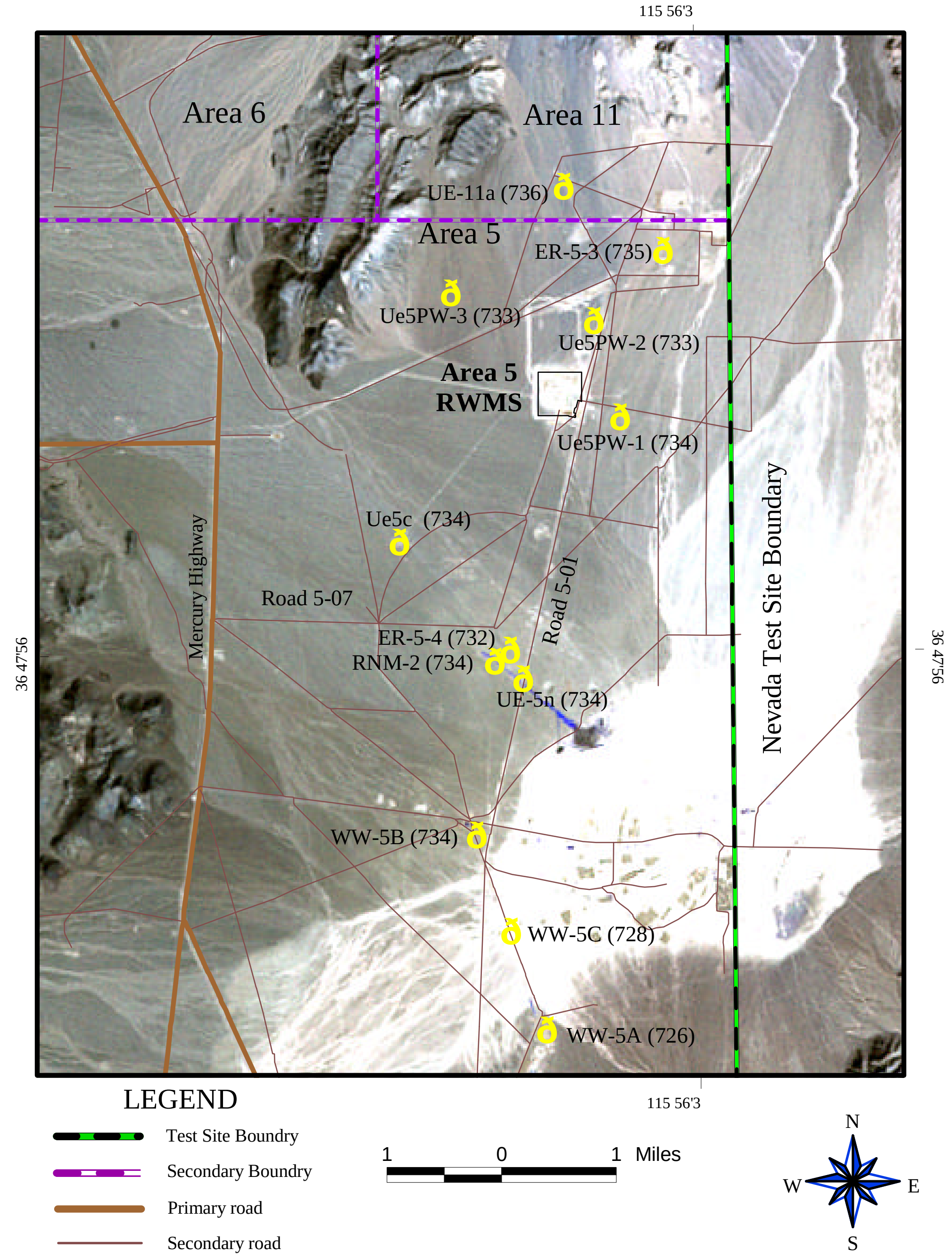

Figure A.3 Locations and Average Water Levels of RWMS Groundwater Monitoring Wells and other Wells in the Vicinity in Meters above Mean Sea Level (DOE, 1997)

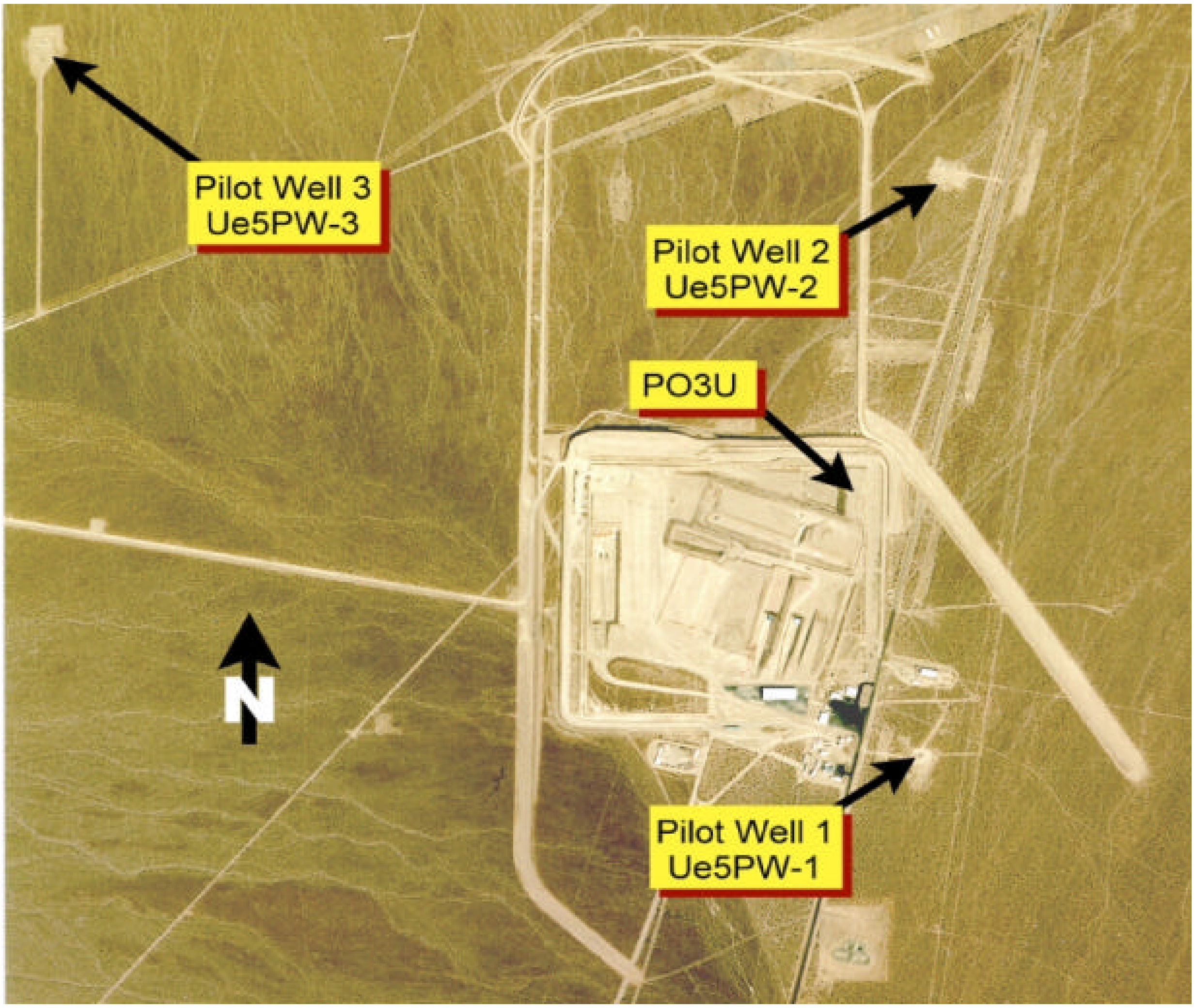

Figure A.4 Location of P03U within the Area 5 RWMS

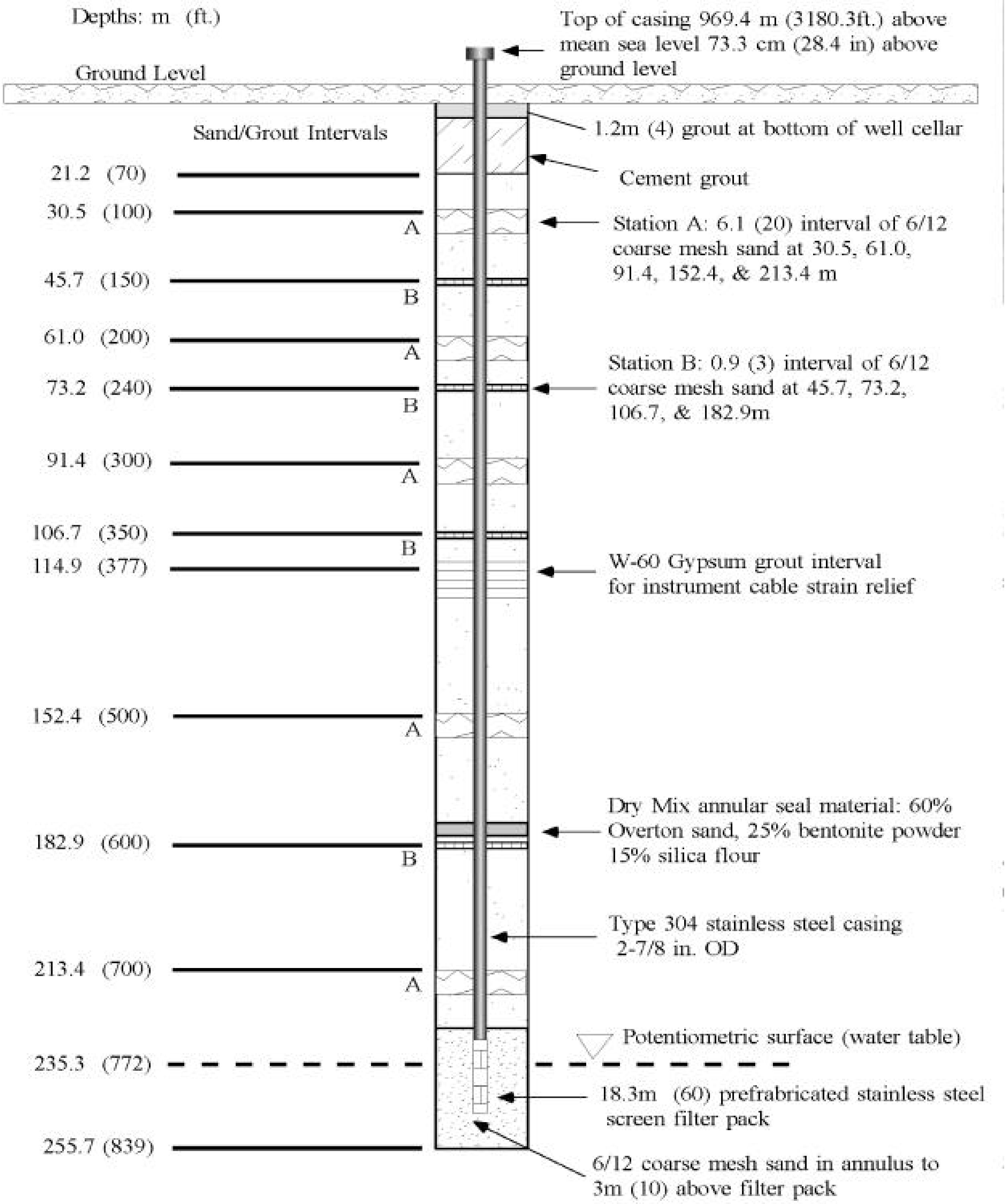

Figure A.5 Completion Detail for Ue5PW-1 (Note: Entire well in alluvium)

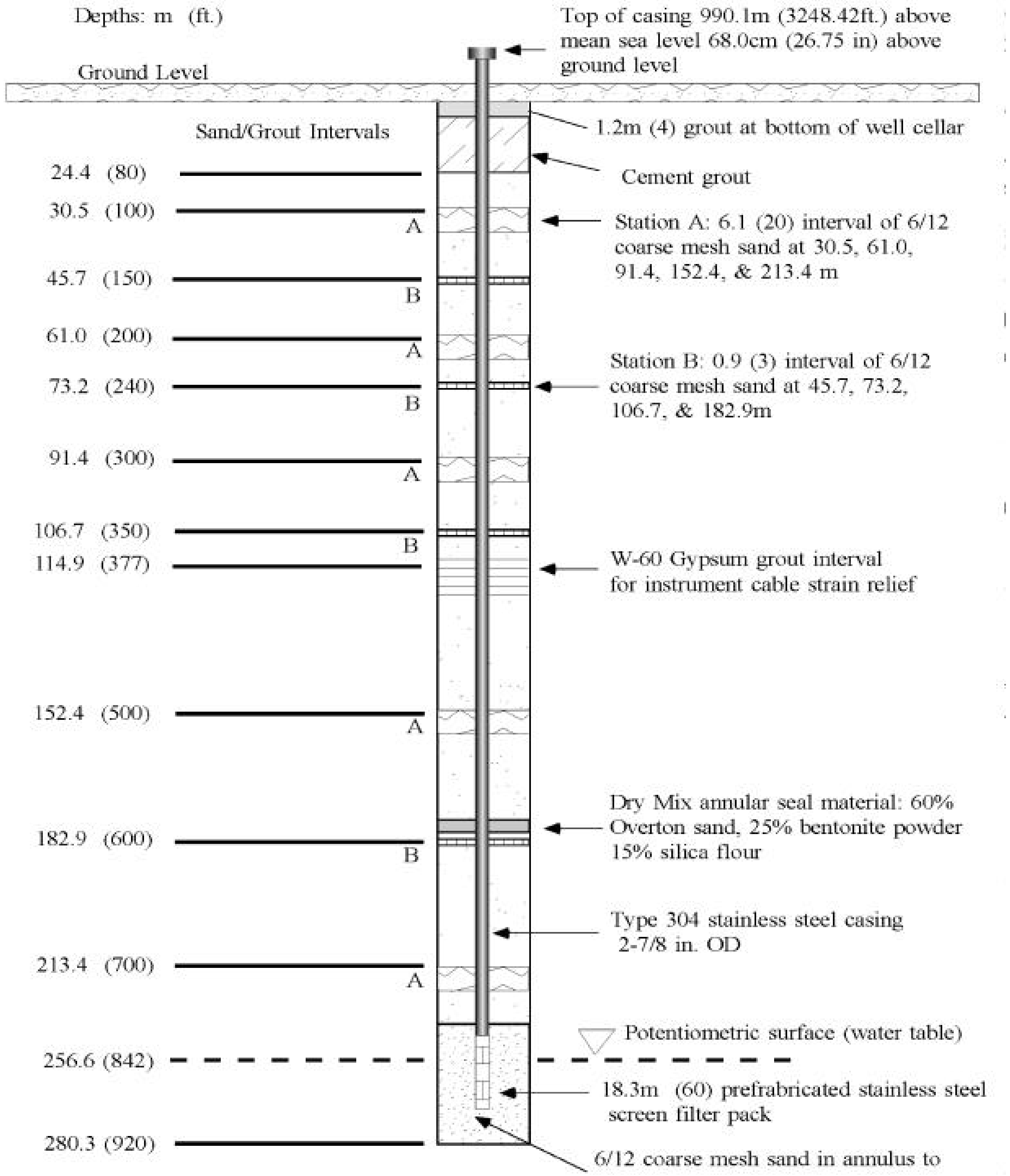

Figure A.6 Completion Detail for Ue5PW-2 (Note: Entire well in alluvium)

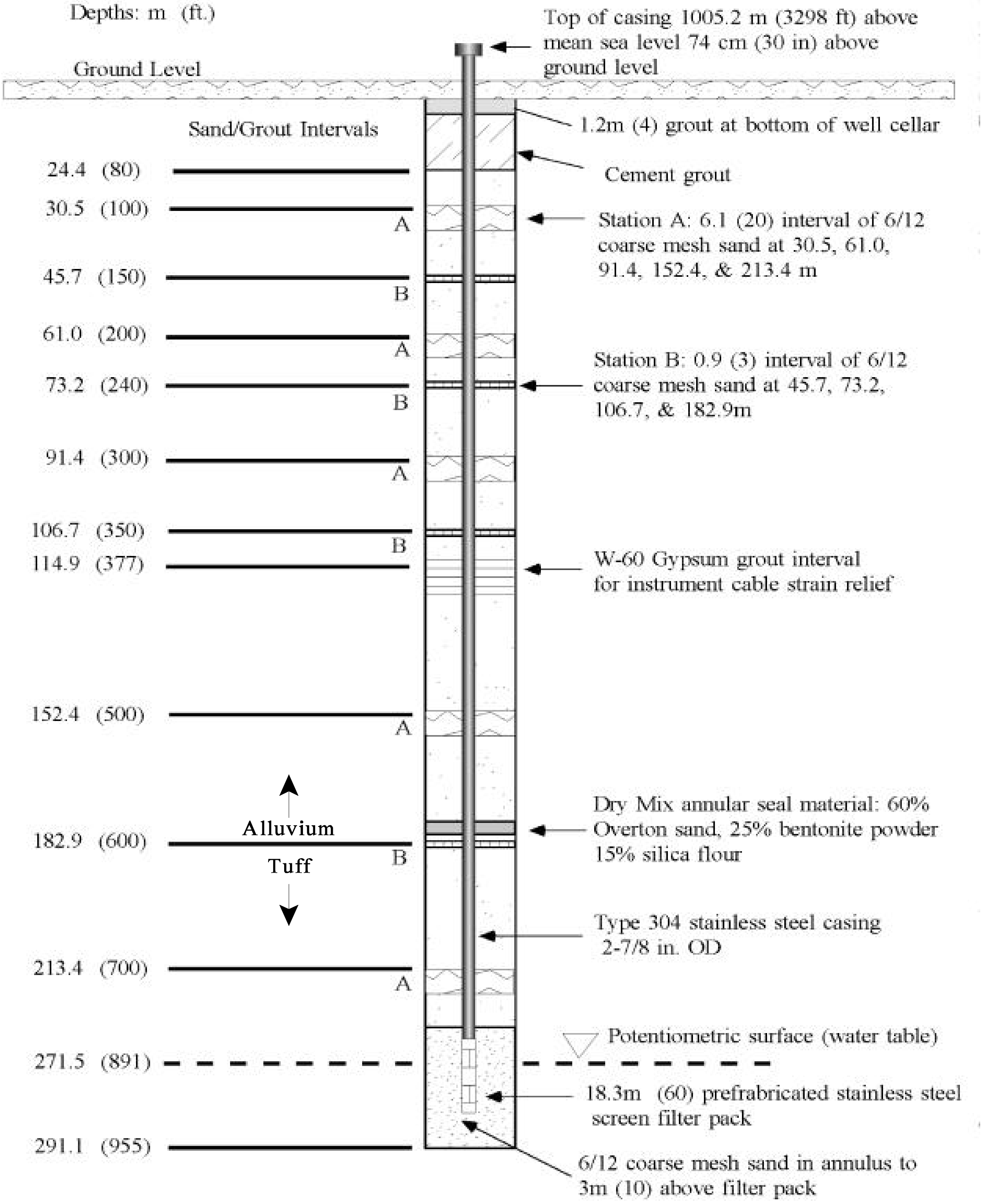

Figure A.7 Completion Detail for Ue5PW-3

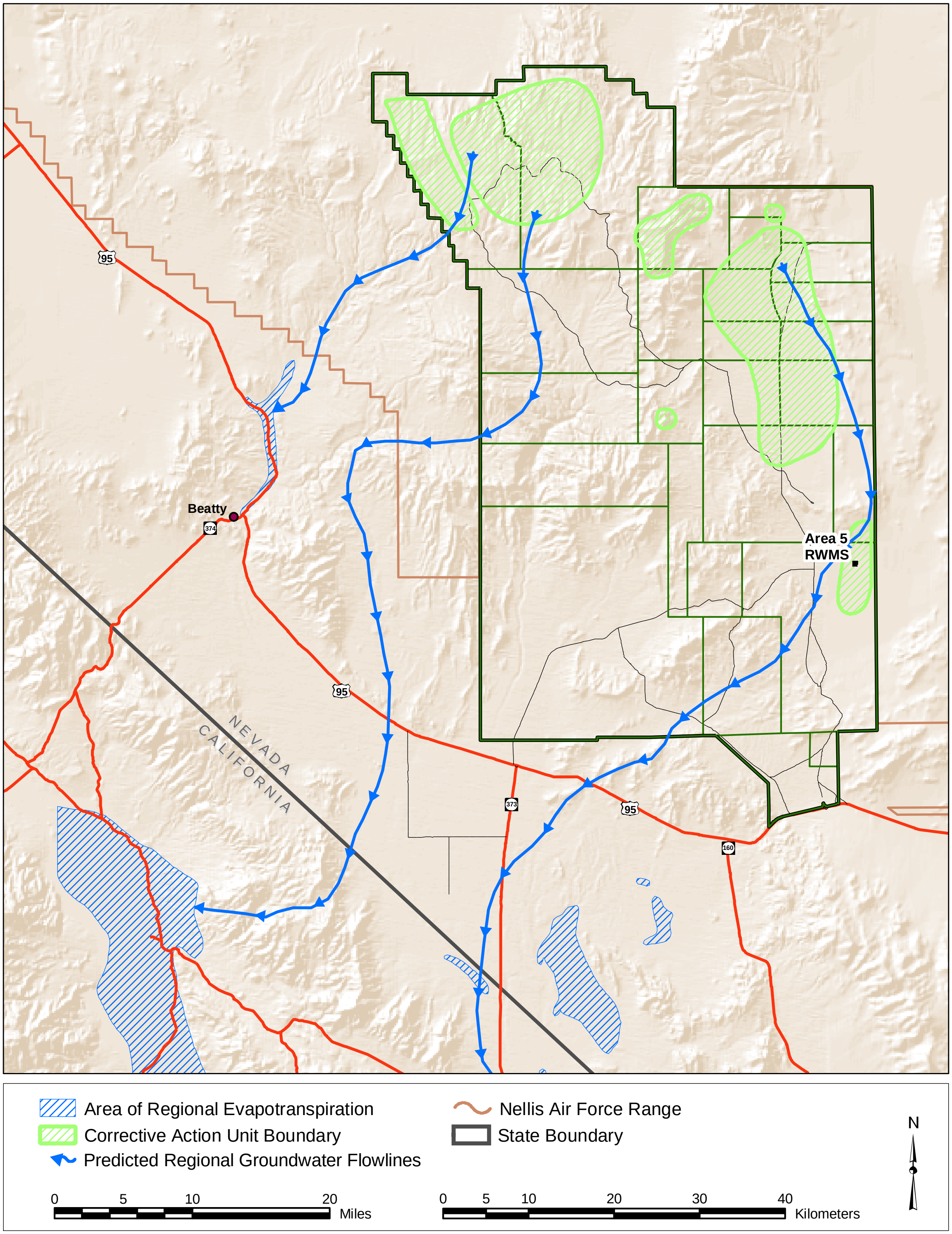

Figure A.8 Nevada Test Site Predicted Regional Groundwater Flow Lines (Rehfelt, 2001)

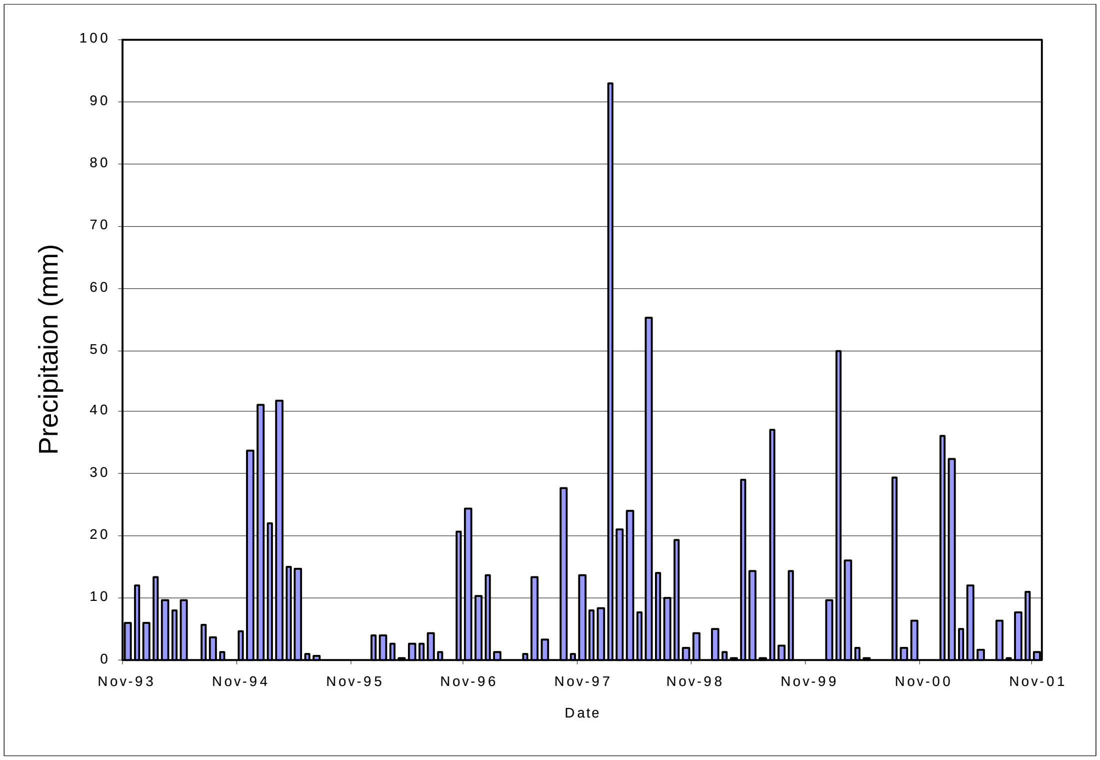

Figure A.9 Area 5 RWMS Monthly Precipitation

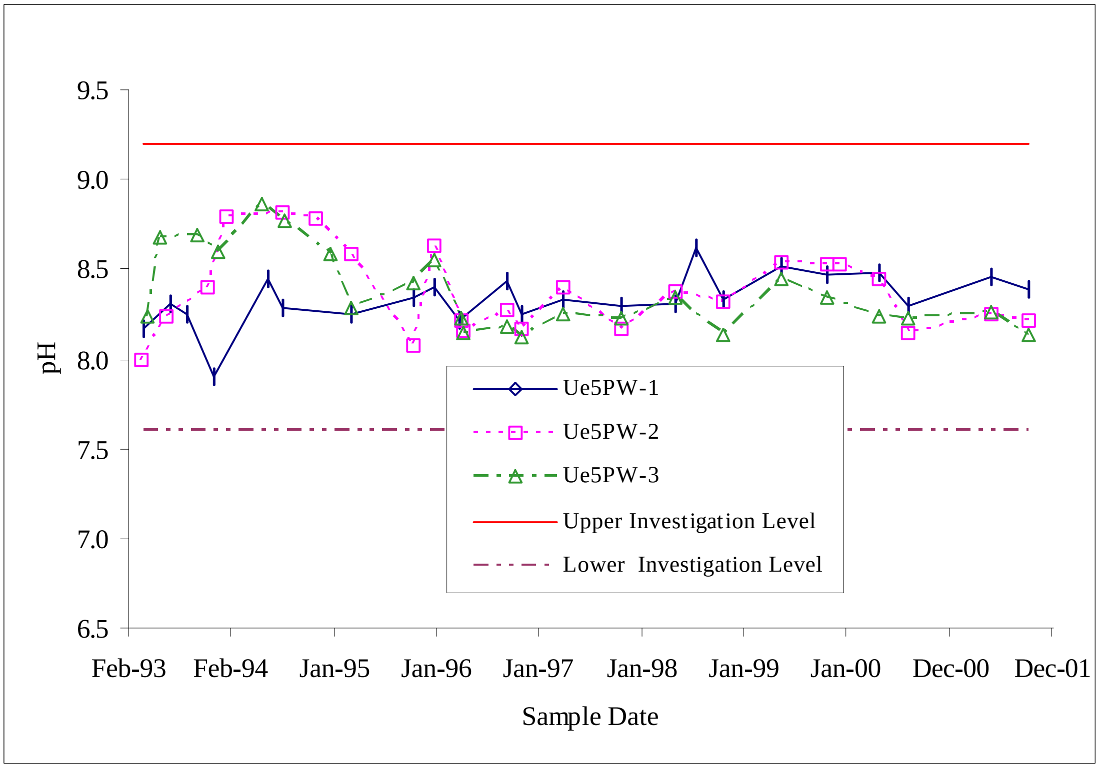

Figure A.10 Area 5 RWMS Time Series Plot of pH

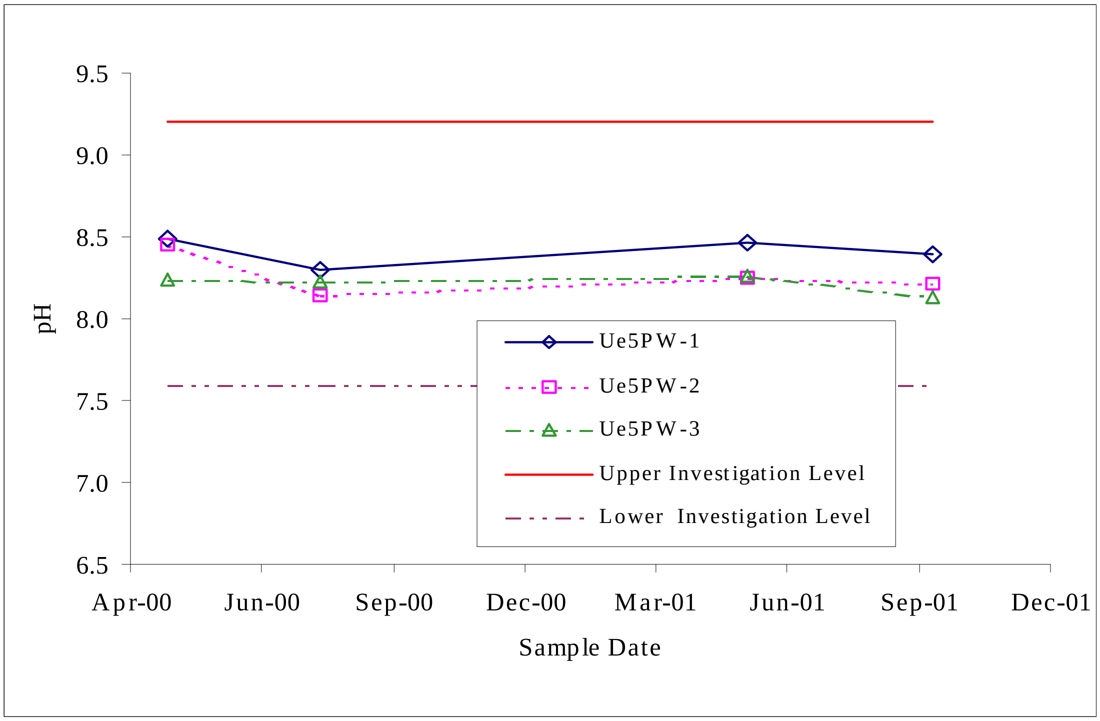

Figure A.11 Area 5 RWMS Two-Year Plot of pH

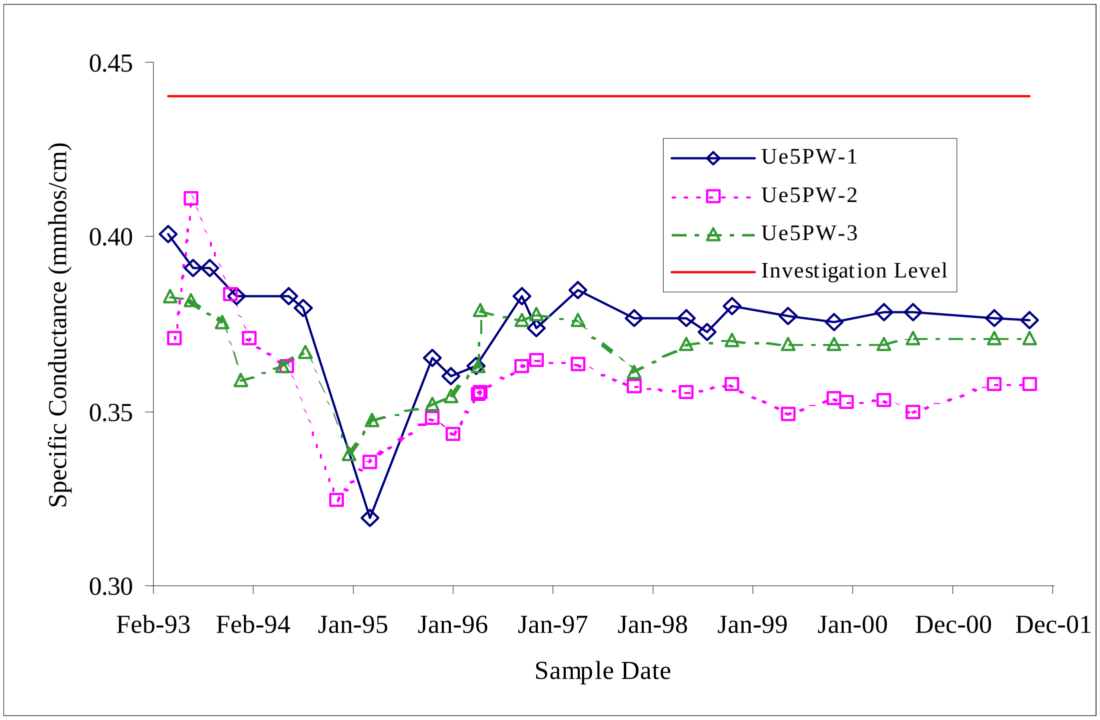

Figure A.12 Area 5 RWMS Time Series Plot of Specific Conductance

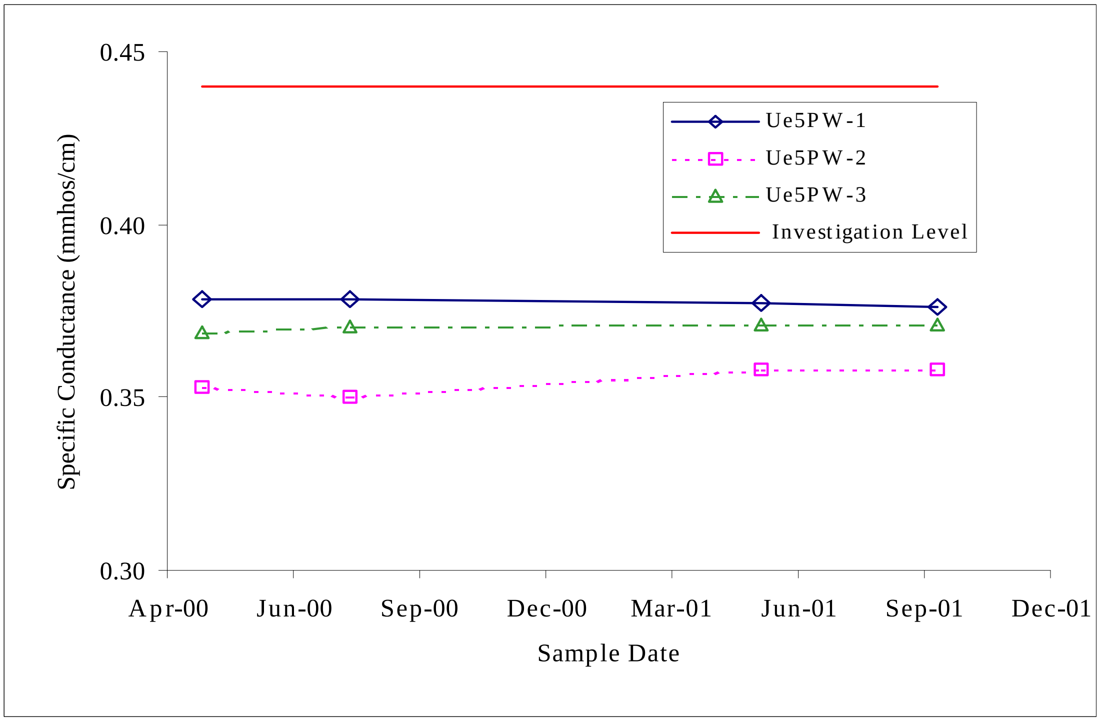

Figure A.13 Area 5 RWMS Two-Year Plot of Specific Conductance

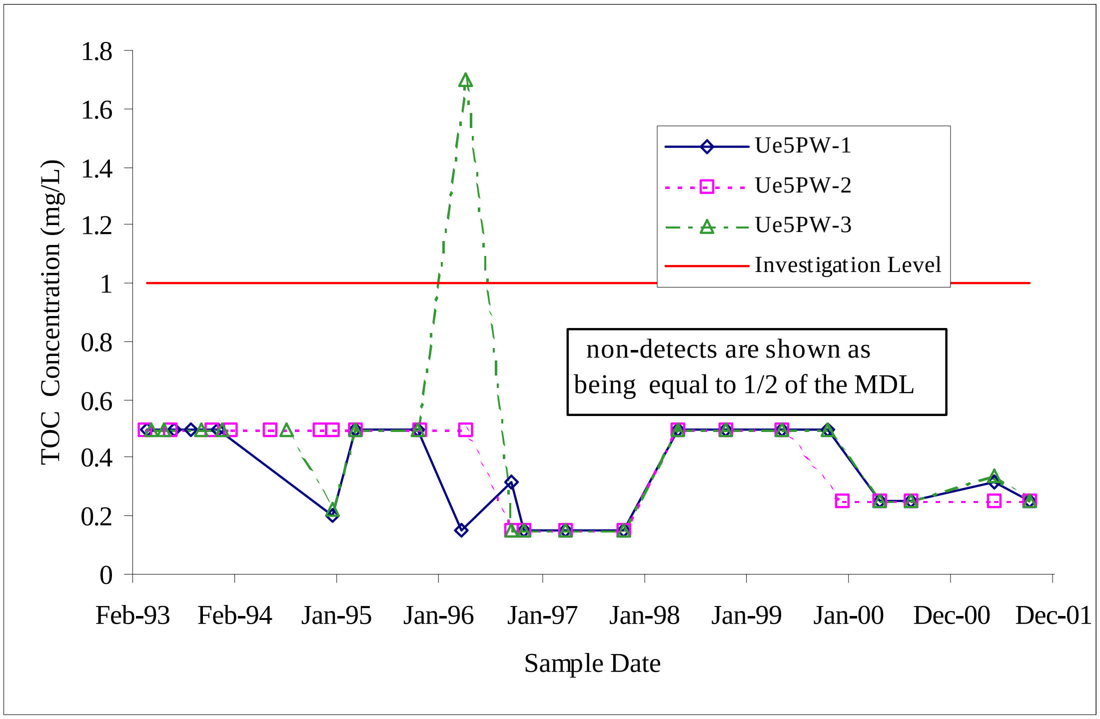

Figure A.14 Area 5 RWMS Time Series Plot of Total Organic Carbon

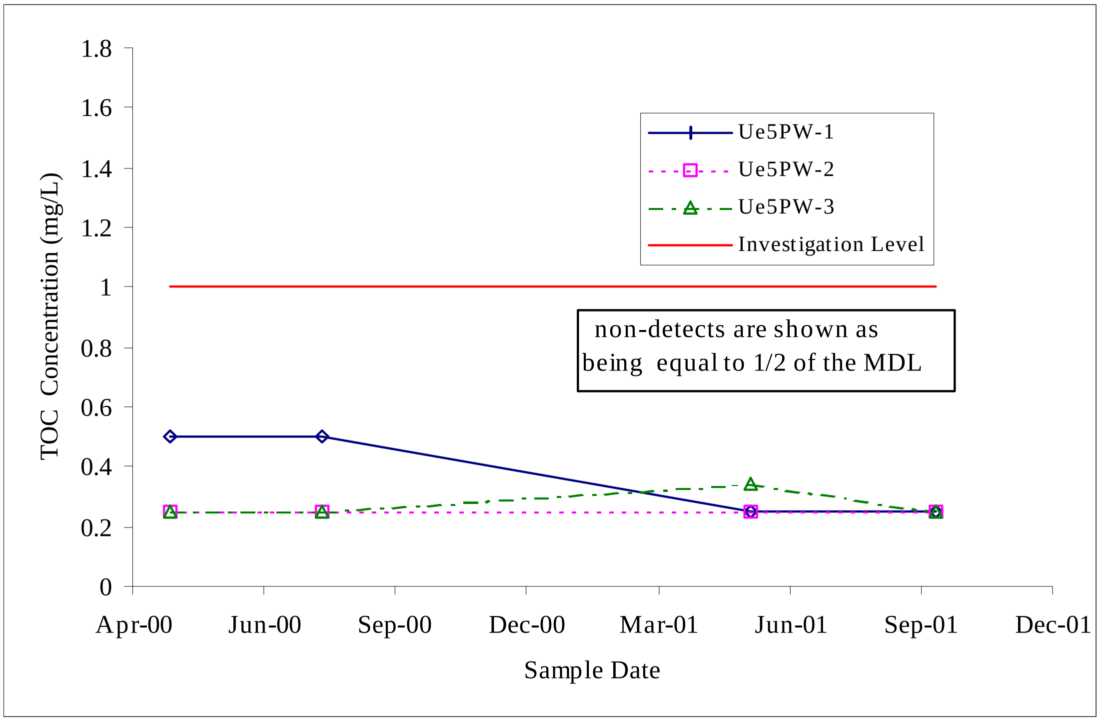

Figure A.15 Area 5 RWMS Two-Year Plot of Total Organic Carbon

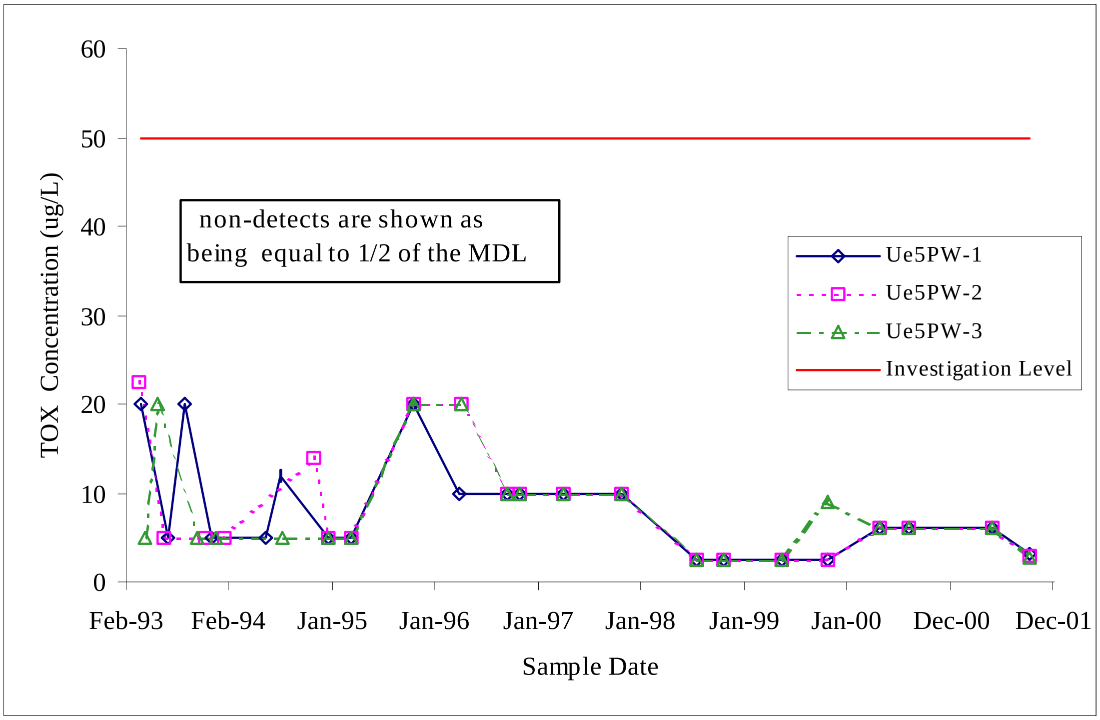

Figure A.16 Area 5 RWMS Time Series Plot of Total Organic Halogen

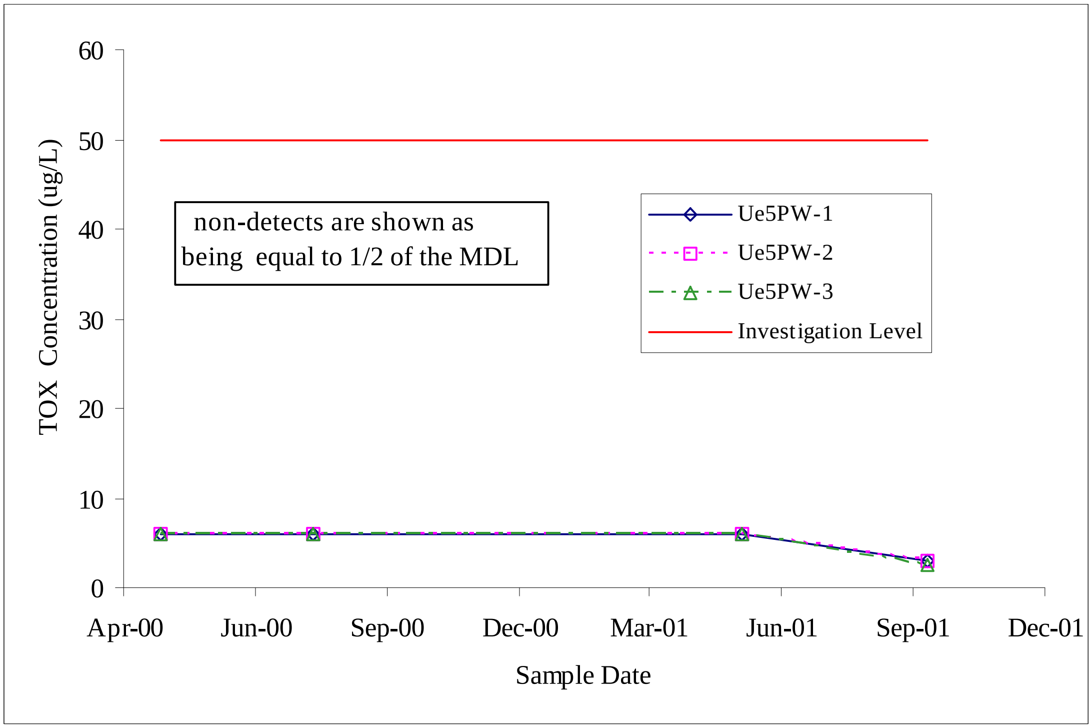

Figure A.17 Area 5 RWMS Two-Year Plot of Total Orgaic Halogen

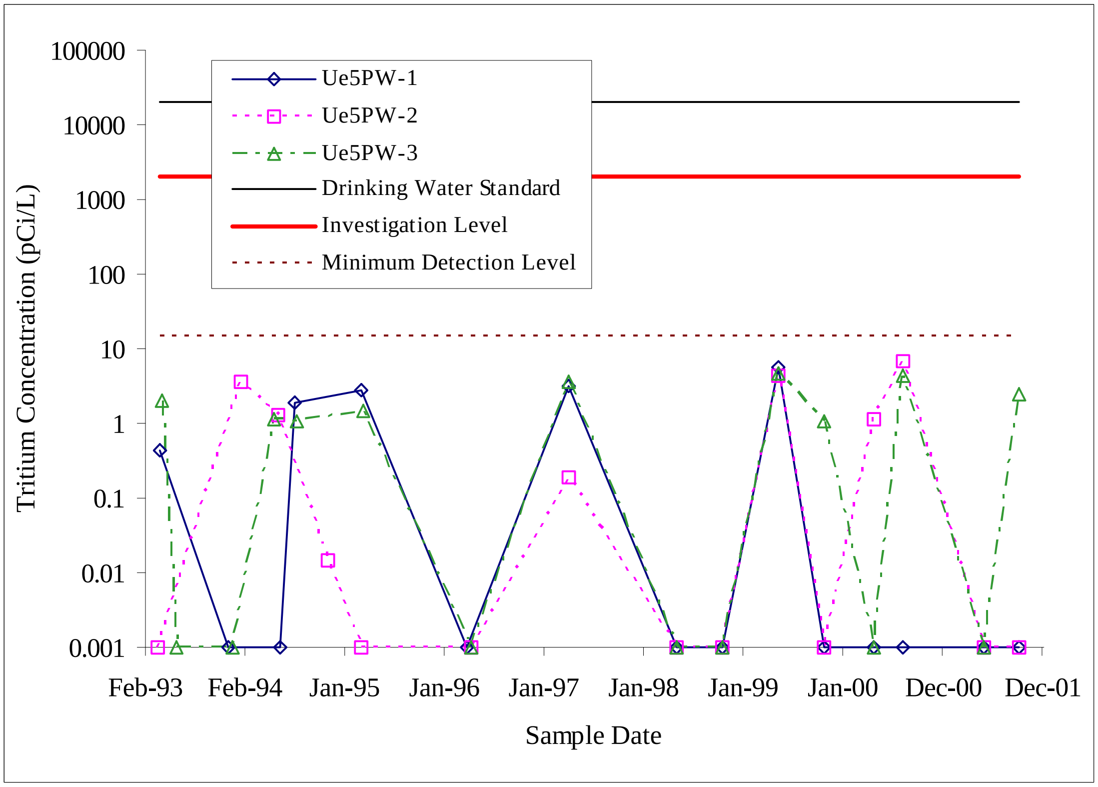

Figure A.18 Area 5 RWMS Time Series Plot of Tritium

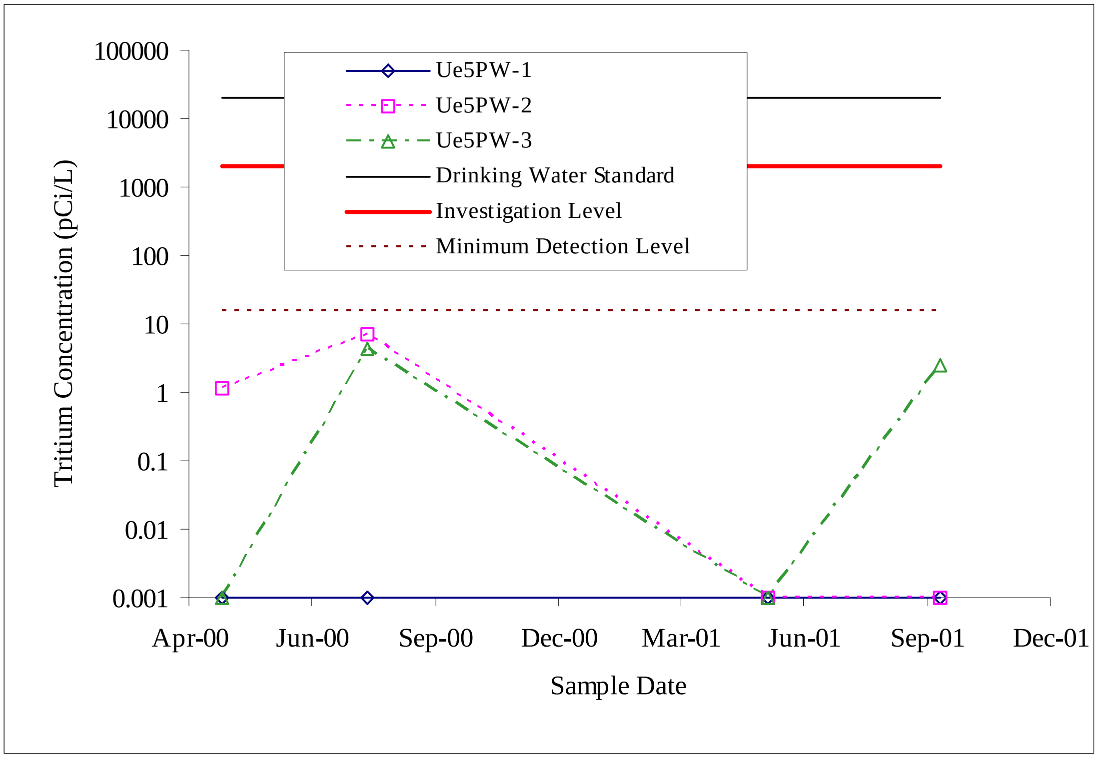

Figure A.19 Area 5 RWMS Two-Year Plot of Tritium

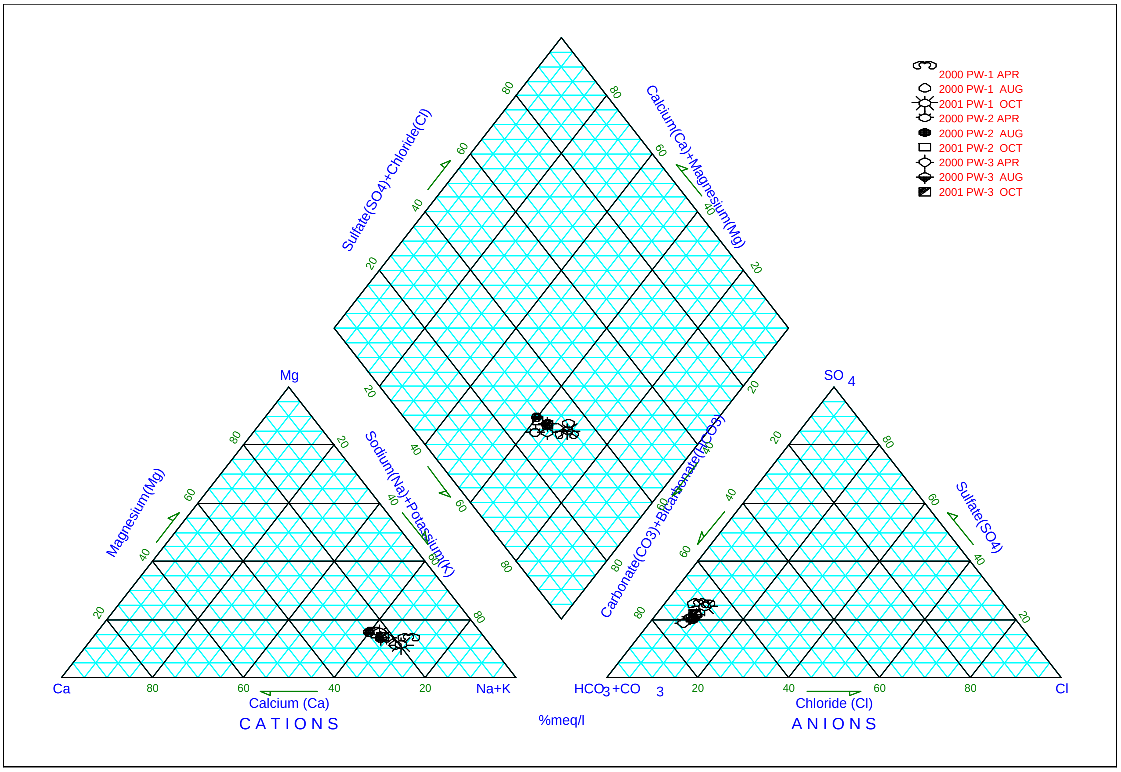

Figure A.20 Area 5 RWMS Two-Year Piper Diagram

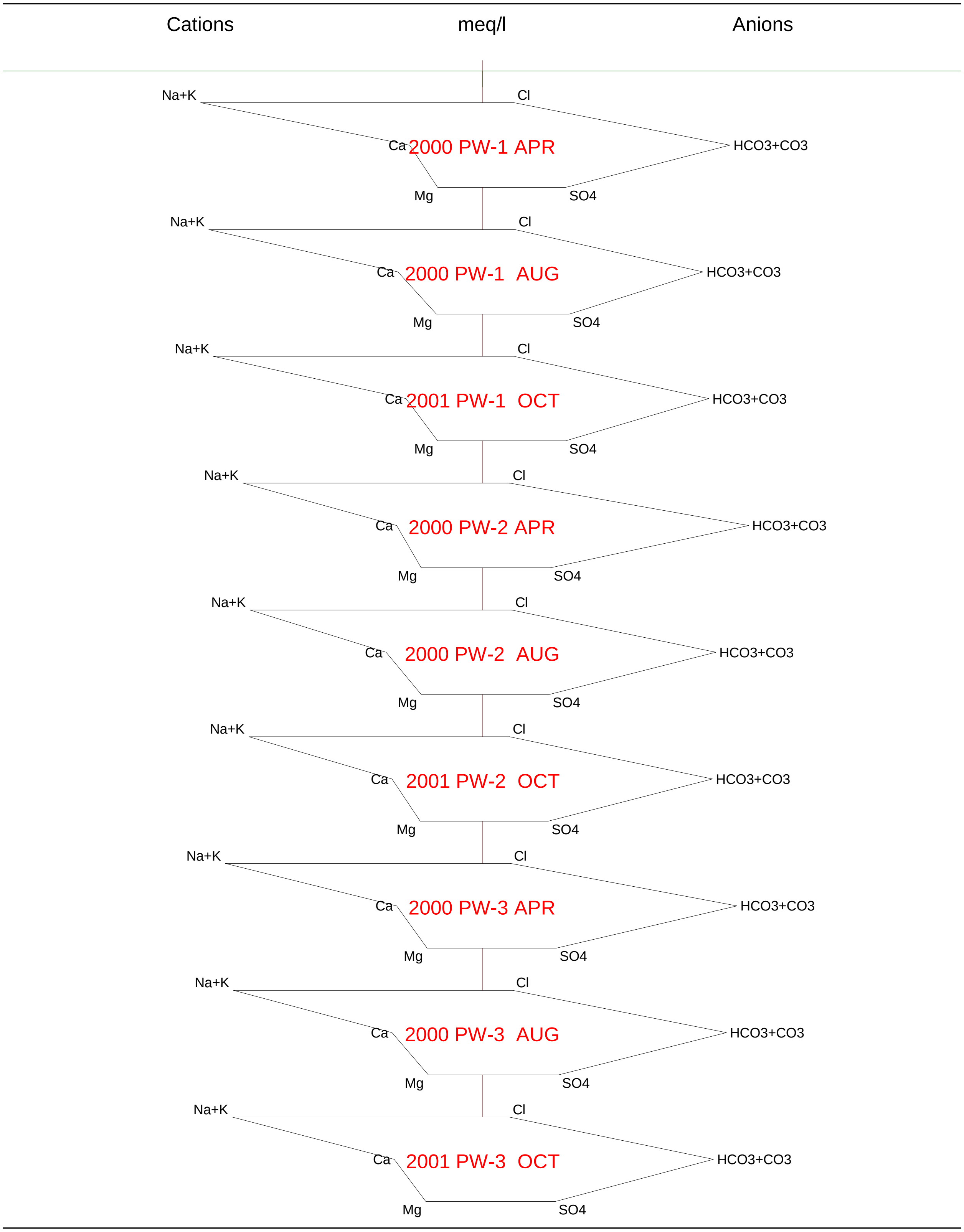

Figure A.21 Area 5 RWMS Stiff Diagrams 2000-2001

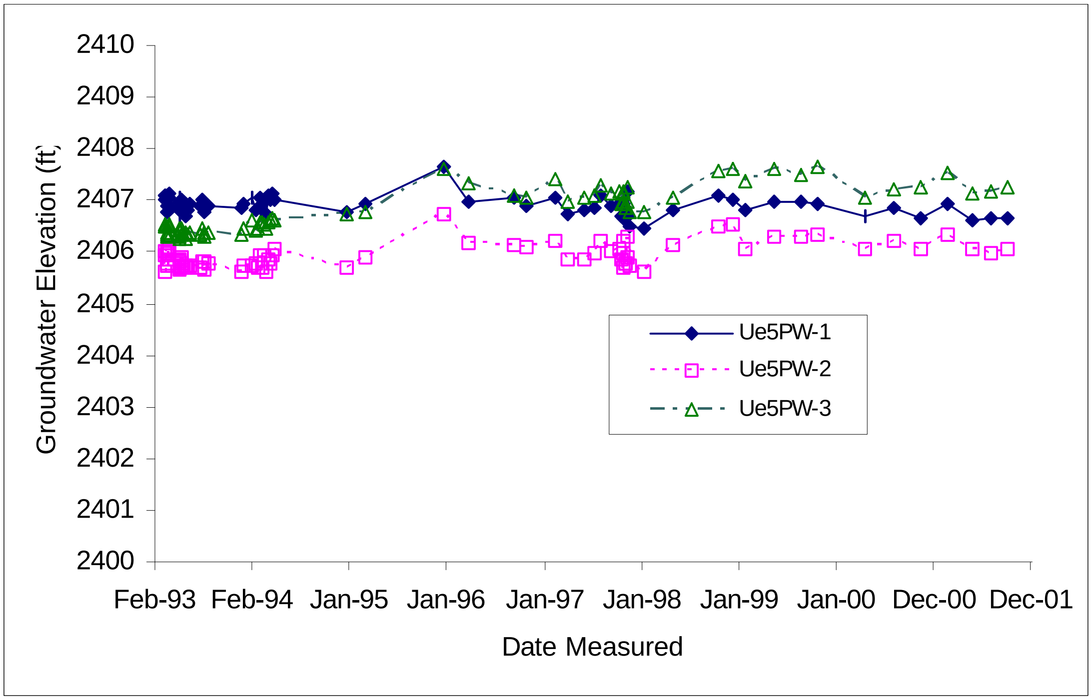

Figure A.22 Area 5 RWMS Time Series Plot of Groundwater Elevation

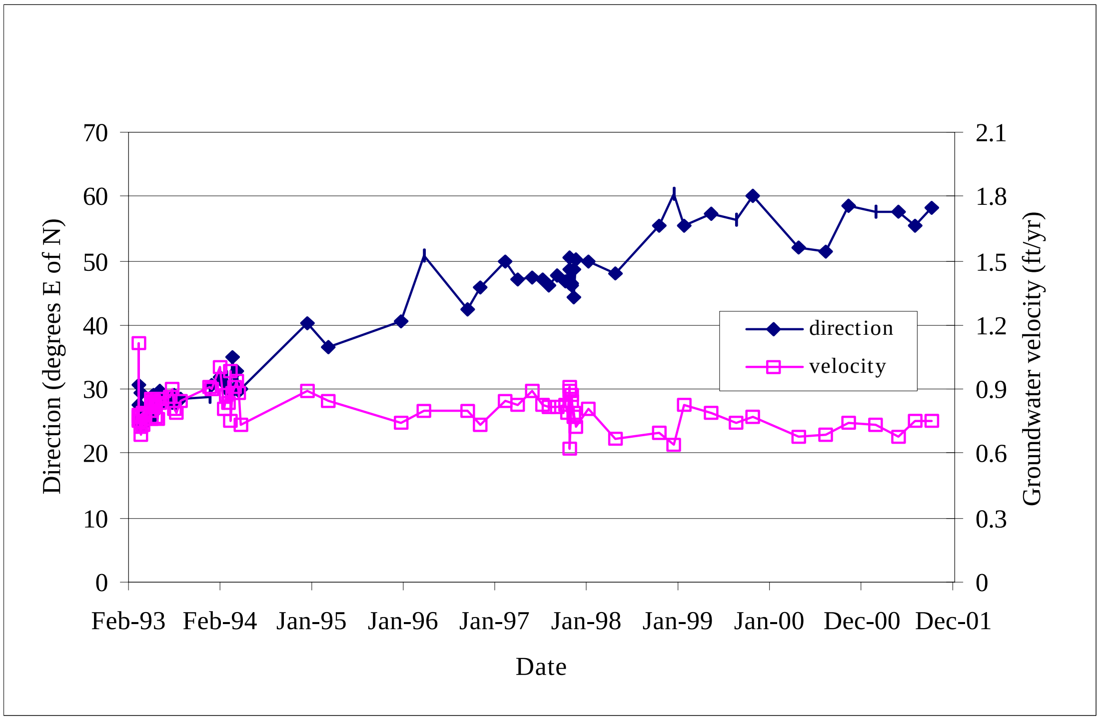

Figure A.23 Area 5 RWMS Time Series Plot of Groundwater Velocity and Direction

REFERENCES

Rehfelt, K., 2001. *Nevada Test Site Regional Groundwater Flow Lines*. Written Communication. Geotrans, Las Vegas, Nevada.

U.S. Department of Energy, 1997. *Regional Groundwater Flow and Tritium Transport Modeling and Risk Assessment of the Underground Test Area, Nevada Test Site, Nevada*. DOE/NV--477, Las Vegas, NV.

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Appendix B

Tables

Table B.1 Area 5 RWMS Hydraulic Parameters

Hydraulic Conductivity	**Hydraulic Gradient**	**Effective Porosity**	**Mean Velocity**	**Flow Direction**
1.12e-3 cm/s[a] (3.36e-5 ft/s)	0.25 m/km (1.3 ft/mi)	0.38[a]	0.22 m/yr (0.7 ft/yr)	58° E of N

[a] (REECO 1994)

Table B.2 Investigation Levels for Indicator Parameters

Parameter	**Investigation Level (IL)**
TOX	50 ug/L
TOC	1 mg/L
pH	less than 7.6 and greater than 9.2
Specific Conductance	0.440 mmhos/cm
Tritium	2,000 pCi/L

Table B.3 Area 5 RWMS pH Values for Ue5PW-1, Ue5PW-2, and Ue5PW-3 (dates are approximated in 1993 and 1994 to make graphs consistent)

Date Sampled	**Ue5PW-1**	**Ue5PW-2**	**Ue5PW-3**
March 1993	8.17	7.99	8.24
July 1993	8.30	8.24	8.68
September 1993	8.25	8.40	8.68
December 1993	7.90	8.79	8.6
June 1994	8.45	8.81	8.87
August 1994	8.28	8.78	8.77
November 1994	no sample	no sample	8.58
April 1995	8.25	8.58	8.28
November 1995	8.34	8.08	8.42
January 1996	8.41	8.63	8.54
April 1996	8.22	8.21	8.23
April 1996	no sample	8.15	8.15
October 1996	8.43	8.28	8.18
November 1996	8.25	8.16	8.12
April 1997	8.32	8.40	8.25
November 1997	8.30	8.16	8.22
May 1998	8.31	8.37	8.34
July 1998	8.63	no sample	no sample
October 1998	8.34	8.32	8.14
May 1999	8.51	8.54	8.45
October 1999	8.47	8.53	8.34
April 2000	8.49	8.45	8.24
August 2000	8.29	8.14	8.23
May 2001	8.46	8.25	8.26
October 2001	8.39	8.22	8.13
Mean	**8.34**	**8.38**	**8.37**
Std Dev	**0.14**	**0.23**	**0.22**

Table B.4 Area 5 RWMS Specific Conductance Values in mmhos/cm for Ue5PW-1, Ue5PW-2, and Ue5PW-3 (dates are approximated in 1993 and 1994 to make graphs consistent)

Date Sampled	**Ue5PW-1**	**Ue5PW-2**	**Ue5PW-3**
March 1993	0.401	0.371	0.383
July 1993	0.391	0.411	0.382
September 1993	0.391	0.384	0.376
December 1993	0.383	0.371	0.359
June 1994	0.383	0.363	0.363
August 1994	0.378	0.324	0.367
November 1994	no sample	no sample	0.347
April 1995	0.320	0.336	0.352
November 1995	0.366	0.348	0.338
January 1996	0.360	0.343	0.354
April 1996	0.362	0.355	0.363
April 1996	no sample	0.356	0.379
October 1996	0.383	0.363	0.376
November 1996	0.374	0.364	0.378
April 1997	0.385	0.363	0.376
November 1997	0.376	0.358	0.361
May 1998	0.377	0.356	0.370
July 1998	0.373	no sample	no sample
October 1998	0.380	0.358	0.370
May 1999	0.378	0.349	0.369
October 1999	0.376	0.354	0.369
April 2000	0.378	0.353	0.369
August 2000	0.379	0.350	0.371
May 2001	0.377	0.358	0.371
October 2001	0.376	0.358	0.371
Mean	**0.376**	**0.358**	**0.367**
Std Dev	**0.015**	**0.016**	**0.011**

Table B.5 Area 5 RWMS TOC values in mg/L for Ue5PW-1, Ue5PW-2, and Ue5PW-3 (dates are approximated in 1993 and 1994 to make graphs consistent)

Date Sampled	**Ue5PW-1**	**Ue5PW-2**	**Ue5PW-3**
March 1993	<1.0	<1.0	<1.0
July 1993	<1.0	<1.0	<1.0
September 1993	<1.0	no sample	<1.0
December 1993	<1.0	<1.0	<1.0
June 1994	no sample	<1.0	no sample
August 1994	1.7[1]	<1.0	<1.0
January 1995	0.20	0.5	0.22
April 1995	<1.0	<1.0	<1.0
November 1995	<1.0	<1.0	<1.0
April 1996	<0.3	<1.0	1.7[2]
October 1996	0.32	<0.3	<0.3
November 1996	<0.3	<0.3	<0.3
April 1997	<0.3	<0.3	<0.3
November 1997	<0.3	<0.3	<0.3
May 1998	<1.0	<1.0	<1.0
October 1998	<1.0	<1.0	<1.0
May 1999	<1.0	<1.0	<1.0
October 1999	<1.0	1.6[1,2]	<1.0
December 1999	no sample	<0.5	no sample
April 2000	0.98[1]	0.48[1]	1.31[1]
August 2000	<0.54[3]	<0.5[3]	<0.5[3]
May 2001	.32[3,4]	<0.5[3]	0.34[3,4]
October 2001	<0.5	<0.5	<0.5

[1] determined to be a false positive through resampling

[2] duplicate sample results were <1.0

[3] multiple labs used, this value represents RECRA lab result only

[4] multiple replicates analyzed, assumes nondetects are equal to one-half the MDL

Table B.6 Area 5 RWMS TOX Values in ug/L for Ue5PW-1, Ue5PW-2, and Ue5PW-3 (dates are approximated in 1993 and 1994 to make graphs consistent)

Date Sampled	Ue5PW-1	Ue5PW-2	Ue5PW-3
March 1993	20	23	<10
July 1993	<10	<10	20[2]
September 1993	20[2]	<10	<10
December 1993	<10	<10	<10
June 1994	<10	no sample	no sample
August 1994	12[2]	no sample	<10
November 1994	no sample	14[2]	no sample
January 1995	<10	<10	<10
April 1995	<10	<10	<10
November 1995	<40	<40	<40
April 1996	<20	<40	<40
October 1996	<20	<20	<20
November 1996	<20	<20	<20
April 1997	<20	<20	<20
November 1997	<20	<20	<20
May 1998	391[1]	842[1]	1000[1]
July 1998	<5	no sample	no sample
October 1998	<5	<5	<5
May 1999	<5	<5	<5
October 1999	<5	<5	9[2]
April 2000	71.7[1]	59.3[1]	56.5[1]
August 2000	91.8[1,3]	73.0[1,3]	82.8[1,3]
May 2001	<12.6[3]	<12[3]	<12[3]
October 2001	<6.1	<5.8	<5.2

[1] determined to be false positive through resampling
[2] duplicate sample results were less than MDL
[3] multiple labs used, this value represents RECRA lab result only

Table B.7 Area 5 RWMS Tritium Values in pCi/L for Ue5PW-1, Ue5PW-2, Ue5PW-3 (dates are approximated in 1993 and 1994 to make graphs consistent)

Date Sampled	**Ue5PW-1**	**Ue5PW-2**	**Ue5PW-3**
March 1993	0.442	-4.28	1.96
December 1993	-1.58	32.2[1]	-2.74
January 1994	no sample	3.69	-0.46
June 1994	-2.04	1.29	1.13
August 1994	1.86	0.015	1.04
April 1995	2.8	-0.92	1.5
April 1996	-1.72	-1.91	-2.29
April 1997	3.15	0.19	3.69
May 1998	-2.35	-1.95	-4.71
October 1998	-1.09	-1.85	-8.25
May 1999	5.17	4.23	4.60
October 1999	-1.36	-3.37	1.08
April 2000	-2.55	1.67	-0.08
August 2000	-2.52	6.97	4.34
May 2001	-1.9	-11.5	-12.4
October 2001	-2.93	-2.82	2.45

[1] standard, not enriched analysis performed

Table B.8 Ue5PW-1 General Water Chemistry Values (mg/L)

Date	Ca	Fe	Mg	Mn	K	Si	Na	SO_4	HCO_3	Cl	F
03-31-1993	no analysis	0.013	no analysis	<0.006	no analysis	no analysis	48	32	137	9.2	1.2
06-06-1993	no analysis	0.059	no analysis	<0.001	no analysis	no analysis	58	37	132	9.7	1.4
09-01-1993	no analysis	0.027	no analysis	0.0066	no analysis	no analysis	56	no analysis	157.5	8.4	5.7
12-07-1993	no analysis	0.012	no analysis	<0.0012	no analysis	no analysis	57	36	150	9.9	1.5
06-15-1994	no analysis	0.01	no analysis	<0.004	no analysis	no analysis	61	no analysis	no analysis	no analysis	no analysis
08-01-1994	no analysis	0.021	no analysis	<0.0012	no analysis	no analysis	53	36	no analysis	10	no analysis
04-04-1995	no analysis	<0.05	no analysis	<0.01	no analysis	no analysis	58	34	no analysis	9.9	no analysis
04-16-1996	no analysis	0.02	no analysis	<0.001	no analysis	no analysis	61	34	no analysis	9.9	no analysis
04-16-1997	15.1	0.012	5.31	<0.001	5.90	no analysis	54.5	32.2	128	9.2	1.3
11-05-1997	15.5	0.012	5.61	no analysis	6.44	no analysis	57.8	35.2	123.5	10.2	1.2
05-13-1998	14.0	0.034	5.36	0.0015	5.21	25.4	55.8	34.6	123.5	9.6	1.1
10-28-1998	14.9	0.024	5.58	0.0015	6.87	28.3	57.6	34	131	9.7	1.1
05-19-1999	12.5	<0.05	5.30	<0.0025	6.85	32	61	34	120	10	1
10-27-1999	14.5	<0.1	6.0	<0.005	6.6	29	63.5	35	130	8.8	1.1
04-26-2000	12.8	0.032	4.80	0.001	6.69	27.2	53.7	35.6	135	10	1.0
08-09-2000	15.0	<0.0164	4.90	0.00045	6.6	28	52.0	37.1	120	10.4	1.1
05-29-2001	14.4	0.009	4.9	<0.0018	6.0	28.9	59.0	no analysis[1]	117	no analysis[2]	no analysis[1]
10-03-2001	13.6	0.008	4.8	0.0002	6.6	27.2	51	36.0	123.5	10.1	1.0
Mean	**14.2**	**NA[3]**	**5.27**	**NA[3]**	**6.38**	**28.2**	**56.55**	**34.85**	**130.6**	**9.69**	**1.52**
Std Dev	**1.0**	**NA[3]**	**0.39**	**NA[3]**	**0.53**	**1.91**	**3.99**	**1.52**	**11.5**	**0.54**	**1.26**

[1] no analysis due to laboratory erroneously acidifying sample
[2] assumes nondetects are equal to one-half the MDL
[3] not applicable

Table B.9 Ue5PW-2 General Water Chemistry Values (mg/L)

Date	Ca	Fe	Mg	Mn	K	Si	Na	SO$_4$	HCO$_3$	Cl	F
03-24-1993	no analysis	0.062	no analysis	0.11	no analysis	no analysis	46	28	130	8.4	1
06-22-1993	no analysis	0.25	no analysis	0.032	no analysis	no analysis	54	30	150	9.7	1.1
11-15-1993	no analysis	0.180	no analysis	<0.004	no analysis	no analysis	51	31	140	9.4	1.3
01-19-1994	no analysis	0.074	no analysis	<0.0012	no analysis	no analysis	45	29	130	no analysis	1.2
06-07-1994	no analysis	0.14	no analysis	<0.004	no analysis	no analysis	55	no analysis	no analysis	no analysis	no analysis
11-29-1994	no analysis	no analysis	no analysis	no analysis	no analysis	no analysis	no analysis	28	no analysis	8	no analysis
04-04-1995	no analysis	<0.05	no analysis	<0.01	no analysis	no analysis	50	28	no analysis	8.5	no analysis
04-30-1996	no analysis	0.013	no analysis	<0.001	no analysis	no analysis	51	29	no analysis	8.3	no analysis
04-16-1997	15.9	0.012	5.98	<0.001	5.04	no analysis	47.6	26.4	122	7.9	1.21
11-05-1997	17.4	0.018	6.83	no analysis	4.87	no analysis	50.6	28.9	115	8.6	0.91
05-13-1998	14.8	0.066	5.68	<0.0011	3.83	23.8	45.2	28.4	123.5	8.2	1.0
10-28-1998	15.8	0.015	6.18	0.0009	5.56	26.2	47.4	28.4	128.5	8.3	0.98
05-19-1999	15.0	<0.05	6.3	<0.0025	6.2	29	52	27.5	110	8.7	0.92
10-27-1999	16.0	<0.1	6.7	<0.005	5.7	26	52	28	125	7.4	0.96
04-26-2000	15.2	0.029	6.53	0.0007	5.6	26.1	45.6	29.1	145	8.6	0.84
08-09-2000	17.0	<0.0164	6.59	<0.0002	5.3	27.7	44.4	28.7	127	9.26	0.94
05-29-2001	16.6	<10.7	6.6	<0.0018	4.8	28.2	48.8	no analysis[1]	124.5	no analysis[1]	no analysis[1]
10-03-2001	16	0.017	6.7	0.0002	5.4	27.5	44.6	28.4	125	8.65	.95
Mean	**16.0**	**NA[3]**	**6.41**	**NA[3]**	**5.24**	**26.8**	**48.8**	**28.55**	**128.2**	**8.52**	**1.02**
Std Dev	**0.84**	**NA[3]**	**0.37**	**NA[3]**	**0.65**	**1.65**	**3.40**	**1.03**	**10.76**	**0.60**	**0.14**

[1] no analysis due to laboratory erroneously acidifying sample
[2] assumes nondetects are equal to one-half the MDL
[3] not applicable

Table B.10 Ue5PW-3 General Water Chemistry Values (mg/L)

Date	Ca	Fe	Mg	Mn	K	Si	Na	SO_4	HCO_3	Cl	F
04-14-1993	no analysis	0.024	no analysis	0.042	no analysis	no analysis	46.0	31	129	8.5	1.3
06-02-1993	no analysis	0.014	no analysis	0.009	no analysis	no analysis	53.0	31	133	9.1	1.2
10-12-1993	no analysis	0.11	no analysis	<0.006	no analysis	no analysis	57.0	30	128	7.9	1.2
12-20-1993	no analysis	0.1	no analysis	<0.0012	no analysis	no analysis	48.0	33	128	8.7	1.3
05-24-1994	no analysis	0.02	no analysis	<0.0012	no analysis	no analysis	56.0	no analysis	no analysis	no analysis	no analysis
08-08-1994	no analysis	<0.009	no analysis	<0.0012	no analysis	no analysis	51.0	33	no analysis	8.9	no analysis
04-05-1995	no analysis	<0.05	no analysis	<0.01	no analysis	no analysis	55.0	31	no analysis	8.8	no analysis
04-30-1996	no analysis	0.0088	no analysis	<0.001	no analysis	no analysis	57.0	32	no analysis	8.7	no analysis
04-16-1997	15.8	<0.006	5.71	<0.001	3.95	no analysis	54.2	29	127.5	8.39	1.26
11-05-1997	16.8	0.0133	6.06	no analysis	4.32	no analysis	55.5	32.1	115	9.15	1.09
05-13-1998	15.8	0.035	5.8	<0.0011	3.33	26.4	53.8	31	124	8.6	1
10-28-1998	15.6	0.009	5.7	0.0009	4.16	26.7	53.7	31.4	128	8.7	1
05-19-1999	15.0	<0.05	5.8	<0.0025	4.8	31.0	56.0	30.5	120	9.2	0.88
10-27-1999	16.0	<0.1	6.4	<0.005	3.75	28.0	58.5	31	130	7.6	0.94
04-26-2000	15.2	0.014	5.89	0.0003	4.5	27.4	49.8	32	138.5	9.1	0.86
08-09-2000	16.0	<0.016	5.78	<0.0002	4.3	27.0	48.2	32.6	133	9.85	0.96
05-29-2001	16.4	<10.7	5.9	<0.0018	2.4	28.3	54.8	no analysis[1]	123.5	no analysis[1]	no analysis[1]
10-03-2001	15.6	0.02	6.0	0.0002	4.5	27.0	48.4	31.5	126	8.8	<1.0
Mean	**15.82**	**NA[3]**	**5.90**	**NA[3]**	**4.00**	**27.7**	**53.11**	**31.37**	**127.4**	**8.76**	**1.04[2]**
Std Dev	**0.53**	**NA[3]**	**0.20**	**NA[3]**	**0.68**	**1.46**	**3.66**	**1.13**	**5.78**	**0.52**	**0.22[2]**

[1] no analysis due to laboratory erroneously acidifying sample
[2] assumes nondetects are equal to one-half the MDL
[3] not applicable

Table B.11 Area 5 Groundwater Elevation Data

	Nevada State Central Zone Coordinates		Top of Casing Elevation (ft)	Top of Casing to Land Surface (ft)	Land Surface Elevation (ft)	Deviation Correction (ft)
Borehole	North (m)	East (m)				
Ue5PW-1	233,386.48	216,357.08	3180.35	2.40	3177.99	-0.27
Ue5PW-2	234,817.13	216,376.00	3248.42	2.23	3246.23	-0.67
Ue5PW-3	235,089.93	214,415.04	3297.97	2.49	3295.51	-0.05

	Ue5PW-1 Water Level Measurements Top of Casing Elevation: 3180.35 ft			Ue5PW-2 Water Level Measurements Top of Casing Elevation: 3248.42 ft			Ue5PW-3 Water Level Measurements Top of Casing Elevation: 3297.97 ft		
Date	**Depth to Water (ft)**	**Elevation (ft)**	**Elevation Corrected for Deviation (ft)**	**Depth to Water (ft)**	**Elevation (ft)**	**Elevation Corrected for Deviation (ft)**	**Depth to Water (ft)**	**Elevation (ft)**	**Elevation Corrected or Deviation (ft)**
03/22/1993	773.08	2407.27	2407.00	841.82	2406.60	2405.93	891.43	2406.54	2406.49
03/23/1993	772.99	2407.36	2407.09	842.15	2406.27	2405.60	891.40	2406.57	2406.52
03/24/1993	773.00	2407.35	2407.08	841.75	2406.67	2406.00	891.43	2406.54	2406.49
03/25/1993	772.99	2407.36	2407.09	841.72	2406.70	2406.03	891.43	2406.54	2406.49
03/29/1993	773.20	2407.15	2406.88	841.83	2406.59	2405.92	891.56	2406.41	2406.36
03/30/1993	773.31	2407.04	2406.77	841.98	2406.44	2405.77	891.64	2406.33	2406.28
03/31/1993	773.30	2407.05	2406.78	842.03	2406.39	2405.72	891.59	2406.38	2406.33
04/01/1993	773.03	2407.32	2407.05	841.79	2406.63	2405.96	891.43	2406.54	2406.49
04/05/1993	772.93	2407.42	2407.15	841.71	2406.71	2406.04	891.38	2406.59	2406.54
04/06/1993	773.20	2407.15	2406.88	841.90	2406.52	2405.85	891.63	2406.34	2406.29
05/10/1993	773.37	2406.98	2406.71	842.08	2406.34	2405.67	891.67	2406.30	2406.25
05/11/1993	773.10	2407.25	2406.98	841.94	2406.48	2405.81	891.48	2406.49	2406.44
05/12/1993	773.04	2407.31	2407.04	841.88	2406.54	2405.87	891.52	2406.45	2406.40
05/13/1993	773.28	2407.07	2406.80	842.05	2406.37	2405.70	891.64	2406.33	2406.28
05/17/1993	773.26	2407.09	2406.82	842.05	2406.37	2405.70	891.58	2406.39	2406.34
05/18/1993	773.21	2407.14	2406.87	842.04	2406.38	2405.71	891.60	2406.37	2406.32
05/19/1993	773.20	2407.15	2406.88	842.03	2406.39	2405.72	891.57	2406.40	2406.35
05/20/1993	773.05	2407.30	2407.03	841.87	2406.55	2405.88	891.48	2406.49	2406.44
05/24/1993	773.25	2407.10	2406.83	841.98	2406.44	2405.77	891.60	2406.37	2406.32
05/25/1993	773.27	2407.08	2406.81	842.05	2406.37	2405.70	891.60	2406.37	2406.32
06/01/1993	773.16	2407.19	2406.92	842.00	2406.42	2405.75	891.56	2406.41	2406.36
06/07/1993	773.37	2406.98	2406.71	842.07	2406.35	2405.68	891.65	2406.32	2406.27
06/14/1993	773.28	2407.07	2406.80	842.07	2406.35	2405.68	891.58	2406.39	2406.34
06/21/1993	773.16	2407.19	2406.92	842.00	2406.42	2405.75	891.55	2406.42	2406.37
07/26/1993	773.20	2407.15	2406.88	842.05	2406.37	2405.70	891.58	2406.39	2406.34
08/03/1993	773.05	2407.30	2407.03	841.95	2406.47	2405.80	891.47	2406.50	2406.45
08/09/1993	773.31	2407.04	2406.77	842.08	2406.34	2405.67	891.62	2406.35	2406.30
08/16/1993	773.20	2407.15	2406.88	841.95	2406.47	2405.80	891.55	2406.42	2406.37
08/30/1993	773.17	2407.18	2406.91	841.99	2406.43	2405.76	891.53	2406.44	2406.39
12/28/1993	773.21	2407.14	2406.87	842.12	2406.30	2405.63	891.60	2406.37	2406.32
01/03/1994	773.15	2407.20	2406.93	842.02	2406.40	2405.73	891.45	2406.52	2406.47
02/02/1994	773.02	2407.33	2407.06	842.02	2406.40	2405.73	891.32	2406.65	2406.60
02/22/1994	773.25	2407.10	2406.83	841.99	2406.43	2405.76	891.49	2406.48	2406.43
02/28/1994	773.22	2407.13	2406.86	842.04	2406.38	2405.71	891.45	2406.52	2406.47
03/07/1994	773.03	2407.32	2407.05	841.82	2406.60	2405.93	891.33	2406.64	2406.59
03/14/1994	773.08	2407.27	2407.00	842.05	2406.37	2405.70	891.36	2406.61	2406.56
03/21/1994	773.12	2407.23	2406.96	841.81	2406.61	2405.94	891.40	2406.57	2406.52
03/28/1994	773.34	2407.01	2406.74	842.13	2406.29	2405.62	891.45	2406.52	2406.47
04/04/1994	772.99	2407.36	2407.09	841.89	2406.53	2405.86	891.33	2406.64	2406.59
04/13/1994	773.08	2407.27	2407.00	841.97	2406.45	2405.78	891.30	2406.67	2406.62
04/20/1994	772.95	2407.40	2407.13	841.81	2406.61	2405.94	891.28	2406.69	2406.64
04/26/1994	773.06	2407.29	2407.02	841.71	2406.71	2406.04	891.29	2406.68	2406.63
01/18/1995	773.32	2407.03	2406.76	842.05	2406.35	2405.68	891.20	2406.77	2406.72
04/03/1995	773.13	2407.22	2406.95	841.85	2406.55	2405.88	891.16	2406.81	2406.76

Table B.11 (Area 5 Groundwater Elevation Data, cont.)

	Nevada State Central Zone Coordinates					
Borehole	North (m)	East (m)	Top of Casing Elevation (ft)	Top of Casing to Land Surface (ft)	Land Surface Elevation (ft)	Deviation Correction (ft)
Ue5PW-1	233,386.48	216,357.08	3180.35	2.40	3177.99	-0.27
Ue5PW-2	234,817.13	216,376.00	3248.42	2.23	3246.23	-0.67
Ue5PW-3	235,089.93	214,415.04	3297.97	2.49	3295.51	-0.05

	Ue5PW-1 Water Level Measurements Top of Casing Elevation: 3180.35 ft			Ue5PW-2 Water Level Measurements Top of Casing Elevation: 3248.42 ft			Ue5PW-3 Water Level Measurements Top of Casing Elevation: 3297.97 ft		
Date	**Depth to Water (ft)**	**Elevation (ft)**	**Elevation Corrected for Deviation (ft)**	**Depth to Water (ft)**	**Elevation (ft)**	**Elevation Corrected for Deviation (ft)**	**Depth to Water (ft)**	**Elevation (ft)**	**Elevation Corrected or Deviation (ft)**
01/16/1996	772.45	2407.90	2407.63	841.00	2407.42	2406.75	890.32	2407.65	2407.60
04/15/1996	773.10	2407.25	2406.98	841.56	2406.86	2406.19	890.57	2407.40	2407.35
10/01/1996	773.04	2407.31	2407.04	841.63	2406.79	2406.12	890.84	2407.13	2407.08
11/19/1996	773.19	2407.16	2406.89	841.66	2406.76	2406.09	890.87	2407.10	2407.05
08/20/1997	772.97	2407.38	2407.11	841.53	2406.89	2406.22	890.62	2407.35	2407.30
09/25/1997	773.19	2407.16	2406.89	841.72	2406.70	2406.03	890.77	2407.20	2407.15
10/27/1997	773.13	2407.22	2406.95	841.69	2406.73	2406.06	890.75	2407.22	2407.17
11/03/1997	773.40	2406.95	2406.68	841.89	2406.53	2405.86	890.98	2406.99	2406.94
11/06/1997	773.14	2407.21	2406.94	841.77	2406.65	2405.98	890.75	2407.22	2407.17
11/12/1997	773.44	2406.91	2406.64	842.05	2406.37	2405.70	890.95	2407.02	2406.97
11/13/1997	773.23	2407.12	2406.85	841.52	2406.90	2406.23	890.79	2407.18	2407.13
11/19/1997	773.35	2407.00	2406.73	841.96	2406.46	2405.79	890.97	2407.00	2406.95
11/20/1997	773.41	2406.94	2406.67	841.99	2406.43	2405.76	891.05	2406.92	2406.87
11/25/1997	773.37	2406.98	2406.71	841.84	2406.58	2405.91	890.93	2407.04	2406.99
11/26/1997	772.92	2407.43	2407.16	841.47	2406.95	2406.28	890.65	2407.32	2407.27
12/03/1997	773.60	2406.75	2406.48	842.00	2406.42	2405.75	891.13	2406.84	2406.79
01/26/1998	773.64	2406.71	2406.44	842.12	2406.30	2405.63	891.14	2406.83	2406.78
05/12/1998	773.25	2407.10	2406.83	841.62	2406.80	2406.13	890.87	2407.10	2407.05
10/2719/98	772.98	2407.37	2407.10	841.27	2407.15	2406.48	890.35	2407.62	2407.57
12/22/1998	773.05	2407.30	2407.03	841.22	2407.20	2406.53	890.31	2407.66	2407.61
02/02/1999	773.28	2407.07	2406.80	841.69	2406.73	2406.06	890.56	2407.41	2407.36
05/18/1999	773.10	2407.25	2406.98	841.44	2406.98	2406.31	890.33	2407.64	2407.59
08/25/1999	773.12	2407.23	2406.96	841.44	2406.98	2406.31	890.42	2407.55	2407.50
10/26/1999	773.14	2407.21	2406.94	841.42	2407.00	2406.33	890.29	2407.68	2407.63
04/24/2000	773.37	2406.98	2406.71	841.69	2406.73	2406.06	890.86	2407.11	2407.06
08/07/2000	773.21	2407.14	2406.87	841.55	2406.87	2406.20	890.71	2407.26	2407.21
11/13/2000	773.42	2406.93	2406.66	841.70	2406.72	2406.05	890.65	2407.32	2407.27
02/22/2001	773.14	2407.21	2406.94	841.43	2406.99	2406.32	890.40	2407.57	2407.52
05/21/2001	773.47	2406.88	2406.61	841.71	2406.71	2406.04	890.78	2407.19	2407.14
08/01/2001	773.42	2406.93	2406.66	841.76	2406.66	2405.99	890.74	2407.23	2407.18
10/01/2001	773.42	2406.93	2406.66	841.71	2406.71	2406.04	890.65	2407.32	2407.27

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Appendix C

Gradient/Velocity Calculations

CALCULATION OF MAGNITUDE AND DIRECTION OF AREA 5 ALLUVIAL AQUIFER GRADIENT

Water level elevations measured at three wells in the alluvial aquifer near the Area 5 RWMS are used to calculate the magnitude and direction of the hydraulic gradient. The wells sampled are Ue5PW-1, Ue5PW-2, and Ue5PW-3. The locations of the three wells are given in Nevada State Central Zone coordinates in meters as North (N) and East (E) values.

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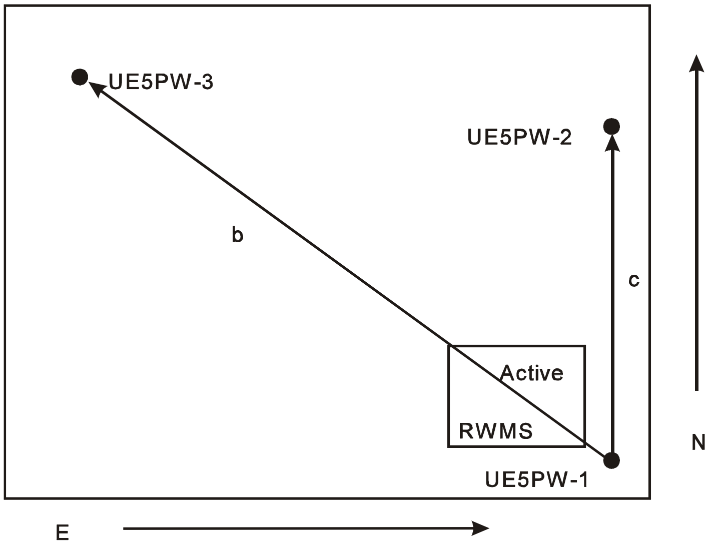
The locations of the wells are shown in the figure below.

Area 5 RWMS Monitoring Wells
(Not to Scale)



The coordinates of each of the three points on the plane are given by (E, N, e) where E is the East coordinate, N is the North coordinate, and e is the water table elevation. The vector $\vec{\mathbf{b}}$ representing the line segment 13 is given by $(E_3-E_1)\mathbf{I} + (N_3-N_1)\mathbf{j} + (e_3-e_1)\mathbf{k}$. Similarly the vector $\vec{\mathbf{c}}$ representing the line segment 12 is given by

$(E_2\text{-}E_1)\mathbf{I} + (N_2\text{-}N_1)\mathbf{j} + (e_2\text{-}e_1)\mathbf{k}$. A normal vector to the plane is given by the vector product of **b** and **c**.

$$\mathbf{b} \times \mathbf{c} = \begin{vmatrix} \mathbf{I} & \mathbf{j} & \mathbf{k} \\ [E_2\text{-}E_1] & [N_2\text{-}N_1] & [e_2\text{-}e_1] \\ [E_3\text{-}E_1] & [N_3\text{-}N_1] & [e_3\text{-}e_1] \end{vmatrix}$$

Expanding the determinant gives,

$$\begin{aligned} &\mathbf{[}\, [N_2\text{-}N_1]\ [e_3 - e_1] \ - \ [N_3\text{-}N_1]\ [e_2 - e_1] \,\mathbf{]}\ \mathbf{I}\ - \\ &\mathbf{[}\, [E_2\text{-}E_1]\ [e_3 - e_1] \ - \ [E_3\text{-}E_1]\ [e_2 - e_1] \,]\ \mathbf{j} + \\ &\mathbf{[}\, [E_2\text{-}E_1]\ [N_3 - N_1] \ - \ [E_3\text{-}E_1]\ [N_2\text{-}N_1 \,]\mathbf{]}\ \mathbf{k}. \end{aligned}$$

This gives the representation for the plane as,

$A (E) + B (N) + C (e) = D$

Where:

$A = [N_2\text{-}N_1]\ [e_3\text{-}e_1] - [N_3\text{-}N_1]\ [e_2\text{-}e_1]$

$B = -\mathbf{[}[E_2\text{-}E_1]\ [e_3\text{-}e_1] - [E_3\text{-}E_1]\ [e_2\text{-}e_1]\mathbf{]}$

$C = [E_2\text{-}E_1]\ [N_3\text{-}N_1] - [E_3\text{-}E_1]\ [N_2\text{-}N_1]$.

The constant D can be determined by substituting the N, E, and e values for PW-1 into the equation for the plane.

The equation is then written in terms of the elevation:

$e = -A/C\ (E) - B/C\ (N) + D/C$.

The gradient is given by the derivative of the function e in the direction of the unit vector **u**.

$$D_u e = \ e \bullet \mathbf{u}$$

e points in the direction **u** that produces the largest directional derivative. | e| is that largest directional derivative.

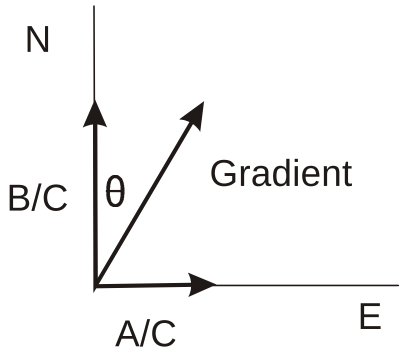
For the water table elevations,

e = -A/C **I** + B/C **j**.

The gradient is calculated from the E and N components,

Gradient = $\sqrt{(A/C)^2 + (B/C)^2}$

The direction of the gradient with respect to North is calculated from the component vectors.



The direction of the gradient is given by:

$$\theta = 90 - \mathrm{Arctan}\ (B/A).$$

Calculation of Mean Groundwater Velocity

Once the gradient has been calculated, the mean groundwater velocity may be calculated using Darcy's Law:

$$q = Ki$$

where

$$V = q/\Phi$$

Where:

q equals the specific discharge or darcian flux

K is the saturated hydraulic conductivity (length/time)

i is the hydraulic gradient (dimensionless)

Φ is the effective porosity (dimensionless)

V is the mean groundwater velocity (length/time)

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Appendix D

Instructions for Area 5 RWMS Groundwater Well Preparation and Groundwater Sampling

Bechtel Nevada

ORGANIZATION PROCEDURE

Title: **INSTRUCTIONS FOR AREA 5 RWMS GROUNDWATER WELL PREPARATION AND GROUNDWATER SAMPLING** **Page 1 of 24**

Number: **OP-2151.214** Revision Number: **0**

Document Control Information

Responsible Organization: **Environmental Operations**

Instructions: This is a new procedure.

Signature Approval:

Manager, Environmental Operations ______________________ Date ______________

1.0 PURPOSE

1.1 This procedure establishes procedures for sampling groundwater at the Area 5 Radioactive Waste Management Site (RWMS), as required by Title 40 Code of Federal Regulations (CFR) 265, Subpart F, "Storage and Disposal Facilities"; and U.S. Department of Energy (DOE) Order 5820.2A, "Radioactive Waste Management."

2.0 SCOPE

2.1 This procedure applies to the routine collection of groundwater samples for groundwater characterization and detection monitoring at the Area 5 RWMS. The Area 5 RWMS is an interim status treatment, storage, and disposal facility.

3.0 RESPONSIBILITIES

3.1 The following entities have responsibilities in this procedure:

- **Monitoring Activity Manager**
- **Samplers**
- **Analytical Services Laboratory (ASL) Personnel**

4.0 PROCEDURE

4.1 GENERAL RESPONSIBILITIES

NOTE: It is the responsibility of all personnel to stop work if they feel they are sampling in an unsafe environment.

4.1.1 The **Monitoring Activity Manager** shall:

4.1.1.1 Ensure that the groundwater sampling program is in full compliance with this procedure.

4.1.1.2 Ensure that all work conducted follows safety standards.

4.1.1.3 Order and control supplies for groundwater sampling.

4.1.1.4 Determine groundwater analytes of interest.

4.1.1.5 Act as the point of contact for all issues regarding groundwater sampling procedures, operations, technical questions, and problem reporting.

4.1.1.6 Ensure that there exists a statement of work with qualified laboratories to perform the following actions.

4.1.1.6.1 Provide laboratory analyses which may consist of inorganic, organic, and radiological samples.

4.1.1.6.2 Provide laboratory quality control tests and maintain a laboratory quality assurance program.

4.1.1.6.3 Review and report data results, as required.

4.1.1.6.4 Maintain complete data analysis packages.

4.1.1.6.5 Provide requested quality control trip blanks.

4.1.2 **Samplers** shall:

4.1.2.1 Prepare/oversee monitoring wells for sampling.

4.1.2.2 Perform analyses of field parameters.

4.1.2.3 Oversee the collection, preservation, transport, and analysis of groundwater samples.

4.1.2.4 Assure accuracy and completeness of the Chain-of-Custody form for samples taken.

4.1.2.5 Evaluate and maintain laboratory data, and coordinate with the Monitoring Activity Manager to determine parameters to be sampled.

4.1.2.6 Conduct all work in accordance with safety standards.

4.2 GROUNDWATER EQUIPMENT AND SITE PREPARATION

NOTE: All personnel working in and around the sampling location must maintain the highest level of cleanliness and housekeeping and adhere to the following requirements:

- Where appropriate, gloves, safety glasses and other personal protective equipment (PPE) as necessary shall be worn.
- Spills and other sampling material shall be cleaned up immediately.
- All equipment shall be inspected and cleaned prior to entering the sampling well.
- All readings must be recorded in the Groundwater Sampling Logbook.
- For groundwater sampling activities, the process outlined in Appendix A, “Groundwater Sampling Flow Diagram” shall be followed.

4.2.1 **Samplers** shall perform the following steps prior to sampling:

4.2.1.1 Inspect the area around the transportainer for any possible source of contamination (vehicles, spill test facility, etc.).

4.2.1.2 Have the water master wet the road and area around the pilot well before sampling if dust control is needed.

4.2.1.3 Note weather conditions and direction of the wind to determine if contamination to the sampling area is possible.

4.2.1.4 Ensure that vehicles are located at a safe distance from the sampling area to minimize contamination.

4.2.1.5 Gather the necessary sample collection containers, preservatives, coolers, etc.

4.2.1.6 Inspect the area around the wellhead for cleanliness and any possible contamination.

4.2.1.7 Loosen the wellhead cap to allow borehole pressure to equilibrate.

NOTE: Bennett™ pumps that are dedicated to and permanently located at the pilot well do not require washing unless they have been contaminated in some fashion or have been removed from the pilot well (e.g. shipped to manufacturer for maintenance).

4.2.2 **Samplers** shall clean any nondedicated equipment (except water level probes) used in the collection of water quality data by the following method prior to sampling:

4.2.2.1 Wash with mild Liquinox™ detergent solution.

4.2.2.2 Triple rinse equipment with tap water.

4.2.2.3 Triple rinse equipment with deionized or distilled water.

4.2.2.4 Thoroughly dry all sampling equipment before use.

4.2.2.5 Use this cleaning method on metal bailers, pumps, and associated equipment used in sampling and/or purging of the monitor well.

4.2.3 When checking and purging Bennett™ pumps, **samplers** shall:

4.2.3.1 Place the Bennett™ pump in a spare purge jar. Turn on the water level sensor.

4.2.3.2 Add enough tap water to cover the top of pump. Listen for audible sound.

4.2.3.3 Remove the pump and dry using Kimwipes™.

4.2.3.4 Check connectors and fittings on pump head.

4.2.3.5 Place the Bennett™ pump in its dedicated purge jar. Add 11 gallons of distilled water.

4.2.3.6 Pump water through the pump until approximately six inches of water remains and water is coming out of the pump.

4.2.4 When measuring the static water level, **samplers** shall:

4.2.4.1 Test the probe's audible electronic signal in tap water.

4.2.4.2 Attach the bell cap and clean the probe and tape with distilled water and Kimwipe™ while lowering down the borehole.

4.2.4.3 Lower the probe down the borehole until an audible electronic signal sounds.

4.2.4.4 Remove bell cap and hold the tape next to the marked rim of the casing to take the measurement. Measure to the nearest 0.01 foot.

4.2.4.5 Repeat measurements until two consecutive measurements are within 0.02 foot.

4.2.4.6 Record the individual's name taking the measurement, the well, the date, the time, and the depth to water from the rim of the casing.

4.2.4.7 The approximate depth to water is 773 feet at Ue5PW-1, 842 feet at Ue5PW-2, and 891 feet at Ue5PW-3.

4.2.4.8 Remove the water level probe, cleaning the tape as it is being wound into the reel.

4.2.4.9 Clean the probe with distilled water and dry with Kimwipes™.

NOTE: Measuring tapes shall be calibrated annually at well WW 5A. Calibration of measuring tapes shall be noted in the Groundwater Sampling Logbook.

4.2.5 When placing the pump, **samplers** shall:

4.2.5.1 Place the Bennett™ hose bundle through the pulley.

4.2.5.2 Inspect the tubing and tape around the bundle and cut or replace the tape as required.

4.2.5.3 Rinse and wipe the unreeled hose using distilled water and Kimwipes™.

4.2.5.4 Attach a bell cap.

4.2.5.5 Lower the pump into the well until the water sensor sounds.

4.2.5.6 Place the tape on the tubing bundle to indicate 5 feet of water depth.

4.2.5.7 Lower the pump to 5 feet below the water surface.

4.2.5.8 Seal the wellhead using plastic.

4.2.6 When setting up the water quality monitoring equipment calibration, **samplers** shall:

4.2.6.1 Set up the Multi-Parameter Water Quality Monitor System without connecting to the well pump lines.

4.2.6.2 Calibrate the water quality monitoring equipment using the manufacturer’s instructions. Note calibration of equipment in the logbook. Re-check calibration at the end of the sampling period to assure that there has been no drift.

NOTE: The temperature probe shall be checked quarterly or prior to use against a certified, calibrated mercury filled thermometer (readings must be within ± 0.5 C of the certified thermometer). Record all calibration data in the Groundwater Sampling Logbook.

4.2.7 When purging the well, **samplers** shall:

4.2.7.1 Purge the well at least three screened casing volumes (150 liters or 40 gallons) at a flow rate greater than or equal to the expected sample rate.

4.2.7.2 During the purging process, measure the following field parameters approximately every 20 liters.

- pH.
- Specific conductance.
- Temperature.

4.2.7.3 Consider the purging process complete when both of the following conditions are satisfied.

- Three screened casing volumes are removed.
- The field parameters remain relatively constant during pumping (±10 percent over last three measurements (U.S. Environmental Protection Agency [EPA], 1995) **or** pH readings within ±0.1, specific conductance ±50 µmhos/cm, and temperature ±0.5 C [the latter is per DOE ERD-05-304]).

NOTE: Purged water shall be stored until analytical results are available, at which time proper arrangements for disposal should be made.

4.3 GROUNDWATER SAMPLE AND COLLECTION

NOTE: Groundwater samples should be collected according to the volatility of the target analytes (e.g. volatile organic compounds [VOCs], total organic carbon [TOC], semi-volatile organic compounds, metals, water quality cations and anions, and radionuclides).

4.3.1 **Samplers** shall:

4.3.1.1 Record the following information in the Groundwater Sampling Logbook.

- Names of personnel collecting samples
- Type of sampling (detection/assessment)
- Date and time of sampling
- Well identification
- Well depth

- Static water level
- Field parameters
- Total volume purged
- Purge pumping rate
- Well yield (high/low)
- Sample flow rate
- Field observations (sample conditions: sediment, odors, immiscible layers)
- Weather conditions (air temperature, wind, dust, etc.)

4.3.1.2 Measure and record the temperature of all ice chests to be used for sample storage and transport.

4.4 COLLECTION OF LABILE ORGANIC PARAMETERS

4.4.1 **Samplers** shall:

4.4.1.1 Collect samples for the parameters listed in Appendix B (TOX and TOC).

4.4.1.2 Select the appropriate container as specified in Appendix B.

4.4.1.3 Collect the number of samples listed in Appendix B.

4.4.1.4 Partially fill and rinse the container with the sample.

4.4.1.5 Place the rinsate in the waste storage container.

4.4.1.6 Fill the container 95 percent full slowly to minimize turbulence.

4.4.1.7 Add the appropriate preservative from Appendix B, remove a small sample, and check the pH. Fill the container slowly with a minimum of turbulence until the meniscus touches the lip of the bottle and cap. Do not allow any plastic material such as gloves to contact the sample during collection.

4.4.1.8 Fill out and attach the premade sample label.

4.4.1.9 Cap the bottle and gently invert. If any air bubbles are observed rising to the top of the container, repeat the collection procedure.

4.4.1.10 Record in the Groundwater Sampling Logbook the sequence in which the samples were collected, the sample identification, the sample container volume and type, and the preservative added.

4.4.1.11 Attach the custody seal to the bottle and fill out the Chain-of-Custody form.

4.4.1.12 Place each sample in a plastic bag (to protect the labels from water), then place the bag in an ice chest and cover with ice immediately after collection to avoid unnecessary heating of the sample.

4.5 COLLECTION OF TOTAL METAL AND ANION SAMPLES

4.5.1 **Samplers** shall:

4.5.1.1 Collect samples for the parameters listed in Appendix B.

4.5.1.2 Select the appropriate container as listed in Appendix B.

4.5.1.3 Partially fill and rinse the container with sample. Place the rinsate in the waste storage drum.

4.5.1.4 Fill the container slowly with a minimum of turbulence until the meniscus touches the lip of the bottle.

4.5.1.5 Add the appropriate preservative listed in Appendix B to the sample container.

4.5.1.6 If a pH value is specified in Appendix B, remove a small sample and check the pH with pH paper.

4.5.1.7 Cap the bottle.

4.5.1.8 Fill out and attach the premade sample label.

4.5.1.9 Attach a custody seal to the bottle and fill out the Chain-of-Custody form.

4.5.1.10 Care should be taken (especially on warm days) to place the sample(s) in a plastic bag (to protect the label from water), then place the bag in the ice chest and cover with ice as soon as reasonable to avoid unnecessary heating of the sample.

4.5.1.11 Record in the Groundwater Sampling Logbook the sequence whereby the samples were collected, the sample identification, the sample container volume and type, and the preservative added.

4.6 COLLECTION OF DISSOLVED METAL SAMPLES

4.6.1 **Samplers** shall:

4.6.1.1 If necessary, attach a 0.45 µm Teflon® in-line filter to the pump outlet (this determination will be made by the Monitoring Activity Manager).

4.6.1.2 Filter approximately 100 ml of the sample and discard.

4.6.1.3 Select the appropriate container as listed in Appendix B.

4.6.1.4 Fill out and attach the premade sample label. Partially fill and rinse the container with the sample. Place the rinse in the waste storage drum.

4.6.1.5 Fill the container slowly with a minimum of turbulence until the meniscus touches the lip of the bottle.

4.6.1.6 Add the appropriate preservative listed in Appendix B to the sample container.

4.6.1.7 If a pH value is specified in Appendix B, remove a small sample and check the pH with pH paper.

4.6.1.8 Cap the bottle.

4.6.1.9 Attach a custody seal to the bottle and fill out the Chain-of-Custody form.

4.6.1.10 Care should be taken (especially on warm days) to place the sample(s) in a plastic bag (to protect the label from water), then place the bag in the ice chest and cover with ice as soon as reasonable to avoid unnecessary heating of the sample.

4.6.1.11 Record in the Groundwater Sampling Logbook the sequence whereby the samples were collected, the sample identification, the sample container volume and type, and the preservative added.

4.7 COLLECTION OF TRITIUM SAMPLES

4.7.1 **Samplers** shall:

4.7.1.1 Remove any luminous materials, such as watch dials, from the immediate area.

4.7.1.2 Rinse the sample bottle with the sample and return the rinse to the waste storage tank.

4.7.1.3 Fill the container slowly (to minimize turbulence) until full and then cap it.

4.7.1.4 Fill out and attach the premade sample label to bottle.

4.7.1.5 Attach a custody seal to the bottle and fill out the Chain-of-Custody form.

4.7.1.6 Care should be taken (especially on warm days) to place the sample(s) in a plastic bag (to protect the label from water), then place the bag in the ice chest and cover with ice as soon as reasonable to avoid unnecessary heating of the sample.

4.7.1.7 Record in the Groundwater Sampling Logbook the sequence whereby the samples were collected, sample identification, sample container volume and type, and preservative added.

4.8 COLLECTION OF COLIFORM BACTERIA SAMPLES

4.8.1 Coliform samples shall be collected by the Bechtel Nevada (BN) Environmental Health Section.

4.9 COMPLETION OF THE GROUNDWATER SAMPLING

4.9.1 **Samplers** shall:

4.9.1.1 Remeasure the field parameters to ensure that the groundwater chemistry has remained constant during sampling.

4.9.1.2 Place the Bennett™ pump in its dedicated purge jar. Add 11 gallons of distilled water.

4.9.1.3 Pump water through the pump until approximately 6 inches of water remains and the water is coming out of the pump

4.9.1.4 Remove the sample input screen from the pump and connect a source of nitrogen to the inlet.

4.9.1.5 Purge the pump of water by passing nitrogen at 20 to 40 psi through the pump.

4.9.1.6 Replace the input screen.

4.9.1.7 Remove the pump and dry using Kimwipes™.

4.9.1.8 Check connectors and fittings on the pump head.

4.9.1.9 Dismantle and store the equipment and probes per the manufacturer's instructions.

4.9.1.10 Cap and lock the wellhead.

4.10 FIELD QUALITY CONTROL

4.10.1 **Samplers** shall:

4.10.1.1 Prepare field blanks and field duplicates for each parameter (parameters which are analyzed by the same method do not require individual blanks and duplicates), excluding field parameters, at a frequency that is the greater of once per each week whereby sampling occurs or once for every 20 samples. A trip blank shall be prepared for volatile organics (if volatile organics are a target analyte) and tritium for each sampling trip.

NOTE: In the event that nondedicated sampling pumps are used to withdraw samples, a set of equipment blanks will be prepared before placement of the pump in the wells.

4.10.1.2 Prepare field blanks by filling a sample container with laboratory pure water in the field. The blank shall use the same container and preservative as the sample.

4.10.1.3 Prepare equipment blanks by passing distilled water (~10 gallons) through the pump apparatus. The blank shall use the same container and preservative as the target sample.

4.10.1.4 Prepare a field duplicate by collecting two groundwater samples in sequence. The field duplicate is used to assess sampling and analysis precision.

4.10.1.5 Prepare a trip blank for volatile organics (if volatile organics are a target analyte) and tritium by filling the appropriate container with laboratory pure water at the laboratory.

4.10.1.6 Preserve the trip blank by the same method as the samples. The trip blank shall be carried into the field during the sample collection operations.

4.11 TRANSPORT OF SAMPLES

4.11.1 **Samplers** shall:

4.11.1.1 At the conclusion of each sampling day, measure and record in the Groundwater Sampling Logbook the temperature in each cooler.

4.11.1.2 Whenever control of the samples is passed from one individual to another, enter the transfer on the Chain-of-Custody form. Samples shall be considered to be under a custodian's control if they are in the custodian's possession or are in a locked, secure enclosure.

NOTE: A radiological survey of the samples is required before laboratory analysis may be conducted.

4.11.1.3 Ensure that samples to be sent to the ASL are transported to the laboratory receiving area. The person receiving the samples shall sign the Chain-of-Custody form.

4.12 GROUNDWATER DATA QUALITY REVIEW

4.12.1 The **Monitoring Activity Manager** shall ensure that data is reviewed in the following manner:

NOTE: The following instructions pertain to the manual review of analytical data. An automated system (BN Integrated Data Management System [BEIDMS]) is being developed and will perform the specified review automatically when completed.

4.12.1.1 Enter on the Data Quality Summary (Appendix D) or the electronic version, the project, monitoring well identification, sampling date, reviewer's signature, analytical parameters, and field identification numbers.

4.12.1.2 Verify that the analytical method has been reported. Verify that the method used was the method requested. Mark the “Complete” and “Acceptable” column of the “Method” row with Yes (Y) or No (N), as appropriate.

4.12.1.3 Verify that the analysis date has been reported and the extraction date has been reported for organic parameters. Mark the “Complete” column of the “Method” row with Yes (Y) or No (N), as appropriate.

4.12.1.4 Calculate the analysis holding time for the sample group. If semivolatile organics are a target analyte, calculate the extraction holding time (method 8270 semivolatile organics). Record the holding times on the Data Quality Summary. Mark the “Acceptable” column Yes (Y) or No (N), as appropriate.

4.12.1.5 Verify that the concentration and units have been reported for each sample in the packet. Mark the “Complete” column of the “Sample Concentration” and “Concentration Units” row with Yes (Y) or No (N), as appropriate.

4.12.1.6 Verify that the uncertainty and number of standard deviations have been reported for radiological parameters for each sample in the packet. Mark the “Complete” column of the “Concentration Uncertainty” row with Yes (Y) or No (N), as appropriate.

4.12.1.7 Verify that the detection limit has been reported for each sample in the packet. Mark the “Complete” column of the “Detection Limit” row with Yes (Y) or No (N), as appropriate.

4.12.1.8 Compare the reported detection limit with the data quality objectives. Mark the “Acceptable” column with Yes (Y) or No (N), as appropriate.

4.12.1.9 Verify that the laboratory has analyzed and reported blank values and spike results for inorganic and radiological parameters. Verify that the laboratory has analyzed and reported blank and surrogate spike results for organic parameters. Mark the “Complete” column of the “Laboratory QC” row with yes (Y) or No (N), as appropriate.

4.12.1.10 Compare the matrix spike percent recovery with the data quality objectives. Mark the “Acceptable” column of the “Laboratory QA” row with Yes (Y) or No (N), as appropriate.

4.12.1.11 Verify that the Chain-of-Custody form is present. Mark the "Complete" column of the "Chain of Custody" row with Yes (Y) or No (N), as appropriate.

4.12.1.12 Verify that laboratory management has reviewed and signed the data package. Mark the "Complete" column of the "Laboratory Approval" row with Yes (Y) or No (N), as appropriate.

4.12.1.13 Calculate the relative percent difference of the field duplicates or co-located samples for any analyte detected in both samples. If the analyte is not detected in both samples, fill the blank with N/A. Otherwise, record the relative percent difference in the blank. Mark the "Acceptable" column of the "Relative Percent Difference" row with Yes (Y) or No (N), as appropriate.

4.12.1.14 Review the field blank and the trip blank for volatile organics (if volatile organics are a target analyte).

4.12.1.15 If all blanks in the complete and acceptable column are marked (Y) or N/A, the package is considered acceptable. If any blank has been marked (N), the package may still be accepted. For these cases, describe the justification for accepting the package under data qualification. Attach additional pages if necessary. Mark the "Acceptable" column on the "Date Package" row, as appropriate.

5.0 TRAINING

5.1 All personnel shall be trained on the safety and operations of the equipment required for the proper implementation of this procedure as described below.

5.2 Personnel involved in this activity shall read and understand this procedure and demonstrate proper implementation of this procedure.

5.3 All sampling personnel shall have the following training:

- Occupational Safety and Health Administration 40-hour Hazardous Waste Site General Worker
- Radiation Worker Training

5.4 Attend the periodic facility safety training program. See Appendix C for the Groundwater Sampling Qualification and Training History documentation.

6.0 FORMS

NOTE: The implementation of the BEIDMS system may change the number of forms required.

6.1 Analytical Services Laboratory Statement of Work.

6.2 Chain-of-Custody.

7.0 RECORDS MANAGEMENT

7.1 This procedure generates the following records:

Record	Disposition Authority	Disposition Instructions	Office of Record
Analytical Services Laboratory Statement of Work	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Chain-of-Custody	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Data Quality Summary	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Groundwater Sampling Qualification and Training History	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Groundwater Sampling Logbook	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Groundwater Sampling Instruction Procedure	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Laboratory deliverables	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07

8.0 REFERENCES

8.1 Title 40 CFR Part 265, U.S. Environmental Protection Agency, “Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities.”

8.2 U.S. Environmental Protection Agency, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846.

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

8.4 U.S. EPA, RCRA Ground Water Monitoring: Draft Technical Guidance, 1994.

8.5 Nevada Administrative Code, Public Water Supplies, State of Nevada, Chapter 445, December 30, 1980.

8.6 DOE Order 5820.2A, "Radioactive Waste Management," 1988.

8.7 *Radiological Control Manual*, DOE N 5480.6, 1999, Revision 3.

8.8 DOE, 1995. Revision 0, "Groundwater Monitoring Well Purging and Sampling," ERD-05-304. Las Vegas, Nevada.

8.9 Bechtel Nevada, Revised Area 5 Radioactive Waste Management Site Outline of a Comprehensive Groundwater Monitoring Program, February 1998.

8.10 Bechtel Nevada Company Policy A-A11.01, "Safety and Health Policy."

8.11 Bechtel Nevada Company Safety Procedure M-A11.001, "General Safety Rules."

8.12 Bechtel Nevada Company Safety Procedure M-A11.003, "Safety Meetings."

8.13 Bechtel Nevada Company Safety Procedure M-A11.006, "Employee/Supervisor Safety Inspections."

8.14 Bechtel Nevada Company Safety Procedure M-A11.014, "Selecting, Using, and Storing Chemicals."

8.15 Bechtel Nevada Company Safety Procedure M-A11.015, "Hazard Communication."

8.16 Bechtel Nevada Company Safety Procedure M-A11.050, "Housekeeping/Fire Protection."

8.17 Bechtel Nevada Company Safety Procedure M-A11.060, "Personal Protective Equipment."

9.0 DEFINITIONS

9.1 **Accuracy**. A measure of the deviation of a measured value from the true value.

9.2 **Completeness**. The percentage of required data that is obtained that meets the data quality objectives.

9.3 **Data Quality Objective**. Data quality requirements used to assure that environmental data is usable for its intended purpose.

9.4 **Equipment Blank**. A field quality control sample prepared by rinsing sampling equipment with laboratory pure water. The equipment blank is used to assess contamination by sampling equipment.

9.5 **Field Blank**. A field quality control sample prepared from laboratory pure water in the field. The field blank is used to assess contamination from sample containers and contamination present in the sampling environment.

9.6 **Field Duplicate**. A field quality control sample prepared by collecting two groundwater samples in sequence. The field duplicate is used to assess sampling and analysis precision.

9.7 **Percent Recovery**. The percentage of an analyte added to a sample that is recovered in analysis. Computationally, the measured concentration of a spiked sample divided by the sum of the concentration of the analyte added and the concentration of the sample, expressed as a percentage.

9.8 **Precision**. A measure of the dispersion of replicate measurements about the mean value.

9.9 **Relative Percent Difference**. An estimate of the precision of replicate samples. Computationally, the difference between two measure values divided by the mean, expressed as a percentage.

9.10 **Representativeness**. The extent to which the concentration of an analyte in a sample represents the concentration of the analyte in the environment.

9.11 **Sensitivity**. A measure of the ability of an analysis system to detect the presence of an analyte.

9.12 **Trip Blank**. A quality control sample prepared from laboratory pure water in the laboratory and transported to and from the sampling site with the samples. The trip blank is used to assess contamination of samples by volatile parameters during transport.

10.0 APPENDICES

10.1 Appendix A: Groundwater Sampling Flow Diagram.

10.2 Appendix B: Sample Containers and Preservation.

10.3 Appendix C: Groundwater Sampling Qualification and Training History.

10.4 Appendix D: Sample Data Quality Summary.

ORGANIZATION PROCEDURE

Title: **INSTRUCTIONS FOR AREA 5 RWMS GROUNDWATER WELL PREPARATION AND GROUNDWATER SAMPLING** **Page 20 of 24**

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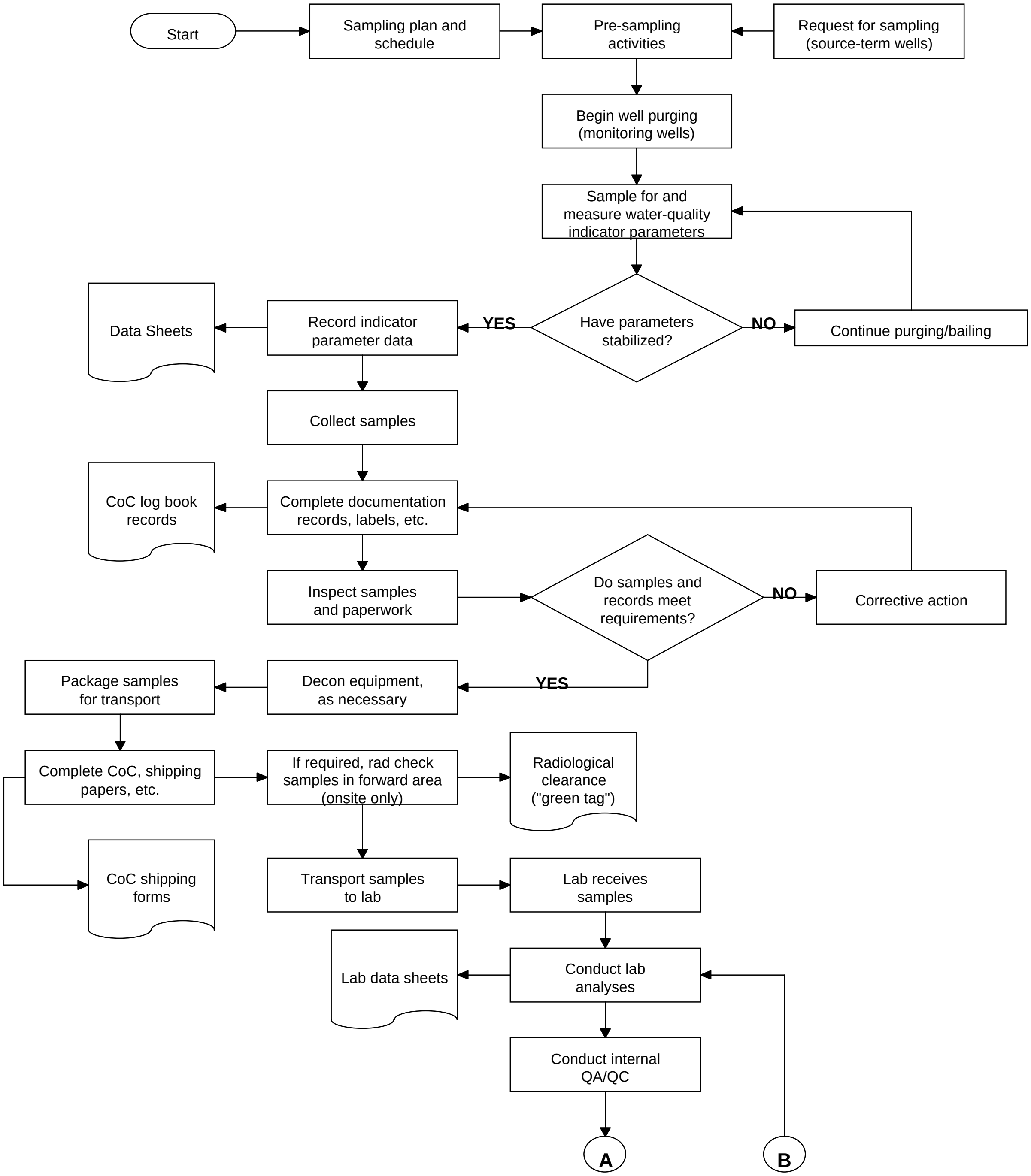
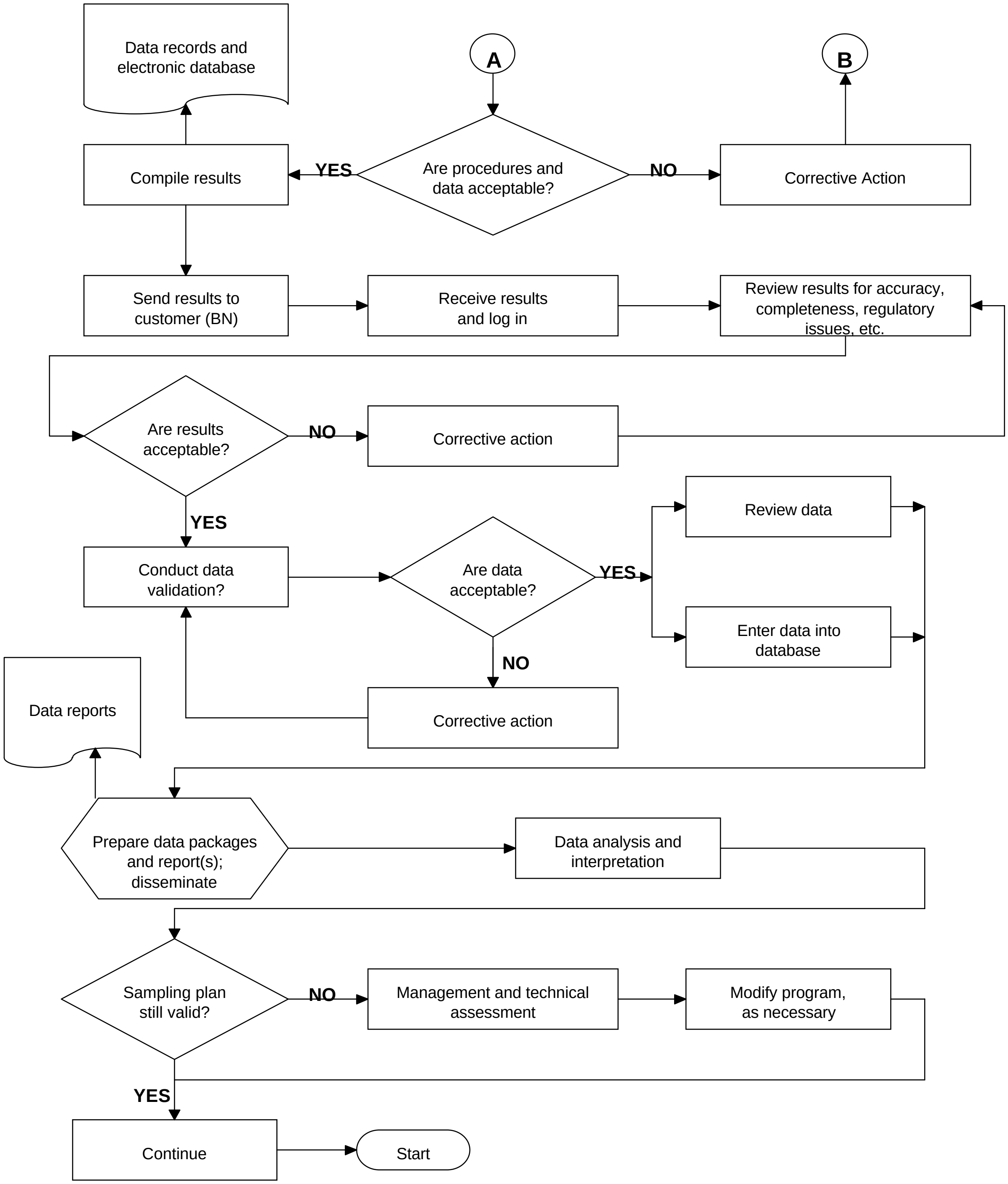
APPENDIX A - Groundwater Sampling Flow Diagram



APPENDIX A (Continued)



APPENDIX B

Sample Containers and Preservation

Parameter (Method)	# per Sample	Volume	Container	Preservation	Holding Time
TOX (9020B)	1	500 ml	Amber glass bottle with Teflon™-lined cap	Acidify pH < 2 with concentrated H_2SO_4; cool to 4°C. No headspace.	7 days for extraction 40 days for analysis
TOC (415.2)	1	250 ml	Amber glass bottle with Teflon™-lined cap	Acidify to pH < 2 with concentrated HCl; cool to 4°C. No headspace.	28 days
Cl, SO_4, F (300)	1	250 ml	Polyethylene bottle	None required per method.	28 days
HCO_3 and H_2CO_3 (2320B)	1	250 ml	Polyethylene bottle	None required per method.	14 days
Na, Ca, Mg, Mn, K, Fe, SiO_2 (200.7)	1	500 ml	Polyethylene bottle	Acidify to pH < 2 with HNO_3.	180 days
Enriched Tritium (L-E10.615.PL)	1	1 liter	Glass bottle	None	6 months

ORGANIZATION PROCEDURE

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APPENDIX C

Groundwater Sampling Qualification and Training History

Name:	Activity Manager:			
QUALIFICATIONS				
Education:				
Brief Description of Experience				
ASSIGNMENT	Required (Y/N)	1) Initials and Date	2) Initials and Date	3) Initials and Date
Read instruction	Y			
Demonstrate proper implementation of instruction	Y			
Familiar with Facility Safety & Area 5 Contingency Plan	Y			
OSHA 40-hr/Hazardous Waste Site General Worker	Y			
Radiation Worker Training	Y			
Attend Program Safety Training Meetings	Y			
Proper handling of acid	Y			
Familiar with MSDS's	Y			

ORGANIZATION PROCEDURE

Title: **INSTRUCTIONS FOR AREA 5 RWMS GROUNDWATER WELL PREPARATION AND GROUNDWATER SAMPLING**

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APPENDIX D - Sample Data Quality Summary

WELL IDENTIFICATION **Ue5PW-1**
SAMPLE COLLECTION DATE: **DD MM YY**

SAMPLE IDENTIFICATION NUMBER	ID		ID		ID	
Fraction	X=A X=B X=C X=D	X=A X=B X=C X=D	X=A X=B X=C X=D	X=A X=B X=C X=D	X=A X=B X=C X=D	X=A X=B X=C X=D
Parameter	Parameter	Parameter	Parameter	Parameter	Parameter	Parameter
Method	Method	Method	Method	Method	Method	Method
Extraction/Prep Holding Time	NA	NA	NA	NA	NA	NA
Analysis Holding Time	YES	YES	YES	YES	YES	YES
Sample Concentration	YES	YES	YES	YES	YES	YES
Concentration Units	YES	YES	YES	YES	YES	YES
Concentration Uncertainty (Rad)	NA	NA	NA	NA	NA	NA
Number of Standard Deviations (Rad)	NA	NA	NA	NA	NA	NA
Detection Limit	YES	YES	YES	YES	YES	YES
Laboratory QC	YES	YES	YES	YES	YES	YES
Laboratory QA	YES	YES	YES	YES	YES	YES
Chain of Custody	YES	YES	YES	YES	YES	YES
Laboratory Approval	YES	YES	YES	YES	YES	YES
Relative Percent Difference	YES	YES	YES	YES	YES	YES
Field Blank/Trip Blank	NA	NA	NA	NA	YES	YES
Data Package	YES	YES	YES	YES	YES	YES
Data Qualifications	YES	YES	YES	YES	YES	YES
REVIEWER:						
REVIEWER'S INITIALS AND DATE:						

COMMENTS: YES - Complete and acceptable; NO - Incomplete and/or unacceptable; NA - Nonapplicable

Appendix E

Quality Control Results

I. INTRODUCTION

To aid in determining the source of the anomalous TOX and TOC results received for some samples collected in 2000, quality control samples were submitted (blind) to the laboratories (RECRA and General Engineering Laboratories) selected for use in 2001. These control samples were prepared by Environmental Resource Associates (ERA) using DOE provided sample containers. Control samples consisting of both spiked and blank containers were submitted prior to conducting sampling events and along with field samples. Control samples submitted prior to the sampling events were used to evaluate laboratory performance and determine if the sampling equipment (bottles preservatives, and blank water) used by DOE were contaminated. Control samples submitted along with collected field samples were used to evaluate batch specific analytical performance. Tables E.1 and E.2 present results from quality control samples submitted for TOC and TOX analyses, respectively. Dates of May 29 and October 2, 2001 listed in the tables represent control samples submitted with field samples. Dates prior to these represent analytical batches of control samples only.

II. RESULTS

A. TOC

Data received from TOC control samples submitted prior to field sampling has shown analytical performance to be wide ranging. Combined (both labs) results for spiked samples ranged from 110-254 percent recovery. An ERA blank and samples consisting of ERA blank water acidified with H_2SO_4 and HCl, provided by the NNSA, had reported detections above the MDL from RECRA Laboratory. The two samples prepared, using the acid provided by the NNSA, had reported concentrations above 1 mg/L (the current investigation level). Initially, these results indicated contaminated acids; however, later analyzes by RECRA and General Engineering Laboratories have shown the acid to be uncontaminated, indicating previous detections were false positives. The same lot number and specific bottles of acid have been used throughout the 2000 and 2001 sampling and quality control investigations. General Engineering Laboratories did not report any detections above 0.5 mg/L in any blank sample.

Control samples submitted with field samples had spike recoveries ranging from 97-124 percent, while all blank samples submitted were reported as non-detect.

B. TOX

Data received from TOX control samples submitted prior to field sampling has yielded some interesting information. Primarily, HPLC grade water previously used for field blanks had a detection of 38 ug/L. This result was confirmed during several unrelated sampling events where HPLC grade water was used for volatiles analysis (VOA) trip blanks and the halogenated compound chloroform was reported at concentrations of 40-50 ug/L. These data are generally consistent with levels previously reported in TOX field blanks and prompted the NNSA to use VOA-free certified water for all TOX blank samples. Interestingly, the sample prepared with off the shelf variety of Sparkletts distilled water was reported as a non-detect. The ERA prepared blank samples and ERA blank water acidified with acids provided by the NNSA results were all below detection levels, with the exception of a small (<20 ug/L) detection, as expected, due to the presence of chloride in the sample preserved with HCl.

Control samples submitted with field samples had spike recoveries ranging from 48-81 percent, while all but one of the blank samples submitted were reported as non-detect.

III. SUMMARY

From the relatively small set of samples submitted, the following general conclusions may be made:

- TOC concentrations tend to be overestimated, especially at low levels
- TOX concentrations tend to be underestimated
- HPLC grade water is not appropriate for use as TOX analyses blanks
- False positives for TOC have been reported at significant (3 x MDL) levels by RECRA
- Sampling equipment, containers, and preservatives used by the NNSA were not the source of detections above the IL reported in 2000
- TOX and TOC methods may exhibit significant variability with low-level concentrations

Table E.1 TOC Quality Control Results

Date	Analyte	Sample Prep	True Value	Result	Units	% Recovery	Qualifier	MDL	Laboratory	Method
12-Feb 2001	TOC	ERA blank		0.76	MG/L			0.5	RECRA	SW9060
12-Feb 2001	TOC	ERA blank, DOE HCl		1.7	MG/L			0.5	RECRA	SW9060
12-Feb 2001	TOC	ERA blank, DOE H2SO4		1.2	MG/L			0.5	RECRA	SW9060
12-Feb 2001	TOC	ERA blank, DOE HNO3		0.5	MG/L		U	0.5	RECRA	SW9060
12-Feb 2001	TOC	ERA spiked @ 0.5 mg/L TOC	0.5	0.87	MG/L	174		0.5	RECRA	SW9060
19-Feb 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	1.1	MG/L	110		0.5	RECRA	SW9060
12-Feb 2001	TOC	ERA spiked @ 1.5 mg/L TOC	1.5	2.1	MG/L	140		0.5	RECRA	SW9060
26-Mar 2001	TOC	ERA blank		0.175	MG/L		J	0.0406	GEL	EPA415.1
26-Mar 2001	TOC	ERA blank, DOE HCl		0.5	MG/L		U	0.0406	GEL	EPA415.1
26-Mar 2001	TOC	ERA blank, DOE H2SO4		0.0646	MG/L		J	0.0406	GEL	EPA415.1
26-Mar 2001	TOC	ERA blank, DOE HNO3		0.133	MG/L		J	0.0406	GEL	EPA415.1
28-Mar 2001	TOC	DOE Sparkletts blank		0.216	MG/L		J	0.0406	GEL	EPA415.1
26-Mar 2001	TOC	ERA spiked @ 0.5 mg/L TOC	0.5	1.27	MG/L	254		0.0406	GEL	EPA415.1
26-Mar 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	1.43	MG/L	143		0.0406	GEL	EPA415.1
26-Mar 2001	TOC	ERA spiked @ 1.5 mg/L TOC	1.5	1.88	MG/L	125		0.0406	GEL	EPA415.1
29-May 2001	TOC	ERA blank		0.0712	MG/L		J	0.0406	GEL	EPA415.1
29-May 2001	TOC	ERA blank		0.0501	MG/L		J	0.0406	GEL	EPA415.1
29-May 2001	TOC	ERA blank		0.0514	MG/L		J	0.0406	GEL	EPA415.1
29-May 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	1.24	MG/L	124		0.0406	GEL	EPA415.1
29-May 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	1.21	MG/L	121		0.0406	GEL	EPA415.1
29-May 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	1.2	MG/L	120		0.0406	GEL	EPA415.1
29-May 2001	TOC	ERA blank		0.5	MG/L		U	0.5	RECRA	EPA415.1
29-May 2001	TOC	ERA blank		0.5	MG/L		U	0.5	RECRA	EPA415.1
29-May 2001	TOC	ERA blank		0.5	MG/L		U	0.5	RECRA	EPA415.1
29-May 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	0.97	MG/L	97		0.5	RECRA	EPA415.1
29-May 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	1.1	MG/L	110		0.5	RECRA	EPA415.1
29-May 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	1.1	MG/L	110		0.5	RECRA	EPA415.1
02-Oct 2001	TOC	ERA blank		0.5	MG/L		U		RECRA	EPA415.1
02-Oct 2001	TOC	ERA blank		0.5	MG/L		U		RECRA	EPA415.1
02-Oct 2001	TOC	ERA blank		0.5	MG/L		U		RECRA	EPA415.1
02-Oct 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	1.2	MG/L	120			RECRA	EPA415.1
02-Oct 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	1.2	MG/L	120			RECRA	EPA415.1
02-Oct 2001	TOC	ERA spiked @ 1.0 mg/L TOC	1.0	1.2	MG/L	120			RECRA	EPA415.1

U = result is less than the method detection limit

J = result is less than the requested method detection limit but greater than the actual detection limit achieved

Table E.2 TOX Quality Control Results

Date	Analyte	Sample Prep	True Value	Result	Units	% Recovery	Qualifier	MDL	Laboratory	Method
12-Feb 2001	TOX	ERA blank		12	UG/L		U	12	RECRA	SW9020B
12-Feb 2001	TOX	ERA blank, DOE HCl		19.7	UG/L			12	RECRA	SW9020B
12-Feb 2001	TOX	ERA blank, DOE HNO3		12	UG/L		U	12	RECRA	SW9020B
12-Feb 2001	TOX	ERA blank, DOE H2SO4		12	UG/L		U	12	RECRA	SW9020B
14-Feb 2001	TOX	DOE Fisher HPLC grade water		38.5	UG/L			12	RECRA	SW9020B
12-Feb 2001	TOX	ERA spiked @ 25 ug/L TOX	25	23.1	UG/L	92		12	RECRA	SW9020B
19-Feb 2001	TOX	ERA spiked @ 50 ug/L TOX	50	38.2	UG/L	76		12	RECRA	SW9020B
12-Feb 2001	TOX	ERA spiked @ 100 ug/L TOX	100	92.3	UG/L	92		12	RECRA	SW9020B
26-Mar 2001	TOX	ERA blank		10	UG/L		U	2.96	GEL	SW9020B
26-Mar 2001	TOX	ERA blank, DOE H2SO4		10	UG/L		U	2.96	GEL	SW9020B
26-Mar 2001	TOX	ERA blank, DOE HNO3		10	UG/L		U	2.96	GEL	SW9020B
26-Mar 2001	TOX	ERA blank, DOE HCl		9.36	UG/L		J	2.96	GEL	SW9020B
28-Mar 2001	TOX	DOE Sparkletts blank		10	UG/L		U	2.96	GEL	SW9020B
26-Mar 2001	TOX	ERA spiked @ 25 ug/L TOX	25	8.64	UG/L	35	J	2.96	GEL	SW9020B
26-Mar 2001	TOX	ERA spiked @ 50 ug/L TOX	50	28.9	UG/L	58		2.96	GEL	SW9020B
26-Mar 2001	TOX	ERA spiked @ 100 ug/L TOX	100	45.9	UG/L	46		2.96	GEL	SW9020B
29-May 2001	TOX	ERA blank		12	UG/L		U	12	RECRA	SW9020B
29-May 2001	TOX	ERA blank		12	UG/L		U	12	RECRA	SW9020B
29-May 2001	TOX	ERA blank		12	UG/L		U	12	RECRA	SW9020B
29-May 2001	TOX	ERA spiked @ 50 ug/L TOX	50	32.3	UG/L	65		12	RECRA	SW9020B
29-May 2001	TOX	ERA spiked @ 50 ug/L TOX	50	34.8	UG/L	70		12	RECRA	SW9020B
29-May 2001	TOX	ERA spiked @ 50 ug/L TOX	50	37.3	UG/L	75		12	RECRA	SW9020B
29-May 2001	TOX	ERA blank		10	UG/L		U	2.96	GEL	SW9020B
29-May 2001	TOX	ERA blank		10	UG/L		U	2.96	GEL	SW9020B
29-May 2001	TOX	ERA blank		6.24	UG/L		J	2.96	GEL	SW9020B
29-May 2001	TOX	ERA spiked @ 50 ug/L TOX	50	28.1	UG/L	56		2.96	GEL	SW9020B
29-May 2001	TOX	ERA spiked @ 50 ug/L TOX	50	23.9	UG/L	48		2.96	GEL	SW9020B
02-Oct 2001	TOX	ERA blank		5.2	UG/L		U		RECRA	SW9020B
02-Oct 2001	TOX	ERA blank		5.2	UG/L		U		RECRA	SW9020B
02-Oct 2001	TOX	ERA blank		5.2	UG/L		U		RECRA	SW9020B
02-Oct 2001	TOX	ERA spiked @ 50 ug/L TOX	50	30.4	UG/L	61			RECRA	SW9020B
02-Oct 2001	TOX	ERA spiked @ 50 ug/L TOX	50	29.7	UG/L	59			RECRA	SW9020B
02-Oct 2001	TOX	ERA spiked @ 50 ug/L TOX	50	40.3	UG/L	81			RECRA	SW9020B

U = result is less than the method detection limit

J = result is less than the requested method detection limit but greater than the actual detection limit achieved