BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT

Rocky Flats Plant

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

SEPTEMBER 30, 1993

EG&G Rocky Flats, Inc.
Golden, Colorado

DOCUMENT CLASSIFICATION
REVIEW WAIVER PER
CLASSIFICATION OFFICE

BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT

ROCKY FLATS PLANT
GOLDEN, COLORADO

September 30, 1993

Prepared for:
U.S. Department of Energy
Rocky Flats Plant
Golden, Colorado 80401

Prepared by:
EG&G Rocky Flats, Inc.
P.O. Box 464
Golden, Colorado 80402

CONTENTS

CONTENTS

Page

TABLES, FIGURES, AND PLATES ix
ACRONYMS AND ABBREVIATIONS xi

EX. EXECUTIVE SUMMARY EX-1

1. INTRODUCTION AND METHODS 1-1
1.1 INTRODUCTION 1-1
1.2 HISTORICAL BACKGROUND OF ROCKY FLATS PLANT 1-2
1.3 GENERAL APPROACH: SAMPLE CLASSIFICATION 1-3
1.4 PRELIMINARY DATA ANALYSIS 1-3
1.4.1 Treatment of Quality Control Data 1-4
1.4.2 Treatment of Duplicates 1-4
1.4.3 Screening of Outliers 1-4
1.4.4 Data Below the Detection Limit 1-6
1.4.5 Evaluation of Data Distributions 1-8
1.5 EVALUATION OF POPULATIONS 1-9
1.5.1 Definitions 1-9
1.5.2 Sample Media 1-10
1.5.3 Selection Criteria 1-11
1.5.4 Analysis of Variance Designs 1-11
1.5.5 Parametric Analysis of Variance and Related Tests 1-13
1.5.6 Test of Assumptions for Analysis of Variance 1-14
1.5.6.1 Tests of Normality 1-14
1.5.6.2 Testing Homogeneity of Variance 1-14
1.5.7 Nonparametric Analysis of Variance 1-14
1.6 CALCULATION OF DESCRIPTIVE STATISTICS 1-15
1.6.1 Tolerance Limits 1-15
1.6.2 Statistical Formulas 1-17
1.6.3 Seasonality Investigations 1-20
1.7 COMPARISON OF BACKGROUND AND NON-BACKGROUND POPULATIONS 1-21
1.7.1 Selection of Evaluation Methods 1-21
1.8 GEOCHEMICAL EVALUATIONS 1-23
1.8.1 Review of Geochemical Data 1-24
1.8.2 Water-Quality Trends 1-24

2. PHYSICAL SETTING OF ROCKY FLATS PLANT 2-1
2.1 TOPOGRAPHY 2-1
2.2 SURFACE WATER HYDROLOGY 2-1
2.3 REGIONAL AND LOCAL GEOLOGY 2-4
2.3.1 Quaternary-Aged Alluvia 2-4
2.3.2 Cretaceous-Aged Deposits 2-11
2.3.2.1 Arapahoe Formation 2-11

Page

2.3.2.2 Laramie Formation 2-12
2.3.2.3 Fox Hills Sandstone 2-13
2.3.3 Structural Features 2-13
2.4 HYDROGEOLOGY 2-14
2.4.1 Summary: Rocky Flats Plant Groundwater Flow 2-16
2.5 METEOROLOGY AND CLIMATOLOGY 2-16

3. BACKGROUND SAMPLING PROGRAM 3-1
3.1 SAMPLING LOCATIONS 3-1
3.1.1 Geologic Materials from Boreholes 3-2
3.1.1.1 Boreholes in Rocky Flats Alluvium 3-3
3.1.1.2 Boreholes in Colluvium 3-3
3.1.1.3 Boreholes in Weathered Bedrock 3-3
3.1.2 Groundwater 3-4
3.1.2.1 Groundwater in Rocky Flats Alluvium 3-4
3.1.2.2 Groundwater in Colluvium 3-5
3.1.2.3 Groundwater in Valley-Fill Alluvium 3-5
3.1.2.4 Groundwater in Bedrock 3-5
3.1.3 Surface Water 3-6
3.1.4 Stream Sediment 3-7
3.2 SAMPLING AND DATA COLLECTION 3-8
3.2.1 Drilling and Logging 3-9
3.2.2 Borehole Sampling 3-12
3.2.2.1 Boreholes in Rocky Flats Alluvium 3-12
3.2.2.2 Boreholes in Colluvium and Bedrock 3-12
3.2.3 Installation of Monitoring Wells 3-13
3.2.4 Well Development 3-16
3.2.5 Sampling of Groundwater 3-18
3.2.6 Sampling of Surface Water 3-18
3.2.7 Sampling of Sediment 3-19
3.3 CHEMICAL ANALYSES 3-19
3.3.1 Analytical Parameters 3-19
3.3.1.1 Radionuclides and Metals 3-20
3.3.1.2 Other Inorganics and Anions 3-20
3.3.1.3 Indicators and Field Parameters 3-20
3.3.1.4 Organics 3-24
3.3.2 Data Quality 3-24
3.3.2.1 Analytical Methods 3-24
3.3.2.2 Instrument Detection Limits 3-24
3.3.2.3 Comparison Between Detection Limits and Exposure Limits 3-25

4. DATA QUALITY 4-1
4.1 QUALITY ASSURANCE/QUALITY CONTROL 4-1
4.2 DATA VALIDATION 4-1

Page

4.3 DATA-QUALITY ASSESSMENT - PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY PARAMETERS 4-3
4.3.1 Introduction 4-3
4.3.2 Precision 4-4
4.3.2.1 Groundwater Assessment 4-5
4.3.2.1.1 Dissolved Metals 4-5
4.3.2.1.2 Total Metals 4-6
4.3.2.1.3 Dissolved Radionuclides 4-6
4.3.2.1.4 Total Radionuclides 4-7
4.3.2.1.5 Anions, Cyanide, and Water-Quality Parameters 4-7
4.3.2.1.6 Organic Compounds 4-8
4.3.2.2 Stream Water Assessment 4-8
4.3.2.2.1 Dissolved Metals 4-8
4.3.2.2.2 Total Metals 4-9
4.3.2.2.3 Dissolved Radionuclides 4-9
4.3.2.2.4 Total Radionuclides 4-10
4.3.2.2.5 Anions, Cyanide, and Water-Quality Parameters 4-10
4.3.2.2.6 Organic Compounds 4-11
4.3.2.3 Seep/Spring Water Assessment 4-11
4.3.2.3.1 Dissolved Metals 4-11
4.3.2.3.2 Total Metals 4-12
4.3.2.3.3 Dissolved Radionuclides 4-12
4.3.2.3.4 Total Radionuclides 4-12
4.3.2.3.5 Anions, Cyanide, and Water-Quality Parameters 4-12
4.3.2.3.6 Organic Compounds 4-13
4.3.2.4 Borehole Materials 4-13
4.3.2.4.1 Metals 4-13
4.3.2.4.2 Radionuclides 4-13
4.3.2.4.3 Anions, Cyanide, and Water-Quality Parameters 4-14
4.3.2.4.4 Organic Compounds 4-14
4.3.2.5 Stream Sediment Assessment 4-14
4.3.2.5.1 Metals 4-14
4.3.2.5.2 Radionuclides 4-15
4.3.2.5.3 Anions, Cyanide, and Water-Quality Parameters 4-15
4.3.2.5.4 Organic Compounds 4-15
4.3.2.6 Seep/Spring Sediment Assessment 4-15
4.3.2.6.1 Metals 4-15
4.3.2.6.2 Radionuclides 4-16
4.3.2.6.3 Anions, Cyanide, and Water-Quality Parameters 4-16
4.3.2.6.4 Organic Compounds 4-16
4.3.3 Accuracy 4-16
4.3.3.1 Groundwater Assessment 4-18
4.3.3.1.1 Dissolved Metals 4-18
4.3.3.1.2 Total Metals 4-18

Page

4.3.3.1.3 Radionuclides 4-18
4.3.3.1.4 Anions, Cyanide, and Water-Quality Parameters 4-19
4.3.3.1.5 Organic Compounds 4-19
4.3.3.2 Stream Water Assessment 4-19
4.3.3.2.1 Dissolved Metals 4-19
4.3.3.2.2 Total Metals 4-20
4.3.3.2.3 Radionuclides 4-20
4.3.3.2.4 Anions, Cyanide, and Water-Quality Parameters 4-20
4.3.3.2.5 Organic Compounds 4-20
4.3.3.3 Spring/Seep Water Assessment 4-21
4.3.3.4 Borehole Materials Assessment 4-21
4.3.3.5 Stream Sediment Assessment 4-22
4.3.3.5.1 Metals 4-22
4.3.3.5.2 Radionuclides 4-22
4.3.3.5.3 Anions, Cyanide, and Water-Quality Parameters 4-22
4.3.3.5.4 Organic Compounds 4-22
4.3.3.6 Seep/Spring Sediment Assessment 4-23
4.3.3.6.1 Metals 4-23
4.3.3.6.2 Radionuclides 4-23
4.3.3.6.3 Anions, Cyanide, and Water-Quality Parameters 4-24
4.3.3.6.4 Organic Compounds 4-24
4.3.4 Representativeness 4-24
4.3.4.1 Groundwater Assessment 4-25
4.3.4.1.1 Dissolved Metals 4-25
4.3.4.1.2 Total Metals 4-26
4.3.4.1.3 Dissolved Radionuclides 4-26
4.3.4.1.4 Total Radionuclides 4-26
4.3.4.1.5 Anions, Cyanide, and Water-Quality Parameters 4-27
4.3.4.1.6 Organic Compounds 4-27
4.3.4.2 Stream Water Assessment 4-27
4.3.4.2.1 Dissolved and Total Metals 4-27
4.3.4.2.2 Dissolved and Total Radionuclides 4-28
4.3.4.2.3 Anions, Cyanide, and Water-Quality Parameters 4-28
4.3.4.2.4 Organic Compounds 4-28
4.3.4.3 Seep/Spring Water Assessment 4-29
4.3.4.4 Borehole Materials Assessment 4-29
4.3.4.5 Stream Sediment Assessment 4-29
4.3.4.5.1 Metals 4-29
4.3.4.5.2 Radionuclides 4-29
4.3.4.5.3 Anions, Cyanide, and Water-Quality Parameters 4-30
4.3.4.5.4 Organic Compounds 4-30
4.3.4.6 Seep/Spring Sediment Assessment 4-30
4.3.5 Completeness 4-30

Page

4.3.6 Comparability 4-31
4.3.6.1 Groundwater Assessment 4-32
4.3.6.2 Stream Water Assessment 4-32
4.3.6.3 Seep/Spring Water Assessment 4-32
4.3.6.4 Borehole Materials Assessment 4-33
4.3.6.5 Stream Sediment Assessment 4-33
4.3.6.6 Seep/Spring Sediment Assessment 4-33
4.3.7 Summary by Medium 4-33
4.3.7.1 Groundwater Assessment 4-36
4.3.7.2 Stream Water Assessment 4-37
4.3.7.3 Seep/Spring Water Assessment 4-38
4.3.7.4 Borehole Materials Assessment 4-38
4.3.7.5 Stream Sediment Assessment 4-39
4.3.7.6 Seep/Spring Sediment Assessment 4-40
4.4 GEOCHEMICAL DATA-QUALITY CRITERIA 4-40
4.4.1 Groundwater Quality Criteria 4-40
4.4.2 Surface-Water Quality Criteria 4-42

5. BACKGROUND GEOCHEMICAL CHARACTERIZATION 5-1
5.1 INTRODUCTION 5-1
5.2 GROUNDWATER 5-2
5.2.1 Statistical Results for Groundwater 5-2
5.2.1.1 Filtered Metals in Groundwater 5-3
5.2.1.2 Total Metals in Groundwater 5-3
5.2.1.3 Filtered Radionuclides in Groundwater 5-4
5.2.1.4 Total Radionuclides in Groundwater 5-4
5.2.1.5 Water-Quality Parameters in Groundwater 5-5
5.2.1.6 Organics in Groundwater 5-5
5.2.1.7 Groundwater Field Parameters 5-5
5.2.2 Groundwater Geochemistry 5-6
5.2.2.1 Stiff Plots Depicting Groundwater Chemistry 5-6
5.2.2.2 Piper Diagrams Depicting Groundwater Chemistry 5-13
5.2.2.3 Schoeller Diagram Depicting Groundwater Chemistry 5-16
5.2.2.4 Other Chemical Diagrams 5-23
5.3 STREAM WATER 5-23
5.3.1 Statistics 5-23
5.3.2 Stream Water Geochemistry 5-23
5.4 SEEP/SPRING WATER 5-29
5.4.1 Statistics 5-29
5.4.2 Geochemistry of Seep Water 5-33
5.5 STREAM SEDIMENTS AND SEEP/SPRING SEDIMENTS 5-33
5.5.1 Statistics for Stream Sediments 5-33
5.5.2 Statistics for Seep/Spring Sediments 5-33

Page

5.6 GEOLOGIC MATERIALS 5-36
5.6.1 Statistical Results for Geologic (Borehole) Materials 5-36
5.6.1.1 Total Metals in Geologic (Borehole) Materials 5-36
5.6.1.2 Total Radionuclides in Geologic (Borehole) Materials 5-36
5.6.1.3 Total Water-Quality Parameters in Geologic Materials . . . 5-37
5.7 SEASONALITY IN THE NATURAL WATERS OF ROCKY FLATS PLANT 5-37
5.7.1 Seasonality in Groundwater 5-39
5.7.1.1 Seasonality for Dissolved Metals in Groundwater 5-39
5.7.1.2 Seasonality for Total Metals in Groundwater 5-39
5.7.1.3 Seasonality for Dissolved Radionuclides in Groundwater . . 5.40
5.7.1.4 Seasonality in Total Radionuclides in Groundwater 5-40
5.7.1.5 Seasonality in Water-Quality Parameters in Groundwater . 5-40
5.7.2 Seasonality in Stream Water 5-40
5.7.2.1 Seasonality for Dissolved Metals in Stream Water 5-40
5.7.2.2 Seasonality for Total Metals in Stream Water 5-41
5.7.2.3 Seasonality for Dissolved Radionuclides in Stream Water . 5-41
5.7.2.4 Seasonality for Total Radionuclides in Stream Water 5-41
5.7.2.5 Seasonality for Water-Quality Parameters in Stream Water 5-41
5.7.3 Seasonality in Seep/Spring Water 5-42
5.7.3.1 Seasonality for Dissolved Metals in Seep/Spring Water . . . 5-42
5.7.3.2 Seasonality for Total Metals in Seep/Spring Water 5-42
5.7.3.3 Seasonality for Dissolved Radionuclides in Seep/Spring Water 5.42
5.7.3.4 Seasonality for Total Radionuclides in Seep/Spring Water 5-42
5.7.3.5 Seasonality for Water-Quality Parameters in Seep/Spring Water 5-43
5.7.4 Overall Seasonality in Aqueous Media 5-43
5.8 DISTINGUISHING BACKGROUND URANIUM FROM CONTAMINATION 5-43

REFERENCES R-1

APPENDIX A . . . . . .
CHEMICAL DATA (AND DISKETTE) A-1

APPENDIX B . . . . . .
GRAPHICAL RESULTS FROM ANALYSIS OF VARIANCE B-1

APPENDIX C . . . . . .
UPPER TOLERANCE LIMITS C-1

APPENDIX D . . . . . .
DESCRIPTIVE SUMMARY STATISTICS D-1

APPENDIX E . . . . . .
OUTLIER SUMMARY E-1

APPENDIX F . . . . . .
DATA QUALITY ASSESSMENT TABLES F-1

PLATES . . . . . Back Pockets

TABLES, FIGURE, AND PLATES

Table **Page**

1-1 Summary of Statistical Models by Sample Type 1-12
1-2 Tolerance Factors for Normal Tolerance Limits for 99% Population at 99% Confidence 1-18
2-1 Wind Direction Frequency (Percent) by Five Wind-Speed Classes, Rocky Flats Plant 2-18
3-1 Surface Water Background Stations at Rocky Flats Plant 3-7
3-2 Sediment Background Stations at Rocky Flats Plant 3-8
3-3 Data for Background Wells at Rocky Flats Plant 3-10
3-4 Background Sediment, Borehole, Surface Water, and Groundwater Sampling Parameters 3-21
4-1 Summary of Data Quality Assessment - Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC) Parameters 4-34
5-1 Summary of Results from Seasonality Testing by Nonparametric Analysis of Variance 5-38

Figure **Page**

1-1 Methodology for Computation of Background Statistics 1-5
1-2 Selection of Statistical Method for Comparison of Background and Non-background Populations 1-22
2-1 Rocky Flats Plant Vicinity Map 2-2
2-2 Rocky Flats Plant Boundaries and Buffer Zone 2-3
2-3 Generalized East-West Cross Section, Front Range to Denver Basin 2-5
2-4 Generalized Stratigraphic Section for Denver Basin 2-6
2-5 Local Stratigraphic Section of the Rocky Flats Plant 2-7
2-6 Surficial Geology for the Rocky Flats Plant (color foldout) 2-8
2-7 Erosional Surfaces and Alluvial Deposits East of the Front Range 2-9
2-8 Schematic of Groundwater/Surface Water Interaction 2-15
2-9 1990 Wind Rose for the Rocky Flats Plant 2-19
3-1 Typical Alluvial Monitor Well Construction 3-14
3-2 Typical Shallow Bedrock Well Construction 3-15
3-3 Typical Deep Bedrock Monitor Well Construction 3-17
4-1 Cation-Anion Balance in Groundwater 4-41
4-2 Total Dissolved Solids vs Charge Balance for Groundwater 4-43
4-3 Histogram of pH in Groundwater 4-44
4-4 Cation-Anion Balance in Surface Water 4-45
4-5 Total Dissolved Solids vs Charge Balance for Surface Water 4-47
4-6 Histogram of pH in Surface Water 4-48

Figure **Page**

5-1 Stiff diagrams showing typical chemistry of groundwater from wells screened in VFA 5-7
5-2 Stiff diagrams showing typical chemistry of groundwater from wells screened in RFA 5-9
5-3 Stiff diagrams showing typical chemistry of groundwater from wells screened in COL 5-11
5-4 Stiff diagrams showing typical chemistry of groundwater from wells screened in WCS 5-13
5-5 Stiff diagrams showing typical chemistry of groundwater from wells screened in KAR 5-14
5-6 Piper diagram showing major-ion chemistry of groundwater from VFA 5-17
5-7 Piper diagram showing major-ion chemistry of groundwater from RFA 5-18
5-8 Piper diagram showing major-ion chemistry of groundwater from COL 5-19
5-9 Piper diagram showing major-ion chemistry of groundwater from WCS 5-20
5-10 Piper diagram showing major-ion chemistry of groundwater from KAR 5-21
5-11 Schoeller diagram of the mean major-ion chemistry in background groundwater 5-22
5-12 Comparison of cation proportions in groundwaters from the upper and lower flow-systems 5-24
5-13 Stiff diagram showing typical chemistry of stream water from background sampling stations 5-25
5-14 Piper diagram showing major-ion chemistry of stream water from the background stations in the Rock Creek drainage 5-27
5-15 Piper diagram showing major-ion chemistry of stream water from the background stations in the Woman Creek drainage 5-28
5-16 Schoeller diagram of the mean major-ion chemistry in Rock and Woman Creeks 5-30
5-17 Comparison of cation proportions in stream water from the Rock Creek and Woman Creek drainages 5-31
5-18 Comparison of tritium in stream water with tritium in the interstitial waters of stream sediments 5-32
5-19 Stiff diagram showing typical chemistry of seep/spring water from background sampling stations 5-34
5-20 Piper diagram showing major-ion chemistry of seep/spring water from background sampling stations 5-35

Plate

1 Background Geochemical Characterization Plan Individual Hazardous Substance Site
2 Background Geochemical Characterization Plan Water Table Elevation of Surficial Materials
3 Background Geochemical Characterization Plan Background Boreholes
4 Background Geochemical Characterization Plan Alluvial Monitoring Wells
5 Background Geochemical Characterization Plan Background Monitoring Wells
6 Background Geochemical Characterization Plan Background Surface Water and Sediment Sampling Stations

ACRONYMS AND ABBREVIATIONS

A	acceptable for use with qualification (data-validation flag)
Ag	Silver
Al	Aluminum
Am	Americium
ANOVA	analysis of variance
As	Arsenic
B	value is larger than IDL but less than MDL, for inorganics only (laboratory flag)
Ba	Barium
Be	Beryllium
Ca	Calcium
CAR	Chemical Analyte Roster
Cd	Cadmium
CDH	Colorado Department of Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curie (defined as 3.7×10^{10} disintegrations per second)
Cl	Chlorine (Chloride, Cl^-, is the anionic form in aqueous media)
CLP	Contract Laboratory Program
cm	centimeter
Co	Cobalt
CO_3^{2-}	Carbonate (anion in aqueous media)
COL	colluvium
CN	Cyanide
Cr	Chromium
CRDL	contract-required detection limit
CRQL	contract-required quantitation limit
Cs	Cesium
CSF	Carcinogenic Slope Factor
Cu	Copper
DOE	Department of Energy
EL	exposure limit
EMD	Environmental Management Department
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
F	Fluorine (Fluoride, F^-, is the anionic form in aqueous media)
Fe	Iron
FS	Feasibility Study
ft	foot
g	gram
gal	gallon
GRRASP	General Radiochemistry and Routine Analytical Services Protocol
HCO_3^-	Bicarbonate (anion in aqueous media)
Hg	Mercury
HSWA	Hazardous and Solid Waste Amendments
IDL	Instrument detection limit

IHSS	Individual Hazardous Substance Site
IM	Interim Measure
in.	inch
IRA	Interim Remedial Action
J	an estimated value above IDL but below CRDL (data-validation flag)
K	Potassium
KAR	undifferentiated sandstones of Arapahoe/Laramie Formations
L	liter
Li	Lithium
m	meter
meq	milliequivalent
MDL	method detection limit
mg	milligram
Mg	Magnesium
min	minute
Mn	Manganese
Mo	Molybdenum
MS	matrix spike
MSD	matrix spike duplicate
NO_2^-	Nitrite (anion in aqueous media)
NO_3^-	Nitrate (anion in aqueous media)
Na	Sodium
Ni	Nickel
NPDES	National Pollutant Discharge Elimination System
ODEX	air-rotary downhole percussion-hammer
OU	Operable Unit
oz.	ounce
%Bias	percent bias
%R	percent recovery
P	Phosphorus
PARCC	precision, accuracy, representativeness, completeness, and comparability
Pb	Lead
PCB	polychlorinated biphenyl
PO_4^{3-}	orthophosphate
pCi	picoCurie (one pCi = 10^{-12} Ci)
Pu	Plutonium
PVC	polyvinyl chloride
QA	quality assurance
QAPjP	QA Project Plan
QC	quality control
R	rejected (unacceptable for use) (data-validation flag)
Ra	Radium
RL	reporting limit
RCRA	Resource Conservation and Recovery Act
RDL	required detection limit
%RPD	relative percent difference
RFA	Rocky Flats Alluvium

RfD	reference dose
RFEDS	Rocky Flats Environmental Database System
RFI	RCRA Facility Investigation
RFP	Rocky Flats Plant
RI	Remedial Investigation
s	second
Sb	Antimony
SC	specific conductance
Se	Selenium
Si	Silicon
SiO_2	Silica
SO_4^{2-}	Sulfate (anion in aqueous media)
Sn	Tin
SOP	Standard Operating Procedure
Sr	Strontium
SVOC	semivolatile organic compound
T	Tritium
TAL	Target Analyte List
TCL	Target Compound List
TDS	total dissolved solids
Th	Thorium
Tl	Thallium
TSS	total suspended solids
U	analyte not detected at a level above detection limit (laboratory or data-validation flag)
U	Uranium
UJ	analyte not detected, value estimated (laboratory or data-validation flag)
UTL	upper tolerance limit
V	valid and usable without qualification (data-validation flag)
V	Vanadium
VFA	valley-fill alluvium
VOC	volatile organic compound
vs.	versus
WCS	weathered claystone of upper Arapahoe/Laramie Formations
Zn	Zinc

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

OBJECTIVE

To monitor for environmental degradation that may have resulted from past work practices at the Rocky Flats Plant (RFP), it is necessary to know the chemistry of environmental materials from areas near the plant that remain undisturbed by plant operations. The statistical and geochemical comparisons of background with non-background populations can then be used to identify and assess potential environmental contamination.

For this study, these undisturbed or "background" locations were characterized by analyzing environmental materials collected at a number of representative sampling sites. The resulting chemical data were statistically summarized to provide a basis for comparison with chemical results from non-background areas of the RFP.

As presented in the 1992 *Background Geochemical Characterization Plan*, tolerance intervals were used as one of the principal statistics to characterize the chemistry of background stations at the RFP. Tolerance intervals were computed assuming normality or lognormality for chemicals having greater than three detectable concentrations and greater than 20-percent detects. If, for samples of groundwater and geologic materials, there were more than 10 observations and greater than 50-percent detects, then parametric or nonparametric ANOVA was used to test for significant differences between subgroups in these two media.

Data from non-background areas may be compared against background data using some form of ANOVA testing (either parametric or nonparametric ANOVA, depending on the population distribution and variance). The upper tolerance limits (UTLs) may be used as a "hot-spot" test to help identify potential areas of chemical contamination.

SAMPLING AND ANALYSIS PLAN

This report describes and summarizes background geochemical data collected from calendar year 1989 to calendar year 1993 under the Background Geochemical Characterization Program at the

RFP. The data include information about the geochemistry of stream water, seep/spring water, stream and seep/spring sediments, groundwater, and geologic materials. Samples for the Background Characterization Program were collected at stations located in buffer zone areas west, north, and south of the Plant industrial area. Samples were analyzed for radioactive isotopes, U.S. Environmental Protection Agency (EPA) target analyte list metals, EPA target compound list organics, major anions, and indicator parameters such as pH, specific conductance, and total dissolved solids (TDS).

Chemical data were classified into subgroups by lithology (geologic unit) and by flow-system for groundwater and geologic material. Data for surface water and surface sediments were classified into groups for streams, and seeps/springs. Parametric and nonparametric ANOVA were used to define the groups and subgroups. (The application of each statistical procedure is discussed in this report). Various summary statistics were also compiled for each set of chemical data within each group, including calculations of mean, standard deviation, upper tolerance limit (upper and lower for pH), maximum concentration, sample size, the 85th percentile (for aqueous media only), and percentage of detectable concentrations.

Groundwater samples collected from wells completed in Rocky Flats Alluvium (RFA), valley-fill alluvium (VFA), colluvium (COL), weathered claystone of upper Arapahoe/Laramie Formations (WCS), and unweathered, undifferentiated Arapahoe/Laramie Formations (KAR), were statistically compared with each other for all chemical constituents that met the criteria for ANOVA. Similarly, samples of geologic material from the different lithologic units at the RFP were also compared with one another. In addition to these pairwise comparisons by geologic unit, data were grouped into the upper (RFA + VFA + COL + WCS) and lower (KAR) flow-systems, and the chemistry of the two flow-systems was compared.

Surface water was divided into two separate classification groups—stream water and seep/spring water. Correspondingly, stream sediments and seep/spring sediments were also treated as separate groups.

Both surface water and groundwater were examined for seasonality by nonparametric ANOVA. Because no seasonal effects should be evident in solid samples, neither sediments nor geologic materials were analyzed for seasonality.

RESULTS OF GEOCHEMICAL ANALYSIS

Ongoing hydrogeological investigations suggest that groundwater at the RFP may consist of two flow-systems. In terms of major-ion chemistry, background groundwater can be classified into an upper flow-system composed of RFA, VFA, COL, and WCS; and a lower flow-system in KAR. However, the major-ion chemistry of the Arapahoe number-one sandstone is similar to that of the upper flow-system. Therefore, the chemistry supports the definition that the number-one sandstone is part of the upper flow-system.

Geochemical plots (Piper and Stiff diagrams) of the major-ion chemistry of groundwater indicate that the lower flow-system (unweathered sandstone) is predominantly a sodium-bicarbonate to sodium-sulfate type, whereas the upper flow-system is largely a calcium-bicarbonate type. Within the upper flow-system, some spatial trends exist in the concentration of TDS. For example, TDS appears to increase downgradient in valley-fill groundwater within the Rock Creek drainage and in alluvial groundwater within the northern buffer zone.

For background groundwater, the mean concentrations of many metals, radionuclides, and water-quality parameters showed some significant differences among the five lithologic units. These differences are summarized in Section 5 and Appendix B. Tables presented in Appendix C identify the upper tolerance limits (UTLs) for the groundwater analytes categorized by lithology and flow-system, as defined from the statistical testing. Summary statistics, including mean, standard deviation, sample size, percent detects, as well as minimum and maximum values, and the 85th percentile, are given in Appendix D.

For geologic materials, the mean concentrations of many metals, radionuclides, and other inorganic constituents also showed some significant differences between the five lithologic units and the two flow-systems (see Section 5). Tables in Appendix C list the UTLs for the analytes categorized into lithologic and flow-system subgroups. Summary statistics, including mean,

standard deviation, sample size, percent detects, as well as minimum and maximum values, are given in Appendix D.

Chemical data for samples of surface water were only tested for significant differences in geochemistry between seasons. Summary statistics, including mean, standard deviation, sample size, percent detects, as well as minimum and maximum values, and the 85th percentile are given in Appendix D.

Nonparametric ANOVA was used to examine seasonality in water chemistry by comparing the mean concentrations of chemicals by quarters of the year. No systematic seasonal variations in analyte concentrations were apparent in background groundwater or surface water (see Section 5).

Beginning in May 1990, sediments, surface water, and groundwater were sampled and analyzed for volatile and semivolatile organic compounds. Of these compounds, acetone and methylene chloride were detected most frequently in the samples; however, the presence of these compounds is believed to be a laboratory artifact. These compounds were also present in laboratory blanks, and the concentrations in the field blanks and field samples were similar. These solvents are commonly used in the laboratory, and their presence at low concentrations in the samples and laboratory blanks is not unusual. Trichloroethene, toluene, and tetrachloroethene were present at low concentrations in a few of the groundwater samples. Although tetrachloroethene and trichloroethene did not appear in the laboratory or field blanks (toluene was present occasionally), these three compounds occurred infrequently in the field samples, and mostly at estimated concentrations below the detection limit. Furthermore, none of these compounds were detected more than once in samples from any one well, so it does not appear that these compounds are actually present in background groundwater. Lastly, bis(2-ethylhexyl)phthalate and polynuclear aromatic hydrocarbons were present in a few of the stream sediment samples. Bis(2-ethylhexyl)phthalate was detected in some of the laboratory blanks, but is known to be a common laboratory contaminant arising from sample contact with plastics. However, both bis(2-ethylhexyl)phthalate and the polynuclear aromatic hydrocarbons are ubiquitous in the environment (phthalates from plastics, tires, etc., and polynuclear aromatic

hydrocarbons from burning of organic material) and may indeed be present at low concentrations in background sediments at the RFP.

SUMMARY AND CONCLUSIONS

The background geochemistry of groundwater and surface water at the RFP has been well characterized through the geochemical and statistical analysis of four years of data. Extensive analytical data now exist for the six background environmental media studied for this report. In addition, seasonality in surface and groundwater has been shown to be unimportant. Further sample collection and characterization beyond the 1992 data will yield diminishing returns for the cost of the program; therefore, the *1993 Background Geochemical Characterization Report* is proposed to be the final report of the program.

SECTION 1

SECTION 1
INTRODUCTION AND METHODS

1.1 INTRODUCTION

The geochemical characterization of undisturbed areas (also known as "background areas") is essential to the assessment of possible environmental degradation. To determine the nature and extent of the environmental impact potentially resulting from industrial activities, the contribution from natural sources must be quantified. At the Rocky Flats Plant (RFP), the average chemistry of background, as well as the range of chemical variability of background, has been determined by analyzing samples of surface water, surface sediments, groundwater, and geologic (borehole) materials collected from representative sampling locations (see Section 3). The sampling sites are called "background stations" or "upgradient locations" and are situated in the buffer zone west, north, and south (i.e., upslope and upwind) of the main plant site.

Representative background data for surface water, sediments, groundwater, and borehole materials are necessary to support Resource Conservation and Recovery Act (RCRA) facility investigations (RFIs) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial investigations (RIs). Background data assist in the identification of potential environmental contamination by defining the spatial and temporal variability in the concentration of naturally occurring constituents. Background data can be compared statistically with data from downgradient sites to assist in determining the likelihood that a particular concentration of chemicals represents a release of contaminants.

The goal of the *Background Geochemical Characterization Plan* (EG&G, 1992b), and of this report, is to provide some of the background data necessary to identify concentration levels of various chemicals that may indicate contamination at the RFP. To achieve this goal, the *Background Geochemical Characterization Report* (1) describes the statistical methods used to define and characterize background chemical (analyte) distributions at the RFP; (2) reports on the background hydrogeochemical characterization conducted from 1989 to 1993, pursuant to the *Background Geochemical Characterization Plan* (EG&G, 1992b); and (3) describes how these background data may be compared to non-background or downgradient analytical data.

The report characterizes the chemistry of borehole materials, stream and seep/spring sediments, groundwater samples collected quarterly, and surface-water samples collected monthly or quarterly. It also addresses whether statistically significant differences in geochemistry are discernable in groundwater contained in separate, mappable geologic lithologies and in separate hydrostratigraphic units (flow-systems). The geochemistry of the geologic materials themselves were also analyzed for significant differences between the geologic units and flow-systems. The issue of seasonal effects on water chemistry (groundwater, stream water, and seep/spring water) is also covered. This report supersedes the report submitted to U.S. Environmental Protection Agency (EPA) and Colorado Department of Health (CDH) on September 30, 1992.

Background data generated during the Background Geochemical Characterization Program at the RFP are applicable to RCRA interim measures (IMs) and CERCLA interim remedial actions (IRAs), so that the IMs and IRAs are consistent with the final corrective and remedial actions. The final RI/feasibility study (FS) reports and closure plans will use this background information.

1.2 HISTORICAL BACKGROUND OF ROCKY FLATS PLANT

The RFP is a Department of Energy (DOE) facility that manufactured components for nuclear weapons from 1952 through 1989. The plant fabricated these components from Pu, U, Be, and stainless steel. Plant operations generated non-hazardous, hazardous, radioactive, and mixed (hazardous and radioactive) waste streams during the period of weapons manufacture. On-site storage and disposal of hazardous and radioactive waste took place throughout the duration of weapons production, and some waste continues to be stored on-site. Preliminary assessments under the DOE Comprehensive Environmental Assessment and Response Program, now called Environmental Restoration (ER), have identified the locations historically used for on-site storage and disposal as potential sources of environmental contamination. Current waste-handling practices involve both on-site and off-site recycling of hazardous materials, as well as off-site disposal of solid radioactive materials at another DOE facility.

The ER Program is a comprehensive, phased program of site characterization, environmental monitoring, RIs, risk assessments, FSs, remedial/corrective actions, and site closures. The

Program includes CERCLA, RCRA 3004(u) and RCRA closure projects, and addresses the Hazardous and Solid Waste Amendment provisions of RCRA and the Colorado Hazardous Waste Act. Draft RI/FS reports and RCRA closure plans have been submitted to EPA and CDH. However, because of aggressive investigation and clean-up schedules, sufficient data for background characterization were not collected before the initiation of the Background Geochemical Characterization Program in 1989.

1.3 GENERAL APPROACH: SAMPLE CLASSIFICATION

To characterize background variations within selected environmental media, samples were collected from many upgradient locations across the entire Plant site. As noted above, media included geologic materials, stream and seep/spring sediments, groundwater, and surface water. In addition, samples were collected within subgroups of some media having different geological and hydrogeological characteristics. For example, groundwater was sampled in Rocky Flats Alluvium (RFA), valley-fill alluvium (VFA), colluvium (COL), weathered claystone of upper Arapahoe/Laramie Formations (WCS), and undifferentiated Arapahoe/Laramie Formations (KAR). Surface water was divided into two subgroups; (1) stream water, and (2) seep/spring water. The geochemical differences among these subgroups, as well as possible seasonal differences within aqueous media, were examined.

1.4 PRELIMINARY DATA ANALYSIS

Chemical data for all samples collected at the RFP were carefully reviewed in a multistep process to identify recurring sampling or analytical problems. These data were validated by an independent subcontractor (QuantaLex) upon receipt from the analytical laboratory. Both the data and the validation results were then stored in the Rocky Flats Environmental Database System (RFEDS) for later retrieval and use. A number of quality control (QC) checks were run routinely during the RFEDS data-entry process to ensure data reliability.

For the creation of the *1993 Background Geochemical Characterization Report*, background data were retrieved from RFEDS, then subjected to additional quality checks, including the review and interpretation of field QC data, outlier testing, and application of a variety of statistical and

geochemical tests (see Sections 4 and 5). The overall methodology for computing background statistics is illustrated by a flow chart (Figure 1-1). Application of many of the more complex procedures is discussed in detail later in this section.

1.4.1 Treatment of Quality Control Data

As part of the initial data cleanup, QC data such as rinsates, blanks, and spikes were excluded from the working data set used for statistical and geochemical analysis. QC data were compiled in a separate data set for analysis of data quality. Data validation and evaluation of QC data are discussed in Section 4.

It should also be noted that all data that received an "R" (rejected) in the validation field of the data set, were excluded from all statistical and geochemical analyses.

1.4.2 Treatment of Duplicates

Duplicate samples were collected in the field to assess sampling precision (Section 4). The analytical results for duplicates were averaged for all analytes prior to univariate statistical analysis (Figure 1-1). If a detected and non-detected value comprised a duplicate pair, one-half of the established detection limit of the non-detected value was averaged with the detected concentration. The resulting averaged value was evaluated as a single detected observation.

1.4.3 Screening of Outliers

Following the preparation and initial cleanup of statistical data sets, the data sets were examined for outliers. An outlier is an extreme observation that does not conform to the pattern established by other observations and is unlikely to be a valid member of the population of interest. An outlier may be the result of an incorrectly read, recorded, or transcribed measurement; an incorrect calculation; an error in documentation (field or laboratory); or an actual environmental condition. Although there are no universally applicable outlier tests, two procedures were chosen which, when taken together, provided a conservative evaluation of potential outliers.

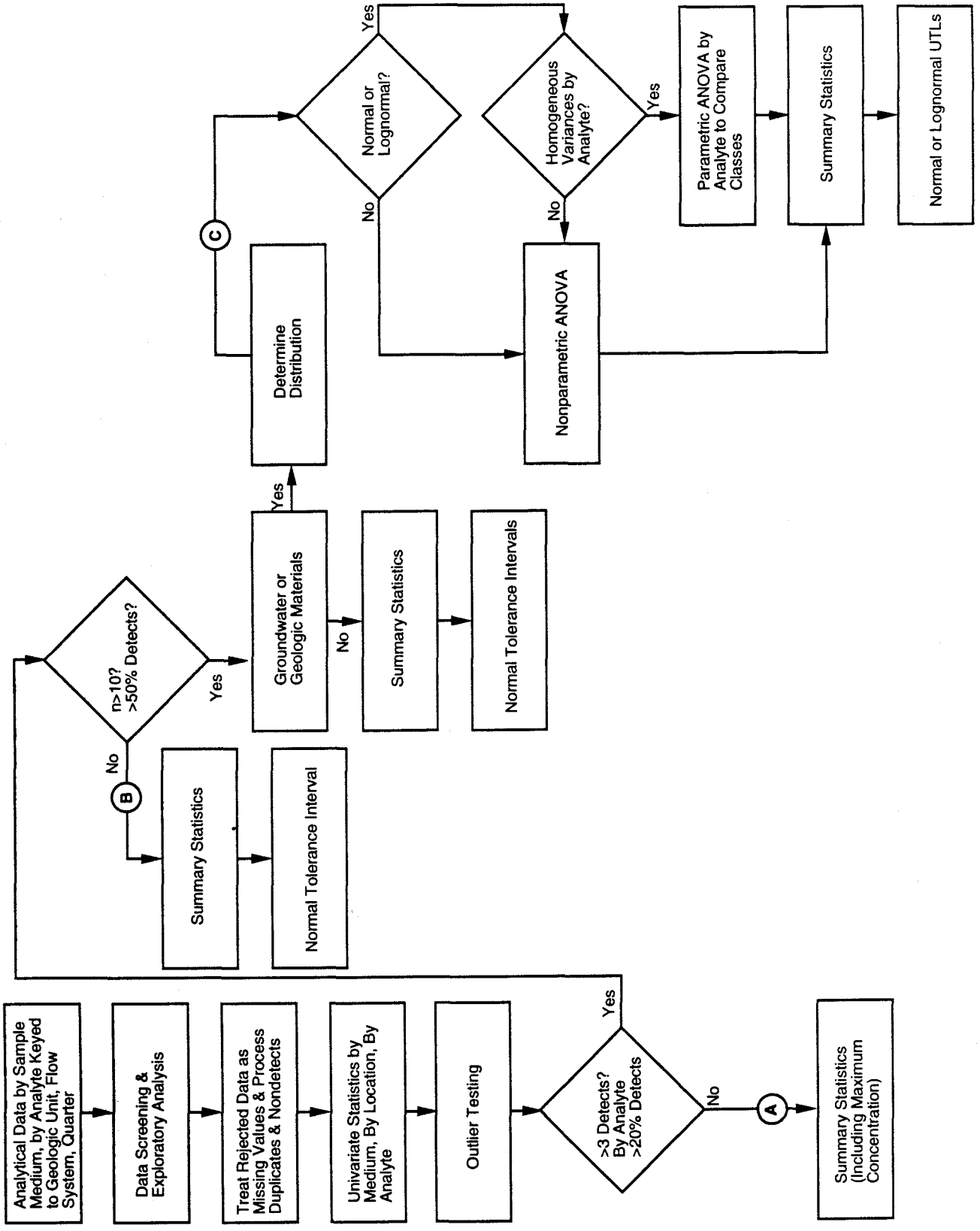


Figure 1-1 Methodology for Computation of Background Statistics

The first test followed the outlier selection procedure outlined in ASTM Paper E178-75 (ASTM 1975). This test assumes the data follow a near-normal distribution. The second test flagged any result that was greater than Q_3 + 1.5 times the inter-quartile range (IQR), or less than Q_1 - 1.5 times the IQR, calculated by analyte.

To evaluate the presence of outliers, the following procedure was applied to the analytes by sample type:

1. The two types of outlier tests outlined above were run to flag anomalous data. Any result that failed either test was flagged.
2. These flagged values were examined, then checked individually if judged to be geochemically questionable. Each flagged outlier was evaluated with respect to the historical trend of the data for that specific location, as well as laboratory conditions such as matrix interference, in an attempt to determine why the datum was aberrant.
3. If the outlier resulted from a correctable error, the value was changed, and the correct value was included in the data set. Data that were believed to have resulted from laboratory contamination (e.g., acetone "hits"), irresolvable transcription errors, or other noncorrectable errors that gave results not thought to be representative of background were excluded from subsequent statistical analysis.

A summary list of outliers excluded from statistical analysis is given as a table in Appendix E.

1.4.4 Data Below the Detection Limit

The presence of data below the detection limit ("non-detects") is a result of low levels (or absence) of some analytes within the background areas sampled, relative to the magnitude of the analytical detection limits. In the case of metals, the issue of detection limits was more complicated. In some instances, analytical laboratories reported the contract-required detection limit (CRDL) as the analytical result if data were above the instrument detection limit (IDL), but below CRDL. The value of CRDL may be one to two orders of magnitude greater than the actual IDL, so data treated in this manner were, in effect, "artificially censored." The "result

qualifier" (qual) field in the data set is supposed to be used to distinguish detects from non-detects. However, the result-qualifier field has 26 unique qualifiers for one data group alone (groundwater, filtered metals file), and the reporting-limit field has multiple values for every analyte. For the 28 metals in the above file, the number of reporting limits ranges from a low of 4 for Hg to a high of 12 for Pb and Tl. The mean number of reporting limits for the 28 metals is 8.9 with a standard deviation of 1.6.

The numerous reporting limits and result qualifiers lead to confusion and inconsistent treatment of the data. To promote a more consistent treatment of the data, and to maximize the amount of useful data collected for metals, the approach taken in the 1993 Background Report addressed both the presence of multiple detection limits and the presence of CRDL data:

(1) Completely uncensored (except excluding outliers) histograms of metals data (by analyte) were prepared, and reviewed with respect to data distributions (one graph is worth a thousand words).

(2) The data sets for metals were then reviewed as to reporting (i.e., detection) limits, result qualifier codes, and validation codes. The following screen was then used to define detects; if the qual field had a "B" code (indicating that the result was above the IDL, but below the CRDL), or if the validation field had a "JA" code (estimated value above IDL, but below CRDL, and acceptable), or if the result was greater than the reporting limit (RL field), the result was taken to be a detected value. If the observation did not meet at least one of these criteria, then it was taken as a non-detect, with result = result/2.

(3) Summary statistics and UTLs were calculated using result/2 as a replacement for non-detects. Summary statistics are provided for all analytes; UTLs are given only for those analytes with fewer than 80 percent non-detects (i.e., there must be at least 20 percent detects for that analyte).

It is important to note that all observations that were greater than IDLs were included in the statistical and geochemical analyses, even if the data were less than the CRDL. Non-detect values were replaced with a value of the result/2 or rl/2, **not** with the value of the CRDL/2. Although other treatments of non-detects, such as the "maximum likelihood method" (Cohen, 1961) may yield somewhat different values, the use of a fixed replacement value for non-detects

(i.e., one-half the detection limit) has the virtues of simplicity and widespread use. Also, as detailed by Sanford *et al.* (1993), the use of simple substitution yields reasonably correct values for as much as 80-percent censoring. When the proportion of non-detects exceeds about 80 percent, replacement of censored values becomes a more difficult issue. However, the worst possible treatment of non-detect values is to drop them from the data set used for statistical analysis (Helsel, 1990; Sanford *et al.*, 1993).

For radiochemicals, all non-rejected values—including the negative numbers that sometimes occur because of instrument calibrations—were used in the statistical analysis. For organic constituents, in the case of multiple detection limits and to set an acceptable upper detection limit, all non-detects greater than two times the minimum reporting limit were omitted from statistical analysis and the remaining non-detects replaced with one-half the detection limit (Gansecki, EPA comments, 1991).

A comparison of upper tolerance intervals from the *1992 Background Geochemical Characterization Report* with upper tolerance limits (UTLs) calculated using the above detection limit screening method showed no major discrepancies in the values, although the values in the 1993 Report are generally lower than those in the 1992 Report. However, any decrease in the value of UTLs between 1992 and 1993 reports may be partly explained by larger sample sizes, which result in smaller tolerance factors (see Table 1-2).

It should be noted also, that all downgradient (OU) metals data compared to the background data summarized in this report should undergo the same screening for non-detects. The use of a standardized, consistent method of treatment of inorganic data is a pragmatic approach to the potentially confusing issue of non-detects. If background and downgradient data are treated in the same manner, the end result will still discriminate between "potentially contaminated" and "uncontaminated" sites. The benefit is clear, consistent treatment of the data.

1.4.5 Evaluation of Data Distributions

The Shapiro-Wilk test for normality was performed on the ANOVA residuals to test the hypothesis that the distribution of the residuals was normal (Shapiro and Wilk, 1965). If the

resulting test statistics indicated that data were not normally distributed, data were transformed by computing the natural logarithm of the raw data. Residuals of the transformed data were evaluated in the same manner. The distribution of residuals was classified as either normal, lognormal, or indeterminate.

1.5 EVALUATION OF POPULATIONS

This subsection presents the approach and statistical methods that were used to establish appropriate populations for the results of background geochemistry.

1.5.1 Definitions

Before presenting statistical methods for defining background populations, some statistical definitions are in order. A *population* is a well-defined set of all possible observations. All groundwater at the RFP is a population. A *subpopulation* is a well-defined subset of the population. A *sample* is a small subset of the population taken to represent the larger population. An *observation* is a measurement on the smallest sampling unit. One geochemical analysis or set of analyses is an observation. Although the observation is based on a groundwater sample, a groundwater sample is not a statistical term and should not be confused with a statistical sample. *Univariate* is an adjective indicating that there is only one dependent variable.

A *classification factor* is a criterion by which an observation may be grouped. For a groundwater observation, the originating water-bearing unit is a classification factor. The water-bearing units that were sampled (RFA, VFA, COL, WCS, and KAR) are *levels* of the classification factor. A *one-way* statistical test evaluates the sample with respect to one classification factor (although many levels may be involved).

1.5.2 Sample Media

Six media (geologic materials, groundwater, stream sediment, stream water, seep/spring sediment, and seep/spring water) were sampled at the RFP (see Sections 2 and 3). Two of these media were classified into groupings that may represent subpopulations:

- **Geologic materials** were sampled in 1989 by geologic unit; RFA, VFA, COL, WCS, and KAR. Data were also grouped by flow-system (upper flow-system = RFA + VFA + COL + WCS, lower flow-system = KAR) and analyzed both statistically and geochemically.
- **Groundwater** was sampled quarterly from 1989 through 1992 as RFA groundwater, COL groundwater, VFA groundwater, WCS groundwater, and KAR groundwater. Groundwater data were also grouped by flow-system (upper flow-system = RFA + VFA + COL + WCS, lower flow-system = KAR), and analyzed both statistically and geochemically.

Samples were collected from each geologic unit because before sampling it was not known if the subpopulations were geochemically distinct. Possible sources of variability include: (1) the geologic unit or hydrogeologic flow-system for geologic materials and groundwater, and (2) seasonality (i.e., annual systematic fluctuations) for groundwater and surface water. A background sample composed of subpopulations with markedly different geochemical compositions could result in extraneous variability in the background sample and, consequently, a poor characterization of background geochemistry.

Seep/spring sediments, and seep/spring water were identified as separate media from stream sediments and stream water in the data analysis undertaken in the *1992 Background Geochemical Characterization Report* (EG&G, 1992b), and in EPA comments (Gansecki, 1991). The 1993 report follows the same distinction of separating seep/spring water and sediments from stream water and sediments.

1.5.3 Selection Criteria

Parametric and nonparametric analysis of variance (ANOVA) were used to evaluate the effect of the proposed classification factor(s) on the population of each sample type. As shown in Figure 1-1, this evaluation was based upon the percentage of detected observations by analyte and the number of observations available. If less than three observations were available and less than 50 percent of the observations were detects, the data followed Path A (Figure 1-1), in which the data were tabulated with respect to summary statistics, including the maximum observed concentration and the frequency of detection (see Appendix D). If the percentage of detected observations was greater than 50 percent, and the number of observations was more than three, but less than or equal to ten (Path B in Figure 1-1), then UTLs (one-sided) were calculated (Appendix C) in addition to summary statistics (Appendix D). If the medium was geologic materials or groundwater, and the percentage of detected observations was greater than 50 and the number of observations was greater than 10, the analyte was evaluated by ANOVA (Path C in Figure 1-1), in addition to summary statistics and UTLs, with other related statistical tests as described below.

ANOVA is a statistical procedure for determining if there is a significant difference between the average values of a variable (i.e., the dependent variable) for different levels of a classification factor(s). A "classification factor" can be geologic type, season, or any kind of distinguishing factor.

1.5.4 Analysis of Variance Designs

This study used mostly one-way, fixed-effects parametric ANOVA models and one-way, fixed-effects nonparametric ANOVA models (Table 1-1). As discussed in Section 3, not all analytes were measured in the initial rounds of sampling. Table 3-4 in Section 3 lists the analytes (dependent variables) sampled for the background program. Dissolved radiochemicals were not analyzed subsequent to the first round of sampling. It should also be noted that many radiochemical analyses for geologic materials collected in 1989 were rejected during validation; all rejected data were excluded from statistical and geochemical analysis.

Table 1-1. Summary of Statistical Models by Sample Type

Sample Type	Classification Factors	Levels	Maximum Number of Sampling Locations
Seep/Spring Water Stream Water	Seasonality	Winter Spring Summer Fall	3[a,b]
Groundwater	Geologic unit	Rocky Flats Alluvium (RFA)	51[b]
		Colluvium (COL)	
		Valley-fill Alluvium (VFA)	
		Weathered Arapahoe/ Laramie claystone (WCS)	
		Unweathered Arapahoe/ Laramie (KAR)	
	Flow-system	Upper Lower	
	Seasonality	Winter Spring Summer Fall	
Stream Sediments[d]	—	—	6
Geologic Materials	Geologic unit	Rocky Flats Alluvium (RFA)	18[c]
		Colluvium (COL)	
		Weathered Arapahoe/ Laramie claystone (WCS)	
		Unweathered Arapahoe/ Laramie (KAR)	
	Flow-system	Upper Lower	

[a]Not all sampling locations were in use at the start of sampling.

[b]Number of sampling locations available in any one event may be reduced because of insufficient water.

[c]Multiple samples taken at various depths at each borehole. Colluvium and weathered bedrock samples collected in the same boreholes. Total number of samples (excluding field duplicates and redrills) is 119.

[d]Seep sediments and stream sediments will be treated as separate sample types.

Seasonality effects are sometimes observed in natural waters, but are not expected in solids such as sediment and geologic material. The *1992 Background Geochemical Characterization Report* concluded that seasonal effects were unimportant, but seasonality was evaluated again in the current report by nonparametric ANOVA for groundwater and surface water. Seasonality is further discussed in Section 1.6.3 and in Section 5.

Groundwater was evaluated for three classification factors: (1) by geologic unit (RFA, VFA, COL, WCS, or KAR), (2) by hydrogeologic flow-system (upper flow-system vs. lower flow-system), and (3) for seasonality.

Geologic materials were evaluated for two classification factors: (1) by geologic unit (RFA, VFA, COL, WCS, or KAR) and (2) by hydrogeologic flow-system (upper flow-system vs. lower flow-system).

Surface water (both stream and seep/spring) and surface sediments (both stream and seep/spring) were collected quarterly and were evaluated only for seasonality.

1.5.5 Parametric Analysis of Variance and Related Tests

Parametric ANOVA and related statistical tests were applied in the following hierarchical manner:

1. A one-way (by class) parametric ANOVA test for each analyte was evaluated (null hypothesis: no class effects for an individual analyte). If this test was not significant for a given analyte, no further testing was done and the sample was not subdivided for the analyte.
2. If the null hypothesis of one class in the parametric ANOVA was rejected, then multiple comparisons tests (Bonferroni tests) (EPA, 1989, pp. 5-6 to 5-13) were conducted to identify which levels of the classes were different from each other (null hypothesis: no differences between levels).

Two requirements that underlie the use of parametric ANOVA were evaluated prior to the acceptance of the results:

- either the raw data or their residuals are normally distributed or
- either the raw data or their residuals have equal variances.

A *residual* is the difference between a measured value and the predicted group mean. Residuals that were calculated in the course of the ANOVA were saved and analyzed for normality and homogeneity of variance, as well as seasonal effects for residuals vs. time.

1.5.6 Test of Assumptions for Analysis of Variance

1.5.6.1 Tests of Normality

Normality of raw data or of residuals was evaluated by examining the results of the Shapiro-Wilk test, as well as the normal probability plots that were printed for each analyte. ANOVA is robust with respect to moderate departures from normality. If the departure from normality was substantial and if data transformations could not achieve a reasonable degree of normality, then nonparametric statistical.methods were used for evaluating data instead of the parametric ANOVA.

1.5.6.2 Testing Homogeneity of Variance

Variance is a measure of the dispersion of a set of observations around the mean of a random variable. Levene's test was used to test the equality of variances of residuals by class (Milliken, 1984).

1.5.7 Nonparametric Analysis of Variance

A *nonparametric ANOVA* evaluates differences in the mean rankings of data (rather than raw data or transformations of raw data) for subsets of data defined by levels of a classification factor. Nonparametric tests are less powerful (less sensitive to actual differences in means) than

parametric tests when the requirements of normality and homogeneity of variance are met. However, when these requirements are not met, the power of nonparametric tests may be substantially higher than their parametric counterparts (Conover, 1980).

Nonparametric tests used in this study were the Wilcoxon Rank-Sum test for a comparison of two levels and the Kruskal-Wallis test (an extension of the Wilcoxon Rank-Sum test) for comparison of more than two levels. Both tests analyze ranks of data using Wilcoxon scores (see Gilbert, 1987, pp. 247–252).

1.6 CALCULATION OF DESCRIPTIVE STATISTICS

Once the appropriate geochemical population was determined for each analyte within each group, the following procedures were applied to the respective statistical sample:

- the maximum and minimum concentrations were identified;
- the percentage of non-detects was calculated;
- based on the evaluated data distribution, the mean and standard deviation were calculated if the sample contained only detected concentrations or they were estimated using the procedure described in Section 1.4.4, if non-detects were present in the sample; and
- tolerance limits were computed in cases where there were at least three detected observations, and greater than 20 percent of the values were detects.

1.6.1 Tolerance Limits

Tolerance limits define a range that contains at least P percent of a population with p-percent probability (level of confidence). A probability (level of confidence) is associated with tolerance limits because they are estimated from the data set and therefore have some level of uncertainty associated with them. For the tolerance limit to be useful in decision making, both "p" and "P" should be large. Based on the report by Gilbert (July 30, 1993), UTLs were calculated (see Appendix C) at the 99/99 level ($p = 0.99$ and $P = 99$ percent). These UTLs are suggested as

the appropriate "hot-spot" test, recognizing however, that the selection of a "hot-spot" test is a policy issue.

Tolerance limits are either one-sided or two-sided. Two-sided tolerance limits are appropriate for pH data, where values either larger or smaller than background may be associated with contamination. A one-sided tolerance limit is appropriate for all other constituents for which values greater than those of background may be indicative of potential contamination.

The equation for the 99-percent tolerance limits of normally distributed data is as follows:

$$L_1 = \bar{x} - Ks \quad \textit{and}$$
$$L_2 = \bar{x} + Ks$$

where

L_1 = lower 99-percent tolerance limit,

L_2 = upper 99-percent tolerance limit,

$\bar{x}$ = sample mean of the data,

s = sample standard deviation,

K = the normal tolerance factor (dependent on p, P, and n).

The equation for the 99-percent tolerance limits of lognormally distributed data is as follows:

$$L_1 = \bar{x}_l - Ks_l \quad \textit{and}$$
$$L_2 = \bar{x}_l + Ks_l$$

where

L_1 = lower 99-percent tolerance limit,

L_2 = upper 99-percent tolerance limit,

$\bar{x}_l$ = back-transformed sample mean of log-transformed data,

s_l = Back-transformed sample standard deviation of log-transformed data,

K = the normal tolerance factor [dependent on p, P, and n (Table 1-2).]

1.6.2 Statistical Formulas

If the distribution of data was indeterminate, then statistics based on the normal distribution were used. This was done for simplicity and to avoid the transformation bias associated with nonlinear transformations. For lognormal transformed data the mean and variance were calculated in log-space, and the results were back-transformed according to the formulas suggested by Gilbert (Gilbert, 1987). The following formulas for sample statistics were used:

Mean

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

where

$\bar{x}$ = sample mean of untransformed data,

n = number of observations,

x_i = the ith concentration (observation).

Variance

$$s^2 = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}$$

where

s^2 = variance of untransformed data,

$\bar{x}$ = sample mean of untransformed data,

n = number of observations,

x_i = the ith concentration (observation).

Table 1-2. Tolerance Factors for Normal Tolerance Limits for 99-Percent Population at 99-Percent Confidence

N	K
4	12.3873
5	8.9390
6	7.3346
7	6.4119
8	5.8118
9	5.3889
10	5.0737
11	4.8290
12	4.6330
13	4.4720
14	4.3372
15	4.2224
16	4.1233
17	4.0367
18	3.9604
19	3.8924
20	3.8316
21	3.7766
22	3.7267
23	3.6812
24	3.6395
25	3.6011
26	3.5656
27	3.5326
28	3.5019
29	3.4733
30	3.4465
31	3.4214
32	3.3977
33	3.3754
34	3.3543
35	3.3344
36	3.3154
37	3.2975
38	3.2804
39	3.2641
40	3.2486
41	3.2337
42	3.2195
43	3.2059
44	3.1929
45	3.1804
60	3.05
>60	2.33

Source: Hahn, G.J., 1970. Statistical Intervals for a Normal Population. Part 1. Tables, Examples and Applications. *Journal of Quality Technology*, v. 2, n.3, p. 115-125

Standard Deviation

$$s = \sqrt{s^2}$$

where

s = standard deviation of untransformed data,

s^2 = sample variance of untransformed data.

For lognormally distributed samples, the following formulas for sample statistics were used:

Mean

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} \ln(x_i)$$

where

$\bar{y}$ = mean of the transformed data,

x_i = the ith concentration (observation).

Back-Transformed Mean

$$\bar{x}_l = \exp\left(\bar{y} + \frac{s_y^2}{2}\right)$$

where

$\bar{x}_l$ = back-transformed mean of transformed data,

s^2_y = sample variance of the transformed data,

$\bar{y}$ = sample mean of transformed data.

Variance

$$s_y^2 = \frac{\sum_{i=1}^{n} [\ln(x_i)-\bar{y}]^2}{n-1}$$

where

s_y^2 = sample variance of transformed result,

$\bar{y}$ = sample mean of transformed results,

n = number of observations,

x_i = the ith concentration (observation).

Back-Transformed Variance

$$s_l^2 = \bar{x}_l^2 \, [\exp\,(s_y^2) - 1]$$

where

s_l^2 = back-transformed sample variance,

$\bar{x}_l$ = back-transformed sample mean,

s^2_y = sample variance of transformed data.

1.6.3 Seasonality Investigations

Chemical data for natural waters sometimes vary seasonally as a function of local weather patterns, including the amount of rainfall, snowmelt, and infiltration. If the chemical concentrations in background waters varied significantly on a seasonal basis, it might be useful to compute separate background statistics by season. However, the *1992 Background Geochemical Characterization Report* found no indication of significant seasonality in the data from 1989 to 1992. Only significant and systematic seasonality can be adjusted for in the statistical treatment of data; small amounts of irregular seasonal fluctuation cannot be corrected.

Three years of background monitoring data are considered the minimum for evaluating seasonality (EPA, 1992a). Seasonality may also show up in simple "time-series plots" of the concentration of selected analytes vs. date of sampling at a given station.

Seasonal effects cannot be tested in geological materials because boreholes are drilled and sampled only one time at a given location. Furthermore, rock units, as well as seep and stream sediments, have relatively long residence times compared to those of natural waters. Therefore, although sediments were sampled quarterly, seasonality was not considered for these solids. Variability between samples of sediments collected from the same site are believed to represent natural heterogeneities in the solids, in addition to analytical variance.

Seasonality of data was evaluated in the *1993 Background Geochemical Characterization Report* by nonparametric ANOVA. The summarized results, which are discussed in detail in Section 5 and summarized in Table 5-1, show that seasonality is largely unimportant for background waters.

1.7 COMPARISON OF BACKGROUND AND NON-BACKGROUND POPULATIONS

Actual comparisons between background and non-background data are not within the scope of the background study. However, these comparison techniques will be of interest to users of the statistics provided by the background program.

1.7.1 Selection of Evaluation Methods

Before selecting a statistical method to compare background and non-background observations, it is first necessary to categorize the non-background observation(s) by classification factors and levels that have been identified for that medium (Figure 1-2). Data for an analyte in a non-background area are grouped in accordance with the combined background classes that represent independent background populations.

Selection of the appropriate statistical test to determine significant differences between background and non-background populations is a two-step process (EPA, 1989). First, if there

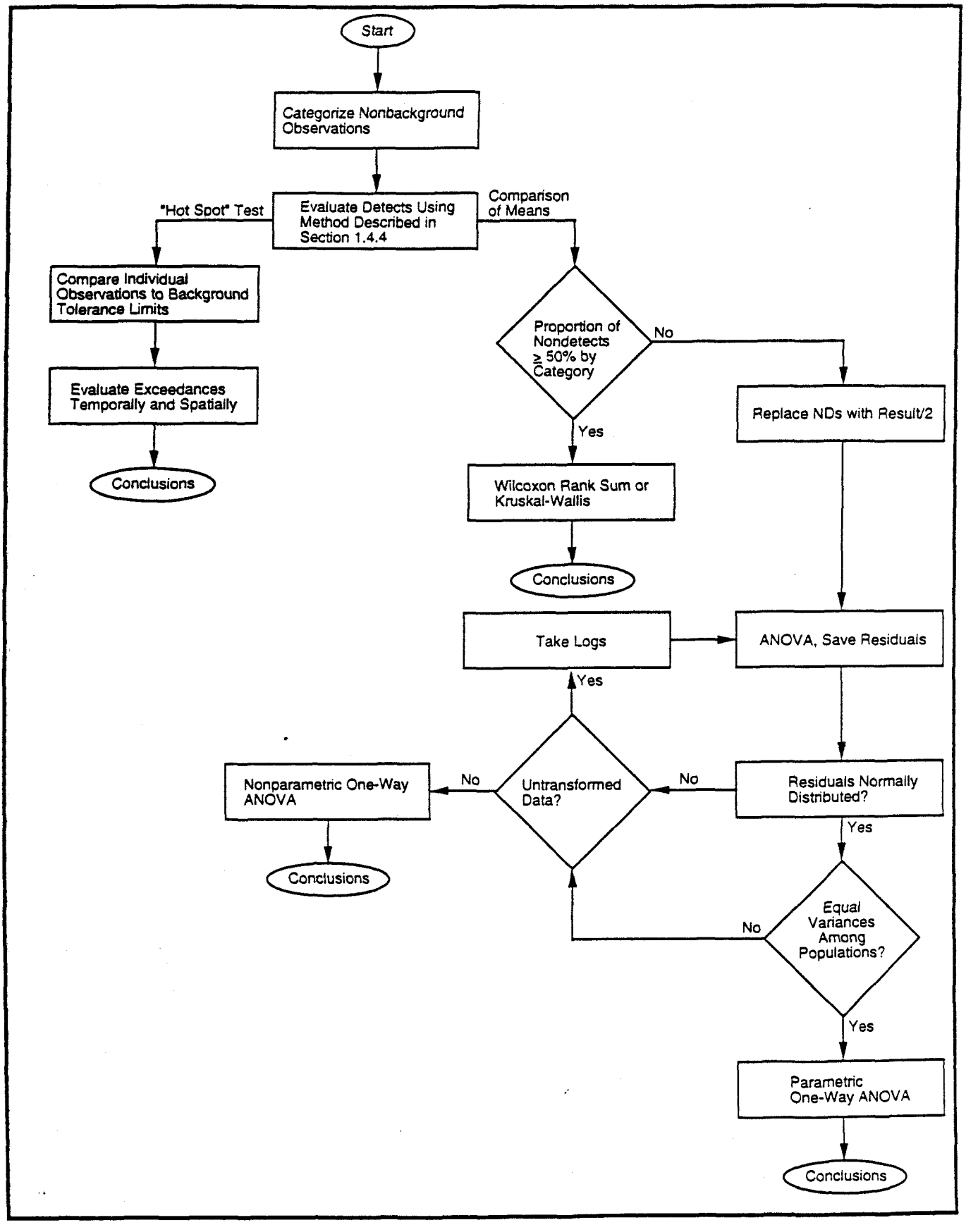


Figure 1-2 Selection of Statistical Method for Comparison of Background and Non-background Populations

are fewer than 50-percent detects in the grouped background and non-background populations, a Wilcoxon Sum-Rank test or Kruskal-Wallis nonparametric ANOVA are the recommended statistical methods (see EPA, 1992a). If greater than 50 percent of the data are detects, then ANOVA or tolerance intervals are both options for conducting the statistical analysis, although they serve different purposes. ANOVA is the preferred method for statistical analysis and comparison of population means, but this will require at least three observations from the non-background area. In using ANOVA, it is necessary to identify sample distributions and equality of variances to determine whether parametric or nonparametric ANOVA should be used (see Figure 1-2). ANOVA methods are described in EPA, 1989.

Analyte concentrations in an individual sample from a non-background area can also be compared individually to the tolerance interval calculated for the appropriate background population. When these data are examined for spatial and temporal associations, the UTL can be an effective tool for flagging potential "hot spots." Basically, the tolerance interval answers the question: where do most of the observations lie for the background population or subpopulation?

Where intrawell comparisons over time are required to ensure continued background status of downgradient wells, control charts are an appropriate procedure. Construction of control charts is discussed in EPA, 1989, Section 7.

1.8 GEOCHEMICAL EVALUATIONS

Statistical methodology and tests are helpful in the analysis and interpretation of data. However, exclusive reliance on statistics to investigate issues such as mean contaminant levels and their differences between areas can be misleading and may even defy common sense. Geological, geochemical, and hydrological principles must be applied to completely understand the geochemical origin and significance of the statistical results. Section 3 of this report discusses how background samples were collected and chemically analyzed. The following subsection summarizes how the background data were evaluated geochemically.

1.8.1 Review of Geochemical Data

Raw background data sets were examined for "geochemical reasonableness" (e.g., whether chemical concentrations were within expected ranges; if gravimetrically determined dissolved solids concentrations approximated the sum of the cations and anions; etc.). If errors were identified in the review, they were corrected. Consistency of data was also checked by plotting specific conductance measurements vs. total dissolved solids (TDS) (either measured or computed).

1.8.2 Water-Quality Trends

Groundwater and surface-water data from the Rocky Flats site were examined using one or more types of standard geochemical plots: Stiff, Piper, or Schoeller diagrams (see Hem, 1992). Although these plots differ in format and number of constituents, they all use major-ion chemistry to help classify and compare natural waters from different host rocks or different stream drainages. Such plots, along with a more detailed discussion of the background chemical data, are presented in Section 5 of this report.

Geochemical ratio maps may be constructed by plotting and contouring concentration ratios (of elements or ions) or activity ratios on a base map. Ratio maps may be particularly helpful in interpreting the sources of radionuclides in various media. Activity-ratio data for $^{233,234}U/^{238}U$ may be useful in identifying uranium of potential RFP origin from naturally occurring U in various background media (see Section 5.8).

SECTION 2

SECTION 2
PHYSICAL SETTING OF THE ROCKY FLATS PLANT

The Rocky Flats Plant (RFP) is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver (Figure 2-1). Other nearby cities include Arvada, Boulder, and Westminster, which are located less than 10 miles to the southeast, northwest, and east, respectively. The RFP site consists of approximately 6,550 acres of federally owned land in Sections 1 through 4, and 9 through 15 of T2S, R70W, 6th Principal Meridian. Major buildings are located within the RFP security area of approximately 400 acres. The security area is surrounded by a buffer zone of approximately 6,150 acres (Figure 2-2).

2.1 TOPOGRAPHY

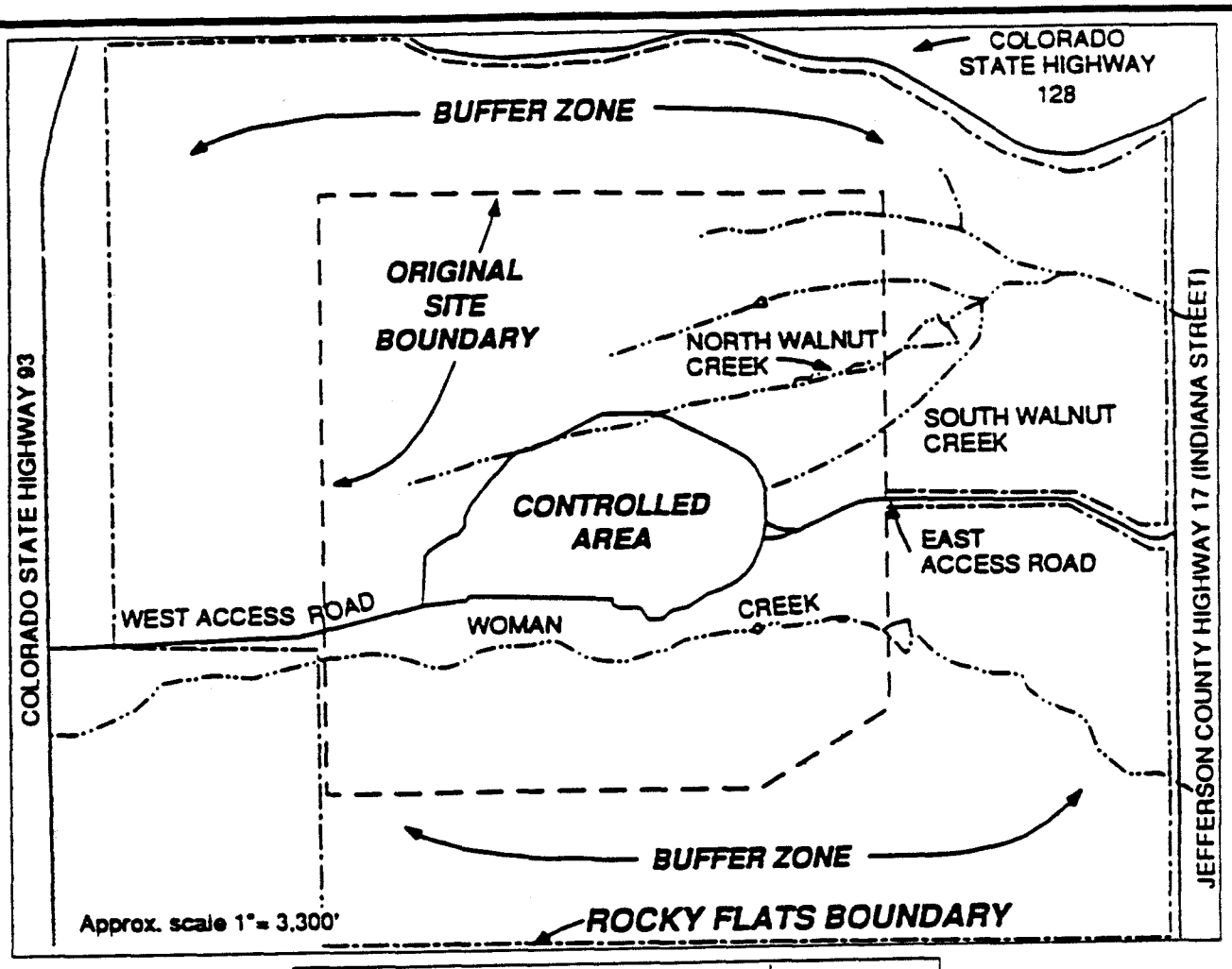
The natural environment of the Rocky Flats area is influenced primarily by its proximity to the Front Range of the Rocky Mountains. The RFP is located just east of the north–south trending Front Range, and about 16 miles east of the Continental Divide.

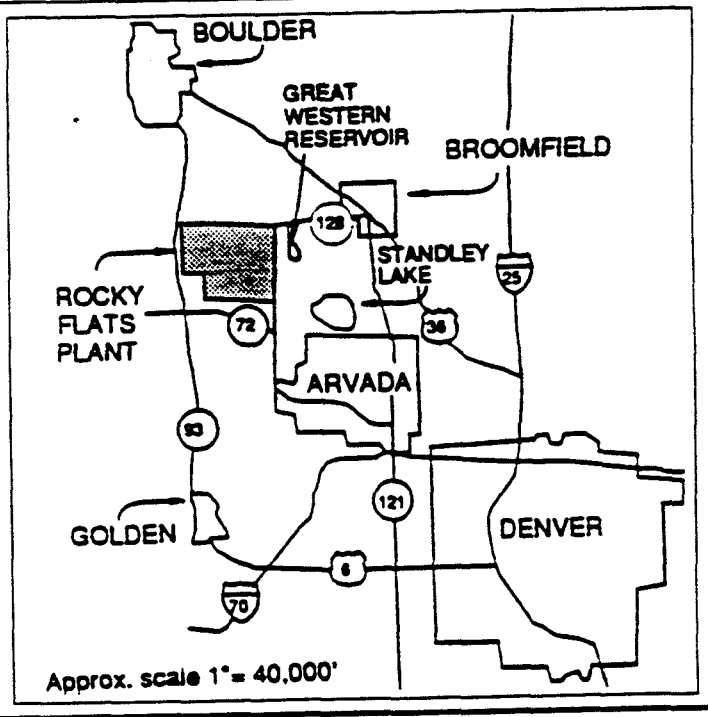
The Rocky Flats geomorphic surface is a broad, eastward-sloping plain of coalescing alluvial fans developed along the Front Range. These fans extend about five miles east from their origin at Coal Creek Canyon, and terminate at a break in slope to low rolling hills. The Plant lies on the central plain of the Rocky Flats surface, at an altitude of approximately 6,000 ft above mean sea level. The operational area is located near the eastern edge of the fans on a terrace between stream-cut valleys (North Walnut Creek and Woman Creek).

2.2 SURFACE-WATER HYDROLOGY

Three east-flowing, intermittent streams traverse the RFP, dividing it into three primary drainages; Rock Creek, Walnut Creek, and Woman Creek (Figure 2-2).

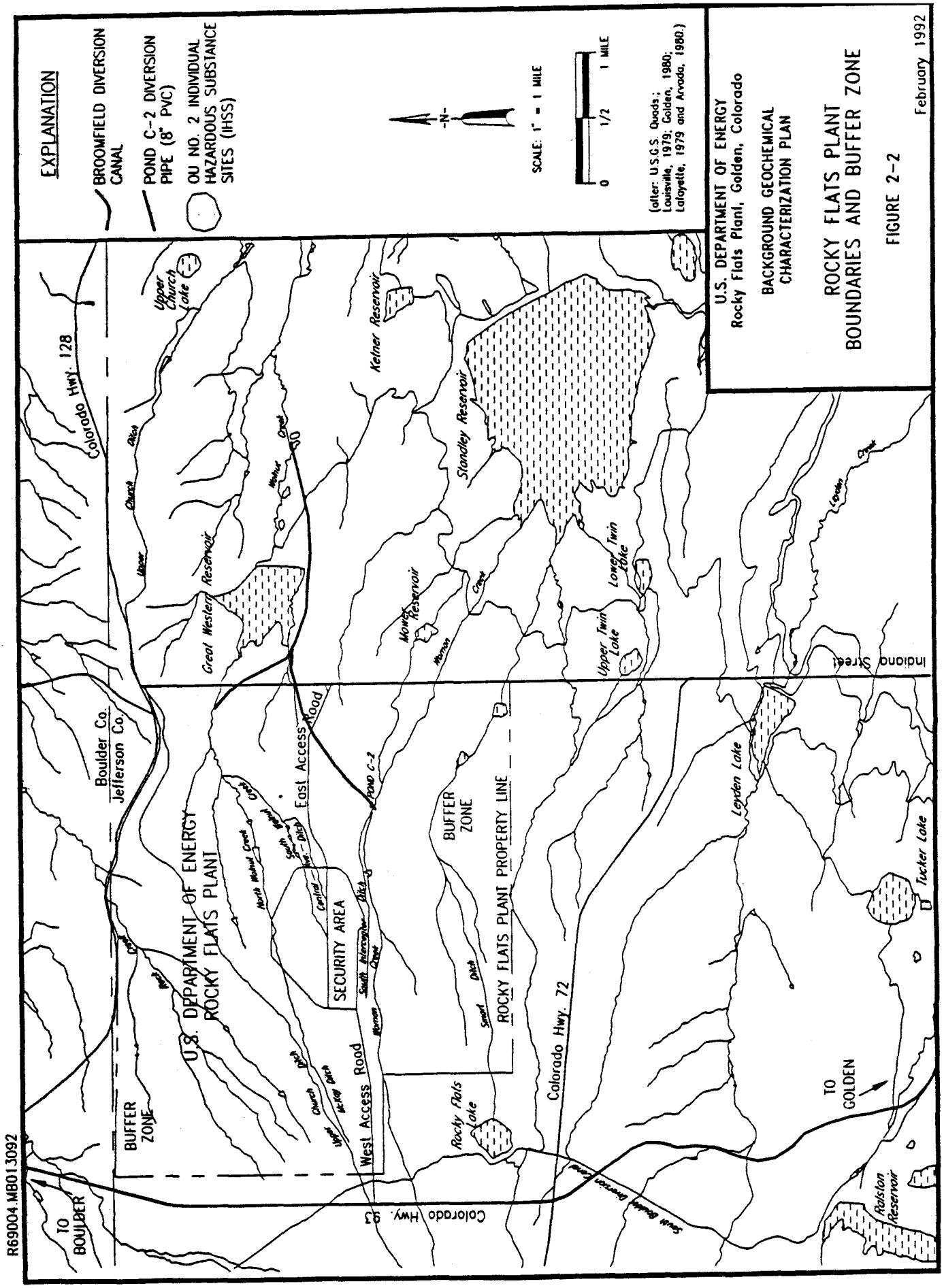
Rock Creek lies wholly outside of the industrial area of the site. It drains the northwestern corner of the RFP and flows northeast through the buffer zone to an off-site confluence with Coal Creek.





U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	ROCKY FLATS PLANT Golden, Colorado VICINITY MAP	FIGURE 2-1

R69009.MB013092


EXPLANATION
BROOMFIELD DIVERSION CANAL
POND C-2 DIVERSION PIPE (8" PVC)
OU NO. 2 INDIVIDUAL HAZARDOUS SUBSTANCE SITES (IHSS)
N
SCALE: 1" = 1 MILE
0
1/2
1 MILE
(after: U.S.G.S. Quads.; Louisville, 1979; Golden, 1980; Lafayette, 1979 and Arvada, 1980.)
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado
BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
ROCKY FLATS PLANT
BOUNDARIES AND BUFFER ZONE
FIGURE 2-2
February 1992
R69004.MB013092
TO BOULDER
Boulder Co.
Jefferson Co.
Colorado Hwy. 128
Upper Church Lake
Upper Church Ditch
Great Western Reservoir
Walnut Creek
Kelner Reservoir
Standley Reservoir
Mower Reservoir
Woman Creek
Lower Twin Lake
Upper Twin Lake
Indiana Street
Leyden Creek
Leyden Lake
Tucker Lake
Ralston Reservoir
TO GOLDEN
South Boulder Diversion Canal
Colorado Hwy. 72
Colorado Hwy. 93
Rocky Flats Lake
Smart Ditch
ROCKY FLATS PLANT PROPERTY LINE
BUFFER ZONE
BUFFER ZONE
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
SECURITY AREA
West Access Road
East Access Road
POND C-2
North Walnut Creek
South Walnut Creek
Walnut Ditch
Central Ditch
Church Ditch
Woman Creek
South Interceptor Ditch

North and South Walnut Creeks, and an unnamed tributary, drain the northern portion of the RFP security area. The three forks of Walnut Creek join in the buffer zone and flow toward Great Western Reservoir, which is located approximately one mile east of the confluence. However, since 1989, flow from Walnut Creek has been routed around Great Western Reservoir by the Broomfield Diversion Canal operated by the City of Broomfield.

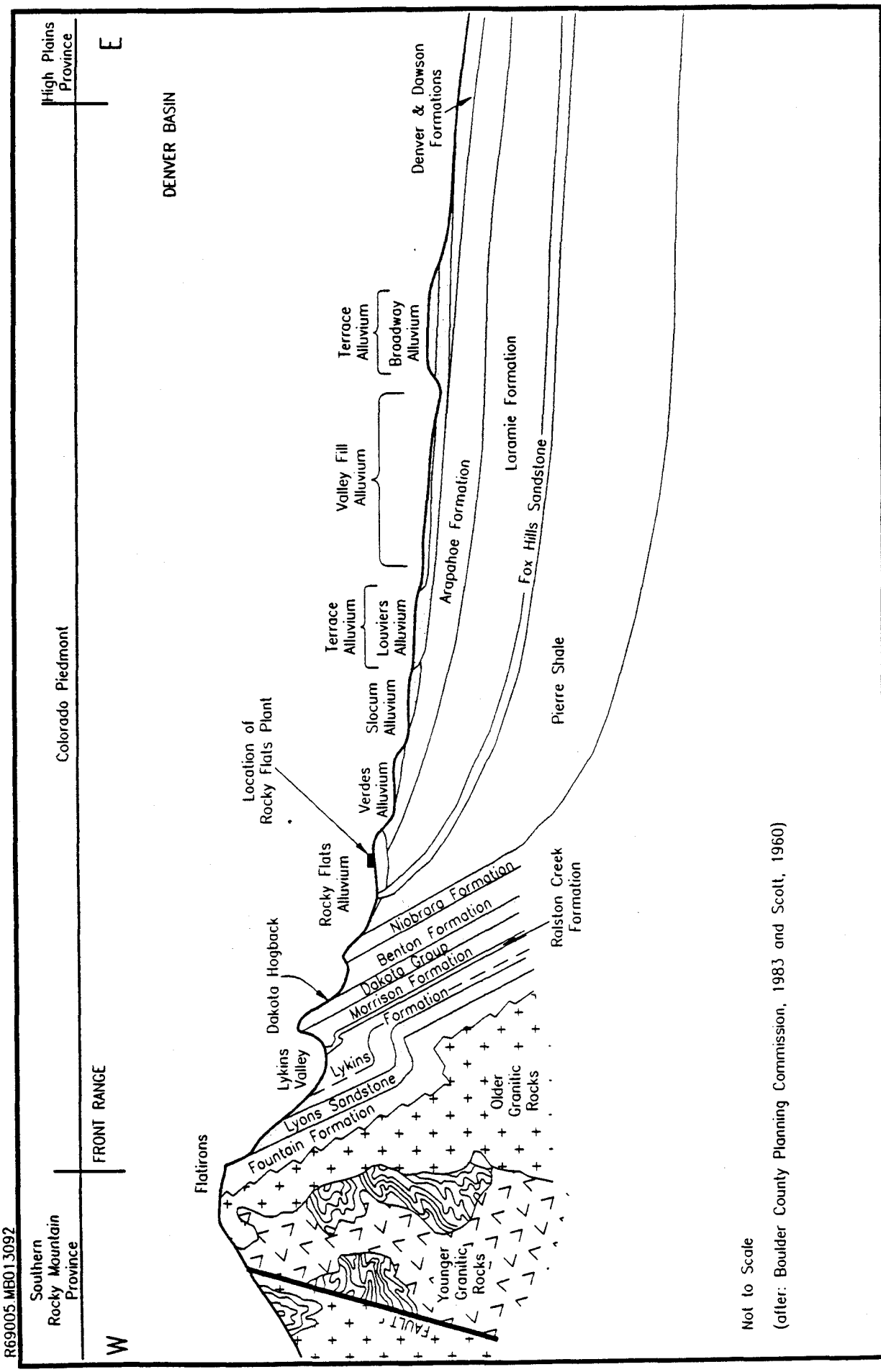
An east-west trending interflueve separates the Walnut and Woman Creek drainages. The Woman Creek flow is diverted on plant site to Mower Reservoir via the Mower Ditch. The South Interceptor Ditch, constructed between the Plant and Woman Creek, collects runoff from the southern Plant security area and diverts it to Pond C-2, where it is treated and monitored in accordance with National Pollutant Discharge Elimination System (NPDES) permit held by the RFP. Consequently, Woman Creek now receives no direct inflow from Plant runoff. Treated water from Pond C-2 is pumped to the Walnut Creek watershed, where it is released to the Broomfield Diversion Canal.

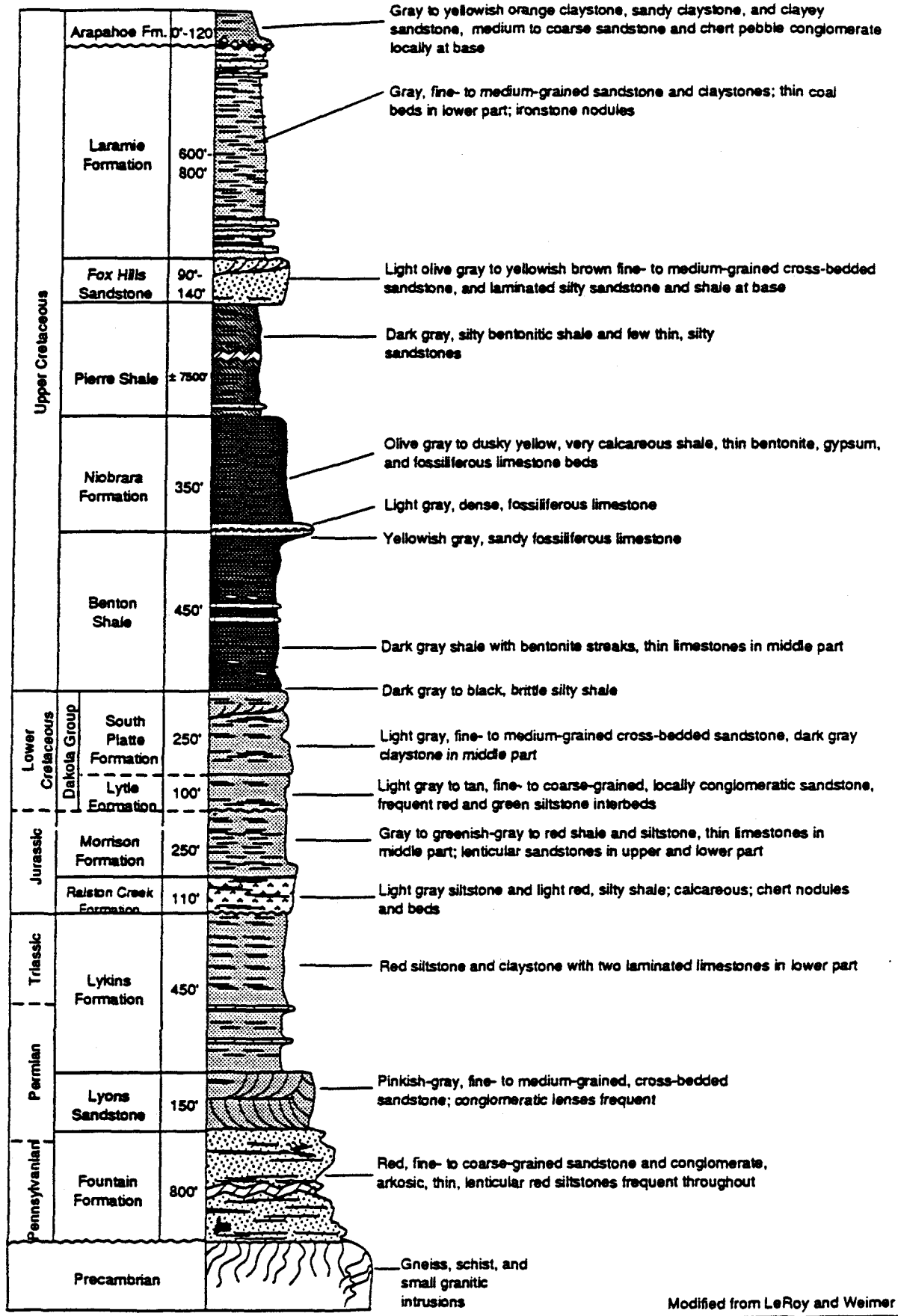
2.3 REGIONAL AND LOCAL GEOLOGY

Geologic units at the Rocky Flats site consist of unconsolidated surficial units of Quaternary age (Rocky Flats Alluvium - RFA, valley-fill alluvium - VFA, and colluvium - COL), which unconformably overlie Cretaceous bedrock (Arapahoe Formation/Laramie Formation - KAR, and Fox Hills Sandstone) (Figure 2-3). This geologic sequence forms part of a monoclinal fold whose western edge is composed of uplifted strata of Mesozoic age. A generalized stratigraphic section of the Denver Basin bedrock (Figure 2-4) and a stratigraphic section for the RFP, including unconsolidated deposits (Figure 2-5), illustrate the geology of the area. Surficial geology (EG&G, 1992a) is also shown (Figure 2-6).

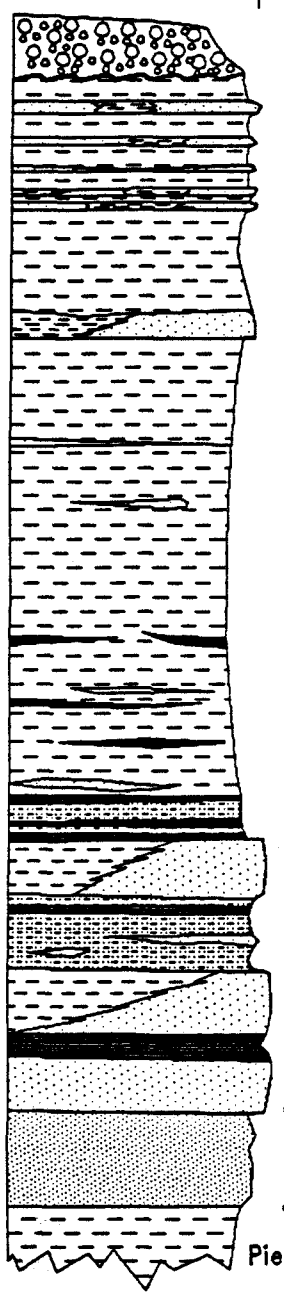
2.3.1 Quaternary-Aged Alluvia

Quaternary alluvia along the Front Range have been correlated based on their height above modern drainages and major streams. Each height represents a stable geomorphic level developed during the Quaternary Period (Scott, 1965) (Figure 2-7).


R69005 MB013092
Southern Rocky Mountain Province
W
FRONT RANGE
Colorado Piedmont
High Plains Province
E
DENVER BASIN
Flatirons
Lykins Valley
Dakota Hogback
Lykins
Fountain Formation
Lyons Sandstone
Morrison Formation
Benton Formation
Niobrara Formation
Dakota Group
Ralston Creek Formation
Rocky Flats Alluvium
Location of Rocky Flats Plant
Verdes Alluvium
Slocum Alluvium
Terrace Alluvium
Louviers Alluvium
Valley Fill Alluvium
Terrace Alluvium
Broadway Alluvium
Denver & Dawson Formations
Arapahoe Formation
Laramie Formation
Fox Hills Sandstone
Pierre Shale
Younger Granitic Rocks
Older Granitic Rocks
FAULT
Not to Scale
(after: Boulder County Planning Commission, 1983 and Scott, 1960)
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado
GENERALIZED EAST-WEST
CROSS SECTION
FRONT RANGE TO DENVER BASIN
FIGURE
2-3



U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, CO	GENERALIZED STRATIGRAPHIC SECTION FOR DENVER BASIN	Figure 2-4



PERIOD	STRATIGRAPHY	LITHOLOGIC UNIT & APPROXIMATE THICKNESS	DESCRIPTION
0 Quaternary		Rocky Flats Alluvium 0–100'	Clayey Sandy Gravels– light brown to yellowish–orange, grayish–orange to dark gray, poorly–sorted, angular to subrounded, cobbles, coarse gravels, coarse sands and gravelly clays; varying amounts of caliche
		Arapahoe Formation 0–120'	sand #1: 0–27.2' sand #2: 0–10' sand #3: 0–16' sand #4: 0–15' sand #5: 0–9'+
Cretaceous		sand: 0–40'	Claystones, Siltstones, Clayey Sandstones, and Sandstones– light to medium olive–gray with some dark olive–black claystone and silty claystone, light to olive–gray, fine– to coarse–grained, moderately–sorted fluvial sandstone intervals; weathered intervals may be yellowed, and basal sand is often conglomeratic
		Laramie Formation 600'–800'	
		upper	Claystones, Siltstones, Sandstones, and Coal– kaolinitic, light to medium gray claystone and siltstone and some dark gray to black carbonaceous claystone, thin (2') coals and discontinuous, very fine to medium grained, moderately sorted sandstone intervals
		lower	Sandstones, Claystones, and Coal– light to medium gray, fine– to coarse–grained, poorly– to moderately–sorted, silty, immature quartzitic sandstone with numerous *lenticular, sub–bituminous coal beds and seams that range from* 2' thick in the upper lower interval to 8' thick at the base of the lower interval
		Fox Hills Sandstone 90'–140'	Sandstones– *grayish–orange to light gray, calcareous, fine–grained, subrounded,* glauconitic, friable sandstone
		Pierre Shale & Older Units	

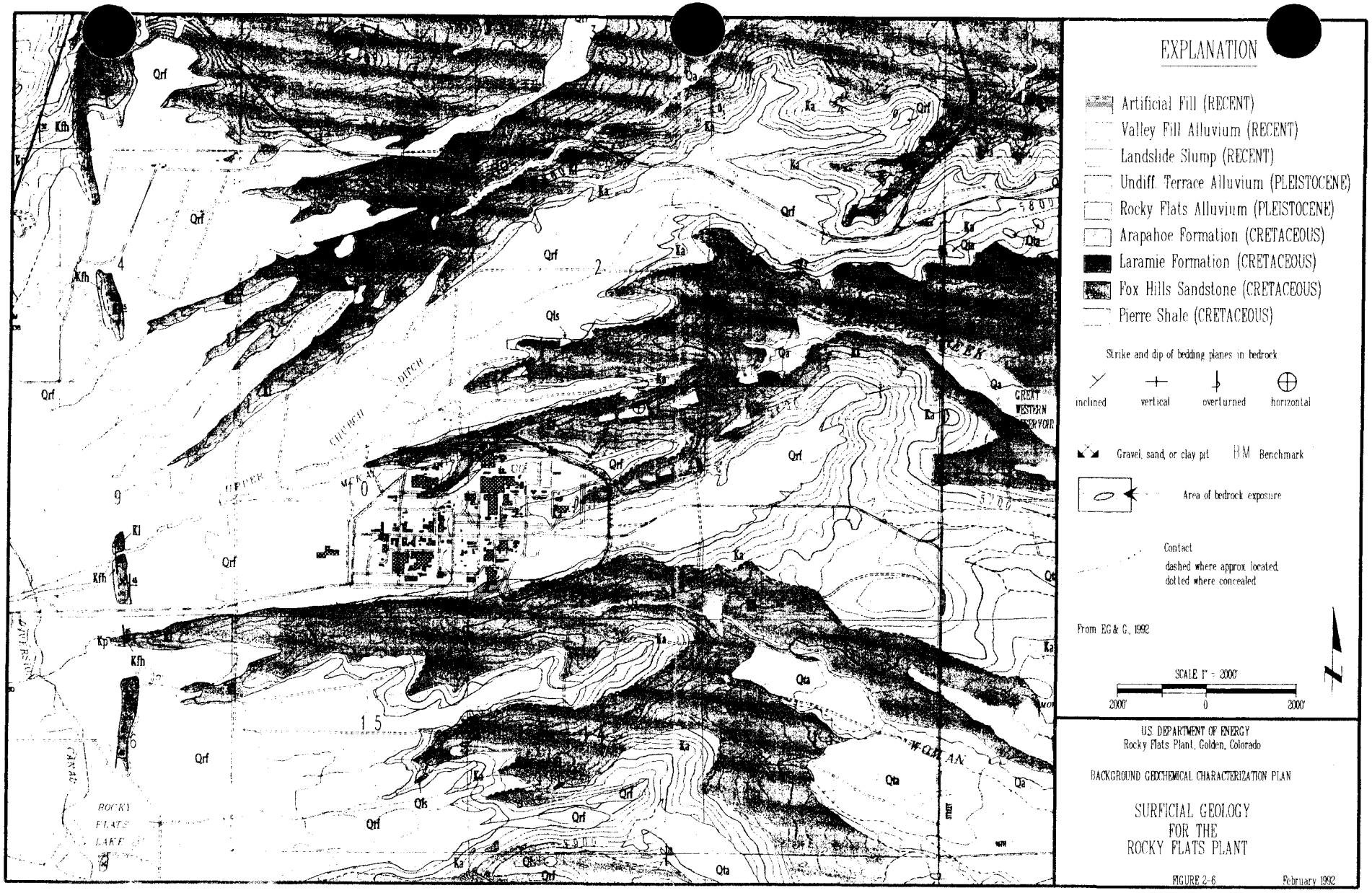
EXPLANATION

- Alluvium
- Coal
- Fine–grained & coarser sandstone
- Fine–grained sandstone
- Siltstone and claystone
- Silty sandstone

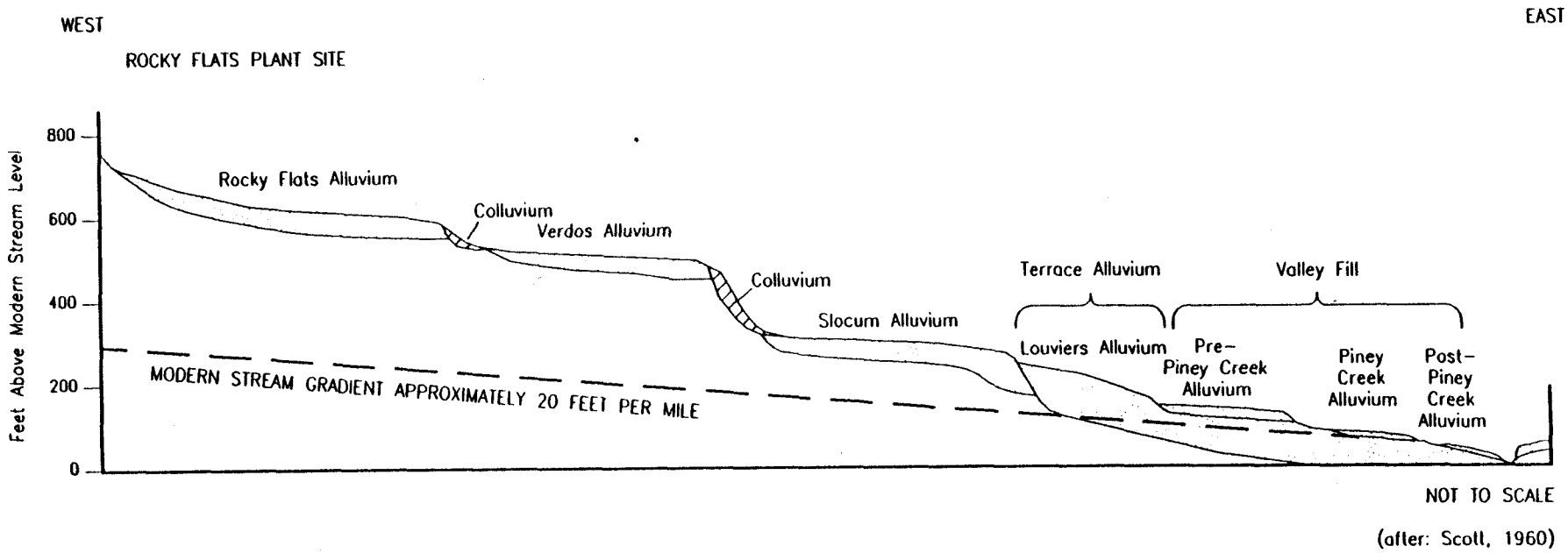
(after EG&G, 1991c)

U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	LOCAL STRATIGRAGHIC SECTION OF THE ROCKY FLATS PLANT	FIGURE 2–5

R69014.PJCW–022192


EXPLANATION
Artificial Fill (RECENT)
Valley Fill Alluvium (RECENT)
Landslide Slump (RECENT)
Undiff. Terrace Alluvium (PLEISTOCENE)
Rocky Flats Alluvium (PLEISTOCENE)
Arapahoe Formation (CRETACEOUS)
Laramie Formation (CRETACEOUS)
Fox Hills Sandstone (CRETACEOUS)
Pierre Shale (CRETACEOUS)
Strike and dip of bedding planes in bedrock
inclined
vertical
overturned
horizontal
Gravel, sand, or clay pit
BM Benchmark
Area of bedrock exposure
Contact
dashed where approx. located
dotted where concealed
From EG & G, 1992
SCALE 1" = 2000'
2000'
0
2000'
US DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado
BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
SURFICIAL GEOLOGY
FOR THE
ROCKY FLATS PLANT
FIGURE 2-6
February 1992
Qrf
Ka
Kfh
Kp
Kl
Qls
Qta
Qa
CREEK
GREAT WESTERN RESERVOIR
CHURCH DITCH
UPPER
WOMAN
ROCKY FLATS LAKE
CANAL
5800
5700

R69008.MB013092



January 1992

U.S. DEPARTMENT OF ENERGY Rocky Flat Plant Golden, Colorado	EROSIONAL SURFACES AND ALLUVIAL DEPOSITS EAST OF THE FRONT RANGE COLORADO	FIGURE 2-7

The pre-Wisconsin (greater than about 70,000 years ago) pediment was not a smooth plane, but rather an erosional surface that was cut by a well-developed network of east-flowing stream drainages. This ancient drainage network probably influenced the configuration of the current drainage system. The ancient pediment surface exhibits as much as 30 ft of relief (EG&G, 1991b). In ravines and drainages, the alluvial sediment is breached, thereby exposing strata of the Arapahoe and Laramie Formations.

The RFA comprises the main alluvial cover at the site. All other surficial deposits occur topographically below RFA within the Walnut, Woman, or Rock Creek drainages. COL (slope wash) mantles the side slopes between the RFA and the valley bottoms. In addition, remnants of younger terrace deposits—including the Verdos, Slocum, and Louviers Alluvia—may also be exposed along the side slopes. Recent VFA accumulates within the active stream channels (Figure 2-7).

The Quaternary-aged RFA is the oldest (Nebraskan or Aftonian) and topographically highest alluvial deposit at the RFP (Scott, 1965). This deposit was formed by a series of coalescing alluvial fans deposited by braided streams (Hurr, 1976). It consists of a topsoil layer underlain by orange to dark gray, poorly sorted cobbles, coarse gravel, coarse sand, and gravelly clay. Generally, the alluvium is coarser grained west of the Plant site, and becomes finer grained toward the east. Caliche may be present in the interstices of the alluvium in amounts greater than 25 percent over an interval of 1 to 2 feet (EG&G, 1991b). Caliche is most likely to occur where evaporation is high, the water table is close to the surface, and the alluvial cover is thin, or where the unconsolidated material is underlain by claystones and siltstones that restrict percolation.

Because of the uneven surface of the pediment on which the RFA was deposited, the thickness of the alluvium ranges from 70 to 110 ft just west of the Plant, to less than 10 ft in the central portion of the site, and to around 45 ft just east of the Plant (EG&G, 1991b). The erosional surface (pediment) on which the alluvium was deposited, slopes gently eastward and truncates, from west to east, progressively younger bedrock units.

Following deposition of the RFA, eastward-flowing streams dissected the deposit by headward erosion and lateral planation. The alluvium was progressively removed by erosion in the Woman Creek drainage, just south of the main industrial area, as well as in the South Walnut Creek drainage to the north. The resulting remnant of RFA now extends eastward from the Plant, and lies between the two drainages.

2.3.2 Cretaceous-Aged Deposits

Cretaceous-aged formations in the vicinity of the RFP were deposited during the Laramide Orogeny. Uplifted strata to the west provided the source material for the prograding sequence of Fox Hills delta-front sands, Laramie delta-plain coastal sediments, and the fluvial deposits of the Arapahoe Formation.

2.3.2.1 Arapahoe Formation

The Arapahoe Formation is the uppermost bedrock unit in the vicinity of the Plant. It unconformably underlies surficial materials beneath most of the site, except in the western portion. There, from approximately the middle of the west buffer zone and west to the gravel quarries, the Laramie Formation unconformably underlies RFA. The thickness of the Arapahoe Formation is about 120 ft in the central portion of the RFP. However, the thickness of the formation is currently under investigation, and may be as little as 50-ft thick in some areas. The unit is nearly flat-lying beneath the central and eastern portions of the RFP (EG&G, 1990a; EG&G, 1990b).

The Arapahoe Formation is a fluvial deposit composed of overbank and channel deposits. It consists predominantly of light to medium olive-gray and olive-black claystones and silty claystones, as well as siltstones with some silty sandstones and sandy conglomerates. Where weathered at the base of the alluvium, the claystones appear dark yellowish-orange as a result of iron-oxide staining below the unconformable contact between alluvium and bedrock. Staining is common at depths of 1 to 20 ft below the alluvium (EG&G, 1991b). Caliche may also be found in this weathered zone in sandstones beneath the RFA, and above claystones or siltstones, as a result of reduced percolation and high evaporation.

The Arapahoe Formation contains sandstone intervals that are lenticular in nature (EG&G, 1991b). Most of the sandstones are very fine- to medium-grained, poorly to moderately sorted, subangular to subrounded, silty, clayey, with frosted quartz grains, although some are coarse-grained or conglomeratic. Commonly, the Arapahoe sandstones that lie within 30 to 40 ft of the base of the alluvium are oxidized and are pale orange, yellowish-gray, and dark yellowish-orange in color. Sandstones that are not in the weathered zone are generally light gray to olive gray.

2.3.2.2 Laramie Formation

The Laramie Formation underlies the Arapahoe Formation and is composed of two units: a thick upper unit composed predominantly of claystone with some siltstones and sandstones and a lower unit containing numerous coals and sandstones that increase in thickness towards the base of the unit. The contact with the overlying Arapahoe Formation is conformable and is defined on the basis of textural and lithologic characteristics, as given in the following description taken from EG&G (1992a).

> "The base of the Arapahoe Formation is defined as the lowest occurrence of lithologically distinct, medium- to coarse-grained, well-rounded, frosted, quartz sandstone or conglomeratic sandstone within a continuous vertical section. Where no distinct Arapahoe sandstones are present within the vertical sequence, no lithologic break defines that contact and the contact surface is projected from the nearest surface exposures of lithologically distinct Arapahoe sandstones."

The upper Laramie is composed of mostly silty claystones, siltstones, and some fine-grained fluvial channel sandstones. The basal 150 ft of the upper Laramie interval contains coal beds that range from 1 to 3 ft in thickness. The silty claystones are light olive-gray to olive-black, massive, and may contain sand or carbonaceous material. Iron-oxide nodules occur within the siltstones (EG&G, 1991b).

The lower Laramie is composed of sandstones, siltstones, claystones, and coal beds. The sandstones are finer grained and more laterally continuous than those found in the Arapahoe

Formation. Coal beds range from 2 to 8 ft in thickness, and one of the sandstone beds is approximately 50-ft thick (EG&G, 1991b).

The total thickness of the Laramie Formation is about 800 ft; the upper Laramie ranges in thickness from 515 to 690 ft, and the lower Laramie ranges from 115 to 285 ft in thickness (Weimer, 1973; EG&G, 1991b). The beds within the Laramie Formation dip at approximately 45 to 50° in areas west of the RFP, and flatten to a less than 2° dip in areas below and east of RFP (EG&G, 1990a; EG&G, 1990b).

2.3.2.3 Fox Hills Sandstone

The Fox Hills Sandstone is approximately 75 to 125 ft thick and is composed chiefly of calcareous, fine-grained feldspathic sandstone with thin interbeds of siltstone and claystone (EG&G, 1991b). The rocks are grayish-orange to light gray in color. The formation has been interpreted as a delta-front sandstone in depositional contact with the underlying Pierre Formation and with the overlying Laramie Formation (Weimer, 1973).

2.3.3 Structural Features

The area in which the RFP is situated was tectonically active during the Laramide Orogeny (approximately 60 to 45 million years ago). Structural activity was manifested mainly as thrust faults resulting from compressional stresses. After a period of quiescence, the tectonic forces shifted from a compressional to an extensional regime, characterized by tensional faulting from the Miocene to the Pliocene period (25 to 5 million years ago). This period of faulting produced the normal and high-angle reverse faults associated with the present-day Front Range.

The RFP lies on a monoclinal fold that trends along the eastern margin of the Front Range; the axial plane of the fold strikes roughly north–south. Just west of the site, steeply east-dipping strata of Pennsylvanian age lie unconformably on Precambrian granitic rocks.

2.4 HYDROGEOLOGY

Unconfined groundwater flows within the relatively permeable RFA (Figure 2-8). Recharge to the alluvium results from precipitation and snowmelt, as well as water losses from ditches, streams, and ponds that are cut into the alluvium. Groundwater levels in the RFA rise in response to recharge during the spring and decline during the remainder of the year.

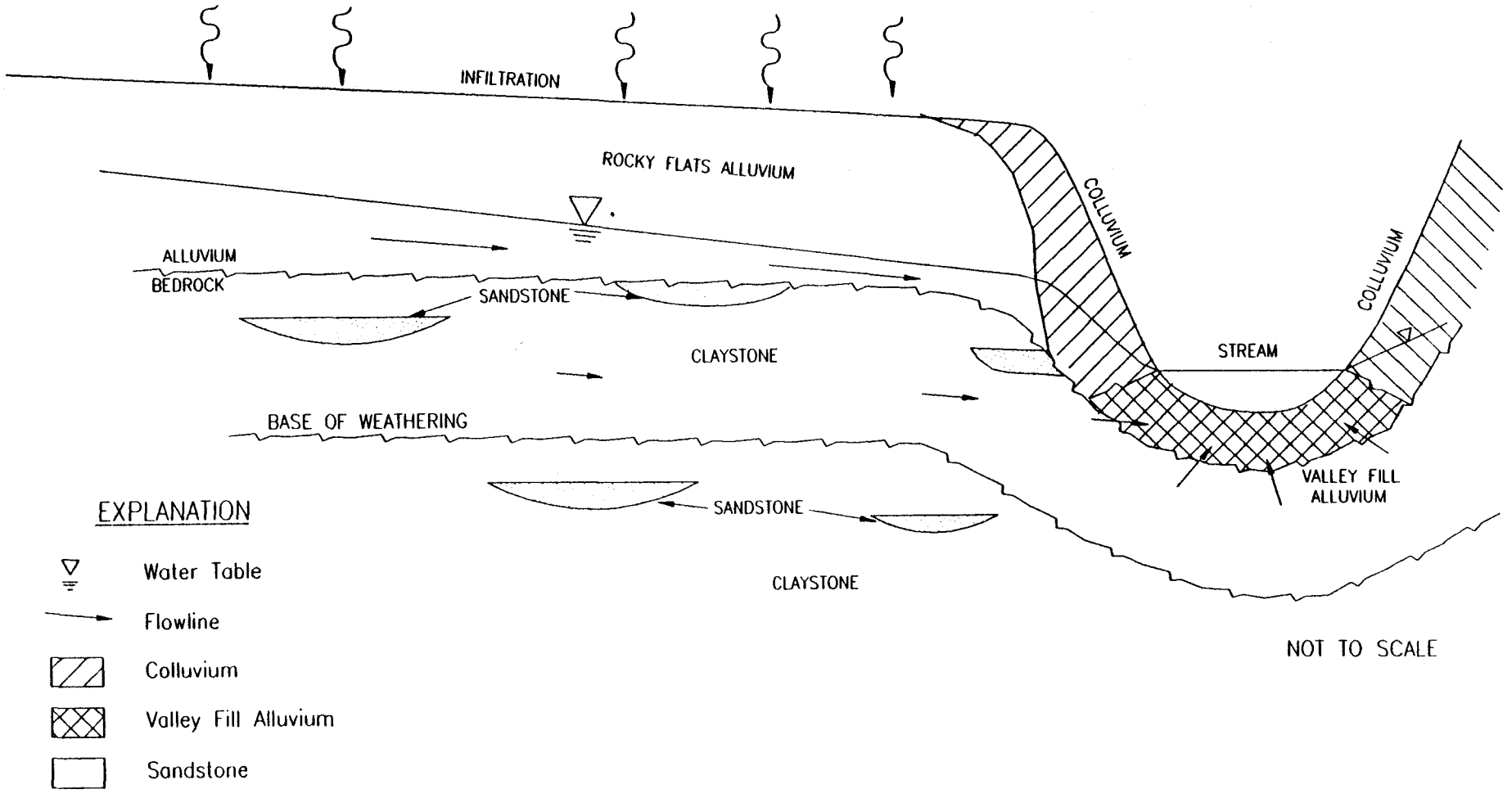
Groundwater movement in RFA is generally from west to east and is controlled by pediment drainages cut into the top of bedrock. Flow is downslope through colluvial materials and then along the course of the stream in valley-fill materials. The alluvium terminates approximately 1,500 ft west of the eastern Plant boundary and does not directly supply water to wells located downgradient of the RFP. Discharge from the alluvium occurs at seeps located at the contact between the alluvium and bedrock along the edges of the valleys. Most seeps flow intermittently.

During periods of high flow, surface water is lost to bank storage in the VFA, and returns to the stream after the runoff subsides. In the western portion of Rocky Flats, where the thickness of the alluvial material is greatest, the depth to the water table is 50 to 70 ft below ground surface (EG&G, 1991b). The water table becomes shallower to the east (with local variations) as the alluvial material thins. The surficial water-table map illustrates the shallowing of the water table in a general west-to-east direction (Plate 2).

The Arapahoe sandstones (KAR) exhibit many of the same hydrogeological characteristics as the RFA. Where the sandstones are in direct contact with the alluvium, groundwater exists under unconfined conditions. However, saturated sandstones that lie beneath claystones and siltstones are confined water-bearing units. Where weathered, the claystones themselves may act as unconfined water-bearing units, but have much lower hydraulic conductivities than the RFA.

The main recharge area for Arapahoe sandstones is under RFA, although some recharge from the COL and VFA may occur along the stream valleys (Figure 2-8). Recharge is greatest during the spring and early summer when rainfall and stream flow are at a maximum and, during this season, water levels in RFA are relatively high. Discharge areas are located at the edges of

R33013.PJCW-021992



U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	SCHEMATIC OF GROUND WATER/SURFACE WATER INTERACTION	FIGURE 2-8

valleys (Figure 2-8). Groundwater flow in the bedrock is from west to east, although flow within individual sandstones is controlled locally by the channel geometries. The Arapahoe sandstones have hydraulic conductivities approximately equivalent to, or less than, those of the overlying RFA (Hydro-Search, 1985; Rockwell International, 1986).

The lower sandstone of the Laramie Formation, together with the underlying Fox Hills Sandstone, comprises a regionally important aquifer in the Denver Basin known as the Laramie-Fox Hills Aquifer (Robson, 1983). Near the center of the basin the aquifer thickness ranges from 200 to 300 ft. The lower Laramie and Fox Hills units subcrop beneath RFA west of Plant site, and are visible in clay pits excavated through the RFA (see Figure 2-3). Recharge to the Laramie-Fox Hills Aquifer infiltrates through a rather limited outcrop area exposed to surface-water flow along the Front Range (Robson *et al.*, 1981). Claystones of the Laramie Formation have very low hydraulic conductivities; therefore, the U.S. Geologic Survey (Hurr, 1976) concluded that Plant operations would not impact any units below the upper claystone unit of the Laramie Formation.

2.4.1 Summary: Groundwater Flow at the Rocky Flats Plant

In summary, two groundwater flow-systems have been distinguished in the current conceptual model of the subsurface hydrology of the RFP. The upper flow-system is unconfined and lies within the RFA, COL, VFA, and WCS. The lower flow-system is confined within unweathered bedrock sandstones of the lower Arapahoe and upper Laramie Formations (KAR). The two flow-systems are probably in hydraulic connection wherever bedrock sandstone subcrops under surficial materials (EG&G, 1991c).

2.5 METEOROLOGY AND CLIMATOLOGY

The area surrounding Rocky Flats has a semiarid climate characteristic of much of the central Rocky Mountain region. Approximately 40 percent of the 15-in. annual precipitation falls during the spring season, much of it as snow. Thunderstorms (June to August) account for an additional 30 percent of the annual precipitation. Autumn and winter are drier seasons, contributing 19 and 11 percent of the annual precipitation, respectively. Snowfall averages 85

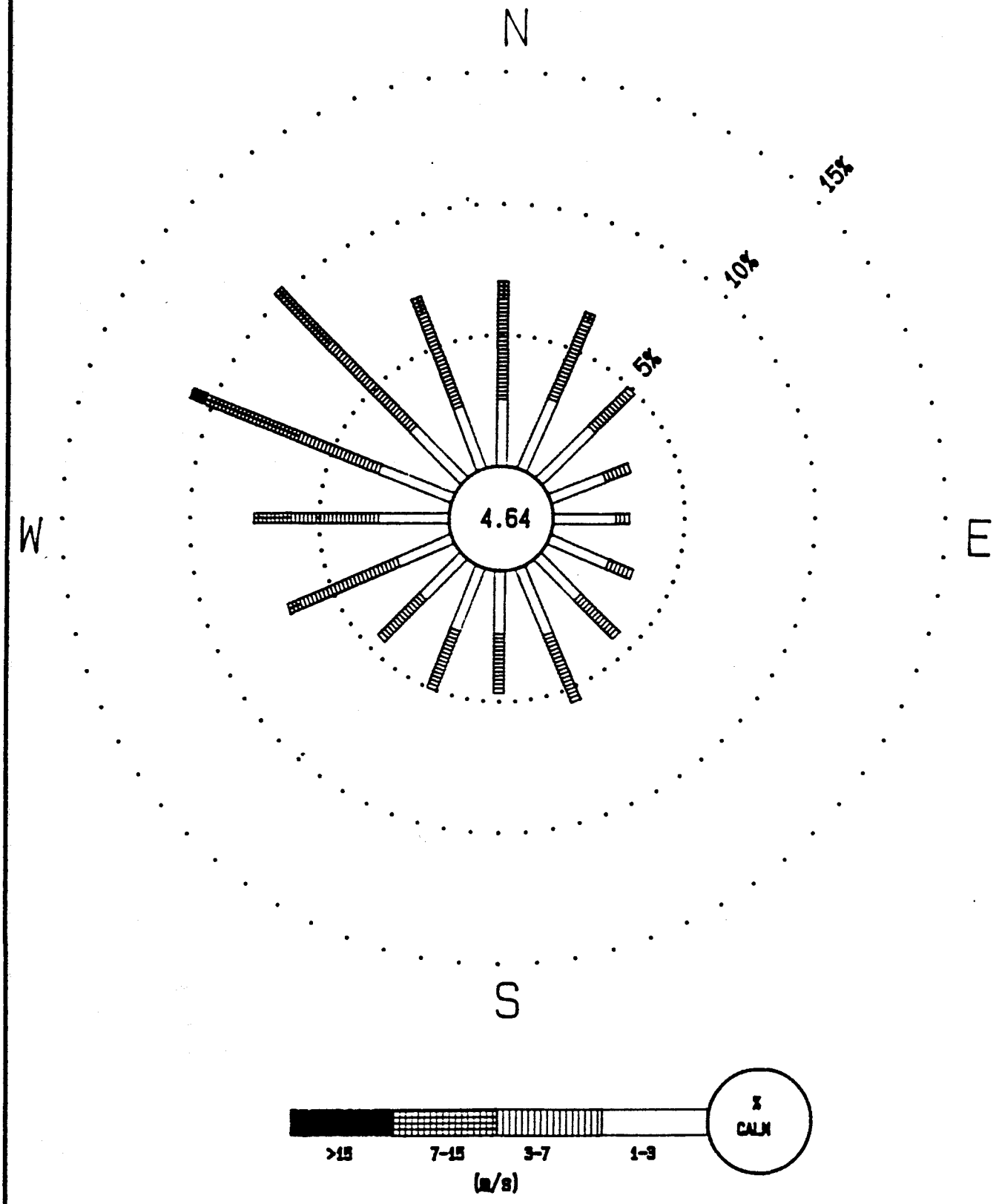
in. per year, falling from October through May (DOE, 1980). Temperatures are moderate; extremely warm and cold weather is usually of short duration. On the average, daily summer temperatures range from 55 to 85°F, and winter temperatures range from 20 to 45°F. The low average relative humidity (46 percent) is because of the blocking effect of the Rocky Mountains. Wind, temperature, and precipitation data are collected on the site and summarized annually. The 1990 annual summary of the percent frequency of wind directions (16 compass points) is divided into five speed categories (Table 2-1 and Figure 2-9). Winds at the RFP are predominantly northwesterly. Winds greater than 4.18 m/s (9.2 miles per hour) with easterly components are less frequent.

Special attention has been focused on dispersion meteorology surrounding the RFP because of the possibility that significant atmospheric releases of toxins might affect the Denver metropolitan area, which is located in the predominant downwind direction (southeast). Studies of air flow and dispersion characteristics (e.g., Hodgin, 1983) indicate that air drainage flows down from the mountains, turns, moves toward the north and northeast along the South Platte River valley, and passes to the west and north of Brighton, Colorado (DOE, 1980), which is just north of Denver.

Table 2-1. Wind Direction Frequency (Percent) by Five Wind-Speed Classes Rocky Flats Plant (15 min averages, 1990 annual)

Wind direction	Calm (m/s)	1-3 m/s	3-7 m/s	7-15 m/s	>15 m/s	Totals (%)
—	4.64					4.64
N	—	2.59	3.92	0.62	0.01	7.14
NNE	—	2.91	3.25	0.30	0.01	6.47
NE	—	2.91	2.01	0.04	0.00	4.96
ENE	—	2.23	0.95	0.01	0.00	3.19
E	—	2.44	0.41	0.00	0.00	2.85
ESE	—	2.35	0.87	0.00	0.00	3.22
SE	—	2.27	2.08	0.00	0.00	4.35
SSE	—	2.71	2.77	0.08	0.00	5.56
S	—	2.47	2.20	0.15	0.00	4.82
SSW	—	2.58	2.45	0.09	0.00	5.12
SW	—	2.21	2.18	0.11	0.00	4.50
WSW	—	2.25	4.05	0.39	0.00	6.69
W	—	2.82	3.37	1.45	0.11	7.75
WNW	—	3.06	3.44	3.84	0.65	10.99
NW	—	2.88	4.68	2.98	0.15	10.69
NNW	—	2.56	3.92	0.58	0.00	7.06
Totals	4.64	41.25	42.54	10.64	0.93	100.00

Source: Rocky Flats Plant Environmental Report for 1992.



U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	WIND ROSE FOR THE ROCKY FLATS PLANT 1990 ANNUAL	FIGURE 2-9

BORDER.CW-021992

SECTION 3

SECTION 3
BACKGROUND SAMPLING PROGRAM

This section describes the sampling locations and data collection techniques employed during geochemical characterization of borehole materials, groundwater, surface water, and sediments from background areas of the RFP. Surface soils were not considered in the Background Geochemical Characterization Program because a separate program is being developed by EG&G to characterize surficial soils in background and non-background areas of the RFP.

3.1 SAMPLING LOCATIONS

The rationale for the selection of background sampling sites considered a number of factors, including:

- **Plant boundaries** - all background sampling sites were located within the 10-square mile RFP property to establish local background with respect to geology, hydrology, and weather patterns.
- **Avoidance of contamination** - background stations were located to avoid all known individual hazardous substance sites (IHSSs).
- **Geology** - all key geologic materials were represented: RFA, COL, VFA, and weathered and unweathered Arapahoe and Laramie Formation bedrock (WCS, KAR).
- **Hydrology** - background sites were located upgradient or sidegradient to the central RFP area and known IHSSs. Sites were selected to be representative of the intermittent streams, associated stream sediments, seep waters, and groundwater. Both surface water and groundwater locations were constrained by the limited availability of water because of the semiarid climate at the RFP.
- **Meteorology** - background stations were located west, north, and south of the central RFP area because the predominant direction of high winds is west to east.
- **Spatial coverage** - an attempt was made to represent all background regions and stream drainages in the RFP buffer zone. However, as noted under "hydrology," the limited availability of water resulted in geographic clustering of sites in wetter areas and a lack of representation for drier areas.

It is recognized that there is the possibility that airborne dispersion of radionuclides from the RFP may extend to background sites. Potential sources of radionuclides include the 1957 and 1969 fires, and resuspended soil from the 903 Pad site. However, radiation surveys across the site (EG&G Energy Measurements, 1982, 1990) have never indicated anomalous readings in background areas. It may be possible to use investigative techniques, such as study of isotopic-ratio data, to distinguish potential radionuclide contributions from the RFP from atmospheric fallout because of nuclear testing, as well as from natural sources (see Section 5.8).

The number of samples collected from each medium was originally based on the concept of minimizing the width of the tolerance interval for a background population (tolerance intervals are described in Section 1). The number of samples in the background population determines the size of the tolerance factor (i.e., the more background samples, the smaller the factor). Nine background sampling locations per geologic unit or medium were originally established to obtain a 99-percent tolerance interval (99 percent of the population within the one-sided interval) with a tolerance factor of three at the 99-percent confidence level (i.e., the upper limit of the tolerance interval is the mean plus three standard deviations of the sample population). A tolerance factor of three has been used extensively to define conservative engineering tolerances (Doctor, Gilbert, and Kinnison, 1986). In addition, the statistical methods used to establish independent background subpopulations affect the number of samples ultimately included in each subpopulation. The absence of groundwater in a monitoring well reduced the sample size for some water-bearing units and, conversely, multiple samples with depth from boreholes in geologic materials increased the sample size for some geologic units.

3.1.1 Geologic Materials from Boreholes

As discussed in Section 2, most IHSSs are located on either (or both) of two types of surficial materials: RFA or COL (Plate 1). Development of background data for geologic materials, therefore, required sampling of both geologic units.

In addition to alluvial and colluvial materials, the geochemistry of claystone and sandstone bedrock of the Arapahoe and Laramie Formations was characterized for comparison to

investigative samples. All geologic materials were collected from boreholes drilled and sampled in 1989 (sampling methods are discussed in Section 3.2).

3.1.1.1 Boreholes in Rocky Flats Alluvium

RFA consists of poorly sorted boulders, cobbles, gravels, sands, silts, and clays deposited in alluvial fans at the base of the mountains of the Colorado Front Range (Hurr, 1976). Eight boreholes were drilled to characterize the lithology, thickness, and geochemistry of RFA [boreholes B400089, B400289, B400389, B400489, B200589, B200689, B200789, and B200889 (Plate 3)]. No IHSSs exist in the vicinity of these eight boreholes (see Plates 1 and 3).

3.1.1.2 Boreholes in Colluvium

COL collects on slopes and at the base of hills and slopes. It is the product of mass-wasting and downslope creep, commonly observed in and on the valley walls of the RFP buffer zones. These deposits consist predominantly of clay with some sandy clay and gravel. Nine boreholes were drilled to characterize COL [boreholes B201089, B201189, B201289, B201489, B201589, B301889, B401989, B302089, and B405989 (Plate 3)].

3.1.1.3 Boreholes in Weathered Bedrock

The uppermost bedrock unit underlying the RFP is the undifferentiated Arapahoe/Laramie Formation. This formation consists predominantly of claystone with interbedded sandstone (WCS, KAR). All nine boreholes drilled to investigate colluvial materials were extended 12 ft into weathered bedrock of the Arapahoe/Laramie Formation (Plate 3). Eight boreholes were drilled and sampled in weathered claystone. Borehole B402189 encountered weathered, non-subcropping sandstone.

3.1.2 Groundwater

Groundwater at the RFP flows in RFA, COL, VFA, and WCS. However, the amount of unconfined groundwater in surficial materials, subcropping sandstone, and surficial bedrock is insufficient to meet the definition of an aquifer (Freeze and Cherry, 1979). Confined groundwater is present in deeper, isolated sandstone hydrostratigraphic units (KAR).

The background boreholes and monitoring wells in the north buffer zone are not downgradient of the West Spray Field, because surface water and groundwater flow is intercepted by a tributary on the upper reaches of Walnut Creek (see Plates 1, 2, and 3). Even if these sampling locations were downgradient of the West Spray Field, travel times for possible contaminants from the West Spray Field would be only about 42 ft/year (4×10^{-5} cm/s) based on a conservative hydraulic conductivity of 1×10^{-3} cm/s for RFA, an effective porosity of 0.3, and a hydraulic gradient of 0.012 (80 ft/6,750 ft). The background sampling locations are 6,750 ft from the eastern edge of the West Spray Field, and it has been only 10 years since the initial spraying of Solar Ponds water (April, 1982); therefore, potential contamination has traveled 410 ft at most. Because the closest background borehole or monitoring well is over 6,000 ft from West Spray Field, the sampling sites should be unaffected by any possible contamination migrating from the field.

3.1.2.1 Groundwater in Rocky Flats Alluvium

Eight boreholes used for characterization of RFA were completed as wells (wells B400189, B400289, B400389, B400489, B200589, B200689, B200789, and B200889), and sampled to characterize the chemistry of groundwater contained in RFA. Well B405586 served as the ninth RFA well (Plate 4). Some wells were installed in the southwest portion of the buffer zone where there are no IHSSs (Plate 1 and 4); this area exhibits lithologies and saturated thicknesses similar to those at the West Spray Field. The rest of the wells were installed in the north buffer zone, sidegradient of main industrial area, where there are also no IHSSs (Plate 1). The northern area was chosen because the lithologies and saturated thicknesses are similar to those at the Solar Evaporation Ponds, 903 Pad, Mound Area, and the East Trenches, based on a similar topographic position.

To evaluate possible geochemical stratification of alluvial groundwater west of the industrial area, one well cluster was also installed in the RFA at the location where the greatest saturated thickness was encountered. The well cluster consisted of three wells constructed on the basis of the static water levels recorded in the area. Well B400489 was screened over the entire saturated thickness of RFA (9.87 to 54.45 ft below ground surface). Well B405789, located approximately 15 ft west of B400489, was screened over the bottom 10 ft of saturated alluvium (43.01 to 52.48 ft below ground surface). Well B405689 was screened from 10 ft above to 10 ft below the water level (3 to 22.51 ft below ground surface) (Plate 4).

3.1.2.2 Groundwater in Colluvium

To characterize the quality of colluvial groundwater, 10 wells were installed in colluvial materials. The wells were installed in different areas of the Plant buffer zone to encompass any spatial variability. Wells B201089, B201189, B201289, B201489, B201589, and B205589 were installed in the north buffer zone, whereas wells B301889, B401989, B302089, and B405989 were installed in the south buffer zone (Plate 4). No IHSSs exist in either of these areas (Plate 1).

3.1.2.3 Groundwater in Valley-Fill Alluvium

Nine wells were installed in VFA to collect groundwater samples for geochemical characterization (Plate 4). Wells B102289, B102389, B202489, and B202589 were installed at four locations along the Rock Creek drainage to investigate possible changes in groundwater quality along the drainage. Wells B402689, B302789, B302889, and B302989 in the south buffer zone were completed in VFA in the Woman Creek drainage. None of the above areas has been impacted by IHSSs.

3.1.2.4 Groundwater in Bedrock

Data for the geochemical characterization of bedrock groundwater were collected by sampling groundwater from 21 monitoring wells screened in bedrock. These wells were drilled throughout the upgradient areas of the buffer zone. Samples of groundwater were collected and

analyzed to fully describe the natural variability in the chemistry and quality of bedrock groundwater (Plate 5).

Eleven bedrock wells were completed in the north buffer zone. Five of the 11 wells (B203189, B203289, B203489, B203589, and B203689) were installed adjacent to the sidegradient alluvial wells in the north buffer zone, and were completed in weathered claystone of the Arapahoe/Laramie Formation (WCS). The remaining six wells (B203789, B203889, B203989, B204089, B204189, and B204689) were completed in unweathered sandstones of the Arapahoe/Laramie Formation (KAR). Well B204689 was installed for this program but has since become an inactive well because a pump became lodged in the well during sampling. The pump was unretrievable and, therefore, the well was sealed and has been abandoned.

Ten bedrock wells were installed in the south buffer zone. Three of the 10 bedrock wells were completed in unweathered sandstones of the Arapahoe/Laramie Formation (B304289, B304989, and B405289); five wells were completed in weathered claystone (B304789, B304889, B405189, B305389, and B405489); and two wells were completed in weathered nonsubcropping sandstones (B402189 and B405889). Well B405489 was installed in weathered claystone of the Arapahoe/Laramie Formation.

3.1.3 Surface Water

Nine surface-water monitoring locations were initially selected as background stations (Plate 6 and Table 3-1). One station (SW107) is located on the Woman Creek drainage upstream of the Plant site, and three stations (SW041, SW080, and SW104) are positioned within tributaries entering Woman Creek from the southwest. Station SW007 is situated in the McKay Ditch upgradient of any IHSSs (Plate 1), and stations SW006, SW005, SW108, and SW004 are located along the Rock Creek drainage. Surface-water stations SW080, SW104, and SW108 are seeps, whereas the rest are in-stream surface-water stations. These locations were chosen to collect an array of surface-water samples that would be representative of the inherent geochemical variability of background conditions.

Table 3-1. Surface Water Background Stations at Rocky Flats Plant

Station Number[a]	Northing Coordinate (ft)	Easting Coordinate (ft)	State Northing Coordinate (ft)	State Easting Coordinate (ft)	Ground Surface Elevation (ft)
SW004	45162.18	22668.42	75148.42	2085747.15	5721.20
SW005	40095.64	16442.91	753062.65	2079539.99	5973.00
SW006	37119.25	12275.44	750073.29	2075383.44	6129.00
SW007	35270.77	11107.42	746995.12	2074221.82	6184.70
SW041	34024.22	17138.39	748221.44	2080255.33	5980.50
SW080	33104.05	17902.55	746995.12	2081022.32	6042.10
SW104	32376.51	18188.09	746077.71	2081310.19	6062.40
SW107	34187.74	14780.90	747150.81	2077897.92	6054.30
SW108	44323.08	22971.45	757310.54	2086052.87	5838.60

[a]See Plate 6 for station locations.
Note: Surface water stations SW127, SW130, SW134, SW135, SW136, and SW137 have not been surveyed yet. Stations SW080, SW104, and SW108 are seep water stations.

Six additional surface-water stations have been added to the Background Geochemical Monitoring Program since 1989. Location SW127 is situated on a tributary of Woman Creek in the far western part of the site. SW130 is located in the south buffer zone, just east and downgradient of Rocky Flats Lake on Smart Ditch. Surface-water stations SW134, SW135, SW136, and SW137 are located on Rock Creek or unnamed tributaries of Rock Creek.

Surface-water stations were sampled monthly in 1989, 1990, and 1991, but were sampled quarterly as of the first quarter of 1992.

3.1.4 Stream Sediment

The geochemistry of stream-bed sediments was evaluated by sampling and chemically analyzing sediments from nine background locations (Plate 6 and Table 3-2). These stations were paired with nine of the background surface-water stations described above. Stations SED020, SED021,

SED022, and SED023 are located in the Rock Creek drainage; station SED004 is located in the McKay Ditch; and stations SED016, SED017, SED018, and SED019 are located in Woman Creek. Stations SED018, SED019, and SED021 are located at seeps. These sites were selected as locations representative of lithologies present in the drainages of the site.

Table 3-2. Sediment Background Stations at Rocky Flats Plant

Station Number[a]	Northing Coordinate (ft)	Easting Coordinate (ft)	State Northing Coordinate (ft)	State Easting Coordinate (ft)	Ground Surface Elevation (ft)
SED004	35270.77	11107.42	74822.44	2074221.82	6184.70
SED016	34187.74	14780.90	747150.81	2077897.92	6054.30
SED017	34024.23	17138.39	746995.12	2080255.33	5980.50
SED018	33110.94	17897.74	746084.58	2081017.49	6041.40
SED019	32376.51	18188.09	745351.30	2081310.19	6062.40
SED020	40107.07	16453.06	753074.11	2079550.10	5972.70
SED021	44323.08	22971.45	757310.54	2086052.87	5838.60
SED022	45167.18	22668.42	758148.42	2085747.15	5721.20
SED023	37119.25	12275.44	750073.29	2075383.44	6129.00

[a]See Plate 6 for station locations.
Note: SED018, SED019, and SED021 are seep-sediment stations.

3.2 SAMPLING AND DATA COLLECTION

Beginning in 1989, field sampling and data collection followed the *Rocky Flats ER Program Standard Operating Procedures (SOPs)* (Rockwell International, 1989a), and the *ER Program Quality Assurance (QA)/QC Plan* (Rockwell International, 1989b). These documents have been superseded by the *Environmental Management Department (EMD) SOPs* (EG&G, 1991a), and the *Rocky Flats Plant Site-Wide QA Project Plan* (QAPjP) (EG&G, 1991d).

3.2.1 Drilling and Logging

All boreholes drilled for soil sampling and construction of monitoring wells were geologically logged and continuously sampled as drilling permitted. Drilling was performed using auger rigs, rotary-coring rigs, and air-rotary downhole percussion-hammer (ODEX) rigs. Hollow-stem augers were used to advance the borehole through surficial materials and weathered bedrock where possible. Materials were continuously sampled through the augers with split-tube samplers on a wireline (see Table 3-3 for summarized details of well construction). All lithologic samples were described, labeled, and packaged by a geologist in the field, as described in the SOPs.

In areas where large cobbles and boulders were encountered, such as in the south-southwest buffer zone (wells B400189, B400289, B400389, B400489, B305389, B405489, B405689, B405789, and B405889), an ODEX rig was used to advance the boring. Casing was simultaneously installed in the borehole as the bit was advanced. Cuttings from the borehole were circulated out of the borehole by high-pressure air and collected for logging and sampling purposes in 55-gal drums. The cuttings from boreholes B400289, B400389, B400489, and B400589 were collected for analytical purposes.

Protective surface casing was installed before the rotary coring of a bedrock hole. After a deep bedrock borehole was augered 3 to 4 ft into unweathered bedrock, augers were pulled, and an 8.25-in. outside-diameter threaded casing was lowered into the hole by an auxiliary wireline cable. The casing was tremie grouted with Portland Type I and II cement. The cement was given 24 hours to set before operations were continued. Bedrock boreholes were then continuously cored from the base of the surface casing to total depth. Continuous core samples were obtained using wireline and split-tube samplers.

Boreholes not completed as monitoring wells were abandoned by backfilling to within 4 to 5 ft of ground surface using Volclay grout, which was tremied downhole and subsequently topped off with Portland Type I and II cement.

Table 3-3. Data for background wells at Rocky Flats Plant. The geologic units of completion are as follows: Rocky Flats Alluvium (RFA), colluvium (COL), valley-fill alluvium (VFA), weathered claystone of upper Arapahoe/Laramie Formation (WCS), and undifferentiated Arapahoe/Laramie Formation (KAR).

WELL DATA FOR BACKGROUND WELLS AT THE ROCKY FLATS PLANT

Well Number	Well Status	Ground Surface Elev. (ft)	Top of Casing Elev. (ft)	Depth to Top of Screen	Depth to Bottom of Screen	Total Depth (ft)	Depth to Bedrock (ft)	Bedrock Elevation	Geologic Unit of Completion	Northing Coordinate (ft) - RFP	Easting Coordinate (ft) - RFP	State Northing (ft)	State Easting (ft)
B302889	ACTIVE	5730.80	5733.16	5.92	10.52	12.10	10.20	5720.60	VFA	32824.94	26406.34	745826.7435	2089524.8098
B302989	ACTIVE	5686.20	5688.15	3.46	7.90	9.65	7.40	5678.80	VFA	32347.94	28146.31	745355.6090	2091265.9007
B303089	ACTIVE	5601.20	5602.93	4.61	7.00	8.90	6.60	5594.60	VFA	29260.92	30864.52	742278.3686	2093993.5910
B203189	ACTIVE	5968.00	5970.12	35.26	44.70	46.47	30.30	5937.70	WCS	41868.42	20466.34	754848.2491	2083556.5118
B203289	ACTIVE	5959.70	5961.59	35.00	44.47	46.00	30.10	5929.60	WCS	42258.71	21087.88	755240.4851	2084176.6034
B203489	ACTIVE	5945.70	5947.71	31.00	40.50	41.25	28.60	5917.10	WCS	42806.76	21964.89	755791.2887	2085051.5736
B203589	ACTIVE	5935.20	5937.07	29.70	39.16	40.94	24.30	5910.90	WCS	43221.96	22658.39	756208.6745	2085743.5243
B203689	INACTIVE	5920.50	5922.45	27.05	36.55	37.30	22.60	5897.90	WCS	43755.65	23487.29	756744.9537	2086570.4441
B203789	ACTIVE	5946.20	5948.28	134.15	138.59	140.84	26.70	5919.50	KAR	42792.37	21944.19	755776.8324	2085030.9263
B203889	ACTIVE	5935.80	5937.69	107.00	111.43	113.90	28.40	5907.40	KAR	43211.47	22635.78	756198.1067	2085720.9611
B203989	ACTIVE	5920.90	5922.78	125.97	130.42	132.70	23.70	5897.20	KAR	43740.80	23469.07	756730.0555	2086552.2860
B204089	ACTIVE	5877.60	5879.29	106.50	112.90	115.23	1.60	5876.00	KAR	41904.59	24227.96	754896.8288	2087317.0381
B204189	ACTIVE	5826.90	5828.86	81.10	95.33	97.62	3.70	5823.20	KAR	42344.56	25382.07	755340.4906	2088469.3930
B304289	ACTIVE	5833.00	5835.18	84.04	88.49	90.95	10.50	5822.50	KAR	31688.14	23092.28	744679.3015	2086215.3718
B304789	ACTIVE	5867.50	5869.56	27.90	37.57	39.14	22.90	5844.60	WCS	34321.35	22184.13	747308.8221	2085298.7662
B304889	ACTIVE	5730.60	5732.56	14.66	24.14	25.90	9.70	5720.90	WCS	32815.29	26451.93	745817.2440	2089570.4247
B304989	ACTIVE	5729.70	5731.85	75.50	82.87	86.25	8.40	5721.30	KAR	32799.24	26481.33	745801.2931	2089599.8741
B405189	ACTIVE	5967.90	5969.91	13.20	22.69	24.45	8.20	5959.70	WCS	33804.20	19330.97	746782.3900	2082448.0614
B405289	ACTIVE	5965.60	5967.31	41.24	45.67	48.00	10.30	5955.30	KAR	33819.62	19347.76	746797.8628	2082464.7930
B305389	ACTIVE	5832.00	5833.90	15.18	24.58	26.30	10.00	5822.00	WCS	31726.76	23109.08	744717.9612	2086232.0415
B405489	ACTIVE	6115.80	6117.67	39.13	48.57	50.05	34.00	6081.80	WCS	32239.76	15235.37	745204.8392	2078358.6905
B205589	ACTIVE	5806.40	5808.46	6.87	16.30	18.00	32.30	5774.10	COL	44664.12	23775.15	757654.1441	2086855.2290
B405689	ACTIVE	6105.20	6107.25	3.00	22.51	23.75	0.00	0.00	RFA	30851.28	16062.22	743819.4561	2079189.9129
B405789	ACTIVE	6104.80	6106.70	43.01	52.48	53.72	52.00	6052.80	RFA	30853.20	16092.40	743821.4683	2079220.0762
B405889	ACTIVE	6024.90	6026.87	36.04	45.50	46.75	6.50	6018.40	KAR (w)	33357.04	18357.49	746332.1311	2081476.3079
B405989	ACTIVE	6023.50	6026.06	2.80	6.70	8.50	6.20	6017.30	COL	33374.00	18357.88	746349.0917	2081476.6474

Table 3-3. Data for background wells at Rocky Flats Plant (Continued)

WELL DATA FOR BACKGROUND WELLS AT THE ROCKY FLATS PLANT

Well Number	Well Status	Ground Surface Elev. (ft)	Top of Casing Elev. (ft)	Depth to Top of Screen	Depth to Bottom of Screen	Total Depth (ft)	Depth to Bedrock (ft)	Bedrock Elevation	Geologic Unit of Completion	Northing Coordinate (ft) - RFP	Easting Coordinate (ft) - RFP	State Northing (ft)	State Easting (ft)
B405586	ACTIVE	6103.62	6105.81	3.55	36.39	36.39	35.50	6068.12	RFA	32259.45	15217.16	745260.8365	2078321.1160
B400089	INACTIVE	6121.80	6123.76	28.58	37.95	38.26	48.50	6073.30	RFA	31599.94	15183.24	744565.0139	2078308.6909
B400189	ACTIVE	6122.10	6124.15	10.09	49.60	51.35	49.80	6072.30	RFA	31600.11	15183.13	744565.1830	2078308.5787
B400289	ACTIVE	6105.90	6107.71	20.52	50.00	51.25	49.60	6056.30	RFA	31676.84	16017.21	744644.6478	2079142.1870
B400389	ACTIVE	6122.00	6124.00	9.50	49.00	50.30	48.50	6073.50	RFA	30794.80	15266.77	743760.3577	2078394.8564
B400489	ACTIVE	6105.90	6107.07	9.87	54.45	55.70	54.00	6051.90	RFA	30852.38	16077.58	743820.5973	2079205.2666
B200589	ACTIVE	5968.40	5970.17	11.86	31.57	33.31	30.00	5938.40	RFA	41857.55	20445.99	754837.3135	2083536.2087
B200689	ACTIVE	5960.10	5961.94	11.58	31.05	32.80	30.60	5929.50	RFA	42256.66	21069.70	755238.3808	2084158.4352
B200789	ACTIVE	5964.10	5948.08	9.07	28.50	30.47	28.00	5918.10	RFA	42781.02	21921.46	755765.4125	2085008.2449
B200889	ACTIVE	5936.10	5938.08	8.60	23.12	24.70	22.80	5913.30	RFA	43199.87	22617.22	756186.4527	2085702.4430
B201089	ACTIVE	5883.10	5885.15	3.48	7.83	9.60	7.50	5875.60	COL	42275.09	24169.13	755267.0405	2087256.9935
B201189	ACTIVE	5806.50	5808.41	20.36	34.80	36.50	34.00	5772.50	COL	44655.14	23771.64	757645.1486	2086851.7585
B201289	ACTIVE	5826.10	5827.80	14.73	23.90	26.11	23.40	5802.70	COL	44616.73	20500.44	757595.9555	2083581.5337
B201489	ACTIVE	5859.40	5861.20	5.58	9.96	11.64	7.00	5852.40	COL	44092.75	22254.49	757077.9028	2085336.8530
B201589	ACTIVE	5846.00	5847.68	4.38	8.76	10.50	8.20	5837.80	COL	44426.56	23548.26	757415.8909	2086629.1867
B301889	ACTIVE	5866.80	5868.83	13.16	22.60	24.45	22.30	5844.50	COL	34321.96	22207.35	747309.5078	2085321.9781
B401989	ACTIVE	6025.60	6027.67	6.55	21.00	22.65	20.50	6005.10	COL	32873.07	18514.33	745848.8073	2081634.7119
B302089	ACTIVE	5907.50	5909.55	3.85	13.30	15.00	13.50	5894.00	COL	33804.66	20373.64	746786.2956	2083490.4539
B402189	ACTIVE	6024.60	6026.49	13.50	22.90	24.60	7.50	6017.10	KAR (w)	33364.04	18357.65	746339.1279	2081476.4480
B102289	ACTIVE	5978.30	5980.06	3.00	12.47	14.22	12.50	5965.80	VFA	40124.54	16414.83	753091.4539	2079511.8166
B102389	ACTIVE	5939.50	5941.18	3.74	10.90	12.61	10.40	5929.10	VFA	40864.32	17161.65	753833.5008	2080256.0041
B202489	ACTIVE	5770.90	5772.83	3.43	12.90	14.65	12.40	5758.50	VFA	44414.51	20812.14	757394.8212	2083893.8232
B202589	ACTIVE	5723.60	5725.45	4.53	11.60	13.40	11.20	5712.40	VFA	45126.22	22633.57	758122.3563	2085712.4261
B402689	ACTIVE	6045.40	6047.07	2.55	3.28	5.85	2.80	6042.60	VFA	34264.35	15145.64	747288.6049	2078262.3035
B302789	ACTIVE	5832.30	5834.17	4.00	8.55	10.17	8.00	5824.30	VFA	31715.79	23104.08	744706.9744	2086227.0822

3.2.2 Borehole Sampling

Sampling methods for all boreholes drilled within the background area are described in this section. The chemical analysis of borehole samples is discussed in Section 3.3.

3.2.2.1 Boreholes in Rocky Flats Alluvium

For boreholes drilled in RFA, the top three feet of each was composited for chemical analysis to characterize the Flatiron Soil. Below this depth, 6-ft composites were submitted for chemical analysis to characterize the RFA. If a lithologically distinct layer greater than two feet in thickness was encountered, a discrete sample was collected for chemical analysis. The alluvium within the interval containing the alluvium/bedrock contact was not sampled for chemical analyses unless the total thickness of alluvium was less than five feet.

Samples were collected in glass jars for radionuclides, inorganics, and metals. Radionuclides and inorganics were collected in 16-oz. jars, and metals were collected in 8-oz. jars. Each container was packed, labeled, and sealed by a geologist in the field. Samples were not preserved in the field, as defined in the *ER Program QA/QC Plan* (Rockwell International, 1989b).

3.2.2.2 Boreholes in Colluvium and Bedrock

All colluvial boreholes were sampled from the surface to 12 ft below the bedrock contact, so that weathered bedrock materials could also be sampled for chemical analysis. The top three feet of the surficial materials were composited for chemical analysis to characterize the hillslope soil developed on COL. All remaining colluvial samples were collected following the methods described for the sampling of RFA.

Samples from the colluvium/bedrock contact, as well as samples of weathered bedrock, were collected from each colluvium/bedrock borehole. The contact sample extended from the colluvium/bedrock contact to six feet below the contact. A sample composited over a distance of six feet was collected from below the contact. If a lithologically distinct unit greater than 2-ft

thick was encountered, a discrete sample was collected. Sample containers and parameters were the same as those described for the borehole samples of RFA.

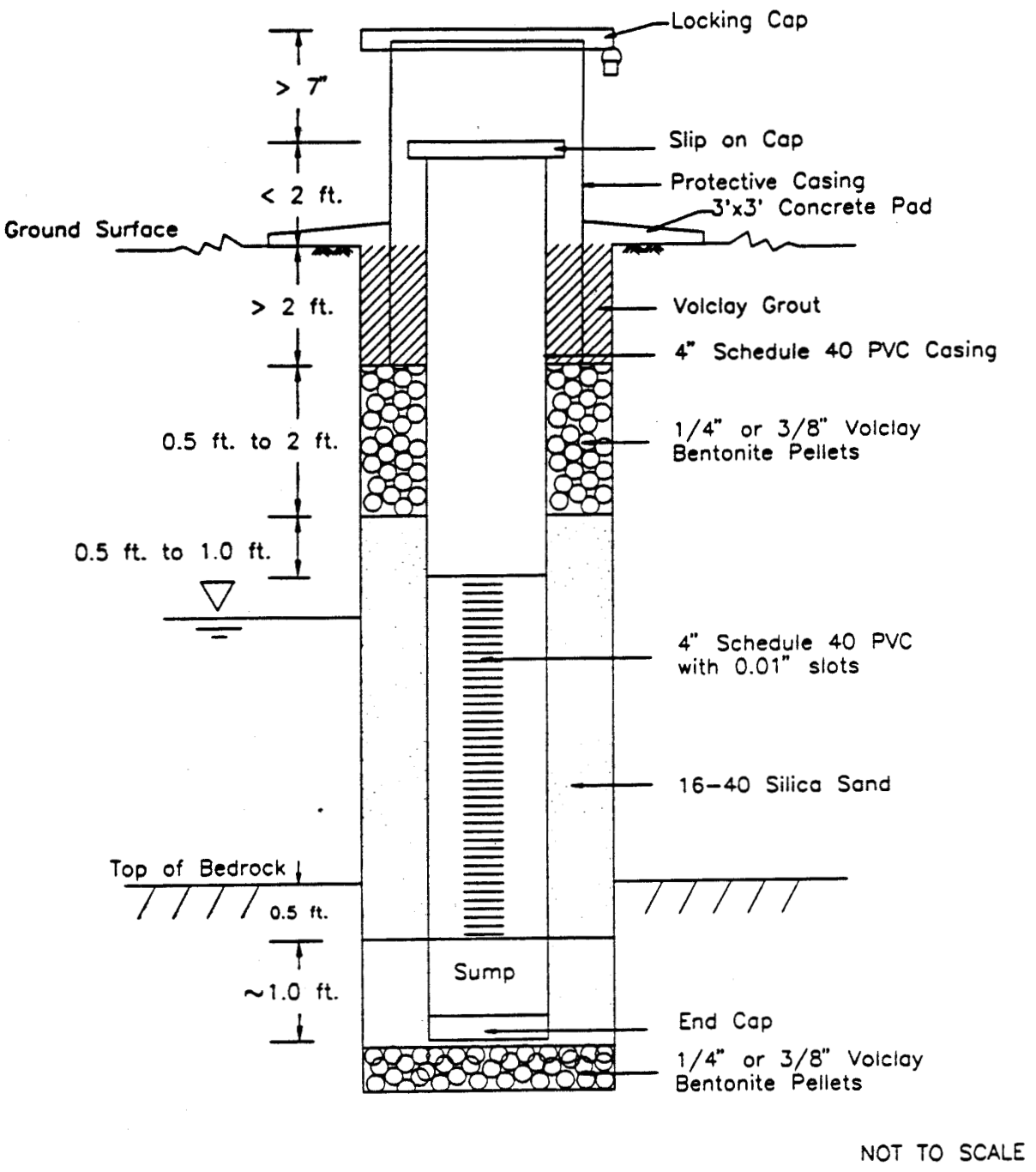
3.2.3 Installation of Monitoring Wells

All alluvial and colluvial wells were completed with 4-in. diameter, Schedule-40 polyvinyl chloride (PVC) casing and 0.01-in. slotted Schedule-40 PVC screen, with the exception of colluvial well B201289, which was completed with 2-in. Schedule-80 PVC. Figure 3-1 illustrates the typical design of wells and annulus materials for wells completed in RFA, COL, and VFA. Except for the well cluster completed in RFA (discussed previously), all background wells completed in surficial materials were screened over the entire saturated thickness of the unconfined aquifer. The screened intervals of these wells extended from 0.5 ft below the bedrock contact to a point above the water table as encountered during drilling or observed in nearby wells installed in similar materials.

Three different types of bedrock wells were installed during the background characterization. Wells were completed in weathered claystone, weathered sandstone, and unweathered sandstone to monitor the groundwater contained in each lithology.

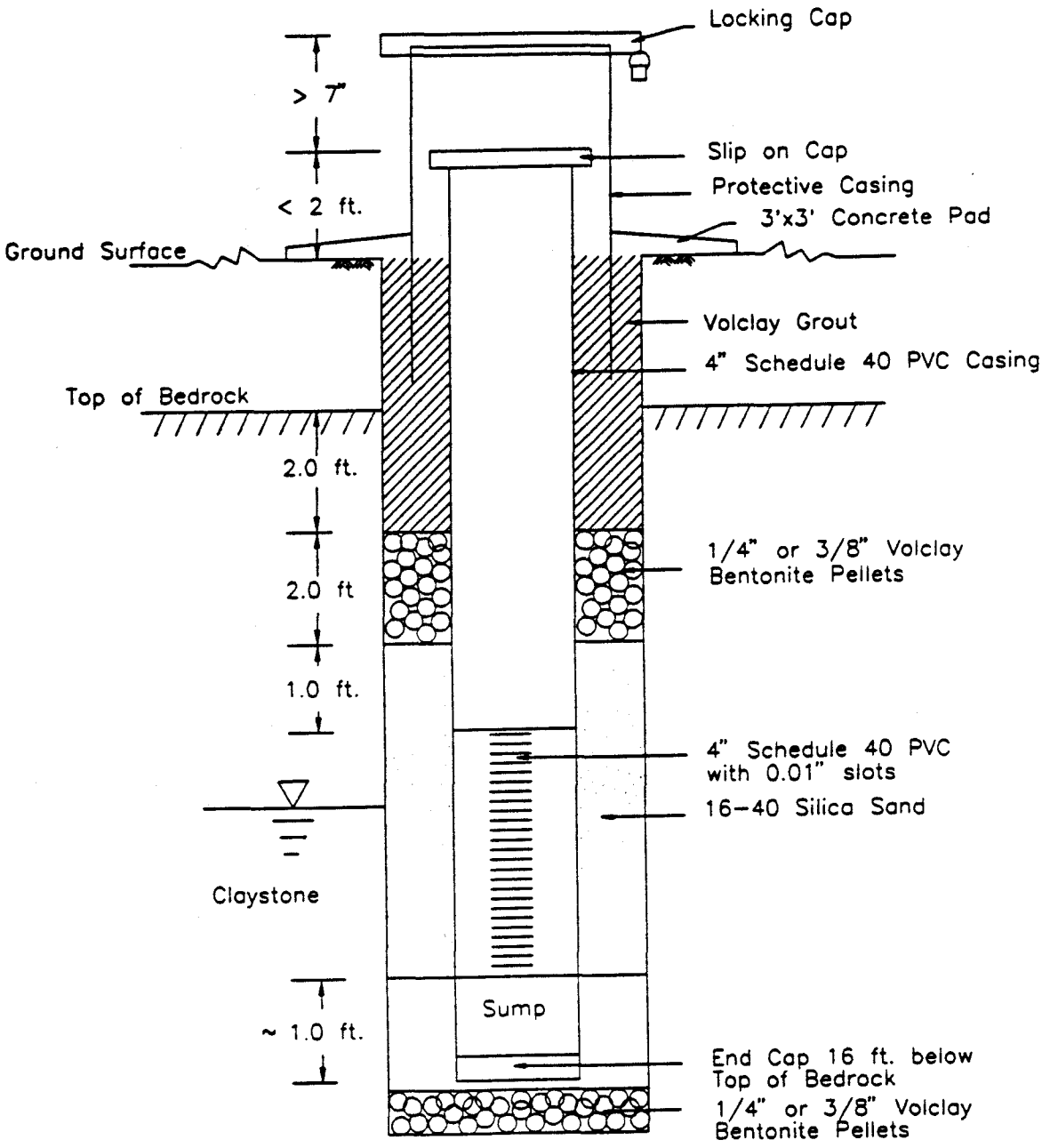
Shallow wells in weathered claystone were augured to total depth and constructed in the open borehole. Where hole stability was a problem, holes were reamed with large-diameter augers to total depth, and then the well was constructed inside the augers. This technique was used for wells B203189, B203489, and B203689. The remainder of the wells were built in an open hole, using a stainless-steel centralizer for downhole stabilization. The wells were screened from approximately 5 ft below bedrock contact to 15 ft below bedrock contact, with the exception of well B203489, in which the screen began 1.4 ft below the contact because of borehole instability during well installation. Figure 3-2 presents the typical design for a well completed in weathered bedrock.

Two wells in weathered sandstone were installed during this program. Well B402189 was constructed to screen the upper 10 ft of a weathered sandstone encountered at 12.5 ft below ground surface, whereas well B405889 was constructed to monitor the bottom 10 ft of the same



U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	TYPICAL ALLUVIAL MONITOR WELL CONSTRUCTION	FIGURE 3-1

R69010.MB013192



NOT TO SCALE

U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	TYPICAL SHALLOW BEDROCK WELL CONSTRUCTION (Weathered Claystone)	FIGURE 3-2

R69011.MB013192

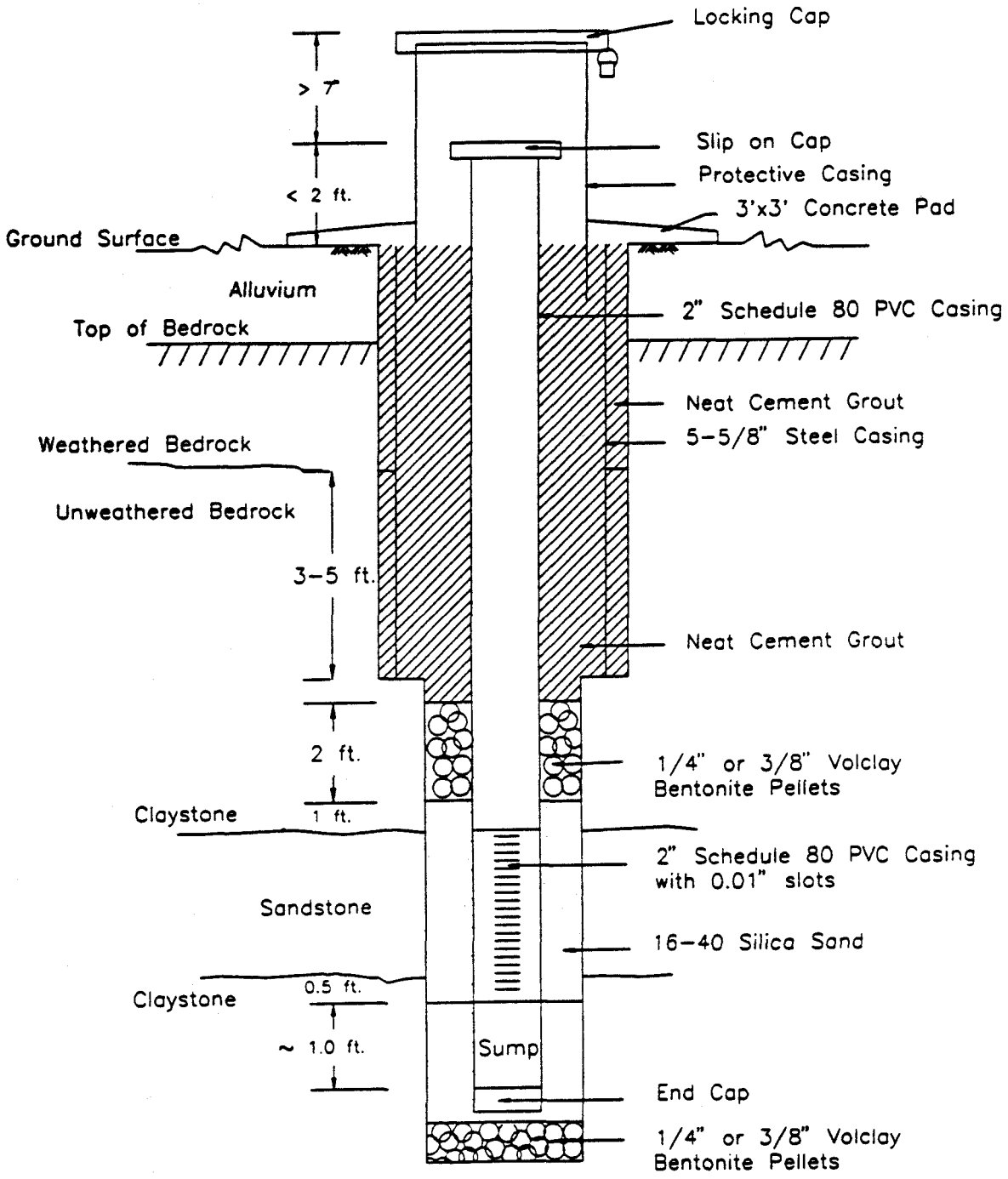
sandstone unit. In both cases, hole instability warranted constructing the wells within large diameter augers or drill pipe. The materials used in well construction were the same as those for wells completed in weathered claystone.

The third type of bedrock well was completed in unweathered sandstone; these are referred to as "deep bedrock wells." Each bedrock boring was advanced with hollow-stem augers through surficial materials into slightly weathered bedrock, and steel surface casing was subsequently installed. The remainder of the hole was then rotary cored to total depth. All deep bedrock wells were completed with 2-in. diameter Schedule-80 PVC and 0.01-in. slotted Schedule-80 PVC, and 2-ft sumps were placed at the base of the screen. The annular materials that were used were the same as those for the wells completed in weathered bedrock, except that Portland Type I cement was used instead of Volclay grout. Figure 3-3 presents the typical design of a well in unweathered bedrock.

3.2.4 Well Development

All monitoring wells were developed subsequent to well completion and before groundwater sampling or hydraulic testing. The purpose of well development is to remove fine materials from the sand pack and the borehole wall to facilitate hydraulic communication between the screened formation and the monitoring well.

The well-development procedures used during construction of the background wells were consistent with those outlined in the *ER Program SOPs* (Rockwell International, 1989a) and the *EMD SOPs* (EG&G, 1991a), with two exceptions. First, the Geological Society of America Rock Color Chart was routinely used in place of a turbidimeter to gauge turbidity and color of the development water. Second, addition of tap water to the top of the sand pack to develop the entire filter pack was not always successful. In some instances the water added to the wells in the southwest buffer zone was lost to the formation almost immediately. Several attempts to recover the additional water were made at each location before the procedure was abandoned.



NOT TO SCALE

U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	TYPICAL DEEP BEDROCK MONITOR WELL CONSTRUCTION (Unweathered Sandstone)	FIGURE 3-3

R69012.MB013192

3.2.5 Sampling of Groundwater

Quarterly sampling of the background wells was initiated in the second quarter of 1989, subsequent to well development. Three quarterly sampling events were completed in 1989 and quarterly sampling events occurred in 1990, 1991, and 1992.

Groundwater sampling was performed in accordance with the *EMD SOPs* (EG&G, 1991a). This included procedures for equipment decontamination, water-level measurements, pre-sample purging, field water-quality measurements, and sample collection, preservation, and shipping. A well was considered dry if the water level was below the base of the screen before the pre-sample purge.

Bedrock well B203689 was deleted from the background sampling program because the water level in B203689 corresponded with that of nearby alluvial well B200889. Well B203689 continued to be sampled, but was not included in the statistical analysis of background conditions. Both water levels were thought to be that of the surficial material zone, so B203689 sampling would not be representative of the chemistry of bedrock groundwater.

Procedures initiated during the fourth quarter 1989 for background groundwater sampling deviated slightly from those of the second and third quarters. Each well was sampled for as many as five days, until the entire sample was collected. If a suite of samples was not collected within the five-day approach, procedures remained consistent with previous quarters.

Prior to pre-sample purging of each well, a water-level measurement was obtained and recorded on the water-level data sheet. This level was measured from the mark present on the north side of the surface casing of each well down to the water table.

3.2.6 Sampling of Surface Water

Surface-water samples were collected from 15 background stations. Nine locations were used to collect surface-water samples starting in the first quarter of 1989 (SW004, SW005, SW006, SW007, SW041, SW080, SW104, SW107, and SW108). Surface-water stations SW127 and

SW130 were used as background locations starting in 1990. Surface-water stations SW134, SW135, SW136, and SW137 were sampled for the background program starting in the first quarter of 1992. Chemical analyses of background surface-water samples are discussed in Section 3.3. Sampling procedures are described in Rockwell International (1989a) and EG&G (1992c).

Stream-flow measurements were taken at each sampling location when adequate flow was available for accurate measurement. Flow measurements were made as described in the *Discharge Measurement SOP* (EG&G, 1991a, Vol. IV, Procedure SW.4).

3.2.7 Sampling of Sediment

Samples of sediment were collected from most of the background sampling locations for surface water (Plate 6). Samples were collected at one point in the stream if the channel width was less than five ft. If the channel width was greater than 5 ft but less than 10 ft, two samples were collected within the channel from locations one-third and two-thirds of the way across the channel. If the width of the channel was greater than 10 ft but less than 20 ft, three samples were obtained within the channel from locations 25, 50, and 75 percent of the way across the channel. Chemical analyses for the background sediment samples are discussed in Section 3.3. Collection of these samples was consistent with the procedures outlined in the *EMD SOPs* (EG&G, 1991a, Vol. IV, Procedure SW.6).

3.3 CHEMICAL ANALYSES

3.3.1 Analytical Parameters

Samples of groundwater, surface water, sediment, and geologic materials were analyzed for an extensive list of parameters to provide data for investigations, as well as offer a complete geochemical characterization of the background geochemistry at the RFP. All parameters on the Chemical Analyte Roster (CAR) were analyzed in accordance with the *General Radiochemistry and Routine Analytical Services Protocol* (GRRASP) (EG&G, 1991e).

3.3.1.1 Radionuclides and Metals

Radionuclides and metals were included on the CAR because Plant records indicate historical releases, and because radionuclides and metals have been detected in surface water, groundwater, soil boring, and sediment samples at the site. Radionuclides known to have been released include Pu, Am, U, and T. Radium-226 was included on the CAR because it is a daughter isotope of uranium decay. Although there is no evidence that a criticality has ever occurred at the RFP, ^{90}Sr and ^{137}Cs were measured because they are fission products; they have been included for completeness and because they exist in the environment as a result of fallout from nuclear testing. Radium-228, a daughter isotope of Th decay, was also included on the list of analytes.

The CAR for metals includes the Contract Laboratory Procedure (CLP) Target Analyte List (TAL). The TAL is used by EPA to investigate contamination at abandoned hazardous-waste sites, and has been used for characterization of OUs at the RFP. Also, the TAL contains several major cations, the data for which are necessary for an adequate geochemical characterization. Five non-TAL metals (Mo, Sr, Cs, Li, and Sn) were also included on the CAR to provide a more comprehensive geochemical characterization.

3.3.1.2 Other Inorganics and Anions

Other inorganics and anions (see Table 3-4) were included on the CAR primarily because they are needed for a complete geochemical characterization. Also, high concentrations of total dissolved solids and nitrate are known to be present in groundwater at some IHSSs.

3.3.1.3 Indicators and Field Parameters

Indicators and field parameters (such as pH, temperature, etc.) are needed for a complete geochemical characterization and provide useful tools to assess the quality of other chemical analyses.

Table 3-4. Background Sediment, Borehole, Surface Water, and Groundwater Sampling Parameters

Target Analyte List Metals

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

Other Metals

Molybdenum
Strontium
Cesium
Lithium
Tin

Anions (Groundwater and Surface Water)

Carbonate
Bicarbonate
Chloride
Sulfate
Nitrate/Nitrite
Cyanide

Anions (Groundwater and Surface Water) (Continued)

Fluoride
Orthophosphate

Other Inorganics/ Parameters (Sediments and Boreholes)

pH
Sulfide (Boreholes only)
Nitrate/Nitrite
Percent Solids or Percent Moisture

Target Compound List Volatile Organic Compounds

Chloromethane
Bromomethane
Vinyl Chloride
Chloroethane
Methylene Chloride
Acetone
Carbon Disulfide
1,1-Dichloroethene
1,1-Dichloroethane
1,2-Dichloroethene
Chloroform
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride
Vinyl Acetate
Bromodichloromethane
1,1,2,2-Tetrachloroethane
1,2-Dichloropropane
trans-1,3-Dichloropropene
Trichloroethene

Table 3-4. Background Sediment, Borehole, Surface Water, and Groundwater Sampling Parameters (Continued)

Target Compound List Volatile Organic Compounds (Continued)

Dibromochloromethane
1,1,2-Trichloroethane
Benzene
cis-1,3-Dichloropropene
Bromoform
2-Hexanone
4-Methyl-2-pentanone
Tetrachloroethene
Toluene
Chlorobenzene
Ethyl Benzene
Styrene
Total Xylenes
Oil and Grease (surface water only)

Target Compound List Semivolatile Organic Compounds

Phenol
bis(2-Chloroethyl)ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl Alcohol
1,2-Dichlorobenzene
2-Methylphenol
bis(2-Chloroisopropyl)ether
4-Methylphenol
N-Nitroso-Dipropylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic Acid
bis(2-Chloroethoxy)methane
2,4-Dichlorophenol

Target Compound List Semivolatile Organic Compounds (Continued)

1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
2-Methylnaphthalene
4-Chloro-3-methylphenol (para-chloro-meta-cresol)
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethylphthalate
Acenaphthylene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Diethylphthalate
4-Chlorophenyl Phenyl ether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-methylphenol
N-nitrosodiphenylamine
4-Bromophenyl Phenyl ether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Di-n-butylphthalate
Fluoranthene
Pyrene
Butyl Benzylphthalate
3,3'-Dichlorobenzidine
Benzo(a)anthracene

Table 3-4. Background Sediment, Borehole, Surface Water, and Groundwater Sampling Parameters (Continued)

Target Compound List Semivolatile Organic Compounds (Continued)

bis(2-ethylhexyl)phthalate
Chrysene
Di-n-octyl Phthalate
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

Target Compound List Pesticides and Polychlorinated Biphenyls

alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
Heptachlor
Aldrin
Heptachlor Epoxide
Endosulfan I
Dieldrin
4,4'-DDE
Endrin
Endosulfan II
4,4'-DDD
Endosulfan Sulfate
4,4'-DDT
Endrin Ketone
Methoxychlor
alpha-Chlordane
gamma-Chlordane
Toxaphene
AROCLOR-1016
AROCLOR-1221
AROCLOR-1232

Target Compound List Pesticides and Polychlorinated Biphenyls (Continued)

AROCLOR-1242
AROCLOR-1248
AROCLOR-1254
AROCLOR-1260
Chlordane
Endrin Aldehyde

Radionuclides

Gross Alpha
Gross Beta
Uranium-233, 234
Uranium-235, 238
Americium-241
Plutonium-239, 240
Tritium
Strontium-89, 90
Strontium-90 only
Cesium-137
Radium-226
Radium-228

Groundwater and Surface Water Field Parameters

pH
Specific Conductance
Temperature
Dissolved Oxygen
Turbidity

Groundwater and Surface Water Indicators

Total Suspended Solids
Total Dissolved Solids

3.3.1.4 Organics

CLP Target Compound List (TCL) organics (Table 3-4) have been analyzed for the background program in surface water and groundwater samples since the first quarter of 1990. They were not initially analyzed because they should be absent from background areas of the plant. They have now been included on the CAR for completeness, and to ensure that background data were not influenced by presently unknown IHSSs.

3.3.2 Data Quality

3.3.2.1 Analytical Methods

Analytical methods and support levels must be evaluated during the development of site-specific data-quality objectives. The parameters for which the analytical method are valid, the limitations of a given method, and any special considerations that will affect data quality must be understood to select appropriate analytical methods for specific uses. Data quality is discussed in detail in Section 4.

3.3.2.2 Instrument Detection Limits

In the *1993 Background Geochemical Characterization Report*, the issue of detection limits was addressed by examining the numerical values given in the reporting-limit (RL) field and by reviewing histograms of data distributions (see also Section 1.4.4). It was discovered that "artificial censoring" of the metals and water-quality data resulted if the CRDLs were used to delineate non-detects. In addition, "artificial data" were produced if the analytical result was reported as equal to the CRDL. It is unclear why some laboratories reported analyte concentrations above the IDL, but below the CRDL, as equal to the value of the CRDL, because Attachment A of the EPA statement of work for the analysis of inorganics clearly states (on p. B-17) that:

"Under the column labeled "Concentration," enter for each analyte either the value of the result (if the concentration is greater than or equal to the Instrument Detection Limit) or the Instrument Detection Limit for the analyte corrected for any dilutions (if the concentration is less that the Instrument Detection Limit)."

The CRDLs appear to have been established for the sake of consistency and high precision, but a significant number of laboratories reported the value of the CRDL as the analytical result for all measured concentrations between the IDL and CRDL. This type of reporting does several things to the resulting data: (1) it artificially censors data above the IDL but less than the CRDL; and (2) it artificially alters the mean and variance. For the OU manager and the risk assessor, the impact of point (2) is that an artificially large number of contaminants of concern may be generated during OU vs. background comparisons; therefore, histograms of both the background and OU data should be reviewed to help assess the significance of the results of the statistical comparisons. If a large percentage of the data are CRDL values, there is little real meaning in the statistical results.

3.3.2.3 Comparison Between Detections Limits and Exposure Limits

In the *1992 Background Geochemical Characterization Plan* (EG&G, 1992b), a comparison was made between detection limits for the CAR and the concentration of each analyte posing a marginally acceptable health risk. This concentration is referred to as an "acceptable exposure limit" (EL) and is given in milligrams per kilogram for soil and micrograms per liter for water. Exposure limits were calculated for radionuclides, TAL metals, TCL volatiles, and several TCL semivolatiles, and pesticides/polychlorinated biphenyls (PCBs) that have been detected at the the RFP.

Some of these compounds have been recognized as inducing chronic or carcinogenic health effects in humans (i.e., an Oral Reference Dose (RfD) or a Carcinogenic Slope Factor (CSF) exists for the substance). It was assumed that if detection limits were adequate for these compounds, they should be adequate for other less toxic metals and chemicals. RfDs and CSFs were taken from the Integrated Risk Information System or the Health Effects Assessment

Summary Tables (EPA, 1991a). Exposure limits were conservatively calculated using exposure scenarios for a future on-site resident.

In most cases for this study, detection limits were less than the computed ELs; in the other cases, the detection limits generally did not exceed the EL to the extent that risk assessment objectives would be compromised. For a few analytes, the CLP Contract Required Quantitation Limits (CRQLs) and the CRDLs appeared to be inadequate for risk assessment purposes. However, it is noted that some CRDLs and CRQLs were as much as an order of magnitude higher than the IDLs (see Section 1 discussion on IDLs). In the last two years of background and OU-specific investigative work, all analyte concentrations above IDLs and less than CRDLs or CRQLs were presented. This adds an additional margin of assurance that risk assessment objectives can be met.

SECTION 4

SECTION 4
DATA QUALITY

4.1 QUALITY ASSURANCE/QUALITY CONTROL

The background geochemical characterization program was conducted in accordance with the *ER Program Quality Assurance/Quality Control Plan* (Rockwell International, 1989b) as amended by the QAPjP (EG&G, 1991d). Fieldwork was conducted in accordance with SOPs (Rockwell International, 1989a) as amended by the RFP *EMD Operating Procedures Manual* (EG&G, 1991a).

Analytical data were generated using EPA and other well-established analytical methods identified in the GRRASP (EG&G, 1991e). Most laboratory analyses for TAL metal parameters and TCL organic compounds were performed by EPA CLP methods. Methods for non-CLP analytes—major ions and radionuclides, for example—were based on EPA and other published references.

4.2 DATA VALIDATION

EPA functional guidelines for data validation (EPA, 1988a; EPA, 1988b) were used for validating metals and organic data for CLP analytes. Non-CLP analytical data were validated using data-validation guidelines developed by the EMD, because such guidelines have not been published by EPA (EG&G, 1991d). These non-CLP guidelines are based on EPA validation functional guideline concepts and tailored to non-CLP analytical methods. Data were validated at EPA Level IV or the equivalent for non-CLP analyses. Validated data are classified by EMD in one of three ways: (1) V = valid and usable without qualification; (2) A = acceptable for use with qualification; and (3) R = rejected (unacceptable for use). Data that have been rejected have not been used in any of the statistical computations or in the data-quality assessment. Data qualified as V or A are considered of equal utility, and both are used in the computations and assessment.

Not all data used in the statistical computations or in the data-quality assessment have been validated. The status of data validation is summarized in Appendix F, Table F-1. Of the total data in the data set, about 50 percent of the results have been validated. The percentage validated varies by medium and by analyte group. The percentage validated by medium lies between 44 percent (surface water) and 62 percent (borehole materials). The percentage validated by analyte group falls between 0 percent for radionuclides in borehole material, and 87 percent for metals in borehole material; the percentage validated for most analytes, however, falls between 40 percent and 60 percent.

Of the total data that have been validated, less than seven percent has been rejected. The percentage of data rejected varies significantly by medium and by analyte group. A higher percentage of the results has been rejected for seep/spring sediments (17 percent) than for any other media, and a notably higher percentage of analyses for radionuclides (>20 percent) has been rejected than for any other analytical group.

There is no correlation between percentage validated and percentage rejected. The percentage rejected calculated from the validated data is probably a reasonable estimate of the percentage rejected for a given analyte group in a given medium for the unvalidated portion of the data set as well. Potentially rejectable data for radionuclides and organic compounds in seep/spring sediments and for radionuclides in all media in the unvalidated portion of the data set could account for more than 10 percent of the records in the total data set for these analytes. For other analytes the percentage of potentially rejectable data in the total data set can be expected to be less than five percent. Section 4.3.5 presents a more detailed discussion of the data validation results.

4.3 DATA-QUALITY ASSESSMENT - PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY PARAMETERS

4.3.1 Introduction

In this section the quality of the analytical data is assessed in terms of the data-quality indicators: precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters (EPA, 1992b). This section (1) summarizes the QC data available to assess the PARCC parameters, (2) presents the results of data-quality evaluations for each analyte in each medium sampled, and (3) evaluates the overall quality of the environmental data over the sampling period for each analyte group in each medium sampled.

Precision is a measure of the reproducibility of analytical results. Precision is expressed quantitatively by the relative percent difference (RPD) between duplicate field samples. The RPD is defined and comparison criteria for precision are specified in Section 4.3.2. *Accuracy* is a measure of how closely an analytical result corresponds to the "true" concentration in a sample. Accuracy is expressed quantitatively by the percent recovery (%R) obtained from spiked samples. The %R is defined and comparison criteria for accuracy are specified in Section 4.3.3.

Representativeness is a qualitative measure of how well data meet the project goal of representing true background concentrations. The only aspect of representativeness addressed in this section is the possible introduction of contamination into environmental samples during sample collection and handling, which is evaluated from field blank and field rinsate samples. Details of this evaluation are presented in Section 4.3.4. *Completeness* is a measure of how much usable data was derived from the sampling program, and for analytical data is expressed by a statement of the percent of the data that was accepted during data validation (Section 4.3.5).

Comparability expresses the extent to which data collected over a period of years and analyzed with different methods can be considered to be equivalent. Comparability is assessed primarily by examining the precision and accuracy data for possible correlations with sample date

(Section 4.3.6). Section 4.3.7 and Table 4-1 located in that subsection present an overall assessment of PARCC parameters for each analyte group for each medium for the period of sampling.

4.3.2 Precision

Precision is assessed using the analytical results for field duplicate samples. Precision based on field duplicates is a measure of reproducibility for the entire sampling and analytical process. Quantitative estimates of precision are made by calculating the RPD as defined by the following equation:

$$RPD = \frac{|(S - D)|}{(S + D)/2} \times 100$$

where

S = first sample value (field sample),

D = second sample value (field duplicate).

Data that were rejected during data validation were eliminated from the data set prior to calculations. Data that were flagged as usable (V, A, or J) or that did not have a data validation indicator in the data base were included in calculations. The RPD was not calculated for duplicate samples, for which the analytical result for either member was flagged with a U, UJ, or B (metals only) by the laboratory or during data validation, or which were reported as less than or equal to zero (anions and radionuclides only). The data flag "J" indicates an estimated value. For most of the data in this data base, U and UJ indicate the analyte was not detected at a level above the CRDL. The data flag "B" indicates the value is larger than the IDL but less than the method detection limit. Results in these categories have inherently poor reproducibility and are described qualitatively.

Field duplicate data were usually not available for the entire period of sampling and analysis for a medium or analyte group. The medium/analyte group-specific discussions below state the period for which duplicates are available, and the evaluations apply only to those periods.

QC criteria for RPD are specified in the QAPjP (EG&G, 1991d) and in GRRASP (EG&G, 1991e). Acceptable RPDs are 20 percent for all analytes in water and 35 percent for all analytes in soil.

Where data are sufficient, summary statistics for RPD over the period of sampling were calculated. These statistics include the number of duplicates for which the RPD could be calculated, the number of duplicates for which the RPD exceeds the QC criterion, the arithmetic average, the standard deviation, and the coefficient of variation. In most cases the average is indicative of the overall quality of the data; however, when the number of samples is small or when the coefficient of variation is above 100 percent, the average may not be a good measure of the central tendency of the data, and it is important to examine the other parameters as well. The complete results of the RPD calculations are shown in Appendix F.

4.3.2.1 Groundwater Assessment

4.3.2.1.1 Dissolved Metals

There are 1,141 records for duplicates in the data set for dissolved metals. More than 80 percent of these results were reported by the laboratory with a qualifier of U, UJ, or B. Elements for which all results for duplicates are in this category are Sb, As, Be, Cs, Co, Cu, Mo, Ni, K, Se, Ag, Tl, Sn, and V. For Al, Cd, and Pb, most results are flagged as non-detects, but for less than five percent of the pairs, the result for one member is flagged, whereas that for the other is not. Precision was not quantified for any of the above elements, but poor reproducibility is inherent in results at levels near detection limits.

The RPD and summary statistics were calculated for the remainder of the elements (Appendix F, Table F-2a). Based on both the fraction of samples exceeding the QC criterion and on the average RPD, overall precision for most of these elements is good. Individual and average RPDs exceed 20 percent only for Fe, Mn, and Zn. The poor precision for these elements reflects both the variability in results near detection limits and the small numbers of samples used in the calculations.

Duplicates included in this data set were collected from 1990 through 1992, and were all analyzed with the CLP method. There is no correlation between precision and collection date. Except for results near detection limits, no correlation between precision and concentration was observed.

4.3.2.1.2 Total Metals

There are 864 records for duplicates in the data set for total metals. More than 70 percent of these results were reported by the laboratory with a qualifier of U, UJ, or B. Elements for which all results for duplicates are in this category are Sb, Be, Cs, and Sn. For Cd, Hg, Se, and Tl, most results are flagged as non-detects, but for less than five percent of the pairs, the result for one member is flagged whereas that for the other is not. Precision was not quantified for any of the above elements, but poor reproducibility is inherent in results at levels near detection limits.

The RPD and summary statistics were calculated for the remainder of the elements (Appendix F, Table F-2b). Based on both the fraction of samples exceeding the QC criterion and on the average RPD, precision is generally poor for Al, Cr, Fe, Pb, Mn, Si, and Zn. Precision is also poor for Ba, Co, Cu, Li, Ni, K, Ag, and V. The poor precision for these latter elements reflects both the variability in results near detection limits and the small numbers of samples used in the calculations.

Duplicates included in this data set were collected from 1990 through 1992, and were all analyzed with the CLP analytical method. There is no correlation between precision and collection date. Except for results near detection limits, no correlation between precision and concentration was observed.

4.3.2.1.3 Dissolved Radionuclides

There are 278 records for duplicates in the data set for dissolved radionuclides. About 40 percent of these results were reported as less than or equal to zero. All results for ^{137}Cs and ^{226}Ra are in this category. There are no duplicate data for ^{241}Am, ^{90}Sr, or the Pu isotopes. The

RPD and summary statistics were calculated for the remainder of the parameters (Appendix F, Table F-2c). Precision for these radionuclides is poor. Individual and average RPDs significantly exceed 20 percent. Most of the results are below required detection limits (RDLs) as specified in the QAPjP (EG&G, 1991d), and the high RPDs reflect inherent variability in results at low concentrations.

Duplicates included in this data set were collected from 1990 through 1992. There is no correlation between precision and collection date. The possible dependence of precision on concentration could not be evaluated because most results are below RDLs.

4.3.2.1.4 Total Radionuclides

There are 111 records for duplicates in the data set for total radionuclides. About 40 percent of these results are reported as less than or equal to zero. There are no duplicate data for the Ra isotopes. The RPD and summary statistics were calculated for the remainder of the parameters, although there are few duplicate data for some parameters (Appendix F, Table F-2d). Based on one duplicate pair each, precision for $^{233,234}U$ and ^{238}U is acceptable for the period represented. Precision for the other radionuclides is poor. Individual and average RPDs significantly exceed 20 percent. Most of the results for radionuclides are below RDLs, and the high RPDs reflect inherent variability in results at these low concentrations.

Duplicates included in this data set were collected from 1990 through 1992, but data do not span the entire period for some analytes. There is no correlation between precision and collection date. The possible dependence of precision on concentration could not be evaluated because most results are below RDLs.

4.3.2.1.5 Anions, Cyanide, and Water-Quality Parameters

There are 416 records for duplicates in the data set for these parameters. About 30 percent of the results are either reported as zero or with a laboratory flag of U or UJ. All results for cyanide (CN) are in this category. Summary statistics were calculated for the remainder of the parameters (Appendix F, Table F-2e). The average RPD is below 20 percent for all parameters

except P and total suspended solids (TSS). About 20 percent of the individual RPD results for fluoride (F^-), nitrate (NO_3^-)/nitrite (NO_2^-), and orthophosphate (PO_4^{3-}) significantly exceed 20 percent. Thus, precision is poor overall for P and TSS and poor for some sampling events for F^-, NO_3^-/NO_2^-, and PO_4^{3-}. Precision is good for the other parameters. Duplicates were collected from 1990 through 1992. There is no correlation of precision with sampling date.

4.3.2.1.6 Organic Compounds

The data set for organic compounds contains 1,298 records for duplicates for volatile organic compounds (VOCs). There are no data for semivolatile organic compounds (SVOCs) or pesticides and polychlorinated biphenyls (PCBs). More than 99 percent of the results for VOCs are reported as non-detects. The few reported results are for common laboratory contaminants and are below RDLs. Although precision is not quantifiable, these results show good consistency for non-detects for VOCs. Because most results are non-detects, there is no correlation of precision with sampling date or concentration.

4.3.2.2 Stream Water Assessment

4.3.2.2.1 Dissolved Metals .

For dissolved metals in surface water there are 267 records for duplicates in the data set. For more than half of these duplicates, the results were reported by the laboratory with a qualifier of U, UJ, or B. The elements for which the results for all pairs are in this category are Sb, As, Be, Cd, Cs, Cr, Co, Mo, Ni, Se, Ag, Tl, Sn, and V. Precision was not quantified for these elements, but poor reproducibility is inherent in results at levels near detection limits.

The RPD and summary statistics were calculated for the remainder of the elements (Appendix F, Table F-3a). Elements for which precision is consistently poor, based on both the fraction of samples exceeding the QC criterion and the average RPD, are Al, Cu, Fe, Pb. Li, K, and Zn. Overall precision for other elements is acceptable. The poor precision for Al, Cu, Li, and Pb reflects both the variability of concentrations near detection limits and the small numbers of samples used in the calculations.

Duplicates included in this data set were collected from 1989 through 1992. No correlation between precision and collection date was observed. Except for results near the detection limit, no correlation between precision and concentration was observed.

4.3.2.2.2 Total Metals

For total metals there are 193 records for duplicates in the data set. About 40 percent of the results for these pairs were reported by the laboratory with a qualifier of U, UJ, or B. The elements for which the results for all duplicates are in this category are Sb, As, Be, Cr, Mo, Se, Ag, and V. Precision was not quantified for these elements, but poor reproducibility is inherent in results at levels near detection limits. There are no duplicate data that have not been rejected for Cd, Cs, Cr, Ni, and Ag; precision for these elements could not be evaluated.

The RPD and summary statistics were calculated for the remainder of the elements (Appendix F, Table F-3b). Based on both the fraction of samples exceeding the RPD criterion and on the average RPD, overall precision is poor for Al, Fe, Pb, Li, Mn, Si, and Zn. The poor precision for Li and Pb reflects both the variability of concentrations near detection limits and the small numbers of samples used in the calculations.

The duplicates for total metals were collected between 1989 and 1992. There is no correlation between precision and collection date. Except for results near RDLs, there is no correlation between precision and concentration.

4.3.2.2.3 Dissolved Radionuclides

There are 45 records for duplicates in the data set for dissolved radionuclides. Results for ^{241}Am, ^{137}Cs, gross alpha, ^{239,240}Pu, and ^{238}Pu were all reported as less than or equal to zero. The RPD and summary statistics were calculated for the remainder of the parameters, although duplicate data are few (Appendix F, Table F-3c). Based on two duplicates and one duplicate, respectively, precision for ^{89,90}Sr and gross gamma is good. Precision for the other radionuclides is poor. Individual and average RPDs significantly exceed 20 percent. Most of the results for

radionuclides are below RDLs, and the high RPDs reflect inherent variability in results at low concentrations.

Duplicates were collected from 1989 through 1992; however, the data do not span the entire period for most analytes. There is no correlation between precision and collection date. The possible dependence of precision on concentration could not be evaluated because most results are below RDLs.

4.3.2.2.4 Total Radionuclides

There are 94 records for duplicates in the data set for total radionuclides. Results for ^{134}Cs, ^{236}Pu, and ^{238}Pu are all reported as less than or equal to zero. The RPD and summary statistics were calculated for the remainder of the radionuclides, although data are few for most analytes (Appendix F, Table F-3d). Based on data for two duplicates each, precision for ^{90}Sr and total U is good. Precision for other radionuclides is poor based both on the fraction of RPDs exceeding 20 percent and on the average RPDs, which significantly exceed 20 percent. All results for radionuclides are below RDLs, and the high RPDs reflect inherent variability in results at these low levels.

Duplicates were collected from 1989 through 1992; however, the data do not span the entire period for most analytes. There is no correlation between precision and collection date. The possible dependence of precision on concentration could not be evaluated because most results are below RDLs.

4.3.2.2.5 Anions, Cyanide, and Water-Quality Parameters

The data set for these parameters contains 191 records for duplicates. The results for cyanide (CN), carbonate (CO_3^{2-}), NO_2^-, and PO_4^{3-} are either reported as zero or have a data validation flag of U or UJ. Precision was not quantified for these parameters, but poor reproducibility is inherent in results at levels near detection limits.

The RPDs and summary statistics were calculated for the other parameters (Appendix F, Table F-3e). Sulfate, oil and grease, and TSS are the only parameters showing RPDs exceeding 20 percent for a large fraction of the samples and showing average RPDs above 20 percent. Precision for other parameters for which RPDs were calculated is good.

Duplicates were collected from 1989 through 1992. There is no correlation between precision and collection date. There are no correlations between precision and concentration.

4.3.2.2.6 Organic Compounds

The data set for organic compounds contains 238 records for duplicates for VOCs, 66 for SVOCs, and 28 for pesticides and PCBs. More than 99 percent of the results for these compounds are reported as non-detects. The few reported results are for common laboratory contaminants and are below the RDL. Based on this limited amount of data, there is good consistency for non-detects for organic compounds. Because most results are non-detects, there are no correlations of precision with analytical method, sampling date, or concentration in the data.

4.3.2.3 Seep/Spring Water Assessment

4.3.2.3.1 Dissolved Metals

There are 55 records for duplicates for dissolved metals in the data set. These records represent complete suites of analytes from two samples collected in 1989. About 85 percent of the results were reported by the laboratory with a qualifier of U, UJ, or B. Precision was not quantified for these results, but poor reproducibility is inherent in results at levels near detection limits. There are only eight duplicates, representing a small fraction of the analytical suite, for which RPD could be calculated (Appendix F, Table F-4a). The RPDs are all below 20 percent, but these data are inadequate to evaluate overall precision for this medium over the period of environmental sampling (1989 to 1992).

4.3.2.3.2 Total Metals

There are 20 records for duplicates for total metals in the data set, representing partial suites of analytes from two samples collected in 1989. About 75 percent of the results were reported by the laboratory with a qualifier of U, UJ, or B. Precision was not quantified for these results, but poor reproducibility is inherent in results at levels near detection limits. The RPD could be calculated for only 11 duplicates (Appendix F, Table F-4b). Nine of the 11 RPDs are below 20 percent, but these data are inadequate to evaluate overall precision for this medium.

4.3.2.3.3 Dissolved Radionuclides

There are no data for duplicates for dissolved radionuclides in the data set for this medium. Consequently, no evaluation of precision could be made.

4.3.2.3.4 Total Radionuclides

There are 20 records for duplicates for total radionuclides in the data set, representing a partial suite of analytes from two samples dated 1989. About 75 percent of the results were reported by the laboratory as less than or equal to zero. Precision was not quantified for these results, but poor reproducibility is inherent in results at levels near detection limits. The RPD could be calculated for only 11 duplicate records (Appendix F, Table F-4c). Nine out of the 11 calculated RPDs are above 20 percent. Precision appears to be poor for the sampling events represented, but the data are inadequate to evaluate overall precision for this medium.

4.3.2.3.5 Anions, Cyanide, and Water-Quality Parameters

There are 18 records for duplicates in the data set for these parameters. They represent partial analytical suites for two samples dated 1989. About 30 percent of these results are reported as zero or were flagged U or UJ during data validation. The RPDs could be calculated for only a few analytes from one of the samples (Appendix F, Table F-4d). The RPDs for all parameters are below 20 percent, but the data are inadequate to evaluate overall precision for this medium.

4.3.2.3.6 Organic Compounds

There are no data for duplicates for organic compounds for this medium; consequently, precision could not be evaluated.

4.3.2.4 Borehole Materials

4.3.2.4.1 Metals

The data set contains 263 records for duplicates for borehole materials. For about 40 percent of these duplicates, the results were reported by the laboratory with a qualifier of U, UJ, or B. Precision was not quantified for these results, but poor reproducibility is inherent in results at levels near detection limits.

The RPDs and summary statistics were calculated for the complete analytical suite (Appendix F, Table F-5a). Based on both the fraction of individual RPDs exceeding the QC criterion and on the average RPD, overall precision for Ba, Co, and Mn is poor. Average RPDs for all other elements are less than 35 percent, although some individual RPDs for most elements exceed 35 percent. With the exceptions of Ba, Co, and Mn, overall precision for metals in this medium is acceptable. All samples were collected in 1989, and there is no correlation of precision with sampling date.

4.3.2.4.2 Radionuclides

There are 85 records for duplicates in the data set for radionuclides. Fourteen percent of these were reported as less than or equal to zero. All results for ^{241}Am are in this category. There are no results reported for ^{137}Cs. The RPD and summary statistics were calculated for the remainder of the radionuclides (Appendix F, Table F-5b). Based on both the fraction of individual RPDs exceeding the QC criterion and on the average RPD, overall precision for ^{239,240}Pu, ^{89,90}Sr, and ^{238}U is poor. This poor precision reflects the inherent variability of results near RDLs for these radionuclides. Average RPDs for all other elements are less than 35 percent, although some individual RPDs for most parameters exceed 35 percent. With the

exceptions of $^{239,240}Pu$, $^{89,90}Sr$, and ^{238}U, overall precision for radionuclides in this medium is acceptable. All samples are dated 1989.

4.3.2.4.3 Anions, Cyanide, and Water-Quality Parameters

The data set contains 20 records for duplicates representing a small fraction of the analytical suite for several samples. The RPDs could be calculated only for several NO_3^-/NO_2^- records and several pH records. These data are inadequate to evaluate precision for this class of analytes.

4.3.2.4.4 Organic Compounds

This medium was not sampled for organic compounds. Consequently, precision for organic compounds in this medium is not evaluated.

4.3.2.5 Stream Sediment Assessment

4.3.2.5.1 Metals

There are 84 duplicate pairs in the data set. Approximately 54 percent of the duplicates were reported by the laboratory with a qualifier of U, UJ, or B. The elements Sb, Cd, Cs, Hg, Mo, Se, Ag, and Tl are all in this category. Precision was not quantified for these elements, but poor reproducibility is inherent in results at levels near detection limits.

The RPDs and summary statistics were calculated for the remaining elements (Appendix F, Table F-6a). Duplicate samples are dated 1989 and 1990. A strong correlation exists between the date that samples were collected and the quality of data. Approximately 58 percent of duplicate pairs analyzed during 1989 with an unspecified method exceed the 35 percent RPD criterion. Only five percent (or one duplicate) of the duplicate pairs analyzed in 1990 by the CLP method exceeded the 35-percent RPD criterion. Thus overall precision for the 1989 samples is poor, whereas that for the 1990 samples is good. Environmental samples were also collected for this medium in 1991; however, the data set contains no duplicate data for that year, and precision for 1991 could not be evaluated.

4.3.2.5.2 Radionuclides

There are 31 duplicate analyses for radionuclides. About 23 percent of these were reported by the laboratory as less than or equal to zero. All results for ^{241}Am and ^{137}Cs are in this category. RPD and summary statistics were calculated for the remainder of the parameters (Appendix F, Table F-6b). With the exception of $^{233,234}U$, all average RPD and most individual RPDs are greater than 35 percent, indicating generally poor precision for radionuclides in this medium. Poor precision occurs for samples with results both above and below RDLs. Duplicates were collected in 1989 and 1990. No correlations with sampling date or analytical method were observed. Again, precision for sampling done in 1991 could not be evaluated.

4.3.2.5.3 Anions, Cyanide, and Water-Quality Parameters

There are only three duplicate records in the data set for these parameters, representing a small fraction of the analytical suite for two samples dated 1989. Precision could not be evaluated.

4.3.2.5.4 Organic Compounds

There are 65 duplicate pairs for SVOCs, 34 duplicate pairs for VOCs, and 27 duplicate pairs for pesticides and PCBs. All of the results were reported by the laboratory as non-detects. Based on this limited amount of data, there is good consistency for non-detects for organic compounds reported for the sampling event represented. However, the data are inadequate to evaluate overall precision for organic compounds in this medium.

4.3.2.6 Seep/Spring Sediment Assessment

4.3.2.6.1 Metals

There are 28 duplicate analyses of metals in the data set, representing one sample dated 1992. Approximately 68 percent of the duplicates were reported by the laboratory with a qualifier of U, UJ, or B. Only the elements Al, Ba, Ca, Cu, Fe, Pb, Mg, and Zn are not in this category. The RPDs calculated for the above nine duplicates are below 35 percent, with the exception of

that for Ca (Appendix F, Table F-7). However, sampling for this medium occurred from 1989 through 1992, and the above data from a single 1992 sample are inadequate to evaluate overall precision for metals in this medium.

4.3.2.6.2 Radionuclides

There are duplicate data available for only 11 records, representing a partial suite of analytes from a sample dated 1992. These data are inadequate to evaluate overall precision for radionuclides in this medium.

4.3.2.6.3 Anions, Cyanide, and Water-Quality Parameters

There are only four duplicate records in the data set for these parameters representing a small fraction of the analytical suite for one sample dated 1992. Precision could not be evaluated.

4.3.2.6.4 Organic Compounds

There are 65 duplicate pairs for SVOCs, 34 duplicate pairs for VOCs, and no duplicate pairs for pesticides and PCBs. All results were reported by the laboratory as non-detects. Based on this limited amount of data, there is good consistency for non-detects for organic compounds reported for the sampling event represented. However, the data are inadequate to evaluate overall precision for organic compounds in this medium.

4.3.3 Accuracy

Accuracy is assessed using the results from spiked samples. The basic measure of accuracy is R, which is defined as:

$$\%R = \frac{(SSR - SR)}{SA} \times 100$$

where

SSR = spiked sample result,

SR = sample result,

SA = spike added.

The %Rs are reported in the data set and are shown in Appendix F. The QC criterion for %R is adopted from EPA (1988a and 1988b) and is 75 to 125 percent for all analytes in all media.

Where sufficient data are available, summary statistics for accuracy over the period of sampling are calculated. Because %R can be either positive or negative, summary statistics are reported in terms of the absolute value of percent bias (%Bias) to better express variations around 100-percent recovery (%Bias = 100 - %R). In terms of %Bias the QC criterion is 25 percent. The number of samples used in the calculations, the number of samples that exceed the QC criterion, the arithmetic average, the standard deviation, and the coefficient of variation are given. In most cases the average is indicative of the overall quality of the data; however, if the sample number is very small or if the coefficient of variation is above 100 percent, the average may not be a good measure of the central tendency of the data, and it is important to examine the other parameters as well. Results of these calculations are shown in Appendix F.

Spike data were usually not available for the entire period of sampling and analysis for a medium or analyte group. The medium/analyte group-specific discussions below state the period for which spikes were available, and the evaluations apply only to those periods.

The exact nature of most of the spiked samples contained in the data set is unknown. For example, it is not known if the samples were spiked before extraction or before analysis, and most samples are not specifically designated matrix spikes or matrix spike duplicates (MSs/MSDs), although they are all assigned a field location. Consequently, there is uncertainty about what portion of the laboratory analysis process the measures of accuracy calculated from the spiked sample results represent, and there is uncertainty in whether the results should be considered to include matrix effects. These uncertainties should be kept in mind throughout the following discussions. Results for samples specifically designated as MS or MSD are treated separately in the analysis from undesignated spikes; however, no significant differences between

results for the two categories were observed. In addition, no information on spike concentrations is available, so possible correlations of accuracy with concentration could not be assessed.

4.3.3.1 Groundwater Assessment

4.3.3.1.1 Dissolved Metals

The data set for dissolved metals contains 70 records for MS samples (Appendix F, Table F-8a) and 361 records for undesignated spikes (Appendix F, Table F-8b). Spikes are dated from 1990 through 1991. All individual %R and average %Bias results for MS samples are within the QC criterion. Almost all (99 percent) of the %R results and all average %Bias results for undesignated spikes are within the QC criterion. Thus overall accuracy for dissolved metals is good. All spike samples for dissolved metals were analyzed by the CLP method. There is no correlation between accuracy and sampling date.

4.3.3.1.2 Total Metals

The data set for total metals contains 24 records for an MS representing one sample dated 1991 (Appendix F, Table F-8c) and 193 records for undesignated spikes dated from 1990 through 1991 (Appendix F, Table F-8d). The following results apply to those periods. All individual %R results for the MS sample are within the QC criterion. For the undesignated spikes, individual values and the average %Bias for Al and Fe significantly exceed 25 percent, indicating that overall accuracy for these elements is questionable. The average %Bias for As and Zn is within the QC criterion as are individual and average %Bias for all other elements, indicating good overall accuracy for these elements. All spike samples for total metals were analyzed by the CLP method. There is no correlation between accuracy and sampling date.

4.3.3.1.3 Radionuclides

The data set contains no spike results for either total or dissolved radionuclides. Consequently, accuracy could not be evaluated for radionuclides in groundwater.

4.3.3.1.4 Anions, Cyanide, and Water-Quality Parameters

The data set contains 55 records for MS samples (Appendix F, Table F-8e) and 187 records for undesignated spikes (Appendix F, Table F-8f). All samples are dated from 1990 through 1991. For the MS samples 95 percent of the %R values are within the QC criterion, and all average %Bias results are below 25 percent, indicating good accuracy overall for all parameters. For the undesignated spikes, 95 percent of the %R values are within the QC criterion and all average %Bias results are below 25 percent, indicating good overall accuracy for all parameters. There is no correlation between accuracy and sampling date.

4.3.3.1.5 Organic Compounds

All spike results for organic compounds are designated MS or MSD. There are 230 %R results reported for VOCs (Appendix F, Table F-8g). There are no data for SVOCs or pesticides and PCBs. The VOC samples are from several sampling events dated between 1990 and 1991. The %R values are reported for only a small fraction of the TCL compounds, and results apply only to those compounds. Ninety-three percent of the reported %R results are within the QC criterion, and all the average %Bias results are below 25 percent, indicating good accuracy overall for the compounds reported. All analyses were done with the CLP method. There is no correlation between accuracy and sampling date.

4.3.3.2 Stream Water Assessment

4.3.3.2.1 Dissolved Metals

No samples designated MS or MSD are available for dissolved metals in surface water, and the accuracy assessment is based on undesignated spikes (Appendix F, Table F-9a). All spikes are dated between 1990 and 1991. Of 114 %R results reported, 109 or 96 percent are within the QC criterion, and the average %Bias for all elements is less than 25 percent, indicating good accuracy overall. There is no correlation between %R and sampling date. All spike samples for dissolved metals were analyzed by the CLP method.

4.3.3.2.2 Total Metals

No samples designated MS are available for total metals in surface water, and the accuracy assessment is based on undesignated spikes (Appendix F, Table F-9b). All spikes are dated between 1990 and 1991. Of 149 %R results reported, 145 (97 percent) are within the QC criterion, and all average %Bias values are below 25 percent, indicating good overall accuracy for total metals in surface water. There is no correlation between %R and sampling date. All spike samples for dissolved metals were analyzed by the CLP method.

4.3.3.2.3 Radionuclides

The data set contains no spike results for either total or dissolved radionuclides. Consequently, accuracy could not be evaluated for radionuclides in surface water.

4.3.3.2.4 Anions, Cyanide, and Water-Quality Parameters

The data set reports 15 %R results for samples designated MS or MSD, representing partial suites of anions for three samples, two dated 1990 and one dated 1991 (Appendix F, Table F-9c). In addition, it contains 82 %R results for undesignated spikes from several dates in 1990 and 1991 (Appendix F, Table F-9d). All the results for the MS and MSD samples meet the QC criterion. More than 99 percent of the results for the undesignated spikes meet the QC criterion, and all average %Bias values are less than 25 percent. Based on these results, accuracy for anions, cyanide, and water-quality parameters is good. There is no correlation between accuracy and sample date.

4.3.3.2.5 Organic Compounds

All spike results for organic compounds are designated MS or MSD. There are 90 %R results reported for VOCs (Appendix F, Table F-9e), 22 for SVOCs (Appendix F, Table F-9f), and 24 for pesticides (Appendix F, Table F-9g). The VOC samples are from several sampling events dated between 1990 and 1991. The pesticide results are from two samples, one taken in 1990 and one taken in 1991. The SVOC results are for a single MS/MSD pair from one sampling

event in 1990. The results described here apply only to the sampling periods represented. The %R values are reported for only a small fraction of the TCL compounds for each class (see Appendix F), and results apply only to those compounds.

Ninety-two percent of the %R values reported for VOCs are within the QC criterion, and all the average %Bias values are less than 25 percent, indicating overall acceptable accuracy for the reported VOCs. Ninety-six percent of the pesticide results are within the QC criterion, indicating good accuracy for the reported pesticides. Ninety-one percent of the %R values reported for SVOCs are significantly less than 75 percent, indicating poor accuracy for the reported compounds for the single sampling event. All analyses were performed by CLP methods. Accuracy is not correlated with sample date for VOCs and pesticides. Possible correlation with sampling date could not be evaluated for SVOCs.

4.3.3.3 Seep/Spring Water Assessment

The data set contains the following spike data: (1) for dissolved metals, a partial suite of analytes (four records) for one undesignated spike sample dated 1991; (2) for total metals, a full suite of analytes for one undesignated spike dated 1991; (3) for anions, cyanide, and water-quality parameters, two records for cyanide dated 1991; and (4) for organic compounds, a partial suite of analyses for SVOCs. There are no spike data for radionuclides, VOCs or pesticides. These data are not adequate to evaluate accuracy for seep/spring water analyses.

4.3.3.4 Borehole Materials Assessment

There are no results in the data set for spike samples for geological borehole materials. Consequently, accuracy could not be evaluated for samples from this medium.

4.3.3.5 Stream Sediment Assessment

4.3.3.5.1 Metals

No samples designated MS or MSD are available for metals in stream sediment; consequently, the accuracy assessment is based on undesignated spikes. There are two spike samples, one dated 1990 and the other 1991 (Appendix F, Table F-10a). There are 22 records in the 1990 data set, and 18 percent of the results exceed the QC criterion. For elements exceeding the QC criterion, this value for Al was 35.6 percent, for Fe was 1550 percent, for Se was 27.7 percent, and for Pb was 71.7 percent. There are 22 records in the 1991 data set, and five percent of the results (one record for Sb) exceed the QC criterion. Based on these limited results, accuracy for several metals in this medium is questionable for the 1990 sampling event. These data are, however, insufficient to evaluate accuracy over the period of sampling (1989 to 1992). All analyses were by the CLP method.

4.3.3.5.2 Radionuclides

The data set contains no spike results for radionuclides; consequently, accuracy could not be evaluated for radionuclides in stream sediments.

4.3.3.5.3 Anions, Cyanide, and Water-Quality Parameters

The data set contains six records for %R, two each for alkalinity, nitrate/nitrite and nitrite, from two samples, one dated 1990 and the other 1991. These results are within the QC criterion, but are not adequate to assess the overall accuracy for this class of parameters.

4.3.3.5.4 Organic Compounds

All spike results for organic compounds are designated MS or MSD. There are 30 %R results reported for VOCs (Appendix F, Table F-10b), 22 for SVOCs (Appendix F, Table F-10c), and 36 for pesticides (Appendix F, Table F-10d). Results are reported for only a small fraction of

the TCL compounds for each class, and the discussion below applies only to those compounds and only to the sampling periods represented.

The %Rs for VOCs are taken from three samples, two dated 1990 and one dated 1991. For the VOC analyses, 87 percent of the %Bias values are within the QC criterion. The average %Bias exceeds 25 percent only for 1,1-dichloroethene. Evaluation of accuracy for SVOCs is based on a 1990 sample and a 1991 sample. Approximately 68 percent of the %Bias values exceed the QC criterion. Based on these limited results, accuracy for SVOCs is poor for this medium.

The pesticide results are from one sample collected in 1991 and two samples collected in 1990. Five out of the 12 results (42 percent) from the 1990 sample exceed the 25 percent %Bias criterion. For one of the two 1990 samples, all of the values for %Bias exceed the 25 percent criterion. For the other 1990 sample all of the values for %Bias are acceptable. Based on these limited results, accuracy for pesticides is poor for this medium. The data are, however, inadequate to evaluate accuracy for organic compounds over the period of sampling.

4.3.3.6 Seep/Spring Sediment Assessment

4.3.3.6.1 Metals

There is only one record for mercury, dated 1991 for an undesignated spike in the date set for seep/spring sediments. No other data are available. Consequently, accuracy could not be evaluated for metals in this medium.

4.3.3.6.2 Radionuclides

The data set contains no spike results for radionuclides; consequently, accuracy could not be evaluated for radionuclides in this medium.

4.3.3.6.3 Anions, Cyanide, and Water-Quality Parameters

The data set contains no spike results for these parameters; consequently, accuracy could not be evaluated for them in this medium.

4.3.3.6.4 Organic Compounds

All spike results for organic compounds are designated MS or MSD. There are 10 %R values reported for VOCs (Appendix F, Table F-11a), 22 for SVOCs (Appendix F, Table F-10b), and 12 for pesticides (Appendix F, Table F-10c). Results are reported for only a small fraction of the TCL compounds for each class (see Appendix F), and the discussion below applies only to those compounds and only to the sampling periods represented. The %Rs for VOCs are taken from one 1991 sample. For the VOC analyses, 100 percent of the %Bias values were within the 25 percent criterion. Evaluation of accuracy for SVOCs is based on one 1990 sample. Twenty out of 22 %Bias values (90 percent) exceeded the 25-percent criterion. The pesticide results are from one sample collected in 1991. Fifty percent of the %Bias values exceed the 25-percent criterion. For the sampling events represented, accuracy is good for VOCs, and poor for SVOCs and pesticides. The data are, however, inadequate to assess accuracy over the period of sampling.

4.3.4 Representativeness

The discussion of representativeness in this section is limited to an evaluation of whether analytical results for field samples are truly representative of environmental concentrations, or whether they may have been influenced by the introduction of contamination during collection and handling. Possible contamination in the laboratory is addressed during data validation. Other aspects of representativeness, such as numbers of samples and the spatial distribution of samples, are discussed in other sections of this report.

Possible introduction of contamination is evaluated by examination of the analytical results for field blanks and equipment rinsates. There are no data for trip blanks in the data set. Field blanks consist of volatile-free ASTM Type II reagent water that is carried through field

collection and preparation, shipping, and analytical procedures along with environmental water samples. They serve to identify contamination that may be introduced during any of these steps. Equipment rinsates are used to assess the efficacy of the decontamination process and possible cross-contamination between environmental samples. They are samples of volatile-free ASTM Type II water that have been poured over or through decontaminated sampling equipment and are subsequently handled in the same manner as environmental samples.

The data set contains field blank data only for groundwater. For groundwater there are far fewer data for field blanks than for rinsate samples. Consequently, the overall evaluations of introduced contamination that follow rely chiefly on rinsate data. Although equipment rinsates are used specifically as indicators of cross-contamination during decontamination of sampling equipment, they are carried through the entire sampling, shipping, and laboratory processes and are, consequently, also good indicators of possible introduced contamination during any of these steps as well.

Rinsate or field blank data were usually not available for the entire period of sampling and analysis for a medium or analyte group. The medium/analyte group-specific discussions below state the periods for which rinsates or field blanks were available, and the evaluations apply only to those periods.

4.3.4.1 Groundwater Assessment

4.3.4.1.1 Dissolved Metals

There are 416 rinsate records for dissolved metals from several sampling events during 1990 and 1991. More than 99 percent of these results were reported with laboratory flags of U, UJ, or B. Only one result for Mn and two results for Fe are above RDLs. There are 142 records for dissolved metals in field blanks, all from several sampling events in 1990. All of these results are reported with laboratory flags of U, UJ, or B. Over the periods represented by the rinsate and field blank results, there is no indication of significant introduced contamination for dissolved metals.

4.3.4.1.2 Total Metals

The data set contains 201 records for total metals in rinsates for several dates in 1991. All results were reported with laboratory flags of U, UJ, or B. There are no data for field blanks. There is no indication of introduced contamination for the sampling events represented. However, data are inadequate to evaluate representativeness over the entire period of sampling.

4.3.4.1.3 Dissolved Radionuclides

There are 107 records for dissolved radionuclides in rinsates from several dates in 1990 and 1991. Many of the results were reported as less than or equal to zero, and 93 percent of the results were flagged "J" by the laboratory (indicating that results are below CRDLs). The results not flagged "J" are for one sample dated November 11, 1990, and are all above RDLs.

There are 31 analyses for field blanks reported in the data set all dated 1990. Thirty percent of these results were reported with a laboratory flag of J and are below RDLs. The results not flagged "J" are for the same sample discussed for rinsates, and all results are above RDLs. Thus both rinsate and field blank results indicate significant introduced contamination for the November 11, 1990, sampling event. There is no indication of introduced contamination for other events during the period represented.

4.3.4.1.4 Total Radionuclides

There are 57 records for rinsates for several dates in 1990 and several dates in 1991. More than 85 percent of the results were reported with a J qualifier, and all results are below RDLs. There are 32 records for field blanks from several sampling dates in 1990. About half were reported with a J qualifier, and all are below RDLs. There is, thus, no indication of significant introduced contamination for the sampling periods represented.

4.3.4.1.5 Anions, Cyanide, and Water-Quality Parameters

There are 193 rinsate results for these parameters from several sampling dates in 1990 and 1991. About 85 percent of these were reported with a laboratory qualifier of U. With the exceptions of one result for PO_4^{3-} and one for SiO_2, all reported values are below RDLs. There are 57 records for field blanks from several sampling dates in 1990. Most results are reported with a laboratory qualifier of U, except for one result for SiO_2; all are below RDLs. Thus, there is no indication of significant introduced contamination during the sampling periods represented.

4.3.4.1.6 Organic Compounds

The data set contains 1,288 records for VOCs in rinsates dated from 1990 to 1992 and 170 records for VOCs in field blanks dated 1990. More than 97 percent of the rinsate results and more than 95 percent of the field blank results were reported by the laboratory as non-detects. The remainder of the results are for the common laboratory contaminants acetone, chloromethane, methylene chloride, and toluene. Most of these results are near RDLs and most have been flagged by the laboratory as associated with laboratory blank contamination. There is, thus, no evidence of the introduction of significant VOC contamination during sample collection and handling. There are no rinsate or field blank data for SVOCs or pesticides and PCBs in groundwater.

4.3.4.2 Stream Water Assessment

4.3.4.2.1 Dissolved and Total Metals

The data set contains 142 records for rinsate samples for dissolved metals collected between 1990 and 1992. Almost 90 percent of the results are reported with laboratory or validation flags of U, UJ, or B. Those results not specifically flagged are all below RDLs. There is, thus, no evidence of significant introduced contamination for dissolved metals during the period represented by the rinsates.

There are 204 records for rinsate samples for total metals collected between 1991 and 1992. More than 80 percent of these results are reported with laboratory or validation flags of U, UJ, or B. The remainder, although not flagged, are below RDLs, with the exception of a single rinsate sample (dated June 30, 1992) that shows levels of Al, Ca, Fe, Mn, and Na significantly above their respective RDLs. There is thus no evidence of significant contamination for total metals during most of the period represented by the rinsates. Contamination does appear to have occurred for the sampling event associated with the June 30, 1992, rinsate with elevated levels of metals.

4.3.4.2.2 Dissolved and Total Radionuclides

The data set contains results for only two rinsate samples, one collected in 1990 and the other in 1991, for dissolved radionuclides (18 records) and for only one sample, collected in 1990, for total radionuclides (4 records). The analytical suite is incomplete for all three samples. The small amount of rinsate data available shows no evidence of cross-contamination; all results are reported as non-detects, or are below RDLs. These data are, however, not adequate to assess the overall probability of cross-contamination for radionuclides during the period of background sampling.

4.3.4.2.3 Anions, Cyanide, and Water-Quality Parameters

Data are available for three rinsates, two collected in 1990 and one collected in 1991 (43 records). With the exception of two analyses for TDS, all results are reported with laboratory flags of U, UJ, or B, or are below RDLs. There is, thus, no evidence of cross contamination for the sampling events represented by the rinsates. These data are, however, not adequate to assess the overall probability of contamination for these parameters during the period of background sampling.

4.3.4.2.4 Organic Compounds

The data set contains results for three rinsates for VOCs, two collected in 1991 and one collected in 1990. For SVOCs and pesticides and PCBs, data are available for one rinsate

collected in 1991. All results for VOCs are reported as non-detects (>90 percent) or are below RDLs, with the exception on one low-level result for acetone. All results for SVOCs and pesticides are non-detects. With the exception of the common laboratory contaminant acetone, there is, thus, no evidence of contamination for the sampling events represented by the rinsates. The data are, however, not adequate to assess the overall probability of cross contamination for organic compounds during the period of background sampling.

4.3.4.3 Seep/Spring Water Assessment

There are no rinsate or field blank data for this medium in the data set. Consequently, representativeness could not be evaluated.

4.3.4.4 Borehole Materials Assessment

There are no rinsate or field blank data for this medium in the data set. Consequently, representativeness could not be evaluated.

4.3.4.5 Stream Sediment Assessment

4.3.4.5.1 Metals

The data set contains 28 records for a full suite of analytes from one rinsate dated 1990. All results were flagged by the laboratory with U, UJ, or B, except for those for Al, Cu, Fe, and Zn. Results for these elements are significantly above RDLs, indicating possible introduced contamination. However, the available data are not adequate to evaluate introduced contamination over the period of sampling.

4.3.4.5.2 Radionuclides

There are data for only a partial suite of analytes for one rinsate sample dated 1990 for radionuclides in this medium. These data are inadequate to evaluate representativeness for this medium.

4.3.4.5.3 Anions, Cyanide, and Water-Quality Parameters

There are only two records for one rinsate, one for alkalinity and one for nitrate, for this medium. These data are inadequate to evaluate representativeness for this medium.

4.3.4.5.4 Organic Compounds

The data set contains 34 records for VOCs, 65 records for SVOCs, and 27 records for pesticides and PCBs, representing complete suites of analytes for these classes from one rinsate sample dated 1990. All results were reported by the laboratory as non-detects with the exception of bis(2-ethylhexyl)phthalate, which was reported a level below its RDL. There is, thus, no indication of introduced contamination for the sampling event represented by this rinsate. However, data are inadequate to evaluate representativeness over the entire sampling period for this medium.

4.3.4.6 Seep/Spring Sediment Assessment

There are no rinsate or field blank data for this medium in the data set for metals, radionuclides, SVOCs, or VOCs. For pesticides and PCBs, anions, cyanide, and water-quality parameters, there are only 31 records for rinsates from one sample dated 1992, which represent partial suites of analytes for both classes. These data are inadequate to evaluate representativeness for this medium.

4.3.5 Completeness

Appendix F, Table F-1, presents a summary of data-validation results. For the entire data set, about 50 percent of the results have been validated. The percentage validated varies by medium and by analyte group. Percentage validated by medium lies between 44 percent (surface water) and 62 percent (borehole materials). The percentage validated by analyte group ranges from 0 percent for radionuclides in borehole material, to 87 percent for metals in borehole material; the percentage validated for most analytes, however, falls between 40 percent and 60 percent.

Of the total data that have been validated, less than seven percent has been rejected. The percentage of data rejected, however, varies significantly by medium and by analyte group. A percentage rejected of more than about 10 percent is used as an indicator of poor completeness.

For groundwater, total radionuclides are the only analyte group for which the percentage rejected exceeds 10 percent. The percentage rejected for total radionuclides in groundwater is 20 percent, indicating poor completeness. In surface water and in seep/spring water, only the percentages rejected for dissolved and total radionuclides exceed 10 percent (22 percent and 24 percent, respectively), indicating that these are the only parameters exhibiting poor completeness for those media.

For metals and anions, cyanide, and water-quality parameters in borehole materials, the proportion rejected is five percent. There are no validated results for radionuclides for borehole materials. For stream sediment, the percentage rejected for radionuclides is 26 percent, indicating poor completeness. The percentages rejected for all other analyte groups are less than 12 percent. For seep/spring sediments, percentages rejected for radionuclides and organic compounds are greater than 17 percent, indicating generally poor completeness. Other parameters have percentages rejected below 10 percent.

There is no correlation between percentage validated and percentage rejected, and the percentage rejected calculated from the validated data is probably a reasonable estimate of the percentage rejected for a given analyte group in a given medium for the unvalidated portion of the data set as well. Potentially rejectable data for radionuclides and organic compounds in seep/spring sediments and for radionuclides in all media in the unvalidated portion of the data set could account for more than 10 percent of the records in the total data set for these analytes. For other analytes the percent of potentially rejectable data in the total data set can be expected to be less than 5 percent.

4.3.6 Comparability

Comparability expresses the extent to which data collected over a period of years and analyzed by different analytical methods can be considered to be equivalent. Except for CLP analyses,

the data base does not report the specific analytical method used; consequently, the comparability assessment is based on sampling date. This section summarizes observations made in previous sections concerning correlations between precision and accuracy and sampling date, and assesses overall comparability of data over the sampling period.

4.3.6.1 Groundwater Assessment

Samples for this medium were collected and analyzed over the period from 1989 to 1992. There is no correlation between precision and sampling date for any analyte group over the period from 1990 to 1992. There are no data from which to assess precision for 1989. There is no correlation between accuracy and sampling date for events in 1990 and 1991. Thus, data collected from 1990 to 1992 are comparable with respect to precision, and data collected in 1990 and 1991 are comparable with respect to accuracy.

4.3.6.2 Stream Water Assessment

Samples for surface water were collected and analyzed over the period from 1989 to 1992. There are no correlations between precision and sampling date for any analyte group over the period of sampling. There are no correlations between accuracy and sampling date for events in 1990 and 1991. Thus, data collected over the entire sampling period are comparable with respect to precision, and data collected in 1990 and 1991 are comparable with respect to accuracy.

4.3.6.3 Seep/Spring Water Assessment

Samples from this medium are dated from 1989 to 1992. However, comparability could not be assessed for this medium because there are insufficient data to evaluate either precision or accuracy for any analyte group.

4.3.6.4 Borehole Materials Assessment

Sampling of this medium took place in 1989. There is no correlation between precision and sampling date for metals or radionuclides. Precision could not be assessed for other parameters because data are inadequate. Accuracy could not be assessed for any parameter because there are no spikes in the data set for this medium. Thus, overall comparability with respect to precision is good for metals and radionuclides. Comparability with respect to precision for other parameters could not be assessed. Comparability with respect to accuracy could not be assessed for this medium for any analytical group.

4.3.6.5 Stream Sediment Assessment

Samples for this medium were collected and analyzed from 1989 to 1991. Precision for metals is clearly correlated with sampling date. Precision for data analyzed in 1989 by an unspecified method is significantly poorer than that for data analyzed in 1990 by the CLP method. Data are insufficient to evaluate comparability either in terms of precision or accuracy for other analyte groups. There are no precision or accuracy data for 1991.

4.3.6.6 Seep/Spring Sediment Assessment

Samples from this medium are dated from 1989 to 1992. However, comparability could not be assessed for this medium because there are insufficient data to assess either precision or accuracy for any analyte group.

4.3.7 Summary by Medium

The following subsections summarize the assessment of PARCC parameters for each medium sampled. The assessment conclusions are also shown on Table 4-1. The overall quality of the data in terms of PARCC parameters is rated good, poor, or mixed. These overall judgements are based on the detailed information presented previously in this section and in Appendix F. The designation mixed means that the quality is good for some analytes but not for others or that it is good for some time periods but not for others. In some cases data were inadequate to

Table 4-1. Summary of Data Quality Assessment - Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC) Parameters

Medium/ PARCC Parameter	Dissolved Metals	Total Metals	Dissolved Radio-nuclides	Total Radio-nuclides	Anions, Cyanide, and Water Quality Parameters	Organic Compounds
Groundwater						
Precision[a]	M[b]/MD[c]	P[d]/MD	P/MD	P/MD	M/MD	ID[e]
Accuracy	G[f]/MD	M/MD	ID	ID	G/MD	G/MD
Representativeness	G/MD	G/MD	M/MD	G/MD	G/MD	G/MD
Completeness	G	G	G	P	G	G
Comparability	G/MD	G/MD	G/MD	G/MD	G/MD	G/MD
Stream Water						
Precision[a]	M	M/MD	P	P	M	ID
Accuracy	G/MD	G/MD	ID	ID	G/MD	M/MD
Representativeness	G/MD	M/MD	ID	ID	ID	ID
Completeness	G	G	P	P	G	G
Comparability	G/MD	G/MD	G/MD	G/MD	G/MD	G/MD
Seep/Spring Water						
Precision[a]	ID	ID	ID	ID	ID	ID
Accuracy	ID	ID	ID	ID	ID	ID
Representativeness	ID	ID	ID	ID	ID	ID
Completeness	G	G	P	P	G	G
Comparability	ID	ID	ID	ID	ID	ID
Borehole Materials						
Precision[a]	--[g]	M	--	M/MD	ID	--
Accuracy	--	ID	--	ID	ID	--
Representativeness	--	ID	--	ID	ID	--
Completeness	--	G	--	ID	G	--
Comparability	--	G/MD	--	G/MD	ID	--

Table 4-1. Summary of Data Quality Assessment - PARCC Parameters (Continued)

Medium/ PARCC Parameter	Dissolved Metals	Total Metals	Dissolved Radio-nuclides	Total Radio-nuclides	Anions, Cyanide, and Water Quality Parameters	Organic Compounds
Stream Sediments						
Precision[a]	--	M/MD	--	P/MD	ID	ID
Accuracy	--	ID	--	ID	ID	ID
Representativeness	--	ID	--	ID	ID	ID
Completeness	--	G	--	P	G	G
Comparability	--	P/MD	--	ID	ID	ID
Seep/Spring Sediments						
Precision[a]	--	ID	--	ID	ID	ID
Accuracy	--	ID	--	ID	ID	ID
Representativeness	--	ID	--	ID	ID	ID
Completeness	--	G	--	P	G	P
Comparability	--	ID	--	ID	ID	ID

[a]Precision applies only to results reported without U, UJ, or B qualifiers and as larger than zero.

[b]M = Overall results for quality indicator are mixed; results for some analytes are good but those for others are not, or results for some time periods are good but those for others are not.

[c]MD= Indicator could not be evaluated for some analytes or for some time period because of missing QC data.

[d]P= Overall results for quality indicator are poor.

[e]ID= There are no or too few QC data to evaluate the indicator.

[f]G = Overall results for quality indicator are good.

[g]-- = Not analyzed.

assess data quality for all analytes or for all time periods; these cases are discussed in the text below and are indicated on Table 4-1 with MD for missing data. In some cases there were no data or too few data to make any assessment of a PARCC parameter; these cases are also discussed in the text and are indicated on Table 4-1 with ID for inadequate data. A dash indicates that no analyses were done for the analyte group.

4.3.7.1 Groundwater Assessment

For all analyte groups in groundwater, a large percentage of the results were reported with laboratory or data validation qualifiers of U, UJ, or B or as less than or equal to zero for radionuclides. Precision for results in these categories was not quantified, but reproducibility is inherently poor for results near detection limits. For other results, overall precision is mixed for dissolved metals and anions, cyanide, and water-quality parameters. It is poor for total metals, dissolved radionuclides, and total radionuclides. For organic compounds, nearly all results for VOCs are non-detects, and there are no data for SVOCs or pesticides and PCBs; consequently, precision could not be evaluated for organic compounds. The data set contains no duplicates for 1989, and precision could not be evaluated for that year.

For sampling events in 1990 and 1991, accuracy for dissolved metals and anions, cyanide, and water-quality parameters is good. Accuracy for total metals is good, except for Al and Fe. Accuracy could not be assessed for either dissolved or total radionuclides because no data for spikes are available. For organic compounds, accuracy for VOCs is good. There are, however, no data for SVOCs or pesticides and PCBs, and accuracy could not be assessed for these classes of organic compounds.

For groundwater samples collected in 1990 and 1991, there is no indication of significant introduced contamination for dissolved metals, total metals, total radionuclides, anions, cyanide, and water-quality parameters, or VOCs. For dissolved radionuclides, results for most analytes for one sample dated 1990 are significantly above RDLs, indicating introduced contamination for the associated sampling event only. There are no rinsate or blank data for SVOCs or pesticides and PCBs in groundwater; consequently, introduced contamination could not be assessed for these classes of organic compounds.

Ninety-seven percent of the data validated were accepted, indicating good completeness overall. However, only 80 percent of the total radionuclide results were accepted, indicating poor completeness for this analyte class. Data collected over the period from 1990 to 1992 are comparable with respect to precision, but no data are available for 1989. Data collected during 1990 and 1991 are comparable with respect to accuracy.

4.3.7.2 Stream Water Assessment

A large percentage of the analytical results were reported with laboratory qualifiers of U, UJ, or B for all analyte groups in stream water or as less than or equal to zero for radionuclides. Precision for results in these categories was not quantified, but reproducibility is inherently poor for results near detection limits. For other results, overall precision is mixed for dissolved metals, total metals, and anions, cyanide, and water-quality parameters. No data are available for several analytes for total metals; consequently, the full suite of total metals could not be evaluated. Precision is poor for both dissolved and total radionuclides. For organic compounds, nearly all results for VOCs are non-detects, and there are few data for SVOCs or pesticides and PCBs; consequently, precision could not be evaluated for these organic compounds.

The %R data are available only for the years 1990 and 1991 for stream water; consequently accuracy could not be evaluated for the entire sampling period (1989 to 1992), and the following assessment applies only to the years 1990 and 1991. Accuracy is good for dissolved metals, total metals, and anions, cyanide, and water-quality parameters for the years represented. Accuracy could not be assessed for either dissolved or total radionuclides because no data for spikes are available. For organic compounds, accuracy for VOCs is good. There are, however, no data for SVOCs or pesticides and PCBs, and accuracy could not be assessed for these classes of organic compounds.

Rinsate or field blank data are not available for the entire period of sampling for any class of analytes. Consequently, the evaluation is summarized in terms of years of available data; for years not mentioned, introduced contamination could not be evaluated for the analyte group. For the years 1990 through 1992, there is no indication of contamination for dissolved metals. For 1991 and 1992, there is no indication of contamination for total metals, with the exception

of a single event. For the years 1990 and 1991, there is no indication of contamination for dissolved or total radionuclides, anions, cyanide, water-quality parameters, or organic compounds; however, there are too few rinsate data to reliably evaluate these parameters even for the years represented.

Ninety-six percent of the data validated were accepted, indicating good overall completeness. However, percentages rejected for both dissolved and total radionuclides exceed 20 percent, indicating poor completeness for these analytes. Data collected over the sampling period are comparable with respect to precision. Data collected during 1990 and 1991 are comparable with respect to accuracy.

4.3.7.3 Seep/Spring Water Assessment

There are insufficient data to evaluate any of PARCC parameters for seep/spring water for any of the analyte groups, with the exception of completeness. Ninety-three percent of the data validated were accepted, indicating good overall completeness. However, percentages rejected for both dissolved and total radionuclides exceed 20 percent, indicating poor completeness for these analytes.

4.3.7.4 Borehole Materials Assessment

Precision was not quantified for results reported with laboratory or validation flags U, UJ, or B or reported as less than or equal to zero, but reproducibility is inherently poor for results near detection limits. Precision is mixed for metals and radionuclides. Because of inadequate data, precision could not be evaluated for anions, cyanide, and water-quality parameters. Borehole materials were not analyzed for organic compounds.

Accuracy could not be evaluated for borehole materials because there are no spike data available. Similarly, introduced contamination could not be evaluated because no data are available for rinsates or field blanks.

Ninety-five percent of the data validated were accepted, indicating good overall completeness. However, no results for radionuclides were validated, so completeness could not be evaluated for radionuclides. All sampling occurred in 1989, and the data for metals and radionuclides are comparable with respect to precision. Comparability for other analyte groups with respect to precision could not be evaluated. Comparability with respect to accuracy could not be evaluated for any analyte group.

4.3.7.5 Stream Sediment Assessment

Precision was not quantified for results reported with laboratory or validation flags U, UJ, or B or reported as less than or equal to zero, but reproducibility is inherently poor for results near detection limits. For other results for the years 1989 and 1990, precision is mixed for metals and poor for radionuclides. There are too few data for anions, cyanide, and water-quality parameters for an assessment. For organic compounds, there are few data, and all results were reported as non-detects. Sampling also occurred in 1991, but no duplicate data are available for that year; consequently, precision for 1991 could not be evaluated.

There were too few data to adequately assess accuracy for metals and organic compounds over the sampling period (1989 to 1991). However, based on the small numbers of spikes available, accuracy appears to be mixed for both metals and organic compounds. There were no spike data for radionuclides, and there were too few data for anions, cyanide, and water-quality parameters to make any assessment.

There is only one rinsate sample dated 1990 in the data set. The data from this sample are inadequate to make an assessment of any analyte group over the sampling period. There is, however, evidence of introduced metal contamination in this single sample.

Ninety percent of the data validated were accepted, indicating acceptable overall completeness. The percentage rejected for radionuclides, however, is 20 percent, indicating poor completeness for this parameter. Comparison of the 1989 and 1990 data for precision shows a strong correlation between precision and sampling date for metals. Precision for data analyzed in 1989 by an unspecified method is significantly poorer than that analyzed in 1990 by the CLP method.

Comparability for other analyte groups could not be evaluated with respect to precision. Comparability with respect to accuracy could not be evaluated.

4.3.7.6 Seep/Spring Sediment Assessment

There are insufficient data to assess any of the PARCC parameters for any analyte group in this medium, with the exception of completeness. Eighty-three percent of the data validated were accepted, indicating poor completeness overall. Percents rejected near 20 percent occur for radionuclides and all organic compound classes. No comparability assessment could be made.

4.4 GEOCHEMICAL DATA-QUALITY CRITERIA

Together with the PARCC parameter assessment presented in Section 4.3, other criteria were used to assess general data quality for use in geochemical interpretation. Some of the standard practices discussed below include calculating cation-anion balances, comparing TDS measured in the laboratory with TDS calculated from analytical results, and comparison of specific conductance vs. TDS. The purpose of these techniques is to further check the consistency of data and to help identify transcription errors, field or lab instrument deficiencies, or other potential problems with the data. These techniques can also be used to explore data for trends and relationships that may indicate incomplete analyses, or geochemical changes between field measurements and laboratory measurements.

4.4.1 Groundwater Quality Criteria

The sum of milliequivalents of cations was plotted against the corresponding value for anions as a quality check of the groundwater data (Figure 4-1). The ideal case of zero charge-balance error and electrical neutrality is indicated by the diagonal line. Most of the data points follow the line closely. The charge-balance calculations incorporated all major ions as well as some lessor ions that were selected after reviewing the data set. Cations used in the summation included Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Fe^{2+}, Sr^{2+}, and Cs^{+}. Anions included HCO_3^-, CO_3^{2-}, Cl^-, SO_4^{2-}, and NO_3^-. For all ions, the conversion factors between milligrams per liter and milliequivalents per liter were taken from Hem (1992).

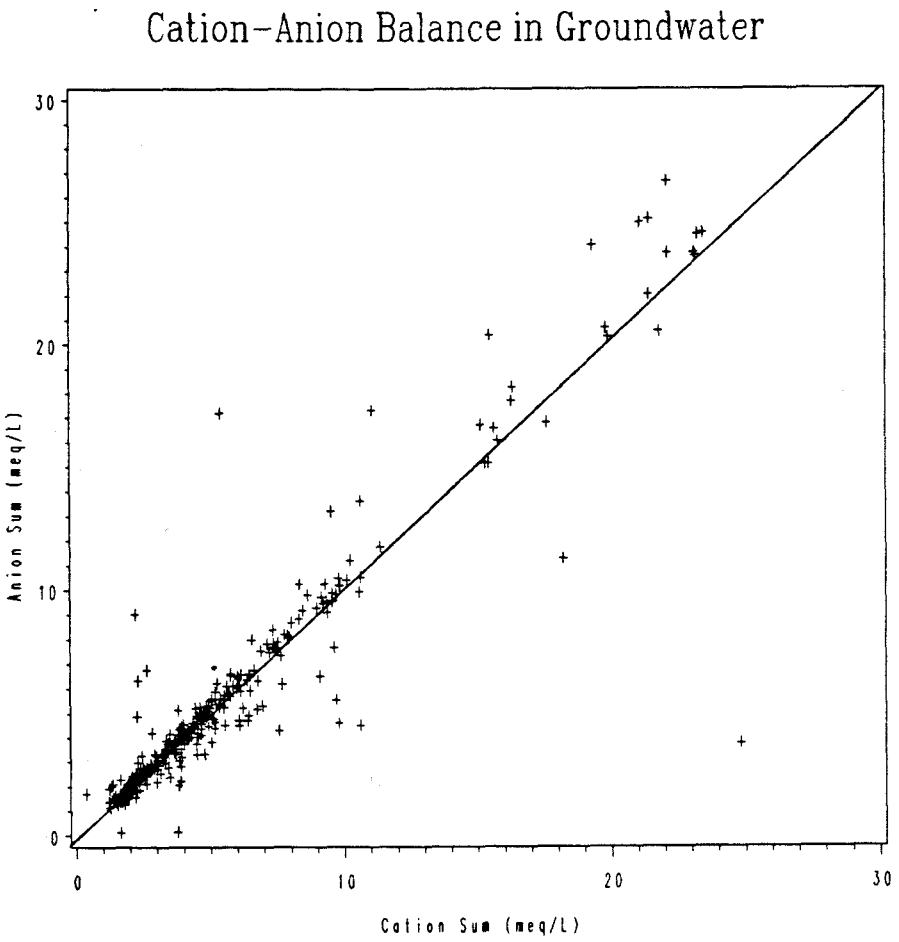


Figure 4-1. Cation-Anion Balance in Groundwater

Percent charge-balance error is computed by the equation; (100)(cations - anions)/(cations + anions), where cations and anions represent the milliequivalent sum of cations and anions, respectively. For the samples analyzed in this study, the charge-balance error appears to increase as the TDS gets smaller (Figure 4-2). Most of the points indicate less than 15-percent error. This confirms that the analyses are reasonably accurate. The data points are equally distributed on the positive and negative sides of the charge-balance error scale; this indicates that all major ions in the water were measured (i.e., there is no systematic positive or negative bias that would suggest that either an anion or cation species was overlooked in the analysis).

Specific conductance (SC) is generally highly correlated with TDS in the geochemical literature (Hem, 1992). A generally good correlation between SC and TDS is seen for groundwaters from the RFP. It should be noted here that field conductivity values measured at different sample temperatures during 1989 were corrected to SC in micromhos/cm at 25°C according to the equation, SC = COND + [0.02 * COND * (25 - T)]. In this equation from Hem (1992), COND is conductivity at sample temperature T°C. Specific conductance was measured directly beginning in 1990.

A histogram of pH values in groundwater shows a reasonably normal distribution, with a mean of approximately pH 7.6 (Figure 4-3). Most of the groundwater values lie in the range 6.7 to 8.1 pH units. The pH values of 10 and 11 appear as one-time measurements from wells that gave lower pH readings in earlier and later sampling episodes.

4.4.2 Surface-Water Quality Criteria

A quality check of analytical data for surface waters is provided by plotting cation milliequivalents vs. anion milliequivalents in surface-water samples (Figure 4-4). If the analyses were completely accurate and precise, all the points would plot along the theoretical line where cation milliequivalents equal anion milliequivalents. Although the data points cluster along the theoretical line, most points fall on the anion side of the line. This indicates that anions were overestimated or cations were underestimated, either by a systematic analytical bias that favored anions, or by the unintentional omission of a cation species.

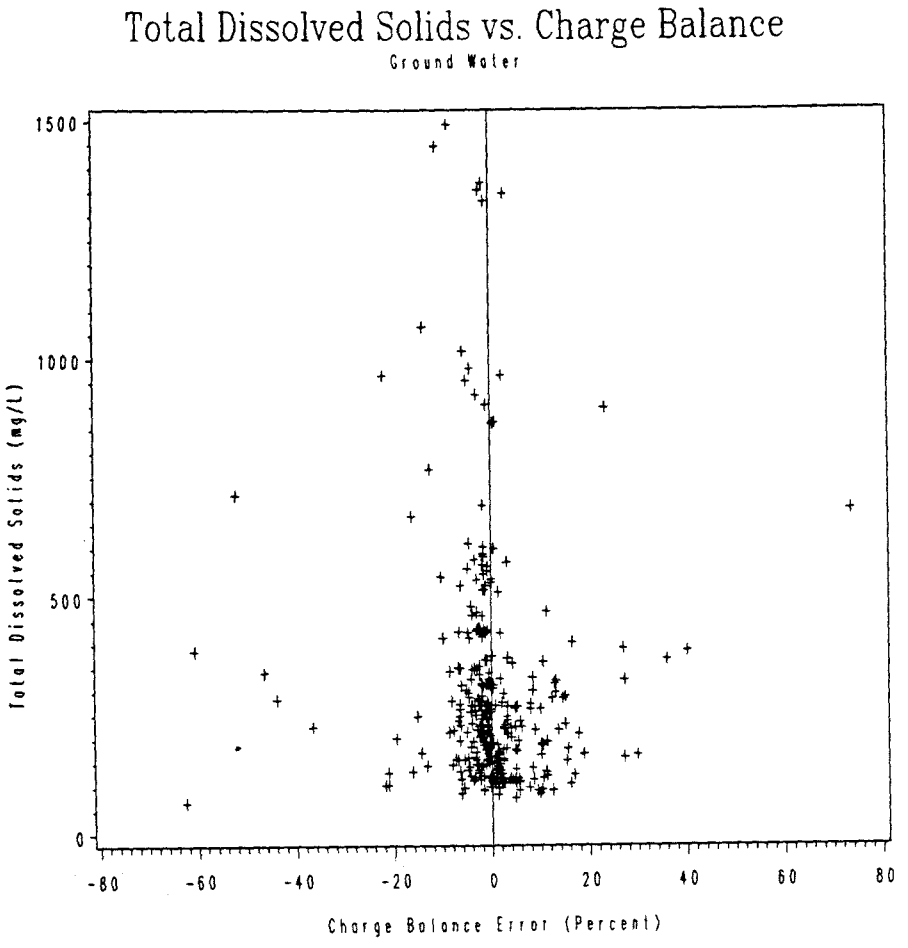


Figure 4-2. Total Dissolved Solids vs Charge Balance for Groundwater

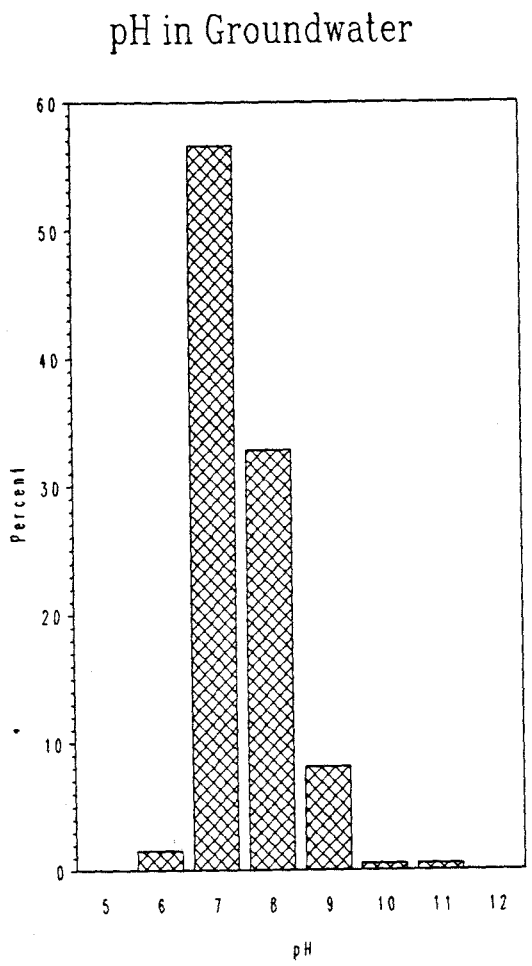


Figure 4-3. Histogram of pH in Groundwater

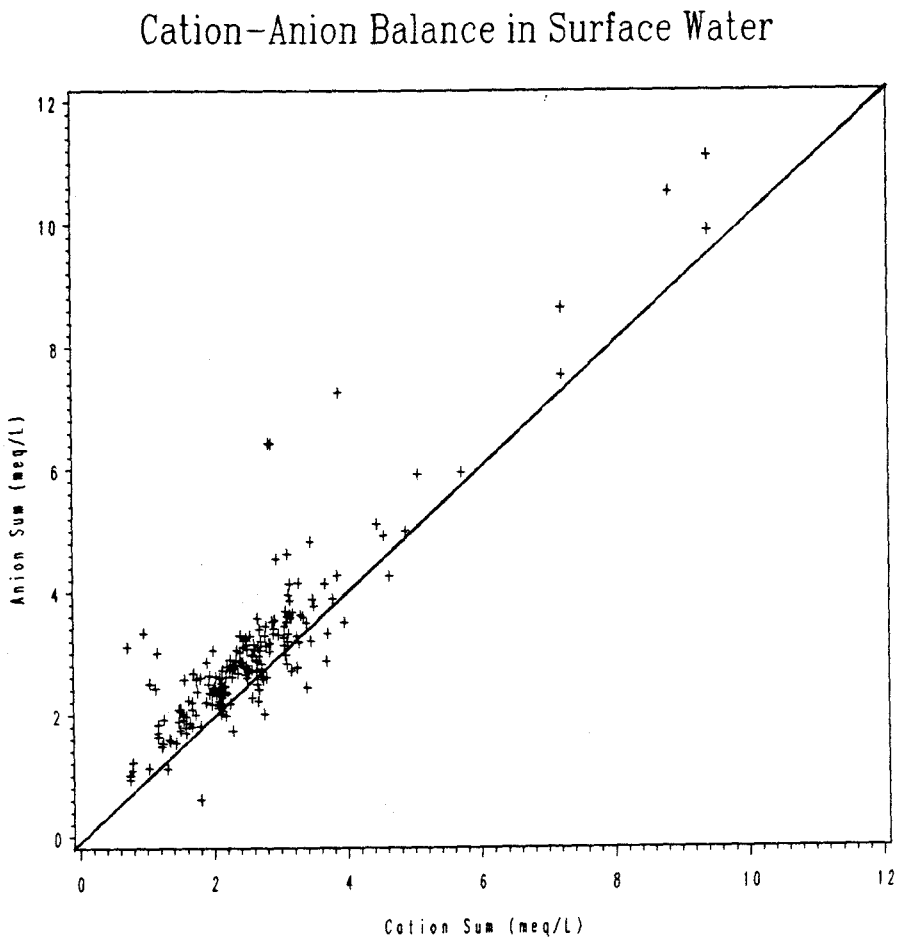


Figure 4-4. Cation-Anion Balance in Surface Water

Another view of surface-water data quality is provided by plotting the percentage charge-balance error against the TDS content of the water (Figure 4-5). There does not appear to be any correlation between TDS and error. The majority of the data fall within ± 15 percent, indicating good analyses. However, the average change-balance error appears to be negative, again suggesting that anions have been overestimated or that cations have been underestimated.

A histogram of pH is surface water shows most values in the range of 7 to 8 (Figure 4-6).

In principle, calculated TDS should equal measured TDS if all dissolved compounds have been identified, measured, and accounted for. Review of a plot of calculated vs. measured TDS in RFP surface-water samples showed that more points fall on the "measured TDS" side of the line than on the "calculated TDS" side. This indicates that measured TDS is, on average, higher than calculated TDS. Again, such a trend suggests that one or more dissolved chemicals present in the surface water were not included in the calculated TDS. The calculated TDS included all major cations and anions, and silica. (Silica exists as a neutral aqueous species in waters of neutral and near-neutral pH, so although it contributes to the TDS, it does not affect the charge balance). The discrepancy between measured and analyzed TDS is due, in part, to the presence of dissolved organic carbon that was not included in the calculated TDS. Dissolved organic carbon concentrations are on the order of 10 mg/L for surface waters at the RFP.

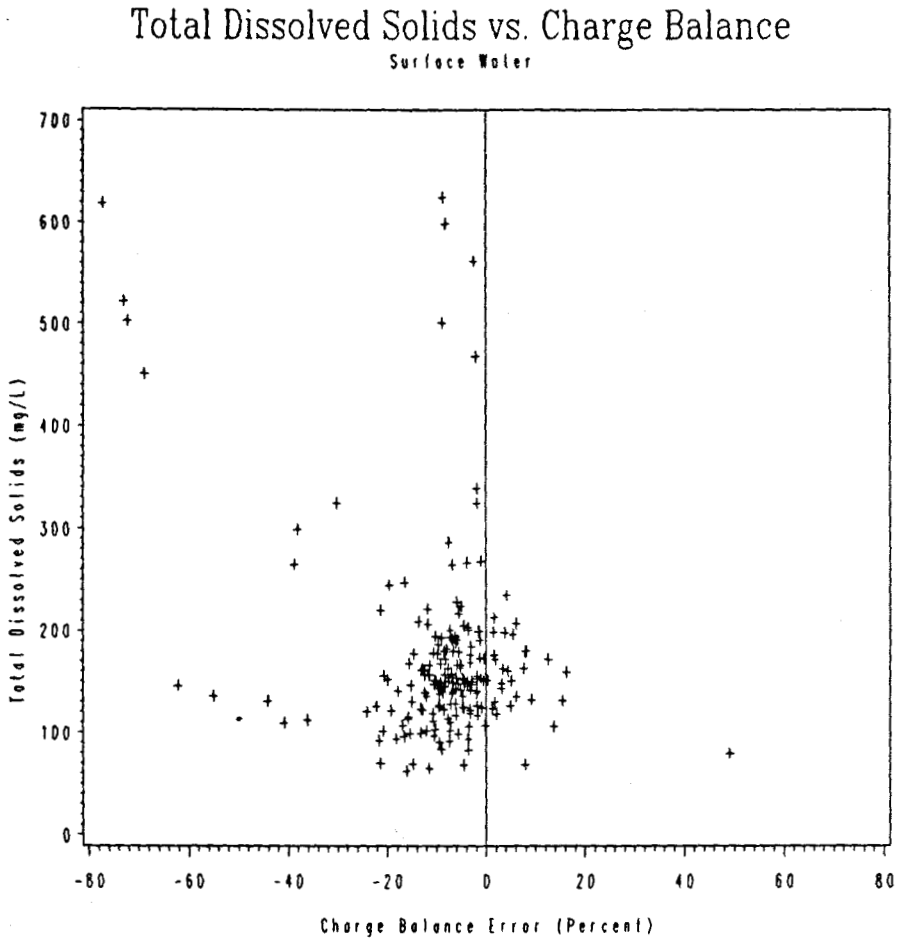


Figure 4-5. Total Dissolved Solids vs Charge Balance for Surface Water

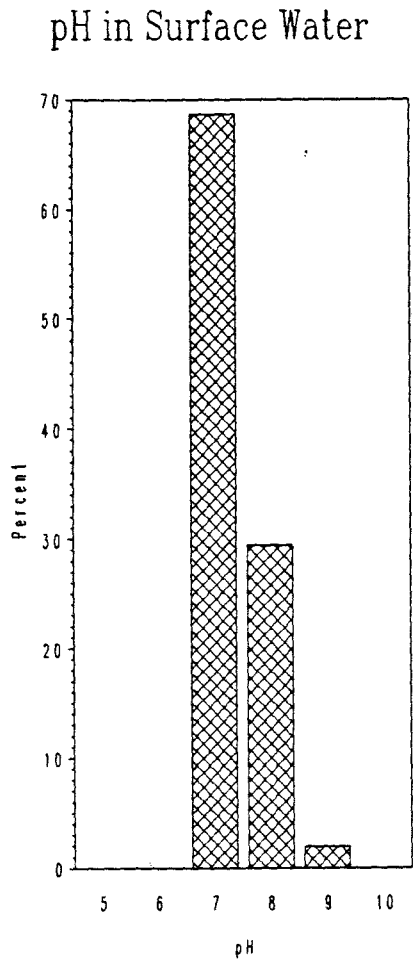


Figure 4-6. Histogram of pH in Surface Water

SECTION 5

SECTION 5
BACKGROUND GEOCHEMICAL CHARACTERIZATION

5.1 INTRODUCTION

This section discusses the results of the statistical and geochemical analysis of background geochemical data for samples of groundwater, stream water, stream sediment, seep/spring water, seep/spring sediment, and geologic borehole material. The evaluation is based on sample data collected at the RFP during calendar years 1989, 1990, 1991, and through 1992. The analytical data sets are voluminous; therefore, they are provided in electronic format on a 1.44 MB diskette as part of Appendix A.

As outlined in Section 1, the analytical results for samples from different media were tested for statistically significant differences as follows: (1) chemical data for surface water and groundwater were evaluated to see if there were seasonal differences in chemical concentrations between the quarters of the year (samples were collected quarterly) within each aqueous medium; and (2) samples of geologic materials and groundwater (collected from five different geologic units at the Plant site) were evaluated by parametric and nonparametric ANOVA to determine if significant differences existed in chemistry among samples from the five geologic units. In addition, data for geologic materials and groundwater were compared by flow-system (upper flow-system = RFA + VFA + COL + WCS; lower flow-system = KAR) using tandem testing (T-test and Wilcoxon Rank-Sum test).

Both parametric and nonparametric ANOVA were used extensively for comparing mean concentrations or mean activities (radionuclides) to determine possible differences among the classification factors; geologic unit, flow-system, and quarter of the year. As shown on the statistics flow-chart in Section 1 (Figure 1-1), class comparisons were not tested for analytes with less than three detectable concentrations or for a sample size of less than ten observations. Instead, all data in different levels for a given sample medium and chemical group (e.g., stream water, dissolved metals) were combined, and tolerance limits and other descriptive statistics were computed for each analyte meeting the above criteria.

GROUNDWATER

At the request of EPA, descriptive statistics were computed for each analyte in each sample medium at each sample location. A printed listing of these statistics is voluminous, so they are provided in electronic format on a 1.44MB diskette as part of Appendix A.

5.2 GROUNDWATER

In many tables, and throughout the text of this chapter, five geologic units are discussed. As previously defined, the following acronyms are used to refer to each unit: Rocky Flats Alluvium is RFA, valley-fill alluvium is VFA, colluvium is COL, weathered claystone of upper Arapahoe/Laramie Formations is WCS, and the undifferentiated Arapahoe/Laramie Formations are designated as KAR.

As noted in Section 1, wells for monitoring background groundwater at the RFP were completed in RFA, VFA, COL, WCS, and unweathered KAR. Samples of groundwater were collected quarterly over four years and analyzed for dissolved and total metals, dissolved and total radionuclides, VOCs, and for water-quality and field parameters. Tolerance limits, percent detects, maximum and minimum values, and other summary statistics were computed for each component in groundwater samples for each lithological unit with a distinctive mean concentration.

5.2.1 Statistical Results for Groundwater

The null hypothesis tested in an ANOVA states that there are no differences in mean concentration between the levels of the applicable classification factor. Using groundwater as an example, a typical null hypothesis would be that no difference exists in mean concentration of calcium between groundwater from RFA and groundwater from VFA.

In addition to comparisons by geologic unit and flow-system, groundwater data were examined for differences in mean concentrations between sampling quarters. Results from the quarterly comparison are discussed under seasonality (Section 5.7). Separate tables of descriptive statistics were not produced by quarter of sampling.

Statistical plots for most metals, radionuclides, and water-quality parameters are presented in Appendix B, including one box-plot for each analyte analyzed by nonparametric ANOVA (compared by geologic unit), and six plots for each analyte analyzed by parametric ANOVA (by geologic unit).

5.2.1.1 Dissolved Metals in Groundwater

Only three analytes for dissolved metals in groundwater met the assumptions for performing parametric ANOVA (Appendix B, Table B-1). Of these analytes (Al, Fe, and Zn), all were found to be lognormally distributed. Comparison of the means between the lithologic units (of the screened interval of the wells) indicated that none of these metals showed any differences between units.

Eleven dissolved metals in groundwater were tested by nonparametric ANOVA to compare mean concentrations by geologic unit, flow-system, and quarter. These included Sb, Ba, Ca, Li, Mg, Mn, K, Se, Na, Sr, and V. Of these, Sb, Ba, and V showed no differences between lithologic units. The other metals had few to numerous differences between lithologies (see Appendix B, Table B-2). Major nutrient species, such as Ca, Mg, K, and Na differed the most frequently between lithologies. Means in RFA for Li and Sr were different from Li and Sr means in the other four geologic units.

When compared by flow-system (all done by nonparametric tandem testing), Al, Sb, Ba, V, and Zn showed no significant differences between the upper and lower flow-systems (Appendix B, Table B-3).

5.2.1.2 Total Metals in Groundwater

Data for four metals (Cu, Mn, Pb, and Si) in unfiltered groundwater samples were suitable for parametric ANOVA; all were lognormally distributed. Only Si showed a number of differences in means between geologic units (Appendix B, Table B-1). Silicon differed between RFA and COL, RFA and KAR, RFA and WCS, and VFA and KAR. Neither Cu, Pb, nor Mn showed significant differences between any of the geologic units.

The results of nonparametric ANOVA for 12 total metals in groundwater showed that only Ba, V, and Zn did not differ between lithologic units. Nutrient species, such as Ca, Mg, and Na showed the greatest number of differences between the five lithologies (Appendix B, Table B-4). Groundwater from RFA differed significantly from the other four geologic units in the mean concentrations of Li, Na, and Sr.

The tandem testing for determining differences between the upper and lower flow-systems indicated that for Ba, Cu, Fe, Pb, Mn, Sr, and Zn, there were no significant differences between flow-systems (Appendix B, Table B-5). Once again, the nutrient species Ca, Mg, K, and Na showed significant differences between groups.

5.2.1.3 Dissolved Radionuclides in Groundwater

Tritium in dissolved groundwater samples was the only radionuclide species to be lognormally distributed. Parametric ANOVA indicated that tritium activities differed significantly between RFA and WCS, RFA and KAR, VFA and WCS, and WCS and COL (Appendix B, Table B-1).
The activities of eight radionuclides in dissolved groundwater were tested for differences in means using nonparametric ANOVA. The tested species included: ^{137}Cs, gross alpha, gross beta, ^{226}Ra, $^{89,90}Sr$, $^{233,234}U$, ^{235}U, and ^{238}U. All but ^{137}Cs showed some differences in mean activity between lithologies (Appendix B, Table B-6).

Nine species of radiochemicals were compared by flow-system using nonparametric tests. No significant differences were shown for ^{137}Cs, gross beta, and $^{89,90}Sr$ between the two flow-systems. Only ^{235}U and ^{238}U were indicated to be significantly different by both the T-test and the Wilcoxon Rank-Sum test (Appendix B, Table B-7).

5.2.1.4 Total Radiochemicals in Groundwater

Chemical data for three unfiltered radiochemicals met the requirements for testing by parametric ANOVA; ^{137}Cs, $^{89,90}Sr$, and T. All three were lognormally distributed. No differences were shown in mean activity for ^{137}Cs and $^{89,90}Sr$ when compared between geologic units, but tritium had a different mean activity in KAR than it did in COL or RFA (Appendix B, Table B-1).

Eight additional unfiltered radiochemicals were tested by nonparametric ANOVA. Only Pu species and ^{241}Am showed no significant differences among the five geologic units. The other radiochemicals showed some differences between geologic units; ^{235}U differed between COL and RFA, COL and KAR, and COL and VFA; ^{238}U differed between COL and RFA, COL and KAR, and RFA and WCS. Significant differences existed for $^{233,234}U$ between COL and KAR, COL and RFA, COL and VFA, WCS and KAR, WCS and RFA, WCS and VFA, and RFA and VFA (Appendix B, Table B-6).

Comparison by flow-system indicated that only ^{137}Cs was significantly different in both the T-test and the Wilcoxon Rank-Sum test. No differences in activity were shown for ^{241}Am, gross alpha, gross beta, $^{239,240}Pu$, $^{89,90}Sr$, and ^{238}U between the two flow-systems (Appendix B, Table B-7).

5.2.1.5 Water-Quality Parameters in Groundwater

Nonparametric ANOVA was used to compare the means of eight water-quality parameters; bicarbonate (as HCO_3^-), Cl^-, F^-, NO_3^-/NO_2^-, SiO_2, SO_4^{2-}, TDS, and TSS. The nonparametric ANOVA showed significant differences in mean concentrations between at least five pairs of geologic units for HCO_3^-, Cl^-, F^-, NO_3^-/NO_2^-, SiO_2, SO_4^{2-}, TDS, and TSS (Appendix B, Table B-8).

Comparison by flow-system indicated that, out of the eight water-quality parameters, only NO_3^-/NO_2^- had no significant differences between the two flow-systems (Appendix B, Table B-9).

5.2.1.6 Organics in Groundwater

VOCs had insufficient detection percentages (all less than 50 percent detects) to appear in the ANOVA analysis. Descriptive statistics and tolerance limits were calculated for any organic analyte with sufficient detects.

5.2.1.7 Groundwater Field Parameters

Selected field parameters, such as specific conductivity and pH, were summarized with descriptive statistics. Summary statistics are presented in Appendix D.

5.2.2 Groundwater Geochemistry

Natural variations in groundwater chemistry exist between geologic units, in particular between the upper and lower flow-systems. Figures 5-1 through 5-10, included later in this section, depict geochemical diagrams (Stiff and Piper diagrams) representative of the water chemistry for each sampling location. Traditionally, Stiff and Piper plots have been used to describe and study variations in the major-ion chemistry of natural waters (see Hem, 1992).

5.2.2.1 Stiff Plots Depicting Groundwater Chemistry

The relative sizes of Stiff diagrams are meaningful in that, the higher the TDS content of the water, the larger the area of the diagram. The shape of the Stiff diagram is determined by the mean concentrations of four major metals and four important anions, expressed in units of milliequivalents per liter (meq/L). In this way, waters of similar chemistry are quickly identified by pattern recognition, rather than by tedious comparison of data tables.

A number of reasons exist for spatial changes and differences in groundwater chemistry. Some changes may be because of the natural evolution of groundwater chemistry along a flow path, such as a systematic increase in TDS content in the downgradient direction. Other changes in water quality may be the result of ion-exchange processes, oxidation/reduction reactions, or mineral precipitation/dissolution processes. And, in downgradient areas, some changes may be the result of local groundwater contamination.

Stiff diagrams were plotted for groundwater from geologic units of both the upper and lower flow-systems. Calcium bicarbonate is the typical groundwater type for the geologic units of the upper hydrostratigraphic unit (geologic units = VFA + COL + RFA + WCS). Wells screened in the four geologic units of the upper flow-system produce groundwaters with similarly shaped Stiff plots, indicating the same calcium-bicarbonate chemistry throughout the upper flow-system.

The water samples from VFA wells all yielded a fairly constant shape indicative of a calcium-bicarbonate water type (Figure 5-1). The groundwater contained in VFA does not show an obvious systematic increase in TDS in the downgradient direction, although there is a possible trend along

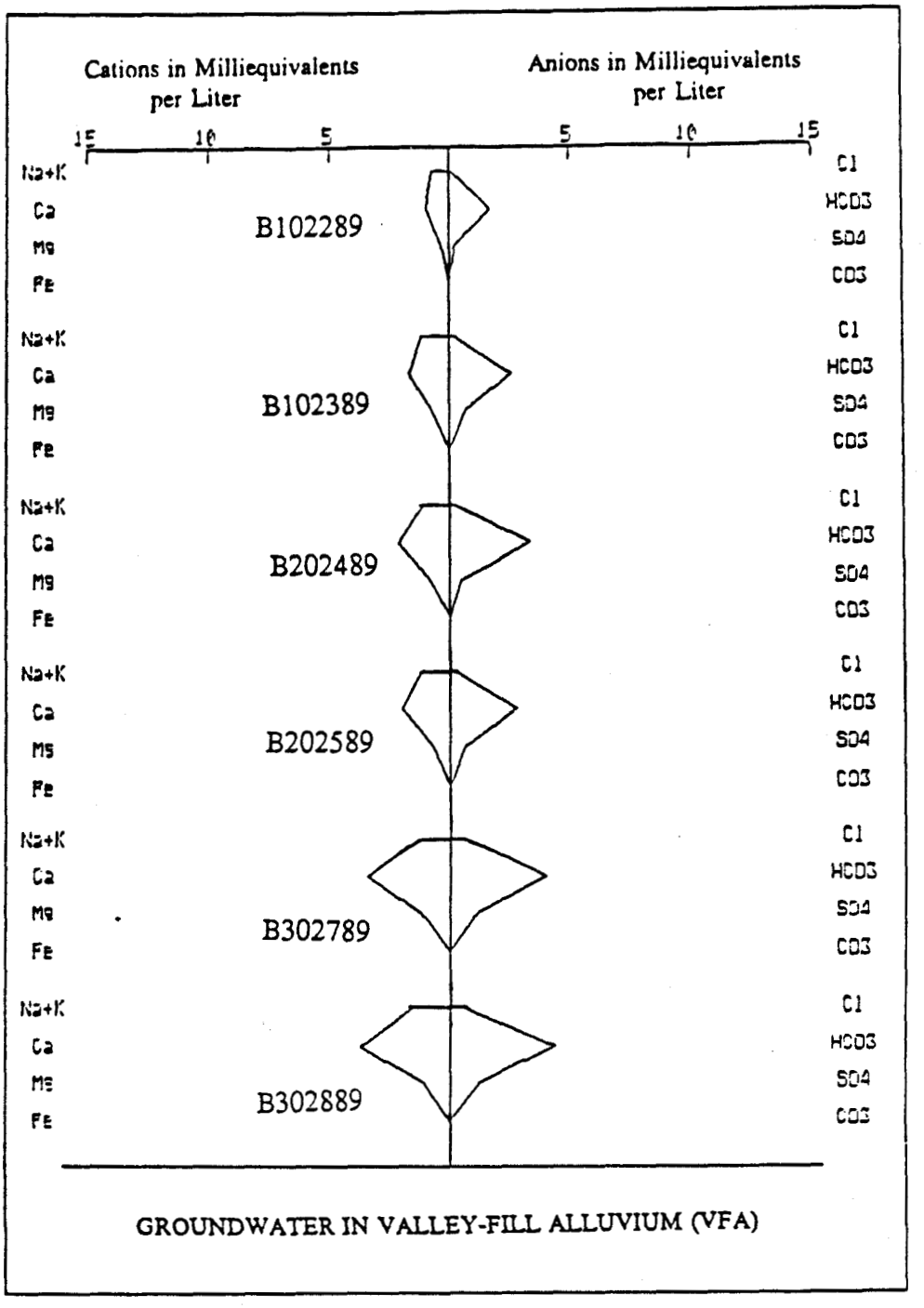


Figure 5-1. Stiff diagrams showing typical chemistry of groundwater from wells screened in VFA.

the Rock Creek drainage from well B102289 to B202589 (see Figure 5-1).

In the *1992 Background Geochemical Characterization Report*, it was speculated that the chemistry in VFA well B303089, which exhibited an unusual sodium-magnesium-sulfate groundwater and did not look like any other Stiff plot for VFA wells, was the result of leachate from a domestic landfill (pre-RFP) located upgradient about 500 ft to the west. However, examination of well logs revealed that well B303089 was screened in bedrock (KAR), not in VFA. After review of all data for this well (samples taken from 1990 through 1992), it was determined that there were no detectable organic components in the groundwater; nor were the concentrations of most trace metals above the detection limit. Metals measured above detection included Ca, Mg, Na, Si, Sr, and Li. Concentrations of SO_4^{2-} and Cl^- were elevated above normal background levels. However, because of the questionable nature of the screened unit in well B303089, and the possible impact of pre-RFP contamination, well B303089 was dropped from consideration as a background well in the *1993 Background Geochemical Characterization Report*.

All wells screened in RFA yielded groundwaters of the calcium-bicarbonate type, and showed only a slight variation in TDS (Figure 5-2). Groundwater from alluvial wells in the north buffer zone (B200589 through B200889) appears to systematically increase in TDS downgradient to the northeast (see Figure 5-2). Samples from colluvial well B201589 (see Figure 5-3) exhibit the same shape, and appear to continue the trend of increasing TDS in a downgradient direction. Groundwater from COL wells is also mainly a calcium-bicarbonate type. However, colluvial well B201289 near the Wind Site is a distinctive calcium-sodium-sulfate water type with relatively high TDS (Figure 5-3). The reasons for this water type are unknown.

Most of the wells completed in WCS produce groundwater of the calcium-bicarbonate type (Figure 5-4). The one major exception is well B304889 in the Woman Creek drainage. Groundwater from this well exhibits a sodium-sulfate composition, and has a higher TDS than water from the other WCS wells. In general, a sodium-sulfate to sodium-bicarbonate chemistry is more typical of the lower flow-system than the upper flow-system.

Stiff plots based on groundwater from the lower flow-system are identified with the Arapahoe/Laramie sandstone units in which the wells are believed to be screened. Groundwater

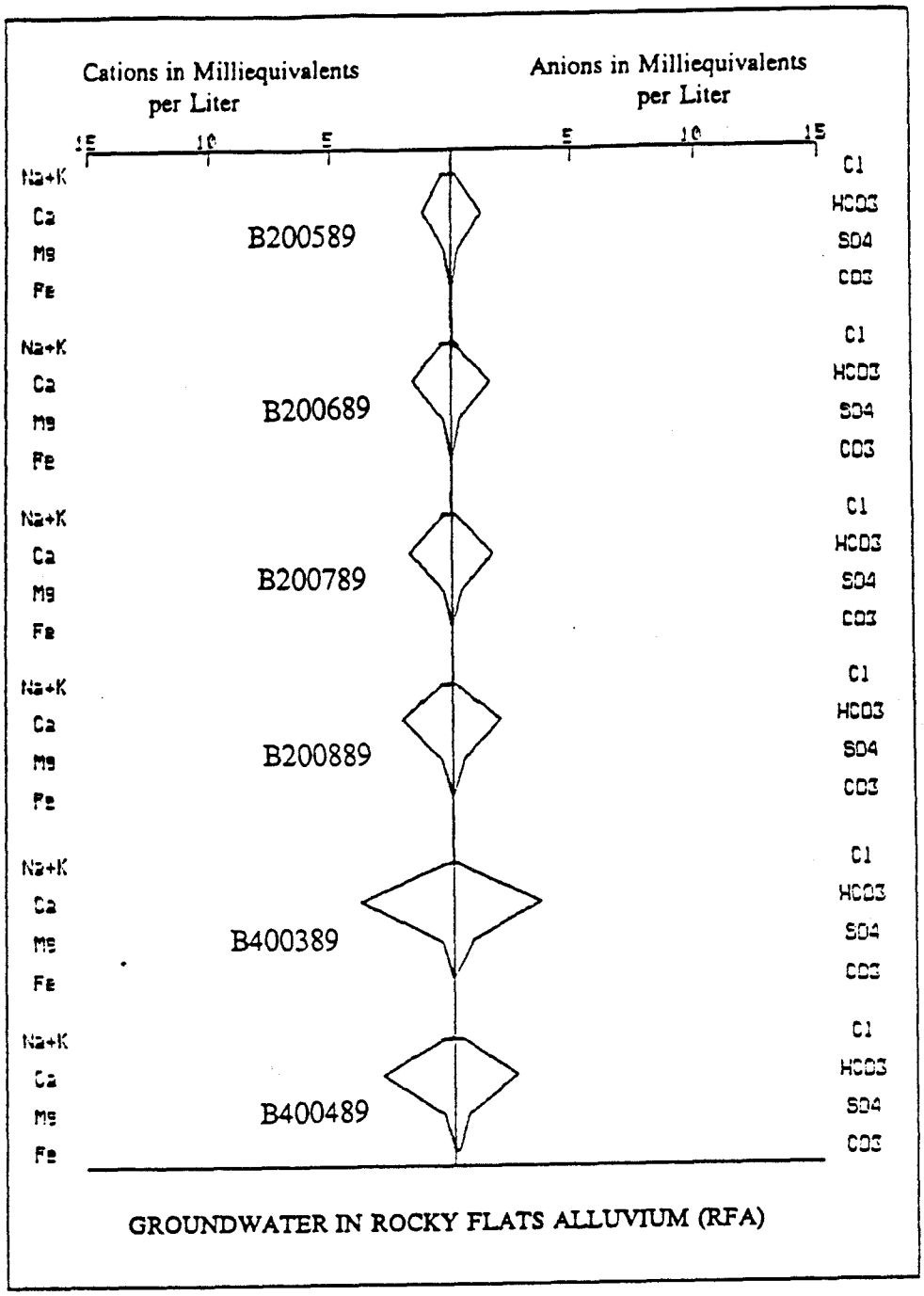


Figure 5-2. Stiff diagrams showing typical chemistry of groundwater from wells screened in RFA.

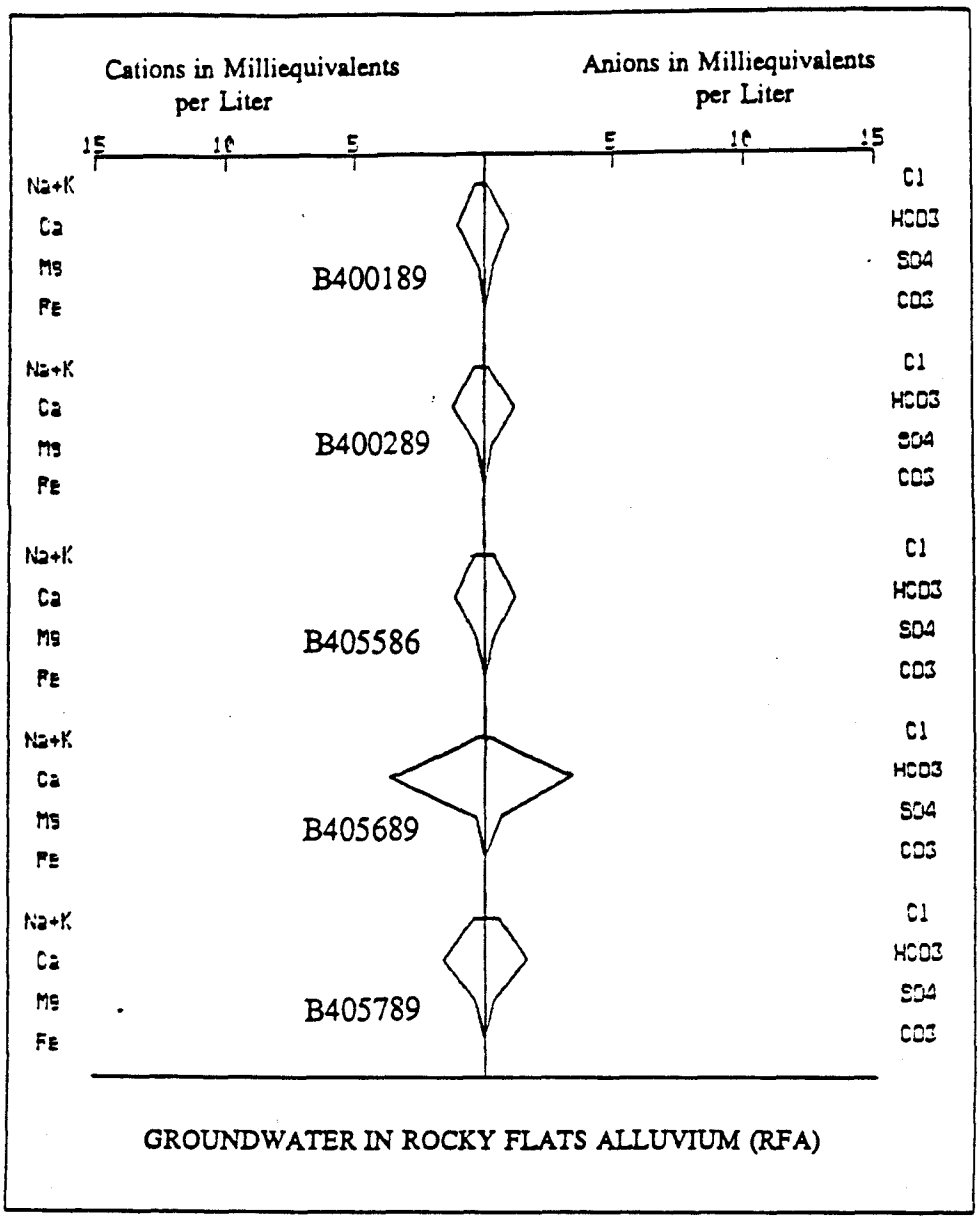


Figure 5-2 (cont').

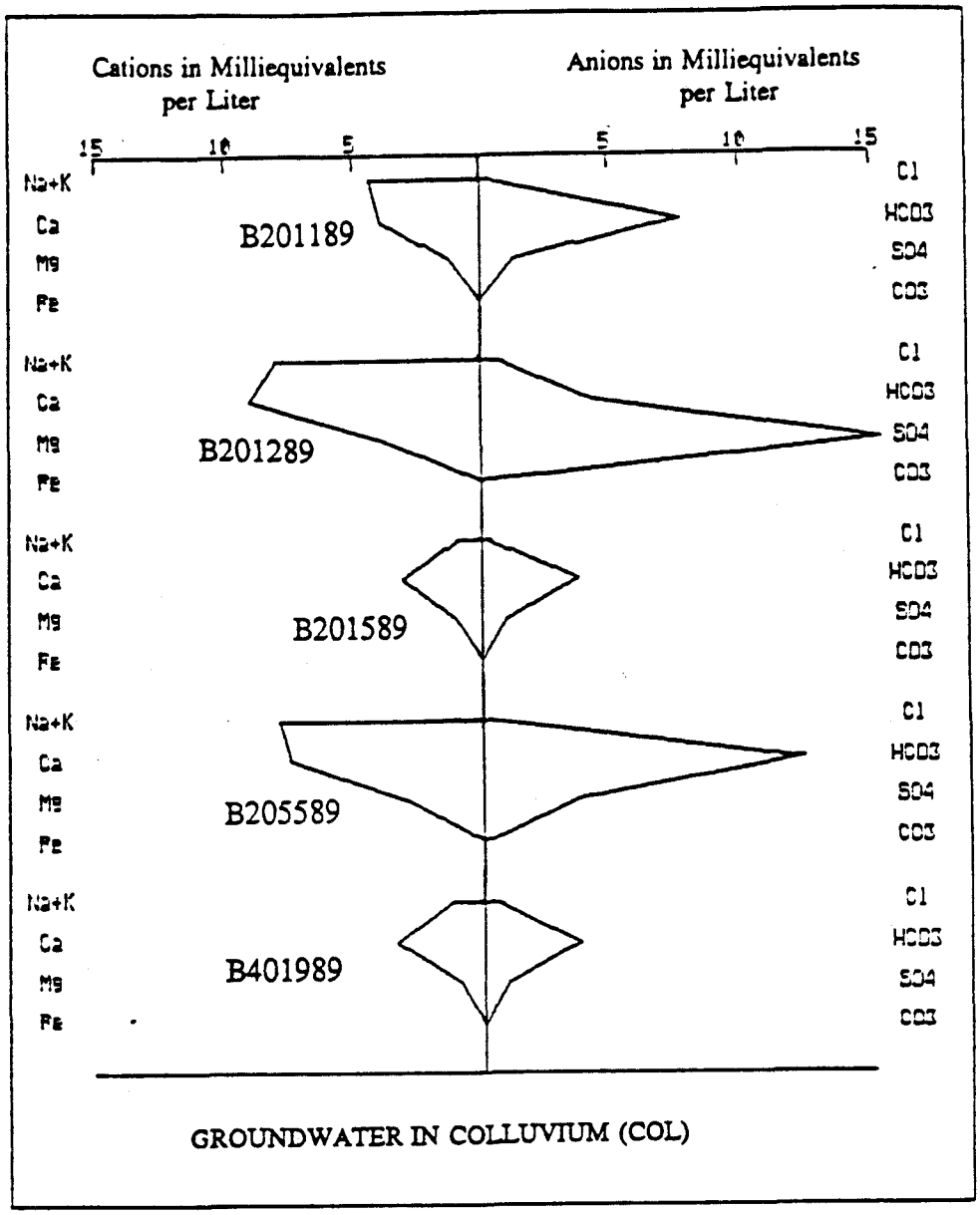


Figure 5-3. Stiff diagrams showing typical chemistry of groundwater from wells screened in COL.

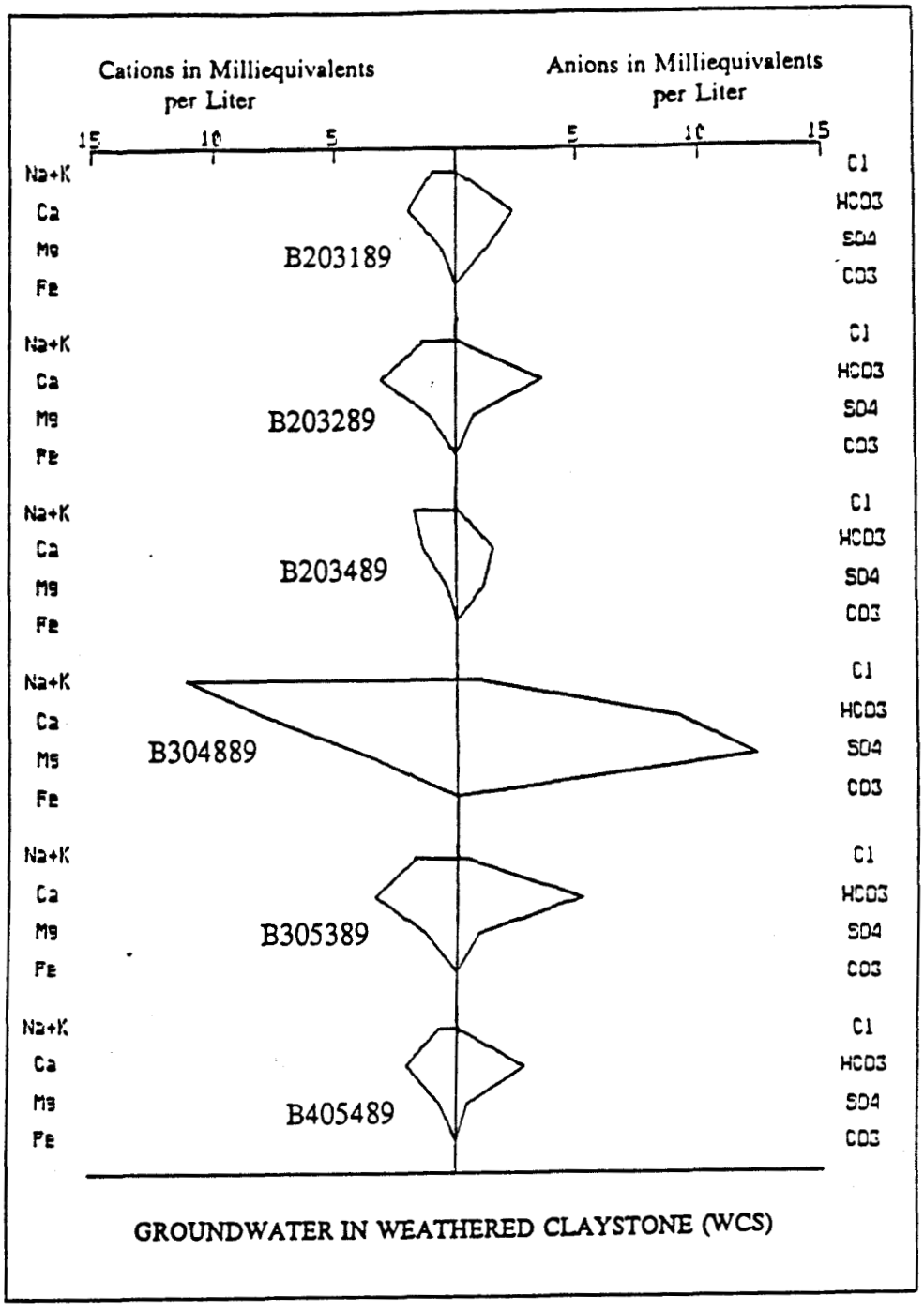


Figure 5-4. Stiff diagrams showing typical chemistry of groundwater from wells screened in WCS.

from the lower flow-system (KAR "deep bedrock wells") generally exhibits a sodium-sulfate to sodium-bicarbonate chemistry (Figure 5-5). The sodium-sulfate composition is common in the lower flow-system and appears to be diagnostic of water from sandstone number four, as well as from undifferentiated Arapahoe/Laramie silty sandstones in the central RFP area. However, the distinctively shaped calcium-bicarbonate water type shows up again in some of the lower flow-system wells, especially those in Arapahoe number-one sandstone (wells B402189 and B405889 in Figure 5-5). This suggests that groundwater contained in the number-one sandstone is of a similar water chemistry to that of the upper flow-system and is hydraulically connected in some areas of the site. This is geochemical evidence that, in the future, it might be more reasonable to group the number-one sandstone with the upper flow-system. If this sandstone was removed from consideration, the chemistry of the lower flow-system water would be predominantly a sodium-sulfate type.

KAR sandstones have been correlated solely on the basis of geologic properties such as their grain-size distribution and thickness, but the reader should be aware that, at present, there is a range of uncertainty in the identification and correlation of the numbered sandstones within the Arapahoe/Laramie Formations. In fact, it may turn out that distinctive geochemical properties, such as water-chemistry type, trace-element concentrations, and stable-isotope ratios, may be useful tools for identifying these sand channels and correlating them between drill holes. A recent report on the palynology of the upper Laramie and Arapahoe Formations (EG&G, 1993), suggested that only the number-one sandstone is Arapahoe Formation, deposited in a fluvial environment. Although the study was not conclusive, it appears that the Arapahoe Formation is thinner at the RFP than previously thought. This palynological study also concluded that the Laramie Formation was deposited in brackish-water, lagoonal conditions, rather than in fluvial conditions as previously assumed.

5.2.2.2 Piper Diagrams Depicting Groundwater Chemistry

The Piper diagram, like the Stiff diagram, uses concentrations of major ions to describe water chemistry and to identify the chemical "type" of a given water. Basically, for a Piper diagram, the major-cation chemistry is plotted on the left-hand triangle, the major-anion chemistry is plotted on the right-hand triangle, and the points on the triangles are projected onto the central diamond.

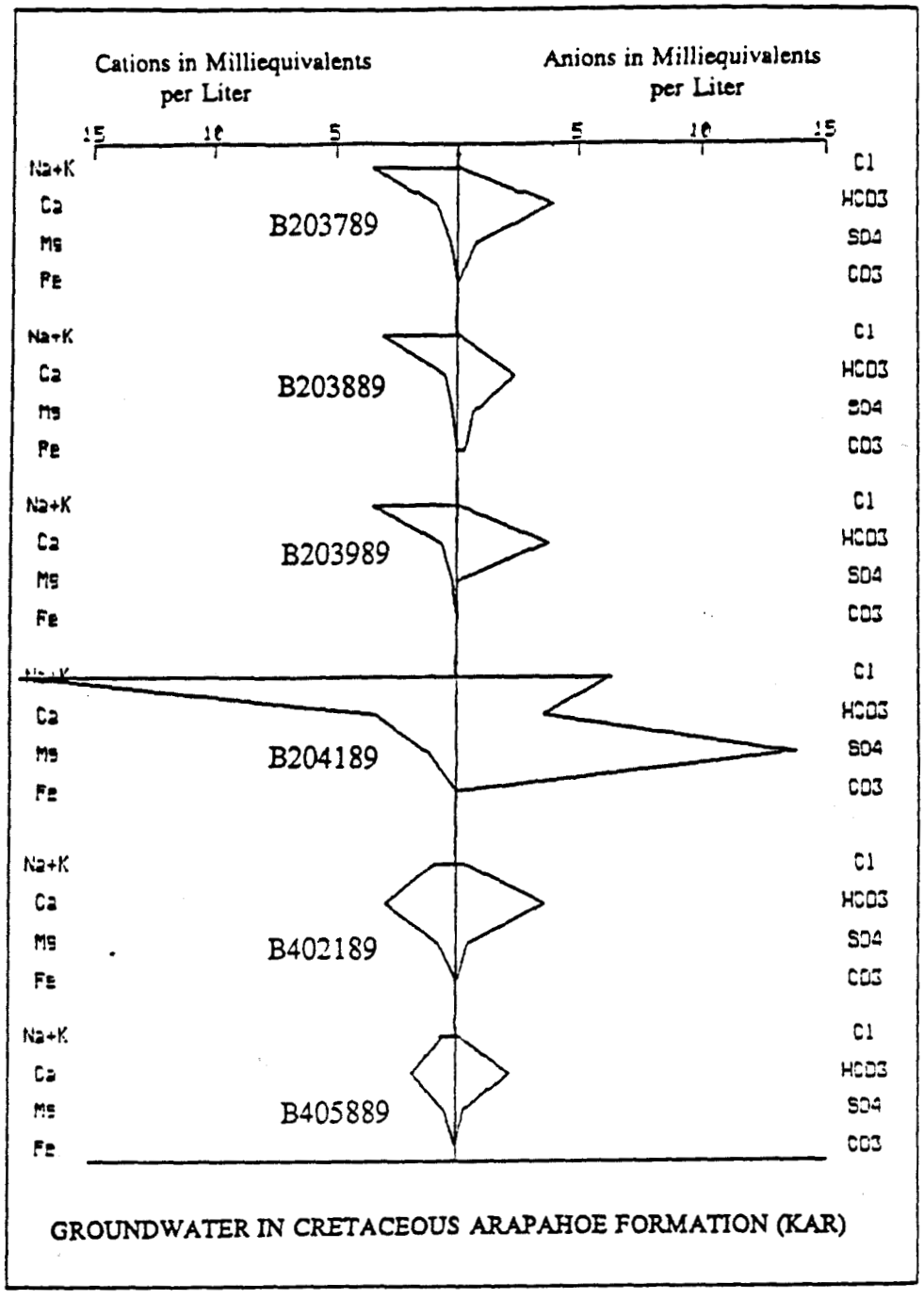


Figure 5-5. Stiff diagrams showing typical chemistry of groundwater from wells screened in KAR.

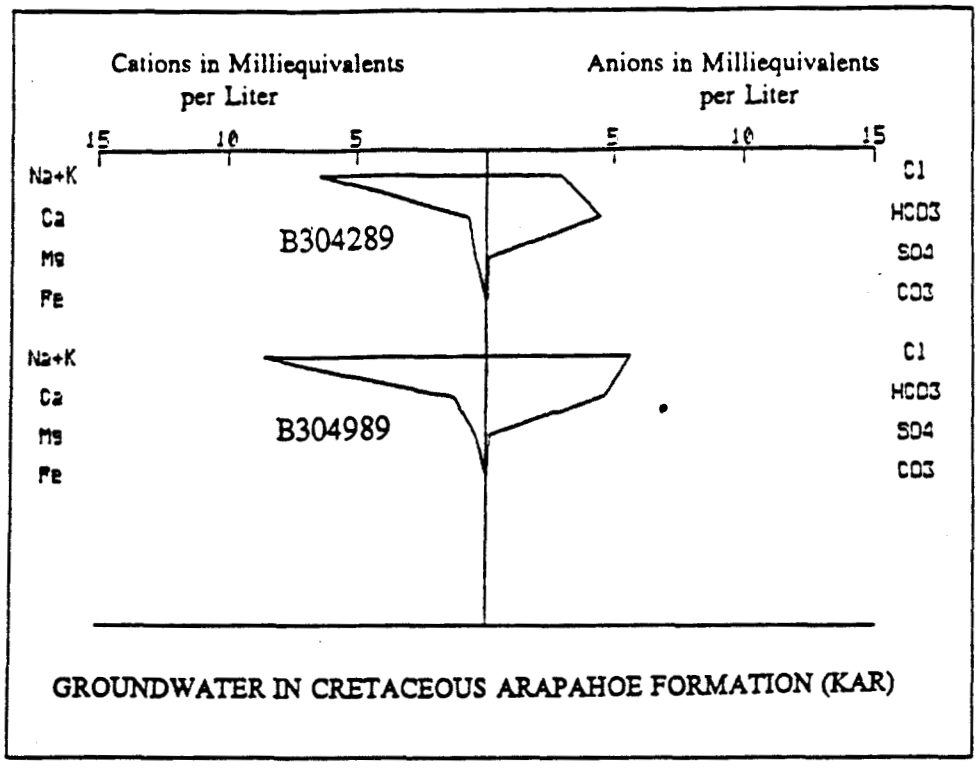


Figure 5-5 (cont').

Each point on a Piper plot represents the chemistry of a single water sample. The positions of groups of points on the diamond are diagnostic of the major-ion chemistry of the groundwater. Points clustered near the left-hand vertex of the diamond are calcium-bicarbonate waters. Those points grouped near the right-hand vertex of the diamond are sodium-sulfate waters. Hence the chemical type shown by the locations of symbols in Figure 5-6 depicts a calcium-bicarbonate water, whereas Figure 5-10 shows a sodium-bicarbonate to sodium-sulfate water type.

As noted above, groundwater from the geologic units of the upper flow-system has a similar major-ion chemistry. The major-ion chemistry for VFA groundwater shows a close grouping on the Piper diagram (Figure 5-6). Similar plots are seen for RFA groundwater (Figure 5-7). Groundwater from COL (Figure 5-8) and WCS (Figure 5-9) shows a wider range of variability in major-ion chemistry, but is still predominantly of a calcium-bicarbonate type. In contrast, the major-ion chemistry of KAR groundwater (Figure 5-10) is clearly distinguished from that of the upper flow-system, with the exception of wells screened in the number-one sandstone. As has been noted previously, the Arapahoe number-one sandstone fits best with the calcium-bicarbonate type. Excluding groundwater from the number-one sandstone, the chemistry of KAR groundwater ranges from a sodium-bicarbonate to sodium-sulfate type (see Figure 5-10).

5.2.2.3 Schoeller Diagram Depicting Groundwater Chemistry

The average chemistry of groundwater from each of the five geologic units can also be represented by different line styles on a Schoeller diagram (Figure 5-11). The scales at the edge of the diagram show milliequivalents of dissolved solids per liter, whereas the inner scales are in milligrams per liter (mg/L) concentrations. It is apparent from the Schoeller plot that RFA groundwater tends to be lower in TDS than the other groundwaters, whereas COL and VFA groundwaters are surprisingly high in TDS. The lower flow-system, KAR, is enriched in Na and Cl, but lower in Ca and Mg, when compared to most waters of the upper flow-system.

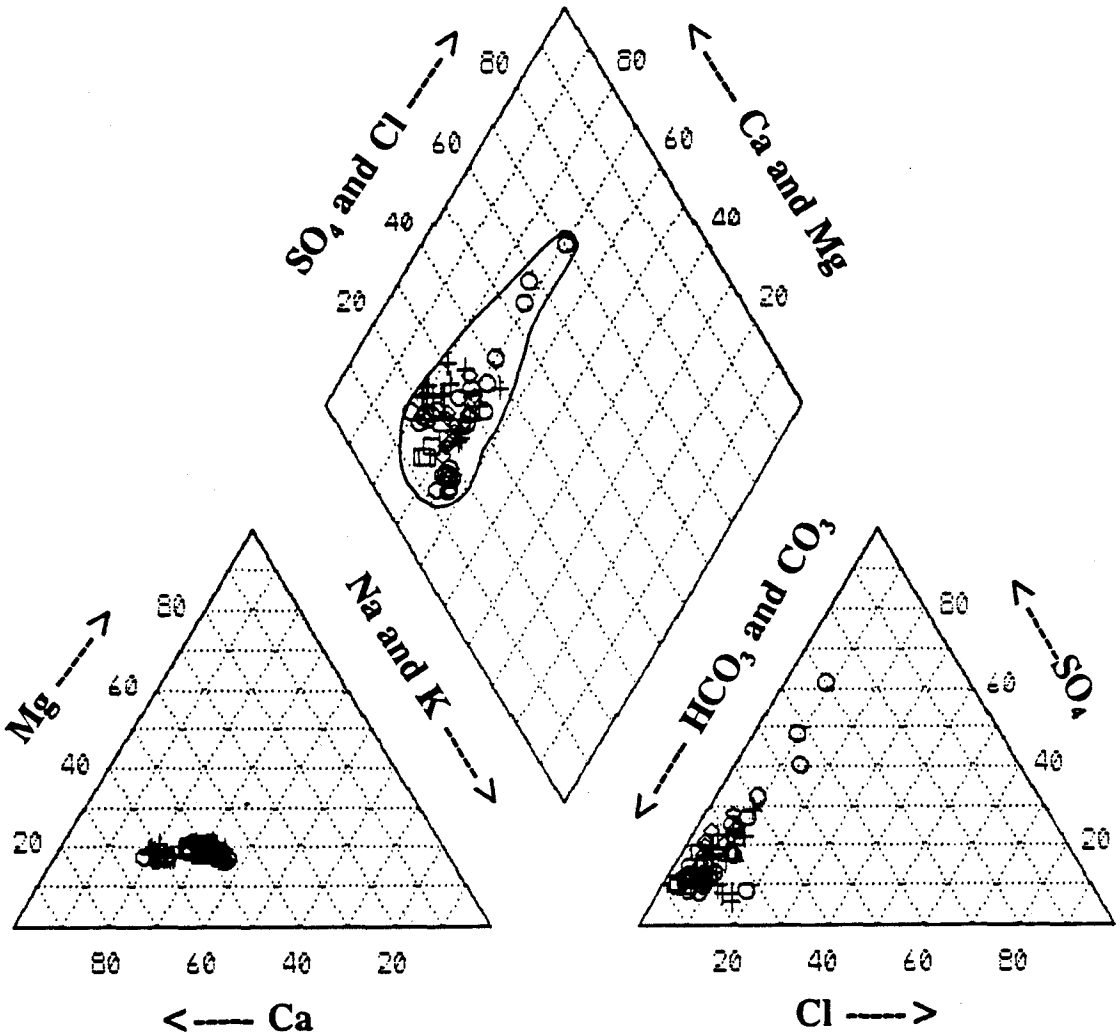


Figure 5-6. Piper diagram showing major-ion chemistry of groundwater from VFA. Concentrations of major ions (as meq/L) are given as percentages of the total milliequivalents per liter.

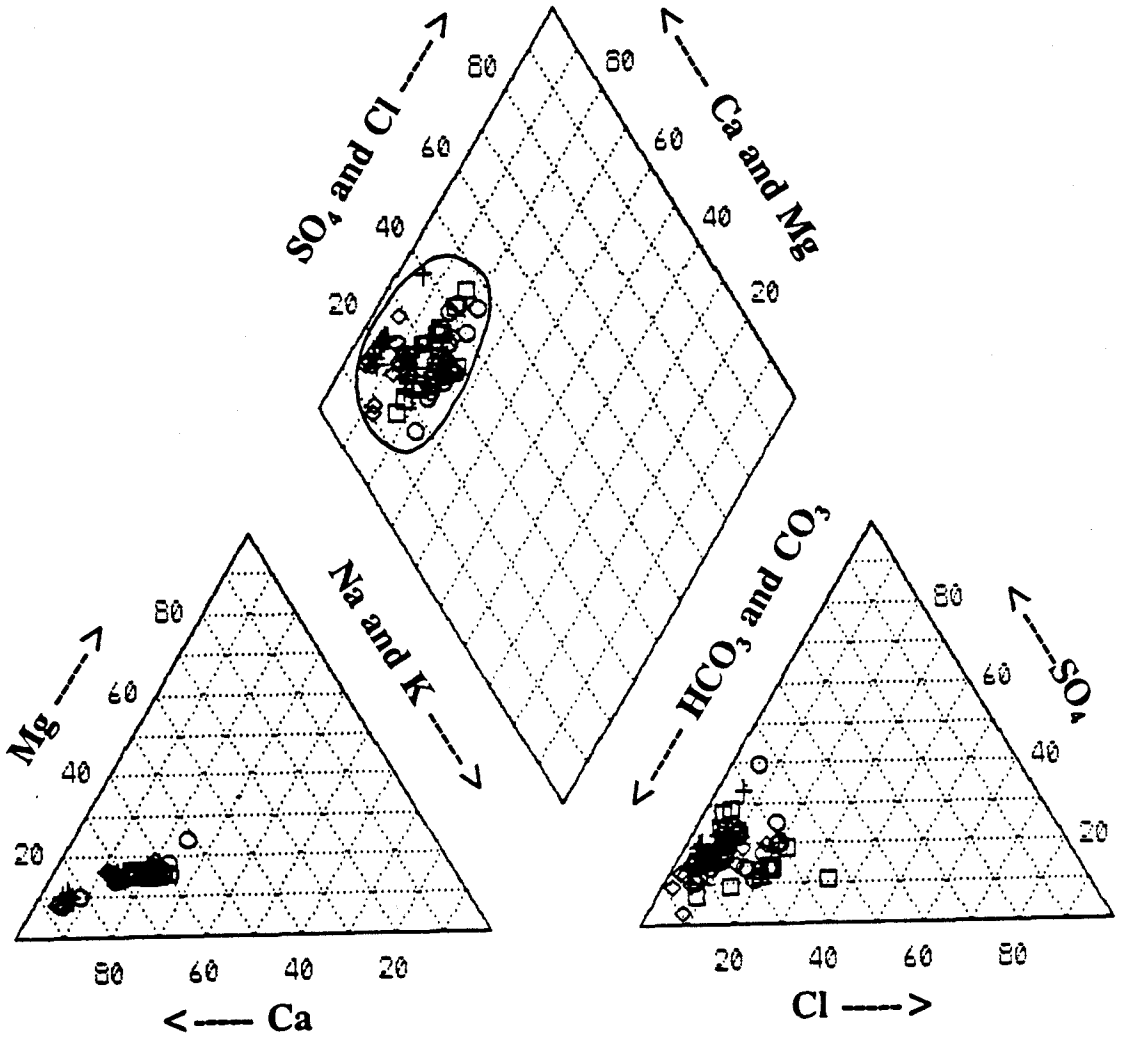


Figure 5-7. Piper diagram showing major-ion chemistry of groundwater from RFA. Concentrations of major ions (as meq/L) are given as percentages of the total milliequivalents per liter.

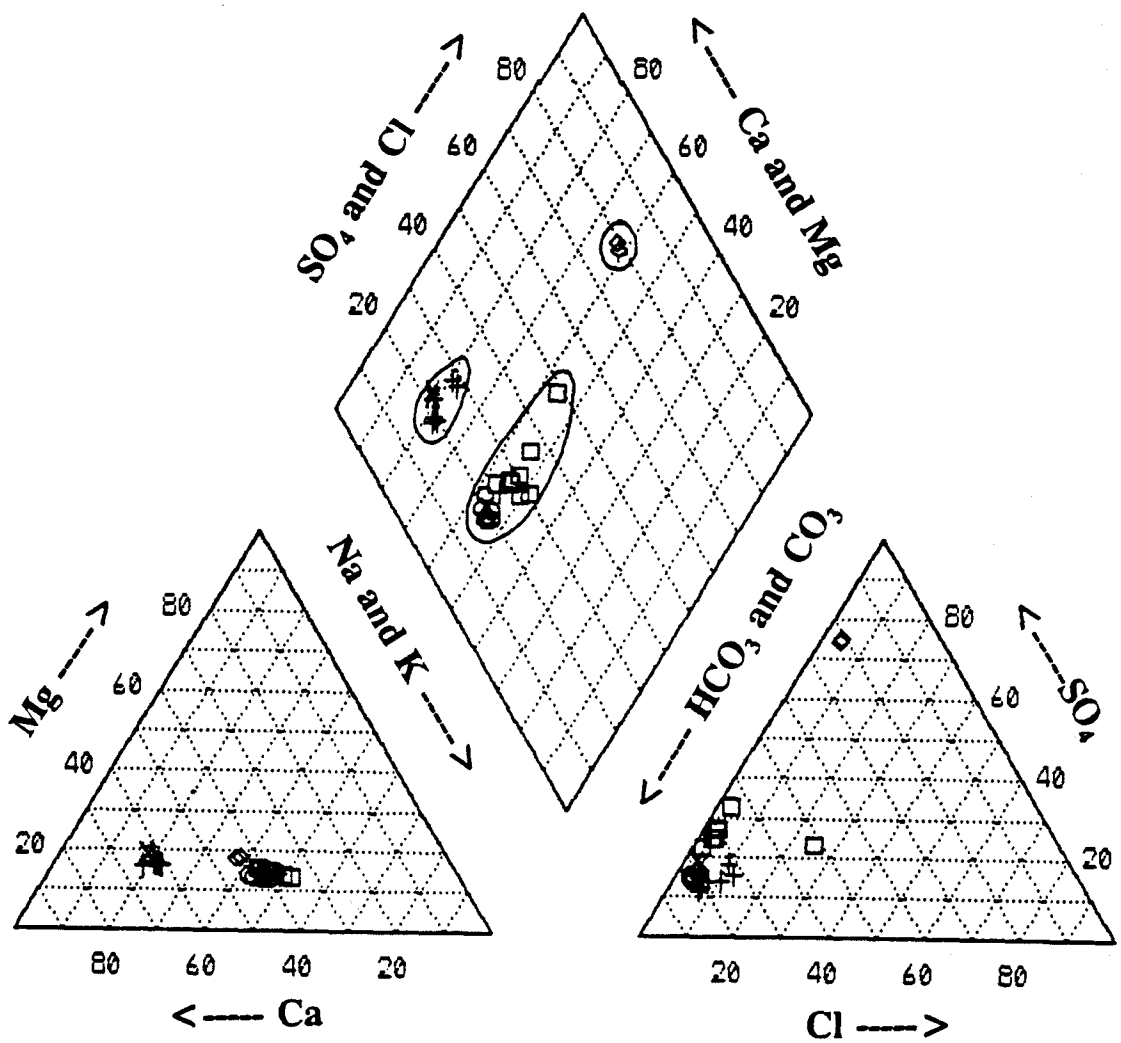


Figure 5-8. Piper diagram showing major-ion chemistry of groundwater from COL. Concentrations of major ions (as meq/L) are given as percentages of the total milliequivalents per liter.

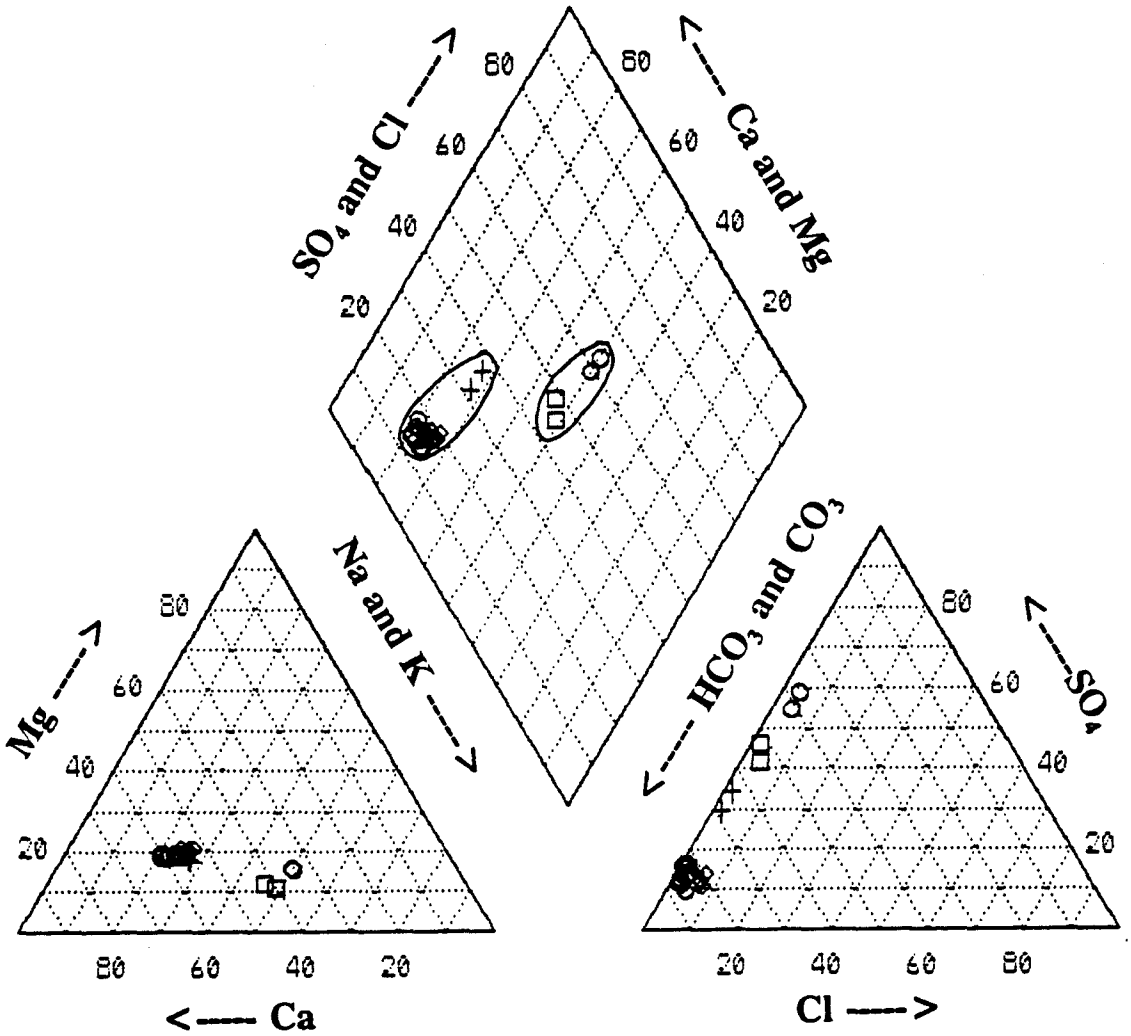


Figure 5-9. Piper diagram showing major-ion chemistry of groundwater from WCS. Concentrations of major ions (as meq/L) are given as percentages of the total milliequivalents per liter.

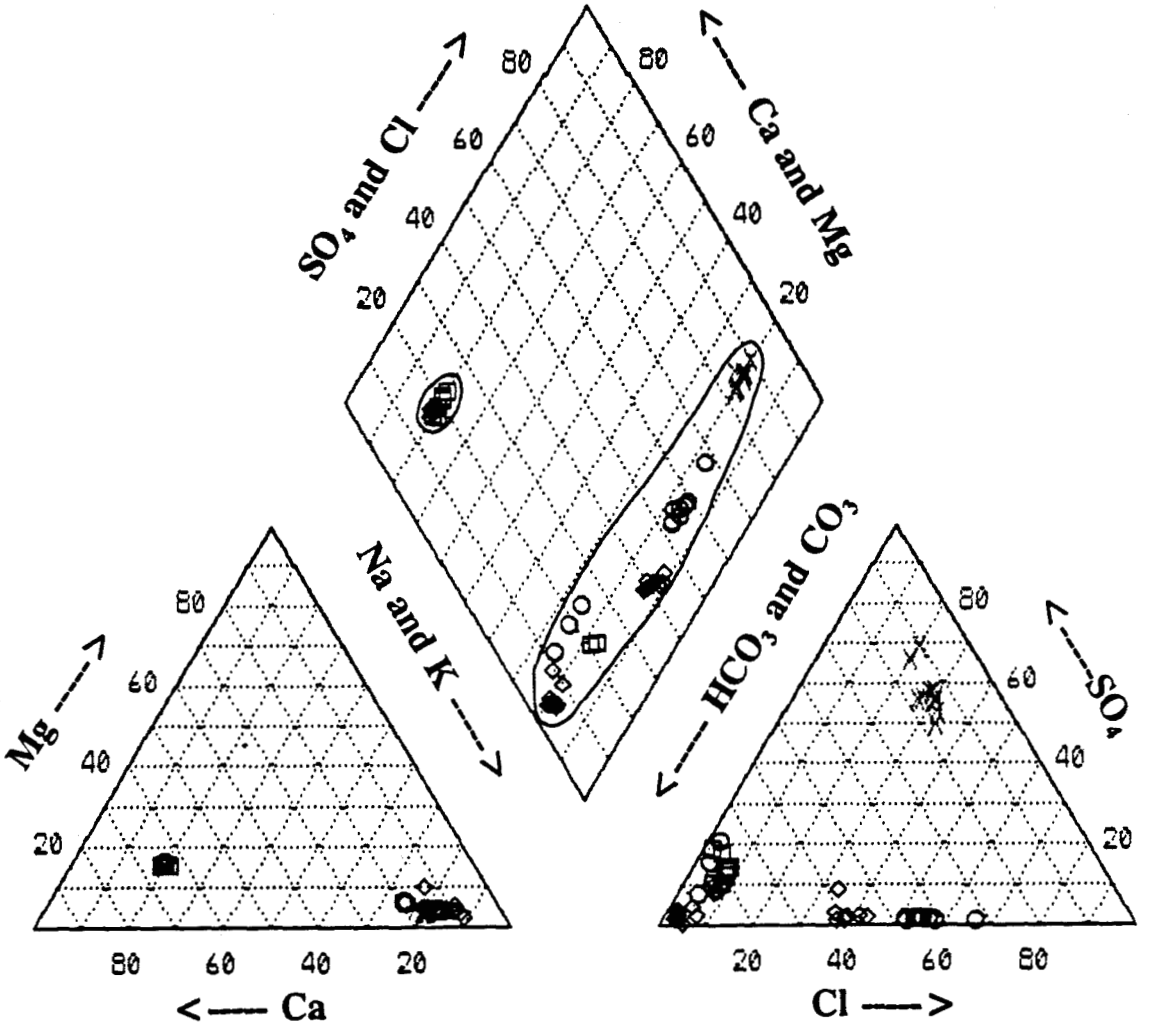
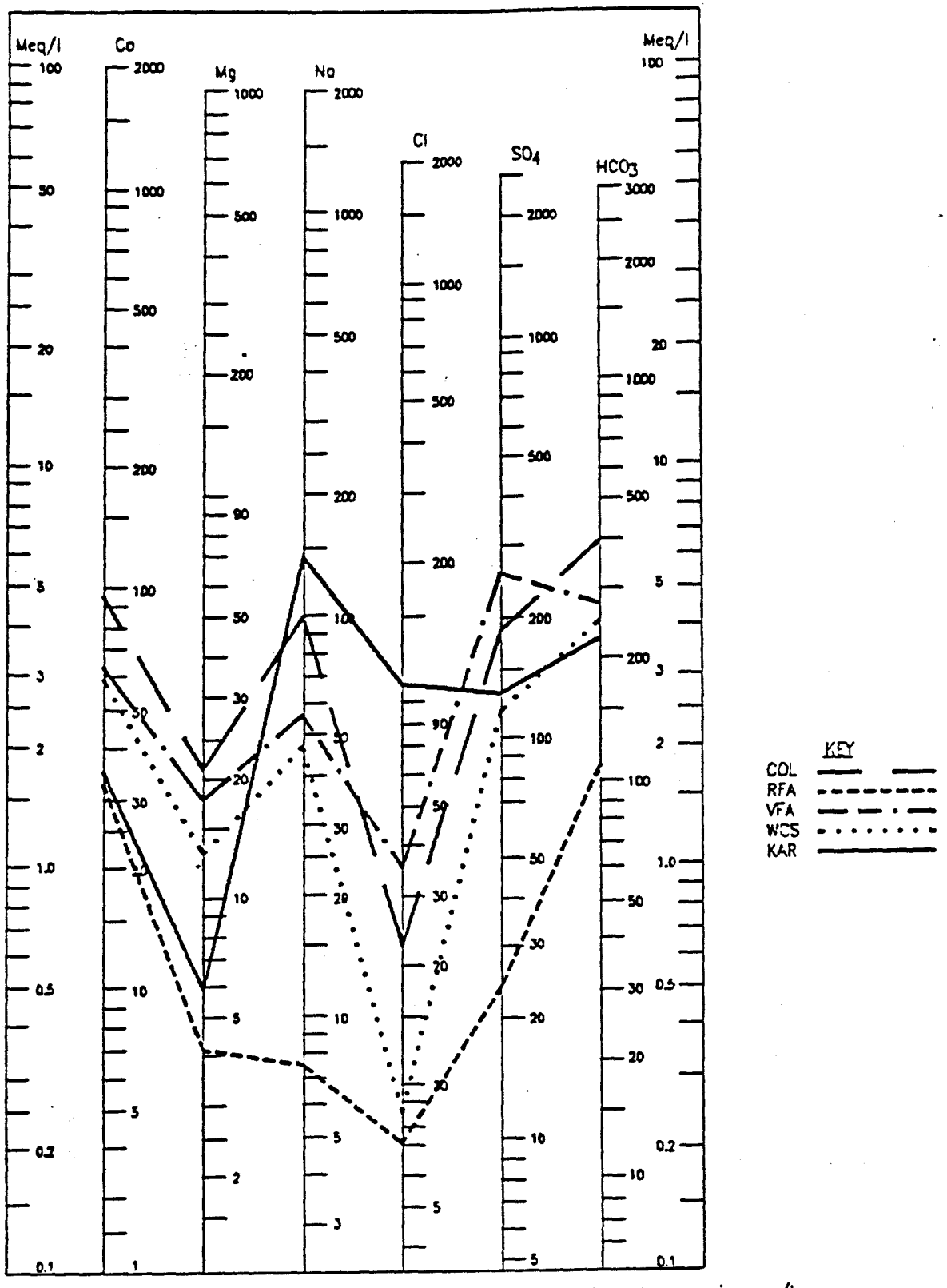


Figure 5-10. Piper diagram showing major-ion chemistry of groundwater from KAR. Concentrations of major ions (as meq/L) are given as percentages of the total milliequivalents per liter.



All constituent concentrations are reported in mg/l units, while the scales along the edges are in meq/l. The scale arrangement is adapted from Hem (1989).

U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	SCHOELLER DIAGRAM OF THE MEAN MAJOR ION CHEMISTRY IN BACKGROUND GROUNDWATER	FIGURE 5-11.

R69017.PJCW-092592

5.2.2.4 Other Chemical Diagrams

Variation diagrams of chemical components, such as Na + K vs. Ca + Mg, or scatterplots of ratios, such as SO_4^{2-}/Cl^- vs. (Na + K)/(Ca + Mg), may be useful in characterizing natural waters. In the case of RFP groundwater, a plot showing the relative proportions of univalent vs. divalent major cations clearly distinguishes the upper and lower flow-systems (Figure 5-12). The higher Na + K concentration in KAR, relative to that of the upper flow-system, may be because of cation-exchange processes, the age or residence time of the groundwater, or the precipitation of calcite, gypsum, or dolomite. In contrast, groundwater in WCS clearly groups with the other upper flow-system units by being low in Na + K relative to Ca + Mg. RFA is seen to be higher in Mg + Ca relative to Na + K, when compared to the other geologic units.

5.3 STREAM WATER

5.3.1 Statistics

Surface-water stations were sampled on a monthly basis during 1989, 1990, and 1991, then quarterly in 1992. Chemical data for surface waters were tested for significant differences in quarterly mean concentrations. Results of the quarterly comparisons are discussed in Section 5.7 under the topic of seasonality. Separate tables of background statistics were not produced for different quarters of sampling.

Surface-water samples were analyzed for dissolved and total metals, dissolved and total radiochemicals, CLP VOCs and SVOCs, pesticides, herbicides, and water-quality and field parameters.

5.3.2 Stream-Water Geochemistry

Stiff plots of the major-ion chemistry of surface water (Figure 5-13) show a low TDS water dominated by a calcium-bicarbonate composition. Likewise, the Piper plots (Figures 5-14 and 5-15) indicate the calcium-bicarbonate chemistry of the stream waters from both Rock and Woman

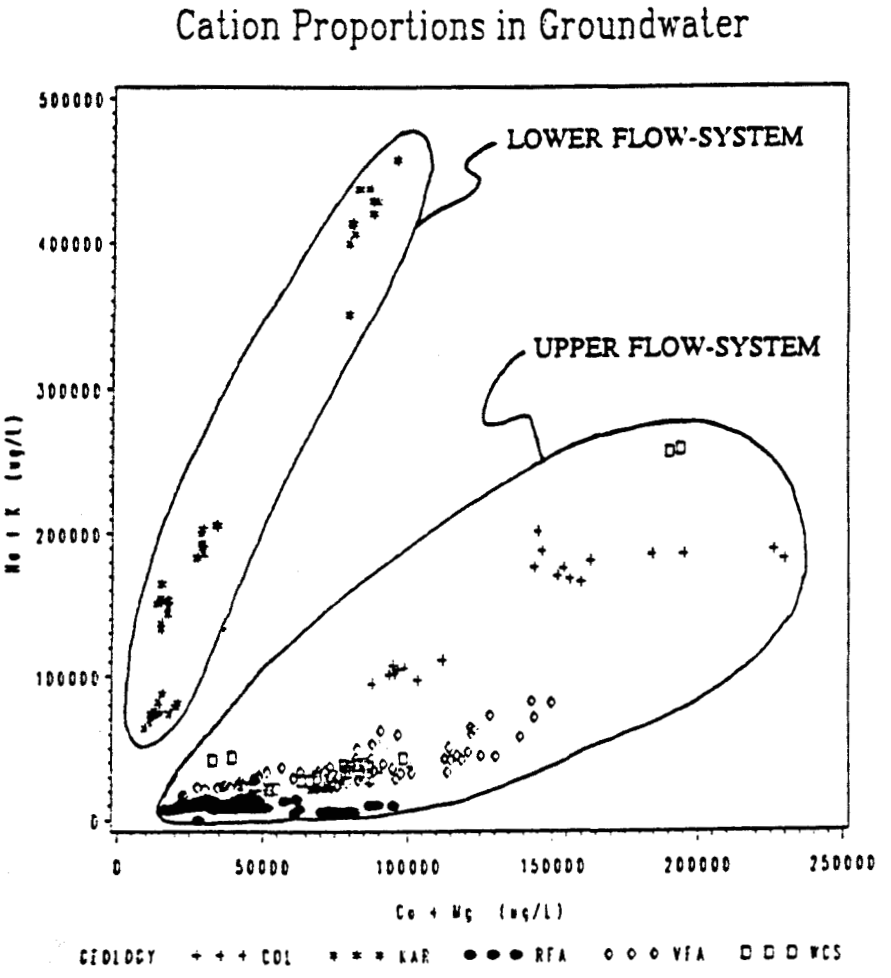


Figure 5-12. Comparison of cation proportions in groundwaters from the upper and lower flow-systems.

STREAM WATER

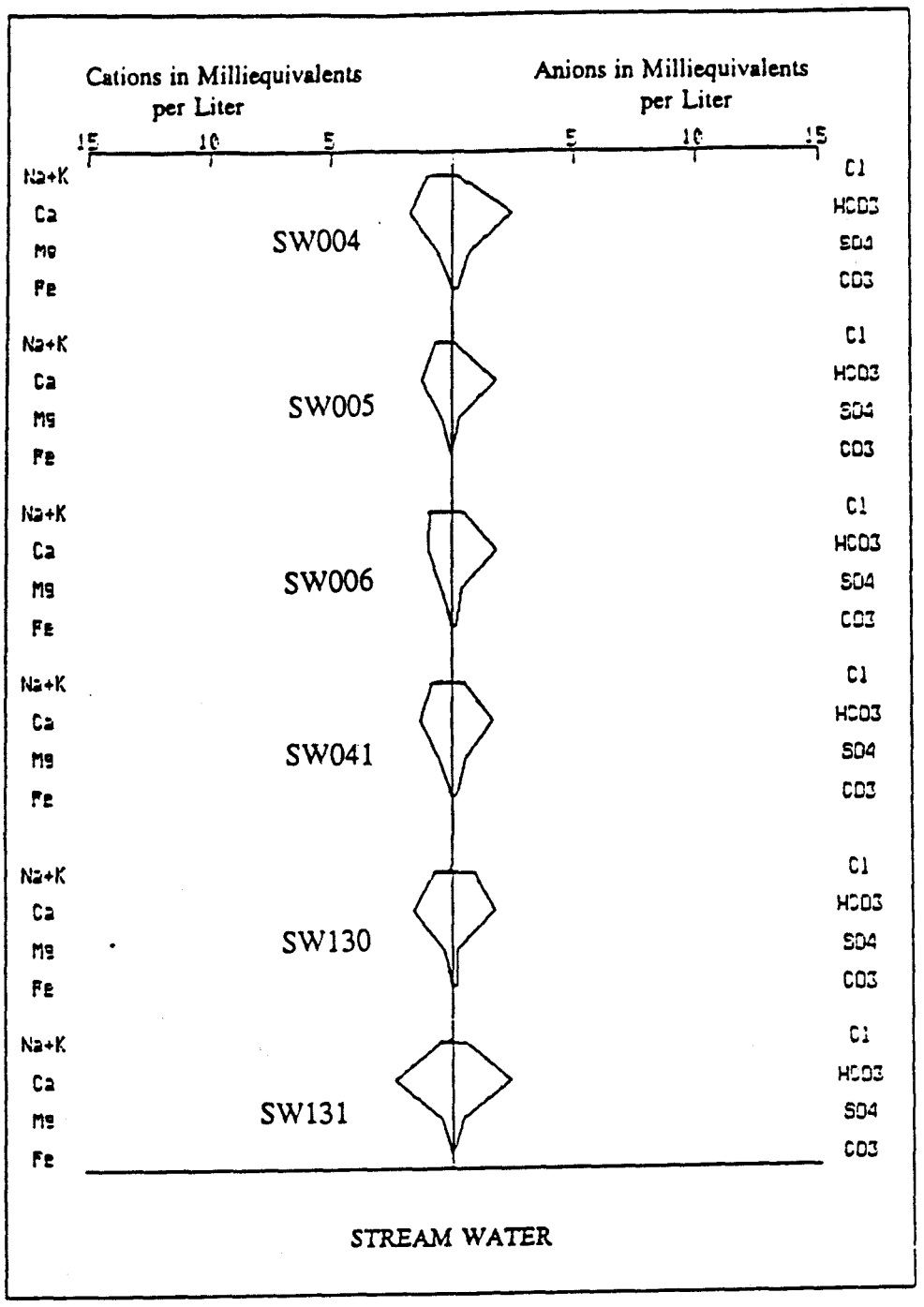


Figure 5-13. Stiff diagram showing typical chemistry of stream water from background sampling stations.

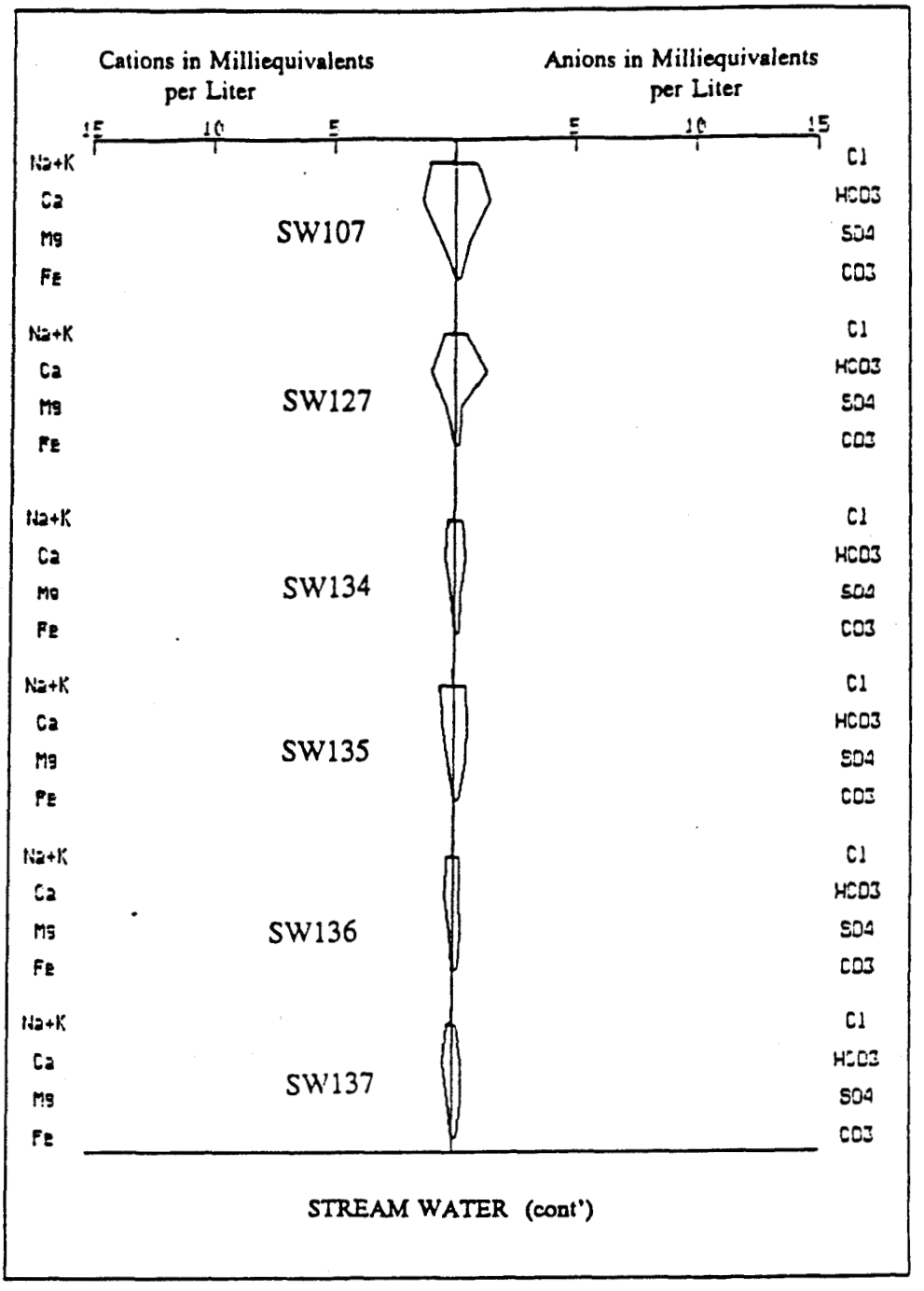


Figure 5-13 (cont').

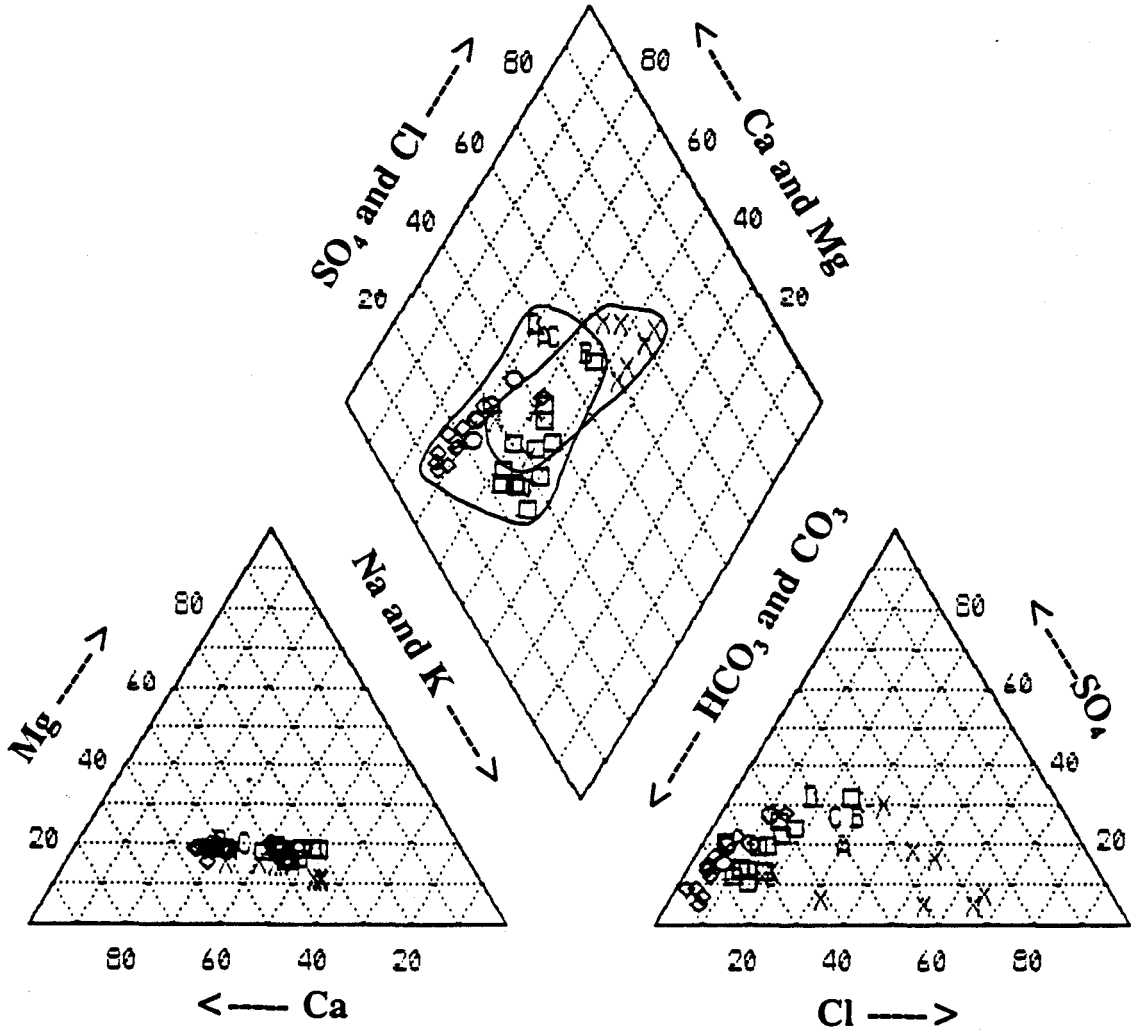


Figure 5-14. Piper diagram showing major-ion chemistry of stream water from Rock Creek. Concentrations of major ions (as meq/L) are given as percentages of the total milliequivalents per liter.

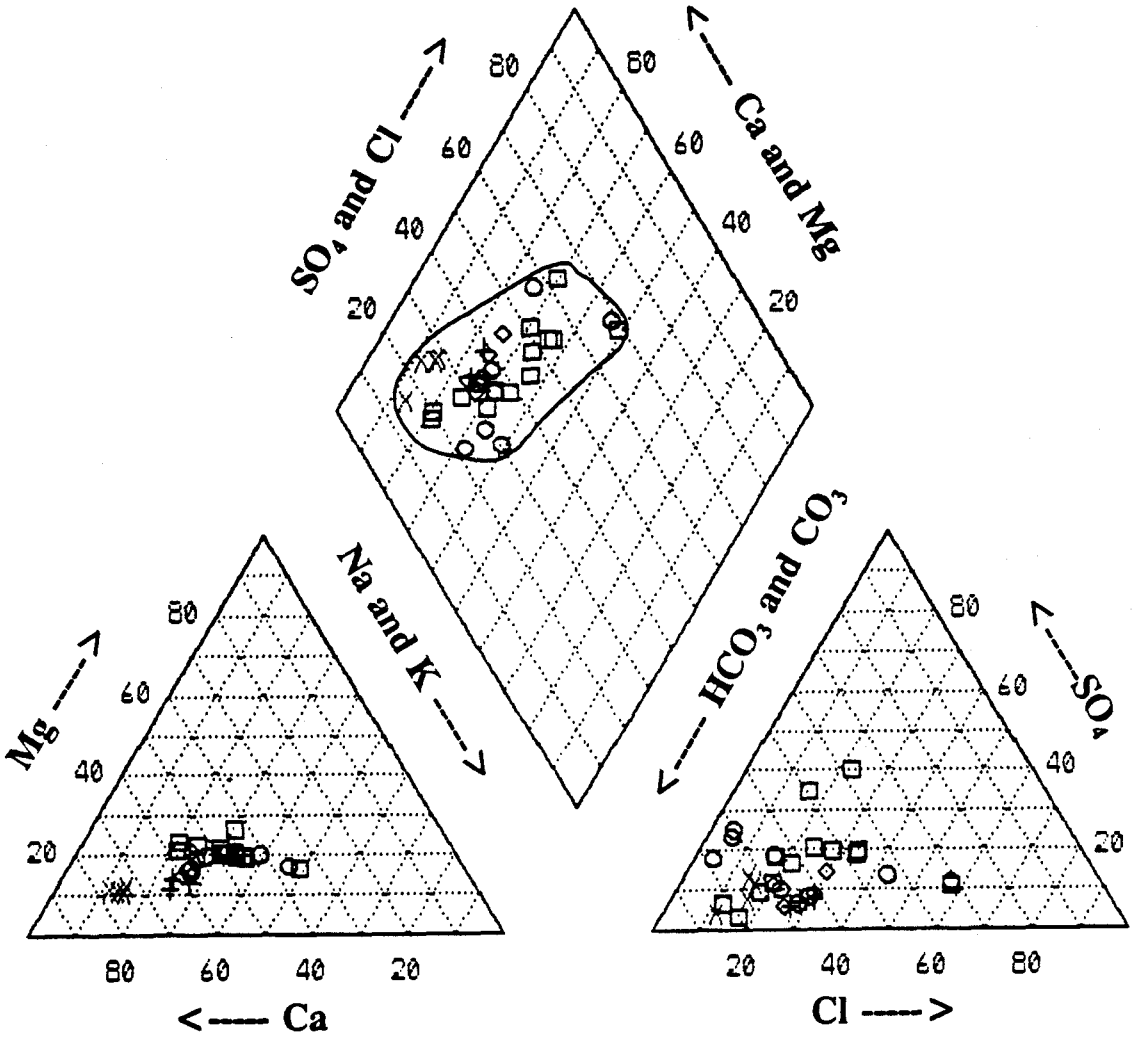


Figure 5-15. Piper diagram showing major-ion chemistry of stream water from Woman Creek. Concentrations of major ions (as meq/L) are given as percentages of the total milliequivalents per liter.

SEEP/SPRING WATER

Creeks. Site SW007 (shown as "X" on the Figure 5-14 diagram) is located along an irrigation ditch and tends to reflect a slightly different chemistry from the rest of the stream-water samples. Also, the Piper diagram for water-quality data from Rock Creek (Figure 5-14), when compared with the corresponding Piper plot for Woman Creek (Figure 5-15), shows that the group of Rock Creek data points is offset slightly towards higher concentrations of Na and lower concentrations of Ca than those of Woman Creek.

A Schoeller diagram for three sampling locations on Rock Creek (solid lines) and three locations on Woman Creek (dashed lines) shows that creek waters are similar in their concentrations of Ca, Mg, Na, SO_4^{2-}, and HCO_3^- (Figure 5-16). However, all three Woman Creek locations are visibly higher in Cl^- concentration (about 20 mg/L) than the Rock Creek stations (about 10 mg/L).

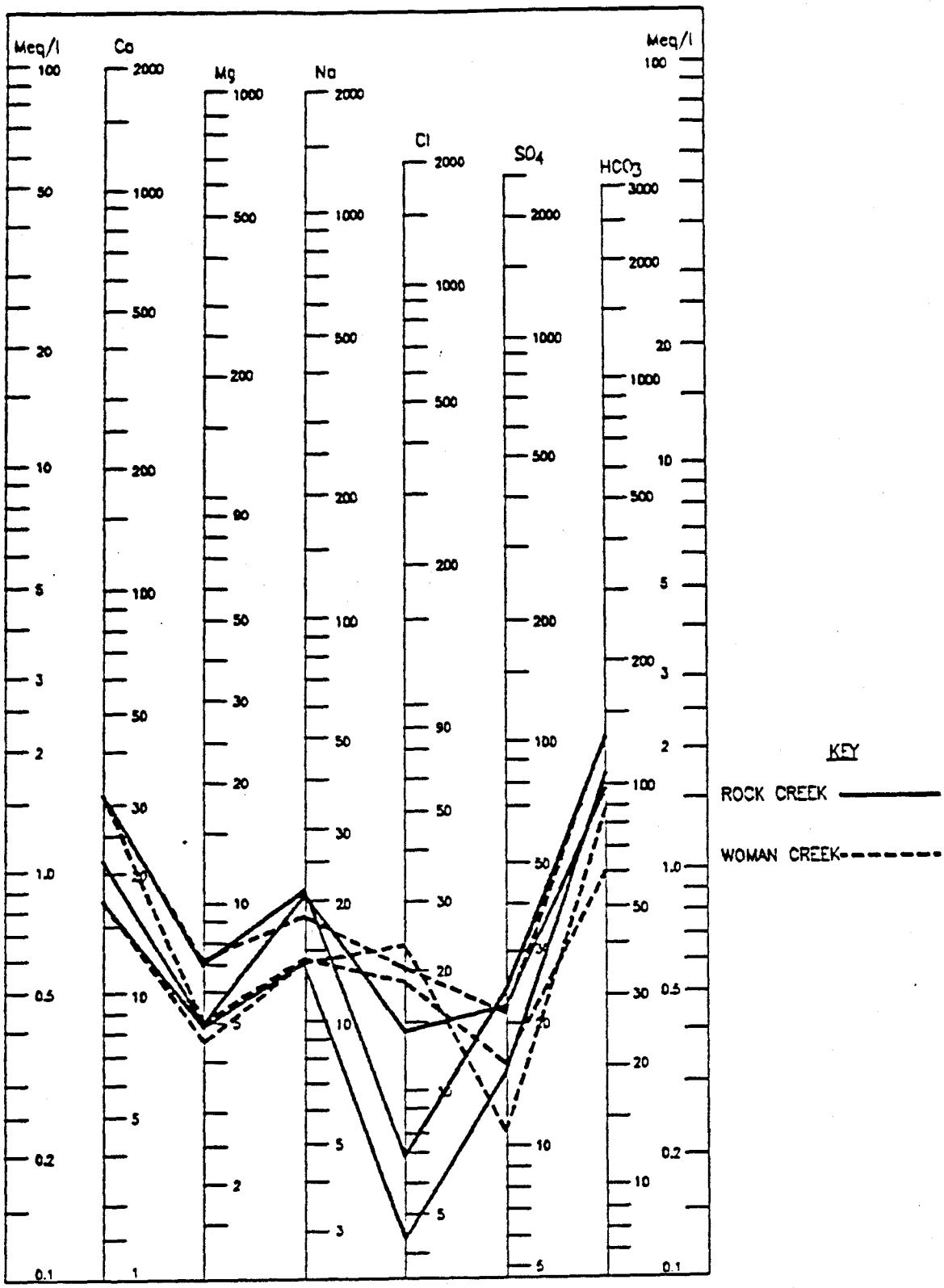
The cation sums of Na + K vs. Ca + Mg were plotted for background stream waters (Figure 5-17). Although the water chemistry from Woman Creek (square symbol) and Rock Creek (plus symbol) is not well distinguished in the plot, Woman Creek generally had a lower Na + K relative to Ca + Mg than did Rock Creek.

Review comments on the December 21, 1990, *Background Geochemical Characterization Report* suggested comparing tritium activities in surface water with tritium in nearby stream sediment. This has been done by plotting tritium in Rock and Woman Creek surface water against tritium in associated stream sediments (Figure 5-18). The sediment and water data were merged by adjacent sample locations, year, and quarter of sampling. This was necessary because the two media are infrequently sampled on the same day at a given location. The tritium activities in water and sediment are of similar magnitude, but there is no obvious trend in Figure 5-18.

5.4 SEEP/SPRING WATER

5.4.1 Statistics

Seep/spring-water stations were sampled as part of the surface-water sampling program on a monthly basis from 1989 through 1991, and quarterly in 1992. Responding to discussions with EPA and CDH in 1991, the chemistry of seep/spring waters, stream waters, and groundwaters



All constituent concentrations are reported in mg/l units, while the scales along the edges are in meq/l. The scale arrangement is adapted from Hem (1989).

U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	SCHOELLER DIAGRAM OF THE MEAN MAJOR ION CHEMISTRY IN ROCK AND WOMAN CREEKS	FIGURE 5-16.

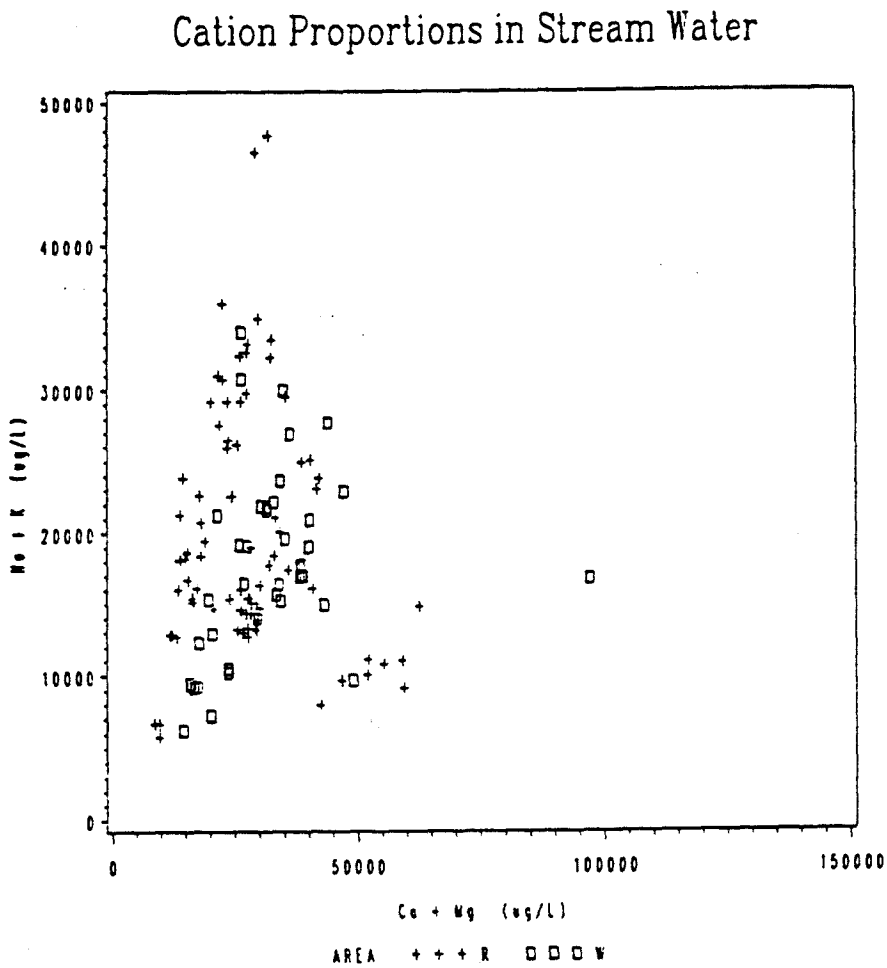


Figure 5-17. Comparison of cation proportions in stream water from the Rock Creek and Woman Creek drainages. Woman Creek data shown as squares, Rock Creek data shown as plus signs.

TRITIUM IN SURFACE WATER vs. TRITIUM IN SURFACE SEDIMENT

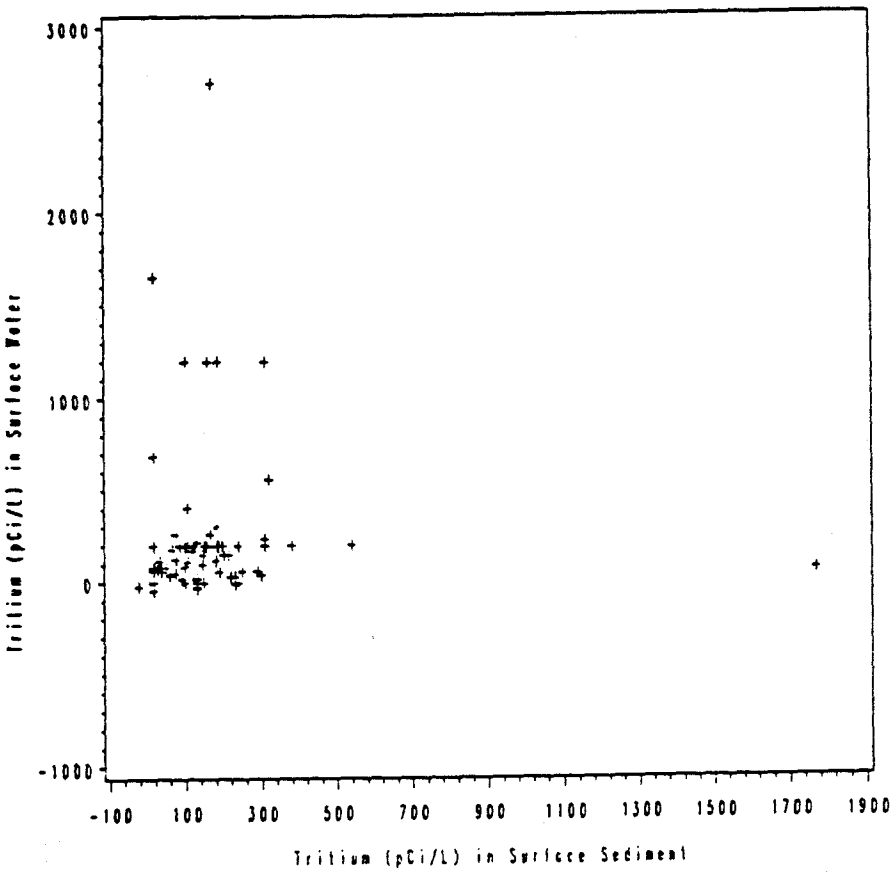


Figure 5-18. Comparison of tritium in stream water with tritium in the interstitial waters of stream sediments.

STREAM SEDIMENTS AND SEEP/SPRING SEDIMENTS

were examined separately in statistical and geochemical analyses. Data on seep/spring-water chemistry were tested in nonparametric ANOVA for significant differences in geochemistry between seasons (see Section 5.7). Summary statistics for background seep/spring waters are reported in tables by analyte group (Appendix D).

5.4.2 Geochemistry of Seep/Spring Water

In general, the chemistry of seep/spring water is similar to that of the units of the upper hydrostratigraphic unit (compare Figures 5-1 and 5-19). Seep/spring waters contain a relatively greater proportion of Ca than most of the stream water sampled for this study (compare Figures 5-14 and 5-20). Relative to all other seep/spring stations, SW108 had elevated SO_4^{2-} values and exhibited the greatest range of variability in the relative proportions of both cations and anions (Figure 5-20). Station SW108 is located at a small pond formed by seep flow from the south hillside of Rock Creek, and probably reflects emerging COL groundwater, which contains concentrations of SO_4^{2-} higher than those of either RFA or VFA groundwater.

5.5 STREAM SEDIMENTS AND SEEP/SPRING SEDIMENTS

5.5.1 Statistics for Stream Sediments

Stream sediments were sampled twice in 1989, and quarterly during 1990, 1991, and 1992. None of the sediments were tested for seasonality because it was assumed that solid phases would not be susceptible to seasonal turnover, as might be the case for aqueous media.

The geochemistry of stream sediments is described by summary statistics in Appendix D. Upper tolerance limits are presented in Appendix C.

5.5.2 Statistics for Seep/Spring Sediments

The few seep/spring-sediment locations were treated as a single statistical population for computing tolerance limits, and descriptive statistics are presented in Appendices C and D. Seasonality and lithologic unit do not apply to seep/spring sediments.

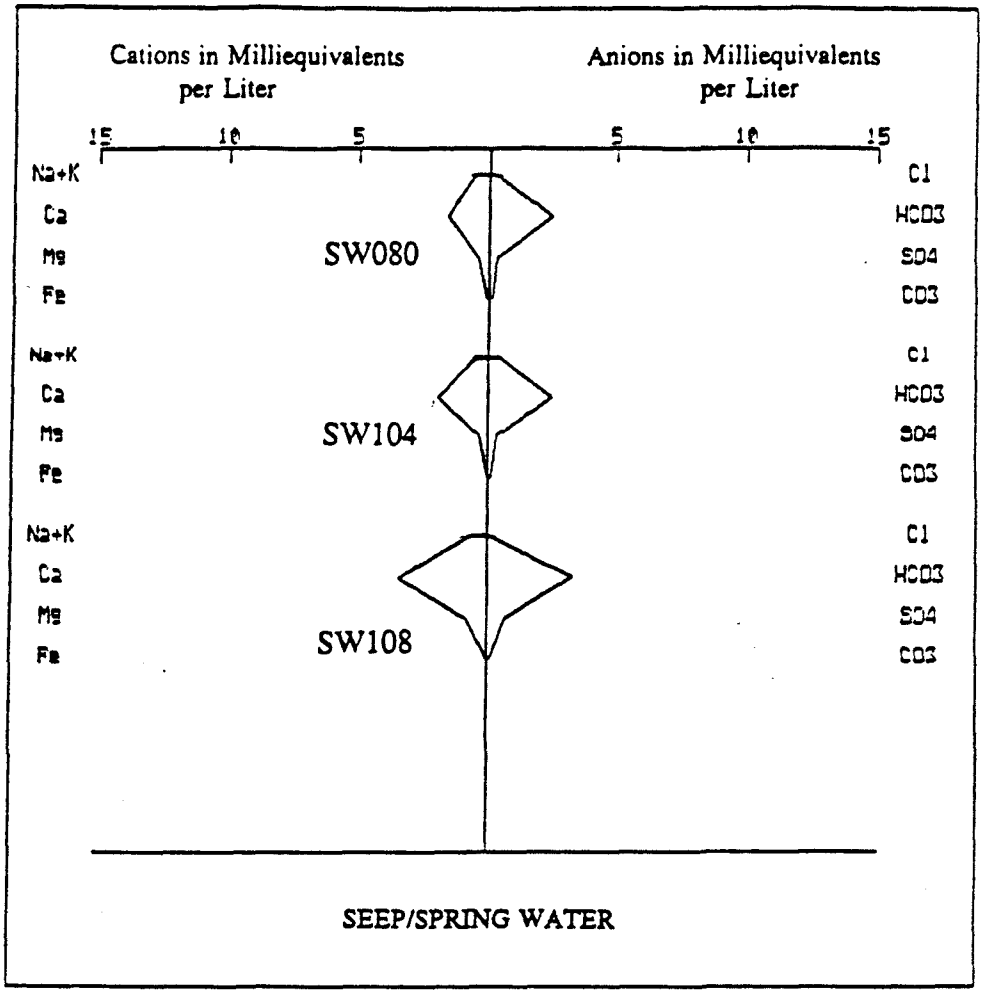


Figure 5-19. Stiff diagram showing typical chemistry of seep/spring water from background sampling stations.

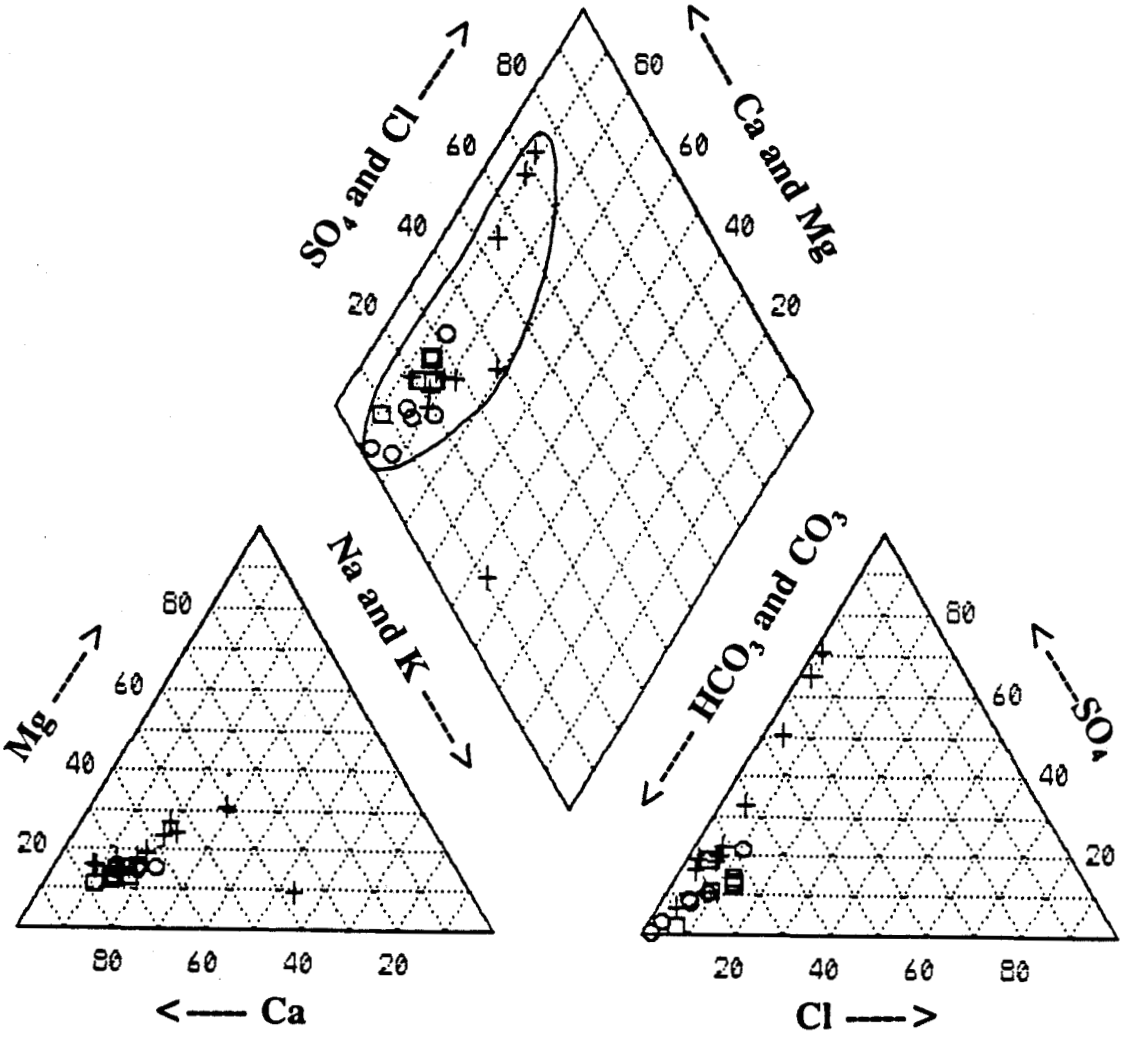


Figure 5-20. Piper diagram showing major-ion chemistry of seep/spring water. Concentrations of major ions (as meq/L) are given as percentages of the total milliequivalents per liter.

GEOLOGIC MATERIALS

5.6 GEOLOGIC MATERIALS

5.6.1 Statistical Results for Geologic (Borehole) Materials

Samples of geologic material were collected in 1989 from boreholes drilled into RFA, COL, WCS, and KAR. No data exist for VFA. Tolerance limits, percent detects, maximum and minimum values, and other summary statistics were computed for each component in samples for each lithological unit with a distinctive mean concentration. In addition to geologic unit, data were examined for differences in mean concentrations between flow-systems (i.e., RFA + COL + WCS as upper vs. KAR as lower). Geologic materials were not examined for seasonality.

5.6.1.1 Total Metals in Geologic (Borehole) Materials

Seven metals were evaluated by parametric ANOVA; As, Ba, Cu, Fe, Mg, Ni, and V. Of these metals, only Ba, Mg, and V showed any significant differences between the geologic units. The concentration of Ba was significantly different between COL and WCS, and COL and RFA; Mg was different between COL and RFA; V was different between COL and KAR (Appendix B, Table B-10).

Ten metals were tested by nonparametric ANOVA. Of these, Al, Cd, Ca, Cs, Pb, and Zn showed some significant differences between lithologies. Beryllium and Mn showed no significant differences (Appendix B, Table B-11).

Seventeen metals were compared by flow-system using tandem testing (T-test and Wilcoxon Rank-Sum test). Nine of these metals showed no significant differences between the two flow-systems; Al, Cr, Pb, V, and Zn were determined to be significantly different by both tests (Appendix B, Table B-12).

5.6.1.2 Total Radionuclides in Geologic (Borehole) Materials

Four radionuclides met the conditions for testing by parametric ANOVA; gross alpha, ^{228}Ra, ^{89,90}Sr, and T were lognormally distributed. Table B-10 of Appendix B shows that tritium, gross alpha,

SEASONALITY

and ^{228}Ra exhibited significant differences between geologic units. The mean activity of gross alpha was significantly different between COL and RFA, COL and WCS, and KAR and WCS. For tritium, the mean activity was significantly different between COL and RFA, and KAR and RFA. Radium-228 showed significant differences between COL and KAR, and COL and RFA.

Nine radionuclide species were tested by nonparametric ANOVA. No significant differences among the four geologic units (no samples were taken from VFA) were shown for ^{241}Am, ^{137}Cs, and $^{239,240}Pu$. Five species (gross beta, total U, $^{233,234}U$, ^{235}U, and ^{238}U) had either one or two significant differences out of the six possible pairwise comparisons. Radium-226 showed significant differences for COL and WCS, COL and RFA, KAR and WCS, and KAR and RFA (Appendix B, Table B-13).

Of the 10 radionuclides compared by flow-system, ^{137}Cs, gross beta, $^{239,240}Pu$, ^{228}Ra, and ^{235}U were determined to have significantly different activities between the two flow-systems (Appendix B, Table B-14).

5.6.1.3 Total Water-Quality Parameters in Geologic Materials

Only laboratory-measured pH for geologic materials was tested in nonparametric ANOVA; it differs between COL and WCS, COL and RFA, and WCS and RFA (see lower part of Table B-11, Appendix B). Data were insufficient to test other "water-quality" parameters by geologic unit.

When compared by flow-system, only pH qualified for ANOVA; pH showed a significant difference between the upper and lower flow-systems (see lower part of Table B-12, Appendix B).

5.7 SEASONALITY IN THE NATURAL WATERS OF THE ROCKY FLATS PLANT

Samples of natural waters collected from background areas of the RFP were tested for seasonality in their chemical composition (Table 5-1). This testing was performed using nonparametric ANOVA to compare the mean concentrations (or activities) of chemicals by the quarters of the year in which the samples were collected.

Table 5-1. Summary of seasonality testing.

SUMMARY OF SEASONALITY TESTING BY NONPARAMETRIC ANOVA

	QUARTERS COMPARED					
	1 2	1 3	1 4	2 3	2 4	3 4
GROUNDWATER						
Number analytes same =	376	324	338	340	352	382
Number analytes different =	13	65	49	47	37	7
Percent same by quarters =	97%	83%	87%	88%	90%	98%
OVERALL PERCENT SAME IN GROUNDWATER = 91%						
STREAM WATER						
Number analytes same =	81	85	83	83	79	88
Number analytes different =	11	7	9	9	13	4
Percent same by quarters =	88%	92%	90%	90%	86%	96%
OVERALL PERCENT SAME IN STREAM WATER = 90%						
SEEP / SPRING WATER						
Number analytes same =	89	90	90	89	87	88
Number analytes different =	1	0	0	1	3	2
Percent same by quarters =	99%	100%	100%	99%	97%	98%
OVERALL PERCENT SAME IN SEEP / SPRING WATER = 99%						

The data presented in Table 5-1 represent analysis of all analytes drawn from all chemical groups. For example, data were included for dissolved metals and for total radiochemicals, as well as other groupings of chemical data. Thus, major ions, trace elements, and radiochemicals, from both dissolved and unfiltered sample treatments were included in the seasonality analysis. The data were collected across a time span of four years of sampling and analysis.

5.7.1 Seasonality in Groundwater

On average, 91 percent of analytes in groundwater had no significant differences between their quarterly concentrations (Table 5-1). The percentage differences ranged from a high of 17 percent for a comparison of quarters one and three, to a low of 2 percent for quarters three and four. The nine percent of analytes that were different seemed to be evenly distributed across all four quarters of the year (Table 5-1).

5.7.1.1 Seasonality for Dissolved Metals in Groundwater

Only Ni and Ag in dissolved metals showed significant differences for groundwater from all geologic units; mean concentrations of these two dissolved metals were significantly different between quarters one and three, and quarters one and four. Three out of five of the geologic units showed significant differences for Cu, Cr, and Mo between quarters one and three; for Tl and V for quarters two and three; and for V only for quarters two and four. In summary, there is little indication of systematic seasonal variations in analyte concentrations in groundwater at the RFP; certainly insufficient and too random to warrant the application of seasonal corrections.

5.7.1.2 Seasonality for Total Metals in Groundwater

Only Cs, Ni, and cyanide showed significant differences between quarters for groundwater from all geologic units; Cs and Ni varied between quarters one and three; Ni between quarters one and four; and cyanide between quarters two and three, and quarters two and four. Three out of five of the geologic units showed significant quarterly differences for Sb, Mo, Ni, and Ag (quarters one and three); Cs, cyanide, and Ag (quarters two and three); Cr, Ni, and Ag (quarters one and four); and cyanide, Ni, Se, and Ag (quarters two and four).

5.7.1.3 Seasonality for Dissolved Radionuclides in Groundwater

No dissolved radionuclides were significantly different between quarters for more than one geologic unit, with the exception of $^{89,90}Sr$, which was significantly different between quarters two and four in RFA and VFA groundwater. All together, out of 132 possible comparisons (7 to 8 species times 6 quarterly pairwise comparisons), only in 7 cases were significant differences noted.

5.7.1.4 Seasonality in Total Radionuclides in Groundwater

There were no significant differences in mean concentration between quarters for any radionuclide species in unfiltered groundwater for any of the five geologic units.

5.7.1.5 Seasonality in Water-Quality Parameters in Groundwater

There were no analytes in this group that showed a significant difference between quarters for more than only one geologic unit (either RFA or VFA only). Carbonate, SiO_2, cyanide, and PO_4 were noted as significantly different in either RFA or VFA, but not both.

5.7.2 Seasonality in Stream Water

Similar to total groundwater, 90 percent of the analytes measured in stream waters from Rock Creek and Woman Creek had no significant differences in quarterly mean concentrations (Table 5-1). The 10 percent of analytes that were different seemed to be evenly distributed across all four quarters of the year.

5.7.2.1 Seasonality for Dissolved Metals in Stream Water

Significant quarterly differences for Al were shown between quarters one and three, quarters one and four, and quarters two and four, whereas Na showed differences between quarters two and three, and quarters two and four; Fe showed differences between quarters one and four, and quarters three and four; and Ba and Sr showed differences between quarters one and two, and

quarters two and four. Four other metals (Sb, Ca, Mg, and Se) showed significant differences in only one case. The remaining 20 metals showed no significant seasonal differences.

5.7.2.2 Seasonality for Total Metals in Stream Water

Of the 29 metals, only Al, Ba, Ca, Mn, K, Na, and V showed any significant differences in mean concentration between quarters. And of these seven, only Al was significantly different between two quarterly comparisons; the other six metals differed in only one comparison.

5.7.2.3 Seasonality for Dissolved Radionuclides in Stream Water

Of seven dissolved radionuclide species, only three showed any significant differences between quarters. A difference was shown for $^{89,90}Sr$ between quarters one and two, and quarters one and four; ^{235}U showed different mean concentrations between quarters one and three, quarters two and four, and quarters three and four; ^{238}U was different between quarters one and four, and quarters three and four.

5.7.2.4 Seasonality for Total Radionuclides in Stream Water

Of the ten radionuclide species analyzed for unfiltered stream water, only four showed any significant differences between quarters of the year. One or more quarterly differences were shown for ^{241}Am, gross alpha, $^{239,240}Pu$, and $^{233,234}U$, for a total of 6 significant differences out of 60 possible for all radionuclide species in stream water.

5.7.2.5 Seasonality for Water-Quality Parameters in Stream Water

Out of 16 water-quality parameters, 7 showed at least one significant difference between quarters. Orthophosphate, and oil and grease, were different for quarters one and two, quarters two and three, and quarters two and four; dissolved organic carbon was different for quarters one and three, and quarters one and four; SO_4^{2-} showed differences between quarters one and three, and two and three; cyanide was different between quarters one and two; and TDS showed a significant difference between quarters two and three.

5.7.3 Seasonality in Seep/Spring Water

Ninety-nine percent of the analytes measured in background seep/spring waters from the RFP had no significant differences in quarterly mean concentrations (Table 5-1). The quarterly differences were evenly spread across all six pairwise comparisons of quarters for the analytes that did show differences in means.

5.7.3.1 Seasonality for Dissolved Metals in Seep/Spring Water

Only three out of 29 metals showed significant quarterly differences; Cr, Tl, and Co were different between quarters two and four, quarters two and three, quarters one and two, and quarters two and four, respectively. Sample sizes for each analyte in seep/spring water were smaller than for other aqueous media and ranged from 11 to 50 analyses per metal analyte.

5.7.3.2 Seasonality for Total Metals in Seep/Spring Water

Only one metal out of 29 showed any significant difference in mean concentration between quarters. Chromium was determined to be different between quarters three and four.

5.7.3.3 Seasonality for Dissolved Radionuclides in Seep/Spring Water

No seasonal differences were indicated for radionuclide species in dissolved samples of seep/spring water.

5.7.3.4 Seasonality for Total Radionuclides in Seep/Spring Water

Of 11 species of radionuclides in unfiltered seep/spring water, only tritium showed a significance difference in mean activity by quarter of the year. Tritium activities were different between quarters two and four.

5.7.3.5 Seasonality for Water-Quality Parameters in Seep/Spring Water

TSS showed a significant difference between quarters three and four. No other water-quality parameters showed any seasonal effects.

5.7.4 Overall Seasonality in Aqueous Media

The overall conclusion from this comparison of quarterly means is that **no systematic seasonal variations are apparent in the mean concentrations of dissolved or total chemicals analyzed for this study of background groundwater and surface water from the RFP.** It is therefore unnecessary to make any corrections in concentration (or activity) for seasonal variability.

5.8 DISTINGUISHING BACKGROUND URANIUM FROM CONTAMINATION

Mineral deposits of uranium have been described for sedimentary rocks east of the Colorado Front Range, and vein-type uranium (e.g., that of the Schwartzwalder Mine) is found in Precambrian rocks within a few miles of the RFP. Because the major uranium isotopes found at the Plant (^{238}U, ^{235}U, ^{234}U) also occur naturally in the local environment, there is considerable interest in methods of distinguishing the naturally occurring background uranium from potential uranium contamination from the RFP.

The activity ratios of uranium isotopes may offer a means of distinguishing potential uranium contamination from natural background uranium. The specific activities of the uranium isotopes differ widely from about 6.2E-3 Ci/g for ^{234}U to only 3.4E-7 Ci/g for ^{238}U. Multiplying the specific activity by the fractional abundance of an isotope yields the "relative activity." Because there are considerable differences in the isotopic abundances of natural, enriched, and depleted uranium, the ratios of the relative activities may be able to differentiate the uranium source, or sources.

The isotopic abundances in typical depleted uranium are 99.75 percent ^{238}U, 0.25 percent ^{235}U, and 0.0005 percent ^{234}U. Natural uranium consists of 99.2739 percent ^{238}U, 0.7204 percent ^{235}U, and 0.0057 percent ^{234}U (EG&G, 1988). Enriched uranium for nuclear power reactors contains about 97 percent ^{238}U, 3 percent ^{235}U, and 0.03 percent ^{234}U, and greater proportions of ^{235}U and ^{234}U enrichment may be found in some nuclear weapons components (EG&G, 1988).

Considering relative activities, ^{234}U contributes about 97 percent of the alpha activity in fully enriched uranium, whereas ^{238}U contributes about 76 percent of the alpha activity in fully depleted uranium (EG&G, 1988). Therefore, ^{234}U and ^{238}U are key isotopes for distinguishing uranium sources. Calculations by the authors indicate that the ratios of relative activities of ^{234}U to ^{238}U are approximately 0.09 in depleted uranium, 1.06 in natural uranium, 5.74 in power-reactor fuel, and a higher ratio for weapons components. Thus, the activity ratio of $^{234}U/^{238}U$ may be useful for separating natural background uranium from potential uranium contamination at the RFP.

The activity ratio $(^{233}U + ^{234}U)/^{238}U$ was computed for dissolved samples of background surface water and groundwater collected in 1989, 1990, 1991, and 1992 (^{233}U is analyzed together with ^{234}U; however, ^{233}U is not a naturally occurring isotope of uranium). Average ratios were computed for surface water from Rock Creek and Woman Creek, and for groundwater from each of the five lithologic units (RFA, VFA, COL, WCS and KAR).

Stream water has a mean activity ratio of 1.30. RFA groundwater has a mean ratio of 1.64; VFA groundwater has a mean ratio of 1.23; COL groundwater has a mean ratio of 1.19; WCS groundwater has a mean ratio of 2.43; and KAR groundwater has a mean ratio of 2.13. All of these mean ratios are close to the 1.06 ratio predicted for natural uranium. In fact, these data are typical of the $^{234}U/^{238}U$ ratios for uranium in natural waters. The ratio usually ranges between one and three; the higher activity of ^{234}U in water apparently resulting from selective mobilization by alpha recoil (Hess *et al.*, 1985).

Activity ratios of (^{233}U + ^{234}U)/^{238}U were also computed for radionuclide analyses of samples of background stream sediments collected in 1989, 1990, 1991, and 1992. Samples of stream sediments had a mean activity ratio of 1.2. These results indicate that the uranium in the background sediment samples is naturally occurring (i.e., the isotopic ratio is approximately 1.06, that of natural uranium).

The activity ratio data for $^{233,234}U/^{238}U$ from downgradient sampling locations could be contoured on isopleth maps to look for spatial trends in the ratios that might indicate potential contamination from depleted uranium or, less probably, from enriched uranium in various environmental media. Only depleted uranium is known to have been disposed of at the RFP. Any potential contamination from depleted uranium would act to lower the activity ratios from near unity towards 0.1. Elevated concentrations of uranium in surface soils at OU-1 have been shown to represent depleted uranium contamination. The ^{233}U, $^{234}U/^{238}U$ activity ratios at OU-1 ranged from 0.018 to 0.038 (EG&G, 1992d).

REFERENCES

REFERENCES

ASTM (American Society of Testing Materials), 1975. *Standard Recommended Practice for Dealing with Outlying Observations.* E178.

Cohen, A.C. Jr., 1961. Tables for Maximum Likelihood Estimates: Singly Truncated and Singly Censored Samples. *Technometrics* **3**, 535—541.

Conover, W.J., 1980. *Practical Nonparametric Statistics*, John Wiley & Sons, 483 pp.

Doctor, P.G., R.O. Gilbert, and R.R. Kinnison, 1986. *Ground Water Monitoring Plans and Statistical Procedures to Detect Leaking at Hazardous Waste Facilities.* Draft Report for U.S. Environmental Protection Agency, Pacific Northwest Laboratory, Richland, Washington.

DOE (U.S. Department of Energy), 1980. *Final Environmental Impact Statement: Rocky Flats Plant Site, Golden, Jefferson County, Colorado*, Vols. 1, 2, and 3. U.S. Department of Energy Report, Washington, D.C. DOE/EIS-0064.

EG&G, 1988. *Health Physics Manual of Good Practices for Uranium Facilities.* EG&G, NTIS DE88-013620.

EG&G, 1990a. *Draft Geologic Characterization Report for U.S. DOE Rocky Flats Plant.* EG&G, January 1990.

EG&G, 1990b. *Background Geochemical Characterization Report for 1989, Rocky Flats Plant, Golden, Colorado.* EG&G, December 1990.

EG&G, 1990c. *Site-Wide Quality Assurance Project Plan for CERCLA RI/FS Activities.* EG&G, August 1990.

EG&G, 1990d. *Draft Task 3 Shallow High-Resolution Seismic Reflection Profiling in the Medium Priority Sites (Operable Unit No. 2) at the Rocky Flats Plant.* EG&G.

EG&G, 1991a. *EMD Operating Procedure Manual, Rocky Flats Plant, Vols. I—IV.* EG&G, 5-21000-OPS.

EG&G, 1991b. *Geologic Characterization, Rocky Flats Plant, Golden, Colorado.* EG&G, July 31, 1991.

EG&G, 1991c. *Final Ground Water Protection and Monitoring Program Plan.* EG&G.

EG&G, 1991d. *Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA RI/FS and RFI/CMS Activities.* EG&G, May 7, 1991.

EG&G, 1991e. *General Radiochemistry and Routine Analytical Services Protocol.* EG&G.

EG&G, 1992a. *Phase II Geologic Characterization Data Acquisition, Task VI, Geologic Mapping of the Rocky Flats Plant and Vicinity, Jefferson and Boulder Counties, Colorado.* EG&G.

EG&G, 1992b. *Background Geochemical Characterization Plan, Rocky Flats Plant, Golden, Colorado.* EG&G, September 30, 1992.

EG&G, 1992c. *Rocky Flats Plant Environmental Management Division Operating Procedures Manual, Vol. IV: Surface Water.* EG&G, 5-2100-OPS-SW, May 22, 1992.

EG&G, 1992d. *Technical Memorandum 5, Addendum to Final Phase III RFI/RI Work Plan, Surface Soil Sampling and Analysis Plan, Rocky Flats Plant, 881 Hillside Area.* EG&G.

EG&G, 1993. *Palynology of the Uppermost Laramie and Arapahoe Formations at the Rocky Flats Plant near Golden, Colorado.* EG&G, ER Program Report, April 30, 1993.

EG&G Energy Measurements, 1982. An Aerial Radiological Survey of the United States Department of Energy's Rocky Flats Plant. Date of survey: August 1981. EG&G, EGG-1183-1771.

EG&G Energy Measurements, 1990. An Aerial Radiological Survey of the United States Department of Energy's Rocky Flats Plant and Surrounding Area. Date of survey: July 1989. EG&G, EGG-10617-1044.

EPA (U.S. Environmental Protection Agency), 1987. *Data Quality Objectives for Remedial Response Activities.* EPA 154-IG-8710003, OSWER Directive 9355.0-7B. March 1987.

EPA (U.S. Environmental Protection Agency), 1988a. *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses.* Prepared by EPA's Data Review Work Group for EPA's Hazardous Site Evaluation Division. EPA, February 1988.

EPA (U.S. Environmental Protection Agency), 1988b. *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses.* Prepared by EPA's Data Review Work Group for EPA's Hazardous Site Evaluation Division. EPA, July 1988.

EPA (U.S. Environmental Protection Agency), 1989. *Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities, Interim Final Guidance.* EPA, PB89-151047.

EPA (U.S. Environmental Protection Agency), 1992a. *Analysis of Ground Water Monitoring Data at RCRA Facilities. Addendum to Interim Final Guidance.* EPA, July 1992.

EPA (U.S. Environmental Protection Agency), 1992b. *Guidance for Data Useability in Risk Assessment, Final.* EPA, 9285.7-09A.

Gansecki, M., 1991. *Comments on Background Geochemical Characterization Report for 1989, Rocky Flats Plant.* Unpublished Report for U.S. EPA, Region VIII, August 1, 1991.

Gilbert, R.O., 1987. *Statistical Methods for Environmental Pollution Monitoring.* Van Nostrand Rheinhold Co., New York, NY.

Gilbert, R.O., 1993. Internal report to DOE/RFO, EPA Region VIII, and CDH; prepared July 30, 1993, 35 pages.

Hahn, G.J., 1970. Statistical Intervals for a Normal Population. Part 1. Tables, Examples and Applications. *Journal of Quality Technology*, v. 2, n.3, p. 115-125.

Helsel, D.R., 1990. Less than Obvious: Statistical Treatment of Data below the Detection Limit. *Environmental Science and Technology* **24**(12), 1766—1774.

Hem, J.D., 1992. *Study and Interpretation of the Chemical Characteristics of Natural Water*, 3rd Ed., U.S. Geological Survey Water Supply Paper 2254, 263 pp.

Hess, C.T. et al., 1985. The Occurrence of Radioactivity in Public Water Supplies in the United States. *Health Physics* **48**(5), 553—586.

Hodgin, C.R., 1983. *A Receptor-Based Technique for Determining Impacts of Wind-Resuspended Particulates.* Rockwell International, Rocky Flats Plant, Golden, Colorado, RFP-3362.

Hurr, R.T., 1976. *Hydrology of a Nuclear-Processing Plant Site, Rocky Flats, Jefferson County, Colorado.* U.S. Geological Survey Open-File Report 76-268.

Hydro-Search, Inc., 1985. Hydrogeologic Characterization of the Rocky Flats Plant, Golden, Colorado. Project No. 1520, December 9, 1985, 55 pp.

Milliken, G.A., and D.E. Johnson, 1984. *Analysis of Messy Data; Vol. 1, Designed Experiments.* Lifetime Learning Publications, Belmont, California.

Robson, S.G., 1983. Hydraulic Characteristics of the Principal Bedrock Aquifers in the Denver Basin, Colorado. *U.S. Geological Survey Hydrologic Investigations Atlas*, HA659.

Robson, S.G., A. Wacinski, S. Zawistowski, and J.C. Romero, 1981. Geologic Structure, Hydrology, and Water Quality of the Laramie-Fox Hills Aquifer in the Denver Basin, Colorado. *U.S. Geological Survey Hydrologic Atlas*, HA-650.

Rockwell International, 1986. *Draft Work Plan, Geological and Hydrological Site Characterization.* U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado.

Rockwell International, 1989a. *Standard Operating Procedures. Environmental Restoration Program, Rocky Flats Plant.* Rockwell International, January 1989.

Rockwell International, 1989b. *ER Program Quality Assurance/Quality Control Plan.* Rockwell International, January 1989.

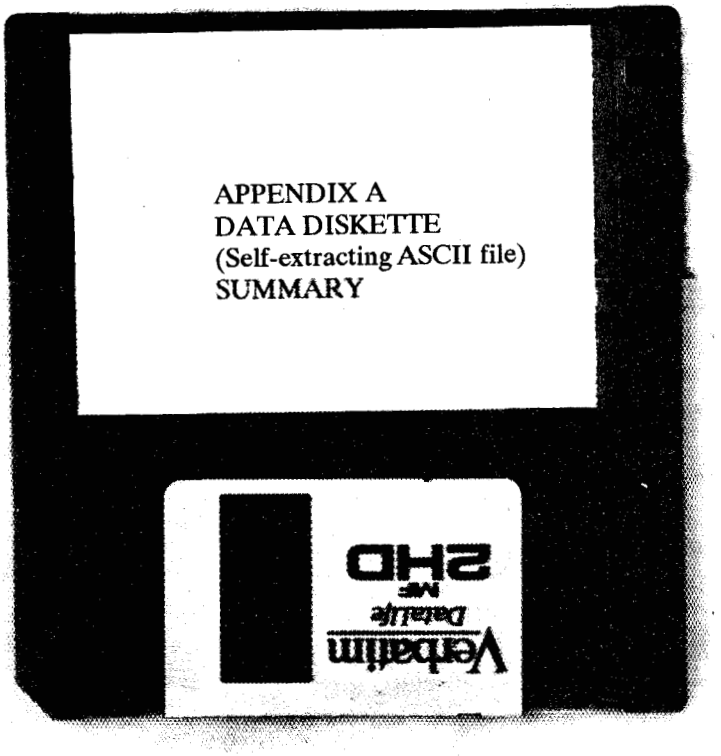
Sanford, R.F., C.T. Pierson, and R.A. Crovelli, 1993. An Objective Replacement Method for Censored Geochemical Data. *Mathematical Geology* **25**(1), 59—80.

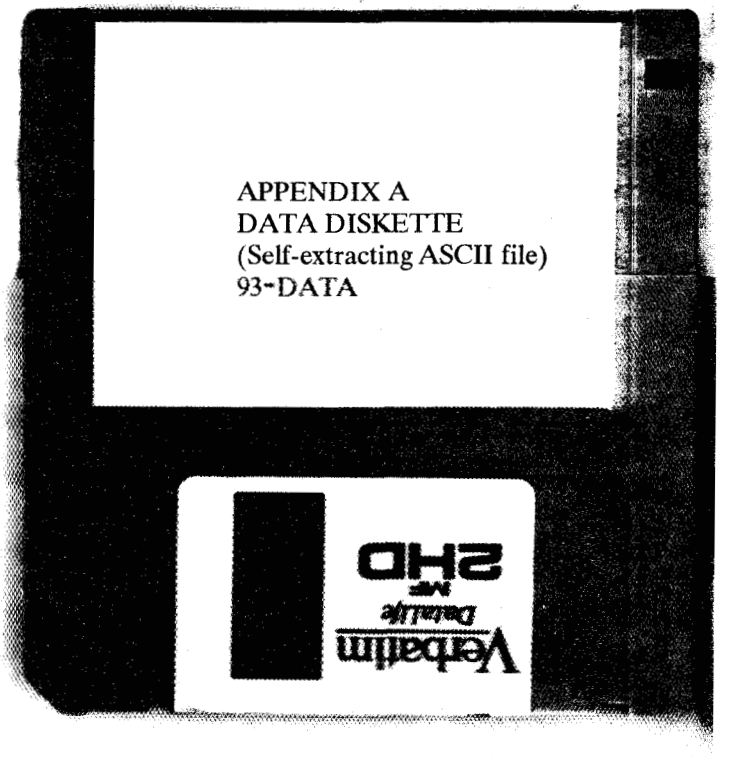
Scott, G.R., 1965. Nonglacial Quaternary Geology of the Southern and Middle Rocky Mountains. *The Quaternary of the United States.* Princeton University Press, pp. 243—254.

Shapiro, S.S., and M.R. Wilk, 1965. An Analysis of Variance Test for Normality (Complete Samples). *Biometrika* **52**, 591—611.

Weimer, R.J., 1973. A Guide to Uppermost Cretaceous Stratigraphy, Central Front Range Colorado: Deltaic Sedimentation, Growth Faulting and Early Laramie Crustal Movement. *The Mountain Geologist* **10**(3), 53—97.

CHEMICAL DATA


APPENDIX A
DATA DISKETTE
(Self-extracting ASCII file)
SUMMARY
Verbatim
Datalife
MF
2HD


APPENDIX A
DATA DISKETTE
(Self-extracting ASCII file)
93-DATA
Verbatim
Datalife
MF
2HD

APPENDIX A

CHEMICAL DATA

APPENDIX A
CHEMICAL DATA

Because of the large amount of data analyzed in this report, the final data set is included in this appendix on diskette as compressed, self-extracting ASCII files. This appendix also includes more than 200 histograms that show the distribution of the data with only the outliers (as given in Appendix E) not shown.

The histograms are meant to give the reader a feel for the overall range in concentration and types of distributions inherent in the background data. For groundwater and geologic materials, the bars are coded to distinguish between upper and lower flow-systems. For surface materials, only analytes from stream water are displayed. Fewer data were available for stream sediments, seep/spring water, and seep/spring sediments, making histograms for these groups less useful.

The groundwater analytes shown include: total and dissolved metals, total and dissolved radionuclides, and water-quality parameters. For geologic materials, only total metals and total radionuclides are presented as histograms. Analytes shown for stream water include: total and dissolved metals, total and dissolved radionuclides, and water-quality parameters.

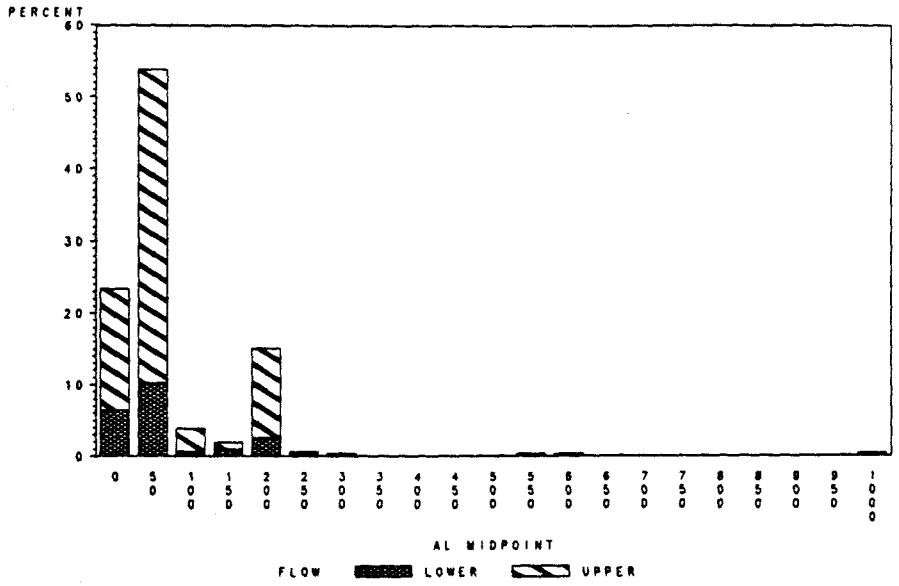


Figure A-1.

Data distribution of dissolved **ALUMINUM** in background groundwater, showing upper and lower flow-systems

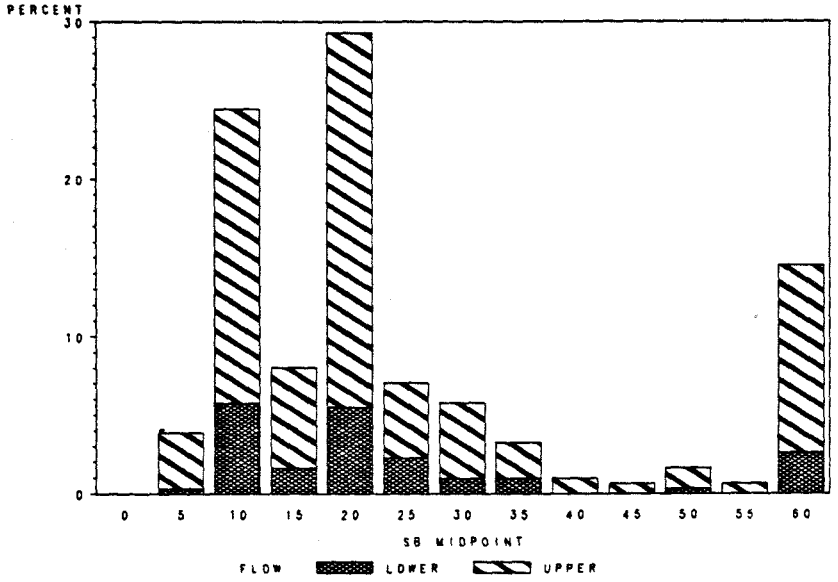


Figure A-2.

Data distribution of dissolved **ANTIMONY** in background groundwater, showing upper and lower flow-systems.

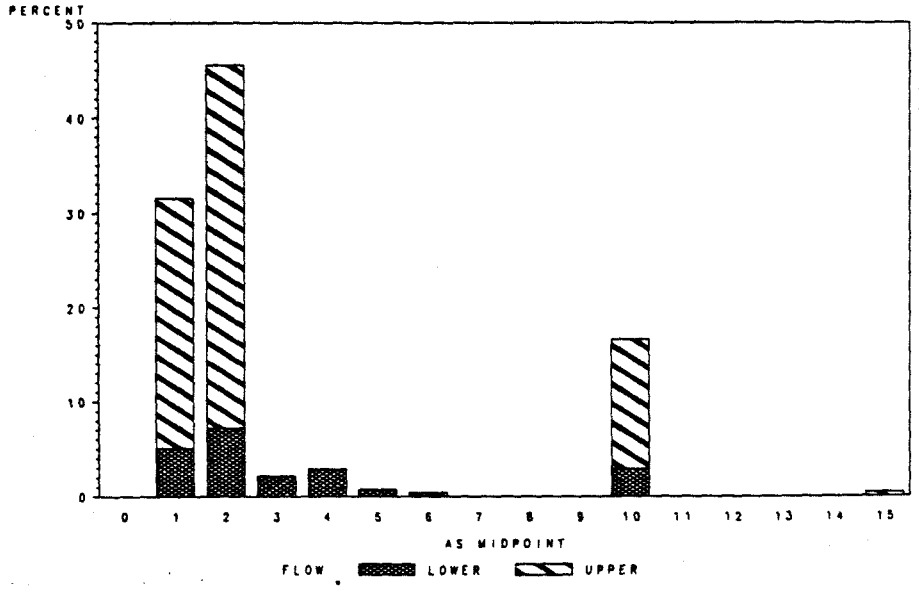


Figure A-3.

Data distribution of dissolved **ARSENIC** in background groundwater, showing upper and lower flow-systems.

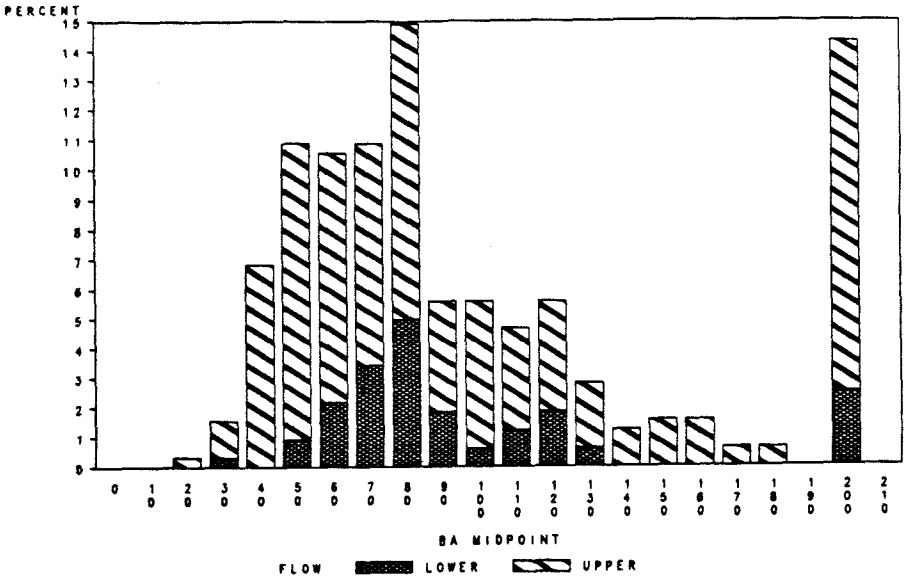


Figure A-4.

Data distribution of dissolved **BARIUM** in background groundwater, showing upper and lower flow-systems

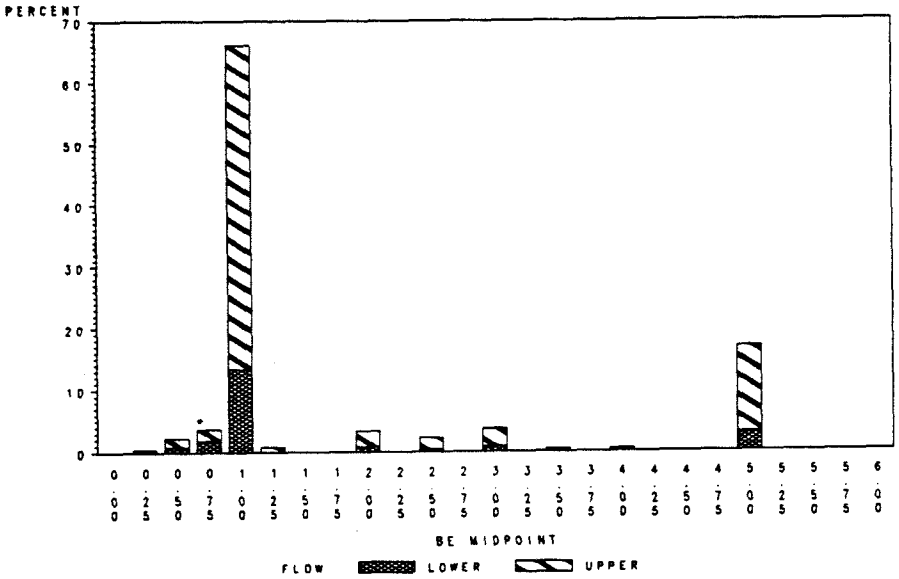


Figure A-5.

Data distribution of dissolved **BERYLLIUM** in background groundwater, showing upper and lower flow-systems.

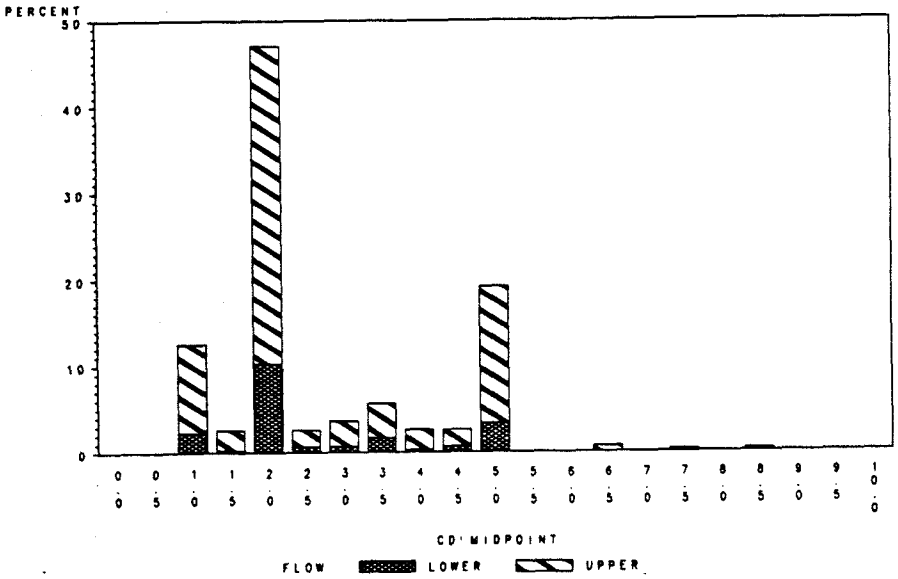


Figure A-6.

Data distribution of dissolved **CADMIUM** in background groundwater, showing upper and lower flow-systems.

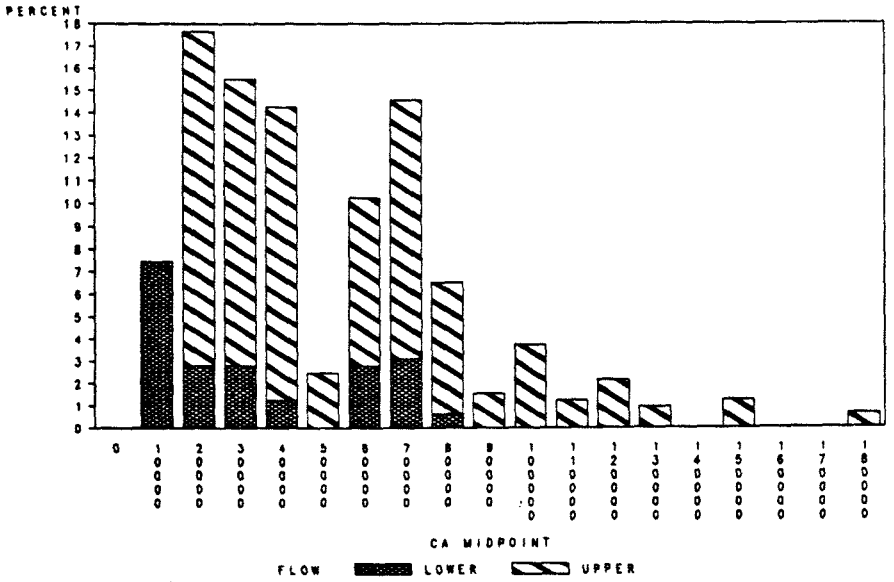


Figure A-7.

Data distribution of dissolved **CALCIUM** in background groundwater, showing upper and lower flow-systems

Figure A-8.

Data distribution of dissolved **CHROMIUM** in background groundwater, showing upper and lower flow-systems.

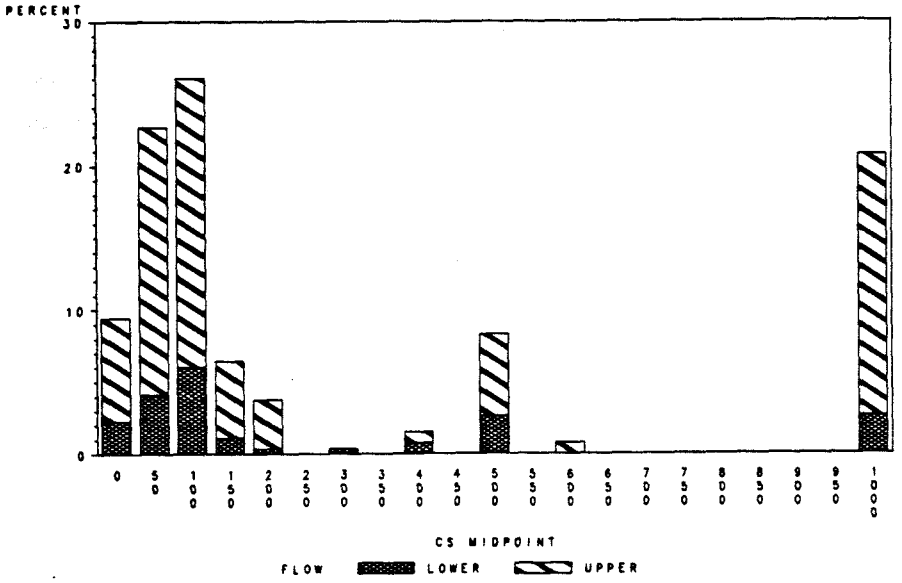


Figure A-9.

Data distribution of dissolved **CESIUM** in background groundwater, showing upper and lower flow-systems.

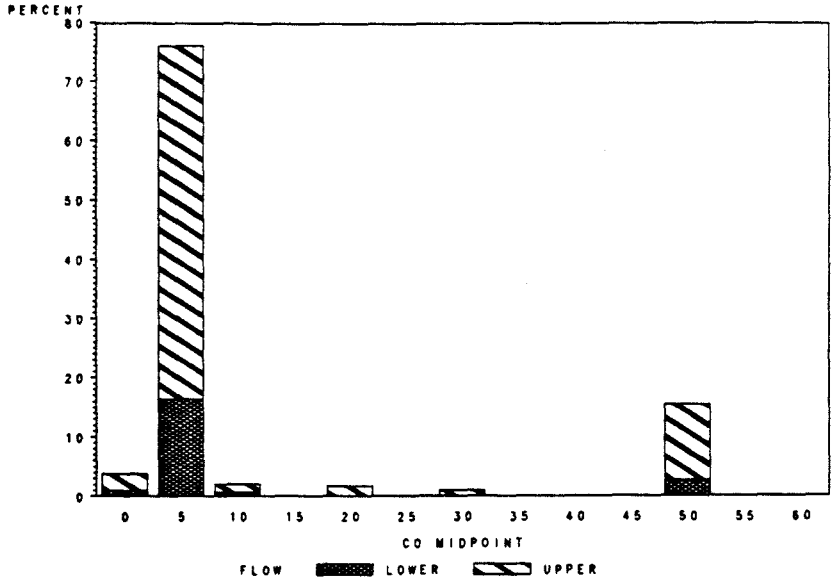


Figure A-10.

Data distribution of dissolved **COBALT** in background groundwater, showing upper and lower flow-systems

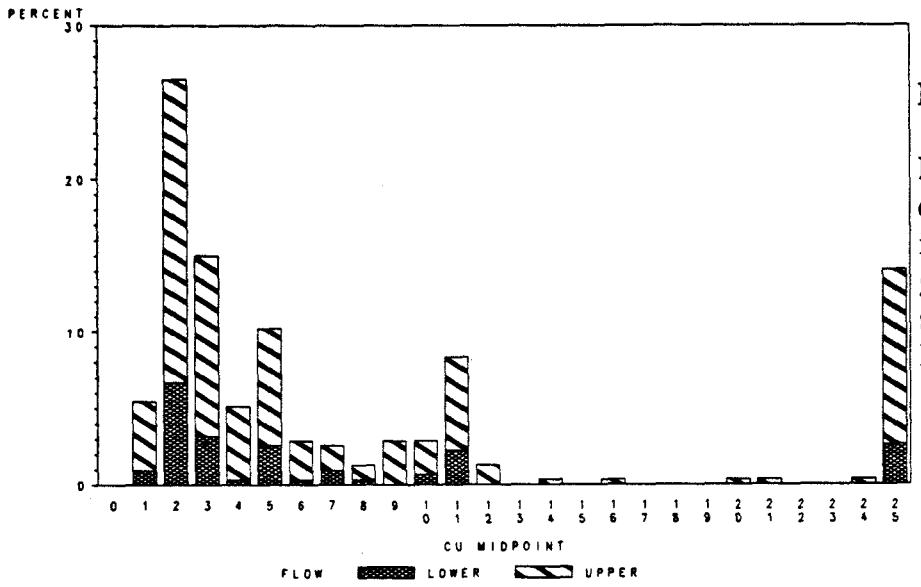


Figure A-11.

Data distribution of dissolved **COPPER** in background groundwater, showing upper and lower flow-systems.

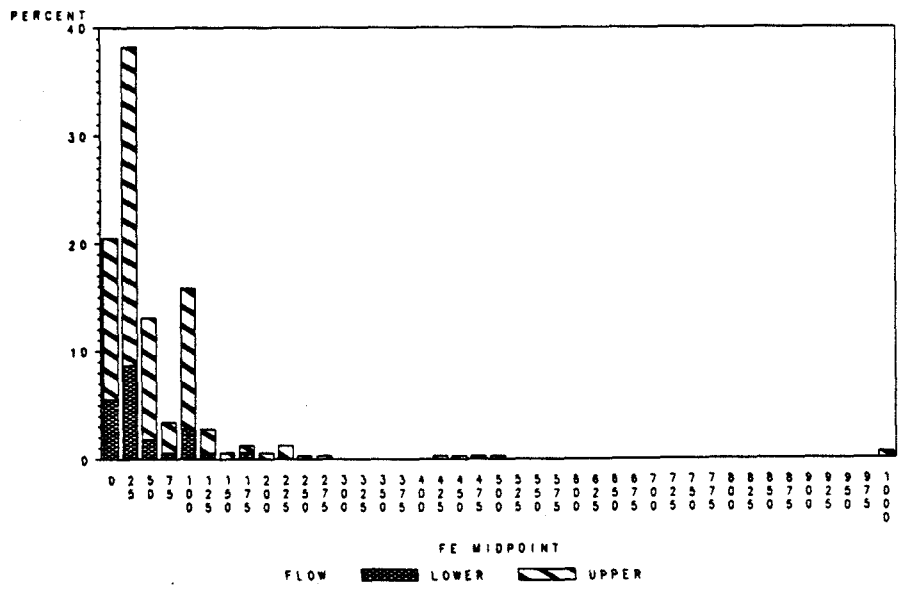


Figure A-12.

Data distribution of dissolved **IRON** in background groundwater, showing upper and lower flow-systems.

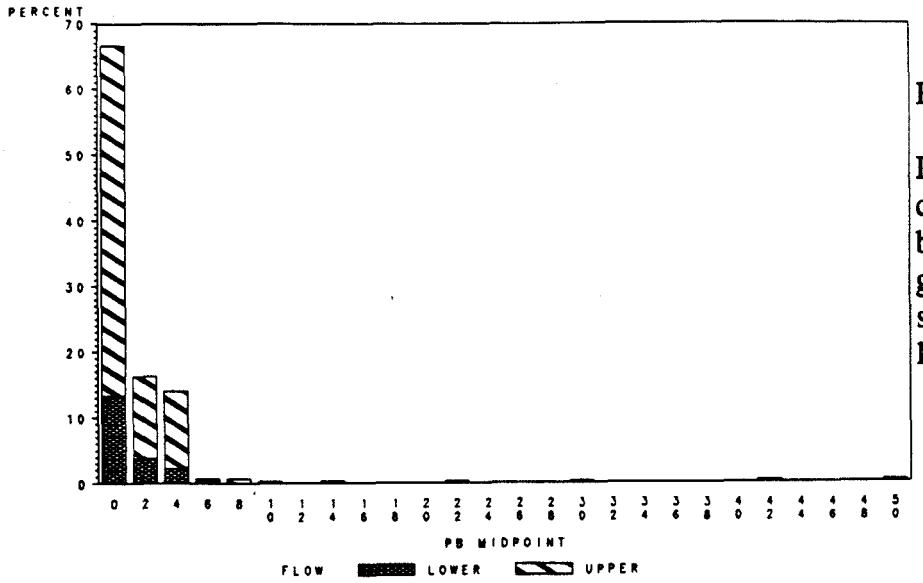


Figure A-13.

Data distribution of dissolved **LEAD** in background groundwater, showing upper and lower flow-systems

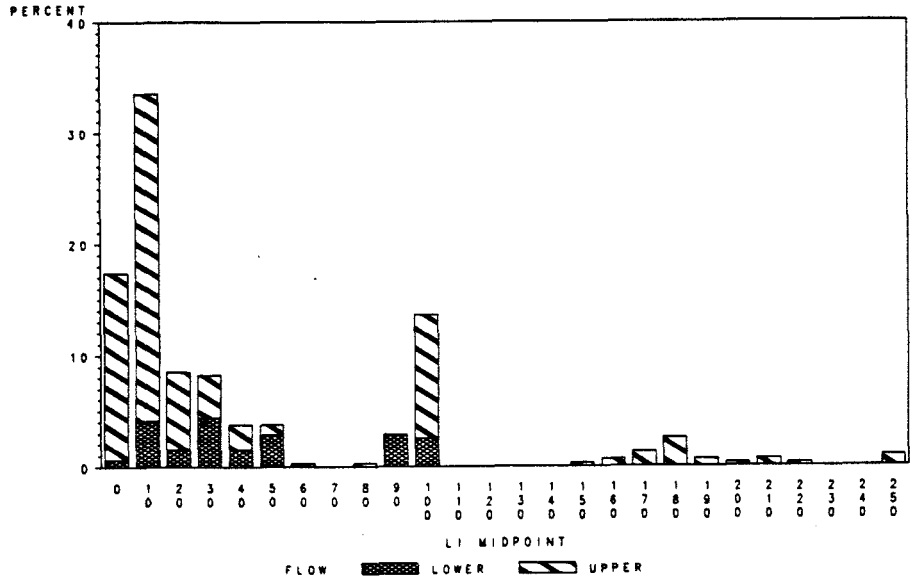


Figure A-14.

Data distribution of dissolved **LITHIUM** in background groundwater, showing upper and lower flow-systems.

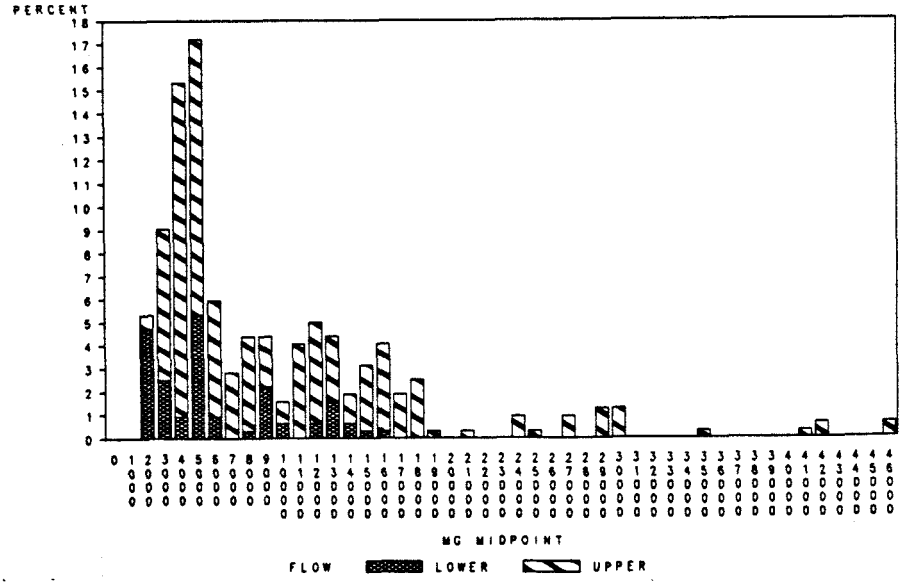


Figure A-15.

Data distribution of dissolved **MAGNESIUM** in background groundwater, showing upper and lower flow-systems.

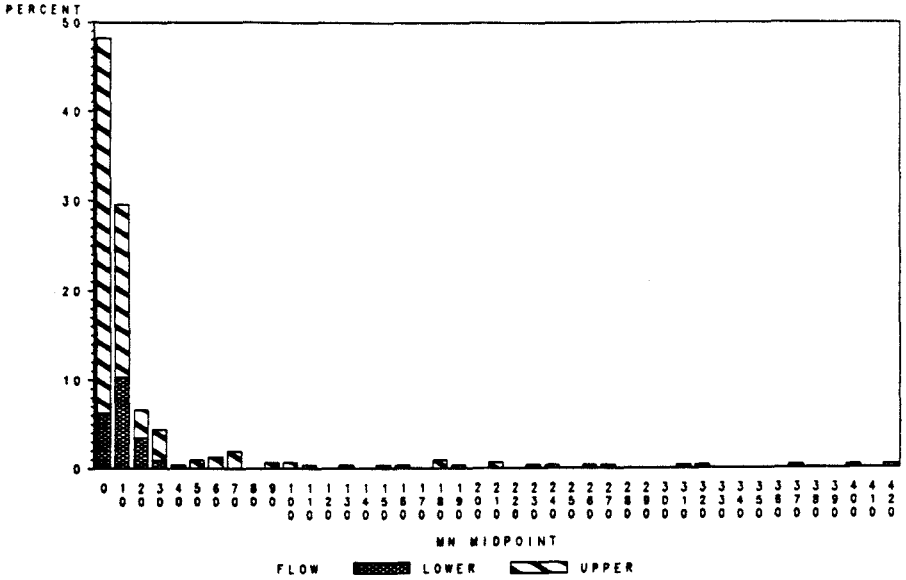


Figure A-16.

Data distribution of dissolved **MANGANESE** in background groundwater, showing upper and lower flow-systems

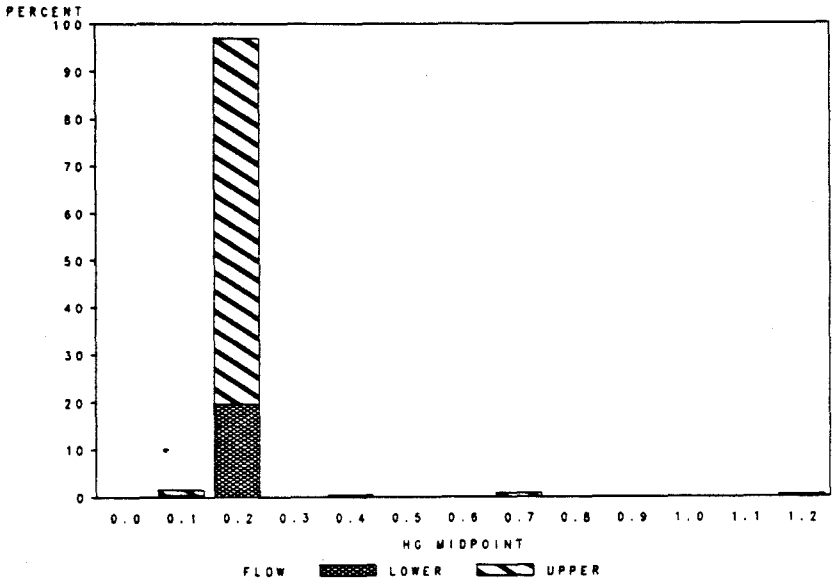


Figure A-17.

Data distribution of dissolved **MERCURY** in background groundwater, showing upper and lower flow-systems.

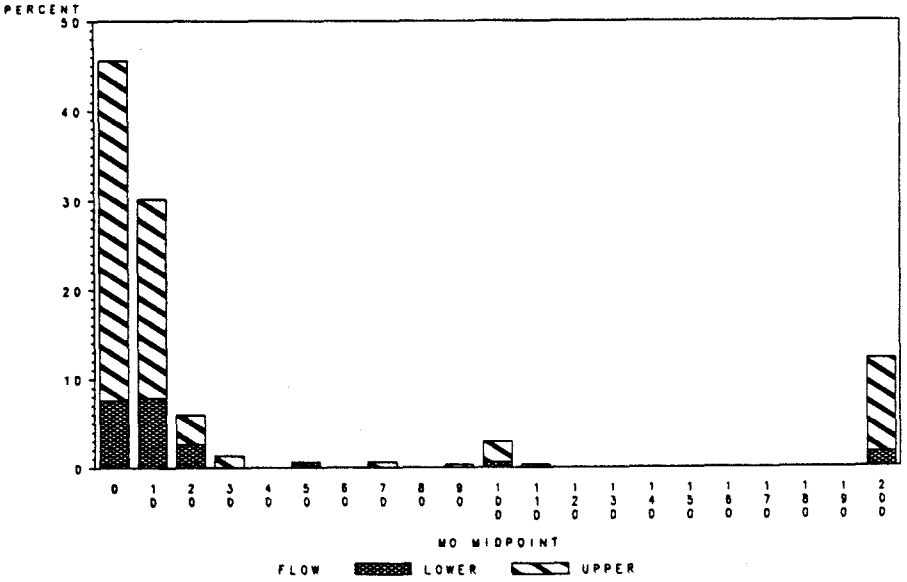


Figure A-18.

Data distribution of dissolved **MOLYBDENUM** in background groundwater, showing upper and lower flow-systems.

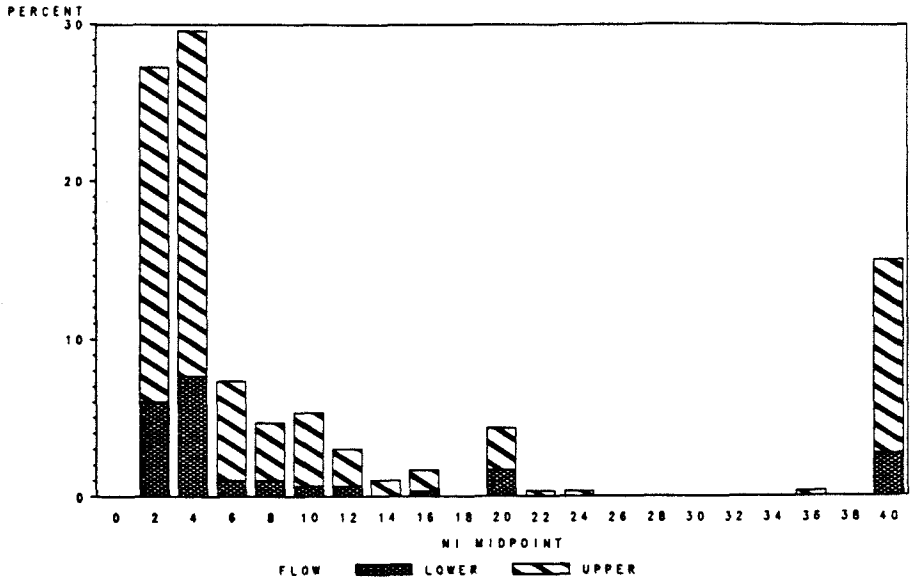


Figure A-19.

Data distribution of dissolved **NICKEL** in background groundwater, showing upper and lower flow-systems

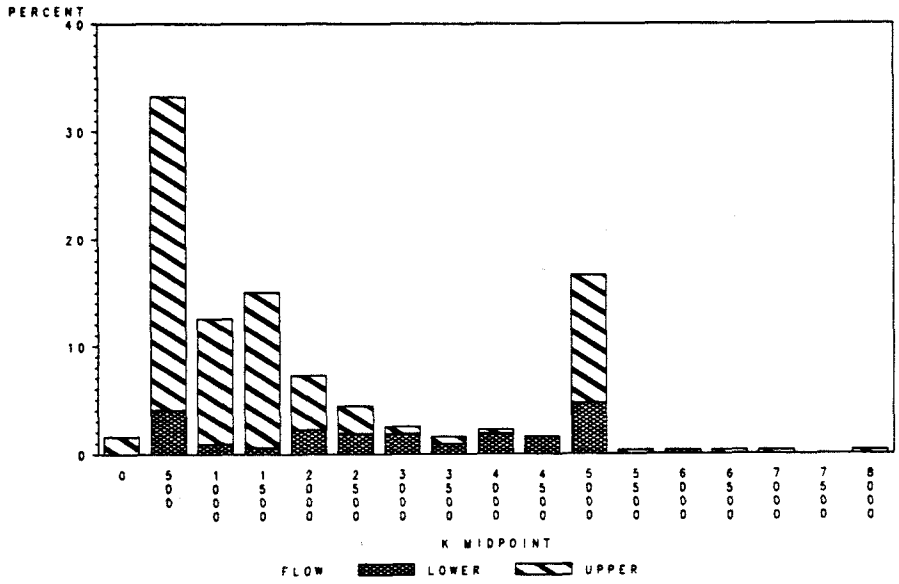


Figure A-20.

Data distribution of dissolved **POTASSIUM** in background groundwater, showing upper and lower flow-systems.

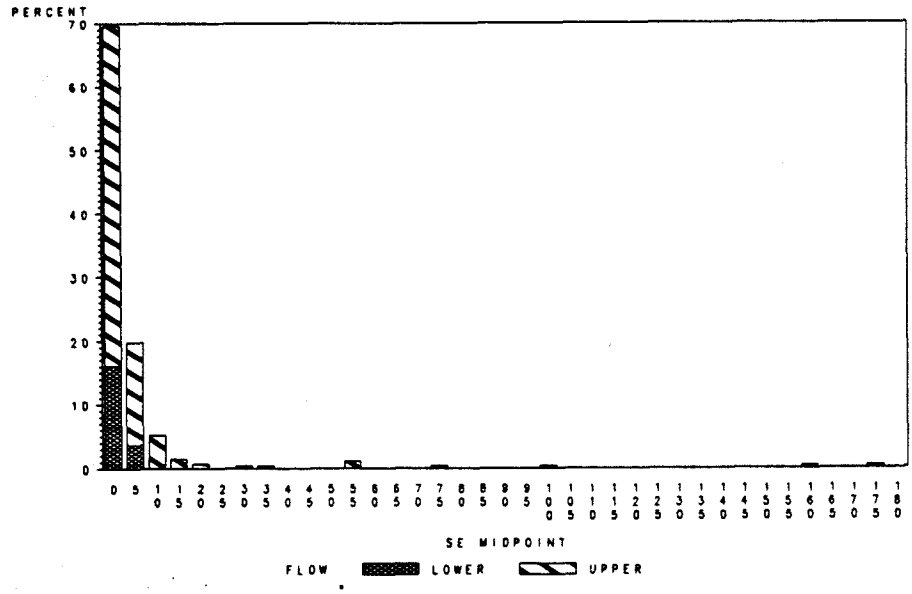


Figure A-21.

Data distribution of dissolved **SELENIUM** in background groundwater, showing upper and lower flow-systems.

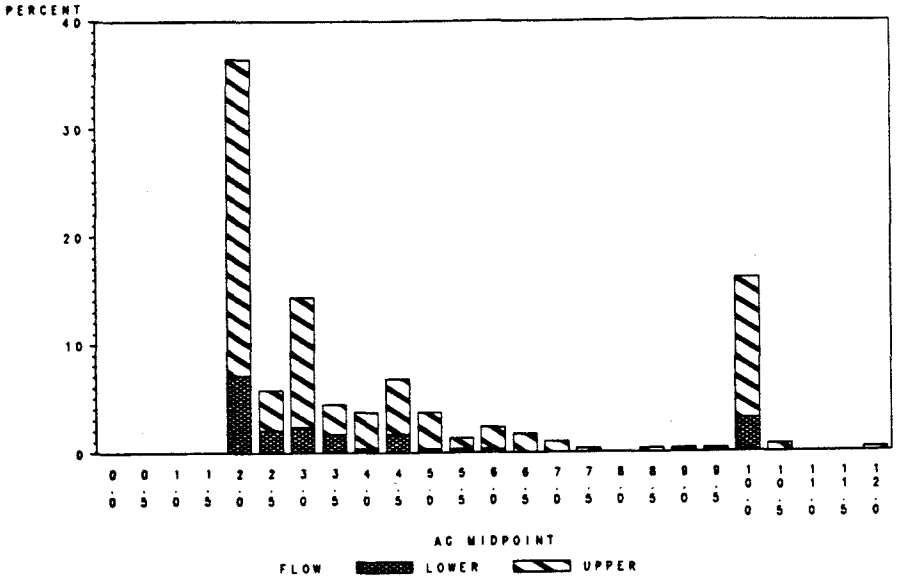


Figure A-22.

Data distribution of dissolved **SILVER** in background groundwater, showing upper and lower flow-systems

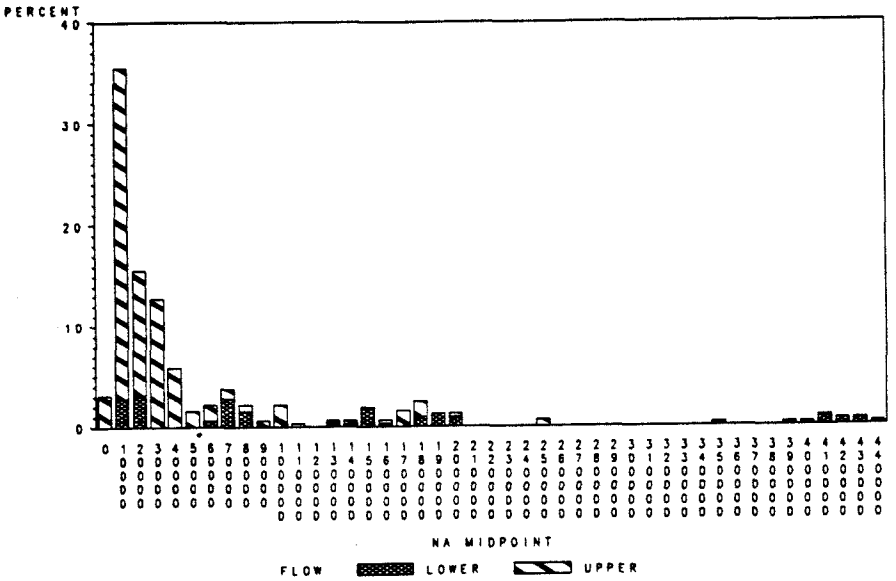


Figure A-23.

Data distribution of dissolved **SODIUM** in background groundwater, showing upper and lower flow-systems.

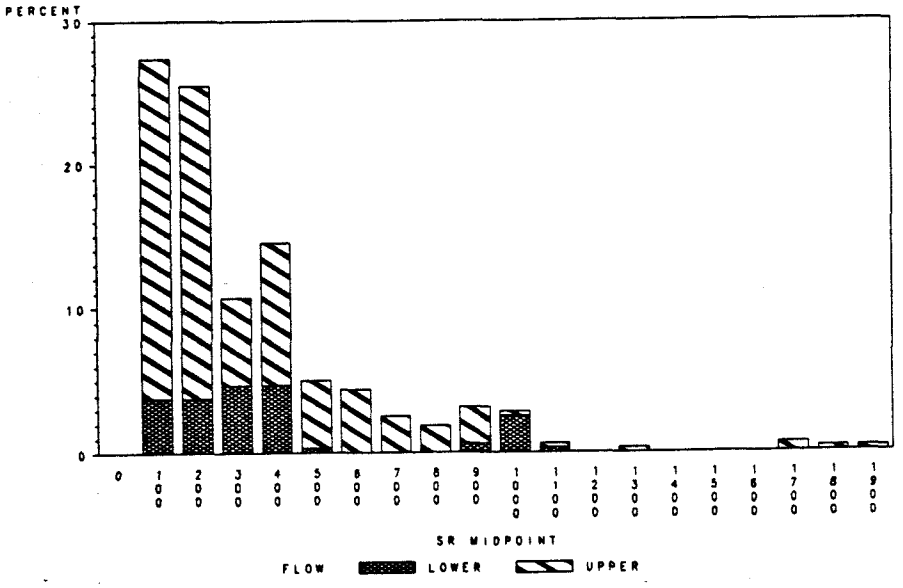


Figure A-24.

Data distribution of dissolved **STRONTIUM** in background groundwater, showing upper and lower flow-systems.

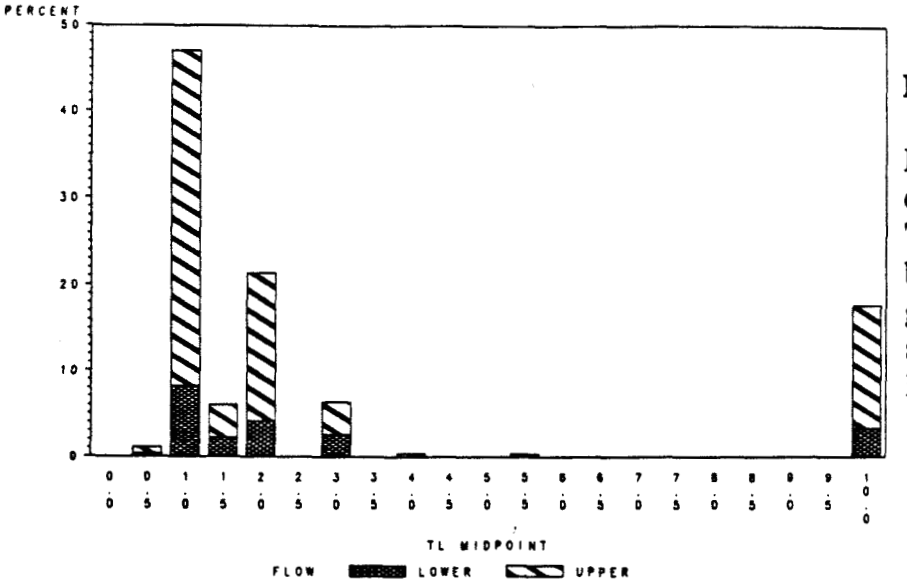


Figure A-25.

Data distribution of dissolved **THALLIUM** in background groundwater, showing upper and lower flow-systems

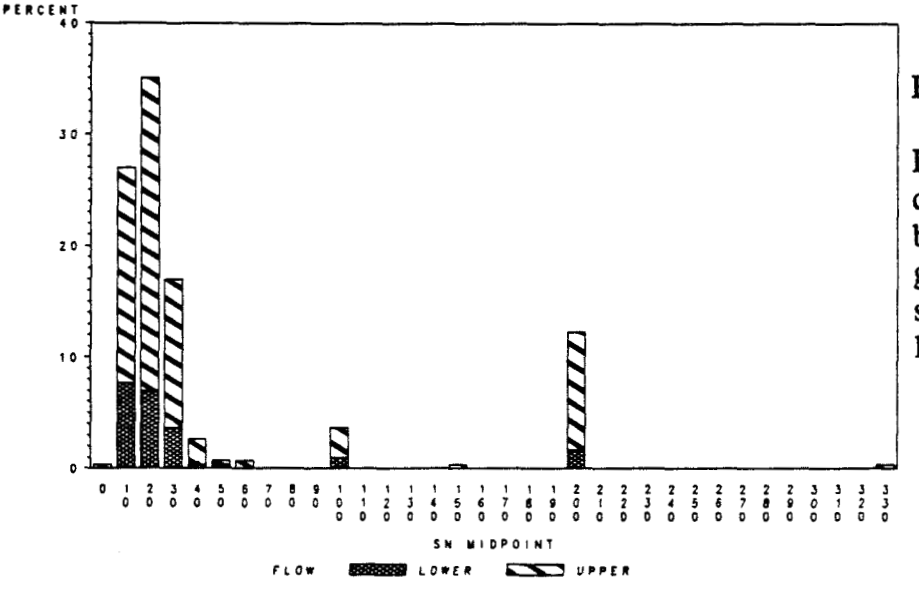


Figure A-26.

Data distribution of dissolved **TIN** in background groundwater, showing upper and lower flow-systems.

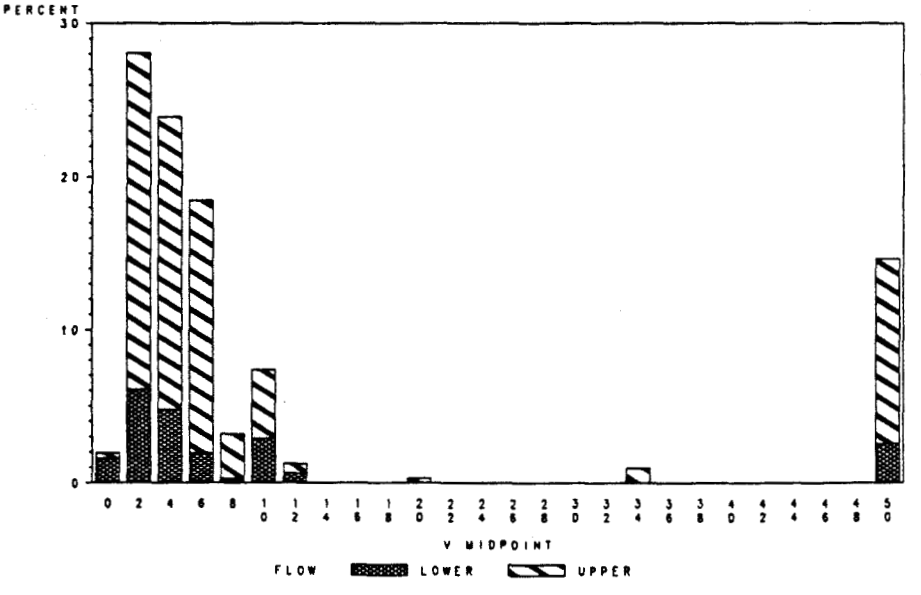


Figure A-27.

Data distribution of dissolved **VANADIUM** in background groundwater, showing upper and lower flow-systems.

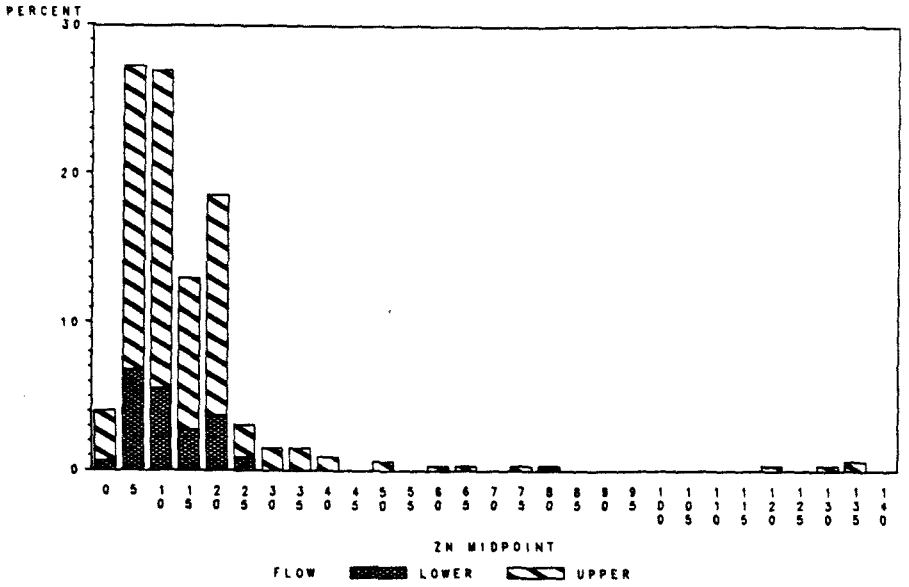


Figure A-28.

Data distribution of dissolved **ZINC** in background groundwater, showing upper and lower flow-systems.

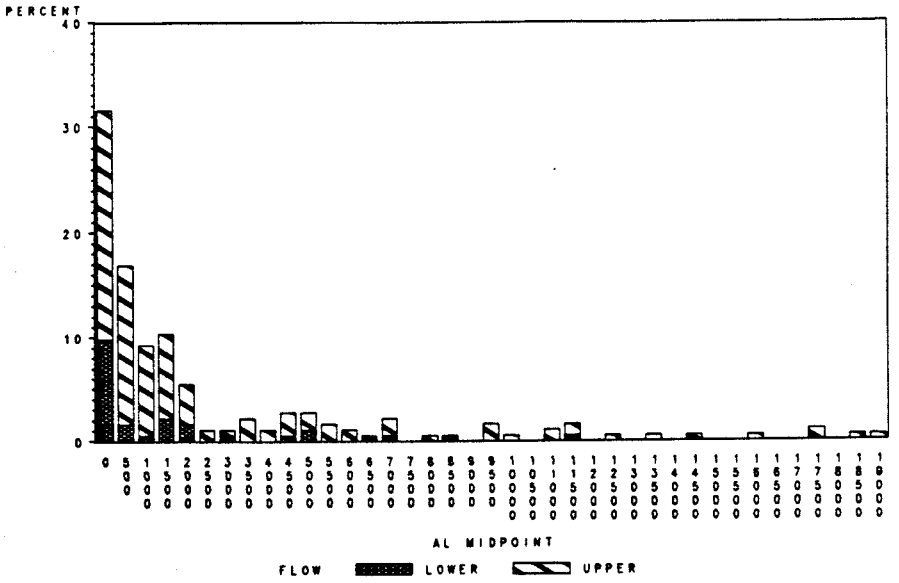


Figure A-29.

Data distribution of total **ALUMINUM** in background groundwater, showing upper and lower flow-systems.

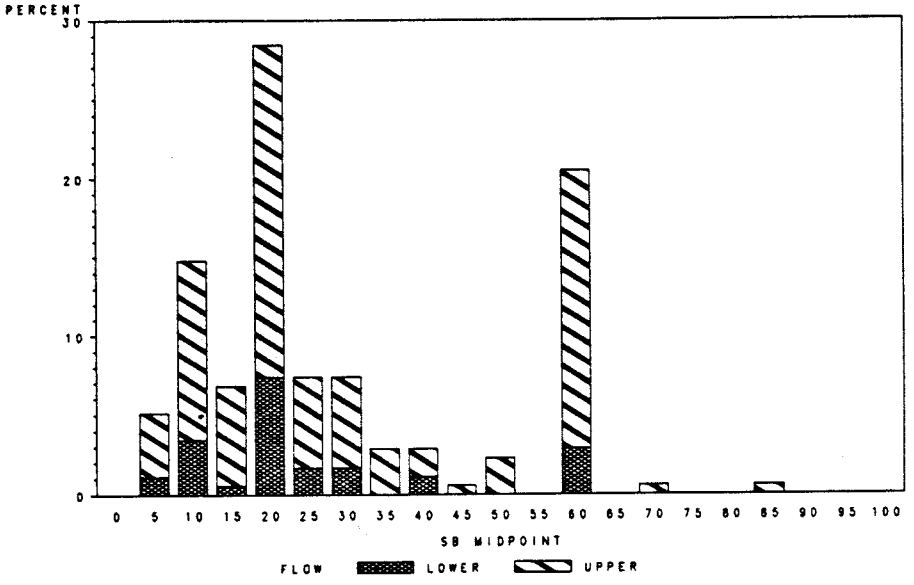


Figure A-30.

Data distribution of total **ANTIMONY** in background groundwater, showing upper and lower flow-systems.

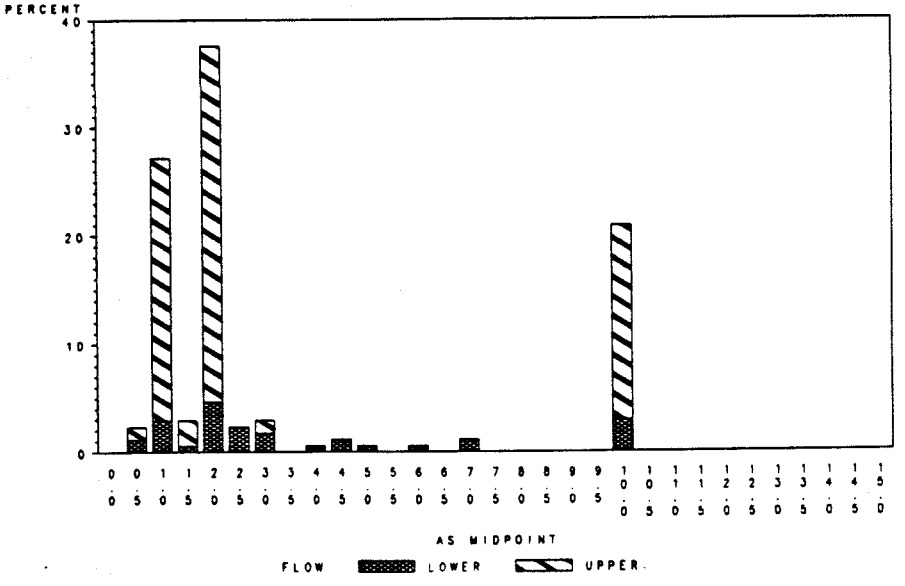


Figure A-31.

Data distribution of total **ARSENIC** in background groundwater, showing upper and lower flow-systems.

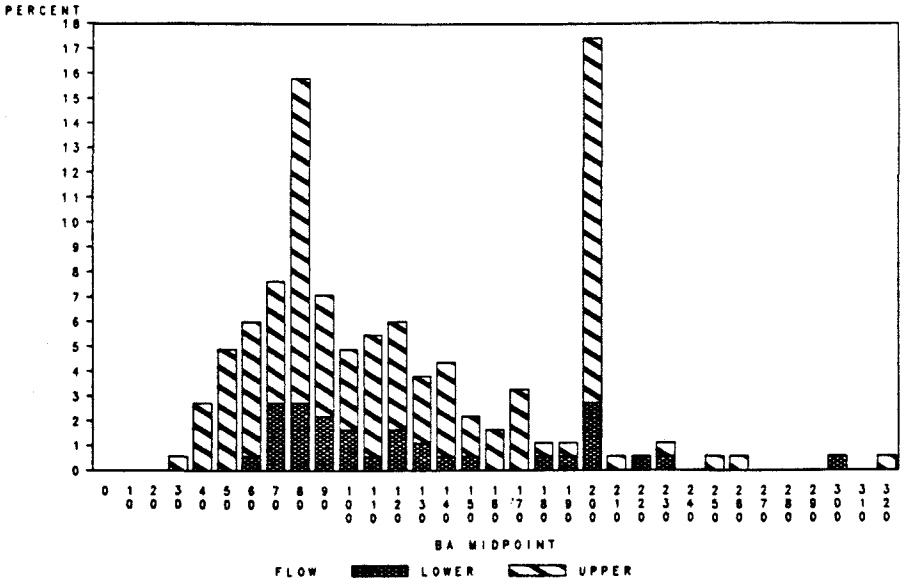


Figure A-32.

Data distribution of total **BARIUM** in background groundwater, showing upper and lower flow-systems.

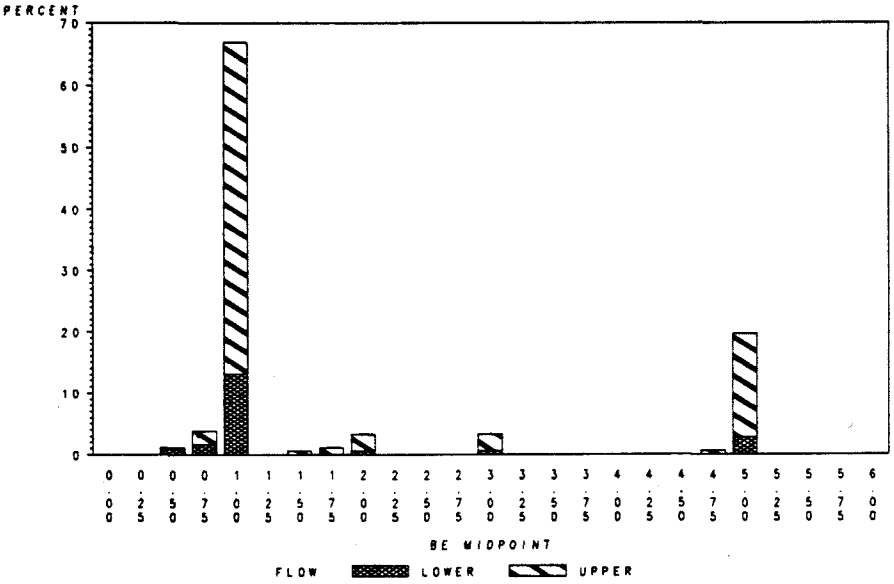


Figure A-33.

Data distribution of total **BERYLLIUM** in background groundwater, showing upper and lower flow-systems.

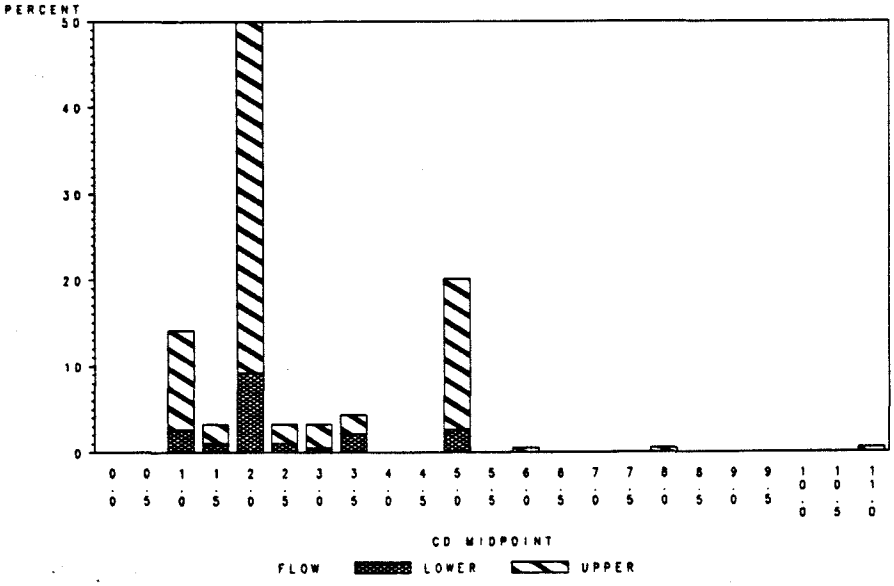


Figure A-34.

Data distribution of total **CADMIUM** in background groundwater, showing upper and lower flow-systems.

Figure A-35.

Data distribution of total **CALCIUM** in background groundwater, showing upper and lower flow-systems.

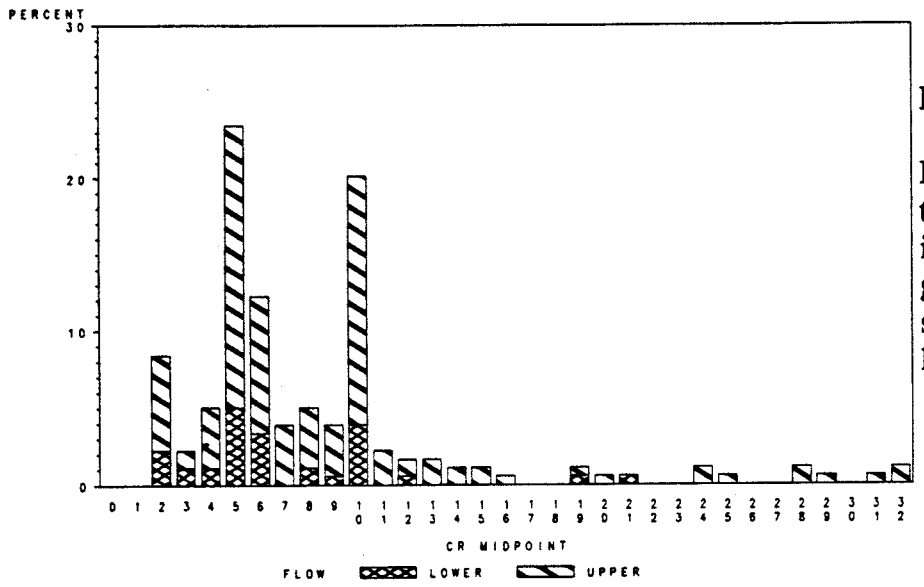


Figure A-36.

Data distribution of total **CHROMIUM** in background groundwater, showing upper and lower flow-systems.

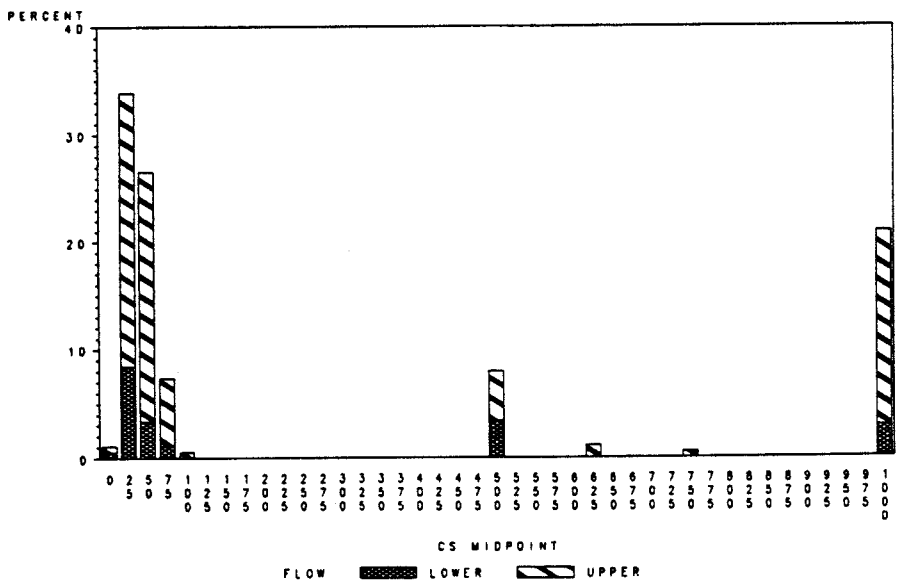


Figure A-37.

Data distribution of total **CESIUM** in background groundwater, showing upper and lower flow-systems.

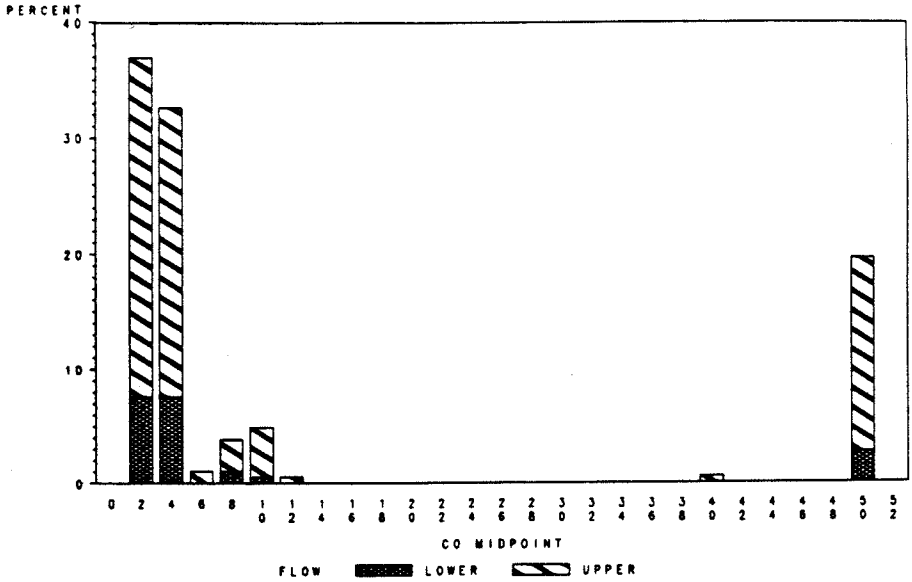


Figure A-38.

Data distribution of total **COBALT** in background groundwater, showing upper and lower flow-systems.

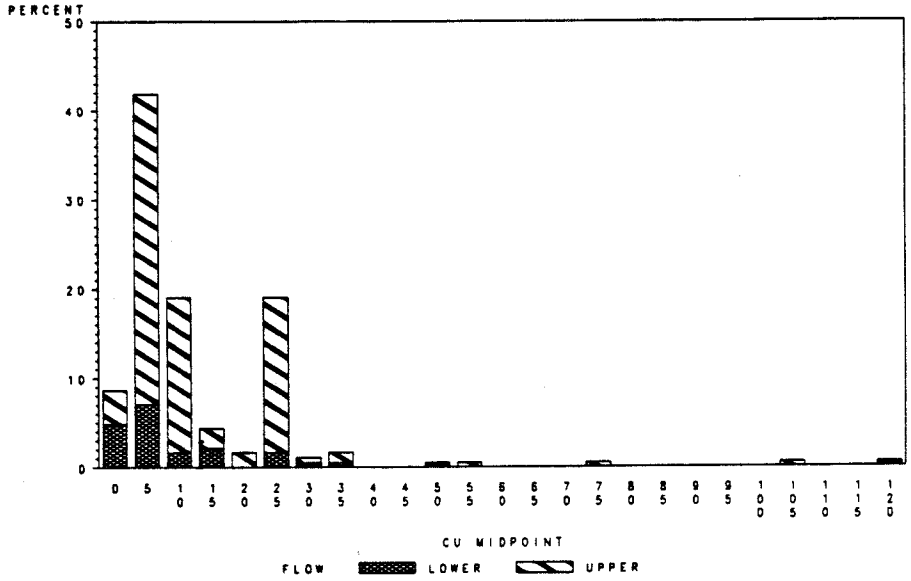


Figure A-39.

Data distribution of total **COPPER** in background groundwater, showing upper and lower flow-systems.

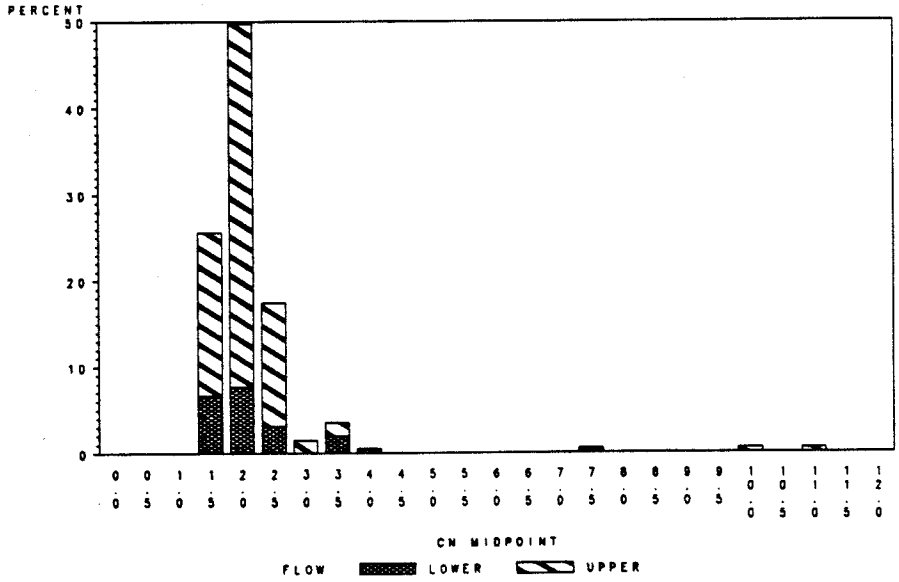


Figure A-40.

Data distribution of total **CYANIDE** in background groundwater, showing upper and lower flow-systems.

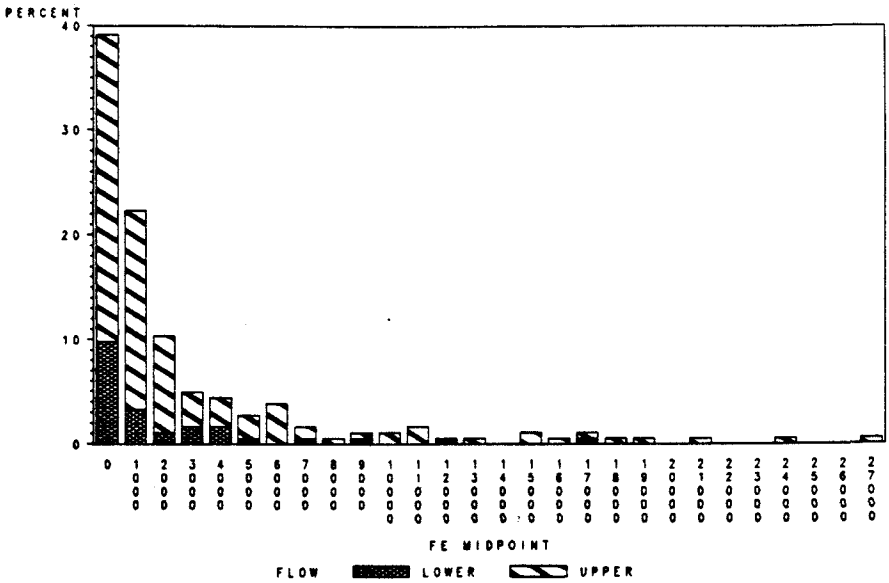


Figure A-41.

Data distribution of total **IRON** in background groundwater, showing upper and lower flow-systems.

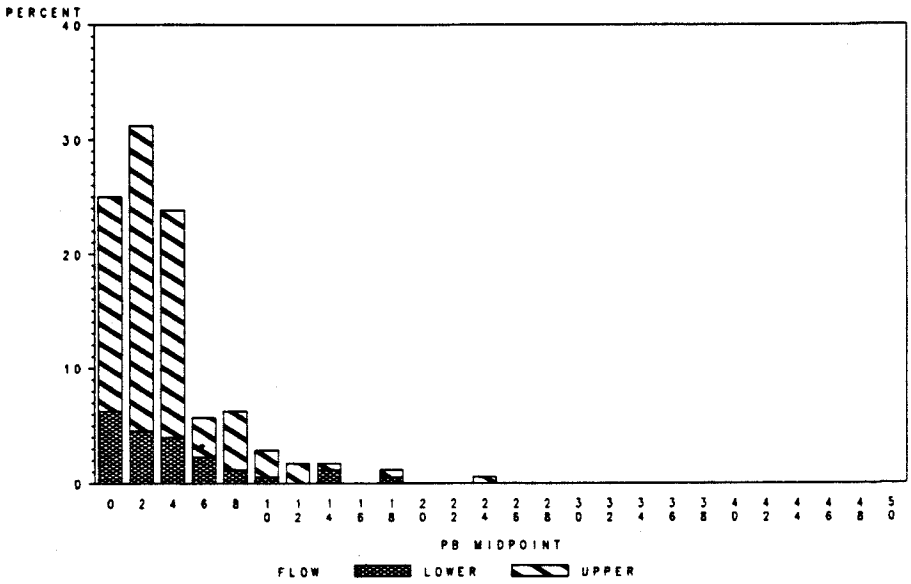


Figure A-42.

Data distribution of total **LEAD** in background groundwater, showing upper and lower flow-systems.

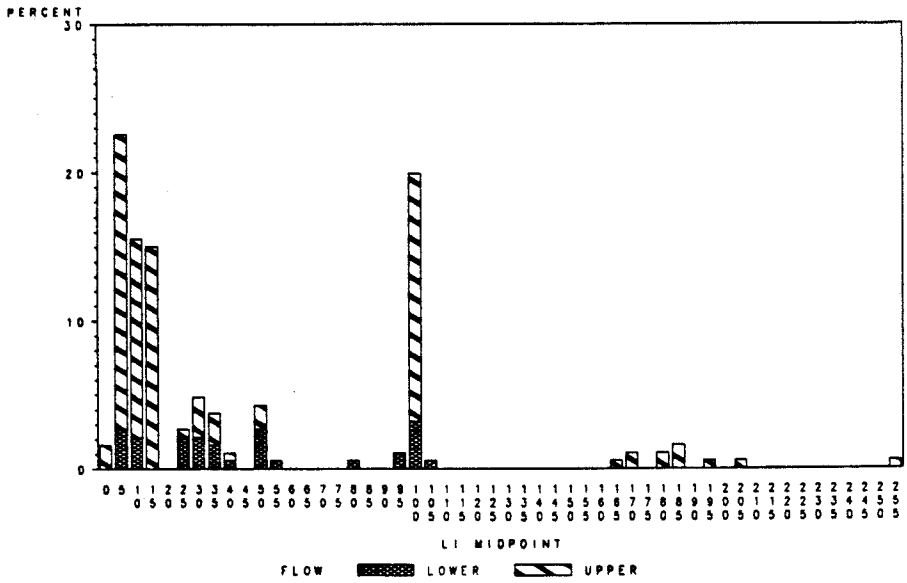


Figure A-43.

Data distribution of total **LITHIUM** in background groundwater, showing upper and lower flow-systems.

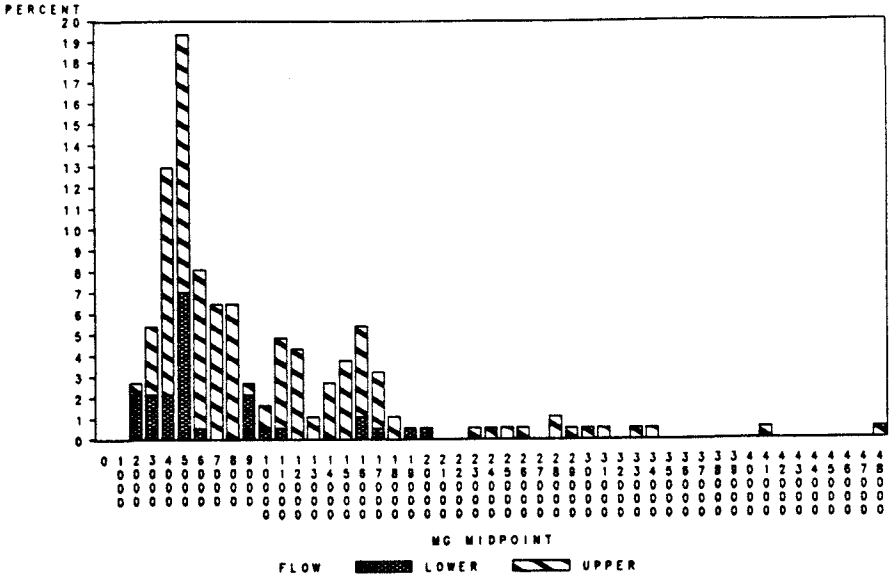


Figure A-44.

Data distribution of total **MAGNESIUM** in background groundwater, showing upper and lower flow-systems.

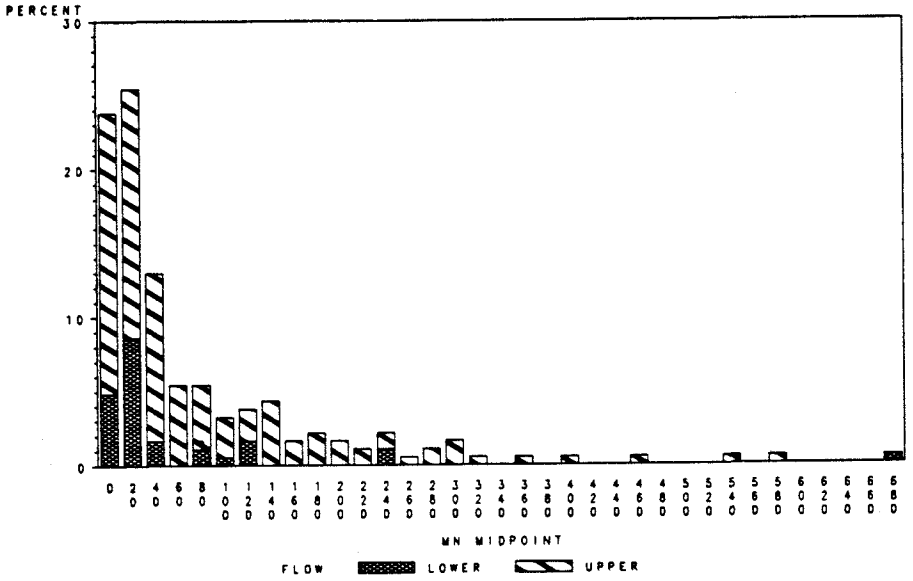


Figure A-45.

Data distribution of total **MANGANESE** in background groundwater, showing upper and lower flow-systems.

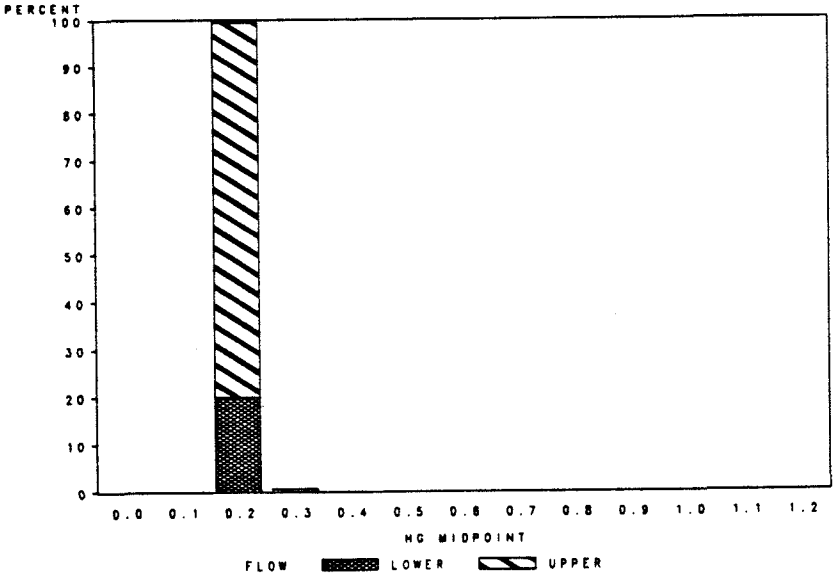


Figure A-46.

Data distribution of total **MERCURY** in background groundwater, showing upper and lower flow-systems.

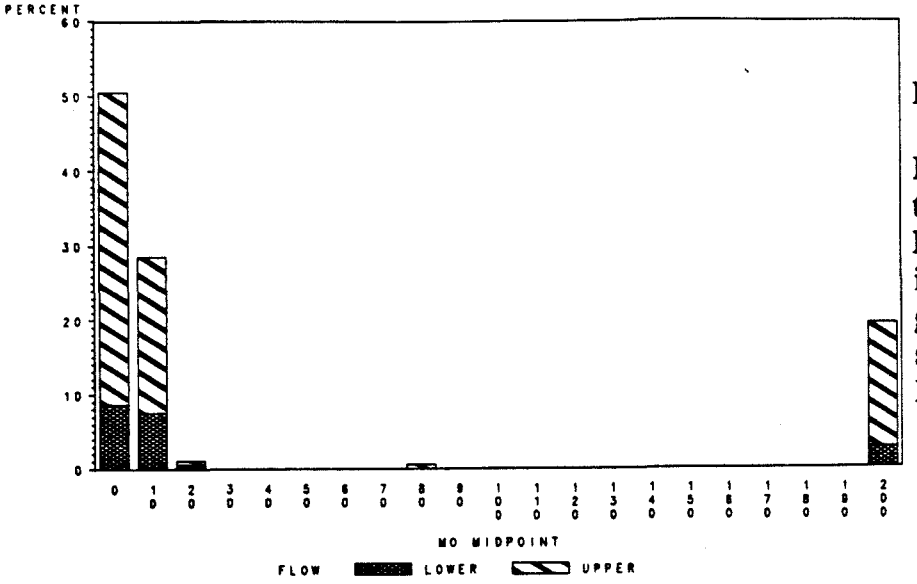


Figure A-47.

Data distribution of total **MOLYBDENUM** in background groundwater, showing upper and lower flow-systems.

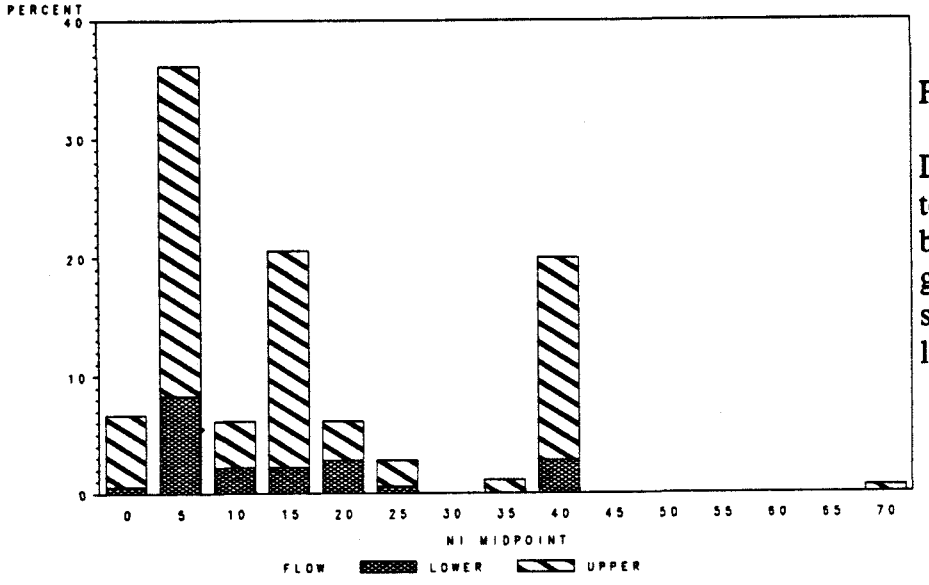


Figure A-48.

Data distribution of total **NICKEL** in background groundwater, showing upper and lower flow-systems.

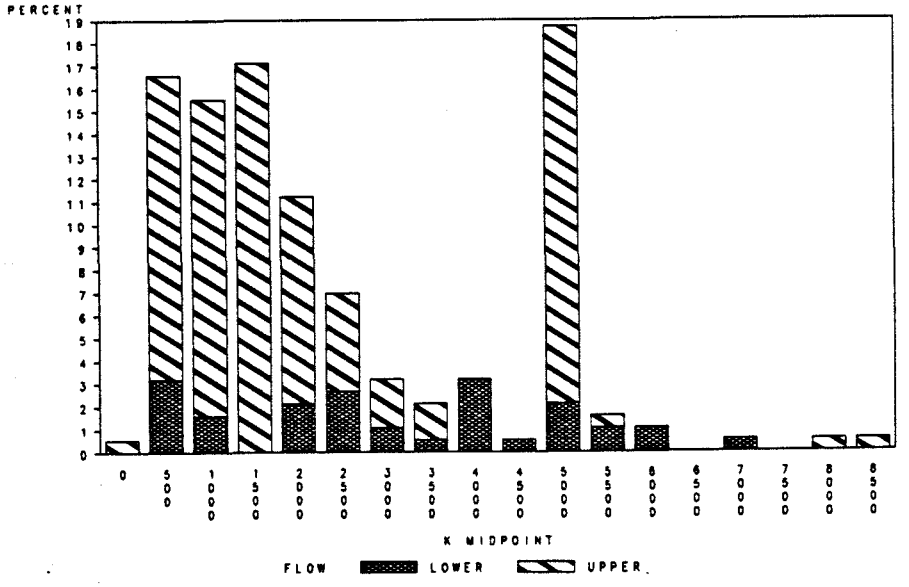


Figure A-49.

Data distribution of total **POTASSIUM** in background groundwater, showing upper and lower flow-systems.

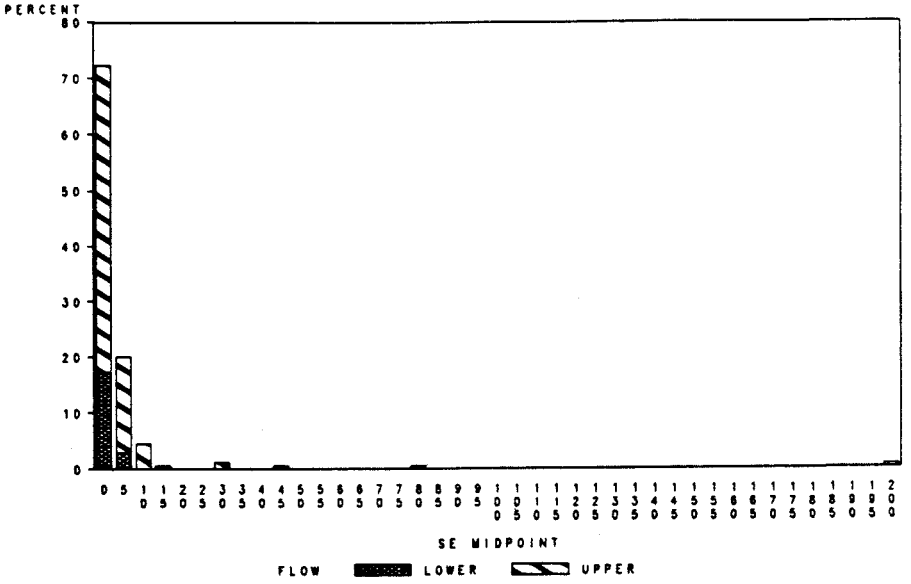


Figure A-50.

Data distribution of total **SELENIUM** in background groundwater, showing upper and lower flow-systems.

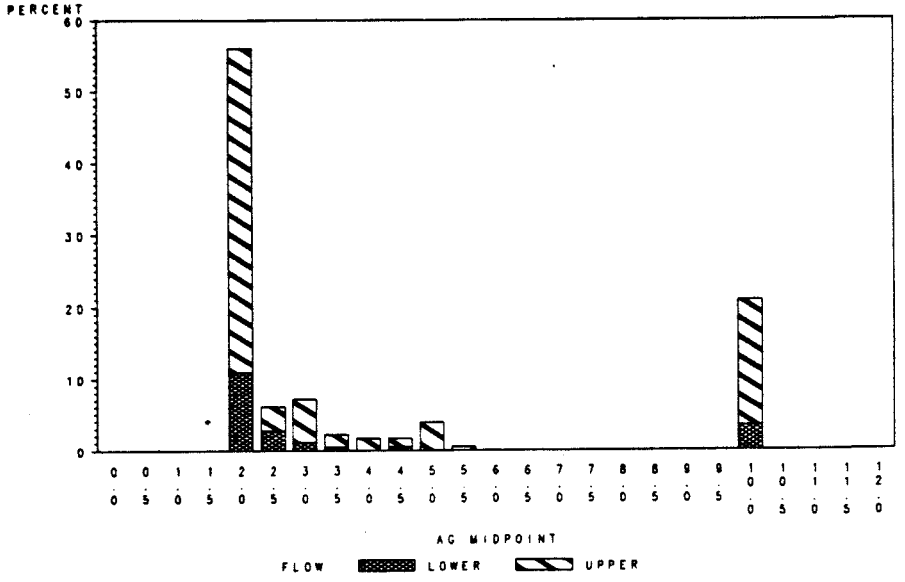


Figure A-51.

Data distribution of total **SILVER** in background groundwater, showing upper and lower flow-systems.

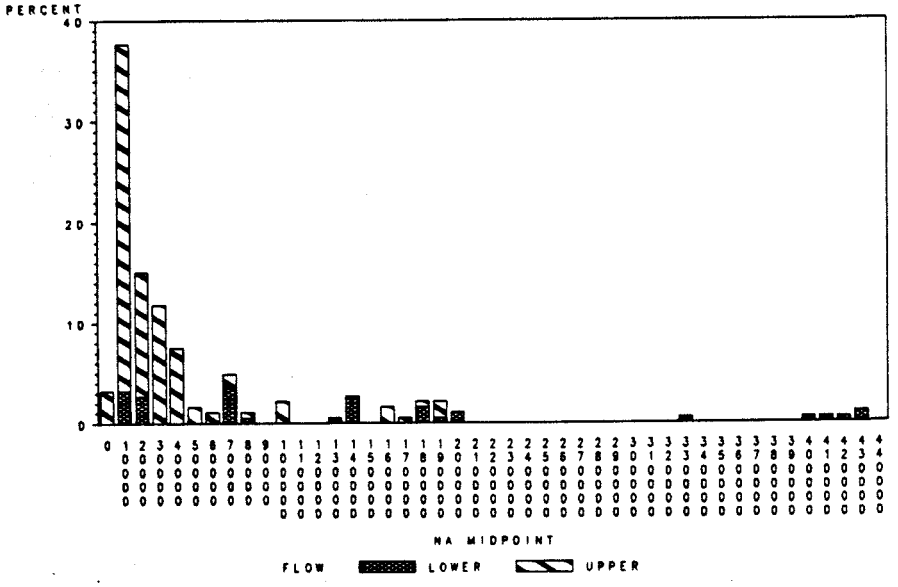


Figure A-52.

Data distribution of total **SODIUM** in background groundwater, showing upper and lower flow-systems.

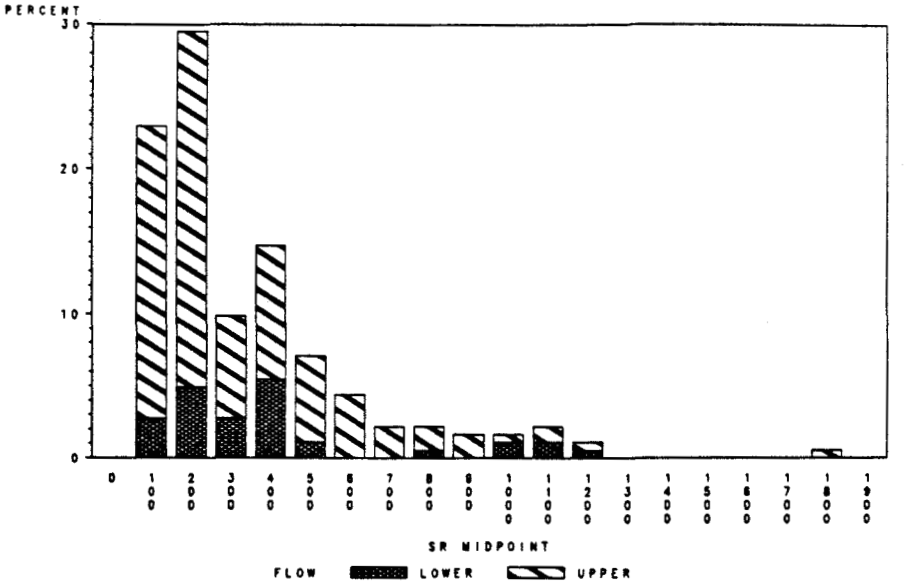


Figure A-53.

Data distribution of total **STRONTIUM** in background groundwater, showing upper and lower flow-systems.

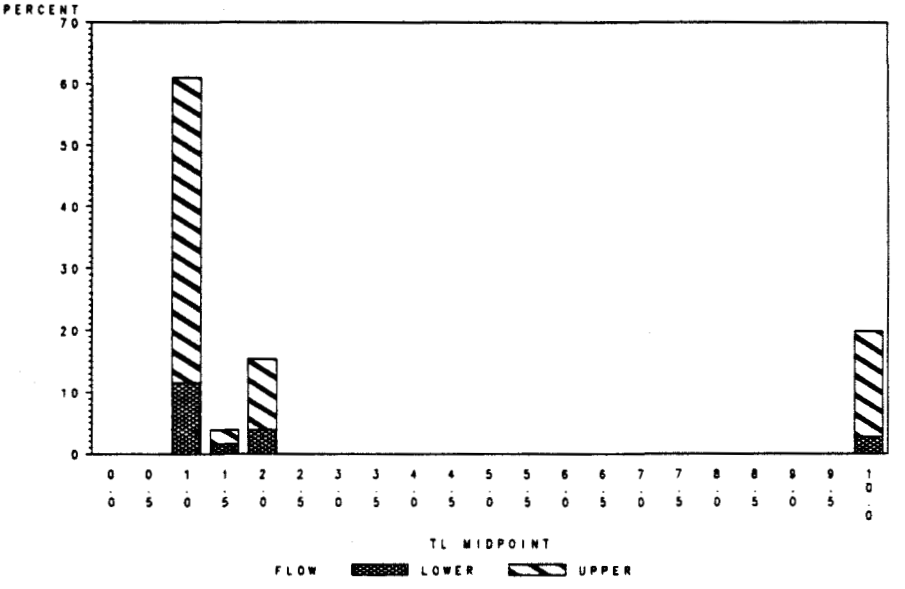


Figure A-54.

Data distribution of total **THALLIUM** in background groundwater, showing upper and lower flow-systems.

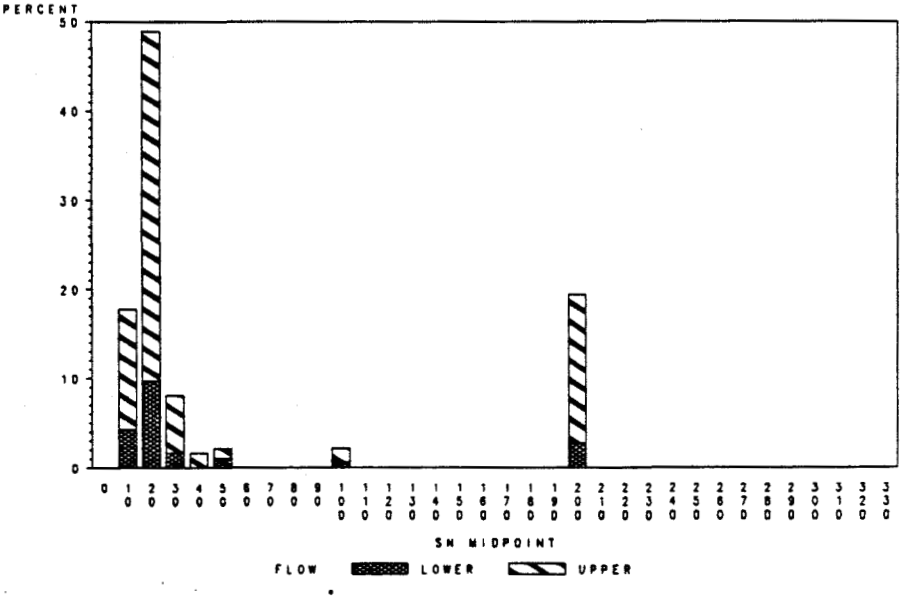


Figure A-55.

Data distribution of total **TIN** in background groundwater, showing upper and lower flow-systems.

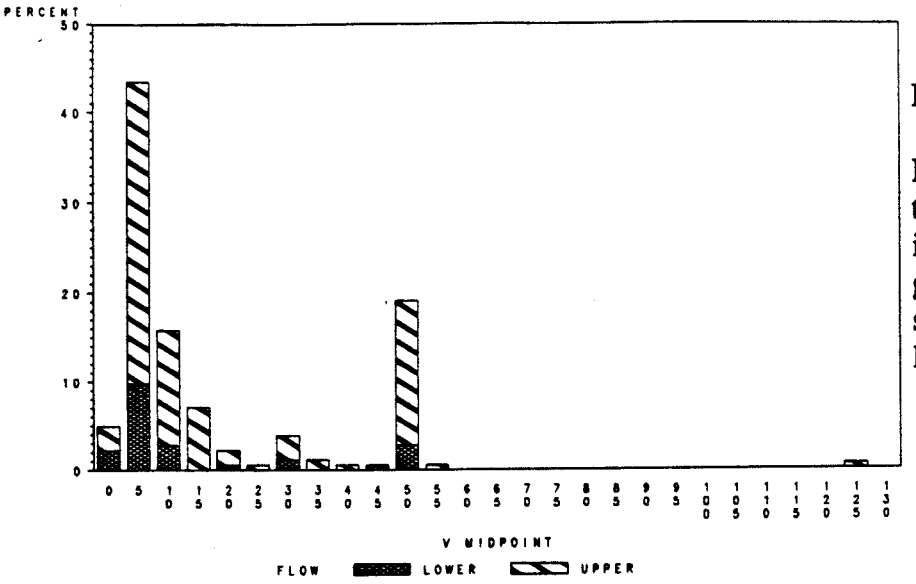


Figure A-56.

Data distribution of total **VANADIUM** in background groundwater, showing upper and lower flow-systems.

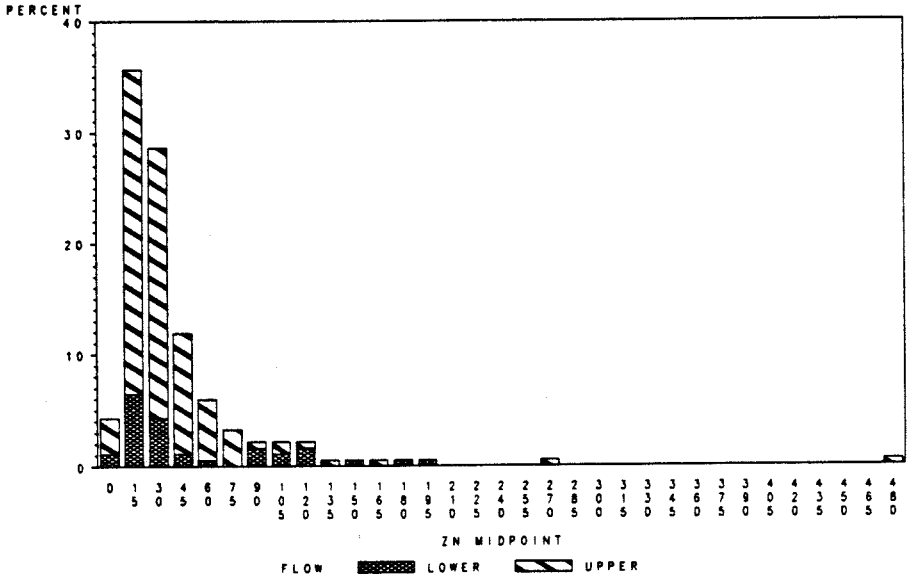


Figure A-57.

Data distribution of total **ZINC** in background groundwater, showing upper and lower flow-systems.

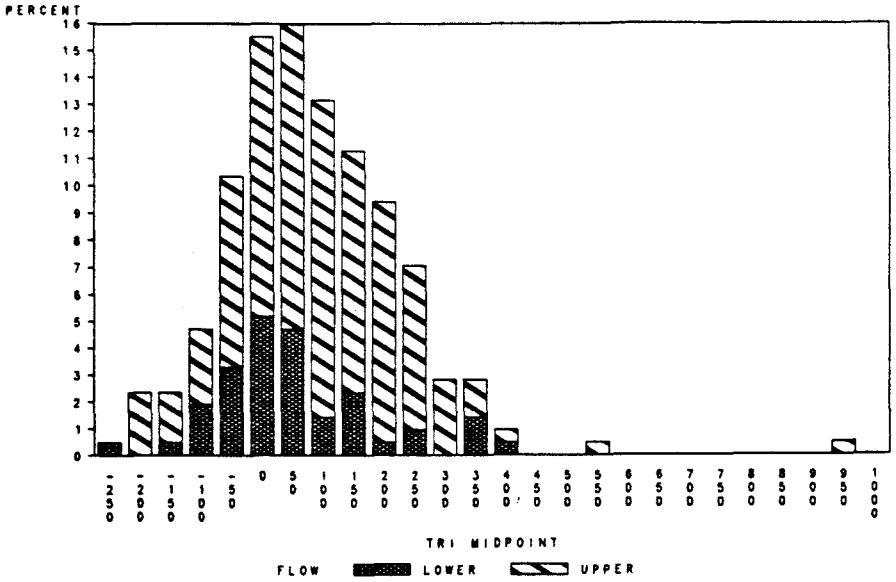


Figure A-58.

Data distribution of dissolved **TRITIUM** in background groundwater, showing upper and lower flow-systems.

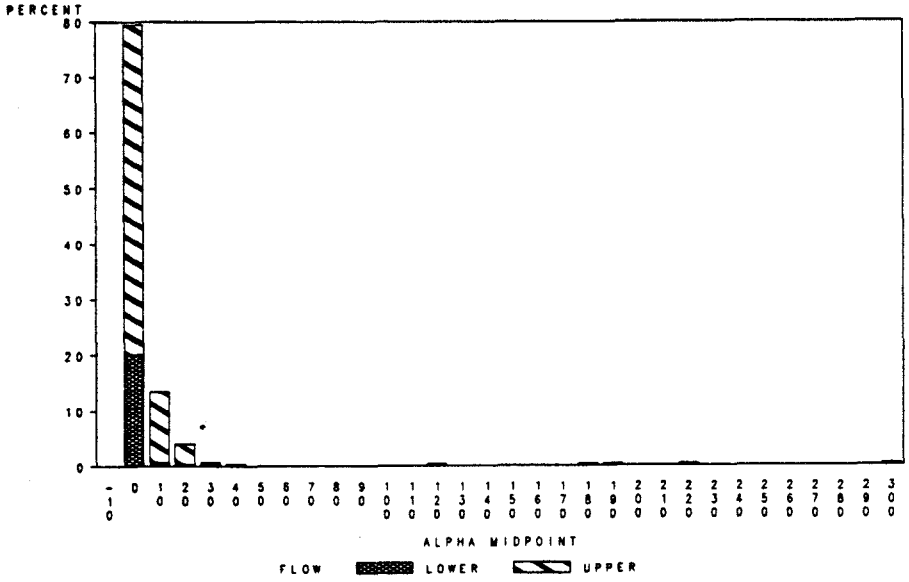


Figure A-59.

Data distribution of dissolved **GROSS ALPHA** in background groundwater, showing upper and lower flow-systems.

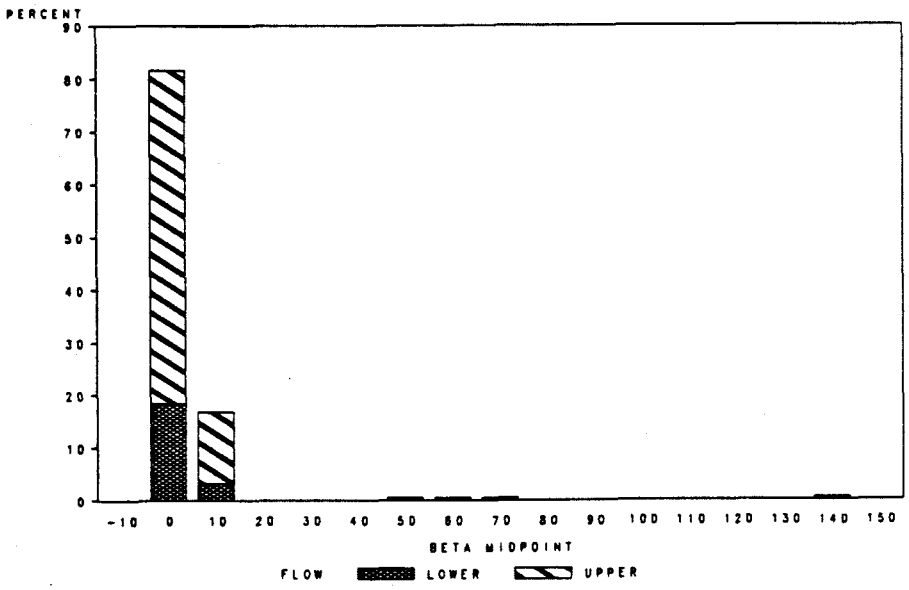


Figure A-60.

Data distribution of dissolved **GROSS BETA** in background groundwater, showing upper and lower flow-systems.

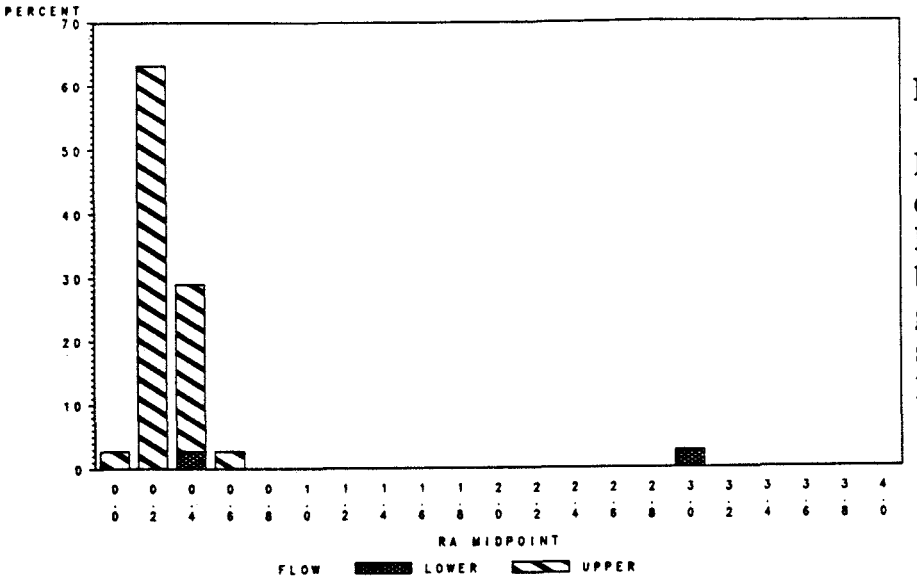


Figure A-61.

Data distribution of dissolved **RADIUM-226** in background groundwater, showing upper and lower flow-systems.

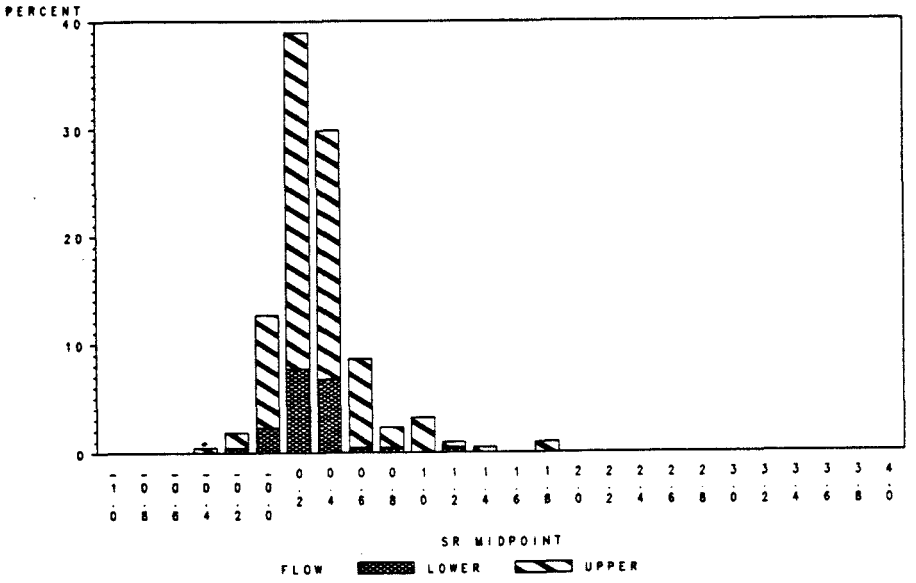


Figure A-62.

Data distribution of dissolved **STRONTIUM-89,90** in background groundwater, showing upper and lower flow-systems.

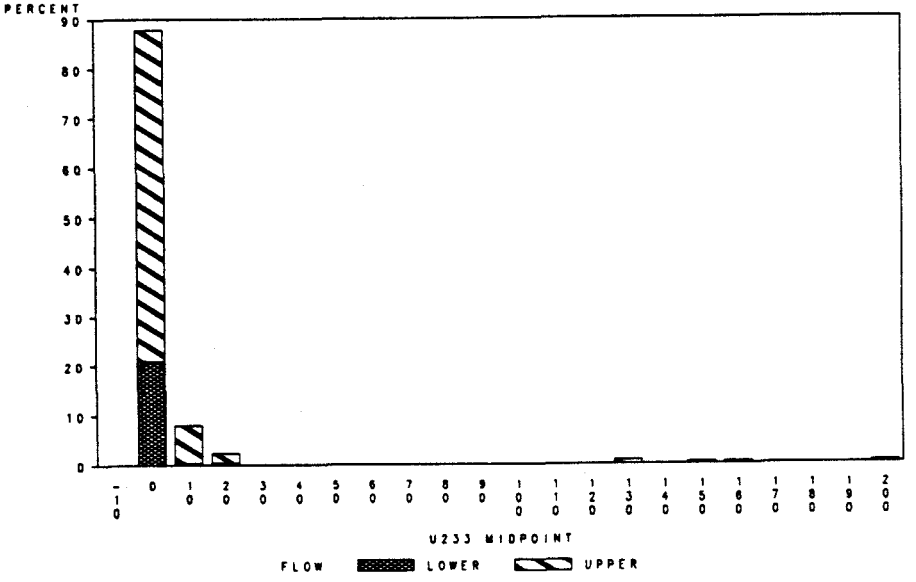


Figure A-63.

Data distribution of dissolved **URANIUM-233,234** in background groundwater, showing upper and lower flow-systems.

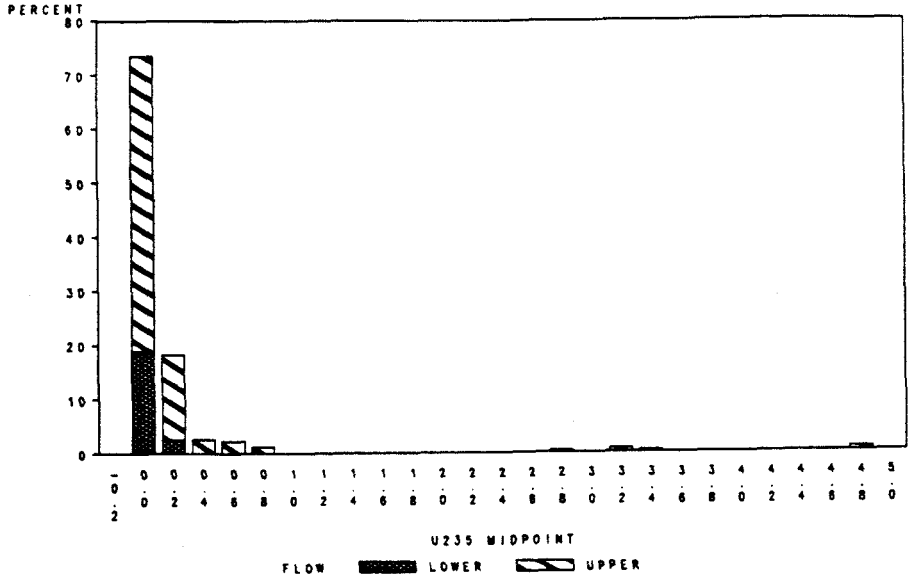


Figure A-64.

Data distribution of dissolved **URANIUM-235** in background groundwater, showing upper and lower flow-systems

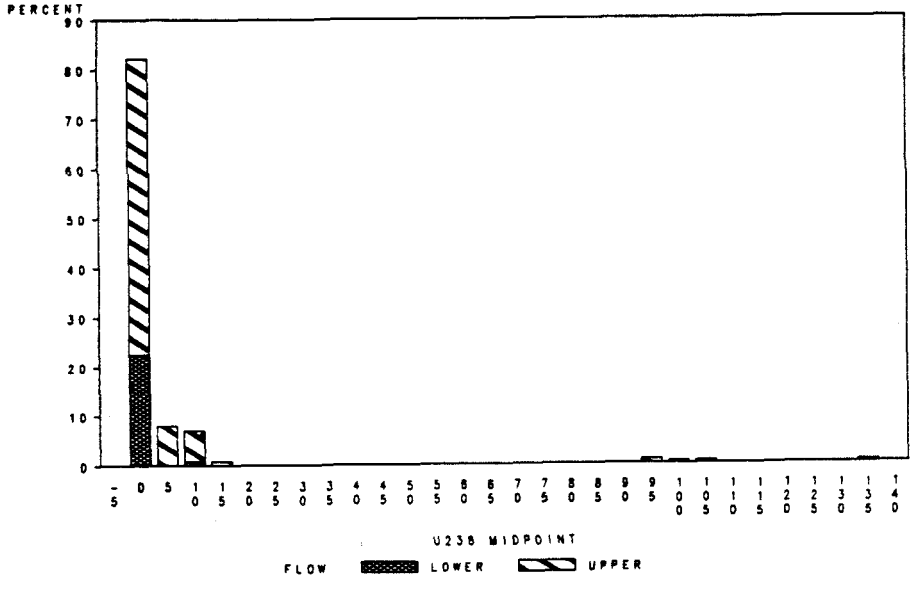


Figure A-65.

Data distribution of dissolved **URANIUM-238** in background groundwater, showing upper and lower flow-systems.

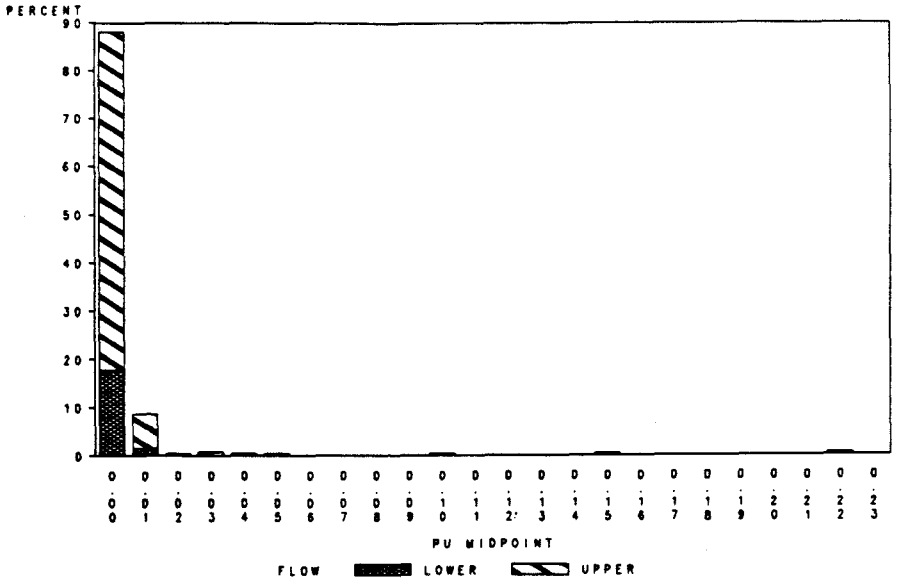


Figure A-66.

Data distribution of total **PLUTONIUM-239,240** in background groundwater, showing upper and lower flow-systems.

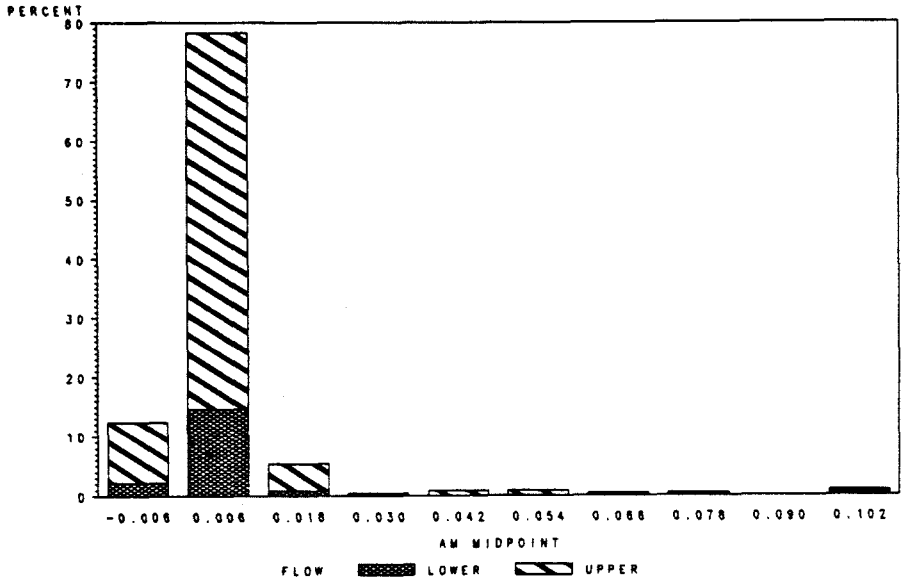


Figure A-67.

Data distribution of total **AMERICIUM-241** in background groundwater, showing upper and lower flow-systems.

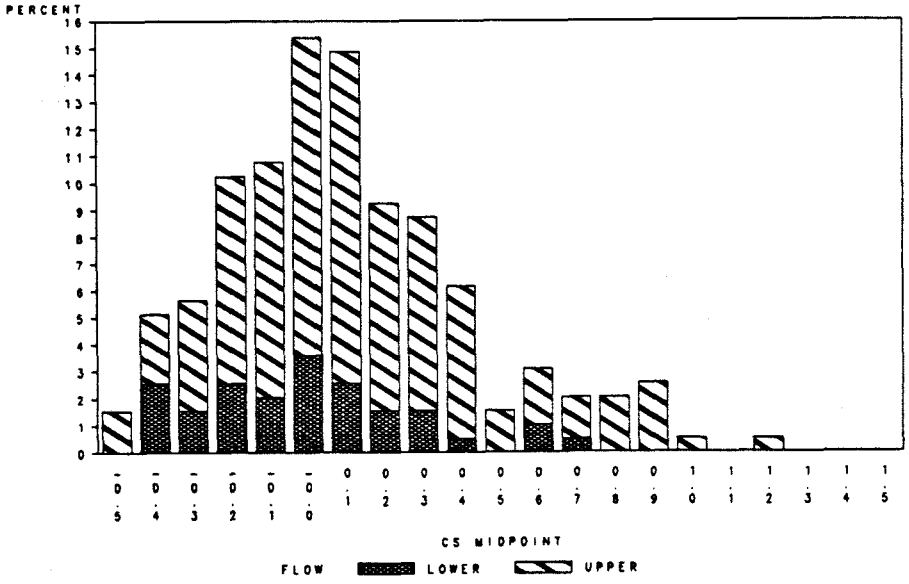


Figure A-68.

Data distribution of total **CESIUM-137** in background groundwater, showing upper and lower flow-systems.

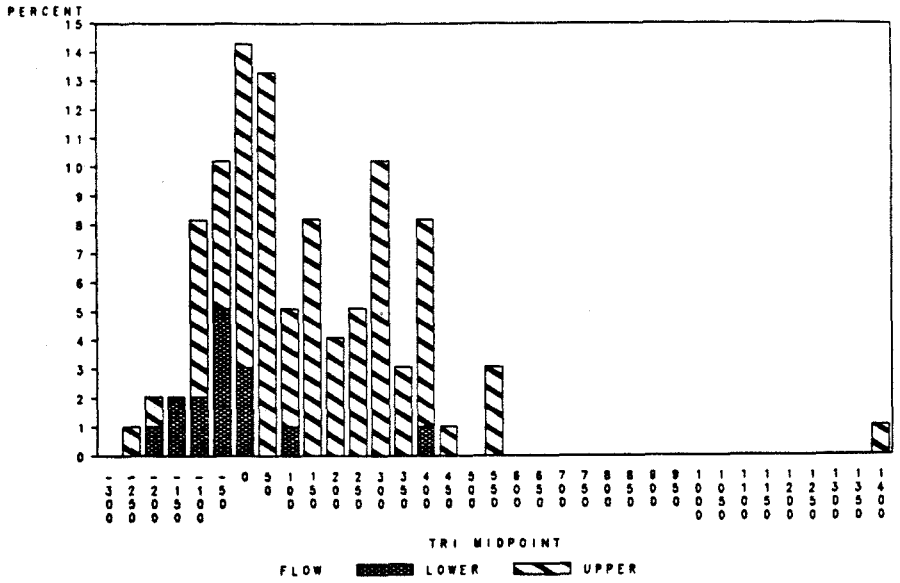


Figure A-69.

Data distribution of total **TRITIUM** in background groundwater, showing upper and lower flow-systems.

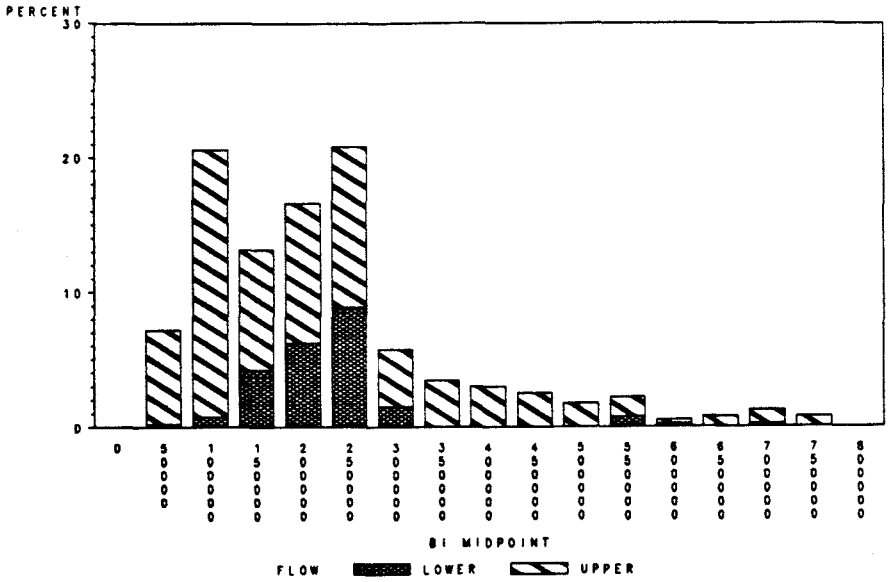


Figure A-70.

Data distribution of **BICARBONATE** in background groundwater, showing upper and lower flow-systems.

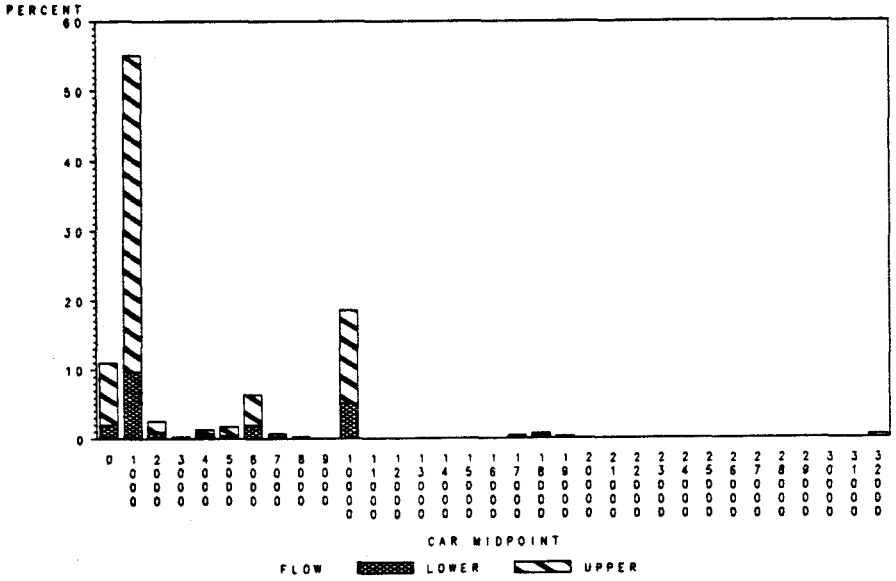


Figure A-71.

Data distribution of **CARBONATE** in background groundwater, showing upper and lower flow-systems.

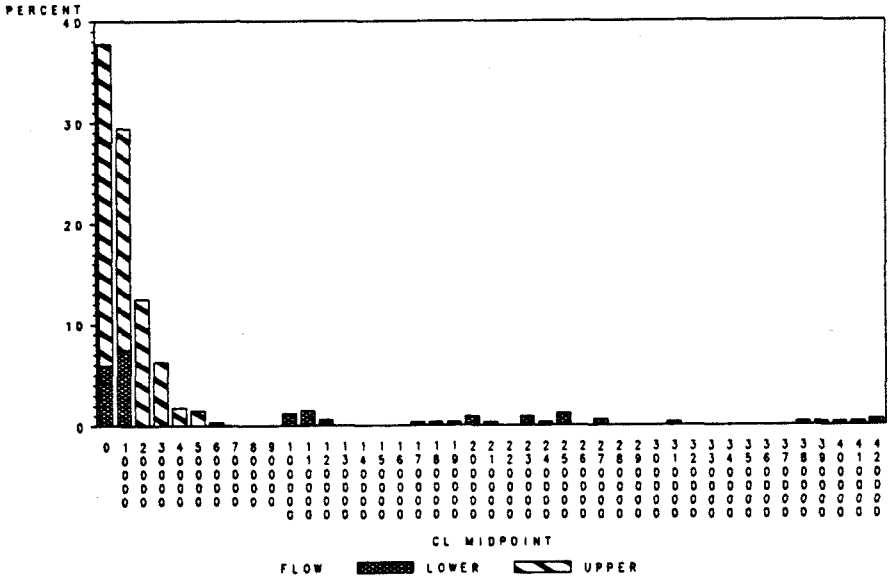


Figure A-72.

Data distribution of **CHLORIDE** in background groundwater, showing upper and lower flow-systems.

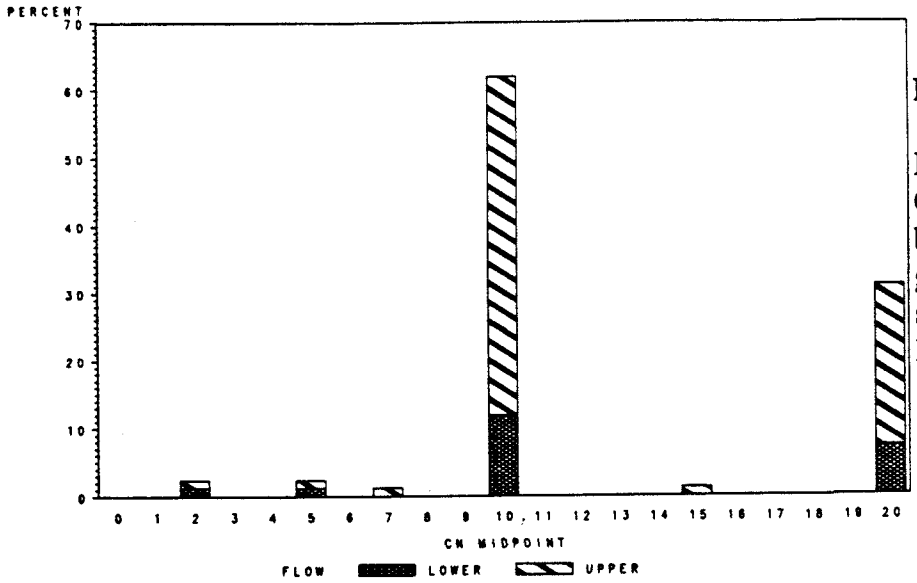


Figure A-73.

Data distribution of **CYANIDE** in background groundwater, showing upper and lower flow-systems.

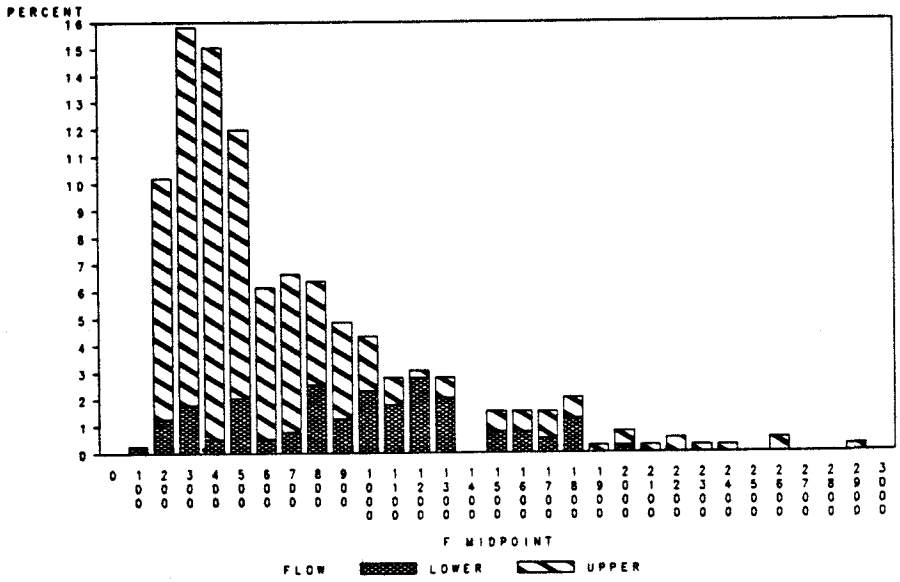


Figure A-74.

Data distribution of **FLUORIDE** in background groundwater, showing upper and lower flow-systems.

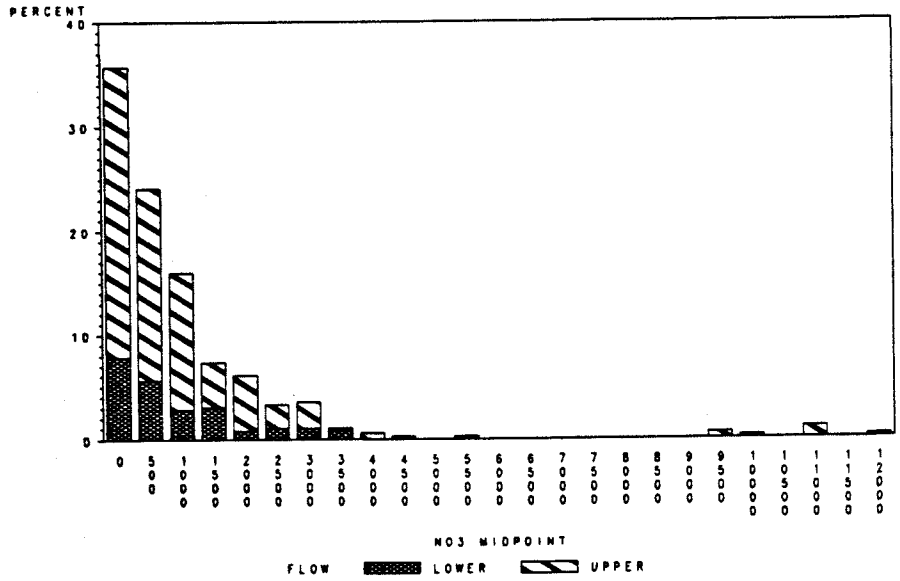


Figure A-75.

Data distribution of **NITRATE / NITRITE** in background groundwater, showing upper and lower flow-systems.

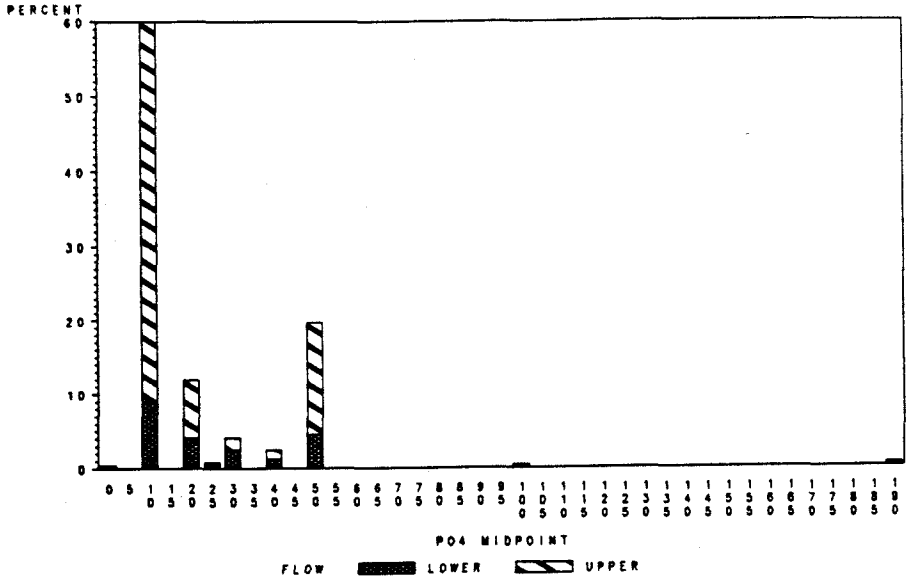


Figure A-76.

Data distribution of **ORTHO-PHOSPHATE** in background groundwater, showing upper and lower flow-systems.

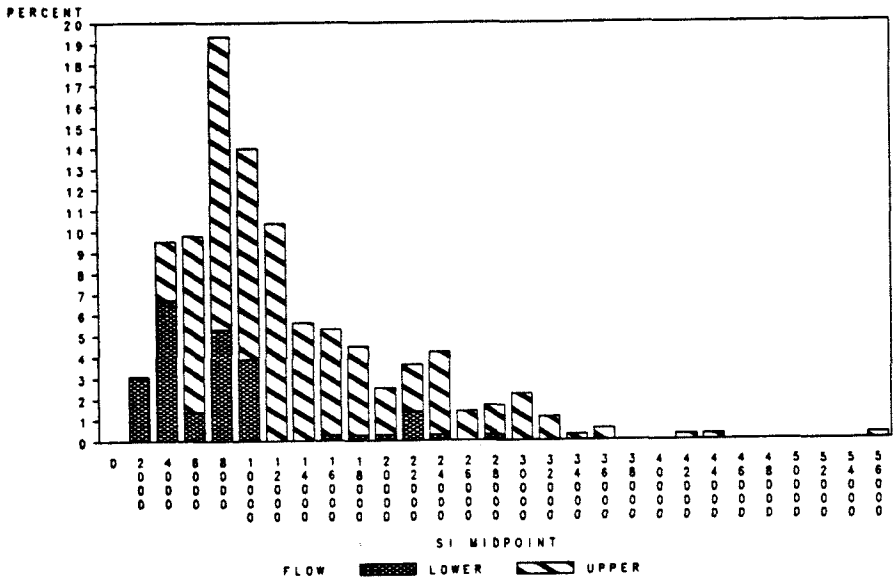


Figure A-77.

Data distribution of **SILICA** in background groundwater, showing upper and lower flow-systems.

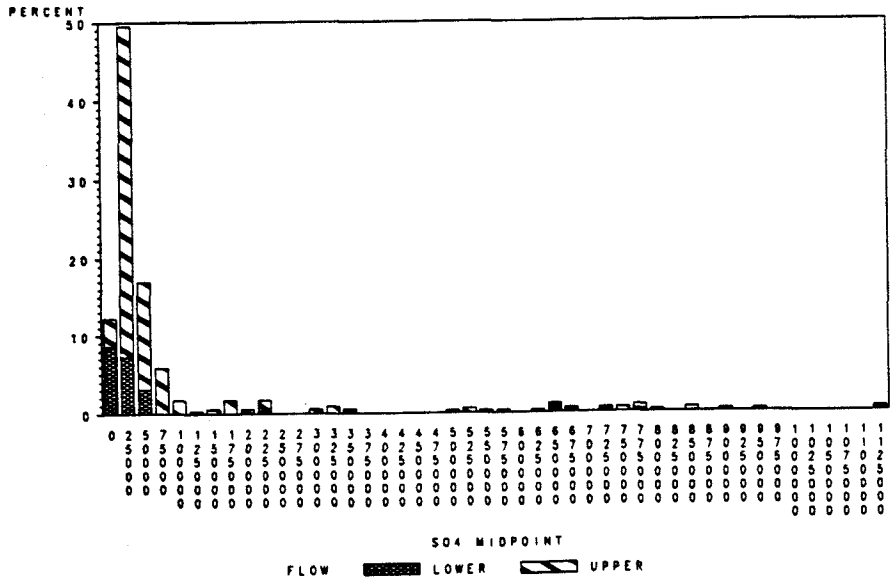


Figure A-78.

Data distribution of **SULFATE** in background groundwater, showing upper and lower flow-systems.

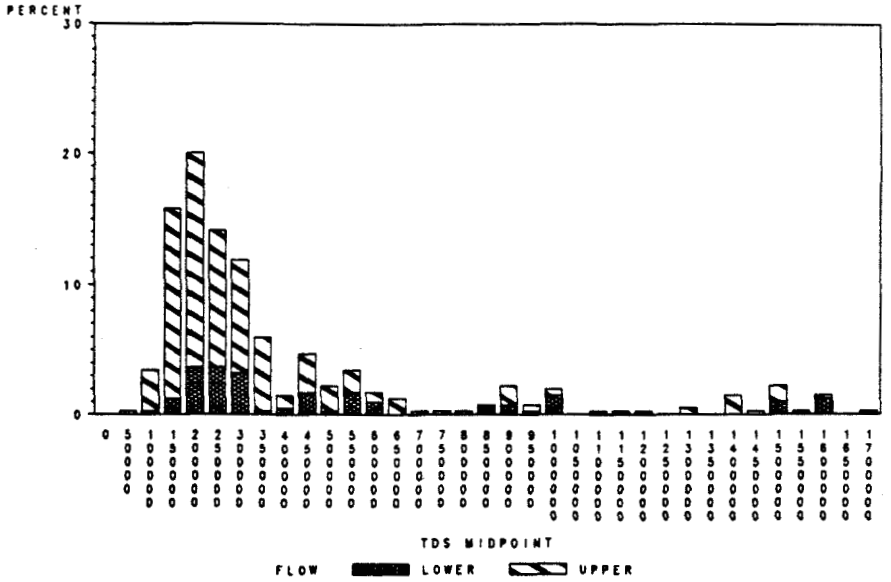


Figure A-79.

Data distribution of **TOTAL DISSOLVED SOLIDS** in background groundwater, showing upper and lower flow-systems.

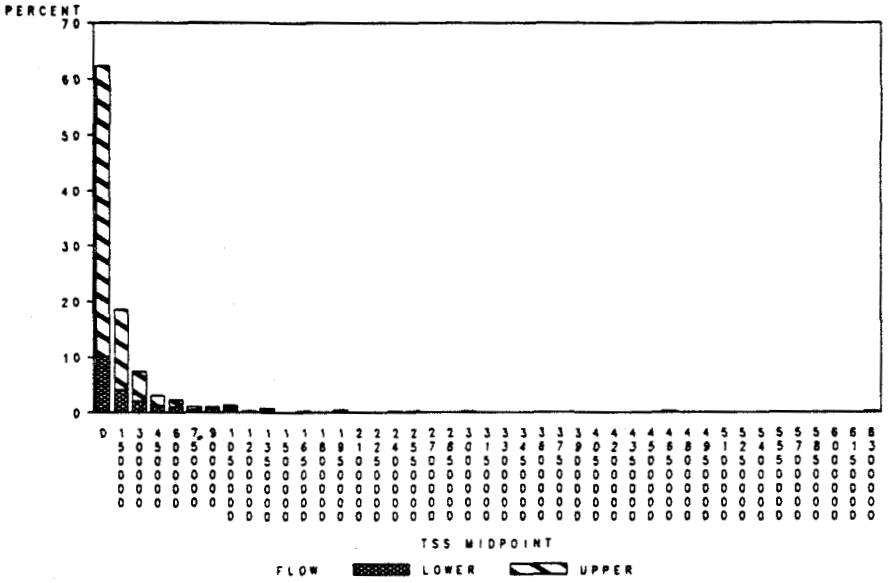


Figure A-80.

Data distribution of **TOTAL SUSPENDED SOLIDS** in background groundwater, showing upper and lower flow-systems.

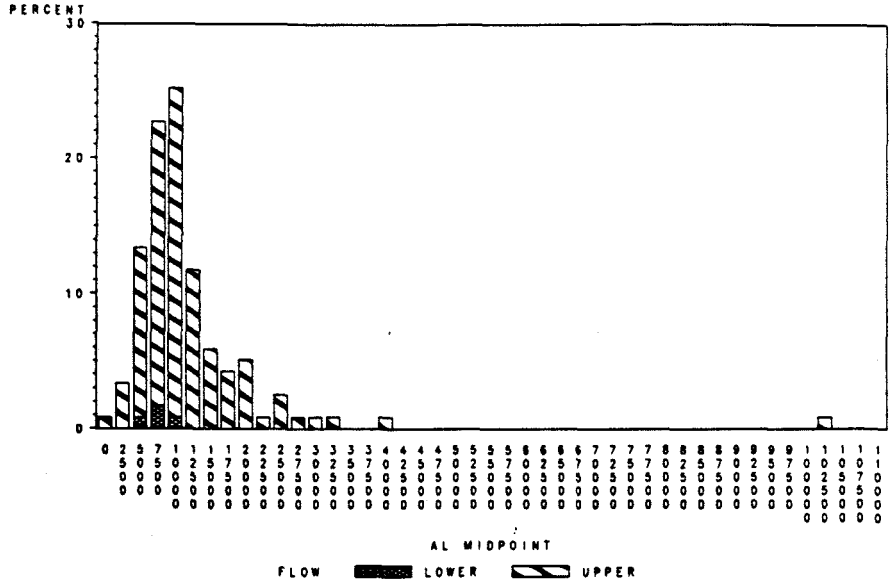


Figure A-81.

Data distribution of total **ALUMINUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

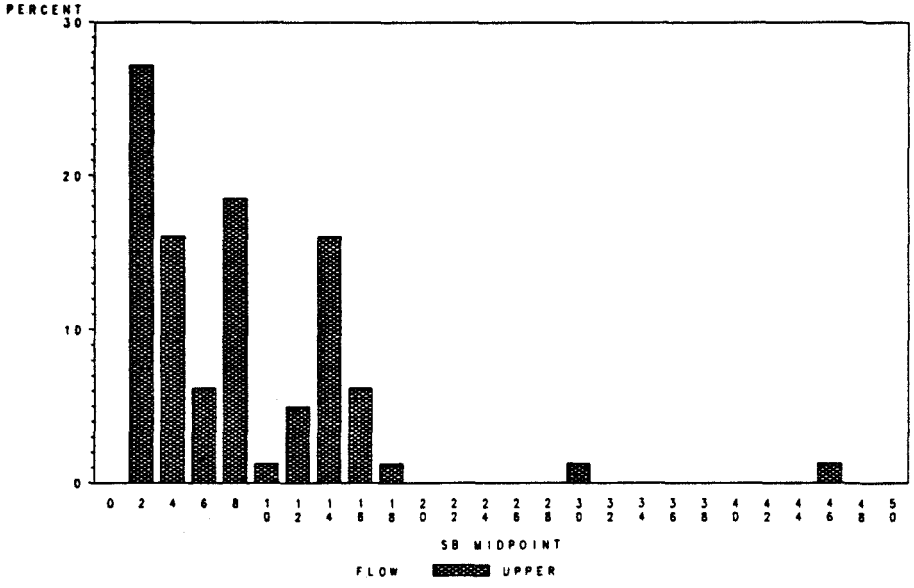


Figure A-82.

Data distribution of total **ANTIMONY** in background geologic (borehole) materials, showing upper and lower flow-systems.

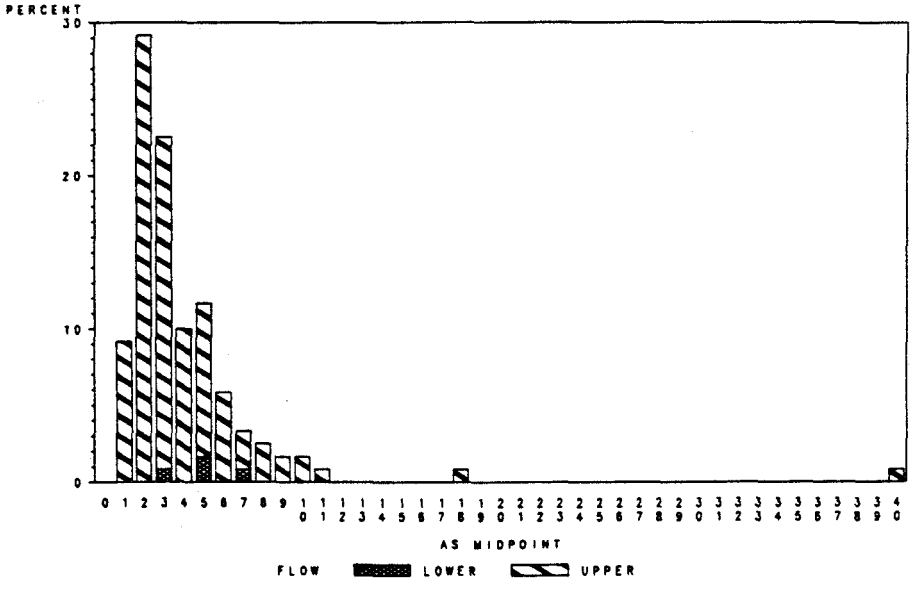


Figure A-83.

Data distribution of total **ARSENIC** in background geologic (borehole) materials, showing upper and lower flow-systems.

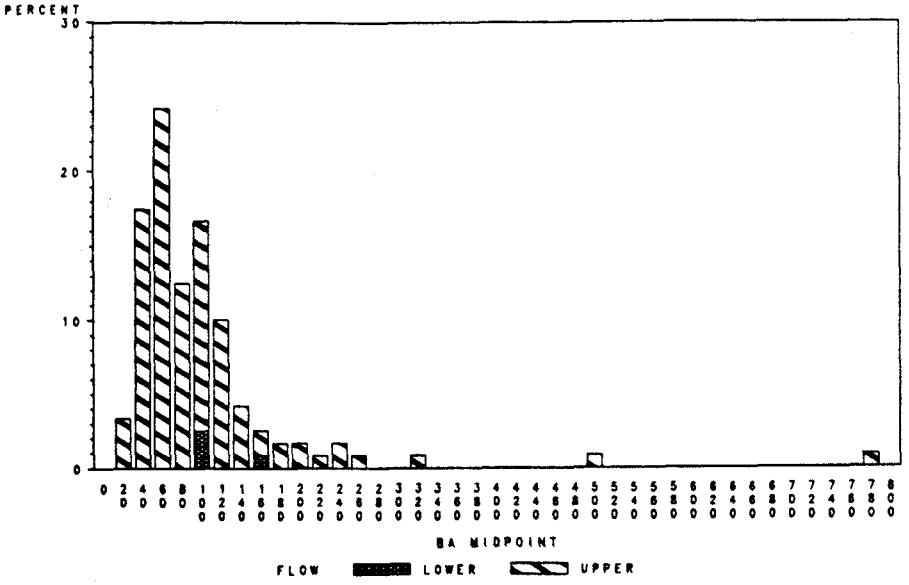


Figure A-84.

Data distribution of total **BARIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

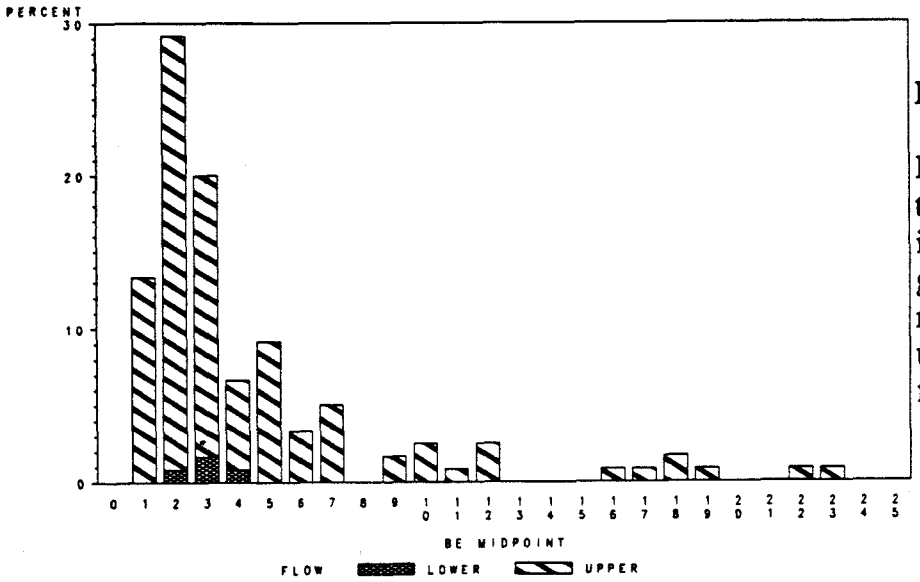


Figure A-85.

Data distribution of total **BERYLLIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

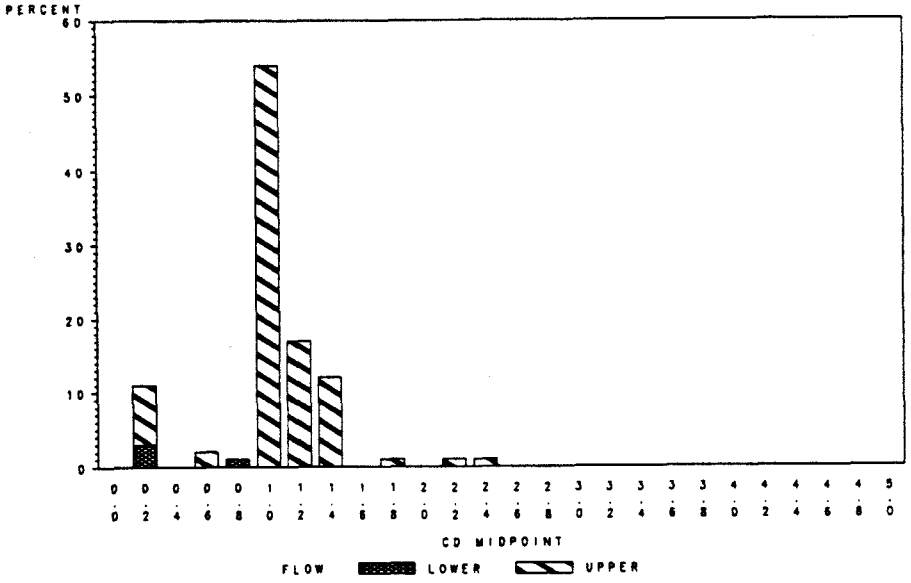


Figure A-86.

Data distribution of total **CADMIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

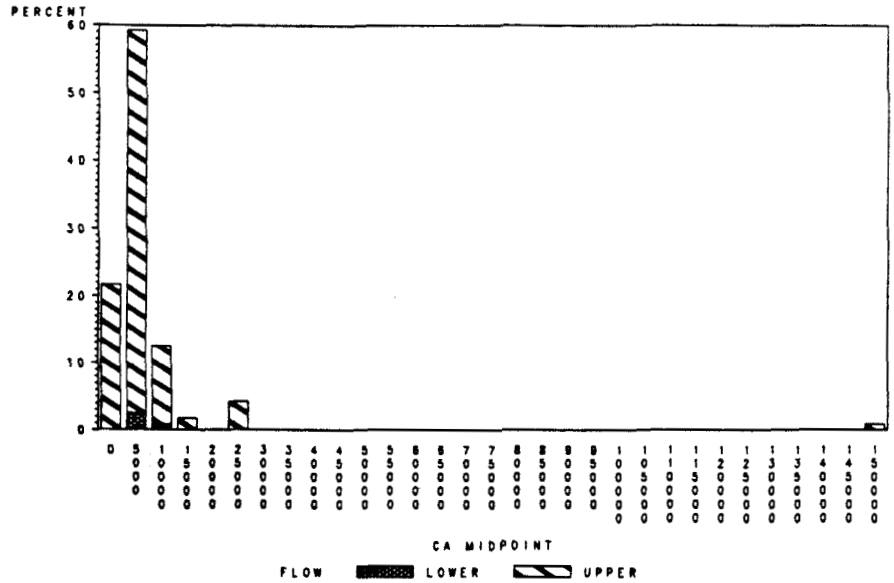


Figure A-87.

Data distribution of total **CALCIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

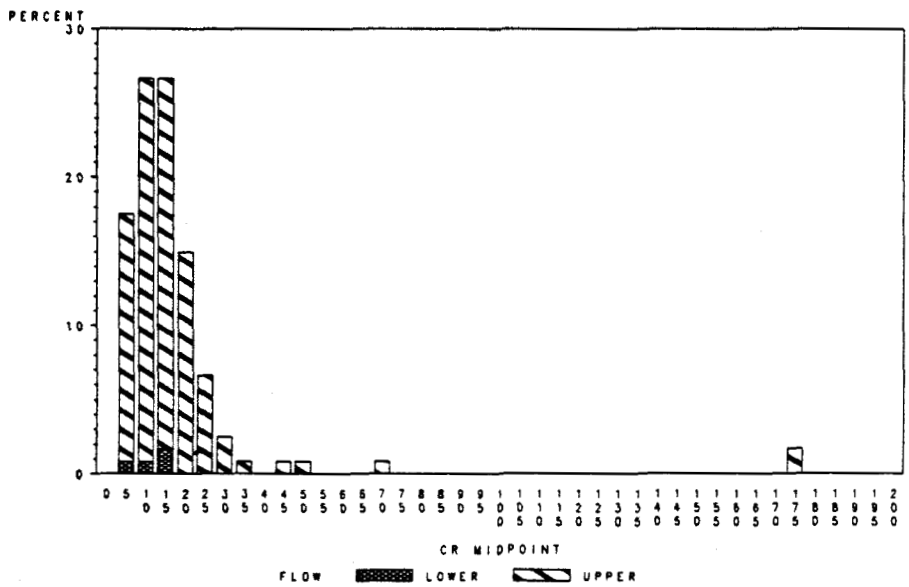


Figure A-88.

Data distribution of total **CHROMIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

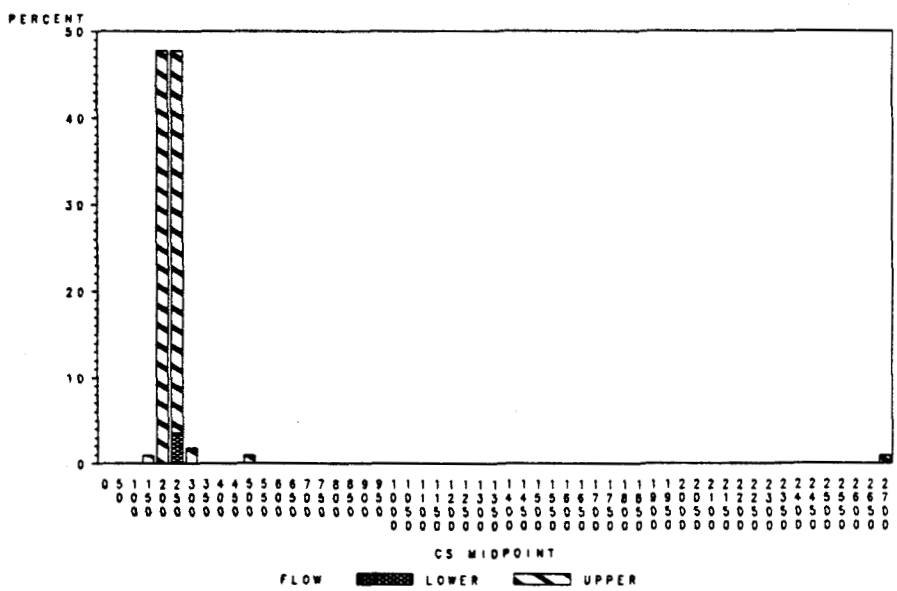


Figure A-89.

Data distribution of total **CESIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

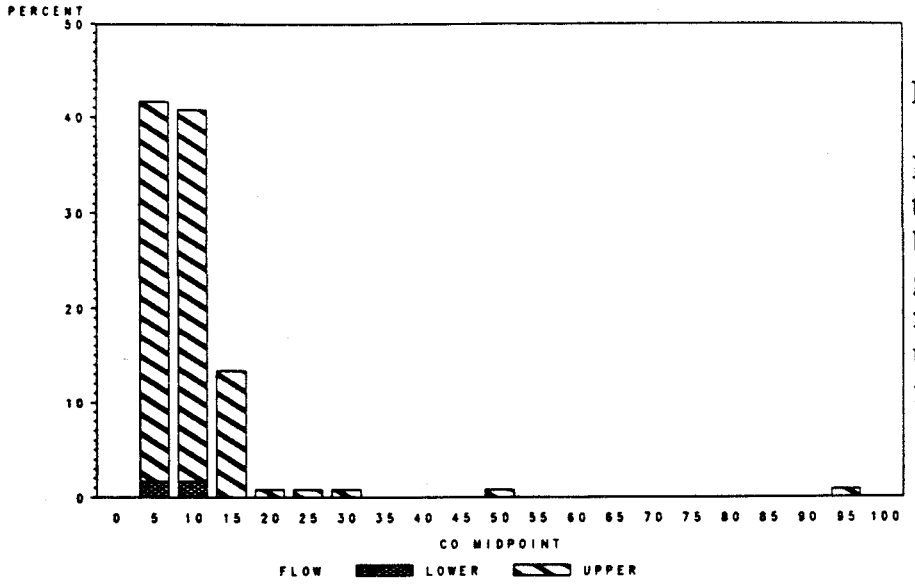


Figure A-90.

Data distribution of total **COBALT** in background geologic (borehole) materials, showing upper and lower flow-systems.

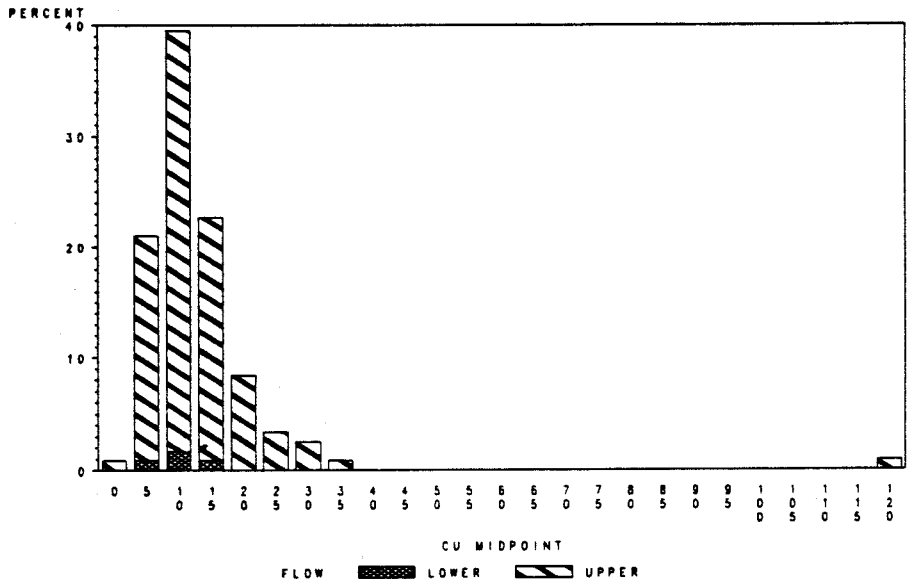


Figure A-91.

Data distribution of total **COPPER** in background geologic (borehole) materials, showing upper and lower flow-systems.

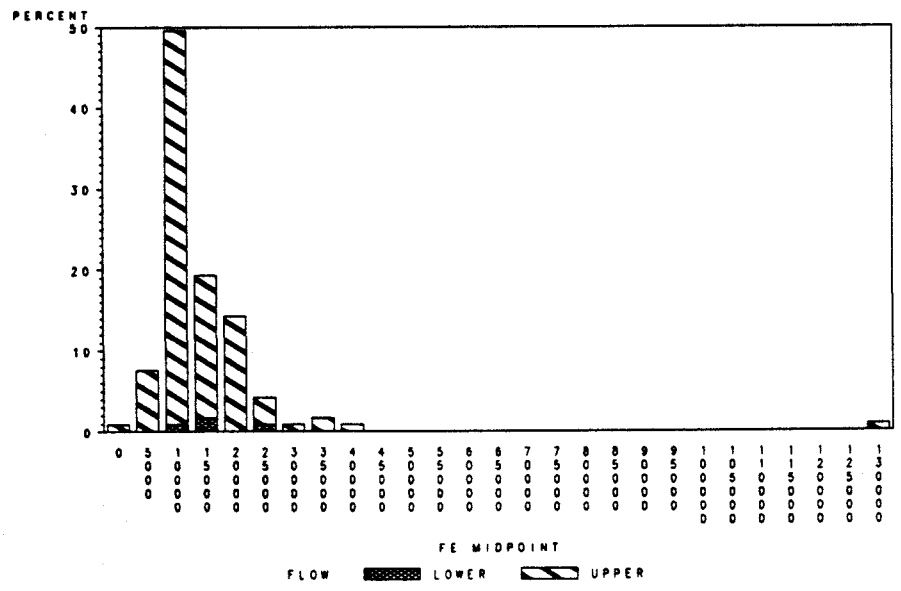


Figure A-92.

Data distribution of total **IRON** in background geologic (borehole) materials, showing upper and lower flow-systems.

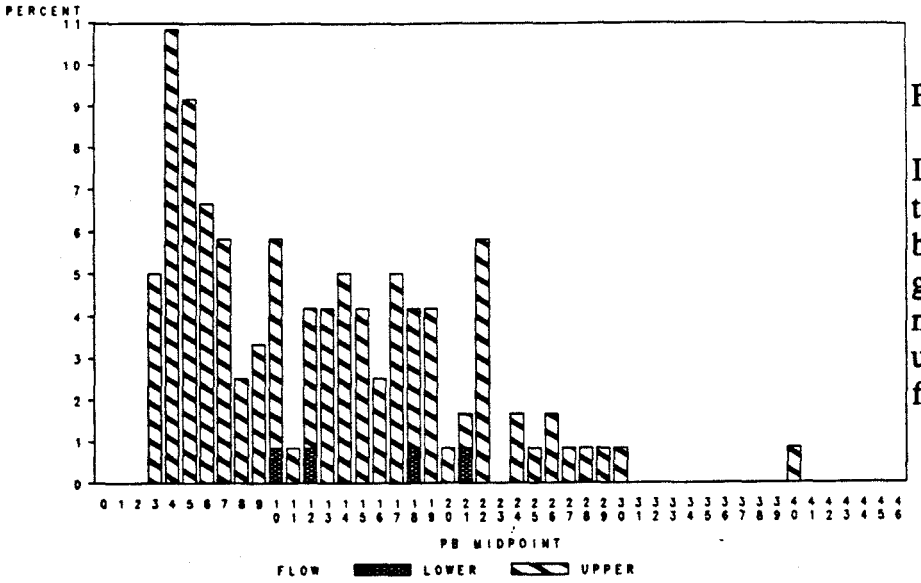


Figure A-93.

Data distribution of total **LEAD** in background geologic (borehole) materials, showing upper and lower flow-systems.

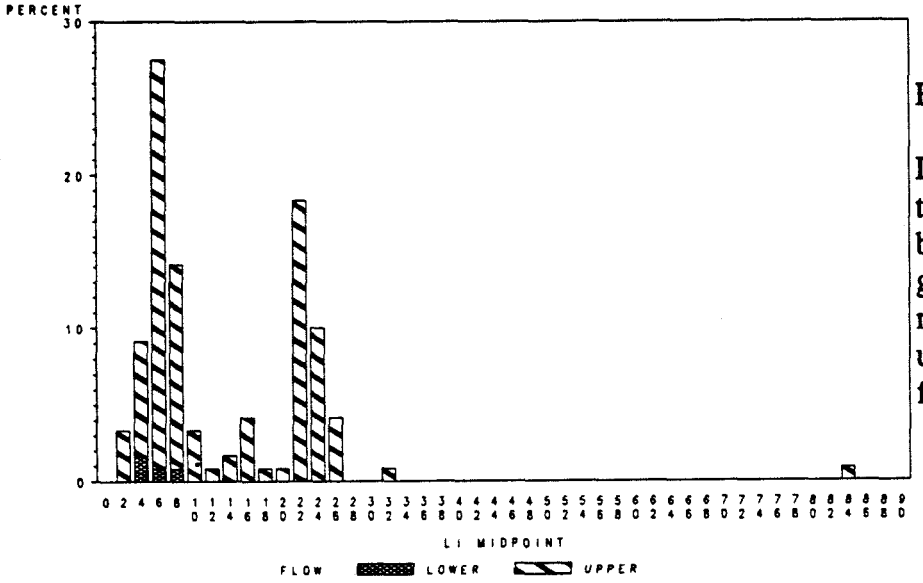


Figure A-94.

Data distribution of total **LITHIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

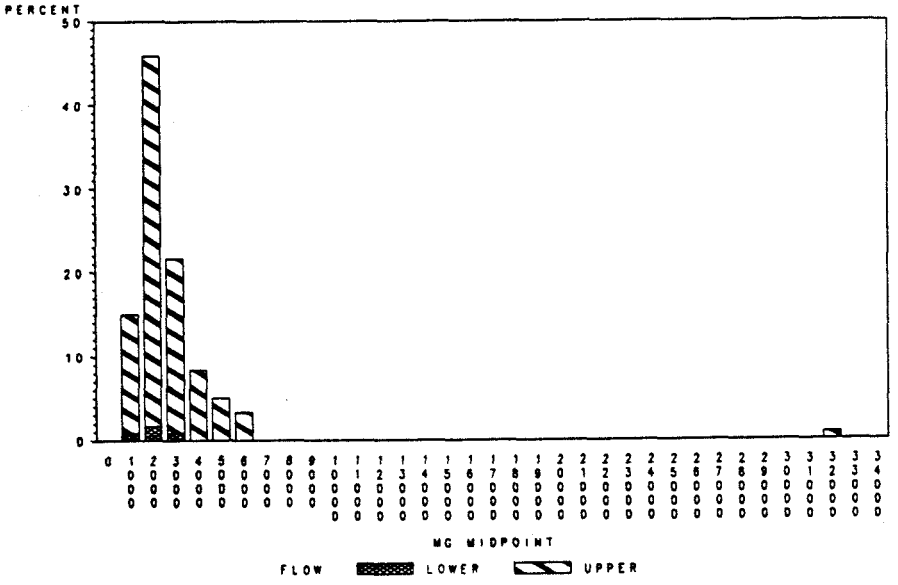


Figure A-95.

Data distribution of total **MAGNESIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

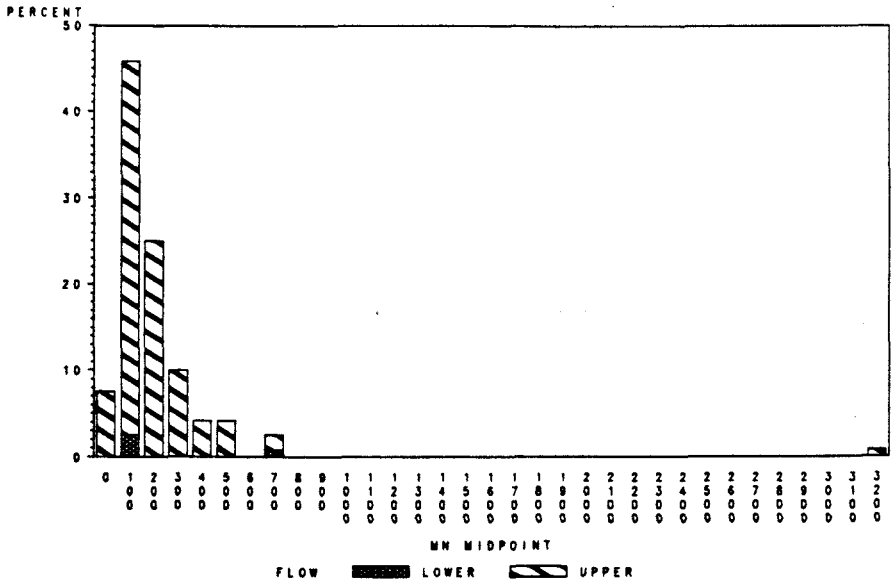


Figure A-96.

Data distribution of total **MANGANESE** in background geologic (borehole) materials, showing upper and lower flow-systems

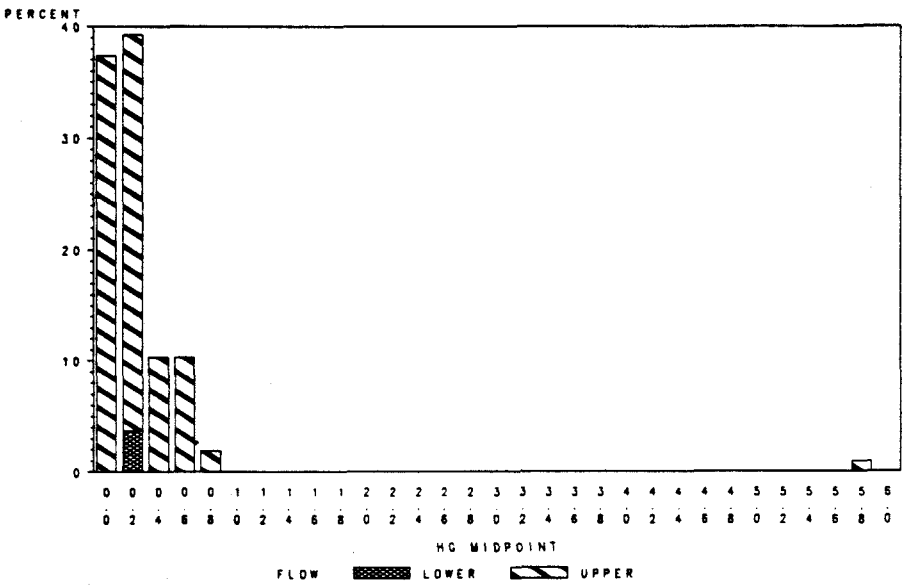


Figure A-97.

Data distribution of total **MERCURY** in background geologic (borehole) materials, showing upper and lower flow-systems.

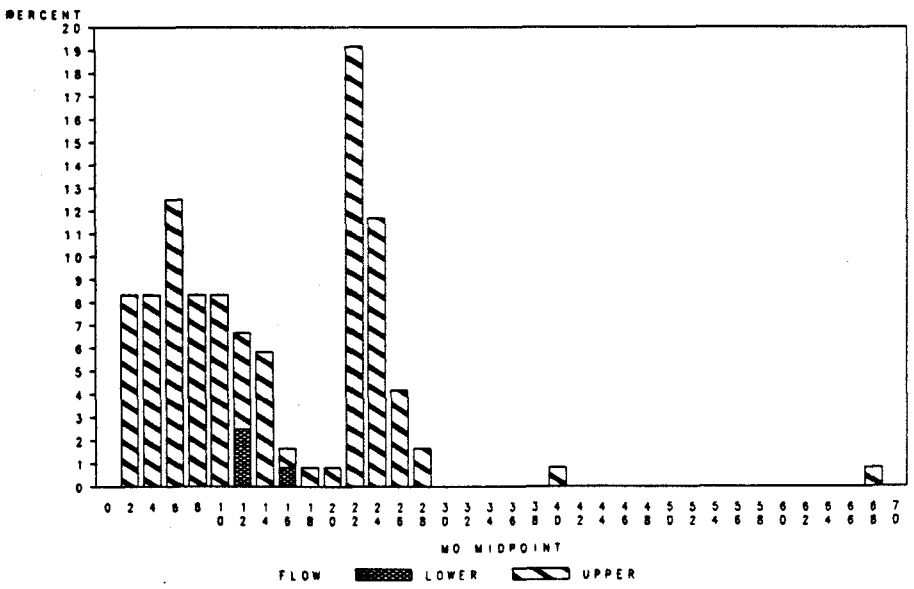


Figure A-98.

Data distribution of total **MOLYBDENUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

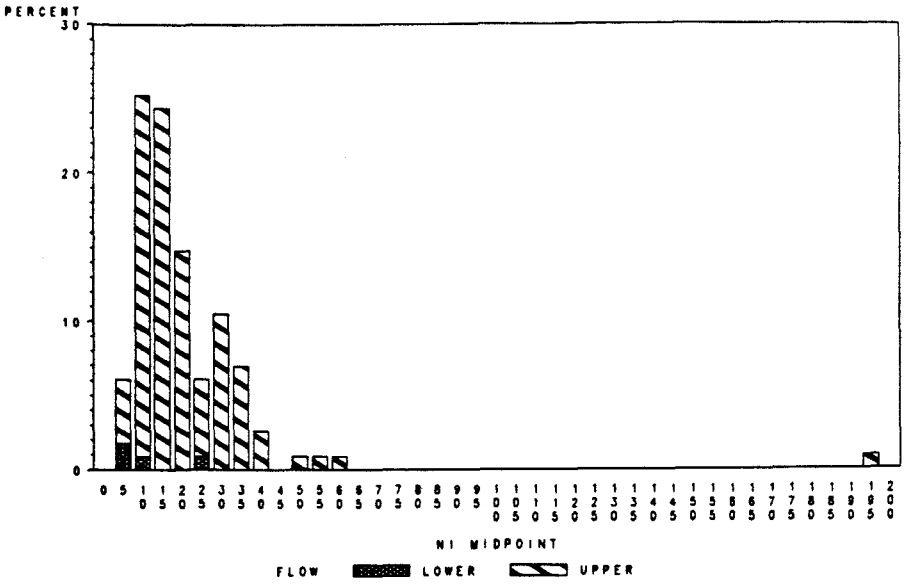


Figure A-99.

Data distribution of total **NICKEL** in background geologic (borehole) materials, showing upper and lower flow-systems.

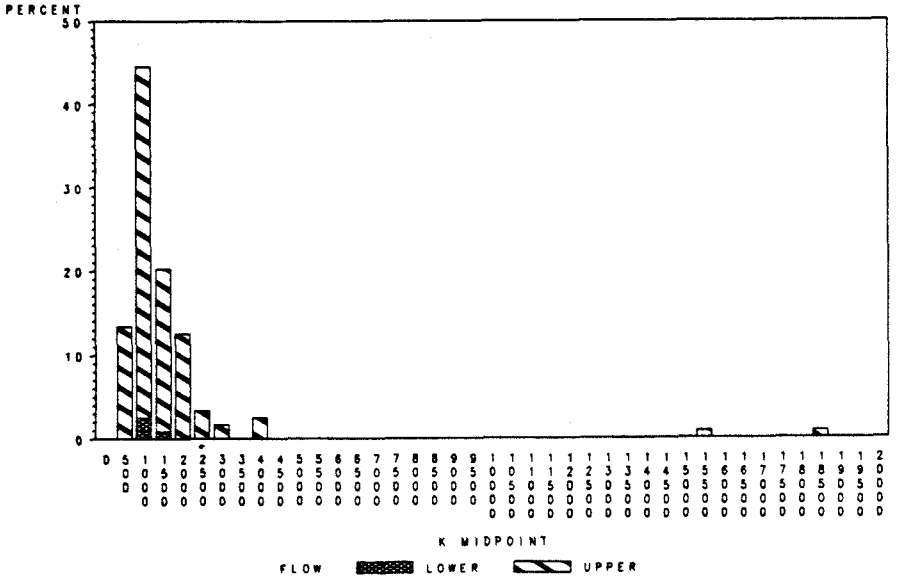


Figure A-100.

Data distribution of total **POTASSIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

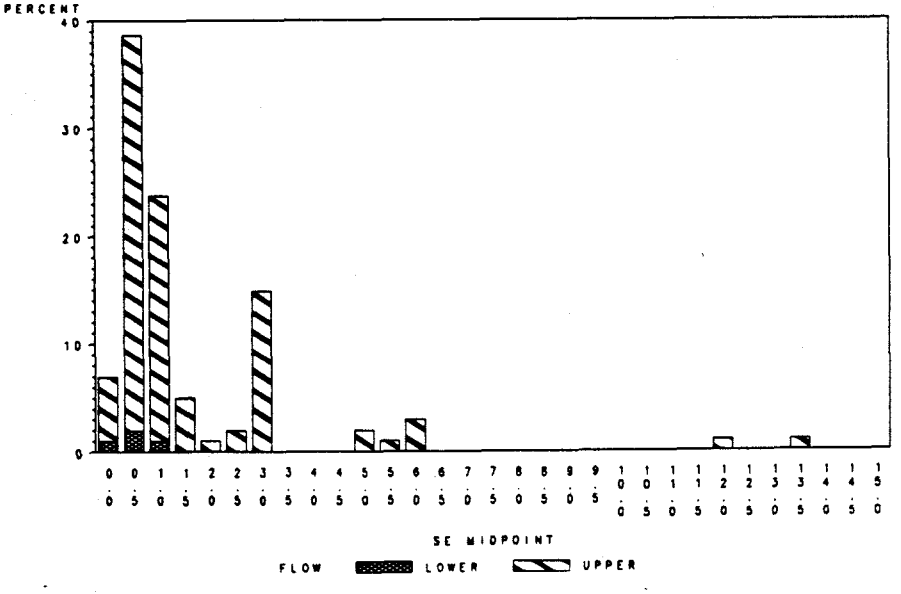


Figure A-101.

Data distribution of total **SELENIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

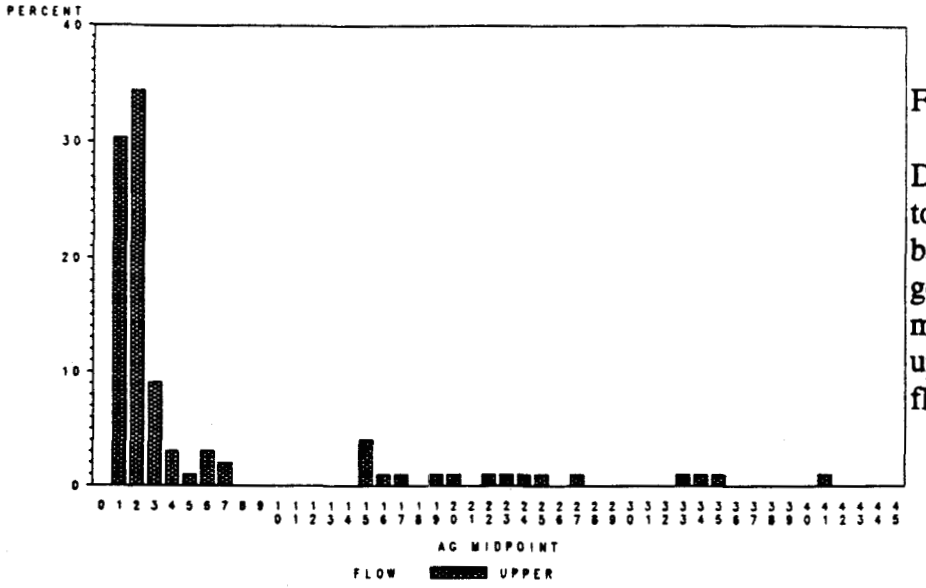


Figure A-102.

Data distribution of total **SILVER** in background geologic (borehole) materials, showing upper and lower flow-systems.

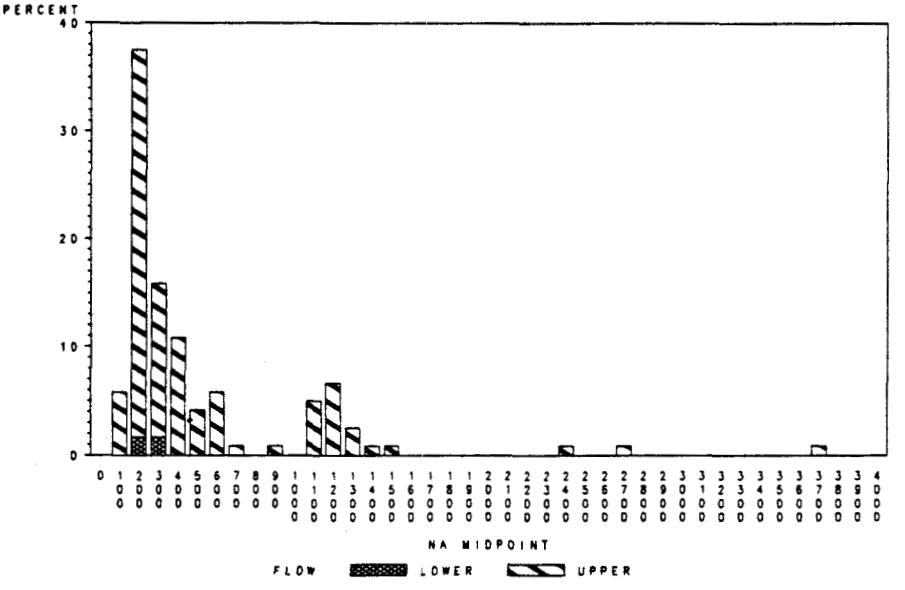


Figure A-103.

Data distribution of total **SODIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

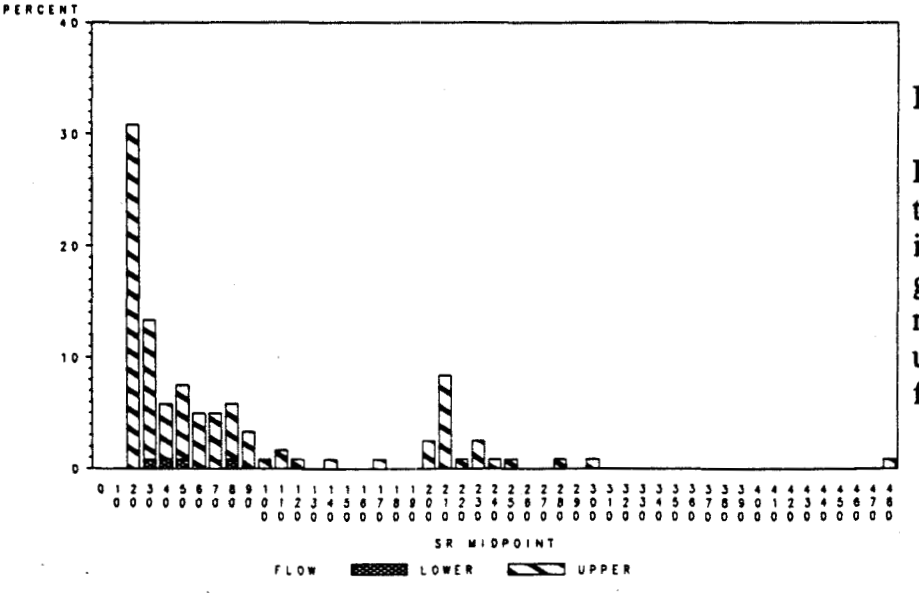


Figure A-104.

Data distribution of total **STRONTIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

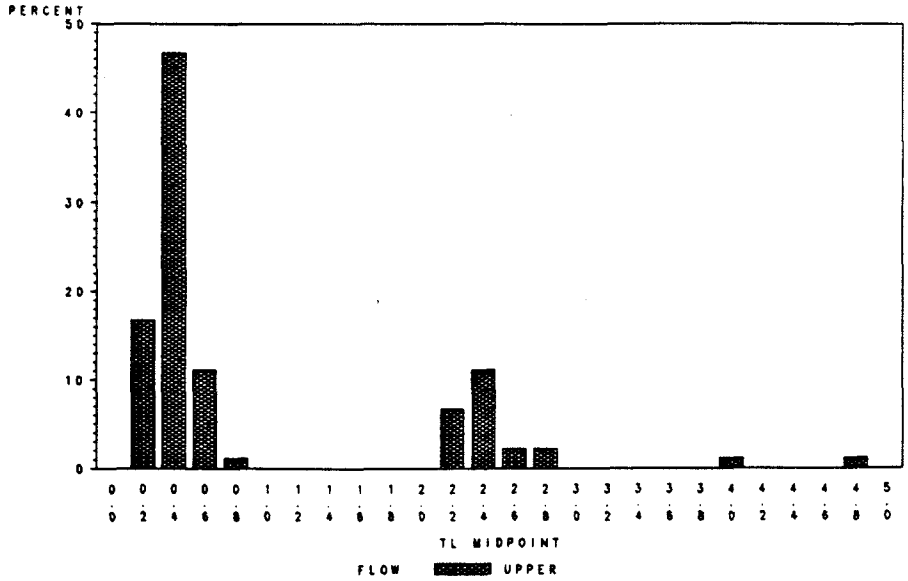


Figure A-105.

Data distribution of total **THALLIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

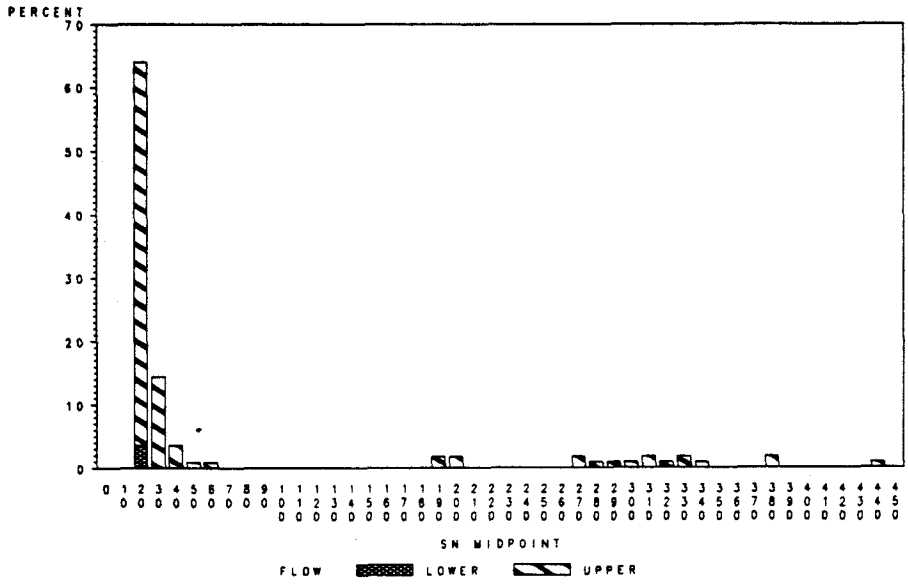


Figure A-106.

Data distribution of total **TIN** in background geologic (borehole) materials, showing upper and lower flow-systems.

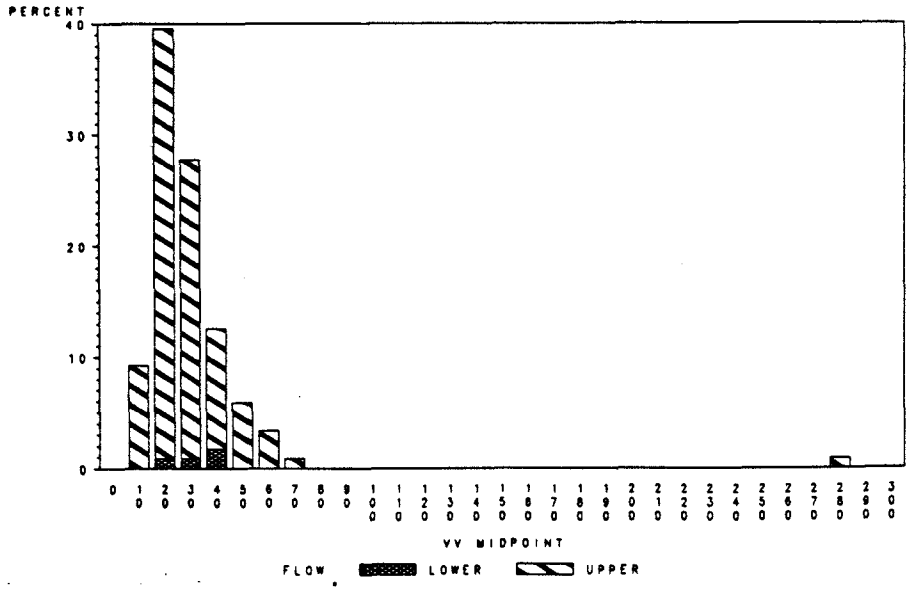


Figure A-107.

Data distribution of total **VANADIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

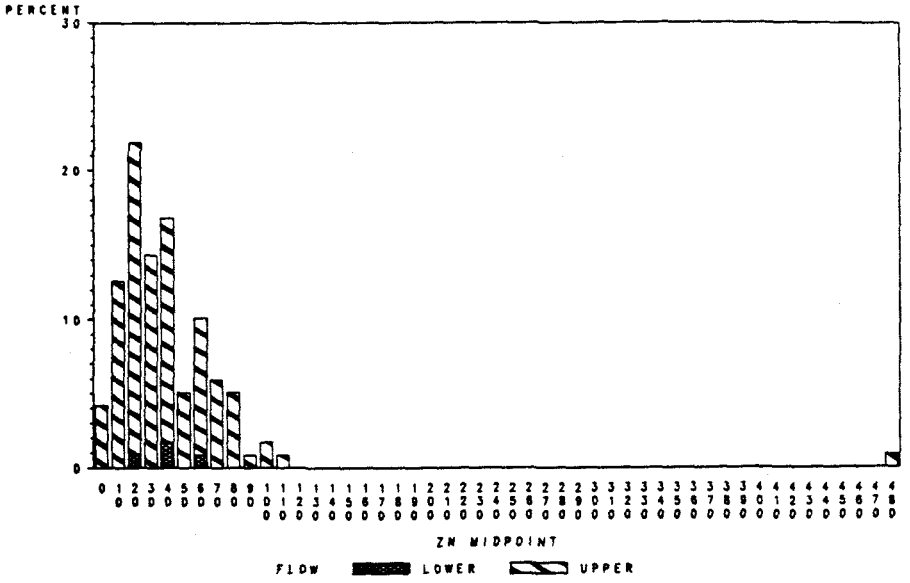


Figure A-108.

Data distribution of total **ZINC** in background geologic (borehole) materials, showing upper and lower flow-systems.

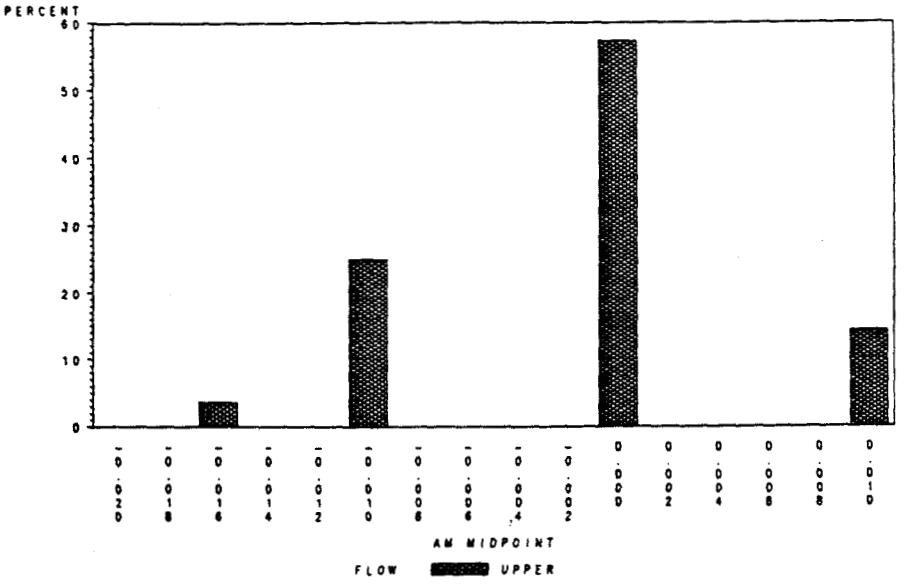


Figure A-109.

Data distribution of total **AMERICIUM-241** in background geologic (borehole) materials, showing upper and lower flow-systems.

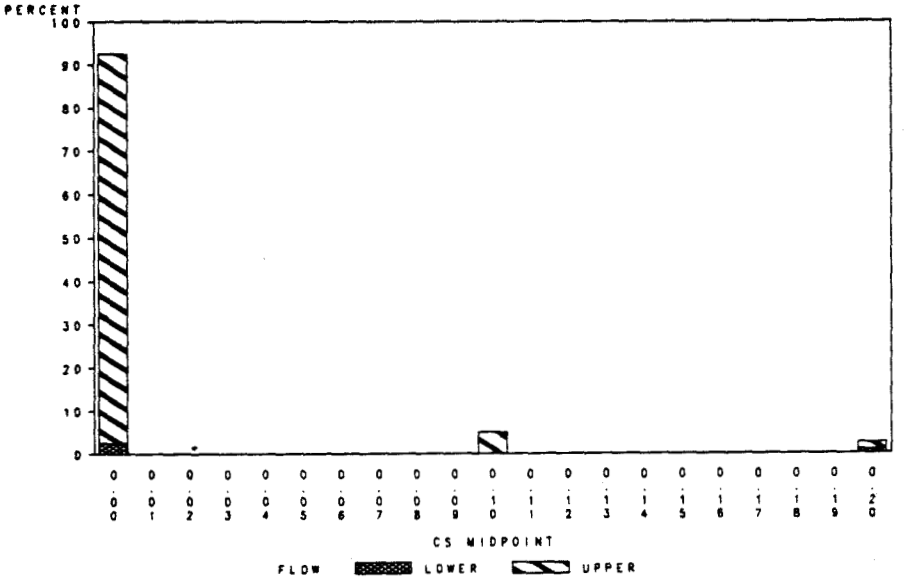


Figure A-110.

Data distribution of total **CESIUM-137** in background geologic (borehole) materials, showing upper and lower flow-systems.

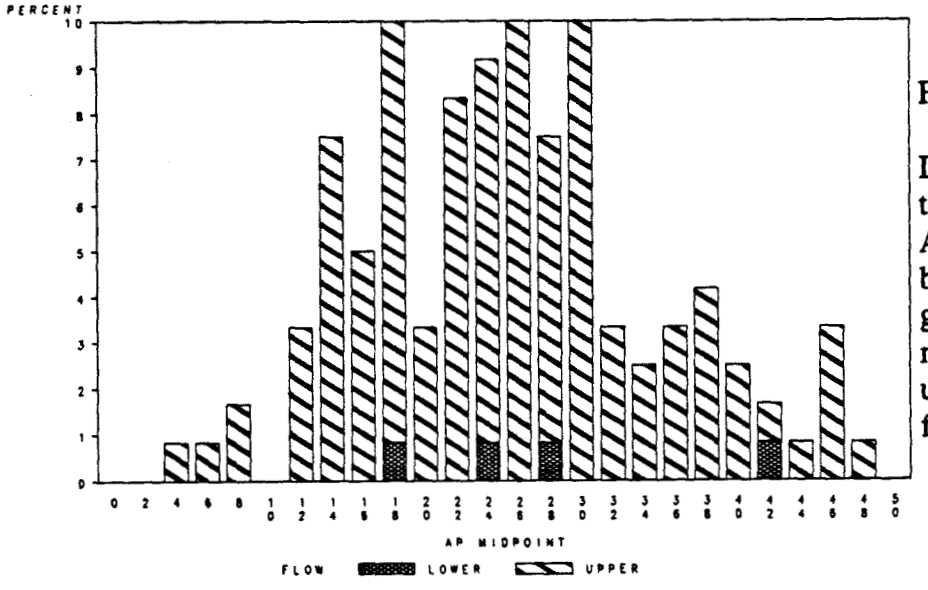


Figure A-111.

Data distribution of total **GROSS ALPHA** in background geologic (borehole) materials, showing upper and lower flow-systems.

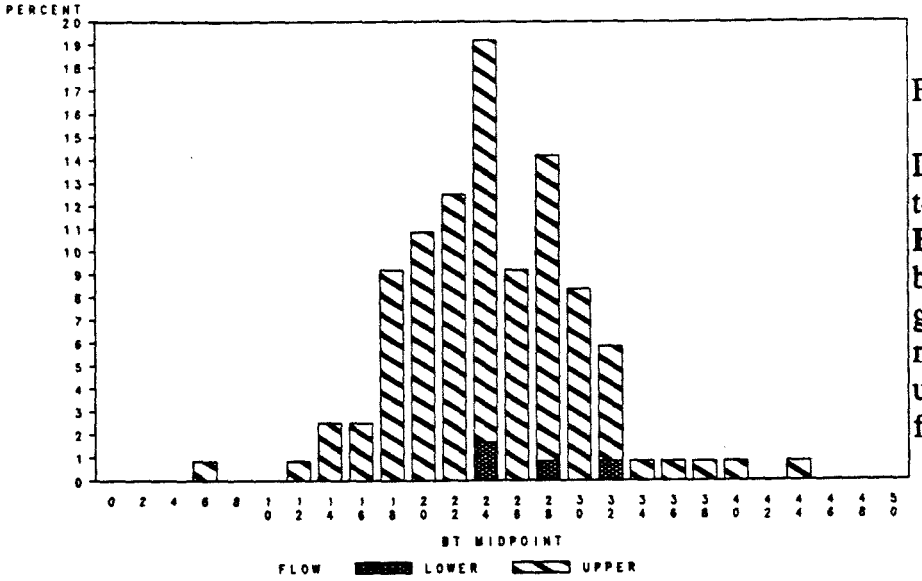


Figure A-112.

Data distribution of total **GROSS BETA** in background geologic (borehole) materials, showing upper and lower flow-systems.

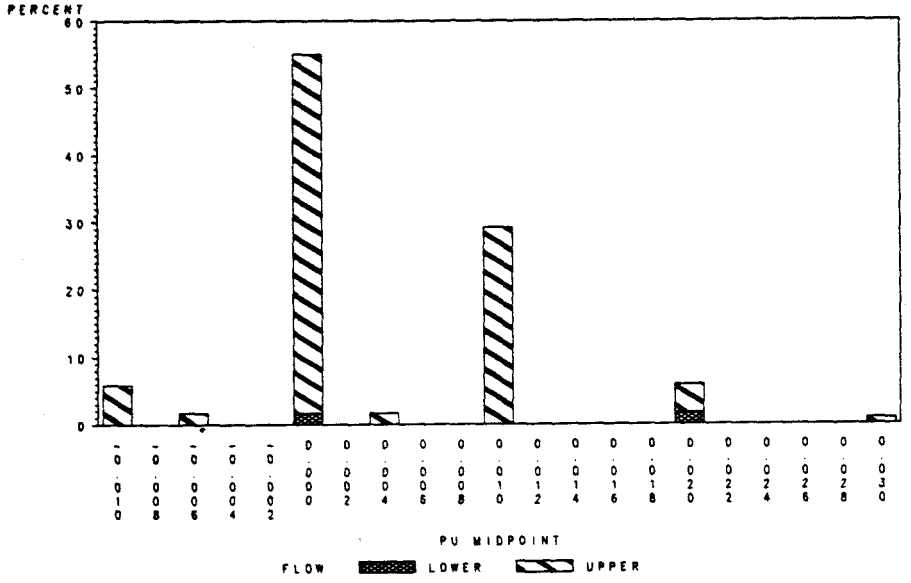


Figure A-113.

Data distribution of total **PLUTONIUM-239,240** in background geologic (borehole) materials, showing upper and lower flow-systems.

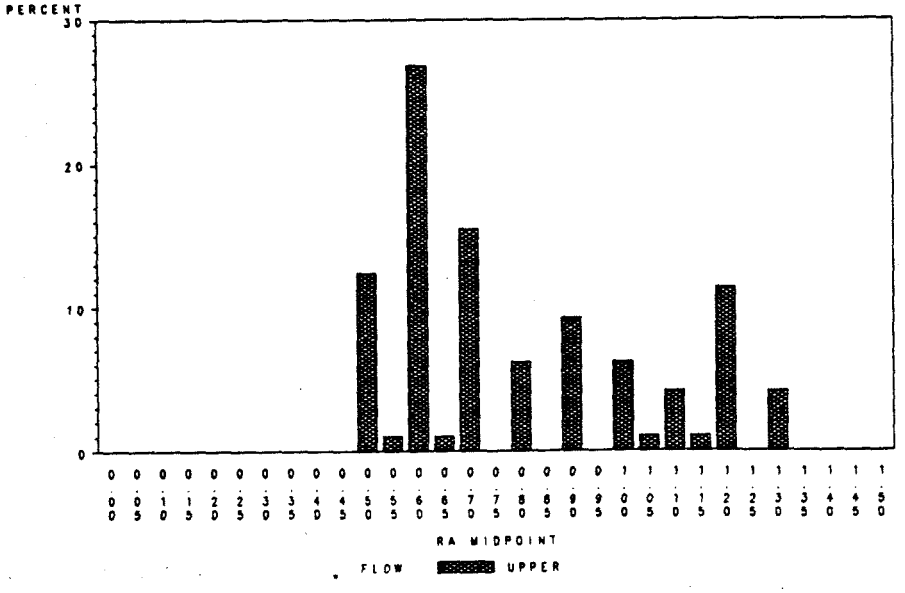


Figure A-114.

Data distribution of total **RADIUM-226** in background geologic (borehole) materials, showing upper and lower flow-systems.

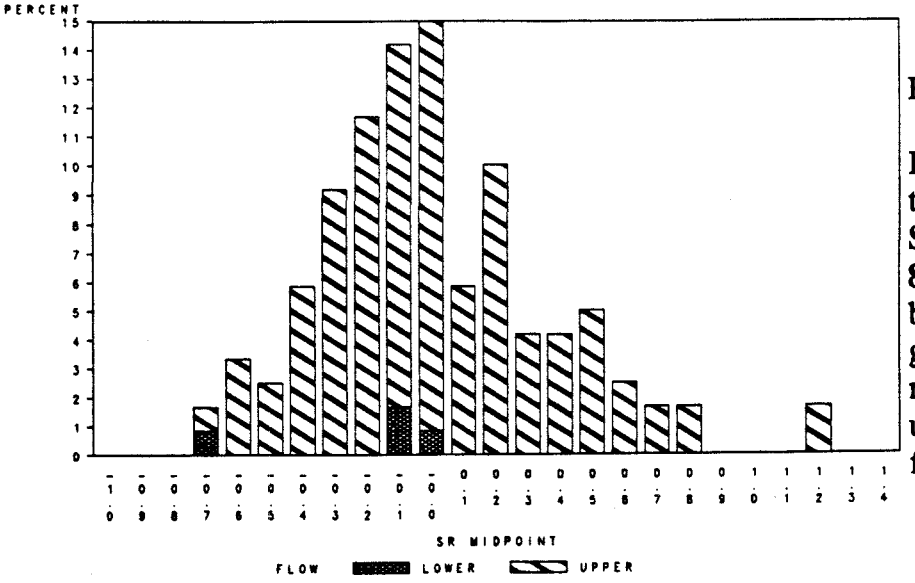


Figure A-115.

Data distribution of total **STRONTIUM-89,90** in background geologic (borehole) materials, showing upper and lower flow-systems.

Figure A-116.

Data distribution of total **TRITIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

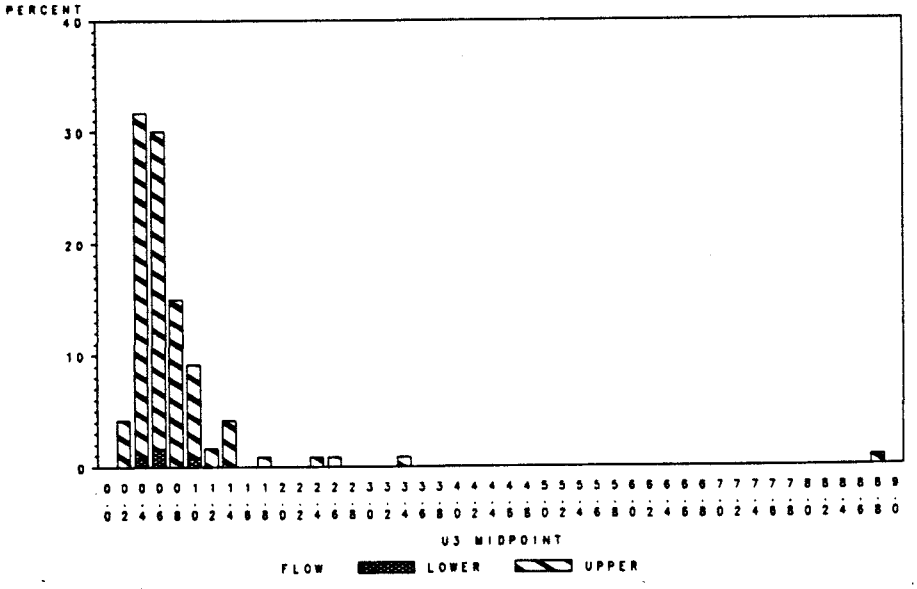


Figure A-117.

Data distribution of total **URANIUM-233,234** in background geologic (borehole) materials, showing upper and lower flow-systems.

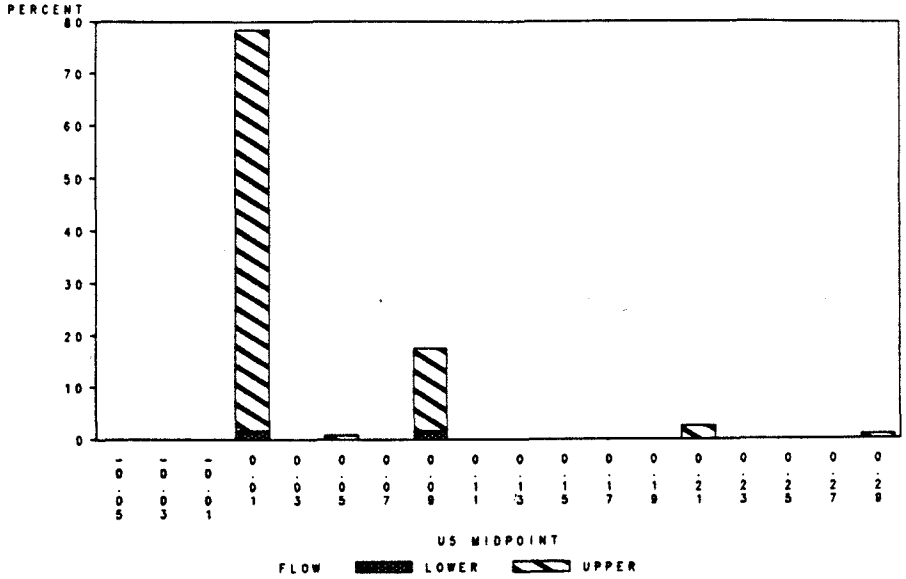


Figure A-118.

Data distribution of total **URANIUM-235** in background geologic (borehole) materials, showing upper and lower flow-systems.

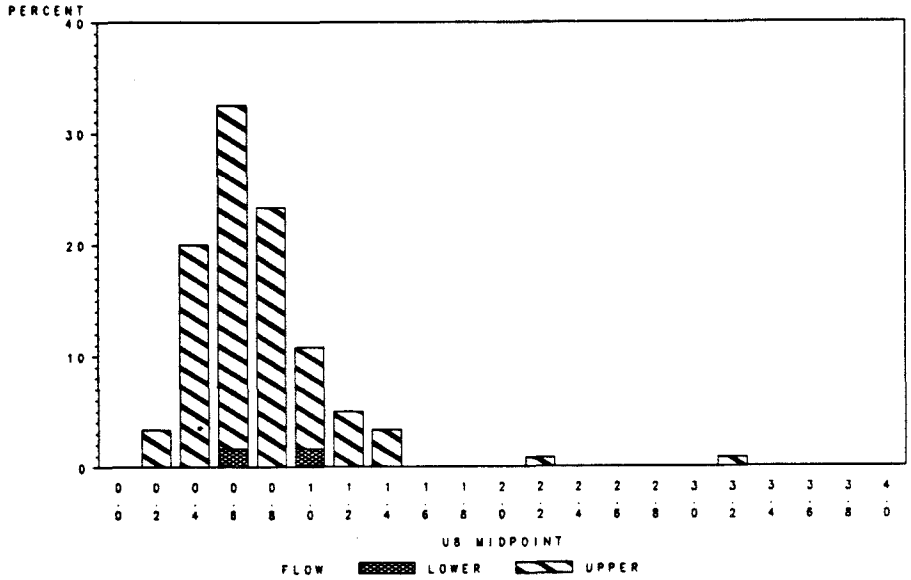


Figure A-119.

Data distribution of total **URANIUM-238** in background geologic (borehole) materials, showing upper and lower flow-systems.

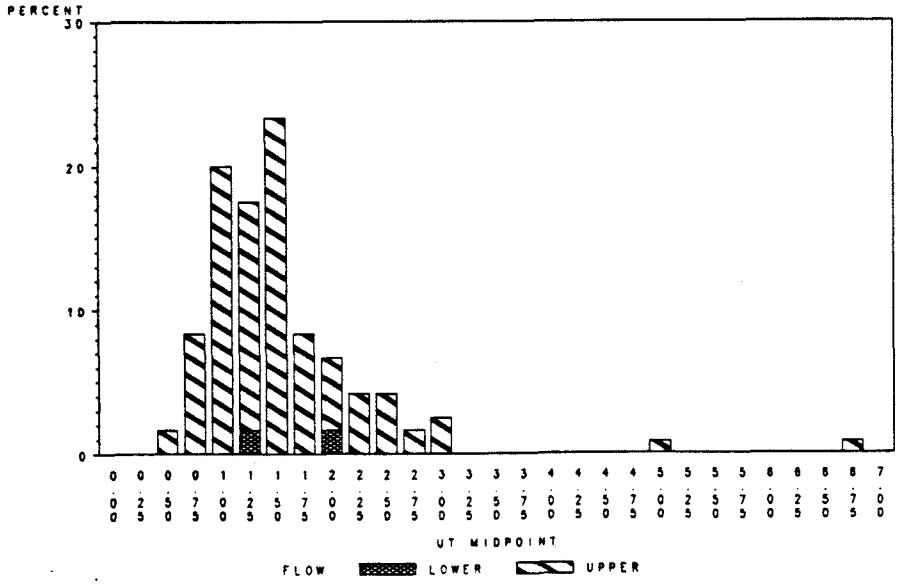


Figure A-120.

Data distribution of total **URANIUM** in background geologic (borehole) materials, showing upper and lower flow-systems.

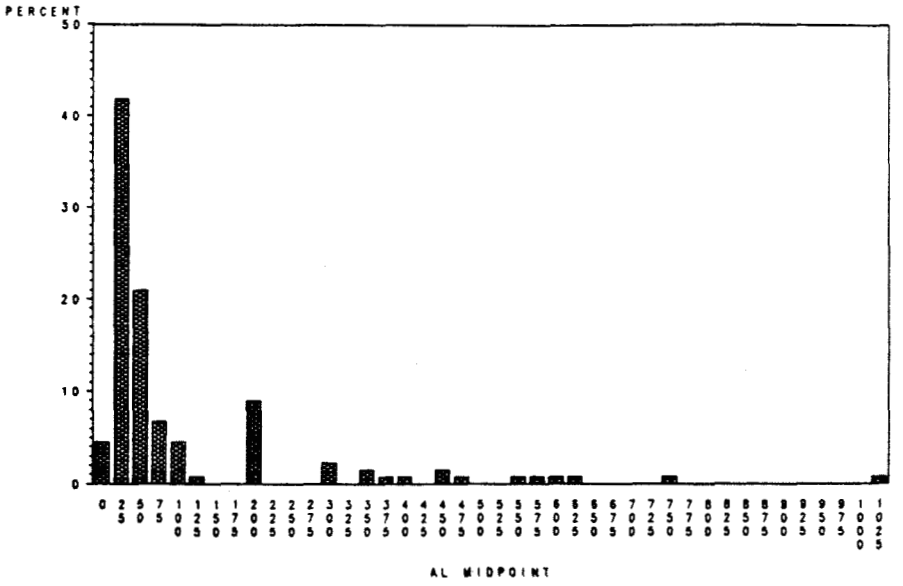


Figure A-121.

Data distribution of dissolved **ALUMINUM** in background stream water.

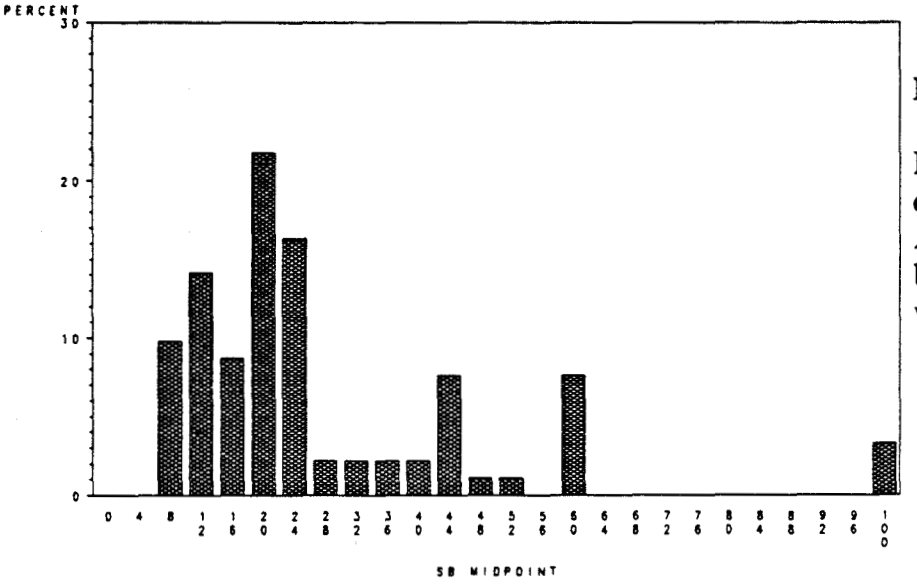


Figure A-122.

Data distribution of dissolved **ANTIMONY** in background stream water.

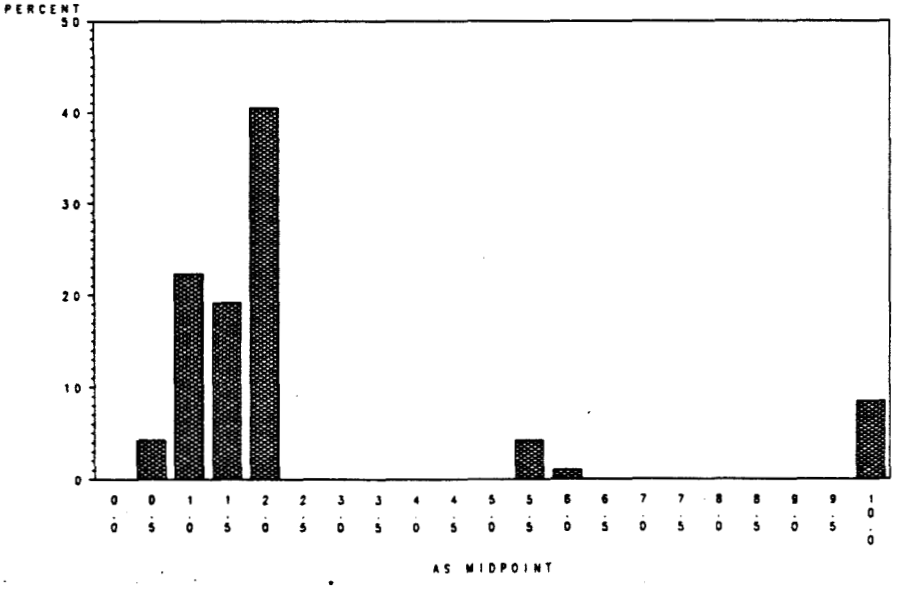


Figure A-123.

Data distribution of dissolved **ARSENIC** in background stream water.

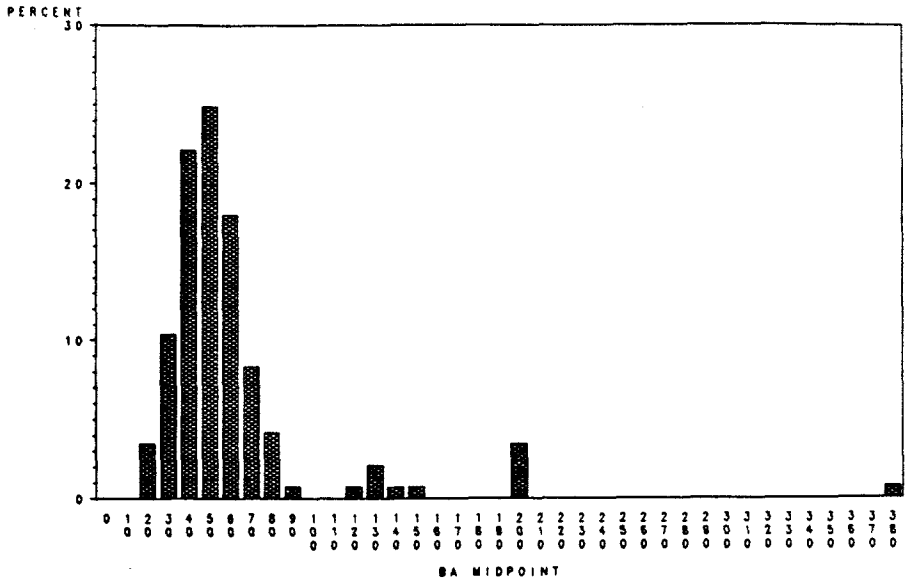


Figure A-124.

Data distribution of dissolved **BARIUM** in background stream water.

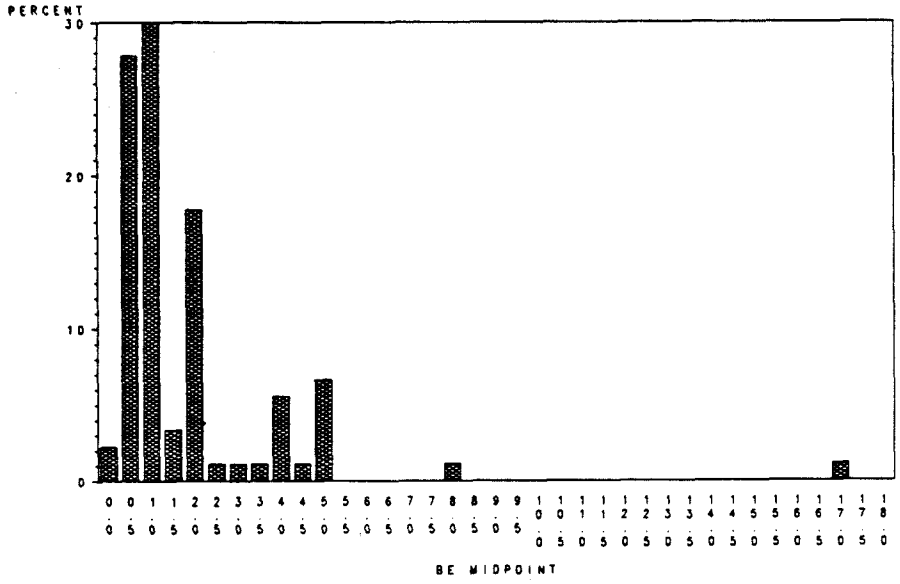


Figure A-125.

Data distribution of dissolved **BERYLLIUM** in background stream water.

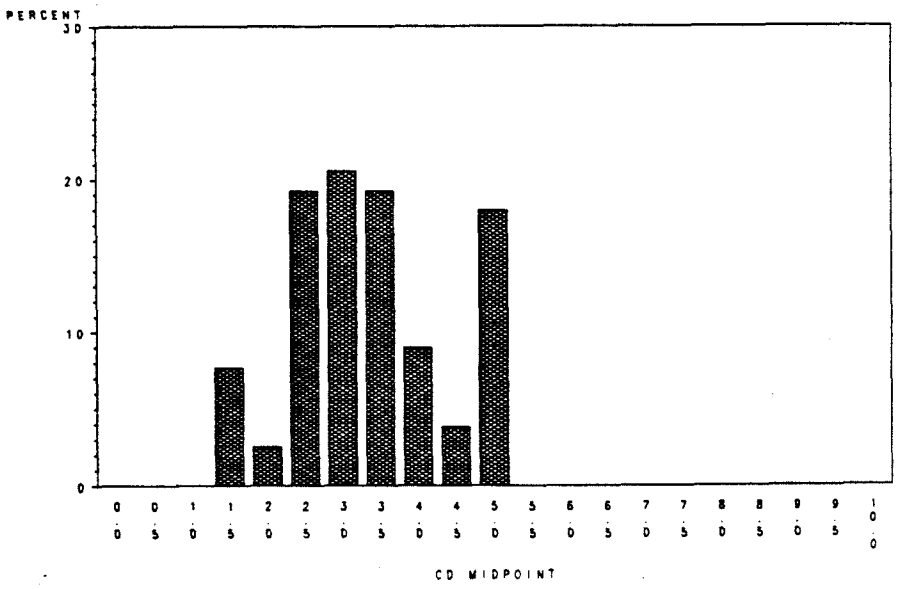


Figure A-126.

Data distribution of dissolved **CADMIUM** in background stream water.

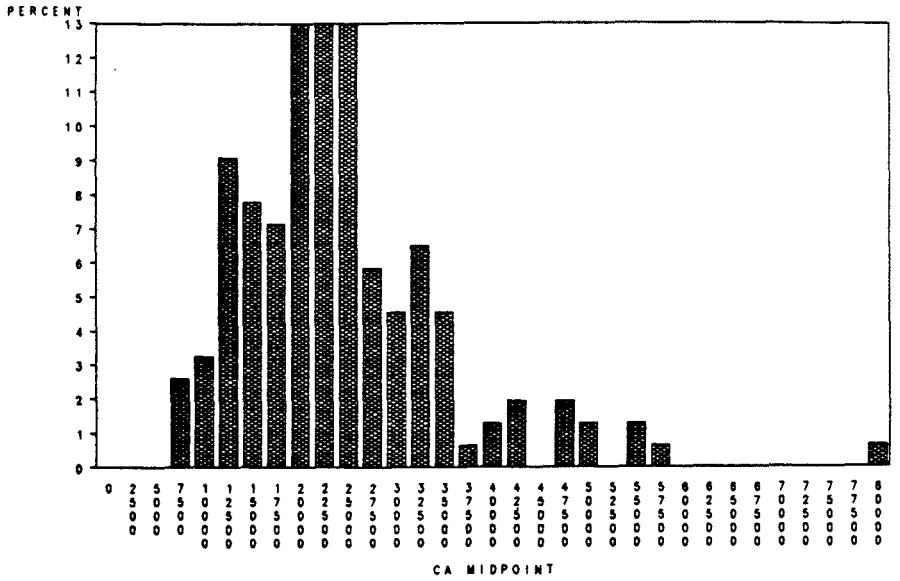


Figure A-127.

Data distribution of dissolved **CALCIUM** in background stream water.

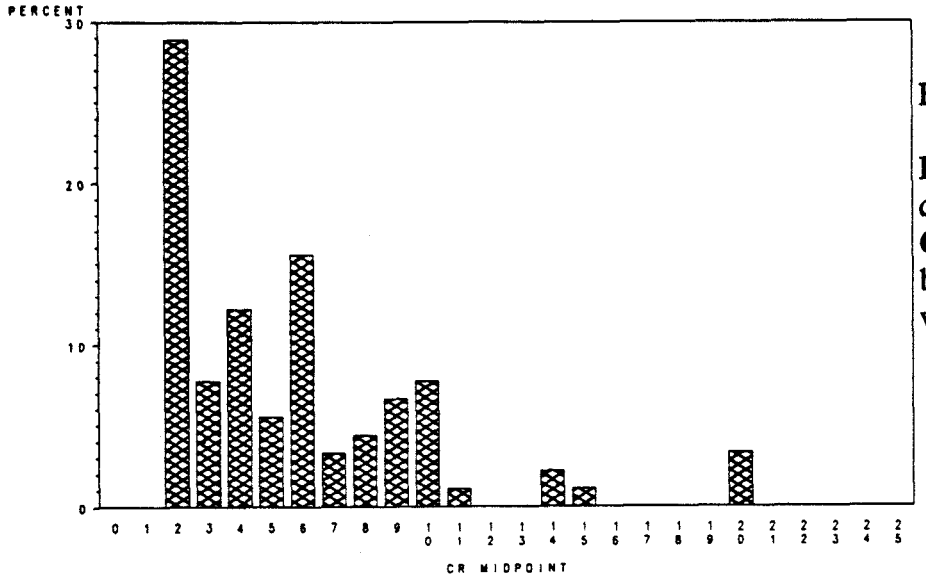


Figure A-128.

Data distribution of dissolved **CHROMIUM** in background stream water.

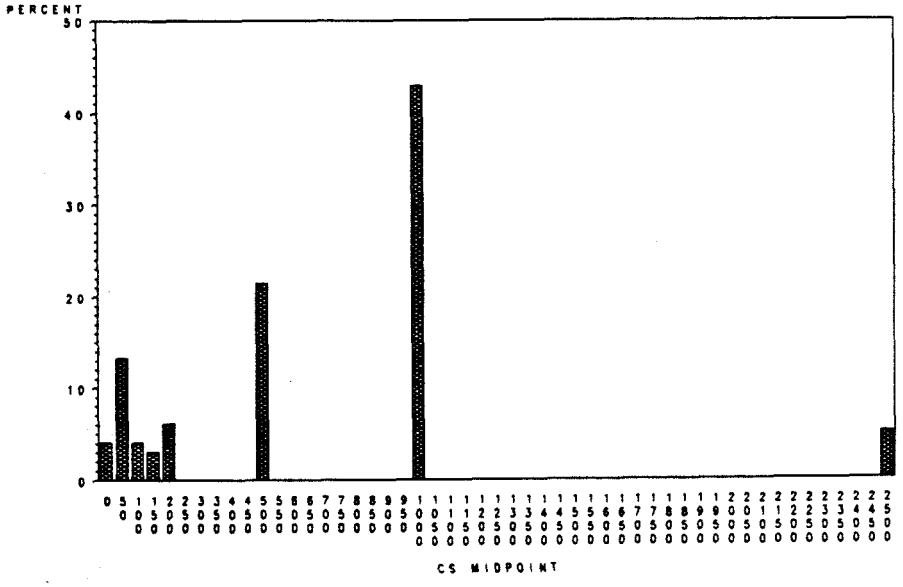


Figure A-129.

Data distribution of dissolved **CESIUM** in background stream water.

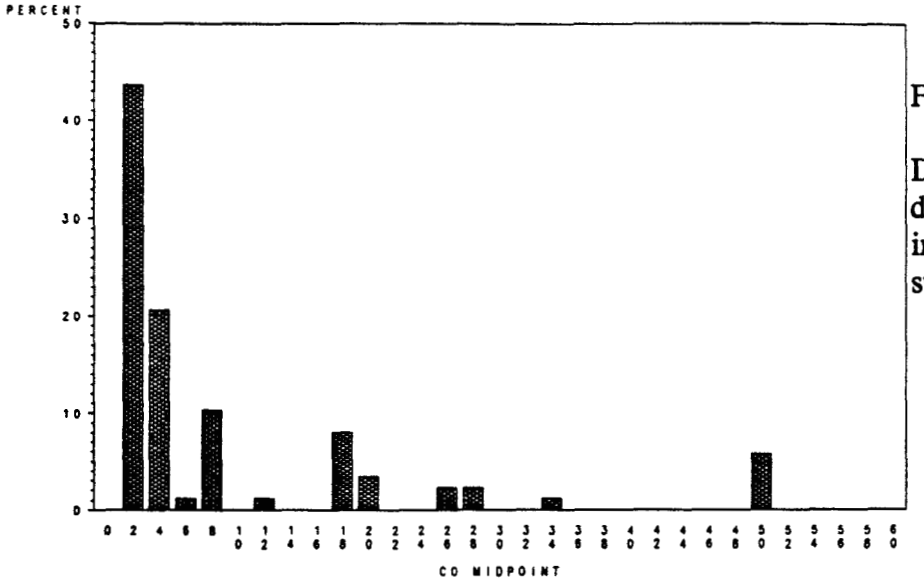


Figure A-130.

Data distribution of dissolved **COBALT** in background stream water.

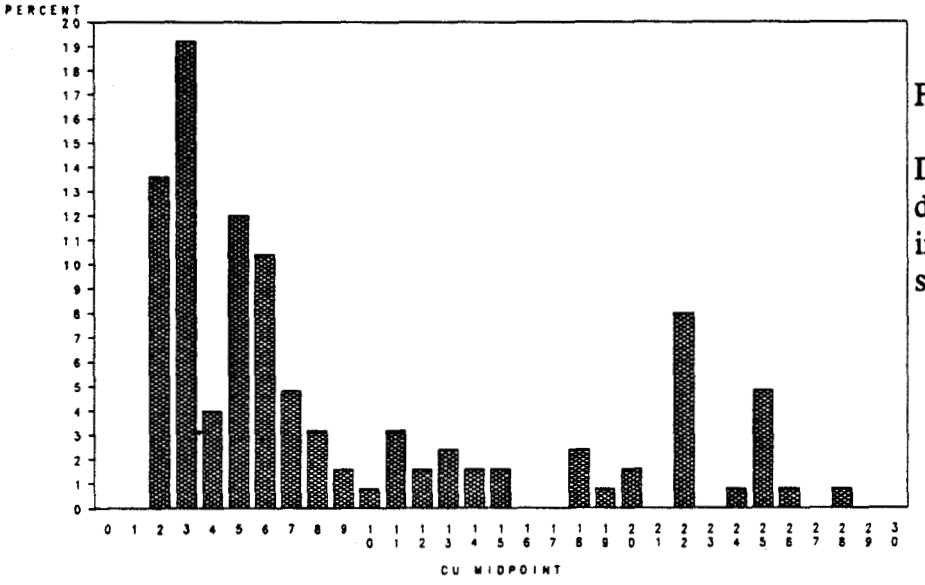


Figure A-131.

Data distribution of dissolved **COPPER** in background stream water.

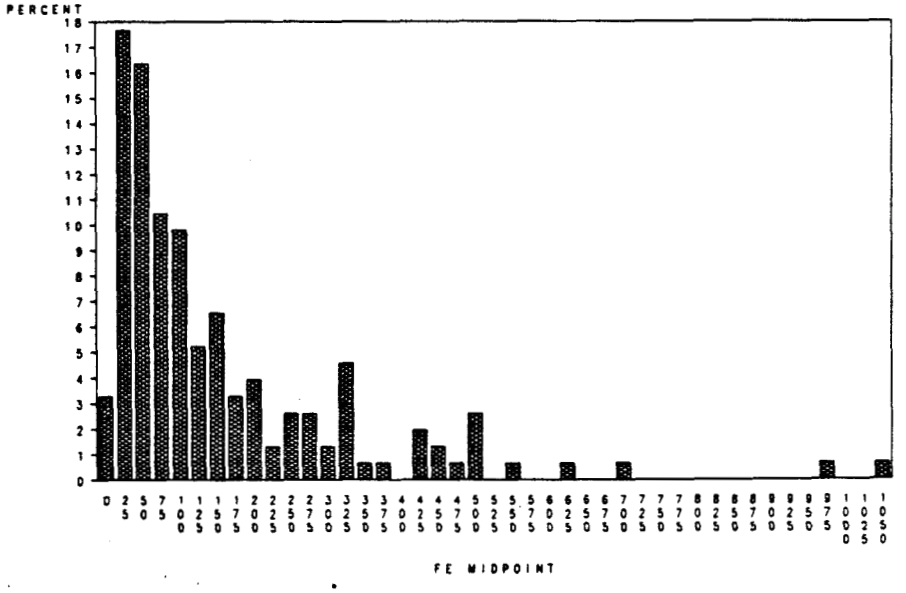


Figure A-132.

Data distribution of dissolved **IRON** in background stream water.

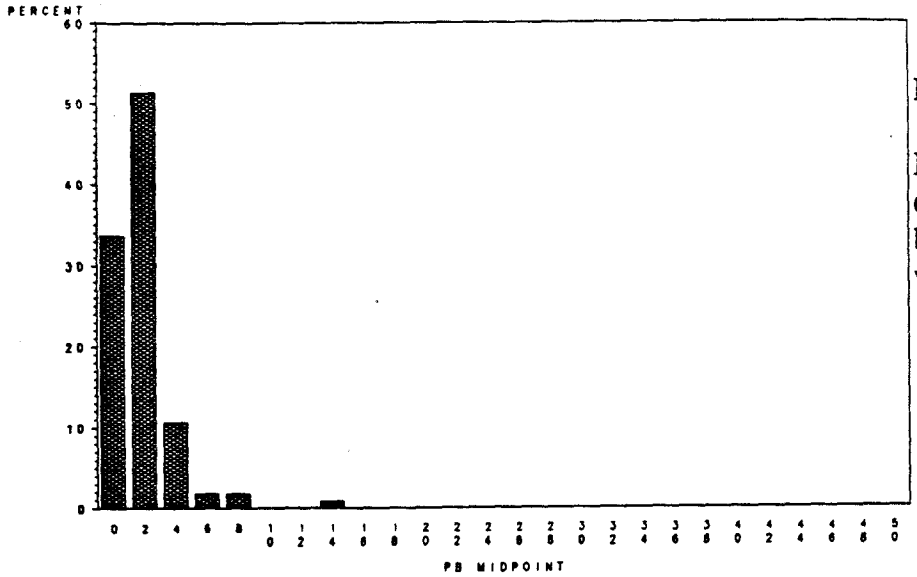


Figure A-133.

Data distribution of dissolved **LEAD** in background stream water.

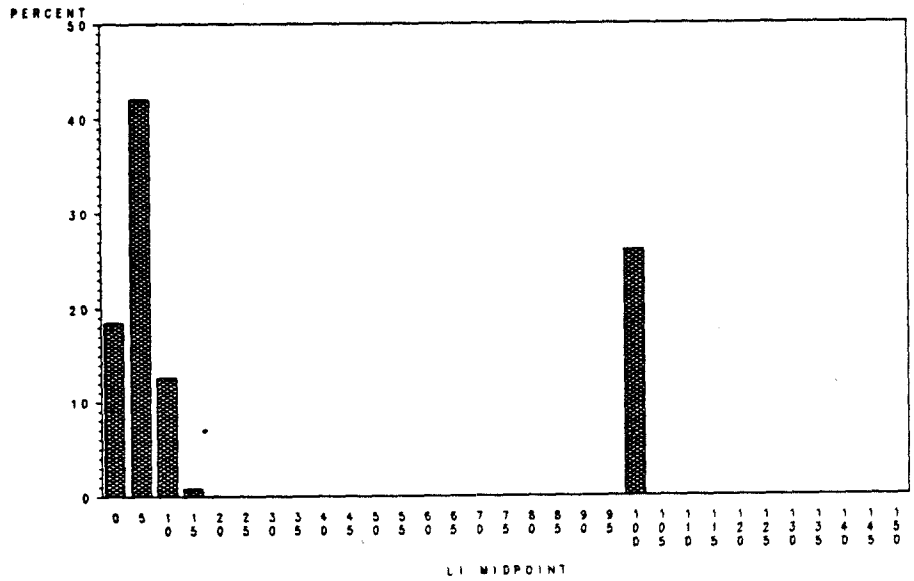


Figure A-134.

Data distribution of dissolved **LITHIUM** in background stream water.

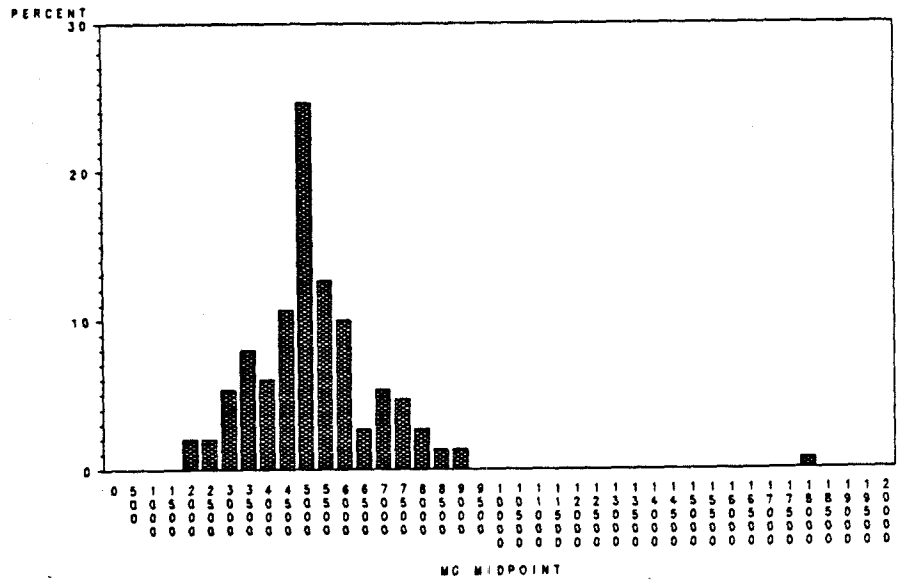


Figure A-135.

Data distribution of dissolved **MAGNESIUM** in background stream water.

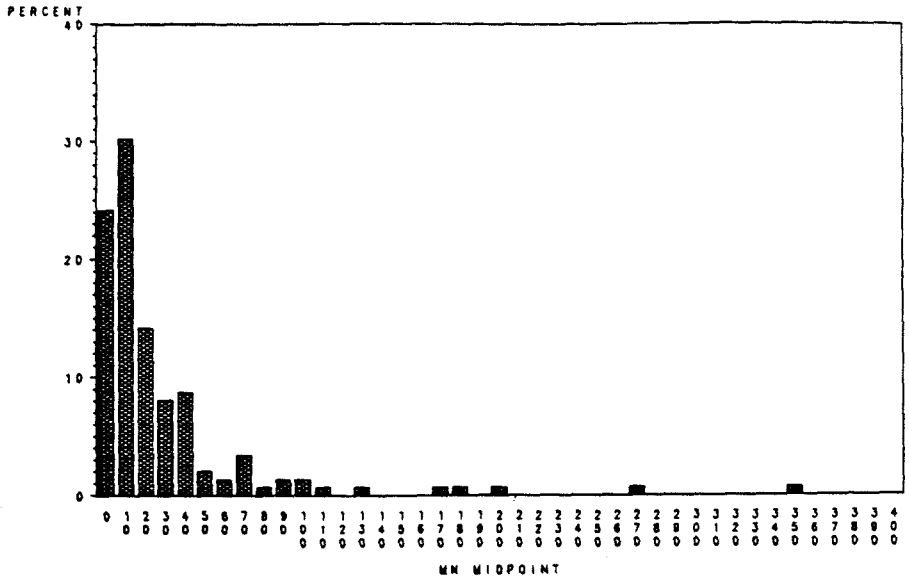


Figure A-136.

Data distribution of dissolved **MANGANESE** in background stream water.

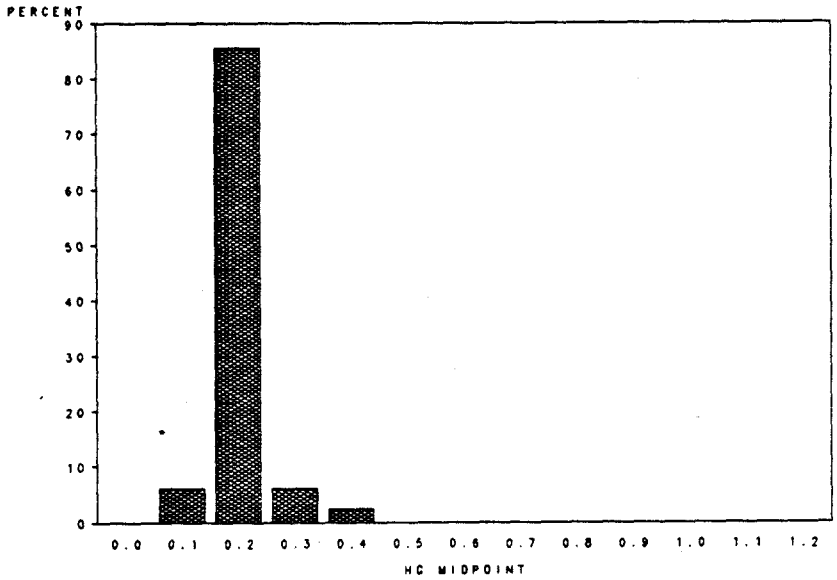


Figure A-137.

Data distribution of dissolved **MERCURY** in background stream water.

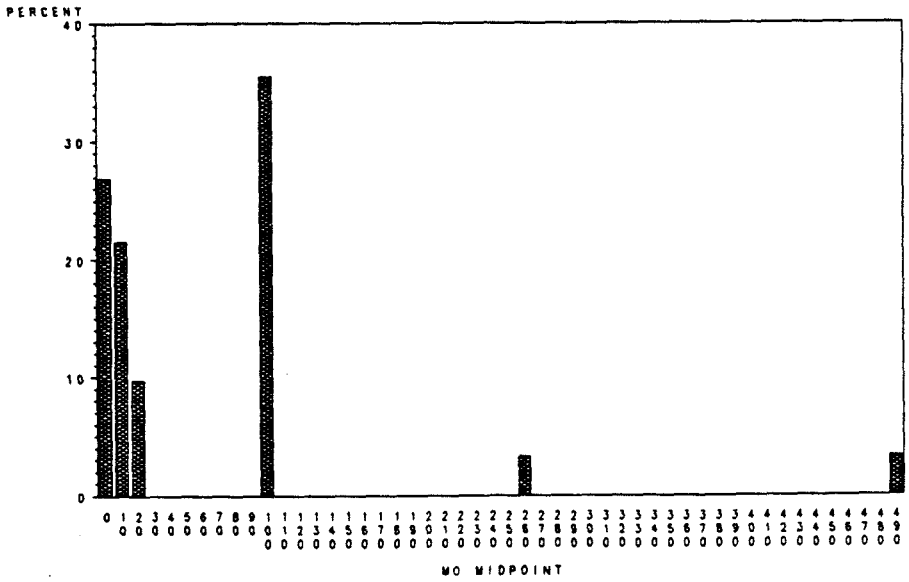


Figure A-138.

Data distribution of dissolved **MOLYBDENUM** in background stream water.

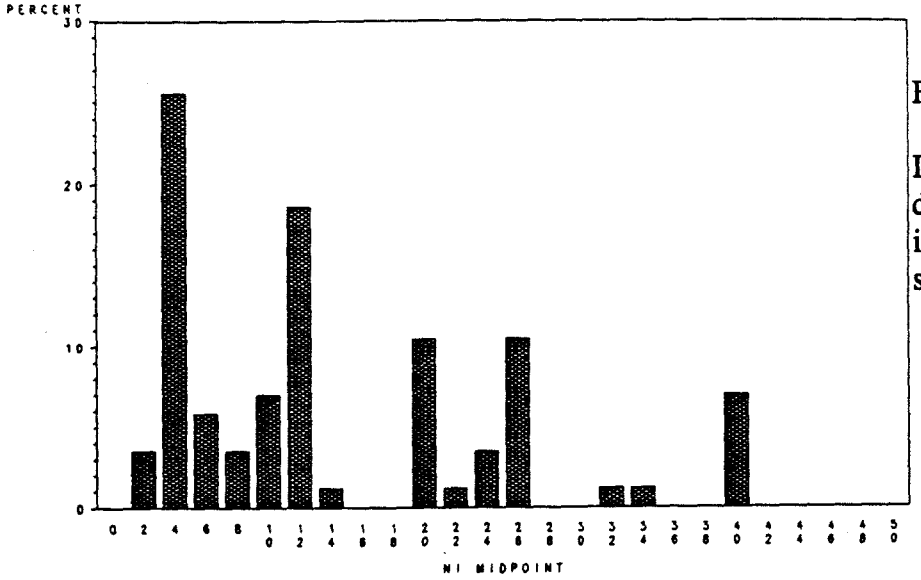


Figure A-139.

Data distribution of dissolved **NICKEL** in background stream water.

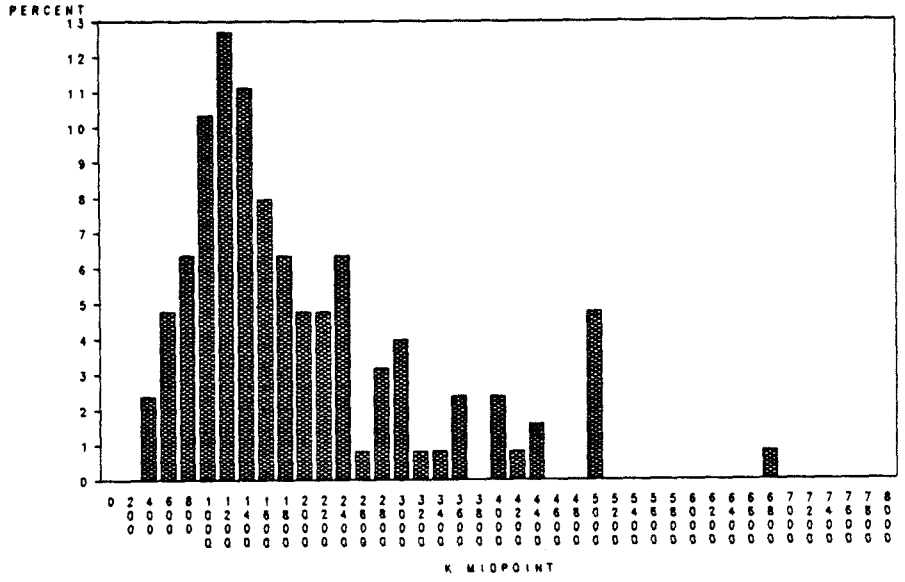


Figure A-140.

Data distribution of dissolved **POTASSIUM** in background stream water.

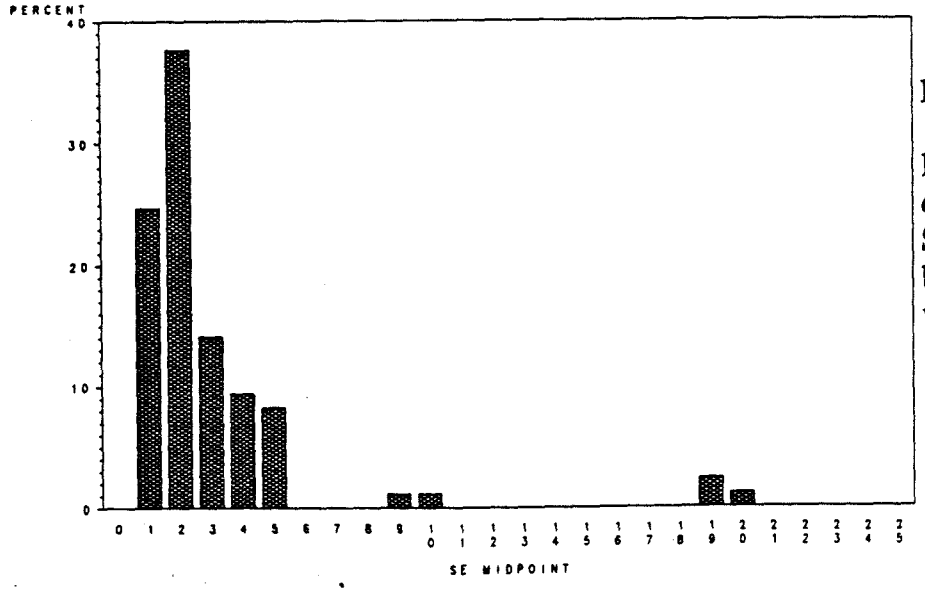


Figure A-141.

Data distribution of dissolved **SELENIUM** in background stream water.

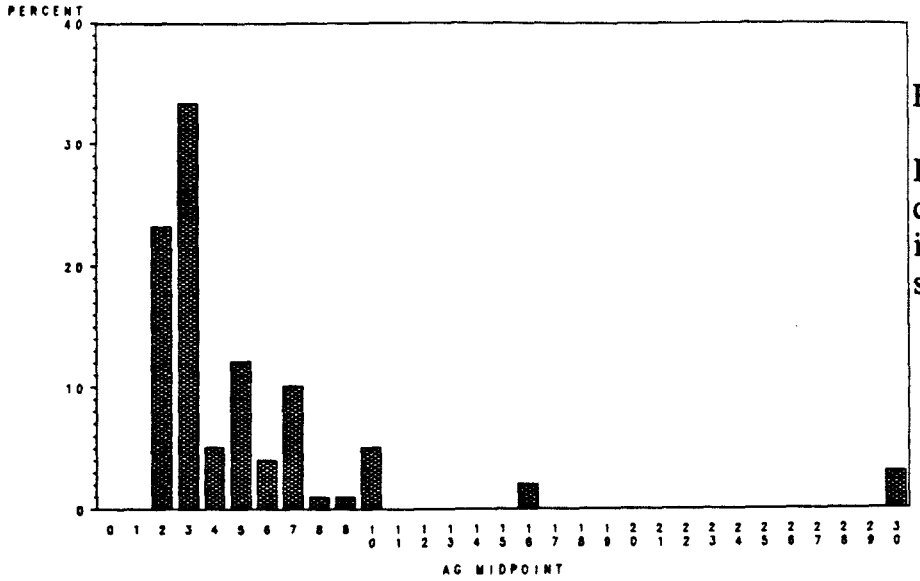


Figure A-142.

Data distribution of dissolved **SILVER** in background stream water.

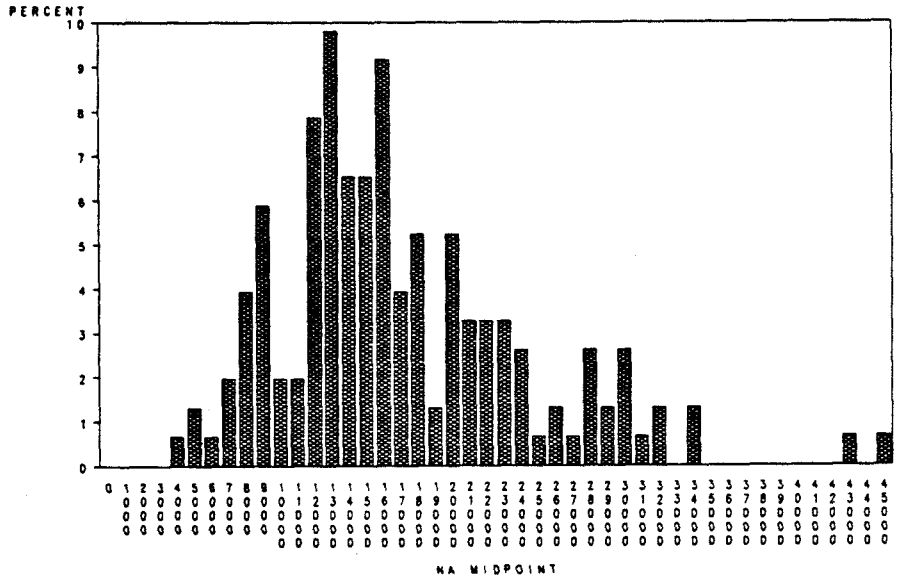


Figure A-143.

Data distribution of dissolved **SODIUM** in background stream water.

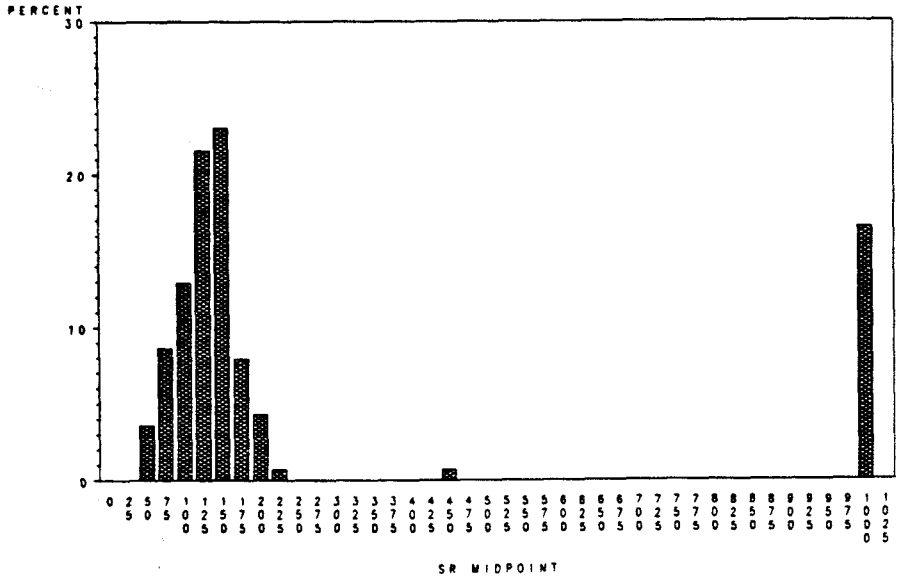


Figure A-144.

Data distribution of dissolved **STRONTIUM** in background stream water.

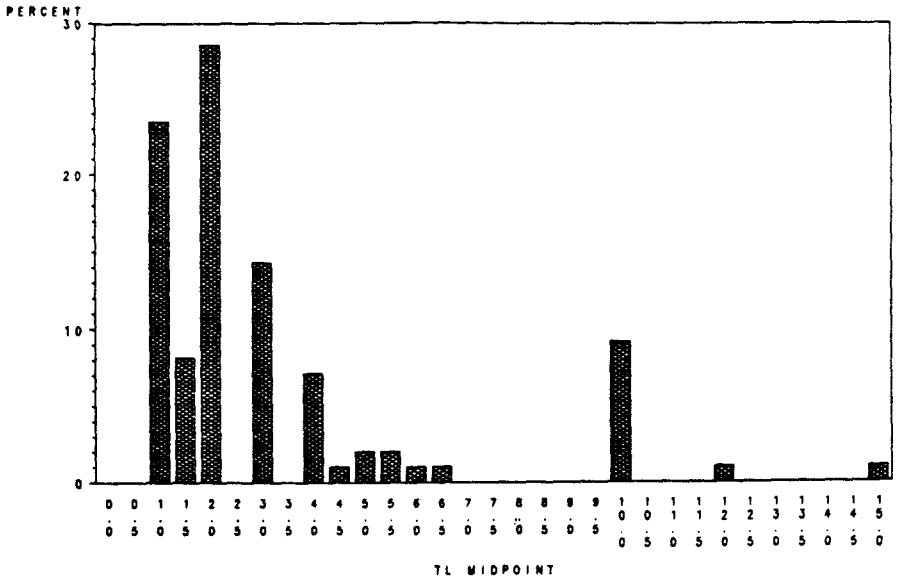


Figure A-145.

Data distribution of dissolved **THALLIUM** in background stream water.

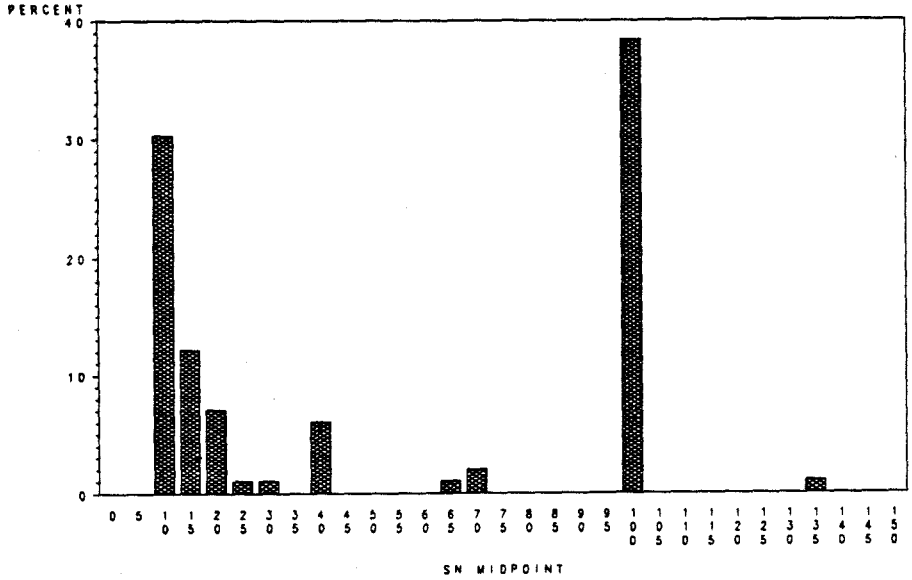


Figure A-146.

Data distribution of dissolved **TIN** in background stream water.

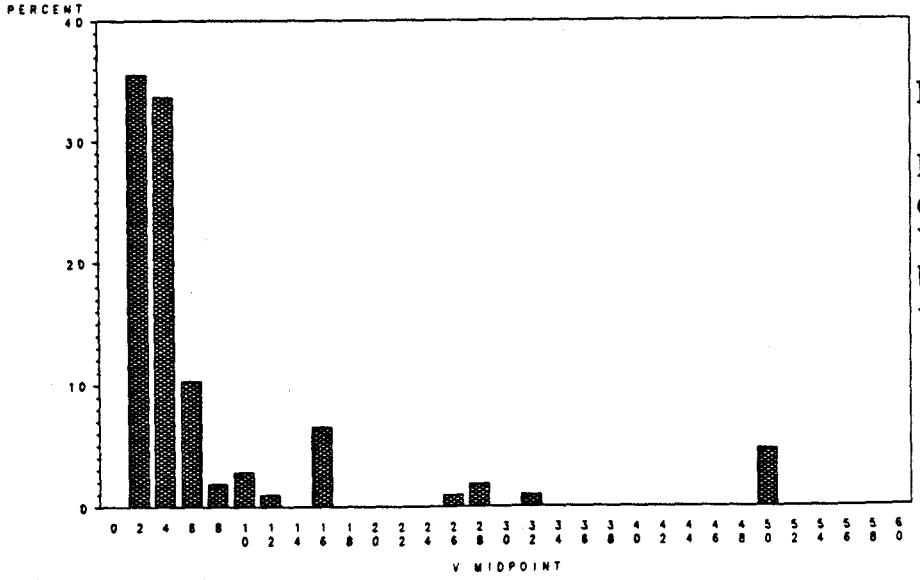


Figure A-147.

Data distribution of dissolved **VANADIUM** in background stream water.

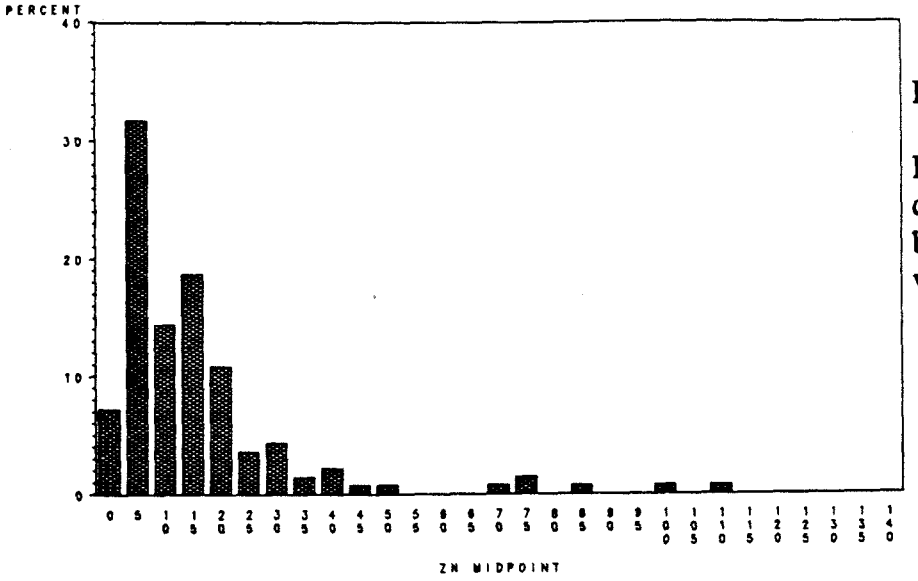


Figure A-148.

Data distribution of dissolved **ZINC** in background stream water.

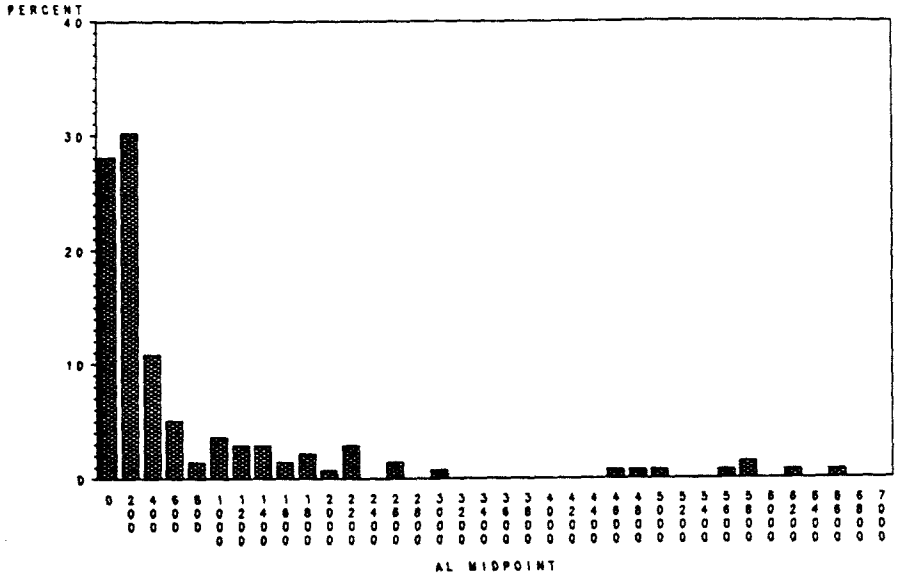


Figure A-149.

Data distribution of total **ALUMINUM** in background stream water.

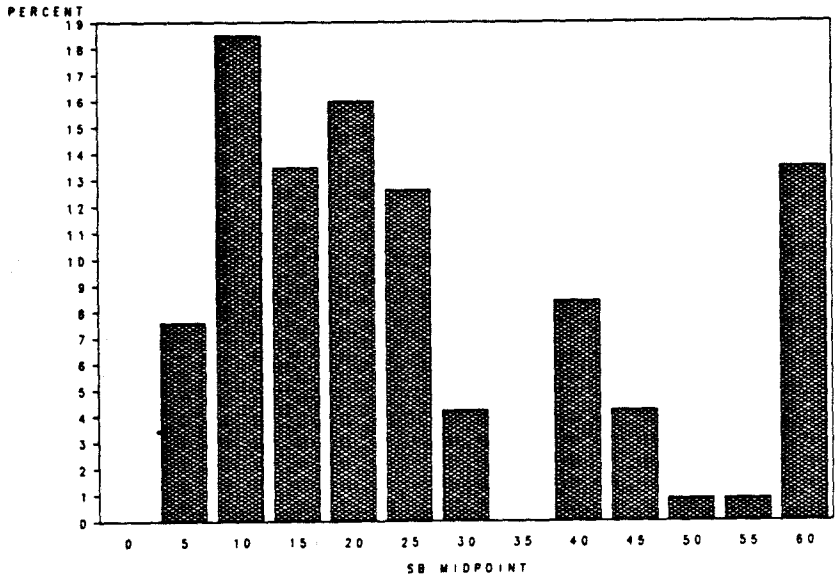


Figure A-150.

Data distribution of total **ANTIMONY** in background stream water.

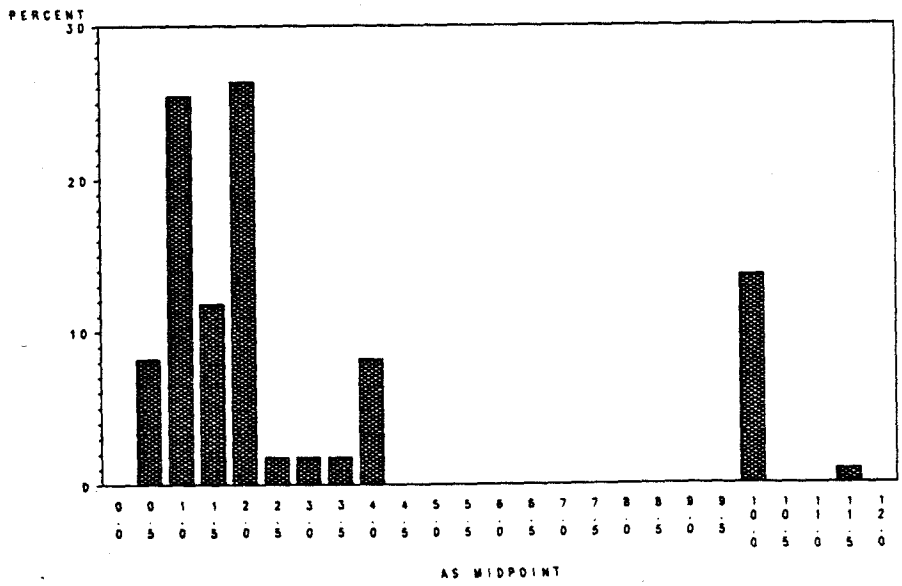


Figure A-151.

Data distribution of total **ARSENIC** in background stream water.

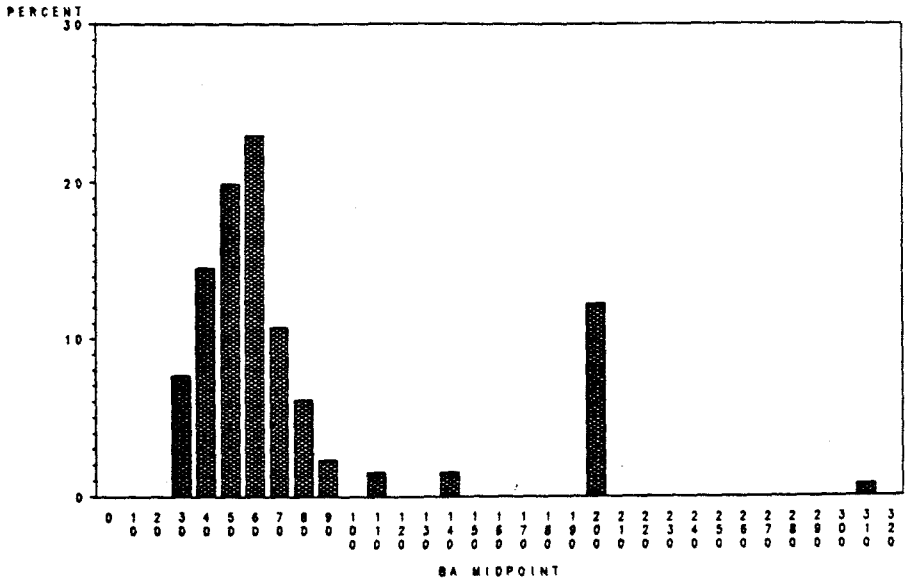


Figure A-152.

Data distribution of total **BARIUM** in background stream water.

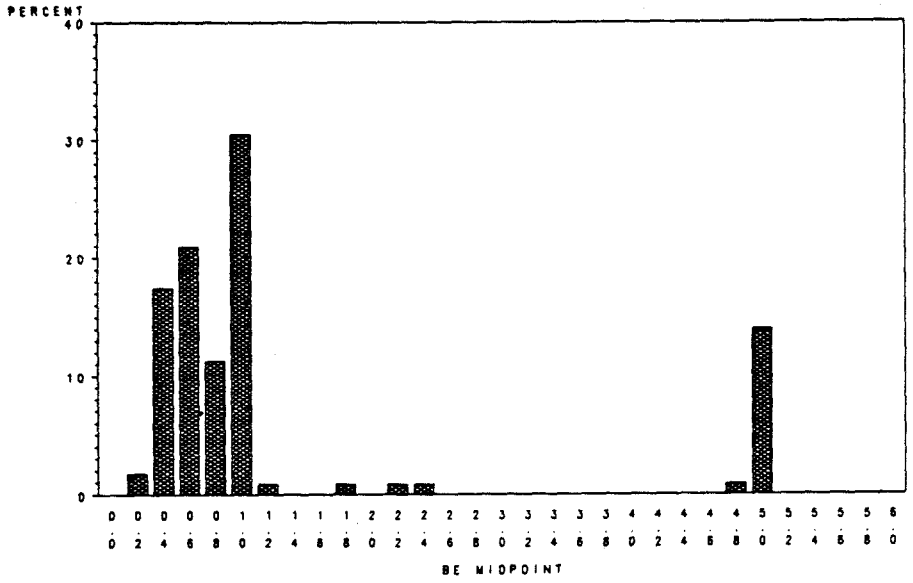


Figure A-153.

Data distribution of total **BERYLLIUM** in background stream water.

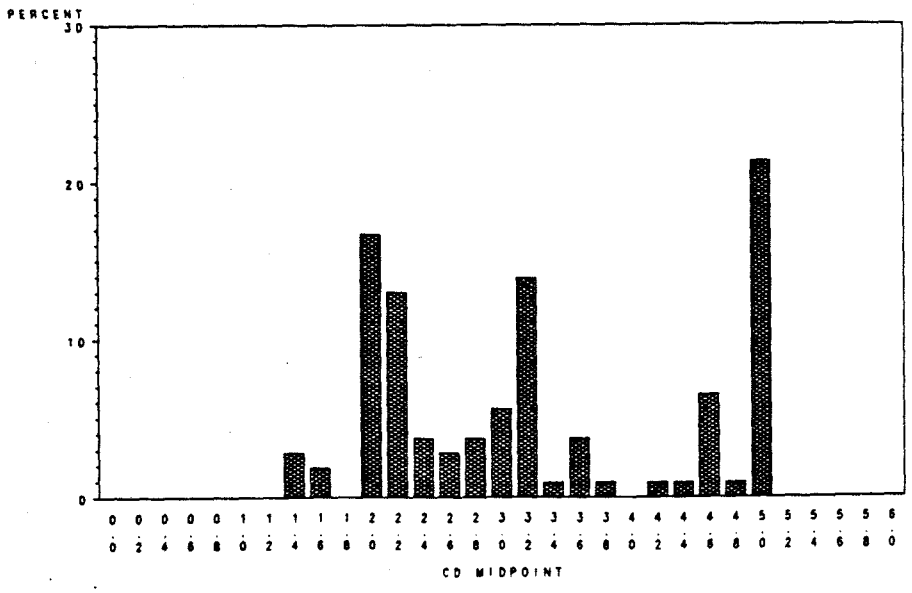


Figure A-154.

Data distribution of total **CADMIUM** in background stream water.

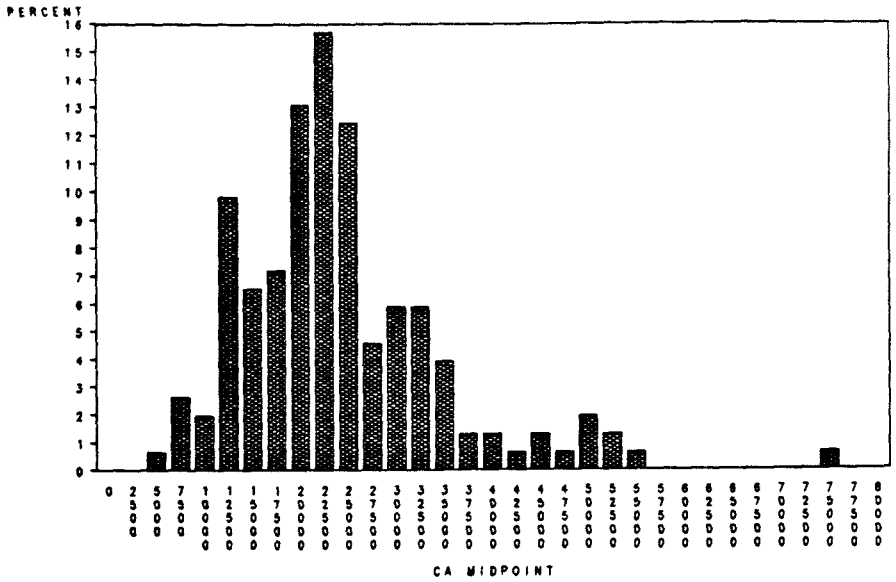


Figure A-155.

Data distribution of total **CALCIUM** in background stream water.

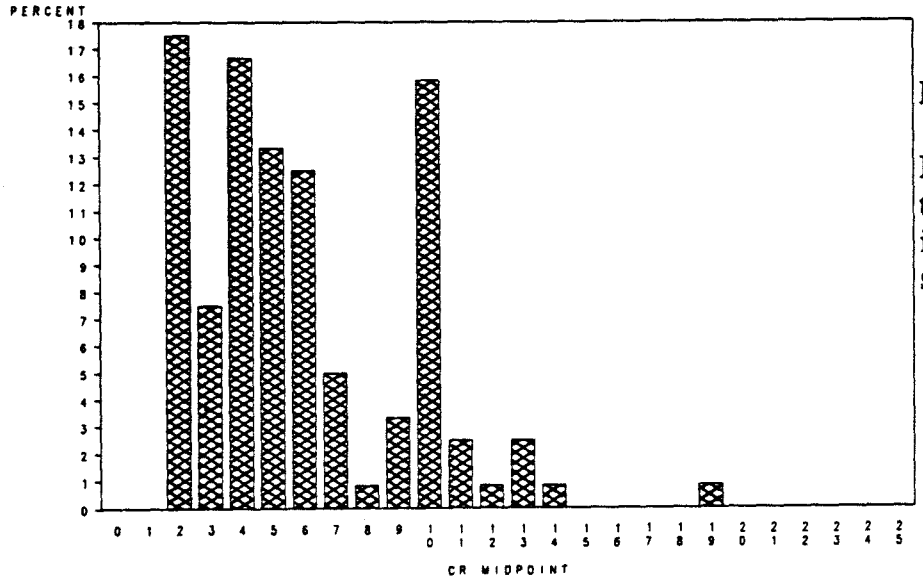


Figure A-156.

Data distribution of total **CHROMIUM** in background stream water.

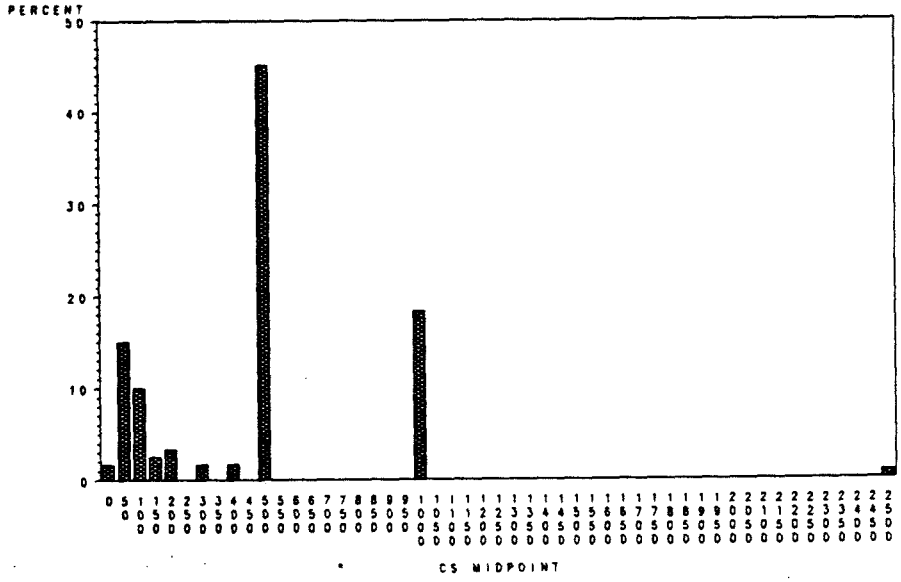


Figure A-157.

Data distribution of total **CESIUM** in background stream water.

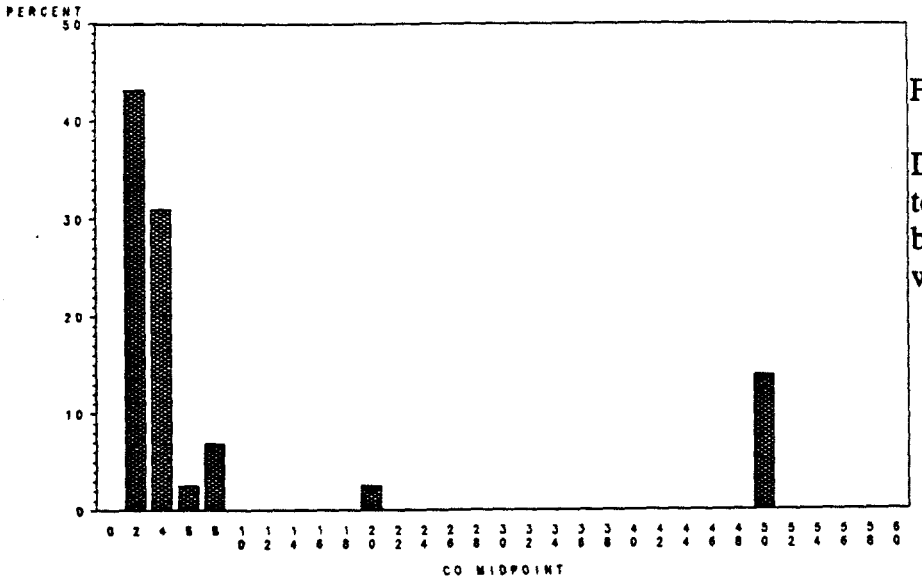


Figure A-158.

Data distribution of total **COBALT** in background stream water.

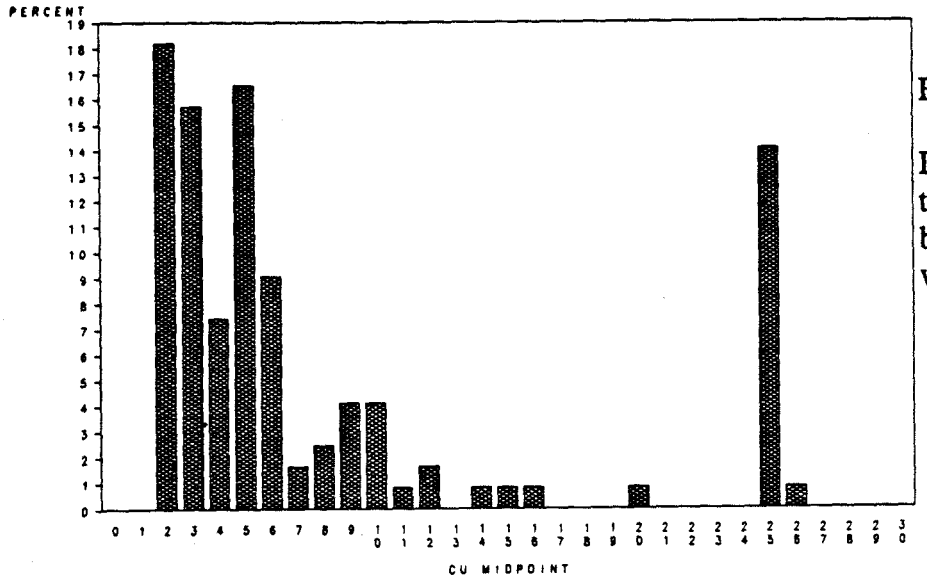


Figure A-159.

Data distribution of total **COPPER** in background stream water.

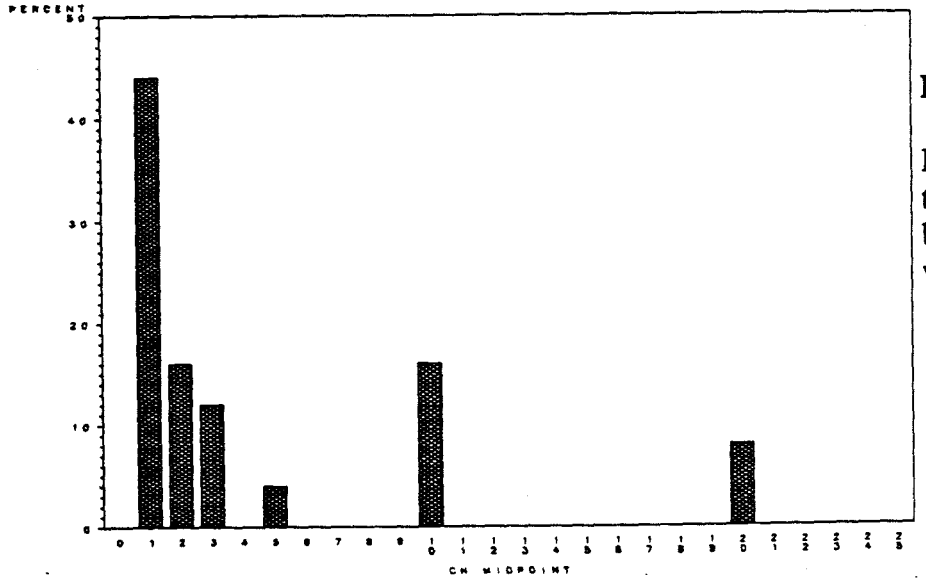


Figure A-160.

Data distribution of total **CYANIDE** in background stream water.

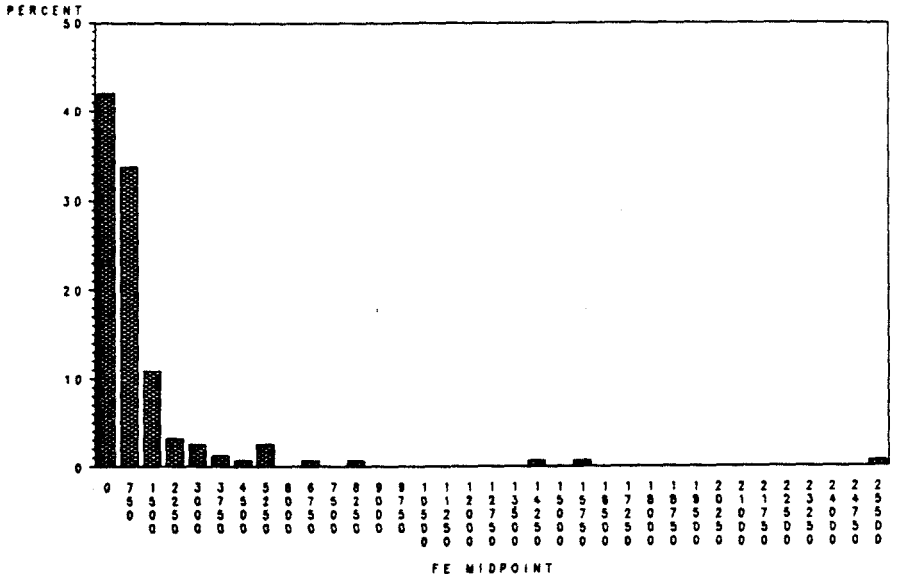


Figure A-161.

Data distribution of total **IRON** in background stream water.

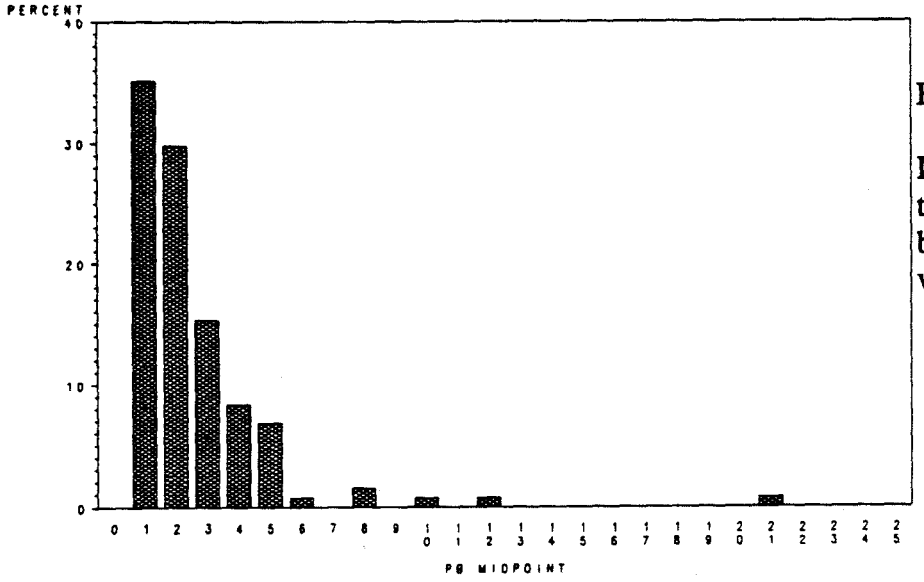


Figure A-162.

Data distribution of total **LEAD** in background stream water.

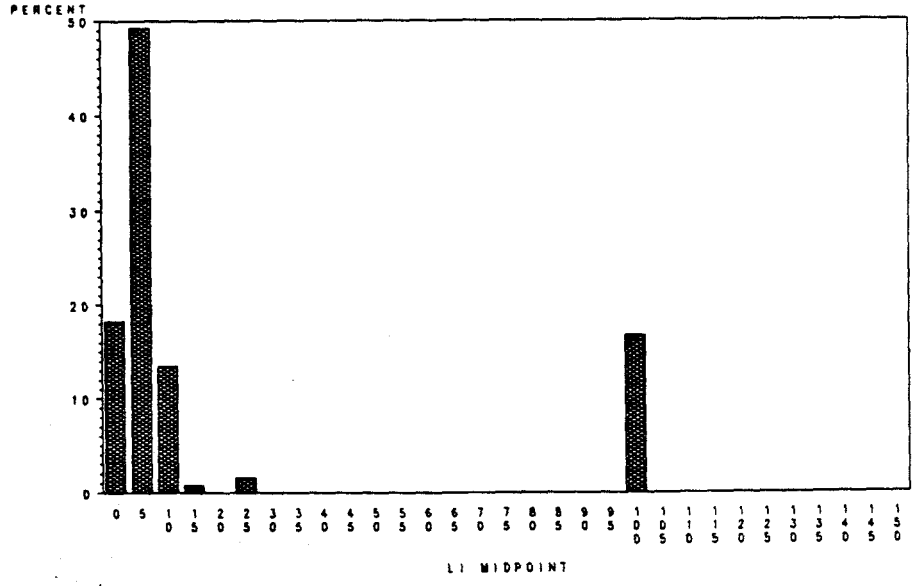


Figure A-163.

Data distribution of total **LITHIUM** in background stream water.

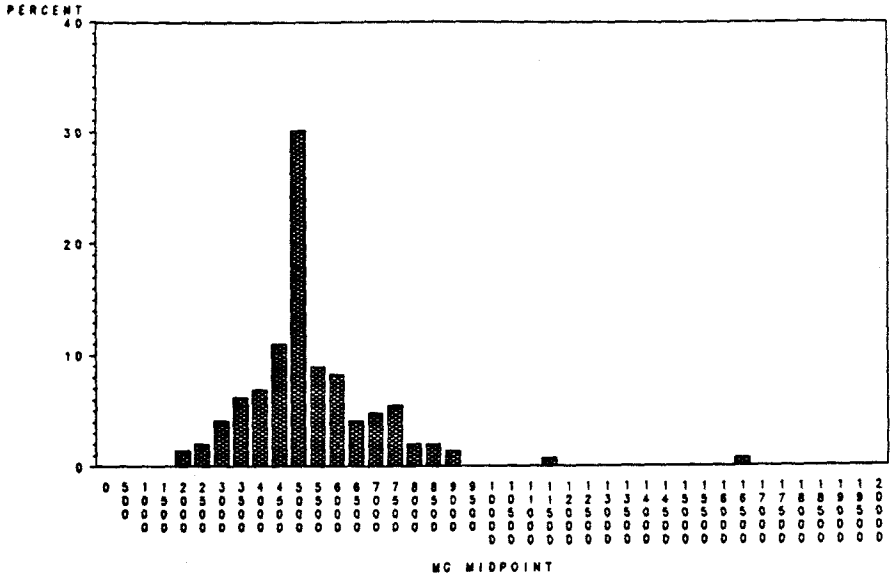


Figure A-164.

Data distribution of total **MAGNESIUM** in background stream water.

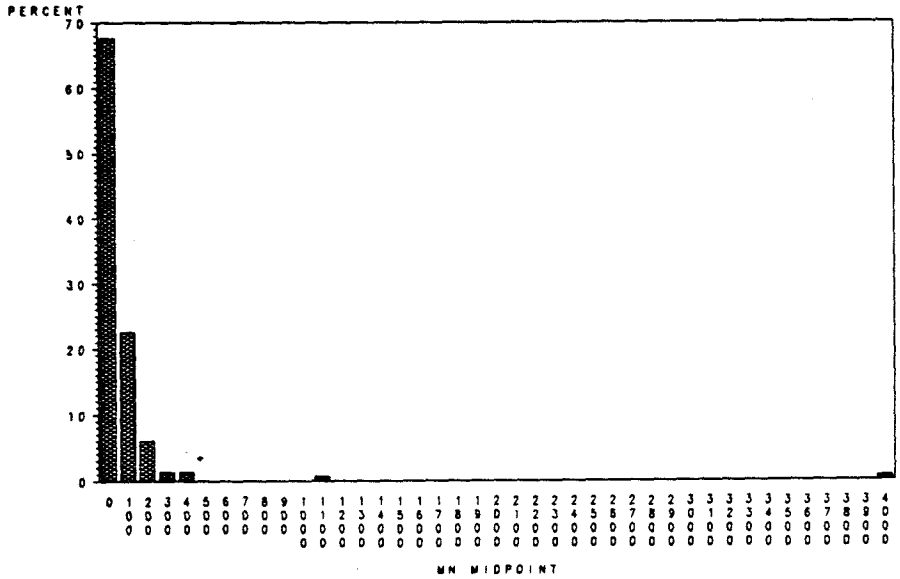


Figure A-165.

Data distribution of total **MANGANESE** in background stream water.

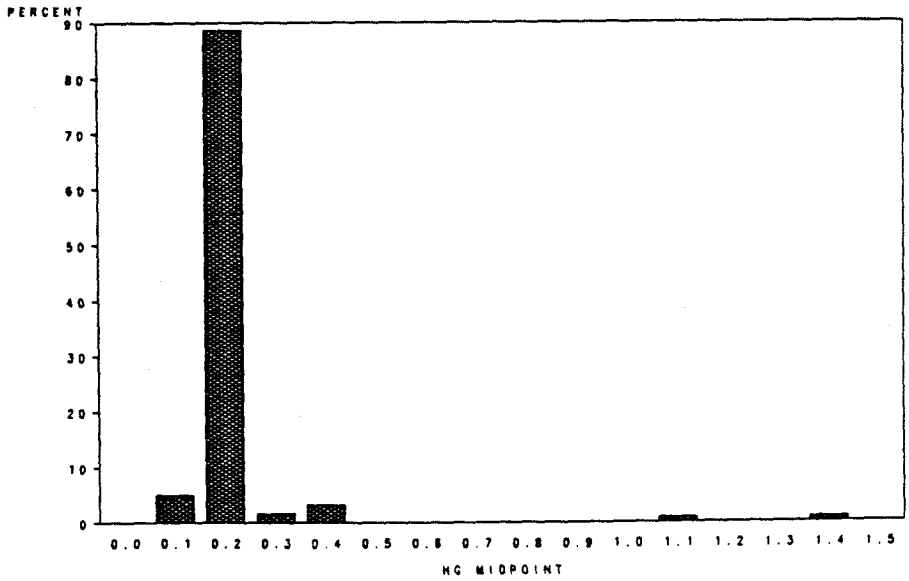


Figure A-166.

Data distribution of total **MERCURY** in background stream water.

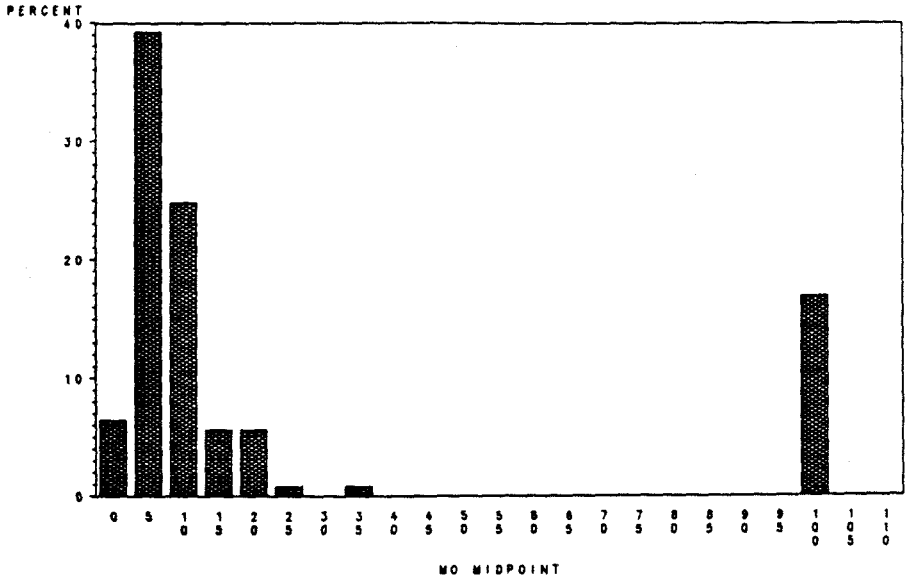


Figure A-167.

Data distribution of total **MOLYBDENUM** in background stream water.

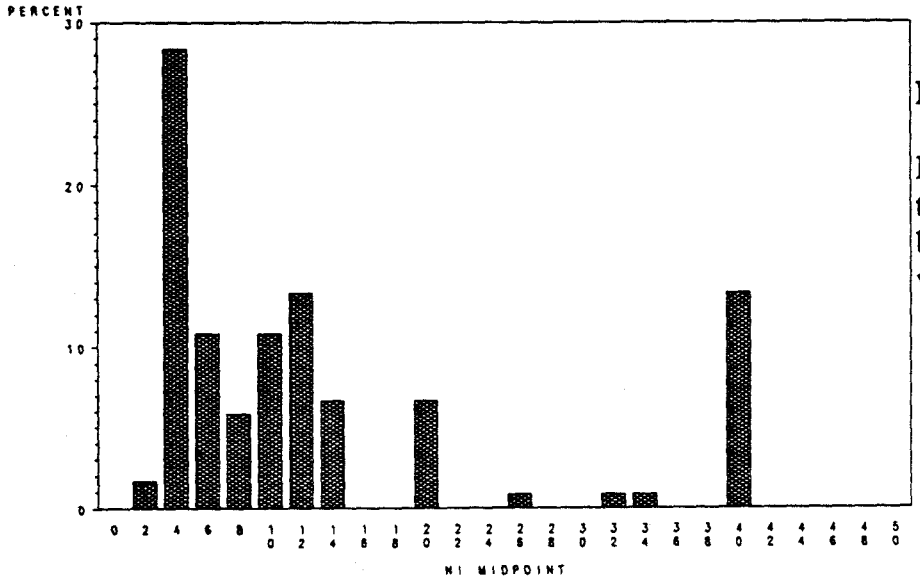


Figure A-168.

Data distribution of total **NICKEL** in background stream water.

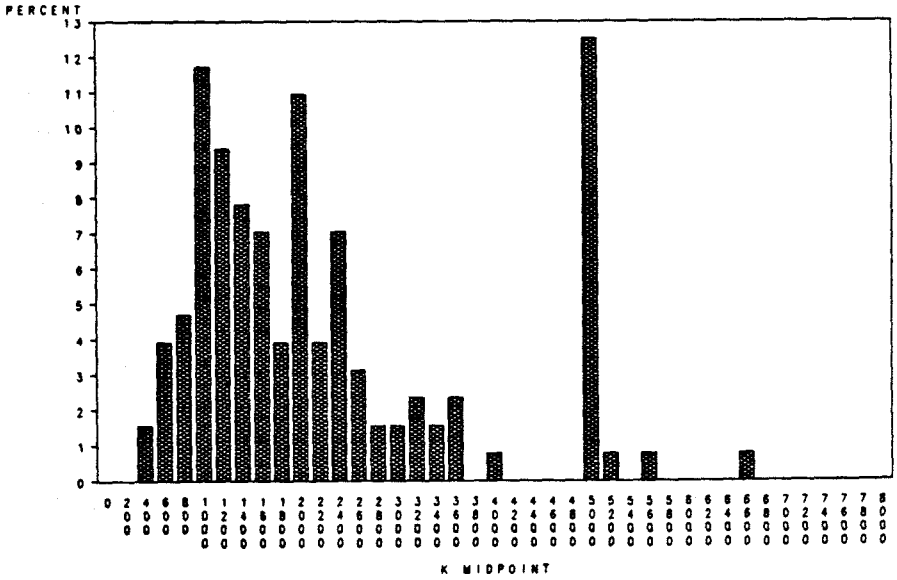


Figure A-169.

Data distribution of total **POTASSIUM** in background stream water.

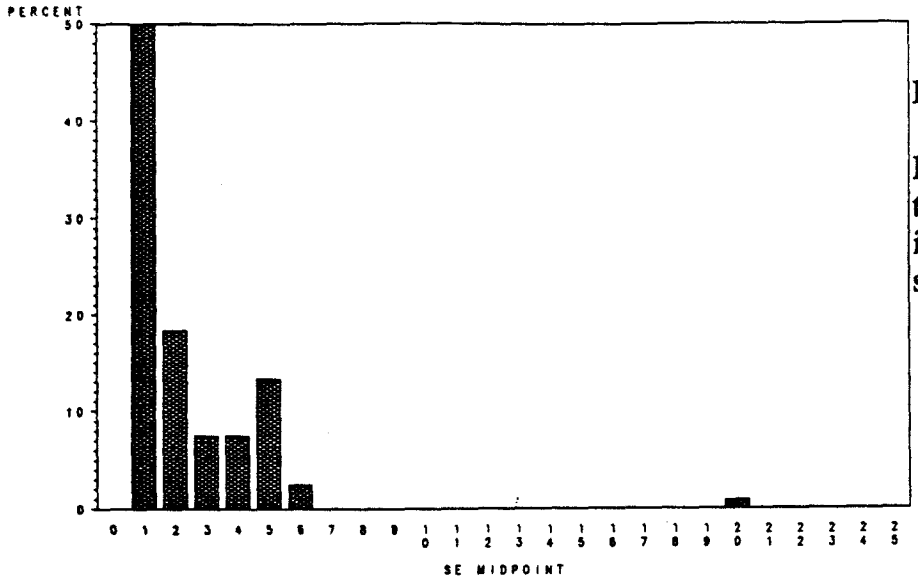


Figure A-170.

Data distribution of total **SELENIUM** in background stream water.

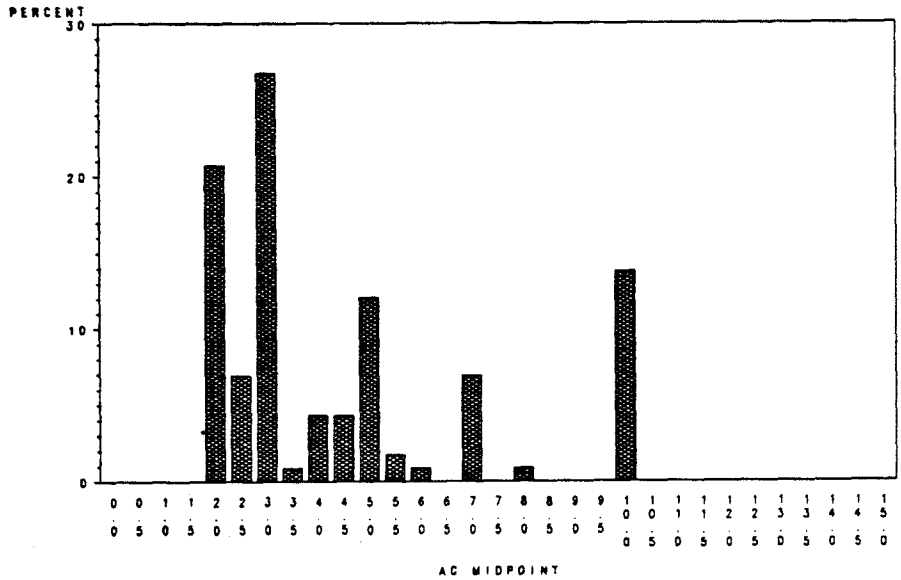


Figure A-171.

Data distribution of total **SILVER** in background stream water.

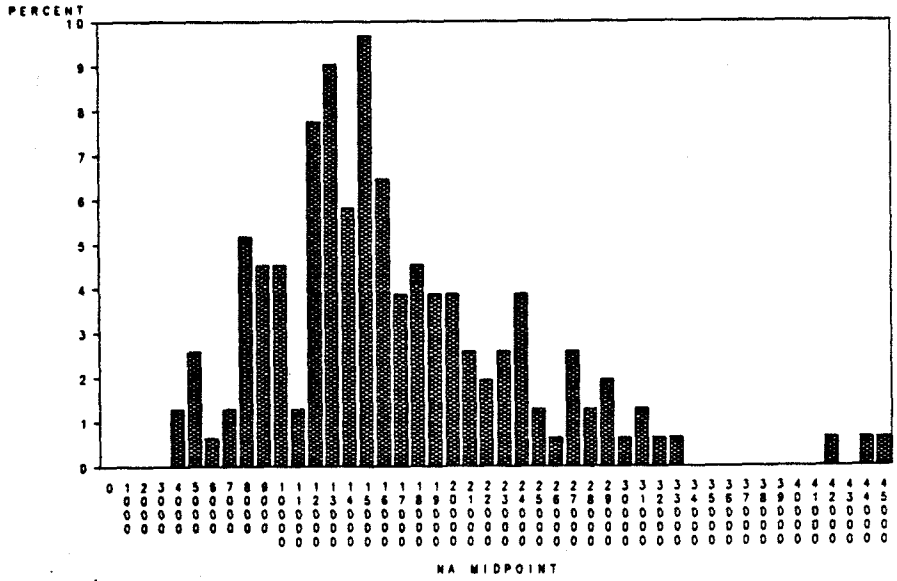


Figure A-172.

Data distribution of total **SODIUM** in background stream water.

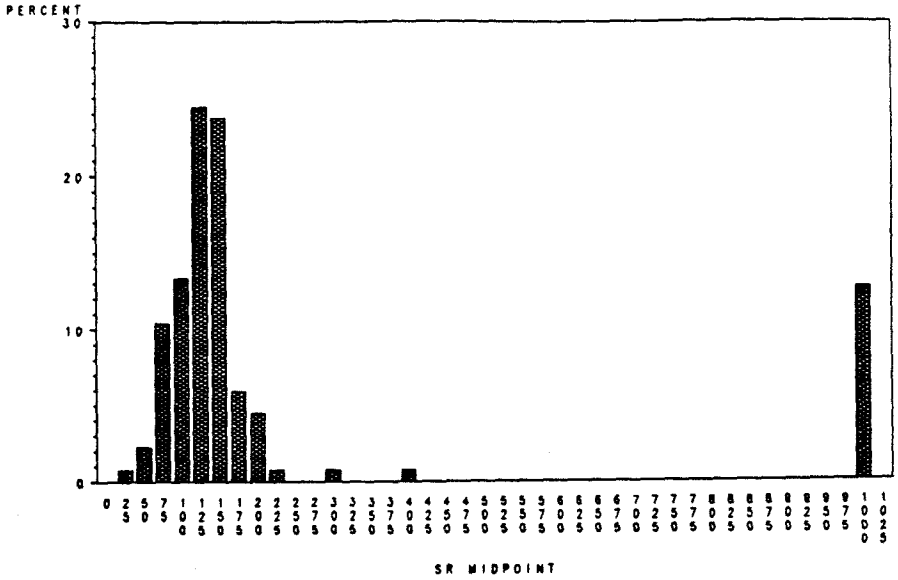


Figure A-173.

Data distribution of total **STRONTIUM** in background stream water.

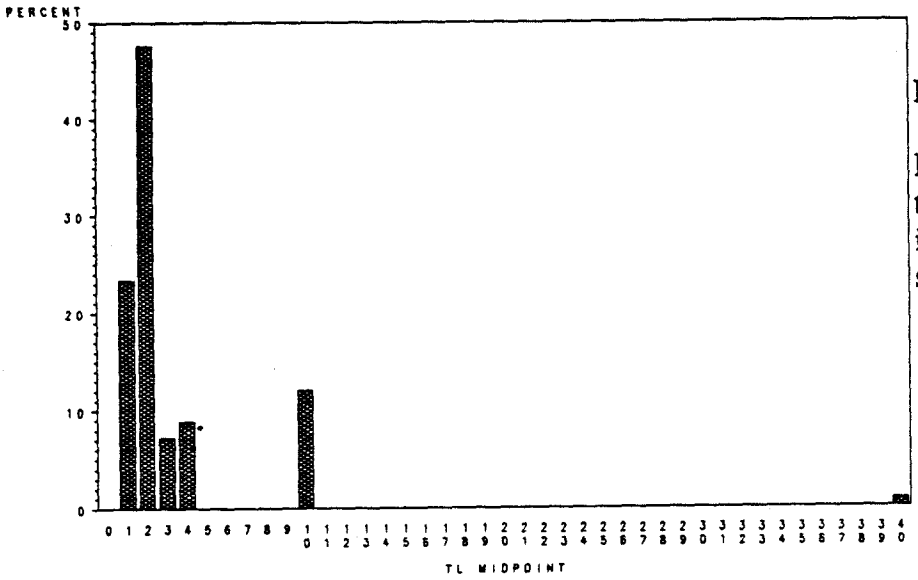


Figure A-174.

Data distribution of total **THALLIUM** in background stream water.

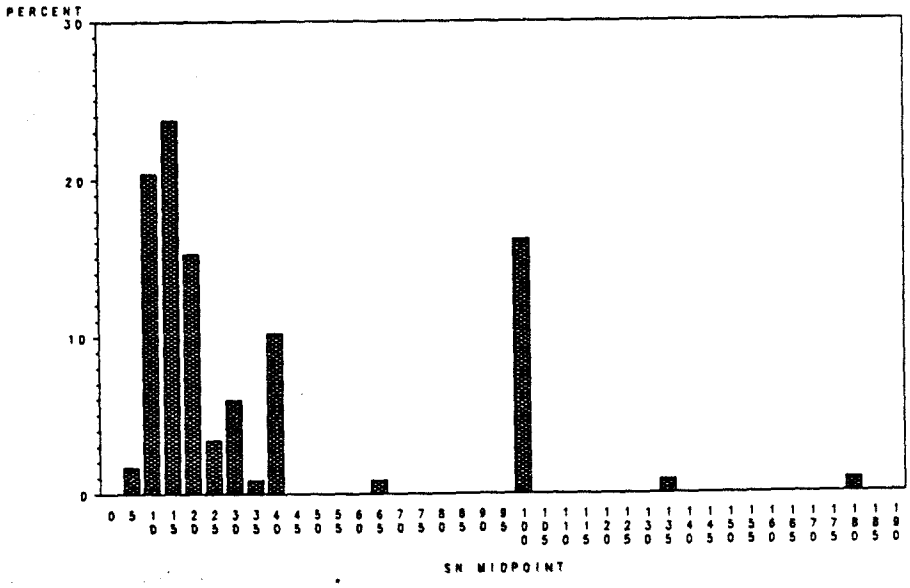


Figure A-175.

Data distribution of total **TIN** in background stream water.

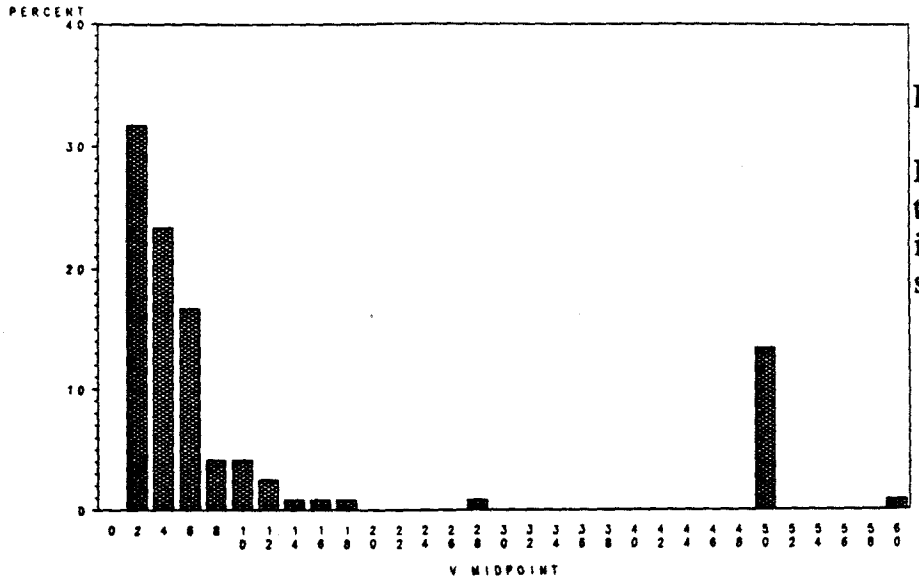


Figure A-176.

Data distribution of total **VANADIUM** in background stream water.

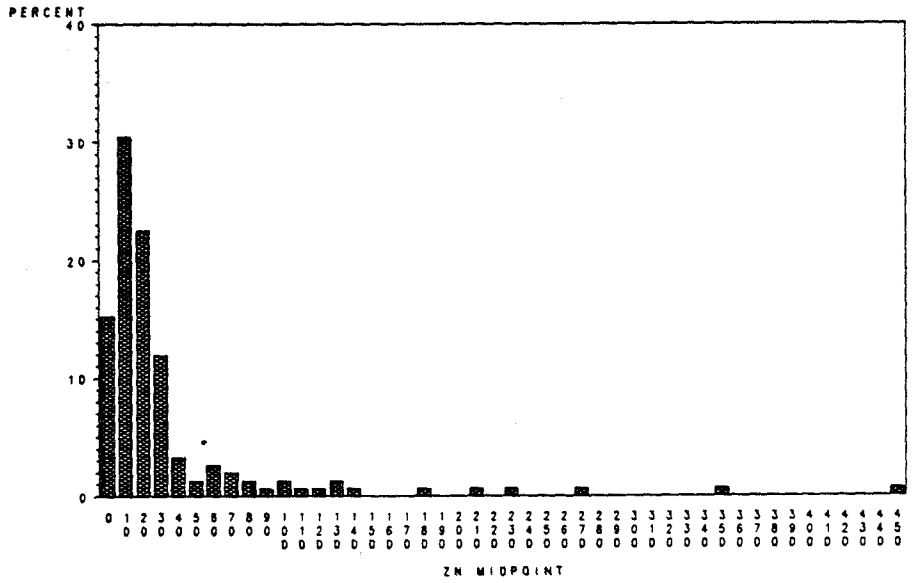


Figure A-177.

Data distribution of total **ZINC** in background stream water.

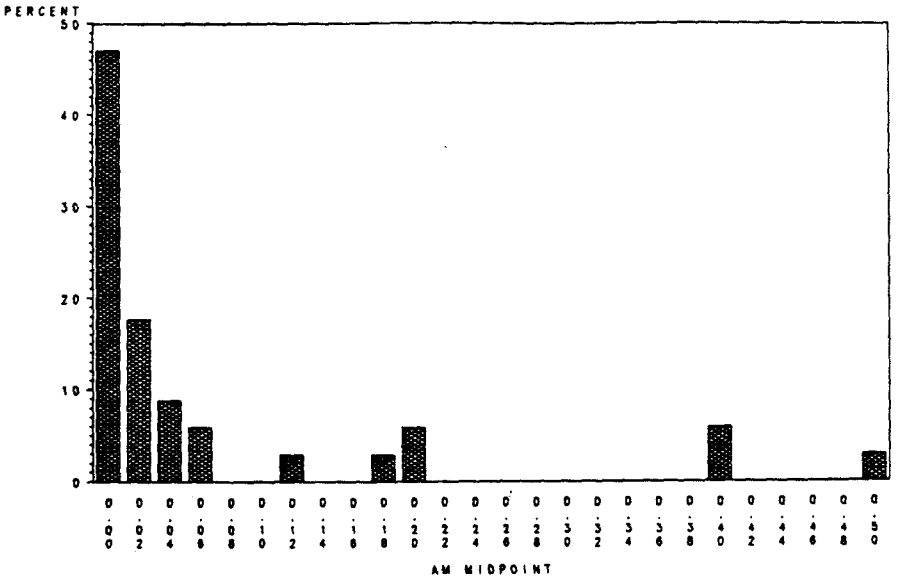


Figure A-178.

Data distribution of dissolved **AMERICIUM-241** in background stream water.

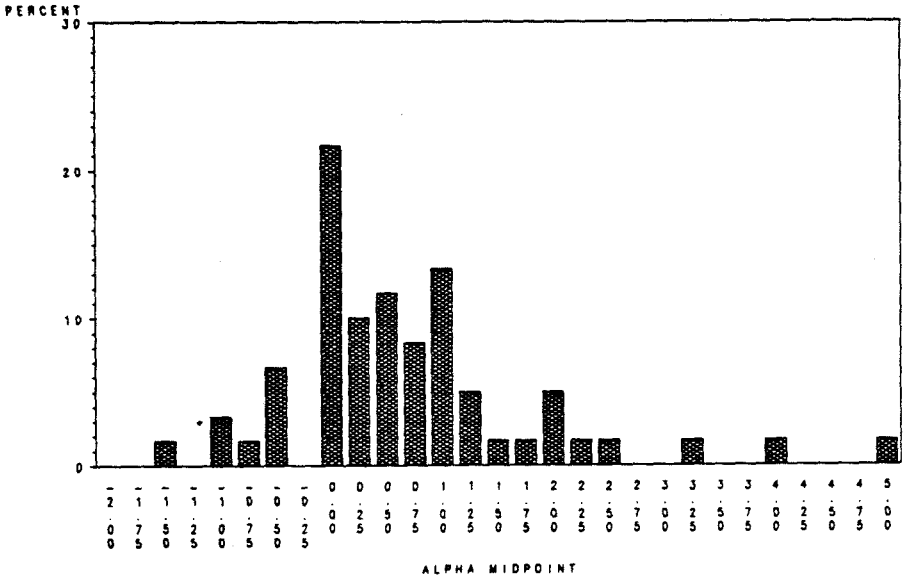


Figure A-179.

Data distribution of dissolved **GROSS ALPHA** in background stream water.

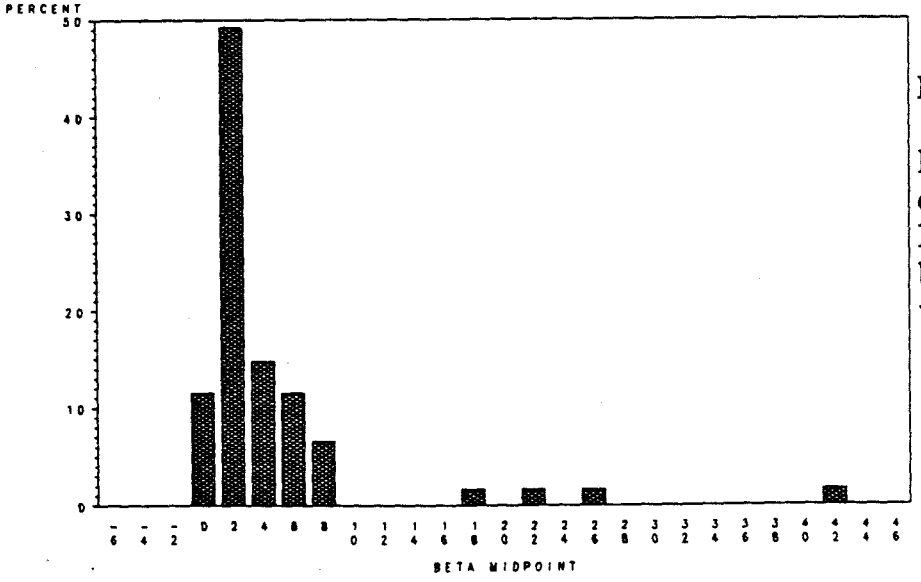


Figure A-180.

Data distribution of dissolved **GROSS BETA** in background stream water.

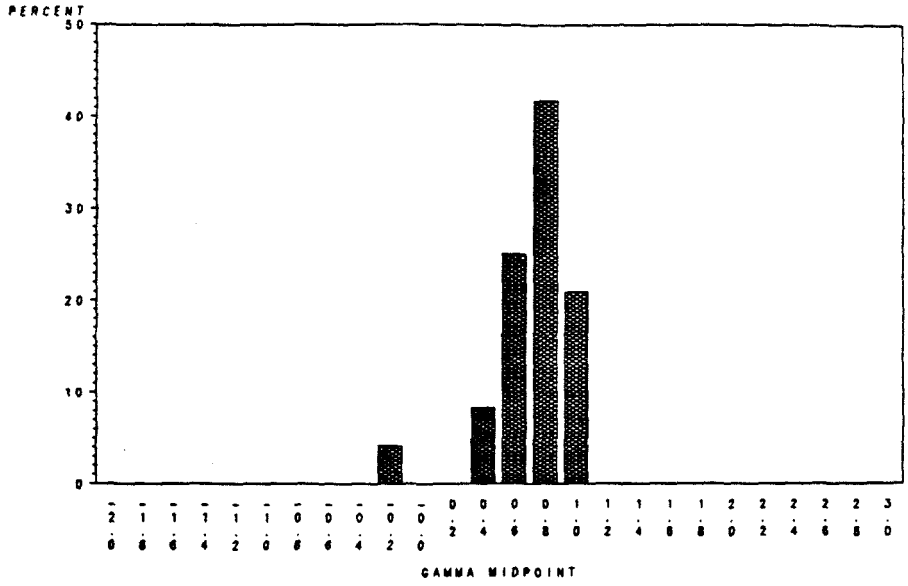


Figure A-181.

Data distribution of dissolved **GROSS GAMMA** in background stream water.

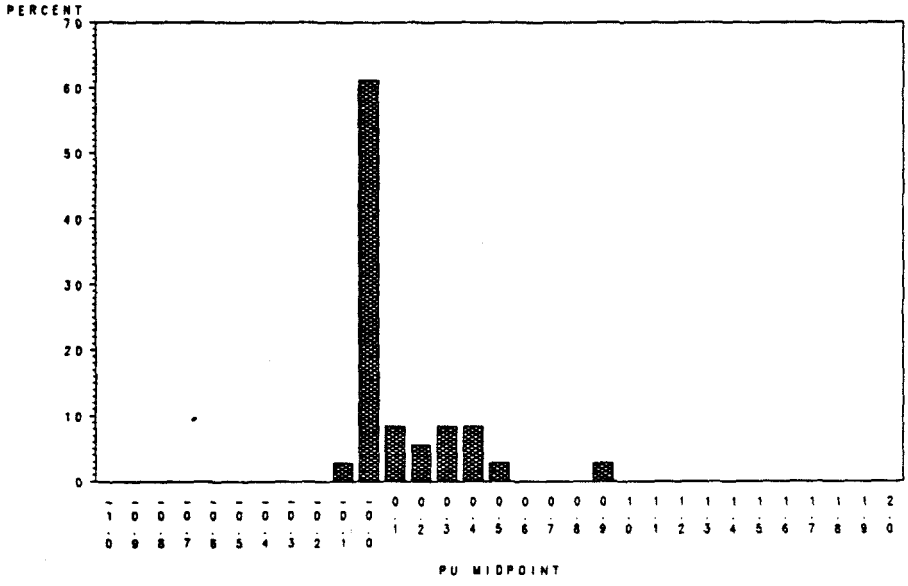


Figure A-182.

Data distribution of dissolved **PLUTONIUM-239,240** in background stream water.

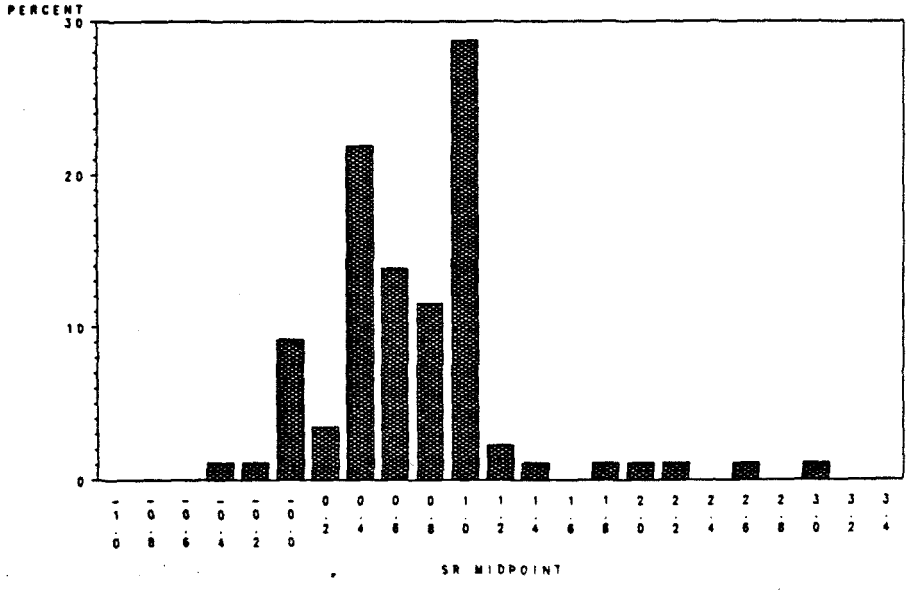


Figure A-183.

Data distribution of dissolved **STRONTIUM-89,90** in background stream water.

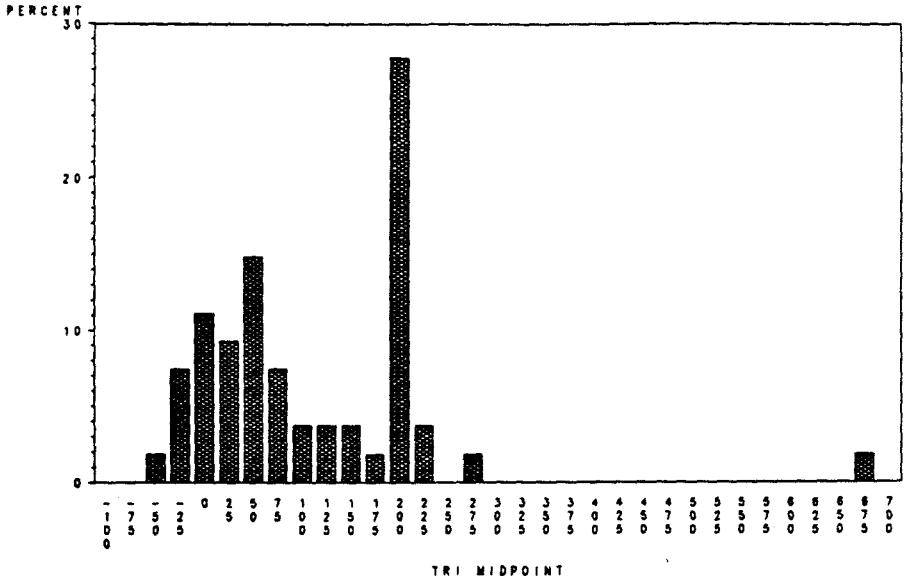


Figure A-184.

Data distribution of dissolved **TRITIUM** in background stream water.

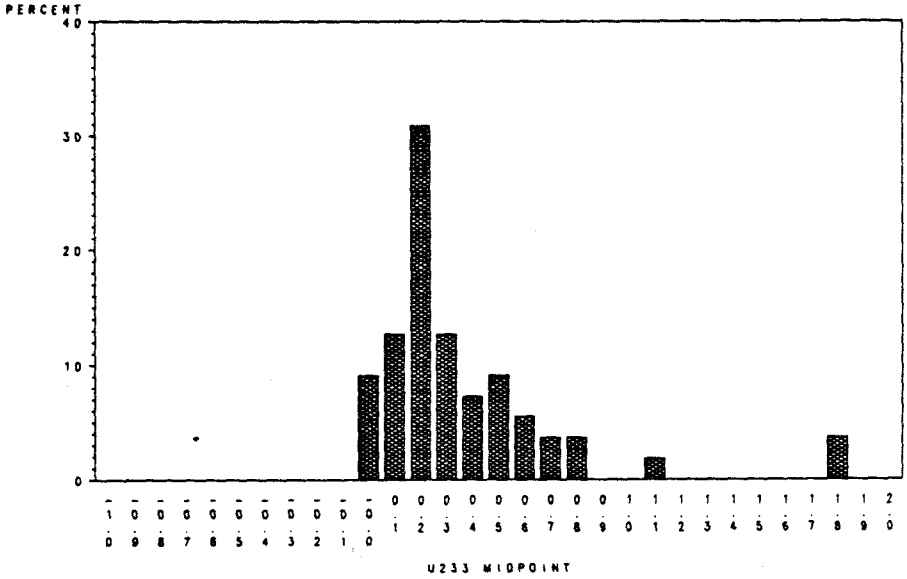


Figure A-185.

Data distribution of dissolved **URANIUM-233,234** in background stream water.

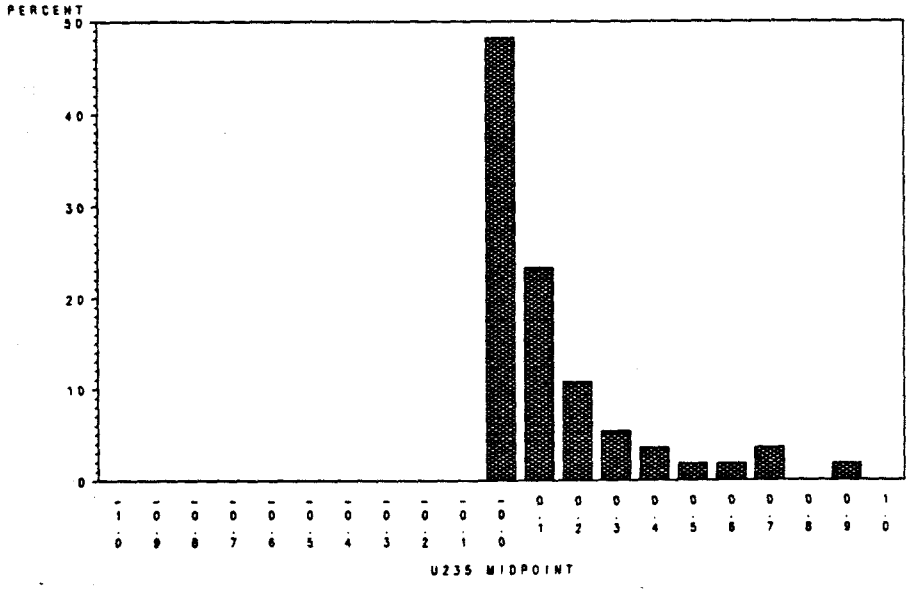


Figure A-186.

Data distribution of dissolved **URANIUM-235** in background stream water.

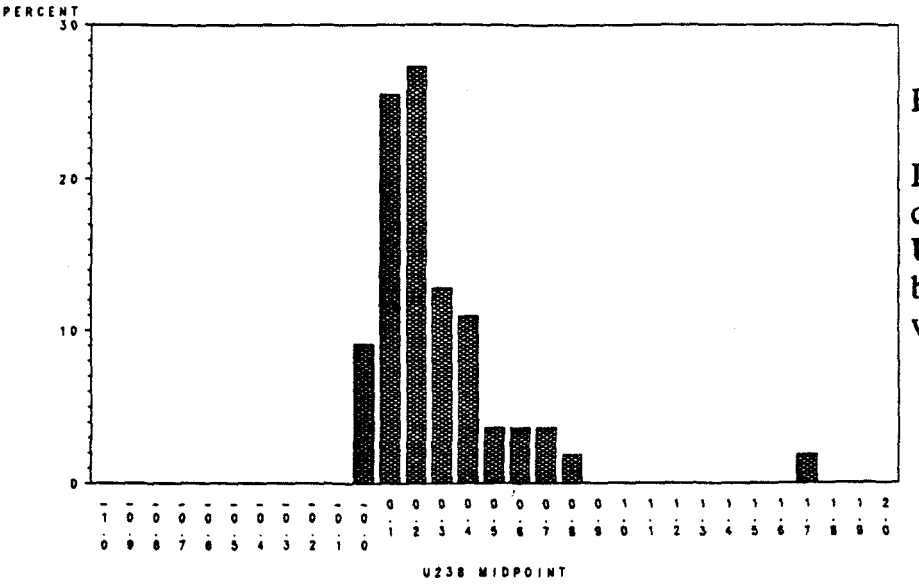


Figure A-187.

Data distribution of dissolved **URANIUM-238** in background stream water.

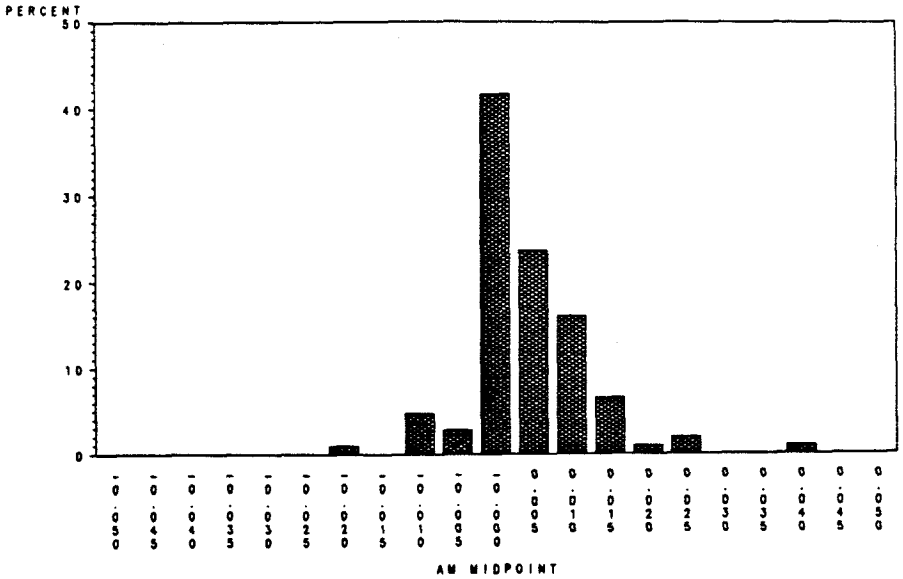


Figure A-188.

Data distribution of total **AMERICIUM-241** in background stream water.

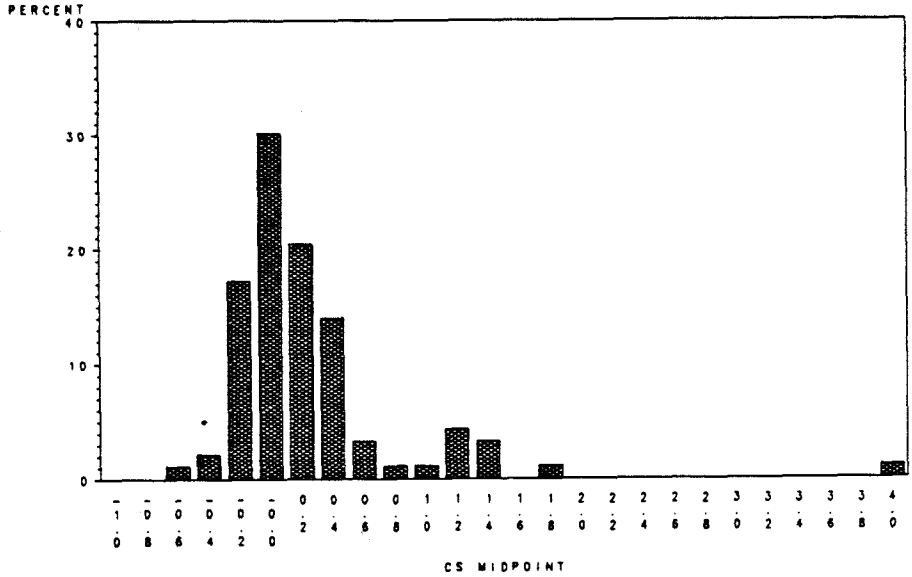


Figure A-189.

Data distribution of total **CESIUM-137** in background stream water.

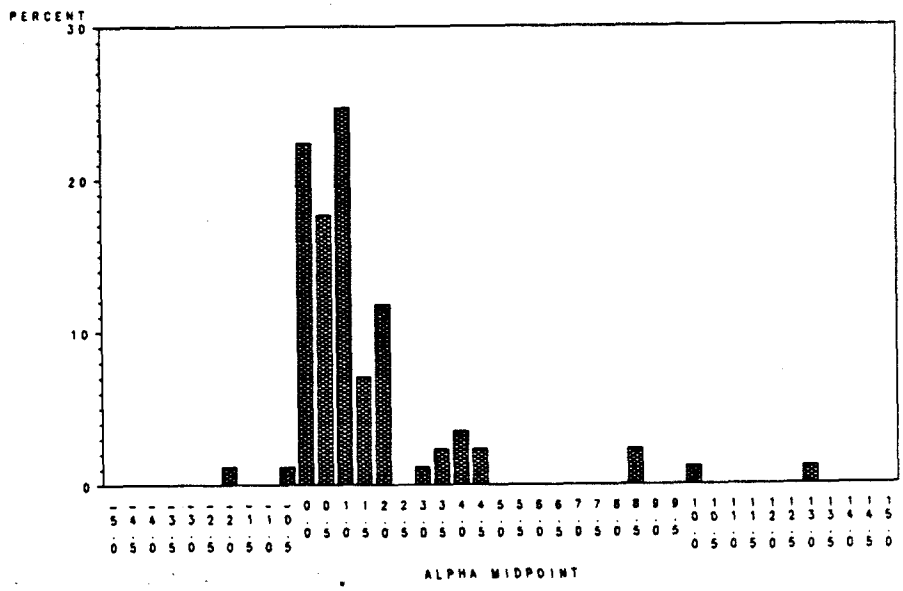


Figure A-190.

Data distribution of total **GROSS ALPHA** in background stream water.

NOTICE:

The following page has been misnumbered when originally printed. Page number A-71 should be numbered A-70, which was omitted in the numbering sequence. No pages are missing from this document. Figure A-191 on page A-71 follows Figure A-190 found on page A-69.

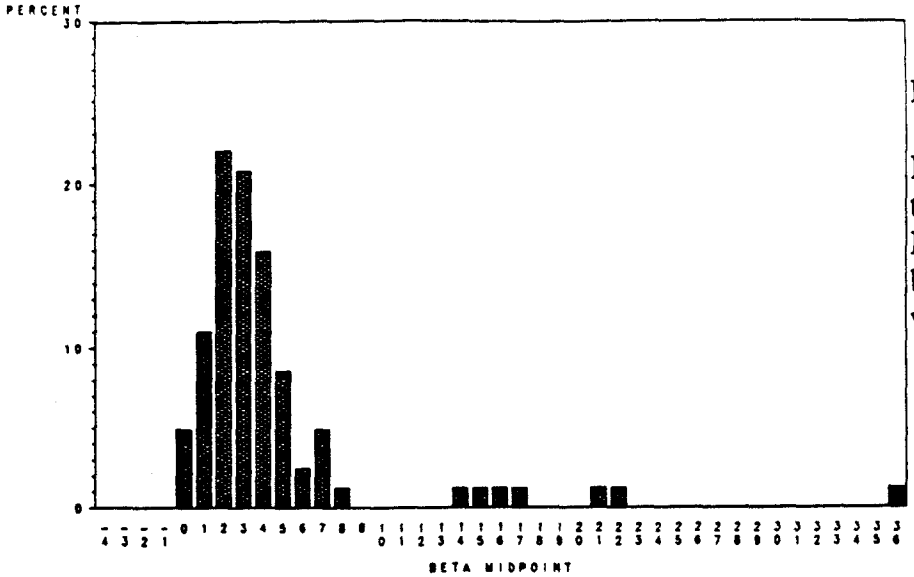


Figure A-191.

Data distribution of total **GROSS BETA** in background stream water.

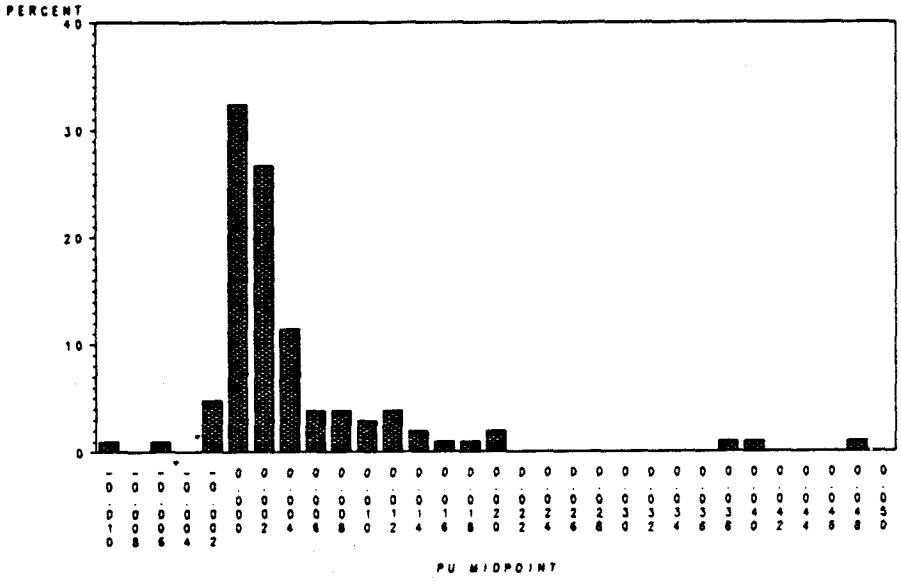


Figure A-192.

Data distribution of total **PLUTONIUM-239,240** in background stream water.

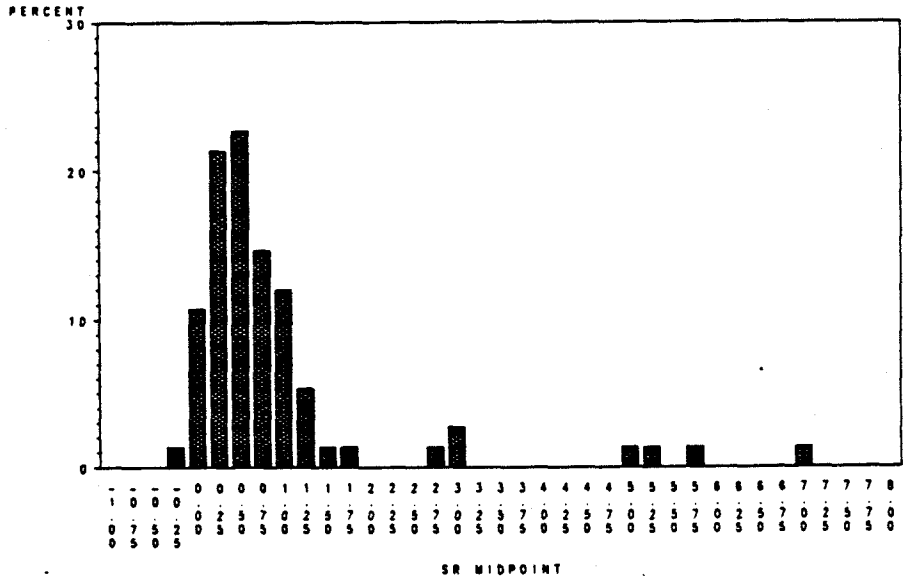


Figure A-193.

Data distribution of total **STRONTIUM-89,90** in background stream water.

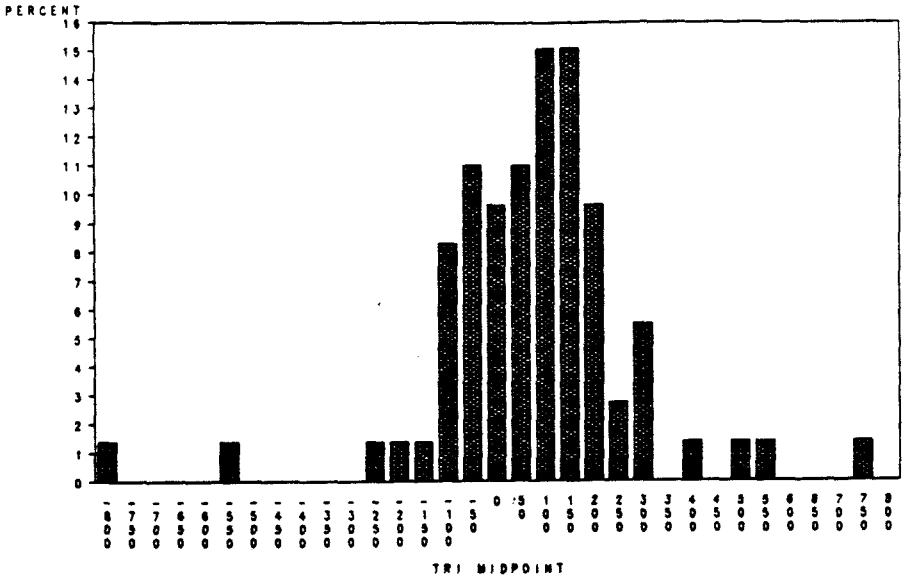


Figure A-194.

Data distribution of total **TRITIUM** in background stream water.

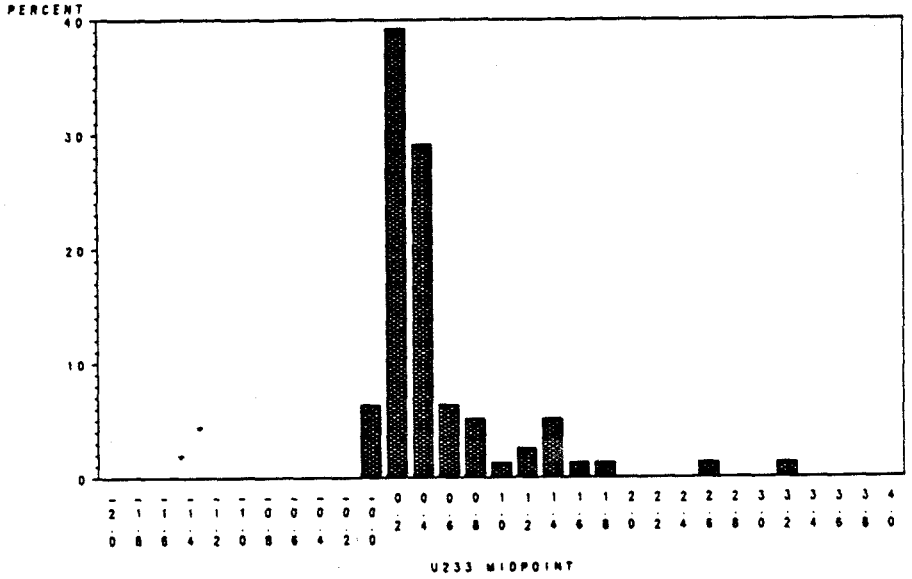


Figure A-195.

Data distribution of total **URANIUM-233,234** in background stream water.

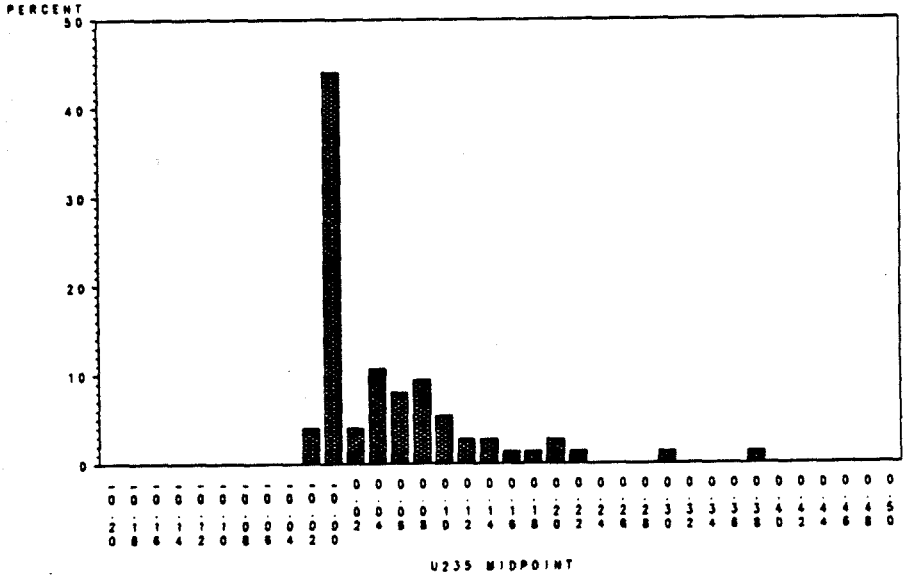


Figure A-196.

Data distribution of total **URANIUM-235** in background stream water.

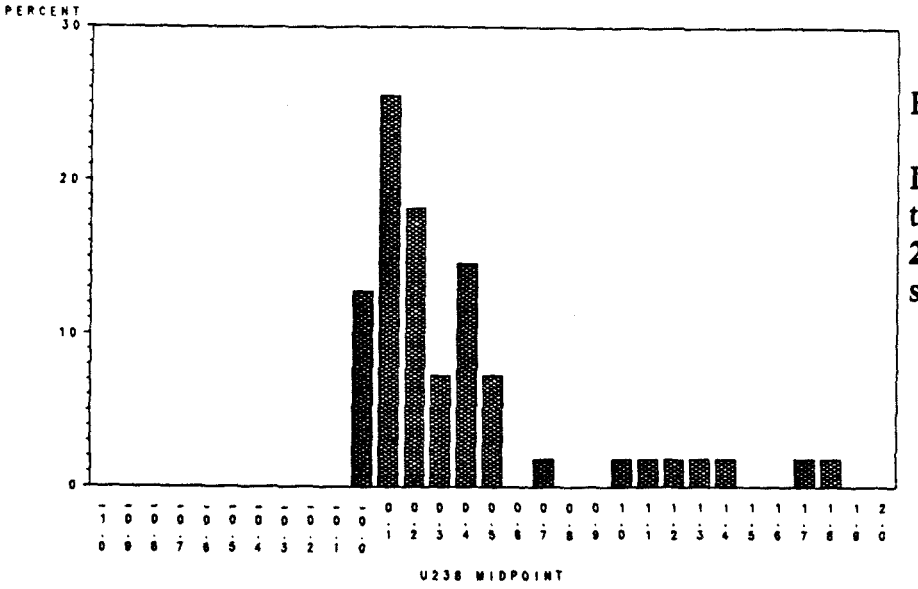


Figure A-197.

Data distribution of total **URANIUM-238** in background stream water.

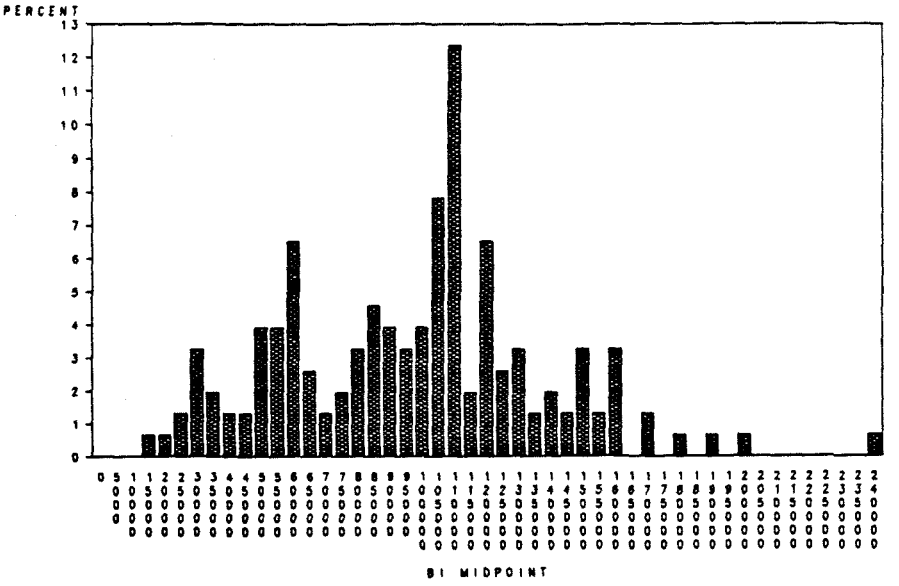


Figure A-198.

Data distribution of **BICARBONATE** in background stream water.

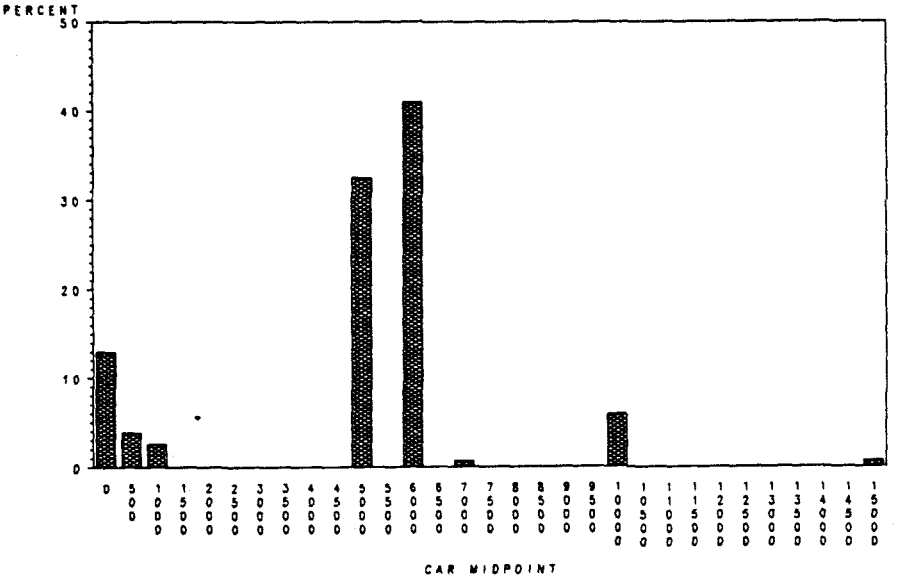


Figure A-199.

Data distribution of **CARBONATE** in background stream water.

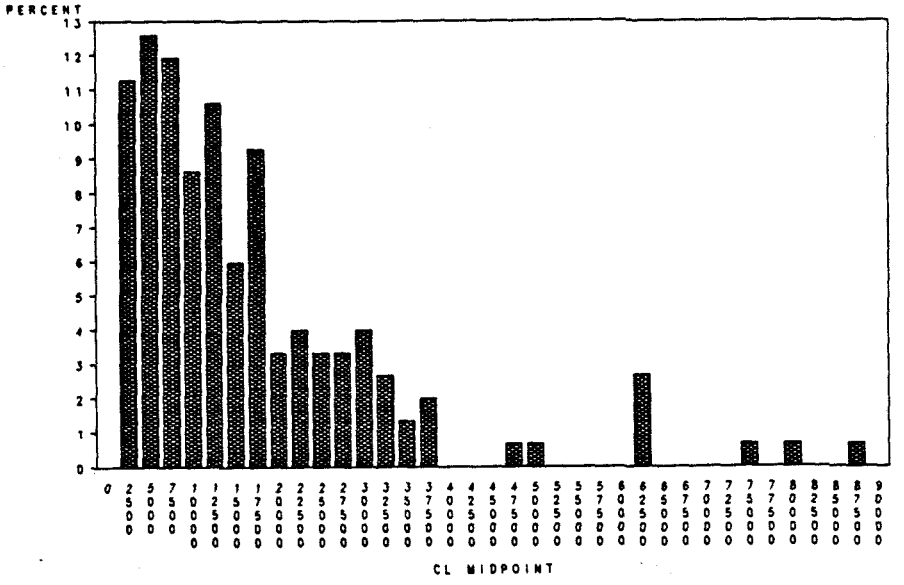


Figure A-200.

Data distribution of **CHLORIDE** in background stream water.

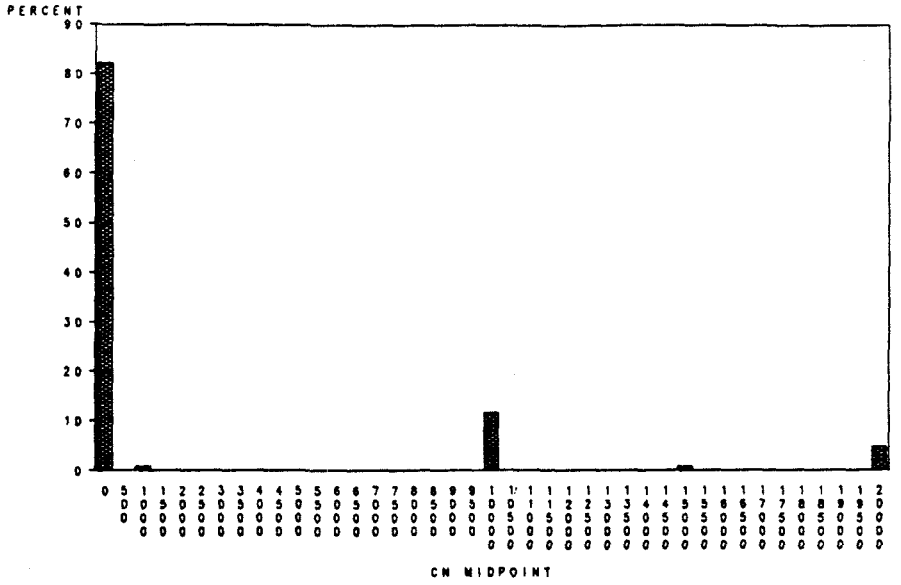


Figure A-201.

Data distribution of **CYANIDE** in background stream water.

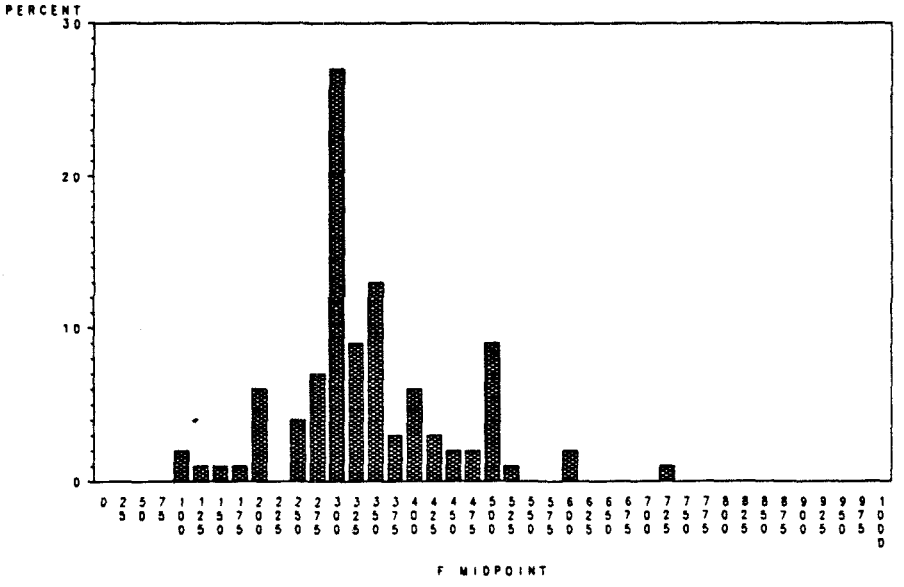


Figure A-202.

Data distribution of **FLUORIDE** in background stream water.

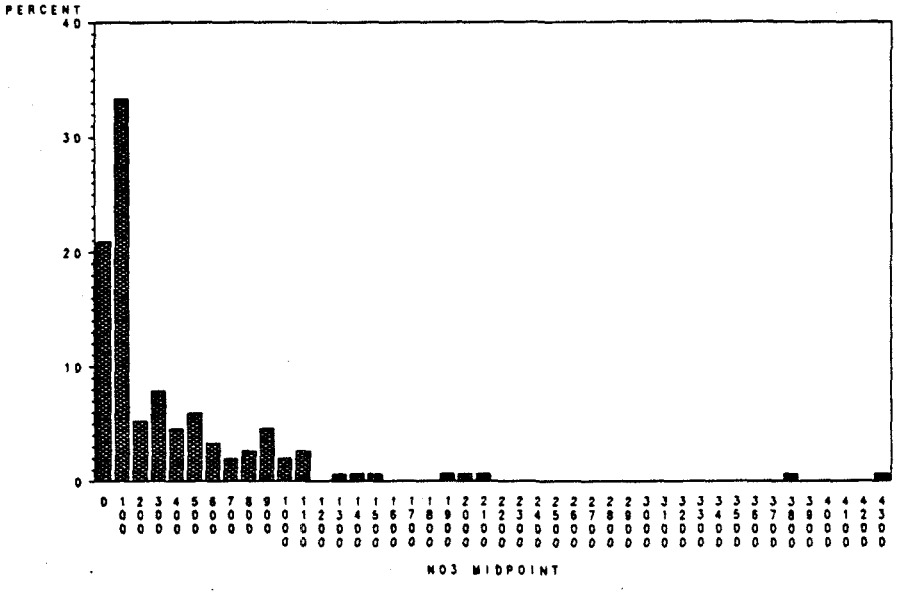


Figure A-203.

Data distribution of **NITRATE / NITRITE** in background stream water.

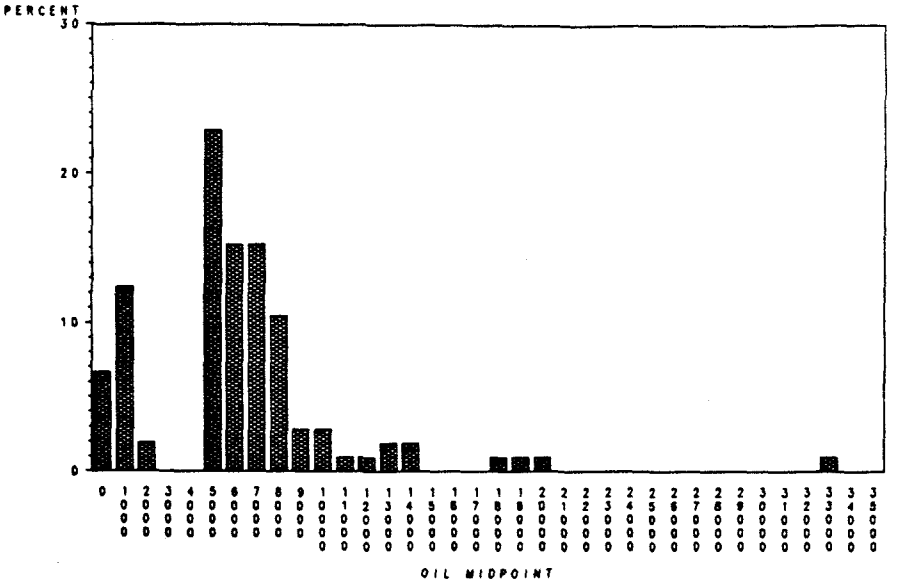


Figure A-204.

Data distribution of **OIL AND GREASE** in background stream water.

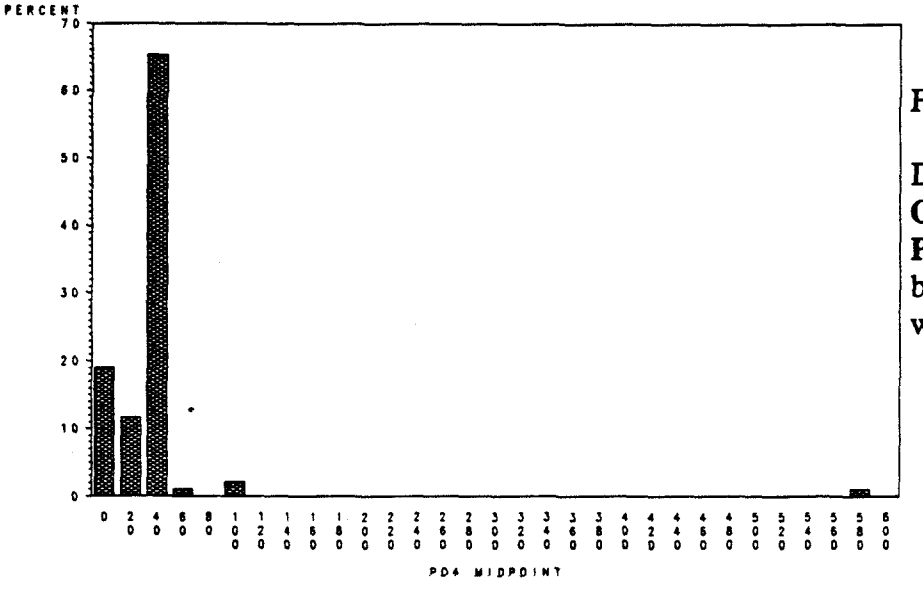


Figure A-205.

Data distribution of **ORTHO-PHOSPHATE** in background stream water.

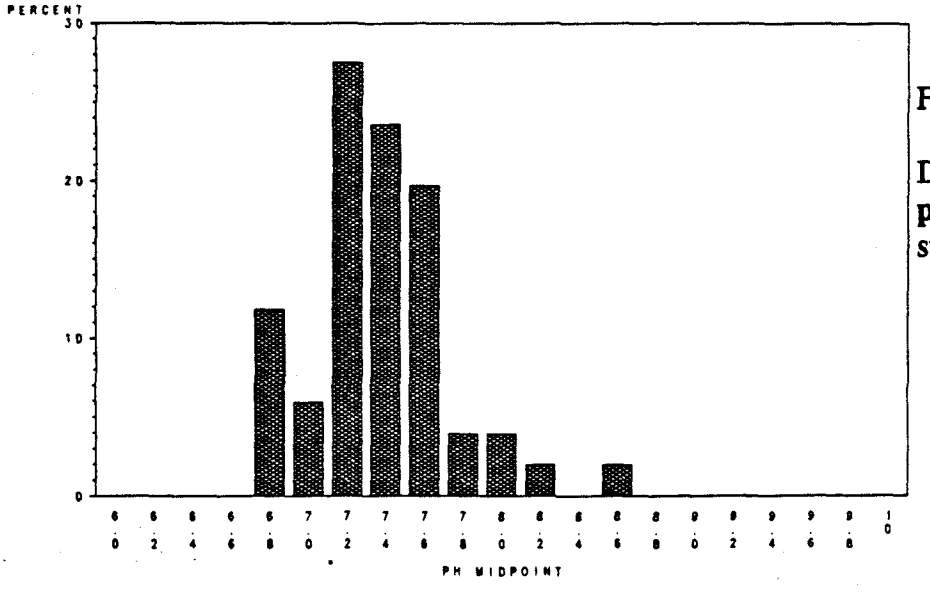


Figure A-206.

Data distribution of **pH** in background stream water.

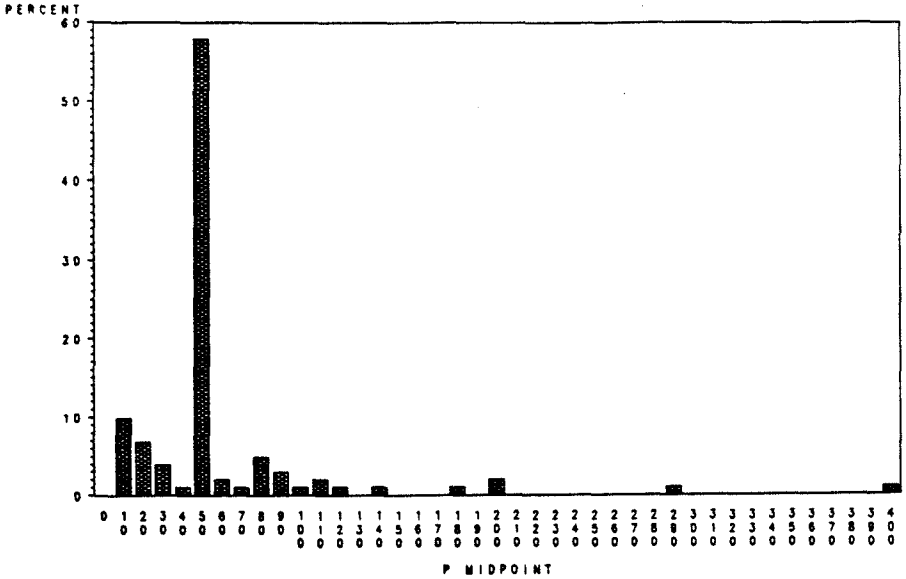


Figure A-207.

Data distribution of **PHOSPHORUS** in background stream water.

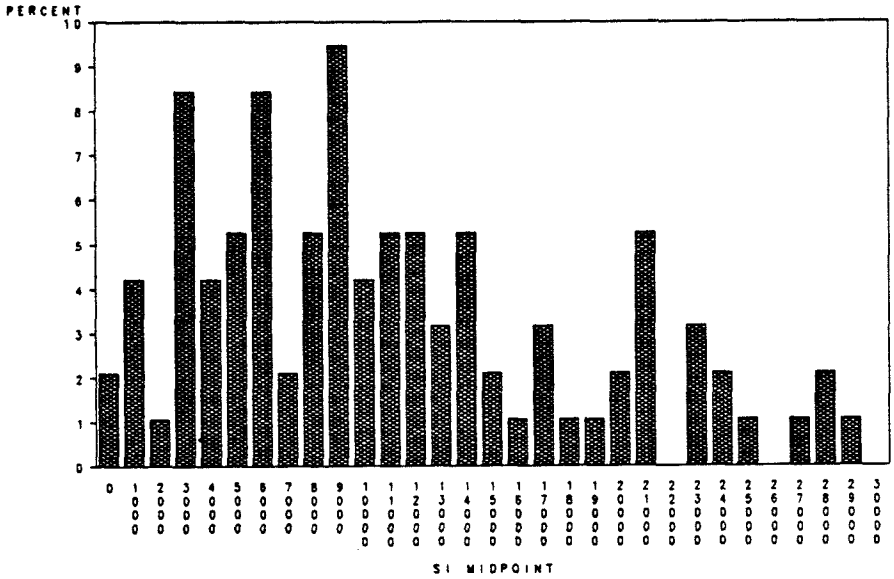


Figure A-208.

Data distribution of **SILICA** in background stream water.

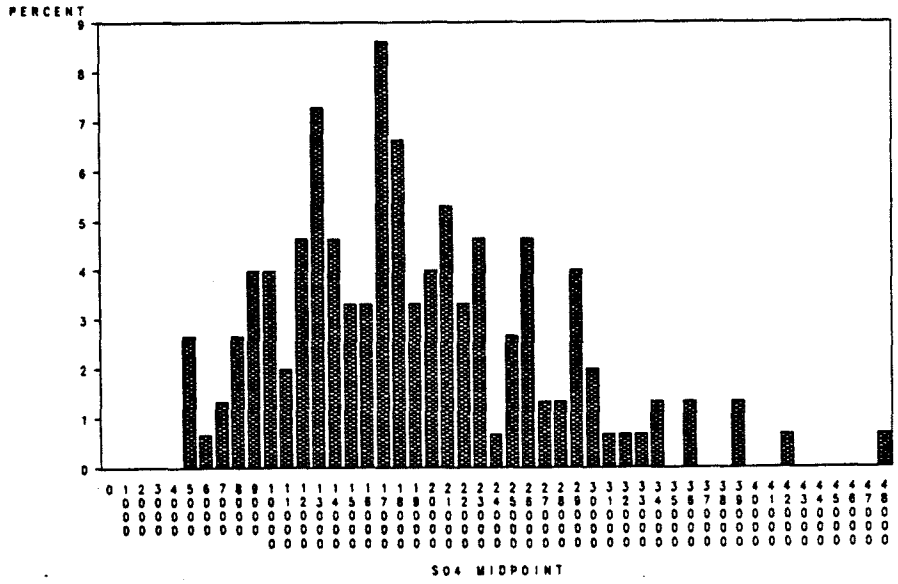


Figure A-209

Data distribution of **SULFATE** in background stream water.

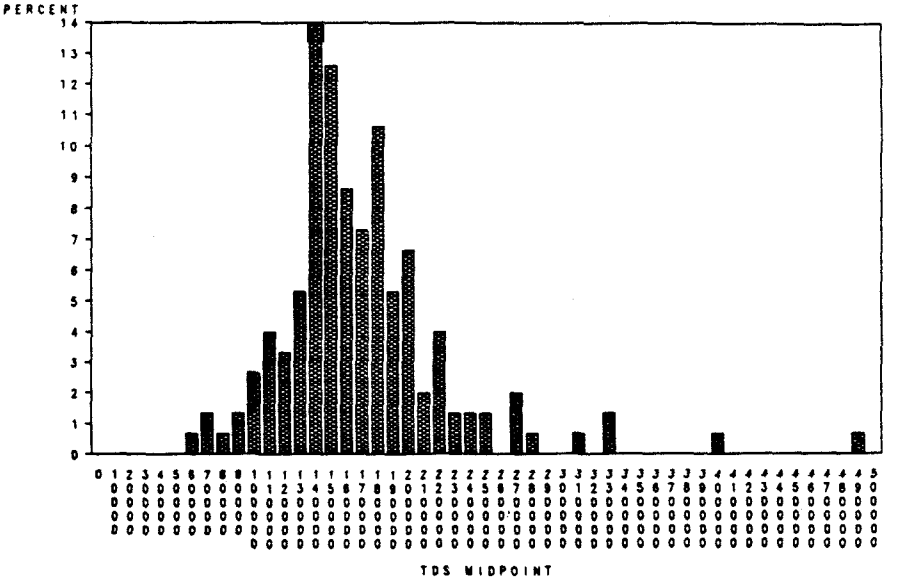


Figure A-210.

Data distribution of **TOTAL DISSOLVED SOLIDS** in background stream water.

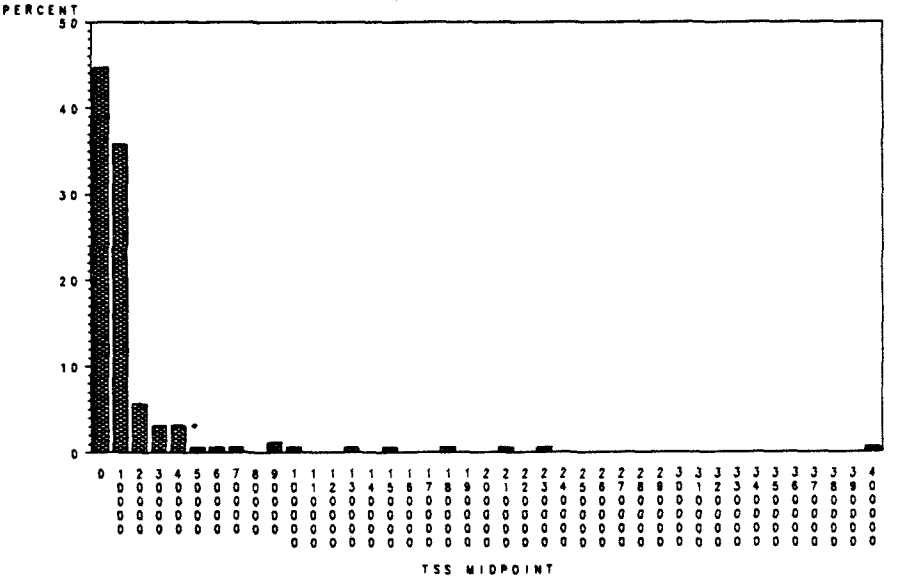


Figure A-211.

Data distribution of **TOTAL SUSPENDED SOLIDS** in background stream water.

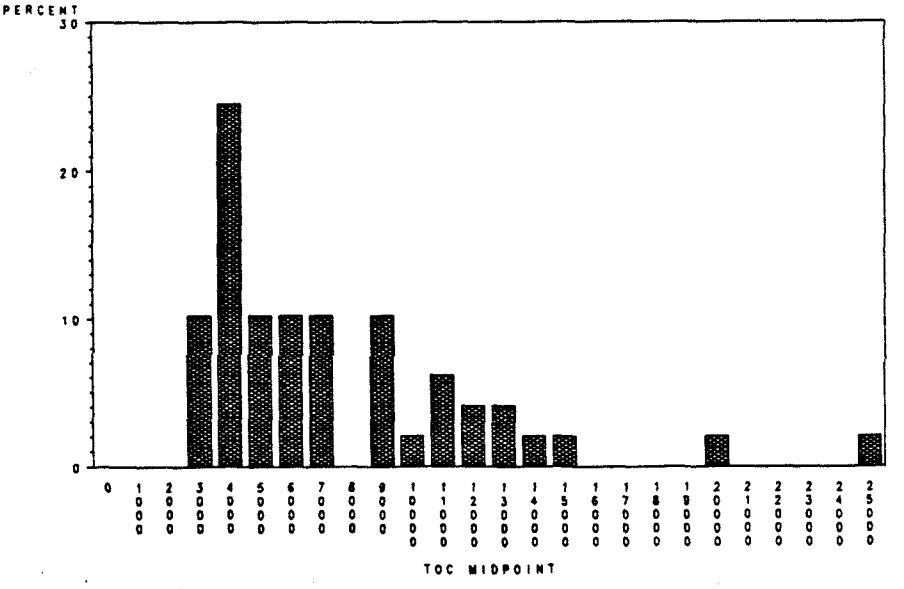


Figure A-212.

Data distribution of **TOTAL ORGANIC CARBON** in background stream water.

RESULTS OF ANALYSIS OF VARIANCE: TABLES AND FIGURES

APPENDIX B

RESULTS OF ANALYSIS OF VARIANCE:

TABLES AND FIGURES

APPENDIX B

RESULTS OF ANALYSIS OF VARIANCE: TABLES AND FIGURES

The following is a brief description of the plots used in this appendix. Box plots by geologic unit are displayed for analytes that were investigated by nonparametric analysis of variance (ANOVA). Only groundwater and geologic materials were subject to ANOVA testing. In addition to box plots, residual plots and confidence interval plots are displayed for the analytes that were analyzed using parametric ANOVA. These plots are intended to offer graphic descriptions of data along with visual verification of the requirements of parametric ANOVA. Each geologic unit is represented by a separate symbol as described below.

The following symbols are used to distinguish the five different geologic formations in all plots:

- ● = Rocky Flats Alluvium (RFA),
- ◇ = valley-fill alluvium (VFA),
- + = colluvium (COL),
- □ = weathered claystone of upper Arapahoe/Laramie Formations (WCS), and
- * = undifferentiated Arapahoe/Laramie Formations (KAR).

DESCRIPTIONS OF PLOTS FOR PARAMETRIC ANOVA TESTS

Results by Time: Results are plotted as a function of time. No obvious trends or patterns should exist that would indicate time dependence.

Lognormal Probability Plot: Probability plots are for the residuals and will be generally linear if the residuals are normal or lognormal in nature. Significant departures from a straight line indicate that the residuals are not normal.

Residuals by Geology: Residuals should be distributed more or less evenly about their respective means and should possess the same variability.

Residuals by Time: Residuals should be distributed uniformly about zero with no obvious trend over time. In addition, the residuals should display no periodic or linear tendencies that might suggest time dependence.

Confidence Interval Plots: Confidence interval plots graphically display the comparisons between means for the parametric ANOVA. The midpoint indicates the mean for that geologic unit and the end points are the upper and lower 95-percent confidence limits for that mean. Non-overlapping intervals suggest a significant difference in means, and tend to confirm the results of the Bonferroni pairwise comparisons.

BOX PLOTS FOR BOTH PARAMETRIC AND NONPARAMETRIC ANOVA

Box plots are intended to display salient features of data. Lower and upper edges of boxes correspond to the 25th and 75th percentiles (first and third quartiles), respectively. The distance between the upper and lower ends of the box then represent the interquartile range. The line through the middle corresponds to the 50th percentile (second quartile or median). The plus symbol (+) inside the box represents the mean.

"Whiskers" are drawn from the ends of the box to a point not exceeding 1.5 times the interquartile range from either edge of the box. Any values exceeding 1.5 times the interquartile range are plotted as individual rectangular symbols extending beyond the ends of the whiskers.

TABLES OF RESULTS FOR PARAMETRIC AND NONPARAMETRIC ANOVA

Tables of test results indicate significant differences between different groups by an "X" given in the field of pairwise comparisons. ANOVA tests were run comparing mean analyte concentrations within the five geologic units for significant differences by geology, and comparing mean analyte concentrations within the upper and lower flow-systems for significant differences by flow-system. Tables are arranged by medium and by analyte group.

Table B-1. Results of parametric ANOVA by **GEOLOGIC UNIT** for **GROUNDWATER.**

PARAMETRIC ANOVA BY GEOLOGIC UNIT											
GROUNDWATER	Geologic Units: Pairwise Comparisons										
	COL KAR	COL WCS	COL RFA	COL VFA	KAR WCS	KAR RFA	KAR VFA	WCS RFA	WCS VFA	RFA VFA	N
DISSOLVED METALS											
Al											312
Fe											322
Zn											323
TOTAL METALS											
Cu											184
Mn											185
Pb											176
Silicon			X			X	X	X			102
DISSOLVED RADS											
Tritium		X				X		X	X		213
TOTAL RADS											
Cs-137											193
Sr-89,90											36
Tritium	X					X					98

Table B-2. Results of nonparametric ANOVA by **GEOLOGIC UNIT** for **DISSOLVED METALS** in **GROUNDWATER.**

NONPARAMETRIC ANOVA BY GEOLOGIC UNIT											
GROUNDWATER	Geologic Units: Pairwise Comparisons										
	COL KAR	COL WCS	COL RFA	COL VFA	KAR WCS	KAR RFA	KAR VFA	WCS RFA	WCS VFA	RFA VFA	N
DISSOLVED METALS											
Sb											311
Ba										X	322
Ca	X	X	X	X	X		X	X		X	323
Li	X		X	X		X		X		X	316
Mg	X	X	X	X	X		X	X		X	320
Mn			X			X				X	322
K			X			X	X	X		X	319
Se	X				X			X	X		273
Na		X	X	X	X	X	X	X		X	321
Sr	X		X	X		X		X		X	318
V											314

Table B-3. Results of nonparametric ANOVA by **FLOW-SYSTEM** for **DISSOLVED METALS** in **GROUNDWATER.**

NONPARAMETRIC ANOVA BY FLOW-SYSTEM					
GROUNDWATER DISSOLVED METALS		Comparison by flow-system			
		Upper flow-system vs. Lower flow-system			
		T-test	Wilcoxon	N Upper	N Lower
GWBUFM	Al			248	66
	Sb			248	63
	Ba			256	66
	Ca	X	X	257	67
	Fe	X	X	256	67
	Li		X	250	66
	Mg	X	X	254	67
	Mn	X		256	67
	K	X	X	253	67
	Se	X		220	54
	Na	X	X	255	67
	Sr		X	253	66
	V			249	65
	Zn			256	67

Table B-4. Results of nonparametric ANOVA by **GEOLOGIC UNIT** for **TOTAL METALS** in **GROUNDWATER.**

NONPARAMETRIC ANOVA BY GEOLOGIC UNIT											
GROUNDWATER	Geologic Units: Pairwise Comparisons										
	COL KAR	COL WCS	COL RFA	COL VFA	KAR WCS	KAR RFA	KAR VFA	WCS RFA	WCS VFA	RFA VFA	N
TOTAL METALS											
Al			X			X		X			184
Ba											184
Ca	X	X	X	X	X		X	X		X	186
Fe			X					X			184
Li			X	X		X		X		X	186
Mg	X		X		X		X	X		X	186
K						X					187
Se	X		X		X						180
Na		X	X	X	X	X	X	X		X	186
Sr	X		X	X		X		X		X	183
V											184
Zn											185

Table B-5. Results of nonparametric ANOVA by **FLOW-SYSTEM** for **TOTAL METALS** in **GROUNDWATER.**

NONPARAMETRIC ANOVA BY FLOW-SYSTEM					
GROUNDWATER TOTAL METALS		Comparison by flow-system			
		Upper flow-system vs. Lower flow-system			
		T-test	Wilcoxon	N Upper	N Lower
GWBUTM	Al		X	149	37
	Ba			149	37
	Ca	X	X	149	37
	Cu			148	37
	Fe			149	37
	Pb			141	36
	Li		X	149	37
	Mg	X	X	149	37
	Mn			149	37
	K	X	X	150	37
	Se	X	X	145	36
	Silicon	X	X	84	20
	Na	X	X	149	37
	Sr			146	37
	V		X	149	37
	Zn			149	37

Table B-6. Results of nonparametric ANOVA by **GEOLOGIC UNIT** for **DISSOLVED RADIONUCLIDES** and **TOTAL RADIONUCLIDES.**

NONPARAMETRIC ANOVA BY GEOLOGIC UNIT

GROUNDWATER	Geologic Units: Pairwise Comparisons										
	COL KAR	COL WCS	COL RFA	COL VFA	KAR WCS	KAR RFA	KAR VFA	WCS RFA	WCS VFA	RFA VFA	N
DISSOLVED RADS											
Cs-137											42
Gross alpha	X		X	X	X	X		X	X	X	273
Gross beta	X		X		X	X		X		X	250
Radium-226	X										38
Sr-89,90							X		X	X	221
U-233,234	X		X	X	X	X	X	X	X	X	262
U-235	X		X	X	X		X	X		X	264
U-238	X		X	X	X	X	X	X	X	X	230

	COL KAR	COL WCS	COL RFA	COL VFA	KAR WCS	KAR RFA	KAR VFA	WCS RFA	WCS VFA	RFA VFA	N
TOTAL RADS											
Am-241											226
Gross alpha	X		X	X		X		X	X		29
Gross beta			X	X		X		X			29
Pu-238											20
Pu-239,240											242
U-233,234	X		X	X	X			X	X	X	39
U-235	X		X	X							39
U-238	X		X					X			24

Table B-7. Results of nonparametric ANOVA by **FLOW-SYSTEM** for **DISSOLVED RADIONUCLIDES** and **TOTAL RADIONUCLIDES.**

NONPARAMETRIC ANOVA BY FLOW-SYSTEM

GROUNDWATER DISSOLVED RADS		Comparison by flow-system			
		Upper flow-system vs. Lower flow-system			
		T-test	Wilcoxon	N Upper	N Lower
GWBUFR	Cs-137			38	4
	Gross alpha	X		213	60
	Gross beta			196	54
	Radium-226		X	36	2
	Sr-89,90			180	42
	Tritium		X	165	49
	U-233,234	X		207	57
	U-235	X	X	207	57
	U-238	X	X	177	54

GROUNDWATER TOTAL RADS		Upper flow-system vs. Lower flow-system			
		T-test	Wilcoxon	N Upper	N Lower
GWBUTR	Am-241			183	43
	Cs-137	X	X	156	39
	Gross alpha			23	6
	Gross beta			23	6
	Pu-238		X	15	5
	Pu-239,240			194	48
	Sr-89,90			32	4
	Tritium		X	84	16
	U-233,234	X		35	4
	U-235	X		35	4
	U-238			22	2

Table B-8. Results of nonparametric ANOVA by **GEOLOGIC UNIT** for **WATER-QUALITY PARAMETERS.**

NONPARAMETRIC ANOVA BY GEOLOGIC UNIT											
GROUNDWATER	Geologic Units: Pairwise Comparisons										
	COL KAR	COL WCS	COL RFA	COL VFA	KAR WCS	KAR RFA	KAR VFA	WCS RFA	WCS VFA	RFA VFA	N
WATER-QUAL PARAM.											
Bicarbonate	X	X	X	X		X		X		X	404
Chloride		X	X		X	X			X	X	336
Fluoride			X	X		X	X	X	X	X	392
NO3/NO2	X		X	X		X	X	X	X	X	395
SiO2	X		X			X	X	X	X		357
SO4	X	X	X	X	X		X	X		X	360
TDS	X	X	X	X	X	X		X		X	404
TSS	X	X	X	X	X						389

Table B-9. Results of nonparametric ANOVA by **FLOW-SYSTEM** for **WATER-QUALITY PARAMETERS.**

NONPARAMETRIC ANOVA BY FLOW-SYSTEM					
GROUNDWATER WATER-QUALITY		Comparison by flow-system			
		Upper flow-system vs. Lower flow-system			
		T-test	Wilcoxon	N Upper	N Lower
GWBUUW	Bicarbonate	X	X	311	93
	Chloride	X	X	258	79
	Fluoride	X	X	301	92
	NO3/NO2			306	90
	SiO2	X	X	275	84
	SO4		X	278	82
	TDS	X	X	311	94
	TSS	X	X	301	88

Table B-10. Results of parametric ANOVA by **GEOLOGIC UNIT** for **GEOLOGIC MATERIALS.**

PARAMETRIC ANOVA BY GEOLOGY

GEOLOGIC (BOREHOLE) MATERIALS	Geologic Units: Pairwise Comparisons						
	COL KAR	COL WCS	COL RFA	KAR WCS	KAR RFA	WCS RFA	N
TOTAL METALS							
As							120
Ba							119
Cu							119
Fe							118
Mg							119
Ni							115
V							118

GEOLOGIC (BOREHOLE) MATERIALS	Geologic Units: Pairwise Comparisons						
	COL KAR	COL WCS	COL RFA	KAR WCS	KAR RFA	WCS RFA	N
TOTAL RADS							
Gross alpha		X	X	X	X		120
Ra-228	X		X				97
Sr-89,90							120
Tritium			X		X		120

Table B-11. Results of nonparametric ANOVA by **GEOLOGIC UNIT** for **TOTAL METALS** in **GEOLOGIC MATERIALS.**

NONPARAMETRIC ANOVA BY GEOLOGY							
GEOLOGIC (BOREHOLE) MATERIALS	Geologic Units: Pairwise Comparisons						
	COL KAR	COL WCS	COL RFA	KAR WCS	KAR RFA	WCS RFA	N
TOTAL METALS							
Al				X	X		119
Be							120
Cd						X	100
Ca		X	X	X	X		120
Cs		X	X	X			111
Cr	X	X		X	X		120
Cu			X		X		119
Pb		X	X	X	X		120
Mn							120
Zn		X	X	X	X		119
pH		X		X	X	X	118

Table B-12. Results of nonparametric ANOVA by **FLOW-SYSTEM** for **TOTAL METALS** in **GEOLOGIC MATERIALS.**

NONPARAMETRIC ANOVA BY FLOW-SYSTEM				
GEOLOGIC (BOREHOLE) MATERIALS	Comparison by flow-system			
	Upper flow-system vs. Lower flow-system			
	T-test	Wilcoxon	N Upper	N Lower
TOTAL METALS				
Al	X	X	98	21
As			99	21
Ba			99	21
Be			99	21
Cd			81	19
Ca		X	99	21
Cs			95	16
Cr	X	X	99	21
Cu		X	99	20
Fe			99	20
Pb	X	X	99	21
Mg			99	21
Mn			99	21
Ni			96	19
Sr		X	99	21
V	X	X	99	20
Zn	X	X	98	21
pH	X	X	97	21

Table B-13. Results of nonparametric ANOVA by **GEOLOGIC UNIT** for **TOTAL RADIONUCLIDES** in **GEOLOGIC MATERIALS.**

NONPARAMETRIC ANOVA BY GEOLOGY							
GEOLOGIC (BOREHOLE) MATERIALS	Geologic Units: Pairwise Comparisons						
	COL KAR	COL WCS	COL RFA	KAR WCS	KAR RFA	WCS RFA	N
TOTAL RADS							
Am-241							28
Cs-137							120
Gross beta			X				120
Pu-239,240							120
Radium-226		X	X	X	X		97
U-Total			X		X		120
U-233,234			X		X		120
U-235			X				120
U-238			X		X		120

Table B-14. Results of nonparametric ANOVA by **FLOW-SYSTEM** for **TOTAL RADIONUCLIDES** in **GEOLOGIC MATERIALS.**

NONPARAMETRIC ANOVA BY FLOW-SYSTEM				
GEOLOGIC (BOREHOLE) MATERIALS	Comparison by flow-system			
	Upper flow-system vs. Lower flow-system			
	T-test	Wilcoxon	N Upper	N Lower
TOTAL RADS				
Cs-137			99	21
Gross alpha	X	X	99	21
Gross beta			99	21
Pu-239,240			99	21
Ra-226	X	X	83	14
Ra-228			83	14
Sr-89,90			99	21
Tritium	X	X	99	21
U-Total	X	X	99	21
U-233,234		X	99	21
U-235			99	21
U-238	X	X	99	21

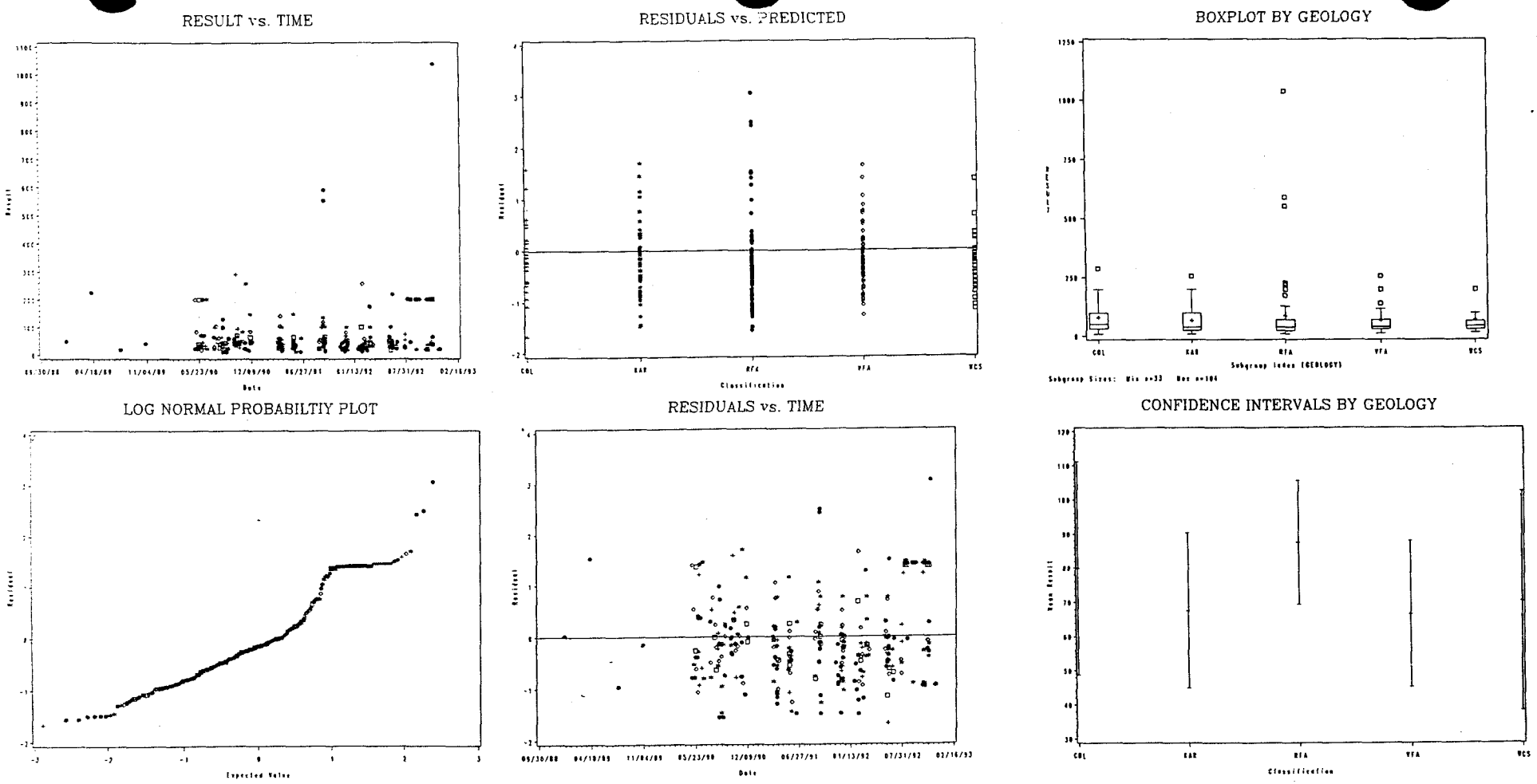


Figure B-1. Results of parametric ANOVA for dissolved Al in groundwater.

Dissolved Al in groundwater.

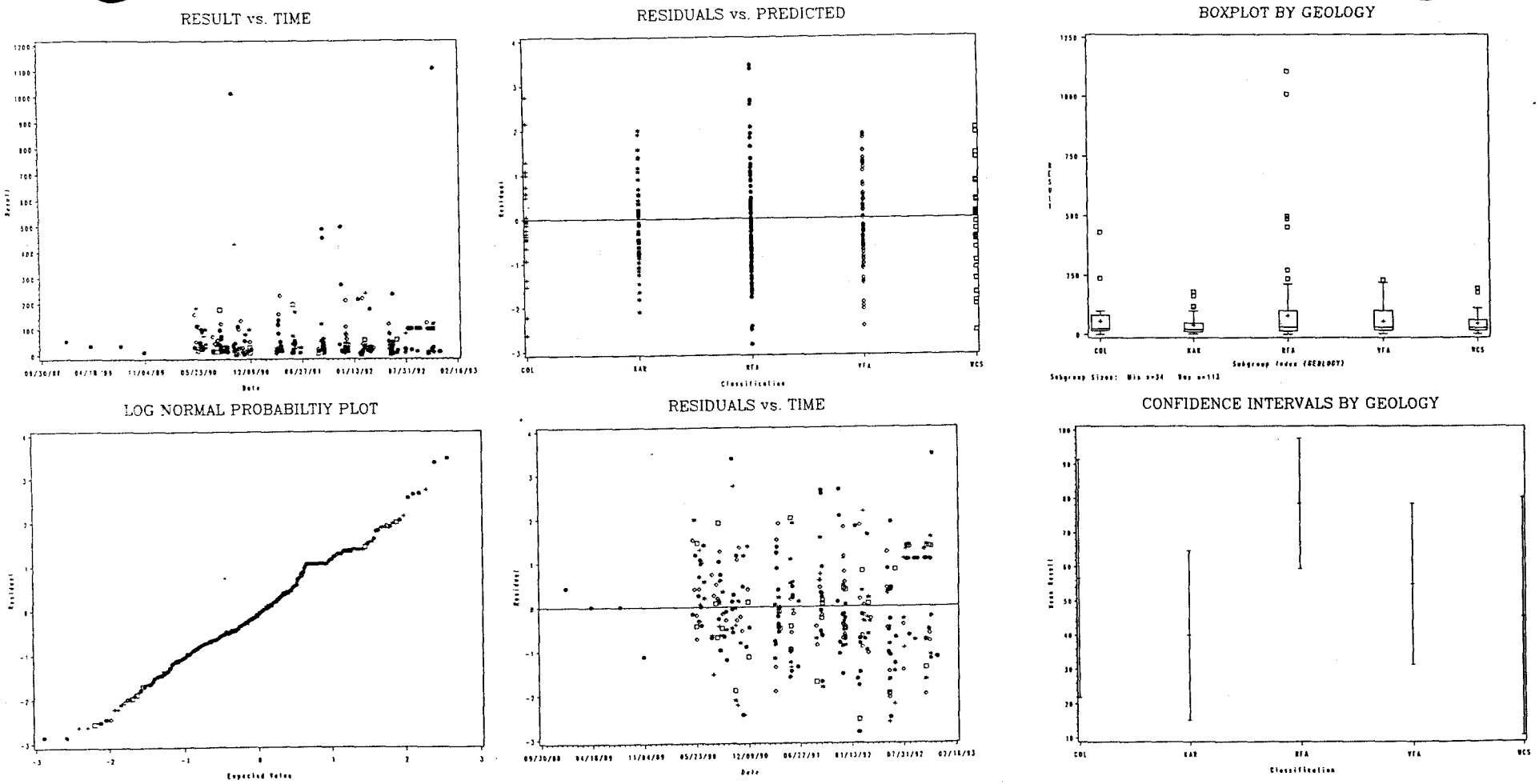


Figure B-2. Results of parametric ANOVA for dissolved Fe in groundwater.

Dissolved Fe in groundwater.

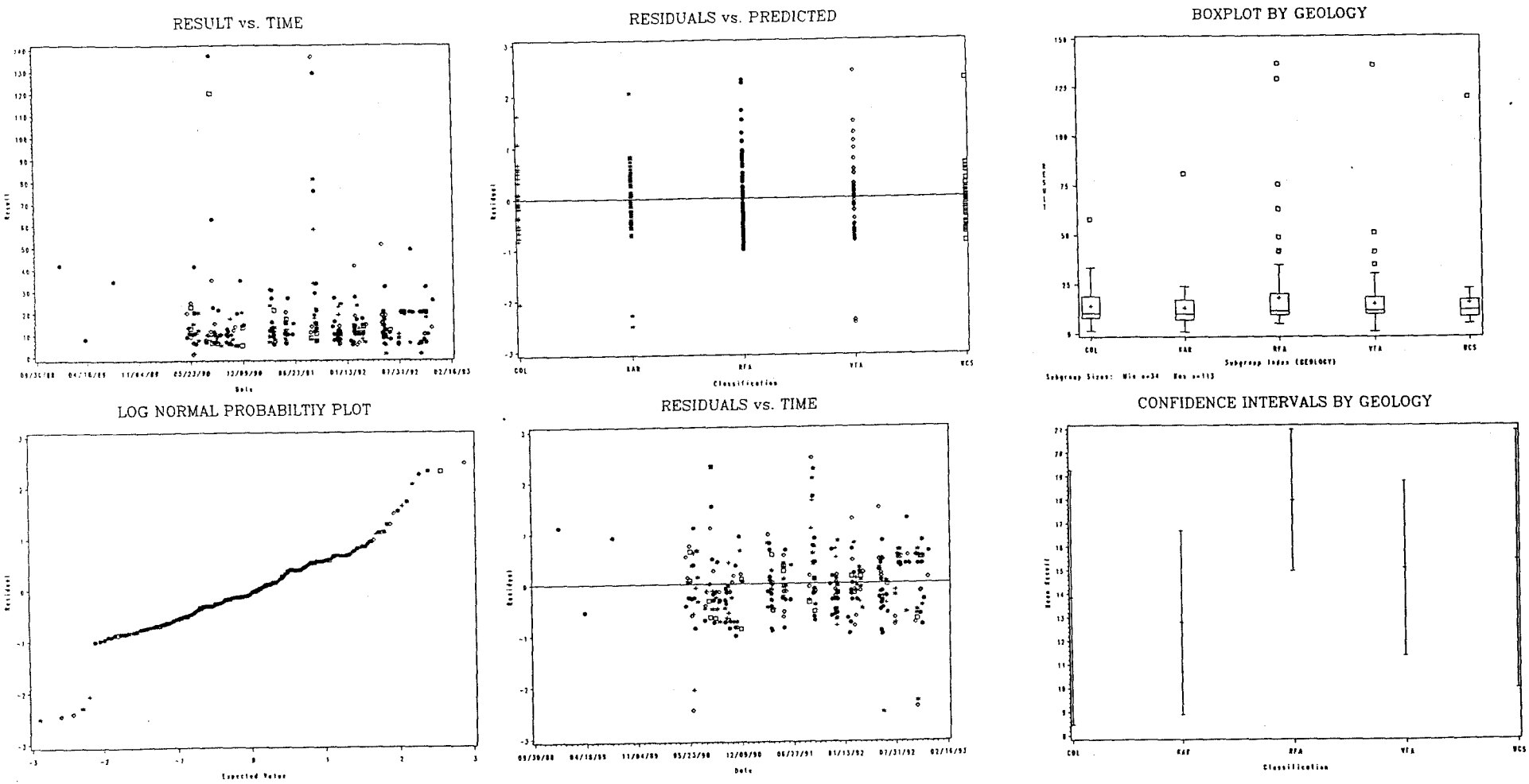


Figure B-3. Results of parametric ANOVA for dissolved Zn in groundwater.

Dissolved Zn in groundwater.

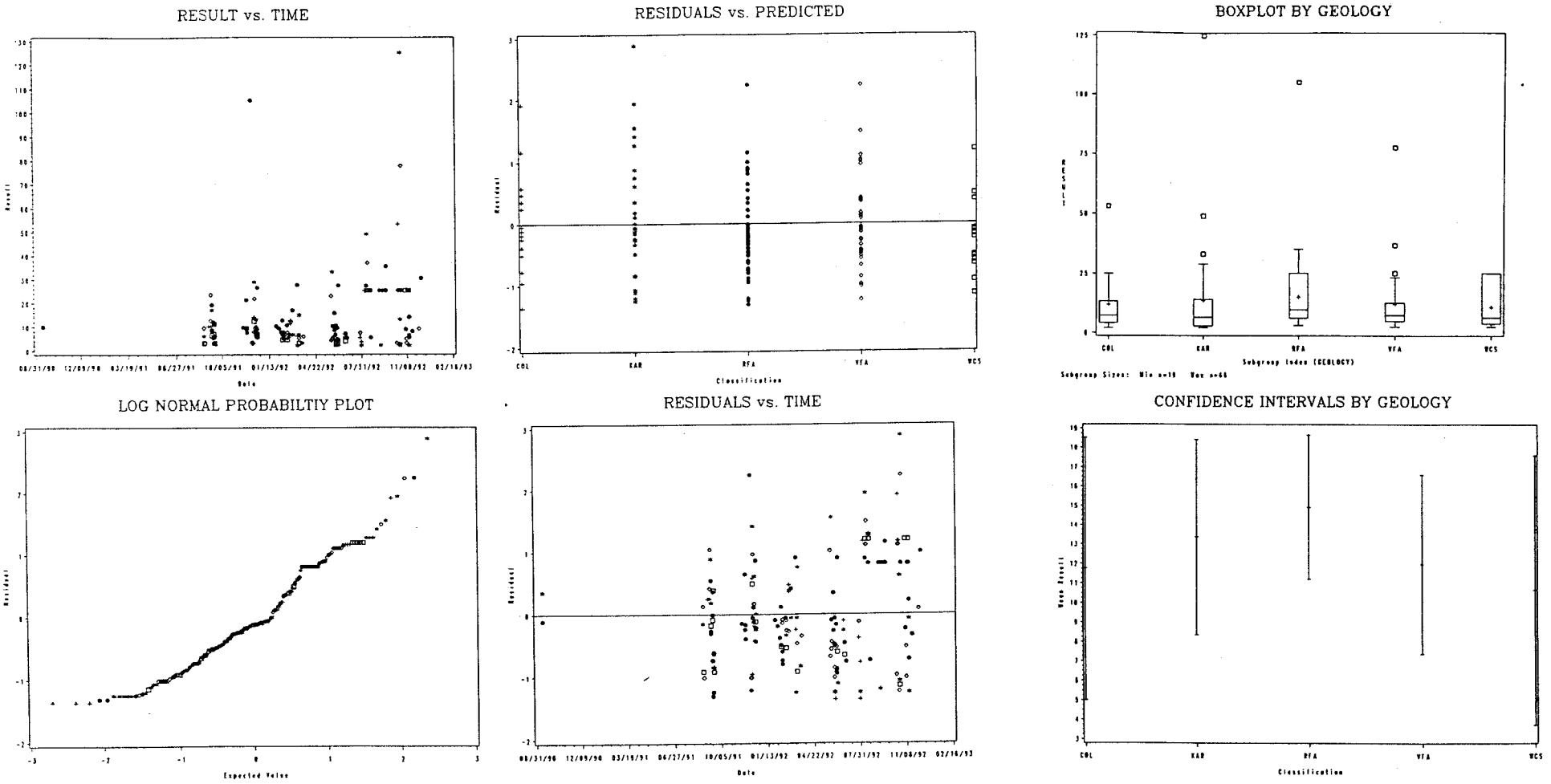


Figure B-4. Results of parametric ANOVA for total Cu in groundwater.

Total Cu in groundwater.

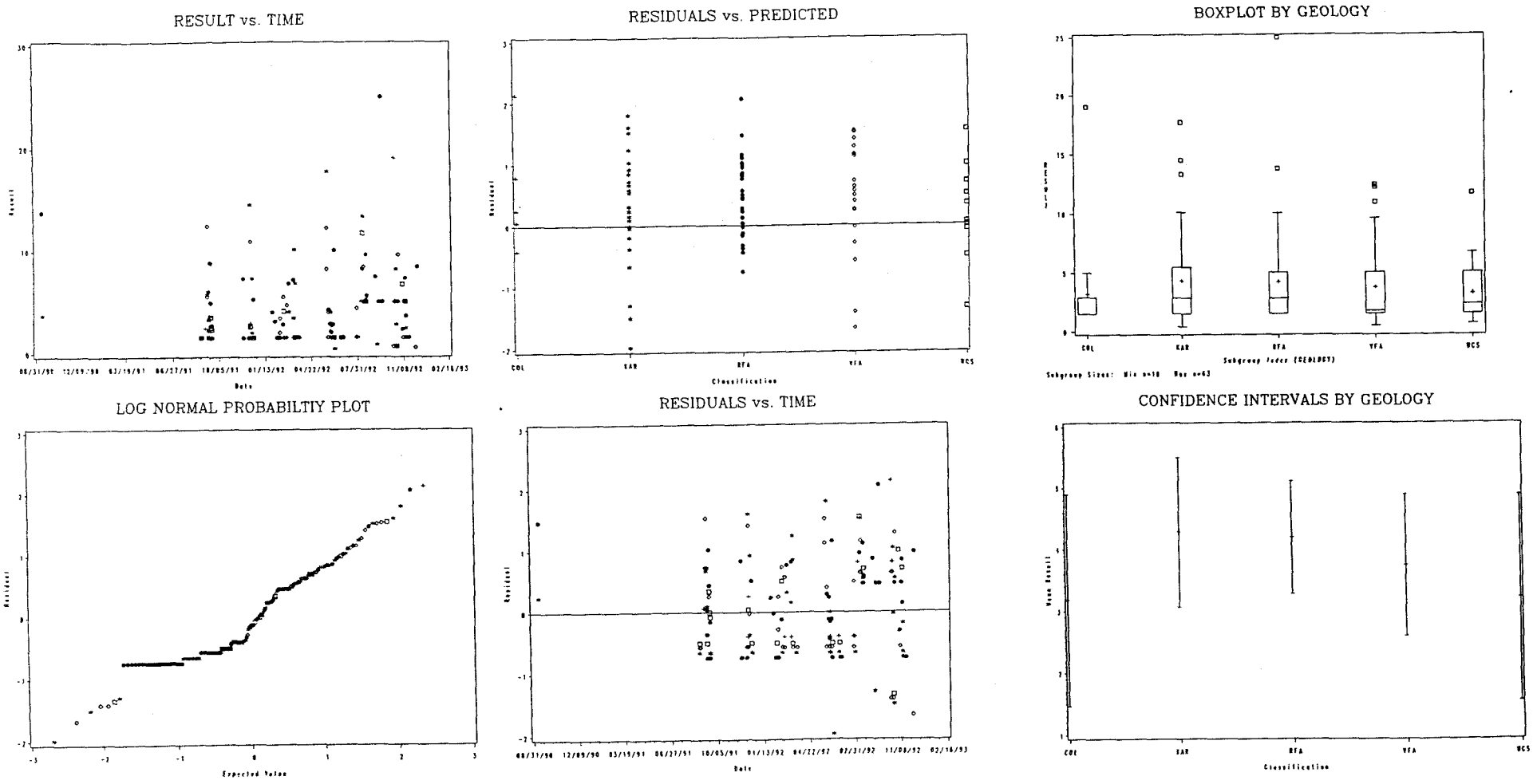


Figure B-5. Results of parametric ANOVA for total Pb in groundwater.

Total Pb in groundwater.

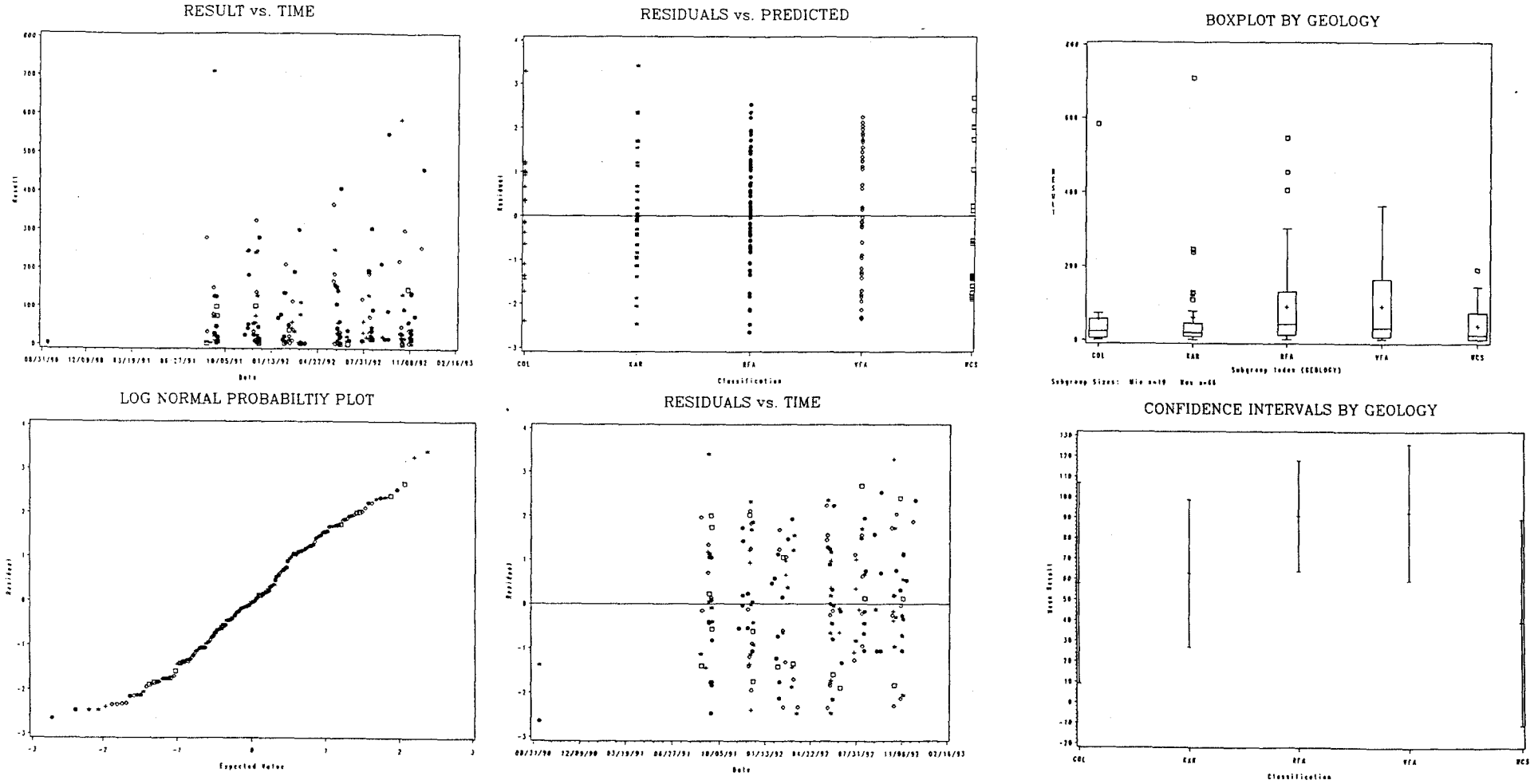


Figure B-6. Results for parametric ANOVA for total Mn in groundwater.

Total Mn in groundwater.

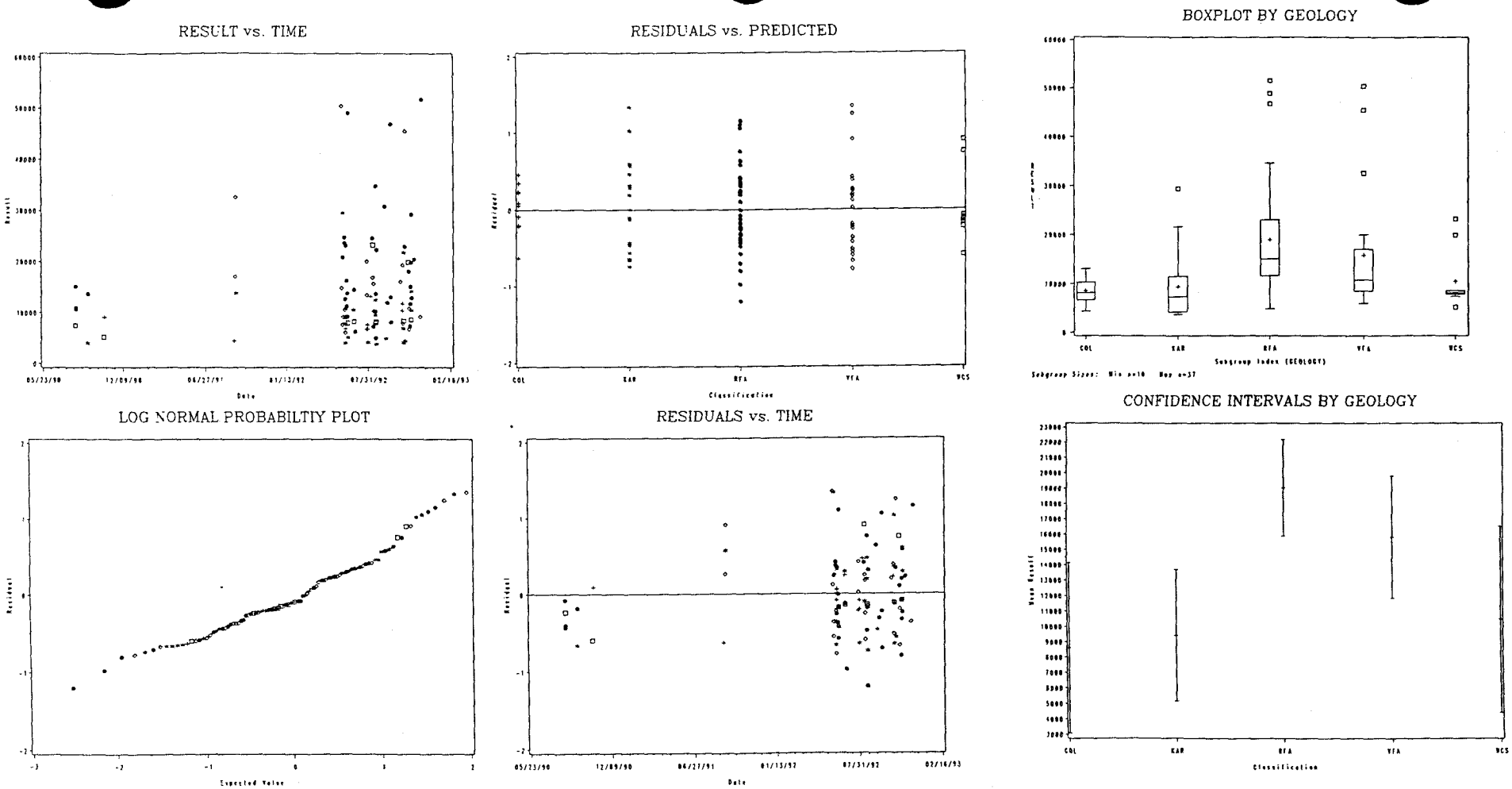


Figure B-7. Results of parametric ANOVA for total Si in groundwater.

Total Silicon in groundwater.

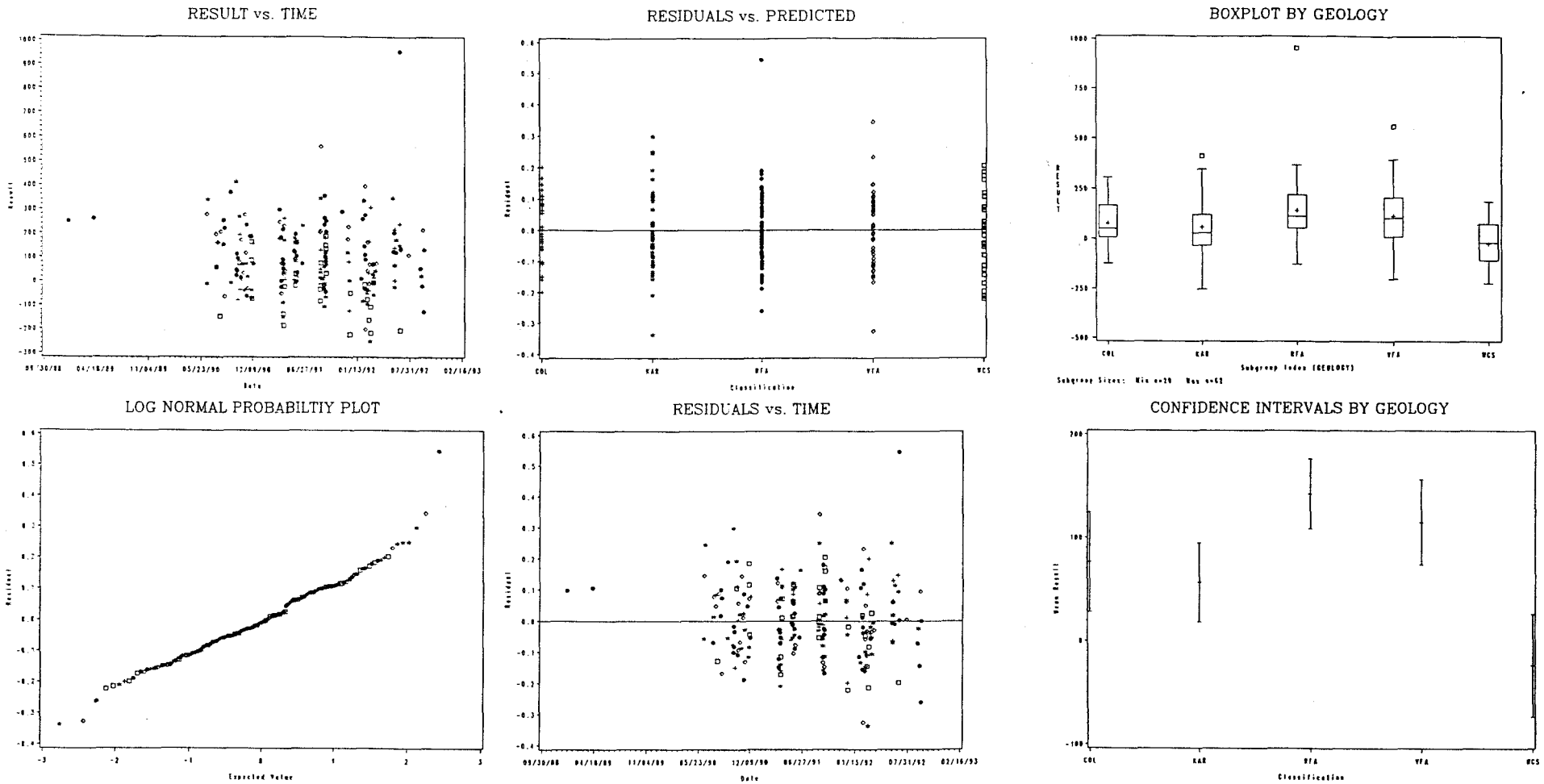


Figure B-8. Results of parametric ANOVA for dissolved Tritium in groundwater.

Dissolved Tritium in groundwater.

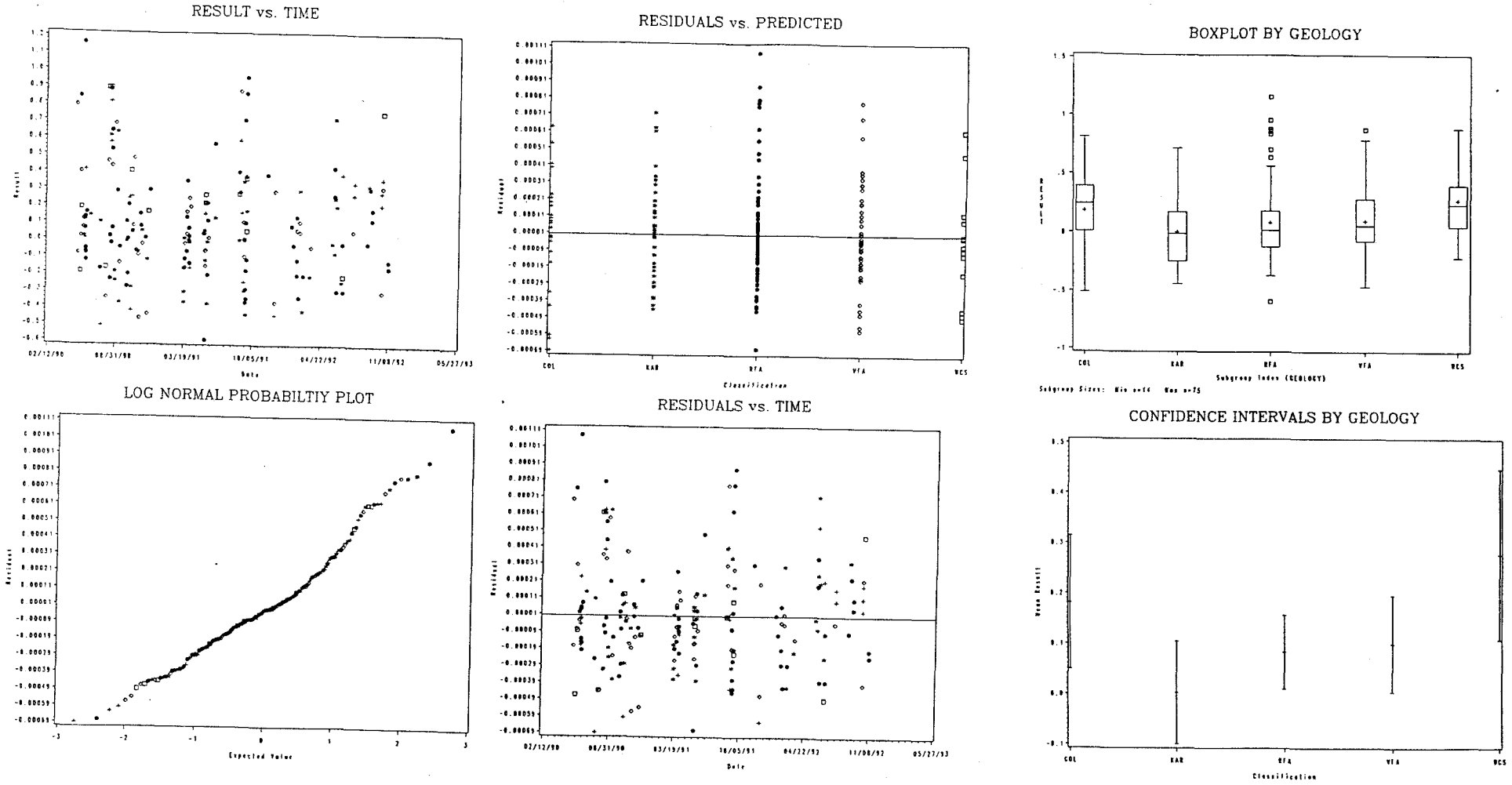


Figure B-9. Results of parametric ANOVA for total Cs-137 in groundwater.

Total Cs-137 in groundwater.

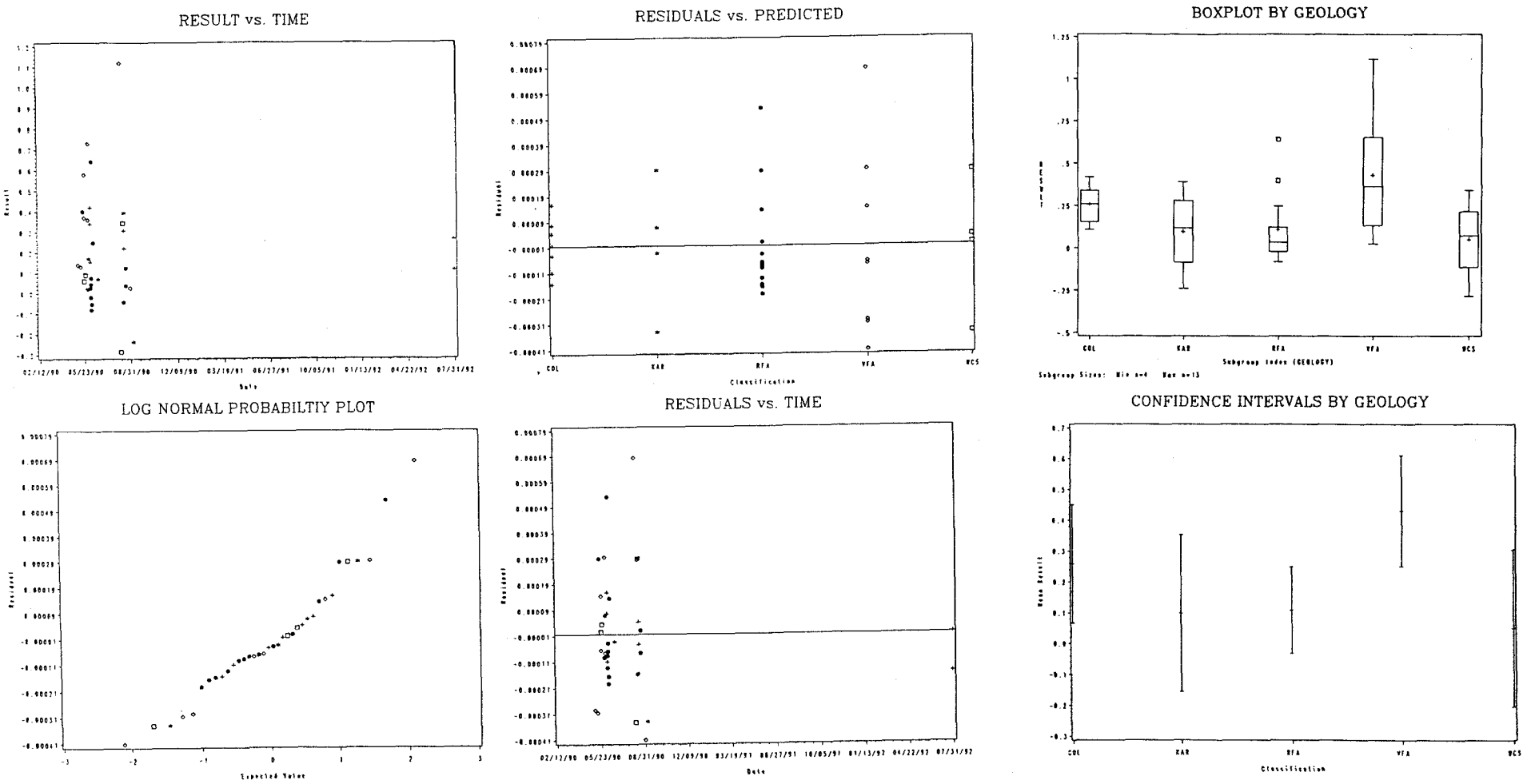
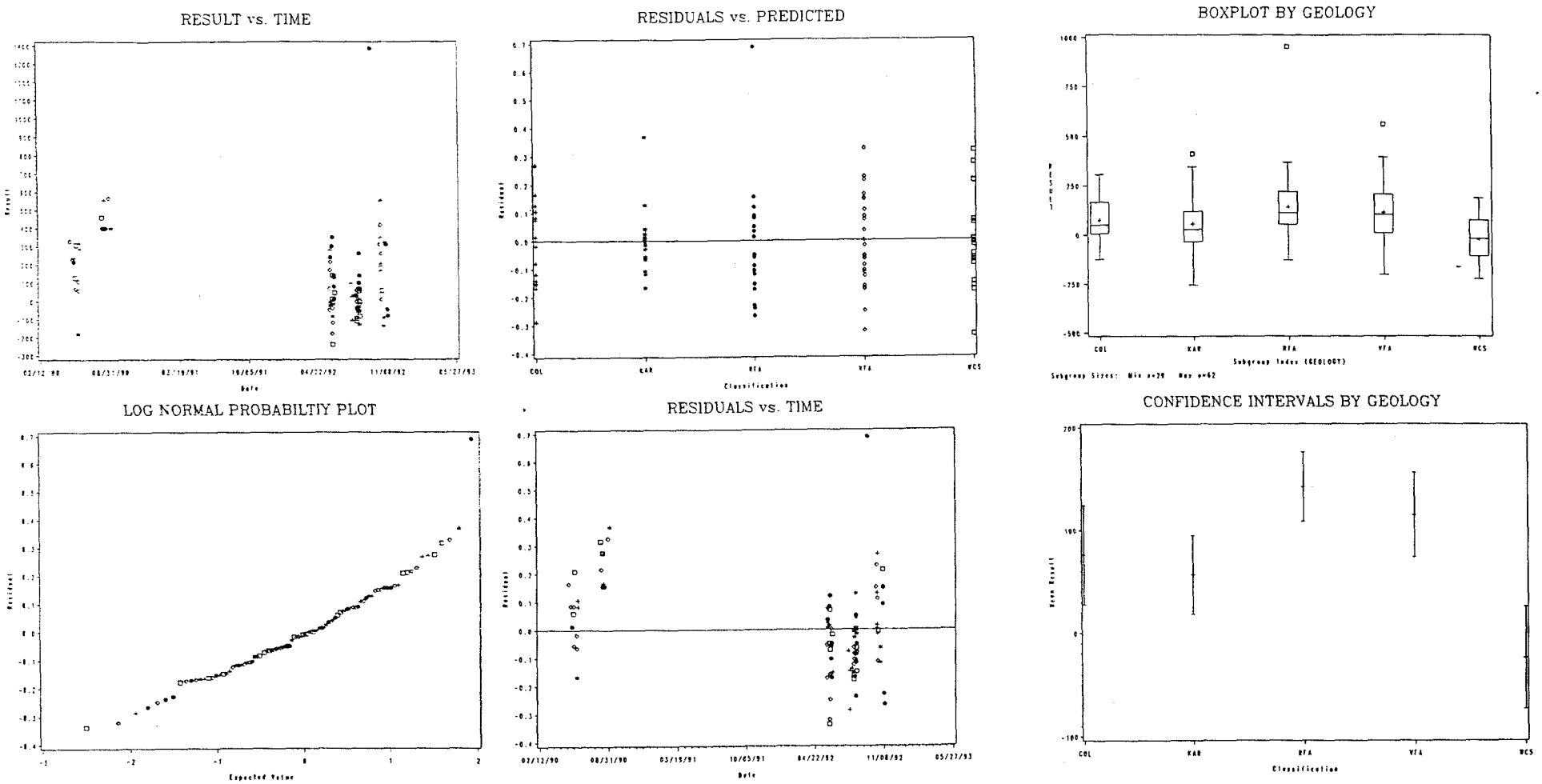


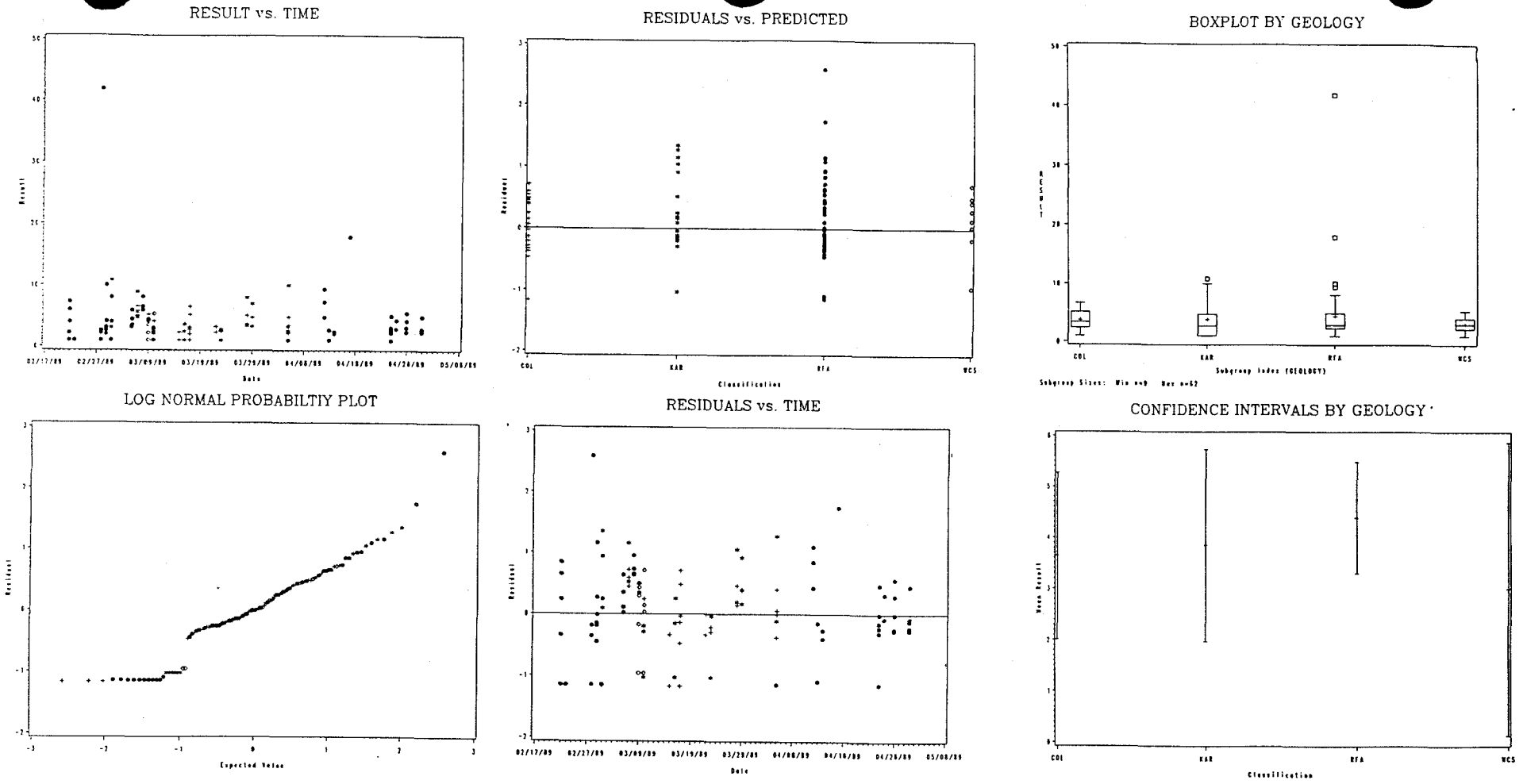
Figure B-10. Results of parametric ANOVA for total Sr-89,90 in groundwater.

Total Sr-89,90 in groundwater.



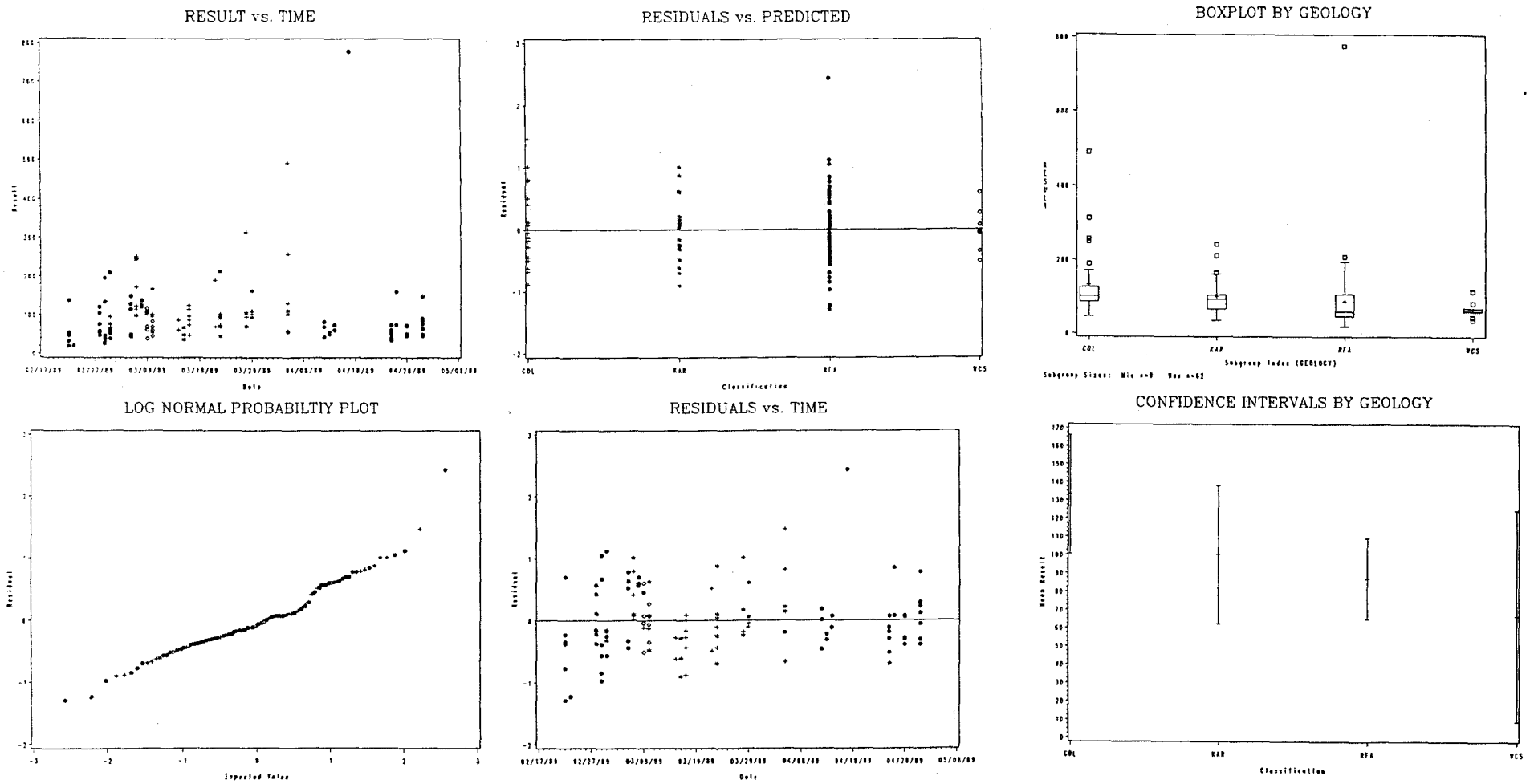
Figures B-11. Results for total Tritium in groundwater.

Total Tritium in groundwater.



Total As in geologic materials.

Figure B-12. Results of parametric ANOVA for total As in geologic (borehole) materials.



Total Ba in geologic materials.

Figure B-13. Results of parametric ANOVA for total Ba in geologic (borehole) materials.

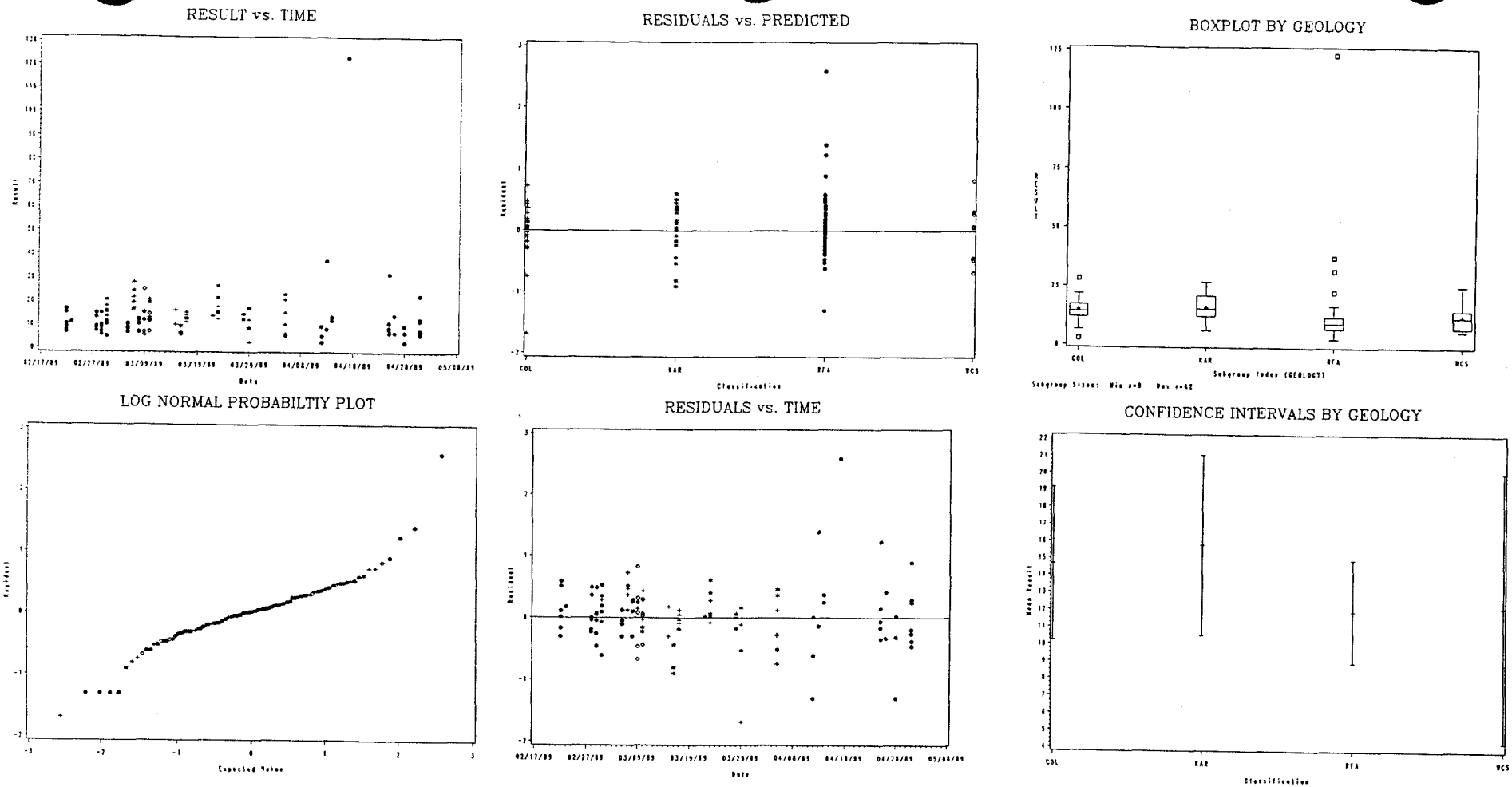


Figure B-14. Results of parametric ANOVA for total Cu in geologic (borehole) materials.

Total Cu in geologic materials.

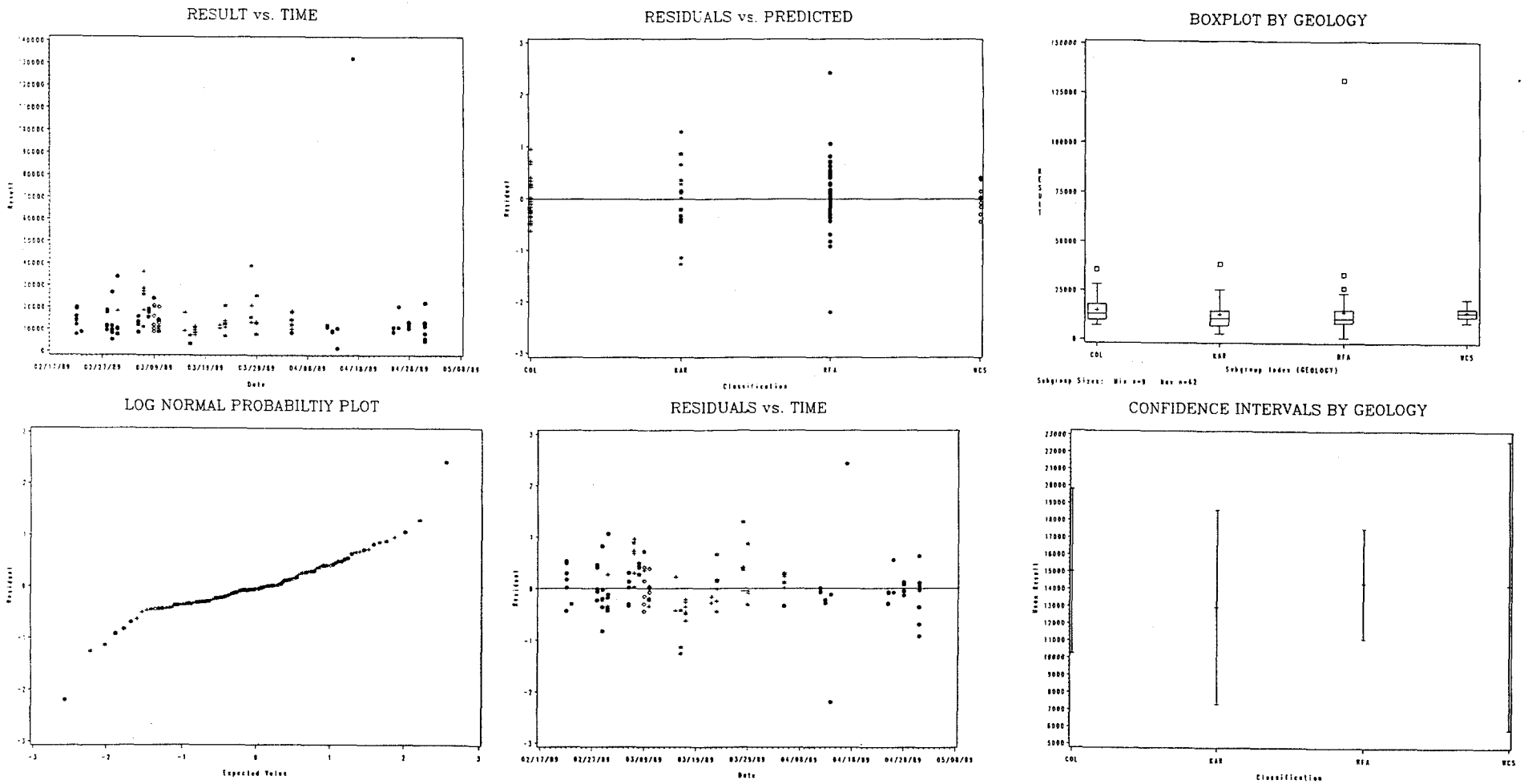


Figure B-15. Results of parametric ANOVA for total Fe in geologic (borehole) materials.

Total Fe in geologic materials.

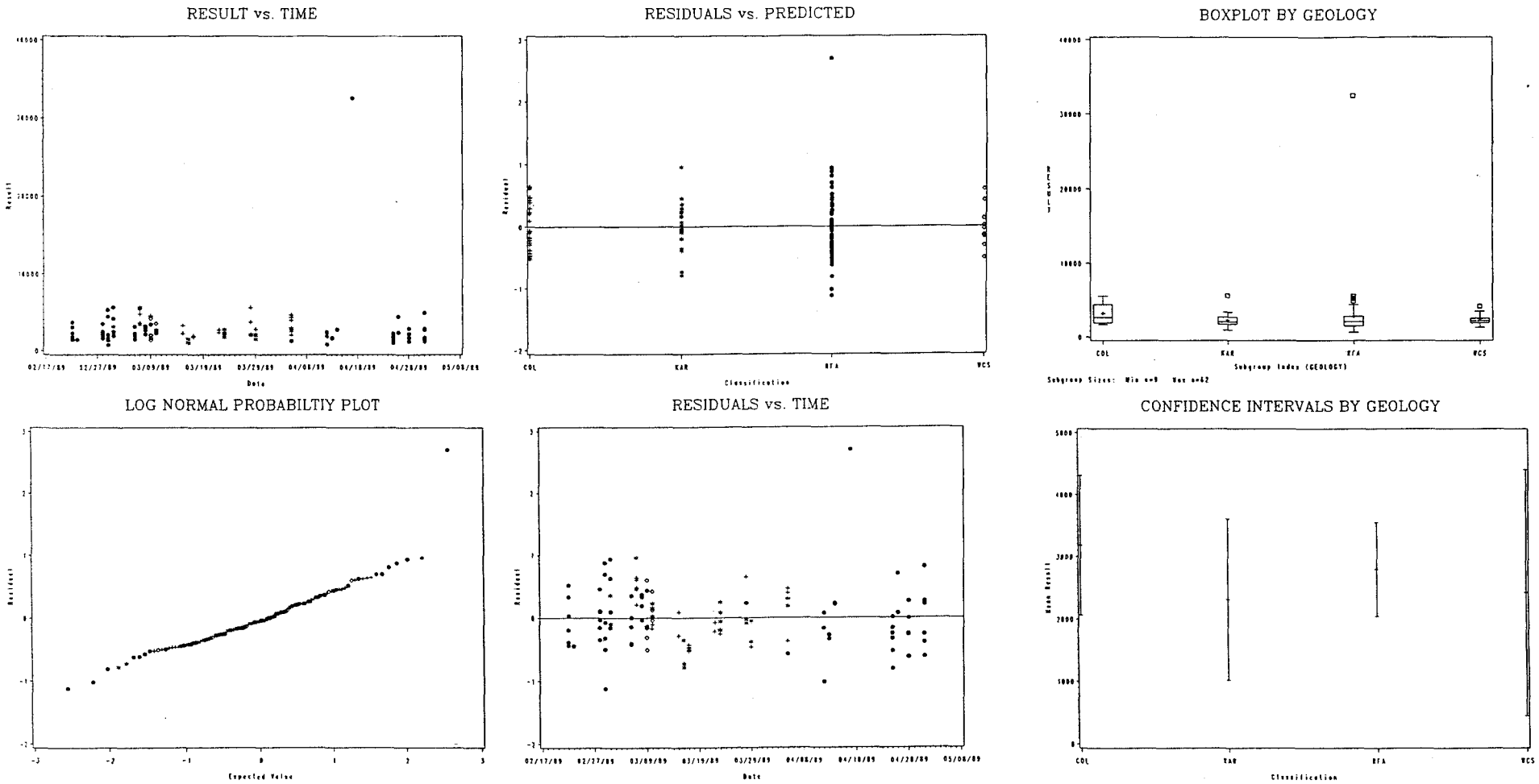


Figure B-16. Results of parametric ANOVA for total Mg in geologic (borehole) materials.

Total Mg in geologic materials.

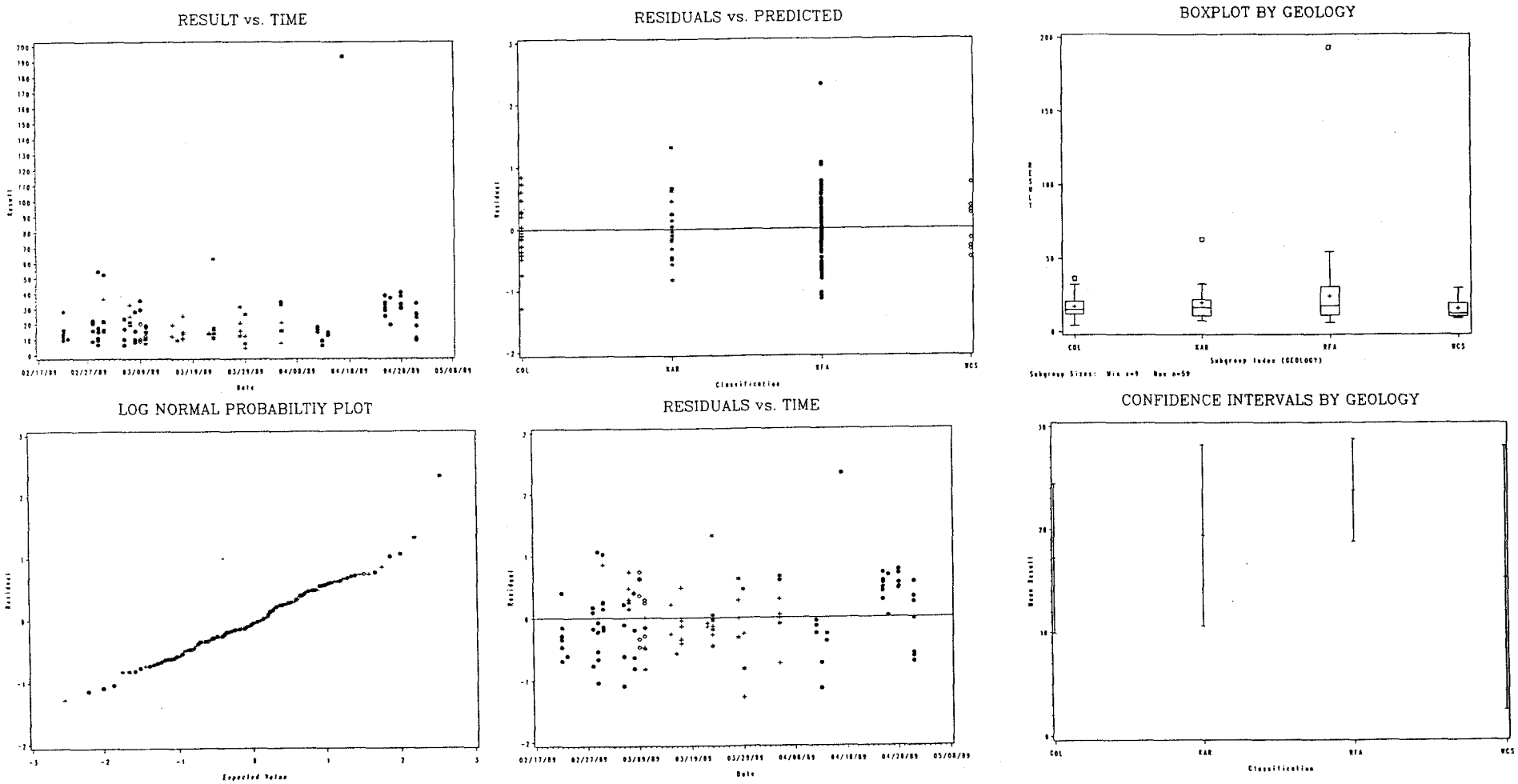


Figure B-17. Results of parametric ANOVA for total Ni in geologic (borehole) materials.

Total Ni in geologic materials.

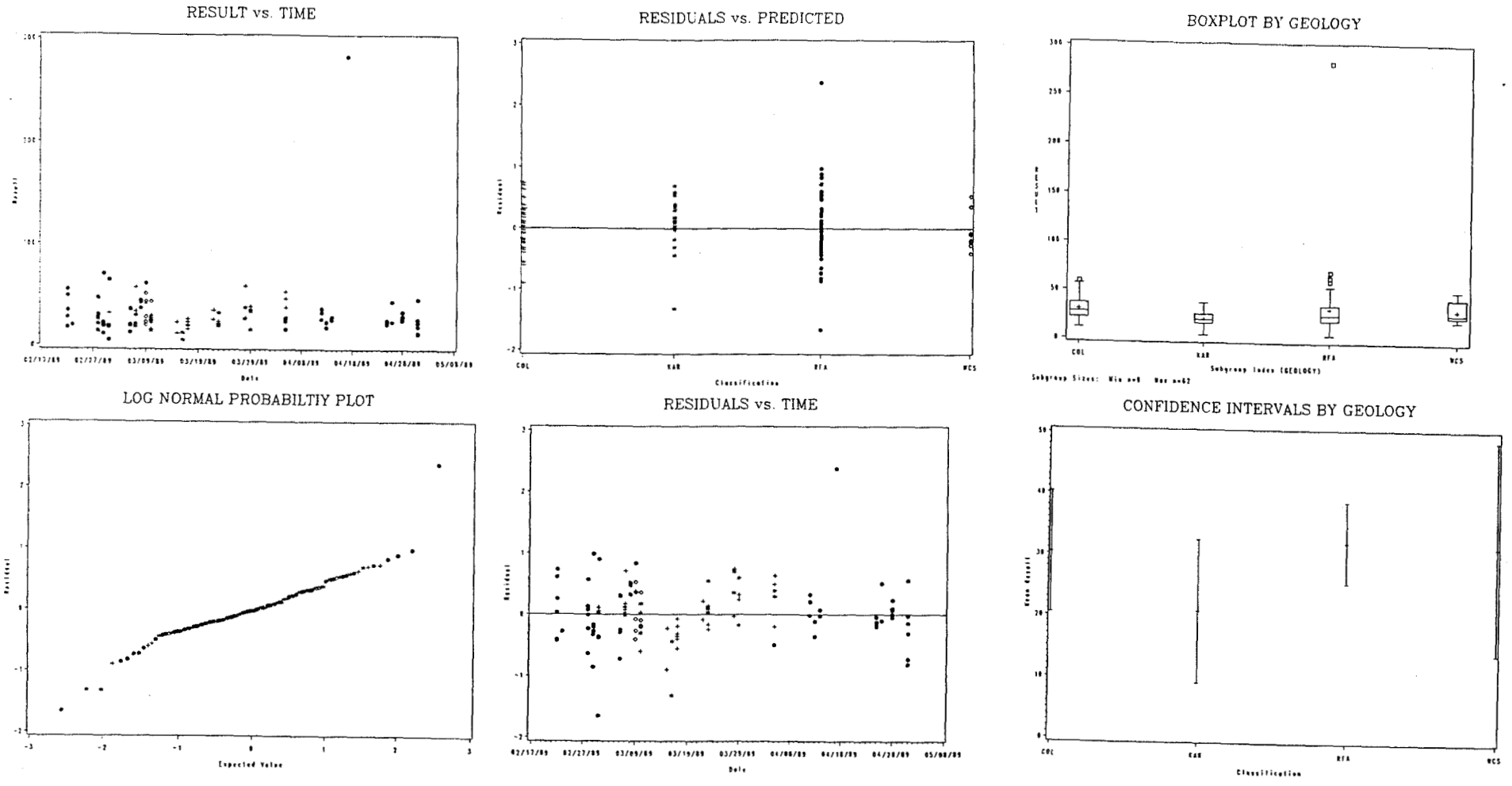


Figure B-18. Results of parametric ANOVA for total V in geologic (borehole) materials.

Total V in geologic materials.

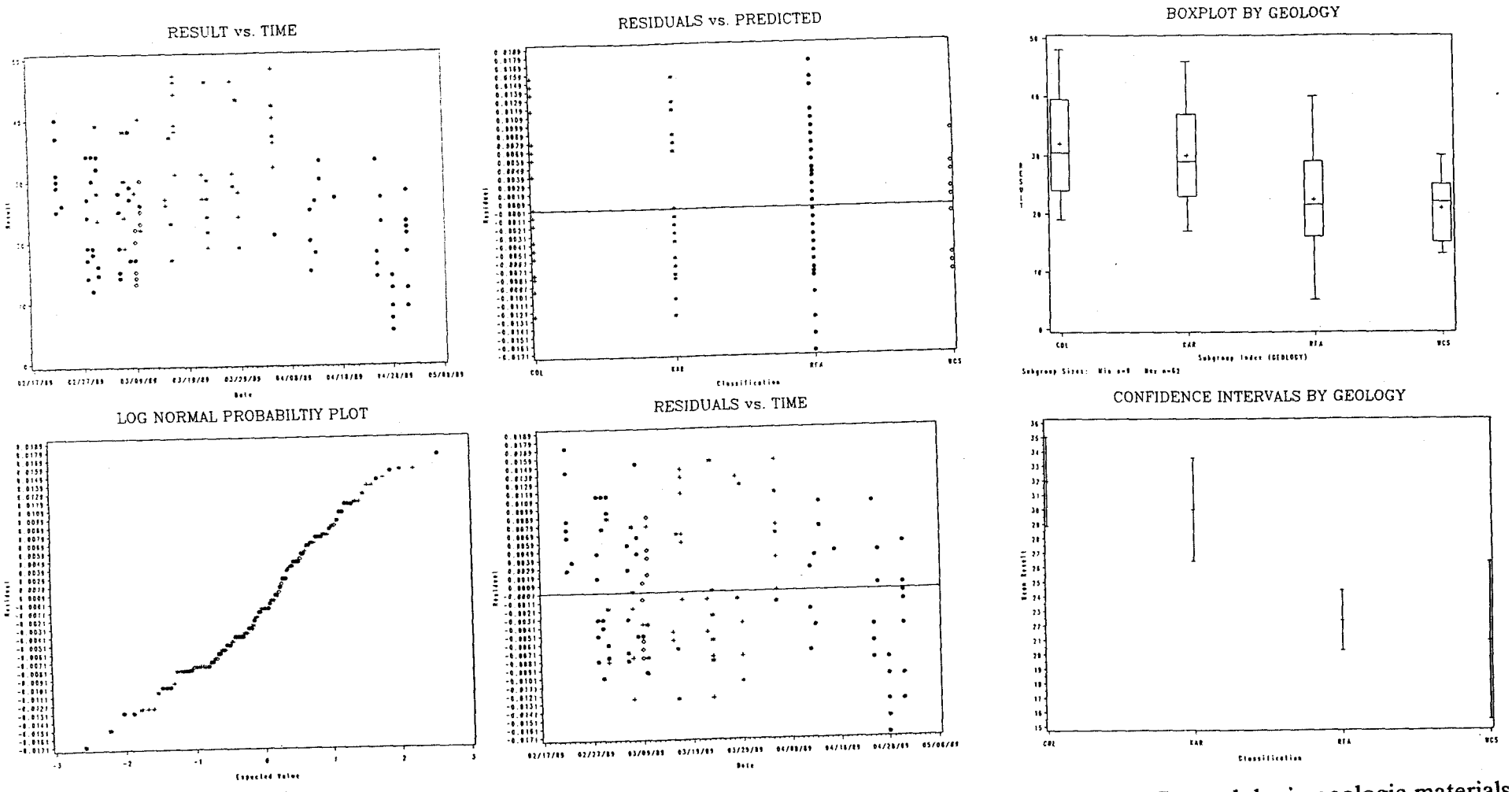


Figure B-19. Results of parametric ANOVA for total Gross alpha in geologic (borehole) materials.

Total Gross alpha in geologic materials.

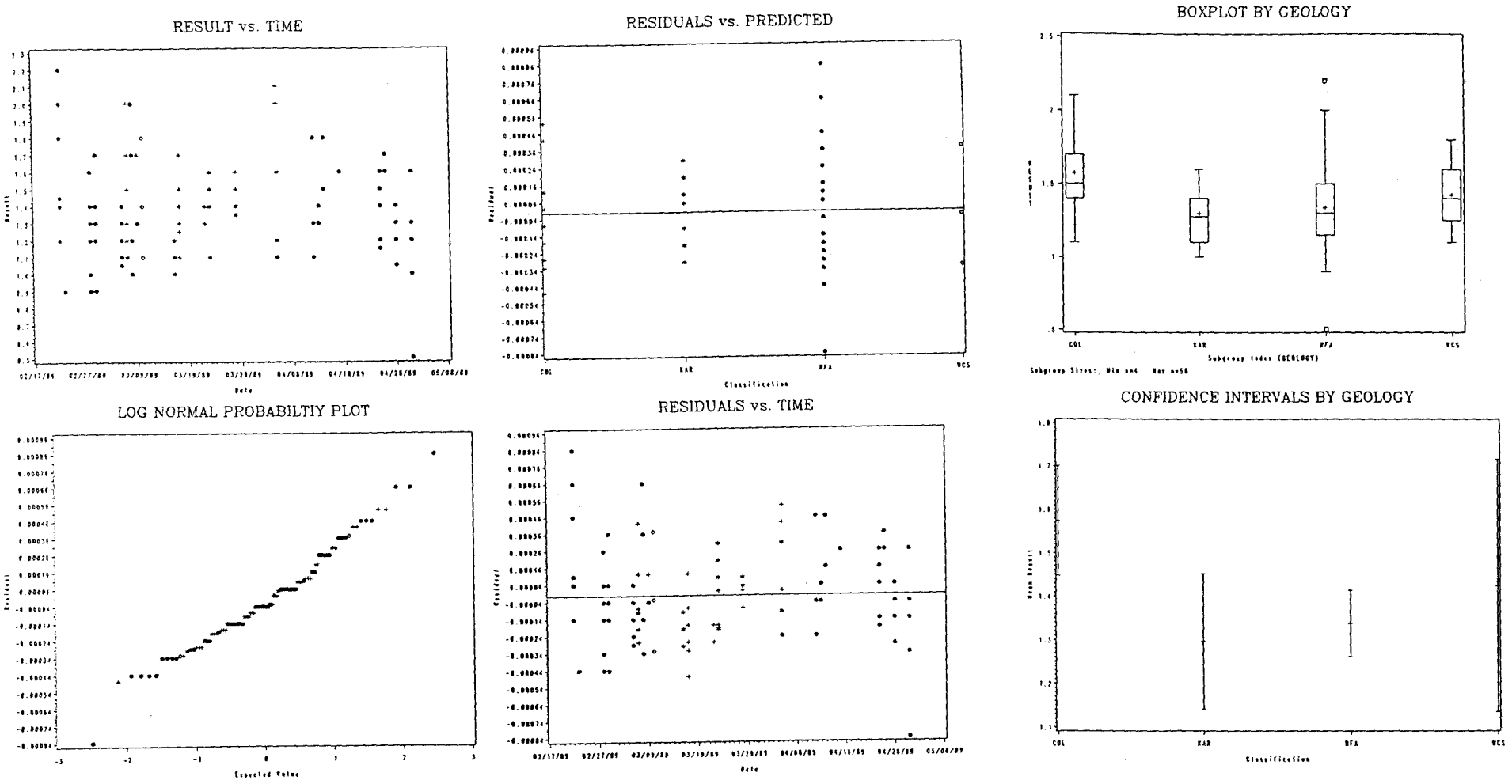


Figure B-20. Results of parametric ANOVA for total Ra-228 in geologic (borehole) materials.

Total Ra-228 in geologic materials.

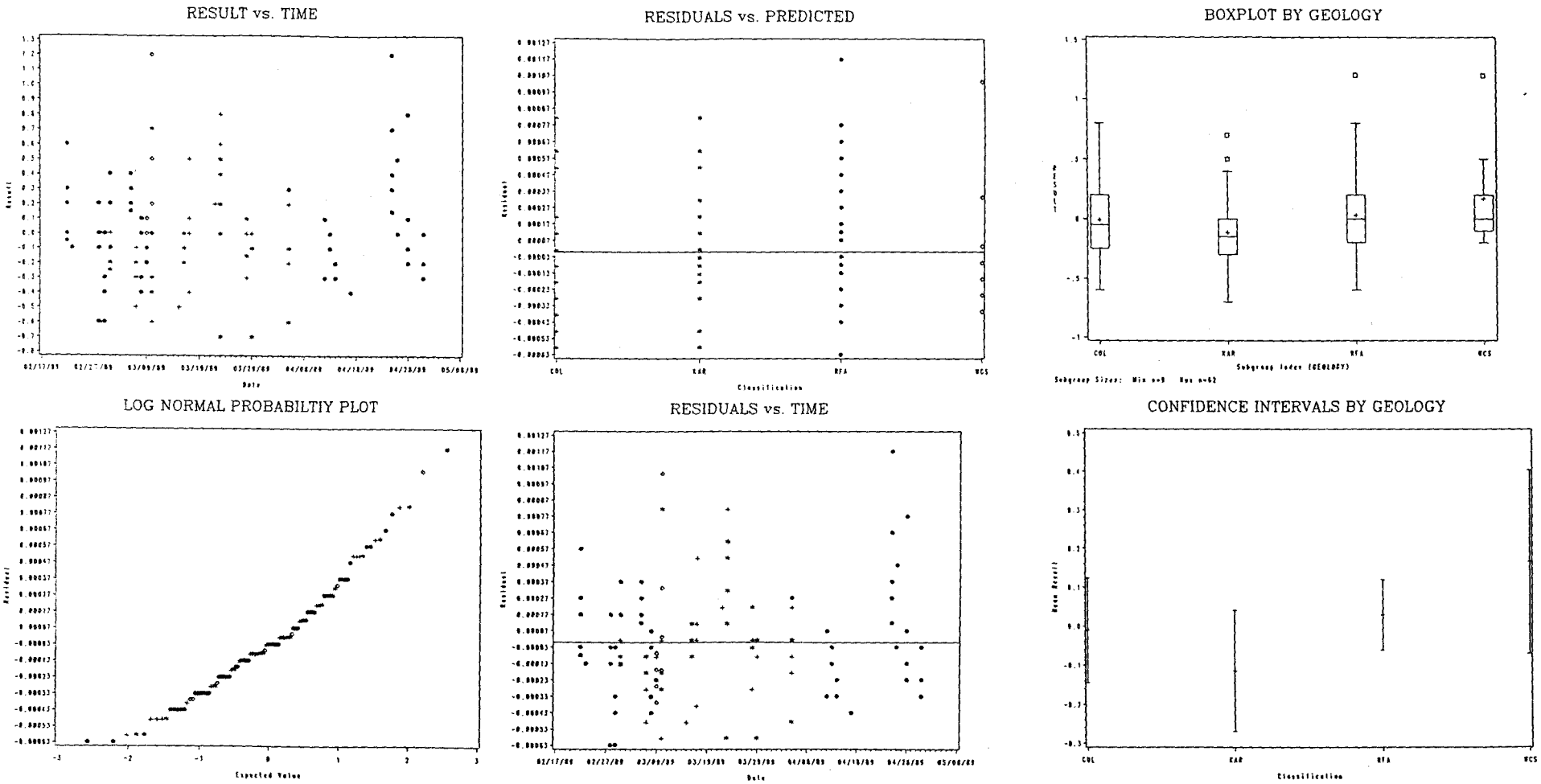


Figure B-21. Results of parametric ANOVA for total Sr-89,90 in geologic (borehole) materials.

Total Sr-89,90 in geologic materials.

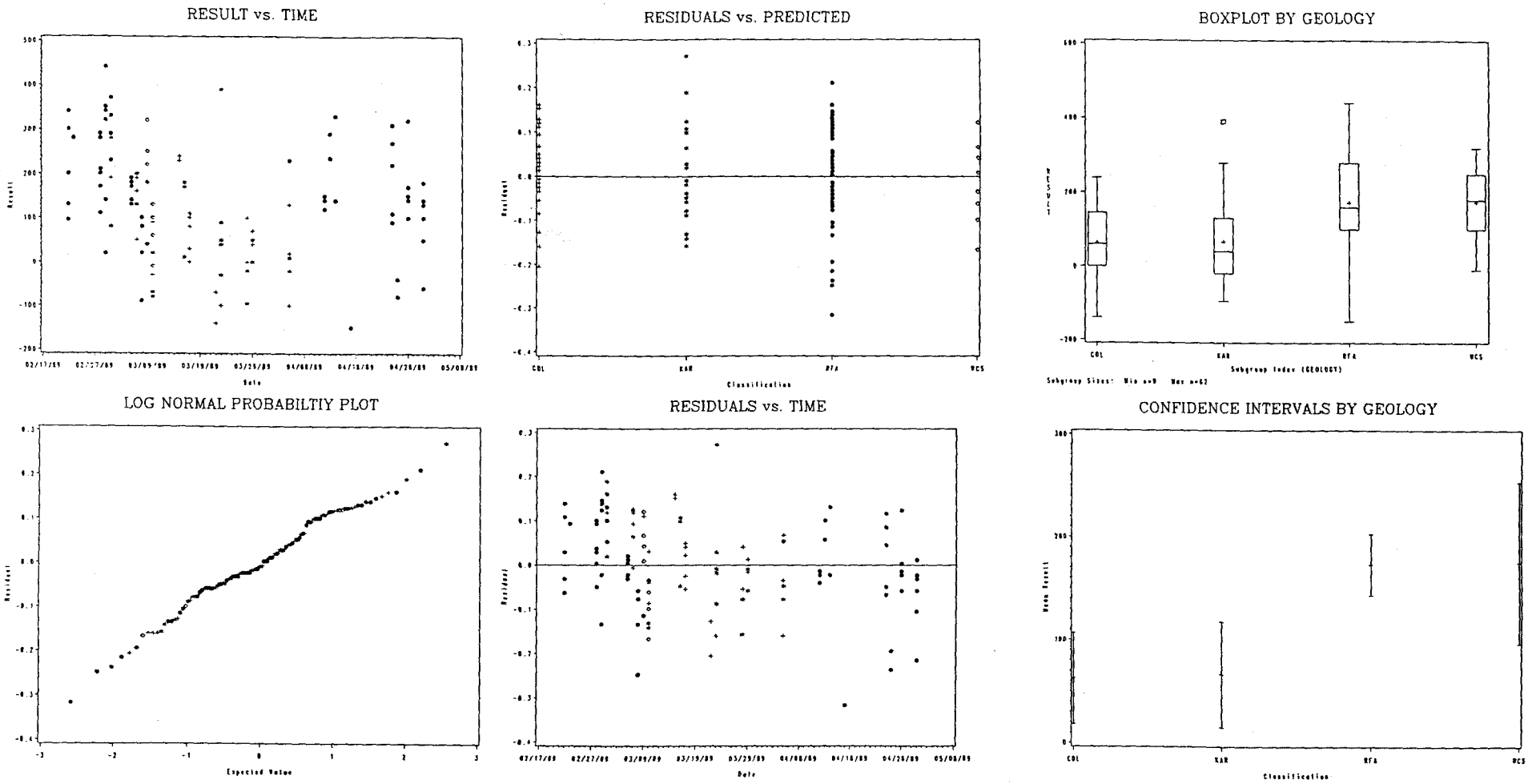


Figure B-22. Results of parametric ANOVA for total Tritium in geologic (borehole) materials.

Total Tritium in geologic materials.

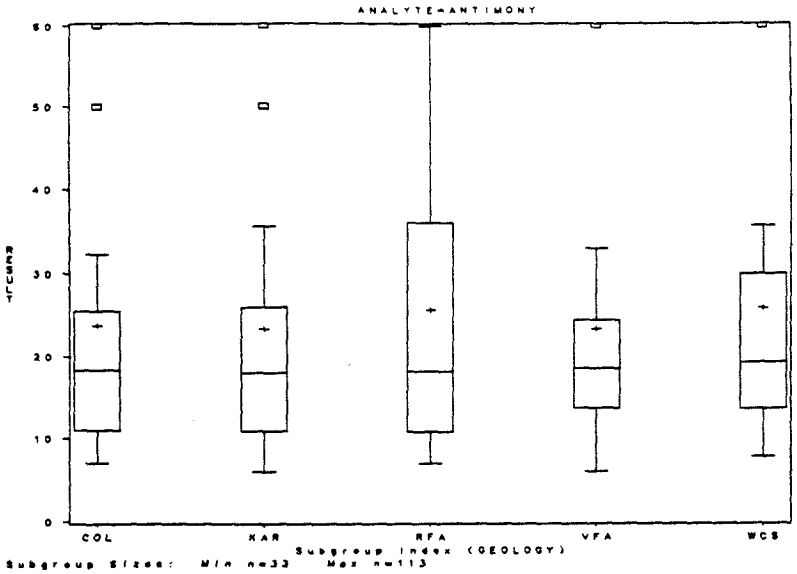


Figure B-23.

Dissolved **ANTIMONY** in groundwater. Comparison between the five geologic units at the RFP.

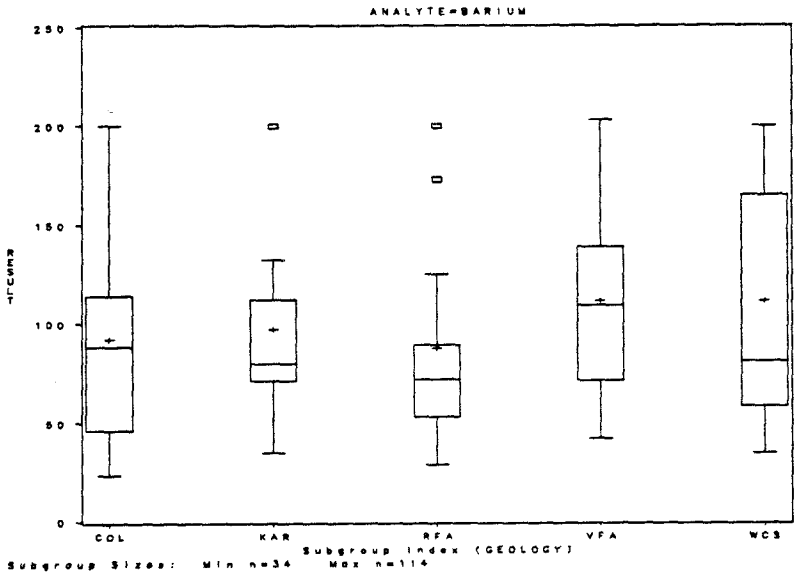


Figure B-24.

Dissolved **BARIUM** in groundwater. Comparison between the five geologic units at the RFP.

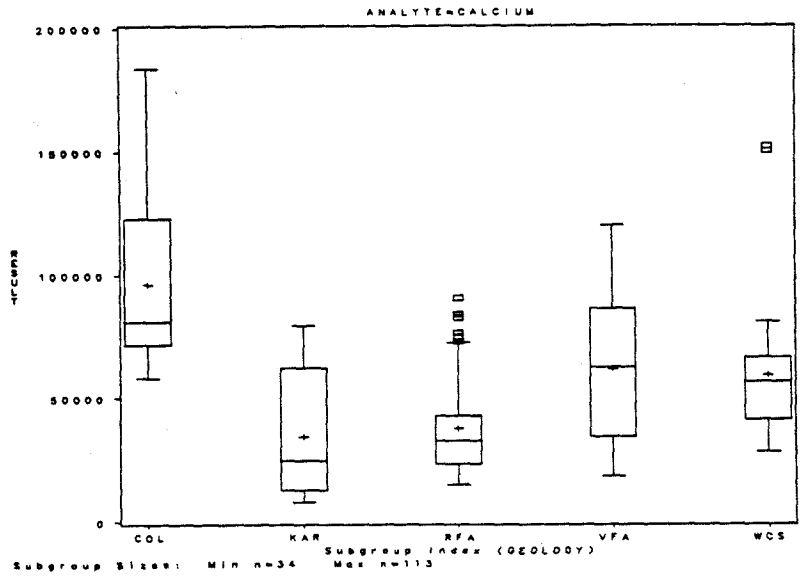


Figure B-25.

Dissolved **CALCIUM** in groundwater. Comparison between the five geologic units at the RFP.

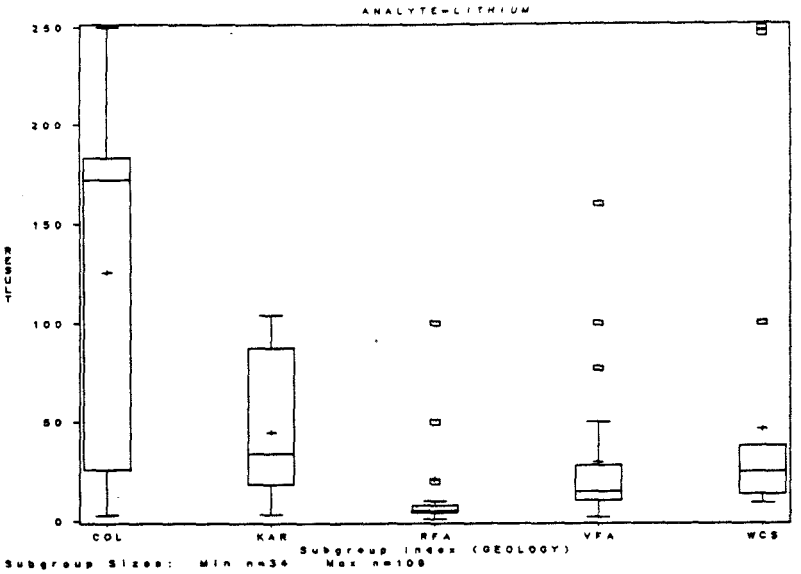


Figure B-26.

Dissolved **LITHIUM** in groundwater. Comparison between the five geologic units at the RFP.

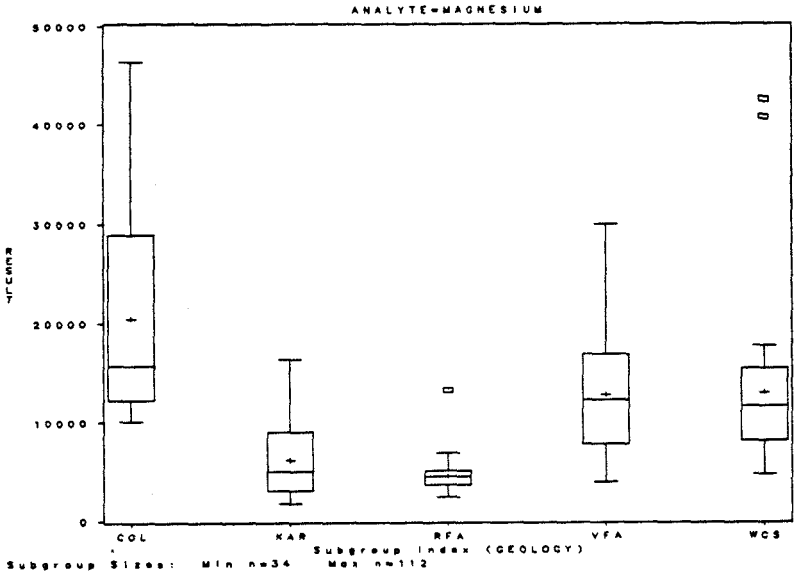


Figure B-27.

Dissolved **MAGNESIUM** in groundwater. Comparison between the five geologic units at the RFP.

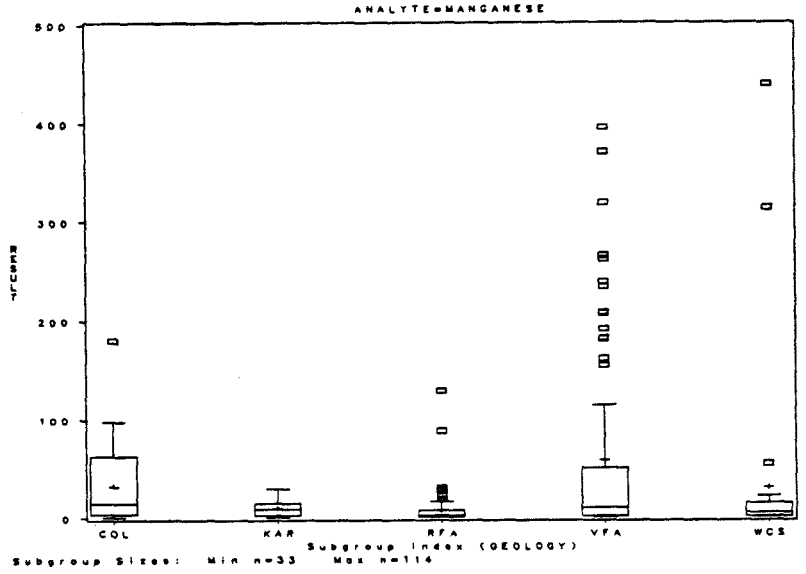


Figure B-28.

Dissolved **MANGANESE** in groundwater. Comparison between the five geologic units at the RFP.

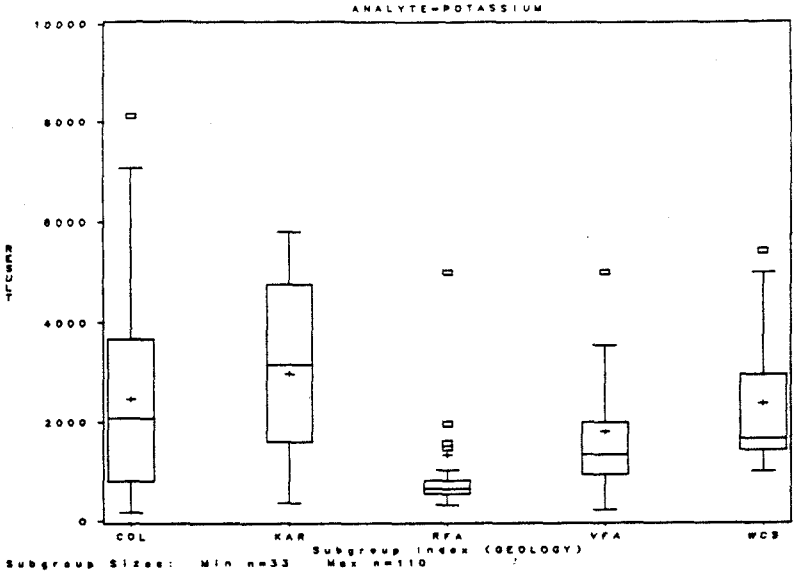


Figure B-29.

Dissolved **POTASSIUM** in groundwater. Comparison between the five geologic units at the RFP.

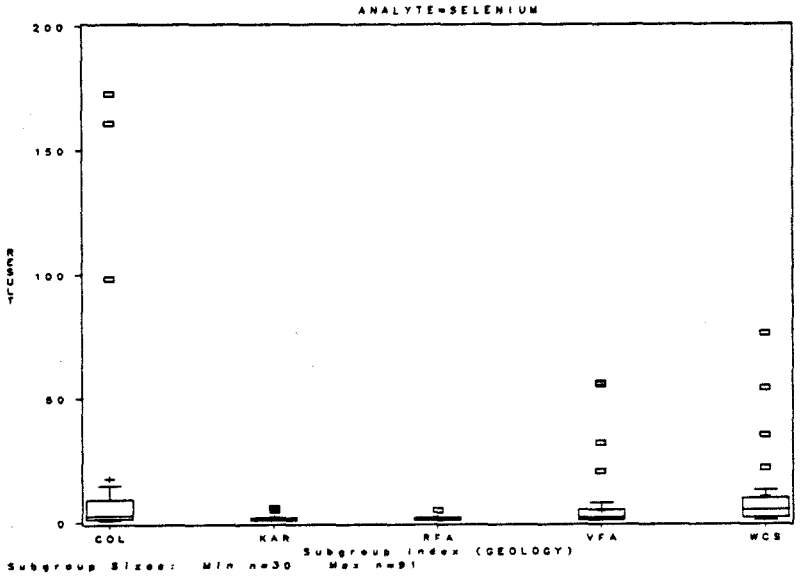


Figure B-30.

Dissolved **SELENIUM** in groundwater. Comparison between the five geologic units at the RFP.

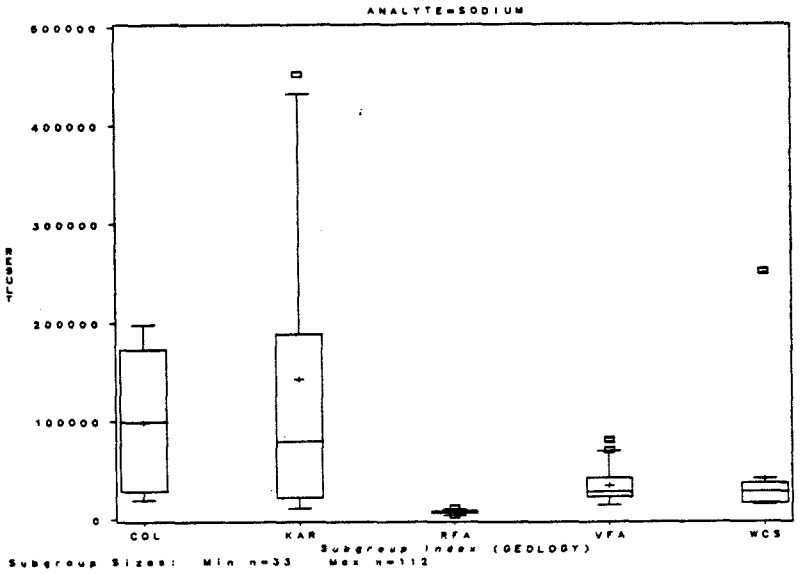


Figure B-31.

Dissolved **SODIUM** in groundwater. Comparison between the five geologic units at the RFP.

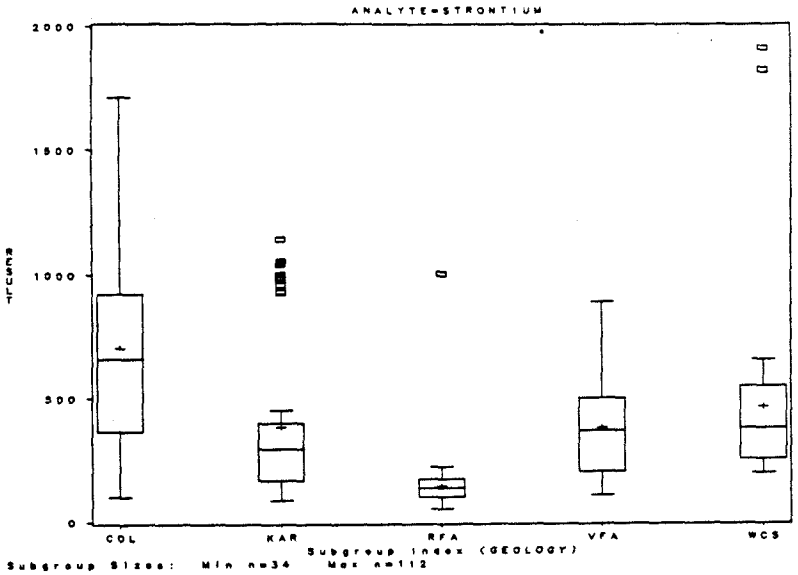


Figure B-32.

Dissolved **STRONTIUM** in groundwater. Comparison between the five geologic units at the RFP.

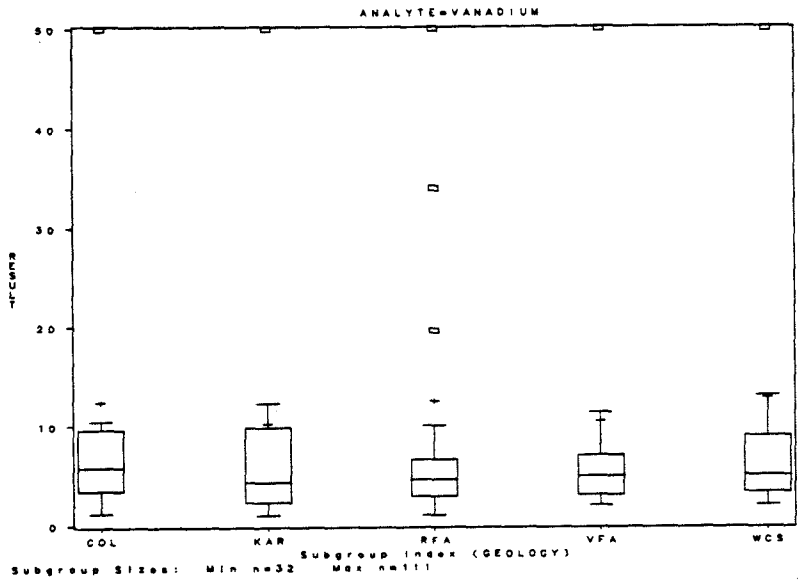


Figure B-33.

Dissolved **VANADIUM** in groundwater. Comparison between the five geologic units at the RFP.

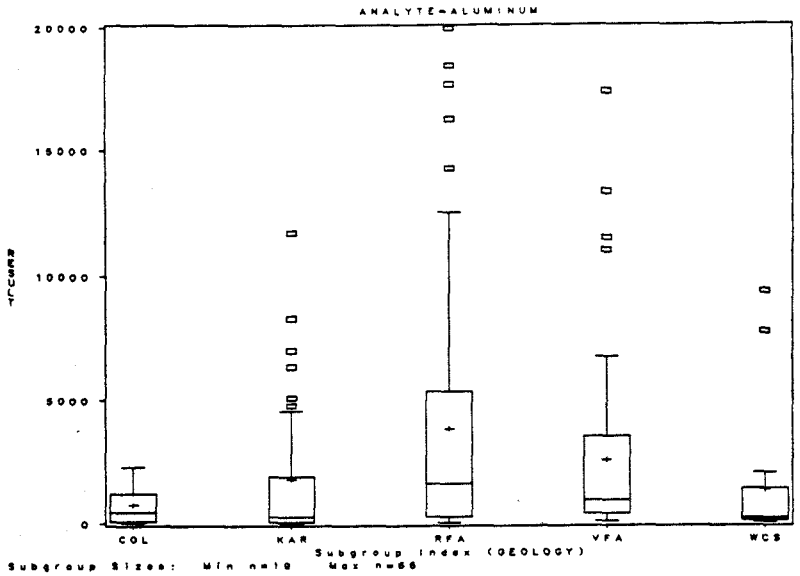


Figure B-34.

Total **ALUMINUM** in groundwater. Comparison between the five geologic units at the RFP.

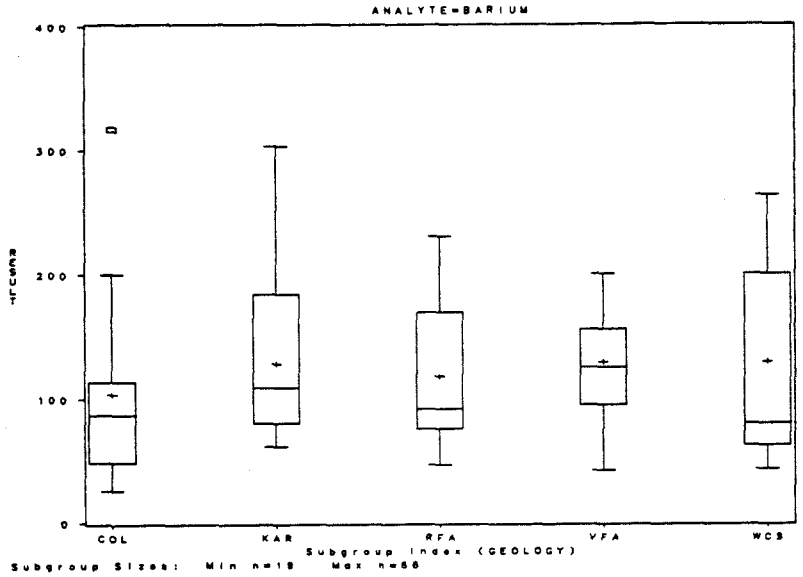


Figure B-35.

Total **BARIUM** in groundwater. Comparison between the five geologic units at the RFP.

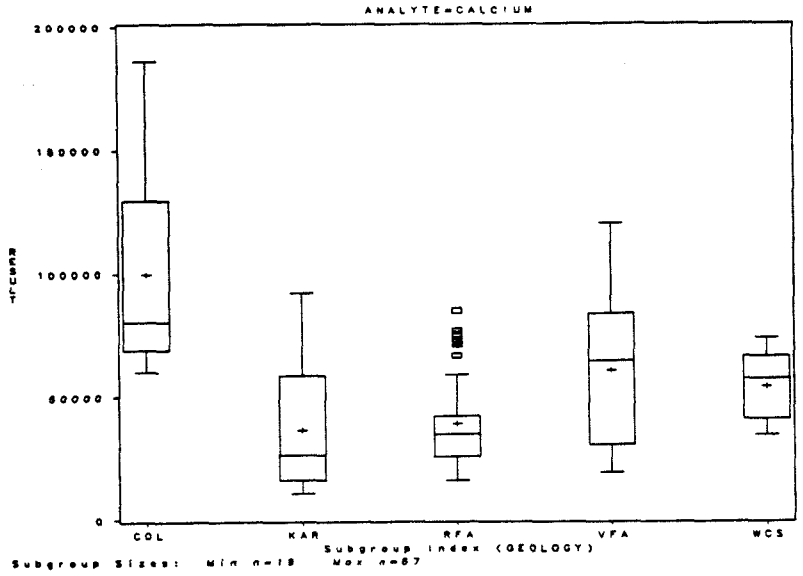


Figure B-36.

Total **CALCIUM** in groundwater. Comparison between the five geologic units at the RFP.

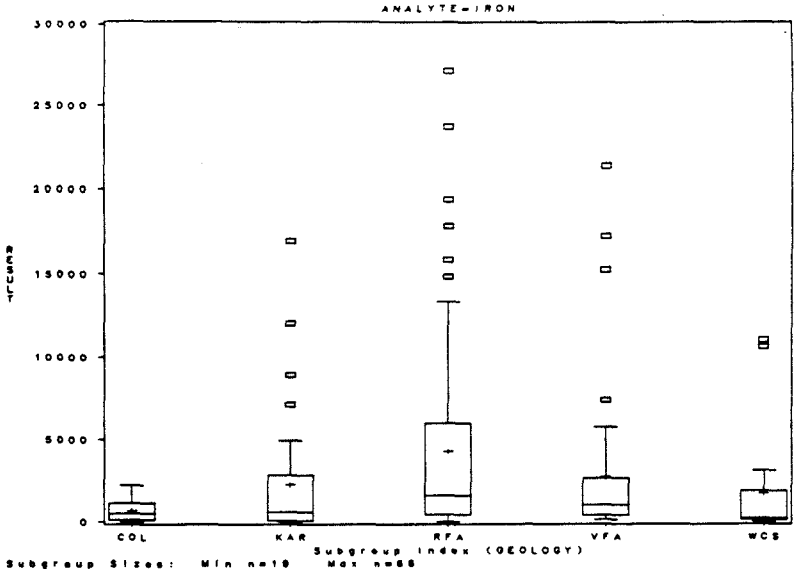


Figure B-37.

Total **IRON** in groundwater. Comparison between the five geologic units at the RFP.

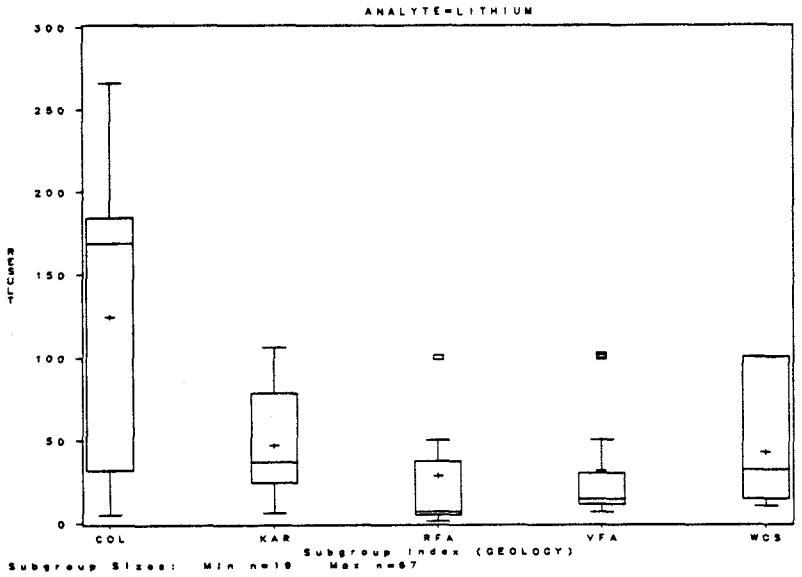


Figure B-38.

Total **LITHIUM** in groundwater. Comparison between the five geologic units at the RFP.

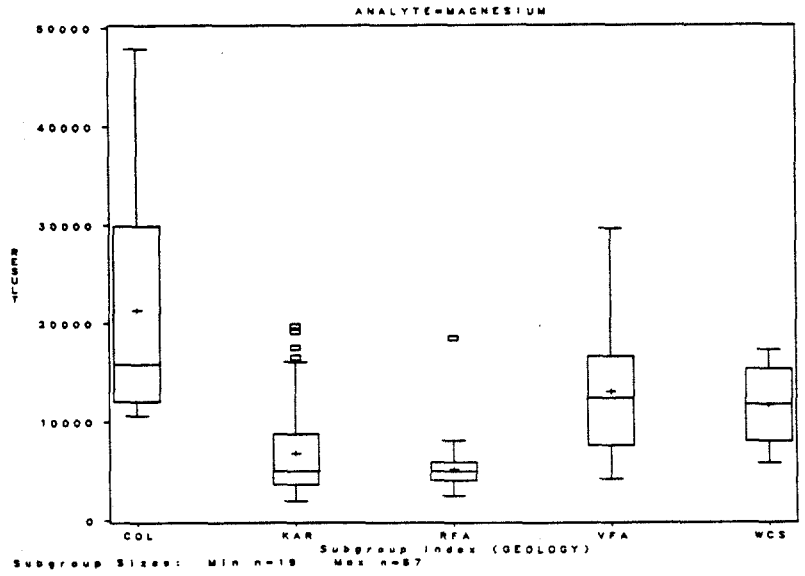


Figure B-39.

Total **MAGNESIUM** in groundwater. Comparison between the five geologic units at the RFP.

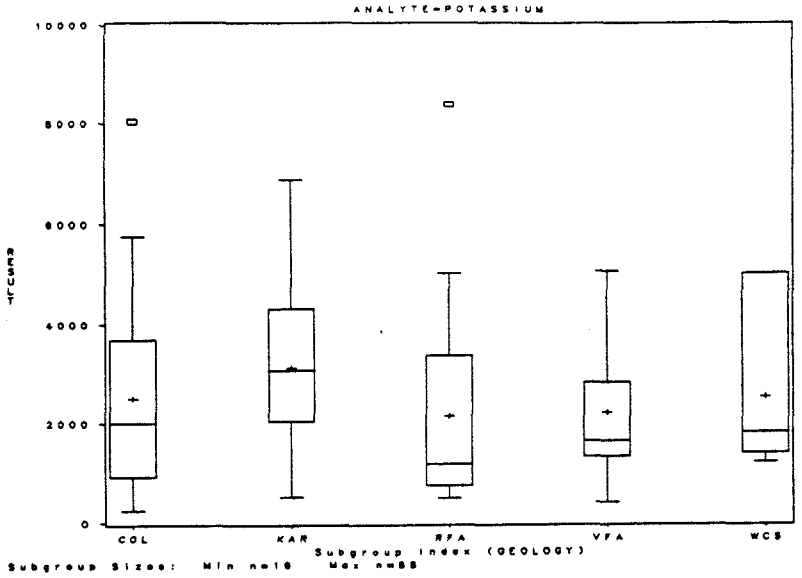


Figure B-40.

Total **POTASSIUM** in groundwater. Comparison between the five geologic units at the RFP.

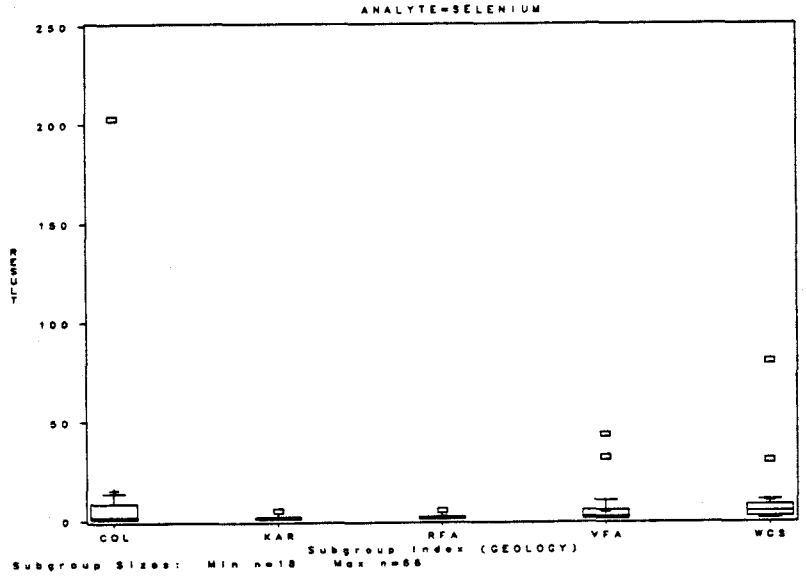


Figure B-41.

Total **SELENIUM** in groundwater. Comparison between the five geologic units at the RFP.

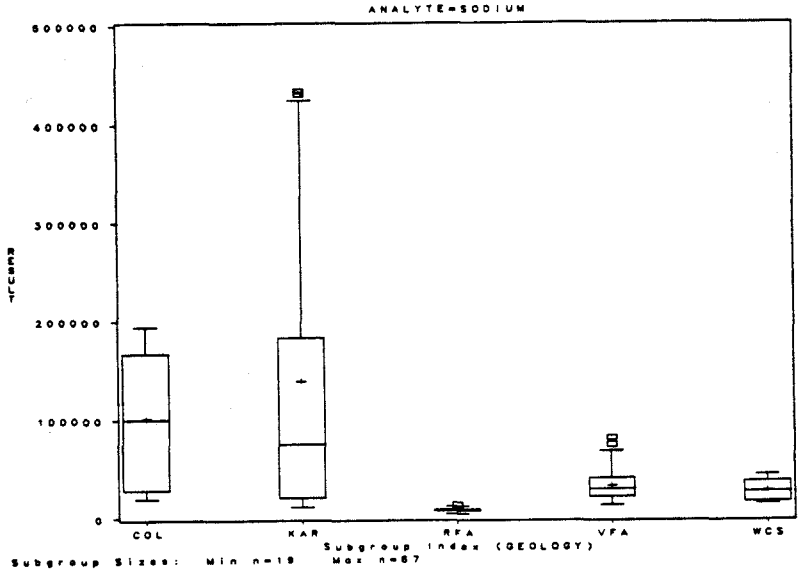


Figure B-42.

Total **SODIUM** in groundwater. Comparison between the five geologic units at the RFP.

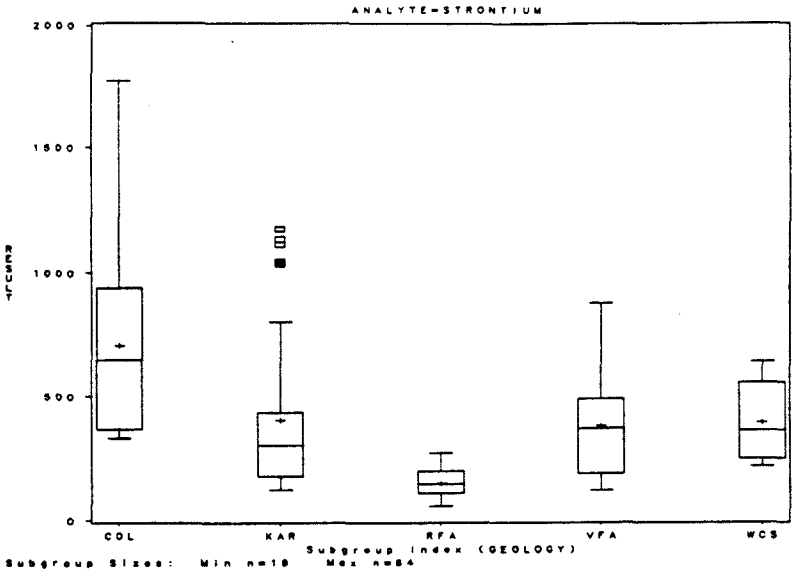


Figure B-43.

Total **STRONTIUM** in groundwater. Comparison between the five geologic units at the RFP.

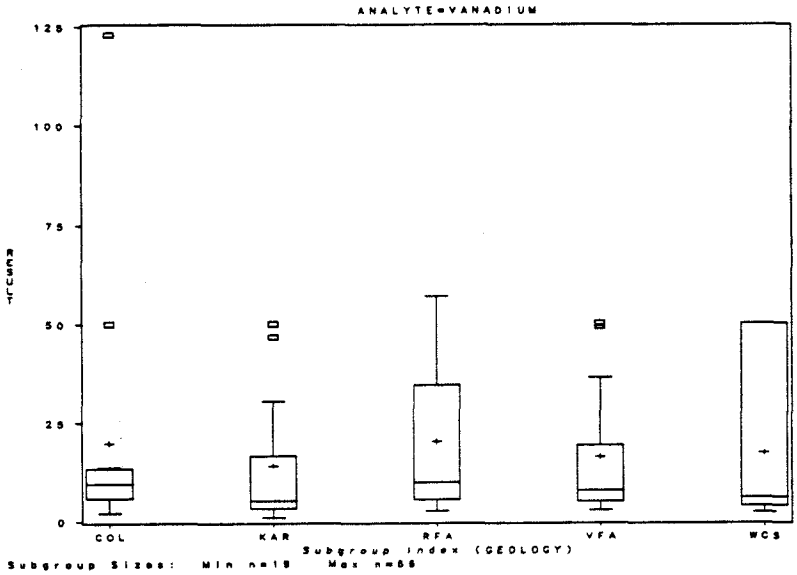


Figure B-44.

Total **VANADIUM** in groundwater. Comparison between the five geologic units at the RFP.

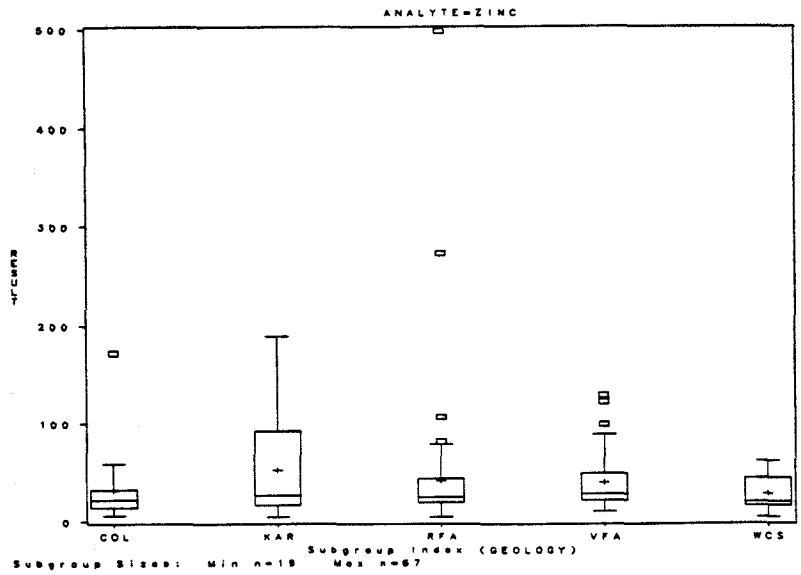


Figure B-45.

Total **ZINC** in groundwater. Comparison between the five geologic units at the RFP.

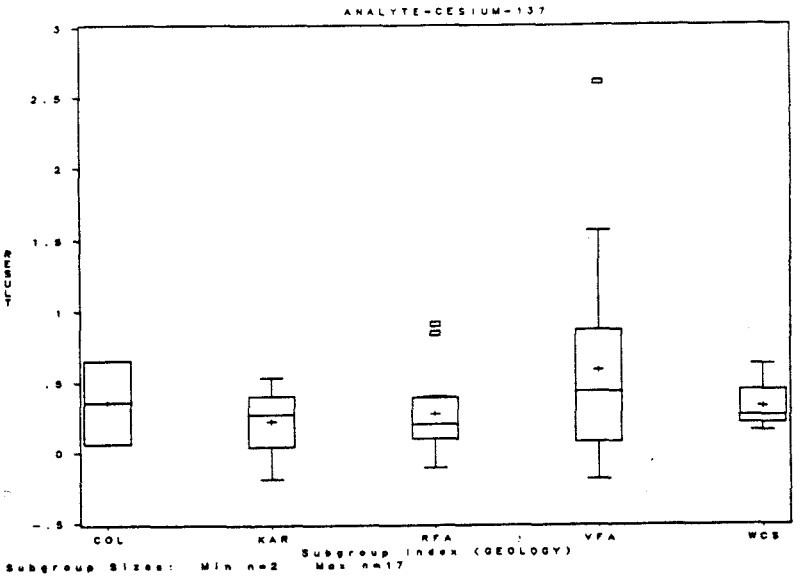


Figure B-46.

Dissolved **CESIUM-137** in groundwater. Comparison between the five geologic units at the RFP.

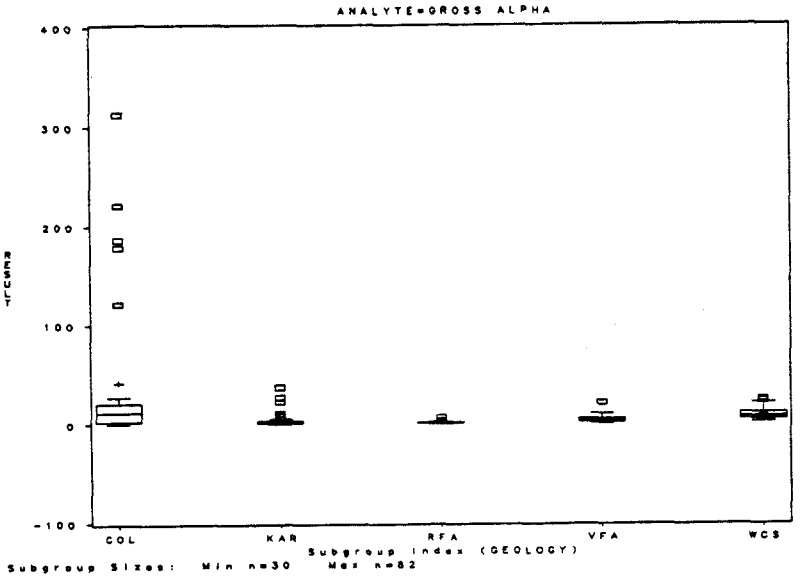


Figure B-47.

Dissolved **GROSS ALPHA** in groundwater. Comparison between the five geologic units at the RFP.

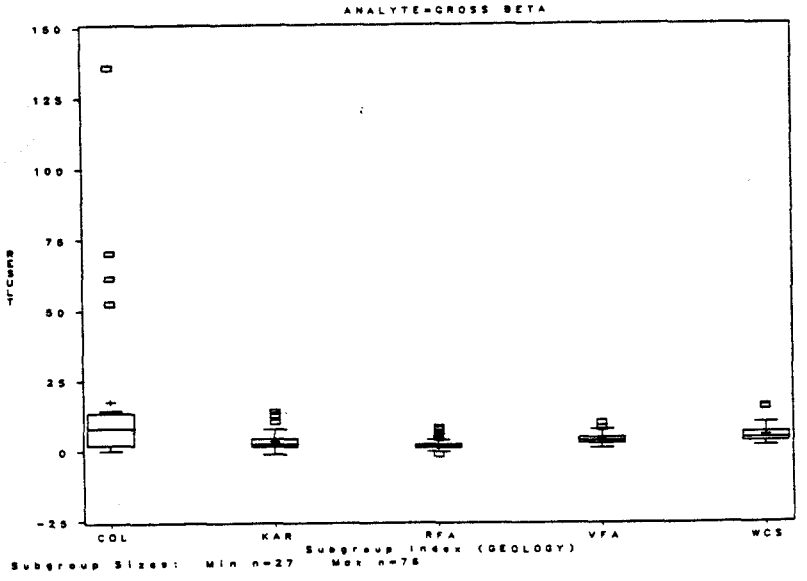


Figure B-48.

Dissolved **GROSS BETA** in groundwater. Comparison between the five geologic units at the RFP.

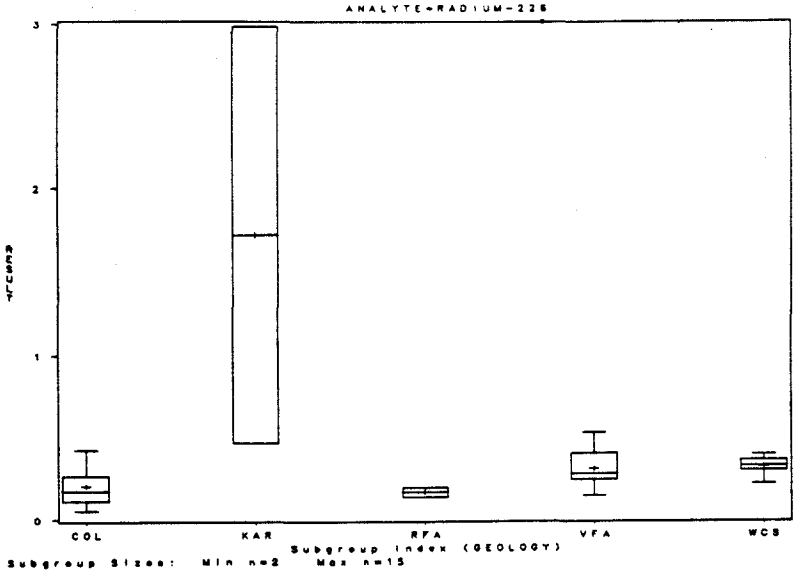


Figure B-49.

Dissolved **RADIUM-226** in groundwater. Comparison between the five geologic units at the RFP.

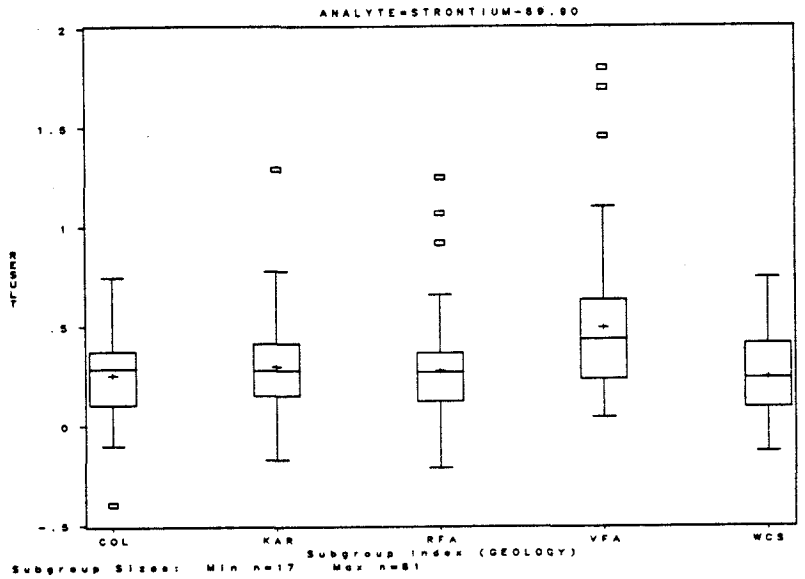


Figure B-50.

Dissolved **STRONTIUM-89,90** in groundwater. Comparison between the five geologic units at the RFP.

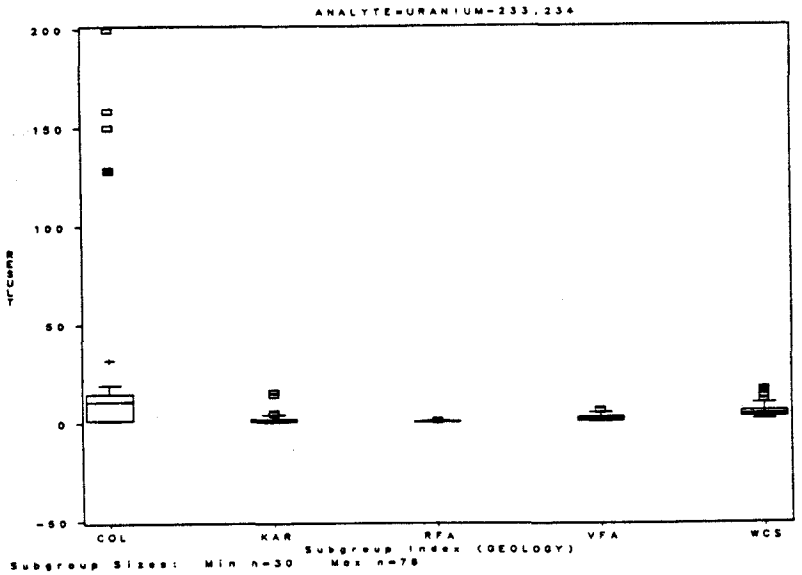


Figure B-51.

Dissolved **URANIUM-233,234** in groundwater. Comparison between the five geologic units at the RFP.

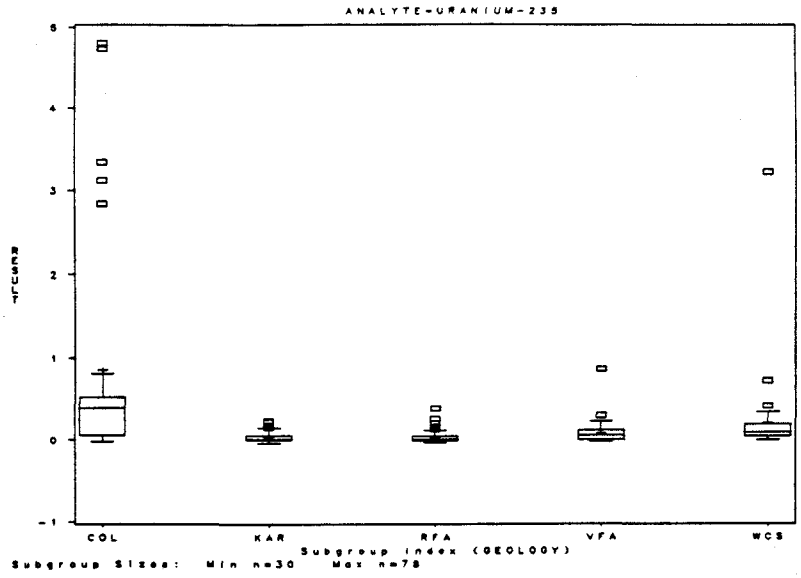


Figure B-52.

Dissolved **URANIUM-235** in groundwater. Comparison between the five geologic units at the RFP.

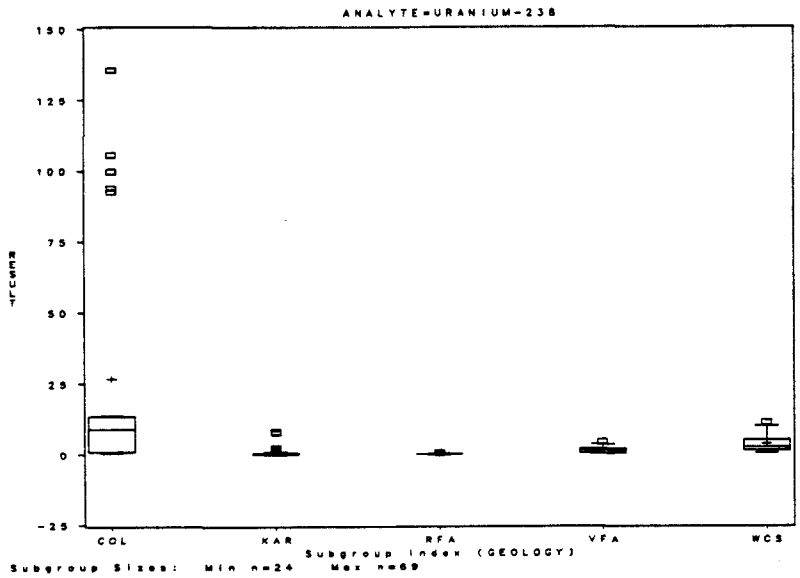


Figure B-53.

Dissolved **URANIUM-238** in groundwater. Comparison between the five geologic units at the RFP.

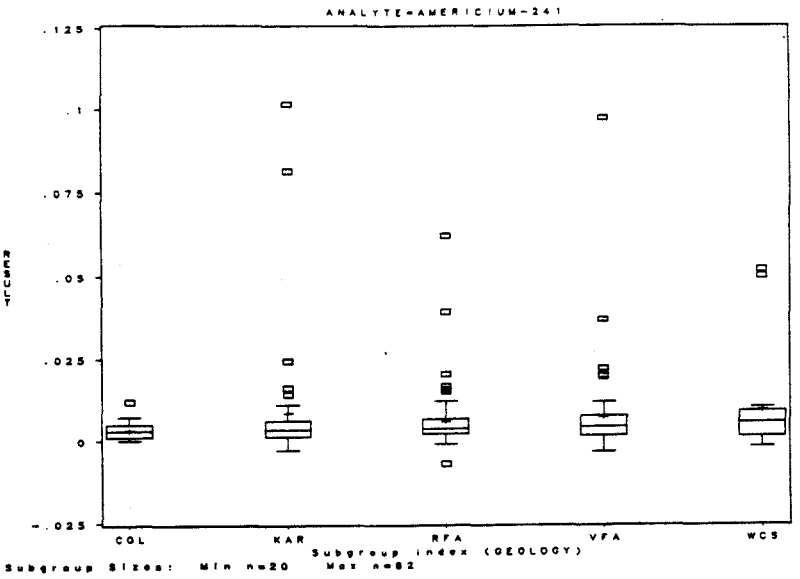


Figure B-54.

Total **AMERICIUM-241** in groundwater. Comparison between the five geologic units at the RFP.

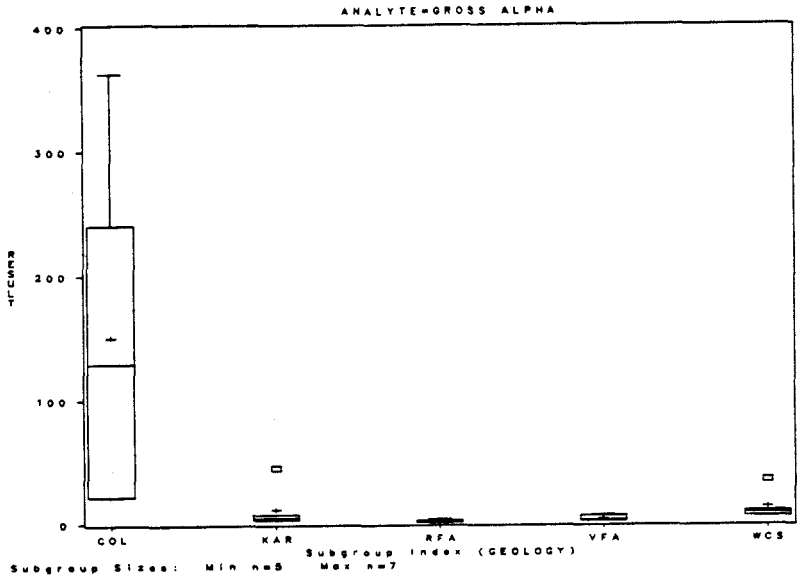


Figure B-55.

Total **GROSS ALPHA** in groundwater. Comparison between the five geologic units at the RFP.

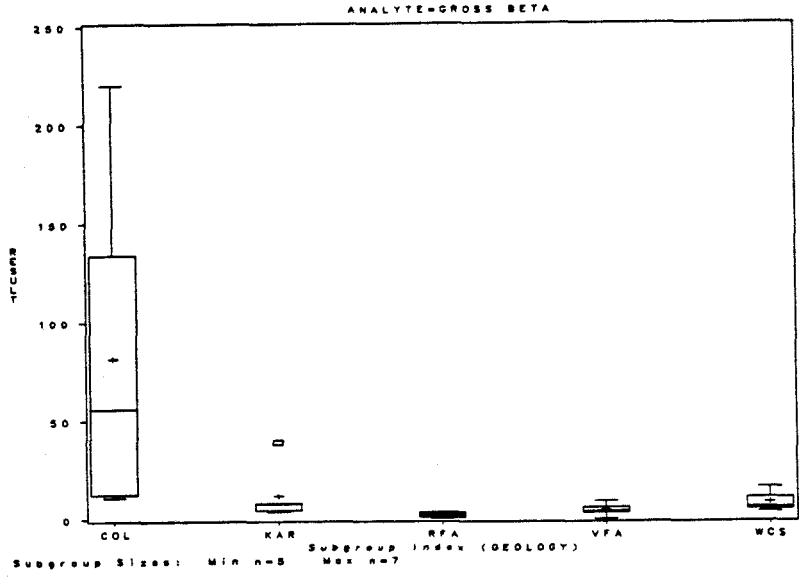


Figure B-56.

Total **GROSS BETA** in groundwater. Comparison between the five geologic units at the RFP.

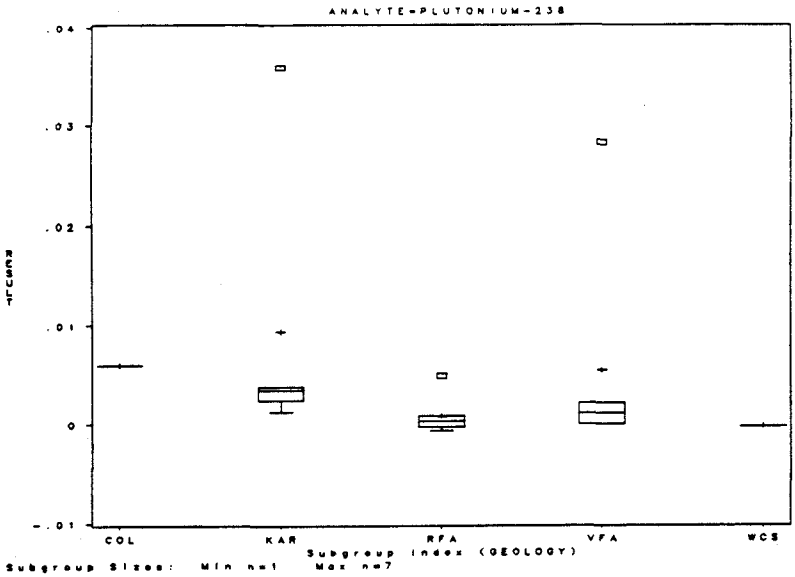


Figure B-57.

Total **PLUTONIUM-238** in groundwater. Comparison between the five geologic units at the RFP.

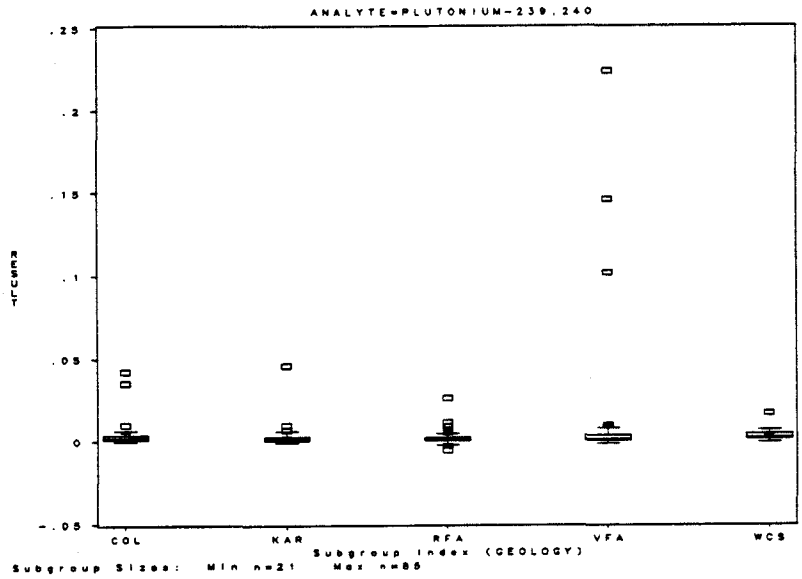


Figure B-58.

Total **PLUTONIUM-239, 240** in groundwater. Comparison between the five geologic units at the RFP.

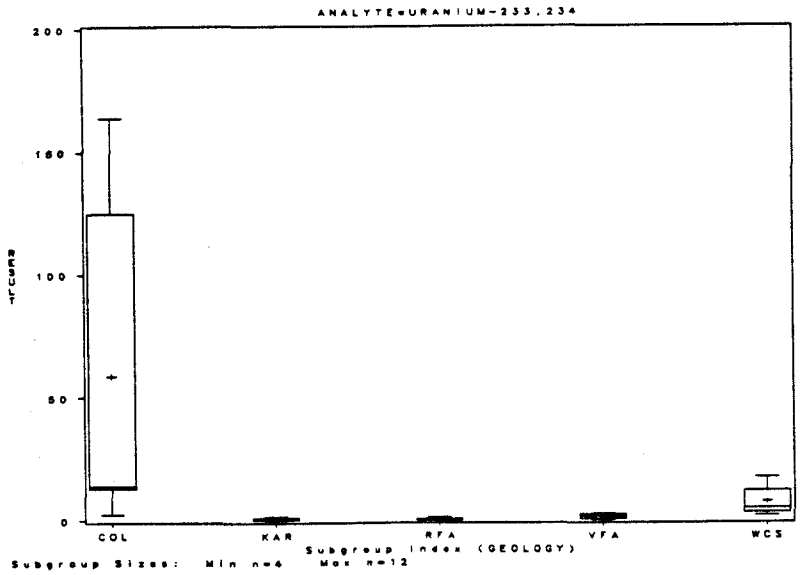


Figure B-59.

Total **URANIUM-233, 234** in groundwater. Comparison between the five geologic units at the RFP.

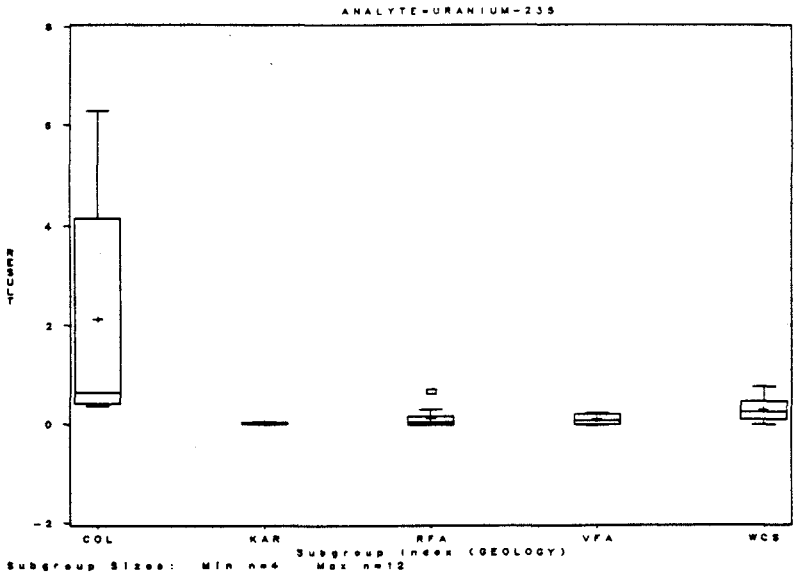


Figure B-60.

Total **URANIUM-235** in groundwater. Comparison between the five geologic units at the RFP.

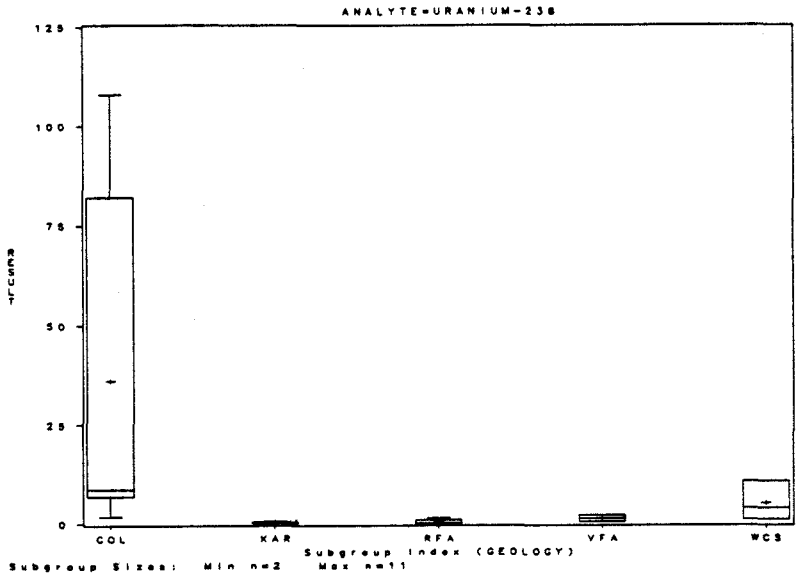


Figure B-61.

Total **URANIUM-238** in groundwater. Comparison between the five geologic units at the RFP.

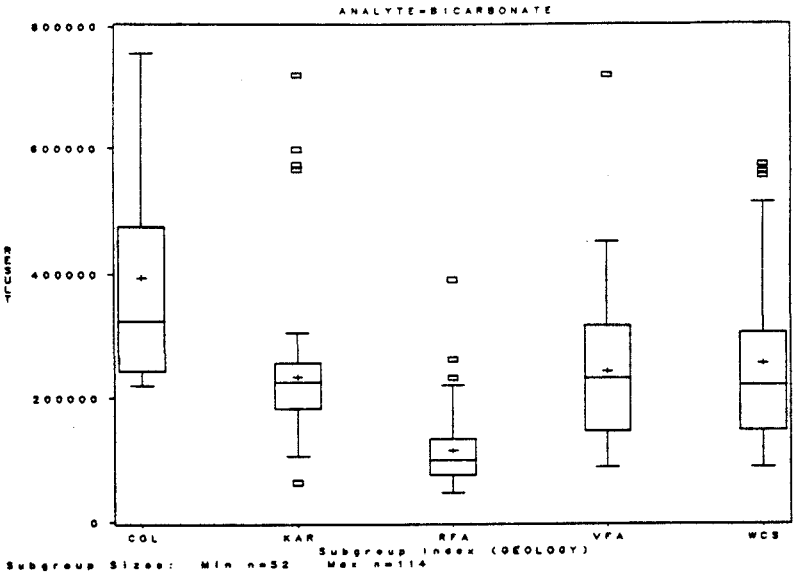


Figure B-62.

BICARBONATE in groundwater. Comparison between the five geologic units at the RFP.

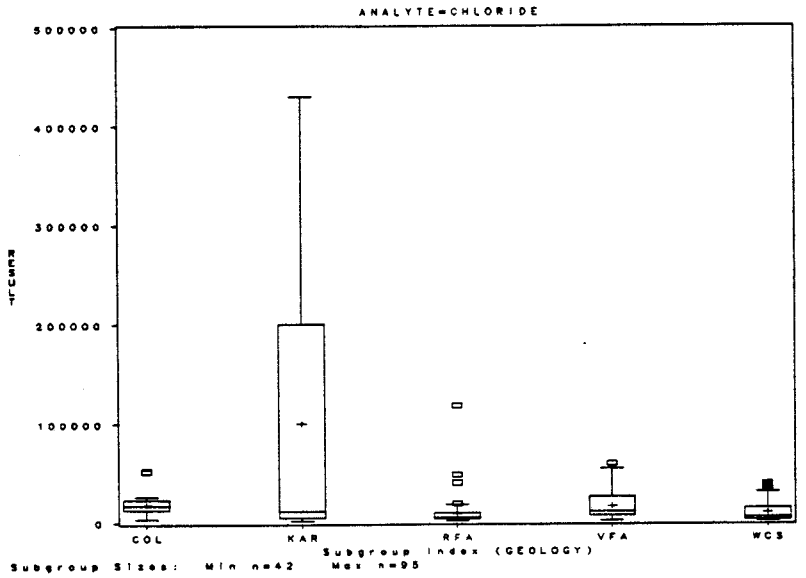


Figure B-63.

CHLORIDE in groundwater. Comparison between the five geologic units at the RFP.

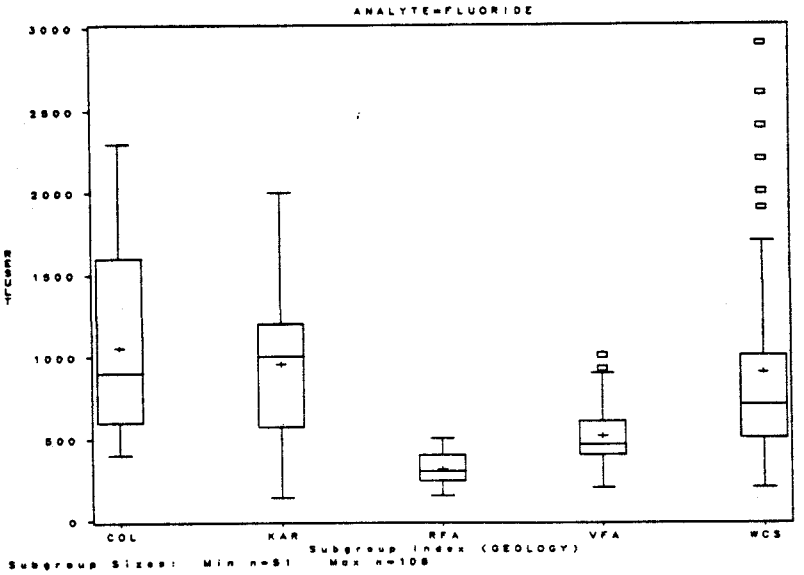


Figure B-64.

FLUORIDE in groundwater. Comparison between the five geologic units at the RFP.

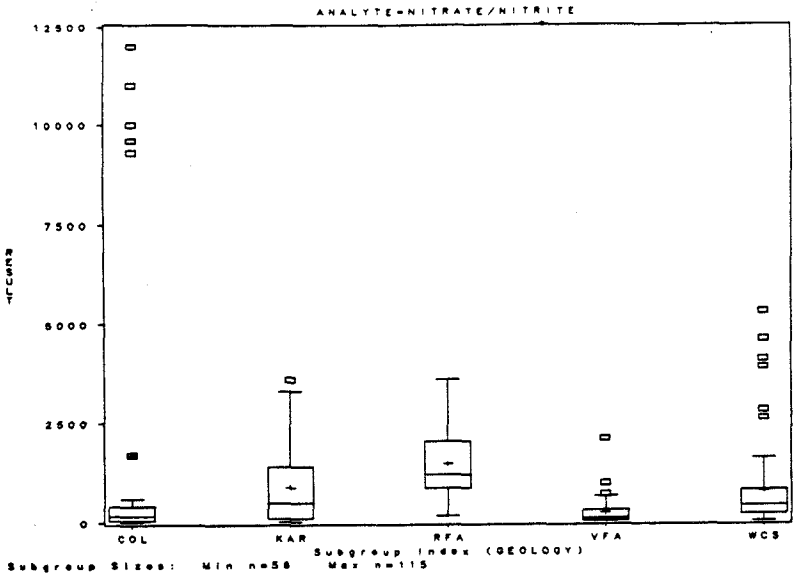


Figure B-65.

NITRATE/NITRITE in groundwater. Comparison between the five geologic units at the RFP.

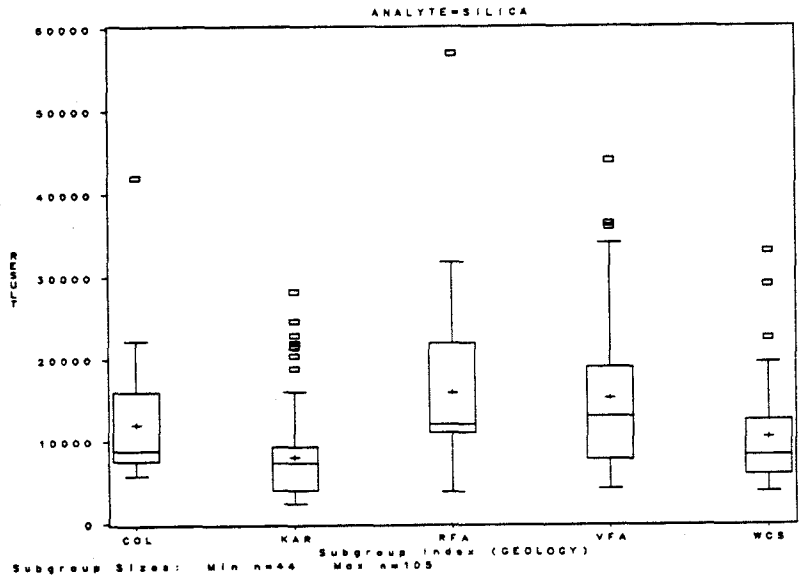


Figure B-66.

SILICA in groundwater. Comparison between the five geologic units at the RFP.

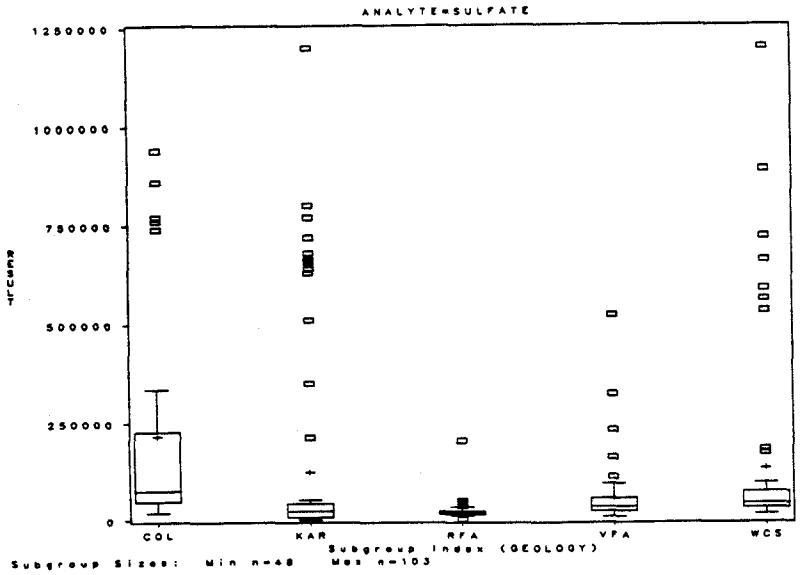


Figure B-67.

SULFATE in groundwater. Comparison between the five geologic units at the RFP.

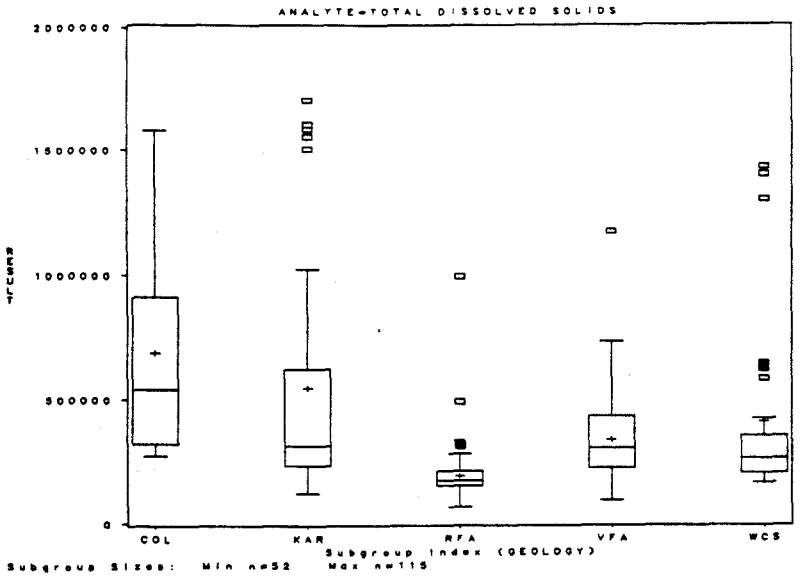


Figure B-68.

TOTAL DISSOLVED SOLIDS in groundwater. Comparison between the five geologic units at the RFP.

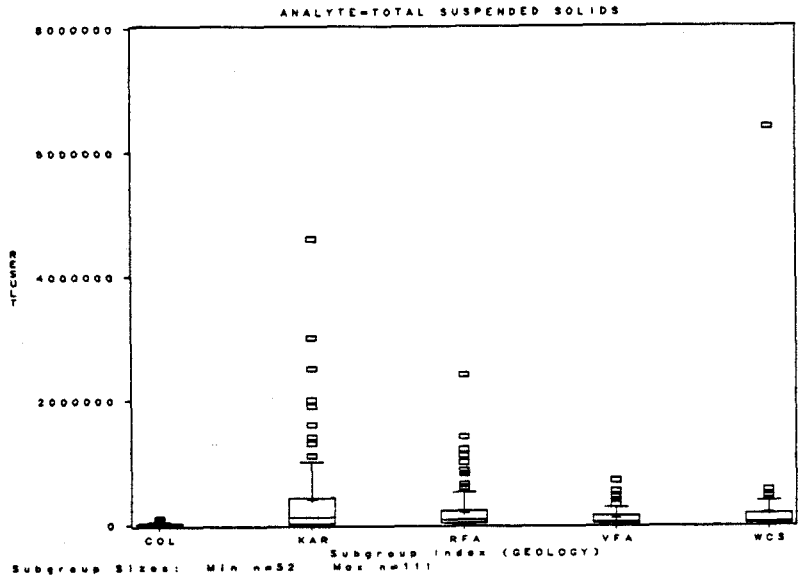


Figure B-69.

TOTAL SUSPENDED SOLIDS in groundwater. Comparison between the five geologic units at the RFP.

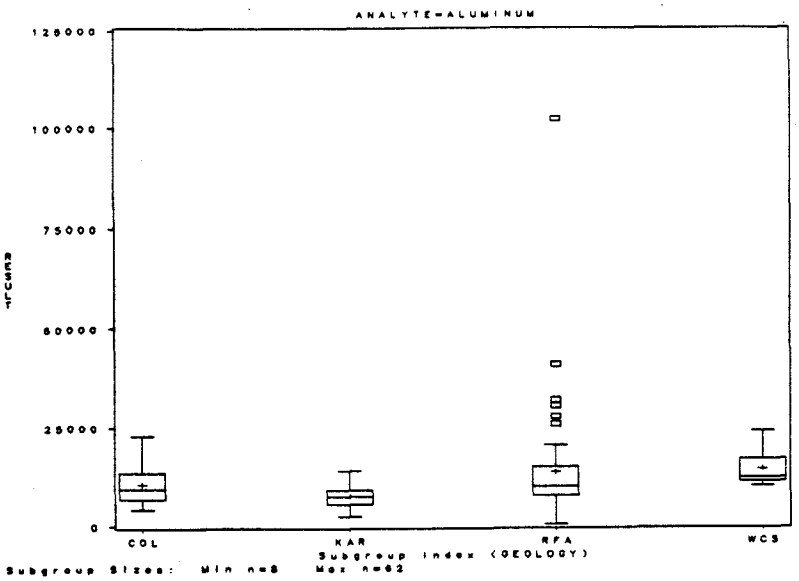


Figure B-70.

Total **ALUMINUM** in geologic materials. Comparison between the four sampled geologic units at the RFP.

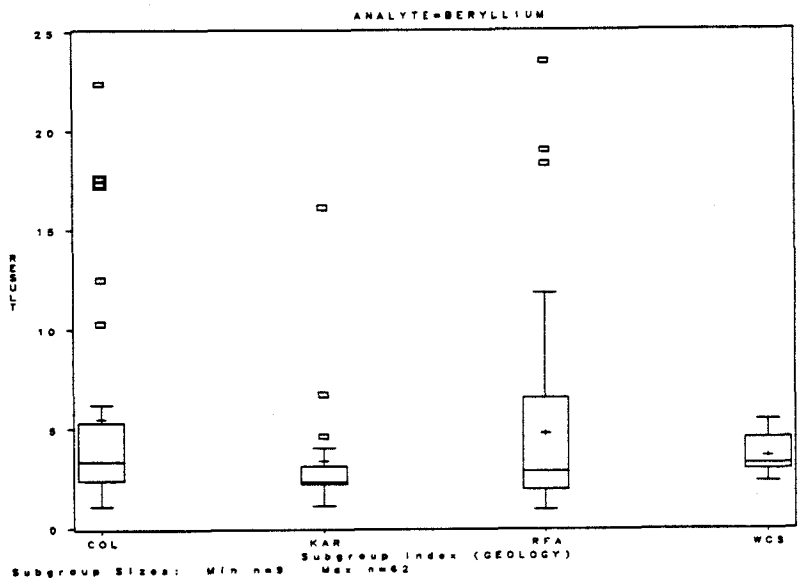


Figure B-71.

Total **BERYLLIUM** in geologic materials. Comparison between the four sampled geologic units at the RFP.

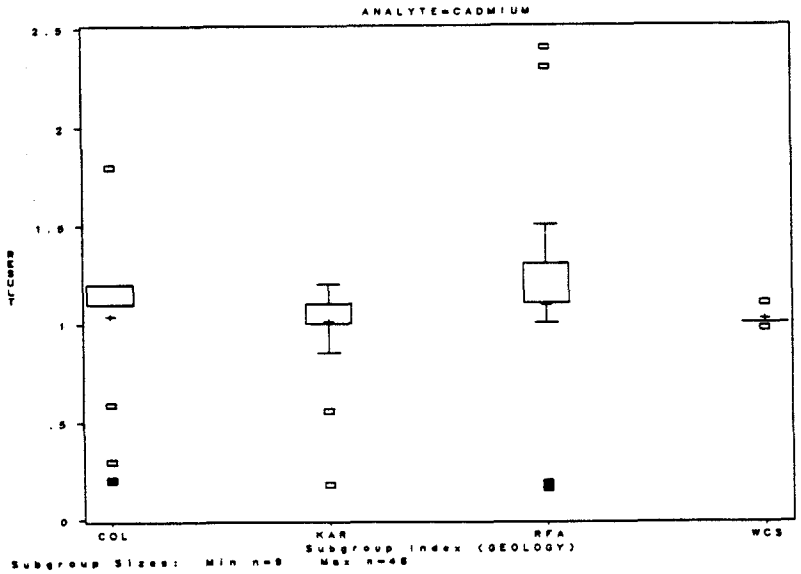


Figure B-72.

Total **CADMIUM** in geologic materials. Comparison between the four sampled geologic units at the RFP.

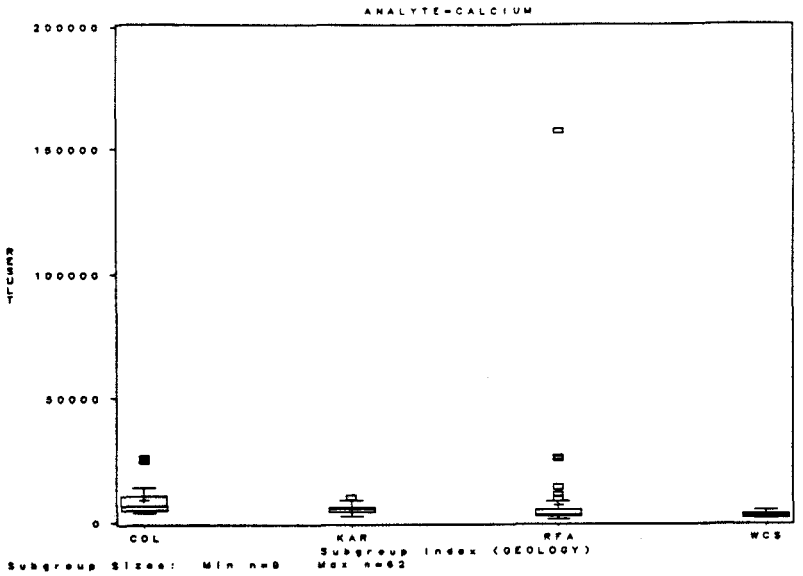


Figure B-73.

Total **CALCIUM** in geologic materials. Comparison between the four sampled geologic units at the RFP.

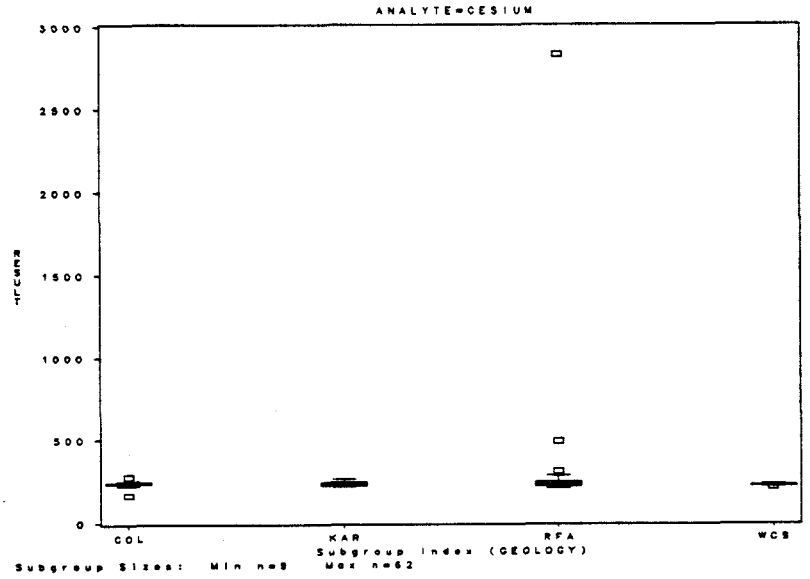


Figure B-74.

Total **CESIUM** in geologic materials. Comparison between the four sampled geologic units at the RFP.

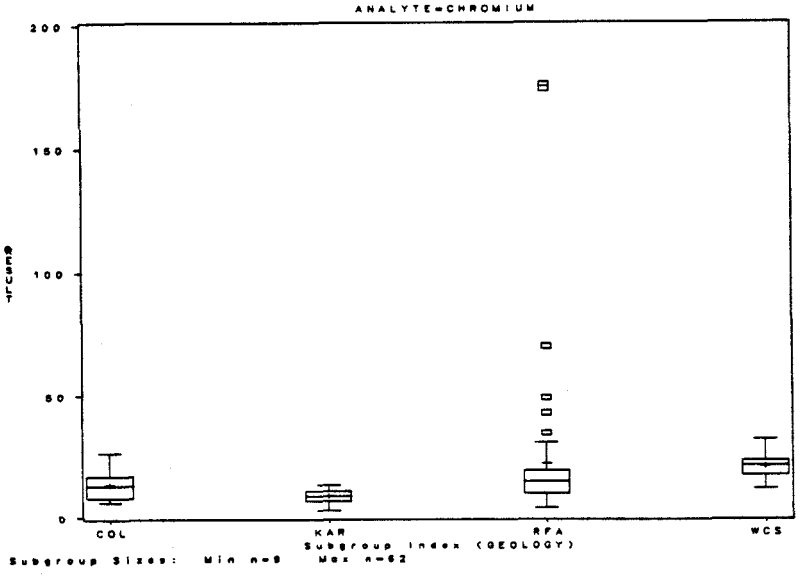


Figure B-75.

Total **CHROMIUM** in geologic materials. Comparison between the four sampled geologic units at the RFP.

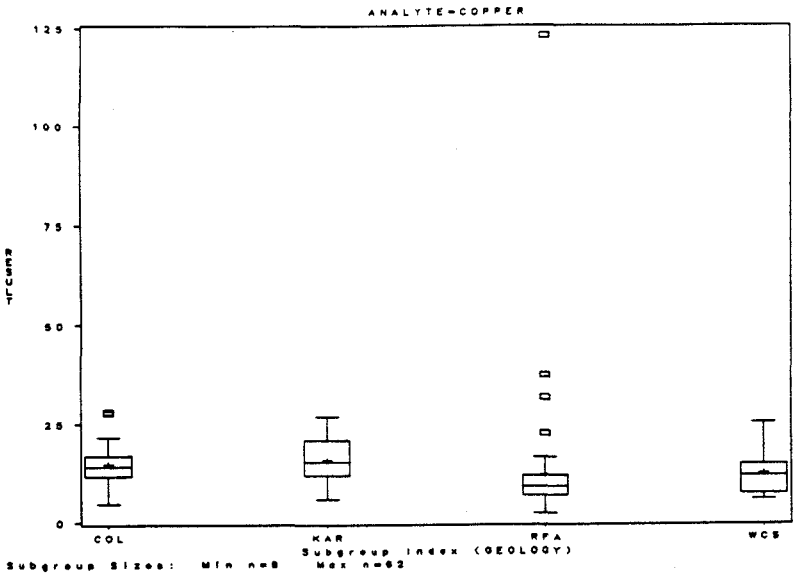


Figure B-76.

Total **COPPER** in geologic materials. Comparison between the four sampled geologic units at the RFP.

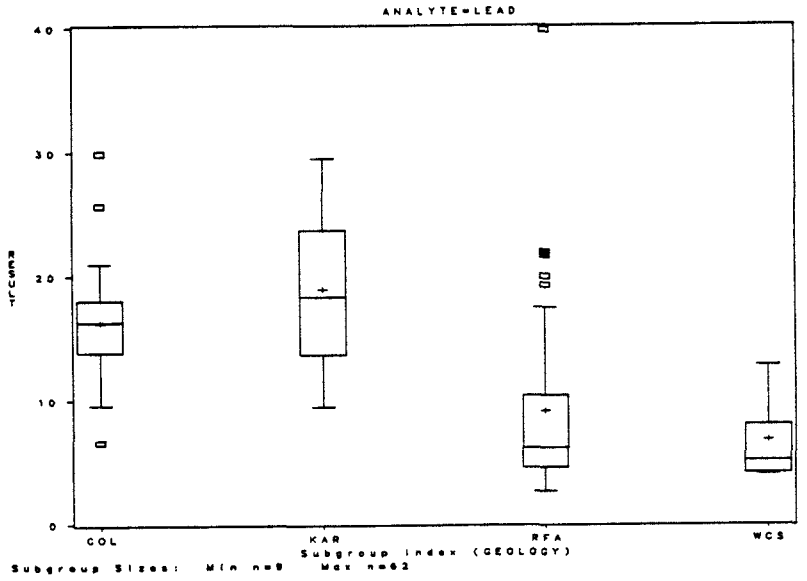


Figure B-77.

Total **LEAD** in geologic materials. Comparison between the four sampled geologic units at the RFP.

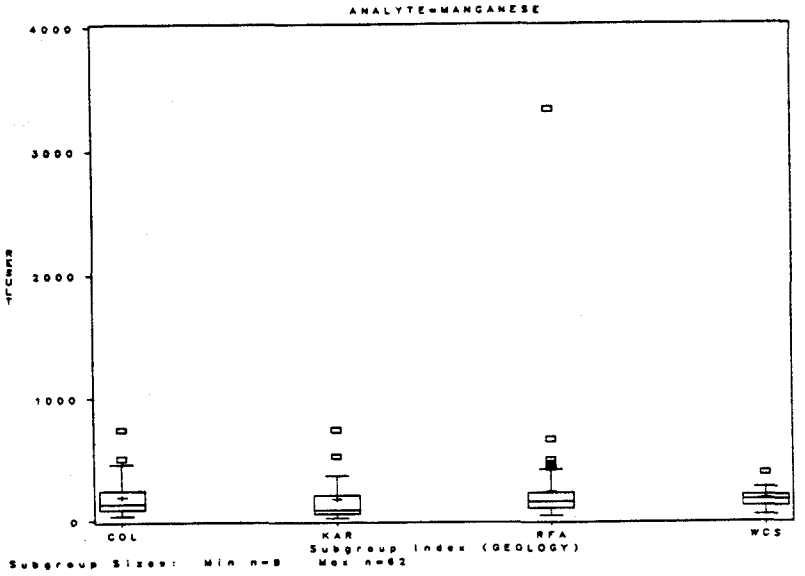


Figure B-78.

Total **MANGANESE** in geologic materials. Comparison between the four sampled geologic units at the RFP.

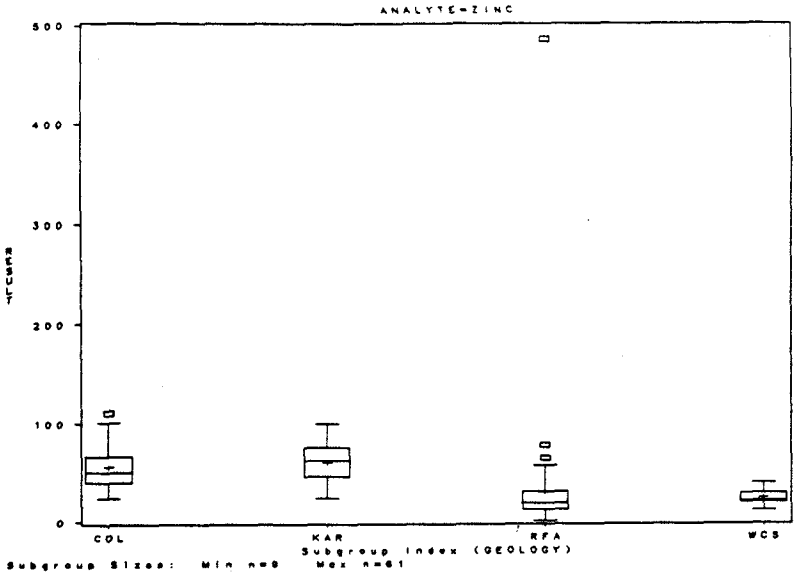


Figure B-79.

Total **ZINC** in geologic materials. Comparison between the four sampled geologic units at the RFP.

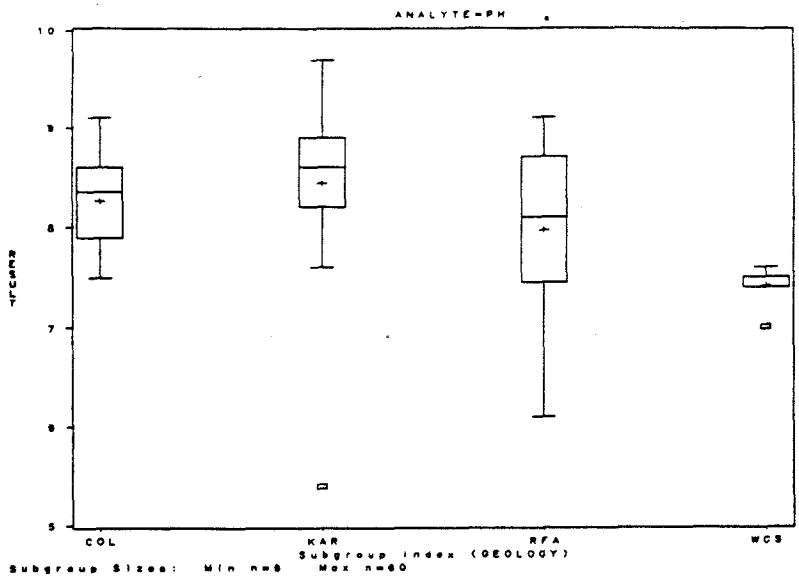


Figure B-80.

Lab **pH** in geologic materials. Comparison between the four sampled geologic units at the RFP.

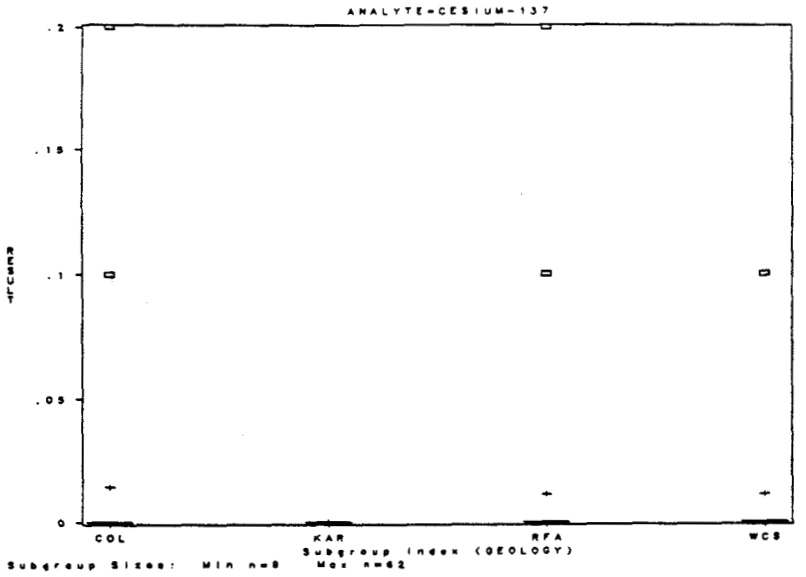


Figure B-81.

Total **CESIUM-137** in geologic materials. Comparison between the four sampled geologic units at the RFP.

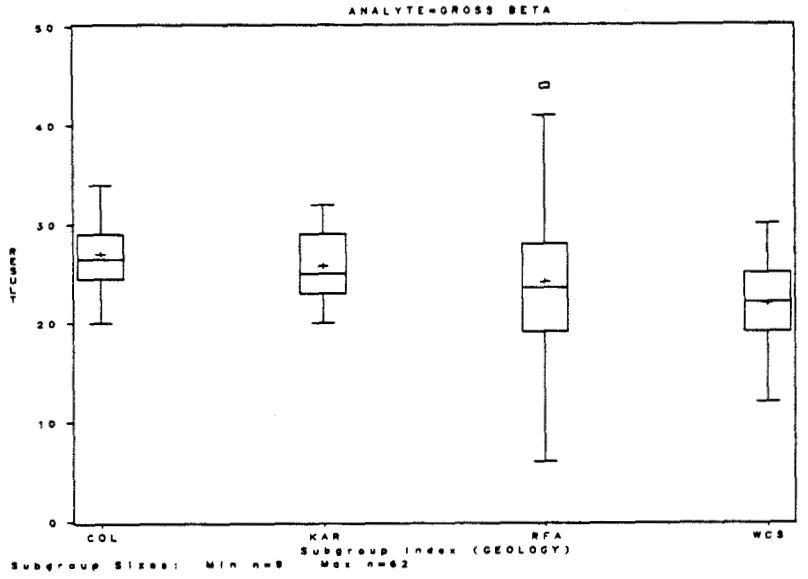


Figure B-82.

Total **GROSS BETA** in geologic materials. Comparison between the four sampled geologic units at the RFP.

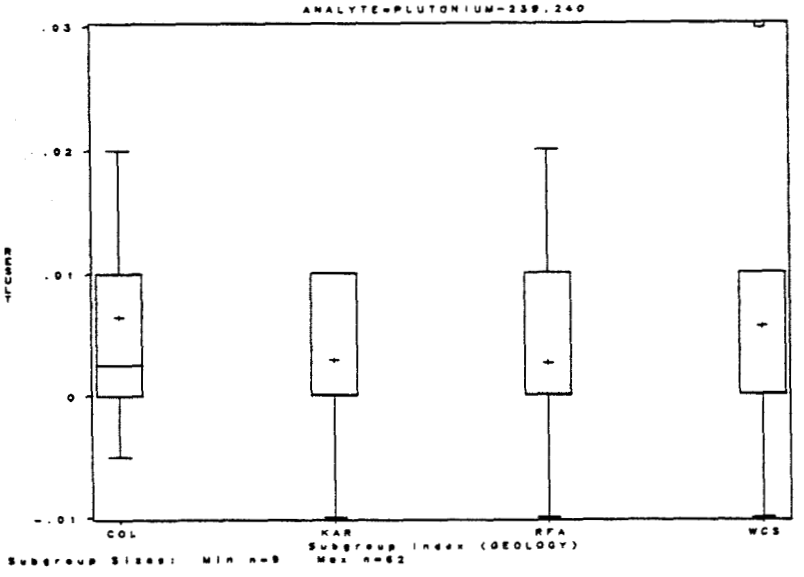


Figure B-83.

Total **PLUTONIUM-239, 240** in geologic materials. Comparison between the four sampled geologic units at the RFP.

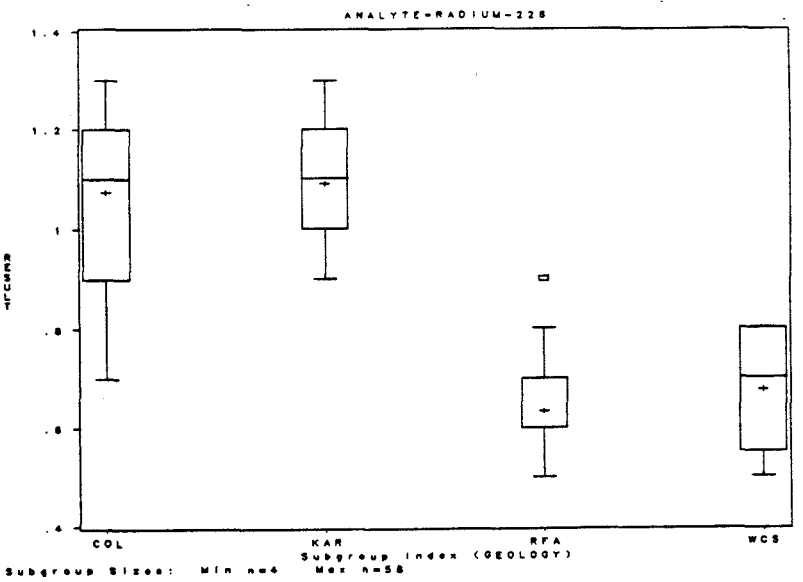


Figure B-84.

Total **RADIUM-226** in geologic materials. Comparison between the four sampled geologic units at the RFP.

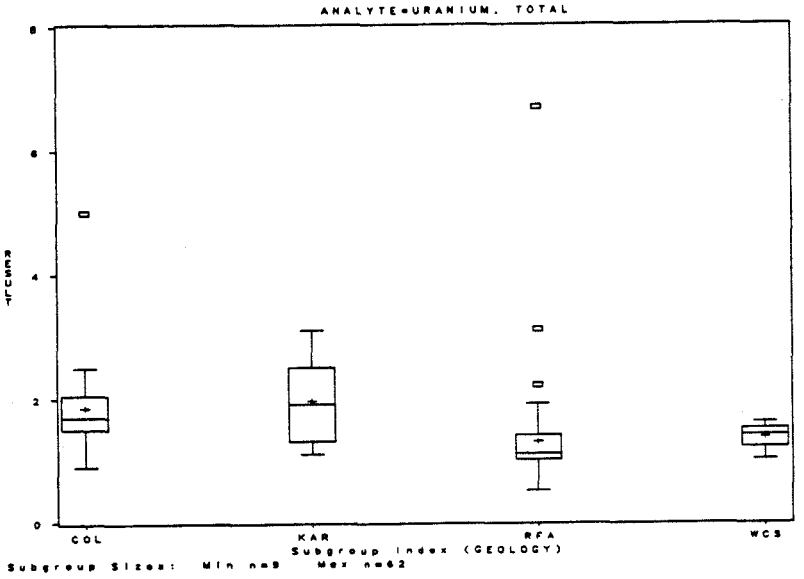


Figure B-85.

Total **URANIUM** in geologic materials. Comparison between the four sampled geologic units at the RFP.

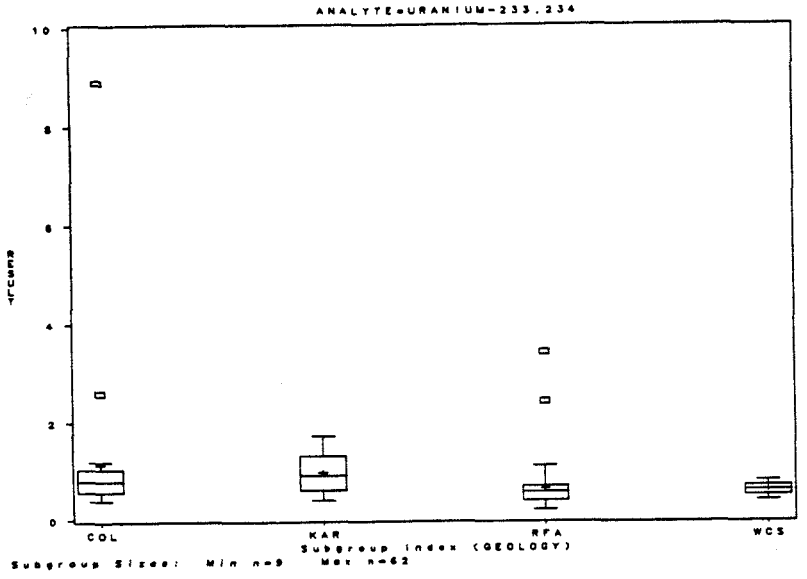


Figure B-86.

Total **URANIUM-233, 234** in geologic materials. Comparison between the four sampled geologic units at the RFP.

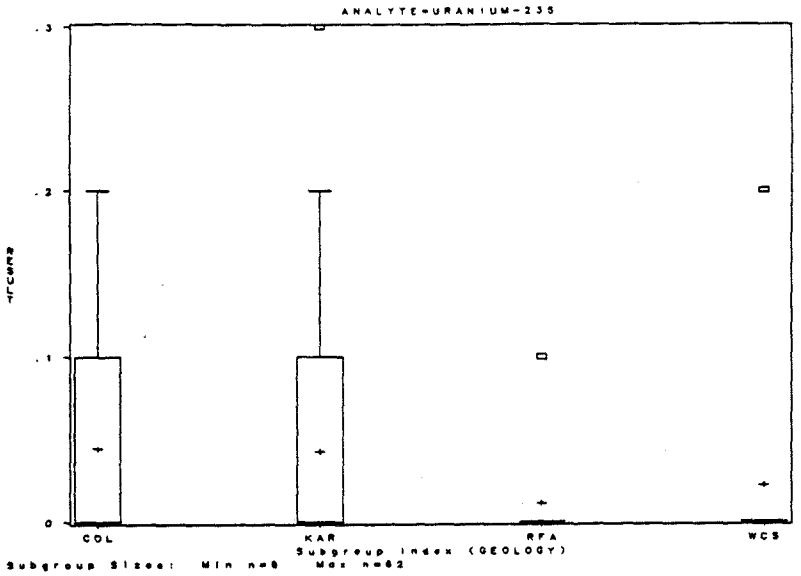


Figure B-87.

Total **URANIUM-235** in geologic materials. Comparison between the four sampled geologic units at the RFP.

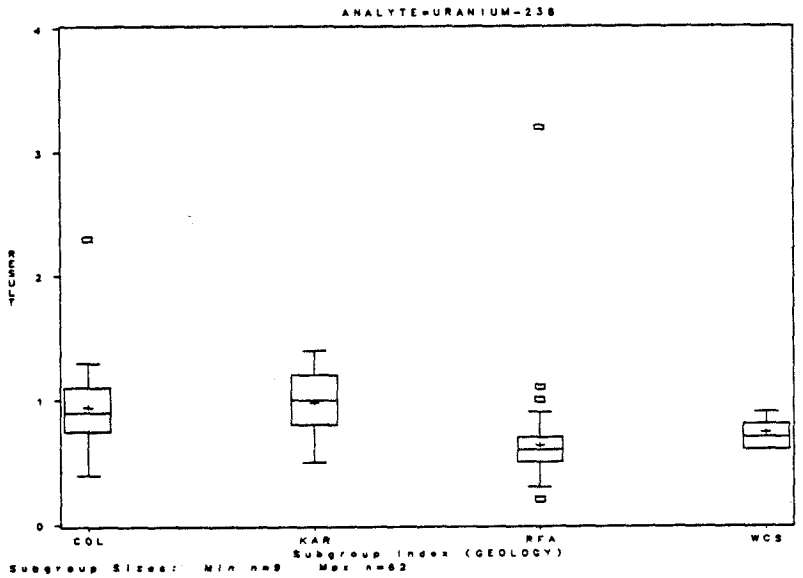


Figure B-88.

Total **URANIUM-238** in geologic materials. Comparison between the four sampled geologic units at the RFP.

UPPER TOLERANCE LIMITS

APPENDIX C

UPPER TOLERANCE LIMITS

APPENDIX C
UPPER TOLERANCE LIMITS

GROUNDWATER

Upper Tolerance Limits by Geologic Unit

Groundwater, Dissolved Metals
Groundwater, Total Metals
Groundwater, Dissolved Radionuclides
Groundwater, Total Radionuclides
Groundwater, Water-Quality Parameters

Upper Tolerance Limits by Flow-system

Groundwater, Dissolved Metals
Groundwater, Total Metals
Groundwater, Dissolved Radionuclides
Groundwater, Total Radionuclides
Groundwater, Water-Quality Parameters

GEOLOGIC MATERIALS

Upper Tolerance Limits by Geologic Unit

Geologic Materials, Total Metals
Geologic Materials, Total Radionuclides
Geologic Materials, Total "Water-Quality" Parameters

Upper Tolerance Limits by Flow-system

Geologic Materials, Total Metals
Geologic Materials, Total Radionuclides
Geologic Materials, Total "Water-Quality" Parameters

STREAM WATER

Stream Water, Dissolved Metals
Stream Water, Total Metals
Stream Water, Dissolved Radionuclides
Stream Water, Total Radionuclides
Stream Water, Water-Quality Parameters

SEEP/SPRING WATER

Seep/Spring Water, Dissolved Metals
Seep/Spring Water, Total Metals
Seep/Spring Water, Dissolved Radionuclides
Seep/Spring Water, Total Radionuclides
Seep/Spring Water, Water-Quality Parameters

STREAM SEDIMENTS

Stream Sediments, Total Metals
Stream Sediments, Total Radionuclides
Stream Sediments, Total "Water-Quality" Parameters

SEEP/SPRING SEDIMENTS

Seep/Spring Sediments, Total Metals
Seep/Spring Sediments, Total Radionuclides
Seep/Spring Sediments, Total "Water-Quality" Parameters

APPENDIX C
UPPER TOLERANCE LIMITS

Tables listing the upper tolerance limits (UTLs) by group and analyte are intended to be used as "look-up" tables for flagging downgradient data as potential contamination. UTLs are meant to be applied to comparisons of individual analyses, not to group means. To use the UTLs in the following tables, it is necessary to classify the downgradient data by the proper group (e.g., "groundwater, dissolved metals, upper-flow system").

It will be necessary to evaluate, both spatially and temporally, all downgradient data that exceed background UTLs. It should be noted that UTLs were calculated at p/P values of 99/99; where p = probability, and P = percent of population. For example, the 99/99 UTLs were computed at 99-percent probability (p) to include 99 percent of the population (P). Keeping these criteria in mind, the user should be able to discern areas of potential contamination that may required further investigation. All data flagged during the UTL comparisons should be evaluated both spatially and temporally before making conclusions about the possible contamination.

GROUNDWATER AND GEOLOGIC MATERIALS

UTLs for groundwater and geologic materials are given both by geologic unit (COL, RFA, VFA, WCS, or KAR) and by flow-system (upper or lower). The user must decide which type of comparison would be best suited to the downgradient data at hand. If, for example, the user decided to group the downgradient data by flow-system to have a larger, more robust sample size, then UTLs by flow-system would be used for comparison.

STREAM WATER AND SEEP/SPRING WATER

UTLs for surface waters were calculated by analyte on a sitewide basis. There is no need for the user to attempt further classification for samples of surface water other than by analytical group (e.g., dissolved metals group, total metals group, etc.).

STREAM SEDIMENTS AND SEEP/SPRING SEDIMENTS

UTLs for sediments were calculated by analyte on a sitewide basis. Downgradient data need only be classified by analytical group (e.g., total metals, total radionuclides, etc.). No background data exist for pond sediments; it is recommended that the reader select values from the literature, or use the data for seep/spring sediments for comparisons.

Table C-1. Groundwater UTLs by geologic unit for dissolved metals.

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, DISSOLVED METALS

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	COL	35	71.43	59.18	49.50	224.21	UG/L
ANTIMONY	COL	33	33.33	14.84	9.50	46.92	UG/L
BARIUM	COL	34	79.41	77.05	39.03	207.99	UG/L
CADMIUM	COL	34	23.53	1.97	1.67	7.57	UG/L
CALCIUM	COL	35	100.00	96,314.29	34,355.90	210,868.89	UG/L
CHROMIUM	COL	32	28.12	5.87	5.93	26.03	UG/L
COPPER	COL	33	36.36	5.08	4.20	19.27	UG/L
IRON	COL	34	61.76	46.38	79.70	313.70	UG/L
LITHIUM	COL	34	88.24	122.77	84.53	406.30	UG/L
MAGNESIUM	COL	34	100.00	20,479.41	10,610.71	56,070.91	UG/L
MANGANESE	COL	35	74.29	32.10	38.69	161.12	UG/L
MOLYBDENUM	COL	33	42.42	19.35	32.15	127.87	UG/L
POTASSIUM	COL	33	84.85	2,086.36	1,903.98	8,513.03	UG/L
SELENIUM	COL	32	62.50	17.40	42.89	163.12	UG/L
SILVER	COL	31	25.81	3.22	2.81	12.84	UG/L
SODIUM	COL	35	100.00	98,454.29	64,522.31	313,594.26	UG/L
STRONTIUM	COL	34	97.06	701.88	374.80	1,959.08	UG/L
TIN	COL	31	41.94	44.01	62.59	258.16	UG/L
VANADIUM	COL	32	65.62	8.17	7.85	34.84	UG/L
ZINC	COL	35	74.29	11.30	10.64	46.78	UG/L
ALUMINUM	RFA	104	75.00	68.23	125.93	361.64	UG/L
ANTIMONY	RFA	113	49.56	18.37	12.98	48.61	UG/L
BARIUM	RFA	114	83.33	72.32	24.50	129.39	UG/L
CADMIUM	RFA	107	22.43	1.66	1.13	4.29	UG/L
CALCIUM	RFA	113	100.00	37,655.53	18,707.96	81,245.08	UG/L
CHROMIUM	RFA	113	41.59	4.86	3.33	12.63	UG/L
COPPER	RFA	112	43.75	4.79	4.13	14.40	UG/L
IRON	RFA	113	76.99	70.28	157.23	436.62	UG/L
LEAD	RFA	111	24.32	1.40	3.01	8.41	UG/L
LITHIUM	RFA	109	68.81	12.68	17.36	53.12	UG/L
MAGNESIUM	RFA	112	91.96	4,266.21	1,369.27	7,456.60	UG/L
MANGANESE	RFA	114	52.63	6.17	15.04	41.21	UG/L
MOLYBDENUM	RFA	106	35.85	19.37	34.13	98.88	UG/L
NICKEL	RFA	106	36.79	7.66	7.65	25.49	UG/L
POTASSIUM	RFA	110	79.09	925.94	705.81	2,570.48	UG/L
SILVER	RFA	105	28.57	2.73	1.88	7.11	UG/L
SODIUM	RFA	112	98.21	7,602.21	1,740.42	11,657.40	UG/L
STRONTIUM	RFA	112	86.61	132.73	91.06	344.89	UG/L
THALLIUM	RFA	92	21.74	1.68	1.64	5.50	UG/L
TIN	RFA	100	41.00	29.72	34.02	108.98	UG/L
VANADIUM	RFA	111	62.16	8.36	9.95	31.54	UG/L
ZINC	RFA	113	79.65	15.69	19.83	61.88	UG/L

Table C-1 (cont').

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, DISSOLVED METALS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	VFA	74	82.43	52.02	38.51	169.11	UG/L
ANTIMONY	VFA	69	52.17	16.63	8.82	43.47	UG/L
BARIUM	VFA	74	86.49	98.78	35.33	206.21	UG/L
CADMIUM	VFA	67	22.39	1.71	1.14	5.18	UG/L
CALCIUM	VFA	74	100.00	61,597.97	30,967.01	155,768.65	UG/L
CESIUM	VFA	62	27.42	266.67	415.61	1,530.54	UG/L
CHROMIUM	VFA	72	30.56	4.27	3.40	14.62	UG/L
COBALT	VFA	65	24.62	5.93	8.12	30.63	UG/L
COPPER	VFA	71	38.03	5.04	4.67	19.23	UG/L
IRON	VFA	74	82.43	47.94	50.37	201.11	UG/L
LEAD	VFA	74	25.68	1.16	1.34	5.24	UG/L
LITHIUM	VFA	73	78.08	22.36	22.93	92.09	UG/L
MAGNESIUM	VFA	73	97.26	12,670.14	6,554.47	32,602.27	UG/L
MANGANESE	VFA	73	71.23	57.72	97.91	355.47	UG/L
MOLYBDENUM	VFA	70	34.29	16.44	31.55	112.37	UG/L
NICKEL	VFA	70	38.57	6.37	6.36	25.72	UG/L
PHOSPHORUS	VFA	4	100.00	178.75	31.85	573.25	UG/L
POTASSIUM	VFA	75	84.00	1,455.52	745.03	3,721.17	UG/L
SELENIUM	VFA	66	34.85	3.98	10.30	35.30	UG/L
SILVER	VFA	68	29.41	2.81	2.21	9.53	UG/L
SODIUM	VFA	74	100.00	33,841.22	16,286.12	83,367.31	UG/L
STRONTIUM	VFA	72	97.22	376.61	205.32	1,000.97	UG/L
THALLIUM	VFA	63	28.57	1.60	1.55	6.32	UG/L
TIN	VFA	72	45.83	27.55	28.07	112.90	UG/L
VANADIUM	VFA	72	70.83	7.03	7.22	28.98	UG/L
ZINC	VFA	74	82.43	13.10	16.73	63.99	UG/L
ALUMINUM	WCS	33	81.82	49.28	28.70	146.14	UG/L
ANTIMONY	WCS	33	51.52	17.84	9.68	50.52	UG/L
BARIUM	WCS	34	82.35	93.57	42.28	235.38	UG/L
CALCIUM	WCS	34	100.00	58,876.47	26,771.24	148,675.25	UG/L
CESIUM	WCS	27	25.93	174.33	195.58	865.25	UG/L
CHROMIUM	WCS	33	36.36	5.04	3.42	16.57	UG/L
COPPER	WCS	32	28.12	5.68	5.17	23.25	UG/L
IRON	WCS	34	76.47	37.63	43.56	183.75	UG/L
LEAD	WCS	33	27.27	1.97	3.84	14.93	UG/L
LITHIUM	WCS	34	76.47	38.22	55.05	222.89	UG/L
MAGNESIUM	WCS	34	100.00	12,960.29	8,069.66	40,028.36	UG/L
MANGANESE	WCS	33	51.52	29.19	91.63	338.48	UG/L
MOLYBDENUM	WCS	32	43.75	27.83	40.01	163.76	UG/L
NICKEL	WCS	31	22.58	6.99	7.49	32.63	UG/L
POTASSIUM	WCS	34	82.35	1,933.82	878.64	4,881.04	UG/L
SELENIUM	WCS	30	60.00	10.04	16.91	68.30	UG/L
SILVER	WCS	31	29.03	2.91	1.97	9.66	UG/L
SODIUM	WCS	33	100.00	40,293.94	55,180.62	226,549.32	UG/L
STRONTIUM	WCS	34	100.00	461.79	380.86	1,739.31	UG/L
THALLIUM	WCS	28	21.43	1.79	1.80	8.08	UG/L
TIN	WCS	32	43.75	29.92	32.07	138.87	UG/L
VANADIUM	WCS	34	58.82	8.11	8.41	36.30	UG/L
ZINC	WCS	34	85.29	13.34	19.41	78.43	UG/L

Table C-1 (cont').

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, DISSOLVED METALS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	KAR	66	78.79	48.81	44.02	182.67	UG/L
ANTIMONY	KAR	63	44.44	15.50	9.17	43.37	UG/L
ARSENIC	KAR	59	49.15	2.41	1.70	7.77	UG/L
BARIUM	KAR	66	86.36	84.18	21.79	150.44	UG/L
CADMIUM	KAR	62	22.58	1.76	1.33	5.80	UG/L
CALCIUM	KAR	67	100.00	34,535.82	23,552.79	106,159.84	UG/L
CESIUM	KAR	54	29.63	160.88	179.94	728.59	UG/L
CHROMIUM	KAR	65	26.15	3.97	3.15	13.55	UG/L
COPPER	KAR	65	27.69	4.17	3.83	15.82	UG/L
IRON	KAR	67	79.10	33.67	35.32	141.06	UG/L
LEAD	KAR	64	20.31	1.80	5.27	17.83	UG/L
LITHIUM	KAR	66	81.82	38.53	27.84	123.21	UG/L
MAGNESIUM	KAR	67	97.01	6,072.16	4,067.56	18,441.63	UG/L
MANGANESE	KAR	67	71.64	9.29	7.24	31.31	UG/L
MOLYBDENUM	KAR	64	53.13	16.86	27.01	99.00	UG/L
NICKEL	KAR	65	23.08	5.81	6.26	24.86	UG/L
PHOSPHORUS	KAR	4	100.00	174.75	85.65	1,235.68	UG/L
POTASSIUM	KAR	67	89.55	2,731.18	1,612.39	7,634.46	UG/L
SELENIUM	KAR	54	29.63	1.34	1.09	4.78	UG/L
SILVER	KAR	59	28.81	2.69	2.01	9.03	UG/L
SODIUM	KAR	67	100.00	142,012.69	135,521.56	554,133.75	UG/L
STRONTIUM	KAR	66	100.00	383.02	294.27	1,277.90	UG/L
THALLIUM	KAR	56	21.43	1.72	1.87	7.62	UG/L
TIN	KAR	65	40.00	23.07	25.30	100.01	UG/L
VANADIUM	KAR	65	56.92	6.71	7.60	29.81	UG/L
ZINC	KAR	67	83.58	10.96	10.20	41.99	UG/L

Table C-2. Groundwater UTLs by geologic unit for total metals.

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, TOTAL METALS

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	COL	19	100.00	745.11	789.02	3,816.32	UG/L
ANTIMONY	COL	20	30.00	17.74	9.52	54.22	UG/L
ARSENIC	COL	20	40.00	1.93	1.65	8.24	UG/L
BARIUM	COL	20	85.00	90.87	66.40	345.29	UG/L
CADMIUM	COL	20	25.00	1.97	1.74	8.64	UG/L
CALCIUM	COL	20	100.00	99,540.00	37,654.79	243,816.53	UG/L
CHROMIUM	COL	18	22.22	4.59	4.36	21.88	UG/L
COPPER	COL	20	65.00	9.29	11.81	54.54	UG/L
IRON	COL	19	100.00	665.11	679.22	3,308.92	UG/L
LEAD	COL	18	38.89	2.28	4.27	19.18	UG/L
LITHIUM	COL	20	85.00	117.94	86.49	449.35	UG/L
MAGNESIUM	COL	20	100.00	21,320.00	11,477.51	65,296.75	UG/L
MANGANESE	COL	20	95.00	57.46	126.39	541.73	UG/L
MOLYBDENUM	COL	20	40.00	23.88	39.19	174.05	UG/L
NICKEL	COL	18	33.33	7.25	6.31	32.26	UG/L
POTASSIUM	COL	20	75.00	2,013.25	1,893.58	9,268.62	UG/L
SELENIUM	COL	18	66.67	15.04	47.11	201.61	UG/L
SILICON	COL	12	100.00	8,600.75	2,462.31	20,008.64	UG/L
SODIUM	COL	20	100.00	101,010.00	68,738.74	364,386.48	UG/L
STRONTIUM	COL	20	100.00	705.85	379.49	2,159.90	UG/L
THALLIUM	COL	20	35.00	1.68	1.76	8.43	UG/L
TIN	COL	20	40.00	35.35	34.62	167.99	UG/L
VANADIUM	COL	20	75.00	16.82	27.37	121.70	UG/L
ZINC	COL	20	95.00	31.55	36.14	170.01	UG/L
ALUMINUM	RFA	66	93.94	3,844.45	5,057.31	19,223.71	UG/L
ANTIMONY	RFA	63	42.86	21.40	15.61	68.88	UG/L
ARSENIC	RFA	61	27.87	2.07	1.76	7.43	UG/L
BARIUM	RFA	66	78.79	96.13	36.76	207.92	UG/L
CALCIUM	RFA	67	100.00	38,690.30	17,954.04	93,288.54	UG/L
CESIUM	RFA	65	23.08	150.64	202.63	766.84	UG/L
CHROMIUM	RFA	64	56.25	8.21	7.49	30.99	UG/L
COBALT	RFA	66	21.21	8.46	10.30	39.78	UG/L
COPPER	RFA	66	77.27	12.25	13.56	53.48	UG/L
IRON	RFA	66	96.48	4,262.08	5,960.89	22,389.15	UG/L
LEAD	RFA	63	71.43	3.64	3.95	15.64	UG/L
LITHIUM	RFA	67	76.12	17.15	19.09	75.19	UG/L
MAGNESIUM	RFA	67	95.52	5,050.67	2,112.67	11,475.30	UG/L
MANGANESE	RFA	66	90.91	90.09	113.99	436.73	UG/L
MOLYBDENUM	RFA	68	33.82	24.80	40.38	147.60	UG/L
NICKEL	RFA	66	40.91	13.25	11.32	47.69	UG/L
POTASSIUM	RFA	68	76.47	1,578.46	1,190.52	5,198.84	UG/L
SILICON	RFA	37	100.00	19,033.92	11,446.15	56,777.23	UG/L
SODIUM	RFA	67	97.01	7,797.16	1,995.38	13,865.12	UG/L
STRONTIUM	RFA	64	78.12	125.27	39.20	244.47	UG/L
TIN	RFA	68	32.35	34.01	36.65	145.45	UG/L
VANADIUM	RFA	66	78.79	14.87	11.21	48.97	UG/L
ZINC	RFA	67	88.06	40.26	67.22	244.69	UG/L

Table C-2 (cont').

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, TOTAL METALS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	VFA	43	97.67	2,560.55	3,909.13	14,893.86	UG/L
ANTIMONY	VFA	41	31.71	16.54	9.86	47.64	UG/L
ARSENIC	VFA	41	31.71	1.70	1.57	6.65	UG/L
BARIUM	VFA	43	83.72	112.77	30.98	210.51	UG/L
CADMIUM	VFA	43	25.58	1.79	1.78	7.39	UG/L
CALCIUM	VFA	43	100.00	60,361.72	30,137.58	155,445.78	UG/L
CESIUM	VFA	40	30.00	142.06	184.65	741.90	UG/L
CHROMIUM	VFA	42	50.00	6.96	6.89	28.69	UG/L
COBALT	VFA	43	20.93	6.73	8.52	33.63	UG/L
COPPER	VFA	43	81.40	10.43	12.48	49.80	UG/L
IRON	VFA	43	100.00	2,732.59	4,579.64	17,181.35	UG/L
LEAD	VFA	40	77.50	3.39	3.26	13.97	UG/L
LITHIUM	VFA	43	81.40	22.51	18.95	82.29	UG/L
MAGNESIUM	VFA	43	97.67	12,865.24	6,410.62	33,090.74	UG/L
MANGANESE	VFA	43	95.35	92.38	104.18	421.07	UG/L
MERCURY	VFA	43	23.26	0.12	0.04	0.26	UG/L
MOLYBDENUM	VFA	43	27.91	18.90	36.26	133.29	UG/L
NICKEL	VFA	43	44.19	8.41	7.05	30.65	UG/L
POTASSIUM	VFA	43	81.40	1,785.13	913.58	4,667.48	UG/L
SELENIUM	VFA	42	42.86	3.42	7.97	28.55	UG/L
SILICON	VFA	23	100.00	15,831.46	11,777.33	59,186.61	UG/L
SODIUM	VFA	43	100.00	32,929.90	16,184.58	83,992.25	UG/L
STRONTIUM	VFA	43	95.35	374.14	206.92	1,026.97	UG/L
THALLIUM	VFA	43	27.91	1.47	1.59	6.49	UG/L
TIN	VFA	42	38.10	31.89	32.57	134.65	UG/L
VANADIUM	VFA	43	79.07	12.20	10.56	45.52	UG/L
ZINC	VFA	43	100.00	39.93	28.56	130.03	UG/L
ALUMINUM	WCS	19	89.47	1,326.18	2,630.79	11,566.37	UG/L
ANTIMONY	WCS	17	47.06	19.09	10.53	61.58	UG/L
BARIUM	WCS	19	84.21	113.17	66.05	370.27	UG/L
CALCIUM	WCS	19	100.00	53,731.58	13,527.83	106,387.86	UG/L
CESIUM	WCS	20	35.00	188.32	215.25	1,013.07	UG/L
CHROMIUM	WCS	19	36.84	5.40	4.02	21.06	UG/L
COPPER	WCS	19	57.89	7.15	4.34	24.03	UG/L
IRON	WCS	19	89.47	1,690.19	3,323.94	14,628.42	UG/L
LEAD	WCS	19	73.68	2.68	2.62	12.89	UG/L
LITHIUM	WCS	19	73.68	29.12	15.94	91.18	UG/L
MAGNESIUM	WCS	19	100.00	11,527.89	3,792.95	26,291.71	UG/L
MANGANESE	WCS	19	68.42	37.44	56.99	259.28	UG/L
MOLYBDENUM	WCS	19	42.11	33.49	44.45	206.49	UG/L
POTASSIUM	WCS	19	73.68	1,858.95	500.67	3,807.76	UG/L
SELENIUM	WCS	18	50.00	9.10	19.03	84.48	UG/L
SILICON	WCS	10	100.00	10,474.00	5,966.37	40,745.70	UG/L
SODIUM	WCS	19	100.00	27,557.89	9,531.60	64,659.09	UG/L
STRONTIUM	WCS	19	100.00	390.47	150.51	976.33	UG/L
THALLIUM	WCS	18	27.78	1.95	1.96	9.71	UG/L
TIN	WCS	19	31.58	36.28	39.56	190.26	UG/L
VANADIUM	WCS	19	68.42	10.57	9.20	46.39	UG/L
ZINC	WCS	19	84.21	25.91	17.93	95.69	UG/L

Table C-2 (cont').

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, TOTAL METALS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	KAR	37	91.89	1,791.87	2,773.43	10,937.17	UG/L
ANTIMONY	KAR	35	31.43	15.62	10.40	50.28	UG/L
ARSENIC	KAR	35	54.29	2.76	2.02	9.51	UG/L
BARIUM	KAR	36	86.11	113.95	51.97	286.27	UG/L
CALCIUM	KAR	37	100.00	36,382.43	23,881.47	115,130.79	UG/L
CESIUM	KAR	35	25.71	131.59	175.16	715.62	UG/L
CHROMIUM	KAR	36	38.89	5.25	4.61	20.54	UG/L
COPPER	KAR	36	61.11	11.99	21.82	84.34	UG/L
IRON	KAR	37	94.59	2,239.92	3,697.44	14,432.11	UG/L
LEAD	KAR	36	61.11	3.82	4.29	18.06	UG/L
LITHIUM	KAR	37	86.49	40.69	29.29	137.26	UG/L
MAGNESIUM	KAR	37	94.59	6,679.46	5,030.81	23,268.40	UG/L
MANGANESE	KAR	37	86.49	61.87	125.21	474.75	UG/L
MERCURY	KAR	37	27.03	0.13	0.05	0.28	UG/L
MOLYBDENUM	KAR	36	47.22	18.59	33.45	129.48	UG/L
NICKEL	KAR	35	34.29	8.70	7.25	32.89	UG/L
POTASSIUM	KAR	37	89.19	2,846.38	1,725.69	8,536.77	UG/L
SELENIUM	KAR	36	33.33	1.19	0.63	3.27	UG/L
SILICON	KAR	20	100.00	9,427.50	6,631.12	34,835.00	UG/L
SODIUM	KAR	37	100.00	139,228.38	134,404.33	582,422.16	UG/L
STRONTIUM	KAR	37	97.30	399.78	312.58	1,430.50	UG/L
THALLIUM	KAR	36	27.78	1.40	1.50	6.36	UG/L
TIN	KAR	37	29.73	27.46	31.18	130.28	UG/L
VANADIUM	KAR	36	69.44	10.43	11.26	47.75	UG/L
ZINC	KAR	36	97.22	52.45	51.31	222.56	UG/L

Table C-3. Groundwater UTLs by geologic unit for dissolved radionuclides.

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, DISSOLVED RADIONUCLIDES

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	UTL 99 / 99	UNITS
CESIUM-137	COL	2	100.00	0.36	0.42	78.73	pCi/L
GROSS ALPHA	COL	30	100.00	41.31	78.79	312.85	pCi/L
GROSS BETA	COL	27	100.00	17.51	29.87	123.04	pCi/L
RADIUM-226	COL	15	100.00	0.21	0.10	0.64	pCi/L
STRONTIUM-89,90	COL	23	100.00	0.25	0.24	1.13	pCi/L
TRITIUM	COL	31	100.00	76.12	109.42	450.48	pCi/L
URANIUM-233,234	COL	30	100.00	31.82	56.44	226.34	pCi/L
URANIUM-235	COL	30	100.00	0.86	1.39	5.63	pCi/L
URANIUM-238	COL	24	100.00	26.70	42.13	180.03	pCi/L
CESIUM-137	RFA	15	100.00	0.27	0.29	1.48	pCi/L
GROSS ALPHA	RFA	82	100.00	0.59	0.80	3.02	pCi/L
GROSS BETA	RFA	76	100.00	1.66	1.52	6.28	pCi/L
RADIUM-226	RFA	2	100.00	0.17	0.04	7.91	pCi/L
RADIUM-228	RFA	2	100.00	2.20	0.42	80.95	pCi/L
STRONTIUM-89,90	RFA	81	100.00	0.27	0.23	0.98	pCi/L
TRITIUM	RFA	63	100.00	163.03	223.01	841.20	pCi/L
URANIUM-233,234	RFA	78	100.00	0.23	0.21	0.88	pCi/L
URANIUM-235	RFA	78	100.00	0.03	0.07	0.23	pCi/L
URANIUM-238	RFA	69	100.00	0.14	0.14	0.56	pCi/L
CESIUM-137	VFA	17	100.00	0.58	0.71	3.43	pCi/L
GROSS ALPHA	VFA	60	100.00	2.93	3.17	12.94	pCi/L
GROSS BETA	VFA	55	100.00	3.20	1.69	8.54	pCi/L
RADIUM-226	VFA	13	100.00	0.31	0.11	0.81	pCi/L
RADIUM-228	VFA	4	100.00	2.08	0.62	9.76	pCi/L
STRONTIUM-89,90	VFA	59	100.00	0.49	0.38	1.68	pCi/L
TRITIUM	VFA	42	100.00	115.00	137.64	549.26	pCi/L
URANIUM-233,234	VFA	60	100.00	2.05	2.77	10.80	pCi/L
URANIUM-235	VFA	60	100.00	0.08	0.12	0.47	pCi/L
URANIUM-238	VFA	49	100.00	1.66	2.30	8.92	pCi/L
CESIUM-137	WCS	4	100.00	0.32	0.20	2.86	pCi/L
GROSS ALPHA	WCS	41	100.00	7.70	5.95	26.47	pCi/L
GROSS BETA	WCS	38	100.00	4.85	3.22	15.41	pCi/L
RADIUM-226	WCS	6	100.00	0.32	0.06	0.78	pCi/L
STRONTIUM-89,90	WCS	17	100.00	0.24	0.24	1.21	pCi/L
TRITIUM	WCS	29	100.00	-23.42	118.54	388.30	pCi/L
URANIUM-233,234	WCS	39	100.00	8.59	21.06	77.33	pCi/L
URANIUM-235	WCS	39	100.00	0.20	0.51	1.88	pCi/L
URANIUM-238	WCS	35	100.00	3.54	3.19	14.17	pCi/L
CESIUM-137	KAR	4	100.00	0.22	0.30	3.92	pCi/L
GROSS ALPHA	KAR	60	100.00	3.13	6.24	22.81	pCi/L
GROSS BETA	KAR	54	100.00	3.23	2.84	12.19	pCi/L
RADIUM-226	KAR	2	100.00	1.72	1.78	331.75	pCi/L
STRONTIUM-89,90	KAR	42	100.00	0.47	1.19	4.21	pCi/L
TRITIUM	KAR	49	100.00	56.88	135.94	485.77	pCi/L
URANIUM-233,234	KAR	57	100.00	1.64	2.85	10.63	pCi/L
URANIUM-235	KAR	57	100.00	0.03	0.06	0.23	pCi/L
URANIUM-238	KAR	54	100.00	0.77	1.53	5.58	pCi/L

Table C-4. Groundwater UTLs by geologic unit for total radionuclides.

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, TOTAL RADIONUCLIDES

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	UTL 99 / 99	UNITS
AMERICIUM-241	COL	25	100.00	0.00	0.00	0.01	pCi/L
CESIUM-137	COL	23	100.00	0.18	0.35	1.49	pCi/L
GROSS ALPHA	COL	6	100.00	150.35	142.75	1,197.38	pCi/L
GROSS BETA	COL	6	100.00	81.55	85.25	706.79	pCi/L
PLUTONIUM-239,240	COL	26	100.00	0.01	0.01	0.04	pCi/L
STRONTIUM-89,90	COL	7	100.00	0.26	0.11	0.95	pCi/L
TRITIUM	COL	17	100.00	201.15	193.39	981.82	pCi/L
URANIUM-233,234	COL	8	100.00	58.74	66.80	446.99	pCi/L
URANIUM-235	COL	8	100.00	2.14	2.39	16.03	pCi/L
URANIUM-238	COL	6	100.00	36.04	46.48	376.92	pCi/L
AMERICIUM-241	RFA	82	100.00	0.01	0.01	0.03	pCi/L
CESIUM-137	RFA	75	100.00	0.08	0.33	1.09	pCi/L
GROSS ALPHA	RFA	5	100.00	1.89	1.28	13.30	pCi/L
GROSS BETA	RFA	5	100.00	2.25	1.48	15.45	pCi/L
PLUTONIUM-238	RFA	7	100.00	0.00	0.00	0.01	pCi/L
PLUTONIUM-239,240	RFA	85	100.00	0.00	0.00	0.01	pCi/L
STRONTIUM-89,90	RFA	13	100.00	0.11	0.21	1.04	pCi/L
TRITIUM	RFA	21	100.00	226.72	307.18	1,386.83	pCi/L
URANIUM-233,234	RFA	12	100.00	0.48	0.45	2.58	pCi/L
URANIUM-235	RFA	12	100.00	0.12	0.20	1.05	pCi/L
URANIUM-238	RFA	11	100.00	0.40	0.50	2.83	pCi/L
AMERICIUM-241	VFA	56	100.00	0.01	0.01	0.05	pCi/L
CESIUM-137	VFA	44	100.00	0.10	0.30	1.05	pCi/L
GROSS ALPHA	VFA	7	100.00	3.66	2.06	16.84	pCi/L
GROSS BETA	VFA	7	100.00	4.54	2.83	22.66	pCi/L
PLUTONIUM-238	VFA	6	100.00	0.01	0.01	0.09	pCi/L
PLUTONIUM-239,240	VFA	62	100.00	0.01	0.04	0.12	pCi/L
STRONTIUM-89,90	VFA	8	100.00	0.43	0.37	2.56	pCi/L
TRITIUM	VFA	27	100.00	142.98	180.32	779.97	pCi/L
URANIUM-233,234	VFA	7	100.00	1.58	1.00	8.01	pCi/L
URANIUM-235	VFA	7	100.00	0.10	0.10	0.75	pCi/L
URANIUM-238	VFA	2	100.00	1.23	1.20	223.18	pCi/L

Table C-4 (cont').

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, TOTAL RADIONUCLIDES (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	UTL 99 / 99	UNITS
AMERICIUM-241	WCS	20	100.00	0.01	0.01	0.07	pCi/L
CESIUM-137	WCS	14	100.00	0.28	0.36	1.86	pCi/L
GROSS ALPHA	WCS	5	100.00	12.65	12.46	124.04	pCi/L
GROSS BETA	WCS	5	100.00	8.27	5.11	53.95	pCi/L
PLUTONIUM-239,240	WCS	21	100.00	0.00	0.00	0.02	pCi/L
RADIUM-226	WCS	4	100.00	0.36	0.15	2.19	pCi/L
STRONTIUM-89,90	WCS	4	100.00	0.05	0.26	3.25	pCi/L
TRITIUM	WCS	19	100.00	2,128.76	8,937.88	36,918.91	pCi/L
URANIUM-233,234	WCS	8	100.00	7.49	6.30	44.13	pCi/L
URANIUM-235	WCS	8	100.00	0.28	0.26	1.81	pCi/L
URANIUM-238	WCS	3	100.00	5.11	4.96	123.65	pCi/L
AMERICIUM-241	KAR	43	100.00	0.01	0.02	0.07	pCi/L
CESIUM-137	KAR	39	100.00	0.00	0.29	0.96	pCi/L
GROSS ALPHA	KAR	6	100.00	11.08	16.63	133.08	pCi/L
GROSS BETA	KAR	6	100.00	12.01	13.45	110.67	pCi/L
PLUTONIUM-238	KAR	5	100.00	0.01	0.01	0.14	pCi/L
PLUTONIUM-239,240	KAR	48	100.00	0.00	0.01	0.02	pCi/L
RADIUM-226	KAR	3	100.00	0.59	0.45	11.30	pCi/L
STRONTIUM-89,90	KAR	4	100.00	0.10	0.26	3.34	pCi/L
TRITIUM	KAR	16	100.00	62.93	367.23	1,577.10	pCi/L
URANIUM-233,234	KAR	4	100.00	0.77	0.57	7.79	pCi/L
URANIUM-235	KAR	4	100.00	0.03	0.02	0.27	pCi/L
URANIUM-238	KAR	2	100.00	0.35	0.26	48.13	pCi/L

Table C-5. Groundwater UTLs by geologic unit for water-quality parameters.

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, WATER-QUALITY PARAMETERS

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
BICARBONATE	COL	52	100.00	393,871.94	175,851.17	948,682.39	UG/L
CHLORIDE	COL	42	100.00	18,114.29	10,104.20	49,993.05	UG/L
FLUORIDE	COL	51	100.00	1,053.73	536.87	2,747.56	UG/L
NITRATE/NITRITE	COL	56	64.29	1,683.75	3,700.64	13,359.28	UG/L
ORTHOPHOSPHATE	COL	27	48.15	11.93	7.48	38.34	UG/L
PHOSPHORUS	COL	10	40.00	30.50	29.86	181.98	UG/L
SILICA	COL	44	100.00	12,037.35	6,549.60	32,701.34	UG/L
SULFATE	COL	48	100.00	215,566.67	264,980.47	1,051,580.04	UG/L
TOTAL DISSOLVED SOLIDS	COL	52	100.00	687,230.77	409,401.70	1,978,893.12	UG/L
TOTAL SUSPENDED SOLIDS	COL	52	67.31	18,038.46	24,207.00	94,411.55	UG/L
BICARBONATE	RFA	114	100.00	114,859.08	56,766.87	247,125.88	UG/L
CHLORIDE	RFA	95	91.58	8,707.47	13,538.26	40,251.63	UG/L
FLUORIDE	RFA	108	96.30	306.39	90.85	518.06	UG/L
NITRATE/NITRITE	RFA	115	97.39	1,448.26	765.26	3,231.31	UG/L
NITRITE	RFA	23	43.48	33.13	53.44	229.87	UG/L
ORTHOPHOSPHATE	RFA	81	56.79	14.44	12.92	53.73	UG/L
PHOSPHORUS	RFA	22	68.18	44.27	49.43	228.50	UG/L
SILICA	RFA	105	100.00	15,873.61	8,274.40	35,152.97	UG/L
SULFATE	RFA	103	99.03	22,384.47	19,440.47	67,680.75	UG/L
TOTAL DISSOLVED SOLIDS	RFA	115	100.00	189,817.39	94,386.90	409,738.87	UG/L
TOTAL SUSPENDED SOLIDS	RFA	111	86.49	182,684.68	334,207.01	961,387.02	UG/L
BICARBONATE	VFA	78	100.00	242,462.09	116,731.17	597,441.57	UG/L
CHLORIDE	VFA	67	97.01	16,061.19	12,727.88	54,766.69	UG/L
CYANIDE	VFA	21	28.57	9.39	5.70	30.92	UG/L
FLUORIDE	VFA	76	97.37	505.27	186.31	1,071.82	UG/L
NITRATE/NITRITE	VFA	72	65.28	202.08	257.28	984.46	UG/L
NITRITE	VFA	12	25.00	19.17	15.05	88.90	UG/L
ORTHOPHOSPHATE	VFA	54	55.56	17.82	27.04	103.13	UG/L
PHOSPHORUS	VFA	15	46.67	44.67	42.49	224.10	UG/L
SILICA	VFA	76	100.00	15,164.53	8,599.63	41,315.99	UG/L
SULFATE	VFA	69	100.00	54,486.96	74,995.26	282,547.55	UG/L
TOTAL DISSOLVED SOLIDS	VFA	76	100.00	334,744.54	167,754.49	844,885.94	UG/L
TOTAL SUSPENDED SOLIDS	VFA	72	88.89	90,727.64	141,259.37	520,297.38	UG/L

Table C-5 (cont').

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GROUNDWATER, WATER-QUALITY PARAMETERS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
BICARBONATE	WCS	67	100.00	255,472.87	134,489.69	664,456.02	UG/L
CHLORIDE	WCS	53	83.02	9,094.34	11,230.61	44,526.93	UG/L
CYANIDE	WCS	7	28.57	10.00	7.07	55.34	UG/L
FLUORIDE	WCS	65	98.46	893.69	595.09	2,703.37	UG/L
NITRATE/NITRITE	WCS	62	87.10	715.40	1,067.15	3,960.61	UG/L
NITRITE	WCS	11	63.64	28.82	27.52	161.71	UG/L
ORTHOPHOSPHATE	WCS	29	44.83	14.48	11.52	54.50	UG/L
PHOSPHORUS	WCS	9	66.67	28.89	31.30	197.58	UG/L
SILICA	WCS	49	100.00	10,404.94	6,489.24	30,878.48	UG/L
SULFATE	WCS	58	100.00	131,008.62	241,197.17	891,985.69	UG/L
TOTAL DISSOLVED SOLIDS	WCS	67	100.00	405,940.30	375,873.93	1,548,972.91	UG/L
TOTAL SUSPENDED SOLIDS	WCS	66	69.70	187,939.39	787,142.93	2,581,641.05	UG/L
ALKALINITY AS CACO3	KAR	3	100.00	305,166.67	160,234.46	4,134,059.44	UG/L
BICARBONATE	KAR	93	100.00	233,546.17	102,980.99	473,491.87	UG/L
CARBONATE	KAR	92	28.26	3,318.77	4,245.24	13,210.17	UG/L
CHLORIDE	KAR	79	96.20	100,205.95	128,066.02	489,654.73	UG/L
FLUORIDE	KAR	92	97.83	949.35	465.34	2,033.58	UG/L
NITRATE/NITRITE	KAR	90	78.89	861.22	945.96	3,737.87	UG/L
NITRITE	KAR	16	56.25	190.62	295.19	1,407.78	UG/L
ORTHOPHOSPHATE	KAR	54	61.11	18.46	10.16	50.52	UG/L
PHOSPHORUS	KAR	14	64.29	173.57	264.99	1,322.89	UG/L
SILICA	KAR	83	100.00	8,077.25	5,808.92	25,742.17	UG/L
SULFATE	KAR	82	95.12	123,943.90	250,872.10	886,845.95	UG/L
TOTAL DISSOLVED SOLIDS	KAR	94	100.00	545,138.30	445,290.59	1,582,665.38	UG/L
TOTAL SOLIDS	KAR	5	80.00	318,240.00	356,657.98	3,506,414.55	UG/L
TOTAL SUSPENDED SOLIDS	KAR	88	77.27	403,085.23	727,972.80	2,616,850.51	UG/L

Table C-6. Groundwater UTLs by flow-system for dissolved metals.

UPPER TOLERANCE LIMITS BY FLOW-SYSTEM

GROUNDWATER, DISSOLVED METALS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL		UNITS
ALUMINUM	LOWER	66	78.79	48.81	44.02	182.67	187.09	UG/L
ANTIMONY	LOWER	63	44.44	15.50	9.17	43.37	50.55	UG/L
ARSENIC	LOWER	59	49.15	2.41	1.70	7.77	8.37	UG/L
BARIUM	LOWER	66	86.36	84.18	21.79	150.44	149.34	UG/L
CADMIUM	LOWER	62	22.58	1.76	1.33	5.80	4.65	UG/L
CALCIUM	LOWER	67	100.00	34,535.82	23,552.79	106,159.84	105108	UG/L
CESIUM	LOWER	54	29.63	160.88	179.94	728.59	932	UG/L
CHROMIUM	LOWER	65	26.15	3.97	3.15	13.55	11.73	UG/L
COPPER	LOWER	65	27.69	4.17	3.83	15.82	23.25	UG/L
IRON	LOWER	67	79.10	33.67	35.32	141.06	142.45	UG/L
LEAD	LOWER	64	20.31	1.80	5.27	17.83	15.76	UG/L
LITHIUM	LOWER	66	81.82	38.53	27.84	123.21	126.93	UG/L
MAGNESIUM	LOWER	67	97.01	6,072.16	4,067.56	18,441.63	18260	UG/L
MANGANESE	LOWER	67	71.64	9.29	7.24	31.31	28.97	UG/L
MOLYBDENUM	LOWER	64	53.13	16.86	27.01	99.00	181.68	UG/L
NICKEL	LOWER	65	23.08	5.81	6.26	24.86	35.18	UG/L
PHOSPHORUS	LOWER	4	100.00	174.75	85.65	1,235.68	—	UG/L
POTASSIUM	LOWER	67	89.55	2,731.18	1,612.39	7,634.46	7391.17	UG/L
SELENIUM	LOWER	54	29.63	1.34	1.09	4.78	5.29	UG/L
SILVER	LOWER	59	28.81	2.69	2.01	9.03	13.92	UG/L
SODIUM	LOWER	67	100.00	142,012.69	135,521.56	554,133.75	548079	UG/L
STRONTIUM	LOWER	66	100.00	383.02	294.27	1,277.90	1266	UG/L
THALLIUM	LOWER	56	21.43	1.72	1.87	7.62	9.50	UG/L
TIN	LOWER	65	40.00	23.07	25.30	100.01	183.12	UG/L
VANADIUM	LOWER	65	56.92	6.71	7.60	29.81	44.4	UG/L
ZINC	LOWER	67	83.58	10.96	10.20	41.99	41.02	UG/L
ALUMINUM	UPPER	246	77.64	59.52	87.29	262.91	1683.7	UG/L
ANTIMONY	UPPER	248	48.39	17.34	11.10	43.20	47.80	UG/L
BARIUM	UPPER	256	83.59	83.42	34.56	163.94	171.20	UG/L
CADMIUM	UPPER	240	22.08	1.73	1.26	4.66	4.26	UG/L
CALCIUM	UPPER	256	100.00	55,414.55	32,564.11	131,288.91	141250	UG/L
CESIUM	UPPER	211	21.33	202.20	285.69	867.87	937.34	UG/L
CHROMIUM	UPPER	250	36.00	4.84	3.80	13.69	13.51	UG/L
COPPER	UPPER	248	39.11	5.01	4.42	15.32	43.00	UG/L
CYANIDE	UPPER	3	33.33	5.83	3.82	97.09		UG/L
IRON	UPPER	255	76.47	56.26	113.44	320.57	1552.97	UG/L
LEAD	UPPER	251	23.90	1.59	4.71	12.57	258.18	UG/L
LITHIUM	UPPER	250	75.20	33.95	54.30	160.47	179.56	UG/L
MAGNESIUM	UPPER	253	95.65	10,038.28	8,309.40	29,399.19	31889.8	UG/L
MANGANESE	UPPER	255	60.78	27.47	67.43	184.57	242.97	UG/L
MOLYBDENUM	UPPER	241	37.34	19.64	33.94	98.73	182.04	UG/L
NICKEL	UPPER	236	32.63	7.01	7.18	23.73	33.14	UG/L
PHOSPHORUS	UPPER	8	100.00	167.00	52.43	471.74		UG/L
POTASSIUM	UPPER	252	81.75	1,371.50	1,069.01	3,862.30	425390	UG/L
SELENIUM	UPPER	219	31.96	5.58	19.07	50.02	482.8	UG/L
SILVER	UPPER	235	28.51	2.84	2.12	7.79		UG/L
SODIUM	UPPER	254	99.21	32,012.98	43,667.67	133,758.65		UG/L
STRONTIUM	UPPER	252	92.86	323.60	303.58	1,030.95		UG/L
THALLIUM	UPPER	212	22.17	1.64	1.63	5.44		UG/L
TIN	UPPER	235	42.98	30.96	37.34	117.96		UG/L
VANADIUM	UPPER	249	64.66	7.92	8.73	28.26		UG/L
ZINC	UPPER	256	80.47	14.03	17.87	55.66		UG/L

Table C-7. Groundwater UTLs by flow-system for total metals.

UPPER TOLERANCE LIMITS BY FLOW-SYSTEM

GROUNDWATER, TOTAL METALS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	LOWER	37	91.89	1,791.87	2,773.43	10,937.17	UG/L
ANTIMONY	LOWER	35	31.43	15.62	10.40	50.28	UG/L
ARSENIC	LOWER	35	54.29	2.76	2.02	9.51	UG/L
BARIUM	LOWER	36	86.11	113.95	51.97	286.27	UG/L
CALCIUM	LOWER	37	100.00	36,382.43	23,881.47	115,130.79	UG/L
CESIUM	LOWER	35	25.71	131.59	175.16	715.62	UG/L
CHROMIUM	LOWER	36	38.89	5.25	4.61	20.54	UG/L
COPPER	LOWER	36	61.11	11.99	21.82	84.34	UG/L
IRON	LOWER	37	94.59	2,239.92	3,697.44	14,432.11	UG/L
LEAD	LOWER	36	61.11	3.82	4.29	18.06	UG/L
LITHIUM	LOWER	37	86.49	40.69	29.29	137.26	UG/L
MAGNESIUM	LOWER	37	94.59	6,679.46	5,030.81	23,268.40	UG/L
MANGANESE	LOWER	37	86.49	61.87	125.21	474.75	UG/L
MERCURY	LOWER	37	27.03	0.13	0.05	0.28	UG/L
MOLYBDENUM	LOWER	36	47.22	18.59	33.45	129.48	UG/L
NICKEL	LOWER	35	34.29	8.70	7.25	32.89	UG/L
POTASSIUM	LOWER	37	89.19	2,846.38	1,725.69	8,536.77	UG/L
SELENIUM	LOWER	36	33.33	1.19	0.63	3.27	UG/L
SILICON	LOWER	20	100.00	9,427.50	6,631.12	34,835.00	UG/L
SODIUM	LOWER	37	100.00	139,228.38	134,404.33	582,422.16	UG/L
STRONTIUM	LOWER	37	97.30	399.78	312.58	1,430.50	UG/L
THALLIUM	LOWER	36	27.78	1.40	1.50	6.36	UG/L
TIN	LOWER	37	29.73	27.46	31.18	130.28	UG/L
VANADIUM	LOWER	36	69.44	10.43	11.26	47.75	UG/L
ZINC	LOWER	36	97.22	52.45	51.31	222.56	UG/L
ALUMINUM	UPPER	147	95.24	2,742.80	4,248.73	12,642.33	UG/L
ANTIMONY	UPPER	141	38.30	19.19	12.85	49.14	UG/L
ARSENIC	UPPER	138	28.26	1.95	1.71	5.93	UG/L
BARIUM	UPPER	148	81.76	102.44	45.37	208.14	UG/L
CALCIUM	UPPER	149	100.00	55,030.23	31,667.78	128,816.15	UG/L
CESIUM	UPPER	142	24.65	154.42	198.79	617.60	UG/L
CHROMIUM	UPPER	143	47.55	7.01	6.68	22.58	UG/L
COPPER	UPPER	148	74.32	10.67	12.21	39.12	UG/L
IRON	UPPER	147	97.96	3,017.34	4,994.50	14,654.53	UG/L
LEAD	UPPER	140	69.29	3.26	3.64	11.75	UG/L
LITHIUM	UPPER	149	78.52	33.75	48.76	147.37	UG/L
MAGNESIUM	UPPER	149	97.32	10,315.84	7,956.43	28,854.11	UG/L
MANGANESE	UPPER	148	89.86	79.59	108.18	331.64	UG/L
MERCURY	UPPER	148	20.27	0.12	0.04	0.22	UG/L
MOLYBDENUM	UPPER	150	34.00	24.09	39.47	116.04	UG/L
NICKEL	UPPER	145	37.24	10.58	9.49	32.68	UG/L
POTASSIUM	UPPER	150	77.33	1,731.21	1,176.59	4,472.65	UG/L
SELENIUM	UPPER	144	30.56	4.57	18.64	47.99	UG/L
SILICON	UPPER	82	100.00	15,564.97	10,797.33	48,399.65	UG/L
SODIUM	UPPER	149	98.66	30,081.85	40,019.71	123,327.78	UG/L
STRONTIUM	UPPER	146	89.04	312.61	271.09	944.25	UG/L
THALLIUM	UPPER	146	23.97	1.67	1.76	5.77	UG/L
TIN	UPPER	149	34.90	33.88	35.33	116.20	UG/L
VANADIUM	UPPER	148	77.03	13.81	14.09	46.64	UG/L
ZINC	UPPER	149	91.95	37.16	49.80	153.21	UG/L

Table C-8. Groundwater UTLs by flow-system for dissolved radionuclides.

UPPER TOLERANCE LIMITS BY FLOW-SYSTEM

GROUNDWATER, DISSOLVED RADIONUCLIDES

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	UTL 99 / 99	UNITS
CESIUM-137	LOWER	4	100.00	0.22	0.30	3.92	pCi/L
GROSS ALPHA	LOWER	60	100.00	3.13	6.24	22.81	pCi/L
GROSS BETA	LOWER	54	100.00	3.23	2.84	12.19	pCi/L
RADIUM-226	LOWER	2	100.00	1.72	1.78	331.75	pCi/L
STRONTIUM-89,90	LOWER	42	100.00	0.47	1.19	4.21	pCi/L
TRITIUM	LOWER	49	100.00	56.88	135.94	485.77	pCi/L
URANIUM-233,234	LOWER	57	100.00	1.64	2.85	10.63	pCi/L
URANIUM-235	LOWER	57	100.00	0.03	0.06	0.23	pCi/L
URANIUM-238	LOWER	54	100.00	0.77	1.53	5.58	pCi/L
AMERICIUM-241	UPPER	2	100.00	0.01	0.01	2.11	pCi/L
CESIUM-137	UPPER	38	100.00	0.42	0.53	2.14	pCi/L
GROSS ALPHA	UPPER	213	100.00	8.35	32.32	93.86	pCi/L
GROSS BETA	UPPER	196	100.00	4.89	12.23	37.25	pCi/L
RADIUM-226	UPPER	36	100.00	0.26	0.11	0.63	pCi/L
RADIUM-228	UPPER	6	100.00	2.12	0.52	5.94	pCi/L
STRONTIUM-89,90	UPPER	180	100.00	0.34	0.31	1.05	pCi/L
TRITIUM	UPPER	165	100.00	101.70	180.30	578.79	pCi/L
URANIUM-233,234	UPPER	207	100.00	6.91	25.44	74.22	pCi/L
URANIUM-235	UPPER	207	100.00	0.20	0.64	1.88	pCi/L
URANIUM-238	UPPER	177	100.00	4.83	17.67	51.60	pCi/L

Table C-9. Groundwater UTLs by flow-system for total radionuclides.

GROUNDWATER

TOTAL RADIONUCLIDES

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	UTL 99 / 99	
AMERICIUM-241	LOWER	43	100.00	0.01	0.02	0.07	pCi/L
CESIUM-137	LOWER	39	100.00	0.00	0.29	0.96	pCi/L
GROSS ALPHA	LOWER	6	100.00	11.08	16.63	133.08	pCi/L
GROSS BETA	LOWER	6	100.00	12.01	13.45	110.67	pCi/L
PLUTONIUM-238	LOWER	5	100.00	0.01	0.01	0.14	pCi/L
PLUTONIUM-239,240	LOWER	48	100.00	0.00	0.01	0.02	pCi/L
RADIUM-226	LOWER	3	100.00	0.59	0.45	11.30	pCi/L
STRONTIUM-89,90	LOWER	4	100.00	0.10	0.26	3.34	pCi/L
TRITIUM	LOWER	16	100.00	62.93	367.23	1,577.10	pCi/L
URANIUM-233,234	LOWER	4	100.00	0.77	0.57	7.79	pCi/L
URANIUM-235	LOWER	4	100.00	0.03	0.02	0.27	pCi/L
URANIUM-238	LOWER	2	100.00	0.35	0.26	48.13	pCi/L
AMERICIUM-241	UPPER	183	100.00	0.01	0.01	0.03	pCi/L
CESIUM-137	UPPER	156	100.00	0.12	0.33	1.00	pCi/L
GROSS ALPHA	UPPER	23	100.00	43.50	94.28	390.58	pCi/L
GROSS BETA	UPPER	23	100.00	24.95	53.34	221.31	pCi/L
PLUTONIUM-238	UPPER	15	100.00	0.00	0.01	0.03	pCi/L
PLUTONIUM-239,240	UPPER	194	100.00	0.00	0.02	0.06	pCi/L
RADIUM-226	UPPER	6	100.00	0.36	0.13	1.29	pCi/L
STRONTIUM-89,90	UPPER	32	100.00	0.22	0.28	1.15	pCi/L
TRITIUM	UPPER	84	100.00	624.85	4,246.75	13,539.22	pCi/L
URANIUM-233,234	UPPER	35	100.00	15.62	38.75	144.83	pCi/L
URANIUM-235	UPPER	35	100.00	0.62	1.38	5.23	pCi/L
URANIUM-238	UPPER	22	100.00	10.84	27.73	114.17	pCi/L

Table C-10. Groundwater UTLs by flow-system for water-quality parameters.

UPPER TOLERANCE LIMITS BY FLOW-SYSTEM

GROUNDWATER, WATER-QUALITY PARAMETERS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALKALINITY AS CACO3	LOWER	3	100.00	305,166.67	160,234.46	4,134,059.44	UG/L
BICARBONATE	LOWER	93	100.00	233,546.17	102,980.99	473,491.87	UG/L
CARBONATE	LOWER	92	28.26	3,318.77	4,245.24	13,210.17	UG/L
CHLORIDE	LOWER	79	96.20	100,205.95	128,066.02	489,654.73	UG/L
FLUORIDE	LOWER	92	97.83	949.35	465.34	2,033.58	UG/L
NITRATE/NITRITE	LOWER	90	78.89	861.22	945.96	3,737.87	UG/L
NITRITE	LOWER	16	56.25	190.62	295.19	1,407.78	UG/L
ORTHOPHOSPHATE	LOWER	54	61.11	18.46	10.16	50.52	UG/L
PHOSPHORUS	LOWER	14	64.29	173.57	264.99	1,322.89	UG/L
SILICA	LOWER	83	100.00	8,077.25	5,808.92	25,742.17	UG/L
SULFATE	LOWER	82	95.12	123,943.90	250,872.10	886,845.95	UG/L
TOTAL DISSOLVED SOLIDS	LOWER	94	100.00	545,138.30	445,290.59	1,582,665.38	UG/L
TOTAL SOLIDS	LOWER	5	80.00	318,240.00	356,657.98	3,506,414.55	UG/L
TOTAL SUSPENDED SOLIDS	LOWER	88	77.27	403,085.23	727,972.80	2,616,850.51	UG/L
ALKALINITY AS CACO3	UPPER	3	100.00	156,900.00	158,643.41	3,947,773.53	UG/L
BICARBONATE	UPPER	311	100.00	223,807.08	151,717.58	577,309.04	UG/L
CHLORIDE	UPPER	257	92.61	12,241.67	12,930.51	42,369.76	UG/L
FLUORIDE	UPPER	300	97.67	611.07	472.04	1,710.92	UG/L
NITRATE/NITRITE	UPPER	305	81.64	1,048.34	1,807.86	5,260.65	UG/L
NITRITE	UPPER	54	37.04	27.94	38.25	148.61	UG/L
ORTHOPHOSPHATE	UPPER	191	53.40	15.05	17.47	55.76	UG/L
PH	UPPER	3	100.00	7.17	0.46	18.20	UG/L
PHOSPHORUS	UPPER	56	57.14	39.45	41.60	170.70	UG/L
SILICA	UPPER	274	100.00	14,082.92	8,075.96	32,899.91	UG/L
SULFATE	UPPER	278	99.64	86,370.14	174,613.96	493,220.67	UG/L
TOTAL DISSOLVED SOLIDS	UPPER	310	100.00	355,495.44	312,010.29	1,082,479.41	UG/L
TOTAL SOLIDS	UPPER	4	75.00	24,025.00	36,789.98	479,752.89	UG/L
TOTAL SUSPENDED SOLIDS	UPPER	301	80.07	133,396.64	429,323.86	1,133,721.25	UG/L

Table C-11. Geologic material UTLs by geologic unit for total metals.

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GEOLOGIC MATERIALS, TOTAL METALS

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	COL	28	100.00	10,541.43	4,945.95	27,861.88	MG/KG
ARSENIC	COL	28	85.71	3.57	1.74	9.65	MG/KG
BARIUM	COL	28	100.00	133.20	94.05	462.57	MG/KG
BERYLLIUM	COL	28	96.43	5.47	5.47	24.62	MG/KG
CADMIUM	COL	26	57.69	0.86	0.42	2.35	MG/KG
CALCIUM	COL	28	100.00	9,082.14	6,369.14	31,386.50	MG/KG
CESIUM	COL	24	75.00	206.24	56.88	413.26	MG/KG
CHROMIUM	COL	28	100.00	13.79	5.86	34.31	MG/KG
COBALT	COL	28	25.00	6.11	3.87	19.66	MG/KG
COPPER	COL	28	96.43	14.67	5.48	33.87	MG/KG
IRON	COL	28	100.00	15,028.07	6,715.26	38,544.51	MG/KG
LEAD	COL	28	100.00	16.23	4.62	32.40	MG/KG
LITHIUM	COL	28	28.57	8.52	7.56	34.99	MG/KG
MAGNESIUM	COL	28	78.57	2,987.32	1,577.90	8,513.05	MG/KG
MANGANESE	COL	28	100.00	191.87	160.26	753.10	MG/KG
MERCURY	COL	27	22.22	0.18	0.20	0.88	MG/KG
NICKEL	COL	28	92.86	16.97	8.28	45.97	MG/KG
POTASSIUM	COL	28	35.71	979.61	721.36	3,505.78	MG/KG
SELENIUM	COL	27	22.22	0.85	0.65	3.15	MG/KG
SILVER	COL	19	42.11	5.85	9.46	42.68	MG/KG
STRONTIUM	COL	28	85.71	55.92	27.04	150.63	MG/KG
TIN	COL	23	26.09	87.36	147.51	630.37	MG/KG
VANADIUM	COL	28	100.00	30.31	12.23	73.15	MG/KG
ZINC	COL	28	100.00	56.13	21.92	132.87	MG/KG
ALUMINUM	RFA	62	100.00	13,565.95	13,657.25	55,097.66	MG/KG
ARSENIC	RFA	62	69.35	4.15	5.70	21.48	MG/KG
BARIUM	RFA	62	83.87	84.46	100.14	388.97	MG/KG
BERYLLIUM	RFA	62	87.10	4.65	4.66	18.83	MG/KG
CADMIUM	RFA	46	47.83	0.84	0.48	2.36	MG/KG
CALCIUM	RFA	62	82.26	6,676.41	19,969.15	67,402.61	MG/KG
CESIUM	RFA	62	75.81	242.09	337.12	1,267.28	MG/KG
CHROMIUM	RFA	62	100.00	22.08	30.15	113.77	MG/KG
COBALT	RFA	62	35.48	8.76	13.16	48.79	MG/KG
COPPER	RFA	62	87.10	11.68	15.59	59.10	MG/KG
IRON	RFA	62	100.00	14,347.10	16,126.79	63,388.67	MG/KG
LEAD	RFA	62	100.00	9.05	7.07	30.54	MG/KG
LITHIUM	RFA	62	59.68	14.33	12.85	53.41	MG/KG
MAGNESIUM	RFA	62	58.06	2,482.38	4,093.78	14,931.58	MG/KG
MANGANESE	RFA	62	100.00	235.92	417.44	1,505.36	MG/KG
MERCURY	RFA	54	42.59	0.29	0.80	2.81	MG/KG
NICKEL	RFA	59	88.14	23.35	25.45	103.63	MG/KG
POTASSIUM	RFA	61	27.87	1,545.33	3,036.93	10,780.63	MG/KG
SILVER	RFA	55	30.91	2.48	5.55	19.99	MG/KG
STRONTIUM	RFA	62	30.65	77.93	87.02	342.55	MG/KG
VANADIUM	RFA	62	96.77	32.03	34.96	138.33	MG/KG
ZINC	RFA	61	93.44	29.97	61.25	216.23	MG/KG

Table C-11 (cont').

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GEOLOGIC MATERIALS, TOTAL METALS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	WCS	8	100.00	14,181.25	5,023.23	43,375.23	MG/KG
ARSENIC	WCS	9	77.78	2.94	1.55	11.27	MG/KG
BARIUM	WCS	9	88.89	64.81	26.27	206.40	MG/KG
BERYLLIUM	WCS	9	100.00	3.57	1.09	9.45	MG/KG
CADMIUM	WCS	9	22.22	0.63	0.27	2.06	MG/KG
CALCIUM	WCS	9	66.67	2,213.33	1,356.05	9,520.93	MG/KG
CESIUM	WCS	9	100.00	214.89	5.99	247.16	MG/KG
CHROMIUM	WCS	9	100.00	20.70	5.93	52.65	MG/KG
COPPER	WCS	9	100.00	12.14	5.91	43.99	MG/KG
IRON	WCS	9	100.00	14,262.22	4,066.80	36,177.70	MG/KG
LEAD	WCS	9	100.00	6.68	3.15	23.66	MG/KG
MAGNESIUM	WCS	9	55.56	2,033.89	1,253.36	8,788.12	MG/KG
MANGANESE	WCS	9	100.00	171.88	99.17	706.30	MG/KG
NICKEL	WCS	9	100.00	15.31	6.87	52.31	MG/KG
SELENIUM	WCS	9	66.67	1.95	1.25	8.71	MG/KG
SILVER	WCS	9	100.00	24.29	6.94	61.68	MG/KG
TIN	WCS	9	100.00	278.00	65.04	628.52	MG/KG
VANADIUM	WCS	9	100.00	31.42	11.01	90.76	MG/KG
ZINC	WCS	9	100.00	23.62	8.30	68.34	MG/KG
ALUMINUM	KAR	21	100.00	7,482.60	2,681.30	17,608.83	MG/KG
ARSENIC	KAR	21	66.67	3.72	3.26	16.05	MG/KG
BARIUM	KAR	21	95.24	99.40	55.10	307.51	MG/KG
BERYLLIUM	KAR	21	100.00	3.35	3.16	15.29	MG/KG
CADMIUM	KAR	19	57.89	0.83	0.37	2.28	MG/KG
CALCIUM	KAR	21	100.00	5,477.14	1,831.78	12,395.06	MG/KG
CESIUM	KAR	16	93.75	223.62	31.26	352.50	MG/KG
CHROMIUM	KAR	21	100.00	8.91	2.98	20.18	MG/KG
COBALT	KAR	21	23.81	6.74	7.20	33.94	MG/KG
COPPER	KAR	20	100.00	15.76	5.93	38.48	MG/KG
IRON	KAR	20	100.00	12,963.25	8,753.38	46,502.32	MG/KG
LEAD	KAR	21	100.00	18.91	6.19	42.29	MG/KG
LITHIUM	KAR	21	28.57	7.17	8.39	38.84	MG/KG
MAGNESIUM	KAR	21	66.67	2,053.71	1,213.43	6,636.37	MG/KG
MANGANESE	KAR	21	100.00	171.90	183.74	865.82	MG/KG
MERCURY	KAR	21	33.33	0.23	0.24	1.13	MG/KG
NICKEL	KAR	19	84.21	18.78	13.39	70.90	MG/KG
SELENIUM	KAR	19	31.58	0.90	1.01	4.85	MG/KG
SILVER	KAR	16	25.00	3.72	6.22	29.37	MG/KG
STRONTIUM	KAR	21	90.48	69.50	30.95	186.40	MG/KG
VANADIUM	KAR	20	90.00	20.70	8.76	54.25	MG/KG
ZINC	KAR	21	100.00	60.24	19.22	132.82	MG/KG

Table C-12. Geologic material UTLs by geologic unit for total radionuclides.

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GEOLOGIC MATERIALS, TOTAL RADIONUCLIDES

ANALYTE	GEOLOGY	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	UTL 99 / 99	UNITS
CESIUM-137	COL	28	100.00	0.01	0.04	0.17	pCi/g
GROSS ALPHA	COL	28	100.00	31.95	8.90	63.10	pCi/g
GROSS BETA	COL	28	100.00	27.00	3.52	39.32	pCi/g
PLUTONIUM-239,240	COL	28	100.00	0.01	0.01	0.03	pCi/g
RADIUM-226	COL	21	100.00	1.07	0.18	1.77	pCi/g
RADIUM-228	COL	21	100.00	1.57	0.29	2.65	pCi/g
STRONTIUM-89,90	COL	28	100.00	-0.01	0.36	1.24	pCi/g
TRITIUM	COL	28	100.00	62.14	106.16	433.90	pCi/g
URANIUM, TOTAL	COL	28	100.00	1.86	0.73	4.41	pCi/g
URANIUM-233,234	COL	28	100.00	1.14	1.58	6.66	pCi/g
URANIUM-235	COL	28	100.00	0.04	0.06	0.24	pCi/g
URANIUM-238	COL	28	100.00	0.94	0.34	2.15	pCi/g
AMERICIUM-241	RFA	28	100.00	-0.00	0.01	0.02	pCi/g
CESIUM-137	RFA	62	100.00	0.01	0.04	0.14	pCi/g
GROSS ALPHA	RFA	62	100.00	22.32	8.18	47.21	pCi/g
GROSS BETA	RFA	62	100.00	24.10	6.75	44.62	pCi/g
PLUTONIUM-239,240	RFA	62	100.00	0.00	0.01	0.02	pCi/g
RADIUM-226	RFA	58	100.00	0.63	0.10	0.96	pCi/g
RADIUM-228	RFA	58	100.00	1.34	0.31	2.32	pCi/g
STRONTIUM-89,90	RFA	62	100.00	0.03	0.35	1.09	pCi/g
TRITIUM	RFA	62	100.00	172.90	122.68	545.96	pCi/g
URANIUM, TOTAL	RFA	62	100.00	1.29	0.81	3.76	pCi/g
URANIUM-233,234	RFA	62	100.00	0.64	0.46	2.04	pCi/g
URANIUM-235	RFA	62	100.00	0.01	0.03	0.11	pCi/g
URANIUM-238	RFA	62	100.00	0.64	0.38	1.79	pCi/g
CESIUM-137	WCS	9	100.00	0.01	0.03	0.19	pCi/g
GROSS ALPHA	WCS	9	100.00	20.89	5.88	52.59	pCi/g
GROSS BETA	WCS	9	100.00	21.89	5.53	51.70	pCi/g
PLUTONIUM-239,240	WCS	9	100.00	0.01	0.01	0.07	pCi/g
RADIUM-226	WCS	4	100.00	0.68	0.15	2.53	pCi/g
RADIUM-228	WCS	4	100.00	1.42	0.29	4.98	pCi/g
STRONTIUM-89,90	WCS	9	100.00	0.17	0.44	2.56	pCi/g
TRITIUM	WCS	9	100.00	174.44	114.47	791.30	pCi/g
URANIUM, TOTAL	WCS	9	100.00	1.36	0.21	2.50	pCi/g
URANIUM-233,234	WCS	9	100.00	0.60	0.12	1.26	pCi/g
URANIUM-235	WCS	9	100.00	0.02	0.07	0.38	pCi/g
URANIUM-238	WCS	9	100.00	0.73	0.12	1.39	pCi/g
CESIUM-137	KAR	21	100.00	0.00	0.00	0.00	pCi/g
GROSS ALPHA	KAR	21	100.00	29.98	8.42	61.78	pCi/g
GROSS BETA	KAR	21	100.00	25.76	3.85	40.29	pCi/g
PLUTONIUM-239,240	KAR	21	100.00	0.00	0.01	0.03	pCi/g
RADIUM-226	KAR	14	100.00	1.09	0.12	1.63	pCi/g
RADIUM-228	KAR	14	100.00	1.30	0.19	2.14	pCi/g
STRONTIUM-89,90	KAR	21	100.00	-0.11	0.36	1.24	pCi/g
TRITIUM	KAR	21	100.00	65.95	122.69	529.32	pCi/g
URANIUM, TOTAL	KAR	21	100.00	1.96	0.64	4.40	pCi/g
URANIUM-233,234	KAR	21	100.00	0.96	0.39	2.42	pCi/g
URANIUM-235	KAR	21	100.00	0.04	0.08	0.35	pCi/g
URANIUM-238	KAR	21	100.00	0.98	0.25	1.92	pCi/g

Table C-13. Geologic material UTLs by geologic unit for total "water-quality" parameters.

UPPER TOLERANCE LIMITS BY GEOLOGIC UNIT

GEOLOGIC MATERIALS, TOTAL "WATER-QUALITY" PARAMETERS

ANALYTE	GEOLOGY	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	UTL 99 / 99	UNITS
PH	COL	28	100.00	8.26	0.45	5 / 10	PH UNITS
SULFIDE	COL	27	18.52	1.87	1.39	6.36	MG/KG
PH	RFA	60	100.00	7.97	0.77	5 / 10.4	PH UNITS
SULFIDE	RFA	53	32.08	2.27	3.02	30,082.97	MG/KG
NITRATE/NITRITE	WCS	9	33.33	1.08	0.62	4.44	MG/KG
PH	WCS	9	100.00	7.41	0.18	5 / 9	PH UNITS
SULFIDE	WCS	9	22.22	3.00	1.84	6.00	MG/KG
PH	KAR	21	100.00	8.43	0.87	5 / 11.7	PH UNITS

Table C-14. Geologic material UTLs by flow-system for total metals.

UPPER TOLERANCE LIMITS BY FLOW-SYSTEM

GEOLOGIC MATERIALS, TOTAL METALS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	LOWER	21	100.00	7,482.60	2,681.30	17,608.83	MG/KG
ARSENIC	LOWER	21	66.67	3.72	3.26	16.05	MG/KG
BARIUM	LOWER	21	95.24	99.40	55.10	307.51	MG/KG
BERYLLIUM	LOWER	21	100.00	3.35	3.16	15.29	MG/KG
CADMIUM	LOWER	19	57.89	0.83	0.37	2.28	MG/KG
CALCIUM	LOWER	21	100.00	5,477.14	1,831.78	12,395.06	MG/KG
CESIUM	LOWER	16	93.75	223.62	31.26	352.50	MG/KG
CHROMIUM	LOWER	21	100.00	8.91	2.98	20.18	MG/KG
COBALT	LOWER	21	23.81	6.74	7.20	33.94	MG/KG
COPPER	LOWER	20	100.00	15.76	5.93	38.48	MG/KG
IRON	LOWER	20	100.00	12,963.25	8,753.38	46,502.32	MG/KG
LEAD	LOWER	21	100.00	18.91	6.19	42.29	MG/KG
LITHIUM	LOWER	21	28.57	7.17	8.39	38.84	MG/KG
MAGNESIUM	LOWER	21	66.67	2,053.71	1,213.43	6,636.37	MG/KG
MANGANESE	LOWER	21	100.00	171.90	183.74	865.82	MG/KG
MERCURY	LOWER	21	33.33	0.23	0.24	1.13	MG/KG
NICKEL	LOWER	19	84.21	18.78	13.39	70.90	MG/KG
SELENIUM	LOWER	19	31.58	0.90	1.01	4.85	MG/KG
SILVER	LOWER	16	25.00	3.72	6.22	29.37	MG/KG
STRONTIUM	LOWER	21	90.48	69.50	30.95	186.40	MG/KG
VANADIUM	LOWER	20	90.00	20.70	8.76	54.25	MG/KG
ZINC	LOWER	21	100.00	60.24	19.22	132.82	MG/KG
ALUMINUM	UPPER	98	100.00	12,752.03	11,310.57	39,105.66	MG/KG
ARSENIC	UPPER	99	74.75	3.88	4.63	14.66	MG/KG
BARIUM	UPPER	99	88.89	96.46	96.46	321.20	MG/KG
BERYLLIUM	UPPER	99	90.91	4.78	4.71	15.75	MG/KG
CADMIUM	UPPER	81	48.15	0.82	0.44	2.17	MG/KG
CALCIUM	UPPER	99	85.86	6,951.09	16,215.59	44,733.41	MG/KG
CESIUM	UPPER	95	77.89	230.46	273.51	867.74	MG/KG
CHROMIUM	UPPER	99	100.00	19.61	24.33	76.30	MG/KG
COBALT	UPPER	99	30.30	7.50	10.77	32.60	MG/KG
COPPER	UPPER	99	90.91	12.57	12.82	42.43	MG/KG
IRON	UPPER	99	100.00	14,531.98	13,257.27	45,421.42	MG/KG
LEAD	UPPER	99	100.00	10.87	7.05	27.29	MG/KG
LITHIUM	UPPER	99	45.45	11.76	11.45	38.45	MG/KG
MAGNESIUM	UPPER	99	63.64	2,584.42	3,365.51	10,426.06	MG/KG
MANGANESE	UPPER	99	100.00	217.64	341.96	1,014.41	MG/KG
MERCURY	UPPER	86	33.72	0.24	0.64	2.20	MG/KG
NICKEL	UPPER	96	90.62	20.73	20.74	69.05	MG/KG
POTASSIUM	UPPER	98	28.57	1,311.57	2,442.62	7,002.88	MG/KG
SELENIUM	UPPER	82	25.61	1.22	1.79	6.68	MG/KG
SILVER	UPPER	83	40.96	5.62	9.46	34.39	MG/KG
STRONTIUM	UPPER	99	43.43	65.62	72.88	235.42	MG/KG
TIN	UPPER	92	22.83	61.75	112.28	323.37	MG/KG
VANADIUM	UPPER	99	97.98	31.49	28.50	97.89	MG/KG
ZINC	UPPER	98	95.92	36.86	51.12	155.97	MG/KG

Table C-15. Geologic material UTLs by flow-system for total radionuclides.

UPPER TOLERANCE LIMITS BY FLOW-SYSTEM

GEOLOGIC MATERIALS, TOTAL RADIONUCLIDES

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	UTL 99 / 99	UNITS
CESIUM-137	LOWER	21	100.00	0.00	0.00	0.00	pCi/g
GROSS ALPHA	LOWER	21	100.00	29.98	8.42	61.78	pCi/g
GROSS BETA	LOWER	21	100.00	25.76	3.85	40.29	pCi/g
PLUTONIUM-239,240	LOWER	21	100.00	0.00	0.01	0.03	pCi/g
RADIUM-226	LOWER	14	100.00	1.09	0.12	1.63	pCi/g
RADIUM-228	LOWER	14	100.00	1.30	0.19	2.14	pCi/g
STRONTIUM-89,90	LOWER	21	100.00	-0.11	0.36	1.24	pCi/g
TRITIUM	LOWER	21	100.00	65.95	122.69	529.32	pCi/g
URANIUM, TOTAL	LOWER	21	100.00	1.96	0.64	4.40	pCi/g
URANIUM-233,234	LOWER	21	100.00	0.96	0.39	2.42	pCi/g
URANIUM-235	LOWER	21	100.00	0.04	0.08	0.35	pCi/g
URANIUM-238	LOWER	21	100.00	0.98	0.25	1.92	pCi/g
AMERICIUM-241	UPPER	28	100.00	-0.00	0.01	0.02	pCi/g
CESIUM-137	UPPER	99	100.00	0.01	0.04	0.11	pCi/g
GROSS ALPHA	UPPER	99	100.00	24.91	9.28	49.48	pCi/g
GROSS BETA	UPPER	99	100.00	24.72	6.06	40.75	pCi/g
PLUTONIUM-239,240	UPPER	99	100.00	0.00	0.01	0.02	pCi/g
RADIUM-226	UPPER	83	100.00	0.75	0.23	1.45	pCi/g
RADIUM-228	UPPER	83	100.00	1.40	0.32	2.37	pCi/g
STRONTIUM-89,90	UPPER	99	100.00	0.03	0.36	0.98	pCi/g
TRITIUM	UPPER	99	100.00	141.72	126.75	477.09	pCi/g
URANIUM, TOTAL	UPPER	99	100.00	1.46	0.79	3.55	pCi/g
URANIUM-233,234	UPPER	99	100.00	0.78	0.93	3.25	pCi/g
URANIUM-235	UPPER	99	100.00	0.02	0.05	0.14	pCi/g
URANIUM-238	UPPER	99	100.00	0.73	0.38	1.73	pCi/g

Table C-16. Geologic material UTLs by flow-system for total "water-quality" parameters.

UPPER TOLERANCE LIMITS BY FLOW-SYSTEM

TOTAL "WATER-QUALITY" PARAMETERS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	UTL 99 / 99	UNITS
PH	LOWER	21	100.00	8.43	0.87	11.73	PH UNIT
PH	UPPER	97	100.00	8.00	0.69	9.61	PH UNIT
SULFIDE	UPPER	88	27.27	2.22	2.52	9.88	MG/KG

Table C-17. Stream water UTLs for dissolved metals.

UPPER TOLERANCE LIMITS (SITE-WIDE) STREAM WATER, DISSOLVED METALS						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	134	41.79	89.80	165.40	475.18	UG/L
ANTIMONY	92	29.35	18.01	17.68	59.20	UG/L
BARIUM	145	57.24	45.17	35.44	127.74	UG/L
CALCIUM	154	93.51	23,621.75	11,474.97	50,358.44	UG/L
COPPER	125	37.60	5.90	4.97	17.48	UG/L
IRON	153	68.63	144.92	178.41	560.62	UG/L
LEAD	113	27.43	1.33	1.63	5.14	UG/L
LITHIUM	119	33.61	15.71	20.58	63.66	UG/L
MAGNESIUM	150	76.67	4,735.82	2,173.67	9,800.47	UG/L
MANGANESE	149	71.14	28.02	47.73	139.22	UG/L
PHOSPHORUS	6	100.00	194.83	124.91	1,111.00	UG/L
POTASSIUM	126	51.59	1,427.16	926.51	3,585.92	UG/L
SELENIUM	85	25.88	2.24	3.63	13.26	UG/L
SODIUM	153	94.12	16,603.04	7,508.05	34,096.80	UG/L
STRONTIUM	139	69.06	241.81	313.57	972.43	UG/L
TIN	99	21.21	28.52	23.40	83.05	UG/L
ZINC	139	58.99	13.59	18.14	55.86	UG/L

Table C-18. Stream water UTLs for total metals.

UPPER TOLERANCE LIMITS (SITE-WIDE) STREAM WATER, TOTAL METALS						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	139	78.42	747.63	1,349.84	3,892.76	UG/L
ARSENIC	110	27.27	1.73	1.76	5.84	UG/L
BARIUM	131	68.70	58.84	34.02	138.11	UG/L
CALCIUM	153	94.77	23,601.21	11,100.19	49,464.66	UG/L
COPPER	121	41.32	5.59	4.87	16.95	UG/L
IRON	157	89.81	1,247.08	2,866.81	7,926.75	UG/L
LEAD	131	35.88	1.88	2.35	7.36	UG/L
LITHIUM	126	41.27	11.77	17.42	52.35	UG/L
MAGNESIUM	146	81.51	4,901.94	2,107.61	9,812.65	UG/L
MANGANESE	151	78.81	84.76	343.57	885.29	UG/L
PHOSPHORUS	6	83.33	186.25	138.68	1,203.40	UG/L
POTASSIUM	128	57.03	1,669.97	1,071.73	4,167.09	UG/L
SELENIUM	120	21.67	1.55	2.05	6.33	UG/L
SILICON	67	100.00	6,076.23	3,377.17	16,346.19	UG/L
SODIUM	155	92.90	16,060.41	7,620.96	33,817.24	UG/L
STRONTIUM	135	63.70	171.63	179.61	590.13	UG/L
TIN	118	20.34	20.18	20.13	67.07	UG/L
VANADIUM	120	27.50	6.97	9.36	28.76	UG/L
ZINC	151	67.55	31.91	61.69	175.64	UG/L

Table C-19. Stream water UTLs for dissolved radionuclides.

UPPER TOLERANCE LIMITS (SITE-WIDE) STREAM WATER, DISSOLVED RADIONUCLIDES						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
AMERICIUM-241	34	100.00	0.07	0.13	0.50	pCi/L
CESIUM-134	3	100.00	2.27	0.10	4.67	pCi/L
CESIUM-137	10	100.00	0.82	1.22	6.99	pCi/L
GROSS ALPHA	61	100.00	1.81	8.85	28.71	pCi/L
GROSS BETA	61	100.00	4.69	6.78	25.30	pCi/L
GROSS GAMMA	24	100.00	0.70	0.25	1.63	pCi/L
PLUTONIUM-236	4	100.00	0.00	0.01	0.07	pCi/L
PLUTONIUM-238	4	100.00	0.01	0.01	0.07	pCi/L
PLUTONIUM-239,240	36	100.00	0.12	0.20	0.79	pCi/L
RADIUM-226	3	100.00	0.19	0.21	5.23	pCi/L
RADIUM-228	2	100.00	1.05	0.49	92.93	pCi/L
STRONTIUM-89,90	87	100.00	0.73	0.55	2.42	pCi/L
TRITIUM	56	100.00	185.58	416.00	1,498.07	pCi/L
URANIUM, TOTAL	6	100.00	0.72	0.48	4.27	pCi/L
URANIUM-233,234	56	100.00	0.92	4.21	14.20	pCi/L
URANIUM-235	56	100.00	0.14	0.20	0.78	pCi/L
URANIUM-238	56	100.00	0.71	3.24	10.93	pCi/L

Table C-20. Stream water UTLs for total radionuclides.

UPPER TOLERANCE LIMITS (SITE-WIDE) STREAM WATER, TOTAL RADIONUCLIDES						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
AMERICIUM-241	106	100.00	0.00	0.01	0.02	pCi/g
CESIUM-134	8	100.00	1.53	1.29	9.04	pCi/g
CESIUM-137	93	100.00	0.23	0.60	1.63	pCi/g
GROSS ALPHA	88	100.00	2.96	8.25	28.06	pCi/g
GROSS BETA	84	100.00	5.49	8.17	30.35	pCi/g
PLUTONIUM-236	12	100.00	-0.00	0.00	0.01	pCi/g
PLUTONIUM-238	12	100.00	-0.00	0.01	0.03	pCi/g
PLUTONIUM-239,240	105	100.00	0.00	0.01	0.02	pCi/g
RADIUM-226	4	100.00	1.07	1.25	16.56	pCi/g
STRONTIUM-89,90	75	100.00	0.92	1.30	4.88	pCi/g
TRITIUM	73	100.00	75.71	209.22	711.94	pCi/g
URANIUM, TOTAL	17	100.00	0.59	0.52	2.69	pCi/g
URANIUM-233,234	79	100.00	0.49	0.55	2.16	pCi/g
URANIUM-235	75	100.00	0.05	0.07	0.28	pCi/g
URANIUM-238	55	100.00	0.36	0.43	1.73	pCi/g

Table C-21. Stream water UTLs for water-quality parameters.

UPPER TOLERANCE LIMITS (SITE-WIDE)

STREAM WATER, WATER-QUALITY PARAMETERS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
BICARBONATE	154	100.00	97,571.20	40,237.29	191,324.08	UG/L
CARBONATE	154	24.03	2,999.74	1,937.53	7,514.19	UG/L
CBOD5	10	100.00	7,635.00	3,912.66	27,486.77	UG/L
CHLORIDE	151	92.05	16,833.01	15,608.95	53,201.88	UG/L
CYANIDE	129	31.01	2,221.93	5,220.92	14,386.67	UG/L
DISSOLVED ORGANIC CARBON	35	100.00	6,102.57	3,267.38	16,997.16	UG/L
FLUORIDE	100	98.00	338.41	107.90	589.81	UG/L
NITRATE/NITRITE	153	56.86	324.55	438.84	1,347.05	UG/L
NITRITE	85	22.35	13.98	14.74	58.81	UG/L
OIL AND GREASE	105	33.33	4,024.29	3,756.06	12,775.89	UG/L
PH	51	98.04	7.34	0.63	9.32	PH UNITS
PHOSPHORUS	102	35.29	43.68	55.07	171.98	UG/L
SILICA	95	97.89	11,128.11	7,265.36	28,056.40	UG/L
SULFATE	151	98.01	18,782.45	8,174.66	37,829.40	UG/L
TOTAL DISSOLVED SOLIDS	151	100.00	170,119.21	56,721.65	302,280.65	UG/L
TOTAL ORGANIC CARBON	49	100.00	7,466.94	4,621.53	22,047.87	UG/L
TOTAL SUSPENDED SOLIDS	159	59.75	18,877.99	45,772.72	125,528.42	UG/L

Table C-22. Seep/spring water UTLs for dissolved metals.

UPPER TOLERANCE LIMITS (SITE-WIDE)						
SEEP / SPRING WATER, DISSOLVED METALS						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	43	25.58	42.77	30.04	137.54	UG/L
ANTIMONY	30	30.00	25.89	28.49	124.08	UG/L
BARIUM	47	44.68	71.95	42.39	205.69	UG/L
CALCIUM	50	98.00	50,222.00	34,498.38	159,064.39	UG/L
COPPER	41	24.39	6.01	5.51	23.40	UG/L
IRON	49	69.39	1,927.00	4,082.76	14,808.10	UG/L
LEAD	42	21.43	1.08	0.86	3.81	UG/L
LITHIUM	43	32.56	29.46	20.72	94.84	UG/L
MAGNESIUM	47	72.34	7,002.07	5,198.40	23,403.02	UG/L
MANGANESE	44	86.36	127.57	185.52	712.90	UG/L
MERCURY	22	22.73	0.18	0.26	1.16	UG/L
MOLYBDENUM	34	20.59	33.81	21.07	104.49	UG/L
POTASSIUM	39	41.03	1,389.94	1,640.62	6,745.06	UG/L
SODIUM	50	98.00	12,297.00	5,585.54	29,919.38	UG/L
STRONTIUM	45	77.78	481.40	401.87	1,749.29	UG/L
ZINC	46	45.65	15.68	21.13	82.33	UG/L

Table C-23. Seep/spring water UTLs for total metals.

UPPER TOLERANCE LIMITS (SITE-WIDE)						
SEEP / SPRING WATER, TOTAL METALS						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	48	83.33	18,115.18	47,149.24	166,871.02	UG/L
ANTIMONY	34	32.35	46.68	108.89	411.91	UG/L
ARSENIC	44	59.09	69.77	192.06	675.73	UG/L
BARIUM	44	75.00	913.39	1,692.11	6,252.00	UG/L
BERYLLIUM	38	34.21	2.81	3.37	13.86	UG/L
CADMIUM	33	30.30	9.08	17.25	67.29	UG/L
CALCIUM	53	90.57	94,329.72	128,636.27	500,177.15	UG/L
CESIUM	33	24.24	419.98	449.37	1,936.79	UG/L
CHROMIUM	40	40.00	23.69	49.27	183.74	UG/L
COBALT	35	34.29	43.39	90.97	346.73	UG/L
COPPER	44	52.27	43.89	99.94	359.20	UG/L
CYANIDE	5	40.00	5.95	7.48	72.83	UG/L
IRON	51	88.24	175,074.71	518,671.63	1,811,483.71	UG/L
LEAD	45	66.67	91.14	207.26	745.05	UG/L
LITHIUM	35	48.57	29.43	26.57	118.02	UG/L
MAGNESIUM	50	80.00	10,370.60	7,644.36	34,488.56	UG/L
MANGANESE	51	80.39	1,798.04	5,027.04	17,658.34	UG/L
MOLYBDENUM	33	27.27	33.46	39.12	165.51	UG/L
NICKEL	35	37.14	50.68	116.39	438.78	UG/L
POTASSIUM	41	48.78	3,386.23	3,069.81	13,071.50	UG/L
SELENIUM	36	38.89	3.31	3.72	15.64	UG/L
SILICON	11	100.00	8,408.18	3,027.84	23,029.71	UG/L
SILVER	32	31.25	10.05	25.69	97.35	UG/L
SODIUM	53	88.68	12,005.80	5,016.89	27,834.09	UG/L
STRONTIUM	42	61.90	506.16	476.35	2,009.06	UG/L
TIN	35	37.14	94.03	190.89	730.54	UG/L
VANADIUM	41	51.22	117.09	280.76	1,002.88	UG/L
ZINC	50	82.00	195.22	431.42	1,556.36	UG/L

Table C-24. Seep/spring water UTLs for dissolved radionuclides.

UPPER TOLERANCE LIMITS (SITE-WIDE)						
SEEP / SPRING WATER, DISSOLVED RADIONUCLIDES						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
AMERICIUM-241	8	100.00	0.13	0.28	1.76	pCi/L
CESIUM-137	3	100.00	-0.27	0.21	4.71	pCi/L
GROSS ALPHA	13	100.00	2.78	5.21	26.09	pCi/L
GROSS BETA	14	100.00	5.94	10.09	49.69	pCi/L
GROSS GAMMA	5	100.00	1.09	1.25	12.27	pCi/L
PLUTONIUM-239,240	8	100.00	0.10	0.16	1.02	pCi/L
RADIUM-226	2	100.00	0.99	1.30	242.36	pCi/L
STRONTIUM-89,90	20	100.00	0.52	0.39	2.01	pCi/L
TRITIUM	13	100.00	301.25	298.70	1,637.06	pCi/L
URANIUM, TOTAL	3	100.00	1.90	2.43	59.89	pCi/L
URANIUM-233,234	13	100.00	0.91	0.73	4.19	pCi/L
URANIUM-235	12	100.00	0.12	0.13	0.72	pCi/L
URANIUM-238	13	100.00	0.60	0.54	3.03	pCi/L

Table C-25. Seep/spring water UTLs for total radionuclides.

UPPER TOLERANCE LIMITS (SITE-WIDE)						
SEEP / SPRING WATER, TOTAL RADIONUCLIDES						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
AMERICIUM-241	37	100.00	0.01	0.02	0.08	pCi/L
CESIUM-137	37	100.00	0.58	1.99	7.16	pCi/L
GROSS ALPHA	36	100.00	42.52	89.77	340.13	pCi/L
GROSS BETA	10	100.00	2.15	1.50	9.74	pCi/L
PLUTONIUM-239,240	33	100.00	0.21	0.78	2.85	pCi/L
RADIUM-226	12	100.00	7.72	9.10	49.88	pCi/L
RADIUM-228	5	100.00	16.38	14.11	142.53	pCi/L
STRONTIUM-89,90	32	100.00	0.32	0.38	1.61	pCi/L
TRITIUM	31	100.00	-87.72	1,275.95	4,277.76	pCi/L
URANIUM, TOTAL	9	100.00	0.85	0.63	4.23	pCi/L
URANIUM-233,234	33	100.00	0.64	1.29	4.99	pCi/L
URANIUM-235	32	100.00	0.02	0.08	0.31	pCi/L
URANIUM-238	28	100.00	0.64	1.21	4.89	pCi/L

Table C-26. Seep/spring water UTLs for water-quality parameters.

UPPER TOLERANCE LIMITS (SITE-WIDE)						
SEEP / SPRING WATER, WATER-QUALITY PARAMETERS						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
BICARBONATE	60	100.00	321,643.17	574,858.46	2,135,321.61	UG/L
CARBONATE	55	43.64	4,495.68	4,965.08	20,160.52	UG/L
CHLORIDE	53	90.57	12,523.58	17,061.93	66,353.96	UG/L
CYANIDE	46	26.09	7.11	7.00	29.21	UG/L
DISSOLVED ORGANIC CARBON	5	100.00	5,000.00	2,236.07	24,988.27	UG/L
FLUORIDE	18	100.00	552.22	264.88	1,601.23	UG/L
NITRATE/NITRITE	53	60.38	945.19	2,118.91	7,630.34	UG/L
OIL AND GREASE	24	37.50	2,448.13	1,934.86	9,490.08	UG/L
PH	35	100.00	7.22	0.43	8.64	PH UNITS
PHOSPHORUS	18	61.11	354.94	804.15	3,539.67	UG/L
SILICA	17	100.00	17,025.45	8,569.50	51,617.95	UG/L
SULFATE	53	96.23	46,962.26	87,305.62	322,411.50	UG/L
TOTAL DISSOLVED SOLIDS	53	100.00	263,867.92	174,307.09	813,806.81	UG/L
TOTAL ORGANIC CARBON	7	100.00	9,014.29	3,184.56	29,433.51	UG/L
TOTAL SUSPENDED SOLIDS	54	87.04	2,712,305.56	7,791,125.40	27,293,306.20	UG/L

Table C-27. Stream sediment UTLs for total metals.

UPPER TOLERANCE LIMITS (SITE-WIDE)

STREAM SEDIMENTS, TOTAL METALS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	59	100.00	5,887.61	4,912.73	21,387.27	MG/KG
ANTIMONY	52	44.23	4.55	4.16	17.68	MG/KG
ARSENIC	59	69.49	2.24	2.50	10.13	MG/KG
BARIUM	57	84.21	74.47	56.85	253.82	MG/KG
BERYLLIUM	57	63.16	0.93	3.40	11.65	MG/KG
CADMIUM	51	39.22	0.72	0.58	2.55	MG/KG
CALCIUM	59	81.36	3,554.57	4,719.98	18,446.12	MG/KG
CESIUM	56	62.50	101.77	107.96	442.39	MG/KG
CHROMIUM	59	84.75	8.25	7.49	31.88	MG/KG
COBALT	59	76.27	5.16	3.57	16.43	MG/KG
COPPER	59	83.05	10.81	8.23	36.78	MG/KG
IRON	59	100.00	8,852.63	6,263.19	28,612.98	MG/KG
LEAD	59	100.00	22.02	36.79	138.09	MG/KG
LITHIUM	57	91.23	10.01	9.83	41.01	MG/KG
MAGNESIUM	59	79.66	1,404.18	1,253.37	5,358.56	MG/KG
MANGANESE	59	100.00	229.52	214.85	907.35	MG/KG
MERCURY	49	48.98	0.12	0.11	0.46	MG/KG
MOLYBDENUM	58	53.45	5.48	8.33	31.75	MG/KG
NICKEL	57	75.44	7.01	5.44	24.16	MG/KG
POTASSIUM	58	70.69	812.50	743.98	3,159.74	MG/KG
SELENIUM	58	43.10	0.45	0.55	2.18	MG/KG
SILICON	19	100.00	331.53	362.31	1,741.79	MG/KG
SILVER	54	33.33	0.86	0.71	3.11	MG/KG
SODIUM	59	79.66	161.47	136.80	593.09	MG/KG
STRONTIUM	58	89.66	45.62	77.91	291.42	MG/KG
THALLIUM	50	24.00	0.34	0.24	1.10	MG/KG
TIN	54	53.70	9.69	9.79	40.57	MG/KG
VANADIUM	57	91.23	18.15	14.34	63.39	MG/KG
ZINC	58	98.28	44.44	29.98	139.04	MG/KG

Table C-28. Stream sediment UTLs for total radionuclides.

UPPER TOLERANCE LIMITS (SITE-WIDE) STREAM SEDIMENTS, TOTAL RADIONUCLIDES						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
AMERICIUM-241	37	100.00	0.17	0.48	1.77	pCi/g
CESIUM-137	35	100.00	0.26	0.38	1.54	pCi/g
GROSS ALPHA	45	100.00	22.98	20.46	87.54	pCi/g
GROSS BETA	43	100.00	35.35	9.98	66.83	pCi/g
PLUTONIUM-238	5	100.00	0.00	0.00	0.00	pCi/g
PLUTONIUM-239,240	45	100.00	0.54	1.61	5.62	pCi/g
RADIUM-226	21	100.00	0.85	0.36	2.22	pCi/g
RADIUM-228	20	100.00	1.70	0.74	4.55	pCi/g
STRONTIUM-89,90	43	100.00	0.21	0.27	1.07	pCi/g
TRITIUM	42	100.00	194.30	265.07	1,030.59	pCi/g
URANIUM, TOTAL	6	100.00	1.48	0.69	6.57	pCi/g
URANIUM-233,234	47	100.00	1.68	1.15	5.29	pCi/g
URANIUM-235	49	100.00	0.06	0.05	0.21	pCi/g
URANIUM-238	36	100.00	1.40	1.03	4.82	pCi/g

Table C-29. Stream sediment UTLs for total "water-quality" parameters.

UPPER TOLERANCE LIMITS (SITE-WIDE) STREAM SEDIMENTS, TOTAL "WATER-QUALITY" PARAMETERS						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALKALINITY AS CACO3	28	92.86	1,970.44	5,102.72	19,839.86	MG/KG
BICARBONATE AS CACO3	4	100.00	1,041.25	1,449.27	18,993.76	MG/KG
NITRATE/NITRITE	52	71.15	7.76	15.67	57.19	MG/KG
NITRITE	12	83.33	0.34	0.19	1.21	MG/KG
PH	51	100.00	7.26	0.66	9.34	PH UNITS
TOTAL ALKALINITY	6	100.00	4,470.00	8,116.00	63,997.31	MG/KG

Table C-30. Seep/spring sediment UTLs for total metals.

UPPER TOLERANCE LIMITS (SITE-WIDE)

SEEP / SPRING SEDIMENTS, TOTAL METALS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALUMINUM	20	100.00	10,354.30	5,010.71	29,553.14	MG/KG
ANTIMONY	18	44.44	8.81	8.14	41.04	MG/KG
ARSENIC	20	90.00	12.55	14.28	67.25	MG/KG
BARIUM	20	95.00	204.61	155.62	800.88	MG/KG
BERYLLIUM	16	81.25	1.13	0.92	4.94	MG/KG
CADMIUM	16	43.75	1.65	1.66	8.52	MG/KG
CALCIUM	20	100.00	19,407.50	16,059.56	80,940.62	MG/KG
CESIUM	17	52.94	260.47	200.55	1,070.01	MG/KG
CHROMIUM	18	94.44	10.98	5.27	31.87	MG/KG
COBALT	19	84.21	8.47	5.48	29.81	MG/KG
COPPER	18	94.44	18.74	10.68	61.04	MG/KG
IRON	18	100.00	20,763.89	22,673.64	110,559.63	MG/KG
LEAD	18	100.00	36.37	22.64	126.03	MG/KG
LITHIUM	18	88.89	19.79	20.12	99.49	MG/KG
MAGNESIUM	20	80.00	2,249.30	1,152.86	6,666.56	MG/KG
MANGANESE	19	100.00	261.63	273.79	1,327.33	MG/KG
MERCURY	15	33.33	0.23	0.31	1.55	MG/KG
MOLYBDENUM	19	57.89	15.77	19.74	92.59	MG/KG
NICKEL	17	88.24	12.99	7.51	43.31	MG/KG
POTASSIUM	18	61.11	1,050.72	616.83	3,493.61	MG/KG
SELENIUM	19	68.42	1.26	0.98	5.07	MG/KG
SILICON	10	100.00	1,698.70	2,117.17	12,440.63	MG/KG
SILVER	15	46.67	2.15	1.98	10.49	MG/KG
SODIUM	20	60.00	251.62	294.04	1,378.24	MG/KG
STRONTIUM	20	90.00	113.70	92.03	466.32	MG/KG
THALLIUM	13	30.77	1.42	2.44	12.33	MG/KG
TIN	19	57.89	22.18	18.75	95.16	MG/KG
VANADIUM	19	100.00	27.63	14.21	82.96	MG/KG
ZINC	20	100.00	56.13	22.67	143.00	MG/KG

Table C-31. Seep/spring sediment UTLs for total radionuclides.

UPPER TOLERANCE LIMITS (SITE-WIDE) SEEP / SPRING SEDIMENTS, TOTAL RADIONUCLIDES						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
AMERICIUM-241	14	100.00	0.13	0.31	1.46	pCi/g
CESIUM-137	13	100.00	0.81	0.60	3.51	pCi/g
GROSS ALPHA	15	100.00	19.71	14.00	78.83	pCi/g
GROSS BETA	14	100.00	23.73	5.08	45.76	pCi/g
PLUTONIUM-238	3	100.00	0.00	0.00	0.01	pCi/g
PLUTONIUM-239,240	16	100.00	0.61	1.71	7.68	pCi/g
RADIUM-226	9	100.00	0.71	0.24	1.97	pCi/g
RADIUM-228	9	100.00	1.18	0.32	2.88	pCi/g
STRONTIUM-89,90	14	100.00	0.35	0.52	2.63	pCi/g
TRITIUM	13	100.00	198.54	127.73	769.75	pCi/g
URANIUM, TOTAL	3	100.00	1.87	0.59	15.87	pCi/g
URANIUM-233,234	16	100.00	0.82	0.38	2.39	pCi/g
URANIUM-235	17	100.00	0.04	0.05	0.25	pCi/g
URANIUM-238	14	100.00	0.73	0.41	2.52	pCi/g

Table C-32. Seep/spring sediment UTLs for total "water-quality" parameters.

UPPER TOLERANCE LIMITS (SITE-WIDE) SEEP / SPRING SEDIMENTS, "WATER-QUALITY" PARAMETERS						
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MEAN	STANDARD DEVIATION	99 / 99 UTL	UNITS
ALKALINITY AS CACO3	8	100.00	14,192.25	27,343.99	173,110.00	MG/KG
NITRATE/NITRITE	17	52.94	4.14	3.90	19.89	MG/KG
NITRITE	3	100.00	1.33	1.53	37.91	MG/KG
PH	18	100.00	7.24	0.56	9.47	PH UNITS
TOTAL ALKALINITY	4	75.00	750.25	1,499.83	19,329.11	MG/KG

DESCRIPTIVE SUMMARY STATISTICS

APPENDIX D

DESCRIPTIVE SUMMARY STATISTICS

APPENDIX D
DESCRIPTIVE SUMMARY STATISTICS

GROUNDWATER

Summary Statistics by Geologic Unit

Groundwater, Dissolved Metals
Groundwater, Total Metals
Groundwater, Dissolved Radionuclides
Groundwater, Total Radionuclides
Groundwater, Water-Quality Parameters
Groundwater, Volatile Organics

Summary Statistics by Flow-system

Groundwater, Dissolved Metals
Groundwater, Total Metals
Groundwater, Dissolved Radionuclides
Groundwater, Total Radionuclides
Groundwater, Water-Quality Parameters
Groundwater, Volatile Organics

GEOLOGIC MATERIALS

Summary Statistics by Geologic Unit

Geologic Materials, Total Metals
Geologic Materials, Total Radionuclides
Geologic Materials, Total "Water-Quality" Parameters

Summary Statistics by Flow-system

Geologic Materials, Total Metals
Geologic Materials, Total Radionuclides
Geologic Materials, Total "Water-Quality" Parameters

Summary Statistics (continued)

STREAM WATER

Stream Water, Dissolved Metals
Stream Water, Total Metals
Stream Water, Dissolved Radionuclides
Stream Water, Total Radionuclides
Stream Water, Water-Quality Parameters
Stream Water, Volatile Organics
Stream Water, Semivolatile Organics
Stream Water, Pesticides
Stream Water, Herbicides

SEEP/SPRING WATER

Seep/Spring Water, Dissolved Metals
Seep/Spring Water, Total Metals
Seep/Spring Water, Dissolved Radionuclides
Seep/Spring Water, Total Radionuclides
Seep/Spring Water, Water-Quality Parameters
Seep/Spring Water, Volatile Organics
Seep/Spring Water, Semivolatile Organics
Seep/Spring Water, Pesticides

STREAM SEDIMENTS

Stream Sediments, Total Metals
Stream Sediments, Total Radionuclides
Stream Sediments, Total "Water-Quality" Parameters
Stream Sediments, Total Volatile Organics
Stream Sediments, Total Semivolatile Organics
Stream Sediments, Total Pesticides

SEEP/SPRING SEDIMENTS

Seep/Spring Sediments, Total Metals
Seep/Spring Sediments, Total Radionuclides
Seep/Spring Sediments, Total "Water-Quality" Parameters
Seep/Spring Sediments, Total Volatile Organics
Seep/Spring Sediments, Total Semivolatile Organics
Seep/Spring Sediments, Total Pesticides

APPENDIX D

DESCRIPTIVE SUMMARY STATISTICS

As noted in Section 1, summary statistics were calculated using 1/2*Result as a replacement value for non-detects in the metals and water-quality files. All results (excepting rejected "R" data) for radionuclides are considered to be detects, and are used "as is" in all statistical calculations. Summary statistics for organics are included, although in most cases, most results were non-detects. Organics are included mainly for completeness.

The minimum and maximum values are reported, along with mean values and standard deviations calculated replacing non-detects as described in the preceding paragraph. Sample size and percent detects are also presented; these should be read as: if N = 100 and percent detects = 50, then 50 observations were above the detection limit and 50 observations were below the detection limit. Values for the 85th percentile are also included.

For groundwater and geologic materials, summary statistics are given both by geologic unit and by flow-system. Summary statistics for all other media groups (stream water, seep/spring water, stream sediments, and seep/spring sediments) were calculated sitewide.

Table D-1. Summary statistics for dissolved metals in groundwater.

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, DISSOLVED METALS

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	COL	35	71	4.00	289.00	59.18	49.50	100.00	UG/L
ANTIMONY	COL	33	33	3.50	32.30	14.84	9.50	30.00	UG/L
ARSENIC	COL	28	14	0.40	5.00	1.61	1.68	5.00	UG/L
BARIUM	COL	34	79	14.75	200.00	77.05	39.03	112.00	UG/L
BERYLLIUM	COL	29	3	0.30	2.50	1.00	0.78	2.50	UG/L
CADMIUM	COL	34	24	0.50	8.60	1.97	1.67	2.50	UG/L
CALCIUM	COL	35	100	58,200.00	184,000.00	96,314.29	34,355.90	130,000.00	UG/L
CESIUM	COL	27	15	10.00	500.00	158.78	193.39	500.00	UG/L
CHROMIUM	COL	32	28	1.00	23.20	5.87	5.93	11.30	UG/L
COBALT	COL	29	7	1.50	25.00	6.13	8.85	25.00	UG/L
COPPER	COL	33	36	0.50	12.50	5.08	4.20	12.50	UG/L
IRON	COL	34	62	1.00	431.00	46.38	79.70	50.00	UG/L
LEAD	COL	33	15	0.20	64.00	2.84	11.01	2.50	UG/L
LITHIUM	COL	34	88	3.00	250.00	122.77	84.53	190.00	UG/L
MAGNESIUM	COL	34	100	10,100.00	46,300.00	20,479.41	10,610.71	29,900.00	UG/L
MANGANESE	COL	35	74	0.50	180.00	32.10	38.69	66.90	UG/L
MERCURY	COL	29	3	0.05	0.36	0.11	0.05	0.10	UG/L
MOLYBDENUM	COL	33	42	1.00	100.00	19.35	32.15	50.00	UG/L
NICKEL	COL	29	14	1.00	20.00	6.16	7.04	20.00	UG/L
PHOSPHORUS	COL	2	100	112.00	198.00	155.00	60.81	198.00	UG/L
POTASSIUM	COL	33	85	170.00	8,110.00	2,086.36	1,903.98	2,500.00	UG/L
SELENIUM	COL	32	63	0.50	173.00	17.40	42.89	14.40	UG/L
SILVER	COL	31	26	1.00	11.80	3.22	2.81	5.20	UG/L
SODIUM	COL	35	100	19,600.00	198,000.00	98,454.29	64,522.31	177,000.00	UG/L
STRONTIUM	COL	34	97	50.00	1,710.00	701.88	374.80	939.00	UG/L
THALLIUM	COL	29	10	0.30	5.00	1.42	1.68	5.00	UG/L
TIN	COL	31	42	5.00	340.00	44.01	62.59	100.00	UG/L
VANADIUM	COL	32	66	0.60	25.00	8.17	7.85	25.00	UG/L
ZINC	COL	35	74	1.00	57.90	11.30	10.64	17.40	UG/L
ALUMINUM	RFA	104	75	2.50	1,036.00	68.23	125.93	100.00	UG/L
ANTIMONY	RFA	113	50	3.50	54.10	18.37	12.98	30.00	UG/L
ARSENIC	RFA	98	5	0.45	5.00	1.57	1.60	5.00	UG/L
BARIUM	RFA	114	83	20.00	173.00	72.32	24.50	100.00	UG/L
BERYLLIUM	RFA	94	13	0.15	4.00	1.03	0.86	2.50	UG/L
CADMIUM	RFA	107	22	0.50	5.00	1.66	1.13	2.50	UG/L
CALCIUM	RFA	113	100	15,150.00	90,500.00	37,655.53	18,707.96	68,200.00	UG/L
CESIUM	RFA	95	18	2.00	1,000.00	180.39	212.93	500.00	UG/L
CHROMIUM	RFA	113	42	1.00	18.60	4.86	3.33	9.00	UG/L
COBALT	RFA	108	19	1.00	29.00	6.95	9.48	25.00	UG/L
COPPER	RFA	112	44	0.50	16.30	4.79	4.13	12.50	UG/L
CYANIDE	RFA	1	0	2.50	2.50	2.50	.	2.50	UG/L
IRON	RFA	113	77	1.00	1,106.50	70.28	157.23	71.70	UG/L
LEAD	RFA	111	24	0.50	31.00	1.40	3.01	2.50	UG/L
LITHIUM	RFA	109	69	0.50	50.00	12.68	17.36	50.00	UG/L
MAGNESIUM	RFA	112	92	2,120.00	13,225.00	4,266.21	1,369.27	5,540.00	UG/L
MANGANESE	RFA	114	53	0.50	129.00	6.17	15.04	7.50	UG/L
MERCURY	RFA	92	15	0.10	0.69	0.13	0.09	0.20	UG/L
MOLYBDENUM	RFA	106	36	1.00	100.00	19.37	34.13	50.00	UG/L
NICKEL	RFA	106	37	1.00	35.80	7.66	7.65	20.00	UG/L
POTASSIUM	RFA	110	79	160.00	2,500.00	925.94	705.81	2,500.00	UG/L
SELENIUM	RFA	91	10	0.50	2.50	1.12	0.75	2.50	UG/L
SILVER	RFA	105	29	1.00	8.60	2.73	1.88	5.00	UG/L
SODIUM	RFA	112	98	2,500.00	12,300.00	7,602.21	1,740.42	9,140.00	UG/L
STRONTIUM	RFA	112	87	50.00	1,000.00	132.73	91.06	171.00	UG/L
THALLIUM	RFA	92	22	0.45	5.00	1.68	1.64	5.00	UG/L
TIN	RFA	100	41	2.00	151.00	29.72	34.02	100.00	UG/L
VANADIUM	RFA	111	62	1.00	50.00	8.36	9.95	25.00	UG/L
ZINC	RFA	113	80	1.00	137.00	15.69	19.83	26.60	UG/L

Table D-1 (cont').

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, DISSOLVED METALS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	VFA	74	82	9.35	256.00	52.02	38.51	100.00	UG/L
ANTIMONY	VFA	69	52	3.00	33.00	16.63	8.82	30.00	UG/L
ARSENIC	VFA	65	5	0.40	5.00	1.47	1.55	5.00	UG/L
BARIUM	VFA	74	86	22.60	203.00	98.78	35.33	130.00	UG/L
BERYLLIUM	VFA	62	10	0.35	2.60	0.91	0.75	2.50	UG/L
CADMIUM	VFA	67	22	0.50	5.00	1.71	1.14	2.50	UG/L
CALCIUM	VFA	74	100	18,550.00	120,000.00	61,597.97	30,967.01	98,800.00	UG/L
CESIUM	VFA	62	27	10.00	2,500.00	266.67	415.61	500.00	UG/L
CHROMIUM	VFA	72	31	1.00	15.20	4.27	3.40	7.65	UG/L
COBALT	VFA	65	25	1.50	25.00	5.93	8.12	20.00	UG/L
COPPER	VFA	71	38	0.50	20.90	5.04	4.67	12.50	UG/L
CYANIDE	VFA	2	50	5.00	10.00	7.50	3.54	10.00	UG/L
IRON	VFA	74	82	2.35	229.00	47.94	50.37	75.50	UG/L
LEAD	VFA	74	26	0.35	8.90	1.16	1.34	2.40	UG/L
LITHIUM	VFA	73	78	1.00	160.00	22.36	22.93	50.00	UG/L
MAGNESIUM	VFA	73	97	2,190.00	29,900.00	12,670.14	6,554.47	18,400.00	UG/L
MANGANESE	VFA	73	71	0.50	396.00	57.72	97.91	182.00	UG/L
MERCURY	VFA	60	7	0.05	0.20	0.11	0.03	0.10	UG/L
MOLYBDENUM	VFA	70	34	1.00	100.00	16.44	31.55	35.00	UG/L
NICKEL	VFA	70	39	1.00	20.00	6.37	6.36	13.00	UG/L
PHOSPHORUS	VFA	4	100	147.00	210.00	178.75	31.85	210.00	UG/L
POTASSIUM	VFA	75	84	225.00	3,540.00	1,455.52	745.03	2,500.00	UG/L
SELENIUM	VFA	66	35	0.50	56.00	3.98	10.30	2.50	UG/L
SILVER	VFA	68	29	1.00	10.40	2.81	2.21	5.00	UG/L
SODIUM	VFA	74	100	14,750.00	80,800.00	33,841.22	16,286.12	51,700.00	UG/L
STRONTIUM	VFA	72	97	64.50	886.00	376.61	205.32	561.00	UG/L
THALLIUM	VFA	63	29	0.50	5.00	1.60	1.55	5.00	UG/L
TIN	VFA	72	46	5.00	100.00	27.55	28.07	47.10	UG/L
VANADIUM	VFA	72	71	1.00	25.00	7.03	7.22	10.00	UG/L
ZINC	VFA	74	82	1.00	136.50	13.10	16.73	15.20	UG/L
ALUMINUM	WCS	33	82	5.10	100.00	49.28	28.70	100.00	UG/L
ANTIMONY	WCS	33	52	4.00	35.80	17.84	9.68	30.00	UG/L
ARSENIC	WCS	29	14	0.40	15.00	2.19	3.00	5.00	UG/L
BARIUM	WCS	34	82	34.60	182.00	93.57	42.28	158.00	UG/L
BERYLLIUM	WCS	27	11	0.30	3.50	1.15	0.96	2.50	UG/L
CADMIUM	WCS	32	19	0.50	6.60	1.76	1.41	2.50	UG/L
CALCIUM	WCS	34	100	28,100.00	152,000.00	58,876.47	26,771.24	67,900.00	UG/L
CESIUM	WCS	27	26	11.50	500.00	174.33	195.58	500.00	UG/L
CHROMIUM	WCS	33	36	1.00	12.40	5.04	3.42	9.50	UG/L
COBALT	WCS	29	10	1.00	25.00	7.31	9.80	25.00	UG/L
COPPER	WCS	32	28	0.50	20.30	5.68	5.17	12.50	UG/L
IRON	WCS	34	76	1.00	194.00	37.63	43.56	50.00	UG/L
LEAD	WCS	33	27	0.50	21.70	1.97	3.84	2.50	UG/L
LITHIUM	WCS	34	76	5.30	249.00	38.22	55.05	50.00	UG/L
MAGNESIUM	WCS	34	100	4,650.00	42,500.00	12,960.29	8,069.66	15,700.00	UG/L
MANGANESE	WCS	33	52	0.50	440.00	29.19	91.63	13.90	UG/L
MERCURY	WCS	26	4	0.05	0.20	0.10	0.02	0.10	UG/L
MOLYBDENUM	WCS	32	44	1.00	114.00	27.83	40.01	100.00	UG/L
NICKEL	WCS	31	23	1.00	20.00	6.99	7.49	20.00	UG/L
PHOSPHORUS	WCS	2	100	80.00	231.00	155.50	106.77	231.00	UG/L
POTASSIUM	WCS	34	82	1,000.00	5,430.00	1,933.82	878.64	2,500.00	UG/L
SELENIUM	WCS	30	60	0.50	76.00	10.04	16.91	13.20	UG/L
SILVER	WCS	31	29	1.00	7.10	2.91	1.97	5.00	UG/L
SODIUM	WCS	33	100	15,300.00	252,000.00	40,293.94	55,180.62	38,100.00	UG/L
STRONTIUM	WCS	34	100	195.00	1,910.00	461.79	380.86	573.00	UG/L
THALLIUM	WCS	28	21	0.30	5.00	1.79	1.80	5.00	UG/L
TIN	WCS	32	44	5.00	100.00	29.92	32.07	100.00	UG/L
VANADIUM	WCS	34	59	1.00	25.00	8.11	8.41	25.00	UG/L
ZINC	WCS	34	85	2.00	120.00	13.34	19.41	13.80	UG/L

Table D-1 (cont').

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, DISSOLVED METALS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	KAR	66	79	3.00	256.00	48.81	44.02	100.00	UG/L
ANTIMONY	KAR	63	44	4.00	35.65	15.50	9.17	30.00	UG/L
ARSENIC	KAR	59	49	0.40	6.20	2.41	1.70	5.00	UG/L
BARIUM	KAR	66	86	34.80	132.50	84.18	21.79	110.00	UG/L
BERYLLIUM	KAR	56	11	0.30	2.50	0.90	0.73	2.00	UG/L
CADMIUM	KAR	62	23	0.50	7.55	1.76	1.33	2.50	UG/L
CALCIUM	KAR	67	100	8,190.00	79,400.00	34,535.82	23,552.79	66,500.00	UG/L
CESIUM	KAR	54	30	2.00	500.00	160.88	179.94	500.00	UG/L
CHROMIUM	KAR	65	26	1.00	15.50	3.97	3.15	6.80	UG/L
COBALT	KAR	61	11	1.00	25.00	5.16	7.88	5.00	UG/L
COPPER	KAR	65	28	0.50	12.50	4.17	3.83	8.00	UG/L
IRON	KAR	67	79	1.50	181.00	33.67	35.32	50.00	UG/L
LEAD	KAR	64	20	0.40	41.60	1.80	5.27	2.50	UG/L
LITHIUM	KAR	66	82	2.00	104.00	38.53	27.84	87.30	UG/L
MAGNESIUM	KAR	67	97	1,720.00	16,400.00	6,072.16	4,067.56	12,300.00	UG/L
MANGANESE	KAR	67	72	0.50	30.20	9.29	7.24	16.80	UG/L
MERCURY	KAR	53	15	0.05	1.20	0.13	0.15	0.20	UG/L
MOLYBDENUM	KAR	64	53	1.00	100.00	16.86	27.01	22.00	UG/L
NICKEL	KAR	65	23	1.00	20.00	5.81	6.26	9.65	UG/L
PHOSPHORUS	KAR	4	100	90.50	285.00	174.75	85.65	285.00	UG/L
POTASSIUM	KAR	67	90	366.00	5,800.00	2,731.18	1,612.39	4,750.00	UG/L
SELENIUM	KAR	54	30	0.50	6.00	1.34	1.09	2.50	UG/L
SILVER	KAR	59	29	1.00	9.40	2.69	2.01	5.00	UG/L
SODIUM	KAR	67	100	11,000.00	452,000.00	142,012.69	135,521.56	346,000.00	UG/L
STRONTIUM	KAR	66	100	89.50	1,140.00	383.02	294.27	931.00	UG/L
THALLIUM	KAR	56	21	0.30	10.00	1.72	1.87	5.00	UG/L
TIN	KAR	65	40	4.70	100.00	23.07	25.30	44.20	UG/L
VANADIUM	KAR	65	57	0.50	25.00	6.71	7.60	11.70	UG/L
ZINC	KAR	67	84	1.00	80.90	10.96	10.20	15.60	UG/L

Table D-2. Summary statistics for total metals in groundwater.

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, TOTAL METALS

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	COL	19	100	26.80	2,290.00	745.11	789.02	2,130.00	UG/L
ANTIMONY	COL	20	30	4.00	32.80	17.74	9.52	30.00	UG/L
ARSENIC	COL	20	40	0.50	5.00	1.93	1.65	5.00	UG/L
BARIUM	COL	20	85	25.90	317.00	90.87	66.40	113.50	UG/L
BERYLLIUM	COL	20	5	0.50	2.50	1.12	0.79	2.50	UG/L
CADMIUM	COL	20	25	0.50	7.80	1.97	1.74	2.50	UG/L
CALCIUM	COL	20	100	59,900.00	186,000.00	99,540.00	37,654.79	143,000.00	UG/L
CESIUM	COL	17	6	10.00	500.00	158.09	209.72	500.00	UG/L
CHROMIUM	COL	18	22	1.00	18.90	4.59	4.36	9.20	UG/L
COBALT	COL	20	0	1.50	25.00	6.67	9.46	25.00	UG/L
COPPER	COL	20	65	1.00	53.00	9.29	11.81	13.20	UG/L
CYANIDE	COL	16	13	0.75	2.20	1.14	0.41	1.25	UG/L
IRON	COL	19	100	6.50	2,200.00	665.11	679.22	1,540.00	UG/L
LEAD	COL	18	39	0.50	19.00	2.28	4.27	2.50	UG/L
LITHIUM	COL	20	85	5.00	266.00	117.94	86.49	190.00	UG/L
MAGNESIUM	COL	20	100	10,600.00	47,900.00	21,320.00	11,477.51	33,600.00	UG/L
MANGANESE	COL	20	95	2.00	584.00	57.46	126.39	65.20	UG/L
MERCURY	COL	20	20	0.10	0.20	0.12	0.04	0.20	UG/L
MOLYBDENUM	COL	20	40	1.00	100.00	23.88	39.19	100.00	UG/L
NICKEL	COL	18	33	1.00	20.00	7.25	6.31	20.00	UG/L
POTASSIUM	COL	20	75	243.00	8,040.00	2,013.25	1,893.58	2,500.00	UG/L
SELENIUM	COL	18	67	0.50	203.00	15.04	47.11	11.20	UG/L
SILICON	COL	12	100	4,399.00	13,100.00	8,600.75	2,462.31	11,700.00	UG/L
SILVER	COL	20	20	1.00	5.00	2.40	1.55	5.00	UG/L
SODIUM	COL	20	100	19,800.00	194,000.00	101,010.00	68,738.74	183,000.00	UG/L
STRONTIUM	COL	20	100	330.00	1,770.00	705.85	379.49	1,065.00	UG/L
THALLIUM	COL	20	35	0.50	5.00	1.68	1.76	5.00	UG/L
TIN	COL	20	40	5.00	100.00	35.35	34.62	100.00	UG/L
VANADIUM	COL	20	75	1.00	123.00	16.82	27.37	25.00	UG/L
ZINC	COL	20	95	5.90	172.00	31.55	36.14	48.30	UG/L
ALUMINUM	RFA	66	94	22.60	19,950.00	3,844.45	5,057.31	9,660.00	UG/L
ANTIMONY	RFA	63	43	3.60	86.60	21.40	15.61	30.00	UG/L
ARSENIC	RFA	61	28	0.50	5.00	2.07	1.76	5.00	UG/L
BARIUM	RFA	66	79	46.30	230.50	96.13	36.76	131.00	UG/L
BERYLLIUM	RFA	66	17	0.50	4.80	1.13	0.95	2.50	UG/L
CADMIUM	RFA	66	15	0.50	3.40	1.47	0.78	2.50	UG/L
CALCIUM	RFA	67	100	15,950.00	84,600.00	38,690.30	17,954.04	66,300.00	UG/L
CESIUM	RFA	65	23	2.00	500.00	150.64	202.63	500.00	UG/L
CHROMIUM	RFA	64	56	1.00	31.60	8.21	7.49	13.30	UG/L
COBALT	RFA	66	21	1.50	39.40	8.46	10.30	25.00	UG/L
COPPER	RFA	66	77	1.50	105.00	12.25	13.56	16.80	UG/L
CYANIDE	RFA	75	7	0.75	5.00	1.11	0.55	1.25	UG/L
IRON	RFA	66	98	10.40	27,100.00	4,262.08	5,960.89	9,615.00	UG/L
LEAD	RFA	63	71	0.50	25.00	3.64	3.95	7.30	UG/L
LITHIUM	RFA	67	76	1.10	50.00	17.15	19.09	50.00	UG/L
MAGNESIUM	RFA	67	96	2,465.00	18,400.00	5,050.67	2,112.67	6,200.00	UG/L
MANGANESE	RFA	66	91	0.50	547.50	90.09	113.99	189.00	UG/L
MERCURY	RFA	66	20	0.10	0.27	0.12	0.04	0.20	UG/L
MOLYBDENUM	RFA	68	34	1.00	100.00	24.80	40.38	100.00	UG/L
NICKEL	RFA	66	41	1.00	71.60	13.25	11.32	20.00	UG/L
POTASSIUM	RFA	68	76	495.00	8,370.00	1,578.46	1,190.52	2,500.00	UG/L
SELENIUM	RFA	66	8	0.50	2.50	1.21	0.75	2.50	UG/L
SILICON	RFA	37	100	4,920.00	51,650.00	19,033.92	11,446.15	29,200.00	UG/L
SILVER	RFA	66	17	1.00	10.00	2.45	2.00	5.00	UG/L
SODIUM	RFA	67	97	2,500.00	13,100.00	7,797.16	1,995.38	9,520.00	UG/L
STRONTIUM	RFA	64	78	58.10	270.00	125.27	39.20	173.00	UG/L
THALLIUM	RFA	65	17	0.45	5.00	1.71	1.83	5.00	UG/L
TIN	RFA	68	32	4.70	100.00	34.01	36.65	100.00	UG/L
VANADIUM	RFA	66	79	2.50	57.00	14.87	11.21	25.00	UG/L
ZINC	RFA	67	88	5.00	498.00	40.26	67.22	50.00	UG/L

Table D-2 (cont').

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, TOTAL METALS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	VFA	43	98	87.70	17,350.00	2,560.55	3,909.13	5,130.00	UG/L
ANTIMONY	VFA	41	32	4.00	36.10	16.54	9.86	30.00	UG/L
ARSENIC	VFA	41	32	0.35	5.00	1.70	1.57	5.00	UG/L
BARIUM	VFA	43	84	41.60	184.50	112.77	30.98	145.00	UG/L
BERYLLIUM	VFA	43	14	0.40	2.50	0.99	0.77	2.50	UG/L
CADMIUM	VFA	43	26	0.50	11.10	1.79	1.78	2.50	UG/L
CALCIUM	VFA	43	100	18,900.00	120,000.00	60,361.72	30,137.58	98,600.00	UG/L
CESIUM	VFA	40	30	10.00	500.00	142.06	184.65	500.00	UG/L
CHROMIUM	VFA	42	50	1.00	31.65	6.96	6.89	11.90	UG/L
COBALT	VFA	43	21	1.00	25.00	6.73	8.52	25.00	UG/L
COPPER	VFA	43	81	1.20	77.50	10.43	12.48	12.50	UG/L
CYANIDE	VFA	46	20	0.75	5.55	1.40	0.92	2.50	UG/L
IRON	VFA	43	100	106.00	21,350.00	2,732.59	4,579.64	4,925.00	UG/L
LEAD	VFA	40	78	0.50	12.40	3.39	3.26	6.85	UG/L
LITHIUM	VFA	43	81	6.60	101.00	22.51	18.95	50.00	UG/L
MAGNESIUM	VFA	43	98	2,230.25	29,600.00	12,865.24	6,410.62	17,100.00	UG/L
MANGANESE	VFA	43	95	3.75	365.00	92.38	104.18	218.00	UG/L
MERCURY	VFA	43	23	0.10	0.22	0.12	0.04	0.20	UG/L
MOLYBDENUM	VFA	43	28	1.00	100.00	18.90	36.26	100.00	UG/L
NICKEL	VFA	43	44	1.00	24.30	8.41	7.05	20.00	UG/L
POTASSIUM	VFA	43	81	388.00	5,040.00	1,785.13	913.58	2,500.00	UG/L
SELENIUM	VFA	42	43	0.50	43.10	3.42	7.97	2.50	UG/L
SILICON	VFA	23	100	6,030.00	50,400.00	15,831.46	11,777.33	20,000.00	UG/L
SILVER	VFA	42	14	1.00	5.00	2.10	1.59	5.00	UG/L
SODIUM	VFA	43	100	13,485.75	80,800.00	32,929.90	16,184.58	49,600.00	UG/L
STRONTIUM	VFA	43	95	59.90	873.00	374.14	206.92	546.00	UG/L
THALLIUM	VFA	43	28	0.50	5.00	1.47	1.59	5.00	UG/L
TIN	VFA	42	38	5.00	100.00	31.89	32.57	100.00	UG/L
VANADIUM	VFA	43	79	1.65	49.10	12.20	10.56	25.00	UG/L
ZINC	VFA	43	100	10.80	128.00	39.93	28.56	74.70	UG/L
ALUMINUM	WCS	19	89	28.90	9,370.00	1,326.18	2,630.79	2,050.00	UG/L
ANTIMONY	WCS	17	47	4.00	31.90	19.09	10.53	30.00	UG/L
ARSENIC	WCS	16	6	0.35	5.00	2.12	2.02	5.00	UG/L
BARIUM	WCS	19	84	43.10	264.00	113.17	66.05	186.00	UG/L
BERYLLIUM	WCS	19	0	0.40	2.50	1.02	0.91	2.50	UG/L
CADMIUM	WCS	19	16	0.50	2.50	1.51	0.77	2.50	UG/L
CALCIUM	WCS	19	100	34,000.00	73,400.00	53,731.58	13,527.83	68,600.00	UG/L
CESIUM	WCS	20	35	11.50	500.00	188.32	215.25	500.00	UG/L
CHROMIUM	WCS	19	37	1.00	14.50	5.40	4.02	10.90	UG/L
COBALT	WCS	19	5	1.00	25.00	7.85	10.54	25.00	UG/L
COPPER	WCS	19	58	1.20	12.50	7.15	4.34	12.50	UG/L
CYANIDE	WCS	18	11	0.75	2.20	1.12	0.40	1.25	UG/L
IRON	WCS	19	89	11.80	11,000.00	1,690.19	3,323.94	3,120.00	UG/L
LEAD	WCS	19	74	0.50	11.70	2.68	2.62	4.10	UG/L
LITHIUM	WCS	19	74	9.90	50.00	29.12	15.94	50.00	UG/L
MAGNESIUM	WCS	19	100	5,710.00	17,100.00	11,527.89	3,792.95	15,700.00	UG/L
MANGANESE	WCS	19	68	0.50	192.00	37.44	56.99	100.00	UG/L
MERCURY	WCS	19	16	0.10	0.20	0.12	0.04	0.20	UG/L
MOLYBDENUM	WCS	19	42	1.00	100.00	33.49	44.45	100.00	UG/L
NICKEL	WCS	18	11	1.00	20.00	9.27	7.47	20.00	UG/L
POTASSIUM	WCS	19	74	1,200.00	2,500.00	1,858.95	500.67	2,500.00	UG/L
SELENIUM	WCS	18	50	0.50	80.00	9.10	19.03	10.20	UG/L
SILICON	WCS	10	100	5,160.00	23,200.00	10,474.00	5,966.37	19,900.00	UG/L
SILVER	WCS	19	16	1.00	5.00	2.53	1.85	5.00	UG/L
SODIUM	WCS	19	100	14,800.00	43,500.00	27,557.89	9,531.60	38,100.00	UG/L
STRONTIUM	WCS	19	100	216.00	640.00	390.47	150.51	568.00	UG/L
THALLIUM	WCS	18	28	0.50	5.00	1.95	1.96	5.00	UG/L
TIN	WCS	19	32	5.00	100.00	36.28	39.56	100.00	UG/L
VANADIUM	WCS	19	68	1.65	25.00	10.57	9.20	25.00	UG/L
ZINC	WCS	19	84	4.20	60.90	25.91	17.93	52.80	UG/L

Table D-2 (cont').

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, TOTAL METALS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	KAR	37	92	11.00	11,700.00	1,791.87	2,773.43	4,790.00	UG/L
ANTIMONY	KAR	35	31	3.50	41.30	15.62	10.40	30.00	UG/L
ARSENIC	KAR	35	54	0.35	7.00	2.76	2.02	5.00	UG/L
BARIUM	KAR	36	86	61.50	303.00	113.95	51.97	147.00	UG/L
BERYLLIUM	KAR	36	8	0.30	2.50	0.86	0.74	2.00	UG/L
CADMIUM	KAR	36	19	0.50	3.50	1.45	0.75	2.50	UG/L
CALCIUM	KAR	37	100	10,800.00	91,900.00	36,382.43	23,881.47	62,000.00	UG/L
CESIUM	KAR	35	26	2.00	500.00	131.59	175.16	250.00	UG/L
CHROMIUM	KAR	36	39	1.00	21.40	5.25	4.61	8.60	UG/L
COBALT	KAR	36	8	1.00	25.00	5.55	8.18	10.00	UG/L
COPPER	KAR	36	61	1.00	125.00	11.99	21.82	14.80	UG/L
CYANIDE	KAR	40	13	0.75	4.00	1.31	0.85	1.87	UG/L
IRON	KAR	37	95	9.80	16,900.00	2,239.92	3,697.44	4,450.00	UG/L
LEAD	KAR	36	61	0.50	17.70	3.82	4.29	7.30	UG/L
LITHIUM	KAR	37	86	6.20	106.00	40.69	29.29	78.30	UG/L
MAGNESIUM	KAR	37	95	1,950.00	19,700.00	6,679.46	5,030.81	11,500.00	UG/L
MANGANESE	KAR	37	86	1.00	710.00	61.87	125.21	126.00	UG/L
MERCURY	KAR	37	27	0.10	0.24	0.13	0.05	0.20	UG/L
MOLYBDENUM	KAR	36	47	1.00	100.00	18.59	33.45	19.00	UG/L
NICKEL	KAR	35	34	1.00	24.50	8.70	7.25	20.00	UG/L
POTASSIUM	KAR	37	89	516.00	6,870.00	2,846.38	1,725.69	4,300.00	UG/L
SELENIUM	KAR	36	33	0.50	2.50	1.19	0.63	2.00	UG/L
SILICON	KAR	20	100	3,720.00	29,500.00	9,427.50	6,631.12	14,000.00	UG/L
SILVER	KAR	35	17	1.00	10.00	2.19	2.03	5.00	UG/L
SODIUM	KAR	37	100	11,500.00	434,000.00	139,228.38	134,404.33	327,000.00	UG/L
STRONTIUM	KAR	37	97	100.00	1,170.00	399.78	312.58	799.00	UG/L
THALLIUM	KAR	36	28	0.45	5.00	1.40	1.50	2.00	UG/L
TIN	KAR	37	30	4.70	100.00	27.46	31.18	50.00	UG/L
VANADIUM	KAR	36	69	0.50	46.70	10.43	11.26	25.00	UG/L
ZINC	KAR	36	97	5.00	189.00	52.45	51.31	114.00	UG/L

Table D-3. Summary statistics for dissolved radionuclides in groundwater.

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, DISSOLVED RADIONUCLIDES

ANALYTE	GEOLOGIC UNIT	N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
CESIUM-137	COL	2	100	0.06	0.65	0.36	0.42	0.65	PCI/L
GROSS ALPHA	COL	30	100	0.40	312.70	41.31	78.79	121.20	PCI/L
GROSS BETA	COL	27	100	0.10	135.90	17.51	29.87	14.22	PCI/L
RADIUM-226	COL	15	100	0.06	0.43	0.21	0.10	0.30	PCI/L
STRONTIUM-89,90	COL	23	100	-0.40	0.75	0.25	0.24	0.45	PCI/L
TRITIUM	COL	31	100	-123.00	307.50	76.12	109.42	194.90	PCI/L
URANIUM-233,234	COL	30	100	1.09	199.50	31.82	56.44	127.90	PCI/L
URANIUM-235	COL	30	100	-0.02	4.80	0.86	1.39	2.84	PCI/L
URANIUM-238	COL	24	100	0.52	135.60	26.70	42.13	93.87	PCI/L
AMERICIUM-241	RFA	1	100	0.02	0.02	0.02	.	0.02	PCI/L
CESIUM-137	RFA	15	100	-0.11	0.90	0.27	0.29	0.40	PCI/L
GROSS ALPHA	RFA	82	100	-0.65	5.56	0.59	0.80	0.96	PCI/L
GROSS BETA	RFA	76	100	-1.50	7.90	1.66	1.52	2.39	PCI/L
PLUTONIUM-239,240	RFA	1	100	0.01	0.01	0.01	.	0.01	PCI/L
RADIUM-226	RFA	2	100	0.14	0.20	0.17	0.04	0.20	PCI/L
RADIUM-228	RFA	2	100	1.90	2.50	2.20	0.42	2.50	PCI/L
STRONTIUM-89,90	RFA	81	100	-0.21	1.25	0.27	0.23	0.42	PCI/L
TRITIUM	RFA	63	100	-127.00	1447.00	163.03	223.01	260.00	PCI/L
URANIUM-233,234	RFA	78	100	-0.02	0.88	0.23	0.21	0.43	PCI/L
URANIUM-235	RFA	78	100	-0.04	0.38	0.03	0.07	0.08	PCI/L
URANIUM-238	RFA	69	100	-0.04	0.67	0.14	0.14	0.27	PCI/L
AMERICIUM-241	VFA	1	100	0.00	0.00	0.00	.	0.00	PCI/L
CESIUM-137	VFA	17	100	-0.19	2.60	0.58	0.71	1.21	PCI/L
GROSS ALPHA	VFA	60	100	-0.17	20.07	2.93	3.17	5.04	PCI/L
GROSS BETA	VFA	55	100	0.56	9.34	3.20	1.69	4.39	PCI/L
RADIUM-226	VFA	13	100	0.15	0.53	0.31	0.11	0.47	PCI/L
RADIUM-228	VFA	4	100	1.70	3.00	2.08	0.62	3.00	PCI/L
STRONTIUM-89,90	VFA	59	100	0.04	1.80	0.49	0.38	0.85	PCI/L
TRITIUM	VFA	42	100	-201.00	561.20	115.00	137.64	228.20	PCI/L
URANIUM-233,234	VFA	60	100	0.09	20.26	2.05	2.77	3.40	PCI/L
URANIUM-235	VFA	60	100	-0.03	0.85	0.08	0.12	0.15	PCI/L
URANIUM-238	VFA	49	100	0.00	15.50	1.66	2.30	2.58	PCI/L
CESIUM-137	WCS	4	100	0.15	0.62	0.32	0.20	0.62	PCI/L
GROSS ALPHA	WCS	41	100	0.86	23.21	7.70	5.95	14.80	PCI/L
GROSS BETA	WCS	38	100	1.10	15.00	4.85	3.22	7.94	PCI/L
RADIUM-226	WCS	6	100	0.22	0.39	0.32	0.06	0.39	PCI/L
STRONTIUM-89,90	WCS	17	100	-0.13	0.74	0.24	0.24	0.52	PCI/L
TRITIUM	WCS	29	100	-223.00	189.20	-23.42	118.54	89.68	PCI/L
URANIUM-233,234	WCS	39	100	1.11	133.80	8.59	21.06	12.11	PCI/L
URANIUM-235	WCS	39	100	-0.01	3.21	0.20	0.51	0.24	PCI/L
URANIUM-238	WCS	35	100	0.39	11.00	3.54	3.19	8.76	PCI/L
AMERICIUM-241	KAR	1	100	0.03	0.03	0.03	.	0.03	PCI/L
CESIUM-137	KAR	4	100	-0.19	0.53	0.22	0.30	0.53	PCI/L
GROSS ALPHA	KAR	60	100	-0.45	36.65	3.13	6.24	3.98	PCI/L
GROSS BETA	KAR	54	100	-1.30	13.80	3.23	2.84	4.88	PCI/L
RADIUM-226	KAR	2	100	0.47	2.98	1.72	1.78	2.98	PCI/L
STRONTIUM-89,90	KAR	42	100	-0.17	7.81	0.47	1.19	0.47	PCI/L
TRITIUM	KAR	49	100	-252.00	413.10	56.88	135.94	174.30	PCI/L
URANIUM-233,234	KAR	57	100	-0.01	15.33	1.64	2.85	3.62	PCI/L
URANIUM-235	KAR	57	100	-0.04	0.23	0.03	0.06	0.08	PCI/L
URANIUM-238	KAR	54	100	-0.18	8.01	0.77	1.53	0.96	PCI/L

Table D-4. Summary statistics for total radionuclides in groundwater.

SUMMARY STATISTICS BY GEOLOGIC UNIT
GROUNDWATER, TOTAL RADIONUCLIDES

ANALYTE	GEOLOGIC UNIT	N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
AMERICIUM-241	COL	25	100	0.00	0.01	0.00	0.00	0.01	PCI/L
CESIUM-137	COL	23	100	-0.51	0.81	0.18	0.35	0.57	PCI/L
GROSS ALPHA	COL	6	100	21.00	362.00	150.35	142.75	362.00	PCI/L
GROSS BETA	COL	6	100	11.00	220.00	81.55	85.25	220.00	PCI/L
PLUTONIUM-238	COL	1	100	0.01	0.01	0.01	.	0.01	PCI/L
PLUTONIUM-239,240	COL	26	100	-0.00	0.04	0.01	0.01	0.01	PCI/L
RADIUM-226	COL	1	100	0.26	0.26	0.26	.	0.26	PCI/L
STRONTIUM-89,90	COL	7	100	0.11	0.42	0.26	0.11	0.34	PCI/L
TRITIUM	COL	17	100	-110.00	555.00	201.15	193.39	400.00	PCI/L
URANIUM-233,234	COL	8	100	2.40	164.00	58.74	66.80	129.67	PCI/L
URANIUM-235	COL	8	100	0.37	6.29	2.14	2.39	4.90	PCI/L
URANIUM-238	COL	6	100	1.77	108.00	36.04	46.48	108.00	PCI/L
AMERICIUM-241	RFA	82	100	-0.01	0.06	0.01	0.01	0.01	PCI/L
CESIUM-137	RFA	75	100	-0.59	1.16	0.08	0.33	0.35	PCI/L
GROSS ALPHA	RFA	5	100	0.35	3.55	1.89	1.28	3.55	PCI/L
GROSS BETA	RFA	5	100	0.40	3.70	2.25	1.48	3.70	PCI/L
PLUTONIUM-238	RFA	7	100	-0.00	0.00	0.00	0.00	0.00	PCI/L
PLUTONIUM-239,240	RFA	85	100	-0.01	0.03	0.00	0.00	0.00	PCI/L
STRONTIUM-89,90	RFA	13	100	-0.08	0.64	0.11	0.21	0.40	PCI/L
TRITIUM	RFA	21	100	-62.00	1385.00	226.72	307.18	400.00	PCI/L
URANIUM-233,234	RFA	12	100	0.00	1.33	0.48	0.45	1.25	PCI/L
URANIUM-235	RFA	12	100	0.00	0.67	0.12	0.20	0.31	PCI/L
URANIUM-238	RFA	11	100	0.00	1.42	0.40	0.50	1.04	PCI/L
AMERICIUM-241	VFA	56	100	-0.00	0.10	0.01	0.01	0.01	PCI/L
CESIUM-137	VFA	44	100	-0.47	0.88	0.10	0.30	0.40	PCI/L
GROSS ALPHA	VFA	7	100	1.68	6.80	3.66	2.08	5.80	PCI/L
GROSS BETA	VFA	7	100	0.20	9.33	4.54	2.83	5.90	PCI/L
PLUTONIUM-238	VFA	6	100	0.00	0.03	0.01	0.01	0.03	PCI/L
PLUTONIUM-239,240	VFA	62	100	-0.00	0.22	0.01	0.04	0.00	PCI/L
RADIUM-226	VFA	1	100	0.44	0.44	0.44	.	0.44	PCI/L
STRONTIUM-89,90	VFA	8	100	0.03	1.12	0.43	0.37	0.73	PCI/L
TRITIUM	VFA	27	100	-180.00	565.50	142.98	180.32	312.30	PCI/L
URANIUM-233,234	VFA	7	100	0.10	2.65	1.56	1.00	2.51	PCI/L
URANIUM-235	VFA	7	100	-0.01	0.23	0.10	0.10	0.21	PCI/L
URANIUM-238	VFA	2	100	0.39	2.08	1.23	1.20	2.08	PCI/L
AMERICIUM-241	WCS	20	100	-0.00	0.05	0.01	0.01	0.01	PCI/L
CESIUM-137	WCS	14	100	-0.21	0.89	0.28	0.36	0.75	PCI/L
GROSS ALPHA	WCS	5	100	5.20	34.70	12.85	12.46	34.70	PCI/L
GROSS BETA	WCS	5	100	3.70	16.10	8.27	5.11	16.10	PCI/L
PLUTONIUM-238	WCS	1	100	-0.00	-0.00	-0.00	.	-0.00	PCI/L
PLUTONIUM-239,240	WCS	21	100	-0.00	0.02	0.00	0.00	0.01	PCI/L
RADIUM-226	WCS	4	100	0.18	0.52	0.36	0.15	0.52	PCI/L
STRONTIUM-89,90	WCS	4	100	-0.29	0.34	0.05	0.26	0.34	PCI/L
TRITIUM	WCS	19	100	-240.00	39030.00	2128.76	8937.88	313.00	PCI/L
URANIUM-233,234	WCS	8	100	1.83	17.50	7.49	6.30	17.17	PCI/L
URANIUM-235	WCS	8	100	-0.02	0.75	0.26	0.26	0.52	PCI/L
URANIUM-238	WCS	3	100	0.95	10.60	5.11	4.96	10.60	PCI/L
AMERICIUM-241	KAR	43	100	-0.00	0.10	0.01	0.02	0.01	PCI/L
CESIUM-137	KAR	39	100	-0.44	0.72	0.00	0.29	0.32	PCI/L
GROSS ALPHA	KAR	6	100	2.89	44.90	11.06	16.63	44.90	PCI/L
GROSS BETA	KAR	6	100	3.90	39.20	12.01	13.45	39.20	PCI/L
PLUTONIUM-238	KAR	5	100	0.00	0.04	0.01	0.01	0.04	PCI/L
PLUTONIUM-239,240	KAR	48	100	-0.00	0.05	0.00	0.01	0.00	PCI/L
RADIUM-226	KAR	3	100	0.07	0.88	0.59	0.45	0.88	PCI/L
STRONTIUM-89,90	KAR	4	100	-0.24	0.39	0.10	0.26	0.39	PCI/L
TRITIUM	KAR	16	100	-180.00	1350.00	62.93	367.23	10.00	PCI/L
URANIUM-233,234	KAR	4	100	0.15	1.52	0.77	0.57	1.52	PCI/L
URANIUM-235	KAR	4	100	0.00	0.04	0.03	0.02	0.04	PCI/L
URANIUM-238	KAR	2	100	0.17	0.53	0.35	0.26	0.53	PCI/L

Table D-5. Summary statistics for water-quality parameters in groundwater.

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, WATER-QUALITY PARAMETERS

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
BICARBONATE	COL	52	100	219,456.00	755,904.00	393,871.94	175,851.17	670,560.00	UG/L
CARBONATE	COL	51	8	0.00	16,788.80	1,723.01	3,036.64	5,000.00	UG/L
CHLORIDE	COL	42	100	3,500.00	52,200.00	18,114.29	10,104.20	25,000.00	UG/L
CYANIDE	COL	9	11	5.00	10.00	7.22	2.64	10.00	UG/L
FLUORIDE	COL	51	100	400.00	2,300.00	1,053.73	536.87	1,700.00	UG/L
NITRATE/NITRITE	COL	56	64	10.00	12,000.00	1,683.75	3,700.64	1,700.00	UG/L
NITRITE	COL	8	0	10.00	50.00	25.00	20.70	50.00	UG/L
ORTHOPHOSPHATE	COL	27	48	5.00	25.00	11.93	7.48	25.00	UG/L
PHOSPHORUS	COL	10	40	5.00	100.00	30.50	29.86	50.00	UG/L
SILICA	COL	44	100	5,800.00	42,000.00	12,037.35	6,549.60	18,141.26	UG/L
SODIUM NITRITE	COL	1	100	20.00	20.00	20.00	.	20.00	UG/L
SULFATE	COL	48	100	18,000.00	940,000.00	215,566.67	264,980.47	334,000.00	UG/L
TOTAL DISSOLVED SOLIDS	COL	52	100	270,000.00	1,580,000.00	687,230.77	409,401.70	1,200,000.00	UG/L
TOTAL SUSPENDED SOLIDS	COL	52	67	2,000.00	97,000.00	18,038.46	24,207.00	43,000.00	UG/L
ALKALINITY AS CACO3	RFA	2	100	60,500.00	70,200.00	65,350.00	6,858.94	70,200.00	UG/L
BICARBONATE	RFA	114	100	46,939.20	390,144.00	114,859.08	56,766.87	195,072.00	UG/L
CARBONATE	RFA	107	7	0.00	32,378.40	1,582.76	3,522.98	5,000.00	UG/L
CHLORIDE	RFA	95	92	1,650.00	118,000.00	8,707.47	13,538.26	16,000.00	UG/L
CYANIDE	RFA	29	14	2.00	20.00	6.62	4.21	10.00	UG/L
FLUORIDE	RFA	108	96	100.00	500.00	306.39	90.85	400.00	UG/L
NITRATE/NITRITE	RFA	115	97	165.00	3,600.00	1,448.26	765.26	2,200.00	UG/L
NITRITE	RFA	23	43	10.00	200.00	33.13	53.44	50.00	UG/L
ORTHOPHOSPHATE	RFA	81	57	0.01	100.00	14.44	12.92	25.00	UG/L
PH	RFA	2	100	6.90	6.90	6.90	0.00	6.90	PH
PHOSPHORUS	RFA	22	68	5.00	170.00	44.27	49.43	90.00	UG/L
SILICA	RFA	105	100	3,800.00	57,000.00	15,873.61	8,274.40	24,922.85	UG/L
SULFATE	RFA	103	99	2,900.00	203,000.00	22,384.47	19,440.47	27,000.00	UG/L
TOTAL DISSOLVED SOLIDS	RFA	115	100	66,000.00	990,000.00	189,817.39	94,386.90	240,000.00	UG/L
TOTAL SOLIDS	RFA	1	100	79,100.00	79,100.00	79,100.00	.	79,100.00	UG/L
TOTAL SUSPENDED SOLIDS	RFA	111	86	2,000.00	2,400,000.00	182,684.68	334,207.01	310,000.00	UG/L
BICARBONATE	VFA	78	100	87,782.40	719,328.00	242,462.09	116,731.17	377,952.00	UG/L
CARBONATE	VFA	77	10	0.00	10,000.00	1,447.23	2,207.06	5,000.00	UG/L
CHLORIDE	VFA	67	97	1,550.00	59,000.00	16,061.19	12,727.88	28,000.00	UG/L
CYANIDE	VFA	21	29	5.00	20.00	9.39	5.70	20.00	UG/L
FLUORIDE	VFA	76	97	155.00	1,000.00	505.27	186.31	700.00	UG/L
NITRATE/NITRITE	VFA	72	65	10.00	1,050.00	202.08	257.28	600.00	UG/L
NITRITE	VFA	12	25	10.00	50.00	19.17	15.05	50.00	UG/L
ORTHOPHOSPHATE	VFA	54	56	5.00	200.00	17.82	27.04	25.00	UG/L
PHOSPHORUS	VFA	15	47	5.00	110.00	44.67	42.49	100.00	UG/L
SILICA	VFA	76	100	4,200.00	44,000.00	15,164.53	8,599.63	24,815.88	UG/L
SULFATE	VFA	69	100	9,000.00	520,000.00	54,486.96	74,995.26	77,500.00	UG/L
TOTAL DISSOLVED SOLIDS	VFA	76	100	90,085.00	1,170,000.00	334,744.54	167,754.49	460,000.00	UG/L
TOTAL SOLIDS	VFA	2	100	6,500.00	8,000.00	7,250.00	1,060.66	8,000.00	UG/L
TOTAL SUSPENDED SOLIDS	VFA	72	89	2,000.00	700,390.00	90,727.64	141,259.37	190,000.00	UG/L

Table D-5 (cont').

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, WATER-QUALITY PARAMETERS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALKALINITY AS CACO3	WCS	1	100	340,000.00	340,000.00	340,000.00	.	340,000.00	UG/L
BICARBONATE	WCS	67	100	87,782.40	573,024.00	255,472.87	134,489.69	365,760.00	UG/L
CARBONATE	WCS	65	17	0.00	32,000.00	2,751.12	4,676.41	5,000.00	UG/L
CHLORIDE	WCS	53	83	1,200.00	38,000.00	9,094.34	11,230.61	17,500.00	UG/L
CYANIDE	WCS	7	29	5.00	20.00	10.00	7.07	20.00	UG/L
FLUORIDE	WCS	65	98	200.00	2,900.00	893.69	595.09	1,300.00	UG/L
NITRATE/NITRITE	WCS	62	87	10.00	5,300.00	715.40	1,067.15	970.00	UG/L
NITRITE	WCS	11	64	10.00	100.00	28.82	27.52	50.00	UG/L
ORTHOPHOSPHATE	WCS	29	45	5.00	50.00	14.48	11.52	25.00	UG/L
PH	WCS	1	100	7.70	7.70	7.70	.	7.70	PH
PHOSPHORUS	WCS	9	67	5.00	100.00	28.89	31.30	60.00	UG/L
SILICA	WCS	49	100	3,800.00	33,000.00	10,404.94	6,489.24	17,970.12	UG/L
SULFATE	WCS	58	100	15,000.00	1,200,000.00	131,008.62	241,197.17	180,000.00	UG/L
TOTAL DISSOLVED SOLIDS	WCS	67	100	160,000.00	1,430,000.00	405,940.30	375,873.93	620,000.00	UG/L
TOTAL SOLIDS	WCS	1	0	2,500.00	2,500.00	2,500.00	.	2,500.00	UG/L
TOTAL SUSPENDED SOLIDS	WCS	66	70	2,000.00	6,400,000.00	187,939.39	787,142.93	250,000.00	UG/L
ALKALINITY AS CACO3	KAR	3	100	205,500.00	490,000.00	305,166.67	160,234.46	490,000.00	UG/L
BICARBONATE	KAR	93	100	63,398.40	719,328.00	233,546.17	102,980.99	268,224.00	UG/L
CARBONATE	KAR	92	28	0.00	19,100.00	3,318.77	4,245.24	7,195.20	UG/L
CHLORIDE	KAR	79	96	1,600.00	430,000.00	100,205.95	128,066.02	250,000.00	UG/L
CYANIDE	KAR	18	17	2.00	20.00	7.19	4.23	10.00	UG/L
FLUORIDE	KAR	92	98	120.00	2,000.00	949.35	465.34	1,500.00	UG/L
NITRATE/NITRITE	KAR	90	79	10.00	3,600.00	861.22	945.96	1,800.00	UG/L
NITRITE	KAR	16	56	10.00	900.00	190.62	295.19	580.00	UG/L
ORTHOPHOSPHATE	KAR	54	61	5.00	40.00	18.46	10.16	30.00	UG/L
PH	KAR	2	100	7.30	8.40	7.85	0.78	8.40	PH
PHOSPHORUS	KAR	14	64	5.00	960.00	173.57	264.99	370.00	UG/L
SILICA	KAR	83	100	2,400.00	28,200.00	8,077.25	5,808.92	11,000.00	UG/L
SULFATE	KAR	82	95	600.00	1,200,000.00	123,943.90	250,872.10	350,000.00	UG/L
TOTAL DISSOLVED SOLIDS	KAR	94	100	120,000.00	1,700,000.00	545,138.30	445,290.59	1,000,000.00	UG/L
TOTAL SOLIDS	KAR	5	80	2,500.00	885,000.00	318,240.00	356,657.98	885,000.00	UG/L
TOTAL SUSPENDED SOLIDS	KAR	88	77	2,000.00	4,600,000.00	403,085.23	727,972.80	868,000.00	UG/L

Table D-6. Summary statistics for volatile organics in groundwater.

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, VOLATILE ORGANICS

ANALYTE	GEOLOGIC UNIT	N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,1,1-TRICHLOROETHANE	COL	59	2	2.50	4.00	2.53	0.20	2.50	UG/L
1,1,2,2-TETRACHLOROETHAN	COL	61	2	2.00	2.50	2.49	0.06	2.50	UG/L
1,1,2-TRICHLOROETHANE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHANE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHENE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROETHANE	COL	60	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROETHENE	COL	54	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROPROPANE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
2-BUTANONE	COL	47	0	5.00	5.00	5.00	0.00	5.00	UG/L
2-HEXANONE	COL	56	2	3.00	5.00	4.96	0.27	5.00	UG/L
4-METHYL-2-PENTANONE	COL	61	2	3.00	5.00	4.97	0.26	5.00	UG/L
ACETONE	COL	57	16	2.00	25.00	5.70	3.07	5.00	UG/L
BENZENE	COL	61	2	0.20	2.50	2.46	0.29	2.50	UG/L
BROMODICHLOROMETHANE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOFORM	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOMETHANE	COL	61	0	5.00	5.00	5.00	0.00	5.00	UG/L
CARBON DISULFIDE	COL	61	5	0.70	8.00	2.65	1.02	2.50	UG/L
CARBON TETRACHLORIDE	COL	60	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROBENZENE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROETHANE	COL	60	0	5.00	5.00	5.00	0.00	5.00	UG/L
CHLOROFORM	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROMETHANE	COL	59	0	5.00	5.00	5.00	0.00	5.00	UG/L
DIBROMOCHLOROMETHANE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
ETHYLBENZENE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
METHYLENE CHLORIDE	COL	61	25	1.00	41.00	4.06	6.24	2.50	UG/L
STYRENE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
TETRACHLOROETHENE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
TOLUENE	COL	61	5	0.40	2.50	2.42	0.38	2.50	UG/L
TOTAL XYLENES	COL	61	2	0.30	2.50	2.46	0.28	2.50	UG/L
TRICHLOROETHENE	COL	61	3	2.50	42.00	3.16	5.06	2.50	UG/L
VINYL ACETATE	COL	53	0	5.00	5.00	5.00	0.00	5.00	UG/L
VINYL CHLORIDE	COL	61	0	5.00	5.00	5.00	0.00	5.00	UG/L
cis-1,3-DICHLOROPROPENE	COL	61	0	2.50	2.50	2.50	0.00	2.50	UG/L
trans-1,2-DICHLOROETHENE	COL	7	0	2.50	2.50	2.50	0.00	2.50	UG/L
trans-1,3-DICHLOROPROPEN	COL	60	0	2.50	2.50	2.50	0.00	2.50	UG/L

Table D-6 (cont').

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, VOLATILE ORGANICS (CONT')

ANALYTE	GEOLOGIC UNIT	N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION		UNITS
1,1,1,2-TETRACHLOROETHAN	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,1,1-TRICHLOROETHANE	RFA	94	2	2.50	8.00	2.57	0.59	2.50	UG/L
1,1,2,2-TETRACHLOROETHAN	RFA	95	0	1.30	2.50	2.49	0.12	2.50	UG/L
1,1,2-TRICHLOROETHANE	RFA	95	0	1.32	2.50	2.49	0.12	2.50	UG/L
1,1-DICHLOROETHANE	RFA	95	1	2.50	2.75	2.50	0.03	2.50	UG/L
1,1-DICHLOROETHENE	RFA	86	2	2.50	7.00	2.59	0.61	2.50	UG/L
1,1-DICHLOROPROPENE	RFA	1	0	0.05	0.05	0.05	.	0.05	UG/L
1,2,3-TRICHLOROBENZENE	RFA	1	0	0.05	0.05	0.05	.	0.05	UG/L
1,2,3-TRICHLOROPROPANE	RFA	1	0	0.20	0.20	0.20	.	0.20	UG/L
1,2,4-TRICHLOROBENZENE	RFA	2	0	0.05	0.10	0.08	0.04	0.10	UG/L
1,2-DIBROMOETHANE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,2-DICHLOROBENZENE	RFA	1	0	0.05	0.05	0.05	.	0.05	UG/L
1,2-DICHLOROETHANE	RFA	95	0	1.30	2.50	2.49	0.12	2.50	UG/L
1,2-DICHLOROETHENE	RFA	101	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROPROPANE	RFA	95	0	1.30	2.50	2.49	0.12	2.50	UG/L
1,2-DIMETHYLBENZENE	RFA	1	0	0.15	0.15	0.15	.	0.15	UG/L
1,3-DICHLOROBENZENE	RFA	1	0	0.05	0.05	0.05	.	0.05	UG/L
1,3-DICHLOROPROPANE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,3-DIMETHYLBENZENE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,4-DICHLOROBENZENE	RFA	1	0	0.15	0.15	0.15	.	0.15	UG/L
2-BUTANONE	RFA	81	0	5.00	5.00	5.00	0.00	5.00	UG/L
2-CHLOROETHYL VINYL ETHE	RFA	3	0	5.00	5.00	5.00	0.00	5.00	UG/L
2-HEXANONE	RFA	98	0	5.00	5.00	5.00	0.00	5.00	UG/L
4-METHYL-2-PENTANONE	RFA	103	0	5.00	5.00	5.00	0.00	5.00	UG/L
ACETONE	RFA	93	18	1.00	19.00	5.49	2.32	5.00	UG/L
BENZENE	RFA	95	0	1.30	2.50	2.48	0.18	2.50	UG/L
BENZENE, 1,2,4-TRIMETHYL	RFA	1	0	0.15	0.15	0.15	.	0.15	UG/L
BENZENE, 1,3,5-TRIMETHYL-	RFA	1	0	0.05	0.05	0.05	.	0.05	UG/L
BROMOBENZENE	RFA	1	0	0.05	0.05	0.05	.	0.05	UG/L
BROMOCHLOROMETHANE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
BROMODICHLOROMETHANE	RFA	95	0	1.30	2.50	2.49	0.12	2.50	UG/L
BROMOFORM	RFA	95	0	1.30	2.50	2.49	0.12	2.50	UG/L
BROMOMETHANE	RFA	92	0	2.52	5.00	4.97	0.26	5.00	UG/L
CARBON DISULFIDE	RFA	99	1	0.90	2.50	2.48	0.18	2.50	UG/L
CARBON TETRACHLORIDE	RFA	85	8	2.00	2800.00	73.96	402.47	2.50	UG/L
CHLOROBENZENE	RFA	95	1	1.27	2.50	2.47	0.17	2.50	UG/L
CHLOROETHANE	RFA	91	0	2.52	5.00	4.97	0.26	5.00	UG/L
CHLOROFORM	RFA	87	2	2.50	130.00	4.43	14.29	2.50	UG/L
CHLOROMETHANE	RFA	91	0	2.55	5.00	4.97	0.26	5.00	UG/L
CUMENE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
DIBROMOCHLOROMETHANE	RFA	95	0	1.30	2.50	2.49	0.12	2.50	UG/L
DIBROMOMETHANE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
DICHLORODIFLUOROMETHAN	RFA	2	0	0.15	0.25	0.20	0.07	0.25	UG/L
ETHYLBENZENE	RFA	95	0	1.27	2.50	2.49	0.13	2.50	UG/L
HEXACHLOROBUTADIENE	RFA	1	0	0.20	0.20	0.20	.	0.20	UG/L
METHYLENE CHLORIDE	RFA	90	32	1.00	82.00	4.39	9.62	3.00	UG/L
NAPHTHALENE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
PROPANE, 1,2-DIBROMO-3-CH	RFA	1	0	0.25	0.25	0.25	.	0.25	UG/L
STYRENE	RFA	93	0	0.05	2.50	2.46	0.28	2.50	UG/L
TETRACHLOROETHENE	RFA	88	6	2.50	230.00	7.79	33.36	2.50	UG/L
TOLUENE	RFA	97	3	0.70	6.00	2.48	0.46	2.50	UG/L
TOTAL XYLENES	RFA	98	0	2.50	2.50	2.50	0.00	2.50	UG/L
TRICHLOROETHENE	RFA	89	8	1.50	210.00	7.15	29.48	2.50	UG/L
TRICHLOROFLUOROMETHANE	RFA	2	0	0.05	0.25	0.15	0.14	0.25	UG/L
VINYL ACETATE	RFA	90	0	5.00	5.00	5.00	0.00	5.00	UG/L
VINYL CHLORIDE	RFA	94	0	2.55	5.00	4.97	0.25	5.00	UG/L
cis-1,2-DICHLOROETHENE	RFA	2	100	66.00	70.00	68.00	2.83	70.00	UG/L
cis-1,3-DICHLOROPROPENE	RFA	96	0	0.05	2.50	2.46	0.28	2.50	UG/L
n-BUTYLBENZENE	RFA	1	0	0.05	0.05	0.05	.	0.05	UG/L
n-PROPYLBENZENE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
o-CHLOROTOLUENE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
p-CHLOROTOLUENE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
p-CYMENE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
p-XYLENE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
sec-BUTYLBENZENE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
sec-DICHLOROPROPANE	RFA	1	0	0.05	0.05	0.05	.	0.05	UG/L
tert-BUTYLBENZENE	RFA	1	0	0.10	0.10	0.10	.	0.10	UG/L
trans-1,2-DICHLOROETHENE	RFA	7	14	0.30	2.50	2.19	0.83	2.50	UG/L
trans-1,3-DICHLOROPROPENE	RFA	92	0	0.05	2.50	2.46	0.28	2.50	UG/L

Table D-6 (cont').

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, VOLATILE ORGANICS (CONT')

ANALYTE	GEOLOGIC UNIT	N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,1,1-TRICHLOROETHANE	VFA	71	1	2.50	10.00	2.61	0.89	2.50	UG/L
1,1,2,2-TETRACHLOROETHA	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1,2-TRICHLOROETHANE	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHANE	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHENE	VFA	72	1	1.00	2.50	2.48	0.18	2.50	UG/L
1,2-DICHLOROETHANE	VFA	70	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROETHENE	VFA	65	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROPROPANE	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
2-BUTANONE	VFA	54	0	5.00	5.00	5.00	0.00	5.00	UG/L
2-HEXANONE	VFA	65	0	5.00	5.00	5.00	0.00	5.00	UG/L
4-METHYL-2-PENTANONE	VFA	71	0	5.00	5.00	5.00	0.00	5.00	UG/L
ACETONE	VFA	69	17	2.00	36.00	6.13	4.22	6.00	UG/L
BENZENE	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMODICHLOROMETHANE	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOFORM	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOMETHANE	VFA	67	0	5.00	5.00	5.00	0.00	5.00	UG/L
CARBON DISULFIDE	VFA	70	4	1.00	21.00	2.75	2.22	2.50	UG/L
CARBON TETRACHLORIDE	VFA	70	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROBENZENE	VFA	71	0	1.50	2.50	2.49	0.12	2.50	UG/L
CHLOROETHANE	VFA	68	0	5.00	5.00	5.00	0.00	5.00	UG/L
CHLOROFORM	VFA	71	1	2.50	4.00	2.52	0.18	2.50	UG/L
CHLOROMETHANE	VFA	70	0	5.00	5.00	5.00	0.00	5.00	UG/L
DIBROMOCHLOROMETHANE	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
ETHYLBENZENE	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
METHYLENE CHLORIDE	VFA	72	26	1.00	19.00	3.20	2.69	3.50	UG/L
STYRENE	VFA	70	0	2.50	2.50	2.50	0.00	2.50	UG/L
TETRACHLOROETHENE	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
TOLUENE	VFA	72	1	1.50	5.00	2.51	0.34	2.50	UG/L
TOTAL XYLENES	VFA	69	0	2.50	2.50	2.50	0.00	2.50	UG/L
TRICHLOROETHENE	VFA	71	1	2.00	2.50	2.49	0.06	2.50	UG/L
VINYL ACETATE	VFA	63	0	5.00	5.00	5.00	0.00	5.00	UG/L
VINYL CHLORIDE	VFA	71	0	5.00	5.00	5.00	0.00	5.00	UG/L
cis-1,3-DICHLOROPROPENE	VFA	71	0	2.50	2.50	2.50	0.00	2.50	UG/L
trans-1,2-DICHLOROETHENE	VFA	6	0	2.50	2.50	2.50	0.00	2.50	UG/L
trans-1,3-DICHLOROPROPEN	VFA	70	0	2.50	2.50	2.50	0.00	2.50	UG/L

Table D-6 (cont').

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, VOLATILE ORGANICS (CONT')

ANALYTE	GEOLOGIC UNIT	N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,1,1-TRICHLOROETHANE	WCS	65	2	2.00	2.50	2.49	0.06	2.50	UG/L
1,1,2,2-TETRACHLOROETHA	WCS	69	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1,2-TRICHLOROETHANE	WCS	69	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHANE	WCS	69	1	2.00	2.50	2.49	0.06	2.50	UG/L
1,1-DICHLOROETHENE	WCS	69	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROETHANE	WCS	69	1	1.00	2.50	2.48	0.18	2.50	UG/L
1,2-DICHLOROETHENE	WCS	65	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROPROPANE	WCS	69	1	1.00	2.50	2.48	0.18	2.50	UG/L
2-BUTANONE	WCS	47	2	2.00	5.00	4.94	0.44	5.00	UG/L
2-HEXANONE	WCS	63	0	5.00	5.00	5.00	0.00	5.00	UG/L
4-METHYL-2-PENTANONE	WCS	67	0	5.00	5.00	5.00	0.00	5.00	UG/L
ACETONE	WCS	65	17	1.00	30.00	5.77	4.16	5.00	UG/L
BENZENE	WCS	69	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMODICHLOROMETHANE	WCS	67	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOFORM	WCS	67	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOMETHANE	WCS	67	0	5.00	5.00	5.00	0.00	5.00	UG/L
CARBON DISULFIDE	WCS	65	8	1.00	31.00	3.14	3.95	2.50	UG/L
CARBON TETRACHLORIDE	WCS	65	2	2.00	2.50	2.49	0.06	2.50	UG/L
CHLOROBENZENE	WCS	69	1	2.00	2.50	2.49	0.06	2.50	UG/L
CHLOROETHANE	WCS	67	0	5.00	5.00	5.00	0.00	5.00	UG/L
CHLOROFORM	WCS	69	3	1.00	2.50	2.46	0.25	2.50	UG/L
CHLOROMETHANE	WCS	67	0	5.00	5.00	5.00	0.00	5.00	UG/L
DIBROMOCHLOROMETHANE	WCS	69	0	2.50	2.50	2.50	0.00	2.50	UG/L
ETHYLBENZENE	WCS	69	0	2.50	2.50	2.50	0.00	2.50	UG/L
METHYLENE CHLORIDE	WCS	69	22	1.00	18.00	2.83	2.08	2.50	UG/L
STYRENE	WCS	67	0	2.50	2.50	2.50	0.00	2.50	UG/L
TETRACHLOROETHENE	WCS	69	3	2.50	42.00	3.08	4.75	2.50	UG/L
TOLUENE	WCS	69	4	0.40	2.50	2.43	0.35	2.50	UG/L
TOTAL XYLENES	WCS	65	0	2.50	2.50	2.50	0.00	2.50	UG/L
TRICHLOROETHENE	WCS	69	3	2.00	27.00	2.85	2.95	2.50	UG/L
VINYL ACETATE	WCS	60	0	5.00	5.00	5.00	0.00	5.00	UG/L
VINYL CHLORIDE	WCS	69	0	5.00	5.00	5.00	0.00	5.00	UG/L
cis-1,3-DICHLOROPROPENE	WCS	69	1	2.50	3.00	2.51	0.06	2.50	UG/L
trans-1,2-DICHLOROETHENE	WCS	4	0	2.50	2.50	2.50	0.00	2.50	UG/L
trans-1,3-DICHLOROPROPEN	WCS	69	0	2.50	2.50	2.50	0.00	2.50	UG/L

Table D-6 (cont').

SUMMARY STATISTICS BY GEOLOGIC UNIT

GROUNDWATER, VOLATILE ORGANICS (CONT')

ANALYTE	GEOLOGIC UNIT	N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,1,1-TRICHLOROETHANE	KAR	87	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1,2,2-TETRACHLOROETHA	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1,2-TRICHLOROETHANE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHANE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHENE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROETHANE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROETHENE	KAR	82	1	2.50	3.00	2.51	0.06	2.50	UG/L
1,2-DICHLOROPROPANE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
2-BUTANONE	KAR	68	1	1.00	5.00	4.94	0.49	5.00	UG/L
2-HEXANONE	KAR	84	0	2.50	5.00	4.97	0.27	5.00	UG/L
4-METHYL-2-PENTANONE	KAR	88	0	5.00	5.00	5.00	0.00	5.00	UG/L
ACETONE	KAR	82	18	1.00	18.00	5.35	2.03	5.00	UG/L
BENZENE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMODICHLOROMETHANE	KAR	87	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOFORM	KAR	87	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOMETHANE	KAR	83	0	5.00	5.00	5.00	0.00	5.00	UG/L
CARBON DISULFIDE	KAR	88	2	0.20	12.00	2.58	1.04	2.50	UG/L
CARBON TETRACHLORIDE	KAR	86	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROBENZENE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROETHANE	KAR	87	0	5.00	5.00	5.00	0.00	5.00	UG/L
CHLOROFORM	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROMETHANE	KAR	88	0	5.00	5.00	5.00	0.00	5.00	UG/L
DIBROMOCHLOROMETHANE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
ETHYLBENZENE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
METHYLENE CHLORIDE	KAR	88	30	1.00	17.00	3.18	2.77	2.50	UG/L
STYRENE	KAR	88	0	2.50	2.50	2.50	0.00	2.50	UG/L
TETRACHLOROETHENE	KAR	89	2	1.00	3.50	2.49	0.19	2.50	UG/L
TOLUENE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
TOTAL XYLENES	KAR	88	2	1.00	7.00	2.53	0.51	2.50	UG/L
TRICHLOROETHENE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
VINYL ACETATE	KAR	83	0	5.00	5.00	5.00	0.00	5.00	UG/L
VINYL CHLORIDE	KAR	89	0	5.00	5.00	5.00	0.00	5.00	UG/L
cis-1,3-DICHLOROPROPENE	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
trans-1,2-DICHLOROETHENE	KAR	5	0	2.50	2.50	2.50	0.00	2.50	UG/L
trans-1,3-DICHLOROPROPEN	KAR	89	0	2.50	2.50	2.50	0.00	2.50	UG/L

Table D-7. Summary statistics for dissolved metals in groundwater.

SUMMARY STATISTICS BY FLOW-SYSTEM

GROUNDWATER, DISSOLVED METALS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	LOWER	66	79	3.00	256.00	48.81	44.02	100.00	UG/L
ANTIMONY	LOWER	63	44	4.00	35.65	15.50	9.17	30.00	UG/L
ARSENIC	LOWER	59	49	0.40	6.20	2.41	1.70	5.00	UG/L
BARIUM	LOWER	66	86	34.80	132.50	84.18	21.79	110.00	UG/L
BERYLLIUM	LOWER	56	11	0.30	2.50	0.90	0.73	2.00	UG/L
CADMIUM	LOWER	62	23	0.50	7.55	1.76	1.33	2.50	UG/L
CALCIUM	LOWER	67	100	8,190.00	79,400.00	34,535.82	23,552.79	66,500.00	UG/L
CESIUM	LOWER	54	30	2.00	500.00	160.88	179.94	500.00	UG/L
CHROMIUM	LOWER	65	26	1.00	15.50	3.97	3.15	6.80	UG/L
COBALT	LOWER	61	11	1.00	25.00	5.16	7.88	5.00	UG/L
COPPER	LOWER	65	28	0.50	12.50	4.17	3.83	8.00	UG/L
IRON	LOWER	67	79	1.50	181.00	33.67	35.32	50.00	UG/L
LEAD	LOWER	64	20	0.40	41.60	1.80	5.27	2.50	UG/L
LITHIUM	LOWER	66	82	2.00	104.00	38.53	27.84	87.30	UG/L
MAGNESIUM	LOWER	67	97	1,720.00	16,400.00	6,072.16	4,067.56	12,300.00	UG/L
MANGANESE	LOWER	67	72	0.50	30.20	9.29	7.24	16.80	UG/L
MERCURY	LOWER	53	15	0.05	1.20	0.13	0.15	0.20	UG/L
MOLYBDENUM	LOWER	64	53	1.00	100.00	16.86	27.01	22.00	UG/L
NICKEL	LOWER	65	23	1.00	20.00	5.81	6.26	9.65	UG/L
PHOSPHORUS	LOWER	4	100	90.50	285.00	174.75	85.65	285.00	UG/L
POTASSIUM	LOWER	67	90	366.00	5,800.00	2,731.18	1,612.39	4,750.00	UG/L
SELENIUM	LOWER	54	30	0.50	6.00	1.34	1.09	2.50	UG/L
SILVER	LOWER	59	29	1.00	9.40	2.69	2.01	5.00	UG/L
SODIUM	LOWER	67	100	11,000.00	452,000.00	142,012.69	135,521.56	346,000.00	UG/L
STRONTIUM	LOWER	66	100	89.50	1,140.00	383.02	294.27	931.00	UG/L
THALLIUM	LOWER	56	21	0.30	10.00	1.72	1.87	5.00	UG/L
TIN	LOWER	65	40	4.70	100.00	23.07	25.30	44.20	UG/L
VANADIUM	LOWER	65	57	0.50	25.00	6.71	7.60	11.70	UG/L
ZINC	LOWER	67	84	1.00	80.90	10.96	10.20	15.60	UG/L

Table D-7 (cont').

SUMMARY STATISTICS BY FLOW-SYSTEM

GROUNDWATER, DISSOLVED METALS (CONT')

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	UPPER	248	78	2.50	1,036.00	59.52	87.29	100.00	UG/L
ANTIMONY	UPPER	248	48	3.00	54.10	17.34	11.10	30.00	UG/L
ARSENIC	UPPER	220	7	0.40	15.00	1.63	1.84	5.00	UG/L
BARIUM	UPPER	256	84	14.75	203.00	83.42	34.56	116.00	UG/L
BERYLLIUM	UPPER	212	10	0.15	4.00	1.01	0.83	2.50	UG/L
CADMIUM	UPPER	240	22	0.50	8.60	1.73	1.26	2.50	UG/L
CALCIUM	UPPER	256	100	15,150.00	184,000.00	55,414.55	32,564.11	83,300.00	UG/L
CESIUM	UPPER	211	21	2.00	2,500.00	202.20	285.69	500.00	UG/L
CHROMIUM	UPPER	250	36	1.00	23.20	4.84	3.80	8.65	UG/L
COBALT	UPPER	231	18	1.00	29.00	6.60	9.04	25.00	UG/L
COPPER	UPPER	248	39	0.50	20.90	5.01	4.42	12.50	UG/L
CYANIDE	UPPER	3	33	2.50	10.00	5.83	3.82	10.00	UG/L
IRON	UPPER	255	76	1.00	1,106.50	56.26	113.44	59.90	UG/L
LEAD	UPPER	251	24	0.20	64.00	1.59	4.71	2.50	UG/L
LITHIUM	UPPER	250	75	0.50	250.00	33.95	54.30	50.00	UG/L
MAGNESIUM	UPPER	253	96	2,120.00	46,300.00	10,038.28	8,309.40	16,500.00	UG/L
MANGANESE	UPPER	255	61	0.50	440.00	27.47	67.43	30.70	UG/L
MERCURY	UPPER	207	10	0.05	0.69	0.11	0.07	0.10	UG/L
MOLYBDENUM	UPPER	241	37	1.00	114.00	19.64	33.94	50.00	UG/L
NICKEL	UPPER	236	33	1.00	35.80	7.01	7.18	20.00	UG/L
PHOSPHORUS	UPPER	8	100	80.00	231.00	167.00	52.43	210.00	UG/L
POTASSIUM	UPPER	252	82	160.00	8,110.00	1,371.50	1,069.01	2,500.00	UG/L
SELENIUM	UPPER	219	32	0.50	173.00	5.58	19.07	6.50	UG/L
SILVER	UPPER	235	29	1.00	11.80	2.84	2.12	5.00	UG/L
SODIUM	UPPER	254	99	2,500.00	252,000.00	32,012.98	43,667.67	46,900.00	UG/L
STRONTIUM	UPPER	252	93	50.00	1,910.00	323.60	303.58	579.00	UG/L
THALLIUM	UPPER	212	22	0.30	5.00	1.64	1.63	5.00	UG/L
TIN	UPPER	235	43	2.00	340.00	30.96	37.34	58.80	UG/L
VANADIUM	UPPER	249	65	0.60	50.00	7.92	8.73	25.00	UG/L
ZINC	UPPER	256	80	1.00	137.00	14.03	17.87	19.05	UG/L

Table D-8. Summary statistics for total metals in groundwater.

SUMMARY STATISTICS BY FLOW-SYSTEM

GROUNDWATER, TOTAL METALS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	LOWER	37	92	11.00	11,700.00	1,791.87	2,773.43	4,790.00	UG/L
ANTIMONY	LOWER	35	31	3.50	41.30	15.62	10.40	30.00	UG/L
ARSENIC	LOWER	35	54	0.35	7.00	2.76	2.02	5.00	UG/L
BARIUM	LOWER	36	86	61.50	303.00	113.95	51.97	147.00	UG/L
BERYLLIUM	LOWER	36	8	0.30	2.50	0.86	0.74	2.00	UG/L
CADMIUM	LOWER	36	19	0.50	3.50	1.45	0.75	2.50	UG/L
CALCIUM	LOWER	37	100	10,800.00	91,900.00	36,382.43	23,881.47	62,000.00	UG/L
CESIUM	LOWER	35	26	2.00	500.00	131.59	175.16	250.00	UG/L
CHROMIUM	LOWER	36	39	1.00	21.40	5.25	4.61	8.60	UG/L
COBALT	LOWER	36	8	1.00	25.00	5.55	8.18	10.00	UG/L
COPPER	LOWER	36	61	1.00	125.00	11.99	21.82	14.80	UG/L
CYANIDE	LOWER	40	13	0.75	4.00	1.31	0.85	1.87	UG/L
IRON	LOWER	37	95	9.80	16,900.00	2,239.92	3,697.44	4,450.00	UG/L
LEAD	LOWER	36	61	0.50	17.70	3.82	4.29	7.30	UG/L
LITHIUM	LOWER	37	86	6.20	106.00	40.69	29.29	78.30	UG/L
MAGNESIUM	LOWER	37	95	1,950.00	19,700.00	6,679.46	5,030.81	11,500.00	UG/L
MANGANESE	LOWER	37	86	1.00	710.00	61.87	125.21	126.00	UG/L
MERCURY	LOWER	37	27	0.10	0.24	0.13	0.05	0.20	UG/L
MOLYBDENUM	LOWER	36	47	1.00	100.00	18.59	33.45	19.00	UG/L
NICKEL	LOWER	35	34	1.00	24.50	8.70	7.25	20.00	UG/L
POTASSIUM	LOWER	37	89	516.00	6,870.00	2,846.38	1,725.69	4,300.00	UG/L
SELENIUM	LOWER	36	33	0.50	2.50	1.19	0.63	2.00	UG/L
SILICON	LOWER	20	100	3,720.00	29,500.00	9,427.50	6,631.12	14,000.00	UG/L
SILVER	LOWER	35	17	1.00	10.00	2.19	2.03	5.00	UG/L
SODIUM	LOWER	37	100	11,500.00	434,000.00	139,228.38	134,404.33	327,000.00	UG/L
STRONTIUM	LOWER	37	97	100.00	1,170.00	399.78	312.58	799.00	UG/L
THALLIUM	LOWER	36	28	0.45	5.00	1.40	1.50	2.00	UG/L
TIN	LOWER	37	30	4.70	100.00	27.46	31.18	50.00	UG/L
VANADIUM	LOWER	36	69	0.50	46.70	10.43	11.26	25.00	UG/L
ZINC	LOWER	36	97	5.00	189.00	52.45	51.31	114.00	UG/L

Table D-8 (cont').

SUMMARY STATISTICS BY FLOW-SYSTEM

GROUNDWATER, TOTAL METALS (CONT')

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	UPPER	147	95	22.60	19,950.00	2,742.80	4,248.73	5,470.00	UG/L
ANTIMONY	UPPER	141	38	3.60	86.60	19.19	12.85	30.00	UG/L
ARSENIC	UPPER	138	28	0.35	5.00	1.95	1.71	5.00	UG/L
BARIUM	UPPER	148	82	25.90	317.00	102.44	45.37	142.00	UG/L
BERYLLIUM	UPPER	148	12	0.40	4.80	1.07	0.87	2.50	UG/L
CADMIUM	UPPER	148	20	0.50	11.10	1.64	1.29	2.50	UG/L
CALCIUM	UPPER	149	100	15,950.00	186,000.00	55,030.23	31,667.78	81,000.00	UG/L
CESIUM	UPPER	142	25	2.00	500.00	154.42	198.79	500.00	UG/L
CHROMIUM	UPPER	143	48	1.00	31.65	7.01	6.68	11.40	UG/L
COBALT	UPPER	148	16	1.00	39.40	7.64	9.67	25.00	UG/L
COPPER	UPPER	148	74	1.00	105.00	10.67	12.21	12.50	UG/L
CYANIDE	UPPER	155	12	0.75	5.55	1.20	0.67	1.25	UG/L
IRON	UPPER	147	98	6.50	27,100.00	3,017.34	4,994.50	5,990.00	UG/L
LEAD	UPPER	140	69	0.50	25.00	3.26	3.64	6.15	UG/L
LITHIUM	UPPER	149	79	1.10	266.00	33.75	48.76	50.00	UG/L
MAGNESIUM	UPPER	149	97	2,230.25	47,900.00	10,315.64	7,956.43	15,900.00	UG/L
MANGANESE	UPPER	148	90	0.50	584.00	79.59	108.18	181.00	UG/L
MERCURY	UPPER	148	20	0.10	0.27	0.12	0.04	0.20	UG/L
MOLYBDENUM	UPPER	150	34	1.00	100.00	24.09	39.47	100.00	UG/L
NICKEL	UPPER	145	37	1.00	71.60	10.58	9.49	20.00	UG/L
POTASSIUM	UPPER	150	77	243.00	8,370.00	1,731.21	1,176.59	2,500.00	UG/L
SELENIUM	UPPER	144	31	0.50	203.00	4.57	18.64	2.50	UG/L
SILICON	UPPER	82	100	4,399.00	51,650.00	15,564.97	10,797.33	23,200.00	UG/L
SILVER	UPPER	147	16	1.00	10.00	2.35	1.80	5.00	UG/L
SODIUM	UPPER	149	99	2,500.00	194,000.00	30,081.85	40,019.71	42,000.00	UG/L
STRONTIUM	UPPER	146	89	58.10	1,770.00	312.61	271.09	560.00	UG/L
THALLIUM	UPPER	146	24	0.45	5.00	1.67	1.76	5.00	UG/L
TIN	UPPER	149	35	4.70	100.00	33.88	35.33	100.00	UG/L
VANADIUM	UPPER	148	77	1.00	123.00	13.81	14.09	25.00	UG/L
ZINC	UPPER	149	92	4.20	498.00	37.16	49.80	53.60	UG/L

Table D-9. Summary statistics for dissolved radionuclides in groundwater.

SUMMARY STATISTICS BY FLOW-SYSTEM

GROUNDWATER, DISSOLVED RADIONUCLIDES

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
AMERICIUM-241	LOWER	1	100	0.03	0.03	0.03	.	0.03	PCI/L
CESIUM-137	LOWER	4	100	-0.19	0.53	0.22	0.30	0.53	PCI/L
GROSS ALPHA	LOWER	60	100	-0.45	36.65	3.13	6.24	3.98	PCI/L
GROSS BETA	LOWER	54	100	-1.30	13.80	3.23	2.84	4.88	PCI/L
RADIUM-226	LOWER	2	100	0.47	2.98	1.72	1.78	2.98	PCI/L
STRONTIUM-89,90	LOWER	41	100	-0.17	1.29	0.29	0.25	0.47	PCI/L
TRITIUM	LOWER	49	100	-252.00	413.10	56.88	135.94	174.30	PCI/L
URANIUM-233,234	LOWER	57	100	-0.01	15.33	1.64	2.85	3.62	PCI/L
URANIUM-235	LOWER	57	100	-0.04	0.23	0.03	0.06	0.08	PCI/L
URANIUM-238	LOWER	54	100	-0.18	8.01	0.77	1.53	0.96	PCI/L
AMERICIUM-241	UPPER	2	100	0.00	0.02	0.01	0.01	0.02	PCI/L
CESIUM-137	UPPER	38	100	-0.19	2.60	0.42	0.53	0.86	PCI/L
GROSS ALPHA	UPPER	213	100	-0.65	312.70	8.35	32.32	9.00	PCI/L
GROSS BETA	UPPER	196	100	-1.50	135.90	4.89	12.23	6.20	PCI/L
PLUTONIUM-239,240	UPPER	1	100	0.01	0.01	0.01	.	0.01	PCI/L
RADIUM-226	UPPER	36	100	0.06	0.53	0.26	0.11	0.39	PCI/L
RADIUM-228	UPPER	6	100	1.70	3.00	2.12	0.52	3.00	PCI/L
STRONTIUM-89,90	UPPER	180	100	-0.40	1.80	0.34	0.31	0.55	PCI/L
TRITIUM	UPPER	164	100	-223.00	955.45	93.50	146.76	228.20	PCI/L
URANIUM-233,234	UPPER	205	100	-0.02	199.50	6.23	23.94	4.69	PCI/L
URANIUM-235	UPPER	207	100	-0.04	4.80	0.20	0.64	0.20	PCI/L
URANIUM-238	UPPER	176	100	-0.04	135.60	4.77	17.71	4.20	PCI/L

Table D-10. Summary statistics for total radionuclides in groundwater.

SUMMARY STATISTICS BY FLOW-SYSTEM

GROUNDWATER, TOTAL RADIONUCLIDES

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
AMERICIUM-241	LOWER	43	100	-0.00	0.10	0.01	0.02	0.01	PCI/L
CESIUM-137	LOWER	39	100	-0.44	0.72	0.00	0.29	0.32	PCI/L
GROSS ALPHA	LOWER	6	100	2.89	44.90	11.08	16.63	44.90	PCI/L
GROSS BETA	LOWER	6	100	3.90	39.20	12.01	13.45	39.20	PCI/L
PLUTONIUM-238	LOWER	5	100	0.00	0.04	0.01	0.01	0.04	PCI/L
PLUTONIUM-239,240	LOWER	48	100	-0.00	0.05	0.00	0.01	0.00	PCI/L
RADIUM-226	LOWER	3	100	0.07	0.88	0.59	0.45	0.88	PCI/L
STRONTIUM-89,90	LOWER	4	100	-0.24	0.39	0.10	0.26	0.39	PCI/L
TRITIUM	LOWER	15	100	-180.00	400.00	-22.87	135.19	10.00	PCI/L
URANIUM-233,234	LOWER	4	100	0.15	1.52	0.77	0.57	1.52	PCI/L
URANIUM-235	LOWER	4	100	0.00	0.04	0.03	0.02	0.04	PCI/L
URANIUM-238	LOWER	2	100	0.17	0.53	0.35	0.26	0.53	PCI/L
AMERICIUM-241	UPPER	183	100	-0.01	0.10	0.01	0.01	0.01	PCI/L
CESIUM-137	UPPER	156	100	-0.59	1.16	0.12	0.33	0.41	PCI/L
GROSS ALPHA	UPPER	23	100	0.35	362.00	43.50	94.28	42.90	PCI/L
GROSS BETA	UPPER	23	100	0.20	220.00	24.95	53.34	16.10	PCI/L
PLUTONIUM-238	UPPER	15	100	-0.00	0.03	0.00	0.01	0.00	PCI/L
PLUTONIUM-239,240	UPPER	194	100	-0.01	0.22	0.00	0.02	0.00	PCI/L
RADIUM-226	UPPER	6	100	0.18	0.52	0.36	0.13	0.52	PCI/L
STRONTIUM-89,90	UPPER	32	100	-0.29	1.12	0.22	0.28	0.42	PCI/L
TRITIUM	UPPER	83	100	-240.00	1,385.00	162.14	225.49	350.00	PCI/L
URANIUM-233,234	UPPER	35	100	0.00	164.00	15.62	38.75	14.00	PCI/L
URANIUM-235	UPPER	35	100	-0.02	6.29	0.62	1.38	0.67	PCI/L
URANIUM-238	UPPER	22	100	0.00	108.00	10.84	27.73	9.30	PCI/L

Table D-11. Summary statistics for water-quality parameters in groundwater.

SUMMARY STATISTICS BY FLOW-SYSTEM

GROUNDWATER, WATER-QUALITY PARAMETERS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALKALINITY AS CACO3	LOWER	3	100	205,500.00	490,000.00	305,166.67	160,234.46	490,000.00	UG/L
BICARBONATE	LOWER	93	100	63,398.40	719,328.00	233,546.17	102,980.99	268,224.00	UG/L
CARBONATE	LOWER	92	28	0.00	19,100.00	3,318.77	4,245.24	7,195.20	UG/L
CHLORIDE	LOWER	79	96	1,600.00	430,000.00	100,205.95	128,066.02	250,000.00	UG/L
CYANIDE	LOWER	18	17	2.00	20.00	7.19	4.23	10.00	UG/L
FLUORIDE	LOWER	92	98	120.00	2,000.00	949.35	465.34	1,500.00	UG/L
NITRATE/NITRITE	LOWER	90	79	10.00	3,600.00	861.22	945.96	1,800.00	UG/L
NITRITE	LOWER	16	56	10.00	900.00	190.62	295.19	580.00	UG/L
ORTHOPHOSPHATE	LOWER	54	61	5.00	40.00	18.46	10.16	30.00	UG/L
PH	LOWER	2	100	7.30	8.40	7.85	0.78	8.40	PH
PHOSPHORUS	LOWER	14	64	5.00	960.00	173.57	264.99	370.00	UG/L
SILICA	LOWER	83	100	2,400.00	28,200.00	8,077.25	5,808.92	11,000.00	UG/L
SULFATE	LOWER	82	95	600.00	1,200,000.00	123,943.90	250,872.10	350,000.00	UG/L
TOTAL DISSOLVED SOLIDS	LOWER	94	100	120,000.00	1,700,000.00	545,138.30	445,290.59	1,000,000.00	UG/L
TOTAL SOLIDS	LOWER	5	80	2,500.00	885,000.00	318,240.00	356,657.98	885,000.00	UG/L
TOTAL SUSPENDED SOLIDS	LOWER	88	77	2,000.00	4,600,000.00	403,085.23	727,972.80	868,000.00	UG/L
ALKALINITY AS CACO3	UPPER	3	100	60,500.00	340,000.00	156,900.00	158,643.41	340,000.00	UG/L
BICARBONATE	UPPER	311	100	46,939.20	755,904.00	223,807.08	151,717.58	365,760.00	UG/L
CARBONATE	UPPER	300	10	0.00	32,378.40	1,824.96	3,479.53	5,000.00	UG/L
CHLORIDE	UPPER	257	93	1,200.00	118,000.00	12,241.67	12,930.51	23,000.00	UG/L
CYANIDE	UPPER	66	20	2.00	20.00	7.94	5.01	10.00	UG/L
FLUORIDE	UPPER	300	98	100.00	2,900.00	611.07	472.04	900.00	UG/L
NITRATE/NITRITE	UPPER	305	82	10.00	12,000.00	1,048.34	1,807.86	2,000.00	UG/L
NITRITE	UPPER	54	37	10.00	200.00	27.94	38.25	50.00	UG/L
ORTHOPHOSPHATE	UPPER	191	53	0.01	200.00	15.05	17.47	25.00	UG/L
PH	UPPER	3	100	6.90	7.70	7.17	0.46	7.70	PH
PHOSPHORUS	UPPER	56	57	5.00	170.00	39.45	41.60	97.00	UG/L
SILICA	UPPER	274	100	3,800.00	57,000.00	14,082.92	8,075.96	23,104.44	UG/L
SODIUM NITRITE	UPPER	1	100	20.00	20.00	20.00	.	20.00	UG/L
SULFATE	UPPER	278	100	2,900.00	1,200,000.00	86,370.14	174,613.96	93,000.00	UG/L
TOTAL DISSOLVED SOLIDS	UPPER	310	100	66,000.00	1,580,000.00	355,495.44	312,010.29	530,000.00	UG/L
TOTAL SOLIDS	UPPER	4	75	2,500.00	79,100.00	24,025.00	36,789.98	79,100.00	UG/L
TOTAL SUSPENDED SOLIDS	UPPER	301	80	2,000.00	6,400,000.00	133,396.64	429,323.86	220,000.00	UG/L

Table D-12. Summary statistics for volatile organics in groundwater.

SUMMARY STATISTICS BY FLOW-SYSTEM

GROUNDWATER, VOLATILE ORGANICS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,1,1-TRICHLOROETHANE	LOWER	87	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1,2,2-TETRACHLOROETHANE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1,2-TRICHLOROETHANE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHANE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHENE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROETHANE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROETHENE	LOWER	82	1	2.50	3.00	2.51	0.06	2.50	UG/L
1,2-DICHLOROPROPANE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
2-BUTANONE	LOWER	68	1	1.00	5.00	4.94	0.49	5.00	UG/L
2-HEXANONE	LOWER	84	0	2.50	5.00	4.97	0.27	5.00	UG/L
4-METHYL-2-PENTANONE	LOWER	88	0	5.00	5.00	5.00	0.00	5.00	UG/L
ACETONE	LOWER	82	18	1.00	18.00	5.35	2.03	5.00	UG/L
BENZENE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMODICHLOROMETHANE	LOWER	87	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOFORM	LOWER	87	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOMETHANE	LOWER	83	0	5.00	5.00	5.00	0.00	5.00	UG/L
CARBON DISULFIDE	LOWER	88	2	0.20	12.00	2.58	1.04	2.50	UG/L
CARBON TETRACHLORIDE	LOWER	86	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROBENZENE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROETHANE	LOWER	87	0	5.00	5.00	5.00	0.00	5.00	UG/L
CHLOROFORM	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROMETHANE	LOWER	88	0	5.00	5.00	5.00	0.00	5.00	UG/L
DIBROMOCHLOROMETHANE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
ETHYLBENZENE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
METHYLENE CHLORIDE	LOWER	88	30	1.00	17.00	3.18	2.77	2.50	UG/L
STYRENE	LOWER	88	0	2.50	2.50	2.50	0.00	2.50	UG/L
TETRACHLOROETHENE	LOWER	89	2	1.00	3.50	2.49	0.19	2.50	UG/L
TOLUENE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
TOTAL XYLENES	LOWER	88	2	1.00	7.00	2.53	0.51	2.50	UG/L
TRICHLOROETHENE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
VINYL ACETATE	LOWER	83	0	5.00	5.00	5.00	0.00	5.00	UG/L
VINYL CHLORIDE	LOWER	89	0	5.00	5.00	5.00	0.00	5.00	UG/L
cis-1,3-DICHLOROPROPENE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L
trans-1,2-DICHLOROETHENE	LOWER	5	0	2.50	2.50	2.50	0.00	2.50	UG/L
trans-1,3-DICHLOROPROPENE	LOWER	89	0	2.50	2.50	2.50	0.00	2.50	UG/L

Table D-12 (cont').

SUMMARY STATISTICS BY FLOW-SYSTEM

GROUNDWATER, VOLATILE ORGANICS (CONT')

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,1,1,2-TETRACHLOROETHANE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,1,1-TRICHLOROETHANE	UPPER	289	2	2.00	10.00	2.55	0.56	2.50	UG/L
1,1,2,2-TETRACHLOROETHANE	UPPER	296	0	1.30	2.50	2.49	0.08	2.50	UG/L
1,1,2-TRICHLOROETHANE	UPPER	296	0	1.32	2.50	2.50	0.07	2.50	UG/L
1,1-DICHLOROETHANE	UPPER	296	1	2.00	2.75	2.50	0.03	2.50	UG/L
1,1-DICHLOROETHENE	UPPER	288	1	1.00	7.00	2.52	0.35	2.50	UG/L
1,1-DICHLOROPROPENE	UPPER	1	0	0.05	0.05	0.05	.	0.05	UG/L
1,2,3-TRICHLOROBENZENE	UPPER	1	0	0.05	0.05	0.05	.	0.05	UG/L
1,2,3-TRICHLOROPROPANE	UPPER	1	0	0.20	0.20	0.20	.	0.20	UG/L
1,2,4-TRICHLOROBENZENE	UPPER	2	0	0.05	0.10	0.08	0.04	0.10	UG/L
1,2-DIBROMOETHANE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,2-DICHLOROBENZENE	UPPER	1	0	0.05	0.05	0.05	.	0.05	UG/L
1,2-DICHLOROETHANE	UPPER	294	0	1.00	2.50	2.49	0.11	2.50	UG/L
1,2-DICHLOROETHENE	UPPER	285	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROPROPANE	UPPER	296	0	1.00	2.50	2.49	0.11	2.50	UG/L
1,2-DIMETHYLBENZENE	UPPER	1	0	0.15	0.15	0.15	.	0.15	UG/L
1,3-DICHLOROBENZENE	UPPER	1	0	0.05	0.05	0.05	.	0.05	UG/L
1,3-DICHLOROPROPANE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,3-DIMETHYLBENZENE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,4-DICHLOROBENZENE	UPPER	1	0	0.15	0.15	0.15	.	0.15	UG/L
2-BUTANONE	UPPER	229	0	2.00	5.00	4.99	0.20	5.00	UG/L
2-CHLOROETHYL VINYL ETHER	UPPER	3	0	5.00	5.00	5.00	0.00	5.00	UG/L
2-HEXANONE	UPPER	280	0	3.00	5.00	4.99	0.12	5.00	UG/L
4-METHYL-2-PENTANONE	UPPER	302	0	3.00	5.00	4.99	0.12	5.00	UG/L
ACETONE	UPPER	280	16	1.00	19.00	5.42	1.97	5.00	UG/L
BENZENE	UPPER	296	0	0.20	2.50	2.48	0.16	2.50	UG/L
BENZENE, 1,2,4-TRIMETHYL	UPPER	1	0	0.15	0.15	0.15	.	0.15	UG/L
BENZENE, 1,3,5-TRIMETHYL-	UPPER	1	0	0.05	0.05	0.05	.	0.05	UG/L
BROMOBENZENE	UPPER	1	0	0.05	0.05	0.05	.	0.05	UG/L
BROMOCHLOROMETHANE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
BROMODICHLOROMETHANE	UPPER	294	0	1.30	2.50	2.50	0.07	2.50	UG/L
BROMOFORM	UPPER	294	0	1.30	2.50	2.50	0.07	2.50	UG/L
BROMOMETHANE	UPPER	287	0	2.52	5.00	4.99	0.15	5.00	UG/L
CARBON DISULFIDE	UPPER	293	3	0.70	17.00	2.57	0.98	2.50	UG/L
CARBON TETRACHLORIDE	UPPER	277	1	2.00	15.00	2.54	0.75	2.50	UG/L
CHLOROBENZENE	UPPER	296	1	1.27	2.50	2.49	0.12	2.50	UG/L
CHLOROETHANE	UPPER	286	0	2.52	5.00	4.99	0.15	5.00	UG/L
CHLOROFORM	UPPER	286	1	1.00	4.00	2.49	0.15	2.50	UG/L
CHLOROMETHANE	UPPER	287	0	2.55	5.00	4.99	0.14	5.00	UG/L
CUMENE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
DIBROMOCHLOROMETHANE	UPPER	296	0	1.30	2.50	2.50	0.07	2.50	UG/L
DIBROMOMETHANE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
DICHLORODIFLUOROMETHANE	UPPER	2	0	0.15	0.25	0.20	0.07	0.25	UG/L
ETHYLBENZENE	UPPER	296	0	1.27	2.50	2.50	0.07	2.50	UG/L
HEXACHLOROBUTADIENE	UPPER	1	0	0.20	0.20	0.20	.	0.20	UG/L
METHYLENE CHLORIDE	UPPER	286	25	1.00	19.00	2.92	2.08	2.50	UG/L
NAPHTHALENE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
PROPANE, 1,2-DIBROMO-3-CHLORO-	UPPER	1	0	0.25	0.25	0.25	.	0.25	UG/L
STYRENE	UPPER	290	0	1.30	2.50	2.50	0.07	2.50	UG/L
TETRACHLOROETHENE	UPPER	286	1	2.50	13.00	2.57	0.84	2.50	UG/L
TOLUENE	UPPER	299	3	0.40	6.00	2.46	0.39	2.50	UG/L
TOTAL XYLENES	UPPER	292	0	2.50	2.50	2.50	0.00	2.50	UG/L
TRICHLOROETHENE	UPPER	286	3	1.50	14.00	2.56	0.85	2.50	UG/L
TRICHLOROFLUOROMETHANE	UPPER	2	0	0.05	0.25	0.15	0.14	0.25	UG/L
VINYL ACETATE	UPPER	288	0	5.00	5.00	5.00	0.00	5.00	UG/L
VINYL CHLORIDE	UPPER	295	0	2.55	5.00	4.99	0.14	5.00	UG/L
cis-1,2-DICHLOROETHENE	UPPER	2	100	66.00	70.00	68.00	2.83	70.00	UG/L
cis-1,3-DICHLOROPROPENE	UPPER	296	0	1.27	3.00	2.50	0.08	2.50	UG/L
n-BUTYLBENZENE	UPPER	1	0	0.05	0.05	0.05	.	0.05	UG/L
n-PROPYLBENZENE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
o-CHLOROTOLUENE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
p-CHLOROTOLUENE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
p-CYMENE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
p-XYLENE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
sec-BUTYLBENZENE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
sec-DICHLOROPROPANE	UPPER	1	0	0.05	0.05	0.05	.	0.05	UG/L
tert-BUTYLBENZENE	UPPER	1	0	0.10	0.10	0.10	.	0.10	UG/L
trans-1,2-DICHLOROETHENE	UPPER	24	4	0.30	2.50	2.41	0.45	2.50	UG/L
trans-1,3-DICHLOROPROPENE	UPPER	290	0	1.32	2.50	2.50	0.07	2.50	UG/L

Table D-13. Summary statistics for total metals in geologic materials.

SUMMARY STATISTICS BY GEOLOGIC UNIT

GEOLOGIC MATERIALS, TOTAL METALS

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	COL	28	100	4,300.00	22,900.00	10,541.43	4,945.95	16,100.00	MG/KG
ANTIMONY	COL	18	0	1.00	7.45	4.59	2.17	7.25	MG/KG
ARSENIC	COL	28	86	0.50	6.60	3.57	1.74	5.20	MG/KG
BARIUM	COL	28	100	46.95	491.00	133.20	94.05	189.00	MG/KG
BERYLLIUM	COL	28	96	0.55	22.40	5.47	5.47	10.30	MG/KG
CADMIUM	COL	26	58	0.10	1.80	0.86	0.42	1.20	MG/KG
CALCIUM	COL	28	100	3,830.00	25,900.00	9,082.14	6,369.14	11,700.00	MG/KG
CESIUM	COL	24	75	81.75	274.00	206.24	56.88	244.00	MG/KG
CHROMIUM	COL	28	100	6.30	26.90	13.79	5.86	21.30	MG/KG
COBALT	COL	28	25	2.05	15.90	6.11	3.87	10.60	MG/KG
COPPER	COL	28	96	2.35	28.00	14.67	5.48	19.50	MG/KG
IRON	COL	28	100	7,420.00	35,900.00	15,028.07	6,715.26	19,700.00	MG/KG
LEAD	COL	28	100	6.60	29.90	16.23	4.62	19.40	MG/KG
LITHIUM	COL	28	29	2.35	24.40	8.52	7.56	18.00	MG/KG
MAGNESIUM	COL	28	79	865.00	5,580.00	2,987.32	1,577.90	4,730.00	MG/KG
MANGANESE	COL	28	100	37.00	747.00	191.87	160.26	303.00	MG/KG
MERCURY	COL	27	22	0.05	0.87	0.18	0.20	0.36	MG/KG
MOLYBDENUM	COL	28	18	1.10	26.80	8.95	5.57	12.20	MG/KG
NICKEL	COL	28	93	2.15	36.20	16.97	8.28	25.10	MG/KG
POTASSIUM	COL	28	36	328.00	3,090.00	979.61	721.36	1,790.00	MG/KG
SELENIUM	COL	27	22	0.12	3.05	0.85	0.65	1.45	MG/KG
SILVER	COL	19	42	0.28	33.50	5.85	9.46	16.40	MG/KG
SODIUM	COL	28	7	115.00	3,680.00	409.75	660.82	590.00	MG/KG
STRONTIUM	COL	28	86	14.25	121.00	55.92	27.04	82.30	MG/KG
THALLIUM	COL	19	0	0.14	1.25	0.56	0.49	1.20	MG/KG
TIN	COL	23	26	11.45	441.00	87.36	147.51	293.00	MG/KG
VANADIUM	COL	28	100	11.40	58.80	30.31	12.23	40.90	MG/KG
ZINC	COL	28	100	23.90	111.00	56.13	21.92	74.90	MG/KG
ALUMINUM	RFA	62	100	279.00	102,000.00	13,565.95	13,657.25	19,300.00	MG/KG
ANTIMONY	RFA	47	4	0.95	47.00	4.82	7.15	7.55	MG/KG
ARSENIC	RFA	62	69	0.27	41.80	4.15	5.70	6.00	MG/KG
BARIUM	RFA	62	84	9.40	777.00	84.46	100.14	128.00	MG/KG
BERYLLIUM	RFA	62	87	0.46	23.50	4.65	4.66	8.65	MG/KG
CADMIUM	RFA	46	48	0.08	2.30	0.84	0.48	1.30	MG/KG
CALCIUM	RFA	62	82	580.00	157,000.00	6,676.41	19,969.15	5,875.00	MG/KG
CESIUM	RFA	62	76	105.00	2,830.00	242.09	337.12	237.00	MG/KG
CHROMIUM	RFA	62	100	4.10	176.00	22.08	30.15	25.70	MG/KG
COBALT	RFA	62	35	1.90	93.90	8.76	13.16	12.70	MG/KG
COPPER	RFA	62	87	1.10	123.00	11.68	15.59	13.90	MG/KG
IRON	RFA	62	100	1,300.00	132,000.00	14,347.10	16,126.79	18,500.00	MG/KG
LEAD	RFA	62	100	2.60	39.80	9.05	7.07	17.40	MG/KG
LITHIUM	RFA	62	60	1.45	83.20	14.33	12.85	23.00	MG/KG
MAGNESIUM	RFA	62	58	356.50	32,500.00	2,482.38	4,093.78	3,380.00	MG/KG
MANGANESE	RFA	62	100	37.00	3,330.00	235.92	417.44	293.00	MG/KG
MERCURY	RFA	54	43	0.03	5.90	0.29	0.80	0.42	MG/KG
MOLYBDENUM	RFA	62	15	1.15	67.60	9.67	9.64	12.45	MG/KG
NICKEL	RFA	59	88	3.00	193.00	23.35	25.45	34.20	MG/KG
POTASSIUM	RFA	61	28	186.50	18,700.00	1,545.33	3,036.93	2,300.00	MG/KG
SELENIUM	RFA	46	20	0.11	13.70	1.29	2.25	2.80	MG/KG
SILVER	RFA	55	31	0.27	40.90	2.48	5.55	3.30	MG/KG
SODIUM	RFA	62	11	63.00	2,720.00	278.15	398.26	580.00	MG/KG
STRONTIUM	RFA	62	31	10.43	242.00	77.93	87.02	207.00	MG/KG
THALLIUM	RFA	47	4	0.09	4.10	0.56	0.76	1.20	MG/KG
TIN	RFA	60	10	10.10	312.00	19.50	39.41	17.90	MG/KG
VANADIUM	RFA	62	97	4.22	283.00	32.03	34.96	43.40	MG/KG
ZINC	RFA	61	93	0.26	486.00	29.97	61.25	36.10	MG/KG

Table D-13 (cont').

SUMMARY STATISTICS BY GEOLOGIC UNIT

GEOLOGIC MATERIALS, TOTAL METALS (CONT')

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	WCS	8	100	9,950.00	23,900.00	14,181.25	5,023.23	20,000.00	MG/KG
ANTIMONY	WCS	1	0	1.60	1.60	1.60	.	1.60	MG/KG
ARSENIC	WCS	9	78	0.60	5.30	2.94	1.55	4.30	MG/KG
BARIUM	WCS	9	89	19.10	116.00	64.81	26.27	83.20	MG/KG
BERYLLIUM	WCS	9	100	2.30	5.40	3.57	1.09	4.90	MG/KG
CADMIUM	WCS	9	22	0.48	1.10	0.63	0.27	1.10	MG/KG
CALCIUM	WCS	9	67	650.00	4,630.00	2,213.33	1,356.05	3,350.00	MG/KG
CESIUM	WCS	9	100	203.00	223.00	214.89	5.99	221.00	MG/KG
CHROMIUM	WCS	9	100	11.70	31.70	20.70	5.93	26.10	MG/KG
COBALT	WCS	9	11	1.95	11.30	3.13	3.07	2.50	MG/KG
COPPER	WCS	9	100	5.60	25.10	12.14	5.91	15.10	MG/KG
IRON	WCS	9	100	8,860.00	20,700.00	14,262.22	4,066.80	20,100.00	MG/KG
LEAD	WCS	9	100	3.90	12.70	6.68	3.15	10.30	MG/KG
LITHIUM	WCS	9	0	2.75	7.75	4.19	1.45	4.50	MG/KG
MAGNESIUM	WCS	9	56	690.00	4,170.00	2,033.89	1,253.36	3,500.00	MG/KG
MANGANESE	WCS	9	100	39.90	377.00	171.88	99.17	259.00	MG/KG
MERCURY	WCS	5	0	0.05	0.05	0.05	0.00	0.05	MG/KG
MOLYBDENUM	WCS	9	0	1.00	6.75	3.73	2.24	6.60	MG/KG
NICKEL	WCS	9	100	8.80	29.50	15.31	6.87	20.20	MG/KG
POTASSIUM	WCS	9	11	401.50	2,100.00	760.00	519.16	775.00	MG/KG
SELENIUM	WCS	9	67	0.27	2.90	1.95	1.25	2.80	MG/KG
SILVER	WCS	9	100	15.20	35.20	24.29	6.94	34.20	MG/KG
SODIUM	WCS	9	0	89.50	149.50	116.39	17.03	127.00	MG/KG
STRONTIUM	WCS	9	0	10.15	13.20	11.04	0.86	11.15	MG/KG
THALLIUM	WCS	9	0	0.16	0.39	0.24	0.08	0.34	MG/KG
TIN	WCS	9	100	188.00	338.00	278.00	65.04	333.00	MG/KG
VANADIUM	WCS	9	100	19.90	50.70	31.42	11.01	43.00	MG/KG
ZINC	WCS	9	100	11.20	39.00	23.62	8.30	32.20	MG/KG
ALUMINUM	KAR	21	100	2,470.00	13,900.00	7,482.60	2,681.30	9,720.00	MG/KG
ANTIMONY	KAR	15	13	1.00	16.10	4.45	4.53	7.05	MG/KG
ARSENIC	KAR	21	67	0.50	10.80	3.72	3.26	8.00	MG/KG
BARIUM	KAR	21	95	18.00	243.00	99.40	55.10	162.00	MG/KG
BERYLLIUM	KAR	21	100	1.10	16.10	3.35	3.16	4.00	MG/KG
CADMIUM	KAR	19	58	0.09	1.20	0.83	0.37	1.20	MG/KG
CALCIUM	KAR	21	100	2,310.00	9,970.00	5,477.14	1,831.78	6,420.00	MG/KG
CESIUM	KAR	16	94	117.00	258.00	223.62	31.26	244.00	MG/KG
CHROMIUM	KAR	21	100	3.00	13.70	8.91	2.98	12.10	MG/KG
COBALT	KAR	21	24	1.65	29.70	6.74	7.20	11.60	MG/KG
COPPER	KAR	20	100	5.90	26.70	15.76	5.93	22.30	MG/KG
IRON	KAR	20	100	3,040.00	38,900.00	12,963.25	8,753.38	23,000.00	MG/KG
LEAD	KAR	21	100	9.40	29.50	18.91	6.19	25.80	MG/KG
LITHIUM	KAR	21	29	1.05	24.80	7.17	8.39	22.85	MG/KG
MAGNESIUM	KAR	21	67	490.50	5,600.00	2,053.71	1,213.43	2,880.00	MG/KG
MANGANESE	KAR	21	100	14.90	737.00	171.90	183.74	305.00	MG/KG
MERCURY	KAR	21	33	0.05	0.71	0.23	0.24	0.59	MG/KG
MOLYBDENUM	KAR	21	5	1.05	12.40	5.45	3.67	11.43	MG/KG
NICKEL	KAR	19	84	3.65	62.50	18.78	13.39	31.00	MG/KG
POTASSIUM	KAR	21	0	194.00	700.00	486.51	135.78	645.00	MG/KG
SELENIUM	KAR	19	32	0.17	3.20	0.90	1.01	2.90	MG/KG
SILVER	KAR	16	25	0.27	18.70	3.72	6.22	14.75	MG/KG
SODIUM	KAR	21	0	61.04	585.00	215.82	116.13	294.50	MG/KG
STRONTIUM	KAR	21	90	11.95	141.00	69.50	30.95	94.20	MG/KG
THALLIUM	KAR	15	0	0.12	1.20	0.29	0.26	0.30	MG/KG
TIN	KAR	19	16	10.60	274.00	48.69	88.91	195.50	MG/KG
VANADIUM	KAR	20	90	3.35	37.60	20.70	8.76	29.85	MG/KG
ZINC	KAR	21	100	24.10	99.50	60.24	19.22	78.00	MG/KG

Table D-14. Summary statistics for total radionuclides in geologic materials.

SUMMARY STATISTICS BY GEOLOGIC UNIT

GEOLOGIC MATERIALS, TOTAL RADIONUCLIDES

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
CESIUM-137	COL	28	100	0.00	0.20	0.01	0.04	0.00	PCI/G
GROSS ALPHA	COL	28	100	19.00	48.00	31.95	8.90	44.00	PCI/G
GROSS BETA	COL	28	100	20.00	34.00	27.00	3.52	31.00	PCI/G
PLUTONIUM-239,240	COL	28	100	-0.01	0.02	0.01	0.01	0.02	PCI/G
RADIUM-226	COL	21	100	0.70	1.30	1.07	0.18	1.20	PCI/G
RADIUM-228	COL	21	100	1.10	2.10	1.57	0.29	2.00	PCI/G
STRONTIUM-89,90	COL	28	100	-0.60	0.80	-0.01	0.36	0.50	PCI/G
TRITIUM	COL	28	100	-140.00	240.00	62.14	106.16	190.00	PCI/L
URANIUM, TOTAL	COL	28	100	0.90	5.00	1.86	0.73	2.30	PCI/G
URANIUM-233,234	COL	28	100	0.40	8.90	1.14	1.58	1.10	PCI/G
URANIUM-235	COL	28	100	0.00	0.20	0.04	0.06	0.10	PCI/G
URANIUM-238	COL	28	100	0.40	2.30	0.94	0.34	1.15	PCI/G
AMERICIUM-241	RFA	28	100	-0.02	0.01	-0.00	0.01	0.00	PCI/G
CESIUM-137	RFA	62	100	0.00	0.20	0.01	0.04	0.00	PCI/G
GROSS ALPHA	RFA	62	100	5.00	40.00	22.32	8.18	31.00	PCI/G
GROSS BETA	RFA	62	100	6.00	44.00	24.10	6.75	30.00	PCI/G
PLUTONIUM-239,240	RFA	62	100	-0.01	0.02	0.00	0.01	0.01	PCI/G
RADIUM-226	RFA	58	100	0.50	0.90	0.63	0.10	0.70	PCI/G
RADIUM-228	RFA	58	100	0.50	2.20	1.34	0.31	1.70	PCI/G
STRONTIUM-89,90	RFA	62	100	-0.60	1.20	0.03	0.35	0.40	PCI/G
TRITIUM	RFA	62	100	-150.00	440.00	172.90	122.68	310.00	PCI/L
URANIUM, TOTAL	RFA	62	100	0.50	6.70	1.29	0.81	1.60	PCI/G
URANIUM-233,234	RFA	62	100	0.20	3.40	0.64	0.46	0.70	PCI/G
URANIUM-235	RFA	62	100	0.00	0.10	0.01	0.03	0.00	PCI/G
URANIUM-238	RFA	62	100	0.20	3.20	0.64	0.38	0.80	PCI/G
CESIUM-137	WCS	9	100	0.00	0.10	0.01	0.03	0.00	PCI/G
GROSS ALPHA	WCS	9	100	13.00	30.00	20.89	5.88	26.00	PCI/G
GROSS BETA	WCS	9	100	12.00	30.00	21.89	5.53	28.00	PCI/G
PLUTONIUM-239,240	WCS	9	100	-0.01	0.03	0.01	0.01	0.01	PCI/G
RADIUM-226	WCS	4	100	0.50	0.80	0.68	0.15	0.80	PCI/G
RADIUM-228	WCS	4	100	1.10	1.80	1.42	0.29	1.80	PCI/G
STRONTIUM-89,90	WCS	9	100	-0.20	1.20	0.17	0.44	0.50	PCI/G
TRITIUM	WCS	9	100	-10.00	320.00	174.44	114.47	320.00	PCI/L
URANIUM, TOTAL	WCS	9	100	1.00	1.60	1.36	0.21	1.60	PCI/G
URANIUM-233,234	WCS	9	100	0.40	0.80	0.60	0.12	0.70	PCI/G
URANIUM-235	WCS	9	100	0.00	0.20	0.02	0.07	0.00	PCI/G
URANIUM-238	WCS	9	100	0.60	0.90	0.73	0.12	0.90	PCI/G
CESIUM-137	KAR	21	100	0.00	0.00	0.00	0.00	0.00	PCI/G
GROSS ALPHA	KAR	21	100	17.00	46.00	29.98	8.42	39.00	PCI/G
GROSS BETA	KAR	21	100	20.00	32.00	25.76	3.85	31.00	PCI/G
PLUTONIUM-239,240	KAR	21	100	-0.01	0.01	0.00	0.01	0.01	PCI/G
RADIUM-226	KAR	14	100	0.90	1.30	1.09	0.12	1.20	PCI/G
RADIUM-228	KAR	14	100	1.00	1.60	1.30	0.19	1.50	PCI/G
STRONTIUM-89,90	KAR	21	100	-0.70	0.70	-0.11	0.36	0.20	PCI/G
TRITIUM	KAR	21	100	-95.00	390.00	65.95	122.69	180.00	PCI/L
URANIUM, TOTAL	KAR	21	100	1.10	3.10	1.96	0.64	2.70	PCI/G
URANIUM-233,234	KAR	21	100	0.40	1.70	0.96	0.39	1.50	PCI/G
URANIUM-235	KAR	21	100	0.00	0.30	0.04	0.08	0.10	PCI/G
URANIUM-238	KAR	21	100	0.50	1.40	0.98	0.25	1.20	PCI/G

Table D-15. Summary statistics for total "water-quality" parameters in geologic materials.

SUMMARY STATISTICS BY GEOLOGIC UNIT

GEOLOGIC MATERIALS, TOTAL "WATER-QUALITY" PARAMETERS

ANALYTE	GEOLOGIC UNIT	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
NITRATE/NITRITE	COL	28	7	0.55	1.90	0.95	0.46	1.50	MG/KG
PH	COL	28	100	7.50	9.10	8.26	0.45	8.70	PH
SULFIDE	COL	27	22	1.00	5.00	1.87	1.39	3.00	MG/KG
NITRATE/NITRITE	RFA	61	18	0.50	7.10	0.92	0.94	1.20	MG/KG
PH	RFA	60	100	6.10	9.10	7.97	0.77	8.80	PH
SULFIDE	RFA	52	25	1.00	21.00	2.27	3.02	4.00	MG/KG
NITRATE/NITRITE	WCS	9	33	0.55	2.10	1.08	0.62	1.75	MG/KG
PH	WCS	9	100	7.00	7.60	7.41	0.18	7.60	PH
SULFIDE	WCS	9	56	1.50	6.00	3.00	1.84	6.00	MG/KG
NITRATE/NITRITE	KAR	19	0	0.55	1.00	0.66	0.14	0.80	MG/KG
PH	KAR	21	100	5.40	9.70	8.43	0.87	8.90	PH
SULFIDE	KAR	19	16	1.00	5.00	1.62	1.22	2.00	MG/KG

Table D-16. Summary statistics for total metals in geologic materials.

SUMMARY STATISTICS BY FLOW-SYSTEM

GEOLOGIC MATERIALS, TOTAL METALS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	LOWER	21	100	2,470.00	13,900.00	7,482.60	2,681.30	9,720.00	MG/KG
ANTIMONY	LOWER	15	13	1.00	16.10	4.45	4.53	7.05	MG/KG
ARSENIC	LOWER	21	67	0.50	10.80	3.72	3.26	8.00	MG/KG
BARIUM	LOWER	21	95	18.00	243.00	99.40	55.10	162.00	MG/KG
BERYLLIUM	LOWER	21	100	1.10	16.10	3.35	3.16	4.00	MG/KG
CADMIUM	LOWER	19	58	0.09	1.20	0.83	0.37	1.20	MG/KG
CALCIUM	LOWER	21	100	2,310.00	9,970.00	5,477.14	1,831.78	6,420.00	MG/KG
CESIUM	LOWER	16	94	117.00	258.00	223.62	31.26	244.00	MG/KG
CHROMIUM	LOWER	21	100	3.00	13.70	8.91	2.98	12.10	MG/KG
COBALT	LOWER	21	24	1.65	29.70	6.74	7.20	11.60	MG/KG
COPPER	LOWER	20	100	5.90	26.70	15.76	5.93	22.30	MG/KG
IRON	LOWER	20	100	3,040.00	38,900.00	12,963.25	8,753.38	23,000.00	MG/KG
LEAD	LOWER	21	100	9.40	29.50	18.91	6.19	25.80	MG/KG
LITHIUM	LOWER	21	29	1.05	24.80	7.17	8.39	22.85	MG/KG
MAGNESIUM	LOWER	21	67	490.50	5,600.00	2,053.71	1,213.43	2,880.00	MG/KG
MANGANESE	LOWER	21	100	14.90	737.00	171.90	183.74	305.00	MG/KG
MERCURY	LOWER	21	33	0.05	0.71	0.23	0.24	0.59	MG/KG
MOLYBDENUM	LOWER	21	5	1.05	12.40	5.45	3.67	11.43	MG/KG
NICKEL	LOWER	19	84	3.65	62.50	18.78	13.39	31.00	MG/KG
POTASSIUM	LOWER	21	0	194.00	700.00	486.51	135.78	645.00	MG/KG
SELENIUM	LOWER	19	32	0.17	3.20	0.90	1.01	2.90	MG/KG
SILVER	LOWER	16	25	0.27	18.70	3.72	6.22	14.75	MG/KG
SODIUM	LOWER	21	0	61.04	585.00	215.82	116.13	294.50	MG/KG
STRONTIUM	LOWER	21	90	11.95	141.00	69.50	30.95	94.20	MG/KG
THALLIUM	LOWER	15	0	0.12	1.20	0.29	0.26	0.30	MG/KG
TIN	LOWER	19	16	10.60	274.00	48.69	88.91	195.50	MG/KG
VANADIUM	LOWER	20	90	3.35	37.60	20.70	8.76	29.85	MG/KG
ZINC	LOWER	21	100	24.10	99.50	60.24	19.22	78.00	MG/KG

Table D-16 (cont').

SUMMARY STATISTICS BY FLOW-SYSTEM

GEOLOGIC MATERIALS, TOTAL METALS (CONT')

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	UPPER	98	100	279.00	102,000.00	12,752.03	11,310.57	19,000.00	MG/KG
ANTIMONY	UPPER	66	3	0.95	47.00	4.71	6.13	7.45	MG/KG
ARSENIC	UPPER	99	75	0.27	41.80	3.88	4.63	5.90	MG/KG
BARIUM	UPPER	99	89	9.40	777.00	96.46	96.46	133.00	MG/KG
BERYLLIUM	UPPER	99	91	0.46	23.50	4.78	4.71	8.65	MG/KG
CADMIUM	UPPER	81	48	0.08	2.30	0.82	0.44	1.20	MG/KG
CALCIUM	UPPER	99	86	580.00	157,000.00	6,951.09	16,215.59	9,310.00	MG/KG
CESIUM	UPPER	95	78	81.75	2,830.00	230.46	273.51	239.00	MG/KG
CHROMIUM	UPPER	99	100	4.10	176.00	19.61	24.33	25.40	MG/KG
COBALT	UPPER	99	30	1.90	93.90	7.50	10.77	12.30	MG/KG
COPPER	UPPER	99	91	1.10	123.00	12.57	12.82	15.60	MG/KG
IRON	UPPER	99	100	1,300.00	132,000.00	14,531.98	13,257.27	19,100.00	MG/KG
LEAD	UPPER	99	100	2.60	39.80	10.87	7.05	18.90	MG/KG
LITHIUM	UPPER	99	45	1.45	83.20	11.76	11.45	22.90	MG/KG
MAGNESIUM	UPPER	99	64	356.50	32,500.00	2,584.42	3,365.51	4,170.00	MG/KG
MANGANESE	UPPER	99	100	37.00	3,330.00	217.64	341.96	294.00	MG/KG
MERCURY	UPPER	86	34	0.03	5.90	0.24	0.64	0.39	MG/KG
MOLYBDENUM	UPPER	99	14	1.00	67.60	8.93	8.34	12.30	MG/KG
NICKEL	UPPER	96	91	2.15	193.00	20.73	20.74	32.40	MG/KG
POTASSIUM	UPPER	98	29	186.50	18,700.00	1,311.57	2,442.62	2,060.00	MG/KG
SELENIUM	UPPER	82	26	0.11	13.70	1.22	1.79	2.80	MG/KG
SILVER	UPPER	83	41	0.27	40.90	5.62	9.46	15.20	MG/KG
SODIUM	UPPER	99	9	63.00	3,680.00	300.66	475.29	580.00	MG/KG
STRONTIUM	UPPER	99	43	10.15	242.00	65.62	72.88	202.00	MG/KG
THALLIUM	UPPER	75	3	0.09	4.10	0.52	0.66	1.20	MG/KG
TIN	UPPER	92	23	10.10	441.00	61.75	112.28	188.00	MG/KG
VANADIUM	UPPER	99	98	4.22	283.00	31.49	28.50	43.40	MG/KG
ZINC	UPPER	98	96	0.26	486.00	36.86	51.12	58.90	MG/KG

Table D-17. Summary statistics for total radionuclides in geologic materials.

SUMMARY STATISTICS BY FLOW-SYSTEM

GEOLOGIC MATERIALS, TOTAL RADIONUCLIDES

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
CESIUM-137	LOWER	21	100	0.00	0.00	0.00	0.00	0.00	PCI/G
GROSS ALPHA	LOWER	21	100	17.00	46.00	29.98	8.42	39.00	PCI/G
GROSS BETA	LOWER	21	100	20.00	32.00	25.76	3.85	31.00	PCI/G
PLUTONIUM-239,240	LOWER	21	100	-0.01	0.01	0.00	0.01	0.01	PCI/G
RADIUM-226	LOWER	14	100	0.90	1.30	1.09	0.12	1.20	PCI/G
RADIUM-228	LOWER	14	100	1.00	1.60	1.30	0.19	1.50	PCI/G
STRONTIUM-89,90	LOWER	21	100	-0.70	0.70	-0.11	0.36	0.20	PCI/G
TRITIUM	LOWER	21	100	-95.00	390.00	65.95	122.69	180.00	PCI/L
URANIUM, TOTAL	LOWER	21	100	1.10	3.10	1.96	0.64	2.70	PCI/G
URANIUM-233,234	LOWER	21	100	0.40	1.70	0.96	0.39	1.50	PCI/G
URANIUM-235	LOWER	21	100	0.00	0.30	0.04	0.08	0.10	PCI/G
URANIUM-238	LOWER	21	100	0.50	1.40	0.98	0.25	1.20	PCI/G
AMERICIUM-241	UPPER	28	100	-0.02	0.01	-0.00	0.01	0.00	PCI/G
CESIUM-137	UPPER	99	100	0.00	0.20	0.01	0.04	0.00	PCI/G
GROSS ALPHA	UPPER	99	100	5.00	48.00	24.91	9.28	34.00	PCI/G
GROSS BETA	UPPER	99	100	6.00	44.00	24.72	6.06	31.00	PCI/G
PLUTONIUM-239,240	UPPER	99	100	-0.01	0.03	0.00	0.01	0.01	PCI/G
RADIUM-226	UPPER	83	100	0.50	1.30	0.75	0.23	1.05	PCI/G
RADIUM-228	UPPER	83	100	0.50	2.20	1.40	0.32	1.70	PCI/G
STRONTIUM-89,90	UPPER	99	100	-0.60	1.20	0.03	0.36	0.40	PCI/G
TRITIUM	UPPER	99	100	-150.00	440.00	141.72	126.75	290.00	PCI/L
URANIUM, TOTAL	UPPER	99	100	0.50	6.70	1.46	0.79	1.85	PCI/G
URANIUM-233,234	UPPER	99	100	0.20	8.90	0.78	0.93	0.90	PCI/G
URANIUM-235	UPPER	99	100	0.00	0.20	0.02	0.05	0.10	PCI/G
URANIUM-238	UPPER	99	100	0.20	3.20	0.73	0.38	0.90	PCI/G

Table D-18. Summary statistics for total "water-quality" parameters in geologic materials.

SUMMARY STATISTICS BY FLOW-SYSTEM

GEOLOGIC MATERIALS, TOTAL "WATER-QUALITY" PARAMETERS

ANALYTE	FLOW-SYSTEM	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
NITRATE/NITRITE	LOWER	19	0	0.55	1.00	0.66	0.14	0.80	MG/KG
PH	LOWER	21	100	5.40	9.70	8.43	0.87	8.90	PH
SULFIDE	LOWER	19	16	1.00	5.00	1.62	1.22	2.00	MG/KG
NITRATE/NITRITE	UPPER	98	16	0.50	7.10	0.94	0.80	1.40	MG/KG
PH	UPPER	97	100	6.10	9.10	8.00	0.69	8.80	PH
SULFIDE	UPPER	88	27	1.00	21.00	2.22	2.52	4.00	MG/KG

Table D-19. Summary statistics for dissolved metals in stream water.

SUMMARY STATISTICS (SITEWIDE)

STREAM WATER, DISSOLVED METALS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	134	42	4.50	1,050.00	89.80	165.40	100.00	UG/L
ANTIMONY	92	29	3.75	104.00	18.01	17.68	26.00	UG/L
ARSENIC	94	12	0.35	5.00	1.32	1.25	2.00	UG/L
BARIUM	145	57	12.25	391.00	45.17	35.44	62.80	UG/L
BERYLLIUM	90	8	0.10	17.00	1.08	1.98	2.10	UG/L
CADMIUM	78	10	0.70	3.50	1.80	0.64	2.45	UG/L
CALCIUM	154	94	5,425.00	79,300.00	23,621.75	11,474.97	33,200.00	UG/L
CESIUM	98	14	1.00	2,500.00	384.06	400.68	500.00	UG/L
CHROMIUM	90	8	1.00	14.80	3.15	2.59	5.00	UG/L
COBALT	87	5	1.00	25.00	4.87	6.23	9.25	UG/L
COPPER	125	38	1.00	28.00	5.90	4.97	11.25	UG/L
CYANIDE	1	0	5.00	5.00	5.00	.	5.00	UG/L
IRON	153	69	3.00	1,060.00	144.92	178.41	317.00	UG/L
LEAD	113	27	0.20	13.10	1.33	1.63	1.75	UG/L
LITHIUM	119	34	0.50	50.50	15.71	20.58	50.00	UG/L
MAGNESIUM	150	77	1,345.00	17,800.00	4,735.82	2,173.67	6,770.00	UG/L
MANGANESE	149	71	0.47	353.00	28.02	47.73	43.45	UG/L
MERCURY	83	10	0.05	0.44	0.12	0.07	0.10	UG/L
MOLYBDENUM	93	17	1.00	250.00	32.82	49.18	50.00	UG/L
NICKEL	86	6	1.50	21.80	7.45	5.58	12.70	UG/L
PHOSPHORUS	6	100	80.00	398.00	194.83	124.91	398.00	UG/L
POTASSIUM	126	52	195.00	6,800.00	1,427.16	926.51	2,290.00	UG/L
SELENIUM	85	26	0.50	20.00	2.24	3.63	2.90	UG/L
SILVER	99	10	1.00	15.00	2.76	2.70	3.72	UG/L
SODIUM	153	94	3,640.00	44,700.00	16,603.04	7,508.05	24,000.00	UG/L
STRONTIUM	139	69	33.45	1,000.00	241.81	313.57	500.00	UG/L
THALLIUM	98	10	0.45	15.00	1.82	2.12	2.72	UG/L
TIN	99	21	4.65	136.00	28.52	23.40	50.00	UG/L
VANADIUM	107	12	1.00	25.00	4.19	5.53	7.65	UG/L
ZINC	139	59	0.85	111.50	13.59	18.14	21.00	UG/L

Table D-20. Summary statistics for total metals in stream water.

SUMMARY STATISTICS (SITEWIDE)

STREAM WATER, TOTAL METALS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	139	78	9.35	6,560.00	747.63	1,349.84	1,380.00	UG/L
ANTIMONY	119	18	3.50	54.80	15.10	9.94	30.00	UG/L
ARSENIC	110	27	0.25	11.50	1.73	1.76	4.10	UG/L
BARIUM	131	69	19.15	306.00	58.84	34.02	100.00	UG/L
BERYLLIUM	115	14	0.10	2.50	0.78	0.78	2.10	UG/L
CADMIUM	108	13	0.70	5.00	1.89	1.02	2.50	UG/L
CALCIUM	153	95	5,505.75	74,600.00	23,601.21	11,100.19	33,550.00	UG/L
CESIUM	120	13	1.00	1,250.00	256.15	200.54	500.00	UG/L
CHROMIUM	120	19	1.00	18.90	3.88	3.35	6.30	UG/L
COBALT	116	16	1.00	25.00	5.71	8.33	20.00	UG/L
COPPER	121	41	1.00	25.60	5.59	4.87	12.50	UG/L
CYANIDE	25	20	0.75	20.00	3.50	5.41	5.00	UG/L
IRON	157	90	4.85	26,300.00	1,247.08	2,866.81	1,450.00	UG/L
LEAD	131	36	0.40	21.00	1.88	2.35	2.90	UG/L
LITHIUM	126	41	1.00	50.00	11.77	17.42	50.00	UG/L
MAGNESIUM	146	82	1,360.00	16,600.00	4,901.94	2,107.61	7,040.00	UG/L
MANGANESE	151	79	0.65	4,060.00	84.76	343.57	109.00	UG/L
MERCURY	122	12	0.05	1.40	0.13	0.14	0.10	UG/L
MOLYBDENUM	125	19	1.00	50.00	12.65	17.47	50.00	UG/L
NICKEL	120	13	1.50	20.00	7.37	6.25	20.00	UG/L
PHOSPHORUS	6	83	50.50	456.00	186.25	138.68	456.00	UG/L
POTASSIUM	128	57	190.00	6,700.00	1,669.97	1,071.73	2,500.00	UG/L
SELENIUM	120	22	0.40	20.00	1.55	2.05	2.50	UG/L
SILICON	67	100	690.00	15,200.00	6,076.23	3,377.17	10,000.00	UG/L
SILVER	116	16	1.00	7.80	2.59	1.66	5.00	UG/L
SODIUM	155	93	1,850.00	45,400.00	16,060.41	7,620.96	23,600.00	UG/L
STRONTIUM	135	64	32.95	1,000.00	171.63	179.61	211.00	UG/L
THALLIUM	124	15	0.30	20.00	1.80	2.14	2.10	UG/L
TIN	118	20	3.50	136.00	20.18	20.13	50.00	UG/L
VANADIUM	120	28	1.00	60.00	6.97	9.36	16.55	UG/L
ZINC	151	68	0.85	480.00	31.91	61.69	41.70	UG/L

Table D-21. Summary statistics for dissolved radionuclides in stream water.

SUMMARY STATISTICS (SITEWIDE)

STREAM WATER, DISSOLVED RADIONUCLIDES

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
AMERICIUM-241	34	100	-0.01	0.50	0.07	0.13	0.18	PCI/L
CESIUM-134	3	100	2.17	2.37	2.27	0.10	2.37	PCI/L
CESIUM-137	10	100	-0.44	2.40	0.82	1.22	2.18	PCI/L
GROSS ALPHA	60	100	-1.38	5.00	0.69	1.12	1.60	PCI/L
GROSS BETA	61	100	-0.68	41.82	4.69	6.78	6.60	PCI/L
GROSS GAMMA	24	100	-0.12	1.00	0.70	0.25	1.00	PCI/L
PLUTONIUM-236	4	100	0.00	0.01	0.00	0.01	0.01	PCI/L
PLUTONIUM-238	4	100	0.00	0.01	0.01	0.01	0.01	PCI/L
PLUTONIUM-239,240	36	100	-0.12	0.90	0.12	0.20	0.30	PCI/L
RADIUM-226	3	100	-0.05	0.34	0.19	0.21	0.34	PCI/L
RADIUM-228	2	100	0.70	1.40	1.05	0.49	1.40	PCI/L
STRONTIUM-89,90	87	100	-0.50	3.00	0.73	0.55	1.00	PCI/L
TRITIUM	54	100	-41.80	686.10	111.86	119.12	200.00	PCI/L
URANIUM, TOTAL	6	100	0.10	1.40	0.72	0.48	1.40	PCI/L
URANIUM-233,234	55	100	-0.02	1.80	0.36	0.36	0.60	PCI/L
URANIUM-235	56	100	-0.02	0.90	0.14	0.20	0.30	PCI/L
URANIUM-238	55	100	0.00	1.70	0.28	0.27	0.40	PCI/L

Table D-22. Summary statistics for total radionuclides in stream water.

SUMMARY STATISTICS (SITEWIDE)

STREAM WATER, TOTAL RADIONUCLIDES

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
AMERICIUM-241	106	100	-0.02	0.04	0.00	0.01	0.01	PCI/L
CESIUM-134	8	100	1.03	4.73	1.53	1.29	1.14	PCI/L
CESIUM-137	93	100	-0.56	4.20	0.23	0.60	0.53	PCI/L
GROSS ALPHA	85	100	-2.00	13.00	1.51	2.24	2.25	PCI/L
GROSS BETA	82	100	-0.40	36.00	4.55	5.52	6.00	PCI/L
PLUTONIUM-236	12	100	-0.01	0.00	-0.00	0.00	0.00	PCI/L
PLUTONIUM-238	12	100	-0.02	0.01	-0.00	0.01	0.01	PCI/L
PLUTONIUM-239,240	105	100	-0.02	0.05	0.00	0.01	0.01	PCI/L
RADIUM-226	4	100	-0.10	2.30	1.07	1.25	2.30	PCI/L
STRONTIUM-89,90	75	100	-0.20	6.95	0.92	1.30	1.20	PCI/L
TRITIUM	73	100	-800.00	751.00	75.71	209.22	220.00	PCI/L
URANIUM, TOTAL	17	100	0.10	2.20	0.59	0.52	1.00	PCI/L
URANIUM-233,234	79	100	-0.01	3.21	0.49	0.55	0.82	PCI/L
URANIUM-235	75	100	-0.03	0.38	0.05	0.07	0.10	PCI/L
URANIUM-238	55	100	0.00	1.82	0.36	0.43	0.53	PCI/L

Table D-23. Summary statistics for water-quality parameters in stream water.

SUMMARY STATISTICS (SITEWIDE)

STREAM WATER, WATER-QUALITY PARAMETERS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
BICARBONATE	154	100	15,727.68	243,840.00	97,571.20	40,237.29	136,550.40	UG/L
CARBONATE	154	24	0.00	15,289.80	2,999.74	1,937.53	5,000.00	UG/L
CBOD5	10	100	3,800.00	14,500.00	7,635.00	3,912.68	13,100.00	UG/L
CHLORIDE	151	92	885.00	88,200.00	16,833.01	15,608.95	29,600.00	UG/L
CYANIDE	129	31	1.25	20,000.00	2,221.93	5,220.92	10,000.00	UG/L
DISSOLVED ORGANIC CARBON	35	100	2,000.00	16,000.00	6,102.57	3,267.38	9,000.00	UG/L
FLUORIDE	100	98	50.00	720.00	338.41	107.90	468.50	UG/L
HYDROGEN SULFIDE	3	0	500.00	500.00	500.00	0.00	500.00	UG/L
NITRATE/NITRITE	153	57	10.00	2,150.00	324.55	438.84	770.00	UG/L
NITRITE	85	22	10.00	100.00	13.98	14.74	20.00	UG/L
OIL AND GREASE	105	33	100.00	20,400.00	4,024.29	3,756.06	6,200.00	UG/L
ORTHOPHOSPHATE	95	20	5.00	580.00	30.67	59.64	40.00	UG/L
PH	51	98	3.75	8.60	7.34	0.63	7.70	PH
PHOSPHORUS	102	35	5.00	420.00	43.68	55.07	78.00	UG/L
SILICA	95	98	200.00	28,666.62	11,128.11	7,265.36	20,836.78	UG/L
SODIUM NITRITE	17	0	25.00	50.00	27.94	8.30	25.00	UG/L
SULFATE	151	98	2,500.00	48,000.00	18,782.45	8,174.66	27,000.00	UG/L
SULFIDE	73	18	500.00	4,000.00	739.73	697.76	1,000.00	UG/L
TOTAL DISSOLVED SOLIDS	151	100	58,000.00	486,000.00	170,119.21	56,721.65	212,000.00	UG/L
TOTAL ORGANIC CARBON	49	100	2,780.00	25,000.00	7,466.94	4,621.53	11,850.00	UG/L
TOTAL SUSPENDED SOLIDS	159	60	1,000.00	400,000.00	18,877.99	45,772.72	22,000.00	UG/L

Table D-24. Summary statistics for volatile organics in stream water.

SUMMARY STATISTICS (SITEWIDE)

STREAM WATER, VOLATILE ORGANICS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,1,1,2-TETRACHLOROETHANE	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,1,1-TRICHLOROETHANE	116	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1,2,2-TETRACHLOROETHANE	116	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1,2-TRICHLOROETHANE	115	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHANE	115	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHENE	116	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROPROPENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,2,3-TRICHLOROBENZENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,2,3-TRICHLOROPROPANE	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,2,4-TRICHLOROBENZENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,2-DIBROMOETHANE	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,2-DICHLOROBENZENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,2-DICHLOROETHANE	116	1	2.00	2.50	2.50	0.05	2.50	UG/L
1,2-DICHLOROETHENE	116	1	1.00	2.50	2.49	0.14	2.50	UG/L
1,2-DICHLOROPROPANE	116	2	1.00	2.50	2.48	0.15	2.50	UG/L
1,2-DIMETHYLBENZENE	12	0	0.25	2.50	2.31	0.65	2.50	UG/L
1,3-DICHLOROBENZENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,3-DICHLOROPROPANE	1	0	0.10	0.10	0.10	.	0.10	UG/L
1,3-DIMETHYLBENZENE	1	0	0.25	0.25	0.25	.	0.25	UG/L
1,4-DICHLOROBENZENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
2-BUTANONE	114	1	3.00	5.00	4.98	0.19	5.00	UG/L
2-CHLOROETHYL VINYL ETHER	16	0	5.00	5.00	5.00	0.00	5.00	UG/L
2-HEXANONE	111	0	5.00	25.00	5.18	1.90	5.00	UG/L
2-PROPENENITRILE	1	0	5.00	5.00	5.00	.	5.00	UG/L
4-METHYL-2-PENTANONE	109	1	4.00	5.00	4.99	0.10	5.00	UG/L
ACETONE	104	35	2.00	28.00	7.28	5.16	11.00	UG/L
BENZENE	116	2	1.00	2.50	2.48	0.15	2.50	UG/L
BENZENE, 1,2,4-TRIMETHYL	1	0	0.25	0.25	0.25	.	0.25	UG/L
BENZENE, 1,3,5-TRIMETHYL-	1	0	0.25	0.25	0.25	.	0.25	UG/L
BROMOBENZENE	1	0	0.25	0.25	0.25	.	0.25	UG/L
BROMOCHLOROMETHANE	1	0	0.10	0.10	0.10	.	0.10	UG/L
BROMODICHLOROMETHANE	116	1	2.00	2.50	2.50	0.05	2.50	UG/L
BROMOFORM	116	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOMETHANE	116	0	5.00	5.00	5.00	0.00	5.00	UG/L
CARBON DISULFIDE	113	1	2.50	6.00	2.53	0.33	2.50	UG/L
CARBON TETRACHLORIDE	116	1	2.00	2.50	2.50	0.05	2.50	UG/L
CHLOROBENZENE	116	1	2.00	2.50	2.50	0.05	2.50	UG/L
CHLOROETHANE	116	0	5.00	5.00	5.00	0.00	5.00	UG/L
CHLOROFORM	116	1	2.00	2.50	2.50	0.05	2.50	UG/L
CHLOROMETHANE	115	0	5.00	5.00	5.00	0.00	5.00	UG/L
CUMENE	1	0	0.25	0.25	0.25	.	0.25	UG/L
DIBROMOCHLOROMETHANE	116	0	2.50	2.50	2.50	0.00	2.50	UG/L
DIBROMOMETHANE	1	0	0.10	0.10	0.10	.	0.10	UG/L
DICHLORODIFLUOROMETHANE	1	0	0.10	0.10	0.10	.	0.10	UG/L
ETHYLBENZENE	115	0	2.50	2.50	2.50	0.00	2.50	UG/L
HEXACHLOROBUTADIENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
METHYLENE CHLORIDE	111	41	1.00	31.00	4.49	5.49	7.00	UG/L
NAPHTHALENE	1	0	0.25	0.25	0.25	.	0.25	UG/L
PROPANE, 1,2-DIBROMO-3-CHLORO-	1	0	0.10	0.10	0.10	.	0.10	UG/L
STYRENE	115	1	2.00	2.50	2.50	0.05	2.50	UG/L
TETRACHLOROETHENE	116	1	1.00	2.50	2.49	0.14	2.50	UG/L
TOLUENE	116	5	1.00	2.50	2.48	0.21	2.50	UG/L
TOTAL XYLENES	113	3	1.00	2.50	2.48	0.16	2.50	UG/L
TRICHLOROETHENE	116	3	1.00	3.00	2.49	0.15	2.50	UG/L
TRICHLOROFLUOROMETHANE	1	0	0.10	0.10	0.10	.	0.10	UG/L
VINYL ACETATE	115	0	5.00	25.00	5.17	1.87	5.00	UG/L
VINYL CHLORIDE	116	0	5.00	5.00	5.00	0.00	5.00	UG/L
cis-1,2-DICHLOROETHENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
cis-1,3-DICHLOROPROPENE	116	2	1.00	3.00	2.49	0.15	2.50	UG/L
n-BUTYLBENZENE	1	0	0.25	0.25	0.25	.	0.25	UG/L
n-PROPYLBENZENE	1	0	0.25	0.25	0.25	.	0.25	UG/L
o-CHLOROTOLUENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
p-CHLOROTOLUENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
p-CYMENE	1	0	0.25	0.25	0.25	.	0.25	UG/L
p-XYLENE	1	0	0.25	0.25	0.25	.	0.25	UG/L
sec-BUTYLBENZENE	1	0	0.25	0.25	0.25	.	0.25	UG/L
sec-DICHLOROPROPANE	1	0	0.10	0.10	0.10	.	0.10	UG/L
tert-BUTYLBENZENE	1	0	0.25	0.25	0.25	.	0.25	UG/L
trans-1,2-DICHLOROETHENE	1	0	0.10	0.10	0.10	.	0.10	UG/L
trans-1,3-DICHLOROPROPENE	116	0	2.50	2.50	2.50	0.00	2.50	UG/L

Table D-25. Summary statistics for semi-volatile organics in stream water.

SUMMARY STATISTICS (SITEWIDE)

STREAM WATER, SEMI-VOLATILE ORGANICS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,2,4-TRICHLOROBENZENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
1,2-DICHLOROBENZENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
1,3-DICHLOROBENZENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
1,4-DICHLOROBENZENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
2,4,5-TRICHLOROPHENOL	16	0	5.00	29.00	24.25	5.23	26.00	UG/L
2,4,6-TRICHLOROPHENOL	16	0	0.50	5.75	4.77	1.15	5.00	UG/L
2,4-DICHLOROPHENOL	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
2,4-DIMETHYLPHENOL	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
2,4-DINITROPHENOL	16	0	25.00	29.00	25.50	1.02	26.00	UG/L
2,4-DINITROTOLUENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
2,6-DINITROTOLUENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
2-CHLORONAPHTHALENE	15	0	5.00	5.75	5.05	0.19	5.00	UG/L
2-CHLOROPHENOL	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
2-METHYLNAPHTHALENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
2-METHYLPHENOL	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
2-NITROANILINE	16	0	25.00	29.00	25.50	1.02	26.00	UG/L
2-NITROPHENOL	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
3,3'-DICHLOROBENZIDINE	16	0	10.00	11.75	10.20	0.46	10.50	UG/L
3-NITROANILINE	16	0	25.00	29.00	25.50	1.02	26.00	UG/L
4,6-DINITRO-2-METHYLPHENOL	16	0	25.00	29.00	25.50	1.02	26.00	UG/L
4-BROMOPHENYL PHENYL ETHER	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
4-CHLORO-3-METHYLPHENOL	16	0	5.00	10.00	5.36	1.25	5.00	UG/L
4-CHLOROANILINE	16	0	5.00	10.00	5.36	1.25	5.00	UG/L
4-CHLOROPHENYL PHENYL ETHER	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
4-METHYLPHENOL	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
4-NITROANILINE	16	0	25.00	29.00	25.50	1.02	26.00	UG/L
4-NITROPHENOL	16	0	25.00	29.00	25.50	1.02	26.00	UG/L
ACENAPHTHENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
ACENAPHTHYLENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
ANTHRACENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
BENZENAMINE	1	0	26.00	26.00	26.00	.	26.00	UG/L
BENZIDINE	2	0	5.00	26.00	15.50	14.85	26.00	UG/L
BENZO(a)ANTHRACENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
BENZO(a)PYRENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
BENZO(b)FLUORANTHENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
BENZO(ghi)PERYLENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
BENZO(k)FLUORANTHENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
BENZOIC ACID	16	0	25.00	29.00	25.50	1.02	26.00	UG/L
BENZYL ALCOHOL	16	0	5.00	10.00	5.36	1.25	5.00	UG/L
BIS(2-CHLOROETHOXY)METHANE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
BIS(2-CHLOROETHYL)ETHER	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
BIS(2-CHLOROISOPROPYL)ETHER	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
BIS(2-ETHYLHEXYL)PHTHALATE	16	6	5.00	7.50	5.16	0.63	5.00	UG/L
BUTYL BENZYL PHTHALATE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
CHRYSENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
DI-n-BUTYL PHTHALATE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
DI-n-OCTYL PHTHALATE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
DIBENZO(a,h)ANTHRACENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
DIBENZOFURAN	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
DIETHYL PHTHALATE	16	13	2.00	5.75	4.86	0.79	5.00	UG/L
DIMETHYL PHTHALATE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
FLUORANTHENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
FLUORENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
HEXACHLOROBENZENE	16	0	0.50	5.75	4.77	1.15	5.00	UG/L
HEXACHLOROBUTADIENE	16	0	0.50	5.75	4.77	1.15	5.00	UG/L
HEXACHLOROCYCLOPENTADIENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
HEXACHLOROETHANE	16	0	0.50	5.75	4.77	1.15	5.00	UG/L
INDENO(1,2,3-cd)PYRENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
ISOPHORONE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
N-NITROSO-DI-n-PROPYLAMINE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
N-NITROSODI-N-BUTYLAMINE	1	0	2.50	2.50	2.50	.	2.50	UG/L
N-NITROSODIETHYLAMINE	1	0	2.50	2.50	2.50	.	2.50	UG/L
N-NITROSODIMETHYLAMINE	2	0	2.50	10.50	6.50	5.66	10.50	UG/L
N-NITROSODIPHENYLAMINE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
N-NITROSOPYRROLIDINE	1	0	5.00	5.00	5.00	.	5.00	UG/L
NAPHTHALENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
NITROBENZENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
PENTACHLOROPHENOL	16	0	25.00	29.00	25.50	1.02	26.00	UG/L
PHENANTHRENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L
PHENOL	15	0	5.00	5.75	5.05	0.19	5.00	UG/L
PYRENE	16	0	5.00	5.75	5.05	0.19	5.00	UG/L

Table D-26. Summary statistics for pesticides in stream water.

SUMMARY STATISTICS (SITEWIDE)

STREAM WATER, PESTICIDES

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
4,4'-DDD	15	0	0.01	0.08	0.05	0.01	0.05	UG/L
4,4'-DDE	15	0	0.00	0.08	0.05	0.02	0.05	UG/L
4,4'-DDT	15	0	0.01	0.08	0.05	0.01	0.05	UG/L
ALDRIN	15	0	0.00	0.04	0.02	0.01	0.03	UG/L
AROCLOR-1016	15	0	0.10	0.40	0.25	0.06	0.27	UG/L
AROCLOR-1221	15	0	0.10	0.40	0.25	0.06	0.27	UG/L
AROCLOR-1232	15	0	0.07	0.40	0.25	0.06	0.27	UG/L
AROCLOR-1242	15	0	0.03	0.40	0.25	0.07	0.27	UG/L
AROCLOR-1248	15	0	0.03	0.40	0.25	0.07	0.27	UG/L
AROCLOR-1254	15	0	0.03	0.80	0.50	0.15	0.55	UG/L
AROCLOR-1260	15	0	0.03	0.80	0.50	0.15	0.55	UG/L
CHLORDANE	1	0	0.01	0.01	0.01	.	0.01	UG/L
DIELDRIN	15	0	0.00	0.08	0.05	0.02	0.05	UG/L
ENDOSULFAN I	15	0	0.01	0.04	0.03	0.01	0.03	UG/L
ENDOSULFAN II	15	0	0.00	0.08	0.05	0.02	0.05	UG/L
ENDOSULFAN SULFATE	15	0	0.03	0.08	0.05	0.01	0.05	UG/L
ENDRIN	15	0	0.00	0.08	0.05	0.02	0.05	UG/L
ENDRIN ALDEHYDE	1	0	0.01	0.01	0.01	.	0.01	UG/L
ENDRIN KETONE	14	0	0.05	0.08	0.05	0.01	0.05	UG/L
HEPTACHLOR	15	0	0.00	0.04	0.02	0.01	0.03	UG/L
HEPTACHLOR EPOXIDE	15	0	0.03	0.04	0.03	0.01	0.03	UG/L
METHOXYCHLOR	14	0	0.25	0.40	0.26	0.04	0.27	UG/L
TOXAPHENE	15	0	0.12	0.80	0.50	0.13	0.55	UG/L
alpha-BHC	15	0	0.00	0.04	0.02	0.01	0.03	UG/L
alpha-CHLORDANE	14	0	0.25	0.40	0.26	0.04	0.27	UG/L
beta-BHC	15	0	0.00	0.04	0.02	0.01	0.03	UG/L
delta-BHC	15	0	0.00	0.04	0.02	0.01	0.03	UG/L
gamma-BHC (LINDANE)	15	0	0.00	0.04	0.02	0.01	0.03	UG/L
gamma-CHLORDANE	14	0	0.25	0.40	0.26	0.04	0.27	UG/L

Table D-27. Summary statistics for herbicides in stream water.

SUMMARY STATISTICS (SITEWIDE)

STREAM WATER, HERBICIDES

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
2,2-DICHLOROPROPANOIC ACID	1	0	2.90	2.90	2.90	.	.	UG/L
2,4,5-TRICHLOROPHENOXYACETIC A	1	0	0.10	0.10	0.10	.	.	UG/L
2,4-DB	1	0	0.46	0.46	0.46	.	.	UG/L
2,4-DICHLOROPHENOXYACETIC ACID	1	0	0.60	0.60	0.60	.	.	UG/L
AMETRYN	1	0	0.09	0.09	0.09	.	.	UG/L
ATRAZINE	1	0	0.08	0.08	0.08	.	.	UG/L
CYANAZINE	1	0	0.15	0.15	0.15	.	.	UG/L
DICAMBA	1	0	0.14	0.14	0.14	.	.	UG/L
DICHLOROPROP	1	0	0.33	0.33	0.33	.	.	UG/L
MCPA	1	0	125.00	125.00	125.00	.	.	UG/L
MCPP	1	0	95.00	95.00	95.00	.	.	UG/L
PHENOL, 2-(1-METHYLPROPYL)-4,6	1	0	0.04	0.04	0.04	.	.	UG/L
PROMETON	1	0	0.04	0.04	0.04	.	.	UG/L
PROMETRYN	1	0	0.09	0.09	0.09	.	.	UG/L
PROPANOIC ACID, 2-(2,4,5-TRICH	1	0	0.09	0.09	0.09	.	.	UG/L
PROPAZINE	1	0	0.04	0.04	0.04	.	.	UG/L
SIMAZINE	1	0	0.09	0.09	0.09	.	.	UG/L
SIMETRYN	1	0	0.11	0.11	0.11	.	.	UG/L
TERBUTHYLAZINE	1	0	0.04	0.04	0.04	.	.	UG/L

Table D-28. Summary statistics for dissolved metals in seep/spring water.

SUMMARY STATISTICS (SITEWIDE)

SEEP / SPRING WATER, DISSOLVED METALS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	43	26	9.35	100.00	42.77	30.04	100.00	UG/L
ANTIMONY	30	30	5.00	104.00	25.89	28.49	32.50	UG/L
ARSENIC	35	17	0.35	18.00	1.92	3.04	2.50	UG/L
BARIUM	47	45	19.05	211.00	71.95	42.39	111.00	UG/L
BERYLLIUM	22	0	0.10	2.50	0.75	0.62	1.20	UG/L
CADMIUM	27	0	0.80	2.50	1.54	0.51	2.40	UG/L
CALCIUM	50	98	18,500.00	216,000.00	50,222.00	34,498.38	60,600.00	UG/L
CESIUM	31	13	25.00	2,500.00	710.39	731.77	1,250.00	UG/L
CHROMIUM	28	7	1.00	14.80	3.11	2.62	4.35	UG/L
COBALT	31	6	1.10	25.00	4.17	4.92	9.25	UG/L
COPPER	41	24	1.15	27.80	6.01	5.51	11.25	UG/L
IRON	49	69	0.55	16,700.00	1,927.00	4,082.76	3,540.00	UG/L
LEAD	42	21	0.05	5.40	1.08	0.86	1.50	UG/L
LITHIUM	43	33	2.00	50.00	29.46	20.72	50.00	UG/L
MAGNESIUM	47	72	1,595.00	27,400.00	7,002.07	5,198.40	11,600.00	UG/L
MANGANESE	44	86	0.50	760.00	127.57	185.52	347.00	UG/L
MERCURY	22	23	0.05	1.30	0.18	0.26	0.22	UG/L
MOLYBDENUM	34	21	1.70	50.00	33.81	21.07	50.00	UG/L
NICKEL	24	13	1.50	20.00	6.28	5.02	12.45	UG/L
PHOSPHORUS	1	100	134.00	134.00	134.00	.	134.00	UG/L
POTASSIUM	39	41	127.50	7,073.00	1,389.94	1,640.62	2,450.00	UG/L
SELENIUM	28	18	0.40	19.00	2.25	3.96	2.50	UG/L
SILVER	32	16	1.00	12.50	2.54	2.20	4.00	UG/L
SODIUM	50	98	4,005.00	35,200.00	12,297.00	5,585.54	16,600.00	UG/L
STRONTIUM	45	78	64.50	1,000.00	481.40	401.87	1,000.00	UG/L
THALLIUM	27	4	0.45	5.00	1.88	1.21	3.00	UG/L
TIN	36	17	4.65	50.00	38.27	16.45	50.00	UG/L
VANADIUM	38	16	1.00	25.00	5.43	5.46	7.65	UG/L
ZINC	46	46	0.85	105.00	15.68	21.13	25.60	UG/L

Table D-29. Summary statistics for total metals in seep/spring water.

SUMMARY STATISTICS (SITEWIDE)

SEEP / SPRING WATER, TOTAL METALS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	48	83	35.25	293,000.00	18,115.18	47,149.24	22,500.00	UG/L
ANTIMONY	34	32	3.75	643.00	46.68	108.89	30.00	UG/L
ARSENIC	44	59	0.45	1,030.00	69.77	192.06	78.00	UG/L
BARIUM	44	75	23.00	7,070.00	913.39	1,692.11	2,140.00	UG/L
BERYLLIUM	38	34	0.25	14.00	2.81	3.37	3.80	UG/L
CADMIUM	33	30	0.80	68.40	9.08	17.25	18.10	UG/L
CALCIUM	53	91	18,725.00	803,000.00	94,329.72	128,636.27	152,000.00	UG/L
CESIUM	33	24	25.00	2,530.00	419.98	449.37	500.00	UG/L
CHROMIUM	40	40	1.00	275.00	23.69	49.27	39.05	UG/L
COBALT	35	34	1.00	489.00	43.39	90.97	73.00	UG/L
COPPER	44	52	1.15	607.00	43.89	99.94	81.70	UG/L
CYANIDE	5	40	0.75	17.00	5.95	7.48	17.00	UG/L
IRON	51	88	48.75	3,220,000.00	175,074.71	518,671.63	198,000.00	UG/L
LEAD	45	67	0.35	950.00	91.14	207.26	153.00	UG/L
LITHIUM	35	49	3.50	140.00	29.43	26.57	50.00	UG/L
MAGNESIUM	50	80	1,165.00	30,300.00	10,370.60	7,644.36	16,400.00	UG/L
MANGANESE	51	80	2.10	27,700.00	1,798.04	5,027.04	3,210.00	UG/L
MERCURY	33	18	0.05	1.30	0.17	0.24	0.20	UG/L
MOLYBDENUM	33	27	1.50	203.00	33.46	39.12	50.00	UG/L
NICKEL	35	37	1.50	646.00	50.68	116.39	76.90	UG/L
PHOSPHORUS	1	100	105.00	105.00	105.00	.	105.00	UG/L
POTASSIUM	41	49	379.50	13,500.00	3,386.23	3,069.81	5,810.00	UG/L
SELENIUM	36	39	0.50	16.50	3.31	3.72	6.00	UG/L
SILICON	11	100	2,290.00	12,700.00	8,408.18	3,027.84	12,000.00	UG/L
SILVER	32	31	1.00	148.00	10.05	25.69	10.60	UG/L
SODIUM	53	89	280.00	26,100.00	12,005.80	5,016.89	16,850.00	UG/L
STRONTIUM	42	62	62.25	2,100.00	506.16	476.35	703.00	UG/L
THALLIUM	39	10	0.45	5.00	2.41	1.83	5.00	UG/L
TIN	35	37	4.65	969.00	94.03	190.89	119.00	UG/L
VANADIUM	41	51	1.00	1,650.00	117.09	280.76	164.00	UG/L
ZINC	50	82	2.50	2,680.00	195.22	431.42	288.00	UG/L

Table D-30. Summary statistics for dissolved radionuclides in seep/spring water.

SUMMARY STATISTICS (SITEWIDE)								
SEEP / SPRING WATER, DISSOLVED RADIONUCLIDES								
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
AMERICIUM-241	8	100	0.00	0.80	0.13	0.28	0.20	PCI/L
CESIUM-137	3	100	-0.50	-0.10	-0.27	0.21	-0.10	PCI/L
GROSS ALPHA	13	100	-0.25	19.49	2.78	5.21	4.00	PCI/L
GROSS BETA	14	100	-2.00	39.15	5.94	10.09	6.40	PCI/L
GROSS GAMMA	5	100	-0.13	3.20	1.09	1.25	3.20	PCI/L
PLUTONIUM-239,240	8	100	0.00	0.40	0.10	0.16	0.30	PCI/L
RADIUM-226	2	100	0.07	1.91	0.99	1.30	1.91	PCI/L
RADIUM-228	1	100	0.70	0.70	0.70	.	0.70	PCI/L
STRONTIUM-89,90	20	100	-0.30	1.00	0.52	0.39	1.00	PCI/L
TRITIUM	12	100	82.59	560.00	226.36	133.36	405.00	PCI/L
URANIUM, TOTAL	3	100	-0.10	4.60	1.90	2.43	4.60	PCI/L
URANIUM-233,234	13	100	0.00	2.60	0.91	0.73	1.70	PCI/L
URANIUM-235	12	100	-0.02	0.30	0.12	0.13	0.30	PCI/L
URANIUM-238	13	100	-0.10	1.70	0.60	0.54	1.60	PCI/L

Table D-31. Summary statistics for total radionuclides in seep/spring water.

SUMMARY STATISTICS (SITEWIDE)								
SEEP / SPRING WATER, TOTAL RADIONUCLIDES								
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
AMERICIUM-241	37	100	0.00	0.10	0.01	0.02	0.02	PCI/L
CESIUM-137	37	100	-0.30	12.00	0.58	1.99	0.80	PCI/L
GROSS ALPHA	36	100	-0.50	440.00	42.52	89.77	82.00	PCI/L
GROSS BETA	10	100	0.30	4.30	2.15	1.50	3.97	PCI/L
PLUTONIUM-239,240	32	100	0.00	1.00	0.08	0.21	0.14	PCI/L
RADIUM-226	12	100	0.20	30.00	7.72	9.10	19.00	PCI/L
RADIUM-228	5	100	-1.10	36.00	16.38	14.11	36.00	PCI/L
STRONTIUM-89,90	32	100	-0.20	1.10	0.32	0.38	0.90	PCI/L
TRITIUM	30	100	-80.00	475.00	140.35	126.53	250.00	PCI/L
URANIUM, TOTAL	9	100	0.35	2.30	0.85	0.63	1.20	PCI/L
URANIUM-233,234	33	100	-0.02	6.90	0.64	1.29	0.80	PCI/L
URANIUM-235	32	100	-0.20	0.19	0.02	0.08	0.11	PCI/L
URANIUM-238	28	100	-0.05	5.93	0.64	1.21	0.70	PCI/L

Table D-32. Summary statistics for water-quality parameters in seep/spring water.

SUMMARY STATISTICS (SITEWIDE)

SEEP / SPRING WATER, WATER-QUALITY PARAMETERS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
BICARBONATE	60	100	69,982.08	4,100,000.00	321,643.17	574,858.46	358,976.00	UG/L
CARBONATE	55	44	0.00	24,223.84	4,495.68	4,965.08	5,000.00	UG/L
CBOD5	2	100	11,700.00	20,400.00	16,050.00	6,151.83	20,400.00	UG/L
CHLORIDE	53	91	2,000.00	130,000.00	12,523.58	17,061.93	15,000.00	UG/L
CYANIDE	46	26	1.25	45.20	7.11	7.00	10.00	UG/L
DISSOLVED ORGANIC CARBON	5	100	2,000.00	8,000.00	5,000.00	2,236.07	8,000.00	UG/L
FLUORIDE	18	100	200.00	960.00	552.22	264.88	900.00	UG/L
NITRATE/NITRITE	53	60	10.00	11,000.00	945.19	2,118.91	1,300.00	UG/L
NITRITE	16	13	10.00	60.00	13.13	12.50	10.00	UG/L
OIL AND GREASE	24	38	205.00	7,800.00	2,448.13	1,934.86	4,150.00	UG/L
ORTHOPHOSPHATE	18	11	5.00	70.00	22.22	15.65	25.00	UG/L
PH	35	100	6.00	7.90	7.22	0.43	7.70	PH
PHOSPHORUS	18	61	25.00	3,400.00	354.94	804.15	480.00	UG/L
SILICA	17	100	586.17	39,000.00	17,025.45	8,569.50	24,601.95	UG/L
SODIUM NITRITE	3	0	25.00	25.00	25.00	0.00	25.00	UG/L
SULFATE	53	96	2,500.00	560,000.00	46,962.26	87,305.62	49,600.00	UG/L
SULFIDE	10	10	500.00	1,000.00	550.00	158.11	500.00	UG/L
TOTAL DISSOLVED SOLIDS	53	100	18,000.00	1,100,000.00	263,867.92	174,307.09	383,000.00	UG/L
TOTAL ORGANIC CARBON	7	100	3,000.00	12,000.00	9,014.29	3,184.56	11,700.00	UG/L
TOTAL SUSPENDED SOLIDS	54	87	2,000.00	46000000.00	2,712,305.56	7,791,125.40	3,000,000.00	UG/L

Table D-33. Summary statistics for volatile organics in seep/spring water.

SUMMARY STATISTICS (SITEWIDE)

SEEP / SPRING WATER, VOLATILE ORGANICS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,1,1-TRICHLOROETHANE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1,2,2-TETRACHLOROETHANE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1,2-TRICHLOROETHANE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHANE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,1-DICHLOROETHENE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROETHANE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROETHENE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DICHLOROPROPANE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
1,2-DIMETHYLBENZENE	9	0	2.50	2.50	2.50	0.00	2.50	UG/L
2-BUTANONE	26	0	5.00	5.00	5.00	0.00	5.00	UG/L
2-CHLOROETHYL VINYL ETHER	9	0	5.00	5.00	5.00	0.00	5.00	UG/L
2-HEXANONE	26	0	5.00	5.00	5.00	0.00	5.00	UG/L
4-METHYL-2-PENTANONE	25	0	5.00	5.00	5.00	0.00	5.00	UG/L
ACETONE	21	29	2.00	32.00	6.67	6.38	5.00	UG/L
BENZENE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMODICHLOROMETHANE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOFORM	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
BROMOMETHANE	26	0	5.00	5.00	5.00	0.00	5.00	UG/L
CARBON DISULFIDE	25	4	2.50	3.00	2.52	0.10	2.50	UG/L
CARBON TETRACHLORIDE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROBENZENE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROETHANE	26	0	5.00	5.00	5.00	0.00	5.00	UG/L
CHLOROFORM	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
CHLOROMETHANE	26	4	4.00	5.00	4.96	0.20	5.00	UG/L
DIBROMOCHLOROMETHANE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
ETHYLBENZENE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
METHYLENE CHLORIDE	24	50	0.00	14.00	3.46	3.50	6.00	UG/L
STYRENE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
TETRACHLOROETHENE	26	4	2.50	10.00	2.79	1.47	2.50	UG/L
TOLUENE	26	4	1.00	2.50	2.44	0.29	2.50	UG/L
TOTAL XYLENES	26	4	2.00	2.50	2.48	0.10	2.50	UG/L
TRICHLOROETHENE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
VINYL ACETATE	26	0	5.00	5.00	5.00	0.00	5.00	UG/L
VINYL CHLORIDE	26	0	5.00	5.00	5.00	0.00	5.00	UG/L
cis-1,3-DICHLOROPROPENE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L
trans-1,3-DICHLOROPROPENE	26	0	2.50	2.50	2.50	0.00	2.50	UG/L

Table D-34. Summary statistics for semi-volatile organics in seep/spring water.

SUMMARY STATISTICS (SITEWIDE)

SEEP / SPRING WATER, SEMI-VOLATILE ORGANICS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,2,4-TRICHLOROBENZENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
1,2-DICHLOROBENZENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
1,3-DICHLOROBENZENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
1,4-DICHLOROBENZENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
2,4,5-TRICHLOROPHENOL	6	0	25.00	25.00	25.00	0.00	0.00	UG/L
2,4,6-TRICHLOROPHENOL	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
2,4-DICHLOROPHENOL	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
2,4-DIMETHYLPHENOL	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
2,4-DINITROPHENOL	6	0	25.00	25.00	25.00	0.00	0.00	UG/L
2,4-DINITROTOLUENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
2,6-DINITROTOLUENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
2-CHLORONAPHTHALENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
2-CHLOROPHENOL	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
2-METHYLNAPHTHALENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
2-METHYLPHENOL	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
2-NITROANILINE	6	0	25.00	25.00	25.00	0.00	0.00	UG/L
2-NITROPHENOL	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
3,3'-DICHLOROBENZIDINE	6	0	10.00	10.00	10.00	0.00	0.00	UG/L
3-NITROANILINE	6	0	25.00	25.00	25.00	0.00	0.00	UG/L
4,6-DINITRO-2-METHYLPHENOL	6	0	25.00	25.00	25.00	0.00	0.00	UG/L
4-BROMOPHENYL PHENYL ETHER	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
4-CHLORO-3-METHYLPHENOL	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
4-CHLOROANILINE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
4-CHLOROPHENYL PHENYL ETHER	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
4-METHYLPHENOL	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
4-NITROANILINE	6	0	25.00	25.00	25.00	0.00	0.00	UG/L
4-NITROPHENOL	6	0	25.00	25.00	25.00	0.00	0.00	UG/L
ACENAPHTHENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
ACENAPHTHYLENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
ANTHRACENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
BENZENAMINE	3	0	25.00	25.00	25.00	0.00	0.00	UG/L
BENZIDINE	3	0	25.00	25.00	25.00	0.00	0.00	UG/L
BENZO(a)ANTHRACENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
BENZO(a)PYRENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
BENZO(b)FLUORANTHENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
BENZO(ghi)PERYLENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
BENZO(k)FLUORANTHENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
BENZOIC ACID	6	0	25.00	25.00	25.00	0.00	0.00	UG/L
BENZYL ALCOHOL	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
BIS(2-CHLOROETHOXY)METHANE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
BIS(2-CHLOROETHYL)ETHER	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
BIS(2-CHLOROISOPROPYL)ETHER	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
BIS(2-ETHYLHEXYL)PHTHALATE	6	17	5.00	9.00	5.67	1.63	1.63	UG/L
BUTYL BENZYL PHTHALATE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
CHRYSENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
DI-n-BUTYL PHTHALATE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
DI-n-OCTYL PHTHALATE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
DIBENZO(a,h)ANTHRACENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
DIBENZOFURAN	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
DIETHYL PHTHALATE	6	17	3.00	5.00	4.67	0.82	0.82	UG/L
DIMETHYL PHTHALATE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
FLUORANTHENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
FLUORENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
HEXACHLOROBENZENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
HEXACHLOROBUTADIENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
HEXACHLOROCYCLOPENTADIENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
HEXACHLOROETHANE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
INDENO(1,2,3-cd)PYRENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
ISOPHORONE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
N-NITROSO-DI-n-PROPYLAMINE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
N-NITROSODIMETHYLAMINE	3	0	10.00	10.00	10.00	0.00	0.00	UG/L
N-NITROSODIPHENYLAMINE	6	17	0.00	5.00	4.17	2.04	2.04	UG/L
NAPHTHALENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
NITROBENZENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
PENTACHLOROPHENOL	6	0	25.00	25.00	25.00	0.00	0.00	UG/L
PHENANTHRENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
PHENOL	6	0	5.00	5.00	5.00	0.00	0.00	UG/L
PYRENE	6	0	5.00	5.00	5.00	0.00	0.00	UG/L

Table D-35. Summary statistics for pesticides in seep/spring water.

SUMMARY STATISTICS (SITEWIDE)

SEEP / SPRING WATER, PESTICIDES

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
4,4'-DDD	6	0	0.05	0.05	0.05	0.00	0.00	UG/L
4,4'-DDE	6	0	0.05	0.05	0.05	0.00	0.00	UG/L
4,4'-DDT	6	0	0.05	0.05	0.05	0.00	0.00	UG/L
ALDRIN	6	0	0.03	0.03	0.02	0.00	0.00	UG/L
AROCLOR-1016	6	0	0.25	0.25	0.25	0.00	0.00	UG/L
AROCLOR-1221	6	0	0.25	0.25	0.25	0.00	0.00	UG/L
AROCLOR-1232	6	0	0.25	0.25	0.25	0.00	0.00	UG/L
AROCLOR-1242	6	0	0.25	0.25	0.25	0.00	0.00	UG/L
AROCLOR-1248	6	0	0.25	0.25	0.25	0.00	0.00	UG/L
AROCLOR-1254	6	0	0.50	0.50	0.50	0.00	0.00	UG/L
AROCLOR-1260	6	0	0.50	0.50	0.50	0.00	0.00	UG/L
DIELDRIN	6	0	0.05	0.05	0.05	0.00	0.00	UG/L
ENDOSULFAN I	6	0	0.03	0.03	0.02	0.00	0.00	UG/L
ENDOSULFAN II	6	0	0.05	0.05	0.05	0.00	0.00	UG/L
ENDOSULFAN SULFATE	6	0	0.05	0.05	0.05	0.00	0.00	UG/L
ENDRIN	6	0	0.05	0.05	0.05	0.00	0.00	UG/L
ENDRIN KETONE	6	0	0.05	0.05	0.05	0.00	0.00	UG/L
HEPTACHLOR	6	0	0.03	0.03	0.02	0.00	0.00	UG/L
HEPTACHLOR EPOXIDE	6	0	0.03	0.03	0.02	0.00	0.00	UG/L
METHOXYCHLOR	6	0	0.25	0.25	0.25	0.00	0.00	UG/L
TOXAPHENE	6	0	0.50	0.50	0.50	0.00	0.00	UG/L
alpha-BHC	6	0	0.03	0.03	0.02	0.00	0.00	UG/L
alpha-CHLORDANE	6	0	0.25	0.25	0.25	0.00	0.00	UG/L
beta-BHC	6	0	0.03	0.03	0.02	0.00	0.00	UG/L
delta-BHC	6	0	0.03	0.03	0.02	0.00	0.00	UG/L
gamma-BHC (LINDANE)	6	0	0.03	0.03	0.02	0.00	0.00	UG/L
gamma-CHLORDANE	6	0	0.25	0.25	0.25	0.00	0.00	UG/L

Table D-36. Summary statistics for total metals in stream sediments.

SUMMARY STATISTICS (SITEWIDE)

STREAM SEDIMENTS, TOTAL METALS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	59	100	549.00	25,200.00	5,887.61	4,912.73	11,400.00	MG/KG
ANTIMONY	52	44	0.80	18.75	4.55	4.16	8.50	MG/KG
ARSENIC	59	69	0.20	17.30	2.24	2.50	3.70	MG/KG
BARIUM	57	84	6.50	244.00	74.47	56.85	145.00	MG/KG
BERYLLIUM	57	63	0.03	26.00	0.93	3.40	0.85	MG/KG
CADMIUM	51	39	0.13	3.10	0.72	0.58	1.20	MG/KG
CALCIUM	59	81	93.50	17,100.00	3,554.57	4,719.98	6,000.00	MG/KG
CESIUM	56	63	0.52	458.00	101.77	107.96	228.00	MG/KG
CHROMIUM	59	85	0.48	29.70	8.25	7.49	16.50	MG/KG
COBALT	59	76	0.29	16.65	5.16	3.57	8.20	MG/KG
COPPER	59	83	0.31	36.70	10.81	8.23	19.20	MG/KG
IRON	59	100	1,040.00	31,400.00	8,852.63	6,263.19	15,400.00	MG/KG
LEAD	59	100	2.10	244.00	22.02	36.79	31.10	MG/KG
LITHIUM	57	91	1.15	45.80	10.01	9.83	21.50	MG/KG
MAGNESIUM	59	80	98.50	5,850.00	1,404.18	1,253.37	2,600.00	MG/KG
MANGANESE	59	100	9.00	1,280.00	229.52	214.85	355.00	MG/KG
MERCURY	49	49	0.01	0.50	0.12	0.11	0.21	MG/KG
MOLYBDENUM	58	53	0.33	45.80	5.48	8.33	10.95	MG/KG
NICKEL	57	75	0.65	25.60	7.01	5.44	12.60	MG/KG
POTASSIUM	58	71	57.00	3,770.00	812.50	743.98	1,440.00	MG/KG
SELENIUM	58	43	0.11	2.90	0.45	0.55	0.55	MG/KG
SILICON	19	100	46.70	1,450.00	331.53	362.31	890.00	MG/KG
SILVER	54	33	0.20	3.40	0.86	0.71	1.40	MG/KG
SODIUM	59	80	28.80	705.00	161.47	136.80	230.00	MG/KG
STRONTIUM	58	90	2.80	421.00	45.62	77.91	58.00	MG/KG
THALLIUM	50	24	0.10	1.30	0.34	0.24	0.50	MG/KG
TIN	54	54	1.50	45.80	9.69	9.79	13.80	MG/KG
VANADIUM	57	91	2.00	73.00	18.15	14.34	32.30	MG/KG
ZINC	58	98	6.10	155.00	44.44	29.98	73.20	MG/KG

Table D-37. Summary statistics for total radionuclides in stream sediments.

SUMMARY STATISTICS (SITEWIDE)

STREAM SEDIMENTS, TOTAL RADIONUCLIDES

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
AMERICIUM-241	35	100	-0.01	0.82	0.07	0.19	0.03	PCI/G
CESIUM-137	35	100	-0.03	1.50	0.26	0.38	0.41	PCI/G
GROSS ALPHA	45	100	2.92	72.00	22.98	20.46	54.90	PCI/G
GROSS BETA	43	100	19.46	59.00	35.35	9.98	47.46	PCI/G
PLUTONIUM-238	5	100	-0.00	0.00	0.00	0.00	0.00	PCI/G
PLUTONIUM-239,240	42	100	0.00	2.36	0.17	0.59	0.03	PCI/G
RADIUM-226	21	100	0.43	1.80	0.85	0.36	1.10	PCI/G
RADIUM-228	20	100	0.52	3.45	1.70	0.74	2.54	PCI/G
STRONTIUM-89,90	43	100	-0.60	1.17	0.21	0.27	0.38	PCI/G
TRITIUM	41	100	-23.20	380.00	155.87	91.83	240.00	PCI/L
URANIUM, TOTAL	6	100	0.90	2.60	1.48	0.69	2.60	PCI/G
URANIUM-233,234	47	100	0.14	4.50	1.68	1.15	2.69	PCI/G
URANIUM-235	49	100	0.00	0.19	0.06	0.05	0.10	PCI/G
URANIUM-238	36	100	0.13	3.82	1.40	1.03	2.60	PCI/G

Table D-38. Summary statistics for total "water-quality" parameters in stream sediments.

SUMMARY STATISTICS (SITEWIDE)

STREAM SEDIMENTS, TOTAL "WATER-QUALITY" PARAMETERS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
% SOLIDS	2	100	16.80	43.20	30.00	18.67	43.20	%
ALKALINITY AS CACO3	28	93	0.33	25,000.00	1,970.44	5,102.72	1,900.00	MG/KG
BICARBONATE AS CACO3	4	100	93.00	3,180.00	1,041.25	1,449.27	3,180.00	MG/KG
CARBONATE	4	0	0.00	26.50	19.87	13.25	26.50	MG/KG
NITRATE/NITRITE	52	71	0.30	76.00	7.76	15.67	11.00	MG/KG
NITRITE	12	83	0.10	0.80	0.34	0.19	0.50	MG/KG
PH	51	100	6.05	8.70	7.26	0.66	7.90	PH
TOTAL ALKALINITY	6	100	320.00	21,000.00	4,470.00	8,116.00	21,000.00	MG/KG
TOTAL ORGANIC CARBON	1	100	24,000.00	24,000.00	24,000.00	.	24,000.00	MG/KG

Table D-39. Summary statistics for total volatile organics in stream sediments.

SUMMARY STATISTICS (SITEWIDE)

STREAM SEDIMENTS, TOTAL VOLATILE ORGANICS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,1,1-TRICHLOROETHANE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
1,1,2,2-TETRACHLOROETHANE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
1,1,2-TRICHLOROETHANE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
1,1-DICHLOROETHANE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
1,1-DICHLOROETHENE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
1,2-DICHLOROETHANE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
1,2-DICHLOROETHENE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
1,2-DICHLOROPROPANE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
2-BUTANONE	37	16	2.00	180.00	13.04	28.75	9.25	UG/KG
2-HEXANONE	25	0	5.00	10.00	7.09	1.34	8.50	UG/KG
4-METHYL-2-PENTANONE	29	0	5.00	10.00	7.09	1.25	8.50	UG/KG
ACETONE	36	58	5.00	520.00	50.50	107.09	85.00	UG/KG
BENZENE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
BROMODICHLOROMETHANE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
BROMOFORM	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
BROMOMETHANE	34	0	5.00	10.00	7.11	1.25	8.50	UG/KG
CARBON DISULFIDE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
CARBON TETRACHLORIDE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
CHLOROBENZENE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
CHLOROETHANE	35	0	5.00	10.00	7.05	1.28	8.50	UG/KG
CHLOROFORM	35	3	2.50	5.00	3.45	0.65	4.00	UG/KG
CHLOROMETHANE	35	0	5.00	10.00	7.05	1.28	8.50	UG/KG
DIBROMOCHLOROMETHANE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
ETHYLBENZENE	35	3	1.00	5.00	3.38	0.77	4.00	UG/KG
METHYLENE CHLORIDE	31	52	2.50	56.00	9.81	10.62	18.00	UG/KG
STYRENE	35	3	2.00	5.00	3.41	0.70	4.00	UG/KG
TETRACHLOROETHENE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
TOLUENE	35	6	2.00	8.00	3.56	1.03	4.00	UG/KG
TOTAL XYLENES	35	3	2.50	6.00	3.55	0.76	4.00	UG/KG
TRICHLOROETHENE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
VINYL ACETATE	29	0	5.00	10.00	7.09	1.25	8.50	UG/KG
VINYL CHLORIDE	35	0	5.00	10.00	7.05	1.28	8.50	UG/KG
cis-1,3-DICHLOROPROPENE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG
trans-1,3-DICHLOROPROPENE	35	0	2.50	5.00	3.45	0.65	4.00	UG/KG

Table D-40. Summary statistics for total semi-volatile organics in stream sediments.

SUMMARY STATISTICS (SITEWIDE)

STREAM SEDIMENTS, TOTAL SEMI-VOLATILE ORGANICS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,2,4-TRICHLOROBENZENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
1,2-DICHLOROBENZENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
1,3-DICHLOROBENZENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
1,4-DICHLOROBENZENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
2,4,5-TRICHLOROPHENOL	23	0	850.00	1,650.00	1,166.30	195.34	1,350.00	UG/KG
2,4,6-TRICHLOROPHENOL	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
2,4-DICHLOROPHENOL	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
2,4-DIMETHYLPHENOL	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
2,4-DINITROPHENOL	22	0	900.00	1,650.00	1,180.68	187.07	1,350.00	UG/KG
2,4-DINITROTOLUENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
2,6-DINITROTOLUENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
2-CHLORONAPHTHALENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
2-CHLOROPHENOL	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
2-METHYLNAPHTHALENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
2-METHYLPHENOL	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
2-NITROANILINE	23	0	850.00	1,650.00	1,166.30	195.34	1,350.00	UG/KG
2-NITROPHENOL	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
3,3'-DICHLOROBENZIDINE	25	0	340.00	650.00	484.20	90.65	625.00	UG/KG
3-NITROANILINE	23	0	850.00	1,650.00	1,166.30	195.34	1,350.00	UG/KG
4,6-DINITRO-2-METHYLPHENOL	22	0	900.00	1,650.00	1,180.68	187.07	1,350.00	UG/KG
4-BROMOPHENYL PHENYL ETHER	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
4-CHLORO-3-METHYLPHENOL	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
4-CHLOROANILINE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
4-CHLOROPHENYL PHENYL ETHER	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
4-METHYLPHENOL	26	23	68.00	1,500.00	316.87	301.69	330.00	UG/KG
4-NITROANILINE	23	0	850.00	1,650.00	1,166.30	195.34	1,350.00	UG/KG
4-NITROPHENOL	23	0	850.00	1,650.00	1,166.30	195.34	1,350.00	UG/KG
ACENAPHTHENE	24	8	75.00	330.00	229.27	51.48	270.00	UG/KG
ACENAPHTHYLENE	24	8	170.00	450.00	241.56	59.75	280.00	UG/KG
ANTHRACENE	25	16	75.00	700.00	264.10	138.32	310.00	UG/KG
BENZO(a)ANTHRACENE	25	32	37.00	1,700.00	309.14	355.82	312.50	UG/KG
BENZO(a)PYRENE	24	21	59.00	900.00	276.19	182.56	312.50	UG/KG
BENZO(b)FLUORANTHENE	24	21	48.00	2,400.00	334.40	453.13	312.50	UG/KG
BENZO(ghi)PERYLENE	23	9	175.00	460.00	247.28	59.49	280.00	UG/KG
BENZO(k)FLUORANTHENE	24	17	64.00	760.00	254.69	137.31	280.00	UG/KG
BENZOIC ACID	29	21	270.00	1,650.00	1,056.03	319.81	1,300.00	UG/KG
BENZYL ALCOHOL	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
BIS(2-CHLOROETHOXY)METHANE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
BIS(2-CHLOROETHYL)ETHER	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
BIS(2-CHLOROISOPROPYL)ETHER	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
BIS(2-ETHYLHEXYL)PHTHALATE	29	76	37.00	610.00	234.91	179.37	360.00	UG/KG
BUTYL BENZYL PHTHALATE	23	13	56.00	330.00	214.33	67.94	265.00	UG/KG
CHRYSENE	25	32	50.00	2,000.00	331.66	414.98	312.50	UG/KG
DI-n-BUTYL PHTHALATE	29	34	73.00	1,900.00	350.61	407.47	330.00	UG/KG
DI-n-OCTYL PHTHALATE	22	0	175.00	330.00	237.64	38.17	265.00	UG/KG
DIBENZO(a,h)ANTHRACENE	22	5	175.00	330.00	236.70	38.32	265.00	UG/KG
DIBENZOFURAN	23	4	170.00	330.00	232.07	41.41	265.00	UG/KG
DIETHYL PHTHALATE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
DIMETHYL PHTHALATE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
FLUORANTHENE	26	42	70.00	3,100.00	452.94	784.19	360.00	UG/KG
FLUORENE	24	8	170.00	420.00	248.23	61.13	312.50	UG/KG
HEXACHLOROBENZENE	23	4	170.00	440.00	243.37	56.51	280.00	UG/KG
HEXACHLOROBUTADIENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
HEXACHLOROCYCLOPENTADIENE	20	0	175.00	330.00	239.67	39.46	272.50	UG/KG
HEXACHLOROETHANE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
INDENO(1,2,3-cd)PYRENE	23	9	175.00	470.00	246.65	61.39	280.00	UG/KG
ISOPHORONE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
N-NITROSO-DI-n-PROPYLAMINE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
N-NITROSODIPHENYLAMINE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
NAPHTHALENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
NITROBENZENE	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
PENTACHLOROPHENOL	23	0	850.00	1,650.00	1,166.30	195.34	1,350.00	UG/KG
PHENANTHRENE	25	28	59.00	3,200.00	469.54	786.10	312.50	UG/KG
PHENOL	23	0	170.00	330.00	234.89	39.89	265.00	UG/KG
PYRENE	26	42	61.00	4,700.00	469.60	945.60	312.50	UG/KG

Table D-41. Summary statistics for total metals in seep/spring sediments.

SUMMARY STATISTICS (SITEWIDE)

SEEP / SPRING SEDIMENTS, TOTAL METALS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
ALUMINUM	20	100	4,760.00	21,600.00	10,354.30	5,010.71	16,100.00	MG/KG
ANTIMONY	18	44	1.85	30.50	8.81	8.14	19.70	MG/KG
ARSENIC	20	90	0.55	49.20	12.55	14.28	29.40	MG/KG
BARIUM	20	95	57.00	706.00	204.61	155.62	342.50	MG/KG
BERYLLIUM	16	81	0.36	3.00	1.13	0.92	2.70	MG/KG
CADMIUM	16	44	0.37	6.10	1.65	1.66	1.75	MG/KG
CALCIUM	20	100	3,900.00	61,000.00	19,407.50	16,059.56	34,900.00	MG/KG
CESIUM	17	53	37.35	702.00	260.47	200.55	448.00	MG/KG
CHROMIUM	18	94	4.20	22.50	10.98	5.27	18.30	MG/KG
COBALT	19	84	0.65	21.90	8.47	5.48	13.65	MG/KG
COPPER	18	94	6.80	43.20	18.74	10.68	35.20	MG/KG
IRON	18	100	2,250.00	85,200.00	20,763.89	22,673.64	38,800.00	MG/KG
LEAD	18	100	8.10	80.30	36.37	22.64	61.00	MG/KG
LITHIUM	18	89	4.20	70.20	19.79	20.12	35.70	MG/KG
MAGNESIUM	20	80	525.00	4,730.00	2,249.30	1,152.86	3,655.00	MG/KG
MANGANESE	19	100	34.90	974.00	261.63	273.79	591.00	MG/KG
MERCURY	15	33	0.06	1.30	0.23	0.31	0.32	MG/KG
MOLYBDENUM	19	58	1.50	70.20	15.77	19.74	27.30	MG/KG
NICKEL	17	88	3.80	29.90	12.99	7.51	25.00	MG/KG
POTASSIUM	18	61	222.00	2,350.00	1,050.72	616.83	1,890.00	MG/KG
SELENIUM	19	68	0.23	3.50	1.26	0.98	2.90	MG/KG
SILICON	10	100	313.00	7,100.00	1,698.70	2,117.17	3,280.00	MG/KG
SILVER	15	47	0.48	6.80	2.15	1.98	3.80	MG/KG
SODIUM	20	60	70.10	1,365.00	251.62	294.04	358.50	MG/KG
STRONTIUM	20	90	15.90	343.00	113.70	92.03	222.00	MG/KG
THALLIUM	13	31	0.13	9.20	1.42	2.44	2.75	MG/KG
TIN	19	58	3.45	70.20	22.18	18.75	36.40	MG/KG
VANADIUM	19	100	13.80	61.20	27.63	14.21	49.60	MG/KG
ZINC	20	100	17.30	112.00	56.13	22.67	78.00	MG/KG

Table D-42. Summary statistics for total radionuclides in seep/spring sediments.

SUMMARY STATISTICS (SITEWIDE)								
SEEP / SPRING SEDIMENTS, TOTAL RADIONUCLIDES								
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
AMERICIUM-241	13	100	0.00	0.54	0.05	0.15	0.09	PCI/G
CESIUM-137	13	100	0.15	2.30	0.81	0.60	1.40	PCI/G
GROSS ALPHA	15	100	5.02	47.60	19.71	14.00	35.00	PCI/G
GROSS BETA	14	100	16.37	32.50	23.73	5.08	29.00	PCI/G
PLUTONIUM-238	3	100	0.00	0.00	0.00	0.00	0.00	PCI/G
PLUTONIUM-239,240	15	100	0.00	2.30	0.21	0.59	0.08	PCI/G
RADIUM-226	9	100	0.24	1.10	0.71	0.24	0.82	PCI/G
RADIUM-228	9	100	0.71	1.60	1.18	0.32	1.58	PCI/G
STRONTIUM-89,90	14	100	-0.20	1.73	0.35	0.52	0.80	PCI/G
TRITIUM	13	100	50.00	540.00	198.54	127.73	320.00	PCI/L
URANIUM, TOTAL	3	100	1.20	2.30	1.87	0.59	2.30	PCI/G
URANIUM-233,234	16	100	0.06	1.43	0.82	0.38	1.16	PCI/G
URANIUM-235	17	100	0.00	0.21	0.04	0.05	0.06	PCI/G
URANIUM-238	14	100	0.07	1.61	0.73	0.41	1.10	PCI/G

Table D-43. Summary statistics for total "water-quality" parameters in seep/spring sediments.

SUMMARY STATISTICS (SITEWIDE)								
SEEP / SPRING SEDIMENTS, TOTAL "WATER-QUALITY" PARAMETERS								
ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
% SOLIDS	1	100	60.70	60.70	60.70	.	60.70	%
ALKALINITY AS CACO3	8	100	68.00	81,000.00	14,192.25	27,343.99	11,000.00	MG/KG
NITRATE/NITRITE	17	53	0.90	17.10	4.14	3.90	6.30	MG/KG
NITRITE	3	100	0.40	3.10	1.33	1.53	3.10	MG/KG
PH	18	100	6.10	7.90	7.24	0.56	7.90	PH

Table D-44. Summary statistics for total volatile organics in seep/spring sediments.

SUMMARY STATISTICS (SITEWIDE)

SEEP / SPRING SEDIMENTS, TOTAL VOLATILE ORGANICS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,1,1-TRICHLOROETHANE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
1,1,2,2-TETRACHLOROETHANE	8	0	4.00	22.00	9.19	6.65	15.50	UG/KG
1,1,2-TRICHLOROETHANE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
1,1-DICHLOROETHANE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
1,1-DICHLOROETHENE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
1,2-DICHLOROETHANE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
1,2-DICHLOROETHENE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
1,2-DICHLOROPROPANE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
2-BUTANONE	11	36	8.00	320.00	70.14	105.49	180.00	UG/KG
2-HEXANONE	8	0	8.00	44.00	18.19	13.24	30.50	UG/KG
4-METHYL-2-PENTANONE	8	0	8.00	44.00	18.19	13.24	30.50	UG/KG
ACETONE	10	60	8.00	990.00	317.20	353.08	780.00	UG/KG
BENZENE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
BROMODICHLOROMETHANE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
BROMOFORM	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
BROMOMETHANE	9	0	8.00	44.00	17.11	12.80	30.50	UG/KG
CARBON DISULFIDE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
CARBON TETRACHLORIDE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
CHLOROBENZENE	8	0	4.00	22.00	9.19	6.65	15.50	UG/KG
CHLOROETHANE	9	0	8.00	44.00	17.11	12.80	30.50	UG/KG
CHLOROFORM	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
CHLOROMETHANE	9	0	8.00	44.00	17.11	12.80	30.50	UG/KG
DIBROMOCHLOROMETHANE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
ETHYLBENZENE	8	0	4.00	22.00	9.19	6.65	15.50	UG/KG
METHYLENE CHLORIDE	10	30	4.00	240.00	40.00	72.55	65.00	UG/KG
STYRENE	8	0	4.00	22.00	9.19	6.65	15.50	UG/KG
TETRACHLOROETHENE	8	0	4.00	22.00	9.19	6.65	15.50	UG/KG
TOLUENE	10	50	4.00	120.00	24.80	34.87	31.00	UG/KG
TOTAL XYLENES	7	0	4.00	22.00	9.43	7.15	15.50	UG/KG
TRICHLOROETHENE	9	11	4.00	22.00	9.22	6.18	15.50	UG/KG
VINYL ACETATE	9	0	8.00	44.00	17.11	12.80	30.50	UG/KG
VINYL CHLORIDE	9	0	8.00	44.00	17.11	12.80	30.50	UG/KG
cis-1,3-DICHLOROPROPENE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG
trans-1,3-DICHLOROPROPENE	9	0	4.00	22.00	8.67	6.42	15.50	UG/KG

Table D-45. Summary statistics for total semi-volatile organics in seep/spring sediments.

SUMMARY STATISTICS (SITEWIDE)

SEEP / SPRING SEDIMENTS, TOTAL SEMI-VOLATILE ORGANICS

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
1,2,4-TRICHLOROBENZENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
1,2-DICHLOROBENZENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
1,3-DICHLOROBENZENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
1,4-DICHLOROBENZENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
2,4,5-TRICHLOROPHENOL	4	0	1,350.00	1,500.00	1,425.00	64.55	1,500.00	UG/KG
2,4,6-TRICHLOROPHENOL	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
2,4-DICHLOROPHENOL	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
2,4-DIMETHYLPHENOL	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
2,4-DINITROPHENOL	3	0	1,350.00	1,500.00	1,416.67	76.38	1,500.00	UG/KG
2,4-DINITROTOLUENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
2,6-DINITROTOLUENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
2-CHLORONAPHTHALENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
2-CHLOROPHENOL	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
2-METHYLNAPHTHALENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
2-METHYLPHENOL	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
2-NITROANILINE	4	0	1,350.00	1,500.00	1,425.00	64.55	1,500.00	UG/KG
2-NITROPHENOL	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
3,3'-DICHLOROBENZIDINE	5	0	550.00	650.00	590.00	41.83	650.00	UG/KG
3-NITROANILINE	4	0	1,350.00	1,500.00	1,425.00	64.55	1,500.00	UG/KG
4,6-DINITRO-2-METHYLPHENOL	3	0	1,350.00	1,500.00	1,416.67	76.38	1,500.00	UG/KG
4-BROMOPHENYL PHENYL ETHER	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
4-CHLORO-3-METHYLPHENOL	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
4-CHLOROANILINE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
4-CHLOROPHENYL PHENYL ETHER	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
4-METHYLPHENOL	7	57	275.00	2,400.00	1,292.14	1,027.19	2,300.00	UG/KG
4-NITROANILINE	4	0	1,350.00	1,500.00	1,425.00	64.55	1,500.00	UG/KG
4-NITROPHENOL	4	0	1,350.00	1,500.00	1,425.00	64.55	1,500.00	UG/KG
ACENAPHTHENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
ACENAPHTHYLENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
ANTHRACENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
BENZO(a)ANTHRACENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
BENZO(a)PYRENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
BENZO(b)FLUORANTHENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
BENZO(ghi)PERYLENE	3	0	280.00	305.00	291.67	12.58	305.00	UG/KG
BENZO(k)FLUORANTHENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
BENZOIC ACID	9	67	270.00	3,300.00	1,161.11	922.30	1,450.00	UG/KG
BENZYL ALCOHOL	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
BIS(2-CHLOROETHOXY)METHANE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
BIS(2-CHLOROETHYL)ETHER	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
BIS(2-CHLOROISOPROPYL)ETHER	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
BIS(2-ETHYLHEXYL)PHTHALATE	11	91	80.00	1,000.00	475.91	324.66	880.00	UG/KG
BUTYL BENZYL PHTHALATE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
CHRYSENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
DI-n-BUTYL PHTHALATE	5	60	66.00	2,200.00	604.20	897.47	2,200.00	UG/KG
DI-n-OCTYL PHTHALATE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
DIBENZO(a,h)ANTHRACENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
DIBENZOFURAN	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
DIETHYL PHTHALATE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
DIMETHYL PHTHALATE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
FLUORANTHENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
FLUORENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
HEXACHLOROBENZENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
HEXACHLOROBUTADIENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
HEXACHLOROCYCLOPENTADIENE	3	0	275.00	305.00	286.67	16.07	305.00	UG/KG
HEXACHLOROETHANE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
INDENO(1,2,3-cd)PYRENE	3	0	280.00	305.00	291.67	12.58	305.00	UG/KG
ISOPHORONE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
N-NITROSO-DI-n-PROPYLAMINE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
N-NITROSODIPHENYLAMINE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
NAPHTHALENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
NITROBENZENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
PENTACHLOROPHENOL	5	20	350.00	1,500.00	1,210.00	483.99	1,500.00	UG/KG
PHENANTHRENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG
PHENOL	7	43	170.00	660.00	330.00	153.98	330.00	UG/KG
PYRENE	4	0	275.00	305.00	287.50	13.23	305.00	UG/KG

Table D-46. Summary statistics for total pesticides in seep/spring sediments.

SUMMARY STATISTICS (SITEWIDE)

SEEP / SPRING SEDIMENTS, TOTAL PESTICIDES

ANALYTE	SAMPLE SIZE, N	PERCENT DETECTS	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	85 th PERCENTILE	UNITS
4,4'-DDD	3	0	13.00	14.50	13.83	0.76	0.76	UG/KG
4,4'-DDE	3	0	13.00	14.50	13.83	0.76	0.76	UG/KG
4,4'-DDT	3	0	13.00	14.50	13.83	0.76	0.76	UG/KG
ALDRIN	3	0	6.50	7.00	6.83	0.29	0.29	UG/KG
AROCLOR-1016	4	0	4.50	70.00	52.38	32.00	32.00	UG/KG
AROCLOR-1221	4	0	4.50	70.00	52.38	32.00	32.00	UG/KG
AROCLOR-1232	4	0	3.00	70.00	52.00	32.75	32.75	UG/KG
AROCLOR-1242	4	0	1.50	70.00	51.63	33.50	33.50	UG/KG
AROCLOR-1248	4	0	1.50	70.00	51.63	33.50	33.50	UG/KG
AROCLOR-1254	4	25	33.00	145.00	112.00	53.03	53.03	UG/KG
AROCLOR-1260	4	0	1.50	145.00	104.12	68.70	68.70	UG/KG
DIELDRIN	3	0	13.00	14.50	13.83	0.76	0.76	UG/KG
ENDOSULFAN I	3	0	6.50	7.00	6.83	0.29	0.29	UG/KG
ENDOSULFAN II	3	0	13.00	14.50	13.83	0.76	0.76	UG/KG
ENDOSULFAN SULFATE	3	0	13.00	14.50	13.83	0.76	0.76	UG/KG
ENDRIN	3	0	13.00	14.50	13.83	0.76	0.76	UG/KG
ENDRIN KETONE	3	0	13.00	14.50	13.83	0.76	0.76	UG/KG
HEPTACHLOR	3	0	6.50	7.00	6.83	0.29	0.29	UG/KG
HEPTACHLOR EPOXIDE	3	0	6.50	7.00	6.83	0.29	0.29	UG/KG
METHOXYCHLOR	3	0	65.00	70.00	68.33	2.89	2.89	UG/KG
TOXAPHENE	3	0	130.00	145.00	138.33	7.64	7.64	UG/KG
alpha-BHC	3	33	0.00	7.00	4.50	3.91	3.91	UG/KG
alpha-CHLORDANE	3	0	65.00	70.00	68.33	2.89	2.89	UG/KG
beta-BHC	3	0	6.50	7.00	6.83	0.29	0.29	UG/KG
delta-BHC	3	0	6.50	7.00	6.83	0.29	0.29	UG/KG
gamma-BHC (LINDANE)	3	33	0.00	7.00	4.50	3.91	3.91	UG/KG
gamma-CHLORDANE	3	0	65.00	70.00	68.33	2.89	2.89	UG/KG

OUTLIER SUMMARY

APPENDIX E

OUTLIER SUMMARY

APPENDIX E
OUTLIER SUMMARY

Outliers are extreme values that may represent an incorrectly read, recorded, or transcribed measurement, an incorrect calculation, an error in documentation (field or laboratory), or an actual environmental condition. Those outliers that were correctable were changed to the correct value; some outliers that were inexplicable are described in detail below. A complete listing of excluded outliers is presented in Table E-1.

Samples from well B303089 consistently showed higher than average concentrations for some constituents, such as SO_4^{2-}, Mg, Na, Sr, and $^{233,234}U$. Well B303089 is located in the extreme southeastern corner of the RFP, and may not represent background because of its location downgradient of a small, pre-RFP landfill. The $^{233,234}U$ concentration may reflect naturally occurring uranium. The ^{238}U and ^{235}U concentrations were not outside of normal background values. However, because of the questionable nature of well B303089 as a truly background well and conflicting reports of the screened lithology, this well has been dropped from use in the *1993 Background Geochemical Characterization Report*.

Trace-element data for a sample collected September 11, 1991, from well B203989 show anomalously high values for those analytes measured by inductively coupled plasma emission spectroscopy (ICP). Analytes measured by atomic absorption spectroscopy (AA) for the same sample did not show such high concentrations. A sample mix-up is suspected in the case of the ICP analysis, and the values for trace metals from this analysis were excluded from further statistical and geochemical analysis.

High concentrations of total metals in the December 7, 1991 sample from well B200589 appear to be related to the high values of total suspended solids (TSS) measured in the same sample, and as a result, are probably not a good measure of water chemistry. However, the values do represent background and could be compared against the analytical results for other high TSS waters.

In the September 14, 1990 sample from well B400289, some anomalous values exist for some dissolved metals. It appears that a transcription error shifted the data to the wrong fields. Because the anomalous values are a one-time event for this well, and are most probably because of a transcription error, they have been omitted from further data analysis.

A sample from well B205589 contained some unreasonable values for Tl, Sn, Si, and Sr. A transcription error is again suspected. Likewise, a one-time high value of 185 mg/L for Cl^- (June 5, 1990) is an order of magnitude higher than the usual range of 19 to 22 mg/L for this well, and is probably a transcription error. Less easily explained are the consistently high values obtained for this well for certain radionuclides; specifically $^{233,234}U$ and ^{238}U. Gross alpha and gross beta are elevated in the same samples. These high concentrations of radionuclides are not a one-time event for this well, so the data probably do not reflect analytical or transcription errors. The data were flagged during outlier testing, but may actually represent an anomalously "hot" background well, and as such, should not be (and were not) excluded as outliers.

Well B201189 had one sample (October 20, 1992) with reported concentrations for total metals that were one to three orders of magnitude above all other samples from this well. These were flagged as outliers and excluded from statistical analysis.

Table E-1. Outlier summary. (See section 1.4.3 for discussion of outliers).

SUMMARY OF OUTLIERS EXCLUDED FROM STATISTICAL ANALYSIS

GROUNDWATER, DISSOLVED METALS

LOCATION	SAMPLE	ANALYTE	RESULT	UNITS
B202589	GW00230IT	MANGANESE	934	UG/L
B205589	GW01746IT	THALLIUM	328	UG/L
B205589	GW01746IT	TIN	8830	UG/L
B304889	G-4089-0523-02-1445	CESIUM	2500	UG/L
B400189	GW0189003	CALCIUM	1700	UG/L
B400189	GW0189003	MAGNESIUM	28.5	UG/L
B400289	GW00397IT	POTASSIUM	20	UG/L
B400289	GW00397IT	SELENIUM	607	UG/L
B400289	GW00397IT	SILVER	13600	UG/L
B400289	GW00397IT	SODIUM	10	UG/L
B400289	GW00397IT	STRONTIUM	7930	UG/L
B400289	GW00397IT	THALLIUM	99.8	UG/L
B400389	GW01789IT	ALUMINUM	8610	UG/L
B400389	GW01789IT	IRON	8790	UG/L
B400489	GW03482IT	COPPER	168.5	UG/L
B405489	GW00118IT	ALUMINUM	3780	UG/L
B405489	GW00118IT	COPPER	175	UG/L

GROUNDWATER, TOTAL METALS

B200589	GW02043IT	ALUMINUM	63900	UG/L
B200589	GW02043IT	BARIUM	752	UG/L
B200589	GW02043IT	CHROMIUM	98.7	UG/L
B200589	GW02043IT	IRON	97000	UG/L
B200589	GW02043IT	LEAD	52.5	UG/L
B200589	GW02043IT	MANGANESE	1950	UG/L
B200589	GW02043IT	VANADIUM	167	UG/L
B201189	GW03774IT	ALUMINUM	53900	UG/L
B201189	GW03774IT	CHROMIUM	729	UG/L
B201189	GW03774IT	IRON	41900	UG/L
B201189	GW03774IT	NICKEL	334	UG/L
B201189	GW03774IT	SELENIUM	456	UG/L
B201189	GW03774IT	SILICON	116000	UG/L
B203989	GW01756IT	ANTIMONY	1610	UG/L
B203989	GW01756IT	BARIUM	1810	UG/L
B203989	GW01756IT	BERYLLIUM	160	UG/L
B203989	GW01756IT	CADMIUM	1720	UG/L
B203989	GW01756IT	CHROMIUM	1590	UG/L
B203989	GW01756IT	COBALT	1620	UG/L
B203989	GW01756IT	COPPER	1750	UG/L
B203989	GW01756IT	MOLYBDENUM	1600	UG/L
B203989	GW01756IT	NICKEL	1660	UG/L
B203989	GW01756IT	SILVER	300	UG/L
B203989	GW01756IT	VANADIUM	1670	UG/L
B203989	GW01756IT	ZINC	1800	UG/L
B205589	GW01746IT	SILICON	1.31	UG/L
B400189	G-0189-0606-02-1115	CYANIDE	28	UG/L

Table E-1 (cont').

SUMMARY OF OUTLIERS EXCLUDED FROM STATISTICAL ANALYSIS

GROUNDWATER, DISSOLVED RADIONUCLIDES

LOCATION	SAMPLE	ANALYTE	RESULT	UNITS
B102389	GW01759IT	URANIUM-233,234	20.26	PCI/L
B102389	GW01759IT	URANIUM-238	15.5	PCI/L
B200789	GW02554IT	TRITIUM	1447	PCI/L
B305389	GW03761IT	URANIUM-233,234	133.8	PCI/L
B402189	GW02540IT	STRONTIUM-89,90	7.81	PCI/L

GROUNDWATER, TOTAL RADIONUCLIDES

B203489	GW03786IT	TRITIUM	39030	PCI/L
B304989	GW00212IT	TRITIUM	1350	PCI/L

GROUNDWATER, WATER-QUALITY PARAMETERS

B102389	GW00106IT	SILICA	70598	UG/L
B201289	G-1189-0614-02-1124	NITRATE/NITRITE	311000	UG/L
B202589	GW01368IT	TOTAL DISSOLVED SOLIDS	6000	UG/L
B203989	GW00608IT	SILICA	17	UG/L
B205589	G-4689-0604-02-1205	CHLORIDE	185000	UG/L
B305389	GW02153IT	CARBONATE	14390.4	UG/L
B400489	GW00247IT	FLUORIDE	50000	UG/L
B405789	GW00161IT	PHOSPHORUS	15000	UG/L
B405889	G-4989-0614-02-0930	CYANIDE	100	UG/L

GROUNDWATER, VOLATILE ORGANICS

B200589	GW03471IT	CARBON TETRACHLORIDE	2300	UG/L
B200589	GW03471IT	CARBON TETRACHLORIDE	2800	UG/L
B200589	GW03471IT	CARBON TETRACHLORIDE	970	UG/L
B200589	GW03471IT	CHLOROFORM	43	UG/L
B200589	GW03471IT	CHLOROFORM	130	UG/L
B200589	GW03471IT	METHYLENE CHLORIDE	42	UG/L
B200589	GW03471IT	METHYLENE CHLORIDE	82	UG/L
B200589	GW03471IT	TETRACHLOROETHENE	230	UG/L
B200589	GW03471IT	TETRACHLOROETHENE	220	UG/L
B200589	GW03471IT	TRICHLOROETHENE	190	UG/L
B200589	GW03471IT	TRICHLOROETHENE	210	UG/L
B201089	G-0989-0605-02-1510	ACETONE	25	UG/L
B201289	GW01071IT	METHYLENE CHLORIDE	25	UG/L
B201589	G-1389-0604-02-1500	TRICHLOROETHENE	42	UG/L
B203289	GW01064IT	ACETONE	25	UG/L
B203489	GW00307IT	TRICHLOROETHENE	27	UG/L
B302089	GW00048IT	METHYLENE CHLORIDE	21	UG/L
B302089	GW03340IT	METHYLENE CHLORIDE	41	UG/L
B302089	GW03740IT	TOTAL XYLENES	0.3	UG/L
B302989	G-2589-0523-02-1125	ACETONE	36	UG/L
B304889	G-4089-0523-02-1445	ACETONE	30	UG/L
B304889	GW02149IT	CARBON DISULFIDE	31	UG/L
B400289	GW02959IT	STYRENE	0.1	UG/L
B400289	GW02959IT	cis-1,3-DICHLOROPROPENE	0.1	UG/L
B400289	GW02959IT	trans-1,3-DICHLOROPROPENE	0.1	UG/L
B402689	GW02475IT	CARBON DISULFIDE	21	UG/L
B405489	G-4589-0521-02-1445	TETRACHLOROETHENE	42	UG/L
B405789	GW01338IT	METHYLENE CHLORIDE	23	UG/L

Table E-1 (cont').

SUMMARY OF OUTLIERS EXCLUDED FROM STATISTICAL ANALYSIS

STREAM WATER, DISSOLVED METALS

LOCATION	SAMPLE	ANALYTE	RESULT	UNITS
SW005	SW00590001	ANTIMONY	500	UG/L
SW005	SW00590001	TIN	1000	UG/L
SW005	SW00590002	ANTIMONY	500	UG/L
SW005	SW00590002	TIN	1000	UG/L
SW006	SW006002	MAGNESIUM	10	UG/L
SW006	SW006007	ANTIMONY	272.3	UG/L
SW006	SW006007	TIN	520.5	UG/L
SW006	SW00690001	ANTIMONY	272.3	UG/L
SW006	SW00690001	TIN	520.5	UG/L
SW006	SW06001	IRON	1340.5	UG/L
SW007	SW07001	ZINC	320	UG/L
SW041	SW04190001	ANTIMONY	500	UG/L
SW041	SW04190001	TIN	1000	UG/L
SW107	SW107004	MANGANESE	1100	UG/L
SW107	SW10790002	BARIUM	0.85	UG/L

STREAM WATER, DISSOLVED RADIONUCLIDES

SW005	SW00108WC	GROSS ALPHA	69.23	PCI/L
SW005	SW00108WC	URANIUM-233,234	31.75	PCI/L
SW005	SW00108WC	URANIUM-238	24.45	PCI/L
SW131	SW00469WC	TRITIUM	2700	PCI/L
SW137	SW01840WC	TRITIUM	1652	PCI/L

STREAM WATER, TOTAL RADIONUCLIDES

SW104	SW01841WC	GROSS BETA	47.27	PCI/L
SW041	SW041003	GROSS ALPHA	57	PCI/L
SW041	SW041003	GROSS BETA	41	PCI/L
SW041	SW041W060490A	GROSS ALPHA	40.1	PCI/L
SW107	SW107004	GROSS ALPHA	35	PCI/L

STREAM WATER, VOLATILE ORGANICS

SW042	SW042040390QM	2-BUTANONE	100	UG/L
SW042	SW042040390QM	4-METHYL-2-PENTANONE	50	UG/L
SW042	SW042040390QM	ACETONE	100	UG/L

STREAM WATER, WATER-QUALITY PARAMETERS

SW005	SW005W060190A	TOTAL DISSOLVED SOLIDS	620000	UG/L
SW006	SW00465WC	SULFIDE	9409	UG/L
SW041	SW00522WC	SULFIDE	10000	UG/L
SW041	SW00568WC	SULFIDE	9409	UG/L
SW127	SW00571WC	SULFIDE	9409	UG/L
SW131	SW00573WC	SULFIDE	9409	UG/L

Table E-1 (cont').

SUMMARY OF OUTLIERS EXCLUDED FROM STATISTICAL ANALYSIS

STREAM SEDIMENTS, TOTAL METALS

LOCATION	SAMPLE	ANALYTE	RESULT	UNITS
SED020	SED020001B	TIN	421	MG/KG
SED023	SD00318WC	ZINC	639	MG/KG

STREAM SEDIMENTS, TOTAL RADIONUCLIDES

SED004	SS00103WC	TRITIUM	1770	PCI/L
SED016	SS00004WC	AMERICIUM-241	2.53	PCI/G
SED017	SS00005WC	PLUTONIUM-239,240	4.44	PCI/G
SED020	SS00002WC	AMERICIUM-241	1.3	PCI/G
SED020	SS00002WC	PLUTONIUM-239,240	8.93	PCI/G
SED022	SS00001WC	PLUTONIUM-239,240	3.48	PCI/G

STREAM SEDIMENTS, VOLATILE ORGANICS

SED017	SD00210WC	2-BUTANONE	600	UG/KG
SED017	SD00210WC	ACETONE	2300	UG/KG
SED022	SD00214WC	METHYLENE CHLORIDE	190	UG/KG
SED023	SS00024WC	ACETONE	830	UG/KG

SEEP / SPRING SEDIMENTS, TOTAL METALS

SED018	SS00110WC	COPPER	178	MG/KG
SED018	SS00110WC	IRON	112000	MG/KG
SED018	SS00110WC	MANGANESE	1740	MG/KG
SED021	SS00179WC	LEAD	255	MG/KG

SEEP / SPRING SEDIMENTS, TOTAL RADIONUCLIDES

SED018	SS00006WC	AMERICIUM-241	1.07	PCI/G
SED018	SS00006WC	PLUTONIUM-239,240	6.67	PCI/G
SED021	SS00023WC	ACETONE	250000	UG/KG

SEEP / SPRING SEDIMENTS, "WATER-QUALITY" PARAMETERS

SED018	SD00211WC	NITRATE/NITRITE	63.8	MG/KG

GEOLOGIC MATERIALS, "WATER-QUALITY" PARAMETERS

B200689	BH06890410	SULFIDE	43000	MG/KG

Table E-1 (cont').

SUMMARY OF OUTLIERS EXCLUDED FROM STATISTICAL ANALYSIS

LOCATION	SAMPLE	ANALYTE	RESULT	UNITS
SEEP / SPRING WATER, DISSOLVED METALS				
SW104	SW10490001	MERCURY	5.1	UG/L
SEEP / SPRING WATER, DISSOLVED RADIONUCLIDES				
SW080	SW00466WC	TRITIUM	1200	PCI/L
SEEP / SPRING WATER, TOTAL RADIONUCLIDES				
SW080	SW080004	PLUTONIUM-239,240	4.4	PCI/L
SW080	SW080008	TRITIUM	-6930	PCI/L
SEEP / SPRING WATER, VOLATILE ORGANICS				
SW080	SW080W040390A	METHYLENE CHLORIDE	22	UG/L
SW108	SW00873WC	ACETONE	56	UG/L
SW108	SW01082WC	ACETONE	91	UG/L
SEEP / SPRING WATER, WATER-QUALITY PARAMETERS				
SW080	SW00466WC	SULFIDE	18000	UG/L

DATA QUALITY ASSESSMENT TABLES

APPENDIX F

DATA QUALITY ASSESSMENT TABLES

APPENDIX F
DATA QUALITY ASSESSMENT TABLES

Table	Title
F-1	**Data Validation Summary**
F-2	**%RPD Groundwater**
F-2a	Dissolved Metals
F-2b	Total Metals
F-2c	Dissolved Radionuclides
F-2d	Total Radionuclides
F-2e	Anions, Cyanide, and Water Quality Parameters
F-3	**%RPD Stream Water**
F-3a	Dissolved Metals
F-3b	Total Metals
F-3c	Dissolved Radionuclides
F-3d	Total Radionuclides
F-3e	Anions, Cyanide, and Water Quality Parameters
F-4	**%RPD Seep/Spring Water**
F-4a	Dissolved Metals
F-4b	Total Metals
F-4c	Total Radionuclides
F-4d	Anions, Cyanide, and Water Quality Parameters
F-5	**%RPD Borehole Materials**
F-5a	Metals
F-5b	Radionuclides
F-6	**%RPD Stream Sediment**
F-6a	Metals
F-6b	Radionuclides
F-7	**%RPD Seep/Spring Sediment - Metals**
F-8	**%Bias Groundwater**
F-8a	Dissolved Metals (MS/MSD)
F-8b	Dissolved Metals (Undesignated Spikes)
F-8c	Total Metals (MS/MSD)
F-8d	Total Metals (Undesignated Spikes)
F-8e	Anions, Cyanide, and Water Quality Parameters (MS/MSD)
F-8f	Anions, Cyanide, and Water Quality Parameters (Undesignated Spikes)
F-8g	Volatile Organic Compounds (MS/MSD)

F-9 %Bias Stream Water

F-9a	Dissolved Metals (Undesignated Spikes)
F-9b	Total Metals (Undesignated Spikes)
F-9c	Anions, Cyanide, and Water Quality Parameters (MS/MSD)
F-9d	Anions, Cyanide, and Water Quality Parameters (Undesignated Spikes)
F-9e	Volatile Organic Compounds (MS/MSD)
F-9f	Semivolatile Organic Compounds (MS/MSD)
F-9g	Pesticides and PCBs (MS/MSD)

F-10 %Bias Stream Sediment

F-10a	Metals (Undesignated Spikes)
F-10b	Volatile Organic Compounds (MS/MSD)
F-10c	Semivolatile Organic Compounds (MS/MSD)
F-10d	Pesticides and PCBs (MS/MSD)

F-11 %Bias Seep/Spring Sediment

F-11a	Volatile Organic Compounds (MS/MSD)
F-11b	Semivolatile Organic Compounds (MS/MSD)
F-11c	Pesticides and PCBs (MS/MSD)

Abbreviations

%RPD	Relative Percent Difference
%R	Percent Recovery
%Bias	Percent Bias = ABS(100 - %R)
N	Number of %RPDs calculated or %Rs reported
N>#	Number of %RPDs or %Bias above QC criterion
Avg	Arithmetic Average
StDev	Standard Deviation
%CV	Coefficient of Variation = (StDev/Avg)x100

Table F-1
Data Validation Summary

Medium/Analyte Group	Total Results	No. Results Validated	No. Results Rejected	% Results Validated	% Validated Results Rejected
Groundwater					
Dissolved Metals	11303	4286	85	38	2
Total Metals	7082	4359	58	62	1
Dissolved Radionuclides	2417	1162	105	48	9
Total Radionuclides	1357	532	106	39	20
Anions, Cyanide, WQP	4963	2921	49	59	2
VOCs	18321	10762	413	59	4
SVOCs	0				
Pesticides/PCBs	0				
Herbicides	0				
Total All Groups	45443	24022	816	53	3
Surface Water					
Dissolved Metals	4065	2363	143	58	6
Total Metals	4391	1801	31	41	2
Dissolved Radionuclides	673	185	40	27	22
Total Radionuclides	1087	328	78	30	24
Anions, Cyanide, WQP	2352	1215	6	52	0
VOCs	4948	1868	25	38	1
SVOCs	1456	645	0	44	0
Pesticides/PCBs	550	215	0	39	0
Herbicides	19	0	0	0	NA
Total All Groups	19541	8620	323	44	4
Seep/Spring Water					
Dissolved Metals	1211	846	82	70	10
Total Metals	1287	476	17	37	4
Dissolved Radionuclides	136	38	8	28	21
Total Radionuclides	413	99	25	24	25
Anions, Cyanide, WQP	620	324	5	52	2
VOCs	902	238	4	26	2
SVOCs	529	63	0	12	0
Pesticides/PCBs	162	54	0	33	0
Herbicides	0				
Total All Groups	5260	2138	141	41	7
Borehole Materials					
Total Metals	3504	3040	152	87	5
Total Radionuclides	1187	0	0	0	NA
Anions, Cyanide, WQP	298	154	7	52	5
VOCs	0				
SVOCs	0				
Pesticides/PCBs	0				
Herbicides	0				
Total All Groups	4989	3194	159	64	5

Table F-1
Data Validation Summary

Medium/Analyte Group	Total Results	No. Results Validated	No. Results Rejected	% Results Validated	% Validated Results Rejected
Stream Sediment					
Total Metals	1593	934	70	59	7
Total Radionuclides	527	273	72	52	26
Anions, Cyanide, WQP	150	66	8	44	12
VOCs	1526	782	75	51	10
SVOCs	3207	1489	157	46	11
Pesticides/PCBs	1187	675	54	57	8
Herbicides	0				
Total All Groups	8190	4219	436	52	10
Spring/Seep Sediment					
Total Metals	911	681	66	75	10
Total Radionuclides	293	178	42	61	24
Anions, Cyanide, WQP	95	44	1	46	2
VOCs	941	509	106	54	21
SVOCs	1820	1039	201	57	19
Pesticides/PCBs	331	162	27	49	17
Herbicides	0				
Total All Groups	4391	2613	443	60	17

Table F-2a
%RPD Groundwater
Dissolved Metals

Location	Date	Analyte	Result*	%RPD	N	N > 20%	Avg	StDev	%CV
5586	6/11/92	BARIUM	54.4	10.95					
B400189	8/20/92	BARIUM	39.7	1.25					
5586	12/8/92	BARIUM	65.8	0.61	3	0	4.27	5.79	135.72
B400289	5/19/90	CALCIUM	23600.0	1.68					
B102289	8/30/90	CALCIUM	19700.0	2.51					
B402189	10/17/90	CALCIUM	61600.0	2.25					
B102289	10/24/90	CALCIUM	19500.0	4.02					
B202589	11/1/90	CALCIUM	58000.0	2.55					
B400289	11/29/90	CALCIUM	14700.0	5.94					
B402189	3/21/91	CALCIUM	57400.0	9.14					
B102289	3/28/91	CALCIUM	19200.0	2.06					
B202589	3/28/91	CALCIUM	37800.0	7.14					
B402189	5/20/91	CALCIUM	64100.0	2.01					
B102289	5/23/91	CALCIUM	19600.0	0.00					
B202589	5/31/91	CALCIUM	39900.0	0.25					
B202589	9/10/91	CALCIUM	59800.0	1.49					
B102289	9/17/91	CALCIUM	18400.0	2.68					
B400289	9/19/91	CALCIUM	13800.0	30.67					
B202589	12/9/91	CALCIUM	38000.0	0.26					
B102289	12/12/91	CALCIUM	20400.0	0.49					
B405586	12/18/91	CALCIUM	24400.0	1.22					
B402189	12/19/91	CALCIUM	63200.0	0.63					
B200589	1/28/92	CALCIUM	22100.0	0.45					
B102289	2/28/92	CALCIUM	18500.0	0.54					
5586	3/13/92	CALCIUM	21800.0	7.08					
B402189	3/23/92	CALCIUM	63700.0	0.31					
B202589	3/26/92	CALCIUM	31300.0	1.27					
B102289	5/26/92	CALCIUM	18700.0	1.59					
B202589	5/29/92	CALCIUM	38700.0	1.28					
B200889	6/4/92	CALCIUM	40700.0	1.46					
5586	6/11/92	CALCIUM	21900.0	5.76					
B200589	6/26/92	CALCIUM	23000.0	2.15					
B102289	7/28/92	CALCIUM	19100.0	0.52					
B202589	8/13/92	CALCIUM	66200.0	3.12					
B402189	8/18/92	CALCIUM	67500.0	0.59					
B400189	8/20/92	CALCIUM	17400.0	0.57					
B400289	9/8/92	CALCIUM	28500.0	1.39					
B400489	9/15/92	CALCIUM	40600.0	33.95					
B200589	9/23/92	CALCIUM	26800.0	0.37					
B400389	9/23/92	CALCIUM	83900.0	0.24					
B202589	10/21/92	CALCIUM	71500.0	0.56					
B102289	10/27/92	CALCIUM	21900.0	7.47					
B200589	11/5/92	CALCIUM	23100.0	0.86					
B200889	11/12/92	CALCIUM	45500.0	1.53					
B400189	11/19/92	CALCIUM	19100.0	0.52					
5586	12/8/92	CALCIUM	28000.0	2.12	43	2	3.55	6.82	191.87
B202589	11/1/90	CHROMIUM	10.0	51.30	1	1	NA	NA	NA
B102289	3/28/91	IRON	104.0	19.13					
B202589	3/28/91	IRON	119.0	48.89	2	1	34.01	21.04	61.87
5586	12/8/92	LITHIUM	6.8	13.70	1	0	NA	NA	NA
B402189	10/17/90	MAGNESIUM	8910.0	1.34					
B202589	11/1/90	MAGNESIUM	13000.0	0.77					
B402189	3/21/91	MAGNESIUM	8440.0	7.85					
B202589	3/28/91	MAGNESIUM	8150.0	5.72					
B402189	5/20/91	MAGNESIUM	9090.0	2.07					
B202589	5/31/91	MAGNESIUM	8930.0	0.67					
B202589	9/10/91	MAGNESIUM	12800.0	3.83					
B202589	12/9/91	MAGNESIUM	8690.0	0.57					
B402189	12/19/91	MAGNESIUM	9120.0	0.55					
B402189	3/23/92	MAGNESIUM	9650.0	0.21					
B202589	3/26/92	MAGNESIUM	7400.0	1.48					
B202589	5/29/92	MAGNESIUM	8780.0	0.11					
B200889	6/4/92	MAGNESIUM	5510.0	2.51					
5586	6/11/92	MAGNESIUM	4400.0	13.16					

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2a
%RPD Groundwater
Dissolved Metals

Location	Date	Analyte	Result*	%RPD	N	N > 20%	Avg	StDev	%CV
B202589	8/13/92	MAGNESIUM	14800.0	2.01					
B402189	8/18/92	MAGNESIUM	9500.0	2.29					
B400189	8/20/92	MAGNESIUM	2720.0	0.37					
B400489	9/15/92	MAGNESIUM	5650.0	114.56					
B400389	9/23/92	MAGNESIUM	5850.0	0.00					
B202589	10/21/92	MAGNESIUM	15900.0	0.63					
B200889	11/12/92	MAGNESIUM	6100.0	1.30					
5586	12/8/92	MAGNESIUM	4780.0	2.28	22	1	7.47	24.11	322.97
B102289	8/30/90	MANGANESE	24.0	21.89					
B202589	11/1/90	MANGANESE	93.1	0.86					
B102289	3/28/91	MANGANESE	21.9	59.16					
B102289	5/26/92	MANGANESE	27.8	18.89					
5586	12/8/92	MANGANESE	5.2	9.17	5	2	22.00	22.37	101.72
B200889	11/12/92	MERCURY	0.7	4.51	1	0	NA	NA	NA
B400289	5/19/90	SILICON	14000.0	0.00					
B402189	10/17/90	SILICON	10100.0	2.93					
B102289	3/28/91	SILICON	4146.2	71.90					
B202589	9/10/91	SILICON	4454.7	77.57					
B102289	5/26/92	SILICON	12300.0	0.81					
B202589	5/29/92	SILICON	9170.0	0.65					
B200889	6/4/92	SILICON	9360.0	2.74					
5586	6/11/92	SILICON	13200.0	8.00					
B200589	6/26/92	SILICON	10900.0	1.82					
B102289	7/28/92	SILICON	12800.0	0.00					
B202589	8/13/92	SILICON	11200.0	0.00					
B400189	8/20/92	SILICON	13000.0	2.28					
B400289	9/8/92	SILICON	13700.0	0.73					
B400489	9/15/92	SILICON	12200.0	3.23					
B200589	9/23/92	SILICON	12500.0	1.59					
B400389	9/23/92	SILICON	7760.0	0.77					
B202589	10/21/92	SILICON	11100.0	6.96					
B102289	10/27/92	SILICON	13400.0	0.74					
B200589	11/5/92	SILICON	11600.0	0.86					
B200889	11/12/92	SILICON	10200.0	0.98					
5586	12/8/92	SILICON	14600.0	3.37	21	2	8.95	21.99	245.75
B400289	5/19/90	SODIUM	7880.0	9.89					
B102289	8/30/90	SODIUM	15400.0	1.93					
B402189	10/17/90	SODIUM	21200.0	1.41					
B102289	10/24/90	SODIUM	15500.0	7.45					
B202589	11/1/90	SODIUM	31900.0	2.48					
B400289	11/29/90	SODIUM	6650.0	6.83					
B402189	3/21/91	SODIUM	19700.0	11.93					
B102289	3/28/91	SODIUM	15900.0	0.63					
B202589	3/28/91	SODIUM	25300.0	4.26					
B402189	5/20/91	SODIUM	22100.0	2.24					
B102289	5/23/91	SODIUM	15300.0	0.00					
B202589	5/31/91	SODIUM	27100.0	1.10					
B202589	9/10/91	SODIUM	34400.0	0.58					
B102289	9/17/91	SODIUM	15700.0	5.57					
B400289	9/19/91	SODIUM	6420.0	8.93					
B202589	12/9/91	SODIUM	26600.0	0.75					
B405586	12/18/91	SODIUM	8580.0	2.76					
B402189	12/19/91	SODIUM	21100.0	0.00					
B200589	1/28/92	SODIUM	8300.0	3.32					
B102289	2/28/92	SODIUM	14700.0	0.68					
5586	3/13/92	SODIUM	8130.0	6.43					
B402189	3/23/92	SODIUM	22600.0	0.88					
B202589	3/26/92	SODIUM	20900.0	1.43					
B102289	5/26/92	SODIUM	14800.0	0.00					
B202589	5/29/92	SODIUM	26400.0	1.13					
B200889	6/4/92	SODIUM	7730.0	8.54					
5586	6/11/92	SODIUM	7770.0	5.75					
B200589	6/26/92	SODIUM	8300.0	3.55					
B102289	7/28/92	SODIUM	16100.0	0.00					

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2a
%RPD Groundwater
Dissolved Metals

Location	Date	Analyte	Result*	%RPD	N	N > 20%	Avg	StDev	%CV
B202589	8/13/92	SODIUM	37500.0	1.59					
B402189	8/18/92	SODIUM	21400.0	2.76					
B400189	8/20/92	SODIUM	6690.0	0.74					
B400289	9/8/92	SODIUM	8360.0	0.36					
B400489	9/15/92	SODIUM	8360.0	23.63					
B200589	9/23/92	SODIUM	9480.0	0.21					
B400389	9/23/92	SODIUM	5420.0	0.55					
B202589	10/21/92	SODIUM	38000.0	0.79					
B102289	10/27/92	SODIUM	17100.0	5.68					
B200589	11/5/92	SODIUM	8490.0	0.59					
B200889	11/12/92	SODIUM	7980.0	0.25					
B400189	11/19/92	SODIUM	7230.0	1.92					
5586	12/8/92	SODIUM	9030.0	2.08	42	1	3.37	4.44	131.64
B400289	5/19/90	STRONTIUM	97.2	0.72					
B402189	10/17/90	STRONTIUM	260.0	0.38					
B202589	11/1/90	STRONTIUM	369.0	0.81					
B402189	3/21/91	STRONTIUM	275.0	4.62					
B402189	5/20/91	STRONTIUM	291.0	2.38					
B202589	5/31/91	STRONTIUM	249.0	0.80					
B202589	9/10/91	STRONTIUM	362.0	3.26					
B202589	12/9/91	STRONTIUM	231.0	0.00					
B402189	12/19/91	STRONTIUM	284.0	1.05					
B402189	3/23/92	STRONTIUM	292.0	0.00					
B202589	5/29/92	STRONTIUM	249.0	0.40					
5586	6/11/92	STRONTIUM	103.0	8.37					
B202589	8/13/92	STRONTIUM	438.0	2.26					
B400189	8/20/92	STRONTIUM	57.9	8.28					
B202589	10/21/92	STRONTIUM	452.0	0.44					
5586	12/8/92	STRONTIUM	126.0	3.89	16	0	2.35	2.72	115.70
B102289	10/24/90	ZINC	4.6	37.17					
B400289	11/29/90	ZINC	33.9	4.89					
B402189	3/21/91	ZINC	20.4	24.14					
B202589	9/10/91	ZINC	136.0	0.73					
5586	12/8/92	ZINC	18.3	56.19	5	3	24.62	22.99	93.36

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2b
%RPD Groundwater
Total Metals

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
B202589	9/10/91	ALUMINUM	6110	9.97					
B102289	9/17/91	ALUMINUM	1740	17.80					
B400289	9/19/91	ALUMINUM	629	46.18					
B102289	12/12/91	ALUMINUM	10100	16.36					
B405586	12/18/91	ALUMINUM	13500	15.14					
B102289	2/28/92	ALUMINUM	6370	11.82					
5586	3/13/92	ALUMINUM	20400	31.16					
B202589	3/26/92	ALUMINUM	516	10.18					
B102289	5/26/92	ALUMINUM	17700	4.03					
B202589	5/29/92	ALUMINUM	267	12.96					
5586	6/11/92	ALUMINUM	12800	42.46					
B200589	6/26/92	ALUMINUM	2040	41.42					
B102289	7/28/92	ALUMINUM	2530	63.43					
B400189	8/20/92	ALUMINUM	5540	51.82					
B400289	9/8/92	ALUMINUM	11000	20.00					
B200589	9/23/92	ALUMINUM	21600	16.54					
B202589	10/21/92	ALUMINUM	4290	42.03					
B102289	10/27/92	ALUMINUM	14500	17.23					
B200589	11/5/92	ALUMINUM	3710	42.48					
B200889	11/12/92	ALUMINUM	509	133.22					
5586	12/8/92	ALUMINUM	8140	111.62	21	10	36.09	33.22	92.05
5586	6/11/92	ARSENIC	1.8	5.41	1	0	NA	NA	NA
5586	6/11/92	BARIUM	153	18.40					
B400189	8/20/92	BARIUM	78	37.80					
B200589	9/23/92	BARIUM	248	15.18					
5586	12/8/92	BARIUM	103	78.47	4	2	37.46	29.10	77.69
B202589	9/10/91	CALCIUM	64100	1.39					
B102289	9/17/91	CALCIUM	18700	2.12					
B400289	9/19/91	CALCIUM	13400	31.97					
B102289	12/12/91	CALCIUM	23600	9.68					
B405586	12/18/91	CALCIUM	26700	1.13					
B402189	12/19/91	CALCIUM	61600	0.32					
B200589	1/28/92	CALCIUM	23000	1.75					
B102289	2/28/92	CALCIUM	20900	1.90					
5586	3/13/92	CALCIUM	25700	0.78					
B402189	3/23/92	CALCIUM	61200	2.58					
B202589	3/26/92	CALCIUM	30300	0.33					
B202589	5/29/92	CALCIUM	36800	3.21					
B200889	6/4/92	CALCIUM	40600	3.39					
5586	6/11/92	CALCIUM	25600	1.17					
B200589	6/26/92	CALCIUM	24000	0.42					
B202589	8/13/92	CALCIUM	63600	1.25					
B402189	8/18/92	CALCIUM	62200	0.81					
B400189	8/20/92	CALCIUM	18200	2.79					
B400289	9/8/92	CALCIUM	29200	0.34					
B400489	9/15/92	CALCIUM	37100	4.41					
B200589	9/23/92	CALCIUM	33900	5.45					
B400389	9/23/92	CALCIUM	76600	0.79					
B202589	10/21/92	CALCIUM	68800	0.58					
B102289	10/27/92	CALCIUM	27000	4.16					
B200589	11/5/92	CALCIUM	23900	0.84					
B200889	11/12/92	CALCIUM	43200	3.86					
B400189	11/19/92	CALCIUM	19200	1.55					
5586	12/8/92	CALCIUM	27500	13.24	28	1	3.65	6.26	171.58
B102289	12/12/91	CHROMIUM	24.7	21.34					
5586	3/13/92	CHROMIUM	31.4	49.21					
5586	6/11/92	CHROMIUM	24.4	45.57					
B200589	9/23/92	CHROMIUM	30.2	13.05					
B102289	10/27/92	CHROMIUM	23.9	2.97					
5586	12/8/92	CHROMIUM	18.2	82.58	6	4	35.79	29.22	81.64
5586	6/11/92	COBALT	7.9	14.12					
5586	12/8/92	COBALT	5.6	89.66	2	1	51.89	53.41	102.94
B202589	8/13/92	COPPER	31.8	26.70					
B200589	9/23/92	COPPER	39.2	22.73					

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2b
%RPD Groundwater
Total Metals

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
5586	12/8/92	COPPER	15.9	94.70	3	3	48.04	40.46	84.21
B202589	9/10/91	IRON	5630	28.63					
B102289	9/17/91	IRON	2330	7.04					
B400289	9/19/91	IRON	647	48.37					
B202589	12/9/91	IRON	1030	44.95					
B102289	12/12/91	IRON	13500	22.37					
B405586	12/18/91	IRON	14800	22.56					
B402189	12/19/91	IRON	1410	29.27					
B200589	1/28/92	IRON	6500	35.72					
B102289	2/28/92	IRON	6820	15.05					
5586	3/13/92	IRON	20500	30.34					
B202589	3/26/92	IRON	481	5.78					
B102289	5/26/92	IRON	20900	4.22					
B202589	5/29/92	IRON	358	3.99					
B200889	6/4/92	IRON	1240	25.35					
5586	6/11/92	IRON	16700	27.39					
B200589	6/26/92	IRON	2320	25.24					
B102289	7/28/92	IRON	3900	54.07					
B202589	8/13/92	IRON	1720	70.92					
B402189	8/18/92	IRON	2410	19.48					
B400189	8/20/92	IRON	6590	82.23					
B400289	9/8/92	IRON	10900	26.73					
B200589	9/23/92	IRON	29800	19.93					
B202589	10/21/92	IRON	3320	41.45					
B102289	10/27/92	IRON	18900	19.77					
B200589	11/5/92	IRON	4610	45.21					
B200889	11/12/92	IRON	559	109.44					
B400189	11/19/92	IRON	1510	122.46					
5586	12/8/92	IRON	8150	131.15	28	20	39.97	34.11	85.35
B202589	9/10/91	LEAD	6.4	32.73					
B102289	9/17/91	LEAD	3.5	2.90					
B102289	12/12/91	LEAD	9.3	30.14					
B405586	12/18/91	LEAD	5.7	17.14					
B200589	1/28/92	LEAD	4.1	5.00					
B102289	2/28/92	LEAD	4.2	21.28					
5586	3/13/92	LEAD	7.7	15.38					
B102289	5/26/92	LEAD	11.6	9.84					
5586	6/11/92	LEAD	8.5	30.85					
B102289	7/28/92	LEAD	3.2	52.87					
B202589	8/13/92	LEAD	8.7	5.92					
B400289	9/8/92	LEAD	7.3	4.03					
B200589	9/23/92	LEAD	28.2	25.60					
B102289	10/27/92	LEAD	9.9	6.25					
5586	12/8/92	LEAD	4.6	90.48	15	7	23.36	23.28	99.65
5586	6/11/92	LITHIUM	9.7	34.19					
5586	12/8/92	LITHIUM	9.4	68.53	2	2	51.36	24.28	47.28
B202589	9/10/91	MAGNESIUM	15000	0.67					
B102289	12/12/91	MAGNESIUM	6590	13.97					
B405586	12/18/91	MAGNESIUM	6580	6.59					
B102289	2/28/92	MAGNESIUM	5290	3.53					
5586	3/13/92	MAGNESIUM	7050	12.03					
B402189	3/23/92	MAGNESIUM	9510	2.39					
B202589	3/26/92	MAGNESIUM	7370	0.27					
B102289	5/26/92	MAGNESIUM	7610	1.82					
B202589	5/29/92	MAGNESIUM	8180	3.25					
5586	6/11/92	MAGNESIUM	6610	11.28					
B202589	8/13/92	MAGNESIUM	14400	4.08					
B402189	8/18/92	MAGNESIUM	9170	1.30					
B400189	8/20/92	MAGNESIUM	3810	19.60					
B400289	9/8/92	MAGNESIUM	5590	6.46					
B400489	9/15/92	MAGNESIUM	5370	3.02					
B200589	9/23/92	MAGNESIUM	8860	19.44					
B400389	9/23/92	MAGNESIUM	5350	5.18					
B102289	10/27/92	MAGNESIUM	7910	10.09					

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2b
%RPD Groundwater
Total Metals

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
B200889	11/12/92	MAGNESIUM	5970	6.01					
5586	12/8/92	MAGNESIUM	5450	49.45	20	1	9.02	11.14	123.44
B202589	9/10/91	MANGANESE	95.6	43.57					
B102289	9/17/91	MANGANESE	46.4	6.68					
B400289	9/19/91	MANGANESE	21.2	20.83					
B102289	12/12/91	MANGANESE	274	30.08					
B405586	12/18/91	MANGANESE	323	32.37					
B200589	1/28/92	MANGANESE	79.5	29.77					
B102289	2/28/92	MANGANESE	95.6	29.74					
5586	3/13/92	MANGANESE	351	34.78					
B102289	5/26/92	MANGANESE	363	1.10					
B200889	6/4/92	MANGANESE	45.1	7.12					
5586	6/11/92	MANGANESE	369	18.67					
B102289	7/28/92	MANGANESE	100	31.22					
B202589	8/13/92	MANGANESE	92.7	55.72					
B402189	8/18/92	MANGANESE	49.8	17.47					
B400189	8/20/92	MANGANESE	140	107.52					
B400289	9/8/92	MANGANESE	255	41.71					
B200589	9/23/92	MANGANESE	636	32.33					
B202589	10/21/92	MANGANESE	50.3	14.27					
B102289	10/27/92	MANGANESE	325	18.12					
B200589	11/5/92	MANGANESE	78.8	66.22					
B200889	11/12/92	MANGANESE	16.2	95.65					
B400189	11/19/92	MANGANESE	31.7	114.73					
5586	12/8/92	MANGANESE	171	125.00	23	16	42.38	35.67	84.17
5586	6/11/92	MOLYBDENUM	8.1	7.14	1	0	NA	NA	NA
5586	12/8/92	NICKEL	18.7	88.52	1	1	NA	NA	NA
5586	12/8/92	POTASSIUM	1970	69.97	1	1	NA	NA	NA
B202589	9/10/91	SILICON	23900	80.05					
B102289	5/26/92	SILICON	51300	3.57					
B202589	5/29/92	SILICON	8960	3.62					
B200889	6/4/92	SILICON	11700	14.29					
5586	6/11/92	SILICON	47200	7.15					
B200589	6/26/92	SILICON	15200	11.11					
B102289	7/28/92	SILICON	17500	25.00					
B202589	8/13/92	SILICON	12300	42.31					
B400189	8/20/92	SILICON	24700	22.52					
B400289	9/8/92	SILICON	33900	20.13					
B400489	9/15/92	SILICON	12200	5.04					
B200589	9/23/92	SILICON	48100	5.56					
B400389	9/23/92	SILICON	8270	5.34					
B202589	10/21/92	SILICON	20900	17.14					
B102289	10/27/92	SILICON	48200	12.10					
B200589	11/5/92	SILICON	19500	16.07					
B200889	11/12/92	SILICON	10700	33.46					
B400189	11/19/92	SILICON	16100	42.16					
5586	12/8/92	SILICON	32000	76.09	19	8	23.30	22.72	97.53
5586	6/11/92	SILVER	2.9	79.17	1	1	NA	NA	NA
B202589	9/10/91	SODIUM	35700	3.31					
B102289	9/17/91	SODIUM	16200	1.23					
B102289	12/12/91	SODIUM	15600	3.77					
B405586	12/18/91	SODIUM	8860	32.51					
B402189	12/19/91	SODIUM	20500	0.49					
B200589	1/28/92	SODIUM	8020	1.12					
B102289	2/28/92	SODIUM	14700	1.37					
5586	3/13/92	SODIUM	8630	1.27					
B402189	3/23/92	SODIUM	22200	1.79					
B102289	5/26/92	SODIUM	16100	1.25					
B202589	5/29/92	SODIUM	24800	3.56					
B200889	6/4/92	SODIUM	7690	2.44					
5586	6/11/92	SODIUM	8600	0.58					
B200589	6/26/92	SODIUM	8520	1.05					
B102289	7/28/92	SODIUM	15900	0.63					
B202589	8/13/92	SODIUM	38600	1.29					

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2b
%RPD Groundwater
Total Metals

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
B402189	8/18/92	SODIUM	20100	1.97					
B400189	8/20/92	SODIUM	6300	0.95					
B400289	9/8/92	SODIUM	10600	0.94					
B400489	9/15/92	SODIUM	9680	4.33					
B200589	9/23/92	SODIUM	11000	7.55					
B202589	10/21/92	SODIUM	39800	1.99					
B102289	10/27/92	SODIUM	19200	2.64					
B200589	11/5/92	SODIUM	8670	0.58					
B200889	11/12/92	SODIUM	7950	1.99					
B400189	11/19/92	SODIUM	7100	0.99					
5586	12/8/92	SODIUM	11700	1.72	27	1	3.09	6.07	196.89
B202589	9/10/91	STRONTIUM	405	0.98					
B402189	12/19/91	STRONTIUM	274	1.09					
B402189	3/23/92	STRONTIUM	284	2.43					
B202589	5/29/92	STRONTIUM	234	3.36					
5586	6/11/92	STRONTIUM	126	5.41					
B202589	8/13/92	STRONTIUM	427	3.00					
B400189	8/20/92	STRONTIUM	93.2	34.17					
B202589	10/21/92	STRONTIUM	458	0.44					
5586	12/8/92	STRONTIUM	125	23.94	9	2	8.31	12.13	145.87
5586	6/11/92	VANADIUM	31.4	18.23					
B400189	8/20/92	VANADIUM	11.2	78.26					
B200589	9/23/92	VANADIUM	61.8	16.84					
5586	12/8/92	VANADIUM	13.5	131.39	4	2	61.18	54.87	89.68
B202589	9/10/91	ZINC	51	64.54					
B102289	9/17/91	ZINC	145	38.78					
B102289	12/12/91	ZINC	68.1	24.82					
B200589	1/28/92	ZINC	31.8	28.78					
B102289	2/28/92	ZINC	50.7	8.64					
5586	3/13/92	ZINC	56.6	19.59					
B202589	3/26/92	ZINC	59.6	78.50					
B102289	5/26/92	ZINC	87.7	2.14					
5586	6/11/92	ZINC	44.7	18.84					
B102289	7/28/92	ZINC	28.7	21.18					
B202589	8/13/92	ZINC	43.6	22.58					
B402189	8/18/92	ZINC	38.3	36.42					
B400289	9/8/92	ZINC	44.5	6.94					
B200589	9/23/92	ZINC	116	18.25					
B202589	10/21/92	ZINC	34.6	5.34					
B102289	10/27/92	ZINC	68.8	60.16					
B200589	11/5/92	ZINC	23.3	10.86					
5586	12/8/92	ZINC	44.7	85.90	18	10	30.68	25.39	82.75

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2c
%RPD Groundwater
Dissolved Radionuclides

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
B202589	11/1/90	GROSS ALPHA - DISSOLVED	1.072	84.92					
B400289	11/29/90	GROSS ALPHA - DISSOLVED	0.1483	114.02					
B402189	3/21/91	GROSS ALPHA - DISSOLVED	1.304	38.06					
B102289	3/28/91	GROSS ALPHA - DISSOLVED	0.8255	9.92					
B202589	3/28/91	GROSS ALPHA - DISSOLVED	0.7464	97.73					
B402189	5/20/91	GROSS ALPHA - DISSOLVED	1.164	38.45					
B102289	5/23/91	GROSS ALPHA - DISSOLVED	0.01334	176.79					
B202589	5/31/91	GROSS ALPHA - DISSOLVED	1.066	31.46					
B402189	8/29/91	GROSS ALPHA - DISSOLVED	1.136	60.01					
B202589	9/10/91	GROSS ALPHA - DISSOLVED	3.371	14.09					
B102289	9/17/91	GROSS ALPHA - DISSOLVED	0.3441	4.93					
B400289	9/19/91	GROSS ALPHA - DISSOLVED	0.1704	51.24					
B202589	12/9/91	GROSS ALPHA - DISSOLVED	2.081	24.65					
B102289	2/28/92	GROSS ALPHA - DISSOLVED	0.2282	94.61					
5586	3/13/92	GROSS ALPHA - DISSOLVED	0.02479	116.17					
B402189	3/23/92	GROSS ALPHA - DISSOLVED	1.782	20.14					
B202589	3/26/92	GROSS ALPHA - DISSOLVED	0.2539	55.66					
B102289	5/26/92	GROSS ALPHA - DISSOLVED	0.78	34.04					
B202589	5/29/92	GROSS ALPHA - DISSOLVED	0.84	50.00					
B200889	6/4/92	GROSS ALPHA - DISSOLVED	0.2381	92.76					
5586	6/11/92	GROSS ALPHA - DISSOLVED	0.1351	34.94					
B200589	6/26/92	GROSS ALPHA - DISSOLVED	0.2378	83.56					
B400489	9/15/92	GROSS ALPHA - DISSOLVED	0.7019	31.02					
B200589	9/23/92	GROSS ALPHA - DISSOLVED	0.3189	71.15					
B202589	10/21/92	GROSS ALPHA - DISSOLVED	2.568	7.68	25	21	57.52	41.77	72.62
B402189	10/17/90	GROSS BETA - DISSOLVED	1.88	85.84					
B102289	10/24/90	GROSS BETA - DISSOLVED	0.4017	57.69					
B202589	11/1/90	GROSS BETA - DISSOLVED	3.17	44.76					
B400289	11/29/90	GROSS BETA - DISSOLVED	1.425	9.43					
B402189	3/21/91	GROSS BETA - DISSOLVED	0.8179	59.10					
B102289	3/28/91	GROSS BETA - DISSOLVED	0.727	52.83					
B202589	3/28/91	GROSS BETA - DISSOLVED	2.14	15.64					
B102289	5/23/91	GROSS BETA - DISSOLVED	1.201	118.27					
B202589	5/31/91	GROSS BETA - DISSOLVED	2.643	3.64					
B402189	8/29/91	GROSS BETA - DISSOLVED	1.229	21.82					
B202589	9/10/91	GROSS BETA - DISSOLVED	4.523	34.16					
B102289	9/17/91	GROSS BETA - DISSOLVED	1.014	26.81					
B400289	9/19/91	GROSS BETA - DISSOLVED	0.467	87.40					
B202589	12/9/91	GROSS BETA - DISSOLVED	2.906	6.01					
B200589	1/28/92	GROSS BETA - DISSOLVED	0.2357	117.36					
B102289	2/28/92	GROSS BETA - DISSOLVED	1.397	4.20					
5586	3/13/92	GROSS BETA - DISSOLVED	1.606	40.64					
B402189	3/23/92	GROSS BETA - DISSOLVED	0.6865	61.28					
B202589	3/26/92	GROSS BETA - DISSOLVED	1.16	86.83					
B200889	6/4/92	GROSS BETA - DISSOLVED	1.44	23.91					
5586	6/11/92	GROSS BETA - DISSOLVED	0.8167	86.32					
B200589	6/26/92	GROSS BETA - DISSOLVED	1.483	0.67					
B400289	9/8/92	GROSS BETA - DISSOLVED	1.761	52.94					
B400489	9/15/92	GROSS BETA - DISSOLVED	0.6545	45.04					
B200589	9/23/92	GROSS BETA - DISSOLVED	1.08	10.03					
B202589	10/21/92	GROSS BETA - DISSOLVED	3.228	59.90	26	19	46.63	34.69	74.39
B200589	11/5/92	RADIUM-228	2.1	32.00	1	1	NA	NA	NA
B402189	10/17/90	STRONTIUM-89,90	0.1533	67.84					
B102289	10/24/90	STRONTIUM-89,90	0.4672	10.64					
B202589	11/1/90	STRONTIUM-89,90	0.05837	148.83					
B400289	11/29/90	STRONTIUM-89,90	0.07294	136.16					
B402189	3/21/91	STRONTIUM-89,90	0.1519	119.26					
B102289	3/28/91	STRONTIUM-89,90	0.2971	37.43					
B202589	3/28/91	STRONTIUM-89,90	0.2795	86.59					
B402189	5/20/91	STRONTIUM-89,90	0.4732	1.84					
B102289	5/23/91	STRONTIUM-89,90	0.1158	112.22					
B202589	5/31/91	STRONTIUM-89,90	0.4106	20.56					
B202589	9/10/91	STRONTIUM-89,90	0.1904	105.00					
B102289	9/17/91	STRONTIUM-89,90	0.04901	55.97					

* Result in pCi/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2c
%RPD Groundwater
Dissolved Radionuclides

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
B400289	9/19/91	STRONTIUM-89,90	0.1892	60.57					
B202589	12/9/91	STRONTIUM-89,90	0.593	21.29					
B200589	1/28/92	STRONTIUM-89,90	0.1792	63.98					
B102289	2/28/92	STRONTIUM-89,90	0.2821	7.77					
5586	3/13/92	STRONTIUM-89,90	0.1924	87.72					
B402189	3/23/92	STRONTIUM-89,90	0.1453	196.28					
B202589	3/26/92	STRONTIUM-89,90	0.1225	94.05					
B202589	5/29/92	STRONTIUM-89,90	0.25	18.18					
B200889	6/4/92	STRONTIUM-89,90	0.1208	89.35					
5586	6/11/92	STRONTIUM-89,90	0.2821	37.48					
B400289	9/8/92	STRONTIUM-89,90	0.136	14.40					
B400489	9/15/92	STRONTIUM-89,90	0.0869	57.95					
B200589	9/23/92	STRONTIUM-89,90	0.3984	42.45					
B202589	10/21/92	STRONTIUM-89,90	0.8877	5.37	26	20	65.35	50.25	76.88
B402189	10/17/90	TRITIUM	228.3	31.05					
B202589	11/1/90	TRITIUM	19.29	88.88					
B400289	11/29/90	TRITIUM	24.05	174.43					
B202589	3/28/91	TRITIUM	29.86	122.02					
B402189	5/20/91	TRITIUM	173.5	10.02					
B202589	5/31/91	TRITIUM	2.789	176.93					
B400289	9/19/91	TRITIUM	249.6	3.04					
B202589	12/9/91	TRITIUM	168.9	9.42					
B200589	1/28/92	TRITIUM	8.703	36.36					
B102289	2/28/92	TRITIUM	71.36	0.00					
5586	3/13/92	TRITIUM	54.92	45.96					
B202589	3/26/92	TRITIUM	49.3	69.32					
B200889	6/4/92	TRITIUM	110.4	91.55					
5586	6/11/92	TRITIUM	113.1	14.51					
B200589	6/26/92	TRITIUM	356.9	125.29					
B400289	9/8/92	TRITIUM	42.46	42.84	16	11	65.10	59.01	90.64
B200589	1/28/92	URANIUM-233,-234	0.1752	23.96					
B102289	2/28/92	URANIUM-233,-234	0.2205	8.59					
5586	3/13/92	URANIUM-233,-234	0.0389	109.74					
B402189	3/23/92	URANIUM-233,-234	0.7285	16.58					
B102289	5/26/92	URANIUM-233,-234	0.31	36.84					
B202589	5/29/92	URANIUM-233,-234	0.43	15.05					
B200889	6/4/92	URANIUM-233,-234	0.01037	188.96					
5586	6/11/92	URANIUM-233,-234	0.0652	109.66					
B200589	6/26/92	URANIUM-233,-234	0.2131	50.27					
B102289	7/28/92	URANIUM-233,-234	0.52	50.36					
B202589	8/13/92	URANIUM-233,-234	1.7	30.00					
B400189	8/20/92	URANIUM-233,-234	0.17	66.67					
B400489	9/15/92	URANIUM-233,-234	0.1447	61.50					
B200589	9/23/92	URANIUM-233,-234	0.03718	31.52					
B400389	9/23/92	URANIUM-233,-234	0.7	19.35					
B202589	10/21/92	URANIUM-233,-234	1.881	42.07					
B402189	10/17/90	URANIUM-233,234	0.5124	3.19					
B102289	10/24/90	URANIUM-233,234	0.3661	73.85					
B202589	11/1/90	URANIUM-233,234	1.801	7.23					
B400289	11/29/90	URANIUM-233,234	0.08008	51.96					
B102289	3/28/91	URANIUM-233,234	0.4685	26.18					
B202589	3/28/91	URANIUM-233,234	0.8766	26.04					
B102289	5/23/91	URANIUM-233,234	0.2871	0.17					
B402189	8/29/91	URANIUM-233,234	0.3228	24.35					
B202589	9/10/91	URANIUM-233,234	1.717	39.01					
B102289	9/17/91	URANIUM-233,234	0.08807	114.68	26	19	47.22	43.12	91.31
B202589	5/31/91	URANIUM-235	0.04986	100.31					
B102289	7/28/92	URANIUM-235	0.037	69.03					
B400289	9/8/92	URANIUM-235	0.0466	19.31					
B400489	9/15/92	URANIUM-235	0.03446	12.44					
B202589	10/21/92	URANIUM-235	0.05025	136.20	5	3	67.46	52.80	78.28
B402189	10/17/90	URANIUM-238	0.07557	137.73					
B102289	10/24/90	URANIUM-238	0.05709	128.32					
B202589	11/1/90	URANIUM-238	1.263	15.08					

* Result in pCi/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2c
%RPD Groundwater
Dissolved Radionuclides

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
B402189	3/21/91	URANIUM-238	0.3536	33.83					
B102289	3/28/91	URANIUM-238	0.1407	66.57					
B202589	3/28/91	URANIUM-238	0.8422	40.51					
B102289	5/23/91	URANIUM-238	0.08421	77.92					
B202589	5/31/91	URANIUM-238	0.8474	15.84					
B402189	8/29/91	URANIUM-238	0.3051	31.46					
B202589	9/10/91	URANIUM-238	1.606	7.20					
B200589	1/28/92	URANIUM-238	0.1674	5.91					
B102289	2/28/92	URANIUM-238	0.1954	77.18					
5586	3/13/92	URANIUM-238	0.08119	31.02					
B402189	3/23/92	URANIUM-238	0.4824	39.09					
B102289	5/26/92	URANIUM-238	0.18	64.15					
B202589	5/29/92	URANIUM-238	0.64	52.87					
B200889	6/4/92	URANIUM-238	0.03525	64.12					
B200589	6/26/92	URANIUM-238	0.1934	29.15					
B102289	7/28/92	URANIUM-238	0.22	113.73					
B202589	8/13/92	URANIUM-238	1.5	12.50	20	15	52.21	39.18	75.05

* Result in pCi/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2d
%RPD Groundwater
Total Radionuclides

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
B102289	10/24/90	AMERICIUM-241	0.002184	42.93					
B202589	11/1/90	AMERICIUM-241	0.001851	53.01					
B400289	11/29/90	AMERICIUM-241	0.004631	54.63					
B402189	5/20/91	AMERICIUM-241	0.006428	30.14					
B402189	8/29/91	AMERICIUM-241	0.00467	19.81					
B202589	9/10/91	AMERICIUM-241	0.01585	36.39					
B102289	9/17/91	AMERICIUM-241	0.002664	141.04					
B202589	12/9/91	AMERICIUM-241	0.005635	8.45					
B200589	1/28/92	AMERICIUM-241	0.001948	124.25					
B102289	2/28/92	AMERICIUM-241	0.00127	73.91					
5586	3/13/92	AMERICIUM-241	0.003628	119.28					
B402189	3/23/92	AMERICIUM-241	0.002694	93.38					
B202589	3/26/92	AMERICIUM-241	0.000607	171.97					
B400489	9/15/92	AMERICIUM-241	0.002125	58.12					
B200589	9/23/92	AMERICIUM-241	0.01228	33.21	15	13	70.70	48.66	68.83
B102289	10/24/90	CESIUM-137	0.006799	183.34					
B202589	9/10/91	CESIUM-137	0.04655	113.74					
B102289	9/17/91	CESIUM-137	0.2558	63.85					
B202589	12/9/91	CESIUM-137	0.0308	178.81					
B200889	6/4/92	CESIUM-137	0.1523	84.82					
B400489	9/15/92	CESIUM-137	0.2908	11.23					
B200589	9/23/92	CESIUM-137	0.158	26.94					
B202589	10/21/92	CESIUM-137	0.1066	132.29	8	7	99.38	64.52	64.92
B102289	8/30/90	GROSS ALPHA	1.43	68.81	1	1	NA	NA	NA
B102289	8/30/90	GROSS BETA	1.6	104.90	1	1	NA	NA	NA
B402189	10/17/90	PLUTONIUM-238	0.000913	52.02	1	1	NA	NA	NA
B102289	8/30/90	PLUTONIUM-239,240	0.0448	111.64					
B402189	10/17/90	PLUTONIUM-239,240	0.001594	70.35					
B102289	10/24/90	PLUTONIUM-239,240	0.000279	121.90					
B400289	11/29/90	PLUTONIUM-239,240	0.000507	136.20					
B102289	3/28/91	PLUTONIUM-239,240	0.00072	4.69					
B402189	5/20/91	PLUTONIUM-239,240	0.002867	3.90					
B402189	8/29/91	PLUTONIUM-239,240	0.001318	67.97					
B102289	9/17/91	PLUTONIUM-239,240	0.000841	93.74					
B102289	2/28/92	PLUTONIUM-239/240	0.000979	61.49					
5586	3/13/92	PLUTONIUM-239/240	0.000349	86.72					
B102289	5/26/92	PLUTONIUM-239/240	0.004	93.33					
B202589	5/29/92	PLUTONIUM-239/240	0.004	40.00					
B400289	9/8/92	PLUTONIUM-239/240	0.003528	172.51	13	11	81.88	48.72	59.50
B400289	5/19/90	STRONTIUM-89,90	0.01	195.00	1	1	NA	NA	NA
B400289	5/19/90	TRITIUM	180	32.56					
B102289	8/30/90	TRITIUM	403	57.47					
B400389	9/23/92	TRITIUM	370	146.57					
B202589	10/21/92	TRITIUM	112.3	113.21	4	4			
B102289	8/30/90	URANIUM-233,234	0.67	2.21	1	0	NA	NA	NA
B102289	8/30/90	URANIUM-235	0.107	97.12	1	1	NA	NA	NA
B102289	8/30/90	URANIUM-238	0.376	6.68	1	0	NA	NA	NA

*Result in pCi/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2e
%RPD Groundwater
Anions, Cyanide, and Water Quality Parameters

Location	Date	Analyte	Result*	Units	%RPD	N	N>20%	Avg	StDev	%CV
5586	6/11/92	ALKALINITY AS CACO3	58	MG/L	8.26			NA	NA	NA
B400289	5/19/90	BICARBONATE AS CACO3	63500	UG/L	1.72					
B102289	8/30/90	BICARBONATE AS CACO3	86000	UG/L	4.55					
B402189	10/17/90	BICARBONATE AS CACO3	190000	UG/L	5.13					
B102289	10/24/90	BICARBONATE AS CACO3	82000	UG/L	0.00					
B202589	11/1/90	BICARBONATE AS CACO3	180000	UG/L	0.00					
B400289	11/29/90	BICARBONATE AS CACO3	40000	UG/L	26.09					
B402189	3/21/91	BICARBONATE AS CACO3	180000	UG/L	5.41					
B102289	3/28/91	BICARBONATE AS CACO3	280	UG/L	198.45					
B202589	3/28/91	BICARBONATE AS CACO3	140000	UG/L	0.00					
B402189	5/20/91	BICARBONATE AS CACO3	200000	UG/L	0.00					
B102289	5/23/91	BICARBONATE AS CACO3	83000	UG/L	1.20					
B202589	5/31/91	BICARBONATE AS CACO3	160000	UG/L	0.00					
B402189	8/29/91	BICARBONATE AS CACO3	170000	UG/L	5.71					
B202589	9/10/91	BICARBONATE AS CACO3	205000	UG/L	7.96					
B102289	9/17/91	BICARBONATE AS CACO3	80000	UG/L	11.76					
B400289	9/19/91	BICARBONATE AS CACO3	36000	UG/L	12.99					
B202589	12/9/91	BICARBONATE AS CACO3	130000	UG/L	7.41					
B102289	12/12/91	BICARBONATE AS CACO3	81000	UG/L	8.28					
B405586	12/18/91	BICARBONATE AS CACO3	63000	UG/L	0.00					
B402189	12/19/91	BICARBONATE AS CACO3	190000	UG/L	0.00					
B200589	1/28/92	BICARBONATE AS CACO3	53	MG/L	5.50					
B102289	2/28/92	BICARBONATE AS CACO3	81	MG/L	1.23					
5586	3/13/92	BICARBONATE AS CACO3	61	MG/L	1.63					
B402189	3/23/92	BICARBONATE AS CACO3	190	MG/L	0.00					
B202589	3/26/92	BICARBONATE AS CACO3	110	MG/L	0.00					
B102289	5/26/92	BICARBONATE AS CACO3	80	MG/L	1.24					
B202589	5/29/92	BICARBONATE AS CACO3	150	MG/L	0.00					
B200889	6/4/92	BICARBONATE AS CACO3	100	MG/L	0.00					
5586	6/11/92	BICARBONATE AS CACO3	70	MG/L	8.22					
B200589	6/26/92	BICARBONATE AS CACO3	61	MG/L	1.63					
B102289	7/28/92	BICARBONATE AS CACO3	82	MG/L	2.41					
B202589	8/13/92	BICARBONATE AS CACO3	210	MG/L	0.00					
B402189	8/18/92	BICARBONATE AS CACO3	170	MG/L	5.71					
B400289	9/8/92	BICARBONATE AS CACO3	72	MG/L	1.38					
B400489	9/15/92	BICARBONATE AS CACO3	86	MG/L	0.00					
B200589	9/23/92	BICARBONATE AS CACO3	89	MG/L	1.12					
B400389	9/23/92	BICARBONATE AS CACO3	170	MG/L	0.00					
B202589	10/21/92	BICARBONATE AS CACO3	210	MG/L	13.33					
B102289	10/27/92	BICARBONATE AS CACO3	83	MG/L	5.85					
B200589	11/5/92	BICARBONATE AS CACO3	60	MG/L	12.50					
B200889	11/12/92	BICARBONATE AS CACO3	110	MG/L	0.00					
B400189	11/19/92	BICARBONATE AS CACO3	48	MG/L	4.08	42	2	8.63	30.47	353.09
B202589	12/9/91	CARBONATE AS CACO3	2000	UG/L	0.00	1	0	NA	NA	NA
B102289	8/30/90	CHLORIDE	2200	UG/L	12.77					
B402189	10/17/90	CHLORIDE	11000	UG/L	0.00					
B102289	10/24/90	CHLORIDE	3300	UG/L	11.43					
B202589	11/1/90	CHLORIDE	11000	UG/L	8.70					
B400289	11/29/90	CHLORIDE	2400	UG/L	15.38					
B402189	3/21/91	CHLORIDE	13000	UG/L	0.00					
B102289	3/28/91	CHLORIDE	2.9	UG/L	199.61					
B202589	3/28/91	CHLORIDE	8000	UG/L	0.00					
B402189	5/20/91	CHLORIDE	13000	UG/L	14.29					
B202589	5/31/91	CHLORIDE	6800	UG/L	13.70					
B402189	8/29/91	CHLORIDE	11000	UG/L	0.00					
B202589	9/10/91	CHLORIDE	7800	UG/L	21.71					
B202589	12/9/91	CHLORIDE	11000	UG/L	0.00					
B402189	3/23/92	CHLORIDE	14	MG/L	6.90					
B202589	3/26/92	CHLORIDE	10	MG/L	0.00					
B102289	5/26/92	CHLORIDE	3	MG/L	0.00					
B202589	5/29/92	CHLORIDE	7	MG/L	0.00					
B200889	6/4/92	CHLORIDE	5	MG/L	0.00					
B200589	6/26/92	CHLORIDE	4	MG/L	0.00					
B102289	7/28/92	CHLORIDE	3	MG/L	0.00					

*Result is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2e
%RPD Groundwater
Anions, Cyanide, and Water Quality Parameters

Location	Date	Analyte	Result*	Units	%RPD	N	N>20%	Avg	StDev	%CV
B400189	8/20/92	CHLORIDE	9.6	MG/L	69.39					
B202589	10/21/92	CHLORIDE	8.7	MG/L	1.14					
B200589	11/5/92	CHLORIDE	5	MG/L	0.00					
B200889	11/12/92	CHLORIDE	4	MG/L	0.00					
B400189	11/19/92	CHLORIDE	4	MG/L	0.00	25	3	15.00	41.11	274.03
B102289	8/30/90	FLUORIDE	400	UG/L	0.00					
B402189	10/17/90	FLUORIDE	500	UG/L	0.00					
B102289	10/24/90	FLUORIDE	400	UG/L	0.00					
B202589	11/1/90	FLUORIDE	400	UG/L	0.00					
B400289	11/29/90	FLUORIDE	300	UG/L	0.00					
B402189	3/21/91	FLUORIDE	600	UG/L	0.00					
B102289	3/28/91	FLUORIDE	0.3	UG/L	199.70					
B202589	3/28/91	FLUORIDE	500	UG/L	33.33					
B402189	5/20/91	FLUORIDE	500	UG/L	0.00					
B102289	5/23/91	FLUORIDE	400	UG/L	0.00					
B202589	5/31/91	FLUORIDE	500	UG/L	0.00					
B402189	8/29/91	FLUORIDE	500	UG/L	0.00					
B202589	9/10/91	FLUORIDE	430	UG/L	2.30					
B102289	9/17/91	FLUORIDE	400	UG/L	0.00					
B400289	9/19/91	FLUORIDE	200	UG/L	0.00					
B202589	12/9/91	FLUORIDE	400	UG/L	0.00					
B102289	12/12/91	FLUORIDE	300	UG/L	28.57					
B405586	12/18/91	FLUORIDE	200	UG/L	0.00					
B402189	12/19/91	FLUORIDE	400	UG/L	0.00					
B200589	1/28/92	FLUORIDE	0.3	MG/L	0.00					
B102289	2/28/92	FLUORIDE	0.2	MG/L	40.00					
5586	3/13/92	FLUORIDE	0.2	MG/L	0.00					
B402189	3/23/92	FLUORIDE	0.5	MG/L	18.18					
B202589	3/26/92	FLUORIDE	0.4	MG/L	0.00					
B102289	5/26/92	FLUORIDE	0.3	MG/L	28.57					
B202589	5/29/92	FLUORIDE	0.4	MG/L	0.00					
B200889	6/4/92	FLUORIDE	0.4	MG/L	0.00					
B200589	6/26/92	FLUORIDE	0.2	MG/L	40.00					
B102289	7/28/92	FLUORIDE	0.4	MG/L	0.00					
B200589	11/5/92	FLUORIDE	0.2	MG/L	40.00					
B200889	11/12/92	FLUORIDE	0.4	MG/L	0.00					
B400189	11/19/92	FLUORIDE	0.3	MG/L	0.00					
B202589	8/13/92	FLUORIDE, SOLUBLE	0.39	MG/L	2.53					
B402189	8/18/92	FLUORIDE, SOLUBLE	0.44	MG/L	8.70					
B400189	8/20/92	FLUORIDE, SOLUBLE	0.2	MG/L	13.95					
B400289	9/8/92	FLUORIDE, SOLUBLE	0.15	MG/L	6.45					
B400489	9/15/92	FLUORIDE, SOLUBLE	0.2	MG/L	9.52					
B200589	9/23/92	FLUORIDE, SOLUBLE	0.23	MG/L	0.00					
B400389	9/23/92	FLUORIDE, SOLUBLE	0.33	MG/L	8.70					
B202589	10/21/92	FLUORIDE, SOLUBLE	0.37	MG/L	2.67					
B102289	10/27/92	FLUORIDE, SOLUBLE	0.32	MG/L	8.96	41	7	12.00	32.57	271.32
B402189	10/17/90	NITRATE	310	UG/L	0.00	1	0	NA	NA	NA
B400289	5/19/90	NITRATE/NITRITE	1200	UG/L	0.00					
B102289	8/30/90	NITRATE/NITRITE	600	UG/L	0.00					
B102289	10/24/90	NITRATE/NITRITE	700	UG/L	0.00					
B202589	11/1/90	NITRATE/NITRITE	600	UG/L	0.00					
B400289	11/29/90	NITRATE/NITRITE	30	UG/L	163.64					
B402189	3/21/91	NITRATE/NITRITE	300	UG/L	0.00					
B102289	3/28/91	NITRATE/NITRITE	600	UG/L	15.38					
B402189	5/20/91	NITRATE/NITRITE	300	UG/L	28.57					
B102289	5/23/91	NITRATE/NITRITE	700	UG/L	0.00					
B202589	5/31/91	NITRATE/NITRITE	50	UG/L	18.18					
B402189	8/29/91	NITRATE/NITRITE	400	UG/L	0.00					
B102289	9/17/91	NITRATE/NITRITE	600	UG/L	15.38					
B400289	9/19/91	NITRATE/NITRITE	90	UG/L	107.69					
B202589	12/9/91	NITRATE/NITRITE	70	UG/L	44.44					
B102289	12/12/91	NITRATE/NITRITE	600	UG/L	0.00					
B405586	12/18/91	NITRATE/NITRITE	1500	UG/L	53.66					
B402189	12/19/91	NITRATE/NITRITE	400	UG/L	0.00					

* Result is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2e
%RPD Groundwater
Anions, Cyanide, and Water Quality Parameters

Location	Date	Analyte	Result*	Units	%RPD	N	N>20%	Avg	StDev	%CV
B200589	1/28/92	NITRATE/NITRITE	2.1	MG/L	0.00					
B102289	2/28/92	NITRATE/NITRITE	0.6	MG/L	0.00					
5586	3/13/92	NITRATE/NITRITE	1.2	MG/L	22.22					
B402189	3/23/92	NITRATE/NITRITE	0.3	MG/L	0.00					
B102289	5/26/92	NITRATE/NITRITE	0.6	MG/L	0.00					
B202589	5/29/92	NITRATE/NITRITE	0.05	MG/L	18.18					
B200889	6/4/92	NITRATE/NITRITE	2.9	MG/L	0.00					
5586	6/11/92	NITRATE/NITRITE	1.2	MG/L	15.38					
B200589	6/26/92	NITRATE/NITRITE	2	MG/L	0.00					
B102289	7/28/92	NITRATE/NITRITE	0.6	MG/L	15.38					
B402189	8/18/92	NITRATE/NITRITE	0.35	MG/L	2.82					
B400189	8/20/92	NITRATE/NITRITE	0.63	MG/L	25.00					
B400289	9/8/92	NITRATE/NITRITE	1.2	MG/L	0.00					
B400489	9/15/92	NITRATE/NITRITE	0.71	MG/L	0.00					
B200589	9/23/92	NITRATE/NITRITE	2	MG/L	4.88					
B400389	9/23/92	NITRATE/NITRITE	0.93	MG/L	5.24					
B202589	10/21/92	NITRATE/NITRITE	0.12	MG/L	50.00					
B102289	10/27/92	NITRATE/NITRITE	0.61	MG/L	1.63					
B200589	11/5/92	NITRATE/NITRITE	1.9	MG/L	5.13					
B200889	11/12/92	NITRATE/NITRITE	2.8	MG/L	10.17					
B400189	11/19/92	NITRATE/NITRITE	0.6	MG/L	15.38	38	8	16.80	32.46	193.20
B202589	11/1/90	ORTHOPHOSPHATE	20	UG/L	66.67					
B402189	3/21/91	ORTHOPHOSPHATE	20	UG/L	0.00					
B402189	8/29/91	ORTHOPHOSPHATE	20	UG/L	40.00					
B202589	9/10/91	ORTHOPHOSPHATE	22	UG/L	4.44					
B400289	9/19/91	ORTHOPHOSPHATE	10	UG/L	0.00					
B202589	12/9/91	ORTHOPHOSPHATE	20	UG/L	0.00					
B402189	12/19/91	ORTHOPHOSPHATE	10	UG/L	100.00					
B402189	3/23/92	ORTHOPHOSPHATE	0.01	MG/L	0.00					
B202589	3/26/92	ORTHOPHOSPHATE	0.01	MG/L	0.00					
B202589	5/29/92	ORTHOPHOSPHATE	0.02	MG/L	0.00					
B200889	6/4/92	ORTHOPHOSPHATE	0.01	MG/L	0.00					
B200889	11/12/92	ORTHOPHOSPHATE	0.01	MG/L	0.00	12	3	17.59	33.51	190.46
5586	6/11/92	pH	6.9	PH	0.00	1	0	NA	NA	NA
B102289	8/30/90	PHOSPHORUS	80	UG/L	31.58					
B102289	10/24/90	PHOSPHORUS	30	UG/L	80.00					
B202589	3/28/91	PHOSPHORUS	15	UG/L	33.33	3	3	48.30	27.46	56.86
B102289	8/30/90	SILICA	12000	UG/L	0.00					
B402189	10/17/90	SILICA	12500	UG/L	111.35					
B102289	10/24/90	SILICA	13000	UG/L	0.00					
B202589	11/1/90	SILICA	11000	UG/L	0.00					
B400289	11/29/90	SILICA	12000	UG/L	8.00					
B402189	3/21/91	SILICA	8600	UG/L	3.43					
B402189	5/20/91	SILICA	9300	UG/L	0.00					
B102289	5/23/91	SILICA	12000	UG/L	0.00					
B202589	5/31/91	SILICA	9500	UG/L	0.00					
B402189	8/29/91	SILICA	9700	UG/L	0.00					
B102289	9/17/91	SILICA	14000	UG/L	0.00					
B400289	9/19/91	SILICA	10000	UG/L	9.52					
B202589	12/9/91	SILICA	7600	UG/L	0.00					
B102289	12/12/91	SILICA	12000	UG/L	8.00					
B405586	12/18/91	SILICA	13000	UG/L	0.00					
B402189	12/19/91	SILICA	9700	UG/L	3.05					
B200589	1/28/92	SILICA, DISSOLVED	12	MG/L	0.00					
B102289	2/28/92	SILICA, DISSOLVED	12	MG/L	0.00					
5586	3/13/92	SILICA, DISSOLVED	12	MG/L	8.00					
B402189	3/23/92	SILICA, DISSOLVED	9.3	MG/L	1.07					
B202589	3/26/92	SILICA, DISSOLVED	7.4	MG/L	2.67	21	1	7.38	24.05	325.62
B102289	8/30/90	SULFATE	12000	UG/L	40.00					
B402189	10/17/90	SULFATE	24000	UG/L	0.00					
B102289	10/24/90	SULFATE	11000	UG/L	0.00					
B202589	11/1/90	SULFATE	69000	UG/L	9.66					
B400289	11/29/90	SULFATE	18000	UG/L	10.53					
B402189	3/21/91	SULFATE	27000	UG/L	0.00					

* Result is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2e
%RPD Groundwater
Anions, Cyanide, and Water Quality Parameters

Location	Date	Analyte	Result*	Units	%RPD	N	N>20%	Avg	StDev	%CV
B102289	3/28/91	SULFATE	10	UG/L	199.56					
B202589	3/28/91	SULFATE	30000	UG/L	3.28					
B402189	5/20/91	SULFATE	30000	UG/L	0.00					
B102289	5/23/91	SULFATE	9000	UG/L	0.00					
B202589	5/31/91	SULFATE	24000	UG/L	4.08					
B402189	8/29/91	SULFATE	25000	UG/L	3.92					
B202589	9/10/91	SULFATE	47700	UG/L	19.66					
B102289	9/17/91	SULFATE	11000	UG/L	8.70					
B400289	9/19/91	SULFATE	15000	UG/L	6.45					
B202589	12/9/91	SULFATE	37000	UG/L	0.00					
B102289	12/12/91	SULFATE	11000	UG/L	8.70					
B405586	12/18/91	SULFATE	19000	UG/L	0.00					
B402189	12/19/91	SULFATE	28000	UG/L	0.00					
B200589	1/28/92	SULFATE	12	MG/L	0.00					
B102289	2/28/92	SULFATE	9	MG/L	10.53					
5586	3/13/92	SULFATE	20	MG/L	9.52					
B402189	3/23/92	SULFATE	34	MG/L	0.00					
B202589	3/26/92	SULFATE	37	MG/L	2.67					
B102289	5/26/92	SULFATE	11	MG/L	8.70					
B202589	5/29/92	SULFATE	33	MG/L	0.00					
B200889	6/4/92	SULFATE	23	MG/L	0.00					
B200589	6/26/92	SULFATE	16	MG/L	0.00					
B102289	7/28/92	SULFATE	12	MG/L	8.00					
B400189	8/20/92	SULFATE	19.6	MG/L	8.78					
B200589	9/23/92	SULFATE	13	MG/L	0.00					
B400389	9/23/92	SULFATE	29	MG/L	0.00					
B202589	10/21/92	SULFATE	61	MG/L	7.87					
B102289	10/27/92	SULFATE	9.9	MG/L	0.00					
B200589	11/5/92	SULFATE	13	MG/L	7.41					
B200889	11/12/92	SULFATE	23	MG/L	4.26					
B400189	11/19/92	SULFATE	17	MG/L	5.71	37	2	10.49	32.82	312.99
B400289	5/19/90	TOTAL DISSOLVED SOLIDS	170000	UG/L	21.05					
B102289	8/30/90	TOTAL DISSOLVED SOLIDS	160000	UG/L	6.06					
B402189	10/17/90	TOTAL DISSOLVED SOLIDS	280000	UG/L	0.00					
B102289	10/24/90	TOTAL DISSOLVED SOLIDS	140000	UG/L	0.00					
B202589	11/1/90	TOTAL DISSOLVED SOLIDS	330000	UG/L	5.88					
B400289	11/29/90	TOTAL DISSOLVED SOLIDS	100000	UG/L	18.18					
B402189	3/21/91	TOTAL DISSOLVED SOLIDS	260000	UG/L	0.00					
B102289	3/28/91	TOTAL DISSOLVED SOLIDS	170	UG/L	199.62					
B202589	3/28/91	TOTAL DISSOLVED SOLIDS	250000	UG/L	3.92					
B402189	5/20/91	TOTAL DISSOLVED SOLIDS	280000	UG/L	0.00					
B102289	5/23/91	TOTAL DISSOLVED SOLIDS	180000	UG/L	5.41					
B202589	5/31/91	TOTAL DISSOLVED SOLIDS	6000	UG/L	0.00					
B402189	8/29/91	TOTAL DISSOLVED SOLIDS	240000	UG/L	4.08					
B202589	9/10/91	TOTAL DISSOLVED SOLIDS	368000	UG/L	0.81					
B102289	9/17/91	TOTAL DISSOLVED SOLIDS	160000	UG/L	6.06					
B400289	9/19/91	TOTAL DISSOLVED SOLIDS	110000	UG/L	0.00					
B202589	12/9/91	TOTAL DISSOLVED SOLIDS	220000	UG/L	0.00					
B102289	12/12/91	TOTAL DISSOLVED SOLIDS	150000	UG/L	0.00					
B405586	12/18/91	TOTAL DISSOLVED SOLIDS	160000	UG/L	11.76					
B402189	12/19/91	TOTAL DISSOLVED SOLIDS	250000	UG/L	3.92					
B200589	1/28/92	TOTAL DISSOLVED SOLIDS	150	MG/L	12.50					
B102289	2/28/92	TOTAL DISSOLVED SOLIDS	160	MG/L	0.00					
5586	3/13/92	TOTAL DISSOLVED SOLIDS	140	MG/L	13.33					
B402189	3/23/92	TOTAL DISSOLVED SOLIDS	280	MG/L	0.00					
B202589	3/26/92	TOTAL DISSOLVED SOLIDS	190	MG/L	5.13					
B102289	5/26/92	TOTAL DISSOLVED SOLIDS	96	MG/L	60.87					
B202589	5/29/92	TOTAL DISSOLVED SOLIDS	220	MG/L	0.00					
B200889	6/4/92	TOTAL DISSOLVED SOLIDS	170	MG/L	5.71					
5586	6/11/92	TOTAL DISSOLVED SOLIDS	220	MG/L	4.44					
B200589	6/26/92	TOTAL DISSOLVED SOLIDS	130	MG/L	7.41					
B102289	7/28/92	TOTAL DISSOLVED SOLIDS	160	MG/L	0.00					
B202589	8/13/92	TOTAL DISSOLVED SOLIDS	310	MG/L	3.17					
B402189	8/18/92	TOTAL DISSOLVED SOLIDS	260	MG/L	7.41					

* Result is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-2e
%RPD Groundwater
Anions, Cyanide, and Water Quality Parameters

Location	Date	Analyte	Result*	Units	%RPD	N	N>20%	Avg	StDev	%CV
B400189	8/20/92	TOTAL DISSOLVED SOLIDS	156	MG/L	24.72					
B400289	9/8/92	TOTAL DISSOLVED SOLIDS	170	MG/L	0.00					
B400489	9/15/92	TOTAL DISSOLVED SOLIDS	170	MG/L	5.71					
B200589	9/23/92	TOTAL DISSOLVED SOLIDS	190	MG/L	82.72					
B202589	10/21/92	TOTAL DISSOLVED SOLIDS	370	MG/L	2.67					
B102289	10/27/92	TOTAL DISSOLVED SOLIDS	160	MG/L	0.00					
B200589	11/5/92	TOTAL DISSOLVED SOLIDS	150	MG/L	6.45					
B200889	11/12/92	TOTAL DISSOLVED SOLIDS	200	MG/L	0.00					
B400189	11/19/92	TOTAL DISSOLVED SOLIDS	120	MG/L	8.00	42	5	12.79	33.47	261.73
B400289	5/19/90	TOTAL SUSPENDED SOLIDS	47000	UG/L	30.63					
B102289	8/30/90	TOTAL SUSPENDED SOLIDS	400000	UG/L	9.52					
B402189	10/17/90	TOTAL SUSPENDED SOLIDS	33000	UG/L	100.75					
B202589	11/1/90	TOTAL SUSPENDED SOLIDS	73000	UG/L	48.70					
B400289	11/29/90	TOTAL SUSPENDED SOLIDS	23000	UG/L	8.33					
B402189	3/21/91	TOTAL SUSPENDED SOLIDS	12000	UG/L	40.00					
B102289	3/28/91	TOTAL SUSPENDED SOLIDS	780	UG/L	199.78					
B202589	3/28/91	TOTAL SUSPENDED SOLIDS	130000	UG/L	7.41					
B402189	5/20/91	TOTAL SUSPENDED SOLIDS	20000	UG/L	88.89					
B102289	5/23/91	TOTAL SUSPENDED SOLIDS	120000	UG/L	15.38					
B202589	5/31/91	TOTAL SUSPENDED SOLIDS	220000	UG/L	4.44					
B202589	9/10/91	TOTAL SUSPENDED SOLIDS	210000	UG/L	28.57					
B102289	9/17/91	TOTAL SUSPENDED SOLIDS	60000	UG/L	28.57					
B400289	9/19/91	TOTAL SUSPENDED SOLIDS	12000	UG/L	15.38					
B202589	12/9/91	TOTAL SUSPENDED SOLIDS	4000	UG/L	85.71					
B102289	12/12/91	TOTAL SUSPENDED SOLIDS	520000	UG/L	3.77					
B405586	12/18/91	TOTAL SUSPENDED SOLIDS	98000	UG/L	53.73					
B200589	1/28/92	TOTAL SUSPENDED SOLIDS	110	MG/L	48.28					
B102289	2/28/92	TOTAL SUSPENDED SOLIDS	160	MG/L	31.58					
5586	3/13/92	TOTAL SUSPENDED SOLIDS	340	MG/L	8.45					
B202589	3/26/92	TOTAL SUSPENDED SOLIDS	6	MG/L	58.82					
B102289	5/26/92	TOTAL SUSPENDED SOLIDS	400	MG/L	22.22					
B202589	5/29/92	TOTAL SUSPENDED SOLIDS	8	MG/L	152.94					
B200889	6/4/92	TOTAL SUSPENDED SOLIDS	56	MG/L	79.57					
5586	6/11/92	TOTAL SUSPENDED SOLIDS	280	MG/L	19.35					
B200589	6/26/92	TOTAL SUSPENDED SOLIDS	38	MG/L	10.00					
B102289	7/28/92	TOTAL SUSPENDED SOLIDS	210	MG/L	41.51					
B202589	8/13/92	TOTAL SUSPENDED SOLIDS	92	MG/L	106.12					
B402189	8/18/92	TOTAL SUSPENDED SOLIDS	34	MG/L	139.29					
B400289	9/8/92	TOTAL SUSPENDED SOLIDS	180	MG/L	40.00					
B200589	9/23/92	TOTAL SUSPENDED SOLIDS	860	MG/L	0.00					
B202589	10/21/92	TOTAL SUSPENDED SOLIDS	100	MG/L	51.85					
B102289	10/27/92	TOTAL SUSPENDED SOLIDS	440	MG/L	32.38					
B200589	11/5/92	TOTAL SUSPENDED SOLIDS	100	MG/L	40.00					
B200889	11/12/92	TOTAL SUSPENDED SOLIDS	44	MG/L	35.51					
B400189	11/19/92	TOTAL SUSPENDED SOLIDS	53	MG/L	36.92	36	25	47.90	45.47	94.93

* Result is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-3a
%RPD Stream Water
Dissolved Metals

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
SW006	2/24/89	ALUMINUM	252	63.23					
SW006	4/2/91	ALUMINUM	33.9	13.74	2	1	38.48	35.00	90.94
SW006	4/2/91	BARIUM	45.2	26.65					
SW007	5/2/91	BARIUM	63.9	5.92					
SW107	4/14/92	BARIUM	62.9	0.16					
SW006	8/28/92	BARIUM	31.1	10.08					
SW006	12/2/92	BARIUM	40.4	1.23	5	1	8.81	10.73	121.83
SW006	2/24/89	CALCIUM	23900	6.48					
SW006	8/1/89	CALCIUM	18300	1.63					
SW006	9/5/89	CALCIUM	14800	0.67					
SW006	10/2/89	CALCIUM	10700	2.76					
SW006	11/1/89	CALCIUM	11300	3.48					
SW006	12/4/89	CALCIUM	12400	6.25					
SW005	1/4/90	CALCIUM	23100	132.11					
SW006	1/9/90	CALCIUM	13600	4.32					
SW041	2/6/90	CALCIUM	25700	0.78					
SW006	3/5/90	CALCIUM	19500	3.03					
SW006	4/2/91	CALCIUM	20700	0.48					
SW007	5/2/91	CALCIUM	25800	1.54					
SW107	4/14/92	CALCIUM	21600	1.83					
SW006	6/30/92	CALCIUM	24600	2.81					
SW006	8/28/92	CALCIUM	10500	6.45					
SW006	12/2/92	CALCIUM	16600	2.97	16	1	11.10	32.33	291.29
SW006	4/2/91	COPPER	3	80.00	1	1	NA	NA	NA
SW006	2/24/89	IRON	901	65.57					
SW006	10/2/89	IRON	276	2.50					
SW006	12/4/89	IRON	155	13.81					
SW005	1/4/90	IRON	54.6	135.88					
SW041	8/6/90	IRON	276	30.93					
SW006	4/2/91	IRON	147	9.09					
SW007	5/2/91	IRON	50.9	46.92					
SW006	8/28/92	IRON	76.1	68.28					
SW006	12/2/92	IRON	118	34.39	9	6	45.26	41.24	91.11
SW005	1/4/90	LEAD	2	4.88					
SW006	8/28/92	LEAD	2.3	136.11	2	1	70.49	92.80	131.64
SW006	1/9/90	LITHIUM	2	163.64	1	1	NA	NA	NA
SW006	2/24/89	MAGNESIUM	7190	7.24					
SW006	9/5/89	MAGNESIUM	5250	0.95					
SW005	1/4/90	MAGNESIUM	5020	131.51					
SW041	2/6/90	MAGNESIUM	6930	0.58					
SW006	3/5/90	MAGNESIUM	5540	2.85					
SW041	8/6/90	MAGNESIUM	5510	3.39					
SW006	4/2/91	MAGNESIUM	6570	0.46					
SW007	5/2/91	MAGNESIUM	5560	1.25					
SW107	4/14/92	MAGNESIUM	5560	0.54					
SW006	6/30/92	MAGNESIUM	7220	2.73					
SW006	8/28/92	MAGNESIUM	2600	6.69					
SW006	12/2/92	MAGNESIUM	4900	3.61	12	1	13.48	37.24	276.21
SW006	2/24/89	MANGANESE	338	8.50					
SW006	8/1/89	MANGANESE	40.9	1.70					
SW006	1/9/90	MANGANESE	94.9	1.78					
SW006	3/5/90	MANGANESE	74.5	1.20					
SW041	8/6/90	MANGANESE	28.7	67.89					
SW006	4/2/91	MANGANESE	11.6	18.75					
SW007	5/2/91	MANGANESE	5.3	17.24					
SW107	4/14/92	MANGANESE	18.6	111.85					
SW006	12/2/92	MANGANESE	33.1	0.60	9	2	25.50	38.72	151.85
SW005	1/4/90	POTASSIUM	961	132.22					
SW006	4/2/91	POTASSIUM	2090	1.43					
SW007	5/2/91	POTASSIUM	2510	30.41					
SW006	8/28/92	POTASSIUM	2750	3.57					
SW006	12/2/92	POTASSIUM	3820	6.58	5	2	34.84	55.67	159.77
SW006	4/2/91	SILICON	618	6.12					
SW007	5/2/91	SILICON	3430	7.84					

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-3a
%RPD Stream Water
Dissolved Metals

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
SW107	4/14/92	SILICON	4100	7.51					
SW006	6/30/92	SILICON	871	0.91					
SW006	8/28/92	SILICON	3420	1.74					
SW006	12/2/92	SILICON	1420	10.67	6	0	5.80	3.77	65.10
SW006	2/24/89	SODIUM	27000	8.17					
SW006	8/1/89	SODIUM	21100	10.76					
SW006	9/5/89	SODIUM	24000	1.65					
SW006	10/2/89	SODIUM	14600	12.22					
SW006	11/1/89	SODIUM	15400	5.06					
SW006	12/4/89	SODIUM	17000	6.82					
SW005	1/4/90	SODIUM	13400	130.93					
SW006	1/9/90	SODIUM	15900	3.10					
SW041	2/6/90	SODIUM	19000	1.57					
SW006	4/2/91	SODIUM	30200	1.97					
SW007	5/2/91	SODIUM	44600	0.45					
SW107	4/14/92	SODIUM	17700	0.56					
SW006	6/30/92	SODIUM	30000	2.63					
SW006	8/28/92	SODIUM	12800	6.06					
SW006	12/2/92	SODIUM	23200	3.39	15	1	13.02	32.82	252.00
SW006	2/24/89	STRONTIUM	163	5.95					
SW006	10/2/89	STRONTIUM	73.7	3.86					
SW005	1/4/90	STRONTIUM	143	132.31					
SW006	1/9/90	STRONTIUM	101	0.99					
SW006	4/2/91	STRONTIUM	134	1.48					
SW107	4/14/92	STRONTIUM	140	2.82					
SW006	8/28/92	STRONTIUM	64.5	7.17					
SW006	12/2/92	STRONTIUM	108	10.53	8	1	20.64	45.23	219.17
SW005	1/4/90	ZINC	21.3	112.88					
SW006	1/9/90	ZINC	110	2.69					
SW006	3/5/90	ZINC	23.7	39.32					
SW007	5/2/91	ZINC	6.1	122.78	4	3	69.42	58.01	83.56

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-3b
%RPD Stream Water
Total Metals

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
SW006	8/1/89	ALUMINUM	2390	21.31					
SW006	1/9/90	ALUMINUM	2060	1.45					
SW041	2/6/90	ALUMINUM	1450	65.43					
SW006	4/2/91	ALUMINUM	176	113.09					
SW006	8/28/92	ALUMINUM	31.3	194.56					
SW006	12/2/92	ALUMINUM	69.4	46.12	6	5	73.66	70.64	95.91
SW006	4/2/91	BARIUM	55.3	15.67					
SW007	5/2/91	BARIUM	71.2	15.90					
SW107	4/14/92	BARIUM	61	1.63					
SW006	8/28/92	BARIUM	33.2	29.96					
SW006	12/2/92	BARIUM	42.3	1.18	5	1	12.87	11.96	92.97
SW006	2/24/89	CALCIUM	24100	8.35					
SW006	8/1/89	CALCIUM	19000	2.60					
SW006	9/5/89	CALCIUM	15200	2.60					
SW006	10/2/89	CALCIUM	11.5	199.58					
SW006	11/1/89	CALCIUM	11900	0.84					
SW006	12/4/89	CALCIUM	11700	2.53					
SW005	1/4/90	CALCIUM	23300	0.43					
SW006	1/9/90	CALCIUM	14100	4.17					
SW041	2/6/90	CALCIUM	25100	2.36					
SW006	3/5/90	CALCIUM	18700	2.64					
SW041	8/6/90	CALCIUM	33200	2.09					
SW006	4/2/91	CALCIUM	21900	3.59					
SW007	5/2/91	CALCIUM	25500	4.22					
SW107	4/14/92	CALCIUM	21200	0.94					
SW006	8/28/92	CALCIUM	10500	1.89					
SW006	12/2/92	CALCIUM	17100	2.31	16	1	15.07	49.24	326.72
SW006	4/2/91	COPPER	5.7	13.11					
SW007	5/2/91	COPPER	5.4	18.49	2	0	15.80	3.80	24.04
SW006	2/24/89	IRON	2210	8.66					
SW006	8/1/89	IRON	3360	71.39					
SW006	9/5/89	IRON	465	4.00					
SW006	10/2/89	IRON	594	0.17					
SW006	11/1/89	IRON	488	16.89					
SW006	12/4/89	IRON	577	4.07					
SW006	1/9/90	IRON	2080	1.90					
SW041	2/6/90	IRON	1970	57.25					
SW006	3/5/90	IRON	1380	3.56					
SW006	4/2/91	IRON	984	56.04					
SW007	5/2/91	IRON	82.3	143.85					
SW107	4/14/92	IRON	122	4.80					
SW006	8/28/92	IRON	85.1	184.28					
SW006	12/2/92	IRON	327	21.31	14	6	41.30	57.63	139.55
SW041	2/6/90	LEAD	3.3	51.69					
SW006	4/2/91	LEAD	1.9	38.30					
SW006	8/28/92	LEAD	2.8	25.00	3	3	38.33	13.34	34.81
SW006	1/9/90	LITHIUM	3	28.57	1	1	NA	NA	NA
SW006	2/24/89	MAGNESIUM	7630	4.73					
SW006	8/1/89	MAGNESIUM	5210	2.28					
SW006	9/5/89	MAGNESIUM	5120	2.51					
SW006	1/9/90	MAGNESIUM	4390	3.14					
SW041	2/6/90	MAGNESIUM	6630	4.28					
SW006	3/5/90	MAGNESIUM	5220	2.83					
SW041	8/6/90	MAGNESIUM	5270	3.72					
SW006	4/2/91	MAGNESIUM	7030	3.22					
SW007	5/2/91	MAGNESIUM	5650	0.71					
SW107	4/14/92	MAGNESIUM	5450	1.46					
SW006	8/28/92	MAGNESIUM	2610	8.09					
SW006	12/2/92	MAGNESIUM	4980	3.16	12	0	3.34	1.86	55.71
SW006	2/24/89	MANGANESE	371	1.87					
SW006	8/1/89	MANGANESE	76.3	34.40					
SW006	9/5/89	MANGANESE	28.8	2.06					
SW006	10/2/89	MANGANESE	30.2	7.03					
SW006	11/1/89	MANGANESE	25.8	23.59					

* Result in ug/L is shown for one of duplicate pair samples to indicate concentration levels.

Table F-3b
%RPD Stream Water
Total Metals

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
SW006	12/4/89	MANGANESE	20.2	22.42					
SW006	1/9/90	MANGANESE	111	4.41					
SW041	2/6/90	MANGANESE	38.8	1.79					
SW006	3/5/90	MANGANESE	159	9.01					
SW041	8/6/90	MANGANESE	23.4	17.19					
SW006	4/2/91	MANGANESE	63.4	27.60					
SW007	5/2/91	MANGANESE	5.8	102.11					
SW107	4/14/92	MANGANESE	17.8	1.12					
SW006	8/28/92	MANGANESE	7.4	160.85					
SW006	12/2/92	MANGANESE	35.2	8.44	15	6	28.26	44.60	157.85
SW006	1/9/90	POTASSIUM	2450	0.41					
SW006	4/2/91	POTASSIUM	2200	4.44					
SW007	5/2/91	POTASSIUM	3100	5.34					
SW107	4/14/92	POTASSIUM	687	79.31					
SW006	8/28/92	POTASSIUM	2680	5.80					
SW006	12/2/92	POTASSIUM	3560	2.77	6	1	16.35	30.91	189.12
SW006	4/2/91	SILICON	917	63.49					
SW007	5/2/91	SILICON	3820	4.85					
SW107	4/14/92	SILICON	3900	2.28					
SW006	6/30/92	SILICON	200	142.03	4	2	53.16	65.64	123.47
SW006	2/24/89	SODIUM	27800	8.28					
SW006	8/1/89	SODIUM	2350	162.77					
SW006	9/5/89	SODIUM	23000	11.09					
SW006	10/2/89	SODIUM	14500	5.37					
SW006	11/1/89	SODIUM	16100	2.45					
SW006	12/4/89	SODIUM	15900	0.63					
SW005	1/4/90	SODIUM	13100	6.64					
SW006	1/9/90	SODIUM	16200	7.14					
SW041	2/6/90	SODIUM	18600	1.07					
SW006	3/5/90	SODIUM	15900	30.40					
SW041	8/6/90	SODIUM	15800	9.64					
SW006	4/2/91	SODIUM	31600	1.57					
SW007	5/2/91	SODIUM	43900	2.70					
SW107	4/14/92	SODIUM	17100	1.74					
SW006	8/28/92	SODIUM	12700	1.56					
SW006	12/2/92	SODIUM	23000	5.50	16	2	16.16	39.75	246.00
SW006	2/24/89	STRONTIUM	171	3.45					
SW006	1/9/90	STRONTIUM	102	4.78					
SW006	4/2/91	STRONTIUM	143	4.78					
SW107	4/14/92	STRONTIUM	140	0.71					
SW006	8/28/92	STRONTIUM	65.8	0.30					
SW006	12/2/92	STRONTIUM	120	0.83	6	0	2.48	2.10	84.94
SW006	8/1/89	ZINC	106	33.73					
SW006	9/5/89	ZINC	345	5.08					
SW006	12/4/89	ZINC	23.9	88.84					
SW006	1/9/90	ZINC	129	3.80					
SW006	3/5/90	ZINC	23.6	17.76					
SW007	5/2/91	ZINC	6.1	129.48					
SW006	12/2/92	ZINC	4.7	47.15	7	4	46.55	46.91	100.79

* Result in ug/L is shown for one of duplicate pair samples to indicate concentration levels.

Table F-3c
%RPD Stream Water
Dissolved Radionuclides

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
SW006	2/24/89	GROSS BETA	5	18.18					
SW006	4/2/91	GROSS BETA	3.5	2.82					
SW041	8/6/90	GROSS BETA - DISSOLVED	2.571	93.15	3	1	38.05	48.33	127.03
SW006	4/2/91	GROSS GAMMA	0.34	2.90	1	0	NA	NA	NA
SW006	2/24/89	STRONTIUM-89,90	0.9	10.53					
SW041	8/6/90	STRONTIUM-89,90	0.5401	8.90	2	0	9.71	1.15	11.85
SW006	4/2/91	STRONTIUM-90	0.58	53.16	1	1	NA	NA	NA
SW041	8/6/90	TRITIUM	110.9	53.84	1	1	NA	NA	NA
SW006	2/24/89	URANIUM, TOTAL	0.5	66.67	1	1	NA	NA	NA
SW006	2/24/89	URANIUM-233,234	0.3	80.00					
SW041	8/6/90	URANIUM-233,234	0.1246	73.53					
SW006	4/2/91	URANIUM-233,234	0.29	58.54	3	3	70.69	11.01	15.58
SW041	8/6/90	URANIUM-235	0.06708	32.32	1	1	NA	NA	NA
SW006	2/24/89	URANIUM-238	0.2	40.00					
SW041	8/6/90	URANIUM-238	0.1342	27.28					
SW006	4/2/91	URANIUM-238	0.34	27.85	3	3	31.71	7.18	22.66

* Result in pCi/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-3d
%RPD Stream Water
Total Radionuclides

Location	Date	Analyte	Result*	%RPD	N	N>20%	Avg	StDev	%CV
SW006	2/24/89	AMERICIUM-241	0.01	66.67					
SW006	1/9/90	AMERICIUM-241	0.008	96.77					
SW041	2/6/90	AMERICIUM-241	0.012	8.00					
SW041	8/6/90	AMERICIUM-241	0.001381	7.73	4	2	44.79	44.38	99.07
SW006	8/1/89	CESIUM-137	0.2	85.71					
SW006	1/9/90	CESIUM-137	0.05	120.00					
SW006	12/2/92	CESIUM-137	0.2324	89.96	3	3	98.56	18.69	18.96
SW006	8/1/89	GROSS ALPHA	3	50.00					
SW006	1/9/90	GROSS ALPHA	1.2	93.33					
SW006	3/5/90	GROSS ALPHA - SUSPENDED	0.7254	57.72	3	3	67.02	23.11	34.49
SW006	2/24/89	GROSS BETA	7	13.33					
SW006	8/1/89	GROSS BETA	4	22.22					
SW006	10/2/89	GROSS BETA	2.9	43.24					
SW006	1/9/90	GROSS BETA	3.9	30.43					
SW006	3/5/90	GROSS BETA	4.346	20.91					
SW006	6/30/92	GROSS BETA - SUSPENDED	3.6	10.53	6	4	23.45	11.98	51.11
SW006	9/5/89	PLUTONIUM-239,240	0.002	100.00					
SW006	10/2/89	PLUTONIUM-239,240	0.003	142.86					
SW006	1/9/90	PLUTONIUM-239,240	0.011	8.70					
SW041	2/6/90	PLUTONIUM-239,240	0.006	58.82					
SW006	3/5/90	PLUTONIUM-239,240	0.001696	63.28					
SW006	12/2/92	PLUTONIUM-239/240	0.001034	20.10	6	5	65.63	50.02	76.23
SW006	2/24/89	STRONTIUM-89,90	1.1	30.77					
SW006	8/1/89	STRONTIUM-89,90	1.5	18.18					
SW006	10/2/89	STRONTIUM-89,90	1.03	61.74					
SW107	4/14/92	STRONTIUM-89,90	4.94	8.34					
SW006	8/28/92	STRONTIUM-89,90	2.9	0.34					
SW006	12/2/92	STRONTIUM-89,90	0.4282	110.52	6	3	38.32	41.39	108.02
SW006	1/9/90	STRONTIUM-90	0.85	13.19					
SW006	3/5/90	STRONTIUM-90	0.9143	9.65	2	0	11.42	2.50	21.90
SW006	8/1/89	TRITIUM	110	37.04					
SW107	4/14/92	TRITIUM	22.52	164.48					
SW006	12/2/92	TRITIUM	106.6	41.43	3	3	80.98	72.34	89.33
SW006	2/24/89	URANIUM, TOTAL	0.6	15.38					
SW006	9/5/89	URANIUM, TOTAL	0.56	5.22	2	0	10.30	7.19	69.79
SW107	4/14/92	URANIUM-233,-234	0.151	190.60					
SW006	6/30/92	URANIUM-233,-234	0.29	3.39					
SW006	8/28/92	URANIUM-233,-234	0.121	181.85					
SW006	12/2/92	URANIUM-233,-234	0.08654	18.99					
SW006	8/1/89	URANIUM-233,234	0.2	40.00					
SW006	12/4/89	URANIUM-233,234	0.15	66.67					
SW005	1/4/90	URANIUM-233,234	0.39	9.76					
SW006	1/9/90	URANIUM-233,234	0.47	8.16					
SW041	2/6/90	URANIUM-233,234	1.3	18.82					
SW006	3/5/90	URANIUM-233,234	0.3473	37.23	10	5	57.55	70.40	122.33
SW006	12/4/89	URANIUM-235	0.06	40.00					
SW005	1/4/90	URANIUM-235	0.06	73.68					
SW006	3/5/90	URANIUM-235	0.06007	64.07					
SW006	8/28/92	URANIUM-235	0.016	177.85	4	4	88.90	60.97	68.58
SW006	8/1/89	URANIUM-238	0.1	100.00					
SW006	12/4/89	URANIUM-238	0.1	40.00					
SW005	1/4/90	URANIUM-238	0.39	9.76					
SW006	1/9/90	URANIUM-238	0.34	70.48					
SW041	2/6/90	URANIUM-238	1.17	26.02					
SW006	3/5/90	URANIUM-238	0.3375	16.20	6	4	43.74	34.99	79.99

* Result in pCi/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-3e
%RPD Stream Water
Anions, Cyanide, and Water Quality Parameters

Location	Date	Analyte	Result*	Units	%RPD	N	N>20%	Avg	StDev	%CV
SW006	2/24/89	BICARBONATE	120000	UG/L	0.00					
SW006	8/1/89	BICARBONATE	100000	UG/L	9.52					
SW006	9/5/89	BICARBONATE	55000	UG/L	58.06					
SW006	10/2/89	BICARBONATE	54000	UG/L	43.48					
SW006	11/1/89	BICARBONATE	56000	UG/L	10.17					
SW005	1/4/90	BICARBONATE	88000	UG/L	18.56					
SW006	1/9/90	BICARBONATE	59000	UG/L	9.68					
SW041	2/6/90	BICARBONATE	130000	UG/L	0.00					
SW006	3/5/90	BICARBONATE	110000	UG/L	0.00					
SW041	8/6/90	BICARBONATE AS CACO3	84000	UG/L	4.65					
SW006	4/2/91	BICARBONATE AS CACO3	102000	UG/L	11.11					
SW007	5/2/91	BICARBONATE AS CACO3	68200	UG/L	14.42					
SW006	6/30/92	BICARBONATE AS CACO3	105	MG/L	3.74					
SW006	8/28/92	BICARBONATE AS CACO3	42.1	MG/L	2.58	14	2	13.28	17.09	128.66
SW006	4/2/91	CBOD5	10900	UG/L	9.61	1	0	NA	NA	NA
SW006	2/24/89	CHLORIDE	14000	UG/L	6.90					
SW006	8/1/89	CHLORIDE	13000	UG/L	7.41					
SW006	9/5/89	CHLORIDE	11000	UG/L	0.00					
SW006	10/2/89	CHLORIDE	12000	UG/L	0.00					
SW006	11/1/89	CHLORIDE	11000	UG/L	8.70					
SW005	1/4/90	CHLORIDE	3000	UG/L	0.00					
SW006	1/9/90	CHLORIDE	12000	UG/L	8.00					
SW041	2/6/90	CHLORIDE	7000	UG/L	0.00					
SW006	3/5/90	CHLORIDE	15000	UG/L	0.00					
SW041	8/6/90	CHLORIDE	29000	UG/L	0.00					
SW006	4/2/91	CHLORIDE	11800	UG/L	19.85					
SW007	5/2/91	CHLORIDE	78300	UG/L	1.40					
SW107	4/14/92	CHLORIDE	22.2	MG/L	0.00	13	0	4.02	5.97	148.61
SW107	4/14/92	DISSOLVED ORGANIC CARBON	4	MG/L	40.00					
SW006	6/30/92	DISSOLVED ORGANIC CARBON	10.7	MG/L	1.85					
SW006	12/2/92	DISSOLVED ORGANIC CARBON	12	MG/L	0.00	3	1	13.95	22.58	161.85
SW041	8/6/90	FLUORIDE	400	UG/L	0.00					
SW006	4/2/91	FLUORIDE	580	UG/L	6.67					
SW007	5/2/91	FLUORIDE	280	UG/L	3.51					
SW107	4/14/92	FLUORIDE, SOLUBLE	0.32	MG/L	6.06					
SW006	6/30/92	FLUORIDE, SOLUBLE	0.469	MG/L	3.35					
SW006	8/28/92	FLUORIDE, SOLUBLE	0.31	MG/L	6.25	6	0	4.31	2.55	59.21
SW006	2/24/89	NITRATE/NITRITE	250	UG/L	87.64					
SW006	1/9/90	NITRATE/NITRITE	510	UG/L	5.71					
SW041	2/6/90	NITRATE/NITRITE	80	UG/L	0.00					
SW007	5/2/91	NITRATE/NITRITE	310	UG/L	0.00					
SW006	6/30/92	NITRATE/NITRITE	0.337	MG/L	25.84					
SW006	12/2/92	NITRATE/NITRITE	0.21	MG/L	0.00	6	2	19.87	34.68	174.57
SW041	8/6/90	OIL AND GREASE	900	UG/L	36.36					
SW006	6/30/92	OIL AND GREASE	17.8	MG/L	2.22					
SW006	12/2/92	OIL AND GREASE	7.5	MG/L	65.47	3	2	34.69	31.66	91.27
SW006	2/24/89	PH	7.2	PHUNIT	1.38					
SW006	8/1/89	PH	7.4	PHUNIT	1.34					
SW006	9/5/89	PH	6.9	PHUNIT	8.33					
SW006	10/2/89	PH	7.1	PHUNIT	1.40					
SW006	11/1/89	PH	7.2	PHUNIT	0.00					
SW006	1/9/90	PH	6.8	PHUNIT	1.46					
SW041	2/6/90	PH	7.2	PHUNIT	1.38					
SW006	3/5/90	PH	7.2	PHUNIT	1.38	8	0	2.08	2.57	123.40
SW041	8/6/90	PHOSPHORUS	10	UG/L	0.00					
SW006	8/28/92	PHOSPHORUS	0.079	MG/L	0.00	2	0	0.00	0.00	NA
SW041	8/6/90	SILICA	2800	UG/L	0.00			NA	NA	NA
SW006	2/24/89	SULFATE	5000	UG/L	128.57					
SW006	8/1/89	SULFATE	26000	UG/L	3.77					
SW006	9/5/89	SULFATE	19000	UG/L	110.59					
SW006	10/2/89	SULFATE	21000	UG/L	13.33					
SW006	11/1/89	SULFATE	22000	UG/L	4.44					
SW005	1/4/90	SULFATE	18000	UG/L	0.00					
SW006	1/9/90	SULFATE	23000	UG/L	0.00					

*Result is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-3e
%RPD Stream Water
Anions, Cyanide, and Water Quality Parameters

Location	Date	Analyte	Result*	Units	%RPD	N	N>20%	Avg	StDev	%CV
SW041	2/6/90	SULFATE	29000	UG/L	6.67					
SW006	3/5/90	SULFATE	22000	UG/L	4.44					
SW041	8/6/90	SULFATE	10000	UG/L	9.52					
SW006	4/2/91	SULFATE	20500	UG/L	3.36					
SW007	5/2/91	SULFATE	10100	UG/L	29.54					
SW107	4/14/92	SULFATE	20.9	MG/L	18.66					
SW006	8/28/92	SULFATE	13.8	MG/L	22.51	14	4	25.39	40.99	161.47
SW006	2/24/89	TOTAL DISSOLVED SOLIDS	200000	UG/L	0.00					
SW006	8/1/89	TOTAL DISSOLVED SOLIDS	150000	UG/L	0.00					
SW006	9/5/89	TOTAL DISSOLVED SOLIDS	170000	UG/L	5.71					
SW006	10/2/89	TOTAL DISSOLVED SOLIDS	110000	UG/L	8.70					
SW006	11/1/89	TOTAL DISSOLVED SOLIDS	100000	UG/L	9.52					
SW006	1/9/90	TOTAL DISSOLVED SOLIDS	120000	UG/L	8.00					
SW041	2/6/90	TOTAL DISSOLVED SOLIDS	150000	UG/L	0.00					
SW006	3/5/90	TOTAL DISSOLVED SOLIDS	150000	UG/L	6.45					
SW041	8/6/90	TOTAL DISSOLVED SOLIDS	160000	UG/L	0.00					
SW006	4/2/91	TOTAL DISSOLVED SOLIDS	240000	UG/L	7.23					
SW007	5/2/91	TOTAL DISSOLVED SOLIDS	234000	UG/L	8.98					
SW107	4/14/92	TOTAL DISSOLVED SOLIDS	150	MG/L	3.92					
SW006	6/30/92	TOTAL DISSOLVED SOLIDS	189	MG/L	1.05					
SW006	8/28/92	TOTAL DISSOLVED SOLIDS	132	MG/L	14.08					
SW006	12/2/92	TOTAL DISSOLVED SOLIDS	242	MG/L	44.87	15	1	7.90	11.11	140.65
SW006	4/2/91	TOTAL ORGANIC CARBON	11900	UG/L	2.49					
SW107	4/14/92	TOTAL ORGANIC CARBON	6	MG/L	15.38					
SW006	6/30/92	TOTAL ORGANIC CARBON	11.3	MG/L	9.28					
SW006	8/28/92	TOTAL ORGANIC CARBON	10	MG/L	9.52					
SW006	8/28/92	TOTAL ORGANIC CARBON	13	MG/L	7.41					
SW006	12/2/92	TOTAL ORGANIC CARBON	15	MG/L	6.45	6	0	8.42	4.26	50.52
SW006	2/24/89	TOTAL SUSPENDED SOLIDS	18000	UG/L	0.00					
SW006	8/1/89	TOTAL SUSPENDED SOLIDS	100000	UG/L	0.00					
SW006	9/5/89	TOTAL SUSPENDED SOLIDS	12000	UG/L	0.00					
SW006	11/1/89	TOTAL SUSPENDED SOLIDS	6000	UG/L	50.00					
SW006	1/9/90	TOTAL SUSPENDED SOLIDS	6000	UG/L	28.57					
SW041	2/6/90	TOTAL SUSPENDED SOLIDS	180000	UG/L	0.00					
SW006	4/2/91	TOTAL SUSPENDED SOLIDS	13000	UG/L	20.69					
SW007	5/2/91	TOTAL SUSPENDED SOLIDS	10000	UG/L	40.00					
SW006	6/30/92	TOTAL SUSPENDED SOLIDS	6	MG/L	28.57					
SW006	8/28/92	TOTAL SUSPENDED SOLIDS	7	MG/L	88.00	10	6	25.58	28.60	111.78

*Result is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-4a
Seep and Spring Water
Dissolved Metals

Location	Date	Analyte	Result*	%RPD
SW108	5/30/89	CALCIUM	63900	0.16
SW104	11/20/89	CALCIUM	39000	2.28
SW108	5/30/89	LITHIUM	16.5	0.60
SW108	5/30/89	MAGNESIUM	11800	0.00
SW108	5/30/89	MANGANESE	162	0.62
SW108	5/30/89	SODIUM	20000	0.50
SW104	11/20/89	SODIUM	7530	4.54
SW104	11/20/89	STRONTIUM	128	1.55

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-4b
%RPD Seep and Spring Water
Total Metals

Location	Date	Analyte	Result*	%RPD
SW108	5/30/89	ALUMINUM	4930	1.01
SW104	11/20/89	CALCIUM	36100	7.21
SW108	5/30/89	IRON	4190	3.06
SW104	11/20/89	IRON	361	46.22
SW108	5/30/89	LITHIUM	18.3	4.80
SW108	5/30/89	MAGNESIUM	12200	0.82
SW108	5/30/89	MANGANESE	214	1.85
SW108	5/30/89	MERCURY	0.36	107.69
SW108	5/30/89	SODIUM	21500	1.84
SW104	11/20/89	SODIUM	7570	10.16
SW104	11/20/89	STRONTIUM	123	2.41

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-4c
%RPD Seep and Spring Water
Total Radionuclides

Location	Date	Analyte	Result*	%RPD
SW104	11/20/89	AMERICIUM-241	0.005	123.08
SW104	11/20/89	GROSS ALPHA	0.1	155.56
SW108	5/30/89	GROSS BETA	2	40.00
SW104	11/20/89	GROSS BETA	0.9	61.54
SW104	11/20/89	STRONTIUM-89,90	0.05	147.37
SW108	5/30/89	TRITIUM	230	82.05
SW108	5/30/89	URANIUM, TOTAL	0.6	15.38
SW108	5/30/89	URANIUM-233,234	0.4	0.00
SW104	11/20/89	URANIUM-235	0.09	28.57
SW108	5/30/89	URANIUM-238	0.2	40.00
SW104	11/20/89	URANIUM-238	0.09	28.57

* Result in pCi/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-4d
%RPD Seep and Spring Water
Anions, Cyanide, and Water Quality Parameters

Location	Date	Analyte	Result*	Units	%RPD
SW108	5/30/89	BICARBONATE	230000	UG/L	0.00
SW108	5/30/89	CHLORIDE	4600	UG/L	0.00
SW108	5/30/89	PH	7.6	PHUNIT	0.00
SW108	5/30/89	SULFATE	45000	UG/L	2.20
SW108	5/30/89	TOTAL DISSOLVED SOLIDS	260000	UG/L	7.41
SW108	5/30/89	TOTAL SUSPENDED SOLIDS	96000	UG/L	0.00

* Result is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-5a
%RPD Borehole Materials
Metals

Location	Date	Analyte	Result*	%RPD	N	N>35%	Avg	StDev	%CV
B200589	2/22/89	ALUMINUM	9900	2.00					
B200989	3/2/89	ALUMINUM	12200	73.54					
B201089	3/2/89	ALUMINUM	17300	26.89					
B200889	3/6/89	ALUMINUM	16800	11.24					
B201489	3/10/89	ALUMINUM	13900	20.63					
B201189	3/17/89	ALUMINUM	6950	7.88					
B201289	3/23/89	ALUMINUM	7300	3.63					
B302089	3/28/89	ALUMINUM	6410	31.75					
B400289	4/13/89	ALUMINUM	13000	5.53					
B400389	4/25/89	ALUMINUM	8980	0.67					
B400489	4/28/89	ALUMINUM	10700	9.70	11	1	17.59	21.20	120.53
B400489	4/28/89	ANTIMONY	3.5	41.38	1	1	NA	NA	NA
B201289	3/23/89	ARSENIC	2.6	14.29					
B302089	3/28/89	ARSENIC	3.4	41.86					
B400389	4/25/89	ARSENIC	3.1	14.93					
B400489	4/28/89	ARSENIC	3.1	10.17	4	1	20.31	14.52	71.49
B200589	2/22/89	BARIUM	48.4	0.62					
B200989	3/2/89	BARIUM	57.9	62.88					
B201089	3/2/89	BARIUM	95.3	9.22					
B200889	3/6/89	BARIUM	148	25.88					
B201489	3/10/89	BARIUM	54.8	96.02					
B201189	3/17/89	BARIUM	114	68.08					
B201289	3/23/89	BARIUM	73	55.69					
B302089	3/28/89	BARIUM	61.9	22.64					
B400289	4/13/89	BARIUM	54.6	16.24					
B400489	4/28/89	BARIUM	51.1	3.84	10	4	36.11	32.34	89.57
B200989	3/2/89	BERYLLIUM	4.6	111.86					
B201089	3/2/89	BERYLLIUM	10.3	34.09					
B200889	3/6/89	BERYLLIUM	9.9	29.31					
B201489	3/10/89	BERYLLIUM	2.6	8.00					
B201189	3/17/89	BERYLLIUM	2.4	15.38					
B201289	3/23/89	BERYLLIUM	2.6	10.91					
B400389	4/25/89	BERYLLIUM	2.3	4.26	7	1	30.54	37.51	122.80
B200589	2/22/89	CADMIUM	1.4	25.00	1	0	NA	NA	NA
B200589	2/22/89	CALCIUM	2690	13.92					
B200989	3/2/89	CALCIUM	25500	91.01					
B201089	3/2/89	CALCIUM	5330	157.04					
B200889	3/6/89	CALCIUM	9310	18.29					
B201489	3/10/89	CALCIUM	4980	6.98					
B201189	3/17/89	CALCIUM	7040	22.96					
B201289	3/23/89	CALCIUM	6610	5.76					
B302089	3/28/89	CALCIUM	4140	8.11					
B400289	4/13/89	CALCIUM	2330	25.67					
B400389	4/25/89	CALCIUM	8050	16.73					
B400489	4/28/89	CALCIUM	5490	8.88	11	2	34.12	47.28	138.57
B201089	3/2/89	CHROMIUM	14	51.12					
B201489	3/10/89	CHROMIUM	13.7	25.51					
B201189	3/17/89	CHROMIUM	7.9	1.26					
B201289	3/23/89	CHROMIUM	9.8	4.17					
B302089	3/28/89	CHROMIUM	8.8	28.29					
B400289	4/13/89	CHROMIUM	14.9	24.06					
B400389	4/25/89	CHROMIUM	10.5	44.44	7	2	25.55	18.57	72.66
B201289	3/23/89	COBALT	6.9	24.20					
B302089	3/28/89	COBALT	15.3	49.80	2	1	37.00	18.10	48.91
B200589	2/22/89	COPPER	15.3	20.94					
B201089	3/2/89	COPPER	18	32.26					
B201489	3/10/89	COPPER	12.4	4.72					
B201189	3/17/89	COPPER	12.4	8.40					
B201289	3/23/89	COPPER	17.8	20.20					
B302089	3/28/89	COPPER	14.6	30.23					
B400289	4/13/89	COPPER	6.7	163.98					
B400389	4/25/89	COPPER	8.7	6.67					
B400489	4/28/89	COPPER	3.3	5.88	9	1	32.59	50.38	154.60
B200589	2/22/89	IRON	19800	14.05					

* Result in mg/kg is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-5a
%RPD Borehole Materials
Metals

Location	Date	Analyte	Result*	%RPD	N	N>35%	Avg	StDev	%CV
B200989	3/2/89	IRON	9630	51.93					
B201089	3/2/89	IRON	18100	39.74					
B200889	3/6/89	IRON	15800	27.79					
B201489	3/10/89	IRON	10900	10.73					
B201189	3/17/89	IRON	11200	11.52					
B201289	3/23/89	IRON	10900	53.20					
B302089	3/28/89	IRON	38900	48.17					
B400289	4/13/89	IRON	9360	11.64					
B400389	4/25/89	IRON	8710	10.76					
B400489	4/28/89	IRON	11200	3.64	11	4	25.74	19.02	73.90
B200589	2/22/89	LEAD	6.8	1.48					
B200989	3/2/89	LEAD	4.2	66.67					
B201089	3/2/89	LEAD	13.8	7.52					
B200889	3/6/89	LEAD	8	105.04					
B201489	3/10/89	LEAD	13.8	0.72					
B201189	3/17/89	LEAD	16.8	10.00					
B201289	3/23/89	LEAD	25.7	1.96					
B302089	3/28/89	LEAD	22	2.30					
B400289	4/13/89	LEAD	4.9	29.57					
B400389	4/25/89	LEAD	4.2	19.35					
B400489	4/28/89	LEAD	4.5	18.18	11	2	23.89	33.09	138.50
B201489	3/10/89	LITHIUM	10.4	22.46					
B201189	3/17/89	LITHIUM	5.2	10.91					
B201289	3/23/89	LITHIUM	7.1	1.42					
B302089	3/28/89	LITHIUM	6.5	8.00					
B400289	4/13/89	LITHIUM	5.1	24.14	5	0	13.39	9.81	73.26
B200589	2/22/89	MAGNESIUM	2250	7.69					
B200989	3/2/89	MAGNESIUM	4090	69.52					
B201089	3/2/89	MAGNESIUM	5480	18.54					
B200889	3/6/89	MAGNESIUM	3110	3.60					
B201489	3/10/89	MAGNESIUM	2700	13.86					
B201189	3/17/89	MAGNESIUM	1820	5.35					
B201289	3/23/89	MAGNESIUM	2270	0.88					
B302089	3/28/89	MAGNESIUM	2080	8.74					
B400289	4/13/89	MAGNESIUM	1650	11.54					
B400389	4/25/89	MAGNESIUM	1290	3.80					
B400489	4/28/89	MAGNESIUM	1670	1.81	11	1	13.21	19.44	147.10
B200589	2/22/89	MANGANESE	346	16.25					
B200989	3/2/89	MANGANESE	90.6	12.80					
B201089	3/2/89	MANGANESE	145	55.39					
B200889	3/6/89	MANGANESE	136	94.57					
B201489	3/10/89	MANGANESE	54.8	3.15					
B201189	3/17/89	MANGANESE	141	39.29					
B201289	3/23/89	MANGANESE	161	38.19					
B302089	3/28/89	MANGANESE	367	177.86					
B400289	4/13/89	MANGANESE	107	14.43					
B400389	4/25/89	MANGANESE	103	9.26					
B400489	4/28/89	MANGANESE	197	6.28	11	5	42.50	52.49	123.52
B400389	4/25/89	MERCURY	0.37	31.25	1	0	NA	NA	NA
B200589	2/22/89	MOLYBDENUM	21.4	5.01					
B201489	3/10/89	MOLYBDENUM	5.1	83.33					
B201289	3/23/89	MOLYBDENUM	11.3	8.29					
B400289	4/13/89	MOLYBDENUM	10.2	0.98					
B400389	4/25/89	MOLYBDENUM	4.2	17.39					
B400489	4/28/89	MOLYBDENUM	6.7	19.67	6	1	22.45	30.68	136.67
B200889	3/6/89	NICKEL	23.3	17.25					
B201489	3/10/89	NICKEL	10.2	37.21					
B201189	3/17/89	NICKEL	10.6	6.83					
B201289	3/23/89	NICKEL	8.7	71.11					
B302089	3/28/89	NICKEL	31	52.03					
B400389	4/25/89	NICKEL	22.6	41.68					
B400489	4/28/89	NICKEL	30.3	3.36	7	4	32.78	24.90	75.95
B200589	2/22/89	POTASSIUM	1210	6.84					
B200989	3/2/89	POTASSIUM	1850	71.96					

* Result in mg/kg is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-5a
%RPD Borehole Materials
Metals

Location	Date	Analyte	Result*	%RPD	N	N>35%	Avg	StDev	%CV
B201089	3/2/89	POTASSIUM	2180	34.41					
B201489	3/10/89	POTASSIUM	1400	27.64					
B201289	3/23/89	POTASSIUM	894	12.35	5	1	30.64	25.65	83.71
B200589	2/22/89	SILVER	4	19.18					
B201089	3/2/89	SILVER	2.5	22.22					
B201489	3/10/89	SILVER	18.7	10.70	3	0	17.37	5.97	34.36
B201489	3/10/89	SODIUM	600	11.17					
B201289	3/23/89	SODIUM	506	2.40	2	0	6.79	4.94	72.72
B200989	3/2/89	STRONTIUM	71.8	96.08					
B201089	3/2/89	STRONTIUM	47.1	31.48					
B200889	3/6/89	STRONTIUM	33.8	0.30					
B201489	3/10/89	STRONTIUM	53.8	15.91					
B201189	3/17/89	STRONTIUM	54.4	7.83					
B302089	3/28/89	STRONTIUM	94.2	4.34	6	1	25.99	36.06	138.76
B201489	3/10/89	TIN	274	30.74	1	1	NA	NA	NA
B200589	2/22/89	VANADIUM	54.5	24.51					
B201089	3/2/89	VANADIUM	31.3	42.64					
B200889	3/6/89	VANADIUM	35.4	51.10					
B201489	3/10/89	VANADIUM	22.3	29.90					
B201189	3/17/89	VANADIUM	20.3	7.13					
B201289	3/23/89	VANADIUM	21.8	21.68					
B302089	3/28/89	VANADIUM	37.6	1.32					
B400289	4/13/89	VANADIUM	19.4	12.60					
B400389	4/25/89	VANADIUM	23.1	11.43					
B400489	4/28/89	VANADIUM	26.3	1.53	10	2	20.38	16.94	83.12
B200989	3/2/89	ZINC	13.6	59.05					
B201089	3/2/89	ZINC	39.1	27.99					
B200889	3/6/89	ZINC	27.8	5.25					
B201489	3/10/89	ZINC	64.3	56.18					
B201189	3/17/89	ZINC	44.3	11.20					
B201289	3/23/89	ZINC	74.9	53.07					
B302089	3/28/89	ZINC	78	52.13					
B400289	4/13/89	ZINC	25	16.92					
B400489	4/28/89	ZINC	2.9	9.84	9	4	32.40	22.49	69.41

* Result in mg/kg is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-5b
%RPD Borehole Materials
Radionuclides

Location	Date	Analyte	Result*	%RPD	N	N>35%	Avg	StDev	%CV
B200589	2/22/89	GROSS ALPHA	30	33.33					
B200989	3/2/89	GROSS ALPHA	14	6.90					
B201089	3/2/89	GROSS ALPHA	20	29.79					
B200889	3/6/89	GROSS ALPHA	28	38.30					
B201489	3/10/89	GROSS ALPHA	22	40.00					
B201189	3/17/89	GROSS ALPHA	47	26.51					
B201289	3/23/89	GROSS ALPHA	19	27.27					
B302089	3/28/89	GROSS ALPHA	29	15.87					
B400289	4/13/89	GROSS ALPHA	17	71.70					
B400489	4/28/89	GROSS ALPHA	9	20.00	10	3	30.97	17.52	56.58
B200589	2/22/89	GROSS BETA	33	40.00					
B200989	3/2/89	GROSS BETA	18	28.57					
B201089	3/2/89	GROSS BETA	27	20.41					
B200889	3/6/89	GROSS BETA	18	40.00					
B201489	3/10/89	GROSS BETA	30	0.00					
B201189	3/17/89	GROSS BETA	23	16.00					
B201289	3/23/89	GROSS BETA	28	0.00					
B302089	3/28/89	GROSS BETA	24	8.00					
B400289	4/13/89	GROSS BETA	28	13.33					
B400389	4/25/89	GROSS BETA	22	9.52					
B400489	4/28/89	GROSS BETA	21	4.88	11	2	16.43	14.41	87.71
B200989	3/2/89	PLUTONIUM-239,240	0.01	0.00					
B400289	4/13/89	PLUTONIUM-239,240	0.01	200.00	2	1	100.00	141.42	141.42
B200889	3/6/89	RADIUM-226	0.5	0.00					
B302089	3/28/89	RADIUM-226	1.2	8.00					
B400289	4/13/89	RADIUM-226	0.6	28.57					
B400389	4/25/89	RADIUM-226	0.4	54.55					
B400489	4/28/89	RADIUM-226	0.6	18.18	5	1	21.86	21.19	96.96
B200589	2/22/89	RADIUM-228	1.8	5.41					
B200889	3/6/89	RADIUM-228	1.2	0.00					
B201189	3/17/89	RADIUM-228	1.4	0.00					
B201289	3/23/89	RADIUM-228	1.4	24.00					
B302089	3/28/89	RADIUM-228	1.4	0.00					
B400289	4/13/89	RADIUM-228	1.4	0.00					
B400389	4/25/89	RADIUM-228	1.5	22.22	7	0	7.38	10.94	148.35
B200889	3/6/89	STRONTIUM-89,90	0.3	40.00					
B201289	3/23/89	STRONTIUM-89,90	0.6	400.00					
B302089	3/28/89	STRONTIUM-89,90	0.1	0.00					
B400389	4/25/89	STRONTIUM-89,90	0.7	54.55	4	3	123.64	185.68	150.18
B200589	2/22/89	TRITIUM	200	85.71					
B200989	3/2/89	TRITIUM	330	9.52					
B201089	3/2/89	TRITIUM	190	53.33					
B201189	3/17/89	TRITIUM	80	0.00					
B400289	4/13/89	TRITIUM	260	21.28					
B400389	4/25/89	TRITIUM	110	37.04					
B400489	4/28/89	TRITIUM	320	32.73	7	3	34.23	28.80	84.13
B200989	3/2/89	URANIUM, TOTAL	6.7	152.63					
B201089	3/2/89	URANIUM, TOTAL	1.2	0.00					
B200889	3/6/89	URANIUM, TOTAL	0.8	0.00					
B201489	3/10/89	URANIUM, TOTAL	1.9	5.13					
B201189	3/17/89	URANIUM, TOTAL	1.3	20.69					
B201289	3/23/89	URANIUM, TOTAL	2.4	8.70					
B302089	3/28/89	URANIUM, TOTAL	2.6	3.77					
B400289	4/13/89	URANIUM, TOTAL	1.6	6.06					
B400389	4/25/89	URANIUM, TOTAL	1.9	30.30					
B400489	4/28/89	URANIUM, TOTAL	1.1	9.52	10	1	23.68	46.28	195.44
B200989	3/2/89	URANIUM-233,234	3.4	157.89					
B201089	3/2/89	URANIUM-233,234	0.5	18.18					
B200889	3/6/89	URANIUM-233,234	0.4	0.00					
B201489	3/10/89	URANIUM-233,234	0.8	0.00					
B201189	3/17/89	URANIUM-233,234	0.5	0.00					
B201289	3/23/89	URANIUM-233,234	1.2	28.57					
B302089	3/28/89	URANIUM-233,234	1.5	14.29					
B400289	4/13/89	URANIUM-233,234	0.8	13.33					

* Result in pCi/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-5b
%RPD Borehole Materials
Radionuclides

Location	Date	Analyte	Result*	%RPD	N	N>35%	Avg	StDev	%CV
B400389	4/25/89	URANIUM-233,234	1.1	58.82					
B400489	4/28/89	URANIUM-233,234	0.5	22.22	10	2	31.33	47.84	152.69
B400389	4/25/89	URANIUM-235	0.1	200.00					
B200989	3/2/89	URANIUM-238	3.2	145.95					
B201089	3/2/89	URANIUM-238	0.7	33.33					
B201489	3/10/89	URANIUM-238	1	18.18					
B201189	3/17/89	URANIUM-238	0.7	44.44					
B302089	3/28/89	URANIUM-238	1.1	24.00					
B400289	4/13/89	URANIUM-238	0.8	22.22	7	3	69.73	72.74	104.32

* Result in pCi/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-6a
%RPD Stream Sediment
Metals

Location	Date	Analyte	Result*	%RPD	N	>35	Avg	StDev	%CV
SED004	10/27/1989	ALUMINUM	3100.00	30.37					
SED023	11/12/1990	ALUMINUM	6300.00	14.57					
SED004	02/21/1989	ALUMINUM	3070.00	76.21	3	1	40.38	26.14	64.73
SED023	11/12/1990	ARSENIC	2.70	25.81					
SED004	02/21/1989	ARSENIC	1.60	0.00					
SED004	10/27/1989	ARSENIC	1.20	34.48	3	0	20.10	14.65	72.87
SED023	11/12/1990	BARIUM	109.00	18.33					
SED004	02/21/1989	BARIUM	9.80	71.48					
SED004	10/27/1989	BARIUM	26.00	21.92	3	1	37.24	24.25	65.12
SED023	11/12/1990	BERYLLIUM	0.44	16.67	1	0	NA	NA	NA
SED023	11/12/1990	CALCIUM	2310.00	13.71					
SED004	10/27/1989	CALCIUM	677.00	8.22					
SED004	02/21/1989	CALCIUM	771.00	111.15	3	1	44.36	47.28	106.59
SED004	10/27/1989	CHROMIUM	4.60	2.15					
SED023	11/12/1990	CHROMIUM	12.70	17.27	2	0	9.71	7.56	77.85
SED023	11/12/1990	COBALT	5.00	29.06	1	0	NA	NA	NA
SED004	02/21/1989	COPPER	7.70	96.30					
SED023	11/12/1990	COPPER	10.20	19.47	2	1	57.88	38.41	66.36
SED004	10/27/1989	IRON	4200.00	34.48					
SED004	02/21/1989	IRON	6900.00	73.97					
SED023	11/12/1990	IRON	9210.00	19.50	3	1	42.65	22.98	53.87
SED023	11/12/1990	LEAD	21.70	104.09					
SED004	02/21/1989	LEAD	5.90	81.41					
SED004	10/27/1989	LEAD	4.40	33.96	3	2	73.15	29.22	39.94
SED023	11/12/1990	LITHIUM	5.10	11.11	1	0	NA	NA	NA
SED004	02/21/1989	MAGNESIUM	1190.00	75.72					
SED023	11/12/1990	MAGNESIUM	1340.00	15.81	2	1	45.76	29.96	65.46
SED023	11/12/1990	MANGANESE	60.10	23.62					
SED004	02/21/1989	MANGANESE	139.00	74.21					
SED004	10/27/1989	MANGANESE	202.00	54.15	3	2	50.66	20.80	41.05
SED023	11/12/1990	NICKEL	8.40	9.09	1	0	NA	NA	NA
SED023	11/12/1990	POTASSIUM	868.00	18.02	1	0	NA	NA	NA
SED023	11/12/1990	SODIUM	138.00	9.66	1	0	NA	NA	NA
SED023	11/12/1990	STRONTIUM	18.30	15.15	1	0	NA	NA	NA
SED023	11/12/1990	TIN	4.00	18.18	1	0	NA	NA	NA
SED004	10/27/1989	VANADIUM	12.80	61.62					
SED023	11/12/1990	VANADIUM	17.50	19.59	2	1	40.60	21.02	51.76
SED004	10/27/1989	ZINC	49.90	41.96					
SED023	11/12/1990	ZINC	33.40	20.67	2	1	31.32	10.65	33.99

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-6b
Stream Sediment
Radionuclides

Location	Date	Analyte	Result*	%RPD	N	>35	Avg	StDev	%CV
SED004	02/21/1989	GROSS ALPHA	25.00	63.01					
SED004	10/27/1989	GROSS ALPHA	8.90	32.08					
SED004	10/27/1989	GROSS ALPHA	8.90	94.99	3	2	63.36	31.46	49.65
SED004	02/21/1989	GROSS BETA	33.00	5.88	1	0	NA	NA	NA
SED004	10/27/1989	PLUTONIUM-239,240	0.02	131.03					
SED023	11/12/1990	PLUTONIUM-239,240	0.01	200.00					
SED023	11/12/1990	PLUTONIUM-239,240	0.01	35.31	3	3	122.12	67.53	55.30
SED004	02/21/1989	RADIUM-226	0.80	0.00	1	0	NA	NA	NA
SED004	02/21/1989	RADIUM-228	1.40	13.33	1	0	NA	NA	NA
SED023	11/12/1990	STRONTIUM-89,90	0.31	146.49					
SED023	11/12/1990	STRONTIUM-89,90	0.31	200.00	2	2	173.25	26.75	15.44
SED004	02/21/1989	TRITIUM	90.00	75.86	1	1	NA	NA	NA
SED004	02/21/1989	URANIUM, TOTAL	2.10	0.00	1	0	NA	NA	NA
SED004	02/21/1989	URANIUM-233,234	1.00	9.52					
SED023	11/12/1990	URANIUM-233,234	1.92	9.04					
SED023	11/12/1990	URANIUM-233,234	1.92	63.11	3	1	27.22	25.37	93.20
SED004	10/27/1989	URANIUM-235	0.02	94.46					
SED004	10/27/1989	URANIUM-235	0.02	40.00					
SED023	11/12/1990	URANIUM-235	0.06	47.52	3	3	60.66	24.10	39.72
SED004	02/21/1989	URANIUM-238	1.00	44.66					
SED004	10/27/1989	URANIUM-238	0.39	78.13					
SED023	11/12/1990	URANIUM-238	1.58	120.61					
SED023	11/12/1990	URANIUM-238	1.58	22.34	4	3	66.43	37.05	55.77

* Result in pCi/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-7
%RPD Seep and Spring Sediment
Metals

Location	Date	Analyte	Result*	%RPD
SED016	08/21/199	ALUMINUM	6820	0.73
SED016	08/21/199	BARIUM	78.8	4.10
SED016	08/21/199	CALCIUM	3460	37.75
SED016	08/21/199	COPPER	10.2	18.67
SED016	08/21/199	IRON	8590	1.27
SED016	08/21/199	LEAD	17.8	13.12
SED016	08/21/199	MAGNESIUM	1970	1.01
SED016	08/21/199	MANGANESE	93	4.52
SED016	08/21/199	ZINC	53.5	5.28

* Result in ug/L is shown for one of the duplicate pair samples to indicate concentration levels.

Table F-8a
%Bias Groundwater
Dissolved Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B405689	7/19/90	MS	ALUMINUM	99.9	0.1					
B402189	7/20/90	MS	ALUMINUM	96.8	3.2					
B202589	12/9/91	MS	ALUMINUM	97.2	2.8	3	0	2.03	1.69	82.93
B405689	7/19/90	MS	ANTIMONY	99.2	0.8					
B402189	7/20/90	MS	ANTIMONY	96.5	3.5					
B202589	12/9/91	MS	ANTIMONY	107.2	7.2	3	0	3.83	3.21	83.82
B405689	7/19/90	MS	ARSENIC	87.5	12.5					
B402189	7/20/90	MS	ARSENIC	105	5					
B202589	12/9/91	MS	ARSENIC	92.5	7.5	3	0	8.33	3.82	45.83
B405689	7/19/90	MS	BARIUM	103.1	3.1					
B402189	7/20/90	MS	BARIUM	100.7	0.7					
B202589	12/9/91	MS	BARIUM	100.7	0.7	3	0	1.50	1.39	92.38
B405689	7/19/90	MS	BERYLLIUM	102.5	2.5					
B402189	7/20/90	MS	BERYLLIUM	104.7	4.7					
B202589	12/9/91	MS	BERYLLIUM	101.1	1.1	3	0	2.77	1.81	65.59
B405689	7/19/90	MS	CADMIUM	105.9	5.9					
B402189	7/20/90	MS	CADMIUM	92.9	7.1					
B202589	12/9/91	MS	CADMIUM	106.8	6.8	3	0	6.60	0.62	9.46
B405689	7/19/90	MS	CESIUM	80	20					
B402189	7/20/90	MS	CESIUM	85	15					
B202589	12/9/91	MS	CESIUM	89.5	10.5	3	0	15.17	4.75	31.33
B405689	7/19/90	MS	CHROMIUM	92.6	7.4					
B402189	7/20/90	MS	CHROMIUM	92.7	7.3					
B202589	12/9/91	MS	CHROMIUM	101.9	1.9	3	0	5.53	3.15	56.87
B405689	7/19/90	MS	COBALT	101.3	1.3					
B402189	7/20/90	MS	COBALT	95.8	4.2					
B202589	12/9/91	MS	COBALT	103.9	3.9	3	0	3.13	1.59	50.90
B405689	7/19/90	MS	COPPER	105.3	5.3					
B402189	7/20/90	MS	COPPER	104.3	4.3					
B202589	12/9/91	MS	COPPER	105.3	5.3	3	0	4.97	0.58	11.62
B405689	7/19/90	MS	IRON	100.4	0.4					
B402189	7/20/90	MS	IRON	98.3	1.7					
B202589	12/9/91	MS	IRON	95.9	4.1	3	0	2.07	1.88	90.83
B405689	7/19/90	MS	LEAD	96	4					
B402189	7/20/90	MS	LEAD	92	8					
B202589	12/9/91	MS	LEAD	89	11	3	0	7.67	3.51	45.81
B405689	7/19/90	MS	LITHIUM	98.1	1.9					
B402189	7/20/90	MS	LITHIUM	96.5	3.5					
B202589	12/9/91	MS	LITHIUM	90.3	9.7	3	0	5.03	4.12	81.85
B405689	7/19/90	MS	MANGANESE	101.9	1.9					
B402189	7/20/90	MS	MANGANESE	100.9	0.9					
B202589	12/9/91	MS	MANGANESE	104.4	4.4	3	0	2.40	1.80	75.12
B402189	7/20/90	MS	MERCURY	108.3	8.3					
B202589	12/9/91	MS	MERCURY	78	22	2	0	15.15	9.69	63.94
B405689	7/19/90	MS	MOLYBDENUM	100.2	0.2					
B402189	7/20/90	MS	MOLYBDENUM	98.1	1.9					
B202589	12/9/91	MS	MOLYBDENUM	94.7	5.3	3	0	2.47	2.60	105.28
B405689	7/19/90	MS	NICKEL	102.8	2.8					
B402189	7/20/90	MS	NICKEL	98.5	1.5					
B202589	12/9/91	MS	NICKEL	99.7	0.3	3	0	1.53	1.25	81.54
B405689	7/19/90	MS	SELENIUM	80	20					
B402189	7/20/90	MS	SELENIUM	80	20					
B202589	12/9/91	MS	SELENIUM	100	0	3	0	13.33	11.55	86.60
B405689	7/19/90	MS	SILVER	100.8	0.8					
B402189	7/20/90	MS	SILVER	92.7	7.3					
B202589	12/9/91	MS	SILVER	101.5	1.5	3	0	3.20	3.57	111.50
B405689	7/19/90	MS	STRONTIUM	100.9	0.9					
B402189	7/20/90	MS	STRONTIUM	100.3	0.3					
B202589	12/9/91	MS	STRONTIUM	94.8	5.2	3	0	2.13	2.67	125.28
B405689	7/19/90	MS	THALLIUM	86	14					
B402189	7/20/90	MS	THALLIUM	96	4	2	0	9.00	7.07	78.57
B405689	7/19/90	MS	TIN	98.8	1.2					
B402189	7/20/90	MS	TIN	94.4	5.6					
B202589	12/9/91	MS	TIN	90.5	9.5	3	0	5.43	4.15	76.43

Table F-8a
%Bias Groundwater
Dissolved Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B405689	7/19/90	MS	VANADIUM	101.2	1.2					
B402189	7/20/90	MS	VANADIUM	97.2	2.8					
B202589	12/9/91	MS	VANADIUM	92.1	7.9	3	0	3.97	3.50	88.21
B405689	7/19/90	MS	ZINC	100.7	0.7					
B402189	7/20/90	MS	ZINC	96.2	3.8					
B202589	12/9/91	MS	ZINC	102.5	2.5	3	0	2.33	1.56	66.72

Table F-8b
%Bias Groundwater
Dissolved Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B200689	10/8/90	S1	ALUMINUM	96.1	3.9					
B202589	11/1/90	S1	ALUMINUM	92.3	7.7					
B405789	11/16/90	S1	ALUMINUM	95.8	4.2					
B400289	11/29/90	S1	ALUMINUM	95.1	4.9					
B402189	3/21/91	S1	ALUMINUM	92.1	7.9					
B201189	4/5/91	S1	ALUMINUM	92.2	7.8					
B402189	5/20/91	S1	ALUMINUM	99	1					
B202589	5/31/91	S1	ALUMINUM	101.1	1.1					
B102289	9/17/91	S1	ALUMINUM	92.7	7.3					
B202589	12/9/91	S1	ALUMINUM	97.2	2.8					
B102289	12/12/91	S1	ALUMINUM	98.3	1.7					
B302889	12/16/91	S1	ALUMINUM	95.6	4.4					
B405586	12/18/91	S1	ALUMINUM	95.7	4.3					
B402189	12/19/91	S1	ALUMINUM	93.8	6.2	15	0	4.89	2.54	51.81
B200689	10/8/90	S1	ANTIMONY	103.7	3.7					
B202589	11/1/90	S1	ANTIMONY	102.3	2.3					
B405789	11/16/90	S1	ANTIMONY	101	1					
B400289	11/29/90	S1	ANTIMONY	102	2					
B402189	3/21/91	S1	ANTIMONY	102.4	2.4					
B201189	4/5/91	S1	ANTIMONY	101.7	1.7					
B402189	5/20/91	S1	ANTIMONY	98.7	1.3					
B102289	5/23/91	S1	ANTIMONY	92.7	7.3					
B202589	5/31/91	S1	ANTIMONY	103.6	3.6					
B102289	9/17/91	S1	ANTIMONY	100.8	0.8					
B202589	12/9/91	S1	ANTIMONY	107.2	7.2					
B102289	12/12/91	S1	ANTIMONY	107.4	7.4					
B302889	12/16/91	S1	ANTIMONY	101.1	1.1					
B405586	12/18/91	S1	ANTIMONY	102.4	2.4					
B402189	12/19/91	S1	ANTIMONY	101.4	1.4	16	0	3.04	2.36	77.70
B200689	10/8/90	S1	ARSENIC	97.5	2.5					
B202589	11/1/90	S1	ARSENIC	87.5	12.5					
B405789	11/16/90	S1	ARSENIC	95	5					
B400289	11/29/90	S1	ARSENIC	100	0					
B402189	3/21/91	S1	ARSENIC	92.5	7.5					
B201189	4/5/91	S1	ARSENIC	102.5	2.5					
B402189	5/20/91	S1	ARSENIC	92.5	7.5					
B102289	5/23/91	S1	ARSENIC	92.5	7.5					
B202589	5/31/91	S1	ARSENIC	87.5	12.5					
B200889	9/13/91	S1	ARSENIC	95	5					
B102289	9/17/91	S1	ARSENIC	82.5	17.5					
B202589	12/9/91	S1	ARSENIC	92.5	7.5					
B102289	12/12/91	S1	ARSENIC	100	0					
B302889	12/16/91	S1	ARSENIC	92.5	7.5					
B405586	12/18/91	S1	ARSENIC	102.5	2.5					
B402189	12/19/91	S1	ARSENIC	100	0	16	0	6.09	5.00	82.01
B200689	10/8/90	S1	BARIUM	97.8	2.2					
B202589	11/1/90	S1	BARIUM	95.8	4.2					
B405789	11/16/90	S1	BARIUM	98.3	1.7					
B400289	11/29/90	S1	BARIUM	97.7	2.3					
B402189	3/21/91	S1	BARIUM	95.1	4.9					
B201189	4/5/91	S1	BARIUM	95.7	4.3					
B402189	5/20/91	S1	BARIUM	102.3	2.3					
B102289	5/23/91	S1	BARIUM	96.6	3.4					
B202589	5/31/91	S1	BARIUM	103.6	3.6					
B102289	9/17/91	S1	BARIUM	102	2					
B202589	12/9/91	S1	BARIUM	100.7	0.7					
B102289	12/12/91	S1	BARIUM	98.7	1.3					
B302889	12/16/91	S1	BARIUM	95.7	4.3					
B405586	12/18/91	S1	BARIUM	99.2	0.8					
B402189	12/19/91	S1	BARIUM	97.2	2.8	15	0	2.72	1.34	49.27
B200689	10/8/90	S1	BERYLLIUM	106.3	6.3					
B202589	11/1/90	S1	BERYLLIUM	103.8	3.8					
B405789	11/16/90	S1	BERYLLIUM	105.9	5.9					
B400289	11/29/90	S1	BERYLLIUM	108	8					

Table F-8b
%Bias Groundwater
Dissolved Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B402189	3/21/91	S1	BERYLLIUM	103.1	3.1					
B201189	4/5/91	S1	BERYLLIUM	102.5	2.5					
B402189	5/20/91	S1	BERYLLIUM	106.3	6.3					
B102289	5/23/91	S1	BERYLLIUM	100.4	0.4					
B202589	5/31/91	S1	BERYLLIUM	108	8					
B102289	9/17/91	S1	BERYLLIUM	108.1	8.1					
B202589	12/9/91	S1	BERYLLIUM	101.1	1.1					
B102289	12/12/91	S1	BERYLLIUM	103.9	3.9					
B302889	12/16/91	S1	BERYLLIUM	96.9	3.1					
B405586	12/18/91	S1	BERYLLIUM	101.7	1.7					
B402189	12/19/91	S1	BERYLLIUM	100.7	0.7	15	0	4.19	2.72	64.97
B200689	10/8/90	S1	CADMIUM	106.8	6.8					
B202589	11/1/90	S1	CADMIUM	103	3					
B405789	11/16/90	S1	CADMIUM	101.9	1.9					
B400289	11/29/90	S1	CADMIUM	104.5	4.5					
B402189	3/21/91	S1	CADMIUM	95.5	4.5					
B201189	4/5/91	S1	CADMIUM	96.7	3.3					
B402189	5/20/91	S1	CADMIUM	102.4	2.4					
B102289	5/23/91	S1	CADMIUM	94.5	5.5					
B202589	5/31/91	S1	CADMIUM	104	4					
B102289	9/17/91	S1	CADMIUM	103.7	3.7					
B202589	12/9/91	S1	CADMIUM	106.8	6.8					
B102289	12/12/91	S1	CADMIUM	108.3	8.3					
B302889	12/16/91	S1	CADMIUM	96.9	3.1					
B405586	12/18/91	S1	CADMIUM	105.1	5.1					
B402189	12/19/91	S1	CADMIUM	101.7	1.7	15	0	4.31	1.92	44.48
B200689	10/8/90	S1	CESIUM	110	10					
B202589	11/1/90	S1	CESIUM	105	5					
B405789	11/16/90	S1	CESIUM	110	10					
B400289	11/29/90	S1	CESIUM	90	10					
B402189	3/21/91	S1	CESIUM	95.5	4.5					
B201189	4/5/91	S1	CESIUM	99	1					
B402189	5/20/91	S1	CESIUM	114.5	14.5					
B102289	5/23/91	S1	CESIUM	101.5	1.5					
B202589	5/31/91	S1	CESIUM	97	3					
B200889	9/13/91	S1	CESIUM	70.5	29.5					
B102289	9/17/91	S1	CESIUM	101	1					
B202589	12/9/91	S1	CESIUM	89.5	10.5					
B102289	12/12/91	S1	CESIUM	86.5	13.5					
B302889	12/16/91	S1	CESIUM	87	13					
B405586	12/18/91	S1	CESIUM	87.5	12.5					
B402189	12/19/91	S1	CESIUM	87	13	16	1	9.53	7.18	75.28
B200689	10/8/90	S1	CHROMIUM	97	3					
B202589	11/1/90	S1	CHROMIUM	101.3	1.3					
B405789	11/16/90	S1	CHROMIUM	97.1	2.9					
B400289	11/29/90	S1	CHROMIUM	99.2	0.8					
B402189	3/21/91	S1	CHROMIUM	99.9	0.1					
B201189	4/5/91	S1	CHROMIUM	95.5	4.5					
B402189	5/20/91	S1	CHROMIUM	100.8	0.8					
B102289	5/23/91	S1	CHROMIUM	91.7	8.3					
B202589	5/31/91	S1	CHROMIUM	99.1	0.9					
B102289	9/17/91	S1	CHROMIUM	96.1	3.9					
B202589	12/9/91	S1	CHROMIUM	101.9	1.9					
B102289	12/12/91	S1	CHROMIUM	99.9	0.1					
B302889	12/16/91	S1	CHROMIUM	95.6	4.4					
B405586	12/18/91	S1	CHROMIUM	99.6	0.4					
B402189	12/19/91	S1	CHROMIUM	98.1	1.9	15	0	2.35	2.23	95.08
B200689	10/8/90	S1	COBALT	102.9	2.9					
B202589	11/1/90	S1	COBALT	100.9	0.9					
B405789	11/16/90	S1	COBALT	102.3	2.3					
B400289	11/29/90	S1	COBALT	102.6	2.6					
B402189	3/21/91	S1	COBALT	97	3					
B201189	4/5/91	S1	COBALT	97.6	2.4					
B402189	5/20/91	S1	COBALT	102.9	2.9					

Table F-8b
%Bias Groundwater
Dissolved Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B102289	5/23/91	S1	COBALT	96.5	3.5					
B202589	5/31/91	S1	COBALT	104.3	4.3					
B102289	9/17/91	S1	COBALT	104.7	4.7					
B202589	12/9/91	S1	COBALT	103.9	3.9					
B102289	12/12/91	S1	COBALT	103	3					
B302889	12/16/91	S1	COBALT	98.6	1.4					
B405586	12/18/91	S1	COBALT	102.5	2.5					
B402189	12/19/91	S1	COBALT	100.5	0.5	15	0	2.72	1.16	42.79
B200689	10/8/90	S1	COPPER	98.7	1.3					
B202589	11/1/90	S1	COPPER	100.3	0.3					
B405789	11/16/90	S1	COPPER	100.9	0.9					
B400289	11/29/90	S1	COPPER	102.3	2.3					
B402189	3/21/91	S1	COPPER	99.3	0.7					
B201189	4/5/91	S1	COPPER	97.5	2.5					
B402189	5/20/91	S1	COPPER	101	1					
B102289	5/23/91	S1	COPPER	90.7	9.3					
B202589	5/31/91	S1	COPPER	102.4	2.4					
B102289	9/17/91	S1	COPPER	100.7	0.7					
B202589	12/9/91	S1	COPPER	105.3	5.3					
B102289	12/12/91	S1	COPPER	104.9	4.9					
B302889	12/16/91	S1	COPPER	98.1	1.9					
B405586	12/18/91	S1	COPPER	103	3					
B402189	12/19/91	S1	COPPER	101.4	1.4	15	0	2.53	2.38	94.18
B200689	10/8/90	S1	IRON	101.3	1.3					
B202589	11/1/90	S1	IRON	94.8	5.2					
B405789	11/16/90	S1	IRON	102.3	2.3					
B400289	11/29/90	S1	IRON	102	2					
B402189	3/21/91	S1	IRON	94.5	5.5					
B201189	4/5/91	S1	IRON	94.3	5.7					
B402189	5/20/91	S1	IRON	99.8	0.2					
B102289	5/23/91	S1	IRON	90.2	9.8					
B202589	5/31/91	S1	IRON	97.1	2.9					
B102289	9/17/91	S1	IRON	93.3	6.7					
B202589	12/9/91	S1	IRON	95.9	4.1					
B102289	12/12/91	S1	IRON	99.9	0.1					
B302889	12/16/91	S1	IRON	108	8					
B405586	12/18/91	S1	IRON	98.5	1.5					
B402189	12/19/91	S1	IRON	95.6	4.4	15	0	3.98	2.87	72.00
B200689	10/8/90	S1	LEAD	108	8					
B202589	11/1/90	S1	LEAD	94.5	5.5					
B405789	11/16/90	S1	LEAD	103.5	3.5					
B400289	11/29/90	S1	LEAD	100.5	0.5					
B402189	3/21/91	S1	LEAD	107.5	7.5					
B201189	4/5/91	S1	LEAD	112	12					
B402189	5/20/91	S1	LEAD	108	8					
B102289	5/23/91	S1	LEAD	111	11					
B202589	5/31/91	S1	LEAD	103	3					
B200889	9/13/91	S1	LEAD	111.5	11.5					
B102289	9/17/91	S1	LEAD	85.5	14.5					
B202589	12/9/91	S1	LEAD	89	11					
B102289	12/12/91	S1	LEAD	103.5	3.5					
B302889	12/16/91	S1	LEAD	107	7					
B405586	12/18/91	S1	LEAD	102	2					
B402189	12/19/91	S1	LEAD	99	1	16	0	6.84	4.33	63.28
B200689	10/8/90	S1	LITHIUM	101	1					
B202589	11/1/90	S1	LITHIUM	96.4	3.6					
B405789	11/16/90	S1	LITHIUM	96.3	3.7					
B400289	11/29/90	S1	LITHIUM	94.2	5.8					
B402189	3/21/91	S1	LITHIUM	94.6	5.4					
B201189	4/5/91	S1	LITHIUM	92.9	7.1					
B402189	5/20/91	S1	LITHIUM	102.3	2.3					
B102289	5/23/91	S1	LITHIUM	102.1	2.1					
B202589	5/31/91	S1	LITHIUM	100.9	0.9					
B102289	9/17/91	S1	LITHIUM	96.8	3.2					

Table F-8b
%Bias Groundwater
Dissolved Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B202589	12/9/91	S1	LITHIUM	90.3	9.7					
B102289	12/12/91	S1	LITHIUM	90.4	9.6					
B302889	12/16/91	S1	LITHIUM	91.7	8.3					
B405586	12/18/91	S1	LITHIUM	92	8					
B402189	12/19/91	S1	LITHIUM	91.6	8.4	15	0	5.27	3.10	58.71
B200689	10/8/90	S1	MANGANESE	103	3					
B202589	11/1/90	S1	MANGANESE	101.4	1.4					
B405789	11/16/90	S1	MANGANESE	101.2	1.2					
B400289	11/29/90	S1	MANGANESE	103.2	3.2					
B402189	3/21/91	S1	MANGANESE	99.5	0.5					
B201189	4/5/91	S1	MANGANESE	98.8	1.2					
B402189	5/20/91	S1	MANGANESE	101.5	1.5					
B102289	5/23/91	S1	MANGANESE	95	5					
B202589	5/31/91	S1	MANGANESE	106.9	6.9					
B102289	9/17/91	S1	MANGANESE	103.1	3.1					
B202589	12/9/91	S1	MANGANESE	104.4	4.4					
B102289	12/12/91	S1	MANGANESE	99.5	0.5					
B302889	12/16/91	S1	MANGANESE	99.3	0.7					
B405586	12/18/91	S1	MANGANESE	104.8	4.8					
B402189	12/19/91	S1	MANGANESE	101.8	1.8	15	0	2.61	1.94	74.27
B200689	10/8/90	S1	MERCURY	104.9	4.9					
B202589	11/1/90	S1	MERCURY	99.5	0.5					
B405789	11/16/90	S1	MERCURY	116.1	16.1					
B400289	11/29/90	S1	MERCURY	97	3					
B402189	3/21/91	S1	MERCURY	116.2	16.2					
B201189	4/5/91	S1	MERCURY	114	14					
B402189	5/20/91	S1	MERCURY	106.2	6.2					
B102289	5/23/91	S1	MERCURY	100.6	0.6					
B202589	5/31/91	S1	MERCURY	86.8	13.2					
B200889	9/13/91	S1	MERCURY	102	2					
B102289	9/17/91	S1	MERCURY	95.3	4.7					
B202589	12/9/91	S1	MERCURY	78	22					
B102289	12/12/91	S1	MERCURY	86	14					
B302889	12/16/91	S1	MERCURY	99	1					
B405586	12/18/91	S1	MERCURY	100	0					
B402189	12/19/91	S1	MERCURY	105	5	16	0	7.71	7.04	91.34
B200689	10/8/90	S1	MOLYBDENUM	101.8	1.8					
B202589	11/1/90	S1	MOLYBDENUM	95.9	4.1					
B405789	11/16/90	S1	MOLYBDENUM	97.9	2.1					
B400289	11/29/90	S1	MOLYBDENUM	99.6	0.4					
B402189	3/21/91	S1	MOLYBDENUM	93.7	6.3					
B201189	4/5/91	S1	MOLYBDENUM	95.9	4.1					
B402189	5/20/91	S1	MOLYBDENUM	102.8	2.8					
B102289	5/23/91	S1	MOLYBDENUM	101.3	1.3					
B202589	5/31/91	S1	MOLYBDENUM	102.5	2.5					
B102289	9/17/91	S1	MOLYBDENUM	92.3	7.7					
B202589	12/9/91	S1	MOLYBDENUM	94.7	5.3					
B102289	12/12/91	S1	MOLYBDENUM	95.6	4.4					
B302889	12/16/91	S1	MOLYBDENUM	92.2	7.8					
B405586	12/18/91	S1	MOLYBDENUM	93.9	6.1					
B402189	12/19/91	S1	MOLYBDENUM	92.7	7.3	15	0	4.27	2.42	56.69
B200689	10/8/90	S1	NICKEL	100.3	0.3					
B202589	11/1/90	S1	NICKEL	98.5	1.5					
B405789	11/16/90	S1	NICKEL	99.6	0.4					
B400289	11/29/90	S1	NICKEL	101.5	1.5					
B402189	3/21/91	S1	NICKEL	98.4	1.6					
B201189	4/5/91	S1	NICKEL	97.2	2.8					
B402189	5/20/91	S1	NICKEL	106.3	6.3					
B102289	5/23/91	S1	NICKEL	97.4	2.6					
B202589	5/31/91	S1	NICKEL	107.8	7.8					
B102289	9/17/91	S1	NICKEL	100	0					
B202589	12/9/91	S1	NICKEL	99.7	0.3					
B102289	12/12/91	S1	NICKEL	102.3	2.3					
B302889	12/16/91	S1	NICKEL	96.5	3.5					

Table F-8b
%Bias Groundwater
Dissolved Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B405586	12/18/91	S1	NICKEL	99	1					
B402189	12/19/91	S1	NICKEL	97.6	2.4	15	0	2.29	2.21	96.66
B200689	10/8/90	S1	SELENIUM	100	0					
B202589	11/1/90	S1	SELENIUM	100	0					
B405789	11/16/90	S1	SELENIUM	90	10					
B400289	11/29/90	S1	SELENIUM	90	10					
B402189	3/21/91	S1	SELENIUM	100	0					
B201189	4/5/91	S1	SELENIUM	70	30					
B402189	5/20/91	S1	SELENIUM	60	40					
B102289	5/23/91	S1	SELENIUM	90	10					
B202589	5/31/91	S1	SELENIUM	90	10					
B200889	9/13/91	S1	SELENIUM	110	10					
B102289	9/17/91	S1	SELENIUM	110	10					
B202589	12/9/91	S1	SELENIUM	100	0					
B102289	12/12/91	S1	SELENIUM	100	0					
B302889	12/16/91	S1	SELENIUM	60.8	39.2					
B402189	12/19/91	S1	SELENIUM	90	10	15	3	11.95	13.62	113.98
B200689	10/8/90	S1	SILVER	103.4	3.4					
B202589	11/1/90	S1	SILVER	102.9	2.9					
B405789	11/16/90	S1	SILVER	98.7	1.3					
B400289	11/29/90	S1	SILVER	97.8	2.2					
B402189	3/21/91	S1	SILVER	97.3	2.7					
B201189	4/5/91	S1	SILVER	94.9	5.1					
B402189	5/20/91	S1	SILVER	95.3	4.7					
B102289	5/23/91	S1	SILVER	87	13					
B202589	5/31/91	S1	SILVER	92.4	7.6					
B102289	9/17/91	S1	SILVER	90.8	9.2					
B202589	12/9/91	S1	SILVER	101.5	1.5					
B102289	12/12/91	S1	SILVER	101.1	1.1					
B302889	12/16/91	S1	SILVER	101.3	1.3					
B405586	12/18/91	S1	SILVER	98.5	1.5					
B402189	12/19/91	S1	SILVER	96.8	3.2	15	0	4.05	3.44	84.91
B200689	10/8/90	S1	STRONTIUM	99.3	0.7					
B202589	11/1/90	S1	STRONTIUM	97.7	2.3					
B405789	11/16/90	S1	STRONTIUM	98.9	1.1					
B400289	11/29/90	S1	STRONTIUM	98.4	1.6					
B402189	3/21/91	S1	STRONTIUM	96.5	3.5					
B201189	4/5/91	S1	STRONTIUM	96.7	3.3					
B402189	5/20/91	S1	STRONTIUM	101.5	1.5					
B102289	5/23/91	S1	STRONTIUM	100.2	0.2					
B202589	5/31/91	S1	STRONTIUM	102.1	2.1					
B102289	9/17/91	S1	STRONTIUM	95.3	4.7					
B202589	12/9/91	S1	STRONTIUM	94.8	5.2					
B102289	12/12/91	S1	STRONTIUM	93.3	6.7					
B302889	12/16/91	S1	STRONTIUM	89.1	10.9					
B405586	12/18/91	S1	STRONTIUM	93.4	6.6					
B402189	12/19/91	S1	STRONTIUM	91	9	15	0	3.96	3.18	80.30
B200689	10/8/90	S1	THALLIUM	108	8					
B202589	11/1/90	S1	THALLIUM	80	20					
B405789	11/16/90	S1	THALLIUM	72	28					
B400289	11/29/90	S1	THALLIUM	88	12					
B402189	3/21/91	S1	THALLIUM	80	20					
B201189	4/5/91	S1	THALLIUM	92	8					
B402189	5/20/91	S1	THALLIUM	112	12					
B102289	5/23/91	S1	THALLIUM	92	8					
B202589	5/31/91	S1	THALLIUM	92	8					
B200889	9/13/91	S1	THALLIUM	104	4					
B102289	9/17/91	S1	THALLIUM	90	10					
B302889	12/16/91	S1	THALLIUM	96	4	13	1	11.83	7.26	61.35
B200689	10/8/90	S1	TIN	97	3					
B202589	11/1/90	S1	TIN	94.3	5.7					
B405789	11/16/90	S1	TIN	92.1	7.9					
B400289	11/29/90	S1	TIN	93.5	6.5					
B402189	3/21/91	S1	TIN	93.8	6.2					

Table F-8b
%Bias Groundwater
Dissolved Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B201189	4/5/91	S1	TIN	90.8	9.2					
B402189	5/20/91	S1	TIN	98.4	1.6					
B102289	5/23/91	S1	TIN	99.6	0.4					
B202589	5/31/91	S1	TIN	101.9	1.9					
B102289	9/17/91	S1	TIN	91.4	8.6					
B202589	12/9/91	S1	TIN	90.5	9.5					
B102289	12/12/91	S1	TIN	90	10					
B302889	12/16/91	S1	TIN	90.4	9.6					
B405586	12/18/91	S1	TIN	93.3	6.7					
B402189	12/19/91	S1	TIN	88.6	11.4	15	0	6.55	3.42	52.26
B200689	10/8/90	S1	VANADIUM	99.1	0.9					
B202589	11/1/90	S1	VANADIUM	96.9	3.1					
B405789	11/16/90	S1	VANADIUM	99.9	0.1					
B400289	11/29/90	S1	VANADIUM	107.1	7.1					
B402189	3/21/91	S1	VANADIUM	95.7	4.3					
B201189	4/5/91	S1	VANADIUM	96	4					
B402189	5/20/91	S1	VANADIUM	102.8	2.8					
B102289	5/23/91	S1	VANADIUM	96.7	3.3					
B202589	5/31/91	S1	VANADIUM	104.6	4.6					
B102289	9/17/91	S1	VANADIUM	88.2	11.8					
B202589	12/9/91	S1	VANADIUM	92.1	7.9					
B102289	12/12/91	S1	VANADIUM	92.4	7.6					
B302889	12/16/91	S1	VANADIUM	88.2	11.8					
B405586	12/18/91	S1	VANADIUM	90.6	9.4					
B402189	12/19/91	S1	VANADIUM	89	11	15	0	5.98	3.84	64.27
B200689	10/8/90	S1	ZINC	102.4	2.4					
B202589	11/1/90	S1	ZINC	101	1					
B405789	11/16/90	S1	ZINC	100.8	0.8					
B400289	11/29/90	S1	ZINC	103.6	3.6					
B402189	3/21/91	S1	ZINC	97.2	2.8					
B201189	4/5/91	S1	ZINC	98.2	1.8					
B402189	5/20/91	S1	ZINC	102.6	2.6					
B102289	5/23/91	S1	ZINC	95.3	4.7					
B202589	5/31/91	S1	ZINC	104.3	4.3					
B102289	9/17/91	S1	ZINC	102.3	2.3					
B202589	12/9/91	S1	ZINC	102.5	2.5					
B102289	12/12/91	S1	ZINC	104.7	4.7					
B302889	12/16/91	S1	ZINC	100.5	0.5					
B405586	12/18/91	S1	ZINC	102.2	2.2					
B402189	12/19/91	S1	ZINC	100.7	0.7	15	0	2.46	1.39	56.68

Table F-8c
%Bias Groundwater
Total Metals

Location	Date	ID	Analyte	%R	%Bias
B202589	12/9/91	MS	ALUMINUM	113.9	13.9
B202589	12/9/91	MS	ANTIMONY	93.7	6.3
B202589	12/9/91	MS	ARSENIC	95	5
B202589	12/9/91	MS	BARIUM	96.2	3.8
B202589	12/9/91	MS	BERYLLIUM	95.7	4.3
B202589	12/9/91	MS	CADMIUM	97.5	2.5
B202589	12/9/91	MS	CESIUM	86.5	13.5
B202589	12/9/91	MS	CHROMIUM	92.6	7.4
B202589	12/9/91	MS	COBALT	97.6	2.4
B202589	12/9/91	MS	COPPER	97.8	2.2
B202589	12/9/91	MS	IRON	101.9	1.9
B202589	12/9/91	MS	LEAD	102.5	2.5
B202589	12/9/91	MS	LITHIUM	94.4	5.6
B202589	12/9/91	MS	MANGANESE	96.1	3.9
B202589	12/9/91	MS	MERCURY	108	8
B202589	12/9/91	MS	MOLYBDENUM	90.1	9.9
B202589	12/9/91	MS	NICKEL	93.6	6.4
B202589	12/9/91	MS	SELENIUM	90	10
B202589	12/9/91	MS	SILVER	88.1	11.9
B202589	12/9/91	MS	STRONTIUM	90.1	9.9
B202589	12/9/91	MS	THALLIUM	110	10
B202589	12/9/91	MS	TIN	85.9	14.1
B202589	12/9/91	MS	VANADIUM	87.6	12.4
B202589	12/9/91	MS	ZINC	96.6	3.4

Table F-8d
%Bias Groundwater
Total Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B200889	9/13/91	S1	ALUMINUM	112.4	12.4					
B102289	9/17/91	S2	ALUMINUM	94.9	5.1					
B400289	9/19/91	S1	ALUMINUM	108.9	8.9					
B202589	12/9/91	S1	ALUMINUM	113.9	13.9					
B102289	12/12/91	S1	ALUMINUM	624.1	524.1					
B302889	12/16/91	S1	ALUMINUM	98.1	1.9					
B405586	12/18/91	S1	ALUMINUM	333.9	233.9					
B402189	12/19/91	S1	ALUMINUM	92.5	7.5	8	2	100.96	188.36	186.56
B200889	9/13/91	S1	ANTIMONY	89.9	10.1					
B102289	9/17/91	S1	ANTIMONY	86.0	14					
B400289	9/19/91	S1	ANTIMONY	97.8	2.2					
B202589	12/9/91	S1	ANTIMONY	93.7	6.3					
B102289	12/12/91	S1	ANTIMONY	90.4	9.6					
B302889	12/16/91	S1	ANTIMONY	97.4	2.6					
B405586	12/18/91	S1	ANTIMONY	90.4	9.6					
B402189	12/19/91	S1	ANTIMONY	95.9	4.1	8	0	7.31	4.19	57.24
B200889	9/13/91	S1	ARSENIC	90.0	10					
B102289	9/17/91	S1	ARSENIC	87.5	12.5					
B400289	9/19/91	S1	ARSENIC	87.5	12.5					
B202589	12/9/91	S1	ARSENIC	95.0	5					
B102289	12/12/91	S1	ARSENIC	77.5	22.5					
B302889	12/16/91	S1	ARSENIC	77.5	22.5					
B405586	12/18/91	S1	ARSENIC	62.5	37.5					
B402189	12/19/91	S1	ARSENIC	91.5	8.5	8	1	16.38	10.58	64.60
B200889	9/13/91	S1	BARIUM	90.6	9.4					
B102289	9/17/91	S1	BARIUM	89.9	10.1					
B400289	9/19/91	S1	BARIUM	98.1	1.9					
B202589	12/9/91	S1	BARIUM	96.2	3.8					
B102289	12/12/91	S1	BARIUM	97.6	2.4					
B302889	12/16/91	S1	BARIUM	95.2	4.8					
B405586	12/18/91	S1	BARIUM	95.2	4.8					
B402189	12/19/91	S1	BARIUM	94.9	5.1	8	0	5.29	2.99	56.56
B200889	9/13/91	S1	BERYLLIUM	99.4	0.6					
B102289	9/17/91	S1	BERYLLIUM	98.2	1.8					
B400289	9/19/91	S1	BERYLLIUM	108.2	8.2					
B202589	12/9/91	S1	BERYLLIUM	95.7	4.3					
B102289	12/12/91	S1	BERYLLIUM	103.5	3.5					
B302889	12/16/91	S1	BERYLLIUM	100.0	0					
B405586	12/18/91	S1	BERYLLIUM	97.5	2.5					
B402189	12/19/91	S1	BERYLLIUM	97.2	2.8	8	0	2.96	2.55	86.02
B200889	9/13/91	S1	CADMIUM	92.0	8					
B102289	9/17/91	S1	CADMIUM	89.9	10.1					
B400289	9/19/91	S1	CADMIUM	105.5	5.5					
B202589	12/9/91	S1	CADMIUM	97.5	2.5					
B102289	12/12/91	S1	CADMIUM	100.4	0.4					
B302889	12/16/91	S1	CADMIUM	97.6	2.4					
B405586	12/18/91	S1	CADMIUM	97.6	2.4					
B402189	12/19/91	S1	CADMIUM	97.8	2.2	8	0	4.19	3.35	80.10
B200889	9/13/91	S1	CESIUM	104.0	4					
B102289	9/17/91	S1	CESIUM	99.5	0.5					
B400289	9/19/91	S1	CESIUM	91.5	8.5					
B202589	12/9/91	S1	CESIUM	86.5	13.5					
B102289	12/12/91	S1	CESIUM	80.0	20					
B302889	12/16/91	S1	CESIUM	84.5	15.5					
B405586	12/18/91	S1	CESIUM	82.0	18					
B402189	12/19/91	S1	CESIUM	84.0	16	8	0	12.00	6.96	57.99
B200889	9/13/91	S1	CHROMIUM	94.4	5.6					
B102289	9/17/91	S1	CHROMIUM	93.4	6.6					
B400289	9/19/91	S1	CHROMIUM	99.4	0.6					
B202589	12/9/91	S1	CHROMIUM	92.6	7.4					
B102289	12/12/91	S1	CHROMIUM	100.8	0.8					
B302889	12/16/91	S1	CHROMIUM	94.4	5.6					
B405586	12/18/91	S1	CHROMIUM	94.3	5.7					
B402189	12/19/91	S1	CHROMIUM	93.4	6.6	8	0	4.86	2.64	54.38

Table F-8d
%Bias Groundwater
Total Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B200889	9/13/91	S1	COBALT	91.7	8.3					
B102289	9/17/91	S1	COBALT	91.2	8.8					
B400289	9/19/91	S1	COBALT	102.5	2.5					
B202589	12/9/91	S1	COBALT	97.6	2.4					
B102289	12/12/91	S1	COBALT	100.7	0.7					
B302889	12/16/91	S1	COBALT	97.4	2.6					
B405586	12/18/91	S1	COBALT	97.6	2.4					
B402189	12/19/91	S1	COBALT	98.3	1.7	8	0	3.68	3.08	83.68
B200889	9/13/91	S1	COPPER	93.0	7					
B102289	9/17/91	S1	COPPER	87.8	12.2					
B400289	9/19/91	S1	COPPER	99.8	0.2					
B202589	12/9/91	S1	COPPER	97.8	2.2					
B102289	12/12/91	S1	COPPER	101.1	1.1					
B302889	12/16/91	S1	COPPER	97.0	3					
B405586	12/18/91	S1	COPPER	98.2	1.8					
B402189	12/19/91	S1	COPPER	97.3	2.7	8	0	3.78	3.95	104.75
B200889	9/13/91	S1	IRON	120.2	20.2					
B102289	9/17/91	S2	IRON	96.0	4					
B400289	9/19/91	S1	IRON	111.0	11					
B202589	12/9/91	S1	IRON	101.9	1.9					
B102289	12/12/91	S1	IRON	462.5	362.5					
B302889	12/16/91	S1	IRON	88.6	11.4					
B405586	12/18/91	S1	IRON	131.2	31.2					
B402189	12/19/91	S2	IRON	94.9	5.1	8	2	55.91	124.25	222.23
B200889	9/13/91	S1	LEAD	94.5	5.5					
B102289	9/17/91	S1	LEAD	107.0	7					
B400289	9/19/91	S1	LEAD	115.5	15.5					
B202589	12/9/91	S1	LEAD	102.5	2.5					
B102289	12/12/91	S1	LEAD	101.0	1					
B302889	12/16/91	S1	LEAD	94.5	5.5					
B405586	12/18/91	S1	LEAD	85.5	14.5					
B402189	12/19/91	S1	LEAD	98.5	1.5	8	0	6.63	5.59	84.31
B200889	9/13/91	S1	LITHIUM	101.2	1.2					
B102289	9/17/91	S1	LITHIUM	101.2	1.2					
B400289	9/19/91	S1	LITHIUM	93.9	6.1					
B202589	12/9/91	S1	LITHIUM	94.4	5.6					
B102289	12/12/91	S1	LITHIUM	90.6	9.4					
B302889	12/16/91	S1	LITHIUM	90.5	9.5					
B405586	12/18/91	S1	LITHIUM	90.3	9.7					
B402189	12/19/91	S1	LITHIUM	89.7	10.3	8	0	6.63	3.76	56.80
B200889	9/13/91	S1	MANGANESE	90.5	9.5					
B102289	9/17/91	S1	MANGANESE	89.7	10.3					
B400289	9/19/91	S1	MANGANESE	101.7	1.7					
B202589	12/9/91	S1	MANGANESE	96.1	3.9					
B102289	12/12/91	S1	MANGANESE	104.8	4.8					
B302889	12/16/91	S1	MANGANESE	97.6	2.4					
B405586	12/18/91	S1	MANGANESE	99.3	0.7					
B402189	12/19/91	S1	MANGANESE	97.2	2.8	8	0	4.51	3.56	78.87
B200889	9/13/91	S1	MERCURY	96.9	3.1					
B102289	9/17/91	S1	MERCURY	94.6	5.4					
B400289	9/19/91	S1	MERCURY	104.6	4.6					
B202589	12/9/91	S1	MERCURY	108.0	8					
B102289	12/12/91	S1	MERCURY	100.0	0					
B302889	12/16/91	S1	MERCURY	96.0	4					
B405586	12/18/91	S1	MERCURY	105.0	5					
B402189	12/19/91	S1	MERCURY	107.0	7	8	0	4.64	2.45	52.74
B200889	9/13/91	S1	MOLYBDENUM	92.3	7.7					
B102289	9/17/91	S1	MOLYBDENUM	91.5	8.5					
B400289	9/19/91	S1	MOLYBDENUM	89.5	10.5					
B202589	12/9/91	S1	MOLYBDENUM	90.1	9.9					
B102289	12/12/91	S1	MOLYBDENUM	91.7	8.3					
B302889	12/16/91	S1	MOLYBDENUM	90.3	9.7					
B405586	12/18/91	S1	MOLYBDENUM	88.5	11.5					
B402189	12/19/91	S1	MOLYBDENUM	89.7	10.3	8	0	9.55	1.28	13.42

Table F-8d
%Bias Groundwater
Total Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B200889	9/13/91	S1	NICKEL	97.3	2.7					
B102289	9/17/91	S1	NICKEL	88.0	12					
B400289	9/19/91	S1	NICKEL	99.7	0.3					
B202589	12/9/91	S1	NICKEL	93.6	6.4					
B102289	12/12/91	S1	NICKEL	102.0	2					
B302889	12/16/91	S1	NICKEL	95.6	4.4					
B405586	12/18/91	S1	NICKEL	94.5	5.5					
B402189	12/19/91	S1	NICKEL	94.7	5.3	8	0	4.83	3.54	73.40
B200889	9/13/91	S1	SELENIUM	90.0	10					
B102289	9/17/91	S1	SELENIUM	100.0	0					
B400289	9/19/91	S1	SELENIUM	100.0	0					
B202589	12/9/91	S1	SELENIUM	90.0	10					
B102289	12/12/91	S1	SELENIUM	80.0	20					
B302889	12/16/91	S1	SELENIUM	80.0	20					
B405586	12/18/91	S1	SELENIUM	90.0	10					
B402189	12/19/91	S1	SELENIUM	100.0	0	8	0	8.75	8.35	95.37
B200889	9/13/91	S1	SILVER	97.0	3					
B102289	9/17/91	S1	SILVER	94.7	5.3					
B400289	9/19/91	S1	SILVER	99.6	0.4					
B202589	12/9/91	S1	SILVER	88.1	11.9					
B102289	12/12/91	S1	SILVER	96.8	3.2					
B302889	12/16/91	S1	SILVER	95.0	5					
B405586	12/18/91	S1	SILVER	92.9	7.1					
B402189	12/19/91	S1	SILVER	91.2	8.8	8	0	5.59	3.63	64.95
B200889	9/13/91	S1	STRONTIUM	93.7	6.3					
B102289	9/17/91	S1	STRONTIUM	93.6	6.4					
B400289	9/19/91	S1	STRONTIUM	91.8	8.2					
B202589	12/9/91	S1	STRONTIUM	90.1	9.9					
B102289	12/12/91	S1	STRONTIUM	91.1	8.9					
B302889	12/16/91	S1	STRONTIUM	88.9	11.1					
B405586	12/18/91	S1	STRONTIUM	90.1	9.9					
B402189	12/19/91	S1	STRONTIUM	89.1	10.9	8	0	8.95	1.86	20.83
B200889	9/13/91	S1	THALLIUM	94.0	6					
B102289	9/17/91	S1	THALLIUM	92.0	8					
B400289	9/19/91	S1	THALLIUM	64.0	36					
B202589	12/9/91	S1	THALLIUM	110.0	10					
B102289	12/12/91	S1	THALLIUM	104.0	4					
B302889	12/16/91	S1	THALLIUM	92.0	8					
B405586	12/18/91	S1	THALLIUM	80.0	20					
B402189	12/19/91	S1	THALLIUM	76.0	24	8	0	14.50	11.15	76.89
B200889	9/13/91	S1	TIN	97.4	2.6					
B102289	9/17/91	S1	TIN	96.9	3.1					
B400289	9/19/91	S1	TIN	87.5	12.5					
B202589	12/9/91	S1	TIN	85.9	14.1					
B102289	12/12/91	S1	TIN	92.0	8					
B302889	12/16/91	S1	TIN	85.6	14.4					
B405586	12/18/91	S1	TIN	85.2	14.8					
B402189	12/19/91	S1	TIN	85.1	14.9	8	0	10.55	5.26	49.83
B200889	9/13/91	S1	VANADIUM	83.5	16.5					
B102289	9/17/91	S1	VANADIUM	83.0	17					
B400289	9/19/91	S1	VANADIUM	85.9	14.1					
B202589	12/9/91	S1	VANADIUM	87.6	12.4					
B102289	12/12/91	S1	VANADIUM	93.1	6.9					
B302889	12/16/91	S1	VANADIUM	87.2	12.8					
B405586	12/18/91	S1	VANADIUM	86.6	13.4					
B402189	12/19/91	S1	VANADIUM	87.1	12.9	8	0	13.25	3.09	23.30
B200889	9/13/91	S1	ZINC	109.1	9.1					
B102289	9/17/91	S1	ZINC	64.2	35.8					
B400289	9/19/91	S1	ZINC	100.6	0.6					
B202589	12/9/91	S1	ZINC	96.6	3.4					
B102289	12/12/91	S1	ZINC	103.8	3.8					
B302889	12/16/91	S1	ZINC	98.2	1.8					
B405586	12/18/91	S1	ZINC	97.4	2.6					
B402189	12/19/91	S1	ZINC	97.9	2.1	8	1	7.40	11.75	158.84

Table F-8e
%Bias Groundwater
Anions, Cyanide, and Water Quality Parameters

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B402189	7/20/90	MS	BICARBONATE AS CACO3	90	10					
B202589	12/9/91	MS	BICARBONATE AS CACO3	87	13					
B102289	12/12/91	MS	BICARBONATE AS CACO3	88	12					
B302889	12/16/91	MS	BICARBONATE AS CACO3	85	15					
B405586	12/18/91	MS	BICARBONATE AS CACO3	87	13					
B402189	12/19/91	MS	BICARBONATE AS CACO3	76	24	6	0	14.5	4.9	34.0
B402189	7/20/90	MS	CARBONATE AS CACO3	90	10					
B202589	12/9/91	MS	CARBONATE AS CACO3	87	13					
B102289	12/12/91	MS	CARBONATE AS CACO3	88	12					
B302889	12/16/91	MS	CARBONATE AS CACO3	85	15					
B405586	12/18/91	MS	CARBONATE AS CACO3	87	13					
B402189	12/19/91	MS	CARBONATE AS CACO3	76	24	6	0	14.5	4.9	34.0
B402189	7/20/90	MS	CHLORIDE	105	5					
B405789	8/16/90	MS	CHLORIDE	102	2					
B405789	8/16/90	MSD	CHLORIDE	104	4					
B202589	12/9/91	MS	CHLORIDE	102	2					
B102289	12/12/91	MS	CHLORIDE	106	6					
B302889	12/16/91	MS	CHLORIDE	99	1					
B405586	12/18/91	MS	CHLORIDE	82	18					
B402189	12/19/91	MS	CHLORIDE	87	13	8	0	6.4	6.0	94.5
B405689	7/19/90	MS	CYANIDE	100	0					
B402189	7/20/90	MS	CYANIDE	10	90					
B302989	8/6/90	MS	CYANIDE	98	2					
B202589	12/9/91	MS	CYANIDE	105	5	4	1	24.3	43.9	181.0
B202589	12/9/91	MS	FLUORIDE	95	5					
B102289	12/12/91	MS	FLUORIDE	94	6					
B302889	12/16/91	MS	FLUORIDE	93	7					
B405586	12/18/91	MS	FLUORIDE	93	7					
B402189	12/19/91	MS	FLUORIDE	92	8	5	0	6.6	1.1	17.3
B402189	7/20/90	MS	NITRATE/NITRITE	87	13					
B202589	12/9/91	MS	NITRATE/NITRITE	94	6					
B102289	12/12/91	MS	NITRATE/NITRITE	90	10					
B302889	12/16/91	MS	NITRATE/NITRITE	86	14					
B405586	12/18/91	MS	NITRATE/NITRITE	91	9					
B402189	12/19/91	MS	NITRATE/NITRITE	90	10	6	0	10.3	2.9	27.8
B402189	7/20/90	MS	NITRITE	90	10	1	0	NA	NA	NA
B202589	12/9/91	MS	ORTHOPHOSPHATE	94	6					
B102289	12/12/91	MS	ORTHOPHOSPHATE	96	4					
B302889	12/16/91	MS	ORTHOPHOSPHATE	100	0					
B405586	12/18/91	MS	ORTHOPHOSPHATE	108	8					
B402189	12/19/91	MS	ORTHOPHOSPHATE	145	45	5	1	12.6	18.4	145.7
B405789	8/16/90	MS	PHOSPHORUS	98	2					
B405789	8/16/90	MSD	PHOSPHORUS	98	2	2	0	2.0	0.0	0.0
B402189	7/20/90	MS	SILICA	80	20					
B202589	12/9/91	MS	SILICA	90	10					
B102289	12/12/91	MS	SILICA	82	18					
B302889	12/16/91	MS	SILICA	90	10					
B405586	12/18/91	MS	SILICA	83	17					
B402189	12/19/91	MS	SILICA	89	11	6	0	14.3	4.5	31.4
B402189	7/20/90	MS	SULFATE	117	17					
B202589	12/9/91	MS	SULFATE	60	40					
B102289	12/12/91	MS	SULFATE	116	16					
B302889	12/16/91	MS	SULFATE	101	1					
B405586	12/18/91	MS	SULFATE	93	7					
B402189	12/19/91	MS	SULFATE	76	24	6	1	17.5	13.7	78.1

Table F-8f
%Bias Groundwater
Anions, Cyanide, and Water Quality Parameters

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B405689	7/19/90	S	BICARBONATE AS CACO3	80	20					
B400489	10/5/90	S	BICARBONATE AS CACO3	92	8					
B200689	10/8/90	S	BICARBONATE AS CACO3	92	8					
B202589	11/1/90	S	BICARBONATE AS CACO3	90	10					
B405789	11/16/90	S	BICARBONATE AS CACO3	91	9					
B400289	11/29/90	S	BICARBONATE AS CACO3	92	8					
B402189	3/21/91	S	BICARBONATE AS CACO3	92	8					
B201189	4/5/91	S	BICARBONATE AS CACO3	79	21					
B402189	5/20/91	S	BICARBONATE AS CACO3	97	3					
B102289	5/23/91	S	BICARBONATE AS CACO3	91	9					
B202589	5/31/91	S	BICARBONATE AS CACO3	97	3					
B402189	8/29/91	S	BICARBONATE AS CACO3	81	19					
B200889	9/13/91	S	BICARBONATE AS CACO3	88	12					
B102289	9/17/91	S	BICARBONATE AS CACO3	87	13					
B400289	9/19/91	S	BICARBONATE AS CACO3	91	9					
B202589	12/9/91	S	BICARBONATE AS CACO3	87	13					
B102289	12/12/91	S	BICARBONATE AS CACO3	88	12					
B302889	12/16/91	S	BICARBONATE AS CACO3	85	15					
B405586	12/18/91	S	BICARBONATE AS CACO3	87	13					
B402189	12/19/91	S	BICARBONATE AS CACO3	76	24	20	0	11.9	5.7	47.7
B405689	7/19/90	S	CARBONATE AS CACO3	80	20					
B400489	10/5/90	S	CARBONATE AS CACO3	92	8					
B200689	10/8/90	S	CARBONATE AS CACO3	92	8					
B202589	11/1/90	S	CARBONATE AS CACO3	90	10					
B405789	11/16/90	S	CARBONATE AS CACO3	91	9					
B400289	11/29/90	S	CARBONATE AS CACO3	92	8					
B402189	3/21/91	S	CARBONATE AS CACO3	92	8					
B201189	4/5/91	S	CARBONATE AS CACO3	79	21					
B402189	5/20/91	S	CARBONATE AS CACO3	97	3					
B102289	5/23/91	S	CARBONATE AS CACO3	91	9					
B202589	5/31/91	S	CARBONATE AS CACO3	97	3					
B402189	8/29/91	S	CARBONATE AS CACO3	81	19					
B200889	9/13/91	S	CARBONATE AS CACO3	88	12					
B102289	9/17/91	S	CARBONATE AS CACO3	87	13					
B400289	9/19/91	S	CARBONATE AS CACO3	91	9					
B202589	12/9/91	S	CARBONATE AS CACO3	87	13					
B102289	12/12/91	S	CARBONATE AS CACO3	88	12					
B302889	12/16/91	S	CARBONATE AS CACO3	85	15					
B405586	12/18/91	S	CARBONATE AS CACO3	87	13					
B402189	12/19/91	S	CARBONATE AS CACO3	76	24	20	0	11.9	5.7	47.7
B405689	7/19/90	S	CHLORIDE	98	2					
B400489	10/5/90	S	CHLORIDE	96	4					
B200689	10/8/90	S	CHLORIDE	97	3					
B202589	11/1/90	S	CHLORIDE	96	4					
B405789	11/16/90	S	CHLORIDE	96	4					
B400289	11/29/90	S	CHLORIDE	95	5					
B402189	3/21/91	S	CHLORIDE	99	1					
B201189	4/5/91	S	CHLORIDE	101	1					
B402189	5/20/91	S	CHLORIDE	105	5					
B102289	5/23/91	S	CHLORIDE	105	5					
B202589	5/31/91	S	CHLORIDE	99	1					
B402189	8/29/91	S	CHLORIDE	100	0					
B200889	9/13/91	S	CHLORIDE	101	1					
B102289	9/17/91	S	CHLORIDE	97	3					
B400289	9/19/91	S	CHLORIDE	99	1					
B202589	12/9/91	S	CHLORIDE	102	2					
B102289	12/12/91	S	CHLORIDE	106	6					
B302889	12/16/91	S	CHLORIDE	99	1					
B405586	12/18/91	S	CHLORIDE	82	18					
B402189	12/19/91	S	CHLORIDE	87	13	20	0	4.0	4.4	109.4
B402189	7/20/90	S2	CYANIDE	15.0	85					
B400489	10/5/90	S1	CYANIDE	90.0	10					
B200689	10/8/90	S1	CYANIDE	87.0	13					
B202589	11/1/90	S1	CYANIDE	93.0	7					

Table F-8f
%Bias Groundwater
Anions, Cyanide, and Water Quality Parameters

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B405789	11/16/90	S1	CYANIDE	94.0	6					
B400289	11/29/90	S1	CYANIDE	86.0	14					
B402189	3/21/91	S1	CYANIDE	109.0	9					
B201189	4/5/91	S1	CYANIDE	95.0	5					
B402189	5/20/91	S1	CYANIDE	113.0	13					
B102289	5/23/91	S1	CYANIDE	84.5	15.5					
B202589	5/31/91	S1	CYANIDE	99.5	0.5					
B200889	9/13/91	S1	CYANIDE	111.0	11					
B102289	9/17/91	S1	CYANIDE	109.0	9					
B400289	9/19/91	S1	CYANIDE	101.5	1.5					
B202589	12/9/91	S1	CYANIDE	105.0	5					
B102289	12/12/91	S1	CYANIDE	98.0	2					
B302889	12/16/91	S1	CYANIDE	99.0	1					
B405586	12/18/91	S1	CYANIDE	101.0	1					
B402189	12/19/91	S1	CYANIDE	92.5	7.5	19	1	11.37	18.45	162.28
B405689	7/19/90	S	FLUORIDE	103	3					
B400489	10/5/90	S	FLUORIDE	99	1					
B200689	10/8/90	S	FLUORIDE	108	8					
B202589	11/1/90	S	FLUORIDE	90	10					
B405789	11/16/90	S	FLUORIDE	95	5					
B400289	11/29/90	S	FLUORIDE	117	17					
B402189	3/21/91	S	FLUORIDE	100	0					
B201189	4/5/91	S	FLUORIDE	98	2					
B402189	5/20/91	S	FLUORIDE	100	0					
B102289	5/23/91	S	FLUORIDE	101	1					
B202589	5/31/91	S	FLUORIDE	105	5					
B402189	8/29/91	S	FLUORIDE	104	4					
B200889	9/13/91	S	FLUORIDE	104	4					
B102289	9/17/91	S	FLUORIDE	101	1					
B400289	9/19/91	S	FLUORIDE	110	10					
B202589	12/9/91	S	FLUORIDE	95	5					
B102289	12/12/91	S	FLUORIDE	94	6					
B302889	12/16/91	S	FLUORIDE	93	7					
B405586	12/18/91	S	FLUORIDE	93	7					
B402189	12/19/91	S	FLUORIDE	92	8	20	0	5.2	4.2	80.5
B405689	7/19/90	S	NITRATE/NITRITE	97	3					
B400389	10/5/90	S	NITRATE/NITRITE	91	9					
B200789	10/8/90	S	NITRATE/NITRITE	88	12					
B202589	11/1/90	S	NITRATE/NITRITE	85	15					
B405789	11/16/90	S	NITRATE/NITRITE	87	13					
B400289	11/29/90	S	NITRATE/NITRITE	22	78					
B402189	3/21/91	S	NITRATE/NITRITE	85	15					
B201189	4/5/91	S	NITRATE/NITRITE	96	4					
B402189	5/20/91	S	NITRATE/NITRITE	92	8					
B102289	5/23/91	S	NITRATE/NITRITE	95	5					
B202589	5/31/91	S	NITRATE/NITRITE	108	8					
B402189	8/29/91	S	NITRATE/NITRITE	91	9					
B200889	9/13/91	S	NITRATE/NITRITE	90	10					
B102289	9/17/91	S	NITRATE/NITRITE	91	9					
B400289	9/19/91	SD	NITRATE/NITRITE	131	31					
B400289	9/19/91	S	NITRATE/NITRITE	132	32					
B202589	12/9/91	S	NITRATE/NITRITE	94	6					
B102289	12/12/91	S	NITRATE/NITRITE	90	10					
B302889	12/16/91	S	NITRATE/NITRITE	86	14					
B405586	12/18/91	S	NITRATE/NITRITE	91	9					
B402189	12/19/91	S	NITRATE/NITRITE	90	10	20	3	14.8	16.3	110.2
B405689	7/19/90	S	NITRITE	92	8					
B400389	10/5/90	S	NITRITE	88	12					
B200789	10/8/90	S	NITRITE	86	14	3	0	11.3	3.1	27.0
B202589	11/1/90	S	ORTHOPHOSPHATE	88	12					
B405789	11/16/90	S	ORTHOPHOSPHATE	88	12					
B400289	11/29/90	S	ORTHOPHOSPHATE	92	8					
B402189	3/21/91	S	ORTHOPHOSPHATE	98	2					
B201189	4/5/91	S	ORTHOPHOSPHATE	102	2					

Table F-8f
%Bias Groundwater
Anions, Cyanide, and Water Quality Parameters

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B402189	5/20/91	S	ORTHOPHOSPHATE	94	6					
B102289	5/23/91	S	ORTHOPHOSPHATE	97	3					
B202589	5/31/91	S	ORTHOPHOSPHATE	98	2					
B402189	8/29/91	S	ORTHOPHOSPHATE	91	9					
B200889	9/13/91	S	ORTHOPHOSPHATE	86	14					
B102289	9/17/91	S	ORTHOPHOSPHATE	94	6					
B400289	9/19/91	S	ORTHOPHOSPHATE	91	9					
B202589	12/9/91	S	ORTHOPHOSPHATE	94	6					
B102289	12/12/91	S	ORTHOPHOSPHATE	96	4					
B302889	12/16/91	S	ORTHOPHOSPHATE	100	0					
B405586	12/18/91	S	ORTHOPHOSPHATE	108	8					
B402189	12/19/91	S	ORTHOPHOSPHATE	145	45					
B402189	12/19/91	SD	ORTHOPHOSPHATE	183	83	18	2	12.8	20.1	156.6
B405689	7/19/90	S	PHOSPHORUS	93	7					
B400489	10/5/90	S	PHOSPHORUS	29	71					
B400489	10/5/90	SD	PHOSPHORUS	68	32					
B200689	10/8/90	S	PHOSPHORUS	25	75					
B200689	10/8/90	SD	PHOSPHORUS	62	38	5	4	44.6	28.4	63.8
B405689	7/19/90	S	SILICA	105	5					
B400489	10/5/90	S	SILICA	87	13					
B200689	10/8/90	S	SILICA	85	15					
B202589	11/1/90	S	SILICA	93	7					
B405789	11/16/90	S	SILICA	76	24					
B400289	11/29/90	S	SILICA	78	22					
B402189	3/21/91	S	SILICA	75	25					
B201189	4/5/91	S	SILICA	83	17					
B402189	5/20/91	S	SILICA	89	11					
B102289	5/23/91	S	SILICA	87	13					
B202589	5/31/91	S	SILICA	83	17					
B402189	8/29/91	S	SILICA	84	16					
B200889	9/13/91	S	SILICA	98	2					
B102289	9/17/91	S	SILICA	88	12					
B400289	9/19/91	S	SILICA	80	20					
B202589	12/9/91	S	SILICA	90	10					
B102289	12/12/91	S	SILICA	82	18					
B302889	12/16/91	S	SILICA	90	10					
B405586	12/18/91	S	SILICA	83	17					
B402189	12/19/91	S	SILICA	89	11	20	0	14.3	6.1	42.5
B405689	7/19/90	S	SULFATE	96	4					
B400489	10/5/90	S	SULFATE	99	1					
B200689	10/8/90	S	SULFATE	109	9					
B202589	11/1/90	S	SULFATE	107	7					
B405789	11/16/90	S	SULFATE	98	2					
B400289	11/29/90	S	SULFATE	100	0					
B402189	3/21/91	S	SULFATE	100	0					
B201189	4/5/91	S	SULFATE	99	1					
B402189	5/20/91	S	SULFATE	113	13					
B102289	5/23/91	S	SULFATE	100	0					
B202589	5/31/91	S	SULFATE	83	17					
B402189	8/29/91	S	SULFATE	98	2					
B200889	9/13/91	S	SULFATE	90	10					
B102289	9/17/91	S	SULFATE	99	1					
B400289	9/19/91	S	SULFATE	87	13					
B202589	12/9/91	S	SULFATE	62	38					
B202589	12/9/91	SD	SULFATE	62	38					
B102289	12/12/91	S	SULFATE	116	16					
B302889	12/16/91	S	SULFATE	101	1					
B405586	12/18/91	S	SULFATE	93	7					
B402189	12/19/91	S	SULFATE	76	24	21	2	9.7	11.6	119.0

Table F-8g
%Bias Groundwater
Volatile Organic Compounds

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B405689	7/19/90	MS	1,1-DICHLOROETHENE	91	9					
B405689	7/19/90	MSD	1,1-DICHLOROETHENE	91	9					
B402189	7/20/90	MS	1,1-DICHLOROETHENE	90	10					
B402189	7/20/90	MSD	1,1-DICHLOROETHENE	91	9					
B203989	9/14/90	MS	1,1-DICHLOROETHENE	71	29					
B203989	9/14/90	MSD	1,1-DICHLOROETHENE	94	6					
B400489	10/5/90	MS	1,1-DICHLOROETHENE	91	9					
B400489	10/5/90	MSD	1,1-DICHLOROETHENE	96	4					
B200689	10/8/90	MS	1,1-DICHLOROETHENE	91	9					
B200689	10/8/90	MSD	1,1-DICHLOROETHENE	94	6					
B202589	11/1/90	MSD	1,1-DICHLOROETHENE	91	9					
B202589	11/1/90	MS	1,1-DICHLOROETHENE	99	1					
B405789	11/16/90	MSD	1,1-DICHLOROETHENE	97	3					
B405789	11/16/90	MS	1,1-DICHLOROETHENE	104	4					
B400289	11/29/90	MS	1,1-DICHLOROETHENE	116	16					
B400289	11/29/90	MSD	1,1-DICHLOROETHENE	129	29					
B402189	3/21/91	MSD	1,1-DICHLOROETHENE	104	4					
B402189	3/21/91	MS	1,1-DICHLOROETHENE	111	11					
B201189	4/5/91	MS	1,1-DICHLOROETHENE	113	13					
B201189	4/5/91	MSD	1,1-DICHLOROETHENE	117	17					
B405586	5/17/91	MS	1,1-DICHLOROETHENE	119	19					
B405586	5/17/91	MSD	1,1-DICHLOROETHENE	134	34					
B402189	5/20/91	MSD	1,1-DICHLOROETHENE	63	37					
B402189	5/20/91	MS	1,1-DICHLOROETHENE	66	34					
B102289	5/23/91	MSD	1,1-DICHLOROETHENE	101	1					
B102289	5/23/91	MS	1,1-DICHLOROETHENE	106	6					
B202589	5/31/91	MSD	1,1-DICHLOROETHENE	85	15					
B202589	5/31/91	MS	1,1-DICHLOROETHENE	86	14					
B402189	8/29/91	MSD	1,1-DICHLOROETHENE	96	4					
B402189	8/29/91	MS	1,1-DICHLOROETHENE	101	1					
B200889	9/13/91	MS	1,1-DICHLOROETHENE	79	21					
B200889	9/13/91	MSD	1,1-DICHLOROETHENE	85	15					
B102289	9/17/91	MS	1,1-DICHLOROETHENE	66	34					
B102289	9/17/91	MSD	1,1-DICHLOROETHENE	79	21					
B400289	9/19/91	MSD	1,1-DICHLOROETHENE	62	38					
B400289	9/19/91	MS	1,1-DICHLOROETHENE	70	30					
B202589	12/9/91	MS	1,1-DICHLOROETHENE	115	15					
B202589	12/9/91	MSD	1,1-DICHLOROETHENE	130	30					
B102289	12/12/91	MSD	1,1-DICHLOROETHENE	124	24					
B102289	12/12/91	MS	1,1-DICHLOROETHENE	129	29					
B302889	12/16/91	MSD	1,1-DICHLOROETHENE	98	2					
B302889	12/16/91	MS	1,1-DICHLOROETHENE	99	1					
B405586	12/18/91	MS	1,1-DICHLOROETHENE	94	6					
B405586	12/18/91	MSD	1,1-DICHLOROETHENE	94	6					
B402189	12/19/91	MSD	1,1-DICHLOROETHENE	104	4					
B402189	12/19/91	MS	1,1-DICHLOROETHENE	110	10	46	10	14.3	11.2	78.5
B405689	7/19/90	MS	BENZENE	101	1					
B405689	7/19/90	MSD	BENZENE	102	2					
B402189	7/20/90	MS	BENZENE	95	5					
B402189	7/20/90	MSD	BENZENE	98	2					
B203989	9/14/90	MS	BENZENE	79	21					
B203989	9/14/90	MSD	BENZENE	87	13					
B400489	10/5/90	MS	BENZENE	90	10					
B400489	10/5/90	MSD	BENZENE	90	10					
B200689	10/8/90	MS	BENZENE	85	15					
B200689	10/8/90	MSD	BENZENE	88	12					
B202589	11/1/90	MSD	BENZENE	83	17					
B202589	11/1/90	MS	BENZENE	89	11					
B405789	11/16/90	MSD	BENZENE	101	1					
B405789	11/16/90	MS	BENZENE	106	6					
B400289	11/29/90	MS	BENZENE	88	12					
B400289	11/29/90	MSD	BENZENE	93	7					
B402189	3/21/91	MSD	BENZENE	98	2					
B402189	3/21/91	MS	BENZENE	106	6					

Table F-8g
%Bias Groundwater
Volatile Organic Compounds

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B201189	4/5/91	MS	BENZENE	101	1					
B201189	4/5/91	MSD	BENZENE	110	10					
B405586	5/17/91	MS	BENZENE	110	10					
B405586	5/17/91	MSD	BENZENE	111	11					
B402189	5/20/91	MSD	BENZENE	83	17					
B402189	5/20/91	MS	BENZENE	87	13					
B102289	5/23/91	MS	BENZENE	94	6					
B102289	5/23/91	MSD	BENZENE	95	5					
B202589	5/31/91	MSD	BENZENE	85	15					
B202589	5/31/91	MS	BENZENE	87	13					
B402189	8/29/91	MS	BENZENE	93	7					
B402189	8/29/91	MSD	BENZENE	96	4					
B200889	9/13/91	MS	BENZENE	85	15					
B200889	9/13/91	MSD	BENZENE	87	13					
B102289	9/17/91	MSD	BENZENE	96	4					
B102289	9/17/91	MS	BENZENE	100	0					
B400289	9/19/91	MS	BENZENE	76	24					
B400289	9/19/91	MSD	BENZENE	79	21					
B202589	12/9/91	MS	BENZENE	107	7					
B202589	12/9/91	MSD	BENZENE	117	17					
B102289	12/12/91	MSD	BENZENE	106	6					
B102289	12/12/91	MS	BENZENE	107	7					
B302889	12/16/91	MS	BENZENE	97	3					
B302889	12/16/91	MSD	BENZENE	97	3					
B405586	12/18/91	MS	BENZENE	94	6					
B405586	12/18/91	MSD	BENZENE	97	3					
B402189	12/19/91	MSD	BENZENE	103	3					
B402189	12/19/91	MS	BENZENE	107	7	46	0	8.8	6.0	68.2
B405689	7/19/90	MS	CHLOROBENZENE	104	4					
B405689	7/19/90	MSD	CHLOROBENZENE	106	6					
B402189	7/20/90	MS	CHLOROBENZENE	95	5					
B402189	7/20/90	MSD	CHLOROBENZENE	97	3					
B203989	9/14/90	MS	CHLOROBENZENE	85	15					
B203989	9/14/90	MSD	CHLOROBENZENE	110	10					
B400489	10/5/90	MS	CHLOROBENZENE	99	1					
B400489	10/5/90	MSD	CHLOROBENZENE	103	3					
B200689	10/8/90	MS	CHLOROBENZENE	94	6					
B200689	10/8/90	MSD	CHLOROBENZENE	97	3					
B202589	11/1/90	MSD	CHLOROBENZENE	93	7					
B202589	11/1/90	MS	CHLOROBENZENE	99	1					
B405789	11/16/90	MSD	CHLOROBENZENE	96	4					
B405789	11/16/90	MS	CHLOROBENZENE	101	1					
B400289	11/29/90	MS	CHLOROBENZENE	90	10					
B400289	11/29/90	MSD	CHLOROBENZENE	97	3					
B402189	3/21/91	MSD	CHLOROBENZENE	101	1					
B402189	3/21/91	MS	CHLOROBENZENE	108	8					
B201189	4/5/91	MS	CHLOROBENZENE	100	0					
B201189	4/5/91	MSD	CHLOROBENZENE	110	10					
B405586	5/17/91	MS	CHLOROBENZENE	108	8					
B405586	5/17/91	MSD	CHLOROBENZENE	108	8					
B402189	5/20/91	MS	CHLOROBENZENE	94	6					
B402189	5/20/91	MSD	CHLOROBENZENE	95	5					
B102289	5/23/91	MSD	CHLOROBENZENE	94	6					
B102289	5/23/91	MS	CHLOROBENZENE	97	3					
B202589	5/31/91	MSD	CHLOROBENZENE	95	5					
B202589	5/31/91	MS	CHLOROBENZENE	97	3					
B402189	8/29/91	MS	CHLOROBENZENE	94	6					
B402189	8/29/91	MSD	CHLOROBENZENE	97	3					
B200889	9/13/91	MS	CHLOROBENZENE	90	10					
B200889	9/13/91	MSD	CHLOROBENZENE	91	9					
B102289	9/17/91	MSD	CHLOROBENZENE	126	26					
B102289	9/17/91	MS	CHLOROBENZENE	129	29					
B400289	9/19/91	MS	CHLOROBENZENE	82	18					
B400289	9/19/91	MSD	CHLOROBENZENE	83	17					

Table F-8g
%Bias Groundwater
Volatile Organic Compounds

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B202589	12/9/91	MS	CHLOROBENZENE	107	7					
B202589	12/9/91	MSD	CHLOROBENZENE	115	15					
B102289	12/12/91	MSD	CHLOROBENZENE	96	4					
B102289	12/12/91	MS	CHLOROBENZENE	98	2					
B302889	12/16/91	MS	CHLOROBENZENE	93	7					
B302889	12/16/91	MSD	CHLOROBENZENE	95	5					
B405586	12/18/91	MS	CHLOROBENZENE	85	15					
B405586	12/18/91	MSD	CHLOROBENZENE	89	11					
B402189	12/19/91	MSD	CHLOROBENZENE	89	11					
B402189	12/19/91	MS	CHLOROBENZENE	93	7	46	2	7.5	6.1	81.4
B405689	7/19/90	MSD	TOLUENE	101	1					
B405689	7/19/90	MS	TOLUENE	103	3					
B402189	7/20/90	MS	TOLUENE	88	12					
B402189	7/20/90	MSD	TOLUENE	89	11					
B203989	9/14/90	MS	TOLUENE	80	20					
B203989	9/14/90	MSD	TOLUENE	105	5					
B400489	10/5/90	MS	TOLUENE	94	6					
B400489	10/5/90	MSD	TOLUENE	96	4					
B200689	10/8/90	MS	TOLUENE	88	12					
B200689	10/8/90	MSD	TOLUENE	92	8					
B202589	11/1/90	MSD	TOLUENE	95	5					
B202589	11/1/90	MS	TOLUENE	104	4					
B405789	11/16/90	MSD	TOLUENE	103	3					
B405789	11/16/90	MS	TOLUENE	109	9					
B400289	11/29/90	MS	TOLUENE	90	10					
B400289	11/29/90	MSD	TOLUENE	97	3					
B402189	3/21/91	MSD	TOLUENE	103	3					
B402189	3/21/91	MS	TOLUENE	108	8					
B201189	4/5/91	MS	TOLUENE	104	4					
B201189	4/5/91	MSD	TOLUENE	106	6					
B405586	5/17/91	MS	TOLUENE	107	7					
B405586	5/17/91	MSD	TOLUENE	108	8					
B402189	5/20/91	MSD	TOLUENE	84	16					
B402189	5/20/91	MS	TOLUENE	91	9					
B102289	5/23/91	MS	TOLUENE	95	5					
B102289	5/23/91	MSD	TOLUENE	95	5					
B202589	5/31/91	MSD	TOLUENE	92	8					
B202589	5/31/91	MS	TOLUENE	93	7					
B402189	8/29/91	MSD	TOLUENE	95	5					
B402189	8/29/91	MS	TOLUENE	96	4					
B200889	9/13/91	MS	TOLUENE	85	15					
B200889	9/13/91	MSD	TOLUENE	86	14					
B102289	9/17/91	MSD	TOLUENE	123	23					
B102289	9/17/91	MS	TOLUENE	130	30					
B400289	9/19/91	MS	TOLUENE	80	20					
B400289	9/19/91	MSD	TOLUENE	84	16					
B202589	12/9/91	MS	TOLUENE	110	10					
B202589	12/9/91	MSD	TOLUENE	115	15					
B102289	12/12/91	MSD	TOLUENE	90	10					
B102289	12/12/91	MS	TOLUENE	96	4					
B302889	12/16/91	MS	TOLUENE	92	8					
B302889	12/16/91	MSD	TOLUENE	94	6					
B405586	12/18/91	MS	TOLUENE	86	14					
B405586	12/18/91	MSD	TOLUENE	89	11					
B402189	12/19/91	MSD	TOLUENE	92	8					
B402189	12/19/91	MS	TOLUENE	95	5	46	1	9.1	6.0	65.3
B405689	7/19/90	MS	TRICHLOROETHENE	102	2					
B405689	7/19/90	MSD	TRICHLOROETHENE	102	2					
B402189	7/20/90	MS	TRICHLOROETHENE	91	9					
B402189	7/20/90	MSD	TRICHLOROETHENE	94	6					
B203989	9/14/90	MS	TRICHLOROETHENE	86	14					
B203989	9/14/90	MSD	TRICHLOROETHENE	105	5					
B400489	10/5/90	MS	TRICHLOROETHENE	98	2					
B400489	10/5/90	MSD	TRICHLOROETHENE	101	1					

Table F-8g
%Bias Groundwater
Volatile Organic Compounds

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
B200689	10/8/90	MS	TRICHLOROETHENE	93	7					
B200689	10/8/90	MSD	TRICHLOROETHENE	96	4					
B202589	11/1/90	MSD	TRICHLOROETHENE	92	8					
B202589	11/1/90	MS	TRICHLOROETHENE	99	1					
B405789	11/16/90	MSD	TRICHLOROETHENE	94	6					
B405789	11/16/90	MS	TRICHLOROETHENE	100	0					
B400289	11/29/90	MS	TRICHLOROETHENE	91	9					
B400289	11/29/90	MSD	TRICHLOROETHENE	96	4					
B402189	3/21/91	MSD	TRICHLOROETHENE	94	6					
B402189	3/21/91	MS	TRICHLOROETHENE	102	2					
B201189	4/5/91	MS	TRICHLOROETHENE	95	5					
B201189	4/5/91	MSD	TRICHLOROETHENE	103	3					
B405586	5/17/91	MS	TRICHLOROETHENE	104	4					
B405586	5/17/91	MSD	TRICHLOROETHENE	105	5					
B402189	5/20/91	MSD	TRICHLOROETHENE	78	22					
B402189	5/20/91	MS	TRICHLOROETHENE	84	16					
B102289	5/23/91	MS	TRICHLOROETHENE	89	11					
B102289	5/23/91	MSD	TRICHLOROETHENE	91	9					
B202589	5/31/91	MSD	TRICHLOROETHENE	96	4					
B202589	5/31/91	MS	TRICHLOROETHENE	99	1					
B402189	8/29/91	MSD	TRICHLOROETHENE	94	6					
B402189	8/29/91	MS	TRICHLOROETHENE	96	4					
B200889	9/13/91	MS	TRICHLOROETHENE	86	14					
B200889	9/13/91	MSD	TRICHLOROETHENE	88	12					
B102289	9/17/91	MSD	TRICHLOROETHENE	104	4					
B102289	9/17/91	MS	TRICHLOROETHENE	108	8					
B400289	9/19/91	MS	TRICHLOROETHENE	75	25					
B400289	9/19/91	MSD	TRICHLOROETHENE	79	21					
B202589	12/9/91	MS	TRICHLOROETHENE	108	8					
B202589	12/9/91	MSD	TRICHLOROETHENE	113	13					
B102289	12/12/91	MS	TRICHLOROETHENE	99	1					
B102289	12/12/91	MSD	TRICHLOROETHENE	99	1					
B302889	12/16/91	MSD	TRICHLOROETHENE	89	11					
B302889	12/16/91	MS	TRICHLOROETHENE	91	9					
B405586	12/18/91	MS	TRICHLOROETHENE	86	14					
B405586	12/18/91	MSD	TRICHLOROETHENE	87	13					
B402189	12/19/91	MSD	TRICHLOROETHENE	88	12					
B402189	12/19/91	MS	TRICHLOROETHENE	96	4	46	0	7.6	5.9	77.7

Table F-9a
%Bias Stream Water
Dissolved Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SW107	10/1/90	S1	ALUMINUM	92	8					
SW127	11/1/90	S1	ALUMINUM	97	3					
SW006	12/3/90	S2	ALUMINUM	99.8	0.2					
SW131	1/3/91	S1	ALUMINUM	94.8	5.2					
SW005	10/1/91	SPK	ALUMINUM	93.7	6.3	5	0	4.54	3.03	66.73
SW107	10/1/90	S1	ANTIMONY	103.1	3.1					
SW127	11/1/90	S1	ANTIMONY	104.3	4.3					
SW006	12/3/90	S2	ANTIMONY	94.8	5.2					
SW131	1/3/91	S1	ANTIMONY	99.8	0.2					
SW005	10/1/91	SPK	ANTIMONY	106	6	5	0	3.76	2.26	60.20
SW107	10/1/90	S1	ARSENIC	97.5	2.5					
SW127	11/1/90	S1	ARSENIC	100	0					
SW006	12/3/90	S1	ARSENIC	147.5	47.5					
SW131	1/3/91	S1	ARSENIC	100	0	4	1	12.50	23.36	186.90
SW107	10/1/90	S1	BARIUM	94.1	5.9					
SW127	11/1/90	S1	BARIUM	103.8	3.8					
SW006	12/3/90	S2	BARIUM	97.3	2.7					
SW131	1/3/91	S1	BARIUM	94.3	5.7					
SW005	10/1/91	SPK	BARIUM	99.3	0.7	5	0	3.76	2.17	57.71
SW107	10/1/90	S1	BERYLLIUM	104.9	4.9					
SW127	11/1/90	S1	BERYLLIUM	110.2	10.2					
SW006	12/3/90	S1	BERYLLIUM	111.3	11.3					
SW131	1/3/91	S1	BERYLLIUM	101.6	1.6					
SW005	10/1/91	SPK	BERYLLIUM	104	4	5	0	6.40	4.17	65.13
SW107	10/1/90	S1	CADMIUM	96.4	3.6					
SW127	11/1/90	S1	CADMIUM	107.6	7.6					
SW006	12/3/90	S1	CADMIUM	97.4	2.6					
SW131	1/3/91	S1	CADMIUM	94	6					
SW005	10/1/91	SPK	CADMIUM	101	1	5	0	4.16	2.64	63.55
SW005	10/1/91	SPK	CALCIUM	97.6	2.4	1	0	NA	NA	NA
SW107	10/1/90	S1	CESIUM	95	5					
SW127	11/1/90	S1	CESIUM	110	10					
SW006	12/3/90	S1	CESIUM	90	10	3	0	6.85	3.79	55.31
SW107	10/1/90	S1	CHROMIUM	100.7	0.7					
SW127	11/1/90	S1	CHROMIUM	100.2	0.2					
SW006	12/3/90	S1	CHROMIUM	96.5	3.5					
SW131	1/3/91	S1	CHROMIUM	97.8	2.2					
SW005	10/1/91	SPK	CHROMIUM	99.2	0.8	5	0	1.48	1.35	91.33
SW107	10/1/90	S1	COBALT	95.6	4.4					
SW127	11/1/90	S1	COBALT	107	7					
SW006	12/3/90	S1	COBALT	99.2	0.8					
SW131	1/3/91	S1	COBALT	95.5	4.5					
SW005	10/1/91	SPK	COBALT	101	1	5	0	3.54	2.63	74.19
SW107	10/1/90	S1	COPPER	98.5	1.5					
SW127	11/1/90	S1	COPPER	101.9	1.9					
SW006	12/3/90	S1	COPPER	97.8	2.2					
SW131	1/3/91	S1	COPPER	98.8	1.2					
SW005	10/1/91	SPK	COPPER	102	2	5	0	1.76	0.40	22.94
SW107	10/1/90	S1	IRON	95.5	4.5					
SW127	11/1/90	S1	IRON	106.7	6.7					
SW006	12/3/90	S1	IRON	108	8					
SW131	1/3/91	S1	IRON	93.8	6.2					
SW005	10/1/91	SPK	IRON	101	1	5	0	5.28	2.70	51.16
SW107	10/1/90	S1	LEAD	112	12					
SW127	11/1/90	S1	LEAD	95.5	4.5					
SW006	12/3/90	S1	LEAD	43.3	56.7					
SW131	1/3/91	S1	LEAD	103	3	4	1	19.05	25.41	133.37
SW107	10/1/90	S1	LITHIUM	103.1	3.1					
SW127	11/1/90	S1	LITHIUM	100.4	0.4					
SW006	12/3/90	S1	LITHIUM	99.1	0.9					
SW131	1/3/91	S1	LITHIUM	98.8	1.2					
SW005	10/1/91	SPK	LITHIUM	99.4	0.6	5	0	1.24	1.08	87.34
SW005	10/1/91	SPK	MAGNESIUM	100	0	1	0	NA	NA	NA

Table F-9a
%Bias Stream Water
Dissolved Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SW107	10/1/90	S1	MANGANESE	99.3	0.7					
SW127	11/1/90	S1	MANGANESE	105.7	5.7					
SW006	12/3/90	S1	MANGANESE	96.6	3.4					
SW131	1/3/91	S1	MANGANESE	98.6	1.4					
SW005	10/1/91	SPK	MANGANESE	102	2	5	0	2.64	1.98	74.93
SW107	10/1/90	S1	MERCURY	73.8	26.2					
SW127	11/1/90	S1	MERCURY	107.6	7.6					
SW006	12/3/90	S1	MERCURY	81	19					
SW131	1/3/91	S1	MERCURY	73.7	26.3	4	2	19.78	8.81	44.54
SW107	10/1/90	S1	MOLYBDENUM	98.7	1.3					
SW127	11/1/90	S1	MOLYBDENUM	101.1	1.1					
SW006	12/3/90	S1	MOLYBDENUM	101.1	1.1					
SW131	1/3/91	S1	MOLYBDENUM	95.8	4.2					
SW005	10/1/91	SPK	MOLYBDENUM	101	1	5	0	1.74	1.38	79.28
SW107	10/1/90	S1	NICKEL	98.6	1.4					
SW127	11/1/90	S1	NICKEL	104.1	4.1					
SW006	12/3/90	S2	NICKEL	96.5	3.5					
SW131	1/3/91	S1	NICKEL	96.4	3.6					
SW005	10/1/91	SPK	NICKEL	105	5	5	0	3.52	1.33	37.66
SW005	10/1/91	SPK	POTASSIUM	94.6	5.4	1	0	NA	NA	NA
SW006	12/3/90	S1	SELENIUM	117.2	17.2	1	0	NA	NA	NA
SW006	12/3/90	S1	SILICON	96.5	3.5					
SW005	10/1/91	SPK	SILICON	102	2	2	0	2.75	1.06	38.57
SW107	10/1/90	S1	SILVER	94.1	5.9					
SW127	11/1/90	S1	SILVER	96.4	3.6					
SW006	12/3/90	S1	SILVER	94.1	5.9					
SW131	1/3/91	S1	SILVER	83.8	16.2					
SW005	10/1/91	SPK	SILVER	96.2	3.8	5	0	7.08	5.22	73.67
SW005	10/1/91	SPK	SODIUM	97.8	2.2	1	0	NA	NA	NA
SW107	10/1/90	S1	STRONTIUM	93.4	6.6					
SW127	11/1/90	S1	STRONTIUM	99.5	0.5					
SW006	12/3/90	S1	STRONTIUM	99.8	0.2					
SW131	1/3/91	S1	STRONTIUM	99.4	0.6					
SW005	10/1/91	SPK	STRONTIUM	102	2	5	0	1.98	2.67	135.07
SW107	10/1/90	S1	THALLIUM	74	26					
SW006	12/3/90	S2	THALLIUM	75.7	24.3					
SW131	1/3/91	S1	THALLIUM	98	2	3	1	17.43	38.80	222.57
SW107	10/1/90	S1	TIN	91.8	8.2					
SW127	11/1/90	S1	TIN	97.9	2.1					
SW131	1/3/91	S1	TIN	91.3	8.7					
SW005	10/1/91	SPK	TIN	102	2	4	0	5.25	3.70	70.49
SW107	10/1/90	S1	VANADIUM	96.3	3.7					
SW127	11/1/90	S1	VANADIUM	102.5	2.5					
SW006	12/3/90	S1	VANADIUM	98	2					
SW131	1/3/91	S1	VANADIUM	95.3	4.7					
SW005	10/1/91	SPK	VANADIUM	104	4	1	0	3.38	1.11	32.77
SW107	10/1/90	S1	ZINC	96.8	3.2					
SW127	11/1/90	S1	ZINC	108.4	8.4					
SW006	12/3/90	S2	ZINC	96	4					
SW131	1/3/91	S1	ZINC	92.2	7.8					
SW005	10/1/91	SPK	ZINC	103	3	5	0	5.28	2.61	49.43

Table F-9b
%Bias Stream Water
Total Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SW107	10/1/90	S1	ALUMINUM	90.5	9.5					
SW107	11/1/90	S1	ALUMINUM	97.7	2.3					
SW127	11/1/90	S1	ALUMINUM	94.1	5.9					
SW006	12/3/90	S1	ALUMINUM	97.2	2.8					
SW131	1/3/91	S1	ALUMINUM	90.6	9.4					
SW006	1/15/91	S1	ALUMINUM	95.7	4.3	6	0	5.70	3.17	55.53
SW107	10/1/90	S1	ANTIMONY	98.1	1.9					
SW107	11/1/90	S1	ANTIMONY	106.9	6.9					
SW127	11/1/90	S1	ANTIMONY	99.8	0.2					
SW006	12/3/90	S1	ANTIMONY	92.8	7.2					
SW131	1/3/91	S1	ANTIMONY	96.8	3.2					
SW006	1/15/91	S1	ANTIMONY	103.9	3.9	6	0	3.88	2.76	71.05
SW107	10/1/90	S1	ARSENIC	102.5	2.5					
SW107	11/1/90	S1	ARSENIC	97.5	2.5					
SW127	11/1/90	S1	ARSENIC	97.5	2.5					
SW006	12/3/90	S2	ARSENIC	144.5	44.5					
SW131	1/3/91	S1	ARSENIC	97.5	2.5					
SW006	1/15/91	S1	ARSENIC	87.5	12.5	6	1	11.17	16.81	150.56
SW107	10/1/90	S1	BARIUM	90.5	9.5					
SW107	11/1/90	S1	BARIUM	104.7	4.7					
SW127	11/1/90	S1	BARIUM	97.8	2.2					
SW006	12/3/90	S2	BARIUM	96.6	3.4					
SW131	1/3/91	S1	BARIUM	90.6	9.4					
SW006	1/15/91	S1	BARIUM	98.9	1.1	6	0	5.05	3.61	71.56
SW107	10/1/90	S1	BERYLLIUM	101.9	1.9					
SW107	11/1/90	S1	BERYLLIUM	110.4	10.4					
SW127	11/1/90	S1	BERYLLIUM	103.3	3.3					
SW006	12/3/90	S1	BERYLLIUM	112	12					
SW131	1/3/91	S1	BERYLLIUM	98.5	1.5					
SW006	1/15/91	S1	BERYLLIUM	102.1	2.1	6	0	5.20	4.71	90.64
SW107	10/1/90	S1	CADMIUM	91.1	8.9					
SW107	11/1/90	S1	CADMIUM	115.3	15.3					
SW127	11/1/90	S1	CADMIUM	102.1	2.1					
SW006	12/3/90	S1	CADMIUM	97.1	2.9					
SW131	1/3/91	S1	CADMIUM	91.1	8.9					
SW006	1/15/91	S1	CADMIUM	100.6	0.6	6	0	6.45	5.59	86.62
SW107	10/1/90	S1	CESIUM	100	0					
SW107	11/1/90	S1	CESIUM	100	0					
SW127	11/1/90	S1	CESIUM	95	5					
SW006	12/3/90	S2	CESIUM	85	15					
SW131	1/3/91	S1	CESIUM	105	5					
SW006	1/15/91	S1	CESIUM	90	10	6	0	5.83	5.85	100.20
SW107	10/1/90	S1	CHROMIUM	95.6	4.4					
SW107	11/1/90	S1	CHROMIUM	106.5	6.5					
SW127	11/1/90	S1	CHROMIUM	99.6	0.4					
SW006	12/3/90	S1	CHROMIUM	98.7	1.3					
SW131	1/3/91	S1	CHROMIUM	95.9	4.1					
SW006	1/15/91	S1	CHROMIUM	101.9	1.9	6	0	3.10	2.29	73.87
SW107	10/1/90	S1	COBALT	92	8					
SW107	11/1/90	S1	COBALT	110.6	10.6					
SW127	11/1/90	S1	COBALT	100.3	0.3					
SW006	12/3/90	S2	COBALT	97.9	2.1					
SW131	1/3/91	S1	COBALT	92.5	7.5					
SW006	1/15/91	S1	COBALT	99.3	0.7	6	0	4.87	4.37	89.80
SW107	10/1/90	S1	COPPER	94.4	5.6					
SW107	11/1/90	S1	COPPER	103	3					
SW127	11/1/90	S1	COPPER	106.9	6.9					
SW006	12/3/90	S2	COPPER	98.6	1.4					
SW131	1/3/91	S1	COPPER	93.9	6.1					
SW006	1/15/91	S1	COPPER	99.4	0.6	6	0	3.93	2.63	66.95
SW107	10/1/90	S1	CYANIDE	103	3					
SW107	11/1/90	S1	CYANIDE	96	4					
SW127	11/1/90	S1	CYANIDE	101.5	1.5					
SW131	1/3/91	S1	CYANIDE	99	1					

Table F-9b
%Bias Stream Water
Total Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SW006	1/15/91	S1	CYANIDE	97	3	5	0	2.50	1.22	48.99
SW107	10/1/90	S1	IRON	95.2	4.8					
SW107	11/1/90	S1	IRON	106.6	6.6					
SW127	11/1/90	S1	IRON	95.7	4.3					
SW006	12/3/90	S1	IRON	95.9	4.1					
SW131	1/3/91	S1	IRON	92.2	7.8					
SW006	1/15/91	S1	IRON	95.5	4.5	6	0	5.35	1.50	28.04
SW107	10/1/90	S1	LEAD	104.5	4.5					
SW107	11/1/90	S1	LEAD	95	5					
SW127	11/1/90	S1	LEAD	92	8					
SW006	12/3/90	S2	LEAD	45.3	54.7					
SW131	1/3/91	S1	LEAD	110	10					
SW006	1/15/91	S1	LEAD	102	2	6	1	14.03	20.12	143.36
SW107	10/1/90	S1	LITHIUM	99.9	0.1					
SW107	11/1/90	S1	LITHIUM	94	6					
SW127	11/1/90	S1	LITHIUM	89.5	10.5					
SW006	12/3/90	S1	LITHIUM	97.8	2.2					
SW131	1/3/91	S1	LITHIUM	95.8	4.2					
SW006	1/15/91	S1	LITHIUM	96.4	3.6	6	0	4.43	3.57	80.56
SW107	10/1/90	S1	MANGANESE	97.3	2.7					
SW107	11/1/90	S1	MANGANESE	107	7					
SW127	11/1/90	S1	MANGANESE	99.7	0.3					
SW006	12/3/90	S1	MANGANESE	98.4	1.6					
SW131	1/3/91	S1	MANGANESE	95.8	4.2					
SW006	1/15/91	S1	MANGANESE	99.9	0.1	6	0	2.65	2.63	99.06
SW107	10/1/90	S1	MERCURY	75.9	24.1					
SW107	11/1/90	S1	MERCURY	109.9	9.9					
SW127	11/1/90	S1	MERCURY	92.8	7.2					
SW006	12/3/90	S1	MERCURY	103	3					
SW131	1/3/91	S1	MERCURY	80.7	19.3					
SW006	1/15/91	S1	MERCURY	107.5	7.5	6	0	11.83	8.10	68.47
SW107	10/1/90	S1	MOLYBDENUM	94.5	5.5					
SW107	11/1/90	S1	MOLYBDENUM	98.9	1.1					
SW127	11/1/90	S1	MOLYBDENUM	90.4	9.6					
SW006	12/3/90	S1	MOLYBDENUM	101.3	1.3					
SW131	1/3/91	S1	MOLYBDENUM	92.2	7.8					
SW006	1/15/91	S1	MOLYBDENUM	98	2	6	0	4.55	3.63	79.81
SW107	10/1/90	S1	NICKEL	94.6	5.4					
SW107	11/1/90	S1	NICKEL	107.1	7.1					
SW127	11/1/90	S1	NICKEL	99.6	0.4					
SW006	12/3/90	S2	NICKEL	99.3	0.7					
SW131	1/3/91	S1	NICKEL	93.2	6.8					
SW006	1/15/91	S1	NICKEL	98.9	1.1	6	0	3.58	3.18	88.80
SW107	10/1/90	S1	SELENIUM	110	10					
SW107	11/1/90	S1	SELENIUM	100	0					
SW127	11/1/90	S1	SELENIUM	100	0					
SW006	12/3/90	S1	SELENIUM	117.6	17.6					
SW131	1/3/91	S1	SELENIUM	90	10					
SW006	1/15/91	S1	SELENIUM	100	0	6	0	6.27	7.40	118.16
SW006	12/3/90	S2	SILICON	96.4	3.6	1	0	NA	NA	NA
SW107	10/1/90	S1	SILVER	94.6	5.4					
SW107	11/1/90	S1	SILVER	106.2	6.2					
SW127	11/1/90	S1	SILVER	96.2	3.8					
SW006	12/3/90	S1	SILVER	98.4	1.6					
SW131	1/3/91	S1	SILVER	86	14					
SW006	1/15/91	S1	SILVER	92.5	7.5	6	0	6.42	4.24	66.05
SW107	10/1/90	S1	STRONTIUM	89.6	10.4					
SW107	11/1/90	S1	STRONTIUM	95.6	4.4					
SW127	11/1/90	S1	STRONTIUM	91.1	8.9					
SW006	12/3/90	S2	STRONTIUM	94.2	5.8					
SW131	1/3/91	S1	STRONTIUM	96.6	3.4					
SW006	1/15/91	S1	STRONTIUM	100.2	0.2	6	0	5.52	3.72	67.52
SW107	10/1/90	S1	THALLIUM	52	48					
SW107	11/1/90	S1	THALLIUM	100	0					

Table F-9b
%Bias Stream Water
Total Metals

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SW127	11/1/90	S1	THALLIUM	76	24					
SW006	12/3/90	S1	THALLIUM	71.7	28.3					
SW131	1/3/91	S1	THALLIUM	86	14					
SW006	1/15/91	S1	THALLIUM	90	10	6	2	20.72	16.74	80.82
SW107	10/1/90	S1	TIN	90.7	9.3					
SW107	11/1/90	S1	TIN	97.8	2.2					
SW127	11/1/90	S1	TIN	95.1	4.9					
SW131	1/3/91	S1	TIN	89	11					
SW006	1/15/91	S1	TIN	90.7	9.3	5	0	7.34	3.66	49.80
SW107	10/1/90	S1	VANADIUM	96.4	3.6					
SW107	11/1/90	S1	VANADIUM	104.4	4.4					
SW127	11/1/90	S1	VANADIUM	98.6	1.4					
SW006	12/3/90	S1	VANADIUM	99.6	0.4					
SW131	1/3/91	S1	VANADIUM	92.7	7.3					
SW006	1/15/91	S1	VANADIUM	98.6	1.4	6	0	3.08	2.56	82.88
SW107	10/1/90	S1	ZINC	94.7	5.3					
SW107	11/1/90	S1	ZINC	111.9	11.9					
SW127	11/1/90	S1	ZINC	101.1	1.1					
SW006	12/3/90	S1	ZINC	97.3	2.7					
SW131	1/3/91	S1	ZINC	90.7	9.3					
SW006	1/15/91	S1	ZINC	94.2	5.8	6	0	6.02	4.03	66.95

Table F-9c
%Bias Stream Water
Anions, Cyanide, and Water Quality Parameters

Location	Date	ID	Analyte	%R	%Bias
SW006	12/3/90	MS	CHLORIDE	118	18
SW006	12/3/90	MSD	CHLORIDE	118	18
SW006	12/3/90	MS	FLUORIDE	100	0
SW006	12/3/90	MSD	FLUORIDE	104	4
SW131	10/2/90	MSD	NITRATE	104.8	4.8
SW131	10/2/90	MS	NITRATE	107.2	7.2
SW006	12/3/90	MS	NITRATE/NITRITE	111	11
SW006	12/3/90	MSD	NITRATE/NITRITE	121	21
SW107	6/3/91	MSD	NITRATE/NITRITE	78.5	21.5
SW006	12/3/90	MS	NITRITE	100	0
SW006	12/3/90	MSD	NITRITE	100	0
SW006	12/3/90	MS	PHOSPHORUS	108	8
SW006	12/3/90	MSD	PHOSPHORUS	110	10
SW006	12/3/90	MS	SULFATE	100	0
SW006	12/3/90	MSD	SULFATE	100	0

Table F-9d
%Bias Stream Water
Anions, Cyanide, and Water Quality Parameters

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SW107	10/1/90	S	BICARBONATE AS CACO3	92	8					
SW107	11/1/90	S	BICARBONATE AS CACO3	94	6					
SW127	11/1/90	S	BICARBONATE AS CACO3	90	10					
SW131	1/3/91	S	BICARBONATE AS CACO3	90	10					
SW006	1/15/91	S	BICARBONATE AS CACO3	92	8	5	0	8.40	1.67	19.92
SW107	10/1/90	S	CARBONATE AS CACO3	92	8					
SW107	11/1/90	S	CARBONATE AS CACO3	94	6					
SW131	1/3/91	S	CARBONATE AS CACO3	90	10					
SW006	1/15/91	S	CARBONATE AS CACO3	92	8	4	0	8.00	1.63	20.41
SW107	10/1/90	S	CHLORIDE	98	2					
SW107	11/1/90	S	CHLORIDE	98	2					
SW127	11/1/90	S	CHLORIDE	101	1					
SW131	1/3/91	S	CHLORIDE	103	3					
SW006	1/15/91	S	CHLORIDE	99	1	5	0	1.80	0.84	46.48
SW006	12/3/90	S1	CYANIDE	93	7					
SW107	6/3/91	SPK	CYANIDE	101	1					
SW041	6/4/91	SPK	CYANIDE	101	1					
SW005	9/4/91	SPK	CYANIDE	87.1	12.9	4	0	5.48	5.70	104.13
SW107	10/1/90	S	FLUORIDE	108	8					
SW107	11/1/90	S	FLUORIDE	90	10					
SW127	11/1/90	S	FLUORIDE	99	1					
SW131	1/3/91	S	FLUORIDE	93	7					
SW006	1/15/91	S	FLUORIDE	107	7					
SW041	6/4/91	SPK	FLUORIDE	98.4	1.6					
SW131	6/4/91	SPK	FLUORIDE	104	4					
SW005	8/1/91	SPK	FLUORIDE	93.2	6.8					
SW006	9/4/91	SPK	FLUORIDE	96.4	3.6	9	0	5.44	3.04	55.86
SW107	10/1/90	S	NITRATE/NITRITE	93	7					
SW107	11/1/90	S	NITRATE/NITRITE	86	14					
SW127	11/1/90	S	NITRATE/NITRITE	91	9					
SW131	1/3/91	S	NITRATE/NITRITE	96	4					
SW006	1/15/91	S	NITRATE/NITRITE	98	2					
SW107	6/3/91	SPK	NITRATE/NITRITE	74.3	25.7					
SW005	8/1/91	SPK	NITRATE/NITRITE	83.8	16.2	7	1	11.13	8.19	73.55
SW107	10/1/90	S	NITRITE	92	8					
SW107	11/1/90	S	NITRITE	89	11					
SW127	11/1/90	S	NITRITE	90	10					
SW006	1/15/91	S	NITRITE	95	5					
SW007	6/3/91	SPK	NITRITE	96	4					
SW005	6/10/91	SPK	NITRITE	97	3					
SW005	8/1/91	SPK	NITRITE	91	9					
SW041	8/5/91	SPK	NITRITE	95	5					
SW005	9/4/91	SPK	NITRITE	81	19					
SW005	10/1/91	SPK	NITRITE	92	8	10	0	8.20	4.64	56.56
SW107	10/1/90	S	ORTHOPHOSPHATE	97	3					
SW107	11/1/90	S	ORTHOPHOSPHATE	100	0					
SW127	11/1/90	S	ORTHOPHOSPHATE	92	8					
SW006	1/15/91	S	ORTHOPHOSPHATE	100	0					
SW007	6/3/91	SPK	ORTHOPHOSPHATE	107	7					
SW005	8/1/91	SPK	ORTHOPHOSPHATE	109	9					
SW041	8/5/91	SPK	ORTHOPHOSPHATE	110	10					
SW005	9/4/91	SPK	ORTHOPHOSPHATE	101	1					
SW005	10/1/91	SPK	ORTHOPHOSPHATE	108	8	9	0	5.11	4.08	79.74
SW107	10/1/90	S	PHOSPHORUS	97	3					
SW107	11/1/90	S	PHOSPHORUS	86	14					
SW127	11/1/90	S	PHOSPHORUS	86	14					
SW131	1/3/91	S	PHOSPHORUS	96	4					
SW006	1/15/91	S	PHOSPHORUS	96	4					
SW041	8/5/91	SPK	PHOSPHORUS	89	11					
SW005	10/1/91	SPK	PHOSPHORUS	105	5	7	0	7.86	4.95	62.97
SW107	10/1/90	S	SILICA	92	8					
SW107	11/1/90	S	SILICA	94	6					
SW127	11/1/90	S	SILICA	90	10					
SW131	1/3/91	S	SILICA	114	14					

Table F-9d
%Bias Stream Water
Anions, Cyanide, and Water Quality Parameters

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SW006	1/15/91	S	SILICA	113	13	5	0	10.20	3.35	32.81
SW107	10/1/90	S	SULFATE	101	1					
SW107	11/1/90	S	SULFATE	101	1					
SW127	11/1/90	S	SULFATE	97	3					
SW131	1/3/91	S	SULFATE	100	0					
SW006	1/15/91	S	SULFATE	100	0					
SW005	8/1/91	SPK	SULFATE	90.9	9.1					
SW041	8/5/91	SPK	SULFATE	111	11	7	0	3.59	4.56	127.20
SW107	11/1/90	S	SULFIDE	90	10					
SW127	11/1/90	S	SULFIDE	80	20					
SW131	1/3/91	S	SULFIDE	80	20					
SW006	1/15/91	S	SULFIDE	80	20					
SW004	6/5/91	SPK	SULFIDE	96.2	3.8					
SW127	8/1/91	SPK	SULFIDE	93.5	6.5	6	0	13.38	7.51	56.12
SW006	6/5/91	SPK	TOTAL DISSOLVED SOLIDS	89.6	10.4					
SW005	6/10/91	SPK	TOTAL DISSOLVED SOLIDS	96.8	3.2					
SW006	10/1/91	SPK	TOTAL DISSOLVED SOLIDS	102	2	3	0	5.20	4.54	87.37
SW006	1/15/91	S2	TOTAL ORGANIC CARBON	101	1	1	0	NA	NA	NA

Table F-9e
%Bias Stream Water
Volatile Organic Compounds

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SW107	10/1/90	MS	1,1-DICHLOROETHENE	96	4					
SW107	10/1/90	MSD	1,1-DICHLOROETHENE	101	1					
SW107	11/1/90	MSD	1,1-DICHLOROETHENE	84	16					
SW107	11/1/90	MS	1,1-DICHLOROETHENE	88	12					
SW127	11/1/90	MS	1,1-DICHLOROETHENE	101	1					
SW127	11/1/90	MSD	1,1-DICHLOROETHENE	112	12					
SW006	12/3/90	MSD	1,1-DICHLOROETHENE	106	6					
SW006	12/3/90	MS	1,1-DICHLOROETHENE	107	7					
SW131	1/3/91	MS	1,1-DICHLOROETHENE	143	43					
SW131	1/3/91	MSD	1,1-DICHLOROETHENE	145	45					
SW006	1/15/91	MS	1,1-DICHLOROETHENE	48	52					
SW006	1/15/91	MSD	1,1-DICHLOROETHENE	51	49					
SW107	6/3/91	MSD	1,1-DICHLOROETHENE	93	7					
SW107	6/3/91	MS	1,1-DICHLOROETHENE	95	5					
SW005	9/4/91	MS	1,1-DICHLOROETHENE	98	2					
SW005	9/4/91	MSD	1,1-DICHLOROETHENE	102	2					
SW006	10/1/91	MS	1,1-DICHLOROETHENE	61	39					
SW006	10/1/91	MSD	1,1-DICHLOROETHENE	79	21	18	5	18.00	18.53	102.95
SW107	10/1/90	MS	BENZENE	86	14					
SW107	10/1/90	MSD	BENZENE	87	13					
SW107	11/1/90	MSD	BENZENE	90	10					
SW107	11/1/90	MS	BENZENE	94	6					
SW127	11/1/90	MS	BENZENE	83	17					
SW127	11/1/90	MSD	BENZENE	84	16					
SW006	12/3/90	MSD	BENZENE	99	1					
SW006	12/3/90	MS	BENZENE	103	3					
SW131	1/3/91	MSD	BENZENE	107	7					
SW131	1/3/91	MS	BENZENE	111	11					
SW006	1/15/91	MS	BENZENE	91	9					
SW006	1/15/91	MSD	BENZENE	92	8					
SW107	6/3/91	MS	BENZENE	92	8					
SW107	6/3/91	MSD	BENZENE	96	4					
SW005	9/4/91	MS	BENZENE	84	16					
SW005	9/4/91	MSD	BENZENE	92	8					
SW006	10/1/91	MS	BENZENE	93	7					
SW006	10/1/91	MSD	BENZENE	124	24	18	0	10.11	5.72	56.55
SW107	10/1/90	MS	CHLOROBENZENE	94	6					
SW107	10/1/90	MSD	CHLOROBENZENE	96	4					
SW107	11/1/90	MSD	CHLOROBENZENE	96	4					
SW107	11/1/90	MS	CHLOROBENZENE	99	1					
SW127	11/1/90	MS	CHLOROBENZENE	95	5					
SW127	11/1/90	MSD	CHLOROBENZENE	101	1					
SW006	12/3/90	MSD	CHLOROBENZENE	96	4					
SW006	12/3/90	MS	CHLOROBENZENE	99	1					
SW131	1/3/91	MSD	CHLOROBENZENE	115	15					
SW131	1/3/91	MS	CHLOROBENZENE	118	18					
SW006	1/15/91	MS	CHLOROBENZENE	101	1					
SW006	1/15/91	MSD	CHLOROBENZENE	106	6					
SW107	6/3/91	MSD	CHLOROBENZENE	94	6					
SW107	6/3/91	MS	CHLOROBENZENE	95	5					
SW005	9/4/91	MS	CHLOROBENZENE	86	14					
SW005	9/4/91	MSD	CHLOROBENZENE	92	8					
SW006	10/1/91	MS	CHLOROBENZENE	106	6					
SW006	10/1/91	MSD	CHLOROBENZENE	136	36	18	1	7.83	8.56	109.31
SW107	10/1/90	MS	TOLUENE	93	7					
SW107	10/1/90	MSD	TOLUENE	94	6					
SW107	11/1/90	MSD	TOLUENE	89	11					
SW107	11/1/90	MS	TOLUENE	97	3					
SW127	11/1/90	MS	TOLUENE	87	13					
SW127	11/1/90	MSD	TOLUENE	90	10					
SW006	12/3/90	MSD	TOLUENE	100	0					
SW006	12/3/90	MS	TOLUENE	104	4					
SW131	1/3/91	MSD	TOLUENE	126	26					
SW131	1/3/91	MS	TOLUENE	129	29					

Table F-9e
%Bias Stream Water
Volatile Organic Compounds

Location	Date	ID	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SW006	1/15/91	MS	TOLUENE	97	3					
SW006	1/15/91	MSD	TOLUENE	108	8					
SW107	6/3/91	MS	TOLUENE	88	12					
SW107	6/3/91	MSD	TOLUENE	91	9					
SW005	9/4/91	MS	TOLUENE	81	19					
SW005	9/4/91	MSD	TOLUENE	85	15					
SW006	10/1/91	MS	TOLUENE	99	1					
SW006	10/1/91	MSD	TOLUENE	126	26	18	2	11.22	8.78	78.26
SW107	10/1/90	MS	TRICHLOROETHENE	93	7					
SW107	10/1/90	MSD	TRICHLOROETHENE	99	1					
SW107	11/1/90	MSD	TRICHLOROETHENE	101	1					
SW107	11/1/90	MS	TRICHLOROETHENE	105	5					
SW127	11/1/90	MS	TRICHLOROETHENE	96	4					
SW127	11/1/90	MSD	TRICHLOROETHENE	99	1					
SW006	12/3/90	MSD	TRICHLOROETHENE	91	9					
SW006	12/3/90	MS	TRICHLOROETHENE	93	7					
SW131	1/3/91	MS	TRICHLOROETHENE	118	18					
SW131	1/3/91	MSD	TRICHLOROETHENE	119	19					
SW006	1/15/91	MS	TRICHLOROETHENE	99	1					
SW006	1/15/91	MSD	TRICHLOROETHENE	104	4					
SW107	6/3/91	MS	TRICHLOROETHENE	85	15					
SW107	6/3/91	MSD	TRICHLOROETHENE	85	15					
SW005	9/4/91	MS	TRICHLOROETHENE	82	18					
SW005	9/4/91	MSD	TRICHLOROETHENE	86	14					
SW006	10/1/91	MS	TRICHLOROETHENE	90	10					
SW006	10/1/91	MSD	TRICHLOROETHENE	116	16	18	0	9.17	6.59	71.90

Table F-9f
%Bias Stream Water
Semivolatile Organic Compounds

Location	Date	ID	Analyte	%R	%Bias
SW107	10/1/90	MS	1,2,4-TRICHLOROBENZENE	43	57
SW107	10/1/90	MSD	1,2,4-TRICHLOROBENZENE	49	51
SW107	10/1/90	MS	1,4-DICHLOROBENZENE	33	67
SW107	10/1/90	MSD	1,4-DICHLOROBENZENE	39	61
SW107	10/1/90	MS	2,4-DINITROTOLUENE	46	54
SW107	10/1/90	MSD	2,4-DINITROTOLUENE	51	49
SW107	10/1/90	MS	2-CHLOROPHENOL	46	54
SW107	10/1/90	MSD	2-CHLOROPHENOL	48	52
SW107	10/1/90	MS	4-CHLORO-3-METHYLPHENOL	61	39
SW107	10/1/90	MSD	4-CHLORO-3-METHYLPHENOL	64	36
SW107	10/1/90	MS	4-NITROPHENOL	0	100
SW107	10/1/90	MSD	4-NITROPHENOL	0	100
SW107	10/1/90	MS	ACENAPHTHENE	48	52
SW107	10/1/90	MSD	ACENAPHTHENE	55	45
SW107	10/1/90	MS	N-NITROSO-DI-n-PROPYLAMINE	38	62
SW107	10/1/90	MSD	N-NITROSO-DI-n-PROPYLAMINE	40	60
SW107	10/1/90	MS	PENTACHLOROPHENOL	56	44
SW107	10/1/90	MSD	PENTACHLOROPHENOL	60	40
SW107	10/1/90	MS	PHENOL	20	80
SW107	10/1/90	MSD	PHENOL	22	78
SW107	10/1/90	MS	PYRENE	76	24
SW107	10/1/90	MSD	PYRENE	77	23

Table F-9g
%Bias Stream Water
Pesticides and PCBs

Location	Date	ID	Analyte	%R	%Bias
SW107	10/1/90	MSD	4,4'-DDT	103	3
SW107	10/1/90	MS	4,4'-DDT	109	9
SW005	10/1/91	MS	4,4'-DDT	109	9
SW005	10/1/91	MSD	4,4'-DDT	117	17
SW107	10/1/90	MSD	ALDRIN	94	6
SW107	10/1/90	MS	ALDRIN	98	2
SW005	10/1/91	MS	ALDRIN	80	20
SW005	10/1/91	MSD	ALDRIN	80	20
SW107	10/1/90	MSD	DIELDRIN	104	4
SW107	10/1/90	MS	DIELDRIN	111	11
SW005	10/1/91	MS	DIELDRIN	103	3
SW005	10/1/91	MSD	DIELDRIN	103	3
SW107	10/1/90	MSD	ENDRIN	101	1
SW107	10/1/90	MS	ENDRIN	106	6
SW005	10/1/91	MS	ENDRIN	108	8
SW005	10/1/91	MSD	ENDRIN	112	12
SW107	10/1/90	MSD	gamma-BHC (LINDANE)	124	24
SW107	10/1/90	MS	gamma-BHC (LINDANE)	130	30
SW005	10/1/91	MS	gamma-BHC (LINDANE)	109	9
SW005	10/1/91	MSD	gamma-BHC (LINDANE)	109	9
SW107	10/1/90	MSD	HEPTACHLOR	96	4
SW107	10/1/90	MS	HEPTACHLOR	101	1
SW005	10/1/91	MS	HEPTACHLOR	99	1
SW005	10/1/91	MSD	HEPTACHLOR	99	1

Table F-10a
%Bias Stream Sediment
Metals

Location	Date	Analyte	%R	%Bias
SED023	11/12/1990	ALUMINUM	56.9	43.1
SED023	11/12/1990	ANTIMONY	92.3	7.7
SED017	08/05/1991	ANTIMONY	64.4	35.6
SED017	08/05/1991	ARSENIC	80.0	20.0
SED023	11/12/1990	ARSENIC	115.8	15.8
SED017	08/05/1991	BARIUM	101.0	1.0
SED023	11/12/1990	BARIUM	94.8	5.2
SED017	08/05/1991	BERYLLIUM	96.5	3.5
SED023	11/12/1990	BERYLLIUM	99.6	0.4
SED017	08/05/1991	CADMIUM	94.1	5.9
SED023	11/12/1990	CADMIUM	90.7	9.3
SED017	08/05/1991	CESIUM	107.5	7.5
SED017	08/05/1991	CHROMIUM	89.6	10.4
SED023	11/12/1990	CHROMIUM	99.6	0.4
SED017	08/05/1991	COBALT	98.8	1.2
SED023	11/12/1990	COBALT	96.2	3.8
SED017	08/05/1991	COPPER	95.9	4.1
SED023	11/12/1990	COPPER	92.4	7.6
SED023	11/12/1990	IRON	1652.9	1552.9
SED023	11/12/1990	LEAD	171.7	71.7
SED017	08/05/1991	LEAD	106.4	6.4
SED017	08/05/1991	LITHIUM	98.0	2.0
SED023	11/12/1990	LITHIUM	95.3	4.7
SED017	08/05/1991	MANGANESE	90.1	9.9
SED023	11/12/1990	MANGANESE	95.9	4.1
SED017	08/05/1991	MERCURY	83.5	16.5
SED023	11/12/1990	MERCURY	108.2	8.2
SED023	11/12/1990	MOLYBDENUM	98.3	1.7
SED017	08/05/1991	MOLYBDENUM	96.5	3.5
SED023	11/12/1990	NICKEL	98.6	1.4
SED017	08/05/1991	NICKEL	96.7	3.3
SED017	08/05/1991	SELENIUM	80.1	19.9
SED023	11/12/1990	SELENIUM	72.3	27.7
SED023	11/12/1990	SILVER	92.3	7.7
SED017	08/05/1991	SILVER	90.7	9.3
SED017	08/05/1991	STRONTIUM	96.1	3.9
SED023	11/12/1990	STRONTIUM	97.9	2.1
SED023	11/12/1990	THALLIUM	114.0	14.0
SED017	08/05/1991	THALLIUM	98.0	2.0
SED017	08/05/1991	TIN	96.2	3.8
SED017	08/05/1991	VANADIUM	91.7	8.3
SED023	11/12/1990	VANADIUM	93.8	6.2
SED023	11/12/1990	ZINC	93.2	6.8
SED017	08/05/1991	ZINC	90.1	9.9

Table F-10b
%Bias Stream Sediment
Volatile Organic Compounds

Location	Date	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SED004	08/05/1991	1,1-DICHLOROETHENE	118	18					
SED004	08/05/1991	1,1-DICHLOROETHENE	127	27					
SED004	11/06/1990	1,1-DICHLOROETHENE	109	9					
SED004	11/06/1990	1,1-DICHLOROETHENE	106	6					
SED023	11/12/1990	1,1-DICHLOROETHENE	160	60					
SED023	11/12/1990	1,1-DICHLOROETHENE	161	61	6	3	30.17	22.48	74.50
SED004	08/05/1991	BENZENE	111	11					
SED004	08/05/1991	BENZENE	111	11					
SED004	11/06/1990	BENZENE	91	9					
SED004	11/06/1990	BENZENE	97	3					
SED023	11/12/1990	BENZENE	108	8					
SED023	11/12/1990	BENZENE	109	9	6	0	8.50	2.69	31.68
SED004	08/05/1991	CHLOROBENZENE	117	17					
SED004	08/05/1991	CHLOROBENZENE	105	5					
SED004	11/06/1990	CHLOROBENZENE	108	8					
SED004	11/06/1990	CHLOROBENZENE	99	1					
SED023	11/12/1990	CHLOROBENZENE	123	23					
SED023	11/12/1990	CHLOROBENZENE	128	28	6	1	13.67	9.76	71.40
SED004	08/05/1991	TOLUENE	113	13					
SED004	08/05/1991	TOLUENE	105	5					
SED004	11/06/1990	TOLUENE	114	14					
SED004	11/06/1990	TOLUENE	106	6					
SED023	11/12/1990	TOLUENE	108	8					
SED023	11/12/1990	TOLUENE	109	9	6	0	9.17	3.34	36.41
SED004	08/05/1991	TRICHLOROETHENE	110	10					
SED004	08/05/1991	TRICHLOROETHENE	111	11					
SED004	11/06/1990	TRICHLOROETHENE	100	0					
SED004	11/06/1990	TRICHLOROETHENE	104	4					
SED023	11/12/1990	TRICHLOROETHENE	119	19					
SED023	11/12/1990	TRICHLOROETHENE	118	18	6	0	10.33	6.85	66.27

Table F-10c
%Bias Stream Sediment
Semivolatile Organic Compounds

Location	Date	Analyte	%R	%Bias
SED017	08/05/1991	1,2,4-TRICHLOROBENZENE	88	12
SED023	11/12/1990	1,2,4-TRICHLOROBENZENE	69	31
SED017	08/05/1991	1,4-DICHLOROBENZENE	77	23
SED023	11/12/1990	1,4-DICHLOROBENZENE	64	36
SED017	08/05/1991	2,4-DINITROTOLUENE	85	15
SED023	11/12/1990	2,4-DINITROTOLUENE	57	43
SED017	08/05/1991	2-CHLOROPHENOL	96	4
SED023	11/12/1990	2-CHLOROPHENOL	70	30
SED017	08/05/1991	4-CHLORO-3-METHYLPHENOL	85	15
SED023	11/12/1990	4-CHLORO-3-METHYLPHENOL	69	31
SED017	08/05/1991	4-NITROPHENOL	87	13
SED023	11/12/1990	4-NITROPHENOL	62	38
SED017	08/05/1991	ACENAPHTHENE	81	19
SED023	11/12/1990	ACENAPHTHENE	61	39
SED017	08/05/1991	N-NITROSO-DI-n-PROPYLAMINE	64	36
SED023	11/12/1990	N-NITROSO-DI-n-PROPYLAMINE	52	48
SED017	08/05/1991	PENTACHLOROPHENOL	72	28
SED023	11/12/1990	PENTACHLOROPHENOL	72	28
SED017	08/05/1991	PHENOL	84	16
SED023	11/12/1990	PHENOL	56	44
SED017	08/05/1991	PYRENE	72	28
SED023	11/12/1990	PYRENE	74	26

Table F-10d
%Bias Stream Sediment
Pesticides and PCBs

Location	Date	Analyte	%R	%Bias	N	N>25%	Avg %Bias	StDev	%CV
SED004	11/06/1990	4,4'-DDT	43	57					
SED004	11/06/1990	4,4'-DDT	49	51					
SED017	08/05/1991	4,4'-DDT	63	37					
SED017	08/05/1991	4,4'-DDT	100	0					
SED023	11/12/1990	4,4'-DDT	118	18					
SED023	11/12/1990	4,4'-DDT	113	13	6	3	29.33	20.61	70.27
SED004	11/06/1990	ALDRIN	42	58					
SED004	11/06/1990	ALDRIN	47	53					
SED017	08/05/1991	ALDRIN	58	42					
SED017	08/05/1991	ALDRIN	90	10					
SED023	11/12/1990	ALDRIN	89	11					
SED023	11/12/1990	ALDRIN	86	14	6	3	31.33	20.26	64.67
SED004	11/06/1990	DIELDRIN	46	54					
SED004	11/06/1990	DIELDRIN	41	59					
SED017	08/05/1991	DIELDRIN	67	33					
SED017	08/05/1991	DIELDRIN	92	8					
SED023	11/12/1990	DIELDRIN	97	3					
SED023	11/12/1990	DIELDRIN	102	2	6	3	26.50	23.63	89.16
SED004	11/06/1990	ENDRIN	50	50					
SED004	11/06/1990	ENDRIN	57	43					
SED017	08/05/1991	ENDRIN	115	15					
SED017	08/05/1991	ENDRIN	84	16					
SED023	11/12/1990	ENDRIN	102	2					
SED023	11/12/1990	ENDRIN	96	4	6	2	21.67	18.41	84.96
SED004	11/06/1990	HEPTACHLOR	48	52					
SED004	11/06/1990	HEPTACHLOR	46	54					
SED017	08/05/1991	HEPTACHLOR	62	38					
SED017	08/05/1991	HEPTACHLOR	81	19					
SED023	11/12/1990	HEPTACHLOR	94	6					
SED023	11/12/1990	HEPTACHLOR	100	0	6	3	28.17	21.22	75.32
SED004	11/06/1990	gamma-BHC (LINDANE)	58	42					
SED004	11/06/1990	gamma-BHC (LINDANE)	53	47					
SED017	08/05/1991	gamma-BHC (LINDANE)	69	31					
SED017	08/05/1991	gamma-BHC (LINDANE)	88	12					
SED023	11/12/1990	gamma-BHC (LINDANE)	88	12					
SED023	11/12/1990	gamma-BHC (LINDANE)	94	6		3	25.00	15.85	63.41

Table F-11a
%Bias Seep and Spring Sediment
Volatile Organic Compounds

Location	Date	Analyte	%R	%Bias
SED018	11/18/1991	1,1-DICHLOROETHENE	108.0	8
SED018	11/18/1991	1,1-DICHLOROETHENE	98.0	2
SED018	11/18/1991	BENZENE	100.0	0
SED018	11/18/1991	BENZENE	98.0	2
SED018	11/18/1991	CHLOROBENZENE	106.0	6
SED018	11/18/1991	CHLOROBENZENE	98.0	2
SED018	11/18/1991	TOLUENE	115.0	15
SED018	11/18/1991	TOLUENE	113.0	13
SED018	11/18/1991	TRICHLOROETHENE	104.0	4
SED018	11/18/1991	TRICHLOROETHENE	95.0	5

Table F-11b
%Bias Seep and Spring Sediment
Semivolatile Organic Compounds

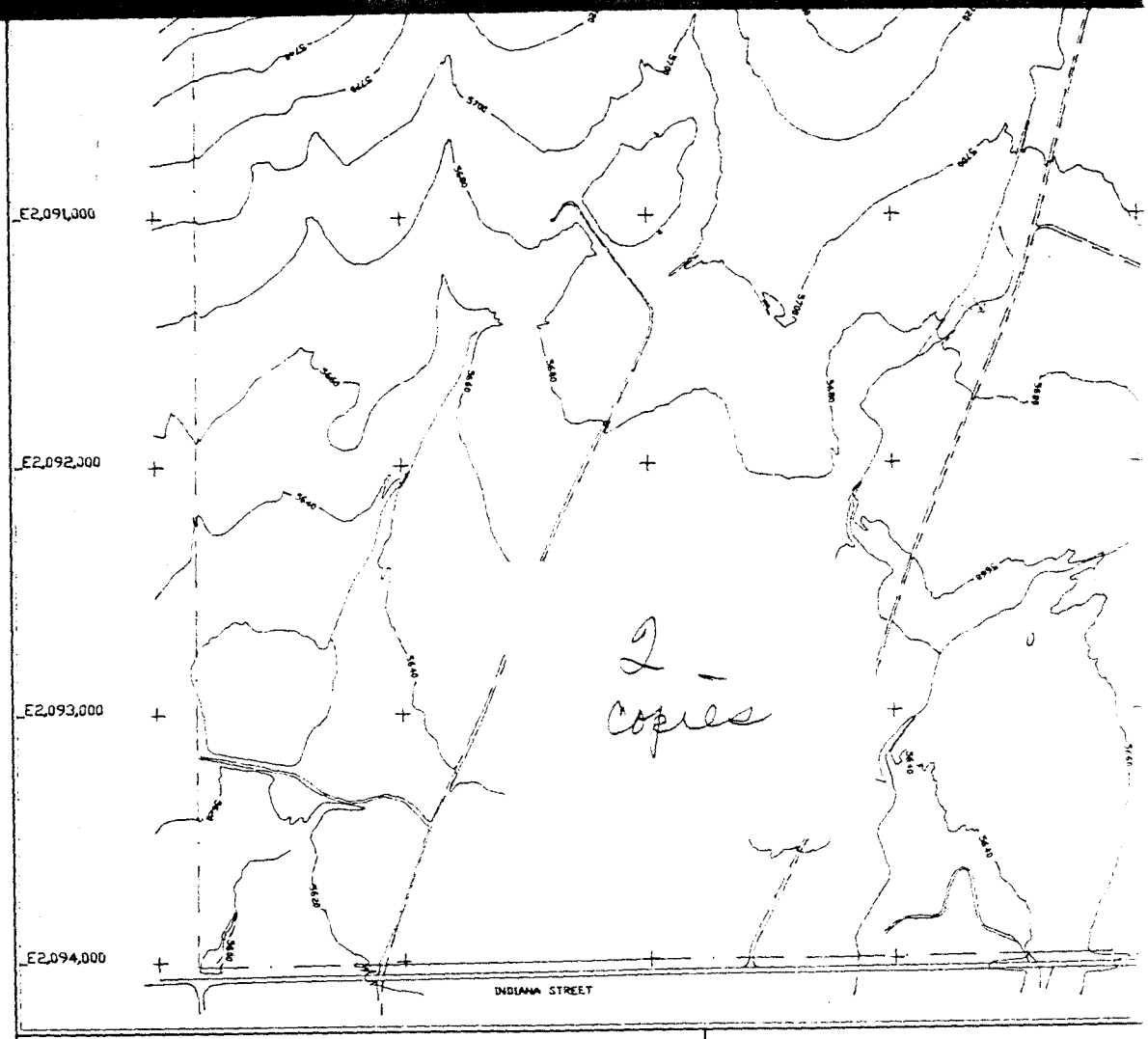
Location	Date	Analyte	%R	%Bias
SED019	11/18/1991	1,2,4-TRICHLOROBENZENE	54.0	46.0
SED019	11/18/1991	1,2,4-TRICHLOROBENZENE	52.0	48.0
SED019	11/18/1991	1,4-DICHLOROBENZENE	44.0	56.0
SED019	11/18/1991	1,4-DICHLOROBENZENE	43.0	57.0
SED019	11/18/1991	2,4-DINITROTOLUENE	67.0	33.0
SED019	11/18/1991	2,4-DINITROTOLUENE	69.0	31.0
SED019	11/18/1991	2-CHLOROPHENOL	67.0	33.0
SED019	11/18/1991	2-CHLOROPHENOL	71.0	29.0
SED019	11/18/1991	4-CHLORO-3-METHYLPHENOL	73.0	27.0
SED019	11/18/1991	4-CHLORO-3-METHYLPHENOL	73.0	27.0
SED019	11/18/1991	4-NITROPHENOL	30.0	70.0
SED019	11/18/1991	4-NITROPHENOL	30.0	70.0
SED019	11/18/1991	ACENAPHTHENE	72.0	28.0
SED019	11/18/1991	ACENAPHTHENE	74.0	26.0
SED019	11/18/1991	N-NITROSO-DI-n-PROPYLAMINE	70.0	30.0
SED019	11/18/1991	N-NITROSO-DI-n-PROPYLAMINE	69.0	31.0
SED019	11/18/1991	PENTACHLOROPHENOL	94.0	6.0
SED019	11/18/1991	PENTACHLOROPHENOL	86.0	14.0
SED019	11/18/1991	PHENOL	32.0	68.0
SED019	11/18/1991	PHENOL	35.0	65.0
SED019	11/18/1991	PYRENE	74.0	26.0
SED019	11/18/1991	PYRENE	74.0	26.0

Table F-11c
%Bias Seep and Spring Sediment
Pesticides and PCBs

Location	Date	Analyte	%R	%Bias
SED018	11/18/1991	4,4'-DDT	66	34
SED018	11/18/1991	4,4'-DDT	70	30
SED018	11/18/1991	ALDRIN	60	40
SED018	11/18/1991	ALDRIN	60	40
SED018	11/18/1991	DIELDRIN	87	13
SED018	11/18/1991	DIELDRIN	87	13
SED018	11/18/1991	ENDRIN	97	3
SED018	11/18/1991	ENDRIN	97	3
SED018	11/18/1991	HEPTACHLOR	69	31
SED018	11/18/1991	HEPTACHLOR	69	31
SED018	11/18/1991	gamma-BHC (LINDANE)	99	1
SED018	11/18/1991	gamma-BHC (LINDANE)	99	1

Plate 1

Background Geochemical Characterization Plan
Individual Hazardous Substance Sites



U.S. DEPARTMENT OF ENERGY

EG &G ROCKY FLATS
ROCKY FLATS PLANT, GOLDEN, COLORADO

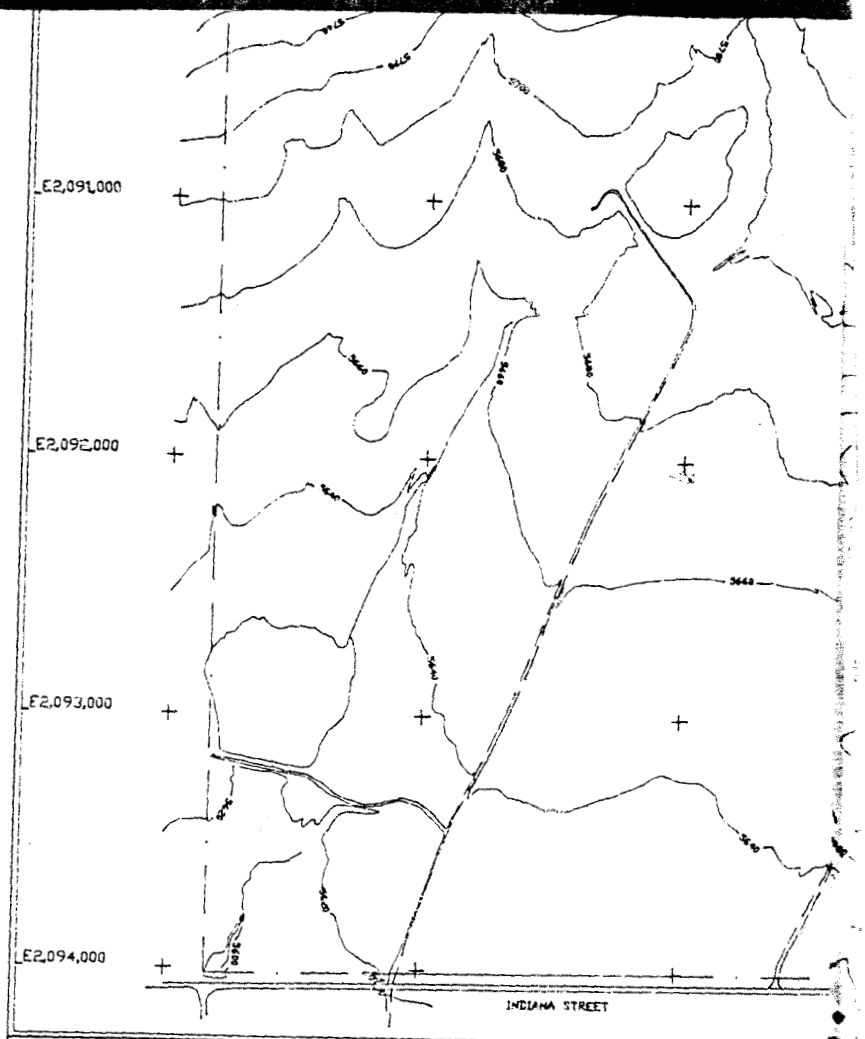
PLATE 1

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
INDIVIDUAL HAZARDOUS SUBSTANCE SITES

K&M Company
Torrance, CA 90505

Plate 2

Background Geochemical Characterization Plan
Water Table Elevation of Surficial Materials



U.S. DEPARTMENT OF ENERGY

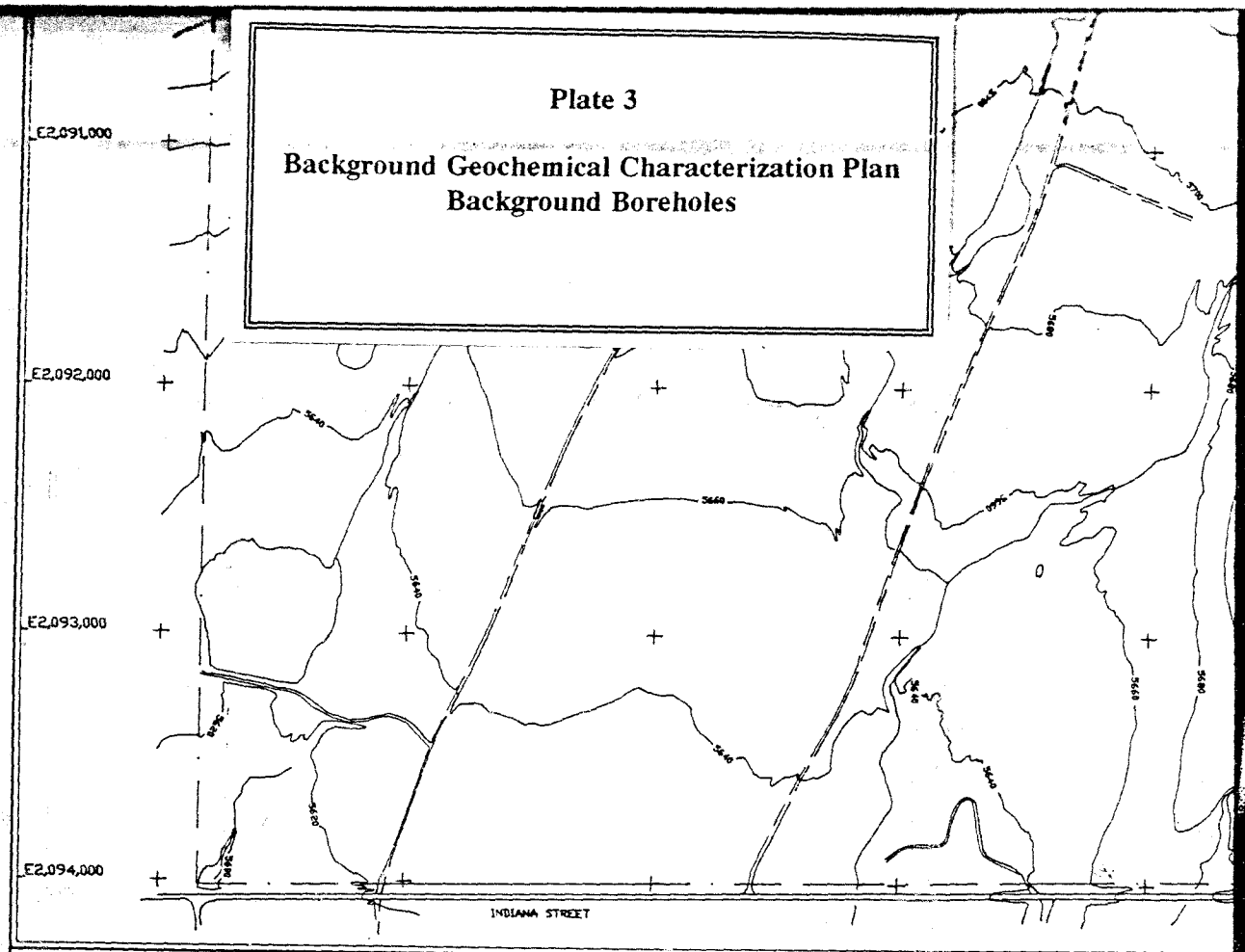
EG &G ROCKY FLATS

ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 2

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
WATER TABLE ELEVATION OF SURFICIAL MATERIALS

R6960M-BMR0220692/750



U.S. DEPARTMENT OF ENERGY

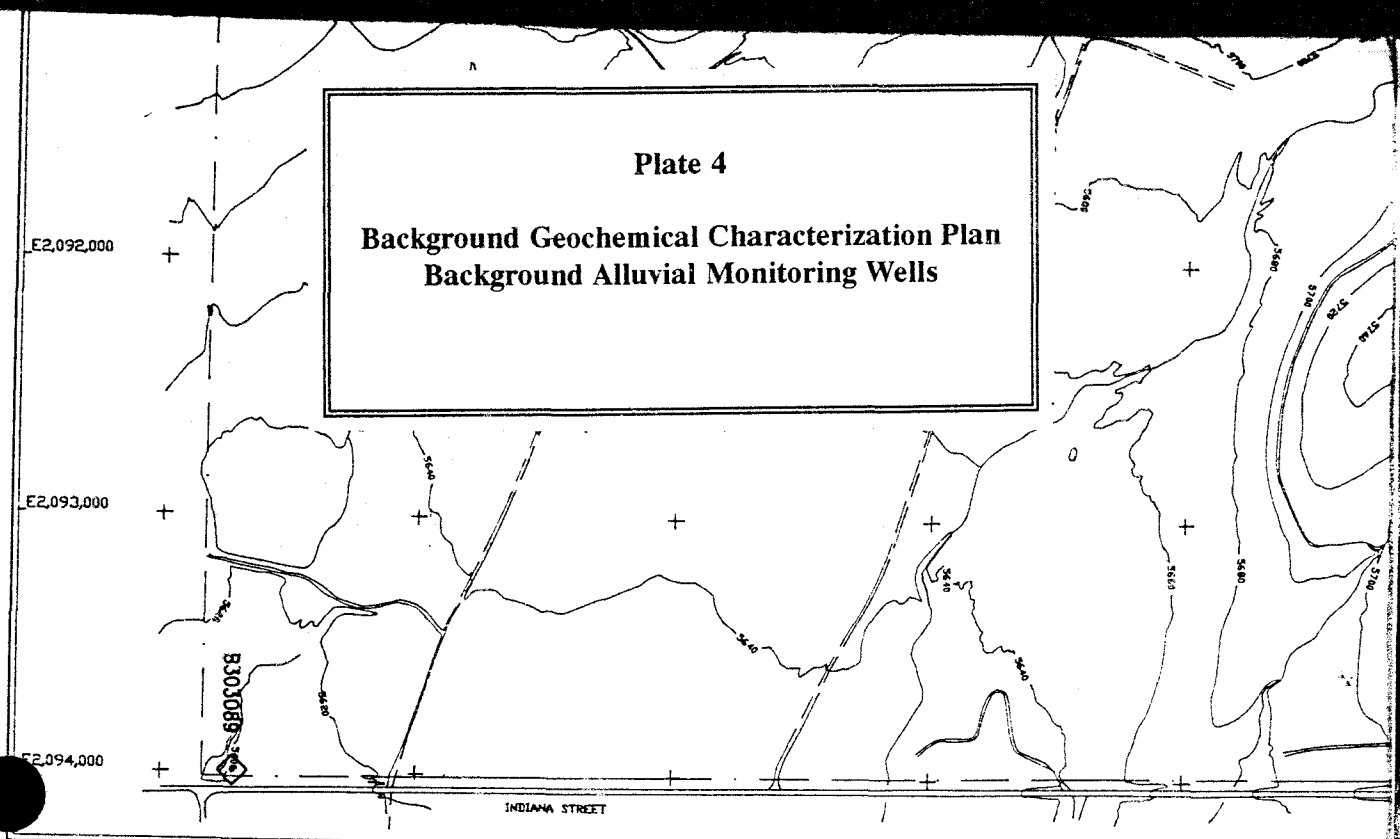
EG&G ROCKY FLATS

ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 3

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
BACKGROUND BOREHOLES

R9400034D012392/30



U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS

ROCKY FLATS PLANT, GOLDEN, COLORADO

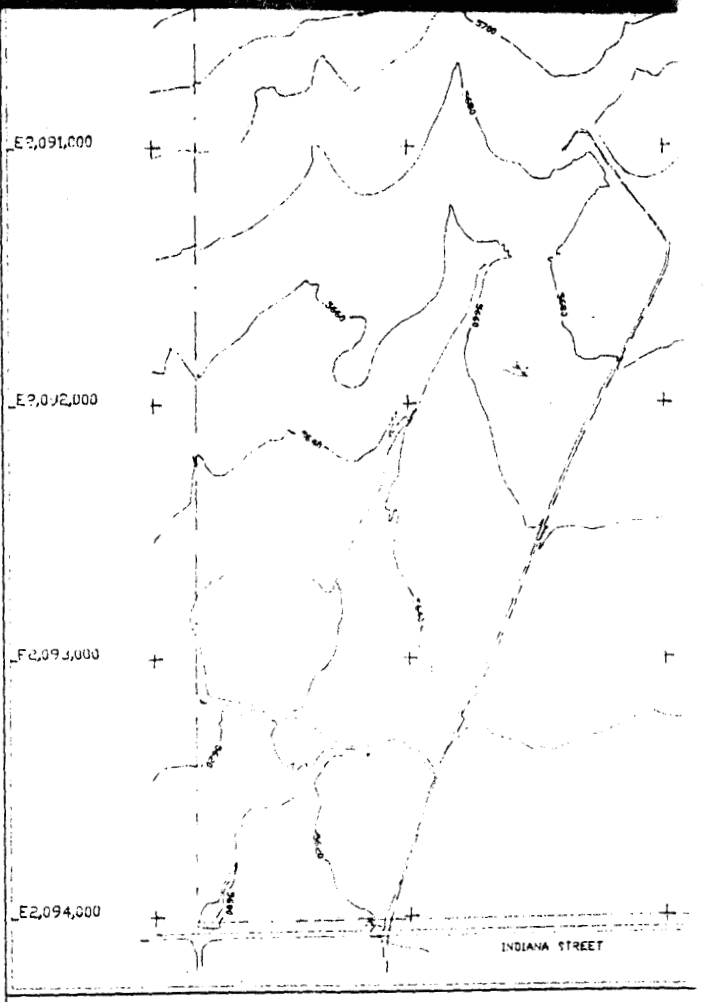
PLATE 4

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
BACKGROUND ALLUVIAL MONITORING WELLS

R9HI001JM012392/750

Plate 5

Background Geochemical Characterization Plan
Background Bedrock Monitoring Wells



U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS

ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 5

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
BACKGROUND BEDROCK MONITORING WELLS

R6900ZAB012392/750

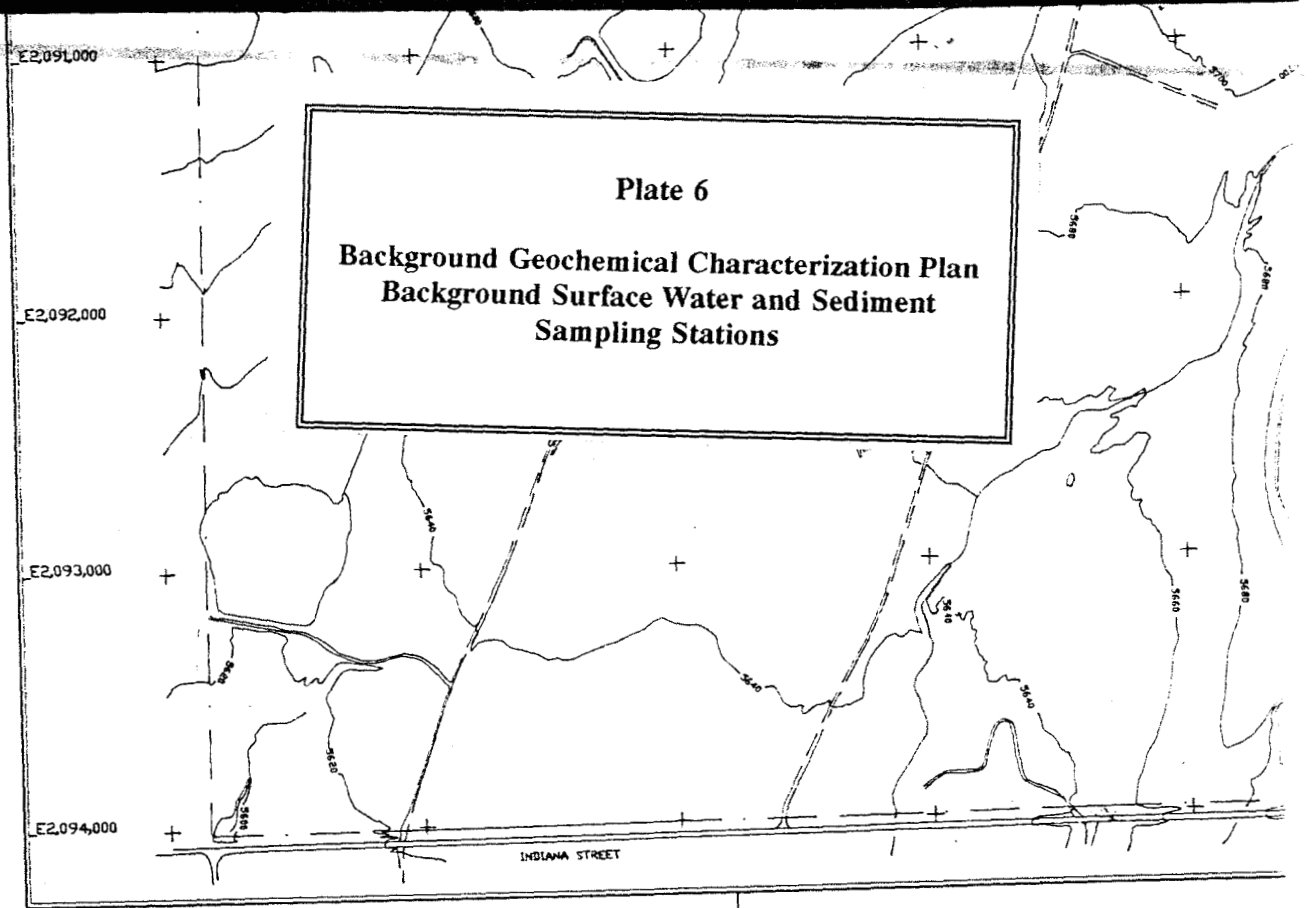


Plate 6

Background Geochemical Characterization Plan
Background Surface Water and Sediment
Sampling Stations

U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS

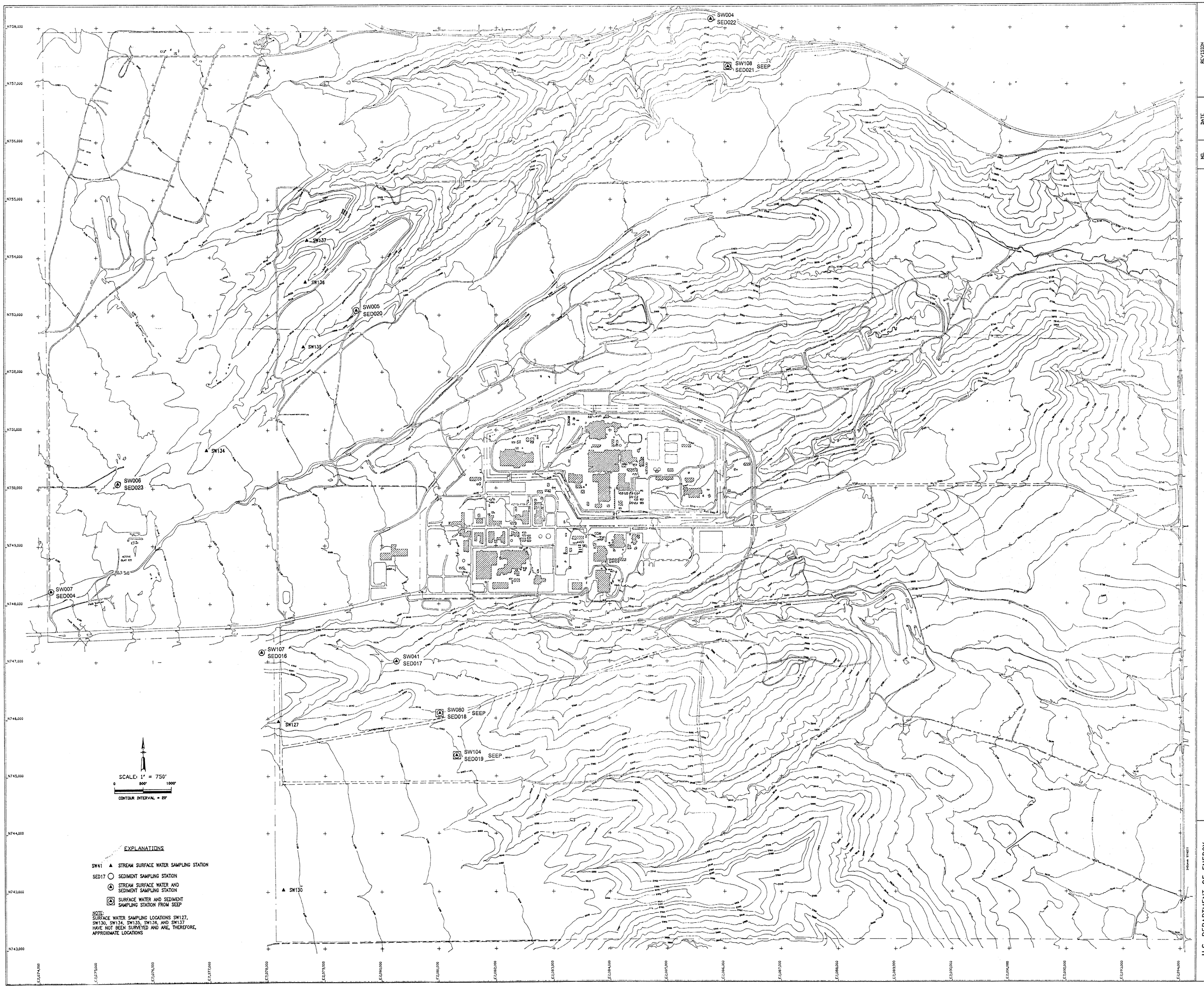
ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 6

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
BACKGROUND SURFACE WATER AND
SEDIMENT SAMPLING STATIONS

R69N004MB012392/750

RAM Company
POLY-VU #PV1198



NO.	DATE	REVISION

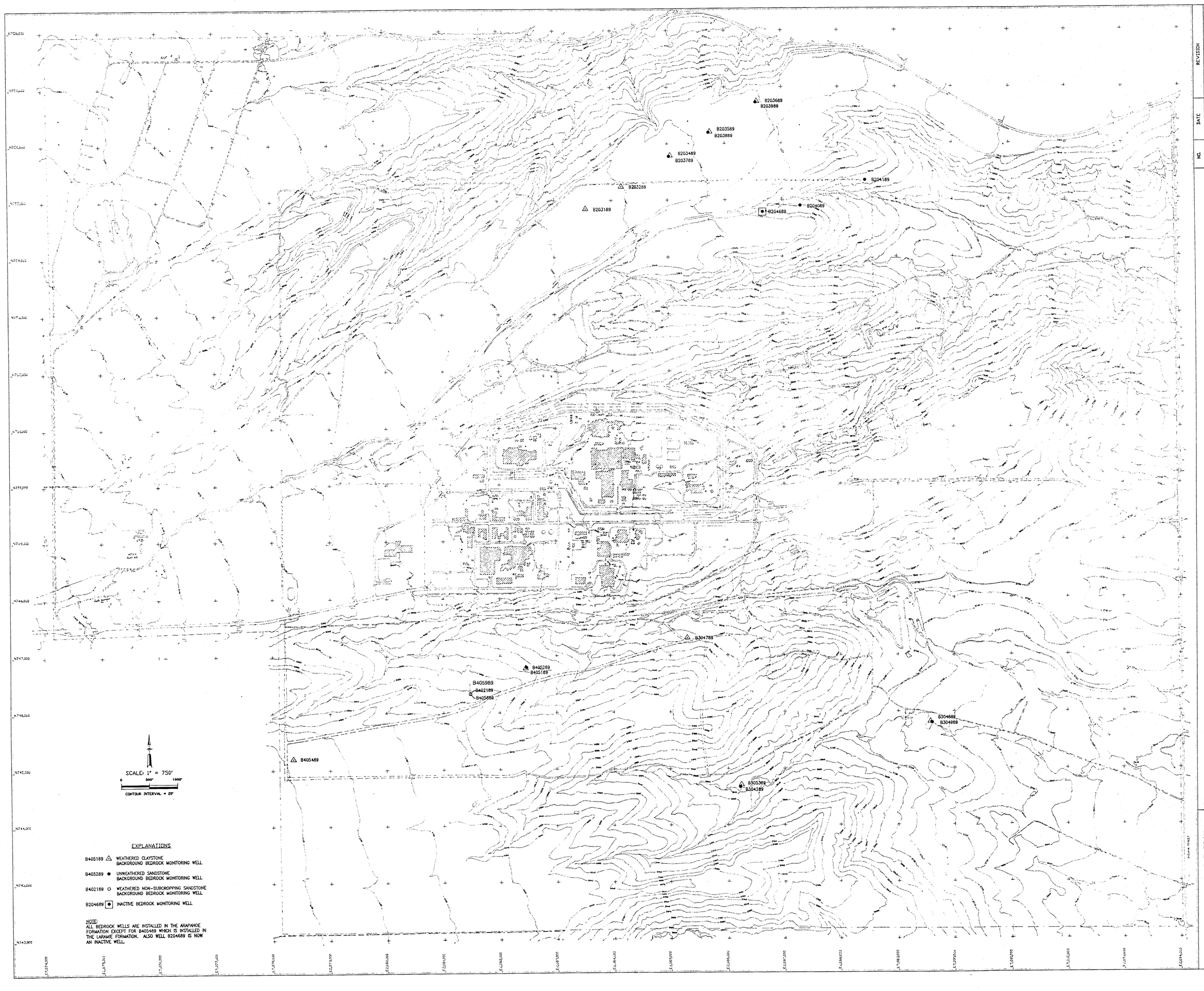
U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS
ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 6

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
BACKGROUND SURFACE WATER AND SEDIMENT SAMPLING STATIONS

R6SW004-R3012392/730



NO.	DATE	REVISION

U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS

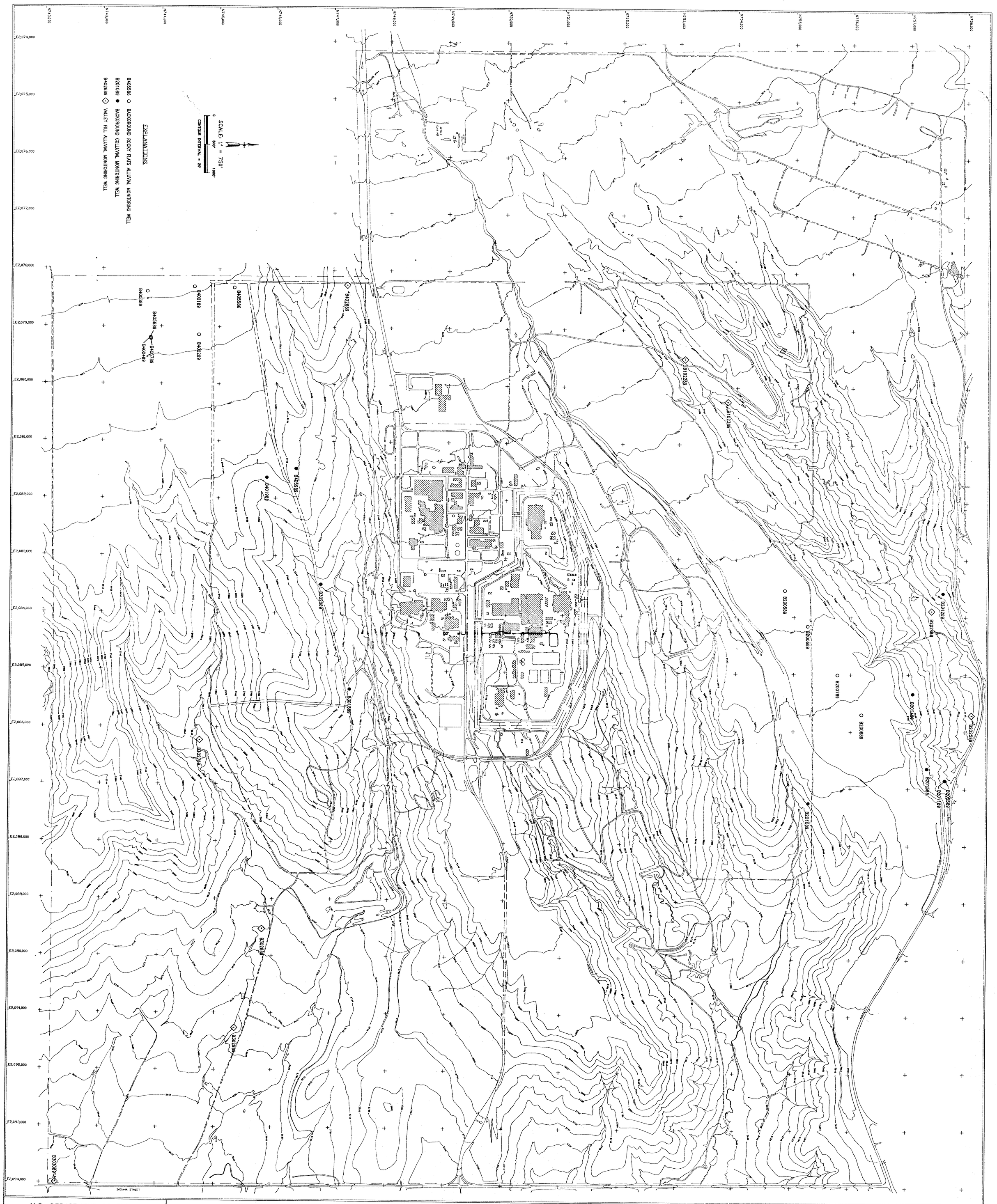
ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 5

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN

BACKGROUND BEDROCK MONITORING WELLS

R6H002A/R012392/750



U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS

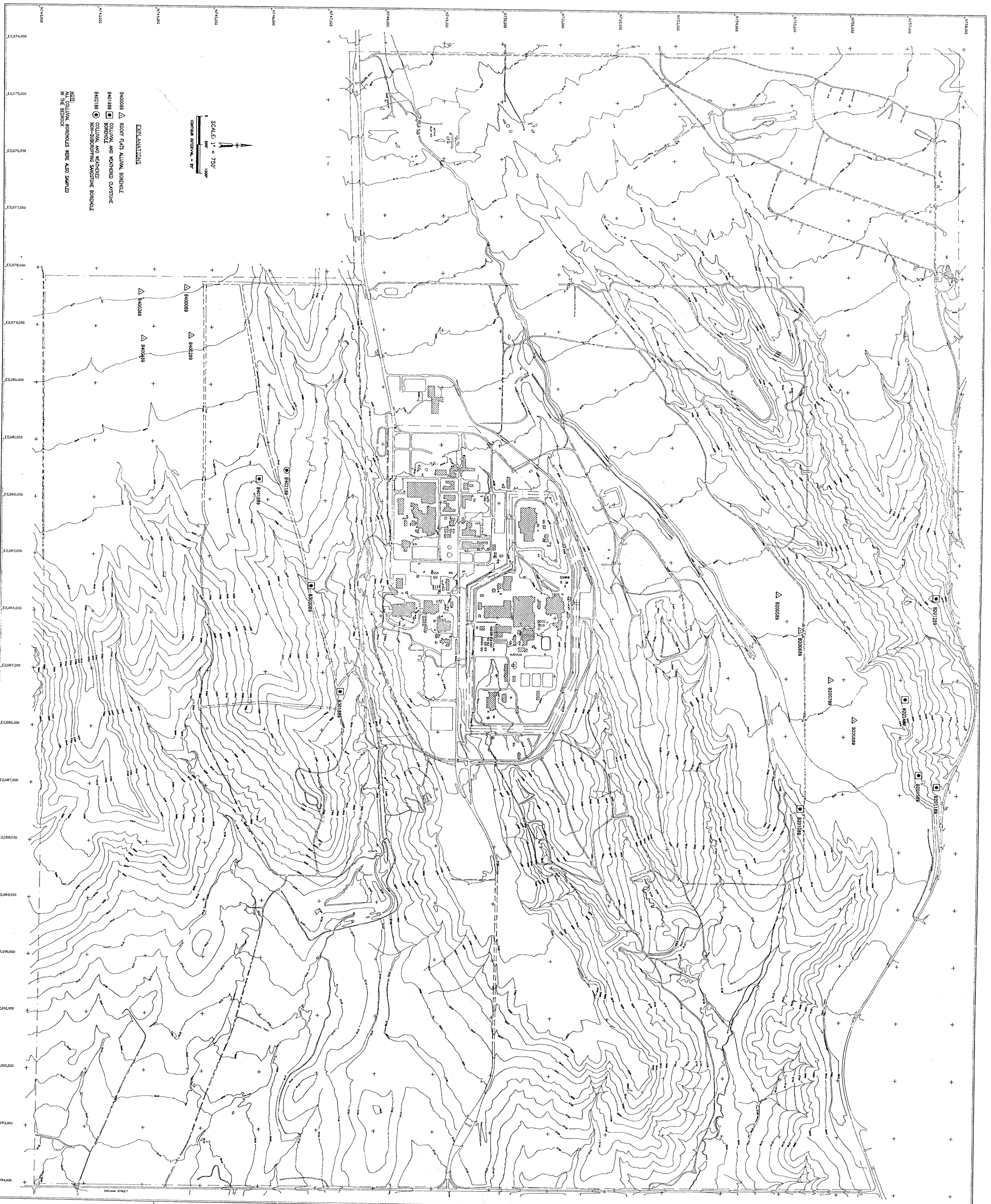
ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 4

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
BACKGROUND ALLUVIAL MONITORING WELLS

NO.	DATE	REVISION

R6900LKR012592/30



U.S. DEPARTMENT OF ENERGY

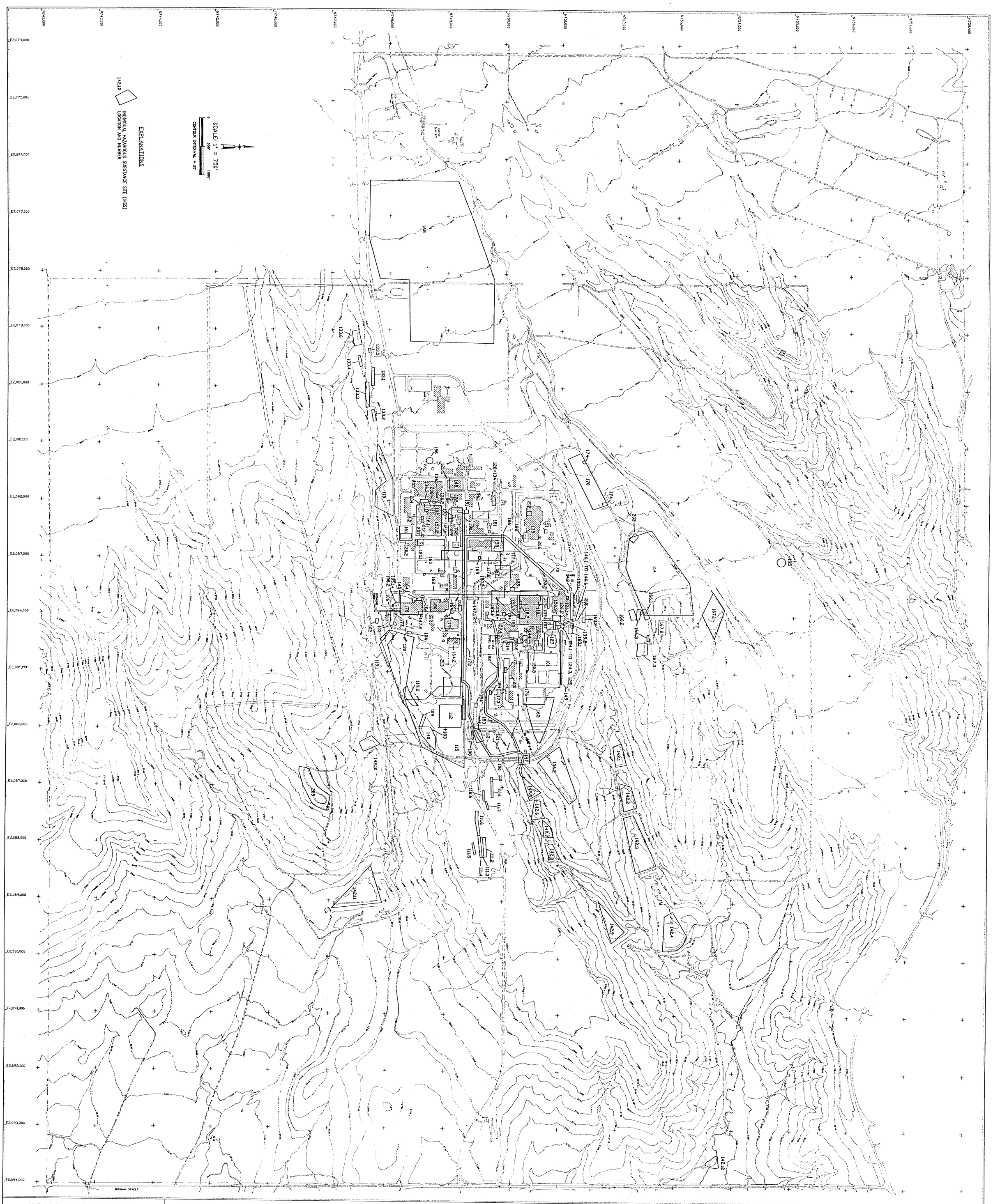
EG&G ROCKY FLATS

ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 3

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
BACKGROUND BOREHOLES

NO.	DATE	REVISION



U.S. DEPARTMENT OF ENERGY

EG &G ROCKY FLATS

ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 1

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN
INDIVIDUAL HAZARDOUS SUBSTANCE SITES

NO.	DATE	REVISION

R6/960CM/01E5/26/90