BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT

Rocky Flats Plant

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

30 SEPTEMBER 1992

EG&G Rocky Flats, Inc.
Golden, Colorado

REVIEWED FOR CLASSIFICATION/UCNI
BY G. T. Ostdiek
DATE 2-8-93

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GOLDEN, COLORADO

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

REVIEWED FOR CLASSIFICATION/UCNI
BY G. T. Ostdiek
DATE 2-8-93

SEPTEMBER 30, 1992

REVIEWED FOR CLASSIFICATION/UCNI
By George H. Setlock
Date 9/30/92 UNU

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ACRONYMS

Al	Aluminum
As	Arsenic
Ba	Barium
Be	Beryllium
BDL	Below Detection Limit
Ca	Calcium
CAR	Chemical Analyte Roster
Cd	Cadmium
CDH	Colorado Department of Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
Co	Cobalt
COL	Colluvium
Cr	Chromium
CRDL	Contract Required Detection Limits
CRQL	Contract Required Quantitation Limits
Cs	Cesium
CSF	Carcinogenic Slope Factor
Cu	Copper
DL	Detection Limit
DOE	Department of Energy
EL	Exposure Limit
EMD	Environmental Management Department
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration Program
FS	Feasibility Study
GRRASP	General Radiochemistry and Routine Analytical Services Protocol
HEAST	Health Effects Assessment Summary Tables
Hg	Mercury
IDL	Instrument Detection Limit
IM/IRA	Interim Measures/Interim Remedial Action
IRIS	Integrated Risk Information System
K	Potassium
KAR	Arapahoe/Laramie formations
Li	Lithium
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum

ACRONYMS (Continued)

Na	Sodium
ND	Nondetected Concentration
Ni	Nickel
NRF	North Rocky Flats
P	Phosporus
Pb	Lead
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RFEDS	Rocky Flats Environmental Database System
RFP	Rocky Flats Plant
RI	Remedial Investigation
RFA	Rocky Flats Alluvium
RPD	Relative Percent Difference
Sb	Antimony
SC	Specific Conductance
Se	Selenium
SRF	South Rocky Flats
Si	Silicon
Sn	Tin
Sr	Strontium
SVOC	Semivolatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TDS	Total Dissolved Solids
Tl	Thallium
TSS	Total Suspended Solids
V	Vanadium
VFA	Valley Fill Alluvium
WCS	Weathered Claystone at Top of Arapahoe/Laramie
Zn	Zinc

EXECUTIVE SUMMARY

In order to monitor for environmental degradation which may have resulted from past work practices at Rocky Flats Plant (RFP), it is necessary to know the chemistry of environmental materials from areas near the plant which are undisturbed by plant operations. These undisturbed, or background locations are characterized by analyzing environmental materials collected at a number of representative sampling sites. The resulting chemical data are summarized by statistics which provide a basis for comparison with chemical results from non-background areas of RFP to help identify and assess potential environmental contamination. This report describes and summarizes background geochemical data collected from calendar year 1989 through calendar year 1992 under the Background Geochemical Characterization Program at RFP.

The geochemistry of surface water, seep water, sediments, groundwater and geologic materials are discussed in this report. The samples were collected at stations located in Buffer Zone areas west, north and south of the main plant. The samples were analyzed for chemical constituents including radioactive isotopes, EPA target analyte list (TAL) metals, the EPA target compound list (TCL) organics, major anions and indicator parameters such as pH, specific conductance (SC), and total dissolved solids (TDS).

Chemical data for each sample medium are classified into groups by geographic location (all media) and by lithology (groundwater and geologic material), and summary statistics are computed for each group. Statistical methods used to define the groups include: multivariate analysis of variance (MANOVA), parametric and non-parametric analysis of variance (ANOVA), and chi-squared contingency tables. The application of each statistical procedure is discussed in this report. Various summary statistics are computed for each chemical data set within each group including: mean, standard deviation, upper tolerance limit (upper and lower for pH), maximum concentration, sample size, and percentage of detectable concentrations.

As presented in the Background Geochemical Characterization Plan, tolerance intervals are the principal statistics used to characterize the chemistry of background stations at RFP. Tolerance intervals are computed assuming normality or lognormality for chemicals that have greater than

50% detectable (above detection limit) concentrations, and a minimum of four detectable concentrations. The maximum detected value and other descriptive statistics are provided when there are insufficient data to calculate a tolerance interval.

Groundwater samples collected from wells completed in Rocky Flats Alluvium, valley fill alluvium, colluvium, and weathered and unweathered bedrock were compared with each other. Wells located in North Rocky Flats were compared against wells from South Rocky Flats. (North and South Rocky Flats are separated by the east and west plant access roads and Central Avenue.) Similarly, geologic material samples from the different lithologic units present at Rocky Flats were tested against each other. Surface water and bed-sediment samples collected in Rock Creek were compared with samples from Woman Creek. Surface and groundwater samples were also examined for seasonality using parametric and non-parametric ANOVA.

For groundwater, the mean concentrations of many metals, radionuclides, and water quality parameters showed significant differences between lithologic unit and geographical location. As a result, 109 tables are presented that identify the tolerance limits and other descriptive statistics for the analytes categorized by unique combinations of geographic location and lithology as defined from the statistical testing. There were many more analytes that showed significant differences between lithologic units than between locations (North vs. South Rocky Flats Plant).

A few metals and radionuclides and one water quality parameter showed significant differences in mean concentrations between Rock Creek and Woman Creek surface water. These included: filtered and unfiltered calcium, sodium, and manganese; filtered americium-241, uranium-233,234, uranium-238, and chloride. There were no significant differences in the unfiltered radiochemical concentrations between the two drainages.

Seep water chemistry data were only tested for significant differences in geochemistry between seasons. No significant differences in mean concentrations were identified although insufficient data rendered many of the statistical test results inconclusive.

Ten metals had significantly different mean concentrations in sediments between Rock Creek and Woman Creek; aluminum, barium, calcium, chromium, lead, magnesium, manganese, sodium,

strontium, and vanadium. There were no significant differences in the radiochemical concentrations between the two drainages.

The mean concentrations of many metals, radionuclides, and other inorganic constituents in geologic materials samples showed significant differences between lithologic unit and geographical location. As a result, 33 tables are presented that identify the tolerance limits and other descriptive statistics for the analytes categorized into unique combinations of geographic location and lithology as defined from the statistical testing. In general, there were fewer metals showing a significant difference in mean concentration between location (North vs. South Rocky Flats Plant) than between lithology. None of the radionuclides had significantly different mean concentrations between locations, but several showed differences between lithologies. Nitrate/nitrite was the only other inorganic constituent where a significant difference in mean concentration existed between North and South Rocky Flats Plant in geologic materials.

Parametric and non-parametric ANOVA were used to examine seasonality in water chemistry by comparing the mean concentrations of chemicals by quarters of the year. The overall conclusion from this comparison is that no systematic seasonal variations are apparent in background groundwater, surface water, or seep water.

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 occurred most frequently in the samples; however, this has been attributed to laboratory artifacts. These compounds were often present in the 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 in the field samples less than 3% of the time and often at estimated concentrations below the detection limit. Further, none of these compounds occurred more than once in samples from any one well. It does not appear that these compounds are 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 occasionally occurred in the laboratory blanks and is 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 Rocky Flats Plant.

Ongoing hydrogeological investigations suggest that groundwater at Rocky Flats may consist of an upper and a lower flow system. In terms of major ion chemistry, background groundwater can be classified into an upper flow system comprised of Rocky Flats Alluvium, valley fill alluvium, colluvium, and weathered bedrock, and a lower flow system in unweathered Arapahoe/Laramie sandstone, siltstone, and claystone. This report concludes that the major ion chemistry of the Arapahoe #1 sandstone is similar to that of the upper flow system. Therefore, it is recommended that the #1 sandstone be included as part of the upper flow system.

Geochemical plots (Stiff diagrams) of groundwater major ion chemistry indicate that unweathered sandstone groundwater is predominantly a sodium sulfate type whereas the upper flow system is a calcium bicarbonate water. Within the upper flow system, there are some spatial trends in total dissolved solids concentrations. For example, total dissolved solids concentrations appear to increase downgradient in valley fill groundwater within the Rocky Creek drainage and in Rocky Flats alluvial groundwater in the northern buffer zone. The Stiff plots for groundwater downgradient and side gradient of the Rocky Flats Plant indicate uncharacteristic major ion chemistry at several locations that may be attributable to releases from Operable Units. Contaminant releases from Operable Units 2 and 7 have been cited as possibly influencing groundwater chemistry immediately downgradient of these units.

The quality of the water chemistry data appear to be good, as indicated by small cation versus anion charge balance errors. Most of the percent charge balance error data for groundwater and surface water are less than 12% and 15%, respectively. This indicates acceptable analyses. A relatively good correlation exists between specific conductivity and total dissolved solids.

Data from non-background areas may be compared against the tolerance intervals and other statistics presented in this report to help identify potential areas of chemical contamination from RFP. Alternatively, analysis of variance techniques may be used to compare background and non-background data.

Extensive, high quality, analytical data now exist for the six background environmental media studied in this report. Also, seasonality in surface and groundwater has now been shown to be unimportant. The background geochemistry of Rocky Flats has now been sufficiently characterized, and further characterization beyond the 1992 data collection program should be terminated. It is suggested that a final Background Geochemical Characterization Report be prepared in 1993.

SECTION 1
INTRODUCTION AND METHODS

1.1 INTRODUCTION

In order to monitor for environmental degradation potentially resulting from work activities at RFP, it is necessary to characterize the chemistry of environmental materials collected from nearby areas which are undisturbed by plant operations. These undisturbed regions are referred to as background areas. The chemistry of these areas is characterized by sampling and chemically analyzing surface water, stream sediments, ground water and borehole materials at 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 of the main plant site.

Representative background analytical data for RFP surface water, sediments, ground water, and borehole materials are necessary to support Resource Conservation and Recovery Act (RCRA) facility investigations and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial investigations. Background data assist in the identification of potential environmental contamination by defining the spatial and temporal variability in concentration of naturally-occurring constituents. Background characteristics can be compared statistically with data from downgradient sites to determine the likelihood that a particular concentration of chemicals represents a release of contaminants. Background data generated during this program are applicable to RCRA interim measures/CERCLA interim remedial actions (IM/IRAs) so that they are consistent with the final corrective and remedial actions. The final remedial investigation/feasibility study reports and closure plans will incorporate this background information.

This report does the following: (1) describes the statistical methods used to define and characterize background chemical (analyte) distributions at RFP; (2) reports on the background hydrogeochemical characterization conducted from 1989 through 1992 pursuant to the Background Geochemical Characterization Plan (EG&G, 1992); and (3) describes how these background data may be compared to non-background or downgradient analytical data.

This report characterizes the chemistry of borehole materials, stream sediments, ground-water samples collected quarterly, and surface water samples collected monthly. It supersedes the report submitted to U.S. Environmental Protection Agency (EPA) and Colorado Department of Health (CDH) on December 21, 1990. The report addresses whether statistically significant differences occur between background locations within ground water, surface water, sediments, and geologic materials, and whether geochemical differences are discernable between separate, mappable, geologic lithologies and between the ground water contained within these units.

1.2 BACKGROUND

The Rocky Flats Plant is a Department of Energy (DOE) facility that manufactures components for nuclear weapons. The Plant fabricates these components from plutonium, uranium, beryllium, and stainless steel. Both radioactive and nonradioactive wastes are generated in the process. Current waste handling practices involve on-site and off-site recycling of hazardous materials and off-site disposal of solid radioactive materials at another DOE facility. Storage and disposal of hazardous and radioactive wastes have occurred in the past and storage is occurring on site. Preliminary assessments under the DOE Comprehensive Environmental Assessment and Response Program (now called the Environmental Restoration (ER) Program) identified past on-site storage and disposal locations as potential sources of environmental contamination.

The ER Program is a comprehensive, phased program of site characterization, environmental monitoring, remedial investigations, risk assessments, feasibility studies, remedial/corrective actions, and site closures. The Program includes CERCLA, RCRA 3004u and RCRA closure projects, and addresses the HSWA provisions of RCRA and the Colorado Hazardous Waste Act. Draft remedial investigation (RI) and feasibility study (FS) reports, and RCRA closure plans have been submitted to EPA and CDH. However, owing to aggressive investigation and clean-up schedules, sufficient background characterization data have not been previously collected. The goal of the background geochemical characterization plan (EG&G, 1992) and of this report is to provide some of the necessary background data to identify the concentration levels of various elements and compounds which may indicate contamination at RFP.

1.3 GENERAL APPROACH

Samples were collected in different locations across the Rocky Flats property to characterize background variations within various media: surficial and bedrock materials, stream sediments, ground water, and surface water. In addition, samples were collected within subgroups of some media with different geological and hydrogeological characteristics. For example, ground water was sampled in Rocky Flats Alluvium, colluvium, valley fill, weathered sandstone, weathered claystone, and unweathered sandstone. This report addresses geochemical differences among the subgroups as well as spatial differences within a sample medium.

The remainder of this section describes the statistical and geochemical methods used to characterize the background chemistry at RFP, and how these background data may be compared to non-background or downgradient data. The overall methodology for computing background statistics is illustrated by the flow chart, Figure 1-1. Application of many of the more complex procedures is discussed in detail later in this section. Data validation and evaluation of quality control data is discussed in Section 4.

1.4 PRELIMINARY DATA ANALYSIS

Available chemical data were carefully reviewed in a multi-step process to establish a reliable set of data upon which conclusions could be drawn, and to identify recurring sampling or analytical problems that can be corrected in the future. Chemical data were validated by an independent subcontractor upon receipt from the analytical laboratory. These data and validation results were stored in the Rocky Flats Environmental Database System (RFEDS) for later retrieval and use. A number of quality control checks were run during the data entry process.

After background data were retrieved from RFEDS, they underwent additional quality checks including review and interpretation of field quality control data and application of a variety of statistical and geochemical methods (see Section 4).

1.4.1 Treatment of Duplicates

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

1.4.2 Replacement of Below Detection Limit Data

The presence of data below the detection limit (nondetects) is a result of both the low levels (or absence) of some analytes within the background areas sampled relative to the magnitude of the analytical detection limits. For statistical analysis, all below detection limit (BDL) data were replaced with one half the detection limit (DL). In the case of multiple detection limits and to set an acceptable upper detection limit, all nondetects (ND) greater than 2 times the minimum reporting limit were omitted from statistical analysis and the remaining nondetects replaced with one half the detection limit (Gansecki, 1991). The percentage of NDs were tabulated with calculated descriptive statistics.

1.4.3 Evaluation of Data Distribution

The data distribution of every analyte with less than 50% NDs and a sample size of at least 10 by sample type was evaluated in order to facilitate outlier detection, and in preparation for later statistical procedures (Figure 1-1).

The Shapiro-Wilk statistic was calculated to determine if the data had a normal distribution (Shapiro and Wilk, 1965). If the resulting test statistics indicated that the data were not normally distributed, the data were transformed by computing the base 10 log of the raw data. The distribution of the transformed data were evaluated in the same manner. The distribution of data was assumed to be either normal, or log normal. The distribution that best fit the data was used in subsequent outlier evaluation and statistical tests.

1.4.4 Outlier Detection

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.

To evaluate the presence of outliers (Figure 1-1), the following procedure was applied to the analytes by sample type:

1. The single outlier test defined in ASTM (1975), and described in the RCRA guidance document (EPA, 1989), was applied (Figure 1-1).

2. The identified outlier was evaluated with respect to the historical data trend and laboratory conditions such as matrix interference in an attempt to determine why the data 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. If an error was not identified, the datum was nevertheless included in subsequent statistical analysis.

1.5 EVALUATION OF POPULATIONS

This subsection presents the approach and statistical methods that will be used to establish appropriate populations for background geochemical results.

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 ground water 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. While this observation is based on a ground water sample, a ground water sample is not a statistical term and should not be confused with a statistical sample. *Multivariate* is an adjective indicating that there is more than one dependent variable (analytes in the statistical models); *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 ground water observation, the originating water bearing unit is a classification factor. The water bearing units that were sampled (Rocky Flats Alluvium, colluvium, valley fill alluvium, weathered bedrock, etc.) 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); a *n-way* statistical test evaluates the sample with respect to n classification factors.

1.5.2 Sample Media

Six media (geologic materials, ground water, stream sediment, stream water, seep sediment, and seep water) have been sampled at RFP (see Sections 2 and 3). Four of these media can be classified into groupings that may represent subpopulations:

- Geologic materials were sampled by geologic unit, for example: Rocky Flats Alluvium, colluvium, and weathered bedrock.
- Ground water was sampled as Rocky Flats Alluvial ground water, colluvial ground water, valley fill ground water, weathered bedrock ground water, and unweathered sandstone ground water.
- Sediments were sampled as Rock Creek sediment and Woman Creek sediment.
- Surface water was sampled as Rock Creek surface water and Woman Creek surface water.

Walnut Creek was not included in the background characterization because most of its drainage basin is downgradient of the RFP facilities and IHSSs such as the West Spray Field.

Samples were collected from each of these groups because prior to sampling it was not known if the subpopulations were geochemically distinct. A background sample made up of geochemically different subpopulations would result in extraneous variability in the background sample and, consequently, a poor characterization of background geochemistry.

Seep sediments and seep surface water were identified as separate media in the process of the data analysis undertaken in the 1989 Background Geochemical Characterization Report (EG&G, 1990c) and subsequent EPA comments (EPA, 1991b).

Other possible sources of variability are location with respect to the main plant for geologic materials and ground water, and seasonality for ground water and surface water (i.e., variations over time).

1.5.3 Selection Criteria

Parametric multivariate analysis of variance (MANOVA), parametric and nonparametric analysis of variance (ANOVA), and Chi-squared contingency tables 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 is based upon the percentage of detected observations by analyte and the number of observations available. If less than 50% of the observations were detected, Chi-squared contingency tables are appropriate. If the percentage of detected observations is greater than 50% up to and including 85%, the appropriate test is a nonparametric ANOVA. A nonparametric ANOVA is appropriate when the distribution is neither normal or log normal, or the variances are heterogeneous. If the percentage of detected observations is greater than 85%, this analyte was evaluated, with similar analytes, in a parametric MANOVA or parametric ANOVA with other related statistical tests as described below.

ANOVA is a statistical procedure for determining if there is a difference between the average values of a variable (i.e., the dependent variable) for different levels of a classification factor(s) (i.e., the main effects). An ANOVA model with "n" classification factors is called a n-way ANOVA model. If the classification factors are specified in the model, the classification factors are termed "fixed." If there is more than one dependent variable in the model, it is called a

MANOVA model. For the most part, this study used 1-way, 2-way and 3-way, fixed-effects, parametric ANOVA models; and 1-way, fixed-effects, nonparametric ANOVA models.

1.5.4 ANOVA Designs

Table 3-4 lists the analytes (dependent variables) sampled for as part of the background program. As discussed in Section 3, not all analytes were measured in the initial rounds of sampling. Dissolved radiochemicals were not analyzed subsequent to the first round of sampling. It should be further noted that many radiochemical analyses for geologic materials collected in 1989 were rejected during validation.

Fixed effects statistical models are proposed in Table 1-1 where these possible sources of variability are identified as classification factors. In general, when statistical differences are identified between the levels of a classification factor, separate tables of tolerance limits and other summary statistics were reported for each level. However, this was not done for seasonality to minimize the number of potential tables of background statistics. Also, seasonal effects were found to be unimportant. Seasonality is further discussed in Section 1.7.2.

Surface water collected at seeps (surface water stations SW080, SW104, and SW108 [see Section 3]) was evaluated for seasonality by ANOVA. The Seasonal Kendall Test (Gilbert, 1987) was used to check for long-term trends. Seep water and seep sediments were identified as separate sample types in the process of data evaluation, and as a result of agency comment response associated with the 1989 Background Geochemical Characterization Report (EG&G, 1990c).

Stream surface water was evaluated for two classification factors: drainage and seasonality. Only two levels of drainage were evaluated: Rock Creek and Woman Creek. Observations collected at surface water station SW007, located on a ditch in the Walnut Creek drainage, were not used to represent Walnut Creek in statistical analyses. However, data originating from SW007 are reported in the appendix of this report. Surface waters from streams were sampled monthly.

Ground water was evaluated for three classification factors: water bearing unit, location, and seasonality. Ground water was collected quarterly, and seasonality was evaluated as for surface water.

Seep sediments were collected quarterly and were not evaluated for any classification factors. The limited number of background seep locations available for sampling are not adequate for statistical comparisons by location. Seasonality effects are sometimes observed in natural waters but are not expected in solids such as sediment and geologic material.

Stream sediments were evaluated for one classification factor—drainage. Only two levels of drainage were evaluated: Rock Creek and Woman Creek. Observations collected at sediment station SED004 located on a ditch in the Walnut Creek drainage were not incorporated in the stream sediment statistical analyses. However, data originating in SED004 are reported in the appendix of this report.

Geologic materials were evaluated for two classification factors: geologic formation and location.

1.5.5 Parametric MANOVA and Related Tests

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

(1) Multivariate test of class(es) (null hypothesis: no class effect).

(2) If the null hypotheses of the multivariate tests were rejected, then an n-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.

(3) If the null hypothesis of one or more classes in the parametric ANOVA was rejected, then multiple comparisons tests (Bonferroni tests) (EPA, 1989; pp. 5-6:

5-13) were conducted to identify which levels of the classes are different from each other (null hypothesis: no differences between levels). The results of these tests were used to determine how the sample should be subdivided for the calculation of background descriptive statistics.

MANOVA was only applied if greater than 50% of the analytes were available, and these analytes each have less than 15% nondetects, are normally or log normally distributed, and have homogeneous variances. In order to increase the likelihood that residuals will be normally distributed, raw data was mathematically transformed (e.g., log of the raw data) for some analytes.

Two assumptions that underlie the use of parametric ANOVA and MANOVA were evaluated prior to the acceptance of the results:

- Either the raw data or their residuals are normally distributed.
- 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 MANOVA were saved and analyzed for normality and homogeneity of variance.

1.5.6 Test of Assumptions for MANOVA/ANOVA

1.5.6.1 Tests of Normality

Normality of the raw data or of the residuals was evaluated by examining the results of the Shapiro-Wilk test. If the residuals were not normally distributed, it was determined if the degree of non-normality is sufficient to invalidate the relatively robust ANOVA or MANOVA test. If the departure from normality was substantial and if data transformations could not achieve normality, then nonparametric statistical methods were used for evaluating the data instead of the parametric ANOVA or MANOVA.

1.5.6.2 Testing Homogeneity of Variance

Variance is a measure of dispersion of a set of observations around the mean of a random variable. Bartlett's test was used to test the equality of variances between residuals from two or more levels.

1.5.7 Nonparametric ANOVA

A nonparametric ANOVA evaluates differences in the mean rankings of the data (rather than the raw data or transformations of the raw data) for subsets of the data defined by levels of a classification factor. However, nonparametric tests are less powerful (less sensitive to actual differences in means) than parametric tests especially when the sample size is small (i.e., there are relatively few samples).

The nonparametric test used was 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 of these tests are outlined in Gilbert (1987, p. 247-252). Both tests analyze ranks of data using Wilcoxon scores.

The nonparametric ANOVA is a univariate one-way ANOVA. Consequently, each variable was evaluated individually (i.e. there is no nonparametric n-way univariate test). Where the statistical models for a given sample type have identified multiple classification factors, the nonparametric ANOVA was run separately by analyte for each classification factor. Multiple comparison tests between levels were not conducted.

1.5.8 Chi-Square Contingency Tables

Contingency tables evaluate univariate count or frequency data assignable to multiple levels of one classification factor. Statistical inferences on the validity of the null hypothesis (frequencies of analyte detection and nondetection are equal at all levels) are based upon the comparison using the actual observed frequency of analyte detection and nondetection to the expected frequency of analyte detection and nondetection.

For those sample types with more than one classification factor, each classification factor was tested to determine significant differences in levels using a one-way contingency table (Freund, 1970) was used to evaluate each classification factor. After testing each classification factor, data for the individual analytes in question would be grouped by levels of the classification factor where these levels are determined to be significantly different from each other (e.g., Rocky Flats Alluvium ground water data may be distinct from valley fill alluvium ground water data, etc.)

Chi-square contingency table analysis was treated as inconclusive when there were less than five observations in more than 20% of the cells, in order to retain sensitivity to actual differences between groups.

1.6 CALCULATION OF DESCRIPTIVE STATISTICS

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

- The maximum and minimum concentrations were identified.
- The percentage of NDs was calculated.
- Based on the evaluated data distribution, the mean, and standard deviation were calculated if the sample contains only detected concentrations, or they were estimated using the Cohen procedure if nondetects were present in the sample.
- Tolerance limits were computed when there was at least one detected observation and the sample size was two or more.

1.6.1 Cohen Procedure

Cohen (1961) developed maximum likelihood estimators of the mean and standard deviation which are applicable when greater than 50% of the data have been detected. Because this procedure is designed to evaluate data censored with a single DL, the mean detection limit was used when multiple detection limits were present in the data set.

1.6.2 Statistical Formulas

If the distribution of the data was unknown, or was not log normal then statistics based on the normal distribution were used. For normally distributed samples the following formulas for sample statistics were used.

Mean

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

where:	$\bar{x}$	=	arithmetic mean of untransformed results.
	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 result.
	$\bar{x}$	=	sample mean of untransformed results.
	n	=	number of observations.
	x_i	=	the ith concentration (observation).

Standard Deviation

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

where:	s	=	standard deviation of untransformed results.
	s^2	=	sample variance of untransformed results.

For lognormally distributed samples, the following formulas for sample statistics were used. Base 10 log transforms are indicated; however, natural log transforms may alternatively be used.

Geometric Mean

$$\bar{x} = 10{**}\left(\frac{1}{n}\sum_{i=1}^{n} y_i\right)$$

where:	$\bar{x}$	=	geometric mean
	y_i	=	the ith base 10, log transformed result.
	n	=	number of observations

Geometric Variance

$$s^2 = 10{**}\left[\frac{\sum_{i=1}^{n}(y_i-\bar{y})^2}{n-1}\right]$$

where:	s^2	=	geometric variance
	$\bar{y}$	=	arithmetic mean of the base 10 log transformed data.
	n	=	sample size.

Equations for mean and variance of log transformed data are discussed in Gilbert (1987, p. 165-166). For data sets with 15 to 50 percent nondetects, $\bar{x}$ and s^2 were estimated using the Cohen procedure applied to the log transformed data.

1.6.3 Tolerance Limits

Tolerance limits define a range that contains at least P% of a population with p% probability (level of confidence). A probability (level of confidence) is associated with the tolerance limits since 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" are chosen

to be large, in this case p=0.95 and P=95%. 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 increases over background are indicative of potential contamination.

Parametric tolerance limits were calculated for normally and lognormally distributed background data as appropriate.

The equation for the 95% tolerance limits of normally distributed data is:

<u>95% Tolerance Limits</u>

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

where:	L_1	=	lower 95% tolerance limit.
	L_2	=	upper 95% tolerance limit.
	$\bar{x}$	=	mean of the sample population of size n.
	s	=	standard deviation of the sample population.
	K	=	the normal tolerance factor. (Dependent on p, P, n and on whether the limit is one sided or two sided.)

The equation for the 95% tolerance limits of lognormally distributed data is:

<u>Upper 95% Tolerance Limit</u>

$$L_1 = 10**(\bar{y} - Ks_y)$$
$$L_2 = 10**(\bar{y} + Ks_y)$$

where:	10**	=	10 raised to the power
	L_1	=	lower 95% tolerance limit.
	L_2	=	upper 95% tolerance limit.
	$\bar{y}$	=	average of base 10 log transforms of the data.
	K	=	the normal tolerance factor. (Dependent on p, P, n and on whether the limit is one sided or two sided [Table 1-2].)
	sy	=	standard deviation of base 10 transforms of the raw data.

1.7 GEOCHEMICAL EVALUATIONS

Statistical tests can identify a trend or a statistical difference, but geological, chemical, and hydrological principals must be applied to understand the geochemical origin and significance of the statistical results. Section 3 of this report discuss how background samples were collected and chemically analyzed. This section discusses how the background data were geochemically evaluated.

1.7.1 Geochemical Data Review

The raw background data sets were examined for "geochemical reasonableness," e.g., chemical concentrations are within expected ranges; gravimetrically determined dissolved solids concentrations approximate the sum of the cations and anions, etc. If errors were identified in the review, they were corrected.

Another check of data consistency was provided by plotting specific conductance measurements versus TDS (either measured or computed). Linear regression analysis should yield a high correlation coefficient.

Because pH data are critical to geochemical modeling, it is useful to plot pH measured at the time of sampling (field-measured pH) versus pH measured later in the analytical laboratory. The lab and field values will usually differ because pH is an unstable parameter best measured *in situ*, or at the time of sampling. However, if no gross errors have been made, the lab and field-measured pH data should still agree within plus or minus 2 pH units.

1.7.2 Seasonality Investigations

Natural water chemistry data sometimes vary seasonally as a function of local weather patterns, including the amount of rainfall and snowmelt. If background aqueous chemical concentrations vary significantly on a seasonal basis at RFP, it may be necessary to compute separate background statistics by season. If seasonality effects are significant, and seasonality is ignored (obscured) by combining data from all seasons, the larger variance of the combined data set would result in wider tolerance intervals. This would make it more difficult to distinguish potential downgradient contamination from background conditions at RFP.

As discussed earlier, seasonality will be tested at RFP by comparing quarterly water quality data in analysis of variance procedures. The Mann-Kendall, or seasonal Kendall statistical tests may be used to look for a long-term monotonic trend. Three years worth of background monitoring data are considered the minimum to start evaluating seasonality. Seasonality may show up in simple "time series plots" of the concentration of selected analytes versus date of sampling at a given station.

Seasonal effects can not be tested in geological materials because boreholes are drilled and sampled only one time at a given location. Furthermore, rock materials and seep and stream bed sediments have relatively long residence times compared to natural waters. Therefore, although bed sediments are sampled quarterly, basically the same solids are collected each time and seasonality will not be considered for these solids. Variability between samples of geologic solids collected from the same site are believed to be the result of natural heterogeneities in the solids and analytical variance.

1.7.3 Water Quality Trends

Surface water and ground water data from RFP were examined using one or more types of standard geochemical plots: Stiff, Trilinear, or Schoeller diagrams. While 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 stream drainages. Stiff or Trilinear diagrams were

plotted on an RFP site-wide base map to visually illustrate how the major ion chemistry of ground water changes on a site-wide scale.

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

Ratio maps, or scatterplots using ion ratios such as (Ca+Mg)/(Na+K) are useful for detecting changes in RFP ground water chemistry, which are potentially the result of cation exchange processes.

1.8 COMPARISON OF BACKGROUND AND NON-BACKGROUND POPULATIONS

Background and non-background data comparisons are not a part of the background study. However, these comparison techniques will be of interest to users of the statistics provided by the background program.

1.8.1 Selection of Evaluation Methods

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

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 are less than 50% detections in the grouped background and non-background populations, a Wilcoxon Sum Rank test or Kruskal-Wallis nonparametric, ANOVA is the recommended statistical method (see EPA, 1992). If there are greater than 50% detections, then ANOVA or

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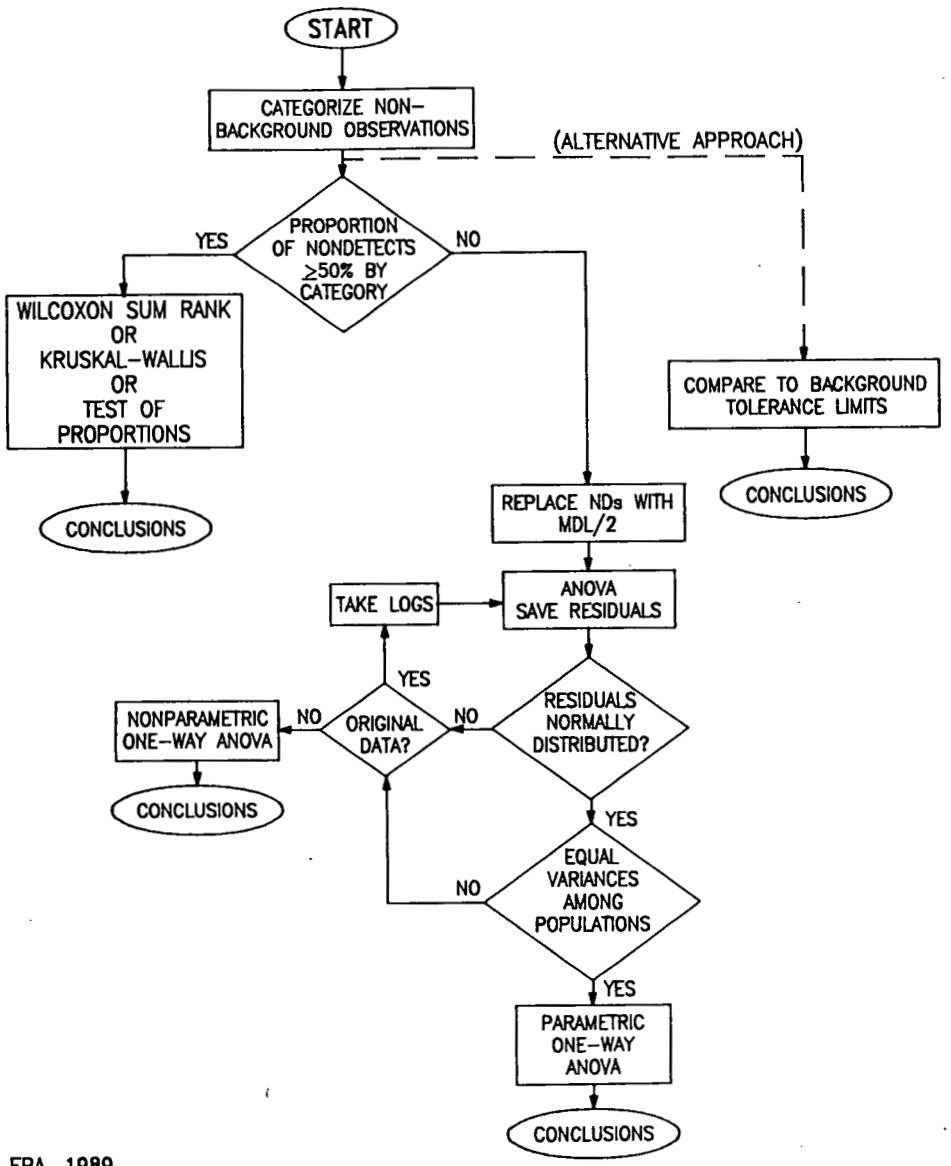


ADAPTED FROM EPA, 1989

U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	SELECTION OF STATISTICAL METHOD FOR COMPARISON OF BACKGROUND AND NON-BACKGROUND POPULATIONS	FIGURE 1-2

tolerance intervals are options for conducting the statistical analysis. ANOVA is the preferred method for statistical analysis but this will require at least three observations from the non-background area. In using ANOVA it will be necessary to identify sample distributions and equality of variances to determine whether parametric or non-parametric ANOVA should be used (see Figure 1-2). ANOVA methods are described in EPA, 1989.

Analyte concentrations from a non-background area can also be individually compared to the tolerance interval for the appropriate background population. Background tolerance intervals are reported in this Background Geochemical Characterization Report. The tolerance interval answers the question: where do most of the background population's observations lie?

Where intra-well 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.

Table 1-1

Summary of Statistical Models by Sample Type

Sample Type	Classification Factors	Levels	Max. No. of Sampling Locations
Seep Surface Water	Seasonality	Winter Spring Summer Fall	3[a]
Stream Surface Water	Drainage	Rock Creek Woman Creek	11[a,b]
	Seasonality	Winter Spring Summer Fall	
Groundwater	Aquifer	Rocky Flats Alluvium Colluvium Valley Fill Alluvium Weathered Bedrock Arapahoe/Laramie	51[a]
	Location	North Rocky Flats[d] South Rocky Flats	
	Seasonality	Winter Spring Summer Fall	
Stream Sediments[c]	Drainage	Rock Creek Woman Creek	6
Geologic Materials	Formation	Rocky Flats Alluvium Colluvium Weathered Bedrock	18
	Location	North Rocky Flats[d] South Rocky Flats	

a Number of sampling locations available in any one event may be reduced due to insufficient water.

b Not all sampling locations were in use at the start of sampling.

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 samples.

d The boundary between North and South Rocky Flats is defined by the centerlines of the east and west plant access roads and Central Avenue.

e Seep sediments and stream sediments will be treated as separate sample types.

Table 1-2

Tolerance Factors for Normal Tolerance Limits for 95% Population at 95% Confidence

n	Two-Sided	One-Sided
2	37.667	26.260
3	9.916	7.655
4	6.370	5.145
5	5.079	4.202
6	4.414	3.707
7	4.007	3.399
8	3.732	3.188
9	3.532	3.031
10	3.379	2.911
11	3.259	2.815
12	3.162	2.736
13	3.081	2.670
14	3.012	2.614
15	2.954	2.566
16	2.903	2.523
17	2.858	2.486
18	2.819	2.453
19	2.784	2.423
20	2.752	2.396
21	2.723	2.371
22	2.697	2.350
23	2.673	2.329
24	2.651	2.309
25	2.631	2.292
26	2.612	2.275
27	2.595	2.260
28	2.579	2.246
29	2.554	2.232
30	2.549	2.220
35	2.490	2.166
40	2.445	2.216
45	2.408	2.092
50	2.379	2.065
60	2.333	2.022
80	2.272	1.965
100	2.233	1.927
500	2.070	1.763
inf.	1.960	1.645

SECTION 2
PHYSICAL SETTING

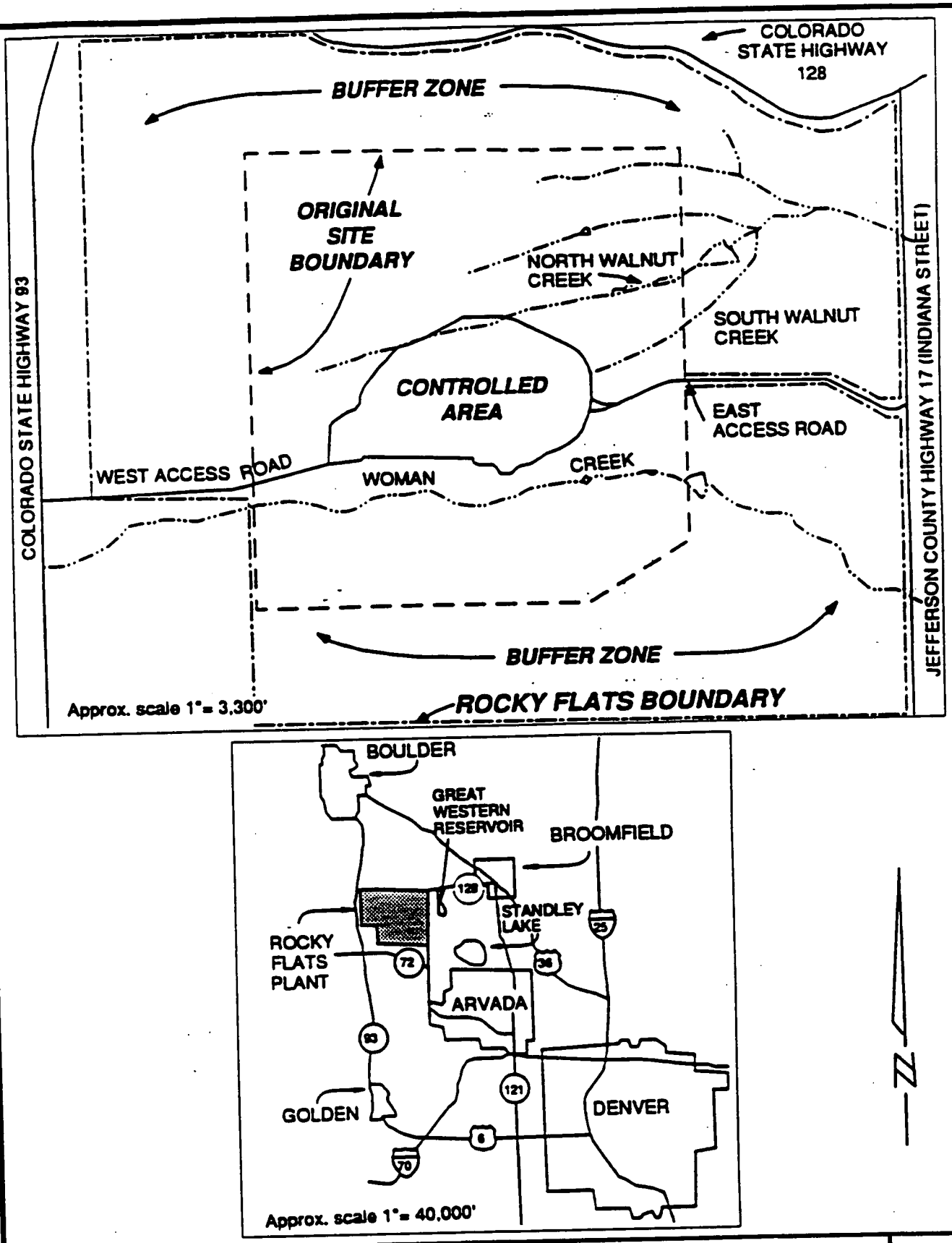
The RFP is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver (Figure 2-1). Other surrounding cities include Arvada, Boulder, and Westminster, which are located less then 10 miles to the southeast, northwest, and east, respectively. The Plant consists of approximately 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 Plant 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 Plant and vicinity is influenced primarily by its proximity to the Front Range of the Rocky Mountains. The Plant is directly east of the north-south trending Front Range, and is located about 16 miles east of the Continental Divide at an elevation of approximately 6,000 feet above mean sea level. The RFP is located on a broad, eastward sloping plain of coalescing alluvial fans developed along the Front Range. The fans extend about 5 miles in an eastward direction from their origin at Coal Creek Canyon and terminate on the east at a break in slope to low rolling hills. The operational area at the Plant 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 intermittent streams drain the Rocky Flats Plant with flow generally from west to east. These drainages are Rock Creek, Walnut Creek, and Woman Creek (Figure 2-2). Rock Creek drains the northwestern corner of the Plant and flows northeast through the buffer zone to its off-site confluence with Coal Creek. An east-west trending interfluve separates the Walnut and Woman Creek drainages. North and South Walnut Creeks and an unnamed tributary drain the northern portion of the Plant security area. These three forks of Walnut Creek join in the buffer zone and flow toward Great Western Reservoir, which is approximately 1 mile east of the



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

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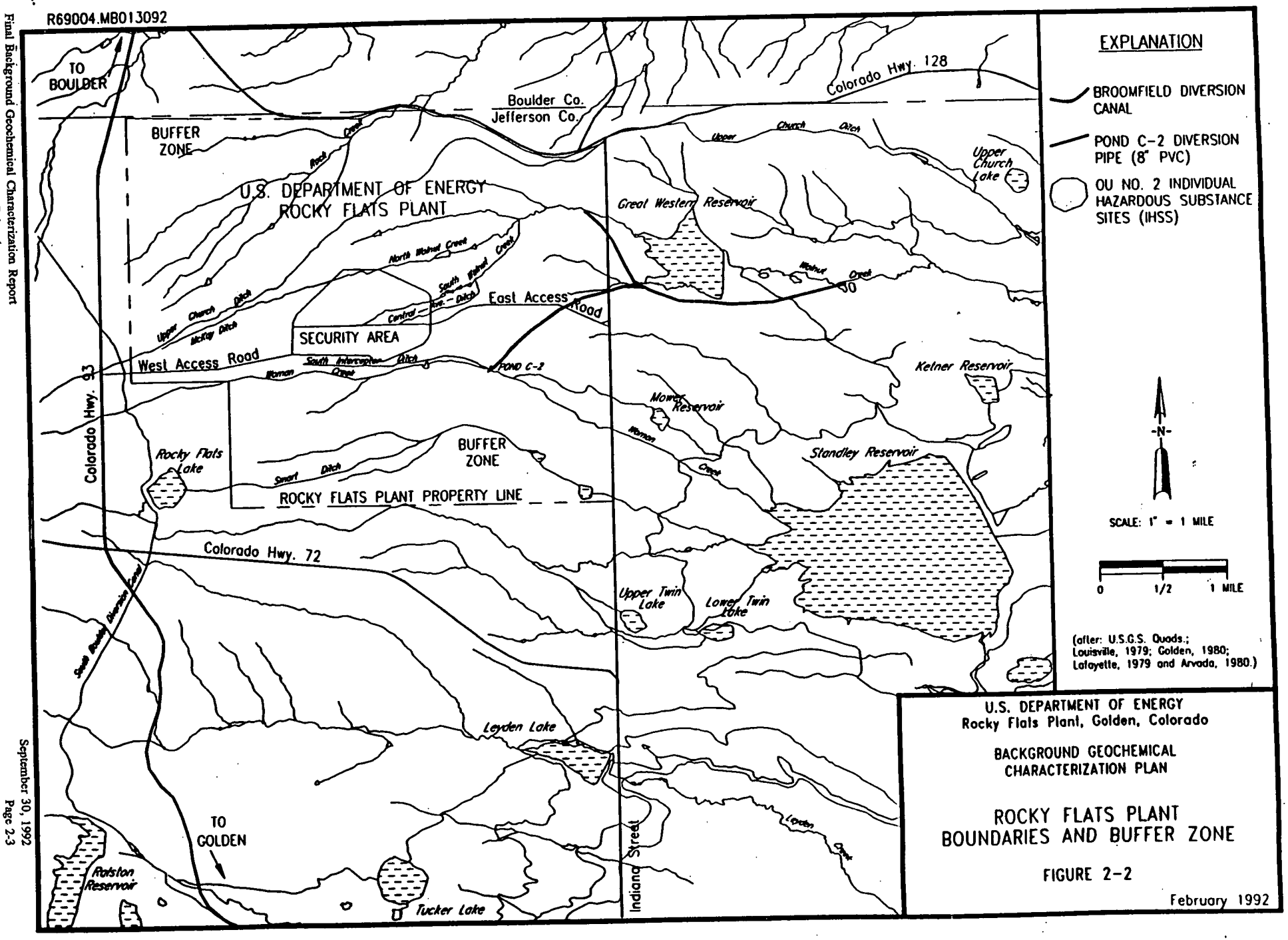

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

BACKGROUND GEOCHEMICAL CHARACTERIZATION PLAN

ROCKY FLATS PLANT
BOUNDARIES AND BUFFER ZONE

FIGURE 2-2

February 1992

confluence. However, this flow is routed around Great Western Reservoir by the Broomfield Diversion Canal, which is operated by the City of Broomfield. Woman Creek drains the southern RFP buffer zone flowing eastward. The Woman Creek flow is diverted on plant site to Mower Reservoir via the Mower Ditch. The South Interceptor Ditch lies between the Plant and Woman Creek. The South Interceptor Ditch collects runoff from the southern Plant security area and diverts it to Pond C-2 where it is treated and monitored in accordance with the Plant NPDES permit. Treated water from Pond C-2 is then pumped to the Walnut Creek watershed where it is released to the Broomfield Diversion Canal.

2.3 REGIONAL AND LOCAL GEOLOGY

Geologic units beneath the Rocky Flats Plant consist of unconsolidated surficial units of Quaternary age (Rocky Flats Alluvium, various terrace alluvia, valley fill alluvium, and colluvium), which unconformably overlie Cretaceous-aged bedrock (Arapahoe Formation, Laramie Formation, 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 that become younger to the east. Figure 2-4 presents a generalized stratigraphic section of the Denver Basin bedrock, and Figure 2-5 shows a stratigraphic section for the RFP including unconsolidated deposits. Figure 2-6 shows the surficial geology of the RFP (EG&G, 1992a).

2.3.1 Quaternary-Aged Alluvia

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

The pre-Wisconsin pediment was not a smooth plane, but rather an erosional surface that was cut by a well-developed network of west to east-flowing stream drainages that have probably, influenced the current drainage system. The pediment surface exhibits as much as 30 feet of relief (EG&G, 1991b). In ravines and drainages the alluvial sediment is breached exposing strata of the Arapahoe and Laramie Formations.

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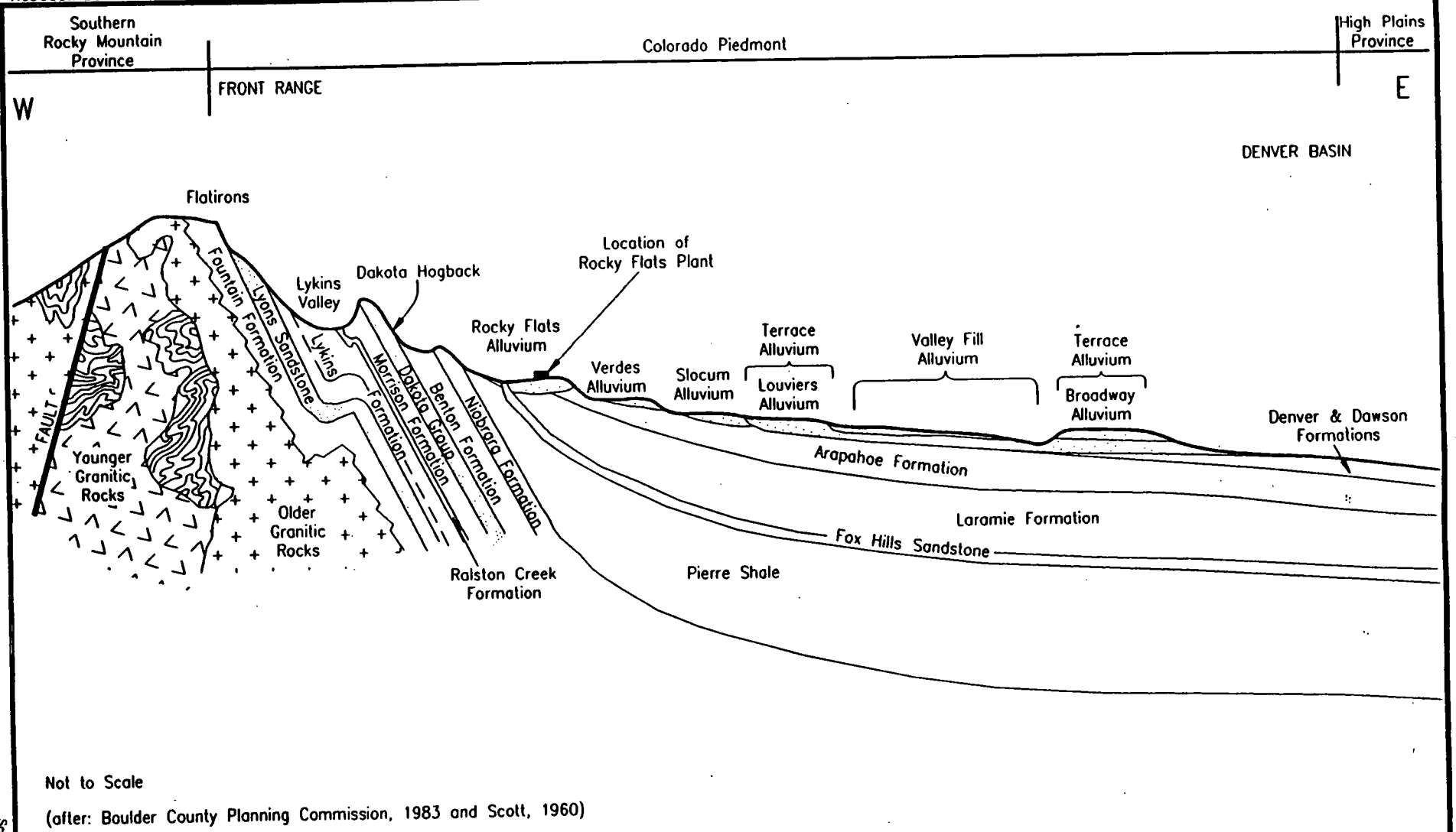
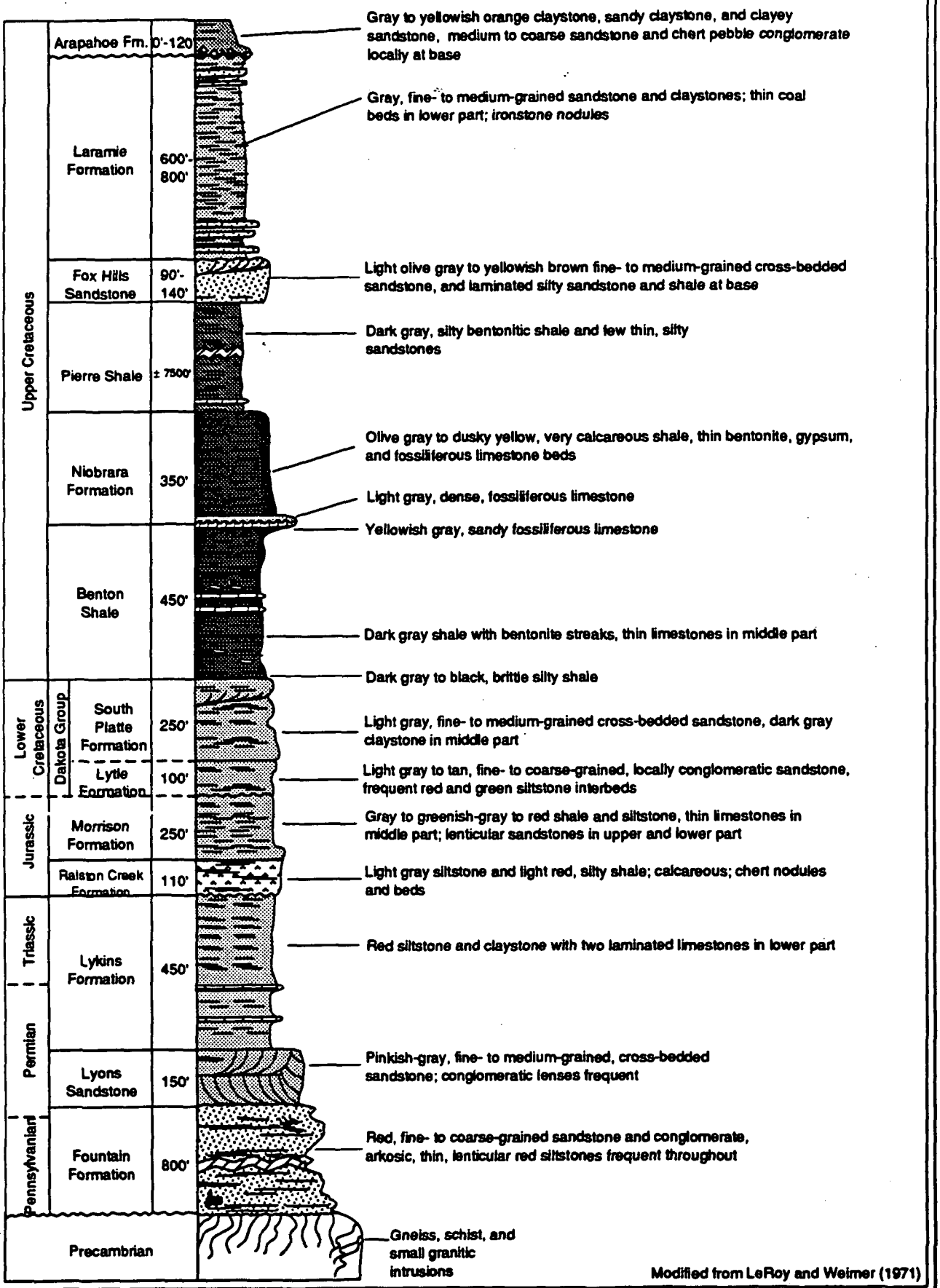


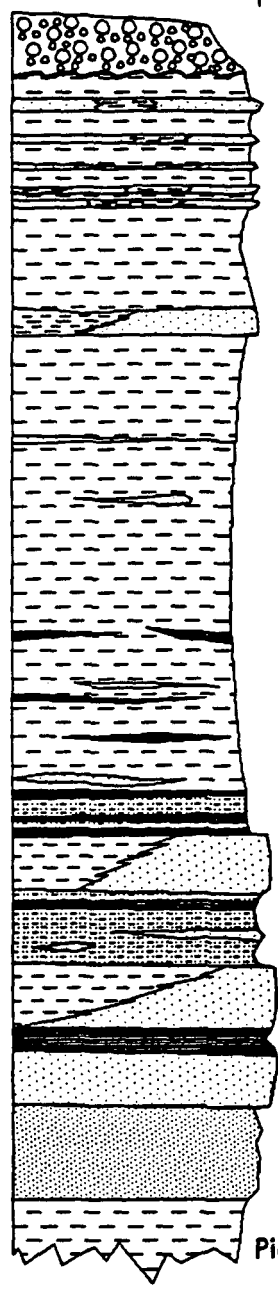
Not to Scale

(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
Cretaceous		Arapahoe Formation 0–120'	sand #1: 0–27.2' sand #2: 0–10' sand #3: 0–18' sand #4: 0–15' sand #5: 0–9'+
		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

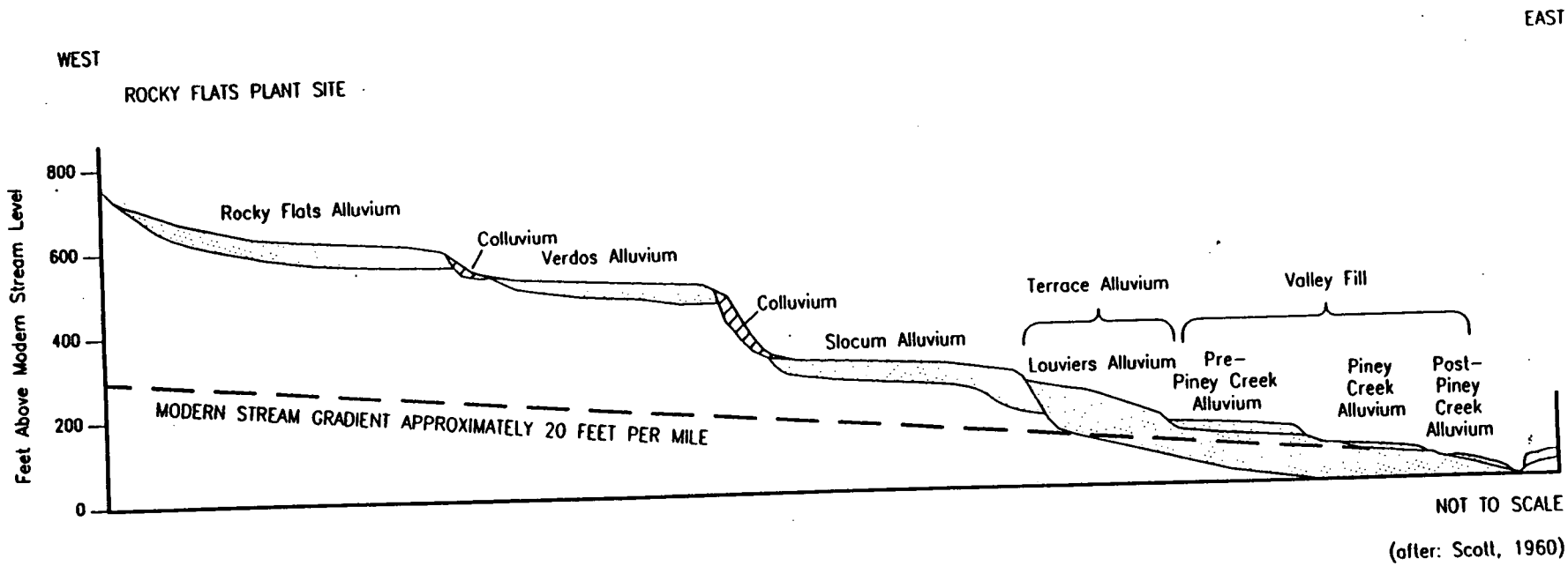
- Alluvium
- Coal
- Fine-grained & coarser sandstone
- Fine-grained sandstone
- Siltstone and claystone
- Silty sandstone

(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

R69008.MB013092



(after: Scott, 1960)

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 Rocky Flats Alluvium comprises the main alluvial cover at RFP. Various other surficial deposits occur topographically below the Rocky Flats Alluvium in the Plant drainages. Colluvium (slope wash) mantles the valley side slopes between the Rocky Flats Alluvium and the valley bottoms. In addition, remnants of younger terrace deposits, including the Verdos, Slocum, and Louviers Alluvia, may occur along the valley side slopes. Recent valley fill alluvium occurs in the active stream channels (Figure 2-7).

The Quaternary-aged Rocky Flats Alluvium is the oldest (Nebraskan or Aftonian) and topographically highest alluvial deposit at the RFP (Scott, 1965). The alluvium is 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 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, the alluvial cover is thin, or the unconsolidated material is underlain by claystones and siltstones which restrict percolation.

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

After deposition of the Rocky Flats Alluvium, eastward flowing streams dissected the deposit by headward erosion and lateral planation. The alluvium was progressively removed by erosion in the Woman Creek drainage south of the plant and in the South Walnut Creek drainage to the north. The result is a remnant of Rocky Flats Alluvium extending eastward from the Plant between the two drainages.

2.3.2 Cretaceous-Aged Deposits

The Cretaceous-aged formations in the vicinity of RFP were deposited during the Laramie 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 Arapahoe fluvial deposits.

2.3.2.1 Arapahoe Formation

The Arapahoe Formation is the uppermost bedrock unit in the vicinity of RFP. It unconformably underlies surficial materials beneath most of the Plant 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 the Rocky Flats Alluvium.

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

The Arapahoe Formation contains sandstone intervals which 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 occurring within 30 to 40 feet of the base of the alluvium are oxidized and are thus pale orange, yellowish-gray, and dark yellowish-orange. The sandstones that are not in the weathered zone are light gray and olive gray.

The formation thickness is slated as 120 feet in the central portion of RFP. However, the thickness of the formation is currently under investigation and may be as little as 50 feet thick. The unit is nearly flat-lying beneath the central and eastern portions of the Plant (EG&G 1990b, 1990e).

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 which contains numerous coals and sandstones that increase in thickness at 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 beds dip at approximately 45° to 50° west of the Plant and flatten to less than 2° dip below and east of the Plant (EG&G, 1990b, 1990e).

The upper Laramie is composed of mostly silty claystones, siltstones, and some fine-grained fluvial channel sandstones. The basal 150 feet of the upper Laramie interval contains coal beds that range from 1 to 3 feet in thickness. The silty claystones are light olive gray to olive black, massive, and may contain sand or carbonaceous material. Iron oxide nodules occur in 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 feet in thickness and one sandstone is 50 feet thick (EG&G, 1991b).

The total thickness of the Laramie Formation is about 800 feet; the upper Laramie ranges in thickness from 515 to 690 feet and the lower Laramie ranges from 115 to 285 feet in thickness (Weimer, 1973; EG&G, 1991b).

2.3.2.3 Fox Hills Sandstone

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

2.3.3 Structural Features

RFP is situated in an area once tectonically active. Structural activity associated with the Laramide Orogeny (approximately 60 to 45 million years ago) was manifested in thrust faults, resulting from compressional stresses. After a period of quiescence, the area underwent tensional faulting from the Miocene to the Pliocene period (25 to 5 million years ago), which produced normal and high angle reverse faults associated with the present Front Range.

The Plant lies on a monoclinal fold along the eastern margin of the Front Range mountains. The axial plane of the fold strikes roughly north–south. Just west of the site steeply dipping strata of Pennsylvanian age lie unconformably on Precambrian granitic rocks.

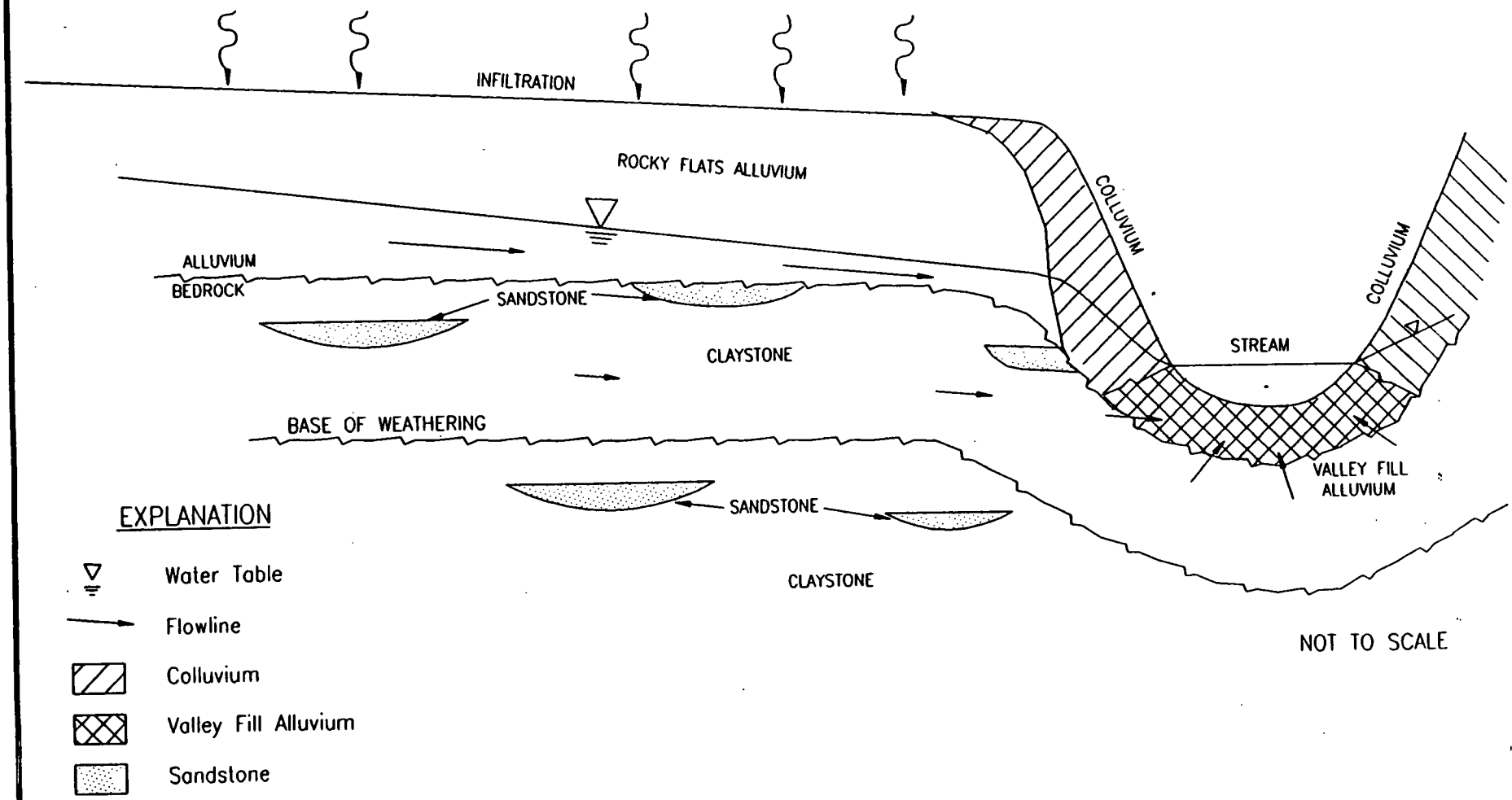
2.4 HYDROGEOLOGY

Unconfined ground water occurs in the Rocky Flats Alluvium which is relatively permeable (Figure 2-8). Recharge to the alluvium is from precipitation, snowmelt, and water losses from ditches, streams, and ponds that are cut into the alluvium. Ground water movement in the Rocky Flats Alluvium 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 Rocky Flats Alluvium terminates approximately 1,500 feet west of the eastern Plant boundary and does not directly supply water to wells located downgradient of the RFP. The surficial water table map is presented on Plate 2. Discharge from the alluvium occurs at seeps that may or may not be covered by colluvium at the contact between the alluvium and bedrock along the edges of the valleys. Most seeps flow intermittently.

Ground water levels in the Rocky Flats Alluvium rise in response to recharge during the spring and decline during the remainder of the year. During periods of high surface water flow, water is lost to bank storage in the valley fill alluvium and returns to the stream after the runoff subsides. In the western portion of RFP, where the thickness of the alluvial material is greatest, the depth to the water table is 50 to 70 feet below the surface (EG&G, 1991b). The water table becomes shallower to the east (with local variations) as the alluvial material thins. Some mounding occurs under ponds, such as the solar ponds.

The Arapahoe sandstones exhibit many of the same hydrological characteristics as the Rocky Flats Alluvium. Where the sandstones are in direct contact with the alluvium, ground water 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 conductivity than the Rocky Flats Alluvium.

The main recharge area for Arapahoe sandstones is under the Rocky Flats Alluvium although some recharge from the colluvium and valley fill alluvium likely occurs along the stream valleys (Figure 2-8). Recharge is greatest during the spring and early summer when rainfall and stream



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

flow are at a maximum and water levels in the Rocky Flats Alluvium are high. Discharge occurs at the edges of valleys (Figure 2-8). Ground-water 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 Rocky Flats Alluvium (Hydro-Search, 1985; Rockwell International, 1986b).

The lower sandstone unit of the Laramie Formation and the underlying Fox Hills Sandstone comprise 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 feet. These units subcrop beneath the Rocky Flats Alluvium west of the Plant and can be seen in clay pits excavated through the Rocky Flats Alluvium (see Figure 2-3). Recharge to the aquifer occurs along the rather limited outcrop area exposed to surface water flow and leakage along the Front Range (Robson et al., 1981b). Claystones of the Laramie Formation have very low hydraulic conductivities; therefore, the U.S. Geologic Survey (Hurr, 1976) concludes that Plant operations will not impact any units below the upper claystone unit of the Laramie Formation.

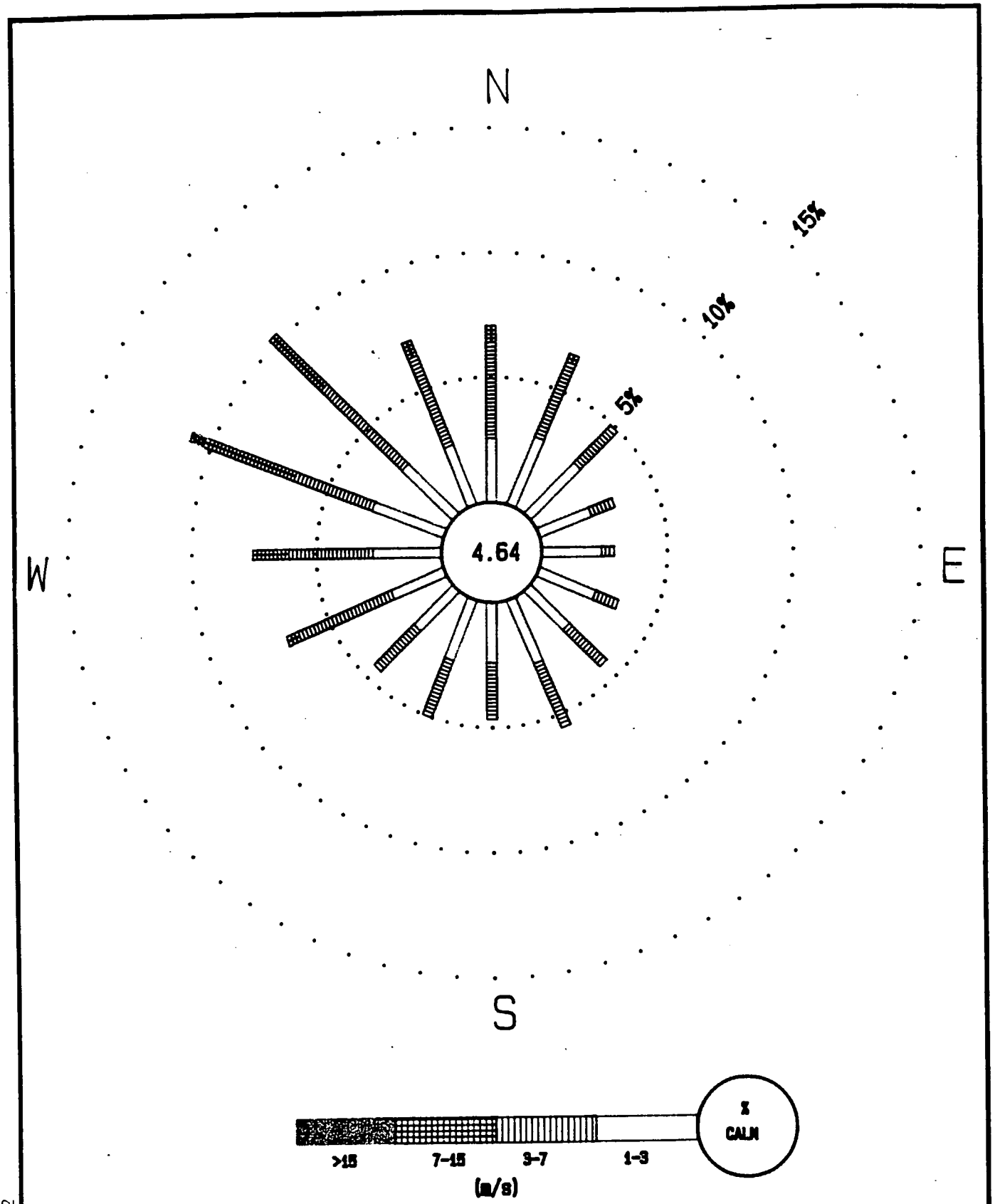
In summary, two ground water flow systems are distinguished in the current conceptual model of the subsurface hydrology of Rocky Flats. The upper flow system is unconfined and lies within the Rocky Flats Alluvium, colluvium, valley fill, and weathered bedrock. The lower flow system is confined within unweathered bedrock sandstones of the lower Arapahoe and upper Laramie Formations. The two flow systems are probably in hydraulic connection wherever bedrock sandstone subcrops under surficial materials (EG&G, 1990c, 1991c).

2.5 METEOROLOGY AND CLIMATOLOGY

The area surrounding the RFP has a semiarid climate characteristic of much of the central Rocky Mountain region. Approximately 40 percent of the 15-inch 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, accounting for 19 and 11 percent of the annual precipitation, respectively. Snowfall averages 85 inches 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°F to 85°F, and winter temperatures range from 20°F to 45°F. The low average relative humidity (46 percent) is due to the blocking effect of the Rocky Mountains. Wind, temperature, and precipitation data are collected on the plant site and summarized annually. Table 2-1 presents the 1990 annual summary of the percent frequency of wind directions (16 compass points) divided into 5 speed categories. These frequency values are represented graphically in Figure 2-9. Winds at the RFP are predominantly northwesterly. Winds greater than 4.18 meters per second (m/s) (9.2 miles per hour [mph]) with easterly components occur with a low frequency.

Special attention has been focused on dispersion meteorology surrounding the Plant due to the possibility that significant atmospheric releases 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, 1984) indicate that drainage flows (winds coming down from the mountains to the west, turn and move toward the north and northeast along the South Platte River valley and pass to the west and north of Brighton, Colorado (DOE, 1980), which is just north of Denver.



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

Table 2-1

Wind Direction Frequency (Percent) by Five Wind-Speed Classes

Rocky Flats Plant

(Fifteen-Minute Averages 1990 Annual)

	Calm	1-3 (m/s)	3-7 (m/s)	7-15 (m/s)	>15 (m/s)	Total
—	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

Reference: EG&G, 1992b. Rocky Flats Plant Site Environmental Report for 1992.

SECTION 3
BACKGROUND SAMPLING PROGRAM

This section describes the sampling locations and data collection techniques employed during the background borehole, ground water, surface water, and sediment geochemical characterization. Surface soils are not considered in this program because it is anticipated that a separate program will be developed by EG&G to characterize surficial soils in background and non-background areas of the RFP.

3.1 SAMPLING LOCATIONS

The rationale for selection of background sampling sites consider a number of factors which are listed below:

- Plant boundaries - all background sites in the present program are 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 are located to avoid all known IHSSs.

- Geology - all key geologic materials are represented: Rocky Flats Alluvium, colluvium, valley fill alluvium, and weathered and unweathered Arapahoe and Laramie Formation bedrock.

- Hydrology - background sites must be upgradient or sidegradient to the central Plant area and to known IHSSs. Sites must be representative of the intermittent streams present at the RFP, associated stream sediments, seep waters, and ground water. Both surface and ground water locations are constrained by the limited availability of water due to the semiarid climate at the RFP.

- Meteorology - background stations are located west, north, and south of the central Plant area because the predominant direction of high winds is to the 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 has resulted in "clumping" of sites, and lack of representation for some 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 at the RFP (EG&G Energy Measurements, 1982, 1990) do not indicate anomalous readings in the 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 due to nuclear testing, and from natural sources.

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 in order to obtain a 95 percent tolerance interval (95% of population within the one-sided interval) with a tolerance factor of three at the 95% 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 is used extensively to define engineering tolerances (Doctor, Gilbert, and Kinnison, 1986). However, the statistical methods for establishing independent background subpopulations affects the number of samples ultimately included in each subpopulation. Also, the absence of ground water in a monitor well reduced the sample size for some water-bearing units, and multiple samples with depth from boreholes in geologic materials increased the sample size for some geologic units.

3.1.1 Geologic Materials/Boreholes

As discussed in Section 2, two types of surficial materials occur beneath IHSSs at the RFP. Many of the IHSSs are situated on Rocky Flats Alluvium (Plate 1). The second type of surficial material consists of colluvial materials that have accumulated on slopes below the Rocky Flats Alluvium. Colluvium is present in the Woman Creek and Walnut Creek drainages. IHSSs within these drainages are a part of OUs 5 and 6. Development of background soil data therefore required sampling of both types of materials.

In addition to surficial materials, Arapahoe and Laramie Formation claystone and sandstone bedrock geochemistry were characterized for comparison to investigative samples. Presented below is a discussion of borehole locations utilized for geologic materials sampled during the background investigation. Boreholes were drilled and sampled in 1989 (sampling methods are discussed in Section 3.2).

3.1.1.1 Rocky Flats Alluvial Boreholes

The Rocky Flats Alluvium consists of poorly sorted boulders, cobbles, gravels, sands, silts, and clays deposited in alluvial fans at the base of the Colorado Front Range Mountains (Hurr, 1976). Eight boreholes were drilled to investigate the Rocky Flats Alluvium chemistry (boreholes B400089, B400289, B400389, B400489, B200589, B200689, B200789, and B200889 [Plate 3]). Boreholes were drilled in both the north buffer zone (boreholes B200589, B200689, B200789 and B200889) and south buffer zone (boreholes B400089, B400289, B400389 and B400489) to characterize the lithology, thickness, and geochemistry of the Rocky Flats Alluvium in different areas of the Plant. There are no IHSSs in either of these two areas (see Plates 1 and 3).

3.1.1.2 Colluvial Boreholes

Colluvium at the Rocky Flats Plant collects on the sides 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 Plant buffer zones. These deposits consist predominantly of clay with occurrences of sandy clay and gravel. Nine boreholes were drilled to characterize the colluvium (boreholes B201089, B201189, B201289, B201489, B201589, B301889, B401989, B302089, and B405989). Boreholes B201089, B201189, B201289, B0201489, and B201589 were drilled in the north buffer zone, and boreholes B301889, B401989, B302089, and B402189 were drilled in the south buffer zone (Plate 3) to investigate spatial variation in colluvial geochemistry.

3.1.1.3 Weathered Bedrock Boreholes

The bedrock units underlying the RFP is the Arapahoe Formation. This formation consists predominantly of claystone with interbedded sandstone. All nine of the boreholes drilled to

investigate colluvial materials were extended 12 feet into weathered bedrock of the Arapahoe Formation (Plate 3). Eight boreholes were drilled and sampled in weathered claystone. Borehole B402189 encountered weathered non-subcropping sandstone.

3.1.2 Ground Water

Ground water at the RFP occurs in Rocky Flats Alluvium, colluvium, valley fill alluvium, and the Arapahoe and upper Laramie Formation. Unconfined ground water flow occurs in surficial materials, subcropping sandstone, and surficial bedrock. In addition, subcropping claystone may be saturated in some locations. Confined ground water occurs in deeper, isolated sandstone hydrostratigraphic units.

As can be observed by comparing Plates 1, 2, and 3, the background boreholes and monitoring wells in the north buffer zone are not downgradient of the West Spray Field. Surface water and ground water flow is intercepted by a tributary on the upper reaches of Walnut Creek. Even if these sampling locations were downgradient of the West Spray Field, travel times would be 42 feet/year (4.0×10^{-5} centimeters per second [cm/sec]) based on a conservative hydraulic conductivity of 1×10^{-3} cm/sec for the Rocky Flats Alluvium, effective porosity of 0.3, and hydraulic gradient of 0.012 (80 feet/ 6,750 feet). The West Spray Field was used for spray application from April 1982 to October 1985. The sampling locations are 6,750 feet from the eastern edge of the West Spray Field, and it has been 10 years since the initial spraying, therefore, potential contamination has traveled 410 feet. Because the closest background borehole or monitoring well is over 6,000 feet from West Spray Field, no impact has occurred.

3.1.2.1 Rocky Flats Alluvial Ground Water

Ground water in Rocky Flats Alluvium was investigated by installing, developing, and sampling alluvial wells in eight boreholes used for characterization of the Rocky Flats Alluvium (wells B400189, B400289, B400389, B400489, B200589, B200689, B200789, and B200889). Well B405586 serves as the ninth background alluvial well (Plate 4). The wells were installed in two different areas of the Plant buffer zone to investigate spatial variability of alluvial ground water quality. Wells B405586, B400189, B400289, B400389, and B400489 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. Wells B200589, B200689, B200789, and B200889 were installed in the north buffer zone sidegradient of the Plant where there are also no IHSSs (Plate 1). This area was chosen because the lithologies and saturated thicknesses are similar to those at the Solar Evaporation Ponds, 903 Pad, Mound, and East Trenches Areas based on a similar topographic position.

One well cluster was also installed in the Rocky Flats Alluvium at the location where the greatest saturated thickness was encountered to evaluate geochemical stratification of alluvial ground water quality west of the Plant. The alluvium exceeds 90 feet in depth in this area. The well cluster consists 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 the Rocky Flats Alluvium (9.87 to 54.45 feet below ground surface). Well B405789, located approximately 15 feet west of B400489, was screened over the bottom 10 feet of saturated alluvium (43.01 to 52.48 feet below ground surface). Well B405689 was screened from 10 feet above to 10 feet below the water level (3.0 to 22.51 feet below ground surface) (Plate 4).

3.1.2.2 Colluvial Ground Water

In order to characterize colluvial ground water quality, 10 wells were installed in colluvial materials. They were installed in various areas of the Plant buffer zone to investigate spatial variability. Wells B201089, B201189, B201289, B201489, B201589, and B205589 were installed in the north buffer, whereas wells B301889, B401989, B302089, and B405989 were installed in the south buffer zone (Plate 4). There are no IHSSs in either of these areas (Plate 1).

3.1.2.3 Valley Fill Alluvial Ground Water

Characterization of valley fill ground water quality was accomplished by installing nine wells in valley fill materials (Plate 4). Wells B102289, B102389, B202489, and B202589 were installed at four locations along the Rock Creek drainage to investigate ground water quality changes along the drainage. To investigate spatial variability of ground water quality between

drainages, wells B402689, B302789, B302889, B302989, and B303089 were installed in the south buffer zone and completed in Woman Creek Valley fill alluvium. None of the above areas have been impacted by IHSSs.

3.1.2.4 Bedrock Ground Water

Data for the characterization of background bedrock ground water quality were collected by installing 21 monitor wells screened in bedrock. These wells were drilled in various areas of the Plant buffer zone to investigate spatial variability of bedrock ground water quality (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 northern alluvial wells and are completed in weathered claystone of the Arapahoe Formation. The remaining six wells (B203789, B203889, B203989, B204089, B204189, and B204689) are completed in unweathered sandstones of the Arapahoe Formation. 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 is awaiting abandonment.

Ten bedrock wells were installed in the south buffer zone. Three of the 10 bedrock wells are completed in unweathered sandstones (B304289, B304989, and B405289), 5 wells are completed in weathered claystone (B304789, B304889, B405189, B305389, and B405489), and 2 wells (B402189 and B405889) are completed in weathered non-subcropping sandstones. Well B405489 is installed in weathered claystone of the 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, and three stations (SW41, SW80, and SW104) are positioned within tributaries entering Woman Creek from the southwest. Station SW07 is situated in the McKay Ditch upgradient of any IHSSs (Plate 1), and stations SW06, SW05, SW108, and SW04 are located along the Rock

Creek drainage. Surface water stations SW080, SW104, and SW108 are seeps while the rest are instream surface water stations. These locations were chosen to collect an array of surface water samples that are representative of background conditions.

Six additional surface water stations have been added to the Background Geochemical Monitoring Plan since its inception in 1989. SW127 is located in the far western part of the Plant on a tributary of Woman Creek. SW130 is located just east and downgradient of Rocky Flats Lake on Smart Ditch in the south buffer zone. 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 are now sampled quarterly as of the first quarter of 1992.

3.1.4 Stream Sediment

Background streambed sediment chemistry is being evaluated by sampling nine sediment monitoring locations for subsequent chemical analyses (Plate 6 and Table 3-2). These stations are paired with nine of the background surface water stations described above. Stations SED20, SED21, SED22, and SED23 are located in the Rock Creek drainage; station SED04 is located in the McKay Ditch; and stations SED16, SED17, SED18, and SED19 are located in Woman Creek. SED18, SED19, and SED21 are located at seeps while the rest and instream sediment stations. These sites have been selected as locations representative of lithologies present in the drainages of the Plant site where impacts from management units are not anticipated.

3.2 SAMPLING AND DATA COLLECTION

Starting in 1989, field sampling and data collection followed the Rocky Flats ER Program SOPs (Rockwell International, 1989c), and the ER Program QA/QC Plan (Rockwell International, 1989d). These documents have been superceded by the EMD SOPs (EG&G, 1991a), and the Rocky Flats Plant Site-Wide QAPjP (EG&G, 1991d). Presented below are brief discussions of data collection methods that were and/or are utilized for background characterization.

3.2.1 Drilling and Logging

All boreholes for soil sampling and monitor well construction were continuously sampled, as drilling permitted, and geologically logged. Drilling was performed utilizing 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, and materials were continuously sampled through the augers with split tube samplers on a wireline.

In areas where large cobbles and boulders were encountered such as the south-southwest buffer zone (wells B400189, B400289, B400389, B400489, B305389, B405489, B405689, B405789, and B405889), an air rotary downhole percussion hammer (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-gallon drums. The cuttings were collected for analytical purposes in boreholes B400289, B400389, B400489, B400589.

Protective surface casing was installed prior to a bedrock hole being rotary cored. After a deep bedrock borehole was augured 3 to 4 feet into unweathered bedrock, augers were pulled, and 8-⅝ inch outside diameter (OD) 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 using water. Continuous core samples were obtained using wireline and split tube samplers.

All lithologic samples were described, labeled and packaged by a geologist in the field as described in the SOPs. Well construction details are summarized in Table 3-3.

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

3.2.2 Borehole Sampling

Sampling methods for all boreholes drilled within the background area are described in this section. Borehole sample chemical analysis is discussed in Section 3.3.

3.2.2.1 Rocky Flats Alluvial Boreholes

Boreholes drilled in the Rocky Flats Alluvium were sampled as follows. The top 3 feet of each boring was composited for chemical analyses to characterize the Flatiron Soil. Below this depth, 6-foot composites were submitted for chemical analyses to characterize the Rocky Flats Alluvium. If a lithologically distinct layer greater than 2 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 alluvium thickness was less than 5 feet.

Samples were collected in glass jars for radionuclides, inorganics, and metals. Radionuclides and inorganics were collected in 16-ounce jars, and metals were collected in 8-ounce 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, 1989d).

3.2.2.2 Colluvium/Bedrock Boreholes

All colluvial boreholes were sampled from the surface to 12 feet below the bedrock contact so weathered bedrock materials could also be sampled for chemical analysis. The top 3 feet of the surficial materials were composited for chemical analysis to characterize the Hillslope soil developed on the colluvium. All remaining colluvial samples collected followed methods described for Rocky Flats Alluvium sampling.

Bedrock contact samples as well as weathered bedrock samples were collected from each colluvium bedrock borehole. The bedrock contact sample extended from the contact to 6 feet below the contact. A 6-foot composite sample was also collected below this depth. If a

lithologically distinct unit greater than 2 feet in thickness was encountered, a discrete sample was collected. Sample containers and parameters were as described for the Rocky Flats Alluvial borehole samples.

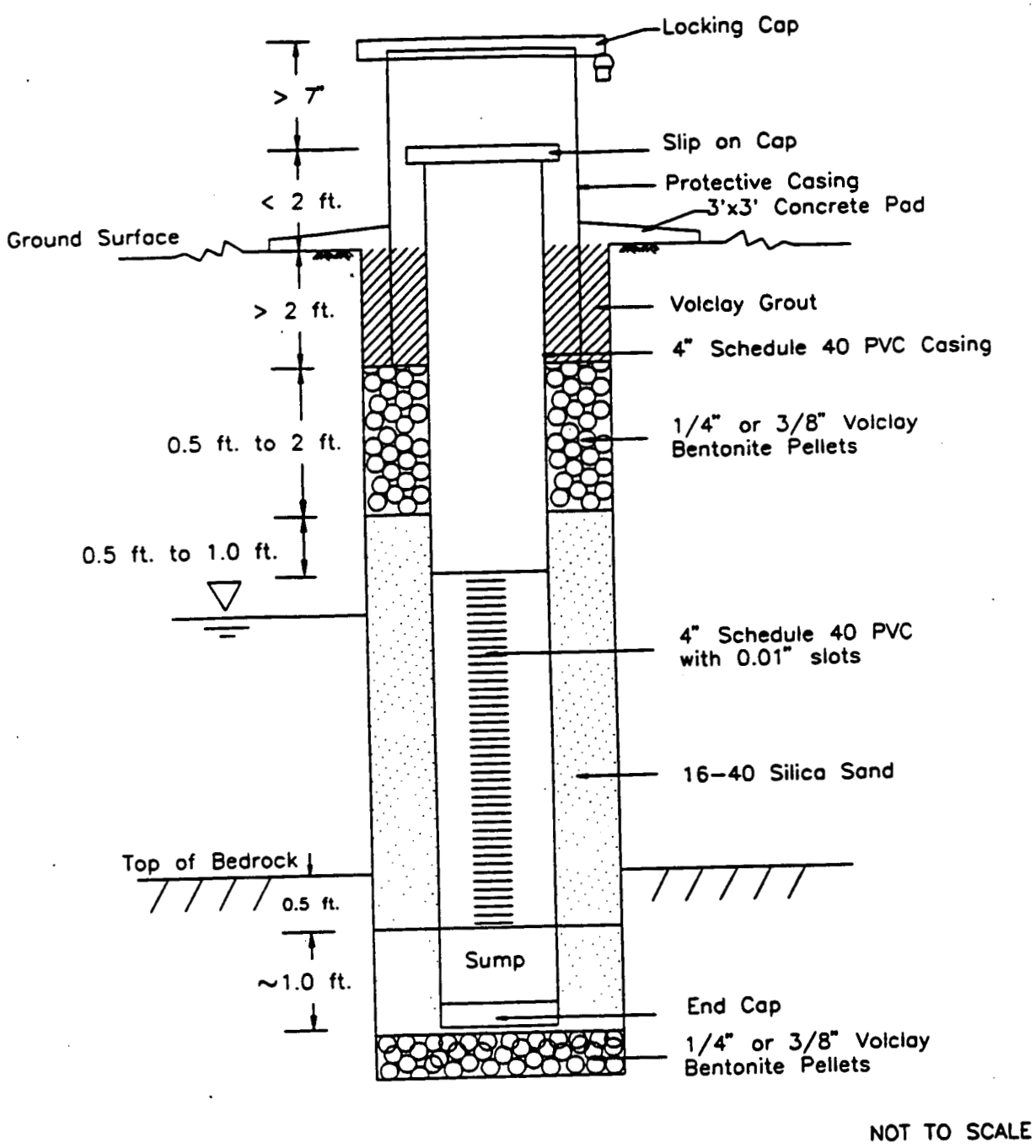
3.2.3 Monitor Well Installation

All alluvial and colluvial wells were completed with 4-inch diameter, Schedule 40 PVC casing and 0.01 inch slotted Schedule 40 PVC screen with the exception of colluvial well B201289, which was completed with 2-inch Schedule 80 PVC. Figure 3-1 illustrates the typical alluvial well design and annulus materials for wells completed in Rocky Flats Alluvium, colluvium, and valley fill alluvium. Except for the well cluster completed in Rocky Flats Alluvium discussed previously, all background wells completed in surficial materials were screened over the entire alluvial saturated thickness. The screened intervals of these wells extended from 0.5 feet below the bedrock contact to a point above the water level encountered during drilling or observed in nearby wells installed in similar materials.

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

Shallow, weathered claystone wells 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 occurred at wells B203189, B203489, and B203689. The remainder of the wells were built open hole, using a stainless steel centralizer for downhole stabilization. The wells were screened from approximately 5 feet below the bedrock contact to 15 feet below the bedrock contact with the exception of well B203489 in which the screen began 1.4 feet below the contact due to borehole instability during well installation. Figure 3-2 presents the typical weathered bedrock well design.

Two weathered sandstone wells were installed during this program. Well B402189 was constructed to screen the upper 10 feet of a weathered sandstone encountered at 12.5 feet below



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

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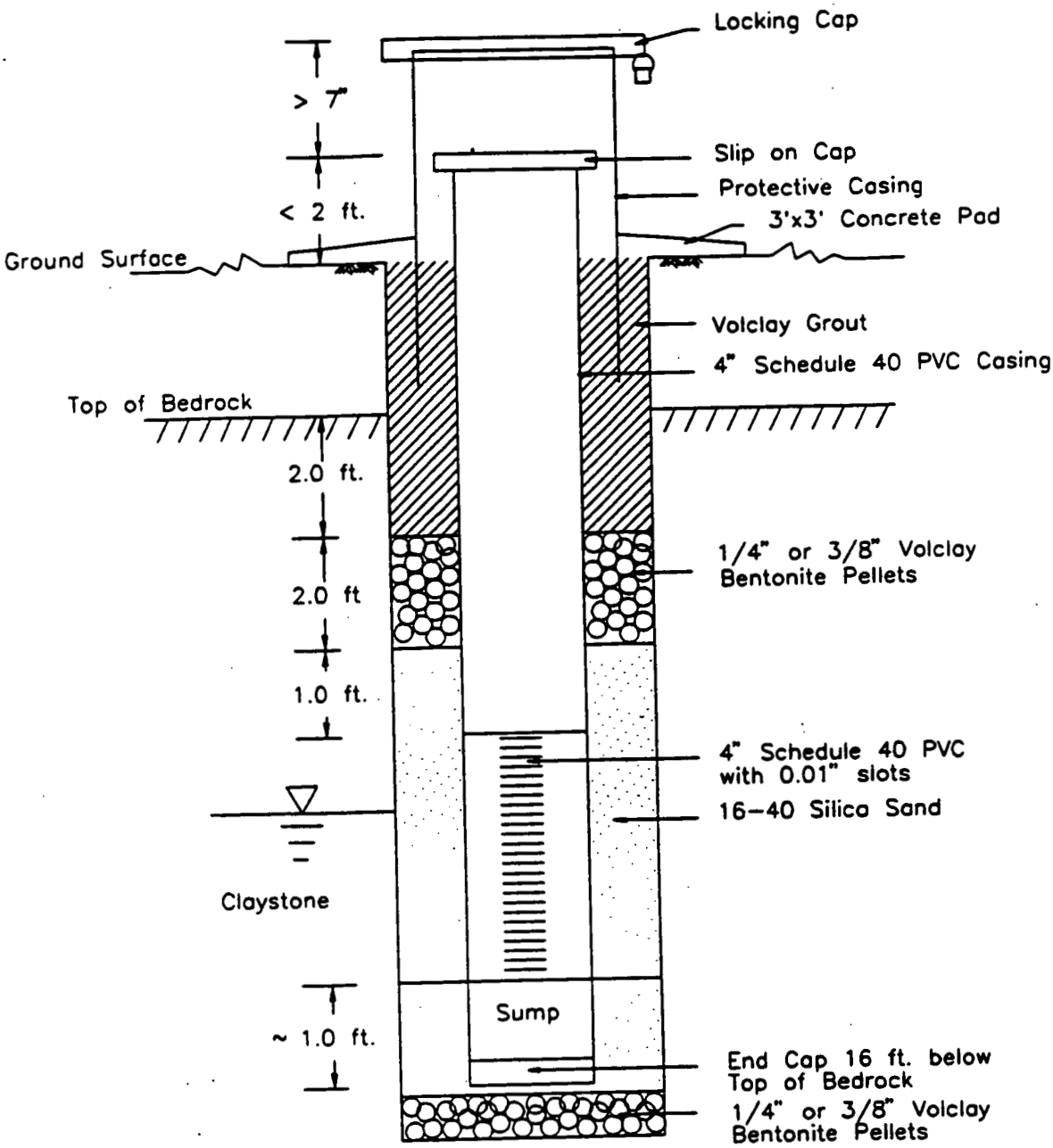

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U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	TYPICAL SHALLOW BEDROCK WELL CONSTRUCTION (Weathered Claystone)	FIGURE 3-2

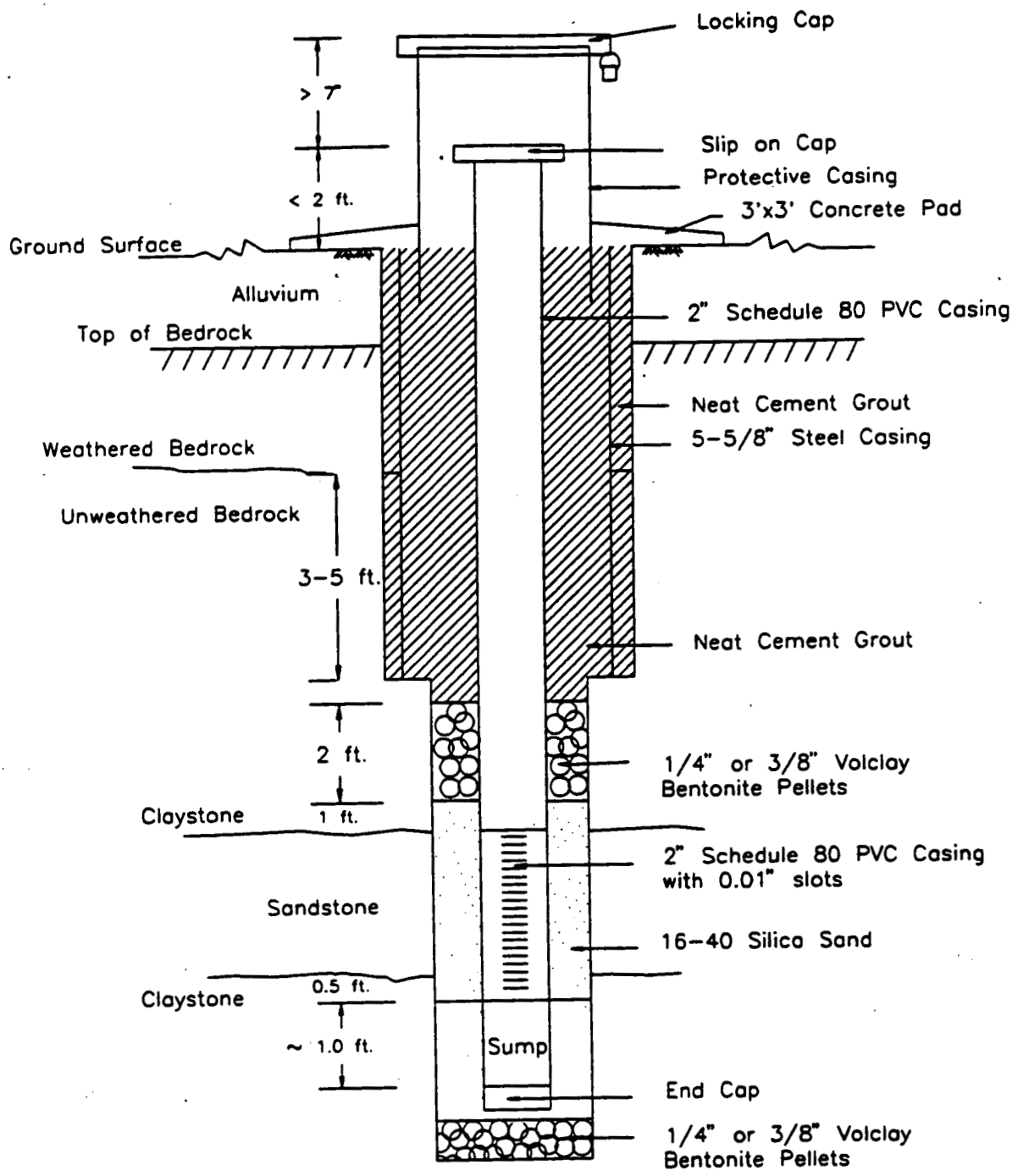
ground surface, whereas well B405889 was constructed to monitor the bottom 10 feet of the same sandstone unit. In both cases, hole instability warranted constructing the wells within large diameter augers or drill pipe. The well construction materials used were the same as those for weathered claystone wells.

The third type of bedrock well was completed in unweathered sandstone; these are referred to as deep bedrock wells. Each deep 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-inch diameter Schedule 80 PVC and 0.01 inch slotted Schedule 80 PVC, and 2-foot sumps were placed at the base of the screen. The annular materials that were used were the same as those for weathered bedrock wells, except Portland Type I cement was used instead of Volclay grout. Figure 3-3 presents the typical unweathered bedrock well design.

3.2.4 Well Development

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

The well development procedures used during the background characterization field activities were consistent with those outlined in the ER Program SOPs (Rockwell International, 1989c) and EMD Standard Operating Procedures (EG&G, 1991a), with two exceptions. First, the Geological Society of America Rock Color Chart was used the majority of the time 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. It was apparent in some instances that 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.



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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 Ground Water Sampling

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

Ground water sampling is performed in accordance with the EMD Standard Operating Procedures (EG&G, 1991a). This includes procedures for equipment decontamination, water level measurements, presample purging, field water quality measurements, sample collection, sample preservation, and sample shipping. A well is considered dry if the water level is below the base of the screen prior to the pre-sample purge. Chemical analyses for ground water samples are discussed in Section 3.3.

Bedrock well B203689 was deleted from the background sampling program because the water level in B203689 corresponded with that of nearby alluvial well B200889. This well is still being sampled, but will not be included in the statistical analysis of background conditions. It was believed that both water levels were that of surficial material water-bearing zones, and B203689 sampling would not be representative of bedrock ground water chemistry.

Procedures initiated during the fourth quarter 1989 for background ground water sampling deviated slightly from second and third quarters. Each well was sampled for up to 5 days until the entire sample was collected. If a suite of samples was not collected within the 5-day approach, procedures remained consistent with previous quarters.

Prior to presample purging of each well, a water level measurement is obtained and recorded on the water level data sheet. This level is measured from the mark present on the north side of the surface casing of each well.

3.2.6 Surface Water Sampling

Surface water samples are now collected from 15 background stations. Nine locations were used to collect surface water samples starting in first quarter 1989 (SW04, SW05, SW06, SW07,

SW41, SW80, SW104, SW107, and SW108). Surface water stations SW127 and SW130 were used as background locations starting in 1990. Surface water stations SW134, SW135, SW136, SW137 will be part of the background program starting in first quarter 1992. Chemical analyses of background surface water samples are discussed in Section 3.3. Sampling procedures are described in Rockwell International, 1989c and EG&G, 1992c.

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

3.2.7 Stream Sediment Sampling

Stream sediment samples are collected from most of the background surface water sampling locations (Plate 6). Samples are collected at one point in the stream if the channel width is less than 5 feet. If the channel width is greater than 5 feet, but less than 10 feet, two samples are collected within the channel at locations 33% and 67% of the width in from the channel boundary. If the width of the channel is greater than 10 feet, but less than 20 feet, three samples are obtained within the channel at locations 25%, 50%, and 75% of the width in from the channel boundary. Chemical analyses for the background sediment samples are discussed in Section 3.3. Collection of these samples is consistent with the procedures outlined in the EMD Standard Operating Procedures (EG&G, 1991a, Volume IV, Procedure SW.6).

3.3 CHEMICAL ANALYSES

3.3.1 Analytical Parameters

Ground water, surface water, sediment, and geologic materials are being analyzed for an extensive list of parameters in order to provide data for investigations, and a complete geochemical characterization. The Chemical Analyte Roster (CAR) is presented in Table 3-4, and the rationale for the CAR is discussed in the following paragraphs. All parameters on the CAR are 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 are included on the CAR because Plant records indicate historical releases, and radionuclides and metals have been detected in surface water, ground water, soil boring, and sediment samples at the Plant site. Radionuclides known to have been released include plutonium, americium, uranium, and tritium. Radium-226 is on the CAR because it is a daughter isotope of uranium decay; strontium^{-90} and cesium^{-137} are included because they are fission products. Although there is no evidence of a criticality at the RFP, they have been included for completeness and because they exist in the environment as a result of nuclear testing fall out. Radium-228, a daughter isotope of thorium decay, is also on the list for completeness. The CLP Target Analyte List (TAL) represent the CAR for metals. The TAL is used by the EPA to investigate contamination at abandoned hazardous waste sites, and has been used for characterization of operable units at the RFP. Also, the TAL contains several major cations, the data for which is necessary for an adequate geochemical characterization. Five non-TAL metals (molybdenum, strontium, cesium, lithium, and tin) are also included on the CAR because they are known to have been released and/or provide a more comprehensive geochemical characterization.

3.3.1.2 Other Inorganics and Anions

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

3.3.1.3 Indicators and Field Parameters

Indicators and field parameters are included on the CAR because they are needed for a complete geochemical characterization and provide useful tools to assess the quality of other chemical analyses.

3.3.1.4 Organics

CLP Target Compound List (TCL) organics have been analyzed for the background program in surface water and ground water samples since first quarter 1990. They were not initially analyzed because their presence in background areas of the plant is not likely. They have now been included on the CAR for completeness to assure that background data are 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, its limitations, and any special considerations that will affect data quality must be understood in order to select appropriate analytical methods for specific uses.

The analytical options available to support data collection activities are presented in five general levels (EPA, 1987). These levels are distinguished by the types of technology and documentation used, and their degree of sophistication.

Chemical data derived from the background sampling and analysis program will be used, in part, to evaluate human health risks posed by contamination at operable units. Toxicological interpretation of soil chemistry requires validation of analytical data. Only LEVEL V and LEVEL IV analytical reports provide sufficient documentation to allow for data validation. Although LEVEL III analytical procedures are similar to LEVEL IV, the documentation provided is not sufficient for data validation; therefore, samples collected as part of this plan will be subjected to LEVEL IV analytical procedures and reporting requirements (TCL and TAL). Other analyses conform to LEVEL III because they are non-CLP analytes. All chemical analyses will be performed in accordance with the GRRASP (EG&G, 1991e).

3.3.2.2 Detection Limits

In the Background Geochemical Characterization Plan (EG&G, 1992), a comparison is made between analytical detection limits for the CAR and the concentration of each analyte which will pose 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. ELs were calculated for the radionuclides, the TAL metals, TCL volatiles, and several TCL semivolatiles and pesticides/PCBs that have been detected at the RFP. Some of these compounds are recognized as having chronic or carcinogenic health effects in humans (i.e., an Oral Reference Dose [RfD] or a Carcinogenic Slope Factor [CSF] exists for the substance). If detection limits are 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 (IRIS) and/or Health Effects Assessment Summary Tables (HEAST) (EPA, 1991a). ELs have been conservatively calculated using exposure scenarios for a future on-site resident.

In most cases, detection limits are less than the computed ELs; in the other cases, the detection limits generally do not exceed the EL to the extent that risk assessment objectives are compromised. Although for a few analytes the detection limits appear to be inadequate for risk assessment purposes, it is noted that these detection limits are CLP Contract Required Quantitation Limits (CRQLs) which can be as much as an order of magnitude higher that the Instrument Detection Limits (IDLs). In the last 2 years of background and OU-specific investigative work, analyte concentrations above IDLs and less that CRQLs are presented. This adds an additional margin of assurance that risk assessment objectives can be met.

Table 3-1

Surface Water Background Stations at Rocky Flats Plant

Station Number	Northing Coordinate (ft) — RFP	Easting Coordinate (ft) — RFP	State Northing Coord. (ft)	State Easting Coord. (ft)	Ground Surface Elev. (ft)
SW04	45162.18	22668.42	75148.42	2085747.15	5721.20
SW05	40095.64	16442.91	753062.65	2079539.99	5973.00
SW06	37119.25	12275.44	750073.29	2075383.44	6129.00
SW07	35270.77	11107.42	746995.12	2074221.82	6184.70
SW41	34024.22	17138.39	748221.44	2080255.33	5980.50
SW80	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

See Plate 6 for station locations.

Notes: Surface water stations SW127, SW130, SW134, SW135, SW136, and SW137 have not been surveyed yet.

SW080, SW104, and SW108 are seep water stations.

Table 3-2

Sediment Background Stations at Rocky Flats Plant

Station Number	Northing Coordinate (ft) — RFP	Easting Coordinate (ft) — RFP	State Northing (ft)	State Easting (ft)	Ground Surface Elev. (ft)
SED04	35270.77	11107.42	74822.44	2074221.82	6184.70
SED16	34187.74	14780.90	747150.81	2077897.92	6054.30
SED17	34024.23	17138.39	746995.12	2080255.33	5980.50
SED18	33110.94	17897.74	746084.58	2081017.49	6041.40
SED19	32376.51	18188.09	745351.30	2081310.19	6062.40
SED20	40107.07	16453.06	753074.11	2079550.10	5972.70
SED21	44323.08	22971.45	757310.54	2086052.87	5838.60
SED22	45167.18	22668.42	758148.42	2085747.15	5721.20
SED23	37119.25	12275.44	750073.29	2075383.44	6129.00

See Plate 6 for station locations.

Note: SED018, SED019, and SED021 are seep sediment stations.

Table 3-3
Well Data
at
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 Strata of Complete.	Northing Coordinate (ft) - RFP	Easting Coordinate (ft) - RFP	State Northing (ft)	State Easting (ft)
8405586	1	6103.62	6105.81	3.55	36.39	36.39	35.50	6068.12	Qrf	32259.45	15217.16	745260.8365	2078321.1160
8400089	5,6	6121.80	6123.76	28.58	37.95	38.26	48.50	6073.30	Qrf	31599.94	15183.24	744565.0139	2078308.6909
8400189	1	6122.10	6124.15	10.09	49.60	51.35	49.80	6072.30	Qrf	31600.11	15183.13	744565.1830	2078308.5787
8400289	1,5	6105.90	6107.71	20.52	50.00	51.25	49.60	6056.30	Qrf	31676.84	16017.21	744644.6478	2079142.1870
8400389	1,5	6122.00	6124.00	9.50	49.00	50.30	48.50	6073.50	Qrf	30794.80	15266.77	743760.3577	2078394.8564
8400489	1,5	6105.90	6107.07	9.87	54.45	55.70	54.00	6051.90	Qrf	30852.38	16077.58	743820.5973	2079205.2666
8200589	1,5	5968.40	5970.17	11.86	31.57	33.31	30.00	5938.40	Qrf	41857.55	20445.99	754837.3135	2083536.2087
8200689	1,5	5960.10	5961.94	11.58	31.05	32.80	30.60	5929.50	Qrf	42256.66	21069.70	755238.3808	2084158.4352
8200789	1,5	5946.10	5948.08	9.07	28.50	30.47	28.00	5918.10	Qrf	42781.02	21921.46	755765.4125	2085008.2449
8200889	1,5	5936.10	5938.08	8.60	23.12	24.70	22.80	5913.30	Qrf	43199.87	22617.22	756186.4527	2085702.4430
8201089	1,5	5883.10	5885.15	3.48	7.83	9.60	7.50	5875.60	Qc	42275.09	24169.13	755267.0405	2087256.9935
8201189	1,5	5806.50	5808.41	20.36	34.80	36.50	34.00	5772.50	Qc	44655.14	23771.64	757645.1486	2086851.7585
8201289	1,5	5826.10	5827.80	14.73	23.90	26.11	23.40	5802.70	Qc	44616.73	20500.44	757595.9555	2083581.5337
8201489	1,5	5859.40	5861.20	5.58	9.96	11.64	7.00	5852.40	Qc	44092.75	22254.49	757077.9028	2085336.8530
8201589	1,5	5846.00	5847.68	4.38	8.76	10.50	8.20	5837.80	Qc	44426.56	23548.26	757415.8909	2086629.1867
8301889	1,5	5866.80	5868.83	13.16	22.60	24.45	22.30	5844.50	Qc	34321.96	22207.35	747309.5078	2085321.9781
8401989	1,5	6028.60	6027.67	6.55	21.00	22.65	20.50	6005.10	Qc	32873.07	18514.33	745848.6073	2081634.7119
8302089	1,5	5907.50	5909.55	3.85	13.30	15.00	13.50	5894.00	Qc	33804.66	20373.64	746786.2956	2083490.4539
8402189	1,5	6024.60	6026.49	13.50	22.90	24.60	7.50	6017.10	Kss(w)	33364.04	18357.65	746339.1279	2081476.4480
8102289	1	5978.30	5980.06	3.00	12.47	14.22	12.50	5965.80	Qvf	40124.54	16414.83	753091.4539	2079511.8166
8102389	1	5939.50	5941.18	3.74	10.90	12.61	10.40	5929.10	Qvf	40864.32	17161.65	753833.5008	2080256.0041
8202489	1	5770.90	5772.83	3.43	12.90	14.65	12.40	5758.50	Qvf	44414.51	20812.14	757394.8212	2083893.8232
8202589	1	5723.60	5725.45	4.53	11.60	13.40	11.20	5712.40	Qvf	45126.22	22633.57	758112.3563	2085712.4261
8402689	1	6045.40	6047.07	2.55	3.28	5.85	2.80	6042.60	Qvf	34264.35	15145.64	747228.6049	2078262.3035
8302789	1	5832.30	5834.17	4.00	8.55	10.17	8.00	5824.30	Qvf	31715.79	23104.08	744706.9744	2086227.0822
8302889	1	5730.80	5733.16	5.92	10.52	12.10	10.20	5720.60	Qvf	32824.94	26406.34	745826.7435	2089524.8098
8302989	1	5686.20	5688.15	3.46	7.90	9.65	7.40	5678.80	Qvf	32347.94	28146.31	745355.6090	2091265.9007

KEY TO STATUS: 1 - Active Well; 2 - Abandoned Borehole; 3 - Well Removed/Replaced; 4 - Inactive Well; 5 - Borehole Sampled; 6 - Observation Well; 7 - Surface Casing Installed: Not Cored

KEY TO GEOLOGIC STRATA: Qaf-Artificial Fill; Qrf-Rocky Flats Alluvium; Qc-Colluvium; Qvf-Valley Fill Alluvium; Qt - Terrace Alluvium; Kcl-Bedrock Weathered Claystone; Kss(u)-Bedrock Unweathered Sandstone; Kss(w)-Bedrock Weathered Sandstone; Kst(w) - Bedrock Weathered Siltstone; AL-undifferentiated Alluvium

Table 3-3 (Continued)
Well Data
at
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 Strata of Complete.	Northing Coordinate (ft) - RFP	Easting Coordinate (ft) - RFP	State Northing (ft)	State Easting (ft)
8303089	1	5601.20	5602.93	4.61	7.00	8.90	6.60	5594.60	Qvf	29260.92	30864.52	742278.3686	2093993.5910
8203189	1	5968.00	5970.12	35.26	44.70	46.47	30.30	5937.70	Kcl	41868.42	20466.34	754848.2491	2083556.5118
8203289	1	5959.70	5961.59	35.00	44.47	46.00	30.10	5929.60	Kcl	42258.71	21087.88	755240.4851	2084176.6034
8203489	1	5945.70	5947.71	31.00	40.50	41.25	28.60	5917.10	Kcl	42806.76	21964.89	755791.2887	2085051.5736
8203589	1	5935.20	5937.07	29.70	39.16	40.94	24.30	5910.90	Kcl	43221.96	22658.39	756208.6745	2085743.5243
8203689	4	5920.50	5922.45	27.05	36.55	37.30	22.60	5897.90	Kcl	43755.65	23487.29	756744.9537	2086570.4441
8203789	1	5946.20	5948.28	134.15	138.59	140.84	26.70	5919.50	Kss(u)	42792.37	21944.19	755776.8324	2085030.9263
8203889	1	5935.80	5937.69	107.00	111.43	113.90	28.40	5907.40	Kss(u)	43211.47	22635.78	756198.1067	2085720.9611
8203989	1	5920.90	5922.78	125.97	130.42	132.70	23.70	5897.20	Kss(u)	43740.80	23469.07	756730.0555	2086552.2860
8204089	1	5877.60	5879.29	106.50	112.90	115.23	1.60	5876.00	Kss(u)	41904.59	24227.96	754896.8288	2087317.0381
8204189	1	5826.90	5828.86	81.10	95.33	97.62	3.70	5823.20	Kss(u)	42344.56	25382.07	755340.4906	2088469.3930
8304289	1	5833.00	5835.18	84.04	88.49	90.95	10.50	5822.50	Kss(u)	31688.14	23092.28	744679.3015	2086215.3718
8304789	1	5867.50	5869.56	27.90	37.57	39.14	22.90	5844.60	Kcl	34321.35	22184.13	747308.8221	2085298.7662
8304889	1	5730.60	5732.56	14.66	24.14	25.90	9.70	5720.90	Kcl	32815.29	26451.93	745817.2440	2089570.4247
8304989	1	5729.70	5731.85	75.50	82.87	86.25	8.40	5721.30	Kss(u)	32799.24	26481.33	745801.2931	2089599.8741
8405189	1	5967.90	5969.91	13.20	22.69	24.45	8.20	5959.70	Kcl	33804.20	19330.97	746782.3900	2082448.0614
8405289	1	5965.60	5967.31	41.24	45.67	48.00	10.30	5955.30	Kss(u)	33819.62	19347.76	746797.8628	2082464.7930
8305389	1	5832.00	5833.90	15.18	24.58	26.30	10.00	5822.00	Kcl	31726.76	23109.08	744717.9612	2086232.0415
8405489	1	6115.80	6117.67	39.13	48.57	50.05	34.00	6081.80	Kcl	32239.76	15235.37	745204.8392	2078358.6905
8205589	1	5806.40	5808.46	6.87	16.30	18.00	32.30	5774.10	Qc	44664.12	23775.15	757654.1441	2086855.2290
8405689	1	6105.20	6107.25	3.00	22.51	23.75	0.00	0.00	Qrf	30851.28	16062.22	743819.4561	2079189.9129
8405789	1	6104.80	6106.70	43.01	52.48	53.72	52.00	6052.80	Qrf	30853.20	16092.40	743821.4683	2079220.0762
8405889	1	6024.90	6026.87	36.04	45.50	46.75	6.50	6018.40	Kss (w)	33357.04	18357.49	746332.1311	2081476.3079
8405989	1	6023.50	6026.06	2.80	6.70	8.50	6.20	6017.30	Qc	33374.00	18357.88	746349.0917	2081476.6474

KEY TO STATUS: 1 - Active Well; 2 - Abandoned Borehole; 3 - Well Removed/Replaced; 4 - Inactive Well; 5 - Borehole Sampled; 6 - Observation Well; 7 - Surface Casing Installed: Not Cor

KEY TO GEOLOGIC STRATA: Qaf-Artificial Fill; Qrf-Rocky Flats Alluvium; Qc-Colluvium; Qvf-Valley Fill Alluvium; Qt - Terrace Alluvium; Kcl-Bedrock Weathered Claystone; Kss(u)-Bedrock Unweathered Sandstone; Kss(w)-Bedrock Weathered Sandstone; Kst(w) - Bedrock Weathered Siltstone; AL-undifferentiated Alluvium

Table 3-4

Background Sediment, Borehole, Surface Water, and Ground Water Sampling Parameters

TOTAL METALS

Target Analyte List -
Sediment and Boreholes

- 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

Sediment and Boreholes

- Molybdenum
- Strontium
- Cesium
- Lithium
- Tin

OTHER INORGANICS

Sediment and Boreholes

- pH
- Sulfide (Boreholes only)
- Nitrate-Nitrite (as N)
- Percent Solids or Percent Moisture
- Silica (as Si or SiO_2)

METALS

Target Analyte List -
Ground Water (Dissolved Metals)
and Surface Water (Total and Dissolved 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

Ground Water and Surface Water

- Molybdenum
- Strontium
- Cesium
- Lithium
- Tin

FIELD PARAMETERS

Ground Water and Surface Water

- pH
- Specific Conductance
- Temperature
- Dissolved Oxygen
- Turbidity

INDICATORS

Ground Water and Surface Water

- pH
- Total Suspended Solids*
- Total Dissolved Solids**

* Surface water only.
** Quarterly for ground-water samples and monthly for surface water samples.

TABLE 3-4 (Continued)

Background Sediment, Borehole, Surface Water, and Ground Water Sampling Parameters

ANIONS

Ground Water and Surface Water

- Carbonate
- Bicarbonate
- Chloride
- Sulfate
- Nitrate/Nitrite as N
- Cyanide
- Fluoride
- Silica (as Si or SiO_2)
- Orthophosphate

DISSOLVED RADIONUCLIDES[a]

Ground Water and Surface Water

- Gross Alpha
- Gross Beta
- Uranium -233&234,235, and 238
- Americium -241
- Plutonium -239&240 (surface water only)
- Tritium
- Strontium -89,90
- Cesium-137
- Radium-226,228[b]

TOTAL RADIONUCLIDES

Sediment and Boreholes

- Gross Alpha
- Gross Beta
- Uranium -233&234,235, and 238
- Americium -241
- Plutonium -239&240
- Tritium
- Strontium -89,90
- Cesium -137
- Radium -226, 288
- Rad Screen

TOTAL RADIONUCLIDES[a]

Surface Water

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

Ground Water

- Plutonium -239&240
- Americium -241
- Tritium

TABLE 3-4 (Continued)

Background Sediment, Borehole, Surface Water, and Ground Water Sampling Parameters

ORGANICS: VOLATILES[c]

Target Compound List -
Ground Water and Surface Water

- 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
- 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)

ORGANICS: SEMI-VOLATILES[c]

Target Compound List -

- 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

ORGANICS: SEMI-VOLATILES[c] (continued)

Target Compound List -

- Isophorone
- 2-Nitrophenol
- 2,4-Dimethylphenol
- Benzoic Acid
- bis(2-Chloroethoxy)methane
- 2,4-Dichlorophenol
- 1,2,4-Trichlorobenzene
- Naphthalene
- 4-Chloroaniline
- Hexachlorobutadiene
- 4-Chloro-3-methylphenol(para-chloro-meta-cresol)
- 2-Methylnaphthalene
- 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
- 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

TABLE 3-4 (Continued)

Background Sediment, Borehole, Surface Water, and Ground Water Sampling Parameters

ORGANICS: PESTICIDES/PCBs[c]

Target Compound List -

Surface Water

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

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[a] Samples for total radionuclides for ground water will be collected if sufficient water can be evacuated from the well to fill the appropriate containers.

[b] Decision tree. If Gross Alpha is $\geq$ 5 pCi/ℓ, the sample will be analyzed for Radium-226,228.

[c] Volatiles, Semi-volatiles and Pesticide/PCB samples have been collected since 1991.

SECTION 4
DATA QUALITY

4.1 QUALITY ASSURANCE/QUALITY CONTROL PRACTICES

The background geochemical characterization program was conducted in accordance with the ER Program Quality Assurance/Quality Control (QA/QC) Plan (Rockwell International, 1989a) as amended by the Sitewide Quality Assurance Project Plan (EG&G, 1990), and with the Standard Operating Procedures (SOPs) (Rockwell International, 1989b) as amended by the Rocky Flats Environmental Management Division Operating Procedures Manual (EG&G, 1992). Sampling and analysis activities were implemented using these procedures to document and assure the precision, accuracy, comparability, completeness, and representativeness of the data.

Analytical data were generated using EPA and other well-established methods identified in the GRRASP (EG&G, 1991). EPA Contract Laboratory Program (CLP) methods and protocols were used in the analysis of TAL metal parameters and TCL organic parameters. Background samples were analyzed for organic compounds starting in May 1990. Methods for non-CLP analytes, for example, major ions and radionuclides, are based on EPA and other published references. The analytical data were reviewed and validated independently of the laboratory, and the results were documented in data validation reports. EPA data validation functional guidelines were used for validating organics and metals data for CLP analytes. Non-CLP analytical data were validated using data validation guidelines developed by the Environmental Management Department (EMD) because such guidelines have not been published by EPA. These non-CLP guidelines are based on EPA validation functional guideline concepts and tailored to non-CLP analytical methods.

Three classes of data quality are used by EMD: (1) V — Valid and usable without qualification; (2) A — Acceptable for Use with Qualification(s); and (3) R — Rejected (unacceptable). Valid data meet the following objective standards, where applicable:

*1. analytical methods followed;
2. acceptance criteria achieved;
3. sufficient number and type of QC samples analyzed;
*4. QC limits achieved;
*5. compounds and analytes correctly identified;
*6. equipment/instrumentation calibration criteria achieved; and
7. sample holding times met.

* primary validation criteria

Data that are acceptable with qualifications meet most, but not all, of the above standards. At the minimum, all of the primary validation criteria are achieved within acceptable limits. Rejected data fail to meet primary validation criteria. As shown in Appendix D, analytical results are coded with the appropriate data qualifier (V, A, or R) based on the results of the data validation. For the purposes of the background geochemical characterization, valid and acceptable data were considered of equal utility. Rejected data have not been used in any statistical computations. However, it should be noted that data that have not yet been validated have been used in the statistical computations out of necessity, i.e., to provide an adequate quantity of data for statistical analysis with an acceptable level of confidence. Use of unvalidated data should not reduce the soundness of the conclusions drawn because most of the data that have been validated are either valid or acceptable.

4.2 STATUS OF DATA VALIDATION

Appendix D, Table D-1 summarizes the data validation status for background geologic material, ground water, seep/spring sediments, seep/spring water, stream/ditch sediment, and stream/ditch water. This table provides the percentage of results that have been validated, and the percentage of rejected data of those results that were validated.

At the time of this writing, 52% of all the data have been validated (Appendix D, Table D-1). The low percentage of data validation for radiochemistry data is the single largest contributing factor to the overall low percent validation, eg., none of the borehole radiochemistry data have been validated, and the percent validation for other groups of radiochemistry data is generally less than 50% (as low as 23% for seep/spring water total radiochemistry). The percent validation for

seep/spring organic data is also quite low (16% and 21% for semivolatiles and volatiles, respectively).

With over one-half the data having been validated, it is important to note that only 5.94% of these data have been rejected. These rejected data have not been used in any of the statistical tests. Of all the analyte groups, radiochemistry data has the highest percentage of rejected data, typically 20 - 25% (Table D-1). As shown in Table D-2, radiochemistry data was often rejected because of insufficient QC documentation or that lab QC samples exceeded the 3 sigma control limits. For the other analytes, the most frequent reason for data rejection was that the percent solids was less than 30% (Table D-2). This criterion was adopted from EPA Region I data validation guidelines. The primary basis for the criterion is that the analytical method does not differentiate between the analyte concentration in the liquid and solid phases. Therefore, the concentration measured is assigned to the solid phase only, whereas the actual solid phase analyte concentration is unknown. Regardless of the reason for data rejection, the low percentage of rejected data indicates that use of non-validated data to perform the statistical test should not compromise the validity of the results.

4.3 FIELD QUALITY CONTROL SAMPLES

Quality Control (QC) samples were collected in the field during the background field investigation program. QC samples are collected to assess whether any sampling equipment contamination contributes to the observed analyte concentrations, and to determine the analyte concentration variability of the medium sampled.

4.3.1 Field and Equipment Rinsate Blanks

Field blanks and equipment rinsate blanks were collected to quantify the analyte concentration in a sample that may be attributable to desorption from sampling equipment. A field blank determines to what extent the sample bottle is a source for the observed analyte concentration in a sample. A field blank is collected by filling a sample bottle with laboratory grade water in the field. Equipment rinsate blanks are used to monitor for sample cross-contamination and the

effectiveness of the decontamination process. The blanks are collected by rinsing decontaminated sampling equipment with laboratory grade water, placing it in the appropriate container, and preserving as required.

The field and equipment rinsate blank data indicate, with few exceptions, that the sampling equipment are not significant sources contributing to the observed analyte concentrations in the background samples. As shown in Table D-3, the filtered and total metal concentrations in the blanks were generally non-detectable or estimated below the Contract Required Detection Limits (CRDL). There were a few analytes where concentrations were quantifiable above the CRDL; however, with few exceptions these concentrations as well as those analyte concentrations estimated below CRDLs are significantly lower (an order of magnitude or more) than the concentrations measured in the associated field samples. The exceptions are copper and beryllium for total metals, and aluminum, beryllium, iron, manganese, and mercury for the filtered metals. In these cases, concentrations of these analytes in the associated field samples were of similar magnitude but the concentrations were near the detection limit. With respect to the total metals for sediment sample equipment rinsate blanks, aluminum, copper, iron, and zinc were detected above the CRDL, but again, these concentrations are insignificant relative to the concentrations found in the associated sediment samples. Concentrations of water quality parameters in the blanks were occasionally quantified above the CRDL, but these concentrations are most often insignificant relative to the field sample concentrations. One exception is the concentrations of nitrite/nitrate in samples associated with the blanks showing 300 and 700 $\mu g/\ell$ of nitrite/nitrate. These field sample concentrations were of similar magnitude; however, the concentrations are relatively low and below health criteria. With respect to organics, methylene chloride and acetone were often detected in the blanks but they generally were detected at estimated values below the CRDL and/or also occurred in associated laboratory blanks. Similar concentrations of these compounds were found in the associated field samples. This would indicate that the presence of these compounds in any sample is laboratory artifact. Toluene was notably present in the equipment rinsate blank for sample B402189 on 12/19/91 (110 $\mu g/\ell$); however, toluene was not present in the associated field samples. However, in some of the field samples associated with the blanks showing 1 $\mu g/\ell$ toluene, the same concentration was also present. Again, the presence of toluene in any sample appears to be laboratory artifact. Lastly, with respect to radiochemical blanks, the field and

equipment rinsate blank for B202589 on 11/1/90 had elevated concentrations of all radionuclides that were measured. However, radionuclide concentrations in the associated field samples are only 1 to 5% of the values in this blank. Review of the sample tracking documentation indicates the sample is not misidentified yet the data suggest otherwise.

4.3.2 Field Duplicate

With respect to ground water and surface water samples, the field duplicates are collected following the actual sample collection using the same sampling technique. For soil samples, it is necessary to obtain splits of the interval being sampled, with the sample and duplicate collected from each of the splits using the same technique. The data from the sample and duplicate provide a measure of the sampling precision and sample homogeneity, i.e., the amount of error in the data attributed to sampling technique, or to variability in the analyte concentration in the medium being sampled.

Precision is quantified by calculating the relative percent difference, i.e., the quotient of the difference between the duplicate analytical results and the average of those results for the given analyte expressed as a percentage:

$$\% \text{ RPD} = 100(C1 - C2)/(C1 + C2)/2$$

where:

RPD = Relative percent difference
C1 = Concentration of analyte in the sample
C2 = Concentration of analyte in the duplicate

The QC criterion for laboratory duplicates is a +/- 20% RPD for water duplicates and +/- 35% RPD for soil. These limits have also been applied to field duplicates, for discussing the results. Appendix D, Table D-4 provides the data for the duplicates and the results are discussed below.

The more abundant metals show the highest variability in water samples, particularly ground-water samples, and most of the metals show high variability in the geologic material samples (Table D-4). Aluminum, iron, manganese, and zinc generally show the greatest variability in water samples. Aluminum, iron and manganese (and zinc through adsorption) are associated with aluminosilicate clay particles and/or exist as metal oxides. It is noted that the variability in the concentrations of these metals is higher for the total metals than for the dissolved (filtered) metals. The variability may be due to the inherent variability of the suspended solids (clays) concentrations in ground water. Because the dissolved concentrations are "mechanically" defined, i.e., that which passes a 0.45μ filter, the variability in the dissolved fraction may simply reflect this variability in the suspended solids concentrations. The high variability in the metal concentrations in geologic materials likely reflects the heterogenous distribution of metals in this medium.

The radionuclide concentration variability for water also seem quite high, and as for geologic materials, shows similar high variability like the metals data. There is less data to assess the variability of radionuclide concentrations in water, but for the given data, the 20% RPD limit is often exceeded. This, at times, is due to the concentrations being near the minimum detectable activities, and thus the variability reflects the precision of the instrumentation. As with metals, the high variability of radionuclides in the geologic materials likely reflects the heterogenous distribution of radionuclides in this medium.

The precision for the water quality parameters is better than for the metals and radiounclides. This likely reflects their higher concentrations, presence in the dissolved phase, and thus more homogeneous distribution in surface waters and ground waters on a small scale. It is noted that the TSS data has the highest variability which supports the variability assessment discussed above for the metals data.

There is very little data to assess the field precision for the organics; however, the existing data generally show the precision to be within the laboratory guidelines.

4.4 IDENTIFICATION OF OUTLIERS

As part of the initial review, data were grouped by sample type (ground water, etc.) and by chemical group (dissolved metals, etc.). Within each chemical group data were ranked in descending concentration by analyte. The top five concentrations for each analyte were manually compared with the original laboratory analytical reports to check for potential outliers and to check the integrity of the database.

Outlier testing was also performed on each analyte within each chemical group and sample medium by the single outlier test defined in ASTM (1975) and described in the RCRA guidance document (EPA, 1989). Outliers identified with the single outlier test were also identified by the ranking procedure, and were therefore checked against the original laboratory data.

Outliers that were transcription errors, laboratory errors, or database errors were corrected in the database. All other outliers that could not be explained as errors were retained in the dataset as suggested by (EPA, 1989). Background sampling stations and wells were chosen upgradient or upstream of plant operations and are assumed to be unimpacted by plant operations. Therefore, outliers that are not explained as errors should be included in the dataset because they represent natural background chemical variability. Results of the ASTM outlier test are reported in Appendix C.

4.5 GEOCHEMICAL DATA QUALITY CRITERIA

Together with the QA/QC practices outlined in Section 4.1, other criteria are 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 versus TDS. The purpose of these techniques is to further check the consistency of the data, and to help identify transcription errors, field or lab instrument deficiencies, and other potential problems with the data. Another purpose is to explore the data for trends and relationships that indicate incomplete analyses, or geochemical changes between field measurements and lab measurements.

4.5.1 Ground Water Quality Criteria

The sum of milliequivalents of cations is plotted against the corresponding value for anions on Figure 4-1 as a quality check of the ground water data. 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 quite closely. The charge balance calculations incorporated all major ions as well as some lessor ions selected after reviewing the dataset. Cations included in the summation included Ca^{++}, Mg^{++}, Na^{+}, K^{+}, Fe^{++}, Sr^{++}, and Cs^{+}. Anions included HCO_3^-, CO_3^-, Cl^-, $SO4^-$, and $NO3^-$. For all ions the conversion factors between milligrams per liter and milliequivalents per liter were taken from Hem (1989).

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. Charge balance error appears to increase as the TDS gets smaller (Figure 4-2). Most of the points indicate less than 15% error. This indicates 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 charged ions in the water have been measured.

Figure 4-3 compares analyzed (measured) TDS against calculated TDS. The points cluster along the theoretical line. The points appear to be equally distributed on both the calculated and analyzed sides of the diagonal line. This indicates that all major dissolved solids in the water have been analyzed.

Field conductivity values measured during 1989 at various temperatures have been corrected to specific conductance in micromhos/cm at 25°C according to the equation, SC = COND +(0.02*COND*(25-T)). In this equation from Hem (1989), "SC" is specific conductance, and "COND" is conductivity at sample temperature "T" degrees C. Specific conductance was measured directly during 1990 and 1991. Specific conductance (SC) is often highly correlated with total dissolved solids in the geochemical literature (Hem, 1989). Figure 4-4 indicates a generally good correlation between SC and TDS in ground waters from Rocky Flats.

FIGURE 4-1

CATION–ANION BALANCE IN GROUND WATER

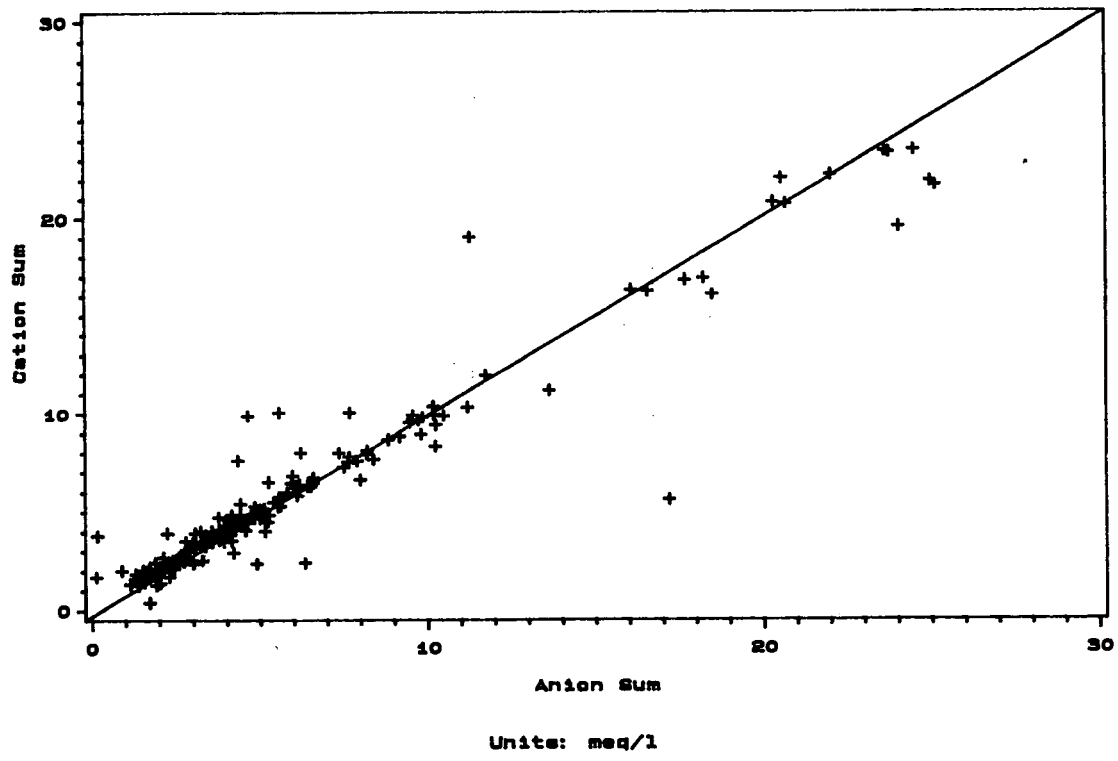


FIGURE 4-2

TOTAL DISSOLVED SOLIDS VS CHARGE BALANCE ERROR IN GROUND WATER

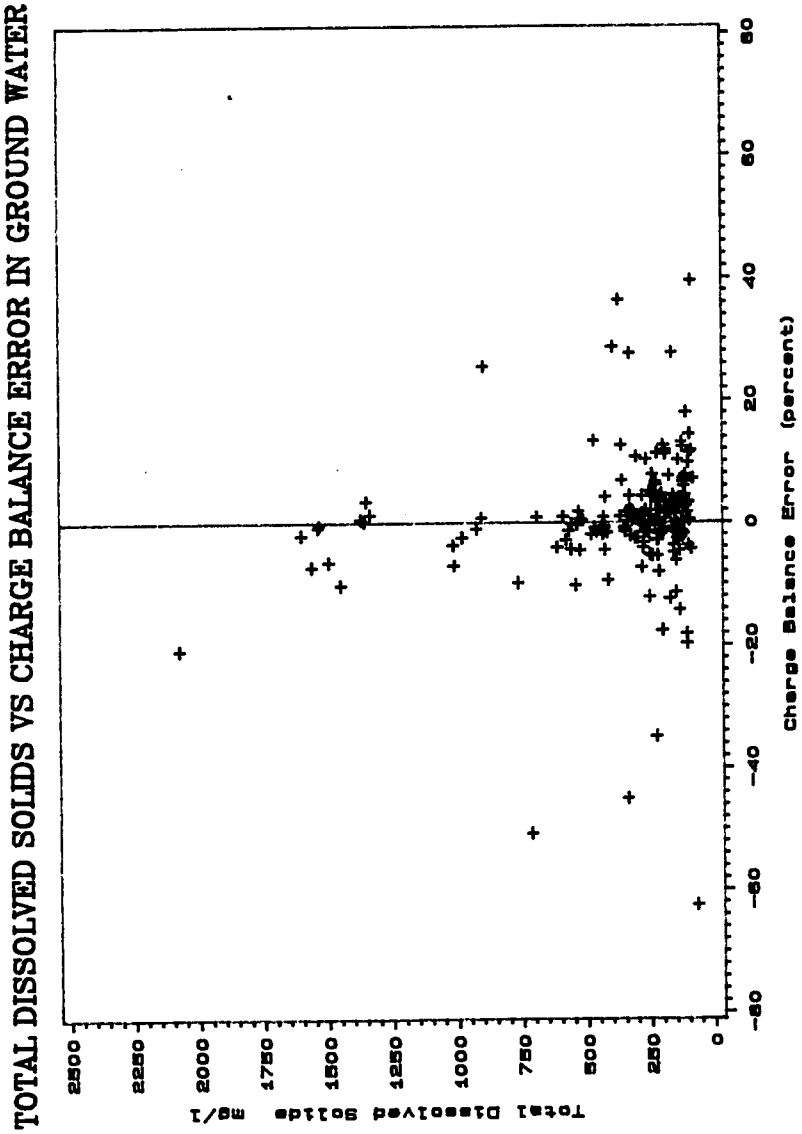


FIGURE 4-3

CALCULATED VS MEASURED TOTAL DISSOLVED SOLIDS IN GROUND WATER

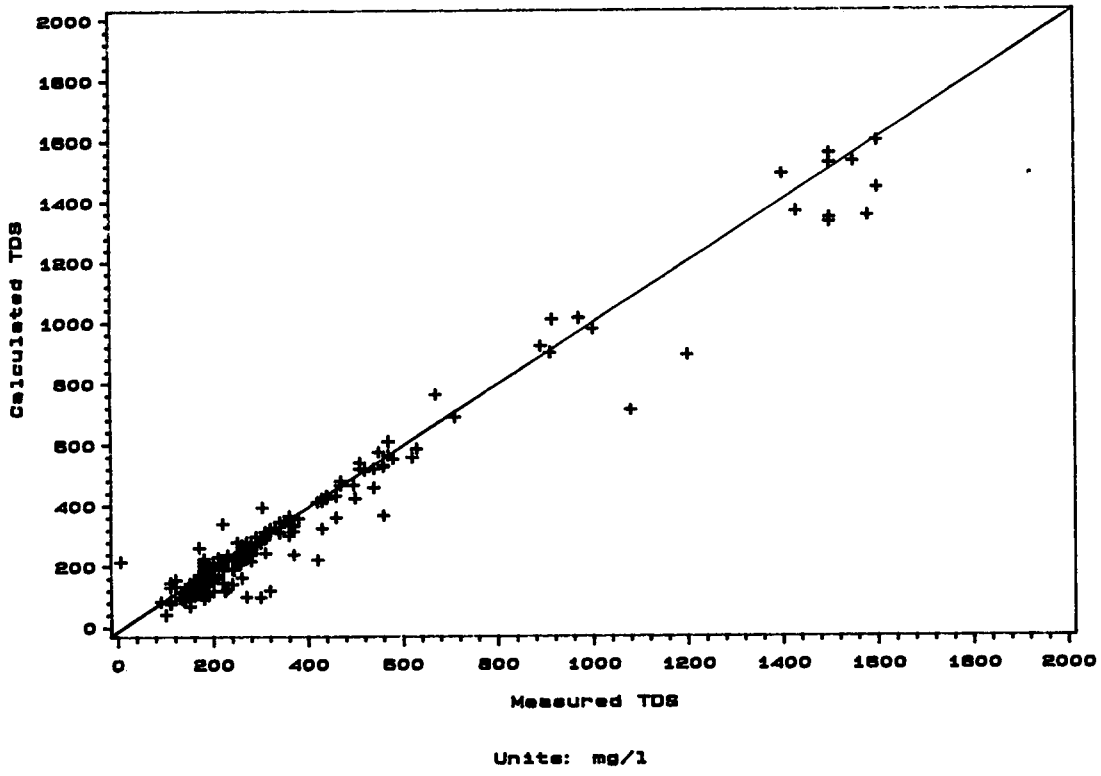


FIGURE 4-4

SPECIFIC CONDUCTANCE VS CALCULATED TDS IN GROUND WATER

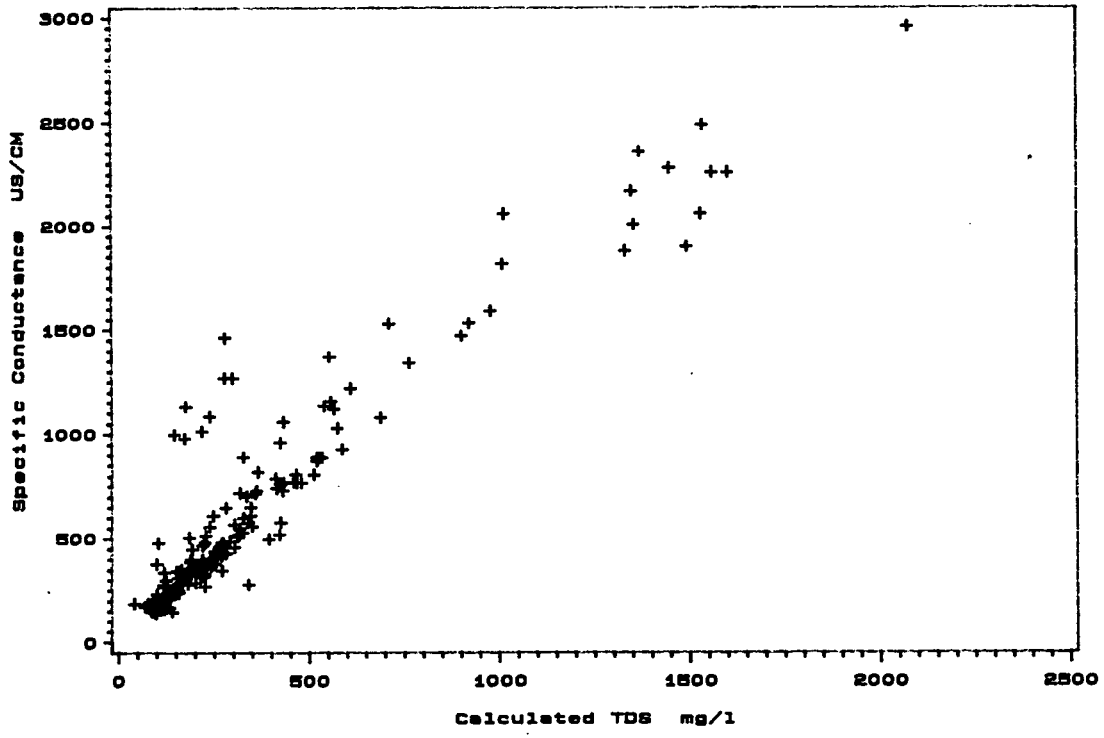


FIGURE 4-5

NORMAL PROBABILITY PLOT FOR: GROUND WATER FIELD MEASURED pH

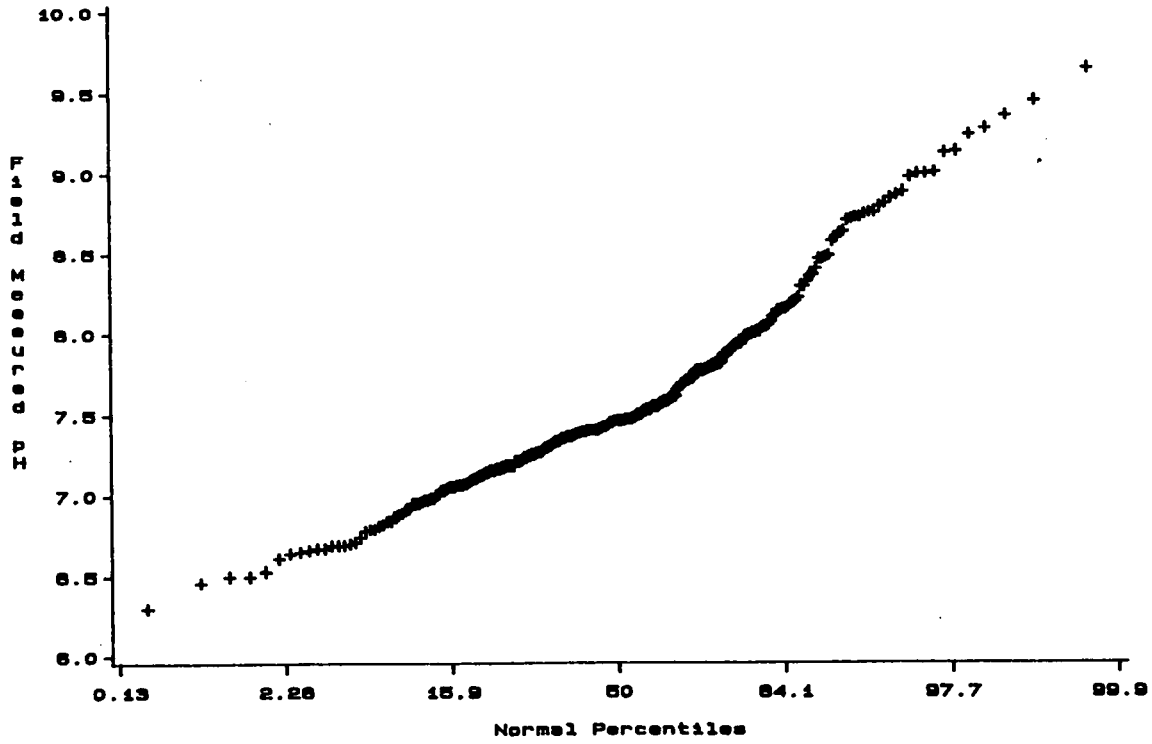


Figure 4-5 in a normal probability plot of pH measured in the field. Four outliers have been removed at pH 5.38, 10.10, 10.12, and 11.71. The plot has a single inflection point near the 88th percentile and two nearly linear segments, one above pH 8.7, the other below pH 7.6. This suggests that the data came from two different normally distributed pH populations. Preliminary investigations suggest that the high pH populations comes from groundwater from approximately 10 wells completed in the Arapahoe and Laramie formations. The lower pH population represents the remainder of the 51 background wells.

A histogram of pH values in ground water is shown on Figure 4-6. The distribution is reasonably normal with a mean of approximately pH 7.6. Most of the ground water pH values lie in the range 6.7 to 8.1 pH units. The small peak at pH 8.7 indicates the possibility of a bimodal distribution and agrees with the interpretation of Figure 4-5.

4.5.2 Surface Water Quality Criteria

Figure 4-7 provides a quality check of surface water analytical data by plotting cation milliequivalents versus anion milliequivalents in surface water samples. If the analyses were accurate and precise all the points would plot along the theoretical line where cation milliequivalents equal anion milliequivalents. The data points cluster along the theoretical line, however most points fall on the anion side of the line. This indicates that anions have been overestimated or cations were underestimated.

Another view of surface water data quality is provided by Figure 4-8 in which percent charge balance error is plotted versus the TDS content of the water. There does not appear to be any correlation between TDS and error. The majority of the data fall within +15% or -15% indicating good analyses. However, the average change balance error appears to be negative, again suggesting that cations have been underestimated.

Figure 4-9 plots specific conductance against computed TDS. A linear relationship is expected and a weak linear trend is observed in the data.

FIGURE 4-6

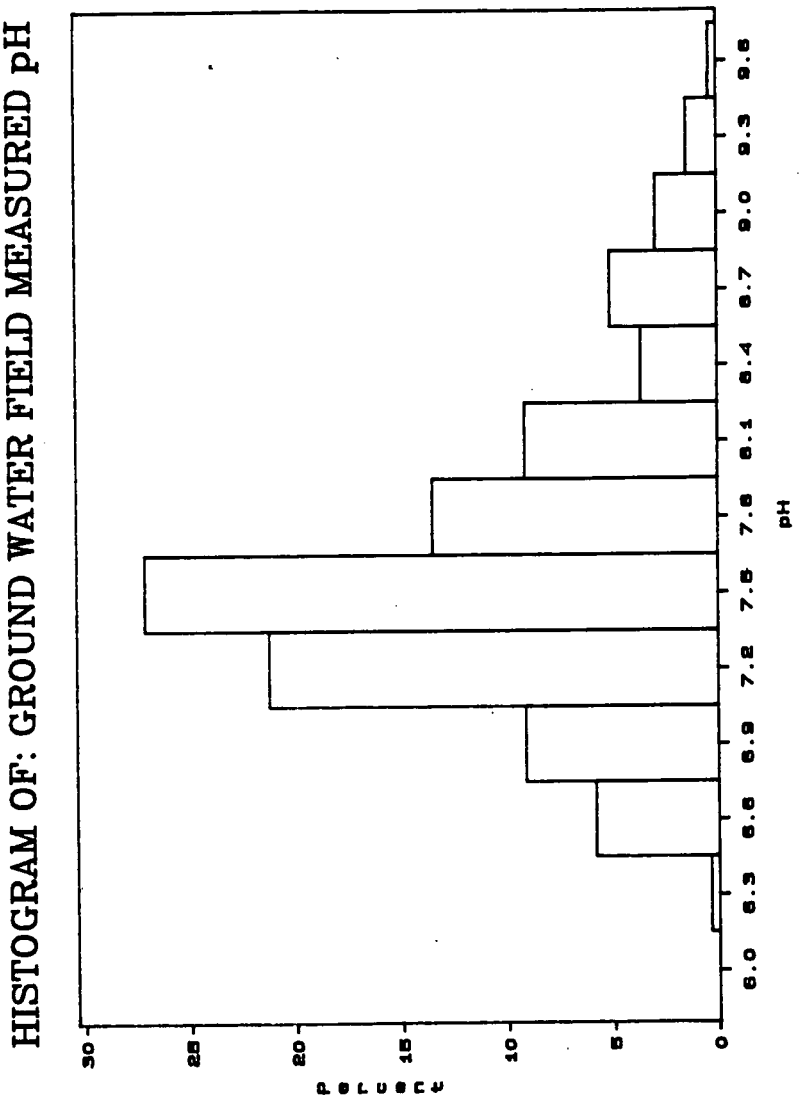

HISTOGRAM OF: GROUND WATER FIELD MEASURED pH
FREQUENCY
30
25
20
15
10
5
0
6.0
6.3
6.6
6.9
7.2
7.5
7.8
8.1
8.4
8.7
9.0
9.3
9.6
pH

FIGURE 4-7

CATION–ANION BALANCE IN SURFACE WATER

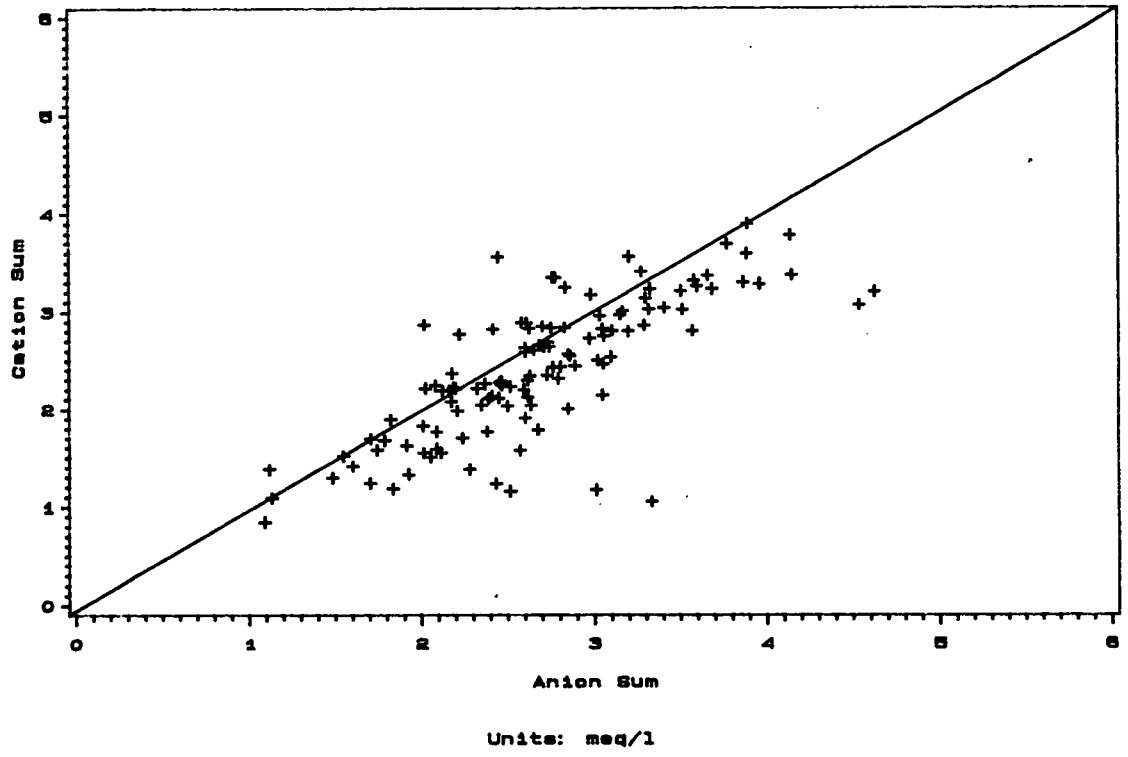


FIGURE 4-8

TOTAL DISSOLVED SOLIDS VS CHARGE BALANCE ERROR IN SURFACE WATER

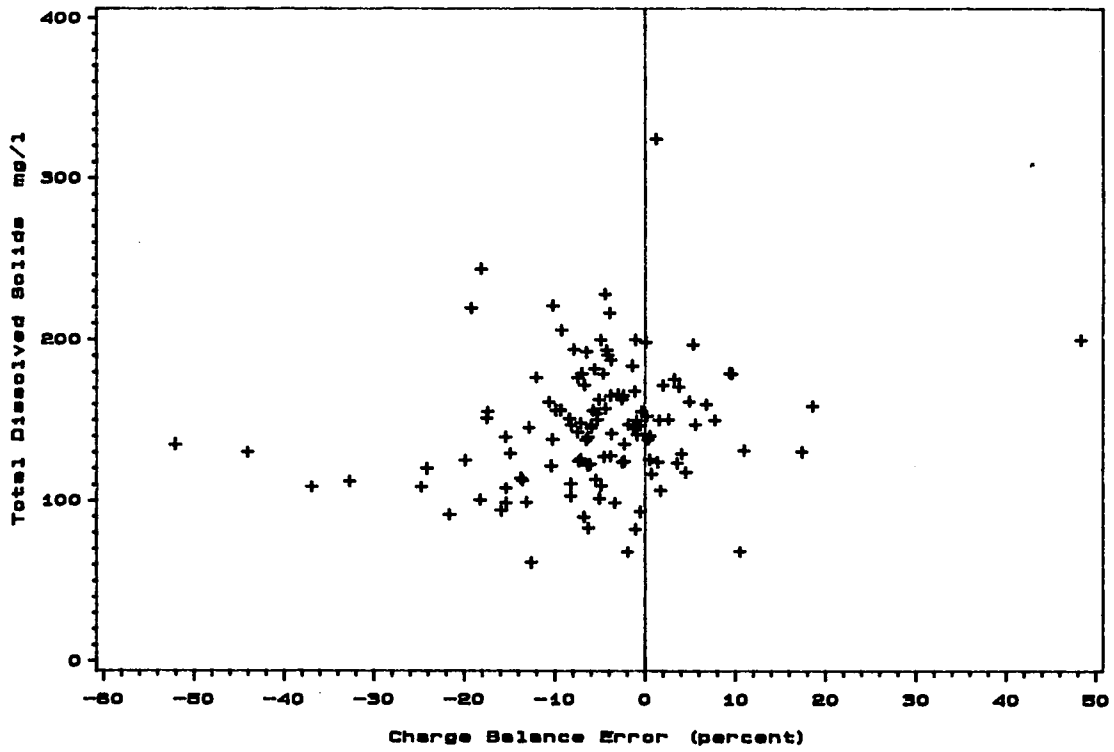


FIGURE 4-9

SPECIFIC CONDUCTANCE VS CALCULATED TDS IN SURFACE WATER

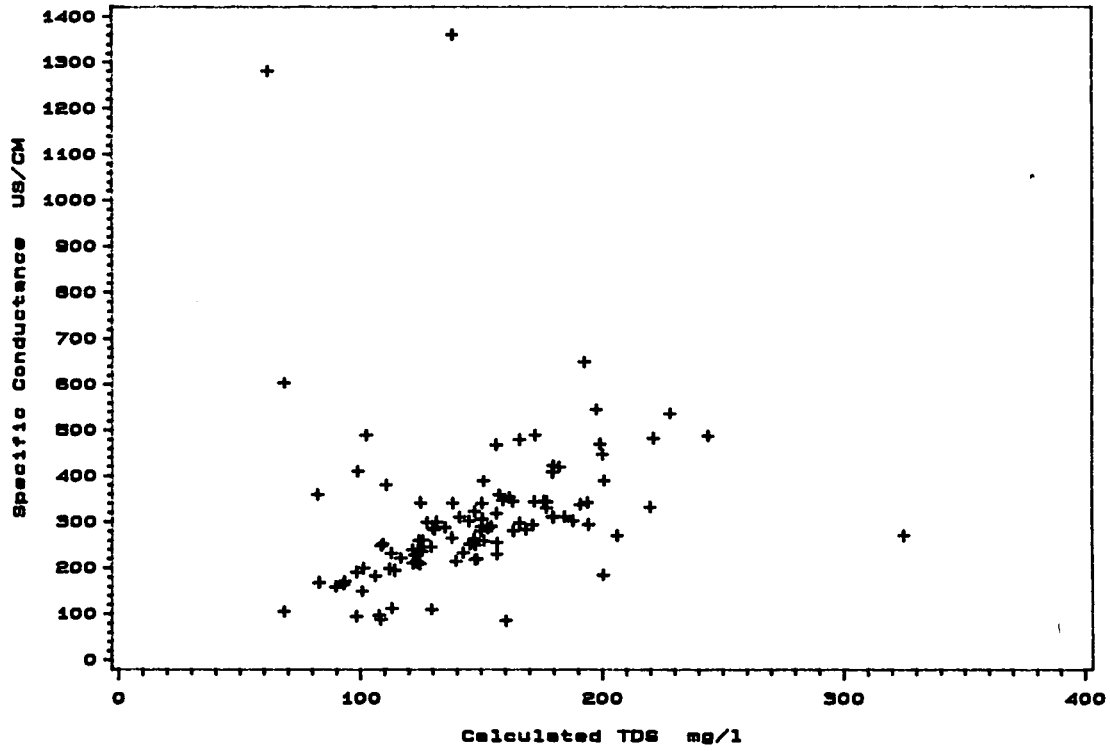


Figure 4-10 indicates that there is almost no correlation between field-measured pH values in surface water and those later measured in the laboratory. This may be the case because the pH of natural waters tends to be an unstable parameter which is best measured *in situ*, or as soon after sampling as possible.

Calculated versus measured TDS in surface water samples has been plotted on Figure 4-11. In principal, calculated TDS should equal measured TDS if all dissolved compounds have been identified, measured, and accounted for. More points fall on the measured TDS side of the line indicating that measured TDS is on average higher than calculated TDS. This 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 including silica. 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.

FIGURE 4-10

COMPARISON OF FIELD MEASURED pH VS LABORATORY MEASURED pH

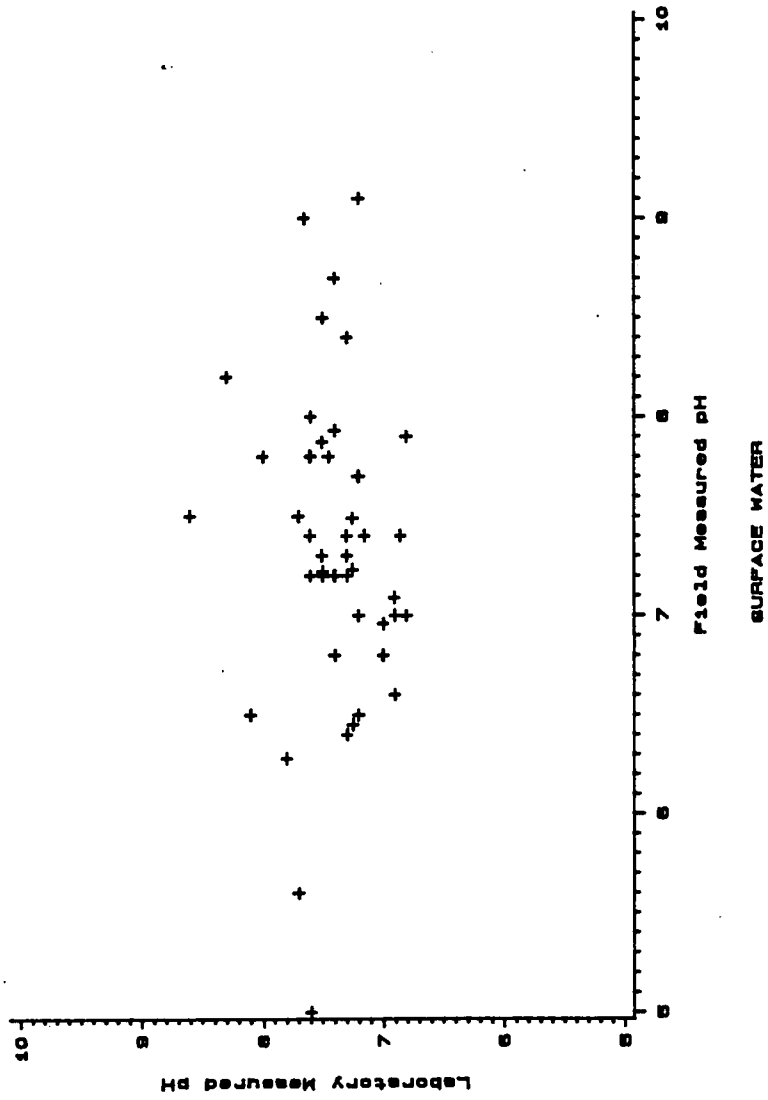
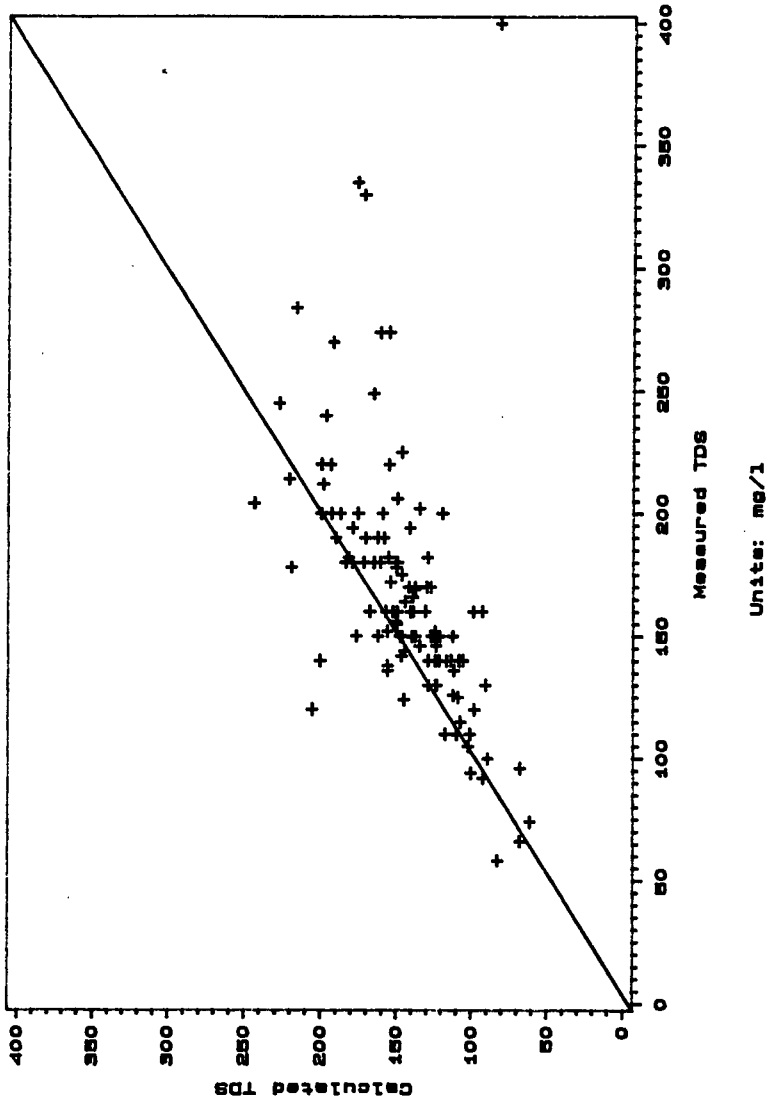


FIGURE 4-11

CALCULATED VS MEASURED TOTAL DISSOLVED SOLIDS IN SURFACE WATER



5.0 BACKGROUND GEOCHEMICAL CHARACTERIZATION

5.1 INTRODUCTION

Concentrations of chemicals in samples of Rocky Flats groundwater, surface water, stream sediment, seep water, seep sediment and borehole materials were measured to establish background conditions in each medium. This chapter discusses the results of the statistical and geochemical analysis of this background chemical data. The evaluation is based on data collected at Rocky Flats Plant during calendar years 1989, 1990 and 1991. The analytical data are voluminous, therefore they are provided in electronic format on a 1.44 MB diskette as Appendix A.

As outlined in Section 1, the chemical concentrations for each sample medium were tested for statistically significant differences in chemistry as follows. Surface water and stream sediment data were each tested for differences in mean concentration between samples collected from Rock Creek and those collected from Woman Creek. Surface water, seep water and groundwater data were individually tested to see if there were differences in chemical concentrations between the quarters of the year in which the samples were collected. Analyses of geologic materials sampled from boreholes, and groundwater samples from wells in North Rocky Flats were each compared with data for the same analytes from South Rocky Flats. Geologic materials samples and groundwater samples are collected from five different geologic units at Rocky Flats. Statistical tests were performed to determine if significant differences exist between geologic units in mean chemical concentrations.

Both parametric analysis of variance (ANOVA) and non-parametric ANOVA are used extensively in this report for comparing mean concentrations or mean activities (radionuclides) for possible differences between the levels of the classification factors: area, geologic unit, and quarter of sampling. When the term "ANOVA" is read without the "non-parametric" adjective, the reader should assume "parametric ANOVA" is being discussed. Chi-squared contingency tables (CSCT) were also used to look for significant differences between the levels of a classification factor based on the relative proportions of detected and non-detected concentrations.

Multivariate Analysis of Variance (MANOVA) was not performed using data for any of the six sample media because they were found to have an insufficient number of analytes (less than 50%) meeting the assumptions of normality and homogeneity of variances.

As shown on the statistics flowchart, Figure 1-1, class comparisons were not tested for analytes with less than 4 detectable concentrations, or a sample size of less than 10 observations. Instead all of the data in different levels for a given sample medium and chemical group (e.g. seep water filtered metals) were combined, and tolerance limits and other descriptive statistics were computed for each analyte meeting the above criteria.

Those analytes which contained less than 50% detects were placed in a separate data directory and chi-squared contingency tables were used to test for differences in the levels of the classification factors.

The distributions of analytes with over 50 percent detectable concentrations and a sample size greater than 10, were tested with the Shapiro-Wilk test for normality or log normality. The ASTM outlier test was then run on either the original concentration data, or on the log transformed data, as appropriate. Approximately 90 outliers were identified and checked prior to proceeding with further statistical analysis. Outliers are listed in Appendix C.

After outlier testing was completed, Bartlet's test was run on those analytes that were found to be normal or log normal, to test for homogeneity of variances between levels. Normal or lognormal analytes with homogeneous variances were then tested by parametric ANOVA using the SAS procedure GLM with no interactions. Analytes which failed Bartlet's test, or which were not definitively normal or lognormal were processed by non-parametric ANOVA, using either the SAS procedure NPAR1WAY, or alternatively, procedure GLM was used on the ranks of the concentration data.

Non-parametric or Parametric ANOVAs were performed for analytes with a sample size greater than 10 and more than 50 percent detectable concentrations. The null hypothesis tested in an ANOVA is 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 is

that no difference exists in mean calcium concentration between groundwater from Rocky Flats alluvium and groundwater from valley fill. Similarly, when chi-squared contingency tables are used, the null hypothesis is that there are no differences in the proportions of detected and nondetected concentrations between the levels of the classification factor being tested.

Five different geologic units are referred to in many tables and throughout the text of this chapter. For brevity the following acronyms are used to refer to each unit: RFA indicates Rocky Flats Alluvium, VFA indicates Valley Fill Alluvium, COL denotes Colluvium, KAR stands for the undifferentiated Arapahoe/Laramie formations, and WCS is the weathered surface of the upper Arapahoe/Laramie formation.

Figure 1-1 shows the logic path and statistical methods used to determine differences between groupings. Tables summarizing the classification results from parametric ANOVA, are presented in Tables 5-1 through 5-24. Tables 5-25 through 5-49 summarize the non-parametric classifications, and Tables 5-50 through 5-68 show the chi-squared classifications. A separate table of summary statistics was computed for each classification level of an analyte when significant differences were found between levels. Tolerance limits and other summary statistics are included in Tables 5-70 through 5-256.

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 Appendix B.

5.2 GROUNDWATER

5.2.1 Statistics

Background groundwater monitoring wells in North and South Rocky Flats were completed in Rocky Flats Alluvium, valley fill alluvium, colluvium, weathered claystone, and unweathered Arapahoe/Laramie formation rocks. Groundwater samples were collected quarterly over three years and analyzed for filtered and total metals, filtered and total radionuclides, volatile organic compounds, and for water quality and field parameters. Tolerance limits, percent detects,

maximum value and other summary statistics are reported for each chemical in groundwater samples from both North and South Rocky Flats when there is a difference in means between areas, and similarly for each lithological unit with a distinctive mean concentration. In addition to area and geologic unit, groundwater data were examined for differences in mean concentrations between sampling quarters. Additional results from the quarterly comparison are discussed under seasonality (Section 5.8). Separate tables of descriptive statistics were not produced by quarter of sampling.

Five analytes for filtered metals in groundwater met the assumptions for performing parametric ANOVA (Table 5-8). Of these analytes, Si was found to be normally distributed while Sb, P, Na, and Sr were log normal. Only Sb and Sr showed significant differences in mean concentrations between North and South Rocky Flats. Comparison of the means between the lithologic units (of the screened interval of the wells) indicated that Na and Sr had distinctly different mean concentrations in RFA than they did in the other four geologic units. Sb and P did not have any significant differences in concentration when comparisons were made between geologic units. All of the quarterly comparisons by ANOVA for filtered metals were not significantly different.

Eleven filtered metals in groundwater were tested by non-parametric ANOVA to compare mean concentrations by quarter, area and lithologic unit. These include: Al, Ba, Ca, Fe, Li, Mg, Mn, K, Sn, V, and Zn. Those chemicals that differed in concentration between North and South Rocky Flats are: Ba, Ca, Mg, Mn, and K. Only Al, Fe, V, and Zn showed no differences between lithologic units. The other metals had numerous differences between lithologies (see Table 5-33). Calcium differed the most frequently between lithologies, by having significantly different mean concentrations in 8 out of 10 unique, paired-unit comparisons. Lithium and potassium are also interesting in that their means in RFA differ from their means in the other four geologic units. Non-parametric ANOVA indicates few differences between sampling quarters for these analytes. Lithium differed between quarters 2 and 4, while V and Zn differed between most quarters.

CSCT were used to identify significant differences in groundwater filtered metals data by area, lithologic unit, and quarter of sampling (Table 5-56). Arsenic, Cs, and Mo were different

between North and South Rocky Flats in their proportions of detects to nondetects, while Cd, Cr, Co, Cu, Pb, Ni, Se, and Ag were not significantly different. Beryllium, Hg, and Tl were indeterminate because of insufficient data in the contingency table cells. With respect to lithologic units, As, Ni and Se had significant differences between units, while Cd, Cu, Cr, Pb, Mo and Ag did not. Beryllium, Cs, Co, Hg, and Tl were indeterminate because fewer than 20% of the cells contained at least 5 values. Cadmium, Cr, Co, Cu, Pb, Mo, Ni, and Ag had significant differences between quarters of sampling, but As and Se did not. Beryllium, Cs, Hg, and Tl were indeterminate with respect to quarterly differences.

Tritium in filtered groundwater samples was normally distributed and had no significant difference in mean activity between North and South Rocky Flats. However, ANOVA indicates that tritium activities differed significantly between RFA and WCS and between VFA and WCS (Table 5-9). Tritium showed no differences between quarterly means.

The activities of seven radiochemicals in filtered groundwater were tested for differences in means using non-parametric ANOVA. These include: gross alpha, gross beta, Ra-226, Sr-89,90, U-233,234, U-235, and U-238. None differed between North and South Rocky Flats. However, except for Ra-226, all showed frequent differences in mean activity between lithologies (Table 5-34). Only gross alpha in filtered groundwater samples differed between quarters of sampling. It differed between quarters 1 and 4, and 2 and 4.

Data for seven metals in unfiltered groundwater samples were suitable for ANOVA. Silicon was normally distributed while Al, Ca, Fe, Mg, Mn, and Zn were log normal. ANOVA indicated that there was no difference in mean concentrations between north and south for Si, Ca, and Mg, but the differences were significant for Al, Fe, and Mn. Table 5-10 indicates a number of differences in means between geologic units. The most interesting difference is that Mg has a different mean concentration in RFA than it does in VFA, COL or WCS.
Iron was the only analyte where a significant difference in mean concentration between quarters 3 and 4 exists.

Table 5-35 summarizes the non-parametric ANOVA results for 8 additional total metals in groundwater. Of these metals, Pb, K, and V differed in mean concentration between North and

South Rocky Flats. Barium, Cr, Li, Na, and Sr did not show any difference in means by area. Barium, Cr, and Pb did not differ between lithologic unit, although the others showed some lithologic differences. The most interesting is that Rocky Flats Alluvium differs significantly from the other four units in Li, Na, and Sr.

CSCT detected significant differences between North and South Rocky Flats groundwater in the proportion of non-detects and detects for the following total metals: Sb, As, and Sn (Table 5-57). No differences were significant for Cd, Co, Cu, Mo and Se. The test was indeterminate for: Be, Cs, cyanide, Ni, Ag and Tl. All 14 unfiltered analytes lacked a sufficient number of points in the CSCT cells to identify differences by geologic unit. However, Sb, Cd, and Sn were found to have differences between sampling quarters, while Co, Cu, Mo, Ni, and Se were non-significant when compared by quarter.

Chemical data for four unfiltered radiochemicals Am-241, Pu-238, U-233,234, and U-238 were tested in ANOVA. All four were log normally distributed and had no difference in mean activity between North and South Rocky Flats groundwater. Table 5-11 indicates that Am-241 and Pu-238 had no differences in mean activity when compared between geologic units. However, U-233,234 had a different mean activity in RFA than it did in COL, VFA, or WCS. Only Am-241 had a complete set of data for quarterly comparisons and it did not have any significant differences between quarterly mean activities.

A number of additional total radiochemicals were tested by non-parametric ANOVA. Plutonium-239,240 and U-235 had different means between North and South Rocky Flats. Cesium-137, gross alpha, gross beta, Sr-89,90, and tritium did not differ by area of the plant. There were only four differences between geologic units: U-235 differed between RFA and COL, COL and VFA, and between COL and KAR. Cesium-137 differed between WCS and KAR. Much of the quarterly data was missing for these analytes, but a significance difference was observed for U-235 between quarters 2 and 3.

Bicarbonate ion in groundwater was found to be log normally distributed and ANOVA indicates significant differences in bicarbonate mean concentrations between most geologic units. Out of the 10 possible unique comparisons of units, only VFA to WCS, VFA to KAR, and WCS to

KAR had no significant difference in mean bicarbonate concentration (Table 5-12). Bicarbonate ion did not vary significantly between quarters of sampling.

Non-parametric ANOVA was applied to 9 water quality parameters in groundwater. Bicarbonate, phosphorus, silica, and sulfate had no differences in means between North and South Rocky Flats, while chloride, fluoride, nitrate/nitrite, total dissolved solids, and total suspended solids did differ (Table 5-37). All of the analytes differed between most of the lithologic units, with the exceptions of bicarbonate and phosphorus which showed no differences in mean concentration by unit. There were few differences by quarter of sampling. Only phosphorus in quarters 1 and 2, and silica in quarters 1 and 4, and total suspended solids in quarters 1 and 2, had different means.

Carbonate, nitrite and orthophosphate data for groundwater were examined in CSCT to test for differences in the proportion of detected and nondetected values between North and South Rocky Flats (Table 5-59). Carbonate and orthophosphate showed no significant differences between areas, or between the geologic units of the screened intervals of the wells. Nitrite had insufficient data to perform a reliable test. None of the three analytes had sufficient data to test for differences by sampling quarter.

Groundwater field parameters suitable for ANOVA included dissolved oxygen (normally distributed) and specific conductance (log normal). Interestingly, most of the geologic units differed significantly for these two parameters. Rocky Flats alluvium differed from COL, VFA, WCS, and KAR in specific conductance, and RFA differed from COL, VFA and KAR in dissolved oxygen. Several other differences between units are indicated on Table 5-24. There were no differences in quarterly means for the two analytes.

Field-measured pH in groundwater did not differ between Rock Creek and Woman Creek when tested by non-parametric ANOVA (Table 5-49). However, field-pH differed between 8 out of 10 unique pairwise combinations of the 5 lithologic units. There were no differences in means between sampling quarters.

Chi-squared contingency tables were used to test volatile organic compounds in groundwater for possible differences between North and South Rocky Flats in the proportion of detects vs. nondetects. Acetone and methylene chloride were not significantly different between North and South Rocky Flats, however they did have differences between quarters. As discussed in Section 4.3, the occurrence of acetone and methylene chloride is likely laboratory artifact. These analytes are often present in the laboratory blanks, and the concentrations in field blanks and field samples are similar. Also, the analytes are not present in greater than 70% of the samples. The apparent difference in quarters for these analytes may simply represent a Type I error which is predicted to occur 5% of the time. Tetrachloroethene, toluene and trichloroethene did not have sufficient data in the CSCT cells to perform a reliable test (Table 5-58). Although tetrachloroethene and trichloroethene did not appear in laboratory or field blanks (toluene was present occasionally), these three compounds occurred in the field samples less than 3% of the time and often at estimated concentrations below the CRDL. Furthermore, none of these compounds occurred more than once in samples from any one well. It does not appear that these compounds are present in background ground water.

5.2.2 Groundwater Geochemistry

Plates 7, 8, 9 and 10 were prepared to help visualize the natural variations in ground water chemistry between geologic units, as well as spatial changes in chemistry across the 10 square miles of the Rocky Flats Plant. In order to get a more complete picture of ground water chemistry across the plant it is necessary to include data for both background and non-background (downgradient) wells. Because of the possibility that some downgradient wells may be contaminated, their chemical data have been used only in selected plates and figures, but not in background statistics. Plates 7 through 10 consist of a basemap of Rocky Flats on which a set of small geochemical diagrams (Stiff or Piper diagrams) are superimposed near the well locations whose ground water chemistry is being depicted. Traditionally Stiff and Piper plots are used to study variations in the major cations and anions present in natural waters. However, it would be easy to extend the approach to radiochemical, or trace element chemistry as well.

There are a number of reasons for spatial changes in ground water chemistry. Some may be due to the natural evolution of ground water chemistry along a flow path. For example, a systematic

increase in total dissolved solids (TDS) content in the downgradient direction. Some changes in water quality may be the result of ion exchange processes, or oxidation/reduction, or mineral precipitation/dissolution processes. Other changes in chemistry in downgradient areas may be the result of local ground water contamination. Examples of some of these changes are observed on Plates 7 through 10 and are discussed below.

Stiff diagrams are plotted on Plate 7 for groundwater from the upper flow system lithologic units. Each of these units are identified by a different "fill style" within the Stiff diagrams. For example, the weathered claystone is indicated by a cross-hatched pattern. The shapes and sizes of Stiff diagrams are meaningful. The higher the total dissolved solids content of the water the larger the area of the diagram. The mean concentrations of four major metals and four important anions are indicated in units of milliequivalents per liter by the widths of the Stiff diagram at 4 different heights along the center line.

Plate 7 has a variety of Stiff plots and of water chemistry. For example, the very wide diagram in the southeast corner at well B303089 (03089) is an unusual sodium and magnesium sulfate ground water in valley fill alluvium. It does not look like any other Stiff plot on Plate 7. The origin of this water chemistry is unknown, but it is speculated that it may be related to leachate from a pre-Rocky Flats Plant, domestic landfill which is located upgradient, about 500 feet to the west.

Notice that after excluding well B303089, the other valley fill alluvial wells on Plate 7 all have a fairly constant shape indicative of a calcium bicarbonate water type. The valley fill alluvial waters do not appear to systematically increase in total dissolved solids in the downgradient direction, although there is a possible trend along the Rock Creek drainage from well B102289 to B202589 (02589).

Rocky Flats alluvial wells from the north buffer zone (B200589 through B200889) appear to systematically increase in TDS downgradient to the northeast. The Stiff plot for the colluvial well B201589 has the same shape as the other wells and continues the increase in TDS.

Colluvial well B201289 near the Wind Site is a distinctive calcium, sodium sulfate water type with relatively high TDS (Plate 7). The reasons for this water type are unknown.

Interestingly, many of the wells in the Woman Creek drainage which are screened in Rocky Flats Alluvium, colluvium, valley fill alluvium or weathered claystone have similarly shaped Stiff plots indicating the same calcium bicarbonate groundwater chemistry (Plate 7). Calcium bicarbonate is the typical ground water type present in the upper flow system geologic units.

The colluvial well 2987 and well P317989 developed in Rocky Flats alluvium, are located close to the central plant area and their large TDS contents and distinctive shapes may indicate ground water contamination. Groundwater from well 2987 is unusual in that it is a sodium chloride water type. Well P317989 is sodium sulfate water type.

Plate 8 shows Stiff plots based on the mean concentrations of major ions in groundwater from the lower flow system. The plots are identified with the Arapahoe/Laramie sandstone unit in which they are believed to be screened. The reader should be aware that at present there is a lot of uncertainty in the identification and correlation of the numbered sandstones. The sandstones have been correlated solely on the basis of geologic properties such as their grain size distributions and thickness. In fact, it may turn out that distinctive geochemical properties such as the basic 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.

The distinctively shaped calcium bicarbonate water type shows up again in some of the lower flow system wells, especially those in Arapahoe sandstone number one. This suggests that 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 plant. This is geochemical evidence that in the future it might be better to group the number one sandstone with the upper flow system.

Well B207189 located below the present landfill and screened in sandstone number 3 has an unusual shape indicative of a high TDS, sodium chloride water type. This water is apparently influenced by leakage from the present landfill, operable unit 7 (OU7). Further to the east, well

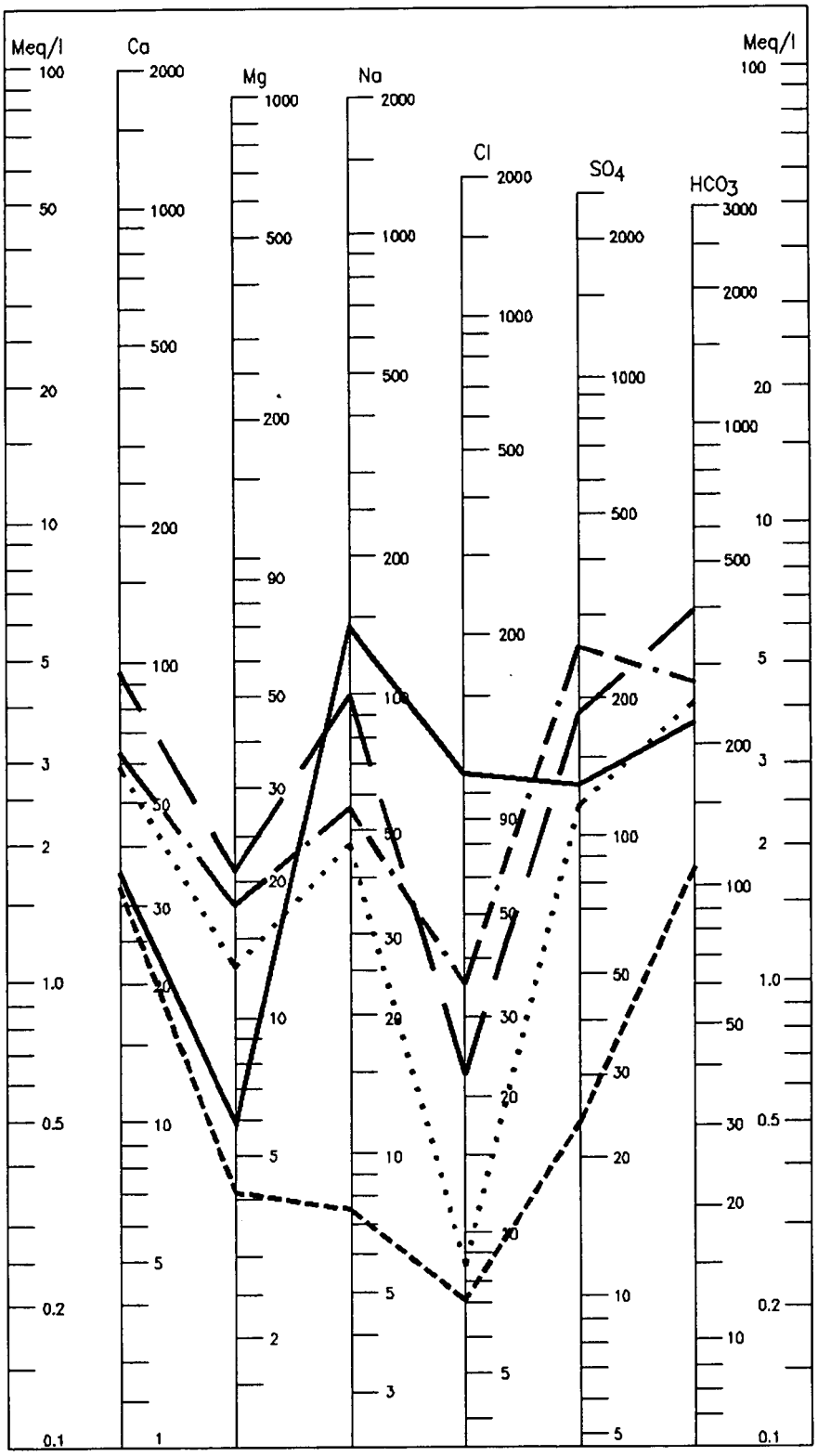
B204189 in Arapahoe silty sandstone has a sodium sulfate water chemistry with considerable chloride. The chloride content suggests that it may also be influenced by OU7.

Sodium sulfate waters are quite common in the lower flow system on Plate 8 and appear to be diagnostic of water from sandstone number four and undifferentiated Arapahoe silty sandstones in the central plant area. If sandstone number one was removed, the remaining lower flow system water chemistry would be predominantly a sodium sulfate type.

Plates 9 and 10 are analogous to Plates 7 and 8, but use Piper diagrams instead of Stiff plots. The explanation of a Piper in the northwest corner of Plate 9 shows the chemicals being plotted are the same as those for a Stiff plot. Basically, the major cation chemistry is plotted on the lefthand triangle, the major anion chemistry is put on the righthand triangle, and the points on the triangles are projected onto the diamond. 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 ground water.

On Plates 9 and 10 points which cluster near the lefthand vertice of a diamond are calcium bicarbonate waters. Those points that group near the righthand vertice of a diamond are sodium sulfate waters. The diameters of the circles shown on some Piper diagrams are proportional to TDS in the water. Since circles are more numerous on Plate 10, the lower flow system appears to be somewhat higher in TDS than the upper flow system groundwater. As mentioned earlier, with careful study these diagrams can be used as tools for hydrostratigraphic correlations.

Figure 5-1 is a Schoeller diagram of the major ion chemistry of background groundwater. Average groundwaters from each of the five geologic units are represented by different line styles. The scales at the edge of the diagram show milliequivalents of dissolved solids per liter (meq/l), while the inner scales are mg/l concentrations. It is apparent from the Schoeller plot that RFA groundwater tends to be lower in TDS than the other groundwaters, while COL and VFA groundwaters are surprisingly high in TDS. It is also seen that the lower flow system KAR is enriched in Na and Cl but low in Ca and Mg in comparison to most of the upper flow system waters.



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 5-1

R69017.PJCW-092592

Scatterplots of ratios like sulfate/chloride versus (Na+K)/(Ca+Mg) may be useful in distinguishing natural waters. Figure 5-2 is such a plot for background groundwater from the five lithologic units of significance at Rocky Flats. Notice that the deep KAR groundwater is cleanly differentiated by being high in Na+K relative to Ca+Mg. This is probably due to cation exchange processes, and or precipitation of calcite, gypsum, or dolomite. Groundwater in the weathered claystone (WCS) at the upper contact of the KAR clearly groups with the other upper flow system units by being low in (Na+K)/(Ca+Mg). The Rocky Flats alluvium (RFA) is high in Mg+Ca and low in Na+K relative to the other units.

Figures 5-3 and 5-4 are trilinear or Piper diagrams for upper and lower flow system groundwaters from both background and downgradient wells at Rocky Flats. Arapahoe sandstone #1 has been grouped with the upper flow system units on Figure 5-3. The large diameter circles are high TDS waters of colluvial well 2987 located east of building 881. The majority of the upper flow system well waters plot in the calcium bicarbonate field. The lower flow system waters are more sodium chloride rich.

5.3 SURFACE WATER

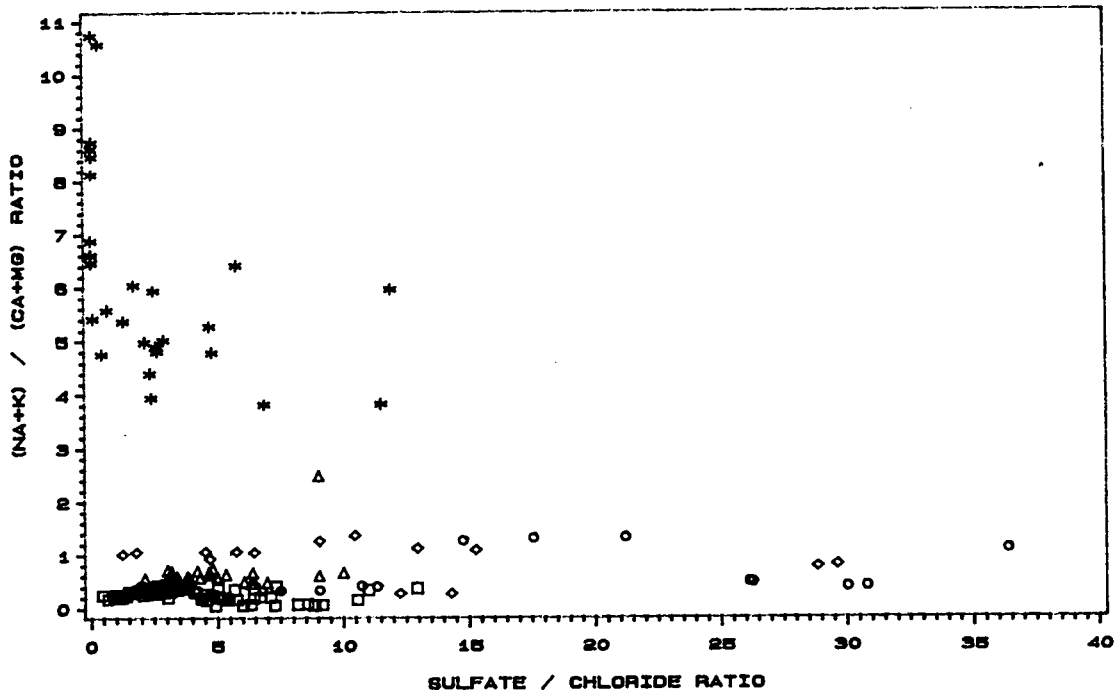
5.3.1 Statistics

Surface water stations were sampled on a monthly basis during 1989, 1990, and 1991. Surface water chemistry data were tested for significant differences in chemistry between Rock Creek and Woman Creek, as well as for differences in quarterly mean concentrations. When differences are indicated in means between creeks a separate table of summary statistics is computed for each creek, otherwise only a single table of surface water statistics is provided. Results of the quarterly comparisons are discussed in Section 5.8 under the topic of seasonality. Separate tables of background statistics were not produced for different quarters of sampling.

Surface water samples were analyzed for filtered and total metals, filtered and total radiochemicals, CLP volatile and semivolatile organic compounds, pesticides, herbicides, and water quality and field parameters.

FIGURE 5-2

MAJOR ION RATIOS IN GROUND WATER



Key: square=RFA, triangle=VFA, diamond=COL, circle=WCS, star=KAR

FIGURE 5-3

PIPER PLOT FOR GROUND WATER FROM THE UPPER FLOW SYSTEM

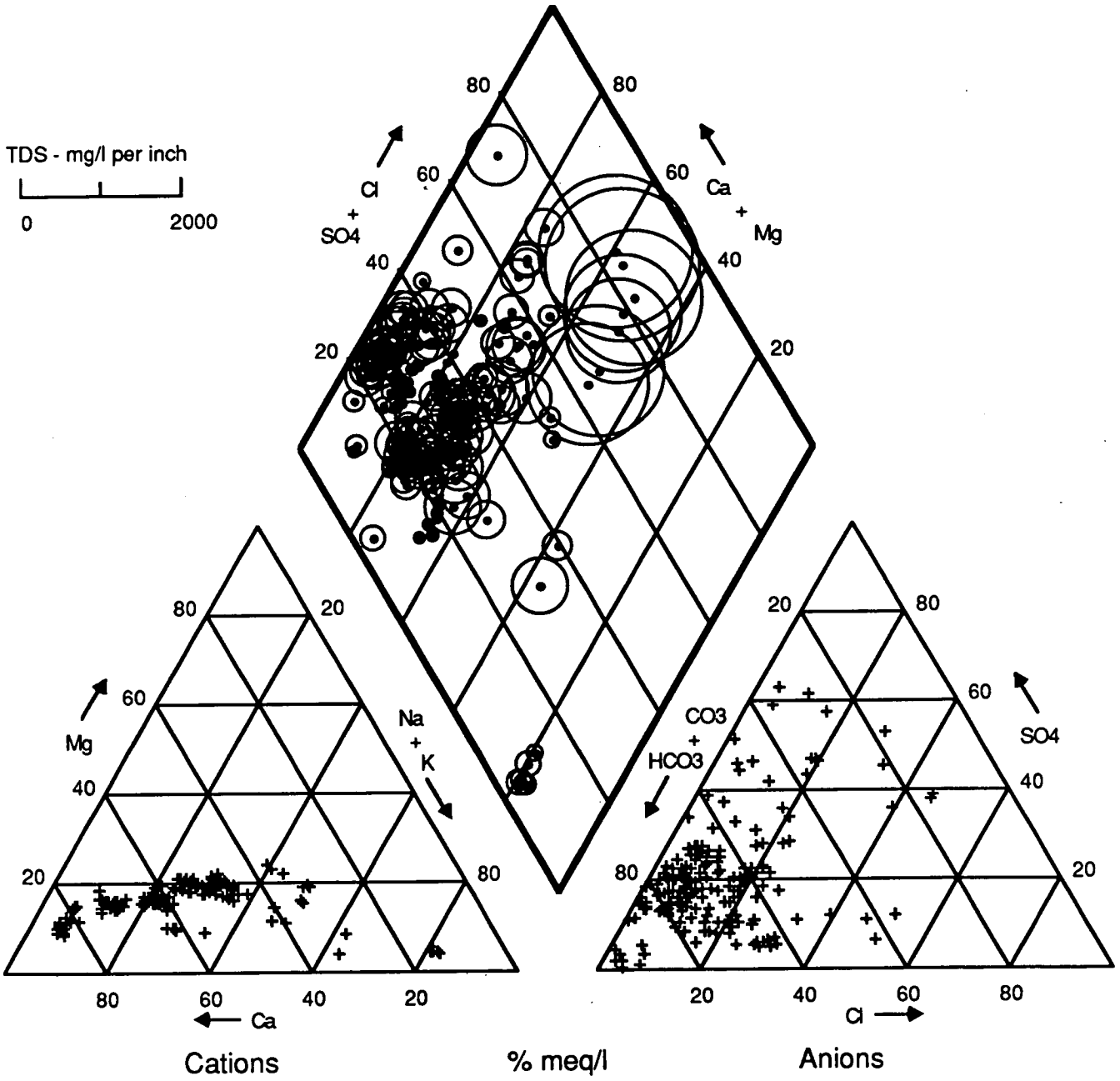
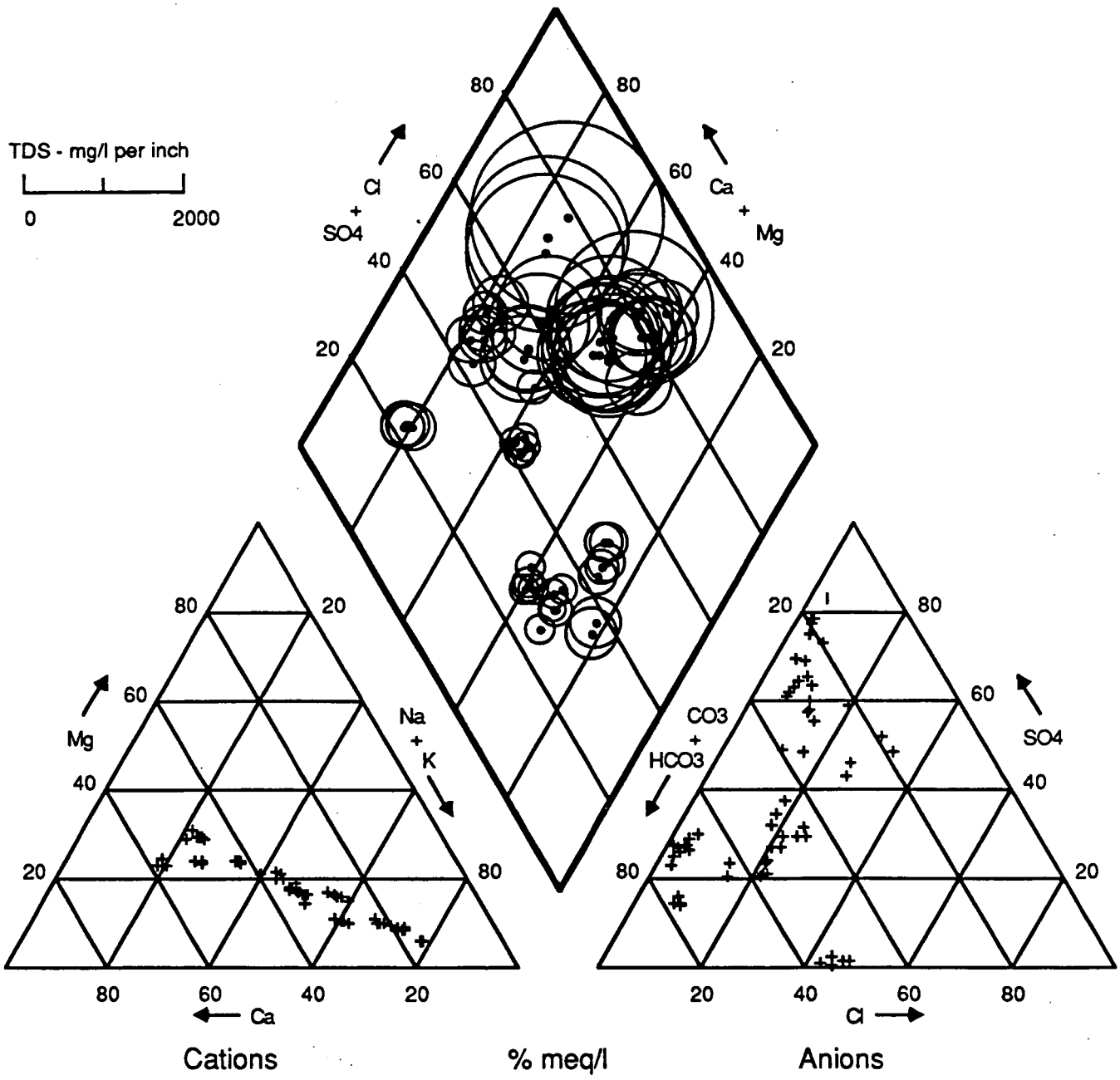


FIGURE 5-4

PIPER PLOT FOR GROUND WATER FROM THE LOWER FLOW SYSTEM



Five filtered metals Si, Ca, Fe, K, and Na were suitable for ANOVA (Table 5-17). Calcium was normally distributed while the other four analytes were log normal. Calcium and Na have significant differences in mean concentrations between Rock Creek and Woman Creek, while the other three chemicals do not. The quarterly mean concentrations of these metals were compared in ANOVA and only Na had significant differences between quarters 1 and 3, 1 and 4, 2 and 3, and 2 and 4.

Barium, Li, Mg, Mn, Sr, and Zn concentration data in filtered surface water were examined in a non-parametric ANOVA to test for different means between drainages (Table 5-42). Only Mn had a significant difference in mean concentration between Rock Creek and Woman Creek surface waters. There were no differences in quarterly means except for Mg which differed between quarters 2 and 3.

Data for twelve filtered metals in surface water samples were examined in chi-squared contingency tables for possible differences between Rock Creek and Woman Creek waters in the proportions of detects and nondetects (Table 5-64). Tin and V showed no significant differences between drainages and Al had no differences between quarters of sampling. Copper had a significant difference between sampling quarters. The test was inconclusive with respect to possible differences between drainages for the following analytes: Al, Sb, Be, Cs, Cr, Cu, Pb, Hg, Mo, Ag.

Gross beta, gross alpha and Am-241 in filtered surface water samples were tested using ANOVA. Gross beta was normally distributed and Am-241 and gross alpha were log normal. Only Am-241 differed in mean activity between Rock Creek and Woman Creek (Table 5-18). No differences were detected between quarterly mean activities.

Strontium-89,90, tritium, U-233,234, U-235, U-238, and gross beta data for filtered surface waters were tested in non-parametric ANOVA. Uranium-233,234 and U-238 had different mean activities in Rock Creek and Woman Creek waters. Strontium-89,90 differed in quarterly means between quarters 1 and 2 and 1 and 3. Uranium-235 showed the most quarterly differences, varying between quarters: 1 and 3, 1 and 4, 2 and 4, and 3 and 4.

Table 5-65 indicates that the use of chi-squared contingency tables produced inconclusive results for possible differences between Rock Creek and Woman Creek surface waters in the proportion of detects to nondetects for filtered radiochemicals: Pu-239,240, gross alpha, and gross gamma.

Nine total metals in surface water samples qualified for ANOVA. Silicon was normally distributed while Al, Cu, Fe, Mg, Mn, K, Na, and Sr were log normally distributed. Only Mn and Na had significantly different mean concentrations between Rock Creek and Woman Creek (Table 5-19). Of the nine metals aluminum differed between quarters 2 and 4 and sodium differed between quarters 1 and 3, 1 and 4, and 2 and 3.

Total barium, Ca, Li, and Zn analytical data were examined by non-parametric ANOVA. Calcium was found to have different mean concentrations between Rock Creek and Woman Creek surface water. No differences between quarters were significant (Table 5-44).

Chi-squared contingency tables were used to test total metals data from surface water samples for possible differences in the proportion of detects and nondetects between Rock Creek and Woman Creek. However, all of the tests were inconclusive due to insufficient data points in the CSCT cells, for: Sb, As, Be, Cs, Cr, Co, Pb, Hg, Mo, Ni, Se, Ag, Tl, Sn, and V. The tests for differences between sampling quarters were also inconclusive for these analytes, except for V and Pb. Vanadium had no differences by quarter of sampling, while Pb had a significant difference (Table 5-66).

A number of total radiochemical activities met the criteria for ANOVA. Americium-241 and Sr-89,90 were normally distributed; Cs-137, gross beta, Pu-239,240, tritium, U-233,234, and U-235 were log normal. None of these analytes had a significant difference in mean activity between Rock Creek and Woman Creek (Table 5-20). Cs-137 and tritium both differed in mean activity between quarters 2 and 4, while Pu-239,240 differed between quarters 1 and 3. The rest of the analytes showed no differences between quarters.

Gross alpha, gross beta, and U-238 in surface water did not differ in mean activity between Rock Creek and Woman Creek when tested in non-parametric ANOVA (Table 5-45). There were no differences between quarters of sampling.

Water quality parameters in surface water were log normally distributed for chloride, lab-measured pH and total organic carbon. Sulfate was normally distributed. Only chloride had a significant difference in mean concentration between Rock Creek and Woman Creek when tested by ANOVA (Table 5-21). ANOVA indicated that only the quarterly means for sulfate differed significantly between quarters 1 and 3.

Bicarbonate, fluoride and nitrate/nitrite had different mean concentrations in Rock Creek and Woman Creek according to the results of non-parametric ANOVA. Phosphorus, silica, and total dissolved and total suspended solids, did not differ by drainage. There were only two differences by quarter, fluoride (quarters 2 and 4) and total dissolved solids (quarters 2 and 3).

Carbonate in surface waters showed a significant difference between quarters of sampling, but not between Rock Creek or Woman Creek, when tested in chi-squared contingency tables (Table 5-68). Oil and grease, sulfide and orthophosphate had insufficient data for the tests to be conclusive.

Dissolved oxygen was normally distributed and specific conductance was log normally distributed in surface water field parameters, which qualified for ANOVA. Specific conductance had significantly different mean values between Rock Creek and Woman Creek, while dissolved oxygen did not (Table 5-22). Neither oxygen or conductance showed any significant differences between quarterly mean concentrations.

Field-measured pH and alkalinity in surface water samples did not differ between drainage according to non-parametric ANOVA. Only quarters 1 and 2 were different in field-measured pH (Table 5-47).

Acetone and methylene chloride in surface water were tested by chi-squared contingency tables to see if there were differences in the proportions of nondetects to detects between drainages at Rocky Flats. The tests were inconclusive due to insufficient data in the CSCT cells (Table 5-67). However, no significant differences were found between sampling quarters for either chemical. Regardless, the occurrence of these compounds in surface water samples is

typical of what was observed for groundwater. As discussed in Section 4-3 and 5.2.1, the presence of these compounds in surface water samples is a laboratory artifact.

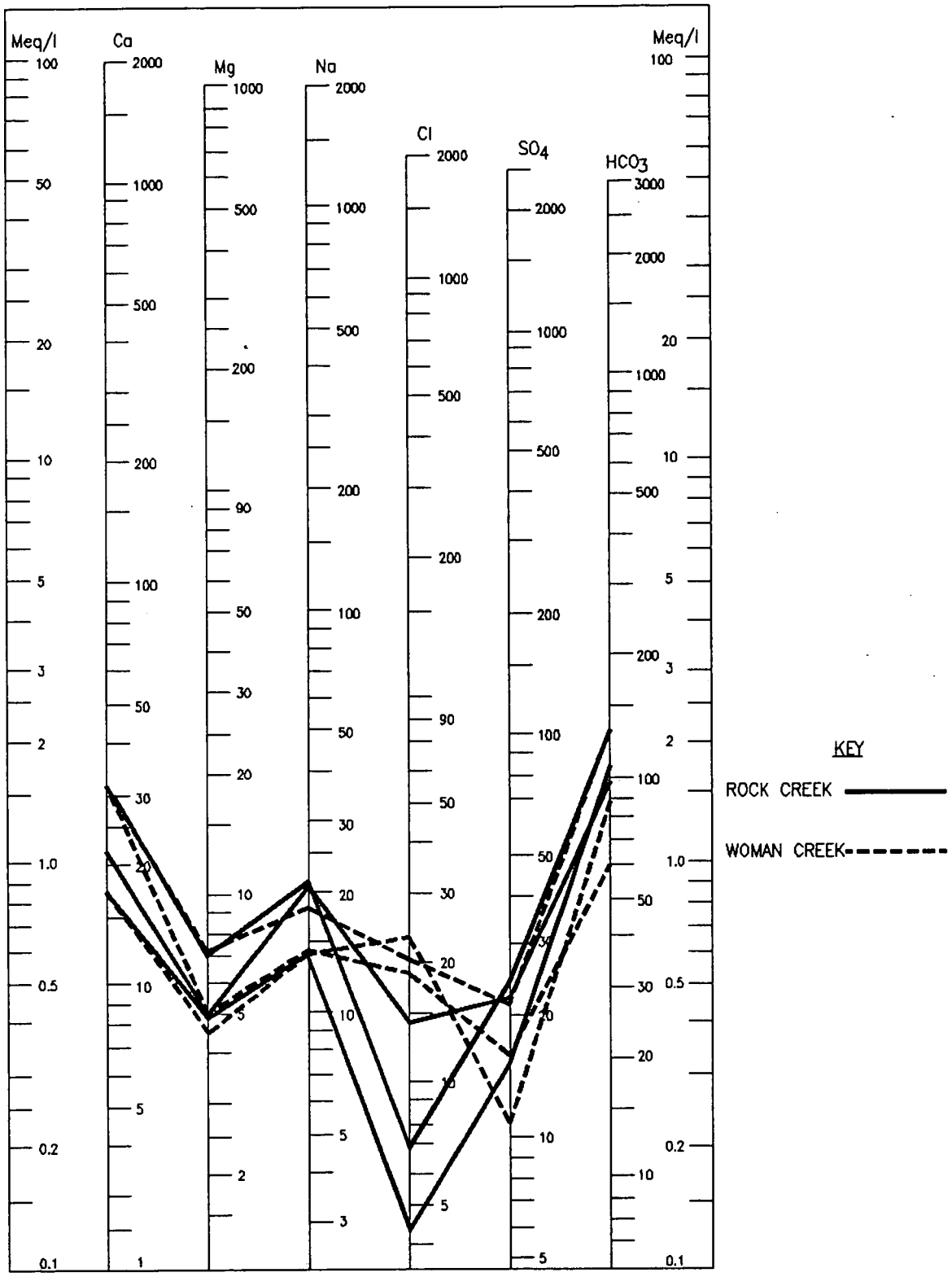
5.3.2 Surface Water Geochemistry

Figure 5-5 is a Schoeller diagram for three sampling locations on Rock Creek (solid lines), and three locations on Woman Creek (dashed lines). The creek waters are similar in Ca, Mg, Na, sulfate and bicarbonate concentrations. However, all three Woman Creek locations are substantially higher in chloride ion (about 20 mg/l) than the Rock Creek stations (which are about 10 mg/l).

The ratio (Na+K)/(Ca+Mg) is plotted versus the sulfate/chloride ratio in Rocky Flats background surface waters (Figure 5-6). The sulfate/chloride ratio does not discriminate the data very well, but the Woman Creek data usually have a lower (Na+K)/(Ca+Mg) ratio than the Rock Creek data.

Figure 5-7 is a Piper diagram for background water quality data from Rock Creek, and Figure 5-8 is the corresponding Piper plot for Woman Creek. Notice that the group of Rock Creek data points is offset (in the diamond) towards higher sodium and lower calcium contents than Woman 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 5-9). 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 water and sediment tritium activities plotted on Figure 5-9 are of similar magnitude, but there is no obvious trend.



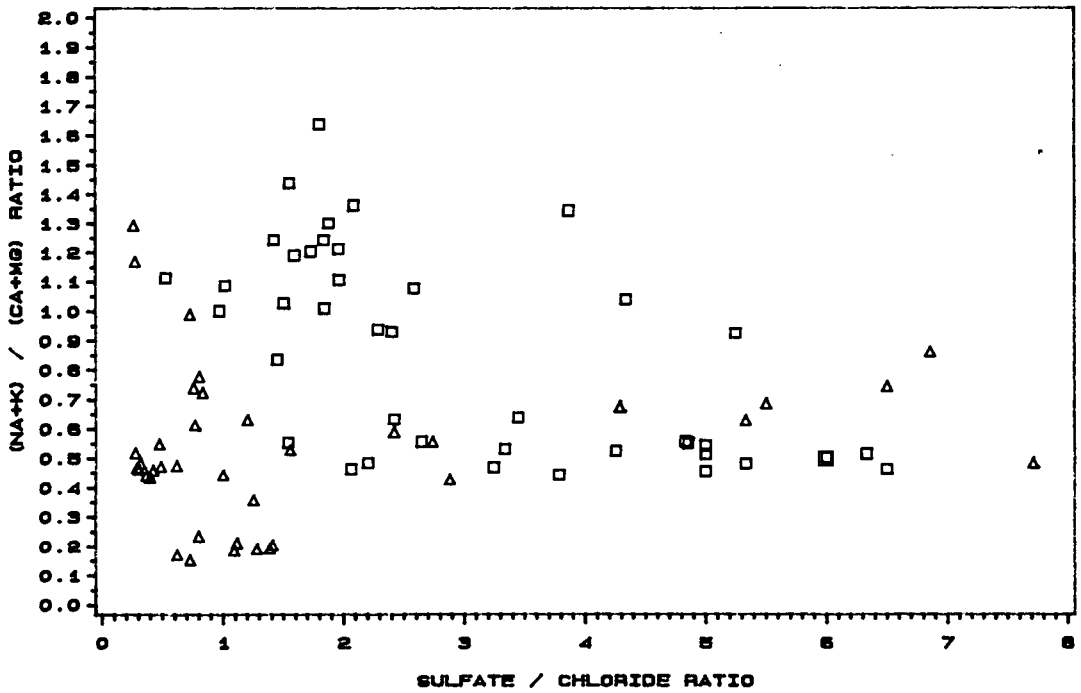
All constituent concentrations are reported in mg/l units, while the scales along the edges are in meq/l. The scale arrangement is adapted from Hem (1989).

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

r69018.pj-092392

FIGURE 5-6

MAJOR ION RATIOS IN SURFACE WATER



Key: square - Rock Creek, triangle - Woman Creek

FIGURE 5-7

Piper Diagram for Surface Water Stations in Rock Creek

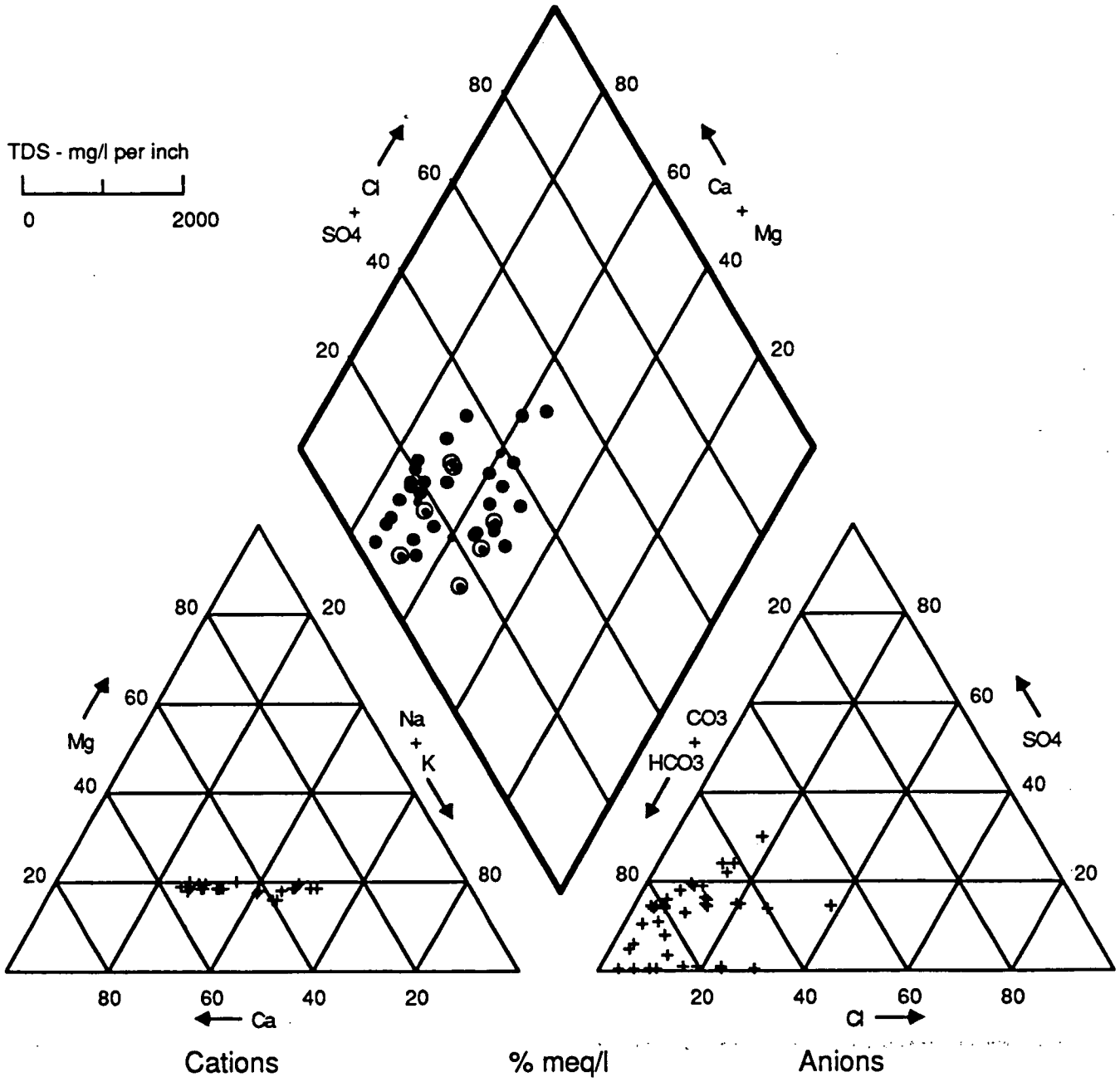
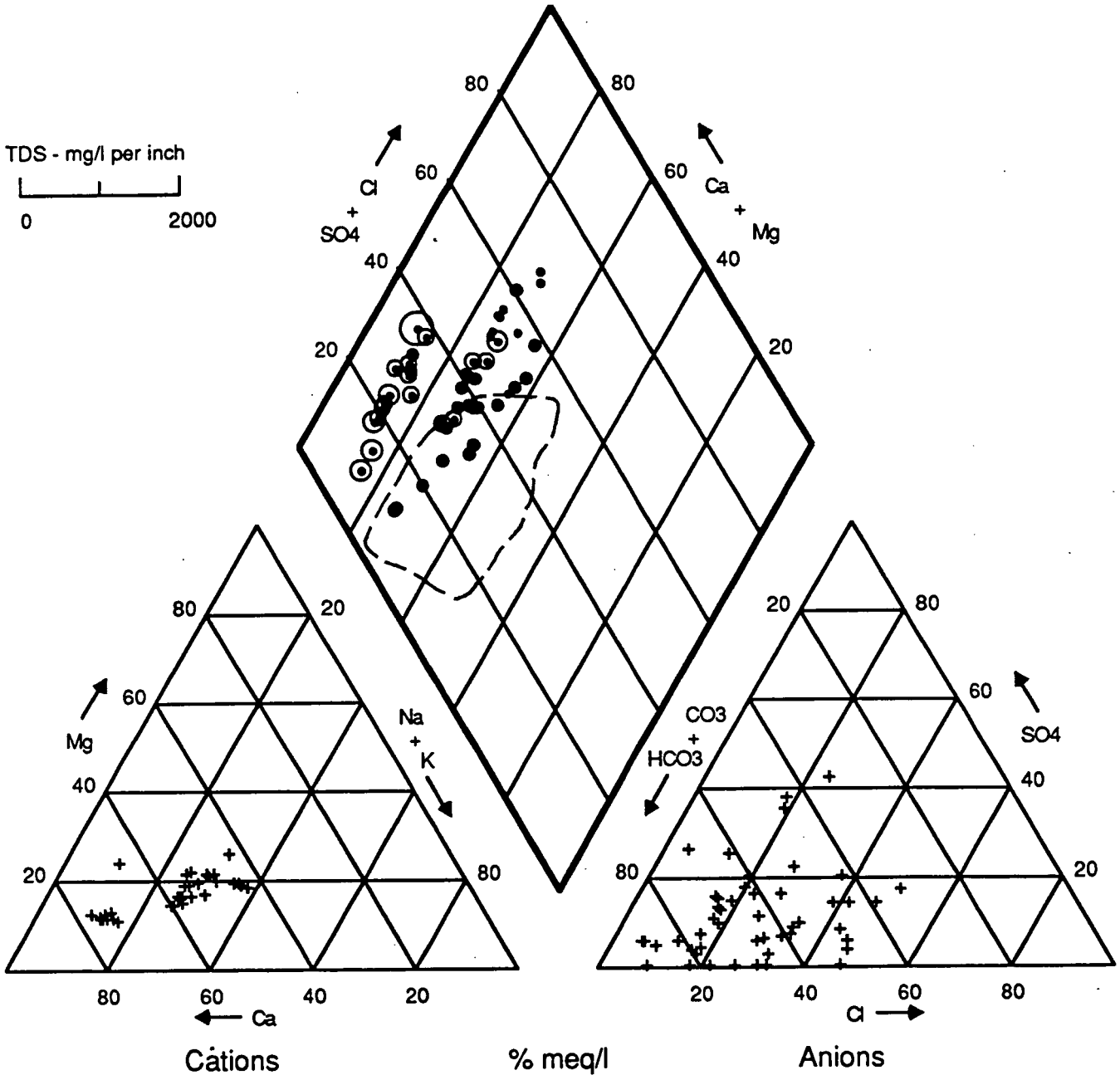


FIGURE 5-8

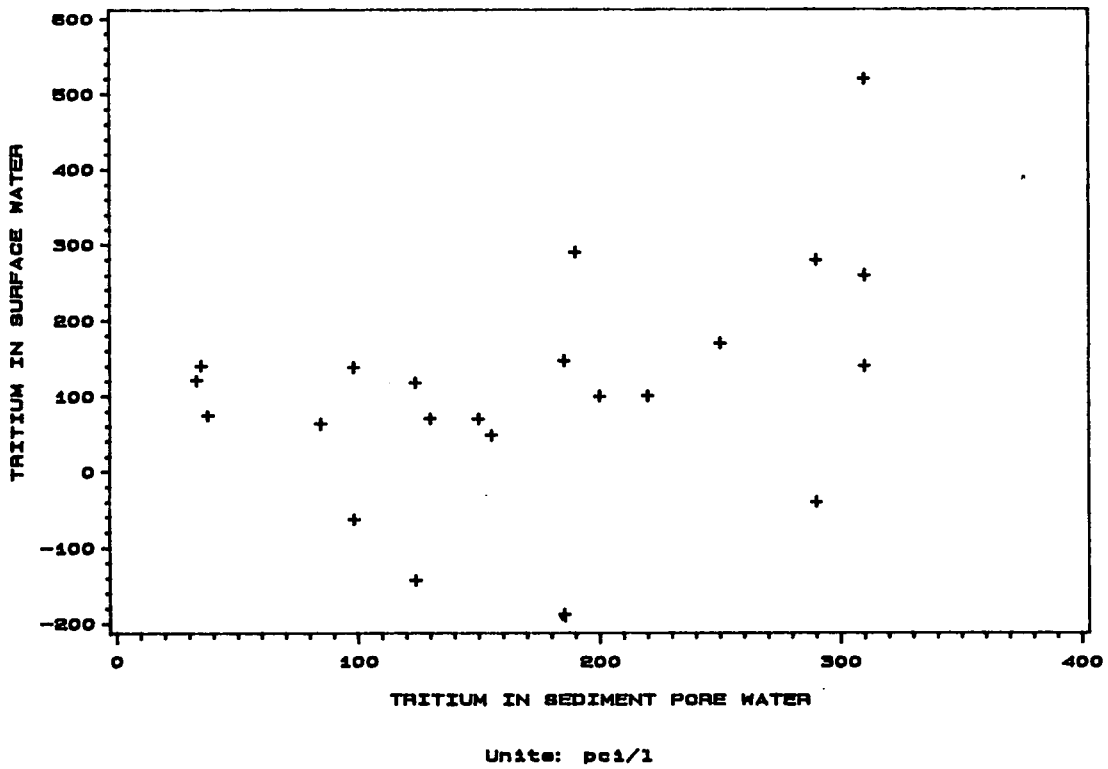
Piper Diagram for Surface Water Stations in Woman Creek



THE DASHED LINE ENCLOSES THE AREA IN WHICH THE DATA FROM THE ROCK CREEK PIPER DIAGRAM WOULD PLOT.

FIGURE 5-9

COMPARISON OF TRITIUM ACTIVITIES IN STREAM SEDIMENTS AND WATER



5.4 SEEP WATER

5.4.1 Statistics

Seep water stations were sampled as part of the surface water sampling program on a monthly basis from 1989 through 1991. Per discussions with the Environmental Protection Agency and the Colorado Department of Health in 1991, it was agreed to separately examine the chemistry of seep waters, stream waters, and groundwaters. Seep water chemistry data were tested in parametric ANOVA, non-parametric ANOVA and chi-squared contingency tables for significant differences in geochemistry between seasons (see Section 5.8). Summary statistics for background seep waters are reported in tables by analyte group.

Iron and manganese are the only two filtered metals in seep water which met the requirements for ANOVA. Both metals are log normally distributed. No differences in mean concentrations were found between quarters of sampling (Table 5-1).

Non-parametric ANOVA was used to compare quarterly means for filtered Ca, Mg, Na, and Sr (Table 5-25). No differences were detected between these mean concentrations.

The relative proportions of detects and nondetects were used in chi-squared contingency tables to identify differences in quarterly mean concentration for the following filtered metals in seep water: Al, Sb, As, Ba, Cu, Pb, Li, Hg, Mo, K, Sn, V, Zn. All of the tests were inconclusive because more than 20% of the cells have less than 5 observations (Table 5-50).

Filtered radiochemicals in seep water that were suitable for testing in ANOVA included: U-233, 234, U-235, and U-238. Uranium-235 was log normal but the other two isotopes were normal. There were no significant differences between quarters except for U-235 which had a significant difference in mean activity between the first and third quarters of sampling (Table 5-2).

Seven total metals from seep water samples were used in ANOVA for comparison of quarterly mean concentrations. These include: Al, Cu, Li, Mg, Sr, V, and Zn. All are log normally distributed. No significant differences in quarterly means were found (Table 5-3).

Chi-squared contingency tables were used to compare sampling quarters by the proportions of detects and nondetects in seep water total metals data. Antimony, Be, Cd, Ce, Cr, Co, Mo, Ni, Se, Ag, and Sn were tested but the results were inconclusive because more than 20% of the cells contained fewer than 5 observations (Table 5-51).

Eight additional total metals from seep water were tested in non-parametric ANOVA for differences in quarterly means (Table 5-26). No significant differences were detected for: As, Ba, Ca, Fe, Pb, Mn, K, and Na. .

The quarterly mean activities of nine unfiltered (total) radiochemicals in seep water samples were compared in ANOVA. These chemicals include: Sr-90, Am-241, Cs-137, gross alpha, gross beta, Ra-226, Sr-89,90, tritium, and U-235. All were log normally distributed except for Sr-90 which was normal. No significant differences existed between quarterly means for any of these analytes (Table 5-4).

Plutonium-239,240, U-233,234, and U-238 were tested in non-parametric ANOVA for possible differences in quarterly mean activities. No differences were detected for seep water (Table 5-27).

Lab-measured pH was normally distributed and nitrate/nitrite was log normal in seep water samples. Comparison of their quarterly means in ANOVA indicated no significant differences (Table 5-5).

Bicarbonate, carbonate, chloride, fluoride, phosphorus, sulfate, total dissolved solids, and total suspended solids data were examined in non-parametric ANOVA to identify possible differences in quarterly mean concentrations in seep water. Only four differences were found: bicarbonate differed between quarters 1 and 2 and between 2 and 4; and phosphorus differed between quarters 2 and 3 and total suspended solids differed between quarters 3 and 4 (Table 5-29).

Analytical data for cyanide and oil and grease in seep water were tested in chi-squared contingency tables for differences in quarter of sampling. The test was indeterminate because of insufficient observations in the cells (Table 5-53).

The only seep water field parameters that qualified for ANOVA were field-measured alkalinity (log normal) and field-measured pH (normal). No differences were detected between quarterly means (Table 5-23).

Dissolved oxygen and specific conductance data were examined by non-parametric ANOVA, and no differences were found between quarterly means (Table 5-48).

Methylene chloride was the only volatile organic compound reported in seep water that qualified for non-parametric ANOVA (Table 5-28). There were no differences in quarterly mean concentrations. However, the occurrence of methylene chloride in seep samples is characteristic of its occurrence in groundwater and surface water samples. As discussed in Section 4.3, 5.2.1, and 5.3.1, the presence of methylene chloride in seep samples is laboratory artifact.

The proportion of detects and nondetects for acetone in seep water was used in a chi-squared contingency table to compare sampling quarters. The test was indeterminate because more than 20% of the cells contained fewer than 5 observations (Table 5-52). However, as discussed above for methylene chloride, the presence of acetone in seep samples is laboratory artifact. Although three observations were at concentrations between 30 and 100 $\mu g/\ell$, in all cases acetone occurred in the associated laboratory blank.

5.4.2 Geochemistry of Seep Water

SW108 has elevated SO_4 values relative to all other seep stations. Station SW108 is located at a small pond formed by seep flow from the south hillside of Rock Creek. The seep flow probably reflects emerging colluvium groundwater that contains elevated SO_4 concentrations relative to the Rocky Flats Alluvium and valley fill groundwater for the North Rocky Flats.

5.5 STREAM SEDIMENTS

5.5.1 Statistics

Stream sediments were sampled twice in 1989, and quarterly during 1990 and 1991. Like surface water, the analytical results were tested for significant differences between Rock Creek and Woman Creek.

Ten metals met the criteria for ANOVA and were all log normal: Ca, Cu, Fe, Mg, Mn, K, Si, Na, Sr, and Zn (Table 5-13). Five of the metals had significant differences in mean concentration in sediment, between Rock Creek and Woman Creek, including; Ca, Mg, Mn, Na, and Sr.

Ten additional metals were tested in non-parametric ANOVA for differences in mean concentrations between Rock Creek and Woman Creek sediments. These metals include; Al, As, Ba, Be, Cr, Co, Pb, Li, Ni, and V. Those with significantly different means are; Al, Ba, Cr, Pb, and V (Table 5-38).

Table 5-60 contains the results of analysis by chi-squared contingency tables, of 6 metals in stream sediment. However, the results are inconclusive. None of the following metals had sufficient data to perform a reliable test for differences between Rock Creek and Woman Creek sediments; Sb, Cd, Cs, Mo, Se, Sn.

Gross beta, Ra-226, Sr-89,90, tritium, U-233,234, and U-238 are log normal analytes for which parametric ANOVA indicated no significant differences in mean activity between Rock Creek and Woman Creek (Table 5-14).

Non-parametric ANOVA indicated no differences in mean activities between Rock Creek sediments and Woman Creek sediments for the following; Am-241, Cs-137, gross alpha, Pu-239,240, Ra-228, and U-235 (Table 5-39).

The only organic compound detected in stream sediments which qualified for testing in ANOVA was bis(2-ethylhexyl)phthalate. It was log normally distributed and there was no difference in mean concentration between Rock Creek and Woman Creek (Table 5-15). This compound was present in 77 of the samples; however, it was always at estimated concentrations below the detection limit and occasionally occurred in the laboratory blanks. Although bis(2-ethylhexyl) phthalate is a common laboratory contaminant, it is also ubiquitous in the environment.

Acetone is the only volatile organic compound which could be tested by non-parametric ANOVA in stream sediment data. It showed no difference between Rock Creek and Woman Creek sediments. However, acetone always occurred in the associated laboratory blank and/or was present at estimated concentrations below the detection limit. As discussed previously for groundwater, surface water, and seep water, the presence of acetone in the field samples is a laboratory artifact.

Tables 5-61, 5-62, and 5-63 summarize the results of testing by chi-squared contingency tables for differences between sediments of Rock Creek and Woman Creek in the proportion of detected and nondetected organic compounds. The following semivolatile and volatile organic chemicals were tested but lacked sufficient data to be conclusive: aroclor-1254, 4-methylphenol, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzoic acid, chrysene, di-n-butyl phthalate, fluoranthene, phenanthrene, pyrene, 2-butanone, and methylene chloride. The data for methylene chloride and 2-butanone suggest, as previously discussed for other media, that the presence of these compounds in sediments is laboratory artifact. 2-butanone is a common laboratory contaminant. With rare exception, the other compounds were present at estimated concentrations below the detection limit, and they infrequently occurred in the samples. The above noted polynuclear aromatic hydrocarbons are ubiquitous in the environment and may indeed be present at very low levels in background sediments at Rocky Flats.

Alkalinity and lab-measured pH were log normally distributed for stream sediments. ANOVA indicated no significant differences in means between Rock Creek and Woman Creek (Table 5-16).

Nitrate/nitrite means in Rock Creek and Woman Creek sediments were compared using non-parametric ANOVA. No significant difference was found (Table 5-41).

5.6 SEEP SEDIMENTS

5.6.1 Statistics

Because there are only a few seep sediment locations, they were not classified by area of the plant. Seasonality and lithologic unit do apply to seep sediments. Therefore, seep sediments were treated as a single statistical population for computing tolerance limits and descriptive statistics presented in Tables 5-217 through 5-222.

5.7 GEOLOGIC MATERIALS

5.7.1 Statistics

Geologic material samples were collected in 1989 from boreholes drilled into Rocky Flats Alluvium, colluvium, and weathered claystone and weathered sandstone of the Arapahoe/Laramie formations. The chemical concentrations in these samples are tested for significant differences between locations (North vs. South Rocky Flats), and for differences between lithological units.

ANOVA was used to compare mean concentrations between areas and lithologic units for metals in geologic materials (Table 5-6). Barium, Cr, Li, K, and Sr were all log normally distributed and only Cr had a significant difference in means between North Rocky Flats and South Rocky Flats. Lithium and potassium did not have any differences between lithologic units. However, Ba and Sr were different between RFA and COL. Chromium and Sr differed between RFA and WCS, and between RFA and KAR.

Non-parametric ANOVA was used to examine 13 metals in geologic materials for potential differences between areas and geologic units. These metals include; Al, As, Be, Ca, Cu, Fe, Pb, Mg, Mn, Mo, Ni, V, and Zn. Only Mo, Ni and V had significant differences between

North and South Rocky Flats. Calcium, Cu, Pb, and Zn showed differences in mean concentration between RFA and COL, RFA and WCS, and RFA and KAR. Molybdenum differed between RFA and KAR, and between COL and KAR. Table 5-30 indicates a few other differences between units.

Seven additional metals in geologic materials were tested for possible differences by area and unit by using chi-squared contingency tables (Table 5-54). A significant difference was detected between North Rocky Flats and South Rocky Flats for Na and Sn. However, Sb, Co, Hg, and Ag were non-significant (no differences in proportion of detects to nondetects), and Cd had insufficient data in the cells to be conclusive. All comparisons by geologic unit were inconclusive because more than 20% of the cells contained fewer than 5 observations.

In geologic materials none of the radiochemicals tested in ANOVA differed between North Rocky Flats and South Rocky Flats. Gross alpha, Pu-239,240, Ra-228, Sr-89,90, and tritium analyses were normally distributed, while Ra-226, U-233,234, and U-238 were log normal. A number of significant differences were identified between geologic units (Table 5-7). Most of these differences lie between RFA and COL, RFA and WCS, and RFA and KAR. There were no data for VFA.

Cesium-137, gross beta, and U-235 data were processed in non-parametric ANOVA to compare levels of area and lithologic unit. None of the three differed between North and South Rocky Flats, and Cs-137 did not differ between units. However, gross beta and U-235 had significant differences in mean activity between RFA and COL, and U-235 also differed between RFA and WCS (Table 5-31).

Lab-measured pH for geologic materials was tested in non-parametric ANOVA and did not differ between North and South Rocky Flats. However, it did differ between RFA and WCS (Table 5-32).

Nitrate/nitrite and sulfide data were examined for differences by area and geologic unit, in the proportion of detects and nondetects. The chi-squared contingency tables found a significant difference between North Rocky Flats and South Rocky Flats for nitrate/nitrite. However,

sulfide was nonsignificant (no difference) between areas (Table 5-55). The test was inconclusive with respect to differences between lithologic units because of an insufficient number of points in the cells.

5.8 Seasonality in Natural Waters of Rocky Flats

Table 5-69 is a summary of seasonality testing on the chemical concentrations in samples of natural waters collected from background areas of Rocky Flats. This testing was performed by using parametric and non-parametric ANOVA to compare the mean concentrations (or activities) of chemicals by the quarters of the year in which the samples were collected. The chi-squared contingency table results (Tables 5-50 through 5-68) appear to be comparable in the proportion of non-significant and significant differences, but they do not identify the specific quarters between which a difference lies. Therefor chi-squared results are not included in Table 5-69.

Table 5-69 shows that the mean concentrations of up to 56 analytes in groundwater were compared by quarter of sampling, and on average 94% of the analytes had no significant differences between their quarterly concentrations. Further, the numbers of analytes with quarterly differences appear to be fairly evenly distributed across all 6 unique pairwise comparisons of the 4 quarters. In other words, there are no indications of systematic seasonal variations in groundwater analyte concentrations at Rocky Flats.

Similarly, about 94% of some 50 analytes measured in surface waters from Rock Creek and Woman Creek had no significant differences in quarterly mean concentrations. Again the 6% of analytes that were different seem to evenly distributed across all four quarters of the year.

Ninety eight percent of chemicals measured in background seep waters from Rocky Flats had no significant differences in quarterly mean concentrations. The quarterly differences are evenly spread across all 6 pairwise comparisons of quarters for the 2% of analytes that did show differences in means.

The data that went into Table 5-69 represent a spectrum of analytes drawn from all chemical groups, for example, from filtered metals and from total radiochemicals. Thus, both major ions

and trace elements and filtered and unfiltered sample treatments have been included. The data were collected across a time span of three years of sampling and analysis. 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 in background groundwater, surface water, or seep water from Rocky Flats.

5.9 DISTINGUISHING BACKGROUND URANIUM FROM CONTAMINATION

Uranium mineralization has been reported to occur in 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 Rocky Flats. Because the major uranium isotopes found at Rocky Flats Plant (U-238, U-235, U-234) 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 Plant.

The activity ratios of uranium isotopes may offer a means of distinguishing potential uranium contamination from background uranium. The specific activities of the uranium isotopes differ widely from about 6.2E-3 Ci/g for U-234 to only 3.4E-7 Ci/g for U-238. 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% U-238, 0.25% U-235, and 0.0005% U-234. Natural uranium is composed of 99.2739% U-238, 0.7204% U-235, and 0.0057% U-234 (EG&G, 1988). Enriched uranium for nuclear power reactors has about 97% U-238, 3% U-235, and 0.03% U-234, and greater degrees of U-235 and U-234 enrichment may be found in some nuclear weapons components (EG&G, 1988).

Considering relative activities, U-234 contributes about 97% of the alpha activity in fully enriched uranium, while U-238 contributes about 76% of the alpha activity in fully depleted uranium (EG&G, 1988). Therefore, U-234 and U-238 are key isotopes for distinguishing

uranium sources. Calculations by the authors indicate that the ratios of relative activities of U-234 to U-238 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 U-234/U-238 may be useful for separating background uranium from potential uranium contamination at Rocky Flats.

The activity ratio (U-233+U-234)/U-238 was computed for filtered samples of background surface water and groundwater collected in 1989, 1990, and 1991. (Uranium-233 is analyzed together with U-234; however, U-233 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.

Rock and Woman Creeks have similar, mean activity ratios of 1.52 and 1.48, respectively. Groundwater from RFA has a mean ratio of 1.21, VFA 2.04, COL 1.58, WCS 1.73, and KAR 0.75. All of these mean ratios are close to the 1.06 ratio predicted for natural uranium. In fact, these data are typical of the U-234/U-238 ratios for uranium in natural waters. The ratio usually ranges between 1 and 3, the higher activity of U-234 in water being due to selective mobilization by alpha recoil (Hess et al., 1985).

Activity ratios of (U-233+U-234)/U-238 were also computed for radionuclide analyses of samples of background stream and seep sediments collected in 1989, 1990, and 1991. Rock Creek bed sediment samples had a mean activity ratio of 1.16. The mean ratio in Woman Creek bed sediments was also 1.16. These results indicate the uranium in the background sediment samples is naturally occurring, i.e., the isotopic ratio is approximately 1.06.

It is suggested that activity ratio data for U-233,234/U-238 from downgradient sampling locations could be contoured on isopleth maps to look for spatial trends in the ratios which 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 Rocky Flats. 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

Operable Unit 1 have been shown to represent depleted uranium contamination. The U-233, U-234/U-238 activity ratios ranged from 0.018 to 0.038 (EG&G, 1992d).

TABLE 5-1. SUMMARY OF PARAMETRIC ANOVA RESULTS
SEEP WATER FILTERED METALS
DATAFILE EWBUFM

ANALYTE	DISTRI-BUTION	AREA		GEOLOGIC UNIT										QUARTER					
		NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
IRON	L													O	O	O	O	O	O
MANGANESE	L													O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-2. SUMMARY OF PARAMETRIC ANOVA RESULTS
SEEP WATER FILTERED RADIONUCLIDES
DATAFILE EWBUFR

ANALYTE	DISTRI-BUTION	AREA		GEOLOGIC UNIT										QUARTER					
		NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
URANIUM-233,234	N													O	O	O	O	O	O
URANIUM-238	N													O	O	O	O	O	O
URANIUM-235	L													O	X	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-3. SUMMARY OF PARAMETRIC ANOVA RESULTS
SEEP WATER TOTAL METALS
DATAFILE EWBUTM

ANALYTE	DISTRI-BUTION	AREA		GEOLOGIC UNIT										QUARTER					
		NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
ALUMINUM	L													O	O	O	O	O	O
COPPER	L													O	O	O	O	O	O
LITHIUM	L													O	O	O	O	O	O
MAGNESIUM	L													O	O	O	O	O	O
STRONTIUM	L													O	O	O	O	O	O
VANADIUM	L													O	O	O	O	O	O
ZINC	L													O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-4. SUMMARY OF PARAMETRIC ANOVA RESULTS
SEEP WATER TOTAL RADIONUCLIDES
DATAFILE EWBUTR

ANALYTE	DISTRI-BUTION	AREA		GEOLOGIC UNIT										QUARTER					
		NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
STRONTIUM-90	N														O	O			O
AMERICIUM-241	L													O	O	O	O	O	O
CESIUM-137	L													O	O	O	O	O	O
GROSS ALPHA	L													O	O	O	O	O	O
GROSS BETA	L													O	O	O	O	O	O
RADIUM-226	L													O	O	O	O	O	O
STRONTIUM-89,90	L													O	O	O	O	O	O
TRITIUM	L													O	O	O	O	O	O
URANIUM-235	L													O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-5. SUMMARY OF PARAMETRIC ANOVA RESULTS
SEEP WATER, WATER QUALITY PARAMETERS
DATAFILE EWBUUW

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
PH	N													O	O	O	O	O	O
NITRATE/NITRITE	L													O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-6. SUMMARY OF PARAMETRIC ANOVA RESULTS
GEOLOGIC MATERIALS TOTAL METALS
DATAFILE GMBUTM

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
BARIUM	L	O		X		O	O		O	O			O						
CHROMIUM	L	X		O		X	X		O	O			O						
LITHIUM	L	O		O		O	O		O	O			O						
POTASSIUM	L	O		O		O	O		O	O			O						
STRONTIUM	L	O		X		X	X		O	O			O						

Key: X=significant difference O=no difference

TABLE 5-7. SUMMARY OF PARAMETRIC ANOVA RESULTS
GEOLOGIC MATERIALS TOTAL RADIONUCLIDES
DATAFILE GMBUTR

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
GROSS ALPHA	N	O		X		O	X		O	O			O						
PLUTONIUM-239,240	N	O		O		O	O		O	O			O						
RADIUM-228	N	O		X		O	O		O	X			O						
STRONTIUM-89,90	N	O		O		O	O		O	O			O						
TRITIUM	N	O		X		O	X		O	O			O						
RADIUM-226	L	O		X		X	X		O	O			O						
URANIUM TOTAL	L	O		X		X	X		O	O			O						
URANIUM-233,234	L	O		X		X	O		O	O			O						
URANIUM-238	L	O		X		X	X		O	O			O						

Key: X=significant difference O=no difference

TABLE 5-8. SUMMARY OF PARAMETRIC ANOVA RESULTS
GROUND WATER FILTERED METALS
DATAFILE GWBUFM

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
SILICON	N	O		O	O	O	X	O	O	O	O	O	O	O	O	O	O	O	O
ANTIMONY	L	X		O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
PHOSPHORUS	L	O		O	O	O	O	O	O	O	O	O	O						O
SODIUM	L	O		X	X	X	X	X	X	O	O	X	X	O	O	O	O	O	O
STRONTIUM	L	X		X	X	X	X	X	O	X	O	O	O	O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-9. SUMMARY OF PARAMETRIC ANOVA RESULTS
GROUND WATER FILTERED RADIONUCLIDES
DATAFILE GWBUFR

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
TRITIUM	N	O		O	O	X	O	O	O	O	X	O	O	O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-10. SUMMARY OF PARAMETRIC ANOVA RESULTS
GROUND WATER TOTAL METALS
DATAFILE GWBUTM

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
SILICON	N	O		O	O	O	O	O	O	O	O	O	O						O
ALUMINUM	L	X		O	O	O	O	O	O	O	O	O	O						O
CALCIUM	L	O		X	O	O	O	O	O	X	O	X	O						O
IRON	L	X		O	O	O	O	O	O	O	O	O	O						X
MAGNESIUM	L	O		X	X	X	O	O	O	X	O	X	X						O
MANGANESE	L	X		O	O	O	O	O	O	O	O	O	O						O
ZINC	L	X		O	O	O	O	O	O	O	O	O	O						O

Key: X=significant difference O=no difference

TABLE 5-11. SUMMARY OF PARAMETRIC ANOVA RESULTS
GROUND WATER TOTAL RADIONUCLIDES
DATAFILE GWBUTR

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
AMERICIUM-241	L	O		O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
PLUTONIUM-238	L	O		O	O		O	O		O		O							O
URANIUM-233,234	L	O		X	X	X	O	O	O	X	O	O	O				O		
URANIUM-238	L	O		X	O	O	O	O	O	O	O	O	O				O		

Key: X=significant difference O=no difference

TABLE 5-12. SUMMARY OF PARAMETRIC ANOVA RESULTS
GROUND WATER, WATER QUALITY PARAMETERS
DATAFILE GWBUUW

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
BICARBONATE AS CACO3	L	X		X	X	X	X	X	X	X	O	O	O	O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-13. SUMMARY OF PARAMETRIC ANOVA RESULTS
STREAM SEDIMENTS TOTAL METALS
DATAFILE SSBUTM

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
CALCIUM	L		X																
COPPER	L		O																
IRON	L		O																
MAGNESIUM	L		X																
MANGANESE	L		X																
POTASSIUM	L		O																
SILICON	L		O																
SODIUM	L		X																
STRONTIUM	L		X																
ZINC	L		O																

Key: X=significant difference O=no difference

TABLE 5-14. SUMMARY OF PARAMETRIC ANOVA RESULTS
STREAM SEDIMENTS TOTAL RADIONUCLIDES
DATAFILE SSBUTR

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
GROSS BETA	L		O																
RADIUM-226	L		O																
STRONTIUM-89,90	L		O																
TRITIUM	L		O																
URANIUM-233,234	L		O																
URANIUM-238	L		O																

Key: X=significant difference O=no difference

TABLE 5-15. SUMMARY OF PARAMETRIC ANOVA RESULTS
STREAM SEDIMENTS TOTAL SEMIVOLATILE ORGANIC COMPOUNDS
DATAFILE SSBUTS

ANALYTE	DISTRI-BUTION	AREA NORTH	AREA ROCK	GEOLOGIC UNIT RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
		SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR						
BIS(2-ETHYLHEXYL)PHTHALATE	L	O																	

Key: X=significant difference O=no difference

TABLE 5-16. SUMMARY OF PARAMETRIC ANOVA RESULTS
STREAM SEDIMENTS TOTAL WATER QUALITY PARAMETERS
DATAFILE SSBUTW

ANALYTE	DISTRI-BUTION	AREA NORTH	AREA ROCK	GEOLOGIC UNIT RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
		SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR						
ALKALINITY AS CACO3	L		O																
PH	L		O																

Key: X=significant difference O=no difference

TABLE 5-17. SUMMARY OF PARAMETRIC ANOVA RESULTS
SURFACE WATER FILTERED METALS
DATAFILE SWBUFM

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
SILICON	N		O											O	O	O	O	O	O
CALCIUM	L		X											O	O	O	O	O	O
IRON	L		O											O	O	O	O	O	O
POTASSIUM	L		O											O	O	O	O	O	O
SODIUM	L		X											O	X	X	X	X	O

Key: X=significant difference O=no difference

TABLE 5-18. SUMMARY OF PARAMETRIC ANOVA RESULTS
SURFACE WATER FILTERED RADIONUCLIDES
DATAFILE SWBUFR

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
GROSS BETA	N		O											O		O		O	
AMERICIUM-241	L		X											O		O		O	
GROSS ALPHA - DISSOLVED	L		O											O	O		O		

Key: X=significant difference O=no difference

TABLE 5-19. SUMMARY OF PARAMETRIC ANOVA RESULTS
SURFACE WATER TOTAL METALS
DATAFILE SWBUTM

ANALYTE	DISTRI-BUTION	AREA		GEOLOGIC UNIT										QUARTER					
		NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
SILICON	N		O											O	O	O	O	O	O
ALUMINUM	L		O											O	O	O	O	X	O
COPPER	L		O											O	O	O	O	O	O
IRON	L		O											O	O	O	O	O	O
MAGNESIUM	L		O											O	O	O	O	O	O
MANGANESE	L		X											O	O	O	O	O	O
POTASSIUM	L		O											O	O	O	O	O	O
SODIUM	L		X											O	X	X	X	O	O
STRONTIUM	L		O											O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-20. SUMMARY OF PARAMETRIC ANOVA RESULTS
SURFACE WATER TOTAL RADIONUCLIDES
DATAFILE SWBUTR

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
AMERICIUM-241	N		O											O	O	O	O	O	O
STRONTIUM-89,90	N		O											O	O	O	O	O	O
STRONTIUM-90	N		O											O	O	O	O	O	O
CESIUM-137	L		O											O	O	O	O	X	O
GROSS BETA - SUSPENDED	L		O																O
PLUTONIUM-239,240	L		O											O	X	O	O	O	O
TRITIUM	L		O											O	O	O	O	X	O
URANIUM, TOTAL	L		O											O	O		O		
URANIUM-233,234	L		O											O	O	O	O	O	O
URANIUM-235	L		O											O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-21. SUMMARY OF PARAMETRIC ANOVA RESULTS
SURFACE WATER, WATER QUALITY PARAMETERS
DATAFILE SWBUUW

ANALYTE	DISTRI-BUTION	AREA NORTH SOUTH	AREA ROCK WOMAN	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
SULFATE	N		O											O	X	O	O	O	O
CHLORIDE	L		X											O	O	O	O	O	O
PH	L		O											O	O	O	O	O	O
TOTAL ORGANIC CARBON	L		O											O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-22. SUMMARY OF PARAMETRIC ANOVA RESULTS
SURFACE WATER FIELD PARAMETERS
DATAFILE SWBUUF

ANALYTE	DISTRI-BUTION	AREA NORTH	AREA ROCK	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
DISSOLVED OXYGEN	N		O											O	O	O	O	O	O
SPECIFIC CONDUCTANCE	L		X											O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-23. SUMMARY OF PARAMETRIC ANOVA RESULTS
SEEP WATER FIELD PARAMETERS
DATAFILE EWBUUF

ANALYTE	DISTRI-BUTION	AREA NORTH	AREA ROCK	GEOLOGIC UNIT RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	QUARTER 1 2	1 3	1 4	2 3	2 4	3 4
FIELD-MEASURED ALKALINITY	L																O	O	O
FIELD-MEASURED PH														O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-24. SUMMARY OF PARAMETRIC ANOVA RESULTS
GROUND WATER FIELD PARAMETERS
DATAFILE GWBUUF

ANALYTE	DISTRI-BUTION	AREA		GEOLOGIC UNIT										QUARTER					
		NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
DISSOLVED OXYGEN	N	O		X	X	O	X	O	O	O	X	O	X	O	O	O	O	O	O
SPECIFIC CONDUCTANCE		O		X	X	X	X	O	X	O	O	O	O	O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-25. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SEEP WATER FILTERED METALS
DATAFILE EWBUFM

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
CALCIUM													O	O	O	O	O	O
MAGNESIUM													O	O	O	O	O	O
SODIUM													O	O	O	O	O	O
STRONTIUM													O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-26. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SEEP WATER TOTAL METALS
DATAFILE EWBUTM

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
ARSENIC													O	O	O	O	O	O
BARIUM													O	O	O	O	O	O
CALCIUM													O	O	O	O	O	O
IRON													O	O	O	O	O	O
LEAD													O	O	O	O	O	O
MANGANESE													O	O	O	O	O	O
POTASSIUM													O	O	O	O	O	O
SODIUM													O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-27. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SEEP WATER TOTAL RADIONUCLIDES
DATAFILE EWBUTR

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
PLUTONIUM-239,240													O	O	O	O	O	O
URANIUM-233,234													O	O	O	O	O	O
URANIUM-238													O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-28. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SEEP WATER VOLATILE ORGANIC COMPOUNDS
DATAFILE EWBUUV

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
METHYLENE CHLORIDE													O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-29. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SEEP WATER, WATER QUALITY PARAMETERS
DATAFILE EWBUUW

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
BICARBONATE													O	O	O	O	O	O
BICARBONATE AS CACO3													X	O	O	O	X	O
CARBONATE AS CACO3													O	O	O	O	O	O
CHLORIDE													O	O	O	O	O	O
FLUORIDE													O	O	O	O	O	O
PHOSPHORUS													O	O	O	X	O	O
SULFATE													O	O	O	O	O	O
TOTAL DISSOLVED SOLIDS													O	O	O	O	O	O
TOTAL SUSPENDED SOLIDS													O	O	O	O	O	X

Key: X=significant difference O=no difference

TABLE 5-30. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
GEOLOGIC MATERIALS TOTAL METALS
DATAFILE GMBUTM

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
ALUMINUM	O		O		O	X		O	O			O						
ARSENIC	O		O		O	O		O	O			O						
BERYLLIUM	O		O		O	O		O	O			O						
CALCIUM	O		X		X	X		O	O			O						
COPPER	O		X		X	X		O	O			O						
IRON	O		O		O	O		O	O			O						
LEAD	O		X		X	X		O	O			O						
MAGNESIUM	O		X		O	O		O	O			O						
MANGANESE	O		O		O	O		O	O			O						
MOLYBDENUM	X		O		O	X		O	X			O						
NICKEL	X		O		O	O		O	O			O						
VANADIUM	X		O		O	O		O	O			O						
ZINC	O		X		X	X		O	O			O						

Key: X=significant difference O=no difference

TABLE 5-31. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
GEOLOGIC MATERIALS TOTAL RADIONUCLIDES
DATAFILE GMBUTR

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
AMERICIUM-241	(INSUFFICIENT DATA)																	
CESIUM-137	O		O		O	O		O	O			O						
GROSS BETA	O		X		O	O		O	O			O						
URANIUM-235	O		X		X	O		O	O			O						

Key: X=significant difference O=no difference

TABLE 5-32. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
GEOLOGIC MATERIALS TOTAL WATER QUALITY PARAMETERS
DATAFILE GMBUTW

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
PH	O		O		X	O		O	O			O						

Key: X=significant difference O=no difference

TABLE 5-33. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
GROUND WATER FILTERED METALS
DATAFILE GWBUFM

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
ALUMINUM	O		O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
BARIUM	X		O	X	O	O	X	O	O	O	O	O	O	O	O	O	O	O
CALCIUM	X		X	X	X	O	X	X	X	O	X	X	O	O	O	O	O	O
IRON	O		O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
LITHIUM	O		X	X	X	X	X	O	O	O	O	O	O	O	O	O	X	O
MAGNESIUM	X		X	X	X	O	O	O	X	O	X	X	O	O	O	O	O	O
MANGANESE	X		X	X	O	X	O	O	O	O	O	O	O	O	O	O	O	O
POTASSIUM	X		X	X	X	X	O	O	O	O	X	O	O	O	O	O	O	O
TIN	O		O	O	O	O	O	O	X	O	O	O	O	O	O	O	O	O
VANADIUM	O		O	O	O	O	O	O	O	O	O	O	X	O	O	X	X	O
ZINC	O		O	O	O	O	O	O	O	O	O	O	X	O	X	X	O	X

Key: X=significant difference O=no difference

TABLE 5-34. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
GROUND WATER FILTERED RADIONUCLIDES
DATAFILE GWBUFR

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
GROSS ALPHA - DIS.	O		X	X	X	X	X	O	X	X	O	X	O	O	X	O	X	O
GROSS BETA - DIS.	O		X	X	X	X	X	O	X	O	O	O	O	O	O	O	O	O
RADIUM-226	O						O	O	O	O	O	O	O	O	O	O	O	O
STRONTIUM-89,90	O		O	X	O	O	X	O	O	O	O	O	O	O	O	O	O	O
URANIUM-233,234	O		X	X	X	X	X	O	X	X	O	X	O	O	O	O	O	O
URANIUM-235	O		X	X	X	O	X	O	X	O	O	X	O	O	O	O	O	O
URANIUM-238	O		X	X	X	X	X	O	X	X	X	X	O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-35. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
GROUND WATER TOTAL METALS
DATAFILE GWBUTM

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
BARIUM	O		O	O	O	O	O	O	O	O	O	O						O
CHROMIUM	O		O	O	O	O	O	O	O	O	O	O						X
LEAD	X		O	O	O	O	O	O	O	O	O	O						O
LITHIUM	O		X	X	X	X	O	O	O	O	O	O						O
POTASSIUM	X		O	O	O	X	O	O	O	O	O	O						O
SODIUM	O		X	X	X	X	O	O	O	O	O	O						O
STRONTIUM	O		X	X	X	X	O	O	O	O	O	O						O
VANADIUM	X		O	O	O	O	O	O	O	X	X	O						O

Key: X=significant difference O=no difference

TABLE 5-36. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
GROUND WATER TOTAL RADIONUCLIDES
DATAFILE GWBUTR

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
CESIUM-137	O		O	O	O	O	O	O	O	O	O	X	O	O	O	O	O	O
GROSS ALPHA	O		O	O	O	O	O	O	O	O	O	O						
GROSS ALPHA - DIS.	O		O	O	O	O	O	O	O	O	O	O						
GROSS BETA	O		O	O	O	O	O	O	O	O	O	O						
GROSS BETA - DIS.	O		O	O	O	O	O	O	O	O	O	O						
PLUTONIUM-239,240	X		O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
STRONTIUM-89,90	O		O	O	O	O	O	O	O	O	O	O						
STRONTIUM-90	O		O	O	O	O	O	O	O	O	O	O				O		
TRITIUM	O		O	O	O	O	O	O	O	O	O	O				O		
URANIUM-235	X		X	O	O	O	X	O	X	O	O	O				X		

Key: X=significant difference O=no difference

TABLE 5-37. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
GROUND WATER, WATER QUALITY PARAMETERS
DATAFILE GWBUUW

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
BICARBONATE	O		O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
CHLORIDE	X		X	X	O	X	O	X	O	O	O	X	O	O	O	O	O	O
FLUORIDE	X		X	X	X	X	X	O	O	X	X	O	O	O	O	O	O	O
NITRATE/NITRITE	X		X	X	X	X	O	O	O	X	X	O	O	O	O	O	O	O
PHOSPHORUS	O		O	O	O	O	O	O	O	O	O	O	X	O	O	O	O	O
SILICA	O		X	O	X	X	O	O	X	O	X	O	O	O	X	O	O	O
SULFATE	O		X	X	X	O	X	O	X	O	X	X	O	O	O	O	O	O
TOTAL DISSOLVED SOLIDS	X		X	X	X	X	X	X	X	O	O	O	O	O	O	O	O	O
TOTAL SUSPENDED SOLIDS	X		X	X	X	O	O	O	X	O	X	X	X	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-38. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
STREAM SEDIMENT TOTAL METALS
DATAFILE SSBUTM

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
ALUMINUM		X																
ARSENIC		O																
BARIUM		X																
BERYLLIUM		O																
CHROMIUM		X																
COBALT		O																
LEAD		X																
LITHIUM		O																
NICKEL		O																
VANADIUM		X																

Key: X=significant difference O=no difference

TABLE 5-39. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
STREAM SEDIMENT TOTAL RADIONUCLIDES
DATAFILE SSBUTR

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
AMERICIUM-241		O																
CESIUM-137		O																
GROSS ALPHA		O																
PLUTONIUM-239,240		O																
RADIUM-228		O																
URANIUM-235		O																

Key: X=significant difference O=no difference

TABLE 5-40. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
STREAM SEDIMENT TOTAL VOLATILE ORGANIC COMPOUNDS
DATAFILE SSBUTV

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
ACETONE		O																

Key: X=significant difference O=no difference

TABLE 5-41. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
STREAM SEDIMENT TOTAL WATER QUALITY PARAMETERS
DATAFILE SSBUTW

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
NITRATE/NITRITE		O																

Key: X=significant difference O=no difference

TABLE 5-42. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SURFACE WATER FILTERED METALS
DATAFILE SWBUFM

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
BARIUM		O											O	O	O	O	O	O
LITHIUM		O											O	O	O	O	O	O
MAGNESIUM		O											O	O	O	X	O	O
MANGANESE		X											O	O	O	O	O	O
STRONTIUM		O											O	O	O	O	O	O
ZINC		O											O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-43. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SURFACE WATER FILTERED RADIONUCLIDES
DATAFILE SWBUFR

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH SOUTH	ROCK WOMAN	RFA COL	RFA VFA	RFA WCS	RFA KAR	COL VFA	COL WCS	COL KAR	VFA WCS	VFA KAR	WCS KAR	1 2	1 3	1 4	2 3	2 4	3 4
GROSS BETA - DIS.		O											O	O		O		
STRONTIUM-89,90		O											X	X		O		
TRITIUM		O											O	O	O	O	O	O
URANIUM-233,234		X											O	O	O	O	O	O
URANIUM-235		O											O	X	X	O	X	X
URANIUM-238		X											O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-44. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SURFACE WATER TOTAL METALS
DATAFILE SWBUTM

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
BARIUM		O											O	O	O	O	O	O
CALCIUM		X											O	O	O	O	O	O
LITHIUM		O											O	O	O	O	O	O
ZINC		O											O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-45. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SURFACE WATER TOTAL RADIONUCLIDES
DATAFILE SWBUTR

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
GROSS ALPHA		O											O	O	O	O	O	O
GROSS ALPHA - SUS.		O												O	O			O
GROSS BETA		O											O	O	O	O	O	O
URANIUM-238		O											O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-46. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SURFACE WATER, WATER QUALITY PARAMETERS
DATAFILE SWBUUW

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
BICARBONATE		X											O	O	O	O	O	O
BICARBONATE AS CACO3		O											O	O	O	O	O	O
FLUORIDE		X											O	O	O	O	X	O
NITRATE/NITRITE		X											O	O	O	O	O	O
PHOSPHORUS		O											O	O	O	O	O	O
SILICA		O												O	O			O
TOTAL DISSOLVED SOLIDS		O											O	O	O	X	O	O
TOTAL SUSPENDED SOLIDS		O											O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-47. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SURFACE WATER FIELD PARAMETERS
DATAFILE SWBUUF

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
FIELD-MEASURED ALKALINITY		O											O	O	O	O	O	O
FIELD-MEASURED PH		O											X	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-48. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
SEEP WATER FIELD PARAMETERS
DATAFILE EWBUUF

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
DISSOLVED OXYGEN													O	O	O	O	O	O
SPECIFIC CONDUCTANCE													O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-49. SUMMARY OF NON-PARAMETRIC ANOVA RESULTS
GROUND WATER FIELD PARAMETERS
DATAFILE GWBUUF

ANALYTE	AREA		GEOLOGIC UNIT										QUARTER					
	NORTH	ROCK	RFA	RFA	RFA	RFA	COL	COL	COL	VFA	VFA	WCS	1	1	1	2	2	3
	SOUTH	WOMAN	COL	VFA	WCS	KAR	VFA	WCS	KAR	WCS	KAR	KAR	2	3	4	3	4	4
FIELD-MEASURED PH	O		X	O	X	X	X	X	X	X	X	O	O	O	O	O	O	O

Key: X=significant difference O=no difference

TABLE 5-50
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
SEEP WATER FILTERED METALS
DATAFILE EWBUFM

ANALYTE	AREA	GEOLOGIC UNIT	QUARTER
	NORTH ROCK SOUTH WOMAN		
ALUMINUM			I
ANTIMONY			I
ARSENIC			I
BARIUM			I
COPPER			I
LEAD			I
LITHIUM			I
MERCURY			I
MOLYBDENUM			I
POTASSIUM			I
TIN			I
VANADIUM			I
ZINC			I

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-51
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
SEEP WATER TOTAL METALS
DATAFILE EWBUTM

ANALYTE	AREA	GEOLOGIC UNIT	QUARTER
	NORTH ROCK SOUTH WOMAN		
ANTIMONY			I
BERYLLIUM			I
CADMIUM			I
CESIUM			I
CHROMIUM			I
COBALT			I
MOLYBDENUM			I
NICKEL			I
SELENIUM			I
SILVER			I
TIN			I

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-52
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
SEEP WATER VOLATILE ORGANIC COMPOUNDS
DATAFILE EWBUUV

ANALYTE	AREA	GEOLOGIC UNIT	QUARTER
	NORTH ROCK SOUTH WOMAN		
ACETONE			I

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-53
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
SEEP WATER, WATER QUALITY PARAMETERS
DATAFILE EWBUUW

ANALYTE	AREA	GEOLOGIC UNIT	QUARTER
	NORTH ROCK SOUTH WOMAN		
CYANIDE			I
OIL AND GREASE			I

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-54
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
GEOLOGIC MATERIALS TOTAL METALS
DATAFILE GMBUTM

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
ANTIMONY	O	I	
CADMIUM	I	I	
COBALT	O	I	
MERCURY	O	I	
SILVER	O	I	
SODIUM	X	I	
TIN	X	I	

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-55
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
GEOLOGIC MATERIALS WATER QUALITY PARAMETERS
DATAFILE GMBUTW

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
NITRATE/NITRITE	X	I	
SULFIDE	O	I	

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-56
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
GROUND WATER FILTERED METALS
DATAFILE GWBUFM

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
ARSENIC	X	X	O
BERYLLIUM	I	I	I
CADMIUM	O	O	X
CESIUM	X	I	I
CHROMIUM	O	O	X
COBALT	O	I	X
COPPER	O	O	X
LEAD	O	O	X
MERCURY	I	I	I
MOLYBDENUM	X	O	X
NICKEL	O	X	X
SELENIUM	O	X	O
SILVER	O	O	X
THALLIUM	I	I	I

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-57
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
GROUND WATER TOTAL METALS
DATAFILE GWBUTM

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
ANTIMONY	X	I	X
ARSENIC	X	I	I
BERYLLIUM	I	I	I
CADMIUM	O	I	X
CESIUM	I	I	I
COBALT	O	I	O
COPPER	O	I	O
CYANIDE	I	I	I
MOLYBDENUM	O	I	O
NICKEL	I	I	O
SELENIUM	O	I	O
SILVER	I	I	I
THALLIUM	I	I	I
TIN	X	I	X

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-58
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
GROUND WATER VOLATILE ORGANIC COMPOUNDS
DATAFILE GWBUUV

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
ACETONE	O	O	X
METHYLENE CHLORIDE	O	O	X
TETRACHLOROETHENE	I	I	I
TOLUENE	I	I	I
TRICHLOROETHENE	I	I	I

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-59
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
GROUND WATER, WATER QUALITY PARAMETERS
DATAFILE GWBUUW

ANALYTE	AREA	GEOLOGIC UNIT	QUARTER
	NORTH ROCK SOUTH WOMAN		
CARBONATE AS CACO3	O	O	I
NITRITE	I	I	I
ORTHOPHOSPHATE	O	O	I

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-60
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
STREAM SEDIMENT METALS
DATAFILE SSBUTM

ANALYTE	AREA	GEOLOGIC UNIT	QUARTER
	NORTH ROCK SOUTH WOMAN		
ANTIMONY	I		
CADMIUM	I		
CESIUM	I		
MOLYBDENUM	I		
SELENIUM	I		
TIN	I		

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-61
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
STREAM SEDIMENT PESTICIDES AND PCBs
DATAFILE SSBUTP

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
AROCLOR-1254	I		

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-62
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
STREAM SEDIMENT SEMIVOLATILE ORGANIC COMPOUNDS
DATAFILE SSBUTS

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
4-METHYLPHENOL	I		
ANTHRACENE	I		
BENZO(a)ANTHRACENE	I		
BENZO(a)PYRENE	I		
BENZO(b)FLUORANTHENE	I		
BENZO(k)FLUORANTHENE	I		
BENZOIC ACID	I		
CHRYSENE	I		
DI-n-BUTYL PHTHALATE	I		
FLUORANTHENE	I		
PHENANTHRENE	I		
PYRENE	I		

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-63
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
STREAM SEDIMENT VOLATILE ORGANIC COMPOUNDS
DATAFILE SSBUTV

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
2-BUTANONE	I		
METHYLENE CHLORIDE	I		

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-64
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
SURFACE WATER FILTERED METALS
DATAFILE SWBUFM

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
ALUMINUM	I		O
ANTIMONY	I		I
BERYLLIUM	I		I
CESIUM	I		I
CHROMIUM	I		I
COPPER	I		X
LEAD	I		I
MERCURY	I		I
MOLYBDENUM	I		I
SILVER	I		I
TIN	O		I
VANADIUM	O		I

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-65
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
SURFACE WATER FILTERED RADIOCHEMICALS
DATAFILE SWBUFR

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
GROSS ALPHA	I		I
GROSS GAMMA	I		I
PLUTONIUM-239,240	I		I

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-66
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
SURFACE WATER TOTAL METALS
DATAFILE SWBUTM

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
ANTIMONY	I		I
ARSENIC	I		I
BERYLLIUM	I		I
CESIUM	I		I
CHROMIUM	I		I
COBALT	I		I
LEAD	I		X
MERCURY	I		I
MOLYBDENUM	I		I
NICKEL	I		I
SELENIUM	I		I
SILVER	I		I
THALLIUM	I		I
TIN	I		I
VANADIUM	I		O

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-67
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
SURFACE WATER VOLATILE ORGANIC COMPOUNDS
DATAFILE SWBUUV

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
ACETONE	I		O
METHYLENE CHLORIDE	I		O

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-68
CLASSIFICATION OF BACKGROUND DATA BY
CHI-SQUARE CONTINGENCY TABLES FOR
SURFACE WATER, WATER QUALITY PARAMETERS
DATAFILE SWBUUW

ANALYTE	AREA NORTH ROCK SOUTH WOMAN	GEOLOGIC UNIT	QUARTER
CARBONATE AS CACO3	I		X
OIL AND GREASE	I		I
ORTHOPHOSPHATE	I		I
SULFIDE	I		I

Key: X=significant difference O=no difference I=test inconclusive because more than 20% of the cells have less than 5 observations. Geologic units tested include: RFA, VRA, COL, WCS and KAR.

TABLE 5-70
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN SURFACE WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	U	78	48.7	9 U	631	.	.	.	.	U	.
ANTIMONY	UG/L	U	41	34.1	7.5 U	104 U	.	.	.	.	U	.
ARSENIC	UG/L	U	41	7.3	0.8 U	10 U	.	.	.	.	U	.
BARIUM	UG/L	L	107	67.3	0.85	391	221.622	.	46.569	2.254	U	1.92
BERYLLIUM	UG/L	U	47	12.8	0.2 U	17	.	.	.	.	U	.
CADMIUM	UG/L	U	42	4.8	2 U	5 U	.	.	.	.	U	.
CESIUM	UG/L	U	58	12.1	5 U	1000 U	.	.	.	.	U	.
CHROMIUM	UG/L	U	55	12.7	2 U	20 U	.	.	.	.	U	.
COBALT	UG/L	U	42	2.4	2 U	51.1 U	.	.	.	.	U	.
COPPER	UG/L	U	79	43.0	2 U	28	.	.	.	.	U	.
CYANIDE	UG/L	U	1	0.0	10 U	10 U	.	.	.	.	U	.
IRON	UG/L	L	87	92.0	3 U	1340.5	1112.682	.	102.210	3.403	U	1.95
LEAD	UG/L	U	51	35.3	0.4 U	6.6	.	.	.	.	U	.
LITHIUM	UG/L	L	65	60.0	1 U	100 U	119.098	.	5.258	4.741	U	2.00
MAGNESIUM	UG/L	N	109	90.8	10 U	17800	9610.910	.	5331.697	2232.800	U	1.92
MERCURY	UG/L	U	49	14.3	0.2 U	0.44	.	.	.	.	U	.
MOLYBDENUM	UG/L	U	53	13.2	2 U	100 U	.	.	.	.	U	.
NICKEL	UG/L	U	46	6.5	3.8 U	60 U	.	.	.	.	U	.
PHOSPHORUS	UG/L	U	6	66.7	80 U	398	617.195	.	163.500	122.366	U	3.71
POTASSIUM	UG/L	L	86	67.4	390 U	6800	4755.058	.	1251.190	1.982	U	1.95
SELENIUM	UG/L	U	49	2.0	1 U	10 U	.	.	.	.	U	.
SILICON	UG/L	N	38	100.0	613	12800	13471.140	.	6267.382	3364.913	U	2.14
SILVER	UG/L	U	61	11.5	2 U	16.4 U	.	.	.	.	U	.
STRONTIUM	UG/L	L	81	98.8	50	422.5	521.087	.	139.600	1.957	U	1.96
THALLIUM	UG/L	U	47	2.1	0.9 U	12 U	.	.	.	.	U	.
TIN	UG/L	U	64	25.0	10.8	100 U	.	.	.	.	U	.
VANADIUM	UG/L	U	68	19.1	2 U	50 U	.	.	.	.	U	.
ZINC	UG/L	L	79	79.7	1.8 U	111.5	140.968	.	10.614	3.725	U	1.97

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-71
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN SURFACE WATER FROM ROCK CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CALCIUM	UG/L	L	56	100.0	2900	68050	46924.799	.	19917.330	1.523	U	2.04
MANGANESE	UG/L	L	41	80.5	0.94 U	353	359.795	.	8.311	5.923	U	2.12
SODIUM	UG/L	L	55	100.0	10500	38800	35874.030	.	17716.923	1.413	U	2.04

TABLE 5-72
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN SURFACE WATER FROM WOMAN CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CALCIUM	UG/L	L	59	100.0	7320	79300	69236.441	.	26176.856	1.616	U	2.03
MANGANESE	UG/L	L	58	89.7	1.3	1100	292.497	.	20.594	3.696	U	2.03
SODIUM	UG/L	L	58	100.0	5630	32300	31918.400	.	13805.220	1.511	U	2.03

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-73
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES IN SURFACE WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CESIUM-137	PCI/L	U	4	100.0	-0.2	0.2	0.899	.	-0.075	0.189	U	5.14
GROSS ALPHA	PCI/L	U	25	40.0	-1	3.3	.	.	.	.	U	.
GROSS ALPHA - DISSOLVED	PCI/L	U	25	100.0	-0.425	69.23	34.865	.	3.346	13.754	U	2.29
GROSS BETA	PCI/L	U	22	68.2	0	6.6	7.946	.	2.929	2.136	U	2.35
GROSS BETA - DISSOLVED	PCI/L	U	28	100.0	0.5868	18.45	11.631	.	3.669	3.546	U	2.25
GROSS GAMMA	PCI/L	U	23	17.4	-0.12	1 U	.	.	.	.	U	.
PLUTONIUM-239,240	PCI/L	U	16	43.7	-0.0615 U	0.52	.	.	.	.	U	.
RADIUM-226	PCI/L	U	3	33.3	-0.025 U	0.3423	.	.	.	.	U	.
RADIUM-228	PCI/L	U	2	50.0	0.7 U	1.4	.	.	.	.	U	.
STRONTIUM-89	PCI/L	U	24	0.0	0.6 U	2 U	.	.	.	.	U	.
STRONTIUM-89,90	PCI/L	U	27	100.0	-0.5	2.586	2.264	.	0.700	0.692	U	2.26
STRONTIUM-90	PCI/L	U	23	13.0	0.3 U	1.1	.	.	.	.	U	.
TRITIUM	PCI/L	U	46	50.0	-41.8	2700	.	.	.	.	U	.
URANIUM-235	PCI/L	U	48	54.2	-0.0178	0.8951	0.369	.	0.032	0.162	C	2.08

TABLE 5-74
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES IN SURFACE WATER FROM ROCK CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/L	U	10	80.0	-0.01	0.41	0.454	.	0.072	0.131	U	2.91
URANIUM-233,234	PCI/L	U	23	82.6	0.1252	31.75	17.026	.	1.796	6.541	U	2.33
URANIUM-238	PCI/L	U	23	73.9	0.07016	24.45	13.063	.	1.314	5.046	U	2.33

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-75
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN SURFACE WATER FROM WOMAN CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/L	U	10	40.0	-0.01	0.026	.	.	.	.	U	.
URANIUM-233,234	PCI/L	U	25	68.0	-0.0157	1.8	1.074	.	0.265	0.353	U	2.29
URANIUM-238	PCI/L	U	26	69.2	0	1.7	0.958	.	0.216	0.326	U	2.28

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-76
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN SURFACE WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	L	87	85.1	22.3 U	5840	5705.632	.	244.981	5.027	U	1.95
ANTIMONY	UG/L	U	39	20.5	7 U	42.2 U	.	.	.	.	U	.
ARSENIC	UG/L	U	38	26.3	0.7 U	2.9	.	.	.	.	U	.
BARIUM	UG/L	L	97	82.5	30.2	306	115.983	.	58.769	1.421	C	1.94
BERYLLIUM	UG/L	U	45	15.6	0.2 U	4.8	.	.	.	.	U	.
CADMIUM	UG/L	U	39	0.0	2 U	5 U	.	.	.	.	U	.
CESIUM	UG/L	U	47	17.0	50 U	1000 U	.	.	.	.	U	.
CHROMIUM	UG/L	U	55	25.5	2 U	18.9	.	.	.	.	U	.
COBALT	UG/L	U	37	16.2	2 U	7.9	.	.	.	.	U	.
COPPER	UG/L	L	58	56.9	2 U	25 U	22.754	.	3.748	2.432	U	2.03
CYANIDE	UG/L	U	23	8.7	1.5 U	20 U	.	.	.	.	U	.
IRON	UG/L	L	116	94.0	39	26300	7559.389	.	498.451	4.164	U	1.91
LEAD	UG/L	U	76	46.1	0.9 U	21	.	.	.	.	U	.
LITHIUM	UG/L	L	76	59.2	2 U	100 U	12.076	.	4.306	1.686	C	1.97
MAGNESIUM	UG/L	L	111	90.1	2870	16600	9851.822	.	4969.164	1.430	U	1.91
MERCURY	UG/L	U	55	10.9	0.1 U	1.4	.	.	.	.	U	.
MOLYBDENUM	UG/L	U	62	19.4	2 U	20.3	.	.	.	.	U	.
NICKEL	UG/L	U	31	41.9	3.6 U	16.9	.	.	.	.	U	.
PHOSPHORUS	UG/L	U	6	16.7	101 U	456 U	.	.	.	.	U	.
POTASSIUM	UG/L	L	79	81.0	380 U	6700	4524.350	.	1335.514	1.860	U	1.97
SELENIUM	UG/L	U	57	8.8	1 U	2.2 U	.	.	.	.	U	.
SILICON	UG/L	N	37	100.0	964	11700	12645.901	.	5960.473	3110.860	U	2.15
SILVER	UG/L	U	64	18.8	2 U	7.2	.	.	.	.	U	.
STRONTIUM	UG/L	L	92	91.3	64.9	1000 U	364.267	.	147.646	1.591	U	1.94
THALLIUM	UG/L	U	36	8.3	1 U	3.4	.	.	.	.	U	.
TIN	UG/L	U	48	35.4	7 U	180	.	.	.	.	U	.
VANADIUM	UG/L	U	55	47.3	2 U	18.2	.	.	.	.	U	.
ZINC	UG/L	L	95	85.3	1.8 U	480	221.480	.	17.934	3.655	U	1.94

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-77
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS IN SURFACE WATER FROM ROCK CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CALCIUM	UG/L	L	55	100.0	5505.75	35100	39390.719	.	20275.245	1.384	U	2.04
MANGANESE	UG/L	L	49	93.9	1	433	490.490	.	21.031	4.579	U	2.07
SODIUM	UG/L	L	56	100.0	3700	31850	36162.159	.	16682.159	1.462	U	2.04

TABLE 5-78
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS IN SURFACE WATER FROM WOMAN CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CALCIUM	UG/L	L	60	100.0	7460	74600	66809.125	.	26378.630	1.583	U	2.02
MANGANESE	UG/L	L	61	95.1	1.8	4060	687.399	.	45.904	3.822	U	2.02
SODIUM	UG/L	L	61	98.4	5000 U	30800	33766.998	.	12959.447	1.607	U	2.02

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-79
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES IN SURFACE WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/L	U	74	98.6	-0.01	0.024	0.018	.	0.005	0.007	U	1.98
CESIUM-137	PCI/L	U	68	98.5	-0.558	1.7	0.734	.	0.083	0.326	U	2.00
GROSS ALPHA	PCI/L	U	32	100.0	-2	57	30.032	.	4.828	11.473	U	2.20
GROSS ALPHA - DISSOLVED	PCI/L	U	8	100.0	0.2	40.1	49.978	.	5.825	13.853	U	3.19
GROSS ALPHA - SUSPENDED	PCI/L	U	19	100.0	-0.5857	8.3	5.449	.	0.941	1.860	U	2.42
GROSS BETA	PCI/L	U	35	100.0	0	41	20.556	.	5.139	7.115	U	2.17
GROSS BETA - DISSOLVED	PCI/L	U	8	87.5	-0.4	36	44.839	.	6.831	11.925	U	3.19
GROSS BETA - SUSPENDED	PCI/L	U	13	100.0	1.098	5.485	5.877	.	2.472	1.275	U	2.67
PLUTONIUM-238	PCI/L	U	3	100.0	-0.000607	-0.000135	.	.	.	.	U	.
PLUTONIUM-239,240	PCI/L	U	75	98.7	-0.001	0.04	0.019	.	0.004	0.007	U	1.98
RADIUM-226	PCI/L	U	3	100.0	-0.1	2.3	.	.	.	.	U	.
STRONTIUM-89,90	PCI/L	U	29	100.0	-0.2	1.65	1.630	.	0.564	0.478	U	2.23
STRONTIUM-90	PCI/L	U	21	100.0	0.02201	1.2	1.409	.	0.557	0.360	U	2.37
TRITIUM	PCI/L	U	47	97.9	-800	520	475.216	.	47.595	205.507	U	2.08
URANIUM-233,234	PCI/L	U	54	98.1	0.05573	2.59	1.456	.	0.482	0.476	U	2.05
URANIUM-235	PCI/L	U	50	96.0	-0.03	0.195	0.152	.	0.039	0.055	U	2.06
URANIUM-238	PCI/L	U	48	100.0	0	1.82	1.332	.	0.390	0.454	U	2.08

TABLE 5-80
BACKGROUND STATISTICS FOR TOTAL FIELD PARAMETER CONCENTRATIONS IN SURFACE WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
DISSOLVED OXYGEN	MG/L	N	110	100.0	0.1	12.8	12.024	.	5.741	3.281	U	1.91
FIELD-MEASURED ALKALINITY	MG/L	L	65	100.0	26.4	606.8	219.514	.	91.191	1.550	U	2.00
FIELD-MEASURED PH	PHUNIT	N	117	100.0	5	9.25	8.841	6.114	7.477	0.614	U	2.22

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-81
BACKGROUND STATISTICS FOR TOTAL FIELD PARAMETER CONCENTRATIONS
IN SURFACE WATER FROM ROCK CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
SPECIFIC CONDUCTANCE	US/CM	L	53	100.0	85.2	1360	639.824	.	247.114	1.590	U	2.05

TABLE 5-82
BACKGROUND STATISTICS FOR TOTAL FIELD PARAMETER CONCENTRATIONS
IN SURFACE WATER FROM WOMAN CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
SPECIFIC CONDUCTANCE	US/CM	L	63	100.0	105	1280	698.456	.	302.496	1.516	U	2.01

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-83
BACKGROUND STATISTICS FOR TOTAL HERBICIDE CONCENTRATIONS
IN SURFACE WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
2,2-DICHLOROPROPANOIC ACID	UG/L	U	1	0.0	5.8 U	5.8 U	.	.	.	.	U	.
2,4,5-TRICHLOROPHENOXYACETIC A	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
2,4-DB	UG/L	U	1	0.0	0.91 U	0.91 U	.	.	.	.	U	.
2,4-DICHLOROPHENOXYACETIC ACID	UG/L	U	1	0.0	1.2 U	1.2 U	.	.	.	.	U	.
AMETRYN	UG/L	U	1	0.0	0.18 U	0.18 U	.	.	.	.	U	.
ATRAZINE	UG/L	U	1	0.0	0.15 U	0.15 U	.	.	.	.	U	.
CYANAZINE	UG/L	U	1	0.0	0.3 U	0.3 U	.	.	.	.	U	.
DICAMBA	UG/L	U	1	0.0	0.27 U	0.27 U	.	.	.	.	U	.
DICHLOROPROP	UG/L	U	1	0.0	0.65 U	0.65 U	.	.	.	.	U	.
MCPA	UG/L	U	1	0.0	250 U	250 U	.	.	.	.	U	.
MCPP	UG/L	U	1	0.0	190 U	190 U	.	.	.	.	U	.
PHENOL, 2-(1-METHYLPROPYL)-4,6	UG/L	U	1	0.0	0.07 U	0.07 U	.	.	.	.	U	.
PROMETON	UG/L	U	1	0.0	0.09 U	0.09 U	.	.	.	.	U	.
PROMETRYN	UG/L	U	1	0.0	0.18 U	0.18 U	.	.	.	.	U	.
PROPANOIC ACID, 2-(2,4,5-TRICH	UG/L	U	1	0.0	0.17 U	0.17 U	.	.	.	.	U	.
PROPAZINE	UG/L	U	1	0.0	0.09 U	0.09 U	.	.	.	.	U	.
SIMAZINE	UG/L	U	1	0.0	0.18 U	0.18 U	.	.	.	.	U	.
SIMETRYN	UG/L	U	1	0.0	0.21 U	0.21 U	.	.	.	.	U	.
TERBUTHYLAZINE	UG/L	U	1	0.0	0.09 U	0.09 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-84
BACKGROUND STATISTICS FOR TOTAL PESTICIDE AND PCB CONCENTRATIONS
IN SURFACE WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
4,4'-DDD	UG/L	U	14	0.0	0.011 U	0.16 U	.	.	.	.	U	.
4,4'-DDE	UG/L	U	14	0.0	0.004 U	0.16 U	.	.	.	.	U	.
4,4'-DDT	UG/L	U	14	0.0	0.012 U	0.16 U	.	.	.	.	U	.
ALDRIN	UG/L	U	14	0.0	0.004 U	0.079 U	.	.	.	.	U	.
AROCLOR-1016	UG/L	U	14	0.0	0.2 U	0.79 U	.	.	.	.	U	.
AROCLOR-1221	UG/L	U	14	0.0	0.2 U	0.79 U	.	.	.	.	U	.
AROCLOR-1232	UG/L	U	14	0.0	0.13 U	0.79 U	.	.	.	.	U	.
AROCLOR-1242	UG/L	U	14	0.0	0.065 U	0.79 U	.	.	.	.	U	.
AROCLOR-1248	UG/L	U	14	0.0	0.065 U	0.79 U	.	.	.	.	U	.
AROCLOR-1254	UG/L	U	14	0.0	0.065 U	1.6 U	.	.	.	.	U	.
AROCLOR-1260	UG/L	U	14	0.0	0.065 U	1.6 U	.	.	.	.	U	.
CHLORDANE	UG/L	U	1	0.0	0.014 U	0.014 U	.	.	.	.	U	.
DIELDRIN	UG/L	U	14	0.0	0.002 U	0.16 U	.	.	.	.	U	.
ENDOSULFAN I	UG/L	U	14	0.0	0.014 U	0.079 U	.	.	.	.	U	.
ENDOSULFAN II	UG/L	U	14	0.0	0.004 U	0.16 U	.	.	.	.	U	.
ENDOSULFAN SULFATE	UG/L	U	14	0.0	0.066 U	0.16 U	.	.	.	.	U	.
ENDRIN	UG/L	U	14	0.0	0.006 U	0.16 U	.	.	.	.	U	.
ENDRIN ALDEHYDE	UG/L	U	1	0.0	0.023 U	0.023 U	.	.	.	.	U	.
ENDRIN KETONE	UG/L	U	13	0.0	0.1 U	0.16 U	.	.	.	.	U	.
HEPTACHLOR	UG/L	U	14	0.0	0.003 U	0.079 U	.	.	.	.	U	.
HEPTACHLOR EPOXIDE	UG/L	U	14	0.0	0.05 U	0.083 U	.	.	.	.	U	.
METHOXYCHLOR	UG/L	U	13	0.0	0.5 U	0.79 U	.	.	.	.	U	.
TOXAPHENE	UG/L	U	14	0.0	0.24 U	1.6 U	.	.	.	.	U	.
alpha-BHC	UG/L	U	14	0.0	0.003 U	0.079 U	.	.	.	.	U	.
alpha-CHLORDANE	UG/L	U	13	0.0	0.5 U	0.79 U	.	.	.	.	U	.
beta-BHC	UG/L	U	14	0.0	0.006 U	0.079 U	.	.	.	.	U	.
delta-BHC	UG/L	U	14	0.0	0.009 U	0.079 U	.	.	.	.	U	.
gamma-BHC (LINDANE)	UG/L	U	14	0.0	0.004 U	0.079 U	.	.	.	.	U	.
gamma-CHLORDANE	UG/L	U	13	0.0	0.5 U	0.79 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-85
BACKGROUND STATISTICS FOR TOTAL SEMIVOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN SURFACE WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,2,4-TRICHLOROBENZENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
1,2-DICHLOROBENZENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
1,3-DICHLOROBENZENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
1,4-DICHLOROBENZENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
2,4,5-TRICHLOROPHENOL	UG/L	U	16	0.0	10 U	58 U	.	.	.	.	U	.
2,4,6-TRICHLOROPHENOL	UG/L	U	16	0.0	1 U	11.5 U	.	.	.	.	U	.
2,4-DICHLOROPHENOL	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
2,4-DIMETHYLPHENOL	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
2,4-DINITROPHENOL	UG/L	U	16	0.0	50 U	58 U	.	.	.	.	U	.
2,4-DINITROTOLUENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
2,6-DINITROTOLUENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
2-CHLORONAPHTHALENE	UG/L	U	14	0.0	10 U	11.5 U	.	.	.	.	U	.
2-CHLOROPHENOL	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
2-METHYLNAPHTHALENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
2-METHYLPHENOL	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
2-NITROANILINE	UG/L	U	16	0.0	50 U	58 U	.	.	.	.	U	.
2-NITROPHENOL	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
3,3'-DICHLOROBENZIDINE	UG/L	U	16	0.0	20 U	23.5 U	.	.	.	.	U	.
3-NITROANILINE	UG/L	U	16	0.0	50 U	58 U	.	.	.	.	U	.
4,6-DINITRO-2-METHYLPHENOL	UG/L	U	16	0.0	50 U	58 U	.	.	.	.	U	.
4-BROMOPHENYL PHENYL ETHER	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
4-CHLORO-3-METHYLPHENOL	UG/L	U	16	0.0	10 U	20 U	.	.	.	.	U	.
4-CHLOROANILINE	UG/L	U	16	0.0	10 U	20 U	.	.	.	.	U	.
4-CHLOROPHENYL PHENYL ETHER	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
4-METHYLPHENOL	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
4-NITROANILINE	UG/L	U	16	0.0	50 U	58 U	.	.	.	.	U	.
4-NITROPHENOL	UG/L	U	16	0.0	50 U	58 U	.	.	.	.	U	.
ACENAPHTHENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
ACENAPHTHYLENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
ANTHRACENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
BENZENAMINE	UG/L	U	1	0.0	52 U	52 U	.	.	.	.	U	.
BENZIDINE	UG/L	U	2	0.0	10 U	52 U	.	.	.	.	U	.
BENZO(a)ANTHRACENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
BENZO(a)PYRENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
BENZO(b)FLUORANTHENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
BENZO(ghi)PERYLENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
BENZO(k)FLUORANTHENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
BENZOIC ACID	UG/L	U	16	0.0	50 U	58 U	.	.	.	.	U	.
BENZYL ALCOHOL	UG/L	U	16	0.0	10 U	20 U	.	.	.	.	U	.
BIS(2-CHLOROETHOXY)METHANE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
BIS(2-CHLOROETHYL)ETHER	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
BIS(2-CHLOROISOPROPYL)ETHER	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-85
BACKGROUND STATISTICS FOR TOTAL SEMIVOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN SURFACE WATER
(Continued)

BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	U	16	6.2	5	10 U	.	.	.	.	U	.
BUTYL BENZYL PHTHALATE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
CHRYSENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
DI-n-BUTYL PHTHALATE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
DI-n-OCTYL PHTHALATE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
DIBENZO(a,h)ANTHRACENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
DIBENZOFURAN	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
DIETHYL PHTHALATE	UG/L	U	16	12.5	2	11.5 U	.	.	.	.	U	.
DIMETHYL PHTHALATE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
FLUORANTHENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
FLUORENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
HEXACHLOROBENZENE	UG/L	U	16	0.0	1 U	11.5 U	.	.	.	.	U	.
HEXACHLOROBUTADIENE	UG/L	U	16	0.0	1 U	11.5 U	.	.	.	.	U	.
HEXACHLOROCYCLOPENTADIENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
HEXACHLOROETHANE	UG/L	U	16	0.0	1 U	11.5 U	.	.	.	.	U	.
INDENO(1,2,3-cd)PYRENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
ISOPHORONE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
N-NITROSO-DI-n-PROPYLAMINE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
N-NITROSODI-N-BUTYLAMINE	UG/L	U	1	0.0	5 U	5 U	.	.	.	.	U	.
N-NITROSODIETHYLAMINE	UG/L	U	1	0.0	5 U	5 U	.	.	.	.	U	.
N-NITROSODIMETHYLAMINE	UG/L	U	2	0.0	5 U	21 U	.	.	.	.	U	.
N-NITROSODIPHENYLAMINE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
N-NITROSOPYRROLIDINE	UG/L	U	1	0.0	10 U	10 U	.	.	.	.	U	.
NAPHTHALENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
NITROBENZENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
PENTACHLOROPHENOL	UG/L	U	16	0.0	50 U	58 U	.	.	.	.	U	.
PHENANTHRENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.
PHENOL	UG/L	U	14	0.0	10 U	11.5 U	.	.	.	.	U	.
PYRENE	UG/L	U	16	0.0	10 U	11.5 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-86
BACKGROUND STATISTICS FOR TOTAL VOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN SURFACE WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,1,1,2-TETRACHLOROETHANE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
1,1,1-TRICHLOROETHANE	UG/L	U	85	0.0	5 U	5 U	.	.	.	.	U	.
1,1,2,2-TETRACHLOROETHANE	UG/L	U	85	0.0	5 U	5 U	.	.	.	.	U	.
1,1,2-TRICHLOROETHANE	UG/L	U	85	0.0	5 U	5 U	.	.	.	.	U	.
1,1-DICHLOROETHANE	UG/L	U	85	0.0	5 U	5 U	.	.	.	.	U	.
1,1-DICHLOROETHENE	UG/L	U	85	0.0	5 U	5 U	.	.	.	.	U	.
1,1-DICHLOROPROPENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
1,2,3-TRICHLOROBENZENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
1,2,3-TRICHLOROPROPANE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
1,2,4-TRICHLOROBENZENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
1,2-DIBROMOETHANE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
1,2-DICHLOROBENZENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
1,2-DICHLOROETHANE	UG/L	U	85	1.2	2	5 U	.	.	.	.	U	.
1,2-DICHLOROETHENE	UG/L	U	85	1.2	1	5 U	.	.	.	.	U	.
1,2-DICHLOROPROPANE	UG/L	U	85	2.4	1	5 U	.	.	.	.	U	.
1,2-DIMETHYLBENZENE	UG/L	U	11	0.0	0.5 U	5 U	.	.	.	.	U	.
1,3-DICHLOROBENZENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
1,3-DICHLOROPROPANE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
1,3-DIMETHYLBENZENE	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
1,4-DICHLOROBENZENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
2-BUTANONE	UG/L	U	84	0.0	10 U	100 U	.	.	.	.	U	.
2-CHLOROETHYL VINYL ETHER	UG/L	U	15	0.0	10 U	10 U	.	.	.	.	U	.
2-HEXANONE	UG/L	U	81	0.0	10 U	50 U	.	.	.	.	U	.
2-PROPENENITRILE	UG/L	U	1	0.0	10 U	10 U	.	.	.	.	U	.
4-METHYL-2-PENTANONE	UG/L	U	85	1.2	4	50 U	.	.	.	.	U	.
ACETONE	UG/L	U	80	28.8	2	100 U	.	.	.	.	U	.
BENZENE	UG/L	U	85	2.4	1	5 U	.	.	.	.	U	.
BENZENE, 1,2,4-TRIMETHYL	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
BENZENE, 1,3,5-TRIMETHYL-	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
BROMOBENZENE	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
BROMOCHLOROMETHANE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
BROMODICHLOROMETHANE	UG/L	U	85	1.2	2	5 U	.	.	.	.	U	.
BROMOFORM	UG/L	U	85	0.0	5 U	5 U	.	.	.	.	U	.
BROMOMETHANE	UG/L	U	85	0.0	10 U	10 U	.	.	.	.	U	.
CARBON DISULFIDE	UG/L	U	82	1.2	5 U	6	.	.	.	.	U	.
CARBON TETRACHLORIDE	UG/L	U	85	1.2	2	5 U	.	.	.	.	U	.
CHLOROBENZENE	UG/L	U	85	1.2	2	5 U	.	.	.	.	U	.
CHLOROETHANE	UG/L	U	85	0.0	10 U	10 U	.	.	.	.	U	.
CHLOROFORM	UG/L	U	85	1.2	2	5 U	.	.	.	.	U	.
CHLOROMETHANE	UG/L	U	84	0.0	10 U	10 U	.	.	.	.	U	.
CUMENE	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
DIBROMOCHLOROMETHANE	UG/L	U	85	0.0	5 U	5 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-86
BACKGROUND STATISTICS FOR TOTAL VOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN SURFACE WATER
(Continued)

DIBROMOMETHANE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
DICHLORODIFLUOROMETHANE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
ETHYLBENZENE	UG/L	U	85	0.0	5 U	5 U	.	.	.	.	U	.
HEXACHLOROBUTADIENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
METHYLENE CHLORIDE	UG/L	U	80	38.7	1	31	.	.	.	.	U	.
NAPHTHALENE	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
PROPANE, 1,2-DIBROMO-3-CHLORO-	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
STYRENE	UG/L	U	85	1.2	2	5 U	.	.	.	.	U	.
TETRACHLOROETHENE	UG/L	U	85	1.2	1	5 U	.	.	.	.	U	.
TOLUENE	UG/L	U	85	3.5	1	5 U	.	.	.	.	U	.
TOTAL XYLENES	UG/L	U	83	3.6	1	5 U	.	.	.	.	U	.
TRICHLOROETHENE	UG/L	U	85	3.5	1	5 U	.	.	.	.	U	.
TRICHLOROFLUOROMETHANE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
VINYL ACETATE	UG/L	U	84	0.0	10 U	50 U	.	.	.	.	U	.
VINYL CHLORIDE	UG/L	U	85	0.0	10 U	10 U	.	.	.	.	U	.
cis-1,2-DICHLOROETHENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
cis-1,3-DICHLOROPROPENE	UG/L	U	85	2.4	1	5 U	.	.	.	.	U	.
n-BUTYLBENZENE	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
n-PROPYLBENZENE	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
o-CHLOROTOLUENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
p-CHLOROTOLUENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
p-CYMENE	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
p-XYLENE	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
sec-BUTYLBENZENE	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
sec-DICHLOROPROPANE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
tert-BUTYLBENZENE	UG/L	U	1	0.0	0.5 U	0.5 U	.	.	.	.	U	.
trans-1,2-DICHLOROETHENE	UG/L	U	1	0.0	0.2 U	0.2 U	.	.	.	.	U	.
trans-1,3-DICHLOROPROPENE	UG/L	U	85	0.0	5 U	5 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-87
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS IN SURFACE WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	N	70	100.0	28000	200000	152257.350	.	90744.286	30913.177	U	1.99
CARBONATE	UG/L	U	50	2.0	1000 U	10000 U	.	.	.	.	U	.
CARBONATE AS CACO3	UG/L	U	60	35.0	0	25500	.	.	.	.	U	.
CBOD5	UG/L	U	9	100.0	3800	14500	17988.309	.	7027.778	3615.860	U	3.03
CYANIDE	UG/L	U	36	5.6	2.5 U	26	.	.	.	.	U	.
DISSOLVED ORGANIC CARBON	UG/L	U	9	100.0	3000	11000	13908.303	.	5777.778	2682.246	U	3.03
NITRATE	UG/L	U	2	50.0	100 U	250	.	.	.	.	U	.
NITRITE	UG/L	U	69	1.4	10 U	58	.	.	.	.	U	.
OIL AND GREASE	UG/L	U	54	38.9	200 U	13000	.	.	.	.	U	.
ORTHOPHOSPHATE	UG/L	U	26	11.5	10 U	98	.	.	.	.	U	.
PH	PHUNIT	L	44	100.0	6.8	8.6	8.395	6.577	7.430	1.052	U	2.42
PHOSPHORUS	UG/L	U	50	58.0	7.5	290	137.550	.	39.530	47.467	U	2.06
SILICA	UG/L	U	24	91.7	400 U	28000	26128.346	.	8017.137	7842.748	U	2.31
SULFATE	UG/L	N	116	98.3	5000 U	48000	35090.871	.	19223.707	8324.426	U	1.91
SULFIDE	UG/L	U	47	12.8	1000 U	4000	.	.	.	.	U	.
TOTAL DISSOLVED SOLIDS	UG/L	L	114	100.0	58000	620000	312491.903	.	163038.906	1.406	U	1.91
TOTAL ORGANIC CARBON	UG/L	L	18	100.0	2800	13000	19661.714	.	5823.177	1.642	U	2.45
TOTAL SUSPENDED SOLIDS	UG/L	L	119	61.3	.	400000	83085.126	.	7423.569	3.561	U	1.90

TABLE 5-88
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS IN SURFACE WATER FROM ROCK CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE	UG/L	L	27	100.0	30000	180000	218482.343	.	93884.747	1.453	U	2.26
CHLORIDE	UG/L	L	57	86.0	2000	33200	33427.942	.	6711.949	2.202	U	2.03
FLUORIDE	UG/L	N	32	90.6	280	600	597.250	.	374.062	101.596	U	2.20
NITRATE/NITRITE	UG/L	L	43	81.4	20 U	2000	7101.659	.	338.306	4.247	C	2.10

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-89
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN SURFACE WATER FROM WOMAN CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE	UG/L	L	20	100.0	25000	170000	288148.728	.	76195.088	1.742	U	2.40
CHLORIDE	UG/L	L	59	100.0	3000	62300	72912.404	.	15552.474	2.144	U	2.03
FLUORIDE	UG/L	N	40	92.5	100	720	527.693	.	319.250	98.068	U	2.13
NITRATE/NITRITE	UG/L	L	35	77.1	20 U	4300	2790.155	.	110.624	4.436	U	2.17

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-90
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN SEEP WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	U	31	25.8	20 U	200 U	.	.	.	.	U	.
ANTIMONY	UG/L	U	27	25.9	8.3	104 U	.	.	.	.	U	.
ARSENIC	UG/L	U	28	21.4	0.8 U	18	.	.	.	.	U	.
BARIUM	UG/L	U	44	47.7	35.8	211	.	.	.	.	U	.
BERYLLIUM	UG/L	U	19	0.0	0.2 U	5 U	.	.	.	.	U	.
CADMIUM	UG/L	U	24	0.0	2 U	5 U	.	.	.	.	U	.
CALCIUM	UG/L	U	47	100.0	21200	216000	124279.352	.	50787.234	35318.956	U	2.08
CESIUM	UG/L	U	23	0.0	147 U	1000 U	.	.	.	.	U	.
CHROMIUM	UG/L	U	25	4.0	2 U	14.8	.	.	.	.	U	.
COBALT	UG/L	U	28	3.6	2.2 U	50 U	.	.	.	.	U	.
COPPER	UG/L	U	35	22.9	2.7	25 U	.	.	.	.	U	.
IRON	UG/L	L	41	70.7	1.1 U	16700	50763.072	.	220.690	13.030	U	2.12
LEAD	UG/L	U	35	17.1	0.1 U	5.4	.	.	.	.	U	.
LITHIUM	UG/L	U	33	48.5	2	100 U	.	.	.	.	U	.
MAGNESIUM	UG/L	U	44	68.2	3190 U	27400	18262.474	.	6930.511	5400.134	U	2.10
MANGANESE	UG/L	L	38	86.8	1 U	760	2734.438	.	37.873	7.381	U	2.14
MERCURY	UG/L	U	20	30.0	0.2 U	5.1	.	.	.	.	U	.
MOLYBDENUM	UG/L	U	31	19.4	3.3	100 U	.	.	.	.	U	.
NICKEL	UG/L	U	21	14.3	3.8 U	40 U	.	.	.	.	U	.
PHOSPHORUS	UG/L	U	1	0.0	134 U	134 U	.	.	.	.	U	.
POTASSIUM	UG/L	U	36	38.9	255 U	7073 U	.	.	.	.	U	.
SELENIUM	UG/L	U	24	4.2	0.8 U	5 U	.	.	.	.	U	.
SILICON	UG/L	U	8	100.0	274	12200	19832.749	.	7708.000	3804.089	U	3.19
SILVER	UG/L	U	29	6.9	2 U	12.5 U	.	.	.	.	U	.
SODIUM	UG/L	U	47	100.0	6950	35200	24221.075	.	12484.787	5640.243	U	2.08
STRONTIUM	UG/L	U	27	100.0	120	1020	685.151	.	253.148	191.148	U	2.26
THALLIUM	UG/L	U	24	0.0	0.9 U	10 U	.	.	.	.	U	.
TIN	UG/L	U	33	15.2	11.4	100 U	.	.	.	.	U	.
VANADIUM	UG/L	U	31	12.9	2 U	50 U	.	.	.	.	U	.
ZINC	UG/L	U	37	43.2	1.8 U	105	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-91
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN SEEP WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/L	U	6	50.0	0	0.01 U	.	.	.	.	U	.
CESIUM-137	PCI/L	U	3	100.0	-0.5	-0.1	.	.	.	.	U	.
GROSS ALPHA	PCI/L	U	7	57.1	0	4	7.035	.	1.735	1.559	U	3.40
GROSS ALPHA - DISSOLVED	PCI/L	U	4	100.0	0.1242	19.49	53.644	.	5.559	9.348	U	5.14
GROSS BETA	PCI/L	U	7	71.4	-2	4.9	9.243	.	1.400	2.307	U	3.40
GROSS BETA - DISSOLVED	PCI/L	U	5	100.0	1.078	39.15	77.672	.	12.078	15.608	U	4.20
GROSS GAMMA	PCI/L	U	5	40.0	-0.13	3.2	.	.	.	.	U	.
PLUTONIUM-239,240	PCI/L	U	5	60.0	0	0.02 U	.	.	.	.	C	.
RADIUM-226	PCI/L	U	2	50.0	0.07 U	1.909	.	.	.	.	U	.
RADIUM-228	PCI/L	U	1	0.0	0.7 U	0.7 U	.	.	.	.	U	.
STRONTIUM-89	PCI/L	U	5	0.0	0.8 U	1 U	.	.	.	.	U	.
STRONTIUM-89,90	PCI/L	U	8	100.0	-0.3	0.8	1.406	.	0.301	0.347	U	3.19
STRONTIUM-90	PCI/L	U	5	0.0	0.4 U	0.8 U	.	.	.	.	U	.
TRITIUM	PCI/L	U	9	66.7	82.59	1200	1336.790	.	243.032	360.829	U	3.03
URANIUM-233,234	PCI/L	U	13	92.3	0	2.6	2.883	.	0.899	0.743	U	2.67
URANIUM-235	PCI/L	U	12	58.3	-0.0183	0.3 U	0.333	.	0.048	0.104	C	2.74
URANIUM-238	PCI/L	U	13	92.3	-0.1	1.7	2.065	.	0.597	0.550	U	2.67

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-92
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN SEEP WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	L	42	95.2	47.4	293000	382571.544	.	2392.782	11.060	U	2.11
ANTIMONY	UG/L	U	20	30.0	10 U	643	.	.	.	.	U	.
ARSENIC	UG/L	U	37	56.8	0.9 U	1030	528.333	.	82.696	207.364	U	2.15
BARIUM	UG/L	U	41	80.5	33.4	7070	4658.715	.	981.293	1736.018	U	2.12
BERYLLIUM	UG/L	U	22	36.4	1 U	14	.	.	.	.	U	.
CADMIUM	UG/L	U	20	35.0	2.1 U	68.4	.	.	.	.	U	.
CALCIUM	UG/L	U	49	100.0	20700	803000	374036.215	.	100478.571	132148.179	U	2.07
CESIUM	UG/L	U	16	25.0	50 U	2530	.	.	.	.	U	.
CHROMIUM	UG/L	U	31	41.9	2 U	275	.	.	.	.	U	.
COBALT	UG/L	U	20	40.0	3 U	489	.	.	.	.	U	.
COPPER	UG/L	L	35	57.1	2.9 U	607	429.490	.	17.602	4.368	U	2.17
CYANIDE	UG/L	U	5	40.0	1.5 U	17	.	.	.	.	U	.
IRON	UG/L	U	48	95.8	97.5 U	3220000	1292392.128	.	186474.255	532882.076	U	2.08
LEAD	UG/L	U	38	76.3	0.9 U	950	583.019	.	107.932	221.916	U	2.14
LITHIUM	UG/L	L	28	60.7	4.8	140	75.293	.	16.664	1.957	C	2.25
MAGNESIUM	UG/L	L	47	85.1	2330 U	30300	41209.066	.	8441.677	2.142	U	2.08
MANGANESE	UG/L	U	48	85.4	2.1	27700	12630.442	.	1916.578	5162.432	U	2.08
MERCURY	UG/L	U	19	15.8	0.2 U	1.3	.	.	.	.	U	.
MOLYBDENUM	UG/L	U	26	30.8	3 U	203	.	.	.	.	U	.
NICKEL	UG/L	U	19	47.4	3.8 U	646	.	.	.	.	U	.
PHOSPHORUS	UG/L	U	1	0.0	105 U	105 U	.	.	.	.	U	.
POTASSIUM	UG/L	L	36	55.6	759 U	13500	16886.243	.	2575.903	2.390	U	2.16
SELENIUM	UG/L	U	26	23.1	1	11.1	.	.	.	.	U	.
SILICON	UG/L	U	8	100.0	2290	12700	17802.633	.	7825.000	3130.440	U	3.19
SILVER	UG/L	U	25	24.0	2 U	148	.	.	.	.	U	.
SODIUM	UG/L	U	50	100.0	560	337000	114173.180	.	18880.900	46146.530	U	2.06
STRONTIUM	UG/L	L	39	71.8	118	2100	1953.147	.	403.748	2.094	U	2.13
THALLIUM	UG/L	U	20	5.0	1 U	10 U	.	.	.	.	U	.
TIN	UG/L	U	26	38.5	10.4 U	969	.	.	.	.	U	.
VANADIUM	UG/L	L	32	59.4	2 U	1650	1782.282	.	31.165	6.309	U	2.20
ZINC	UG/L	L	42	88.1	4.5	2680	2033.588	.	70.005	4.931	U	2.11

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-93
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES IN SEEP WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/L	U	34	100.0	0	0.1	0.059	.	0.014	0.021	U	2.18
CESIUM-137	PCI/L	U	36	100.0	-0.3	12	4.958	.	0.608	2.016	U	2.16
GROSS ALPHA	PCI/L	U	22	100.0	-0.5	440	322.212	.	66.075	109.043	U	2.35
GROSS ALPHA - DISSOLVED	PCI/L	U	4	100.0	0.4	28.3	76.388	.	8.625	13.174	U	5.14
GROSS ALPHA - SUSPENDED	PCI/L	U	9	100.0	0.09618	21.2	24.635	.	4.613	6.605	U	3.03
GROSS BETA	PCI/L	U	24	100.0	0.3	420	332.300	.	63.462	116.416	U	2.31
GROSS BETA - DISSOLVED	PCI/L	U	4	100.0	2	15.7	39.914	.	6.675	6.462	U	5.14
GROSS BETA - SUSPENDED	PCI/L	U	3	100.0	2.611	6.322	.	.	.	.	U	.
PLUTONIUM-238	PCI/L	U	2	100.0	0	0.0006768	.	.	.	.	U	.
PLUTONIUM-239,240	PCI/L	U	36	100.0	-0.007	4.4	1.812	.	0.196	0.749	U	2.16
RADIUM-226	PCI/L	U	12	100.0	0.2	30	32.623	.	7.721	9.100	U	2.74
RADIUM-228	PCI/L	U	5	100.0	-1.1	36	75.692	.	16.380	14.113	U	4.20
STRONTIUM-89,90	PCI/L	U	20	100.0	-0.2	1.1	1.243	.	0.285	0.400	U	2.40
STRONTIUM-90	PCI/L	U	11	100.0	-0.2	0.9	1.219	.	0.316	0.321	U	2.81
TRITIUM	PCI/L	U	30	100.0	-6930	475	2789.766	.	-90.801	1297.648	U	2.22
URANIUM-233,234	PCI/L	U	32	93.7	-0.015	6.9	3.521	.	0.644	1.310	U	2.20
URANIUM-235	PCI/L	U	31	100.0	-0.2	0.19	0.211	.	0.023	0.085	U	2.21
URANIUM-238	PCI/L	U	28	100.0	-0.05	5.93	3.363	.	0.642	1.212	U	2.25

TABLE 5-94
BACKGROUND STATISTICS FOR TOTAL FIELD PARAMETER CONCENTRATIONS IN SEEP WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
DISSOLVED OXYGEN	MG/L	U	41	100.0	0.1	20	16.965	.	5.954	5.198	U	2.12
FIELD-MEASURED ALKALINITY	MG/L	L	14	100.0	84	214	274.065	.	126.572	1.344	U	2.61
FIELD-MEASURED PH	PHUNIT	L	45	100.0	5.8	9.8	9.592	5.758	7.432	1.112	U	2.41
SPECIFIC CONDUCTANCE	US/CM	U	45	100.0	170.8	1904	1060.614	.	428.076	302.309	U	2.09

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-95
BACKGROUND STATISTICS FOR TOTAL PESTICIDE AND PCB CONCENTRATIONS
IN SEEP WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
4,4'-DDD	UG/L	U	6	0.0	0.099 U	0.1 U	.	.	.	.	U	.
4,4'-DDE	UG/L	U	6	0.0	0.099 U	0.1 U	.	.	.	.	U	.
4,4'-DDT	UG/L	U	6	0.0	0.099 U	0.1 U	.	.	.	.	U	.
ALDRIN	UG/L	U	6	0.0	0.05 U	0.05 U	.	.	.	.	U	.
AROCLOR-1016	UG/L	U	6	0.0	0.5 U	0.5 U	.	.	.	.	U	.
AROCLOR-1221	UG/L	U	6	0.0	0.5 U	0.5 U	.	.	.	.	U	.
AROCLOR-1232	UG/L	U	6	0.0	0.5 U	0.5 U	.	.	.	.	U	.
AROCLOR-1242	UG/L	U	6	0.0	0.5 U	0.5 U	.	.	.	.	U	.
AROCLOR-1248	UG/L	U	6	0.0	0.5 U	0.5 U	.	.	.	.	U	.
AROCLOR-1254	UG/L	U	6	0.0	0.99 U	1 U	.	.	.	.	U	.
AROCLOR-1260	UG/L	U	6	0.0	0.99 U	1 U	.	.	.	.	U	.
DIELDRIN	UG/L	U	6	0.0	0.099 U	0.1 U	.	.	.	.	U	.
ENDOSULFAN I	UG/L	U	6	0.0	0.05 U	0.05 U	.	.	.	.	U	.
ENDOSULFAN II	UG/L	U	6	0.0	0.099 U	0.1 U	.	.	.	.	U	.
ENDOSULFAN SULFATE	UG/L	U	6	0.0	0.099 U	0.1 U	.	.	.	.	U	.
ENDRIN	UG/L	U	6	0.0	0.099 U	0.1 U	.	.	.	.	U	.
ENDRIN KETONE	UG/L	U	6	0.0	0.099 U	0.1 U	.	.	.	.	U	.
HEPTACHLOR	UG/L	U	6	0.0	0.05 U	0.05 U	.	.	.	.	U	.
HEPTACHLOR EPOXIDE	UG/L	U	6	0.0	0.05 U	0.05 U	.	.	.	.	U	.
METHOXYCHLOR	UG/L	U	6	0.0	0.5 U	0.5 U	.	.	.	.	U	.
TOXAPHENE	UG/L	U	6	0.0	0.99 U	1 U	.	.	.	.	U	.
alpha-BHC	UG/L	U	6	0.0	0.05 U	0.05 U	.	.	.	.	U	.
alpha-CHLORDANE	UG/L	U	6	0.0	0.5 U	0.5 U	.	.	.	.	U	.
beta-BHC	UG/L	U	6	0.0	0.05 U	0.05 U	.	.	.	.	U	.
delta-BHC	UG/L	U	6	0.0	0.05 U	0.05 U	.	.	.	.	U	.
gamma-BHC (LINDANE)	UG/L	U	6	0.0	0.05 U	0.05 U	.	.	.	.	U	.
gamma-CHLORDANE	UG/L	U	6	0.0	0.5 U	0.5 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-96
BACKGROUND STATISTICS FOR TOTAL SEMIVOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN SEEP WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,2,4-TRICHLOROBENZENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
1,2-DICHLOROBENZENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
1,3-DICHLOROBENZENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
1,4-DICHLOROBENZENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
2,4,5-TRICHLOROPHENOL	UG/L	U	6	0.0	50 U	50 U	.	.	.	.	U	.
2,4,6-TRICHLOROPHENOL	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
2,4-DICHLOROPHENOL	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
2,4-DIMETHYLPHENOL	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
2,4-DINITROPHENOL	UG/L	U	6	0.0	50 U	50 U	.	.	.	.	U	.
2,4-DINITROTOLUENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
2,6-DINITROTOLUENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
2-CHLORONAPHTHALENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
2-CHLOROPHENOL	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
2-METHYLNAPHTHALENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
2-METHYLPHENOL	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
2-NITROANILINE	UG/L	U	6	0.0	50 U	50 U	.	.	.	.	U	.
2-NITROPHENOL	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
3,3'-DICHLOROBENZIDINE	UG/L	U	6	0.0	20 U	20 U	.	.	.	.	U	.
3-NITROANILINE	UG/L	U	6	0.0	50 U	50 U	.	.	.	.	U	.
4,6-DINITRO-2-METHYLPHENOL	UG/L	U	6	0.0	50 U	50 U	.	.	.	.	U	.
4-BROMOPHENYL PHENYL ETHER	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
4-CHLORO-3-METHYLPHENOL	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
4-CHLOROANILINE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
4-CHLOROPHENYL PHENYL ETHER	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
4-METHYLPHENOL	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
4-NITROANILINE	UG/L	U	6	0.0	50 U	50 U	.	.	.	.	U	.
4-NITROPHENOL	UG/L	U	6	0.0	50 U	50 U	.	.	.	.	U	.
ACENAPHTHENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
ACENAPHTHYLENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
ANTHRACENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
BENZENAMINE	UG/L	U	3	0.0	50 U	50 U	.	.	.	.	U	.
BENZIDINE	UG/L	U	3	0.0	50 U	50 U	.	.	.	.	U	.
BENZO(a)ANTHRACENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
BENZO(a)PYRENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
BENZO(b)FLUORANTHENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
BENZO(ghi)PERYLENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
BENZO(k)FLUORANTHENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
BENZOIC ACID	UG/L	U	6	0.0	50 U	50 U	.	.	.	.	U	.
BENZYL ALCOHOL	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
BIS(2-CHLOROETHOXY)METHANE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
BIS(2-CHLOROETHYL)ETHER	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
BIS(2-CHLOROISOPROPYL)ETHER	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-96
BACKGROUND STATISTICS FOR TOTAL SEMIVOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN SEEP WATER
(Continued)

BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	U	6	16.7	9	10 U	.	.	.	.	U	.
BUTYL BENZYL PHTHALATE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
CHRYSENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
DI-n-BUTYL PHTHALATE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
DI-n-OCTYL PHTHALATE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
DIBENZO(a,h)ANTHRACENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
DIBENZOFURAN	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
DIETHYL PHTHALATE	UG/L	U	6	16.7	3	10 U	.	.	.	.	U	.
DIMETHYL PHTHALATE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
FLUORANTHENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
FLUORENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
HEXACHLOROBENZENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
HEXACHLOROBUTADIENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
HEXACHLOROCYCLOPENTADIENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
HEXACHLOROETHANE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
INDENO(1,2,3-cd)PYRENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
ISOPHORONE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
N-NITROSO-DI-n-PROPYLAMINE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
N-NITROSODIMETHYLAMINE	UG/L	U	3	0.0	20 U	20 U	.	.	.	.	U	.
N-NITROSODIPHENYLAMINE	UG/L	U	6	16.7	1	10 U	.	.	.	.	U	.
NAPHTHALENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
NITROBENZENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
PENTACHLOROPHENOL	UG/L	U	6	0.0	50 U	50 U	.	.	.	.	U	.
PHENANTHRENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
PHENOL	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.
PYRENE	UG/L	U	6	0.0	10 U	10 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-97
BACKGROUND STATISTICS FOR TOTAL VOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN SEEP WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,1,1-TRICHLOROETHANE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
1,1,2,2-TETRACHLOROETHANE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
1,1,2-TRICHLOROETHANE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
1,1-DICHLOROETHANE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
1,1-DICHLOROETHENE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
1,2-DICHLOROETHANE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
1,2-DICHLOROETHENE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
1,2-DICHLOROPROPANE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
1,2-DIMETHYLBENZENE	UG/L	U	9	0.0	5 U	5 U	.	.	.	.	U	.
2-BUTANONE	UG/L	U	23	0.0	10 U	10 U	.	.	.	.	U	.
2-CHLOROETHYL VINYL ETHER	UG/L	U	9	0.0	10 U	10 U	.	.	.	.	U	.
2-HEXANONE	UG/L	U	23	0.0	10 U	10 U	.	.	.	.	U	.
4-METHYL-2-PENTANONE	UG/L	U	23	0.0	10 U	10 U	.	.	.	.	U	.
ACETONE	UG/L	U	21	33.3	2	91	.	.	.	.	U	.
BENZENE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
BROMODICHLOROMETHANE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
BROMOFORM	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
BROMOMETHANE	UG/L	U	23	0.0	10 U	10 U	.	.	.	.	U	.
CARBON DISULFIDE	UG/L	U	22	4.5	3	5 U	.	.	.	.	U	.
CARBON TETRACHLORIDE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
CHLOROBENZENE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
CHLOROETHANE	UG/L	U	23	0.0	10 U	10 U	.	.	.	.	U	.
CHLOROFORM	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
CHLOROMETHANE	UG/L	U	23	4.3	4	10 U	.	.	.	.	U	.
DIBROMOCHLOROMETHANE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
ETHYLBENZENE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
METHYLENE CHLORIDE	UG/L	U	22	54.5	1	22	16.922	.	4.545	5.269	U	2.35
STYRENE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
TETRACHLOROETHENE	UG/L	U	23	4.3	5 U	10	.	.	.	.	U	.
TOLUENE	UG/L	U	23	4.3	1	5 U	.	.	.	.	U	.
TOTAL XYLENES	UG/L	U	23	4.3	2	5 U	.	.	.	.	U	.
TRICHLOROETHENE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
VINYL ACETATE	UG/L	U	23	0.0	10 U	10 U	.	.	.	.	U	.
VINYL CHLORIDE	UG/L	U	23	0.0	10 U	10 U	.	.	.	.	U	.
cis-1,3-DICHLOROPROPENE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.
trans-1,3-DICHLOROPROPENE	UG/L	U	23	0.0	5 U	5 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-98
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN SEEP WATER

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE	UG/L	U	36	100.0	97000	4100000	2082941.066	.	446500.000	758427.866	U	2.16
BICARBONATE AS CACO3	UG/L	U	21	100.0	57400	1110000	862419.656	.	222171.429	269984.952	U	2.37
CARBONATE	UG/L	U	36	0.0	1000 U	5000 U	.	.	.	.	U	.
CARBONATE AS CACO3	UG/L	U	16	62.5	0	40400	48193.894	.	11150.000	14678.647	U	2.52
CBOD5	UG/L	U	2	100.0	11700	20400	.	.	.	.	U	.
CHLORIDE	UG/L	U	51	96.1	4000	130000	47973.113	.	12484.314	17226.948	U	2.06
CYANIDE	UG/L	U	13	38.5	2.5 U	45.2	.	.	.	.	U	.
DISSOLVED ORGANIC CARBON	UG/L	U	1	100.0	8000	8000	.	.	.	.	U	.
FLUORIDE	UG/L	U	16	87.5	200	960	1274.084	.	528.750	295.339	U	2.52
NITRATE/NITRITE	UG/L	L	36	83.3	20 U	11000	15299.247	.	291.338	6.270	U	2.16
NITRITE	UG/L	U	15	6.7	10 U	60	.	.	.	.	U	.
OIL AND GREASE	UG/L	U	20	40.0	400	8300 U	.	.	.	.	U	.
ORTHOPHOSPHATE	UG/L	U	11	18.2	10 U	50 U	.	.	.	.	U	.
PH	PHUNIT	N	35	100.0	6	7.9	8.280	6.152	7.216	0.427	U	2.49
PHOSPHORUS	UG/L	U	15	60.0	40	3400	2649.117	.	392.267	879.521	U	2.57
SILICA	UG/L	U	6	100.0	8700	39000	58093.392	.	16283.333	11276.598	U	3.71
SULFATE	UG/L	U	49	93.9	5000 U	560000	235607.327	.	47808.163	90720.615	U	2.07
SULFIDE	UG/L	U	8	12.5	1000 U	18000	.	.	.	.	U	.
TOTAL DISSOLVED SOLIDS	UG/L	U	49	100.0	.	1100000	640041.819	.	269795.918	178855.619	U	2.07
TOTAL ORGANIC CARBON	UG/L	U	3	100.0	7400	11700	.	.	.	.	U	.
TOTAL SUSPENDED SOLIDS	UG/L	U	51	84.3	2000	46000000	19336044.67	.	2869941.176	7992964.552	U	2.06

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-99
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
LITHIUM	UG/L	L	21	81.0	3	250	2618.415	.	55.901	5.064	C	2.37
NICKEL	UG/L	U	15	13.3	2 U	40 U	.	.	.	.	U	.
SELENIUM	UG/L	U	19	57.9	1 U	173	157.956	.	26.642	54.194	U	2.42
SODIUM	UG/L	L	22	100.0	19600	198000	584414.329	.	73813.425	2.413	U	2.35
TIN	UG/L	U	19	47.4	10 U	340	.	.	.	.	U	.

TABLE 5-100
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
LITHIUM	UG/L	L	36	88.9	3.3	100 U	221.946	.	24.879	2.757	U	2.16
NICKEL	UG/L	U	17	17.6	3 U	40 U	.	.	.	.	U	.
SELENIUM	UG/L	U	31	29.0	1	6	.	.	.	.	U	.
SILICON	UG/L	N	12	100.0	2720	10250	11058.616	.	4563.333	2373.710	U	2.74
SODIUM	UG/L	L	43	100.0	11000	432000	912186.843	.	83451.168	3.115	U	2.10
TIN	UG/L	U	32	43.7	10 U	100 U	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-101
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
LITHIUM	UG/L	L	59	64.4	1 U	20 U	12.478	.	3.662	1.831	U	2.03
NICKEL	UG/L	U	46	41.3	3	35.8	.	.	.	.	U	.
SELENIUM	UG/L	U	48	12.5	0.975	607	.	.	.	.	U	.
SILICON	UG/L	N	12	91.7	2 U	14500	19534.566	.	8575.485	4005.011	U	2.74
SODIUM	UG/L	L	69	98.6	10 U	11689	40691.169	.	6652.416	2.481	U	1.99

TABLE 5-102
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
LITHIUM	UG/L	L	40	80.0	2 U	281	145.992	.	16.088	2.823	U	2.13
NICKEL	UG/L	U	26	53.8	2.3	40 U	20.686	.	7.048	5.994	U	2.28
SELENIUM	UG/L	U	35	42.9	1	56	.	.	.	.	U	.
SODIUM	UG/L	L	43	100.0	14800	923000	148389.299	.	34634.399	1.996	U	2.10

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-103
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS IN GROUND WATER IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
LITHIUM	UG/L	L	21	95.2	9	249	197.230	.	22.070	2.518	U	2.37
NICKEL	UG/L	U	10	20.0	3 U	40 U	.	.	.	.	U	.
SELENIUM	UG/L	L	18	66.7	1	76	229.328	.	5.326	4.636	U	2.45
SODIUM	UG/L	L	21	100.0	15300	252000	197886.543	.	30866.205	2.189	U	2.37

TABLE 5-104
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS IN GROUND WATER IN RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	L	173	79.2	5 U	8610	229.710	.	36.630	2.709	U	1.84
BERYLLIUM	UG/L	U	83	6.0	0.3 U	5 U	.	.	.	.	U	.
CADMIUM	UG/L	U	118	25.4	1 U	8.6	.	.	.	.	U	.
CHROMIUM	UG/L	U	185	34.1	1 U	23.2	.	.	.	.	U	.
COBALT	UG/L	U	98	20.4	2	50 U	.	.	.	.	U	.
COPPER	UG/L	U	186	34.9	1 U	175	.	.	.	.	U	.
IRON	UG/L	L	180	71.1	3 U	8790	265.914	.	26.798	3.489	U	1.84
LEAD	UG/L	U	188	22.3	0.4 U	64	.	.	.	.	U	.
MERCURY	UG/L	U	82	7.3	0.1 U	1.2	.	.	.	.	U	.
PHOSPHORUS	UG/L	L	13	53.8	80 U	285 U	587.430	.	109.380	1.877	U	2.67
SILVER	UG/L	U	172	34.3	2 U	20 U	.	.	.	.	U	.
THALLIUM	UG/L	U	83	10.8	0.6 U	328	.	.	.	.	U	.
VANADIUM	UG/L	L	186	50.5	1 U	57.4	15.944	.	3.110	2.440	U	1.83
ZINC	UG/L	L	197	67.5	1.1 U	137	50.223	.	7.901	2.755	U	1.82

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-105
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER IN RFA VFA KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CYANIDE	UG/L	U	4	0.0	2 U	10 U	.	.	.	.	U	.

TABLE 5-106
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER IN RFA VFA WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
TIN	UG/L	L	100	56.0	10 U	151	57.891	.	14.479	2.050	U	1.93

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-107
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER IN VFA COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
SILICON	UG/L	N	28	100.0	4.7678	13800	12332.136	.	6605.448	2549.978	U	2.25

TABLE 5-108
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ARSENIC	UG/L	U	10	10.0	0.9 U	10 U	.	.	.	.	U	.
BARIUM	UG/L	L	16	87.5	23.6	200 U	199.995	.	59.181	1.620	U	2.52
CALCIUM	UG/L	L	17	100.0	58200	184000	251762.508	.	98753.514	1.457	U	2.49
MAGNESIUM	UG/L	L	16	100.0	10700	46300	78665.512	.	21407.536	1.675	U	2.52
MANGANESE	UG/L	L	17	88.2	2.8	180	747.013	.	20.511	4.246	U	2.49
POTASSIUM	UG/L	L	15	93.3	430	8110	17187.011	.	2018.809	2.304	U	2.57
STRONTIUM	UG/L	L	16	93.7	100 U	1710	5421.681	.	672.608	2.286	U	2.52

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-109
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS IN GROUND WATER FROM NORTH ROCKY FLATS IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ARSENIC	UG/L	N	17	76.5	2 U	10 U	5.561	.	3.577	0.798	C	2.49
CALCIUM	UG/L	L	19	100.0	8190	75500	206806.155	.	22777.583	2.485	U	2.42
MAGNESIUM	UG/L	L	19	94.7	1720	13400	35944.456	.	4390.300	2.382	U	2.42
MANGANESE	UG/L	L	19	84.2	3.5 U	16.8	24.330	.	7.684	1.609	U	2.42
POTASSIUM	UG/L	L	16	100.0	2040	5800	9612.334	.	3394.790	1.510	U	2.52
STRONTIUM	UG/L	L	19	100.0	89.5	1050	3209.836	.	280.223	2.736	U	2.42

TABLE 5-110
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS IN GROUND WATER FROM NORTH ROCKY FLATS IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ARSENIC	UG/L	U	17	0.0	1.6 U	10 U	.	.	.	.	U	.
BARIUM	UG/L	L	23	95.7	48	200 U	110.508	.	66.951	1.240	U	2.33
CALCIUM	UG/L	L	23	100.0	20800	45000	57011.102	.	32228.601	1.278	U	2.33
MAGNESIUM	UG/L	L	23	100.0	3210	6120	7042.566	.	4389.806	1.225	U	2.33
MANGANESE	UG/L	L	23	82.6	1 U	22.2	28.879	.	2.732	2.753	U	2.33
POTASSIUM	UG/L	L	21	95.2	425	1470 U	793.046	.	576.383	1.144	U	2.37
STRONTIUM	UG/L	L	23	100.0	94.6	196	237.021	.	135.454	1.272	U	2.33

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-111
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ARSENIC	UG/L	U	16	6.2	0.8 U	2 U	.	.	.	.	U	.
BARIUM	UG/L	L	22	100.0	42.25	130	159.393	.	69.291	1.426	U	2.35
CALCIUM	UG/L	L	22	100.0	18650	78100	89017.272	.	32537.343	1.535	U	2.35
MAGNESIUM	UG/L	L	22	100.0	3840	18600	21407.404	.	7288.375	1.582	U	2.35
MANGANESE	UG/L	L	22	77.3	1 U	934	2110.938	.	11.739	9.119	U	2.35
POTASSIUM	UG/L	L	22	95.5	597	3540	5390.878	.	1360.613	1.797	U	2.35
STRONTIUM	UG/L	L	21	100.0	106.5	611	639.720	.	198.124	1.639	U	2.37

TABLE 5-112
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ARSENIC	UG/L	U	6	16.7	1 U	2 U	.	.	.	.	U	.
CALCIUM	UG/L	L	9	100.0	28100	61800	111353.939	.	45881.545	1.340	U	3.03
MAGNESIUM	UG/L	L	9	100.0	4650	12500	26726.725	.	8868.592	1.439	U	3.03
MANGANESE	UG/L	L	9	100.0	3.5	54.8	132.818	.	10.495	2.310	U	3.03
POTASSIUM	UG/L	L	9	100.0	1600	5430	7240.736	.	2207.810	1.480	U	3.03
STRONTIUM	UG/L	L	9	100.0	195	388	713.696	.	299.510	1.332	U	3.03

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-113
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ANTIMONY	UG/L	U	66	45.5	6 U	60 U	.	.	.	.	U	.
CESIUM	UG/L	U	51	9.8	2 U	1000 U	.	.	.	.	U	.
MOLYBDENUM	UG/L	L	80	51.2	2 U	114	60.686	.	6.053	3.233	U	1.96

TABLE 5-114
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BARIUM	UG/L	L	28	89.3	34.8	200 U	217.840	.	78.265	1.577	U	2.25

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

5-115
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS IN GROUND WATER FROM SOUTH ROCKY FLATS IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ARSENIC	UG/L	U	3	0.0	0.8 U	2 U	.	.	.	.	U	.
BARIUM	UG/L	L	5	80.0	97.1	120	169.894	.	107.221	1.116	C	4.20
CALCIUM	UG/L	L	5	100.0	62400	80900	108075.372	.	72400.926	1.100	U	4.20
MAGNESIUM	UG/L	L	5	100.0	10100	18000	31171.179	.	12401.668	1.245	U	4.20
MANGANESE	UG/L	U	5	60.0	1 U	5.7	.	.	.	.	U	.
POTASSIUM	UG/L	L	5	80.0	170	3670	176851.328	.	496.306	4.048	U	4.20
STRONTIUM	UG/L	L	5	100.0	316	826	2188.331	.	406.899	1.492	U	4.20

TABLE 5-116
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS IN GROUND WATER FROM SOUTH ROCKY FLATS IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ARSENIC	UG/L	U	19	47.4	1 U	10 U	.	.	.	.	U	.
CALCIUM	UG/L	L	24	100.0	11900	64750	109384.457	.	27739.655	1.811	U	2.31
MAGNESIUM	UG/L	L	24	95.8	2080	9370	14572.883	.	4788.145	1.619	U	2.31
MANGANESE	UG/L	L	24	83.3	1 U	30.2	149.813	.	4.808	4.434	C	2.31
POTASSIUM	UG/L	L	23	95.7	366	5170	14589.066	.	1523.058	2.639	U	2.33
STRONTIUM	UG/L	L	23	100.0	168	406	599.523	.	300.969	1.344	U	2.33

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-117
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS IN GROUND WATER FROM SOUTH ROCKY FLATS IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ARSENIC	UG/L	U	37	0.0	0.9 U	10 U	.	.	.	.	U	.
BARIUM	UG/L	L	47	95.7	31.1	200 U	151.368	.	65.376	1.497	U	2.08
CALCIUM	UG/L	L	47	100.0	1700	76500	125662.019	.	30742.576	1.967	U	2.08
MAGNESIUM	UG/L	L	46	95.7	28.5 U	6860	21444.922	.	3526.854	2.375	U	2.09
MANGANESE	UG/L	L	47	68.1	1 U	129	43.659	.	2.670	3.830	U	2.08
POTASSIUM	UG/L	L	39	94.9	320 U	1960	1272.334	.	604.400	1.418	U	2.13
STRONTIUM	UG/L	L	45	97.8	51.05	7930	581.734	.	127.028	2.069	U	2.09

TABLE 5-118
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS IN GROUND WATER FROM SOUTH ROCKY FLATS IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ARSENIC	UG/L	U	17	0.0	0.9 U	10 U	.	.	.	.	U	.
BARIUM	UG/L	L	22	90.9	69.4	203	214.185	.	121.990	1.271	U	2.35
CALCIUM	UG/L	L	22	100.0	62000	149000	156794.709	.	90805.861	1.262	U	2.35
MAGNESIUM	UG/L	L	21	100.0	11200	223000	84998.896	.	19532.740	1.859	U	2.37
MANGANESE	UG/L	L	22	68.2	1 U	396	2791.629	.	7.310	12.566	U	2.35
POTASSIUM	UG/L	L	20	90.0	225	5000 U	5331.389	.	938.649	2.065	U	2.40
STRONTIUM	UG/L	L	21	100.0	351	8730	2925.851	.	601.640	1.948	U	2.37

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-119
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS IN GROUND WATER FROM SOUTH ROCKY FLATS IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ARSENIC	UG/L	U	11	9.1	1 U	15	.	.	.	.	U	.
CALCIUM	UG/L	L	13	100.0	36900	152000	216291.187	.	60834.625	1.608	U	2.67
MAGNESIUM	UG/L	L	13	100.0	7250	42500	66356.399	.	13395.875	1.821	U	2.67
POTASSIUM	UG/L	L	11	90.9	1090	5000 U	4528.665	.	1582.432	1.453	U	2.81
STRONTIUM	UG/L	L	13	100.0	231	1910	3242.179	.	458.855	2.080	U	2.67

TABLE 5-120
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS IN GROUND WATER FROM SOUTH ROCKY FLATS RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ANTIMONY	UG/L	L	61	63.9	7.6	60 U	51.248	.	13.932	1.906	U	2.02
CESIUM	UG/L	U	40	27.5	2 U	2500 U	.	.	.	.	U	.
MOLYBDENUM	UG/L	U	95	35.8	2 U	100 U	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-121
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
MANGANESE	UG/L	L	12	58.3	1 U	440	2222.336	.	2.749	11.550	U	2.74

TABLE 5-122
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BARIUM	UG/L	L	36	94.4	34.6	200 U	153.252	.	81.182	1.342	U	2.16

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-123
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN COL KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
TRITIUM	PCI/L	U	54	100.0	-150	413.1	309.837	.	66.751	118.795	U	2.05

TABLE 5-124
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
GROSS ALPHA - DISSOLVED	PCI/L	U	16	100.0	0.4028	312.7	295.231	.	54.405	95.428	U	2.52
GROSS BETA - DISSOLVED	PCI/L	U	13	100.0	0.6871	135.9	122.203	.	22.290	37.414	U	2.67
STRONTIUM-89,90	PCI/L	U	13	100.0	-0.396	0.7469	0.967	.	0.254	0.267	U	2.67
URANIUM-233,234	PCI/L	U	16	100.0	1.221	199.5	204.433	.	39.723	65.266	U	2.52
URANIUM-235	PCI/L	U	16	100.0	0	4.803	5.073	.	1.064	1.588	U	2.52
URANIUM-238	PCI/L	U	15	100.0	0.5167	135.6	143.657	.	28.464	44.892	U	2.57

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-125
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
GROSS ALPHA - DISSOLVED	PCI/L	U	41	100.0	-0.368	36.65	19.590	.	3.957	7.380	U	2.12
GROSS BETA - DISSOLVED	PCI/L	U	35	100.0	0.8128	13.8	10.687	.	3.874	3.145	U	2.17
URANIUM-233,234	PCI/L	U	38	100.0	-0.0099	15.33	9.057	.	1.944	3.323	U	2.14
URANIUM-235	PCI/L	U	38	100.0	-0.0187	0.231	0.184	.	0.041	0.067	U	2.14
URANIUM-238	PCI/L	U	36	100.0	-0.183	8.01	4.765	.	0.871	1.805	U	2.16

TABLE 5-126
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
GROSS ALPHA - DISSOLVED	PCI/L	U	44	100.0	-0.169	2.47	1.963	.	0.609	0.645	U	2.10
GROSS BETA - DISSOLVED	PCI/L	U	37	100.0	0.03085	7.416	4.467	.	1.677	1.298	U	2.15
STRONTIUM-89,90	PCI/L	U	44	100.0	-0.214	0.5712	0.604	.	0.276	0.157	U	2.10
TRITIUM	PCI/L	U	43	95.3	-61.2	370.3	351.889	.	133.640	103.690	U	2.10
URANIUM-233,234	PCI/L	U	45	100.0	-0.02355	0.88	0.721	.	0.227	0.236	U	2.09
URANIUM-235	PCI/L	U	45	100.0	-0.0271	0.38	0.167	.	0.027	0.067	U	2.09
URANIUM-238	PCI/L	U	45	100.0	-0.022	0.6708	0.478	.	0.151	0.156	U	2.09

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-127
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
GROSS ALPHA - DISSOLVED	PCI/L	U	33	100.0	-0.0405	152.5	65.099	.	7.726	26.243	U	2.19
GROSS BETA - DISSOLVED	PCI/L	U	27	100.0	0.56455	53.05	26.767	.	4.793	9.723	U	2.26
STRONTIUM-89,90	PCI/L	U	32	100.0	0.068055	1.454	1.150	.	0.512	0.291	U	2.20
TRITIUM	PCI/L	U	36	100.0	-64.2	561.2	392.169	.	114.030	128.907	U	2.16
URANIUM-233,234	PCI/L	U	31	100.0	0.09159	20.26	10.467	.	2.465	3.624	U	2.21
URANIUM-235	PCI/L	U	31	100.0	-0.03048	0.8535	0.430	.	0.081	0.158	U	2.21
URANIUM-238	PCI/L	U	30	100.0	0	15.5	8.140	.	1.853	2.832	U	2.22

TABLE 5-128
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
GROSS ALPHA - DISSOLVED	PCI/L	U	27	100.0	1.548	23.21	22.313	.	8.259	6.218	U	2.26
GROSS BETA - DISSOLVED	PCI/L	U	24	100.0	1.66	9.387	10.330	.	4.856	2.370	U	2.31
TRITIUM	PCI/L	U	22	100.0	-223	189.2	274.143	.	4.772	114.677	U	2.35
URANIUM-233,234	PCI/L	U	26	100.0	1.324	15.59	15.176	.	5.377	4.307	U	2.28
URANIUM-235	PCI/L	U	26	100.0	-0.0109	0.4045	0.377	.	0.120	0.113	U	2.28
URANIUM-238	PCI/L	U	26	100.0	0.3893	9.936	10.297	.	3.537	2.971	U	2.28

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-129
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN RFA VFA KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/L	U	3	100.0	0.003	0.028	.	.	.	.	U	.
GROSS ALPHA	PCI/L	U	2	100.0	0.7	0.9	.	.	.	.	U	.
GROSS BETA	PCI/L	U	2	100.0	3.5	7.9	.	.	.	.	U	.
PLUTONIUM-239,240	PCI/L	U	1	100.0	0.011	0.011	.	.	.	.	U	.

TABLE 5-130
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
RADIUM-226	PCI/L	U	20	100.0	0.1026	2.981	1.878	.	0.401	0.616	U	2.40

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-131
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
STRONTIUM-89,90	PCI/L	U	35	100.0	0.009756	1.289	0.908	.	0.350	0.258	U	2.17

TABLE 5-132
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CALCIUM	UG/L	L	6	100.0	59900	144000	354200.012	.	87676.639	1.457	U	3.71
LITHIUM	UG/L	L	6	83.3	6.3	205	15762.425	.	49.235	4.739	U	3.71
MAGNESIUM	UG/L	L	6	100.0	10800	33400	115184.880	.	17001.969	1.675	U	3.71
SODIUM	UG/L	L	6	100.0	23600	190000	2406648.608	.	63987.563	2.660	U	3.71
STRONTIUM	UG/L	L	6	100.0	330	1060	4001.538	.	548.724	1.709	U	3.71

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-133
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CALCIUM	UG/L	L	13	100.0	10800	91900	154031.314	.	26289.005	1.939	U	2.67
LITHIUM	UG/L	L	13	84.6	6.7	99.5	271.802	.	27.881	2.346	U	2.67
MAGNESIUM	UG/L	L	13	100.0	1950	19100	26784.488	.	4900.993	1.889	U	2.67
SODIUM	UG/L	L	13	100.0	11500	425000	1751482.491	.	81572.969	3.153	U	2.67
STRONTIUM	UG/L	L	13	100.0	121	1110	1842.292	.	288.379	2.003	U	2.67

TABLE 5-134
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CALCIUM	UG/L	L	23	100.0	15950	74500	97261.404	.	33742.858	1.576	U	2.33
LITHIUM	UG/L	L	23	95.7	1.2	50 U	34.288	.	5.819	2.142	U	2.33
MAGNESIUM	UG/L	L	23	100.0	2465	18400	11567.976	.	4685.556	1.474	U	2.33
SODIUM	UG/L	L	23	100.0	4340	10580	12460.018	.	7348.811	1.255	U	2.33
STRONTIUM	UG/L	L	23	100.0	58.1	270	289.374	.	128.722	1.416	U	2.33

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-135
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CALCIUM	UG/L	L	13	100.0	18900	116000	314074.899	.	51606.482	1.967	U	2.67
LITHIUM	UG/L	L	13	92.3	6.6	101	120.427	.	18.243	2.027	U	2.67
MAGNESIUM	UG/L	L	13	100.0	4200	29400	56291.142	.	11642.323	1.804	U	2.67
SODIUM	UG/L	L	13	100.0	13485.75	74000	135608.198	.	30906.540	1.740	U	2.67
STRONTIUM	UG/L	L	13	100.0	119.8	873	2051.452	.	327.106	1.989	U	2.67

TABLE 5-136
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
LITHIUM	UG/L	L	8	100.0	9.9	38.9	86.885	.	17.252	1.661	U	3.19
MAGNESIUM	UG/L	L	8	100.0	5710	15900	32173.857	.	9794.577	1.452	U	3.19
SODIUM	UG/L	L	8	100.0	14800	43500	93698.884	.	25955.507	1.496	U	3.19
STRONTIUM	UG/L	L	8	100.0	216	570	1162.795	.	329.074	1.486	U	3.19

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-137
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS IN GROUND WATER IN RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BARIUM	UG/L	U	63	98.4	41.6	1810	603.523	.	134.356	233.233	U	2.01
BERYLLIUM	UG/L	U	62	8.1	1 U	160	.	.	.	.	U	.
CADMIUM	UG/L	U	61	24.6	1 U	1720	.	.	.	.	U	.
CESIUM	UG/L	U	63	6.3	2 U	1000 U	.	.	.	.	U	.
CHROMIUM	UG/L	U	59	55.9	4 U	1590	453.916	.	36.201	206.189	U	2.03
COBALT	UG/L	U	62	22.6	2 U	1620	.	.	.	.	U	.
COPPER	UG/L	U	61	27.9	3 U	1750	.	.	.	.	U	.
CYANIDE	UG/L	U	131	5.3	1.5 U	28	.	.	.	.	U	.
MERCURY	UG/L	U	62	1.6	0.2 U	0.27	.	.	.	.	U	.
MOLYBDENUM	UG/L	U	63	44.4	2 U	1600	.	.	.	.	U	.
NICKEL	UG/L	U	62	16.1	3 U	1660	.	.	.	.	U	.
SELENIUM	UG/L	U	60	23.3	1 U	80	.	.	.	.	U	.
SILICON	UG/L	N	13	100.0	1.3088	32600	32845.609	.	11055.254	8159.642	U	2.67
SILVER	UG/L	U	60	15.0	2 U	300	.	.	.	.	U	.
THALLIUM	UG/L	U	59	16.9	1 U	3	.	.	.	.	U	.

TABLE 5-138
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS IN GROUND WATER IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CALCIUM	UG/L	L	8	100.0	34000	68600	117426.734	.	48006.527	1.324	U	3.19

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-139
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
POTASSIUM	UG/L	L	6	100.0	2150	5950	13626.492	.	2977.848	1.507	U	3.71
VANADIUM	UG/L	U	6	83.3	5.9	1670	2798.237	.	288.317	676.951	U	3.71

TABLE 5-140
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
POTASSIUM	UG/L	L	8	100.0	598	8370	16191.189	.	1061.784	2.351	U	3.19

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-141
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
VANADIUM	UG/L	U	7	100.0	6.2	36.3	55.508	.	16.671	11.424	U	3.40

TABLE 5-142
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN .	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
VANADIUM	UG/L	U	4	75.0	3.8	13.4 U	.	.	.	.	C	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-143
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS RFA COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
VANADIUM	UG/L	U	12	83.3	2 U	167	146.831	.	19.408	46.567	U	2.74

TABLE 5-144
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	L	29	96.6	60 U	63900	46052.412	.	1471.497	4.676	U	2.23
ANTIMONY	UG/L	U	26	46.2	7 U	1610	.	.	.	.	U	.
ARSENIC	UG/L	U	28	32.1	2 U	7	.	.	.	.	U	.
IRON	UG/L	L	29	96.6	14.8	97000	63512.531	.	1540.992	5.290	U	2.23
LEAD	UG/L	U	27	92.6	1 U	52.5	28.377	.	5.796	9.991	U	2.26
MANGANESE	UG/L	L	29	100.0	5.6	1950	1081.507	.	51.277	3.919	U	2.23
TIN	UG/L	U	29	6.9	12.2 U	100 U	.	.	.	.	U	.
ZINC	UG/L	L	29	75.9	5 U	1800	711.145	.	43.083	3.511	U	2.23

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-145
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS VFA COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
POTASSIUM	UG/L	L	15	93.3	383	5040	8260.416	.	1827.481	1.800	U	2.57

TABLE 5-146
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
POTASSIUM	UG/L	L	7	100.0	578	4160	45111.676	.	1788.886	2.584	U	3.40
VANADIUM	UG/L	U	7	42.9	2 U	6.3	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-147
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
POTASSIUM	UG/L	L	15	100.0	501	2780	3854.795	.	933.002	1.738	U	2.57

TABLE 5-148
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
VANADIUM	UG/L	U	6	83.3	5.7	8.4	12.323	.	6.292	1.627	U	3.71

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-149
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
VANADIUM	UG/L	U	4	50.0	2.3	5.9 U	.	.	.	.	C	.

TABLE 5-50
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS RFA COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
VANADIUM	UG/L	U	17	76.5	2.5	29	29.721	.	8.371	8.588	U	2.49

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-151
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS IN GROUND WATER FROM SOUTH ROCKY FLATS RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	L	34	76.5	11 U	12550	23957.775	.	249.663	8.143	U	2.18
ANTIMONY	UG/L	U	31	19.4	7 U	70 U	.	.	.	.	U	.
ARSENIC	UG/L	U	25	8.0	2 U	3	.	.	.	.	U	.
IRON	UG/L	L	33	78.8	9.8 U	14800	36844.569	.	301.557	9.007	U	2.19
LEAD	UG/L	U	27	59.3	1 U	13.8	9.233	.	2.369	3.037	U	2.26
MANGANESE	UG/L	L	34	91.2	1 U	278	932.505	.	14.489	6.778	U	2.18
TIN	UG/L	U	34	26.5	11.75 U	100 U	.	.	.	.	U	.
ZINC	UG/L	U	34	44.1	4.2 U	498	.	.	.	.	U	.

TABLE 5-152
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS IN GROUND WATER FROM SOUTH ROCKY FLATS VFA COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
POTASSIUM	UG/L	L	12	83.3	289 U	2000 U	7464.326	.	930.697	2.140	U	2.74

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-153
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-233,234	PCI/L	U	6	100.0	2.405	164	320.452	.	55.987	71.329	U	3.71
URANIUM-238	PCI/L	U	4	100.0	1.772	108	294.870	.	31.236	51.252	U	5.14

TABLE 5-154
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CESIUM-137	PCI/L	U	29	93.1	-0.442	0.63 U	0.479	.	-0.046	0.235	U	2.23
URANIUM-233,234	PCI/L	U	4	100.0	0.15	1.52	3.685	.	0.770	0.567	U	5.14

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the *minimum* and *maximum* values.

TABLE 5-155
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-233,234	PCI/L	U	12	100.0	0	1.33	1.717	.	0.476	0.454	U	2.74
URANIUM-238	PCI/L	U	11	100.0	0	1.418	1.817	.	0.404	0.502	U	2.81

TABLE 5-156
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-233,234	PCI/L	U	9	100.0	0.1	107.42	156.312	.	23.574	43.790	U	3.03

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. *Tolerance factors are based on 95% confidence of 95% coverage and are one sided,* except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-157
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CESIUM-137	PCI/L	U	12	83.3	-0.19	0.89 U	0.713	.	0.158	0.203	C	2.74
URANIUM-233,234	PCI/L	U	8	100.0	1.83	17.5	27.585	.	7.492	6.304	U	3.19

TABLE 5-158
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN RFA VFA COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CESIUM-137	PCI/L	U	110	93.6	-0.594	1.16	0.700	.	0.091	0.318	U	1.91

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-159
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES IN GROUND WATER IN RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/L	U	129	100.0	-0.00706	0.09698	0.032	.	0.007	0.013	U	1.89
GROSS ALPHA	PCI/L	U	14	100.0	0.351	362	314.552	.	46.929	102.364	U	2.61
GROSS ALPHA - DISSOLVED	PCI/L	U	15	100.0	1.9	214.8	199.271	.	32.780	64.883	U	2.57
GROSS BETA	PCI/L	U	14	100.0	1.1	220	191.580	.	30.150	61.746	U	2.61
GROSS BETA - DISSOLVED	PCI/L	U	15	100.0	0.2	133.9	140.766	.	24.213	45.422	U	2.57
PLUTONIUM-238	PCI/L	U	20	100.0	-0.000669	0.03587	0.028	.	0.005	0.010	U	2.40
STRONTIUM-89,90	PCI/L	U	14	100.0	0.02	0.73	0.836	.	0.277	0.214	U	2.61
STRONTIUM-90	PCI/L	U	20	100.0	-0.286	1.12	0.906	.	0.152	0.315	U	2.40
TRITIUM	PCI/L	U	23	69.6	-180	1350	936.738	.	280.239	281.962	U	2.33

TABLE 5-160
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES IN GROUND WATER IN VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
RADIUM-226	PCI/L	U	7	100.0	0.0709	0.88	1.480	.	0.420	0.312	U	3.40

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-161
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER IN VFA WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-238	PCI/L	U	8	100.0	0.169	73.4	91.978	.	11.489	25.253	U	3.19

TABLE 5-162
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM NORTH ROCKY FLATS IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-235	PCI/L	U	6	100.0	0.37	6.29	10.939	.	1.960	2.422	U	3.71

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-163
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM NORTH ROCKY FLATS IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-235	PCI/L	U	2	100.0	0	0.0427	.	.	.	.	U	.

TABLE 5-164
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM NORTH ROCKY FLATS IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-235	PCI/L	U	5	100.0	0	0.255	0.530	.	0.065	0.110	U	4.20

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-165
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM NORTH ROCKY FLATS IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-235	PCI/L	U	3	100.0	0	0.208	.	.	.	.	U	.

TABLE 5-166
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM NORTH ROCKY FLATS RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
PLUTONIUM-239,240	PCI/L	U	67	100.0	-0.0057	0.1014	0.028	.	0.003	0.012	U	2.00

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-167
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM NORTH ROCKY FLATS WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-235	PCI/L	U	2	100.0	-0.02	0.19	.	.	.	.	U	.

TABLE 5-168
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM SOUTH ROCKY FLATS IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN .	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-235	PCI/L	U	2	100.0	0.034	0.04	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-169
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM SOUTH ROCKY FLATS IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-235	PCI/L	U	7	100.0	0	0.667	0.999	.	0.166	0.245	U	3.40

TABLE 5-170
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM SOUTH ROCKY FLATS IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-235	PCI/L	U	6	100.0	-0.01	3.57	7.652	.	1.234	1.731	U	3.71

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-171
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM SOUTH ROCKY FLATS RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
PLUTONIUM-239,240	PCI/L	U	81	100.0	-0.00327	0.2237	0.064	.	0.006	0.029	U	1.96

TABLE 5-172
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GROUND WATER FROM SOUTH ROCKY FLATS WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN .	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-235	PCI/L	U	6	100.0	-0.01	0.751	1.339	.	0.350	0.267	U	3.71

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-173
BACKGROUND STATISTICS FOR TOTAL FIELD PARAMETER CONCENTRATIONS
IN GROUND WATER IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
DISSOLVED OXYGEN	MG/L	N	43	100.0	0	12.5	13.160	.	6.872	2.988	U	2.10
FIELD-MEASURED PH	PHUNIT	L	44	100.0	6.89	9.13	8.679	6.633	7.588	1.057	U	2.42
SPECIFIC CONDUCTANCE	US/CM	L	45	100.0	460	2492.16	2594.267	.	924.516	1.637	U	2.09

TABLE 5-174
BACKGROUND STATISTICS FOR TOTAL FIELD PARAMETER CONCENTRATIONS
IN GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
DISSOLVED OXYGEN	MG/L	N	56	100.0	1.8	14	10.696	.	5.479	2.560	U	2.04
FIELD-MEASURED PH	PHUNIT	L	60	100.0	6.84	10.12	10.179	6.423	8.086	1.104	U	2.33
SPECIFIC CONDUCTANCE	US/CM	L	60	100.0	240	2957.76	3512.873	.	749.557	2.147	U	2.02

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-175
BACKGROUND STATISTICS FOR TOTAL FIELD PARAMETER CONCENTRATIONS
IN GROUND WATER IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
DISSOLVED OXYGEN	MG/L	N	60	100.0	1	13.6	13.871	.	8.777	2.519	U	2.02
FIELD-MEASURED PH	PHUNIT	L	68	100.0	6.3	8.4	8.099	6.273	7.128	1.057	U	2.31
SPECIFIC CONDUCTANCE	US/CM	L	68	100.0	140	1119	638.643	.	267.188	1.547	U	2.00

TABLE 5-176
BACKGROUND STATISTICS FOR TOTAL FIELD PARAMETER CONCENTRATIONS
IN GROUND WATER IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
DISSOLVED OXYGEN	MG/L	N	53	100.0	0.7	14.2	11.593	.	5.832	2.809	U	2.05
FIELD-MEASURED PH	PHUNIT	L	54	100.0	5.38	8.7	8.556	6.203	7.285	1.071	U	2.36
SPECIFIC CONDUCTANCE	US/CM	L	54	100.0	160	16700	5780.027	.	762.295	2.691	U	2.05

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-177
BACKGROUND STATISTICS FOR TOTAL FIELD PARAMETER CONCENTRATIONS
IN GROUND WATER IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
DISSOLVED OXYGEN	MG/L	N	49	100.0	3	14.2	11.539	.	7.624	1.891	U	2.07
FIELD-MEASURED PH	PHUNIT	L	51	100.0	7.18	11.71	9.594	6.534	7.917	1.084	U	2.37
SPECIFIC CONDUCTANCE	US/CM	L	51	100.0	270	2360	1956.426	.	609.525	1.761	U	2.06

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-178
BACKGROUND STATISTICS FOR TOTAL VOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN GROUND WATER IN RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,1,1-TRICHLOROETHANE	UG/L	U	268	1.1	2	8	.	.	.	.	U	.
1,1,2,2-TETRACHLOROETHANE	UG/L	U	274	0.0	5 U	5 U	.	.	.	.	U	.
1,1,2-TRICHLOROETHANE	UG/L	U	274	0.0	5 U	5 U	.	.	.	.	U	.
1,1-DICHLOROETHANE	UG/L	U	274	0.4	2	5 U	.	.	.	.	U	.
1,1-DICHLOROETHENE	UG/L	U	274	0.4	5 U	7	.	.	.	.	U	.
1,2-DICHLOROETHANE	UG/L	U	274	0.4	1	5 U	.	.	.	.	U	.
1,2-DICHLOROETHENE	UG/L	U	246	0.4	3	5 U	.	.	.	.	U	.
1,2-DICHLOROPROPANE	UG/L	U	274	0.4	1	5 U	.	.	.	.	U	.
1,2-DIMETHYLBENZENE	UG/L	U	9	0.0	5 U	5 U	.	.	.	.	U	.
2-BUTANONE	UG/L	U	196	1.0	1	10 U	.	.	.	.	U	.
2-CHLOROETHYL VINYL ETHER	UG/L	U	12	0.0	10 U	10 U	.	.	.	.	U	.
2-HEXANONE	UG/L	U	255	0.0	5 U	10 U	.	.	.	.	U	.
4-METHYL-2-PENTANONE	UG/L	U	270	0.0	10 U	10 U	.	.	.	.	U	.
ACETONE	UG/L	U	246	18.3	1	36	.	.	.	.	U	.
BENZENE	UG/L	U	274	0.0	5 U	5 U	.	.	.	.	U	.
BROMODICHLOROMETHANE	UG/L	U	271	0.0	5 U	5 U	.	.	.	.	U	.
BROMOFORM	UG/L	U	271	0.0	5 U	10 U	.	.	.	.	U	.
BROMOMETHANE	UG/L	U	262	0.0	10 U	10 U	.	.	.	.	U	.
CARBON DISULFIDE	UG/L	U	263	0.8	1	31	.	.	.	.	U	.
CARBON TETRACHLORIDE	UG/L	U	264	0.8	2	5 U	.	.	.	.	U	.
CHLOROBENZENE	UG/L	U	274	1.1	1.75	5 U	.	.	.	.	U	.
CHLOROETHANE	UG/L	U	261	0.0	10 U	10 U	.	.	.	.	U	.
CHLOROFORM	UG/L	U	274	1.1	1	5 U	.	.	.	.	U	.
CHLOROMETHANE	UG/L	U	263	0.0	10 U	10 U	.	.	.	.	U	.
DIBROMOCHLOROMETHANE	UG/L	U	274	0.0	5 U	5 U	.	.	.	.	U	.
ETHYLBENZENE	UG/L	U	274	0.0	5 U	5 U	.	.	.	.	U	.
METHYLENE CHLORIDE	UG/L	U	274	28.8	1	25	.	.	.	.	U	.
STYRENE	UG/L	U	267	0.0	5 U	5 U	.	.	.	.	U	.
TETRACHLOROETHENE	UG/L	U	274	2.2	1	42	.	.	.	.	U	.
TOLUENE	UG/L	U	274	2.2	1	6	.	.	.	.	U	.
TOTAL XYLENES	UG/L	U	260	0.4	5 U	7	.	.	.	.	U	.
TRICHLOROETHENE	UG/L	U	274	2.9	2	42	.	.	.	.	U	.
VINYL ACETATE	UG/L	U	266	0.0	10 U	10 U	.	.	.	.	U	.
VINYL CHLORIDE	UG/L	U	273	0.0	10 U	10 U	.	.	.	.	U	.
cis-1,3-DICHLOROPROPENE	UG/L	U	274	0.4	3	5 U	.	.	.	.	U	.
trans-1,2-DICHLOROETHENE	UG/L	U	30	0.0	5 U	5 U	.	.	.	.	U	.
trans-1,3-DICHLOROPROPENE	UG/L	U	268	0.0	5 U	5 U	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-179
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
SILICA	UG/L	L	21	100.0	6000	42000	24023.241	.	8742.503	1.532	U	2.37
SULFATE	UG/L	L	27	100.0	30000	770000	1063290.462	.	110782.136	2.720	U	2.26

TABLE 5-180
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
SILICA	UG/L	L	46	100.0	17	28200	37098.104	.	4467.930	2.758	U	2.09
SULFATE	UG/L	L	53	96.2	600	1200000	895031.054	.	26198.326	5.595	U	2.05

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-181
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
SILICA	UG/L	L	51	100.0	3800	57000	22030.351	.	10547.889	1.430	U	2.06
SULFATE	UG/L	L	67	100.0	2900	203000	53734.539	.	20224.383	1.631	U	2.00

TABLE 5-182
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
SILICA	UG/L	L	36	100.0	4200	70597.89	38605.129	.	10232.040	1.850	U	2.16
SULFATE	UG/L	L	47	100.0	4505	2800000	1034598.014	.	53424.304	4.155	U	2.08

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-183
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS IN GROUND WATER IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
SILICA	UG/L	L	28	100.0	3800	33000	25061.682	.	7455.738	1.716	U	2.25
SULFATE	UG/L	L	36	100.0	18000	890000	503510.082	.	54937.168	2.792	U	2.16

TABLE 5-184
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS IN GROUND WATER IN RFA VFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALKALINITY AS CACO3	UG/L	U	2	100.0	70200	205500	.	.	.	.	U	.
BICARBONATE	UG/L	L	16	100.0	60300	526000	770444.867	.	154586.999	1.890	U	2.52
CARBONATE	UG/L	U	32	6.2	500.5 U	10000 U	.	.	.	.	U	.
CARBONATE AS CACO3	UG/L	U	181	39.2	0	54000	.	.	.	.	U	.
CYANIDE	UG/L	U	45	2.2	2 U	20 U	.	.	.	.	U	.
NITRATE	UG/L	U	6	50.0	100 U	1070	.	.	.	.	U	.
NITRITE	UG/L	U	62	11.3	10 U	900	.	.	.	.	U	.
ORTHOPHOSPHATE	UG/L	U	118	45.8	0.01	190	.	.	.	.	U	.
PH	PHUNIT	U	1	100.0	6.9	6.9	.	.	.	.	U	.
PHOSPHORUS	UG/L	L	65	60.0	10 U	15000	612.264	.	27.843	4.671	U	2.00

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-185
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	L	20	100.0	180000	620000	945228.876	.	336000.586	1.540	U	2.40
CHLORIDE	UG/L	L	19	100.0	3500	185000	149863.649	.	16446.904	2.489	U	2.42
FLUORIDE	UG/L	L	20	100.0	550	2100	2790.802	.	1015.675	1.525	U	2.40
NITRATE/NITRITE	UG/L	L	22	72.7	20	311000	208724.379	.	314.956	15.889	U	2.35
TOTAL DISSOLVED SOLIDS	UG/L	L	21	100.0	270000	1580000	2516438.367	.	697798.164	1.718	U	2.37
TOTAL SUSPENDED SOLIDS	UG/L	L	21	71.4	4000 U	96000	372612.066	.	10802.402	4.451	C	2.37

TABLE 5-186
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	L	26	100.0	100000	210000	254833.633	.	160053.925	1.227	U	2.28
CHLORIDE	UG/L	L	25	100.0	2600	420000	2733178.587	.	24581.570	7.813	U	2.29
FLUORIDE	UG/L	L	29	100.0	500	2000	2560.306	.	1130.390	1.442	U	2.23
NITRATE/NITRITE	UG/L	L	22	95.5	20 U	3600	22706.939	.	750.864	4.269	U	2.35
TOTAL DISSOLVED SOLIDS	UG/L	L	29	100.0	190000	1600000	2777362.165	.	437523.152	2.288	U	2.23
TOTAL SUSPENDED SOLIDS	UG/L	L	29	100.0	7000	2500000	5746317.582	.	324315.905	3.624	U	2.23

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-187
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS IN GROUND WATER FROM NORTH ROCKY FLATS IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	L	24	100.0	60000	180000	153625.764	.	84136.662	1.298	U	2.31
CHLORIDE	UG/L	L	20	95.0	3400	11000	8405.936	.	4291.096	1.324	U	2.40
FLUORIDE	UG/L	L	24	95.8	300	500	576.788	.	359.259	1.228	U	2.31
NITRATE/NITRITE	UG/L	L	24	100.0	1600	3200	3469.229	.	2213.553	1.215	U	2.31
TOTAL DISSOLVED SOLIDS	UG/L	L	24	100.0	110000	320000	325266.566	.	179301.354	1.294	U	2.31
TOTAL SUSPENDED SOLIDS	UG/L	L	24	100.0	6000	2400000	1656251.264	.	91620.047	3.503	U	2.31

TABLE 5-188
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS IN GROUND WATER FROM NORTH ROCKY FLATS IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	L	24	100.0	36140	590000	484563.407	.	132637.173	1.753	U	2.31
CHLORIDE	UG/L	L	24	95.8	900	15200	31947.933	.	6410.988	2.005	U	2.31
FLUORIDE	UG/L	L	26	100.0	200.15	600	649.800	.	388.072	1.254	U	2.28
NITRATE/NITRITE	UG/L	L	24	75.0	20	2100	5572.127	.	147.108	4.825	U	2.31
TOTAL DISSOLVED SOLIDS	UG/L	L	26	100.0	6000	1170000	1450045.857	.	205959.109	2.358	U	2.28
TOTAL SUSPENDED SOLIDS	UG/L	L	24	91.7	4000 U	700390	2555499.620	.	40196.913	6.038	U	2.31

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-189
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER FROM NORTH ROCKY FLATS IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	L	20	100.0	76000	220000	332343.997	.	141645.846	1.428	U	2.40
CHLORIDE	UG/L	L	7	100.0	1300	3800	8219.184	.	2338.490	1.447	U	3.40
FLUORIDE	UG/L	L	20	100.0	590	2400	2954.905	.	1059.374	1.534	U	2.40
NITRATE/NITRITE	UG/L	L	17	100.0	110	2600	3516.798	.	421.922	2.346	U	2.49
TOTAL DISSOLVED SOLIDS	UG/L	L	20	100.0	170000	290000	336672.733	.	237070.342	1.158	U	2.40
TOTAL SUSPENDED SOLIDS	UG/L	L	20	100.0	2000	460000	1985123.005	.	85048.508	3.724	U	2.40

TABLE 5-190
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	L	8	100.0	180000	320000	379954.511	.	218106.671	1.190	U	3.19
CHLORIDE	UG/L	L	8	100.0	13000	25000	39980.040	.	18134.330	1.282	U	3.19
FLUORIDE	UG/L	L	8	100.0	500	2200	7841.469	.	873.389	1.991	U	3.19
NITRATE/NITRITE	UG/L	L	7	85.7	20 U	600	25819.417	.	194.069	4.215	U	3.40
TOTAL DISSOLVED SOLIDS	UG/L	L	8	100.0	280000	650000	801632.030	.	342721.987	1.306	U	3.19
TOTAL SUSPENDED SOLIDS	UG/L	L	8	62.5	4000 U	14000	57179.718	.	5466.015	2.089	C	3.19

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-191
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	L	26	100.0	52000	490000	529689.314	.	192820.603	1.559	U	2.28
CHLORIDE	UG/L	L	23	95.7	4200	230000	1278362.938	.	34469.514	4.720	U	2.33
FLUORIDE	UG/L	L	25	100.0	200	1300	2672.161	.	614.351	1.899	U	2.29
NITRATE/NITRITE	UG/L	L	27	85.2	20 U	3300	12663.275	.	204.754	6.203	U	2.26
TOTAL DISSOLVED SOLIDS	UG/L	L	27	100.0	160000	1000000	1206931.634	.	375827.519	1.676	U	2.26
TOTAL SUSPENDED SOLIDS	UG/L	L	26	65.4	4000 U	1600000	2222530.628	.	16827.558	8.553	U	2.28

TABLE 5-192
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	L	41	100.0	38500	180000	227839.588	.	83248.991	1.608	U	2.12
CHLORIDE	UG/L	L	41	92.7	1200	48000	35876.450	.	6144.201	2.300	U	2.12
FLUORIDE	UG/L	L	39	87.2	200 U	50000 U	1716.747	.	302.814	2.256	U	2.13
NITRATE/NITRITE	UG/L	L	46	100.0	165	2050	2577.081	.	923.795	1.635	U	2.09
TOTAL DISSOLVED SOLIDS	UG/L	L	47	100.0	100000	310000	304827.148	.	175907.240	1.302	U	2.08
TOTAL SUSPENDED SOLIDS	UG/L	L	44	88.6	4000 U	1400000	2896760.039	.	52273.465	6.775	U	2.10

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-193
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS IN VFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	L	21	100.0	198000	430000	509332.113	.	295315.309	1.258	U	2.37
CHLORIDE	UG/L	L	23	100.0	15000	260000	347746.155	.	36242.398	2.641	U	2.33
FLUORIDE	UG/L	L	23	100.0	400	8200	9517.363	.	1011.855	2.619	U	2.33
NITRATE/NITRITE	UG/L	L	20	85.0	20 U	2800 U	1123.800	.	108.707	2.651	C	2.40
TOTAL DISSOLVED SOLIDS	UG/L	L	24	100.0	290000	4590000	5208971.594	.	638044.574	2.482	U	2.31
TOTAL SUSPENDED SOLIDS	UG/L	L	23	82.6	4000 U	310000	236329.032	.	14315.729	3.334	U	2.33

TABLE 5-194
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GROUND WATER FROM SOUTH ROCKY FLATS IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BICARBONATE AS CACO3	UG/L	L	16	100.0	140000	470000	770424.028	.	248511.649	1.566	U	2.52
CHLORIDE	UG/L	L	13	100.0	2400	36000	127071.870	.	14039.618	2.282	U	2.67
FLUORIDE	UG/L	L	15	86.7	200 U	800	1781.180	.	477.884	1.670	U	2.57
NITRATE/NITRITE	UG/L	L	17	94.1	90	5300	6317.637	.	454.054	2.883	U	2.49
TOTAL DISSOLVED SOLIDS	UG/L	L	17	100.0	180000	1430000	2760446.587	.	414110.170	2.145	U	2.49
TOTAL SUSPENDED SOLIDS	UG/L	L	17	52.9	4000 U	60000	88706.417	.	5299.024	3.106	U	2.49

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-195
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN UPPER FLOW SYSTEM GROUND WATER IN RFA VFA COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	L	138	81.2	5 U	8610	258.522	.	38.596	2.754	U	1.88
ANTIMONY	UG/L	L	108	52.8	6 U	60 U	46.588	.	11.891	2.038	U	1.92
ARSENIC	UG/L	U	117	3.4	0.8 U	15	.	.	.	.	U	.
BARIUM	UG/L	L	157	94.3	23.6	203	167.008	.	74.572	1.544	U	1.86
BERYLLIUM	UG/L	U	70	7.1	0.3 U	5 U	.	.	.	.	U	.
CADMIUM	UG/L	U	100	26.0	1 U	8.6	.	.	.	.	U	.
CALCIUM	UG/L	L	158	100.0	1700	184000	155636.502	.	45734.855	1.935	U	1.86
CESIUM	UG/L	U	74	14.9	2 U	2500 U	.	.	.	.	U	.
CHROMIUM	UG/L	U	145	37.2	1 U	23.2	.	.	.	.	U	.
COBALT	UG/L	U	83	22.9	2	50 U	.	.	.	.	U	.
COPPER	UG/L	U	149	37.6	1 U	175	.	.	.	.	U	.
CYANIDE	UG/L	U	3	0.0	5 U	10 U	.	.	.	.	U	.
IRON	UG/L	L	143	72.7	3 U	8790	310.708	.	28.937	3.555	U	1.87
LEAD	UG/L	U	150	23.3	0.4 U	64	.	.	.	.	U	.
LITHIUM	UG/L	L	141	75.9	1 U	281	152.211	.	11.045	4.055	U	1.87
MAGNESIUM	UG/L	L	155	98.7	28.5 U	223000	42066.485	.	7538.342	2.522	U	1.86
MANGANESE	UG/L	L	157	74.5	1 U	934	163.079	.	5.066	6.488	U	1.86
MERCURY	UG/L	U	66	3.0	0.1 U	0.36	.	.	.	.	U	.
MOLYBDENUM	UG/L	U	137	40.1	2 U	114	.	.	.	.	U	.
NICKEL	UG/L	U	97	38.1	2 U	40 U	.	.	.	.	U	.
PHOSPHORUS	UG/L	U	9	55.6	80 U	231	376.424	.	130.933	80.987	C	3.03
POTASSIUM	UG/L	L	142	93.7	170	8110	3857.536	.	955.337	2.107	U	1.87
SELENIUM	UG/L	U	120	36.7	0.975	607	.	.	.	.	U	.
SILICON	UG/L	N	40	97.5	2 U	14500	13871.222	.	7196.459	3140.335	U	2.13
SILVER	UG/L	U	137	34.3	2 U	20 U	.	.	.	.	U	.
SODIUM	UG/L	L	155	99.4	10 U	923000	186709.124	.	18213.921	3.498	U	1.86
STRONTIUM	UG/L	L	153	98.7	51.05	8730	1321.221	.	244.805	2.475	U	1.86
THALLIUM	UG/L	U	72	12.5	0.6 U	328	.	.	.	.	U	.
TIN	UG/L	L	119	54.6	10 U	340	105.962	.	16.647	2.646	U	1.90
VANADIUM	UG/L	L	148	54.1	1.2 U	57.4	16.669	.	3.215	2.416	U	1.87
ZINC	UG/L	L	154	68.8	1.1 U	137	56.328	.	8.169	2.825	U	1.86

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-196
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN UPPER FLOW SYSTEM GROUND WATER IN RFA VFA COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/L	U	2	100.0	0.003	0.019	.	.	.	.	U	.
GROSS ALPHA	PCI/L	U	2	100.0	0.7	0.9	.	.	.	.	U	.
GROSS ALPHA - DISSOLVED	PCI/L	U	120	100.0	-0.169	312.7	88.406	.	11.460	40.489	U	1.90
GROSS BETA	PCI/L	U	2	100.0	3.5	7.9	.	.	.	.	U	.
GROSS BETA - DISSOLVED	PCI/L	U	101	100.0	0.03085	135.9	35.591	.	5.918	15.381	U	1.93
PLUTONIUM-239,240	PCI/L	U	1	100.0	0.011	0.011	.	.	.	.	U	.
RADIUM-226	PCI/L	U	18	100.0	0.1026	0.426	0.497	.	0.254	0.099	U	2.45
STRONTIUM-89,90	PCI/L	U	98	100.0	-0.396	1.454	0.841	.	0.354	0.252	U	1.93
TRITIUM	PCI/L	U	121	98.3	-223	561.2	324.761	.	92.879	122.106	U	1.90
URANIUM-233,234	PCI/L	U	118	100.0	-0.02355	199.5	58.497	.	7.305	26.898	U	1.90
URANIUM-235	PCI/L	U	118	100.0	-0.03048	4.803	1.483	.	0.202	0.673	U	1.90
URANIUM-238	PCI/L	U	116	100.0	-0.022	135.6	39.814	.	5.011	18.258	U	1.91

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-197
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN UPPER FLOW SYSTEM GROUND WATER IN RFA VFA COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	L	50	88.0	22.6 U	63900	37773.269	.	664.417	7.076	U	2.06
ANTIMONY	UG/L	U	44	34.1	7 U	86.6	.	.	.	.	U	.
ARSENIC	UG/L	U	41	12.2	2 U	3.55	.	.	.	.	U	.
BARIUM	UG/L	U	50	98.0	41.6	752	318.898	.	109.489	101.409	U	2.06
BERYLLIUM	UG/L	U	49	8.2	1 U	4.8	.	.	.	.	U	.
CADMIUM	UG/L	U	48	25.0	1 U	7.8	.	.	.	.	U	.
CALCIUM	UG/L	L	50	100.0	15950	144000	146299.378	.	44711.668	1.775	U	2.06
CESIUM	UG/L	U	50	6.0	2 U	1000 U	.	.	.	.	U	.
CHROMIUM	UG/L	U	46	58.7	4 U	98.7	40.462	.	10.239	14.485	U	2.09
COBALT	UG/L	U	49	22.4	2 U	39.4	.	.	.	.	U	.
COPPER	UG/L	U	48	29.2	3 U	105	.	.	.	.	U	.
CYANIDE	UG/L	U	103	4.9	1.5 U	28	.	.	.	.	U	.
IRON	UG/L	L	49	87.8	10.4	97000	50270.833	.	732.297	7.713	U	2.07
LEAD	UG/L	U	42	81.0	1 U	52.5	21.687	.	4.214	8.276	U	2.11
LITHIUM	UG/L	U	50	94.0	1.2	205	119.589	.	25.487	45.570	U	2.06
MAGNESIUM	UG/L	U	50	100.0	2465	33400	25316.417	.	9845.900	7491.800	U	2.06
MANGANESE	UG/L	L	50	94.0	1 U	1950	1132.436	.	25.956	6.224	U	2.06
MERCURY	UG/L	U	49	2.0	0.2 U	0.27	.	.	.	.	U	.
MOLYBDENUM	UG/L	U	50	42.0	2.6	80.5	.	.	.	.	U	.
NICKEL	UG/L	U	49	16.3	3 U	71.6	.	.	.	.	U	.
POTASSIUM	UG/L	L	50	94.0	289 U	8370	5098.986	.	1164.663	2.044	U	2.06
SELENIUM	UG/L	U	47	25.5	1 U	80	.	.	.	.	U	.
SILICON	UG/L	N	11	100.0	1.3088	32600	35663.443	.	11446.210	8602.944	U	2.81
SILVER	UG/L	U	47	14.9	2 U	10 U	.	.	.	.	U	.
SODIUM	UG/L	U	50	100.0	4340	190000	107586.445	.	28274.715	38407.740	U	2.06
STRONTIUM	UG/L	L	50	100.0	58.1	1060	1014.593	.	226.855	2.066	U	2.06
THALLIUM	UG/L	U	47	17.0	1 U	3	.	.	.	.	U	.
TIN	UG/L	U	50	18.0	14 U	100 U	.	.	.	.	U	.
VANADIUM	UG/L	U	50	80.0	2 U	167	60.248	.	11.309	23.699	U	2.06
ZINC	UG/L	L	50	58.0	4.2 U	498	250.313	.	22.400	3.218	U	2.06

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-198
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN UPPER FLOW SYSTEM GROUND WATER IN RFA VFA COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/L	U	100	100.0	-0.00706	0.09698	0.031	.	0.007	0.012	U	1.93
CESIUM-137	PCI/L	U	122	92.6	-0.594	1.16	0.692	.	0.103	0.311	U	1.90
GROSS ALPHA	PCI/L	U	12	100.0	0.351	362	353.730	.	54.110	109.496	U	2.74
GROSS ALPHA - DISSOLVED	PCI/L	U	11	100.0	1.9	214.8	249.879	.	39.355	74.787	U	2.81
GROSS BETA	PCI/L	U	12	100.0	1.1	220	215.386	.	33.829	66.350	U	2.74
GROSS BETA - DISSOLVED	PCI/L	U	11	100.0	0.2	133.9	175.433	.	27.936	52.397	U	2.81
PLUTONIUM-238	PCI/L	U	15	100.0	-0.000669	0.02816	0.021	.	0.003	0.007	U	2.57
PLUTONIUM-239,240	PCI/L	U	115	100.0	-0.0057	0.2237	0.056	.	0.005	0.026	U	1.91
RADIUM-226	PCI/L	U	4	100.0	0.182	0.44	0.851	.	0.295	0.108	U	5.14
STRONTIUM-89,90	PCI/L	U	12	100.0	0.02	0.73	0.905	.	0.303	0.220	U	2.74
STRONTIUM-90	PCI/L	U	18	100.0	-0.286	1.12	0.929	.	0.160	0.313	U	2.45
TRITIUM	PCI/L	U	20	70.0	60	565.5	589.218	.	253.775	140.001	U	2.40
URANIUM-233,234	PCI/L	U	35	100.0	0	164	104.331	.	17.536	40.058	U	2.17
URANIUM-235	PCI/L	U	35	100.0	-0.02	6.29	3.610	.	0.662	1.361	U	2.17
URANIUM-238	PCI/L	U	21	100.0	0	108	75.426	.	10.504	27.377	U	2.37

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-199
BACKGROUND STATISTICS FOR TOTAL FIELD PARAMETER CONCENTRATIONS
IN UPPER FLOW SYSTEM GROUND WATER IN RFA VFA COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
DISSOLVED OXYGEN	MG/L	N	205	100.0	0	14.2	12.420	.	7.340	2.791	U	1.82
FIELD-MEASURED PH	PHUNIT	L	217	100.0	5.38	11.71	8.759	6.319	7.439	1.080	U	2.13
SPECIFIC CONDUCTANCE	US/CM	L	218	100.0	140	16700	2393.627	.	542.842	2.266	U	1.81

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-200
BACKGROUND STATISTICS FOR TOTAL VOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN UPPER FLOW SYSTEM GROUND WATER IN RFA VFA COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,1,1-TRICHLOROETHANE	UG/L	U	207	1.4	2	8	.	.	.	.	U	.
1,1,2,2-TETRACHLOROETHANE	UG/L	U	212	0.0	5 U	5 U	.	.	.	.	U	.
1,1,2-TRICHLOROETHANE	UG/L	U	212	0.0	5 U	5 U	.	.	.	.	U	.
1,1-DICHLOROETHANE	UG/L	U	212	0.5	2	5 U	.	.	.	.	U	.
1,1-DICHLOROETHENE	UG/L	U	212	0.5	5 U	7	.	.	.	.	U	.
1,2-DICHLOROETHANE	UG/L	U	212	0.5	1	5 U	.	.	.	.	U	.
1,2-DICHLOROETHENE	UG/L	U	191	0.0	5 U	5 U	.	.	.	.	U	.
1,2-DICHLOROPROPANE	UG/L	U	212	0.5	1	5 U	.	.	.	.	U	.
1,2-DIMETHYLBENZENE	UG/L	U	8	0.0	5 U	5 U	.	.	.	.	U	.
2-BUTANONE	UG/L	U	151	0.7	2	10 U	.	.	.	.	U	.
2-CHLOROETHYL VINYL ETHER	UG/L	U	11	0.0	10 U	10 U	.	.	.	.	U	.
2-HEXANONE	UG/L	U	195	0.0	10 U	10 U	.	.	.	.	U	.
4-METHYL-2-PENTANONE	UG/L	U	209	0.0	10 U	10 U	.	.	.	.	U	.
ACETONE	UG/L	U	191	19.4	1	36	.	.	.	.	U	.
BENZENE	UG/L	U	212	0.0	5 U	5 U	.	.	.	.	U	.
BROMODICHLOROMETHANE	UG/L	U	210	0.0	5 U	5 U	.	.	.	.	U	.
BROMOFORM	UG/L	U	210	0.0	5 U	5 U	.	.	.	.	U	.
BROMOMETHANE	UG/L	U	205	0.0	10 U	10 U	.	.	.	.	U	.
CARBON DISULFIDE	UG/L	U	202	1.0	1	31	.	.	.	.	U	.
CARBON TETRACHLORIDE	UG/L	U	204	1.0	2	5 U	.	.	.	.	U	.
CHLOROBENZENE	UG/L	U	212	1.4	1.75	5 U	.	.	.	.	U	.
CHLOROETHANE	UG/L	U	201	0.0	10 U	10 U	.	.	.	.	U	.
CHLOROFORM	UG/L	U	212	1.4	1	5 U	.	.	.	.	U	.
CHLOROMETHANE	UG/L	U	202	0.0	10 U	10 U	.	.	.	.	U	.
DIBROMOCHLOROMETHANE	UG/L	U	212	0.0	5 U	5 U	.	.	.	.	U	.
ETHYLBENZENE	UG/L	U	212	0.0	5 U	5 U	.	.	.	.	U	.
METHYLENE CHLORIDE	UG/L	U	212	26.4	1	25	.	.	.	.	U	.
STYRENE	UG/L	U	206	0.0	5 U	5 U	.	.	.	.	U	.
TETRACHLOROETHENE	UG/L	U	212	1.9	3	42	.	.	.	.	U	.
TOLUENE	UG/L	U	212	2.8	1	6	.	.	.	.	U	.
TOTAL XYLENES	UG/L	U	199	0.0	5 U	5 U	.	.	.	.	U	.
TRICHLOROETHENE	UG/L	U	212	3.8	2	42	.	.	.	.	U	.
VINYL ACETATE	UG/L	U	205	0.0	10 U	10 U	.	.	.	.	U	.
VINYL CHLORIDE	UG/L	U	211	0.0	10 U	10 U	.	.	.	.	U	.
cis-1,3-DICHLOROPROPENE	UG/L	U	212	0.5	3	5 U	.	.	.	.	U	.
trans-1,2-DICHLOROETHENE	UG/L	U	25	0.0	5 U	5 U	.	.	.	.	U	.
trans-1,3-DICHLOROPROPENE	UG/L	U	206	0.0	5 U	5 U	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-201
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN UPPER FLOW SYSTEM GROUND WATER IN RFA VFA COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALKALINITY AS CACO3	UG/L	U	1	100.0	70200	70200	.	.	.	.	U	.
BICARBONATE	UG/L	L	13	100.0	60300	526000	1023013.311	.	157920.291	2.013	U	2.67
BICARBONATE AS CACO3	UG/L	L	174	100.0	36140	620000	516771.689	.	149407.769	1.962	U	1.84
CARBONATE	UG/L	U	24	4.2	500.5 U	10000 U	.	.	.	.	U	.
CARBONATE AS CACO3	UG/L	U	138	34.1	0	54000	.	.	.	.	U	.
CHLORIDE	UG/L	L	155	96.8	900	260000	68468.565	.	9406.090	2.910	U	1.86
CYANIDE	UG/L	U	34	2.9	2 U	20 U	.	.	.	.	U	.
FLUORIDE	UG/L	L	175	95.4	200 U	50000 U	2350.398	.	545.081	2.212	U	1.84
NITRATE	UG/L	U	4	50.0	100 U	1070	.	.	.	.	U	.
NITRATE/NITRITE	UG/L	L	177	90.4	20	311000	9068.847	.	454.084	5.096	U	1.84
NITRITE	UG/L	U	48	4.2	10 U	180	.	.	.	.	U	.
ORTHOPHOSPHATE	UG/L	U	90	40.0	0.01	190	.	.	.	.	U	.
PH	PHUNIT	U	1	100.0	6.9	6.9	.	.	.	.	U	.
PHOSPHORUS	UG/L	U	51	60.8	10 U	15000	4646.924	.	329.490	2095.766	U	2.06
SILICA	UG/L	L	136	100.0	3800	70597.89	24202.291	.	9463.681	1.648	U	1.88
SULFATE	UG/L	L	177	100.0	2900	2800000	353556.344	.	41574.962	3.203	U	1.84
TOTAL DISSOLVED SOLIDS	UG/L	L	187	100.0	6000	4590000	1186750.226	.	285068.295	2.179	U	1.83
TOTAL SUSPENDED SOLIDS	UG/L	L	181	84.5	2000	2400000	782782.261	.	29698.896	5.943	U	1.84

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-202
BACKGROUND STATISTICS FOR FILTERED METAL CONCENTRATIONS
IN LOWER FLOW SYSTEM GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	L	35	71.4	8.6	256	215.706	.	29.805	2.493	U	2.17
ANTIMONY	UG/L	L	19	63.2	7.6	60 U	34.828	.	12.509	1.526	C	2.42
ARSENIC	UG/L	U	36	61.1	1 U	10 U	5.684	.	2.537	1.458	U	2.16
BARIUM	UG/L	L	42	90.5	34.8	200 U	145.889	.	79.046	1.337	U	2.11
BERYLLIUM	UG/L	U	13	0.0	0.6 U	5 U	.	.	.	.	U	.
CADMIUM	UG/L	U	18	22.2	1 U	7.35	.	.	.	.	U	.
CALCIUM	UG/L	U	43	100.0	8190	75500	83253.917	.	33176.744	23791.778	U	2.10
CESIUM	UG/L	U	17	29.4	2 U	1000 U	.	.	.	.	U	.
CHROMIUM	UG/L	U	40	22.5	2 U	15.5	.	.	.	.	U	.
COBALT	UG/L	U	15	6.7	2 U	50 U	.	.	.	.	U	.
COPPER	UG/L	U	37	24.3	1 U	25 U	.	.	.	.	U	.
CYANIDE	UG/L	U	1	0.0	2 U	2 U	.	.	.	.	U	.
IRON	UG/L	L	37	64.9	3 U	181	231.627	.	19.917	3.132	U	2.15
LEAD	UG/L	U	38	18.4	1 U	41.6	.	.	.	.	U	.
LITHIUM	UG/L	U	36	88.9	3.3	100 U	99.522	.	36.936	29.006	U	2.16
MAGNESIUM	UG/L	U	43	95.3	1720	13400	13954.710	.	5745.465	3900.231	U	2.10
MANGANESE	UG/L	U	43	83.7	1 U	30.2	25.871	.	9.450	7.802	U	2.10
MERCURY	UG/L	U	16	25.0	0.1 U	1.2	.	.	.	.	U	.
MOLYBDENUM	UG/L	U	38	52.6	2 U	100 U	46.534	.	13.104	15.615	U	2.14
NICKEL	UG/L	U	17	17.6	3 U	40 U	.	.	.	.	U	.
PHOSPHORUS	UG/L	U	4	50.0	90.5	285 U	.	.	.	.	U	.
POTASSIUM	UG/L	U	39	97.4	366	5800	6447.280	.	2818.756	1701.138	U	2.13
SELENIUM	UG/L	U	31	29.0	1	6	.	.	.	.	U	.
SILICON	UG/L	U	12	100.0	2720	10250	11058.616	.	4563.333	2373.710	U	2.74
SILVER	UG/L	U	35	34.3	2 U	10 U	.	.	.	.	U	.
SODIUM	UG/L	U	43	100.0	11000	432000	418724.114	.	140317.442	132271.641	U	2.10
STRONTIUM	UG/L	U	42	100.0	89.5	1050	993.624	.	374.988	292.995	U	2.11
THALLIUM	UG/L	U	11	0.0	0.6 U	10 U	.	.	.	.	U	.
TIN	UG/L	U	32	43.7	10 U	100 U	.	.	.	.	U	.
VANADIUM	UG/L	U	38	36.8	1 U	50 U	.	.	.	.	U	.
ZINC	UG/L	L	43	62.8	1.1 U	80.9	48.705	.	7.010	2.512	U	2.10

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-203
BACKGROUND STATISTICS FOR FILTERED RADIOCHEMICAL ACTIVITIES
IN LOWER FLOW SYSTEM GROUND WATER IN KAR

ANALYTE	CONCENTRATION	DISTRI-	SAMPLE UNITS	PERCENT BUTION	MINIMUM SIZE	MAXIMUM DETECTS	UPPER VALUE	LOWER VALUE	MEAN TOL. LIMIT	STANDARD TOL. LIMIT	COHEN	TOLERANCE DEVIATION	ADJUSTED	FACTOR
	AMERICIUM-241		PCI/L	U	1	100.0	0.028	0.028	.	.	.	.	U	.
	GROSS ALPHA - DISSOLVED		PCI/L	U	41	100.0	-0.368	36.65	19.590	.	3.957	7.380	U	2.12
	GROSS BETA - DISSOLVED		PCI/L	U	35	100.0	0.8128	13.8	10.687	.	3.874	3.145	U	2.17
	RADIUM-226		PCI/L	U	2	100.0	0.4665	2.981	.	.	.	.	U	.
	STRONTIUM-89,90		PCI/L	U	26	100.0	0.01429	1.289	0.975	.	0.360	0.270	U	2.28
	TRITIUM		PCI/L	U	34	100.0	-150	413.1	347.420	.	68.318	128.250	U	2.18
	URANIUM-233,234		PCI/L	U	38	100.0	-0.0099	15.33	9.057	.	1.944	3.323	U	2.14
	URANIUM-235		PCI/L	U	38	100.0	-0.0187	0.231	0.184	.	0.041	0.067	U	2.14
	URANIUM-238		PCI/L	U	36	100.0	-0.183	8.01	4.765	.	0.871	1.805	U	2.16

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-204
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN LOWER FLOW SYSTEM GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	UG/L	L	13	76.9	11 U	7000	166826.630	.	302.693	10.629	U	2.67
ANTIMONY	UG/L	U	13	23.1	7 U	1610	.	.	.	.	U	.
ARSENIC	UG/L	U	12	50.0	2 U	7	.	.	.	.	C	.
BARIUM	UG/L	U	13	100.0	61.5	1810	1501.161	.	230.000	476.001	U	2.67
BERYLLIUM	UG/L	U	13	7.7	1 U	160	.	.	.	.	U	.
CADMIUM	UG/L	U	13	23.1	1 U	1720	.	.	.	.	U	.
CALCIUM	UG/L	L	13	100.0	10800	91900	154031.314	.	26289.005	1.939	U	2.67
CESIUM	UG/L	U	13	7.7	2 U	500 U	.	.	.	.	U	.
CHROMIUM	UG/L	U	13	46.2	4.1	1590	.	.	.	.	U	.
COBALT	UG/L	U	13	23.1	2 U	1620	.	.	.	.	U	.
COPPER	UG/L	U	13	23.1	3 U	1750	.	.	.	.	U	.
CYANIDE	UG/L	U	28	7.1	1.5 U	7.5	.	.	.	.	U	.
IRON	UG/L	L	13	84.6	9.8 U	12000	249671.678	.	404.916	11.085	U	2.67
LEAD	UG/L	L	12	58.3	1 U	14.5	50.896	.	2.037	3.242	U	2.74
LITHIUM	UG/L	L	13	84.6	6.7	99.5	271.802	.	27.881	2.346	U	2.67
MAGNESIUM	UG/L	L	13	100.0	1950	19100	26784.488	.	4900.993	1.889	U	2.67
MANGANESE	UG/L	L	13	100.0	1.2	710	2350.214	.	25.800	5.417	U	2.67
MERCURY	UG/L	U	13	0.0	0.2 U	0.2 U	.	.	.	.	U	.
MOLYBDENUM	UG/L	U	13	53.8	2 U	1600	1309.307	.	128.496	442.168	U	2.67
NICKEL	UG/L	U	13	15.4	3 U	1660	.	.	.	.	U	.
POTASSIUM	UG/L	N	13	100.0	578	5950	7133.383	.	2815.692	1616.807	U	2.67
SELENIUM	UG/L	U	13	15.4	1 U	2 U	.	.	.	.	U	.
SILICON	UG/L	U	2	100.0	4010	13800	.	.	.	.	U	.
SILVER	UG/L	U	13	15.4	2 U	300	.	.	.	.	U	.
SODIUM	UG/L	L	13	100.0	11500	425000	1751482.491	.	81572.969	3.153	U	2.67
STRONTIUM	UG/L	L	13	100.0	121	1110	1842.292	.	288.379	2.003	U	2.67
THALLIUM	UG/L	U	12	16.7	1 U	2 U	.	.	.	.	U	.
TIN	UG/L	U	13	15.4	11.75 U	100 U	.	.	.	.	U	.
VANADIUM	UG/L	U	13	61.5	2 U	1670	1366.736	.	134.473	461.434	U	2.67
ZINC	UG/L	L	13	61.5	5 U	1800	4026.665	.	35.791	5.862	U	2.67

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-205
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN LOWER FLOW SYSTEM GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/L	U	29	100.0	-0.00285	0.08117	0.042	.	0.008	0.015	U	2.23
CESIUM-137	PCI/L	U	29	93.1	-0.442	0.63 U	0.479	.	-0.046	0.235	U	2.23
GROSS ALPHA	PCI/L	U	2	100.0	2.89	4.79	.	.	.	.	U	.
GROSS ALPHA - DISSOLVED	PCI/L	U	4	100.0	3	44.9	118.612	.	14.700	20.201	U	5.14
GROSS BETA	PCI/L	U	2	100.0	7.99	8.17	.	.	.	.	U	.
GROSS BETA - DISSOLVED	PCI/L	U	4	100.0	3.9	39.2	100.983	.	13.975	16.915	U	5.14
PLUTONIUM-238	PCI/L	U	5	100.0	0.00123405	0.03587	0.072	.	0.009	0.015	U	4.20
PLUTONIUM-239,240	PCI/L	U	33	100.0	-0.000955	0.009589	0.007	.	0.002	0.002	U	2.19
RADIUM-226	PCI/L	U	3	100.0	0.0709	0.88	.	.	.	.	U	.
STRONTIUM-89,90	PCI/L	U	2	100.0	0.07	0.17	.	.	.	.	U	.
STRONTIUM-90	PCI/L	U	2	100.0	-0.238	0.393	.	.	.	.	U	.
TRITIUM	PCI/L	U	3	66.7	-180	1350	.	.	.	.	U	.
URANIUM-233,234	PCI/L	U	4	100.0	0.15	1.52	3.685	.	0.770	0.567	U	5.14
URANIUM-235	PCI/L	U	4	100.0	0	0.0427	0.131	.	0.029	0.020	U	5.14
URANIUM-238	PCI/L	U	2	100.0	0.169	0.533	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-207
BACKGROUND STATISTICS FOR TOTAL VOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN LOWER FLOW SYSTEM GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,1,1-TRICHLOROETHANE	UG/L	U	61	0.0	5 U	5 U	.	.	.	.	U	.
1,1,2,2-TETRACHLOROETHANE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
1,1,2-TRICHLOROETHANE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
1,1-DICHLOROETHANE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
1,1-DICHLOROETHENE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
1,2-DICHLOROETHANE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
1,2-DICHLOROETHENE	UG/L	U	55	1.8	3	5 U	.	.	.	.	U	.
1,2-DICHLOROPROPANE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
1,2-DIMETHYLBENZENE	UG/L	U	1	0.0	5 U	5 U	.	.	.	.	U	.
2-BUTANONE	UG/L	U	45	2.2	1	10 U	.	.	.	.	U	.
2-CHLOROETHYL VINYL ETHER	UG/L	U	1	0.0	10 U	10 U	.	.	.	.	U	.
2-HEXANONE	UG/L	U	60	0.0	5 U	10 U	.	.	.	.	U	.
4-METHYL-2-PENTANONE	UG/L	U	61	0.0	10 U	10 U	.	.	.	.	U	.
ACETONE	UG/L	U	55	14.5	2	18	.	.	.	.	U	.
BENZENE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
BROMODICHLOROMETHANE	UG/L	U	61	0.0	5 U	5 U	.	.	.	.	U	.
BROMOFORM	UG/L	U	61	0.0	5 U	10 U	.	.	.	.	U	.
BROMOMETHANE	UG/L	U	57	0.0	10 U	10 U	.	.	.	.	U	.
CARBON DISULFIDE	UG/L	U	61	0.0	5 U	5 U	.	.	.	.	U	.
CARBON TETRACHLORIDE	UG/L	U	60	0.0	5 U	5 U	.	.	.	.	U	.
CHLOROBENZENE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
CHLOROETHANE	UG/L	U	60	0.0	10 U	10 U	.	.	.	.	U	.
CHLOROFORM	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
CHLOROMETHANE	UG/L	U	61	0.0	10 U	10 U	.	.	.	.	U	.
DIBROMOCHLOROMETHANE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
ETHYLBENZENE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
METHYLENE CHLORIDE	UG/L	U	62	37.1	1	17	.	.	.	.	U	.
STYRENE	UG/L	U	61	0.0	5 U	5 U	.	.	.	.	U	.
TETRACHLOROETHENE	UG/L	U	62	3.2	1	5 U	.	.	.	.	U	.
TOLUENE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
TOTAL XYLENES	UG/L	U	61	1.6	5 U	7	.	.	.	.	U	.
TRICHLOROETHENE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
VINYL ACETATE	UG/L	U	61	0.0	10 U	10 U	.	.	.	.	U	.
VINYL CHLORIDE	UG/L	U	62	0.0	10 U	10 U	.	.	.	.	U	.
cis-1,3-DICHLOROPROPENE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.
trans-1,2-DICHLOROETHENE	UG/L	U	5	0.0	5 U	5 U	.	.	.	.	U	.
trans-1,3-DICHLOROPROPENE	UG/L	U	62	0.0	5 U	5 U	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-208
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN LOWER FLOW SYSTEM GROUND WATER IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALKALINITY AS CACO3	UG/L	U	1	100.0	205500	205500	.	.	.	.	U	.
BICARBONATE	UG/L	U	3	100.0	106000	190000	.	.	.	.	U	.
BICARBONATE AS CACO3	UG/L	U	52	100.0	52000	490000	336613.944	.	186942.308	72821.677	U	2.06
CARBONATE	UG/L	U	8	12.5	1000 U	10000 U	.	.	.	.	U	.
CARBONATE AS CACO3	UG/L	U	43	55.8	0	30000	21373.872	.	5017.442	7770.977	U	2.10
CHLORIDE	UG/L	U	48	97.9	2600	420000	355538.174	.	100757.708	122764.942	U	2.08
CYANIDE	UG/L	U	11	0.0	2 U	20 U	.	.	.	.	U	.
FLUORIDE	UG/L	N	54	100.0	200	2000	1928.350	.	983.704	461.647	U	2.05
NITRATE	UG/L	U	2	50.0	100 U	310	.	.	.	.	U	.
NITRATE/NITRITE	UG/L	U	49	89.8	20 U	3600	3146.581	.	977.755	1047.700	U	2.07
NITRITE	UG/L	U	14	35.7	10 U	900	.	.	.	.	U	.
ORTHOPHOSPHATE	UG/L	U	28	64.3	10 U	40	43.455	.	13.936	13.144	C	2.25
PHOSPHORUS	UG/L	L	14	57.1	10 U	960	3926.095	.	63.763	4.835	U	2.61
SILICA	UG/L	U	46	100.0	17	28200	15717.717	.	5963.413	4675.016	U	2.09
SULFATE	UG/L	U	53	96.2	600	1200000	683194.770	.	132566.038	268506.085	U	2.05
TOTAL DISSOLVED SOLIDS	UG/L	U	56	100.0	160000	1600000	1422391.120	.	529410.714	438221.271	U	2.04
TOTAL SUSPENDED SOLIDS	UG/L	U	55	83.6	4000 U	2500000	1490663.596	.	382163.636	542868.701	U	2.04

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-209
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN STREAM SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ANTIMONY	MG/KG	U	11	36.4	2.1 U	11.1	.	.	.	.	U	.
ARSENIC	MG/KG	L	40	87.5	0.39	17.3	11.469	.	1.627	2.506	U	2.13
BERYLLIUM	MG/KG	U	33	54.5	0.06 U	1.4 U	1.212	.	0.491	0.330	U	2.19
CADMIUM	MG/KG	U	11	36.4	0.48 U	1.6 U	.	.	.	.	U	.
CESIUM	MG/KG	U	9	55.6	0.56	235 U	231.433	.	64.960	54.919	C	3.03
COBALT	MG/KG	U	37	73.0	0.59 U	15	11.945	.	4.915	3.271	U	2.15
COPPER	MG/KG	L	34	76.5	0.62 U	36.7	55.438	.	7.704	2.476	C	2.18
IRON	MG/KG	L	40	100.0	1040	31400	33548.400	.	6701.808	2.133	U	2.13
LITHIUM	MG/KG	L	37	75.7	1.5	28.3 U	21.279	.	4.883	1.984	C	2.15
MERCURY	MG/KG	U	11	18.2	0.02 U	0.16 U	.	.	.	.	U	.
MOLYBDENUM	MG/KG	U	22	31.8	0.66 U	5.4	.	.	.	.	U	.
NICKEL	MG/KG	L	35	77.1	1.3 U	25.6	40.884	.	5.095	2.615	U	2.17
POTASSIUM	MG/KG	L	40	75.0	114 U	3770	4395.039	.	558.443	2.640	U	2.13
SELENIUM	MG/KG	U	33	24.2	0.21 U	2.9	.	.	.	.	U	.
SILICON	MG/KG	L	14	100.0	46.7	1450	2304.398	.	225.490	2.433	U	2.61
SILVER	MG/KG	U	30	3.3	0.6 U	1.6 U	.	.	.	.	U	.
THALLIUM	MG/KG	U	6	16.7	0.2 U	0.55 U	.	.	.	.	U	.
TIN	MG/KG	U	28	46.4	3 U	27.1	.	.	.	.	U	.
ZINC	MG/KG	L	39	97.4	6.5 U	94	168.581	.	32.070	2.177	U	2.13

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-210
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN STREAM SEDIMENT FROM ROCK CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	MG/KG	U	22	100.0	1620	12300	13985.534	.	6928.773	3004.213	U	2.35
BARIUM	MG/KG	U	22	100.0	16.2	244	237.879	.	103.459	57.225	U	2.35
CALCIUM	MG/KG	L	22	100.0	1080	17100	43078.241	.	4105.465	2.720	U	2.35
CHROMIUM	MG/KG	U	21	85.7	1.9 U	26.5	24.261	.	10.102	5.970	U	2.37
LEAD	MG/KG	U	22	100.0	3.1	244	169.734	.	41.893	54.425	U	2.35
MAGNESIUM	MG/KG	L	22	90.9	418	3230	8371.890	.	1364.954	2.164	U	2.35
MANGANESE	MG/KG	L	21	100.0	9	221	562.729	.	91.489	2.151	U	2.37
SODIUM	MG/KG	L	22	72.7	84.8	351	425.618	.	141.788	1.597	C	2.35
STRONTIUM	MG/KG	L	19	89.5	9.5	421	285.297	.	32.339	2.456	U	2.42
VANADIUM	MG/KG	L	22	95.5	6.3 U	73	79.409	.	18.183	1.873	U	2.35

TABLE 5-211
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN STREAM SEDIMENT FROM WOMAN CREEK

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	MG/KG	U	18	100.0	549	25200	20839.704	.	4569.222	6633.034	U	2.45
BARIUM	MG/KG	U	16	100.0	12.8	180	193.741	.	57.906	53.825	U	2.52
CALCIUM	MG/KG	L	18	94.4	187 U	5060	9957.426	.	870.507	2.701	U	2.45
CHROMIUM	MG/KG	U	18	66.7	1.2 U	29.7	25.263	.	5.722	7.966	U	2.45
LEAD	MG/KG	U	18	100.0	2.1	27.9	28.042	.	8.411	8.003	U	2.45
MAGNESIUM	MG/KG	L	18	88.9	197	5850	9110.102	.	583.338	3.066	U	2.45
MANGANESE	MG/KG	L	18	100.0	96	1280	1675.660	.	297.858	2.022	U	2.45
SODIUM	MG/KG	L	18	83.3	28.8	264 U	327.168	.	67.438	1.904	C	2.45
STRONTIUM	MG/KG	L	16	87.5	2.8	41.9	73.210	.	9.005	2.294	U	2.52
VANADIUM	MG/KG	L	16	87.5	3.4	57.4	102.877	.	7.465	2.828	U	2.52

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-212
BACKGROUND STATISTICS FOR TOTAL PESTICIDE AND PCB CONCENTRATIONS
IN STREAM SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
4,4'-DDD	UG/KG	U	12	0.0	18 U	32 U	.	.	.	.	U	.
4,4'-DDE	UG/KG	U	12	0.0	18 U	32 U	.	.	.	.	U	.
4,4'-DDT	UG/KG	U	12	0.0	18 U	32 U	.	.	.	.	U	.
ALDRIN	UG/KG	U	12	0.0	9 U	16 U	.	.	.	.	U	.
AROCLOR-1016	UG/KG	U	11	0.0	0.09 U	160 U	.	.	.	.	U	.
AROCLOR-1221	UG/KG	U	11	0.0	0.09 U	160 U	.	.	.	.	U	.
AROCLOR-1232	UG/KG	U	11	0.0	0.06 U	160 U	.	.	.	.	U	.
AROCLOR-1242	UG/KG	U	11	0.0	0.03 U	160 U	.	.	.	.	U	.
AROCLOR-1248	UG/KG	U	11	0.0	0.03 U	160 U	.	.	.	.	U	.
AROCLOR-1254	UG/KG	U	14	28.6	0.16	320 U	.	.	.	.	U	.
AROCLOR-1260	UG/KG	U	11	0.0	0.03 U	320 U	.	.	.	.	U	.
DIELDRIN	UG/KG	U	12	0.0	18 U	32 U	.	.	.	.	U	.
ENDOSULFAN I	UG/KG	U	12	0.0	9 U	16 U	.	.	.	.	U	.
ENDOSULFAN II	UG/KG	U	12	0.0	18 U	32 U	.	.	.	.	U	.
ENDOSULFAN SULFATE	UG/KG	U	12	0.0	18 U	32 U	.	.	.	.	U	.
ENDRIN	UG/KG	U	12	0.0	18 U	32 U	.	.	.	.	U	.
ENDRIN KETONE	UG/KG	U	12	0.0	18 U	32 U	.	.	.	.	U	.
HEPTACHLOR	UG/KG	U	12	0.0	9 U	16 U	.	.	.	.	U	.
HEPTACHLOR EPOXIDE	UG/KG	U	12	0.0	9 U	16 U	.	.	.	.	U	.
METHOXYCHLOR	UG/KG	U	12	0.0	90 U	160 U	.	.	.	.	U	.
TOXAPHENE	UG/KG	U	12	0.0	180 U	320 U	.	.	.	.	U	.
alpha-BHC	UG/KG	U	12	0.0	9 U	16 U	.	.	.	.	U	.
alpha-CHLORDANE	UG/KG	U	12	0.0	90 U	160 U	.	.	.	.	U	.
beta-BHC	UG/KG	U	12	0.0	9 U	16 U	.	.	.	.	U	.
delta-BHC	UG/KG	U	12	0.0	9 U	16 U	.	.	.	.	U	.
gamma-BHC (LINDANE)	UG/KG	U	12	0.0	9 U	16 U	.	.	.	.	U	.
gamma-CHLORDANE	UG/KG	U	12	0.0	90 U	160 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-213
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN STREAM SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/G	U	24	100.0	-0.01	2.526	1.597	.	0.241	0.587	U	2.31
CESIUM-137	PCI/G	U	22	100.0	-0.0132	1.5	1.155	.	0.252	0.385	U	2.35
GROSS ALPHA	PCI/G	U	31	100.0	2.918	68.3	69.203	.	22.269	21.256	U	2.21
GROSS BETA	PCI/G	U	29	100.0	19.46	54	55.464	.	33.412	9.878	U	2.23
PLUTONIUM-238	PCI/G	U	4	100.0	-0.000103	0.0007511	0.002	.	0.000	0.000	U	5.14
PLUTONIUM-239,240	PCI/G	U	30	96.7	0	8.933	4.963	.	0.720	1.911	U	2.22
RADIUM-226	PCI/G	U	17	100.0	0.43	1.8	1.780	.	0.864	0.368	U	2.49
RADIUM-228	PCI/G	U	16	100.0	0.52	3.453	3.744	.	1.727	0.799	U	2.52
STRONTIUM-89,90	PCI/G	U	29	100.0	-0.6	1.1654	0.931	.	0.217	0.320	U	2.23
TRITIUM	PCI/L	U	28	92.9	16.68	380	374.202	.	167.421	92.076	U	2.25
URANIUM-233,234	PCI/G	U	33	100.0	0.171	4.258	4.018	.	1.609	1.102	U	2.19
URANIUM-235	PCI/G	U	34	100.0	0	0.191	0.174	.	0.062	0.051	U	2.18
URANIUM-238	PCI/G	U	29	100.0	0.142	3.82	3.717	.	1.400	1.038	U	2.23

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-214
BACKGROUND STATISTICS FOR TOTAL SEMIVOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN STREAM SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,2,4-TRICHLOROBENZENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
1,2-DICHLOROBENZENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
1,3-DICHLOROBENZENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
1,4-DICHLOROBENZENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
2,4,5-TRICHLOROPHENOL	UG/KG	U	16	0.0	1700 U	3300 U	.	.	.	.	U	.
2,4,6-TRICHLOROPHENOL	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
2,4-DICHLOROPHENOL	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
2,4-DIMETHYLPHENOL	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
2,4-DINITROPHENOL	UG/KG	U	15	0.0	1900 U	3300 U	.	.	.	.	U	.
2,4-DINITROTOLUENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
2,6-DINITROTOLUENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
2-CHLORONAPHTHALENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
2-CHLOROPHENOL	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
2-METHYLNAPHTHALENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
2-METHYLPHENOL	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
2-NITROANILINE	UG/KG	U	16	0.0	1700 U	3300 U	.	.	.	.	U	.
2-NITROPHENOL	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
3,3'-DICHLOROBENZIDINE	UG/KG	U	17	0.0	680 U	1300 U	.	.	.	.	U	.
3-NITROANILINE	UG/KG	U	16	0.0	1700 U	3300 U	.	.	.	.	U	.
4,6-DINITRO-2-METHYLPHENOL	UG/KG	U	15	0.0	1900 U	3300 U	.	.	.	.	U	.
4-BROMOPHENYL PHENYL ETHER	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
4-CHLORO-3-METHYLPHENOL	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
4-CHLOROANILINE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
4-CHLOROPHENYL PHENYL ETHER	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
4-METHYLPHENOL	UG/KG	U	18	27.8	68	900	.	.	.	.	U	.
4-NITROANILINE	UG/KG	U	16	0.0	1700 U	3300 U	.	.	.	.	U	.
4-NITROPHENOL	UG/KG	U	16	0.0	1700 U	3300 U	.	.	.	.	U	.
ACENAPHTHENE	UG/KG	U	17	11.8	75	660 U	.	.	.	.	U	.
ACENAPHTHYLENE	UG/KG	U	17	11.8	190	660 U	.	.	.	.	U	.
ANTHRACENE	UG/KG	U	18	22.2	75	700	.	.	.	.	U	.
BENZO(a)ANTHRACENE	UG/KG	U	18	44.4	37	1700	.	.	.	.	U	.
BENZO(a)PYRENE	UG/KG	U	17	29.4	59	900	.	.	.	.	U	.
BENZO(b)FLUORANTHENE	UG/KG	U	17	29.4	48	2400	.	.	.	.	U	.
BENZO(ghi)PERYLENE	UG/KG	U	16	12.5	240	660 U	.	.	.	.	U	.
BENZO(k)FLUORANTHENE	UG/KG	U	17	23.5	64	780	.	.	.	.	U	.
BENZOIC ACID	UG/KG	U	20	20.0	270	3300 U	.	.	.	.	U	.
BENZYL ALCOHOL	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
BIS(2-CHLOROETHOXY)METHANE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
BIS(2-CHLOROETHYL)ETHER	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
BIS(2-CHLOROISOPROPYL)ETHER	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
BIS(2-ETHYLHEXYL)PHTHALATE	UG/KG	L	22	77.3	54	1700 U	1321.719	.	194.159	2.263	C	2.35
BUTYL BENZYL PHTHALATE	UG/KG	U	16	18.8	56	660 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-214
BACKGROUND STATISTICS FOR TOTAL SEMIVOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN STREAM SEDIMENT
(Continued)

CHRYSENE	UG/KG	U	18	44.4	50	2000	.	.	.	.	U	.
DI-n-BUTYL PHTHALATE	UG/KG	U	20	35.0	73	1900	.	.	.	.	U	.
DI-n-OCTYL PHTHALATE	UG/KG	U	15	0.0	370 U	660 U	.	.	.	.	U	.
DIBENZO(a,h)ANTHRACENE	UG/KG	U	15	6.7	220	660 U	.	.	.	.	U	.
DIBENZOFURAN	UG/KG	U	16	6.2	180	660 U	.	.	.	.	U	.
DIETHYL PHTHALATE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
DIMETHYL PHTHALATE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
FLUORANTHENE	UG/KG	U	20	50.0	70	3100	.	.	.	.	U	.
FLUORENE	UG/KG	U	17	11.8	340 U	660 U	.	.	.	.	U	.
HEXACHLOROBENZENE	UG/KG	U	16	6.2	340 U	660 U	.	.	.	.	U	.
HEXACHLOROBUTADIENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
HEXACHLOROCYCLOPENTADIENE	UG/KG	U	13	0.0	370 U	660 U	.	.	.	.	U	.
HEXACHLOROETHANE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
INDENO(1,2,3-cd)PYRENE	UG/KG	U	16	12.5	220	660 U	.	.	.	.	U	.
ISOPHORONE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
N-NITROSO-DI-n-PROPYLAMINE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
N-NITROSODIPHENYLAMINE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
NAPHTHALENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
NITROBENZENE	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
PENTACHLOROPHENOL	UG/KG	U	16	0.0	1700 U	3300 U	.	.	.	.	U	.
PHENANTHRENE	UG/KG	U	18	38.9	59	3200	.	.	.	.	U	.
PHENOL	UG/KG	U	16	0.0	340 U	660 U	.	.	.	.	U	.
PYRENE	UG/KG	U	20	50.0	74	4700	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-215
BACKGROUND STATISTICS FOR TOTAL VOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN STREAM SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,1,1-TRICHLOROETHANE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
1,1,2,2-TETRACHLOROETHANE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
1,1,2-TRICHLOROETHANE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
1,1-DICHLOROETHANE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
1,1-DICHLOROETHENE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
1,2-DICHLOROETHANE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
1,2-DICHLOROETHENE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
1,2-DICHLOROPROPANE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
2-BUTANONE	UG/KG	U	27	18.5	2	600	.	.	.	.	U	.
2-HEXANONE	UG/KG	U	20	0.0	10 U	20 U	.	.	.	.	U	.
4-METHYL-2-PENTANONE	UG/KG	U	21	0.0	10 U	20 U	.	.	.	.	U	.
ACETONE	UG/KG	U	23	60.9	.	2300	1336.087	.	175.522	498.456	U	2.33
BENZENE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
BROMODICHLOROMETHANE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
BROMOFORM	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
BROMOMETHANE	UG/KG	U	24	0.0	10 U	20 U	.	.	.	.	U	.
CARBON DISULFIDE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
CARBON TETRACHLORIDE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
CHLOROBENZENE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
CHLOROETHANE	UG/KG	U	25	0.0	10 U	20 U	.	.	.	.	U	.
CHLOROFORM	UG/KG	U	25	4.0	3	10 U	.	.	.	.	U	.
CHLOROMETHANE	UG/KG	U	25	0.0	10 U	20 U	.	.	.	.	U	.
DIBROMOCHLOROMETHANE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
ETHYLBENZENE	UG/KG	U	25	4.0	1	10 U	.	.	.	.	U	.
METHYLENE CHLORIDE	UG/KG	U	20	55.0	.	190	120.101	.	20.175	41.705	U	2.40
STYRENE	UG/KG	U	25	4.0	2	10 U	.	.	.	.	U	.
TETRACHLOROETHENE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
TOLUENE	UG/KG	U	25	4.0	5 U	10 U	.	.	.	.	U	.
TOTAL XYLENES	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
TRICHLOROETHENE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
VINYL ACETATE	UG/KG	U	21	0.0	10 U	20 U	.	.	.	.	U	.
VINYL CHLORIDE	UG/KG	U	25	0.0	10 U	20 U	.	.	.	.	U	.
cis-1,3-DICHLOROPROPENE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.
trans-1,3-DICHLOROPROPENE	UG/KG	U	25	0.0	5 U	10 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-216
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN STREAM SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALKALINITY AS CACO3	MG/KG	L	18	94.4	0.33	25000	172383.318	.	231.900	14.808	U	2.45
NITRATE	MG/KG	U	1	100.0	3	3	.	.	.	.	U	.
NITRATE/NITRITE	MG/KG	U	31	61.3	0.7	76	41.757	.	7.395	15.563	U	2.21
NITRITE	MG/KG	U	3	66.7	0.2 U	0.3	.	.	.	.	U	.
PH	PHUNIT	L	35	100.0	6.1	8.7	9.090	5.830	7.280	1.093	U	2.49
TOTAL ALKALINITY	MG/KG	U	6	100.0	0.1	21000	34968.782	.	4020.045	8347.189	U	3.71

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-217
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN SEEP SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	MG/KG	L	19	100.0	4760	21600	27507.435	.	9207.107	1.571	U	2.42
ANTIMONY	MG/KG	U	8	12.5	2.6 U	19.7 U	.	.	.	.	U	.
ARSENIC	MG/KG	L	19	94.7	1.1	49.2	128.002	.	6.978	3.322	U	2.42
BARIUM	MG/KG	L	19	100.0	57	706	800.158	.	175.322	1.871	U	2.42
BERYLLIUM	MG/KG	U	7	85.7	0.37	1.1	1.523	.	0.611	0.268	U	3.40
CADMIUM	MG/KG	U	8	37.5	0.74 U	1.7 U	.	.	.	.	U	.
CALCIUM	MG/KG	L	19	100.0	3900	61000	103180.164	.	14810.494	2.228	U	2.42
CESIUM	MG/KG	U	6	16.7	73.9	265 U	.	.	.	.	U	.
CHROMIUM	MG/KG	L	16	100.0	4.2	22.5	31.513	.	9.916	1.581	U	2.52
COBALT	MG/KG	N	16	75.0	1.3 U	17.2	17.379	.	6.775	4.202	U	2.52
COPPER	MG/KG	L	14	92.9	7.8 U	178	203.670	.	19.334	2.461	U	2.61
IRON	MG/KG	L	18	100.0	2250	112000	187508.996	.	15518.222	2.762	U	2.45
LEAD	MG/KG	L	18	100.0	8.1	255	260.083	.	35.398	2.255	U	2.45
LITHIUM	MG/KG	L	12	83.3	4.2	34.3 U	24.789	.	7.795	1.526	C	2.74
MAGNESIUM	MG/KG	L	19	89.5	921	4730	6995.819	.	2074.577	1.651	U	2.42
MANGANESE	MG/KG	L	19	100.0	34.9	1740	2784.556	.	190.845	3.023	U	2.42
MERCURY	MG/KG	U	3	0.0	0.15 U	0.18 U	.	.	.	.	U	.
MOLYBDENUM	MG/KG	U	12	58.3	2.2	21.7	29.792	.	4.476	9.252	C	2.74
NICKEL	MG/KG	L	12	83.3	5.7	25.1	44.500	.	9.610	1.751	U	2.74
POTASSIUM	MG/KG	L	16	62.5	375	2350	4766.114	.	829.296	2.000	U	2.52
SELENIUM	MG/KG	L	18	55.6	0.47 U	3.5	6.091	.	0.929	2.152	U	2.45
SILICON	MG/KG	U	9	100.0	313	7100	8480.839	.	1850.000	2187.502	U	3.03
SILVER	MG/KG	U	8	25.0	0.96 U	6.8	.	.	.	.	U	.
SODIUM	MG/KG	L	13	76.9	72.7	614	906.961	.	159.846	1.916	U	2.67
STRONTIUM	MG/KG	L	17	88.2	15.9	546 U	491.313	.	74.998	2.130	U	2.49
THALLIUM	MG/KG	U	4	0.0	0.26 U	0.82 U	.	.	.	.	U	.
TIN	MG/KG	N	14	57.1	6.9 U	64.7 U	49.203	.	19.025	11.543	U	2.61
VANADIUM	MG/KG	L	17	94.1	13.8 U	61.2	96.144	.	24.276	1.739	U	2.49
ZINC	MG/KG	L	17	100.0	17.3	112	162.239	.	52.473	1.575	U	2.49

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-218
BACKGROUND STATISTICS FOR TOTAL PESTICIDE AND PCB CONCENTRATIONS
IN SEEP SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
4,4'-DDD	UG/KG	U	2	0.0	28 U	29 U	.	.	.	.	U	.
4,4'-DDE	UG/KG	U	2	0.0	28 U	29 U	.	.	.	.	U	.
4,4'-DDT	UG/KG	U	2	0.0	28 U	29 U	.	.	.	.	U	.
ALDRIN	UG/KG	U	2	0.0	14 U	14 U	.	.	.	.	U	.
AROCLOR-1016	UG/KG	U	3	0.0	9 U	140 U	.	.	.	.	U	.
AROCLOR-1221	UG/KG	U	3	0.0	9 U	140 U	.	.	.	.	U	.
AROCLOR-1232	UG/KG	U	3	0.0	6 U	140 U	.	.	.	.	U	.
AROCLOR-1242	UG/KG	U	3	0.0	3 U	140 U	.	.	.	.	U	.
AROCLOR-1248	UG/KG	U	3	0.0	3 U	140 U	.	.	.	.	U	.
AROCLOR-1254	UG/KG	U	3	33.3	33	290 U	.	.	.	.	U	.
AROCLOR-1260	UG/KG	U	3	0.0	3 U	290 U	.	.	.	.	U	.
DIELDRIN	UG/KG	U	2	0.0	28 U	29 U	.	.	.	.	U	.
ENDOSULFAN I	UG/KG	U	2	0.0	14 U	14 U	.	.	.	.	U	.
ENDOSULFAN II	UG/KG	U	2	0.0	28 U	29 U	.	.	.	.	U	.
ENDOSULFAN SULFATE	UG/KG	U	2	0.0	28 U	29 U	.	.	.	.	U	.
ENDRIN	UG/KG	U	2	0.0	28 U	29 U	.	.	.	.	U	.
ENDRIN KETONE	UG/KG	U	2	0.0	28 U	29 U	.	.	.	.	U	.
HEPTACHLOR	UG/KG	U	2	0.0	14 U	14 U	.	.	.	.	U	.
HEPTACHLOR EPOXIDE	UG/KG	U	2	0.0	14 U	14 U	.	.	.	.	U	.
METHOXYCHLOR	UG/KG	U	2	0.0	140 U	140 U	.	.	.	.	U	.
TOXAPHENE	UG/KG	U	2	0.0	280 U	290 U	.	.	.	.	U	.
alpha-BHC	UG/KG	U	2	50.0	0	14 U	.	.	.	.	U	.
alpha-CHLORDANE	UG/KG	U	2	0.0	140 U	140 U	.	.	.	.	U	.
beta-BHC	UG/KG	U	2	0.0	14 U	14 U	.	.	.	.	U	.
delta-BHC	UG/KG	U	2	0.0	14 U	14 U	.	.	.	.	U	.
gamma-BHC (LINDANE)	UG/KG	U	2	50.0	0	14 U	.	.	.	.	U	.
gamma-CHLORDANE	UG/KG	U	2	0.0	140 U	140 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-219
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN SEEP SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/G	U	13	100.0	0	1.072	0.985	.	0.137	0.318	U	2.67
CESIUM-137	PCI/G	U	12	100.0	0.26	2.3	2.496	.	0.867	0.595	U	2.74
GROSS ALPHA	PCI/G	U	14	100.0	5.023	47.6	57.847	.	20.173	14.410	U	2.61
GROSS BETA	PCI/G	U	13	100.0	16.37	32.5	37.877	.	23.955	5.213	U	2.67
PLUTONIUM-238	PCI/G	U	3	100.0	0.0006494	0.001438	.	.	.	.	U	.
PLUTONIUM-239,240	PCI/G	U	15	93.3	0	6.667	5.185	.	0.654	1.766	U	2.57
RADIUM-226	PCI/G	U	9	100.0	0.2359	1.1	1.419	.	0.705	0.235	U	3.03
RADIUM-228	PCI/G	U	9	100.0	0.7142	1.6	2.138	.	1.179	0.316	U	3.03
STRONTIUM-89,90	PCI/G	U	13	92.3	-0.2	1.727	1.818	.	0.370	0.542	U	2.67
TRITIUM	PCI/L	U	12	100.0	50	540	562.552	.	206.250	130.211	U	2.74
URANIUM-233,234	PCI/G	U	15	100.0	0.063	1.427	1.818	.	0.813	0.392	U	2.57
URANIUM-235	PCI/G	U	16	100.0	0	0.2118	0.174	.	0.039	0.053	U	2.52
URANIUM-238	PCI/G	U	14	100.0	0.067	1.61	1.812	.	0.733	0.413	U	2.61

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-220
BACKGROUND STATISTICS FOR TOTAL SEMIVOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN SEEP SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,2,4-TRICHLOROBENZENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
1,2-DICHLOROBENZENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
1,3-DICHLOROBENZENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
1,4-DICHLOROBENZENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
2,4,5-TRICHLOROPHENOL	UG/KG	U	3	0.0	2800 U	3000 U	.	.	.	.	U	.
2,4,6-TRICHLOROPHENOL	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
2,4-DICHLOROPHENOL	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
2,4-DIMETHYLPHENOL	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
2,4-DINITROPHENOL	UG/KG	U	2	0.0	2800 U	3000 U	.	.	.	.	U	.
2,4-DINITROTOLUENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
2,6-DINITROTOLUENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
2-CHLORONAPHTHALENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
2-CHLOROPHENOL	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
2-METHYLNAPHTHALENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
2-METHYLPHENOL	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
2-NITROANILINE	UG/KG	U	3	0.0	2800 U	3000 U	.	.	.	.	U	.
2-NITROPHENOL	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
3,3'-DICHLOROBENZIDINE	UG/KG	U	4	0.0	1100 U	1300 U	.	.	.	.	U	.
3-NITROANILINE	UG/KG	U	3	0.0	2800 U	3000 U	.	.	.	.	U	.
4,6-DINITRO-2-METHYLPHENOL	UG/KG	U	2	0.0	2800 U	3000 U	.	.	.	.	U	.
4-BROMOPHENYL PHENYL ETHER	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
4-CHLORO-3-METHYLPHENOL	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
4-CHLOROANILINE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
4-CHLOROPHENYL PHENYL ETHER	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
4-METHYLPHENOL	UG/KG	U	8	50.0	560 U	3300 U	.	.	.	.	C	.
4-NITROANILINE	UG/KG	U	3	0.0	2800 U	3000 U	.	.	.	.	U	.
4-NITROPHENOL	UG/KG	U	3	0.0	2800 U	3000 U	.	.	.	.	U	.
ACENAPHTHENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
ACENAPHTHYLENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
ANTHRACENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
BENZO(a)ANTHRACENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
BENZO(a)PYRENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
BENZO(b)FLUORANTHENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
BENZO(ghi)PERYLENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
BENZO(k)FLUORANTHENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
BENZOIC ACID	UG/KG	U	9	66.7	270	16000 U	4550.196	.	1071.667	1147.561	C	3.03
BENZYL ALCOHOL	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
BIS(2-CHLOROETHOXY)METHANE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
BIS(2-CHLOROETHYL)ETHER	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
BIS(2-CHLOROISOPROPYL)ETHER	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
BIS(2-ETHYLHEXYL)PHTHALATE	UG/KG	U	10	100.0	80	1000	1470.987	.	496.000	334.936	U	2.91
BUTYL BENZYL PHTHALATE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-220
BACKGROUND STATISTICS FOR TOTAL SEMIVOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN SEEP SEDIMENT
(Continued)

CHRYSENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
DI-n-BUTYL PHTHALATE	UG/KG	U	5	40.0	160	2200	.	.	.	.	U	.
DI-n-OCTYL PHTHALATE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
DIBENZO(a,h)ANTHRACENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
DIBENZOFURAN	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
DIETHYL PHTHALATE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
DIMETHYL PHTHALATE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
FLUORANTHENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
FLUORENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
HEXACHLOROBENZENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
HEXACHLOROBUTADIENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
HEXACHLOROCYCLOPENTADIENE	UG/KG	U	3	0.0	560 U	660 U	.	.	.	.	U	.
HEXACHLOROETHANE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
INDENO(1,2,3-cd)PYRENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
ISOPHORONE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
N-NITROSO-DI-n-PROPYLAMINE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
N-NITROSODIPHENYLAMINE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
NAPHTHALENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
NITROBENZENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
PENTACHLOROPHENOL	UG/KG	U	5	20.0	350	3300 U	.	.	.	.	U	.
PHENANTHRENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.
PHENOL	UG/KG	U	9	33.3	170	3300 U	.	.	.	.	U	.
PYRENE	UG/KG	U	4	0.0	560 U	660 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-221
BACKGROUND STATISTICS FOR TOTAL VOLATILE ORGANIC COMPOUND CONCENTRATIONS
IN SEEP SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
1,1,1-TRICHLOROETHANE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
1,1,2,2-TETRACHLOROETHANE	UG/KG	U	7	0.0	8 U	44 U	.	.	.	.	U	.
1,1,2-TRICHLOROETHANE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
1,1-DICHLOROETHANE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
1,1-DICHLOROETHENE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
1,2-DICHLOROETHANE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
1,2-DICHLOROETHENE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
1,2-DICHLOROPROPANE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
2-BUTANONE	UG/KG	U	10	40.0	14	320	.	.	.	.	U	.
2-HEXANONE	UG/KG	U	7	0.0	16 U	88 U	.	.	.	.	U	.
4-METHYL-2-PENTANONE	UG/KG	U	7	0.0	16 U	88 U	.	.	.	.	U	.
ACETONE	UG/KG	U	10	60.0	16 U	250000	255127.206	.	25302.200	78951.527	U	2.91
BENZENE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
BROMODICHLOROMETHANE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
BROMOFORM	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
BROMOMETHANE	UG/KG	U	8	0.0	16 U	88 U	.	.	.	.	U	.
CARBON DISULFIDE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
CARBON TETRACHLORIDE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
CHLOROBENZENE	UG/KG	U	7	0.0	8 U	44 U	.	.	.	.	U	.
CHLOROETHANE	UG/KG	U	8	0.0	16 U	88 U	.	.	.	.	U	.
CHLOROFORM	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
CHLOROMETHANE	UG/KG	U	8	0.0	16 U	88 U	.	.	.	.	U	.
DIBROMOCHLOROMETHANE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
ETHYLBENZENE	UG/KG	U	7	0.0	8 U	44 U	.	.	.	.	U	.
METHYLENE CHLORIDE	UG/KG	U	9	22.2	8 U	240	.	.	.	.	U	.
STYRENE	UG/KG	U	7	0.0	8 U	44 U	.	.	.	.	U	.
TETRACHLOROETHENE	UG/KG	U	7	0.0	8 U	44 U	.	.	.	.	U	.
TOLUENE	UG/KG	U	10	50.0	5	120	.	.	.	.	U	.
TOTAL XYLENES	UG/KG	U	6	0.0	8 U	44 U	.	.	.	.	U	.
TRICHLOROETHENE	UG/KG	U	8	12.5	9 U	44 U	.	.	.	.	U	.
VINYL ACETATE	UG/KG	U	8	0.0	16 U	88 U	.	.	.	.	U	.
VINYL CHLORIDE	UG/KG	U	8	0.0	16 U	88 U	.	.	.	.	U	.
cis-1,3-DICHLOROPROPENE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.
trans-1,3-DICHLOROPROPENE	UG/KG	U	8	0.0	8 U	44 U	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-222
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN SEEP SEDIMENT

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALKALINITY AS CACO3	MG/KG	U	7	100.0	68	81000	114888.857	.	15676.857	29184.558	U	3.40
NITRATE/NITRITE	MG/KG	L	12	66.7	1.5	63.8	142.534	.	4.065	3.669	U	2.74
NITRITE	MG/KG	U	2	50.0	0.4 U	3.1	.	.	.	.	U	.
PH	PHUNIT	U	17	100.0	6.1	7.9	8.895	5.635	7.265	0.570	U	2.86
TOTAL ALKALINITY	MG/KG	U	4	50.0	0.1 U	3000	.	.	.	.	U	.

Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Code U indicates undetected for the minimum and maximum values.

TABLE 5-223
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL IN COL WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	MG/KG	L	36	100.0	4300	22900	23302.696	.	8961.087	1.557	U	2.16

TABLE 5-224
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BARIUM	MG/KG	L	28	96.4	37.8 U	491	438.136	.	106.162	1.880	U	2.25
CALCIUM	MG/KG	L	28	100.0	3020	25900	23235.833	.	7164.274	1.689	U	2.25
COPPER	MG/KG	L	28	100.0	4.7	28	32.268	.	13.570	1.471	U	2.25
LEAD	MG/KG	L	28	100.0	6.6	29.9	30.029	.	15.627	1.338	U	2.25
MAGNESIUM	MG/KG	L	28	100.0	1730	5580	7373.561	.	2930.637	1.508	U	2.25
STRONTIUM	MG/KG	L	28	100.0	25.1	121	131.132	.	52.372	1.505	U	2.25
ZINC	MG/KG	L	28	100.0	23.9	111	111.420	.	49.391	1.437	U	2.25

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-225
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	MG/KG	L	13	100.0	2470	10700	23111.518	.	6814.647	1.580	U	2.67
CALCIUM	MG/KG	L	13	100.0	2310	9970	12740.760	.	4827.372	1.438	U	2.67
COPPER	MG/KG	L	13	100.0	5.9	24.3	47.835	.	14.079	1.581	U	2.67
LEAD	MG/KG	L	13	100.0	9.4	29.5	42.929	.	17.038	1.413	U	2.67
STRONTIUM	MG/KG	L	13	92.3	23.9 U	141	313.927	.	60.838	1.849	U	2.67
ZINC	MG/KG	L	13	100.0	24.1	94.85	175.692	.	58.282	1.512	U	2.67

TABLE 5-226
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ALUMINUM	MG/KG	L	69	100.0	279	102000	46580.729	.	10685.078	2.094	U	1.99
BARIUM	MG/KG	L	71	85.9	14.9	777	259.619	.	59.259	2.103	U	1.99
CALCIUM	MG/KG	L	71	98.6	1130	157000	16862.533	.	3190.706	2.311	U	1.99
COPPER	MG/KG	L	70	94.3	2.2	123	29.956	.	8.744	1.857	U	1.99
LEAD	MG/KG	L	70	100.0	2.6	39.8	24.489	.	6.967	1.881	U	1.99
MAGNESIUM	MG/KG	L	71	94.4	606 U	32500	7600.652	.	2071.937	1.923	U	1.99
STRONTIUM	MG/KG	U	49	20.4	20.3 U	226	.	.	.	.	U	.
ZINC	MG/KG	L	63	100.0	0.52	486	141.742	.	17.818	2.804	U	2.01

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-227
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS IN GEOLOGIC MATERIAL IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CALCIUM	MG/KG	L	8	100.0	4140	24840	43000.871	.	7164.566	1.755	U	3.19
COPPER	MG/KG	L	7	100.0	9.4	26.7	55.669	.	16.176	1.438	U	3.40
LEAD	MG/KG	L	7	100.0	10.8	28.2	69.360	.	18.468	1.476	U	3.40
STRONTIUM	MG/KG	L	8	100.0	31.6	113	251.807	.	69.323	1.499	U	3.19
ZINC	MG/KG	L	8	100.0	37.7	99.5	171.516	.	60.189	1.389	U	3.19

TABLE 5-228
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS IN GEOLOGIC MATERIAL IN RFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
ANTIMONY	MG/KG	U	79	16.5	1.9 U	18.1 U	.	.	.	.	U	.
ARSENIC	MG/KG	L	113	76.1	0.46	41.8	12.140	.	2.530	2.273	U	1.91
BERYLLIUM	MG/KG	L	109	89.0	0.9	23.5	18.123	.	3.106	2.510	U	1.92
CADMIUM	MG/KG	U	98	7.1	0.16 U	1.8 U	.	.	.	.	U	.
CESIUM	MG/KG	U	101	1.0	114 U	302 U	.	.	.	.	U	.
COBALT	MG/KG	U	118	25.4	3.3 U	29.7	.	.	.	.	U	.
IRON	MG/KG	L	119	100.0	1300	132000	33287.206	.	12056.242	1.706	U	1.90
LITHIUM	MG/KG	L	120	64.2	2 U	83.2	18.531	.	7.020	1.667	C	1.90
MANGANESE	MG/KG	L	119	100.0	16	3330	643.487	.	142.396	2.210	U	1.90
MERCURY	MG/KG	U	82	29.3	0.05 U	0.64	.	.	.	.	U	.
POTASSIUM	MG/KG	L	118	52.5	373 U	18700	3726.431	.	870.045	2.148	U	1.90
SELENIUM	MG/KG	U	77	2.6	0.21 U	3.05	.	.	.	.	U	.
SILVER	MG/KG	U	97	40.2	0.535 U	40.9	.	.	.	.	U	.
THALLIUM	MG/KG	U	87	3.4	0.18 U	2.9 U	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-229
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL IN WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
BARIUM	MG/KG	L	21	95.2	36 U	243	343.408	.	85.296	1.799	U	2.37
MAGNESIUM	MG/KG	L	21	90.5	981 U	5600	7373.128	.	2012.632	1.729	U	2.37

TABLE 5-230
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM NORTH ROCKY FLATS COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CHROMIUM	MG/KG	L	16	100.0	6.1	21.3	24.480	.	9.780	1.438	U	2.52

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-231
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM NORTH ROCKY FLATS IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
MOLYBDENUM	MG/KG	U	16	50.0	2.2 U	23.5 U	.	.	.	.	U	.

TABLE 5-232
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM NORTH ROCKY FLATS IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN .	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CHROMIUM	MG/KG	U	5	60.0	3 U	10.7	.	.	.	.	C	.
MOLYBDENUM	MG/KG	L	5	80.0	2.1 U	8.15	63.890	.	4.788	1.852	C	4.20

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-233
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM NORTH ROCKY FLATS IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CHROMIUM	MG/KG	L	22	100.0	4.8	69.6	78.869	.	15.900	1.977	U	2.35
MOLYBDENUM	MG/KG	U	33	21.2	18.5	41	.	.	.	.	U	.

TABLE 5-234
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM NORTH ROCKY FLATS IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CHROMIUM	MG/KG	L	6	100.0	5.2	13.7	32.554	.	8.890	1.419	U	3.71

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-235
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM NORTH ROCKY FLATS RFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
NICKEL	MG/KG	L	52	82.7	6.3	62.5	41.870	.	12.723	1.785	U	2.06
SODIUM	MG/KG	U	62	33.9	3.42 U	1310 U	.	.	.	.	U	.
TIN	MG/KG	U	50	38.0	20.9 U	441	.	.	.	.	U	.
VANADIUM	MG/KG	L	61	95.1	6.7 U	70	74.257	.	22.007	1.827	U	2.02

TABLE 5-236
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM NORTH ROCKY FLATS WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
MOLYBDENUM	MG/KG	L	8	75.0	3	24.2 U	33.498	.	7.063	1.630	C	3.19

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-237
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM SOUTH ROCKY FLATS COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CHROMIUM	MG/KG	L	9	100.0	12.9	26.9	42.256	.	18.217	1.320	U	3.03

TABLE 5-238
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM SOUTH ROCKY FLATS IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
MOLYBDENUM	MG/KG	U	12	41.7	12.6 U	26.8	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-239
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM SOUTH ROCKY FLATS IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CHROMIUM	MG/KG	L	6	100.0	7.5	12.1	18.604	.	9.883	1.186	U	3.71
MOLYBDENUM	MG/KG	U	8	0.0	2.8 U	24.8 U	.	.	.	.	U	.

TABLE 5-240
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM SOUTH ROCKY FLATS IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CHROMIUM	MG/KG	L	38	100.0	5.6	176	76.172	.	18.895	1.918	U	2.14
MOLYBDENUM	MG/KG	L	38	81.6	2 U	67.6	37.559	.	5.476	2.458	U	2.14

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-241
BACKGROUND STATISTICS FOR TOTAL METAL CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM SOUTH ROCKY FLATS RFA COL KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
NICKEL	MG/KG	L	58	94.8	4.3	193	72.204	.	18.483	1.957	U	2.03
SODIUM	MG/KG	U	56	8.9	102 U	3680	.	.	.	.	U	.
TIN	MG/KG	U	57	15.8	20.2 U	338	.	.	.	.	U	.
VANADIUM	MG/KG	L	58	98.3	11.6 U	283	77.097	.	28.298	1.639	U	2.03

TABLE 5-242
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GEOLOGIC MATERIAL IN COL

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
GROSS ALPHA	PCI/G	U	28	100.0	19	48	51.315	.	31.357	8.887	U	2.25
GROSS BETA	PCI/G	U	28	100.0	20	34	35.060	.	26.679	3.732	U	2.25
RADIUM-226	PCI/G	U	21	100.0	0.7	1.3	1.502	.	1.062	0.186	U	2.37
RADIUM-228	PCI/G	U	21	100.0	1.1	2.1	2.257	.	1.560	0.294	U	2.37
TRITIUM	PCI/L	U	28	100.0	-140	240	303.422	.	60.536	108.152	U	2.25
URANIUM-233,234	PCI/G	U	28	100.0	0.4	2.6	1.749	.	0.827	0.411	U	2.25
URANIUM-235	PCI/G	U	28	100.0	0	0.2	0.171	.	0.043	0.057	U	2.25
URANIUM-238	PCI/G	U	28	100.0	0.4	2.3	1.676	.	0.921	0.336	U	2.25

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-243
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GEOLOGIC MATERIAL IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
GROSS ALPHA	PCI/G	U	13	100.0	17	43	53.145	.	30.692	8.408	U	2.67
RADIUM-226	PCI/G	U	9	100.0	0.9	1.2	1.397	.	1.067	0.109	U	3.03
RADIUM-228	PCI/G	U	9	100.0	1	1.6	1.795	.	1.239	0.183	U	3.03
TRITIUM	PCI/L	U	13	100.0	-110	200	299.889	.	40.000	97.318	U	2.67
URANIUM-238	PCI/G	U	13	100.0	0.6	1.2	1.512	.	0.935	0.216	U	2.67

TABLE 5-244
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GEOLOGIC MATERIAL IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
GROSS ALPHA	PCI/G	U	71	100.0	3	40	37.833	.	21.854	8.042	U	1.99
GROSS BETA	PCI/G	U	71	100.0	6	44	36.932	.	23.613	6.703	U	1.99
RADIUM-226	PCI/G	U	62	100.0	0.4	0.9	0.853	.	0.631	0.110	U	2.02
RADIUM-228	PCI/G	U	62	100.0	0.5	2.2	1.969	.	1.337	0.314	U	2.02
TRITIUM	PCI/L	U	71	100.0	-150	440	411.455	.	169.225	121.903	U	1.99
URANIUM-233,234	PCI/G	U	71	100.0	0.2	3.4	1.488	.	0.629	0.432	U	1.99
URANIUM-235	PCI/G	U	71	100.0	0	0.2	0.081	.	0.011	0.035	U	1.99
URANIUM-238	PCI/G	U	71	100.0	0.2	3.2	1.363	.	0.643	0.362	U	1.99

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-245
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GEOLOGIC MATERIAL IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
RADIUM-226	PCI/G	U	5	100.0	1	1.3	1.704	.	1.140	0.134	U	4.20
URANIUM-233,234	PCI/G	U	8	100.0	0.8	1.7	2.203	.	1.119	0.340	U	3.19
URANIUM-235	PCI/G	U	8	100.0	0	0.3	0.442	.	0.081	0.113	U	3.19
URANIUM-238	PCI/G	U	8	100.0	0.5	1.4	1.935	.	1.044	0.280	U	3.19

TABLE 5-246
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GEOLOGIC MATERIAL IN KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
URANIUM-233,234	PCI/G	U	13	100.0	0.4	1.5	1.858	.	0.850	0.377	U	2.67
URANIUM-235	PCI/G	U	13	100.0	0	0.1	0.100	.	0.015	0.032	U	2.67

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-247
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GEOLOGIC MATERIAL IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
AMERICIUM-241	PCI/G	U	28	100.0	-0.02	0.01	0.013	.	-0.002	0.007	U	2.25

TABLE 5-248
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GEOLOGIC MATERIAL IN RFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
CESIUM-137	PCI/G	U	120	100.0	0	0.2	0.081	.	0.010	0.038	U	1.90
PLUTONIUM-239,240	PCI/G	U	120	100.0	-0.01	0.03	0.017	.	0.003	0.007	U	1.90
STRONTIUM-89,90	PCI/G	U	120	100.0	-0.7	1.2	0.637	.	-0.013	0.342	U	1.90

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-249
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GEOLOGIC MATERIAL IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
GROSS ALPHA	PCI/G	U	8	100.0	18	46	55.251	.	27.625	8.667	U	3.19
RADIUM-228	PCI/G	U	5	100.0	1.1	1.6	2.186	.	1.400	0.187	U	4.20
TRITIUM	PCI/L	U	8	100.0	-110	280	448.928	.	71.250	118.495	U	3.19

TABLE 5-250
BACKGROUND STATISTICS FOR TOTAL RADIOCHEMICAL ACTIVITIES
IN GEOLOGIC MATERIAL IN WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
GROSS BETA	PCI/G	U	21	100.0	18	32	34.627	.	25.524	3.839	U	2.37

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-251
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GEOLOGIC MATERIAL IN COL KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
PH	PHUNIT	N	41	100.0	1.6	9.2	10.971	5.314	8.143	1.161	U	2.44

TABLE 5-252
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GEOLOGIC MATERIAL IN RFA

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
PH	PHUNIT	N	69	100.0	6.1	9.1	9.665	6.040	7.852	0.787	U	2.30

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-253
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GEOLOGIC MATERIAL IN WCS

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
PH	PHUNIT	N	8	100.0	7.6	9.7	11.127	6.273	8.700	0.650	U	3.73

TABLE 5-254
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GEOLOGIC MATERIAL IN RFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
SULFIDE	MG/KG	U	107	18.7	2 U	43000	.	.	.	.	U	.

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

TABLE 5-255
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM NORTH ROCKY FLATS RFA COL WCS KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
NITRATE/NITRITE	MG/KG	U	61	31.1	1.1 U	16.25	.	.	.	.	U	.

TABLE 5-256
BACKGROUND STATISTICS FOR TOTAL WATER QUALITY PARAMETER CONCENTRATIONS
IN GEOLOGIC MATERIAL FROM SOUTH ROCKY FLATS RFA COL KAR

ANALYTE	CONCENTRATION UNITS	DISTRI-BUTION	SAMPLE SIZE	PERCENT DETECTS	MINIMUM VALUE	MAXIMUM VALUE	UPPER TOL. LIMIT	LOWER TOL. LIMIT	MEAN	STANDARD DEVIATION	COHEN ADJUSTED	TOLERANCE FACTOR
NITRATE/NITRITE	MG/KG	U	58	55.2	1 U	3.7	3.224	.	1.345	0.926	U	2.03

Geologic unit codes: RFA=rocky flats alluvium, VFA=valley fill alluvium, COL=colluvium, KAR=Arapahoe/Laramie formation, WCS=weathered claystone at the top of the KAR. Distribution codes: L=log normal, N=normal, U=unknown distribution assumed normal for tolerance calculations. Cohen Adjusted codes: U=un-adjusted mean and standard deviation, C=mean and standard deviation adjusted for nondetects using the Cohen method. Tolerance factors are based on 95% confidence of 95% coverage and are one sided, except for pH which is two sided. When a log normal distribution is identified, untransformed (antilog) values are given, and the mean, standard deviation and tolerance limits are reported as the geometric mean, geometric standard deviation and log normal tolerance limits. Beginning at Highway 93, the boundary between north and south rocky flats follows the west plant access road, First Street to Central Avenue and then the east access road to Indiana Street. Code U indicates undetected for the minimum and maximum values.

6.0 RECOMMENDATIONS

Background environmental sampling at Rocky Flats has been underway since early 1989, and soon the sampling for calendar year 1992 will have been completed. Six different environmental media have been characterized: groundwater, stream or surface water, seep water, geologic materials (from 5 lithologies), stream bed-sediment, and seep sediment. Extensive analytical data and descriptive statistics now exist for the geochemistry of filtered and total metal concentrations in groundwater, surface water and seep water. There are good data for metals and radiochemicals in geologic materials, seep sediments, and stream bed sediments. A large quantity of analytical data exist for both filtered and total radiochemicals in surface water, seep water and groundwater at Rocky Flats. Although pesticides and other organic chemicals are largely undetected (and unexpected) in the background regions of Rocky Flats, a large amount of analytical data have also been collected on volatile and semivolatile organic compounds, pesticides, PCBs, and herbicides in background surface water, seep water, and ground water. In addition, there are pesticide, volatile and semivolatile organic compound data for stream and seep sediments. An extensive collection of water quality and field parameter data have been accumulated for all of the natural waters and some of these parameters have also been analyzed in the sediment and rock samples.

Two Background Geochemical Characterization Reports have now been completed which have evaluated the large collection of background data discussed above. These reports are the December 21, 1990 report and the present September 30, 1992 report. Excepting surficial soils (which are not a part of this program), the authors believe that the background geochemistry of Rocky Flats has now been sufficiently characterized, and that the on-going sample collection portion of the background program should be terminated at the end of calendar year 1992. The chemistry of a background area is not likely to change through time, especially since seasonality has now been shown to be unimportant (Section 5.8). Therefore, the background characterization program should not be converted into an upgradient, routine monitoring program.

The authors propose making some changes to the statistical methodology described on Figure 1-1 of this report. The new proposed methodology is shown on Figure 6-1. It is proposed that chi-squared contingency tables, or test of proportions, not be used in future background reporting.

Instead, the data that would have been tested by contingency tables would be tested using non-parametric ANOVA methods. This change is in concurrence with recent EPA guidance (EPA, 1992, pp. 26-27) that it is technically superior to use non-parametric ANOVA on the ranks of the data, in place of a test of proportions which simply looks at the proportion of detected and nondetected observations.

Any of a number of non-parametric ANOVA methods may be used as appropriate. These include the Wilcoxon rank sum test, Kruskal-Wallis test, Van der Waerden test, Quade test, and the Durbin test. The Van der Waerden test possesses a higher asymptotic relative efficiency than Kruskal-Wallis and is capable of multiple comparisons. The Quade test is equivalent to a two-way ANOVA and is therefore able to do multiple comparisons similar to a randomized complete block design. This might be a good replacement to the chi-squared analysis. The Durbin test is for an incomplete randomized block design. It can be used to estimate missing cells in the ANOVA. It can be used if normality assumptions are not met and with unequal variances. Note also, that Figure 6-1 makes some minor changes to the required sample sizes and percentages of detected observations, for a given analysis pathway.

SECTION 7

REFERENCES

ASTM (American Society of Testing Materials), 1975. Standard Recommended Practice for Dealing with Outlying Observations. E178-75.

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, Volumes 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. NTIS DE88-013620.

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

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

EG&G, 1990c. Site-Wide Quality Assurance Project Plan for CERCLA RI/FS Activities. 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, 1991a. EMD Operating Procedure Manual, Rock Flats Plant, Volume I - IV. Manual No. 5-21000-OPS.

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

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

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

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

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, 1992b. Background Geochemical Characterization Plan, Rocky Flats Plant. Golden, Colorado. September 30, 1992.

EG&G, 1992c. Rocky Flats Plant Environmental Management Division Operating Procedures Manual, Manual No. 5-2100-OPS-SW, Volume IV: Surface Water, 22 May 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. 1992.

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. 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. 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), 1989. Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities, Interim Final Guidance. PB89-151047.

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

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.

Hess, C.T. and others, 1985. The Occurrence of Radioactivity in Public Water Supplies in the United States: Health Physics, V. 48, No. 5, pp. 553-586.

Hem, John D., 1985. Study and Intepretation of the Chemical Characteristics of Natural Water, 3rd ed., U.S.G.S. Water Supply Paper 2254, pp. 1-263.

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, 55 p.

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, 1981b. 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 (Rockwell International), 1986a. Draft Work Plan, Geological and Hydrological Site Characterization; U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado.

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

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

Scott, G.R., 1965. "Nonglacial Quaternary Geology of the Southern and Middle Rocky Mountains." In: *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.* Vol. 52, pp. 591-611.

Weimer, R.J., 1973. A Guide to Uppermost Cretaceous Stratigraphy, Central Front Range Colorado: Deltaic Sedimentation, Growth Faulting and Early Laramide Crustal Movement. The Mountain Geologist, Volume 10, Number 3, pp. 53-97.

APPENDIX A

ANALYTICAL DATA

APPENDIX A
RAW DATA

Raw data for the Rocky Flats Backrground Characterization Report is included in ASCII format on two - 3 1/2 inch floppy disks. Files have been archived using "PKPak" software which is also included on the disks. The names of files are EWBKG.ARC, ESBKG.ARC, SSBKG.ARC, SWBKG.ARC, GMBKG.ARC, GWBKG.ARC, PKUNPAK.EXE, AND PKPAK.EXE. Contents of archived files are indicated below.

Archived File	ASCII File	Contents of File
EWBKG.ARC	EWBUFM07.DAT	Seep/Spring Water Filtered Metals
	EWBUFR07.DAT	Seep/Spring Water Filtered Radiochemistry
	EWBUTM07.DAT	Seep/Spring Water Total Metals
	EWBUTR07.DAT	Seep/Spring Water Total Radiochemistry
	EWBUUP07.DAT	Seep/Spring Water Pesticide/PCBs
	EWBUUS07.DAT	Seep/Spring Water Semivolatiles
	EWBUUV07.DAT	Seep/Spring Water Volatiles
	EWBUUW07.DAT	Seep/Spring Water Water Quality Data
ESBKG.ARC	ESBUTM07.DAT	Seep/Spring Sediment Total Metals
	ESBUTP07.DAT	Seep/Spring Sediment Pesticide/PCBs
	ESBUTR07.DAT	Seep/Spring Sediment Total Radiochemistry
	ESBUTS07.DAT	Seep/Spring Sediment Semivolatiles
	ESBUTV07.DAT	Seep/Spring Sediment Volatiles
	ESBUTW07.DAT	Seep/Spring Sediment Water Quality Parameters
SSBKG.ARC	SSBUTM07.DAT	Stream/Ditch Sediment Total Metals
	SSBUTP07.DAT	Stream/Ditch Sediment Pesticide/PCBs
	SSBUTR07.DAT	Stream/Ditch Sediment Total Radiochemistry
	SSBUTS07.DAT	Stream/Ditch Sediment Semivolatiles
	SSBUTV07.DAT	Stream/Ditch Sediment Volatiles
	SSBUTW07.DAT	Stream/Ditch Sediment Water Quality Parameters
SWBKG.ARC	SWBUFR07.DAT	Stream/Ditch Water Filtered Radiochemistry
	SWBUTR07.DAT	Stream/Ditch Water Total Radiochemistry
	SWBUFM07.DAT	Stream/Ditch Water Filtered Metals
	SWBUTM07.DAT	Stream/Ditch Water Total Metals
	SWBUUH07.DAT	Stream/Ditch Water Herbicides
	SWBUUP07.DAT	Stream/Ditch Water Pesticide/PCBs
	SWBUUS07.DAT	Stream/Ditch Water Semivolatiles
	SWBUUV07.DAT	Stream/Ditch Water Volatiles
	SWBUUW07.DAT	Stream/Ditch Water Water Quality Data
GMBKG.ARC	GMBUTM07.DAT	Geologic Materials Total Metals
	GMBUTR07.DAT	Geologic Materials Total Radiochemistry
	GMBUTW07.DAT	Geologic Materials Water Quality Parameters
GWBKG.ARC	GWBUFM07.DAT	Ground Water Filtered Metals
	GWBUFR07.DAT	Ground Water Filtered Radiochemistry
	GWBUTM07.DAT	Ground Water Total Metals
	GWBUTR07.DAT	Ground Water Total Radiochemistry
	GWBUUV07.DAT	Ground Water Volatiles
	GWBUUW07.DAT	Ground Water Water Quality Data

An example of the ASCII files included is shown on the following page. Some of the codes used in those files are indicated below.

Code Type	Code	Code Explanation
Sample Medium	SW	Stream/Ditch Water
	EW	Seep/Spring Water
	GW	Ground Water
	SS	Stream/Ditch Sediment
	ES	Seep/Spring Sediment
	GM	Geologic (Borehole) Materials
Analytical Fraction	F	Filtered
	T	Total
	P	Potentially Dissolved
	U	Undifferentiated
Chemical Group	H	Herbicides
	M	Metals
	P	Pesticides and PCBs
	R	Radionuclides
	S	Semivolatiles
	V	Volatiles
	W	Water Quality Parameters
Sample Type	PS	Primary Sample
	FD	Field Duplicate
	ER	Equipment Rinsate Blank
	FB	Field Blank
	TB	Trip Blank
	MS	Matrix Spike
	MD	Matrix Spike Duplicate
	LD	Lab Duplicate or Replicate
	SP	Spike

EXAMPLE OF ASCII FILE LAYOUT

LOCATION	MD	TYPE	SAMPLE NO.	DATE	D	ID	GROUP	ANALYTE	RESULT	UNITS	ERROR		RL	VAL	R1	R2	R3	R4	VR	VU	VQ	VD	UNIT	ST	RL2	QUAL2	UNITS2	RESULT2
B202589	GW	REAL	GW01368IT	05/31/91	N	S1	DMETCLPTAL	ALUMINUM	101.1	%	.		200										VFA	SP	200		%	101.1
B405689	GW	REAL	GW00036IT	07/19/90	N	MS	DMETCLPTAL	ALUMINUM	99.9	%	.		200										RFA	MS	200		%	99.9
B402189	GW	REAL	GW01313IT	05/20/91	N	S1	DMETCLPTAL	ALUMINUM	99	%	.		200										KAR	SP	200		%	99
B102289	GW	REAL	GW02126IT	12/12/91	N	S1	DMETCLPTAL	ALUMINUM	98.3	%	.		200										VFA	SP	200		%	98.3
B202589	GW	REAL	GW02099IT	12/09/91	N	S1	DMETCLPTAL	ALUMINUM	97.2	%	.		200										VFA	SP	200		%	97.2
B202589	GW	REAL	GW02099IT	12/09/91	N	MS	DMETCLPTAL	ALUMINUM	97.2	%	.		200		52								VFA	MS	200		%	97.2
B402189	GW	REAL	GW00101IT	07/20/90	N	MS	DMETCLPTAL	ALUMINUM	96.8	%	.		200										KAR	MS	200		%	96.8
B200689	GW	REAL	GW00465IT	10/08/90	N	S1	DMETCLPTAL	ALUMINUM	96.1	%	.		200										RFA	SP	200		%	96.1
B405789	GW	REAL	GW00728IT	11/16/90	N	S1	DMETCLPTAL	ALUMINUM	95.8	%	.		200										RFA	SP	200		%	95.8
B405586	GW	REAL	GW02168IT	12/18/91	N	S1	DMETCLPTAL	ALUMINUM	95.7	%	.		200										RFA	SP	200		%	95.7
B302889	GW	REAL	GW02068IT	12/16/91	N	S1	DMETCLPTAL	ALUMINUM	95.6	%	.		200										VFA	SP	200		%	95.6
B400289	GW	REAL	GW00762IT	11/29/90	N	S1	DMETCLPTAL	ALUMINUM	95.1	%	.		200										RFA	SP	200		%	95.1
B402189	GW	REAL	GW02141IT	12/19/91	N	S1	DMETCLPTAL	ALUMINUM	93.8	%	.		200										KAR	SP	200		%	93.8
B102289	GW	REAL	GW01785IT	09/17/91	N	S1	DMETCLPTAL	ALUMINUM	92.7	%	.		200										VFA	SP	200		%	92.7
B202589	GW	REAL	GW00595IT	11/01/90	N	S1	DMETCLPTAL	ALUMINUM	92.3	%	.		200										VFA	SP	200		%	92.3
B201189	GW	REAL	GW01073IT	04/05/91	N	S1	DMETCLPTAL	ALUMINUM	92.2	%	.		200										COL	SP	200		%	92.2
B402189	GW	REAL	GW01011IT	03/21/91	N	S1	DMETCLPTAL	ALUMINUM	92.1	%	.		200										KAR	SP	200		%	92.1
B102289	GW	REAL	GW01331IT	05/23/91	N	S1	DMETCLPTAL	ALUMINUM	91.8	%	.		200										VFA	SP	200		%	91.8
B400389	GW	REAL	GW01789IT	09/18/91	N	TRG	DMETCLPTAL	ALUMINUM	8610	UG/L	.		200										RFA	PS	200		UG/L	8610
B405689	GW	REAL	GW01783IT	09/17/91	N	TRG	DMETCLPTAL	ALUMINUM	589	UG/L	.		200										RFA	PS	200		UG/L	589
B400489	GW	REAL	GW01778IT	09/16/91	N	TRG	DMETCLPTAL	ALUMINUM	551	UG/L	.		200										RFA	PS	200		UG/L	551
B401989	GW	REAL	GW00544IT	10/12/90	N	TRG	DMETCLPTAL	ALUMINUM	289	UG/L	.		200										COL	PS	200		UG/L	289
B304289	GW	REAL	GW00753IT	11/19/90	N	TRG	DMETCLPTAL	ALUMINUM	256	UG/L	.		10		V								KAR	PS	10		UG/L	256
B402689	GW	REAL	G-2289-0	05/08/90		TRG	DMETCLPTAL	ALUMINUM	200	UG/L	.	U	200										VFA	PS	200	U	UG/L	200
B400189	GW	REAL	G-0189-0	06/06/90		TRG	DMETCLPTAL	ALUMINUM	200	UG/L	.	U	200										RFA	PS	200	U	UG/L	200
B304889	GW	REAL	G-4089-0	05/24/90		TRG	DMETCLPTAL	ALUMINUM	200	UG/L	.	U	200										WCS	PS	200	U	UG/L	200
B304289	GW	REAL	G-3789-0	06/20/90		TRG	DMETCLPTAL	ALUMINUM	200	UG/L	.	U	200										KAR	PS	200	U	UG/L	200
B303089	GW	REAL	G-2689-0	05/24/90		TRG	DMETCLPTAL	ALUMINUM	200	UG/L	.	U	200										VFA	PS	200	U	UG/L	200
B205589	GW	REAL	G-4689-0	06/05/90		TRG	DMETCLPTAL	ALUMINUM	200	UG/L	.	U	200										COL	PS	200	U	UG/L	200
B204189	GW	REAL	G-3689-0	06/19/90		TRG	DMETCLPTAL	ALUMINUM	200	UG/L	.	U	200										KAR	PS	200	U	UG/L	200
B203989	GW	REAL	G-3489-0	06/18/90		TRG	DMETCLPTAL	ALUMINUM	200	UG/L	.	U	200										KAR	PS	200	U	UG/L	200
B200889	GW	REAL	G-0889-0	06/06/90		TRG	DMETCLPTAL	ALUMINUM	200	UG/L	.	U	200										RFA	PS	200	U	UG/L	200
B202589	GW	DUP	GW01015IT	03/28/91	N	TRG	DMETCLPTAL	ALUMINUM	185	UG/L	.	B	200										VFA	FD	200	B	UG/L	185
B304289	GW	REAL	GW01306IT	05/20/91	N	TRG	DMETCLPTAL	ALUMINUM	148	UG/L	.	B	200		JA 7								KAR	PS	200	U	UG/L	148
B304989	GW	REAL	GW00775IT	12/04/90	N	TRG	DMETCLPTAL	ALUMINUM	147	UG/L	.		10		JA 7								KAR	PS	10	U	UG/L	147
B202589	GW	REAL	GW01753IT	09/10/91	N	TRG	DMETCLPTAL	ALUMINUM	135	UG/L	.	B	200		JA 12								VFA	PS	200	B	UG/L	135
B203989	GW	REAL	GW01756IT	09/11/91	N	TRG	DMETCLPTAL	ALUMINUM	134	UG/L	.	B	200		JA 12								KAR	PS	200	B	UG/L	134
B400389	GW	REAL	GW00273IT	08/21/90	N	TRG	DMETCLPTAL	ALUMINUM	129	UG/L	.	B	200										RFA	PS	200	B	UG/L	129
B102289	GW	REAL	GW01055IT	03/28/91	N	TRG	DMETCLPTAL	ALUMINUM	117	UG/L	.	B	200										VFA	PS	200	B	UG/L	117
B201289	GW	REAL	GW01758IT	09/11/91	N	TRG	DMETCLPTAL	ALUMINUM	109	UG/L	.	B	200		JA 12								COL	PS	200	B	UG/L	109
B102389	GW	REAL	GW00106IT	07/27/90	N	TRG	DMETCLPTAL	ALUMINUM	105	UG/L	.	B	200										VFA	PS	200	B	UG/L	105
B304289	GW	REAL	GW01738IT	09/18/91	N	TRG	DMETCLPTAL	ALUMINUM	101	UG/L	.	B	200										KAR	PS	200	B	UG/L	101
B401989	GW	REAL	GW01745IT	09/06/91	N	TRG	DMETCLPTAL	ALUMINUM	100	UG/L	.	U	200		V								COL	PS	200	U	UG/L	100
B205589	GW	REAL	GW01746IT	09/10/91	N	TRG	DMETCLPTAL	ALUMINUM	100	UG/L	.	U	200		V								COL	PS	200	U	UG/L	100
B202589	GW	DUP	GW01755IT	09/10/91	N	TRG	DMETCLPTAL	ALUMINUM	100	UG/L	.	U	200		V								VFA	FD	200	U	UG/L	100
B202589	GW	REAL	GW01014IT	03/28/91	N	TRG	DMETCLPTAL	ALUMINUM	95.9	UG/L	.	B	200										VFA	PS	200	B	UG/L	95.9
B205589	GW	REAL	GW00496IT	10/19/90	N	TRG	DMETCLPTAL	ALUMINUM	94.6	UG/L	.	B	200										COL	PS	200	B	UG/L	94.6
B102289	GW	DUP	GW01054IT	03/28/91	N	TRG	DMETCLPTAL	ALUMINUM	90.9	UG/L	.	B	200										VFA	FD	200	B	UG/L	90.9

LOCATION-SAMPLE LOCATION MD-SAMPLE MEDIA TYPE SAMPLE NO.- SAMPLE ID DATE - SAMPLE DATE D-DRY ID-LAB QC TYPE GROUP-ANALYTE GROUPING ANALYTE-SUBSTANCE ANALYZED FOR
RESULT-ORIGINAL RESULT UNITS-ORIGINAL UNITS ERROR-COUNTING ERROR FOR RADS RL-REPORTING LIMIT VAL-CODE TO INDICATE IF RESULT IS VALID
R1,R2,R3,R4,VR,VU,VQ,VD-REASONS FOR VALIDATION RATING UNIT-GEOLOGIC FORMATION ST-SAMPLE TYPE RL2-CORRECT REPORTING LIMIT QUAL2-CORRECT QUALIFIER
UNITS2-CORRECT UNITS RESULT2-CORRECT RESULT

APPENDIX B

UNIVARIATE STATISTICS BY SAMPLING LOCATION

APPENDIX B
UNIVARIATE STATISTICS BY SAMPLING LOCATION

Appendix B is a series of tables showing univariate statistics by sampling location. This information is included in ASCII format on one - 3 1/2 inch floppy disk. Names and contents of the files, which have not been archived, are listed below.

ASCII File	Contents of File
ESTMSTAT.DAT	Total Metal Statistics for Seep/Spring Sediments
ESUPSTAT.DAT	Pesticide/PCB Statistics for Seep/Spring Sediments
ESUSSTAT.DAT	Semivolatiles Statistics for Seep/Spring Sediments
ESUVSTAT.DAT	Volatile Statistics for Seep/Spring Sediments
ESTRSTAT.DAT	Total Radiochemistry Statistics for Seep/Spring Sediments
ESUWSTAT.DAT	Water Quality Parameter Statistics for Seep/Spring Sediments
SSTMSTAT.DAT	Total Metal Statistics for Stream/Ditch Sediments
SSUPSTAT.DAT	Pesticide/PCB Statistics for Stream/Ditch Sediments
SSTRSTAT.DAT	Total Radiochemistry Statistics for Stream/Ditch Sediments
SSUSSTAT.DAT	Semivolatiles Statistics for Stream/Ditch Sediments
SSUVSTAT.DAT	Volatile Statistics for Stream/Ditch Sediments
SSUWSTAT.DAT	Water Quality Parameters Statistics for Stream/Ditch Sediments
SWFMSTAT.DAT	Filtered Metal Statistics for Stream/Ditch Water
SWFRSTAT.DAT	Filtered Radiochemistry Statistics for Stream/Ditch Water
SWTMSTAT.DAT	Total Metal Statistics for Stream/Ditch Water
SWTRSTAT.DAT	Total Radiochemistry Statistics for Stream/Ditch Water
SWUHSTAT.DAT	Herbicide Statistics for Stream/Ditch Water
SWUPSTAT.DAT	Pesticide/PCB Statistics for Stream/Ditch Water
SWSSSTAT.DAT	Semivolatile Statistics for Stream/Ditch Water
SWUVSTAT.DAT	Volatile Statistics for Stream/Ditch Water
SWUWSTAT.DAT	Water Quality Statistics for Stream/Ditch Water
GMTMSTAT.DAT	Total Metal Statistics for Geologic Materials
GMTRSTAT.DAT	Total Radiochemistry Statistics for Geologic Materials
GMUWSTAT.DAT	Water Quality Parameter Statistics for Geologic Materials
GWFMSTAT.DAT	Filtered Metal Statistics for Ground Water
GWFRSTAT.DAT	Filtered Radiochemistry Statistics for Ground Water
GWTMSTAT.DAT	Total Metal Statistics for Ground Water
GWTRSTAT.DAT	Total Radiochemistry Statistics for Ground Water
GWUVSTAT.DAT	Volatile Statistics for Ground Water
GWUWSTAT.DAT	Water Quality Statistics for Ground Water
EWFRSTAT.DAT	Filtered Radiochemistry Statistics for Seep/Spring Water
EWTRSTAT.DAT	Total Radiochemistry Statistics for Seep/Spring Water
EWUSSTAT.DAT	Semivolatile Statistics for Seep/Spring Water
EWUVSTAT.DAT	Volatile Statistics for Seep/Spring Water
EWUWSTAT.DAT	Water Quality Statistics for Seep/Spring Water
EWFMSTAT.DAT	Filtered Metal Statistics for Seep/Spring Water
EWTMSTAT.DAT	Total Metal Statistics for Seep/Spring Water
EWUPSTAT.DAT	Pesticide/PCB Statistics for Seep/Spring Water

APPENDIX C

LIST OF OUTLIERS

Appendix C
List of Outliers and Corrected Values

ANALYTE/COMPOUND	LOCATION	DATE	SAMPLE	OUTLIER VALUE	CORRECT VALUE	UNITS
GROSS ALPHA - DISSOLVED	B205589	06/05/90	G46890604021205	214.80	--	pci/l
GROSS ALPHA - DISSOLVED	SW005	07/02/90	SW00108WC	69.23	--	pci/l
GROSS BETA	SW041	06/16/89	SW041003	41.0	--	pci/l
GROSS BETA - DISSOLVED	B205589	10/19/90	GW00496IT	135.9	--	pci/l
IRON	B400389	09/18/91	GW01789IT	8790.00	--	ug/l
IRON	SW080	06/16/89	SW080003	3220000.0	--	ug/l
IRON	SW107	07/14/89	SW107004	26300.00	--	ug/l
LEAD	B200589	12/07/91	GW02043IT	52.50	--	ug/l
LEAD	B400289	09/14/90	GW00397IT	13.80	--	ug/l
LEAD	SW080	01/09/90	SW08090001	950.0	--	ug/l
LITHIUM	SW006	12/04/89	SW006009	25051.0 AV	100 U	ug/l
LITHIUM	SW006	12/04/89	SW006009DUP	25051.0 AV	100 U	ug/l
MAGNESIUM	SW108	12/05/89	SW108009	27400.0	--	ug/l
MAGNESIUM - FILTERED	SW041	11/05/90	SW00522WC	17800.0	--	ug/l
MAGNESIUM - TOTAL	SW041	11/05/90	SW00522WC	16600.0	--	ug/l
MANGANESE	SW080	06/16/89	SW080003	27700.0 J	--	ug/l
MANGANESE	SW107	07/14/89	SW107004	4060.0	--	ug/l
METHYLENE CHLORIDE	SW080	04/03/90	SW080W040390A	22.00	--	ug/l
NITRATE/NITRITE	SW006	09/04/91	2000.00	2000.00	--	ug/l
PH	SW005	09/05/89	SW005006	8.60	--	phunit
PHOSPHORUS	B405789	08/16/90	GW00161IT	15000.0	**	ug/l
PHOSPHORUS	SW006	10/01/90	SW00364WC	290.0	--	ug/l
PHOSPHORUS	SW080	08/02/90	SW00209WC	3400.0	--	ug/l
PLUTONIUM-239,240	B302989	12/05/90	GW00778IT	0.22	--	pci/l
PLUTONIUM-239,240	SW080	07/14/89	SW080004	4.40	--	pci/l
RADIUM-226	B204089	10/30/90	GW00607IT	2.98	--	pci/l
SILICON	B202489	09/11/91	GW01757IT	32600.0	--	ug/l
SILVER	B400289	09/14/90	GW00397IT	13600.00	10 U	ug/l
SODIUM - FILTERED	SW108	07/13/89	SW108004	33700.0	--	ug/l
SODIUM - TOTAL	SW108	07/13/89	SW108004	35200.0	--	ug/l
STRONTIUM	SW004	03/26/90	SW00490003	1000.00 U	--	ug/l
STRONTIUM	SW006	12/04/89	SW006009	25050.50 AV	100 U	ug/l
STRONTIUM	SW006	12/04/89	SW006009DUP	25050.50 AV	101 J	ug/l
STRONTIUM	SW041	11/05/90	SW00522WC	438.00	408	ug/l
STRONTIUM	SW108	12/05/89	SW108009	967.0	1020	ug/l
STRONTIUM-89,90	B202489	12/11/91	GW02119IT	1.45	--	pci/l
SULFATE	SW041	11/20/89	SW041008	48000.0	--	ug/l
SULFATE	SW108	12/05/89	SW108009	560000.0	--	ug/l
TIN	8205589	09/10/91	GW01746IT	8830.0	100 U	ug/l
TOTAL DISSOLVED SOLIDS	SW005	06/01/90	SW005W06190A	620000.0	--	ug/l
TOTAL DISSOLVED SOLIDS	SW108	12/05/89	SW108009	1100000.0	--	ug/l
TOTAL SUSPENDED SOLIDS	SW006	02/06/90	SW00690002	68000.00	--	ug/l
TOTAL SUSPENDED SOLIDS	SW006	09/05/90	SW00286WC	210000.00	--	ug/l
TOTAL SUSPENDED SOLIDS	SW041	02/06/90	SW04190002	180000.00	--	ug/l
TOTAL SUSPENDED SOLIDS	SW041	12/04/90	SW00568WC	230000.00	--	ug/l
TOTAL SUSPENDED SOLIDS	SW080	08/10/89	SW080005	46000000.0	--	ug/l
TOTAL SUSPENDED SOLIDS	SW080	01/09/90	SW08090001	22000000.00	--	ug/l
TOTAL SUSPENDED SOLIDS	SW107	07/14/89	SW107004	400000.00	--	ug/l
TRITIUM	B302889	08/30/91	GW01736IT	561.20	--	pci/l
TRITIUM	SW131	11/01/90	SW00469WC	2700.0	--	pci/l
URANIUM-233,234	SW005	07/02/90	SW00108WC	31.75	--	pci/l
URANIUM-233,234	SW108	02/07/90	SW10890002	6.9	--	pci/l
URANIUM-235	B205589	12/05/90	GW00250IT	6.29	**	pci/l
URANIUM-235	SW005	07/02/90	SW00108WC	0.90	--	pci/l
URANIUM-238	SW005	07/02/90	SW00108WC	24.45	--	pci/l
URANIUM-238	SW006	02/06/90	SW00690002	1.82	--	pci/l
URANIUM-238	SW108	02/07/90	SW10890002	5.93	--	pci/l
VANADIUM	B203989	09/11/91	GW01756IT	1670.0	--	ug/l
ZINC	B203989	09/11/91	GW01756IT	1800.0	--	ug/l
ZINC	SW006	12/04/89	SW006009	5019.1 AV	15.7 UJ	ug/l
ZINC	SW006	12/04/89	SW006009DUP	5019.1 AV	38.2 UJ	ug/l

Notes:
AV indicates that the primary sample and its duplicate were averaged to determine value. J indicates an estimated value.
-- indicates value from supporting data was the same as that reported for outlier. U indicates not detected at reporting limit.
** indicates supporting data was not available.

Appendix C
List of Outliers and Corrected Values

ANALYTE/COMPOUND	LOCATION	DATE	SAMPLE	OUTLIER VALUE	CORRECT VALUE	UNITS
ACETONE	SED017	08/27/90	SD00210WC	2300.0	--	ug/kg
ACETONE	SED023	06/04/90	SS0002WC	830.00 J	--	ug/kg
ALUMINUM	B400289	04/17/89	BH02894248	102000.0	--	mg/kg
ALUMINUM	SED127	03/21/91	SS00200WC	25200.0	--	mg/kg
AMERICIUM 241	SED018	05/29/90	SS00006WC	1.07	--	pci/g
AMERICIUM-241	SED016	05/24/90	SS00004WC	2.53	--	pci/g
ARSENIC	B200689	02/28/89	BH06890104	41.80 J	--	mg/kg
BARIUM	B201289	03/22/89	BH12890003	189.00	189 J	mg/kg
BARIUM	B400289	04/17/89	BH02894248	777.00	--	mg/kg
BERYLLIUM	B201089	03/02/89	BH10890106	10.30	--	mg/kg
BERYLLIUM	B400289	04/17/89	BH02894248	23.50 J	--	mg/kg
CALCIUM	B200789	03/01/89	BH07890306	157000.0 E	--	mg/kg
CALCIUM	B400289	04/17/89	BH02894248	26100.00 V	--	mg/kg
CESIUM-137	SED020	05/02/91	SD00212WC	1.50	**	pci/g
CHROMIUM	B400289	04/17/89	BH02894248	176.0	--	mg/kg
CHROMIUM	SED022	03/05/91	SS00180WC	2.0	--	mg/kg
CHROMIUM	SED127	03/21/91	SS00200WC	29.70	--	mg/kg
COBALT	SED018	08/23/90	SS00110WC	17.2 B	--	mg/kg
COBALT	SED127	03/21/91	SS00200WC	15.00	--	mg/kg
COPPER	B400289	04/17/89	BH02894248	123.0 J	--	mg/kg
COPPER	SED018	08/23/90	SS00110WC	178.0	--	mg/kg
GROSS BETA	B200589	05/22/89	BH05891317	44.0	--	pci/g
IRON	B400289	04/17/89	BH02894248	132000.0	--	mg/kg
LEAD	SED022	05/07/91	SD00214WC	244.0	--	mg/kg
LITHIUM	B400289	04/17/89	BH02894248	83.2	--	mg/kg
MAGNESIUM	B400289	04/17/89	BH02894248	32500.0	--	mg/kg
MANGANESE	B400289	04/17/89	BH02894248	3330.0 J	--	mg/kg
METHYLENE CHLORIDE	SED022	05/07/91	SD00214WC	190.00	--	ug/kg
MOLYBDENUM	BH02894248	04/17/89	BH02894248	67.60	--	mg/kg
NICKEL	B400289	04/17/89	BH02894248	193.0 J	--	mg/kg
NITRATE/NITRITE	SED023	08/05/91	SD00249WC	76.0	--	mg/kg
PLUTONIUM-239,240	B405189	03/09/89	BH01890003	0.03	--	pci/g
PLUTONIUM-239,240	SED020	05/23/90	SS00002WC	8.93	--	pci/g
POTASSIUM	B400289	04/17/89	BH02894248	18700.0	--	mg/kg
SODIUM	SED23001	02/21/89	SED23001	1410.00 U	351 B	mg/kg
STRONTIUM	SED020	10/27/89	SED020001B	421.00 J	--	mg/kg
STRONTIUM-89,90	B405189	03/10/89	BH01893638	1.20	--	pci/g
TRITIUM	SED004	08/27/90	SS00103WC	1770.0	--	pci/l
URANIUM-233,234	B301889	03/07/89	BH15890915	8.90	0.9	pci/g
URANIUM-238	B200989	03/02/89	BH09890410	3.20	--	pci/g
VANADIUM	B400289	04/17/89	BH02894248	283.0	--	mg/kg
ALUMINUM	B400389	09/18/91	GW01789IT	8610.0	--	ug/l
ARSENIC	SW080	06/16/89	SW080003	1030.0	--	ug/l
BARIUM	B203989	09/11/91	GW01756IT	1810.0	--	ug/l
BARIUM	SW006	01/09/90	SW00690001	12521.95 AV	46.9	ug/l
BARIUM	SW006	01/09/90	SW00690001DUP	12521.95 AV	43.9	ug/l
BARIUM	SW080	06/16/89	SW080003	4480.00	--	ug/l
BARIUM	SW080	01/09/90	SW08090001	7070.0	--	ug/l
BARIUM	SW107	07/14/89	SW107004	306.0	--	ug/l
BARIUM	SW107	04/02/91	SW00977WC	391.00	--	ug/l
BICARBONATE	SW080	08/10/89	SW080005	4100000.0	--	ug/l
BICARBONATE AS CACO3	SW041	11/05/90	SW00522WC	200000.0	--	ug/l
BICARBONATE AS CACO3	SW080	11/01/90	SW00466WC	1110000.0	--	ug/l
CALCIUM	SW080	06/16/89	SW080003	803000.0	--	ug/l
CALCIUM	SW108	12/05/89	SW108009	216000.0	--	ug/l
CARBONATE AS CACO3	SW041	10/02/91	SW01609WC	10000.00 U	--	ug/l
CESIUM-137	B405789	05/30/90	G48890530021510	1.16	--	pci/l
CHLORIDE	SW080	11/01/90	SW00466WC	130000.0	--	ug/l
CHROMIUM	B203989	09/11/91	GW01756IT	1590.0	--	ug/l
FLUORIDE	B400489	08/15/90	GW00247IT	25000.00 U	**	ug/l
FLUORIDE	SW131	03/13/91	SW00881WC	720.0	--	ug/l
GROSS ALPHA	SW041	06/16/89	SW041003	57.0	--	pci/l

Notes:
AV indicates that the primary sample and its duplicate were averaged to determine value. J indicates an estimated value.
-- indicates value from supporting data was the same as that reported for outlier. U indicates not detected at reporting limit.
** indicates supporting data was not available.

APPENDIX D

DATA VALIDATION SUMMARY

Appendix D
Data Validation

Table D-1 Summary of Number of Results Validated and Rejected

Table D-2 Summary of Rejected Data with Reason Code

Table D-3 Equipment Rinsate Blank and Field Blank Data

- -Total Metals in Waters (Ground Water, Seeps, Streams) and Soils
- -Filtered Metals in Waters
- -Total Radiochemistry in Waters and Soils
- -Filtered Radiochemistry in Waters
- -Water Quality Parameters in Waters and Soils
- -Volatiles in Waters and Soils
- -Semivolatiles in Waters and Soils
- -Pesticide/PCBs in Waters and Soils

Table D-4 Ratio of Relative Percent Differences (RPDs) over Limit to Total Pairings of Field Duplicates and Primary Samples

- -Metals
- -Radiochemistry
- -Water Quality Parameters
- -Volatiles
- -Semivolatiles
- -Pesticide/PCBs
- -Herbicides

Table D-1
Summary of Validation Information
Background Characterization Primary Sample and Field Duplicate Data

	Total Results	No. Results Validated	No. Results Rejected	% Results Validated	% Validated Results Rejected
Background Geologic (Borehole) Mat.					
Total Metals	3668	3206	191	87	6
Total Miscellaneous Parameters*	381	220	9	58	4
Total Radiochemistry	1550	0	0	0	*****
TOTAL	5599	3426	200	62	5.84
Background Ground Water					
Filtered Metals	5672	1906	44	34	2
Total Metals	2081	1815	11	87	1
Total Miscellaneous Parameters*	2591	1598	17	62	1
Filtered Radiochemistry	1241	600	73	48	12
Total Radiochemistry	799	302	69	38	23
Total Volatile Organics	10048	6108	285	61	5
TOTAL	22432	12329	499	55	4.05
Background Seep/Spring Sediment					
Total Metals	541	341	47	63	14
Total Miscellaneous Parameters*	49	18	1	37	6
Total Pesticide/PCB Data	250	162	27	65	17
Total Radiochemistry	182	85	21	47	25
Total Semivolatile Organics	910	390	68	43	17
Total Volatile Organics	407	237	39	58	16
TOTAL	2339	1233	203	53	16.46
Background Seep/Spring Water					
Filtered Metals	1089	817	81	53	10
Total Metals	1115	447	17	40	4
Total Miscellaneous Parameters*	564	302	5	54	2
Total Pesticide/PCB Data	162	54	0	33	0
Filtered Radiochemistry	123	35	4	28	11
Total Radiochemistry	391	89	19	23	21
Total Semivolatile Organics	399	65	0	16	0
Total Volatile Organics	800	170	2	21	1
TOTAL	4643	1979	128	43	6.47
Background Stream/Ditch Sediment					
Total Metals	1471	934	70	63	7
Total Miscellaneous Parameters*	138	66	8	48	12
Total Pesticide/PCB Data	962	648	54	67	8
Total Radiochemistry	487	248	63	51	25
Total Semivolatile Organics	2600	1489	156	57	10
Total Volatile Organics	1292	782	75	61	10
TOTAL	6950	4167	426	60	10.22
Background Stream/Ditch Water					
Total Herbicide Data	19	0	0	0	*****
Filtered Metals	2868	1580	131	55	8
Total Metals	3107	1014	25	33	2
Total Miscellaneous Parameters*	1671	888	4	53	0
Total Pesticide/PCB Data	403	216	0	54	0
Filtered Radiochemistry	548	166	33	30	20
Total Radiochemistry	813	260	63	32	24
Total Semivolatile Organics	1109	581	0	52	0
Total Volatile Organics	3192	1222	13	38	1
TOTAL	13730	5927	269	43	4.54
GRAND TOTAL	55693	29061	1725	52	5.94

*Miscellaneous parameters: Cl, NO2-NO3, PO4, S, SO4, CO3, HCO3, etc.

Table D-2
Listing of Rejected Data with Reason Code
Background Characterization Primary Sample and Field Duplicate Data

Media - Analyte Group	Quantalex Validation Reason Code	Number of Times Code Referenced	Quantalex Validation Report Reason
Soil/Sediment Sample Total Metals	57	41	PERCENT SOLIDS < 30 PERCENT
	8	3	NEGATIVE BIAS WAS INDICATED IN THE BLANKS
	58	30	PERCENT SOLIDS < 10 PERCENT
	13	4	PRE-DIGESTION MATRIX SPIKE CRITERIA WERE NOT MET (< 30 PERCENT)
	9	4	INTERFERENCE INDICATED IN THE ICP INTERFERENCE CHECK SAMPLE
Soil/Sediment Sample Total Pesticide/PCB Data	57	54	PERCENT SOLIDS < 30 PERCENT
	58	27	PERCENT SOLIDS < 10 PERCENT
Soil/Sediment Sample Total Radiochemistry	4	30	CALIBRATION VERIFICATION CRITERIA WERE NOT MET
	63	29	LCS EXPECTED VALUE NOT SUBMITTED/VERIFIABLE
	36	2	MDA EXCEEDED THE RDL
	18	46	DOCUMENTATION WAS NOT PROVIDED
	51	45	NON-VERIFIABLE LABORATORY RESULTS AND/OR UNSUBMITTED DATA
	74	27	LCS DATA NOT SUBMITTED
	30	7	REPLICATE PRECISION CRITERIA WERE NOT MET
	78	34	MDAS WERE CALCULATED BY REVIEWER
	99	18	SEE HARDCOPY FOR FURTHER EXPLANATION
	75	18	BLANK DATA NOT SUBMITTED
	27	10	RECOVERY CRITERIA WERE NOT MET
	61	9	REPLICATE RECOVERY CRITERIA WERE NOT MET
	21	2	REAGENT BLANKS EXCEEDED MDA
	32	2	LAB CONTROL SAMPLES >+/-3 SIGMA
	52	1	TRANSCRIPTION ERROR
Soil/Sediment Sample Total Semivolatile Organics	57	127	PERCENT SOLIDS < 30 PERCENT
	85	64	NEGATIVE BIAS WAS INDICATED IN THE BLANKS
	41	18	ORGANICS CONTINUING CALIBRATION CRITERIA WERE NOT MET
	58	65	PERCENT SOLIDS < 10 PERCENT
	40	2	ORGANICS INITIAL CALIBRATION CRITERIA WERE NOT MET
	43	7	INTERNAL STANDARDS OUTSIDE CRITERIA
Soil/Sediment Sample Miscellaneous Parameters*	6	6	INCORRECT CALIBRATION OF INSTRUMENT
	58	2	PERCENT SOLIDS < 10 PERCENT
	99	1	SEE HARDCOPY FOR FURTHER EXPLANATION
	57	1	PERCENT SOLIDS < 30 PERCENT
Soil/Sediment Sample Total Volatile Organics	57	61	PERCENT SOLIDS < 30 PERCENT
	43	9	INTERNAL STANDARDS OUTSIDE CRITERIA
	58	34	PERCENT SOLIDS < 10 PERCENT
	99	4	SEE HARDCOPY FOR FURTHER EXPLANATION
	40	4	ORGANICS INITIAL CALIBRATION CRITERIA WERE NOT MET
	41	1	ORGANICS CONTINUING CALIBRATION CRITERIA WERE NOT MET
Water Sample Filtered Metals	13	9	PRE-DIGESTION MATRIX SPIKE CRITERIA WERE NOT MET (< 30 PERCENT)
	8	21	NEGATIVE BIAS WAS INDICATED IN THE BLANKS
	5	7	CRDL CHECK SAMPLE RECOVERY CRITERIA WERE NOT MET
	6	10	INCORRECT CALIBRATION OF INSTRUMENT
	99	3	SEE HARDCOPY FOR FURTHER EXPLANATION

*Miscellaneous parameters: Cl, NO2-NO3, PO4, S, SO4, CO3, HCO3, etc.

Table D-2 (continued)
Listing of Rejected Data with Reason Code
Background Characterization Primary Sample and Field Duplicate Data

Media - Analyte Group	Quantalex Validation Reason Code	Number of Times Code Referenced	Quantalex Validation Report Reason
	84	1	NEGATIVE BIAS WAS INDICATED IN THE BLANKS
Water Sample Filtered Radiochemistry	18	49	DOCUMENTATION WAS NOT PROVIDED
	32	63	LAB CONTROL SAMPLES >+/-3 SIGMA
	99	42	SEE HARDCOPY FOR FURTHER EXPLANATION
	85	19	NEGATIVE BIAS WAS INDICATED IN THE BLANKS
	36	11	MDA EXCEEDED THE RDL
	78	63	MDAS WERE CALCULATED BY REVIEWER
	68	9	FREQUENCY OF QUALITY CONTROL SAMPLES NOT MET
	2	1	HOLDING TIMES WERE GROSSLY EXCEEDED
	31	22	REPLICATE ANALYSIS WAS NOT PERFORMED
	74	4	LCS DATA NOT SUBMITTED
	27	9	RECOVERY CRITERIA WERE NOT MET
	4	21	CALIBRATION VERIFICATION CRITERIA WERE NOT MET
	62	16	LCS RELATIVE PERCENT ERROR CRITERIA NOT MET
	21	6	REAGENT BLANKS EXCEEDED MDA
	54	9	INCORRECT REPORTED ACTIVITY OR MDA
	52	8	TRANSCRIPTION ERROR
	6	1	INCORRECT CALIBRATION OF INSTRUMENT
	86	1	NEGATIVE BIAS WAS INDICATED IN THE BLANKS
Water Sample Total Metals	8	5	NEGATIVE BIAS WAS INDICATED IN THE BLANKS
	10	3	LAB CONTROL SAMPLE RECOVERY CRITERIA WERE NOT MET
	5	4	CRDL CHECK SAMPLE RECOVERY CRITERIA WERE NOT MET
	84	1	NEGATIVE BIAS WAS INDICATED IN THE BLANKS
	6	5	INCORRECT CALIBRATION OF INSTRUMENT
	99	2	SEE HARDCOPY FOR FURTHER EXPLANATION
Water Sample Total Radiochemistry	18	36	DOCUMENTATION WAS NOT PROVIDED
	51	15	NON-VERIFIABLE LABORATORY RESULTS AND/OR UNSUBMITTED DATA
	32	46	LAB CONTROL SAMPLES >+/-3 SIGMA
	78	16	MDAS WERE CALCULATED BY REVIEWER
	21	23	REAGENT BLANKS EXCEEDED MDA
	27	6	RECOVERY CRITERIA WERE NOT MET
	4	11	CALIBRATION VERIFICATION CRITERIA WERE NOT MET
	68	39	FREQUENCY OF QUALITY CONTROL SAMPLES NOT MET
	99	39	SEE HARDCOPY FOR FURTHER EXPLANATION
	61	13	REPLICATE RECOVERY CRITERIA WERE NOT MET
	77	7	DETECTOR EFFICIENCY CRITERIA NOT MET
	36	6	MDA EXCEEDED THE RDL
	74	5	LCS DATA NOT SUBMITTED
	53	4	CALCULATION ERROR
	31	28	REPLICATE ANALYSIS WAS NOT PERFORMED
	1	35	HOLDING TIMES WERE EXCEEDED
	85	10	NEGATIVE BIAS WAS INDICATED IN THE BLANKS
	2	11	HOLDING TIMES WERE GROSSLY EXCEEDED

*Miscellaneous parameters: Cl, NO2-NO3, PO4, S, SO4, CO3, HCO3, etc.

Table D-2 (continued)
Listing of Rejected Data with Reason Code
Background Characterization Primary Sample and Field Duplicate Data

Media - Analyte Group	Quantalex Validation Reason Code	Number of Times Code Referenced	Quantalex Validation Report Reason
	52	8	TRANSCRIPTION ERROR
	76	4	INSTRUMENT GAIN AND/OR EFFICIENCY NOT SUBMITTED
	30	17	REPLICATE PRECISION CRITERIA WERE NOT MET
	62	7	LCS RELATIVE PERCENT ERROR CRITERIA NOT MET
	75	1	BLANK DATA NOT SUBMITTED
Water Sample Total Volatile Organics	41	104	ORGANICS CONTINUING CALIBRATION CRITERIA WERE NOT MET
	40	75	ORGANICS INITIAL CALIBRATION CRITERIA WERE NOT MET
Water Sample Total Water Quality Data	4	11	CALIBRATION VERIFICATION CRITERIA WERE NOT MET
Water Sample Total Miscellaneous Parameters*	6	6	INCORRECT CALIBRATION OF INSTRUMENT
	2	2	HOLDING TIMES WERE GROSSLY EXCEEDED

*Miscellaneous parameters: Cl, NO2-NO3, PO4, S, SO4, CO3, HCO3, etc.

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Total Metals
Results reported in ug/l

Station Number	Date Sampled	Blank Type	Aluminum (Al)		Antimony (Sb)		Arsenic (As)		Barium (Ba)		Beryllium (Be)		Cadmium (Cd)		Calcium (Ca)		Cesium (Cs)		Chromium (Cr)	
B102289	09/17/91	ER	11.9	U	7	U	2	U	1.9	U	1	U	2	U	250	B	50	U	6	U
B102289	12/12/91	ER	12	U	7	U	2	U	3.2	U	1	U	2	U	243	B	50	U	6	U
B202589	09/10/91	ER	100	U	50	U	2	U			2	U	3	U	1000	U	500	U	5	U
B202589	12/09/91	ER					2	U	2.4	B	1	U	2	U	193	U	50	U		
B400289	09/19/91	ER	11	U	20.1	U	2	U	3.5	U	1	U	2	U	96.5	B	70	U	6	U
B402189	12/19/91	ER	12	U	14	U	2	U	3.7	U	1	U			204	B	70	U	6.1	U
B405586	12/18/91	ER	19.7	U	14.6	U			2.2	U	1	U	1.4	U	225	B	50	U	6.7	U
SW006	04/02/91	ER	34.9		18.2	U	0.9	U	4.4	U	0.8		2.7	U	252		500	U	6.9	U
SW007	05/02/91	ER	108	U	25.6	U	0.9	U	3.9		0.5	U	3.3	U	517		500	U	4.1	U
SW041	08/06/90	ER	9.8	B	10	U	1	U	4.4	B	1	U	2	U	266	BE	200	B	6	U

Station Number	Date Sampled	Blank Type	Cobalt (Co)		Copper (Cu)		Iron (Fe)		Lead (Pb)		Lithium (Li)		Magnesium (Mg)		Manganese (Mn)		Mercury (Hg)		Molybdenum (Mo)	
B102289	09/17/91	ER	3	U	3	U	12.4	U	1	UW	1	U	20.4	U	1	U	0.2	U	3	U
B102289	12/12/91	ER	3	U	3	U	83.5	U	1	U	1.1	U	27	U	5.4	B	0.2	U	3.3	U
B202589	09/10/91	ER	10	U	10	U	50	U	2.2	U	50	U	1000	U	5	U	0.2	U	10	U
B202589	12/09/91	ER	3	U	3	U	18.5	U	1	U	1	U			2.5	B	0.2	U	3	U
B400289	09/19/91	ER	3	U	3	U	4	U	1	UW					1.1	B	0.2	U	3	U
B402189	12/19/91	ER	3	U	3.2	U	116	N*			1	U	21.1	U	1.7	B	0.2	U	2	U
B405586	12/18/91	ER	3	U	4	U	27	U			1.9	U	38.3	U	2.4	B	0.2	U	2	U
SW006	04/02/91	ER	3	U	4.8		40.6		1.4	U	2	U	35.9	U	6.1		0.2	U	10.9	U
SW007	05/02/91	ER	3.6	U	4.7	U	47.6		1.4	U	4.3	U	38.1		4.5		0.2	U	5.7	U
SW041	08/06/90	ER	4	U	3	U	14	B	1	UW	4	U	55.4	B	3.8	B	0.2	U	2	U

Station Number	Date Sampled	Blank Type	Nickel (Ni)		Potassium (K)		Selenium (Se)		Silver (Ag)		Sodium (Na)		Strontium (Sr)		Thallium (Tl)		Tin (Sn)		Vanadium (V)		Zinc (Zn)	
B102289	09/17/91	ER	17	U	61	U	2	U	2	U	116	B	2.9	B	1	U	17	U	2	U	15.1	U
B102289	12/12/91	ER	17	U	87.7	U	2	U	2	U	119	U	3.2	U	1	U	17	U	2	U	12.8	U
B202589	09/10/91	ER	10	U	2000	U	1	U			2000	U	100	U			100	U	10	U	17.2	B
B202589	12/09/91	ER	17	U	61	U	2	UW	2	U	64.9	B	2.4	B	1	U	17	U	2	U	18.3	U
B400289	09/19/91	ER	17	U	61	U	2	U	2	U	81.7	U	1.8	B	1	UN	17	U	2	U	11.7	U
B402189	12/19/91	ER	3.4	U	111	U	1	U	2.6	U	95.3	U	2.7	B	1	B	10.8	U	1.2	U	5.6	U
B405586	12/18/91	ER	6	U	118	U	2	U	4.2	U	180	B	2.8	B	1	U	11.6	B	2.7	U	7.4	U
SW006	04/02/91	ER	3.9	U	94.8	U	1.1	U	3.8	U	276		7.3	U	1.4	U	24.2	U	2	U	4.7	U
SW007	05/02/91	ER	14.7	U	2050	U	1.1	U	5	U	285		6.9		1.4	U	14.8	U	5.7	U	4.6	
SW041	08/06/90	ER	4	U	68	U	1	U	2	U	276	B	2.3	B	1	U	11	U	3	U	8.1	B

ER=Equipment Rinsate Blank FB=Field Blank W=Post-digestion spike out of control limits
B=Value less than Contract Required Detection Limit (CRDL) but greater than Instrument Detection Limit (IDL) *=Duplicate Analysis not within control limits
U=Analyzed but not detected E=Estimated Value N=Spiked sample recovery not within control limits

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Soil and Sediment Sample Total Metals
Results reported in ug/l

Station Number	Date Sampled	Blank Type	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Cadmium (Cd)	Calcium (Ca)	Cesium (Cs)	Chromium (Cr)
SED023	11/12/90	ER	1470	30 U	2 UW	20.8 B	1 U	5 U	588 B	200 U	10 U

Station Number	Date Sampled	Blank Type	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)
SED023	11/12/90	ER	20 U	38	1640	102 W	5 U	298 B	13.3 B	0.2 U	10 U

Station Number	Date Sampled	Blank Type	Nickel (Ni)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Thallium (Tl)	Tin (Sn)	Vanadium (V)	Zinc (Zn)
SED023	11/12/90	ER	20 U	1000 U	2 UW	5 U	422 B	6.9 E	2 U	20 U	10 U	55.4

ER=Equipment Rinsate Blank FB=Field Blank W=Post-digestion spike out of control limits
B=Value less than Contract Required Detection Limit (CRDL) but greater than Instrument Detection Limit (IDL) *=Duplicate Analysis not within control limits
U=Analyzed but not detected E=Estimated Value N=Spiked sample recovery not within control limits

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Filtered Metals
Results reported in ug/l

Station Number	Date Sampled	Blank Type	Aluminum (Al)		Antimony (Sb)		Arsenic (As)		Barium (Ba)		Beryllium (Be)		Cadmium (Cd)		Calcium (Ca)		Cesium (Cs)		Chromium (Cr)	
B102289	08/30/90	ER	18.4	B	12.1	B	1	U	2.1	B	1	U	2	U	204	B	147	U	6	U
B102289	08/30/90	FB	68.6	B	16.4	B	1	U	7.2	B	1	U	2.4	B	223	B	147	U	7.8	B
B102289	10/24/90	FB	16.6	B	7	U	2	U	5	B	1	U	2	U	162	B	100	B	5	U
B102289	10/24/90	ER	30.7	B	7	U	2	U	5.7	B	1	U	2	U	145	B	100	B	5	U
B102289	03/28/91	ER	46.4	B	19	U	1	U	8	B	1	U	4	U	266	B	500	U	4	U
B102289	05/23/91	ER	11	U	6	U	2	U	2	U	1	U	2	U	148	B	112	U	3	U
B102289	09/17/91	ER	20.3	B	8	U			1.3	BE			1	U	253	B			5.1	B
B102289	12/12/91	ER	11	U	7.6	U									248	B				
B202589	11/01/90	FB	10	U	7	U	2	U	2.8	B	1	U	2	U	117	B	200	B	5	U
B202589	11/01/90	ER	10	U	7	U	2	U	1	U	1	U	2	U	75.6	B	100	B	5	U
B202589	03/28/91	ER	51.2	B	19	U	1	U	4.7	B	1	U	4	U	258	B	500	U	4	U
B202589	05/31/91	ER	11	U	6	U	2	U	2.2	B	1	U	2	U	288	B	70	U	3	U

Station Number	Date Sampled	Blank Type	Cobalt (Co)		Copper (Cu)		Iron (Fe)		Lead (Pb)		Lithium (Li)		Magnesium (Mg)		Manganese (Mn)		Mercury (Hg)		Molybdenum (Mo)	
B102289	08/30/90	ER	4	U	5.8	B	14	B	1	U	4	U	35.6	B	4.4	B	0.2	U	2.2	B
B102289	08/30/90	FB	4	U	5.7	B	67.3	B	1	U	4	U	119	B	8.3	B	0.2	U	4	B
B102289	10/24/90	FB	3	U	2	U	25.3	B	1	U	1	U	21	B	2.8	B	0.2	U	2	U
B102289	10/24/90	ER	3	U	2	U	29.7	B	1	U	1	U	18	B	3	B	0.2	U	2	U
B102289	03/28/91	ER	5	U	6	U	184		1.2	B	20	U	34.1	B	3.4	B	0.2	U	7	U
B102289	05/23/91	ER	3	U	11	U	14	B	1	U	2	U	9	U	3	B	0.2	U	2	U
B102289	09/17/91	ER			3.3	B	53.4	B			2	U	30	B	1.6	B			8	B
B102289	12/12/91	ER			3.9	U	17.1	U			1.6	U	39.1	U	5.2	B			4.8	U
B202589	11/01/90	FB	3	U	2	U	14	U	1	U	2	UE	14	U	3	B	0.2	U	6.1	B
B202589	11/01/90	ER	3	U	2.3	B	66.2	B	1	U	2	UE	14	U	4.7	B	0.2	U	2	U
B202589	03/28/91	ER	5	U	6	U	116		1	U	20	U	67.6	B	3.4	B	0.2	U	7	U
B202589	05/31/91	ER	3	U	11	U	7.3	U	1	U	2	U	17.9	B	4.6	B	0.2	U	10	B

Station Number	Date Sampled	Blank Type	Nickel (Ni)		Potassium (K)		Selenium (Se)		Silver (Ag)		Sodium (Na)		Strontium (Sr)		Thallium (Tl)		Tin (Sn)		Vanadium (V)		Zinc (Zn)	
B102289	08/30/90	ER	4	U	68	U	1	U	2.3	B	167	B	1.8	B	3	U	25.5	B	3	U	11.1	B
B102289	08/30/90	FB	6.5	B	112	B	1	U	3.7	B	142	B	2.3	B	3	UW	11	U	3	U	8.7	B
B102289	10/24/90	FB	4	U	34	U	2	U	4	B	150	B	2.3	B	2	UN	21.4	B	2.3	B	1	U
B102289	10/24/90	ER	4	U	36.2	B	2	U	5.4	B	115	B	2	B	2	UN	28.5	B	2.1	B	1	U
B102289	03/28/91	ER	9	U	320	U	2	U	3.4	B	1750	B	4.1	B	1	U	15	U	3.6	B	15.4	B
B102289	05/23/91	ER	3	U	60	U	1	U	2	U	88.4	B	2.7	B	1	U	10	U	2	U	5.4	B
B102289	09/17/91	ER	5	B					2.7	B	113	BE	3.1	B			15.1	B	2.3	B	12.9	B
B102289	12/12/91	ER			95.4	U			3	U	93.2	U	3.4	U			15.7	U	2.7	U	10.8	U
B202589	11/01/90	FB	4	U	34	U	1	U	3	U	89.5	B	1.8	B	2	U	7	U	2	U	4	BE
B202589	11/01/90	ER	4	U	76.9	B	1	U	3	U	204	B	1.1	B	2	U	7	U	2	U	9.1	BE
B202589	03/28/91	ER	18.9	B	320	U	2	U	3.4	B	1680	B	2.4	B	1	U	15	U	3	U	7	B
B202589	05/31/91	ER	3	U	60	UE	2	U	2	U	137	B	4.1	B	1	UN	10	U	2	U	6.5	U

ER=Equipment Rinsate Blank FB=Field Blank W=Post-digestion spike out of control limits
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U=Analyzed but not detected E=Estimated Value N=Spiked sample recovery not within control limits

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Filtered Metals
Results reported in ug/l

Station Number	Date Sampled	Blank Type	Aluminum (Al)		Antimony (Sb)		Arsenic (As)		Barium (Ba)		Beryllium (Be)		Cadmium (Cd)		Calcium (Ca)		Cesium (Cs)		Chromium (Cr)	
B202589	09/10/91	ER							100	U										
B202589	12/09/91	ER	11	U					1.6	U					211	B			6	U
B400289	11/29/90	ER	10	U	7	U	2	U	1.6	B	1	U	2	U	67.7	B	76	U	5	U
B400289	11/29/90	FB	10	U	7	U	2	U	2	B	1	U	2	U	82.2	B	76	U	5	U
B400289	09/19/91	ER			26	B			1.8	B					87.2	B	51	U		
B402189	10/17/90	ER	65.4	B	26	U	1.6	U	9.5	B	0.6	U	2.9	U	110	B	60	U	4	U
B402189	10/17/90	FB	61.3	B	26	U	1.6	U	11.2	B	0.6	U	2.9	U	112	B	60	U	4	U
B402189	03/21/91	ER	9	U	8	U	2	U	1	U	1	U	2	U	136	B	112	U	5	U
B402189	05/20/91	ER	11	U			2	U	2.6	B	1	U	2	U	213	U	130	U	3	U
B402189	12/19/91	ER	11.9	U	20.7	U			2.9	U			1	U	199	B	30	U	6.7	U
B405586	12/18/91	ER	9.4	U	10.8	U	2	U	1.6	B			1	B	194	U	40	U	4.6	U
SW006	04/02/91	ER	107								0.7				241					

Station Number	Date Sampled	Blank Type	Cobalt (Co)		Copper (Cu)		Iron (Fe)		Lead (Pb)		Lithium (Li)		Magnesium (Mg)		Manganese (Mn)		Mercury (Hg)		Molybdenum (Mo)	
B202589	09/10/91	ER					109		2.4	U					18.9					
B202589	12/09/91	ER					8.2	U							2.8	B				
B400289	11/29/90	ER	3	U	2	U	14	U	1	U	2	U	14	U	5.7	B	0.2	U	3.4	B
B400289	11/29/90	FB	3	U	2	U	14	U	1	U	2	U	14	U	7.2	B	0.2	U	2	U
B400289	09/19/91	ER													1.7	B				
B402189	10/17/90	ER	4	U	3	U	3	U	0.7	B	26	U	79.6	B	4.4	B	0.1	U	13	U
B402189	10/17/90	FB	4	U	3	U	3	U	1.3	B	26	U	63.1	B	4.9	B	0.1	U	13	U
B402189	03/21/91	ER	3	U	2.1	B	41.6	B	1	U	2	U	14.9	B	1.5	B	0.23		9.8	B
B402189	05/20/91	ER	3	U	11	U	9.7	U	1	U	2	U	12.6	U	2.8	B	0.2	U	7.8	U
B402189	12/19/91	ER			2.8	U	33.6	U	1	U			21.2	U	1.6	B	0.28		3.1	B
B405586	12/18/91	ER			1.9	U	11.8	U	1	U	1.4	U	24.2	U	2.5	B				
SW006	04/02/91	ER					81.3								7.3					

Station Number	Date Sampled	Blank Type	Nickel (Ni)		Potassium (K)		Selenium (Se)		Silver (Ag)		Sodium (Na)		Strontium (Sr)		Thallium (Tl)		Tin (Sn)		Vanadium (V)		Zinc (Zn)	
B202589	09/10/91	ER													1	U					16	B
B202589	12/09/91	ER									107	U	5.3	U							6.3	B
B400289	11/29/90	ER	4	U	34	UE	1	U	3	U	114	BE	1.1	B	2	UW	7	U	2	U	12.6	B
B400289	11/29/90	FB	4	U	34	UE	1	U	3	U	84.2	BE	1.4	B	2	UW	7	U	2	U	15.8	B
B400289	09/19/91	ER									52.3	B	1.7	B							6	B
B402189	10/17/90	ER	12	U	1150	B	1.1	U	3.7	B	113	U	2.3	B	0.6	U	17	U	7.2	B	3.5	B
B402189	10/17/90	FB	12	U	1380	B	1.1	U	5.3	B	113	U	2.6	B	0.6	U	17	U	8	B	3.5	B
B402189	03/21/91	ER	4	U	95.2	B	2	U	3	U	33.7	B	2.5	B	3	U	11	U	2	U	9.6	B
B402189	05/20/91	ER	3	U	60	U	1	BN	2	U	77.2	U	3.5	B	1	B	10	U	2	U	6.9	U
B402189	12/19/91	ER	3.9	U	108	U	2	U	2.7	U	96.6	U	3.3	U			10	U	1.3	U	5.9	U
B405586	12/18/91	ER	2	U	91.9	U			2.5	B	104	B					13.2	U	1.8	U	3.3	U
SW006	04/02/91	ER									248											

ER=Equipment Rinsate Blank FB=Field Blank W=Post-digestion spike out of control limits
B=Value less than Contract Required Detection Limit (CRDL) but greater than Instrument Detection Limit (IDL) *=Duplicate Analysis not within control limits
U=Analyzed but not detected E=Estimated Value N=Spiked sample recovery not within control limits

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Filtered Metals
Results reported in ug/l

Station Number	Date Sampled	Blank Type	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Cadmium (Cd)	Calcium (Ca)	Cesium (Cs)	Chromium (Cr)
SW007	05/02/91	ER				5.6			306		
SW041	08/06/90	ER	5 U			1 U			179 B	147 U	

Station Number	Date Sampled	Blank Type	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)
SW007	05/02/91	ER			32.6			221	4		
SW041	08/06/90	ER			13 U			11 U	2.1 B		

Station Number	Date Sampled	Blank Type	Nickel (Ni)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Thallium (Tl)	Tin (Sn)	Vanadium (V)	Zinc (Zn)
SW007	05/02/91	ER					874	3.5 U				3.3
SW041	08/06/90	ER					80.8 B	1 U				7.7 B

ER=Equipment Rinsate Blank FB=Field Blank W=Post-digestion spike out of control limits
B=Value less than Contract Required Detection Limit (CRDL) but greater than Instrument Detection Limit (IDL) *=Duplicate Analysis not within control limits
U=Analyzed but not detected E=Estimated Value N=Spiked sample recovery not within control limits

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Total Radiochemistry
Results reported in pCi/l

Station Number	Date Sampled	Blank Type	Gross Alpha	MDA	Gross Beta	MDA	Americium-241	MDA	Cesium-137	MDA	Plutonium-238	MDA	Plutonium-239,240	MDA	Strontium-89,90	MDA
B102289	08/30/90	ER	0.222	0	0.213	0	0.0166	0	0.53	0			0.0126	0	0.091	0
B102289	08/30/90	FB	0.239	0	0.219	0	0.00406	0	0.88	0			0.0043	0	0.041	0
B102289	10/24/90	FB					0.00513	0	0.37	1			0.00036	0.00		
B102289	10/24/90	ER					0.00201	0	-0.264	1			0.00125	0		
B102289	03/28/91	ER							-0.0716	0.71			0	0		
B102289	05/23/91	ER							0.9213	1.2			0	0		
B102289	09/17/91	ER					0.00249	0.01	0.1066	1			-0.0006	0.01		
B202589	11/01/90	FB					0.00394	0.01	0.2584	1	0	0.01	0.00439	0.01		
B202589	11/01/90	ER					0.00273	0.01	0.1689	1	0	0.01	0.00333	0.01		
B202589	03/28/91	ER							0.3433	0.65			0.00107	0		
B202589	05/31/91	ER					0.00068	0.00	-0.282	1.25			0.00111	0		
B202589	09/10/91	ER					0.00639	0.01	-0.455	1			0	0.01		
B202589	12/09/91	ER					0.00077	0.01	-1.35	1			0.00212	0.01		
B400289	05/19/90	FB	0.3	2	0.3	4			0.24	1			-0.004	0.01	1.94	1
B400289	11/29/90	ER					0.00601	0.01	0.04505	1			0	0.01		
B400289	11/29/90	FB					0.00124	0.01	0.3604	1			0	0.01		
B400289	09/19/91	ER					0.00274	0.01	-0.114	1			-0.0004	0.01		
B402189	10/17/90	ER					0.00168	0.01	0.2513	1	-0.0004	0.01	0.00074	0.01		
B402189	10/17/90	FB					0.00607	0.01	-0.0297	1	-0.0004	0.01	0.00165	0.01		

Station Number	Date Sampled	Blank Type	Tritium	MDA	Uranium-233,234	MDA	Uranium-235	MDA	Uranium-238	MDA	Radium-226	MDA	Radium-228	MDA	Gross Gamma	MDA
B102289	08/30/90	ER	81	0	0.21	0	0.236	0	0.157	0						
B102289	08/30/90	FB	256	0	1.43	0	0.874	0	1.22	0						
B102289	10/24/90	FB														
B102289	10/24/90	ER														
B102289	03/28/91	ER														
B102289	05/23/91	ER														
B102289	09/17/91	ER														
B202589	11/01/90	FB														
B202589	11/01/90	ER														
B202589	03/28/91	ER														
B202589	05/31/91	ER														
B202589	09/10/91	ER														
B202589	12/09/91	ER														
B400289	05/19/90	FB	120	400												
B400289	11/29/90	ER														
B400289	11/29/90	FB														
B400289	09/19/91	ER														
B402189	10/17/90	ER														
B402189	10/17/90	FB														

MDA=Minimum Detectable Activity (from RFEDS RL2 field) ER=Equipment Rinsate Blank FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Total Radiochemistry
Results reported in pCi/l

Station Number	Date Sampled	Blank Type	Gross Alpha	MDA	Gross Beta	MDA	Americium-241	MDA	Cesium-137	MDA	Plutonium-238	MDA	Plutonium-239,240	MDA	Strontium-89,90	MDA
B402189	03/21/91	ER					0.00115	0.00	-0.457	0.8			0.00086	0		
B402189	05/20/91	ER							0.4942	0.57			0	0		
B402189	08/29/91	ER					0.00129	0.01	0.3203	1			0.00202	0.01		
SW041	08/06/90	ER					0.00127	0.01	0.2159	1	0	0.01	0	0.01		

Station Number	Date Sampled	Blank Type	Tritium	MDA	Uranium-233,234	MDA	Uranium-235	MDA	Uranium-238	MDA	Radium-226	MDA	Radium-228	MDA	Gross Gamma	MDA
B402189	03/21/91	ER														
B402189	05/20/91	ER														
B402189	08/29/91	ER														
SW041	08/06/90	ER														

MDA=Minimum Detectable Activity (from RFEDS RL2 field) ER=Equipment Rinsate Blank FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Soil and Sediment Sample Total Radiochemistry
Results reported in pCi/l

Station Number	Date Sampled	Blank Type	Gross Alpha	MDA	Gross Beta	MDA	Americium-241	MDA	Cesium-137	MDA	Plutonium-238	MDA	Plutonium-239,240	MDA	Strontium-89,90	MDA
SED023	11/12/90	ER	0.1205	2	0.3018	4	0.00474	0.01	0.2543	1	0	0.01	0.00185	0.01	0.2657	0.7

Station Number	Date Sampled	Blank Type	Tritium	MDA	Uranium-233,234	MDA	Uranium-235	MDA	Uranium-238	MDA	Radium-226	MDA	Radium-228	MDA	Gross Gamma	MDA
SED023	11/12/90	ER	113.2	400	0	0.6	0	0.6	0.04592	0.6						

MDA=Minimum Detectable Activity (from RFEDS RL2 field) ER=Equipment Rinsate Blank FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Filtered Radiochemistry
Results reported in pCi/l

Station Number	Date Sampled	Blank Type	Gross Alpha	MDA	Gross Beta	MDA	Americium-241	MDA	Cesium-137	MDA	Plutonium-238	MDA	Plutonium-239,240	MDA	Strontium-89,90	MDA
B102289	10/24/90	FB	0.03836	2	0.3836	4									0.4853	1
B102289	10/24/90	ER	-0.0676	2	-0.027	4									0.2615	1
B102289	03/28/91	ER	-0.028	0.4	0.715	1.4									0.5102	0.67
B102289	05/23/91	ER	-0.0235	0.2	0.7534	1.4									0.4659	0.7
B102289	09/17/91	ER	-0.0332	2	0.03957	4									0.2476	1
B202589	11/01/90	FB	86.4	2	61.73	4									1.067	1
B202589	11/01/90	ER	40.66	2	35.78	4									2.849	1
B202589	03/28/91	ER	0.09813	0.2	0.8205	1.4									0.7603	0.76
B202589	05/31/91	ER	0.06054	0.2	0.3076	1.3									0.02365	0.41
B202589	09/10/91	ER	-0.0644	2	0.4804	4									0.2934	1
B202589	12/09/91	ER	-0.0163	2	0.3666	4									0.00454	1
B400289	11/29/90	ER	0.1168	2	0.7544	4									0.4805	1
B400289	11/29/90	FB	0.05812	2	0.8907	4									0.4772	1
B400289	09/19/91	ER	0.1293	2	-0.183	4									0.1633	1
B402189	10/17/90	ER	0.09214	2	0.06777	4									0.3852	1
B402189	10/17/90	FB	-0.0453	2	0.1958	4									0.4033	1
B402189	03/21/91	ER	0.06523	0.4	0.1657	1.4									0.1856	0.66
B402189	05/20/91	ER	0.1557	0.3											-0.105	0.95
B402189	08/29/91	ER	-0.0354	2	1.287	4									0.3071	1

Station Number	Date Sampled	Blank Type	Tritium	MDA	Uranium-233,234	MDA	Uranium-235	MDA	Uranium-238	MDA	Radium-226	MDA	Radium-228	MDA	Gross Gamma	MDA
B102289	10/24/90	FB	136	400	-0.0161	0.14	0.05031	0	0.03824	0.10						
B102289	10/24/90	ER	53.83	400	0.04015	0.11	0.05283	0	-0.0084	0.11						
B102289	03/28/91	ER	-73.2	400	0.05207	0	-0.0104	0.10	0	0						
B102289	05/23/91	ER	30.85	400	-0.0039	0	0.04879	0	-0.0078	0.10						
B102289	09/17/91	ER	-115	400	0.04957	0.6	0	0.6	0	0.6						
B202589	11/01/90	FB	4759	400	92.52	0.6	3.398	0.6	59.94	0.6	1.776	0.5				
B202589	11/01/90	ER	7418	400	36.16	0.6	1.516	0.6	27.98	0.6	4.338	0.5	6.667	1		
B202589	03/28/91	ER	-39.5	400	0	0	-0.0088	0.09	0.02649	0.13						
B202589	05/31/91	ER	-40.9	400	-0.0374	0.24	0.1281	0	0.05605	0.13						
B202589	09/10/91	ER	-67.6	400	0.05294	0.6	0	0.6	-0.0101	0.6						
B202589	12/09/91	ER	195.8	400	0.05531	0.6	0.06012	0.6	0.02645	0.6						
B400289	11/29/90	ER	-212	400	0.05016	0.6	0.05016	0.6	0.04013	0.6						
B400289	11/29/90	FB	55.79	400	0.02826	0.6	0.03768	0.6	-0.0188	0.6						
B400289	09/19/91	ER	172.8	400	-0.0257	0.6	0.0257	0.6	0.1456	0.6						
B402189	10/17/90	ER	215.6	400	0.06527	0.6	0	0.6	0	0.6						
B402189	10/17/90	FB	119	400	0.05728	0.6	0.1146	0.6	0	0.6						
B402189	03/21/91	ER			0.0659	0	0	0	0	0						
B402189	05/20/91	ER	107	370												
B402189	08/29/91	ER	82.25	400	0.2444	0.6	0	0.6	-0.0099	0.6						

MDA=Minimum Detectable Activity (from RFEDS RL2 field) ER=Equipment Rinsate Blank FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Filtered Radiochemistry
Results reported in pCi/l

Station Number	Date Sampled	Blank Type	Gross Alpha	MDA	Gross Beta	MDA	Americium-241	MDA	Cesium-137	MDA	Plutonium-238	MDA	Plutonium-239,240	MDA	Strontium-89,90	MDA
SW006	04/02/91	ER	2	2	2	4	0.04	0.01					0.005	0.01	1	1
SW041	08/06/90	ER	0.1321	2	1.008	4									0.233	1

Station Number	Date Sampled	Blank Type	Tritium	MDA	Uranium-233,234	MDA	Uranium-235	MDA	Uranium-238	MDA	Radium-226	MDA	Radium-228	MDA	Gross Gamma	MDA
SW006	04/02/91	ER	200	400	0.2	0.6	0.07	0.6	0.07	0.6					-0.12	1
SW041	08/06/90	ER	240.5	400	0.09926	0.6	0	0.6	-0.0199	0.6						

MDA=Minimum Detectable Activity (from RFEDS RL2 field) ER=Equipment Rinsate Blank FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Water Quality Parameters
Results reported in ug/l

Station Number	Date Sampled	Blank Type	Bicarbonate as CaCO3	Carbonate	Carbonate as CaCO3	Chloride	Cyanide	Fluoride	Nitrate	Nitrate/ Nitrite	Nitrite	Ortho-Phosphate
B102289	08/30/90	ER	4000		0	500	1.5 U	100 U		20 U	20 U	
B102289	08/30/90	FB	2000		0	600	1.5 U	100 U		20 U	20 U	
B102289	10/24/90	FB	2000		0	200 U	2.5 B	100 U		20 U		10 U
B102289	10/24/90	ER	2000		0	700	2.5 B	100 U		20 U		10 U
B102289	03/28/91	ER	30000	1000 U		100 U	20 U	200 U		100 U		
B102289	05/23/91	ER	2000 U		1000 U	600 U	2.5 U	100 U		40		10 U
B102289	09/17/91	ER	3000 U		1000 U	300 U	2 U	100 U		20 U		10 U
B102289	12/12/91	ER	2000 U		1000 U	200 U	2 U	100 U		20		10 U
B202589	11/01/90	FB	2000		0	700	2 U	100 U		20 U		10 U
B202589	11/01/90	ER	2000		0	1000	2 U	100 U		20 U		10 U
B202589	03/28/91	ER	1000 U	1000 U		100 U	20 U	200 U		100		
B202589	05/31/91	ER	3000 U		1000 U	200 U	2.5 U	100 U		20 U		10 U
B202589	09/10/91	ER	1000 U	1000 U		100 U	20 U	200 U		50 U		10 U
B202589	12/09/91	ER	3000 U		1000 U	200 U	2 U	100 U		20		10 U
B400289	11/29/90	ER	2000		0	300	2 U	100 U		700		10 U
B400289	11/29/90	FB	4000		0	300	2 U	100 U		20 U		10 U
B400289	09/19/91	ER	2000 U		1000 U	200 U	2 U	100 U		20 U		10 U
B402189	10/17/90	ER	2000	1000 U		200	20 U	200 U	100 U		100 U	
B402189	10/17/90	FB	2000	1000 U		100 U	20 U	200 U	100 U		100 U	
B402189	03/21/91	ER	2000		1000 U	200 U	3.5 U	100 U		300		10

Station Number	Date Sampled	Blank Type	Phosporus	Silica	Sulfate	Total Diss. Solids	Total Susp. Solids	CBOD5	Oil and Grease	Sulfide	Total Organic Carbon
B102289	08/30/90	ER	10 U	400 U	2000 U	10000 U	4000 U				
B102289	08/30/90	FB	10 U	400 U	2000 U	10000 U	4000 U				
B102289	10/24/90	FB	10 U	400 U	2000 U	10000 U					
B102289	10/24/90	ER	10 U	400 U	2000 U	10000 U					
B102289	03/28/91	ER	10 U		200 U	10000 U	4000 U				
B102289	05/23/91	ER		400 U	2000 U	10000 U	4000 U				
B102289	09/17/91	ER		400 U	2000 U	13000	4000 U				
B102289	12/12/91	ER		400 U	2000 U	10000 U	4000 U				
B202589	11/01/90	FB		400 U	2000 U	10000 U	4000 U				
B202589	11/01/90	ER		400 U	2000 U	10000 U	4000 U				
B202589	03/28/91	ER	10 U		200 U	10000 U	4000 U				
B202589	05/31/91	ER		400 U	2000 U	4000 U	10000 U				
B202589	09/10/91	ER		500 U	200 U	10000 U	4000 U				
B202589	12/09/91	ER		400 U	2000 U	10000 U	4000 U				
B400289	11/29/90	ER		400 U	2000 U	10000 U	4000 U				
B400289	11/29/90	FB		400 U	2000 U	10000 U	4000 U				
B400289	09/19/91	ER		400 U	2000 U	10000 U	4000 U				
B402189	10/17/90	ER	200 U	30200	200 U	10000 U	4000 U				
B402189	10/17/90	FB	200 U	500	200 U	10000 U	4000 U				
B402189	03/21/91	ER		400 U	2000 U	10000 U	4000 U				

U=Analyzed but not detected at or above method detection limit
B=Value less than Contract Required Detection Limit but greater than Instrument Detection Limit
ER=Equipment Rinsate Blank
FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Water Quality Parameters
Results reported in ug/l

Station Number	Date Sampled	Blank Type	Bicarbonate as CaCO3	Carbonate	Carbonate as CaCO3	Chloride	Cyanide	Fluoride	Nitrate	Nitrate/ Nitrite	Nitrite	Ortho-Phosphate
B402189	05/20/91	ER	4000 U		1000 U	300 U	2.5 U	100 U		60		10 U
B402189	08/29/91	ER	2000 U		1000 U	200 U		100 U		20 U		10
B402189	12/19/91	ER	2000 U		1000 U	200 U	1.5 U	100 U		21 U		20
B405586	12/18/91	ER	4000		1000 U		2 U	100 U		70		10 U
SW006	04/02/91	ER	10000 U		10000 U	5000 U	10 U	100 U		100 U	20 U	50 U
SW007	05/02/91	ER	10000 U		10000 U	5000 U	10 U	100 U		100 U	20 U	50 U
SW041	08/06/90	ER	2000		0	500	1.5 U	100 U		20 U	20 U	10 U

Station Number	Date Sampled	Blank Type	Phosporus	Silica	Sulfate	Total Diss. Solids	Total Susp. Solids	CBOD5	Oil and Grease	Sulfide	Total Organic Carbon
B402189	05/20/91	ER		400 U	2000 U	10000 U	4000 U				
B402189	08/29/91	ER		400 U		10000 U	4000 U				
B402189	12/19/91	ER		400 U	3000	10000 U	4000 U				
B405586	12/18/91	ER		400 U	2000	10000 U	4000 U				
SW006	04/02/91	ER	50 U	140	5000 U	296000	5000 U	1000 U	5200 U	1000 U	1000 U
SW007	05/02/91	ER	50 U	316	5000 U	12000	5000 U		6000 U	1000 U	
SW041	08/06/90	ER	10 U	400 U	2000 U	10000 U	4000 U		900		

U=Analyzed but not detected at or above method detection limit
B=Value less than Contract Required Detection Limit but greater than Instrument Detection Limit
ER=Equipment Rinsate Blank
FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Soil and Sediment Sample Miscellaneous Parameters
Results reported in ug/l

Station Number	Date Sampled	Blank Type	Bicarbonate as CaCO3	Carbonate	Carbonate as CaCO3	Chloride	Cyanide	Fluoride	Nitrate	Nitrate/ Nitrite	Nitrite	Ortho- Phosphate
SED023	11/12/90	ER	4							0.05 U		

Station Number	Date Sampled	Blank Type	Phosporus	Silica	Sulfate	Total Diss. Solids	Total Susp. Solids	CBOD5	Oil and Grease	Sulfide	Total Organic Carbon
SED023	11/12/90	ER									

U=Analyzed but not detected at or above method detection limit
B=Value less than Contract Required Detection Limit but greater than Instrument Detection Limit
ER=Equipment Rinsate Blank
FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Volatile Organics
Results reported in ug/l

Station Number	Date Sampled	Blank Type	1,1,1-Trichloroethane		1,1,2,2-Tetrachloroethane		1,1,2-Trichloroethane		1,1-Dichloroethane		1,1-Dichloroethene		1,2-Dichloroethane		1,2-Dichloroethene		1,2-Dichloropropane		cis-1,3-Dichloropropene		trans-1,2-Dichloroethene		trans-1,3-Dichloropropene	
B102289	08/30/90	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B102289	08/30/90	FB	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B102289	10/24/90	FB	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B102289	10/24/90	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B102289	03/28/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
B102289	05/23/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B102289	09/17/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B102289	12/12/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B202589	11/01/90	FB	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B202589	11/01/90	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B202589	03/28/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
B202589	05/31/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U

Station Number	Date Sampled	Blank Type	2-Butanone		2-Hexanone		4-Methyl-2 pentanone		Acetone		Benzene		Bromodichloromethane		Bromoform		Bromomethane		Carbon disulfide		Carbon Tetrachloride		Chlorobenzene		Chloroethane	
B102289	08/30/90	ER	10	U	10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B102289	08/30/90	FB	10	U	10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B102289	10/24/90	FB	10	U	10	U	10	U	33	B	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B102289	10/24/90	ER	10	U	10	U	10	U	25	B	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B102289	03/28/91	ER	10	U	10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B102289	05/23/91	ER					10	U			5	U	5	U	5	U			5	U	5	U	5	U		
B102289	09/17/91	ER			10	U	10	U			5	U	5	U	5	U	10	U			5	U	5	U	10	U
B102289	12/12/91	ER			10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B202589	11/01/90	FB	10	U	10	U	10	U	21		5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B202589	11/01/90	ER	10	U	10	U	10	U	8	J	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B202589	03/28/91	ER	10	U	10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B202589	05/31/91	ER	10	U	10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U

Station Number	Date Sampled	Blank Type	Chloroform		Chloromethane		Dibromochloromethane		Ethyl Benzene		Methylene Chloride		Styrene		Tetrachloroethene		Toluene		Total Xylenes		Trichloroethene		Vinyl Acetate		Vinyl Chloride	
B102289	08/30/90	ER	5	U	10	U	5	U	5	U	3	BJ	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B102289	08/30/90	FB	5	U	10	U	5	U	5	U	2	BJ	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B102289	10/24/90	FB	5	U	10	U	5	U	5	U	4	BJ	5	U	5	U	1	BJ	5	U	5	U	10	U	10	U
B102289	10/24/90	ER	5	U	10	U	5	U	5	U	4	BJ	5	U	5	U	1	BJ	5	U	5	U	10	U	10	U
B102289	03/28/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B102289	05/23/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B102289	09/17/91	ER	5	U	10	U	5	U	5	U	5	U			5	U	5	U			5	U	10	U	10	U
B102289	12/12/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B202589	11/01/90	FB	5	U	10	U	5	U	5	U	6	B	5	U	5	U	1	J	5	U	5	U	10	U	10	U
B202589	11/01/90	ER	5	U	10	U	5	U	5	U	8	B	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B202589	03/28/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B202589	05/31/91	ER	5	U	10	U	5	U	5	U	1	BJ	5	U	5	U	5	U	5	U	5	U	10	U	10	U

U=Analyzed but not detected J=Present below detection limit E=Estimated Value D=Diluted Sample B=Present in Blank
ER=Equipment Rinsate Blank FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Volatile Organics
Results reported in ug/l

Station Number	Date Sampled	Blank Type	1,1,1-Trichloroethane		1,1,2,2-Tetrachloroethane		1,1,2-Trichloroethane		1,1-Dichloroethane		1,1-Dichloroethene		1,2-Dichloroethane		1,2-Dichloroethene		1,2-Dichloropropane		cis-1,3-Dichloropropene		trans-1,2-Dichloroethene		trans-1,3-Dichloropropene	
B202589	09/10/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
B202589	12/09/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B400289	11/29/90	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B400289	11/29/90	FB	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B400289	09/19/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B402189	10/17/90	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B402189	10/17/90	FB	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B402189	03/21/91	ER	5	U	5	U	5	U	5	U	5	U	5	U			5	U	5	U			5	U
B402189	05/20/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B402189	08/29/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B402189	12/19/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
B405586	12/18/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U

Station Number	Date Sampled	Blank Type	2-Butanone		2-Hexanone		4-Methyl-2 pentanone		Acetone		Benzene		Bromodichloromethane		Bromoform		Bromomethane		Carbon disulfide		Carbon Tetrachloride		Chlorobenzene		Chloroethane	
B202589	09/10/91	ER	10	U	10	U	10	U	12	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B202589	12/09/91	ER					10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B400289	11/29/90	ER			10	U	10	U	10		5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B400289	11/29/90	FB			10	U	10	U	14		5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B400289	09/19/91	ER			10	U	10	U			5	U	5	U	5	U			5	U	5	U	5	U	10	U
B402189	10/17/90	ER			10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B402189	10/17/90	FB			10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B402189	03/21/91	ER	10	U	10	U	10	U	10	U	5	U	5	U	5	U			5	U	5	U	5	U	10	U
B402189	05/20/91	ER					10	U			5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B402189	08/29/91	ER	10	U	10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B402189	12/19/91	ER	10	U	10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
B405586	12/18/91	ER			10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U

Station Number	Date Sampled	Blank Type	Chloroform		Chloromethane		Dibromochloromethane		Ethyl Benzene		Methylene Chloride		Styrene		Tetrachloroethene		Toluene		Total Xylenes		Trichloroethene		Vinyl Acetate		Vinyl Chloride	
B202589	09/10/91	ER	5	U	10	U	5	U	5	U	6	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B202589	12/09/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B400289	11/29/90	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B400289	11/29/90	FB	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B400289	09/19/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B402189	10/17/90	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B402189	10/17/90	FB	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B402189	03/21/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B402189	05/20/91	ER	5	U	10	U	5	U	5	U	2	J	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B402189	08/29/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
B402189	12/19/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	110		5	U	5	U			10	U
B405586	12/18/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			10	U

U=Analyzed but not detected J=Present below detection limit E=Estimated Value D=Diluted Sample B=Present in Blank
ER=Equipment Rinsate Blank FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Volatile Organics
Results reported in ug/l

Station Number	Date Sampled	Blank Type	1,1,1-Trichloroethane		1,1,2,2-Tetrachloroethane		1,1,2-Trichloroethane		1,1-Dichloroethane		1,1-Dichloroethene		1,2-Dichloroethane		1,2-Dichloroethene		1,2-Dichloropropane		cis-1,3-Dichloropropene		trans-1,2-Dichloroethene		trans-1,3-Dichloropropene	
SW006	04/02/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
SW007	05/02/91	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U
SW041	08/06/90	ER	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U			5	U

Station Number	Date Sampled	Blank Type	2-Butanone		2-Hexanone		4-Methyl-2 pentanone		Acetone		Benzene		Bromodichloromethane		Bromoform		Bromomethane		Carbon disulfide		Carbon Tetrachloride		Chlorobenzene		Chloroethane	
SW006	04/02/91	ER	10	U	10	U	10	U	10	U	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
SW007	05/02/91	ER	10	U	10	U	10	U	28		5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U
SW041	08/06/90	ER	10	U	10	U	10	U	8	BJ	5	U	5	U	5	U	10	U	5	U	5	U	5	U	10	U

Station Number	Date Sampled	Blank Type	Chloroform		Chloromethane		Dibromochloromethane		Ethyl Benzene		Methylene Chloride		Styrene		Tetrachloroethene		Toluene		Total Xylenes		Trichloroethene		Vinyl Acetate		Vinyl Chloride	
SW006	04/02/91	ER	5	U	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	10	U	10	U
SW007	05/02/91	ER	5	U	10	U	5	U	5	U	2	J	5	U	5	U	5	U	5	U	5	U	10	U	10	U
SW041	08/06/90	ER	5	U	10	U	5	U	5	U	2	BJ	5	U	5	U	5	U	5	U	5	U	10	U	10	U

U=Analyzed but not detected J=Present below detection limit E=Estimated Value D=Diluted Sample B=Present in Blank
ER=Equipment Rinsate Blank FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Soil and Sediment Volatile Organics
Results reported in ug/l

Station Number	Date Sampled	Blank Type	1,1,1-Tri-chloroethane	1,1,2,2-Tetra-chloroethane	1,1,2-Tri-chloroethane	1,1-Dichloro-ethane	1,1-Di chloroethene	1,2-Di-chloroethane	1,2-Di-chloroethene	1,2-Dichlo-ropropane	cis-1,3-Dichlo-ropropene	trans-1,2-Dichloro-ethene	trans-1,3-Dichloro-propene
SED023	11/12/90	ER	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U		5 U

Station Number	Date Sampled	Blank Type	2-Butanone	2-Hexanone	4-Methyl-2 pentanone	Acetone	Benzene	Bromodichlo-romethane	Bromoform	Bromo-methane	Carbon disulfide	Carbon Te-trachloride	Chloro-benzene	Chloro-ethane
SED023	11/12/90	ER	10 U	10 U	10 U	10 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U	10 U

Station Number	Date Sampled	Blank Type	Chloroform	Chloro-methane	Dibromochlo-romethane	Ethyl Benzene	Methylene Chloride	Styrene	Tetrachloro-ethene	Toluene	Total Xylenes	Trichloro-ethene	Vinyl Acetate	Vinyl Chloride
SED023	11/12/90	ER	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U

U=Analyzed but not detected J=Present below detection limit E=Estimated Value D=Diluted Sample B=Present in Blank
ER=Equipment Rinsate Blank FB=Field Blank

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Semivolatile Organics
Results reported in ug/l

Station Number	Date Sampled	Blank Type	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,4-Dimethylphenol	2,4-Dinitrophenol	2,4-Dinitrotoluene	2,6-Dinitrotoluene
SW006	04/02/91	ER	10 U	10 U	10 U	10 U	50 U	10 U	10 U	10 U	50 U	10 U	10 U

Station Number	Date Sampled	Blank Type	2-Chloronaphthalene	2-Chlorophenol	2-Methylnaphthalene	2-Methylphenol	2-Nitroaniline	2-Nitrophenol	3,3'-Dichlorobenzidine	3-Nitroaniline	4,6-Dinitro-2-methylphenol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol	4-Chloroaniline
SW006	04/02/91	ER	10 U	10 U	10 U	10 U	50 U	10 U	20 U	50 U	50 U	10 U	10 U	10 U

Station Number	Date Sampled	Blank Type	4-Chlorophenyl phenyl ether	4-Methylphenol	4-Nitroaniline	4-Nitrophenol	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene
SW006	04/02/91	ER	10 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Station Number	Date Sampled	Blank Type	Benzoic Acid	Benzyl Alcohol	Bis(2-chloroethoxy) methane	Bis(2-chloroethyl) ether	Bis(2-chloroisopropyl) ether	Bis(2-ethylhexyl) phthalate	Butyl benzyl phthalate	Chrysene	Di-n-butyl phthalate	Di-n-octyl phthalate	Dibenzo (a,h) anthracene	Dibenzofuran
SW006	04/02/91	ER	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Station Number	Date Sampled	Blank Type	Diethyl phthalate	Dimethyl phthalate	Fluoranthene	Fluorene	Hexachlorobenzene	Hexachlorobutadiene	Hexachlorocyclopentadiene	Hexachloroethane	Indeno (1,2,3-cd) pyrene	Isophorone	N-nitrosodi-n-propylamine
SW006	04/02/91	ER	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Station Number	Date Sampled	Blank Type	N-Nitrosodiphenylamine	Naphthalene	Nitrobenzene	Pentachlorophenol	Phenanthrene	Phenol	Pyrene
SW006	04/02/91	ER	10 U	10 U	10 U	50 U	10 U	10 U	10 U

ER=Equipment Rinsate Blank FB=Field Blank E=The associated value exceeds calibration range. J=The associated value is an estimated quantity.
U=The compound was analyzed for but not detected at or above the method detection limit.

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Soil and Sediment Semivolatile Organics
Results reported in ug/l

Station Number	Date Sampled	Blank Type	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,4-Dimethylphenol	2,4-Dinitrophenol	2,4-Dinitrotoluene	2,6-Dinitrotoluene
SED023	11/12/90	ER	10 U	10 U	10 U	10 U	50 U	10 U	10 U	10 U	50 U	10 U	10 U

Station Number	Date Sampled	Blank Type	2-Chloronaphthalene	2-Chlorophenol	2-Methylnaphthalene	2-Methylphenol	2-Nitroaniline	2-Nitrophenol	3,3'-Dichlorobenzidine	3-Nitroaniline	4,6-Dinitro-2-methylphenol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol	4-Chloroaniline
SED023	11/12/90	ER	10 U	10 U	10 U	10 U	50 U	10 U	20 U	50 U	50 U	10 U	10 U	10 U

Station Number	Date Sampled	Blank Type	4-Chlorophenyl phenyl ether	4-Methylphenol	4-Nitroaniline	4-Nitrophenol	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene
SED023	11/12/90	ER	10 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Station Number	Date Sampled	Blank Type	Benzoic Acid	Benzyl Alcohol	Bis(2-chloroethoxy) methane	Bis(2-chloroethyl) ether	Bis(2-chloroisopropyl) ether	Bis(2-ethylhexyl) phthalate	Butyl benzyl phthalate	Chrysene	Di-n-butyl phthalate	Di-n-octyl phthalate	Dibenzo (a,h) anthracene	Dibenzofuran
SED023	11/12/90	ER	50 U	10 U	10 U	10 U	10 U	2 J	10 U	10 U	10 U	10 U	10 U	10 U

Station Number	Date Sampled	Blank Type	Diethyl phthalate	Dimethyl phthalate	Fluoranthene	Fluorene	Hexachlorobenzene	Hexachlorobutadiene	Hexachlorocyclopentadiene	Hexachloroethane	Indeno (1,2,3-cd) pyrene	Isophorone	N-nitroso-di-n-propylamine
SED023	11/12/90	ER	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Station Number	Date Sampled	Blank Type	N-Nitrosodiphenylamine	Naphthalene	Nitrobenzene	Pentachlorophenol	Phenanthrene	Phenol	Pyrene
SED023	11/12/90	ER	10 U	10 U	10 U	50 U	10 U	10 U	10 U

ER=Equipment Rinsate Blank FB=Field Blank E=The associated value exceeds calibration range. J=The associated value is an estimated quantity.
U=The compound was analyzed for but not detected at or above the method detection limit.

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Water Sample Pesticide/PCBs
Results reported in ug/l

Station Number	Date Sampled	Blank Type	4,4'-DDD	4,4'-DDE	4,4'-DDT	ALDRIN	AROCLOR-1016	AROCLOR-1221	AROCLOR-1232	AROCLOR-1242	AROCLOR-1248
SW006	04/02/91	ER	0.11 U	0.11 U	0.11 U	0.054 U	0.54 U	0.54 U	0.54 U	0.54 U	0.54 U

Station Number	Date Sampled	Blank Type	AROCLOR-1254	AROCLOR-1260	DIELDRIN	ENDOSULFAN I	ENDOSULFAN II	ENDOSULFAN SULFATE	ENDRIN	ENDRIN KETONE	HEPTACHLOR
SW006	04/02/91	ER	1.1 U	1.1 U	0.11 U	0.054 U	0.11 U	0.11 U	0.11 U	0.11 U	0.054 U

Station Number	Date Sampled	Blank Type	HEPTACHLOR EPOXIDE	METHOXY-CHLOR	TOXAPHENE	alpha-BHC	alpha-CHLORDANE	beta-BHC	delta-BHC	gamma-BHC (LINDANE)	gamma-CHLORDANE
SW006	04/02/91	ER	0.054 U	0.54 U	1.1 U	0.054 U	0.54 U	0.054 U	0.054 U	0.054 U	0.54 U

ER=Equipment Rinsate Blank

U=The compound was analyzed for but not detected at or above the method detection limit.

TABLE D-3
Field Blank and Equipment Rinsate Blank Data
Soil and Sediment Pesticide/PCBs
Results reported in ug/l

Station Number	Date Sampled	Blank Type	4,4'-DDD	4,4'-DDE	4,4'-DDT	ALDRIN	AROCLOR-1016	AROCLOR-1221	AROCLOR-1232	AROCLOR-1242	AROCLOR-1248
SED023	11/12/90	ER	0.1 U	0.1 U	0.1 U	0.05 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Station Number	Date Sampled	Blank Type	AROCLOR-1254	AROCLOR-1260	DIELDRIN	ENDOSULFAN I	ENDOSULFAN II	ENDOSULFAN SULFATE	ENDRIN	ENDRIN KETONE	HEPTACHLOR
SED023	11/12/90	ER	1 U	1 U	0.1 U	0.05 U	0.1 U	0.1 U	0.1 U	0.1 U	0.05 U

Station Number	Date Sampled	Blank Type	HEPTACHLOR EPOXIDE	METHOXY-CHLOR	TOXAPHENE	alpha-BHC	alpha-CHLORDANE	beta-BHC	delta-BHC	gamma-BHC (LINDANE)	gamma-CHLORDANE
SED023	11/12/90	ER	0.05 U	0.5 U	1 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.5 U

ER=Equipment Rinsate Blank

U=The compound was analyzed for but not detected at or above the method detection limit.

Table D-4
Ratio of RPD's over Limit* to Total Pairings of Field Duplicates and Primary Samples Background Characterization Metals

	Filtered Metal RPD's over Limit*						Total Metal RPD's over Limit*											
	Ground Water		Seep/Spring Water		Stream/Ditch Water		Ground Water		Seep/Spring Water		Stream/Ditch Water		Geologic Materials (Boreholes)		Seep/Spring Sediments		Stream/Ditch Sediments	
Analyte/Compound	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent
ALUMINUM	12/19	63.16	0/2	0.00	2/8	25.00	3/7	42.86	0/1	0.00	7/10	70.00	3/11	27.27	0/0	-	1/3	33.33
ANTIMONY	5/16	31.25	1/2	50.00	1/9	11.11	0/6	0.00	0/0	-	0/5	0.00	1/6	16.67	0/0	-	0/3	0.00
ARSENIC	0/13	0.00	0/2	0.00	0/7	0.00	0/6	0.00	0/0	-	0/5	0.00	8/11	72.73	0/0	-	0/3	0.00
BARIUM	0/19	0.00	0/2	0.00	1/13	7.69	2/7	28.57	0/1	0.00	0/7	0.00	6/11	54.55	0/0	-	1/3	33.33
BERYLLIUM	0/12	0.00	0/2	0.00	0/9	0.00	0/7	0.00	0/1	0.00	1/4	25.00	5/11	45.45	0/0	-	0/3	0.00
CADMIUM	3/16	18.75	0/2	0.00	0/8	0.00	1/7	14.29	0/0	-	0/5	0.00	0/7	0.00	0/0	-	0/3	0.00
CALCIUM	1/19	5.26	0/2	0.00	1/13	7.69	2/7	28.57	0/1	0.00	1/13	7.69	5/11	45.45	0/0	-	1/3	33.33
CESIUM	1/15	6.67	0/2	0.00	1/11	9.09	0/7	0.00	0/1	0.00	0/4	0.00	0/10	0.00	0/0	-	0/3	0.00
CHROMIUM	3/17	17.65	0/2	0.00	0/10	0.00	1/6	16.67	0/1	0.00	2/4	50.00	4/11	36.36	0/0	-	1/3	33.33
COBALT	2/14	14.29	0/2	0.00	0/9	0.00	1/7	14.29	0/0	-	0/3	0.00	8/11	72.73	0/0	-	0/3	0.00
COPPER	4/17	23.53	0/2	0.00	2/12	16.67	1/6	16.67	0/1	0.00	3/7	42.86	6/10	60.00	0/0	-	1/3	33.33
CYANIDE	0/0	-					1/14	7.14										
IRON	10/19	52.63	0/2	0.00	6/13	46.15	6/7	85.71	1/2	50.00	5/13	38.46	4/10	40.00	0/0	-	1/3	33.33
LEAD	3/15	20.00	0/1	0.00	2/12	16.67	2/7	28.57	0/1	0.00	4/8	50.00	6/11	54.55	0/0	-	2/3	66.67
LITHIUM	0/16	0.00	0/2	0.00	2/10	20.00	1/7	14.29	0/1	0.00	2/7	28.57	3/11	27.27	0/0	-	0/3	0.00
MAGNESIUM	1/19	5.26	0/2	0.00	1/13	7.69	2/7	28.57	0/1	0.00	0/12	0.00	5/11	45.45	0/0	-	1/3	33.33
MANGANESE	9/19	47.37	0/2	0.00	1/13	7.69	6/7	85.71	0/1	0.00	6/13	46.15	9/11	81.82	0/0	-	2/3	66.67
MERCURY	1/11	9.09	1/2	50.00	0/8	0.00	0/7	0.00	1/1	100.00	0/4	0.00	1/9	11.11	0/0	-	0/2	0.00
MOLYBDENUM	3/14	21.43	0/1	0.00	0/11	0.00	0/7	0.00	0/1	0.00	1/4	25.00	3/11	27.27	0/0	-	0/3	0.00
NICKEL	2/15	13.33	0/0	-	0/9	0.00	3/7	42.86	0/0	-	0/4	0.00	6/11	54.55	0/0	-	0/3	0.00
PHOSPHORUS	0/1	0.00					3/5	60.00										
POTASSIUM	3/19	15.79	0/2	0.00	2/12	16.67	1/7	14.29	0/1	0.00	0/7	0.00	5/11	45.45	0/0	-	0/3	0.00
SELENIUM	3/13	23.08	0/1	0.00	0/9	0.00	1/6	16.67	0/0	-	0/4	0.00	0/8	0.00	0/0	-	0/3	0.00
SILICON	3/5	60.00	0/0	-	0/2	0.00	1/1	100.00	0/0	-	1/2	50.00			0/0	-	0/0	-
SILVER	5/15	33.33	0/2	0.00	0/11	0.00	0/6	0.00	0/0	-	1/4	25.00	3/11	27.27	0/0	-	0/3	0.00
SODIUM	0/18	0.00	0/2	0.00	1/13	7.69	2/7	28.57	0/2	0.00	2/13	15.38	3/11	27.27	0/0	-	0/3	0.00
STRONTIUM	1/19	5.26	0/2	0.00	1/12	8.33	2/7	28.57	0/1	0.00	0/8	0.00	1/11	9.09	0/0	-	0/3	0.00
THALLIUM	0/12	0.00	0/2	0.00	0/8	0.00	0/7	0.00	0/0	-	0/4	0.00	0/9	0.00	0/0	-	0/2	0.00
TIN	5/16	31.25	0/2	0.00	0/10	0.00	0/7	0.00	0/0	-	1/4	25.00	2/8	25.00	0/0	-	0/3	0.00
VANADIUM	6/18	33.33	0/2	0.00	0/11	0.00	2/7	28.57	0/1	0.00	1/4	25.00	5/10	50.00	0/0	-	2/3	66.67
ZINC	11/19	57.89	0/1	0.00	7/12	58.33	6/7	85.71	0/0	-	8/13	61.54	7/10	70.00	0/0	-	1/3	33.33
Average		20.32		3.70		9.19		26.36		8.33		20.19		36.69				16.67

RPD=Relative Percent Difference *Limit is 20% for Waters and 35% for Soils (QC criterion for laboratory duplicates)

Table D-4
Ratio of RPD's over Limit* to Total Pairings of Field Duplicates and Primary Samples
Background Characterization Radiochemistry

	Filtered Radiochemistry RPD's over Limit*						Total Radiochemistry RPD's over limit											
	Ground Water		Seep/Spring Water		Stream/Ditch Water		Ground Water		Seep/Spring Water		Stream/Ditch Water		Geologic Materials (Boreholes)		Seep/Spring Sediments		Stream/Ditch Sediments	
Analyte/Compound	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent
AMERICIUM-241	0/0	-	0/0	-	0/2	0.00	6/11	54.55	1/2	50.00	3/8	37.50	1/2	50.00	0/0	-	1/1	100.00
CESIUM-137			0/0	-	1/1	100.00	1/17	5.88	1/2	50.00	0/4	0.00	0/11	0.00	0/0	-	0/1	0.00
GROSS ALPHA			0/0	-	0/2	0.00	1/1	100.00	1/2	50.00	3/4	75.00	5/11	45.45	0/0	-	1/2	50.00
GROSS ALPHA-DISS	7/15	46.67	0/0	-	0/1	0.00	1/1	100.00	0/0	-	0/0	-						
GROSS ALPHA-SUSP	0/0	-					0/0	-	0/0	-	0/2	0.00						
GROSS BETA			0/0	-	0/2	0.00	1/1	100.00	1/2	50.00	4/5	80.00	3/11	27.27	0/0	-	0/1	0.00
GROSS BETA-DISS	3/14	21.43	0/0	-	1/1	100.00	1/1	100.00	0/0	-	0/0	-						
GROSS BETA-SUSP	0/0	-					0/0	-	0/0	-	0/0	-						
PLUTONIUM-238							0/2	0.00	0/0	-	0/1	0.00			0/0	-	0/0	-
PLUTONIUM-239,240	0/0	-	0/0	-	1/2	50.00	3/16	18.75	0/1	0.00	1/8	12.50	8/11	72.73	0/0	-	1/3	33.33
RADIUM-226	0/0	-	0/0	-	0/0	-	0/0	-	0/0	-	0/0	-	0/8	0.00	0/0	-	0/1	0.00
RADIUM-228	0/0	-	0/0	-	0/0	-			0/0	-			1/8	12.50	0/0	-	0/1	0.00
STRONTIUM-89,90	0/15	0.00	0/0	-	0/2	0.00	0/1	0.00	2/2	100.00	2/4	50.00	8/11	72.73	0/0	-	2/2	100.00
STRONTIUM-90			0/0	-	0/1	0.00	1/1	100.00	0/0	-	0/2	0.00						
TRITIUM	0/14	0.00	0/0	-	0/2	0.00	1/2	50.00	2/2	100.00	0/4	0.00	3/11	27.27	0/0	-	1/1	100.00
URANIUM-233,234	5/14	35.71	0/0	-	1/3	33.33	0/1	0.00	1/2	50.00	3/8	37.50	7/11	63.64	0/0	-	0/2	0.00
URANIUM-235	1/14	7.14	0/0	-	0/3	0.00	1/1	100.00	1/2	50.00	2/7	28.57	3/11	27.27	0/0	-	3/3	100.00
URANIUM-238	5/14	35.71	0/0	-	1/3	33.33	0/1	0.00	2/2	100.00	3/7	42.86	4/11	36.36	0/0	-	1/3	33.33
Average		20.95				24.36		52.08		60.00		27.99		36.27				43.06

RPD=Relative Percent Difference *Limit is 20% for Waters and 35% for Soils (QC criterion for laboratory duplicates)

Table D-4
Ratio of RPD's over Limit* to Total Pairings of Field Duplicates and Primary Samples Background Characterization Water Quality and Other Parameters

Analyte/Compound	Water Quality and Miscellaneous Soil Parameter RPD's over Limit*											
	Ground Water		Seep/Spring Water		Stream/Ditch Water		Geologic Materials (Boreholes)		Seep/Spring Sediments		Stream/Ditch Sediments	
	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent
ALKALINITY AS CACO3	0/0	-							0/0	-	0/0	-
BICARBONATE	0/0	-	0/2	0.00	2/9	22.22						
BICARBONATE AS CACO3	2/20	10.00	0/0	-	0/3	0.00						
CARBONATE	0/4	0.00	0/2	0.00	0/9	0.00						
CARBONATE AS CACO3	1/15	6.67	0/0	-	0/3	0.00						
CBOD5			0/0	-	0/1	0.00						
CHLORIDE	3/17	17.65	0/2	0.00	0/12	0.00						
CYANIDE	0/5	0.00	0/2	0.00	1/11	9.09						
DISSOLVED ORGANIC CARBON			0/0	-	0/0	-						
FLUORIDE	3/19	15.79	0/0	-	0/3	0.00						
NITRATE	0/1	0.00			0/0	-					0/0	-
NITRATE/NITRITE	5/19	26.32	1/2	50.00	2/12	16.67	2/10	20.00	0/0	-	0/2	0.00
NITRITE	0/2	0.00	0/0	-	0/3	0.00			0/0	-	0/0	-
OIL AND GREASE			0/0	-	1/3	33.33						
ORTHOPHOSPHATE	3/15	20.00	0/0	-	0/3	0.00						
PH	0/0	-	0/2	0.00	0/9	0.00	0/10	0.00	0/0	-	0/2	0.00
PHOSPHORUS	3/5	60.00	0/0	-	0/3	0.00						
SILICA	1/16	6.25	0/0	-	0/1	0.00						
SODIUM NITRITE	0/0	-										
SULFATE	2/19	10.53	1/2	50.00	3/12	25.00						
SULFIDE			0/0	-	0/2	0.00	0/9	0.00				
TOTAL ALKALINITY									0/0	-	0/0	-
TOTAL DISSOLVED SOLIDS	2/20	10.00	0/2	0.00	0/12	0.00						
TOTAL SUSPENDED SOLIDS	11/19	57.89	0/2	0.00	6/12	50.00						
Average		16.07		11.11		8.23		6.67				0.00

RPD=Relative Percent Difference *Limit is 20% for Waters and 35% for Soils (QC criterion for laboratory duplicates)

Table D-4
Ratio of RPD's over Limit* to Total Pairings of Field Duplicates and Primary Samples Background Characterization Volatiles

Analyte/Compound	Volatile RPD's over Limit*											
	Ground Water**		Seep/Spring Water		Stream/Ditch Water		Geologic Materials (Boreholes)**		Seep/Spring Sediments		Stream/Ditch Sediments	
	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent
1,1,1,2-TETRACHLOROETHANE					0/0	-						
1,1,1-TRICHLOROETHANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
1,1,2,2-TETRACHLOROETHANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
1,1,2-TRICHLOROETHANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
1,1-DICHLOROETHANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
1,1-DICHLOROETHENE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
1,2-DICHLOROETHANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
1,2-DICHLOROETHENE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
1,2-DICHLOROPROPANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
2-BUTANONE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
2-CHLOROETHYL VINYL ETHER			0/0	-	0/0	-						
2-HEXANONE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
2-PROPENENITRILE					0/0	-						
4-METHYL-2-PENTANONE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
ACETONE			0/0	-	1/3	33.33			0/0	-	0/1	0.00
BENZENE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
BROMODICHLOROMETHANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
BROMOFORM			0/0	-	0/3	0.00			0/0	-	0/1	0.00
BROMOMETHANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
CARBON DISULFIDE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
CARBON TETRACHLORIDE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
CHLOROBENZENE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
CHLOROETHANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
CHLOROFORM			0/0	-	0/3	0.00			0/0	-	0/1	0.00
CHLOROMETHANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
DIBROMOCHLOROMETHANE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
DICHLOROPROPENE,cis-1,3-			0/0	-	0/3	0.00			0/0	-	0/1	0.00
DICHLOROPROPENE,trans-1,3			0/0	-	0/3	0.00			0/0	-	0/1	0.00
ETHYLBENZENE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
METHYLENE CHLORIDE			0/0	-	1/3	33.33			0/0	-	1/1	100.00
STYRENE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
TETRACHLOROETHENE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
TOLUENE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
TOTAL XYLENES			0/0	-	0/3	0.00			0/0	-	0/1	0.00
TRICHLOROETHENE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
VINYL ACETATE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
VINYL CHLORIDE			0/0	-	0/3	0.00			0/0	-	0/1	0.00
Average						1.96						3.03

RPD=Relative Percent Difference *Limit is 20% for Waters and 35% for Soils (QC criterion for laboratory duplicates)
**Volatiles not run on this media

Table D-4
Ratio of RPD's over Limit* to Total Pairings of Field Duplicates and Primary Samples Background Characterization Semivolatiles

Analyte/Compound	Semivolatiles RPD's over Limit*											
	Ground Water**		Seep/Spring Water		Stream/Ditch Water		Geologic Materials (Boreholes)**		Seep/Spring Sediments		Stream/Ditch Sediments	
	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent
1,2,4-TRICHLOROBENZENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
1,2-DICHLOROBENZENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
1,3-DICHLOROBENZENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
1,4-DICHLOROBENZENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2,4,5-TRICHLOROPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2,4,6-TRICHLOROPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2,4-DICHLOROPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2,4-DIMETHYLPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2,4-DINITROPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2,4-DINITROTOLUENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2,6-DINITROTOLUENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2-CHLORONAPHTHALENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2-CHLOROPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2-METHYLNAPHTHALENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2-METHYLPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2-NITROANILINE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
2-NITROPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
3,3'-DICHLOROBENZIDINE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
3-NITROANILINE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
4,6-DINITRO-2-METHYLPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
4-BROMOPHENYL PHENYL ETHER			0/0	-	0/1	0.00			0/0	-	0/1	0.00
4-CHLORO-3-METHYLPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
4-CHLOROANILINE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
4-CHLOROPHENYL PHENYL ETHER			0/0	-	0/1	0.00			0/0	-	0/1	0.00
4-METHYLPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
4-NITROANILINE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
4-NITROPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
ACENAPHTHENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
ACENAPHTHYLENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
ANTHRACENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BENZENAMINE			0/0	-	0/0	-						
BENZIDINE			0/0	-	0/0	-						
BENZO(a)ANTHRACENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BENZO(a)PYRENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BENZO(b)FLUORANTHENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BENZO(ghi)PERYLENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BENZO(k)FLUORANTHENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BENZOIC ACID			0/0	-	0/1	0.00			0/0	-	1/1	100.00
BENZYL ALCOHOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BIS(2-CHLOROETHOXY)METHANE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BIS(2-CHLOROETHYL)ETHER			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BIS(2-CHLOROISOPROPYL)ETHER			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BIS(2-ETHYLHEXYL)PHTHALATE			0/0	-	1/1	100.00			0/0	-	0/1	0.00
BUTYL BENZYL PHTHALATE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
CHRYSENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
DI-n-BUTYL PHTHALATE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
DI-n-OCTYL PHTHALATE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
DIBENZO(a,h)ANTHRACENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
DIBENZOFURAN			0/0	-	0/1	0.00			0/0	-	0/1	0.00
DIETHYL PHTHALATE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
DIMETHYL PHTHALATE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
FLUORANTHENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
FLUORENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
HEXACHLOROBENZENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
HEXACHLOROBUTADIENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
HEXACHLOROCYCLOPENTADIENE			0/0	-	0/1	0.00			0/0	-	0/0	-
HEXACHLOROETHANE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
INDENO(1,2,3-cd)PYRENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
ISOPHORONE			0/0	-	0/1	0.00			0/0	-	0/1	0.00

RPD=Relative Percent Difference *Limit is 20% for Waters and 35% for Soils (QC criterion for laboratory duplicates)
**Semivolatiles not run on this media

Table D-4
Ratio of RPD's over Limit* to Total Pairings of Field Duplicates and Primary Samples Background Characterization Semivolatiles

Analyte/Compound	Semivolatiles RPD's over Limit*											
	Ground Water**		Seep/Spring Water		Stream/Ditch Water		Geologic Materials (Boreholes)**		Seep/Spring Sediments		Stream/Ditch Sediments	
	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent
N-NITROSO-DI-n-PROPYLAMINE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
N-NITROSODI-N-BUTYLAMINE					0/0	-						
N-NITROSODIETHYLAMINE					0/0	-						
N-NITROSODIMETHYLAMINE			0/0	-	0/0	-						
N-NITROSODIPHENYLAMINE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
N-NITROSOPYRROLIDINE					0/0	-						
NAPHTHALENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
NITROBENZENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
PENTACHLOROPHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
PHENANTHRENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
PHENOL			0/0	-	0/1	0.00			0/0	-	0/1	0.00
PYRENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
Average						1.54						1.56

RPD=Relative Percent Difference *Limit is 20% for Waters and 35% for Soils (QC criterion for laboratory duplicates)
**Semivolatiles not run on this media

Table D-4
Ratio of RPD's over Limit* to Total Pairings of
Field Duplicates and Primary Samples
Background Characterization Pesticide/PCB's

Analyte/Compound	Pesticide/PCB RPD's over Limit*											
	Ground Water**		Seep/Spring Water		Stream/Ditch Water		Geologic Materials (Boreholes)**		Seep/Spring Sediments		Stream/Ditch Sediments	
	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent
4,4'-DDD			0/0	-	0/1	0.00			0/0	-	0/1	0.00
4,4'-DDE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
4,4'-DDT			0/0	-	0/1	0.00			0/0	-	0/1	0.00
ALDRIN			0/0	-	0/1	0.00			0/0	-	0/1	0.00
AROCLOR-1016			0/0	-	0/1	0.00			0/0	-	0/1	0.00
AROCLOR-1221			0/0	-	0/1	0.00			0/0	-	0/1	0.00
AROCLOR-1232			0/0	-	0/1	0.00			0/0	-	0/1	0.00
AROCLOR-1242			0/0	-	0/1	0.00			0/0	-	0/1	0.00
AROCLOR-1248			0/0	-	0/1	0.00			0/0	-	0/1	0.00
AROCLOR-1254			0/0	-	0/1	0.00			0/0	-	0/1	0.00
AROCLOR-1260			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BHC,alpha-			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BHC,beta-			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BHC,delta-			0/0	-	0/1	0.00			0/0	-	0/1	0.00
BHC,gamma- (LINDANE)			0/0	-	0/1	0.00			0/0	-	0/1	0.00
CHLORDANE,alpha-			0/0	-	0/1	0.00			0/0	-	0/1	0.00
CHLORDANE,gamma-			0/0	-	0/1	0.00			0/0	-	0/1	0.00
DIELDRIN			0/0	-	0/1	0.00			0/0	-	0/1	0.00
ENDOSULFAN I			0/0	-	0/1	0.00			0/0	-	0/1	0.00
ENDOSULFAN II			0/0	-	0/1	0.00			0/0	-	0/1	0.00
ENDOSULFAN SULFATE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
ENDRIN			0/0	-	0/1	0.00			0/0	-	0/1	0.00
ENDRIN KETONE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
HEPTACHLOR			0/0	-	0/1	0.00			0/0	-	0/1	0.00
HEPTACHLOR EPOXIDE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
METHOXYCHLOR			0/0	-	0/1	0.00			0/0	-	0/1	0.00
TOXAPHENE			0/0	-	0/1	0.00			0/0	-	0/1	0.00
Average						0.00						0.00

RPD=Relative Percent Difference *Limit is 20% for Waters and 35% for Soils (QC criterion for laboratory duplicates)
** Pesticide/PCB's not run on this media

Table D-4
Ratio of RPD's over Limit* to Total Pairings of
Field Duplicates and Primary Samples
Background Characterization Herbicides

Analyte/Compound	Herbicide RPD's over Limit*											
	Ground Water**		Seep/Spring Water**		Stream/Ditch Water		Geologic Materials (Boreholes)**		Seep/Spring Sediments**		Stream/Ditch Sediments**	
	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent	Ratio	Percent
2,2-DICHLOROPROPANOIC					0/0	-						
2,4,5-TRICHLOROPHENOXYACE					0/0	-						
2,4-DB					0/0	-						
2,4-DICHLOROPHENOXYACETIC					0/0	-						
AMETRYN					0/0	-						
ATRAZINE					0/0	-						
CYANAZINE					0/0	-						
DICAMBA					0/0	-						
DICHLOROPROP					0/0	-						
MCPA					0/0	-						
MCPP					0/0	-						
PHENOL,					0/0	-						
PROMETON					0/0	-						
PROMETRYN					0/0	-						
PROPANOIC ACID,					0/0	-						
PROPAZINE					0/0	-						
SIMAZINE					0/0	-						
SIMETRYN					0/0	-						
TERBUTHYLAZINE					0/0	-						

RPD=Relative Percent Difference *Limit is 20% for Waters and 35% for Soils (QC criterion for laboratory duplicates)
** Herbicides not run on this media

NOTICE

This document (or documents) is oversized for 16mm microfilming, but is available in its entirety on the 35mm fiche card referenced below:

Document # 000555

Titled: Plate 1 Background Geochemical Report Individual Hazardous Substance Site

Fiche location: A-SW M34

NOTICE

This document (or documents) is oversized for 16mm microfilming, but is available in its entirety on the 35mm fiche card referenced below:

Document # 000555

Titled: Plate 2 Background Geochemical Characterization Report water table Elevation of Surfical materials

Fiche location: A-SW M34

NOTICE

This document (or documents) is oversized for 16mm microfilming, but is available in its entirety on the 35mm fiche card referenced below:

Document # 000555

Titled: Plate 3 Background Geochemical Characterization report. Background Boreholes

Fiche location: A-SWM34

NOTICE

This document (or documents) is oversized for 16mm microfilming, but is available in its entirety on the 35mm fiche card referenced below:

Document # 000555

Titled: Plate 4 Background Geochemical Characterization report

Background alluvial monitoring wells

Fiche location: A-SW M34

NOTICE

This document (or documents) is oversized for 16mm microfilming, but is available in its entirety on the 35mm fiche card referenced below:

Document # 000555

Titled: Plate 5 Background Geochemical Characterization report

Background Bedrock monitoring wells

Fiche location: A-SW M35

NOTICE

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Document # 000555

Titled: Plate 6 Background Geochemical Characterization report Background Surface water and Sediment Sampling Stations

Fiche location: A-SW M35

NOTICE

This document (or documents) is oversized for 16mm microfilming, but is available in its entirety on the 35mm fiche card referenced below:

Document # 000555

Titled: Plate 7 Stiff Diagrams for Ground Water in the Rocky Flats Alluvium Valley fill Alluvium Colluvium and Arapahoe Claystone

Fiche location: A-SWM35

NOTICE

This document (or documents) is oversized for 16mm microfilming, but is available in its entirety on the 35mm fiche card referenced below:

Document # 000555

Titled: Plate 8 Stiff Diagrams for Ground water in the Arapahoe formation

Fiche location: A-SW M35

NOTICE

This document (or documents) is oversized for 16mm microfilming, but is available in its entirety on the 35mm fiche card referenced below:

Document # 000555

Titled: Plate 9 Piper diagrams for ground water in the rocky flats alluvium valley fill alluvium Colluvium and Arapahoe Claystone

Fiche location: A-SW M35

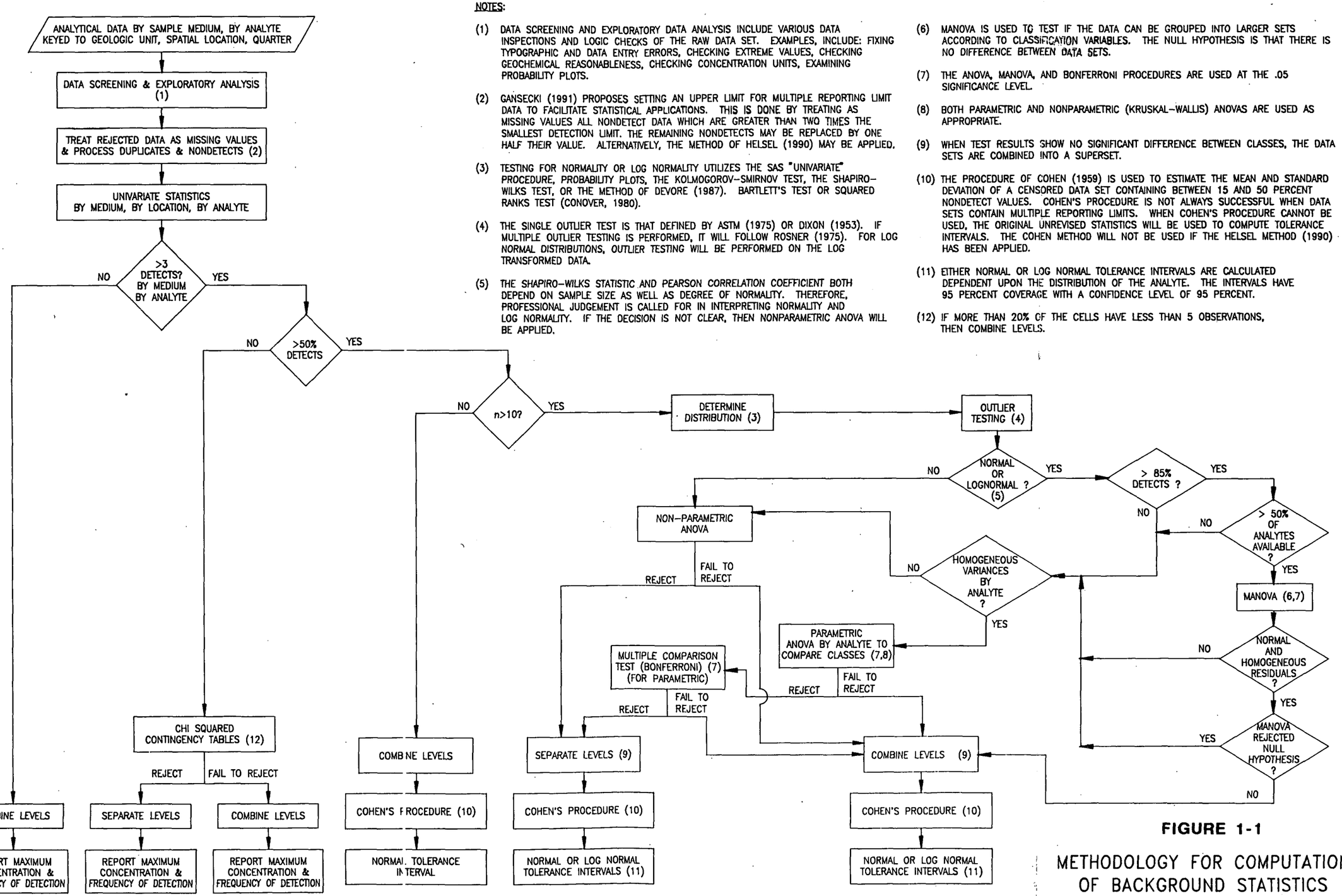
NOTICE

This document (or documents) is oversized for 16mm microfilming, but is available in its entirety on the 35mm fiche card referenced below:

Document # 000555

Titled: Plate 10 Piper Diagrams for ground water in Arapahoe formation sandstones

Fiche location: A-SW M35



NOTES:

(1) DATA SCREENING AND EXPLORATORY DATA ANALYSIS INCLUDE VARIOUS DATA INSPECTIONS AND LOGIC CHECKS OF THE RAW DATA SET. EXAMPLES, INCLUDE: FIXING TYPOGRAPHIC AND DATA ENTRY ERRORS, CHECKING EXTREME VALUES, CHECKING GEOCHEMICAL REASONABLENESS, CHECKING CONCENTRATION UNITS, EXAMINING PROBABILITY PLOTS.

(2) GANSECKI (1991) PROPOSES SETTING AN UPPER LIMIT FOR MULTIPLE REPORTING LIMIT DATA TO FACILITATE STATISTICAL APPLICATIONS. THIS IS DONE BY TREATING AS MISSING VALUES ALL NONDETECT DATA WHICH ARE GREATER THAN TWO TIMES THE SMALLEST DETECTION LIMIT. THE REMAINING NONDETECTS MAY BE REPLACED BY ONE HALF THEIR VALUE. ALTERNATIVELY, THE METHOD OF HELSEL (1990) MAY BE APPLIED.

(3) TESTING FOR NORMALITY OR LOG NORMALITY UTILIZES THE SAS "UNIVARIATE" PROCEDURE, PROBABILITY PLOTS, THE KOLMOGOROV–SMIRNOV TEST, THE SHAPIRO–WILKS TEST, OR THE METHOD OF DEVORE (1987). BARTLETT'S TEST OR SQUARED RANKS TEST (CONOVER, 1980).

(4) THE SINGLE OUTLIER TEST IS THAT DEFINED BY ASTM (1975) OR DIXON (1953). IF MULTIPLE OUTLIER TESTING IS PERFORMED, IT WILL FOLLOW ROSNER (1975). FOR LOG NORMAL DISTRIBUTIONS, OUTLIER TESTING WILL BE PERFORMED ON THE LOG TRANSFORMED DATA.

(5) THE SHAPIRO–WILKS STATISTIC AND PEARSON CORRELATION COEFFICIENT BOTH DEPEND ON SAMPLE SIZE AS WELL AS DEGREE OF NORMALITY. THEREFORE, PROFESSIONAL JUDGEMENT IS CALLED FOR IN INTERPRETING NORMALITY AND LOG NORMALITY. IF THE DECISION IS NOT CLEAR, THEN NONPARAMETRIC ANOVA WILL BE APPLIED.

(6) MANOVA IS USED TO TEST IF THE DATA CAN BE GROUPED INTO LARGER SETS ACCORDING TO CLASSIFICATION VARIABLES. THE NULL HYPOTHESIS IS THAT THERE IS NO DIFFERENCE BETWEEN DATA SETS.

(7) THE ANOVA, MANOVA, AND BONFERRONI PROCEDURES ARE USED AT THE .05 SIGNIFICANCE LEVEL.

(8) BOTH PARAMETRIC AND NONPARAMETRIC (KRUSKAL–WALLIS) ANOVAS ARE USED AS APPROPRIATE.

(9) WHEN TEST RESULTS SHOW NO SIGNIFICANT DIFFERENCE BETWEEN CLASSES, THE DATA SETS ARE COMBINED INTO A SUPERSET.

(10) THE PROCEDURE OF COHEN (1959) IS USED TO ESTIMATE THE MEAN AND STANDARD DEVIATION OF A CENSORED DATA SET CONTAINING BETWEEN 15 AND 50 PERCENT NONDETECT VALUES. COHEN'S PROCEDURE IS NOT ALWAYS SUCCESSFUL WHEN DATA SETS CONTAIN MULTIPLE REPORTING LIMITS. WHEN COHEN'S PROCEDURE CANNOT BE USED, THE ORIGINAL UNREVISED STATISTICS WILL BE USED TO COMPUTE TOLERANCE INTERVALS. THE COHEN METHOD WILL NOT BE USED IF THE HELSEL METHOD (1990) HAS BEEN APPLIED.

(11) EITHER NORMAL OR LOG NORMAL TOLERANCE INTERVALS ARE CALCULATED DEPENDENT UPON THE DISTRIBUTION OF THE ANALYTE. THE INTERVALS HAVE 95 PERCENT COVERAGE WITH A CONFIDENCE LEVEL OF 95 PERCENT.

(12) IF MORE THAN 20% OF THE CELLS HAVE LESS THAN 5 OBSERVATIONS, THEN COMBINE LEVELS.

FIGURE 1-1

METHODOLOGY FOR COMPUTATION OF BACKGROUND STATISTICS

R69013.MBMB091792

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'

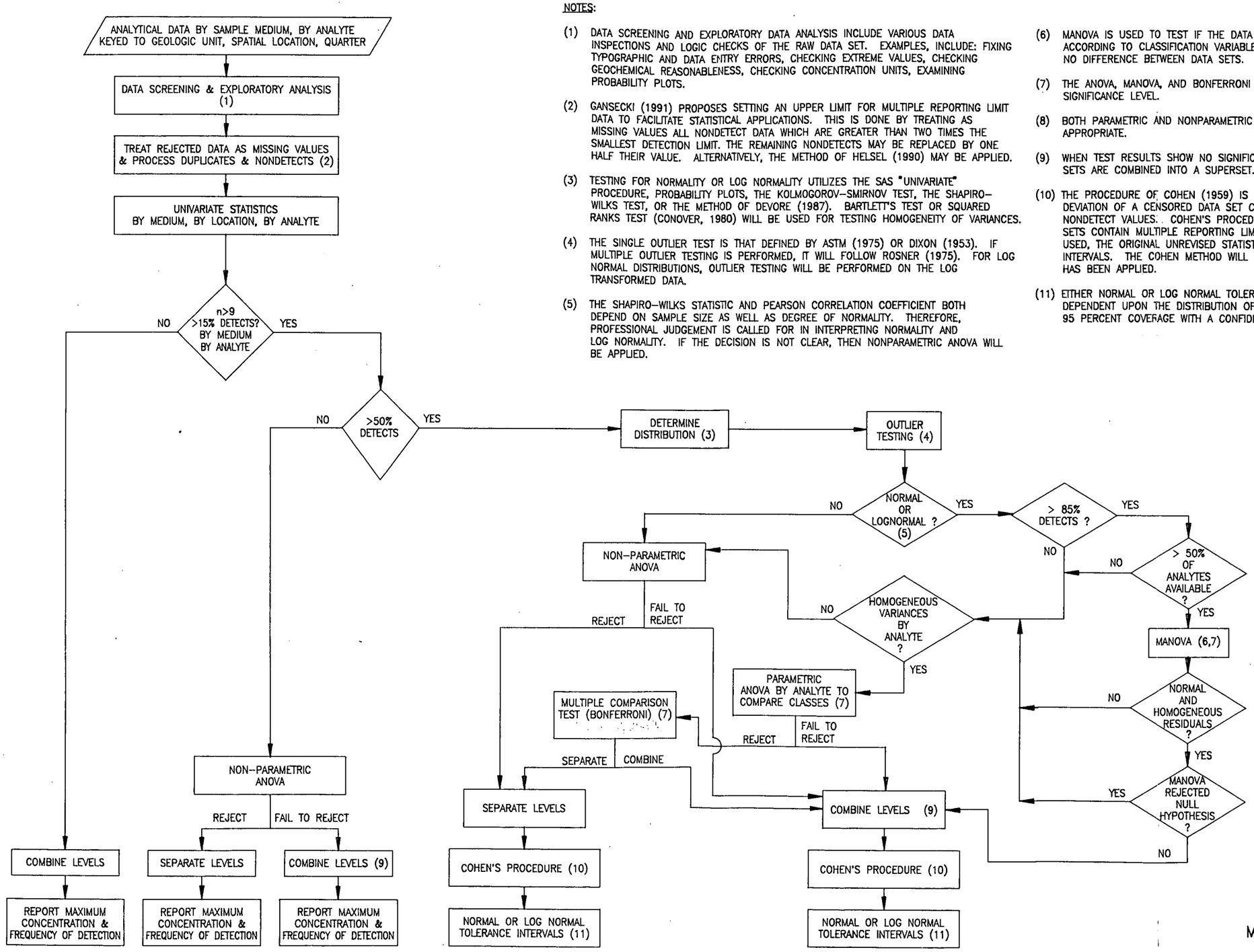
2000' 0 2000'

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

BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT

SURFICIAL GEOLOGY
FOR THE
ROCKY FLATS PLANT

FIGURE 2-6 February 1992



NOTES:

(1) DATA SCREENING AND EXPLORATORY DATA ANALYSIS INCLUDE VARIOUS DATA INSPECTIONS AND LOGIC CHECKS OF THE RAW DATA SET. EXAMPLES, INCLUDE: FIXING TYPOGRAPHIC AND DATA ENTRY ERRORS, CHECKING EXTREME VALUES, CHECKING GEOCHEMICAL REASONABLENESS, CHECKING CONCENTRATION UNITS, EXAMINING PROBABILITY PLOTS.

(2) GANSECKI (1991) PROPOSES SETTING AN UPPER LIMIT FOR MULTIPLE REPORTING LIMIT DATA TO FACILITATE STATISTICAL APPLICATIONS. THIS IS DONE BY TREATING AS MISSING VALUES ALL NONDETECT DATA WHICH ARE GREATER THAN TWO TIMES THE SMALLEST DETECTION LIMIT. THE REMAINING NONDETECTS MAY BE REPLACED BY ONE HALF THEIR VALUE. ALTERNATIVELY, THE METHOD OF HELSEL (1990) MAY BE APPLIED.

(3) TESTING FOR NORMALITY OR LOG NORMALITY UTILIZES THE SAS "UNIVARIATE" PROCEDURE, PROBABILITY PLOTS, THE KOLMOGOROV–SMIRNOV TEST, THE SHAPIRO–WILKS TEST, OR THE METHOD OF DEVORE (1987). BARTLETT'S TEST OR SQUARED RANKS TEST (CONOVER, 1980) WILL BE USED FOR TESTING HOMOGENEITY OF VARIANCES.

(4) THE SINGLE OUTLIER TEST IS THAT DEFINED BY ASTM (1975) OR DIXON (1953). IF MULTIPLE OUTLIER TESTING IS PERFORMED, IT WILL FOLLOW ROSNER (1975). FOR LOG NORMAL DISTRIBUTIONS, OUTLIER TESTING WILL BE PERFORMED ON THE LOG TRANSFORMED DATA.

(5) THE SHAPIRO–WILKS STATISTIC AND PEARSON CORRELATION COEFFICIENT BOTH DEPEND ON SAMPLE SIZE AS WELL AS DEGREE OF NORMALITY. THEREFORE, PROFESSIONAL JUDGEMENT IS CALLED FOR IN INTERPRETING NORMALITY AND LOG NORMALITY. IF THE DECISION IS NOT CLEAR, THEN NONPARAMETRIC ANOVA WILL BE APPLIED.

(6) MANOVA IS USED TO TEST IF THE DATA CAN BE GROUPED INTO LARGER SETS ACCORDING TO CLASSIFICATION VARIABLES. THE NULL HYPOTHESIS IS THAT THERE IS NO DIFFERENCE BETWEEN DATA SETS.

(7) THE ANOVA, MANOVA, AND BONFERRONI PROCEDURES ARE USED AT THE .05 SIGNIFICANCE LEVEL.

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(11) EITHER NORMAL OR LOG NORMAL TOLERANCE INTERVALS ARE CALCULATED DEPENDENT UPON THE DISTRIBUTION OF THE ANALYTE. THE INTERVALS HAVE 95 PERCENT COVERAGE WITH A CONFIDENCE LEVEL OF 95 PERCENT.

FIGURE 6–1
PROPOSED
METHODOLOGY FOR COMPUTATION
OF BACKGROUND STATISTICS

R69016.MB092592

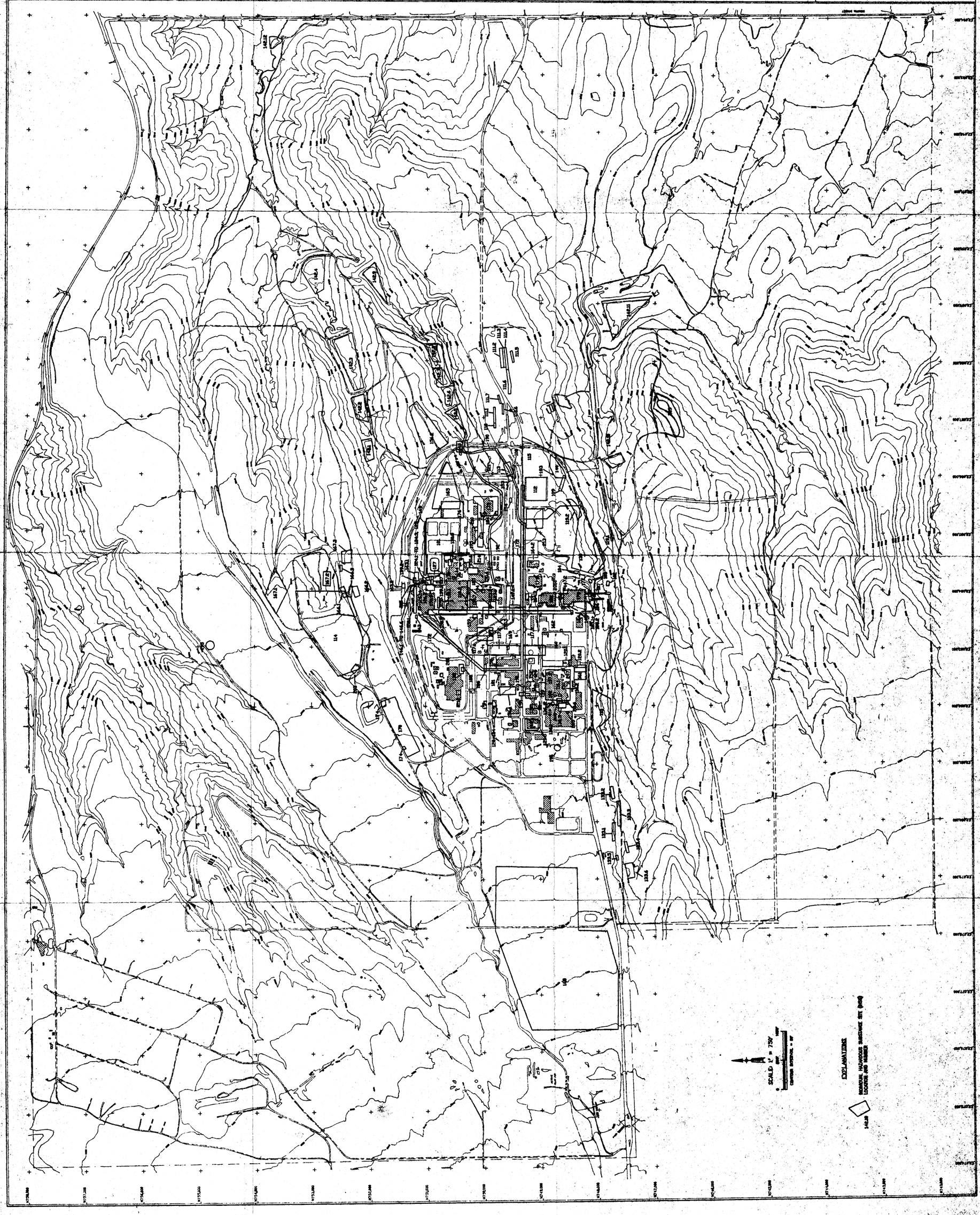
SU-A-000655

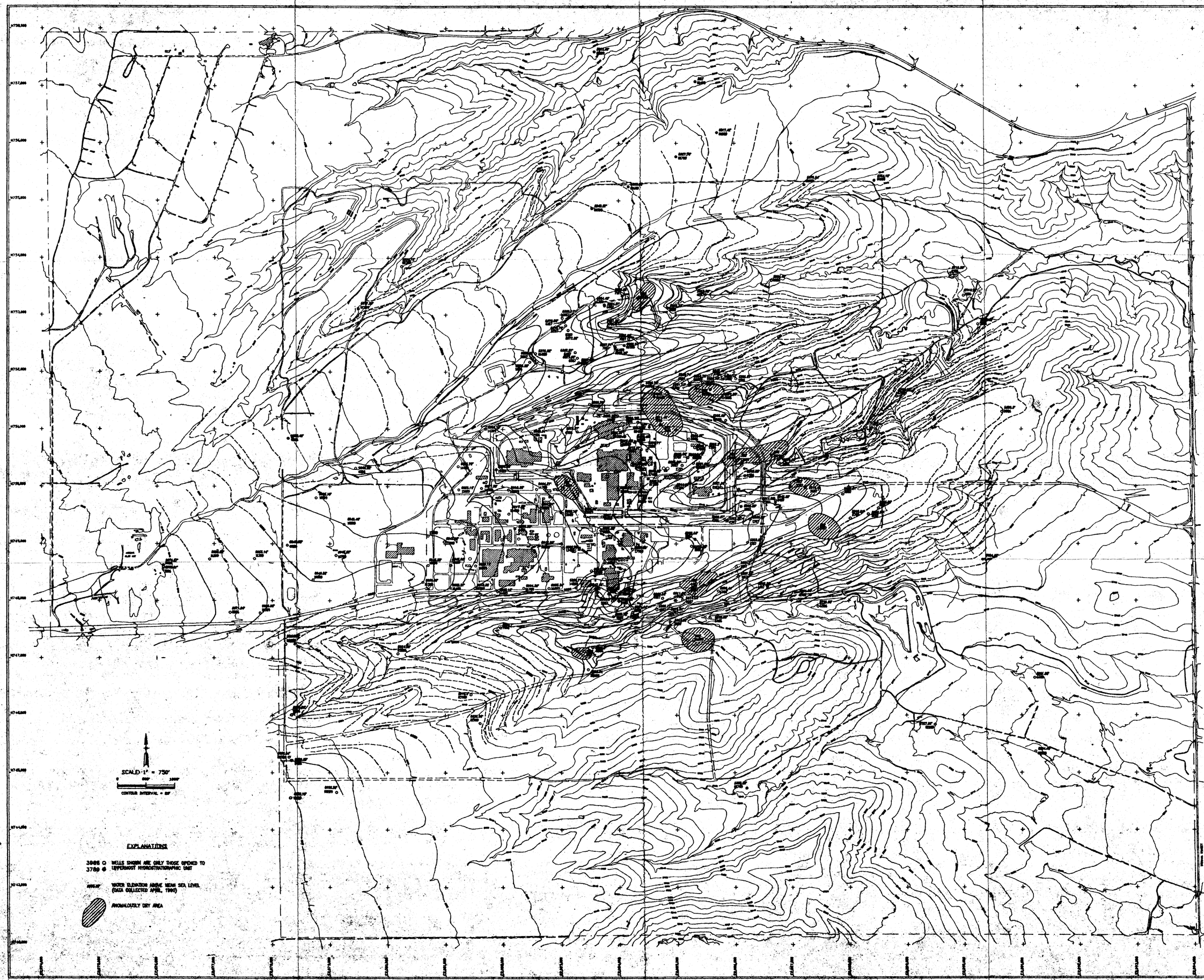
U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS
ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 1
BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT
PRESENT MANAGEMENT AREAS

NO.	DATE	REVISION





NO.	DATE	REVISION

NOTE:
WELL NUMBERS ARE SHOWN WITHOUT THE LEADING LOCATION IDENTIFIER. FOR EXAMPLE WELL 6302089 IS SHOWN AS 02089.

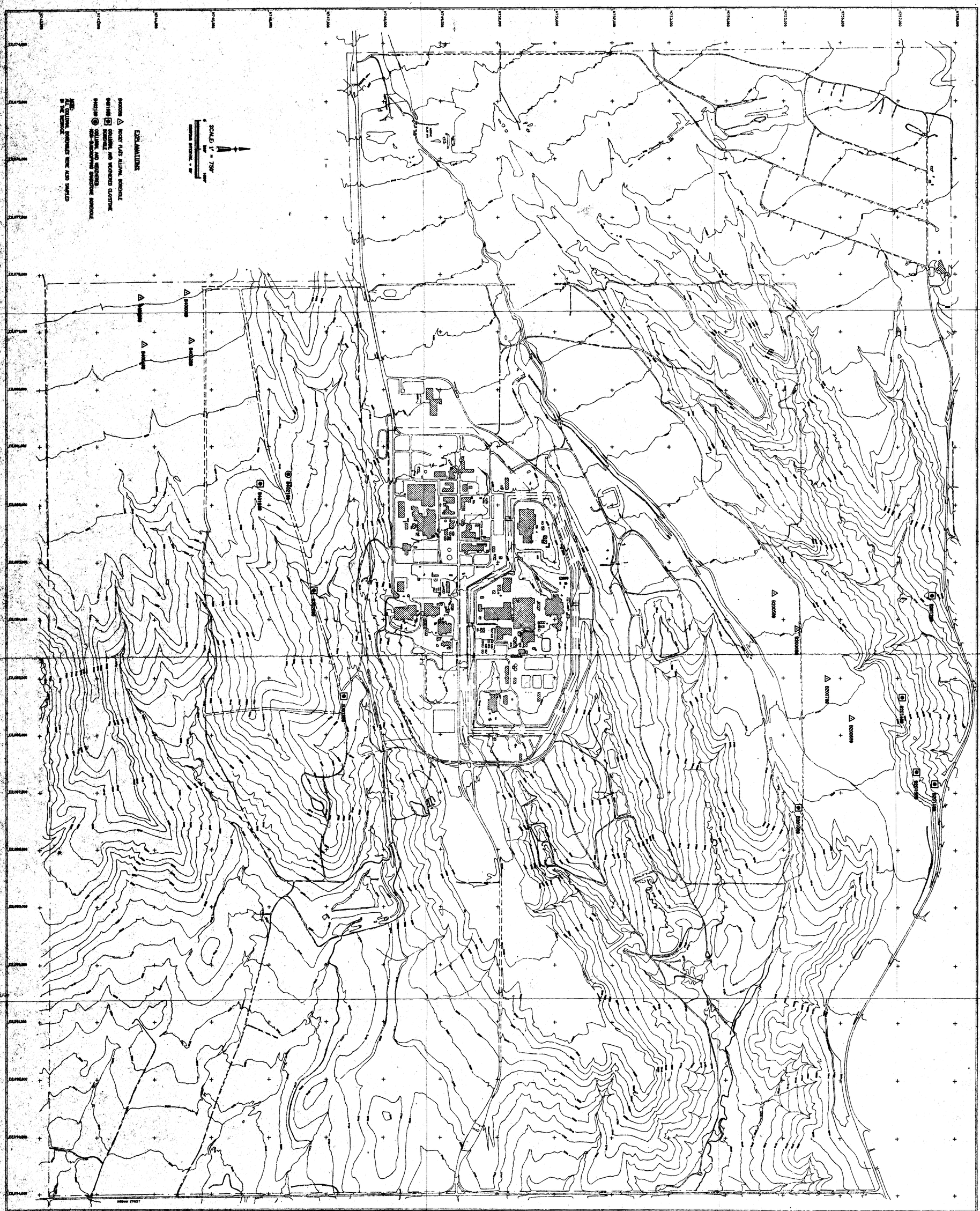
U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS

ROCKY FLATS PLANT, GOLDEN, COLORADO

[redacted]

SW-A-000555



U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS

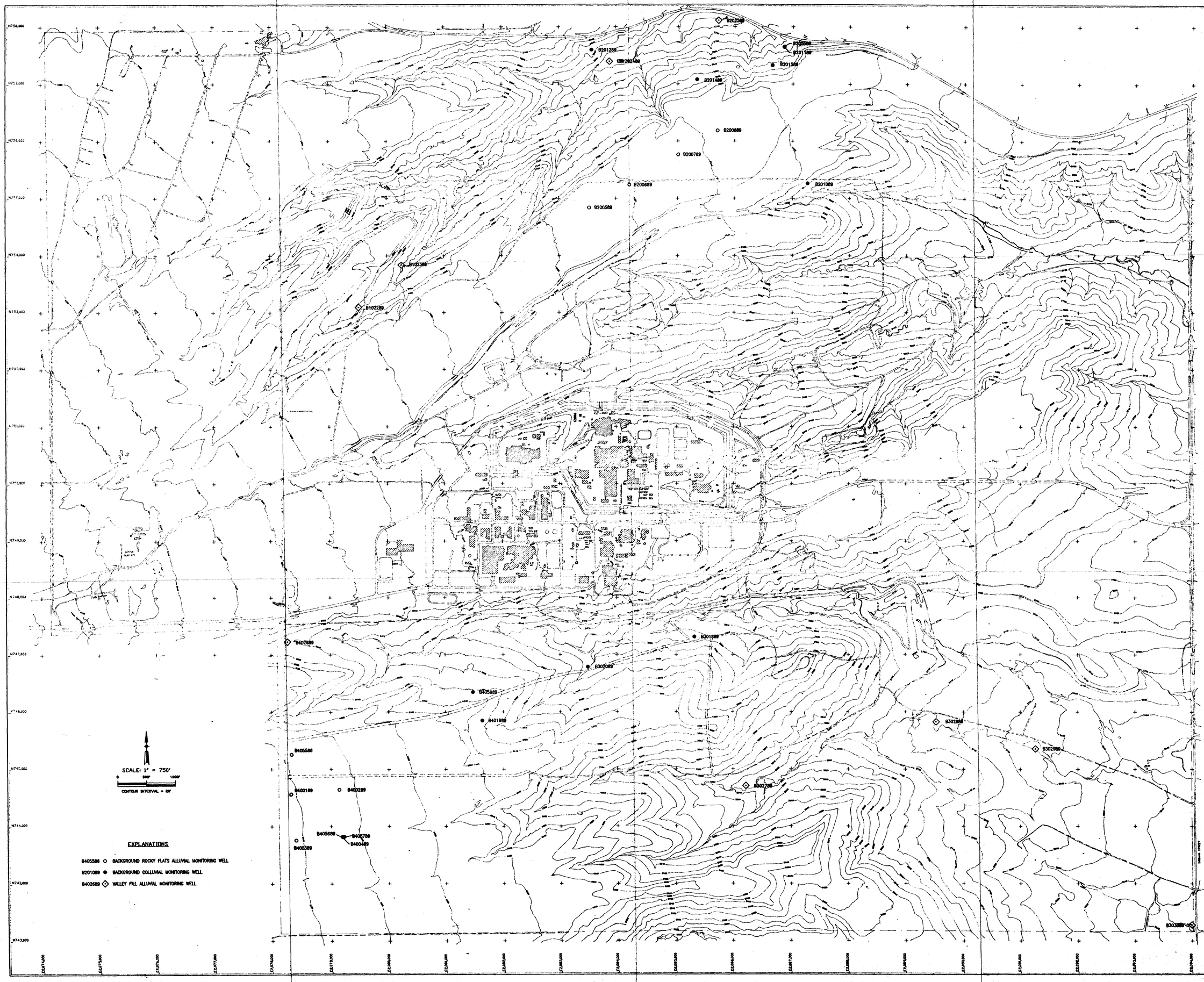
ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 3

BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT

NO.	DATE	REVISION

SW-A-000555



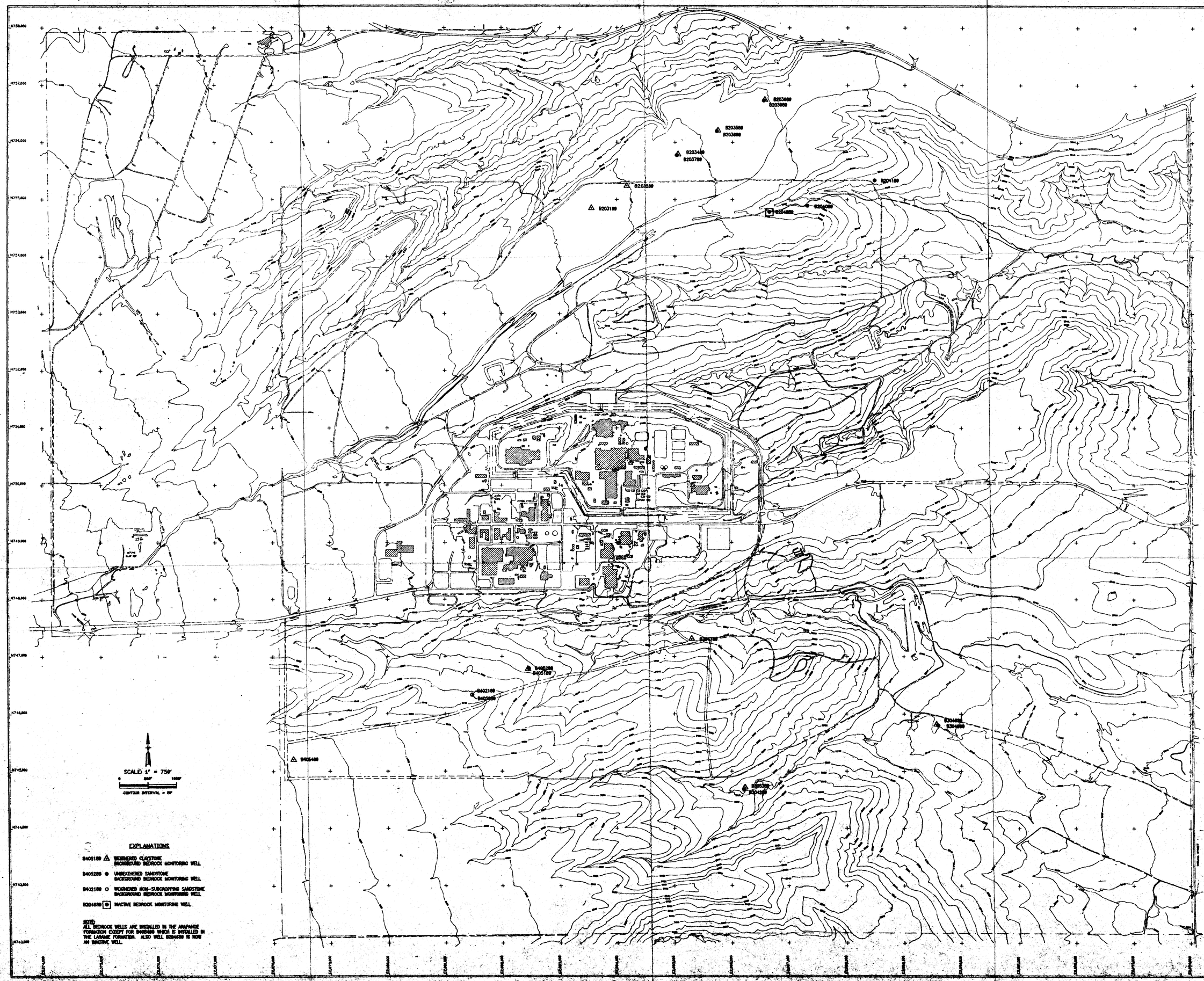
NO.	DATE	REVISION

U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS
ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 6

BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT
BACKGROUND ALLUVIAL MONITORING WELLS


N756,000
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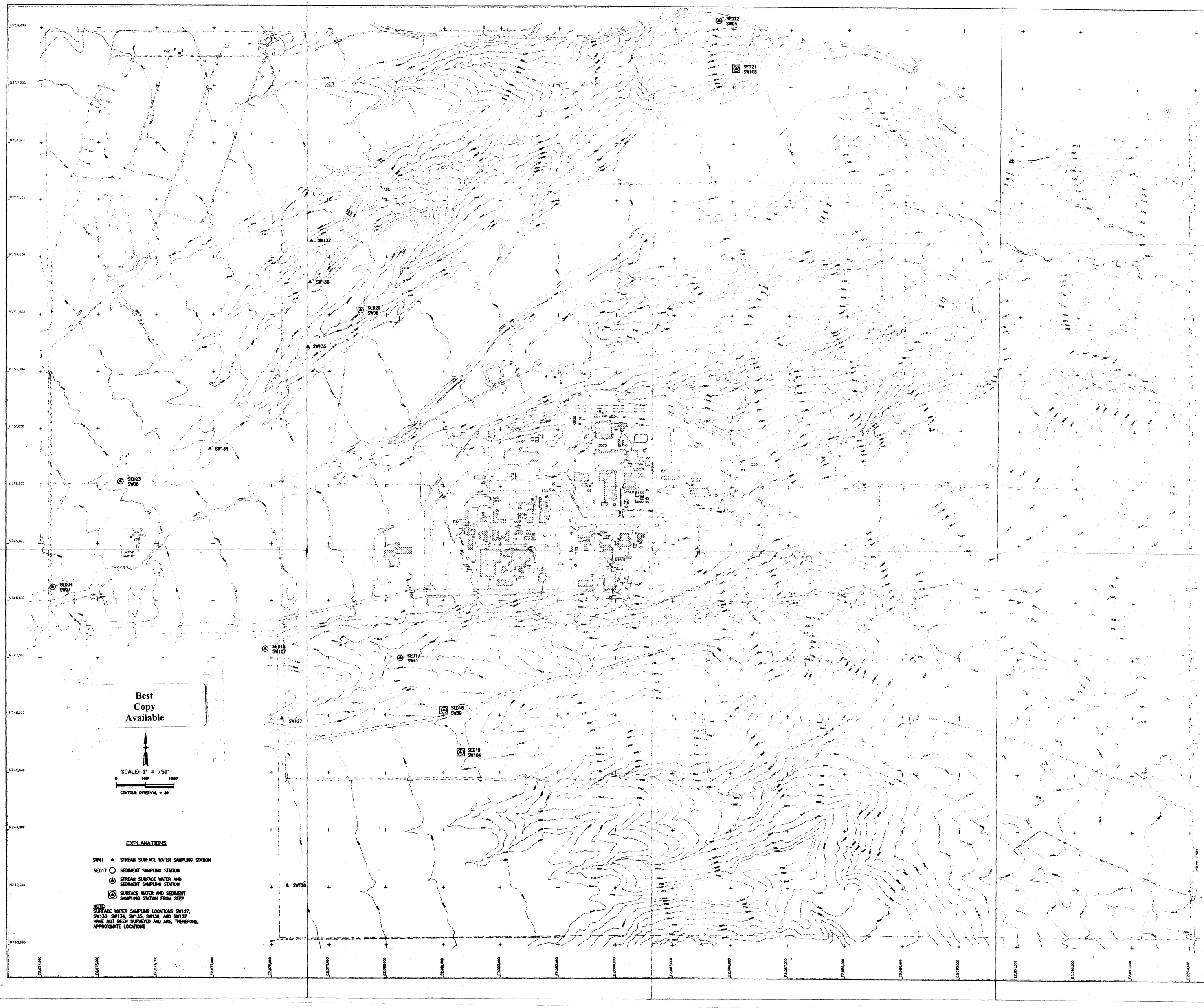
N742,000
8203189
8204189
8204489
8203489
8203789
8203589
8203689
8203689
8402189
8405189
8405289
8405389
8402489
8304489
8304589
SCALE 1" = 750'
0
500'
1000'
CONTOUR INTERVAL = 20'
EXPLANATIONS
8405189 WEATHERED CLAYSTONE BACKGROUND BEDROCK MONITORING WELL
8405289 UNWEATHERED SANDSTONE BACKGROUND BEDROCK MONITORING WELL
8402189 WEATHERED NON-SUBCROPPING SANDSTONE BACKGROUND BEDROCK MONITORING WELL
8204489 INACTIVE BEDROCK MONITORING WELL
NOTE:
ALL BEDROCK WELLS ARE INSTALLED IN THE ARAPAHOE FORMATION EXCEPT FOR 8405489 WHICH IS INSTALLED IN THE LARAMIE FORMATION. ALSO WELL 8204489 IS NOW AN INACTIVE WELL.
REVISION
DATE
NO.
U.S. DEPARTMENT OF ENERGY
EG&G ROCKY FLATS
Golden, Colorado
BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT
BACKGROUND BEDROCK MONITORING WELL LOCATIONS

SW-A-000555



NO.	DATE	REVISION

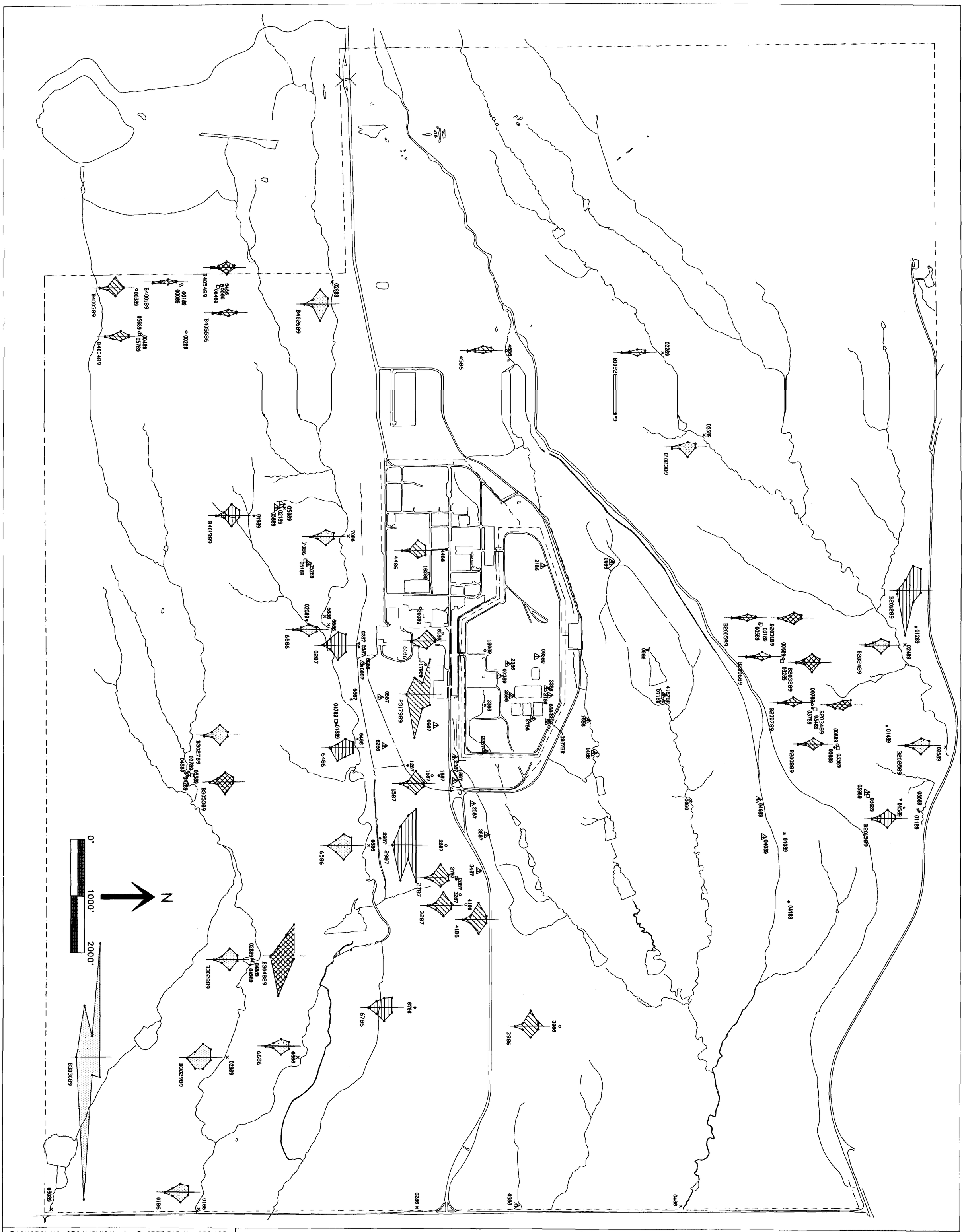
U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS
ROCKY FLATS PLANT, GOLDEN, COLORADO

PLATE 6

BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT
BACKGROUND SURFACE WATER AND SEDIMENT SAMPLING STATIONS

SW-A-000555

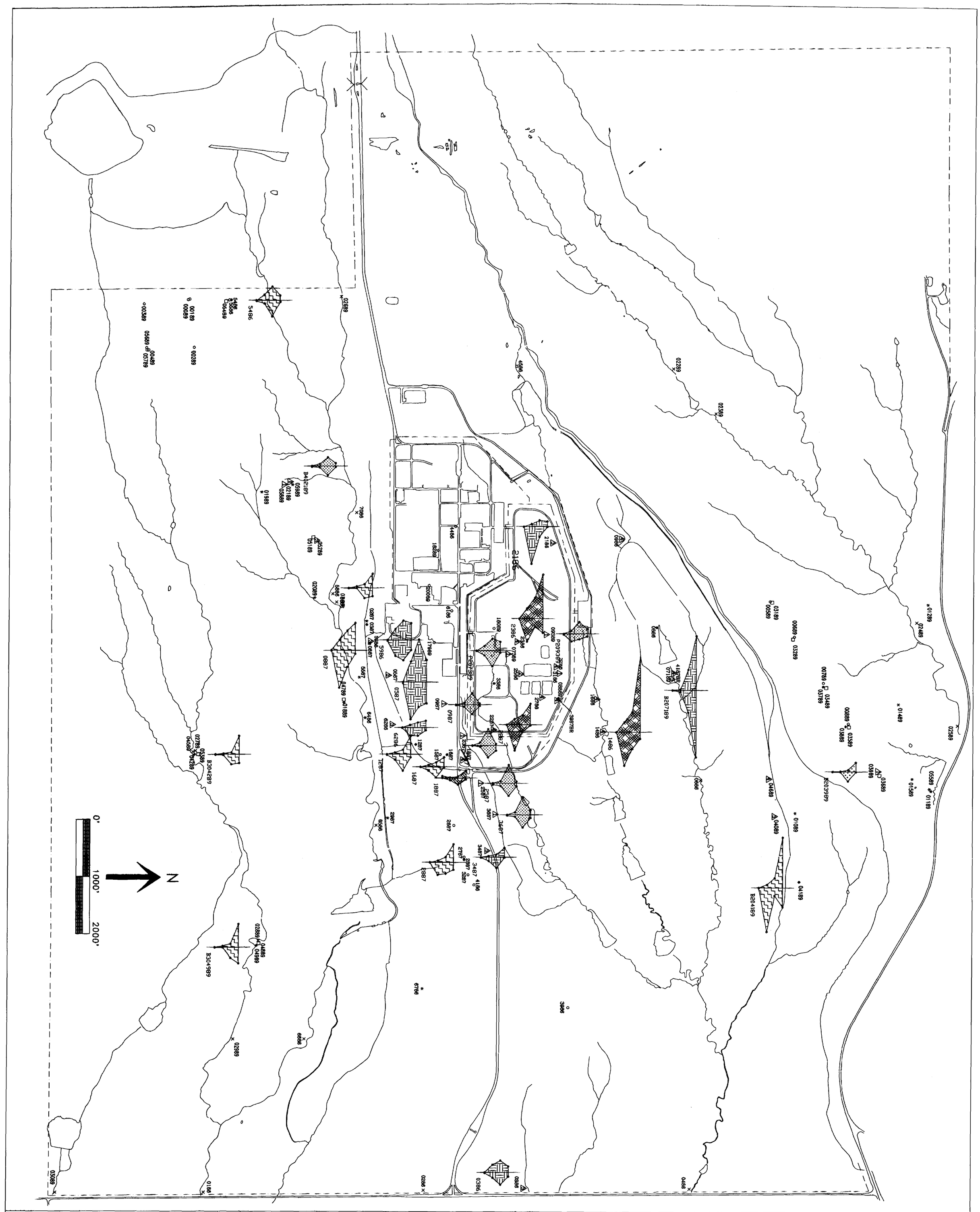


BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT
USDOE, ROCKY FLATS PLANT – Golden, Colorado 9/15/92

PLATE 7

STIFF DIAGRAMS FOR GROUND WATER IN THE ROCKY FLATS ALLUVIUM, VALLEY FILL ALLUVIUM, COLLUVIUM, AND ARAPAHOE CLAYSTONE

SW-A-000555



BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT

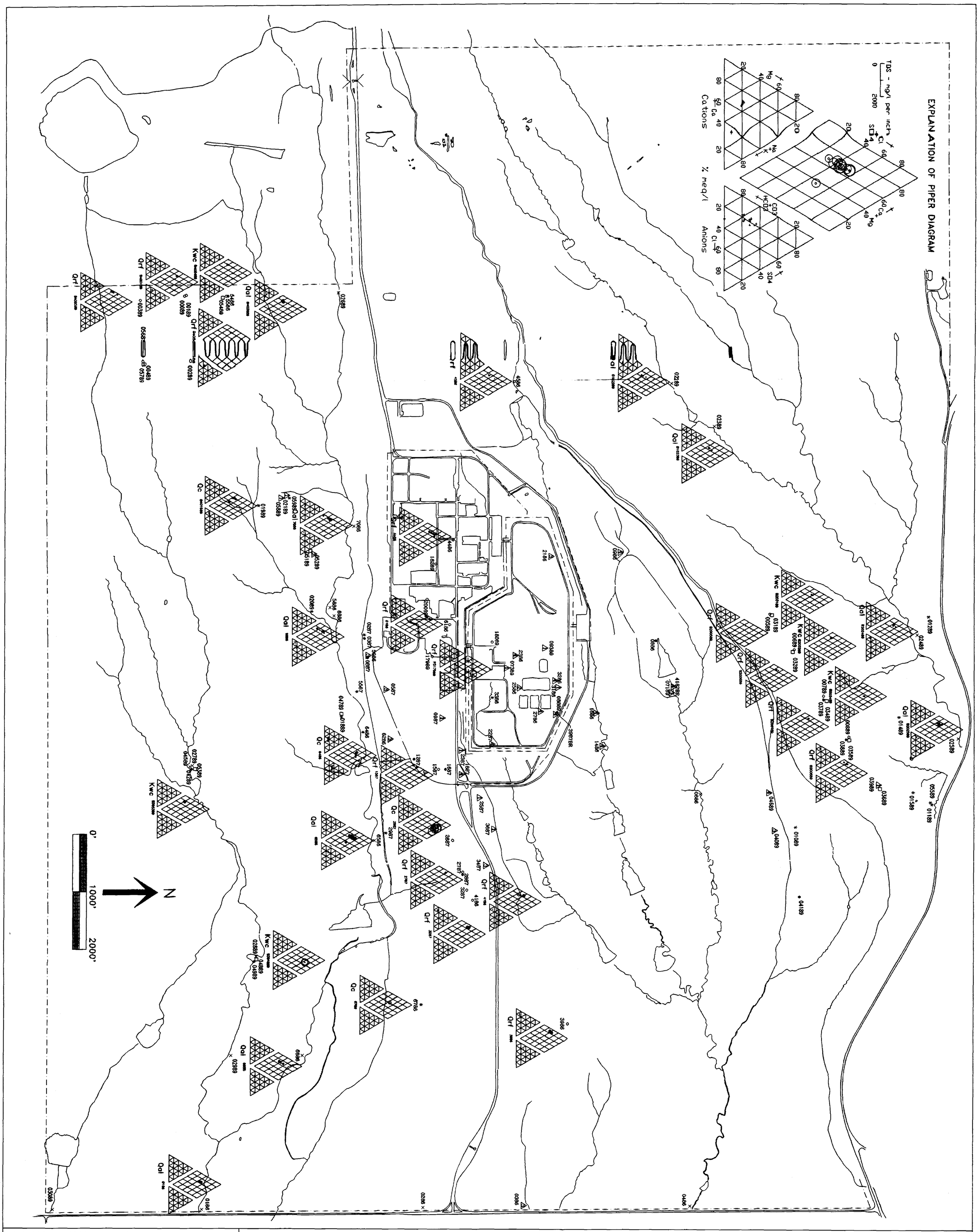
USDOE, ROCKY FLATS PLANT – Golden, Colorado 9/15/92

PLATE 8

STIFF DIAGRAMS FOR GROUND WATER IN THE ARAPAHOE FORMATION

- ○ Rocky Flats Alluvium Wells
- × Valley Fill Alluvium Wells
- * Colluvium Wells
- ● Arapahoe Formation Silty Sand Wells
- □ Weathered Claystone
- Arapahoe Formation Sandstone #1 Wells
- Arapahoe Formation Sandstone #2 Wells
- Arapahoe Formation Sandstone #3 Wells
- Arapahoe Formation Sandstone #4 Wells
- Arapahoe Formation Sandstone #5 Wells

SW-A-000555



BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT
USDOE, ROCKY FLATS PLANT - Golden, Colorado 9/15/92

PLATE 9

PIPER DIAGRAMS FOR GROUND WATER IN THE ROCKY FLATS ALLUVIUM, VALLEY FILL ALLUVIUM, COLLUVIUM, AND ARAPAHOE CLAYSTONE

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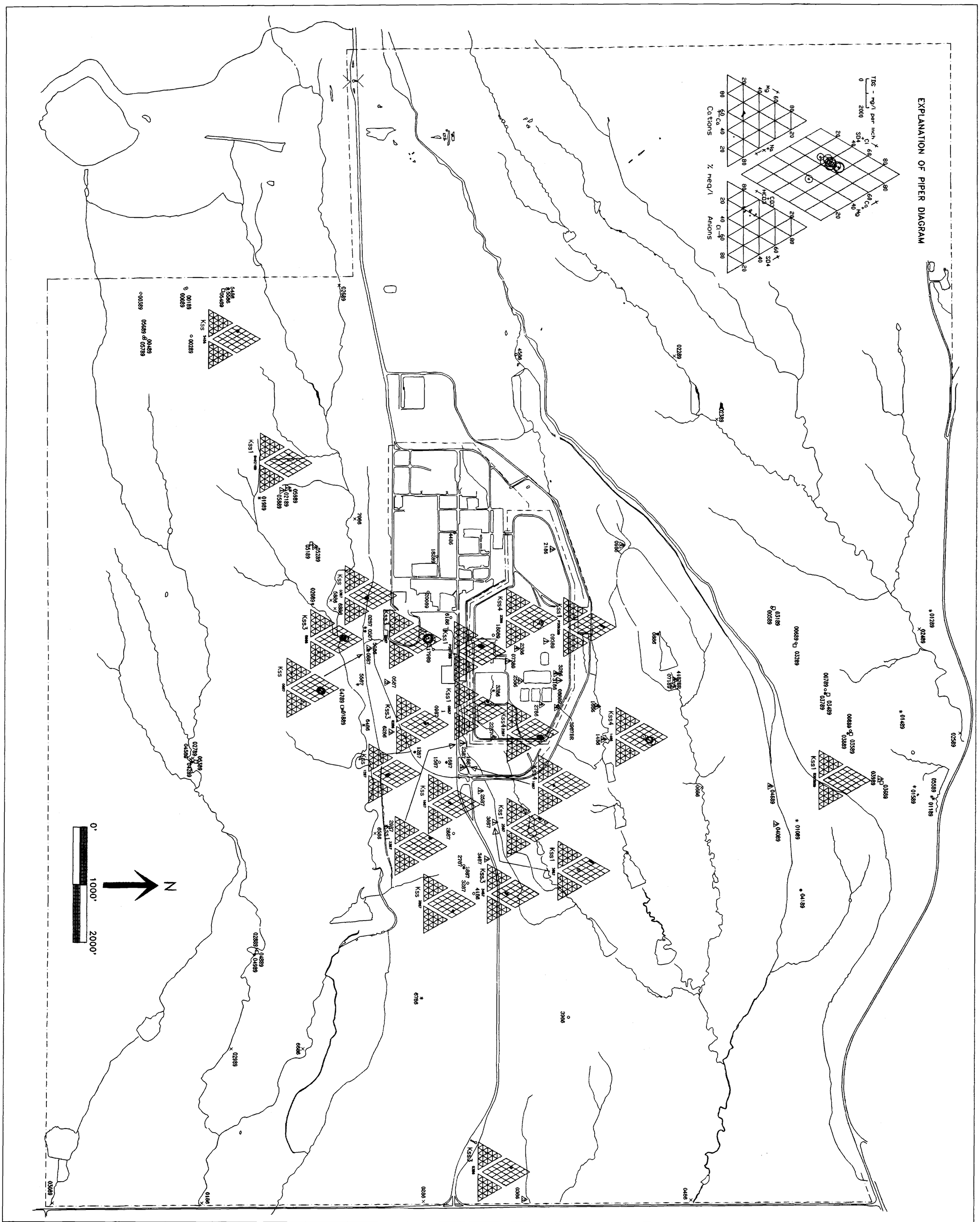

BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT

USDOE, ROCKY FLATS PLANT – Golden, Colorado 9/15/92

PLATE 10

PIPER DIAGRAMS FOR GROUND WATER IN ARAPAHOE FORMATION SANDSTONES

- ○ Rocky Flats Alluvium Wells
- × Valley Fill Alluvium Wells
- * Colluvium Wells
- ● Arapahoe Formation Silty Sand Wells
- □ Weathered Claystone
- Arapahoe Formation Sandstone #1 Wells
- Arapahoe Formation Sandstone #2 Wells
- Arapahoe Formation Sandstone #3 Wells
- Arapahoe Formation Sandstone #4 Wells
- Arapahoe Formation Sandstone #5 Wells

EXPLANATION

- Kss — Arapahoe Formation Silty Sandstone
- Kss1 — Arapahoe Formation Sandstone #1
- Kss3 — Arapahoe Formation Sandstone #3
- Kss4 — Arapahoe Formation Sandstone #4

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