RESPONSES TO CDH COMMENTS
BACKGROUND GEOCHEMICAL CHARACTERIZATION REPORT
DATED DECEMBER, 1989

SECTION 1.0: EXECUTIVE SUMMARY AND RECOMMENDATIONS

Comment 1

The use of maximum detected values where there is insufficient data to calculate tolerance intervals is questionable as a wide range in concentrations is likely.

Response:

The presentation of maximum detected values where there is insufficient data to calculate tolerance intervals is for reference only. The text will be clarified to make this point clear. As noted in the text, alternative statistical methods such as ANOVA have been identified where tolerance intervals have not been calculated.

Comment 2

Explain how the low number of samples for the colluvium, weathered claystone, and weathered sandstone are representative of background for the entire Rocky Flats site (Table 1-1). It is not meaningful to compare specific parameter concentrations between geologic units when the number of samples varied between geologic units.

Response:

We do not claim there are an adequate number of ground-water samples from these units to be representative of the entire Rocky Flats Plant. This is why tolerance intervals were not computed. Even if comparisons between geologic units are only conjecture, this can provide meaningful insights into the geochemical model of the site. However, the text will be revised so that comparisons between ground water sampled in separate geologic units will be limited to comparisons between sample means. The use of sample means should allow meaningful comparisons between sample groups of various sizes. Additional results will be presented in the revised text for all ground-water groups because of two additional quarters of data.

Comment 3

Explain why the error term is absent for radionuclide analyses for unweathered sandstones (Table 1.1).

Response:

In Table 1.1, no error term is presented for any calculated tolerance interval limit. Where the maximum detected value for a radionuclide analysis has been tabulated in lieu of a calculated tolerance interval, the error term has been presented.

Comment 4

Based on the number of samples represented by the data, it is not evident that the Rocky Flats Alluvium can be distinguished from the other shallow ground-water subgroups by the sulfate and TDS content.

Response:

High sulfate is identified in the EXECUTIVE SUMMARY as one of the characteristics distinguishing unweathered (deep) sandstone ground water from shallow ground-water subgroups including the Rocky Flats Alluvium ground water.

The inference that Rocky Flats Alluvium ground water is less saline than any of the other shallow ground-water subgroups will be reevaluated with respect to the additional data now available for the third and fourth quarter of 1989.

Comment 5

Explain how tritium can be present in the sediment sample shown on Table 1-3.

Response:

The upper limit of the tolerance interval for tritium reported in Table 1-3 for background sediments has been calculated from the reported tritium results tabulated in Appendix A-1. Tritium is an isotope of hydrogen existing as water molecules in the environment. The sediments contain water.

Comment 6

Explain why Valley Fill Alluvium and unweathered sandstone are missing in Table 1-4. Comparison of ground-water values with bedrock values can supply information regarding the geochemistry of the system.

Response:

Tolerance interval upper limits are not tabulated for Valley Fill Alluvium and unweathered sandstone, because background borehole samples from these units were not collected.

Comment 7

The concentrations of aluminum and iron in the sediment fall within the range of values for the geologic units. Calcium concentrations in the sediment are higher than those in the other geologic units. The text states differently.

Response:

The text is correct and is based on mean values as reported in the Tables of Section 4.0. However, the text incorrectly refers to Tables 1-3 and 1-4 which only provide the upper limits of the tolerance intervals. The conclusion cannot be drawn from these tables, and the text will be revised to reference the correct tables.

Comment 8

Explain what criteria will be used for determining the basis of evaluation of new data to background data (p. 1-11). Trend analysis and control charts are good methods for determining changes in parameter concentrations, however, they are time dependent. As cleanup activities have already begun at the plant (881 Hillside), it is important to establish background concentrations in as timely a manner as possible to accomplish an efficient and effective remediation.

Response:

The methods recommended for comparing background data to data collected from other areas, and the criteria for the selection of each method are discussed in Section 2.3. The text in Section 1.0, EXECUTIVE SUMMARY, will be revised to summarize the discussion in Section 2.3. Trend analysis and control charts will be clearly identified as inappropriate with the temporally limited data now available.

Comment 9

The data set is not considered complete for surface water as dissolved radionuclides were not analyzed.

Response:

Dissolved radionuclides were collected for the first round of surface water sampling. Analyzed results are presented in Appendix A-2. Dissolved radionuclides were not collected in subsequent rounds of surface water sampling because risk assessments and demonstration of compliance with water quality standards are based on total (unfiltered) concentrations.

SECTION 2.2 BACKGROUND

Comment 1

The ER program will need to meet the HSWA provisions of RCRA and the Colorado Hazardous Waste Act as well as CERCLA.

Response:

Complying with the provisions of HSWA and the CHWA is implied by reference to the RCRA facility investigations. The revised text will be more explicit.

Comment 2

Background data are applicable to interim measures/interim remedial actions (IM/IRAs) in an effort to obtain consistency with the final corrective action/remedial action (CA/RA).

Response:

The above comment will be incorporated into the text of Section 2.2.

SECTION 2.3 GENERAL APPROACH

Comment 1

If ground water was present in the unweathered claystone, then this ground water also needs to be analyzed for background characterization.

Response:

Ground water has not been identified within unweathered claystone within the Rocky Flats Plant. The text will be changed to state that ground water has been sampled in weathered claystone.

Comment 2

The text states that for a sample population with less than 10% detects for a particular parameter, tolerance intervals based on Poisson distribution will be used to determine background levels. For a sample population having between 10% and 50% detects, a test of proportions will be used to determine background levels. Figure 2-1 illustrates this using percent non-detects instead of detects. Wording of the text and the figure must coincide.

Response:

Figure 2-1 will be modified to coincide with the text.

Comment 3

Standard practice advocates the use of normal distributions for nonradionuclide constituents and the Poisson distribution for radionuclide constituents. The Poisson distribution is valid when the probability of an event happening is much less than 1.0. A sample with 10% non-detects is not equivalent to a probability of much less than 1.0.

Response:

Tolerance intervals based on the Poisson distribution will not be advocated as a statistical procedure in the revised text. This statistical procedure will no longer be proposed because the very large number of samples required by this procedure make it inappropriate for this site.

Comment 4

Explain why the test of proportions and ANOVA statistical methods require non-background samples. Explain the plan for selecting the sample locations.

Response:

Use of tolerance intervals is a statistical method that compares a non-background datum to an estimate of the background population range to test the hypothesis that the datum is a subsample of the background population. The background tolerance interval is computed without non-background data. Test of proportions and ANOVA are different statistical methods designed to test the hypotheses that background samples and non-background samples are both subsamples of a single population. Computation of the statistic requires both background and non-background data. The plans for selecting non-background samples are site specific and is identified in the various remedial investigation work plans for the Operable Units.

SECTION 2.4 COMPUTATION OF NORMAL TOLERANCE INTERVAL STATISTICAL METHODS

Comment 1

If a given constituent's concentration ranges over three orders of magnitude in a group of seven to nine samples taken at the same time and the same location, gross systematic errors are most likely at fault. In any cases where concentration varies over this enormous range, the individual seven to nine sample results should be presented, with the statistical analysis. In locations where concentration ranges are a problem and a systematic errors cannot be eliminated, it would be a good idea to increase the number of samples taken in the future, up to as many as 20, or all the water you can get at any one test time.

Response:

The range three orders of magnitude was cited in the text as a criterion for log normal tolerance intervals. This criterion was first proposed in the Background Hydrogeochemical Characterization and Monitoring Plan. Background data collected to date do not range over three orders of magnitude. In the revised text the range, "three orders of magnitude", will be dropped as an indicator of log normality. Normality will be tested using the Shapiro-Wilk test at the 95% confidence level.

Comment 2

If a given constituent's concentration ranges over three orders of magnitude, between the beginning and end of the study round, one year, then the results should be presented in "time-series analysis" or "trend testing": to show the concentration differences on a quarterly or some other seasonal basis. Conclusions regarding contamination versus background concentrations should be referenced seasonally for any chemical constituent ranging over two orders of magnitude or more.

Response:

See previous response. Tolerance intervals are specifically used for point-in-time comparisons of background and site data.

Comment 3

The mean plus three standard deviations reflects a 99% confidence level. The text (p. 2-5) states differently.

Response:

The mean plus three standard deviations was presented for reference only for those analytes where a tolerance interval was inappropriate. The mean plus three standard deviations reflects a 99% confidence level for the mean; this is not the confidence level which is appropriate for a tolerance interval. The mean plus three standard deviations will not be presented in the revised text.

Comment 4

The text explains that one criterion for use of a tolerance interval based on normal distribution is a 50% or greater rate of detection among samples. Figure 2-1 shows the criterion as being less than 50% non-detects. The wording in the text and the figure must be consistent.

Response:

Figure 2-1 will be modified to be consistent with the text.

SECTION 3.0 SAMPLING LOCATIONS AND SAMPLE COLLECTION

Comment 1

CDH requested copies of the QA/QC plan and SOPs after a recent inspection and have received one copy of each. A second copy of each is requested.

Response:

Copies of the QA/QC plan and SOPs are being revised and will be forwarded to CDH in accordance with the IAG Schedule.

SECTION 3.1 GROUND WATER

Comment 1

The surficial flow system includes sandstones in the Arapahoe Formation if the units are in direct hydraulic connection. However, geochemical distinction between the surficial units and bedrock units is possible.

Response:

The revised text will test for geochemical distinctions between ground water sampled in surficial and bedrock units.

<u>Comment 2</u>

VOCs must be sampled for all background media for one round to verify that the locations are upgradient from all known and potentially undiscovered sites of contamination.

Response:

One round of VOCs will be collected as part of the background sampling program for surface water in 1990. These data will be evaluated for the revised report, if available.

<u>Comment 3</u>

Plates 1 and 2 must show locations of all SWMUs.

Response:

All SWMUs will be shown on Plates 1 and 2.

<u>Comment 4</u>

A geologic map with SWMU and sampling locations must be submitted.

Response:

A surficial geology map with SWMU and sampling locations will be submitted.

<u>Comment 5</u>

Detailed geologic cross sections showing the geology of the area in which all background wells are placed must be submitted. The test (p. 3-3) explains that the background wells were located in similar lithologic units as the West Spray Field and Solar Evaporation Ponds. Well construction and geologic logs must be submitted for each of the newly installed wells for verification.

Response:

A separate background characterization field program report will be prepared for submittal to the agencies along with the revised Background Geochemical Characterization Report. The field program report will contain well construction and geologic logs for each background well installed in 1989. A geologic cross section north of the plant comprised of B200589, B203189, B200689, B203289, B203389, B200789, B203789, B203489, B200889, B203889, B203589, B203689, B201589, B201689, B201189, and B205589 will be presented. South of the plant, a geologic fence diagram comprised of B400189, B400289, B400489, and B400389 and a geologic cross section comprised of B405489, B405889, B405289, B302089, and B304789 will be presented. Additional cross sections would not be informative because of the relatively large spacings between boreholes.

Comment 6

Wells B301989 and B303189 are not shown on Plate 1 and are missing from Table 3-1.

Response:

The correct name for well B301989 is B401989 and for well B303189 is B203189 as indicated in Plate 1 and Table 3-1. The text will be corrected.

Comment 7

Proposed well 26-89, located upgradient of Mower Reservoir as shown on Plate 1 of the Background Hydrogeochemical Characterization and Monitoring Plan (Rockwell, 1989), was not installed. Well B303089 is the only well installed in the area. This well is downgradient of Mower Reservoir and possibly not a background well.

Response:

The water body in reference is not Mower Reservoir but rather an unnamed pond on Smart Ditch which is south and outside the Woman Creek drainage. Proposed well 25-89 was located upgradient of the pond with proposed well 26-89 located at the current location of B303089 per Plate 1 of the Background Hydrogeochemical Characterization and Monitoring Plan. Both of these locations are in an area unimpacted by SWMUs. At the time of siting actual well locations, December 1988, the pond was dry. Consequently the location of the background well initially located north of this pond, 25-89, was moved to the current location of B302989 in order to increase the likelihood of encountering saturated valley fill alluvium.

Comment 8

Explain why additional wells screened in the Rocky Flats Alluvium were not installed farther east along Woman Creek.

Response:

Locations for background wells screened in Rocky Flats Alluvium are limited south of Woman Creek because of erosion and north of Woman Creek by SWMUs. The relationship of background well locations to surficial geology and SWMU locations will be shown on plates. See Section 3.1 comments 3 and 4.

Comment 9

Explain how the depth to bedrock can be 0.0 ft for well B405689 when the well is completed in Rocky Flats Alluvium.

Response:

This is an error. Well B405689 did not encounter bedrock. Depth to bedrock will be revised to read "not available."

Comment 10

An updated potentiometric surface map should be drawn with the data gained from the new background wells.

Response:

An updated potentiometric surface map for unconfined flow will be provided. Data from 1989 background wells will be included.

Comment 11

The following wells shown on Plate 1, are not accounted for in the text or in Table 3-1:

B304389, B304489, B304589, B400089, B203389, B201389, B200989, B201689, and B201789.

Response:

Table 3-1 will be revised to include wells B400089 and B304589 and abandoned sample locations B304389, B304489, B203389, B201389, B201689, and B201789. These wells and the abandoned sample locations will be accounted for in the text. Sample location B200989 refers to borehole B200989. This borehole is currently listed in Table 3-9, Background Borehole Data for Rocky Flats Plant, and is discussed in Section 3.4.

Comment 12

Explain possible impacts on well B203389, B203289 and B200689 from SWMU 195.

Response:

Should the potentiometric surface map (per comment 10 above) indicate that background wells are downgradient of any SWMU, the possible impacts of that SWMU will be discussed.

SECTION 3.4 BOREHOLE SAMPLES

Comment 1

Valley Fill Alluvium is also present in the buffer zone and may be impacted by releases from SWMUs. Therefore, the Valley Fill Alluvium should also be evaluated.

Response:

Borehole samples of valley fill alluvium were not collected because valley fill alluvium does not underlie any SWMU. Contamination of the valley fill alluvium via ground water is considered a groundwater contamination issue.

Comment 2

Table 3-10 should identify the lithologic unit (i.e. Rocky Flats Alluvium, Colluvium, Bedrock).

Response:

This table will be revised to reflect this comment.

Comment 3

The contact between the Arapahoe Formation and Laramie Formation must be shown on a geologic map and in cross sections.

Response:

The Laramie Formation was encountered in only one background well, B304289. This well was neither completed nor sampled in the Laramie Formation. The Arapahoe/Laramie contact will not be shown in cross section because of lack of control. The approximate location of the subcropping Arapahoe/Laramie contact will be superimposed on the surficial geologic map discussed in Section 3.1, comment 4.

Comment 4

The drilling logs for boreholes must be submitted.

Response:

Geological logs for all background wells will be provided in the background characterization field program report as discussed in response to Section 3.1, Comment 5, appended to the revised text.

EG&G: Alternatively we can reference and simultaneously submit Background Field Program Report.

SECTION 4.0 BACKGROUND CHEMICAL CHARACTERIZATION

Comment 1

In general, the Stiff diagrams show relatively high sodium plus potassium and chloride. In one case, B204189, does sulfate appear relatively high. This is not reflected in the text.

Response:

The text will be revised to reflect this comment.

Comment 2

Figure 4-1 is not legible.

Response:

The clarity of Figure 4-1 will be improved.

Comment 3

Table 4-3 indicates that tolerance intervals could be determined for only a small proportion of the background dissolved metal parameters due to low percent of detects or number of samples. The number of samples and thus the sample locations must be increased.

Response:

An adequate number of samples for the computation of tolerance intervals is available for all analytes listed in Table 4-3. Increasing the number of sample locations should not increase the percent of detects, because the inclusion of new samples should not alter the observed ratio of the number of detects to the total number of samples.

Comment 4

Ground water from the Rocky Flats Alluvium and colluvium can be compared after further investigation through increased sampling has occurred.

Response:

The text will be revised to reflect this comment.

SECTION 4.1.2 COLLUVIAL GROUND WATER

Comment 1

Lithium was found in the colluvial water and the Valley Fill Alluvium ground water. The text states differently and is not consistent with Section 4.1.3. Analytical data between the ground water from the different media should also be graphically reported to evaluate any differences or similarities. With the amount of information obtained, comparisons of the different ground water types is not fully substantiated.

Response:

The statement that lithium was found only in the colluvial water was made in the context of a comparison of colluvial to Rocky Flats Alluvium ground water only. The text will be revised to clarify this point. Graphical presentations of analytical data for types of ground water will be presented. Additional data (3rd and 4th quarters 1989) will be available to substantiate comparisons of ground water types.

SECTION 4.1.3 VALLEY FILL GROUND WATER

Comment 1

Strontium was not detected in the Valley Fill Alluvium (Appendix A-4). The text states differently.

Response:

The text will be revised to reflect the analytical results.

SECTION 4.2 SURFACE WATER

Comment 1

The sample locations, as represented by the Stiff diagrams, are too few and too far apart to analyze the changes in Na, Cl, Ca, and HCO3 concentrations from west to east across the site or the interaction between the ground water and surface water.

Response:

Although based on limited information, it appears that, qualitatively, the salinity of the surface water increased from west to east, and a reasonable hydrogeochemical mechanism was advanced to support this observation. However, we agree that sample locations are too few and too far apart for a more definitive assessment. The locations of surface-water sampling stations were selected to account for spatial variability. Because only 9 stations were established, assessment of changes in surface water quality with distance downstream is difficult. No conclusions will be drawn on the variation of surface-water quality and the interaction of surface water and ground water based upon Stiff diagrams alone.

SECTION 4.2.2

Comment 1

Explain how changes in the natural system can account for the changes in the surface water geochemistry (i.e., the detection and non-detection of strontium in Rounds 1 and 2, respectively and the detection and non-detection of molybdenum in Rounds 2 and 1, respectively).

Response:

Relative recharge of a stream by ground water is a change in the natural system that would influence the surface water geochemistry. The incorporation of rounds three through nine of surface water data will better document temporal variability in surface water geochemistry. Prior to the collection of even one years worth of geochemical data, however, proposing mechanisms for the temporal variability would be premature.

SECTION 4.3 STREAM SEDIMENTS

Comment 1

The sediments do not have a lower concentration of aluminum and calcium than the weathered claystone. The text states differently.

Response:

The mean concentrations of aluminum and calcium for sediments are 6513.9 and 2590 mg/kg respectively (Table 4-31). The mean concentrations of aluminum and calcium for weathered claystone are 7430 and 5762 mg/kg respectively (Table 4-39).

APPENDICES

Comment 1

Explain the presence of lithium in the field blank for background surface water stations.

Response:

Lithium was detected at 0.0162 mg/l in the field blank collected on 5/20/89 during the second round of surface water sampling. This field blank was collected after station SW-108 where lithium was also detected at 0.0192 and 0.0183 mg/l in the sample and the duplicate. Lithium was not detected at any other surface water station in the second round of sampling. Although this seems indicative of incomplete decontamination, the concentration in field blank is on the same order as the samples, and no other analytes provide such evidence. Possible sampling and/or analysis errors will be investigated.

Comment 2

Explain the presence of mercury in the field blank for Round 1 ground-water sampling.

Response:

Because mercury was generally non-detected or detected at levels significantly lower than in the field blank, cross contamination from the sampling equipment is not the likely explanation. The mercury may have been a containment of the particular sample bottle, or the datum may be in error. Possible sampling and analysis errors will be investigated.

Comment 3

Explain how the field blanks were collected for the boreholes and the presence of molybdenum and zinc in field blanks.

Response:

Some of the zinc concentrations in the field blank were unusually high and possible errors will be investigated.

Analytes which were detected within field blanks will be discussed in the revised text. The text will reference the version of SOPs used in data collection; deviations from the SOPs will be addressed in the text.

Comment 4

Explain how the highest value reported for lithium in the Rocky Flats Alluvium recorded as present below the detection limit.

Response:

The detection limits for soils vary in response to the type of soil matrix, moisture content, and dilution factors. Consequently detection limits for some samples may exceed detected values for other samples. The highest value reported for lithium in the Rocky Flats Alluvium (Appendix A-5) is 31.3 mg/kg in B200989. This value is not reported as below the detection limit.

Comment 5

Sodium was reported to be present in B400289 and in the blank. The QA/QC data does not show sodium present in the blank.

Response:

Sodium was reported at 206B mg/kg for the B400289 sample in Appendix A-5. B is a flag indicating that sodium was present in the laboratory blank. The data reported under APPENDIX A5: QA/QC SAMPLES: TOTAL METALS are for field blanks.

Comment 6

Explain how the lowest value for lithium for Rocky Flats alluvium is reported as the only value above the detection limit.

Response:

Reported results for lithium for Rocky Flats Alluvium (Appendix A-5) range from 3.7 mg/kg in B400289 to 31.3 mg/kg in B200989. In comparison detection limits range from a low of 2.0U mg/kg in B400389 to a high of 26.1U mg/kg in B200589. This range of detection limits reflects variations in soil matrix, moisture content and dilution factors among soil samples.