This technical memorandum presents the Revised Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) Work Plan (Bedrock) for the Rocky Flats Plant (RFP) Operable Unit No 2 (OU-2) This work plan, hereafter referred to as the Revised Bedrock Work Plan, refines and reduces the scope of work for investigation of the Lower Hydrostratigraphic Unit (LHSU) that was presented previously in the Phase II RFI/RI Work Plan (Bedrock) (EG&G 1991e), hereafter referred to as the Bedrock Work Plan This reduction in scope is appropriate based on a review of data previously collected and currently being compiled as part of the implementation of the Phase II RFI/RI Work Plan (Alluvial) (EG&G 1991b) The existing OU-2 data indicate that substantial LHSU contamination is not present Additionally, due to the low permeability and discontinuous nature of the LHSU sandstones, a complete LHSU exposure pathway for health risk to human receptors is unlikely

The Revised Bedrock Work Plan focuses on acquiring data to verify that contamination in the LHSU is limited in nature and extent The field investigation program is a focused program designed to incorporate an observational approach that will allow the field results to be evaluated as each field component is completed With this approach, the investigation of the LHSU can be expedited, while reducing the potential need for additional phases of field investigation Figure ES-1 illustrates the decision process for using field results, as they are obtained, to evaluate the LHSU If groundwater samples cannot be collected from the LHSU or analytical results indicate that contaminants are not present at detectable levels this will confirm the limited nature and extent of contamination in the LHSU As such, theLHSU will be considered an incomplete pathway and a quantitative assessment of the human health risks associated with a LHSU exposure pathway will not be conducted

The Revised Bedrock Work Plan will be implemented simultaneously with ongoing alluvial site characterization and risk assessment work in order to complete the Phase II RFI/RI Report in the spring of 1994, because of the expected condition that contamination in the LHSU has limited nature and extent It is expected that the results of the Revised Bedrock Work Plan will support that assumption The results of the expedited analysis of the indicator parameters for groundwater will be used to evaluate if the expected condition of limited nature and extent of contamination in the LHSU is met The validated analytical results from the Revised Bedrock Work Plan will not be available for inclusion in the Draft Phase II RFI/RI Report However, all available results of the expedited

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indicator parameter analysis, as well as available non-validated analytical results for full suites of LHSU analytical parameters will be included in the data section of the Draft Phase II RFI/RI Report

If the expected condition is found not to exist, delays in the currently identified schedule for submittal of the Draft and Final Phase II RFI/RI Reports may result To minimize potential delays, a contingency plan is being developed so that, if the results of the Revised Bedrock Work Plan do not confirm the assumed site conditions, this plan can be implemented while the field crews are mobilized The contingency plan will be reviewed and approved by EPA/CDH

The Data Quality Objectives (DQO) process was utilized in developing this technical memorandum The DQO process is an iterative process designed to focus on decision making and project objectives to ensure that data acquisition activities are logical and cost effective

Previous field investigations (Phase I and Phase II) conducted at OU-2 have addressed the geologic characterization of the alluvial and bedrock deposits, associated groundwater flow systems, and sources and extent of chemical and radiological contamination Data for the Upper Hydrostratigraphic Unit (UHSU) and LHSU at RFP were reviewed and utilized in developing this technical memorandum Substantially more data are available for the UHSU than LHSU because most of the subsurface data collection activities conducted to date have focused on characterizing the UHSU However, data from 30 existing LHSU wells and 11 borings are available Based on a review of those data, it appears that potential sources of contamination to LHSU sandstones are limited to secondary groundwater plume sources within the UHSU

To evaluate potential UHSU plume sources, alluvial/colluvial and No 1 Sandstone isoconcentration maps for carbon tetrachloride (CCl_4) were prepared (Figures 1-25 and 1-26) to identify UHSU contamination hotspots Isoconcentration maps for PCE and TCE indicate similar UHSU hotspots for the contaminants Six substantial CCl_4 hotspots appear to be present in the UHSU as shown on the isoconcentration maps These UHSU hotspots are likely areas where contamination might be present in the underlying LHSU if migration has occurred between the UHSU and LHSU, therefore the Revised Bedrock Work Plan field investigations will be focused in these areas

Two potential scenarios for migration of groundwater contamination from the UHSU to LHSU have been proposed Scenario 1 (Figure 1-27) involves lateral migration of contaminants from the UHSU alluvium and/or No 1 Sandstone to discharge points beneath the colluvium along

range, usually near the analytical method detection limits In many cases, the detected CHCs in these wells have also been detected in laboratory blanks indicating possible laboratory-related contamination of the samples Based on the available data, it appears unlikely that the contamination identified in these wells is indicative of a LHSU exposure pathway

This technical memorandum discusses the Conceptual Site Model for OU-2 with respect to the LHSU Potential exposure pathways associated with the LHSU have been designated as incomplete for OU-2 This designation is based on existing data that indicate that LHSU contamination is limited where associated with potential LHSU exposure pathways (i e , scenario 2 type) In addition, the low permeability and discontinuous nature of the LHSU sandstones suggests that there is no viable LHSU migration pathway for the contaminants to reach ground surface, nor is there sufficient well production capability in the LHSU sandstones to support a water supply for on-site residents Based on this designation, no quantitative assessment of human health risk through LHSU exposure pathways is anticipated for the OU-2 RFI/RI Contamination believed to be associated with an UHSU exposure pathway (scenario 1) will be quantitatively evaluated in the OU-2 RFI/RI with regard to the associated human health risk

The objective of the Revised Bedrock Work Plan is to gather data necessary to sufficiently verify the assumption that contamination in the LHSU has limited nature and extent and, thus, the LHSU exposure pathway is incomplete The Revised Bedrock Work Plan field program will investigate the most likely areas for LHSU contamination and will evaluate the permeability of LHSU units in those areas The field program focuses on gathering data to sufficiently verify the assumption that substantial LHSU contamination associated with a potential LHSU exposure pathway does not exist, or that, if present, the contamination does not pose a risk to human health because the exposure pathway in the LHSU is incomplete

The Revised Bedrock Work Plan field investigation activities include drilling and sampling of two bedrock boreholes, drilling and sampling of six bedrock pilot boreholes, and installation of 6 to 12 monitoring wells at six locations (Figure 2-1), collecting and analyzing groundwater samples from each newly-installed LHSU monitoring well, and slug testing of each newly-installed LHSU monitoring well Three of the six locations for monitoring well installation (WC-1, WC-5, and WC-6) were selected to evaluate the potential for vertical migration of UHSU contamination to LHSU sandstone units (scenario 2) The other three monitoring well locations (WC-2, WC-3, and WC-4) were selected to verify that contaminants detected in LHSU wells along the slope of Woman Creek (scenario 1) are related to localized infiltration of contaminated colluvial water into the subcropping LHSU sandstones The two borehole locations (SB-1 and SB-2) were selected to investigate the vertical extent of contamination identified previously in LHSU claystones samples

The Revised Bedrock Work Plan focuses on acquiring data to confirm whether or not substantial LHSU contamination exists, and evaluating whether the permeability of LHSU units is sufficient for them to act as a complete LHSU exposure pathway to human receptors (Figure 1-4) If the results of the Revised Bedrock Work Plan confirm that the nature and extent of contamination in the LHSU is limited and that the permeability of LHSU units is insufficient for them to act as a pathway to human receptors, as indicated by available data, a detailed investigation of the LHSU, as previously proposed in the Bedrock Work Plan, will not be necessary to support an OU-2 RFI/RI Report conclusion that human health risk associated with LHSU exposure pathways is negligible Alternatively, if the results of the Revised Bedrock Work Plan fail to confirm that the nature and extent of contamination in the LHSU is limited, then additional investigation may be necessary A contingency plan will be developed for review and approval by EPA and CDH to minimize delays

The Revised Bedrock Work Plan field investigation program is a focused program designed to incorporate an observational approach that will allow field results to be evaluated as each field component is completed With this approach, the investigation of the LHSU can be expedited, while reducing the potential for needing additional phases of field investigation The Revised Bedrock Work Plan will be implemented simultaneously with ongoing alluvial site characterization and risk assessment work in order to complete the Phase II RFI/RI Report in the Spring of 1994, because of the expected condition that contamination in the LHSU is limited in nature and extent It is expected that the results of the Revised Bedrock Work Plan will support that assumption If the assumption is valid, no quantitative assessment of human health risk associated with the LHSU will be performed for the Draft Phase II RFI/RI Report The results of the expedited analysis of indicator parameters for groundwater will be used during the field investigation to evaluate if the expected condition of limited LHSU contamination is met The results of the expedited indicator parameter analyses, as well as available non-validated analytical results for the LHSU analytical parameters, will be included in the data section of the Draft Phase II RFI/RI Report The validated results of analyses of the full LHSU suite will not be available for use in the Draft Phase II RFI/RI Report

If the expected condition is found not to exist, delays in the currently identified schedule for submittal of the Draft and Final Phase II RFI/RI Reports may result To minimize delays, a contingency plan is being developed so that, if the results of the Revised Bedrock Work Plan do not confirm the assumed site conditions, the plan will this plan can be implemented while the field crews are mobilized The contingency plan will be reviewed and approved by EPA/CDH

conclusion will be presented in the RFI/RI Report, and no quantitative analysis of human health risk will be performed for the LHSU pathways shown on Figure 1-32 If the results of the field program fail to support the assumption that the LHSU exposure pathway is incomplete, then a contingency plan will be implemented In that event, additional data may have to be gathered as part of a second LHSU field investigation to support the assessment of human health risk through exposure pathways in the LHSU

1.2.1.4 Objective of Revised Bedrock Work Plan

The objective of the Revised Bedrock Work Plan is to gather data necessary to sufficiently verify the assumption that contamination in the LHSU is limited in nature and extent, and that the permeability of LHSU units is not sufficient for them to act as a complete exposure pathway To accomplish this, it is necessary to

- Evaluate the presence or absence of contamination in LHSU units, and if present, the source, nature, and vertical extent of contaminants in the LHSU For scenario 1, the potential lateral extent of contamination will also be evaluated

- Establish and evaluate the permeability of LHSU units containing contamination to evaluate whether viable migration pathways to human receptors exist, or if the LHSU units have sufficient well production capability to supply an on-site resident

The SAP describes field activities to acquire data for the following purposes

- Evaluate LHSU groundwater quality in areas with the highest potential for LHSU contamination (i e , beneath areas where high levels of contamination are present in the UHSU and where the potential for hydraulic communication between the UHSU and LHSU is greatest)

- Investigate source and vertical extent of contamination in LHSU where contamination has been detected previously (e g , in LHSU sandstone units which subcrop beneath the colluvium)

- Estimate permeability of LHSU units containing contamination to evaluate potential for migration of contaminants within LHSU, or potential for

2 0
SAMPLING AND ANALYSIS PLAN

This section provides a description of the Sampling and Analysis Plan to be implemented for the Revised Bedrock Work Plan field investigation program The purpose of this section of the technical memorandum is to provide a SAP that will address the data needs and describe the work required to fulfill the data quality objectives discussed in Section 1 0

2 1 OBJECTIVES AND APPROACH

The goals of the Revised Bedrock Work Plan field investigation program are to 1) evaluate the presence or absence of contamination in LHSU units, and if present, the source, nature, and vertical extent of contaminants in the LHSU, and 2) estimate the permeability of LHSU units containing contamination to evaluate whether viable migration pathways to human receptors exist As discussed in Section 1 0, this field investigation program is a refinement of the program previously described in the Bedrock Work Plan (EG&G 1991e)

The Revised Bedrock Work Plan field investigation program focuses on gathering data to sufficiently verify the assumption that substantial LHSU contamination associated with potential LHSU exposure pathways does not exist, or that, if present, the permeability of the LHSU units is insufficient for them to act as a complete exposure pathway It is believed that this approach is appropriate because, as discussed in Section 1 2, data collected to date indicate that the potential for migration of contaminants from the UHSU to the LHSU, as well as the potential for migration of contaminants within the LHSU, appears to be limited Additionally, based on the low permeability of LHSU units, it appears that development of an on-site domestic water supply from the LHSU is infeasible In the event that the results of the field investigation program contradict the assumed conditions, provisions of the contingency plan will be implemented, including additional field investigations, if necessary, to characterize the nature and extent of LHSU contamination, and evaluate the potential for human health risk may be required The approach described herein is proposed because it is believed that the potential for human health risk is greatest for the UHSU This approach will allow completion of the RFI/RI in a timely manner so as to address that potential as expediently as possible

The Revised Bedrock Work Plan field investigation program is designed to incorporate an observational approach that will allow the results of the field work to be evaluated as each

locations Prior to drilling, the locations for all boreholes, pilot boreholes, and wells will be geophysically cleared in accordance with SOP GT 10, Borehole Clearing and radiologically surveyed in accordance with SOP FO 16, Field Radiological Measurements

2.3.1 Boreholes SB-1 and SB-2

Two boreholes, SB-1 and SB-2, will be drilled to evaluate the vertical extent of contamination identified in LHSU claystone bedrock samples previously collected in those areas The following paragraphs discuss the drilling and soil/rock sampling procedures to be implemented for the two boreholes Figure 2-8 shows a diagram of a typical borehole

2.3.1 1 Auger Drilling to Install Isolation Casing for Boreholes SB-1 and SB-2

The initial drilling conducted at each location will consist of installing an isolation casing across the UHSU prior to drilling into the underlying LHSU bedrock This casing will isolate the bedrock borehole (to be drilled later) from the UHSU This drilling activity will be performed using hollow-stem auger drilling methods However, if refusal is met using the hollow-stem auger drilling method, then alternative drilling methods capable of performing this drilling activity will be employed The following discussion assumes using the hollow-stem auger drilling method

Drilling will initially proceed through the UHSU with 3 5-inch internal diameter (I D) hollow-stem augers If LHSU claystone is present immediately beneath the UHSU, the auger holes will terminate within the claystone If siltstone or sandstone is present immediately beneath the UHSU, the auger holes will terminate at the base of the UHSU (i e , at the base of the Rocky Flats Alluvium or the No 1 Sandstone) Following completion of drilling with the 3 5-inch I D augers, the borehole will be reamed to a diameter of about 12 inches or greater using hollow-stem augers Hollow-stem drilling and sampling will be performed in accordance with SOP GT 2, Drilling and Sampling Using Hollow-stem Auger Techniques

Following drilling and reaming, an 8-inch I D steel or PVC isolation casing with water tight threaded couplings will be installed to isolate the borehole from the UHSU Following installation of the isolation casing in a borehole, a 3-foot thick bentonite seal will be placed at the bottom of the annulus surrounding the isolation casing to prevent the isolation casing grout seal from intruding into the underlying LHSU unit (Figure 2-8) Following installation of the bentonite seal, the remaining portion of the borehole annulus surrounding the isolation casing will be grouted from the top of the bentonite seal to ground surface to seal the isolation casing

Logging Following geophysical logging, the borehole will be plugged and abandoned in accordance with SOP GT 5, Plugging and Abandonment of Boreholes Because the isolation casing used for the pilot boreholes will be PVC, it will not have to be removed during plugging and abandonment

2.3.2.3 Monitoring Wells

Based on drilling observations and the results of the geophysical logging in the pilot borehole, the LHSU sandstone units of interest will be identified for placement of the a-series and b-series monitoring wells For locations WC-1 and WC-6, the a-series wells unit of interest is expected to be the uppermost sandstone unit in the LHSU bedrock, but may alternatively be a permeable fractured claystone interval if such an interval is present in the LHSU above the first bedrock sandstone unit For location WC-5, the a-series well unit of interest will be the same elevation interval as was screened in Well 2087 This may be a silty claystone or a sandstone For locations WC-2, WC-3, and WC-4, the a-series wells wills be installed in the sandstone units in which contaminants have been detected where the sandstone subcrops beneath the colluvium

The a-series well will be drilled about 15 feet away from the pilot borehole at each location Drilling will be performed using air rotary or hollow-stem auger drilling techniques Air rotary or hollow-stem auger drilling methods will be used to avoid problems associated with drilling mud which can sometimes impact the permeability of the borehole walls and the quality of water samples, and to reduce the amount of waste generated from drilling fluids The well borehole will be advanced to a depth of about 5 feet below the bottom of the interval to be screened Continuous core samples will be collected across the screened interval to verify the lithology of the screened interval

For the b-series wells, the borehole will be advanced using air rotary or hollow-stem auger methods from the top of the LHSU through the LHSU unit being monitored by the a-series well to an elevation a few feet below that unit The borehole will then be reamed to allow installation of a second isolation casing across the unit being monitored by the a-series well (Figure 2-9) A second casing is necessary to ensure that cross-contamination does not occur through the borehole between the a-series well unit and the b-series well LHSU unit Following reaming, a 6-inch I D steel or PVC isolation casing with water-tight joints will be installed in the borehole to seal off the a-series well LHSU unit from the borehole Installation of the isolation casing will be performed in a similar manner as was used for the UHSU isolation casing, and will be in accordance with SOP GT 3, Isolating Bedrock from Alluvium with Grouted

indicator parameters above, as listed in Table 2-6), the constituents listed in Table 2-7 were not selected for use as indicator parameters for the Revised Bedrock Work Plan due to one or more of the following reasons 1) they have not been detected at frequencies greater than 5 percent in source areas or in UHSU groundwater (e g , semi-volatile compounds, certain metals, pesticides, PCBs, radionuclides other than americium, uranium, and plutonium) or, where detected, are believed to be sampling/laboratory artifacts (e g., acetone, bis-2-ethylhexyl-phthalate, 2-butanone, 2-hexanone, methylene chloride, and other phthalates), 2) they are not believed to be present in on-site wastes (e g , chlorides, nitrates); 3) they are generally less mobile than VOCs (e g , certain metals, radionuclides), and 4) they may occur naturally at low concentrations in groundwater systems (e g , certain metals and radionuclides)

The selected VOC indicator parameters listed in Table 2-6 will be analyzed by EPA Method 8260 Groundwater samples to be analyzed for indicator parameters will be submitted for analytical laboratory analysis on a 24-hour turn-around basis so that the analytical results can be used to guide the field investigation work. With the time required for the radiation screen analysis for samples shipped off site, and travel time between the site and laboratory, it is expected that 72 hours will pass between the time of sample shipment and receipt of analytical data

A set of QA/QC samples will also be submitted with the groundwater samples to meet the QA/QC requirements of the project QA/QC requirements and procedures are discussed in Section 3 0

2 7.4.2 LHSU Parameter Analysis Suite

In addition to the indicator parameter samples, a second set of groundwater samples will be collected from each newly-installed LHSU monitoring well This set of samples will be sent to a second analytical laboratory for analysis for a more extensive suite of LHSU analytical parameters (hereafter referred to as the LHSU parameter suite) The purpose of these analyses will be to verify the conclusions drawn based on the results of the indicator parameter analyses and to characterize the full range of contaminants present in a LHSU unit, if contamination is indicated Methodologies for addressing discrepancies between indicator parameter and LHSU parameter results, should they occur, will be discussed in the contingency plan

Table 2-8 lists the LHSU parameter suite selected for the Revised Bedrock Work Plan field investigation program This list is a refinement of the full analytical parameter list used