TABLE OF CONTENTS
FINAL WORK PLAN OPERABLE UNIT 7
PRESENT LANDFILL (IHSS 114) AND INACTIVE HAZARDOUS WASTE STORAGE AREA (IHSS 203)

VOLUME I

Section No	Title	Rev No	Effective Date
	Detailed Table of Contents	0	10/05/94
1 0	Introduction	0	10/05/94
2 0	Site Characterization	0	10/05/94
3 0	Data Quality and Usability	0	10/05/94
4 0	Nature and Extent of Contamination	0	10/05/94
5 0	Data Quality Objectives	0	10/05/94
6 0	Field Sampling Plan	0	10/05/94
	• 94-DMR-ERM-0130 Text Modification to Section 6	0	10/31/94
	• 94-DMR-ERM-0134 IHSS Characterization to Support SVE	0	11/01/94
	• 94-DMR-ERM-0138 Liquid and Soil Characterization-LIMITED SCOPE	0	11/10/94
	• 94-DMR-ERM-0145 Accommodate Non-Producing Wells-LIMITED SCOPE EXPIRES 12/22/94	0	12/13/94
7 0	Quality Assurance and Quality Control	0	10/05/94
8 0	References	0	10/05/94

VOLUME II

APPA	Appendix A Waste Streams to the Present Landfill from 1968 to 1986 (WSIC)	0	10/05/94
APPB	Appendix B Selected As-Built Drawings of Groundwater Intercept System	0	10/05/94
APPC	Appendix C OU7 Phase I Field Investigation	0	10/05/94

ADMIN RECORD

Section No.	Title	Rev No	Effective Date
APPD	Appendix D Cone Penetration Test Profiles and Interpretations	0	10/05/94
APPE	Appendix E Borehole Logs	0	10/05/94
APPF	Appendix F Well Construction Diagrams	0	10/05/94
APPG	Appendix G Phase I RFI/RI Field Data	0	10/05/94
APPH	Appendix H Drawdown Recovery Test Data and Analytical Solutions	0	10/05/94
	VOLUME III		
APPI	Appendix I Water Balance Data	0	10/05/94
APPJ	Appendix J Data-Quality Tables	0	10/05/94
APPK	Appendix K Box Plots	0	10/05/94
	VOLUME IV		
APPL	Appendix L Histograms	0	10/05/94
APPM	Appendix M Results of Statistical Analyses	0	10/05/94
APPN	Appendix N OU7 Analytical Data	0	10/05/94
APPO	Appendix O Time-Series Plots	0	10/05/94
APPP	Appendix P Responses to Comments on the Draft Final Revised Work Plan Technical Memorandum	0	10/05/94

DOCUMENT MODIFICATION REQUEST (DMR)

Refer to 1-A01-PPG-001 for Processing Instructions.
Print or Type All Information (Except Signatures)

1 Date	25 DMR No
10/19/94	94-DMR-ERM-0130

2. Existing Document Number/Revision	3 New Document Number or Document Number if it is to be changed with this Revision
RF/ER-94-00044, Rev 0	NA

4 Originator's Name/Phone/Pager/Location	5 Document Title
Laurie Peterson-Wright/8553/7444/BLDG 080,285	Technical Memorandum Final Work Plan Operable Unit No 7 Present Landfill (IHSS 114) and Inactive Hazardous Waste Storage Area (IHSS 203)

6 Document Type ☐ Procedure ☒ Other Work Plan

7 Document Modification Type (Check only one)
☐ New ☐ Revision ☐ Intent Change ☒ Nonintent Change ☐ Editorial Correction ☐ Cancellation

8 Item	9 Page	10 Step	11 Proposed Modifications
1	2	6 0	Change first sentence to read "Borehole drilling activities, including the technical approach, sampling locations, equipment and procedures, proposed analytical suites, downhole geophysical logging and drum handling and sampling procedures are discussed in Section 6 3 "
2	2	6 1	change ~~third~~ second bullet to read " Determine the flow rate at the leachate seep"
3	6	6 3	Fourth sentence, change "Eight" to"Six"
4	6	6 3	Remove entire second paragraph
5	6	6 3	Third paragraph, remove fourth sentence

12 Justification (Reason for Modification EJO # TP # etc.)

Borehole locations 53294 and 53394 were canceled because locations were not accessible for the drilling rig Wetlands and Preble's Meadow Jumping Mouse issues were also a concern at these locations In addition, the new seep collection design does not require depth to bedrock or thickness of alluvial and weathered bedrock material data The seep flow rate will be measured at SW097 instead of performing drawdown recovery tests in these boreholes The valley-fill alluvium is too thin at location 53094 to allow for a triple-cased construction in accordance with the SOPs (GT 03) Samples will be collected at location 52894 instead of 53094 because the valley-fill alluvium is thicker at this locations and will enable more complete characterization of the valley-fill material in the vadose zone The unweathered bedrock monitoring well (53094) will be geophysically logged in order to identify and optimize well screen placement in the most permeable zone This well will be used as one of the RCRA compliance wells for the next 30 years Verbal guidance was received from Kurt Muenchow (DOE) in October 1994 requiring these necessary changes

If modification is for a new procedure or a revision list concurring disciplines in Block 13 and enter N/A in Blocks 14 and 15 If modification is for any type of change or a cancellation organizations are listed in Block 13 then Concurror prints and signs in Block 14 and dates in Block 15

13 Organization	14 Print Sign (if applicable)	15 Date (if applicable
EQS		10 25 94
3120	Mark R. Wood / Mark R. Wood	10/24/94

16 Originator's Supervisor (print/sign/date) Ed Mast 10/24/94

17 Assigned SME/Phone/Pager/Location	18 Cost Center	19 Charge Number	20 Requested Completion Date	21 Effective Date
Laurie J Peterson-Wright X8553, ~~7444~~ Bldg 80	3119	989035-00	10/20/94	10 31 94 lar

22 Accelerated Review? Yes ☒ No ☐ | 23 ORC Review N/A

24 Responsible Manager (print/sign/date) Ed Mast 10/24/94

RF 47940 (5/93)

REVIEWED FOR CLASSIFICATION / UCNI
BY _____
DATE _____

DMR (continuation sheet)

Refer to 1-A01-PPG-001 for Processing Instructions
Print or Type All Information (Except Signatures)

25 DMR No. 94-DMR-ERM-0130

2. or 3 Document Number/Revision	5 Document Title
RF/ER-94-00044, Rev 0	Technical Memorandum Final Work Plan Operable Unit No 7 Present Landfill (IHSS 114) and Inactive Hazardous Waste Storage Area (IHSS 203)

8. Item	9 Page	10 Step	11 Proposed Modifications
6	7	6 3 1	Fourth paragraph, first sentence, change "triple-cased" to "double-cased"
7	7	6 3 1	Fourth paragraph, second sentence, change "triple-cased" to "double-cased"
8	8	6 3 1	Remove "a 12 inch diameter schedule 80 PVC casing to seal off the valley fill alluvium"
9	8	6 3 1	Insert "valley-fill alluvium and" before "weathered bedrock The borehole "
10	8	6 3 1	Third paragraph, delete "dissolved oxygen"
11	8	6 3 2	First paragraph, first sentence, change "53094" to "52894"
12	11	6 3 7	After section 6 3 7 add "Section 6 3 8 Downhole Geophysical Logging, Downhole geophysical logging will be performed in the borehole at location 53094 before installing the unweathered bedrock monitoring well to identify and optimize well screen placement in the most permeable zone The borehole will be logged with the following logging techniques neutron, natural gamma, gamma-gamma, density, induction, caliper, guard resistivity, and single point resistivity (the last two methods only if sufficient groundwater is encountered in the bedrock) The geophysical surveys will be performed in accordance with Geotechnical SOP GT 15 " Geophysical Borehole Logging" "
13	14	6 4 3	First paragraph, second sentence, remove "and in open boreholes near the leachate seep (53294and 53394)
14	16	6 4 4	Paragraph three, first and third sentences, remove "dissolved oxygen,"
15	18	6 5	Add "The flow rates at the leachate seep (SW097) will be measured using a Parshall flume, or equivalent, in accordance with surface water SOP SW 04, "Discharge Measurement" (EG&G 1992) "

6 FIELD SAMPLING PLAN

Prior to completion of the Phase I RFI/RI and initiation of Phase II, the focus of investigations at OU 7 changed due to the adoption of a presumptive-remedy strategy for streamlined site characterization and site remediation Source containment is the designated presumptive remedy for municipal landfills and consists of the following elements institutional controls, a landfill cap, landfill gas control and treatment, if necessary, source area groundwater control, and leachate collection and treatment. The containment elements will be constructed as two separate remedial actions one for collection of leachate at the seep above the East Landfill Pond and the other for closure of the landfill

The objective of the leachate collection remedial action is to stop discharge of leachate (FO39 listed waste) to the pond and limit downgradient migration of leachate from the source area Leachate will be collected by a French drain installed downgradient of the seep and pumped to onsite storage tanks Leachate will be trucked to the sitewide OU 1/OU 2 facility for treatment The leachate collection system design will be consistent with the presumptive remedy for final landfill closure

The objective of the landfill closure remedial action is to contain waste, prevent leachate formation, control landfill gas, and collect and treat groundwater, if necessary Components of the remedial action include a multiple-layer landfill cover that will extend to the East Landfill Pond dam or to the outer edge of the contaminant plume, a slurry wall or groundwater intercept system constructed under the footprint of the cover, and a groundwater collection system downgradient of the dam

Data for the design of the presumptive remedy and an assessment of the nature and extent of groundwater contamination downgradient of the landfill will be collected under this FSP Site-specific objectives of additional data collection activities are presented in Section 6 1 Surface soil sampling activities, including the technical approach, sampling locations, sampling activities, equipment and procedures, and proposed analytical suites are discussed in

Section 6 2. Borehole drilling activities, including the technical approach, sampling locations, field methods, equipment and procedures, proposed analytical suites, and drum handling and sampling procedures are discussed in Section 6 3 Groundwater monitoring activities, including the technical approach, sampling locations, field methods, equipment and procedures, monitoring well installation, well development, well testing, groundwater sampling, and proposed analytical suites are presented in Section 6 4 Additional field activities to support the design of the landfill cap are discussed in Section 6 5

6 1 Objectives

Presumptive remedies dictate remedial actions at IHSS 114, IHSS 203, IHSS 167 2, and IHSS 167 3 Additional sampling and characterization of PCOCs in the environmental media within these IHSSs will not affect the decision to remediate Therefore, further characterization of media within IHSS 114, IHSS 203, IHSS 167 2, and IHSS 167 3 is not an objective of the Phase II investigation

As discussed in Section 5, surface soils below the East Landfill Pond dam and groundwater downgradient of the landfill have not been adequately characterized to support decisions concerning remedial actions Areas where the proposed leachate collection system, proposed leachate storage tanks, potential slurry wall or groundwater intercept system, and potential downgradient groundwater collection system will be located have not been adequately characterized for the purpose of remedial design Decisions regarding the necessity of remediation and options for remedial design require data from additional samples

The specific objectives of the Phase II field investigation are as follows

- Characterize the spatial extent of contamination in surface soils at locations below the East Landfill Pond dam where analyte concentrations or activities exceed draft PRGs
- Determine the flow rate at the leachate seep
- Determine the depth to bedrock, physical properties, and the load-bearing capability of the foundation materials at the proposed storage tank location

- Determine the depth to bedrock, and thickness of the alluvium along the location of the potential slurry wall or groundwater intercept system
- Determine the depth to bedrock and the thickness of the weathered zone on the slopes below the East Landfill Pond dam
- Characterize the valley-fill alluvium in No Name Gulch
- Further delineate the extent of groundwater contamination in the UHSU along No Name Gulch
- Determine the presence or absence of contamination in LHSU groundwater in No Name Gulch
- Determine the hydraulic conductivity of the alluvium, weathered bedrock, and bedrock in No Name Gulch
- Measure landfill gas emission rates

The monitoring well installation and groundwater sampling is designed to fulfill data needs identified during the DQO process However, if the results of the groundwater sampling do not fully delineate the extent of groundwater contamination in the UHSU and LHSU along No Name Gulch for the purpose of remedial design, additional work will be proposed in an addendum to the Phase II FSP

6 2 Surface Soil Sampling

Statistical comparison of surface soil data to background data identified only three PCOCs in soils around the East Landfill Pond However numerous additional PCOCs were identified on the basis of UTL exceedances Concentrations in excess of UTLs were generally two to three times greater than the maximum concentration of the analyte in background To support presumptive remediation, surface soil samples will be collected in the area below the East Landfill Pond dam Additional surface soil sampling is warranted at "hotspot" locations where analyte concentrations or activities exceeded draft PRGs to delineate the area of soil contamination around each hotspot The number and locations of additional samples needed

to characterize the spatial extent of contamination in surface soils were determined quantitatively and qualitatively by an analysis of PRG exceedances (Section 5 4 7)

Samples will be collected systematically on a grid around the original sample location Systematic sampling grids are the method of choice for estimating trends or patterns of contamination over space (Gilbert 1987) and were used in the Phase I field investigation Samples will be collected from the 0- to 2-inch horizon at three locations where analyte activities exceeded PRGs (Figure 6-1) Four samples will be collected to determine the spatial distribution of contamination around the original sample location At each of the three locations, the samples will be collected at a distance of 25 feet from the original sample location A total of 12 samples will be collected

Samples will be collected from the 0- to 10-inch horizon at one location where analyte activities exceeded PRGs (Figure 6-2) Samples will be collected to determine the spatial distribution of contaminants Four samples will be collected per location as previously described

6 2 1 *Surveying and Screening*

Original Phase I surface soil sampling locations will be re-staked using coordinates from the Phase I investigation Surveying will be performed in accordance with Geotechnical SOP GT 17, Land Surveying (EG&G 1992c) Phase II locations will be staked using a tape and compass Proposed locations are 25 feet north, south, east, and west of the Phase I location (Figure 6-1)

Radiation field screening will be performed at each soil sampling location in accordance with procedures in Field Operations SOP FO 16, Field Radiological Measurements (EG&G 1992c) The prework radiation survey will be performed on a 17-point grid, centered on staked locations, using a Bicron Analyst FIDLER

6 2 2 *Sampling*

Soils will be described in the field in accordance with Geotechnical SOP GT 01, Logging Alluvial and Bedrock Material (EG&G 1992c)

Soil samples from the 0- to 2-inch horizon will be collected using the grab method, outlined in Geotechnical SOP GT 08, Surface Soil Sampling (EG&G 1992c), to be consistent with Phase I sampling methods Grab samples will be collected from a depth of 0 to 2 inches using a stainless-steel scoop To collect enough material for all analyses, four scoops of soil (subsamples) will be obtained from each grid location, north, south, east, and west of the location stake The subsamples will be combined in a stainless-steel bowl, homogenized, split, and then placed into individual sample jars Duplicate and equipment rinse QC samples will be collected in accordance with the QC sampling frequency guidelines in Section 7 1 Each soil sample will be assigned a unique sample number All sampling equipment will be decontaminated between locations in accordance with Field Operations SOP FO 03, General Equipment Decontamination (EG&G 1992c)

Soil samples from the 0- to 10-inch horizon will be collected using the hand auger method outlined in Geotechnical SOP GT 08, Surface Soil Sampling (EG&G 1992c) Vegetation will be removed from the sampling location with a decontaminated shovel The thin layer of soil that contacts the shovel will then be removed with a stainless-steel scoop A hand auger will be used to collect the sample to a depth of 10 inches The soil will be combined in a stainless-steel bowl, homogenized, split, and placed into individual sample jars Duplicate and equipment rinse QC samples will be collected in accordance with the QC sampling frequency guidelines in Section 7 1 Each soil sample will be assigned a unique sample number All sampling equipment will be decontaminated between locations in accordance with Field Operations SOP FO 03, General Equipment Decontamination (EG&G 1992c)

6 2 3 *Analytical Requirements for Soil Samples*

Soil samples collected below the East Landfill Pond dam will be analyzed for metals (standard and additional), gross alpha, gross beta, plutonium-239,240, americium-241, uranium-233,234, uranium-235, uranium-238, cesium-137, strontium-89,90, TOC, and nitrate/nitrite (Table 6-1) This analyte list is the same as that used for surface soil samples collected around the East Landfill Pond during the OU 7 Phase I RFI/RI Samples will be containerized, preserved, handled, and shipped in accordance with QA/QC requirements specified in Section 7 of this report and Field Operations SOP FO 13, Containerization Preserving Handling, and Shipping of Soil and Water Samples (EG&G 1992c) Sample analyses will be performed using EPA CLP and other standard methods as specified in the GRRASP (EG&G 1991g)

6 3 Borehole Drilling and Sampling

Four boreholes will be drilled for the purpose of installing groundwater monitoring wells (Figure 6-3) Three of these will be for a cluster well location in No Name Gulch (52894, 52994, and 53094) and will include an alluvial, weathered bedrock, and bedrock borehole The other is for an alluvial well farther downstream in No Name Gulch (53194) Six additional boreholes will be drilled to gather information for remedial design (Figure 6-3) If bedrock sandstones are encountered in a borehole during drilling, a drawdown recovery test will be performed in the open borehole

~~Two boreholes (53294 and 53394) will be drilled at and north of the leachate seep (SW097) to determine the depth to bedrock and thickness of alluvial and weathered bedrock material for use in the leachate collection system design Estimated depth of these boreholes is 20 feet Drawdown recovery tests will be performed in the open boreholes to estimate hydraulic conductivity values and calculate leachate flow rates Drawdown recovery tests will be conducted in two phases in an isolated alluvium test interval, and in weathered bedrock No samples will be collected at these locations~

One borehole (53694) will be drilled at the proposed leachate storage tank location to determine the depth to bedrock and thickness of the alluvial and weathered bedrock material for use in design of the foundation for the storage tanks The borehole will be drilled to an estimated depth of 30 feet Samples of the alluvial material will be collected for geotechnical testing ~~The load-bearing capability of the material will be tested in the field using American Society of Testing and Materials (ASTM) D1194~~ No analytical samples will be collected

Three boreholes (52794, 53494, and 53594) will be drilled around the landfill to determine the depth to bedrock and thickness of the weathered zone along the probable alignment of the slurry wall or groundwater intercept system for use in landfill closure design Estimated depth of these boreholes is 40 feet Samples will be collected for permeability testing at these locations to support design of the presumptive remedy Drawdown recovery tests will only be performed if bedrock sandstones are encountered

Two boreholes (52694 and 53794) will be drilled to determine the depth to bedrock and thickness of the weathered zone on the slopes below the dam These data will support design

of the possible downgradient groundwater collection system The boreholes will be drilled to estimated depths of 30 feet. No samples will be collected at these boreholes Drawdown recovery tests will be performed if bedrock sandstones are encountered

6 3 1 Borehole Drilling Methods

Prior to invasive activities, Geotechnical SOP GT 24 requirements will be reviewed and followed to acquire soil-disturbance approval from Rocky Flats Construction Management Drilling locations will be staked and cleared in accordance with Geotechnical SOP GT 10, Borehole Clearing (EG&G 1992c) Radiation field screening will be performed at each drilling location on a 17-point grid using a Bicron Analyst FIDLER, in accordance with procedures in Field Operations SOP FO 16, Field Radiological Measurements (EG&G 1992c)

Locations will be drilled using hollow-stem augers equipped for continuous core sampling in accordance with Geotechnical SOP GT 01, Logging Alluvial and Bedrock Material, and GT 02, Drilling and Sampling Using Hollow Stem Auger Techniques (EG&G 1992c) Continuous core samples will be collected from all locations using a 3-inch inside diameter, 2-foot-long sample barrel A moss system will be used to retrieve the core after each run while leaving the augers in place Borehole drilling and sampling will be accomplished using 3 1/4-inch inside diameter hollow-stem augers Boreholes will be reamed with 6 1/4-inch inside diameter hollow-stem augers to allow for well installation in accordance with Geotechnical SOP GT 06, Monitoring Well and Piezometer Installation (EG&G 1992c)

For boreholes drilled into bedrock, 6-inch PVC surface casing will be installed to isolate surficial materials from bedrock, in accordance with Geotechnical SOP GT 03, Isolating Bedrock from Alluvium with Grouted Surface Casing (EG&G 1992c) Drilling and sampling will continue using hollow-stem augers until sample collection activities are completed or poor recovery becomes a problem At that point, rotary coring methods will be used in accordance with Geotechnical SOP GT 04, Rotary Drilling and Rock Coring (EG&G 1992c) Potable Rocky Flats water will be used as a drilling medium A continuous core will be obtained using 1 3/4-inch inside diameter, 5-foot-long core tubes, placed within and retrieved from the lead rod with an overshot system

The borehole for the unweathered bedrock well (53094) at the cluster well location will require double-cased construction to isolate the screen from the upper units Double-cased construction

will be performed in accordance with Geotechnical SOP GT 03, Isolating Bedrock from Alluvium with Grouted Surface Casing (EG&G 1992c), which will require ~~a 12-inch diameter schedule 80 PVC casing to seal off the valley-fill alluvium and~~ an 8-inch diameter schedule 80 PVC casing to seal off the zone of valley-fill alluvium and weathered bedrock The borehole will be advanced as described above for weathered bedrock, initially using hollow-stem auger drilling techniques and then using rotary drilling techniques when drilling becomes impractical or meets refusal The unweathered bedrock borehole will then be converted to a monitoring well as described in Section 6 4

Preliminary core descriptions will be completed in the field, and all core not used for chemical sampling will be boxed at the site Wooden blocks will be labeled and placed in the core boxes to mark the beginning and end depth for each box, indicate the beginning of each drilling interval, and represent sections of no recovery or sections used for chemical samples After the core is brought to the field trailer, it will be described in detail in accordance with Geotechnical SOP GT 01, Logging Alluvial and Bedrock Material (EG&G 1992c)

At each borehole location, measurements will be made of depth to groundwater, pH, dissolved oxygen, and specific conductance in accordance with procedures outlined in Groundwater SOP GW 01, Water Level Measurements in Wells and Piezometers, and GW 05, Field Measurements of Groundwater Field Parameters (EG&G 1992c) Permanent wells will then be installed at the designated locations based on data collected during drilling as described in Section 6 4 Boreholes not used for well installation will be abandoned in accordance with Geotechnical SOP GT 05, Plugging and Abandonment of Boreholes (EG&G 1992c) All downhole drilling equipment will be decontaminated at the main decontamination facility before being used at each new drilling location The drill rig will be decontaminated in accordance with procedures outlined in Field Operations SOP FO 04, Heavy Equipment Decontamination (EG&G 1992c)

6 3 2 Borehole Sampling

Continuous borehole samples will be collected at location 52894 in accordance with Geotechnical SOP GT 02, Drilling and Sampling Using Hollow-Stem Auger Techniques (EG&G 1992c) Two types of samples will be collected 3-inch-long discrete samples collected in stainless-steel sleeves for VOC analyses and 2-foot composite samples collected from 2-foot

core barrels for other chemical analyses Samples will be collected in the unsaturated zone from the surface to the water table

After the core barrel is opened, the core will be measured The stainless-steel sleeve will be removed from the barrel, the exposed ends will be capped with sheets of Teflon® The core will be peeled to remove any surficial material smeared onto the outside of the core Core material will then be placed into a stainless-steel bowl, homogenized, mixed, split, and placed into individual sample containers Duplicate and equipment rinse QC samples will be collected in accordance with the QC sampling frequency guidelines in Section 7 1 Each soil sample will be assigned a unique sample number All sampling equipment will be decontaminated between locations in accordance with Field Operations SOP FO 03, General Equipment Decontamination (EG&G 1992c)

Samples for geotechnical testing will be collected at borehole location 53694 at the proposed leachate storage tank location Samples will be collected from 5-foot core barrels at 2½-foot intervals from the surface down to a depth of 5 feet Geotechnical tests include Atterberg limits, modified proctor density, one-dimensional swelling pressure, moisture density, soil classification, and California bearing ratio (Table 6-2)

Bulk samples will be collected at borehole locations 52794, 53394, and 53594 along the probable slurry wall alignment These samples will be used for permeability testing of the slurry wall mix design (percentage of bentonite slurry and site-specific soils versus permeability) to support design of the presumptive remedy

6 3 3 *Analytical Requirements for Borehole Samples*

Borehole samples will be analyzed for VOCs, SVOCs, PCBs, metals (standard and additional), gross alpha, gross beta, plutonium-239 240, americium-241, uranium-233,234, uranium-235, uranium-238, cesium-137, strontium-89 90, TOC, pH, nitrate/nitrite, and sulfide (Table 6-3) This analyte list is the same as that used for borehole samples collected during the Phase I RFI/RI for OU 7 Samples will be containerized, preserved, handled, and shipped in accordance with QA/QC requirements specified in Section 7 of this report and Field Operations SOP FO 13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples

(EG&G 1992c) Sample analyses will be performed using EPA CLP and other standard methods as specified in the GRRASP (EG&G 1991g)

6 3 4 Drum Handling

Drill cuttings from all locations will be placed in 30-gallon drums in accordance with Field Operations SOPs FO 08, Handling of Drilling Fluids and Cuttings, and FO 10, Receiving, Labeling, and Handling Environmental Materials (EG&G 1992c) Characterization of the investigative-derived materials (IDM) contained in the drums will be based on analytical results of the borehole samples corresponding to the drill cuttings interval in the drums Drum handling will be conducted in accordance with Field Operations SOP FO 23, Management of Soil and Sediment Investigative Derived Materials (EG&G 1994f)

6 3 5 Drum Sampling

If verified field screening results are below background as defined in Field Operations SOP FO 08, Handling of Drilling Fluids and Cuttings, and FO 16 Field Radiological Measurements (EG&G 1992c), residual soil or sediment will be disposed as clean fill onsite (if cuttings are from boreholes with less than 20 feet of bedrock) in accordance with Field Operations SOP FO 23, Management of Soil and Sediment Investigative Derived Materials (EG&G 1994f) These materials will be dispersed and leveled within the disturbed area and reseeded following guidance from the Rocky Flats Ecology Department Bedrock cuttings, if any, will be covered with alluvial materials For cuttings from boreholes with more than 20 feet of bedrock, residual soil or sediment will be disposed in the landfill in accordance with Field Operations SOP FO 23, Management of Soil and Sediment Investigative Derived Materials (EG&G 1994f) Cuttings containerized in drums will be taken to the landfill by Rocky Flats Trucking for disposal

If verified field screening results are above background as defined in Field Operations SOP FO 08, Handling of Drilling Fluids and Cuttings, and FO 16, Field Radiological Measurements (EG&G 1992c), residual soil or sediment will be drummed at the drilling location in accordance with Field Operations SOP FO 08, labeled in accordance with Field Operations SOP FO 10, Receiving, Labeling, and Handling Environmental Materials Containers (EG&G 1992c), and analyzed for appropriate constituents as discussed below Results of this analysis will be used to characterize the drums

6 3 6 Analytical Requirements for Drum Samples

If field screening results are above background, drum samples will be analyzed for VOCs, SVOCs, PCBs, metals (standard and additional), gross alpha, gross beta, plutonium-239,240, americium-241, uranium-233,234, uranium-235, uranium-238, cesium-137, strontium-89,90, TOC, pH, nitrate/nitrite, and sulfide (Table 6-4) This analyte list is the same as that used for borehole samples collected during the Phase I RFI/RI for OU 7 Samples will be containerized, preserved, handled, and shipped in accordance with QA/QC requirements specified in Section 7 of this report and Field Operations SOP FO 13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples (EG&G 1992c) Sample analyses will be performed using EPA CLP and other standard methods as specified in GRRASP (EG&G 1991g)

6 3 7 Surveying

After boreholes are plugged and abandoned, all locations will be surveyed in accordance with Geotechnical SOP GT 17, Land Surveying (EG&G 1992c)

6 3 8 Downhole Geophysical Logging

Downhole geophysical logging will be performed in the borehole at location 53904 before installing the unweathered bedrock monitoring well to identify and optimize well screen placement in the most permeable zone The borehole will be logged with the following logging techniques neutron, natural gamma, gamma-gamma, density, induction, caliper, guard resistivity, and single point resistivity (the last two methods only if sufficient groundwater is encountered in the bedrock) The geophysical surveys will be performed in accordance with Geotechnical SOP GT 15 "Geophysical Borehole Logging "

6 4 Monitoring Well Installation, Well Testing, and Groundwater Sampling

The Phase I investigation identified contamination of groundwater in the UHSU Additional wells are now needed to delineate contaminant plumes thought to be present along No Name Gulch The number and locations of additional wells needed to further delineate contamination in UHSU groundwater were determined qualitatively by an analysis of plume maps and contaminant transport pathways (Section 5 5 7)

PCOCs were also identified in groundwater from the LHSU, but the extent of groundwater contamination appears limited Professional judgment was used to assess whether (1) PCOCs are the result of natural variability in geologic materials, (2) the detections of VOCs are valid, and (3) the occurrence of PCOCs in the LHSU make geochemical sense on the basis of fate and transport characteristics Characterization of contamination in the LHSU directly beneath IHSS 114 will not be performed due to the potential problems associated with drilling through the landfill and the potential for enhancing vertical migration of contaminants during drilling A preliminary characterization of the vertical extent of contamination in the LHSU was performed only at the compliance boundary located just east of the landfill dam using existing data Additional characterization of LHSU groundwater farther east in No Name Gulch is warranted

Four additional wells are proposed to meet the following two objectives delineate contaminant plumes in UHSU groundwater and determine the presence or absence of groundwater contamination in the LHSU

A cluster of three wells is proposed to further delineate contaminant plumes in UHSU groundwater, determine the presence or absence of contamination in LHSU groundwater in No Name Gulch, and meet groundwater-monitoring requirements for post-closure care of the Present Landfill The proposed well locations (Figure 6-3) are approximately 300 feet downgradient of the compliance wells, west of the confluence of No Name Gulch with the intermittent stream draining IHSS 167 1 One well (52894) will be screened in valley-fill alluvium with the screened interval at an estimated depth of 5 to 10 feet below ground surface The second well (52994) will be screened in weathered bedrock with the screened interval at an estimated depth of 15 to 25 feet below ground surface The third well (53094) will be screened in the first unweathered bedrock sandstone encountered with the screened interval at an estimated depth of 40 to 50 feet below ground surface

One monitoring well (53194) is also proposed 700 feet east of the confluence of No Name Gulch and the tributary to the north that drains IHSS 167 1 and 450 feet east of well 4287 (Figure 6-3) The well will be installed in valley-fill alluvium with the screened interval at a depth of approximately 5 to 10 feet

6 4 1 *Monitoring Well Installation*

A total of four monitoring wells will be installed at two locations (Figure 6-3) in accordance with Geotechnical SOP GT 06, Monitoring Well and Piezometer Installation (EG&G 1992c) Monitoring well permits for the State of Colorado, Division of Water Resources, will be prepared and forwarded to DOE to notify the state

After the borehole or well is drilled to total depth, water and fine-grained sediment will be bailed using a sand bailer until the water is relatively clear The well assembly, comprised of a 2-foot sump, 2-inch diameter 0 01-inch slotted screen, and 2-inch diameter blank casing, will then be placed in the borehole A minimum 2-foot bentonite pellet seal will be installed immediately above the filter pack Bentonite grout backfill will be placed from the top of the bentonite seal to the ground surface In open-hole installations, stainless-steel centralizers will be placed above

and below the well screen to ensure that a 2-inch annulus is maintained. For open-hole installations, filter pack will be added through a tremie pipe to at least 6 inches above the top of the screen

After the bentonite grout is allowed to settle for 24 to 72 hours, a 5-foot-long, 6-inch diameter protective steel casing with a locking steel cap will be installed over the monitoring well riser Protrusion of the riser will be a minimum of 2 feet. The protective casing will be embedded 2 to 3 feet below ground surface in concrete or grout. The annulus between the well riser and the protective casing will be filled with concrete, and an external concrete pad approximately 3-feet square will be built around the protective casing at the ground surface The well designation will be inscribed in the concrete before it sets and welded to the protective casing

Alluvial wells will be installed with the base of the screen at the contact between alluvium and weathered bedrock Weathered bedrock wells will be installed in accordance with Geotechnical SOP GT 03, Isolating Bedrock from Alluvium with Grouted Surface Casing, with the base of the screen at the contact between weathered bedrock and unweathered bedrock The bentonite seal will be across the contact between the alluvium and the weathered bedrock to isolate the screen and filter pack from alluvial groundwater Bedrock wells will be constructed similarly, except that the bedrock will be isolated from alluvial and weathered bedrock materials with grouted surface casings installed in accordance with Geotechnical SOP GT 03 (EG&G 1992c) Stainless-steel centralizers will be placed on the casing 3 to 5 feet below ground surface and 3 to 5 feet from the base of the casing to ensure a minimum 2-inch annular space Surface casing is installed using a cement-grout mixture that is forced down and out through pre-drilled ports at the base of the casing into the annulus by pushing a plug down through the casing The annulus will be topped off with cement grout, if necessary, and the cement grout will be allowed to harden for a minimum of 24 hours before the next drilling phase begins After reaching total depth, bedrock wells will be installed in an open borehole using the procedure described above

6 4 2 *Well Development*

Monitoring wells will be developed to remove drilling fluids and particulates from the groundwater and provide physically and chemically representative groundwater samples Well development will be performed in accordance with Groundwater SOP GW 02, Well

Development (EG&G 1992c) Equipment will be decontaminated before and after each use in accordance with Field Operations SOP FO 03, General Equipment Decontamination (EG&G 1992c) Before developing the well, water level and total depth measurements will be taken to determine the volume of water in the well casing The volume of water to be purged from the well will be calculated according to guidelines in Groundwater SOP GW 02, Well Development (EG&G 1992c) The purge amount is generally five well casing volumes During development, water is withdrawn from the wells using a bailer or an inertial pump The purge water will be emptied into a graduated bucket to measure the amount of water removed and transferred to a holding tank for proper disposal The purge and decontamination water will be handled in accordance with Field Operations SOP FO 07, Handling of Decontamination and Wash Water (EG&G 1992c)

Field parameters, including pH, temperature, specific conductance, and turbidity will be measured at regular intervals at least once for each well casing volume following the procedures outlined in Groundwater SOP GW 05, Field Measurement of Groundwater Field Parameters (EG&G 1992c) A well is considered fully developed after a minimum of five casing volumes of water are removed, field parameter measurements range within 10 percent for three consecutive well casing volumes, and the purged water is free of suspended sediment

6 4 3 Drawdown Recovery Testing

Drawdown recovery tests will be performed at all of the recently installed wells to estimate the hydraulic conductivity of saturated geologic materials, including colluvium, valley-fill alluvium, weathered Arapahoe and Laramie Formation, and the uppermost unweathered sandstone in the Arapahoe and Laramie Formation Drawdown recovery tests will also be performed at well 0786 ~~and in open boreholes near the leachate seep (53294 and 53394)~~ Based on results during the Phase I investigation, the drawdown recovery test method, which involves purging a volume of water from the well to lower the water level by approximately 2 to 6 feet, is considered more appropriate than using the slug injection test method Tests will be performed after the wells are developed and the static water level has stabilized

The drawdown recovery tests will be performed in accordance with Groundwater SOP GW 04, Slug Tests (EG&G 1992c) After removing the well cap and monitoring the well for health and safety purposes, the static water level at the well will be measured and verified using a

weighted tape measure Water level and total depth measurements will be recorded and compared to previous measurements to confirm water level stabilization When the water level has stabilized, the test will be conducted

A Hermit® SE 1000 data logger will be coupled to a transducer that has a sensitivity of 10 pounds per square inch and is capable of measuring hydraulic head to an accuracy of approximately three thousandths of a foot. The data logger will be programmed to record change in hydraulic head (in feet) above the transducer at a logarithmic rate All transducer specifications provided by the manufacturer, including serial number, linearity, scale, and offset will be programmed into the data logger The transducer will be lowered into the well to a depth at which it will not be disturbed by a bailer Then the transducer cable will be secured to the well casing with tape to maintain the appropriate depth of the probe To ensure that the transducer and logger are working properly, the transducer cable will be raised and lowered in the well while the change in hydraulic head is observed on the data logger visual read-out screen After the visual check has been completed, the water level will be allowed to stabilize, and the test will be referenced to zero

After the test is set up, a 3-foot-long by 1 5-inch bailer will be lowered down the well Water will be purged from the well until an appropriate drawdown is achieved The test will be started immediately after the last bailer of water is removed from the well The water purged from the well will be containerized and disposed in accordance with Field Operations SOP FO 05, Handling of Purge and Development Water (EG&G 1992c) Purge rates, volumes of water removed, test-start times, and initial drawdowns will be recorded

The duration of each test will be dependent on the drawdown recovery rate or the rate at which the drawdown approaches zero The test will be considered completed when the water level recovers to 90 percent of the drawdown depth The drawdown and percent recovery will be checked by scanning the measurements recorded in the data logger When water levels have recovered the test will be terminated Before and after each test all down-hole equipment will be decontaminated following procedures in Field Operations SOP FO 03, General Equipment Decontamination (EG&G 1992c)

After the data logger reaches storage capacity, the data collected will be downloaded into a computer The time versus drawdown data will be imported into AQTESOLV (Geraghty and

Miller 1991) to compute the estimated hydraulic properties using the appropriate analytical solutions.

6 4 4 Groundwater Sampling

Groundwater samples will be collected from the four new wells installed during the Phase II investigation to characterize groundwater quality downgradient of existing contaminant plumes Four samples will be collected at each location Frequency of sample collection will be monthly Duplicate, equipment rinse, and trip blank QC samples will be collected in accordance with the QC sampling frequency guidelines in Section 7 1 MS, MSD, and laboratory replicate QC samples will be collected in accordance with Groundwater SOP GW 06, Groundwater Sampling (EG&G 1992c) One sample of distilled water will be collected and analyzed to determine if any of the contaminants in groundwater samples are from the decontamination water

Groundwater samples will be collected in accordance with Groundwater SOPs GW 06, Groundwater Sampling, and GW 01, Water Level Measurements in Wells and Piezometers (EG&G 1992c) Water level and total depth measurements will be taken to determine the volume of water in the well casing These data will be taken to determine the volume of water in the well casing, and appropriate purge volumes Standing water will be purged from the well with a bailer The equivalent of three well casing volumes will be purged to guarantee that the sample is representative of the groundwater in the formation

Field parameters, including conductivity, pH, temperature, ~~dissolved oxygen,~~ and turbidity will be measured from an aliquot of the first bailer of water in accordance with Groundwater SOP GW 05, Field Measurement of Groundwater Field Parameters (EG&G 1992c) Conductivity, pH, and temperature will be measured for every half-casing volume of water removed from the well Turbidity and ~~dissolved oxygen~~ will be measured a second time during well purging Well purging will be considered complete when three casing volumes have been purged and the field parameter measurements have been stabilized Purge and decontamination water will be handled in accordance with Field Operations SOP FO 07, Handling of Decontamination and Wash Water (EG&G 1992c)

After completion of well purging, groundwater samples will be collected using a bailer VOC samples will be collected from the first bailer of water The remaining unfiltered samples will be

transferred directly from the bailer to the appropriate sample containers using a bottom-emptying device Samples for dissolved analyses will be transferred to a stainless-steel bucket and filtered using a peristaltic pump with a disposable 0 45-micron filter Groundwater samples from each well will be assigned a unique sample number All sampling equipment will be decontaminated between locations in accordance with Field Operations SOP FO 03, General Equipment Decontamination (EG&G 1992c)

6 4 5 Analytical Requirements for Groundwater Samples

Groundwater samples will be analyzed for VOCs, SVOCs, dissolved and total metals (standard and additional), water-quality parameters (Cl, F, SO_4, CO_3, HCO_3, TDS, TSS), dissolved gross alpha, dissolved gross beta, dissolved and total plutonium-239,240, dissolved and total americium-241, dissolved uranium-233,234, dissolved uranium-235, dissolved uranium-238, dissolved strontium-89,90, dissolved cesium-137, tritium, nitrate/nitrite, cyanide, and sulfide (Table 6-5) This analyte list is the same as that used for groundwater samples collected during the Phase I RFI/RI for OU 7 Samples will be containerized, preserved, handled and shipped in accordance with QA/QC requirements specified in Section 7 of this report and Field Operations SOP FO 13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples (EG&G 1992c) Sample analyses will be performed using EPA CLP and other standard methods as specified in the GRRASP (EG&G 1991g)

6 4 6 Surveying

After groundwater monitoring wells are installed, all locations will be surveyed in accordance with Geotechnical SOP GT 17 Land Surveying (EG&G 1992c)

6 5 Additional Activities for Remedial Design

Additional data needed to support design of the presumptive remedy for closure of the landfill were determined qualitatively using a standard engineering approach and include a topographic map, location of existing utilities, location and soil characteristics of potential borrow areas and landfill gas emission rates (Section 5 6)

A topographic map will be prepared using survey data The map will show the locations of property features, topographic contours, spot elevations, and areas that have recently been graded or mounded Plans for future mounding of waste will be modeled to determine final

configuration of the landfill Location of utilities aboveground or underground that may interfere with construction will be identified In addition, the nearest service locations for electricity, water, and communication lines will be identified for construction and operations of the remedial system Location and soil characteristics of potential borrow areas for clay, sand and gravel, and topsoil will be obtained from existing sources or measured in the field, if necessary These activities will be integrated with Rocky Flats Waste Operations activities and other applicable Rocky Flats projects Data may be collected during the preparation of the landfill closure IM/IRA decision document or during the Phase II investigation, if necessary

Gas emission rates will be measured during the Phase II field investigation A hand-held vane or hot-wire anemometer flow measuring device will be used to measure gas flow rates in each of the five gas-venting wells Either of these instruments is capable of detecting very low flow rates typical of gas well discharges A temporary modification will be made to each well outlet to extend the pipe 1 to 2 feet so that the velocity probe can be inserted into the gas stream through a sample port rather than obtaining a reading at the pipe at the pipe exit This modification will minimize any adverse effects on flow measurement accuracy due to wind The gas composition obtained during the Phase I field investigation will be used to estimate actual methane being released from the site

The flow rates at the leachate seep (SW097) will be measured using a Parshall flume, or equivalent, in accordance with surface water SOP SW 04, "Discharge Measurement" (EG&G 1992)