CORRECTIVE ACTION DECISION/RECORD OF DECISION DECLARATION

SITE NAME AND LOCATION

Rocky Flats Environmental Technology Site, Operable Unit 1: 881 Hillside Area, Jefferson County, Colorado

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action/corrective action for the Rocky Flats Environmental Technology Site (Rocky Flats) Operable Unit (OU) 1: 881 Hillside Area, located near Golden, Colorado. The selected remedial action was chosen in accordance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, the Colorado Hazardous Waste Act (CHWA) and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The Resource Conservation and Recovery Act (RCRA) is administered through the CHWA by the Colorado Department of Public Health and Environment (CDPHE). OU 1 was investigated and a remedial action was selected in compliance with the Federal Facility Agreement and Consent Order - Interagency Agreement (IAG) signed by the U.S. Department of Energy (DOE), the State of Colorado, and the U.S. Environmental Protection Agency (EPA) on January 22, 1991. The selected remedial action is also consistent with the Federal Facility Agreement and Consent Order - Rocky Flats Cleanup Agreement (RFCA) signed by DOE, the State of Colorado and EPA on July 19, 1996. RFCA is now the governing cleanup agreement for Rocky Flats, and the selected remedy for OU 1 will be implemented in accordance with RFCA. The remedial action selection is based on the administrative record file for OU 1, and the State of Colorado concurs on the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Corrective Action Decision/Record of Decision (CAD/ROD), may present a future threat to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

OU 1: 881 Hillside Area is one of sixteen geographically defined OUs at Rocky Flats that are identified in the IAG. RFCA consolidates these sixteen operable units into a fewer number, but OU 1 remains as a separate operable unit due to the fact that it is farther along in the administrative process and is nearing completion. OU 1 is composed of eleven Individual Hazardous Substance Sites (IHSSs). The selected remedy presented in this CAD/ROD includes three primary components:

1. This action addresses the principal threat posed by OU 1 by excavating subsurface soil contamination at IHSS 119.1, a former drum and scrap metal storage area, thereby removing the current source of groundwater contamination. The major components of the selected remedial action at IHSS 119.1 (Soil Excavation and Groundwater Pumping) include:
   - Excavation of approximately one thousand to two thousand cubic yards of contaminated subsurface soils at IHSS 119.1;
   - Extraction and then ultraviolet/hydrogen peroxide and ion-exchange treatment of contaminated groundwater from the excavation; and

- Either thermal treatment and replacement of excavated soil into the original excavation, disposal of excavated soil in an on-site waste disposal cell, or off-site disposal of excavated soil.

2. Institutional controls will be maintained throughout the OU 1 area in a manner consistent with RFCA, the Rocky Flats Vision, and the Action Levels and Standards Framework (ALF) (Attachment 5 to RFCA). These documents recognize that the reasonably foreseeable future land use for the OU 1 area is restricted open space. The institutional controls will ensure that the restricted open space land use is maintained for the OU 1 area and that domestic use of groundwater within the OU 1 area is prevented. If the reasonably foreseeable future land use for the OU 1 area changes when final sitewide land use decisions are made, this remedy will be reexamined to ensure protection of human health and the environment. The specific mechanisms (for example, deed restrictions) to ensure the implementation and continuity of the necessary institutional controls have not been included in this CAD/ROD. Currently, these mechanisms are envisioned to be placed in the Final Sitewide CAD/ROD or in this CAD/ROD during one of the five-year reviews of this document. However, should the Final CAD/ROD not occur or not include these institutional control mechanisms, this OU 1 CAD/ROD will be revised to include them, if it does not already include them as a result of a five-year review. The institutional controls can also be removed at one of the above times, if it is deemed appropriate to do so by the parties.

3. Because of the groundwater and land use controls, the low amounts of contamination in OU 1 outside of IHSS 119.1, and the low levels of risk associated with the contamination, no remedial action will be taken at the remaining ten IHSSs in OU 1.

Any surface soil contamination at OU 1 will be addressed jointly with surface soil contamination at the 903 Pad, Mound and East Trenches area (formerly OU 2).

STATUTORY DETERMINATIONS

The selected remedy for OU 1 satisfies the statutory requirements of CERCLA Section 121. The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Because this remedy will result in hazardous substances remaining in groundwater, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Jessie Roberson, Manager
U.S. Department of Energy, Rocky Flats Field Office

Feb 13, 1997
Date

Max H. Dodson, Assistant Regional Administrator
Office of Ecosystem Protection and Remediation
U.S. Environmental Protection Agency, Region VIII

Feb 27, 1997
Date

Howard Roitman, Director
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment

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3-12-97

Howard Roitman, Director
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment

Date

DECISION SUMMARY

SITE NAME, LOCATION AND DESCRIPTION

The Rocky Flats Environmental Technology Site is located approximately sixteen miles northwest of downtown Denver, in northern Jefferson County, Colorado. A copy of a site location map is attached (Figure 1). Most Rocky Flats structures are located within the industrialized area of Rocky Flats, which occupies approximately four hundred acres and is surrounded by a buffer zone of approximately 6,150 acres. OU 1 is located adjacent to and on the south side of the Rocky Flats industrial area, on the hillside south and east of Building 881 and north of Woman Creek (Figure 2).

Geological Setting

Rocky Flats is located along the eastern edge of the southern Rocky Mountain region, immediately east of the Colorado Front Range. The site is located on a broad, eastward-sloping pediment that is capped by alluvial deposits of Quaternary age (i.e., Rocky Flats Alluvium). The tops of alluvial-covered pediments are nearly flat but slope eastward at fifty to two hundred feet per mile. At Rocky Flats, the alluvial-covered pediment surface is dissected by a series of east-northeast trending stream-cut valleys. The bases of the valleys containing Rock Creek, North and South Walnut Creeks, and Woman Creek lie fifty to two hundred feet below the elevation of the older pediment surface. These valleys incise into the bedrock underlying alluvial deposits, but most bedrock is concealed beneath colluvial material accumulated along the gentle valley slopes. The highest point in the immediate vicinity of OU 1 is Building 881, which is approximately six thousand feet above mean sea level. The lowest point is at Woman Creek, about 5,830 feet above mean sea level.

Surface Water

Rock Creek, North and South Walnut Creeks, and Woman Creek are intermittent streams that flow generally from west to east at Rocky Flats. Surface water within Woman Creek, which flows along the base of the Building 881 hillside south of OU 1, and which is not diverted to Mower Reservoir flows into Woman Creek Reservoir, which is part of the Standley Lake Protection Project. The water in Woman Creek Reservoir is detained and then pumped to Walnut Creek drainage downstream of Great Western Reservoir. The South Interceptor Ditch (SID) crosses OU 1 between the security area and Woman Creek.

Land Use

Land use within ten miles of Rocky Flats includes residential, commercial, industrial, parks and open space, agricultural and vacant, and institutional classifications. Most residential use within five miles of Rocky Flats is located northeast, east and southeast of Rocky Flats. Commercial development is concentrated near residential developments north and southwest of Standley Lake and around Jefferson County Airport, located approximately three miles northeast of Rocky Flats. Industrial land use within five miles of the site is primarily quarrying and mining operations. Natural resources associated with the quarrying and mining activities include sand, gravel and coal. Irrigated and non-irrigated croplands, producing primarily wheat and barley, are located north and northeast of Rocky Flats and in scattered parcels adjacent to the east boundary of the site. Several horse operations and small hay fields are located south of Rocky Flats. Much of the vacant land adjacent to Rocky Flats is rangeland.

OU 1

OU 1 is composed of eleven IHSSs, which are specific locations where solid wastes, hazardous substances, pollutants, contaminants, hazardous wastes, or hazardous constituents may have been disposed or released to the environment within the Rocky Flats site at any time. Figure 2 shows the locations of these IHSSs and a description of each IHSS is provided in Table 1.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Rocky Flats is a government-owned, contractor operated facility that is part of the nationwide nuclear weapons complex. The site was operated for the U.S. Atomic Energy Commission (AEC) from its inception during 1951 until the AEC was dissolved in 1975. Responsibility for Rocky Flats was then assigned to the Energy Research and Development Administration (ERDA), which was succeeded by DOE in 1977. Until 1992 operations at Rocky Flats consisted of fabrication of nuclear weapons components from plutonium, uranium, stainless steel and beryllium. Building 881, which is adjacent to OU 1, was used for enriched uranium operations and stainless steel manufacturing. The laboratories in Building 881 also performed analyses of the materials generated in production. Parts made at the plant were shipped elsewhere for assembly. Support activities at Rocky Flats included chemical recovery and purification of recyclable transuranic radionuclides and research and development in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry and physics. These activities resulted in the generation of radioactive, hazardous and mixed wastes. On-site storage and disposal of these wastes has contributed to hazardous and radioactive contamination in soils, surface water and groundwater. Originally the site was named the Rocky Flats Plant, but in 1994 it was renamed the Rocky Flats Environmental Technology Site to better reflect its new mission of environmental restoration and the advancement of new and innovative technologies for waste management, characterization and remediation.

On January 22, 1991, a Federal Facility Agreement and Consent Order (i.e., the IAG) was signed by DOE, EPA and the State of Colorado. Within the IAG eleven IHSSs were assigned to OU 1: 102, 103, 104, 105.1, 105.2, 106, 107, 119.1, 119.2, 130 and 145 (see Table 1 for a description of these IHSSs and Figure 2 for the location of each IHSS within OU 1). The IAG provided guidance and direction for investigating the OU 1 IHSSs. As per the IAG, draft and final Work Plans and a draft and final RCRA Facility Investigation/Remedial Investigation (RFI/RI) report were prepared and submitted to the regulatory agencies. The RFI/RI report for OU 1 was prepared for submittal of documentation and data necessary to determine if the risk from the OU 1 IHSSs warrants the need for remedial action.

During 1992, as an interim action, a French Drain was constructed across a portion of OU 1 to protect Woman Creek from contaminated groundwater present in OU 1. The French Drain, along with an extraction well, collects contaminated groundwater moving towards Woman Creek. The collected groundwater is transported to an ultraviolet/hydrogen peroxide and ion-exchange water treatment system located in Building 891. In addition, during 1994, plutonium contaminated surface soil "hot spots" that were located in IHSSs 119.1 and 119.2 were removed from OU 1. This hot spot removal was conducted under an Accelerated Response Action per the IAG.

The Proposed Plan and Draft Modification of the Rocky Flats RCRA Permit for OU 1 (Proposed Plan) was prepared and released for public comment in May 1996 pursuant to the IAG and consistent with the draft RFCA. On July 19, 1996, DOE, EPA and the State of Colorado signed the final RFCA, which has replaced the IAG to become the governing cleanup agreement for Rocky Flats. Pursuant to the "Operable Unit Consolidation Plan" in RFCA, OU 1 will continue through the CAD/ROD process with EPA as the lead regulatory agency.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

The first Final Phase III RFI/RI report for OU 1 was submitted to EPA and CDPHE in November 1993 and the Revised Final Phase III RFI/RI report was submitted in June 1994. The Proposed Plan for OU 1 was released to the public in May 1996, and was made available in both the administrative record and in information repositories maintained at Front Range Community College, the EPA Superfund Records Center, CDPHE, the Standley Lake Library and the Citizens Advisory Board. The notice of availability for this document was published in the *Rocky Mountain News* on May 13, 1996. A public comment period on the Proposed Plan was held from May 13 to July 12, 1996. A public hearing was held on June 19, 1996. At this hearing, representatives from DOE gave a presentation that summarized the contamination and risks at OU 1, as well as the preferred remedial alternative for OU 1. DOE also responded to questions about OU 1. In addition, public comments on the Proposed Plan and Draft Permit Modification were received and recorded during the public hearing. This record, as well as responses to the written comments received during the public comment period, is included in the Responsiveness Summary, which is part of this CAD/ROD. This decision document presents the selected remedial action for OU 1: 881 Hillside Area at Rocky Flats, chosen in accordance with CERCLA, as amended by SARA and to the extent practicable, the NCP. The decision for OU 1 is based on the administrative record.

SCOPE AND ROLE OF OU 1

Because of the complexity of the Rocky Flats site, the site was divided into sixteen geographically defined OUs in the IAG. CAD/RODs have already been finalized and signed for three of these OUs (OU 11, OU 15 and OU 16). In all three cases a No Action decision was determined to be appropriate. Although many of the remaining thirteen OUs have been consolidated in RFCA, OU 1 remains as an individual operable unit. The selected remedial action presented in this CAD/ROD includes addressing subsurface soil contamination at IHSS 119.1, a former drum and scrap metal storage area. This action addresses the principal threat posed by OU 1 by excavating contamination sources in subsurface soils, thereby removing the current source of groundwater contamination, and by extracting and treating contaminated groundwater contained at IHSS 119.1. Based on the results of the final RFI/RI, DOE has determined that the remaining IHSSs within OU 1 are already in a protective state with regard to human health and the environment. Thus, no further action relative to these remaining IHSSs will be taken. Any surface soil contamination at OU 1 will be addressed jointly with surface soil contamination at the 903 Pad, Mound and East Trenches area (formerly OU 2, which has been consolidated into the Buffer Zone OU in RFCA). Any additional groundwater associated with OU 1 will be managed consistent with the Integrated Water Management Plan. Surface water and suspended sediments transported from OU 1 have historically flowed into Woman Creek or the South Interceptor Ditch (SID). Since Woman Creek and the SID are being evaluated as part of OU 5: Woman Creek Priority Drainage, surface water and associated sediments originating from OU 1 will be addressed as part of OU 5.

SUMMARY OF SITE CHARACTERISTICS

Geology

Geologic units present at the 881 Hillside Area include the Rocky Flats Alluvium at the top of the hillside, colluvium and artificial fill along central portions of the hillside, and Woman

Creek Valley Alluvium at the base. These thin (three to eighteen feet) Quaternary age surficial units are underlain by thick (six hundred to eight hundred feet) Cretaceous claystones, siltstones and sandstones of the Laramie Formation. The uppermost portion of the Laramie Formation is disturbed as a result of slumping on the hillside and also contains numerous fractures primarily due to weathering. This portion of the Laramie Formation is often referred to as the weathered claystone and may be up to twenty-five feet thick in some areas.

Surface Features/Surface Water Hydrology

Several erosional and depositional processes have combined to produce gently rolling to moderately steep slopes on the 881 Hillside. The terrain has been recontoured in several areas at various times during the construction of Building 881, the placement of fill and waste materials in several IHSSs, road grading, and the construction of the SID and French Drain.

Surface water primarily occurs at OU 1 following precipitation and snow melt events after the soils have become saturated due to infiltration. Surface runoff generally flows south, where it is intercepted by the SID, and subsequently flows to the C-2 Pond where it is batched and sampled before being pumped to the Walnut Creek drainage.

Hydrogeology

Groundwater occurs under unconfined conditions within the unconsolidated Rocky Flats Alluvium, colluvium, fill, and weathered claystone section of the Laramie Formation. This interval is designated as the Upper Hydrostratigraphic Unit (UHSU). Below this, groundwater is limited to the more porous beds within the Laramie Formation and is usually confined. This deeper section of strata is designated as the Lower Hydrostratigraphic Unit (LHSU).

UHSU groundwater is not present across the entire 881 Hillside (OU 1). Groundwater in the unconsolidated material typically is confined to northwest-southeast trending erosion incisions in the bedrock surface, referred to as paleochannels, which are masked by the overlying materials. The extent of groundwater within these paleochannels varies with seasonal changes in precipitation rates. UHSU groundwater also occurs sporadically within the upper portion of the Laramie formation within fractures and along slump block glide planes. As previously discussed, a French Drain was installed between the 881 Hillside and Woman Creek to intercept this shallow unconfined groundwater, and it extends to a maximum depth of twenty-eight feet below top of bedrock. The French Drain acts as an effective hydraulic barrier to horizontal migration of UHSU groundwater into Woman Creek.

Vertical migration between the UHSU and the LHSU is limited by the extremely low hydraulic conductivity of the claystones within the Laramie Formation. The hydraulic conductivity of these claystones (1×10^{-8} cm/sec) is approximately three orders of magnitude less than that of the overlying unconsolidated sediments (1×10^{-5} cm/sec), and as a result the vertical component of migration is extremely small compared to the horizontal component. In addition, the porous saturated sandstones of the LHSU are laterally discontinuous, with intervening claystone aquitards effectively limiting horizontal migration within the LHSU.

Recharge to the UHSU is minimal, and occurs primarily through infiltration of precipitation. Infiltration rates range from approximately two inches per hour for initial infiltration to as little as one half inch per hour for final (saturated) infiltration. Discharge occurs largely through evapotranspiration and surface discharge at seeps and into the SID. Total volumes of UHSU groundwater at OU 1 varies annually and seasonally, but the Final

Phase III RFI/RI report (June 1994) estimated the volume to be approximately 5.0 to 5.8 acre-feet.

Flora /Fauna

Grassland habitats are dominant at OU 1, representing about 82% of the total area. Nine percent is either developed or disturbed; marsh habitat occupies 4%; woodland habitat constitutes 4%; and shrub habitats account for the remaining 1%. A restored wetlands was created to mitigate damages resulting from installing the French Drain. Wildlife species are typical of those in similar habitats throughout the foothills area. As a result of limited ephemeral surface water, aquatic species with short life cycles and small habitats, such as benthic macroinvertebrates, have developed as opposed to fish populations.

Site Contamination

A detailed methodology was developed during the Phase III RFI/RI for determining the nature and extent of contamination at OU 1. Using this methodology, analytes within the following chemical classes were analyzed: volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and radionuclides. The following media were assessed for the presence of contamination: surface soil, subsurface soil, groundwater, surface water/seeps, and sediments. Based on this analysis, VOCs, SVOCs, metals, and radionuclides were identified as contaminants at OU 1 (see Table 2). Note that the data in Table 2 does not reflect the 1994 surface soil hotspot removal.

From this and other data collected, the Phase III RFI/RI concluded that in OU 1 only IHSS 119.1 contains a significant source of contamination in the subsurface soil. The primary contaminants identified at IHSS 119.1 are as follows: carbon tetrachloride; 1,1-dichloroethene; tetrachloroethene; 1,1,1-trichloroethane; trichloroethene; and selenium. No radioactive contamination was identified in the subsurface soil at IHSS 119.1. Also, based on the data collected during the Phase III RFI/RI, the other IHSSs in OU 1 were not found to be contamination source areas and do not contribute significantly to groundwater contamination. Therefore, the other IHSSs do not warrant any further remedial action, and, as previously stated in the "Scope and Role of OU 1" section of this CAD/ROD, the selected remedial action for OU 1 addresses subsurface soil contamination and groundwater contamination at IHSS 119.1.

Groundwater in OU 1 is contaminated by VOCs and metals (see Table 2). Releases of VOCs within IHSS 119.1 are presumed to have occurred in the form of dense non-aqueous phase liquids (DNAPLs). This conclusion is based on the fact that drums at this IHSS contained unknown quantities and types of solvents, coupled with the presence of chlorinated solvent concentrations in groundwater at levels approaching 7% of the solubility limits of the substances. The presence of mobile or residual DNAPL at this location is inferred only, since DNAPL has not been directly observed, and maximum measured concentrations of VOCs in subsurface soil is less than 2.0 mg/l. Table 3 lists monitoring wells in the vicinity of IHSS 119.1 and their contaminant concentration range for the Contaminants of Concern (COCs) for the years 1987 through 1995. The locations of these wells are shown on Figure 3. Only two of the wells (974 and 4387) have concentrations exceeding 1% of the compound solubility.

The lateral extent of groundwater contamination is generally limited to an area north of the SID. The occurrence of contaminants in LHSU groundwater is limited to relatively low levels of VOCs (less than 100 µg/l) and localized occurrences of metals, particularly selenium (concentrations ranging from below background to fifteen times the background level of 80 µg/l).

A soil gas survey was conducted during early 1996 to more accurately define the extent and approximate volume of contaminated subsurface soil that will be excavated at IHSS 119.1. Based on this soil gas survey, two potential subsurface soil contamination source areas were identified (see Figure 3), resulting in an approximate total volume of subsurface soil to be excavated between one thousand and two thousand cubic yards.

Fate and Transport

In general, contaminant migration at the site was evaluated in terms of the identified pathways at OU 1. Migration of VOCs and metals in groundwater at IHSS 119.1 is restricted to northwest-southeast oriented channel features incised on the bedrock surface. The observed extent of groundwater contamination originating from IHSS 119.1 was compared with the predicted extent to confirm the accuracy of the hydrogeologic conceptual model. Contaminant transport rates were estimated by calculating groundwater seepage velocity and contaminant-specific retardation factors (see Table 3). The observed migration distance of VOC and metal contamination originating from IHSS 119.1 (approximately three hundred feet) falls within the predicted range. After implementation of the subsurface soil removal action presented in this CAD/ROD, the present source of this groundwater contamination will be eliminated.

Radionuclides and SVOCs in surface soils are susceptible to redistribution by wind or surface water erosion events. Surface soils at OU 1 were contaminated with windblown low-level radionuclides transported from the 903 Pad area, and any remaining surface soil contamination will be addressed jointly with surface soil contamination at the 903 Pad area. Surface water is intercepted by the SID and will be addressed as part of OU 5.

SUMMARY OF SITE RISKS

As part of the Phase III RFI/RI conducted for OU 1, a Baseline Risk Assessment (BRA) was prepared to identify any current or potential future risks to human health and the environment. The BRA evaluated health risks from surface soil, subsurface soil, groundwater, surface water, and sediments within the OU 1 boundaries.

The surface soil hot spot removal action conducted at OU 1 for plutonium, americium and uranium contamination reduced the risk from this contaminant group and medium by 100 times. The risk from surface soils was reduced to 1 in 100,000 (10^{-5}) after the OU 1 hot spot removal was completed. This contaminant group contributed the highest risk to a human receptor in the OU 1 BRA. With respect to subsurface soils and groundwater, the primary contaminants identified in the Phase III RFI/RI were: carbon tetrachloride; 1,1-dichloroethene; tetrachloroethene; 1,1,1-trichloroethane; trichloroethene; and selenium.

The BRA identified potential health risks from these contaminants associated with current and possible future exposure scenarios at OU 1. The scenarios originally examined in the OU 1 BRA are as follows: current on-site commercial/industrial; current off-site residential; future on-site commercial/industrial; future on-site ecological reserve; and future on-site residential. However, not all of these scenarios are considered valid or currently possible.

The Rocky Flats Future Site Use Working Group, consisting of participants from DOE, EPA, CDPHE, and major stakeholders, recommended in the June 1995 "Future Site Use Recommendations" report that the future on-site residential land use scenario not be considered. The commercial/industrial exposure scenario was recommended for use within the industrial area of the plant and the open space exposure scenario was recommended for the buffer zone. These recommendations are consistent with the conceptual land uses in the ALF and with the Rocky Flats Vision. The OU 1 area lies on the border between these two anticipated land uses. DOE has not yet made a final determination regarding the future land uses for OU 1. This determination will be consistent with RFCA and the Rocky Flats Vision and will take into consideration the fact that the hillside at OU 1 has shown the potential for landslides and slumping. This would make the construction of structures at OU 1 complicated and problematic. In addition, as stated in the ALF, domestic use of groundwater will be prevented through institutional controls.

There are no health risks associated with the future open space park exposure scenario from OU 1 subsurface soil or groundwater since there are no exposure routes available from either medium. The carcinogenic risk calculated in the OU 1 BRA for the future on-site commercial/industrial worker in the industrial area from subsurface soils and groundwater is 2.4×10^{-4}. This risk is slightly above EPA's acceptable risk range of 10^{-4} to 10^{-6}.

The Phase III RFI/RI identified no significant environmental risk; therefore, environmental risks warrant no further examination.

In conclusion, actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this CAD/ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF ALTERNATIVES

Six candidate remedial alternatives were compiled from the treatment technologies that passed a detailed screening process conducted during the Corrective Measures Study/Feasibility Study (CMS/FS), including the No Action alternative. A description of each remedial alternative is given below. The six remedial alternatives are: No Action (Alternative 0), Institutional Controls with the French Drain (Alternative 1), Groundwater Pumping and Soil Vapor Extraction (Alternative 2), Groundwater Pumping and Soil Vapor Extraction with Thermal Enhancement (Alternative 3), Hot Air Injection with Mechanical Mixing (Alternative 4), and Soil Excavation with Groundwater Pumping (Alternative 5). For Alternatives 2, 3, 4 and 5, the volume of soil to be remediated was estimated, from the results of a recent soil gas survey performed at OU 1, to be between one thousand and two thousand cubic yards of soil (approximately a fifty feet by fifty feet by twelve feet deep excavation). During implementation of the remedy, confirmatory soil sampling will be performed to determine where the excavation can be terminated, based on cleanup levels identified in the ALF.

Alternative 0: No Action

The No Action alternative is required by CERCLA as a baseline alternative with which to compare other alternatives. The No Action alternative uses results of the Baseline Risk Assessment to define exposure levels to human and environmental receptors at the site under existing conditions, and specifically excludes remedial activities.

Use of the existing French Drain groundwater collection system would be discontinued under this alternative. Groundwater would, therefore, flow toward Woman Creek. The only activity associated with the No Action alternative is groundwater monitoring to detect changes in contaminant concentrations or migration patterns. Monitoring would begin immediately and would continue until a determination could be made that monitoring is no longer required. Existing wells no longer deemed necessary would be abandoned as appropriate.

No remedial time frame is established for this alternative since the alternative relies solely on natural contaminant degradation and attenuation processes to meet Remedial Action Objectives (RAOs). A thirty year monitoring time frame is assumed, in accordance with EPA guidance. It is estimated that it will cost approximately $1.9 million to implement this remedial alternative and continue monitoring groundwater for thirty years.

Alternative 1: Institutional Controls with the French Drain

Alternative 1 seeks to achieve RAOs by restricting access to wells impacted by OU 1 contaminants through institutional controls, while continuing to treat groundwater collected by the existing French Drain at the Building 891 water treatment system. Institutional controls would also be employed to prevent domestic groundwater use at OU 1. Further degradation of groundwater would be minimized by continued containment and treatment of the groundwater. Subsurface contamination sources would eventually be depleted by dissolution to groundwater, although the length of time for this to occur would be quite extensive.

The existing French Drain and Building 891 treatment system would continue to operate until no longer deemed necessary based on contaminant concentrations in the groundwater. Groundwater monitoring would continue for as long as required to verify that contaminant concentrations in groundwater have been permanently reduced below appropriate limits. Wells no longer deemed necessary for monitoring would be abandoned as appropriate.

No remediation time frame is defined for Alternative 1 since the French Drain system is currently operational and would continue to operate until acceptable contaminant concentrations are achieved. Based on current operations of the existing French Drain system, it is reasonable to assume that due to the slow groundwater collection rate, operation of the French Drain system would be required for an extensive period of time before RAOs are achieved. Experience with similar remedial actions at similar sites suggests that extremely long time frames are required for complete contaminant depletion. For the purpose of preparing a cost estimate, a thirty year time frame for remedial activities is assumed, based on EPA guidance. Based on this time frame, the estimated cost for completion of Alternative 1 is $17.5 million.

Alternative 2: Groundwater Pumping and Soil Vapor Extraction

Alternative 2 seeks to achieve RAOs by dewatering the identified IHSS 119.1 source area using conventional pumping techniques, and by implementing a localized soil vapor extraction (SVE) system. Risk from contaminated groundwater would be eliminated by extraction and treatment, while further degradation of groundwater would be minimized by removal of contaminant sources through SVE.

SVE would enhance volatilization and subsequent contaminant recovery from saturated soils, unsaturated soils and groundwater at OU 1. SVE targets contaminants that have partitioned to the aqueous phase, have adsorbed onto subsurface soils, exist in a free phase or occupy soil pore spaces in a vapor phase. Discrete pools of groundwater located in IHSS 119.1 would be extracted via the existing French Drain and one to three additional recovery wells. Collected groundwater would be treated by the existing Building 891 water treatment system or other appropriate facility. These same areas, once desaturated, would be subjected to SVE to enhance the removal of any residual contaminants.

SVE can be significantly influenced by site geology and contaminant characteristics. Geological factors that can influence the success of SVE include depth to groundwater, subsurface soil/rock type and surface permeability. At OU 1, the subsurface soils contain large amounts of clay which would inhibit the effectiveness of this technology. Contaminants that are effectively recovered by SVE exhibit a vapor pressure of 1.0 mm of mercury or more at 20 degrees Celsius and which have a dimensionless Henry's Law constant greater than 0.01. The contaminants identified at OU 1 would be amenable to recovery by SVE.

It is also assumed that the vapor extraction wells in IHSS 119.1 would be approximately two to six inches in diameter. The wells would be operated cyclically to enhance recovery and would be used in combination with a granular activated carbon (GAC) unit to treat extracted vapors. The existing French Drain and Building 891 treatment system would continue to operate during the remedial activities, but after remediation of the source is complete the French Drain would be decommissioned and groundwater collection and treatment would cease. Groundwater monitoring would be performed consistent with the Integrated Water Management Plan after completion of the remedial action.

The remediation time frame, which is considered to be the time until protection is achieved by the remedial action, is estimated to be approximately five years for Alternative 2. Based on this time frame and other technical information defining this alternative, the estimated cost for completion of Alternative 2 is $8.1 million.

Alternative 3: Groundwater Pumping and SVE with Thermal Enhancement

Alternative 3 seeks to achieve RAOs by combining SVE as described in Alternative 2 with thermal recovery enhancement techniques. Groundwater extraction and treatment would be employed to address groundwater contamination, while SVE with thermal enhancement would be used to remove contamination sources. This alternative considers two innovative treatment technologies that can effect an increase in subsurface soil temperatures and thus enhance SVE: radio frequency heating and electrical resistance (ohmic) heating. These technologies are discussed in detail in the OU 1 CMS/FS report. In general, these thermal enhancement techniques enhance the success of the SVE by increasing the temperature in the subsurface soil which allows more complete and faster volatilization, and thus recovery, of organic constituents in the soil. The increase in temperature of the subsurface soil also assists in dewatering the area by vaporizing pore space moisture.

As in Alternative 2, the existing French Drain and Building 891 treatment system would continue to operate until remediation of the contamination source is complete, at which time the French Drain would be decommissioned and groundwater collection and treatment would cease. Groundwater monitoring would be performed consistent with the Integrated Water Management Plan after completion of the remedial action.

The remediation time frame for Alternative 3 is estimated to be three years. Based on this time frame and other technical information defining this alternative, the estimated cost for completion of Alternative 3 is $7.5 million.

Alternative 4: Hot Air Injection with Mechanical Mixing

Alternative 4 seeks to achieve RAOs through an in-situ technology that combines hot air stripping with vigorous mixing of subsurface media. Contaminated groundwater at IHSS 119.1 would be remediated through extraction and treatment in the Building 891 facility, and the IHSS 119.1 subsurface soil contamination source would be addressed with hot air injection and mechanical mixing.

This technology operates under the same basic principles of SVE and thermal enhancement discussed previously, but combines these principles with vigorous mechanical mixing to increase the effectiveness of the subsurface soil treatment. The primary treatment system in this alternative would consist of a caterpillar mounted drill rig with specialized drilling equipment. The drill equipment is capable of delivering treatment reagents, such as hot air or steam, via piping in a hollow drill bit shaft that has mixing/cutting blades four to twelve feet in diameter.

Groundwater extraction wells would be placed in previously treated soil columns. Dewatering of a small area prior to treating the initial soil column would be accomplished via an extraction well drilled with conventional drilling equipment. Extracted groundwater would be treated in the existing Building 891 treatment system. The treatment columns, or drill shafts, would overlap by thirty percent to ensure adequate treatment throughout the entire site. Four to six columns can be treated per day, depending on site conditions.

The existing French Drain and Building 891 treatment system would continue to operate during the remedial activities, but after remediation of the source is complete the French Drain would be decommissioned and groundwater collection and treatment would cease. Groundwater monitoring would be performed consistent with the Integrated Water Management Plan after completion of the remedial action.

The remediation time frame for Alternative 4 is estimated to be two years. Based on this time frame and other technical information defining this alternative, the estimated cost for completion of Alternative 4 is $4.3 million.

Alternative 5: Soil Excavation with Groundwater Pumping

Alternative 5 is intended to achieve RAOs through excavation of contaminated subsurface soils and contaminated groundwater beneath IHSS 119.1. Based on the report of a recent soil gas survey that was performed at IHSS 119.1 ("Sampling and Analysis Report - Identification and Delineation of Contaminant Source Area for Excavation Design Purposes", April 1996), the estimated volume of soil that will be excavated from IHSS 119.1 is one thousand to two thousand cubic yards (approximately fifty feet by fifty feet by twelve feet deep).

Contaminated groundwater would be extracted from the excavation and treated in the Building 891 water treatment system. The excavated subsurface soils would either be treated on-site with a thermal desorption unit and returned to the excavation, disposed in an on-site disposal cell, or disposed off-site.

The existing French Drain and Building 891 treatment system would continue to operate during the remedial activities, but after remediation of the source is complete the French Drain would be decommissioned and groundwater collection and treatment would cease. Groundwater monitoring would be performed consistent with the Integrated Water Management Plan after completion of the remedial action.

The remediation time frame for Alternative 5 is estimated to be four to six months. Based on this time frame and other technical information defining this alternative, the estimated costs for completion of Alternative 5, depending on how the excavated soil is managed, is as follows: if the soil is treated on-site and returned to the excavation the cost is approximately $3.5 million; if the soil is disposed off-site the cost is approximately $3.9 million; and if the soil is disposed in an on-site disposal cell without treatment the cost is approximately $3.3 million.

SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Threshold Criteria

Overall Protection of Human Health and the Environment: Alternative 5 provides the best overall protection of human health and the environment by providing the largest reduction in exposure potential within the shortest amount of time through removal of the contamination source. Alternatives 2, 3 and 4 provide the next best level of overall protection of human health and the environment, based on the fact that they are designed to reduce exposure potential through in place remediation of the contamination source at IHSS 119.1. However, these alternatives involve technologies that are not proven to be effective in the clay soils that are present at IHSS 119.1. Therefore, they would not be as thorough in removing the contamination source as Alternative 5, and they also involve longer remediation timeframes. Alternative 1 protects human health and the environment by collecting and treating contaminated groundwater, as well as by implementing certain institutional controls to reduce exposure to the contaminants, but it does not address the contamination in the subsurface soil and, therefore, is not as protective as the previously discussed alternatives. Finally, Alternative 0 offers the least amount of protection to human health and the environment because it does not involve any source removal, containment or other controls.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs): The ARARs that have been identified and analyzed for each alternative for the contaminants of concern at IHSS 119.1 are as follows:

- Classifications and Numeric Standards (5 CCR 1002-8, 3.8, So. Platte River Basin)
- Colorado Basic Standards for Surface Water (5 CCR 1002-8, 3.1, Segment 4a of Big Dry Creek):

carbon tetrachloride	0.25 μg/L
1,1-dichloroethene	0.057 μg/L
tetrachloroethene	0.8 μg/L
1,1,1-trichloroethane	200 μg/L
trichloroethene	2.7 μg/L
selenium	20 μg/L (acute); 5 μg/L (chronic)

- Colorado Hazardous Waste Regulations (6 CCR 1007-3 Parts 264 and 268)
- Colorado Air Pollution Control Regulations (5 CCR 1001-5, Regulation 7)
- Colorado Nongame, Endangered or Threatened Species Conservation Act (CRS 33-2-101).

The State contends that 5 CCR 1002-8, 3.12 (Site Specific Water Quality Classifications and Standards for Ground Water) and 5 CCR 1002-8, 3.11 (Basic Standards for Ground Water) are ARARs. DOE disagrees with this contention. Both parties reserve their respective rights to raise this issue and supporting arguments in any relevant forum. The parties do not anticipate that this disagreement will ripen into a formal dispute because 5 CCR 1002-8, 3.12 adopts the standards set forth in 5 CCR 1002-8, 3.1 and 3.8, and these standards are consistent with the enforceable standards set forth in the ALF. In addition, 5 CCR 1002-8, 3.11 contains standards which are generally consistent with or less stringent than the standards set forth in 5 CCR 1002-8, 3.1 and 3.8.

Alternatives 2, 3, 4 and 5 are expected to meet all of the above identified ARARs, while Alternatives 0 and 1 are expected to meet all ARARs except that they may not meet the Colorado Basic Standards for Surface Water. Therefore, Alternatives 0 and 1 rank low under this criterion.

Primary Balancing Criteria

Long-Term Effectiveness and Permanence: Alternative 5 provides the highest level of long-term effectiveness and permanence since it removes both groundwater contamination and subsurface soil contamination sources in IHSS 119.1, and thereby prevents any further contamination of groundwater. Alternatives 2, 3 and 4 also remove groundwater contamination, but are not as effective at removing subsurface soil contamination sources *because the technologies used in these alternatives* have not been proven effective in the clay soils at IHSS 119.1. Alternative 1 provides even less long-term effectiveness and permanence since it only removes groundwater contamination, but not subsurface soil contamination sources. Alternative 0 provides the lowest level of long-term effectiveness and permanence since it does not treat or remove any contamination at IHSS 119.1.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Alternative 5 provides the highest reduction of mobility because it removes the primary source of contamination and treats contaminated groundwater, thereby preventing any further migration of contaminants. In addition, if the excavated soil is treated, as discussed in the "Description of Alternatives" section, Alternative 5 also provides the highest reduction of toxicity and volume through treatment. Alternatives 2, 3 and 4 provide the next highest level of toxicity, mobility and volume reduction since they involve groundwater treatment as well as in place treatment of the subsurface soil contamination source. Alternative 1 provides less reduction of toxicity, mobility and volume through treatment because it treats only contaminated groundwater and does not address the subsurface soil contamination. Alternative 0 ranks lowest in this category because it treats neither groundwater nor subsurface soil contamination, and thus provides no reduction in toxicity, mobility or volume through treatment.

Short-Term Effectiveness: This criterion evaluates community, environmental and site worker protection during the implementation of the remedy. It also evaluates the effectiveness and reliability of protective measures during implementation and the time until RAOs are achieved.

Alternatives 0 and 1 rank highest under the community, environmental and site worker protection during implementation portion of this criterion because they involve no disturbance of the existing site and little or no worker involvement. Alternatives 2, 3, 4 and 5 involve some site disturbance, but the disturbance is not expected to create a significant impact on the community, the environment or site workers. Alternative 3 has the potential to present increased hazards to site workers due to the heating of the subsurface soil.

For the effectiveness and reliability of protective measures during implementation and for the time until RAOs are achieved, Alternative 5 ranks the highest. Excavation has been proven to be the most effective and reliable of the technologies presented here when applied to clay soils. In addition, DOE anticipates that it will take only four to six months for RAOs to be achieved once implementation of Alternative 5 has begun. The amount of time until RAOs are achieved for Alternatives 2, 3 and 4, once implementation of the alternative has begun, is five years, three years and two years, respectively. Alternatives 0 and 1 are the least effective and reliable since they do not address the subsurface soil contamination source. Also, the amount of time until RAOs are achieved for these two alternatives is unknown, but likely to be quite extensive, since they rely on natural degradation of the contaminants.

Implementability: This criterion evaluates the technical and administrative feasibility of implementing the alternatives including the availability of materials and services needed during implementation, as well as the ability to monitor the effectiveness of the remedy.

Alternative 1 is the most easily implementable because it represents the current condition at OU 1. The only additional work that it would involve would be to implement institutional controls at OU 1 and perform groundwater monitoring. Alternative 0 is the next most easily implementable alternative because it involves only decommissioning the French Drain and performing groundwater monitoring. Alternative 5 is the next most implementable alternative. Excavation has been proven to be effective and implementable in clay soils, and the equipment necessary to perform the excavation is readily available. Also, the effectiveness of Alternative 5 can be easily monitored.

Alternatives 2, 3 and 4 use intrusive treatment methods that may pose technical problems, and are, therefore, less implementable than the other alternatives. For example, soil vapor extraction (Alternatives 2 and 3) cannot be reliably conducted in clay soils. Alternative 3 is even more difficult to implement than Alternative 2 because it is still an experimental technology. Alternative 4 is the most difficult option to implement because of the sloping, unstable hillside that the drill rig would have to work on, and because of the limited supply of the specialized equipment that is needed.

Cost: This criterion evaluates the capital cost for each alternative, long-term operation and maintenance (O&M) expenditures required to sustain it, and post-closure costs occurring after the completion of remediation. Future expenditures are adjusted to present worth amounts by discounting all costs to a common base year using present worth cost analysis.

Alternative 0 is the least costly since it involves only decommissioning the French Drain and performing groundwater monitoring for thirty years. The total estimated cost of Alternative 0 is $1.9 million. Alternative 5 is the next least costly alternative, with the following estimated costs of completion: $3.3 million if the excavated soil is placed directly into an on-site waste disposal cell, $3.5 million if the excavated soil is treated on-site with a thermal desorption unit and placed back into the original excavation, and $3.9 million if the excavated soil is disposed off-site. The cost estimates are based on an excavation volume of 1000 to 2000 cubic yards of soil (50 feet by 50 feet by 12 feet deep excavation), which was estimated as the appropriate soil excavation volume in the recent soil gas survey at IHSS 119.1. These cost estimates include all costs of soil excavation, handling and management of the soil, operation of the French Drain and groundwater treatment plant for one year (or until the soil has been excavated), and groundwater monitoring for thirty years.

Alternative 4 is more costly than Alternatives 0 and 5, with an estimated total cost of $4.3 million. This estimate is based on the same volume of soil as Alternative 5 (1000 to 2000 cubic yards), and includes all costs of performing the hot air injection and mechanical mixing, operation of the French Drain and groundwater treatment plant for two years, and groundwater monitoring for thirty years.

Alternative 3 is more costly than the previously discussed alternatives, with an estimated total cost of $7.5 million, which is also based on a soil volume of 1000 to 2000 cubic yards for treatment. This cost estimate includes all costs of performing the soil vapor extraction with thermal enhancement, operation of the French Drain and groundwater treatment plant for three years, and groundwater monitoring for thirty years. Alternative 2 is even more costly, with an estimated total cost of $8.1 million. Again, this cost estimate is based on a soil volume of 1000 to 2000 cubic yards for treatment. It includes all costs of performing the soil vapor extraction, operation of the French Drain and groundwater treatment plant for five years, and groundwater monitoring for thirty years.

Alternative 1 is the most expensive alternative, with an estimated total cost of $17.5 million, which is based on the long-term operation of the French Drain and the water treatment plant for thirty years and groundwater monitoring for thirty years.

Modifying Criteria

State Acceptance: This criterion addresses the State's comments and concerns regarding the appropriateness of the selected remedy. The State of Colorado was represented on the Dispute Resolution Committee that selected the preferred remedial alternative for OU 1 and agrees with the selection. The State has no outstanding, significant comments or concerns with the selected remedy.

Community Acceptance: This criterion evaluates the selected remedy in terms of issues and concerns raised by the public through the public involvement process. At the public hearing for the OU 1 Proposed Plan on June 19, 1996, DOE received one comment from the public that was supportive of the preferred remedial alternative. During the public comment period for the OU 1 Proposed Plan, DOE received one set of written comments from the public, which, in general, expressed concern for funding and timing of the selected remedy, and requested clarification on several issues in the Proposed Plan. These comments are addressed in the attached Responsiveness Summary.

Anticipated Damages to Natural Resources: Alternatives 2, 3, 4 and 5 will not result in any irreversible damages to natural resources and will improve the quality of soil and groundwater by excavation and treatment. Alternative 1 will not result in any irreversible damages to natural resources and will improve the quality of groundwater by treatment. Alternative 0 will not result in any irreversible damages to natural resources, but will continue to degrade the quality of groundwater since the alternative does not involve any remedial activity. Measures to control and reduce the risk of damages to natural resources will be considered prior to beginning the remedial activity.

THE SELECTED REMEDY

The selected remedy for OU 1 includes three primary components:

1. Excavating subsurface soil contamination at IHSS 119.1, a former drum and scrap metal storage area, thereby removing the current source of groundwater contamination. The major components of the selected remedial action at IHSS 119.1, described in detail below, include:
   - Excavation of approximately one thousand to two thousand cubic yards of contaminated subsurface soils at IHSS 119.1;
   - Extraction and then ultraviolet/hydrogen peroxide and ion-exchange treatment of contaminated groundwater from the excavation; and
   - Either thermal treatment and replacement of excavated soil into the original excavation, disposal of excavated soil in an on-site waste disposal cell, or off-site disposal of excavated soil.

This portion of the selected remedy for OU 1 was chosen by the Dispute Resolution Committee (DRC) on August 25, 1995, as part of the dispute resolution process that is defined in the IAG, which was the governing cleanup agreement at the time of the decision. At that time, the DRC was composed of DOE's Assistant Manager for Environmental Restoration, EPA's Federal Facilities Branch Chief, and CDPHE's Program Manager for the Hazardous Waste Control Program. In choosing the remedial action for IHSS 119.1, the DRC was interested in controlling groundwater contamination through source removal. The DRC determined that Alternative 5, Soil Excavation with Groundwater Pumping, is the most appropriate remedial action for IHSS 119.1. This remedial action includes excavation of approximately one thousand to two thousand cubic yards of contaminated subsurface soils at IHSS 119.1; extraction and then ultraviolet/hydrogen peroxide and ion-exchange treatment of contaminated groundwater at IHSS 119.1; either thermal treatment and replacement of excavated soil into the original excavation, disposal of excavated soil in an on-site waste disposal cell, or off-site disposal of the excavated soil; and groundwater monitoring consistent with the Integrated Water Management Plan.

The comparative analysis of alternatives shows that Alternative 5 rates best for overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; and reduction of toxicity, mobility, or volume through treatment. Alternative 5 rates higher than the other alternatives for short-term effectiveness, and rates good for implementability and anticipated damages to natural resources. Alternative 5 is expected to take the least amount of time to achieve protection at IHSS 119.1 (four to six months), and is the least expensive alternative except for Alternative 0, which is to perform no remedial action. In addition, Alternative 5 satisfies the CERCLA statutory preference for remedies that employ treatment as a principal element and achieves the Remedial Action Objectives set for OU 1.

The principal components of the IHSS 119.1 remedial action selected to meet these RAOs and remediation goals are described below:

Excavation of soil: Excavation of contaminated subsurface soils will begin at IHSS 119.1 in the two contamination source areas identified during the recent soil gas survey. The location of these two areas can be found on Figure 3. From the soil gas survey results, it is estimated that the amount of soil that will be excavated is approximately one thousand to two thousand cubic yards. During the excavation, sampling will be performed to confirm the point at which all contaminated subsurface soil has been removed, in accordance with the ALF. In addition, during implementation of the selected remedy, DOE will perform confirmatory soil sampling downgradient of IHSS 119.1 to verify that a contamination source does not exist there. A detailed sampling and analysis plan for both of these confirmatory sampling activities will be prepared as part of the Remedial Design for OU 1. A detailed soil excavation plan will also be prepared as part of the Remedial Design.

Groundwater extraction and treatment: Groundwater will be extracted from the excavation and will be transferred to the existing Building 891 ultraviolet/hydrogen peroxide and ion-exchange water treatment system for final treatment and discharge. After all contaminated subsurface soil has been excavated and all contaminated groundwater has been extracted from the excavation, the French Drain system will be decommissioned and its use will be discontinued. The final details of the groundwater extraction and the decommissioning of the French Drain will be presented in the Remedial Design for OU 1.

Handling and management of excavated soil: DOE is considering three options for managing the excavated soil: on-site treatment and placement back into the original excavation, disposal in an on-site waste disposal cell, or off-site disposal. DOE's preferred method of managing the excavated soil is to treat the soil on-site in a thermal desorption unit to levels that will be identified and approved in the Remedial Design. The treated soil would then be placed back into the original excavation. Again, the final details of how the excavated soil will be handled and managed will be prepared as part of the Remedial Design and will be in accordance with RFCA.

Groundwater monitoring: DOE anticipates that groundwater monitoring will be performed at IHSS 119.1, consistent with the Integrated Water Management Plan, after the remedial action is complete. The details of this groundwater monitoring will be presented in the Remedial Design.

It is possible that changes to the remedial activities described above may be made as a result of the remedial design and construction processes. Any such changes, in general, would reflect modifications resulting from the engineering design process.

2. Institutional controls will be maintained throughout the OU 1 area in a manner consistent with RFCA, the Rocky Flats Vision, and the ALF. These documents recognize that the reasonably foreseeable future land use for the OU 1 area is restricted open space. The institutional controls will ensure that the restricted open space land use is maintained for the OU 1 area and that domestic use of groundwater within the OU 1 area is prevented. If the reasonably foreseeable future land use for the OU 1 area changes when final sitewide land use decisions are made, this remedy will be reexamined to ensure protection of human health and the environment. The specific mechanisms (for example, deed restrictions) to ensure the implementation and continuity of the necessary institutional controls have not been included in this CAD/ROD. Currently, these mechanisms are envisioned to be placed in the Final Sitewide CAD/ROD or in this CAD/ROD during one of the five-year reviews of this document. However, should the Final CAD/ROD not occur or not include these institutional control mechanisms, this OU 1 CAD/ROD will be revised to include them, if it does not already include them as a result of a five-year review. The institutional controls can also be removed at one of the above times, if it is deemed appropriate to do so by the parties.

3. Because of the groundwater and land use controls, the low amounts of contamination in OU 1 outside of IHSS 119.1, and the low levels of risk associated with the contamination, no remedial action will be taken at the remaining ten IHSSs in OU 1.

Implementing the selected remedy will not result in any irreversible damages to natural resources. Wetlands will not be injured; flood elevations will not be affected; soil and groundwater will be temporarily disturbed during excavation activities, but will not be permanently impacted; and no permanent displacement or loss of wildlife will result from the implementation of the selected remedy.

The selected remedy will achieve the Remedial Action Objectives set for OU 1, which were identified in the CMS/FS report as follows:

- Prevent the inhalation of, ingestion of, and/or dermal contact with VOCs and inorganic contaminants in OU 1 groundwater that would result in a total excess cancer risk greater than 10^{-4} to 10^{-6} for carcinogens, and/or a Hazard Index greater than or equal to one for non-carcinogens.

- Prevent migration of contaminants from subsurface soils to groundwater that would result in groundwater contamination in excess of potential groundwater ARARs for OU 1 contamination.
- Prevent migration of contaminants in OU 1 groundwater from adversely impacting surface water quality in Woman Creek.

These RAOs were selected to address the primary risk exposure pathways identified for OU 1, which are groundwater and subsurface soil pathways. The preliminary remediation goals (PRGs) for these RAOs dealing with groundwater and subsurface soils were identified in the CMS/FS report by examining both risk-based and ARAR-based values. The exposure route of groundwater ingestion resulted in the highest potential risk to a future on-site resident, so the Colorado Basic Standards for Groundwater, found in 5 CCR 1002-8, 3.11.5 and 3.11.6 were selected as appropriate PRGs for OU 1.

Subsequent to the selection of PRGs in the CMS/FS report, however, RFCA was finalized and is currently the governing cleanup agreement for Rocky Flats. The remediation goals in RFCA are based on the protection of surface water and are specified in the ALF. Therefore, the remediation goals for the contaminants at OU 1 are based on the ALF. RFCA also identifies points of compliance for all remedial activities conducted at Rocky Flats, which will be used for the remediation of OU 1.

DOCUMENTATION OF SIGNIFICANT CHANGES

The OU 1 Proposed Plan for Rocky Flats was released for public comment on May 13, 1996. The Proposed Plan identified Alternative 5, Soil Excavation with Groundwater Pumping, as the preferred remedial alternative. DOE reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments, it was determined that no significant changes to the remedy, as it was originally identified in the Proposed Plan, were necessary.

RFI/RI in the Proposed Plan, rather than repeat in detail the information already presented in the RFI/RI report. For the characterization of IHSS 104, the Proposed Plan only referred to a review of documentation. However, conclusions on the characterization of IHSS 104 were also based on investigation data, as presented in the RFI/RI report.

Comment: A written comment was received that expressed concern over the requirement in the IAG to incorporate actions that are completed pursuant to CERCLA authority into the Rocky Flats RCRA permit.

Response: RFCA now requires that CDPHE incorporate only final corrective action decisions into the Rocky Flats RCRA permit in order to satisfy the requirement to include a corrective action element in the permit. In addition, RFCA states that activities required under any concurrence CAD/ROD (where both EPA and CDPHE concur with the CAD/ROD) will not require permits.

Comment: Written comments were received that questioned whether RCRA listed hazardous wastes were disposed at OU 1, based on the contaminants of concern that were identified in the Proposed Plan. The commenter questioned whether the excavated soil should be handled as a RCRA listed hazardous waste.

Response: Based on the RFI/RI, DOE does not have any information to indicate that spent solvents, which would have been RCRA listed hazardous wastes, were disposed at OU 1. Rather, the VOCs listed in the Proposed Plan were identified as contaminants of concern based on sampling and analysis of the groundwater and soil that was conducted at OU 1 during the RFI/RI. DOE cannot conclusively say that these VOC contaminants are the result of the disposal of spent solvents (i.e., RCRA listed hazardous waste), therefore, the RCRA hazardous waste listing does not apply to the contaminants, and the soil does not contain a listed hazardous waste.

The Remedial Design will describe in detail how the excavated soil will be managed. At this point, it is anticipated that the excavated soil, which itself is not a waste, would be considered environmental media containing hazardous constituents that exhibit a hazardous waste characteristic for VOCs. The excavated soil would be treated in a thermal desorption unit. Following this treatment, the soil would be sampled and analyzed to verify the successful removal of VOCs from the excavated soil. At that point, the excavated soil would no longer contain hazardous constituents that exhibit a hazardous waste characteristic. Therefore, land disposal restrictions (LDR) and minimum technological requirements (MTR) would not apply to the excavated soils.

Comment: A written question was received concerning the levels of radioactivity that must be met before placement of soils contaminated with radionuclides is allowed.

Response: Information from the RFI/RI for OU 1 indicates that radionuclide contamination is not expected in the subsurface soils at OU 1. However, as required by RFCA, a working group consisting of representatives from DOE, EPA and the State of Colorado are working on developing site specific radionuclide clean-up and put-back levels for soil. The proposal by this working group will be available for public comment from September 1, 1996, through October 4, 1996. A final decision on this issue is expected to be made by October 18, 1996.

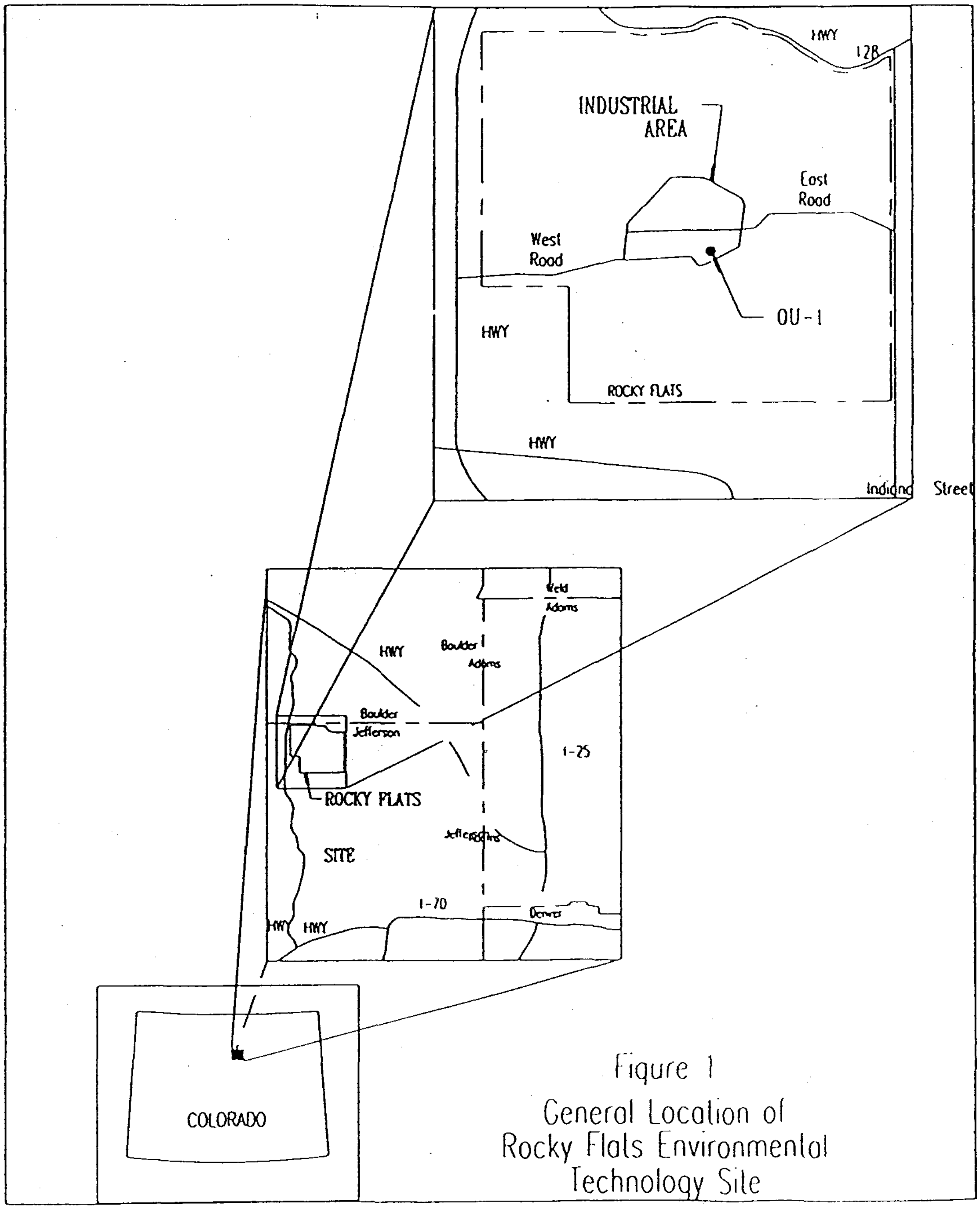


Figure 1
General Location of
Rocky Flats Environmental
Technology Site

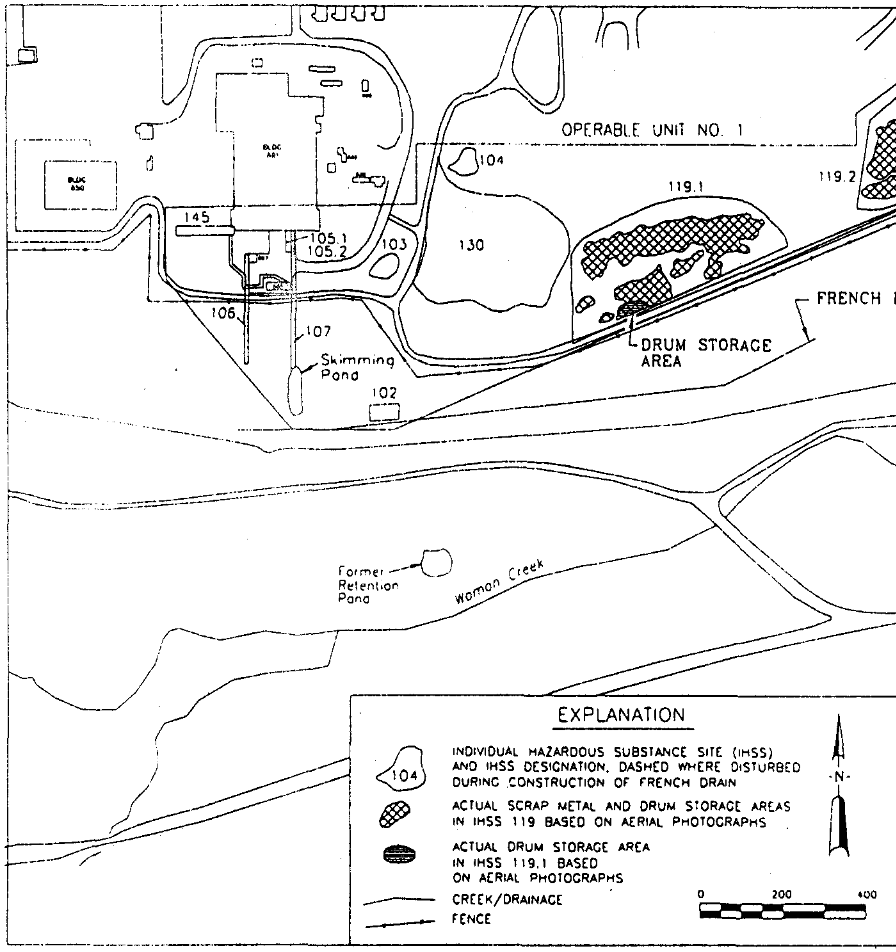


Figure 2

Individual Hazardous Substance Site Locations

Table 1
Individual Hazardous Substance Site Descriptions

IHSS Number	IHSS Name	Description
102	Oil Sludge Pit Site	Approximately 40 x 70 ft^2. area located approximately 180 feet south of Building 881 where 30 to 50 drums of non-radioactive oily sludge were emptied in the late 1950s. The sludge was from the cleaning of two No. 6 fuel oil tanks, designated as IHSSs 105.1 and 105.2, and was backfilled when disposal operations ceased
103	Chemical Burial Site	Approximately 50 feet in diameter (2,000 $ft.^2$), the pit is circular is shape, and is located approximately 150 feet southeast of Building 881 on 1963 aerial photographs. Area was reportedly used to bury unknown chemicals.
104	Liquid Dumping Site	Reportedly a former (pre-1969) liquid waste disposal pond in area east of Building 881 - no exact location or dimensions of pit - location is uncertain due to poor quality of 1965 aerial photograph. Approximate dimensions are 50 x 50 ft^2.
105.1, 105.2	Out-of-Service Fuel Oil Tank Sites	Located immediately south of Building 881, these were storage tanks for No. 6 fuel oil. Suspected leaks in 1972. Tanks closed in place through filling with asbestos-containing material and cement. IHSS 107, the Hillside Oil Leak Site, may have been caused by leakage from these tanks.
106	Outfall Site	Overflow line from the sanitary sewer sump in Building 887. The outfall was used for discharge of untreated sanitary wastes in the 1950s and 1960s. Due to concern about discharges from the outfall entering Woman Creek, several small retention ponds and an interceptor ditch were built in 1955 and 1979, respectively, to divert the outfall water to Pond C-2.
107	Hillside Oil Leak Site	Site of 1972 fuel oil spill from Building 881 foundation drain outfall. A concrete skimming pond was built below the foundation drain outfall to contain the oil flowing from the foundation drain, and an interceptor ditch was constructed to prevent oil-contaminated water from reaching Woman Creek.
119.1, 119.2	Multiple Solvent Spill Sites	Former drum storage areas east of Building 881 along the southern perimeter road. IHSS 119.1 is the larger western drum and scrap metal storage area, and appears to have contained mostly drums in the southern part of the IHSS and mostly scrap metal in the northern part, although material was moved around frequently as documented by aerial photographs. IHSS 119.2 is the smaller eastern drum and scrap metal storage area and appears to have contained mostly scrap metal. The drums contained unknown quantities and types of solvents and wastes. The scrap metal may have been coated with residual oils and/or hydraulic coolants.
130	Radioactive Site - 800 Area #1	Area east of Building 881. Used between 1969 and 1972 to dispose of soil and asphalt contaminated with low levels of plutonium and uranium. IHSS 130 is referred to as the Contaminated Soil Disposal Area East of Building 881 in the HRR to better match the history of waste disposal; the site is included in the discussion of the 900 area at RFETS in that report. IHSS 130 contains approximately 320 tons or 250 cubic yards which came from three sources: 1) plutonium-contaminated soil and asphalt, placed in September of 1969, 2) road asphalt and soil rad contaminated by leaking drum in transit and 3) 60 cu. yds. of plutonium-contaminated soil removed from around the Building 774 process waste tanks in 1972.
145	Sanitary Waste Line Leak	Six-inch cast-iron sanitary sewer line that originates at the Building 887 lift station and that leaked on the hillside south of Building 881. The line had conveyed sanitary wastes and low-level radioactive laundry effluent to the sanitary treatment plant from about 1969 to 1973.

Table 3: Summary of VOC Concentrations in Groundwater, IHSS 119.1, 1987-1995

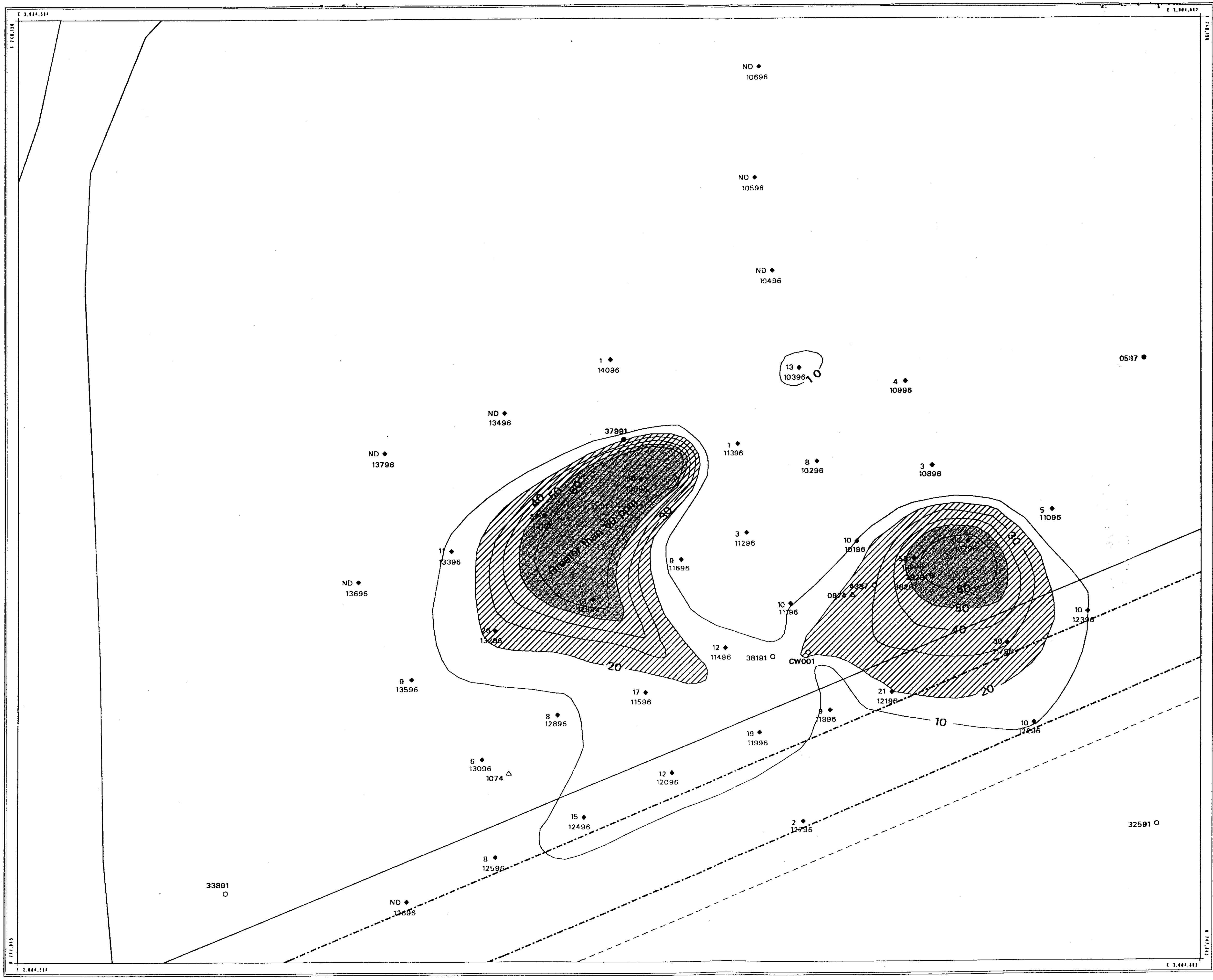
Well No.	Compound	Range of Concentrations (ug/L)
0974	CCL_4	5U - 2,800
	1,1-DCE	500U - 48,000
	TCA	1,220 - 30,250
	PCE	430 - 13,200
	TCE	1,500 - 72,000
1074	CCL_4	2,500E - 5,000
	1,1-DCE	42J - 120
	TCA	50U - 390
	PCE	100U - 49
	TCE	790 - 3,600
0487	CCL_4	46 - 2,600
	1,1-DCE	2U - 12
	TCA	3.2 - 20
	PCE	14 - 590
	TCE	220 - 9,500
4387	CCL_4	40U - 2,100
	1,1-DCE	1,400 - 11,000
	TCA	1,700 - 20,000
	PCE	61 - 7,590
	TCE	100 - 15,540
37891	CCL_4	0.2U
	1,1-DCE	0.2U
	TCA	0.1U
	PCE	0.1U - 7.1B
	TCE	0.1U - 1.3
37991	CCL_4	0.1U - 0.2
	1,1-DCE	0.2U
	TCA	0.1U
	PCE	0.1U - 16
	TCE	0.1U - 3.3
32591	CCL_4	0.1
	1,1-DCE	0.68 - 6
	TCA	0.4 - 2
	PCE	1 - 3
	TCE	5U - 1100

Note: Well 0587 had 12 ug/L TCE on (8/92), well 33491 had 1 ug/L TCE (11/94), and wells 33691, and 38291 were not sampled. U=not detected at or above method detection limit, B=appeared in method blank, E=estimated value, and J=estimated value.

Summary of VOC Physical Characteristics

Compound	Solubility (mg/L)	Specific Density (20°) (g/cc)	Log K_{ow}, Octanol Water Coefficient	Henry's Law Constant (atm-m^3/mol)
CCL_4	800	1.59	2.83	0.0302
1,1-DCE	400	1.22	2.13	0.021
TCA	1360	1.34	2.47	0.018
PCE	150	1.62	2.60	0.0153
TCE	1100	1.46	2.53	0.0091

Compiled from Cohen, R.M., Mercer, J.W., and Mathews, J., 1993. DNAPL Site Evaluation: C.K. Smoley, Publisher.



881 Hillside Area (OU1)
In the Vicinity of IHSS 119.1

Volatile Chlorinated Hydrocarbon Head Space Concentractions

Figure 3

EXPLANATION

- △ Pre-1986 Wells (Abandoned)
- ◆ Borehole Locations
- ○ Groundwater WELLS (Alluvium)
- ● Groundwater WELLS (Bedrock)
- ⊕ Piezometers
- Individual Hazardous Substance Sites
- Fences
- Dirt Roads
- Contours Intervals 10 ppm

ND = Not Detected
NS = Not Sampled
Head Space readings in ppm
Detection limit 0.1 ppm

Concentrations represent greatest readings from 0-22 feet below grades

- Estimated excavation Area using 20ppm head space concentrations as the cut off.
- Estimated excavation area using 50ppm head space concentrations as the cut off.

DATA SOURCE:
Ground Water data provided by RMRS/Hydrogeology, - 1995.
Borehole Sampling locations provided by Geosciences.

N

Scale = 1 : 250
1 inch represents approximately 21 feet

5 0 10 20ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

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MAP ID: Fig6-1

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/home/r618182/projects/ou1/map-1.aml