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CORRECTIVE MEASURES STUDY/FEASIBILITY STUDY
TECHNICAL MEMORANDUM NO. 1
DEVELOPMENT OF CORRECTIVE/REMEDIAL ACTION OBJECTIVES
FOR OPERABLE UNIT NO. 6
WALNUT CREEK PRIORITY DRAINAGE

U.S. Department of Energy
Rocky Flats Environmental Technology Site
Golden, Colorado

Final
Revision 0

May 1995

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CMS/FS TECHNICAL MEMORANDUM NO. 1
APPROVAL SHEET

EG&G Rocky Flats, Inc	Document Number	RF/ER-95-0015
	Section	Approval Sheet
	Page	1 of 1
	Effective Date	May 1995
	Organization	ER OU 5, 6, & 7 Closures

TITLE

Operable Unit No 6, Technical Memorandum No 1
Corrective Measures Study/Feasibility Study
Development of Corrective/Remedial Action Objectives
Rocky Flats Environmental Technology Site
Walnut Creek Priority Drainage

APPROVED BY

_____ _____/_____/_____
OU 5, 6, & 7 Closures Program Manager Date

_____ _____/_____/_____
OU6 Project Manager Date

_____ _____/_____/_____
ER QA Program Manager Date

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LIST OF ACRONYMS

AEA	Atomic Energy Act
ARAR	Applicable or Relevant and Appropriate Requirement
BRA	Baseline Risk Assessment
CAO	Corrective Action Objective
CCR	Colorado Code of Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMS/FS	Corrective Measures Study/Feasibility Study
C/RAO	Corrective and/or Remedial Action Objective
COC	Chemical of Concern
CT	Central Tendency
DCG	Derived Concentration Guide
DOE	U S Department of Energy
EPA	U S Environmental Protection Agency
ERA	Ecological Risk Assessment
FR	Federal Register
GRRASP	General Radiochemistry and Routine Analytical Services Protocol
HHRA	Human Health Risk Assessment
IAG	Interagency Agreement
IHSS	Individual Hazardous Substance Site
LDR	Land Disposal Restriction
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OU	Operable Unit
PCB	Polychlorinated Biphenyl
PQL	Practical Quantification Limit
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure

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LIST OF ACRONYMS
(Continued)

ROD	Record of Decision
TBC	To-Be-Considered (Criterion or Guideline)
TCLP	Toxicity Characteristic Leaching Procedure
TSCA	Toxic Substances Control Act
UHSU	Upper Hydrostratigraphic Unit
UTL	Upper Tolerance Limit
VOC	Volatile Organic Compound
WQCC	Water Quality Control Commission

EXECUTIVE SUMMARY

This Technical Memorandum presents the Corrective/Remedial Action Objectives (C/RAOs) and remediation targets that will be used to identify and develop alternatives for the potential remediation of Operable Unit No 6 (OU6) at the Rocky Flats Environmental Technology Site (RFETS) The C/RAOs and remediation targets were selected to control residual risk to human health and the environment It is proposed that the C/RAOs, remediation targets, and subsequent remedial alternatives, if required, be developed on an environmental medium basis

For the purpose of this Technical Memorandum, potentially contaminated areas are defined as those Individual Hazardous Substance Sites (IHSSs) where Chemical of Concern (COC) concentrations exceed the corresponding remediation targets selected for environmental media IHSSs and/or environmental media where all of the COC concentrations are below the selected remediation targets are not considered contaminated and are, therefore, being recommended for No Further Action The process for selecting the remediation targets generally consisted of the following steps

- Identify the human health COCs based on the results of the Resource Conservation and Recovery Act (RCRA) Facility Investigation and Remedial Investigation (RFI/RI) Technical Memorandum No 4 (DOE, 1994a) [See Section 2 1]

- Eliminate those IHSSs, COCs, and environmental media that do not pose a significant risk, based on the results of the Colorado Department of Public Health and Environment (CDPHE) Conservative Screen (DOE, 1994b) [See Section 2 2]

- Develop general C/RAOs to specify the contaminants and media of interest, exposure pathways, and acceptable ranges for each exposure route [See Section 3 0]

- Select remediation targets for each OU6 environmental medium The remediation targets are considered initial cleanup standards for developing and screening potential remedial alternatives [See Section 4 0]

- Compare the selected remediation targets against the maximum COC concentrations to determine which IHSSs and/or environmental media may need to be remediated and which can be recommended for No Further Action [See Section 5 0]

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The Baseline Risk Assessment (BRA), which includes the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA), has not been completed for OU6 Therefore RFETS-wide programmatic exposure scenarios were used The programmatic exposure scenarios are based on conservatively assumed pathways, receptors, and exposure factors that will most likely be addressed in the OU6 HHRA The programmatic exposure scenarios include the future land uses of Open Space, Office and Construction Work, and Ecological Research Although there is a certain level of risk associated with developing remedial alternatives prior to fully characterizing the risks associated with OU6, the approach adopted for this Technical Memorandum is consistent with the procedures outlined in Section 300 430(e)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Developing and screening remedial alternatives prior to completion of the BRA is intended to focus the OU6 Corrective Measures Study/Feasibility Study (CMS/FS) and to identify potential CMS/FS data needs as early as possible to avoid further delays Although it is not expected that the final HHRA will modify the programmatic Preliminary Remediation Goals (PRGs) significantly, the selected remediation targets will be assessed prior to selecting a final remedy to ensure that the results of the final HHRA are properly addressed

COCs for environmental receptors are currently being developed and are not available for inclusion into this Technical Memorandum In their absence, it was assumed that the remediation targets established for the protection of human health will also be protective of the environment This assumption will allow the development and screening of remedial technologies to progress for OU6 Should the final ERA indicate that the remediation targets selected for OU6 do not adequately protect the environment, the required changes will be incorporated as early as possible during the development of the CMS/FS

Numerous criteria were considered in selecting the remediation targets These include potential chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) and to-be-considered criteria or guidelines (TBCs), programmatic risk-based PRGs, background concentrations, analytical detection limits, and cleanup standards that were previously established at other National Priorities List (NPL) sites within the State of Colorado The rationale for identifying potential chemical-specific ARARs/TBCs and for selecting each remediation target is presented in Section 4 0 of this Technical Memorandum The selected remediation targets were then compared against the maximum RFI/RI COC concentrations This comparison and the results of the CDPHE Conservative Screen led to the following conclusions

- Remediation of surface and subsurface soils, pond and stream sediments, and surface water is not required Although a No Further Action determination is proposed for these OU6 environmental media, pond sediments and surface water will continue to be managed in accordance with the National Pollutant Discharge

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Elimination System (NPDES) permit as an on-going operational activity rather than a remedial/corrective action required under the Interagency Agreement (IAG)

- The groundwater COC concentrations which exceed the selected remediation targets include nitrate, methylene chloride, tetrachloroethene, trichloroethene, and vinyl chloride The potential sources for most of the chemicals detected in upper hydrostratigraphic unit (UHSU) groundwater at OU6 are inferred to be contaminant migration from upgradient sources As such, it is proposed that portions of the OU6 groundwater medium be transferred to other OUs to more effectively assess risks and potential remedial technologies

- The extent of potential contamination for the two groundwater areas that will be carried forward into the development and screening of remedial technologies appears to be very localized and could be the result of analytical laboratory contamination This is especially likely for methylene chloride The potential for laboratory contamination will be assessed during the development of CMS/FS Technical Memorandum No 2 for OU6 If the presence of these groundwater contaminants cannot be attributed to laboratory contamination, alternatives for remediating potentially contaminated groundwater will be developed These alternatives could include treatment, containment, and institutional control The remedial alternatives developed for the contaminated groundwater areas would only be implemented based on the final BRA results

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1.0 INTRODUCTION

Operable Unit No 6 (OU6) is one of several areas at the Rocky Flats Environmental Technology Site (RFETS) which may require remediation in accordance with provisions of the 1991 Interagency Agreement (IAG) between the U S Department of Energy (DOE), the U S Environmental Protection Agency (EPA), and the State of Colorado (IAG, 1991) for the protection of human health and the environment As outlined in Section IX A 1 of the IAG Statement of Work, Corrective/Remedial Action Objectives (C/RAOs) are to be developed to specify the contaminants and media of interest, exposure pathways and receptors, and accepted levels or ranges of levels for each exposure route This Technical Memorandum is intended to fulfill these requirements for OU6 by establishing C/RAOs that are protective of human health and the environment

This Technical Memorandum presents the remediation targets that have been selected for OU6 The following information was considered in establishing these remediation targets

- The human health chemicals of concern (COCs) for OU6 presented in Resource Conservation and Recovery Act (RCRA) Facility Investigation and Remedial Investigation (RFI/RI) Technical Memorandum No 4 (DOE, 1994a) and the results of the Colorado Department of Public Health and Environment (CDPHE) Conservative Screen (DOE, 1994b)

- Potential chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) and to-be-considered criteria or guidelines (TBCs),

- Programmatic risk-based PRGs, and

- Other pertinent information, including background concentrations, analytical detection limits, and cleanup standards that were previously established at other National Priorities List (NPL) sites within the State of Colorado

This Technical Memorandum contains five sections, including this introduction Section 2 0 provides background information for OU6 The C/RAOs and remediation targets developed for the OU6 COCs are described in Sections 3 0 and 4 0, respectively Section 5 0 presents a comparison of the remediation targets against the maximum COC concentrations in addition to the conclusions and recommendations, such as No Further Action, to streamline subsequent Corrective Measures Study/Feasibility Study (CMS/FS) efforts References used to prepare this Technical Memorandum follow Section 5 0 and the results of the CDPHE Conservative Screen are presented in Appendix A

2.0 BACKGROUND

OU6 is one of 16 operable units at the RFETS and is located in the northeastern quadrant of the industrial area and buffer zone The 19 Individual Hazardous Substance Sites (IHSSs) contained within OU6 are shown in Figure 2-1 and include

- Sludge Dispersal Area (IHSS 141),
- A-Series and B-Series Retention Ponds (IHSSs 142 1 through 142 9),
- Walnut and Indiana Pond (IHSS 142 12),
- Old Outfall (IHSS 143),
- Soil Dump Area (IHSS 156 2),
- Triangle Area (IHSS 165),
- Trenches (IHSSs 166 1, 166 2, and 166 3),
- North Area Spray Field (IHSS 167 1), and
- East Area Spray Field (IHSS 216 1)

In addition to the above, IHSS 167 2 (Pond Area Spray Field) and IHSS 167 3 (South Area Spray Field) were originally included as part of the RFI/RI work plan for OU6 However, during the OU6 characterization activities, it was determined that the South Area Spray Field was actually located further north, adjacent to the landfill pond Because the landfill is the most likely source of potential contamination for these two IHSSs, they were administratively transferred to OU7 for investigation and any subsequent remediation The characterization information that was collected for the originally suspected location for IHSS 167 3 is being retained to assess the remediation needs for OU6 The original IHSS 167 3 location has been designated as the Former South Area Spray Field (F167 3) to distinguish it from the current IHSS 167 3 being addressed as part of OU7 Although F167 3 is retained in this document for completeness, this location is not formally considered an OU6 IHSS

Information associated with each IHSS is presented in the *Phase I RFI/RI Workplan for OU6 - Walnut Creek Priority Drainage* (EG&G, 1992) and the *Historical Release Report for the Rocky Flats Plant* (DOE, 1992) An RFI/RI program was implemented to characterize the OU6 IHSSs The RFI/RI workplan was structured so that characterization samples would not be collected from areas which were not suspected to be contaminated Table 2-1 shows the IHSS environmental media that were included as part of the RFI/RI characterization program The table cells with "--" entries represent the IHSS media not covered or suspected to be contaminated These IHSS media are, therefore, not included in developing C/RAOs and remediation targets for OU6

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TABLE 2-1
ENVIRONMENTAL MEDIA SAMPLED DURING OU6 RFI/RI

IHSS/Location	Surface Soil	Subsurface Soil	Sediment [a/]	Ground-water	Surface Water
Sludge Dispersal Area (IHSS 141)	X [b/]	--	--	X	--
Pond A-1 (IHSS 142 1)	--	--	X	X	X
Pond A-2 (IHSS 142 2)	--	--	X	X	X
Pond A-3 (IHSS 142 3)	--	--	X	X	X
Pond A-4 (IHSS 142 4)	--	--	X	X	X
Pond B-1 (IHSS 142 5)	--	--	X	X	X
Pond B-2 (IHSS 142 6)	--	--	X	X	X
Pond B-3 (IHSS 142 7)	--	--	X	X	X
Pond B-4 (IHSS 142 8)	--	--	X	X	X
Pond B-5 (IHSS 142 9)	--	--	X	X	X
Walnut and Indiana Pond (IHSS 142 12)	--	--	X	X	X
Old Outfall (IHSS 143)	X	X	--	X	--
Soil Dump Area (IHSS 156 2)	X	X	--	--	--
Triangle Area (IHSS 165)	X	X	--	X	--
Trench A (IHSS 166 1)	--	X	--	X	--
Trench B (IHSS 166 2)	--	X	--	X	--
Trench C (IHSS 166 3)	--	X	--	X	--
North Area Spray Field (IHSS 167 1)	X	X	--	--	--
Former South Area Spray Field (F167 3)	X	X	--	X	--
East Area Spray Field (IHSS 216 1)	X	X	--	--	--

a/ "X" indicates that the environmental medium was sampled during the RFI/RI
b/ Sediment includes both ponds and stream beds

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The RFI/RI characterization information is being evaluated as part of the Baseline Risk Assessment (BRA) in an effort to determine what IHSSs and environment media may require remediation The activities completed to date include RFI/RI Technical Memorandum No 4 (DOE, 1994a) to identify the human health COCs and the CDPHE Conservative Screen (DOE, 1994b) to identify IHSSs that require early remedial action, IHSSs to be considered further in the risk assessment process, and IHSSs or environmental media warranting No Further Action The results of these two documents were used as the starting point to develop remediation targets and to focus the OU6 CMS/FS Subsection 2 1 presents the methods used to establish the COCs for OU6, and Subsection 2 2 summarizes the results of the CDPHE Conservative Screen

2.1 Chemicals of Concern

COCs are defined as compounds that (1) are detected at concentrations that are statistically different from their corresponding background concentrations, or (2) where background information does not exist, are detected at a frequency and concentration to pose a concern, or are present at limited locations in a sufficiently high concentration to pose a special concern to human health or the environment The COCs are currently based on human health considerations Environmental COCs are being finalized and will be incorporated into subsequent CMS/FS documents, as appropriate In the absence of quantitative exposure pathways to environmental receptors, it is assumed that the remediation targets established for the protection of human health will also be protective of the environment This assumption will allow the development and screening of remedial technologies to progress for OU6 Should the final Ecological Risk Assessment (ERA) indicate that more stringent remediation targets need to be established to protect the environment, future CMS/FS documents will incorporate this information as appropriate A C/RAO was included in Section 3 0 of this Technical Memorandum to ensure that potential ecological impacts are considered during the CMS/FS

Table 2-2 lists the OU6 human health COCs which were previously presented in RFI/RI Technical Memorandum No 4 (DOE, 1994a) The OU6 human health COCs are indicated by the "Xs" in this table and include several metals, radionuclides, volatile organic compounds (VOCs), semivolatile organic compounds, and polynuclear aromatic hydrocarbons, Aroclor-1254 [a polychlorinated biphenyl (PCB)], and nitrate A special-case COC (e g , vinyl chloride for groundwater) is also included in Table 2-2 The human health COCs were evaluated on an IHSS basis for each environmental medium The results of this evaluation are presented in Tables 2-3 through 2-7

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TABLE 2-2
HUMAN HEALTH CHEMICALS OF CONCERN BY ENVIRONMENTAL MEDIUM

Chemical	Surface Soil	Subsurface Soil	Sediment		Ground-water	Surface Water
			Pond	Stream		
Acetone	--	--	--	--	--	X [a/]
Antimony	X	--	X	--	--	--
Aroclor-1254	--	--	X	--	--	--
Barium	--	X	--	--	--	--
Benzo(a)anthracene	--	--	--	X	--	--
Benzo(a)pyrene	--	X	X	X	--	--
Benzo(b)fluoranthene	--	X	X	X	--	--
Bis(2-ethylhexyl)phthalate	--	--	X	--	--	--
Chloroform	--	--	--	--	X	X
Cobalt	--	--	--	X	--	--
1,2-Dichloroethene	--	--	--	--	--	X
Indeno(1,2,3-cd)pyrene	--	--	--	X	--	--
Methylene Chloride	--	X	--	--	X	X
Nitrate	--	--	--	--	X	--
Silver	X	--	X	--	--	--
Strontium	--	--	--	X	--	--
Tetrachloroethene	--	--	--	--	X	--
Trichloroethene	--	--	--	--	X	X
Vanadium	X	--	X	X	--	--
Vinyl Chloride	--	--	--	--	X	--
Zinc	X	--	X	X	--	--
Americium-241	X	X	X	X	X	--
Plutonium-239/240	X	X	X	X	X	--
Radium-226	--	--	--	--	X	--
Uranium-233/234	--	X	--	--	--	--
Uranium-238	--	X	--	--	--	--

[a/] "X" indicates that chemical was identified as a COC for the environmental medium (DOE, 1994a)

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TABLE 2-3
SURFACE SOIL CHEMICALS OF CONCERN BY IHSS

Surface Soil Chemical of Concern	Sludge Dispersal Area (IHSS 141)	Old Outfall (IHSS 143)	Soil Dump Area (IHSS 156 2)	Triangle Area (IHSS 165)	North Area Spray Field (IHSS 167 1)	Former South Area Spray Field (F167 3)	East Area Spray Field (IHSS 216 1)
Antimony	--	--	X [a/]	--	--	--	--
Silver	X	--	--	--	--	--	--
Vanadium	X	X	X	--	--	--	--
Zinc	X	X	X	X	--	X	--
Americium-241	X	--	X	X	X	X	X
Plutonium-239/240	X	X	X	X	X	X	X

[a/] "X" indicates that the chemical is identified as a COC within the IHSS

TABLE 2-4
SUBSURFACE SOIL CHEMICALS OF CONCERN BY IHSS

Subsurface Soil Chemical of Concern	Old Outfall (IHSS 143)	Soil Dump Area (IHSS 156 2)	Triangle Area (IHSS 165)	Trench A (IHSS 166 1)	Trench B (IHSS 166.2)	Trench C (IHSS 166 3)	North Area Spray Field (IHSS 167 1)	Former South Area Spray Field (F167 3)	East Area Spray Field (IHSS 216 1)
Barium	X[a/]	X	X	X	X	X	X	--	X
Benzo(a)pyrene	X	--	X	--	--	--	--	--	--
Benzo(b)fluoranthene	X	--	X	--	--	--	--	--	--
Methylene Chloride	X	X	X	X	X	X	--	X	X
Americium-241	X	X	X	--	X	X	X	X	X
Plutonium-239/240	X	X	X	X	--	X	X	X	X
Uranium-233/234	--	--	--	--	--	--	X	--	--
Uranium-238	X	--	X	--	--	--	X	--	--

[a/] "X" indicates that the chemical is identified as a COC within the IHSS

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TABLE 2-5
SEDIMENT CHEMICALS OF CONCERN BY IHSS

Sediment Chemical of Concern	Pond A-1 (IHSS 142 1)	Pond A-2 (IHSS 142 2)	Pond A-3 (IHSS 142 3)	Pond A-4 (IHSS 142 4)	Pond B-1 (IHSS 142 5)	Pond B-2 (IHSS 142 6)	Pond B-3 (IHSS 142 7)	Pond B-4 (IHSS 142 8)	Pond B-5 (IHSS 142 9)	Walnut & Indiana Pond (IHSS 142 12)	Stream Sediments
Antimony	--	--	--	X [a]	--	--	X	--	--	--	--
Aroclor-1254	X	X	--	--	X	X	X	X	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--	--	--	--	--	X
Benzo(a)pyrene	X	X	X	--	X	X	X	X	--	--	X
Benzo(b)fluoranthene	X	--	X	--	X	--	X	X	--	--	X
Bis(2-ethylhexyl)phthalate	X	X	X	X	X	X	X	X	X	X	--
Cobalt	--	--	--	--	--	--	--	--	--	--	X
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--	--	X
Silver	--	--	--	--	X	X	X	X	--	--	--
Strontium	--	--	--	--	--	--	--	--	--	--	X
Vanadium	--	--	X	X	--	--	--	--	--	--	X
Zinc	X	X	X	X	X	X	X	X	X	--	X
Americium-241	X	X	--	--	X	X	X	X	--	--	X
Plutonium-239/240	X	X	--	--	X	X	X	X	--	--	X

[a] "X" indicates that the chemical is identified as a COC within the IHSS

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TABLE 2-6
GROUNDWATER CHEMICALS OF CONCERN BY GROUNDWATER AREA

Groundwater Chemical of Concern	Groundwater Area 1 [a/]	Groundwater Area 2 [b/]	Groundwater Area 3 [c/]	Groundwater Area 4 [d/]	Groundwater Area 5 [e/]	Groundwater Area 6 [f/]
Chloroform	X [g/]	X	--	--	--	X
Methylene Chloride	X	X	X	X	X	X
Nitrate	--	X	--	--	--	--
Tetrachloroethene	X	X	X	X	--	X
Trichloroethene	X	X	X	X	--	X
Vinyl Chloride	--	--	X	--	--	--
Americium-241	X	X	X	--	X	X
Plutonium-239/240	--	X	X	--	X	X
Radium-226	--	X	--	--	X	X

a/ Associated IHSSs include 166 1, 166 2, and 166 3 Also includes F167 3
b/ Associated IHSSs include 142 1, 142 2, 142 3, and 142 4
c/ Associated IHSSs include 141, 142 5, 142 6, 142 7, 142 8, and 142 9
d/ Associated with IHSS 165
e/ Associated with IHSS 142 12
f/ Associated with IHSS 143
g/ "X" indicates that the chemical is identified as a COC within the Groundwater Area

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TABLE 2-7
SURFACE WATER CHEMICALS OF CONCERN BY IHSS

Surface Water Chemical of Concern	Pond A-1 (IHSS 142 1)	Pond A-2 (IHSS 142 2)	Pond A-3 (IHSS 142.3)	Pond A-4 (IHSS 142 4)	Pond B-1 (IHSS 142 5)	Pond B-2 (IHSS 142.6)	Pond B-3 (IHSS 142.7)	Pond B-4 (IHSS 142 8)	Pond B-5 (IHSS 142 9)	Walnut & Indiana Pond (IHSS 142 12)
Acetone	--	--	--	--	X [a/]	X	X	X	X	X
Chloroform	--	--	--	--	--	--	X	X	X	--
1,2-Dichloroethene	--	--	--	--	--	X	--	--	--	--
Methylene Chloride	--	--	--	--	--	--	X	X	--	--
Trichloroethene	--	--	--	--	--	X	--	X	--	--

a/ "X" indicates that the chemical is identified as a COC within the IHSS

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2.2 CDPHE Conservative Screen Results

The purpose of the CDPHE Conservative Screen was to support the risk assessment efforts through the identification of IHSSs that require early remedial action, IHSSs to be considered further in the risk assessment, and IHSSs or environmental media warranting No Further Action The detailed results of the CDPHE Conservative Screen were presented in a letter report dated October 1994 (DOE, 1994b) This subsection summarizes the results of the CDPHE Conservative Screen to focus the development of the C/RAOs

The conservative screen used the maximum COC concentrations within a given source area to conservatively estimate the human health risks for each environmental medium based on a residential exposure scenario The COC-specific risk ratios within the source area were summed to produce IHSS-specific carcinogenic and hazard index risk ratios Risk ratios below one (e g , carcinogenic risks below 10^{-6} or hazard indices below one for noncarcinogens) indicate that the human health concerns are negligible Although dermal exposure is considered to be an insignificant exposure pathway, it was considered as part of the human health risk calculation when the risk ratio was determined to be less than one to verify that the addition of dermal exposure would not cause the overall risk ratio to exceed one

Table 2-8 identifies the environmental media and IHSSs that warrant further evaluation in the CMS/FS based on the results of the CDPHE Conservative Screen A more detailed summary of the CDPHE Conservative Screen results (i e , the numeric values for the calculated risk ratios) is provided as Appendix A The "yes" entry in this table denotes environmental media and IHSS locations that exceed the risk ratio threshold of one However, none of these IHSSs or environmental media were identified as warranting early remedial action The shaded "no" entries in Table 2-8 are the IHSSs and environmental media that have a risk ratio less than one These IHSSs and environmental media present insignificant risk to human health and were excluded in developing the OU6 C/RAOs and remediation targets The excluded IHSSs and environmental media are being recommended for No Further Action Because risk to human health is assumed to drive remediation, the No Further Action recommendations presented in the CDPHE Conservative Screen are being adopted for this Technical Memorandum The shaded "--" entries indicate those IHSS media that were not included as part of the RFI/RI workplan since there is no reason to suspect that these IHSS media are contaminated

The conclusions and recommendations summarized below originate from the CDPHE Conservative Screen and specifically apply to the development of the CMS/FS

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TABLE 2-8
CDPHE CONSERVATIVE SCREEN SUMMARY

IHSS/Location	Surface Soil	Subsurface Soil	Sediment		Ground-water	Surface Water [a/]
			Pond	Stream		
Sludge Dispersal Area (IHSS 141)	Yes [b/]	--	-- [c/]	--	Yes	--
Pond A-1 (IHSS 142 1)	--	--	Yes	--	Yes	No [d/]
Pond A-2 (IHSS 142 2)	--	--	Yes	--	Yes	No
Pond A-3 (IHSS 142 3)	--	--	Yes	--	Yes	No
Pond A-4 (IHSS 142 4)	--	--	No	--	Yes	No
Pond B-1 (IHSS 142 5)	--	--	Yes	--	Yes	No
Pond B-2 (IHSS 142 6)	--	--	Yes	--	Yes	No
Pond B-3 (IHSS 142 7)	--	--	Yes	--	Yes	No
Pond B-4 (IHSS 142 8)	--	--	Yes	--	Yes	No
Pond B-5 (IHSS 142 9)	--	--	No	--	Yes	No
Walnut and Indiana Pond (IHSS 142 12)	--	--	No	--	Yes	No
Old Outfall (IHSS 143)	Yes	Yes	--	--	Yes	--
Soil Dump Area(IHSS 156 2)	Yes	Yes	--	--	--	--
Triangle Area (IHSS 165)	Yes	Yes	--	--	Yes	--
Trench A (IHSS 166 1)	No	No	--	--	Yes	--
Trench B (IHSS 166 2)	No	No	--	--	Yes	--
Trench C (IHSS 166 3)	No	No	--	--	Yes	--
North Area Spray Field (IHSS 167 1)	Yes	Yes	--	--	--	--
Former South Area Spray Field (F167 3)	No	No	--	--	Yes	--
East Area Spray Field [a/] (IHSS 216 1)	No	No	--	--	--	--
North Walnut Creek	--	--	--	Yes	--	--
South Walnut Creek	--	--	--	Yes	--	--
Upgradient	--	--	--	Yes	--	--
Walnut Creek at Indiana Street [a/]	--	--	--	No	--	--

a/ Shading indicates that medium or IHSS/Location does not warrant further consideration

b/ "Yes" indicates that the sum of the maximum COC concentrations divided by their respective toxicity factor for the IHSS/Location exceeds a risk ratio of one

c/ "--" indicates the IHSS medium is not suspected to be contaminated and was not characterized

d/ "No" indicates IHSS/Location or environmental medium does not pose a significant human health risk

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- The East Area Spray Field (IHSS 216 1) is classified as a No Further Action area based on negligible risk (e g , risk ratios less than 1) [NOTE The added potential risk from dermal exposure was found to be insignificant]

- Walnut Creek stream bed sediments located at Indiana Street were determined to present an insignificant risk

- The soil and sediment risk ratios for the below-listed IHSSs were less than 1 (see Appendix A) As such, these IHSS environmental media do not require remediation (i e , No Further Action) [NOTE The added potential risk from dermal exposure was found to be insignificant]

  - Trenches A, B, and C (IHSSs 166 1 through 166 3),
  - Former South Area Spray Field (F167 3),
  - Pond A-4 (IHSS 142 4),
  - Pond B-5 (IHSS 142 9), and
  - Walnut and Indiana Pond (IHSS 142 12)

- With respect to groundwater, further evaluation was indicated for all of the IHSSs included in the RFI/RI workplan However, the CDPHE Conservative Screen concluded that the OU6 "IHSSs are not considered sources of contamination to groundwater because (1) soil or sediment contaminant levels are so low that measurable impacts on groundwater are unlikely, (2) other sources of groundwater contamination are evident or suspected, or (3) maximum concentrations of COCs in the groundwater area under evaluation were observed at sampling locations remote from these IHSSs " As such, C/RAOs for providing source controls to prevent migration of contaminants to the groundwater have not been included for OU6

- Although not specifically stated in the CDPHE Conservative Screen letter report, the entire surface water medium is being eliminated from further consideration in the CMS/FS This conclusion is based on the low risk ratios estimated for the surface water pathway (see Appendix A) Although surface water remediation is not required, surface waters will continue to be managed in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements and approved plans

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3.0 CORRECTIVE/REMEDIAL ACTION OBJECTIVES FOR OU6

The IAG requires that an appropriate range of C/RAOs be established to screen and evaluate corrective/remedial alternatives The C/RAOs are, at a minimum, to be developed to protect human health and the environment These objectives shall specify the contaminants and media of interest, exposure pathways, and acceptable levels or ranges of levels for each exposure route The OU6 C/RAOs were developed using regulatory guidelines (EPA, 1988) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and by considering programmatic human health exposure pathways Specifically, 40 Code of Federal Regulations (CFR) 300 430(e)(2)(i) states that, "[I]nitially, Preliminary Remediation Goals [PRGs] are developed based on readily available information, such as chemical-specific [ARARs] or other reliable information [PRGs] should be modified, as necessary, as more information becomes available during the RI/FS [Remedial Investigation/Feasibility Study] Final remediation goals will be determined when the remedy is selected " Using programmatic exposure scenarios maintains a consistent approach across all OUs and also expedites the overall remediation schedule for OU6 by allowing the Corrective Measures Study/Feasibility Study (CMS/FS) to proceed Should the BRA (e g , Human Health Risk Assessment (HHRA) or the ERA for Walnut Creek drainage basin) identify additional exposure pathways not addressed, the C/RAOs will be revised accordingly and incorporated in subsequent CMS/FS documents

The Corrective Action Objectives (CAOs) were identified to consider applicable RCRA hazardous waste management requirements during development of the CMS/FS For those remediation wastes determined to be hazardous, proper management will be incorporated into implementation of the selected remedial alternative

The Remedial Action Objectives (RAOs) were identified to consider applicable Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cleanup requirements EPA guidance (EPA, 1988) states that "[RAOs] should be as specific as possible, but not so specific that the range of alternatives that can be developed is unduly limited " The guidance also specifies that in order to quantify RAOs, remediation targets are to identify an acceptable target contaminant level or range of levels for each exposure route of concern

The combined consideration of RCRA CAOs and CERCLA RAOs will implement these two environmental protection programs into the remediation efforts for OU6 The media-specific C/RAOs that have been identified for OU6 are listed below

- Remediate contaminated surface and/or subsurface soils to non-zero chemical-specific ARARs/TBCs, as appropriate In the absence of chemical-specific

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ARARs/TBCs, prevent exposure to contaminated surface and/or subsurface soils that would result in a total excess cancer risk greater than 10^{-4} to 10^{-6} or a hazard index of greater than 1 for noncarcinogens

- Remediate contaminated pond and/or stream sediments to non-zero chemical-specific ARARs/TBCs, as appropriate In the absence of chemical-specific ARARs/TBCs, prevent exposure to contaminated pond and/or stream sediments that would result in a total excess cancer risk greater than 10^{-4} to 10^{-6} or a hazard index of greater than 1 for noncarcinogens

- Remediate the groundwater aquifer, that is the upper hydrostratigraphic unit (UHSU), to non-zero chemical-specific ARARs/TBCs, as appropriate In the absence of chemical-specific ARARs/TBCs, prevent exposure to contaminated groundwater that would result in a total excess cancer risk of greater than 10^{-4} to 10^{-6} or a hazard index greater than 1 for noncarcinogens

- Select a remedial alternative that eliminates, as required, potential exposure to environmental receptors and that minimizes potential impacts to environmental receptors during implementation As noted in Section 2 1, the C/RAOs established for the protection of human health are considered to adequately protect environmental receptors If the ERA indicates that more stringent objectives are required, they will be incorporated into future CMS/FS documents

The above C/RAOs are not intended to establish cleanup levels which are below background or analytical detection levels, or which cannot be achieved through the application of current technologies In addition to considering the technical feasibility of achieving the selected remediation targets, remedial alternatives will be developed and selected on the basis of their cost-effectiveness If necessary, CERCLA waivers or other regulatory-provided variances will be sought when unreasonable remediation targets are required The need to remediate known or suspected contaminant sources prior to remediating OU6 to prevent recontamination of remediated areas will also be considered when evaluating remedial alternatives

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4.0 REMEDIATION TARGETS FOR OU6

This section identifies the remediation targets selected for each OU6 environmental medium The selected remediation targets will form the basis for developing and evaluating remedial technologies and alternatives for OU6 Although parts of the RFI/RI yet to be completed may influence the selection of final remediation goals for OU6, the establishment of remediation targets will allow the CMS/FS to proceed Final remediation goals that are mutually agreeable to DOE, EPA, and CDPHE will be identified in the Record of Decision (ROD) for OU6 A brief description of the information sources considered in selecting the remediation targets for OU6 is described in Section 4 1 The specific information used and the rationale for selecting the remediation targets for each OU6 environmental medium (e g , surface soils, subsurface soils, sediments, and groundwater) are discussed in Sections 4 2 through 4 5

4.1 Resources for Identifying Potential Remediation Targets

The NCP and EPA's RI/FS guidance documents require the remediation targets specify the degree of cleanup the remedial action must achieve to protect human health and the environment Remediation targets are environmental media- and contaminant-specific values developed on the basis of potential chemical-specific ARARs/TBCs, programmatic risk-based PRGs, and other readily available information including background concentrations, minimum analytical detection limits, and cleanup standards established at other NPL sites in the State of Colorado

4.1.1 Chemical-Specific ARARs/TBCs

The DOE is responsible for identifying those promulgated standards, requirements, criteria, or limitations (i e , ARARs) to be met during implementation of the selected remedy This Technical Memorandum only addresses the identification of potential chemical-specific ARARs/TBCs for the purpose of developing remediation targets for the OU6 COCs Action- and location-specific ARARs will be addressed during the development of remedial alternatives for OU6 and will be presented as part of the CMS/FS for OU6

Chemical-specific ARARs are health- or risk-based numerical values that establish the acceptable amount or concentration of a compound that may be found in or discharged to the ambient environment (e g , air emissions or wastewater discharges) In addition to ARARs, other non-promulgated advisories, criteria, or guidance documents (e g , TBCs) were used to establish remediation targets for OU6 Chemical-specific ARARs/TBCs may also include methods which, when applied to site-specific conditions, result in the establishment of numerical values that are protective of human health and/or the environment The potential chemical-specific ARARs/TBCs

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presented in this Technical Memorandum are consistent with the *Draft Master List of Potential Federal and State ARARs for the Rocky Flats Environmental Technology Site* (DOE, 1995a) and subsequent discussions held between DOE, EPA, and CDPHE

4.1.2 Risk-Based Preliminary Remediation Goals

When potential chemical-specific ARARs/TBCs are not available or are not considered sufficiently protective because of the presence of multiple contaminants or multiple exposure pathways, calculated risk-based values can be established As previously discussed, the risk characterization components of the BRA have not been finalized for OU6 Potential exposure routes and receptors to be used in the HHRA for OU6 are currently being refined and the ecological COCs, receptors, and exposure pathways are being evaluated Therefore, to enable the CMS/FS for OU6, programmatic exposure pathways were developed for human health exposures and used to calculate risk-based PRGs

The programmatic exposure scenarios are presented in Table 4-1 and include the future land uses of Open Space, Office and Construction Work, and Ecological Research The programmatic exposure scenarios included the pathways and receptors that will most likely be addressed in the OU6 HHRA Exposure pathways for groundwater were not included since domestic use of the UHSU is not considered a realistic scenario The DOE Rocky Flats Field Office Future Site Use Working Group recommended that onsite residential use be eliminated from the future land use plan and that the remediation of buffer zone OUs should be based on a open space future use scenario (see meeting minutes, 12/8/94) Under the open space scenario, limited use of buildings for office work, as well as limited construction and ecological research activities are considered to be possible As such, these exposure pathways are being retained in selecting the OU6 remediation targets Should the HHRA identify additional exposure pathways not programmatically addressed, the required changes will be incorporated during development of subsequent CMS/FS documents

Consistent with EPA's Risk Assessment Council direction, the risk-based PRGs were calculated using reasonable maximum exposure (RME) and central tendency (CT) exposure factors The intent of providing both RME and CT risk-based PRGs is to determine the sensitivity of contaminant concentrations with respect to risk EPA guidance states that for decision-making purposes in the Superfund Program, the RME exposure level should be used to estimate risk and the CT exposure level is presented for comparative purposes only (EPA, 1992) In keeping with this guidance, the more conservative RME risk-based PRGs were considered in establishing the OU6 remediation targets During the detailed analysis of remedial action alternatives, the CT risk-based PRGs may be considered in conjunction with the RME risk-based PRGs to assess the cost-effectiveness versus risk reduction benefits of the various remedial alternatives

TABLE 4-1
PROGRAMMATIC EXPOSURE PATHWAYS FOR HUMAN HEALTH

Environmental Media	Human Health Exposure Scenarios		
	Open Space	**Commercial/Industrial**	**Ecological Researcher**
Surface Soil	Direct Ingestion of Soils [a/] Inhalation of Particulates [b/] External Radiation Exposure	Office Worker Scenario Direct Ingestion of Soils [a/] Inhalation of Particulates [b/] External Exposure to Radiation	Direct Ingestion of Soils [a/] Inhalation of Particulates [b/] External Radiation Exposure
Subsurface Soil	Not Applicable	Construction Worker Scenario Direct Ingestion of Soils [a/] Inhalation of Particulates [b/] External Exposure to Radiation Inhalation of Volatiles	Not Applicable
Sediment	Direct Ingestion of Sediments [a/] Inhalation of Particulates [b/] External Radiation Exposure	Not Applicable	Not Applicable
Groundwater	Not Applicable	Not Applicable	Not Applicable

[a/] Includes assessment of organics and inorganics (including radionculides)
[b/] Includes assessment of non-volatile organics and inorganics (including radionculides)

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The NCP requires sites to be remediated so that the additional lifetime risk to an individual is between 10^{-4} to 10^{-6} for known or suspected carcinogens As such, the risk-based PRGs for carcinogens were calculated by setting the carcinogenic target risk level at 10^{-6} Similarly, the risk-based PRGs for systemic toxicants (e g , noncarcinogens) were calculated by setting the hazard quotient at one for each contaminant Where a COC exhibits both carcinogenic and noncarcinogenic properties, the more conservative (e g , lower) RME risk-based PRG was selected as the remediation target

The toxicity information used to calculate the risk-based PRGs for radionuclides is based on the inclusion of daughter products where appropriate Since the plutonium-239 and -240, and uranium-233 and -234 isotopes are reported as a single analyte (i e , plutonium-239/240 and uranium-233/234, respectively), the reported risk-based PRG value is the lowest risk-based PRG value calculated for the respective isotopes Using the lowest value is the most conservative approach in establishing remediation targets for these radionuclides

The methodology and equations used to calculate the programmatic risk-based PRGs for the office and construction worker, and ecological researcher exposure scenarios are presented in *Programmatic Risk-Based Preliminary Remediation Goals* (DOE, 1995b) The RME factors are presented in this document and the CT exposure factors are in accordance with DOE, EPA, and CDPHE agreements as of April 1995 The methodology, equations, and RME/CT exposure factors used to calculate the open space PRGs are based on draft values calculated in accordance with DOE, EPA, and CDPHE agreements as of April 1995

4.1.3 Other Readily Available Information

Information such as background concentrations, minimum analytical detection limits, and cleanup standards that have been determined to be protective at other NPL sites were also considered in establishing the OU6 remediation targets These other factors were used as an indicator to verify that chemical-specific ARARs/TBCs and/or calculated risk-based levels are achievable The reasonableness and technical feasibility of the selected remediation targets will be further assessed during the Detailed Analysis of Alternatives Should it be determined that the remedial alternatives are not capable of attaining the selected remediation targets, a regulatory variance, CERCLA waiver, and/or reassessment of the risk-based PRGs may be required

Background concentration information was evaluated to ensure that the remediation targets are above background levels and are, therefore, potentially achievable The background concentration information is from the *Final Background Geochemical Characterization Report* (DOE, 1993) and background surface soil samples collected in the Rock Creek Area during the

1991 OU1 Phase III investigation and the 1993 OU2 Phase II investigation The 99 percent upper tolerance limit (UTL) was used as the background concentration except for organic compounds, whose background was assumed to be zero It is recognized that some of the compounds detected in the environmental media may be the result of other human-made, non-IHSS sources

The minimum analytical detection limits were considered to ensure that achieving the selected remediation target can be verified using standard analytical methods The minimum analytical detection limit was selected as the remediation target where ARARs/TBCs and/or risk-based remediation goals are less than the detection limit The minimum analytical detection limits were obtained from *General Radiochemistry and Routine Analytical Services Protocol (GRRASP)* (EG&G, 1991a, EG&G 1991b)

Available RODs for CERCLA remedial actions undertaken at NPL sites within the State of Colorado were reviewed to identify cleanup levels previously adopted EPA's Record of Decision System was electronically searched to obtain a list of Colorado RODs which address the COCs germane to OU6 The cleanup standards established in these previously issued RODs were not selected as the remediation target Instead, they were used to provide an indication of the acceptability of the selected remediation target The previously established cleanup standards were eliminated from consideration in cases where the basis for the cleanup standard could not be determined, when the cleanup standard was not reasonable, or when the standard was not pertinent to OU6

4.2 Surface Soils

Table 4-2 presents the information considered in selecting the remediation targets for the OU6 surface soil COCs The following subsections provide additional details regarding the resources and methods used to identify and select the remediation targets

4.2.1 Potential Chemical-Specific ARARs/TBCs

For radionuclides, DOE Order 5400 5, *Radiation Protection of the Public and the Environment* (DOE, 1990), is considered a TBC for establishing residual radioactivity levels in surface soils This DOE Order restricts the offsite radiation dose to members of the public to 100 mrem effective dose equivalent per year The TBC values presented in Table 4-2 for americium-241 and plutonium-239/240 are the concentrations that will result in an effective dose equivalent of 100 mrem per year under the office worker exposure scenario using RME factors The TBC values are based on a 100 mrem per year effective dose equivalent for each individual radionuclide The contribution of multiple radionuclides to the effective dose equivalent will be addressed before the final remediation goals are established The provisions of DOE Order

5400 5 are currently in the process of being promulgated as 10 CFR 834 The annual effective dose limit of 100 mrem is considered a TBC until promulgation of 10 CFR 834, at which time this dose limit will be considered an ARAR

4.2.2 Risk-Based Preliminary Remediation Goals

Some of the programmatic risk-based PRGs calculated for zinc exceed the soil saturation limit (e g , greater than 100 percent by weight) and are, therefore, reported as " > 1 00e+06" in Table 4-2

4.2.3 Cleanup Standards at Other Colorado Sites

The following two RODs contain cleanup standards for some of the OU6 surface soil COCs [NOTE For the purpose of this Technical Memorandum, surface soils are defined as soils within 2 inches of the ground surface, subsurface soils are soils deeper than 2 inches Since the ROD cleanup levels were not typically separated by surface or subsurface soil, comparing the cleanup values from the RODs against the programmatic risk-based PRGs calculated specifically for surface soils may not be appropriate]

- The 1986 ROD for the Woodbury Chemical Site specified an 80 mg/kg action level for zinc in soil However, the basis for the 80 mg/kg action level could not be determined Furthermore, this action level is not consistent with the calculated risk-based PRGs and EPA published toxicity information for zinc As such, the zinc action level for the Woodbury Chemical Site is not germane to OU6

- The 1990 ROD for the Martin Marietta, Denver Aerospace Site specified an action level for silver in soil based on meeting the Land Disposal Restriction (LDR) treatment standard contained in 40 CFR 268 The selected remedy included the excavation of contaminated soils which exceed the action levels followed by thermal treatment to remove organic contaminants and stabilization to immobilize inorganic contaminants The ROD also specifies that the contaminated soils are to be treated to meet the action levels or if pilot scale treatability studies demonstrate that the action level cannot be achieved, treatment levels would be based on soil and debris variances

  However, using LDR treatment standards as remediation targets is not consistent with EPA guidance (EPA, 1989a, EPA 1989b) which indicates that LDRs are ARARs for onsite CERCLA response action only in situations where placement of a restricted hazardous waste (i e , applicable) or a waste which is "sufficiently

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similar" to a listed hazardous waste (e g , relevant and appropriate) occurs Since in-place surface soils are neither wastes nor trigger placement, LDR standards should not be used as chemical-specific ARARs for establishing cleanup levels Furthermore, the LDR standards, which are based on Toxicity Characteristic Leaching Procedure (TCLP)-derived extract from the treated waste, are not directly comparable to background and risk-based PRG concentrations, which are based on total concentrations As such, the action levels for the Denver Aerospace Site are not germane to OU6

For the reasons stated above, the ROD cleanup standards were deemed to be inappropriate for comparison purposes

4.2.4 Selection of Remediation Targets for Surface Soils

The remediation targets for antimony, silver, vanadium, and zinc are based on the calculated programmatic risk-based PRGs for an office worker scenario utilizing RME exposure factors since corresponding ARARs/TBCs are not available for these OU6 surface soil COCs The office worker PRGs were selected as the remediation targets because they are more stringent than the PRGs calculated for the open space and ecological research scenarios

The selected remediation targets for americium-241 and plutonium-239/240 are based on the calculated residual radioactivity levels conforming to the 100 mrem per year radiation dose standard contained in DOE Order 5400 5 This TBC level was selected over more stringent risk-based PRGs since the NCP requires, in most cases, that ARARs or other available information be preferentially selected over risk-based PRGs as final remediation goals

All of the selected remediation targets are greater than the corresponding background concentrations and minimum analytical detection limits As such, the selected remediation targets for OU6 surface soils are deemed to be potentially achievable and verifiable for the purpose of developing remedial alternatives

4.3 Subsurface Soils

Table 4-3 presents the information considered in selecting the remediation targets for the OU6 subsurface soil COCs The following subsections provide additional details regarding the resources and methods used to identify and select the remediation targets

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TABLE 4-3
PRELIMINARY REMEDIATION LEVELS FOR SUBSURFACE SOIL

Subsurface Soil Chemical of Concern	Background Concentration ($UTL_{99\%}$)	Minimum Analytical Detection Limit [j]	Potential Chemical-Specific ARARs/TBCs		Risk-Based Preliminary Remediation Goals				Cleanup Standards Established at Other Colorado NPL Sites	Selected Remediation Target
					Construction Worker					
			ARARs	TBCs	RME [a]		CT [b]			
					NC [c]	C [d]	NC [c]	C [d]		
Barium (mg/kg)	3 71e+02	4 00e+01	--	--	1 24e+05	--	6 21e+05	--	1 00e+02 [f]	1 24e+05
Benzo(a)pyrene (mg/kg)	0 00e+00 [e]	3 30e-01	--	--	--	1 70e+01	--	8 59e+01	8 20e+00 [f]	1 70e+01
Benzo(b)fluoranthene (mg/kg)	0 00e+00 [e]	3 30e-01	--	--	--	1 70e+02	--	8 59e+02	--	1 70e+02
Methylene Chloride (mg/kg)	0 00e+00 [e]	5 00e-03	--	--	1 06e+05	1 66e+04	5 38e+05	8 36e+04	7 50e-02 [g]	1 66e+04
Americium-241 (pCi/g)	2 00e-02	2 00e-02	--	7 09e+02 [i]	--	2 16e+02	--	5 37e+02	--	7 09e+02
Plutonium-239/240 (pCi/g)	3 00e-02	3 00e-02	--	1 56e+03 [i]	--	3 01e+02	--	1 51e+03	--	1 56e+03
Uranium-233/234 (pCi/g) [h]	3 44e+00	3 00e-01	--	4 10e+04 [i]	--	4 13e+03	--	1 75e+04	--	4 10e+04
Uranium-238 (pCi/g) [h]	1 81e+00	3 00e-01	--	3 24e+03 [i]	--	7 98e+01	--	8 13e+01	--	3 24e+03

[a] PRGs are based on RME factors
[b] PRGs are based on CT exposure factors
[c] PRGs are based on noncarcinogenic toxicity information
[d] PRGs are based on carcinogenic toxicity information
[e] Background concentrations for organic compounds are assumed to be zero
[f] Martin Marietta, Denver, Aerospace (EPA/ROD/R08-90/035) Cleanup standard for barium is provided as mg/L and is based on a LDR treatment standard which is applied to the TCLP extract from the treated waste Cleanup standard for benzo(a)pyrene is the LDR treatment standard for U022 which is based on incineration as the best available technology
[g] Sand Creek Industrial Site (EPA/ROD/R08-89/024) Cleanup standard is based on protection of groundwater resulting from the migration of soil contaminants
[h] PRG values include daughter products
[i] TBC value is the calculated radionuclide-specific concentration that would result in an exposure equal to 100 mrem per year effective dose equivalent for the construction worker exposure scenario using RME factors
[j] Minimum analytical detection limits are from the *GRRASP* (EG&G, 1991a, EG&G 1991b)

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4.3.1 Potential Chemical-Specific ARARs/TBCs

For radionuclides, DOE Order 5400 5 was followed to establish residual radioactivity levels in subsurface soils The TBC values presented in Table 4-3 for americium-241, plutonium-239/240, uranium-233/234, and uranium-238 are the concentrations that will result in an effective dose equivalent of 100 mrem per year employing the construction worker exposure scenario using RME factors Like surface soils, the TBC values are based on a 100 mrem per year effective dose equivalent for each individual radionuclide The contribution of multiple radionuclides to the effective dose equivalent will be addressed before final remediation goals are established

4.3.2 Risk-Based Preliminary Remediation Goals

The potential exposure scenario evaluated in this Technical Memorandum is for the exposure of a construction worker to subsurface soils In addition to this exposure scenario, the potential for migration of VOCs from the Triangle Area (IHSS 165) subsurface soils is also being modeled within the RFI/RI However, Triangle Area soil gas measurements do not indicate that subsurface soils are a potential source of contaminants If VOC migration is determined to be a potential concern, this pathway will be incorporated appropriately into the selected remedial alternative Risk-based PRGs for the gravel mine worker exposure scenario are also not presented because the feasibility of mining OU6 for commercial purposes is not considered viable (EG&G, 1994) Review of boring logs indicates this exposure scenario is inappropriate for OU6 due to the limited presence of exploitable quantities of minable materials

4.3.3 Cleanup Standards at Other Colorado Sites

The following two RODs contain cleanup standards for some of the OU6 subsurface soil COCs Since the ROD cleanup levels were not separated by surface and subsurface soils, a direct comparison of the ROD levels to the calculated PRGs may not be appropriate

- The 1989 ROD for the Sand Creek Industrial Site specified a soil action level for methylene chloride based on the results of a soil-water leaching model and carcinogenic risk of 10^{-6} for ingestion of groundwater As such, the methylene chloride action level is not directly comparable to the risk-based PRGs listed in Table 4-3 since the CDPHE Conservative Screen concluded that potential migration of OU6 soil COCs to the groundwater is negligible As such, the programmatic exposure scenarios do not include pathways to evaluate the migration of vadose zone contamination to groundwater

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- The 1990 ROD for the Martin Marietta, Denver, Aerospace Site specified action levels for barium and benzo(a)pyrene, based on attaining the RCRA hazardous waste LDR treatment standards specified in 40 CFR 268 The cleanup standard for benzo(a)pyrene is based on the non-wastewater LDR treatment standard for U022 as listed in the Third Third rule making dated January 31, 1991 [see 55 Federal Register (FR) 3908] This treatment standard is given as a total concentration limit and is based on using incineration as the best available treatment technology As discussed in Section 4 2 3, LDR treatment standards are not appropriate for comparison against the selected OU6 remediation targets In addition, the benzo(a)pyrene cleanup standard was considered to be inappropriate since it is based on achievable results using a specified technology instead of the residual risks resulting from the exposure to this compound

For the reasons stated above, the ROD cleanup standards were deemed to be inappropriate for comparison purposes

4.3.4 Selection of Remediation Targets for Subsurface Soils

The remediation targets for barium, benzo(a)pyrene, benzo(b)fluoranthene, and methylene chloride are based on the calculated programmatic risk-based PRGs for the construction worker scenario utilizing RME exposure factors The RME programmatic risk-based PRGs were selected since corresponding ARARs/TBCs are not available for these OU6 subsurface soil COCs

The selected remediation targets for americium-241, plutonium-239/240, uranium 233/234, and uranium-238 are based on the calculated residual radioactivity levels conforming to the 100 mrem per year radiation dose standard contained in DOE Order 5400 5 This TBC level was selected over the more stringent risk-based PRGs since the NCP requires, in most cases, that ARARs or other available information be preferentially selected over risk-based PRGs as final remediation goals

All of the selected remediation targets are greater than the corresponding background concentrations and minimum analytical detection limits As such, the selected remediation targets for OU6 subsurface soils are deemed to be potentially achievable and verifiable for the purpose of developing remedial alternatives

4.4 Sediments

Table 4-4 presents the information considered in selecting the remediation targets for the OU6 sediment COCs The OU6 sediments consist of material deposited within stream beds and

TABLE 4-4
PRELIMINARY REMEDIATION LEVELS FOR SEDIMENT

Sediment Chemical of Concern	Background Concentration ($UTL_{99\%}$)		Minimum Analytical Detection Limit [h]	Potential Chemical-Specific ARARs/TBCs		Risk-Based Preliminary Remediation Goals				Cleanup Standards Established at Other Colorado NPL Sites	Selected Remediation Target
						Open Space					
						RME [a]		CT [b]			
	Pond	Stream		ARARs	TBCs	NC [c]	C [d]	NC [c]	C [d]		
Antimony (mg/kg)	5 50e+01	--	1 20e+01	--	--	3 07e+03	--	1 43e+04	--	--	3 07e+03
Aroclor-1254 (mg/kg)	0 00e+00 [e]	--	4 40e-02	--	1 00e+01 [f]	--	2 32e+00	--	3 62e+01	--	1 00e+01
Benzo(a)anthracene (mg/kg)	--	0 00e+00 [e]	3 30e-01	--	--	--	2 45e+01	--	3 82e+02	--	2 45e+01
Benzo(a)pyrene (mg/kg)	0 00e+00 [e]	0 00e+00 [e]	3 30e-01	--	--	--	2 45e+00	--	3 82e+01	--	2 45e+00
Benzo(b)fluoranthene (mg/kg)	0 00e+00 [e]	0 00e+00 [e]	3 30e-01	--	--	--	2 45e+01	--	3 82e+02	--	2 45e+01
Bis(2-ethylhexyl)phthalate (mg/kg)	0 00e+00 [e]	--	3 30e-01	--	--	1 54e+05	1 23e+03	7 16e+05	1 99e+04	--	1 28e+03
Cobalt (mg/kg)	--	1 93e+01	1 00e+01	--	--	4 61e+05	--	>1 00e+06	--	--	4 61e+05
Indeno(1,2,3-cd)pyrene (mg/kg)	--	0 00e+00 [e]	3 30e-01	--	--	--	2 45e+01	--	3 82e+02	--	2 45e+01
Silver (mg/kg)	1 15e+01	--	2 00e+00	--	--	3 84e+04	--	1 79e+05	--	--	3 84e+04
Strontium (mg/kg)	--	2 95e+02	4 00e+01	--	--	>1 00e+06	--	>1 00e+06	--	--	1 00e+06
Vanadium (mg/kg)	8 30e+01	6 34e+01	1 00e+01	--	--	5 38e+04	--	2 51e+05	--	--	5 38e+04
Zinc (mg/kg)	1 43e+02	8 08e+02	4 00e+00	--	--	>1 00e+06	--	>1 00e+06	--	--	1 00e+06
Americium-241 (pCi/g)	1 47e+00	1 77e+00	2 00e-02	--	1 48e+03 [g]	--	2 49e+01	--	2 39e+02	--	1 48e+03
Plutonium-239/240 (pCi/g)	7 68e+00	5 66e+00	3 00e-02	--	5 70e+03 [g]	--	9 47e+01	--	1 53e+03	--	5 70e+03

[a] PRGs are based on RME factors
[b] PRGs are based on CT exposure factors
[c] PRGs are based on noncarcinogenic toxicity information
[d] PRGs are based on carcinogenic toxicity information
[e] Background concentrations for organic compounds are assumed to be zero
[f] TBC value is based on EPA's PCB Spill Cleanup Policy (see 40 CFR 761 120 and 761 125)
[g] TBC value is the calculated radionuclide-specific concentration that would result in an exposure equal to 100 mrem per year effective dose equivalent for the open space exposure scenario using RME factors
[h] Minimum analytical detection limits are from the *GRRASP* (EG&G, 1991a, EG&G 1991b)

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retention ponds Background concentrations, as well as the human health COCs for pond sediments were developed independently from stream sediments Seep and spring background data were used for comparison to pond sediments, because of the similarity in flow regimes and residence times between seeps and ponds For stream sediment, background data from stream beds were used The different background concentrations are listed in Table 4-4 under the "Background Concentration" column, an "--" entry indicates that the chemical is not a COC for that particular sediment type The following subsections provide additional details regarding the resources and methods used to identify and select the remediation targets

4.4.1 Potential Chemical-Specific ARARs/TBCs

The management and disposal of PCB waste is regulated under the Toxic Substances Control Act (TSCA) The TSCA requirements for cleaning up PCB-contaminated soils are presented in 40 CFR 761, Subpart G, *PCB Spill Cleanup Policy* This policy establishes cleanup criteria for spills that occurred after May 4, 1987 DOE considers the *PCB Spill Cleanup Policy* a TBC for establishing remediation targets that are protective of human health and the environment at OU6 The policy states that spills involving 1 pound or more PCBs by weight in non-restricted areas are to be remediated to 10 ppm PCBs by weight {see 40 CFR 761 125(c)(4)(v)}

For radionuclides, DOE Order 5400 5 was followed to establish residual radioactivity levels in sediments The TBC values presented in Table 4-4 for americium-241 and plutonium-239/240 are the concentrations that will result in an effective dose equivalent of 100 mrem per year under the open space exposure scenario using RME factors The TBC values are based on a 100 mrem per year effective dose equivalent for each individual radionuclide The contribution of multiple radionuclides to the effective dose equivalent will be addressed before the final remediation goals are established

4.4.2 Risk-Based Preliminary Remediation Goals

The programmatic risk-based PRGs calculated for cobalt, strontium, and zinc that exceed the saturation limit (e g , greater than 100 percent by weight) are reported as ">1 00e+06" in Table 4-4

4.4.3 Cleanup Standards at Other Colorado Sites

RODs issued for other Colorado NPL sites do not contained cleanup standards for the OU6 sediment COCs

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4.4.4 Selection of Remediation Targets for Sediments

The remediation targets for all of the sediment COCs, except for Aroclor-1254 and the radionuclides, are based on the calculated open space PRGs using RME exposure factors The risk-based PRGs were selected since corresponding ARARs/TBCs are not available for these OU6 sediment COCs

The 10 ppm cleanup criterion established in 40 CFR 761 for PCBs was selected as the remediation target for Aroclor-1254 since this standard is a widely accepted TBC for the cleanup of PCB spills

The selected remediation targets for americium-241 and plutonium-239/240 are based on the calculated residual radioactivity levels conforming to the 100 mrem per year radiation dose standard contained in DOE Order 5400 5 The TBC levels were selected over the more stringent open space PRGs since the NCP requires, in most cases, that ARARs or other available information be preferentially selected over risk-based PRGs as final remediation goals

All of the selected remediation targets are greater than the corresponding background concentrations and minimum analytical detection limits As such, the selected remediation targets for OU6 sediments are deemed to be potentially achievable and verifiable for the purpose of developing remedial alternatives

4.5 Groundwater

The COCs identified for groundwater are based on OU6 RFI/RI analytical results for the UHSU, which includes both the Rocky Flats Alluvium and the No 1 Sandstone lithologic units Within OU6, the UHSU is comprised of variably- and seasonally-saturated portions of the unconsolidated surficial deposits (Rocky Flats Alluvium and Colluvium) and the Arapahoe Formation No 4 Sandstone, which may be hydraulically connected to the saturated surficial deposits, and underlying weathered claystone of the Arapahoe Formation Groundwater flow within the UHSU at OU6 is generally to the east toward topographic lows The direction of groundwater flow is expected to vary locally near each retention pond due to recharge and removal of the alluvial sediments in this area during pond construction

The UHSU in OU6 is subdivided into six groundwater areas as shown on Figure 2-1 (see Section 2 0) The boundaries of the groundwater areas are based on the variable or seasonal occurrence of groundwater in OU6 and represent isolated areas of recharge and groundwater flow Results from the Phase I RFI/RI investigation have indicated that COCs detected in the groundwater at OU6 are limited to the UHSU

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Table 4-5 presents the information considered in setting the remediation targets for the OU6 groundwater COCs Results for unfiltered background samples are presented because these are considered to be the most representative for potential exposures Background concentrations for VOCs were assumed to be zero The background level for nitrate is a calculated value based on subtracting the background concentration for nitrite of 149 μg/L from the background concentration for total nitrate-nitrite of 5,261 μg/L The following subsections provide additional details regarding the source and/or methods used to identify and select the remediation targets

4.5.1 Potential Chemical-Specific ARARs/TBCs

As required by the NCP, several regulations and other guidance documents were considered when selecting remediation targets for groundwater The NCP states that Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) are to be attained by remedial actions for groundwaters or surface waters that are current or potential sources of drinking water {See 40 CFR 300 430(e)(2)(i)(B)} The NCP also states that water quality criteria established under Sections 303 or 304 of the Clean Water Act qualify as remediation targets only when they are determined to be relevant and appropriate to the circumstance of the release {see 40 CFR 300 430(e)(2)(i)(E)} Although these standards are not directly applicable to the remediation of OU6 groundwater, the NCP requires they be considered as to whether they are relevant and appropriate to the circumstance of the release

Since the capability of the UHSU to produce a sufficient quantity of groundwater for domestic use is questionable, the domestic use of groundwater from the UHSU is not considered to be a realistic exposure scenario The elimination of the domestic use of groundwater is also consistent with the final land uses identified for the RFETS As such, MCLs, non-zero MCLGs, and water quality criteria would not be considered to be relevant and appropriate under the circumstance of a release, if any, to the UHSU aquifer The remainder of this section provides additional details regarding the rationale for the potential ARARs/TBCs identified in Table 4-5

The federal and state requirements that were considered in establishing the chemical-specific ARARs/TBCs include

- Federal MCLs and non-zero MCLGs adopted under the Safe Drinking Water Act, (40 CFR 141 and 142),
- State of Colorado Primary Drinking Water Regulations (5 CCR 1003-1),
- Federal Water Quality Criteria issued by EPA pursuant to Section 303 of the Clean Water Act,

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TABLE 4-5
PRELIMINARY REMEDIATION LEVELS FOR GROUNDWATER

Groundwater Chemical of Concern	Background Concentration ($UTL_{99\%}$)	Minimum Analytical Detection Limit [h]	Potential Chemical-Specific ARARs/TBCs		Cleanup Standards Established at Other Colorado NPL Sites	Selected Remediation Target
			ARARs	TBCs		
Chloroform (μg/L)	0 00e+00 [a]	5 00e+00	6 00e+00 [c]	--	1 00e+02 [f]	1 00e+02
Methylene Chloride (μg/L)	0 00e+00 [a]	5 00e+00	5 00e+00 [c]	--	1 00e+01 [g]	5 00e+00
Nitrate (mg/L)	5 11e+03	5 00e+00	1 00e+00 [c]	--	1 00e+01 [e]	1 00e+01
Tetrachloroethene (μg/L)	0 00e+00 [a]	5 00e+00	5 00e+00 [c]	--	1 00e+01 [f] 5 00e+00 [g]	5 00e+00
Trichloroethene (μg/L)	0 00e+00 [a]	5 00e+00	5 00e+00 [c]	--	5 00e+00 [e g]	5 00e+00
Vinyl Chloride (μg/L)	0 00e+00 [a]	1 00e+01	2 00e+00 [c]	--	2 00e+00 [e]	1 00e+01
Americium-241 (pCi/L)	3 70e-02 [b]	1 00e-02	--	3 00e+01 [d]	--	3 00e+01
Plutonium-239/240 (pCi/L)	6 40e-02	1 00e-02	--	3 00e+01 [d]	--	3 00e+01
Radium-226 (pCi/L)	1 30e+00	5 00e-01	--	1 00e+02 [d]	--	1 00e+02

[a] Background concentrations for organic compounds are assumed to be zero
[b] Background concentration is based on total americium and is not isotope specific
[c] ARAR standard is based on Colorado Statewide Standard for Ground Water (5 CCR 1002-8, Section 3 11)
[d] TBC value is based on the DCGs from DOE Order 5400 5, Chapter III The TBC value is the radionuclide-specific concentration that would result in an effective dose equivalent of 100 mrem per year
[e] Martin Marietta, Denver, Aerospace (EPA/ROD/R08-90/035)
[f] Rocky Mountain Arsenal - OU17 (EPA/ROD/R08-90/037)
[g] Chemical Sales - OU1 (EPA/ROD/R08-91/045) and/or OU2 (EPA/ROD/R08-91/046)
[h] Minimum analytical detection limits are from the *GRRASP* (EG&G, 1991a, EG&G 1991b)

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- State of Colorado groundwater quality standards (5 CCR 1002-8, Section 3 11),
- State of Colorado groundwater protection standards for hazardous waste facilities (6 CCR 1007-3, 264 94), and
- DOE Order 5400 5, *Radiation Protection of the Public and the Environment* (DOE, 1990)

Section 304 of the Clean Water Act allows EPA to adopt water quality standards to protect the use classification assigned to water resources The EPA has adopted Federal Water Quality Criteria which include health based standards for the consumption of drinking water and fish These Federal Water Quality Criteria considered are based on the May 1, 1991 table issued by EPA's Office of Science and Technology and the July 14, 1993 letter containing the updated version of the water quality criteria for EPA Region VIII None of these standards were considered to be ARARs in selecting the remediation targets for the groundwater resources at OU6 because the federal standards are based on the consumption of both water and fish

The Colorado WQCC has promulgated groundwater standards for all source groundwater, unclassified and classified, groundwater that has been classified for a specific existing or potential use, and site-specific standards (see 5 CCR 1002-8, Sections 3 11 and 3 12) Despite questions regarding enforceability, the statewide groundwater standards for groundwater that has not been classified for a specific existing or potential use will be considered potential ARARs, except for standards associated with AEA-regulated radionuclides Where the water quality standard is below (more stringent than) the practical quantification limit (PQL), the PQL is interpreted to be the compliance level {see 5 CCR 1002-8, Section 3 11 5(C)(4)}

The Colorado WQCC has designated site-specific groundwater standards for the RFETS {see 5 CCR 1002-8, Section 3 12 7(1)} However, for the standards associated with the site-specific use classifications and the site-specific standards to be identified as ARARs, they must be of "general applicability" and "enforceable" {see 40 CFR 300 400(g)(4)} The RFETS site-specific groundwater use classifications, and their associated standards, and the RFETS site-specific standards {see 5 CCR 1002-8, Section 3 12 7(1)} are not considered ARARs because those use classifications, their associated standards, and the RFETS site-specific standards have not been generally applied to other remedial sites throughout the state RFETS is the only industrial site in Colorado that has the state groundwater use classifications of domestic use quality, agricultural use quality, and surface water protection imposed upon it As such, the statewide standards associated with a use classification, and the RFETS-specific use classifications

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(including associated standards) and the RFETS site-specific standards are not considered to be ARARs for the remediation of groundwater at OU6

The hazardous waste facility groundwater protection standards are not considered to be applicable since none of the OU6 IHSSs are designated hazardous waste management units Since other, more relevant, groundwater protection ARARs have been identified for drinking water supplies (i e , MCLs), the hazardous waste facility groundwater protection standards were not considered to be relevant and appropriate to OU6

With respect to radionuclides, the AEA grants DOE authority over AEA-regulated radionuclides Pursuant to this authority, DOE has established radiation protection standards for offsite members of the public under DOE Order 5400 5 To ensure that the offsite radiation dose is maintained below established limits, DOE has developed Derived Concentration Guides (DCGs) for exposures via the ingestion of water based on an effective dose equivalent limit to offsite members of the public of 100 mrem per year The DCGs were considered in selecting protective remediation targets for the OU6 groundwater The fact that multiple radionuclides may contribute to the effective dose equivalent was not considered for the values presented in Table 4-5 The risk contributions associated with the presence of multiple radionuclides will be addressed prior to establishing final remediation goals for the groundwater at OU6 Until such time that these factors are considered, the DCGs were deemed to be an appropriate starting point for assessing the groundwater remediation needs for OU6 The provisions of DOE Order 5400 5 are currently in the process of being promulgated as 10 CFR 834 The DCGs are considered TBCs until promulgation of 10 CFR 834, at which time the DOE radiation protection requirements will be identified as ARARs

4.5.2 Risk-Based Preliminary Remediation Goals

Programmatic risk-based PRGs were not developed for OU6 groundwater since the domestic use of groundwater from the UHSU is not considered to be a viable exposure pathway for the proposed future land uses of open space, office and construction work, and ecological research

4.5.3 Cleanup Standards at Other Colorado Sites

The following five RODs for other Colorado NPL sites contain cleanup standards for some of the OU6 groundwater COCs

- The 1986 ROD for Marshall Landfill specified a groundwater cleanup standard for tetrachloroethene and trichloroethene of zero The 1986 Marshall Landfill ROD

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was not included on Table 4-5 for comparison purposes because it is neither possible to technically achieve nor to demonstrate compliance with a cleanup standard of zero

- The 1990 ROD for the Martin Marietta, Denver Aerospace Site includes action levels for nitrate, trichloroethene, and vinyl chloride which are based on MCLs and MCLGs

- The 1990 ROD for the Rocky Mountain Arsenal - OU17 Site includes action levels for chloroform and tetrachloroethene in groundwater which are based on MCLs

- The 1991 RODs for the Chemical Sales - OU1 and OU2 sites include action levels for methylene chloride, tetrachloroethene, and trichloroethene which are primarily based on MCLs

4.5.4 Selection of Remediation Targets for Groundwater

Although the ability of the UHSU to supply groundwater for domestic use is questionable, the OU6 remediation targets selected for methylene chloride, nitrate, tetrachloroethene, and trichloroethene are all based on Colorado statewide standards It is proposed that the selected remediation targets be applied at a point of compliance that is established to protect the current and expected future use of the groundwater The Colorado statewide standards were also determined to be protective of surface waters that may be hydraulically connected to the groundwater

With respect to chloroform, the selected remediation target is based on the cleanup standards established at other Colorado NPL sites which is considered to be technically achievable since it is based on technical factors and other limitations, while the Colorado statewide standard may not be achievable

The Colorado statewide standard for vinyl chloride is set at a level which is below the detection limit Therefore, the remediation target for this COC is based on the minimum analytical detection limit from the *GRRASP*

The remediation targets selected for americium-241, plutonium-239/240, and radium-226 are based on the DCGs provided in DOE Order 5400 5 which are TBCs The DCGs were chosen over other potential standards since DOE has the delegated responsibility for establishing occupational and public radiation protection standards for AEA-regulated radionuclides

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All of the selected remediation targets are greater than the corresponding background concentrations As such, the selected remediation targets for OU6 groundwater are deemed to be potentially achievable for the purpose of developing remedial alternatives

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5.0 CMS/FS CONSIDERATIONS

The RFI/RI characterization information was evaluated to determine which IHSSs, environmental media, and COCs should be considered during the OU6 CMS/FS for potential remediation The intent of this analysis was to reduce the number of IHSSs and environmental media required to be evaluated in the CMS/FS by comparing the selected remediation targets to maximum COC concentrations detected No Further Action is being recommended at IHSSs and environmental media where the maximum COC concentrations are less than the selected remediation targets The results of the remediation target screen are presented in Section 5 1 The conclusions and recommendations for developing and screening the remedial alternatives are presented in Sections 5 2 and 5 3, respectively

5.1 Remediation Target Screen

Maximum COC concentrations for each environmental medium were compared to the selected remediation targets to determine which IHSSs and/or media could be excluded from the CMS/FS Tables 5-1 through 5-4 present the selected remediation targets and the maximum COC concentrations, by IHSS or Groundwater Area Units for the selected remediation targets presented in these tables have been standardized to be consistent with the RFI/RI data The shaded entries indicate that the maximum COC concentration is less than the selected remediation target and that No Further Action is appropriate

The results of the remediation target screen are further summarized in Table 5-5 Shaded "No" entries indicate where the maximum COC concentration is below the selected remediation target Shaded "--" entries indicate that the chemical is not identified as a COC for that environmental medium The shaded COCs, IHSSs, and/or environmental media shown on Tables 5-1 through 5-5 do not require remediation and are, therefore, being recommended for No Further Action Results of the remediation target screen show that remediation of the surface soils, subsurface soils, and sediments is not required The COCs which may require remediation are identified by the "Yes" entries on Table 5-5 and are restricted to the UHSU groundwater

5.2 Conclusions

Based on results of the CDPHE conservative and remediation target screens, the following conclusions and recommendations are presented and will be use to develop the OU6 CMS/FS Both of these screens only consider the OU6 human health COCs as the drivers for remediation When the ERA for the Walnut Creek drainage basin is completed, ecological COCs will be considered to validate the No Further Action conclusions

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TABLE 5-1
REMEDIATION TARGET SCREEN RESULTS FOR SURFACE SOIL

Surface Soil Chemical of Concern	Selected Remediation Target [a]	Sludge Dispersal Area (IHSS 141)	Old Outfall (IHSS 143)	Soil Dump Area (IHSS 156.2)	Triangle Area (IHSS 165)	North Area Spray Field (IHSS 167.1)
Antimony (mg/kg) [b]	818	-- [c]	--	43 6	--	--
Silver (mg/kg)	10,200	52 7	--	--	--	--
Vanadium (mg/kg)	14,300	75 9	45 5	--	--	--
Zinc (mg/kg)	613,000	650	85 4	72.3	117	--
Americium-241 (pCi/g)	852	1 84	--	0 30	3 24	1 15
Plutonium-239/240 (pCi/g)	1,800	10 4	0 52	1 85	15 20	1 85

a/ Selected remediation targets are presented in Table 4-2

b/ Shading indicates that maximum COC concentration for the IHSS is less than the selected remediation target Where the IHSS column or COC row is also shaded, all of the maximum COC concentrations are below the selected remediation target

c/ "--" indicates that chemical was not identified as a COC for the IHSS (see Table 2-3)

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TABLE 5-2
REMEDIATION TARGET SCREEN RESULTS FOR SUBSURFACE SOIL

Subsurface Soil Chemical of Concern	Selected Remediation Target [a]	Old Outfall (IHSS 143)	Soil Dump Area (IHSS 156.2)	Triangle Area (IHSS 165)	North Area Spray Field (IHSS 167.1)
Barium (mg/kg) [b]	124,000	1,150 [b]	864	1,050	866
Benzo(a)pyrene (μg/kg)	17,000	170	-- [c]	130	--
Benzo(b)fluoranthene (μg/kg)	170,000	210	--	170	--
Methylene Chloride (μg/kg)	16,600,000	13	3,600	34	--
Americium-241 (pCi/g)	709	0.04	0.31	0.44	0.03
Plutonium-239/240 (pCi/g)	1560	0.26	0.88	0.53	0.07
Uranium-233/234 (pCi/g)	41000	--	--	--	3.05
Uranium-238 (pCi/g)	3240	1.52	--	1.6	141

a/ Selected remediation targets are presented in Table 4-3

b/ Shading indicates that maximum COC concentration for the IHSS is less than the selected remediation target Where the IHSS column or COC row is also shaded, all of the maximum COC concentrations are below the selected remediation target

c/ "--" indicates that chemical was not identified as a COC for the IHSS (see Table 2-4)

TABLE 5-3
REMEDIATION TARGET SCREEN RESULTS FOR SEDIMENT

Sediment Chemical of Concern	Selected Remediation Target [a]	Pond A-1 (IHSS 142.1)	Pond A-2 (IHSS 142.2)	Pond A-3 (IHSS 142.3)	Pond B-1 (IHSS 142.5)	Pond B-2 (IHSS 142.6)	Pond B-3 (IHSS 142.7)	Pond B-4 (IHSS 142.8)	Stream Sediments
Antimony (mg/kg) [b]	3,070	-- [c]	--	--	--	--	68.5	--	--
Aroclor-1254 (μg/kg)	10,000	590	590	--	10,000	6,600	2,900	1,100	--
Benzo(a)anthracene (μg/kg)	24,500	--	--	--	--	--	--	--	430
Benzo(a)pyrene (μg/kg)	2,450	310	75	240	870	130	260	570	480
Benzo(b)fluoranthene (μg/kg)	24,500	420	--	370	3,100	--	770	1,500	650
Bis(2-ethylhexyl)phthalate (μg/kg)	1,280,000	485	7,800	990	88,000	9,000	9,100	5,000	--
Cobalt (mg/kg)	461,000	--	--	--	--	--	--	--	12.4
Indeno(1,2,3-cd)pyrene (μg/kg)	24,500	--	--	--	--	--	--	--	180
Silver (mg/kg)	38,400	--	--	--	345	207	240	102	--
Strontium (mg/kg)	1,000,000	--	--	--	--	--	--	--	95 8
Vanadium (mg/kg)	53,800	--	--	62 7	--	--	--	--	33.9
Zinc (mg/kg)	1,000,000	110	409	155	1,270	140	346	319	178
Americium-241 (pCi/g)	1,480	13.2	1.74	--	389	23.1	63	7.45	0.76
Plutonium-239/240 (pCi/g)	5,700	36.2	5.65	--	92	41.2	180	24.1	0.68

a/ Selected remediation targets are presented in Table 4-4

b/ Shading indicates that maximum COC concentration for the IHSS is less than the selected remediation target Where the IHSS column or COC row is also shaded, all of the maximum COC concentrations are below the selected remediation target

c/ "--" indicates that chemical was not identified as a COC for the IHSS (see Table 2-5)

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TABLE 5-4
REMEDIATION TARGET SCREEN RESULTS FOR GROUNDWATER

Groundwater Chemical of Concern	Selected Remediation Target [a]	Groundwater Area 1 [b]	Groundwater Area 2 [c]	Groundwater Area 3 [d]	Groundwater Area 4 [e]	Groundwater Area 5 [f]	Groundwater Area 6 [g]
Chloroform (μg/L) [h]	100	8	0 20	-- [i]	--	--	3
Methylene Chloride (μg/L)	5	32	2	14	0 2	10	0 6
Nitrate (mg/L)	10	--	596	--	--	--	--
Tetrachloroethene (μg/L)	5	13	2	2 2	3	--	0 2
Trichloroethene (μg/L)	5	150	2	6	4	--	0 1
Vinyl Chloride (μg/L)	10	--	--	860	--	--	--
Americium-241 (pCi/L)	30	0 06	1 09	0 02	--	3 2	0 04
Plutonium-239/240 (pCi/L)	30	--	3 65	0 01	--	2 2	0 007
Radium-226 (pCi/L)	100	--	0 72	--	--	1 1	8 8

a/ Selected remediation targets are presented in Table 4-5
b/ Associated IHSSs include 166 1, 166 2, and 166 3 Also includes F167 3
c/ Associated IHSSs include 142 1, 142 2, 142 3, and 142 4
d/ Associated IHSSs include 141, 142 5, 142 6, 142 7, 142 8, and 142 9
e/ Associated with IHSS 165
f/ Associated with IHSS 142 12
g/ Associated with IHSS 143
h/ Shading indicates that maximum COC concentration for the Groundwater Area is less than the selected remediation target Where the Groundwater Area column or COC row is also shaded, all of the maximum COC concentrations are below the selected remediation target
i/ "--" indicates that chemical was not identified as a COC for the Groundwater Area (see Table 2-6)

TABLE 5-5
REMEDIATION TARGET SCREEN SUMMARY

Human Health Chemical of Concern	Surface Soil	Subsurface Soil	Sediment		Ground-water
			Pond	Stream	
1,2-Dichloroethene [a/]	--	--	--	--	--
Acetone	--	--	--	--	--
Antimony	No	--	No	--	--
Aroclor-1254	--	--	No	--	--
Barium	--	No	--	--	--
Benzo(a)anthracene	--	--	--	No	--
Benzo(a)pyrene	--	No	No	No	--
Benzo(b)fluoranthene	--	No	No	No	--
Bis(2-ethylhexyl)phthalate	--	--	No	--	--
Chloroform	--	--	--	--	No
Cobalt	--	--	--	No	--
Indeno(1,2,3-cd)pyrene	--	--	--	No	--
Methylene Chloride	--	No	--	--	Yes [a/]
Nitrate	--	--	--	--	Yes
Silver	No	--	No	--	--
Strontium	--	--	--	No	--
Tetrachloroethene	--	--	--	--	Yes
Trichloroethene	--	--	--	--	Yes
Vanadium	No	--	No	No	--
Vinyl Chloride	--	--	--	--	Yes
Zinc	No	--	No	No	--
Americium-241	No	No	No	No	No
Plutonium-239/240	No	No	No	No	No
Radium-226	--	--	--	--	No
Uranium-233/234	--	No	--	--	--
Uranium-238	--	No	--	--	--

a/ "Yes" indicates that maximum COC concentration exceeds the selected remediation target

b/ Shading indicates all maximum COC concentration for the environmental medium is less than the selected remediation target Where the COC row is also shaded, all of the maximum COC concentrations for each environmental media are below the selected remediation targets

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- **Surface and Subsurface Soils** - Surface and subsurface soil remediation is not required As such, surface and subsurface soil remediation will not be considered in the CMS/FS, instead, a No Further Action determination will be sought for the OU6 surface and subsurface soils

- **Pond and Stream Sediments** - All COC concentrations are below their respective remediation targets Therefore, remediation of pond and stream sediments is not required However, the elimination of pond sediments from remediation is contingent on current use of the ponds Should sediments be removed either to maintain retention capacity as required by the NPDES permit or to close the ponds, the sediments will be managed in accordance with all applicable federal and state requirements The maintenance and closure activities are not considered to be an IAG-required remedial/corrective action, but will be implemented through on-going operational programs

- **Groundwater** - Groundwater Areas 1, 2, 3, and 5 have at least one COC which has a maximum concentration greater than the selected remediation target The chemicals detected in UHSU groundwater at OU6 are inferred to be the result of contaminant migration from upgradient sources

  The chemicals detected in Groundwater Area 1 may be the result of leachate migration from the upgradient OU7 landfill or the OU10 Property Utilization and Disposal yard As such, this area is recommended to be administratively transferred to OU7 or OU10 to further evaluate potential risk and the need to implement a remediation program

  The exceedence associated with Groundwater Area 2 is due to nitrate The source of this COC is believed to be the Solar Evaporation Ponds As such, it is proposed that Groundwater Area 2 be administratively transferred to OU4 to more effectively assess risks and potential remedial technologies

  The assessment of potential groundwater contamination and remediation needs for Groundwater Area 3 will be retained by OU6 A review of the RFI/RI characterization results in Groundwater Area 3 indicates that the 95 percent UTLs for methylene chloride and trichloroethene are below their selected remediation targets The 95 percent UTL for vinyl chloride is 134 μg/L and can be attributed to the results from Well #3586 Although vinyl chloride is being retained as a "special case" COC for developing remedial alternatives, the potential risk from

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exposure to this compound will be presented and discussed in the uncertainty analysis of the BRA

Methylene chloride, which is a suspected laboratory contaminant, is the only exceedence for Groundwater Area 5 Therefore, it may not be appropriate to remediate this Groundwater Area It is proposed that existing analytical data be evaluated as part of CMS/FS Technical Memorandum No 2 to determine whether laboratory contamination is the cause of this exceedence If the data are inconclusive, a recommendation for additional characterization may presented in CMS/FS Technical Memorandum No 2

- **Surface Water** - Based on the results of the CDPHE screen, the risk ratios for surface water at OU6 are less than one As such, surface water is a candidate for a No Further Action determination Surface water will continue to be managed in accordance with the NPDES permit as an on-going operational activity rather than a remedial/corrective action required under the IAG

- **Other** - Although OU6 surface and subsurface soils do not need to be remediated based on the remediation target screen, it is proposed that the Old Outfall (IHSS 143) be administratively transfer to OU8 (Industrial Area) due to the proximity of this IHSS to the industrial area

5.3 CMS/FS Recommendations

Based on the conclusions presented in Section 5 2, it is recommended that remedial technologies be developed for the following Groundwater Areas and human health COCs In lieu of developing remedial alternatives, other options such as filing a petition to reclassify the UHSU aquifer or establishing a suitable point of compliance to protect the current and expected future uses of the groundwater should be considered

Groundwater Area	Human Health COCs	Recommendations
Area 1	Methylene Chloride Tetrachloroethene Trichloroethene	Transfer to OU7 or OU10
Area 2	Nitrate	Transfer to OU4

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Groundwater Area	Human Health COCs	Recommendations
Area 3	Methylene Chloride Trichloroethene Vinyl Chloride	Evaluate in OU6 CMS/FS
Area 5	Methylene Chloride	Determine if result is due to laboratory contamination

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REFERENCES

DOE, 1990 *Radiation Protection of the Public and the Environment* DOE Order 5400 5 U S Department of Energy, Washington D C

DOE, 1992 *Historical Release Report for the Rocky Flats Plant - Final* June, 1992 Manual No 21100-TR-12501 01

DOE, 1993 *Final Background Geochemical Characterization Report* EG&G, Rocky Flats Plant Golden, Colorado September

DOE, 1994a *Technical Memorandum No 4, Chemicals of Concern Human Health Risk Assessment Walnut Creek Priority Drainage Operable Unit No 6 - Draft Final* Rocky Flats Environmental Technology Site Golden, Colorado August

DOE, 1994b *Letter Report Colorado Department of Public Health and Environment Source Area Delineation and Risk Based Conservative Screen and Environmental Protection Agency Areas of Concern Delineation, Human Health Risk Assessment - Final* Rocky Flats Environmental Technology Site Golden, Colorado October

DOE, 1995a *Master List of Potential Federal and State ARARs for the Rocky Flats Environmental Technology Site, Draft* U S Department of Energy, Rocky Flats Plant Golden, Colorado February

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EG&G, 1991a *General Radiochemistry and Routine Analytical Services Protocol, Part A, General Analytical Services Protocol, Organics, Inorganics, Water Quality Parameters, Biochemistry, Biota - Statement of Work* Revision 2 EG&G Rocky Flats Environmental Management Department Rocky Flats Plant Golden, Colorado

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EG&G, 1994 Letter from J H French to J Hopkins regarding Assessment of Potential Sand and Gravel Mining Land Use Scenario at Rocky Flats Operable Units August 18, 1994

EPA, 1988 *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* OSWER 9355 3-01 U S Environmental Protection Agency, Office of Emergency and Remedial Response Washington, D C

EPA, 1989a *Superfund LDR Guide #5, Determining When Land Disposal Restrictions (LDR) are Applicable to CERCLA Response Actions* OSWER 9347 3-05FS U S Environmental Protection Agency, Office of Emergency and Remedial Response Washington, D C

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EPA, 1992 *Supplemental Guidance to RAGS Calculating the Concentration Term* OSWER 9285 7-081 Environmental Protection Agency, Office of Solid Waste and Emergency Response Washington, D C

IAG, 1991 *Rocky Flats Interagency Agreement Between the State of Colorado, the Environmental Protection Agency, and the Department of Energy*

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APPENDIX A

CDPHE CONSERVATIVE SCREEN RESULTS

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TABLE A-1
CDPHE CONSERVATIVE SCREEN RESULTS

Source Areas		Medium	Carcinogenic Ratio Sum [a/]	Noncarcinogenic Ratio Sum [a/]	Recommendations
IHSS 141	Sludge Dispersal	Soil 0-12'	3 8E+00	1 0E-01	
		Groundwater Area 3	3 1E+04	2 4E+01	
IHSS 142 1	Pond A-1	Sediment	2 8E+01	3 2E-02	
		Surface Water	3 7E-03	2 3E-04	No Further Action [d/]
		Groundwater Area 2	1 2E+03	5 3E+01	
IHSS 142 2	Pond A-2	Sediment	1 2E+01	4 4E-02	
		Surface Water	3 7E-03	2 3E-04	No Further Action [d/]
		Groundwater Area 2	1 2E+03	5 3E+01	
IHSS 142 3	Pond A-3	Sediment	3 2E+00	3 5E-02	
		Surface Water	3 7E-03	2 3E-04	No Further Action [d/]
		Groundwater Area 2	1 2E+03	5 3E+01	
IHSS 142 4	Pond A-4	Sediment	1 7E-01	4 1E-01	No Further Action [c/]
		Surface Water	3 7E-03	2 3E-04	No Further Action [d/]
		Groundwater Area 2	1 2E+03	5 3E+01	Not a Source Area
IHSS 142 5	Pond B-1	Sediment	3 4E+02	8 0E-01	
		Surface Water	1 8E-02	7 8E-05	No Further Action [d/]
		Groundwater Area 3	3 1E+04	2 4E+01	
IHSS 142 6	Pond B-2	Sediment	1 1E+02	5 0E-01	
		Surface Water	1 8E-02	7 8E-05	No Further Action [d/]
		Groundwater Area 3	3 1E+04	2 4E+01	

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TABLE A-1 (continued)
CDPHE CONSERVATIVE SCREEN RESULTS

Source Areas		Medium	Carcinogenic Ratio Sum [a]	Noncarcinogenic Ratio Sum [a]	Recommendations
IHSS 142 7	Pond B-3	Sediment	1 3E+02	1 0E+00	
		Surface Water	1 8E-02	7 8E-05	No Further Action [d]
		Groundwater Area 3	3 1E+04	2 4E+01	
IHSS 142 8	Pond B-4	Sediment	3 4E+01	1 4E-01	
		Surface Water	1 8E-02	7 8E-05	No Further Action [d]
		Groundwater Area 3	3 1E+04	2 4E+01	
IHSS 142 9	Pond B-5	Sediment	2 6E-01	2 5E-03	No Further Action [c]
		Surface Water	1 8E-02	7 8E-05	No Further Action [d]
		Groundwater Area 3	3 1E+04	2 4E+01	Not a Source Area
IHSS 142 12	Walnut & Indiana Pond	Sediment	3 1E-03	3 4E-05	No Further Action [c]
		Surface Water	---	5 0E-05	No Further Action [d]
		Groundwater Area 5	6 5E+02	3 4E+01	Not a Source Area
IHSS 143	Old Outfall	Soil 0-12'	4 7E+01	1 4E-01	No Further Action for all media in this IHSS under OU6 [b]
		Groundwater Area 6	1 8E+03	9 4E+01	
IHSS 156 2	Soil Dump Area	Soil 0-12'	1 6E+00	4 8E-01	
IHSS 165	Triangle Area	Soil 0-12'	1 4E+01	1 1E-01	
		Groundwater Area 4	1 2E+01	4 8E+00	
IHSSs 166 1, 166 2, and 166 3	Trenches A, B, and C	Soil 0-12'	8 3E-01	1 6E-01	No Further Action [c]
		Groundwater Area 1	2 0E+03	7 4E+01	No Further Action Under OU6 [b], Not a Source Area

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TABLE A-1 (continued)
CDPHE CONSERVATIVE SCREEN RESULTS

Source Areas		Medium	Carcinogenic Ratio Sum [a/]	Noncarcinogenic Ratio Sum [a/]	Recommendations
IHSS 167 1	North Area Spray Field	Soil 0-12'	4 9E+00	5 5E-02	
F167 3	Former South Area Spray Field	Soil 0-12'	1 1E-01	3 8E-03	No Further Action [c/]
		Groundwater Area 1	2 0E+03	7 4E+01	No Further Action Under OU6 [b/], Not a Source Area
IHSS 216 1	East Spray Field	Soil 0-12'	3 5E-01	4 4E-02	No Further Action [c/]
	Stream Sediment	North Walnut	1 4E+00	7 3E-01	
		South Walnut	6 9E+00	2 3E-04	
		Upgradient	2 8E+00	8 2E-05	
		Walnut & Indiana	3 7E-03	3 3E-05	No Further Action [c/]
	Dry Sediment	North Walnut	5 3	1 3E-02	
		South Walnut	6 9E+00	9 0E-03	

NOTES

[a/] For the CDPHE Conservative Screen
Carcinogenic Ratio Sum >1 is equivalent to $>10^{-6}$ cancer risk level
Carcinogenic Ratio Sum >100 is equivalent to $>10^{-4}$ cancer risk level
Noncarcinogenic Ratio Sum >1 is equivalent to Hazard Index >1
(All assuming long-term residential exposure to maximum detected concentrations of chemicals)

[b/] No Further Action is recommended based on transfer of administrative responsibility to another operable unit

[c/] No Further Action is recommended based on risk ratios below one

[d/] No Further Action is recommended based on risk ratios below one Continued monitoring may be required

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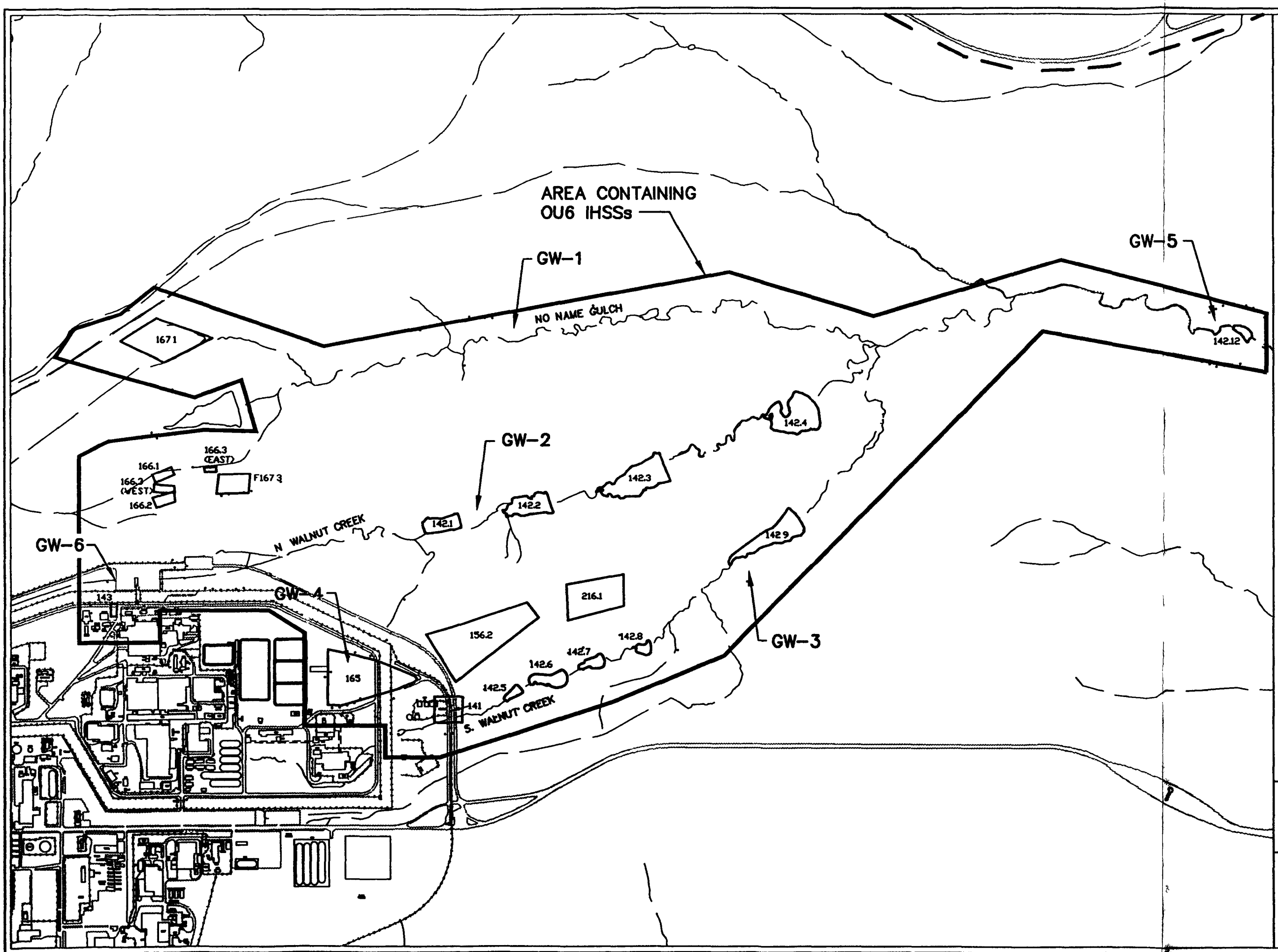

LEGEND

- Streams
- Paved Roads
- Buildings
- Fence
- IHSS Boundary
- Groundwater Area Boundary
- GW-X Groundwater Area Designation

IHSS NO	IHSS NAME
141	Sludge Dispersal Area
142.X	Retention Ponds
143	Old Outfall
156 2	Soil Dump Area
165	Triangle Area
166 X	Trenches A B & C
167 1	North Area Spray Field
216 1	East Area Spray Field

NOTE
ORIGINALLY SUSPECTED LOCATION OF THE SOUTH AREA SPRAY FIELD IS SHOWN AS F167 3

0 500 1000 1500 FEET

PREPARED FOR
U S DEPARTMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

Figure 2 1

Location of OU6 IHSSs
Operable Unit No. 6
Technical Memorandum No. 1

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TABLE 4-2
PRELIMINARY REMEDIATION LEVELS FOR SURFACE SOIL

Surface Soil Chemical of Concern (Units as Indicated)	Background Concentration ($UTL_{95\%}$)	Minimum Analytical Detection Limit[b]	Potential Chemical-Specific ARARs/TBCs		Risk Based Preliminary Remediation Goals												Cleanup Standards Established at Other Colorado NPL Sites	Selected Remediation Target
					Open Space				Office Worker				Ecological Researcher					
			ARARs	TBCs	RME[a]		CT[b]		RME[a]		CT[b]		RME[a]		CT			
					NC[c]	C[d]	NC[c]	C[d]	NC[c]	C[d]	NC[c]	C[d]	NC	C[d]	NC[c]	C[d]		
Antimony (mg/kg)	5 00e+01	1 20e+01	–	–	3 07e+03	–	1 43e+04	–	8 18e+02	–	9 33e+03	–	3 14e+03	–	4 78e+03	–	–	8 18e+02
Silver (mg/kg)	1 00e+01	2 00e+00	–	–	3 84e+04	–	1 79e+05	–	1 02e+04	–	1 17e+05	–	3 93e+04	–	5 97e+04	–	5 00e+00	1 02e+04
Vanadium (mg/kg)	5 56e+01	1 00e+01	-	–	5 38e+04	–	2 51e+05	–	1 43e+04	–	1 63e+05	–	5 50e+04	–	8 36e+04	–	–	1 43e+04
Zinc (mg/kg)	8 66e+01	4 00e+00	–	–	>1 00e+06	–	>1 00e+06	–	6 13e+05	–	>1 00e+06	–	>1 00e+06	–	>1 00e+06	–	8 00e+01	6 13e+05
Americium 241 (pCi/g)	6 00e-02	2 00e-02	–	8 52e+02[g]	–	2 49e+01	–	2 39e+02	–	9 55e+00	–	2 49e+02		2 04e+02	–	36e+02	–	8 52e+02
Plutonium 239/240 (pCi/g)	1 33e-01	3 00e-02	-	1 80e+03[g]	–	9 47e+01	–	1 53e+03	–	1 38e+01	–	9 47e+02	–	5 28e+02	–	7 95e+0?	-	1 80e+03

NOTES

[a] PRGs are based on RME factors
[b] PRGs are based on CT exposure factors
[c] PPGs are based on noncarcinogenic toxicity information
[d] PRGs are based on carcinogenic toxicity information
[e] Martin Marietta Denver Aerospace (EPA/ROD/R08 90/035) Cleanup standard is provided as mg/L and is based on a LDR treatment standard which is applied to the TCLP extract from the treated waste
Woodbury Chemical (EPA/ROD/R08 89/026) Basis for the zinc cleanup standard is not known
[g] TBC value is the radionuclide-specific concentration that would result in an exposure equal to 100 mrem per year effective dose equivalent for the office worker exposure scenario using RME factors
Minimum analytical detection limits are from the *GRRASP* (EG&G 1991 and EG&G 1991a)