

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
IDENTIFICATION FORM	i
APPROVAL FORM	ii
RECORD OF CHANGES	iii
DISTRIBUTION LIST	iv
TABLE OF CONTENTS	v
ABBREVIATIONS AND ACRONYMS	xiii
 EXECUTIVE SUMMARY	 1
 1.0 INTRODUCTION	 7
1.1 PURPOSE	9
1.2 BACKGROUND	11
1.2.1 History of Regulatory Actions and Investigations	11
1.2.2 Description of RI/FS Project Areas	12
1.3 REPORT ORGANIZATION	14
 2.0 REGIONAL SETTING	 16
2.1 SURFACE FEATURES	16
2.2 CLIMATE	18
2.3 STUDY AREA DEMOGRAPHY AND LAND USE	19
 3.0 INVESTIGATIVE TECHNIQUES	 22
3.1 GROUNDWATER LEVEL MEASUREMENTS	22
3.2 GROUNDWATER SAMPLING	24
3.2.1 Municipal Supply Wells	27
3.3 ANALYTICAL METHODS AND DATA QUALITY EVALUATION	27
3.3.1 RAS and SAS Methods	28
3.3.2 Data Quality Objectives Evaluation	28
 4.0 INVESTIGATION AREA CHARACTERISTICS	 33
4.1 GEOLOGY	33
4.1.1 Regional Geology	33
4.2 HYDROGEOLOGY	34
4.2.1 Regional Hydrogeology	34
4.2.2 Muscoy Plume OU Investigation Area Hydrogeology	38
 5.0 NATURE AND EXTENT OF CONTAMINATION	 41
5.1 VOLATILE ORGANIC COMPOUNDS	41
5.2 SEMIVOLATILE ORGANIC COMPOUNDS	46
5.3 METALS	46
5.4 OTHER CONSTITUENTS	46

TABLE OF CONTENTS (Cont'd.)

<u>Section</u>	<u>Page</u>
6.0 CONTAMINANT FATE AND TRANSPORT	48
6.1 CONTAMINANT CHARACTERISTICS AND ENVIRONMENTAL PERSISTENCE	48
6.1.1 Chemical and Physical Characteristics	48
6.1.2 Contaminant Fate and Persistence	50
6.2 AFFECTED ENVIRONMENTAL MEDIA	51
6.2.1 Affected Environmental Media	51
6.3 TRANSPORT MECHANISMS AND PATHWAYS	54
6.3.1 Transport Mechanisms	54
6.3.2 Intermedia Transport Pathways	60
6.4 REVIEW OF PROJECT FLOW MODEL	62
6.4.1 Summary of Model Changes	63
6.4.2 Flow Model Results of Existing Conditions	64
7.0 SUMMARY AND CONCLUSIONS	71
7.1 SUMMARY	71
7.1.1 Nature and Extent of Contamination	71
7.1.2 Fate and Transport	73
7.2 DATA LIMITATIONS	74
8.0 REMEDIAL ACTION OBJECTIVES	75
8.1 IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND OTHER CRITERIA OR GUIDELINES TO BE CONSIDERED	75
8.1.1 Definition of ARARs and Other Criteria or Guidelines to be Considered (TBCs)	75
8.1.2 Identification of ARARs	76
8.1.3 Identification of Other Guidance and Criteria To-Be-Considered	84
8.1.4 Summary of ARARs and TBCs	86
8.2 PRELIMINARY BASELINE RISK ASSESSMENT	86
8.2.1 Background	86
8.2.2 Chemical Concentrations	86
8.2.3 Exposure Pathways	89
8.2.4 Quantification of Health Risks	89
8.2.5 Estimated Risks - Quantitative Assessment	90
8.2.6 Ecological Risks	90
8.2.7 Conclusions	93
9.0 GENERAL RESPONSE ACTIONS	94
9.1 NO ACTION	94
9.2 INSTITUTIONAL ACTIONS	94
9.3 CONTAINMENT	94

TABLE OF CONTENTS (Cont'd.)

<u>Section</u>	<u>Page</u>
10.10.2 Surface Drainage	111
10.11 OFF-SITE DISCHARGE OF TREATED GROUNDWATER	112
10.11.1 POTW	112
10.11.2 Municipal Water Supply	112
11.0 EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS	113
11.1 MONITORING	113
11.2 GROUNDWATER USE RESTRICTIONS	116
11.3 EXTRACTION	116
11.3.1 Extraction Wells	116
11.3.2 Municipal Supply Wells	117
11.4 PHYSICAL/CHEMICAL TREATMENT (ON-SITE)	117
11.4.1 Aqueous-Phase GAC	117
11.4.2 Air Stripping with Vapor-Phase GAC Treatment of Off Gas	118
11.4.3 Air Stripping with Off Gas Treatment by Resin Based Adsorption	118
11.4.4 Advanced Oxidation (Ozone)	119
11.4.5 Advanced Oxidation (Ozone/Peroxide)	119
11.4.6 Advanced Oxidation (UV)	119
11.5 OFF-SITE TREATMENT	120
11.5.1 POTW	120
11.6 ON-SITE DISCHARGE OF TREATED GROUNDWATER	120
11.6.1 Reinjection	121
11.6.2 Surface Drainage	121
11.7 OFF-SITE DISCHARGE OF TREATED GROUNDWATER	121
11.7.1 POTW	121
11.7.2 Municipal Water Supply	122
12.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES	123
12.1 DEVELOPMENT OF EXTRACTION SCENARIOS	123
12.1.1 Project Flow Model and Plume Capture Model	123
12.1.2 Extraction Regions and Extraction Scenarios	124
12.1.3 Results of the Extraction Scenarios	131
12.1.4 Preferred Extraction Scenario	150
12.2 DEVELOPMENT OF ALTERNATIVES	153
12.3 SCREENING OF ALTERNATIVES	153
12.3.1 Alternative 1: No Action (Monitoring)	154
12.3.2 Alternative 2: Aqueous-Phase GAC With Municipal End Use	155
12.3.3 Alternative 3: Air Stripping With BACT Off-Gas Treatment With Municipal End Use	157
12.3.4 Alternative 4: Advanced Oxidation (Ozone/Peroxide) With Municipal End Use	159
12.3.5 Alternative 5: Aqueous-Phase GAC With Reinjection	159
12.3.6 Evaluation Summary	161

TABLE OF CONTENTS (Cont'd.)

<u>Section</u>	<u>Page</u>
13.0 DETAILED ANALYSIS OF ALTERNATIVES	163
13.1 EVALUATION OF ALTERNATIVES	163
13.1.1 Alternative 1: No Action (Monitoring)	167
13.1.2 Alternative 2: Aqueous-Phase GAC with Municipal End Use	172
13.1.3 Alternative 3: Air Stripping with BACT Off-Gas Treatment and Municipal End Use	187
13.1.4 Alternative 4: Advanced Oxidation (Ozone/Peroxide) with Municipal End Use	190
13.1.5 Alternative 5: Aqueous GAC with Reinjection	200
13.2 COMPARATIVE ANALYSIS OF ALTERNATIVES	210
13.2.1 Overall Protection of Human Health and the Environment	210
13.2.2 Compliance with ARARs	210
13.2.3 Long-Term Effectiveness and Permanence	216
13.2.4 Reduction of Toxicity, Mobility, or Volume	216
13.2.5 Short-Term Effectiveness	216
13.2.6 Implementability	216
13.2.7 Cost	217
14.0 REFERENCES	227

APPENDICES

Appendix 1	Water Level Data
Appendix 2	Sample Alteration Checklists
Appendix 3	Data Validation Reports
Appendix 4	Laboratory Analytical Results
Appendix 5	Muscoy Groundwater Modeling Memorandum, November 1993
Appendix 6	Development of Extraction Scenarios
Appendix 7	Preliminary Baseline Risk Assessments
Appendix 8	Monitoring Well 128 (MW128) Preliminary Results

TABLES

Table ES-1	Alternative Comparative Analysis
Table 2-1	State and Federal Ambient Air Quality Standards San Bernardino Fourth Street Station No. 203 1990
Table 3-1	Municipal Supply Well Information Summary
Table 3-2	Analytical Methods Muscoy Plume OU Wells
Table 3-3	Data Quality Objectives for Groundwater Samples Analyzed by RAS and SAS Laboratories
Table 5-1	Municipal Water/Well Volatile Organic Sample Results (detections only) - Muscoy Plume OU
Table 6-1	Physical Properties of PCE and TCE
Table 6-2	Average Groundwater Velocities for Muscoy Plume OU
Table 6-3	Estimated Retardation Factors (R_f) and Velocities of TCE and PCE in the Groundwater
Table 7-1	Contaminants of Concern
Table 7-2	Concentrations of Contaminants of Concern in Groundwater
Table 8-1	Potential State and Federal Chemical-Specific ARARs
Table 8-2	Potential State and Federal Chemical-Specific TBCs
Table 8-3	Summary of Potential ARARs and TBCs for the Muscoy Plume Operable Unit
Table 8-4	Systemic Toxicity Summary Chronic Hazard Index Estimates Average and Reasonable Maximum Exposure (RME) Scenarios
Table 8-5	Carcinogenic Risk Estimates Average and Reasonable Maximum Exposure (RME) Scenarios
Table 9-1	Technologies and Process Options for Groundwater Remedial Action Objectives
Table 10-1	Initial Screening of Technologies and Process Options for Groundwater
Table 11-1	Evaluation of Process Options for Groundwater
Table 12-1	Extraction Scenarios for Muscoy OU Plume
Table 12-2	Screening of Groundwater Alternatives
Table 13-1	Cost Basis
Table 13-2	Summary of Detailed Evaluation of Alternatives
Table 13-3	Estimated Cost - Alternative 1
Table 13-4	Design Criteria - Alternative 2
Table 13-5	Estimated Cost - Alternative 2
Table 13-6	Design Criteria - Alternative 3
Table 13-7	Estimated Cost - Alternative 3
Table 13-8	Design Criteria - Alternative 4
Table 13-9	Estimated Cost - Alternative 4
Table 13-10	Design Criteria - Alternative 5
Table 13-11	Estimated Cost - Alternative 5
Table 13-12	Alternative Comparative Analysis
Table 13-13	Comparison of Cost for Alternatives
Table 13-14	Sensitivity Analysis: Variation of Annual Carbon Usage - Alternative 2

TABLE OF CONTENTS (Cont'd.)

Table 13-15	Sensitivity Analysis: Variation of Air/Water Ratio - Alternative 3
Table 13-16	Sensitivity Analysis: Variation of Dosage Rate - Alternative 4
Table 13-17	Sensitivity Analysis: Variation of Annual Carbon Usage - Alternative 5

FIGURES

Figure ES-1	Newmark Groundwater Contamination Superfund Site
Figure 1-1	Plume Locations
Figure 1-2	Study and Model Areas
Figure 2-1	Muscoy Plume OU Area Surface Features
Figure 3-1	Well Location Map
Figure 4-1	Geologic Cross-Section Location Map
Figure 4-2	Geologic Cross-Section A-A'
Figure 4-3	Groundwater Elevation Contour Map
Figure 5-1	PCE Concentrations
Figure 5-2	TCE Concentrations
Figure 5-3	Freon Concentrations
Figure 6-1	TCE/PCE Release
Figure 6-2	Head Contour and Pathline Plot for Extraction Scenario No. 1, Layer 1
Figure 6-3	Head Contour and Pathline Plot for Extraction Scenario No. 1, Layer 2
Figure 12-1	Location of Extraction and Injection Areas
Figure 12-2	Head Contour and Pathline Plot for Extraction Scenario No. 2, Layer 1
Figure 12-3	Head Contour and Pathline Plot for Extraction Scenario No. 2, Layer 2
Figure 12-4	Head Contour and Pathline Plot for Extraction Scenario No. 3, Layer 1
Figure 12-5	Head Contour and Pathline Plot for Extraction Scenario No. 3, Layer 2
Figure 12-6	Head Contour and Pathline Plot for Extraction Scenario No. 4, Layer 1
Figure 12-7	Head Contour and Pathline Plot for Extraction Scenario No. 4, Layer 2
Figure 12-8	Head Contour and Pathline Plot for Extraction Scenario No. 5, Layer 1
Figure 12-9	Head Contour and Pathline Plot for Extraction Scenario No. 5, Layer 2
Figure 12-10	Head Contour and Pathline Plot for Extraction Scenario No. 6, Layer 1
Figure 12-11	Head Contour and Pathline Plot for Extraction Scenario No. 6, Layer 2
Figure 12-12	Head Contour and Pathline Plot for Extraction Scenario No. 7, Layer 1
Figure 12-13	Head Contour and Pathline Plot for Extraction Scenario No. 7, Layer 2
Figure 12-14	Head Contour and Pathline Plot for Extraction Scenario No. 8, Layer 1
Figure 12-15	Head Contour and Pathline Plot for Extraction Scenario No. 8, Layer 2
Figure 12-16	Head Contour and Pathline Plot for Extraction Scenario No. 9, Layer 1
Figure 12-17	Head Contour and Pathline Plot for Extraction Scenario No. 9, Layer 2
Figure 12-18	Aqueous-Phase Granular Activated Carbon System
Figure 12-19	Air Stripping with BACT Off-Gas Treatment System with Municipal End Use
Figure 12-20	Advanced Oxidation System with Municipal End Use Conceptual Design
Figure 13-1	Treatment Plant, Extraction and Injection Well Location and Pipeline Route
Figure 13-2	Alternative 2 - Aqueous GAC with Municipal End Use

TABLE OF CONTENTS (Cont'd.)

Figure 13-3	Alternative 3 - Air Stripping with BACT Off-Gas Treatment and Municipal End Use
Figure 13-4	Alternative 4 - Advanced Oxidation and Municipal End Use
Figure 13-5	Alternative 5 - Aqueous GAC with ReInjection
Figure 13-6	Comparison of Capital and Annual O&M Costs for Alternatives
Figure 13-7	Comparison of Present-Worth of Alternatives
Figure 13-8	Sensitivity Analysis of Alternatives