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FINAL
REMEDIAL INVESTIGATION REPORT
VOLUME 1 OF 2
SUMMIT NATIONAL SITE
DEERFIELD, OHIO

K.08
2/10/88

EPA WA57-5L04
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TABLE OF CONTENTS

	Page No.
Executive Summary	E-1
1.0 Introduction	1-1
1.1 Purpose	1-1
1.2 Site Background Information	1-1
1.2.1 Facility Location and Description	1-1
1.2.2 Site History and Waste Related Activities	1-3
1.2.3 Site Investigation and Remedial Action	1-7
1.2.4 Types of Wastes	1-8
1.2.5 Physiography	1-8
1.3 Nature and Extent of Problem	1-10
1.3.1 Public Health and Welfare	1-12
1.3.2 Environment	1-12
1.4 Remedial Investigation Summary	1-12
1.4.1 Phase I Remedial Investigation	1-13
1.4.2 Phase II-A Remedial Investigation	1-14
1.4.3 Phase II-B Remedial Investigation	1-15
1.5 Overview of Report	1-17
2.0 Site Features	2-1
2.1 Demography	2-1
2.2 Land Use	2-1
2.3 Industry and Natural Resources	2-4
2.4 Native Vegetation and Wildlife	2-7
2.5 Climatology	2-8
3.0 Methods and Materials	3-1
3.1 Geology and Hydrogeology	3-1
3.1.1 Piezometers	3-1
3.1.2 Monitoring Wells	3-3
3.1.3 Groundwater Sampling	3-9
3.1.4 Hydraulic Conductivity Testing	3-10

Table of Contents (cont'd)
Page 2

	Page No.
3.2 Soils	3-10
3.3 Surface Water	3-23
3.4 Sediments	3-24
3.5 Air Sampling	3-27
3.6 Radiological Monitoring	3-29
3.7 Onsite Structures	3-29
3.8 RI Derived Liquid Waste Disposal	3-29
3.9 Buried Material	3-30
3.9.1 Geophysical Investigations	3-30
3.9.2 Test Pit Investigations	3-33
4.0 Results of RI Investigations	4-1
4.1 Data Considerations	4-1
4.1.1 Data Reduction	4-1
4.1.2 QA/QC Assessment - Laboratory and EPA Protocol	4-1
4.1.3 In-Field Protocol	4-3
4.2 Geology	4-7
4.2.1 Surficial Geology	4-7
4.2.2 Bedrock Geology	4-7
4.3 Hydrogeology	4-15
4.3.1 Hydraulic Conductivities	4-17
4.3.2 Groundwater Flow	4-19
4.3.3 Groundwater Chemistry	4-28
4.3.4 Summary and Conclusions	4-54
4.4 Soils	4-56
4.4.1 Characteristics and Description	4-56
4.4.2 Data and Results	4-57
4.4.3 Summary and Conclusions	4-57
4.4.4 Summary of Onsite Soils	4-86
4.4.5 Offsite Soils	4-93
4.5 Surface Water	4-102
4.5.1 Surface Water Hydrology	4-102
4.5.2 Flood Potential	4-108
4.5.3 Summary and Conclusions	4-109

LIST OF TABLES

		Page No.
E-1	Summary of Potential Risks Associated with Summit National Site	E-8
2-1	Land Use in Portage County - 1980	2-2
2-2	Berlin Reservoir to Meander Creek Pumpages	2-5
2-3	Mean Monthly Temperature and Precipitation	2-9
3-1	Summary of Monitoring Well Construction Data	3-4
3-2	Summary of Monitoring Well Clusters	3-7
3-3	Correlation of Soil Sampling Cell Renumbering	3-16
4-1	SAS Parameters Analyzed	4-2
4-2	Summary of Organic Analytical Problems	4-4
4-3	Summary of Inorganic Analytical Problems	4-5
4-4	Summary of Hydraulic-Conductivity Estimates	4-18
4-5	Water Levels in Monitoring Wells	4-20
4-6	Most Representative Contaminants Identified in the Shallow Groundwater System	4-35
4-7	Identified Organic Contaminants Detected in MW-24	4-44
4-8	Residential Wells Sampled	4-46
4-9	Predicted Concentrations of Contaminants in the Water-Table Aquifer 100 Feet Downgradient of Wastes	4-51
4-10	Predicted Concentrations of Organic Contaminants in the Water-Table Aquifer 1450 Feet Downgradient of Wastes (Second Impoundment)	4-52
4-11	Predicted Concentrations of Organic Contaminants in the Water-Table Aquifer 4500 Feet Downgradient of Wastes (Berlin Reservoir)	4-53
4-12	Retardation Factors for Organic Contaminants	4-55
4-13	Summary List of Organic Parameters Identified in Background Soils	4-62
4-14	Summary List of Inorganic Parameters Identified in Background Soils	4-63
4-15	Summary List of Volatile Parameters in Onsite Surface Soils	4-66
4-16	Summary List of BNA and Pesticide/PCB Parameters in Onsite Surface Soils	4-67
4-17	Summary List of Inorganic Parameters in Onsite Surface Soils	4-68
4-18	Typical Concentrations of Metals in U. S. Soils	4-76
4-19	Summary List of Volatile Parameters in Onsite Soils (6 - 8 ft.)	4-78
4-20	Summary List of BNA and Pesticide/PCB Parameters in Onsite Soils (6 - 8 ft.)	4-79

List of Tables (cont'd)
Page 2

		Page No.
4-21	Summary List of Inorganic Parameters in Onsite Soils (6 - 8 ft.)	4-80
4-22	Summary List of Volatile Parameters in Onsite Soils (2 - 4 ft.)	4-87
4-23	Summary List of BNA and Pesticide/PCB Parameters in Onsite Surface Soils (2 - 4 ft.)	4-88
4-24	Summary List of Inorganic Parameters in Onsite Soils (2 - 4 ft.)	4-89
4-25	Summary List of Volatile Parameters in Onsite Soils (4 - 6 ft.)	4-90
4-26	Summary List of BNA and Pesticide/PCB Parameters in Onsite Soils (4 - 6 ft.)	4-91
4-27	Summary List of Inorganic Parameters in Onsite Soils (4 - 6 ft.)	4-92
4-28	Summary of Organic Parameters Identified in Cement Plant Surface Soils	4-96
4-29	Summary of Inorganic Parameters Identified in Cement Plant Surface Soils	4-97
4-30	Summary List of Organic Parameters Identified in Cement Plant Subsurface (2 - 6 ft.) Soils	4-98
4-31	Summary List of Inorganic Parameters Identified in Cement Plant Subsurface (2 - 6 ft.) Soils	4-99
4-32	Summary List of Organic Parameters Identified in Eastern Perimeter Soils	4-101
4-33	Summary List of Inorganic Parameters Identified in Eastern Perimeter Soils	4-103
4-34	Summary List of Organic Parameters Identified in Onsite Surface Water	4-110
4-35	Summary List of Inorganic and SAS Parameters Identified in Onsite Surface Water	4-111
4-36	Comparison of Total Fraction Concentrations Detected in Onsite Pond Surface Areas	4-112
4-37	Summary List of Organic Parameters Identified in Offsite Surface Water	4-115
4-38	Summary List of Inorganic and SAS Parameters Identified in Offsite Surface Water	4-117
4-39	Summary List of Volatile Parameters in East Pond Sediment	4-119
4-40	Summary List of BNA and PCB Parameters in East Pond Sediment	4-120
4-41	Summary List of Inorganic Parameters in East Pond Sediment	4-121
4-42	Summary List of Volatile Parameters in West Pond Sediments	4-124
4-43	Summary List of BNA and PCB Parameters in West Pond Sediments	4-125
4-44	Summary List of Inorganic Parameters in West Pond Sediments	4-126

LIST OF FIGURES

		Page No.
1-1	Summit Site Location	1-2
1-2	Site Map	1-4
1-3	Map of Active Site	1-5
1-4	Physiographic Map	1-9
1-5	Site Topographic Map	1-11
2-1	Existing Land Use	2-3
2-2	Existing Industries	2-6
2-3	Prevailing Wind Directions	2-10
3-1	Location of Monitoring Wells in Water Table Aquifer	3-2
3-2	Location of Monitoring Wells in Intermediate Zone	3-5
3-3	Location of Monitoring Wells in Upper Sharon Aquifer	3-6
3-4	Typical Monitoring Well Construction	3-8
3-5	Location of Sampled Residential Wells	3-11
3-6	Location of Reference Grid and Placement of Auger Holes	3-12
3-7	Soil Sampling Locations with Phase I Numbering System	3-13
3-8	Soil Sampling Locations with Phase II Numbering System	3-15
3-9	Onsite Surface Soil Sampling Locations	3-18
3-10	Screening Selection Protocol Onsite Drum Soil Samples	3-20
3-11	Screening Selection Protocol Onsite Drum Area Soil Boring Samples	3-22
3-12	Surface Water Sampling Locations	3-25
3-13	Sediment Sampling Locations	3-26
3-14	Air Sampling Locations	3-28
3-15	RI Derived Liquid Waste Disposal Activities	3-31
3-16	Carbon Adsorption Treatment System	3-32
3-17	Potential Drum Burial Sites and Approximate Test Pit Locations	3-34
4-1a	Section Line A-A'	4-8
4-1b	Geologic Cross Section A-A'	4-9
4-2a	Section Line B-B'	4-10
4-2b	Geologic Cross Section B-B'	4-12
4-3	Generalized Stratigraphic Column	4-11
4-4	Regional Geologic Cross Section	4-14
4-5	Water-Table Contour Map, June 1986	4-21
4-6	Water-Table Map, September 1986	4-22
4-7	Piezometric Surface on the Upper Sharon Aquifer	4-25
4-8	Vertical Gradients in Bedrock Limits	4-26
4-9	Piper Diagram	4-29

		Page No.
4-10	Water Table Aquifer Sampling Locations	4-32
4-11	Intermediate Aquifer Sampling Locations	4-33
4-12	Upper Sharon Aquifer Sampling Locations	4-34
4-13	Distribution of 2-Butanone in the Water Table Aquifer	4-37
4-14	Distribution of Phenol in the Water Table Aquifer	4-39
4-15	Distribution of Toluene in the Water Table Aquifer	4-40
4-16	Distribution of Bis (2-Ethylhexyl) Phthalate in the Water Table Aquifer	4-41
4-17	Water Table Aquifer Sample Location	4-42
4-18	Distribution of Chromium in the Water Table Aquifer	4-48
4-19	Distribution of Ammonia in the Water Table Aquifer	4-49
4-20	Onsite Surface Soil Sampling Locations	4-59
4-21	Perimeter and Offsite Soil Sampling Locations	4-60
4-22	Background Soil Sampling Locations	4-58
4-23	Prevailing Wind Directions	4-64
4-24	Total Volatile Parameters in Onsite Surface Soil	4-69
4-25	Total BNA Parameters in Onsite Surface Soil	4-70
4-26	Total PCB and Pesticide Parameters in Onsite Surface Soil	4-71
4-27	Total Inorganic Parameters in Onsite Surface Soil	4-72
4-28	Total Volatile Parameters in Onsite Soil (6-8 ft.)	4-81
4-29	Total BNA Parameters in Onsite Soil (6-8 ft.)	4-82
4-30	Total PCB and Pesticide Parameters in Onsite Soil (6-8 ft.)	4-83
4-31	Total Inorganic Parameters in Onsite Soil (6-8 ft.)	4-84
4-32	Perimeter and Offsite Soil Sample Locations	4-95
4-33	Location of Major Surface Water Features	4-104
4-34	Surface Water Features and Site Drainage Prior to 1975	4-105
4-35	Existing Surface Water Features and Site Drainage	4-106
4-36	Site Structures Map	4-139
4-37	RI Derived Liquid Waste Disposal Activities	4-144
4-38	Potential Drum Burial Sites and Approximate Test Pit Locations	4-149

Table of Contents (cont'd)
Page 3

	Page No.
4.6 Sediment	4-118
4.6.1 Onsite Sediment	4-118
4.6.2 Offsite Sediment	4-127
4.7 Air Monitoring	4-134
4.8 Radiological Monitoring	4-136
4.8.1 Preliminary Monitoring	4-136
4.8.2 Radiological Health and Safety Monitoring	4-136
4.9 Onsite Structures	4-138
4.10 RI Derived Liquid Waste Disposal	4-138
4.11 Buried Material	4-146
4.11.1 Geophysical Surveys	4-146
4.11.1.1 Magnetometer	4-146
4.11.1.2 GPR Survey	4-147
4.11.1.3 EM Survey	4-148
4.11.2 Buried Tanks	4-150
4.11.2.1 Tank Locations and Descriptions	4-150
4.11.2.2 Tank Sampling and Results	4-150
4.11.3 Buried Drums	4-157
4.11.3.1 Conditions Encountered at Test Pit Locations	4-157
4.11.3.2 Total Estimated Number of Buried Drums	4-158
4.11.3.3 Drum Sampling and Results	4-158
5.0 Contaminant Transport and Fate	5-1
5.1 Organic Chemicals	5-1
5.1.1 Aliphatic Ketones	5-3
5.1.2 Chlorinated Aliphatics	5-3
5.1.3 Monocyclic Aromatics	5-6
5.1.4 Phthalates	5-7
5.1.5 PCB's	5-8
5.1.6 Polycyclic Aromatic Hydrocarbons	5-10

	Page No.
5.2 Inorganic Chemicals	5-10
5.2.1 Antimony	5-11
5.2.2 Barium	5-12
5.2.3 Cadmium	5-13
5.2.4 Chromium	5-14
5.2.5 Cyanide	5-16
5.2.6 Nickel	5-17
5.2.7 Zinc	5-17
6.0 Public Health Evaluation	6-1
6.1 Introduction	6-1
6.2 Site History	6-2
6.3 Selection of Chemicals of Concern	6-2
6.3.1 Soil	6-7
6.3.2 Groundwater	6-8
6.3.3 Sediment	6-9
6.3.4 Surface Water	6-9
6.4 Exposure Assessment	6-10
6.4.1 Site and Surrounding Area Under Current-Use Conditions	6-10
6.4.2 Site and Surrounding Area Under Future Use Scenarios	6-14
6.4.2.1 Exposure Point Concentrations	6-17
6.5 Hazard Assessment	6-18
6.6 Risk Assessment	6-24
6.6.1 General Principles	6-24
6.6.2 Uncertainties in Risk Assessment	6-29
6.6.3 Risks Under Current-Use Conditions	6-30
6.6.3.1 Estimation of Intakes	6-30
6.6.3.2 Estimation of Risks	6-46
6.6.4 Risks Under Future-Use Conditions	6-51
6.6.4.1 Estimation of Intakes	6-51
6.6.4.2 Estimation of Risks	6-54

		Page No.
4-45	Summary List of Volatile Parameters in Offsite Sediments	4-128
4-46	Summary List of BNA and PCB Parameters in Offsite Sediments	4-130
4-47	Summary List of Inorganic Parameters in Offsite Sediments	4-132
4-48	Organic Contaminants Detected in Air Samples	4-135
4-49	Summary of Air Monitoring Levels During Site Investigation Activities	4-137
4-50	Onsite Structure Survey Summary	4-140
4-51	Potential Use of Onsite Structures	4-142
4-52	RI Derived Waste Drum Inventory	4-143
4-53	Comparison of Treated RI Derived Liquid Waste Inorganic Concentrations with West Pond Surface Water	4-145
4-54	Summary List of Parameters Identified in Tank by Incinerator	4-152
4-55	Summary of Parameters Identified in Tank by Incinerator	4-155
4-56	Comparison of Drum Sample DR008001 with 2BB5 and 2BB6	4-159
4-57	Test Pit Summary	4-161
4-58	Buried Drums Estimate	4-164
4-59	Drum Waste Sample Summary	4-165
4-60	Summary List of Parameters Identified in Buried Drums	4-167
5-1	Physical and Chemical Properties of Organic Indicator Chemicals	5-2
6-1	Chemicals That Were Detected Infrequently at the Summit National Site	6-5
6-2	Chemicals Identified on or in the Vicinity of the Summit National Site	6-6
6-3	Potential Pathways of Exposure to Contaminants Originating at the Summit National Site	6-11
6-4	Concentrations of Indicator Chemicals in Onsite Soil and Offsite Subareas	6-15
6-5	Concentrations of Indicator Chemicals in the Sediment from Offsite Ditches and Impoundments	6-16
6-6	Concentrations of Indicator Chemicals in Groundwater Beneath and Downgradient of Summit National Site	6-19
6-7	Federal and State Standards and Criteria for Chemical Contaminants in Drinking Water	6-21

		Page No.
6-8	Critical Toxicity Values for Assessment of Risks to Human Health	6-23
6-9	Comparison of Concentrations of Indicator Chemicals in the Groundwater Beneath and Downgradient of the Summit National Site with Standards and Criteria for Drinking Water	6-26
6-10	Assumptions used in Estimating Exposure of Trespassing Teenagers to Contaminants via Direct Contact with Soils	6-33
6-11	Exposure Estimates and Cancer Risk for Trespassing Teenagers to Direct Contact with Soils	6-34
6-12	Exposure Estimates and Non-carcinogenic Risks for Trespassing Teenagers from Direct Contact with Soil	6-35
6-13	Assumptions used in Estimating Worker Exposure to Contaminants Via Direct Contact with Soils Near the Summit National Site	6-36
6-14	Exposure Estimates and Cancer Risks for Workers from Direct Contact with Soils near the Summit National Site	6-37
6-15	Exposure Estimates and Non-carcinogenic Risks for Workers from Direct Contact with Soil near the Summit National Site	6-38
6-16	Assumptions Used in Estimating Residential Exposure to Contaminants Via Direct Contact with Soils Near the Summit National Site	6-40
6-17	Exposure Estimates and Cancer Risks for Residential Exposure to Chemicals in Soil near the Summit National Site	6-41
6-18	Exposure Estimates and Non-carcinogenic Risks for Residential Exposure to Chemicals in Soil near the Summit National Site	6-42
6-19	Assumptions Used in Estimating Exposure of Children to Contaminants Via Direct Contact with Sediments Near the Summit National Site	6-43
6-20	Exposure Estimates and Cancer Risks for Children from Direct Contact with Sediment in Ditches and First Impoundment Near the Summit National Site	6-44
6-21	Exposure Estimates and Noncarcinogenic Risks for Children from Direct Contact with Sediment in Ditches and First Impoundment Near Summit National Site	6-45

		Page No.
7-1	Groundwater Operable Unit Representative Remedial Alternatives	7-2
7-2	Onsite Soils Operable Unit Representative Remedial Alternatives	7-3
7-3	Onsite Surface Water Operable Unit Representative Remedial Alternatives	7-4
7-4	Onsite and Offsite Sediment Operable Units Representative Remedial Alternatives	7-7
7-5	Buried Drums and Tanks Operable Unit Representative Remedial Alternatives	7-8

		Page No.
6-22	Assumptions Used in Estimating Exposure of Teenagers to Contaminants Via Direct Contact with Sediments in the Second Impoundment	6-47
6-23	Exposure Estimates and Cancer Risks for Teenagers from Direct Contact with Sediment in the Second Impoundment	6-48
6-24	Exposure Estimates and Noncarcinogenic Risks for Teenagers from Direct Contact with Sediment in the Second Impoundment	6-49
6-25	Exposure Estimates and Cancer Risks for Workers From Direct Contact with Soils at the Summit National Site	6-52
6-26	Exposure Estimates and Non-carcinogenic Risks for Workers from Direct Contact with Soils at the Summit National Site	6-53
6-27	Daily Intake by Workers Via Ingestion of Groundwater at the Summit National Site	6-55
6-28	Exposure Estimates and Cancer Risks for Onsite Residents from Direct Contact with Soils	6-56
6-29	Exposure Estimates and Noncarcinogenic Risks for Onsite Residents from Direct Contact with Soils	6-57
6-30	Daily Intake by Residents Via Ingestion of Groundwater at the Summit National Site	6-58
6-31	Chemicals in Groundwater Exceeding Federal Standards and Criteria for Drinking Water	6-61
6-32	Cancer Risks to Workers from Ingestion of Groundwater at the Summit National Site	6-62
6-33	Noncarcinogenic Risks to Workers from Ingestion of Groundwater	6-64
6-34	Cancer Risks to Residents from Ingestion of Groundwater	6-66
6-35	Noncarcinogenic Risks to Residents from Ingestion of Groundwater	6-67
6-36	Assumptions Used in Estimating Residential Exposure to Contaminants Via Direct Contact with Soils	6-70
6-37	Exposure Estimates and Cancer Risks from Direct Contact with Background Soils	6-71
6-38	Exposure Estimates and Noncarcinogenic Risks from Direct Contact with Background Soils	6-72
6-39	Summary of Potential Risks Associated with the Summit National Site	6-74

	Page No.
6.7 Evaluation of Exposure to Offsite Background Soil	6-69
6.8 Conclusions	6-73
7.0 Identification of Preliminary Remedial Actions	7-1
7.1 Groundwater	7-1
7.2 Soils	7-3
7.3 Surface Water	7-3
7.4 Sediments	7-6
7.5 Buried Tanks and Drums	7-6

VOLUME 2 - APPENDICES

A RI Data Summary Tables

B Laboratory and EPA QA Protocol

C Contract Required Detection Limits

D Boring Logs and Well Construction

E Hydrogeologic Calculations

F Radiological Monitoring Data

G Weston Geophysical Survey

H Public Health Evaluation Appendices

EXECUTIVE SUMMARY

PURPOSE OF REMEDIAL INVESTIGATION

The purpose of this Remedial Investigation (RI)is to collect data and provide interpretation of the results of the RI field activities. The RI provides site specific data for the performance of a public health evaluation and provides a basis for the identification and evaluation of applicable remedial action alternatives at the Summit National site. The objectives of the RI are:

- Provide a summary of the field sampling activities at the site.
- Present the data obtained through analysis of the samples collected.
- Determine the extent and degree of contamination at the site.
- Assess contaminant migration through identification of migration pathways and the impact on potential receptors.
- Perform a risk and exposure assessment under current and future conditions.

SITE BACKGROUND AND DESCRIPTION

The Summit National site is located in Deerfield Township, Portage County, Ohio, approximately 45 miles southeast of Cleveland and 20 miles west of Youngstown. The site is basically rectangular in shape and occupies approximately 11.5 acres at the southeast corner of the intersection of Ohio Route 225 and U.S. Route 224. The site was formerly a coal strip mine and contained a coal wash pond and coal stockpile. The site was in operation as an incinerator facility from April 1974 until June 1978.

In November 1980 an agreement was reached between the State and eight generators that provided $2.5 million for surface cleanup. Surface cleanup operations, including removal of drums, tanks and various surface debris and a small amount of contaminated soil, were concluded in June 1982.

Over the years, the Summit National site was used for disposal of a variety of industrial wastes. Drummed and tanked wastes disposed included waste oils, resins, paint sludges, flammable solvents, chlorinated solvents, plating sludges, pesticide wastes, phenols, cyanides, acids, various polymers, and lab packs. Many of the drums and bulk tanks stored on the surface leaked quantities of these

materials on the site, and it is reported that the concrete block pit used for liquid waste mixing and solidification overflowed on a recurring basis during periods of heavy rainfall. Onsite soils have been reported by the Ohio EPA to be contaminated by spills and leakage of materials containing PCBs and C-56.

The problems at the Summit National site are caused by the presence of hazardous materials that could be or have been released into the environment. The effects of potential contaminant migration create a number of environmental concerns:

- Direct human contact with the wastes and contaminated water or soil on site and off site.
- Contamination of domestic and game animals or fish coming in direct contact with the waste or contaminated water and the subsequent use of the contaminated animal or fish for human consumption.
- Direct human contact with waste or contaminated materials in site surface water runoff or sediments.
- Contamination of the drinking water aquifers in the area.

SUMMARY OF THE PHASED RI

The field activities performed during the Summit National Remedial Investigation were conducted in two separate phases. Phase I RI activities were conducted during October, November and December, 1984. Phase II RI activities were conducted in two separate episodes during December 1985 through January 1986 and June 1986 through September 1986.

During the Phase I RI the following activities were performed:

- A geophysical study
- Monitoring well installation and groundwater sampling
- Hydrogeologic testing
- Onsite and offsite surface water sampling
- Onsite and offsite sediment sampling
- Onsite surface soil sampling
- Residential well sampling
- Onsite tank sampling
- Air sampling

During the Phase II-A RI the following activities were performed:

- Monitoring well installation
- Onsite subsurface soil sampling and screening
- Offsite surface soil sampling
- Test pit excavation
- Buried drum and tank sampling

During the Phase II-B RI the following activities were performed:

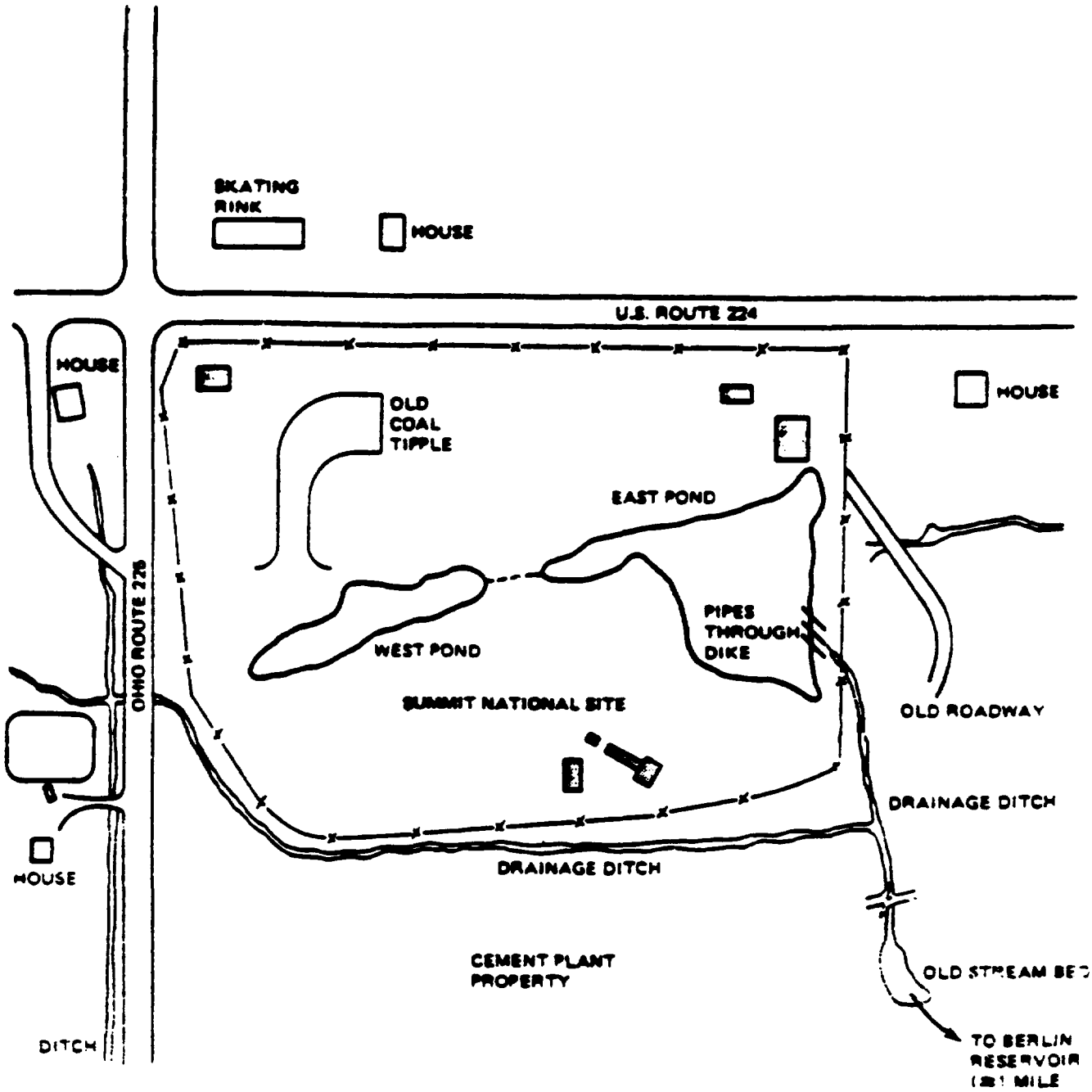
- Monitoring well installation
- Hydrogeologic testing
- Tipple well rehabilitation
- Surface water sampling
- Sediment sampling
- Soils sampling
- Residential well sampling
- Structure survey
- RI derived waste disposal

MAJOR FINDINGS

The following paragraphs present the major findings and conclusions for each of the media sampled based on the results from the data obtained. A site map is presented on Figure E-1 to serve as a locational reference for the site features mentioned.

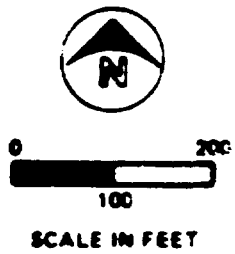
The hydrogeology of the Summit National site is complex. For purposes of discussion and analysis, the strata at the site has been separated into three hydrogeologic units; the water table aquifer, the "intermediate" units, and the Upper Sharon "aquifer."

Groundwater flow directions were developed from numerous water level measurements obtained throughout the RI. Groundwater in the water table aquifer beneath the site flows southward and eastward and does not vary much on a seasonal basis. There is also some northeasterly flow on the northern portion of the site. The water table is generally 5 to 12 ft. below grade. A french drain was installed around the site at an estimated depth of 15 to 20 ft. below grade. It is probable that groundwater in the water table discharges to the onsite ponds, the french drain and the marshy area adjacent to the site. All of these features are shallow and groundwater also probably continues flowing southward, eastward and northeasterly from the site until lower elevations are encountered.



LEGEND

ABANDONED STRUCTURES



NOTE: ALL LOCATIONS OF STRUCTURES AND PHYSICAL FEATURES APPROXIMATE.

SOURCE: MODIFIED FROM USEPA

FIGURE E-1
SITE MAP
SUMMIT NATIONAL RI

Groundwater flow direction in the intermediate group cannot be characterized as one unit due to the high heterogeneity of the strata in this zone. Separating the group into strata above and below the unnamed limestone indicates that lateral flow is southeastward in the upper portion and westward in the lower portion. Groundwater in the Upper Sharon aquifer flows northward.

Vertical gradients within bedrock vary across the study area. The gradient between the water-table aquifer and all deeper strata is downward at all locations. In bedrock, vertical components are upward at the southern portion of the site and downward in the central portion.

Shallow onsite groundwater in the water-table aquifer and uppermost intermediate units is contaminated with a number of organic compounds, including 2-butanone, phenol, toluene, and bis (2-ethyl hexyl) phthalate. The highest concentration of these contaminants occur in the southwestern quarter of the site and generally decrease across the southern half of the site, from west to east.

Of the deeper intermediate wells, levels of contaminants were detected in only MW-24. Wells in the Upper Sharon aquifer do not present contamination problems. None of the residential wells, which represent water in the intermediate unit and Upper Sharon aquifer, indicated levels of organic contaminants above background.

The background soils representing local residential, farm and strip mine soil had detectable levels of numerous organic and inorganic compounds. The origins of these contaminants were not able to be determined from the data obtained during the RI.

The onsite surface and subsurface soils (down to 8 ft.) were found to have levels of numerous organic and inorganic contaminants that were up to several orders of magnitude above background, based on comparison to all background and to residential background alone, indicating a site-related contamination problem. Offsite soils south of the site at the cement plant also contained numerous polynuclear aromatic hydrocarbons (PAH's) and other organics at levels above background. The eastern offsite soils also showed contamination, particularly PCB, at levels that exceeded background.

Surface water flow at and near the site was observed to occur only in response to seasonal precipitation events. Therefore, no flow estimates or stream loading characteristics were able to be made. The onsite surface

water was found to be contaminated. The east pond was found to have consistently higher levels of contaminants than the west pond, based on total fraction concentration. The analytical results indicate that offsite surface water is also contaminated with organics and metals. The major areas of contamination were found to be the south ditch (downstream) and the lower east drainage ditch (Figure E-1).

Onsite sediments were found to be contaminated in all fractions analyzed based on concentrations that exceeded background soil concentrations. The west pond samples detected higher concentrations of contaminants in the organic fraction, while the east pond samples showed higher levels of inorganics. This is opposite of the surface water results. The offsite sediment in the southern ditch (upstream and downstream) and lower east drainage ditch were found to have levels of organics that exceeded background. The first and second impoundments located off site to the southeast also showed minor contamination. Based on the analytical data and current drainage pattern, the second impoundment is currently probably more affected by the adjacent landfill and mine spoil piles rather than the Summit site (see Figure E-1). During the active incineration activities from April 1974 through 1975, the second impoundment was hydraulically connected directly to the site drainage. The landfill to the south filled in the old stip pit sometime after 1975. The low level of sediment contamination in the second impoundment could have been deposited during that period.

The results of the air sampling and air monitoring performed during the RI suggested that onsite or offsite air contamination should not occur unless there is a surface disturbance of the site. Radiation is not a health or environmental concern at the site.

In general, the permanent structures remaining on site are in poor condition, but some may possibly serve as temporary storage facilities if needed during some future site activities.

Results of the buried materials investigation at the site indicate that three buried tanks and an estimated 900 to 1,600 drums are buried on site. Estimates indicate that the total number of drums existing intact that may contain waste to be 675 to 1,200.

In the public health evaluation it was determined that risks to human health may exist at the Summit National site under a number of exposure scenarios. Potential pathways

of exposure to contaminants originating at the Summit National site under both current and future use conditions were evaluated. A summary table showing potential risks associated with the site is presented in Table E-1. Under current-use conditions, trespasser exposure to onsite surface soil through incidental ingestion, as well as exposure to workers along the southern perimeter of the site and residents along the eastern perimeter through incidental ingestion of soils, were determined to be complete pathways with a moderate potential for significant exposure. A quantitative estimation of the risks associated with these pathways indicated that for onsite workers and workers along the southern perimeter, the potential excess lifetime cancer risks under the average exposure conditions are less than 10^{-6} for exposure to carcinogens. The potential excess lifetime cancer risks for residents along the eastern perimeter are 3×10^{-6} for the exposure scenarios evaluated. However, for the plausible maximum exposures, the total excess cancer risk exceeds 10^{-6} for each of these three scenarios by at least one order of magnitude. For both the average and plausible maximum cases of each of these three exposure scenarios, noncarcinogenic health effects are not likely to result from exposure.

Under current-use conditions, exposure of local residents to sediments in the ditches and second impoundment through incidental ingestion of soils was quantitatively evaluated. The potential excess lifetime cancer risks to children through the incidental ingestion of sediment in ditches under the average conditions evaluated, and to teenagers in the second impoundment under both average and plausible maximum exposure conditions are less than 10^{-6} for exposure to carcinogens. However, for the plausible maximum exposure of children in ditches, the potential excess lifetime cancer risk is 6×10^{-6}. In addition, the total hazard index for exposure of children in ditches exceeds one under the plausible maximum exposure scenario evaluated, indicating that noncarcinogenic health effects may also result from exposure to chemicals in the ditches. For the other three exposure scenarios involving exposure to sediment, noncarcinogenic health effects are not likely to result from exposure. Exposure to surface water was not quantitatively evaluated because the surface water bodies near the site are for drainage only and are not used as a source of potable water or for recreational purposes on a regular basis. Because surface water flow only occurs in response to precipitation, exposure to surface water will occur very infrequently, if at all, and there would be little, if any, potential for repeated exposure to occur through contact with surface water.

TABLE E-1

SUMMARY OF POTENTIAL RISKS ASSOCIATED WITH THE SUMMIT NATIONAL SITE

Exposure Scenario	Total Cancer Risks		Noncarcinogenic Hazard Index	
	Average	Plausible Maximum	Average	Plausible Maximum
Current Conditions - Soil				
On-site trespassers	1×10^{-8}	3×10^{-5}	<1	<1
Off-site workers (southern perimeter)	6×10^{-7}	4×10^{-5}	<1	<1
Off-site residents (eastern perimeter)	3×10^{-6}	2×10^{-4}	<1	<1
Current Conditions - Sediment				
Children in ditches	2×10^{-7}	6×10^{-6}	<1	>1
Teenagers in second impoundment	6×10^{-12}	1×10^{-7}	<1	<1
Future Conditions				
On-site workers				
Soil	2×10^{-7}	2×10^{-4}	<1	<1
Groundwater				
Water Table	5×10^{-5}	3×10^{-2}	>1	>1
Intermediate Unit	2×10^{-5}	1×10^{-3}	<1	>1
Upper Sharon Aquifer	4×10^{-9}	NA	<1	NA
On-site residents				
Soil	1×10^{-5}	5×10^{-3}	<1	>1
Groundwater				
Water Table	1×10^{-3}	3×10^{-1}	>1	>1
Intermediate Unit	4×10^{-4}	2×10^{-2}	<1	>1
Upper Sharon Aquifer	8×10^{-8}	NA	<1	NA

NA = not applicable, only one representative sample.

If the Summit National site is reused in the future for light industrial work or a residential dwelling, exposure to onsite soil through direct contact and incidental ingestion may occur. Additionally, exposure to groundwater in any one of the three water-bearing units beneath the site may occur through ingestion. Estimation of risk to workers associated with incidental ingestion of onsite soils indicates the total excess cancer risks exceed 10^{-6} for the plausible maximum, but not the average conditions evaluated. This evaluation indicated that noncarcinogenic health effects are not likely to result from this type of exposure to the indicator chemicals present in onsite soils.

The total excess cancer risks to workers associated with ingestion of groundwater from the water-table aquifer, and intermediate unit, exceed 10^{-6} under average and plausible maximum exposure conditions. In addition, the total hazard index for exposure under average and plausible maximum conditions to the water table aquifer and the plausible maximum exposure conditions to the intermediate unit exceed one, indicating that noncarcinogenic health effects also may result from exposure to chemicals in these units.

Estimation of risk to residents associated with lifetime incidental ingestion of onsite soils indicates the total excess cancer risks exceed 10^{-6} for both the average and plausible maximum exposure conditions evaluated. In addition, under the plausible maximum exposure conditions, noncarcinogenic health effects may also result from exposure to the indicator chemicals present in the onsite soils.

The total excess cancer risks to residents associated with lifetime ingestion of groundwater from the water table and intermediate unit exceed 10^{-6} under the average and plausible maximum exposure conditions. In addition, the total hazard index for exposure under average and plausible maximum exposure conditions to the intermediate unit exceed one, indicating that noncarcinogenic health effects also may result from exposure to chemicals in these units.

At the request of EPA Region V, exposures to offsite background soils were evaluated in Section 6.7. In estimating exposure of residents to background concentrations of chemicals in the vicinity of the Summit National site, the conservative assumption is made that an individual could be exposed throughout an entire lifetime.

The total cancer risks associated with incidental ingestion of soil over a lifetime exceeds 10^{-6} for a plausible maximum exposure, and is equal to 10^{-6} for the average exposure evaluated. Noncarcinogenic health effects are not likely to result from exposure to these background chemicals.

DATA PROBLEMS AND UNRESOLVED DATA NEEDS

The hydrogeology of the Summit National site is complex; but, in general, it is adequately defined for selection and evaluation of appropriate remedial measures during the performance of a feasibility study. The only problem with existing data is the presence of organic contaminants in MW-24. Resolution of this question is important to the understanding of site hydrogeology and contaminant transport. Additional samples should be collected from MW-24 during the design phase of the selected remedial alternative. If these samples are contaminated, then the well should be examined for leakage by geophysical logging, field observations, and possibly pumping. If leakage cannot be proven, it may be necessary to install one or more additional wells in this area.

CONCLUSION

Inorganic and organic soil contamination, and groundwater, surface water, and sediment contamination emanating from the Summit National site does pose a threat to public health, welfare, and the environment. A feasibility study of remedial actions aimed at cost effective mitigation of these site hazards is warranted.

1.0 INTRODUCTION

1.1 PURPOSE

This report presents the data collected and provides interpretation of the results of the Remedial Investigation (RI) field activities for the Summit National site in Portage County, Ohio. The RI investigation was performed in two phases, beginning in November 1984 and ending in September, 1986. The RI provides site specific data for the performance of a public health evaluation and provides a basis for the identification of general response actions and associated remedial technologies at the site. Prior to performance of the RI, the existing data base for the Summit site was insufficient to support a feasibility study to assess remedial action alternatives. The objectives of the RI report are:

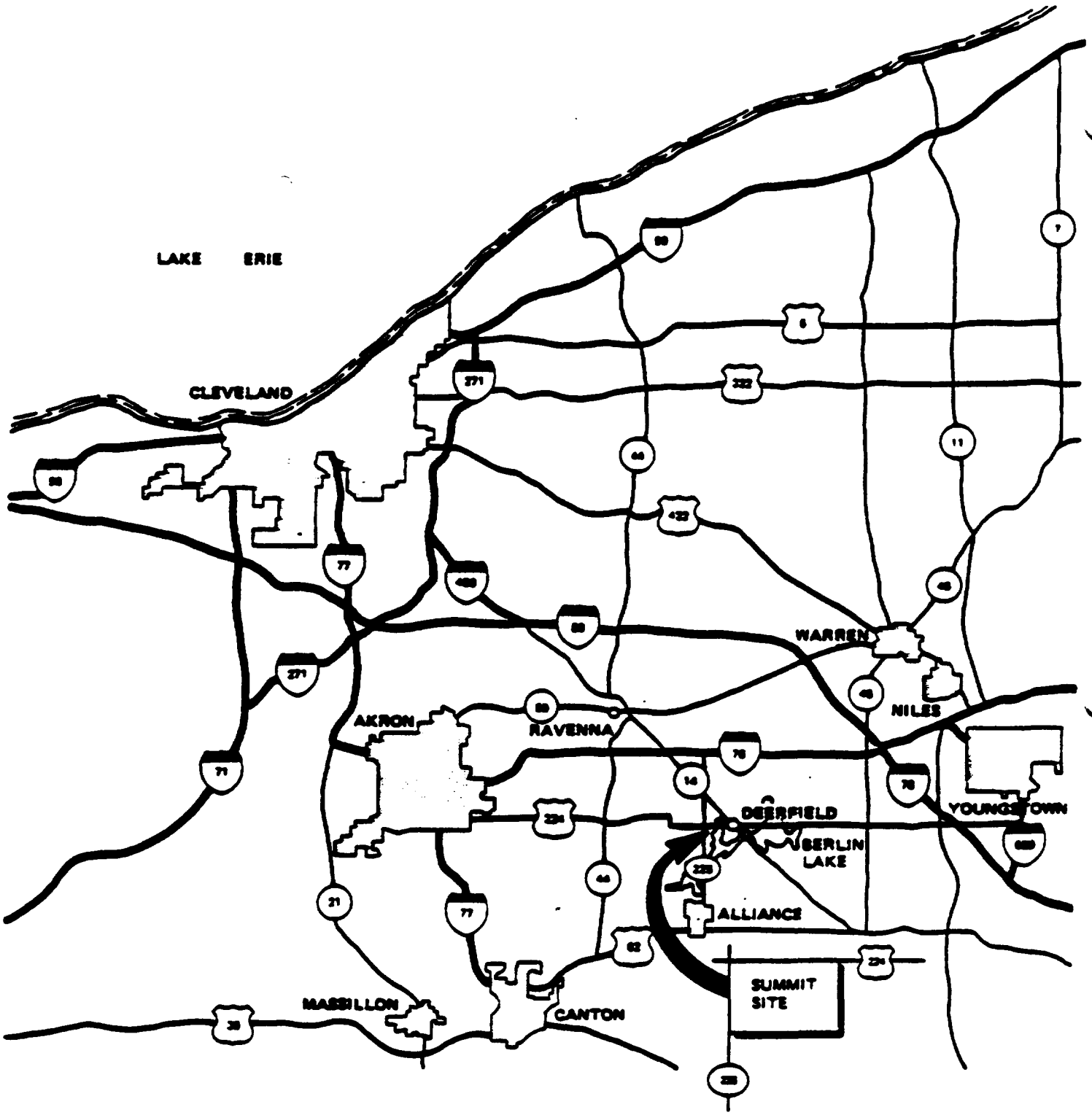
- Provide a summary of the field sampling activities at the site.
- Present the data obtained through analysis of the samples collected.
- Determine the nature, extent and degree of contamination at the site.
- Assess contaminant migration through identification of migration pathways and the impact on potential receptors.
- Perform a risk and exposure assessment under current and future conditions.

1.2 SITE BACKGROUND INFORMATION

All information in Section 1.2 pertaining to site history, waste related activities, and remedial actions prior to the RI/FS was obtained from and based on the existing Summit National Remedial Action Master Plan (RAMP) (CH2M Hill, August 1983) and the Ohio EPA files in Twinsburg.

1.2.1 Facility Location and Description

The Summit National site is located in Deerfield Township, Portage County, Ohio, approximately 45 miles southeast of Cleveland and 20 miles west of Youngstown (Figure 1-1). The site is approximately rectangular



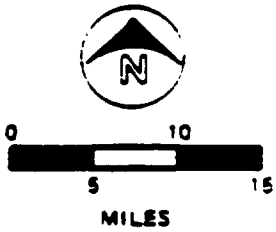


FIGURE 1-1
SUMMIT SITE LOCATION
SUMMIT NATIONAL RI

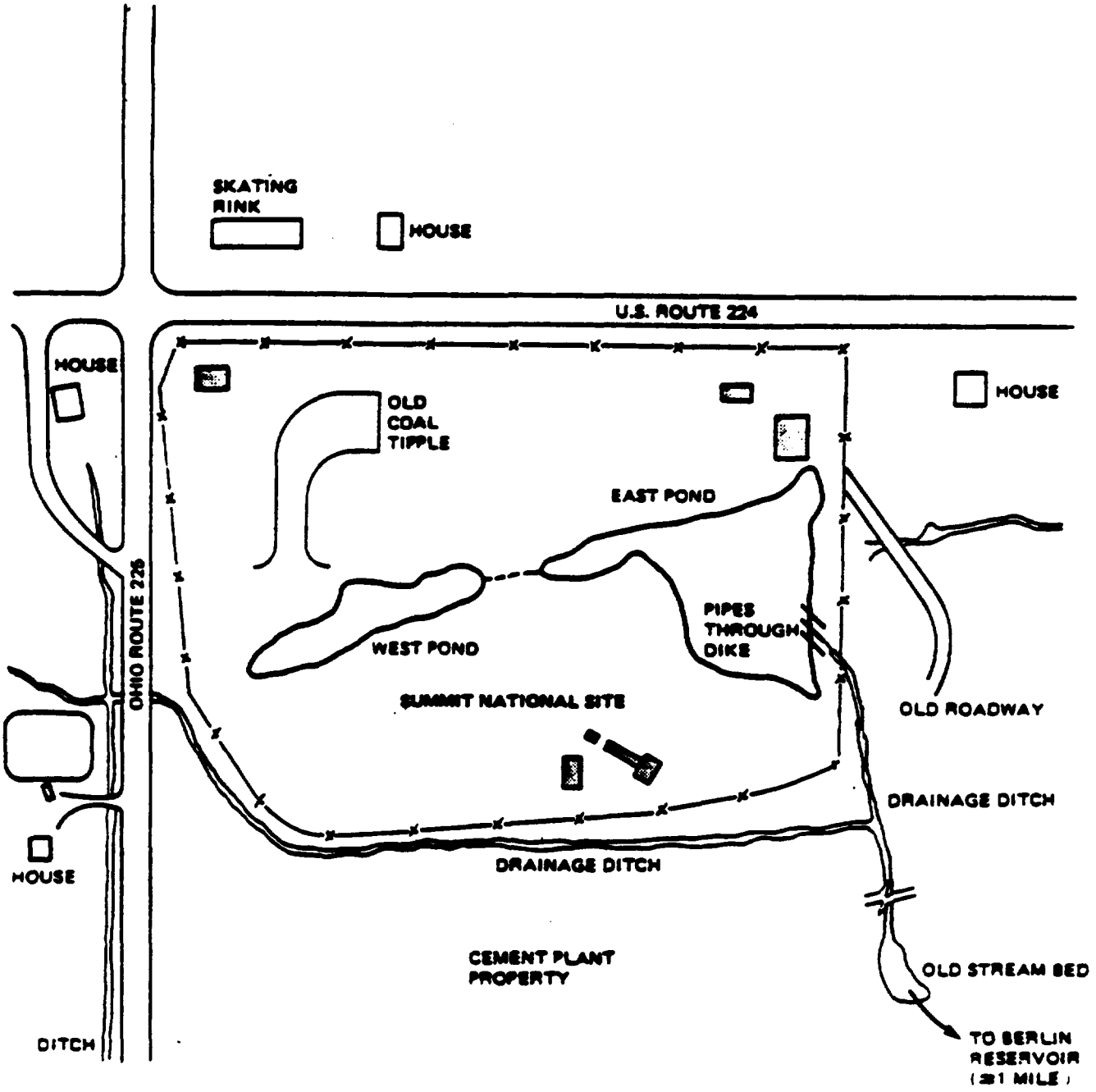
in shape and occupies approximately 11.5 acres at the southeast corner of the intersection of Ohio Route 225 and U. S. Route 224 (Figure 1-2). The site was formerly a coal strip mine and contained a coal wash pond and coal stock pile. The coal tipple remains as a 15 ft. high embankment in the northwest corner of the site with a loading dock and concrete debris remaining from the original coal processing facilities. Other prominent features on site are two ponds located in the midsection of the site, an abandoned incinerator and two buildings in the southeast corner, a scale house in the northwest corner, and two dilapidated buildings in the northeast corner. Little vegetation is growing on site since most of the site was graded following surface cleanup activities. The site is enclosed by a 6 ft. high fence with two locked gates for entrance from Route 224 and one locked gate for entrance from Route 225.

1.2.2 Site History and Waste Related Activities

In June 1973, Mr. Don Georgeoff obtained a "Permit to Install" for an 18,000 gallon per month waste liquid incinerator at the present Summit site. In April 1974 an operating permit issued by the Ohio EPA was obtained for the incinerator. The facility, called Summit National Liquid Services, received liquid wastes from various manufacturing and chemical companies. The wastes were either delivered in bulk using tanker trucks or in 55 gallon drums on flatbed trucks. Wastes were stored unprotected in 55 gallon drums, an open pit or bulk tanks of varying size. Many wastes were mixed with flammable liquids and incinerated. Some wastes were buried on site, while other wastes were dumped or leaked onto the site soil.

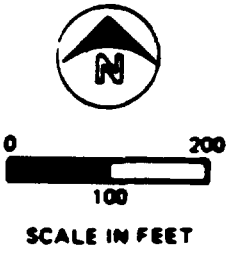
The appearance of the site during its operating life was different than it is today (Figure 1-3). Originally, a highway drainage ditch bisected the property in the area where the ponds are presently situated. A new drainage ditch running along the southern property boundary was constructed between 1972 and 1975 to divert area drainage from the west around the site.

In June 1975 the Northeast District Office of the Ohio EPA investigated a complaint of an unauthorized discharge of waste water. At the request of Ohio EPA, the U.S. EPA conducted an investigation of the site on October 29, 1976. Evidence of numerous leaks and



LEGEND

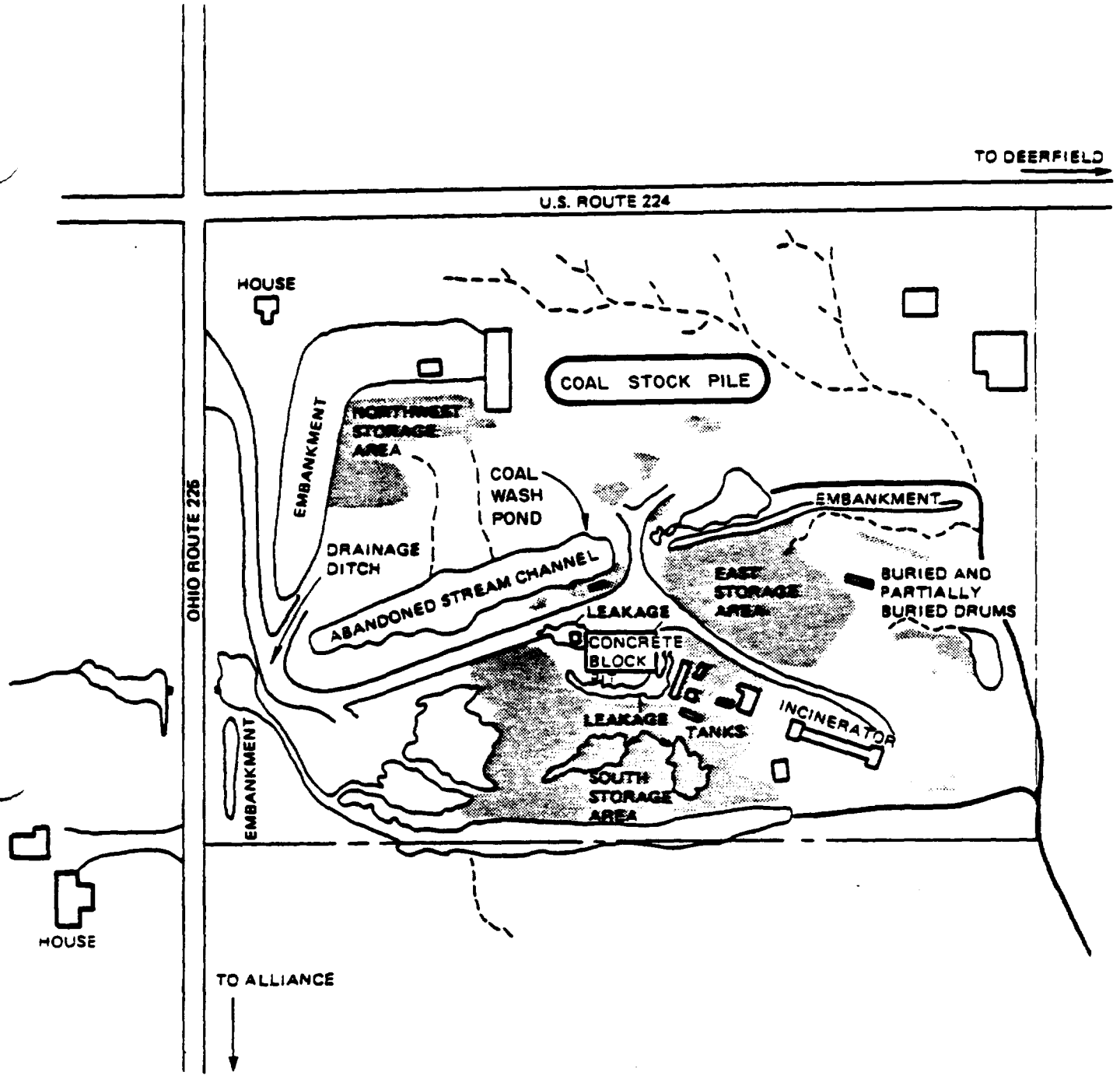
ABANDONED STRUCTURES



NOTE: ALL LOCATIONS OF STRUCTURES AND PHYSICAL FEATURES APPROXIMATE.

SOURCE: MODIFIED FROM USEPA

FIGURE 1-2
SITE MAP
SUMMIT NATIONAL RI



LEGEND

DRUM STORAGE AREA

SEASONAL DRAINAGE

INTERMITTENT DRAINAGE

0 100 200

SCALE IN FEET

SOURCE: Summit RAMP (8/83)

FIGURE 1-3
MAP OF ACTIVE SITE
SUMMIT NATIONAL RI

spills was found. Mr. Georgeoff was notified verbally at that time of requirements for a Spill Prevention Control and Countermeasure Plan (SPCC). In December of that year, he was officially notified of the need for an SPCC plan and informed that he was in violation of state laws relating to treatment and disposal of industrial wastes.

The Ohio EPA Director issued Final Findings and Orders to Summit National on June 12, 1978. These required Summit National to cease receiving waste materials, remove all liquid waste from the site, and receive written approval prior to removing any material from the facility. No further waste material was received after this date.

Further surface water sampling at the site by Ohio EPA in October 1978 found several pollutants. Onsite sediment sampling in January 1979 reportedly detected PCB's in sediments.

On March 15, 1979, Mr. Georgeoff sold the Summit site to Mr. Angelo Sottanti. In April and May 1979, Ohio EPA sampled surface waters near the site and found violations of state water quality standards for ammonia, iron, cyanide, lead, phenols, pH and zinc.

On June 28, 1979 Mr. Sottanti sold the property to Mr. John Vasi. In August 1979, the State of Ohio filed a complaint against Mr. Georgeoff, Mr. Sottanti and Mr. Vasi alleging the operation of a solid waste disposal site without a permit, creation of a public nuisance, failure to comply with orders from the Ohio EPA, and installation of facilities for the storage and disposal of liquid wastes without submitting plans to the Ohio EPA. Testing of onsite waste materials established the presence of over 7,500 gallons of a toxic chemical, hexachlorocyclopentadiene, commonly called HCCPD or C-56. In September 1979, U. S. EPA notified Mr. Vasi that, because C-56 and other hazardous chemicals were leaking to the environment, remedial action was being planned pursuant to Section 311 of the Clean Water Act. Mr. Vasi refused to take voluntary action or fund the cleanup operation, so U.S. EPA funded the cleanup of C-56 wastes that took place between September and November 1980.

Over the next year, activity centered around continued monitoring of the site and negotiations between Ohio EPA and various waste generators in an attempt to

obtain compensation funds for site cleanup. In November 1980, an agreement was reached between the State and eight generators that provided $2.5 million for surface cleanup. Surface cleanup operations, including removal of drums, tanks and various surface debris and a small amount of contaminated soil, were concluded in June 1982.

1.2.3 Site Investigation and Remedial Action

From early spring to late fall of 1980, Ohio EPA expended funds to fence the site, to grade the site to control surface water runon and runoff and near-surface groundwater flow, to identify and stage about 2,000 drums of wastes, to sample and analyze the contents of several bulk tanks, and to install and develop groundwater monitoring wells (two on site, four off site).

During the fall of 1980, U.S. EPA utilized Federal funds in a 311 action to remove three bulk tanks, their contents (approximately 7,500 gallons), and some contaminated soil, and to treat contaminated water. The contaminant of greatest concern on this project was C-56. Not all of the C-56 was removed at this time.

During 1980 and 1981, some of the companies that had previously used Summit's services identified themselves and voluntarily removed wastes they had sent to Summit for disposal.

A surface waste cleanup at the site, conducted from fall of 1981 through late spring of 1982, was funded by three generators and the state. The state's share came from a settlement account that had been previously established by the State expressly for site cleanup purposes.

The cleanup included removal and treatment or offsite disposal of all surface drums, bulk tanks, containers, the concrete block pit, and their contents. The cleanup was accomplished by a private contractor under the supervision of Ohio EPA and one of the generators. Some incidental contaminated soil removal was necessary as part of the cleanup operation, but soil removal was not extensive. Subsurface cleanup, including removal of buried drums and tanks, was not included as part of this surface cleanup project.

During the Spring of 1987, USEPA Region V Emergency Response Section responded to an emergency situation related to periodic overflows from the east pond to the adjacent residential property. Emergency activity included the removal of a buried tank near the incinerator.

1.2.4 Types of Wastes

Over the years, the Summit site was used for disposal of a variety of industrial wastes. Drummed and tanked wastes disposed included waste oils, resins, paint sludges, flammable solvents, chlorinated solvents, plating sludges, pesticide wastes, phenols, cyanides, acids, various polymers, and lab packs. Many of the drums and bulk tanks stored on the surface leaked quantities of these materials to the site and it is reported that the concrete block pit overflowed on a recurring basis during periods of heavy rainfall.

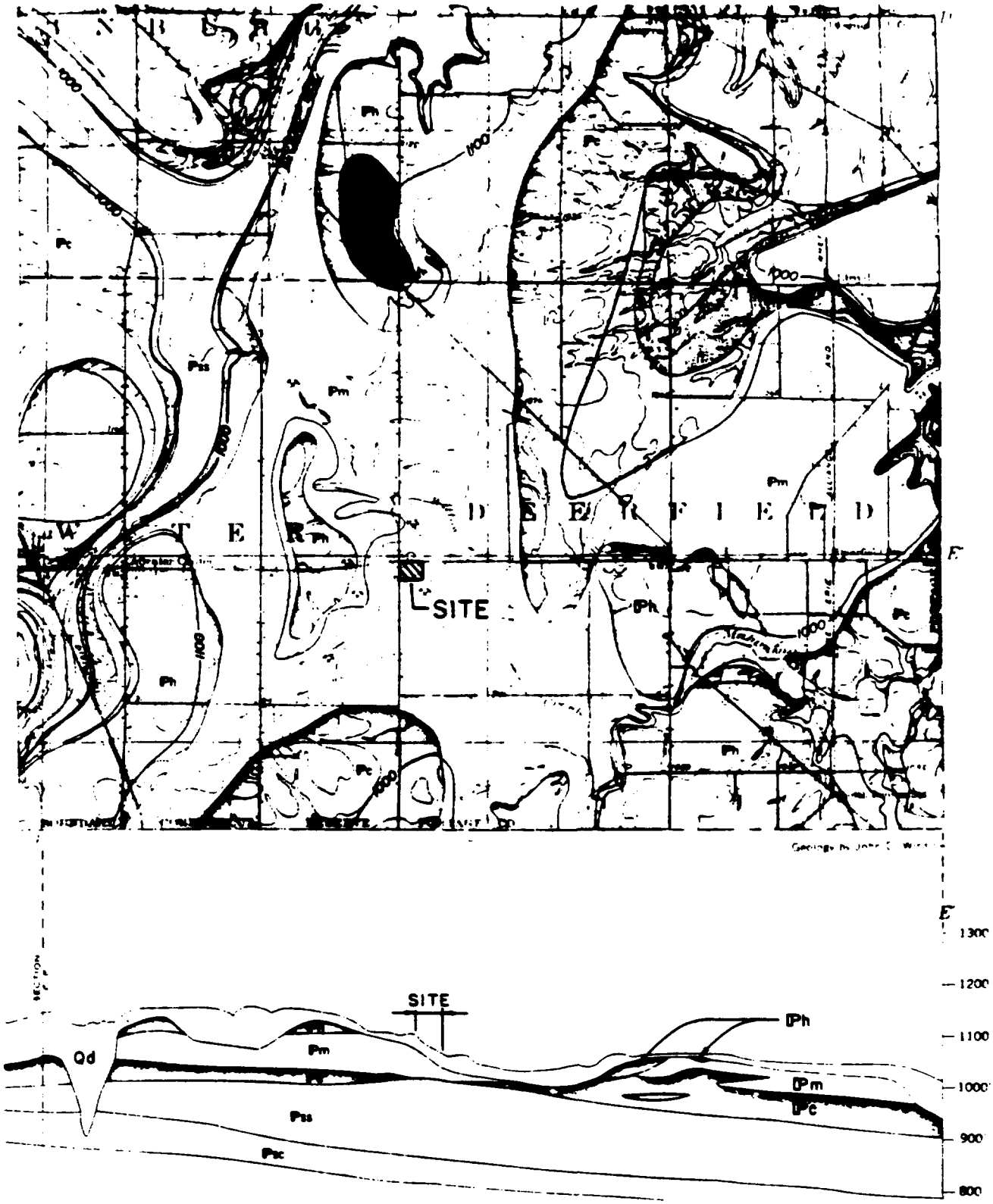
Onsite soils have been reported by the Ohio EPA to be contaminated by spills and leakage of materials containing PCBs and C-56. Analyses of contents of surface tanks prior to the RI investigation disclosed the presence of pesticides, herbicides and fungicides including C-56, Thimet and Avenge. This is not conclusive evidence that similar materials are contained in buried drums and tanks.

The 1981-82 surface cleanup project removed much of the source of site contamination, but did not include subsurface exploration or cleanup.

During the site cleanup, the Ohio EPA identified several areas potentially containing buried drums and/or tanks. The specific types and quantities of below ground materials are unknown. The Ohio EPA estimated that there could be many drums and several bulk tanks, with unknown contents, buried on the site.

1.2.5 Physiography

Portage County is in the northwestern part of the glaciated Allegheny Plateau and lies on the divide between the Lake Erie and the Ohio River drainage basins (Figure 1-4). Elevation ranges from a minimum of approximately 910 ft. Mean Sea Level (MSL) where Eagle Creek leaves the county in northeastern Windham



LEGEND

MILES

Qd QUATERNARY, UNDIFFERENTIATED

Ph HOMEWOOD MEMBER

Pm MERCER MEMBER

Pc CONNOQUENESSING SANDSTONE

Pss SHARON MEMBER, SHALE

Psc SHARON MEMBER, CONGLOMERATE

SOURCE: WINSLOW AND WHITE, 1962

FIGURE 1-4
PHYSIOGRAPHIC MAP
SUMMIT NATIONAL RI

Township to a maximum of 1,340 ft. MSL in central Hiram Township. Elevations at the site range from a high of 1,113 ft. MSL at the abandoned coal tipple in the northwest corner of the site to 1,084 ft. MSL along the eastern fence (see Figure 1-5). Other than the coal tipple, the surface is relatively flat, with elevations varying from 10 to 15 ft. across the site.

1.3 NATURE AND EXTENT OF PROBLEM

The problems at the Summit National site are caused by the presence of hazardous materials that could be or have been released into the environment. Previous environmental sampling activities by both State and Federal agencies have identified both organic and inorganic hazardous substances at the site. These contaminants were found in metal drums stored on the surface, buried drums, chemical waste materials on the ground, and in the onsite soil, sediment and surface water. Although the surface removal action (concluded in June, 1982) removed the drums from the surface of the site, onsite contaminants still exist underground, on the surface, and in the ponds. The site has been fenced, which reduces the risk of onsite contact with contaminants by the public. Investigations performed to date have also identified some environmental contamination in groundwater and soil samples obtained from offsite areas. The effects of potential contaminant migration create a number of environmental concerns:

- Direct human contact with the wastes and contaminated water or soil on site and off site.

- Contamination of domestic and game animals or fish coming in direct contact with the waste or contaminated water and the subsequent use of the contaminated animal or fish for human consumption.

- Direct human contact with waste or contaminated materials in site surface water runoff or sediments.

- Contamination of the drinking water aquifers in the area.

1.3.1 Public Health and Welfare

The current risks associated with the Summit site stem from buried wastes and the soil and groundwater contamination that exists. Since surface cleanup was conducted in late 1981 to mid-1982, contamination caused by runoff has been only partially controlled. Contamination from leaking buried drums and tanks and site runoff carrying suspended contaminants could be a major, ongoing problem.

Incidents of past surface water contamination by substances including C-56 and PCBs have been documented prior to the RI investigation. The concentration and extent of current and future contamination can be estimated using RI obtained data. Because of the toxic and/or carcinogenic effects of these substances and the possible widespread human contact through the intake of contaminated water, danger to public health and safety must be considered to exist. Another danger to public health and safety is through the contamination of private wells.

Air quality problems associated with the site have been mitigated by the surface cleanup activities already accomplished unless a surface disturbance occurs.

1.3.2 Environment

The impact of hazardous materials from the Summit site on the environment could potentially occur via surface or subsurface pathways. Contamination of surface waters by leaching of pollutants or hydraulic transport of contaminated sediments could adversely affect adjacent flora and fauna. Also, subsurface migration of contaminants could spread hazardous materials throughout the downgradient watershed. Due to the persistent nature of some of the hazardous materials involved, it is conceivable that a buildup of pollutants could have long-term effects.

1.4 REMEDIAL INVESTIGATION SUMMARY

The field activities performed during the Summit National Remedial Investigation were conducted in two separate phases. Phase I remedial investigation activities were conducted during October, November and

December, 1984. Phase II remedial investigation activities were conducted in two separate episodes during December, 1985 through January, 1986, and June through September, 1986. Separate detailed work plans and Quality Assurance Project Plans (QAPP) were prepared for each phase of field sampling activities. The purpose and objective of each activity performed during the remedial investigation is presented in the following overview of investigations conducted.

1.4.1 Phase I Remedial Investigation

During the Phase I RI, the following activities were performed:

- A geophysical study
- Monitoring well installation and groundwater sampling
- Hydrogeologic testing
- Onsite and offsite surface water sampling
- Onsite and offsite sediment sampling
- Onsite surface soils sampling
- Residential well sampling
- Onsite tanks sampling
- Air sampling

Prior to initiating any of the above field activities, a site specific health and safety plan was also developed for the Summit National Site.

A multiple technique, geophysical survey was performed during Phase I to evaluate overall site conditions in terms of total field magnetics, surface and subsurface conductivity and stratigraphy. The objective of the magnetometer survey was to locate buried metallic objects. The Electromagnetic Conductivity (EM) survey was used to attempt to define relationships between site stratigraphy and conductivity and to evaluate the extent of groundwater contamination and direction of migration. The objective of the Ground Penetrating Radar (GPR) survey was to evaluate the source of the magnetic anomalies while the borehole logging survey was conducted to define certain parameters related to site stratigraphy.

The objective of the monitoring well installation and groundwater sampling activities was to obtain site specific geologic, hydrogeologic and potential groundwater contamination information. The hydrogeologic testing or time lag permeability tests were performed to provide data on the characteristic of the water bearing units existing at the site.

The sampling and analysis of the onsite ponds was performed to collect data on the contaminant concentrations in the standing liquid and bottom sediments in the ponds. The data are to be used to determine the degree of treatment or pretreatment that is feasible or necessary for remediation, and to set the appropriate criteria for proper management or disposal. Data from the offsite surface water and sediment sampling will be used to examine offsite contaminant migration.

The purpose of the Phase I onsite soil sampling at the Summit National site was to collect data on the areal extent and concentration of hazardous constituents at potential source areas on the site. The Phase I results were used to select areas to be sampled at greater depths during the Phase II soil sampling for the determination of the depths of subsurface contamination.

The residential well sampling and analysis was performed to evaluate possible contamination of private water supplies.

The objective of the onsite tank sampling was to determine if hazardous materials are contained within the buried tanks.

Air sampling was performed at the site for the purpose of identifying potential respiratory hazards prior to the commencement of site investigation activities.

1.4.2 Phase II-A Remedial Investigation

During the Phase II-A RI, the following activities were performed:

- Monitoring well installation
- Onsite subsurface soil sampling and screening
- Offsite surface soil sampling
- Test pit excavation
- Buried drum and tank sampling

The objective of the additional monitoring well installation activities was to obtain data on the vertical and lateral extent of groundwater contamination, and on three-dimensional aspects of groundwater flow.

The Phase II-A soil sampling activities were conducted to provide data on the background chemical characteristics of soils presumed to be isolated from possible site-related contamination and the degree of offsite migration. The objective of the onsite soil sampling was to provide data concerning vertical and horizontal extent of onsite contamination in the soil zone and to estimate volume of contaminated soil.

The objective of the soil screening activities was to reduce the total number of samples sent to the CLP for analysis. The samples selected were those in which high concentrations of contamination were detected, as well as those that were representative of the type of contamination found in an area. Comparisons of screening results versus laboratory results on the same samples were made to evaluate potential use of screening data during analysis of contaminant levels in the soils.

The test pit excavations were performed to investigate the magnetic anomalies identified during the Phase I magnetometer survey. In test pits where buried drums were encountered, an estimate of the total number of buried drums was made. The conditions of the buried drums was also noted and any drums found leaking were sampled to provide data on waste sources that were leaking into the onsite soil and/or shallow groundwater. The objective of the additional onsite tank sampling was to determine if hazardous materials are contained within known buried tanks.

1.4.3 Phase II-B Remedial Investigations

During the Phase II-B RI, the following activities were performed:

- Monitoring well installation
- Hydrogeologic testing
- Tipple well rehabilitation
- Surface water sampling
- Sediment sampling
- Soils sampling
- Residential wall sampling
- Structure survey
- RI derived waste disposal

The Phase II-B monitoring well installation activities was a continuation and completion of the work that was planned to be performed during Phase II-A. All wells were not installed during Phase II-A due to extreme cold and inclement weather. Again, the objective of the well installation activities was to obtain data on the vertical and lateral extent of groundwater contamination, and on the three dimensional aspects of groundwater flow. Extensive permeability testing was performed to better characterize the hydraulic characteristic of the water bearing units at the site.

The existing tipple well rehabilitation activities were performed to investigate the potential contamination of the deep regional aquifer (approximately 300-400 feet deep) that was suspected to have been possibly used for deep well injection of liquid wastes.

The surface water and sediment sampling activities were performed to characterize quality and provide data to estimate volumes of the contaminated onsite surface water and sediments; to determine the degree of treatment or pretreatment that is feasible or necessary for remediation; to set appropriate criteria for disposal of the pond contents; and to determine if contaminants are migrating offsite.

The objective of the Phase II-B soils sampling was to provide additional data to fill in data gaps identified in the Phase II-A data.

The residential well sampling was performed to evaluate the risk to human health through use of potentially contaminated groundwater and to aid in formulating and evaluating remedial measures.

The objective of the onsite structures survey was to provide data to evaluate potential demolition procedures and identify potential salvage uses for the feasibility study.

The purpose of the RI derived waste disposal activity is to plan and arrange for the disposal of RI generated wastes either onsite or offsite at an approved RCRA disposal facility.

1.5 OVERVIEW OF REPORT

Section 1.0, INTRODUCTION, presents general information about the Summit National site from existing reports and studies. The current conditions of the site are presented through an explanation of the nature and extent of problems identified during the RI field activities. The objectives of the RI are detailed by each phase and activity.

Section 2.0, SITE FEATURES, presents the results of the investigation of key parameters for the site including demography, land use, natural resources, climatology, and onsite structures.

Section 3.0, METHODS AND MATERIALS, provides the sampling methodology and sampling equipment used to collect environmental samples during the RI field sampling activities.

Section 4.0, RESULTS AND DISCUSSIONS, presents and discusses findings on the groundwater, surface and subsurface soils, surface water, sediments, and buried drums and tanks at the site. The analytical results, conclusions and observations are presented. It also provides a summary of all the EPA Region 5 QA/QC data validation reports. Invalid data as well as specific data qualified are present and discussed.

Soil characteristics and groundwater aquifer characteristics are also presented. Volume of contaminated onsite soil is estimated. Details of the procedures and methods used to dispose of the RI derived liquid waste generated during the hydrogeologic investigation are presented.

Site drainage details both for the active site and current site conditions are presented. The flood potential is also assessed. Volumes of contaminated sediments onsite are also estimated.

Details of the air sampling activities performed prior to development of the Health and Safety plans, as well as air monitoring procedures conducted during onsite activities are presented.

The results of the preliminary radiological monitoring performed prior to the development of the site health and safety plan are presented. Results of analysis of the TLD badges worn during all onsite activities are also presented.

The results of the Phase I geophysical investigations are provided. These results were used to develop the test pit excavation and drum sampling plan. The results of the drum and tank sampling is presented and discussed. Estimated numbers and conditions of buried drums are presented.

Section 5.0, CONTAMINANT TRANSPORT AND FATE, presents potential pathways for migration of contaminants from the site with specific emphasis being placed on the selected indicator chemicals. The considerations provided are a statement of the general environmental behavior of the types of contaminants identified at the Summit National site.

Section 6.0, PUBLIC HEALTH EVALUATION, characterizes the existing and potential effects of chemicals present at the Summit site for the no-action alternative. The discussion includes potential receptors, public health and environmental impacts.

Section 7.0, REMEDIAL ACTIONS, identifies the general response actions, as well as associated remedial technologies to address each operable unit.

2.0 SITE FEATURES

All site data provided in Sections 2.1 through 2.4 were obtained from a compilation of data provided by the Portage County Planning Commission (November, 1986).

2.1 DEMOGRAPHY

The population of Portage County in 1980 was 135,856, with most of the population concentrated in the central, western, and northern portions of the County, based on information from the U.S. Bureau of Census data. The population of Portage County was projected to have increased to 137,521 by July, 1984. Population within a three mile radius of the site is estimated at about 4,500. At present, there are approximately 20 residences within 1,000 feet of the site (see Figure 2-1). The water supply for residents of these nearby homes is groundwater from private wells, cisterns and city water delivery.

2.2 LAND USE

Approximately 232,206 acres (or 72%) of Portage County's total 322,348 acres are considered undeveloped or agricultural land, based on 1980 land use figures provided by the Portage County Planning Commission, The remaining acreage has been developed for residential, commercial, industrial, and recreational purposes. Of the 33,021 acres comprising Deerfield and Atwater Townships, about 25,225 acres (or 76%) is described as undeveloped or agricultural land with the remaining acreage used for other purposes. The Summit site is located in western Deerfield Township adjacent to Atwater Township. Land use estimates for Portage County, including Deerfield and Atwater Townships, for the year 1980 are presented in Table 2-1.

The area immediately surrounding the site has been developed for a variety of uses, primarily rural residences, light industries and agriculture. Several residences are located to the north, east and west within 500 feet of the site. A roller skating rink is immediately north of the site. Light industries in the area include a fuel distributor, a cement plant, a manufacturer of septic tanks, two sanitary landfills and used tire storage lots. Unused land near the site is either wooded or unvegetated strip mined lands. Land use within the immediate vicinity of the site is shown on Figure 2-1.

TABLE 2-1

LAND USE IN PORTAGE COUNTY - 1980
SUMMIT NATIONAL SITE

	County Totals	Percent of Total	Deerfield Township	Percent of Total	Atwater Township	Percent of Total
RESIDENTIAL	22224.5	6.9	823.9	5.0	557.0	3.4
Low Density - Less than 2 d.u./acre	14330.1	4.4	549.1	3.3	493.3	3.0
Medium Density - 2.8 d.u./acre	7330.3	2.3	274.8	1.7	63.7	<1
High Density - Greater than 8 d.u./acre	564.1	<1	0.0	0.0	0.0	<1
COMMERCIAL	1798.2	<1	57.0	<1	31.3	<1
INDUSTRIAL	1110.4	<1	15.9	<1	0.9	<1
General Industry	1099.2	<1	4.7	<1	0.9	<1
Industrial Wastes	11.2	<1	11.2	<1	0.0	<1
TRANSPORTATION/COMMUNICATION/UTILITIES	11256.5	3.5	351.7	2.1	490.4	2.9
PUBLIC/SEMI PUBLIC	21881.7	6.8	12.7	<1	46.2	<1
Governmental, Educational, Cultural	21713.4	6.7	12.7	<1	46.2	<1
Health Care Facilities	168.3	<1	0.0	<1	0.0	<1
RECREATION & OPEN SPACE	15405.3	4.8	2199.6	13.4	209.8	1.3
Parks & Recreation	15171.1	4.7	2194.8	13.3	200.1	1.2
Cemetaries	234.2	<1	4.8	<1	9.7	<1
RESOURCE PRODUCTION & EXTRACTION	3561.2	1.1	53.4	<1	538.0	3.2
WATER	12903.9	4.0	2025.9	12.3	382.5	2.3
UNDEVELOPED	232206.1	72	10913.3	66.3	14311.7	86.4
TOTAL:	322347.8		16453.4		16567.8	

Note all figures expressed in acres.
d.u. - demographic unit
Source: Portage County Planning Commission, 1987

2.3 INDUSTRY AND NATURAL RESOURCES

The major source of income in Portage County is from agricultural products, with field crops and livestock the principal items produced.

Industrial products produced in the County include rubber and plastic products, transport and construction equipment, cast metal, machine tools, and other metal products. Light industries in the immediate vicinity of the site include a cement plant and septic tank manufacturer, a fuel distributor, used tire disposal areas and a landfill operation (see Figure 2-2, Existing Industries).

The mineral industries in Portage County produce sand and gravel, crushed sandstone, and coal. The southeastern portion of the county, where the site is located, has been heavily strip mined for coal during the 1960's. The County also produces oil and natural gas.

Water for industry, urban and domestic needs, and to a limited extent for irrigation of specialized farm crops, is available from surface water bodies and from aquifers in buried glacial valleys in the county. The Berlin Lake Reservoir is located one mile southeast of the Summit site.

Berlin Lake was constructed on the Mahoning River in 1942 by the U. S. Army Corps of Engineers to provide flood control, a water supply for industry downstream, and serve as a backup water supply for Youngstown, Ohio. The primary water supply for Youngstown is Meander Lake. Yearly pumpage volumes from Berlin Reservoir to Meander Lake from 1961 through 1986 provided by the Mahoning Valley Sanitary District are presented on Table 2-2. The reservoir and surrounding land formed an 8,518 acre wildlife area which provides maintenance and protection of existing woodlands, a natural habitat for native wildlife, and an area for public hunting and fishing.

TABLE 2-2
BERLIN RESERVOIR TO MEANDER LAKE PUMPAGES (MG)
SUMMIT NATIONAL SITE

1961	127.755
1962	526.790
1963	1846.890
1964	1257.700
1965	1063.040
1966	1669.880
1967	2729.210
1968	2213.430
1969	1606.340
1970	976.010
1971	2634.540
1972	0.000
1973	0.000
1974	0.000
1975	0.000
1976	480.460
1977	0.000
1978	0.000
1979	0.000
1980	0.000
1981	0.000
1982	1458.579
1983	728.040
1984	0.000
1985	98.640
1986	0.000

Notes:

MG - million gallons
Source: Mahoning Valley Sanitary District, February 4, 1987

2.4 NATIVE VEGETATION AND WILDLIFE

The original plant cover in Portage County was a dense cover of hardwood trees. However, timbering for commercial purposes and clearing for farmland have essentially eliminated these virgin stands. Present day woodlands, which consist of second and third growth stands, account for approximately 89,000 acres (or nearly 28% of Portage County's total land area), with most of the wooded acreage occurring in small woodlots. Tree species are similar to those of the original forests, which consisted mainly of beech, maple, oak, hickory, and poplar trees.

The site itself is located in a previously strip mined area. Native vegetation was destroyed by the strip mining operations, but has revived to some degree in adjacent areas where till was replaced after coal was removed. Due to the nature of some of the wastes spilled at the Summit facility, vegetative growth on the site is sparse. Also, much of the site was regraded during the 1981-82 surface cleanup activities and vegetation has not yet been re-established in these areas.

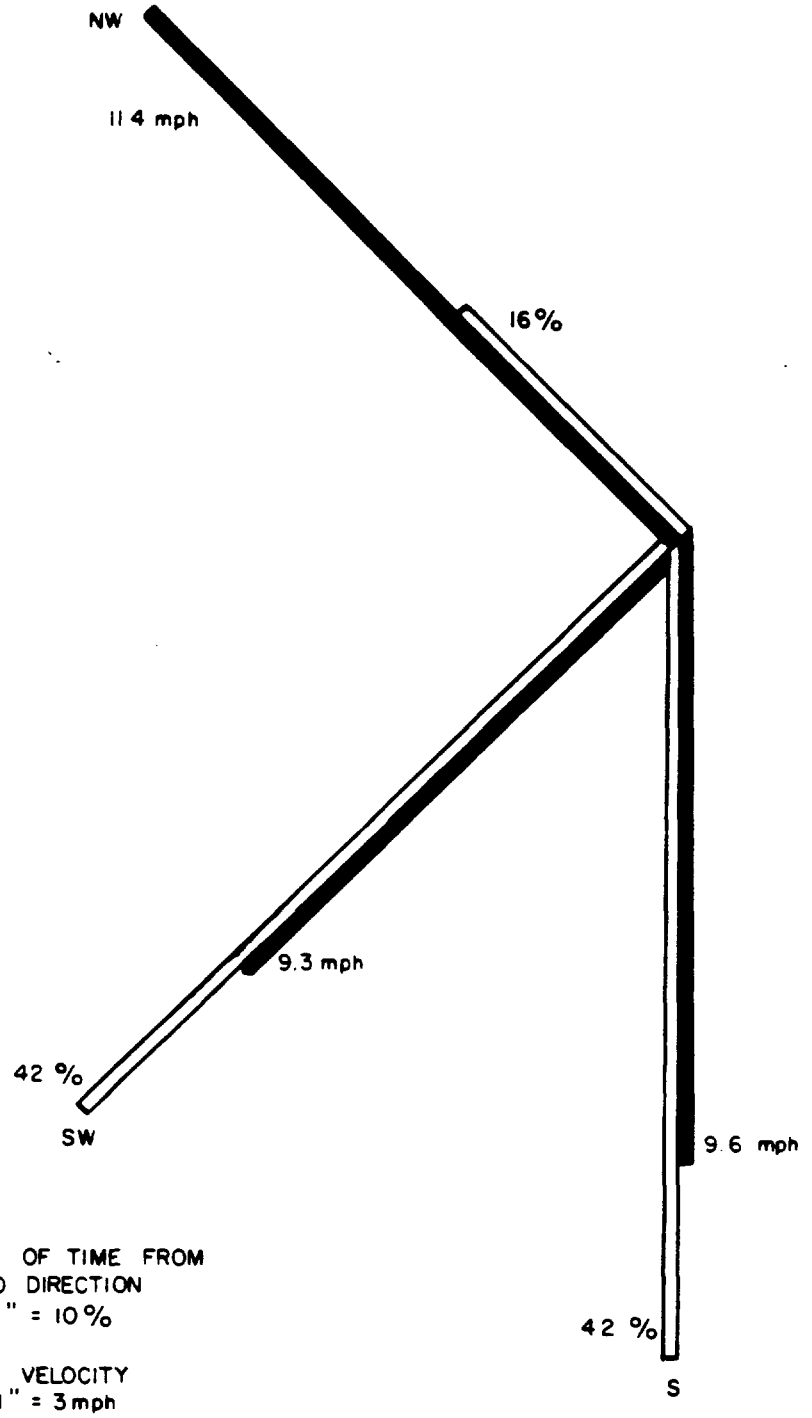
Wildlife in the areas adjacent to the site is quite varied because of its rural setting and proximity to the Berlin Lake Wildlife Area. Openland, woodland, and wetland wildlife may all be found near the site. Examples of openland wildlife are bobwhite quail, ringneck pheasant, meadowlark, field sparrow, dove, cottontail rabbit, red fox, and woodchuck. Examples of wildlife preferring the woodland habitat are ruffed grouse, turkey, woodcock, thrush, vireo, scarlet tanager, red, gray and fox squirrels, red and gray foxes, opossum, white-tail deer, and racoon. Ducks, Canada geese, rails, herons, beaver, and muskrat are examples of wetland wildlife. None of the above-mentioned wildlife species were actually observed residing at the site during the RI field activities.

Berlin Lake contains diverse sport fish populations which include the largemouth bass, smallmouth bass, white bass, walleye, white crappie, black crappie, bluegill, channel catfish, brown bullhead, and muskellunge.

TABLE 2-3
MEAN MONTHLY TEMPERATURE AND PRECIPITATION - AKRON, OHIO
PERIOD OF RECORD 1887 - 1985
SUMMIT NATIONAL SITE

Month	Mean Temperature (°F)	Mean Precipitation (inches)
January	26.4	2.56
February	27.3	2.21
March	36.5	3.14
April	48.0	3.13
May	59.1	3.82
June	68.2	3.61
July	72.3	3.91
August	70.6	3.37
September	64.2	3.18
October	52.8	2.44
November	40.8	2.56
December	30.2	2.54

Source: National Oceanic and Atmospheric Administration (NOAA)



LEGEND:

PERCENT OF TIME FROM INDICATED DIRECTION
SCALE 1" = 10%

AVERAGE VELOCITY
SCALE 1" = 3 mph

NOTE: BASE ON PREVALING MONTHLY WIND DIRECTIONS THROUGH 1963

SOURCE: 1985 LOCAL CLIMATOLOGICAL DATA ANNUAL SUMMARY WITH COMPARITIVE DATA AKRON, OHIO

NOAA - ASHVILLE, NC - 595

FIGURE 2 - 3
PREAILING WIND DIRECTIONS
SUMMIT NATIONAL R I

3.0 METHODS AND MATERIALS

The sampling methodologies and sampling equipment used to obtain environmental samples during the Summit RI field activities are provided in detail in past sampling plans. The following sections provide a summary of the sampling methodologies used.

3.1 GEOLOGY AND HYDROGEOLOGY

Hydrogeologic investigations were conducted at the Summit National Site for the purpose of determining the extent of soil contamination, the direction of groundwater flow, and the presence of groundwater contamination. Specific activities included:

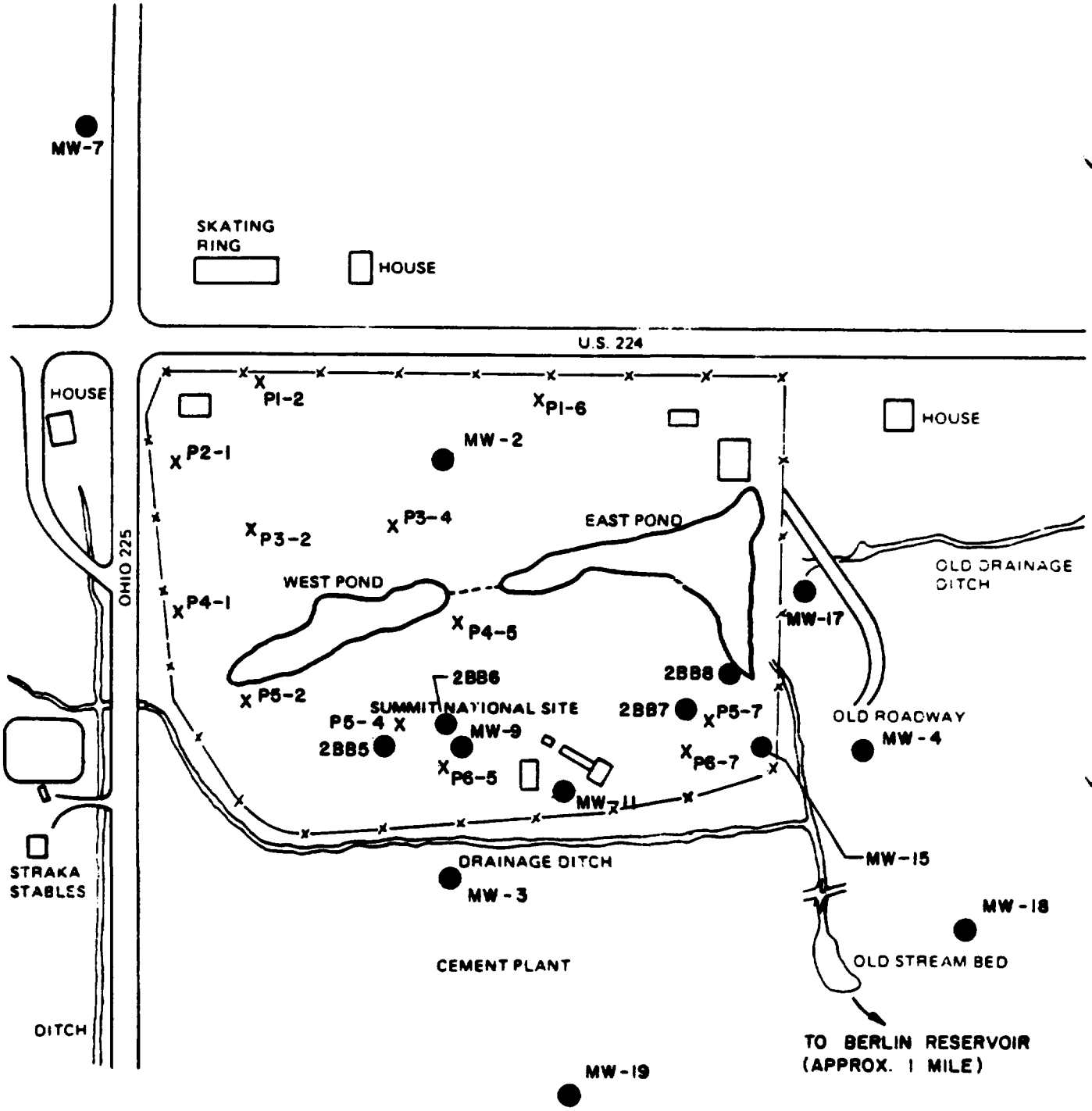
- drilling, logging, and installation of 24 monitoring wells and 12 shallow piezometers
- collecting of samples from the 24 monitoring wells and five existing monitoring wells
- monitoring of water levels in the wells
- performing in-situ hydraulic conductivity tests
- collecting subsurface soil samples from soil borings

These activities were conducted between November 1984 and September 1986.

3.1.1 Piezometers

A total of 47 soil borings were installed on a 100-foot grid to obtain samples of subsurface soils. Borings were advanced to a depth of 12 feet by augering and continuous split-spoon sampling. Twelve of the test borings were completed as piezometers to provide additional water level data in areas of the site where no wells were located (Figure 3-1). These borings were advanced an additional five feet to a total depth of 17 ft. Piezometers were constructed of two-inch PVC pipe, and were installed in the same manner as the monitoring wells except that protective casings were not added. All screens were five feet long.

The borings not completed as piezometers were grouted to the ground surface.



LEGEND

● MONITORING WELL IN WATER TABLE AQUIFER

X PIEZOMETER IN WATER TABLE AQUIFER

NOTE All locations of structures and physical features approximate.

SOURCE Modified from USEPA.

FIGURE 3-1
LOCATION OF MONITORING WELLS IN WATER TABLE AQUIFER
SUMMIT NATIONAL RI

3.1.2 Monitoring Wells

During the 1984 field activities, 11 monitoring wells were installed to form a groundwater monitoring network. During the 1985-1986 field activities, 13 additional monitoring wells were installed to supplement the existing network. These additional wells were installed to provide information on vertical gradients, refine the understanding of the piezometric surface on the deep bedrock units, and extend mapping of the water table further downgradient.

The four wells with the 2BB designation were installed downgradient of known buried drums that were uncovered and sampled during the test pit excavation activities, and were screened across the water table to intercept any immiscible contaminants floating on the water table. Construction data for all monitoring wells at the Summit National Site are summarized in Table 3-1 and locations are shown on Figures 3-1, 3-2 and 3-3.

Wells were installed as "nests" or "clusters", groups of wells located close together, but completed to different depths. This arrangement of wells was for the purpose of analysis of vertical hydraulic gradients. Well clusters are summarized in Table 3-2. Wells in some clusters, particularly #1, are not located as close together as would be desirable; however, they are still illustrative for some purposes. At each cluster, the deepest boring was advanced to the bedrock surface by augering and split-spoon sampling. At bedrock, temporary casing was installed. The boring was cored to the selected depth, then reamed to eight inches in diameter using air hammer. Shallower clustered wells were drilled by augering in unconsolidated material, then air-hammering in rock. No water was introduced in drilling any of the borings to prevent possible outside contamination.

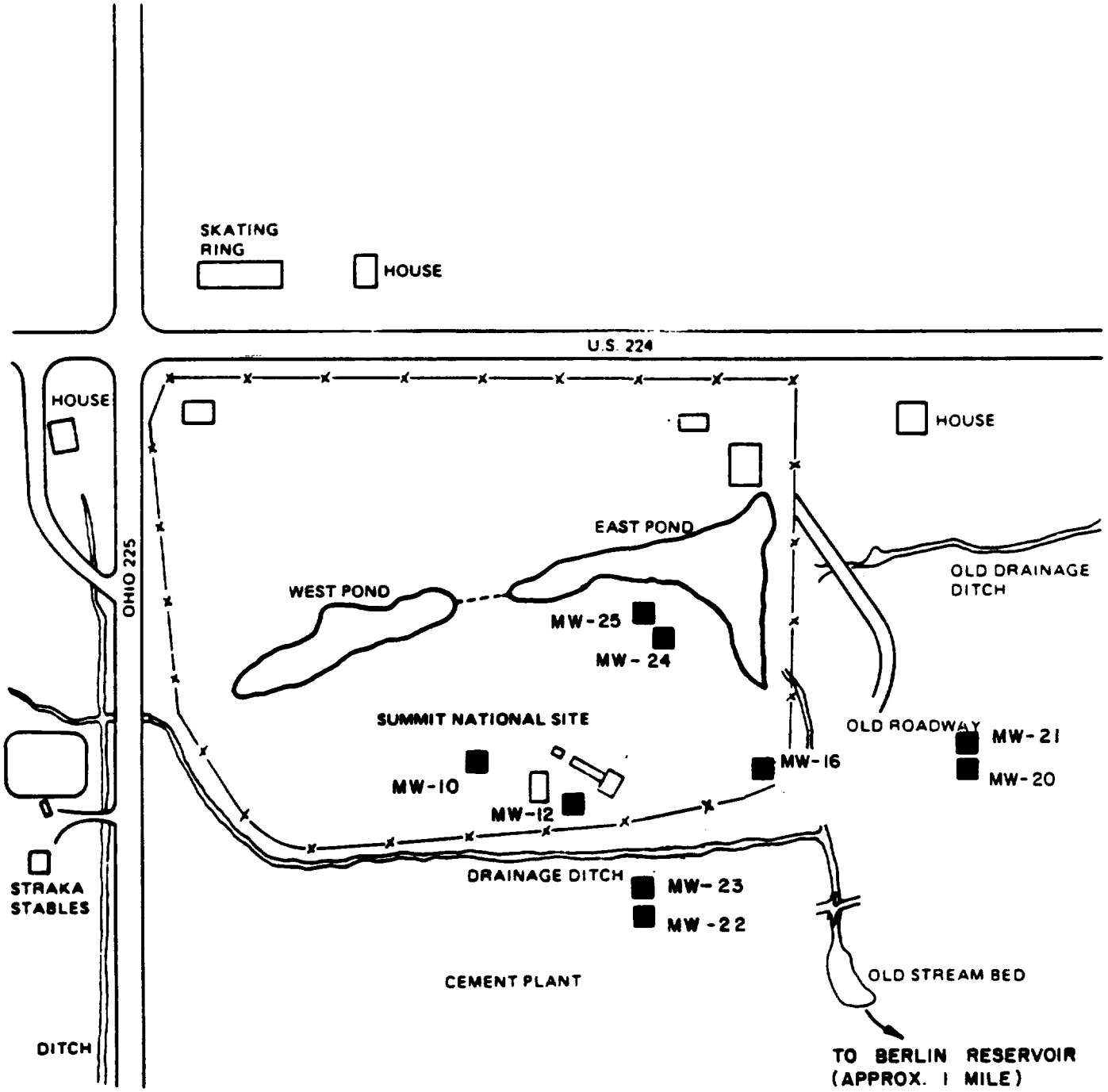
Wells were constructed of two- or four-inch diameter, threaded, flush-joint, Schedule-80 PVC pipe and machine-slotted screens (Figure 3-4). Slot sizes for the screens were 0.020 inches in bedrock and 0.010 inches in unconsolidated materials. A filter pack was placed around each screen to a level selected by the site hydrogeologist on the basis of the individual well log. A bentonite seal was installed above the filter pack, and the remainder of the annulus was backfilled with a 5:1 [approximate] cement-bentonite slurry.

TABLE 3-1

SUMMARY OF MONITORING-WELL CONSTRUCTION DATA
SUMMIT NATIONAL SITE

ZONE DESIGNATION	WELL #	CASING ELEVATON	TOTAL DEPTH	TOP OF SCREEN	TOP OF PACK	BOTTOM ELEVATION	SCREEN ELEVATION	PACK ELEVATION	INSTALLER	DATE INSTALLED
Bedford Coal	MW- 4	1,089.12	24.0	19.0	17.0	1,063.12	1,068.12	1,070.12	Penn Environmental	July 1980
Fill	2BB5	1,093.91	13.0	3.0	2.0	1,078.91	1,088.91	1,089.91	SRW	July 1986
	2BB6	1,095.06	13.0	3.0	2.0	1,080.06	1,090.06	1,091.06	SRW	July 1986
	2BB7	1,095.62	14.0	4.0	3.0	1,079.62	1,089.62	1,090.62	SRW	July 1986
	2BB8	1,093.23	14.0	4.0	3.0	1,077.23	1,087.23	1,088.23	SRW	July 1986
	MW- 3	1,099.52	38.5	33.5	30.0	1,059.02	1,064.02	1,067.52	Penn Environmental	July 1980
	MW- 9	1,097.31	30.0	25.0	24.0	1,065.31	1,070.31	1,071.31	SRW	November 1984
	MW-15	1,098.00	19.0	14.0	12.5	1,077.00	1,082.00	1,083.50	SRW	November 1984
	MW-18	1,098.70	33.0	23.0	20.0	1,063.70	1,073.70	1,076.70	SRW	June 1986
Till	MW- 7	1,106.74	20.0	15.0	14.0	1,084.74	1,089.74	1,090.74	SRW	November 1984
	MW-11	1,096.14	25.0	20.0	15.0	1,069.14	1,074.14	1,079.14	SRW	November 1984
	MW-17	1,084.40	10.4	5.4	4.0	1,072.00	1,077.00	1,078.40	SRW	November 1984
	MW-19	1,099.21	38.0	28.0	25.0	1,059.21	1,069.21	1,072.21	SRW	June 1986
Unnamed Coal #1	MW- 2	1,101.02	31.0	26.0	24.0	1,068.02	1,073.02	1,075.02	Penn Environmental	June 1980
Unnamed Coal #1a	MW-10	1,097.13	40.0	35.0	34.0	1,055.13	1,060.13	1,061.13	SRW	November 1984
	MW-16	1,097.95	41.0	36.0	30.0	1,054.95	1,059.95	1,065.95	SRW	November 1984
Unnamed Coal #2	MW-22	1,102.28	63.4	58.4	56.2	1,036.88	1,041.88	1,044.08	SRW	December 1985
	MW-25	1,095.87	55.0	50.0	47.6	1,038.87	1,043.87	1,046.27	SRW	July 1986
Unnamed Coal #3	MW-12	1,096.73	87.0	77.0	73.0	1,007.73	1,017.73	1,021.73	SRW	November 1984
	MW-20	1,089.75	72.7	67.7	66.0	1,015.05	1,020.05	1,021.75	SRW	December 1985
	MW-23	1,101.13	81.0	75.5	73.0	1,018.13	1,023.63	1,026.13	SRW	July 1986
	MW-24	1,096.38	68.0	63.0	59.6	1,026.38	1,031.38	1,034.78	SRW	July 1986
Unnamed Limestone	MW-21	1,089.51	63.0	57.8	55.1	1,024.51	1,029.71	1,032.41	SRW	June 1986
Upper Sharon	MW- 5	1,087.78	102.0	90.0	87.0	983.78	995.78	998.78	Penn Environmental	June 1980
	MW- 6	1,101.70	136.0	126.0	101.0	963.70	973.70	998.70	Penn Environmental	July 1980
	MW- 8	1,106.62	140.0	130.0	112.0	964.62	974.62	992.62	SRW	November 1984
	MW-13	1,096.41	117.0	107.0	95.0	977.41	987.41	999.41	SRW	November 1984
	MW-14	1,099.27	132.0	122.0	107.0	965.27	975.27	990.27	SRW	November 1984
	MW-26	1,096.74	125.0	105.5	90.0	969.74	989.24	1,004.74	SRW	January 1986

NOTE: Elevations are feet above mean sea level (MSL).
Depths are feet from ground surface.



LEGEND:

■ MONITORING WELL IN INTERMEDIATE ZONE

N

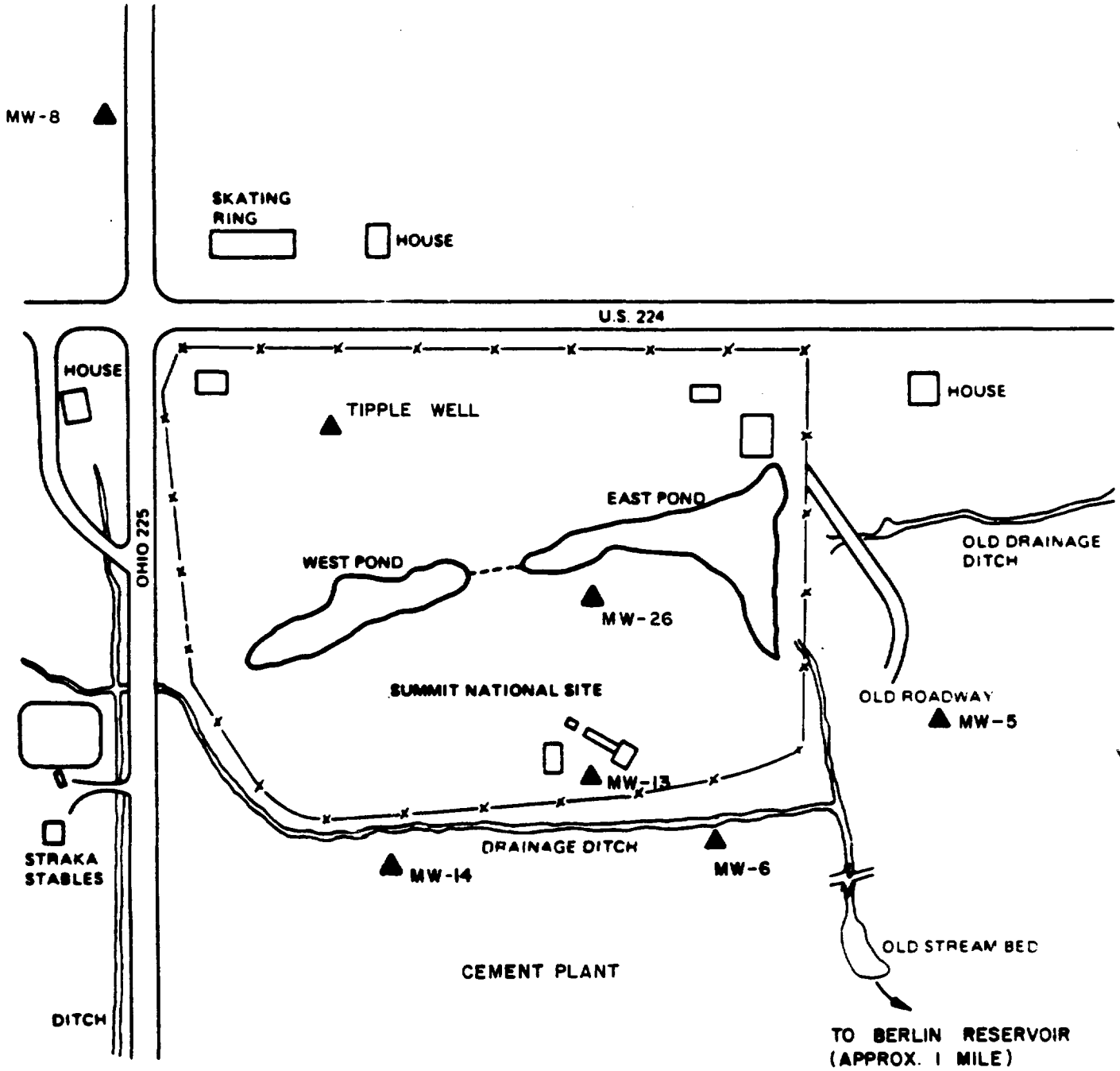
0 100 200

SCALE IN FEET APPROXIMATE

NOTE All locations of structures and physical features approximate.

SOURCE Modified from USEPA.

FIGURE 3-2
LOCATION OF MONITORING WELLS IN INTERMEDIATE ZONE
SUMMIT NATIONAL RI



LEGEND:

▲ MONITORING WELL IN UPPER SHARON AQUIFER

N

0 200

100

SCALE IN FEET APPROXIMATE

NOTE: All locations of structures and physical features approximate.

SOURCE: Modified from USEPA.

FIGURE 3-3
LOCATION OF MONITORING WELLS IN UPPER SHARON AQUIFER
SUMMIT NATIONAL RI

TABLE 3-2

SUMMARY OF MONITORING-WELL CLUSTERS
SUMMIT NATIONAL SITE

NEST #	WELL #	HEAD (9/86)	BOTTOM ELEVATION	SCREEN ELEVATION	PACK ELEVATION	MONITORED	DEPTH	ZONE DESIGNATION
1	MW-14	1,067.02	965.27	975.27	990.27	132.0	107.0	Upper Sharon
	MW- 3	1,085.32	1,059.02	1,064.02	1,067.52	38.5	30.0	Fill
2	MW- 5	1,066.48	983.78	995.78	998.78	102.0	87.0	Upper Sharon
	MW-20	1,066.55	1,015.05	1,020.05	1,021.75	72.7	66.0	Unnamed Coal #3
	MW-21	1,049.41	1,024.51	1,029.71	1,032.41	63.0	55.1	Unnamed Limestone
	MW- 4	1,079.73	1,063.12	1,068.12	1,070.12	24.0	17.0	Bedford Coal
3	MW- 6	1,066.00	963.70	973.70	998.70	136.0	101.0	Upper Sharon
	MW-23	1,065.08	1,018.13	1,023.63	1,026.13	81.0	73.0	Unnamed Coal #3
	MW-22	1,064.88	1,036.88	1,041.88	1,044.08	63.4	56.2	Unnamed Coal #2
4	MW- 8	1,073.62	964.62	974.62	992.62	140.0	112.0	Upper Sharon
	MW- 7	1,098.19	1,084.74	1,089.74	1,090.74	20.0	14.0	Till
5	MW-10	1,086.93	1,055.13	1,060.13	1,061.13	40.0	34.0	Unnamed Coal #1a
	MW- 9	1,087.11	1,065.31	1,070.31	1,071.31	30.0	24.0	Unnamed Coal #1
6	MW-13	1,067.81	977.41	987.41	999.41	117.0	95.0	Upper Sharon
	MW-12	1,063.88	1,007.73	1,017.73	1,021.73	87.0	73.0	Unnamed Coal #3
	MW-11	1,081.94	1,069.14	1,074.14	1,079.14	25.0	15.0	Till
7	MW-16	1,068.35	1,054.95	1,059.95	1,065.95	41.0	30.0	Unnamed Coal #1a
	MW-15	1,084.80	1,077.00	1,082.00	1,083.50	19.0	12.5	Fill
8	MW-26	1,063.14	969.74	989.24	1,004.74	125.0	90.0	Upper Sharon
	MW-24	1,064.68	1,026.38	1,031.38	1,034.78	68.0	59.6	Unnamed Coal #3
	MW-25	1,076.07	1,038.87	1,043.87	1,046.27	55.0	47.6	Unnamed Coal #2

Elevations are feet above mean sea level (MSL).
Depths are feet from ground surface.

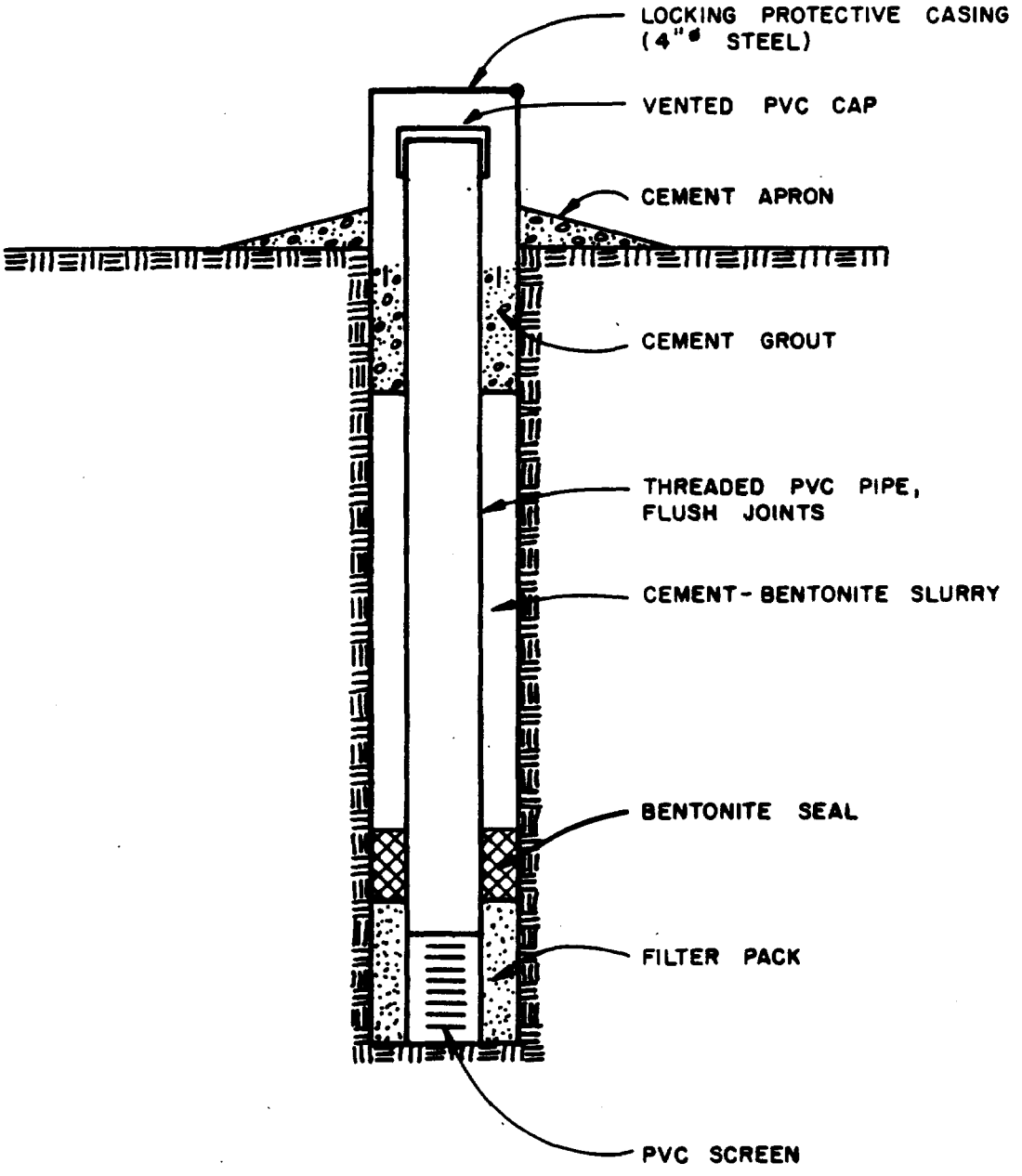


FIGURE 3-4
TYPICAL MONITORING WELL CONSTRUCTION
SUMMIT NATIONAL RI

Protective steel casings were placed at the surface. Detailed construction information for each well is presented in Appendix D.

All drilling tools were decontaminated according to the sampling plan after each boring was completed.

Newly installed monitoring wells were developed by air lift. The sampling plan procedures were to develop the wells until the discharge water achieved visual clarity, but many of the wells had poor yields and complete development with air was not practicable.

Phase II activities included rehabilitation of the existing abandoned production well near the coal tipple. The tipple well is reported to have a depth of 300 ft. (Source: OEPA) Approximately 20 ft. of 8 in. steel casing was removed, but the remaining casing was still plugged with earth, rock, wood, and metal debris. Attempts were made to clear the casing with air rotary drilling. At approximately 60 ft., an obstruction was encountered that could not be cleared with a 7-7/8 in. OD bit. Switching to a smaller bit, the obstruction was cleared. Apparently the obstruction was the end of the casing which had been crushed, presumably due to advancement by cable tool method during installation. Finally, at a depth of 101 ft., another obstruction was encountered. This time metal shavings came up in the cuttings and the hole was abandoned. Apparently the well is cased to a depth of 60 ft., with an open borehole extending to a depth of at least 101 ft. This depth interval corresponds to the intermediate units.

Well casings were surveyed for top elevation.

3.1.3 Groundwater Sampling

During the RI field activities, groundwater samples were collected twice: once in December 1984 through January 1985, and once in September 1986. Samples were collected from all existing monitoring wells using the protocol detailed in the sampling plan, including recording the water level; purging the well by removing five well-volumes of water, or until dry; collecting the sample with dedicated PVC bailers, decontaminated teflon bailers or sampling pumps; and recording the pH, specific conductance, and temperature of the sample. Total metals (unfiltered) samples were also obtained in Phase II.

A total of 14 samples were obtained from nine domestic wells (Figure 3-5) after being allowed to flow freely for 10 to 15 minutes. Samples were collected at the tap closest to the holding tank, ahead of any treatment system.

Groundwater analyses are summarized in Appendix A.

3.1.4 Hydraulic Conductivity Testing

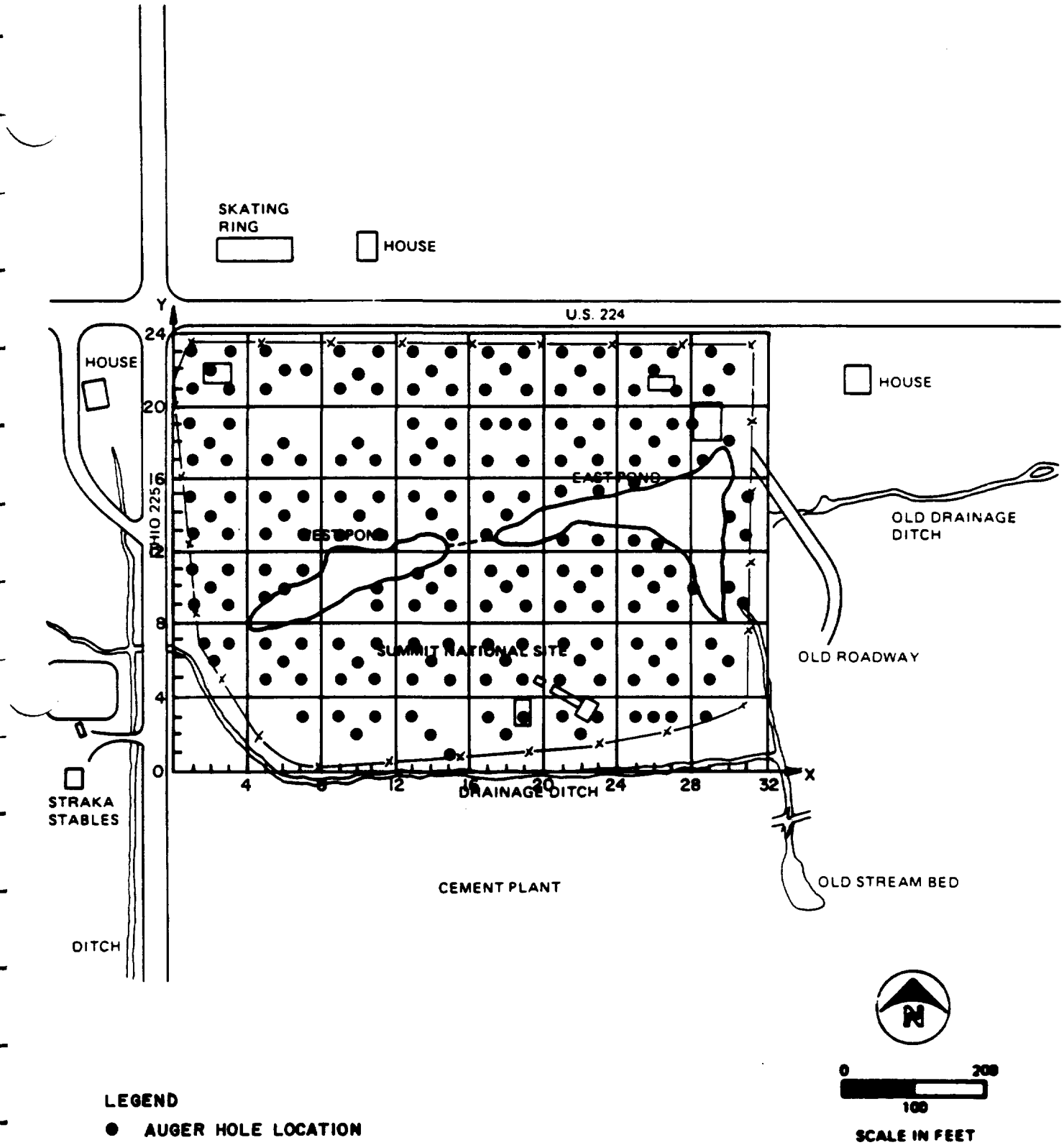
Falling-head hydraulic conductivity tests were performed in all monitoring wells, except the 2BB series. These wells were installed to intercept any floating layer in the water table. Before each test an initial water level was measured and a pressure transducer was installed in the boring and connected to an In-Situ Hermit data logger. The system was set to record drawdown in the well at logarithmic intervals. A solid mass, constructed from a capped, weighted length of PVC pipe, was then inserted into the well as the data logger was started. Readings were taken until the water level in the well recovered to the pre-test level or until a minimum of one-half hour had passed. The data were then transferred to a computer for analysis.

Hydraulic conductivity values were calculated with a microcomputer program (Thompson, in press) which uses the methods of Hvorslov (1951) and Cedengren (1972). Calculations are presented in Appendix E.

3.2 SOILS

The soil sampling program at the Summit National site was developed as a two phased sampling activity. Phase I was designed to obtain data only on the onsite surface soils. Before the surface soil sampling, the Summit National site area was surveyed to establish a 100 ft. by 100 ft. grid system. Each 100 ft. grid square was then subdivided into 25 ft. square subareas and marked with flagging. One composite sample was obtained from each 100 ft. by 100 ft. area by combining samples from five separate auger holes drilled at the intersection of alternating 25 ft. grid nodes. The grid system, as well as the distribution of auger holes, is illustrated in Figure 3-6. The Phase I sample locations are shown on Figure 3-7.

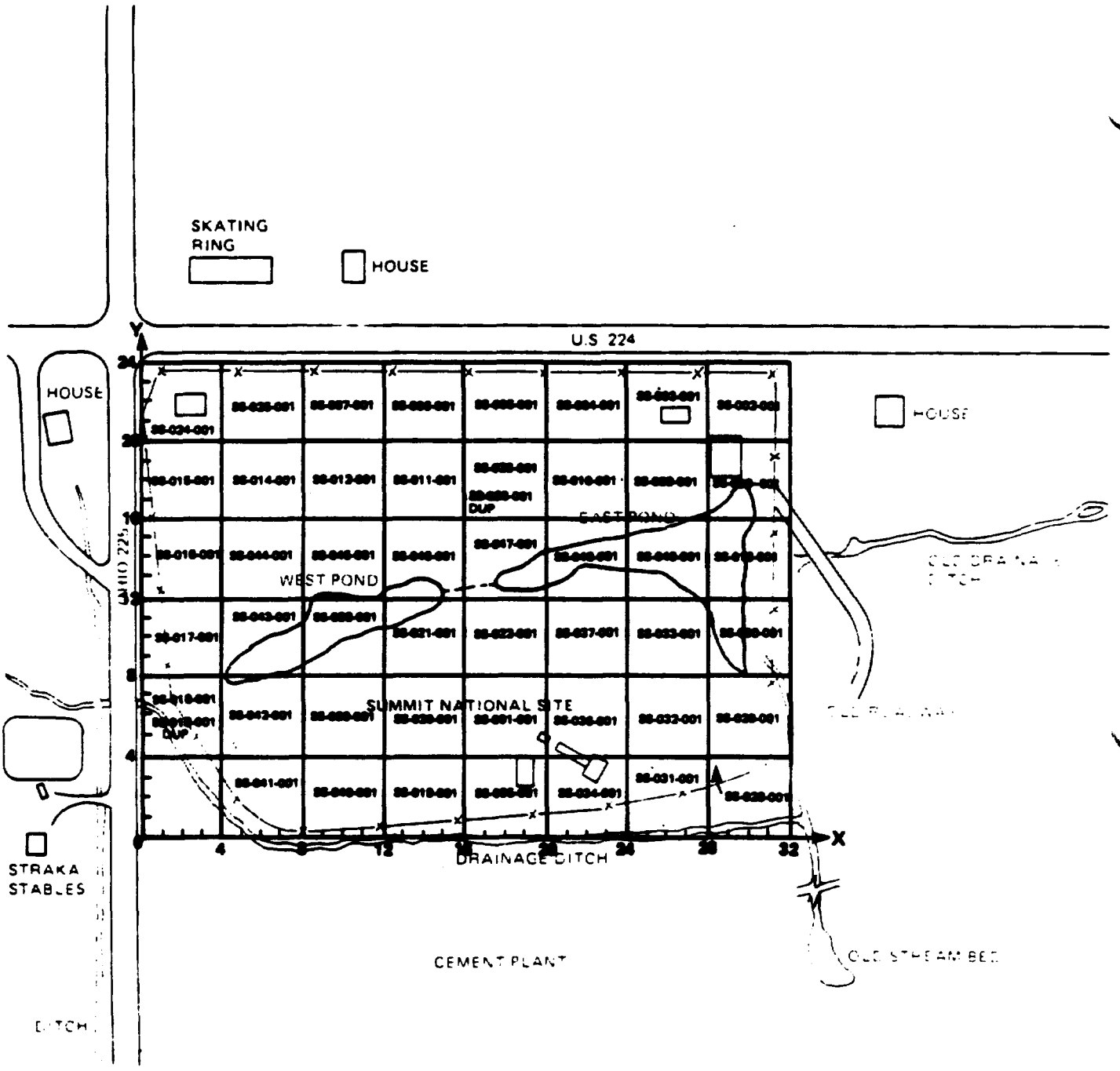
Samples were obtained using a stainless steel hand bucket auger according to procedures in the sampling plan. Each hole was advanced to a depth of up to 2 ft.



NOTE: All locations of structures and physical features approximate.

SOURCE: Modified from USEPA.

FIGURE 3-6
LOCATION OF REFERENCE GRID AND PLACEMENT OF AUGER HOLES SOIL SAMPLING PHASE I
SUMMIT NATIONAL RI



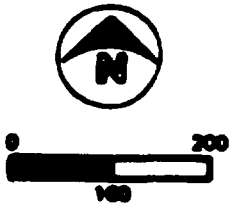


FIGURE 3-7
SOIL SAMPLING LOCATIONS WITH PHASE I NUMBERING SYSTEM
SUMMIT NATIONAL RI

NOTE: All locations of structures and physical features are approximate.

SOURCE: Modified from USEPA.

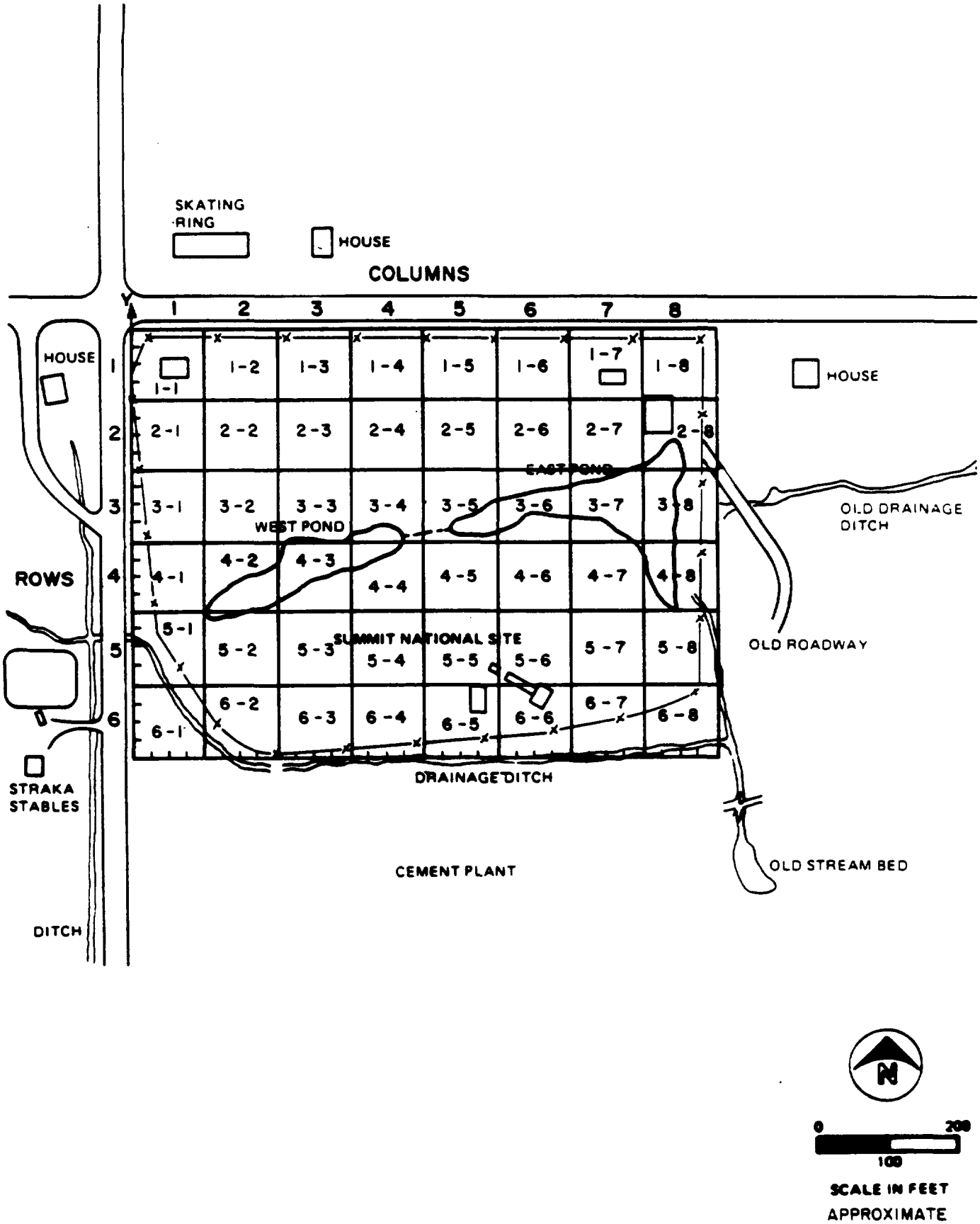
The stainless steel auger, stainless steel pail, stainless steel garden trowel, and the sampler's gloves were decontaminated after completion of each grid square according to procedures outlined in the sampling plan.

The Phase I soil samples were numbered sequentially as they were taken. As a result, the Phase I numbering system is confusing to follow in trying to locate a particular cell of interest. A new numbering system was used during Phase II to define the soil sampling cells. The new system used a matrix number in which the first number represents the row and the second number represents the column, i.e., the number 2-1 represents the second row, first column. The Phase I surface soil sample numbering system is shown on Figure 3-7, and the Phase II sampling cell system is shown on Figure 3-8. Table 3-3 presents a correlation of the old and the new numbers.

The Phase II soil samples were collected using several different techniques. Soil borings were drilled with augers of at least 6 inches in diameter. The type of auger varied depending on drilling rig availability. Samples were obtained by continuously advancing split-spoon samplers using 2 ft. intervals. Because of the loose nature of much of the soil sampled, soil compaction in the split-spoon sampler, and the presence of small rocks contributing to poor soil recovery in the spoons, about 27% of the spoon samples had to be composited with adjacent spoon samples.

Twenty-three initial borings were made. Two 8 oz. bottles and one 120 ml vial were filled with soil for possible analysis by CLP labs for each sample. In addition, several ounces of soil were placed in an 8 oz. bottle for screening by the SRW onsite mobile lab. On the basis of the results of the screening by the onsite mobile lab, nine additional borings were selected to fill in data gaps or to expand coverage. The locations of the onsite surface soil samples are shown on Figure 3-9.

The soil samples were screened for indicators of organic chemical contamination. The volatile screening target compounds included 1,1,1-trichloroethane, trichloroethylene, and tetrachloroethylene. The method detection limit (MDL) for tetrachloroethylene 2 ng/g, while the MDL for the other two target compounds was



NOTE: All locations of structures and physical features are approximate.

SOURCE: Modified from USEPA.

FIGURE 3-8
SOIL SAMPLING LOCATIONS
WITH PHASE II NUMBERING SYSTEM
SUMMIT NATIONAL RI

TABLE 3-3
CORRELATION OF SOIL SAMPLING CELL RENUMBERING
SUMMIT NATIONAL SITE

Phase I Soil Sample Number	Phase II Number
SS-024-001	1-1
SS-025-001	1-2
SS-007-001	1-3
SS-006-001	1-4
SS-005-001	1-5
SS-004-001	1-6
SS-003-001	1-7
SS-002-001	1-8
SS-015-001	2-1
SS-014-001	2-2
SS-012-001	2-3
SS-011-001	2-4
SS-026-001	2-5
SS-026-001 DUP	2-5 DUP
SS-010-001	2-6
SS-009-001	2-7
SS-008-001	2-8
SS-016-001	3-1
SS-044-001	3-2
SS-045-001	3-3
SS-046-001	3-4
SS-047-001	3-5
SS-048-001	3-6
SS-049-001	3-7
SS-033-001	3-8
SS-017-001	4-1
SS-043-001	4-2
SS-038-001	4-3
SS-021-001	4-4
SS-022-001	4-5
SS-037-001	4-6
SS-033-001	4-7
SS-030-001	4-8
SS-018-001	5-1
SS-018-001 DUP	5-1 DUP
SS-042-001	5-2
SS-039-001	5-3
SS-020-001	5-4
SS-001-001	5-5
SS-036-001	5-6
SS-032-001	5-7
SS-029-001	5-8

Table 3-3 (cont'd)
Page 2

Phase I Soil Sample Number	Phase II Number
SS-041-001	6-2
SS-040-001	6-3
SS-019-001	6-4
SS-035-001	6-5
SS-034-001	6-6
SS-031-001	6-7
SS-028-001	6-8

10 ng/g. The MDL varied depending on the nature of interferences in the sample matrix and the extract solvent purity.

The BNA screening target compounds included Naphthalene, Phenanthrene, Di-n-butyl phthalate, Fluoranthene, Pyrene, Di-n-octyl phthalate, and Hexachlorobenzene. The method detection limit (MDL) for the BNA target compounds was 0.5 mg/kg. The MDL varied depending on the nature of interferences in the sample matrix and the extract solvent purity.

The soil sample screening program was designed to eliminate the necessity of sending all the samples taken to a CLP laboratory for complete priority pollutant analysis. As a result of screening, samples with high contaminant concentrations and those which may be representative of a whole area of contamination within the site were identified and selected for CLP analysis.

The samples were screened following the protocol defined by the flow chart in Figure 3-10 for samples obtained from areas where there are no buried drums. At a minimum, the top and bottom samples from each hole were screened for the volatile indicator parameters. Based on these results, the screening program progressed as indicated on the flow chart.

"Contaminated," as used in the flow chart, was defined as the concentrations of chemicals which are greater than or equal to one standard deviation above the mean concentration of constituents in the 15 background samples. The mean concentration was established from the results of screening the 15 background samples for all indicator parameters prior to the initiation of onsite sample screening. If no contaminants were found in the background samples, a sample was designated "contaminated" if one or more indicator parameters exceeded the established instrument detection limit. The screening of background samples did not detect any indicator compounds, so exceedences of instrument detection limits were the protocol used to indicate a "contaminated" sample and determined the appropriate pathway in the flow chart.

All non-drum sample screening results were plotted on a representation of the site according to the sample location. The development of this sectional profile allowed for the definition of areas of high levels of

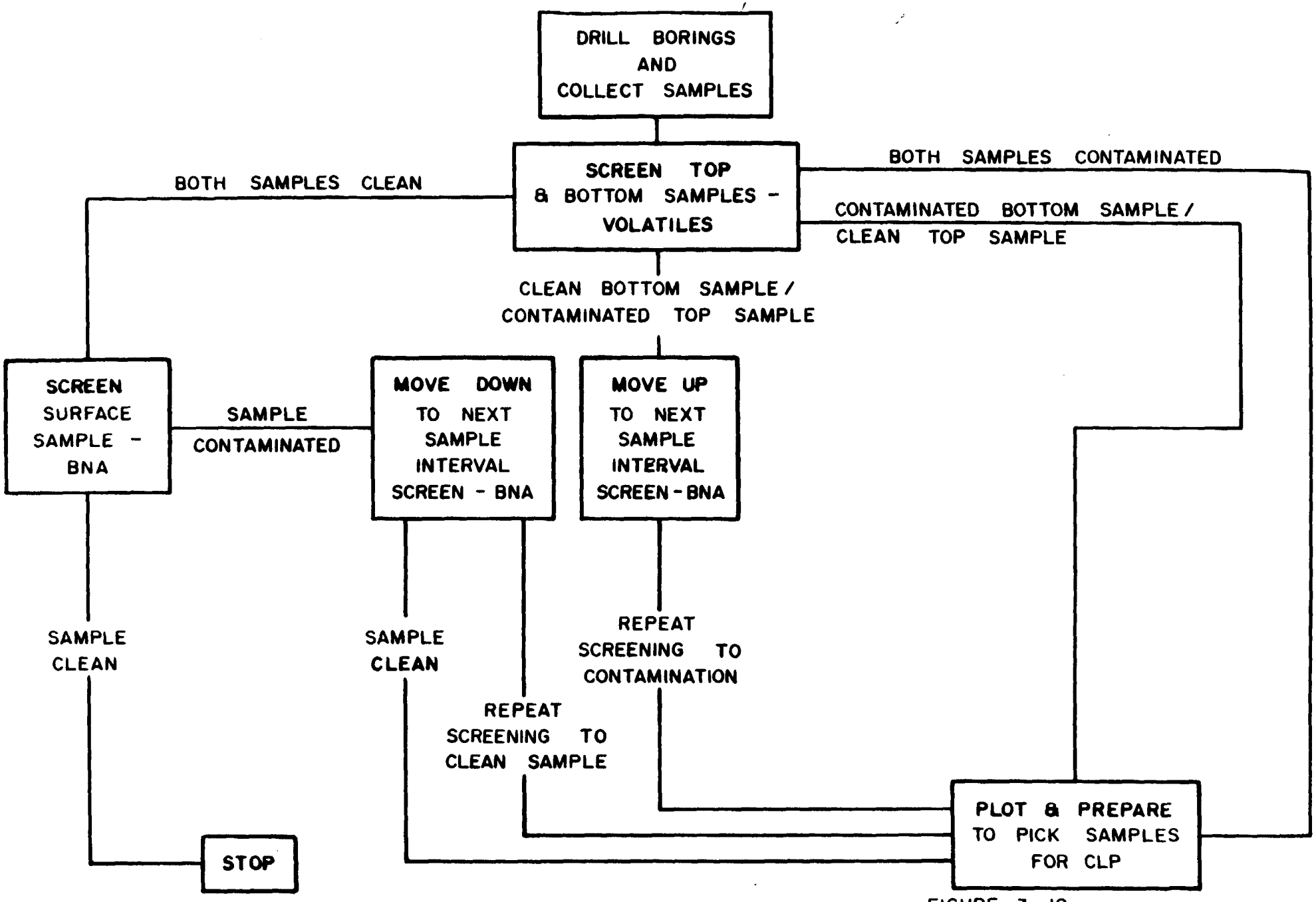


FIGURE 3-10
SCREENING SELECTION PROTOCOL
ONSITE NON-DRUM SOIL SAMPLES
SUMMIT NATIONAL RI

contamination, as well as those where patterns of contamination are similar. It also gave an indication of the relative depths of contamination throughout the site.

For boreholes in areas where buried drums are located, the screening program was defined by the flow chart in Figure 3-11. The middle and bottom samples in these holes were screened for the volatile indicators as a minimum for each hole. As with the non-drum samples, the screening results of these two samples determined the path of the screening program for the rest of the hole. Sample results were also plotted on the site layout to establish contamination levels and patterns.

After the screening of all the onsite soil samples (drum and non-drum) was complete, the plot of the results was evaluated so that the appropriate samples could be sent to the CLP laboratories. The selection of samples for CLP analysis was based on the following criteria:

a. The concentration of contaminant levels.
b. The number of contaminants identified in a particular sample or group of samples.
c. The location of the sample on the site.
d. The depth of the sample from the surface.
e. The proximity of the sample to a buried drum or visually contaminated area.

Several "clean" samples were selected for CLP analysis to verify the accuracy of the screening program. In addition, field blanks and duplicates were included for quality assurance/quality control purposes.

The 15 surface samples collected from the area to the east of the site were solvent extracted and also screened in the mobile laboratory for both volatiles and BNA indicator parameters. From the screening results of these 15 samples, five samples (plus one duplicate) were selected for CLP analysis. The criteria for selection was similar to those used for onsite samples, including a comparison of screening result levels, the number of contaminants identified in a sample, and the sample location. The remaining five offsite samples (from the cement plant), and one duplicate were sent to a CLP laboratory for analysis without prior screening for contaminants.

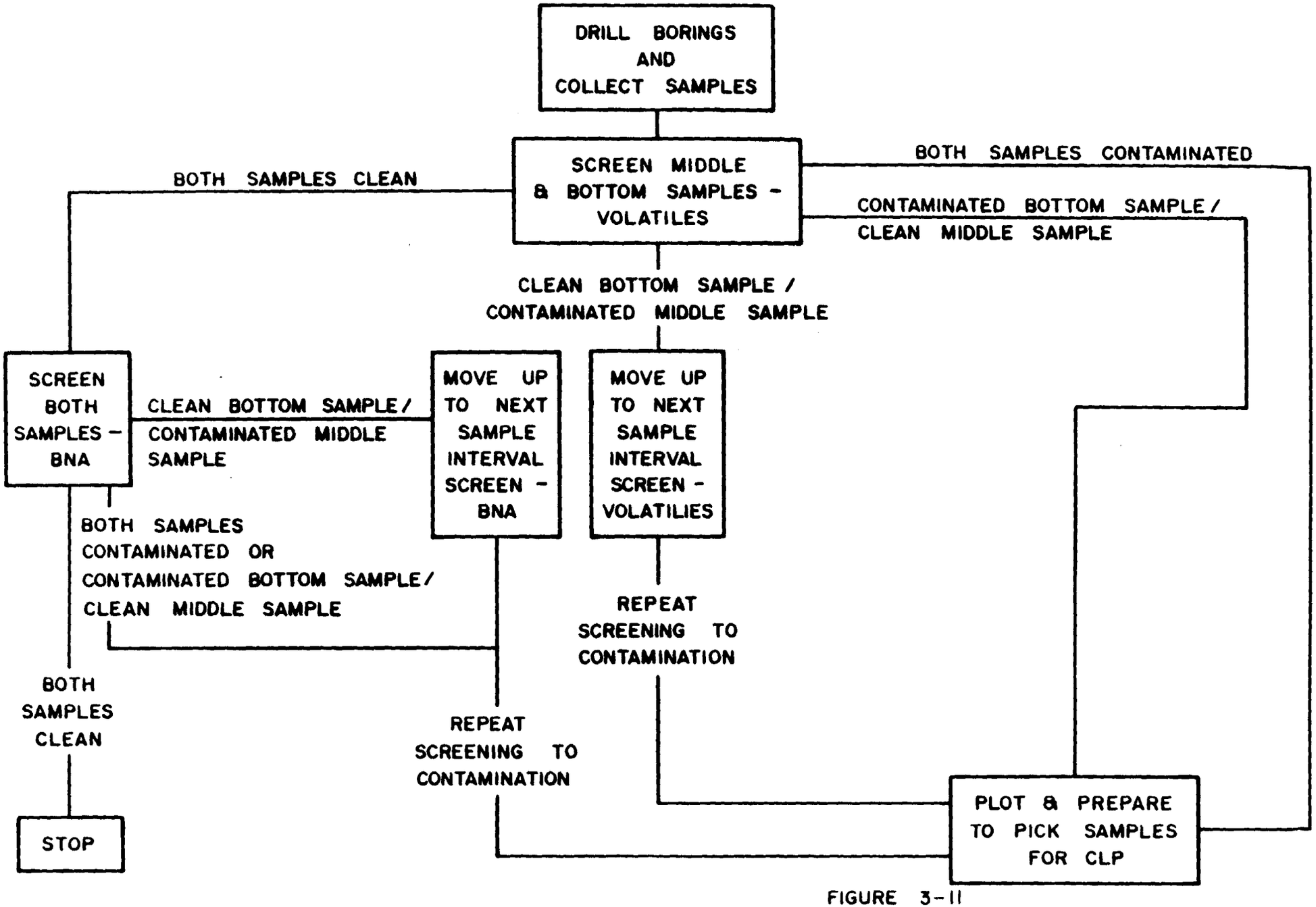


FIGURE 3-11
SCREENING SELECTION PROTOCOL
ONSITE DRUM AREA SOIL BORING SAMPLES
SUMMIT NATIONAL RI

All background samples were sent to a CLP laboratory for complete analysis, regardless of the sample screening results. Screening of the background samples was primarily for the establishment of contamination criteria.

Between samples, all spoons, augers, sampling trowels, pails and mixing tray, and sampler's gloves were decontaminated according to the procedures specified in the sampling plan.

3.3 SURFACE WATER

Surface water samples were collected during two separate sampling phases. The Phase I sampling program, conducted on November 28 and 29, 1984, involved sampling the site's ponds and nearby drainage ditches and streams in order to characterize onsite and offsite surface water contamination. The Phase II sampling program was conducted on September 15, 16 and 17, 1986. The purpose of the second sampling program was to further characterize onsite and offsite surface water contamination and to corroborate the results obtained during the Phase I sampling program. The locations of both the onsite and offsite surface water samples are shown on Figure 3-12.

Surface water samples were collected by dipping the sample bottle directly into the pond or stream or by using a dip sampler and transferring the sample to the sample bottle. Sample bottles used for each surface water sample included four 1 liter high density polyethylene bottles, two 40 ml glass VOA bottles, and two half-gallon glass amber bottles. The dip sampler was comprised of a one liter nalgene beaker attached to a pole by an adjustable clamp. The sample bottle or dip sampler was filled carefully so as not to disturb the underlying sediments. Duplicate samples taken from the same location were collected simultaneously and in the same manner. Decontamination of the sampling equipment after each sample and of the sample bottles prior to their shipment to the laboratory was performed in accordance with the procedures outlined in the Phase I and II Quality Assurance Plans.

The surface water samples and duplicates, along with several field blanks, were submitted for chemical analysis for the HSL organic and inorganic parameters. In addition, pH and specific conductance were measured

in the field. Organic and inorganic analytical results for the surface water samples are presented in Appendix A.

3.4 SEDIMENTS

Sediment sampling at the site was performed in two separate phases in conjunction with the surface water sampling programs. The Phase I sediment sampling program was conducted on November 26 and 27, 1984, and involved collecting sediment samples from the site ponds and nearby drainage ditches and streams. The purpose of this initial sampling phase was to characterize onsite and offsite sediment contamination. Onsite sediment samples included four samples, plus one duplicate sample from the west pond and four samples from the east pond. The samples were collected at uniform intervals across the length of each pond according to procedures detailed in the sampling plan. Sediment thickness was estimated by obtaining sounding measurements with the PVC sampling equipment. The eighteen offsite samples, plus two duplicates, were collected in the same general areas from which the Phase I surface water samples were taken. Sample collection methods are presented in the sampling plan.

The Phase II sediment sampling program was conducted on September 16 and 17, 1986. The purpose of this sampling program was to further characterize the contamination of onsite and offsite sediments and to corroborate the results of the Phase I sampling program. Onsite sediment samples consisted of three samples from both the west and east ponds and one duplicate sample from the west pond. Seven offsite sediment samples, plus one duplicate, were collected during this phase of the investigation. These samples were taken in the same general locations as the Phase I sediment samples, except for the drainage ditch east of the site, which was sampled further east and downstream of the Phase I sample locations.

The locations of both the onsite and offsite sediment samples from both investigation phases are shown on Figure 3-13.

A stainless steel trowel, a stainless steel pipe dredge, and a Nalgene dip sampler were used to collect the sediment samples according to methods detailed in the sampling plan.

After collection by one of the means described above, each sediment sample was placed in a stainless steel pail and thoroughly mixed using the stainless steel trowel. The mixed sediment sample was then placed in the sample bottle and sealed according to sampling plan protocol.

Decontamination of the sampling equipment after each use and of the sample bottles prior to their shipment to the laboratory was performed in accordance with the procedures outlined in the Phase I and Phase II Sampling Plans.

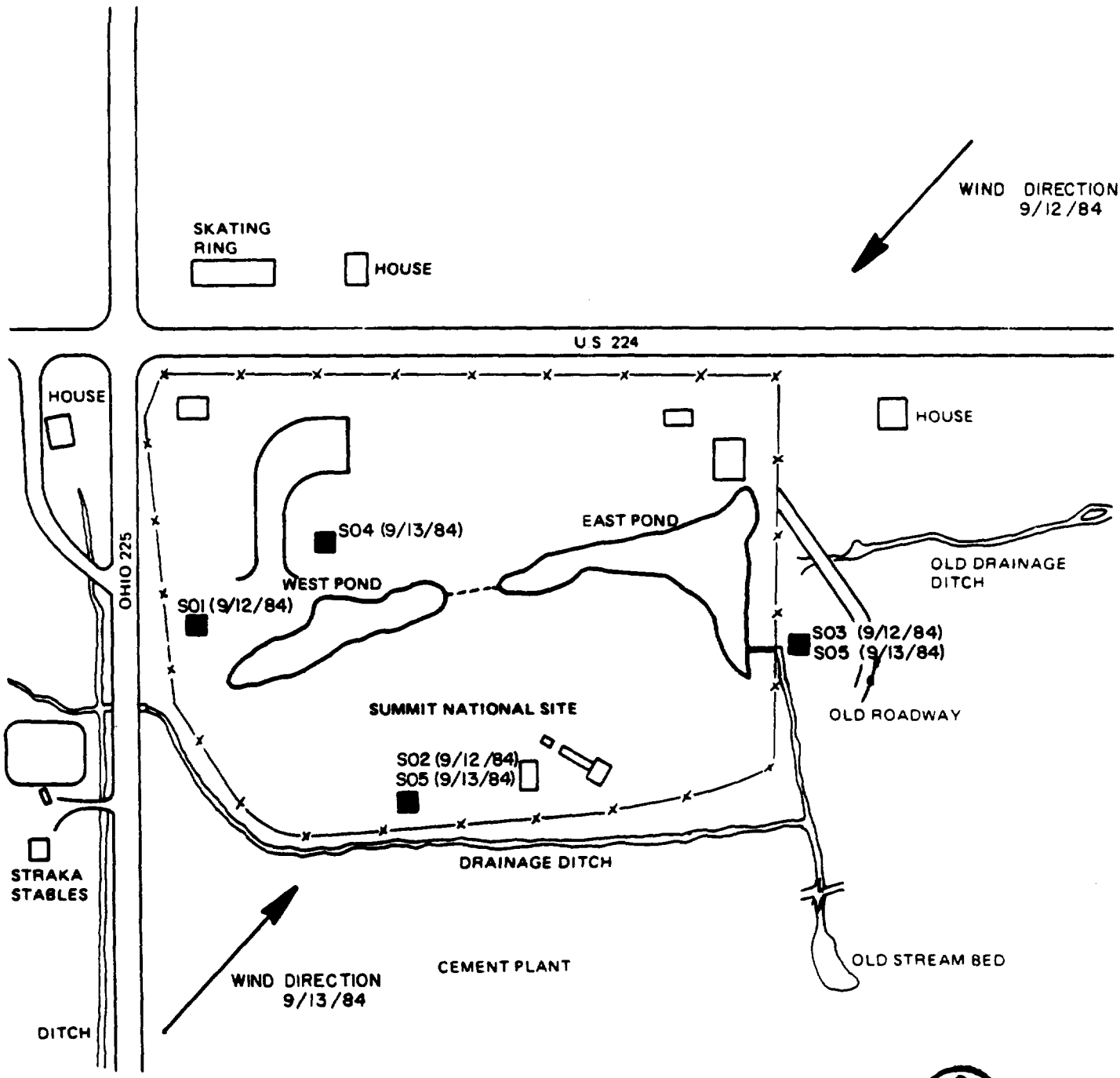
The sediment samples and duplicates, along with several field blanks, were submitted for chemical analyses for the HSL organic and inorganic parameters. Organic and inorganic analytical results for the sediment samples are presented in Appendix A.

The total volume of sediment within the two onsite ponds was estimated to be approximately 23,000 cu. ft. The east pond had an average thickness of .75 ft., and a surface area of 13,200 sq. ft. The west pond had an average thickness of 1.75 ft. and a surface area of 7,400 sq. ft. These measurements were taken during Phase II sampling.

3.5 AIR SAMPLING

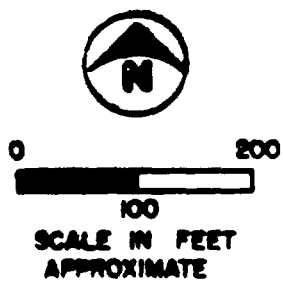
Air sampling and/or monitoring was performed both prior to the startup of site investigation activities and during the performance of the activities. The sampling and monitoring were performed primarily to obtain data to determine the levels of respiratory protection required for various activities on site. Although the data was obtained for this purpose, it does provide an indication of the hazards due to inhalation of contaminants on site.

Air sampling was performed at the site by Phoenix Safety Associates, Ltd. on September 12 and 13, 1984, for the purpose of identifying potential respiratory hazards prior to the commencement of site investigation activities. Results of this sampling were used to develop the site Health and Safety Plan. Six samples (S01-S06) were collected at locations upwind, downwind, and at midrange (in the old drum area), as shown on Figure 3-14. Each sample was collected over a six hour sampling period using a battery operated pump to draw a



NOTE: All locations of structures and physical features approximate.

SOURCE: Modified from USEPA.



LEGEND

ABANDONED STRUCTURES

APPROXIMATE AIR SAMPLING LOCATION

FIGURE 3-14
AIR SAMPLING LOCATIONS
SUMMIT NATIONAL RI

measured amount of air through a charcoal sample tube. The samples were analyzed for the presence of volatile organics.

Air monitoring was performed during the air sampling investigation by Phoenix Safety in September 1984, and during the performance of the site investigation activities. The site was scanned with a Century Organic Vapor Analyzer (OVA), Model 128. A pipe was driven 1 to 3 feet into the ground in the pond areas, the old south storage area, and the east storage area to simulate investigation activities.

An OVA and strip chart recorder in the survey mode was also set up downwind of the site during the air sampling investigation.

Routine air monitoring was performed at the site during the onsite investigation activities in accordance with the site Health and Safety Plan. The monitoring included a site scan with an OVA at the start of each work day, frequent readings with the OVA at individual work areas during the performance of specific activities, and periodic readings with the HNu, explosimeter and oxygen meter over the entire site.

3.6 RADIOLOGICAL MONITORING

Radiological monitoring was performed using a Ludlum Model 3 Survey Meter prior to initiation of site investigation activities. During field activities, all personnel were required to wear TLD badges continuously.

3.7 ONSITE STRUCTURES

A survey of existing onsite structures was performed that consisted of descriptions, measurements, and four-sided photographs of all structures remaining on site.

3.8 RI DERIVED LIQUID WASTE DISPOSAL

The purpose of the liquid waste disposal activities was to eliminate the possibility of drums containing wastes generated primarily during RI hydrogeologic investigations from rupturing due to freezing temperatures. The liquid wastes handled included water generated from the drilling and installation, development, and purging of monitoring wells. The

drums in question were inventoried according to their contents, externally labeled as such, and the results tabulated and recorded. All empty and partially full drums were left on site in a staging area near the abandoned coal tipple.

The scope of the waste disposal activities included the following:

- Open approximately 200 drums located as shown in Figure 3-15 by means of ratchets, adjustable crescent wrenches and bolt cutters.

- Evacuate the liquids from all of the drums by means of a centrifugal pump and consolidate the liquids into a 6,500 gallon tank trailer, as shown in Figure 3-15.

- Evacuate the composite liquid from the tank trailer by pumping it through a carbon adsorption treatment system (see Figure 3-16) prior to final disposal into the westernmost pond located on site.

- Obtain a composite sample of the liquid after treatment by the carbon adsorption system. The sample was sent to the CLP for full HSL analysis.

- Inventory all affected drums according to their natural contents, externally label the drums as such, and record and tabulate the results.

- Close and temporarily reseal those drums still containing waste.

3.9 BURIED MATERIAL

3.9.1 Geophysical Investigations

Geophysical investigations were performed at the site by Weston Geophysical Corporation Inc. from October 31 through November 7, 1984. A magnetometer survey and ground penetrating radar (GPR) survey were performed on site in order to locate anomalies which may be buried drums or tanks. An electromagnetic conductivity (EM) survey was performed to estimate conductivities at various locations and depths on site and areas downgradient of the site. Anomalous conductivities can be indicative of waste concentrations or contaminated

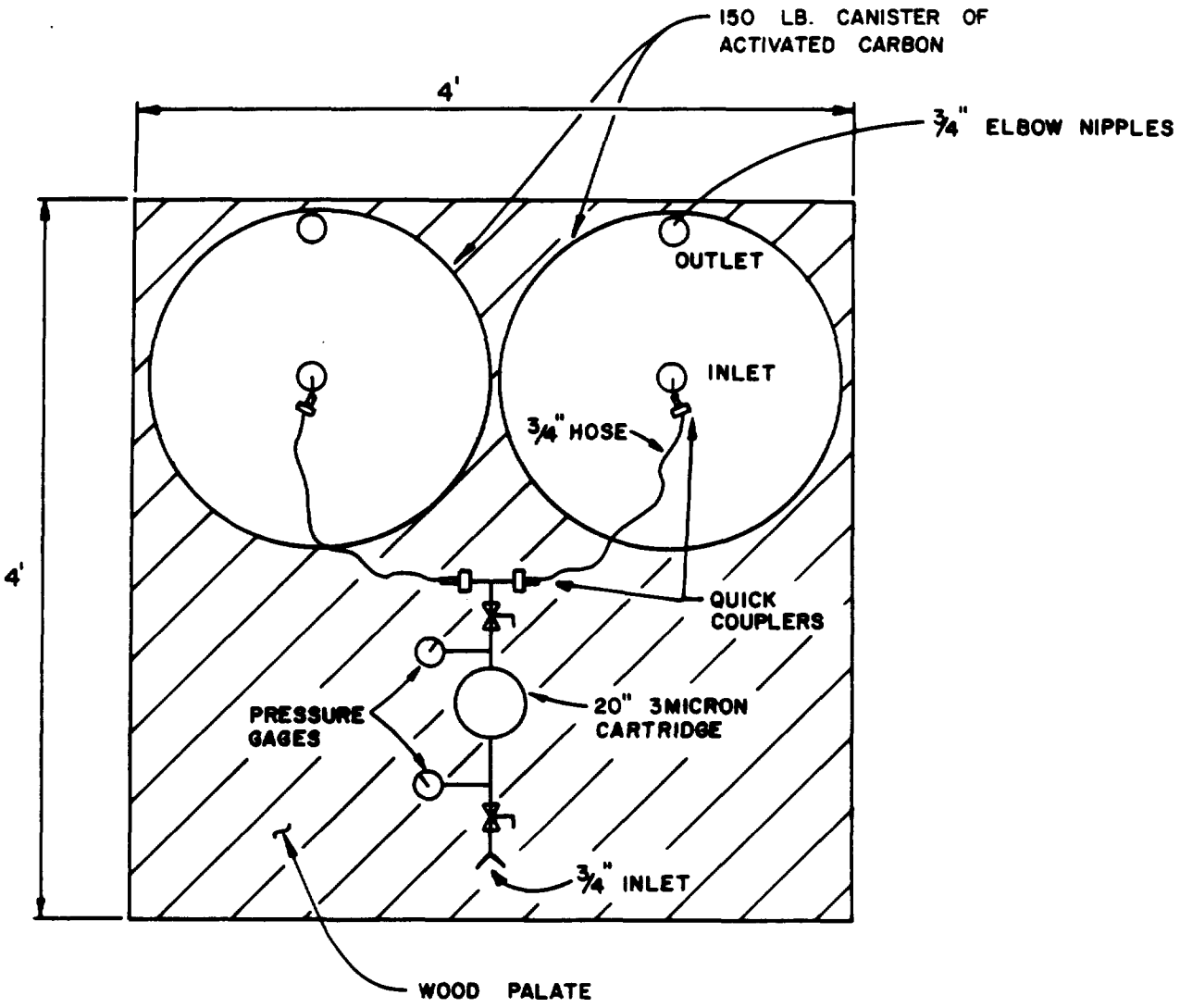


FIGURE 3-16
CARBON ADSORPTION TREATMENT SYSTEM
SUMMIT NATIONAL RI

groundwater. The report prepared by Weston Geophysical Corporation, Inc. presenting the results of the surveys is included in Appendix G.

Areas exhibiting anomalous magnetometer readings were surveyed using a Subsurface Interface Radar (SIR) System with a 300 MHz transducer.

An EM survey was performed both on and off the site using both the Geonics EM31 and EM34-3. The EM31 was used to provide information on the conductivity of the near surface material with measurements made at 12.5 feet intervals. The EM34-3 provided information on subsurface conductivity with increasing depth.

Measurement intervals for the EM34-3 were 25 feet and 50 feet, respectively, for the 10 and 20 meter coil springs.

3.9.2 Test Pit Investigations

A total of thirteen test pits were excavated on December 11 and 12, 1985 at the site in areas suspected of containing buried drums based on the magnetometer survey. The excavations were performed in order to 1) determine if the drums exist; 2) evaluate their condition if present; 3) provide an estimate for the total number of drums buried at the site; and 4) sample any leaking drums if possible. The locations of the test pit excavations are shown on Figure 3-17.

4.0 RESULTS OF RI INVESTIGATIONS

4.1 DATA CONSIDERATIONS

4.1.1 Data Reduction

Due to the large number of EPA laboratory data sheets provided by the CLP laboratories with the results from the organic and inorganic analysis, it was necessary to organize the data into a more workable format. All samples were analyzed for full HSL parameters listed in Appendix C. The groundwater and surface water samples were analyzed for additional SAS parameters shown on Table 4-1. A number of summary tables were developed for each medium sampled. The groupings were selected to identify the presence of contamination. In preparing the summary tables, only those parameters that were detected in at least one sample of any medium were included. These parameters were grouped according to volatile, base/neutral/acid extractables, and PCB/pesticide organic constituents and inorganic constituents according to the medium sampled. Compounds tested for and not detected were not included on the data summary tables and were not considered in the discussion and analysis section of this report. These tables are presented in Appendix A.

During completion of the summary tables, the data were further reviewed by applying the laboratory EPA QA/QC protocols and identifying data problems accordingly. A discussion of EPA protocol concerning data quality problems is presented in Section 4.1.2. The data with identified problems remained in the summary tables, except for that data which was invalidated by the QA review. Problem data presented in the tables were noted as such and considered with caution in the discussions and data analysis.

4.1.2 QA/QC Assessment - Laboratory and EPA Protocol

All of the data developed during the remedial investigation and presented on the various summary tables have been reviewed in accordance with EPA CLP quality assurance protocols. Requirements for the organic and inorganic routine analytical services quality control and the CLP quality assurance guidelines are provided in Appendix B. These guidelines were obtained from EPA's User's Guide to the Contract Laboratory Program (July 1984). All data results and supporting raw data have been reviewed by

TABLE 4-1
SAS PARAMETERS ANALYZED
SUMMIT NATIONAL SITE

	- Media Analyzed In -			
Parameter	Groundwater	Residential Well	Surface Water	Onsite Soils
Nitrate/Nitrite			X	
Ammonia	X		X	
Total Suspended Solids	X		X	
Total Dissolved Solids	X	X	X	
Alkalinity/Acidity	X	X	X	
Chloride	X	X	X	
Sulfate	X		X	
Mirex				X

EPA Region V technical staff. During this review, a number of analytical problems were identified and presented on EPA Organic and Inorganic QA checklists. The majority of the data were found to be usable even with the qualifications noted on the QA review sheets. A list of significant analytical problems is presented in Tables 4-2 and 4-3. Constituent concentrations invalidated by the QA review were omitted from the summary tables.

During the review of the quality control data supplied by the contract laboratories (CLP), several organic compounds were noted to have been detected in low concentrations in some of the laboratory-prepared blank samples and in some of the field-prepared blank samples. As a result, analytical results for environmental samples that also detected these constituents were used with caution. Positive results for these compounds may be due to laboratory glassware or sample container contamination. When contaminants were detected in laboratory blanks, the sample results were reported with an appropriate qualifier indicating the contaminant was found in the blank. The use of these data is therefore limited. Additional discussion of field blanks is presented in Section 4.1.3.

Appendix C contains the required Method Detection Limits (MDL's) for inorganic parameters and Hazardous Substance List (HSL) organic compounds required for the CLP. All of the laboratories used under the CLP program provided proper certification that these limits were met by their analytical instrumentation. However, for individual samples, several factors may cause a reduction in sensitivity that raises the detectable concentration above normal limits. Some of these influences include matrix effects, extraction procedures, moisture content (soils and sediments), and high concentrations of one or more constituents in a sample which dictates that a sample or its extract be diluted prior to analysis. Thus, the limits shown in Appendix C should be considered as the lower limits of detection for the parameters.

4.1.3 In-Field Procotol

In addition to the required CLP quality control procedures and EPA's review, in-field procedures were implemented to provide additional quality control data. These procedures are presented in the RI/FS Phase I and II QA Project Plans dated November 1984 and

TABLE 4-2

SUMMARY OF ANALYTICAL PROBLEMS (ORGANIC DATA)
SUMMIT NATIONAL SITE

Media	Sample Nos.	Problem/Qualifier
Residential Wells	RW001001-RW005001	Chloromethane data invalid due to unacceptable standard (omitted from summary table)
Soil	SS024001-SS036001	Pesticide data questionnable due to meaningless surrogate recoveries
Soil	SL001001-SL009001	BNA and PCB/Pesticide data invalid due to excessive extract holding times (omitted from summary table)

TABLE 4-3
SUMMARY OF ANALYTICAL PROBLEMS (INORGANIC DATA)
SUMMIT NATIONAL SITE

Media	Sample Nos.	Analytical Problems
Groundwater	GW002001-GW017002	Thallium and tin data invalid due to recoveries of 9% and 0%, respectively (omitted from summary table)
		Iron data may lack precision due to Relative Percent Difference (RPD) of 49%
Surface Water	SW001001-SW011001	Silver data biased low due to 0% recovery
		Zinc data may lack precision due to RPD of 24%
		Arsenic data may lack precision in SW003001 and SW007001
Soil	SL019001-SLS022001 and SS024001-SS039001	Antimony data biased low due to 0% recovery
		Lead data may lack precision due to RPD of 53%
Soil	SS040001-SS049001	Antimony data biased low due to 0% recovery
		Cyanide data may lack precision due to RPD of 35%
Soil	SS038001-SS058001	Selenium data invalid (EPA QA review not specific)
Sediment	SD001001-SD003001	Arsenic and selenium data invalid due to 0% recoveries (omitted from summary table)
		Iron data may lack precision due to RPD of 72%
Drum and Tank Waste	DR006001 and TK002001	Cobalt data invalid (omitted from summary table; EPA QA review not specific)
Drum Waste	DR001001-DR003001	Sodium data invalid (omitted from summary table; EPA QA review not specific)
Tank Waste	TK001001	Calcium, nickel, selenium and silver invalid (omitted from summary table; EPA QA review not specific)

October 24, 1986 respectively. The QA Project Plan (QAPP) is required by EPA for all contractors to assure the precision, accuracy, completeness, and representativeness of all generated data that is known and documented. Therefore, the QAPP presents, in specific terms, the policies, organization objectives, functional activities, and specific QA and quality control activities designed to achieve the data quality goals of this report.

In accordance with procedures outlined in the QAPP, duplicate samples and field blanks were obtained for each medium sampled. The actual number of duplicate samples and field blanks varied for each medium and are presented as follows:

Medium	Duplicate Samples	Field Blanks
Surface Water	3	3
Sediment	3	5
Groundwater	4	6
Soil	5	4
Residential Wells	2	2

Field blanks for each medium were obtained and included in the laboratory analyses. The surface water and groundwater field blanks were ultrapure distilled water while field blanks for the sediment and soil consisted of diatomaceous earth. The field blanks were provided to detect any possible introduction of contaminants through sampling or laboratory handling procedures.

Duplicate samples were two distinct samples taken from the same location during a very short period of time using identical equipment that was decontaminated in a similar manner and placed in two identical sets of sample bottles. The purpose of duplicate sampling was to obtain an estimate of variability due to sampling.

Organic compounds and metals were reported in field blanks from all media; but, the total number of compounds detected and the concentrations of these constituents were generally much lower in the field blanks than in the actual samples.

4.2 GEOLOGY

4.2.1 Surficial Geology

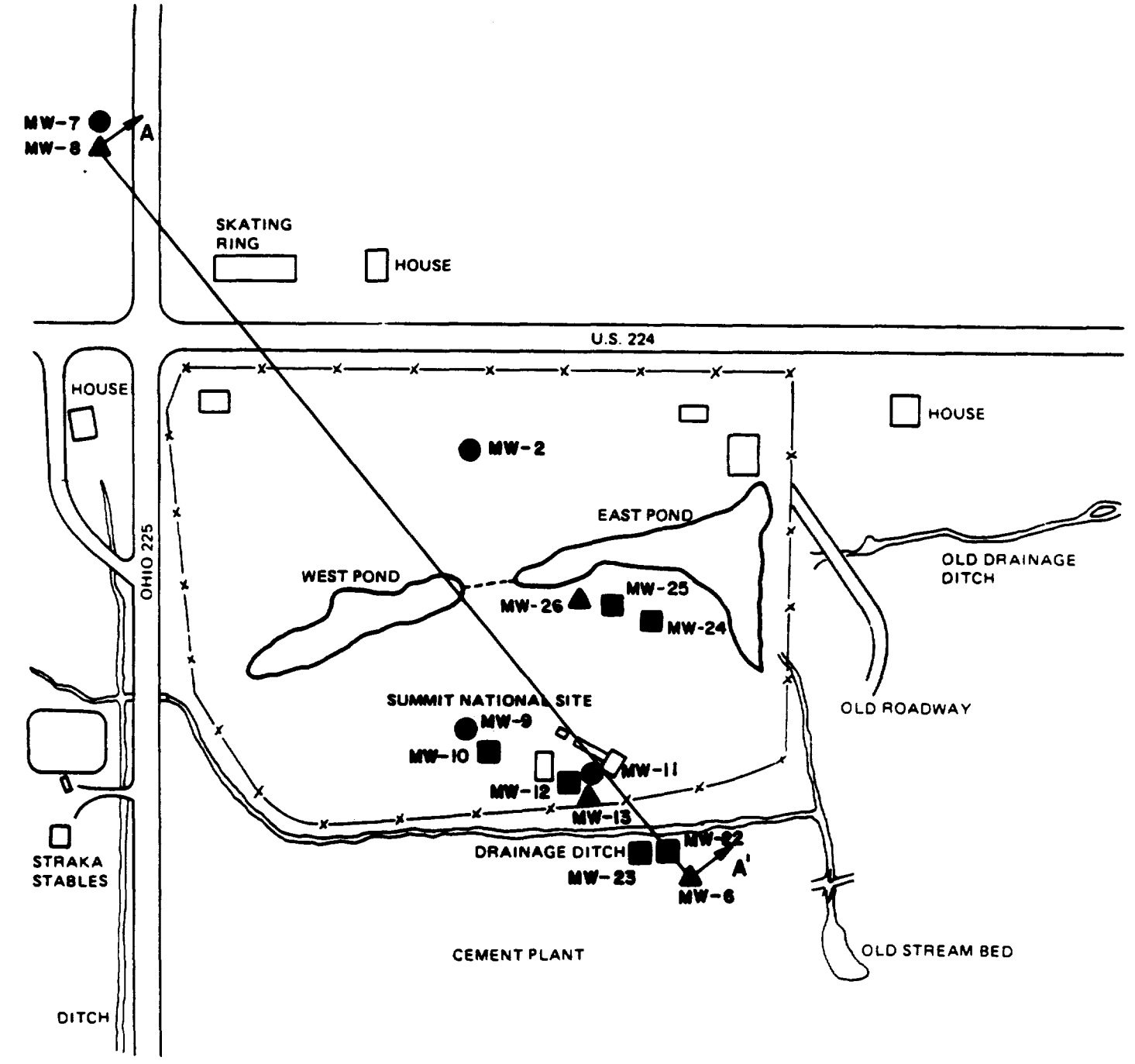
Surficial deposits at the Summit National Site include glacial till, fill and mine spoil. Cross-sections presenting the geologic results of the RI are shown on Figures 4-1b and 4-2b. The locations of each section line are shown on Figures 4-1a and 4-2a, respectively. The till, specifically ground moraine of the Wisconsinan-age Hiram till (Winslow and White, 1966), is a brown-to-ochre mixture of unstratified silt, sand, and clay, with some rock fragments. The grain-size distribution is highly variable. Occasional sand lenses are present in the material. The ground surface north of the site and on the site north of the ponds is developed on till. The unit generally ranges in thickness from ten to twenty feet, where undisturbed.

The fill and mine spoil tend to occur together on site. Mine spoil is the rock and soil refuse generated by strip mining. The fill is comprised of a variety of man-placed materials, apparently including disturbed till, crushed rock, and miscellaneous refuse. These deposits are prevalent on the southern portion of the site and in offsite areas south of the site. Fill and mine spoil are also present as a mantle over the till on the northern portion of the site, apparently placed during grading for initial remediation of the site. The man-placed materials were found to be thickest on the southern portion of the site and immediately south of the site, where they ranged from thirty to forty feet thick.

Residual soils are not present on site because of ground disturbance. Off site, residual soils are absent or poorly developed.

4.2.2 Bedrock Geology

Bedrock beneath the site is the Pennsylvanian-age Pottsville Formation (Figure 4-3), which is comprised of sandstones, shales, siltstones, coals, and limestones. Two members of this formation were encountered during the RI, the upper unit of the Sharon Member and the Mercer Member. Normally, the Connoquenessing Sandstone separates these two units, but it is apparently absent beneath the site (Winslow and White, 1966). Wells MW-8 and MW-14 were geophysically logged, and these logs were used in



LEGEND

- ● MONITORING WELL IN WATER-TABLE AQUIFER
- ■ MONITORING WELL IN INTERMEDIATE ZONE
- ▲ MONITORING WELL IN UPPER SHARON AQUIFER
- A ↑ ↑ A' LINE OF PROFILE

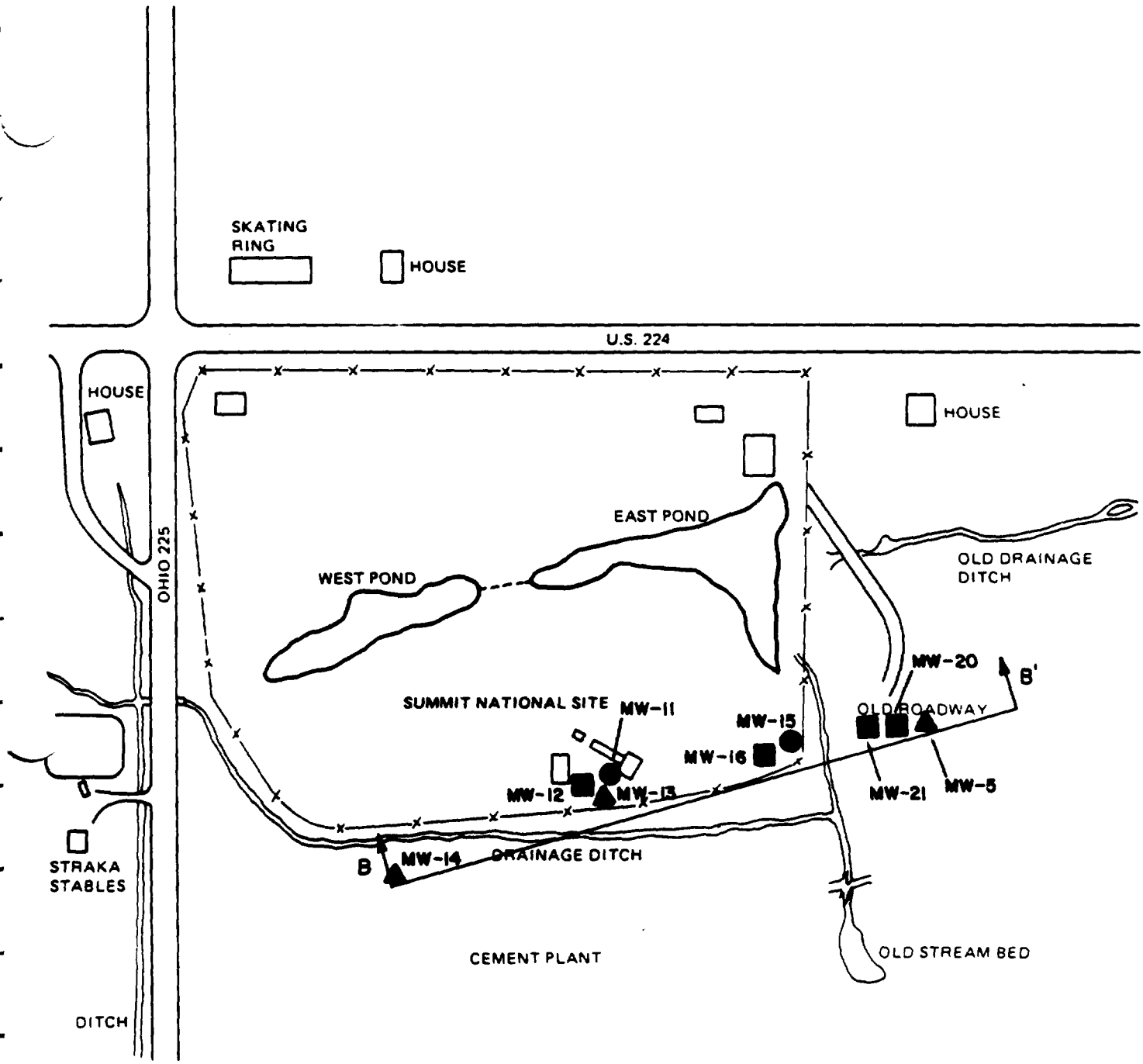
N

0 200
100
SCALE IN FEET

NOTE: All locations of structures and physical features are approximate.

SOURCE: Modified from USEPA.

FIGURE 4-1a
SECTION LINE A-A'
SUMMIT NATIONAL RI



LEGEND

- ● MONITORING WELL IN WATER-TABLE AQUIFER
- ■ MONITORING WELL IN INTERMEDIATE ZONE
- ▲ MONITORING WELL IN UPPER SHARON AQUIFER
- B ↑——↑ B' LINE OF PROFILE

N

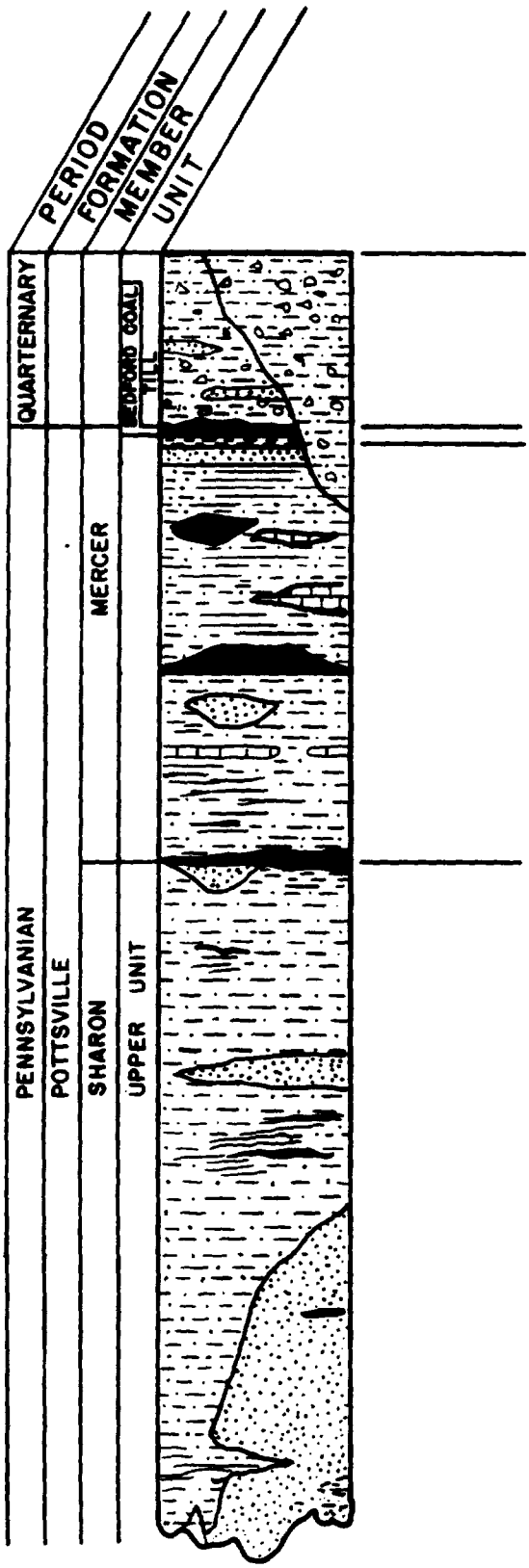
0 100 200

SCALE IN FEET

NOTE: All locations of structures and physical features are approximate.

SOURCE: Modified from USEPA.

FIGURE 4-2a
SECTION LINE B-B'
SUMMIT NATIONAL RI



GLACIAL TILL : SILT WITH SAND, GRAVEL AND ROCK FRAGMENTS, OCCASSIONAL SANDY LENSES (0 - 20 FT.)

MINE SPOIL AND FILL (0 - 35 FT.)

MERCER MEMBER : SILTSTONE AND SHALE WITH BEDS OF COAL, CLAYSTONE AND SANDSTONE ; LENSES OF LIMESTONE AND COAL (15 - 35 FT.)

SHARON MEMBER: SILTSTONE WITH LENSES OF SILTY SANDSTONE, COAL AND OCCASSIONAL LIMESTONE, SHALEY IN PLACES (100 + FT)

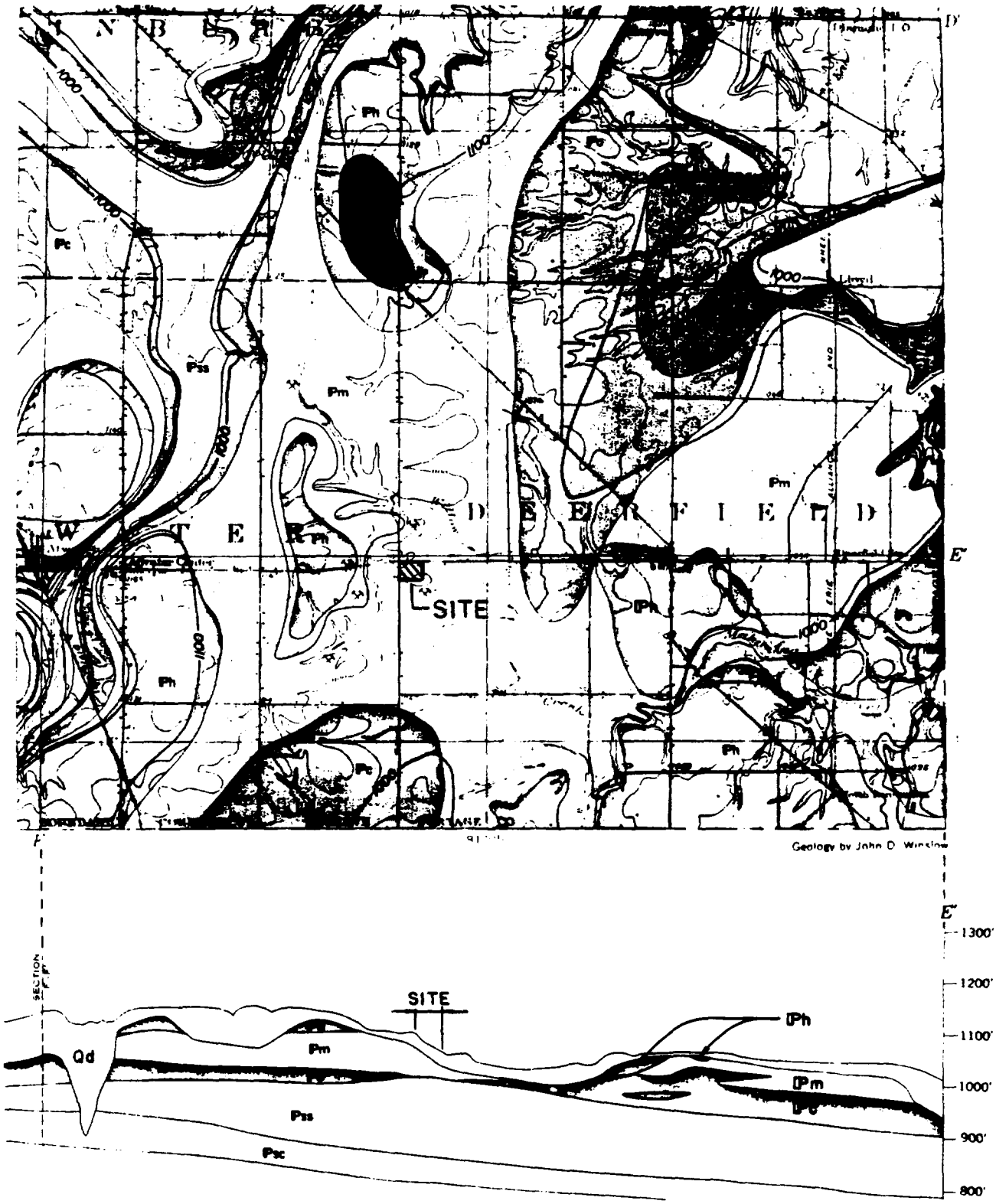
FIGURE 4 - 3
GENERALIZED STRATIGRAPHIC COLUMN
SUMMIT NATIONAL RI

stratigraphic interpretations. Also, lithologic logs for some of the borings were developed from drill cuttings; inherent inaccuracies of this method of logging have been considered in construction of the sections.

The Sharon Member was the deepest unit studied during the RI. The Sharon Member consists of a lower conglomeratic unit and an upper fine-grained ("shale") unit. The lower unit of the Sharon Member was not studied during this investigation. Beneath the site, the "shale" unit of the Sharon Member was found to be a series of siltstones, silty sandstones, and sandstones, with some shale, coal, and limestone (Figures 4-1b and 4-2b). The shales and limestone are apparently discontinuous; the coals vary in lateral extent. The term "coal", as used for purposes of this report, refers to various carbonaceous materials, including bituminous coal, carbonaceous shale, and true black shale. Individual carbonaceous strata tend to grade between these rock types; they have been grouped together as "coals" to simplify terminology. Only one distinctive marker bed was encountered, an interlaminated-to-interbedded siltstone and sandstone unit at an elevation of approximately 990 feet msl. Based upon the stratigraphic correlations of Winslow and White (1966), the top of the Sharon Member is defined at the base of Unnamed Coal #3.

Where present, the Connoquenessing Sandstone consists of a massive, coarse- to medium-grained, light-colored sandstone. Regionally, this unit can be up to 140 feet thick (Sedam, 1973), and may have a central shaley unit. This unit occurs throughout most of the area, and probably exists in the area immediately surrounding the site (Winslow and White, 1977; Pinzon, 1986). However, the Connoquenessing Sandstone pinches out beneath the site (Figure 4-4, Regional Geologic Cross Section).

Beneath the site, the Sharon Member is unconformably overlain by the Mercer Member, which consists primarily of silty to carbonaceous shales with coals, underclays, limestones, and sandstones. As in the underlying strata, the carbonaceous strata tend to grade laterally between coal, carbonaceous shale, and black shale. The base of this member is defined as the Lower Mercer "Coal", which is believed to correlate with the unit designated as Unnamed Coal #3 for purposes of this investigation. Three other carbonaceous units were



LEGEND

MILES

Qd QUATERNARY, UNDIFFERENTIATED

Ph HOMEWOOD MEMBER

Pm MERCER MEMBER

Pc CONNOQUENESSING SANDSTONE

Pss SHARON MEMBER, SHALE

Psc SHARON MEMBER, CONGLOMERATE

SOURCE: WINSLOW AND WHITE, 1962

FIGURE 4-4
REGIONAL GEOLOGIC
CROSS SECTION
SUMMIT NATIONAL RI

found to be relatively continuous, and are designated as "Unnamed Coal #1," "Unnamed Coal #1a," and "Unnamed Coal #2". A relatively continuous limestone was encountered at the elevation of 1040 ft. msl; this unit may correspond to the Lower Mercer Limestone discussed in regional geologic reports. The bedrock surface is often developed on the Bedford Coal.

True dip of the strata is difficult to determine because of sedimentary structures. Orientation of the strata appears to vary with depth.

It was not possible to determine the fracture density beneath the site from rock cores because the air coring method used caused excessive breakage of the rock samples. Regional literature indicate that the major joint orientations in the area are N 40° W and N 35-40° E (Carswell and Bennett, 1963; Poth, 1963).

4.3 HYDROGEOLOGY

Regional Hydrogeology: Two regional water-supply aquifers are present in the vicinity of the Summit National site - the Connoquenessing Sandstone and the lower conglomeratic unit of the Sharon Member (Sedam, 1973). Units below the Sharon tend to yield saline water (Sedam and Stein, 1970). The upper unit of the Sharon Member and the Mercer Member are less permeable, and regionally function as confining units.

The conglomerate of the Sharon Member is poorly cemented and is therefore dominated by primary permeability (Winslow and White, 1966). Well yields of up to 200 gpm may be achieved. This unit is not often exploited in the vicinity of the site because sufficient yield can generally be obtained from shallower strata. The lower Sharon occurs below the depth of investigation for this study.

The Connoquenessing, because of its shallower depth, is more heavily exploited than the Sharon, particularly for private wells. This unit is more heavily cemented than the Sharon conglomerate (Winslow and White, 1966). The cementation varies laterally, and this unit probably transmits water by a combination of primary and secondary permeability (Carswell and Bennett, 1963). Well yields from this aquifer are generally less than 50 gpm. Winslow and White (1966) report a specific capacity of 0.05 gpm/ft for a Connoquenessing well located 500 ft northeast of the site. As

discussed earlier, this unit is absent beneath the site proper, but apparently occurs in the area immediately around the site.

The less-permeable units - the Sharon shale and the Mercer Member - probably transmit water by a combination of primary and secondary permeability (Carswell and Bennett, 1963). Although these units function regionally as aquitards, they do yield sufficient water for completion of domestic wells, and more conductive strata and zones do occur within them.

Site Hydrogeology: The strata evaluated beneath the Summit National site can be divided into three groups for purposes of this discussion: the water-table aquifer, a group of "intermediate units", and an Upper Sharon "aquifer." The water-table aquifer occurs in the fill, till, mine spoil, and shallow bedrock, apparently extending to the base of Unnamed Coal #1 (Figures 4-1b and 4-2b).

The intermediate units are the predominately fine-grained strata between the base of the water-table aquifer and the top of the marker bed. The intermediate units correspond to the Mercer Member and the uppermost beds of the Sharon Member. They include a wide range of materials, and flow directions and quantities are variable from stratum to stratum.

The Upper Sharon "aquifer" is defined as the strata between the marker bed and the depth of investigation. This zone is also heterogeneous, but is generally more coarse-grained than the intermediate units. The strata correspond to part of the shale unit of the Sharon Member.

Water Supply: The site is in a mixed rural and industrial area, and wells are commonly used for water supply for both domestic and industrial purposes. Water-well records obtained from Ohio EPA (via Pinzon, 1986) indicate the existence of over 50 private wells within two miles of the Summit National site. Drillers' logs are available for 36 of these wells. As discussed earlier, regional literature indicates that the major aquifers in the area are the Connoquenessing Sandstone and the lower conglomerate of the Sharon Member. However, the available well logs indicate that many domestic wells are completed in units not considered to be regional aquifers, including the Mercer member and the upper unit of the Sharon Member.

Comparison of the drillers' logs with aquifer maps prepared by Sedam (1973) indicates that, of 36 logged wells within two miles of the site, 10 draw all or part of their water from the Connoquenessing Sandstone, 3 draw from the lower unit of the Sharon Member, and 23 draw water from units not identified as regional aquifers. Of the 23, 20 tap the Mercer Member and three draw from the shale of the Sharon Member.

4.3.1 Hydraulic Conductivities

Hydraulic conductivity values from falling-head tests are summarized in Table 4-4 and indicated on Figures 4-1b and 4-2b. Values obtained from questionable tests have been omitted. Values ranged from 6×10^{-7} to 3×10^{-3} cm/sec, with most values being of the order of magnitude 10^{-5} cm/sec.

Values for the water-table aquifer, which includes fill, till, and bedrock through the base of Unnamed Coal #1, ranged from 1×10^{-5} cm/sec to 3×10^{-3} cm/sec. There was no clear separation in hydraulic conductivity between the various materials. The logarithmic average of the values for unconsolidated materials is 4×10^{-4} cm/sec. Of the two values available for bedrock (MW-2 and MW-4) in the water-table aquifer, one, 1×10^{-4} cm/sec, falls within the range of values for the unconsolidated materials. The other value, 1×10^{-5} cm/sec. at MW-2, is below the range for unconsolidated materials, but not far below.

Hydraulic-conductivity estimates for the intermediate units do not vary as greatly as would be expected given the variable lithology. The two wells open to the Unnamed Limestone, MW-21 and MW-25, exhibited such poor recovery rates during testing that the results were not considered reliable. This seems to indicate that the Unnamed Limestone is not highly transmissive. The two valid tests which included some thickness of sandstone, those for MW-12 and MW-22, resulted in low hydraulic-conductivity estimates - 6×10^{-6} cm/sec and 3×10^{-6} cm/sec, respectively. MW-10, MW-16, and MW-24 monitor true coal seams; hydraulic-conductivity estimates for these wells are 2×10^{-5} cm/sec, 6×10^{-7} cm/sec, and 6×10^{-5} cm/sec, respectively.

TABLE 4-4

SUMMARY OF HYDRAULIC-CONDUCTIVITY ESTIMATES
SUMMIT NATIONAL SITE

ZONE DESIGNATION	WELL #	HYDRAULIC CONDUCTIVITY	LITHOLOGIES MONITORED
Bedford Coal	MW- 4	1E-4	shale, coal
Fill	MW- 3	3E-3	fill, siltstone
	MW- 9	2E-4	fill, weathered carbonaceous shale
	MW-15	1E-4	fill, till
Till	MW- 7	2E-3	till, coal, carbonaceous shale
	MW-17	6E-5	clay, weathered silty shale
	MW-19	6E-4	till
Unnamed Coal #1	MW- 2	1E-5	carbonaceous shale, coal, siltstone, underclay
Unnamed Coal #1a	MW-10	2E-5	poor recovery, but some coal apparent
	MW-16	6E-7	siltstone, coal
Unnamed Coal #2	MW-22	3E-6	siltstone, mudstone, carbonaceous shale, sandstone
Unnamed Coal #3	MW-12	6E-6	siltstone, silty sandstone
	MW-20	9E-6	siltstone, black to carbonaceous shale
	MW-23	1E-5	Siltstone, carbonaceous shale
	MW-24	6E-5	siltstone, coal, carbonaceous shale, silty shale
Upper Sharon	MW- 5	3E-4	siltstone, sandstone
	MW- 8	1E-5	siltstone, sandy siltstone
	MW-14	5E-5	siltstone, black shale, silty sandstone, sandy siltstone, sandstone
	MW-26	2E-4	sandstone, silty shale, sandy siltstone, silty sandstone

NOTE: All values are cm/sec.
Fill includes mine spoil

Wells MW-20 and MW-23 did not intercept any materials which would be expected to be highly permeable; these wells had estimated hydraulic conductivities of 9 x 10^{-6} cm/sec and 1 x 10^{-5} cm/sec, respectively. In summary, the distribution of hydraulic conductivity according to apparent water-yielding lithology is:

Rock Type	Observed Range of Hydraulic Conductivity
Sandstone	3 x 10^{-6} to 6 x 10^{-6} cm/sec.
True Coal	6 x 10^{-7} to 6 x 10^{-5}
Siltstone and Shale	9 x 10^{-6} to 1 x 10^{-5}

Falling-head tests are generally considered to be order-of-magnitude estimates only, and most of the hydraulic-conductivity results for the intermediate units fall within one order of magnitude (6 x 10^{-6} to 6 x 10^{-5} cm/sec). Only two values fall outside of this range - MW-16 (6 x 10^{-7} cm/sec.) and MW-22 (3 x 10^{-6} cm/sec). Within the accuracy of the method, there is little variation in hydraulic conductivity.

Hydraulic conductivity estimates for the Upper Sharon aquifer ranged from 1 x 10^{-5} cm/sec for MW-8 to 3 x 10^{-4} cm/sec at MW-5. MW-8 does not intercept any sandstones, and would therefore be expected to have a low hydraulic conductivity. All other hydraulic conductivity values for this zone represent at least some sandstone. The strata of the Upper Sharon aquifer are, on the average, more conducive than the intermediate units, although there is some overlap of individual values.

4.3.2 Groundwater Flow

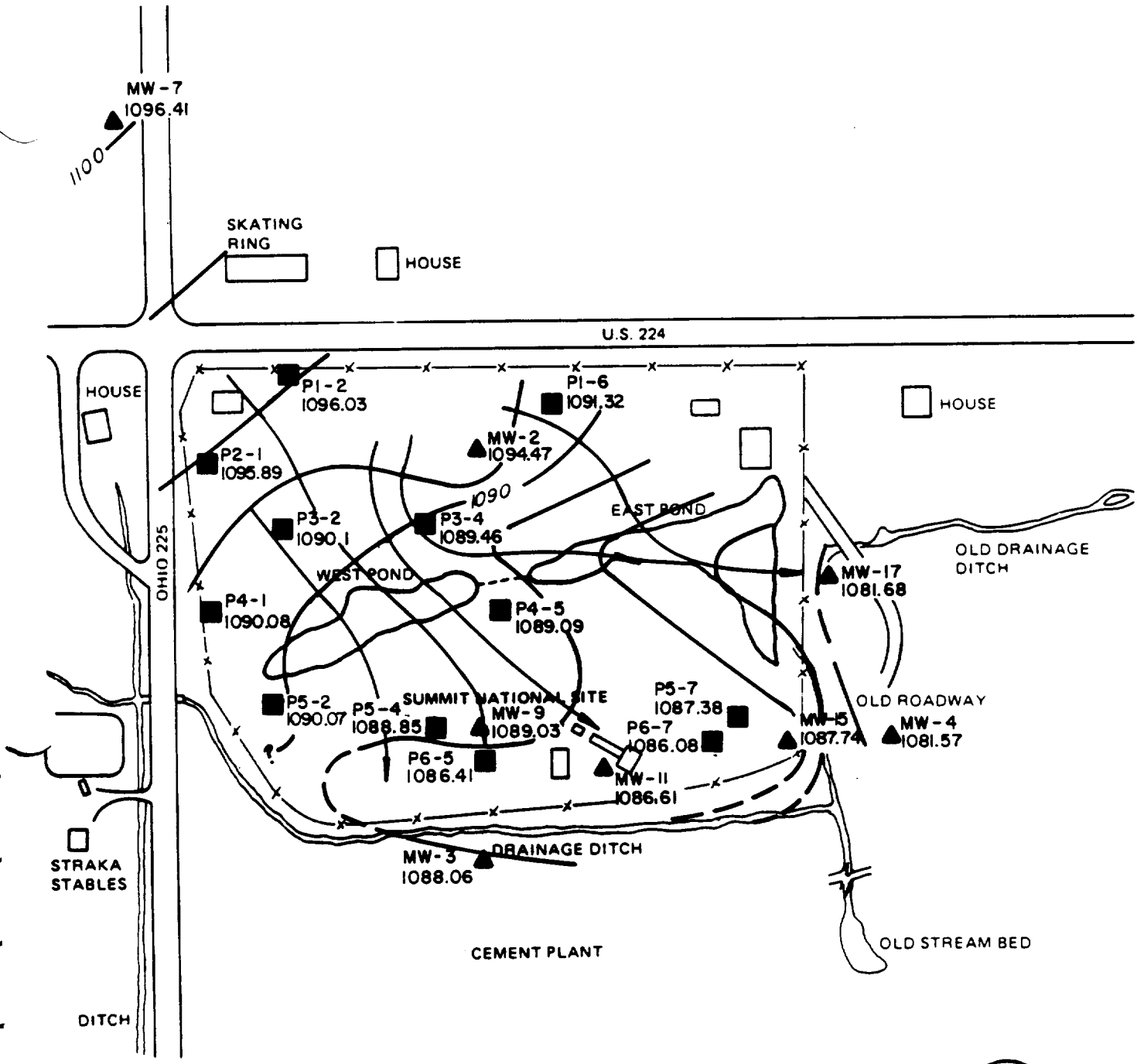
Water levels in the monitoring wells were measured several times, and these measurements are reported in Table 4-5. Unless otherwise stated, calculations discussed herein are for the September 1986 data.

Groundwater in the water-table aquifer beneath the site flows southward and eastward (Figures 4-5 and 4-6), and the direction of flow does not vary much on a seasonal basis, although the eastward component is apparently more important during periods of higher water table. The water table is generally five to 12 feet below grade. Flow from the site in these materials for the September 1986 data set is estimated to be between 2,000 gpd and 68,000 gpd based upon the minimum and maximum calculated hydraulic conductivities. The

TABLE 4-5
SUMMIT NATIONAL SITE
WATER LEVEL SUMMARY (ALL DATA IN FEET)

WELL/PIEZOMETER NUMBER	PVC ELEVATION	CASING ELEVATION	DECEMBER, 1985 WATER LEVEL (1) DEPTH	DECEMBER, 1985 WATER LEVEL (1) ELEVATION	JANUARY, 1986 WATER LEVEL (2) DEPTH	JANUARY, 1986 WATER LEVEL (2) ELEVATION	JUNE, 1986 WATER LEVEL (3) DEPTH	JUNE, 1986 WATER LEVEL (3) ELEVATION	SEPTEMBER, 1986 ELEVATION (4)	SEPTEMBER, 1986 WATER LEVEL (2) DEPTH	SEPTEMBER, 1986 WATER LEVEL (2) ELEVATION
MW-2	1100.92	1101.06	7.87	1093.19	7.2	1093.86	6.45	1094.47	1101.02	8.05	1092.97
MW-3	1099.61	1099.61	12.09	1087.52	12.4	1087.21	11.55	1088.06	1099.52	14.2	1085.32
MW-4	1088.87	1089.02	8.06	1080.96	8.9	1080.12	7.3	1081.57	1089.12	9.39	1079.73
MW-5	1087.48	1087.58	20.34	1067.24	20.7	1066.88	20.35	1067.13	1087.78	21.3	1066.48
MW-6	1101.71	1101.81	30.25	1071.56	37.6	1064.21	36.85	1064.86	1101.7	35.7	1066
MW-7	1106.66	1106.86	7.58	1099.28	7.25	1099.61	6.25	1100.41	1106.74	8.55	1098.19
MW-8	1106.56	1106.74	32.32*	1074.24	32.95	1073.79	31.95	1074.61	1106.62	33	1073.62
MW-9	1097.03	1097.28	9.36*	1087.67	9.5	1087.78	8	1089.03	1097.31	10.2	1087.11
MW-10	1095.4	1097.07	23.78	1073.29	9.3	1087.77	6.65	1088.75	1097.13	10.2	1086.93
MW-11	1095.81	1096.16	9.87	1086.29	10.4	1085.76	9.2	1086.61	1096.14	14.2	1081.94
MW-12	1096.49	1096.77	68.75	1028.02	31.3	1065.47	26.5	1069.99	1096.73	32.85	1063.88
MW-13	1096.2	1096.43	29.79	1066.64	26.9	1069.53	26.75	1069.45	1096.41	28.6	1067.81
MW-14	1098.84	1099.34	42.19	1057.15	34.9	1064.44	33.55	1065.29	1099.27	32.25	1067.02
MW-15	1097.69	1098.04	11.73	1086.31	11.6	1086.44	9.95	1087.74	1098	13.2	1084.8
MW-16	1097.78	1097.12	32.92	1064.2	28.3	1068.82	25.75	1072.03	1097.95	29.6	1068.35
MW-17	1083.83	1084.25	1.81	1082.44	NA	NA	2.15	1081.68	1084.4	3.4	1081
MW-18	NA	NA	--	--	--	--	--	--	1098.7	30.56	1068.14
MW-19	NA	NA	--	--	--	--	--	--	1099.21	37.2	1062.01
MW-20	1089.54	1089.55	--	--	21.55	1068	20	1069.54	1089.75	23.2	1066.55
MW-21	NA	NA	--	--	--	--	--	--	1089.51	40.1	1049.41
MW-22	1102	1102.4	--	--	32.65	1069.75	28.75	1073.25	1102.28	37.4	1064.88
MW-23	NA	NA	--	--	--	--	--	--	1101.13	36.05	1065.08
MW-24	NA	NA	--	--	--	--	--	--	1096.38	31.7	1064.68
MW-25	NA	NA	--	--	--	--	--	--	1095.87	19.8	1076.07
MW-26	1096.53	1096.72	--	--	36.5	1060.22	32.85	1063.68	1096.74	33.6	1063.14
2BB5	NA	NA	--	--	--	--	--	--	1093.91	6.61	1087.3
2BB6	NA	NA	--	--	--	--	--	--	1095.06	7.3	1087.76
2BB7	NA	NA	--	--	--	--	--	--	1095.62	9.8	1085.82
2BB8	NA	NA	--	--	--	--	--	--	1093.23	7.2	1086.03
TIPPLE	NA	NA	NA	NA	NA	NA	NA	NA	1101.44	11.3	1090.14
P1-2	1102.78	NA	--	--	7.4	1095.38	6.75	1096.03	1102.78	8.2	1094.58
P1-6	1096.87	NA	--	--	10.6	1086.27	5.55	1091.32	1096.82	7.42	1089.4
P2-1	1101.14	NA	--	--	6.3	1094.84	5.25	1095.89	1101.26	7.48	1093.78
P3-2	1101.85	NA	--	--	12.6	1089.25	11.75	1090.1	1101.89	13.78	1088.11
P3-4	1098.16	NA	--	--	10.1	1088.06	8.7	1089.46	1098.11	10.54	1087.57
P4-1	1098.01	NA	--	--	8.9	1089.11	8	1090.01	1098.03	9.87	1088.16
P4-5	1096.79	NA	--	--	8.9	1087.89	7.7	1089.09	1095.7	8.21	1087.49
P5-2	1096.2	NA	--	--	7.6	1088.6	5.5	1090.7	1096.18	8.6	1087.58
P5-4	1094.5	NA	--	--	6.5	1088	5.65	1088.85	1094.49	7.73	1086.76
P5-7	1094.88	NA	--	--	8.1	1086.78	7.5	1087.38	1094.91	9.34	1085.57
P6-5	1094.66	NA	--	--	8	1086.66	8.25	1086.41	1094.57	12.22	1082.35
P6-7	1097.28	NA	--	--	11.8	1085.48	11.2	1086.08	1097.3	14.64	1082.66

NOTES: (1) DEPTHS ARE FROM TOP OF CASING, EXCEPT WHERE NOTED BY *(TOP OF PVC)
(2) DEPTHS ARE FROM TOP OF CASING FOR WELLS AND TOP OF PVC FOR PIEZOMETERS
(3) ALL DEPTHS ARE FROM TOP OF PVC
-- WELL/PIEZOMETER NOT INSTALLED ON THAT DATE
(4) CASING ELEVATION USED FOR WELLS AND PVC ELEVATION FOR PIEZOMETERS
NA-NOT AVAILABLE



LEGEND:

▲ MONITORING WELL

■ PIEZOMETER

1090.08 HYDRAULIC HEAD, (FT.)

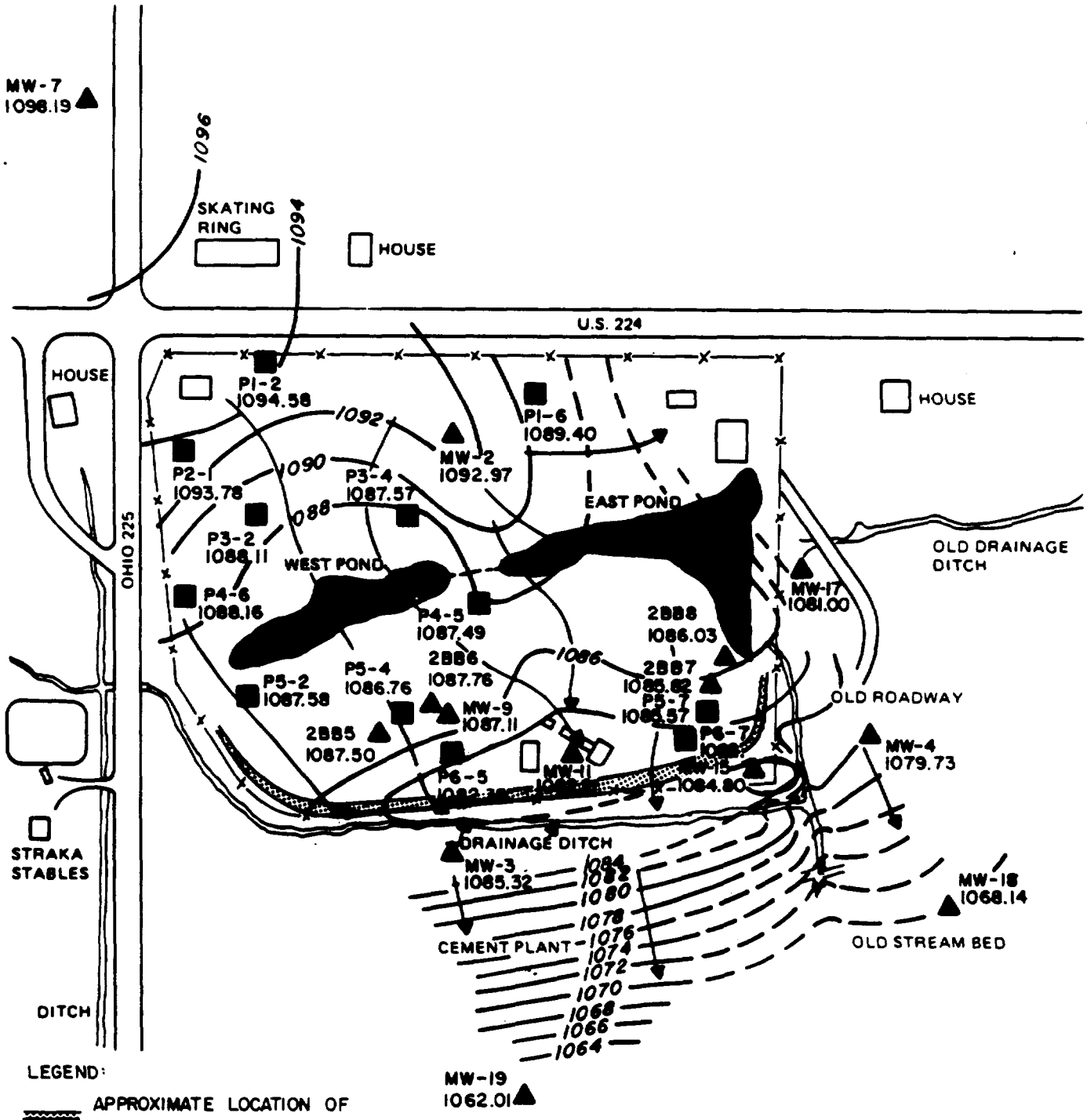
WATER-TABLE CONTOUR LINE, DASHED WHERE TENTATIVE (CONTOUR INTERVAL = 2FT.)

FLOW LINE

NOTE: All locations of structures and physical features are approximate.

SOURCE: Modified from USEPA.

FIGURE 4-5
WATER-TABLE CONTOUR MAP FOR JUNE 1986
SUMMIT NATIONAL RI



NOTE: All locations of structures and physical features approximate.

SOURCE: Modified from USEPA.

FIGURE 4-6
WATER-TABLE MAP
FOR SEPTEMBER 1986
SUMMIT NATIONAL RI

average darcian flow velocity in the water-table aquifer is estimated as between 0.02 and 0.7 ft/day. The onsite ponds are similar in elevation to the water table, indicating that they may be hydraulically connected to that aquifer.

When the water table is high (above 1085 ft msl at the extreme downgradient portions of the site), some groundwater may discharge to the drainage ditches on the southern and eastern perimeter of the site. The onsite ponds and the marshy area east of the site may also act as partial groundwater sinks.

A french drain (shown on Figure 4-6) was installed during initial remedial measures and, although construction reports are not available, field observations and design drawings indicates that the drain penetrates to a depth of 15 to 20 feet below grade. Crushed limestone was observed during the drilling of MW-13 to an elevation of approximately 1079 feet, and was also encountered in test pits. This drain may act as a partial groundwater sink even when the water table is low.

Although the discharge area of the drain is not documented, it would have to be at an elevation lower than the water table for the drain to actually function. Elevations consistently below the water table occur only at the southeastern site perimeter.

In summary, the water-table aquifer may discharge to the onsite ponds, the french drain, and the marshy area adjacent to the site. During periods of high groundwater levels, the drainage ditches along the site perimeter also act as discharge areas. All of these features, however, are relatively shallow, and groundwater can pass beneath them at depth. Using 1070 as the minimum elevation for the water table to contact with and discharge to the surface, the closest distance would be 1500 feet east, 2000 feet southeast, or 1000 feet northeast. There is no indication of water table/surface interconnection at these points. The closest surface water contact discharge point is the Berlin Reservoir located at 3800 feet southeast and at an elevation of 1032.

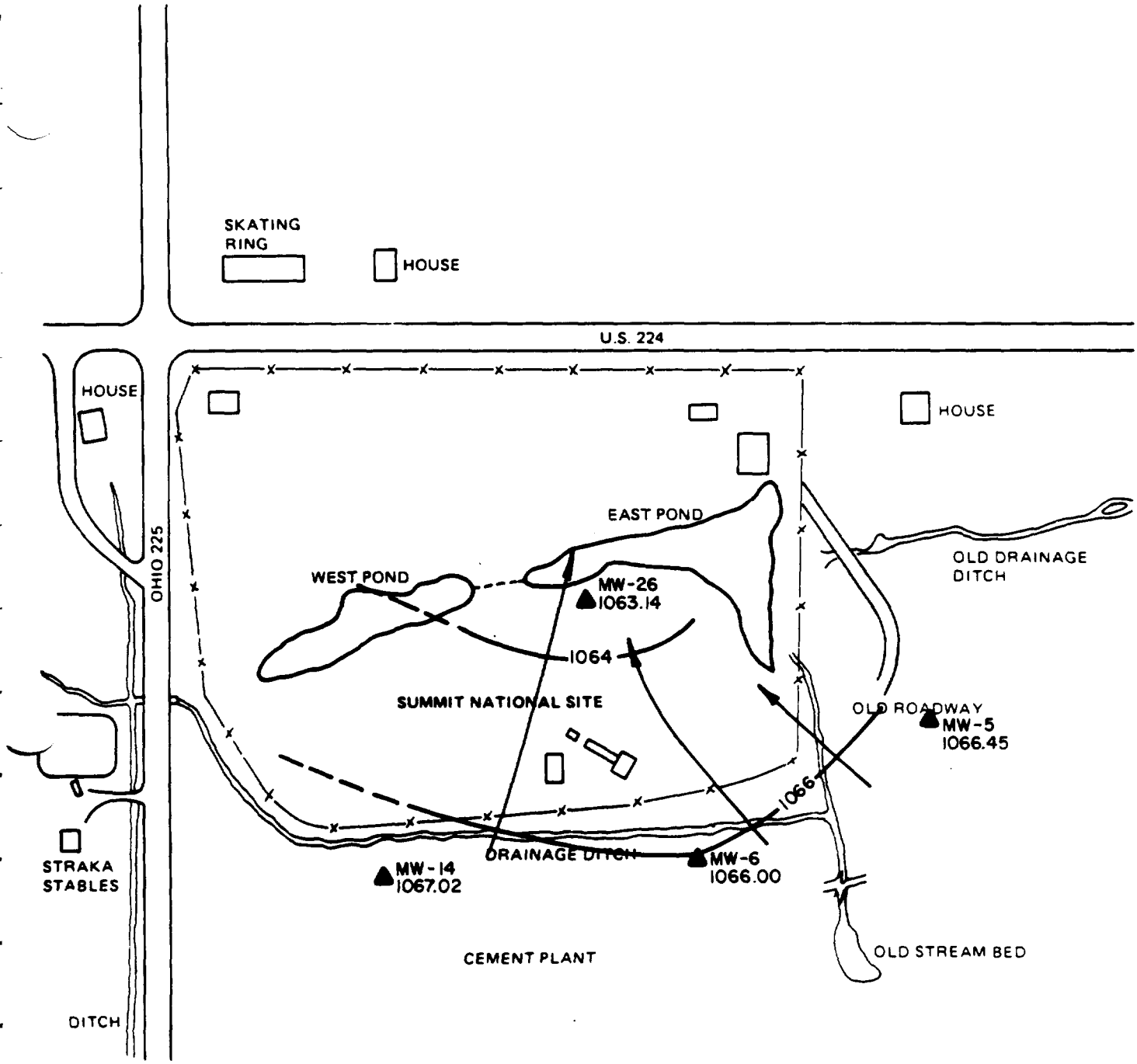
The wells in the intermediate units are completed in a variety of strata, and cannot be used together to construct a piezometric-surface map for the zone as a whole. However, separation of intermediate wells above

and below the Unnamed Limestone seems to indicate that lateral flow is southeastward in the upper portion of the zone and westward in the lower portion of the unit (Appendix E). Extrapolating of these gradients across the contaminated area and weighting the hydraulic conductivities for the rock types (Appendix E), flow beneath the site in the strata between the base of Unnamed Coal #1a and the Unnamed Limestone is estimated to be between 75 and 100 gpd, at an average flow velocity between 9×10^{-4} and 9×10^{-2} ft/day. Flow in this zone beneath the base of the Unnamed Limestone is estimated to be between 15 and 30 gpd, at an average linear flow velocity between 2×10^{-4} and 2×10^{-2} ft/day. Both velocity estimates are based upon an assumed effective porosity of 10%. Cross-sectional areas were calculated from the width of the southern half of the site perpendicular to flow. For strata above the Unnamed Limestone, width of flow is 380 ft. For strata below that unit, the width is 340 ft. Thicknesses of various strata were considered by computing a transmissivity weighted for the various rock types. Although these directions and quantities may not be entirely accurate, the magnitudes of flow and velocity indicate that lateral flow within this zone is of minor importance.

Groundwater in the Upper Sharon aquifer flows northward (Figure 4-7). The absolute flow quantity in this zone cannot be calculated because the total thickness is not known, but flow in the approximately 45 feet penetrated is estimated as between 250 and 1,500 gpd, based on the minimum and maximum hydraulic conductivity estimates for Upper Sharon wells penetrating sandstone. The average flow velocity is estimated at 0.01 to 0.06 ft/day, assuming an effective porosity of 10% for the strata involved.

Vertical gradients within bedrock vary across the study area. The gradient between the water-table aquifer and all deeper strata is downward at all locations. In bedrock, vertical components are upward at the southern portion of the study area and downward in the central portion (Figure 4-8).

Using the vertical gradients for onsite nests 5 and 7, which both include wells completed in the shallowest portion of the intermediate units, using an area of 245,000 ft^2 for the area of waste disposal, and assuming the vertical and horizontal hydraulic conductivities are equal, the quantity of downward flow



LEGEND:

▲ MONITORING WELL

1066.45 HYDRAULIC HEAD (FT.)

EQUIPOTENTIAL LINE, DASHED WHERE TENTATIVE (CONTOUR INTERVAL = 2 FT.)

FLOW LINE

N

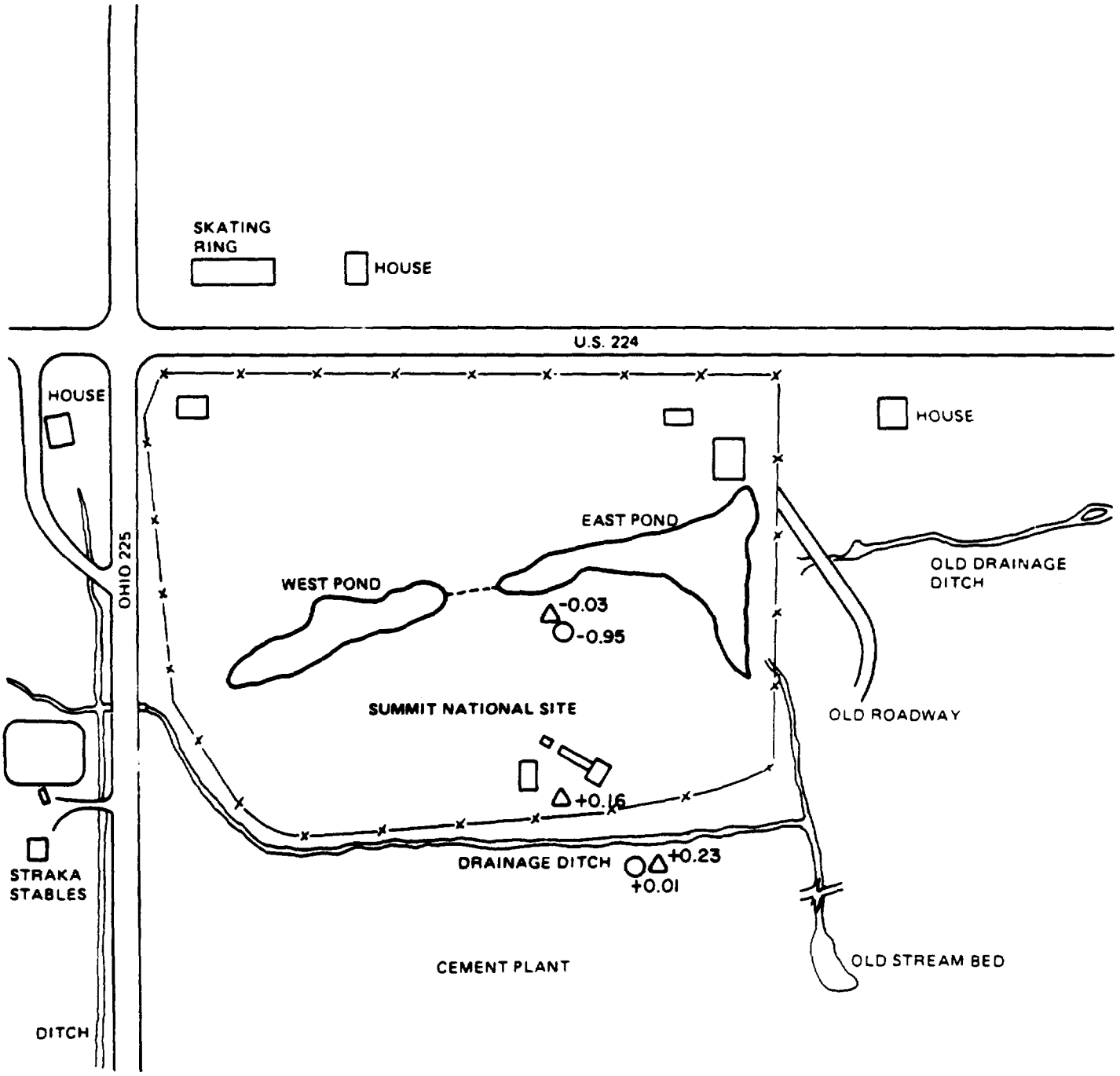
0 100 200

SCALE IN FEET

NOTE. All locations of structures and physical features approximate.

SOURCE. Modified from USEPA.

FIGURE 4 - 7
PIEZOMETRIC SURFACE ON THE UPPER SHARON AQUIFER
SUMMIT NATIONAL RI



LEGEND

○ GRADIENTS IN INTERMEDIATE UNITS

△ GRADIENTS BETWEEN INTERMEDIATE UNITS AND UPPER SHARON AQUIFER

\+ VALUES ARE UPWARD

\- VALUES ARE DOWNWARD

NOTE All locatio... of structures and physical features approximate.

SOURCE Modified from USEPA.

FIGURE 4-8
VERTICAL GRADIENTS IN BEDROCK LIMITS
SUMMIT NATIONAL RI

from the contaminated portion of the water-table aquifer is estimated at 1,600 to 1,800 gpd. Based upon an average ratio of horizontal to vertical hydraulic conductivity of 1.5 (Freeze and Cherry, 1979), it is probable that the actual flow quantities are more likely to be in the 1,100 to 1,200 gpd range, at a rate of 0.01 ft/day. Given this range and the estimated lateral flow of 2,000 to 68,000 gpd, the total flow in the water-table aquifer beneath the site is calculated at 3,100 to 69,200 gpd, of which 65 to 98% is lateral within the aquifer. The remaining 2 to 35% moves downward into bedrock, and could potentially carry contaminants to deeper aquifers.

The area of downward gradient in bedrock is important because it occurs beneath the area of waste disposal (the southern half of the site). Downward flow in this area could transport contaminants from the water-table aquifer to the Upper Sharon aquifer. The quantity of downward flow is estimated at 9,400 to 31,000 gpd, assuming a ratio of horizontal to vertical hydraulic conductivity of 1.5. These values are much higher than the estimated flows downward from the water-table aquifer. It appears that the ratio of vertical to horizontal hydraulic conductivity may decrease with depth, causing the calculated values to be greater than the actual values. Using a horizontal to vertical ratio of 10 (which is common for sedimentary units - Freeze and Cherry, 1979) results in a flow estimate of 1,400 to 4,700 gpd, a range of values more amenable with calculations discussed earlier. Regardless of the ratio used, the values do, however, indicate that vertical flow in the intermediate units is much more important than lateral flow. Assuming a porosity of 10%, the flow velocity in this zone is estimated at 0.05 to 0.2 ft/day (based upon the horizontal to vertical hydraulic conductivity ratio of 1.5).

Although the abandoned production well is apparently completed in the intermediate units or deeper, the head in this well (Table 4-5) is very similar to the water-table elevation. This indicates that the casing in the well is not properly sealed, allowing communication between the well and the water-table aquifer. During investigations, it was determined that this well casing was not grouted in place, so groundwater can move easily along the casing.

In summary, groundwater flow beneath the site varies laterally and vertically. In the water-table aquifer, groundwater moves southward and eastward, with some (probably small) components moving downward.

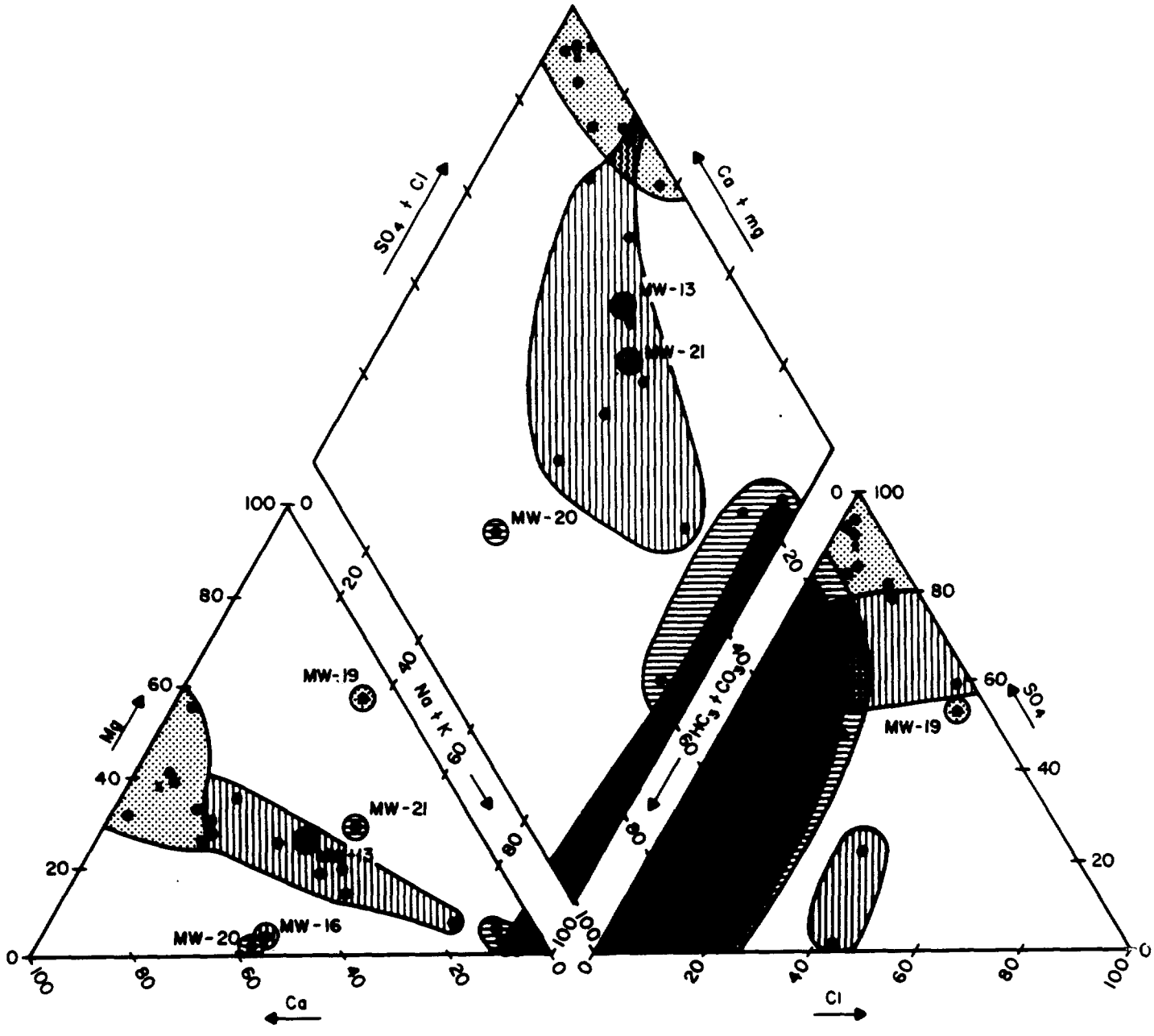
In bedrock, groundwater moves upward in the area immediately south of the site, then downward in the central portion of the site. At a depth corresponding to the Upper Sharon aquifer, groundwater begins to move laterally northward.

4.3.3 Groundwater Chemistry

Regional Geochemistry: Native groundwater in the water-table aquifer in the Deerfield area is calcium-magnesium-sulfate type which has high concentrations of total dissolved solids. Groundwater in the deeper units studied ranges from a sodium-bicarbonate type to a sodium-sulfate type. Approximately seven miles southeast of the site, the lower conglomerate of the Sharon Member contains naturally saline waters (Sedam and Stein, 1970), and the high sodium contents of the Upper Sharon waters may be a manifestation of the saline waters. These waters tend to be somewhat lower in total dissolved solids than waters of the water-table aquifer.

Local land use has probably had an impact on groundwater quality, particularly in the water-table aquifer in the Deerfield area. Extensive strip mining in the Deerfield area results in locally high concentrations of sulfate, iron, manganese, and other metals. Landfills operating near the site may also be releasing some constituents to the groundwater. Numerous oil wells operate in the Deerfield area; any leaky casings on these wells could allow oil or brines to be released to shallower formations. However, no oil wells were encountered within the area under study and are therefore ruled out as a source of contamination.

Site-Specific Geochemistry: Relative abundances of major anions and cations for waters from different zones beneath the site show distinct water-quality groupings. Analyses of water from all monitoring wells were plotted on a Piper diagram (Figure 4-9). This technique allows geochemical "fingerprinting" of groundwaters from different sources and examination of mixing relationships.



LEGEND

x ABANDONED PRODUCTION WELL (DEPTH UNKNOWN)

● MONITORING WELL

WELLS COMPLETED IN THE WATER-TABLE AQUIFER OUTSIDE OF CONTAMINATED AREA

WELLS COMPLETED IN THE WATER-TABLE AQUIFER WITHIN THE CONTAMINATED AREA

INTERMEDIATE WELLS

WELLS COMPLETED IN THE UPPER SHARON AQUIFER

INDIVIDUAL WELLS WHICH FALL OUTSIDE THE APPROXIMATE QUALITY GROUPING

FIGURE 4-9
PIPER DIAGRAM OF GROUNDWATER CHEMISTRY
SUMMIT NATIONAL RI

Waters from the water-table aquifer outside of the waste area and from the Upper Sharon aquifer are distinctly different from one another, particularly in their anion composition. Analyses of these two water sources plot as two distinctly different sources, with no perturbances which may be indicative of mixing between the groups. This wide separation of water quality indicates that the hydraulic connection between the water-table aquifer and the Upper Sharon does not dominate water quality in the Upper Sharon.

Analyses from most of the intermediate wells plot very close to the the Upper Sharon wells, indicating that these zones, too, lack a strong geochemical similarity to the shallow groundwater. This chemistry can be explained by one of two phenomena: 1) the primary source of groundwater in the intermediate units is lateral underflow rather than downward flow from the water-table aquifer; or 2) groundwater in the intermediate unit moves so slowly that its geochemistry is greatly altered during the time it spends flowing through this zone. Based upon other conclusions of this investigation, the latter appears to be the more plausible explanation. As the water moves slowly through the rock units, it has time to react with rock materials. Reactions involve dissolution and precipitation, and cause a change in geochemical character of the water. Exceptions to this observation are MW-20 and MW-21, a pair of nested wells located east of the site. MW-20 does not plot near any other well; apparently its composition is strongly influenced by some localized effect, perhaps a slight variation in lithology. Field observations of very slow recovery and low water levels in MW-21 indicate that this well is not functioning properly.

Groundwater in the water-table aquifer beneath the waste area is distinctly different from groundwater in the same aquifer outside of the waste area. These waters have higher concentrations of sodium, chlorides, and bicarbonate than native groundwaters. The form of the area in which these waters plot on Figure 4-9 indicates a mixing of native groundwaters with another groundwater which is best represented by well 2BB8. Waters from 2BB5 and 2BB6 are similar to native groundwater in major-ion composition. The other onsite shallow wells, which are all located east of 2BB5 and 2BB6, plot farther from the area of native groundwater quality. This scatter indicates a definite variation in water quality across the waste area. Although the

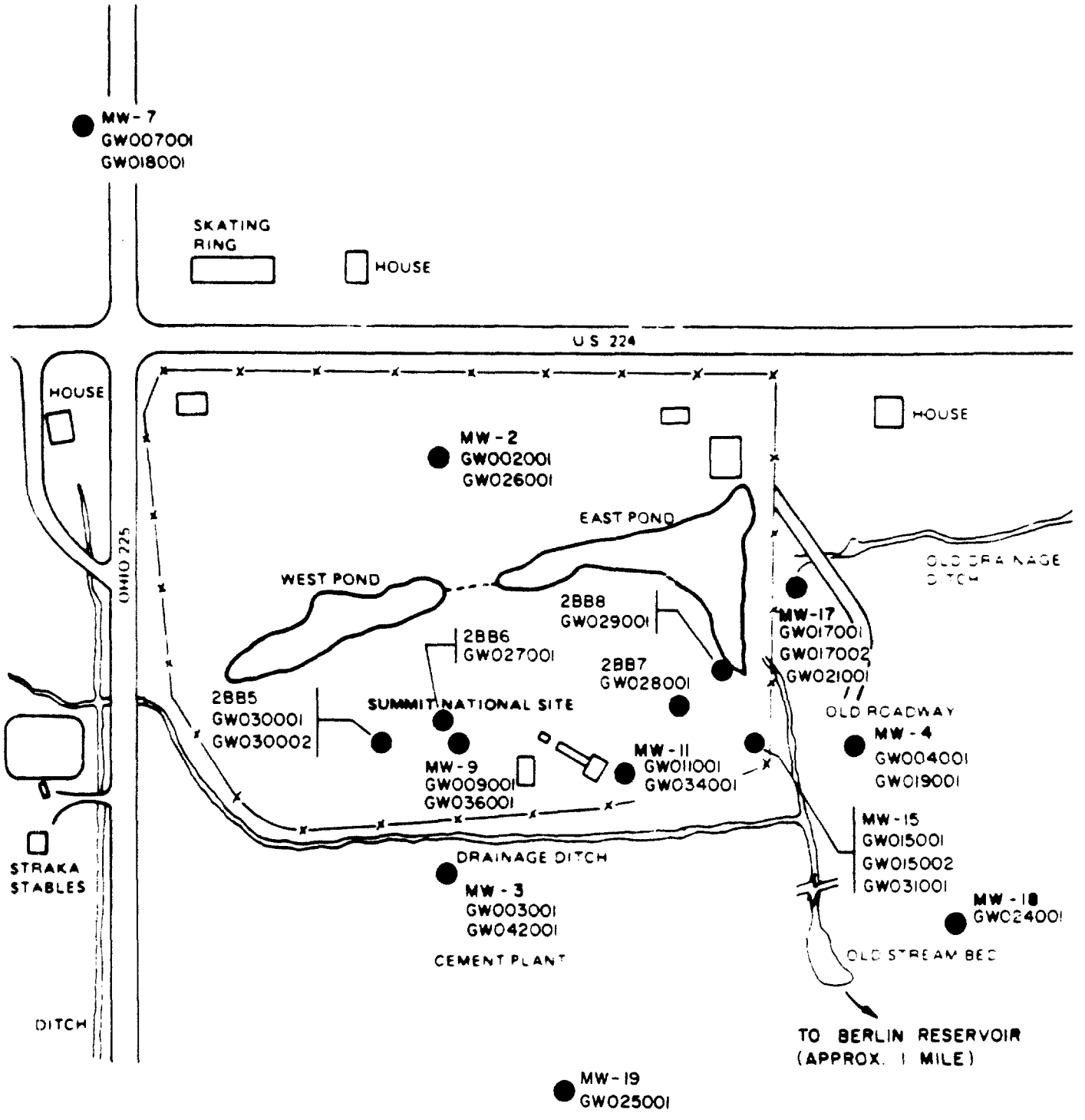
shape of this area could be construed as indicating that groundwater beneath the waste area is a mixture of native shallow groundwater and deep groundwater, there is no physical reason for this conclusion because the head on the water-table aquifer is much higher than the head on the Upper Sharon aquifer and water cannot flow from a low head to a high head.

The abandoned production well has water quality typical of the uncontaminated water-table aquifer, even though it is reported to be at least 300 feet deep. During investigations, the well could be cleared to a depth of only 101 ft. As discussed previously, this well apparently derives much of its water from the water-table aquifer via leakage along the ungrouted casing. Because of these considerations and the downward vertical gradients discussed earlier, this well may be acting as a conduit for flow from the shallow aquifers to deeper ones.

MW-13, completed in the Upper Sharon, also plots outside of the range for water quality in the deeper strata. This well has water quality which may be a mixture of shallow and deep groundwater. Because MW-12, a shallower well in the same cluster with MW-13, has water quality typical of the deeper strata, it is unlikely that this mixing is occurring naturally. Difficulties were encountered during the installation of this well, and it is possible that the sealing is inadequate, allowing shallow groundwater to migrate downward via the well bore.

Groundwater Contamination: Discussions on groundwater contamination will be based on data obtained during both phases of the RI site activities. Data summary tables of groundwater data are presented in Appendix A. Locations of all groundwater sampling points and corresponding monitoring wells are shown on Figures 4-10 through 4-12.

Shallow onsite groundwater in the water-table aquifer and uppermost intermediate units is contaminated with a number of organic compounds. Table 4-6 summarizes the most representative organic contaminants present on site and the portion of the shallow groundwater system affected by each. Compounds which were identified in only one well are:



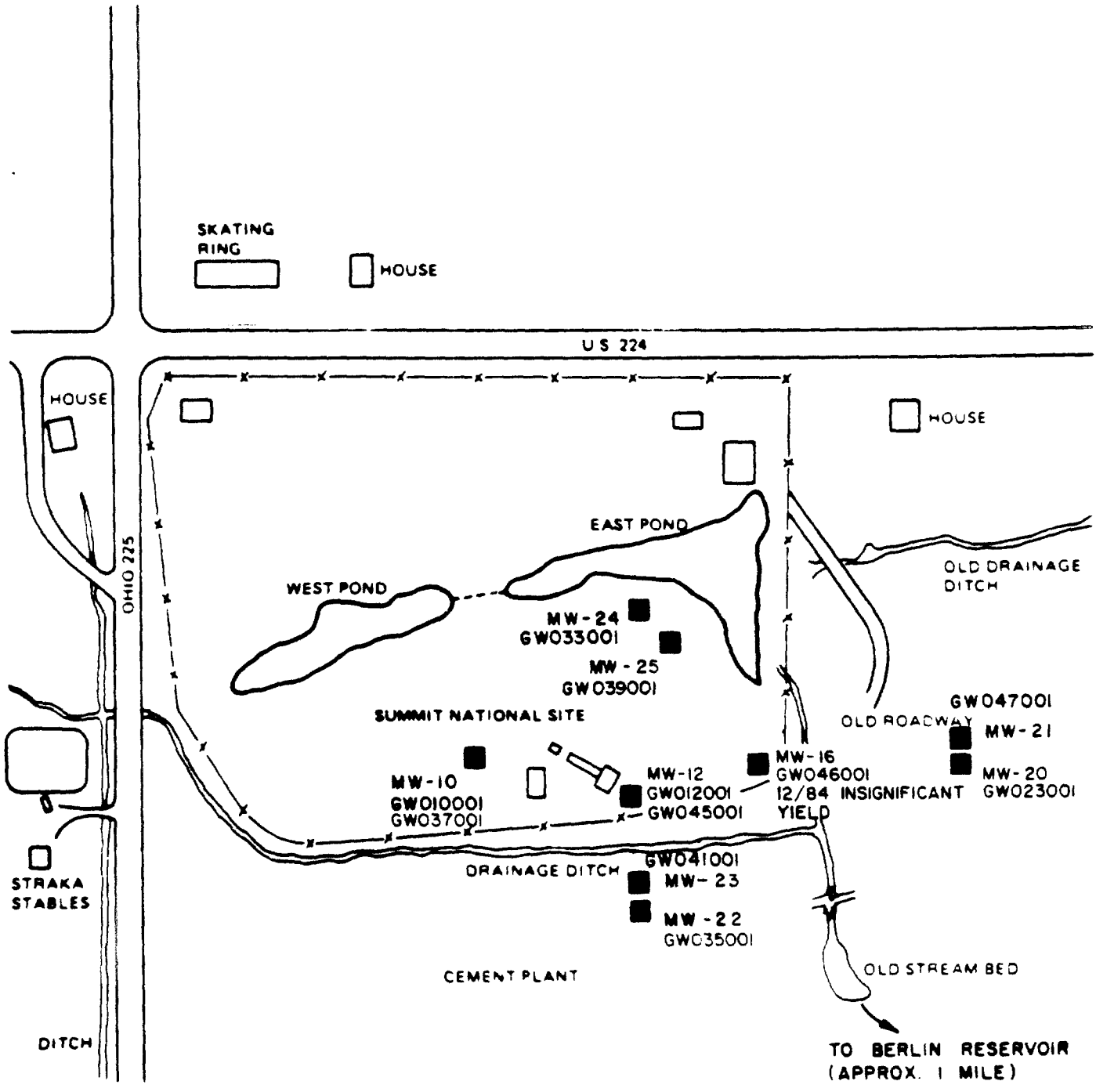
LEGEND

● EXISTING MONITORING WELL (WATER TABLE)

NOTE All locations of structures and physical features approximate

SOURCE Modified from USEPA

FIGURE 4-10
WATER TABLE
AQUIFER SAMPLE LOCATIONS
SUMMIT NATIONAL RI



LEGEND:

■ EXISTING MONITORING WELL (INTERMEDIATE)

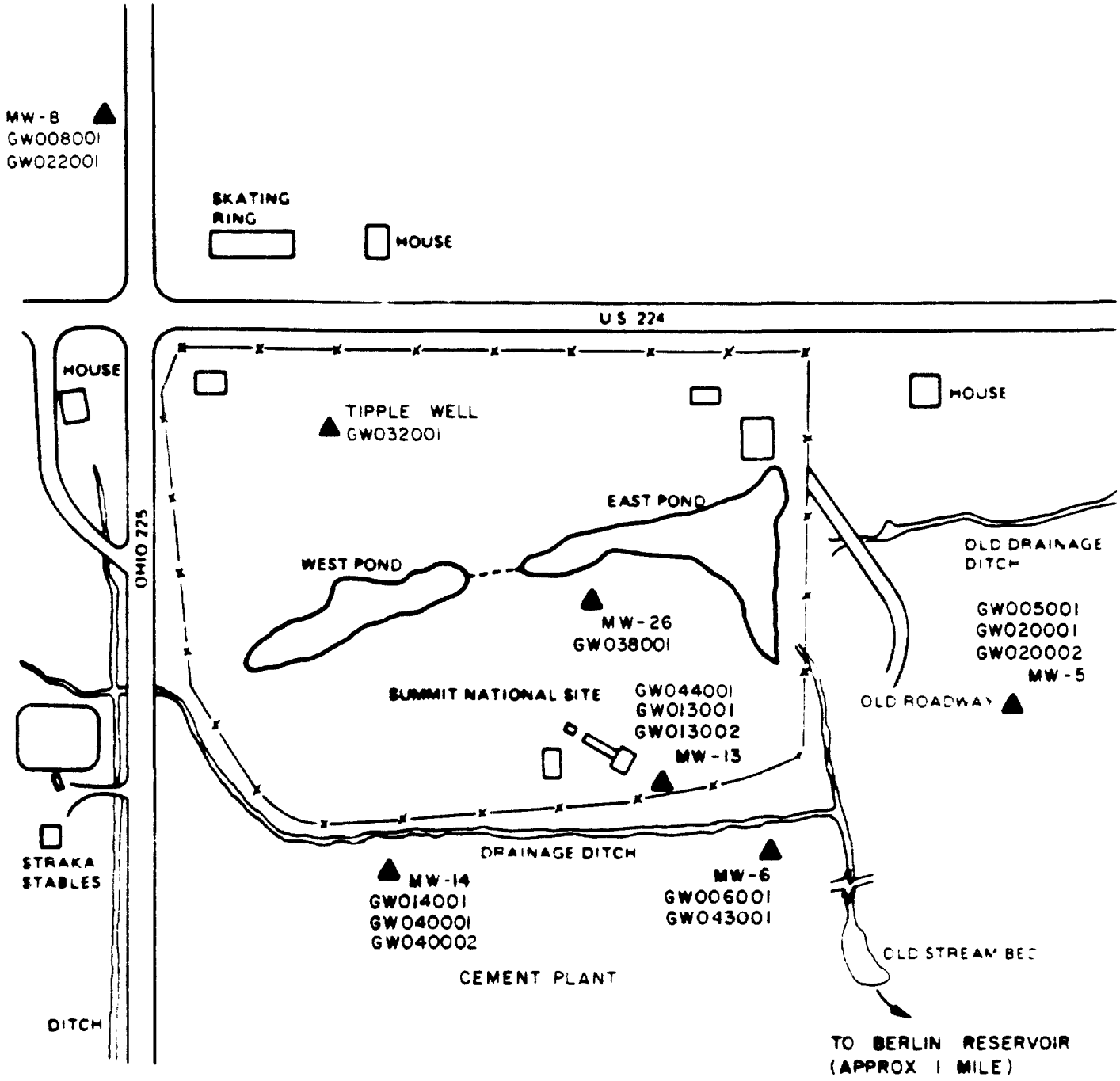
N

0 200
100
SCALE IN FEET
APPROXIMATE

NOTE All locations of structures and physical features approximate

SOURCE Modified from USEPA

FIGURE 4-11
INTERMEDIATE
AQUIFER SAMPLE LOCATIONS
SUMMIT NATIONAL RI



LEGEND

▲ EXISTING MONITORING WELL (UPPER SHARON)

N

0 200
100
SCALE IN FEET
APPROXIMATE

NOTE All locations of structures and physical features approximate

SOURCE Modified from USEPA

FIGURE 4-12
UPPER SHARON AQUIFER
SAMPLE LOCATIONS
SUMMIT NATIONAL RI

TABLE 4-6

MOST REPRESENTATIVE ORGANIC CONTAMINANTS IDENTIFIED

IN THE SHALLOW GROUNDWATER SYSTEM

SUMMIT NATIONAL SITE

Contaminant	Area Affected	Maximum Conc. (ug/l)	Background Conc. (ug/l)	Comments
VOLATILES				
Methylene Chloride	Southwestern quadrant	24,000	2**	
Acetone	Southern half of site	1,300,000	4**	
1,1-Dichloroethane	Southern half of site	12,000	ND	Tends to occur at higher concentrations in shallower wells
1,2-Dichloroethane	Southern half of site	115,000*	ND	
2-Butanone	Southern half of site	650,000	14**	
1,1,1-Trichloroethane	Southern half of site	53,000	ND	Tends to occur at higher concentrations in shallower wells
Trichloroethene	Southern half of site	27,000	16	Tends to occur at higher concentrations in shallower wells
4-Methyl-2-Pentanone	Southwestern quadrant	62,000	ND	Tends to occur at higher concentrations in shallower wells
Toluene	Southwestern quadrant	18,000*	16**	Tends to occur at higher concentrations in deeper wells
Ethylbenzene	Southern half	11,000	ND	Tends to occur at higher concentrations in shallower wells
SEMI-VOLATILES				
4-Methylphenol	Southwest quadrant	510	ND	
2,4-Dimethylphenol	Southwest quadrant	130*	ND	
Phenol	Southwest quadrant	7,000	ND	
Isophorone	Southern half of site	2,600	ND	Tends to occur at higher concentrations in deeper wells
Naphthalene	Southwest quadrant	620	ND	Tends to occur at higher concentrations in shallower wells
2-Methylnaphthalene	Southwest quadrant	370	ND	Tends to occur at higher concentrations in shallower wells
Bis(2-ethylhexyl)Phthalate	Southern half of the site	7,250*	5	Tends to occur at higher concentrations in deeper wells

Note:

MW-7 used for background concentration

* Average of 2 duplicates, duplicates not averaged had one value of 0

** Concentration level can be attributed to lab contamination

Compound	Maximum Concentration (ppb)	Frequency
1,1-Dichloroethene	2,600	3
Trans-1,2-Dichloroethene	4,600	3
Benzene	38	1
Xylenes	52,000	2
Benzoic Acid	2,700	3
1,2,4-Trichlorobenzene	24	1
4-Chloro-3-Methylphenol	130	1
Hexachlorocyclopentadiene	2,800	2
Dimethyl Phthalate	22	2
Pyrene	79	1
Di-n-Octyl Phthalate	1,600	2
Acenaphthylene	100	2
Dibenzofuran	59	2
Diethylphthalate	53	1
Fluorene	75	2
Hexachlorobenzene	630	2
Phenanthrene	200	2
Anthracene	41	2
Di-n-Butylphthalate	130	8
Fluoranthene	77	2
Butylbenzylphthalate	950	2
Tetrachloroethene	2,000	1

These substances do occur on site, but only in small areas as low concentrations. They are not characteristic of the contaminated groundwater as a whole.

Because of the number of substances identified as ~~major~~ contaminants, not all substances will be discussed in detail. Instead, examples of different modes of migration are presented. Shallow intermediate wells MW-10 and MW-16 are included in this discussion to present the vertical extent of contamination. Deeper portions of the intermediate units are discussed later. Samples from wells screened across the water table may have contained some free product, so the analytical results may not be indicative of actual concentrations dissolved in groundwater. Free product was observed in well 2BB5, but was not analyzed separately. Free product was also encountered in MW-9, screened well below the water table.

The compound 2-butanone is an example of a substance which contaminates the entire waste area (Figure 4-13). This chemical has a density of 0.81 gm/cm^3 and is very soluble. Although the 2-butanone is

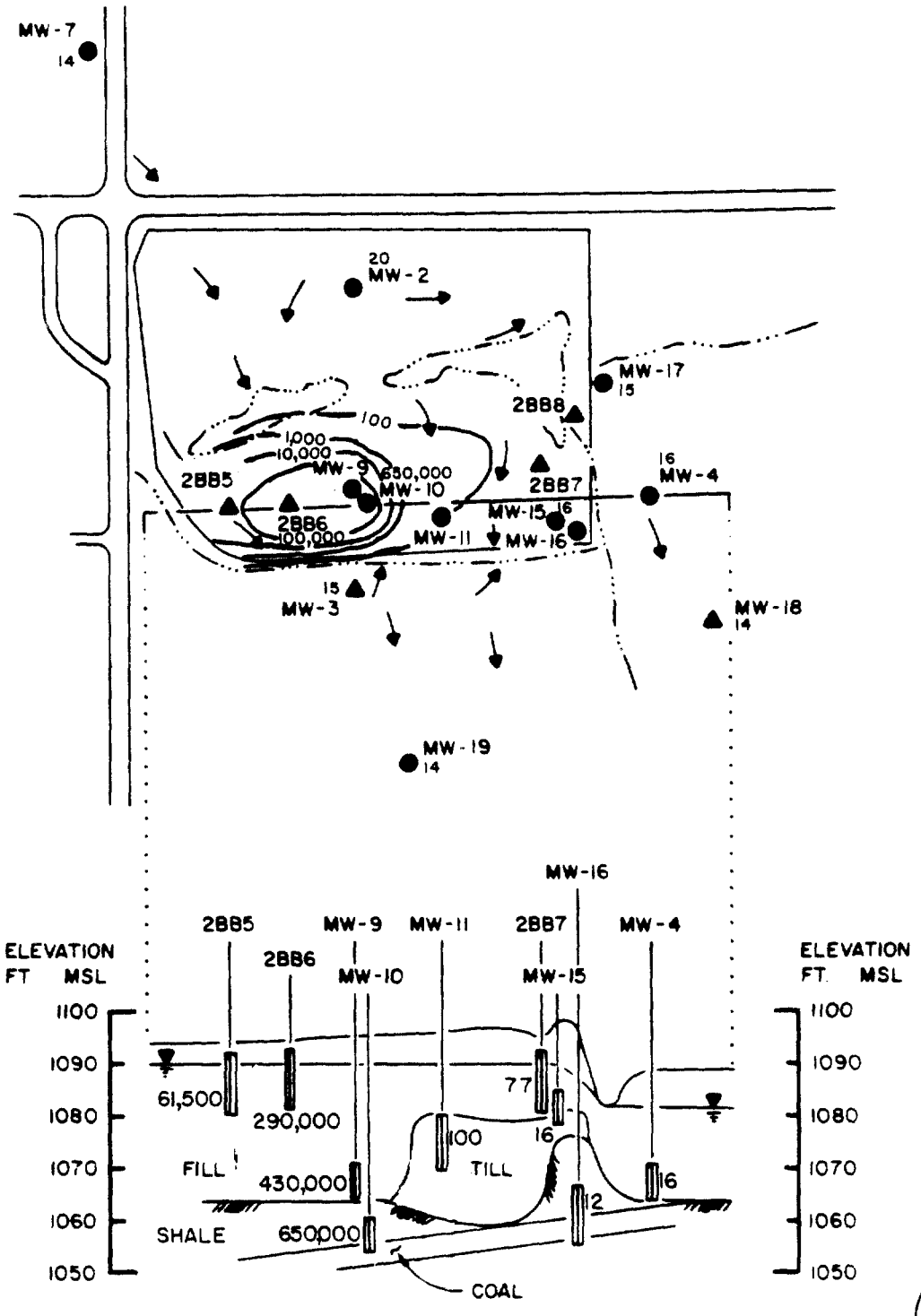


FIGURE 4-13
DISTRIBUTION OF 2-BUTANONE IN THE WATER TABLE AQUIFER, 9/86
SUMMIT NATIONAL RI

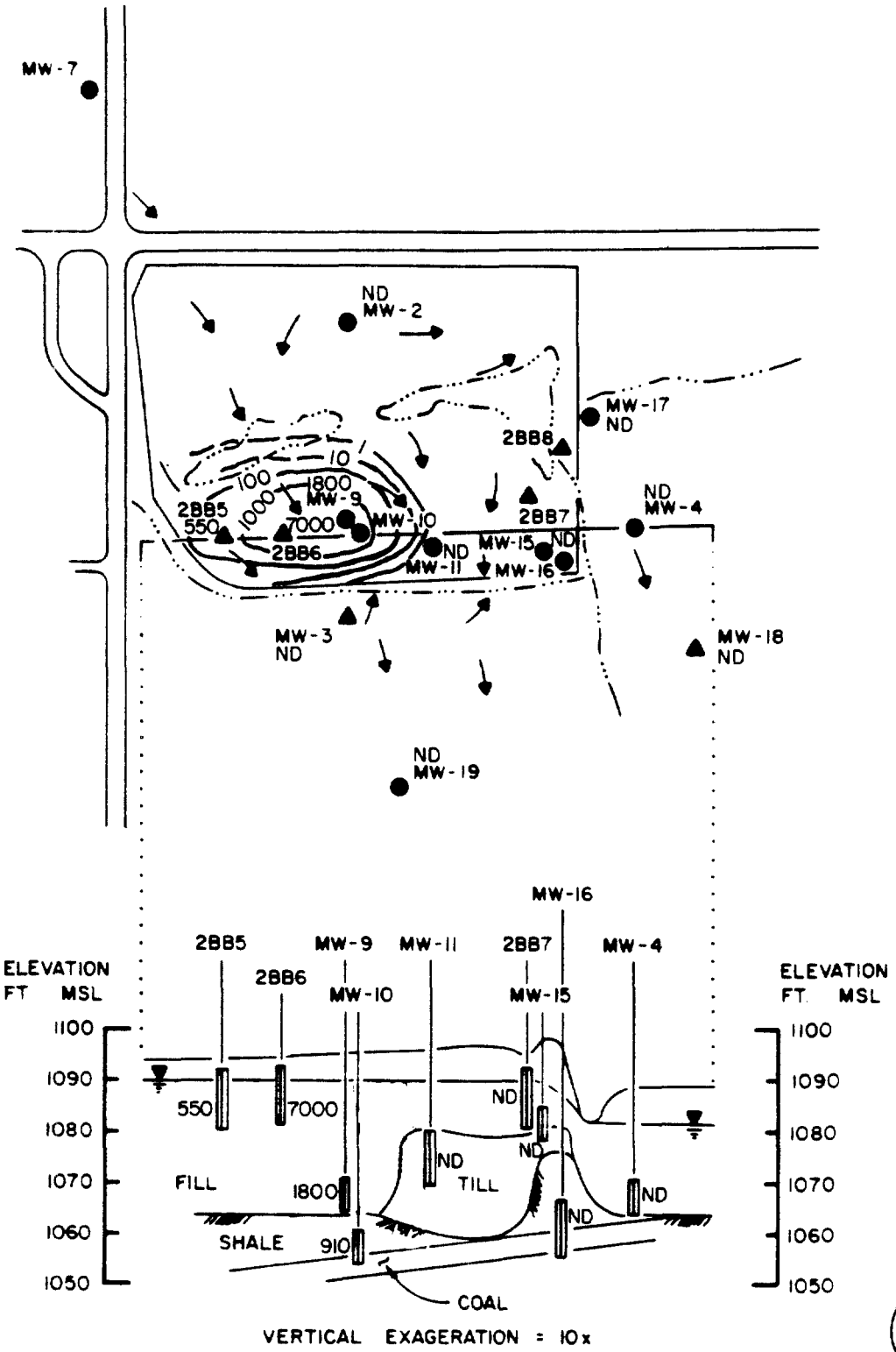
lighter than water, its concentration increases with depth. This apparent sinking may occur because the high solubility allows the chemical to be moved easily in flowing groundwater, which has a downward flow component.

Phenol (Figure 4-14) has a pattern of occurrence similar to that of 2-butanone, but is of more limited extent. This substance occurs only in the southwestern quarter of the site, and does not extend across the entire waste area.

Toluene is one of the chemicals which tends to occur in the shallow portion of the aquifer (Figure 4-15). Toluene has a solubility of 515 mg/l and a density of 0.87 gm/cm^3 at a typical groundwater temperature of 20°C. This substance was detected at concentrations of up to 27,000 ug/l in water-table wells, but was not detected in any of the wells completed near the base of the aquifer.

An example of a contaminant which occurs preferentially in the lower portions of the aquifer is bis(2-ethylhexyl) phthalate (Figure 4-16). This contaminant has a density very similar to that of water, so it is probable that the downward hydraulic gradients are responsible for the stratification of the contaminant.

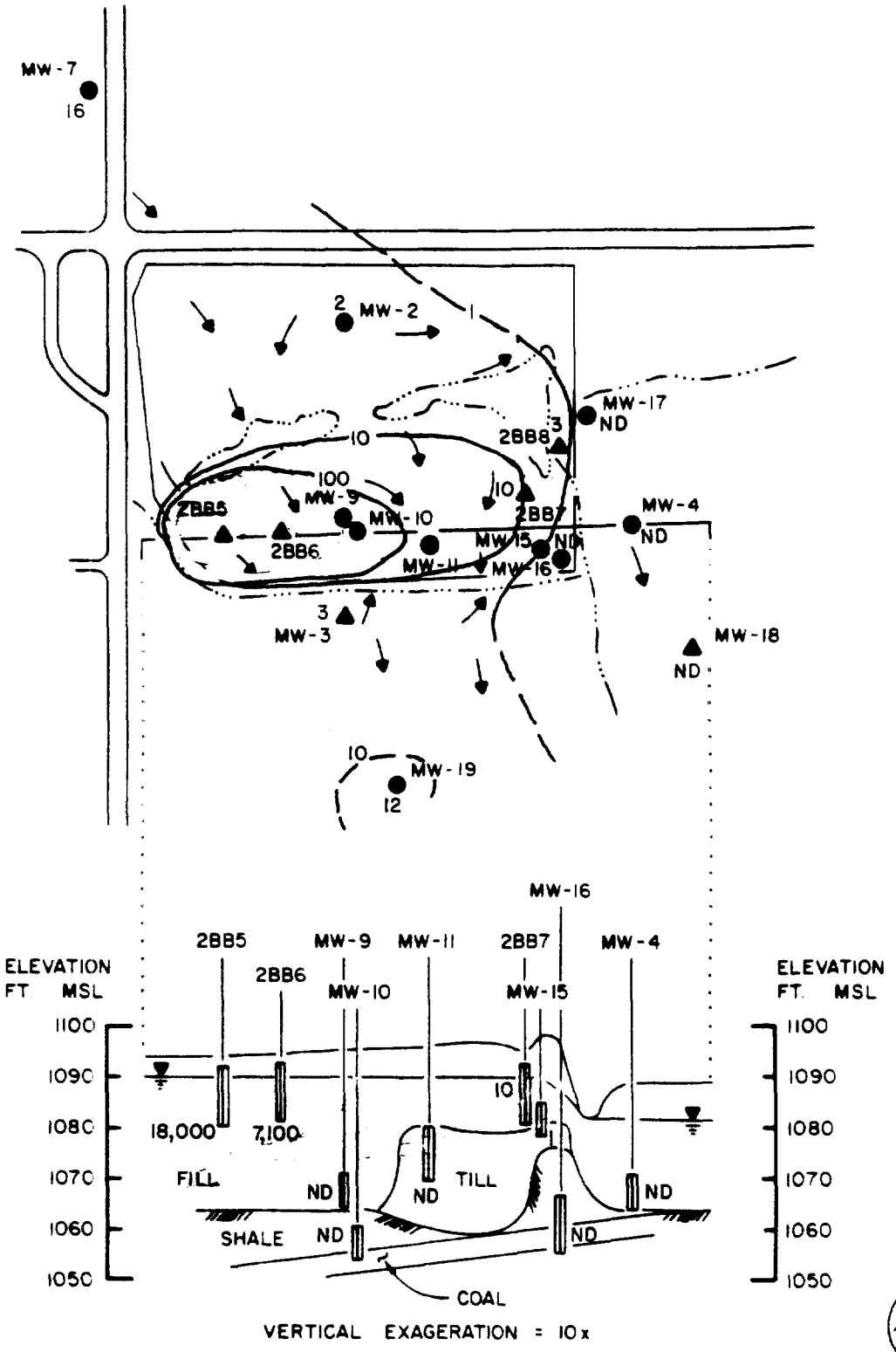
All of the contaminants observed have their highest concentrations in the southwestern quarter of the site, in the vicinity of water-table wells 2BB5 and 2BB6. Oily, free product was encountered in 2BB5 and nearby MW-9. This area was the location of a former concrete-block pit which was used for chemical mixing prior to disposal and would be expected to be a highly contaminated area. The locations of the water table aquifer wells in relation to the test pits which contained buried drums and the former concrete block pit are shown on Figure 4-17. Observations during excavation of test pits and the presence of free product in 2BB5, which is screened across the water table, indicate that oily contaminants occur as a separate phase on the water table. The oil phase was not analyzed separately, but lighter-than-water liquids found in the water sample at concentrations greater than 10% of saturation include di-n-octyl phthalate and xylenes. The water sample may have contained some free product. The other well which contained free product, MW-9, is screened at the base of the aquifer, so the



LEGEND

- ● WELL COMPLETED IN NATURAL MATERIAL
- ▲ WELL COMPLETED IN MAN-MADE MATERIAL
- SURFACE WATER
- DIRECTION OF GROUNDWATER
- 12 CONCENTRATION OF PHENOL, ug/l (ND = NOT DETECTED)
- ISOCHEMICAL LINE, CONTOUR INTERVAL = 10^n
- MONITORING WELL
- FILTER PACK
- BEDROCK SURFACE
- WATER TABLE

FIGURE 4 - 14
DISTRIBUTION OF PHENOL IN THE WATER TABLE AQUIFER, 9/86
SUMMIT NATIONAL RI



LEGEND

- ● WELL COMPLETED IN NATURAL MATERIAL
- ▲ WELL COMPLETED IN MAN-MADE MATERIAL
- SURFACE WATER
- DIRECTION OF GROUNDWATER
- 12 CONCENTRATION OF TOLUENE, ug/l
- ISOCHEMICAL LINE, CONTOUR INTERVAL 10^n
- MONITORING WELL
- FILTER PACK
- BEDROCK SURFACE
- WATER TABLE

NOTE: WELLS SCREENED ACROSS THE WATER TABLE MAY CONTAIN FLOATING FREE PRODUCTS.

N

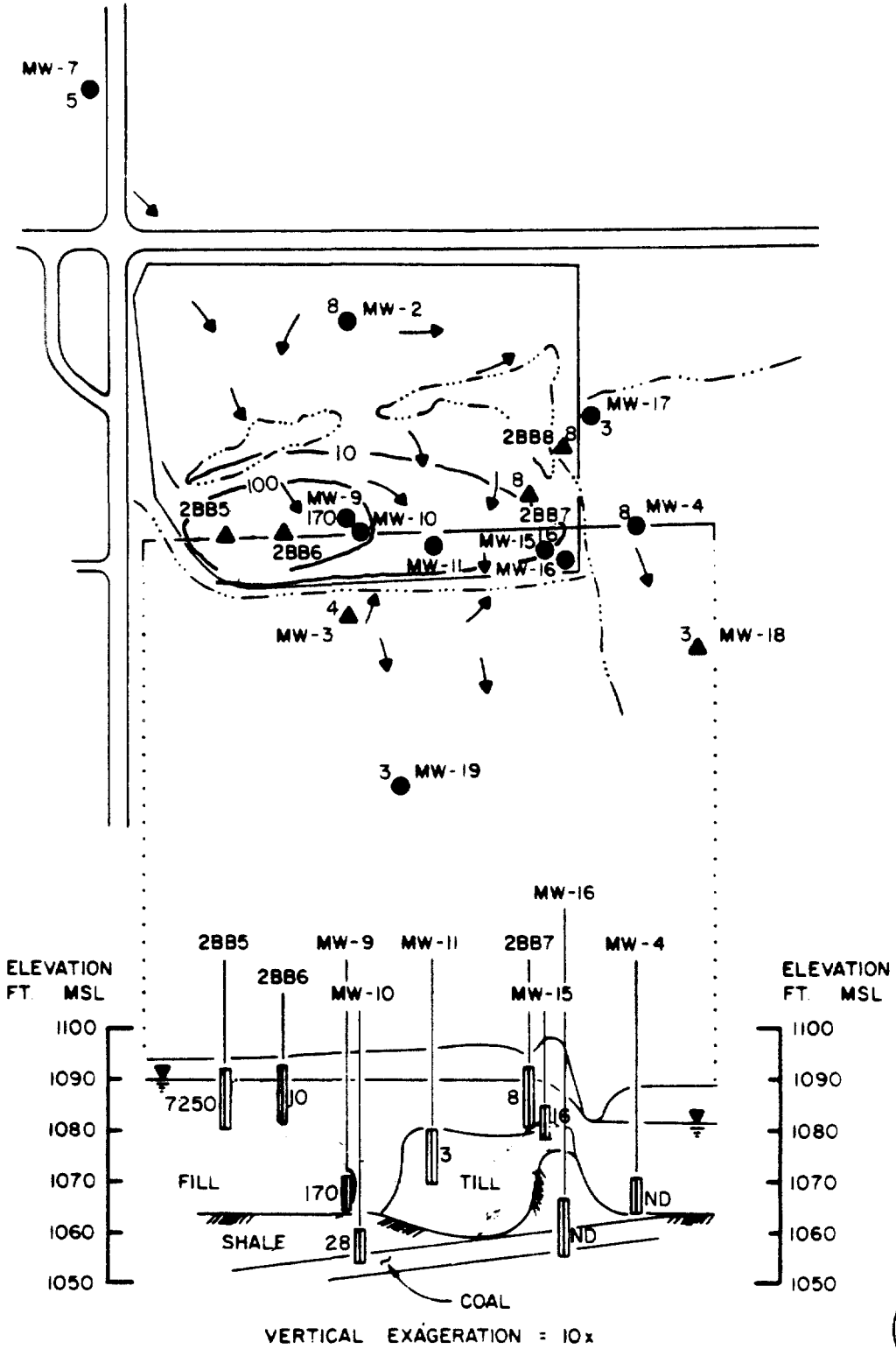
0 200

100

SCALE IN FEET

FIGURE 4-15
DISTRIBUTION OF TOLUENE IN THE WATER TABLE AQUIFER, 9/86

SUMMIT NATIONAL RI



LEGEND

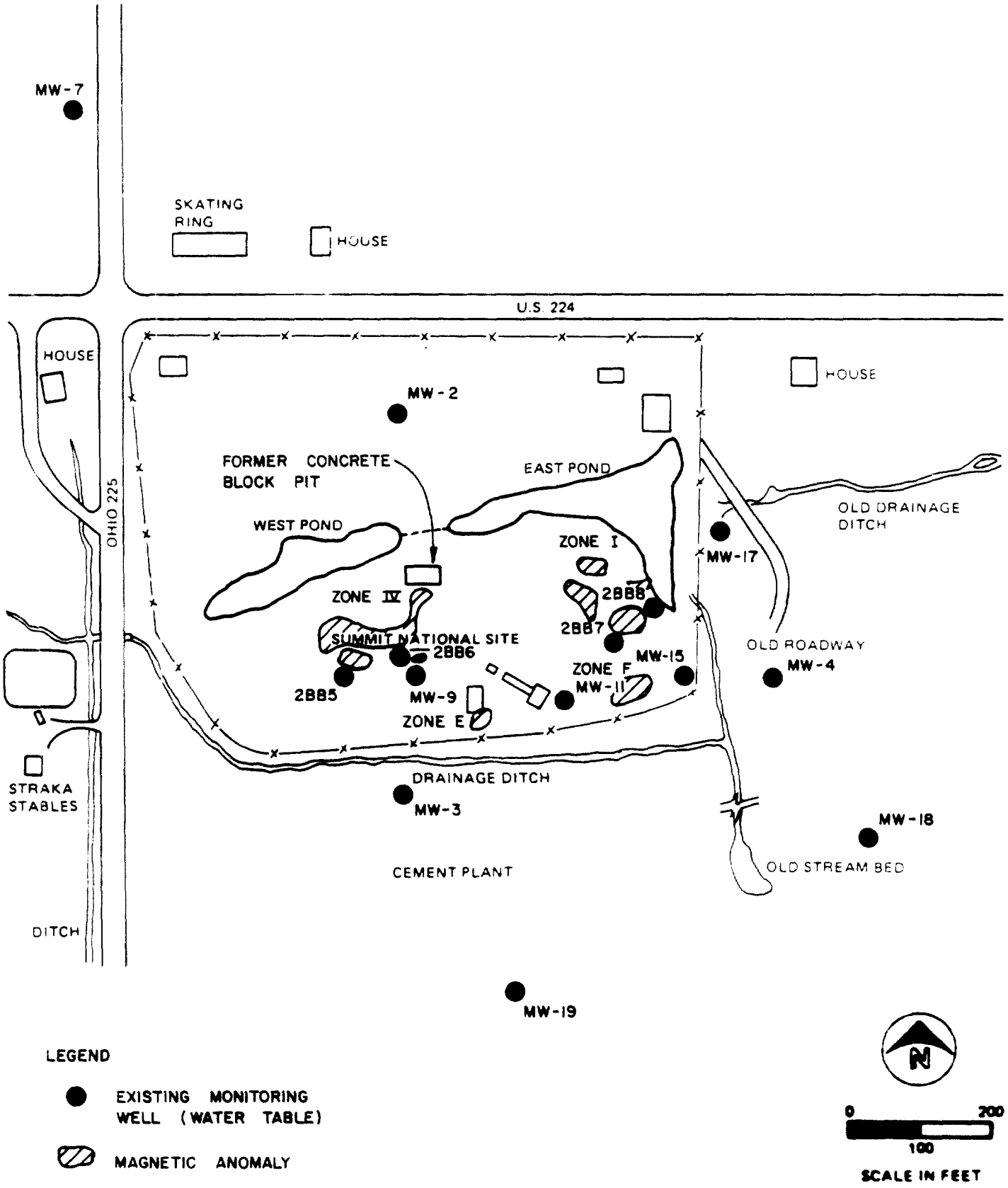
- ● WELL COMPLETED IN NATURAL MATERIAL
- ▲ WELL COMPLETED IN MAN-MADE MATERIAL
- —·—·— SURFACE WATER
- → DIRECTION OF GROUNDWATER
- 12 CONCENTRATION OF BIS(2-ETHYLHEXYL) PHTHALATE, ug/l
- ∫ ISOCHEMICAL LINE, CONTOUR INTERVAL 10ⁿ
- MONITORING WELL
- FILTER PACK
- BEDROCK SURFACE
- WATER TABLE

NOTE: WELLS SCREENED ACROSS THE WATER TABLE MAY CONTAIN FLOATING FREE PRODUCT.

N

0 200
100
SCALE IN FEET

FIGURE 4-16
DISTRIBUTION OF BIS(2-ETHYLHEXYL) PHTHALATE IN THE WATER TABLE AQUIFER, 9/86
SUMMIT NATIONAL RI



LEGEND

● EXISTING MONITORING WELL (WATER TABLE)

MAGNETIC ANOMALY

NOTE: All locations of structures and physical features are approximate.

SOURCE: Modified from USEPA.

FIGURE 4-17
WATER TABLE
AQUIFER SAMPLE LOCATIONS
SUMMIT NATIONAL RI

oils encountered must constitute a free phase of compounds which are heavier than water. Heavier-than-water compounds found in this well at greater than 10% saturation include methylene chloride and tetrachloroethene.

Concentrations of most organic contaminants decrease across the southern half of the site, from west to east. This pattern indicates that the primary source of organic contaminants is in the southwestern quarter of the site, and that the eastern portion of the waste area is presently a less significant source of organic chemicals. The southwest quarter of the site is the location of observed leaking buried drums and the former concrete block pit.

It is also significant that MW-10 has high levels of some organics contaminants. This well is completed below the base of the water-table aquifer, so the presence of these substances indicates that some contamination extends below the water-table aquifer.

Of the deeper intermediate wells, high levels of contaminants were detected in only MW-24, an onsite intermediate well, as compared to MW-7, a background well completed in the water table. The water-table aquifer is considered appropriate as background for the intermediate units because the water-table aquifer recharges the intermediate units. Trace levels of contaminants were detected in MW-25, an intermediate well completed next to MW-24, but open to a shallower interval. MW-24 contained many of the substances identified as site-related contaminants in the water-table aquifer (Table 4-7). MW-25 also contained some of these same compounds, but at much lower levels. The presence of contaminants in these wells and intermediate wells MW-10 and MW-16 indicate that the intermediate units beneath the site are contaminated. The groundwater moving downward from the water-table aquifer, although not large in quantity, is apparently sufficient to adversely affect water quality in these units. Once the contaminants enter the intermediate units, they may move laterally in permeable zones, but movement is primarily downward in the areas where downward gradients exist.

Naphthalene and 2-methylnaphthalene were detected at trace (3 ug/l) concentration in MW-22, an intermediate well located off site. It is difficult to establish a flow connection between this well and the site based

TABLE 4-7
IDENTIFIED ORGANIC CONTAMINANTS DETECTED IN MW-24
SUMMIT NATIONAL SITE

Contaminant	Concentration in MW-24	Concentration in MW-25	Concentration in MW-22	Maximum Concentration in Water-Table Aquifer
Methylene Chloride	180 ug/l	3 ug/l	1 ug/l	24,000 ug/l
Acetone	2,700	13	9	1,300,000
1,1-Dichloroethane	820	5	ND	12,000
1,2-Dichloroethane	5,800	100	ND	115,000
2-Butanone	1,800	15	15	650,000
1,1,1-Trichloroethane	360	3	ND	53,000
Trichloroethene	55	ND	ND	18,000
4-Methyl-2-Pentanone	250	ND	ND	62,000
Toluene	3,200	9	ND	27,000
Ethylbenzene	590	ND	ND	11,000
4-Methylphenol	140	ND	ND	510
Isophorone	41	ND	ND	2,600
2,4-Dimethylphenol	16	ND	ND	140
Naphthalene	11	ND	3	620
2-Methylnaphthalene	5	ND	3	370

ND - Not Detected

upon existing data. However, the presence of an upward vertical gradient at this location and the very low concentrations observed make the likelihood of a relationship between these two chemical occurrences and the site low because water is supplied to that area by the portion of the Upper Sharon aquifer upgradient of the site, rather than the onsite water-table aquifer.

In the Upper Sharon aquifer, MW-14 and MW-8 are appropriate as background monitoring points. The only groundwater sample from the Upper Sharon which contained any organic substances above background levels was MW-13, which had 46 ug/l of TCE. It is not likely that this substance is migrating from the site to the Upper Sharon aquifer at this location because the well is on the upgradient end of the site and the vertical hydraulic gradient is upward from the Upper Sharon. As discussed previously, the seal on this well is suspect. The sample from this well is not believed to be a true representation of water quality at that location. It is recommended that this well be grouted during remedial actions.

DDT was detected in MW-6 and MW-14, but is probably not indicative of contamination caused by the sites because these wells are not downgradient of the sites.

Ohio EPA sampled intermediate wells MW-20 and MW-22 at the same time the RI samples were obtained, and analyzed the samples for volatiles and pesticides (EPA 601 and 602 parameters). None of these compounds were detected in either sample at a detection of 10 ug/l. These findings are in agreement with CLP results, which identified traces of methylene chloride and toluene at less than 10 ug/l. These substances, when found at trace levels, are likely to be laboratory contaminants.

Nine residential wells in the vicinity of the site were sampled (Appendix A). These wells are listed on Table 4-8. None of these wells, which represent waters from the intermediate units and the Upper Sharon aquifer, indicated levels of organic contaminants above background.

Metals which were detected in concentrations above background in the onsite water-table aquifer included aluminum, arsenic, barium, cadmium, chromium, iron, manganese, nickel, and tin. Coal and coal refuse produce characteristic acid mine drainage, and the detection of some metals can be attributed to the

TABLE 4-8
RESIDENTIAL WELLS SAMPLED
SUMMIT NATIONAL SITE

Owner/User	Depth (ft.)	Casing Depth (ft.)	Probable Water-Bearing Unit	Sample Number
[redacted]	61	34	Mercer Member	RW011001
[redacted]	225	183	Shale unit of Sharon Member	RW009001
[redacted]	290	100	Conglomerate unit of Sharon Member	RW007001 RW004001
[redacted]	91	53	Mercer Member	RW008001 RW002001 RW002002
[redacted]	62	32	Mercer Member	RW012001
[redacted]	85*	Unknown	Mercer Member	RW006001
[redacted]	Unknown	Unknown	Insufficient data	RW010001 RW010002
[redacted]	75*	Unknown	Mercer Member	RW013001
[redacted]	Unknown	Unknown	Insufficient data	RW014001
[redacted]	52	28	Connoquenessing Member	RW005001

Notes:

* Reported by owner.
References: Pinzon, 1986
Sedam, 1973.

effects of mining at the site, rather than to waste disposal. Aluminum, arsenic, iron, manganese, and nickel can all be released by coal and coal refuse (Davis and Boegly, 1981; Hem, 1985). The only metallic contaminants detected on site which cannot be attributed to typical acid mine drainage are barium and chromium.

The distribution of chromium is presented as an example of the distribution of an inorganic contaminant concentrations not related to coal mining activities (Figure 4-18). This metal tends to be stratified in the water-table aquifer, occurring preferentially in the lower portion of the unit.

Among non-metallic inorganics, ammonia, chloride, and total dissolved solids all occur in above-background concentrations in the onsite water-table aquifer. The ammonia and chloride are probably the result of miscellaneous refuse disposal, while the elevated levels of TDS are the culmination of the effects of disposal of organic chemicals, miscellaneous refuse, and strip mining. Ammonia occurs at the highest concentrations on in the southeast quadrant of the site (Figure 4-19), which was also the area with the highest relative concentrations of sodium; this combination of parameters may indicate a greater effect of miscellaneous refuse on that portion of the site.

Neither barium nor chromium were detected in above-background concentrations in the samples from intermediate units or the Upper Sharon aquifer. Similarly, the patterns of consideration for ammonia and chloride indicate that the site is not contributing these substances to the deeper strata.

None of the residential well samples contained above-background levels of barium or chromium, with the exception of slightly elevated concentrations of barium in the [redacted] and [redacted] wells. These wells had barium concentrations of 184 and 86 ppb respectively. The [redacted] well is located adjacent to and downgradient of the site, and the barium in that well may be due to the site. It is unlikely that the site is the source of the elevated barium concentration detected in the [redacted] well. Although the [redacted] well is downgradient from the site, it is not within the influence zone of site migration in the Sharon unit.

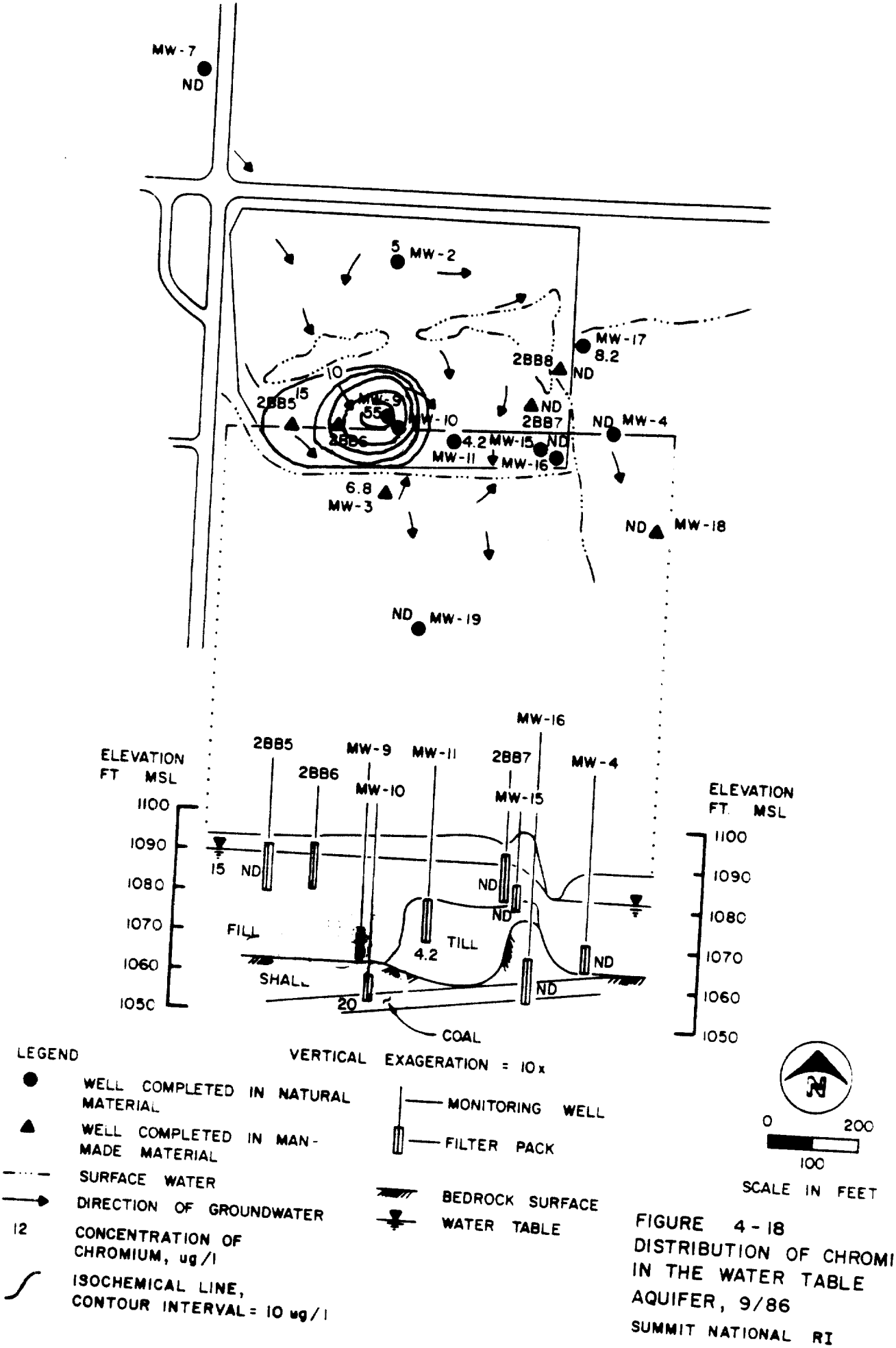
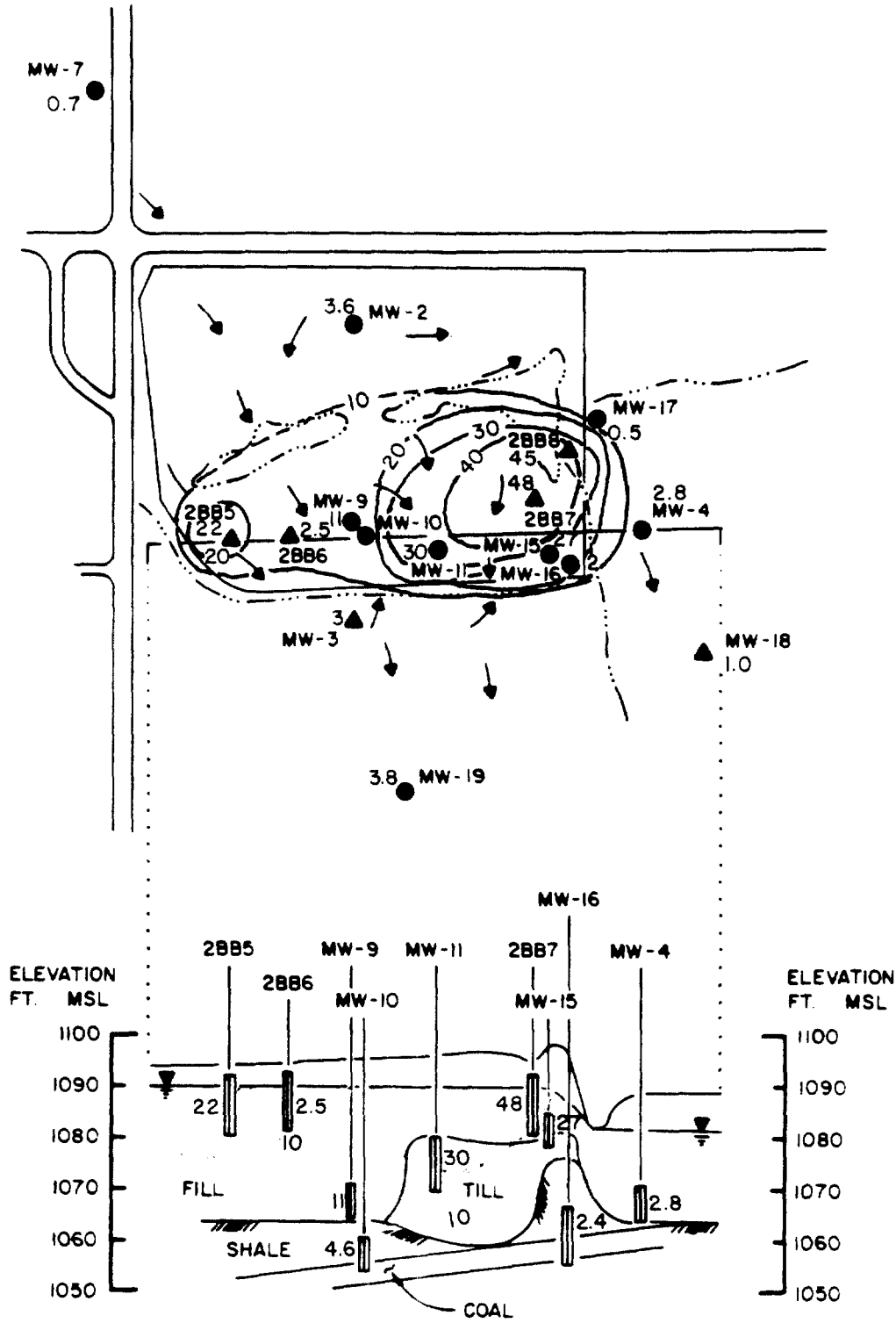


FIGURE 4-18
DISTRIBUTION OF CHROMIUM IN THE WATER TABLE AQUIFER, 9/86
SUMMIT NATIONAL RI



LEGEND

- ● WELL COMPLETED IN NATURAL MATERIAL
- ▲ WELL COMPLETED IN MAN-MADE MATERIAL
- SURFACE WATER
- DIRECTION OF GROUNDWATER
- 12 CONCENTRATION OF AMMONIA, ug/l AS NITROGEN
- ISOCHEMICAL LINE, CONTOUR INTERVAL = 10 ug/l
- MONITORING WELL
- FILTER PACK
- BEDROCK SURFACE
- WATER TABLE

FIGURE 4-19
DISTRIBUTION OF AMMONIA IN THE WATER TABLE AQUIFER, 9/86
SUMMIT NATIONAL RI

The [redacted] well is located approximately 1/4 mile from the site and the [redacted] well sample, located nearby, had a much lower level of barium (28 ppb). The [redacted] well sample also detected levels of copper which were higher than other domestic and monitoring wells; however, this metal was not identified as a site contaminant.

Potential for Contaminant Migration: It was demonstrated earlier in this section that groundwater in the water-table aquifer is contaminated with a variety of organic substances. These contaminants migrate southward and eastward from the contaminated areas, partially discharging to the french drain, drainage ditches, wetland, and ponds, but primarily moving off site. Based upon the method of Domenico and Robbins (1985), predicted concentrations of contaminants in groundwater at an arbitrary point 100 feet downgradient from the site are presented in Table 4-9. These calculations are intended to be schematic only, and are presented to predict relative concentrations and changes. The method of calculation assumes purely lateral flow in an aquifer of finite vertical extent, uniform flow velocity and properties, and a closed-form, continuous point source. Calculations assume a longitudinal dispersivity of 60 ft, transverse dispersivity of 10 ft (Walton, 1984), 40% porosity, 1% organic carbon, and a bulk material density of 100 lb/ft^3, and do consider retardation. Values are presented for the low velocity estimate of 0.03 ft/day and the high velocity estimate of 0.9 ft/day. Calculations are presented in Appendix E.

Similarly, predicted concentrations of contaminants in groundwater at points corresponding to the second impoundment (1,450 ft. downgradient) and the Berlin Reservoir (4,500 ft. downgradient) are presented on Tables 4-10 and 4-11, respectively. These concentrations represent an extremely conservative case based on the following assumptions: 1) no mixing; 2) no dilution by precipitation; 3) a constant source without any decrease in source concentration; 4) no biodegradation or breakdown; and 5) a continuous flow velocity. There is considerable dilution of the groundwater when and if it reaches these two surface water bodies and mixes with the surface water. The upper range of flow in the water table was estimated at 68,000 gallons per day. If this volume discharged into the second impoundment (112,000 gallons) or the

TABLE 4-9
PREDICTED CONCENTRATIONS OF ORGANIC CONTAMINANTS IN THE WATER-TABLE AQUIFER
100 FEET DOWNGRADIENT OF WASTES
SUMMIT NATIONAL SITE

Compound	Initial Concentration	Flow Velocity =	Time = 10 years 0.03 ft/yr	Time = 10 years 0.9 ft/yr	Time = 50 years 0.03 ft/yr	Time = 50 years 0.9 ft/yr	Time = 100 years 0.03 ft/yr	Time = 100 years 0.9 ft/yr
Methylene Chloride	24,000		1,816	4,080	3,754	4,080	4,039	4,080
1,1-Dichloroethane	12,000		367	2,040	1,459	2,040	1,836	2,040
1,2-Dichloroethane	115,000		5,572	19,550	16,422	19,550	18,866	19,550
2-Butanone	650,000		58,565	110,500	105,528	110,500	109,948	110,500
1,1,1-Trichloroethane	53,000		405	8,695	4,505	9,010	6,667	9,010
Trichloroethene	18,000		77	2,876	1,270	3,060	2,035	3,060
Toluene	27,000		2	3,397	666	4,567	1,652	4,590
Ethylbenzene	11,000		935	1,870	1,786	1,870	1,861	1,870
Phenol	7,000		369	1,190	1,000	1,190	1,148	1,190
Isophorone	26,000		2,343	4,420	4,221	4,420	4,398	4,420
2,4-Dimethylphenol	140		12	24	23	24	24	24
Naphthalene	620		30	105	86	105	101	105
Bis(20-ethylhexyl)phthalate	7,250		0	0	0	0	0	0

All concentrations are ug/l

Calculations are presented in Appendix E

TABLE 4-10
PREDICTED CONCENTRATIONS OF ORGANIC CONTAMINANTS IN THE WATER-TABLE AQUIFER
1450 FEET DOWNGRADIENT OF WASTES (SECOND IMPOUNDMENT)
SUMMIT NATIONAL SITE

Compound	Initial Concentration	Flow Velocity =	Time = 10 Years 0.03 ft/yr	Time = 10 Years 0.9 ft/yr	Time = 50 Years 0.03 ft/yr	Time = 50 Years 0.9 ft/yr	Time = 100 Years 0.03 ft/yr	Time = 100 Years 0.9 ft/yr
Methylene Chloride	24,000		0	1,060	7	1,079	12	1,079
1,1-Dichloroethane	12,000		0	97	1	339	3	539
1,2-Dichloroethane	115,000		0	3,565	20	5,169	41	5,169
2-Butanone	650,000		15	29,171	229	29,214	363	29,214
1,1,1-Trichloroethane	53,000		0	1	1	2,363	4	2,382
Trichloroethene	18,000		0	0	0	761	1	809
Toluene	27,000		0	0	0	123	0	1,057
Ethylbenzene	11,000		0	492	4	494	6	494
Phenol	7,000		0	225	1	315	2	315
Isophorone	26,000		1	1,166	9	1,169	15	1,169
2,4-Dimethylphenol	140		0	6	0	6	0	6
Naphthalene	620		0	17	0	28	0	28
Bis(2-ethylhexyl)phthalate	7,250		0	0	0	0	0	0

All concentrations are ug/l

Calculations are presented in Appendix E

TABLE 4-11
PREDICTED CONCENTRATIONS OF ORGANIC CONTAMINANTS IN THE WATER-TABLE AQUIFER
4500 FEET DOWNGRADIENT OF WASTES (BERLIN RESERVOIR)
SUMMIT NATIONAL SITE

Compound	Initial Concentration	Flow Velocity =	Time = 10 Years 0.03 ft/yr	Time = 10 Years 0.9 ft/yr	Time = 50 Years 0.03 ft/yr	Time = 50 Years 0.9 ft/yr	Time = 100 Years 0.03 ft/yr	Time = 100 Years 0.9 ft/yr
Methylene Chloride	24,000		0	0	0	324	1	324
1,1-Dichloroethane	12,000		0	0	0	145	0	162
1,2-Dichloroethane	115,000		0	0	0	1,550	1	1,550
2-Butanone	650,000		0	209	1	8,762	76	8,762
1,1,1-Trichloroethane	53,000		0	0	0	3	0	714
Trichloroethene	18,000		0	0	0	0	0	135
Toluene	27,000		0	0	0	0	0	0
Ethylbenzene	11,000		0	0	0	148	1	148
Phenol	7,000		0	0	0	94	0	94
Isophorone	26,000		1	0	0	350	3	350
2,4-Dimethylphenol	140		0	0	0	2	0	2
Naphthalene	620		0	0	0	8	0	8
Bis(2-ethylhexyl)phthalate	7,250		0	0	0	8	0	0

All concentrations are ug/l

Calculations are presented in Appendix E

westernmost branch of the Berlin Reservoir west of Ohio Route 14 (1.3×10^9 gallons), the majority of the concentration estimated on Tables 4-10 and 4-11 after this mixing and dilution would approach zero or below detention limits.

Contaminants which enter bedrock will move primarily downward until they reach the Upper Sharon aquifer. The velocity of this downward movement is estimated at 0.01 to 0.2 ft/day (4 to 73 ft/yr), ignoring dispersion and retardation. It is this mechanism which has transported the organic chemicals to the zone sampled by MW-24 (Table 4-7). At this range of rates, it will take contaminants one to 15 years to reach the Upper Sharon aquifer. However, because of retardation, most substances will not travel this quickly (Table 4-12). Once in the Upper Sharon aquifer, contaminants will migrate northward at an estimated rate of 0.01 to 0.06 ft/day (4 to 22 ft/yr).

4.3.4 Summary and Conclusions

The groundwater system beneath the Summit National site can be divided into three hydrogeologic units:

- the water-table aquifer, which consists of the unconsolidated materials and shallow bedrock;
- a series of intermediate units which form a hydrologically and lithologically complex zone;
- the Upper Sharon aquifer, a deep water-bearing unit which has been arbitrarily delineated for purposes of this investigation.

Two other aquifers are present in the area, but were not investigated. The Connoquenessing Sandstone generally occurs above the Sharon Formation, but was absent beneath the site The lower conglomeratic unit of the Sharon Member is also a regional aquifer, and underlies the strata penetrated during the RI.

TABLE 4-12
RETARDATION FACTORS FOR ORGANIC CONTAMINANTS
SUMMIT NATIONAL SITE

Substance	Retardation Factor
Methylene Chloride	1.3
1,1-Dichloroethane	2.9
1,2-Dichloroethane	2.0
2-butanone	1.0
1,1,1-Trichloroethane	5.7
Trichloroethene	7.1
Toluene	16.4
Ethylbenzene	1.1
Phenol	1.9
Isophorone	1.0
2,4-Dimethylphenol	1.1
Naphthalene	2.1
Bis (2-ethylhexyl)phthalate	17,000,000

See Appendix E for calculations and assumptions.

Groundwater in the water-table aquifer beneath the site flows southward and eastward. There is also some northeasterly flow on the northern portion of the site, outside of the contaminated area. Groundwater in the southern portion of the site is contaminated with a number of organic HSL parameters and with numerous metals. Most of the metals, however, are probably the result of strip-mining activities on site. The southwest quarter of the site is the source of the greatest concentration of organic contaminants. The southeast quarter of the site appears to be more influenced by miscellaneous refuse-related contaminants.

Groundwater flow in the intermediate units is complex. Lateral components are vanishingly small. Vertical gradients across the units vary from upward in the area immediately south of the site to downward in the central portion of the site. Portions of the intermediate units are contaminated with the same organic substances identified in the water-table aquifer.

Groundwater in the Upper Sharon aquifer flows northward. These waters are uncontaminated, but do have a naturally high sodium content. The potential for contaminant migration to this zone does exist, and it may become contaminated in the future.

Numerous private wells are present in the site vicinity, and are completed in all strata present beneath the site, as well as the Connoquenessing Sandstone, which is absent beneath the site. No contamination was detected in any of the nine domestic wells sampled except for slightly elevated levels of barium observed in the [redacted] private well.

4.4 SOILS

4.4.1 Characteristics and Description

Soils in this area of Portage County were deposited by the fourth advance of the Wisconsin Glacier and are characterized by low fertility and moderate to high acidity, with a pH in the range of 4.5 to 6.5 (USGS, July 1981). The soils in the area of the Summit National site are of the Remsen-Geeburg-Trumbull association which is a high clay content clayey till derived from sandstone and shale. The soil is nearly

level or gently sloping, very poorly drained to somewhat poorly drained, and moderately permeable to very slowly permeable. The soils at the north half of the site are primarily till. The southern half of the site has been disturbed by past mining activities leaving fill and mine spoil. Residual soils are not present at the site due to past disturbances and regrading during surface cleanup activities.

4.4.2 Data and Results

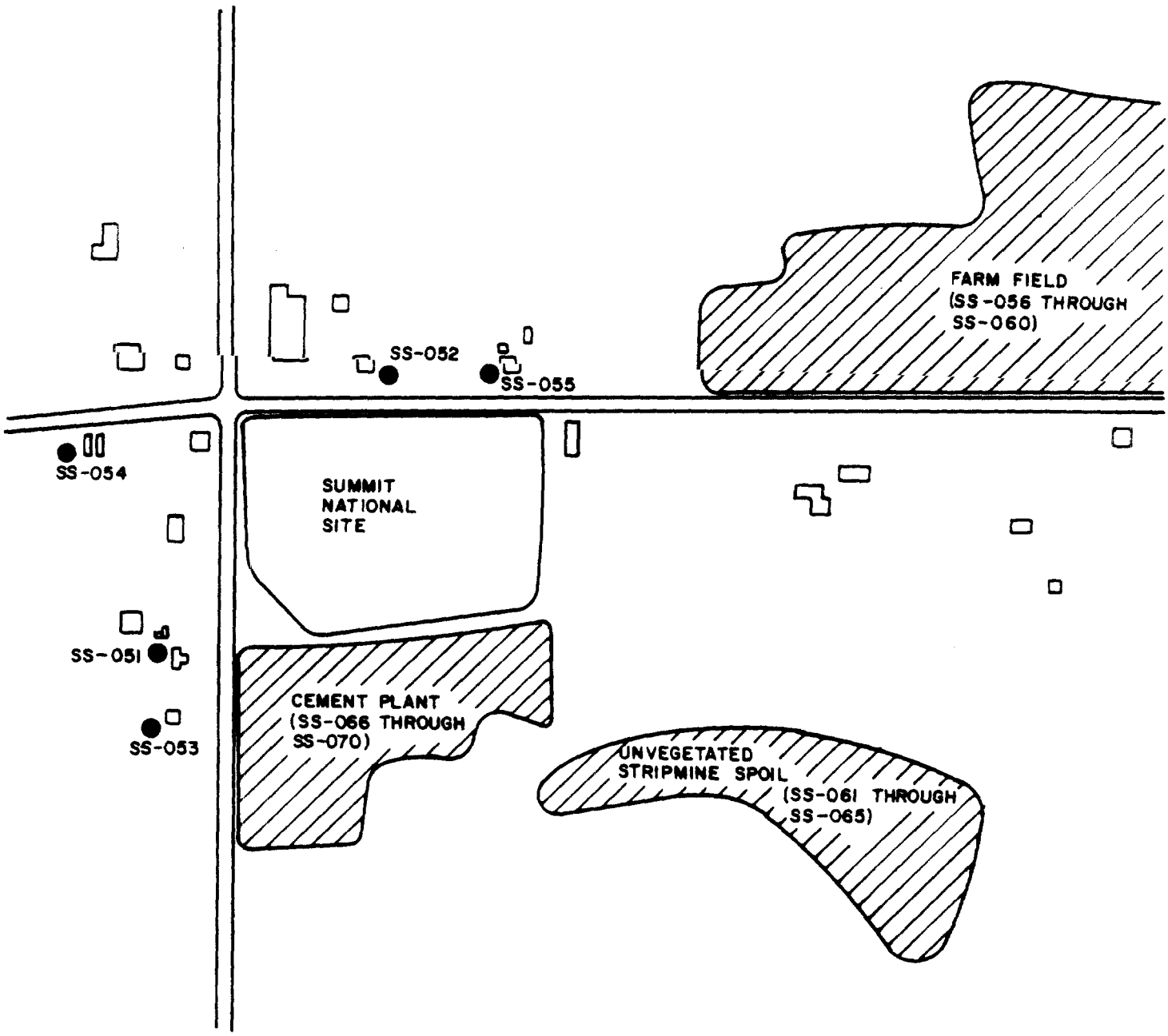
Data summary tables for onsite and offsite soils are presented in Appendix A. The surface soils and soils from 0 to 2 ft. are tabulated together. The remaining soils will be addressed in 2 ft. intervals down to a depth of 8 ft. The selection of soils for complete HSL analysis was based on the soil screening procedures and selection scenarios detailed in Section 3.2. As a rule, if an onsite surface sample and the sample at a depth of 6 to 8 ft. were both found to be contaminated, then the entire soil column was considered contaminated. In areas where the bottom (6 to 8 ft.) sample was not contaminated, then the next higher samples (i.e., 4 to 6 ft., then 2 to 4 ft.) were evaluated. A total of 61 samples were obtained from 0 to 2 ft., 8 from 2 to 4 ft., 5 from 4 to 6 ft., and 26 from 6 to 8 ft. Onsite soil sampling locations are shown on Figure 4-20.

The perimeter and offsite soil samples were either surface samples collected at depths from 0 to 2 ft. or from the 2 to 4 ft. or 4 to 6 ft. range (in Borings 2BB1 through 2BB4). Perimeter and offsite soil sample locations are shown on Figure 4-21. Background soil samples were taken at the surface after removal of vegetation and their locations are shown on Figure 4-22.

4.4.3 Summary and Conclusions

4.4.3.1 Criteria for Determining Contamination Levels

A total of 20 background samples were selected to represent local soil characteristics at the locations shown on Figure 4-22. The locations selected during the development of the work plan were assumed to be free of contamination from the site. Information collected during the field activities from current operators of the cement plant located adjacent to the southern site boundary indicated that soils from the



LEGEND

● SS-051 SOIL SAMPLING LOCATION

APPROXIMATE SAMPLING AREA

N

0 200 400

SCALE IN FEET

FIGURE 4 - 22
BACKGROUND
SOIL SAMPLING LOCATIONS
SUMMIT NATIONAL RI

cement plant would probably not be representative of local soils. It was reported that past dust control practices included the application of an oil brine to all of the plant's access roads. The oil brine is a possible source of the elevated levels of numerous organics, specifically PAH's, in the cement plant samples. Based on this information, these samples were eliminated as a basis for establishing background and only the farm, residential, and mine soil samples were used (total of 15). The cement plant soils will be addressed as perimeter and offsite soils.

A summary of organic and inorganic parameters identified in background soils is presented on Tables 4-13 and 4-14. A large number of parameters were detected in both the organic and inorganic fractions of the background soils. The source of these compounds is unknown based on available data. The elevated levels found in the surrounding background soils may be partially due to past incinerator activities that were performed at the site (USEPA, 1985). Fifteen of the 46 organic and inorganic compounds identified in background soils have been identified as products of incineration by USEPA studies (USEPA, 1985).

NOAA wind direction information obtained for Akron indicated a prevailing wind direction from the south five months a year, from the southwest five months a year, and from the northwest two months a year (Figure 4-23). This would result in some of the residential, farm, and mine soil background samples being downwind of the site for a portion of the year. However, primarily BNA compounds were found off site. None of the chlorinated volatiles found in the onsite soils were found in the background soils.

Another possibility for elevated levels of contaminants in background soils is that most of the organic (17 of 24) and inorganic (21 of 22) compounds detected in the background soils are commonly associated with coal mining regions. Many organic compounds, specifically PAH's and metals, are known products of coal mining, processing and burning (White, 1980 and USEPA, 1978). Since this area around the Summit National site is a coal mining region, past mining-related activities and their residuals may be influencing background soil characteristics. Other possible sources of PAHs include road oiling and paving activities, truck and car exhaust, as well as coal residue. Phthalates are also common field and laboratory contaminants.

TABLE 4-13
SUMMARY LIST OF ORGANIC PARAMETERS IDENTIFIED
IN BACKGROUND (1) SOILS
SUMMIT NATIONAL SITE

	Number of Times Detected (2)	Range of Detected Concentrations (3)	Mean Concentration(3)(4)	Standard Deviations(3)	Upper 95% Confidence Limit (3)
Volatile Parameters					
Toluene	14	4J - 31	9	8	13
Total Xylenes	2	6 - 7	1	2	2
BNA Parameters					
Benzoic Acid	3	160J - 1100J	126	331	297
Naphthalene	10	110J - 3500	859	1124	1438
2-Methylnaphthalene	11	55J - 3700	972	1196	1587
Acenaphthylene	2	83J - 150J	14	40	35
Dibenzofuran	8	230J - 810	212	265	349
Fluorene	2	65J - 94J	9	27	23
Hexachlorobenzene	1	330J	19	80	61
Pentachlorophenol	1	87J	5	21	16
Phenanthrene	15	42J - 2400	725	712	1091
Anthracene	3	67J - 280J	30	76	69
Di-N-Butylphthalate	6	49J - 270J	45	79	86
Fluoranthene	16	69J - 2100	353	470	594
Pyrene	16	54J - 1500	331	352	512
Benzo(a)Anthracene	14	59J - 1000	222	241	346
Bis(2-ethylhexyl)Phthalate	8	40J - 120	32	39	52
Chrysene	15	47J - 1100	268	302	423
Benzo(b)Fluoranthene	14	49J - 1900	351	480	598
Benzo(k)Fluoranthene	14	49J - 1900	351	480	598
Benzo(a)Pyrene	11	65J - 1100	161	271	301
Indeno(1,2,3-cd)Pyrene	4	82J - 550	68	158	150
Dibenz(a,h)Anthracene	2	97J - 120J	13	36	31
Benzo(g,h,i)Perylene	4	150J - 470	65	136	135
Pesticides/PCB's					
None	--	--			

Notes:

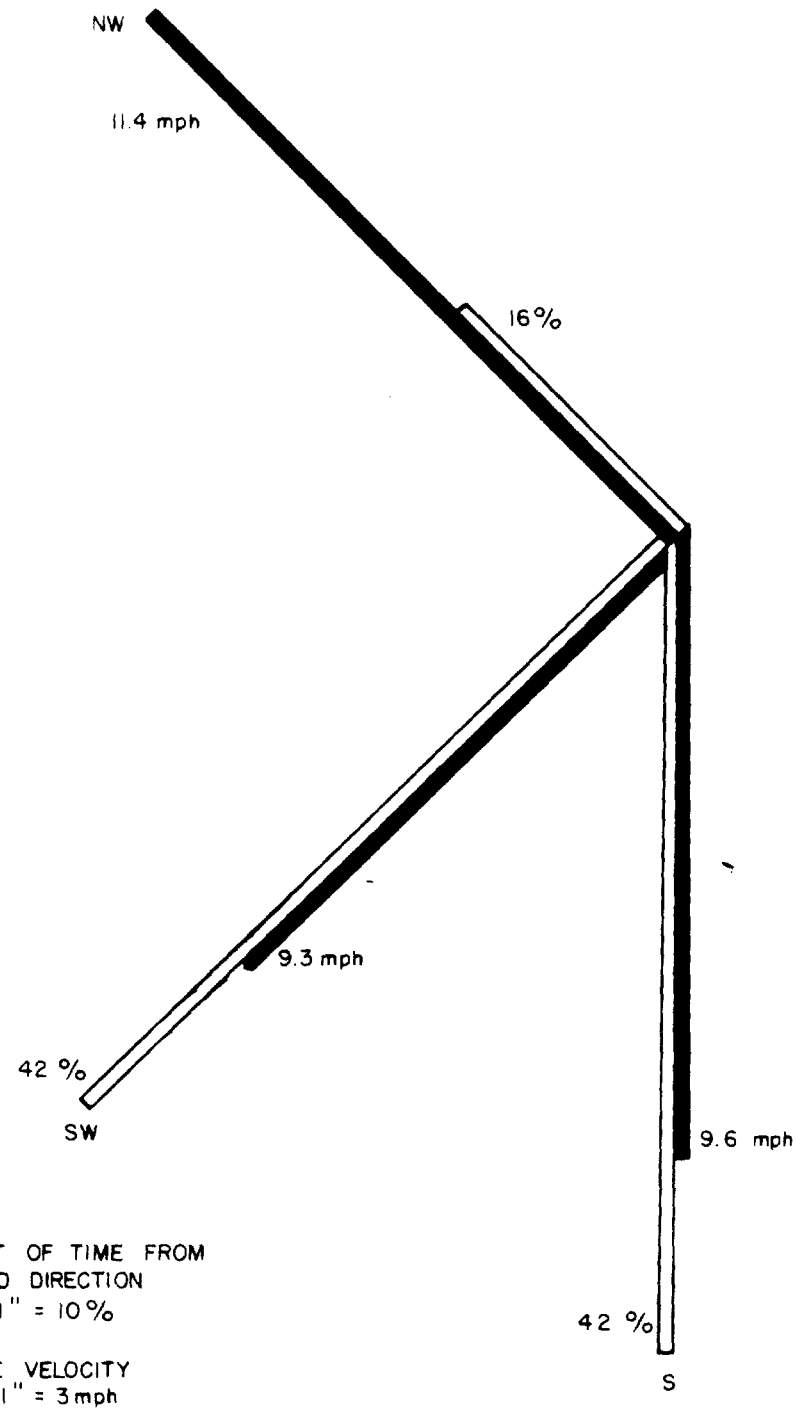
(1) - Includes residential, farm and mine soil samples
(2) - Out of total 17 samples
(3) - Units - ug/kg
(4) - Mean calculated using zero for samples where parameters not detected
J - Estimated Value
B - Found in laboratory blank

TABLE 4-14
SUMMARY LIST OF INORGANIC PARAMETERS IDENTIFIED
IN BACKGROUND SOILS (1)
SUMMIT NATIONAL SITE

Parameter	Number of Times Detected (2)	Range of Detected Concentrations (3)	Mean Concentration (3)(4)	Standard Deviations(3)	Upper 95% Confidence Limit (3)
Aluminum	17	4070 - 18100	9661	3964	11699
Antimony	1	[20]R	1	5	4
Arsenic	16	[5.8] - 26	16	6	19
Barium	17	[28] - [145]	85	29	100
Beryllium	15	[0.32] - [1.3]	0.54	0.538	0.726
Cadmium	11	[2.3] - 4.1	2	2	3
Calcium	14	[201] - 5510	3253	7903	7316
Chromium	17	12 - 24	17	3	18
Cobalt	17	[5.9] - 21	11	4	13
Copper	17	[16] - 51	25	9	29
Iron	17	16600 - 39400	25694	7543	29572
Lead	17	17 - 391	66	98	117
Cyanide	8	.69 - 4.2	0.65	1.045	1.186
Magnesium	17	[1720] - 5340	2356	829	2782
Manganese	17	105J,R - 1580J,R	729	531	1003
Mercury	3	[.095] - .38	0.043	0.108	0.098
Nickel	17	[11] - 38	16	6	19
Potassium	17	[905] - [3100]	1832	639	2161
Silver	10	[2.5]J,R - 16J,R	3	4	5
Sodium	1	[779]	46	189	143
Vanadium	17	[14] - [36]	24	6	26
Zinc	17	50 - 227	87	49	113

Notes:

(1) Includes residential, farm, and mine soil samples
(2) Out of total 17 samples
(3) Units - mg/kg dry weight
(4) Mean calculated using zero for samples where parameters not detected
[] - Positive value less than contract required detection limit
R - Spike sample recovery not within contract limits
J - Estimated value



LEGEND:

PERCENT OF TIME FROM INDICATED DIRECTION
SCALE: 1" = 10%

AVERAGE VELOCITY
SCALE: 1" = 3 mph

NOTE: BASE ON PREVALING MONTHLY WIND DIRECTIONS THROUGH 1963

SOURCE: 1985 LOCAL CLIMATOLOGICAL DATA ANNUAL SUMMARY WITH COMPARITIVE DATA AKRON, OHIO

NOAA - ASHVILLE, NC - 595

FIGURE 4-23
PREAILING WIND DIRECTIONS
SUMMIT NATIONAL R I

4.4.3.2 Methods of Evaluation

The assessment of soil contaminants will address all compounds detected in soils at levels that exceeded background. An onsite soil was considered to be contaminated if its maximum and mean values both exceeded the upper 95% confidence limit for background soils. For those compounds where the mean did not exceed, but the maximum value was found to exceed the upper 95% confidence limit, an evaluation of the number of samples that exceeded background was made. If only a few samples exceeded background, then the compound was excluded from the summary table and addressed separately. Any parameters found at levels less than 100 ug/kg for organics, or 100 mg/kg for inorganics and also found in the blank were considered to be zero for statistical analysis. Any parameters reported below the detection limit were also considered to be zero for statistical analysis.

4.4.3.3 Onsite Surface Soils

Based on the data obtained during the RI sampling, the onsite surface soils at the Summit National site are contaminated with compounds from all of the fractions analyzed.

A summary list of volatile, BNA and PCB and inorganic parameters identified in onsite surface soils is presented in Tables 4-15 through 4-17, respectively. An areal distribution of total volatile, BNA and PCB and inorganic parameters is presented in Figures 4-24 through 4-27, respectively.

The focus of the discussion of the onsite soils contamination will be centered on the surface soils and the 6 to 8 ft. soils. Based on the screening methodology used for sample collection, if the surface and 6 to 8 ft. soils were contaminated, they were sent to the laboratory for analysis and the soils from 2 to 6 ft. were assumed to also be contaminated. It is felt that those in between soils (2 to 6 ft.) would not be isolated and separated during any soil removal activities that may occur. The 2 to 4 ft. and 4 to 6 ft. deep soils will be addressed in a later section to provide complete site soil characterization.

TABLE 4-15

SUMMARY LIST OF VOLATILE PARAMETERS IDENTIFIED

IN ONSITE SURFACE SOILS THAT EXCEED BACKGROUND

SUMMIT NATIONAL SITE

Volatile Parameters	Number of Times Detected (1) Onsite	Range of Detected Concentrations (2) Onsite	Mean Concentrations (2)(3) Onsite	Standard Deviation (2) Onsite	Upper 95% Confidence Limit in Background Samples (2)	Upper 95% Confidence Limit in Residential Soil Samples (2)
Methylene Chloride	22	3.8-18000B	406	2375	ND	ND
Acetone	25	6J-520000B	9484	66152	ND	ND
Carbon Disulfide	3	5-10	0	2	ND	ND
1,1-Dichloroethene	2	3.2-33	1	4	ND	ND
1,1-Dichloroethane	5	7-15	1	3	ND	ND
Trans-1,2-Dichloroethene	7	2.4-381	9	49	ND	ND
Chloroform	10	2J-4300J,**	72	546	ND	ND
1,2-Dichloroethane	9	44-80000**	3177	14120	ND	ND
2-Butanone	15	5J-38000B,**	1682	6901	ND	ND
1,1,1-Trichloroethane	31	3J-51000**	2216	9022	ND	ND
Trichloroethene	38	2J-160000**	8017	30691	ND	ND
1,1,2-Trichloroethane	2	14-48	1	6	ND	ND
Benzene	30	1J-24	3	5	ND	ND
Hexanone	5	19-4400**	146	783	ND	ND
4-Methyl-2-Pentanone	2	78-45000**	739	5714	ND	ND
Tetrachloroethene	12	1J-4600J,**	97	604	ND	ND
Toluene	40	2.2-260000**	7002	34207	13	11
Chlorobenzene	9	4J-3600**	62	457	ND	ND
Ethylbenzene	18	3.7-180000**	4882	24924	ND	ND
Total Xylenes	27	7.3-730000**	20440	101649	2	ND

(1) Out of total 61 samples

(2) Units ug/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

J Estimated value

B Found in laboratory blank, indicates possible/probable contamination

** Analyzed at medium concentration

ND Not detected

TABLE 4-16
SUMMARY LIST OF BNA AND PESTICIDE/PCB PARAMETERS IDENTIFIED
IN ONSITE SURFACE SOILS THAT EXCEED BACKGROUND
SUMMIT NATIONAL SITE

BNA Parameters	Number of Times Detected (1) Onsite	Range of Detected Concentrations (2) Onsite	Mean Concentrations (2)(3) Onsite	Standard Deviation (2) Onsite	Upper 95% Confidence Limit in Background Samples (2)	Upper 95% Confidence Limit in Residential Soil Samples (2)
Phenol	8	290J-44000**	1304	6368	ND	ND
1,3-Dichlorobenzene	2	330J	11	59	ND	ND
1,4-Dichlorobenzene	4	76J-18000J,**	304	2285	ND	ND
1,2-Dichlorobenzene	9	52J-140000**	3811	19627	ND	ND
2-Methylphenol	6	310J-4800	165	689	ND	ND
4-Methylphenol	4	45J-830	29	136	ND	ND
Isophorone	4	63J-3000	111	533	ND	ND
2,4-Dimethylphenol	5	800J-7000	213	966	ND	ND
Benzoic Acid	6	1,600J-8000J	370	1299	297	885
1,2,4-Trichlorobenzene	6	330J-14000	293	1786	ND	ND
Naphthalene	30	260J-43000**	1965	5883	1438	1214
2-Methylnaphthalene	30	370-14000	1856	3410	1587	1726
Hexachlorocyclopentadiene	3	53000**-2800000**	84475	456241	ND	ND
Acenaphthene	7	48J-1600J	69	252	35	106
Diethylphthalate	8	330J-1600J	95	283	ND	ND
Fluorene	10	65J-1600J	81	256	23	71
N-Nitrosodiphenylamine	5	800J-1600J	79	279	ND	ND
Hexachlorobenzene	21	48J-250000**	8811	38049	61	196
Phenanthrene	28	270J-13000J,**	1095	2231	1091	1122
Anthracene	2	1600J-13000J,**	239	1660	69	199
Di-N-Butylphthalate	23	140J,B-12000J,**	1538	3107	86	213
Butylbenzylphthalate	11	330-12000J,**	592	2052	ND	ND
Bis(2-ethylhexyl)Phthalate	47	550B-3300000**	103511	453957	52	107
Di-N-Octyl Phthalate	30	48J-170000**	7925	28180	ND	ND
Pesticide Parameters						
Heptachlor Epoxide	2	19.8J-20J	1	4	ND	ND
PCB's (4)	19	40J-590000C,**	17058	83969	ND	ND

(1) Out of total 61 samples
(2) Units ug/kg dry weight
(3) Mean calculated using zero for samples where parameters not detected
(4) Arochlor 1232, 1242, 1248, 1254
J Estimated value
** Analyzed at medium concentration
B Found in laboratory blank, possible/probable contamination
ND Not detected
C Identification confirmed by GC/MS

TABLE 4-17

SUMMARY LIST OF INORGANIC PARAMETERS IDENTIFIED
IN ONSITE SURFACE SOILS THAT EXCEED BACKGROUND
SUMMIT NATIONAL SITE

Inorganic Parameters	Number of Times Detected (1) Onsite	Range of Detected Concentrations (2) Onsite	Mean Concentrations (2)(3) Onsite	Standard Deviation (2) Onsite	Upper 95% Confidence Limit in Background Samples (2)	Upper 95% Confidence Limit in Residential Soil Samples (2)
Antimony	11	[16]R-545R	17	71	4	ND
Arsenic	53	7.3S-[35]R	17	9	19	24
Barium	61	[39]-343	103	58	100	133
Beryllium	36	[0.32]-[1.9]	0.59	0.56	0.726	1.074
Cadmium	13	[2.4]-112	3	14	3	3
Calcium	61	[864]-38029	8982	9281	7316	4289
Chromium	61	8.7-102	27	18	18	23
Cobalt	48	[4.6]-[28]	11	8	13	18
Copper	61	[7]-175	37	27	29	43
Cyanide	37	0.31*-43.6	4	11	1.186	2.895
Iron	61	11489-95300	39531	18264	29572	30494
Magnesium	60	[326]-6120	2827	1344	2782	4142
Manganese	61	29-2620	365	346	1003	1362
Mercury	36	[0.084]-0.81	0.167	0.198	0.098	0.289
Nickel	58	[5.3]-56	26	12	19	30
Selenium	2	3R-8.2R	0	1	ND	ND
Sodium	34	[106]-[1280]	164	229	143	ND
Tin	7	[13]R-106	3	14	ND	ND
Vanadium	61	[14]-62	28	12	26	32
Zinc	61	24-803	168	149	113	197

(1) Out of total 61 samples
(2) Units mg/kg dry weight
(3) Mean calculated using zero for samples where parameters not detected
R Spike recovery not within control limits
[ ] Positive values less than the contract required detection limit
S Value determined by standard addition

A total of 20 volatile parameters were detected in the onsite surface soils at levels that exceeded background. Eighteen of these volatiles were not detected in background samples (see Table 4-13).

Toluene and total xylene were detected in background soils, but the mean onsite levels were found to be 2 and 4, respectively, orders of magnitude greater than the upper 95% confidence limit for background. This data suggests the onsite soils are contaminated with both toluene and xylene. Methylene chloride, acetone, 1,1,1-trichloroethane, trichloroethene, benzene, toluene, and total xylene were detected in at least 22 (36%) of the onsite surface soil samples. Methylene chloride and acetone are common laboratory contaminants, but the mean concentrations (406 and 9484 ug/kg) found in the onsite surface soil is above what could possibly be attributed to the laboratory.

A summation of total volatiles detected in each sample was made to locate the areas of the site that had the highest levels of volatile contamination. The total volatile concentrations for each sample are shown on Figure 4-24. Fifteen out of 61 samples (or upper 25%) representing the cells with the greatest concentrations of total volatile organics are highlighted on Figure 4-24. The highest concentrations of surface contamination were detected in the south central area of the site, at or near the concrete block pit. All of the cells have volatile contamination.

The background soils were found to have detectable levels of 20 BNA compounds. The onsite surface soils generally had mean concentrations that exceed upper 95% confidence limits in background soils. Hexachlorocyclopentadiene (C-56) was detected in three samples at concentrations that ranged from 53,000 to 2,800,000 ug/kg. This is a compound that has been identified as a drummed waste that was found during early site investigations. It was one of the compounds that was the basis for a federally sponsored emergency removal action involving the site surface cleanup (RAMP 8/83). The high levels detected indicate a concentrated area of C-56. All three samples were from cell 5-4, the location of the concrete block pit. Napthalene, 2-methyl napthalene, hexachlorobenzene, phenanthrene, di-n-butyl phthalate, fluoranthene, pyrene, bis (2-ethylhexyl) phthalate, and di-n-octyl phthalate were detected in at least 21 (34%) of the onsite surface soil samples.

Dibenzofuran, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)flouranthene, benzo(a)pyrene, ideno (1,2,3-cd)pyrene and benzo(g,h,i)perylene were all found to have mean concentrations that were below the upper 95% confidence limit in background samples. Only 15% or less of the 61 samples for each compound had concentrations that exceeded background. These samples were located in the northwest and southeast corner of the site and are not used to represent overall surface soil contamination.

Fifteen of the 61 samples (or upper 25%) representing the cells with the highest concentrations of total BNA organics are highlighted on Figure 4-25. As was the case with the volatiles, the highest concentrations of BNA surface contamination occur in the south central area of the site, but are spread out and distributed over a much larger area to the north than the volatile contamination. All but 10 of the cells have BNA contamination.

PCBs (primarily arochlor 1248) were detected in 19 or 31% of the onsite surface soils sampled at a mean concentration of 17,058 ug/kg. Seven of the 19 samples with PCBs detected were reported by the EPA QA/QC review to be questionable due to meaningless surrogate recoveries (Table 4-2). The highest valid level detected (590,000 ug/kg) was for arochlor 1248 in cell 4-5 (see Figure 4-26). Fifteen out of 61 samples (or upper 25%) representing the highest PCB contaminated cells are highlighted on Figure 4-26. Twenty of the 47 cells have PCB contamination. There were no PCBs detected in the background samples. The areas contaminated with PCBs are spread out across the site more than those with volatile or BNA contamination.

Eight of the 20 inorganic compounds detected at levels that exceeded background were found in all 61 onsite surface soil samples. Iron was detected in the highest levels at a mean concentration of 39,531 mg/kg. Arsenic, beryllium, cobalt and mercury had means that did not exceed the upper 95% confidence limit for background soils. Each of these compounds, however, was detected at levels exceeding background in over 40% of the 61 samples and were included on the summary list. Aluminum, lead, potassium and silver were detected in less than 20% of the 61 samples at concentrations exceeding background and were not included to represent overall site soil contamination.

Aluminum and potassium were scattered over the site, lead was found near the concrete block pit, and silver was found in the sample along the west border of the site. A comparison of onsite data to typical U. S. concentrations (Table 4-18) showed that 11 of the 20 compounds that exceeded background levels were also greater than the average typical U. S. levels. This would add additional context to the noted exceedences of background levels used to indicate that the onsite soils have been contaminated. Fifteen out of 61 samples (or upper 25%) representing the highest inorganic contaminated cells are highlighted on Figure 4-26. All of the cells have inorganic contamination. The inorganic contamination appears concentrated in the northern half of the site and is more widely scattered than the organic contamination.

An additional comparison of onsite surface soil to only residential background soils was also made. The upper 95% confidence limits for residential soils are also shown on Tables 4-15 through 4-17. The results of this comparison also concluded that the onsite soils are contaminated and that contaminant concentrations exceed background (residential only) for a nearly equivalent number of compounds as in the comparison to all background. A summary of this additional comparison follows:

	Comparing to All Background	Comparing to Residential Only
Volatile Fraction	20 of 20 parameters detected on site exceeded background (18 ND in background)	20 of 20 parameters detected on site exceeded residential (19 ND in residential)
BNA Fraction	23 of 24 parameters detected on site exceeded background (14 ND in background)	22 of 24 parameters detected on site exceeded residential (14 ND in background)
Inorganic Fraction	8 of 20 parameters detected on site exceeded background (2 ND in background)	8 of 20 parameters detected on site exceeded residential (4 ND in residential)

TABLE 4-18
TYPICAL CONCENTRATIONS OF METALS IN U. S. SOILS
SUMMIT NATIONAL SITE

Metal	Range	Average
Aluminum	--	71,000
Antimony	2-10	--
Arsenic	1-50	10
Barium	100-3,000	430
Beryllium	0.1-40	6
Boron	2-100	--
Cadmium	0.01-0.7	0.06
Chromium	1-1,000	100
Cobalt	1-40	8
Copper	2-100	30
Iron	50,000-300,000*	50,000*
Lead	2-200	10
Lithium	--	20
Manganese	20-3,000	600
Mercury	0.01-0.3	0.03
Molybdenum	0.2-5.0	2
Nickel	5-500	100
Selenium	0.1-2.0	0.50
Silver	0.01-5	0.05
Strontium	50-1,000	300
Thallium	--	5
Tin	2-200	10
Vanadium	20-500	100
Zinc	10-300	50

Notes:

units - mg/kg
-- Unknown
* From Bohn, McNeal, and O'Connor, 1979
Source: U. S. EPA, 1983

Based on screening methodologies, the next zone of soils investigated was the 6 to 8 ft. depth. If contamination was found here, then all soils in between 2 to 6 ft. were considered contaminated. The 6 to 8 ft. was the second step for soil samples screened and resulted in the second highest number of samples obtained, 26.

The summary list of volatile, BNA and PCB, and inorganic parameters identified in onsite subsurface soils (6 to 8 ft.) is presented in Tables 4-19 through 4-21, respectively. The areal distribution of total volatile, BNA and PCB, and inorganic parameters is presented in Figures 4-28 through 4-31, respectively. All subsurface data was collected during Phase II.

A total of 17 volatile compounds were detected in the 6 to 8 ft. soils at levels that exceeded background. Fifteen of these were not detected in background.

Toluene and total xylenes were detected in background samples but their mean onsite concentrations of 9,818 and 39,927 ug/kg, respectively, were 3 to 4 orders of magnitude greater than the upper 95% confidence limit for background. Acetone, carbon disulfide, 1,1-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane, trichloroethene, benzene, toluene, ethylbenzene and total xylene were detected in at least 9 (35%) of the onsite samples at 6 to 8 ft. In general, the volatile results correlate with the onsite surface soil contamination data and are indicative of onsite contamination. The 7 out of 26 (or upper 25%) samples representing cells contaminated with total volatiles are highlighted on Figure 4-28 and are located primarily in the south central portions of the site. All of the 26 cells sampled have volatile contamination.

The onsite 6 to 8 ft. soils had 18 BNA compounds found at mean concentrations that exceeded the upper 95% confidence limit in background soils. Pentachlorophenol, anthracene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene had mean concentrations below the upper 95% confidence limit in background soils. Each

TABLE 4-19

SUMMARY LIST OF VOLATILE PARAMETERS IDENTIFIED

IN ONSITE SOILS (6-8 FT.) THAT EXCEED BACKGROUND

SUMMIT NATIONAL SITE

Volatile Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentrations (2)(3)	Standard Deviation (2)	Upper 95% Confidence Level in Background Samples(2)
Methylene Chloride	8	190J,**-6000B,J,**	814	1766	ND
Acetone	10	130B-42000B,**	5272	11024	ND
Carbon Disulfide	10	3J-10	2	3	ND
1,1-Dichloroethene	5	3J-7600J,**	293	1461	ND
1,1-Dichloroethane	10	3J-41000**	2104	8169	ND
Trans-1,2-Dichloroethene	5	3J-7100	482	1682	ND
1,2-Dichloroethane	9	14-68000**	5887	17558	ND
2-Butanone	7	180J,B,**-40000B,**	5368	11033	ND
1,1,1-Trichloroethane	15	4J-230000**	10252	44102	ND
Trichloroethene	20	4J-430000**	21525	83962	ND
Benzene	19	4J-110	19	23	ND
4-Methyl-2-Pentanone	8	4J-6400J,**	354	1301	ND
Tetrachloroethene	6	3J-2500J,**	193	639	ND
Toluene	26	17-140000**	9818	28420	13
Chlorobenzene	5	5-5200**	203	999	ND
Ethylbenzene	24	3J-76000J,**	9789	20794	ND
Total Xylenes	26	9-270000**	39927	84355	2

(1) Out of total 26 samples

(2) Units ug/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

J Estimated value

B Found in laboratory blank, indicates possible/probable contamination

** Analyzed at medium concentration

ND Not detected

TABLE 4-20
SUMMARY LIST OF BNA AND PESTICIDE/PCB PARAMETERS IDENTIFIED
IN ONSITE SOILS (6 - 8 FT.) THAT EXCEED BACKGROUND
SUMMIT NATIONAL SITE

BNA and PCB Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentrations (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Background Samples (2)
Phenol	2	87J-740	32	143	ND
1,4-Dichlorobenzene	2	240J-2300J,**	9	46	ND
1,2-Dichlorobenzene	4	49J-17000**	748	3266	ND
Isophorone	2	44J-720	29	138	ND
1,2,4-Trichlorobenzene	2	100J-210J	12	44	ND
Naphthalene	24	79J-7800**	1802	2101	1438
2-Methylnapthalene	25	130J-6800**	1639	1604	1587
Fluorene	11	63J-380	83	125	23
Hexachlorobenzene	3	960-34000**	1445	6532	61
Phenanthrene	25	110J-4700J,**	1122	1214	1091
Di-N-Butylphthalate	16	100J,B-2400J,**	357	586	86
Butylbenzylphthalate	4	450J-4900J,**	383	1133	ND
Bis(2-ethylhexyl)Phthalate	26	71J-370000**	28086	76468	52
Di-N-Octyl Phthalate	12	44J-22000**	1307	4272	ND
Indeno(1,2,3-cd)pyrene	5	54J-2900J,**	134	558	150
Dibenz(a,h)Anthracene	3	66J-2700J,**	122	522	31
Benzo(g,h,i)Perylene	14	53J-4500J**	255	855	135
Pesticides					
4,4'-DDT	2	27-36	2	8	ND
PCB's(4)	7	990-37000**	2230	7245	ND

(1) Out of total 26 samples
(2) Units ug/kg dry weight
(3) Mean calculated using zero for samples where parameters not detected
(4) Arochlor 1232, 1242, 1248, 1254
J Estimated value
** Analyzed at medium concentration
B Found in laboratory blank, possible/probable contamination
ND Not detected

TABLE 4-21

SUMMARY LIST OF INORGANIC PARAMETERS IDENTIFIED

IN ONSITE SOILS (6 - 8 FT.) THAT EXCEED BACKGROUND

SUMMIT NATIONAL SITE

Inorganic Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentrations (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Background (2)
Arsenic	26	9.3J-29J	19	5	19
Barium	26	[35]-253	81	50	100
Beryllium	26	[0.45]-[1.8]	0.54	0.35	0.726
Chromium	26	8.8-29	17	4	18
Cobalt	26	[7]-51	15	8	13
Copper	26	19-66	30	9	29
Iron	26	20800-48900	32462	7310	29572
Magnesium	26	[1340]-5140	3233	1060	2782
Nickel	26	[14]-47	29	9	19
Potassium	26	[1220]-3450	1730	494	2161
Zinc	26	41-195	90	35	113

(1) Out of total 26 samples

(2) Units mg/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

R Spike recovery not within control limits

[ ] Positive values less than the contract required detection limit

S Value determined by standard addition

J Estimated value

of these compounds had less than 8% (2 out of 26) samples that exceeded the background and were eliminated from discussion. Acenapthene and dibenzofuran had only 20% or fewer samples exceeding background and were also not considered to represent overall site soil characteristics in the 6 to 8 ft. depth.

Similar numbers and types of contaminants found in the 6 to 8 ft. depth were also found in the surface soils, including naphthalene, 2-methylnapthalene, fluorene, phenanthrene and four others (see Table 4-20). The VOC concentrations detected in the 6 to 8 feet range were higher than those levels detected in onsite surface samples. The increase in VOC concentration with depth can have several causes in addition to the surface remedial activity in 1980. VOC can be concentrated at lower levels through infiltration of bulk materials, and they could be moved through percolation of precipitation through contaminated material. These mechanisms have an influence in the observed concentration gradients. BNAs were found in 11 (42%) of the samples. Seven out of 26 (or upper 25%) samples representing the highest contamination are highlighted on Figure 4-29 and are located in the central area of the site. All of the 26 cells sampled have BNA contamination.

PCBs were detected in 7 or 25% of the samples at a total mean concentration of 2,230 ug/kg for four species of Arochlor. The PCBs were found on site in the central area (Figure 4-30). Nine of the 26 cells sampled have PCB contamination. The highest total PCB concentration was in cell 4-6.

All 11 of the inorganic compounds detected at mean levels that exceeded background were found in all 26 samples obtained from the 6 to 8 ft. depth. Iron was detected in the highest levels with a mean concentration of 32,462 mg/kg. Comparison to typical U.S. concentrations (Table 4-18) showed that 5 of the 11 compounds that exceeded background were still less than U.S. levels. Antimony, cadmium, calcium, cyanide, and silver were found to have mean concentrations that were lower than the upper 95% confidence limit for background soils. These compounds were in 12% or fewer samples that exceeded background and were not considered to represent site soil characteristics. Sodium and mercury also had mean concentrations less than background. This data suggested these did not

represent overall site soil contamination at this depth. Seven out of 20 samples (upper 25%) representing cells with the highest inorganic concentrations are highlighted on Figure 4-31. All of the cells sampled have inorganic contamination. The majority are located in the southern half of the site which was the portion of the site that was the most disturbed due to past strip mining activities. These soils at 6 to 8 ft. may be residual mining soils.

A total of eight subsurface soil samples were obtained for the 2 to 4 ft. depth range. A summary list of volatile, BNA and PCB, and inorganic parameters identified in onsite subsurface soils (2 to 4 ft.) whose mean and maximum concentrations exceed the upper 95% confidence limit for background are presented in Tables 4-22 through 4-24, respectively. Compounds with 50% or more samples exceeding background were also listed. All subsurface soil data was collected during Phase II.

A summary list of volatile, BNA and PCB, and inorganic parameters identified in onsite subsurface soils (4 to 6 ft.) whose mean and maximum concentration exceeded the upper 95% criteria limit for background are presented in Tables 4-25 through 4-27. Compounds with 50% or more samples exceeding background were also listed. The data for the 2 to 4 and 4 to 6 ft. soils indicate that fewer numbers of contaminants were detected in these soils than in the surface and 6 to 8 ft. soils. However, enough parameters were detected at mean concentration that exceeded the upper 95% confidence limit for background to conclude that contamination is still a problem.

4.4.4 Summary of Onsite Soils

The onsite surface soils are contaminated at mean levels that exceeded the upper 95% confidence limit in background, based on all the surface soil data obtained during the Phase I and and Phase II sampling activities. The greatest volume of data was available for the surface soils and it demonstrated that contamination is widespread at the site. The volatile organic contamination was found in greatest concentrations in the south central area of the site near the concrete block pit. The BNA and PCB contamination were more widespread toward the north and inorganic contamination showed no identifiable pattern of contamination.

TABLE 4-22

SUMMARY LIST OF VOLATILE PARAMETERS IDENTIFIED

IN ONSITE SOILS (2-4 FT.) THAT EXCEED BACKGROUND

SUMMIT NATIONAL SITE

Volatile Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentrations (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Background Samples (2)
Methylene Chloride	1	470J,B	59	155	ND
Acetone	3	120B-17000B,**	2263	5579	ND
Carbon Disulfide	4	3J-20	6	7	ND
1,1-Dichloroethene	1	430J	54	142	ND
1,1-Dichloroethane	2	14-430J	56	142	ND
Trans-1,2-Dichloroethene	2	1400J-7700**	1138	2522	ND
1,2-Dichloroethane	2	81-3200J	410	1055	ND
2-Butanone	2	45000B,J-49000B,**	11750	20376	ND
1,1,1-Trichloroethane	5	10-43000**	8391	15255	ND
Trichloroethene	5	5-140000**	21502	45996	ND
1,1,2-Trichloroethane	1	510J	64	169	ND
Benzene	6	1J-110	26	34	ND
4-Methyl-2-Pentanone	3	14-15000J	2577	5040	ND
Tetrachloroethene	3	3J-3800J,**	476	1256	ND
Toluene	8	17-46000J	6990	15027	13
Chlorobenzene	4	11-670J	98	217	ND
Ethylbenzene	7	7-3800J	916	1553	ND
Total Xylenes	8	11-30000J	6083	10771	2

(1) Out of total 8 samples

(2) Units ug/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

J Estimated value

B Found in laboratory blank, indicates possible/probable contamination

** Analyzed at medium concentration

ND Not detected

TABLE 4-23
SUMMARY LIST OF BNA AND PESTICIDE/PCB PARAMETERS IDENTIFIED
IN ONSITE SOILS (2 - 4 FT.) THAT EXCEED BACKGROUND
SUMMIT NATIONAL SITE

Semi-Volatile Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentrations (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Background Samples (2)
Phenol	2	52J-3300	419	1089	ND
1,4-Dichlorobenzene	2	76J-1500J	197	493	ND
1,2-Dichlorobenzene	1	8300	1038	2745	ND
4-Methylphenol	1	68J	9	22	ND
2,4-Dimethylphenol	1	190J	24	63	ND
Benzoic Acid	1	9300	1163	3076	297
1,2,4-Trichlorobenzene	1	4200	525	1389	ND
Naphthalene	7	200J-27000**	5197	8493	1438
2-Methylnaphthalene	7	310J-44000**	8030	13854	1587
Dibenzofuran	6	120J-6300J,**	1468	2062	349
Fluorene	5	59J-2800J,**	527	916	23
Hexachlorobenzene	1	5800	725	1918	61
Phenanthrene	6	290J-16000**	3506	5113	1091
Di-N-Butylphthalate	5	150J,B-1800B	675	670	86
Fluoranthene	6	59J-2200J,**	760	840	594
Pyrene	6	160J-3600J,**	903	1159	512
Butylbenzylphthalate	1	2200	275	728	ND
Benzo(a)anthracene	4	78J-3000J,**	580	984	346
Bis(2-ethylhexyl)Phthalate	6	58J-130000	16622	42857	52
Chrysene	5	76J-2700J,**	522	880	423
Di-N-Octyl Phthalate	1	13000	1625	4299	ND
Indeno(1,2,3-cd)Pyrene	3	68J-1400J	194	457	150
Benzo(g,h,i)Perylene	4	73J-1200J	207	384	135
Pesticides					
Heptachlor Epoxide	1	550**	69	182	ND
PCB's (4)	1	6400C	800	2117	ND
Mirex	1	9000**	1125	2976	ND

(1) Out of total 8 samples
(2) Units ug/kg dry weight
(3) Mean calculated using zero for samples where parameters not detected
(4) Arochlor 1232, 1242, 1248, 1254
J Estimated value
B Found in laboratory blank, possible/probable contamination
C Identification confirmed by GC/MS
** Analyzed at medium concentrations

TABLE 4-24

SUMMARY LIST OF INORGANIC PARAMETERS IDENTIFIED

IN ONSITE SOILS (2 - 4 FT.) THAT EXCEED BACKGROUND

SUMMIT NATIONAL SITE

Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentrations (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Background (2)
Arsenic	8	14-61J	24	15	19
Barium	8	[61]-245	130	62	100
Beryllium	6	[0.49]-[0.93]	0.61	0.37	0.726
Cadmium	3	[2.7]-13	4	5	3
Chromium	8	9-732	102	238	18
Copper	8	22-43	34	6	29
Mercury	4	[0.074]-0.32	0.12	0.14	0.098
Nickel	8	[8.6]-27	20	7	19
Selenium	1	5.1S	1	2	ND
Thallium	1	[5.9]	1	2	ND
Tin	2	[15]-[20]	4	8	ND

(1) Out of total 8 samples

(2) Units mg/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

[ ] Positive values less than the contract required detection limit

J Estimated value

TABLE 4-25

SUMMARY LIST OF VOLATILE PARAMETERS IDENTIFIED

IN ONSITE SOILS (4 - 6 FT.) THAT EXCEED BACKGROUND

SUMMIT NATIONAL SITE

Volatile Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentrations (2)(3)	Standard Deviation (2)	Upper 95% Confidence Level in Background Samples (2)
Methylene Chloride	1	1700J,B	340	680	ND
Acetone	3	100B-48000B,J	9644	19178	ND
1,2-Dichloroethane	1	8900J	1780	3560	ND
2-Butanone	1	190000B,J	38000	76000	ND
1,1,1-Trichloroethane	2	5-2800J	561	1120	ND
Trichloroethene	2	4J-1100J	221	440	ND
Benzene	4	4J-31	15	13	ND
Toluene	5	36-26000J	5270	10365	13
Chlorobenzene	1	4J	1	2	ND
Ethylbenzene	5	4J-41000J	8206	16397	ND
Total Xylenes	5	11-240000J	48036	95982	2

(1) Out of total 5 samples

(2) Units ug/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

J Estimated value

B Found in laboratory blank, indicates possible/probable contamination

ND Not detected

TABLE 4-26

SUMMARY LIST OF BNA AND PESTICIDE/PCB PARAMETERS IDENTIFIED

IN ONSITE SOILS (4 - 6 FT.) THAT EXCEED BACKGROUND

SUMMIT NATIONAL SITE

BNA and PCB Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentrations (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Background Samples (2)
1,2-Dichlorobenzene	1	54J	11	22	ND
Fluorene	2	57J-69J	25	31	23
Di-n-Butylphthalate	3	380B-1095B	435	421	86
Butylbenzylphthalate	1	59J	12	24	ND
Bis(2-ethylhexyl)phthalate	5	47J-4500	1787	1884	52
Di-N-Octyl Phthalate	1	1300	260	520	ND
Pesticides					
Heptachlor Epoxide	1	680**	136	272	ND
Mirex	1	12000**	2400	4800	ND

(1) Out of total 5 samples

(2) Units ug/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

J Estimated value

B Found in laboratory blank, possible/probable contamination

ND Not detected

** Analyzed at medium concentrations

TABLE 4-27

SUMMARY LIST OF INORGANIC PARAMETERS IDENTIFIED

IN ONSITE SOILS (4 - 6 FT.) THAT EXCEED BACKGROUND

SUMMIT NATIONAL SITE

Inorganic Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentrations (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Background (2)
Antimony	1	[16]J,R	3	6	4
Chromium	5	11-115	35	40	18
Copper	5	29-43	34	5	29
Iron	5	24700-50800	34060	8933	29572
Magnesium	5	[1260]-6020	2954	1636	2782
Mercury	2	0.19-0.25	0.088	0.109	0.098
Nickel	5	[15]-40	25	9	19
Sodium	1	[680]	136	272	143
Zinc	5	51-359	129	116	113

(1) Out of total 5 samples

(2) Units mg/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

R Spike recovery not within control limits

[ ] Positive values less than the contract required detection limit

J Estimtaed value

Results from the samples obtained at 6 to 8 ft. suggest that the soils are contaminated down to the water table or saturation level. The 6 to 8 ft. samples detected similar volatiles as the surface samples.

PAH contamination appeared to be an offsite local area problem rather than a site related problem due to high levels in background and offsite soils after comparing offsite soil contamination levels to levels in the onsite surface soils. PCB concentrations were also found from the surface down to 8 ft. at concentrations in excess of background.

Inorganic parameters were found to exceed background in the surface soils and down to 8 ft. Iron was the parameter with the highest concentration in all surface and subsurface samples. This may be directly attributed to past mining activities. The elevated levels of inorganics in the onsite soils may not be directly attributed to onsite waste contamination, but rather to onsite chemically diverse environments different than offsite that may create a situation where metals are more easily released from the soil. Data that supports elevated metals concentration due to a combination of past mining and waste related site activities was detected in the 6 to 8 ft. samples. Metals contamination in the surface soils occurs over the entire site, while metal contamination in the deeper subsurface soils (mainly 6 to 8 ft.) is found mainly in the southern half of the site. The northern soils are only disturbed near the surface due to site surface cleanup, while the southern soils are disturbed down to rock due to past mining activities.

4.4.5 Offsite Soils

The northern and western boundaries of the site are defined by U.S. Route 224 and Ohio 225, respectively. The southern boundary is delineated by the existing drainage ditch. The extent of surface soil contamination migration off site by surface runoff is probably limited by these existing barriers and site topography. The eastern boundary has no such physical barrier and therefore perimeter samples were collected east of the boundary. The cement plant was originally sampled as part of the background sampling efforts.

The background soils were previously addressed in the first part of Section 4.4.3.

The cement plant soils were eliminated from the background category due to high contamination levels and reported use of oils in their operations which could directly relate to the PAHs (Polynuclear Aromatic Hydrocarbons) found in the samples. A closer look at the contamination problem in offsite soils at the cement plant or south of the site is presented next.

The first phase of off site and perimeter surface soil samples was obtained during Phase II-A activities. Samples obtained at the cement plant (specifically SS060001-SS070001) were found to have elevated levels of BNA parameters. As a result, the cement plant area was sampled again during Phase II-B. A total of 13 surface samples (0 to 2 ft.), three 2 to 4 ft. samples and two 4 to 6 ft. samples were obtained at the cement plant (see Figure 4-32). A summary of the parameters identified in these samples is present in Tables 4-28 through 4-31.

Two volatiles, methylene chloride and 1,2-dichloroethane were detected in the cement plant soils at levels that exceeded background. The number of volatiles in the surface samples was found to be slightly higher than the number found in the subsurface samples. Onsite surface soils showed higher mean volatile values than the cement plant soils, indicating they could have been a source of contamination. Aerial photographs that depict site drainage prior to 1975 when the southern ditch was rerouted show the northern edge of the cement plant to be a low-lying area that received drainage from the site.

Seventeen BNA compounds were detected at levels that exceed the upper 95% confidence limit for background. The majority of them are PAHs. High PAH levels are common in all offsite soils and the data indicate they may not be site-related contamination. The levels of PCBs detected in all the cement plant soils are in excess of background. The fact that PCB was found in samples obtained from all depths (0 to 6 ft.) is not inexplicable. The current cement plant operator has reported that the ground levels along the northern edge of the cement plant have been sequentially elevated in the past by dumping of waste cement and other debris. The molds used to cast the cement septic tanks are lubricated with an oil product. These may explain the

TABLE 4-28
SUMMARY OF ORGANIC PARAMETERS IDENTIFIED IN
CEMENT PLANT SURFACE SOILS THAT EXCEED BACKGROUND
SUMMIT NATIONAL SITE

Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentration (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Onsite Soil	Upper 95% Confidence Limit in Background
Soil						
Volatiles						
Methylene Chloride	6	2J-18	3	5	1007	ND
1,2-Dichloroethane	2	4J-16	1	4	6750	ND
BNA and PCB						
Naphthalene	7	229J-36000**	3628	9476	3453	1438
2-Methylnaphthalene	11	90J-55000**	5353	14471	2719	1587
Dibenzofuran	4	57J-12000**	1069	3174	96	349
Flourene	1	100J	8	27	146	23
Phenanthrene	7	136J-30000**	3338	8029	1660	1091
Anthracene	2	2500J,**-5500J,**	615	1559	659	69
Di-N-Butylphthalate	10	82J-1677B	425	469	2324	86
Fluoranthene	5	130J-20000**	2689	6217	300	594
Pyrene	5	130J-20000**	2455	5837	280	512
Benzo(a)Anthracene	4	190J-16000**	1787	4468	187	346
Bis(2-ethylhexyl)Phthalate	2	330J-469J	61	147	218378	52
Chrysene	5	72J-16000**	1999	4715	227	423
Benzo(b)fluoranthene	4	250J-21000**	2511	6078	160	598
Benzo(k)fluoranthene	4	250J-21000**	2511	6078	82	598
Benzo(a)pyrene	4	150J-10000**	1258	2981	116	301
Indeno (1,2,3-cd)Pyrene	1	5200J,**	400	1386	32	150
Benzo(g,h,i)Perylene	1	3900J,**	300	1039	175	135
PCB's	6	398-3100	887	1234	38305	ND

(1) Out of a total of 13 samples
(2) ug/kg dry weight
(3) Mean calculated using zero for samples where parameters not detected
J Estimated value
B Found in laboratory blank
** Analyzed at medium concentration

TABLE 4-29

SUMMARY OF INORGANIC PARAMETERS IDENTIFIED IN

CEMENT PLANT SURFACE SOILS THAT EXCEED BACKGROUND

SUMMIT NATIONAL SITE

Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentration (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Onsite Soil (2)	Upper 95% Confidence Limit in Background Soil(2)
Arsenic	12	8.7-78	21	19	19	19
Barium	13	[51]-578	166	154	118	100
Calcium	13	[982]-11400	19867	29892	11331	7316
Copper	13	[17]-119	36	25	44	29
Iron	13	6620-51700	32186	12702	44152	29572
Mercury	6	0.1-0.52	0.13	0.16	0.217	0.098
Nickel	12	[14]-36	25	10	29	19
Sodium	5	[766]-[5090]	676	1343	222	143

(1) Out of a total of 13 samples

(2) mg/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

[] Positive values less than the contract required detection limit

J Estimated value

E Estimated due to interference

R Spike recovery not within control limits

TABLE 4-30
SUMMARY OF ORGANIC PARAMETERS IDENTIFIED IN
CEMENT PLANT SUBSURFACE SOILS (2 - 6 FEET) THAT EXCEED BACKGROUND
SUMMIT NATIONAL SITE

Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentration (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Onsite Soil (2)	Upper 95% Confidence Limit in Background Soil(2)
Volatiles						
Methylene Chloride	3	2J-97	20	38	907	ND
BNA & PCB						
Isophorone	1	448	90	179	246	ND
Di-N-Butylphthalate	5	303J,B-1313B	743	349	2324	86
Butylbenzylphthalate	1	68J	14	27	1111	ND
Bis(2-ethylhexyl)phthalate	1	59J	12	24	218378	52
PCB	5	170-1240	628	483	38305	ND

(1) Out of a total of 5 samples
(2) ug/kg dry weight
(3) Mean calculated using zero for samples where parameters not detected
J Estimated value
B Found in laboratory blank

TABLE 4-31
SUMMARY OF INORGANIC PARAMETERS IDENTIFIED IN
CEMENT PLANT SUBSURFACE SOILS (2 - 6 FEET) THAT EXCEED BACKGROUND
SUMMIT NATIONAL SITE

Parameters	Number of Times Detected (1)	Range of Detected Concentrations (2)	Mean Concentration (2)(3)	Standard Deviation (2)	Upper 95% Confidence Limit in Onsite Soil (2)	Upper 95% Confidence Limit in Background Soil(2)
Cobalt	5	[14]-[23]	17	3	13	13
Copper	5	26-30	28	1	44	29
Magnesium	5	[2520]-4890	3608	852	3168	2782
Nickel	5	[22]-40	32	6	29	19

(1) Out of a total of 5 samples
(2) mg/kg dry weight
(3) Mean calculated using zero for sample where parameters not detected
[ ] Positive values less than the contract required detection limit
E Estimated due to interference

levels of PCB in the subsurface soils since they may have been surface soils subjected to lubricating oils. This is contradicted somewhat due to lack of PAHs in the subsurface soils. Therefore, the presence of PCBs but lack of PAHs poses a doubt whether the oil is the source of contamination. The persistence of PCBs and PAHs on site, and considering the previous drainage pattern (prior to rerouting of ditch in 1975) suggests that Summit National is the more probable source of contamination.

A summary of the inorganic parameters identified in the cement plant surface soils are present in Table 4-29. Eight of the parameters were detected at levels above background. Aluminum, beryllium, chromium, cobalt, lead, magnesium, potassium and zinc were detected at concentrations whose mean did not exceed the upper 95% confidence limit for background soils and had fewer than half of the samples whose maximum concentration exceeded the same 95% confidence limit. These compounds are not representative of contamination. Arsenic and barium were detected at concentrations that exceeded onsite surface soil levels. The cement plant has the highest maximum levels of arsenic and barium of any soils sampled during the RI. This fact, coupled with the 8 parameters exceeding background, presents a metals contamination problem at the cement plant. It is unknown if past cement plant activities could have partially attributed to these elevated levels, but the inorganic problem may not be entirely site related.

The eastern perimeter soils sampling locations are also shown on Figure 4-32. Samples SS-1-9-001 through SS-5-9-001 were sampled along a line 50 ft. east of the eastern fence.

The only volatile compound detected in the eastern perimeter soils above background concentration was toluene (Table 4-32). Onsite levels of toluene had an upper 95% confidence limit of 15,658 ug/kg, while the upper 95% confidence limit for background soils was 13 ug/kg. Toluene was detected in 7 of 9 samples at levels whose mean concentration did not exceed the upper 95% confidence limit for background soils, but the maximum concentration exceeded the same 95% confidence limit. In the BNA fraction, 21 parameters were detected with either maximum or mean concentrations in excess of the upper 95% concentration limit in background soils. Five of these parameters

TABLE 4-32
SUMMARY LIST OF ORGANIC PARAMETERS IDENTIFIED IN
EASTERN PERIMETER SOILS THAT EXCEED BACKGROUND (2)
SUMMIT NATIONAL SITE

Parameters	Eastern Perimeter Soils No. of Times Detected (1)	Range of Detected Concentration	Mean Concentration(3)	Standard Deviation	Upper 95% Confidence Limit in Onsite Surface Soils	Upper 95% Confidence Limit in Background Soils
Volatiles						
Toluene	7	4J-28	11	9	15658	13
BNA Parameters						
Benzoic Acid	1	500J	56	157	699	297
Naphthalene	7	125J-2000	872	766	3453	1438
2-Methylnaphthalene	7	125J-3200	1329	1187	2719	1587
Acenapthene	1	240J	27	75	133	35
Dibenzofuran	5	120J-870	260	310	96	349
Fluorene	1	480	53	151	146	23
Phenanthene	7	204J-6500	1334	1924	1660	1091
Anthracene	1	910	101	286	659	69
Di-n-butylphthalate	7	60J-10868	279	364	2324	86
Fluoranthene	5	86J-7100	947	2192	300	594
Pyrene	6	130J-4700	685	1434	280	512
Butylbenzylphthalate	1	67J	7	21	1111	ND
Benzo(a)Anthracene	4	88J-3000	429	931	187	346
Bis(2-ethylhexyl)Phthalate	4	45J-206J	54	72	218378	52
Chrysene	4	83J-2400	315	741	227	423
Benzo(b)Fluoranthene	4	120J-3200	462	992	160	598
Benzo(k)Fluoranthene	4	120J-3200	462	992	82	598
Benzo(a)Pyrene	3	41J-1700	238	531	116	301
Indeno(1,2,3-cd)Pyrene	3	41J-1700	238	531	32	150
Dibenz(a,h)Anthracene	2	89J-410	55	128	ND	31
Benzo(g,h,i)Perylene	4	120J-1200	194	368	175	135
PCB's	2	450-540	110	207	38305	ND

Notes:

(1) Out of a total of 9 samples
(2) ug/kg dry weight
(3) Mean calculated using zero for those samples where parameters were not detected
J Estimated value
B Found in laboratory blank

only exceeded background for one sample. All of these compounds except dibenz(a,h)Anthracene were found in the onsite surface soils and could be attributed to site-related transport of contamination.

In addition, PCBs were detected at levels higher than background (none detected) in the eastern perimeter soils. PCBs are a site related offsite contamination problem in the eastern perimeter soils. PCBs occur only in the soils near the site boundary (eastern perimeter and cement plant).

The inorganic compounds detected in eastern perimeter soils had either maximum or mean values that exceeded background in 22 of the parameters tested (Table 4-33). Nine compounds had mean concentrations that exceeded the upper 95% confidence limit in background soils. The high metals concentration in the onsite surface soils are probably the source of this contamination as site surface runoff from the easternmost pond has been observed to discharge offsite to the east.

4.5 SURFACE WATER

4.5.1 Surface Water Hydrology

The site is located within the watershed drained by the Mahoning River. The Mahoning River meanders generally to the east until joining the Ohio River in the state of West Virginia. The locations of the Mahoning River and Berlin Lake Reservoir with respect to the site are shown on Figure 4-33.

Comparison of site aerial photographs from the period between 1970 and 1985 indicates that the drainage pattern at the site prior to 1975 (Figure 4-34) was substantially different than the site's existing drainage pattern (Figure 4-35). Prior to 1975, surface water originating in the area west of the site crossed beneath Ohio Route 225 and was conveyed through the length of the site by means of an easterly flowing drainage ditch. It appears that this ditch received a majority of the site's surface water runoff. Runoff

TABLE 4-33
SUMMARY LIST OF INORGANIC PARAMETERS IDENTIFIED IN
EASTERN PERIMETER SOILS THAT EXCEED BACKGROUND (2)
SUMMIT NATIONAL SITE

Parameters	Eastern Perimeter Soils No. of Times Detected (1)	Range of Detected Concentration	Mean Concentration(3)	Standard Deviation	Upper 95% Confidence Limit in Onsite Surface Soils	Upper 95% Confidence Limit in Background Soils
Aluminum	9	2300-12700	8169	2627	9640	11699
Arsenic	9	9.9-20	13	3	19	19
Barium	9	[53]-295	134	73	118	100
Beryllium	7	[.52]-1.3	.529	.366	0.729	0.726
Cadmium	4	[2.8]-4.2	2	2	6	3
Calcium	9	[402]-19700	4706	5883	11331	7316
Chromium	9	15-22	18	3	32	18
Cobalt	9	[5]-[15]	11	3	13	13
Copper	9	29-56	36	7	44	29
Iron	9	26100-40600	30211	4452	44152	29572
Lead	9	17-241	99	85	49	117
Magnesium	9	[515]-4700	2742	1126	3168	2782
Manganese	9	54J-1350J	512	394	452	1003
Mercury	5	.2-1.1	.272	.347	0.217	0.098
Nickel	9	[18]-30	24	5	29	19
Potassium	9	[1190]-[2230]	1826	323	1923	2161
Selenium	1	3.3	0	1	0	ND
Silver	4	[2.7]J,R-[4.5]J,R	2	2	1	5
Sodium	6	[674]-[1150]	581	438	222	143
Tin	2	[16]-[22]	4	8	7	ND
Vanadium	9	[16]-[25]	20	3	31	26
Zinc	9	36-380	155	114	205	113

Notes:

(1) Out of a total of 9 samples
(2) mg/kg dry weight
(3) Mean calculated using zero for samples where parameters not detected
[ ] Positive values less than the contract required detection limit
R Spike recovery not within control limits
S Value determined by standard addition
J Estimated value

from the southern half of the site appeared to flow both to the north into the easterly flowing drainage ditch and to the south into a low-lying area outside of the current site boundaries. This area corresponds to what is now the northern boundary of the cement plant property south of the surface drainage ditch. Near the east end of the site, the drainage ditch turned south, crossing over the site's lower east boundary. From here, drainage continued to the south, forming a channel through the spoil piles left from previous strip mining operations. The drainage channel emptied into a long, narrow body of water formed by an abandoned strip mine pit. This strip pit, which was located approximately 800 feet south of the site, was also recharged by surface water runoff from the adjacent mine spoil piles and from a second mine spoil channel entering it near its east end. Overflow from the abandoned strip pit was discharged at the pit's east end. From this point, surface water generally flowed to the southeast.

For the site's existing drainage pattern (Figure 4-35), surface water flow originating in the area west of the site is no longer conveyed through the site after crossing under Route 225, but has been rerouted through a new drainage ditch along the outside of the site's south boundary. This south boundary drainage ditch, estimated to have been constructed prior to 1975 flows in an easterly direction until joining the southerly flowing drainage ditch near the site's southeast corner. The drainage ditch which crossed through the site prior to 1975 was apparently dammed in several places to form the two existing onsite ponds. The two ponds were estimated to contain a combined total of approximately 500,000 gallons of water, based on their surface water area and on depth soundings taken in these ponds during the Phase II site investigation. The east pond averaged 4.25 ft. deep with a surface area of 13,200 sq. ft., while the west pond averaged 1.25 ft. deep with a surface area of 7,400 sq. ft. The west pond empties into the east pond by way of a concrete culvert while the east pond conveys water off site through three metal pipes into the southerly flowing drainage ditch just outside the site's lower east boundary.

From the junction of these two ditches, drainage moves in a southerly direction along the old mine spoil channel until being impounded by a solid waste embankment about 500 feet south of the site. The refuse embankment was reported to have been built in late 1978 or early 1979 by a landfill company and fills the mine spoil channel to a height of 30 to 40 feet above channel bottom. The surface water impounded behind the embankment evidently percolates into the ground or through the embankment along the underlying drainage channel. Landfill operations also covered most of the abandoned strip mine pit into which the mine spoil channel previously emptied. A second impoundment, located approximately 950 feet to the southeast of the first impoundment, is actually the east end of the abandoned strip mine pit which was left uncovered during landfilling operations. This second impoundment appears to be recharged primarily by surface water runoff from the strip mine spoil drainage channel emptying into its north side. Water in the second impoundment apparently percolates into the ground or through its northeast embankment into the adjacent drainage channel. Drainage collected by the drainage channel is directed to the southeast and continues to flow within the watershed of the Berlin Reservoir.

Another drainage ditch crosses over the old roadway in the area east of the site. Drainage in this ditch has remained essentially the same since before 1975. Surface water collected by the portion of the ditch east of the old roadway is directed towards the east. Runoff collected by the portion of the ditch west of the old roadway flows west and then south along the site's east boundary until its junction with the lower east boundary ditch.

4.5.2 Flood Potential

A detailed flood study for the area surrounding the Berlin Lake Reservoir has never been undertaken, based on personal communication with the Army Corps of Engineers, Pittsburgh District (Jim Mendicino, November 1986). However, the threat of flooding at the site from the Berlin Lake Reservoir and its tributaries is reported by the Corps to be very unlikely. The minimal flood risk is due to the large difference in elevation between the site (approximately 1100 ft. MSL) and the maximum pool elevation of the reservoir (approximately 1025 ft. MSL), as shown on Figure 4-33.

4.5.3 Summary and Conclusions

Evaluation of the degree and extent of surface water contamination, both on and off site, would typically be based on the comparison of surface water data with background and upstream surface water concentrations. Based on field observations during the RI site investigation activities, surface water flow at or near the site exists only in response to precipitation events or discharge from the easternmost onsite pond. This accounted for the lack of flow data and the inability to collect surface water samples from several drainage channels during the Phase II sampling conducted in September, 1986. Since a perennial flow pattern has not been identified at the site, it is not possible to identify a sampling location that would be representative of upstream or background surface water quality. Several samples obtained in the stream channels during Phase II were of surface water ponded in low lying depressions in the stream channel. Therefore, background concentrations are assumed to be zero for comparative purposes. This will be used to represent local surface water that is assumed not to be affected by the site. Any parameters reported below the detection limit were considered zero for statistical analysis.

To assess whether some of the constituents detected in the surface water might be attributable to past surface mining activities, onsite ranges of concentrations for iron, manganese and sulfate, along with ranges for pH and specific conductance, were compared to a range of values for these parameters for surface water in the general mining region in which the site is located. These ranges were derived from numerous surface water samples collected in Area 4 of the Eastern Coal Province as part of a study by the USGS (1981). Area 4 encompasses portions of extreme eastern Ohio and western Pennsylvania, and the entire northern panhandle of West Virginia, and includes the Upper Ohio, Shenango, Beaver, and Mahoning River Basins.

4.5.3.1 Onsite Surface Water

A summary list of the organic constituents identified in onsite surface water are presented in Table 4-34. A summary list of inorganic and SAS parameters is presented in Table 4-35. The analytical results indicate that onsite surface water contains volatile, BNA and inorganic constituents at levels that exceed background.

TABLE 4-34
SUMMARY LIST OF ORGANIC PARAMETERS IDENTIFIED IN ONSITE SURFACE WATER
SUMMIT NATIONAL SITE[a]

Parameters	No. of Times Detected[b]	Range of Detected Concentrations	Mean Concentration[c]	Standard Deviation	Upper 95% Confidence Limit
Volatiles					
Methylene Chloride	4	2B,J-51	9	19	28
Acetone	6	30B,J-4000	1324	1857	3273
1,1-Dichloroethane	2	3J	1	1	2
1,2-Dichloroethane	4	38-860	295	389	704
2-Butanone	3	11B-16B	--	--	--
1,1,1-Trichloroethane	3	5-66	13	24	38
4-Methyl-2-pentanone	1	78	NA	NA	NA
Tetrachloroethene	1	24	NA	NA	NA
Toluene	3	1J-120	21	45	67
Chlorobenzene	1	59	NA	NA	NA
Total Xylenes	3	1J-100	17	37	56
BNAs					
Phenol	2	8J-12	3	5	8
Aniline	2	227-231	76	108	190
1,4-Dichlorobenzene	1	49J	NA	NA	NA
1,2-Dichlorobenzene	1	24J	NA	NA	NA
Hexachloroethane	1	14J	NA	NA	NA
Isophorone	2	12-13	4	6	10
Benzoic Acid	1	47J	NA	NA	NA
Bis(2-ethylhexyl)Phthalate	6	7B,J-25B	--	--	--
Benzo(b)Fluoranthene	1	3J	NA	1	NA
Benzo(k)Fluoranthene	1	3J	NA	1	NA
Benzo(a)Pyrene	1	4J	NA	1	NA
Indeno(1,2,3-cd)Pyrene	1	3J	NA	1	NA
Dibenz(a,h)Anthracene	1	3J	NA	1	NA
Benzo(g,h,i)Perylene	1	3J	NA	1	NA
Pesticides/PCB's					
None Detected					

Notes

a All values expressed in parts per billion (ppb) unless otherwise noted
b Based on total of six samples
c Mean is calculated using zero for samples where parameters not detected
B Analyte found in laboratory blank as well; indicates possible/probable laboratory contamination
J Estimated value
All values show laboratory contamination and statistically treated as zero
NA Not applicable; only one value

TABLE 4-35

SUMMARY LIST OF INORGANIC AND SAS PARAMETERS IDENTIFIED IN ONSITE SURFACE WATER
SUMMIT NATIONAL SITE[a]

Parameters	No. of Times Detected[b]	Range of Detected Concentrations	Mean Concentration[c]	Standard Deviation	Upper 95% Confidence Limit	Area 4 USGS (1981)
Inorganic Parameters						
Aluminum	5	200-39800	9932	14746	25409	NA
Antimony	2	62-121	31	46	79	NA
Arsenic	2	25-27	9	12	22	NA
Barium	3	9.9-25	10	11	21	NA
Beryllium	2	5-7.9	2	3	5	NA
Cadmium	3	9-35	11	13	25	NA
Calcium	6	139000-297000E	216283	63373	282800	NA
Chromium	3	4.2-28	9	11	21	NA
Cobalt	4	13-123	37	45	84	NA
Copper	4	11-122	41	51	94	NA
Iron	6	3030-68500	23332	26386	51026	0-27000
Magnesium	6	32500-120000	77647	34140	113480	NA
Manganese	6	3740-8100	6380	1681	8145	0-4900
Nickel	6	20-322	112	114	232	NA
Potassium	6	3670-12400	8155	3308	11627	NA
Selenium	1	16	--	--	--	NA
Sodium	6	14700-72100	44833	23674	69682	NA
Zinc	6	202-1660	749	630	1411	NA
SAS Parameters						
Ammonia as N (mg/l)	2	4.5-4.6	3	2	8	NA
Chloride (mg/l)	3	47-123	85	31	162	NA
Suspended Solids (mg/l)	3	7-41	18	16	58	NA
Dissolved Solids (mg/l)	3	1320-2210	1873	394	2853	NA
Sulfate (mg/l)	3	850-1330	1160	220	1705	1.0-2500
Acidity (mg/l)	3	43-320	137	130	459	NA
Field Parameters						
pH (standard units)	6	3.4-6.5	--	--	--	3.3-9.2
Specific Conductance (umhos/cm)	6	1050-2000	1463	398	2163	30-14500

Notes:

[a] All values expressed in parts per billion (ppb) unless otherwise noted
[b] Based on total of six samples except for SAS parameters which were analyzed in three samples
[c] Mean is calculated using zero for samples where parameters not detected
E Value is estimated due to interference
NA Not available
-- Not applicable

A total of 11 volatile parameters were detected in the onsite surface water at levels that exceeded background quality. Acetone was detected in all six samples at a mean concentration of 1,324 ppb. One compound, 1,2-dichloroethane, was detected in four of the six samples. The range of concentration for 1,2-dichloroethane was 38-860 ppb with a mean concentration of 295 ppb. Methylene chloride and 2-butanone were detected, but also found in the laboratory blanks; and therefore were attributed to be laboratory contaminants.

A total of 14 BNA parameters were detected in the onsite surface water at levels that exceeded background. Bis (2-ethylhexyl) phthalate was detected in all six samples, but was also found in the laboratory blanks at concentrations low enough to be attributed to laboratory contamination. Phenol, aniline, and isophorone were all detected in two samples at mean concentrations of 3, 76, and 4 ppb, respectively. The remaining BNAs were found in only one sample.

There were no PCBs detected in any of the onsite surface water.

The results of the inorganic analysis identified 18 metals in the onsite surface water with concentrations above background levels. Calcium, iron, manganese, magnesium, nickel, potassium, sodium and zinc were detected in all six of the onsite samples. Selenium was found in only one sample at a concentration of 16 ppb. Iron was detected at a mean concentration of 23,332 ppb. The maximum value of 68,500 ppb was higher than the area 4 value of 27,000 ppb (USGS, 1981) for surface water in the general mining region in which the site is located. The maximum concentration for manganese (8,100 ppb) exceeded the area 4 maximum value of 4,900 ppb for surface water in this mining region.

Concentrations for all SAS parameters detected in the onsite ponds were above background levels. Sulfate and specific conductance were found in mean concentrations that were within the ranges expected for surface water in this general mining region.

In conclusion, the onsite ponds are contaminated based on the presence of both organic and inorganic constituents at levels that exceed background. A comparison of total contamination levels made between the two onsite ponds is presented on Table 4-36.

TABLE 4-36
COMPARISON OF TOTAL FRACTION CONCENTRATIONS
DETECTED IN ONSITE POND SURFACE WATER
SUMMIT NATIONAL SITE

	East Pond[1]	West Pond[2]
Range of Total VOAs	97-5145	45-143
Range of Total BNAs	10-335	10-96
Range of Total Pesticides/PCBs	0	0
Range of Total Inorganics	338,500-513,136	218,701-283,612

[1] Based on 4 samples (ppb)
[2] Based on 2 samples (ppb)

The east pond was found to have consistently higher levels of contamination than the west pond, based on total fraction concentrations. There is offsite transport of contaminants via surface water since the east pond is the onsite surface water body that directly discharges off site to the eastern drainage ditches during high flow periods.

4.5.3.2 Offsite Surface Water

The analytical results indicate that offsite surface water is contaminated with organic constituents and metals. A summary list of the organic constituents identified in offsite surface water, along with ranges of onsite surface water concentrations, are presented in Table 4-37. Comparisons to background are based on the maximum concentrations in each of the six identified offsite areas. Onsite surface water concentrations are examined only to evaluate the potential for offsite migration to offsite drainage channels that receive direct discharge from the site.

Results for the volatile fraction showed that samples in the south ditch upstream have detectable levels of methylene chloride, acetone and 2-butanone. These are all attributed to laboratory contamination and do not indicate a site-related problem. The downstream sampling location in the south ditch is the offsite location with the most parameters identified. The sample representing this location was found to have elevated levels of 10 of the 12 volatiles detected in offsite surface water at concentrations that exceed background. Seven of the 10 volatiles detected in this reach of the ditch were also detected in onsite surface waters. This reach of the south ditch does not, however, receive direct discharge from the onsite surface waters. Methylene chloride was also detected in the laboratory blank. Vinyl chloride, trans-1,2-dichloroethene, and trichloroethane were also found in this area, but were not detected in any onsite surface water. They are, however, dehalogenation products of tetrachloroethene which is detected on site. Samples from the lower east drainage ditch were also found to have similar compounds as the onsite surface water samples, particularly the east pond. This reach of the ditch receives any outfall from or seepage through the eastern onsite pond and is being contaminated by the site. Four or five volatiles detected were found at levels that were within the range of concentration for the onsite surface water.

TABLE 4-37
SUMMARY LIST OF ORGANIC PARAMETERS IDENTIFIED
IN OFFSITE SURFACE WATER THAT EXCEED BACKGROUND (1) (2)
SUMMIT NATIONAL SITE

Parameters	Concentration in South Ditch-Upstream	Concentration in South Ditch-Downstream*	Concentration in Lower East Drainage Ditch	Concentration in East Drainage Ditch(3)	Concentration in First Impoundment(3)	Concentration in Second Impoundment	Range of Concentration Detected in Onsite Surface Water
Volatiles							
Vinyl Chloride	ND	7J	ND	ND	ND	ND	ND
Methylene Chloride	1J,B	25B	ND	15	ND	2J,B	2B,J-51
Acetone	17B	15B,J	3100	13	ND	18B	30B,J-4000
1,1-Dichloroethane	ND	34	ND	ND	ND	ND	3J
Trans-1,2-dichloroethene	ND	78	5	ND	ND	ND	ND
1,2-Dichloroethane	ND	78	500	ND	16	11	38-860
2-Butanone	19B	13B	15B	ND	ND	18B	--
1,1,1-Trichloroethane	ND	29	ND	ND	ND	ND	5-66
Trichloroethene	ND	6	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	ND	ND	58	ND	ND	ND	78[a]
Toluene	ND	ND	ND	ND	ND	13	1J-120
Chlorobenzene	ND	25	ND	ND	ND	ND	59[a]
BNAs							
Phenol	ND	107	7J	ND	ND	ND	8J-12
Aniline	ND	ND	283	ND	ND	ND	227-231
Isophorone	ND	ND	14	ND	ND	ND	12-13
Benzoic Acid	ND	ND	31J	ND	ND	ND	47J[a]
Bis(2-ethylhexyl) Phthalate	6J,B	12B,J	14B,J	25B	13B	10B	--

Notes:

(1) Maximum concentration in particular area
(2) Units in ppb
(3) 1984 sample only - dry in 1986
B Analyte found in laboratory blank as well; indicates possible/probable laboratory contamination
J Estimated value
* 1986 sample - represents low flow or worst case
ND Not detected
-- All values show laboratory contamination and statistically treated as zero
[a] Only one sample

The east drainage ditch contained no volatiles other than methylene chloride and acetone which are typical parameters identified as laboratory contaminants. This drainage channel is not affected by site runoff. The only volatile detected in the first impoundment sample was 1,2-dichloromethane at 16 ppb. The first impoundment is directly downstream of the lower east drainage ditch which had 1,2-dichloroethane at 500 ppb. Concentration at levels above background were detected for five volatiles in the second impoundment. The only parameters not attributed to laboratory contamination were 1,2-dichloroethane and toluene. Other offsite and onsite samples have also shown detected levels of 1,2-dichloroethane. Based on local hydrology developed from aerial photographs, it is most likely that the second impoundment is more affected by the adjacent landfill operation than the site. The potential that contamination in the second impoundment is due to the site cannot be separated from potential contamination from the landfill.

Contamination in the BNA fraction followed a similar pattern as the volatiles. The sample representing the south ditch (downstream) had phenol detected at 107 ppb which was above background. Samples obtained from this station were obtained during low flow conditions and represent a worst case scenario. Again, the lower east drainage ditch appears to be similar to east pond discharges for phenol, isophorone, and benzoic acid. Aniline was detected at 283 ppb, which was slightly above the range of concentrations in the onsite surface water. Other offsite surface waters had no detectable levels of BNAs, except for bis (2-ethylhexyl)phthalate, which was also found as a laboratory blank.

Pesticides or PCBs were not detected in any of the offsite surface water samples.

A summary list of inorganic and SAS parameters identified in offsite surface water are presented in Table 4-38.

The results of the inorganic analysis identified 17 metals in the offsite surface water with concentrations above background levels. Calcium, copper, iron, magnesium, manganese, potassium, sodium and zinc were

TABLE
SUMMARY LIST OF INORGANIC AND [illegible] PARAMETERS IDENTIFIED
IN OFFSITE SURFACE WATER THAT EXCEED BACKGROUND (1) (2)
SUMMIT NATIONAL SITE

Inorganic Parameters	Concentration in South Ditch-Upstream	Concentration in South Ditch-Downstream*	Concentration in Lower East Drainage Ditch	Concentration in East Drainage Ditch(3)	Concentration in First Impoundment(3)	Concentration in Second Impoundment	Range of Concentration Detected in Onsite Surface Water	Area 4 USGS (1981)
Aluminum	343ND	570	10400	2015ND	ND	243	200-39800	NA
Antimony	ND	ND	94	178	ND	ND	62-121	NA
Arsenic	ND	ND	38+,S	ND	ND	ND	25-27	NA
Barium	[76]	ND	220	ND	ND	[12]	9.9-25	NA
Cadmium	ND	ND	9	6	ND	5	9-35	NA
Calcium	386000E	383000E	364000E	206600	105700	237300	139000-297000E	NA
Chromium	11	ND	22	ND	ND	ND	4.2-28	NA
Cobalt	[8.7]	[23]	[15]	173	ND	ND	13-123	NA
Copper	[16]	[10]	28	70	100	[9.4]	11-122	NA
Iron	17200	8520	131000	17560	1500	21100	3030-68500	27000
Magnesium	112000	92900	130000	67700	32510	68810	32500-120000	NA
Manganese	5170	3670	8000	19000	900	4700	3740-8100	4900
Nickel	[9.9]	62	46	172	ND	ND	20-322	NA
Potassium	20400	9700	11700	4510	4040	18900	3670-12400	NA
Sodium	130000	142000	312000	37300	34400	64200	14700-72100	NA
Vanadium	[5.6]	ND	[8.3]	ND	ND	ND	ND	NA
Zinc	155	40	320	930	104	75	202-1660	NA
SAS Parameters								
Total Alkalinity ($CaCO_3$)	287	195	343	--	--	48	ND	NA
Ammonia as N (mg/l)	2.3	2.6	13	--	--	0.9	4.5-4.6	NA
Chloride (mg/l)	293	144	242	--	--	79	47-123	NA
Suspended Solids (mg/l)	486	33	456	--	--	21	7-41	NA
Dissolved Solids (mg/l)	2410	2320	2900	--	--	1060	1320-2210	NA
Sulfate (mg/l)	1270	1200	1490	--	--	536	850-1330	2500
Field Parameters								
pH (standard units)	6.0	6.5	6.0	3.0	5.6	5.5	NA	3.3-9.2
Sp. Cond. (umhos/cm)	2400	1335	3000	1640	940	1210	1050-2000	14500

Notes:

(1) Maximum concentration in particular area
(2) Units in ppb unless otherwise noted
(3) 1984 sample only - dry in 1986
[ ] Positive values less than the contract required detection limit
E Value is estimated due to interference
NA Not available
+ Correlation coefficient for method of standard addition is less than 0.995
S Value is determined by standard addition
* 1986 sample - represents low flow or worst case
ND Not detected
-- Not analyzed

The lower east drainage ditch showed the highest total levels of inorganic and SAS contaminants in the offsite water. Again, this ditch receives direct discharge and seepage from the east pond and has similar quality as the east pond. The second impoundment is potentially more affected by the landfill operation and adjacent coal spoil piles than by the site and the levels of inorganics are more attributed to these sources rather than the Summit site.

4.6 SEDIMENTS

4.6.1 Onsite Sediment

Evaluation of onsite soils discussed in Section 4.4 concluded that the onsite surface soils at the Summit National site were contaminated in all fractions analyzed. Since the onsite surface drainage is directed into the two ponds, the sediments deposited in the ponds are water transported site surface soils. Onsite soils with contaminant concentrations that exceeded background surface soils were considered contaminated. The same comparison was made for onsite sediments. An evaluation of maximum levels of concentration between onsite sediments and the most upstream sediment samples off site (SD011001 and SD032001) was made. Onsite sediment contamination was based on exceedences of background surface soil levels. Correlations of parameters identified in the onsite sediments and onsite surface soils were made where appropriate. An onsite sediment sample was considered to be contaminated if its maximum and mean values both exceeded the upper 95% confidential limit for background soils. For those compounds whose maximum values were found to exceed the upper 95% confidence limit for background soils, but the mean was below, an evaluation of the number of samples that exceeded background was made. If only a few samples exceeded background, the compound was excluded from the summary table and addressed separately. Any parameters found at levels less than 100 ug/kg for organics or 100 mg/kg for inorganics and also found in the blank were considered to be zero for statistical analysis. Any parameters reported below the detection limit were also considered to be zero for statistical analysis.

A summary list of volatile, BNA and PCB, and inorganic parameters identified in the east pond sediments that exceeded background are presented in Tables 4-39 through 4-41. Ten volatiles that were detected in

TABLE 4-39

SUMMARY LIST OF VOLATILE PARAMETERS IDENTIFIED
IN EAST POND SEDIMENT THAT EXCEEDED BACKGROUND SOILS
SUMMIT NATIONAL SITE

Volatile Parameters	Number of Times Detected(1)	Range of Detected Concentrations(2)	Mean Concentrations(2)(3)	Standard Deviation	Upper 95% Confidence Limit in Onsite Surface Soils(2)	Upper 95% Confidence Limit in Background Soil Samples(2)	Maximum Concentration in Upstream Sediment(2)
Methylene Chloride	6	8J,B-870B	314	310	1007	ND	230
Acetone	5	46B-510A	180	199	26222	ND	ND
1,1-Dichloroethane	3	69-2261	534	854	2	ND	ND
1,2-Dichloroethane	2	13115-16608	4246	6778	6750	ND	ND
1,1,1-Trichloroethane	4	30.5A-787	243	343	4499	ND	508J
Trichloroethene	2	10-20	4	7	15782	ND	ND
Benzene	2	10J-25	5	9	4	ND	ND
Chlorobenzene	4	20A-329	95	117	177	ND	ND
Ethylbenzene	3	24A-146	35	32	11189	ND	ND
Total Xylenes	2	43-67	16	26	46161	2	ND

(1) Out of total 7 samples
(2) Units ug/kg dry weight
(3) Mean calculated using zero for sample where parameters not identified
J Estimated value
B Found in laboratory blank, indicates possible/probable contamination
ND Not detected
A Detected below quantitation limit

TABLE 4-40

SUMMARY LIST OF BNA AND PCB PARAMETERS IDENTIFIED

IN EAST POND SEDIMENT THAT EXCEEDED BACKGROUND SOILS

SUMMIT NATIONAL SITE

Semi-Volatile Parameters	Number of Times Detected(1)	Range of Detected Concentrations(2)	Mean Concentrations(2)(3)	Standard Deviation	Upper 95% Confidence Limit in Onsite Surface Soils(2)	Upper 95% Confidence Limit in Background Soil Samples(2)	Maximum Concentration in Upstream Sediment(2)
N-Nitrosodiphenylamine	3	490J-22951J	3505	7948	149	ND	409J
Hexachlorobenzene	2	518J-1080A	228	391	18438	61	518J
Di-n-butylphthalate	2	2521B-6714B	1319	2368	2324	86	2348B
Bis(2-ethylhexyl)Phthalate	7	9244-291808	70076	95172	218378	52	197J
Di-n-Octyl Phthalate	5	339J-55378J	11111	18792	15056	ND	ND
PCBs (4)	3	8171-21000	4748	7236	38305	ND	ND

(1) Out of total 7 samples

(2) Units ug/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

(4) Arochlor 1232, 1242, 1248, 1254

J Estimated value

B Found in laboratory blank, indicates possible/probable contamination

ND Not detected

A Detected below quantitation limit

B Found in laboratory blank, indicates possible/probable contamination

TABLE 4-41

SUMMARY LIST OF INORGANIC PARAMETERS IDENTIFIED

IN EAST POND SEDIMENT THAT EXCEEDED BACKGROUND SOILS

SUMMIT NATIONAL SITE

Inorganic Parameters	Number of Times Detected(1)	Range of Detected Concentrations(2)	Mean Concentrations(2)(3)	Standard Deviation	Upper 95% Confidence Limit in Onsite Surface Soils(2)	Upper 95% Confidence Limit in Background Soil Samples(2)	Maximum Concentration in Upstream Sediment(2)
Antimony	2	68-[85]R	22	35	35	4	ND
Barium	7	[82]R-[151]	106	25	118	100	[128]
Chromium	7	12R-73	44	18	32	18	10
Iron	7	30728-118000	57806	38168	44152	29572	25682
Cyanide	2	3R-74R	11	26	7	1.186	ND
Mercury	4	.17-.29	0.13	.119	0.217	0.098	ND
Nickel	6	[21]R-[38]	24	11	29	19	30R
Sodium	2	[1870]-[1960]	547	865	222	143	ND
Zinc	7	100R,E-1570	471	470	205	113	85R,E

(1) Out of total 7 samples

(2) Units mg/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

R Spike recovery not within control limits

[ ] Positive values less than the contract required detection limit

E Value is estimated due to the presence of interference

these sediments were found at levels that exceeded background surface soils, indicating contamination. Methylene chloride and acetone, the most frequently detected volatiles, are both known laboratory contaminants.

Two volatiles (1,1-dichloroethane and benzene) were detected at levels whose mean values exceeded the upper 95% confidence limit for onsite surface soils. The parameter 1,1-dichloroethane in the sediment samples was three orders of magnitude greater than the levels found in onsite surface soils. This data suggests surface soils are not the only sources of contamination for the onsite sediments in the east pond. Vinyl chloride, 1,1-dichloroethene, 2-butanone, and 2-hexanone were detected in one east pond sediment sample. These compounds were not detected in background soils. Vinyl chloride was not detected in onsite surface soils, but is a known dehalogenation product of tetrachloroethene which was detected in onsite surface soils. The remaining volatile concentrations were generally several orders of magnitude lower than those found in the onsite surface soils indicating that these compounds are not readily transported or are volatilized during transportation.

Two volatile compounds, methylene chloride and 1,1,1-trichloroethane, were detected in the upstream sediment samples. The maximum levels detected in the east pond sediments exceeded both of these background maximum levels. Past drainage at the site shows the stream channel flowed through what is now the two onsite ponds, creating the possibility that at some time in the past upstream sediments could have been transported downstream to the onsite ponds. The onsite ponds could also be influenced by the water table and buried material which can subsequently deposit contaminants in the onsite sediments.

A total of five BNA parameters were detected in the east pond sediment at levels that exceeded background. Bis(2-ethylhexyl)phthalate was found in all seven samples at a mean concentration of 70,076 ug/kg. This value exceeded background surface soil levels by four orders of magnitude. BNA parameters were detected in 5 of 6 samples at levels much lower than onsite surface soils indicating they are less easily transported than the volatiles. N-nitrosodiphenylamine was found to have a mean concentration 26 times greater than the onsite surface soil. PCBs were also found at levels in

excess of background, indicating a contamination problem. Again, BNA concentrations in the east pond sediment were greater than those detected in the upstream sediments.

Nine inorganic compounds were detected at maximum levels that exceeded background surface soil concentrations (see Table 4-41). Aluminum, arsenic, calcium, cobalt, magnesium, and vanadium were found to have mean concentrations that were lower than the upper 95% confidence limit for background soils. Since these metals had only 1 or 2 hits that exceeded the background upper 95% confidence limit, they are not used to represent overall east pond sediment characteristics. The mean concentrations for 5 of these compounds were found to be higher than the upper 95% confidence limit found in onsite surface soils. Upstream sediment inorganic concentrations were, in general, much lower than east pond sediments.

A summary list of volatile, BNA and PCB, and inorganic parameters identified in the west pond sediments are presented in Tables 4-42 through 4-44. Thirteen volatile compounds were found to exceed background. The most frequently detected volatile was 1,2-dichloroethane (8 of 9 samples) at a mean concentration of 2,426 ug/kg. The highest sediment concentrations were for toluene at a mean of 23,335 ug/kg. Methylene chloride, 1,1-dichloroethene, 1,1-dichloroethane, 2-butanone, 1,1,1-trichloroethane, toluene and chlorobenzene were found to have mean concentrations above the upper 95% confidence limit for onsite surface soils. The chlorinated ethanes were also found in the east pond sediment at levels exceeding onsite surface soils. The data suggests that transport of contamination from the soils to the sediments may be more related to soil source concentrations rather than onsite surface runoff. The west pond sediment had maximum volatile concentration two or more orders of magnitude greater than upstream.

The BNA fraction in the west pond sediment samples were found to have four of the same compounds as the east pond; N-nitrosodiphenylamine, di-n-octylphthalate, bis(2-ethylhexyl)phthalate and hexachlorobenzene. All four exceed background soil levels. Phenanthene was only detected above background in one sediment sample. Again, the data suggests that BNAs are less transportable than volatiles. PCBs were detected in

TABLE 4-42

SUMMARY LIST OF VOLATILE PARAMETERS IDENTIFIED

IN WEST POND SEDIMENT THAT EXCEEDED BACKGROUND SOILS

SUMMIT NATIONAL SITE

Volatile Parameters	Number of Times Detected(1)	Range of Detected Concentrations(2)	Mean Concentrations(2)(3)	Standard Deviation	Upper 95% Confidence Limit in Onsite Surface Soils(2)	Upper 95% Confidence Limit in Background Soil Samples(2)	Maximum Concentration in Upstream Sediment(2)
Methylene Chloride	6	50-41000**	6263	12574	1007	ND	230
Acetone	2	300A-2600**	322	811	26222	ND	ND
1,1-Dichloroethene	3	13-16	5	7	2	ND	ND
1,1-Dichloroethane	1	86	10	27	2	ND	ND
Trans-1,2-Dichloroethene	1	9A	1	3	22	ND	ND
1,2-Dichloroethane	8	3J-8900**	2426	3408	6750	ND	ND
2-Butanone	3	12000**-18000**	5000	7211	3429	ND	508J
1,1,1-Trichloroethane	7	50A-2500A,**	670	747	4499	ND	ND
Trichloroethene	3	10-500**	58	156	15782	ND	ND
Toluene	4	12A-174000**	23335	53791	15658	13	ND
Chlorobenzene	4	8J-1000**	183	345	177	ND	ND
Ethylbenzene	6	16A-28000**	8037	10817	11189	ND	ND
Total Xylenes	5	4J-92000**	29023	39332	44161	2	ND

(1) Out of total 9 samples

(2) Units ug/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

J Estimated value

B Found in laboratory blank, indicates possible/probable contamination

** Analyzed at medium concentration

ND Not detected

A Detected below quantitation limit

TABLE 4-43

SUMMARY LIST OF BNA AND PCB PARAMETERS IDENTIFIED

IN WEST POND SEDIMENT THAT EXCEEDED BACKGROUND SOILS

SUMMIT NATIONAL SITE

BNA and PCB Parameters	Number of Times Detected(1)	Range of Detected Concentrations(2)	Mean Concentrations(2)(3)	Standard Deviation	Upper 95% Confidence Limit in Onsite Surface Soils(2)	Upper 95% Confidence Limit in Background Soil Samples(2)	Maximum Concentration in Upstream Sediment(2)
N-Nitrosodiphenylamine	2	8262J-11546J	2201	4190	149	ND	409J
Hexachlorobenzene	2	2400-2700A	567	1062	18438	61	518J
Bis(2-ethylhexyl)Phthalate	9	5128J-87000	36707	26376	218378	52	197J
Di-n-Octyl Phthalate	3	2300-9400	1933	3206	15056	ND	ND
PCBs (4)	5	1100A-35000C	6022	10597	38305	ND	ND

(1) Out of total 9 samples

(2) Units ug/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

(4) Arochlor 1232, 1242, 1248, 1254

J Estimated value

A Detected below quantitation limit

ND Not detected

C Pesticide parameter confirmed by GC/MS

TABLE 4-44

SUMMARY LIST OF INORGANIC PARAMETERS IDENTIFIED

IN WEST POND SEDIMENTS THAT EXCEEDED BACKGROUND SOILS

SUMMIT NATIONAL SITE

Inorganic Parameters	Number of Times Detected(1)	Range of Detected Concentrations(2)	Mean Concentrations(2)(3)	Standard Deviation	Upper 95% Confidence Limit in Onsite Surface Soils(2)	Upper 95% Confidence Limit in Background Soil Samples(2)	Maximum Concentration in Upstream Sediment(2)
Antimony	1	148R	16	47	35	4	ND
Chromium	9	15R-55R	32	14	32	18	10
Copper	9	18R-57	37	13	44	29	[17]
Iron	9	34354-72667	47789	11250	44152	29572	25682
Cyanide	4	2.1R-25R	4	8	7	1.186	ND
Mercury	4	.16-.3	.094	.111	0.217	0.098	ND
Nickel	9	[15]-37A	23	6	29	19	30R
Sodium	4	[793]-[1310]	482	556	222	143	ND
Vanadium	9	[14]-[35]R	24	7	31	26	[24]R
Zinc	9	71R,E-915R,E	263	259	205	113	85R,E

(1) Out of total 9 samples

(2) Units mg/kg dry weight

(3) Mean calculated using zero for samples where parameters not detected

[ ] Positive values less than the contract required detection limit

R Spike sample recovery is not within control limits

E Estimated due to presence of interference

the west pond sediments at a mean concentration of 6,022 ug/kg. The west pond sediment had maximum BNA concentrations at least five times greater than upstream.

Ten inorganic compounds were identified in the west pond sediment samples that exceeded background levels. Arsenic, barium, beryllium, magnesium, and potassium were detected in west pond sediment samples with mean concentrations that did not exceed the upper 95% confidence limit in background soils. Less than half of the samples in which the compounds were detected did not exceed background and are not considered representative of overall sediment contamination. Inorganic contaminants are accumulating in pond sediments with ongoing surface runoff. Upstream sediment inorganic concentrations were, in general, much lower than in the west pond sediment.

A brief comparison of contamination levels was made between the two onsite ponds. The west pond samples detected higher concentrations of contaminants in the organic fraction, while the east pond samples detected higher levels of inorganics. This is the opposite of the surface water results. The east surface water samples detected the highest levels of contamination of all fractions analyzed.

4.6.2 Offsite Sediment

The concentrations of parameters detected in the offsite sediments were compared to first the upstream concentrations (SD011001 and SD032001, same sampling station) and secondly to background surface soils. These two samples were obtained at the farthest upstream location that was still identifiable as a stream channel. A worst case scenario was assumed, and the highest concentration detected for each compound between these two upstream samples was used. The same worst case scenario was used for the downstream sediment sampling stations locations with multiple samples.

A summary list of volatile parameters detected in offsite sediment samples that exceeded background surface soils and upstream sediments is presented in Table 4-45. Two volatile compounds were detected in the upstream sediment samples. Samples from the south ditch (upstream), were found to have concentrations of methylene chloride, acetone and 1,1-trichloroethane

TABLE 4-45

SUMMARY LIST OF VOLATILE PARAMETERS IDENTIFIED

IN OFFSITE SEDIMENTS THAT EXCEED BACKGROUND (1) (2)

SUMMIT NATIONAL SITE

Volatile Parameters	Concentration in South Ditch-Upstream	Concentration in South Ditch-Downstream	Concentration in Lower East Drainage Ditch	Concentration in East Drainage Ditch	Concentration in First Impoundment	Concentration in Second Impoundment	Maximum Concentration in Upstream Sediment (2)	Upper 95% Confidence Limit in Background Soil Samples (2)
Methylene Chloride	340	400	278B	670	--	--	230	ND
Acetone	229	ND	ND	64B	1400	15J	ND	ND
Trans-1,2-Dichloro-ethene	ND	290	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	240	ND	ND	ND	ND	ND
1,1,1-Trichloro-ethane	863J	ND	ND	ND	27	423	508J	ND
Trichloroethene	ND	110A	ND	ND	ND	ND	ND	ND
Benzene	ND	33A	ND	ND	ND	ND	ND	ND
Toluene	97	ND	ND	ND	ND	ND	ND	13
Total Volatiles(3)	1229	780	375	670	1600	160	514	NA

(1) Maximum concentrations in particular area

(2) Units ug/kg dry weight

(3) Based on highest single sample in particular area

J Estimated value

A Detected below quantitation limit

B Found in laboratory blank, indicates possible/probable contamination

ND Not detected

NA Not applicable

-- Detected below background

above upstream concentrations. The south ditch (downstream) sample had four volatiles detected that were above upstream concentration, while the lower east drainage ditch had two (see Table 4-45). Other than acetone and methylene chloride, the data for the east drainage ditch do not show upstream sediment exceedences. The first and second impoundment samples detected levels above upstream concentration for acetone and 1,1,1-trichloroethane. An evaluation of the data was made using total volatile concentrations. The upstream sediment sample had a total VOA of 514 ug/kg. Four of the downstream samples detected increases in total volatiles which may suggest offsite migration of contaminants. The source of the volatiles in the most upstream sample was unknown based on available data.

A summary list of BNA and PCB parameters is presented in Table 4-46. The upstream sediment sample had detectable concentrations of N-nitrosodiphenylamine, di-n-butyl phthalate, bis(2-ethylhexyl)phthalate and hexachlorobenzene at 409J, 2,348B, 197J, and 518J ug/kg, respectively. The only other offsite sediments that had hexachlorobenzene was the sample from the second impoundment at a concentration of 2,800 ug/kg. The upstream sample is located in an area that cannot be affected by direct runoff from the site; therefore, the data suggests that some unidentified source is contaminating these samples. The second impoundment sediments are shown to have had a direct hydraulic connection to the active site prior to 1975. This suggests the site could have been a source of the hexachlorobenzene. Since 1978 the recently closed landfill adjacent to the second impoundment has filled in the abandoned strip pit and is another possible source of more recent (post 1978) contamination.

Overall, the offsite sediments contain more detectable levels of compounds in the BNA fraction that in the VOA fraction. A total of 24 BNA compounds were found in these sediments. The south ditch (upstream) was by far the most contaminated of all the samples. Samples from the south ditch upstream of the site detected phenol at 558J ug/kg. This was the only offsite sediment sample in which phenol was detected. It was also the only sample that had levels of 10 other compounds that exceeded upstream sediment concentrations making it have the highest total BNA contamination. The most probable explanation for this contamination is from site runoff at some time in the past during active site

TABLE 4-46
SUMMARY LIST OF BNA AND PESTICIDE/PCB PARAMETERS IDENTIFIED
IN OFFSITE SEDIMENTS THAT EXCEED BACKGROUND (1) (2)
SUMMIT NATIONAL SITE

Semi-Volatile Parameters	Concentration in South Ditch-Upstream	Concentration in South Ditch-Downstream	Concentration in Lower East Drainage Ditch	Concentration in East Drainage Ditch	Concentration in First Impoundment	Concentration in Second Impoundment	Maximum Concentration in Upstream Sediment	Upper 95% Confidence Limit in Background Soil Samples (2)
Phenol	558J	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	680A	ND	ND	ND	ND	ND	ND
4-Methylphenol	997J	ND	ND	ND	ND	ND	ND	ND
Naphthalene	1600	800A	ND	ND	2100	470A	ND	1438
2-Methylnapthalene	630A	1200A	ND	430A	2400A	580A	ND	1587
Acenapthylene	1100A	ND	ND	ND	ND	ND	ND	ND
Acenapthene	1300A	ND	ND	ND	ND	ND	ND	35
Dibenzofuran	2100A	183J	ND	ND	370A	ND	ND	349
Fluorene	3100	ND	ND	ND	ND	ND	ND	23
N-Nitrosodiphenylamine	809J	ND	ND	ND	1727J	809J	409J	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	2800	518J	61
Phenanthene	6400	710A	ND	ND	1700A	470A	ND	1091
Di-N-Butylphthalate	5121J	ND	7336B	--	8636B	4313B	2348B	86
Fluoranthene	24000	ND	ND	670	309J	ND	ND	594
Pyrene	16000	ND	ND	640A	359J	ND	ND	512
Benzo(a)Anthracene	9000	ND	ND	ND	ND	ND	ND	346
Bis(2-ethylhexyl) Phthalate	704J	15000	26000	ND	5909J	997B,J	197J	52
Chrysene	16000	590A	ND	ND	ND	ND	ND	423
Benzo(b)Fluoranthene	13000	ND	ND	640A	ND	ND	ND	598
Benzo(k)Fluoranthene	413J	ND	ND	ND	ND	ND	ND	598
Benzo(a)Pyrene	7300	ND	ND	ND	ND	ND	ND	301
Indeno(1,2,3-cd) Pyrene	5200	ND	ND	ND	ND	ND	ND	150
Dibenz(a,h)Anthracene	5400	ND	ND	ND	ND	ND	ND	31
Benzo(g,h,i)Perylene	6900	ND	ND	ND	ND	ND	ND	135
Pesticides								
Heptachlor Epoxide	ND	ND	ND	ND	8.1	ND	ND	ND
PCBs (4)	ND	4200A	ND	ND	ND	ND	ND	ND
Total BNAs (3):	124530	15480	26000	2340	20517	26800	3128	NA

(1) Maximum concentrations in particular area
(2) Units ug/kg dry weight
(3) Based on highest single sample in particular area
(4) Arochlor 1232, 1242, 1248, 1254
J Estimated value
B Found in laboratory blank, possible/probable contamination
ND Not detected
A Detected below quantitation limit
-- Detected below background

operations, when site drainage probably flowed along a road drainage ditch that runs south along the west boundary of the site. A former drum staging area was located near the abandoned tipple and drainage from this area could reach the stream channel. This possibility is supported by past aerial photographs of site drainage. It is probable that the south ditch downstream, lower east drainage ditch, and first impoundment are receiving contamination from the site. The offsite sediment contains elevated levels of BNA contamination; however, the site cannot be positively identified as the only source.

PCBs were detected in the south ditch (downstream) at a total concentration of 4,200A ug/kg which was above background. Heptachlor epoxide was detected in the first impoundment at 8.1 ug/kg. There were no pesticides/PCBs detected in the upstream sample. A summary list of inorganic parameters in offsite sediments is presented in Table 4-47. In general, inorganic levels detected in the offsite sediments are above upstream sediment concentration. Since there is the possibility of accumulation of inorganic metals concentration in sediments over time, the data does not identify any major irregularities or unexpected extremely high levels of inorganics.

The comparison of offsite sediment to background surface soils was also made. The background soils are generally more contaminated than the upstream sediments (except in volatile fraction) which makes the degree and number of exceedences of background soils somewhat less than comparing to upstream sediment only. The south ditch upstream and downstream and the lower east drainage ditch still showed organic contamination in excess of background soils. The first and second impoundments still showed minor organic contamination above background soils. It cannot be ruled out based on this new comparison that the background surface soils may be an additional source of offsite sediment contamination. Assuming that the effect of background soils on all offsite sediments is equal, the same basic conclusions are derived; the downstream sediments show elevated levels of contamination. Several specific changes in comparisons in each fraction were noted as follows:

TABLE 4-47
SUMMARY LIST OF INORGANIC PARAMETERS IDENTIFIED
IN OFFSITE SEDIMENTS THAT EXCEED BACKGROUND (1) (2)
SUMMIT NATIONAL SITE

Inorganic Parameters	Concentration in South Ditch-Upstream	Concentration in South Ditch-Downstream	Concentration in Lower East Drainage Ditch	Concentration in East Drainage Ditch	Concentration in First Impoundment	Concentration in Second Impoundment	Maximum Concentration in Upstream Sediment	Upper 95% Confidence Limit in Background Soil Samples (2)
Aluminum	13800	17600	16700	10556	15431	22,300	9560	11699
Antimony	ND	ND	143	52	ND	ND	ND	4
Arsenic	19	43	38	28	39	54	ND	19
Barium	145	165	--	--	170	--	[128]	100
Cadmium	4.6	14	19	18	8.1	17	ND	3
Calcium	11800	17236	[10500]	--	84400	[5,420]	[2855]	7316
Chromium	24	41	55	26	20	36	10	18
Cobalt	[21]	[32]	[20]	--	[14]	[25]	[18]R	13
Copper	48	89	74	66	42	35	[17]R	29
Iron	49000	112000	92589	166000	41600	113877	25682	29572
Lead	131	71	35	134	42	49	20	117
Cyanide	ND	2.4	ND	ND	ND	ND	ND	1.186
Magnesium	[3980]	[5000]	--	--	18897	[8,240]	3247	2782
Manganese	855	2810	1500	248	2014	542	447R	1003
Mercury	ND	0.15	ND	ND	ND	0.24	ND	0.098
Nickel	[36]	51	[49]	--	[40]	[39]	30R	19
Potassium	[1950]	[2450]	[2090]	[1574]	[6410]	[3,180]	[863]	2161
Sodium	ND	[1780]	[6720]	[1520]	[3260]	[1,830]	ND	143
Vanadium	[24]	[36]R	[28]	[34]R	[37]	[41]	[24]R	26
Zinc	235	355	1254	134	279	200	85R,E	113

(1) Maximum concentration in particular area
(2) Units mg/kg dry weight
R Spike recovery not within control limits
[ ] Positive values less than the contract required detection limit
E Estimated due to presence of interference
-- Detected below background
ND Not detected

<u>Volatile Fraction</u>	
1,1,1-Trichloroethane	1/6 areas exceeded upstream sediments 3/6 areas exceeded background soil
<u>BNA Fraction</u>	
Napthalene, Phenanthrene	4/6 areas exceeded upstream sediments 2/6 areas exceeded background soils
Dibenzofuran, Fluoranthene, Pyrene	3/6 areas exceeded upstream sediments 2/6 areas exceeded background soils
2-Methylnapthalene	5/6 areas exceeded upstream sediments 1/6 areas exceeded background soils
Benzo(k)Fluoranthene	1/6 areas exceeded upstream sediments 0/6 areas exceeded background soils
<u>Inorganic Fraction</u>	
Aluminum, Vanadium	6/6 areas exceeded upstream sediments 5/6 ares exceeded background soils
Calcium	5/6 areas exceeded upstream sediments 4/6 areas exceeded background soils
Cobalt	4/6 areas exceeded upstream sediments 5/6 areas exceeded background soils
Lead	6/6 areas exceeded upstream sediments 2/6 areas exceeded background soils

Manganese	5/6 areas exceeded upstream sediments 3/6 areas exceeded background soils
Potassium	6/6 areas exceeded upstream sediments 3/6 areas exceeded background soils

In the Volatile Fraction more exceedences occurred by comparing to background soils. In the BNA Fraction more exceedences occurred by comparing to upstream sediments. In the Inorganic Fraction more exceedences occurred by comparing to upstream sediment except for cobalt.

4.7 AIR MONITORING

Air sampling and/or monitoring was performed both prior to the startup of site investigation activities and during the performance of the activities. The sampling and monitoring were performed primarily to obtain data to determine the levels of respiratory protection required for various activities on site. Although the data was obtained for this purpose, it does provide an indication of the hazards due to inhalation of contaminants onsite.

Air sampling was performed at the site for the purpose of identifying potential respiratory hazards prior to the commencement of site investigation activities. Results of this sampling were used to develop the site Health and Safety Plan. Six air samples (S01-S06) were collected over a six hour sampling period by Phoenix Safety Associates, Ltd. on September 12 and 13, 1984 using a battery operated pump to draw a measured amount of air through a charcoal sample tube. The samples were analyzed for the presence of volatile organics. The results, presented in Table 4-48, indicate that low levels of toluene and tetrachloroethylene (<0.001 ppm) were present in the ambient air at midrange sample location S02 and upwind sample location S03 on September 12, 1984. These levels were noted to be far below the American Conference of Governmental Industrial Hygienists Threshold Limit Values for toluene (100 ppm) and tetrachloroethylene (50 ppm).

TABLE 4 48
ORGANIC CONTAMINANTS DETECTED IN AIR SAMPLES
SUMMIT NATIONAL SITE

Sample No.	S01		S02		S03		S04		S05		S06	
Location	Downwind		Midrange		Upwind		Downwind		Midrange		Upwind	
Date Sampled	9/12/84		9/12/84		9/12/84		9/13/84		9/13/84		9/13/84	
	Front	Back	Front	Back	Front	Back	Front	Back	Front	Back	Front	Back
Tetrachloroethene	--	--	<0.001	<0.001	<0.001	--	--	--	--	--	--	--
Toluene	--	--	<0.001	--	<0.001	--	--	--	--	--	--	--

Notes:

All concentrations reported in parts per million (ppm)
-- Not detected
Front - Front section of charcoal tube
Back - Back section of charcoal tube

During the September air sample collection activities the site was scanned with a Century Organic Vapor Analyzer (OVA) Model 128. OVA readings did not exceed background during this sampling.

An OVA and strip chart recorder in the survey mode was also set up downwind of the site during the air sampling investigation. No readings above background were recorded on the strip chart.

In general, ambient air readings were at background levels during routine sampling activities that did not disturb onsite features. Table 4-49 presents a summary of the air monitoring levels recorded during site investigation activities, along with the level of protection used.

The results of the air sampling and air monitoring performed at the Summit National site suggested that onsite or offsite air contamination should not occur unless there is a surface disturbance of the site.

4.8 RADIOLOGICAL MONITORING

4.8.1 Preliminary Monitoring

Radiological monitoring was performed at the site by Phoenix Safety Associates, Ltd., in September, 1984 using a Ludlum Model 3 Survey Meter prior to the initiation of site investigation activities. The monitoring, which was performed using a radiation detector, did not indicate the presence of any radiation hazard.

4.8.2 Radiological Health and Safety Monitoring

During the field activities, all onsite personnel were required to wear TLD badges continually. Readings on the radiation survey meter were never observed to exceed or approach 2.0 mr/hr, the level which constitutes a radiation hazard. The results (Appendix F) from the TLD badges indicated that the personnel on site received no radiation above background (established by control badges) which was well below the permissible whole body dose for occupational exposures. Radiation is not a health or environmental concern at the site.

TABLE 4-49
SUMMARY OF AIR MONITORING LEVELS
DURING SITE INVESTIGATION ACTIVITIES
SUMMIT NATIONAL SITE

Activity	Range of OVA Readings (ppm)	Respiratory Protection*
Drill Offsite Wells	0 - 15	C/D
Drill Onsite Wells	0 - 1,000	B/C
Develop/Sample Offsite Wells	0 - 2	D
Develop/Sample Onsite Wells	0 - 300	B/C/D
Sample Onsite Soil, Water & Sediment	0 - 10	C/D
Sample Offsite Soil, Water & Sediment	NM	D
Residential Well Sampling	NM	D

Notes:

*Level D - No Respiratory Protection
Level C - Cartridge Respirator
Level B - Self-Contained Breathing Apparatus
NM - Not monitored

4.9 ONSITE STRUCTURES

In addition to the permanent structures identified, there are some temporary facilities in place that are associated with past and present onsite investigations. These facilities are located in the northwest corner of the site and include an Ohio EPA storage trailer, an Ohio EPA portable laboratory trailer, a REM Contractor office trailer (removed as of September 1986), and a concrete decontamination pad. The locations of these structures and facilities are shown on Figure 4-36. Detailed descriptions of the permanent structures are presented in Table 4-50.

In general, the permanent structures are in poor condition, but some may serve as temporary storage facilities if needed during future site activities. A summary of the potential uses of onsite structures is presented in Table 4-51.

4.10 RI DERIVED LIQUID WASTE DISPOSAL

Locations of all inventoried drums and related equipment are shown on Figure 4-37. A summary of the drum inventory is presented in Table 4-52. Liquid waste was derived from water developed from monitoring wells during RI field activities. The RI derived liquid waste disposal activities were completed December 12, 1986. Based on the analytical data of the monitoring wells, there were minor contaminants with much lower concentrations that those detected in surface water of the ponds. The results of the HSL analysis of the treated water prior to discharge to the west pond did not indicate any potential for influencing the quality of the west pond. The VOA fraction of the sample was invalidated through the Region 5 QA review. The re-analysis of this fraction was also rejected. No BNA's or Pesticide/PCB's were detected in the treated water. A summary of the detected inorganics compared to west pond levels is presented on Table 4-53.

TABLE 4-50
ONSITE STRUCTURE SURVEY SUMMARY
SUMMIT NATIONAL SITE

Structure Designation	Description
Structure A	Structure A is the scale house constructed of yellow concrete blocks, located in the northwest corner of the site. It is 20 ft. long, 28 ft. wide, and 10 ft. high. The building was observed to have some wall cracks. A 30 ft. by 8 ft. concrete pad that is part of the scales lies directly in front of the north wall of the building. There is a telephone pole adjacent to the east wall and one at the northwest corner.
Structure B	Structure B is an abandoned dump truck that stands directly south of the scale house. It was observed to have a hole in the right panel. The tires are still inflated.
Structures C and D	Structure C represents the spoil pile surrounding the concrete remains of the coal tipple, Structure D, located in the northwest corner of the site. The spoil pile is "L" shaped and is about 5 ft. high in the southwest corner and rises to about 20 ft. along its east/west axis. It is approximately 215 ft. long and 60 ft. wide along its east/west axis and 220 ft. long and 60 ft. wide along its north/south axis. The remains of the tipple are 100 ft. long, 30 ft. wide, and 25 ft. high.
Structure E	Structure E is the abandoned liquid waste incinerator located in the southeast corner of the site. The incinerator consists of a yellow brick chimney and a rusted kiln extending to the west. The chimney is 8 ft. long, 18 ft. wide, and 30 ft. high, with a 4 in. pipe extending 20 ft. from the northeast wall. The kiln is 55 ft. long and 10 ft. in diameter. Debris from incineration activities lies at the open (west) end of the kiln.
Structure F	Structure F is a dilapidated corrugated metal shed, 12 ft. square, 10 ft. high, located 5 ft. west of the kiln in the southeast corner of the site. Debris is scattered in and around the shed. The shed has no east wall.

Table 4-50 (cont'd)
Page 2

Structure Designation	Description
Structure G	Structure G is a frame storage shed located in the southeast corner of the site. It is 24 ft. square and 15 ft. high and open to the south. It has particle board siding and an asphalt shingle roof and is filled with approximately 100 empty barrels that were reportedly used during surface cleanup activities. A tree has fallen on the northwest corner of the shed causing minor damage.
Structure H	Structure H is a rusted metal hopper or blender located in the southeast corner of the site. It is 6 ft. long, 3 ft. wide and 14 ft. high.
Structure I	Structure I consists of three rusty gate valves at the east side of the east pond which regulate the pond's outflow. They are 2.5 ft. high. The valves are set in concrete.
Structure J	Structure J is a dilapidated frame garage covered with insulbrick located in the northeast corner of the site. It is 50 ft. long, 40 ft. wide and 15 ft. high. The east and north walls are still standing. The roof has collapsed into the structure. This structure was apparently not involved with site operations. It is impossible to enter safely.
Structure K	Structure K is a garage constructed of concrete blocks located in the northeast corner of the site. It is 29.5 ft. long, 21 ft. wide and 12 ft. high. It has a poured concrete foundation. It was observed to have some wall cracks. It was apparently not involved in the former site operations.

TABLE 4-51
POTENTIAL USE OF ONSITE STRUCTURES
SUMMIT NATIONAL SITE

Structure	Dimensions (ft.)	Comments
Structure A Scale House	20Lx28Wx10H	Could be used for storage
Structure B Dump Truck	18Lx8W	Could be towed offsite
Structure C Spoil Pile	215Lx220Wx5to15H	Of no use
Structure D Coal Tipple Remains	100Lx30Wx25H	Of no use
Structure E Incinerator	63Lx18Wx30H	Of no use
Structure F Corrugated Shed	12Lx12Wx10H	Could be used for storage
Structure G Particle Board Shed	24Lx24Wx15H	Northeast corner partially damaged; could be used for storage
Structure H Metal Hopper	3Lx6Wx14H	Of no use
Structure I Gate Valves	2-1/2H	Valves work; pipes apparently clogged
Structure J Frame Garage	50Lx40Wx15H	Badly damaged; of no use; dangerous
Structure K CMU Building	29Lx21Wx12H	Could be used for storage

TABLE 4-52
RI DERIVED DRUM WASTE INVENTORY
December 10, 1986
SUMMIT NATIONAL SITE

Drum Description	Example of External Labeling	No. of Drums
Empty Drum (Turned Upside Down)	E24	56
Protective Clothing	PC	27
Drums Containing Soil Less than 1/4 Full	S24	12
Drums Containing Soil 1/4 Full	S25	12
Drums Containing Soil 1/2 Full	S26	31
Drums Containing Soil 3/4 Full	S27	34
Drums Containing Soil Full	S28	27
Drum Left from Carbon Adsorption System	--	2

Note:

Approximately 50 empty drums are located in a corrugated aluminum building beside the incinerator; not part of this remedial investigation waste disposal program

TABLE 4-53
COMPARISON OF TREATED RI DERIVED
LIQUID WASTE INORGANIC CONCENTRATIONS
WITH WEST POND SURFACE WATER (1)
SUMMIT NATIONAL SITE

Parameter	Maximum Concentration in West Pond	Concentration in Treated Discharge
Arsenic	27S	18S,R,J
Barium	[9.9]	[2.1]
Calcium	162000E	276000
Cobalt	123	[9.5]
Copper	122	[4.3]
Iron	8740	304
Magnesium	44500	130000
Manganese	4760	4630
Potassium	6280	17400
Sodium	15200	243000

(1) units - ug/l
S Value is determined by standard addition
R Spike sample recovery not within control limits
J Estimated value
E Value is estimated due to presence of interference
[ ] Positive value less than contract required detection limit

4.11 BURIED MATERIAL

4.11.1 Geophysical Surveys

4.11.1.1 Magnetometer Survey

The magnetometer survey utilized readings from a Geometric G816 magnetometer over the site on a 25 ft. grid pattern. Several areas were defined as being potentially underlain by buried drums or tanks and are indicated as Zones I through VII on Figure 4-37. Metal debris scattered on the surface of the site was accounted for in the interpretation of the magnetic data.

Zone I is located on the east side of the site in the area south of the east pond. This zone was the largest of the anomalous areas measuring approximately 125 ft. square. The nature of the anomaly and extent of the zone suggests it may contain a large amount of buried metal. The material buried in this area is likely to be similar to that observed at the surface (i.e., drums, barrels, cans, and general debris).

Zone II is a small area located near the southeast corner of the site, north of the incinerator. The location, size and nature of this magnetic anomaly suggest that a tank is buried in this area. This area was also the location of seepage of a tar-like material from the ground surface.

Zone III is a relatively small (40 feet by 50 feet) area located in the south central portion of the site. The anomaly observed in this zone was interpreted as probably being due to metal debris on the surface rather than a concentration of buried drums. However, it is possible that buried material exists within this zone.

Zone IV is also located in the south central portion of the site, just west of Zone III. This zone covers an area approximately 90 feet by 130 feet. The anomaly observed in Zone IV was believed to be due to buried drums and barrels rather than surface debris. It is possible that two discrete dumping areas make up this zone, one at the western edge and a smaller one at the eastern edge.

Zones V, VI, and VII are situated on the north side of the ponds. Each covers an area 50 feet square or less and are partially related to surface material.

In addition to the anomalous zones discussed above, six additional potential drum burial zones were identified at the site. These areas, designated as Zones A through F on Figure 4-38, were identified following further evaluation of the magnetometer data.

Zones A and B are located due west of the west onsite pond. Each covers an area 50 ft. square or less and are partially related to surface material.

Zones C and D are located between the east and west ponds with an area of 50 ft. square or less. The anomalies in this area are due to surface debris.

Zone E is a small area (700 sq. ft.) along the southern fence of the site. Test pit excavation activities in this zone did encounter buried drums and two drum samples were able to be obtained.

Zone F is an area of approximately 3,100 sq. ft. located near the southeast corner of the site. Drums were encounteed during the test pit excavations and one sample of drummed contents was obtained.

4.11.1.2 Ground Penetrating Radar (GPR) Survey

Due to the conductive nature of the surface materials at this site the depth of penetration achieved by the Subsurface Interface Radar (SIR) was limited to approximately 2 to 3 feet. GPR data did locate shallow point targets, possibly barrels, in magnetic anomaly Zones IV and VI. The survey conducted in the area of the scale house showed a large buried tank adjacent to the scale house on the west side and two smaller tanks buried side by side adjacent to the scale house on the east side. The depth to the top of these tanks was estimated to be less than three feet.

GPR was performed in the vicinity of the coal tipple ruins, incinerator and incinerator stacks to determine if tanks were buried at these locations. Several small shallow targets were detected at these locations, but signal penetration was limited. Buried tanks, if present, were not detected within the depth range of the GPR.

4.11.1.3 Electromagnetic Terrain Conductivity (EM) Survey

Based on results from the onsite survey, a zone of high conductivity, extending to depth, exists within the south central portion of the site in an area generally coinciding with magnetic anomaly Zones III and IV. Aside from this specific anomalous zone, several general observations can be made concerning the onsite area. Results indicated terrain conductivity to be generally high both near the surface (40 to 60 mmhos/m) and at depth (less than 40 mmhos/m). The relatively high conductivity conditions appear to extend to a depth which includes the water-table aquifer.

Available geologic information indicates the water-table aquifer extends to a depth of about 25 to 33 feet deep in the site area. The intermediate units were found to exhibit lower conductivities than materials of the water-table aquifer. This would be expected since the vertical and horizontal migration rate of contaminants into and through this low permeability layer should be lower than the rates in the water-table aquifer, as discussed in Section 4.3. Information indicates a zone of lower hydraulic conductivity exists at a depth of about 30 to 95 feet beneath the site. In addition, the variation in conditions within this zone vary from trends established in the shallow data, thus indicating that either the vertical migration of contaminants in the shallow-intermediate units is variable or the depth and/or stratigraphy of the intermediate units varies. Drilling information proves the latter case to be true. Due to the variation in conductivity across the site and the limited coverage, contaminant migration pathways could not be identified.

The offsite EM survey was conducted in an area approximately 300 by 400 ft. in size directly east of the site. The survey was performed to investigate surface and subsurface conductivities in the vicinity of the small swampy area and eastern drainage ditch.

As in the onsite area, the surface materials (25 to 50 mmhos/m) and water-table aquifer (25 to 40 mmhos/m) exhibited much higher conductivity values than those detected for the intermediate zones at depth. The intermediate units appear to be limiting the vertical migration of contaminants.

4.11.2 Buried Tanks

4.11.2.1 Tank Locations and Descriptions

The GPR survey detected a large buried tank adjacent to the west side of the scale house and two smaller tanks buried side by side adjacent to the east side of the scale house. The tanks on the east side of the scale house (Tanks A and B as shown on Figure 4-38) were partially uncovered by hand excavations on January 18, 1985, but could not be sampled due to the inaccessibility of an opening. Subsequent excavation operations with a backhoe in January, 1986 uncovered Tank A and B even further. Tank A was found in an east-west orientation and was 5 ft. in diameter and 12 ft. long with an estimated volume of 1,762 gallons.

The east end was 1-1/2 ft. below ground surface and the west end was buried 3 ft. This tank was believed to contain gasoline based on the smell of the tank and the soil around it. Tank B was uncovered in a north-south orientation and was measured at 5 ft. in diameter by 12-1/2 ft. long with an estimated volume of 1,836 gallons. This tank was believed to contain kerosene based on the odor given off by the tank and the soil around it. Odors detected in the soils appear to be caused by leakage of contents from the two tanks.

The large buried tank on the west side of the scale house was not uncovered. Another underground tank is known to be located in the area just north of the incinerator. This tank, which showed up as an anomalous Zone II in the magnetometer survey (Figure 4-38), is evident from the vent or filler pipe extending above ground and from the tar-like substance exuding from the pipe. Information provided by the Ohio EPA indicates the volume of this tank to be 12,000 gallons. In early Spring of 1987, USEPA Region V removed the buried tank and its contents. The contents are stored temporarily on site until proper disposal is authorized.

4.11.2.2 Tank Sampling and Results

One sample (TK002001) was collected from Tank A on January 9, 1986. The sample, which appeared to be gasoline, was described as an amber-brown liquid containing rust colored sediment. The sample was

analyzed for the HSL organic and inorganic parameters with a separate organic analysis performed for the top liquid (hydrocarbon) phase, the middle liquid (water) phase, and the solid (sediment) phase, while separate inorganic analyses were performed for each of the two liquid phases. The complete analytical results for this sample are presented in Appendix A. Tank B could not be sampled as no access to this tank was found.

The analytical results for Tank A showed the presence of several organic and inorganic constituents, which are summarized in Table 4-54. Volatiles observed in all three phases included methylene chloride, benzene, toluene, ethylbenzene, and total xylenes. Acetone and 2-butanone were also detected in the middle and/or solid phases. The highest concentrations for the VOA fraction were primarily observed in the solid phase which exhibited total VOA's of 142,600,000 ug/kg while the next highest concentrations were detected in the top liquid (hydrocarbon) phase with total VOA's at 21,100,000 ug/kg. The middle liquid (water) phase of the sample showed the lowest volatile concentrations with total VOA's of 259,300 ug/kg. BNA compounds detected in the lighter liquid phase of the sample included naphthalene, 2-methylnaphthalene, acenaphthene, fluorene, and di-n-butylphthalate with naphthalene and 2-methylnaphthaline also present in the heavier liquid phase. BNA compounds detected in the solid phase of this sample differed from those in the liquid phases and included pentachlorophenol, and the polynuclear aromatic hydrocarbons (PAH's), phenanthrene, anthracene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene and benzo(k)fluoranthene. Total BNA's were highest in the top liquid phase (890,200 ug/kg) and again lowest in the middle liquid phase (23,000 ug/kg). Total BNA's in the solid phase were 85,400 ug/kg. No pesticides or PCB's were detected in any phase of the sample.

Results of the inorganic fraction analysis for the two liquid phases of the sample revealed the presence of several metals, including aluminum (6,210 mg/kg), copper (120 mg/kg), iron (162,000 mg/kg), lead (460 mg/kg), magnesium (871 mg/kg), manganese (331 mg/kg), titanium (428 mg/kg) and zinc (629 mg/kg) in only the higher hydrocarbon phase. Silicon (2,160 to 21,900 mg/kg) was detected in both liquid phases with the highest concentration in the hydrocarbon phase.

TABLE 4-54
SUMMARY LIST OF PARAMETERS IDENTIFIED IN TANK A
SUMMIT NATIONAL SITE

Parameter	Range	Phases Detected
Volatiles		
Methylene Chloride	6,300B-1,200,000B,J	T,M,S
Acetone	36,000B-9,500,000B	M,S
2-Butanone	72,000B	M
Benzene	43,000-13,000,000	T,M,S
Toluene	64,000-54,000,000	T,M,S
Ethylbenzene	6,000-10,000,000	T,M,S
Total Xylenes	32,000-55,000,000	T,M,S
Base/Neutrals and Acids		
Naphthalene	12,000J,**-360,000**	T,M
2-Methylnaphthalene	11,000J,**-470,000**	T,M
Acenaphthene	28,000J,**	T
Fluorene	4,200J,**	T
Pentachlorophenol	34,000J,**	S
Phenanthrene	34,000**	S
Anthracene	4,000J,**	S
Di-n-butylphthalate	28,000J,**	T
Pyrene	4,700J,**	S
Benzo(a)Anthracene	2,000J,**	S
Chrysene	2,800J,**	S
Benzo(b)Fluoranthene	2,300J,**	S
Benzo(k)Fluoranthene	1,600J,**	S
Pesticides/PCB's		
None Detected		
Inorganics		
Aluminum	6,210	T
Calcium	1,680-2,680	T,M
Copper	120	T
Iron	162,000F	T
Lead	460	T
Magnesium	871	T
Manganese	331	T
Silicon	2,160-21,900E	T,M

Table 4-54 (cont'd)
Page 2

Parameter	Range	Phases Detected
Titanium	428	T
Zinc	629	T

Notes:

Organic results expressed in ug/kg; inorganic results expressed in mg/kg dry weight.

B Analyte found in laboratory blank, indicates possible/probable laboratory contamination
J An estimated value
E Value is estimated due to presence of interference
F Sample concentration is greater than four times the spike value
** Sample analyzed at medium concentration
T Top (hydrocarbon) phase
M Middle (water) phase
S Solid (sediment) phase

Several samples of the tar-like material exuding from the tank just north of the incinerator were also obtained. The most recent samples were two duplicate samples (TK010001 and TK001002) collected on November 14, 1984 as part of the remedial investigation and analyzed for the HSL organic and inorganic parameters. The complete analytical results for these samples are presented in Appendix A. Another two samples were collected in May and September, 1982 and analyzed for organic compounds (RAMP, August 1983). A single sample was collected by the U. S. EPA on March 27, 1979 and also analyzed for organic compounds.

The most recent waste samples (TK001001 and TK001002) from the tank near the incinerator show that several organic and inorganic constituents are present, as summarized in Table 4-55. Volatiles detected in both samples from this tank included methylene chloride, 2-butanone, 1,1,1-trichloroethane, toluene, and ethylbenzene, while those detected in one sample (TK001001) included 1,1-dichloroethene and total xylenes. The major volatile constituent detected was 1,1,1-trichloroethane, which was detected at concentrations of 3,120,000 to 3,550,000 ug/kg. Total VOA's in these two samples ranged from 3,860,000 in TK001002 to 4,650,000 in TK001001. BNA compounds detected in both samples included 4-methylphenol, 2,4-dimethylphenol, napthalene, anthracene, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate. Occurring in only one sample were phenanthrene in TK001001 and phenol in TK001002. The BNA constituents detected at the highest concentrations were 4-methylphenol, which had concentrations ranging from 525,000 to 664,000 ug/kg and bis(2-ethylhexyl) phthalate, which was detected at concentrations of 281,000 to 298,000 ug/kg. Total BNAs detected in these two samples ranged from 996,000 in TK001001 to 1,302,000 ug/kg in TK001002. Pesticides were detected only in one sample (TK001001) and included delta-BHC (6,250 ug/kg), aldrin (4,750 ug/kg), endosulfan I (1,700 ug/kg) and 4,4-DDE (1,800 ug/kg). The total concentration of the pesticide fraction was 14,500 ug/kg.

TABLE 4-55
SUMMARY OF PARAMETERS IDENTIFIED IN TANK BY INCINERATOR
SUMMIT NATIONAL SITE

Parameter	Range	No. of Samples Detected
Volatiles		
Methylene Chloride	110,000B	2
1,1-Dichloroethene	50,000J	1
2-Butanone	250,000-270,000	2
1,1,1-Trichloroethane	3,120,000-3,550,000	2
Toluene	240,000-260,000	2
Ethylbenzene	140,000-160,000	2
Total Xylenes	250,000	1
Base/Neutrals and Acids		
Phenol	67,000J	1
4-Methylphenol	525,000-664,000	2
2,4-Dimethylphenol	101,000-109,000	2
Naphthalene	23,000J-24,000J	2
Phenanthrene	25,000J	1
Anthracene	25,000J-28,000J	2
Di-n-butylphthalate	16,000J-112,000	2
Bis(2-ethylhexyl) Phthalate	281,000-298,000	2
Pesticides/PCB's		
Delta-BHC	6,250**	1
Aldrin	4,750**	1
Endosulfan I	1,700**	1
4,4'-DDE	1,800**	1
Inorganics		
Aluminum	699-803	2
Barium	88-89	2
Cadmium	2.4-7.9	2
Chromium	189R-202R	2
Copper	28	2
Iron	2050	2
Lead	168-195	2

Table 4-55 (cont'd)
Page 2

Parameter	Range	No. of Samples Detected
Manganese	14-17	2
Sodium	4,760-4,800	2
Thallium	[2.3]	1
Tin	18R	1
Zinc	67-71	2

Notes:

Based on duplicate samples TK001001 and TK001002 from 11/14/84

Organic results expressed in ug/kg; inorganic results expressed in mg/kg dry weight.

B Analyte found in laboratory blank; indicates possible/probable laboratory contamination
J An estimated value
R Spike sample recovery is not within control limits
** Sample analyzed at medium concentration
[ ] Positive values less than the contract required detection limit

Results of the inorganic fraction analyses of the two duplicate samples indicated that both samples contained several metals including aluminum (699-803 mg/kg), barium (88-89 mg/kg), cadmium (2.4-7.9 mg/kg), chromium (189-202 mg/kg), copper (28 mg/kg), iron (2,050 mg/kg), lead (168-195 mg/kg), manganese (14-17 mg/kg), and zinc (67-71 mg/kg). Thallium (2.3 mg/kg) and tin (18 mg/kg) were also detected in sample TK001002 only.

Organic results from the two 1982 samples of the tank waste were comparable to those from the 1984 samples in that 1,1,1-trichloroethane was noted to be the organic constituent with the highest concentration and occurred at concentrations (3,800,000-4,620,000 ug/kg) similar to those observed in the 1984 samples. Other volatile compounds found in the 1982 samples that were detected in the 1984 samples included 2-butanone (630,000 ug/kg), toluene (400,000-450,000 ug/kg) and xylene (560,000 ug/kg). These compounds generally occurred at concentrations approximately double those observed in the 1984 samples. Organic compounds detected in the 1982 samples which were not observed in the 1984 samples included t-butyl alcohol (1,910,000 ug/kg), cyclohexane (1,260,000 ug/kg), 3-methylpentane (390 ug/kg), hexane (2,080,000 ug/kg), and 2-methylpentane (200,000 ug/kg). No pesticides were detected above detectable limits in either of the 1982 samples of the tank waste.

Organic compounds identified in the single 1979 sample of waste from the tank by the incinerator were BNA compounds 2,6-di-tert-butyl-4-methyl phenol and an isomer of this compound.

4.11.3 Buried Drums

4.11.3.1 Conditions Encountered at Test Pit Locations

A total of 13 test pits were excavated to determine the location of buried drums. Six of the test pits encountered buried drums. The majority of drums appeared to be intact and were not corroded to the point of leaking. The test pits in which drums were encountered were shallow (2 to 6 ft.) pits with the drums laid in and covered. One area (TP 1S-1W) was mounded higher than the ground surface. At this location, drums were found deeper. The site north of the ponds appears fairly undisturbed and no drums were

found. The site soils south of the ponds were generally fill and coal spoil and contained some buried drums. The areas where no drums were found usually had visible metal debris uncovered, while the areas where drums were observed had little debris metal than drums. Based on observations in TP 3W, it appears that leaking wastes from drums may be floating on top of the groundwater table at the site. This was not supported, however, by a comparison of data from DR008001 with the groundwater samples obtained from wells 2BB5 and 2BB6 (see Table 4-56). It is possible that the lighter hydrocarbon layer was not obtained during the groundwater sampling activities. A summary of test pit dimensions and findings is presented in Table 4-57.

4.11.3.2 Total Estimated Number of Buried Drums

A total estimate of buried drums at the site was developed, based on the observations and estimates of numbers of drums in each test pit The total number of drums were estimated by dividing the total surface area of each zone by the number of observation sectors (15 by 15 ft. or 225 sq. ft.). Based on field observations, the number of drums observed in each test pit for a measured square foot sector of the test pit was estimated. This value, number of drums per sector, was assumed to represent conditions for the entire drum burial zone in which the test pit was located. Multiplying this value by the total number of sectors in each zone gave an estimate of the number of drums in each zone. All the zones were totaled to arrive at a total estimate of buried drums. The calculations are summarized on Table 4-58. A total of 900 to 1,600 drums are estimated to be buried on site. If the majority of drums are indeed intact (approximately 75% based on field observations), then a total number of intact drums containing waste may be in the range of 675 to 1,200.

4.11.3.3 Drum Sampling and Results

A total of eight samples were collected from various drums found within the test pits excavated. A description of the sampled drum wastes, along with the test pits from which they were obtained, is presented in Table 4-59. These samples were analyzed for the HSL organic and inorganic parameters. A separate

TABLE 4-56
COMPARISON OF RESULTS IN
DRUM SAMPLE DR008001 (TP-3S) with
GROUNDWATER IN WELLS 2BB5 AND 2BB6
SUMMIT NATIONAL SITE

Sample No./Location	GW027001/2BB6	GW030001/2BB5	GW030002/2BB5	DR008001/TP-3S
Volatiles				
Methylene Chloride	8100J	5300B	4900J,B	20000J,B
Acetone	59000B,J	85000B	76000B	160000B
1,1-Dichloroethene	2600J	ND	ND	ND
1,1-Dichloroethane	12000J	2400J	2100J	ND
Trans-1,2-Dichloroethene	4600J	ND	ND	72000
1,2-Dichloroethane	ND	130000	100000	ND
2-Butanone	290000B,J	67000	56000B	37000J,B
1,1,1-Trichloroethane	53000J	9000	7100	19000J
Trichloroethene	27000J	1000J	ND	140000
4-Methyl-2-Pentanone	62000J	5300J	4500J	ND
Toluene	7100J	20000	16000	31000J
Ethylbenzene	ND	11000	6100	190000
Total Xylenes	ND	52000	26000	840000
BNAs				
Phenol	7000	ND	1100	ND
2-Methylphenol	ND	ND	210	ND
4-Methylphenol	ND	ND	510	ND
Isophorone	ND	920	1100	ND
2,4-Dimethylphenol	ND	120	140	ND
Benzoic Acid	ND	2700	2600	ND
1,2,4-Trichlorobenzene	ND	ND	35J	ND
Naphthalene	82	620	510	85000J
4-Chloro-3-Methylphenol	ND	ND	130	ND
2-Methylnaphthalene	60	370	350	ND
Hexachlorocyclopentadiene	ND	2800	1100	ND
Dimethyl Phthalate	10	ND	22J	ND
Acenaphthene	ND	ND	110	78J
Dibenzofuran	ND	ND	59J	48J
Diethylphthalate	ND	ND	ND	53J
Fluorene	ND	ND	75J	57J
Hexachlorobenzene	ND	ND	630	430
Phenanthrene	ND	ND	200	120
Anthracene	ND	ND	41J	24J
Di-N-Butylphthalate	2J,B	130B	72J,B	28000J
Fluoranthene	ND	77J	41J	ND

Table 4-56 (cont'd)
Page 2

Sample No./Location	GW027001/2BB6	GW030001/2BB5	GW030002/2BB5	DR008001/TP-3S
Pyrene	ND	79J	ND	ND
Butylbenzylphthalate	ND	950	360	ND
Bis(2-ethylhexyl) Phthalate	10B	8600B	5900B	ND
Di-N-Octyl Phthalate	ND	1600	860	ND
Inorganics				
Aluminum	4840	1630	1620	ND
Antimony	ND	149	134	ND
Arsenic	16S	12	18S	ND
Cadmium	58	ND	ND	88R
Calcium	648000	607000	616000	ND
Chromium	ND	[19]	[11]	ND
Cobalt	896	120	116	ND
Copper	ND	ND	ND	69.7
Iron	982000	539000	614000	ND
Magnesium	309000	184000	189000	ND
Manganese	72200	25600	26100	ND
Nickel	1120	198	182	189
Potassium	[20100]	19200	20500	ND
Sodium	350000	272000	289000	ND
Zinc	3750	295	324	ND

Notes:

units - ppb except for inorganic drum samples (mg/kg)
J - Estimated value
B - Analyte has been found in laboratory blank as well as sample. Indicates possible/probable contamination
[ ] - Positive value less than contract required detection limit
S - Value determined by standard addition
R - Spike recovery is not within control limits
ND - Not detected

TABLE 4-57
TEST PIT SUMMARIES
SUMMIT NATIONAL SITE

Test Pit Number	Zone	Field Notes and Description
1S	I	First drum encountered at a depth of 2 ft. A white liquid waste squirted onto ground after drum was penetrated by backhoe (sampled as DR001001). Soil in pit was fill and spoil, very loose, caving in and water intrusion a problem. Observed other drums in pit, estimated to be half intact and half crushed. Crushed drums not corroded indicating that corrosion was not a cause of leaking drums. Estimate 8-10 drums in a 15 ft. square area laying in two layers from 2-10 ft. deep. DR002001 sample obtained from leaking drum; a greenish-brown thick liquid. Observed a yellow crystalline solid waste in another drum - unable to sample. OH Materials reported most drums intact and that crushing occurred during excavation.
1W	I	Encountered mostly 5 gal. cans. Sample DR004001 taken from one 5 gal. can. Observed a crushed 55 gal. drum. The 5 gal. cans are intact for most part. Soil observed to be mine spoil. Encountered old washing machine at a depth of 5 ft. Cans and drums at depth of 2 to 5 ft. Below drums, pit penetrated a brown till and hit water at 17 ft. Inventoried eight 5 gal. cans and two 55 gal. drums in pit.
2S	E	Eliminated due to location near fence; access by backhoe was restricted.
2W	E	Encountered first drum at a depth of 2 ft. that contained a white-gray powder and was sampled as DR006001. At a depth of 3 ft. observed a plastic sheet with water entering pit at a point along top of plastic. Soil is spoil with rock fragments. Encountered a vertical standing leaking drum. Muddy water running out of drum was sampled as DR007001, which could be groundwater that has filled the drum. The drums were observed at depths of 2 to 4 ft. Estimate 8 to 10 drums in 15 ft. square area.
3S	IV	Hit drums at a depth of 3 ft. located in saturated fill and mine spoil. Observed a dark red fluid (similar to transmission fluid) leaking from drums and sampled as DR008001. Water intrusion was a problem. Drums observed from 2 to 6 ft. deep

Test Pit Number	Zone	Field Notes and Description
3S (Cont'd)	IV	laying both horizontal and vertical in what appears to be two layered depths. As pit was excavated toward east to find bottom of drums, continued to encounter drums. Estimate 8 to 10 drums in a 15 ft. square area in one to two layers.
3W	IV	OH Materials reported that when test pit encountered groundwater they observed a red liquid waste entering the trench from what appeared to be top of water table. This may indicate that any leaking wastes from drums may be floating and moving along top of groundwater - drums located in loose spoil and fill. Same estimate as 3S.
4S	A	Soil appeared undisturbed. No drums encountered. Southern end of trench had some concrete several inches thick on surface. Along west side of trench encountered french drain. Observed some staining of soil on west wall of trench.
4W	A	Eliminated due to location near fence. Access by backhoe was restricted.
5S	B	Test pit actually into west end of west pond. Bottom of pond filled with sediment and fines. Southern bank was spoil from 0 to 2 ft., and till from 2 to 15 ft. Trench filled up almost instantly with water.
5W	B	Eliminated due to access problem - test pit location in west pond.
6S	V	Eliminated due to access problem - location too close to pond and access by backhoe was restricted.
6W	V	No drums encountered. Trench had caved in by time SRW arrived to observe. Reported depth was 20 ft. into loose fill into brown clay or till. Some staining observed. Not a lot of visible metal observed, some small aluminum fragments. Soil was damp, but no visible water.

Table 4-57 (cont'd)
Page 3

Test Pit Number	Zone	Field Notes and Description
7S	VI	Top 2 ft.-gray fill. From 2 to 12 ft.-brown till, clay or silty clay. Soil appears natural and undisturbed. Hole remained open for observation and then caved. Observed steel scrap objects in top 2 ft. No drums encountered.
7W	VI	No drums encountered. Top 2 ft.-trash, fill, brick, slag, concrete. Below 2 ft.-into brown fill, no observed metal objects. Surface is coal spoil, very stoney
8S	VII	Excavated soil was brown and gray soil and fill. Difficult to tell if undistrubed. Observed water intrusion from surface. Western wall of trench collapsed. No visible metal scraps. No drums observed.
8W	VII	No drums observed - similar description as 8S.
9S	F	No drums observed. Encountered groundwater at 8 ft. Soil excavated was rock and coal spoil.
9W	F	Encountered rusted drums 2 ft. below ground surface. Drum was standing upright and top was sheared off. Observed and sampled as DR005001 a green viscous liquid that appeared to settle out as a black sediment. Soil is fill and coal spoil. Test pit is near fence and encountered the french drain that is installed around the perimeter of the site.

Note: See Figure 4-38 for location of test pits

TABLE 4-58
BURIED DRUM ESTIMATE
SUMMIT NATIONAL SITE

Zone (1)	Test Pits	Surface Area of Zone (sq. ft.)	Number of Observation Sectors (2)	Number of Drums per Sector	Total Number of Drums Per Zone
I	1S, 1W	8200(min.)	36.4	16	582
		11000(max)	48.9	20	978
IV	3S, 3W	3400(min.)	15.1	12	181
		6400(max.)	28.4	15	426
E	2W	700	3.1	8(min.)	25
				10(max.)	31
F	9W	3100	13.8	8(min.)	110
				10(max.)	138

Range of Total Drums: 898 - 1573

Notes:

(1) Zones where buried drums were encountered
(2) Each observation sector was 15 ft. by 15 ft. or 225 sq. ft.
(3) Range of total drums rounded to 900-1600 for discussion

TABLE 4-59
DRUM WASTE SAMPLE SUMMARY
SUMMIT NATIONAL SITE

Sample No.	Test Pit No.	Description of Drum Waste
DR001001	1S	White liquid with gray residue
DR002001	1S	Greenish-brown viscous liquid
DR003001	100 ft. NW of 1S	Brown liquid
DR004001	1W	Brown liquid
DR005001	9W	Green-brown liquid with black residue
DR006001	2W	White-gray powder
DR007001	2W	Muddy brown groundwater
DR008001	3S	Red liquid

organic analysis was performed for the top liquid and solid phases in drum waste sample DR002001, while a separate inorganic analysis was performed for both the lighter and heavier liquid phases in drum waste samples DR001001, DR002001, and DR003001. Inorganic analyses for DR004001, DR005001, and DR008001 were performed only for the solid waste phase. The complete analytical results for these samples are presented in Appendix A. The analyses of samples from these drums is not intended to give complete characterization of contents of all buried drums at the site. Characterizations are specific only for the particular drums sampled and may or may not represent all buried drummed material.

The analytical results indicate that organic compounds (primarily volatiles) and metals are present in the wastes sampled from the buried drums. A summary list of the parameters identified in the drum wastes is presented in Table 4-60. The most frequently identified organic contaminants were methylene chloride and toluene, which were detected in at least one of the phases from all of the drum samples. The highest concentration for methylene chloride (1,800,000 ug/kg) was detected in the solid phase of drum sample DR002001 from Test Pit 1S in the vicinity of anomalous Zone I. The maximum concentration detected for toluene (340,000 ug/kg) was in drum sample DR006001 from Test Pit 2W in the area of anomalous Zone E. Other volatiles occurring in at least half of the drum samples were acetone, 2-butanone, 1,1,1-trichloroethane, trichloroethene, ethyl benzene, and total xylene. As with methylene chloride, the highest concentration for acetone (4,800,000 ug/kg) was observed in the solid phase of sample DR002001, while the highest concentration for 2-butanone (84,000 ug/kg), like toluene, was observed in drum sample DR006001. The highest concentrations for 1,1,1-trichloroethane (19,000 ug/kg), trichloroethene (140,000 ug/kg), ethyl benzene (190,000 ug/kg) and total xylenes (840,000 ug/kg) were found in drum sample DR008001 from Test Pit 3S in the vicinity of anomalous Zone IV. Volatile compounds occurring in at least one phase from less than half of the drum samples included chloromethane, trans-1,2-dichloroethene, chloroform, 1,2-dichloroethane, benzene, and styrene. Chloromethane (20,000 ug/kg) was detected only in drum sample DR004001. Trans-1,2-dichloroethene was detected in two samples, with the highest

TABLE 4-60
SUMMARY LIST OF PARAMETERS IDENTIFIED IN BURIED DRUMS
SUMMIT NATIONAL SITE

Parameter	Range	No. of Drums Detected In
Volatiles		
Chloromethane	20,000	1
Methylene Chloride	5,700B,**-1,800,000B,J	8
Acetone	1,600B,**-4,800,000B	7
Trans-1,2-Dichloro-ethene	370J,**-72,000	2
Chloroform	620B,J-770B,**	3
1,2-Dichloroethane	3,100**	1
2-Butanone	5,400B,**-84,000B,J	6
1,1,1-Trichloroethane	1,500J-19,000J	4
Trichloroethene	1,400J-140,000	4
Benzene	1,200J	1
Toluene	2,000J-340,000	8
Chlorobenzene	15,000J-110,000	2
Ethylbenzene	570J-190,000	5
Styrene	370,000	1
Total Xylenes	650J,**-840,000	6
Base/Neutrals and Acids		
Phenol	8,200J,**	1
Naphthalene	85,000J	1
Di-n-Butylphthalate	5,700J,**-28,000J	2
Pyrene	2,900J,**	1
Bis(2-ethylhexyl) Phthalate	21,000**	1
Di-n-Octyl Phthalate	43,000**-100,000**	1
Pesticides/PCB's		
None Detected		
Inorganics		
Aluminum	2,790-16,500	3
Cadmium	88R-139R	2
Calcium	2,700-6,240	6
Chromium	68	1
Copper	69.7-527	2

Table 4-60 (cont'd)
Page 2

Parameter	Range	No. of Drums Detected In
Iron	226-25,700F	6
Cyanide	768-1,330F	2
Magnesium	809-2,340	4
Manganese	60.6-982	3
Nickel	55-241	8
Silicon	897-49,700E	5
Titanium	602-979	2
Zinc	111-198,000	4

Notes:

Organic results expressed in ug/kg; inorganic results expressed in mg/kg dry weight

B Analyte found in laboratory blank; indicates possible/probable laboratory contamination
E Value is estimated due to the presence of interference
F Sample concentration is greater than four times the spike value
** Sample analyzed at medium concentration

concentration (72,000 ug/kg) found in drum sample DR008001 near anomalous Zone IV and the lowest concentration (370 ug/kg) observed in drum sample DR005001 from Test Pit 9W near anomalous Zone F. Chloroform was detected at concentrations ranging from 620 to 770 ug/kg in three drum samples, sample DR003001 in the area of anomalous Zone I, sample DR005001, and sample DR007001 from Test Pit 2W near anomalous Zone E. Detected in only one drum sample were 1,2-dichloroethane (3,100 ug/kg) in DR005001, benzene (1,200 ug/kg) in DR003001, and styrene (370,k000 ug/kg) in DR001001 from Test Pit 1S near anomalous Zone I. Overall, the highest volatile contamination was observed in the solid phase portion of sample DR002001 which showed a total VOA concentration of 6,600,000 ug/kg. The highest volatile contamination in the liquid phase of a drum sample waste was obtained in DR008001. The total VOA concentration in this sample was 1,509,000 ug/kg.

BNA compounds were only detected in samples from Test Pit 1S and included phenol, di-n-butyl phthalate, pyrene, bis(2-ethylhexyl)phthalate, and di-n-octyl phthalate. Phenol (8,200 ug/kg) and pyrene (2,900 ug/kg) were found in sample DR001001. Di-n-butyl phthalate (5,700-14,000 ug/kg) and di-n-octyl phthalate (43,000-100,000 ug/kg) were detected in both the light liquid and solid phases of DR002001, while bis(2-ethylhexyl)phthalate (21,000 ug/kg) was detected only in the light liquid phase of this sample. The highest total BNA concentration (114,000 ug/kg) was observed in the solid phase of drum sample DR002001. Results of the pesticide/PCB fraction of the organic analyses did not indicate the presence of any of these constituents in the drum waste samples.

Metals detected in the buried drum samples included aluminum, cadmium, chromium, copper, iron, nickel, titanium, and zinc. Of these, nickel was the most frequently detected, occurring in all the samples analyzed at concentrations ranging from 55 ug/kg to 241 ug/kg. The highest concentration for nickel was observed in sample DR004001 from Test Pit 1W. Aluminum was detected in a total of three drum samples, DR002001 (7,810 ug/kg) from Test Pit 1S, DR003001 (2,790 ug/kg) from Zone I, and DR006001 (16,500 ug/kg) from Test Pit 2W. This metal was found in the light liquid phase of each of these samples.

Cadmium and copper were observed in two samples, the light liquid phase of drum sample DR006001 (139 ug/kg for cadmium, 527 ug/kg for copper) and the solid phase of sample DR008001 (88 ug/kg for cadmium, 69.7 ug/kg for copper). Chromium was only observed in one sample, the light liquid phase of DR006001 (68 ug/kg). Six of the drum samples were found to contain iron with the highest concentration (25,700 ug/kg) observed in sample DR006001. Titanium was found in only two drum samples, the light liquid phase of sample DR002001 from test pit 1S (602 ug/kg) and the light liquid phase of sample DR006001 (979 ug/kg). Zinc was detected in a total of four samples, DR002001, DR003001, and DR008001 had zinc concentrations ranging from 111 to 203 ug/kg, while the light liquid phase of sample DR006001 was observed to have a zinc concentration of 198,000 ug/kg. Other notable inorganic constituents detected in the buried drum samples included cyanide which was found in samples DR006001 (768 ug/kg) and DR007001 (1,330 ug/kg) from Test Pit 2W, and silicon, which was found in five of the drum samples. The highest concentrations for silicon were observed in the light liquid phase of drum sample DR006001 (49,700 ug/kg). In general, the greatest number of inorganic constituents and highest concentrations were detected in drum sample DR006001 from Test Pit 2W in the area of anomalous Zone E. This sample exhibited the highest concentrations for all of the inorganic constituents detected with the exception of cyanide and nickel.

5.0 CONTAMINANT TRANSPORT AND FATE

During the remedial investigation many chemicals were detected in the surface soil, groundwater, surface water and sediment at the Summit National Site. The following discussion will focus on the environmental chemistry, fate and transport of some of these compounds. Both inorganic and organic compounds were detected and since these two classes of compounds have different controls on their fate and transport, they will be treated separately. In addition, only a subset of compounds detected at the site will be considered. These chemicals of concern represent the most persistent, toxic, and/or highly concentrated compounds found at the site. The rationale behind their selection will be discussed in Section 6.3.

5.1 ORGANIC CHEMICALS

The organic chemicals identified during this study range from highly mobile and volatile compounds to chemicals that are relatively immobile and nonvolatile. To facilitate the discussion of the fate and transport mechanisms, several classes of organic compounds are discussed. These include chlorinated aliphatics, monocyclic aromatics, phthalates, polynuclear aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). Table 5-1 summarizes the physical and chemical properties of these organic chemicals which are important determinants of their environmental behavior.

The water solubility of a substance is a critical property affecting environmantal fate: highly soluble chemicals can be rapidly leached from wastes and soils and are generally mobile in groundwater. Solubilities range from less than 1 ppb to greater than 100,000 ppm, with most common organic chemicals falling between 1 ppm and 100,000 ppm (EPA 1986a). Solubility, along with several other factors, also affects volatilization from water. In general, high solubility is associated with lower volatilization rates. Vapor pressure and Henry's law constants are also measures of a chemical's volatility. Vapor pressure, a relative measure of the volatility of chemicals in their pure state, ranges from 0.001 to 760 mm Hg for liquids, with solids ranging down to 10^{-7} (EPA 1986a). Henry's law constant, which combines vapor pressure with solubility and molecular weight, is more appropriate for estimating releases to air from water. Chemicals with Henry's law constants in the range of 10^{-3} and larger can be expected to rapidly volatilize from water; those with values ranging from 10^{-3} to 10^{-5} are associated with possibly significant but not rapid volatilization, while chemicals with values less than

TABLE 5-1

PHYSICAL AND CHEMICAL PROPERTIES OF ORGANIC INDICATOR CHEMICALS

Indicator Chemicals	Media Detected in: Soil	Ground-Water	Sediment	Surface Water	Water Solubility (mg/l)	Vapor Pressure (mm Hg at 20°C)	Henry's Law Constant (atm-mm^3/mole)	Log K_{OW}	K_{OC} (ml/g)
ALIPHATIC KETONES									
Acetone	X	X	X	X	1.0×10^{-6}	270	2.1×10^{-5}	-0.24	2.2
CHLORINATED ALIPHATICS									
1,1-Dichloroethane		X			5,500	182	4.3×10^{-3}	1.79	30
1,2-Dichloroethane	X	X	X	X	8,520	64	9.8×10^{-4}	1.48	14
1,1-Dichloroethene		X	X		2,250	600	3.4×10^{-2}	1.84	65
Trans-1,2-Dichloroethene	X	X	X	X	6,300	324	6.6×10^{-3}	0.48	59
Hexachloroethane				X	50	0.4	2.5×10^{-3}	4.60	20,000
Tetrachloroethene	X			X	150	17.8	2.6×10^{-2}	2.60	364
Trichloroethene	X	X	X		1,100	57.9	9.1×10^{-3}	2.38	126
Vinyl Chloride			X	X	2,670	2,660	8.2×10^{-2}	1.38	57
MONOCYCLIC AROMATICS									
Chlorobenzene	X		X	X	466	11.7	3.7×10^{-3}	2.84	330
Ethylbenzene	X	X	X		152	7	6.4×10^{-3}	3.15	1,100
Hexachlorobenzene	X		X		0.01	1.09×10^{-5}	5.23	3,900	
Phenol	X	X			93,000	0.3	4.5×10^{-7}	1.46	14
Toluene	X	X	X	X	535	28	6.4×10^{-3}	2.73	300
Total Xylenes	X	X	X		130-198	10	7.0×10^{-3}	2.95-3.26	240
PHTHALATES									
Bis(2-ethylhexyl)Phthalate	X	X	X	X	0.4	2×10^{-7}	3.0×10^{-7}	9.2	2.0×10^{-9}
POLYNUCLEAR AROMATIC HYDROCARBONS	X	X	X	X	0.01-1.3	10^{-4}-10^{-11}		4.4-6.8	14,000 -5,500,000
POLYCHLORINATED BIPHENYLS									
Arochlor 1242	X				0.23	1.3×10^{-3}	2×10^{-3}	5.6	6,300
Arochlor 1248	X				0.054	5×10^{-4}	3.5×10^{-3}	6.1	280,000

Notes:

Sources: EPA 1986a, Mabey et al. 1982

10^{-5} are associated with possibly significant but not rapid volatilization, while chemicals with values less than 10^{-5} will only volatilize slowly from water (Lyman 1982).

The log octanol-water partition coefficient (K_{ow}) is often used to estimate the extent to which a chemical will partition from water into lipophilic parts of organisms, for example, animal fat. Similarly the organic carbon partition coefficient (K_{oc}) reflects the propensity of a compound to sorb to the organic matter found in soil. The normal range of K_{oc} values is from 1 to 10^7, with higher values indicating greater sorption potential.

Since the fate and transport processes for each chemical are also medium-specific, the media in which the chemicals are detected were also included in Table 5-1.

5.1.1 Aliphatic Ketones

The mobility of acetone in the environment is governed by its high vapor pressure and the fact that it is readily soluble in water.

Acetone has a K_{oc} of 2.2 which indicates that it is not readily adsorbed to soil organic matter. Its vapor pressure at $20^{o}c$ is 270 mm Hg (EPA 1986a). The combination of both of these parameters would indicate that acetone would volatilize from surface soils.

Acetone is readily soluble in water. Therefore any acetone that does not volatilize from soil would be expected to leach from the soil and move freely in groundwater. If acetone is present in surface water, it will likely remain in the water. Acetone has a Henry's law constant of 2.1×10^{-5} (EPA 1986a) and is in the range where volatilization is a slow removal process from surface water (Lyman et al. 1982).

5.1.2 Chlorinated Aliphatics

With the exception of hexachloroethane, the chlorinated aliphatics are relatively volatile and will be referred to as volatile organic compounds (VOCs). All seven of these compounds have relatively high vapor pressures (ranging from 17.8 to 2,660 mm Hg) implying that in their pure form these materials will readily vaporize.

Vinyl chloride is a gas at room temperature and is the most volatile compound of these seven VOCs. In the soil matrix, there are other factors in addition to the vapor pressure that contribute to the volatilization rate. A chemical in the soil may be partitioned between the soil water, soil air and the soil solid constituents. The extent to which an organic chemical partitions itself between the solid and solution phase of a water-saturated or unsaturated soil is determined by several physical and chemical properties of both the chemical and the soil. In most cases, the adsorption coefficient, K_{oc}, is a good measure of the chemicals tendency to sorb to the organic matter in the soil. Given the fact that all the VOCs selected as indicator chemicals have relatively small K_{oc}s (Table 5-1) they are likely to be sorbed significantly to soil and volatilization from surface soil would be a likely migration pathway for these chemicals.

Since these VOCs are relatively soluble in water (their solubilities range from 150-8,520 mg/l), they are likely to be leached out of the contaminated soil and transported into the groundwater and surface water. This may in part explain the fact that most of the VOCs were detected in the groundwater more frequently than they were in the surface soil. Once in the groundwater, these VOCs are expected to be rather mobile. Groundwater transport is a function of a chemical's solubility in water as well as its tendency to adsorb soil particles. Chemicals moving in groundwater by advection tend to partition between a mobile dissolved phase in the groundwater and a stationary adsorbed phase bound to the surface of soil particles in contact with groundwater. The overall effect of this sorption process is a retardation of the rate of a chemical's transport with respect to the rate of groundwater flow. In Section 4.3.3 (Table 4-10) it is shown that retardation factors for some of these VOCs range from 2 to 7 in the water table, indicating the amount of retardation is relatively small. Therefore, based on little adsorption and relatively high solubilities, the VOCs which are chemicals of concern in groundwater are expected to be mobile. Finally, these mobile contaminants in the soil may be transported to the surface water via groundwater discharge or leaching from the surface soil followed by surface flow. Once in the surface water, the VOCs may also volatilize. Major factors affecting the volatilization rate from surface water are solubility, molecular weight, and vapor pressure of the chemical

and the nature of the air-water interface through which it must pass. Ambient temperature will also influence volatilization since the volatilization rate increases with increasing temperature. Henry's law constants, which relate the concentration of a chemical in the gas phase to its concentration in the liquid phase, are a good indication of the likelihood of a chemical to volatilize from water. When other conditions remain the same, a larger Henry's law constant indicates there is a stronger possibility that the chemical will volatilize from water. As indicated in Table 5-1, all the VOCs selected as indicator chemicals have Henry's law constants approximately equal to or greater than 10^{-3} atm-m^3/mol, which strongly suggests that once the chemicals are present in the surface water, volatilization is likely to be rapid.

Biological processes are however considered to be more important than chemical processes for chlorinated aliphatics since biodegradation of these compounds can occur in soils. The extent and rates of these reactions, however, are difficult to predict because of a limited scientific data base. The state of knowledge in this field as reported in recent reviews (SAIC 1985, Smith and Dragun 1984) is summarized below.

Several facts emerge from the currently available literature. First, these biological reactions are primarily reductive dechlorination and occur in an anaerobic environment; one exception to this general rule is aerobic degradation of TCE in the presence of methane (Wilson and Wilson 1985). Second, the transformation is sequential, for example, tetrachlorinated compounds yielding trichlorinated, then dichlorinated compounds, with the final degradation product being vinyl chloride (Cline and Viste 1984). This sequential transformation does not specifically refer to aerobic or anaerobic environments. In addition, the nature and extent of degradation, along with the type and number of products, appears to be highly dependent on soil conditions. Some investigators (Wilson et al. 1983, Schwarzenbach et al. 1983) found no transformations of chlorinated alkenes (for example the chlorinated ethenes) in soil, whereas others (Kleipfer et al. 1985, Parsons et al. 1984) found substantial transformation.

One area of controversy that remains is the degree of mineralization (i.e., degradation to carbon dioxide and water) of the compounds compared with the degree of production of daughter organic compounds. In the methane-assisted aerobic study performed by Wilson and Wilson (1984), carbon dioxide was the main product.

Vogel and McCarty (1985) found 24% conversion of tetrachloroethene to carbon dioxide in an anaerobic continuous flow fixed film reactor. Most other studies have not measured mineralization.

Hexachloroethane is expected to behave differently from the other aliphatic indicator chemicals. Volatilization and sorption of hexachloroethane to soils and sediments are likely to be the dominant influences in the transport of hexachloroethane. Biodegradation is probably not an important process (Callahan et al. 1979).

Volatilization of hexachloroethane is probably an important removal process from surface water (Lyman et al. 1982) based on the Henry's law Constant (2.5×10^{-3} atm-m^3/mol). Dilling et al. (1975) studied volatilization from an open, agitated container and found the half-life to be 45 minutes. MacKay and Leinonen (1975) report similar rates from their theoretical study. These experimental results can be used to give a relative rate of volatilization. Environmental conditions are likely to vary from laboratory conditions, and therefore, actual volatilization rates will be different.

The K_{oc} for hexachloroethane is 20,000 (Mabey et al. 1982). This indicates that moderate sorption to the organic matter in soils and sediments is likely to occur. In addition, its vapor pressure (0.4 mm Hg) indicates that if hexachloroethane was detected in the soils, it would not be expected to volatilize. Hexachloroethane was detected only once in the surface water and not in other media. The presence of this chemical in surface water may be due to surface water run off which would have transported any hexachloroethane adsorbed onto soil particles.

5.1.3 Monocyclic Aromatics

Most of the monocyclic aromatic chemicals of concern are expected to be rather mobile within and between media. Toluene, xylene, and chlorobenzene are moderately soluble in water with solubilities ranging from 130-535 mg/l and have K_{oc} values in the order of 200 to 300 ml/g. Ethylbenzene has a water solubility of 152 mg/l and it has a K_{oc} of 1,100 ml/g. In addition the vapor pressures of these four chemicals are about 10 to 30 mm of Hg, indicating that there is a strong likelihood that these chemicals will volatilize

from the soil. The water solubilities would also imply that these chemicals can be leached into the groundwater. Once in the groundwater, they are expected to be mobile, although the mobility may be slightly less than the VOCs described previously. This is mainly because these four chemicals have higher K_{oc} values than the VOCs and tend to adsorb to the surface of soil particles in contact with groundwater, resulting in an overall retardation of the transport rate. In addition, the Henry's law constants for these four chemicals are on the order of 10^{-3} m^3-atm/mole. Consequently, once in the surface water, volatilization will be the most likely transport process.

The remaining two monocyclic aromatics, phenol and hexachlorobenzene are expected to behave differently than the other four monocyclic aromatics. Phenol has a low vapor pressure, a low K_{oc}, and a high water solubility. Consequently, volatilization from surface soil is not likely to be an important pathway. However, because of its high water solubility, it could readily leach from soil into the ground or surface water.

Hexachlorobenzene, on the other hand, is expected to be rather immobile. Its high Koc and low vapor pressure indicate it will be adsorbed strongly on the surface soil. In addition, hexachlorobenzene is relatively insoluble in water and consequently leaching into groundwater is not expected to be an important transport mechanism.

5.1.4 Phthalates

Bis(2-ethylhexyl) phthalate was detected in both the soil and aqueous media at the Summit National Site. Bis(2-ethylhexyl)- phthalate is persistent in the environment. Sorption will contribute to the removal of bis(2-ethylhexyl)phthalate from aquatic systems, but desorption can occur as easily. In a stream, for example, bis(2-ethyl- hexyl)phthalate can be removed in one place and put back into solution in another. Hydrolysis, biodegradation, photolysis, and volatilization of bis(2-ethylhexyl)phthalate occur very slowly or not at all and will, therefore, be insignificant in aquatic environments.

Bis(2-ethylhexyl)phthalate tends to adsorb onto a variety of solids and reach a steady-state equilibrium after 12 hours (Sullivan et al. 1982). Sullivan et al. also found that this process is completely reversible for all samples except seawater sediments. They postulate that the ionic strength of seawater may hold the bis(2-ethylhexyl)- phthalate on the sediments. Wolfe et al. (1980) obtained similar results. In the four aquatic environments they studied, DEHP was adsorbed onto the sediments.

The hydrolytic decomposition of bis(2-ethyl-hexyl)phthalate is very slow. The half-life of the reaction depends on the extent to which sorption processes dominate the system. In a system with a low sediment load, the half-life will be on the order of 100 years, while it can increase to 2,000 years for a system with a high sediment load (Wolfe et al. 1980).

Biodegradation of bis(2-ethylhexyl)phthalate will also occur slowly. In fact, transformation of bis(2-ethyl-hexyl)phthalate is not thought to be a significant process. Under the anaerobic conditions of the local groundwater, bis(2-ethylhexyl)phthalate is not expected to biodegrade.

Volatilization of bis(2-ethylhexyl)phthalate can account for very little (2%) of the bis(2-ethylhexyl) phthalate lost from an ecosystem due to its low vapor pressure (2×10^{-7} mm Hg). In a lake, volatilization might contribute to a greater extent. Photolysis will also be a slow process, dependent upon the available light, and it would only account for about 2% of the bis(2-ethylhexyl)phthalate lost.

The presence of bis(2-ethylhexyl) phthalate in surface water may be due to surface runoff transporting bis(2-ethylhexyl)phthalate that is sorbed to soil particles. Once in the surface water, biodegradation and biotransformation are expected to be unimportant. Biodegradation and biotransformation occur in surface water, at a very slow rate, if at all. Therefore, bis(2-ethylhexyl)-phthalate is expected to be persistent.

5.1.5 PCB's

The most common forms of PCBs found in the soil at the site are characterized as Aroclor 1242 and 1248. PCBs are generally sorbed strongly to the soil, and are not

readily leached from the soil matrix. The sorption properties of PCB have been extensively studied (Griffin and Chou 1981; Weber et al. 1983). These investigators report strong binding between PCB and soils and high capacity of soils for PCB. Whole soil capacities (as Freundlich constants K_f) ranged from 0.14 ug/g to 4.2 ug/g depending on the organic carbon content of the soil. Aroclor 1254 was also found to bind to clay (Kaolinite K_f = 0.32 ug/g), river sediment (K_f = 7.7 to 17.4), algae (K_f = 270), and bacteria (K_f = 420 to 605). For comparison, the capacity of activated carbon for PCB is >200 mg/g (Dobbs and Cohen 1980).

DiToro and Horzampa (1983) found that adsorption of PCB is not totally reversible, i.e., some finite residual quantity will always remain in the sorbed phase. Based on the above data, it is not expected that PCBs will be leached to an appreciable extent from the soils at the Summit National Site.

PCBs are not subject to hydrolysis, oxidation, or thermal degradation at environmentally significant rates (EPA 1980; Callahan et al. 1979). This leaves photolysis and biodegradation as the only chemical routes for PCB decay. Most PCB cogeners will undergo photolysis to some extent. However, the rates of these processes are very slow and quantum yields are low (Zabik 1983). Taken in conjunction with the fact that sorbed PCB may not be available for absorption of solar energy, photolysis will probably not be important at Summit National. Additionally, photolysis does not result in complete degradation of the PCB molecule. Reaction products may be more toxic than PCB themselves, a fact which is addressed in greater detail below.

PCB with four or fewer chlorines are biodegradable; however, again the rates are slow. Tucker and co-workers (1975) found that only 19 percent of Aroclor 1254 are degraded in 48 hours of treatment with activated sludge. The rates for biodegradation in sediment range between 10^{-10} to 10^{-13} ng/ml-hr (NAS 1979). Thus, although it is unlikely that biodegration will be significant at Summit National, there may ultimately be some removal of cogeners with four or less chlorines.

5.1.6 Polynuclear Aromatic Hydrocarbons

Polynuclear aromatic hydrocarbons (PAHs) were detected in all the environmental media sampled at Summit National. These compounds differ widely in both physiochemical characteristics and toxicity. In general, the low molecular weight PAHs are more mobile in groundwater, soil and air.

The environmental fate of the PAHs can be inferred from their physical and chemical properties as well as from the available data (Callahan et al. 1979). The PAHs have K_{oc}s ranging from 14,000 to 5,500,000 (EPA 1986a). This indicates that they would be strongly adsorbed onto soils high in organic matter. Once PAHs reach the soil, they are likely to remain there. The PAHs found in the surface water may have been transported by surface water runoff. The PAHs have low solubilities in water ranging from 0.01 to 1.3 mg/liter (Callahan et al. 1979, EPA 1986a). Therefore, once in the surface water the PAHs tend to sorb onto the sediments or suspended particulate matter.

The lower molecular weight PAHs have the highest vapor pressures and could volatilize and be transported in the air. Volatilization for most PAHs is not, however, considered a significant process (Callahan et al. 1979).

Biodegradation and biotransformation by benthic organisms are significant fate processes for PAHs. The data suggest that multi-cellular organisms readily metabolize high molecular weight PAHs while microbes only slowly degrade PAHs (Callahan et al. 1979). Biodegradation may occur more readily in soils than in aquatic systems. The data indicate that systems which are chemically exposed to PAHs will have higher biodegradation rates than otherwise expected. It should be noted that only PAHs with four or less rings have been found to be biodegraded (Callahan et al. 1979).

5.2 INORGANIC CHEMICALS

The inorganic chemicals of concern selected for this study are antimony, barium, cadmium, chromium, cyanide, nickel, and zinc. Cyanide is an anion and behaves differently than the other inorganic compounds chosen as chemicals of concern. Antimony is an amphoteric element, exhibiting both metallic and non-metallic

behavior. The other five metals, with the exception of chromium, are generally present in water as the divalent cation. Chromium can be present as either the trivalent cation (Cr^{3+}) or as the hexavalent cation (Cr^{6+}). In the soil, metals are generally quite immobile particularly under neutral or alkaline conditions. In addition, inorganic metal ions are not volatile. Thus, metals in the soil are probably strongly sorbed to the soil particles, but may be desorbed when the conditions (mainly pH and oxidation-reduction potential) of the leaching water are appropriate. Rain water is generally mildly acidic due to the presence of carbon dioxide. Thus the potential exists for the indicator inorganic chemicals to be leached into the groundwater, or to be carried to the surface water in runoff.

Once in water, the metal cation may be removed from the dissolved phase through reactions with anions. Since most inorganic chemicals do not degrade, the loss mechanisms are limited to the immobilization processes, which in turn are determined by local environmental factors that affect their chemical forms.

Environmental factors that affect the chemical forms, and hence the mobility of a metal include pH, redox potential, the ion exchange capacity of the soil or sediments and the concentration of organics and specific anions in local groundwater or surface water. Unfortunately, several of these parameters were not monitored at the Summit National site, and consequently, the discussion of the mobility of metals in groundwater can only be presented in a general form.

5.2.1 Antimony

The behavior of antimony (Sb) in the environment is not well documented (Callahan et al. 1979, Kabata-Pendias and Pendias 1984, Brannon and Patrick 1985). Antimony is found in waters, sediments, and soils and is associated with iron oxides, which indicates that it is relatively mobile (Kabata-Pendias and Pendias 1984).

Antimony is present as the soluble oxide or antimonite (+3) salt in most natural waters. In reducing environments, the volatile stibine (SbH_3) may be formed. Stibine is a gas at room temperature, and it is quite soluble in water. However, it is not stable in aerobic waters or air and under those conditions is oxidized to form Sb_2O_3.

The extent to which sorption reduces the aqueous transport of antimony is unknown, but it is clear that sorption to clays and metal oxides is normally the most important mechanism for removing antimony from natural waters. It is also possible that heavy metals in solution could react with antimonite (+3) or antimonate (+5) to form insoluble compounds. The importance of such processes is unknown, but it is likely that most species of antimony in natural waters are soluble and quite mobile (Callahan et al. 1979, Cotton and Wilkinson 1972).

5.2.2 Barium

Barium (Ba) forms compounds in the +2 oxidation state. Barium has not been found to form complex ions in water (Cotton and Wilkinson 1972) and the Ba^{+2} ion is stable under the pH-Eh range of natural systems. $Ba(OH)_2 \cdot 8H_2O$ will form above pH 12. BaH_2 is stable under reducing conditions (Eh less than -1.2 ev.) over the entire pH range of aquatic systems (Pourbaix 1963).

In soils, barium is not very mobile. In the presence of carbonate or sulfate, $BaCO_3$ or $BaSO_4$ will precipitate. Barium can also strongly adsorb to clay (Kabata-Pendias and Pendias 1984). Humic and fulvic acid interactions that could increase the mobility of the element by increasing its solubility have not been found to occur (U.S. EPA 1984). Barium can form compounds with acetate, nitrate, chloride, and hydroxide, and these compounds are very soluble. Their presence in soil would increase barium's mobility. In general, the solubility of barium compounds increases with decreasing pH (U.S. EPA 1984). The mobility of barium in soil is low under oxidizing and acidic conditions and very low under neutral, alkaline, or reducing conditions (Kabata-Pendias and Pendia 1984). Barium is probably associated with suspended particles or sediments in aquatic media. The solubility product of barium carbonate is likely to control soluble barium concentrations. In the absence of carbonate or clays to sorb barium, it is likely to remain in solution (U.S. EPA 1984).

The Summit National Site is located in an area that is rich in coal. Therefore, the sulfate concentration in groundwater should be at levels which could control barium's mobility. The groundwater beneath the contaminated area is high in bicarbonate. Therefore,

there should be a competition between sulfate and carbonate for barium resulting in concentrations somewhere between that expected based on the solubility product of barium sulfate and barium carbonate (i.e., 1.2-342 mg/liter).

5.2.3 Cadmium

Cadmium (Cd) is found in the +2 oxidation state in the environment (Cotton and Wilkinson 1972). Redox potential has little influence on cadmium speciation in water (Callahan et al. 1979). Rather, the pH of water will tend to control speciation of cadmium through the formation of hydroxides: $CdOH^{1+}$, $Cd(OH)_2(aq)$, $Cd(OH)_3^{1-}$, and $Cd(OH)_4^{2-}$. The dominant ion will be Cd(2+) at pH levels up to 8 (Pourbaix 1963; Moore and Ramamoorthy 1984). Under reducing conditions and in the presence of sulfur, the relatively insoluble cadmium sulfide (CdS) will form. Therefore, under anaerobic conditions, CdS will be expected to control cadmium's solubility and hence its mobility (Callahan et al. 1979).

Organic matter such as humic acids, fulvic acids, and other naturally occurring substances can influence the speciation of cadmium. Gardiner (1974) found that the amount of cadmium ion in the lake water is inversely related to pH and the amount of organic matter present. A cadmium-organic complex was found to bind cadmium at pH levels as low as 3 (Guy and Chakrabarti 1976). Water hardness limits the extent of complex formation, and O'Shea and Mancy (1978) reported that an increase in hardness resulted in decrease in complex formation.

The chemistry of cadmium in natural systems is dominated by the ionic, dissolved form of the metal. In the presence of organic acids, a complex ion may form. As the pH of water increases, cadmium hydroxide forms and may remove some of the cadmium from solution. Carbonate will also precipitate some of the cadmium at very high pH levels.

Cadmium is among the most mobile of the heavy metals, and its mobility depends more on sorption processes than on precipitation reactions (Kabata-Pendias and Pendias 1984). Sorption of cadmium is influenced by the clay (Korte et al. 1976) and metal oxide (Callahan et al. 1979) content of the soil and sediments and is a pH-dependent process that increases with increasing pH

(Frost and Griffin 1977). Below pH 6 to 7, desorption is the dominant process. Huang et al. (1977) found that organic anions enhance sorption even at low pH levels. The organic acids react with cadmium to form an organo-cadmium complex, which can then be sorbed to soil or sediment particles. Nevertheless, cadmium has considerably less affinity for two sludge-treated soils than do copper, zinc, or lead and is thought to be more mobile than those chemicals (Williams et al. 1984).

Cadmium transport in the Mississippi River was found to be related to levels or organic materials and metal oxides (Eisenreich et al. 1980). Clay material also removes cadmium effectively. Cadmium adsorbed to clay, however, is more available for resuspension than cadmium associated with carbonate minerals or precipitated as a solid or with hydrous iron oxide. The presence of phosphate can enhance cadmium removal by processes similar to those discussed above for organic ions (Farrah and Pickering 1977). Sedimentary iron oxides and carbonates are thought to play a key role in removing cadmium from solution.

5.2.4 Chromium

The mobility of chromium in the environment depends, to a large extent, on the oxidation state of the element. Chromium is most commonly found in the +3 [Cr(III)] and +6 [Cr(VI)] oxidation states.

Cr(VI) is thought to be more mobile in the environment than Cr(III); Cr(III) can be adsorbed or complexed to soil particles, metal oxides, or organic matter and is therefore relatively immobile. Most of the Cr(III) found in soils is in the form of mixed Cr(III) and Fe(III) oxides or in the lattice of minerals. In addition, Schnitzer and Kendorff (1981) found that fulvic acid (a naturally occurring water-soluble, high molecular weight organic material) can render Cr(III) immobile. However, Cr(III) can be mobilized in very acidic media (Kabata-Pendias and Pendias 1984).

The migration of chromium through soils is dependent upon the pH, presence of oxygen, amount of organic matter, and the concentration of other metals in the soil.

As noted, soil pH can influence the mobility of chromium. The adsorption of chromium onto clays is pH dependent; Cr(III) adsorption increases with increasing pH and Cr(VI) adsorption decreases with increasing pH

(Griffin et al. 1977). However, James and Bartlett (1983) disagreed with Griffin et al. (1977) and suggested that processes other than anionic adsorption could be removing the Cr(VI). Griffin (1976) noted that above pH 5, Cr(III) will be immobile due to precipitation. Below pH 4, Cr(III) adsorbs strongly to clays. In the pH range between 4 and 5, the combination of adsorption and precipitation contribute to immobility. Cr(VI) compounds are more mobile but can be sorbed to soil particles as polynuclear bridged chromium compounds. Chromate (CrO_4^{2-}) may behave similarly to other anions, such as hydrogen phosphate (HPO_4^{2-}), and form a bridge complex with iron (Fe) or aluminum (Al) oxides or with other positively charged soil constituents. These phosphate bridges are very stable and can render hydrogen phosphate (HPO_4^{2-}) and by analogy chromate (CrO_4^{2-}), unavailable for movement or use by plants. Hydrogen chromate ($HCrO_4^-$) may be tightly held by soils like dihydrogen phosphate ($H_2PO_4^-$) or behave similar to bicarbonate (HCO_3^-) and remain mobile (James and Bartlett 1983).

The presence of soil organic matter has been found to greatly enhance the reduction of Cr(VI) to Cr(III) thus lowering the mobility of chromium. Bartlett and Kimble (1976) observed reduction only in soils containing organic matter and not in a soil which was characterized as "organic free". Schroeder and Lee (1975) found that Cr(VI) reduction occurs in the presence of ferrous iron [Fe(II)], dissolved sulfides, and organic compounds, especially those with sulfhydryl groups. These groups are likely to be present in partially decayed protein and probably also in humic materials. Cr(III) oxidation was only found to occur in the presence of a large amount of MnO_2 and at a very slow rate by atmospheric oxygen. The Electric Power Research Institute (EPRI 1986) also reported that oxidation of Cr(III) was only favored in the presence of large amounts of manganese dioxide (MnO_2), and Bartlett and James (1979) also observed oxidation of Cr(III) to Cr(VI) in soils with high MnO_2. Their results point to an oxidation-reduction-reoxidation scenario with a steady state or equilibrium being reached.

From a thermodynamic standpoint, Brown et al. (1986) found that the most likely forms of Cr(III) would be chromite ($FeCr_2O_4$) and chromic oxide (Cr_2O_3).

They further noted that the solubility product of Cr_2O_3 was sufficient to keep dissolved chromium concentrations at very low levels.

5.2.5 Cyanide

The behavior of cyanide (CN) in soils has not been widely studied. The fate and transport of cyanides will depend upon their form. The simplest cyanide, hydrogen cyanide (HCN), is an acid and can dissociate into the cyanide ion (CN^-). The negative log of the dissociation constant (pK_a) of HCN is about 9.2. This implies that under natural environmental conditions, HCN will be the predominant simple cyanide. Hydrogen cyanide is soluble in all proportions in water. The term cyanide can also refer to any material containing the CN group; these may include simple cyanides, metallocyanide complexes, and organic compounds (nitriles) (Callahan et al. 1979). Hydrogen cyanide will volatilize rapidly from water or soil surfaces. Since HCN is lighter than air, it will diffuse rapidly once it volatilizes.

The simple cyanides are generally thought of as those formed with Group I and Group II metals, such as NaCN and $Ca(CN)_2$. These rapidly dissociate in water leaving CN^- to hydrolyze or to react with trace metals. Iron, gold, cadmium, copper, nickel, silver, and zinc have been found to form metallocyanides (Fuller 1977, 1978). Metallocyanides have varying stabilities. Cadmium and zinc complexes are found to be dissociated in water while the stability of copper and nickel cyanides depends on pH. Iron and cobalt cyanide complexes are very stable (Callahan et al. 1979).

The mobility of cyanide in soils was studied by Alesii and Fuller (1976). They looked at the leaching of KCN in water and landfill leachate and $K_3Fe(CN)_6$ through five soils. Cyanide mobility was found to be pH dependent. Iron oxide and clay concentrations were found to retard cyanide. Overall, cyanide was found to be very mobile, with the lowest mobility occurring at low pH and high iron oxide concentrations. Biological utilization of cyanide in soil has been studied (Raef et al. 1977a,b, Strobel 1967, Ware and Printer 1955). Strobel (1967) found that cyanide could be broken down into CO_2 and NH_3. Similar results were reported by Raef et al. (1977a,b). Cyanide can, in fact, be used as a source of nitrogen by plants (Fuller (1977).

The fate of cyanide in soils is rather complex. Cyanide ions are not strongly sorbed to soils except at low pH and high oxide and clay concentrations. Cyanide ions are expected to either be complexed by trace metals or hydrolyzed to HCN. Ultimately, the cyanide species in soil will be biodegraded. There are few physical and chemical controls on cyanide mobility (Towill et al. 1978). Cyanide is not, however, a common contaminant in groundwater because of biological controls on its mobility. Volatilization of HCN may occur from soil surfaces.

5.2.6 Nickel

Nickel is found in the +2 oxidation state in the environment. Nickel forms complexes with hydroxide, nitrate, sulfate, and humic and fulvic acids. These complexes are moderately soluble and, when the pH is below 9, can maintain Ni^{+2} concentrations above 60 ug/liter. Nickel hydroxide or carbonate will precipitate from solution if the pH is above 9 (Cotton and Wilkinson 1972, Callahan et al. 1979). Nickel is a mobile element in the environment. It can be sorbed to hydrous iron and manganese oxides and organic matter. Iron oxide forms a stronger complex with nickel than does manganese oxide (Kabata-Pendias and Pendias 1984). Clay is also a good sorbent for nickel, removing nickel or hindering its transport in soils (Korte et al. 1976). Solid organic matter sorbs nickel in both soils and sediments. The organo-nickel complex is stable under basic conditions. Hydrous iron oxides attract nickel from organic matter, but this reaction is enhanced under acidic conditions.

There are few controls on nickel's mobility in the environment. Nickel can complex with commonly occurring inorganic ligands; however, these complexes are fairly soluble. Organic matter can complex with nickel, increasing the metal's mobility. Solid organic matter can sorb nickel, as can metal oxides and clay.

5.2.7 Zinc

Zinc is found in the +2 oxidation state in the environment. It can be found as a hydrated ion, a metal-organic complex, or a metal-inorganic complex in water. The redox potential does not affect zinc speciation directly; instead it affects the ligands with which zinc may react (Cotton and Wilkinson 1972, Callahan et al. 1979).

Hydrous metal oxides, clays, and organic matter can all sorb zinc. Iron oxide and phosphates were found to remove zinc from the Vesdie River, trapping it in the sediments (Honba et al. 1983). In addition to sorption, coprecipitation of zinc with hydrous oxides have been found to occur. This process can take place when reduced iron or manganese oxides are oxidized. As the new solids are formed, they can trap various ions into their crystal lattice (Callahan et al. 1979).

The soil chemistry of zinc is governed by the pH of the soil. In acidic soils, zinc absorption is related to cation exchange sites; while in alkaline soils, the chemistry is dominated by organic ligands. Cation exchange processes will be influenced by the type of cations moving through the soil. This implies that when there are mobile metals, competition for the binding sites will occur, and zinc may be mobilized. In more alkaline soils, zinc can form an organo-zinc complex, which would also increase the metal's mobility (Kabata-Pendias and Pendias 1984).

Metal oxides also influence zinc's mobility in soils. Zinc was found be highly associated with oxides. Clay is also capable of sorbing zinc. Soils that contain high levels of calcium and phosphorus immobilize the metal (Kabata-Pendias and Pendias 1984).

Zinc can form complexes with humic and fulvic acids, and the formation of these complexes can increase its solubility (Ong et al. 1970, Rashid and Leonard 1973). Guy and Chakrabarti (1976) found that these complexes could keep zinc bound but dissolved to a pH as low as 3.

6.0 PUBLIC HEALTH EVALUATION

6.1 INTRODUCTION

A public health evaluation (PHE) is an estimation of the magnitude and probability of actual or potential harm to public health caused by threatened or actual release of a hazardous substance. It is a site-specific risk assessment performed as part of the Remedial Investigation/Feasibility Studies (RI/FS) performed under CERCLA for abandoned hazardous waste sites.

This baseline public health evaluation addresses the potential hazards to public health associated with the Summit National site under the no-action alternative -- i.e., in the absence of remedial (corrective) action.

This public health evaluation is consistent with guidelines from the Office of Emergency and Remedial Response (EPA 1986a) and federal guidelines for risk assessments (EPA 1986c,d,e).

The public health evaluation is organized as follows: Following a brief site history, contaminants of concern associated with site activities (indicator chemicals) detected on or at the site perimeter are identified. Next, an exposure assessment is performed in which potential exposure pathways under current and plausible future-use scenarios are identified, and concentrations of contaminants at points of potential human exposure are estimated. The exposure assessment is then followed by a toxicity assessment in which the indicator chemicals are characterized with respect to their toxic effects on humans. In the toxicity assessment environmental standards, and criteria [applicable or relevant and appropriate requirements (ARAR's)], and critical toxicity values are identified. In the last section of this assessment, information developed in the toxicity assessment and exposure assessment are integrated to evaluate risk to human populations potentially exposed to contaminants originating from the site. Risk is determined both by comparison to environmental standards or criteria where available and also by quantitative risk estimation.

In addition to this evaluation of the risks associated with chemicals that are considered to have originated from the site, at the request of EPA Region V, the potential impacts from exposure to chemicals in offsite background soils will also be evaluated.

6.2 SITE HISTORY

Although the entire site history is presented in detail in Section 1.2.2 of this RI, it will briefly be presented here in order to provide context for this PHE. The Summit National site, which is located in an old strip mining area, contained a coal stockpile and a pond that had been used as a coal wash pond. A liquid waste incineration facility was operated at the site from 1973 until June 1978. Wastes reportedly taken to the site included resins, paint sludges, waste oils, flammable solvents, plating sludges, pesticide wastes, phenols, cyanides, acids, labpacks and various polymers. Some of these wastes, which were either delivered in bulk or in 55 gallon drums, were incinerated, while others were stored in bulk, spilled or leaked into the site soils. At the time the operation was abandoned the site had an inventory of over 15,000 drums of liquid and solid wastes, 50,000 gallons of bulk storage liquids and 250,000 gallons of open storage liquids. In the fall of 1980 U.S. EPA funded the removal and disposal of over 7,500 gallons of hexachlorocyclo- pentadiene (HCCPD or C-56). In November 1980, an agreement between the major waste generators and the State of Ohio EPA provided $2.5 million for surface cleanup of the site. This cleanup included removal of aboveground drums, tanks, debris and a small quantity of contaminated soil.

The site currently has several aboveground structures including portions of the incinerator and storage shed as well as a loading dock and debris of the original coal processing facilities. Since the site is located in an old strip mining area and because it was regraded during surface cleanup activities there is little vegetation growing on site. The site is enclosed by a locked 6-foot-high fence. Surrounding land use is residential, commercial, light industrial (including two landfills), and agricultural.

6.3 SELECTION OF CHEMICALS OF CONCERN

As can be seen from the results of environmental sampling undertaken during the two phases of this RI presented in earlier sections of this report, a large number of chemicals (more than 100) have been detected on and in the vicinity of the site. A subset of these chemicals will be selected to be evaluated in this assessment. Experience has shown that it is more useful to identify chemicals of concern by medium for

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further evaluation rather than the development of a master list of chemicals as outlined in the Superfund Public Health Evaluation Manual (EPA 1986a). This approach allows for evaluation of chemicals in each medium which are predicted to have the greatest potential risk associated with any particular exposure pathway involving that medium.

Validated data generated during Phases I and II of the RI/FS will be considered; however, in order to focus on contaminants that are of current and future concern and that any remediation will address, the most recent data and/or most complete data sets will be principally used.

There were several steps in the screening process. First, chemicals detected in samples that were also detected in blanks from the same medium at similar concentrations (within approximately one order of magnitude) were considered to be unrelated to activities at the site. This screening step eliminated the following organic chemicals from each medium: di-n-butylphthalate from soil; methylene chloride and 2-butanone from surface water; and methylene chloride, chloroform, toluene, di-ethylphthalate, di-n-butylphthalate, and bis-2-ethylhexylphthalate from groundwater samples collected from residential wells. These chemicals have historically been associated with laboratory contamination.

The second step in this selection process was to examine the frequency with which chemicals were detected in each medium; the intent being to eliminate from further consideration chemicals only detected in a small percentage of the samples. If only a small number of samples were taken from a particular medium, then this step was not employed. As a rule of thumb, if more than 15 samples were collected from one medium during the most recent sampling period and a chemical was detected in less than 10% of the samples it was considered for elimination. Only after considering the toxicity, concentration, and location of the samples containing infrequently detected chemicals, and prevalence of the chemical in other media, was the chemical eliminated. Using this procedure, no chemicals were eliminated from surface water, sediment, off-site surface soils, or off-site subsurface soils because fewer than 15 samples were collected from these media during their most recent sampling. However, 25 chemicals were eliminated from consideration in

groundwater monitoring wells at or downgradient from the site because they were detected in 2 or fewer samples out of 23. Twenty-seven chemicals were eliminated from further consideration in onsite surface soil and 14 were eliminated from further consideration in onsite subsurface soil using this procedure. The specific chemicals that were eliminated and the media in which they were detected are listed in Table 6-1.

The third step in this selection process was to identify those chemicals for which chronic toxicity data are not available. Table 6-2, which is a summary of the contaminants identified on site, indicates the contaminants that lack relevant toxicity data, as well as indicating groups of chemicals for which a group toxicity value is available, i.e., polynuclear aromatic hydrocarbons and polychlorinated biphenyls. The chemicals that are indicated in Table 6-2 as not having relevant toxicity data listed in USEPA (1986a) were additionally reviewed by a toxicologist to ensure that suitable toxicity data for the chemicals being eliminated in this step had not recently become available or that, based on available data, the chemicals would not be expected to add significantly to the potential hazards associated with the site. This review did not result in any chemicals being added back to the list of chemicals being reviewed in more detail. Chemicals grouped based on toxicity data, (PCBs and PAHs) will be treated as groups throughout the remainder of the selection process.

The initial screening steps described above eliminated more than one-half of the original 110 chemicals detected in samples collected from or in the vicinity of the Summit National site. The final screening described below was media specific and generally followed the procedure recommended by USEPA's Office of Emergency and Remedial Response, outlined in the Superfund Public Health Evaluation Manual (SPHEM) (EPA 1986a). This procedure identifies chemicals of concern in each of the media sampled.

In the SPHEM selection process, a score is calculated for each chemical in each medium by multiplying the maximum concentration by a medium-specific toxicity constant provided in the SPHEM. The toxicity constants used for contaminants detected in both water and soil were derived based on ingestion being the only route of exposure. Chemicals having carcinogenic effects and noncarcinogenic effects are scored separately, and

TABLE 6-1

CHEMICALS THAT WERE DETECTED INFREQUENTLY
AT THE SUMMIT NATIONAL SITE

Surface Soil	Subsurface Soil	Groundwater
Anthracene	Anthracene	Acenapthene
Benzo(k)fluoranthene	Antimony	Anthracene
Bis(2-chloroisopropyl)ether	Chloroform	Antimony
4-chloro-3-methylphenol	4-Chloro-3-Methylphenol	Benzene
1,1-Dichloroethane	4,4'-DDT	Benzyl Alcohol
1,1-Dichloroethene	Dibenzo(a,h)anthracene	Butylbenzylphthalate
1,2-Dichlorobenzene	1,2-Dichlorobenzene	Cadmium
1,3-Dichlorobenzene	Heptachlor epoxide	4-Chloro-3-Methylphenol
1,4-Dichlorobenzene	Isophorone	Dibenzofuran
Dieldrin	2-Methylphenol	Diethylphthalate
2,4-Dimethylphenol	Mirex	Dimethylphthalate
Dimethylphthalate	4-Nitrophenol	Di-N-Octyl Phthalate
Gamma BHC	Nitrosodiphenylamine	Fluoranthene
Heptachlor Epoxide	1,1,2-Trichloroethane	Fluorene
Hexachlorocyclopentadiene		Hexachlorobenzene
Indeno(1,2,3-c,d)pyrene		Hexachloropentadiene
Isophorone		2-Hexanone
4-Methyl-2-pentanone		2-Methylphenol
2-Methylphenol		2-Nitrophenol
4-Methylphenol		Pentachlorophenol
N-Nitrosodimethylamine		Phenanthrene
Selenium		Pyrene
Silver		Tetrachloroethene
Styrene		1,2,4-Trichlorobenzene
1,1,2,2-Tetrachloroethane		Total Xylenes
1,2,4-Trichlorobenzene		
1,1,2-Trichloroethane		

TABLE 6-2

CHEMICALS IDENTIFIED ON OR IN THE VICINITY OF THE SUMMIT NATIONAL SITE

Volatile Organics	Base/Neutrals and Acids		Pesticides and PCBs	Inorganic Compounds
Vinyl chloride	N-Nitrosodimethylamine	Pentachlorophenol	Alpha-BHC	Aluminum
Methylene chloride	Phenol	[o]Phenanthrene	Beta-BHC	Antimony
Acetone	Aniline	[o]Anthracene	Delta-BHC	Arsenic
Carbondisulfide	1,3-Dichlorobenzene	Di-n-Butylphthalate	Gamma-BHC	Barium
Benzene	1,4-Dichlorobenzene	Fluoranthene[a]	Heptachlor	Beryllium
[o]2-Hexanone	Benzyl Alcohol	[o]Pyrene	Aldrin	Cadmium
[o]4-Methyl-2-Pentanone	1,2-Dichlorobenzene	[o]Butylbenzylphthalate	Heptachlor Epoxide	Calcium
Tetrachloroethene	2-Methylphenol	Benzo(a)Anthracene	Endosulfan	Chromium
Toluene	[o]4-Methylphenol	Bis(2-ethylhexyl)Phthlate	Dieldrin	Cobalt
Chlorobenzene	Hexachloroethane	chrysene	Endrin	Copper
Ethylbenzene	Isophorone	[o]Di-n-Octyl Phthalate	4,4'-DDT	Iron
Styrene	2-Nitrophenol	Benzo(b)Fluoranthene[a]	Toxaphene	Lead
Total Xylenes	[o]2,4-Dimethylphenol	Benzo(k)Fluoranthene[a]	Aroclor 1232[b]	Cyanide
1,1-Dichloroethene	Benzoic Acid	Benzo(a)Pyrene[a]	Aroclor 1242[b]	Magnesium
1,1-Dichloroethane	1,2,4-Trichlorobenzene	Indeno(1,2,3-cd)Pyrene[a]	Aroclor 1248[b]	Manganese
1,2-Dichloroethane	[o]Naphthalene	Dibenzo(a,h)Anthracene[a]	Aroclor 1254[b]	Mercury
Trans-1,2-Dichloroethene	4-Chloro-3-Methylphenol	[o]Benzo(g,h,i)Perylene	Mirex	Nickel
Chloroform	Hexachlorocyclopentadiene			Potassium
[o]2-Butanone	Dimethylphthalate			Selenium
1,1,1-Trichloroethane	Acenaphthylene			Silver
1,1,2,2-Trichloroethane	Acenaphthene			Sodium
Trichloroethene	4-Nitrophenol			Thallium
1,1,2-Trichloroethane	[o]Dibenzofuran			Tin
	Diethylphthalate			Vanadium
	[o]Fluorene			Zinc
	[o]N-Nitrosodiphenylamine			
	Hexachlorobenzene			

[o]Lacks chronic toxicity data (USEPA, 1986a).

[a]Carcinogenic polynuclear aromatic hydrocarbons (PAHs) for which the potency factor for Benzo(A)pyrene applies.

[b]Potency factor for polychlorinated biphenyls (PCBs) applies to sum of Aroclors.

chemicals are ranked according to these scores. Some contaminants are ranked as having both potential carcinogenic and noncarcinogenic effects because the SPHEM assigns different toxicity factors for each type of effect. Additionally, it should be noted that the indicator scores for each type of effect are not directly comparable.

Chemicals of concern were selected from the ranked lists for each media after examining the scores and considering the background concentrations of each contaminant. Chemicals having concentrations similar to background concentrations are not considered to be site related and were accordingly not selected.

The results of the final screening process are discussed below by medium.

6.3.1 Soil

The extent of soil contamination has been discussed in detail in Section 4.4. Both organic and inorganic chemicals have been detected in on and offsite soils. Although the source of the offsite organic chemicals has not been determined based on available data, the concentrations of both organics and inorganics in offsite soils are considered to be representative of background. To avoid selecting natural constituents of soils as indicator chemicals, the maximum concentrations of metals and organics in surface soils, as given in Table 1 in Appendix H (PHE-1), were compared to the upper 95% confidence limit of local background soil concentrations (see Section 4.4.3), as well as typical concentrations of metals in U. S. Soils (Table 4-16). This comparison resulted in the selection of antimony, cadmium, and zinc as inorganic indicator chemicals in soil. Although surface soil data was primarily used in selecting indicator chemicals in soil, as shown in Table 2 in Appendix H (PHE-1), similar chemicals were detected in the subsurface (6 to 8 ft.) soil samples. For the organic chemicals, the top six chemicals that were ranked based on potential carcinogenic effects and the top six that were ranked based on noncarcinogenic effects were selected as organic indicator chemicals in soils. Total xylenes which were not ranked because of the absence of an indicator chemical selection toxicity constant in the SPHEM were added to the indicator chemical list because chronic toxicity data available for xylenes in a later section of the SPHEM indicates that they can pose a risk when sufficiently high concentrations are ingested.

The selected indicator chemicals in soil are as follows:

Antimony
Bis(2-ethylhexyl)Phthalate
Cadmium
1,2-Dichloroethane
Hexachlorobenzene
Phenol
Polychlorinated biphenyls
Polynuclear aromatic hydrocarbons
Toluene
Trichloroethene
Total xylenes
Zinc

6.3.2 Groundwater

The extent of groundwater contamination has been discussed in detail in Section 4.3.3. The organic contaminants detected in groundwater samples (not attributable to blanks) are all believed to be site related. However, as has been discussed in Section 4.3.3, many of the metals may be related to the effects of mining at the site. Barium and chromium are the only inorganic chemicals present in groundwater that reportedly may be attributed to site activities; these two inorganics will therefore be the only ones selected as indicator chemicals. The organic indicator chemicals selected from Table 3 in Appendix H (PHE-1) are the four organics with potential carcinogenic effects along with the top 7 ranked organic chemicals having noncarcinogenic effects (some of which were ranked as potential carcinogens also). In addition acetone, total cyanide (Table 4 in Appendix H (PHE-1), and trans-1,2-dichloroethene which were not ranked because of the absence of an indicator chemical selection toxicity constant in the SPHEM, were also selected. These chemicals were added to the indicator chemical list because chronic toxicity data available in a later section of the SPHEM indicates that these compounds may be of potential concern. The resulting indicator chemicals in groundwater are as follows:

Acetone
Barium
Bis(2-ethylhexyl)Phthalate
Chromium
Cyanide
1,1-Dichloroethane

1,2-Dichloroethane
1,1-Dichloroethene
trans-1,2-Dichloroethene
Ethylbenzene
Phenol
Toluene
Trichloroethene

6.3.3 Sediment

The extent of sediment contamination has been discussed in detail in Section 4.6. Table 5 in Appendix H (PHE-1) presents concentrations of selected chemicals present in onsite sediments as well as in sediment samples collected downgradient of the site. The maximum concentrations of two of the inorganic chemicals in this table, antimony and zinc exceed both the concentrations in background sediment samples as well as the maximum background in soil in the United States (Table 4-16). Therefore, these two metals are selected as indicator chemicals. The top five organic chemicals with potential carcinogenic effects and the top six organic chemicals ranked based on noncarcinogenic effects are also selected as indicator chemicals. Two of these chemicals, bis(2-ethylhexyl) phthalate and di-n-butylphthalate were detected in a background sediment sample at concentrations of 197 ug/kg and 2,398 ug/kg, respectively. The resulting indicator chemicals in sediment are as follows:

Antimony
Bis-(2-ethylhexyl)Phthalate
Di-n-Butylphthalate
1,2-Dichloroethane
Hexachlorobenzene
Polychlorinated biphenyls
Polynuclear aromatic hydrocarbons
Vinyl chloride
Zinc

6.3.4 Surface Water

The extent of surface water contamination has been discussed in detail in Section 4.5.3. The frequency and concentrations of selected chemicals in surface water are presented in Table 6 in Appendix H (PHE-1). As reported in Section 4.5.3, there were no samples collected that were considered to be representative of background surface water quality. As indicated in Table 6 in Appendix H, one-half of the inorganic chemicals were only detected once. Of the inorganic

chemicals detected more than one time, nickel and zinc are ranked the highest and will be selected as indicator chemicals. Although antimony was only detected one time it will be selected as an indicator chemical in surface water because of its presence in and selection as an indicator chemical in soil and sediment. The top 5 organic chemicals having potential carcinogenic effects are selected as indicator chemicals, as are the top 5 organic chemicals based on noncarcinogenic effects. The resulting indicator chemicals in surface water are as follows:

Antimony
Chlorobenzene
1,1-Dichloroethane
1,2-Dichloroethane
Hexachloroethane
Nickel
Polynuclear aromatic hydrocarbons
Tetrachloroethene
Trichloroethene
Vinyl chloride
Zinc

6.4 EXPOSURE ASSESSMENT

In this section, the potential pathways by which human populations could be exposed to contaminants will be addressed based on the site and surrounding area both under current-use conditions and under future-use scenarios.

The following elements are important in identifying potential exposure pathways from the Summit National site: (1) a source and mechanism of chemical release to the environment, (2) an environmental receiving and transport medium for the released chemical, (3) a point of potential exposure of humans or biota with the contaminated medium, and (4) a route of exposure to the contaminants. A pathway is considered complete if all of these elements are present.

6.4.1 Site and Surrounding Area under Current-Use Conditions

Table 6-3 summarizes the potential pathways of exposure to site-related contaminants under current-use conditions of the site and surrounding area. For each exposure medium, the potential route of exposure and

TABLE 6-3

POTENTIAL PATHWAYS OF EXPOSURE TO CONTAMINANTS ORIGINATING AT THE SUMMIT NATIONAL SITE UNDER CURRENT-USE CONDITIONS

Exposure Medium	Potential Routes of Exposure	Potential Receptors	Pathway Complete?	Potential for Significant Exposure
Soil (on-site)	Dermal absorption, incidental ingestion	Trespassers	Yes. Although site is fenced, access can be gained near the western border by going under the fence or by climbing over the fence in any location.	Moderate. Surface soils are highly contaminated; however, trespassing may not occur regularly.
Soil (off-site southern and eastern perimeters)	Dermal absorption, incidental ingestion	Workers on adjacent properties/ nearby residents	Yes. Contaminants have been found in surface soils on adjacent properties.	Moderate.
Air	Inhalation of volatile contaminants from soil or surface water and/or fugitive dust	Trespassers	Yes, if access is gained.	Low. On-site monitoring detected organic vapor concentrations that exceeded background only when the subsurface was disturbed. The potential for dust generation is low given site conditions.
	Inhalation of volatile contaminants from soil or surface water and/or fugitive dust	Workers on adjacent properties/ nearby residents	Yes. Contaminants have been found on adjacent properties and/or could be transported off site to adjacent areas.	Minimal. Monitoring downwind of the site did not detect concentrations of vapors greater than background.
Groundwater	Ingestion, inhalation, dermal absorption	Nearby residents/ workers using well water	Yes. Although no organic contaminants have been detected to date in the residential wells sampled.[a]	None currently. Contaminants may migrate to these wells in the future.
Surface water	Dermal absorption, incidental ingestion	Local population	Not known if ditches, ponds, and/or impoundments are used for recreation.	Minimal. Surface water flow is intermittent. No contaminants detected in surface water in areas where exposure most likely occurs (i.e., east of site).
	Ingestion of fish	Local population	Not known if ponds support fish or if people fish in them.	NA. If used, likely to be low.
Sediments	Dermal absorption, incidental ingestion	Local population	Yes, although it is not known if ditches and/or impoundments are used for recreation.	Moderate. Sediment is exposed in dry ditches the majority of the time.

[a]Barium has been detected at a concentration of 184 ppb in one residential well. As discussed in Section 5, this concentration could occur under local natural conditions.

NA = not applicable. Exposure pathway not known to be complete.

the potential receptors are listed. Then the completeness of the pathway is evaluated and the potential for significant exposure is qualitatively assessed.

Data in Table 6-3 indicates that under current use of the site and surrounding area the pathways considered to have the greatest potential for significant exposure are exposure to trespassers, nearby workers or residents along the perimeter by dermal absorption and incidental ingestion of onsite or site-related contaminants in soil. Additionally, the local population may have a moderate potential for significant exposure to occur through dermal absorption and incidental ingestion of sediments in nearby ditches.

An additional exposure to these potential receptors may occur through inhalation of volatile contaminants and/or fugitive dust. However, as discussed in Section 4.7, organic vapor monitoring downwind of the Summit National site did not detect concentrations higher than background. Therefore, the potential for significant exposure to occur to workers or residents on adjacent properties via inhalation of organic vapors is negligible. On site monitoring with the OVA did reveal concentrations of organic vapors that exceeded background.

However this monitoring was only recorded in areas where a pipe was driven into the ground during monitoring. Without site disturbance, no organic vapor readings greater than background were recorded. Although site trespassers may on occasion, disturb the soil, activities resulting in repeated disturbance are unlikely. Therefore the potential for significant exposure to occur to onsite trespassers via inhalation of volatile organics, in the absence of site disturbance, is considered to be low.

It is not likely that contaminated fugitive dust would be transported on or off-site in sufficient quantities for significant exposure to occur. The coarse fraction of the surface materials, abandoned onsite structures and lack of site activity (vehicle traffic) all work together to impede fugitive dust generation. Therefore, only the direct contact route of soil exposure will be evaluated quantitatively in this risk assessment of the site under current use conditions.

Although groundwater is currently being used by residents, commercial properties, and an industry in the vicinity of the site, analysis of samples collected from residential wells did not reveal any site-related organic contaminants (the industrial well was not sampled). As discussed in Section 4.3.3, the only inorganic chemical possibly related to the site detected in residential wells is barium, at a concentration of 184 ppb in the [redacted] well.

Of the residential wells sampled, casing depths were reported to range from 32 to 183 feet below land surface with several others of unknown depths. Some of these wells may be cased through the unconsolidated deposits and consist of open boreholes in the bedrock and may intercept groundwater from more than just one of the water-bearing units beneath the site. It has been demonstrated in Section 4.3.4, and discussed in Section 5, that contaminants will migrate in the groundwater. However, quantification of future concentrations in residential well is not possible at this time.

Human exposure pathways involving surface water as the exposure medium will not be quantitatively evaluated. It is thought that these surface water bodies are for drainage only and would not be used as a source of potable water or for recreational purposes on a regular basis, since as discussed in Section 4, a perennial flow pattern has not been identified at the site. Because surface water flow only occurs in response to precipitation, exposure to offsite streams will occur very infrequently, if at all. Therefore, there would be little, if any, potential for repeated exposure to occur through contact with surface water. Once off site, the surface water is impounded by municipal solid waste and as discussed previously, this assessment does evaluate surface water or sediment beyond this impoundment since there may be a hydraulic connection between surface water draining the site and the Berlin Reservoir.

Since the ditches and first impoundment are dry during the majority of the time the potential does exist for children to come into contact with sediments. Exposure to contaminants in sediment may occur through dermal contact and incidental ingestion.

6.4.1.1 <u>Exposure Point Concentrations</u>. Exposures of site trespassers to contaminated soils will be evaluated using the geometric mean and maximum

concentrations of the indicator chemicals in the onsite surface soils. The geometric mean is used because most measurements of environmental contaminants are log-normally distributed (Dean 1981). These concentrations are presented in Table 6-4. Workers to the south of the site and residents along the eastern perimeter may be exposed to the concentrations of indicator chemicals presented for specific subareas (i.e., industrial and residential) in Table 6-4. As reported in Section 4.4.3, past practices at the cement plant to the south of the site included the uses of oil for lubrication. Therefore, it is not known if all of the chemicals in the cement plant soils along the southern perimeter of the site are a result of activities at the site.

Exposures of the local population (children and teenagers) to contaminated sediment will be evaluated for two subareas. The lower east, east, and southern ditches are considered to represent one area in which exposure may potentially occur. The other area to be evaluated is the second impoundment. Surface water was present in the second impoundment when it was sampled during the RI; however, exposure to the sediment in this impoundment will be evaluated assuming it is dry during some time periods in the future. The geometric mean and maximum concentrations of indicator chemicals in sediment in these two areas are presented in Table 6-5.

6.4.2 Site and Surrounding Area under Future-Use Scenarios

In the absence of institutional actions limiting access to, or future uses of the site and surrounding area, there are additional potential exposure pathways that must be evaluated. Since the site is located in an area of mixed land use, it could be reused for a variety of purposes. However, reuse of the site for light industry appears to be the most realistic use scenario; an alternate use could be residential. The potential routes of exposure related to workers in Table 6-3 would be the same under this scenario except the workers and residents would be on site. Therefore, there is a potential for exposure to contaminated soil through dermal absorption and incidental ingestion. Additionally, reuse of the site could involve site disturbance for construction activities. Contaminants in the subsurface soil or in buried drums or tanks

TABLE 6-4

CONCENTRATIONS OF INDICATOR CHEMICALS IN ON-SITE SOIL AND OFF-SITE SUBAREAS

(All concentrations in ug/kg)

	On-site			Residential (Eastern Perimeter)			Industrial (Southern Perimeter)		
	Number of Positive Detections[a]	Geometric Mean	Maximum	Number of Positive Detections[b]	Geometric Mean	Maximum	Number of Positive Detections[c]	Geometric Mean	Maximum
Antimony	47	61,000	545,000	0	ND	ND	0	ND	ND
Bis(2-ethylhexyl)Phthalate	34	10,000	700,000	4	110	206	2	390	470
Cadmium	7	5,000	112,000	4	3,400	4,200	0	ND	ND
1,2-Dichloroethane	6	1,300	23,000	0	ND	ND	2	8	16
Hexachlorobenzene	11	2,100	59,000	0	ND	ND	0	ND	ND
Phenol	5	2,100	44,000	0	ND	ND	0	ND	ND
PCBs	14	4,600	590,000	2	490	540	3	3,000	3,100
PAHs	13	400	1,600	5	400	7,100	4	2,000	21,000
Toluene	29	56	260,000	7	12	28	2	4	4
Trichloroethene	28	60	86,000	0	ND	ND	0	ND	ND
Total Xylenes	18	76	210,000	0	ND	ND	0	ND	ND
Zinc	47	120,000	643,000	9	120,000	380,000	10	85,000	135,000

[a]Out of 47 total samples.

[b]Out of 9 total samples.

[c]Out of 10 total samples.

ND = not detected.

TABLE 6-5

CONCENTRATIONS OF INDICATOR CHEMICALS IN THE SEDIMENT
FROM THE OFFSITE DITCHES AND IMPOUNDMENTS
(All concentrations in ug/kg)

	Ditches[a]			Second Impoundment		
Indicator Chemical	Number of Positive Detections[b]	Geometric Mean	Maximum	Number of Positive Detections[c]	Geometric Mean	Maximum
Antimony	2	86,000	143,000	0	ND	ND
Bis(2-ethylhexyl)Phthalate	10	3,800	26,000	3	2,900	24,000
Di-n-butylphthalate	3	5,200	8,600	1	NA	4,300
1,2-Dichloroethane	3	172	240	0	ND	ND
Hexachlorobenzene	0	ND	ND	1	NA	2,800
PCBs	1	1,100	4,200	0	ND	ND
PAHs	2	580	1,080	0	ND	ND
Zinc	18	200,000	1,070,000	4	110,000	200,000

[a]Includes lower east, east, southern ditches and first impoundment.

[b]Out of 18 total samples.

[c]Out of 4 total samples.

ND = not detected.

NA = not applicable; only detected in one sample.

could be released under this reuse scenario, resulting in a greater potential for exposure to occur via inhalation of volatile contaminants and/or fugitive dust. These additional exposures may result in exposure to higher concentrations of chemicals than are evaluated in the surface soil scenarios. However, since the concentrations of contaminants vary with location in the subsurface and since exposure of this type is likely to only be short in duration (i.e., construction will not be an ongoing activity resulting in continual exposure over long periods of time) only risk associated with exposure to surface soils will be quantified.

Reuse of the site for light industry or a private residence may result in the need of a source of water for process water and/or for drinking water. Groundwater could be obtained for such purposes from the water-table, Upper Sharon or combination of the three water-bearing zones beneath the site. If this groundwater is used as a source of drinking water, it is likely that there would be a high probability for exposure through this pathway.

Future use of the site for industry may result in the filling in of the ponds to allow for more onsite usable surface area. This would result in a temporary release of the surface water in the ponds to off-site surface water in the ditches and impoundment. The effect of the ultimate fate of this surface water cannot be evaluated because of the presence of municipal waste impoundments downgradient, however, as discussed there appears to be a hydraulic connection between the site and the Berlin Reservoir.

6.4.2.1 Exposure Point Concentrations

Under the scenario of using the site for light industrial or residential purposes in the future, exposure to onsite surface soil will be evaluated using the geometric mean and maximum concentrations presented in Table 6-4.

To evaluate exposure to workers or residents that may ingest the groundwater beneath and slightly downgradient of the site, concentrations of contaminants in the water-table, intermediate units, and Upper Sharon aquifer will be used. The geometric mean and maximum concentrations of indicator chemicals in each of these three water-bearing units are

presented in Table 6-6. This data summary does not include chemical concentrations from well MW-21 in the intermediate unit or MW-13 in the Upper Sharon because these wells were of questionable integrity and the analyses may not have been representative of the strata sampled. Some of the maximum concentrations in the water-table may be due to the presence of a separate phase floating on the water table.

Samples collected from onsite tanks and drums indicate that releases of high concentrations of contaminants may occur in the future as these vessels deteriorate. Many of the indicator chemicals used to estimate the risk associated with exposure to soil and groundwater are present in these onsite vessels. This indicates that the concentrations of contaminants at exposure points may increase in the future, resulting in increased risk.

6.5 HAZARD ASSESSMENT

The effects on both humans and experimental animals of the organic and inorganic indicator chemicals present in soil and groundwater in the vicinity of the Summit National site are described in detail in the toxicity profiles in Appendix H (PHE-2). These profiles also list standards and criteria that EPA has developed, in response to legislative mandate, to protect the health of persons exposed to these chemicals or to reduce exposure to the lowest technologically and economically feasible levels under specific conditions. The profiles summarize the information used to derive these standards and criteria, and, where appropriate, review and summarize the results of more recent studies that provide significant new information. The standards and requirements that will be used to assess risk in the section that follows (Section 6.6, "Risk Assessment") are discussed and presented below.

In its "Superfund Public Health Evaluation Manual" (EPA 1986a), EPA recommends that concentrations of contaminants at exposure points should be compared with applicable or relevant and appropriate requirements (ARARs) and with other criteria, advisories, and guidance that may be available. Following guidelines outlined by EPA, the most appropriate Federal requirements, standards, and criteria for the exposure conditions considered in this assessment were selected. ARARs or other suitable criteria are not available for chemical contaminants in soil. However,

TABLE 6-6

CONCENTRATIONS OF INDICATOR CHEMICALS IN THE GROUNDWATER BENEATH AND DOWNGRADIENT OF THE SUMMIT NATIONAL SITE

(All concentrations in ug/liter)

	Water Table			Intermediate Units			Upper Sharon Aquifer	
Indicator Chemical	Number of Positive Detections[a]	Geometric Mean	Maximum	Number of Positive Detections[b]	Geometric Mean	Maximum	Number of Positive Detections[c]	Concentration
Acetone	13	63	890,000	8	91	1,300,000	1	18
Barium[d]	10/4	100/32	320/284	8/8	136/38	2,230/1,550	1/1	12/4.8
Bis(2-ethylhexyl)Phthalate	13	13	7,250	5	8	28	1	4
Chromium[d]	11/6	25/10	58/55	6/1	8.2/20	30/20	0	ND
Cyanide (total)	3	47	239	1	37	37	0	ND
1,1-Dichloroethane	6	280	12,000	3	20	820	0	ND
1,2-Dichloroethane	7	104	115,000	3	140	5,800	0	ND
1,1-Dichloroethene	3	35	2,600	0	ND	ND	0	ND
Trans-1,2-Dichloroethene	3	121	4,600	0	ND	ND	0	ND
Ethylbenzene	3	68	8,550	1	590	590	0	ND
Phenol	3	2,400	7,000	2	490	910	1	6
Toluene	9	25	20,000	3	39	3,200	0	ND
Trichloroethene	4	900	27,000	1	55	55	0	ND

[a]Out of 13 total samples.
[b]Out of 8 total samples (well MW-21 was not included).
[c]Sample from well MW-26 (well MW-13 was not included).
[d]Metal frequencies and concentrations reported as total/dissolved.

ND = not detected.

several Federal ARARs exist for the chemical contaminants in groundwater at the Summit National site. These values are shown in Table 6-7. The administrative code for the State of Ohio Water Quality Standards states that Federal Regulations apply to waters used for human consumption. Therefore, no state standards for drinking water are presented in Table 6-7. In addition, two types of critical toxicity values, were selected to be used in conjunction with the results of the exposure assessment (Section 6.4) for all the scenarios considered (i.e., exposure to indicator chemicals in soil, sediment or drinking water). These values, listed in the toxicity appendices for each indicator chemical (in media for which risk are being quantified) are summarized in Table 6-8. Toxicity criteria include (1) acceptable daily intakes for chronic exposure (AICs) or reference doses (RfDs) and (2) cancer potency factors. The AICs or RfDs, which are similarly derived values, are used to assess the potential noncarcinogenic health risks associated with lifetime (70 years) exposure to chemical contaminants. Conservatively, in a protective sense, these values may also be appropriate for exposure periods greater than approximately 2-5 years. The cancer potency factors are used to assess cancer risks associated with exposure to potential carcinogens.

According to EPA's 5-group system for characterization of the overall weight-of-evidence for carcinogenicity associated with oral exposure, bis(2-ethylhexyl) phthalate, 1,2-dichloroethane, hexachlorobenzene, polychlorinated biphenyls (PCBs), the subset of polynuclear aromatic hydrocarbons (PAHs) considered in this report, and trichloroethene are currently classified in Group B2, meaning they are probable human carcinogens based on sufficient evidence in experimental animals. 1,1-Dichloroethene is classified in Group C, meaning it is a possible human carcinogen based on limited evidence of carcinogenicity in animals. For exposure by inhalation, cadmium is classified in Group B1, meaning it is a probable human carcinogen based on limited evidence of carcinogenicity from epidemiologic studies, and chromium is classified in Group A, meaning it is a human carcinogen based on sufficient evidence from epidemiologic studies. However, there is no evidence that these chemicals have carcinogenic effects via exposure by ingestion and can thus be classified in Group D for this route, meaning they are not classified as to potential human carcinogenicity because of inadequate experimental

TABLE 6-7

FEDERAL AND STATE STANDARDS AND CRITERIA FOR CHEMICAL CONTAMINANTS IN DRINKING WATER
(ppb)

Chemical	Primary MCL[a]	MCLG[b]	Proposed MCLG[b]	AWQC[c]	Lifetime Health Advisories[d]
Acetone	--	--	--	--	--
Barium	1,000	--	1,500	--	1,500[e]
Bis (2-ethylhexyl) Phthalate	--	--	--	21,000	--
Chromium	50	--	120	50(CrVI) 179,000 (CrIII)	120[e]
Cyanide	--	--	--	200	750
1,1-Dichloroethane	--	--	--	--	--
1,2-Dichloroethane	5	0	--	0(0.94)	--
1,1-Dichloroethene	7	7	--	0(0.033)	70[e]
t-1,2-Dichloroethene	--	--	70	--	70[e]
Ethylbenzene	--	--	680	2,400	680[e]
Phenol	--	--	--	3,500	--
Toluene	--	--	2,000	15,000	2,000[e]
Trichloroethene	5	0	--	0(2.8)	260

[a]Primary MCLs (maximum contaminant levels) are standards promulgated under the Safe Drinking Water Act to protect the health of individuals exposed to contaminants in drinking water. MCLs represent the allowable lifetime exposure to a contaminant in drinking water for a 70 kg adult who is assumed to ingest 2 liters of water per day. In addition to health and exposure considerations, MCLs reflect the technolgical and economic feasibility of removing a contaminant from the water supply.

[b]Final and proposed MCLGs (maximum contaminant level goals) are developed as part of the process for developing final drinking water standards (i.e., MCLs) under the Safe Drinking Water Act. MCLGs are entirely health-based and are always less than or equal to the proposed or final MCLs subsequently developed. Proposed MCLGs can be changed before they are promulgated as final requirements. New Primary MCLs for barium and chromium, based on the proposed MCLGs shown, will eventually replace the existing MCLs shown.

[c]Ambient water quality criteria (AWQC) are estimates of the ambient surface water concentration that will not result in adverse health effects in humans. In the case of potential carcinogens, concentrations associated with a range of incremental cancer risks are provided to supplement a criterion of zero. The value associated with an incremental cancer risk of 10^{-6} is shown in parentheses for the potential carcinogens listed. All values have been adjusted to account for exposure to chemical contaminants only by ingestion of drinking water. These federal criteria are non-enforceable guidelines.

Table 6-7 (cont'd)
Page 2

[d]Health advisories are non-enforceable guidelines prepared by EPA's Office of Drinking Water. They have been prepared for various chemicals that may be encountered in a drinking water system and are concentrations of contaminants in drinking water at which adverse effects would not be likely to occur. Health advisories are developed from data describing non-carcinogenic end-points of toxicity. The criteria shown in this table are for lifetime exposure via ingestion of 2\liters of water per day by a 70-kg individual. Relative source contribution factors from drinking water are considered when available.

[e]Assumes a relative contribution factor from drinking water.

Source: Superfund Public Health Evaluation Manual (EPA 1986a).

TABLE 6-8

CRITICAL TOXICITY VALUES FOR ASSESSMENT OF RISKS TO HUMAN HEALTH AS A RESULT OF EXPOSURE BY INGESTION

Chemical	Noncarcinogenic Effects (mg/kg/day)	Cancer Potency Factors[a] $(mg/kg/day)^{-1}$
Acetone	1.0×10^{-1} (b)	NA [D]
Antimony	4.0×10^{-4} (b)	NA [D]
Barium	5.1×10^{-2} (c)	NA [D]
Bis(2-ethylhexyl) Phthalate	2.0×10^{-2} (b)	6.86×10^{-4} [B2]
Cadmium	5.9×10^{-4} (c)	NA [D]
Chromium	1.0 (CrIII)[b]	
	5.0×10^{-3} (CrVI)	NA [D]
Cyanide	2.0×10^{-2} (b)	NA [D]
Di-n-butylphthalate	1.0×10^{-1} (b)	NA [D]
1,1-Dichloroethane	1.2×10^{-1} (c)	NA [D]
1,2-Dichloroethane	--	9.1×10^{-2} [B2]
1,1-Dichloroethene	9.0×10^{-3} (b)	5.8×10^{-1} [C]
t-1,2-Dichloroethene	1.0×10^{-2} (c)	NA [D]
Ethylbenzene	0.1[b]	NA [D]
Hexachlorobenzene	--	1.69 [B2]
Phenol	0.1[b]	NA [D]
Polychlorinated Biphenyls	--	4.34 [B2]
Polynuclear Aromatic Hydrocarbons	--	1.15×10^{1} [B2]
Toluene	3.0×10^{-1} (b)	NA [D]
Trichloroethene	7.35×10^{-3} (d)	1.1×10^{-2} [B2]
Vinyl Chloride	--	2.3 [A]
Total Xylenes	1.0×10^{-2} (c)	NA [D]
Zinc	2.1×10^{-1} (c)	NA [D]

a Upper 95% confidence limit potency factors (EPA 1986a); EPA weight of evidence classifications is shown in brackets and defined in the text.

b EPA reference dose (RfD) (EPA 1986b).

c Acceptable intake for chronic exposure (AIC) (EPA 1986a).

d Risk reference dose (RRPD) (EPA 1985); estimate of daily exposure which appears to be without appreciable risk of deleterious non-carcinogenic effects over a lifetime of exposure.

NA = Not applicable.

evidence in animals. The remaining chemicals considered in this report (shown in Table 6-8) are all classified in Group D. Although EPA has not officially classified antimony, the available toxicity data for this chemical suggest that it belongs in Group D. None of the chemicals considered in this assessment are classified in Group E, which includes chemicals that are considered noncarcinogenic in humans based on at least two adequate animal tests in different species or in both adequate epidemiologic and animal studies. Weight-of-evidence designations are given in brackets following the cancer potency factors or cancer risk estimates presented throughout this report.

6.6 RISK ASSESSMENT

In the first subsection of this risk assessment, general toxicological principles used and assumptions made in evaluating potential human health risks are discussed. Potential risks under current-use and future-use conditions are discussed in the two succeeding subsections.

6.6.1 General Principles

According to the procedures for public health evaluations developed by EPA, the potential adverse effects on human health should be assessed where possible by comparing concentrations found at or near the site with applicable or relevant and appropriate requirements (ARARs) that have been developed for the protection of human health or the environment. Currently, EPA considers maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) developed under the Safe Drinking Water Act, federal ambient water quality criteria (AWQC), national ambient air quality standards (NAAQS), and state environmental standards to be potential ARARs for use in risk assessment at Superfund sites. According to EPA (1986a) guidelines, if suitable ARARs are not available for all of the selected indicator chemicals and for the exposure scenarios considered, a quantitative risk assessment must also be performed for all of the contaminants. Suitable ARARs do not exist for all of the indicator chemicals considered in this risk assessment. Specifically, ARARs for exposure to chemical contaminants present in soil do not exist. In addition, suitable ARARs for exposure to contaminants present in drinking water are not available for all the groundwater indicator chemicals considered in this

report. Consequently, a quantitative risk assessment was performed. The available Federal ARARs and other criteria are, however, noted in Table 6-7. In Table 6-9, mean and maximum concentrations of indicator chemicals in each water bearing unit beneath the site are compared to ARARs.

Evaluation of the noncarcinogenic health risks associated with contaminants of concern considered in this report is based primarily on a comparison of the estimated daily intake of the indicator chemicals with appropriate critical toxicity values for the protection of human health. These critical toxicity values (Table 6-8) are derived primarily from the studies in experimental animals.

For the potential human carcinogens considered in this report, the estimated cancer risks associated with exposure are calculated using EPA-derived cancer potency factors. As noted previously, excess lifetime cancer risks are obtained by multiplying the cancer potency factor by the daily intake of the contaminant under consideration. EPA recommends that the total carcinogenic risk to individuals resulting from exposure at a Superfund site be reduced to zero where possible. However, according to agency policy, the target total individual carcinogenic risk resulting from exposures may range between 10^{-4} and 10^{-7} (i.e., one excess cancer in every 10,000 or 10,000,000 individuals, respectively, exposed throughout their lifetime) (EPA 1986a). Thus, an excess cancer risk of 10^{-6} is commonly used as an approximate guideline for determining an acceptable level of exposure within one or two orders of magnitude. The procedures outlined in EPA's Superfund Public Health Evaluation (PHE) Manual (EPA 1986a) and other EPA publications were used in performing this assessment.

In this assessment, the effects of exposure to each of the contaminants under the scenarios evaluated have initially been considered separately. However, the pollutants occur together in soil and groundwater, and individuals may be exposed to mixtures of contaminants, including many of the indicator chemicals and some of the other chemicals detected. Consequently, it is important to recognize the potential adverse effects that these mixtures can have in humans. Suitable data are not available to characterize the effects of chemical mixtures similar to those present in soil or groundwater in the vicinity of the Summit National

TABLE 6-9

COMPARISON OF CONCENTRATIONS OF INDICATOR CHEMICALS IN THE GROUNDWATER BENEATH AND DOWNGRADIENT OF THE SUMMIT NATIONAL SITE WITH STANDARDS AND CRITERIA FOR DRINKING WATER[a]

(All concentrations in ug/liter)

	Water Table[b]		Intermediate Unit[b]		Upper Sharon[b,c]
Indicator Chemical	Geometric Mean	Maximum	Geometric Mean	Maximum	Concentration
Primary MCL					
Barium[d]	100/1000	320/1000	136/1000	2,230/1000	12/1000
Chromium[d]	25/50	58/50	8.2/50	30/50	ND
1,2-Dichloroethane	104/5	115,000/5	140/5	5,800/5	ND
1,1-Dichloroethene	35/7	2,600/7	ND	ND	ND
Trichloroethene	900/5	27,000/5	55/5	55/5	ND
MCLG					
1,2-Dichloroethane	104/0	115,000/0	140/0	5,800/0	ND
1,1-Dichloroethene	35/7	2,600/7	ND	ND	ND
Trichloroethene	900/0	27,000/0	55/0	55/0	ND
Proposed MCLG					
Barium[d]	100/1,500	320/1,500	136/1,500	2,230/1,500	12/1,500
Chromium[d]	25/120	58/120	8.2/120	30/120	ND
trans-1,2-Dichloroethene	121/70	4,600/70	ND	ND	ND
Ethylbenzene	68/680	8,550/680	590/680	590/680	ND
Toluene	25/2,000	20,000/2,000	3,200/2,000	3,200/2,000	ND

Table 6-9 (Continued)

Indicator Chemical	Water Table[b] Geometric Mean	Water Table[b] Maximum	Intermediate Unit[b] Geometric Mean	Intermediate Unit[b] Maximum	Upper Sharon[b,c] Concentration
AWQC					
Bis(2-ethylhexyl)phthalate	13/21,000	7,250/21,000	8/21,000	28/21,000	4/21,000
Chromium(VI)[d]	25/50	58/50	8.2/50	30/50	ND
Chromium(III)[d]	25/179,000	58/179,000	8.2/179,000	30/179,000	ND
Cyanide	47/200	239/200	37/200	37/200	ND
1,2-Dichloroethane	104/0.94	115,000/0.94	140/0.94	5,800/0.94	ND
1,1-Dichloroethene	35/0.033	2,600/0.033	ND	ND	ND
Ethylbenzene	68/2,400	8,550/2,400	590/2,400	590/2,400	ND
Phenol	2,400/3,500	7,000/3,500	490/3,500	910/3,500	6/3,500
Toluene	25/15,000	20,000/15,000	39/15,000	3,200/15,000	ND
Trichloroethene	900/2.8	27,000/2.8	55/2.8	55/2.8	ND
Lifetime Health Advisories					
Barium[d]	100/1,500	320/1,500	136/1,500	2,230/1,500	12/1,500
Chromium[d]	25/120	58/120	8.2/120	30/120	ND
Cyanide	47/750	239/750	37/750	37/750	ND
1,1-Dichloroethene	35/70	2,600/70	ND	ND	ND
trans-1,2-Dichloroethene	121/70	4,600/70	ND	ND	ND
Ethylbenzene	68/680	8,550/680	590/680	590/680	ND
Toluene	25/2,000	20,000/2,000	39/2,000	3,200/2,000	ND
Trichloroethene	900/260	27,000/260	55/260	55/260	ND

[a]Standards and criteria are presented and discussed in Table 6-7.

[b]Concentration of chemical standard or criteria.

[c]Only one representative sample available, therefore, mean and maximum do not apply.

[d]Total metal concentrations.

ND = not detected.

site. As suggested in EPA's Superfund PHE Manual (EPA 1986a) and in EPA's Guidelines for the Health Risk Assessment of Chemical Mixtures (EPA 1986c), for potential carcinogens it may be useful to sum the excess cancer risks. For chemicals having noncarcinogenic effects it may be useful to calculate hazard indices (sum the CDI:RfD ratios) for chemical mixtures.

The excess cancer risks are calculated using cancer potency factors estimated for potential human carcinogens. The cancer potency factors for the compounds considered in this assessment that are potentially carcinogenic by ingestion are shown in Table 6-8; the derivations of these values are discussed in the toxicity profiles in Appendix H (PHE-2). Excess cancer risks associated with exposure to mixtures of these chemicals can be calculated by summing the risks determined for each of the chemicals individually. A hazard index is the sum of the ratios of the environmental concentrations of noncarcinogenic substances to their corresponding relevant criteria. The noncarcinogenic effects of potential carcinogens may also be considered in the hazard index. Hazard indices are not absolute measures of the potential risks for human health, but they provide indications of the relative risks associated with mixtures of chemicals. A hazard index of less than 1 indicates that adverse effects on human health are unlikely to result from a given exposure; an index greater than 1 suggests a cause for concern. This approach to assessing risks associated with mixtures of chemicals is based on the assumption that there are no synergistic or antagonistic interactions among the compounds involved and that all compounds have the same toxic end points and mechanisms of action. If these assumptions are incorrect, the actual risk could be under- or overestimated. Furthermore, it also should be noted that compounds present at the site, but not considered explicitly in this assessment, also may act to increase or decrease the overall risk.

These procedures may be useful in assessing the relative degree of hazard, but because of the uncertainties involved, they should not be regarded as measures of absolute risk.

6.6.2 Uncertainties in Risk Assessment

The procedures and inputs used to assess potential human health risks in this evaluation are subject to a wide variety of uncertainties. In general, there are six main sources of uncertainty.

- Environmental chemistry sampling and analysis
- Environmental parameter measurement
- Fate and transport modeling
- Exposure parameter estimation
- Toxicological data
- Errors through combinations of the above.

Environmental chemistry sampling and analysis error can stem from the error inherent in the procedures, from a failure to take an adequate number of samples to arrive at sufficient areal resolution, from mistakes on the part of the sampler, or from the heterogeneity of the matrix being sampled. One of the most effective ways of minimizing procedural or systematic error is to subject the data to a strict quality control review, which has been done in the case of this study. Even with all data rigorously quality assured, however, there is still error inherent in all analytical procedures.

Environmental parameter measurements primarily contribute to uncertainty because of their absence. Lack of site-specific measurements dictates that estimates must be made based on literature values, regression equations, extrapolations, and/or best professional judgment.

There are inherent uncertainties in determining the exposure parameters that are combined with toxicological information to assess risk. For example, there are a number of uncertainties regarding assumptions in estimating the likelihood that an individual would come into contact with chemical contaminants originating at the site, the concentration of contaminants in the environmental medium of concern, and the period of time over which such exposures would occur.

Toxicological data error is also a large source of uncertainty in this risk assessment. As noted in its Guidelines for Carcinogenic Risk Assessment (EPA 1986d):

"There are major uncertainties in extrapolating both from animals to humans and from high to low doses. There are important species differences in uptake, metabolism, and organ distribution of carcinogens, as well as species and strain differences in target site susceptibility. Human populations are variable with respect to geometric constitution, diet, occupational and home environment, activity patterns, and other cultural factors."

All of these individual errors from different sources may be propogated into larger errors by mathematical combination in the risk assessment. For purposes of evaluating remedial alternatives, however, risk assessment may provide a useful decision-making tool despite the uncertainties. Our assessment of the potential human health risks associated with use of the Summit National site and surrounding area follows.

6.6.3 Risks under Current-Use Conditions

6.6.3.1 Estimation of Intakes

To assess the average exposure to onsite trespassers, it was assumed that older children (ages 12-16) visit the site once a month during the warmer periods of the year (April-September: 6 visits per year), while more frequent visits (24 per year) are assumed for the maximum exposure case. It is assumed that children younger than 12 years old would be unlikely to trespass on to such a site and that older individuals would not want to play in such an area. In order to estimate the intake of contaminants from direct contact with contaminated soil, it is necessary to estimate the quantities of soil coming into contact with trespassers considered in this current-use exposure scenario. Values of 1 g and 5 g per exposure event have been selected for this parameter for the average exposure and plausible maximum exposure cases, respectively. These values were selected after a consideration of several studies that estimated the levels of soil that come into contact with exposed skin (Appendix H (PHE-3)). There are two mechanisms by which soil contacting the skin can enter the body--absorption through the skin and ingestion of soil present on hands, through smoking, eating, or incidental contact.

All of the organic compounds of concern present in soil at the Summit National site may be absorbed through the skin to some extent, thereby potentially producing

toxic effects. However, this route of exposure has not been well studied and thus is difficult to quantify. In a study by Feldmann and Maibach (1970), twenty-one organic compounds were applied to the forearms of human volunteers who were subsequently monitored for 5 days. Maximum hourly absorption rates were reported for benzoic acid (3.3%) and dinitrochlorobenzene (3.5%). The hourly absorption rates for most of the compounds tested were less than 1%. However, experimental methods employed by Feldmann and Maibach (1970) are likely to promote greater dermal absorption than would be expected from environmental exposures. Thus, these values would probably overestimate potential dermal absorption rates for chemical contaminants in soil. Depending on the types and concentrations of chemicals present in soil, the strength with which individual chemicals adsorb to soil particles and the extent to which they move through the skin may vary considerably. Since dermal absorption factors for the majority of the indicator chemicals present in soil are not available, only risks associated with ingestion of contaminated soil are addressed quantitatively. Based on consideration of the amount of soil potentially contacting the skin in the scenarios considered in this report (1-5g) and the absorption factors noted above (1-3%), it is unlikely that the total intake of contaminants present in soil would increase by more than a factor of 2 if dermal absorption were considered in addition to incidental ingestion as an exposure pathway.

With respect to incidental ingestion of soil, it is assumed that for the populations considered, ingestion of soil amounts to 20 mg/visit and 100 mg/visit for the average and plausible maximum exposure cases, respectively. These values are based on a review of a number of studies dealing with this aspect of exposure (Appendix H (PHE-2)). An oral absorption factor represents the ratio of the percentage of contaminants absorbed from the solvent or food in which it was administered in an experimental study to the percentage absorbed from ingested soil. PCBs and PAHs are likely to be more strongly absorbed to soil particles than the other indicator chemicals under consideration. The data of McConnell et al. (1984), suggest that the estimated relative oral absorption factor for these compounds is approximately 0.7 after consideration of adsorption to soil. However, a conservative oral absorption factor of 1 (the default value) is used for

all the indicator chemicals considered. The assumptions used in estimating exposure of trespassing teenagers are summarized in Table 6-10.

Intake estimates for soil ingestion are calculated using the following equation which is based on principles presented in the Superfund Public Health Evaluation Manual (EPA 1986a):

$$EXP = \frac{(C_s)(I_s)(E)(Y)(K)}{(Bw)(D)}$$

where

EXP	=	estimated intake for a given chemical (mg/kg/day),
C_s	=	chemical concentration in soil (mg/kg),
I_s	=	amount of soil ingested per exposure event (mg),
E	=	number of exposure events (events/yr),
Y	=	years of exposure (yr),
K	=	conversion factor (kg/10^6 mg),
BW	=	average body weight (kg), and
D	=	days in period for which risk is estimated (365 days per year of exposure for noncarcinogens, 25,550 days (lifetime) for carcinogens).

Exposure to chemical contaminants under this scenario having carcinogenic effects and noncarcinogenic effects are presented in Tables 6-11 and 6-12, respectively.

To assess the exposures to workers adjacent to the site along the southern perimeter, it is assumed the frequency of exposure would be 5 days/week during 8 months of each year. It is assumed that during the 4 winter months of each year frozen ground, snow cover and/or winter clothing would minimize exposure. It is assumed that the average exposure would occur over 10 years, while the maximum exposure would occur over a period of 20 years. It is assumed that the quantities of soil coming in contact with workers, as well as the quantities incidentally ingested, are the same as for onsite trespassers. The assumptions used in estimating worker exposure are summarized in Table 6-13. Worker exposures are calculated using the equation for estimation of chemical intake from ingested soil shown above. The results of these calculations are presented in Tables 6-14 and 6-15.

TABLE 6-10

ASSUMPTIONS USED IN ESTIMATING EXPOSURE OF TRESPASSING TEENAGERS TO CONTAMINANTS VIA DIRECT CONTACT WITH SOILS AT THE SUMMIT NATIONAL SITE

Parameter	Average Exposure	Plausible Maximum Exposure
Frequency of contact	6 visits/year	24 visits/year
Ages of children exposed	12-16 years	12-16 years
Average weight over period of exposure	45 kg	45 kg
Years of exposure	5	5
Concentration of contaminant in soil contacted[a]	Geometric mean	Maximum concentration
Quantity of soil incidentally ingested	20 mg/visit	100 mg/visit

[a]Values given in Table 6-4.

TABLE 6-11

EXPOSURE ESTIMATES AND CANCER RISKS FOR TRESPASSING TEENAGERS FROM DIRECT CONTACT WITH SOILS AT THE SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg) Geometric Mean		Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day) Average	Plausible Maximum	Cancer Risk Average	Plausible Maximum
Bis (2-ethylhexyl) Phthalate	10,000	700,000	5.2×10^{-9}	7.3×10^{-6}	4×10^{-12}	5×10^{-9}
1,2-Dichloroethane	1,300	23,000	6.8×10^{-10}	2.4×10^{-7}	6×10^{-11}	2×10^{-8}
Hexachlorobenzene	2,100	59,000	1.1×10^{-9}	6.2×10^{-7}	2×10^{-9}	1×10^{-6}
PCBs	4,600	590,000	2.4×10^{-9}	6.2×10^{-6}	1×10^{-8}	3×10^{-5}
PAHs	400	1,600	2.1×10^{-10}	1.7×10^{-8}	2×10^{-9}	2×10^{-7}
Trichloroethene	60	86,000	3.1×10^{-11}	9.0×10^{-7}	3×10^{-13}	1×10^{-8}
				Total risk	1×10^{-8}	3×10^{-5}

[a]Assumptions used for this exposure scenario are summarized in Table 6-10. Cancer Potency factors used to calculate cancer risks are shown in Table 6-8. For this analysis, the average daily dose received over the assumed exposure period was prorated over a 70-year lifetime, and the lifetime risk was calculated accordingly. This procedure is recommended in EPA's "Guidelines for Carcinogen Risk Assessment" (EPA 1986d).

[b]Daily intake under average exposure conditions (mg/kg/day)

$$= \frac{(\text{Conc. soil mg/kg})(20\ \text{mg/visit})(6\ \text{visits/year})(5\ \text{years})(\text{kg}/10^6\ \text{mg})}{(45\ \text{kg})(70\ \text{years})(365\ \text{days/year})} = (\text{Conc. soil mg/kg})(5.22\times10^{-10}\ \text{kg soil/kg body weight/day})$$

where: Conc. soil = geometric mean.

Daily intake under plausible maximum exposure conditions (mg/kg/day)

$$= \frac{(\text{Conc. soil mg/kg})(100\ \text{mg/visit})(24\ \text{visits/year})(5\ \text{years})(\text{kg}/10^6\ \text{mg})}{(45\ \text{kg})(70\ \text{years})(365\ \text{days/year})} = (\text{Conc. soil mg/kg})(1.04\times10^{-8}\ \text{kg soil/kg body weight/day})$$

where: Conc. soil = maximum concentration.

TABLE 6-12

EXPOSURE ESTIMATES AND NONCARCINOGENIC RISKS FOR TRESPASSING TEENAGERS FROM DIRECT CONTACT WITH SOILS AT THE SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg)		Chronic Daily Intake (CDI)[b] (mg/kg/day)		Hazard Index (CDI/RfD)	
	Geometric Mean	Maximum	Average	Plausible Maximum	Average	Plausible Maximum
Antimony	61,000	545,000	4.5×10^{-7}	8.0×10^{-5}	1×10^{-3}	2×10^{-1}
Bis (2-ethylhexyl)phthalate	10,000	700,000	7.3×10^{-8}	1.0×10^{-4}	4×10^{-6}	5×10^{-3}
Cadmium	5,000	112,000	3.7×10^{-8}	1.6×10^{-5}	7×10^{-5}	3×10^{-2}
1,2-Dichloroethane	1,300	23,000	9.5×10^{-9}	3.4×10^{-6}	NQ	NQ
Hexachlorobenzene	2,100	59,000	1.5×10^{-8}	8.6×10^{-6}	NQ	NQ
Phenol	2,100	44,000	1.5×10^{-8}	6.4×10^{-6}	2×10^{-7}	6×10^{-5}
PCBs	4,600	590,000	3.4×10^{-8}	8.6×10^{-5}	NQ	NQ
PAHs	400	1,600	2.9×10^{-9}	2.3×10^{-7}	NQ	NQ
Toluene	56	260,000	4.1×10^{-10}	3.8×10^{-5}	1×10^{-9}	1×10^{-4}
Trichloroethene	60	86,000	4.4×10^{-10}	1.3×10^{-5}	6×10^{-8}	2×10^{-3}
Total Xylenes	76	210,000	5.6×10^{-10}	3.1×10^{-5}	6×10^{-8}	3×10^{-3}
Zinc	120,000	643,000	8.8×10^{-7}	9.4×10^{-5}	4×10^{-6}	4×10^{-4}
				Total Hazard Index	1×10^{-3}	3×10^{-1}

a Assumptions used for this exposure scenario are summarized in Table 6-10. Reference dose (RfD) used to calculate hazard indices are shown in Table 6-8.

b Daily intake under average exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(20 mg/visit)(6 visits/year)(5 years)(kg/10}^6\text{ mg)}}{\text{(45 kg)(5 years)(365 days/year)}}$ = (Conc. soil mg/kg)(7.31×10^{-9} kg soil/kg body weight/day)

where: Conc. soil = geometric mean.

Daily intake under average plausible maximum exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(100 mg/visit)(24 visits/year)(5 years)(kg/10}^6\text{ mg)}}{\text{(45 kg)(5 years)(365 days/year)}}$ = (Conc. soil mg/kg)(1.46×10^{-7} kg soil/kg body weight/day)

where: Conc. soil = maximum concentration.

NQ = Not quantified. Reference dose (RfD) for noncarcinogenic effects associated with these chemicals are not available; however, cancer risks associated with exposure to these chemicals are shown in Table 6-11.

TABLE 6-13

ASSUMPTIONS USED IN ESTIMATING WORKER EXPOSURE TO CONTAMINANTS VIA DIRECT CONTACT WITH SOILS NEAR THE SUMMIT NATIONAL SITE

Parameter	Average Exposure	Plausible Maximum Exposure
Frequency of contact	160 visits/year	160 visits/yr
Average weight over period of exposure	70 kg	70 kg
Years of exposure	10	20
Concentration of contaminant in soil contacted[a]	Geometric mean	Maximum concentration
Incidental ingestion of contaminated soil	20 mg/visit	100 mg/visit

[a]Values given in Table 6-4.

TABLE 6-14

EXPOSURE ESTIMATES AND CANCER RISKS FOR WORKERS FROM DIRECT CONTACT WITH SOILS NEAR THE SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg) Geometric Mean	Concentration (ug/kg) Maximum	Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day) Average	Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day) Plausible Maximum	Cancer Risk Average	Cancer Risk Plausible Maximum
Bis (2-ethylhexyl) phthalate	390	470	7.0×10^{-9}	8.4×10^{-8}	5×10^{-12}	6×10^{-11}
1,2-Dichloroethane	8	16	1.4×10^{-10}	2.9×10^{-9}	1×10^{-11}	3×10^{-10}
PCBs	3,000	3,100	5.4×10^{-8}	5.5×10^{-7}	2×10^{-7}	2×10^{-6}
PAHs	2,000	21,000	3.6×10^{-8}	3.8×10^{-6}	4×10^{-7}	4×10^{-5}
				Total risk	6×10^{-7}	4×10^{-5}

a Assumptions used for this exposure scenario are summarized in Table 6-13. Cancer Potency factors used to calculate cancer risks are shown in Table 6-8. For this analysis, the average daily dose received over the assumed exposure period was prorated over a 70-year lifetime, and the lifetime risk was calculated accordingly. This procedure is recommended in EPA's "Guidelines for Carcinogen Risk Assessment" (EPA 1986d).

b

Daily intake under average exposure conditions (mg/kg/day) = $\frac{(\text{Conc. soil mg/kg})(20\ \text{mg/visit})(160\ \text{visits/year})(10\ \text{years})(\text{Kg}/10^6\ \text{mg})}{(70\ \text{kg})(70\ \text{years})(365\ \text{days/year})}$ = (Conc. Soil mg/kg)(1.79×10^{-8} kg soil/kg body weight/day)

where Conc. Soil = Geometric mean

Daily intake under plausible maximum exposure conditions (mg/kg/day) = $\frac{(\text{Conc. Soil mg/kg})(100\ \text{mg/visit})(160\ \text{visits/year})(20\ \text{years})(\text{Kg}/10^6\ \text{mg})}{(70\ \text{kg})(70\ \text{years})(365\ \text{days/year})}$ = (Conc. Soil mg/kg)(1.79×10^{-7} kg soil/kg body weight/day)

where Conc. Soil = Maximum concentration

TABLE 6-15

EXPOSURE ESTIMATES AND NONCARCINOGENIC RISKS FOR WORKERS FROM DIRECT CONTACT WITH SOILS NEAR THE SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg) Geometric Mean	Concentration (ug/kg) Maximum	Chronic Daily Intake (CDI)[b] (mg/kg/day) Average	Chronic Daily Intake (CDI)[b] (mg/kg/day) Plausible Maximum	Hazard Index (CDI/RfD) Average	Hazard Index (CDI/RfD) Plausible Maximum
Bis (2-ethylhexyl) Phthalate	390	470	4.9×10^{-8}	2.9×10^{-7}	2×10^{-6}	1×10^{-5}
1,2-Dichloroethane	8	16	1.0×10^{-9}	1.0×10^{-8}	NQ	NQ
PCBs	3,000	3,100	3.4×10^{-7}	1.9×10^{-6}	NQ	NQ
PAHs	2,000	21,000	2.5×10^{-7}	1.3×10^{-5}	NQ	NQ
Toluene	4	4	5.0×10^{-10}	2.5×10^{-9}	2×10^{-9}	8×10^{-9}
Zinc	85,000	135,000	1.1×10^{-5}	8.4×10^{-5}	5×10^{-5}	4×10^{-4}
				Total Hazard Index	5×10^{-5}	4×10^{-4}

a Assumptions used for this exposure scenario are summarized in Table 6-13. Reference doses (RfDs) used to calculate hazard indices are shown in Table 6-8.

b Daily intake under average exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(20 mg/visit)(160 visits/year)(10 years)(Kg/10}^6\text{ mg)}}{\text{(70 kg)(10 years)(365 days/year)}}$ = (Conc. Soil mg/kg)(1.25×10^{-7} kg soil/kg body weight/day)

where Conc. Soil = Geometric mean

Daily intake under plausible maximum exposure conditions (mg/kg/day) = $\frac{\text{(Conc. Soil mg/kg)(100mg/visit)(160 visits/year)(20 years)(Kg/10}^6\text{ mg)}}{\text{(70 kg)(20 years)(365 days/year)}}$ = (Conc. Soil mg/kg)(6.27×10^{-7} kg soil/kg body weight/day)

where Conc. Soil = Maximum concentration

NQ Not quantified. Reference doses (RfDs) for noncarcinogenic effects associated with these chemicals are not available; however, cancer risks associated with exposure to these chemicals are shown in Table 6-14.

To assess the exposures to residents living near the eastern perimeter of the site, it is assumed an individual could be exposed throughout an entire lifetime. Thus, in this exposure scenario, not only infants and children, but also adults (e.g., gardeners) could potentially come into contact with contaminated soils and subsequently ingest them. It is assumed that an individual would be involved in activities in the yard (e.g., a child playing or an adult gardening) 5 days/week during 8 months of the year, for a total of approximately 160 days per year.

Average lifetime soil ingestion rates were estimated based on the age-specific soil ingestion rates presented in Appendix H (PHE-3) as 0.92 mg/kg-day and 4.6 mg/kg-day for the average and plausible maximum exposure cases, respectively.

The assumptions used to estimate exposure to individuals living near the eastern perimeter of the site are summarized in Table 6-16 and intake estimates are shown in Tables 6-17 and 6-18 for evaluation of carcinogenic and noncarcinogenic effects, respectively.

To assess the exposure to children playing in the lower east, east, south ditch, and first impoundment near the site, it was assumed that children (ages 4 to 6) play in these areas during 8 months of the year (this excludes the 4 winter months when frozen sediment, snow cover and/or winter clothing would minimize exposure). For the average exposure case, it is assumed that children play in these ditches once a week; while, for the plausible maximum exposure case, children are assumed to play in these ditches two times a week. It is assumed that younger children would be unlikely to venture from their homes and that older children would have other interests and would not want to play in the ditches. Because these ditches are dry, the majority of the time the quantities of sediment ingested were selected based on the age-specific soil ingestion rates presented in Appendix H (PHE-3). Assumptions used in estimating exposure of children to sediment in offsite ditches are summarized in Table 6-19.

Intake estimates for sediment ingestion are calculated using the same equation presented on Page 6-32 for estimating intakes through soil ingestion. Exposure to indicator chemicals present in sediment under these exposure scenarios are presented in Tables 6-20 and 6-21 for carcinogenic effects and noncarcinogenic effects respectively.

TABLE 6-16

ASSUMPTIONS USED IN ESTIMATING RESIDENTIAL EXPOSURE TO CONTAMINANTS VIA DIRECT CONTACT WITH SOILS NEAR THE SUMMIT NATIONAL SITE

Parameter	Average Exposure	Plausible Maximum Exposure
Frequency of contact	160 visits/year	160 visits/year
Lifetime average soil ingestion rate	0.92 mg/kg-visit	4.6 mg/kg-visit
Years of exposure	70	70
Concentration of contaminant in soil contacted[a]	Geometric mean concentration	Maximum concentration

Notes:

[a]Values given in Table 6-4.

TABLE 6-17

EXPOSURE ESTIMATES AND CANCER RISKS FOR RESIDENTIAL EXPOSURE TO CHEMICALS IN SOIL NEAR THE EASTERN PERIMETER OF THE SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg)		Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day)		Cancer Risk	
	Average	Maximum	Average	Plausible Maximum	Average	Plausible Maximum
Bis (2-ethylhexyl) phthalate	110	206	4.4×10^{-8}	4.2×10^{-7}	3×10^{-11}	3×10^{-10}
PCBs	490	540	2.0×10^{-7}	1.1×10^{-6}	9×10^{-7}	5×10^{-6}
PAHs	400	7,100	1.6×10^{-7}	1.4×10^{-5}	2×10^{-6}	2×10^{-4}
				Total risk	3×10^{-6}	2×10^{-4}

a Assumptions used for this scenario are summarized in Table 6-16. Cancer potency factors used to calculate cancer risks are shown in Table 6-8. For this analysis, the average daily dose received over the assumed exposure period was prorated over a 70-year lifetime, and the lifetime risk was calculated accordingly. This procedure is recommended in EPA's "Guidelines for Carcinogen Risk Assessment" (EPA 1986d).

b Daily intake under average exposure conditions (mg/kg/day) = $\frac{(\text{Conc. soil mg/kg})(0.92\ \text{mg/kg-visit})(160\ \text{visits/yr})(70\ \text{yrs})(\text{Kg}/10^6\ \text{mg})}{(70\ \text{years})(365\ \text{days/year})}$ = (Conc. Soil mg/kg)(4.03×10^{-7} kg soil/kg body weight/day)

where Conc. Soil = Geometric mean

Daily intake under plausible maximum exposure conditions (mg/kg/day) = $\frac{(\text{Conc. Soil mg/kg})(4.6\ \text{mg/kg-visit})(160\ \text{visit/yr})(70\ \text{years})(\text{Kg}/10^6\ \text{mg})}{(70\ \text{years})(365\ \text{days/year})}$ = (Conc. Soil mg/kg)(2.02×10^{-6} kg soil/kg body weight/day)

where Conc. Soil = Maximum concentration

TABLE 6-18
EXPOSURE ESTIMATES AND NONCARCINOGENIC RISKS FOR RESIDENTIAL EXPOSURE TO CHEMICALS IN SOIL NEAR THE EASTERN PERIMETER OF THE SUMMIT NATIONAL SITE[a]

	Concentration (ug/kg)		Chronic Daily Intake (CDI)[b] (mg/kg/day)		Hazard Index (CDI/RfD)	
Chemical	Average	Maximum	Average	Plausible Maximum	Average	Plausible Maximum
Bis (2-ethylhexyl) Phthalate	110	206	4.4×10^{-8}	4.2×10^{-7}	2×10^{-6}	2×10^{-5}
Cadmium	3,400	4,200	1.4×10^{-6}	8.5×10^{-6}	2×10^{-3}	1×10^{-2}
PCBs	490	540	2.0×10^{-7}	1.1×10^{-6}	NQ	NQ
PAHs	400	7,100	1.6×10^{-7}	1.4×10^{-5}	NQ	NQ
Toluene	12	28	4.8×10^{-9}	5.7×10^{-8}	2×10^{-8}	2×10^{-7}
Zinc	120,000	380,000	4.8×10^{-5}	7.7×10^{-4}	2×10^{-4}	4×10^{-3}
				Total Hazard Index	2×10^{-3}	1×10^{-2}

NQ Not quantified. Reference doses (RfDs) for noncarcinogenic effects associated with these chemicals are not available; however, cancer risks associated with exposure to these chemicals are shown in Table 6-17.

a Assumptions used for this exposure scenario are summarized in Table 6-16. Reference doses (RfDs) used to calculate hazard indices are shown in Table 6-8.

b Daily intake under average exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(0.92 mg/kg-visit)(160 visits/yr)(70 yrs)(Kg/10}^6\text{ mg)}}{\text{(70 years)(365 days/year)}}$ = (Conc. Soil mg/kg)(4.03×10^{-7} kg soil/kg body weight/day)

where: Conc. soil = goemetric mean.

c Daily intake plausible maximum exposure conditions (mg/kg/day) = $\frac{\text{(Conc. Soil mg/kg)(4.6 mg/kg-visit)(160 visit/yr)(70 yrs)(Kg/10}^6\text{ mg)}}{\text{(70 years)(365 days/year)}}$ = (Conc. Soil mg/kg)(2.02×10^{-6} kg soil/kg body weight/day)

where Conc. Soil = Maximum concentration

TABLE 6-19

ASSUMPTIONS USED IN ESTIMATING EXPOSURE OF CHILDREN TO CONTAMINANTS VIA DIRECT CONTACT WITH SEDIMENTS NEAR THE SUMMIT NATIONAL SITE

Parameter	Average Exposure	Plausible Maximum Exposure
Frequency of contact	32 visits/year	64 visits/year
Ages of children exposed	4-6 years	4-6 years
Average weight over period of exposure	19 kg[a]	19 kg[a]
Years of exposure	3	3
Concentration of contaminant in soil contacted[b]	Geometric mean	Maximum concentration
Quantity of soil incidentally ingested	100 mg/visit	500 mg/visit

[a]Body weight represents 50th percentile for age groups exposed (Anderson et al 1985)
[b]Values given in Table 6-5.

TABLE 6-20

EXPOSURE ESTIMATES AND CANCER RISKS FOR CHILDREN FROM DIRECT CONTACT WITH SEDIMENT IN DITCHES AND FIRST IMPOUNDMENT NEAR THE SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg)		Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day)		Cancer Risk	
	Geometric Mean	Maximum	Average	Plausible Maximum	Average	Plausible Maximum
Bis (2-ethylhexyl) Phthalate	3,800	26,000	7.5×10^{-8}	5.1×10^{-6}	5×10^{-11}	4×10^{-9}
1,2-Dichloroethane	172	240	3.4×10^{-9}	4.7×10^{-8}	3×10^{-10}	4×10^{-9}
PCBs	1.100	4,200	2.2×10^{-8}	8.3×10^{-7}	1×10^{-7}	4×10^{-6}
PAHs	580	1,080	1.1×10^{-8}	2.1×10^{-7}	1×10^{-7}	2×10^{-6}
				Total risk	2×10^{-7}	6×10^{-6}

[a]Assumptions used for this scenario are summarized in Table 6-14. Cancer potency factors used to calculate cancer risks are shown in Table 6-8. For this analysis, the average daily dose received over the assumed exposure period was prorated over a 70-year lifetime, and the lifetime risk was calculated accordingly. This procedure is recommended in EPA's "Guidelines for Carcinogen Risk Assessment" (EPA 1986d).

[b]Daily intake under average exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(100 mg/visit)(32 visits/year)(3 years)(kg/10}^6\text{ mg)}}{\text{(19 kg)(70 years)(365 days/year)}}$ = (Conc. soil mg/kg)(1.98×10^{-8} kg soil/kg body weight/day)

where: Conc. soil = geometric mean.

Daily intake under plausible maximum exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(500 mg/visit)(64 visits/year)(3 years)(kg/10}^6\text{ mg)}}{\text{(19 kg)(70 years)(365 days/year)}}$ = (Conc. soil mg/kg)(1.98×10^{-7} kg soil/kg body weight/day)

where: Conc. soil = maximum concentration.

TABLE 6-21

EXPOSURE ESTIMATES AND NONCARCINOGENIC RISKS FOR CHILDREN FROM DIRECT CONTACT WITH SEDIMENT IN DITCHES AND FIRST IMPOUNDMENT NEAR SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg) Geometric Mean	Concentration (ug/kg) Maximum	Chronic Daily Intake (CDI)[b] (mg/kg/day) Average	Chronic Daily Intake (CDI)[b] (mg/kg/day) Plausible Maximum	Hazard Index (CDI/RfD) Average	Hazard Index (CDI/RfD) Plausible Maximum
Antimony	86,000	143,000	4.0×10^{-5}	6.6×10^{-4}	1×10^{-1}	2
Bis (2-ethylhexyl) Phthalate	3,800	26,000	1.8×10^{-6}	1.2×10^{-4}	9×10^{-5}	6×10^{-3}
Di-n-butylphthalate	5,200	8,600	2.4×10^{-6}	4.0×10^{-5}	2×10^{-5}	4×10^{-4}
1,2-Dichloroethane	172	240	7.9×10^{-8}	1.1×10^{-6}	NQ	NQ
PCBs	1,100	4,200	5.1×10^{-7}	1.9×10^{-5}	NQ	NQ
PAHs	580	1,080	2.7×10^{-7}	5.0×10^{-6}	NQ	NQ
Zinc	200,000	1,070,000	9.2×10^{-5}	4.9×10^{-3}	4×10^{-4}	2×10^{-2}
				Total Hazard Index	1×10^{-1}	2

[a]Assumptions used for this exposure scenario are summarized in Table 6-19. Reference does (RfDs) used to calculate hazard indices are shown in Table 6-8.

[b]Daily intake under average exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(100 mg/visit)(32 visits/year)(3 years)(kg/}10^6\text{ mg)}}{\text{(19 kg)(3 years)(365 days/year)}}$ = (Conc. soil mg/kg)(4.61×10^{-7} kg soil/kg body weight/day)

where: Conc. soil = geometric mean.

Daily intake under plausible maximum exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(500 mg/visit)(64 visits/year)(3 years)(kg/}10^6\text{ mg)}}{\text{(19 kg)(3 years)(365 days/year)}}$ = (Conc. soil mg/kg)(4.61×10^{-6} kg soil/kg body weight/day)

where: Conc. soil = maximum concentration.

NQ = Not quantified. Reference does (RfDs) for noncarcinogenic effects associated with these chemicals are not available; however, cancer risks associated with exposure to these chemicals are shown in Table 6-20.

Because the second impoundment is a greater distance from houses than the ditches, and because access to this impoundment may be difficult due to the steepness of the sides of the impoundment, it is more likely that teenagers (ages 12 to 16 years) rather than young children would be attracted to this area and be exposed to the sediments. The frequency of exposure evaluated will be the same as that assumed for children playing in the ditches and the quantity of sediment incidentally ingested will be the same as was used in evaluating exposure to this age group earlier (trespassing teenagers on site). These exposure assumptions are summarized in Table 6-22. Intake estimates are presented in Tables 6-23 and 6-24 for evaluation of carcinogenic and noncarcinogenic effects, respectively.

6.6.3.2 Estimation of Risks

The excess lifetime cancer risks associated with direct contact with soils by trespassers visiting the Summit National site are shown in Table 6-11. For the average exposure case, the excess cancer risks associated with incidental ingestion of soil at the site are 3 orders of magnitude less than 10^{-6} for exposure to potential carcinogens present either individually or concurrently. Under the plausible maximum exposure conditions considered for this scenario, the excess cancer risk is 3×10^{-5} due primarily to exposure to the PCBs present in soil at the site. The estimated intakes by onsite trespassers of the chemicals present in soil under both the average and plausible maximum cases are less than the available criteria for protection against noncarcinogenic effects of the carcinogenic and noncarcinogenic indicator chemicals considered. As shown in Table 6-12, the individual and total hazard indices for these chemicals are less than one. Thus, based on available data, it appears that noncarcinogenic health effects are not likely to result from exposure, either individually or concurrently, to the compounds shown in Table 6-12 for which critical toxicity values are available.

The potential excess lifetime cancer risks to workers from direct contact with soil along the southern perimeter of the Summit National site are shown in Table 6-14. The total excess cancer risks associated with incidental ingestion of soil during normal work activities exceed 10^{-6} for the plausible maximum, but not the average, exposure conditions evaluated. Under

TABLE 6-22

ASSUMPTIONS USED IN ESTIMATING EXPOSURE OF TEENAGERS TO CONTAMINANTS VIA DIRECT CONTACT WITH SEDIMENTS IN THE SECOND IMPOUNDMENT

Parameter	Average Exposure	Plausible Maximum Exposure
Frequency of contact	32 visits/year	64 visits/year
Ages of children exposed	12-16 years	12-16 years
Average weight over period of exposure	45 kg	45 kg
Years of exposure	5	5
Concentration of contaminant in soil contacted[a]	Geometric mean	Maximum concentration
Quantity of soil incidentally ingested	20 mg/visit	100 mg/visit

[a]Values given in Table 6-5.

TABLE 6-23

EXPOSURE ESTIMATES AND CANCER RISKS FOR TEENAGERS FROM DIRECT CONTACT WITH SEDIMENT IN THE SECOND IMPOUNDMENT[a]

Chemical	Concentration (ug/kg) Geometric Mean	Concentration (ug/kg) Maximum	Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day) Average	Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day) Plausible Maximum	Cancer Risk Average	Cancer Risk Plausible Maximum
Bis (2-ethylhexyl) Phthalate	2,900	24,000	8.1×10^{-9}	6.7×10^{-7}	6×10^{-12}	5×10^{-10}
Hexachlorobenzene	NA	2,800	NA	7.8×10^{-8}	NA	1×10^{-7}
				Total risk	6×10^{-12}	1×10^{-7}

[a]Assumptions used for this scenario are summarized in Table 6-23. Cancer potency factors used to calculate cancer risks are shown in Table 6-8. For this analysis, the average daily dose received over the assumed exposure period was prorated over a 70-year lifetime, and the lifetime risk was calculated accordingly. This procedure is recommended in EPA's "Guidelines for Carcinogen Risk Assessment" (EPA 1986d).

[b]Daily intake under average exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(20 mg/visit)(32 visits/year)(5 years)(kg/10}^6\text{ mg)}}{\text{(45 kg)(70 years)(365 days/year)}}$ = (Conc. soil mg/kg)(2.78×10^{-9} kg soil/kg body weight/day)

where: Conc. soil = geometric mean.

Daily intake under plausible maximum exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(100 mg/visit)(64 visits/year)(5 years)(kg/10}^6\text{ mg)}}{\text{(45 kg)(70 years)(365 days/year)}}$ = (Conc. soil mg/kg)(2.78×10^{-8} kg soil/kg body weight/day)

where: Conc. soil = maximum concentration.

NA = not applicable, only detected in one sample.

TABLE 6-24

EXPOSURE ESTIMATES AND NONCARCINOGENIC RISKS FOR TEENAGERS FROM DIRECT CONTACT WITH SEDIMENT IN THE SECOND IMPOUNDMENT[a]

Chemical	Concentration (ug/kg) Geometric Mean	Concentration (ug/kg) Maximum	Chronic Daily Intake (CDI)b (mg/kg/day) Average	Chronic Daily Intake (CDI)b (mg/kg/day) Plausible Maximum	Hazard Index (CDI/RfD) Average	Hazard Index (CDI/RfD) Plausible Maximum
Bis (2-ethylhexyl) Phthalate	2,900	24,000	1.1×10^{-7}	9.3×10^{-6}	6×10^{-6}	5×10^{-4}
Di-n-butylphthalate	NA	4,300	NA	1.7×10^{-6}	NA	2×10^{-5}
Hexachlorobenzene	NA	2,800	NA	1.1×10^{-6}	NQ	NQ
Zinc	110,000	200,000	4.3×10^{-6}	7.8×10^{-5}	2×10^{-5}	4×10^{-4}
				Total Hazard Index	3×10^{-5}	9×10^{-4}

[a]Assumptions used for this exposure scenario are summarized in Table 6-22. Reference does (RfDs) used to calculate hazard indices are shown in Table 6-8.

[b]Daily intake under average exposure conditions (mg/kg/day) = $\frac{(\text{Conc. soil mg/kg})(20\ \text{mg/visit})(32\ \text{visits/year})(5\ \text{years})(\text{kg}/10^6\ \text{mg})}{(45\ \text{kg})(5\ \text{years})(365\ \text{days/year})}$ = (Conc. soil mg/kg)(3.90×10^{-8} kg soil/kg body weight/day)

where: Conc. soil = geometric mean.

Daily intake under plausible maximum exposure conditions (mg/kg/day) = $\frac{(\text{Conc. soil mg/kg})(100\ \text{mg/visit})(64\ \text{visits/year})(5\ \text{years})(\text{kg}/10^6\ \text{mg})}{(45\ \text{kg})(5\ \text{years})(365\ \text{days/year})}$ = (Conc. soil mg/kg)(3.90×10^{-7} kg soil/kg body weight/day)

where: Conc. soil = maximum concentration.

NA = not applicable. Only detected in one sample.

NQ = Not quantified. Reference does (RfDs) for noncarcinogenic effects associated with these chemicals are not available; however, cancer risks associated with exposure to these chemicals are shown in Table 6-23.

the plausible maximum exposure conditions, the cancer risk of 4×10^{-5} associated with PAHs is more than an order of magnitude higher than the risks associated with the other potential carcinogens present in off-site soils in industrial areas. The estimated intakes by off-site workers of the indicator chemicals present in soil under both the average and plausible maximum cases are less than the available criteria for protection against noncarcinogenic effects of the carcinogenic and noncarcinogenic indicator chemicals considered. As shown in Table 6-15, the individual and total hazard indices for these chemicals are less than one. Thus, based on available data, it appears that noncarcinogenic health effects are not likely to result from exposure to the compounds shown in Table 6-15 for which critical toxicity values are available.

The potential excess lifetime cancer risks to residents along the eastern perimeter of the site from direct contact with soil are shown in Table 6-17. The total excess cancer risks associated with incidental ingestion of soil exceeds 10^{-6} for both the average and plausible maximum exposure conditions evaluated. Under the plausible maximum exposure conditions, the cancer risk of 2×10^{-4} associated with exposure to PAHs is at least an order of magnitude higher than the risks associated with the other potential carcinogens that may be present in soils in this offsite residential area along the eastern perimeter. The estimated intakes by residents of the indicator chemicals present in soil under both the average and plausible maximum cases are less than the available criteria for protection against noncarcinogenic effects of the carcinogenic and noncarcinogenic indicator chemicals considered. As shown in Table 6-18, the individual and total hazard indices for these chemicals are less than one. Thus, based on available data, it appears that noncarcinogenic health effects are not likely to result from exposure to the compounds shown in Table 6-18 for which critical toxicity values are available.

The potential excess lifetime cancer risks to children playing in ditches near the site (lower east, east, south and first impoundment) from direct contact with sediment are shown in Table 6-20. The total excess cancer risks associated with incidental ingestion of sediment are less than 10^{-6} for the average exposure scenario. Under the plausible maximum exposure scenario, the potential excess lifetime cancer risks associated with both PCBs and PAHs exceed 10^{-6}. As

shown in Table 6-21, under the average exposure scenario, the estimated intakes by children of the indicator chemicals present in sediment in the ditches are less than the available criteria for protection against noncarcinogenic effects of the chemicals considered. Thus, based on available data, it appears that under the average exposure scenario considered, noncarcinogenic health effects are not likely to result from exposure to the compounds shown in Table 6-21 for which critical toxicity values are available. However, under the plausible maximum exposure scenario considered, the estimated intake of antimony exceeds the available criteria for protection against noncarcinogenic effects. Consequently, the total hazard index for exposure under the plausible maximum exposure conditions exceeds one.

The potential excess lifetime cancer risks to teenagers exposed to sediment in the second impoundment through incidental ingestion are shown in Table 6-23. The total excess cancer risks associated with both the average and plausible maximum exposure scenarios are less than 10^{-6}. The estimated intakes by teenagers of the indicator chemicals present in sediment in the second impoundment under both the average and plausible maximum cases are less than the available criteria for protection against noncarcinogenic effects of the indicator chemicals considered. As shown in Table 6-24, the individual and total hazard indices for these chemicals are less than one. Thus, based on the available data, it appears that noncarcinogenic health effects are not likely to result from exposure to the compounds shown in Table 6-24 for which critical toxicity values are available.

6.6.4 Risks under Future-Use Conditions

6.6.4.1 Estimation of Intakes

To assess the average and maximum exposure to workers, assuming the site is reused for light industrial work, the assumptions outlined in Table 6-13 will be used with one exception. The geometric mean and maximum concentrations for onsite soils, presented in Table 6-4, will be used. Doses are presented in Tables 6-25 and 6-26 for evaluation of carcinogenic and noncarcinogenic effects, respectively.

In addition to exposure to contaminated soil, workers may be exposed to contaminants through ingestion of groundwater. Since workers will only be at the site a

TABLE 6-25

EXPOSURE ESTIMATES AND CANCER RISKS FOR WORKERS FROM DIRECT CONTACT WITH SOILS AT THE SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg) Geometric Mean	Concentration (ug/kg) Maximum	Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day) Average	Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day) Plausible Maximum	Cancer Risk Average	Cancer Risk Plausible Maximum
Bis (2-ethylhexyl) phthalate	10,000	700,000	1.8×10^{-7}	1.3×10^{-4}	1×10^{-10}	9×10^{-8}
1,2-Dichloroethane	1,300	23,000	2.3×10^{-8}	4.1×10^{-6}	2×10^{-9}	4×10^{-7}
Hexachlorobenzene	2,100	59,000	3.8×10^{-8}	1.1×10^{-5}	6×10^{-8}	2×10^{-5}
PCBs	4,600	590,000	2.9×10^{-8}	5.3×10^{-5}	1×10^{-7}	2×10^{-4}
PAHs	400	1,600	2.5×10^{-9}	1.4×10^{-7}	3×10^{-8}	2×10^{-6}
Trichloroethene	60	86,000	1.1×10^{-9}	1.5×10^{-5}	1×10^{-11}	2×10^{-7}
				Total risk	2×10^{-7}	2×10^{-4}

a Assumptions used for this scenario are summarized in Table 6-13. Cancer potency factors used to calculate cancer risks are shown in Table 6-8. For this analysis, the average daily dose received over the assumed exposure period was prorated over a 70-year lifetime, and the lifetime risk was calculated accordingly. This procedure is recommended in EPA's "Guidelines for Carcinogen Risk Assessment" (EPA 1986d).

b Daily intake under average exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(20 mg/visit)(160 visits/year)(10 years)(Kg/10}^6\text{ mg)}}{\text{(70 kg)(70 years)(365 days/year)}}$ = (Conc. Soil mg/kg)(1.79×10^{-8} kg soil/kg body weight/day)

where Conc. Soil = Geometric mean

Daily intake under plausible maximum exposure conditions (mg/kg/day) = $\frac{\text{(Conc. Soil mg/kg)(100 mg/visit)(160 visit/year)(20 years)(Kg/10}^6\text{ mg)}}{\text{(70 kg)(70 years)(365 days/year)}}$ = (Conc. Soil mg/kg)(1.79×10^{-7} kg soil/kg body weight/day)

where Conc. Soil = Maximum concentration

TABLE 6-26

EXPOSURE ESTIMATES AND NONCARCINOGENIC RISKS FOR WORKERS FROM DIRECT CONTACT WITH SOILS AT THE SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg) Geometric Mean	Concentration (ug/kg) Maximum	Chronic Daily Intake (CDI)[b] (mg/kg/day) Average	Chronic Daily Intake (CDI)[b] (mg/kg/day) Plausible Maximum	Hazard Index (CDI/RfD) Average	Hazard Index (CDI/RfD) Plausible Maximum
Antimony	61,000	545,000	7.6×10^{-6}	3.4×10^{-4}	2×10^{-2}	8×10^{-1}
Bis (2-ethylhexyl) Phthalate	10,000	700,000	1.3×10^{-6}	4.4×10^{-4}	6×10^{-5}	2×10^{-2}
Cadmium	5,000	112,000	6.3×10^{-7}	7.0×10^{-5}	1×10^{-3}	1×10^{-1}
1,2-Dichloroethane	1,300	23,000	1.6×10^{-7}	1.4×10^{-5}	NQ	NQ
Hexachlorobenzene	2,100	59,000	2.6×10^{-7}	3.7×10^{-5}	NQ	NQ
Phenol	2,100	44,000	2.6×10^{-7}	2.8×10^{-5}	3×10^{-6}	3×10^{-4}
PCBs	4,600	590,000	2.0×10^{-8}	1.8×10^{-4}	NQ	NQ
PAHs	400	1,600	1.8×10^{-9}	5.0×10^{-7}	NQ	NQ
Toluene	56	260,000	7.0×10^{-9}	1.6×10^{-4}	2×10^{-8}	5×10^{-4}
Trichloroethene	60	86,000	7.5×10^{-9}	5.4×10^{-5}	1×10^{-6}	7×10^{-3}
Total Xylenes	76	210,000	9.5×10^{-9}	1.3×10^{-4}	1×10^{-6}	1×10^{-2}
Zinc	120,000	643,000	1.5×10^{-5}	4.0×10^{-4}	7×10^{-5}	2×10^{-3}
				Total Hazard Index	2×10^{-2}	9×10^{-1}

a Assumptions used for this exposure scenario are summarized in Table 6-13. Reference does (RfDs) used to calculate hazard indices are shown in Table 6-8.

b Daily intake under average exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(20 mg/visit)(160 visits/year)(10 years)(Kg/10}^6\text{ mg)}}{\text{(70 kg)(10 years)(365 days/year)}}$ = (Conc. Soil mg/kg)(1.25×10^{-7} kg soil/kg body weight/day)

where Conc. Soil = Geometric mean

Daily intake under plausible maximum exposure conditions (mg/kg/day) = $\frac{\text{(Conc. Soil mg/kg)(100mg/visit)(160 visits/year)(20 years)(Kg/10}^6\text{ mg)}}{\text{(70 kg)(20 years)(365 days/year)}}$ = (Conc. Soil mg/kg)(6.27×10^{-7} kg soil/kg body weight/day)

where Conc. Soil = Maximum concentration

NQ Not quantified. Reference doses (RfDs) for noncarcinogenic effects associated with these chemicals are not available; however, cancer risks associated with exposure to these chemicals are shown in Table 6-25.

portion of the day, it is assumed that they will ingest 1 liter of water/day, 230 days/year (assumes a 5 day work week with allowances for vacation, holidays, and sick leave).

Assuming a 70-kg person ingests this water and using the concentrations presented in Table 6-6, average daily intake of chemical contaminants by workers via ingestion of groundwater are shown in Table 6-27.

To assess the exposures to residents living on the site in the future, it is assumed an individual could be exposed to contaminants in soils throughout an entire lifetime. The assumptions outlined in Table 6-16 will be used with one exception. The geometric mean and maximum concentrations for onsite soils presented in Table 6-4 will be used. Doses are presented in Tables 6-28 and 6-29 for carcinogenic and noncarcinogenic effects respectively.

In addition to exposure to contaminated soil, residents may be exposed to site contaminants through ingestion of onsite groundwater. It is assumed that the residents would drink 2 liters of water per day over a 70 year lifetime. The resulting average daily intake of chemical contaminants by residents via ingestion of groundwater are shown in Table 6-30.

6.6.4.2 Estimation of Risks

The potential excess lifetime cancer risks to workers from direct contact with onsite soil if the Summit National site is reused for light industrial work are shown in Table 6-25. The total excess cancer risks exceed 10^{-6} for the plausible maximum, but not the average, exposure conditions evaluated. Under the plausible maximum exposure conditions, the potential excess cancer risks associated with exposure to PCBs, hexachlorobenzene, and PAHs are $2x10^{-4}$, $2x10^{-5}$, and $2x10^{-6}$, respectively. Excess cancer risks associated with the remaining potential carcinogens are $4x10^{-7}$ or lower. The estimated intakes by onsite workers of the indicator chemicals present in soil under both the average and plausible maximum cases are less than the available criteria for protection against noncarcinogenic effects of the carcinogenic and noncarcinogenic indicator chemicals considered. As shown in Table 6-26, the individual and total hazard indices for these chemicals are less than one. Thus, based on available data, it appears that noncarcinogenic health effects are not likely to result

TABLE 6-27

DAILY INTAKE BY WORKERS VIA INGESTION OF GROUNDWATER AT THE SUMMIT NATIONAL SITE[a]

	Water Table				Intermediate Unit				Upper Sharon Aquifer[b]	
	Concentration (ug/l) Geometric Mean	Maximum	Average Intake (mg/kg/day)	Plausible Maximum Intake (mg/kg/day)	Concentration (ug/l) Geometric Mean	Maximum	Average Intake (mg/kg/day)	Plausible Maximum Intake (mg/kg/day)	Concentration (ug/l)	Average Intake (mg/kg/day)
Acetone	63	890,000	5.6×10^{-4}	8.0	91	1,300,000	8.2×10^{-4}	12	18	1.6×10^{-4}
Barium	100	320	9.0×10^{-4}	2.9×10^{-3}	136	2,230	1.2×10^{-3}	2.0×10^{-2}	12	1.1×10^{-4}
Bis(2-ethylhexyl) Phthalate	13	7,250	1.2×10^{-4}	6.5×10^{-2}	8	28	7.2×10^{-5}	2.6×10^{-4}	4	3.6×10^{-5}
Chromium	25	58	2.3×10^{-4}	5.2×10^{-4}	8.2	30	7.2×10^{-5}	2.7×10^{-4}	ND	ND
Cyanide	47	239	4.2×10^{-4}	2.2×10^{-3}	37	37	3.3×10^{-4}	3.3×10^{-4}	ND	ND
1,1-Dichloroethane	280	12,000	2.6×10^{-3}	1.1×10^{-1}	20	820	1.9×10^{-4}	7.3×10^{-3}	ND	ND
1,2-Dichloroethane	104	115,000	9.3×10^{-4}	1.0	140	5,800	1.3×10^{-3}	5.2×10^{-2}	ND	ND
1,1-Dichloroethene	35	2,600	3.2×10^{-4}	2.3×10^{-2}	ND	ND	ND	ND	ND	ND
Trans-1,2-Dichloroethene	121	4,600	1.1×10^{-3}	4.2×10^{-2}	ND	ND	ND	ND	ND	ND
Ethylbenzene	68	8,550	6.2×10^{-4}	7.8×10^{-2}	590	590	5.3×10^{-3}	5.3×10^{-3}	ND	ND
Phenol	2,400	7,000	2.2×10^{-2}	6.3×10^{-2}	490	910	4.5×10^{-3}	8.2×10^{-3}	6	5.4×10^{-5}
Toluene	25	20,000	2.3×10^{-4}	1.9×10^{-1}	39	3,200	3.5×10^{-4}	2.9×10^{-2}	ND	ND
Trichloroethene	900	27,000	8.1×10^{-3}	2.4×10^{-1}	55	55	4.9×10^{-4}	4.9×10^{-4}	ND	ND

ND Not detected

a Average daily intake = $\frac{\text{(Conc gw mg/l)(1 liter/day)(230 days)}}{\text{(70 kg)(365 days)}}$ = (Conc. gw mg/l)(9.0×10^{-3} l/kg/day), where conc. gw equals the geometric mean concentration
Plausible maximum daily intake is calculated as above with Conc. gw equal to the maximum concentration.

b Based on samples from one well; therefore, no maximum is presented.

TABLE 6-28

EXPOSURE ESTIMATES AND CANCER RISKS FOR ON-SITE RESIDENTS FROM DIRECT CONTACT WITH SOILS AT THE SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg) Geometric Mean	Concentration (ug/kg) Maximum	Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day) Average	Daily Intake Prorated Over a 70-Year Lifetime[b] (mg/kg/day) Plausible Maximum	Cancer Risk Average	Cancer Risk Plausible Maximum
Bis (2-ethylhexyl) Phthalate	10,000	700,000	4.0×10^{-6}	1.4×10^{-3}	3×10^{-9}	1×10^{-6}
1,2-Dichloroethane	1,300	23,000	5.2×10^{-7}	4.6×10^{-5}	5×10^{-8}	4×10^{-6}
Hexachlorobenzene	2,100	59,000	8.5×10^{-7}	1.2×10^{-4}	1×10^{-6}	2×10^{-4}
PCBs	4,600	590,000	1.9×10^{-6}	1.2×10^{-3}	8×10^{-6}	5×10^{-3}
PAHs	400	1,600	1.6×10^{-7}	3.2×10^{-6}	2×10^{-6}	4×10^{-5}
Trichloroethene	60	86,000	2.4×10^{-8}	1.7×10^{-4}	3×10^{-10}	2×10^{-6}
				Total risk	1×10^{-5}	5×10^{-3}

[a]Assumptions used for this scenario are summarized in Table 6-16. Cancer potency factors used to calculate cancer risks are shown in Table 6-8. For this analysis, the average daily dose received over the assumed exposure period was prorated over a 70-year lifetime, and the lifetime risk was calculated accordingly. This procedure is recommended in EPA's "Guidelines for Carcinogen Risk Assessment" (EPA 1986d).

[b]Daily intake under average exposure conditions (mg/kg/day)

$$\frac{(\text{Conc. soil mg/kg})(0.92\ \text{mg/kg-visit})(160\ \text{visits/year})(70\ \text{years})(\text{kg}/10^{6}\ \text{mg})}{(70\ \text{years})(365\ \text{days/year})} = (\text{Conc. soil mg/kg})(4.03\times10^{-7}\ \text{kg soil/kg body weight/day})$$

where: Conc. soil = geometric mean.

Daily intake under plausible maximum exposure conditions (mg/kg/day)

$$\frac{(\text{Conc. soil mg/kg})(4.6\ \text{mg/kg-visit})(160\ \text{visits/year})(70\ \text{years})(\text{kg}/^{6}\ \text{mg})}{(70\ \text{years})(365\ \text{days/year})} = (\text{Conc. soil mg/kg})(2.02\times10^{-6}\ \text{kg soil/kg body weight/day})$$

where: Conc. soil = maximum concentration.

TABLE 6-29

EXPOSURE ESTIMATES AND NONCARCINOGENIC RISKS FOR ONSITE RESIDENTS FROM DIRECT CONTACT WITH SOILS AT THE SUMMIT NATIONAL SITE[a]

Chemical	Concentration (ug/kg) Geometric Mean	Concentration (ug/kg) Maximum	Chronic Daily Intake (CDI)[b] (mg/kg/day) Average	Chronic Daily Intake (CDI)[b] (mg/kg/day) Plausible Maximum	Hazard Index (CDI/RfD) Average	Hazard Index (CDI/RfD) Plausible Maximum
Antimony	61,000	545,000	2.5×10^{-5}	1.1×10^{-3}	6×10^{-2}	3
Bis (2-ethylhexyl) Phthalate	10,000	700,000	4.0×10^{-6}	1.4×10^{-3}	2×10^{-4}	7×10^{-2}
Cadmium	5,000	112,000	2.0×10^{-6}	2.3×10^{-4}	3×10^{-3}	4×10^{-1}
1,2-Dichloroethane	1,300	23,000	5.2×10^{-7}	4.6×10^{-5}	NQ	NQ
Hexachlorobenzene	2,100	59,000	8.5×10^{-7}	1.2×10^{-4}	NQ	NQ
Phenol	2,100	44,000	8.5×10^{-7}	8.9×10^{-5}	8×10^{-6}	9×10^{-4}
PCBs	4,600	590,000	1.9×10^{-6}	1.2×10^{-3}	NQ	NQ
PAHs	400	1,600	1.6×10^{-7}	3.2×10^{-6}	NQ	NQ
Toluene	56	260,000	2.3×10^{-8}	5.2×10^{-4}	8×10^{-8}	2×10^{-3}
Trichloroethene	60	86,000	2.4×10^{-8}	1.7×10^{-4}	3×10^{-6}	2×10^{-2}
Total Xylenes	76	210,000	3.1×10^{-8}	4.2×10^{-4}	3×10^{-6}	4×10^{-2}
Zinc	120,000	643,000	4.8×10^{-5}	1.3×10^{-3}	2×10^{-4}	6×10^{-3}
				Total Hazard Index	6×10^{-2}	4

a Assumptions used for this exposure scenario are summarized in Table 6-16. Reference does (RfDs) used to calculate hazard indices are shown in Table 6-8.

b Daily intake under average exposure conditions (mg/kg/day) = $\frac{\text{(Conc. soil mg/kg)(0.92 mg/kg-visit)(160 visits/yr)(70 yrs)(Kg/10}^6\text{ mg)}}{\text{(70 kg)(365 days/year)(5 years)}}$ = (Conc. Soil mg/kg)(4.03×10^{-7} kg soil/kg body weight/day)

where Conc. Soil = Geometric mean

Daily intake under plausible maximum exposure conditions (mg/kg/day) = $\frac{\text{(Conc. Soil mg/kg)(4.6 mg/kg-visit)(160 visits/yr)(70 yrs)(Kg/10}^6\text{ mg)}}{\text{(70 years)(365 days/year)}}$ = (Conc. Soil mg/kg)(2.02×10^{-6} kg soil/kg/body weight/day)

where Conc. Soil = Maximum concentration

NQ Not quantified. Reference does (RfDs) for noncarcinogenic effects associated with these chemicals are not available; however, cancer risks associated with exposure to these chemicals are shown in Table 6-28.

TABLE 6-30

DAILY INTAKE BY RESIDENTS VIA INGESTION OF GROUNDWATER AT THE SUMMIT NATIONAL SITE[a]

	Water Table				Intermediate Unit				Upper Sharon Aquifer[b]	
	Concentration (ug/l) Geometric Mean	Maximum	Average Intake (mg/kg/day)	Plausible Maximum Intake (mg/kg/day)	Concentration (ug/l) Geometric Mean	Maximum	Average Intake (mg/kg/day)	Plausible Maximum Intake (mg/kg/day)	Concentration (ug/l)	Intake (mg/kg/day)
Acetone	63	890,000	$1.8x10^{-3}$	$2.6x10^{1}$	91	1,300,000	$2.6x10^{-3}$	$3.8x10^{1}$	18	$5.2x10^{-4}$
Barium	100	320	$2.9x10^{-3}$	$9.3x10^{-3}$	136	2,230	$3.9x10^{-3}$	$6.5x10^{-2}$	12	$3.5x10^{-4}$
Bis(2-ethylhexyl) Phthalate	13	7,250	$3.8x10^{-4}$	$2.1x10^{-1}$	8	28	$2.3x10^{-4}$	$8.1x10^{-4}$	4	$1.2x10^{-4}$
Chromium	25	58	$7.3x10^{-4}$	$1.7x10^{-3}$	8.2	30	$2.4x10^{-4}$	$8.7x10^{-4}$	ND	ND
Cyanide	47	239	$1.4x10^{-3}$	$6.9x10^{-3}$	37	37	$1.1x10^{-3}$	$1.1x10^{-3}$	ND	ND
1,1-Dichloroethane	280	12,000	$8.1x10^{-3}$	$3.5x10^{-1}$	20	820	$5.8x10^{-4}$	$2.4x10^{-2}$	ND	ND
1,2-Dichloroethane	104	115,000	$3.0x10^{-2}$	3.3	140	5,800	$4.1x10^{-3}$	$1.7x10^{-1}$	ND	ND
1,1-Dichloroethene	35	2,600	$1.0x10^{-3}$	$7.5x10^{-2}$	ND	ND	ND	ND	ND	ND
Trans-1,2-Dichloroethene	121	4,600	$3.5x10^{-3}$	$1.3x10^{-1}$	ND	ND	ND	ND	ND	ND
Ethylbenzene	68	8,550	$2.0x10^{-3}$	$2.5x10^{-1}$	590	590	$1.7x10^{-2}$	$1.7x10^{-2}$	ND	ND
Phenol	2,400	7,000	$7.0x10^{-2}$	$2.0x10^{-1}$	490	910	$1.4x10^{-2}$	$2.6x10^{-2}$	6	$1.7x10^{-4}$
Toluene	25	20,000	$7.3x10^{-4}$	$5.8x10^{-1}$	39	3,200	$1.1x10^{-3}$	$9.3x10^{-2}$	ND	ND
Trichloroethene	900	27,000	$2.6x10^{-2}$	$7.8x10^{-1}$	55	55	$1.6x10^{-3}$	$1.6x10^{-3}$	ND	ND

ND Not detected

a Average daily intake = $\frac{\text{(Conc gw mg/l)(2 liter/day)(365 days)(70 years)}}{\text{(70 kg)(365 days)(70 years)}}$ = (Conc. gw mg/l)($2.9x10^{-2}$ l/kg/day),

where conc. gw equals the geometric mean concentration

Plausible maximum daily intake is calculated as above with Conc. gw equal to the maximum concentration.

b Based on samples from one well; therefore, no maximum is presented.

from exposure to the compounds shown in Table 6-26 for which critical toxicity values are available. It should, however, be noted that the total hazard index is close to one, primarily from potential exposure to antimony and cadmium. If other chemicals are present at the site which have similar end-points of toxicity (e.g., kidney effects for cadmium and heart and blood effects for antimony), but have not been specifically evaluated, exposure to chemicals at the site by direct contact with soils could also pose risks due to noncarcinogenic toxic effects. However, these risks are likely to be outweighed by the potential excess cancer risks.

The potential excess lifetime cancer risks to residents from direct contact with onsite soil if the Summit National site is reused for residential dwellings are shown in Table 6-28. The total excess risks exceed 10^{-6} for both the plausible maximum and average exposure conditions evaluated. Under the plausible maximum exposure conditions excess cancer risks for each individual chemical is equal to or exceeds 10^{-6}. The potential excess cancer risks associated with exposure to PCBs, hexachlorobenzene and PAHs are $5x10^{-3}$, $2x10^{-4}$ and $4x10^{-5}$, respectively. The total excess cancer risks associated with the average exposure conditions is equal to or exceeds 10^{-6} for these three chemicals. Under the average exposure conditions the intakes by onsite residents of the indicator chemicals present in soil are less than the available criteria for the protection against noncarcinogenic effects. Thus, based on available data, it appears that noncarcinogenic health effects are not likely to result from the average exposure to the compounds in Table 6-29. Under the plausible maximum exposure conditions, the estimated intake of antimony exceeds the available criteria for protection against noncarcinogenic effects of these compounds. Consequently the total hazard index for exposure under the plausible maximum exposure conditions exceeds one.

Not all chemicals present in the soil exhibit the same end-points of toxicity. Consequently, if evaluated according to similar toxicity end-points, the total hazard indices for the plausible maximum exposure in soil may not exceed one. Conversely, consideration of other chemicals present at the site, but not specifically evaluated in this assessment, could potentially result in an even higher total hazard index. This type of analysis was not done because,

although noncarcinogenic risks may be present, the potential carcinogenic risks associated with incidental ingestion of soil appear to far outweigh the potential noncarcinogenic risks.

Primary MCLs, proposed MCLs, proposed MCLGs, ambient water quality criteria (AWQC), and EPA Health Advisories are available for a number of the indicator chemicals that could potentially occur in drinking water obtained from groundwater beneath the Summit National site. These values are shown in Table 6-7. Although only the primary MCLs are legally enforceable, the MCLGs and AWQCs listed are also considered to be ARARs. In addition the Health Advisories may also be useful for making risk management decisions. Table 6-9 presents a comparison of the groundwater indicator chemical concentrations shown in Table 6-6 with the standards and criteria shown in Table 6-7. This table shows that several chemicals present in the water-table, and intermediate unit exceed the legallyrequired or recommended values. Table 6-31 gives the chemicals present in groundwater that exceed at least one of the criteria shown in Table 6-7. The criteria and standards shown in Table 6-7 were developed based on an assumption that an individual drinks approximately 2 liters of water per day, while this assumption is used for evaluating residential exposure, workers at the Summit National site are assumed to ingest only 1 liter of water per day. Nevertheless, the concentrations of some indicator chemicals present in groundwater are commonly much higher than the corresponding standards and criteria and could therefore pose health risks to workers.

The potential excess lifetime cancer risks to workers from ingestion of water from wells at the Summit National site are shown in Table 6-32. The total excess cancer risks associated with ingestion of groundwater from the water-table, and intermediate unit exceed 10^{-6} under average and plausible maximum exposure conditions. The highest risks are associated with use of the water-table aquifer are due primarily to 1,1-dichloroethene, 1,2-dichloroethane, and trichloroethene. Risks associated with use of groundwater from the intermediate unit are somewhat lower and are due primarily to 1,2-dichloroethane. The total excess cancer risk associated with ingestion of water from the Upper Sharon aquifer by workers does not exceed 10^{-6}.

TABLE 6-31

CHEMICALS IN GROUNDWATER EXCEEDING FEDERAL STANDARDS AND CRITERIA FOR DRINKING WATER[a]

Water Table		Intermediate Unit	
Average Concentration	Maximum Concentration	Average Concentration	Maximum Concentration
1,2-Dichloroethane	Chromium	1,2-Dichloroethane	Barium
1,1-Dichloroethene	Cyanide	Ethylbenzene	1,2-Dichloroethane
Trans-1,2-Dichloroethene	1,2-Dichloroethane	Trichloroethene	Ethylbenzene
Trichloroethene	Trans-1,2-Dichloroethene		Toluene
	Ethylbenzene		Trichloroethene
	Phenol		
	Toluene		
	Trichloroethene		

[a] Groundwater concentrations are shown in Table 6-6, Drinking Water Standards and Criteria are shown in Table 6-7, and a comparison of concentrations to ARARs is shown in Table 6-9.

TABLE 6-32

CANCER RISKS TO WORKERS FROM INGESTION OF GROUNDWATER AT THE SUMMIT NATIONAL SITE[a]

	Water Table		Intermediate Unit		
	Average	Plausible Max.	Average	Plausible Max.	Upper Sharon Aquifer[b]
Bis (2-ethylhexyl) Phthalate	1×10^{-8}	1×10^{-5}	7×10^{-9}	5×10^{-8}	4×10^{-9}
1,2-Dichloroethane	1×10^{-5}	3×10^{-2}	2×10^{-5}	1×10^{-3}	ND
1,1-Dichloroethene	3×10^{-5}	4×10^{-3}	ND	ND	ND
Trichloroethene	1×10^{-5}	8×10^{-4}	8×10^{-7}	2×10^{-6}	ND
Total Risk	5×10^{-5}	3×10^{-2}	2×10^{-5}	1×10^{-3}	4×10^{-9}

ND Not detected

a Daily intakes of chemicals in groundwater by workers are shown in Table 6-27. Cancer potency factors used to calculate cancer risks are shown in Table 6-8. For this analysis, the average daily dose received over the assumed exposure period was prorated over a 70-year lifetime, and the lifetime risk was calculated accordingly. This procedure is recommended in EPA's "Guidelines for Carcinogen Risk Assessment" (EPA 1986d).

b Risk based on samples from one well.

Hazard indices for noncarcinogenic effects associated with the indicator chemicals present in groundwater beneath the Summit National site are shown in Table 6-33. The estimated intakes by onsite workers of acetone, bis(2-ethylhexyl)phthalate, 1,1-dichloroethene, trans-1,2-dichloroethene, and trichloroethene present in the water-table aquifer under plausible maximum exposure conditions each exceed the available criteria for protection against noncarcinogenic effects of these compounds. In addition, the total hazard index for exposure under average conditions to water from the water table aquifer exceeds one due primarily to the presence of trichloroethene. Not all chemicals present in the water table aquifer exhibit the same end-points of toxicity. Consequently, if evaluated according to similar toxicity end-points, the total hazard indices for the average case in the water table aquifer may not exceed one. Conversely, consideration of other chemicals present at the site, but not specifically evaluated in this assessment, could potentially result in an even higher total hazard index. This type of analysis was not done because, although noncarcinogenic risks may be present, the potential carcinogenic risks associated with ingestion of groundwater appear to far outweigh the potential noncarcinogenic risks. The total hazard index for intake of chemicals present in the intermediate unit under plausible maximum, but not average, exposure conditions exceeds one, based primarily on exposure to acetone. It should be noted that hexavalent chromium is not expected to be the dominant species of this metal in groundwater. Accordingly, the potential noncarcinogenic health risks associated with exposure to chromium may actually be lower than estimated under the assumption that hexavalent chromium is the only species present. None of the indicator chemicals present in the Upper Sharon aquifer occur at concentrations exceeding available critical toxicity values, and the total hazard indices are less than one for both the average and plausible maximum cases. Thus, based on available data, it appears that noncarcinogenic health effects are not likely to result to workers from exposure to chemicals present in the Upper Sharon aquifer for which critical toxicity values are available.

Under future conditions, workers at the Summit National site could potentially be exposed to chemical contaminants by both direct contact with soil and ingestion of groundwater. Consequently, both of these

TABLE 6-33

NONCARCINOGENIC RISKS TO WORKERS FROM INGESTION OF GROUNDWATER AT THE SUMMIT NATIONAL SITE[a]

	Hazard Indices				
	Water Table		Intermediate Unit		Upper Sharon Aquifer[b]
	Average	Plausible Max.	Average	Plausible Max.	
Acetone	6×10^{-3}	80	8×10^{-3}	120	2×10^{-3}
Barium	2×10^{-2}	6×10^{-2}	2×10^{-2}	4×10^{-1}	2×10^{-3}
Bis (2-ethylhexyl) Phthalate	6×10^{-3}	3	4×10^{-3}	1×10^{-2}	2×10^{-3}
Chromium III	2×10^{-4}	5×10^{-4}	7×10^{-5}	3×10^{-4}	ND
Chromium VI	5×10^{-2}	1×10^{-1}	3×10^{-2}	6×10^{-1}	ND
Cyanide	2×10^{-2}	1×10^{-1}	2×10^{-2}	2×10^{-2}	ND
1,1-Dichloroethane	2×10^{-2}	9×10^{-1}	2×10^{-3}	6×10^{-2}	ND
1,2-Dichloroethane	NQ	NQ	NQ	NQ	ND
1,1-Dichloroethene	4×10^{-2}	3	ND	ND	ND
Trans-1,2-Dichloroethene	1×10^{-1}	4	ND	ND	ND
Ethylbenzene	6×10^{-3}	8×10^{-1}	5×10^{-2}	5×10^{-2}	ND
Phenol	2×10^{-1}	6×10^{-1}	5×10^{-2}	8×10^{-2}	5×10^{-4}
Toluene	8×10^{-4}	6×10^{-1}	1×10^{-3}	1×10^{-2}	ND
Trichloroethene	1	33	7×10^{-2}	7×10^{-2}	ND
Total Hazard Index	1.5	126	3×10^{-1}	121	7×10^{-3}

Notes:

ND = Not detected

NQ = Not quantified. Reference dose (RfD) for noncarcinogenic effects associated with this chemical is not available; however, cancer risks associated with exposure to this chemical are shown in Table 6-32.

[a] Daily intakes of chemicals in groundwater by workers are shown in Table 6-27. Reference doses (RfDs) used to calculate hazard indices are shown in Table 6-8.

[b] Risks based on samples from one well.

pathways would be expected to contribute to the potential health risks associated with exposure to these chemicals, and may be assumed to act additively. The resulting total health risks would be dependent upon which water bearing zone or combination of zones groundwater was obtained from for ingestion. The total potential excess lifetime cancer risk to future workers at the site may range from 2×10^{-5} to 2×10^{-7} for the average exposure conditions and under the plausible maximum exposure conditions the total potential excess lifetime cancer risks may range from 3×10^{-2} to 2×10^{-4}. For exposure to noncarcinogens, the total hazard index for indicator chemicals is less than one for exposure to soil and ingestion of water from the intermediate unit or Upper Sharon under average exposure conditions. Under all other conditions, the total hazard index for exposure to indicator chemicals present in both soil and groundwater exceeds one.

The potential excess lifetime cancer risks to residents from ingestion of water from wells at the Summit National site are shown in Table 6-34. The total excess cancer risks associated with ingestion of groundwater from the water-table, and intermediate unit exceed 10^{-6} under average and plausible maximum exposure conditions. The highest risks are associated with use of the water-table aquifer are due primarily to 1,1-dichloroethene, 1,2-dichloroethane, and trichloroethene. Risks associated with use of groundwater from the intermediate unit are somewhat lower and are due primarily to 1,2-dichloroethane. The potential excess lifetime cancer risks to residents ingesting water from the Upper Sharon aquifer is less than 10^{-6}.

Hazard indices for noncarcinogenic effects to residents associated with the ingestion of indicator chemicals present in groundwater beneath the Summit National site are shown in Table 6-35. Using the maximum concentrations, the estimated intakes by onsite residents of acetone, bis(2-ethylhexyl)phthalate, 1,1-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, phenol, toluene and trichloroethene present in the water-table aquifer under plausible maximum exposure conditions each exceed the available criteria for protection against noncarcinogenic effects of these compounds. In addition, the total hazard index for exposure under average conditions to water from the water table aquifer exceeds one due primarily

TABLE 6-34

CANCER RISKS TO RESIDENTS FROM INGESTION OF GROUNDWATER AT THE SUMMIT NATIONAL SITE[a]

	Water Table		Intermediate Unit		Upper Sharon Aquifer[b]
	Average	Plausible Max.	Average	Plausible Max.	
Bis (2-ethylhexyl) Phthalate	3×10^{-7}	1×10^{-4}	2×10^{-7}	6×10^{-7}	8×10^{-8}
1,2-Dichloroethane	3×10^{-4}	3×10^{-1}	4×10^{-4}	2×10^{-2}	ND
1,1-Dichloroethene	6×10^{-4}	4×10^{-2}	ND	ND	ND
Trichloroethene	3×10^{-4}	9×10^{-3}	2×10^{-5}	2×10^{-5}	ND
Total Risk	1×10^{-3}	3×10^{-1}	4×10^{-4}	2×10^{-2}	8×10^{-8}

Notes:

ND Not detected

a Daily intakes of chemicals in groundwater by residents are shown in Table 6-30. Cancer potency factors used to calculate cancer risks are shown in Table 6-8. For this analysis, the average daily dose received over the assumed exposure period was prorated over a 70-year lifetime, and the lifetime risk was calculated accordingly. This procedure is recommended in EPA's "Guidelines for Carcinogen Risk Assessment" (EPA 1986d).

b Risks based on samples from one well.

TABLE 6-35

NONCARCINOGENIC RISKS TO RESIDENTS FROM INGESTION OF GROUNDWATER AT THE SUMMIT NATIONAL SITE[a]

	Hazard Indices				
	Water Table		Intermediate Unit		Upper Sharon Aquifer[b]
	Average	Plausible Max.	Average	Plausible Max.	
Acetone	2×10^{-2}	258	3×10^{-2}	377	5×10^{-3}
Barium	6×10^{-2}	2×10^{-1}	8×10^{-2}	1	7×10^{-3}
Bis (2-ethylhexyl) Phthalate	2×10^{-2}	10	1×10^{-2}	4×10^{-2}	6×10^{-3}
Chromium III	7×10^{-4}	2×10^{-3}	2×10^{-4}	9×10^{-4}	ND
Chromium VI	1×10^{-1}	3×10^{-1}	5×10^{-2}	2×10^{-1}	ND
Cyanide	7×10^{-2}	3×10^{-1}	5×10^{-2}	5×10^{-2}	ND
1,1-Dichloroethane	7×10^{-2}	4×10^{-1}	5×10^{-3}	2×10^{-1}	ND
1,2-Dichloroethane	NQ	NQ	NQ	NQ	ND
1,1-Dichloroethene	1×10^{-1}	8	ND	ND	ND
Trans-1,2-Dichloroethene	4×10^{-1}	13	ND	ND	ND
Ethylbenzene	2×10^{-2}	2.5	2×10^{-1}	2×10^{-1}	ND
Phenol	7×10^{-1}	2	1×10^{-1}	3×10^{-1}	2×10^{-3}
Toluene	2×10^{-3}	2	4×10^{-3}	3×10^{-1}	ND
Trichloroethene	3	100	2×10^{-1}	2×10^{-1}	ND
Total Hazard Index	4.6	400	7×10^{-1}	380	2×10^{-2}

Notes:

ND = Not detected

NQ = Not quantified. Reference dose (RfD) for noncarcinogenic effects associated with this chemical is not available; however, cancer risks associated with exposure to this chemical are shown in Table 6-26.

[a] Daily intakes of chemicals in groundwater by residents are shown in Table 6-22. Reference doses (RfDs) used to calculate hazard indices are shown in Table 6-7.

[b] Risks based on samples from one well.

to the presence of trichloroethene and phenol. As discussed previously, not all chemicals present in the water table aquifer exhibit the same end-points of toxicity. Consequently, if evaluated according to similar toxicity end-points, the total hazard indices for the average case in the water table aquifer may not exceed one. Conversely, consideration of other chemicals present at the site, but not specifically evaluated in this assessment, could potentially result in an even higher total hazard index. This type of analysis was not done because, although noncarcinogenic risks may be present, the potential carcinogenic risks associated with ingestion of groundwater appear to far outweigh the potential noncarcinogenic risks. The total hazard index for intake of chemicals present in the intermediate unit under plausible maximum, but not average, exposure conditions exceeds one, based primarily on exposure to acetone and barium. It should be noted that hexavalent chromium is not expected to be the dominant species of this metal in groundwater. Accordingly, the potential noncarcinogenic health risks associated with exposure to chromium may actually be lower than estimated under the assumption that hexavalent chromium is the only species present. None of the indicator chemicals present in the Upper Sharon aquifer occur at concentrations exceeding available critical toxicity values, and the total hazard indices are less than one for both the average and plausible maximum cases. Thus, based on available data, it appears that noncarcinogenic health effects are not likely to result to residents from exposure to chemicals present in the Upper Sharon aquifer for which critical toxicity values are available.

Under future conditions, residents at the Summit National site could potentially be exposed to chemical contaminants by both direct contact with soil and ingestion of groundwater. Consequently, both of these pathways would be expected to contribute to the potential health risks associated with exposure to these chemicals, and may be assumed to act additively. The resulting total health risk would be dependent upon the specific water bearing zone or combination of zones groundwater was obtained from for ingestion. The total potential excess lifetime cancer risk to future site residents may range from 1×10^{-3} to 1×10^{-5} for the average exposure conditions and under the plausible maximum exposure conditions the total potential excess

lifetime cancer risks may range from 3×10^{-1} to 5×10^{-3}. For exposure to noncarcinogens, the total hazard index for indicator chemicals is less than one for exposure to soil and ingestion of water from the intermediate unit or Upper Sharon under average exposure conditions. Under all other conditions, the total hazard index for exposure indicator chemicals in these two media exceeds one.

6.7 EVALUATION OF EXPOSURE TO OFFSITE BACKGROUND SOIL

As shown in Section 6.3.1, both organic and inorganic chemicals have been detected in samples collected from offsite residential, farm and mine soils. As has been discussed in Section 4.4.3, based on available data, the source of the offsite chemicals is not known. It has been suggested that the presence of these chemicals in soils may partially be due to past incineration activities at the site and/or be influenced by past mining-related activities in the area. At the request of EPA Region V, exposure to these offsite background soils is evaluated in this section.

The most likely potential exposures would be to populations residing in these areas. In estimating exposure of residents to background concentrations of chemicals in the vicinity of the Summit National site, the conservative assumption is made that an individual could be exposed throughout an entire lifetime. Thus in this exposure scenario, not only infants and children, but also adults (e.g., gardeners) could potentially come into contact with contaminated soils and subsequently ingest them. It is assumed that an individual would be involved in activities in the yard (e.g., a child playing or an adult gardening) 5 days a week during 8 months of the year (i.e., excluding months when the ground is frozen) for a total of approximately 160 days per year. Average lifetime soil ingestion rates were estimated based on the age-specific soil ingestion rates presented in Appendix H (PHE-3) as 0.92 mg/kg-day and 4.6 mg/kg-day for the average and plausible maximum exposure cases, respectively. These assumptions are summarized in Table 6-36.

Resulting exposure estimates, as well as cancer risks and noncarcinogenic risks are presented in Tables 6-37 and 6-38 respectively. The total cancer risks associated with incidental ingestion of soil over a lifetime exceeds 10^{-6} for the plausible maximum

TABLE 6-36

ASSUMPTIONS USED IN ESTIMATING RESIDENTIAL EXPOSURE TO CONTAMINANTS VIA DIRECT CONTACT WITH SOILS NEAR THE SUMMIT NATIONAL SITE

Parameter	Average Exposure	Plausible Maximum Exposure
Frequency of contact	160 visits/year	160 visits/year
Lifetime average soil ingestion rate	0.92 mg/kg-visit	4.6 mg/kg-visit
Years of exposure	70	70
Concentration of contaminant in soil contacted[a]	Geometric mean concentration	Maximum concentration

[a]Values given in Tables 6-37 and 6-38.

TABLE 6-37

EXPOSURE ESTIMATES AND CANCER RISKS FROM DIRECT CONTACT WITH BACKGROUND SOILS IN THE VICINITY OF THE SUMMIT NATIONAL SITE[a]

	Concentration (ug/kg)		Daily Intake Prorated Over a 70 Year Lifetime[b] (mg/kg/day)		Cancer Risk	
	Geometric Mean	Maximum	Average	Plausible Maximum	Average	Plausible Maximum
Bis (2-ethylhexyl) phthalate	64	120	2.6×10^{-8}	2.4×10^{-7}	2×10^{-11}	2×10^{-10}
Hexachlorobenzene	330	330	1.3×10^{-7}	6.7×10^{-7}	2×10^{-7}	1×10^{-6}
PAHs	200	2,100	8.1×10^{-8}	4.2×10^{-6}	9×10^{-7}	5×10^{-5}
				Total Risk:	1×10^{-6}	5×10^{-5}

Notes:

[a]Cancer potency factors used to calculate cancer risks are shown in Table 6-8.

[b]Daily intake under average exposure conditions (mg/kg/day)

$$= \frac{(\text{Conc. soil mg/kg})(0.92\ \text{mg/kg-visit})(160\ \text{visits/year})(70\ \text{years})(\text{kg}/10^6\ \text{mg})}{(70\ \text{years})(365\ \text{days/year})} = (\text{Conc. soil mg/kg})(4.03 \times 10^{-7}\ \text{kg soil/kg body weight/day})$$

where: Conc. soil = geometric mean.

Daily intake under plausible maximum exposure conditions (mg/kg/day)

$$= \frac{(\text{Conc. soil mg/kg})(4.6\ \text{mg/kg-visit})(160\ \text{visits/year})(70\ \text{years})(\text{kg}/10^6\ \text{mg})}{(70\ \text{years})(365\ \text{days/year})} = (\text{Conc. soil mg/kg})(2.02 \times 10^{-6}\ \text{kg soil/kg body weight/day})$$

where: Conc. soil = maximum concentration

TABLE 6-38

EXPOSURE ESTIMATES AND NONCARCINOGENIC RISKS FROM DIRECT CONTACT WITH BACKGROUND SOILS IN THE VICINITY OF THE SUMMIT NATIONAL SITE[a]

	Concentration (ug/kg)		Daily Intake Prorated Over a 70 Year Lifetime[b] (mg/kg/day)		Hazard Index (CDI/RFD)	
	Geometric Mean	Maximum	Average	Plausible Maximum	Average	Plausible Maximum
Bis(2-ethylhexyl) phthalate	64	120	2.6×10^{-8}	2.4×10^{-7}	1×10^{-6}	1×10^{-5}
Cadmium	3,200	4,100	1.3×10^{-6}	8.3×10^{-6}	2×10^{-3}	1×10^{-2}
Hexachlorobenzene	330	330	1.3×10^{-7}	6.7×10^{-7}	NQ	NQ
PAHs	200	2,100	8.1×10^{-8}	4.2×10^{-6}	NQ	NQ
Toluene	9.4	31	3.8×10^{-9}	6.3×10^{-8}	1×10^{-8}	2×10^{-7}
Zinc	79,000	227,000	3.2×10^{-5}	4.6×10^{-4}	2×10^{-4}	2×10^{-3}
				Total Hazard Index	2×10^{-3}	1×10^{-2}

Notes:

NQ Not quantified. Reference does (RfDs) for noncarcinogenic effects associated with these chemicals are not available; however, cancer risks associated with exposure to these chemicals are shown in Table 6-37.

[a]Reference doses used to calculate hazard indices shown in Table 6-8.

[b]Daily intake under average exposure conditions (mg/kg/day)

$$= \frac{(\text{Conc. soil mg/kg})(0.92\ \text{mg/kg-visit})(160\ \text{visits/year})(70\ \text{years})(\text{kg}/10^6\ \text{mg})}{(70\ \text{years})(365\ \text{days/year})} = (\text{Conc. soil mg/kg})(4.03 \times 10^{-7}\ \text{kg soil/kg body weight/day})$$

where: Conc. soil = geometric mean.

Daily intake under plausible maximum exposure conditions (mg/kg/day)

$$= \frac{(\text{Conc. soil mg/kg})(4.6\ \text{mg/kg-visit})(160\ \text{visits/year})(70\ \text{years})(\text{kg}/10^6\ \text{mg})}{(70\ \text{years})(365\ \text{days/year})} = (\text{Conc. soil mg/kg})(2.02 \times 10^{-6}\ \text{kg soil/kg body weight/day})$$

where: Conc. soil = maximum concentration

exposure and is equal to 10^{-6} for the average exposure evaluated. As can be seen from Table 6-37, the highest risks are associated with exposure to PAHs in these background soils. Table 6-38 indicates that since the hazard indices for these chemicals are less than one, noncarcinogenic health effects are not likely to result from exposure to these chemicals.

6.8 CONCLUSIONS

In this public health evaluation it was determined that risks to human health may exist at the Summit National site under a number of exposure scenarios. Potential pathways of exposure to contaminants originating at the Summit National site under both current and future use conditions were evaluated. A summary table showing potential risks associated with the site is presented in Table 6-39. Under current-use conditions, trespasser exposure to onsite surface soil through incidental ingestion, as well as exposure to workers along the southern perimeter of the site and residents along the eastern perimeter through incidental ingestion of soils, were determined to be complete pathways with a moderate potential for significant exposure. A quantitative estimation of the risks associated with these pathways indicated that for onsite trespassers and workers along the southern perimeter, the potential excess lifetime cancer risks under the average exposure conditions are less than 10^{-6} for exposure to carcinogens. The potential excess lifetime cancer risks for residents along the eastern perimeter are 3×10^{-6} for the average exposure scenario evaluated. However, for the plausible maximum exposures, the total excess cancer risk exceeds 10^{-6} for each of these three scenarios by at least one order of magnitude. For both the average and plausible maximum cases of each of these three exposure scenarios, noncarcinogenic health effects are not likely to result from exposure.

Under current-use conditions, exposure of local residents to sediments in the ditches and second impoundment through incidental ingestion of soils was quantitatively evaluated. The potential excess lifetime cancer risks to children through incidental ingestion of sediment in ditches under the average conditions evaluated, and to teenagers in the second impoundment under both average and plausible maximum exposure conditions are less than 10^{-6} for exposure to carcinogens. However, for the plausible maximum

TABLE 6-39

SUMMARY OF POTENTIAL RISKS ASSOCIATED WITH THE SUMMIT NATIONAL SITE

	Total Cancer Risks		Noncarcinogenic Hazard Index	
Exposure Scenario	Average	Plausible Maximum	Average	Plausible Maximum
Current Conditions - Soil				
On-site trespassers	1×10^{-8}	3×10^{-5}	<1	<1
Off-site workers (southern perimeter)	6×10^{-7}	4×10^{-5}	<1	<1
Off-site residents (eastern perimeter)	3×10^{-6}	2×10^{-4}	<1	<1
Current Conditions - Sediment				
Children in ditches	2×10^{-7}	6×10^{-6}	<1	>1
Teenagers in second impoundment	6×10^{-12}	1×10^{-7}	<1	<1
Future Conditions				
On-site workers				
Soil	2×10^{-7}	2×10^{-4}	<1	<1
Groundwater				
Water Table	5×10^{-5}	3×10^{-2}	>1	>1
Intermediate Unit	2×10^{-5}	1×10^{-3}	<1	>1
Upper Sharon Aquifer	4×10^{-9}	NA	<1	NA
On-site residents				
Soil	1×10^{-5}	5×10^{-3}	<1	>1
Groundwater				
Water Table	1×10^{-3}	3×10^{-1}	>1	>1
Intermediate Unit	4×10^{-4}	2×10^{-2}	<1	>1
Upper Sharon Aquifer	8×10^{-8}	NA	<1	NA

NA = not applicable, only one representative sample.

exposure of children in ditches, the potential excess lifetime cancer risk is 6×10^{-6}. In addition, the total hazard index for exposure of children in ditches exceeds one under the plausible maximum exposure scenario evaluated, indicating that noncarcinogenic health effects may also result from exposure to chemicals in the ditches. For the other three exposure scenarios involving exposure to sediment, noncarcinogenic health effects are not likely to result from exposure. Exposure to surface water was not quantitatively evaluated because the surface water bodies near the site are for drainage only and are not used as a source of potable water or for recreational purposes on a regular basis. Because surface water flow only occurs in response to precipitation, exposure to surface water will occur very infrequently if at all, and there would be little, if any, potential for repeated exposure to occur through contact with surface water.

If the Summit National site is reused in the future for light industrial work or a residential dwelling, exposure to onsite soil through direct contact and incidental ingestion may occur. Additionally, exposure to groundwater in any one of the three water-bearing units beneath the site may occur through ingestion. Estimation of risk to workers associated with incidental ingestion of onsite soils indicates the total excess cancer risks exceed 10^{-6} for the plausible maximum but not the average conditions evaluated. This evaluation indicates that noncarcinogenic health effects are not likely to result from this type of exposure to the indicator chemicals present in onsite soils.

The total excess cancer risks to workers associated with ingestion of groundwater from the water-table, and intermediate unit, exceed 10^{-6} under average and plausible maximum exposure conditions. In addition, the total hazard index for exposure under average and plausible maximum conditions to the water table aquifer and the plausible maximum exposure conditions to the intermediate unit exceed one, indicating that noncarcinogenic health effects also may result from exposure to chemicals in these units.

Under future conditions, workers at the Summit National site could potentially be exposed to chemical contaminants by both direct contact with soil and ingestion of groundwater. The resulting total

potential excess lifetime cancer risk to future workers at the site may range from 3×10^{-2} to 2×10^{-7}, depending on the actual exposure conditions. For exposure to noncarcinogens, the total hazard index for indicator chemicals is less than one only for exposure to soil and ingestion of water from the intermediate unit or Upper Sharon.

Estimation of risk to residents associated with lifetime incidental ingestion of onsite soils indicates the total excess cancer risks exceed 10^{-6} for both the average and plausible maximum exposure conditions evaluated. In addition, under the plausible maximum exposure conditions noncarcinogenic health effects may also result from exposure to the indicator chemicals present in the onsite soils.

The total excess cancer risks to residents associated with lifetime ingestion of groundwater from the water table and intermediate unit exceed 10^{-6} under the average and plausible maximum exposure conditions. In addition, the total hazard index for exposure under average and plausible maximum exposure conditions to the water-table and plausible maximum exposure conditions to the intermediate unit exceed one, indicating that noncarcinogenic health effects also may result from exposure to chemicals in these units.

Under future conditions, residents at the Summit National site could potentially be exposed to contaminants by both direct contact with soil and ingestion of groundwater. Thus, the total potential excess lifetime cancer risk to future residents may range from 3×10^{-1} to 1×10^{-5}. For exposure to noncarcinogens, the total hazard index for indicator chemicals is less than one only for exposure to soil and ingestion of water from the intermediate unit or Upper Sharon.

At the request of EPA Region V, exposures to offsite background soils were evaluated in Section 6.7. In estimating exposure of residents to background concentrations of chemicals in the vicinity of the Summit National site, the conservative assumption is made that an individual could be exposed throughout an entire lifetime. The total cancer risks associated with incidental ingestion of soil over a lifetime exceeds 10^{-6} for a plausible maximum exposure, and is equal to 10^{-6} for the average exposure evaluated. Noncarcinogenic health effects are not likely to result from exposure to these background chemicals.

7.0 IDENTIFICATION OF PRELIMINARY REMEDIAL ACTIONS

7.1 GROUNDWATER

The hydrogeology of the Summit National site is complex; but, in general, it is adequately defined for selection and design of appropriate remedial measures. However, because MW-24 is the only intermediate well which detected contamination, additional samples may be collected for verification purposes during the subsequent design phase of the final selection of alternatives by EPA.

A summary of the potentially feasible remedial alternatives identified for groundwater and the engineering solutions or technology for each alternative are presented in Figure 7-1.

To address the pump and treat or in-situ treatment alternatives, greater detail for site-specific data will be required. Water quality in deeper units is apparently defined. However, test pumping of the water-table aquifer should be performed to define the radius of influence for proposed wells.

To support any of the potentially feasible remedial alternatives, the hydraulic connection between aquifers must be understood.

After Phase I activities, a pump test in deep strata was suggested as a means of testing aquifer characteristics and testing hydraulic connections between water-bearing units. However, preliminary field observations indicated that, because of low yields in deep wells, such a test was not feasible. Although the strata penetrated have sufficient yield for domestic water supply, they are not permeable enough to permit continuous pumping at a reasonable rate for lengths of time typical of each test. For this reason, the understanding of aquifer characteristics and hydraulic connections has been gained from single-well permeability tests and geochemical fingerprinting.

7.2 SOILS

The analytical results of the surface and subsurface soil samples show that contaminated surface and subsurface soils are present throughout the site. A summary of the potentially feasible remedial alternatives identified for the onsite soils and the potential engineering solutions or technology for each alternative are presented on Figure 7-2.

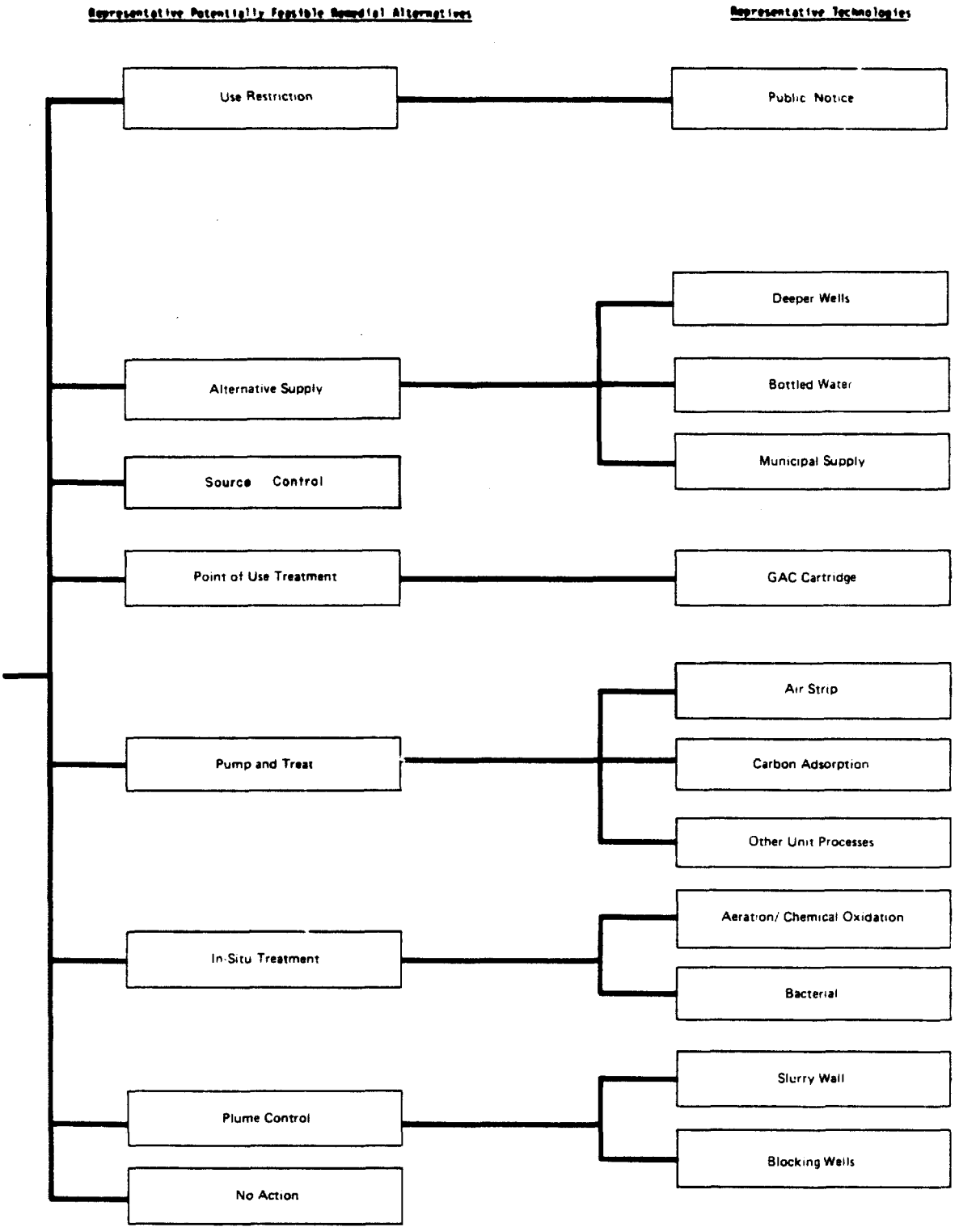

FIGURE 7-1
GROUNDWATER OPERABLE UNIT
REPRESENTATIVE REMEDIAL
ALTERNATIVES
SUMMIT NATIONAL RI

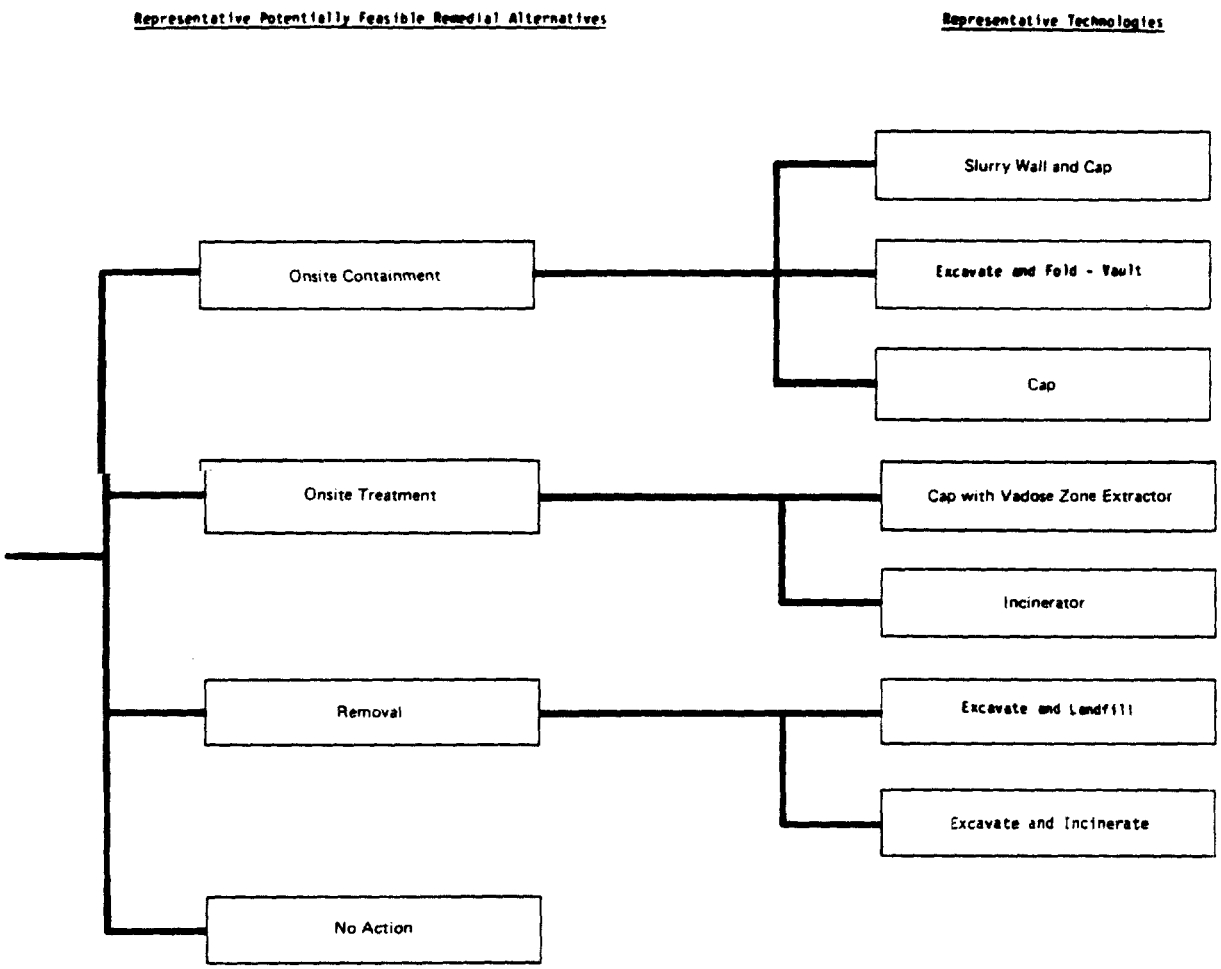

FIGURE 7-2
ONSITE SOILS OPERABLE UNIT
REPRESENTATIVE REMEDIAL
ALTERNATIVES
SUMMIT NATIONAL RI

The onsite containment alternative requires that the distribution of contamination be known to determine the location of the containment devices (e.g., cap, slurry wall, etc.).

Alternatives that include treatment of the soils require information on the types and concentrations of contaminants present in the soil, as well as the volume of contaminated soils. Further testing or bench scale testing may be required during the feasibility study to establish waste characterization (i.e., BTU, etc.) for selected treatment techniques.

The offsite soils are not identified as yet as an operable unit.

7.3 SURFACE WATER

Based on the analytical results for the RI sampling, the east pond is the onsite surface water body with higher concentrations of contaminants than other surface water in all fractions analyzed. Since the west pond empties into the east pond and shows lower levels of contamination, the east pond is probably receiving contaminated runoff from the adjacent surface soils or some other as yet unidentified source. A summary of potentially feasible remedial alternatives identified for the onsite surface water and the engineering solutions or technology for each alternative are presented on Figure 7-3.

Volume of surface water at time of design and removal will be needed to evaluate either the treatment or removal remedial alternatives. The water surface elevation of each pond was monitored concurrently with the groundwater investigations and is believed to be connected with the shallow groundwater.

7.4 SEDIMENTS

The sediment data collected during the RI field activities indicates both onsite and offsite contamination of sediments. The additional sampling of sediments from both ponds further characterized the levels of contamination which can now be used to address the remedial alternatives during the feasibility study. A summary of the initial potentially feasible alternatives identified for the onsite and offsite sediments and the engineering solutions or technologies for each alternative are presented on Figure 7-4.

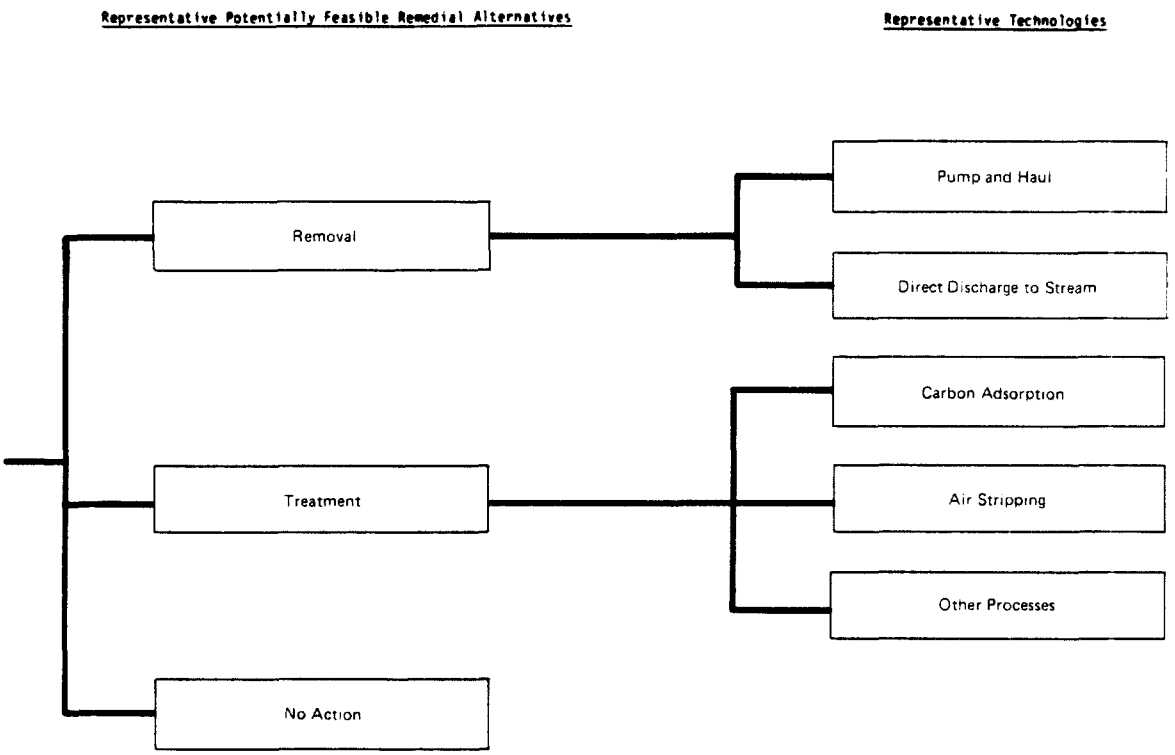

FIGURE 7-3
ONSITE SURFACE WATER OPERABLE UNIT
REPRESENTATIVE REMEDIAL ALTERNATIVES
SUMMIT NATIONAL RI

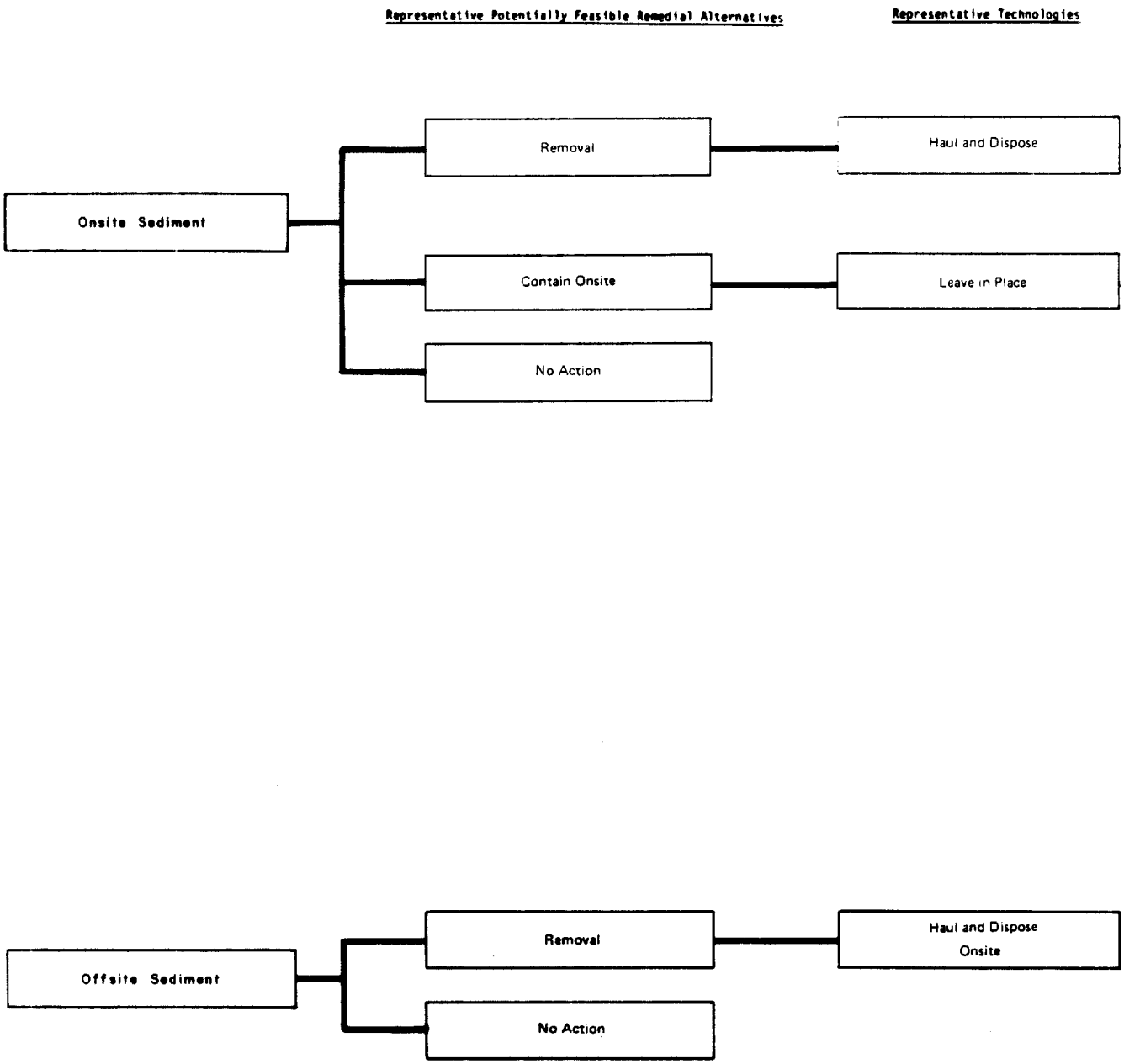

FIGURE 7-4
ONSITE AND OFFSITE
SEDIMENT OPERABLE UNITS
REPRESENTATIVE REMEDIAL ALTERNATIVES
SUMMIT NATIONAL RI

The potentially feasible remedial alternatives for the onsite sediments include removal and onsite containment. To adequately address these alternatives, data defining the volume and level of contamination of the onsite sediment was obtained.

The elevated levels of contamination in the semi-volatile fraction of the offsite sediment has not been explainable. Conclusions indicate that the site is not solely responsible for this contamination. As a result, additional sampling may be required if another source needs to be identified. However, some cleanup of these sediments will be required.

7.5 BURIED MATERIAL

The potentially feasible remedial alternatives concerning potential buried drums and tanks shown on Figure 7-5 require that the location, condition and contents of the drums and tanks be known. The number of drums were estimated as accurately as possible during Phase II in order to estimate the volume of their contents.

To expose the drums and examine their condition, test pits were necessary. The location and approach to excavation was planned using the Phase I magnetic survey to delineate the extent of buried drums. The tanks suspected to be buried in the vicinity of the buildings at the northwest corner of the site were also uncovered.

The Phase II drum investigations primarily addressed the location and condition of the drums. Drums were not removed from the site during these operations. The drums that were found to be opened or leaking and easily accessible with a sampler were sampled. The possible vertical extent of migration of contaminants from leaking or deteriorated drums into adjacent soils was investigated by drilling additional soil borings (2BB5-2BB8) near the excavations if visually contaminated soils are encountered.

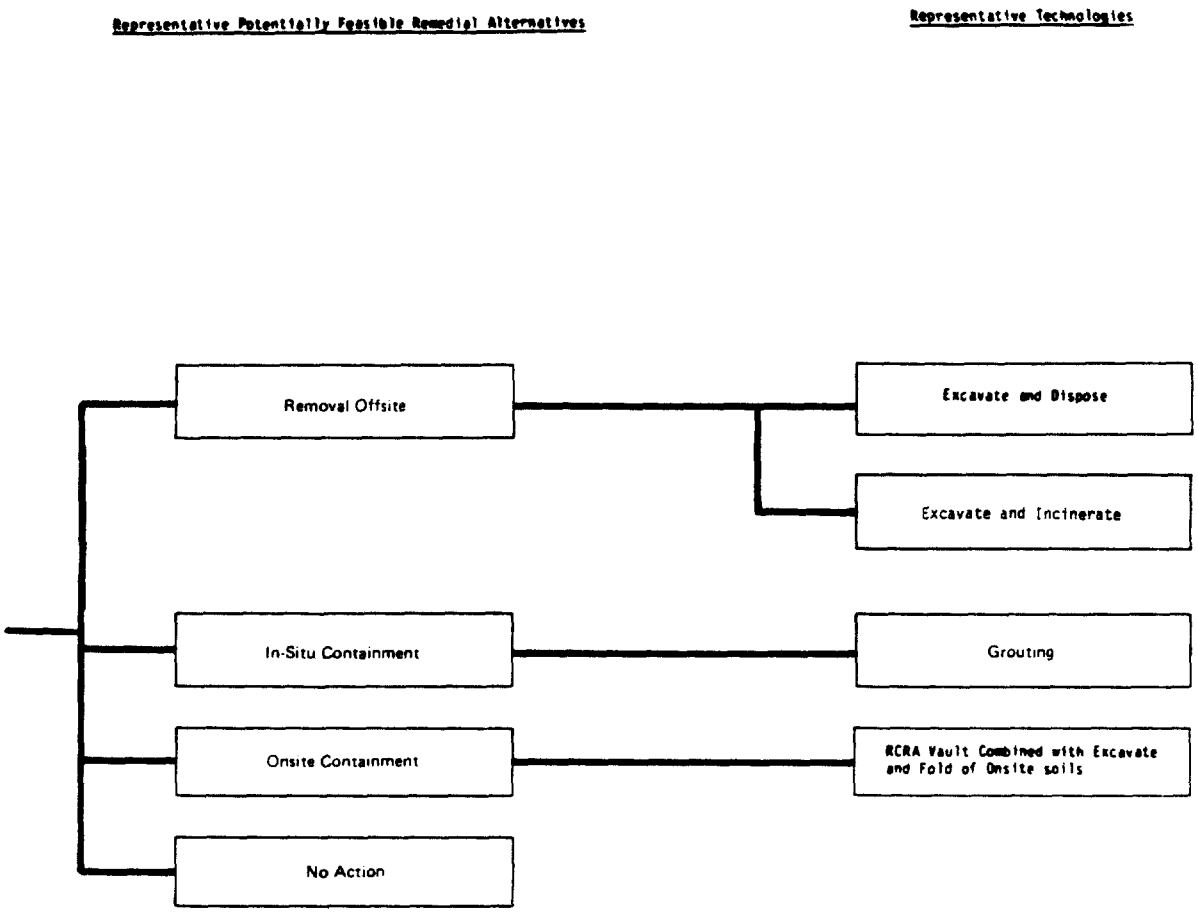

FIGURE 7-5
BURIED DRUMS AND TANKS OPERABLE UNIT
REPRESENTATIVE REMEDIAL ALTERNATIVES
SUMMIT NATIONAL RI

LIST OF REFERENCES
PUBLIC HEALTH EVALUATION

Alessii, B.A., and Fuller, W.H. 1976. The Mobility of Three Cyanide Forms in Soils. In Fuller, W.H., ed. Residual Management by Land Disposal, Proceedings of the Hazardous Waste Research symposium. EPA 600/7-76-015, NTIS PB-256 768 (July).

Bartlett, R.J., and James, B.R. 1979. Behavior of Chromium in Soils: III. Oxidation. J. Environ. Qual. 8:31-25

Bartlett, R.J. and Kimble, J.M. 1976. Behavior of Chromium in Sub. II. Hexavalent Forms. J. Environ. Qual. 5:383-386

Brannon, J.M., and Patrick, W.H., Jr. 1985. Fixation and Mobilization of Antimony in Sediments. Environ. Pollut. Ser. B. 9:107-126

Brown, D.S., Calton, R.E., and Mulkey, L.A. 1986. Development of Land Disposal Decisions for Metals. Draft. Assessment Branch, Environmental Research Laboratory, USEPA, Athens, Georgia

Callahan, M.A., Slimak, M.W., Gabel, N.W., May, C.P., Fowler, G.F., Freed, J.R., Jennings, P., Durfee, R.L., Whitmore, F.C., Maestri, B., Mahey, W.R., Holt, B.R., and Gould, C. 1979. Water-related Environmental Fate of 129 Priority Pollutants. 2 volumes. Office of Water Planning and Standards, U.S. Environmental Protection Agency, Washington, D.C. EPA 440/4-79-029a,b

Cline, P.V., and Viste, D.R. 1984. Migration and Degradation Patterns of Volatile Organic Compounds. Harzardous Waste Conference. Pp. 217-220

Cotton, F.A., and Wilkinson, G. 1972. Advanced Inorganic Chemistry. 3rd ed. John Wiley and Sons, New York

Dilling, W.L., Tefertiller, N.B., and Kallos, G.J. 1975. Evaporation Rates of Methylene Chloride, Chloroform, 1,1,1-Trichloroethane, Trichloroethylene, Tetrachloroethylene, and Other Chlorinated Compounds in Dilute Aqueous Solutions. Environ. Sci. Technol. 9:833-838

DiToro, D.M. and Horzempa, L.M. 1983. Reversible and Resistant Component Model of Hexachlorobiphenyl Adsorption-Desorption Resuspension and Dilution, in Physical Behavior of PCBs in the Great Lakes, D. Mackay et al., eds. Ann Arbor Science

Dobbs, R.A. and Cohen, J.M. 1980. Carbon Adsorption Isotherms for Toxic Organics. EPA-60018-80-023

Eisenreich, S.J., Hoffman, M.R., Rastetter, D., Yost, E., and Maier, W.J. 1980. Metal Transport Phases in the Upper Mississippi River. In Kavanaugh, M.C., and Leckie, J.O., eds. Particulates in Water. American Chemical Society, Washington, D.C. pp. 135-176

Electric Power Research Institute (EPRI). 1986. Geochemical Reactions of Cr(III) and Cr(VI). Final Report. Prepared by Battelle, Pacific Northwest Laboratories. RP2485-3, February 1986

Environmental Protection Agency (EPA). 1980. Ambient Water Quality for Polychlorinated Biphenyls. U.S. EPA Environmental Criteria and Assessment Office, Washington

Environmental Protection Agency (EPA). 1984. Health Effects Assessment for Barium, Environmental Criteria and Assessment Office, Cincinnati, Ohio. September 1984. EPA 540/1-86-021

Environmental Protection Agency (EPA). 1985. Health Advisory for Trichloroethylene. Office of Drinking Water. Washington, D.C. September 30, 1985

Environmental Protection Agency (EPA). 1986a. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response, Washington, D.C. October 1986. EPA 40/186/060

Environmental Protection Agency (EPA). 1986b. Verified Reference Doses (RfD) of the USEPA. The ADI Work Group of the Risk Assessment Forum. January 1986. ECAO-CIN-475

Environmental Protection Agency (EPA). 1986c. Guidelines for the Health Risk Assessment of Chemical Mixtures. Fed. Reg. 51:34014-34023 (September 24, 1986)

Environmental Protection Agency (EPA). 1986d. Guidelines for Carcinogen Risk Assessment. Fed. Reg. 33992-34002 (September 24, 1986)

Environmental Protection Agency (EPA). 1986e. Guidelines for Exposure Assessment. Fed. Reg. 51:34042-34054 (September 24, 1986)

Farrah, H., and Pickering, W.F. 1977. Influence of Clay-Solute Interactions on Aqueous Heavy Methal Ion Levels. Water, Air, Soil Pollut. 8:89-197

Feldmann, R.J., and Mailbach, H.I. 1970. Absorption of Some Organic Compounds Through the Skin in Man. J. Investigative Dermatology 54:399-404

Frost, R.R., and Griffin, R.A. 1977. Effect on pH on Adsorption of Arsenic and Selenium from Landfill Leachate by Clay Materials. Soil Sci., Soc. Am. J. 41:53-57.

Fuller, W.H. 1977. Movement of Selected Metals, Asbestos, and Cyanide in Soil: Applications to Waste Disposal Problems. Prepared for the Municipal Research Labortory, EPA 600/2-77-020, NTIS PB-266 905, April

Fuller, W.H. 1978. Investigation of Landfill Leachate Pollutant Attenuation by Soils, EPA/600 12-78-158, NTIS-PB-286 995. Prepared for the Municipal Environmental Research Laboratory, Office of Research and Development. Cincinnati, Ohio: USEPA

Gardiner, J. 1974. The Chemistry of Cadmium in Natural Waters -- I. A Study of Cadmium Complex Formation Using the Cadmium Specific-Ion-Electrode. Water Res. 8(1):23-30

Griffin, R.A. 1976. Effect of pH on Removal of Heavy Metals from Leachates by Clay Materials in Residual Management and Land Disposal. Proceedings of the Hazardous Waste Research Symposium. Arizona University. July 1976. EPA 600/9-76-015. NTIS PB 256-768

Griffin, R.A. and Chou, S.F.J. 1981. Movement of PCBs and Other Persistent Compounds Through Soil. Nat. Sci. 13:1153-1163

Griffin, R.A., AU, A.K., and FROST, R.R. 1977. Effect of pH on Adsorption of Chromium from Landfill-Leachate by Clay Materials. J. Environ. Sci. Health 12:431-449

Guy, R.D. and Chakrabarti, C.L. 1976. Studies of Metal-Organic Interactions in Model Systems Pertaining to Natural Waters. Can. J. Chem. 54:2600-2611

Huang, C.P., Elliott, H.A., and ASHMEAN, R.M. 1977. Interfacial Reactions and the Fate of Heavy Methals in Soil-Water Systems. J. Water Pollut. Control Fed. 49:745-756

Honba, C. Remacle, J., Dubois, D., and Thorez, J. 1983. Factors Affecting the Concentrations of Cadmium, Zinc, Copper, and Lead in the Sediments of the Vesdie River. Water. Res. 17:1281-1286

James, B.R. and Bartlett, R.J. 1983. Behavior of Chromium in Soils: VII. Adsorption and Reduction of Hexavalent Forms. J. Environ. Qual. 12:177-181

Kabata-Pendias, A., and Pendias, H. 1984. Trace Elements in Soils and Plants. CRC Press, Boca Raton, Florida

Kleipfer, R.D., Easley, D.M., Haas, B.P., Delhl, T.G., Jackson,D.E., and Wurrey, C.J. 1985. Anaerobic Degradation of Tetrachloroethylene in Soil. Environ. Sci. Techol. 19:277-280

Lyman, W.J., Reehl, W.F., and Rosenblatt, D.H. 1982. Handbook of Chemical Property Estimation Methods: Environmental Behavior of Organic Compounds. McGraw-Hill Book Co., New York

McConnell, E., Lucier, G., Rumbaugh, R., Albro, A., Harvan, D., Hass J., and Harris, M. 1984. Dioxin in Soil: Bioavailability After Ingestion by Rats and Guinea Pigs. Science 223:1077-1079

Mabey, W.R., Smith, J.H., Podoll, R.T., Johnson, H.L., Mill, T., Chou, T.-W., Gates, J., Waight Partridge, I., Jaber, H., and Vandenberg, D. 1982. Aquatic Fate Process Data for Organic Priority Pollutants. Office of Water Regulations and Standards, Washington, D.C. December 1982. EPA 44/4-81-014

Mackay, D., and Leinonen, P.J. 1975. Rate of Evaporation of Low-Solubility Contaminants from Water Bodies to Atmosphere. Environ. Sci. Technol. 7:1178-1180

Martell, A.E., and Smith, R.M. 1977. Critical Stability Constants. Plenum Press, New York

Moore, J.W., and Ramamoorthy, S. 1984. Heavy Metals in Natural Waters. New York: Springer-Verlag.

National Academy of Sciences (NAS). 1979. Polychlorinated Biphenyls: A Report Prepared by the Committee on the Assessment of Polychlorinated Biphenyls. NAS, Washington, D.C. 182 pp.

National Oceanic and Atmospheric Administration (NOAA). 1984. Local Climatological Data, Annual Summary with Comparative Data, Youngstown, Ohio. U.S. Department of Commerce National Climatic Data Center, Asheville, North Carolina.

Ong, H.L., Swanson, V.E., and Bisque, R.E. 1970. Natural Organic Acids as Agents of Chemical Weathering. U.S. Geological Survey Professional Paper 700-C:C130-137

O'Shea, T.A., and Mancy, K.H. 1978. The Effect of pH and Hardness on the Competitive Interaction Between Trace Metal Ions and Inorganic and Organic Complexing Agents Found in Natural Waters. Water Res. 12:703-711

Parsons, F., Wood, P.R., and Demarco, J. 1984. Transformations of Tetrachloroethane and Trichloroethene in Microcosms and Groundwater Research and Technology. Pp. 56-59

Pourbaix, M. 1963. Atlas D'Equilibres Electrochemiques. Gauthier-Villar and Co., Paris

Raef, S.F., Charackles, W.G., Kessick, M.A., and Ward, C.H. 1977a. Fate of Cyanide and Related Compounds in Aerobic Microbial Systems - I. Chemical Reaction with Substrate and Physical Removal. Water Res. 11:477-483

Raef, S.F., Charackles, W.G., Kessick, M.A., and Ward, C.H. 1977b. Fate of Cyanide and Related Compounds in Aerobic Microbial Systems - II. Microbial Degradation. Water Res. 11:485-492

Rashid, M.A., and Leonard, J.D. 1973. Modifications in the Solubility and Precipitation Behavior of Various Metals as a Result of their Interactions with Sedimentary Humic Acid. Chem. Geol. 11:89-97

Schnitzer, M. and Kendorff, H. 1981. Reactions of Fluvic Acid Metal Ions. Water, Air, Soil Pollut. 15:7-109

Schwartzenbach, R.P., Giger, W., Hoehn, E., and Schneider, J.F. 1983. Behavior of Organic Compounds During Infiltration of River Water to Groundwater. Environ. Sci. Technol. 17:472-479

Science Application International Corp. (SAIC). 1985. Summary of Available Information Related to the Occurrence of Vinyl Chloride and Groundwater as a Transformation Product of Other Volatile Organic Chemicals. Prepared for the U.S. Environmental Protection Agency. Washington, D.C. NTIS PB 86-117868

Smith, L.R., and Dragun, J. 1984. Degradation of Volatile Chlorinated Aliphatic Priority Pollutants in Groundwater. Environ. Int. 10:291-298

Strobel, G.A. 1967. Cyanide Utilization in Soil. Soil Sci. 103:299-302

Sullivan, K.F., Atlas, E.L., and Giam, C.S. 1982. Adsorption of Phtalic Acid Esters from Seawater. Environ. Sci. Technol. 16:428-432

Towill, L.E., Drury, J.S., Whitfield, B.L., Lewis, E.G., Galyan, E.L., and Hammons, A.S. 1978. Review of the Environmental Effects of Pollutants: V. Cyanide, EPA 600/1-78-027. Oak Ridge National Laboratory, Oak Ridge, Tennessee

Tucker, E.S., Saeger, V.W., and Hicks, C. 1975 Activated Sludge Primary Biodegration of Polychlorinated Biphenyls. Bull. Environ. Contam. Toxicol. 14(6)705-713

Verschueren, K. 1983. Handbook of Environmental Data on Organic Chemicals. 2nd ed. Van Nostrand Reinhold Co.., New York

Vogel, T.M., and McCarty, P.L. 1985. Biotransformation of Tetrachloroethylene to Trichloroethylene, Dichloroethylene, Vinyl Chloride, and Carbon Dioxide under Methanogenic Conditions. Applied Environmental Microbiology. Pp. 1080-1083

Ware, G.C., and Painter, H.A. 1955. Bacterial Utilization of Cyanide: Nature 171:900

Weber, W.J. et al. 1983. Sorption of Hydrophobic Compounds by Sediments, Soils, and Suspended Solids. Water Res. 17(10):1445

LIST OF REFERENCES
SUMMIT NATIONAL RI

Alder, Henry L. and Roessler, Edward B., 1968. Introduction to Probability and Statistics, 4th Ed. W. H. Freeman and Co., San Francisco, California.

Bohn, H., McNeal, B., and O'Connor, G., 1979. Soil Chemistry. John Wiley and Sons, Inc., New York, NY.

Carswell, L. D. and Bennett, G. D., 1963. Geology and Hydrology of the Neshannok Quadrangle, Mercer and Lawrence Counties, Pennsylvania, Pennsylvania Geologic Survey Ground Water Report W15. 90 pp.

Cedergren, H.R., 1977. Seepage, Drainage, and Flow Nets, 2nd. ed. John Wiley & Sons. 534 pp.

CH2M Hill, August 15, 1983. Remedial Action Master Plan, Summit. USEPA, Cincinnati, Ohio.

CH2M Hill, SRW/ICF Technology, 1984, 1985, Summit Phase I and Phase II Sampling Plans.

Davis, E.C. and Boegly, W.J., Jr., 1981. A Review of Water Quality Issues Associated with Coal Storage in Journal of Environmental Quality, v. 10, no. 2. pp. 127-133.

Dean, R.B., 1981. Use of log-normal statistics in environmental monitoring. Cooper, W.J., ed. Chemistry in Water Reuse, Vol. 1. Ann Arbor Science, Ann Arbor, Michigan.

Domenico, P. A., and Robbins, G. A., 1985. "A New Method for Contaminant Plume Analysis," Groundwater, V. 23, No. 4, pp 476-485.

Freeze, R. A. and Cherry, J. A., 1979. Groundwater, Prentice-Hall, Englewood Cliffs, NJ. 604 pp.

Gillham, R. W., 1982. "Applicability of Solute Transport Models to Problems of Aquifer Rehabilitation," in Aquifer Restoration and Ground Water Rehabilitation, Proceedings of the 2nd National Symposium on Aquifer Restoration and Ground Water Modeling.

Hem, J.D., 1985. Study and Interpretation of the Chemical Characteristics of Natural Water (3rd ed.), US Geological Survey Water-Supply Paper 2254. 263 pp.

Hvorslev, M.J., 1951. Time Lag and Soil Permeability if Groundwater Observations, U. S. Army Corps of Engineers Waterways Experiment Station Bulletin 36. Vicksburg, Miss.

Mahoning Valley Sanitation District, February 4, 1987. Berlin Reservoir Pumpage 1961-1986.

Ohio Department of Health, 1982. Analytical Results of Tank 30 Waste Sampling. Columbus, Ohio.

Penn Environmental Consultants, September, 1980. Subsurface Investigation for NUS Corporation at the Summit National Services Industrial Waste Disposal Facility. 48 pp.

Phoenix Safety Associates, Ltd., October, 1984. Health and Safety Plan, Summit National Site. Phoenixville, Pennsylvania.

Pinzon, G., October 2, 1986. Letter Transmitting Ohio EPA File Information.

Portage County Planning Commission, November 21, 1986. Miscellaneous Site Features Data.

Poth, C. W., 1963. Geology and Hydrology of the Mercer Quadrangle, Mercer, Lawrence, and Butler Counties, Pennsylvania, Pennsylvania Topographic and Geologic Survey Water Resource Report 16. 149 pp.

Sedam, A.C. and Stein, R.B., 1970. Saline Ground-Water Resource of Ohio, US Geological Survey Hydrologic Investigations Atlas HA-366. 2 plates.

Sedam, A.C., 1973. Hydrogeology of the Pottsville Formation in Northeastern Ohio, US Geological Survey Hydrologic Investigations Atlas HA-494. 2 plates.

Thompson, D.B., in press. "A Microcomputer Program for the Interpretation of Time-Lag Permeability Tests," in Ground Water, v. 25, no. 2.

U. S. Department of Commerce, National Oceanic and Atmospheric Administration, 1961-1985. Local Climatological Data, Annual Summary with Comparative Data, Akron, Ohio. National Climatic Data Center, Asheville, North Carolina.

Williams, D.E., Vlamis, J., Pukite, A.H., and Corey, J.E. 1984. Metal Movement in Sludge-treated Soils After Six Years of Sludge Addition: 1. Cadmium, Copper, Lead and Zinc. Soil Sci. 137:351-359

Wilson, J.T., McNabb, J.F., Wilson, B.H., and Noonan, M.J. 1983. Biotransformation of Selected Organic Pollutants in Groundwater. Developments in Industrial Microbiology. Pp. 225-233

Wilson, J.T., and Wilson, B.H. 1984. Biotransformation of Trichloroethylene in Soil. Applied Environmental Microbiology. Pp. 242-243

Wolfe, N.L., Burns, L.A., and Steen, W.C. 1980. Use of Linear Free Energy Relationships and an Evaluative Model to Assess the Fate and Transport of the Phthalate Esters in the Aquatic Environment. Chemosphere 9:393-402

Zabik, M.J. 1983. The Photochemistry of PCBs, in PCBS: Human and Environmental Hazards, F.M. D'Itri and M.A. Kamrin, eds. Butterworth, Boston

U. S. Department of Commerce, National Atmospheric Administration, January 1986 - August 1986. Local Climatological Data, Monthly Summary, Akron, Ohio. National Climatic Data Center, Asheville, North Carolina.

U. S. Department of the Interior, Geological Survey, July, 1981. Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia. Water-Resources Investigation Open File Report 81-343, Columbus, Ohio.

U. S. Environmental Protection Agency, May, 1978. Water Pollutants from Coal Storage Areas, Office of Research and Development - Hazardous Waste Engineering Research Laboratory, Cincinnati, Ohio.

U. S. Environmental Protection Agency, March 29, 1979. Inspection Report and Tank Waste Sample Results. Cincinnati, Ohio.

U. S. Environmental Protection Agency, November 28, 1980. Ambient Water Quality Criteria Documents. Federal Register, Vol. 45, No. 231, pp. 79324-79341.

U. S. Environmental Protection Agency, 1983. Hazardous Waste Land Treatment. SW-874, Office of Solid Waste and Emergency Response, Washington, DC.

U. S. Environmental Protection Agency, July, 1984. User's Guide to the Contract Laboratory Program, Office of Emergency and Remedial Response, Washington, DC.

U. S. Environmental Protection Agency, May, 1985. Guidance on Remedial Investigations Under CERCLA, Office of Research and Development - Hazardous Waste Engineering Research Laboratory, Cincinnati, Ohio.

U. S. Environmental Protection Agency, September, 1985. Incineration and Treatment of Hazardous Waste, Office of Research and Development - Hazardous Waste Engineering Research Laboratory, Cincinnati, Ohio.

Verschueren, K., 1983. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold, New York. 1310 pp.

Walton, W. C., 1984. Practical Aspects of Groundwater Modeling, National Water Well Association, Columbus, Ohio. 566 pp.

Weston Geophysical Corporation, May 28, 1985. Geophysical Survey, Summit National Site, Deerfield Township, Portage County, Ohio. Westboro, Massachusetts.

White, Curt M. and Lee, Milton L. Lee, 1980. Identification and Geochemical Significance of Some Aromatic Components of Coal. U. S. Department of Energy.

Winslow, J.D. and White, G.W, 1966. Geology and Ground-Water Resources of Portage County, Ohio, US Geological Survey Professional Paper 511. 80pp.

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