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TECHNICAL SUPPORT FOR
ROCKY MOUNTAIN ARSENAL

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FINAL
HUMAN HEALTH EXPOSURE ASSESSMENT
FOR ROCKY MOUNTAIN ARSENAL
STUDY AREA EVALUATIONS
VOLUME VI-F
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EXPOSURE ASSESSMENT
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Prepared by:

EBASCO SERVICES INCORPORATED
Applied Environmental, Inc.
CH2M HILL
DataChem, Inc.
R.L. Stollar and Associates

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Prepared for:

U.S. ARMY PROGRAM MANAGER'S OFFICE
FOR THE ROCKY MOUNTAIN ARSENAL CONTAMINATION CLEANUP

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<p>13. ABSTRACT (Maximum 200 words)</p> <p style="text-align: center;">THE OBJECTIVES OF THE HUMAN HEALTH EXPOSURE ASSESSMENT INCLUDE:</p> <ol style="list-style-type: none"> 1. ESTIMATE THE TYPE AND MAGNITUDE OF EXPOSURES TO CONTAMINANTS 2. IDENTIFY CONTAMINANTS OF CONCERN 3. IDENTIFY SITES FOR REMEDIAL ACTION 4. RECOMMEND SITES FOR THE NO ACTION REMEDIAL ALTERNATIVE 5. PROVIDE A BASIS FOR DETAILED CHARACTERIZATION OF THE RISK ASSOCIATED WITH ALL SITES. <p>THIS DOCUMENT CONSISTS OF THE FOLLOWING: AN EXECUTIVE SUMMARY. VOL. I - LAND USE AND EXPOSED POPULATION EVALUATIONS. VOL. II & III - TOXICITY ASSESSMENT (INCLUDES ARMY AND SHELL TOXICITY PROFILES). VOL. IV - PPLV METHODOLOGY. VOL. V - PPLV CALCULATIONS. VOL. VI - STUDY AREA EXPOSURE ANALYSIS (A INTRODUCTION, B WESTERN STUDY AREA, C SOUTHERN STUDY AREA, D NORTHERN CENTRAL STUDY AREA, E CENTRAL STUDY AREA, F EASTERN STUDY AREA, G SOUTH PLANTS STUDY AREA, AND H NORTH PLANTS STUDY AREA. VOL. VII - SUMMARY EXPOSURE ASSESSMENT. VOL. VIII -</p>				
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LIST OF ACRONYMS

CAR	Contamination Assessment Report
COC	contaminant of concern
COS	contaminant of significance
CRL	certified reporting limit
d	depth to the top of the contamination zone
EI	exposure index
ESA	Eastern Study Area
h	depth to the bottom of the contamination zone
ICP	Inductively Coupled Plasma
ISCLT	Industrial Source Complex Long Term Plume Dispersion
PPLV	preliminary pollutant limit value
RI	remedial investigation
RMA	Rocky Mountain Arsenal
RMACCPMT	Rocky Mountain Arsenal Contamination Control Program Management Team
SAR	Study Area Report
SPPPLV	single pathway preliminary pollutant limit value
VEI	vapor exposure index

EXECUTIVE SUMMARY

The Eastern Study Area (ESA) Exposure Assessment presents detailed exposure analyses for the 26 potentially contaminated areas defined by the Eastern Study Area Report (SAR). The evaluations were based on the soil and sediment contaminant concentrations presented in the site-specific Contamination Assessment Reports (CARs) and the overall SARs and groundwater contaminants from DP Associates Groundwater Database. The maximum concentrations for each contaminant detected were extracted from these data and reported. Draft preliminary pollutant limit values (PPLVs) were computed for each of these site-specific contaminants as described in Volume IV of the Exposure Assessment Report for the direct (soil ingestion, suspended particulate inhalation, and dermal contact) and indirect (open and enclosed space vapor inhalation) exposure pathways. Cumulative PPLVs were computed for the five exposed populations (regulated visitors, casual visitors, recreational visitors, commercial workers, and industrial workers). The site-by-site evaluations consisted of comparisons of the maximum site contaminant concentrations to their corresponding cumulative Draft PPLVs in order to determine exceedances and, hence, established a first screen for determining sites which may be considered as candidates for remedial action during the Feasibility Study. These are ranked into two categories: Priority 1 which consists of sites where available soil contaminant concentration data indicate that the maximum detected concentrations exceed the draft human health based criteria, and Priority 2 which consists of sites where available soil contaminant concentration data indicate that the maximum detected concentrations do not exceed the draft human health based criteria. Site designations will be reconsidered throughout the Endangerment Assessment process as health based criteria are refined and additional data become available.

No groundwater plume has been identified in the ESA. Therefore, only the direct soil exposure evaluations were calculated. The exposure evaluations were performed for the most sensitive exposed population (i.e., the industrial worker).

Of the 26 sites evaluated in the ESA, 14 were designated Priority 1 sites based on the most sensitive exposed population PPLV (i.e., the industrial worker). These include:

- Section 19 - Surface Burn (ESA-1a)
- Section 20 - Surface Burn (ESA-1b)
- Section 29 - Surface Burn (ESA-1c)
- Section 30 - Surface Burn (ESA-1d)
- Burn Pits (ESA-2a)
- Sanitary Landfill (ESA-2b)
- Open Trenches (ESA-2c)
- Old Toxic Storage Yard (ESA-3b)
- New Toxic Storage Yard (ESA-3c)
- Toxic Yard Plots (ESA-3d)
- Demilitarization Area (ESA-5)
- Section 6 - Chromium, Copper, Lead, and Zinc Detections (ESA-6a)
- Section 30 - Fluoroacetic Acid Detection (ESA-6b)
- Section 30 - Arsenic Detection (ESA-6c).

Of the 26 sites evaluated in the ESA, 12 were designated Priority 2 sites based on the most sensitive exposed population PPLV (i.e., the industrial worker). These include:

- Storage Yard (ESA-3a)
- Concrete VX Demilitarization Pad (ESA-3e)
- Rail Spur and Loading Dock (ESA-3f)
- Open Drum Storage Area (ESA-3g)
- Open Storage Area Ditch (ESA-3h)
- Toxic Storage Plots Ditch (ESA-3i)
- Toxic Storage Yard Fence (ESA-3j)
- Trash Pit (ESA-3k)
- Impact Area (ESA-4a)
- Demolition Area (ESA-4b)
- Trench and Mound (ESA-4c)
- Section 20 - Hexachlorobenzene Detection (ESA-6d).

The contaminants of concern (COCs) in soils (i.e., those displaying cumulative exposure indices (EIs) greater than 0.1) for the ESA, based on the most sensitive exposed population PPLV (i.e., the industrial worker), are:

- Benzene
- Dieldrin
- Fluoroacetic acid
- Methylene chloride
- Trichloroethylene
- Arsenic
- Cadmium
- Chromium
- Lead
- Zinc.

No groundwater plume has been identified in the ESA, therefore, no COSs were identified for this study area.

1.0 INTRODUCTION

The analyses and evaluations performed under the Rocky Mountain Arsenal (RMA) Exposure Assessment are documented in eight report volumes. These include Volume I, Surface Use and Exposed Population Evaluations; Volumes II and III, Toxicity Assessment; Volumes IV and V, Preliminary Pollutant Limit Value (PPLV) Methodology; Volume VI, Study Area Exposure Assessments; Volume VII, Summary Exposure Assessment; and Volume VIII, Response to Comments on the Draft Exposure Assessment.

Volume VI of the Exposure Assessment is a detailed presentation of the study area exposure analyses, consisting of site-by-site comparisons of measured maximum contaminant concentrations to their Draft PPLVs derived for an industrial worker (the most sensitive receptor). Volume VI consists of eight subvolumes, VI-A through VI-H. Subvolume F (this document) constitutes the Study Area Exposure Assessment for the Eastern Study Area (ESA). The remaining subvolumes are: VI-A, Introduction; VI-B, Western Study Area; VI-C, Southern Study Area; VI-D, North Central Study Area; VI-E, Central Study Area; VI-G, South Plants Study Area; and VI-H, North Plants Study Area. A description of the contents, approach, specific procedures, and format in preparing the Study Area Exposure Assessment documents is presented in Volume VI-A.

The exposure assessment for the ESA was performed on a site-by-site basis. The site designations are consistent with those used in the remedial investigation (RI) Study Area Report (SAR) for the ESA (EBASCO, 1989a). The analytical data used for each site were based on the original Rocky Mountain Arsenal Contamination Control Program Management Team (RMACCPMT)/Phase I and II RI site Contamination Assessment Reports (CARs). Additional information on the history of these sites can be found in Section 3.2 of the SAR (EBASCO, 1989a). The SARs present a regional overview of the extent of contamination and migration characteristics throughout the Arsenal. An analogous regional overview of the exposure assessment for the ESA is presented in the Study Area Exposure Summary, Section 3.0 of this report volume. This regional summary is integrated with the other study area exposure summaries in Volume VII to provide an Arsenal-wide perspective of the significance of the measured contamination.

The sites included in the ESA Exposure Assessment are as follows:

- ESA-1a: Section 19 - Surface Burn
- ESA-1b: Section 20 - Surface Burn
- ESA-1c: Section 29 - Surface Burn
- ESA-1d: Section 30 - Surface Burn
- ESA-2a: Burn Pits
- ESA-2b: Sanitary Landfill
- ESA-2c: Open Trenches
- ESA-3a: Storage Yard
- ESA-3b: Old Toxic Storage Yard
- ESA-3c: New Toxic Storage Yard
- ESA-3d: Toxic Yard Plots
- ESA-3e: Concrete VX Demilitarization Pad
- ESA-3f: Rail Spur and Loading Dock
- ESA-3g: Open Drum Storage Area
- ESA-3h: Open Storage Area Ditch
- ESA-3i: Toxic Storage Plots Ditch
- ESA-3j: Toxic Storage Yard Fence
- ESA-3k: Trash Pit
- ESA-4a: Impact Area
- ESA-4b: Demolition Area
- ESA-4c: Trench and Mound
- ESA-5: Demilitarization Area
- ESA-6a: Section 6 - Chromium, Copper, Lead and Zinc Detections
- ESA-6b: Section 30 - Fluoroacetic Acid Detection
- ESA-6c: Section 30 - Arsenic Detection
- ESA-6d: Section 20 - Hexachlorobenzene Detection

The locations of each of the sites listed above in the ESA were depicted in the Eastern SAR (EBASCO, 1989a). The site-by-site exposure assessments for each of the 26 areas

investigated are presented in Sections 2.1 through 2.26. A study area exposure summary for the ESA is presented in Section 3.0.

The Soil Contaminant Concentration Tables in Sections 2.1 through 2.26, list the maximum concentrations that were calculated for each site over two depth intervals, designated as Horizon 1 and Horizon 2. Horizon 1 included depths from 0 to 10 feet (ft), and Horizon 2 accounted for all depths, including 0 to 10 ft. If the maximum concentration for all depths is in Horizon 1, then the listed concentration in Horizon 2 will equal Horizon 1. For a further discussion, see Volume VI-A, Section 2.2.4. The Inductively Coupled Plasma (ICP) metals (i.e., cadmium, chromium, copper, lead, and zinc), arsenic, and mercury identified as site contaminants in the tables include only those which were detected above indicator levels. The following are the indicator levels used:

<u>Contaminant</u>	<u>Indicator Level</u>
Arsenic	CRL ^{1/} -10 ug/g ^{2/}
Cadmium	1-2 ug/g
Chromium	25-40 ug/g
Copper	20-35 ug/g
Lead	25-40 ug/g
Mercury	CRL-0.10 ug/g
Zinc	60-80 ug/g

As described in Volume VI-A of this report, nontarget contaminants were subjected to two screening processes to determine whether or not they should be evaluated in detail in the site-by-site exposure assessments. The first screening was conducted as part of the RMA Chemical Index (EBASCO, 1988a/RIC 88357R01), and was based on the toxicity, concentration, and frequency of occurrence of the nontarget compounds. Contaminants passing through this first screening were then subjected to a second screening that was conducted on a study area-by-study area basis within Appendix A of each Study Area Exposure Assessment (Volumes VI-B through VI-H). This second screening process

1/ certified reporting limit
2/ micrograms per gram

considered frequency of occurrence, similarity of the nontarget concentration to that of target contaminants, and co-occurrence of nontarget compounds with target compounds in the soil and sediment samples. The reader is encouraged to consult the RMA Chemical Index and the Study Area Exposure Assessment Appendices for details of the screening processes, as it was judged too repetitive to include this information in each site where nontargets were detected.

Draft PPLVs for each of the site contaminants were computed for the five exposed populations of concern which are regulated visitors, casual visitors, recreational visitors, commercial workers, and industrial workers for the direct (i.e., soil ingestion, dermal contact, and suspended particulate inhalation) and indirect (i.e., open and enclosed space vapor inhalation) exposure pathways, according to the methodology detailed in Volume IV of the Exposure Assessment. Draft PPLVs for each site are presented in the Exposure Evaluation Tables. Figure ESA-1-0 explains various aspects of the data presented in the Exposure Evaluation Tables. For a further discussion of these tables, see Section 3.0 in Volume VI-A.

The cumulative Draft PPLVs in these tables for ICP metals, arsenic, and mercury do not include the single pathway preliminary pollutant limit values (SPPPLVs) computed for vapor inhalation exposure pathways since the potential for inhalation of vaporized ICP metals, arsenic, and mercury is assumed to be negligible (see Volume VI-A). SPPPLVs for the inhalation pathways are not included in the cumulative Draft PPLVs for chloroacetic acid, 1,2-dichloroethylene, dimethylmethyl phosphonate, Dithiane, fluoroacetic acid, isopropylmethyl phosphate, isopropylmethyl phosphonic acid, n-nitrosodimethylamine, 1,4-Oxathiane, Sarin, and thiodiglycol. These chemicals are highly soluble (log Kow less than one) and, therefore, are assumed to have low potential for vaporization.

The chemical-specific and site-specific parameters used to calculate the open and enclosed space vapor inhalation PPLVs are included in the RMA Source Data File, provided as part of the PPLV Computer Model for RMA (Volume V). Contaminant-specific parameters for the open space pathways are the depth to the top of the contamination zone (d), and the

Figure ESA-1-0
Sample Exposure Summary Table

1	2	3	4	5	6	7	8	9	10
Contaminant	Direct PPLV	Indirect OSVI ^{1/}	Indirect PPLV ^{1/} ESVI ^{4/}	Cumulative PPLV	Direct EI ^{5/}	Indirect EI	Cumulative EI	OPN ^{6/}	VEI ^{2/} ENC ^{7/}
Aldrin	1.16E-01	1.17E+04	4.20E+01	1.16E-01	6.87E+02*	1.91E+00*	6.89E+02*	2.23E-06	1.68E-03
Carbon Tetrachloride	1.52E+01	0.00E+00	0.00E+00	1.52E+01	0.00E+00	0.00E+00	0.00E+00	6.07E-04	4.58E-01
Chlordane	1.52E+00	1.26E+06	5.17E+00	1.17E+00	5.27E+02*	1.55E+02*	6.81E+02*	0.00E+00	0.00E+00
Chloroform	3.11E+02	0.00E+00	0.00E+00	3.11E+02	0.00E+00	0.00E+00	0.00E+00	1.36E-05	1.02E-02
PPDDE	5.72E+00	7.07E+05	1.95E+01	4.42E+00	1.43E-02	4.21E-03	1.85E-02	1.34E-07	1.02E-04
PPDDT	5.72E+00	1.49E+06	1.95E+01	4.42E+00	1.75E+00*	5.14E-01*	2.26E+00*	0.00E+00	0.00E+00
Dieldrin	1.22E-01	5.35E+03	1.92E+01	1.22E-01	2.45E+04*	1.57E+02*	2.47E+04*	0.00E+00	0.00E+00
Diisopropylmethyl Phosphonate	6.77E+04	0.00E+00	0.00E+00	6.77E+04	0.00E+00	0.00E+00	0.00E+00	3.13E-10	2.37E-07
Endrin	2.54E+02	4.33E+06	1.00E+06	2.50E+02	7.88E-02	1.29E-03 a	8.01E-02	0.00E+00	0.00E+00
Hexachlorocyclopentadiene	3.84E+02	5.96E+01	8.34E-01	8.20E-01	7.81E+00*	3.65E+03*	3.66E+03*	0.00E+00	0.00E+00
Isodrin	5.92E+01	8.47E+05	3.04E+03	5.81E+01	8.45E+00*	1.65E-01*	8.61E+00*	0.00E+00	0.00E+00
Supona	1.27E+02	0.00E+00	0.00E+00	1.27E+02	00.E+00	0.00E+00	0.00E+00	1.39E-12	1.05E-09
Arsenic	1.61E+00	0.00E+00	0.00E+00	1.61E+00	1.30E+01*	0.00E+00	1.30E+01*	0.00E+00	0.00E+00
Copper	5.71E+02	0.00E+00	0.00E+00	5.71E+04	6.83E-04	0.00E+00	6.83E-04	0.00E+00	0.00E+00
Mercury	4.61E+02	0.00E+00	0.00E+00	4.61E+02	2.38E-03	0.00E+00	2.38E-03	0.00E+00	0.00E+00
Zinc	1.39E+05	0.00E+00	0.00E+00	1.39E+05	7.17E-04	0.00E+00	7.17E-04	0.00E+00	0.00E+00

Only contaminants found in either the soil or the groundwater are listed.

ORGANICS

9-1
METALS

a This contaminant saturates the soil gas and produces a vapor flux that is below one-tenth of the critical flux. The SPPPLV^M for this contaminant is considered to be equal to pure compound. The SPPPLV has therefore been set to 1.00E+05 mg/kg (See volume VI-A).

A direct PPLV will be computed even if contaminant does not occur in the soil but only in the groundwater.

Indirect PPLVs are not computed for the nonvolatile contaminants (metals).

Contaminants with a Direct EI > 0.1 are denoted with an asterisk.

Contaminants with an Indirect EI > 0.1 are denoted with an asterisk.

A contaminant which saturates the soil gas will not show a VEI.

A contaminant which saturates the soil gas but does not have an Indirect EI exceedance will be denoted with the footnote marker "a." The indirect PPLVs (OSVI, ESVI) are set to 1.00E+06 (pure compound).

Contaminants which occur in the groundwater, but also occur in the soil may not have a computed VEI if the contamination saturates the soil gas.

VEIs are not computed for metals or organics if the contaminant does not occur in the groundwater.

An enclosed space VEI may not be computed if the reported depth to groundwater is less than 10 ft. In such cases, the enclosed space VEI will have "NA" for not applicable. No enclosed space VEI will be computed for lake sites. For lake sites, the enclosed space VEI will have "LS" for lake site.

- 1/ PPLV - preliminary pollutant limit value
- 2/ VEI - vapor exposure index
- 3/ OSVI - open space vapor inhalation PPLV
- 4/ ESVI - enclosed space vapor inhalation PPLV
- 5/ EI - exposure index
- 6/ OPN - open
- 7/ ENC - enclosed
- 8/ SPPPLV - single pathway preliminary pollutant limit value

depth to the bottom of the contamination zone (h), diffusivity and soil concentration. These variables are calculated as described in Volume IV. The site-specific parameter, X/F_o , represents the wind dispersion factor at the receptor location receiving the maximum concentration. This parameter was generated by the Industrial Source Complex Long Term (ISCLT) model as described in Volume IV. The distance from the center of the site to the critical receptor location, D_{max} , used with the computation of X/F_o , was calculated as described in Volume IV.

Site-by-site comparisons of the maximum site contaminant concentrations to their corresponding cumulative Draft PPLVs were done in order to determine sites which may be considered for remedial action during the Feasibility Study. These are ranked into two categories: Priority 1 which consists of sites where available soil contaminant concentration data indicate that the maximum detected concentrations exceed the draft human health based criteria, and Priority 2 which consists of sites where available soil contaminant concentration data indicate that the maximum detected concentrations do not exceed the draft human health based criteria. Site designations will be reconsidered throughout the Endangerment Assessment process as health based criteria are refined and additional data become available.

2.0 SITE-BY-SITE EXPOSURE ASSESSMENT

2.1 SITE ESA-1a: SECTION 19 - SURFACE BURN (formerly Site 19-1: Burn Site Incendiaries; ESE, 1988a/RIC 88063R02; Site 19-1: Burn Site ESE, 1988b/RIC 88063R02A)

2.1.1 Site-Specific Considerations

Figure ESA-1a-1 and Table ESA-1a-1 depict the target contaminants for Site ESA-1. Borings 5282 through 5288, 5532, and 5533 were included in the exposure assessment consistent with the Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-1a (ESE, 1988a/RIC 88063R02).

2.1.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-1a are shown in Figure ESA-1a-1. o,p-Xylene, occurring in Boring 5285 (0-1 ft), was not included on this figure because it was detected in the nontarget analysis, but is still considered a target contaminant for this exposure assessment (see Appendix A). Methyl naphthalene, occurring in Boring 5285 (0-1 ft), was not included on this figure, since it was not considered a target contaminant during the Phase I and Phase II investigations. Although not shown on this figure, methyl naphthalene was included in the Eastern SAR and in this exposure assessment because it passed through the screening process performed in the RMA Chemical Index (EBASCO, 1988a/RIC 88357R01).

Table ESA-1a summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and certified reporting limits (CRLs) for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury for Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

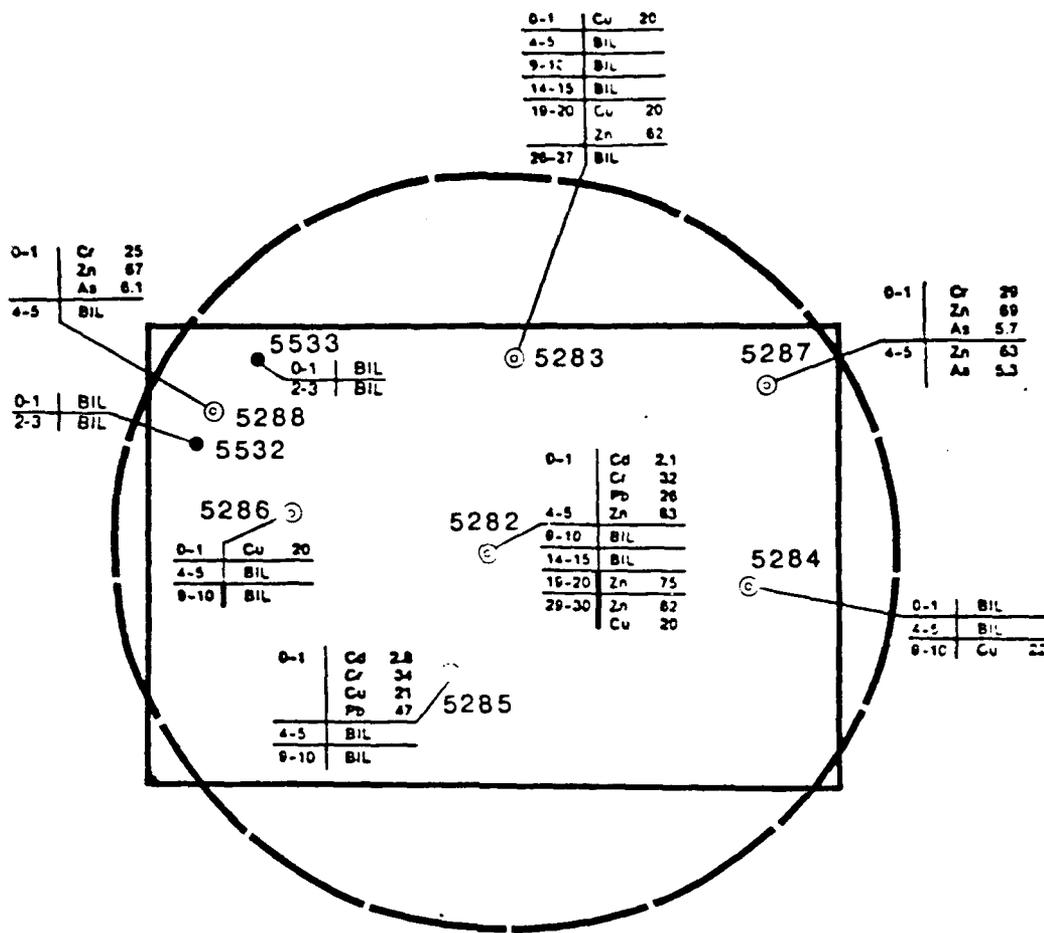
2.1.3 Site Exposure Summary

Tables ESA-1a-2 through ESA-1a-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Cadmium	--	--	--	--	Direct

Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-1a is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Legend

5282 ⊙ Phase I Boring

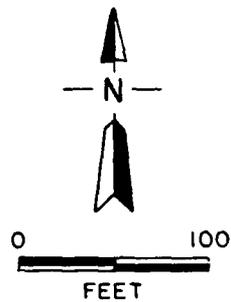
5532 ● Phase II Boring

□ Site Boundary

--- Site Investigated

Sample Interval (ft.) → 0-1 | Cr 25 → Analyte
 → Bedrock Sample → Concentration (ug/g)

- BIL - Below indicator level
- As - Arsenic
- Cd - Cadmium
- Cr - Chromium
- Cu - Copper
- Pb - Lead
- Zn - Zinc



Prepared for:

Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

Source: HLA, 1988

FIGURE ESA-1a-1

Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels

Rocky Mountain Arsenal
 Prepared by Ebasco Services Incorporated

TABLE ESA-1a-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-1a

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Methyl naphthalene ^{1/}	0.50	0-1	5285	0.50	0-1	5285
o,p-Xylene	0.70	0-1	5285	0.70	0-1	5285
Cadmium	2.8	0-1	5285	--	--	--
Lead	47	0-1	5285	--	--	--

1/ Nontarget contaminant. Refer to the exposure assessment nontarget screen in Appendix A.

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-1a-2
EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
O,P-XYLENE	1.4E+07	4.4E+06	3.4E+06	4.9E-08	1.6E-07	2.1E-07	0.0E+00
CADMIUM	4.5E+02	0.0E+00	4.5E+02	6.2E-03	0.0E+00	6.2E-03	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	3.0E-03	0.0E+00	3.0E-03	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-1a-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
O,P-XYLENE	1.4E+07	4.4E+06	3.4E+06	4.9E-08	1.6E-07	2.1E-07	0.0E+00
CADMIUM	4.5E+02	0.0E+00	4.5E+02	6.2E-03	0.0E+00	6.2E-03	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	3.0E-03	0.0E+00	3.0E-03	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-1a-4
EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
O,P-XYLENE	5.8E+06	1.6E+06	1.3E+06	1.2E-07	4.4E-07	5.6E-07	0.0E+00
CADMIUM	5.8E+01	0.0E+00	5.8E+01	4.8E-02	0.0E+00	4.8E-02	0.0E+00
LEAD	9.2E+03	0.0E+00	9.2E+03	5.1E-03	0.0E+00	5.1E-03	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-1a-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
O,P-XYLENE	7.0E+06	8.2E+04	8.1E+04	1.0E-07	8.5E-06	8.6E-06	0.0E+00
CADMIUM	3.6E+02	0.0E+00	3.6E+02	7.8E-03	0.0E+00	7.8E-03	0.0E+00
LEAD	6.5E+03	0.0E+00	6.5E+03	7.2E-03	0.0E+00	7.2E-03	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-1a-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
O,P-XYLENE	8.8E+05	5.9E+05	2.5E+05	1.5E+05	7.9E-07	4.0E-06	4.8E-06	0.0E+00	0.0E+00
CADMIUM	7.6E+00	0.0E+00	0.0E+00	7.6E+00	3.7E-01*	0.0E+00	3.7E-01*	0.0E+00	0.0E+00
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	2.1E-02	0.0E+00	2.1E-02	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

2.2 SITE ESA-1b: SECTION 20 - SURFACE BURN (formerly Site 20-1: Burn Site Incendiaries; ESE, 1988c/RIC 88293R01)

2.2.1 Site-Specific Considerations

Figure ESA-1b-1 and Table ESA-1b-1 depict the target contaminants for Site ESA-1b. Borings 5290 through 5297 were included in this exposure assessment, consistent with the Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-1b (ESE, 1988c/RIC 88293R01).

2.2.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-1b are shown in Figure ESA-1b-1. Methyl naphthalene, occurring in Boring 5294 (0-1 ft), is not included in this figure since it was not considered a target contaminant during the Phase I investigation. Although not shown on this figure, this nontarget compound was included in the Eastern SAR and in this exposure assessment because it passed through the screening process performed in the RMA Chemical Index (EBASCO, 1988a/RIC 88357R01).

Table ESA-1b-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury for Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

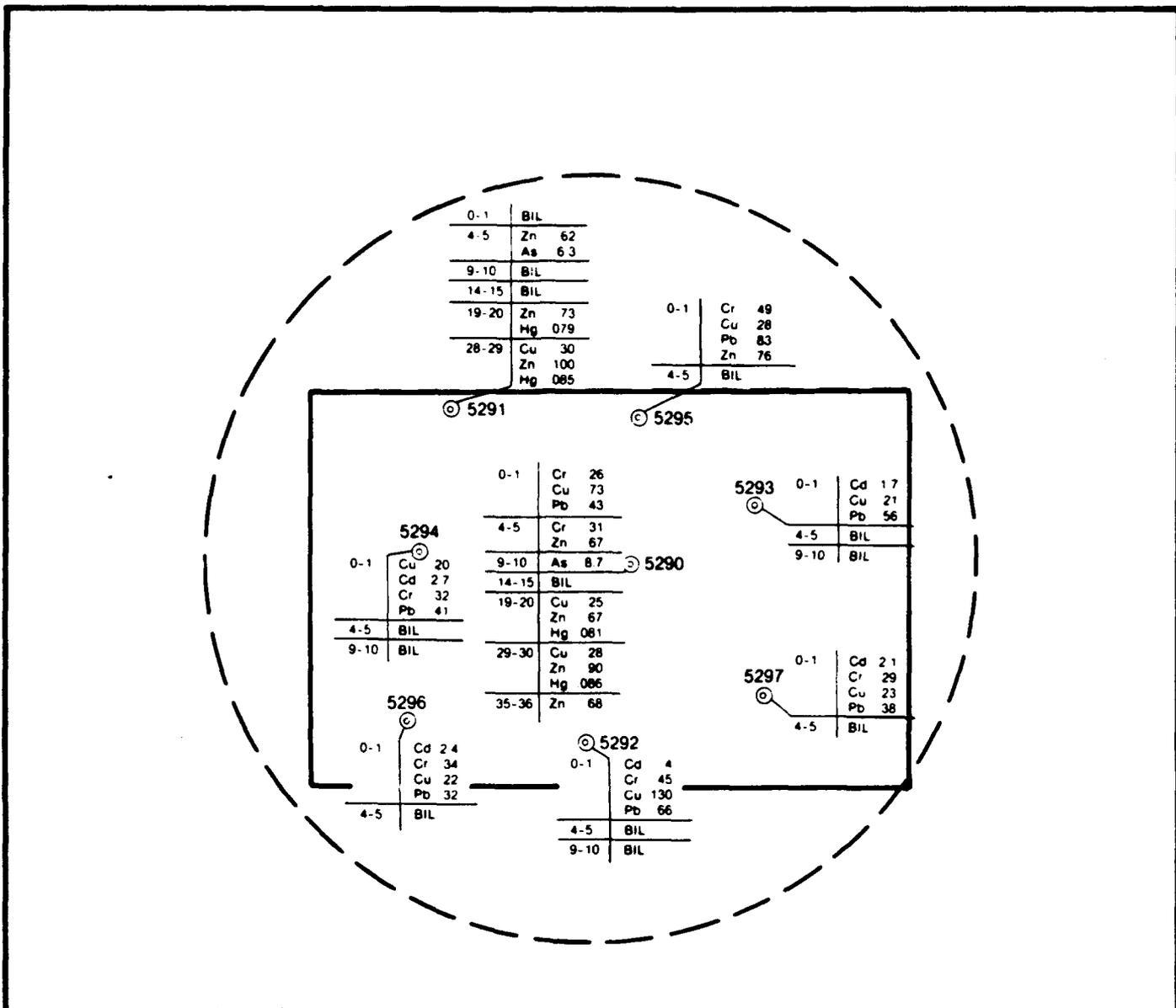
2.2.3 Site Exposure Summary

Tables ESA-1b-2 through ESA-1b-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Chromium	Direct	Direct	Direct	Direct	Direct
Cadmium	--	--	--	--	Direct

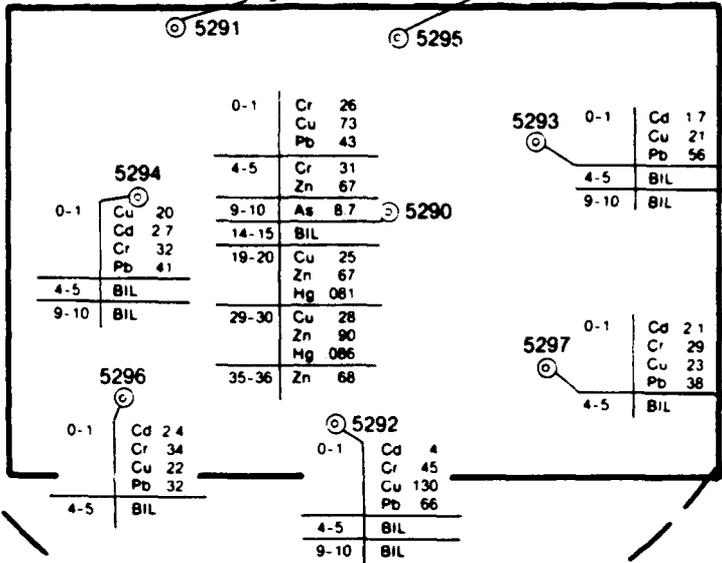
Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-1b is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



0-1	BIL
4-5	Zn 62
	As 6.3
9-10	BIL
14-15	BIL
19-20	Zn 73
	Hg 079
28-29	Cu 30
	Zn 100
	Hg 085

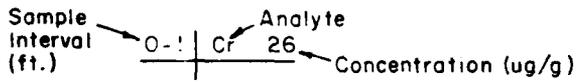
0-1	Cr 49
	Cu 28
	Pb 83
	Zn 76
4-5	BIL



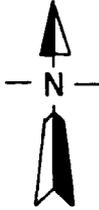
5290 ⊙ Phase I Boring

□ Site Boundary

- - - Site Investigated



- BIL - Below indicator level.
- As - Arsenic
- Cd - Cadmium
- Cr - Chromium
- Cu - Copper
- Pb - Lead
- Hg - Mercury
- Zn - Zinc



Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

Source HLA, 1987

FIGURE ESA-Ib-1
 Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

TABLE ESA-1b-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-1b

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Methyl naphthalene ^{1/}	0.60	0-1	5294	0.60	0-1	5294
Cadmium	4	0-1	5292	--	--	--
Chromium	49	0-1	5295	--	--	--
Copper	130	0-1	5292	--	--	--
Lead	83	0-1	5295	--	--	--

1/ Nontarget contaminant. Refer to the exposure assessment nontarget screen in Appendix A.

ESA Max. ug/g ft Eastern Study Area Maximum microgram per gram foot/feet

ESA-1b-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV	PPLV	PPLV	EI	EI	EI	OPN
	(mg/kg)	(mg/kg)	(mg/kg)				
CADMIUM	4.5E+02	0.0E+00	4.5E+02	8.9E-03	0.0E+00	8.9E-03	0.0E+00
CHROMIUM	6.9E+01	0.0E+00	6.9E+01	7.1E-01*	0.0E+00	7.1E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	3.1E-04	0.0E+00	3.1E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	5.4E-03	0.0E+00	5.4E-03	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-1b-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
CADMIUM	4.5E+02	0.0E+00	4.5E+02	8.9E-03	0.0E+00	8.9E-03	0.0E+00
CHROMIUM	6.9E+01	0.0E+00	6.9E+01	7.1E-01*	0.0E+00	7.1E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	3.1E-04	0.0E+00	3.1E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	5.4E-03	0.0E+00	5.4E-03	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-1b-4
EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
CADMIUM	5.8E+01	0.0E+00	5.8E+01	6.9E-02	0.0E+00	6.9E-02	0.0E+00
CHROMIUM	8.8E+00	0.0E+00	8.8E+00	5.6E+00*	0.0E+00	5.6E+00*	0.0E+00
COPPER	2.5E+05	0.0E+00	2.5E+05	5.2E-04	0.0E+00	5.2E-04	0.0E+00
LEAD	9.2E+03	0.0E+00	9.2E+03	9.0E-03	0.0E+00	9.0E-03	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-1b-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
CADMIUM	3.6E+02	0.0E+00	3.6E+02	1.1E-02	0.0E+00	1.1E-02	0.0E+00
CHROMIUM	5.5E+01	0.0E+00	5.5E+01	8.9E-01*	0.0E+00	8.9E-01*	0.0E+00
COPPER	1.8E+05	0.0E+00	1.8E+05	7.4E-04	0.0E+00	7.4E-04	0.0E+00
LEAD	6.5E+03	0.0E+00	6.5E+03	1.3E-02	0.0E+00	1.3E-02	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-1b-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI EI	EI EI	EI EI	OPN	ENC
CADMIUM	7.6E+00	0.0E+00	0.0E+00	7.6E+00	5.2E-01*	0.0E+00	5.2E-01*	0.0E+00	0.0E+00
CHROMIUM	1.1E+00	0.0E+00	0.0E+00	1.1E+00	4.3E+01*	0.0E+00	4.3E+01*	0.0E+00	0.0E+00
COPPER	5.7E+04	0.0E+00	0.0E+00	5.7E+04	2.3E-03	0.0E+00	2.3E-03	0.0E+00	0.0E+00
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	3.8E-02	0.0E+00	3.8E-02	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

2.3 SITE ESA-1c: SECTION 29 - SURFACE BURN (formerly Site 29-1: Burn Site Incendiaries; ESE, 1987a/RIC 88013R04)

2.3.1 Site-Specific Considerations

Figure ESA-1c-1 and Table ESA-1c-1 depict the target contaminants for Site ESA-1c. Borings 5298 through 5305 were included in the exposure assessment, consistent with the Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-1c (ESE, 1987a/RIC 88013R04).

2.3.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-1c are shown in Figure ESA-1c-1. Methyl naphthalene and phenanthrene, occurring in Borings 5304 (0-1 ft) and 5305 (0-1 ft), respectively, are not included in this figure since they were not considered target contaminants during the Phase I investigation. Although not shown on this figure, these nontarget compounds were included in the Eastern SAR and in this exposure assessment because they passed through the screening process performed in the RMA Chemical Index (EBASCO, 1988a/RIC 88357R01).

Table ESA-1c-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury for Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

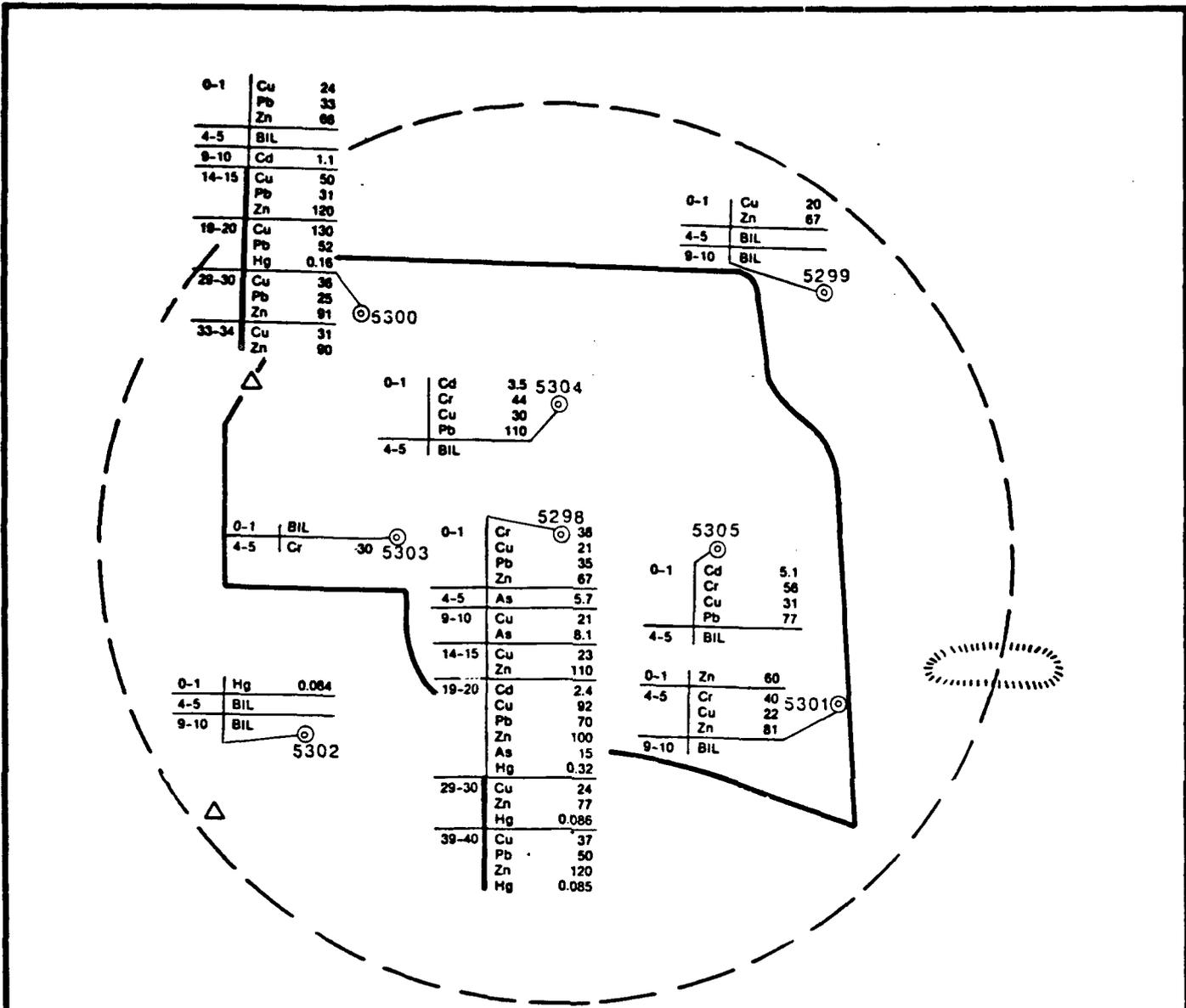
2.3.3 Site Exposure Summary

Tables ESA-1c-2 through ESA-1c-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Chromium	Direct	Direct	Direct	Direct	Direct
Cadmium	--	--	--	--	Direct

Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

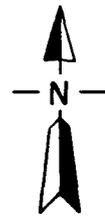
The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-1c is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Legend

5298 ⊙ Phase I Boring
 □ Site Boundary
 - - - Site Investigated
 Sample Interval (ft.) | Analyte | Concentration (ug/g)
 0-1 | Cu | 24
 | | | Bedrock Sample

△ Surface Metal
 ⋯⋯⋯ Manmade Mound
 As - Arsenic
 Cd - Cadmium
 Cr - Chromium
 Cu - Copper
 Pb - Lead
 Hg - Mercury
 Zn - Zinc
 BIL - Below indicator level



Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

Source: HLA, 1987

FIGURE ESA-1c-1
 Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

TABLE ESA-1c-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-1c

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Methyl naphthalene ^{1/}	1.0	0-1	5304	1.0	0-1	5304
Phenanthrene ^{1/}	1.0	0-1	5305	1.0	0-1	5305
Cadmium	5.1	0-1	5305	--	--	--
Chromium	56	0-1	5305	--	--	--
Lead	110	0-1	5304	--	--	--
Zinc	81	4-5	5301	--	--	--

1/ Nontarget contaminant. Refer to the exposure assessment nontarget screen in Appendix A.

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-1c-2
EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI OPN
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI EI	EI EI	EI EI	
CADMIUM	4.5E+02	0.0E+00	4.5E+02	1.1E-02	0.0E+00	1.1E-02	0.0E+00
CHROMIUM	6.9E+01	0.0E+00	6.9E+01	8.1E-01*	0.0E+00	8.1E-01*	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	7.1E-03	0.0E+00	7.1E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	4.1E-05	0.0E+00	4.1E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-1c-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV	PPLV	PPLV	EI	EI	EI	OPN
	(mg/kg)	(mg/kg)	(mg/kg)				
CADMIUM	4.5E+02	0.0E+00	4.5E+02	1.1E-02	0.0E+00	1.1E-02	0.0E+00
CHROMIUM	6.9E+01	0.0E+00	6.9E+01	8.1E-01*	0.0E+00	8.1E-01*	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	7.1E-03	0.0E+00	7.1E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	4.1E-05	0.0E+00	4.1E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-1c-4
EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI EI	EI EI	EI EI	OPN
CADMIUM	5.8E+01	0.0E+00	5.8E+01	8.8E-02	0.0E+00	8.8E-02	0.0E+00
CHROMIUM	8.8E+00	0.0E+00	8.8E+00	6.4E+00*	0.0E+00	6.4E+00*	0.0E+00
LEAD	9.2E+03	0.0E+00	9.2E+03	1.2E-02	0.0E+00	1.2E-02	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	7.7E-05	0.0E+00	7.7E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-1c-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
CADMIUM	3.6E+02	0.0E+00	3.6E+02	1.4E-02	0.0E+00	1.4E-02	0.0E+00
CHROMIUM	5.5E+01	0.0E+00	5.5E+01	1.0E+00*	0.0E+00	1.0E+00*	0.0E+00
LEAD	6.5E+03	0.0E+00	6.5E+03	1.7E-02	0.0E+00	1.7E-02	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	1.0E-04	0.0E+00	1.0E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-1c-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
CADMIUM	7.6E+00	0.0E+00	0.0E+00	7.6E+00	6.7E-01*	0.0E+00	6.7E-01*	0.0E+00	0.0E+00
CHROMIUM	1.1E+00	0.0E+00	0.0E+00	1.1E+00	4.9E+01*	0.0E+00	4.9E+01*	0.0E+00	0.0E+00
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	5.0E-02	0.0E+00	5.0E-02	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	5.8E-04	0.0E+00	5.8E-04	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

2.4 SITE ESA-1d: SECTION 30 - SURFACE BURN (formerly Site 30-2: Burn Site Incendiaries; ESE, 1988d/RIC 88293R03)

2.4.1 Site-Specific Considerations

Figure ESA-1d-1 and Table ESA-1d-1 depict the target contaminants for Site ESA-1d. Borings 5306 through 5313 were included in this exposure assessment, consistent with the ESA. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-1d (ESE, 1988d/RIC 88293R03).

2.4.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-1d are shown in Figure ESA-1d-1. Table ESA-1d-1 summarizes the maximum concentration of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury for Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). No organic contaminants were detected at this location. Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

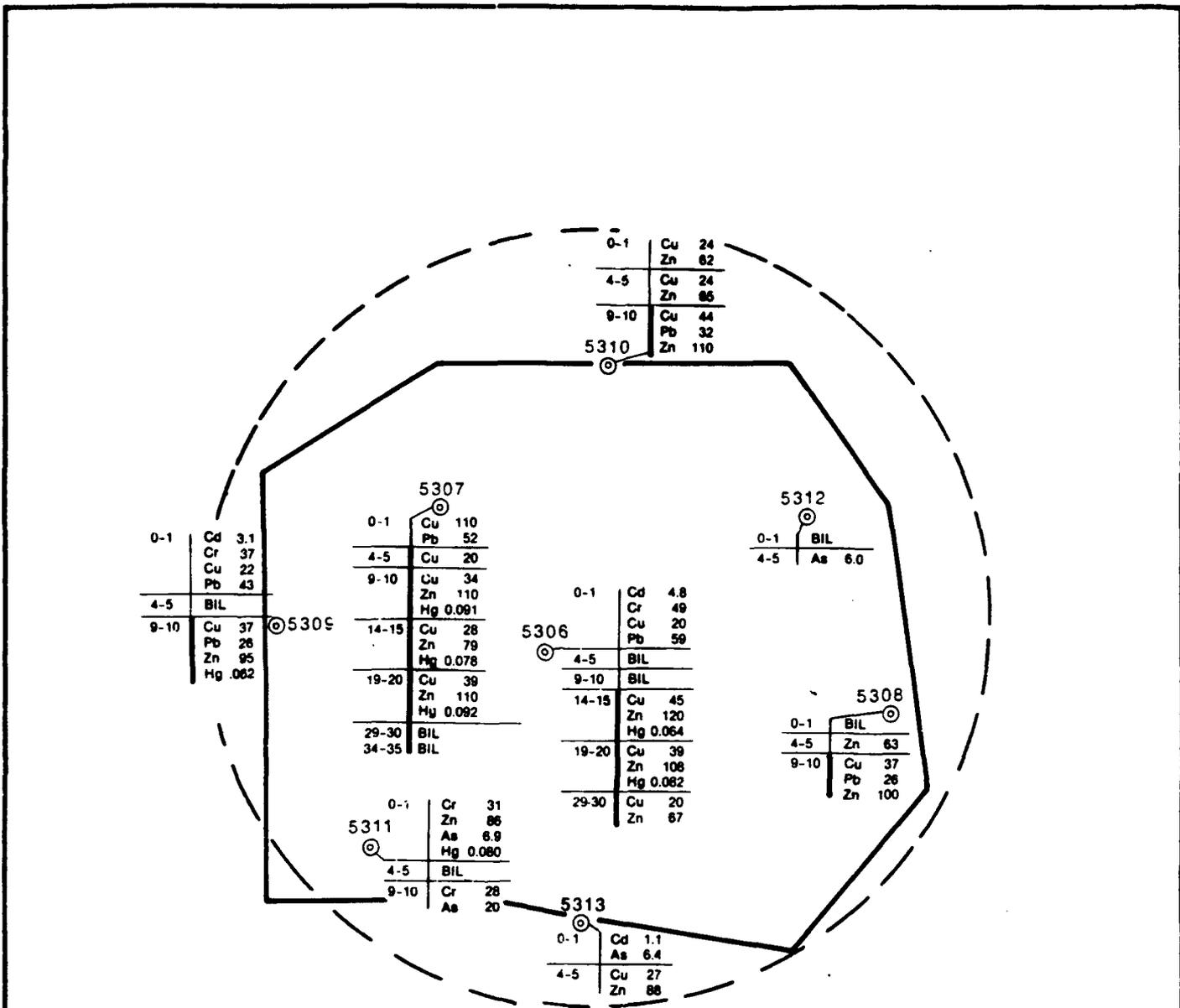
2.4.3 Site Exposure Summary

Tables ESA-1d-2 through ESA-1d-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Arsenic	Direct	Direct	Direct	Direct	Direct
Chromium	Direct	Direct	Direct	Direct	Direct
Cadmium	--	--	--	--	Direct

Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-1d is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Legend

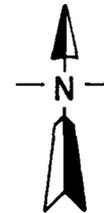
5306 ⊙ Phase I Boring

--- Site Investigated

Sample Interval (ft.) | Analyte | Concentration (ug/g) | Bedrock Sample

0-1 | Cu | 24

- As - Arsenic
- Cd - Cadmium
- Cr - Chromium
- Cu - Copper
- Pb - Lead
- Hg - Mercury
- Zn - Zinc
- BIL - Below indicator level



Prepared for:

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

Source: HLA, 1987

FIGURE ESA-Id-1

Phase I and Phase II Analytes
Detected Within or Above
Indicator Levels

Rocky Mountain Arsenal
Prepared by: Ebasco Services Incorporated

TABLE ESA-1d-1
CONTAMINANT CONCENTRATIONS
FOR SITE ESA-1d

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Arsenic	20	9-10	5311	--	--	--
Cadmium	4.8	0-1	5306	--	--	--
Chromium	49	0-1	5306	--	--	--
Copper	110	0-1	5307	--	--	--
Lead	59	0-1	5306	--	--	--
Zinc	110	9-10	5307	--	--	--
		9-10	5310	--	--	--

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-1d-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI OPN
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	
ARSENIC	2.2E+01	0.0E+00	2.2E+01	9.3E-01*	0.0E+00	9.3E-01*	0.0E+00
CADMIUM	4.5E+02	0.0E+00	4.5E+02	1.1E-02	0.0E+00	1.1E-02	0.0E+00
CHROMIUM	6.9E+01	0.0E+00	6.9E+01	7.1E-01*	0.0E+00	7.1E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	2.6E-04	0.0E+00	2.6E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	3.8E-03	0.0E+00	3.8E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	5.5E-05	0.0E+00	5.5E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-1d-3

EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI OPN
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	
ARSENIC	2.2E+01	0.0E+00	2.2E+01	9.3E-01*	0.0E+00	9.3E-01*	0.0E+00
CADMIUM	4.5E+02	0.0E+00	4.5E+02	1.1E-02	0.0E+00	1.1E-02	0.0E+00
CHROMIUM	6.9E+01	0.0E+00	6.9E+01	7.1E-01*	0.0E+00	7.1E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	2.6E-04	0.0E+00	2.6E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	3.8E-03	0.0E+00	3.8E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	5.5E-05	0.0E+00	5.5E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-1d-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
ARSENIC	3.9E+00	0.0E+00	3.9E+00	5.1E+00*	0.0E+00	5.1E+00*	0.0E+00
CADMIUM	5.8E+01	0.0E+00	5.8E+01	8.3E-02	0.0E+00	8.3E-02	0.0E+00
CHROMIUM	8.8E+00	0.0E+00	8.8E+00	5.6E+00*	0.0E+00	5.6E+00*	0.0E+00
COPPER	2.5E+05	0.0E+00	2.5E+05	4.4E-04	0.0E+00	4.4E-04	0.0E+00
LEAD	9.2E+03	0.0E+00	9.2E+03	6.4E-03	0.0E+00	6.4E-03	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	1.0E-04	0.0E+00	1.0E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-1d-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	ENC
ARSENIC	2.0E+01	0.0E+00	2.0E+01	1.0E+00*	0.0E+00	1.0E+00*	0.0E+00
CADMIUM	3.6E+02	0.0E+00	3.6E+02	1.3E-02	0.0E+00	1.3E-02	0.0E+00
CHROMIUM	5.5E+01	0.0E+00	5.5E+01	8.9E-01*	0.0E+00	8.9E-01*	0.0E+00
COPPER	1.8E+05	0.0E+00	1.8E+05	6.3E-04	0.0E+00	6.3E-04	0.0E+00
LEAD	6.5E+03	0.0E+00	6.5E+03	9.0E-03	0.0E+00	9.0E-03	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	1.4E-04	0.0E+00	1.4E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-1d-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
ARSENIC	1.6E+00	0.0E+00	0.0E+00	1.6E+00	1.2E+01*	0.0E+00	1.2E+01*	0.0E+00	0.0E+00
CADMIUM	7.6E+00	0.0E+00	0.0E+00	7.6E+00	6.3E-01*	0.0E+00	6.3E-01*	0.0E+00	0.0E+00
CHROMIUM	1.1E+00	0.0E+00	0.0E+00	1.1E+00	4.3E+01*	0.0E+00	4.3E+01*	0.0E+00	0.0E+00
COPPER	5.7E+04	0.0E+00	0.0E+00	5.7E+04	1.9E-03	0.0E+00	1.9E-03	0.0E+00	0.0E+00
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	2.7E-02	0.0E+00	2.7E-02	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	7.9E-04	0.0E+00	7.9E-04	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

2.5 SITE ESA-2a: BURN PITS (formerly Site 32-5: Burning Pits; EBASCO, 1988b/RIC 88256R01 and EBASCO, 1988c/RIC 88256R01A; and Site 32-6: Burning Pits; EBASCO 1988d/RIC 88256R02 and EBASCO, 1988e/RIC 88256R02A)

2.5.1 Site-Specific Considerations

Figures ESA-2a-1 and ESA-2a-2 and Table ESA-2a-1 depict the target contaminants for Site ESA-2a. Borings 1 through 10, 10B, and 11 through 13 for Site 32-5 (Figure ESA-2a-1) and Borings 1 through 17 for Site 32-6 (Figure ESA-2a-2) were included in the exposure assessment, consistent with Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-2a (EBASCO, 1988b/RIC 88256R01 and EBASCO, 1988d/RIC 88256R02).

2.5.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-2a are shown in Figures ESA-2a-1 and ESA-2a-2. Table ESA-2a-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.5.3 Site Exposure Summary

Tables ESA-2a-2 through ESA-2a-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Arsenic	Direct	Direct	Direct	Direct	Direct
Cadmium	Direct	Direct	Direct	Direct	Direct
Lead	Direct	Direct	Direct	Direct	Direct
Benzene	--	--	--	Indirect	Indirect
Zinc	--	--	--	--	Direct

Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.
 Indirect exposure pathways include open and enclosed space vapor inhalation.

The results of the soil exposure summary indicate that exposure to contamination from the direct and indirect pathways both contribute to the exceedance of the cumulative PPLVs. Site ESA-2a is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).

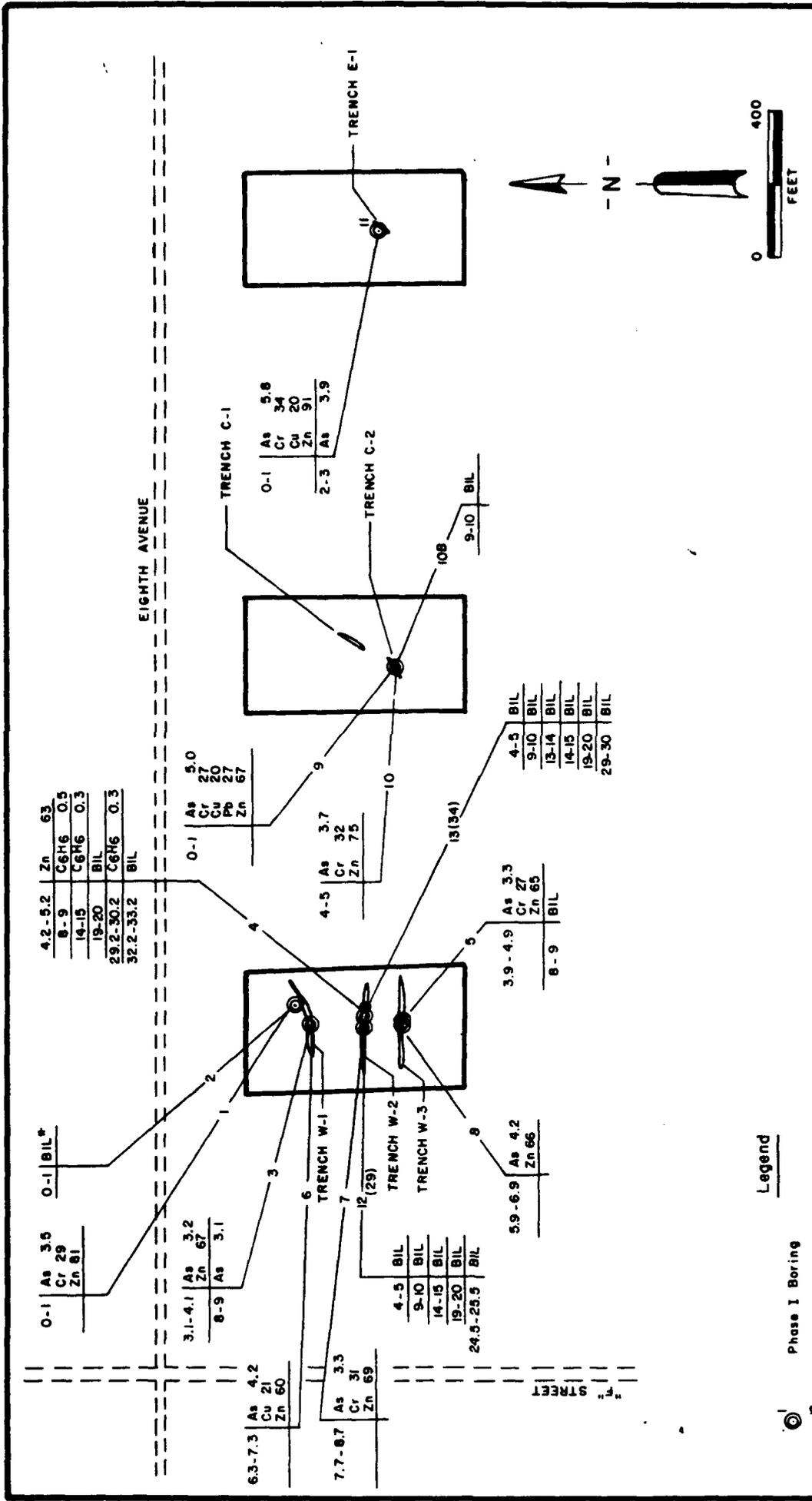
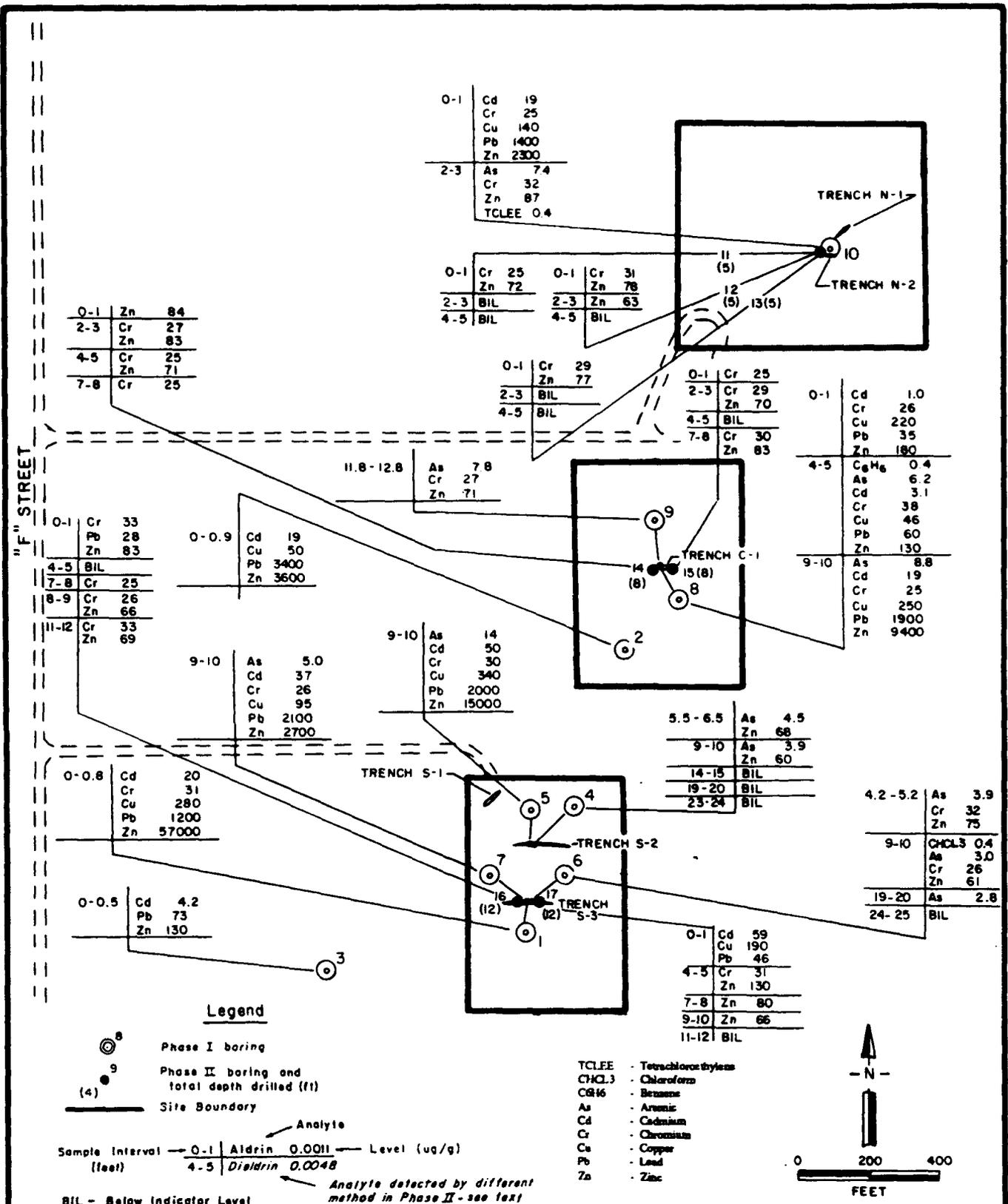


FIGURE ESA-2a-1
 Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland



Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-2a-2
Phase I and Phase II Analytes Detected
Within or Above Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

TABLE ESA-2a-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-2a

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Benzene	0.5	8-9	4	0.5	8-9	4
Chloroform	0.4	9-10	6+	0.4	9-10	6+
Tetrachloroethylene	0.4	2-3	10+	0.4	2-3	10+
Arsenic	14	9-10	5+	--	--	--
Cadmium	59	0-1	17+	--	--	--
Copper	340	9-10	5+	--	--	--
Lead	3400	0-0.9	2+	--	--	--
Zinc	57000	0-0.8	1+	--	--	--

+ Boring is in Figure ESA-2a-2.

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-2a-2
EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI OPN
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	
BENZENE	8.6E+02	2.5E+02	1.9E+02	5.8E-04	2.0E-03	2.6E-03	0.0E+00
CHLOROFORM	4.0E+03	6.2E+03	2.5E+03	9.9E-05	6.4E-05	1.6E-04	0.0E+00
TETRACHLOROETHYLENE	5.1E+02	1.7E+04	5.0E+02	7.8E-04	2.3E-05	8.1E-04	0.0E+00
ARSENIC	2.2E+01	0.0E+00	2.2E+01	6.5E-01*	0.0E+00	6.5E-01*	0.0E+00
CADMIUM	4.5E+02	0.0E+00	4.5E+02	1.3E-01*	0.0E+00	1.3E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	8.1E-04	0.0E+00	8.1E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	2.2E-01*	0.0E+00	2.2E-01*	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	2.9E-02	0.0E+00	2.9E-02	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-2a-3

EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
BENZENE	8.6E+02	2.5E+02	1.9E+02	5.8E-04	2.0E-03	2.6E-03	0.0E+00
CHLOROFORM	4.0E+03	6.2E+03	2.5E+03	9.9E-05	6.4E-05	1.6E-04	0.0E+00
TETRACHLOROETHYLENE	5.1E+02	1.7E+04	5.0E+02	7.8E-04	2.3E-05	8.1E-04	0.0E+00
ARSENIC	2.2E+01	0.0E+00	2.2E+01	6.5E-01*	0.0E+00	6.5E-01*	0.0E+00
CADMIUM	4.5E+02	0.0E+00	4.5E+02	1.3E-01*	0.0E+00	1.3E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	8.1E-04	0.0E+00	8.1E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	2.2E-01*	0.0E+00	2.2E-01*	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	2.9E-02	0.0E+00	2.9E-02	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-2a-4
EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI OPN
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	
BENZENE	1.2E+02	3.9E+01	2.9E+01	4.2E-03	1.3E-02	1.7E-02	0.0E+00
CHLOROFORM	5.6E+02	9.6E+02	3.5E+02	7.1E-04	4.2E-04	1.1E-03	0.0E+00
TETRACHLOROETHYLENE	7.1E+01	2.6E+03	6.9E+01	5.6E-03	1.5E-04	5.8E-03	0.0E+00
ARSENIC	3.9E+00	0.0E+00	3.9E+00	3.5E+00*	0.0E+00	3.5E+00*	0.0E+00
CADMIUM	5.8E+01	0.0E+00	5.8E+01	1.0E+00*	0.0E+00	1.0E+00*	0.0E+00
COPPER	2.5E+05	0.0E+00	2.5E+05	1.4E-03	0.0E+00	1.4E-03	0.0E+00
LEAD	9.2E+03	0.0E+00	9.2E+03	3.7E-01*	0.0E+00	3.7E-01*	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	5.4E-02	0.0E+00	5.4E-02	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-2a-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	ENC
BENZENE	1.1E+03	3.0E-01	3.0E-01	4.6E-04	1.6E+00*	1.6E+00*	0.0E+00
CHLOROFORM	5.1E+03	6.7E+00	6.7E+00	7.8E-05	6.0E-02	6.0E-02	0.0E+00
TETRACHLOROETHYLENE	6.5E+02	2.0E+03	4.9E+02	6.2E-04	2.0E-04	8.1E-04	0.0E+00
ARSENIC	2.0E+01	0.0E+00	2.0E+01	7.0E-01*	0.0E+00	7.0E-01*	0.0E+00
CADMIUM	3.6E+02	0.0E+00	3.6E+02	1.6E-01*	0.0E+00	1.6E-01*	0.0E+00
COPPER	1.8E+05	0.0E+00	1.8E+05	1.9E-03	0.0E+00	1.9E-03	0.0E+00
LEAD	6.5E+03	0.0E+00	6.5E+03	5.2E-01*	0.0E+00	5.2E-01*	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	7.3E-02	0.0E+00	7.3E-02	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-2a-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
BENZENE	6.7E+01	3.3E+01	3.0E-01	3.0E-01	7.5E-03	1.7E+00*	1.7E+00*	0.0E+00	0.0E+00
CHLOROFORM	3.1E+02	8.3E+02	6.7E+00	6.5E+00	1.3E-03	6.0E-02	6.1E-02	0.0E+00	0.0E+00
TETRACHLOROETHYLENE	4.1E+01	2.3E+03	2.0E+03	4.0E+01	9.7E-03	3.7E-04	1.0E-02	0.0E+00	0.0E+00
ARSENIC	1.6E+00	0.0E+00	0.0E+00	1.6E+00	8.7E+00*	0.0E+00	8.7E+00*	0.0E+00	0.0E+00
CADMIUM	7.6E+00	0.0E+00	0.0E+00	7.6E+00	7.7E+00*	0.0E+00	7.7E+00*	0.0E+00	0.0E+00
COPPER	5.7E+04	0.0E+00	0.0E+00	5.7E+04	6.0E-03	0.0E+00	6.0E-03	0.0E+00	0.0E+00
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	1.6E+00*	0.0E+00	1.6E+00*	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	4.1E-01*	0.0E+00	4.1E-01*	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

2.6 SITE ESA-2b: SANITARY LANDFILL (formerly Site 30-4: Sanitary Landfill; EBASCO, 1987a/RIC 87216R09 and EBASCO, 1988f/RIC 87216R09A)

2.6.1 Site-Specific Considerations

Figure ESA-2b-1 and Table ESA-2b-1 depict the target contaminants for Site ESA-2b. Borings 1 through 9 and 11 through 30 were included in this exposure assessment, consistent with the Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-2b (EBASCO, 1987a/RIC 87216R09).

2.6.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-2b are shown in Figure ESA-2b-1. Phosphoric acid, tributyl ester, occurring in Boring 2 (3.7-4.7 ft), was not included in this figure, since it was not considered a target contaminant during the Phase I and Phase II investigations. Although not shown on this figure, this nontarget compound was included in the Eastern SAR and in this exposure assessment because it passed through the screening process performed in the RMA Chemical Index (EBASCO, 1988a/RIC 88357R01).

Table ESA-2b-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. Aldrin, chlorophenylmethyl sulfone, Dieldrin, and trichloroethylene were not detected in the 0-10 ft interval; therefore, no data were included for Horizon 1. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.6.3 Site Exposure Summary

Tables ESA-2b-2 through ESA-2b-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Benzene	--	--	--	Indirect	Indirect
Dieldrin	--	--	--	Indirect	Indirect
Methylene chloride	--	--	--	Indirect	Indirect
Trichloroethylene	--	--	--	Indirect	Indirect

Note: Indirect exposure pathways include open and enclosed space vapor inhalation.

The results of the soil exposure summary indicate that exposure to contamination from the indirect pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-2b is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).

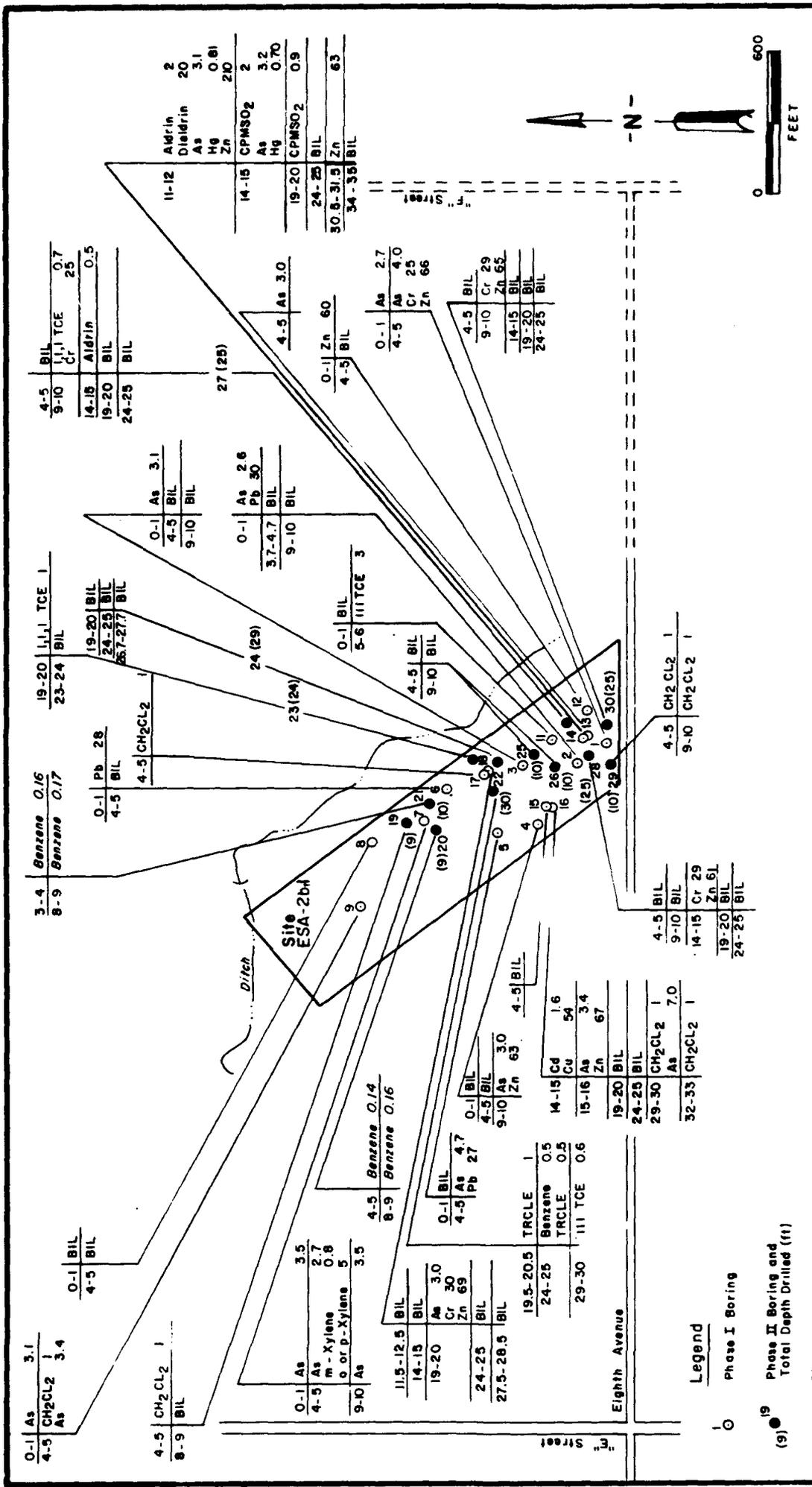


FIGURE ESA-2b-1

Phase I and Phase II Analytes
Detected Within or Above
Indicator Levels

Rocky Mountain Arsenal
Prepared by: Ebasco Services Incorporated

Prepared for:

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

0-1	As	3.1
4-5	CH ₂ CL ₂	1
As		3.4

0-1	BIL	
4-5	BIL	

3-4	Benzene	0.16
8-9	Benzene	0.17

19-20	1,1,1 TCE	1
23-24	BIL	

19-20	BIL	
24-25	BIL	
26-27	BIL	

4-5	BIL	
9-10	1,1,1 TCE	0.7
Cr		25

14-15	Aldrin	0.5
19-20	BIL	
24-25	BIL	

0-1	As	3.5
4-5	As	2.7
m-Xylene		0.8
o or p-Xylene		5
9-10	As	3.5

11.5-12.5	BIL	
14-15	BIL	
19-20	As	3.0
Cr		30
Zn		69

4-5	Benzene	0.14
8-9	Benzene	0.16

0-1	BIL	
4-5	As	4.7
Pb		27

0-1	BIL	
4-5	BIL	
9-10	As	3.0
Zn		66

0-1	As	2.7
4-5	As	4.0
Cr		25
Zn		66

11-12	Aldrin	2
Dieldrin		20
As		3.1
Hg		0.81
Zn		20

19.5-20.5	TRCLE	1
24-25	Benzene	0.5
TRCLE		0.5
29-30	1,1,1 TCE	0.6

0-1	BIL	
4-5	As	3.0
Zn		63

14-15	Cd	1.6
Cu		54
15-16	As	3.4
Zn		67

4-5	BIL	
9-10	BIL	
14-15	Cr	29
Zn		61
19-20	BIL	
24-25	BIL	

0-1	BIL	
4-5	BIL	
9-10	Cr	29
Zn		65

0-1	As	2.7
4-5	As	4.0
Cr		25
Zn		66

14-15	BIL	
19-20	BIL	
24-25	BIL	

19.5-20.5	TRCLE	1
24-25	Benzene	0.5
TRCLE		0.5
29-30	1,1,1 TCE	0.6

0-1	BIL	
4-5	As	4.7
Pb		27

4-5	Benzene	0.14
8-9	Benzene	0.16

0-1	BIL	
4-5	BIL	
9-10	As	3.0
Zn		63

14-15	Cd	1.6
Cu		54
15-16	As	3.4
Zn		67

4-5	BIL	
9-10	BIL	
14-15	Cr	29
Zn		61
19-20	BIL	
24-25	BIL	

0-1	As	2.7
4-5	As	4.0
Cr		25
Zn		66

0-1	As	3.1
4-5	CH ₂ CL ₂	1
As		3.4

0-1	BIL	
4-5	BIL	

3-4	Benzene	0.16
8-9	Benzene	0.17

19-20	1,1,1 TCE	1
23-24	BIL	

19-20	BIL	
24-25	BIL	
26-27	BIL	

4-5	BIL	
9-10	1,1,1 TCE	0.7
Cr		25

14-15	Aldrin	0.5
19-20	BIL	
24-25	BIL	

11.5-12.5	BIL	
14-15	BIL	
19-20	As	3.0
Cr		30
Zn		69

4-5	Benzene	0.14
8-9	Benzene	0.16

0-1	BIL	
4-5	As	4.7
Pb		27

0-1	BIL	
4-5	BIL	
9-10	As	3.0
Zn		66

0-1	As	2.7
4-5	As	4.0
Cr		25
Zn		66

11-12	Aldrin	2
Dieldrin		20
As		3.1
Hg		0.81
Zn		20

14-15	CPMSO ₂	2
As		3.2
Hg		0.70
19-20	CPMSO ₂	0.9
24-25	BIL	
30.8-31.5	Zn	63
34-35	BIL	

- Sample Interval (ft) → 0-1 Cr 23 ← Level (ug/g) Analyte detected by Phase II analytical method
- Legend
- Phase I Boring
 - Phase II Boring and Total Depth Drilled (ft)
 - Site Boundary
 - Bedrock Sample
- ANALYTE
- As - Arsenic
 - CH₂CL₂ - Methylene chloride
 - CPMSO₂ - Chlorophenylmethyl sulfone
 - 1,1,1TCE - 1,1,1-Trichloroethane
 - TRCLE - Trichloroethylene
 - Cr - Chromium
 - Cd - Cadmium
 - Cu - Copper
 - Pb - Lead
 - Hg - Mercury
 - Zn - Zinc

TABLE ESA-2b-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-2b

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Aldrin	--	--	--	2	11-12	14
Benzene	0.17	8-9	21	0.5	24-25	22
Chlorophenylmethyl sulfone	--	--	--	2	14-15	14
Dieldrin	--	--	--	20	11-12	14
Methylene chloride	1	4-5	9	1	4-5	9
		4-5	17		4-5	17
		4-5	19		4-5	19
		4-5	29		4-5	29
		9-10	29		9-10	29
	--	--	--		29-30	16
	--	--	--		32-33	16
Phosphoric acid, tributyl ester ^{1/}	0.50	3.7-4.7	2	0.50	3.7-4.7	2
1,1,1-Trichloroethane	3.0	5-6	11	3.0	5-6	11
Trichloroethylene	--	--	--	1	19.5-20.5	22
m-Xylene	0.8	4-5	7	0.8	4-5	7
o,p-Xylene	5	4-5	7	5	4-5	7

1/ Nontarget contaminant. Refer to the exposure assessment nontarget screen in Appendix A.

ESA Eastern Study Area
Max. Maximum
ug/g microgram per gram
ft foot/feet

ESA-2b-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
ALDRIN	1.5E+00	3.9E+06	1.5E+00	0.0E+00	5.2E-07	5.2E-07	0.0E+00
BENZENE	8.6E+02	3.3E+02	2.4E+02	2.0E-04	1.5E-03	1.7E-03	0.0E+00
CHLOROPHENYLMETHYL SULFONE	1.6E+05	5.2E+06	1.6E+05	0.0E+00	3.8E-07	3.8E-07	0.0E+00
DIELDRIN	1.6E+00	1.0E+06	1.6E+00	0.0E+00	6.1E-05 ^a	6.1E-05	0.0E+00
METHYLENE CHLORIDE	3.3E+03	5.3E+02	4.5E+02	3.1E-04	1.9E-03	2.2E-03	0.0E+00
1,1,1-TRICHLOROETHANE	7.5E+05	1.2E+06	4.5E+05	4.0E-06	2.6E-06	6.6E-06	0.0E+00
TRICHLOROETHYLENE	2.3E+03	1.1E+03	7.4E+02	0.0E+00	9.1E-04	9.1E-04	0.0E+00
M-XYLENE	1.4E+07	3.2E+06	2.6E+06	5.6E-08	2.5E-07	3.0E-07	0.0E+00
O,P-XYLENE	1.4E+07	1.9E+06	1.7E+06	3.5E-07	2.7E-06	3.0E-06	0.0E+00

a: This contaminant saturates the soil gas and produces a vapor flux which is below one-tenth of the critical flux. The SPPPLV for this contaminant is considered to be equal to pure compound. The SPPPLV has therefore been set to 1.00E+06 mg/kg (See volume VI-A).

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-2b-3

EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
ALDRIN	1.5E+00	3.9E+06	1.5E+00	0.0E+00	5.2E-07	5.2E-07	0.0E+00
BENZENE	8.6E+02	3.3E+02	2.4E+02	2.0E-04	1.5E-03	1.7E-03	0.0E+00
CHLOROPHENYLMETHYL SULFONE	1.6E+05	5.2E+06	1.6E+05	0.0E+00	3.8E-07	3.8E-07	0.0E+00
DIELDRIN	1.6E+00	1.0E+06	1.6E+00	0.0E+00	6.1E-05 ^a	6.1E-05	0.0E+00
METHYLENE CHLORIDE	3.3E+03	5.3E+02	4.5E+02	3.1E-04	1.9E-03	2.2E-03	0.0E+00
1,1,1-TRICHLOROETHANE	7.5E+05	1.2E+06	4.5E+05	4.0E-06	2.6E-06	6.6E-06	0.0E+00
TRICHLOROETHYLENE	2.3E+03	1.1E+03	7.4E+02	0.0E+00	9.1E-04	9.1E-04	0.0E+00
M-XYLENE	1.4E+07	3.2E+06	2.6E+06	5.6E-08	2.5E-07	3.0E-07	0.0E+00
O,P-XYLENE	1.4E+07	1.9E+06	1.7E+06	3.5E-07	2.7E-06	3.0E-06	0.0E+00

a: This contaminant saturates the soil gas and produces a vapor flux which is below one-tenth of the critical flux. The SPPLV for this contaminant is considered to be equal to pure compound. The SPPLV has therefore been set to 1.00E+06 mg/kg (See volume VI-A).

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-2b-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI OPN
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	
ALDRIN	2.1E-01	2.6E+05	2.1E-01	0.0E+00	7.8E-06	7.8E-06	0.0E+00
BENZENE	1.2E+02	5.2E+01	3.6E+01	1.4E-03	9.7E-03	1.1E-02	0.0E+00
CHLOROPHENYLMETHYL SULFONE	7.0E+04	8.1E+05	6.4E+04	0.0E+00	2.5E-06	2.5E-06	0.0E+00
DIELDRIN	2.2E-01	1.0E+06	2.2E-01	0.0E+00	9.1E-04 ^a	9.1E-04	0.0E+00
METHYLENE CHLORIDE	4.5E+02	8.2E+01	6.9E+01	2.2E-03	1.2E-02	1.4E-02	0.0E+00
1,1,1-TRICHLOROETHANE	3.2E+05	4.2E+05	1.8E+05	9.4E-06	7.2E-06	1.7E-05	0.0E+00
TRICHLOROETHYLENE	3.2E+02	1.7E+02	1.1E+02	0.0E+00	5.9E-03	5.9E-03	0.0E+00
M-XYLENE	5.8E+06	1.2E+05	1.2E+05	1.4E-07	6.6E-06	6.7E-06	0.0E+00
O,P-XYLENE	5.8E+06	6.8E+05	6.1E+05	8.6E-07	7.3E-06	8.2E-06	0.0E+00

a: This contaminant saturates the soil gas and produces a vapor flux which is below one-tenth of the critical flux. The SPPPLV for this contaminant is considered to be equal to pure compound. The SPPPLV has therefore been set to 1.00E+06 mg/kg (See volume VI-A).

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-2b-5

EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI ENC
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	
ALDRIN	1.9E+00	4.3E+03	1.9E+00	0.0E+00	4.7E-04	4.7E-04	0.0E+00
BENZENE	1.1E+03	4.5E-01	4.5E-01	1.6E-04	1.1E+00*	1.1E+00*	0.0E+00
CHLOROPHENYLMETHYL SULFONE	9.1E+04	2.7E+03	2.6E+03	0.0E+00	7.5E-04	7.5E-04	0.0E+00
DIELDRIN	2.0E+00	5.8E+01	1.9E+00	0.0E+00	3.5E-01*	3.5E-01*	0.0E+00
METHYLENE CHLORIDE	4.1E+03	6.0E-01	6.0E-01	2.4E-04	1.7E+00*	1.7E+00*	0.0E+00
1,1,1-TRICHLOROETHANE	4.2E+05	4.1E+02	4.1E+02	7.2E-06	7.4E-03	7.4E-03	0.0E+00
TRICHLOROETHYLENE	2.9E+03	1.1E+00	1.1E+00	0.0E+00	9.3E-01*	9.3E-01*	0.0E+00
M-XYLENE	7.0E+06	3.0E+03	3.0E+03	1.1E-07	2.7E-04	2.7E-04	0.0E+00
O,P-XYLENE	7.0E+06	9.2E+03	9.1E+03	7.2E-07	5.5E-04	5.5E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-2b-6

EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
ALDRIN	1.2E-01	5.2E+05	1.4E+03	1.2E-01	0.0E+00	1.4E-03	1.4E-03	0.0E+00	0.0E+00
BENZENE	6.7E+01	4.4E+01	4.5E-01	4.4E-01	2.5E-03	1.1E+00*	1.1E+00*	0.0E+00	0.0E+00
CHLOROPHENYLMETHYL SULFONE	1.7E+04	7.0E+05	2.7E+03	2.3E+03	0.0E+00	7.5E-04	7.5E-04	0.0E+00	0.0E+00
DIELDRIN	1.2E-01	4.4E+04	1.9E+01	1.2E-01	0.0E+00	1.0E+00*	1.0E+00*	0.0E+00	0.0E+00
METHYLENE CHLORIDE	2.5E+02	7.0E+01	6.0E-01	5.9E-01	4.0E-03	1.7E+00*	1.7E+00*	0.0E+00	0.0E+00
1,1,1-TRICHLOROETHANE	7.8E+04	1.5E+05	1.2E+03	1.2E+03	3.8E-05	2.5E-03	2.5E-03	0.0E+00	0.0E+00
TRICHLOROETHYLENE	1.8E+02	1.5E+02	1.1E+00	1.1E+00	0.0E+00	9.4E-01*	9.4E-01*	0.0E+00	0.0E+00
M-XYLENE	8.8E+05	4.3E+05	3.9E+02	3.9E+02	9.1E-07	2.0E-03	2.0E-03	0.0E+00	0.0E+00
O,P-XYLENE	8.8E+05	2.5E+05	2.7E+04	2.4E+04	5.7E-06	2.0E-04	2.1E-04	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

2.7 SITE ESA-2c: OPEN TRENCHES (formerly Site 30-6: Liquid Disposal Trenches; ESE, 1988e/RIC 88063R03 and ESE, 1988f/RIC 88063R03A)

2.7.1 Site-Specific Considerations

Figure ESA-2c-1 and Table ESA-2c-1 depict the target contaminants for Site ESA-2c. Borings 5356 through 5362 and 5540 through 5553 were included in this exposure assessment, consistent with the Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-2c (ESE, 1988e/RIC 88063R03).

2.7.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-2c are shown in Figure ESA-2c-1. Table ESA-2c-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

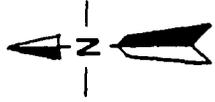
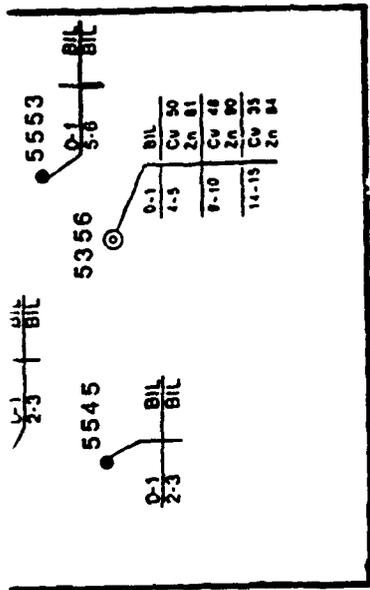
2.7.3 Site Exposure Summary

Tables ESA-2c-2 through ESA-2c-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Fluoroacetic acid	Direct	Direct	Direct	Direct	Direct
Arsenic	Direct	Direct	Direct	Direct	Direct

Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-2c is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Legend

- 5359 Phase I Boring
- 5550 Phase II Boring



Sample Interval \rightarrow 0-1 Mg \rightarrow 0.17 \rightarrow Concentration (ug/g)
 4-5 \rightarrow

- BIL: Below indicator level
- PCZA: Fluorotoluene acid
- As: Arsenic
- Cd: Cadmium
- Cu: Copper
- Pb: Lead
- Hg: Mercury
- Zn: Zinc

FIGURE ESA-2c-1
 Phase I and Phase II Analytes Detected
 Within or Above Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland
 Source: HLA, 1988

B

TABLE ESA-2c-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-2c

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Dieldrin	0.0030	4-5	5550	0.0030	4-5	5550
Fluoroacetic acid	19	0-1	5543	19	0-1	5543
Arsenic	32	4-5	5361	--	--	--
Copper	88	4-5	5358	--	--	--
Lead	43	0-1	5359	--	--	--
Zinc	120	9-10	5361	--	--	--

2-66

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-2c-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
DIELDRIN	1.6E+00	4.3E+06	1.6E+00	1.9E-03	6.9E-10	1.9E-03	0.0E+00
FLUOROACETIC ACID	3.9E+01	0.0E+00	3.9E+01	4.9E-01*	0.0E+00	4.9E-01*	0.0E+00
ARSENIC	2.2E+01	0.0E+00	2.2E+01	1.5E+00*	0.0E+00	1.5E+00*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	2.1E-04	0.0E+00	2.1E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	2.8E-03	0.0E+00	2.8E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	6.0E-05	0.0E+00	6.0E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-2c-3

EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI OPM
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	
DIELDRIN	1.6E+00	4.3E+06	1.6E+00	1.9E-03	6.9E-10	1.9E-03	0.0E+00
FLUOROACETIC ACID	3.9E+01	0.0E+00	3.9E+01	4.9E-01*	0.0E+00	4.9E-01*	0.0E+00
ARSENIC	2.2E+01	0.0E+00	2.2E+01	1.5E+00*	0.0E+00	1.5E+00*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	2.1E-04	0.0E+00	2.1E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	2.8E-03	0.0E+00	2.8E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	6.0E-05	0.0E+00	6.0E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-2c-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI OPN
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	
DIELDRIN	2.2E-01	2.9E+05	2.2E-01	1.4E-02	1.0E-08	1.4E-02	0.0E+00
FLUOROACETIC ACID	1.7E+01	0.0E+00	1.7E+01	1.1E+00*	0.0E+00	1.1E+00*	0.0E+00
ARSENIC	3.9E+00	0.0E+00	3.9E+00	8.1E+00*	0.0E+00	8.1E+00*	0.0E+00
COPPER	2.5E+05	0.0E+00	2.5E+05	3.5E-04	0.0E+00	3.5E-04	0.0E+00
LEAD	9.2E+03	0.0E+00	9.2E+03	4.7E-03	0.0E+00	4.7E-03	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	1.1E-04	0.0E+00	1.1E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-2c-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	ENC
DIELDRIN	2.0E+00	5.8E+01	1.9E+00	1.5E-03	5.2E-05	1.6E-03	0.0E+00
FLUOROACETIC ACID	2.2E+01	0.0E+00	2.2E+01	8.8E-01*	0.0E+00	8.8E-01*	0.0E+00
ARSENIC	2.0E+01	0.0E+00	2.0E+01	1.6E+00*	0.0E+00	1.6E+00*	0.0E+00
COPPER	1.8E+05	0.0E+00	1.8E+05	5.0E-04	0.0E+00	5.0E-04	0.0E+00
LEAD	6.5E+03	0.0E+00	6.5E+03	6.6E-03	0.0E+00	6.6E-03	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	1.5E-04	0.0E+00	1.5E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-2c-6

EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
DIELDRIN	1.2E-01	5.8E+05	1.9E+01	1.2E-01	2.5E-02	1.6E-04	2.5E-02	0.0E+00	0.0E+00
FLUOROACETIC ACID	4.0E+00	0.0E+00	0.0E+00	4.0E+00	4.8E+00*	0.0E+00	4.8E+00*	0.0E+00	0.0E+00
ARSENIC	1.6E+00	0.0E+00	0.0E+00	1.6E+00	2.0E+01*	0.0E+00	2.0E+01*	0.0E+00	0.0E+00
COPPER	5.7E+04	0.0E+00	0.0E+00	5.7E+04	1.5E-03	0.0E+00	1.5E-03	0.0E+00	0.0E+00
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	2.0E-02	0.0E+00	2.0E-02	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	8.6E-04	0.0E+00	8.6E-04	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

2.8 SITE ESA-3a: STORAGE YARD (formerly Site 5-2: Potential Mustard and Distilled Mustard Contamination; EBASCO, 1988g/RIC 88196R05 and EBASCO, 1988h/RIC 88196R05A)

2.8.1 Site-Specific Considerations

Figure ESA-3a-1 and Table ESA-3a-1 depict the target contaminants for Site ESA-3a. Borings 1 through 12 were included in this exposure assessment consistent with the Eastern SAR. According to the site history, Mustard degradation products were suspected to be present at this site. No other chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3a (EBASCO, 1988g/RIC 88196R05).

2.8.2 Spatial Distribution of Measured Contaminant Concentrations

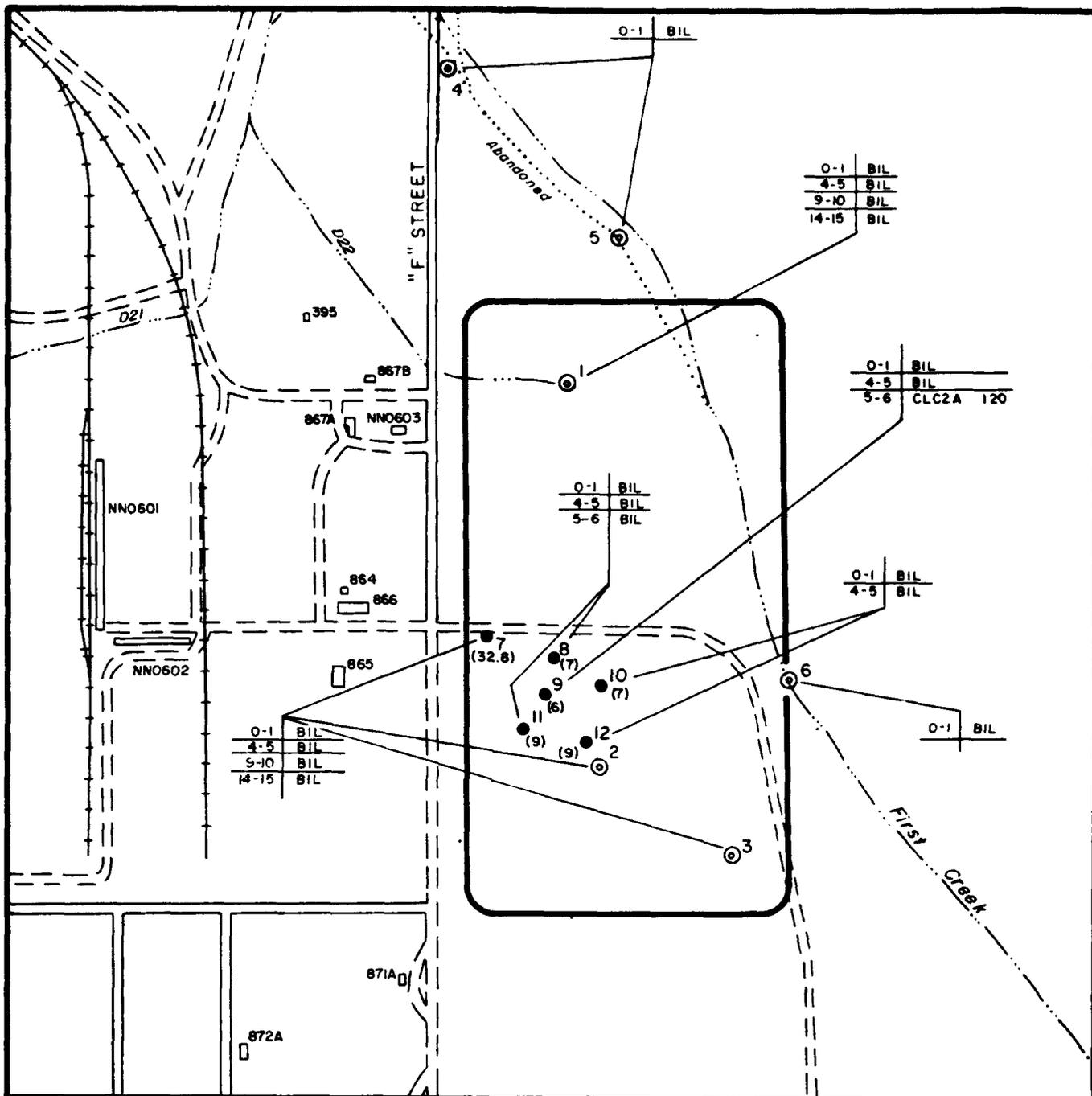
The locations and concentrations of the target contaminants that were detected in Site ESA-3a are shown in Figure ESA-3a-1. Table ESA-3a-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.8.3 Site Exposure Summary

Tables ESA-3a-2 through ESA-3a-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
None	--	--	--	--	--

The results of the soil exposure summary indicate that there are no COCs. Site ESA-3a is designated as a Priority 2 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Legend

- 2⊙ Phase I Boring
- 10● (7) Phase II Boring with Total Depth Drilled (ft.)
- Site Boundary

Sample Interval (ft.) | Analyte Concentration (ug/g)

5-6	CLC2A 120
-----	-----------

BIL - Below Indicator Level
 CLC2A - Chloroacetic acid

N

0 400
 FEET

Prepared for:

Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-3a-1

Phase I and Phase II Analytes Detected
 Within or Above Indicator Levels

Rocky Mountain Arsenal

Prepared by: Ebasco Services Incorporated

TABLE ESA-3a-1
 SOIL CONTAMINANT CONCENTRATIONS
 FOR SITE ESA-3a

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Chloroacetic acid	120	5-6	9	120	5-6	9

ESA
 Max. ug/g
 Eastern Study Area
 Maximum microgram per gram
 foot/feet

ESA-3a-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
CHLOROACETIC ACID	1.7E+04	0.0E+00	1.7E+04	7.3E-03	0.0E+00	7.3E-03	0.0E+00

ESA-3a-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
CHLOROACETIC ACID	1.7E+04	0.0E+00	1.7E+04	7.3E-03	0.0E+00	7.3E-03	0.0E+00

ESA-3a-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
CHLOROACETIC ACID	7.0E+03	0.0E+00	7.0E+03	1.7E-02	0.0E+00	1.7E-02	0.0E+00

ESA-3a-5

EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
CHLOROACETIC ACID	9.2E+03	0.0E+00	9.2E+03	1.3E-02	0.0E+00	1.3E-02	NA

ESA-3a-6

EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV	OSVI	ESVI	PPLV	EI	EI	EI	OPN	ENC
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)					
CHLOROACETIC ACID	1.7E+03	0.0E+00	0.0E+00	1.7E+03	7.1E-02	0.0E+00	7.1E-02	0.0E+00	NA

2.9 SITE ESA-3b: OLD TOXIC STORAGE YARD (formerly Site 6-6: Former Toxic Gas Storage Yard; EBASCO, 1988i/RIC 88196R02 and EBASCO, 1988j/RIC 88196R02A)

2.9.1 Site-Specific Considerations

Figure ESA-3b-1 and Table ESA-3b-1 depict the target contaminants for Site ESA-3b. Borings 1 through 29 were included in this exposure assessment, consistent with the Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3b (EBASCO, 1988i/RIC 88196R02).

2.9.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-3b are shown in Figure ESA-3b-1. 2-Butoxyethanol, occurring in Boring 5 (0-1 and 4-5 ft), is not included in this figure since it was not considered a target contaminant during the Phase I and Phase II investigations. Although not shown on this figure, this nontarget compound was included in the Eastern SAR and in this exposure assessment because it passed through the screening process performed in the RMA Chemical Index (EBASCO, 1988a/RIC 88357R01).

Table ESA-3b-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury for Horizon 2 because direct soil exposure from below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

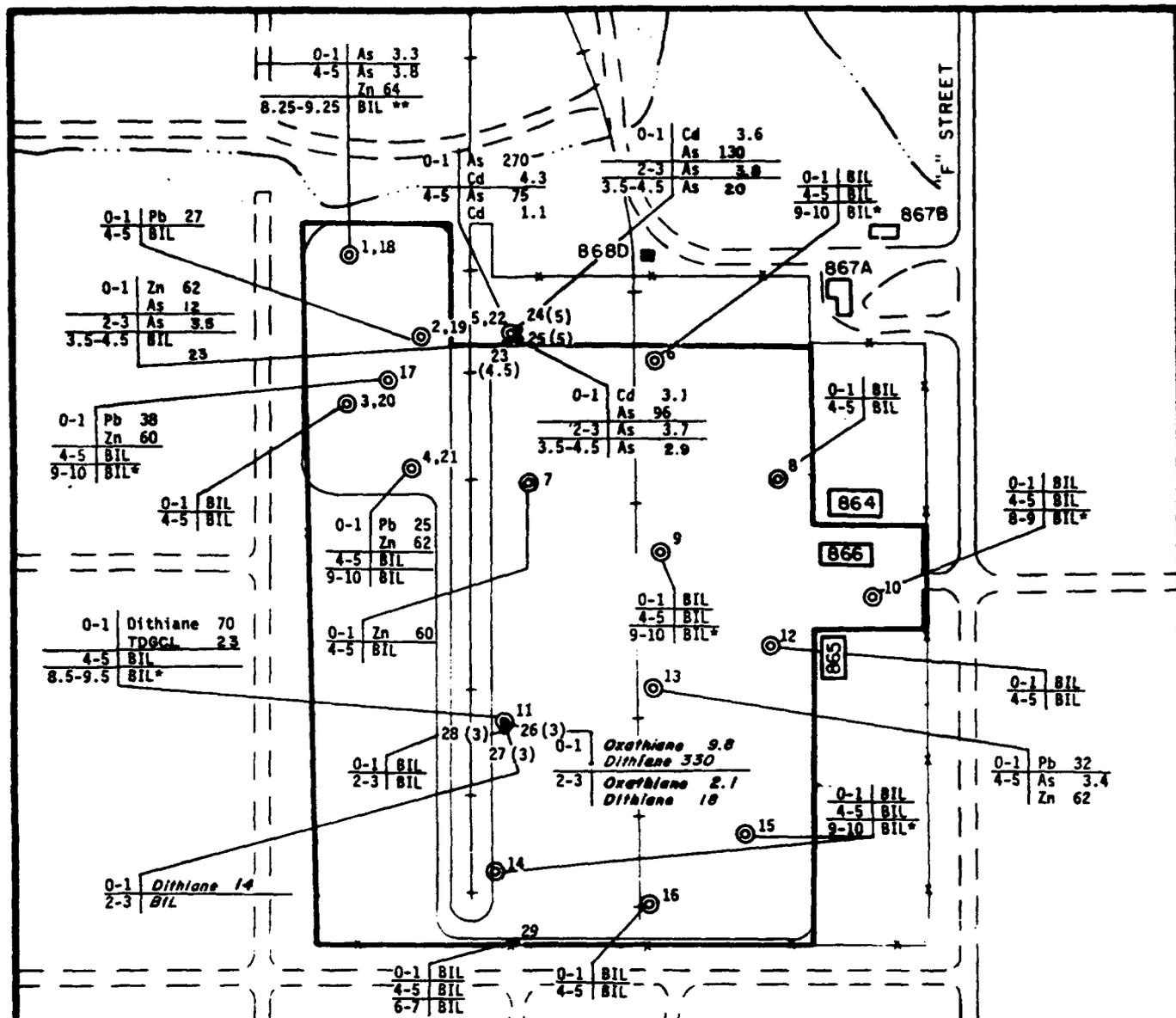
2.9.3 Site Exposure Summary

Tables ESA-3b-2 through ESA-3b-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Arsenic	Direct	Direct	Direct	Direct	Direct
Cadmium	--	--	--	--	Direct

Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-3b is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Prepared for:

Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-3b-1

Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels

Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

TABLE ESA-3b-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-3b

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
2-Butoxyethanol ^{1/}	0.30	0-1	5	0.30	0-1	5
		4-5	5		4-5	5
Dithiane	330	0-1	26	330	0-1	26
1,4-Oxathiane	9.8	0-1	26	9.8	0-1	26
Thiodiglycol	23	0-1	11	23	0-1	11
Arsenic	270	0-1	5	--	--	--
Cadmium	4.3	0-1	5	--	--	--

1/ Nontarget contaminant. Refer to the exposure assessment nontarget screen in Appendix A.

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-3b-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
DITHIANE	8.3E+04	0.0E+00	8.3E+04	4.0E-03	0.0E+00	4.0E-03	0.0E+00
1,4-OXATHIANE	2.5E+05	0.0E+00	2.5E+05	4.0E-05	0.0E+00	4.0E-05	0.0E+00
THIODIGLYCOL	3.3E+05	0.0E+00	3.3E+05	7.0E-05	0.0E+00	7.0E-05	0.0E+00
ARSENIC	2.2E+01	0.0E+00	2.2E+01	1.2E+01*	0.0E+00	1.2E+01*	0.0E+00
CADMIUM	4.5E+02	0.0E+00	4.5E+02	9.5E-03	0.0E+00	9.5E-03	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-3b-3

EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
DITHIANE	8.3E+04	0.0E+00	8.3E+04	4.0E-03	0.0E+00	4.0E-03	0.0E+00
1,4-OXATHIANE	2.5E+05	0.0E+00	2.5E+05	4.0E-05	0.0E+00	4.0E-05	0.0E+00
THIODIGLYCOL	3.3E+05	0.0E+00	3.3E+05	7.0E-05	0.0E+00	7.0E-05	0.0E+00
ARSENIC	2.2E+01	0.0E+00	2.2E+01	1.2E+01*	0.0E+00	1.2E+01*	0.0E+00
CADMIUM	4.5E+02	0.0E+00	4.5E+02	9.5E-03	0.0E+00	9.5E-03	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-3b-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV	PPLV	PPLV	EI	EI	EI	OPN
	(mg/kg)	(mg/kg)	(mg/kg)				
DITHIANE	3.5E+04	0.0E+00	3.5E+04	9.4E-03	0.0E+00	9.4E-03	0.0E+00
1,4-OXATHIANE	1.1E+05	0.0E+00	1.1E+05	9.3E-05	0.0E+00	9.3E-05	0.0E+00
THIODIGLYCOL	1.4E+05	0.0E+00	1.4E+05	1.6E-04	0.0E+00	1.6E-04	0.0E+00
ARSENIC	3.9E+00	0.0E+00	3.9E+00	6.8E+01*	0.0E+00	6.8E+01*	0.0E+00
CADMIUM	5.8E+01	0.0E+00	5.8E+01	7.4E-02	0.0E+00	7.4E-02	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-3b-5

EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
DITHIANE	4.6E+04	0.0E+00	4.6E+04	7.2E-03	0.0E+00	7.2E-03	NA
1,4-OXATHIANE	1.4E+05	0.0E+00	1.4E+05	7.1E-05	0.0E+00	7.1E-05	NA
THIODIGLYCOL	1.8E+05	0.0E+00	1.8E+05	1.3E-04	0.0E+00	1.3E-04	NA
ARSENIC	2.0E+01	0.0E+00	2.0E+01	1.4E+01*	0.0E+00	1.4E+01*	NA
CADMIUM	3.6E+02	0.0E+00	3.6E+02	1.2E-02	0.0E+00	1.2E-02	NA

*: EI is equal to or exceeds 1.0E-01

ESA-3b-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
DITHIANE	8.5E+03	0.0E+00	0.0E+00	8.5E+03	3.9E-02	0.0E+00	3.9E-02	0.0E+00	NA
1,4-OXATHIANE	2.5E+04	0.0E+00	0.0E+00	2.5E+04	3.9E-04	0.0E+00	3.9E-04	0.0E+00	NA
THIODIGLYCOL	3.4E+04	0.0E+00	0.0E+00	3.4E+04	6.8E-04	0.0E+00	6.8E-04	0.0E+00	NA
ARSENIC	1.6E+00	0.0E+00	0.0E+00	1.6E+00	1.7E+02*	0.0E+00	1.7E+02*	0.0E+00	NA
CADMIUM	7.6E+00	0.0E+00	0.0E+00	7.6E+00	5.6E-01*	0.0E+00	5.6E-01*	0.0E+00	NA

*: EI is equal to or exceeds 1.0E-01

2.10 SITE ESA-3c: NEW TOXIC STORAGE YARD (formerly Site 31-4: Toxic Storage Yard; EBASCO, 1988k/RIC 88196R09 and EBASCO, 1988l/RIC 88196R09A)

2.10.1 Site-Specific Considerations

Figure ESA-3c-1 and Table ESA-3c-1 depict the target contaminants for Site ESA-3c. Borings 1 through 18, 21, and 22 were included in this exposure assessment, consistent with the Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3c (EBASCO, 1988k/RIC 88196R09).

2.10.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-3c are shown in Figure ESA-3c-1. Table ESA-3c-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury for Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.10.3 Site Exposure Summary

Tables ESA-3c-2 through ESA-3c-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Trichloroethylene	--	--	--	Indirect	Indirect

Note: Indirect exposure pathways include open and enclosed space vapor inhalation.

The results of the soil exposure summary indicate that exposure to contamination from the indirect pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-3c is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).

TABLE ESA-3c-1
 SOIL CONTAMINANT CONCENTRATIONS
 FOR SITE ESA-3c

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Trichloroethylene	0.80	9-10	21	0.80	9-10	21
Lead	54	0-1	9	--	--	--
Zinc	180	0-1	21	--	--	--

ESA
 Max.
 ug/g
 ft

Eastern Study Area
 Maximum
 microgram per gram
 foot/feet

ESA-3c-2
EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
TRICHLOROETHYLENE	2.3E+03	5.8E+03	1.6E+03	3.5E-04	1.4E-04	4.9E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	3.5E-03	0.0E+00	3.5E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	9.1E-05	0.0E+00	9.1E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3c-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
TRICHLOROETHYLENE	2.3E+03	5.8E+03	1.6E+03	3.5E-04	1.4E-04	4.9E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	3.5E-03	0.0E+00	3.5E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	9.1E-05	0.0E+00	9.1E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3c-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPM
TRICHLOROETHYLENE	3.2E+02	8.9E+02	2.3E+02	2.5E-03	8.9E-04	3.4E-03	0.0E+00
LEAD	9.2E+03	0.0E+00	9.2E+03	5.8E-03	0.0E+00	5.8E-03	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	1.7E-04	0.0E+00	1.7E-04	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3c-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
TRICHLOROETHYLENE	2.9E+03	2.5E+00	2.5E+00	2.8E-04	3.2E-01*	3.2E-01*	0.0E+00
LEAD	6.5E+03	0.0E+00	6.5E+03	8.3E-03	0.0E+00	8.3E-03	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	2.3E-04	0.0E+00	2.3E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-3c-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
TRICHLOROETHYLENE	1.8E+02	7.7E+02	2.5E+00	2.4E+00	4.6E-03	3.2E-01*	3.3E-01*	0.0E+00	0.0E+00
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	2.5E-02	0.0E+00	2.5E-02	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	1.3E-03	0.0E+00	1.3E-03	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

2.11 SITE ESA-3d: TOXIC YARD PLOTS (formerly Site 31-6: Toxic Yard Storage Sheds; EBASCO, 1988m/RIC 88196R03 and EBASCO, 1988n/RIC 88196R03A; and Site 31-7: Toxic Storage Yard Storage Sheds; EBASCO, 1988o/RIC 88166R02 and EBASCO, 1988p/RIC 88166R02A)

2.11.1 Site-Specific Considerations

Figures ESA-3d-1 and ESA-3d-2 and Table ESA-3d-1 depict the target contaminants for Site ESA-3d. Borings 1 through 24 for Site 31-6 (Figure ESA-3d-1) and 1 through 26, 28 through 30, 32, 33, 33B, 34, 35, 37, and 37B for Site 31-7 (Figure ESA-3d-2) were included in the exposure assessment, consistent with the Eastern SAR. The historical search conducted under the contamination assessment revealed that spills or leaks of Sarin (GB) and Mustard and sprayings of Malathion and Aldrin may have occurred on Site ESA-3d (EBASCO, 1988m/RIC 88196R03 and EBASCO, 1988o/RIC 88166R02), but these chemicals and their degradation products were not detected during the Phase I and Phase II investigations. According to the site history, no other chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3d (EBASCO, 1988m/RIC 88196R03 and EBASCO, 1988o/RIC 88166R02).

2.11.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-3d are shown in Figures ESA-3d-1 and ESA-3d-2. Table ESA-3d-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury for Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

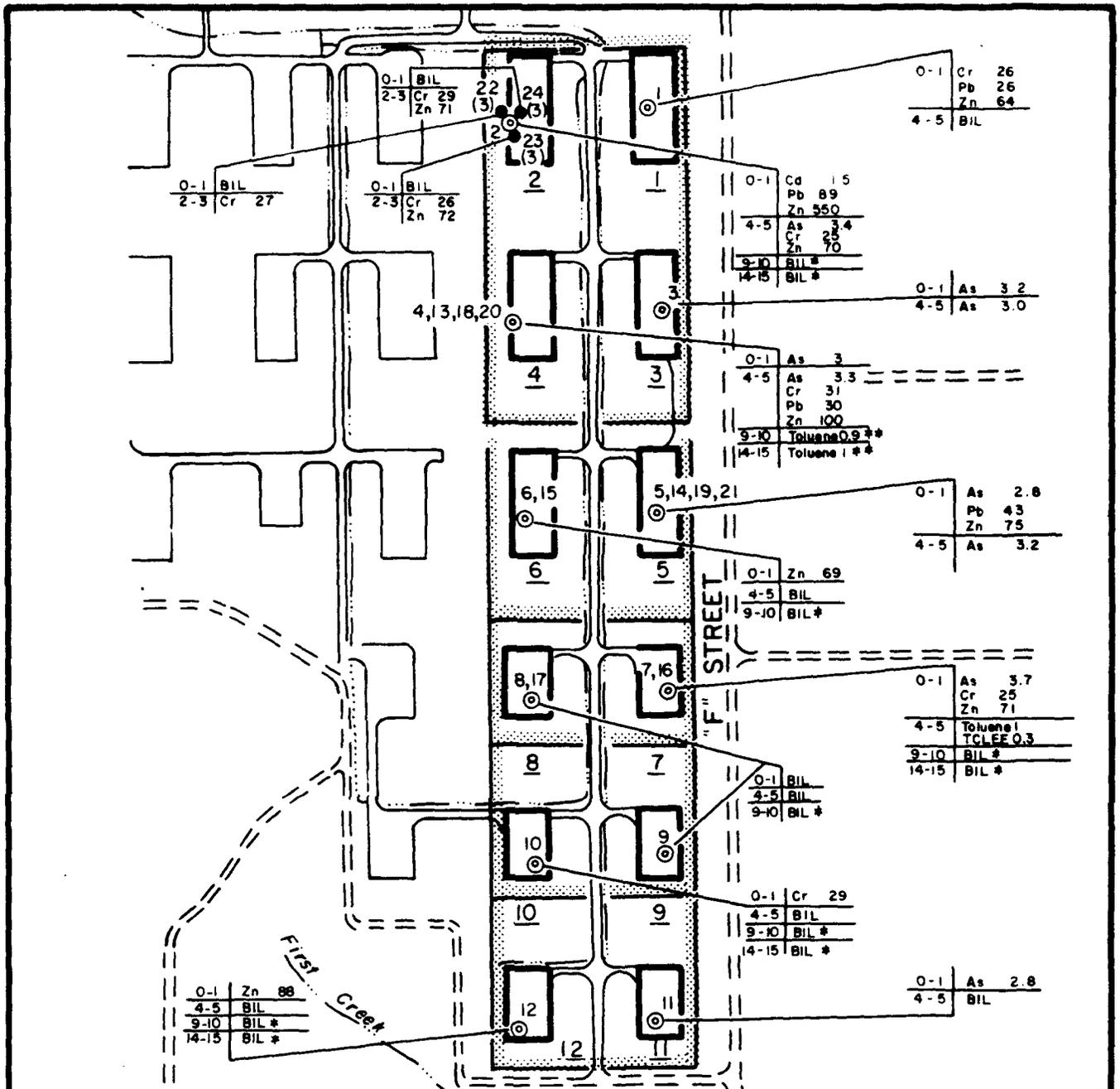
2.11.3 Site Exposure Summary

Tables ESA-3d-2 through ESA-3d-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Chromium	Direct	Direct	Direct	Direct	Direct

Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-3d is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Legend

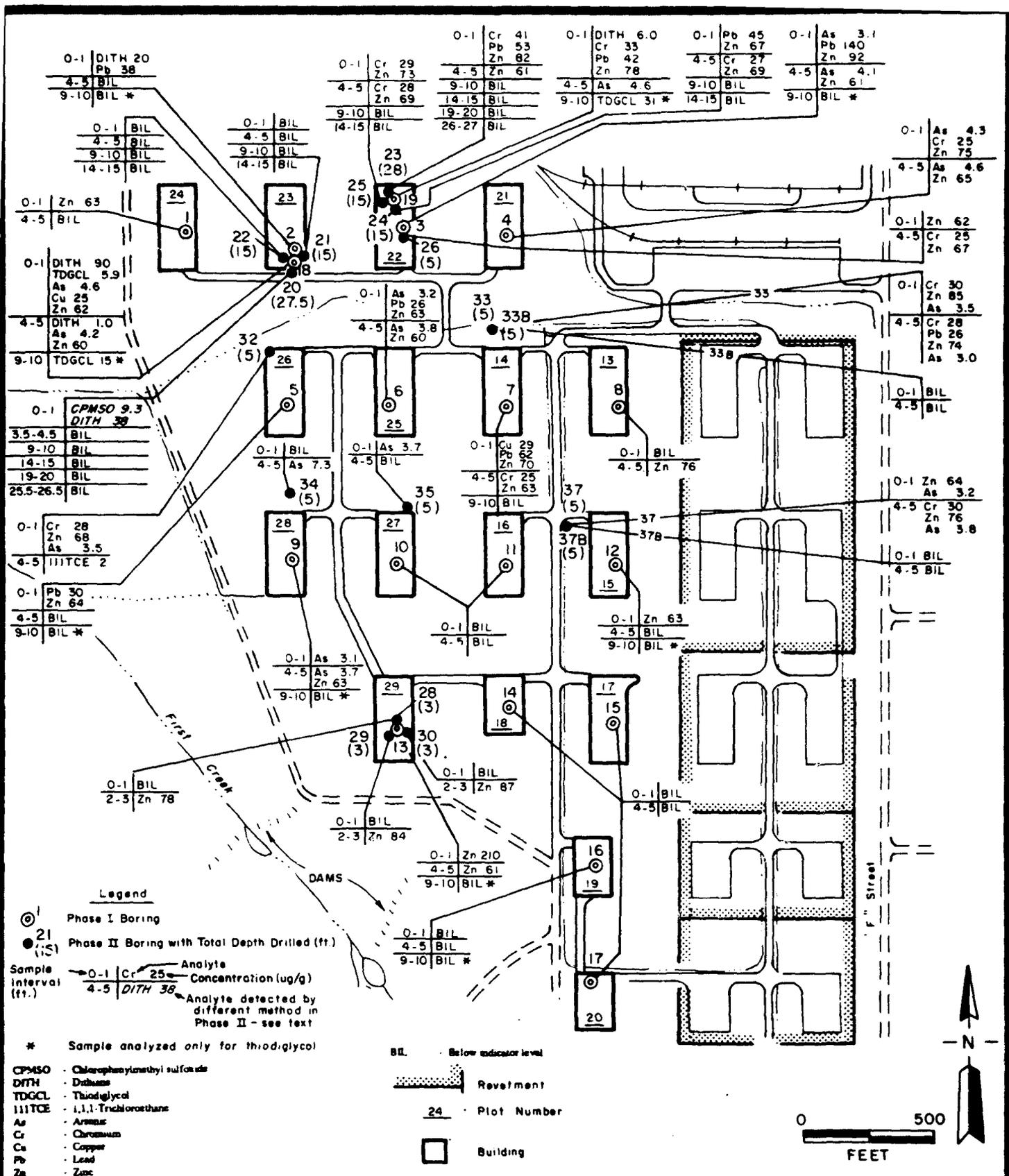
- ⊙ | Phase I Boring
- ⊙ | Phase II Boring with Total Depth Drilled (ft)
- Sample Interval (ft.) | 0-1 | Pb 43 | Analyte Concentration (ug/g)
- * Analyzed only for isopropylmethyphosphonic acid
- ** Analyzed only for volatile organic compounds and GB degradation products
- Building
- 6 Plot Number
- Site Boundary
- ▨ Revetment
- BIL - Below indicator level
- TCLEE - Tetrachloroethylene
- As - Arsenic
- Cd - Cadmium
- Cr - Chromium
- Pb - Lead
- Zn - Zinc

Prepared for:

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

FIGURE ESA-3d-1
Phase I and Phase II Analytes
Detected Within or Above Indicator
Levels

Rocky Mountain Arsenal
Prepared by: Ebasco Services Incorporated



Prepared for:

Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-3d-2

**Phase I and Phase II Analytes Detected
 Within or Above Indicator Levels**

Rocky Mountain Arsenal

Prepared by Ebasco Services Incorporated

TABLE ESA-3d-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-3d

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Chlorophenylmethyl sulfoxide	9.3	0-1	20+	9.3	0-1	20+
Dithiane	90	0-1	18+	90	0-1	18+
Tetrachloroethylene	0.3	4-5	7	0.3	4-5	7
Toluene	1	4-5	7	1	4-5	7
Thiodiglycol	--	--	--	31	14-15	4
1,1,1-Trichloroethane	2	9-10	19+	2	9-10	19+
Chromium	41	4-5	32	2	4-5	32
Lead	140	0-1	23	--	--	--
Zinc	550	0-1	3+	--	--	--
			2	--	--	--

+ Boring is in Figure ESA-3d-2.

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-3d-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV	PPLV	PPLV	EI	EI	EI	OPN
	(mg/kg)	(mg/kg)	(mg/kg)				
CHLOROPHENYLMETHYL SULFOXIDE	1.6E+05	1.4E+06	1.5E+05	5.7E-05	6.7E-06	6.4E-05	0.0E+00
DITHIANE	8.3E+04	0.0E+00	8.3E+04	1.1E-03	0.0E+00	1.1E-03	0.0E+00
TETRACHLOROETHYLENE	5.1E+02	1.6E+04	5.0E+02	5.9E-04	1.9E-05	6.1E-04	0.0E+00
TRICHOGLYCOL	3.3E+05	0.0E+00	3.3E+05	9.4E-05	0.0E+00	9.4E-05	0.0E+00
TOLUENE	2.5E+06	3.6E+06	1.5E+06	4.0E-07	2.8E-07	6.8E-07	0.0E+00
1,1,1-TRICHLOROETHANE	7.5E+05	1.7E+06	5.2E+05	2.7E-06	1.1E-06	3.8E-06	0.0E+00
CHROMIUM	6.9E+01	0.0E+00	6.9E+01	5.9E-01*	0.0E+00	5.9E-01*	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	9.1E-03	0.0E+00	9.1E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	2.8E-04	0.0E+00	2.8E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3d-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
CHLOROPHENYLMETHYL SULFOXIDE	1.6E+05	1.4E+06	1.5E+05	5.7E-05	6.7E-06	6.4E-05	0.0E+00
DITHIANE	8.3E+04	0.0E+00	8.3E+04	1.1E-03	0.0E+00	1.1E-03	0.0E+00
TETRACHLOROETHYLENE	5.1E+02	1.6E+04	5.0E+02	5.9E-04	1.9E-05	6.1E-04	0.0E+00
THIODIGLYCOL	3.3E+05	0.0E+00	3.3E+05	9.4E-05	0.0E+00	9.4E-05	0.0E+00
TOLUENE	2.5E+06	3.6E+06	1.5E+06	4.0E-07	2.8E-07	6.8E-07	0.0E+00
1,1,1-TRICHLOROETHANE	7.5E+05	1.7E+06	5.2E+05	2.7E-06	1.1E-06	3.8E-06	0.0E+00
CHROMIUM	6.9E+01	0.0E+00	6.9E+01	5.9E-01*	0.0E+00	5.9E-01*	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	9.1E-03	0.0E+00	9.1E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	2.8E-04	0.0E+00	2.8E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3d-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
CHLOROPHENYLMETHYL SULFOXIDE	7.0E+04	5.0E+05	6.1E+04	1.3E-04	1.9E-05	1.5E-04	0.0E+00
DITHIANE	3.5E+04	0.0E+00	3.5E+04	2.6E-03	0.0E+00	2.6E-03	0.0E+00
TETRACHLOROETHYLENE	7.1E+01	2.5E+03	6.9E+01	4.2E-03	1.2E-04	4.3E-03	0.0E+00
THIODIGLYCOL	1.4E+05	0.0E+00	1.4E+05	2.2E-04	0.0E+00	2.2E-04	0.0E+00
TOLUENE	1.1E+06	1.3E+06	5.8E+05	9.4E-07	7.8E-07	1.7E-06	0.0E+00
1,1,1-TRICHLOROETHANE	3.2E+05	6.3E+05	2.1E+05	6.3E-06	3.2E-06	9.5E-06	0.0E+00
CHROMIUM	8.8E+00	0.0E+00	8.8E+00	4.7E+00*	0.0E+00	4.7E+00*	0.0E+00
LEAD	9.2E+03	0.0E+00	9.2E+03	1.5E-02	0.0E+00	1.5E-02	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	5.2E-04	0.0E+00	5.2E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3d-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI ENC
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	
CHLOROPHENYLMETHYL SULFOXIDE	9.1E+04	1.9E+04	1.6E+04	1.0E-04	4.9E-04	5.9E-04	0.0E+00
DITHIANE	4.6E+04	0.0E+00	4.6E+04	2.0E-03	0.0E+00	2.0E-03	0.0E+00
TETRACHLOROETHYLENE	6.5E+02	2.2E+02	1.7E+02	4.6E-04	1.3E-03	1.8E-03	0.0E+00
THIODIGLYCOL	1.8E+05	0.0E+00	1.8E+05	1.7E-04	0.0E+00	1.7E-04	0.0E+00
TOLUENE	1.4E+06	9.8E+02	9.8E+02	7.2E-07	1.0E-03	1.0E-03	0.0E+00
1,1,1-TRICHLOROETHANE	4.2E+05	4.6E+02	4.6E+02	4.8E-06	4.3E-03	4.3E-03	0.0E+00
CHROMIUM	5.5E+01	0.0E+00	5.5E+01	7.5E-01*	0.0E+00	7.5E-01*	0.0E+00
LEAD	6.5E+03	0.0E+00	6.5E+03	2.1E-02	0.0E+00	2.1E-02	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	7.0E-04	0.0E+00	7.0E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3d-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
CHLOROPHENYLMETHYL SULFOXIDE	1.7E+04	1.8E+05	5.7E+04	1.2E+04	5.6E-04	2.1E-04	7.7E-04	0.0E+00	0.0E+00
DITHIANE	8.5E+03	0.0E+00	0.0E+00	8.5E+03	1.1E-02	0.0E+00	1.1E-02	0.0E+00	0.0E+00
TETRACHLOROETHYLENE	4.1E+01	2.1E+03	2.2E+02	3.4E+01	7.3E-03	1.5E-03	8.8E-03	0.0E+00	0.0E+00
THIODIGLYCOL	3.4E+04	0.0E+00	0.0E+00	3.4E+04	9.2E-04	0.0E+00	9.2E-04	0.0E+00	0.0E+00
TOLUENE	2.6E+05	4.8E+05	2.9E+03	2.9E+03	3.9E-06	3.4E-04	3.5E-04	0.0E+00	0.0E+00
1,1,1-TRICHLOROETHANE	7.8E+04	2.3E+05	1.4E+03	1.4E+03	2.6E-05	1.4E-03	1.5E-03	0.0E+00	0.0E+00
CHROMIUM	1.1E+00	0.0E+00	0.0E+00	1.1E+00	3.6E+01*	0.0E+00	3.6E+01*	0.0E+00	0.0E+00
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	6.4E-02	0.0E+00	6.4E-02	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	3.9E-03	0.0E+00	3.9E-03	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

2.12 SITE ESA-3e: CONCRETE VX DEMILITARIZATION PAD (formerly Site 31-4: Toxic Storage Yard; EBASCO, 1988k/RIC 88196R09 and EBASCO, 1988l/RIC 88196R09A)

2.12.1 Site-Specific Considerations

Figure ESA-3e-1 and Table ESA-3e-1 depict the target contaminants for Site ESA-3e. Borings 19, 20, and 25 were included in the exposure assessment, consistent with Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3e (EBASCO, 1988k/RIC 88196R09).

2.12.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-3e are shown in Figure ESA-3e-1. 1,1,2,2-Tetrachloroethane, occurring in Boring 19 (0-1 ft), was not included in this figure, since it was detected in the nontarget analysis during the Phase I and Phase II investigations. Although not shown in this figure, this nontarget compound was included in the Eastern SAR and in this exposure assessment because it passed through the screening process performed in the RMA Chemical Index (EBASCO 1988a/RIC 88357R01).

Table ESA-3e-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury for Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.12.3 Site Exposure Summary

Tables ESA-3e-2 through ESA-3e-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
None	--	--	--	--	--

The results of the soil exposure summary indicate that there are no COCs. Site ESA-3e is designated as a Priority 2 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).

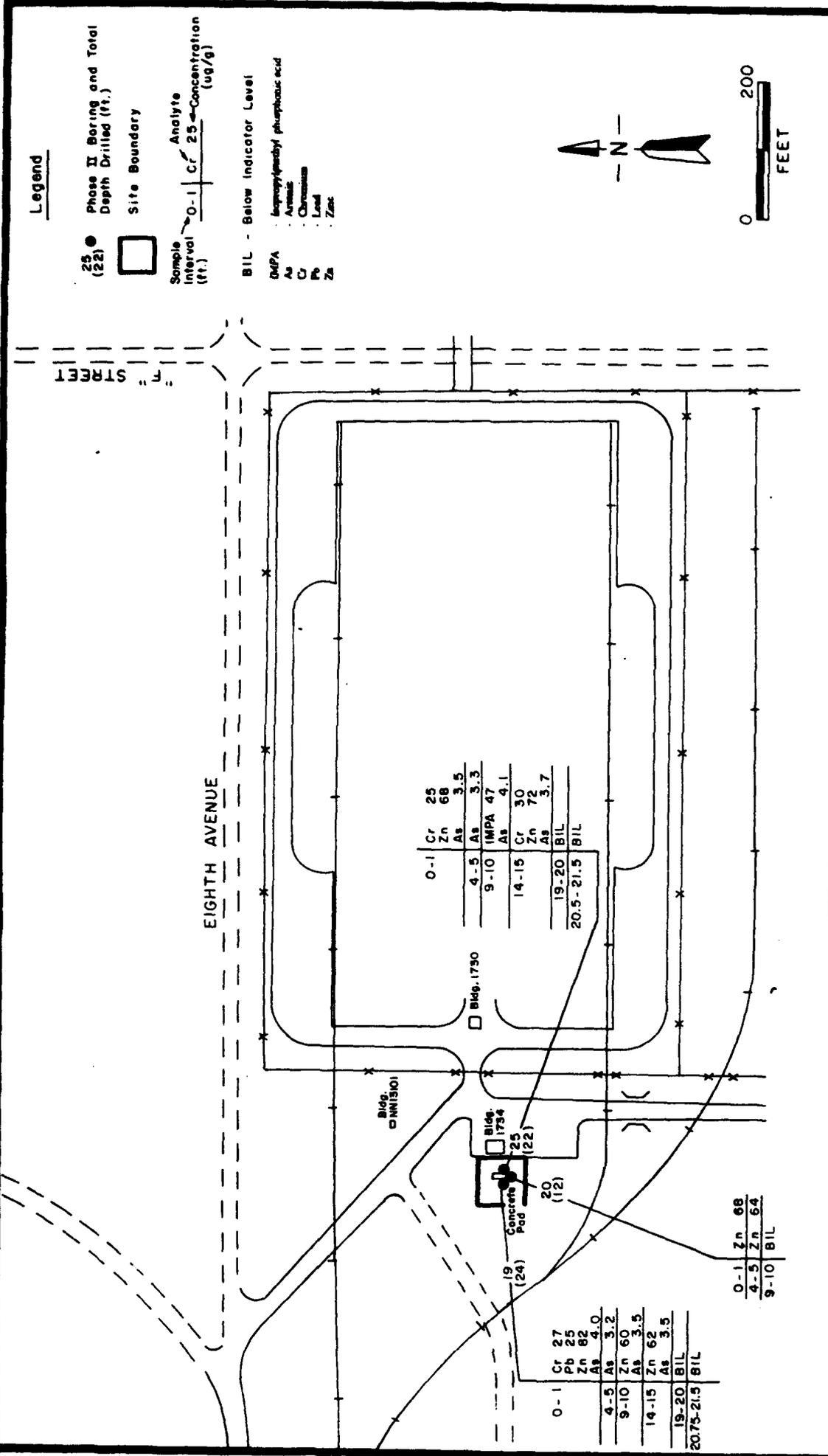


FIGURE ESA-3e-1
 Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

TABLE ESA-3e-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-3e

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Isopropylmethyl phosphonic acid	47	9-10	25	47	9-10	25
1,1,2,2-Tetrachloroethane ^{1/}	0.60	0-1	19	0.60	0-1	19
Zinc	82	0-1	19	--	--	--

1/ Nontarget contaminant. Refer to the exposure assessment nontarget screen in Appendix A.

ESA Max. ug/g ft Eastern Study Area Maximum microgram per gram foot/feet

ESA-3e-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
ISOPROPYL METHYL PHOSPHONIC ACID	2.5E+06	0.0E+00	2.5E+06	1.9E-05	0.0E+00	1.9E-05	0.0E+00
1,1,2,2-TETRACHLOROETHANE	1.3E+02	1.1E+03	1.1E+02	4.7E-03	5.4E-04	5.3E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	4.1E-05	0.0E+00	4.1E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3e-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
ISOPROPYL METHYL PHOSPHONIC ACID	2.5E+06	0.0E+00	2.5E+06	1.9E-05	0.0E+00	1.9E-05	0.0E+00
1,1,2,2-TETRACHLOROETHANE	1.3E+02	1.1E+03	1.1E+02	4.7E-03	5.4E-04	5.3E-03	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	4.1E-05	0.0E+00	4.1E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3e-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
ISOPROPYL METHYL PHOSPHONIC ACID	1.1E+06	0.0E+00	1.1E+06	4.5E-05	0.0E+00	4.5E-05	0.0E+00
1,1,2,2-TETRACHLOROETHANE	1.8E+01	1.7E+02	1.6E+01	3.4E-02	3.5E-03	3.8E-02	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	7.8E-05	0.0E+00	7.8E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3e-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	ENC
ISOPROPYL METHYL PHOSPHONIC ACID	1.4E+06	0.0E+00	1.4E+06	3.4E-05	0.0E+00	3.4E-05	0.0E+00
1,1,2,2-TETRACHLOROETHANE	1.6E+02	3.4E+01	2.8E+01	3.7E-03	1.8E-02	2.2E-02	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	1.0E-04	0.0E+00	1.0E-04	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3e-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
ISOPROPYL METHYL PHOSPHONIC ACID	2.5E+05	0.0E+00	0.0E+00	2.5E+05	1.9E-04	0.0E+00	1.9E-04	0.0E+00	0.0E+00
1,1,2,2-TETRACHLOROETHANE	9.9E+00	1.5E+02	3.4E+01	7.3E+00	6.1E-02	2.2E-02	8.3E-02	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	5.9E-04	0.0E+00	5.9E-04	0.0E+00	0.0E+00

2.13 SITE ESA-3f: RAIL SPUR AND LOADING DOCK (formerly Site 31-4: Toxic Storage Yard; EBASCO, 1988k/RIC 88196R09 and EBASCO, 1988l/RIC 88196R09A)

2.13.1 Site-Specific Considerations

Figure ESA-3f-1 and Table ESA-3f-1 depict the target contaminants for Site ESA-3f. Borings 23 and 24 were included in the exposure assessment, consistent with the Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3f (EBASCO, 1988k/RIC 88196R09).

2.13.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-3f are shown in Figure ESA-3f-1. Table ESA-3f-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). No organic contaminants were detected at this location. Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.13.3 Site Exposure Summary

Tables ESA-3f-2 through ESA-3f-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
None	--	--	--	--	--

The results of the soil exposure summary indicate that there are no COCs. Site ESA-3f is designated as a Priority 2 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).

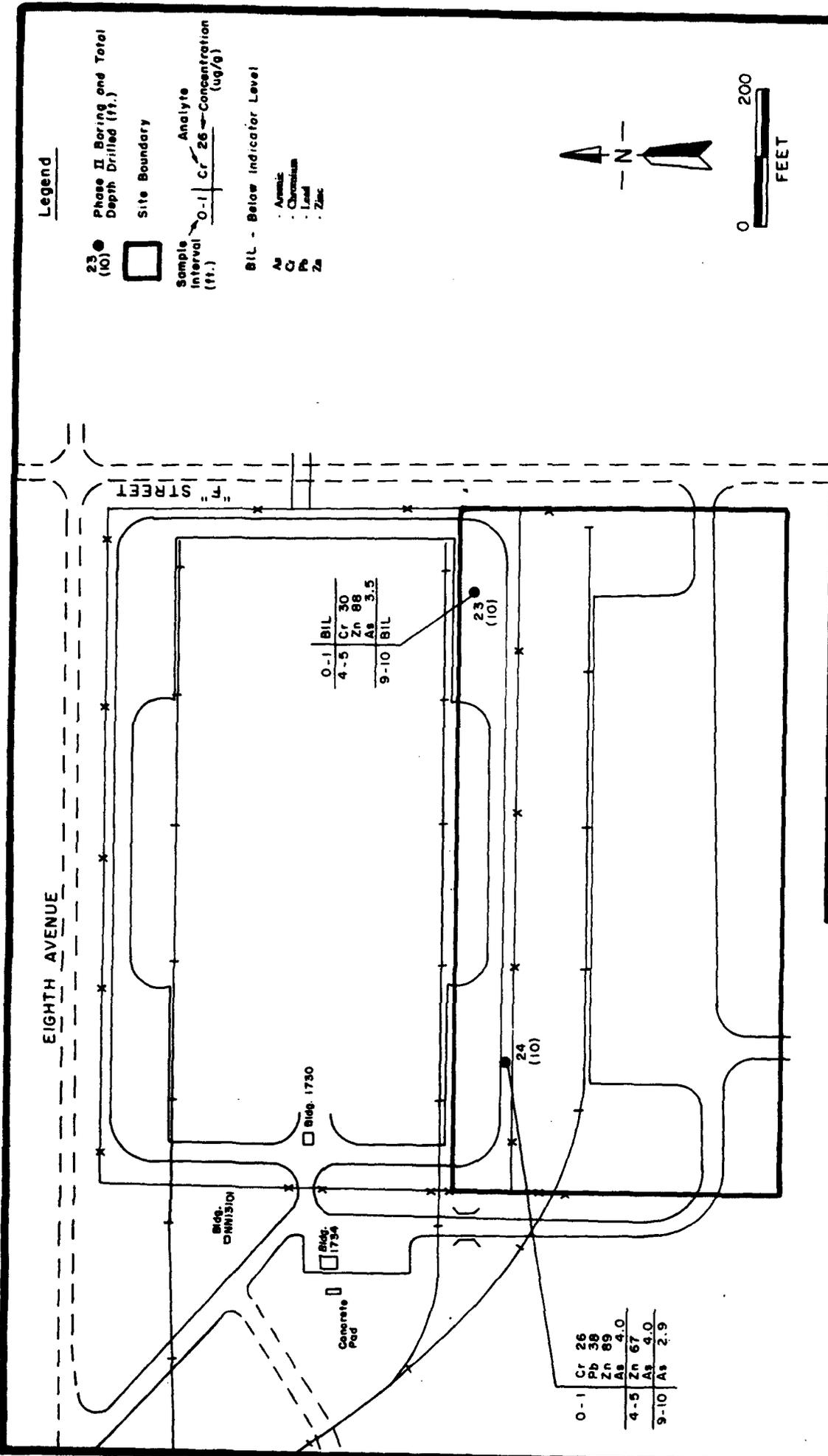


FIGURE ESA-3f-1
 Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

TABLE ESA-3f-1
 SOIL CONTAMINANT CONCENTRATIONS
 FOR SITE ESA-3f

Contaminant	Horizon 1		Horizon 2	
	Max. (ug/g)	Depth (ft)	Boring Number	Depth (ft)
Zinc	89	0-1	24	--

ESA Max. ug/g ft
 Eastern Study Area
 Maximum microgram per gram
 foot/feet

ESA-3f-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
ZINC	2.0E+06	0.0E+00	2.0E+06	4.5E-05	0.0E+00	4.5E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3f-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
ZINC	2.0E+06	0.0E+00	2.0E+06	4.5E-05	0.0E+00	4.5E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3f-4
EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
ZINC	1.1E+06	0.0E+00	1.1E+06	8.5E-05	0.0E+00	8.5E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-3f-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
ZINC	7.8E+05	0.0E+00	7.8E+05	1.1E-04	0.0E+00	1.1E-04	0.0E+00

ESA-3f-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	6.4E-04	0.0E+00	6.4E-04	0.0E+00	0.0E+00

2.14 SITE ESA-3g: OPEN DRUM STORAGE AREA (formerly Site 31-7: Toxic Storage Yard Storage Sheds; EBASCO, 1988o/RIC 88166R02 and EBASCO, 1988p/RIC 88166R02A)

2.14.1 Site-Specific Considerations

Figure ESA-3g-1 and Table ESA-3g-1 depict the target contaminants for Site ESA-3g. Borings 27 and 36 were included in this exposure assessment, consistent with the Eastern SAR. The historical search conducted under the contaminant assessment revealed that spills and leaks of GB and Mustard and sprayings of Malathion and Aldrin may have occurred on Site 31-7 (EBASCO, 1988o/RIC 88166R02); however, these chemicals were not detected in the soil during the Phase I and Phase II investigations. According to site history, no other chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3g (EBASCO, 1988o/RIC 88166R02).

2.14.2 Spatial Distribution of Measured Contaminant Concentrations

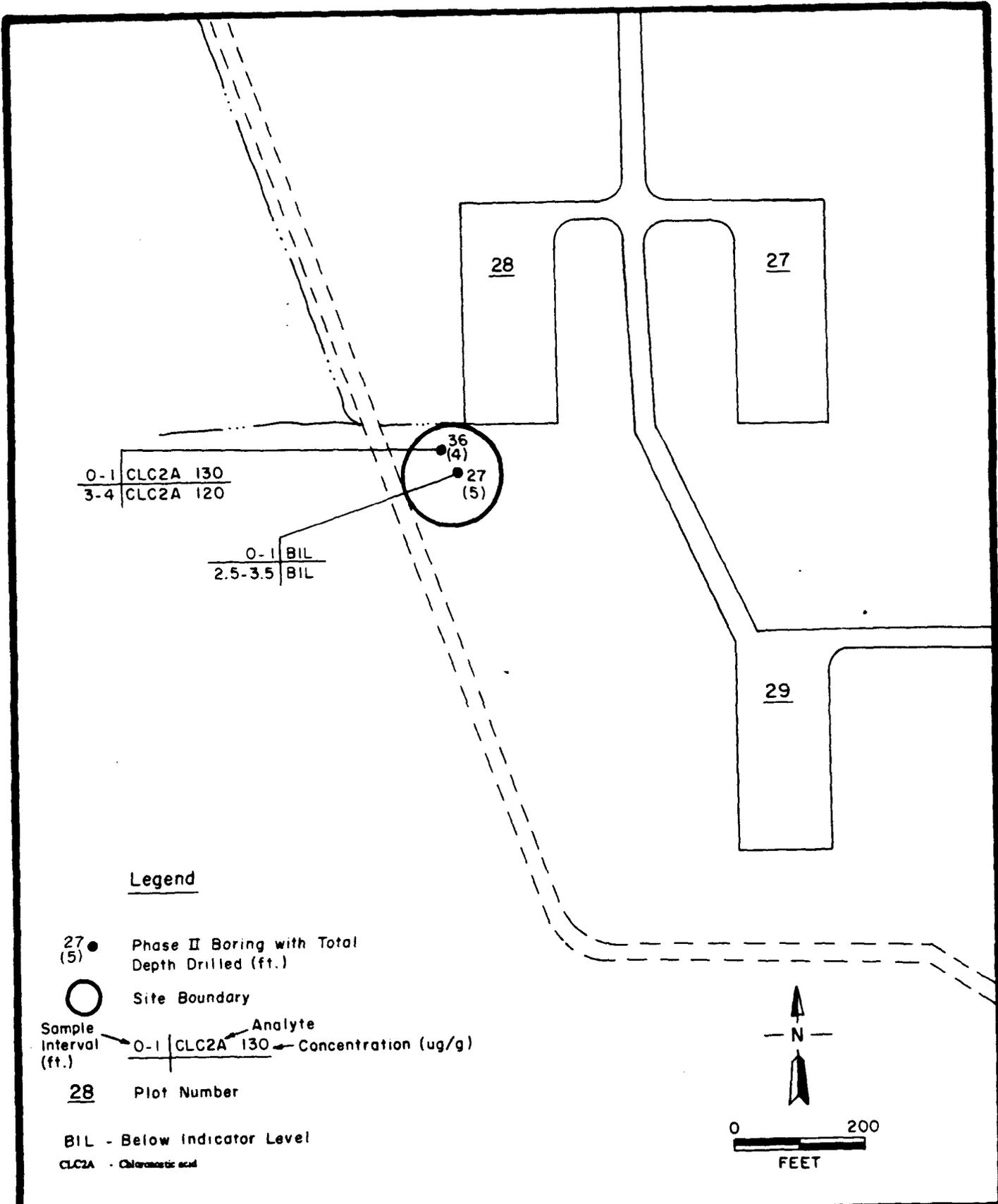
The locations and concentrations of the target contaminants that were detected in Site ESA-3g are shown in Figure ESA-3g-1. Table ESA-3g-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.14.3 Site Exposure Summary

Tables ESA-3g-2 through ESA-3g-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
None	--	--	--	--	--

The results of the soil exposure summary indicate that there are no COCs. Site ESA-3g is designated as a Priority 2 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Prepared for:

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

FIGURE ESA-3g-1

Phase I and Phase II Analytes
Detected Within or Above
Indicator Levels

Rocky Mountain Arsenal
Prepared by: Ebasco Services Incorporated

TABLE ESA-3g-1
 SOIL CONTAMINANT CONCENTRATIONS
 FOR SITE ESA-3g

Contaminant	Horizon 1		Horizon 2	
	Max. (ug/g)	Depth (ft)	Boring Number	Depth (ft)
Chloroacetic acid	130	0-1	36	0-1

ESA Max. ug/g ft
 Eastern Study Area
 Maximum microgram per gram
 foot/feet

ESA-3g-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
CHLOROACETIC ACID	1.7E+04	0.0E+00	1.7E+04	7.9E-03	0.0E+00	7.9E-03	0.0E+00

ESA-3g-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
CHLOROACETIC ACID	1.7E+04	0.0E+00	1.7E+04	7.9E-03	0.0E+00	7.9E-03	0.0E+00

ESA-3g-4
EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
CHLOROACETIC ACID	7.0E+03	0.0E+00	7.0E+03	1.8E-02	0.0E+00	1.8E-02	0.0E+00

ESA-3g-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
CHLOROACETIC ACID	9.2E+03	0.0E+00	9.2E+03	1.4E-02	0.0E+00	1.4E-02	0.0E+00

ESA-3g-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
CHLOROACETIC ACID	1.7E+03	0.0E+00	0.0E+00	1.7E+03	7.7E-02	0.0E+00	7.7E-02	0.0E+00	0.0E+00

2.15 SITE ESA-3h: OPEN STORAGE AREA DITCH (formerly Site 31-7: Toxic Storage Yard Storage Sheds; EBASCO, 1988o/RIC 88166R02 and EBASCO, 1988p/RIC 88166R02A; and Section 31-Nonsource Area, EBASCO, 1987b/RIC 87336R11 and EBASCO, 1988s/RIC87336R11A)

2.15.1 Site-Specific Considerations

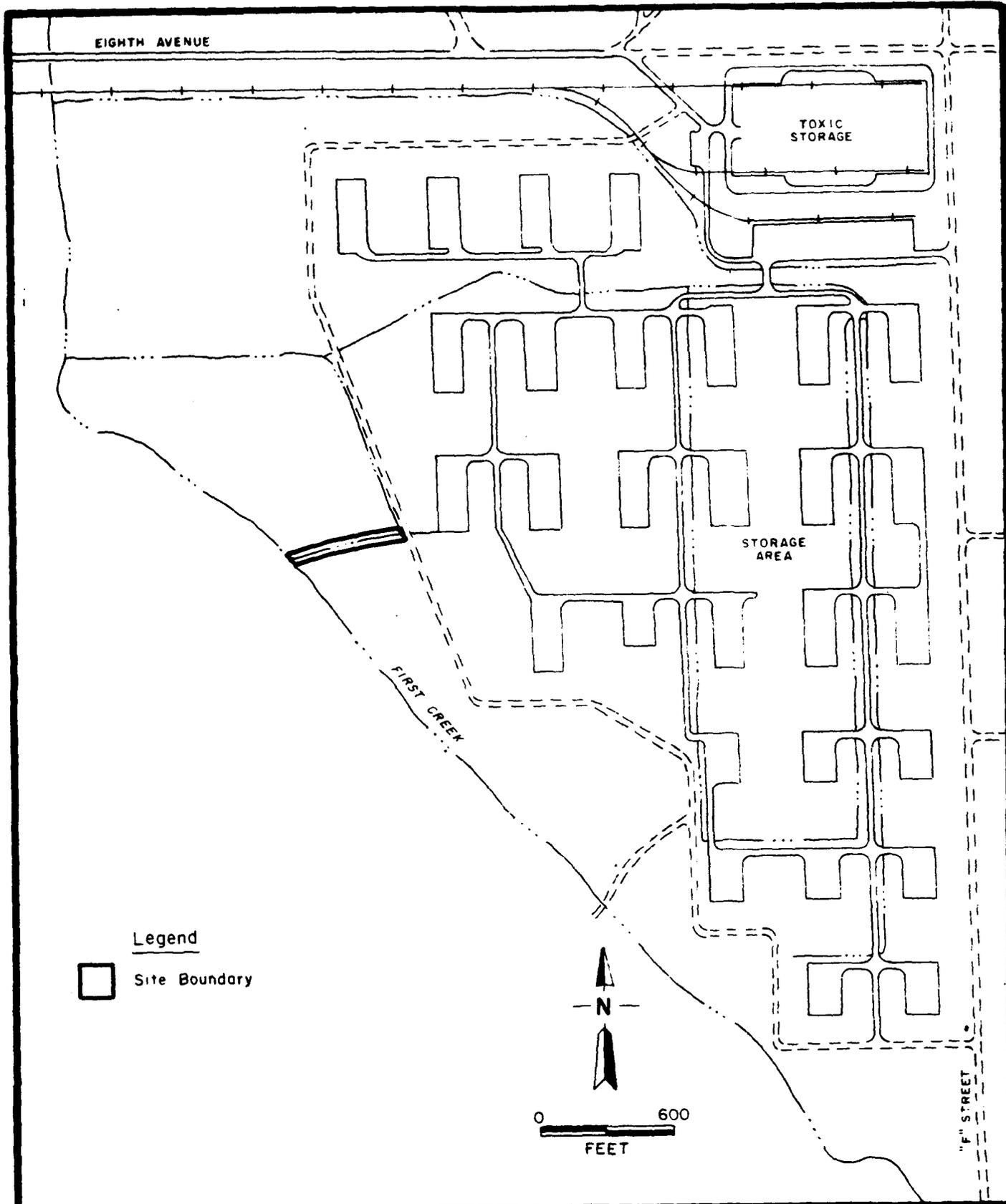
No borings were included in this exposure assessment, since contamination is inferred via migration through the ditch originating from ESA-3g, consistent with the Eastern SAR. Therefore, Figure ESA-3h-1 and Table ESA-3h-1 show no target contaminants for Site ESA-3h. The historical search conducted under the contaminant assessment revealed that spills and leaks of GB and Mustard and sprayings of Malathion and Aldrin may have occurred in Site ESA-31-7 (EBASCO, 1988o/RIC 88166R02). According to site history, no other chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3h (EBASCO, 1988o/RIC 88166R02 and EBASCO, 1987b/RIC 87336R11).

2.15.2 Spatial Distribution of Measured Contaminant Concentrations

The location of Site ESA-3h is depicted in Figure ESA-3h-1. Table ESA-3h-1 shows that no target contaminants were inferred above the indicator level. Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.15.3 Site Exposure Summary

Based on the available data, no COCs have been identified. Site ESA-3h is designated as a Priority 2 site.



Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-3h-1
 Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

TABLE ESA-3h-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-3h

Contaminant	Horizon 1		Horizon 2	
	Max. (ug/g)	Depth (ft)	Max. (ug/g)	Depth (ft)

None Open Storage Area Ditch - Reported Agent Migration From ESA-3g

ESA
Max. ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

2.16 SITE ESA-3i: TOXIC STORAGE PLOTS DITCH (formerly Site 31-7: Toxic Storage Yard Storage Sheds; EBASCO, 1988o/RIC 88166R02 and EBASCO, 1988p/RIC 88166R02A; and Section 31 - Nonsource Area, EBASCO, 1987b/RIC 87336R11 and EBASCO, 1988s/RIC 87336R11A)

2.16.1 Site-Specific Considerations

Figure ESA-3i-1 and Table ESA-3i-1 depict the target contaminants for Site ESA-3i. Borings 7 and 34 through 36 were included in this exposure assessment, consistent with the Eastern SAR. The historical search conducted under the contaminant assessment revealed that spills and leaks of GB and Mustard sprayings of Malathion and Aldrin may have occurred in Site ESA-31-7 (EBASCO, 1988o/RIC 88166R02). According to site history, no other chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3i (EBASCO, 1988o/RIC 88166R02 and EBASCO, 1987b/RIC 87336R11).

2.16.2 Spatial Distribution of Measured Contaminant Concentrations

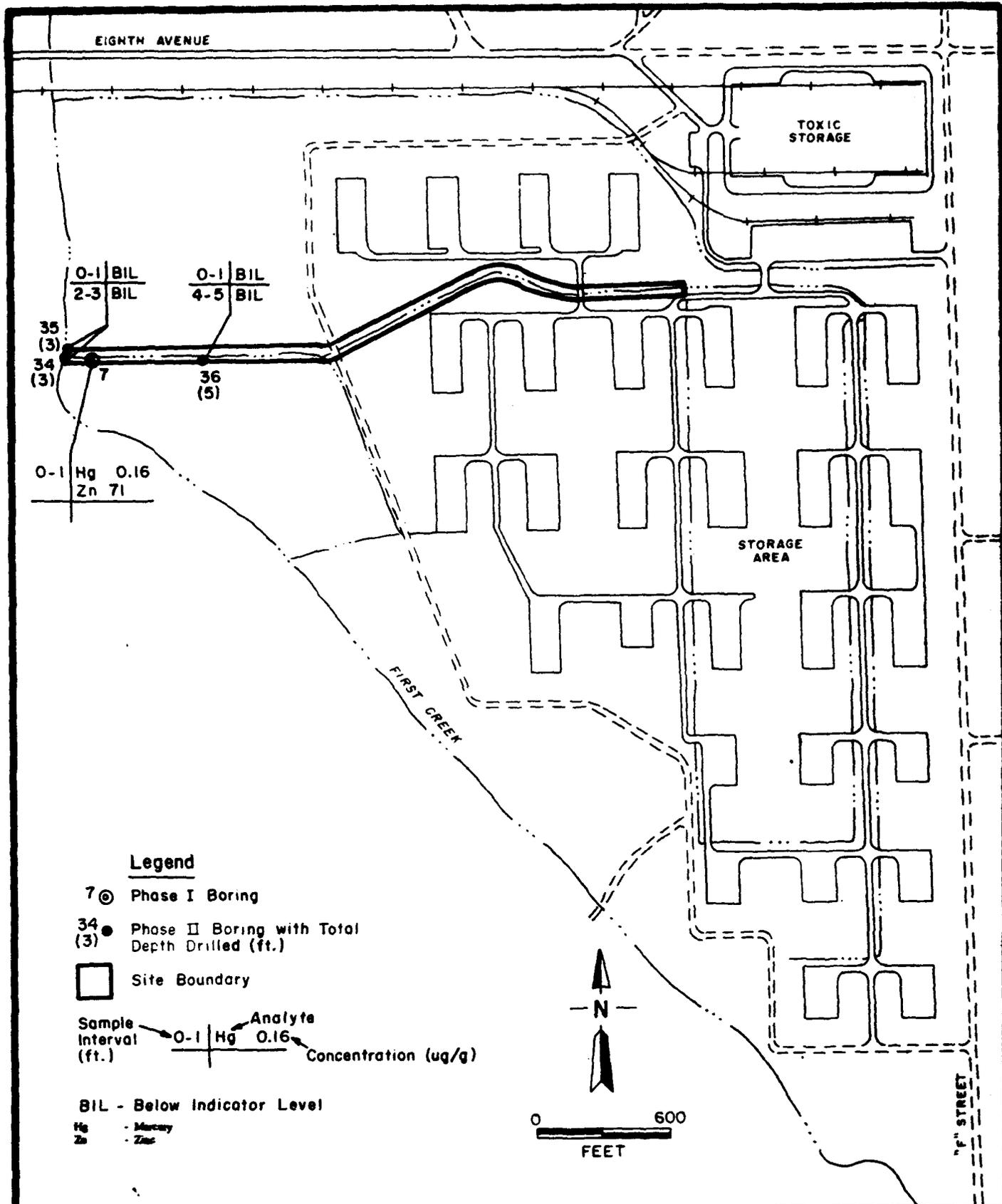
The locations and concentrations of the target contaminants that were detected in Site ESA-3i are shown in Figure ESA-3i-1. Table ESA-3j-1 summarizes the maximum concentrations measured in soil above indicator levels for ICP metals, arsenic, and mercury from the Phase I and Phase II investigations. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed negligible (see Volume VI-A). No organic contaminants were detected at this location. Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.16.3 Site Exposure Summary

Tables ESA-3i-2 through ESA-3i-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
None	--	--	--	--	--

The results of the soil exposure summary indicate that there are no COCs. Site ESA-3i is designated as a Priority 2 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Prepared for:

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

FIGURE ESA-3i-1

Phase I and Phase II Analytes
Detected Within or Above
Indicator Levels

Rocky Mountain Arsenal
Prepared by: Ebasco Services Incorporated

TABLE ESA-3i-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-3i

Contaminant	Horizon 1		Horizon 2	
	Max. (ug/g)	Depth (ft)	Boring Number	Depth (ft)
Mercury	0.16	0-1	7	--

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-3i-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
MERCURY	3.3E+03	0.0E+00	3.3E+03	4.8E-05	0.0E+00	4.8E-05	0.0E+00

ESA-3i-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPM
MERCURY	3.3E+03	0.0E+00	3.3E+03	4.8E-05	0.0E+00	4.8E-05	0.0E+00

ESA-3i-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
MERCURY	2.0E+03	0.0E+00	2.0E+03	8.1E-05	0.0E+00	8.1E-05	0.0E+00

ESA-3i-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
MERCURY	1.4E+03	0.0E+00	1.4E+03	1.1E-04	0.0E+00	1.1E-04	NA

ESA-3i-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
MERCURY	4.6E+02	0.0E+00	0.0E+00	4.6E+02	3.5E-04	0.0E+00	3.5E-04	0.0E+00	NA

2.17 SITE ESA-3j: TOXIC STORAGE YARD FENCE (formerly Site 31-7: Toxic Storage Yard Sheds; EBASCO, 1988o/RIC 88166R02 and EBASCO, 1988p/RIC 88166R02A; and Section 31 - Nonsource Area, EBASCO, 1987b/RIC 87336R11 and EBASCO, 1988s/RIC 87336R11A)

2.17.1 Site-Specific Considerations

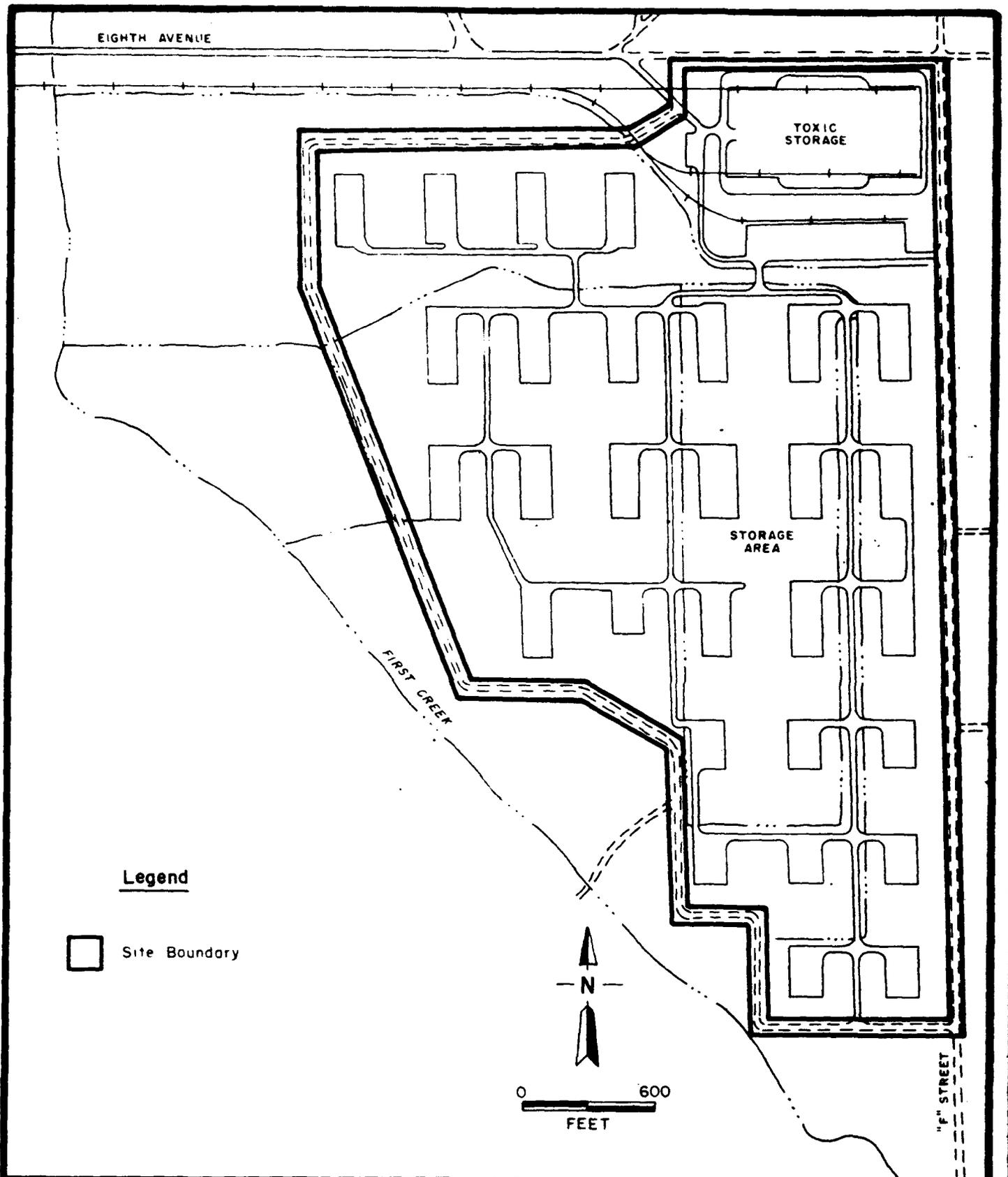
Figure ESA-3j-1 and Table ESA-3j-1 depict the target contaminants for Site ESA-3j. Boring 8 was included in this exposure assessment, consistent with the Eastern SAR. The historical search conducted under the contaminant assessment revealed that spills and leaks of GB and Mustard and sprayings of Malathion and Aldrin may have occurred in Site ESA-31-7 (EBASCO, 1988o/RIC 88166R02). According to site history, no other chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3j (EBASCO, 1988o/RIC 88166R02 and EBASCO, 1987b/RIC 87336R11).

2.17.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-3j are depicted in Figure ESA-3j-1. Table ESA-3j-1 shows that no target contaminants were found above the indicator level. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.17.3 Site Exposure Summary

No soil contaminants are shown on Table ESA-3j-1, therefore, no COCs were identified for this site. Site ESA-3j is designated as a Priority 2 site.



Prepared for:

Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-3j-1

Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels

Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

TABLE ESA-3j-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-3j

Contaminant	Horizon 1		Horizon 2			
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
None	Toxic storage yard fence - reported pesticide spraying around fence					

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

2.18 SITE ESA-3k: TRASH PIT (formerly Site 31-6: Toxic Storage Yard Storage Sheds; EBASCO 1988m/RIC 88196R03 and EBASCO, 1988m/RIC 88196R03A)

2.18.1 Site-Specific Considerations

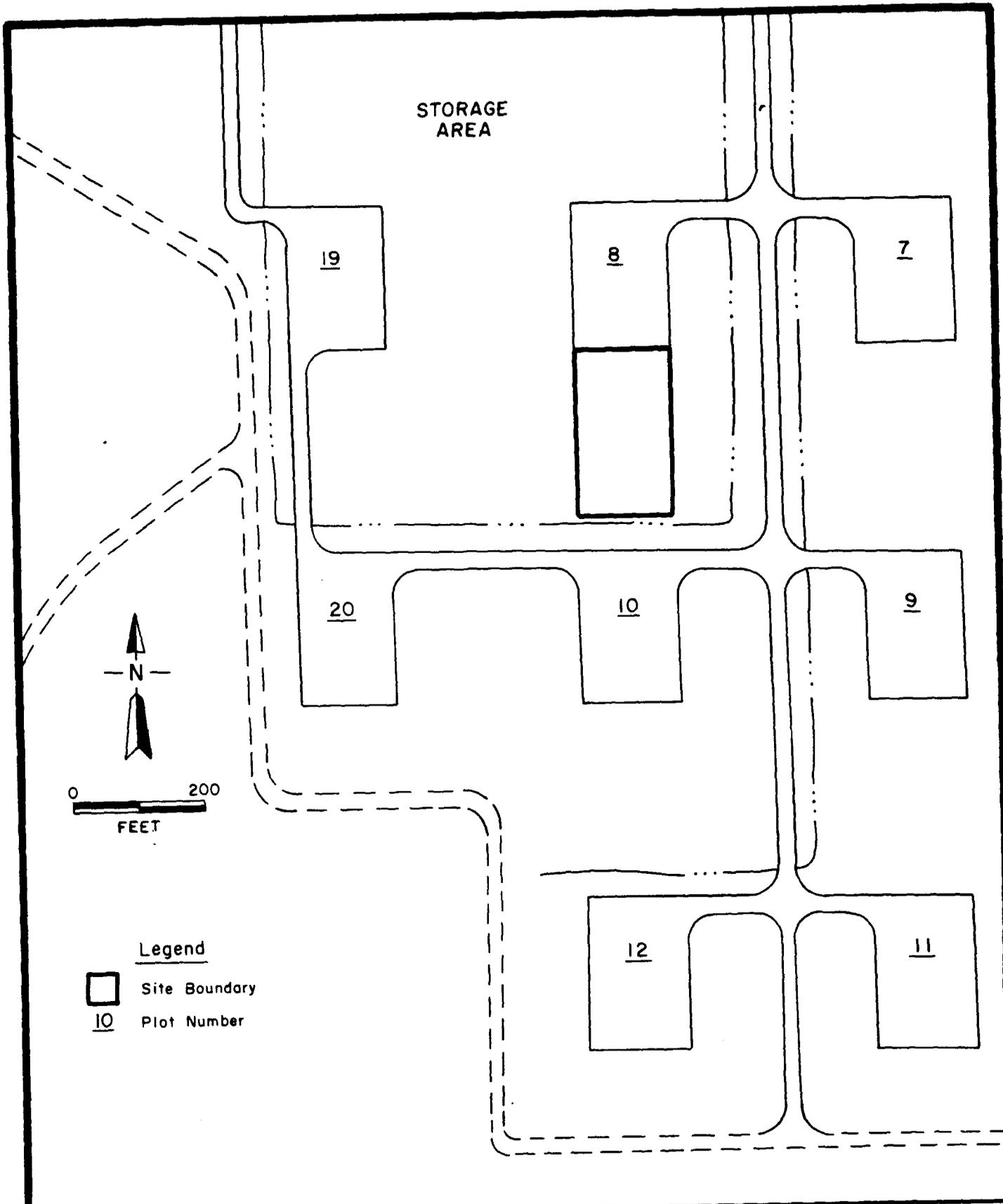
No borings were included in this exposure assessment, since contamination is inferred in the trash pit for Site ESA-3d (Toxic Storage Yard), consistent with the Eastern SAR. Therefore, Figure ESA-3k-1 and Table ESA-3k-1 show no target contaminants for Site ESA-3k. The historical search conducted under the contaminant assessment revealed that spills or leaks of GB and Mustard and sprayings of Malathion and Aldrin may have occurred on Site ESA-3k (EBASCO, 1988m/RIC 88196R03). According to site history, no other chemicals from the RMA target contaminant list were suspected to be present in Site ESA-3k (EBASCO, 1988m/RIC 88196R03).

2.18.2 Spatial Distribution of Measured Contaminant Concentrations

The locations of Site ESA-3k is depicted in Figure ESA-3k-1. Table ESA-3k-1 shows that no target contaminants were inferred above the indicator level. Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.18.3 Site Exposure Summary

Based on the available data, no COCs have been identified. Site ESA-3k is designated as a Priority 2 site.



Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-3k-1
 Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

TABLE ESA-3k-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-3k

Contaminant	Horizon 1		Horizon 2			
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
None	Trash Pit - Reported trash disposal south of Plot 8					

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

2.19 SITE ESA-4a: IMPACT AREA (formerly Site 30-1: Impact Area; ESE, 1988g/RIC 88033R03)

2.19.1 Site-Specific Considerations

Figure ESA-4a-1 and Table ESA-4a-1 depict the target contaminants for Site ESA-4a. Borings 5339, 5340, 5342, 5343, 5345, and 5348 were included in this exposure assessment, consistent with the Eastern SAR. According to site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-4a (ESE, 1988g/RIC 88033R03).

2.19.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-4a are shown in Figure ESA-4a-1. Table ESA-4a-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). No organic contaminants were detected at this location. Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.19.3 Site Exposure Summary

Tables ESA-4a-2 through ESA-4a-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
None	--	--	--	--	--

The results of the soil exposure summary indicate that there are no COCs. Site ESA-4a is designated as a Priority 2 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).

Legend

5340 Phase I Boring

Site Boundary

Existing Trench

Sample Interval (ft.)

Analyte

Concentration (ug/g)

Bedrock Sample

BIL - Below Indicator Level

- As : Arsenic
- Cu : Copper
- Pb : Lead
- Hg : Mercury
- Zn : Zinc

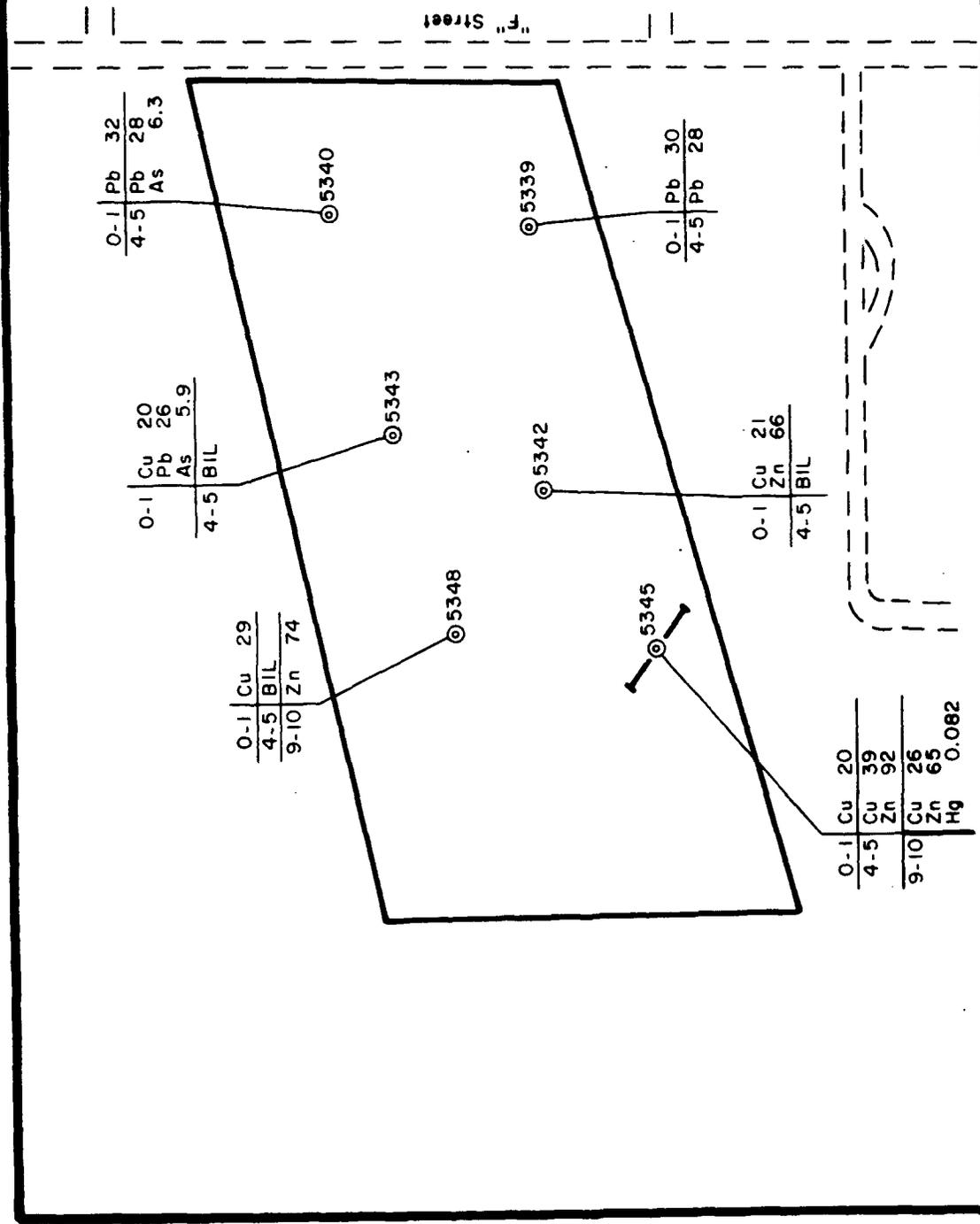


FIGURE ESA-4a-1
Phase I and Phase II Analytes
Detected Within or Above
Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

TABLE ESA-4a-1
 SOIL CONTAMINANT CONCENTRATIONS
 FOR SITE ESA-4a

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Copper	39	4-5	5345	--	--	--
Zinc	92	4-5	5345	--	--	--

ESA Max. ug/g ft
 Eastern Study Area Maximum microgram per gram foot/feet

ESA-4a-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPM
COPPER	4.2E+05	0.0E+00	4.2E+05	9.3E-05	0.0E+00	9.3E-05	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	4.6E-05	0.0E+00	4.6E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-4a-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPM
COPPER	4.2E+05	0.0E+00	4.2E+05	9.3E-05	0.0E+00	9.3E-05	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	4.6E-05	0.0E+00	4.6E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-4a-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
COPPER	2.5E+05	0.0E+00	2.5E+05	1.6E-04	0.0E+00	1.6E-04	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	8.8E-05	0.0E+00	8.8E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-4a-5

EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	ENC
COPPER	1.8E+05	0.0E+00	1.8E+05	2.2E-04	0.0E+00	2.2E-04	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	1.2E-04	0.0E+00	1.2E-04	0.0E+00

ESA-4a-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
COPPER	5.7E+04	0.0E+00	0.0E+00	5.7E+04	6.8E-04	0.0E+00	6.8E-04	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	6.6E-04	0.0E+00	6.6E-04	0.0E+00	0.0E+00

2.20 SITE ESA-4b: DEMOLITION AREA (formerly Site 29-4: Disposal Site Explosives and Incendiaries; ESE, 1988h/RIC 88103R04 and ESE, 1988i/RIC 88103R04A)

2.20.1 Site-Specific Considerations

Figure ESA-4b-1 and Table ESA-4b-1 depict the target contaminants for Site ESA-4b. Borings 5374 through 5380, 5480, 5481, 5522, 5523, 5586 and 5593 were included in the exposure assessment, consistent with the Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-4b (ESE, 1988h/RIC 88103R04).

2.20.2 Spatial Distribution of Measured Contaminant Concentrations

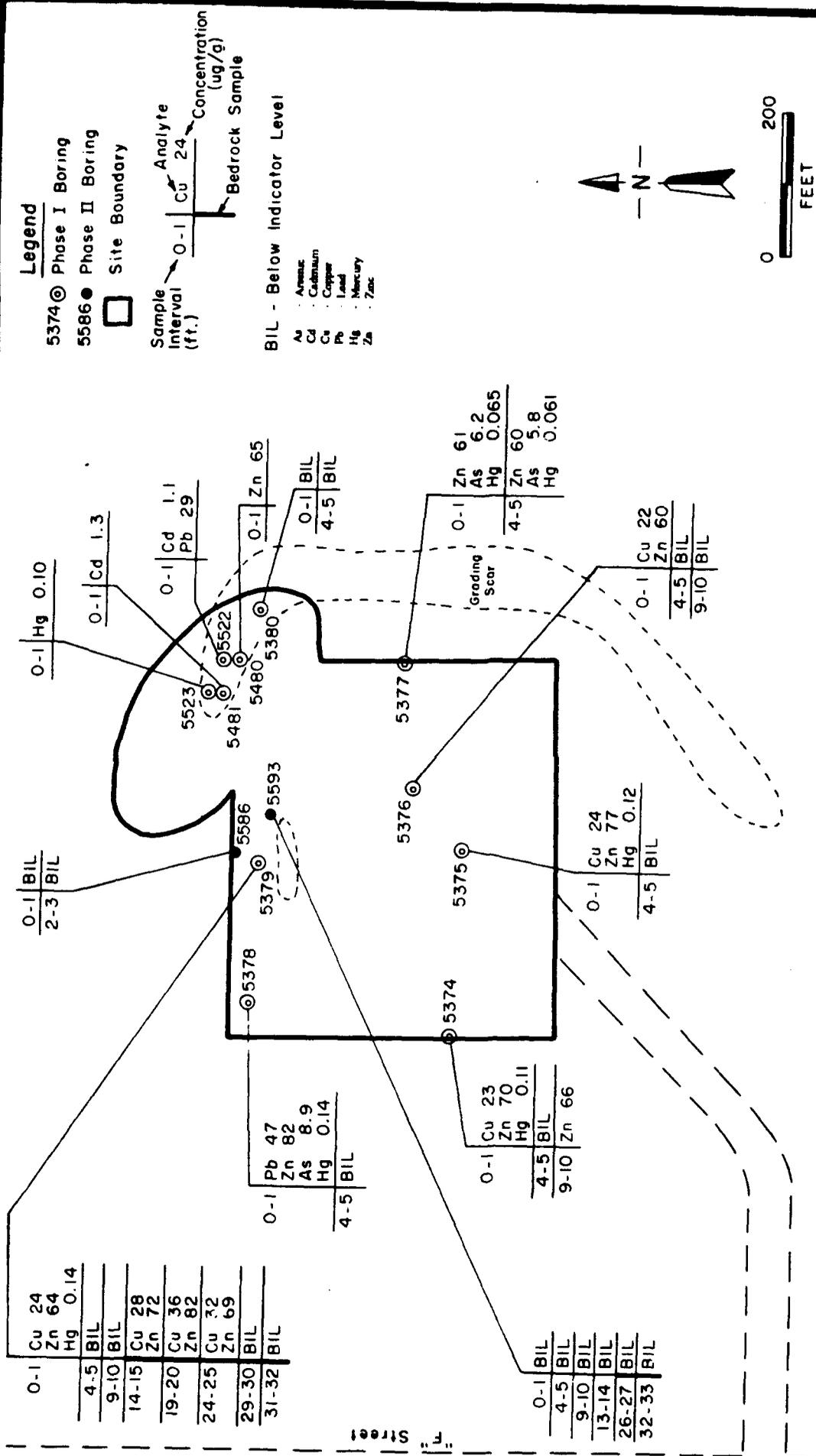
The locations and concentrations of the target contaminants that were detected in Site ESA-4b are shown in Figure ESA-4b-1. Table ESA-4b-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). No organic contaminants were detected at this location. Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.20.3 Site Exposure Summary

Tables ESA-4b-2 through ESA-4b-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
None	--	--	--	--	--

The results of the soil exposure summary indicate that there are no COCs. Site ESA-4b is designated as a Priority 2 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-4b-1
 Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

TABLE ESA-4b-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-4b

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Lead	47	0-1	5378	--	--	--
Mercury	0.14	0-1	5378	--	--	--
		0-1	5379	--	--	--
Zinc	82	0-1	5378	--	--	--

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-4b-2
EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (ng/kg)	PPLV (mg/kg)	EI EI	EI EI	EI EI	OPN
LEAD	1.5E+04	0.0E+00	1.5E+04	3.0E-03	0.0E+00	3.0E-03	0.0E+00
MERCURY	3.3E+03	0.0E+00	3.3E+03	4.2E-05	0.0E+00	4.2E-05	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	4.1E-05	0.0E+00	4.1E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-4b-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
LEAD	1.5E+04	0.0E+00	1.5E+04	3.0E-03	0.0E+00	3.0E-03	0.0E+00
MERCURY	3.3E+03	0.0E+00	3.3E+03	4.2E-05	0.0E+00	4.2E-05	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	4.1E-05	0.0E+00	4.1E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-4b-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI EI	EI EI	EI EI	OPN
LEAD	9.2E+03	0.0E+00	9.2E+03	5.1E-03	0.0E+00	5.1E-03	0.0E+00
MERCURY	2.0E+03	0.0E+00	2.0E+03	7.1E-05	0.0E+00	7.1E-05	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	7.8E-05	0.0E+00	7.8E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-4b-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
LEAD	6.5E+03	0.0E+00	6.5E+03	7.2E-03	0.0E+00	7.2E-03	0.0E+00
MERCURY	1.4E+03	0.0E+00	1.4E+03	1.0E-04	0.0E+00	1.0E-04	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	1.0E-04	0.0E+00	1.0E-04	0.0E+00

ESA-4b-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	2.1E-02	0.0E+00	2.1E-02	0.0E+00	0.0E+00
MERCURY	4.6E+02	0.0E+00	0.0E+00	4.6E+02	3.0E-04	0.0E+00	3.0E-04	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	5.9E-04	0.0E+00	5.9E-04	0.0E+00	0.0E+00

2.21 SITE ESA-4c: TRENCH AND MOUND (formerly Site 29-4: Disposal Site Explosives and Incendiaries; ESE, 1988h//RIC 88103R04 and ESE, 1988i//RIC 88103R04A)

2.21.1 Site-Specific Considerations

Figure ESA-4c-1 and Table ESA-4c-1 depict the target contaminants for Site ESA-4c. Borings 5482, 5524, 5582, and 5583 were included in this exposure assessment, consistent with the Eastern SAR. According to site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-4c (ESE, 1988h//RIC 88103R04).

2.21.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-4c are shown in Figure ESA-4c-1. Table ESA-4c-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). No organic contaminants were detected at this location. Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.21.3 Site Exposure Summary

Tables ESA-4c-2 through ESA-4c-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
None	--	--	--	--	--

The results of the soil exposure summary indicate that there are no COCs. Site ESA-4c is designated as a Priority 2 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).

NINTH AVENUE

Legend

5482 @ Phase I Boring

5582 ● Phase II Boring

□ Site Boundary

— Excavated Trench

⌋ Soil Mound with Metal Debris

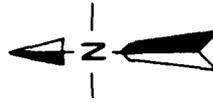
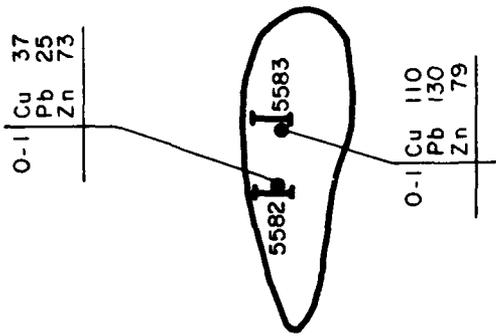
Sample Interval (ft.) | Analyte Concentration (ug/g)

· Cadmium
· Copper
· Lead
· Zinc

0-1	Cu	37
	Pb	25
	Zn	73

0-1	Cd	1.4
	Cu	33
	Pb	55
	Zn	63

0-1	Cu	500
	Pb	210
	Zn	160



Prepared for:

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

FIGURE ESA-4c-1

Phase I and Phase II Analytes
Detected Within or Above
Indicator Levels

Rocky Mountain Arsenal

Prepared by: Ebasco Services Incorporated

TABLE ESA-4c-1
 SOIL CONTAMINANT CONCENTRATIONS
 FOR SITE ESA-4c

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Copper	500	0-1	5482	--	--	--
Lead	210	0-1	5482	--	--	--
Zinc	160	0-1	5482	--	--	--

ESA
 Max.
 ug/g
 ft

Eastern Study Area
 Maximum
 microgram per gram
 foot/feet

ESA-4c-2
EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI EI	EI EI	EI EI	OPN
COPPER	4.2E+05	0.0E+00	4.2E+05	1.2E-03	0.0E+00	1.2E-03	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	1.4E-02	0.0E+00	1.4E-02	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	8.1E-05	0.0E+00	8.1E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-4c-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
COPPER	4.2E+05	0.0E+00	4.2E+05	1.2E-03	0.0E+00	1.2E-03	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	1.4E-02	0.0E+00	1.4E-02	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	8.1E-05	0.0E+00	8.1E-05	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-4c-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN
COPPER	2.5E+05	0.0E+00	2.5E+05	2.0E-03	0.0E+00	2.0E-03	0.0E+00
LEAD	9.2E+03	0.0E+00	9.2E+03	2.3E-02	0.0E+00	2.3E-02	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	1.5E-04	0.0E+00	1.5E-04	0.0E+00

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-4c-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
COPPER	1.8E+05	0.0E+00	1.8E+05	2.8E-03	0.0E+00	2.8E-03	0.0E+00
LEAD	6.5E+03	0.0E+00	6.5E+03	3.2E-02	0.0E+00	3.2E-02	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	2.0E-04	0.0E+00	2.0E-04	0.0E+00

ESA-4c-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
COPPER	5.7E+04	0.0E+00	0.0E+00	5.7E+04	8.8E-03	0.0E+00	8.8E-03	0.0E+00	0.0E+00
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	9.6E-02	0.0E+00	9.6E-02	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	1.1E-03	0.0E+00	1.1E-03	0.0E+00	0.0E+00

2.22 SITE ESA-5: DEMILITARIZATION AREA (formerly Site 30-5: M-34 Demilitarization Operation Area; ESE, 1988j/RIC 88013R07; Site 30-5: Liquid Disposal Trenches; ESE, 1988k/RIC 88013R07A)

2.22.1 Site-Specific Considerations

Figure ESA-5-1 and Table ESA-5-1 depict the target contaminants for Site ESA-5. Borings 5319 through 5324 and 5525 through 5531 were included in this exposure assessment, consistent with the Eastern SAR. According to the site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-5 (ESE, 1988j/RIC 88013R07).

2.22.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-5 are shown in Figure ESA-5-1. Table ESA-5-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

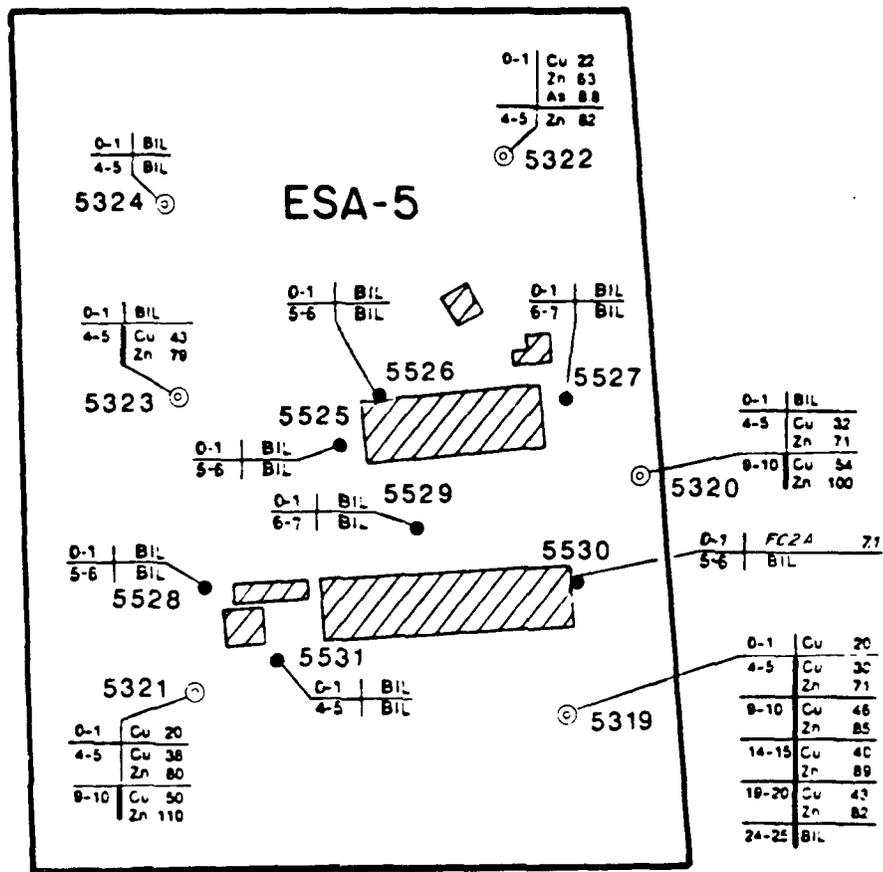
2.22.3 Site Exposure Summary

Tables ESA-5-2 through ESA-5-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Fluoroacetic acid	Direct	Direct	Direct	Direct	Direct

Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-5 is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Legend

5319⊙ Phase I Boring

5525● Phase II Boring

□ Site Boundary

▨ Metal Buildings

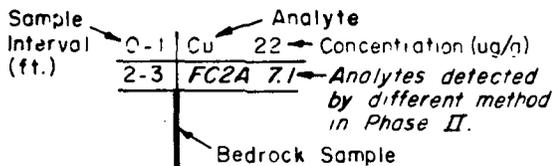
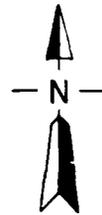
BIL - Below Indicator Level

FC2A - Fluoroacetic acid

As - Arsenic

Cu - Copper

Zn - Zinc



Prepared for.

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

Source HLA, 1968

FIGURE ESA-5-1

Phase I and Phase II Analytes
Detected Within or Above
Indicator Levels

Rocky Mountain Arsenal

Prepared by Ebasco Services Incorporated

TABLE ESA-5-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-5

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Fluoroacetic acid	7.1	0-1	5530	7.1	0-1	5530
Copper	54	9-10	5320	--	--	--
Zinc	110	9-10	5321	--	--	--

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-5-2
EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPM
FLUOROACETIC ACID	3.9E+01	0.0E+00	3.9E+01	1.8E-01*	0.0E+00	1.8E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	1.3E-04	0.0E+00	1.3E-04	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	5.5E-05	0.0E+00	5.5E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-5-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
FLUOROACETIC ACID	3.9E+01	0.0E+00	3.9E+01	1.8E-01*	0.0E+00	1.8E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	1.3E-04	0.0E+00	1.3E-04	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	5.5E-05	0.0E+00	5.5E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-5-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI
	PPLV	PPLV	PPLV	EI	EI	EI	OPN
	(mg/kg)	(mg/kg)	(mg/kg)				
FLUOROACETIC ACID	1.7E+01	0.0E+00	1.7E+01	4.3E-01*	0.0E+00	4.3E-01*	0.0E+00
COPPER	2.5E+05	0.0E+00	2.5E+05	2.2E-04	0.0E+00	2.2E-04	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	1.0E-04	0.0E+00	1.0E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-5-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
FLUOROACETIC ACID	2.2E+01	0.0E+00	2.2E+01	3.3E-01*	0.0E+00	3.3E-01*	0.0E+00
COPPER	1.8E+05	0.0E+00	1.8E+05	3.1E-04	0.0E+00	3.1E-04	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	1.4E-04	0.0E+00	1.4E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-5-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
FLUOROACETIC ACID	4.0E+00	0.0E+00	0.0E+00	4.0E+00	1.8E+00*	0.0E+00	1.8E+00*	0.0E+00	0.0E+00
COPPER	5.7E+04	0.0E+00	0.0E+00	5.7E+04	9.5E-04	0.0E+00	9.5E-04	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	7.9E-04	0.0E+00	7.9E-04	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

**2.23 SITE ESA-6a: SECTION 6 - CHROMIUM, COPPER, LEAD, AND ZINC
DETECTIONS (formerly Section 6-Nonsource Area; EBASCO, 1988q/RIC
88196R08 and EBASCO, 1988r/RIC 88196R08A)**

2.23.1 Site-Specific Considerations

Figure ESA-6a-1 and Table ESA-6a-1 depict the target contaminants for Site ESA-6a. Borings 54, 59 through 62, and 65 were included in this exposure assessment, consistent with the Eastern SAR. According to site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-6a (EBASCO 1988q/RIC 88196R08).

2.23.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-6a are shown in Figure ESA-6a-1. Table ESA-6a-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury for Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). No organic contaminants were detected at this location. Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.23.3 Site Exposure Summary

Tables ESA-6a-2 through ESA-6a-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Chromium	Direct	Direct	Direct	Direct	Direct

Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-6a is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).

Legend

54⊙ Phase I Boring

59● Phase II Boring with Total
(8) Depth Drilled (ft.)

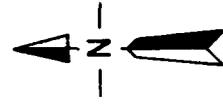
□ Site Boundary



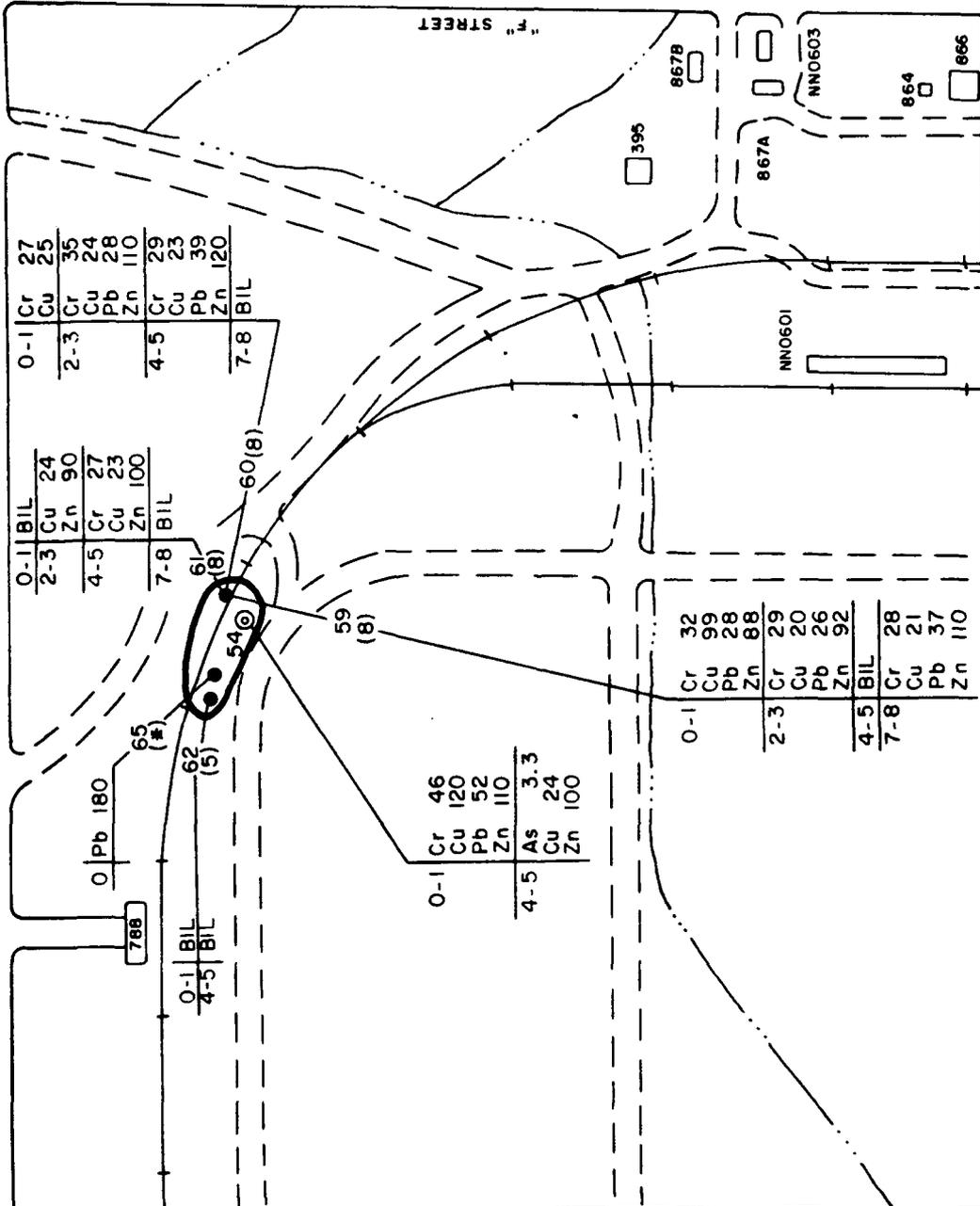
BIL - Below Indicator Level
* - Grab Sample from Ton Container

- Leak
- Arsenic
 - Chromium
 - Copper
 - Lead
 - Zinc

As
Cr
Cu
Pb
Zn



DECEMBER SEVENTH AVENUE



Prepared for:
 Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-6a-1
 Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels
 Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

TABLE ESA-6a-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-6a

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Chromium	46	0-1	54	--	--	--
Copper	120	0-1	54	--	--	--
Lead	180	0	65	--	--	--
Zinc	120	4-5	60	--	--	--

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-6a-2
EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
CHROMIUM	6.9E+01	0.0E+00	6.9E+01	6.6E-01*	0.0E+00	6.6E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	2.9E-04	0.0E+00	2.9E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	1.2E-02	0.0E+00	1.2E-02	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	6.0E-05	0.0E+00	6.0E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-6a-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT	INDIRECT	CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI OPN
	PPLV (mg/kg)	PPLV (mg/kg)	PPLV (mg/kg)	EI	EI	EI	
CHROMIUM	6.9E+01	0.0E+00	6.9E+01	6.6E-01*	0.0E+00	6.6E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	2.9E-04	0.0E+00	2.9E-04	0.0E+00
LEAD	1.5E+04	0.0E+00	1.5E+04	1.2E-02	0.0E+00	1.2E-02	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	6.0E-05	0.0E+00	6.0E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-6a-4

EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
CHROMIUM	8.8E+00	0.0E+00	8.8E+00	5.2E+00*	0.0E+00	5.2E+00*	0.0E+00
COPPER	2.5E+05	0.0E+00	2.5E+05	4.8E-04	0.0E+00	4.8E-04	0.0E+00
LEAD	9.2E+03	0.0E+00	9.2E+03	1.9E-02	0.0E+00	1.9E-02	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	1.1E-04	0.0E+00	1.1E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-6a-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
CHROMIUM	5.5E+01	0.0E+00	5.5E+01	8.4E-01*	0.0E+00	8.4E-01*	NA
COPPER	1.8E+05	0.0E+00	1.8E+05	6.8E-04	0.0E+00	6.8E-04	NA
LEAD	6.5E+03	0.0E+00	6.5E+03	2.8E-02	0.0E+00	2.8E-02	NA
ZINC	7.8E+05	0.0E+00	7.8E+05	1.5E-04	0.0E+00	1.5E-04	NA

*: EI is equal to or exceeds 1.0E-01

ESA-6a-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
CHROMIUM	1.1E+00	0.0E+00	0.0E+00	1.1E+00	4.0E+01*	0.0E+00	4.0E+01*	0.0E+00	NA
COPPER	5.7E+04	0.0E+00	0.0E+00	5.7E+04	2.1E-03	0.0E+00	2.1E-03	0.0E+00	NA
LEAD	2.2E+03	0.0E+00	0.0E+00	2.2E+03	8.2E-02	0.0E+00	8.2E-02	0.0E+00	NA
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	8.6E-04	0.0E+00	8.6E-04	0.0E+00	NA

*: EI is equal to or exceeds 1.0E-01

2.24 SITE ESA-6b: SECTION 30 - FLUOROACETIC ACID DETECTION (formerly Site 30-1: Impact Area; ESE, 1988g/RIC 88033R03)

2.24.1 Site-Specific Considerations

Figure ESA-6b-1 and Table ESA-6b-1 depict the target contaminants for Site ESA-6b. Borings 5335, 5537, and 5538 were included in this exposure assessment, consistent with the Eastern SAR. According to site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-6b (ESE, 1988g/RIC 88033R03).

2.24.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-6b are shown in Figure ESA-6b-1. Table ESA-6b-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

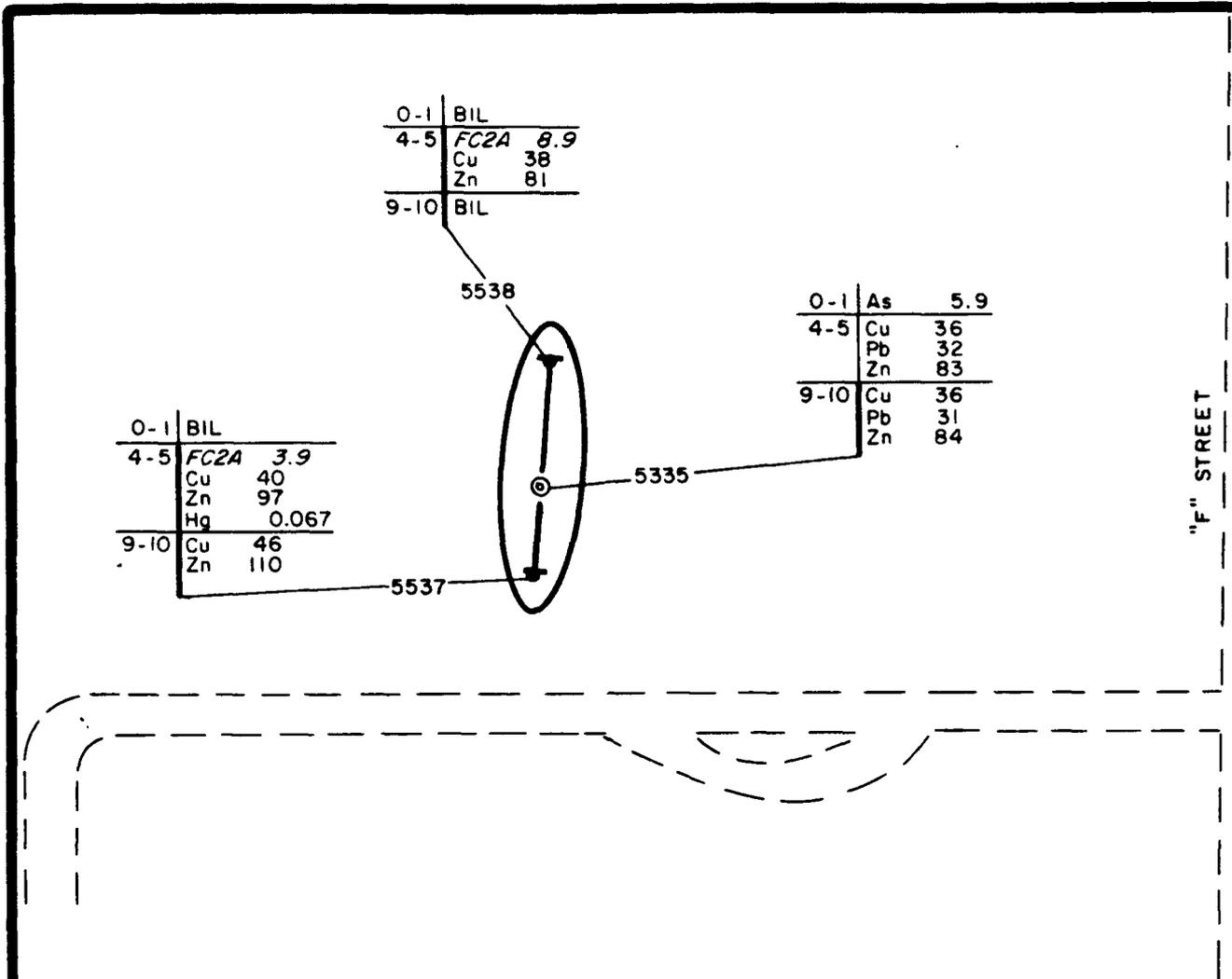
2.24.3 Site Exposure Summary

Tables ESA-6b-2 through ESA-6b-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Fluoroacetic acid	Direct	Direct	Direct	Direct	Direct

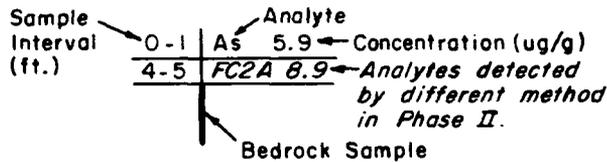
Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-6b is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).

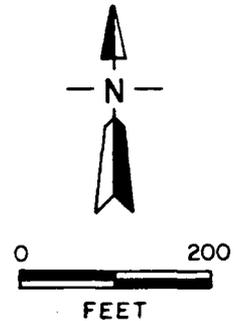


Legend

- 5335⊙ Phase I Boring
- 5537● Phase II Boring
- Site Boundary
- Existing Trench



- BIL - Below indicator level
- FC2A - Fluoroacetic acid
- As - Arsenic
- Cu - Copper
- Pb - Lead
- Hg - Mercury
- Zn - Zinc



Prepared for:

Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-6b-1

Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels

Rocky Mountain Arsenal

Prepared by: Ebasco Services Incorporated

TABLE ESA-6b-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-6b

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Fluoroacetic acid	8.9	4-5	5538	8.9	4-5	5538
Copper	46	9-10	5537	--	--	--
Zinc	110	9-10	5537	--	--	--

ESA
Max.
ug/g
ft

Eastern Study Area
Maximum
microgram per gram
foot/feet

ESA-6b-2
EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
FLUOROACETIC ACID	3.9E+01	0.0E+00	3.9E+01	2.3E-01*	0.0E+00	2.3E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	1.1E-04	0.0E+00	1.1E-04	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	5.5E-05	0.0E+00	5.5E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-6b-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
FLUOROACETIC ACID	3.9E+01	0.0E+00	3.9E+01	2.3E-01*	0.0E+00	2.3E-01*	0.0E+00
COPPER	4.2E+05	0.0E+00	4.2E+05	1.1E-04	0.0E+00	1.1E-04	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	5.5E-05	0.0E+00	5.5E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-6b-4
EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
FLUOROACETIC ACID	1.7E+01	0.0E+00	1.7E+01	5.4E-01*	0.0E+00	5.4E-01*	0.0E+00
COPPER	2.5E+05	0.0E+00	2.5E+05	1.9E-04	0.0E+00	1.9E-04	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	1.0E-04	0.0E+00	1.0E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-6b-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
FLUOROACETIC ACID	2.2E+01	0.0E+00	2.2E+01	4.1E-01*	0.0E+00	4.1E-01*	0.0E+00
COPPER	1.8E+05	0.0E+00	1.8E+05	2.6E-04	0.0E+00	2.6E-04	0.0E+00
ZINC	7.8E+05	0.0E+00	7.8E+05	1.4E-04	0.0E+00	1.4E-04	0.0E+00

*: EI is equal to or exceeds 1.0E-01

ESA-6b-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
FLUOROACETIC ACID	4.0E+00	0.0E+00	0.0E+00	4.0E+00	2.2E+00*	0.0E+00	2.2E+00*	0.0E+00	0.0E+00
COPPER	5.7E+04	0.0E+00	0.0E+00	5.7E+04	8.1E-04	0.0E+00	8.1E-04	0.0E+00	0.0E+00
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	7.9E-04	0.0E+00	7.9E-04	0.0E+00	0.0E+00

*: EI is equal to or exceeds 1.0E-01

2.25 SITE ESA-6c: SECTION 30 - ARSENIC DETECTION (formerly Section 30 - Nonsource Area; ESE, 1988p/RIC 88133R01 and ESE, 1988q/RIC 88133R01A, and Section 25 - Nonsource Area; ESE, 1988n/RIC 88063R09 and ESE 1988o/RIC 88063R09A)

2.25.1 Site-Specific Considerations

Figure ESA-6c-1 and Table ESA-6c-1 depict the target contaminants for Site ESA-6c. Borings 5260 from Site 30 - Nonsource Area and 5134, 5574, and 5575 from Site 25 - Nonsource Area were included in this exposure assessment, consistent with the Eastern SAR. According to site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-6c (ESE, 1988p/RIC 88133R01 and ESE, 1988n/RIC 88063R09).

2.25.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-6c are shown in Figure ESA-6c-1. Table ESA-6c-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

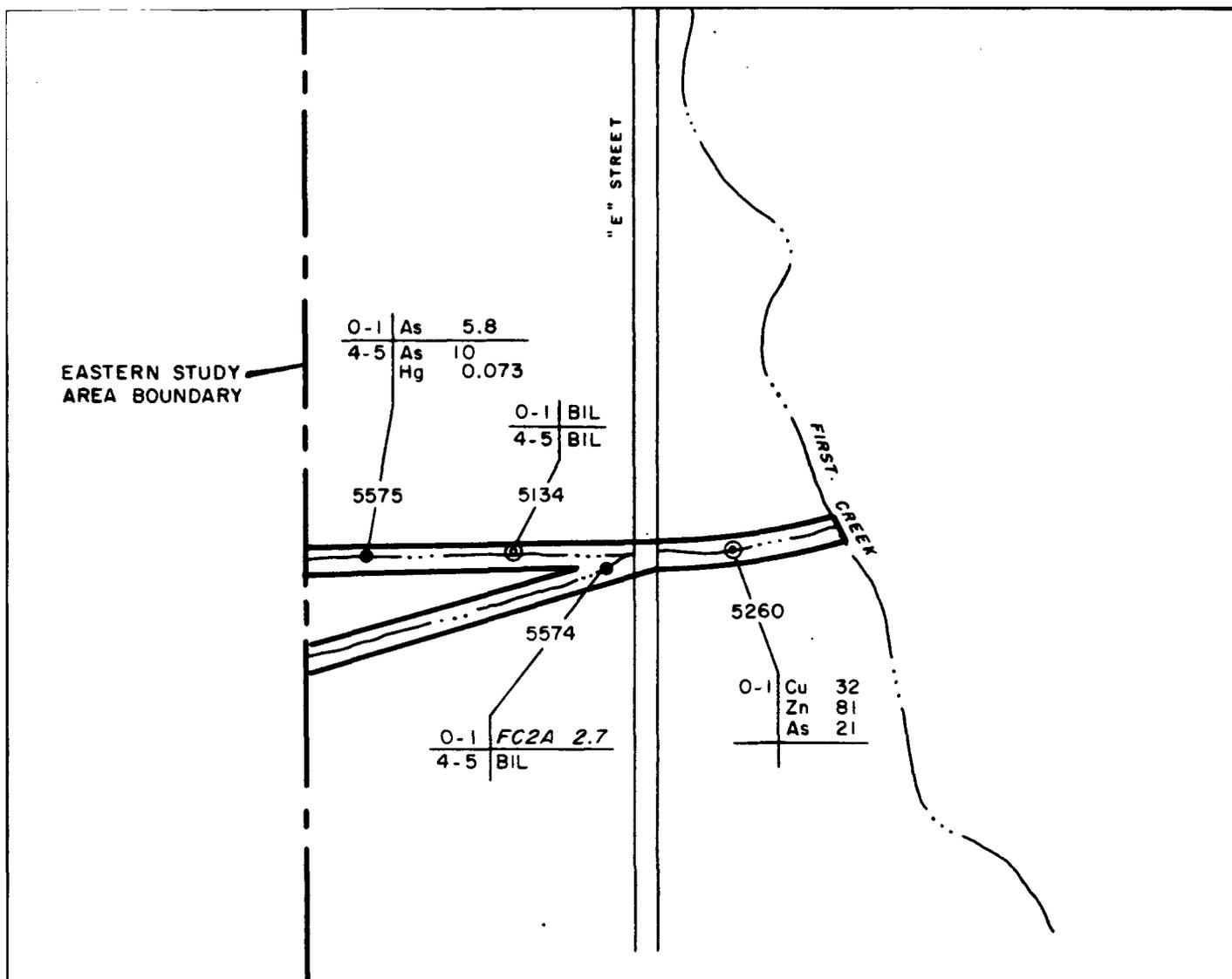
2.25.3 Site Exposure Summary

Tables ESA-6c-2 through ESA-6c-6 present Draft PPLVs and EIs for each site contaminant. The COCs are summarized below for each exposed population and with the critical exposure pathway identified.

Contaminants of Concern	Regulated Visitor	Casual Visitor	Recreational Visitor	Commercial Worker	Industrial Worker
Arsenic	Direct	Direct	Direct	Direct	Direct
Fluoroacetic acid	--	--	Direct	Direct	Direct

Note: Direct exposure pathways for soils include soil ingestion, suspended particulate inhalation, and dermal contact.

The results of the soil exposure summary indicate that exposure to contamination from the direct pathways are the primary contributors to the exceedance of the cumulative PPLVs. Site ESA-6c is designated as a Priority 1 site, based on the most sensitive exposed population PPLV (i.e., the industrial worker).



Legend

5260⊙ Phase I Boring

5574● Phase II Boring

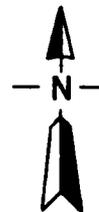
□ Site Boundary

Sample Interval (ft.) | Analyte | Concentration (ug/g)

0-1	As	5.8
2-3	FC2A	2.7

Analytes detected by different method in Phase II.

- BIL - Below indicator level
- PC2A - Fluorocetic acid
- As - Arsenic
- Hg - Mercury
- Zn - Zinc
- Cu - Copper



Prepared for:

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

FIGURE ESA-6c-1

Phase I and Phase II Analytes
Detected Within or Above
Indicator Levels

Rocky Mountain Arsenal
Prepared by: Ebasco Services Incorporated

TABLE ESA-6c-1
SOIL CONTAMINANT CONCENTRATIONS
FOR SITE ESA-6c

Contaminant	Horizon 1			Horizon 2		
	Max. (ug/g)	Depth (ft)	Boring Number	Max. (ug/g)	Depth (ft)	Boring Number
Fluoroacetic acid	2.7	0-1	5574	2.7	0-1	5574
Arsenic	21	0-1	5260	--	--	--
Zinc	81	0-1	5260	--	--	--

ESA Max. ug/g ft
Eastern Study Area Maximum microgram per gram foot/feet

ESA-6c-2

EXPOSURE EVALUATIONS FOR REGULATED VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPM
FLUOROACETIC ACID	3.9E+01	0.0E+00	3.9E+01	7.0E-02	0.0E+00	7.0E-02	0.0E+00
ARSENIC	2.2E+01	0.0E+00	2.2E+01	9.7E-01*	0.0E+00	9.7E-01*	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	4.1E-05	0.0E+00	4.1E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-6c-3
EXPOSURE EVALUATIONS FOR CASUAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
FLUOROACETIC ACID	3.9E+01	0.0E+00	3.9E+01	7.0E-02	0.0E+00	7.0E-02	0.0E+00
ARSENIC	2.2E+01	0.0E+00	2.2E+01	9.7E-01*	0.0E+00	9.7E-01*	0.0E+00
ZINC	2.0E+06	0.0E+00	2.0E+06	4.1E-05	0.0E+00	4.1E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-6c-4
EXPOSURE EVALUATIONS FOR RECREATIONAL VISITORS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI OPN
FLUOROACETIC ACID	1.7E+01	0.0E+00	1.7E+01	1.6E-01*	0.0E+00	1.6E-01*	0.0E+00
ARSENIC	3.9E+00	0.0E+00	3.9E+00	5.3E+00*	0.0E+00	5.3E+00*	0.0E+00
ZINC	1.1E+06	0.0E+00	1.1E+06	7.7E-05	0.0E+00	7.7E-05	0.0E+00

*: EI is equal to or exceeds 1.0E-01

If the PPLV value indicated is greater than 1.00E+06 the calculations imply that the contaminant does not pose unacceptable chronic exposure through the exposure pathway considered, even in its pure form.

ESA-6c-5
EXPOSURE EVALUATIONS FOR COMMERCIAL WORKERS

CONTAMINANT	DIRECT PPLV (mg/kg)	INDIRECT PPLV (mg/kg)	CUMULATIVE PPLV (mg/kg)	DIRECT EI	INDIRECT EI	CUMULATIVE EI	VEI ENC
FLUOROACETIC ACID	2.2E+01	0.0E+00	2.2E+01	1.3E-01*	0.0E+00	1.3E-01*	NA
ARSENIC	2.0E+01	0.0E+00	2.0E+01	1.1E+00*	0.0E+00	1.1E+00*	NA
ZINC	7.8E+05	0.0E+00	7.8E+05	1.0E-04	0.0E+00	1.0E-04	NA

*: EI is equal to or exceeds 1.0E-01

ESA-6c-6
EXPOSURE EVALUATIONS FOR INDUSTRIAL WORKERS

CONTAMINANT	DIRECT	INDIRECT		CUMULATIVE	DIRECT	INDIRECT	CUMULATIVE	VEI	
	PPLV (mg/kg)	OSVI (mg/kg)	ESVI (mg/kg)	PPLV (mg/kg)	EI	EI	EI	OPN	ENC
FLUOROACETIC ACID	4.0E+00	0.0E+00	0.0E+00	4.0E+00	6.8E-01*	0.0E+00	6.8E-01*	0.0E+00	NA
ARSENIC	1.6E+00	0.0E+00	0.0E+00	1.6E+00	1.3E+01*	0.0E+00	1.3E+01*	0.0E+00	NA
ZINC	1.4E+05	0.0E+00	0.0E+00	1.4E+05	5.8E-04	0.0E+00	5.8E-04	0.0E+00	NA

*: EI is equal to or exceeds 1.0E-01

2.26 SITE ESA-6d: SECTION 20 - HEXACHLOROBENZENE DETECTION (formerly Section 20 - Nonsource Area; ESE, 1988m/RIC 88173R05)

2.26.1 Site-Specific Considerations

Figure ESA-6d-1 and Table ESA-6d-1 depict the target contaminants for Site ESA-6d. Boring 5427 was included in this exposure assessment, consistent with the Eastern SAR. According to site history, no chemicals from the RMA target contaminant list were suspected to be present in Site ESA-6d (ESE, 1988m/RIC 88173R05).

2.26.2 Spatial Distribution of Measured Contaminant Concentrations

The locations and concentrations of the target contaminants that were detected in Site ESA-6d are shown in Figure ESA-6d-1. Hexachlorobenzene, occurring in Boring 5427 (0-0.5 ft), was not included in this figure, since it was not considered a target contaminant during the Phase I and Phase II investigations. Although not shown on this figure, this nontarget compound was included in the Eastern SAR and in this exposure assessment because it passed through the screening process performed in the RMA Chemical Index (EBASCO, 1988a/RIC 88357R01).

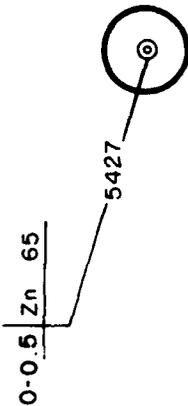
Table ESA-6d-1 summarizes the maximum concentrations of contaminants measured in soil above indicator levels for the ICP metals, arsenic, and mercury and CRLs for organic contaminants from the Phase I and Phase II investigations. The boring number and depth where the maximum value was observed are shown. Table ESA-6d-1 shows that no target contaminants were found above the indicator level. No data were included for ICP metals, arsenic, and mercury in Horizon 2 because direct soil exposure below 10 ft is assumed to be negligible (see Volume VI-A). Based on available groundwater data from the first quarter 1987 to the first quarter 1989 sampling period, no evidence of groundwater contamination beneath this site was found (see Volume VI-A).

2.26.3 Site Exposure Summary

Only nontarget soil contaminants are shown on Table ESA-6d-1. Since nontarget contaminants (excluding 1,1,2,2-tetrachloroethane) were not assessed using the PPLV methodology, no COCs were identified for this site. Site ESA-6d is designated as a Priority 2 site.

"F" STREET

NINTH AVENUE

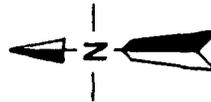


Legend

⊙ Phase I 0-6 Inch Surface Sample

○ Site Boundary

Sample Interval (ft.) | Zn | Zn | Analyte Concentration (ug/g)



Prepared for:

Program Manager's Office for
 Rocky Mountain Arsenal Cleanup
 Aberdeen Proving Ground, Maryland

FIGURE ESA-6d-1

Phase I and Phase II Analytes
 Detected Within or Above
 Indicator Levels

Rocky Mountain Arsenal
 Prepared by: Ebasco Services Incorporated

TABLE ESA-6d-1
 SOIL CONTAMINANT CONCENTRATIONS
 FOR SITE ESA-6d

Contaminant	Horizon 1		Horizon 2	
	Max. (ug/g)	Depth (ft)	Boring Number	Depth (ft)
Hexachlorobenzene ^{1/}	0.50	0-0.5	5427	0-0.5

1/ Nontarget contaminant. Refer to the exposure assessment nontarget screen in Appendix A.

ESA Eastern Study Area
 Max. Maximum
 ug/g microgram per gram
 ft foot/feet

3.0 STUDY AREA EXPOSURE SUMMARY

The exposure assessment results for the ESA are summarized in Table 3-1. Of the 26 sites evaluated, 14 sites were designated as Priority 1 sites based on the most sensitive exposed population PPLV (i.e., the industrial worker). These include:

- Section 19 - Surface Burn (ESA-1a)
- Section 20 - Surface Burn (ESA-1b)
- Section 29 - Surface Burn (ESA-1c)
- Section 30 - Surface Burn (ESA-1d)
- Burn Pits (ESA-2a)
- Sanitary Landfill (ESA-2b)
- Open Trenches (ESA-2c)
- Old Toxic Storage Yard (ESA-3b)
- New Toxic Storage Yard (ESA-3c)
- Toxic Yard Plots (ESA-3d)
- Demilitarization Area (ESA-5)
- Section 6 - Chromium, Copper, Lead, and Zinc Detections (ESA-6a)
- Section 30 - Fluoroacetic Acid Detection (ESA-6b)
- Section 30 - Arsenic Detection (ESA-6c)

Twelve sites were designated as Priority 2 sites based on the most sensitive exposed population PPLV (i.e., the industrial worker). These include:

- Storage Yard (ESA-3a)
- Concrete VX Demilitarization Pad (ESA-3e)
- Rail Spur and Loading Dock (ESA-3f)
- Open Drum Storage Area (ESA-3g)
- Open Storage Area Ditch (ESA-3h)
- Toxic Storage Plots Ditch (ESA-3i)
- Toxic Storage Yard Fence (ESA-3j)
- Trash Pit (ESA-3k)
- Impact Area (ESA-4a)
- Demolition Area (ESA-4b)

- Trench and Mound (ESA-4c)
- Section 20 - Hexachlorobenzene Detection (ESA-6d)

The COCs in soils (i.e., those displaying an EI greater than 0.1) for the ESA, based on the most sensitive exposed population PPLV (i.e., the industrial worker), are:

- Benzene
- Dieldrin
- Fluoroacetic acid
- Methylene chloride
- Trichloroethylene
- Arsenic
- Cadmium
- Chromium
- Lead
- Zinc

No groundwater plume has been identified in the ESA, therefore, no COSs were identified for this study area.

TABLE 3-1
NUMBER OF EXCEEDANCES FOR CONTAMINANTS OF CONCERN
IN THE EASTERN STUDY AREA

Contaminant of Concern	Number of Exceedances
Benzene	2
Dieldrin	1
Fluoroacetic Acid	4
Methylene Chloride	1
Trichloroethylene	2
Arsenic	5
Cadmium	6
Chromium	5
Lead	1
Zinc	1

4.0 REFERENCES

RIC 87216R09

EBASCO (Ebasco Services Incorporated). 1987a. Final Phase I Contamination Assessment Report. Site 30-4: Sanitary Landfill. Version 3.2. July 1987. Task No. 7. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 87336R11

EBASCO. 1987b. Final Phase I Contamination Assessment Report. Section 31: Nonsource Area. Version 3.2. December 1987. Task No. 15 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88357R01

EBASCO. 1988a. Proposed Final Rocky Mountain Arsenal Chemical Index, Volumes I-II. May, 1988. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88256R01

EBASCO. 1988b. Final Phase I Contamination Assessment Report. Site 32-5: Burning Pits. Version 3.2. July 1988. Task No. 15 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88256R01A

EBASCO. 1988c. Final Phase II Data Addendum. Site 32-5: Burning Pits. Version 3.1. October 1988. Task No. 22 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88256R02

EBASCO. 1988d. Final Phase I Contamination Assessment Report. Site 32-6: Burning Pits. Version 3.2. August 1988. Task No. 15 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88256R02A

EBASCO. 1988e. Final Phase II Data Addendum. Site 32-6: Burning Pits. Version 3.1. October 1988. Task No. 22 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 87216R09A

EBASCO. 1988f. Final Phase II Data Addendum. Site 30-4: Sanitary Landfill. Version 3.1. October 1988. Task No. 20 - Lower Lakes Survey. Contract

No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88196R05

EBASCO. 1988g. Final Phase I Contamination Assessment Report. Site 5-2: Potential Mustard and Distilled Mustard Contamination. Version 3.2. May 1988. Task No. 15- Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88196R05A

EBASCO. 1988h. Final Phase II Data Addendum. Site 5-2: Potential Mustard and Distilled Mustard Contamination. Version 3.1. October 1988. Task No. 22 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88196R02

EBASCO. 1988i. Final Phase I Contamination Assessment Report. Site 6-6: Former Toxic Gas Storage Yard. Version 3.2. June 1988. Task No. 15. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88196R02A

EBASCO. 1988j. Final Phase II Data Addendum. Site 6-6: Former Toxic Gas Storage Yard. Version 3.1. October 1988. Task No. 22 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88196R09

EBASCO. 1988k. Final Phase I Contamination Assessment Report. Site 31-4: Toxic Storage Yard. Version 3.1. June 1988. Task No. 15. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88196R09A

EBASCO. 1988l. Final Phase II Data Addendum. Site 31-4: Toxic Storage Yard. Version 3.1. October 1988. Task No. 22 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88196R03

EBASCO. 1988m. Final Phase I Contamination Assessment Report. Site 31-6: Toxic Storage Yard Storage Sheds. Version 3.2. June 1988. Task No. 15. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88196R03A

EBASCO. 1988n. Final Phase II Data Addendum. Site 31-6: Toxic Storage Yard Storage Sheds. Version 3.1. October 1988. Task No. 22 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88166R02

EBASCO. 1988o. Final Phase I Contamination Assessment Report. Site 31-7: Toxic Storage Yard Storage Sheds. Version 3.1. May 1988. Task No. 15 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88166R02A

EBASCO. 1988p. Final Phase II Data Addendum. Site 31-7: Toxic Storage Yard Storage Sheds. Version 3.1. October 1988. Task No. 22 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88196R08

EBASCO. 1988q. Final Phase I Contamination Assessment Report. Section 6: Nonsource Area. Version 3.1. June 1988. Task No. 15 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88196R08A

EBASCO. 1988r. Final Phase II Data Addendum. Section 6: Nonsource Area. Version 3.1. October 1988. Task No. 22 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 87336R11A

EBASCO. 1988s. Final Phase II Data Addendum. Section 31: Nonsource Area. Version 3.1. October 1988. Task No. 22 - Army Sites South. Contract No. DAAK11-84-D-0017. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

EBASCO. 1989a. Remedial Investigation Report. Volume VII. Eastern Study Area. Version 3.3. June 1989. Contract No. DAAK15-88-D-0024. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88013R04

ESE (Environmental Science and Engineering, Inc). 1987a. Final Phase I Contamination Assessment Report. Site 29-1: Burn Site, Incendiaries. Version 3.1. December 1987. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88063R02

ESE. 1988a. Final Phase I Contamination Assessment Report. Site 19-1: Burn Site, Incendiaries. Version 3.2. January 1988. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88063R02A

ESE. 1988b. Final Phase II Data Addendum. Site 19-1: Burn Site. Version 3.1. August 1988. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88293R01

ESE. 1988c. Final Phase I Contamination Assessment Report. Site 20-1: Burn Site, Incendiaries. Version 3.2. September 1988. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88293R03

ESE. 1988d. Final Phase I Contamination Assessment Report. Site 30-2: Burn Site, Incendiaries. Version 3.2. September 1988. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88063R03

ESE. 1988e. Final Phase I Contamination Assessment Report. Site 30-6: Liquid Disposal Trenches. Version 3.2. February 1988. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88063R03A

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RIC 88033R03

ESE. 1988g. Final Phase I Contamination Assessment Report. Site 30-1: Impact Area (Includes 30-7: Ground Disturbance). Version 3.3. January 1988. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88103R04

ESE. 1988h. Final Phase I Contamination Assessment Report. Site 29-4: Disposal Site, Explosives and Incendiaries. Version 3.2. April 1988. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88103R04A

ESE. 1988i. Final Phase II Data Addendum. Site 29-4: Disposal Site, Explosives and Incendiaries. Version 3.1. August 1988. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88013R07

ESE. 1988j. Final Phase I Contamination Assessment Report. Site 30-5: M-34 Demilitarization Operation Area. Version 3.3. January 1988. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88013R07A

ESE. 1988k. Final Phase II Data Addendum. Site 30-5: Liquid Disposal Trenches. Version 3.1. September 1988. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88173R05

ESE. 1988m. Final Phase I Contamination Assessment Report. Section 20: Nonsource Area. Version 3.1. May 1988. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88063R09

ESE. 1988n. Final Phase I Contamination Assessment Report. Section 25: Nonsource Area. Version 3.2. March 1988. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88063R09A

ESE. 1988o. Final Phase II Data Addendum. Section 25: Nonsource Area. Version 3.1. September 1988. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88133R01

ESE. 1988p. Final Phase I Contamination Assessment Report. Section 30: Nonsource Area. Version 3.1. April 1988. Task No. 14 - Army Sites North. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

RIC 88133R01A

ESE. 1988q. Final Phase II Data Addendum. Section 30: Nonsource Area. Version 3.1. August 1988. Contract No. DAAK11-84-D-0016. Prepared for: U.S. Army Program Manager's Office for RMA Contamination Cleanup.

APPENDIX A
NONTARGET SCREENING

NONTARGET SCREENING

A number of nontarget contaminants were originally identified through a screen (i.e., toxicity, concentration, frequency of occurrence) of the nontarget fraction of the Phases I and II RI data as part of the RMA Chemical Index (EBASCO, 1988a/RIC88357R01). These contaminants were carried through to the exposure assessment where an additional screening was performed to determine whether PPLVs should be developed for each of the site-specific nontarget contaminants. Development of PPLVs for these contaminants was based on four screening criteria, namely, frequency of occurrence, similarity of the nontarget concentration to that of target contaminants, suspicion that the detection was a laboratory contaminant, and co-occurrence of nontargets with targets in Arsenal soils (see Volume VI-A, Section 2.2.3.1).

The results of the nontarget evaluations for each site of Eastern Study Area, their screening parameters, and the decision to further consider or reject them, are presented in Table A-1.

TABLE A-1
EASTERN STUDY AREA NONTARGET SCREENING

Site	Nontarget Contaminant	Frequency of Occurrence	Relative Concentration	Suspected Lab Contam.	Co-occurs with Drivers	Nontarget Decision
ESA-1a	Methyl naphthalene	Low	Low	No	No	Reject
ESA-1b	Methyl naphthalene	Low	Low	No	No	Reject
ESA-1c	Methyl naphthalene	Low	Low	No	No	Reject
	Phenanthrene	Low	Low	No	No	Reject
ESA-2b	Phosphoric acid, tributyl ester	Low	Low	No	No	Reject
ESA-3b	2-Butoxyethanol	Low	Low	No	Yes	Reject
ESA-3b	1,1,2,2-Tetrachloroethane	Low	High	No	No	Reject ^{1/}
ESA-6d	Hexachlorobenzene	Low	Low	No	No	Reject

1/ Although rejected, PPLVs are composited for this chemical since it was detected in the Eastern Study Area.