8796

U.S. Army Environmental Center

Final Record of Decision/ Remedial Action Plan
Nine Sites
Sierra Army Depot
Lassen County, California

Prepared by:

Harding Lawson Associates
707 Seventeenth Street
Suite 2400
Denver, Colorado 80202

In conjunction with:

Montgomery Watson
365 Lennon Lane
Walnut Creek, California 94598

October 1996

19980713 025

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, MD 21010-5401

Distribution unlimited,
approved for public release

Contract No. DACA 31-94-D-0069
Delivery Order No. 0005

Printed on Recycled Paper

HLA

TOTAL ENVIRONMENTAL PROGRAM SUPPORT

Final Record of Decision/Remedial Action Plan Nine Sites Sierra Army Depot Lassen County, California

Prepared for

U.S. Army Environmental Center
Building E4480 (Edgewood Area)
Aberdeen Proving Ground, Maryland 20101

HLA Project No. 12299 14.02.00

October 1, 1996

Harding Lawson Associates
Engineering and Environmental Services
707 Seventeenth Street, Suite 2400
Denver, CO 80202 - (303) 292-5365

IN ACCORDANCE WITH ARMY REGULATION 200-2, THIS DOCUMENT IS INTENDED BY THE ARMY TO COMPLY WITH THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) OF 1969.

THE INFORMATION AND CONCLUSIONS PRESENTED IN THIS REPORT REPRESENT THE OFFICIAL POSITION OF THE DEPARTMENT OF THE ARMY UNLESS EXPRESSLY MODIFIED BY A SUBSEQUENT DOCUMENT. THIS REPORT CONSTITUTES THE RELEVANT PORTION OF THE ADMINISTRATIVE RECORD FOR THIS OPERABLE UNIT.

SIERRA ARMY DEPOT
RECORD OF DECISION/REMEDIAL ACTION PLAN

AMMUNITION DEMILITARIZATION AND RENOVATION AREA
BUILDING 1003 AREA
CHEMICAL BURIAL SITE
CONSTRUCTION DEBRIS LANDFILL
EXISTING LANDFILL
EXISTING POPPING FURNACE
LARGE SEWAGE TREATMENT PONDS
LOWER BURNING GROUND
1960 DEMOLITION AREA

Donald D. Whitfield, II
Colonel, OD
Commander
Sierra Army Depot

9 Jun 96
Date

Billy K. Solomon
Major General, U.S. Army
Chief of Staff
U.S. Army Materiel Command

25 Sep 96
Date

Anthony J. Landis, P.E.
Chief of Regional Operations
Office of Military Facilities
California Department of Toxic Substances Control

October 1, 1996
Date

Harold Singer
Executive Officer
California Regional Water Quality Control Board
Lahontan Region

Sep 27, 1996
Date

TOTAL ENVIRONMENTAL PROGRAM SUPPORT

Final Record of Decision/Remedial Action Plan
Nine Sites
Sierra Army Depot
Lassen County, California

Report Preparation Team

Shari L. Arroyo
Anita M. Larson
Michelle M. Parent
Juliana M. Silvers
Paul H. Weaverling
Jerry T. Wickham

CONTENTS

TABLES

FIGURES

1.0 INTRODUCTION

This Record of Decision (ROD)/Remedial Action Plan (RAP) has been prepared by Harding Lawson Associates (HLA) and Montgomery Watson for the U.S. Army Environmental Center (USAEC), under the Total Environmental Program Support (TEPS) Contract.

1.1 Site Names and Locations

This ROD/RAP addresses nine sites at Sierra Army Depot (SIAD), Lassen County, California. These nine sites and the selected remedy for each site include the following:

- Ammunition Demilitarization and Renovation Area - No Action
- Building 1003 Area - Excavation and offsite asphalt incorporation of petroleum hydrocarbon impacted soil
- Chemical Burial Site (subsite of the Construction Debris Landfill) - No Action
- Construction Debris Landfill - No Action
- Existing Landfill - No Action, regulated as Subtitle D facility under the Resource Conservation and Recovery Act (RCRA)
- Existing Popping Furnace (in Building P556 near the trinitrotoluene [TNT] Leaching Beds Site) - No Action, regulated under RCRA
- Large Sewage Treatment Ponds - Excavation and offsite disposal of polychlorinated biphenyl (PCB)-contaminated soil
- Lower Burning Ground - No Action, deed and access restrictions due to potential unexploded ordnance
- 1960 Demolition Area - No Action, deed and access restrictions due to potential unexploded ordnance

The locations of these sites are shown in Figure 1.1.

1.2 Statement of Basis and Purpose

This ROD/RAP presents the selected response actions for nine sites at SIAD. The response actions were selected by the U.S. Department of the Army (Army) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments Reauthorization Act of 1986 (SARA)(collectively referred to as CERCLA), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and Section 6.8 of the California Health and Safety Code. This ROD/RAP includes the factual and legal basis for selecting the response action at each of the nine sites listed above. The data used to support the selected response action are contained in the Administrative Record for each site. The State of California as represented by the Department of Toxic Substances Control (DTSC), and the Lahontan Regional Water Quality Control Board (RWQCB) concur with the selected response action at each site.

As set forth in Section 25356.1(d) of the California Health and Safety Code, a RAP approved by DTSC must include a non-binding, preliminary allocation of financial responsibility among all identifiable potentially responsible parties. DTSC has reviewed the relevant evidence and concluded that the preliminary non-binding allocation of financial responsibility for the sites incorporated in this ROD/RAP is as follows:

• U.S. Army, Sierra Army Depot	100 percent

1.3 Site Background Information

This section provides a description and history of SIAD.

1.3.1 Sierra Army Depot Site Description

SIAD is located in the Honey Lake Valley of Lassen County in northeastern California (Figure 1.2). The installation is located approximately 3 miles northeast of U.S. Highway 395 and 4 miles west of the California-Nevada state border. Susanville, California (40 miles to the northwest), and Reno, Nevada (50 miles to the southeast), are the nearest large cities to SIAD. Nearby communities include Herlong, and Sage Flats, California. Herlong is situated on the installation along its southern border. Sage Flats is outside the main gate to SIAD, on the south side of the installation.

SIAD is divided into two sections: the Main Depot and the Upper Burning Ground (Figure 1.2). The Main Depot covers 33,163 acres (approximately 52 square miles). The sites included in this ROD/RAP are located on the Main Depot. The Main Depot's surface elevation varies from approximately 4,000 to 4,130 feet above mean sea level, showing little topographic relief.

Honey Lake, west of the Main Depot, covers approximately 60,524 acres (95 square miles) and occupies the lower part of Honey Lake Valley. Honey Lake is included in the SIAD boundary. In

1977, 60,106 acres of the lake were offered on a Quit Claim Deed to the State of California. The offer was not accepted.

The Honey Lake Valley is located in the Basin and Range physiographic province. This area is characterized by northwest trending block-faulted mountains and valleys. The valley is bordered by the Shaffer and Antelope mountains to the north, the Skedaddle and Amedee mountains to the northeast, the Fort Sage and Virginia mountains to the southeast, and the Diamond Mountains to the south and southwest.

1.3.1.1 Meteorology

Honey Lake Valley has an arid climate characterized by low relative humidity and low precipitation. The average summer temperature is approximately 68 degrees Fahrenheit (°F) and the average winter temperature is approximately 35°F (JMM and ECJ, 1991).

The annual mean precipitation at SIAD is 5.6 inches with approximately half of the precipitation occurring as snow during the winter (USATHAMA, 1979). The annual mean precipitation in the mountains surrounding SIAD is approximately four times the amount that the valley floor receives (ESE, 1983).

The prevailing wind direction ranges from the south to the northwest with an average wind speed of approximately 6 miles per hour (USATHAMA, 1979).

1.3.1.2 Surface-Water Hydrology

The most prominent surface-water feature in Honey Lake Valley is Honey Lake. Honey Lake is a shallow basin that fluctuates greatly in area and volume in response to recharge from precipitation and runoff. On average, Honey Lake has a surface area of approximately 73 square miles (Handman et al., 1990). Several smaller lakes and reservoirs are also present in the Honey Lake Valley.

Main surface drainages from the surrounding mountain ranges include the Susan River to the northwest, Baxter Creek to the northeast, and Long Valley Creek to the southeast of SIAD (Benioff et al., 1988). These streams and rivers, excluding the Susan River, are considered ephemeral. The

Honey Lake Valley appears to be isolated because no surface water flows from the valley. The United States Geological Survey (USGS) topographic quadrangle maps containing SIAD indicate that no main surface drainages cross the Main Depot. Occasional springs and surface seeps are evident adjacent to mountain ranges on area topographic maps (USGS, 1988a, 1988b, 1988c, and 1988d). Water from Amedee Hot Springs reportedly forms a permanent wetland of about 200 acres to the northwest of the Main Depot on the northeast side of Honey Lake (J. Colberg, oral commun., 1993).

1.3.1.3 Geology

The geologic history of the Honey Lake Valley is characterized by Tertiary block-faulting, volcanism, and basin-fill sedimentation. A major regional structural feature of probable mid-Miocene origin known as the Walker Lane fault system extends into Honey Lake Valley from the southeast. This fault system exerted primary control on the Tertiary basin-fill sedimentation in the Honey Lake Valley and the development of its present day topographic features.

Granitic rocks of late Mesozoic origin are present in the Diamond Mountains south of SIAD and are believed to lie beneath the basin-fill Tertiary sedimentary deposits and volcanic rocks (Handman et al., 1990). Miocene and Pleistocene volcanic rocks overlie the granitic basement in the eastern and northern mountain ranges of the Honey Lake Valley. The basin-fill sequence of Honey Lake Valley is comprised of Pliocene to Holocene unconsolidated and semiconsolidated sediment and pyroclastic rock. Figure 1.3 illustrates the stratigraphic column in the Honey Lake vicinity (California Department of Water Resources [DWR], 1963). A geologic cross section (Figure 1.4) from Handman et al., (1990), illustrates the generalized stratigraphic relationships that comprise the Honey Lake vicinity.

The basin-fill deposits beneath SIAD consist of unconsolidated and semiconsolidated lacustrine and fluvial deposits of clay, silt, sand, and gravel. The distal lake sediments and proximal alluvial fan deposits are characterized by a transgressive-regressive migrating shoreface that resulted in an interfingering of fine- and coarse-grained deposits in the sedimentary basin fill. This depositional environment displays rapid facies changes over short distances and is interbedded with Pliocene and Pleistocene basalts and pyroclastics.

During recent environmental studies, numerous soil borings have been drilled and monitoring wells have been installed throughout the Main Depot. Lithologic logs for these borings indicate that the northern half of the Main Depot is underlain predominantly by clays and silts with thin sand interbeds to a depth of 250 feet below ground surface (bgs) (JMM and ECJ, 1991). The southern half of SIAD is underlain predominately by sand in this interval with occasional thin interbeds of clay and silt.

1.3.1.4 Hydrogeology

The relatively thick, unconsolidated and semiconsolidated Pliocene to Pleistocene basin-fill deposits provide the principal water-bearing formations in the Honey Lake Valley (Figure 1.3). Beneath SIAD, the water-bearing zones encountered in monitoring wells and Potable Supply Wells are interpreted to consist of Lahontan Lake deposits. Recharge to the basin-fill deposits originates primarily as infiltration of precipitation in upland areas and infiltration of stream flow in alluvial fan areas (Handman et al., 1990). Discharge from the aquifers within the basin-fill deposits is likely to occur at Honey Lake. Discharge also occurs from irrigation and water-supply wells in the valley.

The hydraulic conductivity of the unconsolidated sediment generally decreases with decreasing elevation. The median hydraulic conductivity of the basin-fill deposits and volcanic rocks has been estimated to be approximately 8 feet per day (3×10^{-3} centimeters per second [cm/s]) on the basis of production tests of supply wells and descriptions of geologic materials that occur in the basin (Handman et al., 1990).

Depth to groundwater varies widely over the Main Depot. The depth to water adjacent to Honey Lake is less than 3 feet, but the depth to groundwater is approximately 120 feet near the southern end of the Main Depot in the vicinity of the four Potable Supply Wells for SIAD. The southern portion of SIAD lies on a sand terrace and is slightly higher in elevation than the northern portion of the installation.

Figure 1.5 indicates that groundwater flow is generally to the north in the southern portion of the Main Depot and to the southwest and west in the northern portion of the Main Depot. The western portion of the Main Depot is characterized by a relatively flat hydraulic gradient with westward groundwater flow. Regional water-level data indicate that groundwater flow in the central portion of Honey Lake Valley east of the Main Depot is to the east (California DWR, 1963; Handman et al., 1990). Eastward groundwater flow is evident in the southeast portion of the Main Depot.

Two groundwater mounds are present in the southern portion of the Main Depot. These two groundwater mounds form a local groundwater divide from which groundwater flows north and south at the southern end of the Main Depot.

Local variation in the piezometric surface may also occur in the vicinity of groundwater supply wells at SIAD (USAEHA, 1972; ESE, 1983; Benioff et al., 1988). The four current SIAD Potable Supply Wells located in the southern portion of the Main Depot (Figure 1.1) may cause seasonal variations in groundwater flow direction because of the variation in pumping during the wet and dry seasons. Water-supply wells used for irrigation between the Main Depot and the Upper Burning Ground may cause variation in groundwater flow direction; however, this variation has not been documented (ESE, 1983).

1.3.1.5 Demography and Land Use

SIAD is located in a sparsely populated area of northeast California. There are no major cities in the region and few towns exist in the vicinity of SIAD (Figure 1.2). Approximately 1,000 people reside in the communities of Herlong and Sage Flats, which are located at the southern entrance to the Main Depot. The Main Depot has a current population of approximately 800 people including military personnel and their families. The town of Milford, located approximately 12 miles west of SIAD, has a population of 70 people, with an additional 300 people located in the surrounding area. Several hamlets are also scattered throughout the valley floor, each containing few domestic dwellings. The towns of Amedee and Wendel are located approximately 2 and 5 miles northwest of the Main Depot, respectively (Figure 1.2).

Lassen County has prepared a series of "area" plans covering selected portions of the county (Resource Concepts, Inc., 1987; Lassen County Planning Department, 1990). SIAD is located within the Wendel Planning Area. Due to limited development and the sparse population, the basic land-use categories in this planning area include (1) grazing/open space, (2) military, (3) agricultural, (4) towns and urban reserve, and (5) wildlife areas.

The largest land-use category is grazing/open space and most of the land in this category is covered with native vegetation. A vast majority of this land is in public ownership, with some private lands included. Approximately one-third of the total Wendel Planning Area is devoted to military use (SIAD). Several parcels of land in the planning area are designated for agricultural purposes, although not all of this designated land is currently under cultivation. According to aerial photographs that cover the planning area (U.S. Fish and Wildlife Service [USFWS], 1989a, 1989b, 1989c, and 1989d), a few agricultural fields are present outside of the areas designated for agricultural use by the Lassen County Planning Department. Agricultural activity in the area around SIAD includes primarily hay production and cattle ranching. A potato farm is located northeast of the Main Depot, on the land that separates the Main Depot from the Upper Burning Ground. The fourth land use category, towns and urban reserve, consists of the towns of Wendel and Amedee located northwest of SIAD, and Herlong and Sage Flats located on the southern border of SIAD. A wintering habitat for mule deer and antelope is located just south of the southern boundary of SIAD in the Doyle State Wildlife Area.

1.3.1.6 Ecology

The ecological setting at SIAD is characterized by expansive areas dominated by shrubs and grasses typical of semidesert regions in the intermountain western United States. Greasewood (*Sarcobatus vermiculatus*) is the dominant vegetative cover in poorly drained, highly alkaline soil where the water table is near ground surface. Big sagebrush (*Artemisia tridentata*) and rabbitbrush (*Chrysothamnus nauseosus* and *C. viscidiflorus*) codominate in areas where soil is well drained. Saltgrass (*Distichlis stricta*) is the dominant plant species on seasonally flooded alkali flats including the dry lakebed of Honey Lake.

Several tree species have been introduced at SIAD for erosion control purposes, including Chinese elm (*Ulmus pumila*), Russian olive (*Elaeagnus angustifolia*), Engelmann spruce (*Picea engelmannii*), ponderosa pine (*Pinus ponderosa*), junipers (*Juniperus* spp.), and cottonwoods (*Populus* spp.). Naturalized Chinese elm trees are sparsely distributed along water courses on and around SIAD.

Water from Amedee Hot Springs forms a permanent wetland of about 200 or more acres on the northeast side of Honey Lake (J. Colberg, oral commun., January, 1993). A wetland survey was conducted for SIAD in October 1995. The results of that survey were not available at the time that this ROD/RAP was prepared.

The following discussion of animal species known to occur on and near SIAD is summarized from the Sierra Army Depot Wildlife Management Plan (Colberg, 1992). There are approximately 349 different known species of birds, mammals, reptiles, amphibians, and fish at SIAD. Bird life is abundant because Honey Lake Valley is a major western flyway for migratory birds. Over 100 bird species including waterfowl, raptors, game birds, perching birds, and others are known to migrate through or inhabit SIAD.

Common large mammals known to inhabit the Honey Lake Valley include gray, red, and kit fox (*Urocyon cinereoargenteus, Vulpes fulva,* and *V. microtis*); coyote (*Canis latrans*); mountain lion (*Felis concolor*); bobcat (*Felis rufus*); pronghorn antelope (*Antilocapra americana*); mule deer (*Odocoileus hemionus*); and wild horse (*Equus caballus*). Small mammals inhabiting areas at SIAD include a variety of bats, rabbits, rodents, shrews, and small carnivores such as badger (*Taxidea taxus*), weasel (*Mustela frenata*), mink (*Mustela vison*), and skunk (*Mephitis mephitis*). Many species of reptiles and amphibians inhabit SIAD as well.

The water level of Honey Lake fluctuates from year to year depending upon the amount of regional precipitation. According to the Sierra Army Depot Wildlife Management Plan (Colberg, 1992), naturally occurring and stocked fish species that may be present in Honey Lake and its tributaries are largemouth bass (*Micropterus salmodes*), brown bullhead (*Ictaluras nebulosus*), black crappie (*Pomoxis nigromaculatus*), Sacramento perch (*Archoplitesa interruptus*), bluegill (*Lepomis macrochrus*), pumpkinseed sunfish (*Lepomus gibbosus*), tui chub (*Gila bicolor*), redside shiner (*Richardsonius* *egregius*), catfish (*Ictalurus puncatus*), speckled dace (*Richimichthys osculus*), Tahoe sucker (*Catostomus tahoensis*), and mosquito fish (*Gambusia affinis*).

Two federally listed endangered avian species and three state-listed threatened avian species are known to occur or potentially occur near SIAD. The federally endangered bald eagle (*Haliaeetus leucocephalus*) and peregrine falcon (*Falco peregrinus*) (proposed for delisting) are frequent migrants that may use Honey Lake for feeding purposes. The greater sandhill crane (*Grus canadensis*), a state-listed threatened species, is known to migrate through the Honey Lake Valley. The state-listed threatened bank swallow (*Riparia riparia*) is included on the list of SIAD wildlife (Colberg, 1992). Bank swallows typically build nests or burrows in eroding river banks and coastal bluffs. A portion of the current population of bank swallows exists in widely scattered, generally small colonies in northern California (Steinhart, 1990). Swainson's hawk (*Buteo swainsoni*), listed by the State of California as threatened, has been observed at SIAD.

Additional plant and animal species that are federal candidate species, federal sensitive species, and California species of special concern are discussed in the Group III A Final Sites Remedial Investigation (RI) Report (HLA, 1994a).

1.3.2 Sierra Army Depot History

Honey Lake was acquired by the Army Air Corps in 1933 for use as an aerial bombing and gunnery range. In 1942, Sierra Ordnance Depot began operations as a reserve storage and supply depot for inert materials belonging to the U.S. Department of the Treasury. The Sierra Ordnance Depot was redesignated as the SIAD in 1962 because of the reorganization of the Army's Logistical Support Command under the Army Material Command.

During the 1940s, the Army Air Corps ceased its activities at Honey Lake; however, portions of the lakebed were used by the Sierra Ordnance Depot during the 1940s and 1950s as a demolition and function test range. Upon completion of the extensive Igloo Storage Area, the Sierra Ordnance Depot mission expanded to include storage of ammunition and explosives. In 1954, the function of receiving, storing, and issuing guided missiles and propellant fuels was added. During the Vietnam War, SIAD was also used as a vehicle maintenance location.

The work force and activity at SIAD fluctuated with the involvement of the United States in military conflicts. Work force peaks were noted during the Korean Conflict and the Vietnam War. After the Vietnam War, the civilian work force was reduced when large-scale vehicle maintenance activities ceased.

The present mission of SIAD is the receipt, storage, surveillance, maintenance of munitions, strategic and critical material, and obligated war reserve material. To fulfill this mission, SIAD has a current population of approximately 800 personnel, including soldiers and their families. On February 28, 1995, the Secretary of Defense submitted a recommendation to Congress that SIAD be selected for major realignment under Public Law (P.L.) 100 to 526 and P.L. 101 to 510. In July of 1995, Congress and the President finalized the Base Realignment and Closure (BRAC) 95 list of base closures and realignments. SIAD, as part of the BRAC 1995 (BRAC 95) realignment bases, is undergoing transformation of missions and anticipates to release property for reuse in accordance with the Community Environmental Response Facilitation Act (CERFA). The SIAD parcels identified for reuse in 1995 are Honey Lake and an estimated 540 acres in the southwestern section of the main post.

Current and past operations at SIAD are as follows:

- Routine maintenance of depot equipment and vehicles
- Maintenance and renovation of munitions
- Demilitarization of munitions
- Aerial bombing and gunnery practice

Specific work practices involved with these operations include the following:

- Spray painting
- Welding and soldering
- Degreasing

- Lubricating
- Preserving with oils and waxes
- Removing rust and paint
- Explosive washout and destruction in popping furnaces
- Grinding and machining
- Abrasive blasting
- Packaging items (including explosives)
- Maintaining batteries
- Steam cleaning
- Heat-treating metal parts
- Handling asbestos and insecticides
- Explosive detonation and burning

1.4 Community Participation

The remedial investigation reports for the nine sites were released to the public beginning in 1990. Feasibility study reports for the Building 1003 Area and the Lower Burning Ground and the Large Sewage Treatment Ponds were finalized and released to the public in February 1996. Copies of these documents were placed in both the Administrative Record and at the following information repositories:

- Sierra Army Depot Library in Herlong, California
- Lassen County Free Library in Susanville, California

The public was informed of the availability of these documents by publishing a notice of availability in the *Lassen County Times* on February 7 and 14, 1996, in the *Reno Gazette Journal* on February 8 and 15, 1996, and on the Susanville Cable Television Public Announcement Bulletin on approximately February 8 and 15, 1996.

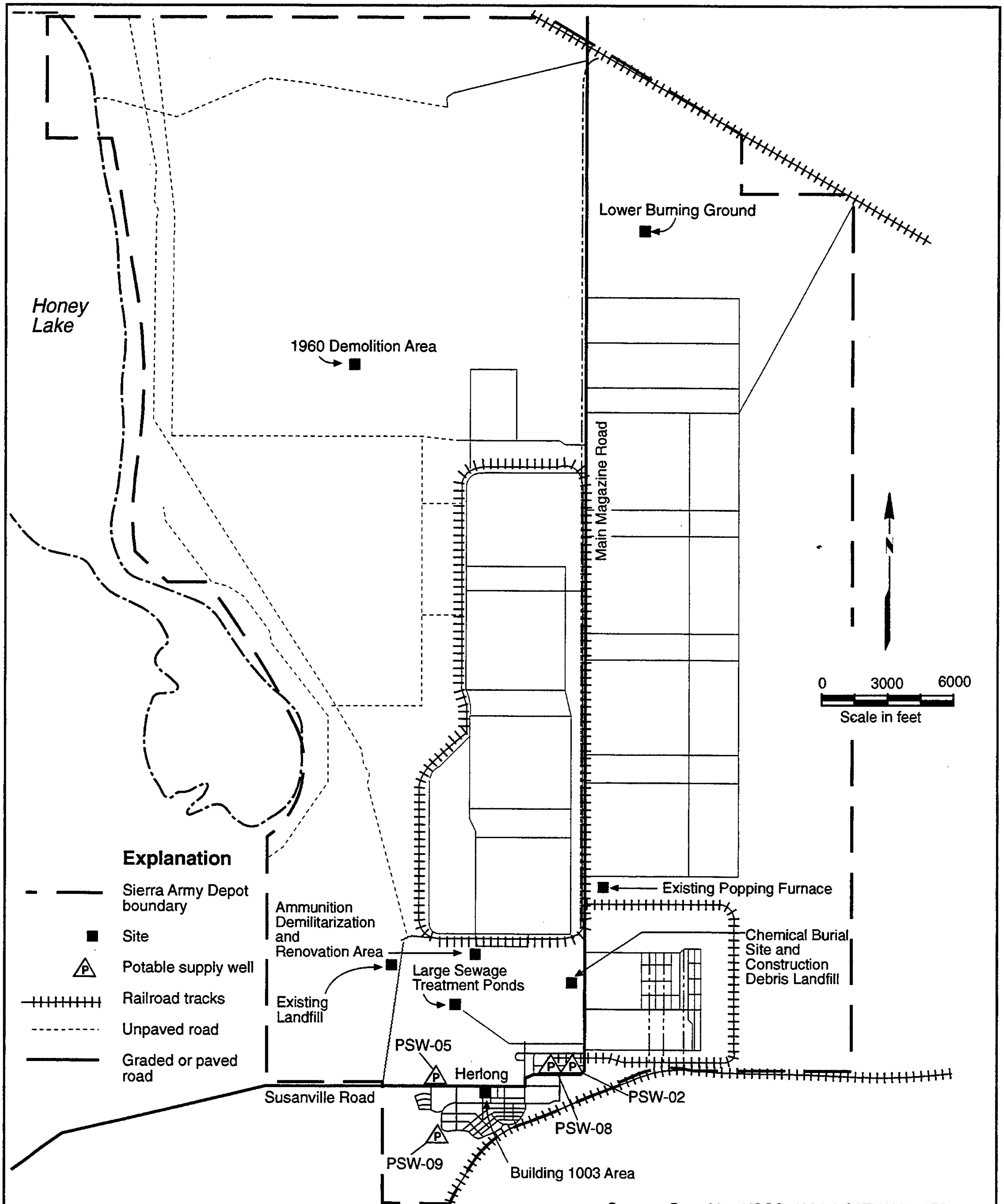
One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and Lahontan

RWQCB were present at the meeting. Responses to questions raised by the public at this meeting for a specific site are presented in the site-specific responsiveness summary.

The public participation requirements of CERCLA § 113(k)(2)(B)(i-v) and § 117 and § 25356.1 of the California Health and Safety Code were met in the remedy selection for each of the nine sites addressed herein. The response actions presented in this ROD/RAP were selected in accordance with CERCLA, NCP, Chapter 6.8 of the California Health and Safety Code, and the California Water Code. The basis for the respective response action selected at each site is documented in the Administrative Record.

1.5 Report Organization

The remaining sections of this ROD/RAP have been organized on a site-by-site basis. The discussion for each site follows a format consistent with the preferred alternative for that site as outlined in the Interim Final Guidance in Preparing Superfund Decision Documents (EPA, 1989a).



Sources: Base Map USGS, 1964; USATHAMA MEP, 1988

SRA 1070 02/01/96 ECS

Harding Lawson Associates

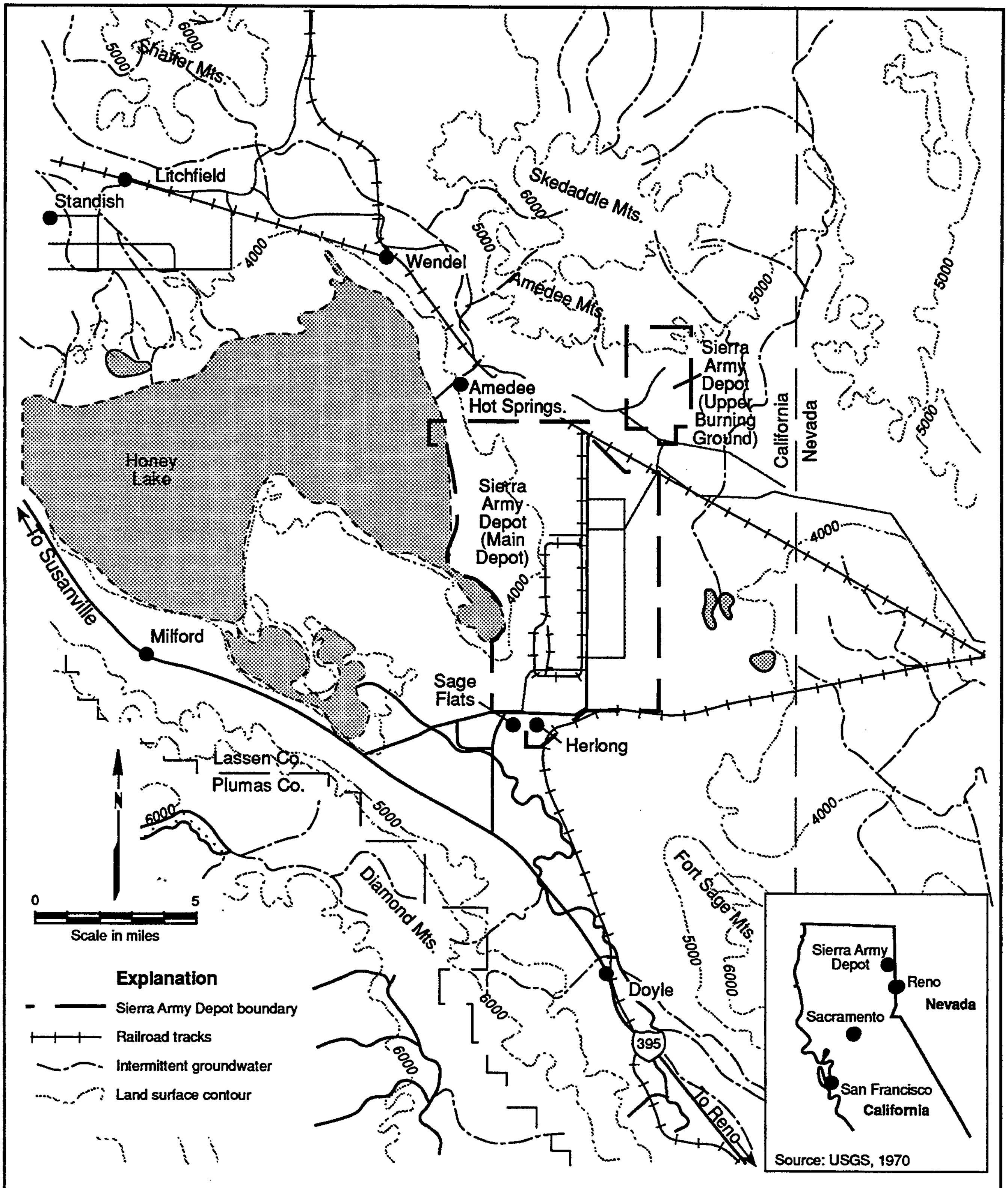
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 1.1

Site Locations



Explanation

- Sierra Army Depot boundary
- Railroad tracks
- Intermittent groundwater
- Land surface contour

SRA 1070.1 11/3/95 ECS

Harding Lawson Associates
Engineering and
Environmental Services

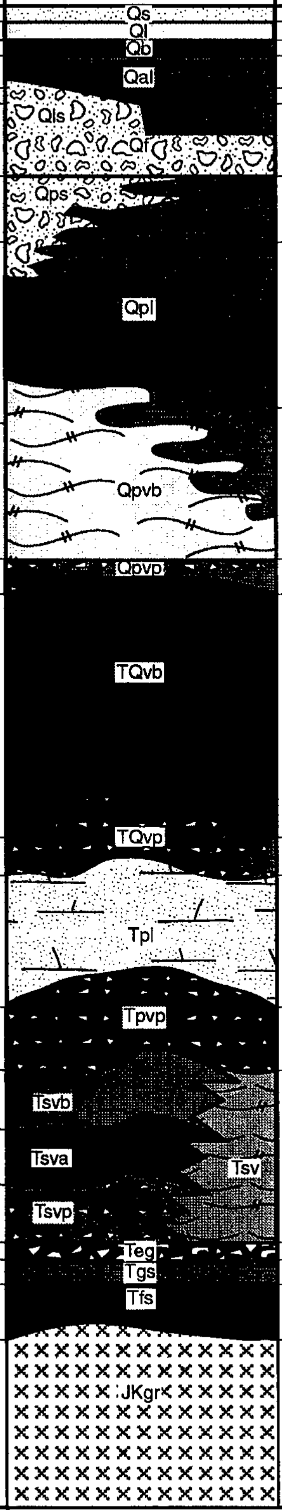
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 1.2

Sierra Army Depot Location Map

SRA 1070.2 10/31/95 ECS



Geologic Age			Geologic Formation		Stratigraphy	Approximate Thickness in Meters
Cenozoic	Quaternary	Recent		Sand Deposits	Qs	0-8
				Lake Deposits	Ql	0-8
				Basin Deposits	Qb	0-16
				Intermediate Alluvium	Qal	0-30
				Landslides	Qls	0-16
				Alluvial Fans	Qf	0-100
		Pleistocene		Near-shore Deposits	Qps	0-120
				Lahontan Lake Deposits	Qpl	0-210
			Pleistocene Volcanic Rocks	Basalt	Qpvb	16-160
	Tertiary			Pyroclastics	Qpvp	0-60
		Plio-Pleistocene	Plio-Pleistocene Volcanic Rocks	Basalt	TQvb	1200
				Pyroclastic Rocks	TQvp	?
		Pliocene		Pliocene Lake Deposits	Tpl	0-1500
				Pliocene Pyroclastic Rocks	Tpvp	300
		Pre-Pliocene	Sierran Volcanic Rocks	Basalt	Tsvb Tsv	600
				Andesite	Tsva	
				Pyroclastic Rocks	Tsvp	
				Auriferous Gravels	Teg	?
				Gold Rum Sandstone	Tgs	?
				Fort Sage Sandstone	Tfs	?
Mesozoic	Jurassic to Cretaceous	Basement Complex		Granitic Rocks	JKgr	?

Physical Characteristics	Water-bearing Characteristics
Qsd: Loose, wind-blown sand.	Highly permeable but located above water table, hence, contains little water.
Ql: Unconsolidated silt and clay. Contains alkali.	Very low permeability and of little importance to groundwater.
Qb: Unconsolidated sand, silt, and clay. Often contains alkali.	Low permeability. May yield small amounts of water to domestic wells.
Qal: Unconsolidated sand, silt, and gravel with lenses of clay.	Moderate permeability. Yields small to moderate quantities of water to wells.
Qls: Unconsolidated mixtures of rock, sand, and clay.	Moderate permeability. May yield moderate quantities of water to wells in Hidden Valley.
Qf: Unconsolidated gravel, sand, and silt, with some clay lenses.	Moderate to high permeability. Yields large quantities of water to wells. May contain confined water.
Qps: Unconsolidated, poorly cemented, bedded gravel, sand, and silt.	Highly permeable. Frequently occurs above water table. Where saturated, yields large quantities of water to wells and sumps.
Qpl: Poorly consolidated bedded sand, silt, and clay.	Permeability ranges low to high. Contains important aquifers in Honey Lake Valley. Often yields large quantities of water to wells.
Qpvb: Jointed basalt flows containing zones of acoria.	Moderate to high permeability. May yield large quantities of water to wells. Acts as forebay for groundwater recharge.
Qpvp: Bedded mudflows and tuffs.	Low permeability, unimportant to groundwater.
TQvb: Jointed, fractured flows of vesicular basalt with some pyroclastic rocks.	Moderate permeability. May yield moderate amounts of water to wells. May contain confined water. Important as forebay for groundwater recharge.
TQvp: Pale-colored bedded tuff.	Unimportant to groundwater.
Tpl: Bedded, consolidated sandstone, tuffaceous siltstone, and diatomite.	Generally of low permeability. Locally may yield moderate quantities of water to wells. Contains confined water.
Tpvp: Massive, cemented tuff and mudflows.	Essentially impermeable.
Tsvb, Tsva, Tsvp, Tsv: Flows of fractured basalt, andesite, and minor amounts of other types of lava. Massive mudflows and tuffs.	Permeability ranges from poor to moderate. Basalt is generally above zone of saturation, is underlain by impermeable rock, and is unimportant to groundwater. A few areas may contain perched groundwater. Andesite and pyroclastic rocks are essentially impermeable.
Teg: Semi-consolidated gravel, sand, and clay.	Low to moderate permeability. Yields water to many springs. Not important to groundwater in Honey Lake Valley.
Tys: Semi-consolidated, poorly cemented sandstone and shale.	Low permeability. May yield small quantities of groundwater to wells.
Tfs: Consolidated, cemented sandstone.	Essentially impermeable.
JKqr: Massive, poorly jointed diorite. Locally weathered and decomposed.	Impermeable where fresh. Decomposed rock may yield small quantities of water to wells and sumps.

Sources: State of California, Department of Water Resources, 1963; ESE, 1983

Harding Lawson Associates
Engineering and
Environmental Services

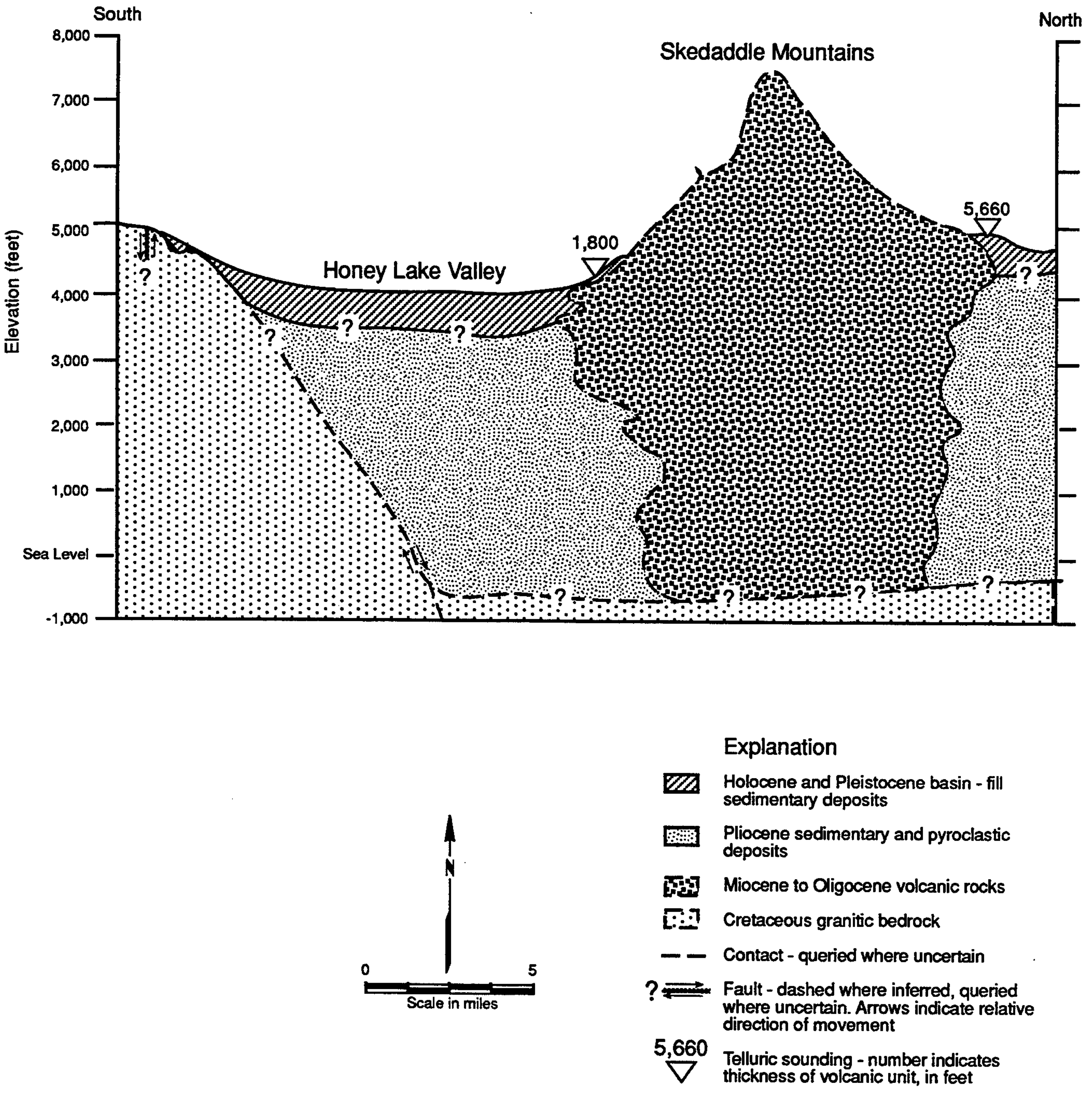
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 1.3

Geologic Formations in Honey Lake Valley

SRA 1070.3 11/8/95 ECS



Source: Handman et al., 1990.

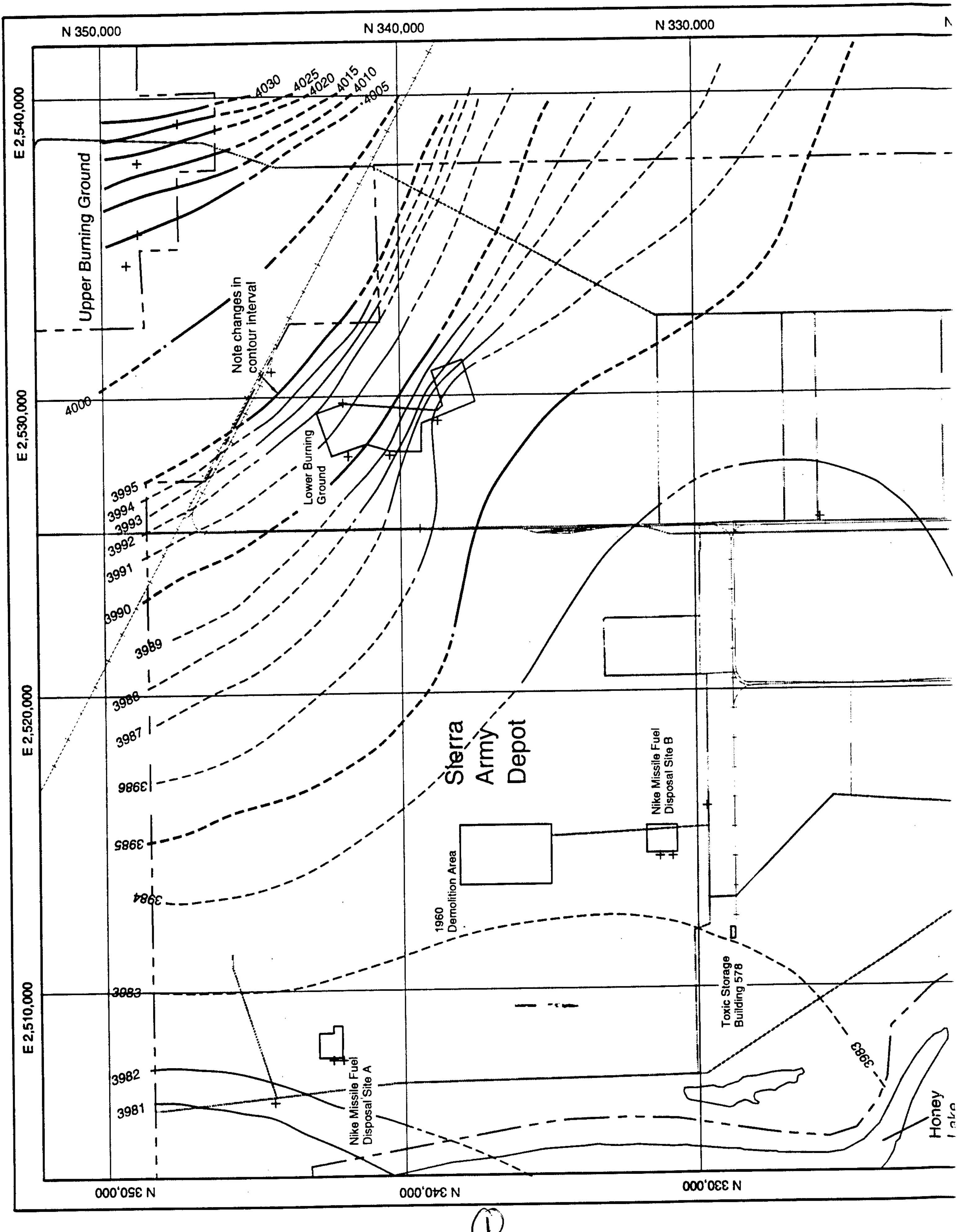
Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

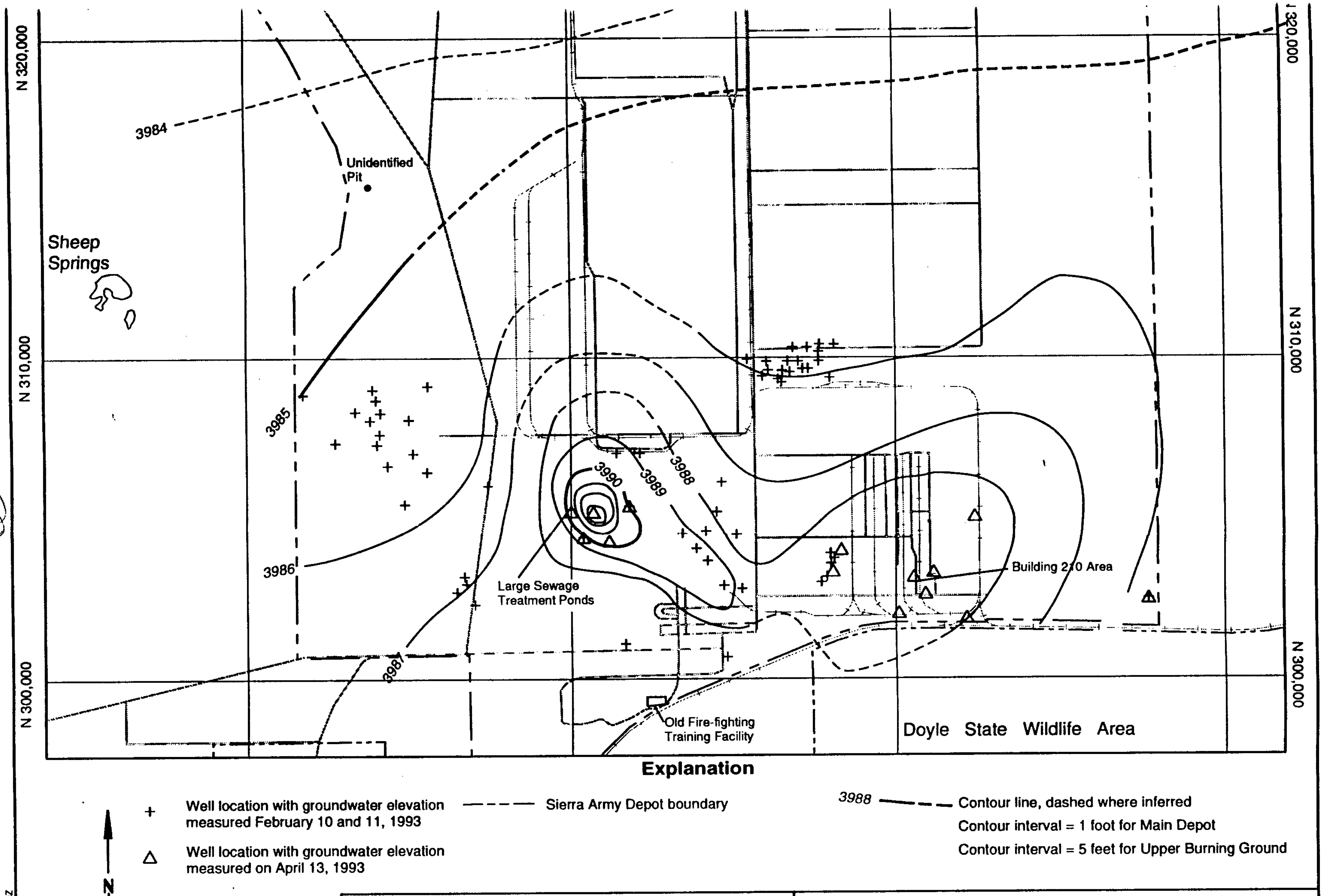
Sierra Army Depot, Lassen County, California

Figure 1.4

Geologic Cross Section Through Honey Lake Valley


N 350,000
N 340,000
N 330,000
E 2,540,000
E 2,530,000
E 2,520,000
E 2,510,000
Upper Burning Ground
Lower Burning Ground
Note changes in contour interval
4030
4025
4020
4015
4010
4005
4000
3995
3994
3993
3992
3991
3990
3989
3988
3987
3986
3985
3984
3983
3982
3981
Sierra Army Depot
Nike Missile Fuel Disposal Site B
Nike Missile Fuel Disposal Site A
Demolition Area
1960 Demolition Area
Toxic Storage Building 578
Honey Lake

(1)



Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 1.5

Approximate Water-table Surface

SIERRA/1229910B 11/10/95 LDZ

2.0 AMMUNITION DEMILITARIZATION AND RENOVATION AREA

2.1 Declaration

This section provides the declaration portion of the ROD/RAP for the Ammunition Demilitarization and Renovation Area (ADRA).

2.1.1 Location

The ADRA is located in the southern portion of SIAD, approximately 1 mile north of Susanville Road (Figure 1.1).

2.1.2 Assessment of the Site

The distribution and extent of contamination at the ADRA was assessed based on activities conducted and data obtained during the 1991 Group II RI (JMM, 1992) and the 1993 Group I and II Follow-Up RI (Montgomery Watson, 1994). The results are summarized as follows:

- The potential source of contamination at the ADRA was discharges to two parallel sets of underground drainage pipes, septic tanks, and leach fields.
- No volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), or explosives were present at detectable concentrations in soil samples collected from test pits and two soil borings. No VOCs, SVOCs, or explosives were present at detectable concentrations in surface and subsurface soil collected from two soil borings. All metals present at detectable concentrations are interpreted to be naturally occurring.
- Low levels of VOCs were detected in two of four Hydropunch groundwater samples collected from the first 5 feet of the water table directly below the leachfield. Trace to low levels of VOCs have been detected sporadically during four of the six rounds of sampling of the three monitoring wells at the site. All levels were below the respective California or federal maximum contaminant levels (MCLs) for each compound.
- No explosives were detected in the four Hydropunch samples. Trace to low levels of explosives have been detected during three of six rounds of groundwater sampling.
- All metals and nitrate plus nitrite present in the groundwater at detectable concentrations are interpreted to be naturally occurring.

Potentially unacceptable risks to human health from the detected concentrations of arsenic in groundwater and soil were identified in residential exposure scenarios during a baseline risk assessment. However, the arsenic levels in the soil and groundwater at the ADRA are interpreted to represent native conditions. No adverse effects to ecological receptors at the ADRA were identified in the baseline risk assessment. Therefore, no further action is recommended at this site.

2.1.3 Description of the Selected Remedy

As discussed in the preceding section, no further action is recommended for the ADRA.

2.1.4 Statutory Determinations

Because no remedial actions are required at this site, no statutory determinations of remedial actions are necessary.

2.2 Decision Summary

This section provides the site-specific factors and analysis that were considered in the selection of the response action for the ADRA.

2.2.1 Site Description

The ADRA consisted of four buildings: Buildings 408 and 409, Boiler Plant No. 5 (Building 407), and a shower/bathroom facility (Figure 2.1). Buildings 408 and 409 and the shower/bathroom facility were torn down and the boiler plant was abandoned in 1974. Presently, two concrete platforms are all that remain of the original Buildings 408 and 409. The foundation of the shower/bathroom facility also remains. Each platform contained a floor drain that according to the SIAD general sewer map, led to an underground drainage pipe, septic tank, and leach field located south of the platforms (Figure 2.1).

The underground drainage pipes extend south from the concrete platforms beneath one set of railroad tracks and a chain-link fence. The septic tanks and leach fields are in a broad open space (Figure 2.1).

2.2.2 Site History and Enforcement Activities

The ADRA was active from 1958 to 1974. Operations carried out at the ADRA included ammunition pull-apart, repacking, and painting. Wastes generated were primers, charges, waste rags, paints, and solvents. Excess propellants were taken to the lower burning ground/demolition grounds, and solvents and paint sludges were taken to the burning pits at the old dump and fill area (Benioff, et al. 1988). Each platform contained a floor drain that, according to the base sanitary sewer map, led to an underground drainage pipe, septic tank, and leach field south of the platforms. It is possible that small quantities of munitions compounds were washed down the drains; however, because this was not routine practice, the total volume is expected to be small (ESE, 1983).

Investigations conducted at the ADRA include the following:

- 1991 Group II RI, J.M. Montgomery Consulting Engineers, Inc. (JMM)
- 1993 Group I and II Follow-Up RI, Montgomery Watson

No soil contamination was detected along either of the leach field alignments during the 1991 Group II RI. The three monitoring wells that were installed during the 1991 Group II RI have been sampled for six rounds. The wells have had detectable concentrations of explosives and VOCs in some of the sampling rounds but at trace to low levels detected sporadically.

The 1993 Group I and II Follow-Up investigation of the ADRA focused on determining the presence of VOCs and/or explosives in the groundwater beneath the leach field at the site. During the 1993 Group I and II Follow-Up RI, four Hydropunch groundwater samples were collected from beneath the leach field lines in areas where contamination potential is high. Two of the Hydropunch groundwater samples contained low levels of VOCs.

No explosives were detected in any of the Hydropunch groundwater samples. Low levels of VOCs and explosives may have been present in the washwater disposed at the site, so low levels of these constituents are not unexpected. The levels detected were below the respective California or federal MCLs for each compound.

2.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 2.3 of this ROD/RAP.

The public participation requirements of CERCLA § 113(K)(2)(B)(i-v) and § 117, and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site. The response action presented for this site in this ROD/RAP was selected in accordance with CERCLA, NCP, Chapter 6.8 of the California Health and Safety Code, and California Water Code. The basis for this decision is documented in the Administrative Record.

2.2.4 Scope and Role of Response Action

This ROD/RAP presents the final response action for the ADRA. This site poses no potential threat to human health and the environment. The selected remedy is No Action. This will be the final action for the ADRA.

2.2.5 Site Characteristics

Contamination at the ADRA was suspected due to disposal of washwater and liquid wastes through the leach fields at the site. An assessment of potential contamination at the site was based on surface geophysical data, surface- and subsurface-soil analytical data, and groundwater analytical data.

2.2.5.1 Geophysical Survey

A geophysical survey was conducted during the 1991 Group II RI to locate the two leach field alignments associated with Buildings 408 and 409. Each alignment consisted of a buried sewer line, septic tank, and leach field (Figure 2.1). Ground penetrating radar (GPR) was the primary method used to locate the alignments.

2.2.5.2 Surface Soil

Two surface-soil samples were collected from the ADRA during the 1991 Group II RI. The samples were collected from the surface interval of soil borings ADR-01-SB and ADR-02-SB (Figure 2.1). These samples were analyzed for California Title 22 metals, VOCs, SVOCs, and explosives.

The metals detected in surface soil are interpreted to be naturally occurring (Table 2.1). Because the potential sources of contamination at the site are buried sewer lines, septic tanks, and leach field lines, there are no known potential sources of surface-soil contamination at the ADRA. No VOCs, SVOCs, or explosives were detected in the surface-soil samples.

2.2.5.3 Subsurface Soil

Twenty-six subsurface-soil samples were collected from the ADRA during the 1991 Group II RI. Samples were collected every 5 feet from ground surface to the water table in ADR-01-SB and ADR-02-SB and analyzed for California Title 22 metals, VOCs, and explosives. Samples were analyzed for SVOCs every 10 feet from ground surface to the borehole terminus. Ten test pits (Figure 2.1) were excavated and one soil sample was collected from below the leach field lines (approximately 4 to 5 feet bgs) in each excavation. All samples were analyzed for California Title 22 metals, VOCs, SVOCs, and explosives. No VOCs, SVOCs, or explosives were present in detectable concentrations in subsurface-soil samples collected from the soil borings and test pits. All metals present are interpreted to be naturally occurring (Table 2.2).

2.2.5.4 Groundwater

The groundwater below the ADRA was characterized using data obtained from three water-table monitoring wells installed during the 1991 Group II RI and four Hydropunch groundwater samples collected during the 1993 Group I and II Follow-Up RI.

Hydropunch Samples

Hydropunch samples were collected from the first 5 feet of the water table at four locations below the leach field at the ADRA during the 1993 Group I and II Follow-Up RI (Figure 2.1). The groundwater samples were analyzed for California Title 22 metals, VOCs, and explosives. One of the samples, ADR-02-HP, was also analyzed for SVOCs and nitrate plus nitrite. Low levels of VOCs were detected in two of the Hydropunch groundwater samples (Table 2.3). Low concentrations of VOCs may have been present in the wastewater that was discharged through the leach field, so low concentrations in the groundwater could be expected. These levels are below the respective California or federal MCLs for each compound. No explosives were detected in the Hydropunch samples (Table 2.3). All metals and nitrate plus nitrite present in the groundwater at detectable concentrations are interpreted to be naturally occurring.

Monitoring Well Samples

Three water-table monitoring wells were installed at the ADRA during the 1991 Group II RI. These wells have been sampled during six rounds of groundwater sampling. Two rounds of groundwater sampling were conducted during the 1991 Group II RI, and the samples were analyzed for EPA priority pollutant metals, VOCs, SVOCs, explosives, and macroparameters. During the 1992 Group I Follow-Up RI, the wells were sampled for two rounds and analyzed for EPA priority pollutant metals, VOCs, and explosives. The last two rounds of sampling were conducted during the 1993 Group I and II Follow-Up RI, and the samples were analyzed for VOCs and explosives. In addition, groundwater samples were also analyzed for nitrates plus nitrites during the last round of sampling.

Four metals were detected above the maximum background concentrations observed at SIAD (Table 2.3). No metals were detected above the current California MCLs and all are considered to represent native conditions.

Low levels of toluene and trichloroethylene (TCE) have been detected sporadically in two of the wells at the ADRA (Table 2.3). The levels of toluene detected are below the federal MCL for toluene of 1,000 micrograms per liter (μg/l). There is no current California MCL for toluene. All detections of TCE were below the federal and California MCLs for TCE.

No SVOCs were detected in the three monitoring wells.

Low levels of explosives were detected sporadically in the three monitoring wells during the six groundwater sampling rounds (Table 2.3). No explosives were detected during the most recent round of sampling (January 1994).

Groundwater samples collected during the 1993 Group I and II Follow-Up RI second round of groundwater sampling were analyzed for nitrate plus nitrite as a general water quality parameter to help evaluate groundwater flow and aquifer conditions in the southern portion of the depot. Nitrate plus nitrite is not a suspected site contaminant at the ADRA. Nitrate and nitrite levels can be elevated as a result of the breakdown of explosives compounds. However, if the nitrate plus nitrite in the groundwater at the ADRA was present due to the breakdown of explosive compounds then explosive compounds would be present in comparable concentrations. Explosive compounds have not been detected at concentrations exceeding 5 μg/l, but the levels of nitrate plus nitrite detected in groundwater at the ADRA range from 7,300 μg/l to 17,000 μg/l. The nitrate plus nitrite concentrations in the ADRA wells are similar to the levels detected in the designated background wells: BKG-01-MWA at 13,000 μg/l; BKG-02-MWA at 2,000 μg/l; and DSB-04-MWA at <10μg/l. No current MCLs are available for the sum of nitrate plus nitrite.

2.2.6 Summary of Site Risks

This section presents a summary of the baseline risk assessment conducted for the ADRA during the 1993 Group I and II Follow-Up RI (Montgomery Watson, 1994).

2.2.6.1 Compounds of Potential Concern

The process of selecting compounds of potential concern (COPCs) considers a number of factors, such as toxicity, physical and chemical properties of the compound, environmental persistence, medium-specific mobility, ability to bioaccumulate, potential routes of exposure, spatial extent of monitoring data, range and magnitude of concentrations detected, and frequency of detection. Compounds that were detected at least once in an environmental medium (soil and groundwater) were qualitatively screened to determine frequency of detection and toxicity (i.e., whether the compound is an essential nutrient, a carcinogen, or a noncarcinogen). Background concentrations have not been used in the selection of COPCs. The COPCs in surface soil at the ADRA are arsenic, barium, and vanadium.

The COPCs in subsurface soil at the ADRA are arsenic, barium, mercury, and vanadium. The COPCs in groundwater at the ADRA are TCE, antimony, arsenic, barium, calcium, lead, mercury, molybdenum, selenium, sodium, and 1,3,5-trinitrobenzene. Groundwater is not a current completed pathway at the site.

2.2.6.2 Contaminant Fate and Transport

Fate and transport properties were evaluated for chemicals identified as COPCs at the ADRA in the 1993 Group I and II Follow-Up RI Report (Montgomery Watson, 1994). The purpose of evaluating fate and transport properties of COPCs was to assess the potential for these COPCs to migrate to other media, or to human or ecological receptor locations. Chemical transport mechanisms considered for this site include wind dispersion and surface-water runoff. Because the COPCs are nonvolatile metals, volatilization from soil to air is not expected.

Wind dispersion is a potentially important release mechanism due to the arid character of the site and erodible surface soil (USATHAMA, 1979). Surface-water runoff is expected to be a negligible release mechanism due to the low annual precipitation at SIAD (less than 6 inches on average) and high infiltration capacity of the surface soil.

Because metals tend to be persistent and relatively insoluble, these chemicals are expected to bind closely to particulate matter and bioavailability is expected to be limited (i.e., uptake in the primary organism may occur, but concentrations would not be expected to significantly biomagnify through the food web). Therefore, the fate and transport potential for metals at the site is of low significance.

2.2.6.3 Human Health Risks

The results of the human health risk assessment for the ADRA are summarized in Table 2.4. Potential noncancer health effects and cancer risk were evaluated separately.

Soil

The excess lifetime cancer risk (ELCR) and the hazard index (HI) for current baseworkers at the ADRA are 1.6×10^{-5} and 0.044, respectively (Table 2.4). The ELCR estimates are above the California benchmark of 1×10^{-6}. Cancer risks at the ADRA are primarily due to arsenic, with a much lower contribution to risk from chromium. Arsenic at the ADRA is present at naturally occurring levels in the surface soil. The cancer risk estimates are within the range (1×10^{-4} to 1×10^{-6}) provided in the NCP (1990) for the Superfund site remediation goals. The HIs are less than the benchmark of 1.

The ELCR and HI for construction workers exposed to surface soil at the ADRA are 3.2×10^{-6} and 0.19, respectively (Table 2.4). The risks are estimated for construction worker exposure to surface soil at the ADRA site via inhalation, ingestion, and dermal routes of exposure. The ELCR estimates are above the California benchmark of 1×10^{-6} for both sites. However, cancer risks to future construction workers at the site are due entirely to arsenic, which is present at naturally occurring levels in surface soil. The HI is less than the benchmark of 1.

Risks were also estimated for construction worker exposure to subsurface soil at the ADRA site via inhalation, ingestion, and dermal routes of exposure (Table 2.4). The ELCR and HI for subsurface soil exposure at the ADRA are 3 x 10^{-6} and 0.17, respectively. The ELCR estimate is above the California benchmark of 1 x 10^{-6} but represents the risks due to naturally occurring levels of arsenic in subsurface soil. The HI is less than the benchmark of 1. In addition, the cancer risk estimate is within the range (1 x 10^{-4} to 1 x 10^{-6}) provided in the NCP (1990) for the Superfund site remediation goals.

Risks for hypothetical future residents at the ADRA site also were estimated. Risks were estimated for adult and child residential exposure to surface soil via inhalation, ingestion, and dermal routes of exposure. The ELCR and HI for a hypothetical future adult resident exposure to surface soil are 3.6 x 10^{-5} and 0.086 at the ADRA, respectively (Table 2.4). The ELCR and HI for a hypothetical future child resident exposure to surface soil are 6.8 x 10^{-5} and 0.66 for the ADRA, respectively. The ELCR estimates are above the California benchmark of 1 x 10^{-6} for adult and child future residents for both sites. However, cancer risks to future adult residents are due entirely to arsenic, which is present at naturally occurring levels in surface soil. The HIs are less than the benchmark of 1. In addition, the cancer risk estimates are within the range (1 x 10^{-4} to 1 x 10^{-6}) provided in the NCP (1990) for the Superfund site remediation goals.

Groundwater

Four potable supply wells are used by SIAD. The nearest potable supply well is approximately 1 mile south (upgradient) of the ADRA and will not be affected by chemicals in groundwater at the ADRA. Therefore, groundwater is not a completed pathway for the site.

Risks were estimated for hypothetical future residential use of groundwater even though potential future use of the shallow groundwater is highly unlikely. Risks were estimated for adult and child residential exposure to groundwater soil via inhalation, ingestion, and dermal routes of exposure (Table 2.4). The ELCR and the HI for a hypothetical future adult resident exposure to groundwater are 7.5 x 10^{-4} and 3.4, respectively, for the ADRA. The ELCR and HI for a hypothetical future child resident exposure to groundwater are 4.4 x 10^{-4} and 8.0, respectively. The ELCR estimates are above the California benchmark of 1×10^{-6} for the hypothetical adult and child resident at both sites. In addition, the HIs are all above the benchmark of 1. These exceedances represent the risks due to arsenic and antimony in groundwater. Although antimony was quantitatively evaluated in the baseline risk assessment, it is much more likely that the antimony detected in the groundwater is related to equipment contamination. Rinsate blanks from the field investigation indicate the presence of antimony, suggesting it is a common contaminant in the filters used in the groundwater sampling at the site. Therefore, the risks associated with antimony in groundwater at the ADRA are not considered to represent site-related risk estimates. In addition, evaluation of arsenic in groundwater and soil strongly suggest that this compound is present at levels representing native conditions at the ADRA site.

Total hypothetical future site risk was estimated as follows: the site risk calculated for the child resident (0 to 6 years) is added to the site risk calculated for the adult resident (6 to 24 years) in order to provide a 30-year residential exposure. Further, the total site risk sums all of the residential exposures considered in the risk assessment, which includes soil exposures by adult and child residents and groundwater exposure by adult and child residents. The combined risk across all pathways (groundwater and soil) for a total hypothetical future resident results in a total site ELCR of 1.3×10^{-3} and a HI of 12.

2.2.6.4 Environmental Risks

A qualitative environmental assessment was performed for the ADRA (Montgomery Watson, 1994). The purpose of this assessment was to evaluate the potential for adverse effects to ecological receptors as a result of possible exposure to chemicals originating from the ADRA.

Risk is a function of exposure and toxicity. While it is expected that on occasion the site may be utilized as a secondary hunting area by some avian species of special concern, the site is relatively small compared to expanded home ranges typical of desert biomes. Moreover, the quality of hunting is likely inferior to that of surrounding regions. Toxicologically, the bioaccumulation potential for the COPCs would be expected to be relatively small due to the ability of organisms to metabolize, excrete, or sequester these chemicals, posing no significant threat to wildlife. These circumstances strongly suggest that ecological species of special concern are not adversely impacted by chemicals detected at the site.

2.2.7 Description of the No Action Alternative

Based on the results of the baseline risk assessment and environmental risk assessment conducted for the ADRA site, there are no adverse impacts to human health or the environment from site-related activities. The elevated risks appear to be from naturally occurring levels of arsenic in the soil and groundwater. Thus, the No Action alternative is supported by the baseline risk assessment discussed in Section 2.2.6 and the Administrative Record.

2.2.8 Explanation of Significant Changes

The Proposed Plan for Nine Sites at SIAD was released to the public for comment on February 7, 1996. The preferred alternative identified for the ADRA was No Action. Based on the absence of any new information or comments during the public comment period, no significant changes to the selected remedy for the ADRA outlined in the Proposed Plan for Nine Sites were necessary.

2.3 Responsiveness Summary

The public comment period for the Proposed Plan for Nine Sites at SIAD began on February 7, 1996, and extended through March 7, 1996. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. No oral comments were received regarding the ADRA at the public meeting.

Table 2.1: Metals Above Background in Surface Soil Ammunition Demilitarization and Renovation Area

	Concentrations in μg/kg (dry)									
Compound	CRL*	CRL (JS11) (1990-1991)	CRL (JS16) (1992-1993)	Number of Samples Above Median Soil Type - 365	Number of Samples Above Maximum Soil Type - 365	Number of Samples Above Median All Soil Types	Number of Samples Above Maximum All Soil Types	Frequency of Detects	Minimum	Maximum
Arsenic	0.25	---	---	2/2	2/2	2/2	0/2	2/2	6.24	7.51
Antimony	---	3.80	7.14	0/2	0/2	0/2	0/2	0/2	<3.80	<3.80
Barium	---	29.6	5.20	1/2	1/2	1/2	0/2	2/2	92.6	390
Beryllium	---	1.86	0.500	0/2	0/2	0/2	0/2	0/2	<1.86	<1.86
Cadmium	---	3.05	0.700	0/2	0/2	0/2	0/2	0/2	<3.05	<3.05
Chromium	---	12.7	4.05	0/2	0/2	0/2	0/2	0/2	<12.7	<12.7
Cobalt	---	15.0	1.42	0/2	0/2	0/2	0/2	0/2	<15.0	<15.0
Copper	---	58.6	0.965	0/2	0/2	0/2	0/2	0/2	<58.6	<58.6
Lead	0.177	6.62	10.5	0/2	0/2	0/2	0/2	0/2	<6.62	<6.62
Mercury	0.05	---	---	0/2	0/2	0/2	0/2	0/2	<0.05	<0.05
Molybdenum	---	1.15	1.12	0/2	0/2	0/2	0/2	0/2	<1.15	<1.15
Nickel	---	12.6	1.71	0/2	0/2	0/2	0/2	0/2	<12.6	<12.6
Selenium	0.25	---	---	0/2	0/2	0/2	0/2	0/2	<0.25	<0.25
Silver	---	2.50	0.589	0/2	0/2	0/2	0/2	0/2	<2.50	<2.50
Thallium	---	31.3	6.623	0/2	0/2	0/2	0/2	0/2	<31.3	<31.3
Vanadium	---	13.0	3.39	2/2	0/2	0/2	0/2	2/2	22.2	36.1
Zinc	---	30.2	8.03	0/2	0/2	0/2	0/2	0/2	<30.2	<30.2

μg/kg Micrograms per kilogram

* Certified Reporting Limit (CRL) for analyses other than JS11 and JS16

Table 2.2: Metals Above Background in Subsurface Soil Ammunition Demilitarization and Renovation Area

	Concentrations in µg/kg (dry)									
Compound	CRL*	CRL (JS11) (1990-1991)	CRL (JS16) (1992-1993)	Number of Samples Above Median USCS Soil Type for Individual Sample	Number of Samples Above Maximum USCS Soil Type for Individual Sample	Number of Samples Above Median for all USCS Soil Types	Number of Samples Above Maximum for All USCS Soil Types	Frequency of Detects	Minimum	Maximum
Arsenic	0.25	---	---	22/26	0/26	21/26	0/26	26/26	1.44	14.0
Antimony	---	3.80	7.14	0/26	0/26	0/26	0/26	0/26	<3.80	<3.80
Barium	---	29.6	5.20	13/26	1/26	10/26	0/26	21/26	<29.6	268
Beryllium	---	1.86	0.500	0/26	0/26	0/26	0/26	0/26	<1.86	<1.86
Cadmium	---	3.05	0.700	0/26	0/26	0/26	0/26	0/26	<3.05	<3.05
Chromium	---	12.7	4.05	0/26	0/26	0/26	0/26	0/26	<12.7	<12.7
Cobalt	---	15.0	1.42	0/26	0/26	0/26	0/26	0/26	<15.0	<15.0
Copper	---	58.6	0.965	0/26	0/26	0/26	0/26	0/26	<58.6	<58.6
Lead	0.177	6.62	10.5	0/26	0/26	0/26	0/26	0/26	<6.62	<6.62
Mercury	0.05	---	---	2/26	2/26	2/26	2/26	2/26	<0.05	0.131
Molybdenum	---	1.15	1.12	1/26	0/26	1/26	0/26	1/26	<1.15	2.18
Nickel	---	12.6	1.71	0/26	0/26	0/26	0/26	0/26	<12.6	<12.6
Selenium	0.25	---	---	0/26	0/26	0/26	0/26	0/26	<0.25	<0.25
Silver	---	2.50	0.589	0/26	0/26	0/26	0/26	0/26	<2.50	<2.50
Thallium	---	31.3	6.623	0/26	0/26	0/26	0/26	0/26	<31.3	<31.3
Vanadium	---	13.0	3.39	15/26	4/26	8/26	0/26	25/26	<13.0	80.0
Zinc	---	30.2	8.03	2/26	1/26	2/26	0/26	2/26	<30.2	76.8

µg/kg	Micrograms per kilogram
USCS	Unified Soil Classification System

* Certified Reporting Limit (CRL) for analyses other than JS11 and JS16

Table 2.3: Summary of Compounds Detected in Groundwater Ammunition Demilitarization and Renovation Area

	Concentrations in μg/l								
Analyte	**State MCL**	**Federal MCL**	**MRL**	**Round 1**	**Round 2**	**Round 3**	**Round 4**	**Round 5**	**Round 6**
ADR-01-MWA				**4/16/91**	**7/16/91**	**2/26/92**	**4/23/92**	**11/1/93**	**1/23/94**
Organic Compounds									
Toluene	150	1,000[b]	0.5	ND	ND	0.49	ND	ND	ND
TCE	5	5	0.5	ND	ND	ND	ND	0.95	0.49
Explosive Compounds									
1,3,5-Trinitrobenzene	NA	NA	0.63	3.65	2.94	ND	ND	ND	ND
1,3-Dinitrobenzene	NA	NA	0.61	ND	ND	ND	ND	1.98	ND
Metals[a]									
Copper	NA	1,000	8.09	ND	20.0	ND	8.26	NA	NA
Mercury	2	2	0.24	0.603	ND	ND	ND	NA	NA
Lead	50	NA[c]	1.26	ND	ND	2.17	ND	NA	NA
Nitrate plus nitrite	NA	NA	10	NA	NA	NA	NA	NA	16,000
ADR-02-MWA				**4/16/91**	**7/16/91**	**2/25/92**	**4/24/92**	**11/1/93**	**1/23/94**
Organic Compounds				ND	ND	ND	ND	ND	ND
Explosive Compounds									
1,3,5-Trinitrobenzene	NA	NA	0.63	1.03	0.81	ND	ND	ND	ND
Metals[a]									
Barium	1,000	2,000	5	45.7	43.8	46.5	47.5	NA	NA
Nitrate plus nitrite	NA	NA	10	NA	NA	NA	NA	NA	17,000
ADR-03-MWA				**4/16/93**	**7/16/93**	**2/25/92**	**4/24/92**	**11/1/93**	**1/25/94**
Organic Compounds									
TCE	5	5	0.5	0.829	ND	ND	ND	ND	0.71
Toluene	NA	1,000[b]	0.5	ND	ND	0.569	ND	ND	ND
Explosive Compounds									
1,3,5-Trinitrobenzene	NA	NA	0.63	0.818	ND	ND	ND	ND	ND
Metals[a]									
Barium	1,000	2,000	5	ND	29.9	31.5	ND	NA	NA
Copper	NA	1,000	8.09	ND	11.1	ND	8.53	NA	NA
Nitrate plus nitrite	NA	NA	10	NA	NA	NA	NA	NA	7,300
ADR-01-HP				-	-	-	-	-	**8/17/93**
Organic Compounds									
Xylenes	1,750	10,000[d]	0.84	NA	NA	NA	NA	NA	1.9
Explosive Compounds				NA	NA	NA	NA	NA	ND
Metals[a]									
Barium	1,000	2,000	5	NA	NA	NA	NA	NA	37.8

Table 2.3: Summary of Compounds Detected in Groundwater Ammunition Demilitarization and Renovation Area (continued)

	Concentrations in $\mu g/l$								
Analyte	State MCL	Federal MCL	MRL	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
ADR-02-HP				-	-	-	-	-	8/17/93
Organic Compounds									
Butylbenzyl phthalate	4	6	3.40	NA	NA	NA	NA	NA	3.5
Toluene	NA	1,000[b]	0.5	NA	NA	NA	NA	NA	17
TCE	5	5	0.5	NA	NA	NA	NA	NA	0.95
Explosive Compounds				NA	NA	NA	NA	NA	ND
Metals[a]									
Barium	1,000	2,000	5	NA	NA	NA	NA	NA	31
Copper	NA	1,000	8.09	NA	NA	NA	NA	NA	10.7
Nitrate plus nitrite	NA	NA	10	NA	NA	NA	NA	NA	14,000
ADR-03-HP				-	-	-	-	-	8/17/93
Organic Compounds				NA	NA	NA	NA	NA	ND
Explosive Compounds				NA	NA	NA	NA	NA	ND
Metals[a]									
Barium	1,000	2,000	5.00	NA	NA	NA	NA	NA	65.7
ADR-04-HP				-	-	-	-	-	8/18/93
Organic Compounds				NA	NA	NA	NA	NA	ND
Explosive Compounds				NA	NA	NA	NA	NA	ND
Metals[a]									
Barium	1,000	2,000	5.00	NA	NA	NA	NA	NA	31.5
Copper	NA	1,000	8.09	NA	NA	NA	NA	NA	9.11

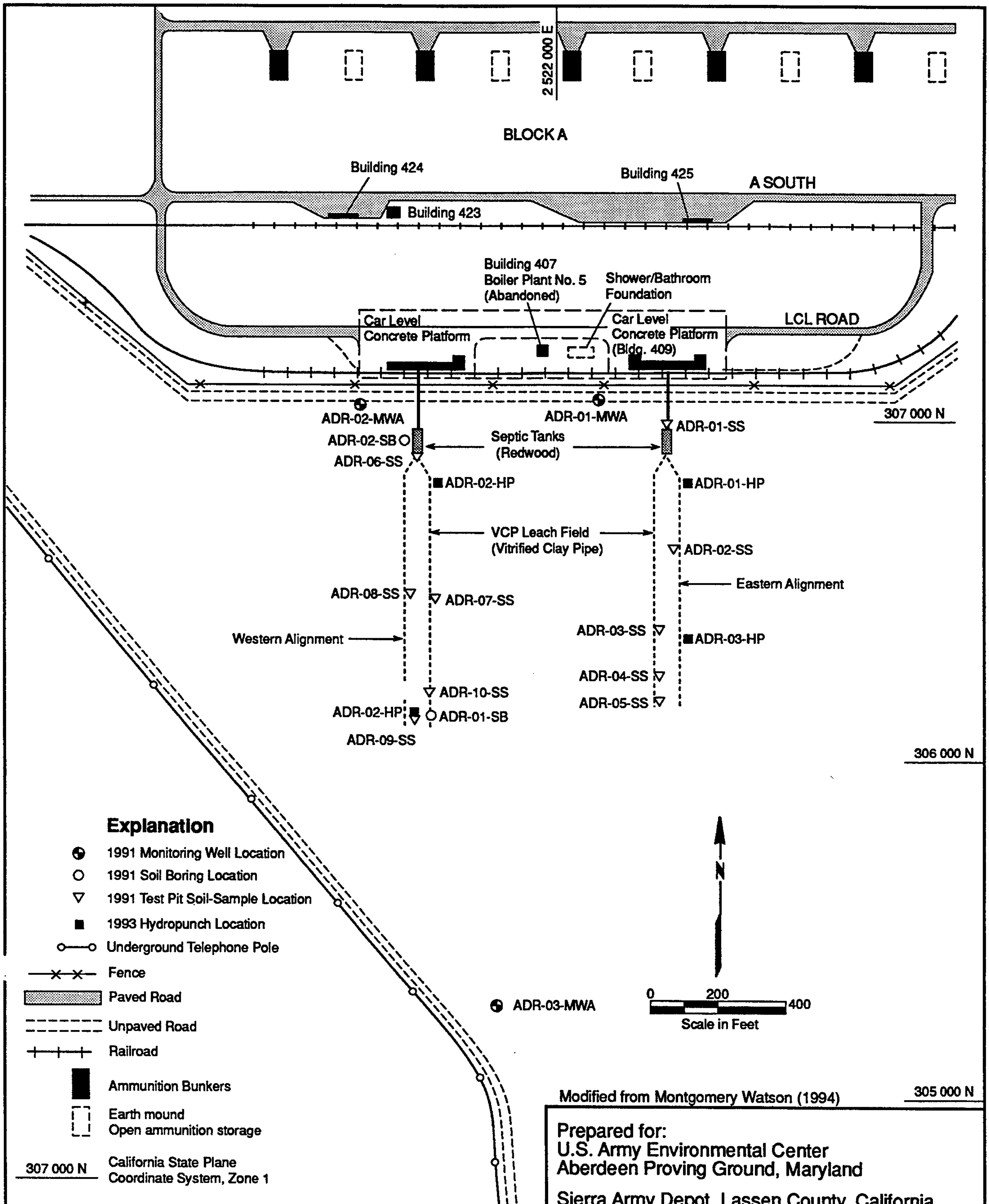
MCL	Maximum contaminant level
MRL	Method reporting limit
NA	Not analyzed/not available
ND	Not detected
TCE	Trichloroethylene
$\mu g/l$	Micrograms per liter

a. Metals detected above the maximum background concentration for each analyte shown on Table 6-6.
b. Secondary federal MCL for toluene is 40 $\mu g/l$.
c. Federal action level for lead is 15 $\mu g/l$.
d. Secondary federal MCL for xylenes is 20 $\mu g/l$.

Table 2.4: Summary of Multipathway Exposures at the Ammunition Demilitarization and Renovation Area

Exposure Scenario/Exposure Pathway	Hazard Index	Excess Lifetime Cancer Risk
Current Baseworker		
Soil exposure	0.044	1.6E-05
Current and Future Construction Worker		
Surface-soil exposure	0.19	3.2E-06
Subsurface-soil exposure	0.17	3.0E-06
Current Casual Visitor		
Surface-soil exposure	0.011	2.0E-06
Hypothetical Future Adult Resident		
Soil exposure	0.086	3.6E-05
Groundwater exposure	3.4	7.5E-04
Hypothetical Future Child Resident		
Soil exposure	0.66	6.8E-05
Groundwater exposure	8.0	4.4E-04

SRA 1071.3 12/8/95 ECS



HLA

Harding Lawson Associates

Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 2.1

Test Pit, Soil Boring, and Monitoring Well Locations
Ammunition Demilitarization and Renovation Area

3.0 BUILDING 1003 AREA

3.1 Declaration

This section provides the declaration portion of the ROD/RAP for the Building 1003 Area.

3.1.1 Location

The Building 1003 Area is located north of Susanville Road and a gas station (Building 1003) within the southern portion of SIAD (Figure 1.1). The site is located 1,600 feet east-southeast of Potable Supply Well (PSW) No. 5.

3.1.2 Assessment of the Site

A contamination assessment of the Building 1003 Area was conducted in the 1993 Group I and II Follow-Up RI Report (Montgomery Watson, 1994). The results of that assessment are summarized as follows:

- Overflow of an oil/water separator at Building 1003 caused a release of waste oil through an underground storm drain into an open field north of Susanville Road.
- Lead, zinc, and petroleum hydrocarbons are present in the upper 2 feet of soil within the area of the storm drain release.
- Petroleum hydrocarbons are present at detectable concentrations at depths greater than 2 feet bgs in a small area approximately 125 feet north of the storm drain outlet.
- Groundwater beneath the area of soil contamination does not appear to have been affected by the 1988 waste oil release.

Potentially unacceptable risks to human health from the detected concentrations of arsenic in groundwater, surface soil, and subsurface soil were identified in residential exposure scenarios during the baseline risk assessment (Montgomery Watson, 1994). However, the arsenic in the soil and groundwater at the Building 1003 Area is interpreted to represent native conditions. No adverse effects to ecological receptors from exposure to contaminants at the Building 1003 Area were identified in the baseline risk assessment.

3.1.3 Description of the Selected Remedy

The selected remedy involves excavation and offsite asphalt incorporation of surface and subsurface soil contaminated with motor oil constituents. The total present-worth cost for this remedy is $106,000.

3.1.4 Statutory Determinations

The selected remedy for the Building 1003 Area satisfies the statutory requirements of CERCLA § 121 and § 120(a)(4). The following mandates are satisfied:

- The selected remedy is protective of human health and the environment.
- The selected remedy complies with federal and state requirements that are legally applicable or relevant and appropriate for the remedial action.
- The selected remedy is cost effective.
- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.
- The selected remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

3.2 Decision Summary

This section provides the site-specific factors and analysis that were considered in the selection of the response action for the Building 1003 Area.

3.2.1 Site Description

A waste oil spill was discovered at the gas station (Building 1003) located along Susanville Road on January 27, 1988. Waste oil spilled at the gas station and was transported through a storm drain to a gently sloping drainage area north of Susanville Road. The spill, which was estimated to have occurred over a 20- to 24-month period, is estimated to be 900 gallons of waste oil. The spill was the result of a clogged oil/water separator that diverted waste oil from the underground storage tank to the storm drain (Benioff, et al., 1988).

The area of soil contamination consists of a broad open area north of a storm drain outfall. The storm drain collects surface flow from the area south of Susanville Road, including the gas station. A small drainage channel eroded into the sandy surface soil extends about 70 feet north from the storm drain outfall. Beyond a distance of about 70 feet north of the storm drain outlet, the drainage channel becomes indistinct and much of the stormwater flow probably dissipates and occurs as sheet flow across the ground surface prior to infiltration into the subsurface. Little or no drainage appears to leave the site; surface water appears to infiltrate within the area of preferential drainage shown in Figure 3.1.

3.2.2 Site History and Enforcement Activities

Investigations that have been conducted at the Building 1003 Area include:

- 1991 Group II Remedial Investigation, JMM
- 1992 Group I Follow-Up Remedial Investigation, Montgomery Watson
- 1993 Group I and II Follow-Up Remedial Investigation, Montgomery Watson

An oil/water separator at the gas station on Susanville Road overflowed in January 1988. The waste oil was transported through an underground storm drain and was released into a field north of Susanville Road. Previous investigations at this site had focused on the characterization of the waste oil in the surface and subsurface soil at the site.

One monitoring well was installed during the 1991 Group II RI approximately 25 feet north of the storm drain outlet. This monitoring well has been sampled six times and no total petroleum hydrocarbons (TPHs) have been detected.

The 1993 Group I and II Follow-Up Remedial Investigation focused on the presence and extent, if present, of TPH in the groundwater beneath the site and further characterization of waste oil in the soil. The Hydropunch groundwater samples collected during the 1993 Group I and II Follow-Up RI indicated that the groundwater directly beneath the soil contamination does not appear to have received constituents from the 1988 waste oil release.

3.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 3.3 of this ROD/RAP.

The public participation requirements of CERCLA § 113(K)(2)(B)(i-v) and § 117, and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site. The response action presented for this site in this ROD/RAP was selected in accordance with CERCLA, the NCP, Chapter 6.8 of the California Health and Safety Code, and California Water Code. The basis for this decision is documented in the Administrative Record.

3.2.4 Scope and Role of Response Action

This ROD/RAP presents the final response action for the Building 1003 Area. The purpose of the response action at the Building 1003 Area is to remove soil contaminated with motor oil to protect human health and the environment. This will be the final response action for the Building 1003 Area.

3.2.5 Site Characteristics

The suspected source of waste oil, and metals associated with waste oil, in the soil at the Building 1003 Area is an oil/water separator that became clogged and overflowed, discharging water mixed with waste oil to a storm drain leading to the drainage outlet at the Building 1003 Area. The distribution and extent of chemicals present at the Building 1003 Area were assessed on the basis of data obtained from 35 surface-soil samples, 18 near-surface samples, 9 soil borings, 4 Hydropunch groundwater samples, and 1 water-table monitoring well.

3.2.5.1 Surface Soil

SIAD conducted an investigation at the Building 1003 Area when the waste oil spill was discovered in January 1988. As part of the 1988 investigation, waste oil samples were collected from the underground storage tank at the gas station and analyzed for VOCs, iron, manganese, and California Title 22 metals. Toluene and xylenes were detected above their respective detection limits. All metals detected in the waste oil were below the Title 22 Total Threshold Limit Concentration (TTLC) values (Benioff, et al., 1988).

During the 1988 investigation, 12 surface-soil samples were also collected at several locations and analyzed for total recoverable petroleum hydrocarbons (TRPH) (EPA Method 418.1), benzene, toluene, and xylenes. TRPH was detected in all 12 samples with concentrations ranging from 43 micrograms per gram ($\mu g/g$) to 23,000 $\mu g/g$. Benzene, toluene, and xylenes were not detected in any of the surface-soil samples (Benioff, et al., 1988).

During the 1991 Group II RI, 15 discrete surface-soil samples (BU1-01-SS through BU1-15-SS) were collected from the 0- to 6-inch interval. Four soil samples were also collected from the surface interval of 3 soil borings (BU1-01-SB through BU1-03-SB) and 1 monitoring well boring (BU1-01-MWA). The 19 surface-soil samples were analyzed for EPA priority pollutant metals, TRPH (EPA Method 418.1), SVOCs, and VOCs.

During the 1993 Group I and II Follow-Up RI, 10 discrete surface-soil samples (BU1-24-SS through BU1-34-SS) and the surface interval of 6 soil borings were collected and analyzed for lead and TRPH (EPA Method 418.1). Two of the sixteen 1993 Group I and II Follow-Up surface-soil samples were also analyzed for total petroleum hydrocarbons as gasoline (TPH-gas), TPH-diesel, Microtox bioassay, and heterotrophic plate count. One of the surface-soil samples also underwent fuel fingerprint characterization to determine the type of hydrocarbons present. The results of the 1991 and 1993 investigations conducted at the Building 1003 Area are discussed below.

Lead, zinc, chromium, mercury, and antimony were detected above background levels in surface and near-surface soil (Table 3.1; Figures 3.2 and 3.3). Lead, zinc, and possibly chromium in the surface soil are suspected to be above background levels as a result of the overflow of the oil/water separator in 1988. These metals are limited to the preferential drainage course and are typically associated with waste oil. Antimony and mercury are at levels that could be considered naturally occurring and are unlikely to be a result of the waste oil spill.

TRPH was detected in 23 of 35 surface-soil samples (Figure 3.4). The concentrations of TRPH in samples collected during the 1991 Group II RI range from <28.0 μg/g to 29,000 μg/g. The surface-soil samples collected during the 1993 Group I and II Follow-Up RI had lower detectable concentrations of TRPH in the surface soil. Concentrations ranged from <28 μg/g to 221 μg/g. This may be a result of biased sampling during the 1991 Group II RI; many samples were collected from locations of visible staining or in the preferential drainage course. Surface-soil sampling during the 1993 Group I and II Follow-Up RI took place within the preferential drainage course but was not as heavily biased toward soil with the highest concentrations of TRPH because of the general absence of visible staining. Actual decreases in the TRPH concentrations in surface soil may also have occurred from degradation of the TRPH constituents.

TPH-gas and TPH-diesel were not detected in the three surface-soil samples analyzed for these parameters. Hydrocarbon fingerprinting results show that the petroleum hydrocarbons in the soil at the Building 1003 Area have high carbon numbers that are indicative of motor oil constituents.

No SVOCs were detected in surface-soil samples collected at the Building 1003 Area during the 1991 Group II RI. Therefore, the surface-soil samples collected during the 1993 Group I and II Follow-Up RI were not analyzed for SVOCs.

Low levels of VOCs (acetone; ethanol; 1,1,2-trichloro-1,2,2-trifluoroethane;and toluene) were detected in 2 of the 19 surface-soil samples collecting during the 1991 Group II RI. Ethanol and 1,1,2-trichloro-1,2,2-trifluoroethane were identified as tentatively identified compounds (TICs). Based on these trace concentrations, no further VOC analysis of surface-soil samples was performed during the 1993 Group I and II Follow-Up RI.

Results of heterotrophic plate count (HPC) and Microtox analyses showed that the motor oil constituents in surface soil are amenable to biodegradation.

3.2.5.2 Subsurface Soil

Eighteen near-surface (2 feet bgs) soil samples were collected and nine soil borings were drilled and sampled at the Building 1003 Area to characterize subsurface soil. During the 1991 Group II RI, eight near-surface soil samples (BU1-16-SS through BU1-23-SS) were collected. These samples were collected in locations where TRPH was detected in surface-soil samples. The samples were analyzed for EPA priority pollutant metals, VOCs, SVOCs, and TRPH. Three soil borings were drilled and sampled every 5 feet from ground surface to the water table (approximately 105 feet bgs) and analyzed for EPA priority pollutant metals, VOCs, and TRPH. Every other sample was analyzed for SVOCs. Ten soil samples were collected from 2 feet bgs at all 1993 Group I and II Follow-Up surface-soil sample locations and analyzed for lead and TRPH. Two of the ten near-surface soil samples were also analyzed for TPH-gas, TPH-diesel, oil and grease, Microtox, and HPC. Six soil borings were drilled and sampled to 30 feet bgs during the 1993 Group I and II Follow-Up RI. The samples were analyzed for lead and TRPH. Four samples were also analyzed for TPH-gas, TPH-diesel, oil and grease, Microtox, and HPC. All TRPH analyses were performed using EPA Method 418.1.

Arsenic, antimony, barium, beryllium, lead, mercury, thallium, and zinc were detected above the maximum concentrations for soil type (Table 3.2). Metals detected in the subsurface above the maximum background concentrations for all soil types are shown in Figure 3.5.

Lead was detected in 22 of 135 subsurface-soil samples (Figure 3.5). Below a depth of 5 feet, the lead detected above the maximum background concentration is most likely related to variations in naturally occurring levels of lead and not the 1988 waste oil release. However, it is possible that in limited areas with higher TRPH concentrations, lead levels may be slightly elevated in the subsurface due to the 1988 waste oil release.

Arsenic, antimony, barium, beryllium, mercury, thallium, and zinc are believed to be naturally occurring and thus are not considered potential site contaminants.

VOCs at the Building 1003 Area are limited to isolated detections of trace VOC concentrations in the surface and subsurface soil.

SVOCs were not been detected in any of the subsurface-soil samples.

TRPH was detected in 23 of 135 subsurface-soil samples collected at the Building 1003 Area at concentrations ranging from <28.0 μg/g to 5,170 μg/g (Figure 3.6). TRPH was detected in 11 of 18 near-surface (2 feet bgs) soil samples. TRPH was only detected in 12 of 117 samples collected below 2 feet bgs.

TPH-gas and TPH-diesel were not detected in any of the five subsurface-soil samples analyzed for these parameters.

Results of HPC and Microtox analyses showed that the subsurface-soil contaminants are amenable to biodegradation.

3.2.5.3 Groundwater

The groundwater below the Building 1003 Area was evaluated using six rounds of groundwater samples from one water-table monitoring well installed during the 1991 Group II RI (BU1-01-MWA) and four groundwater samples collected using a Hydropunch groundwater sampling device during the 1993 Group I and II Follow-Up RI.

Hydropunch Samples

Four Hydropunch groundwater samples were collected from the first 5 feet of the water table directly below the area of known soil contamination at the Building 1003 Area (Figure 3.1). These samples were analyzed for lead, VOCs, TPH-gas, TPH-diesel, and oil and grease. BU1-01-HP was located near Soil Boring BU1-01-SB in which TRPH was detected intermittently from ground surface to the water table (approximately 105 feet bgs). The other three Hydropunch samples were located radially around BU1-01-HP, because the groundwater gradient is not known at this site (Figure 3.1). The results of the groundwater sampling conducted at the Building 1003 Area are summarized in Table 3.3.

Lead was not detected in any of the Hydropunch groundwater samples. The Hydropunch groundwater samples were not analyzed for other metals.

Methyl ethyl ketone (MEK) was detected in one of the Hydropunch groundwater samples but was not detected in any of the other groundwater samples or in the soil samples collected at the site. The source of the MEK is unknown but it is not likely to be a product of the waste oil spill or representative of the groundwater beneath the site. No other VOCs were detected in any of the Hydropunch groundwater samples.

TPH-gas, TPH-diesel, or oil and grease were not detected in any of the Hydropunch groundwater samples.

Monitoring Well Samples

A total of six groundwater samples have been collected and analyzed from BU1-01-MWA since it was installed. Two sampling rounds were conducted during the 1991 Group II RI and were analyzed for EPA priority pollutant metals, TRPH, VOCs, SVOCs, and macroparameters (sulfate, total dissolved solids, chloride, sodium, calcium, alkalinity, and total organic carbon). Two sampling rounds were conducted during the 1992 Group I Follow-Up RI and samples were analyzed for EPA priority pollutant metals, TRPH, VOCs, and SVOCs. Two sampling rounds were conducted during the 1993 Group I and II Follow-Up RI and the samples were analyzed for lead, VOCs, SVOCs, TPH-gas, TPH-diesel, and oil and grease. One sample was also analyzed for nitrates plus nitrites during the second round of groundwater sampling in 1993. The results of all groundwater sampling are summarized in Table 3.3.

Barium, copper, lead, selenium, and silver were detected in BU1-01-MWA above the maximum concentrations detected in background wells (Tables 3.3 and 3.4). Although barium was detected above maximum background levels, it is below the current California MCL of 1,000 μg/l. Copper, lead, and silver were detected during the first round of groundwater sampling but were not detected during subsequent rounds of groundwater sampling. Selenium was detected in the first four rounds of sampling. However, selenium was not detected in soil at the Building 1003 Area and is not expected to be a potential site contaminant. Therefore, selenium found in groundwater at this site is interpreted to represent natural conditions.

TRPH, TPH-gas, TPH-diesel, or oil and grease were not detected in any of the groundwater samples collected from BU1-01-MWA.

Low levels of methylene chloride and TCE were detected in the second and sixth rounds of groundwater sampling conducted at BU1-01-MWA. Methylene chloride is a common laboratory contaminant and was not detected in subsequent rounds of sampling. TCE was detected at a level below the current California MCL of 5 μg/l.

Bis(2-ethylhexylphthalate) was detected in BU1-01-MWA during the July 1991 sampling round; this compound is a common laboratory contaminant. No other SVOCs were detected at BU1-01-MWA in any of the groundwater sampling rounds.

Groundwater samples collected during the 1993 Group I and II Follow-Up RI second round of groundwater sampling were analyzed for nitrate plus nitrite as a general water quality parameter to help evaluate groundwater flow and aquifer conditions in the southern portion of the depot. Nitrates and nitrites have not been associated with waste oil and are not suspected to be part of the waste oil release at the Building 1003 Area. There is no reason to suspect an additional nitrate/nitrite source at the Building 1003 Area, so it is unlikely that the nitrate plus nitrite in the groundwater is related to SIAD activities.

The concentration of nitrate plus nitrite in BU1-01-MWA is greater than the concentrations detected in the designated background wells. However, the concentration is comparable to the levels detected in other wells located in the southern portion of the depot. The nitrate plus nitrite data are variable across the southern portion of the depot and appear to represent natural diversity in the water quality of the depot.

3.2.6 Summary of Site Risks

This section presents a summary of the baseline risk assessment conducted for the Building 1003 Area during the 1993 Group I and II Follow-Up RI (Montgomery Watson, 1994).

3.2.6.1 Compounds of Potential Concern

Petroleum hydrocarbons, lead, and zinc in surface and subsurface soil were identified as the COPCs in the 1993 Group I and II Follow-Up RI Report (Montgomery Watson, 1994).

3.2.6.2 Contaminant Fate and Transport

The fate and transport of chemicals in the environment is a function of numerous environmental factors. This section describes processes expected to control fate and transport of chemicals detected at the Building 1003 Area, and the primary chemical and physical properties impacting those processes.

Petroleum hydrocarbons, lead, and zinc in soil have been identified as the chemicals associated with the waste oil spill at the Building 1003 Area. Potential routes of migration of these chemicals include volatilization or dust emissions from surface soil, leaching from the soil to shallow groundwater, and lateral migration via surface-water runoff.

Soil at SIAD are best characterized as distal alluvial fan, alluvium, and lacustrine sediments. The organic carbon content of these soil ranges from low to high. Therefore, sorption of organic constituents and certain inorganic constituents (e.g., metallic mercury) can be expected to occur within zones in the unsaturated soil and aquifer. The sorption of most inorganic constituents is not affected as much by organic carbon content as are organic constituents; however, clays do effectively sorb many inorganic species. Clay-sized sediments are a small percentage of the soil at the Building 1003 Area.

Petroleum hydrocarbons representative of motor oil constituents were detected in surface and subsurface soil at the Building 1003 Area. The potential for migration and biodegradation of motor oil constituents is lower than for lighter petroleum hydrocarbons such as gasoline and diesel fuel constituents. Generally, the greater the number of carbons and the greater the molecular weight of the compound, the more stable it will be in the environment. Petroleum hydrocarbons in the midcarbon range (C_6 to C_{30}) are considered moderately degradable. Motor oil constituents are usually in the C_{15} to C_{50} range.

Lead is generally immobile in soil at normal pH ranges and, therefore, is resistant to leaching. Lead sorbs strongly to soil, especially in the presence of iron, manganese, and aluminum oxides. Natural compounds of lead have low solubilities in water; therefore, the ratio of lead in suspended solids to dissolved lead is high. Lead will not volatilize from shallow soil; however, it may adsorb to airborne particulate matter. Lead is resistant to biodegradation but may bioaccumulate in plant and animal species.

Zinc is moderately mobile in soil under normal redox and pH conditions with mobility increasing with decreasing pH. Zinc is readily adsorbed by clays, carbonates, or hydrous oxides but will desorb if high concentrations of other metals are present. This metal will form complexes with inorganic and organic ligands. Some complexes have relatively high solubilities and will be mobile. Zinc is not volatile but may adsorb to airborne particulate matter. Zinc is resistant to biodegradation but will readily be taken up by most plant species and will bioconcentrate.

In summary, petroleum hydrocarbons and metals detected in the vadose zone at the Building 1003 Area are not expected to migrate to groundwater. This is primarily because the groundwater is relatively deep (approximately 105 feet bgs), the driving force is minimal (i.e., limited precipitation and only intermittent storm-water runoff), and petroleum hydrocarbons, lead, and zinc tend to sorb to soil. However, the intermittent storm-water runoff could cause some lateral migration of petroleum hydrocarbons and metals in surface soil.

3.2.6.3 Human Health Risks

The results of the human health risk assessment conducted for the Building 1003 Area are summarized in Table 3.5.

Soil

The ELCR and the HI for the current baseworker scenario are 1.6 x 10^{-5} and 0.035, respectively. The ELCR estimate is above the California benchmark of 1 x 10^{-6}. Cancer risks for the current baseworker scenario are primarily due to naturally occurring levels of arsenic in surface soil, with a much lower contribution to risk from chromium. As discussed in the 1993 Group I and II Follow-up RI report (Montgomery Watson, 1994), the distribution of arsenic in soil at the Building 1003 Area is comparable to the distribution of arsenic in background soil. The cancer risk estimate is within the range (1 x 10^{-4} to 1 x 10^{-6}) provided in the NCP (1990) for Superfund site remediation goals. The hazard index is less than the benchmark of 1.

The ELCR and HI for a construction worker exposed to surface soil at the Building 1003 Area are 3.3 x 10^{-6} and 0.14, respectively. The ELCR and HI for a construction worker exposed to subsurface soil at the site are 1.2 x 10^{-5} and 0.65, respectively. Both ELCR estimates are above the California benchmark of 1 x 10^{-6}. However, the ELCR estimates are due primarily to naturally occurring levels of arsenic in soil at the site. In addition, the cancer risk estimates are within the range (1 x 10^{-4} to 1 x 10^{-6}) provided in the NCP (1990) for Superfund site remediation goals. Both HI estimates are less than the benchmark of 1.

The ELCR and HI for a current casual visitor are 2.0 x 10^{-6} and 0.11, respectively. The ELCR is within EPA benchmarks and slightly above the California benchmark of 1 x 10^{-6}. The HI is below the California and EPA benchmarks.

The ELCR and HI for a hypothetical future adult resident exposure to surface soil are 3.6 x 10^{-5} and 0.067, respectively. The ELCR and HI for a hypothetical future child resident exposure to surface soil are 6.8 x 10^{-5} and 0.5, respectively. The ELCR estimates for adult and child future residents are above the California benchmark of 1 x 10^{-6}. However, the ELCR estimates are due primarily to naturally occurring arsenic levels in surface soil. In addition, the cancer risk estimates are within the range (1 x 10^{-4} to 1 x 10^{-6}) provided in the NCP (1990) for the Superfund site remediation goals. The hazard indices are less than the benchmark of 1.

Groundwater

Risks were estimated for adult and child future residential exposure to groundwater via inhalation, ingestion, and dermal routes of exposure. The ELCR and HI for a hypothetical future adult resident exposed to groundwater are 2.3 x 10^{-3} and 4.3, respectively. The ELCR and HI for a hypothetical future child resident exposed to groundwater are 1.3 x 10^{-3} and 10, respectively. The ELCR estimates are above the California benchmark of 1 x 10^{-6}, and the hazard indices are both above the benchmark of 1. These ELCR and HI estimates are primarily due to naturally occurring levels of arsenic in groundwater at the Building 1003 Area.

Total Site Risks

Total hypothetical future site risk for residential use was estimated by assuming that a future child resident could live on the site (a 6-year period), grow up, and continue to live there as an adult for a total residency period of 30 years. This total site risk is obtained by summing all of the residential exposures considered in the human health assessment: soil exposures by adult (24-year period) and child residents and groundwater ingestion by adult and child residents. The combined risk across all pathways (groundwater and soil) for a total hypothetical future resident results in a total site ELCR of 3.7 x 10^{-3}, and a hazard index of 15.

3.2.6.4 Environmental Risks

The metals concentrations in surface and subsurface soil at the Building 1003 Area are not expected to significantly affect vegetation or wildlife. Adverse effects are expected to be low due to the relative infrequency with which chemicals were detected, low concentrations, and the small areal extent of the site. It should be noted that the Building 1003 Area site comprises less than 0.05 percent of the total acreage of the Main Depot at SIAD.

Petroleum hydrocarbons at the Building 1003 Area are in moderate to high concentrations, with moderate persistence in surface soil. However, their relatively low bioaccumulation potential indicates that there is less opportunity for these compounds to have a cumulative effect on wildlife, including threatened raptors, which have been found near the site. The major possibility for exposure is through ingestion of small mammals, a secondary dietary choice. Thus, the petroleum hydrocarbons are not considered to be a significant risk to environmental receptors, but localized removal may need to be considered for conservative protection.

Vegetation in this desert environment is sparse under natural conditions, but prior site usage does appear to have resulted in some restriction of growth and, ultimately, habitat. However, the diminished quality of these areas as habitat for wildlife is related to physical disturbances associated with site development and usage rather than chemical exposure.

3.2.7 Description of Alternatives

Six alternatives were developed for the Building 1003 Area in the Focused Feasibility Study prepared for this site (Montgomery Watson, 1996). The remedial alternatives are:

- Alternative 1 - No Action
- Alternative 2 - In Situ Bioremediation
- Alternative 3 - Excavation, Onsite Bioremediation, and Onsite Disposal
- Alternative 4 - Excavation and On-Base Reuse in Road Construction

- Alternative 5 - Excavation and Offsite Recycling
- Alternative 6 - Excavation and Offsite Asphalt Incorporation

3.2.7.1 Alternative 1 - No Action

The no-action alternative serves as a baseline for comparison with other remedial alternatives. No remedial actions would be performed at the Building 1003 Area to eliminate future potential exposure pathways, and thus any risks to human health and the environment would not be reduced. Because contaminants would remain onsite, the site would be reviewed every 5 years, as required under CERCLA. The total present-worth cost for this alternative is $60,000.

3.2.7.2 Alternative 2 - In Situ Bioremediation

This alternative consists of treating surface soil with TPH concentrations greater than 1,000 μg/g using in situ bioremediation. Surface soil would be regularly tilled and wetted with a water-nutrient solution to enhance the natural biodegradation of the petroleum hydrocarbons. To minimize disturbing the natural habitat of the site, tilling could be performed in a manner such that desert scrub vegetation is not destroyed. Storm water from the storm drain outfalls would be diverted during bioremediation treatment to prevent further lateral migration of soil contaminants. In situ bioremediation treatment would treat only the first 6 to 12 inches of soil. Therefore, contaminated soil deeper than 12 inches and with TPH levels greater than 1,000 μg/g (approximately 120 cy), would be excavated and transported to an offsite facility for incorporation into asphalt. This alternative is expected to take 1 year to achieve the TPH remediation level of 1,000 μg/g in surface soil. The total present-worth cost for this alternative is $151,000.

3.2.7.3 Alternative 3 - Excavation, Onsite Bioremediation, and Onsite Disposal

This alternative is similar to Alternative 2 except that all soil with TPH concentrations greater than 1,000 μg/g would be excavated and then treated aboveground using bioremediation. Following treatment, the soil would be backfilled at the site. The total present-worth cost for this alternative is $224,000.

3.2.7.4 Alternative 4 - Excavation and On-Base Reuse

This alternative involves excavating soil that has concentrations of TPH above 1,000 μg/g, and transporting it to another location at SIAD where it would be used in road construction. The excavated soil at the site would be replaced with clean fill. The time necessary for implementation of this alternative is expected to be less than 3 months. The total present-worth cost for this alternative is $90,000.

3.2.7.5 Alternative 5 - Excavation and Offsite Recycling

This alternative involves excavating soil that has concentrations of TPH above 1,000 μg/g and transporting it to an offsite facility for recycling. The excavated soil at the site would be replaced with clean fill. The nearest recycling facility to SIAD is in Reno, Nevada. It should be noted, however, that the actual facility used for offsite recycling will be selected during the remedial design phase. The time necessary for implementation of this alternative is expected to be less than 3 months. The total present-worth cost for this alternative is $116,000.

3.2.7.6 Alternative 6 - Excavation and Offsite Asphalt Incorporation

This alternative involves excavating soil with concentrations of TPH above 1,000 μg/g and transporting it to an offsite asphalt batch plant for incorporation into asphalt. The excavated soil at the site would be replaced with clean fill. The nearest asphalt batch plant to SIAD is in Doyle, California. It should be noted, however, that the actual facility used for asphalt incorporation will be selected during the remedial design phase. The time necessary for implementation of this alternative is expected to be less than 3 months. The total present-worth cost for this alternative is $106,000.

3.2.8 Summary of Comparative Analysis of Alternatives

The remedial alternatives described in Section 3.2.7 have been assessed in accordance with the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988b). That guidance and the NCP provide for analysis of nine criteria when evaluating remedial alternatives. The criteria are as follows:

- Threshold Criteria
  - Overall protection of human health and the environment
  - Compliance with ARARs
- Primary Balancing Criteria
  - Long-term effectiveness
  - Reduction of toxicity, mobility, and volume
  - Short-term effectiveness
  - Implementability
  - Cost
- Modifying Criteria
  - State acceptance
  - Community acceptance

Threshold criteria are requirements that each alternative must satisfy to be eligible for selection as the preferred alternative. Primary balancing criteria are used to weigh trade-offs among alternatives. Modifying criteria may be used to alter aspects of the preferred remedial alternative when preparing the Proposed Plan.

In the Focused Feasibility Study prepared for the Building 1003 Area (Montgomery Watson, 1996), the remedial alternatives were evaluated in terms of threshold and primary balancing criteria. Final evaluation of modifying criteria (state and community acceptance) was conducted after completion of the comment period on the Draft Final Feasibility Study (FS).

A brief description of each of the nine criteria is presented below.

- Overall Protection of Human Health and the Environment
  - How alternative provides human health and environmental protection

- Compliance with Applicable or Relevant and Appropriate Requirements
    - Compliance with Chemical-specific ARARs
    - Compliance with Action-specific ARARs
    - Compliance with Location-specific ARARs
    - Compliance with other criteria, advisories, and guidance
- Long-term Effectiveness and Permanence
    - Magnitude of residual risk
    - Adequacy and reliability of controls
- Reduction of Toxicity, Mobility, and Volume Through Treatment
    - Treatment process used and materials treated
    - Amount of hazardous materials destroyed or treated
    - Degree of expected reductions in toxicity, mobility, and volume
    - Degree to which treatment is irreversible
    - Type and quantity of residuals remaining after treatment
- Short-term Effectiveness
    - Protection of community during remedial actions
    - Protection of workers during remedial actions
    - Environmental impacts
    - Time until remedial action objectives (RAOs) are achieved
- Implementability
    - Ability to construct and operate the technology
    - Reliability of the technology
    - Ease of undertaking additional remedial actions, if necessary
    - Ability to monitor effectiveness of remedy
    - Coordination with other agencies
    - Availability of offsite treatment, storage, and disposal services and capacity

  - Availability of necessary equipment and specialists
  - Availability of prospective technologies
- Cost
  - Capital costs
  - Operating and maintenance costs
  - Present-worth cost

3.2.8.1 Overall Protection of Human Health and the Environment

The human health assessment conducted for the Building 1003 Area identified potential risks to future receptors based on soil and groundwater exposure (Montgomery Watson, 1994). However, these risks are due primarily to naturally occurring levels of arsenic in both media. Although zinc and lead were detected in soil at levels indicating that these metals are related to the waste oil discharge, these metals do not pose human health risks. Environmental assessment results indicate that the metals detected at the site also do not pose risks to ecological receptors. Therefore, metals are not considered constituents of concern for remedial action at the Building 1003 Area.

Risks based on exposure to petroleum hydrocarbons in soil at the Building 1003 Area were not quantitatively evaluated in the baseline risk assessment. From a qualitative standpoint, the petroleum hydrocarbons in motor oil are considered to have low toxicity to both human and ecological receptors. Despite the relatively low toxicity of motor oil constituents, the Army considers remediation of petroleum hydrocarbons in soil at the Building 1003 Area beneficial to the overall protection of human health and the environment at SIAD.

As discussed in Section 3.2.6.2, petroleum hydrocarbons and metals in the vadose zone are not expected to migrate vertically to groundwater. However, intermittent storm-water runoff at the site could cause some lateral migration of petroleum hydrocarbons that would increase the areal extent of surface-soil contamination.

The State of California has previously recommended TPH remediation levels between 100 μg/g and 1,000 μg/g for other sites with petroleum hydrocarbon contamination. The Army proposes to remediate soil with TPH concentrations greater than 1,000 μg/g at the Building 1003 Area; this remediation level corresponds to an approximate soil volume of 170 cubic yards (cy). The 1,000 μg/g remediation level is proposed instead of the 100 μg/g level because motor oil constituents have relatively low mobility and toxicity. In addition, the lower remediation level would require treatment of approximately five times more soil (790 cy) but only an additional 20 percent of TPH mass in the soil would be treated.

Implementation of the no-action alternative (Alternative 1) would not reduce contaminant concentrations. Therefore, the potential for future exposure and lateral migration of soil contaminants remains. However, petroleum hydrocarbon concentrations in surface soil may decrease with time due to natural biodegradation. Alternative 2 (In Situ Bioremediation) would reduce TPH concentrations to below 1,000 μg/g in surface soil, thereby significantly reducing the potential for future exposure and lateral migration of soil contaminants. In addition, Alternative 2 would permanently remove contaminated subsurface soil from the site; this soil would be transported to a nearby asphalt batch plant for incorporation into asphalt. Alternatives 3 (Ex Situ Bioremediation), 4 (On-Base Reuse in Road Construction), 5 (Offsite Recycling), and 6 (Offsite Asphalt Incorporation) are expected to provide significant overall protection to human health and the environment by permanently removing contaminated soil from the site.

Because the contaminated soil at the Building 1003 Area currently poses no risks to ecological receptors, all the alternatives are considered to provide protection to the environment. Additionally, soil contamination at the site currently does not pose a threat to groundwater; therefore, all the alternatives are considered protective of groundwater quality. The 1,000 μg/g soil remediation level is considered protective of groundwater quality due to site conditions. The groundwater is relatively deep (approximately 105 feet bgs). Fine-grained layers, which act to retard the downward movement of chemicals in the soil, are present in the shallow subsurface beneath the site. Additionally, the site receives little precipitation and has relatively high rates of evaporation, which further inhibits the transport of chemicals downward through the soil column.

3.2.8.2 Compliance with Applicable or Relevant and Appropriate Requirements

SIAD is not on the National Priorities List (NPL). Pursuant to CERCLA § 120(a)(4), remedial actions at non-NPL sites must comply with all state laws regarding removal or remedial actions. Further, the Army, as the lead agency, must select a remedial action that complies with CERCLA § 121(d)(1). Pursuant to CERCLA § 121(d)(1), remedial actions must attain a degree of cleanup that assures protection of human health and the environment. Additionally, remedial actions that leave hazardous substances, pollutants, or contaminants onsite must meet standards, requirements, limitations, or criteria that are applicable or relevant and appropriate requirements (ARARs). To the extent consistent with CERCLA and the NCP, the Army is not required to obtain federal, state, or local permits for those portions of the remedial actions conducted entirely onsite, but need only comply with the substantive, not procedural, provisions which would have been included in any such permit.

CERCLA § 121 states that, at the completion of a remedial action, a level or standard of control required by an ARAR will be attained for wastes that remain on site. In addition, the NCP, 40 CFR 300.435(b)(2), requires compliance with ARARs during the course of the remedial design/remedial action.

ARARs are identified on a site-specific basis from information about specific chemicals at the site, specific actions that are being considered as remedies, and specific features of the site location. There are three types of ARARs:

- Chemical-specific ARARs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. If a chemical has more than one ARAR, the most stringent value will be complied with.

- Location-specific ARARs are restrictions placed on the concentration of a chemical or the activities to be conducted solely because they are in a specific location. Examples of special locations possibly requiring location-specific restrictions include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.
- Action-specific ARARs are usually technology- or activity-based restrictions or requirements for remedial actions. These ARARs do not determine the remedial alternative to be applied at a site; rather, they indicate how a selected alternative will be implemented. The potential action-specific ARARs will vary depending on the remedial alternatives selected for the sites.

Where no standards exist for a given chemical or situation, nonpromulgated advisories and guidance issued by the state or federal government programs may represent "to be considered" (TBC) criteria or guidelines in the Remedial Investigation/Feasibility Study (RI/FS) process. Although TBC requirements are not legally binding, they may be evaluated along with ARARs as part of the risk assessment to establish protective target cleanup levels.

The following sections discuss the ARARs that were considered for the Building 1003 Area. A listing of federal and state laws that are ARARs for the Building 1003 Area is provided in Tables 3.6 and 3.7.

Chemical-specific ARARs

The Army has not identified any state or federal chemical-specific ARARs for any of the constituents detected in soil at the Building 1003 Area.

Location-specific ARARs

The Army has not identified any state or federal location-specific ARARs for the Building 1003 Area.

Action-specific ARARs

Chapter 15 of Title 23 Code of California Regulation (CCR) Division 3 ("Chapter 15") contains regulations governing discharges of waste to land where water quality could be adversely impacted. Chapter 15 regulations govern the discharge of waste to land for treatment, storage, and disposal and establish siting, containment, monitoring, and closure standards. Activities included in this program are the issuance of waste discharge requirements (WDRs) by the Regional Water Quality Control Board for the discharge of hazardous, designated, and nonhazardous solid wastes to land and the oversight of corrective actions at leaking waste management units. Cleanup activities involving the discharge of waste to land or the closure of leaking waste management units at a CERCLA site would also be subject to the substantive requirements of Chapter 15. As discussed in Section 3.2.6.2, petroleum hydrocarbons and metals in the vadose zone at the Building 1003 Area are not expected to migrate to groundwater. Therefore, the remedial provisions of Chapter 15 have not been triggered.

Disposal of contaminated soil from Building 1003 Area could trigger California Hazardous Waste Management (HWM) land disposal restrictions due to elevated levels of lead in the soil exceeding the CCR Title 22 soluble threshold limit concentration (STLC) for lead. (However, as discussed in the Focused Feasibility Study [Montgomery Watson, 1996], waste extraction test [WET] results for several soil samples from the site indicate that is unlikely that soluble lead concentrations will exceed the lead STLC.) If land disposal restrictions are triggered, excavated soil would need to meet treatment standards and California HWM disposal regulations.

Disposal of contaminated soil from the Building 1003 Area could also trigger federal Department of Transportation (DOT) material shipment regulations. DOT regulations are applicable to the shipment of media containing waste oil and other hazardous materials. DOT regulations are found at 40 CFR 100-180.

Additional action-specific ARARs for all of the alternatives include state hazardous waste management, and state and federal occupational health and safety regulations (Tables 3.6 and 3.7).

To Be Considered Criteria

DTSC has indicated that a soil remediation level of 1,000 μg/g is appropriate for the Building 1003 Area. This remediation level is not promulgated; therefore, it is not an ARAR but a TBC.

Compliance with ARARs

Alternative 1 would not actively reduce motor oil constituent concentrations in soil to below the 1,000 μg/g remediation level for TPH. Because the 1,000 μg/g remediation level for TPH has been determined by the State of California to be protective of groundwater at this site, the Army has agreed to remediate TPH soil concentrations to this level. The Army and State of California have agreed to disagree on the applicability or relevance and appropriateness of Chapter 15 to this site but have agreed that the site remediation of TPH contaminated soil to a level below 1,000 μg/g will eliminate any potential threat to groundwater at this site. Alternative 2 would use in situ bioremediation to reduce TPH concentrations in surface soil to below 1,000 μg/g; subsurface soil with TPH levels above 1,000 μg/g would be excavated and incorporated into asphalt at an offsite facility. Alternatives 3 through 6 would involve removing all soil with TPH levels above 1,000 μg/g from the site.

3.2.8.3 Long-term Effectiveness and Permanence

Alternative 1 (No Action) would not provide long-term effectiveness and permanence because motor oil constituents would remain in soil. However, petroleum hydrocarbon concentrations in surface soil may decrease with time due to natural biodegradation. Alternatives 2 through 6 would provide long-term effectiveness and permanence by removing motor oil-contaminated soil from the site.

3.2.8.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternative 1 would not reduce the toxicity, mobility, or volume of contaminants through treatment because this alternative does not involve active treatment. Alternative 2 would accelerate the natural biodegradation process in surface soil thereby actively reducing the toxicity, mobility, and volume of motor oil constituents in surface soil. Asphalt incorporation of the subsurface soil as part of

Alternative 2 would reduce the mobility of motor oil constituents in this soil. Alternatives 3 and 5 would utilize active treatment (ex situ bioremediation and thermal desorption, respectively) to reduce the toxicity, mobility, and volume of soil contaminants. Alternatives 4 and 6 would reduce the mobility but not the toxicity or volume of soil contaminants.

3.2.8.5 Short-term Effectiveness

All of the alternatives are judged to offer a high degree of short-term effectiveness because of the lack of risk posed to the community and/or workers during the construction and implementation phase. Alternatives 2, 3, 4, 5, and 6 could potentially expose the community/workers by excavating contaminated soil. The community/workers could also be exposed during transportation of the soil to an offsite facility. However, any potential threat posed by soil excavation could be readily controlled by using appropriate dust control measures.

No significant adverse environmental impacts are anticipated from the construction and implementation of any of the alternatives. Alternatives 2, 3, 4, 5, and 6 would temporarily destroy the natural habitat of the site due to soil excavation activities.

3.2.8.6 Implementability

Alternative 1 (No Action) is the easiest alternative to implement. Alternatives 2, 3, 4, 5, and 6 would be slightly more difficult to implement because these alternatives require excavation and additional analyses to confirm that the excavated soil is not considered a hazardous waste. Alternative 4 (Excavation and On-base Reuse) may also be more difficult to implement because this alternative depends on the future need for road construction material at SIAD, which is currently unknown. Alternative 6 (Excavation and Offsite Asphalt Incorporation) could not be implemented during the winter months because the asphalt batch plants near SIAD do not operate during the winter.

3.2.8.7 Cost

The alternatives evaluated for the Building 1003 Area are presented below in order of increasing cost:

- Alternative 1 - No Action ($60,000)
- Alternative 4 - Excavation and On-Base Reuse ($90,000)
- Alternative 6 - Excavation and Offsite Asphalt Incorporation ($106,000)
- Alternative 5 - Excavation and Offsite Recycling ($116,000)
- Alternative 2 - In Situ Bioremediation ($151,000)
- Alternative 3 - Excavation, Onsite Bioremediation, and Onsite Disposal ($224,000)

3.2.9 Selected Remedy

The Army has selected Alternative 6, Excavation and Offsite Asphalt Incorporation, as the preferred remedy for the contaminated soil at the Building 1003 Area. Based on the results presented in the RI/FS documents for the site, the State of California concurs with the selected remedy.

Alternative 6 will involve excavating all soil with TPH concentrations greater than 1,000 $\mu g/g$ (approximately 170 cy). This soil will be transported to a nearby asphalt batch plant for incorporation into asphalt.

The estimated present worth for Alternative 6 is $106,000. Table 3.8 presents the breakdown of the estimated costs for Alternative 6.

3.2.10 Statutory Determinations

The selected remedy satisfies statutory requirements of CERCLA § 121 and § 120(a)(4) such that the following mandates are satisfied:

- The selected remedy is protective of human health and the environment.
- The selected remedy complies with federal and state ARARs.
- The selected remedy is cost effective.
- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable.

- The selected remedy satisfies the preference for treatment that reduces toxicity, mobility, and/or volume as a principal element.

3.2.10.1 Protection of Human Health and the Environment

The selected remedy protects human health and the environment through the permanent removal of soil contaminated with motor oil constituents from the site. By removing the contaminated soil, any potential risks to humans and ecological receptors would be mitigated. Furthermore, the potential for continued lateral migration of soil contaminants would be eliminated.

Section 3.2.8.5 discussed the short-term effectiveness of the evaluated alternatives. The selected remedy will not pose unacceptable short-term risks to human health or the environment during implementation.

3.2.10.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy of excavation and offsite asphalt incorporation will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements (ARARs). The ARARs are presented below.

- Chemical-specific ARARs
    - None.
- Location-specific ARARs
    - None.
- Action-specific ARARs
    - California requirements for hazardous waste management in 22 CCR, Div. 4, Chapter 30, § 66001 et seq.
    - California and federal requirements for occupational health and safety in Labor Code, Div. 5, § 6300 et seq., and 29 USC §§ 651-678, respectively.
    - Federal DOT material shipment regulations, 49 CFR 100-180.

- Other Criteria, Advisories, or Guidance To Be Considered for this Remedial Action (TBCs)
    - The State of California has recommended that TPH concentrations in soil at the Building 1003 Area be reduced to below the 1,000 μg/g remediation level. The selected remedy, when complete, will have removed soil with TPH levels greater than 1,000 μg/g from the site.

3.2.10.3 Cost Effectiveness

The selected remedy, Alternative 6, utilizes cost-effective treatment for the type and volume of contaminants present. Although Alternative 6 will cost more than the no-action alternative, this alternative will satisfy the regulatory preference for active treatment, when practicable (40 Code of Federal Regulations [CFR] 300.430 (a)(1)(iii)(A)).

3.2.10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the final response action at the Building 1003 Area. This selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in mobility achieved through treatment, short-term effectiveness, implementability, cost, the statutory preference for treatment as a principal element, and considers California Environmental Protection Agency (Cal-EPA) and community acceptance.

The selected remedy offers a high degree of long-term effectiveness and permanence. It will significantly reduce the inherent hazards posed by the contaminated soil through permanent removal of soil contaminated with motor oil constituents from the site. The selected remedy can be implemented quickly and with little difficulty and is therefore assessed to be the most appropriate solution for the contaminated soil at the Building 1003 Area.

3.2.10.5 Preference for Treatment as a Principal Element

The selected remedy does not employ active treatment of the soil to reduce soil contaminant concentrations. However, incorporation of the excavated soil into asphalt will effectively immobilize the motor oil constituents.

3.3 Responsiveness Summary

The public comment period for the Proposed Plan for Nine Sites at SIAD began on February 7, 1996, and extended through March 7, 1996. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. Oral comments were received for the Building 1003 Area at the public meeting.

3.3.1 Community Preferences

At the public hearing, Ms. Geralyn Smith questioned whether the Army had considered employing a technique (such as using foam in the soil) that would allow for the affected soil to remain in place rather than be excavated, hauled, and disposed offsite. Mr. Wickham, Montgomery Watson, noted that in situ and other innovative technologies had been evaluated during the feasibility study and that they did not meet the cost-effectiveness criteria at this site. He also noted that the soil removed from the Building 1003 Area would be taken to a facility in the SIAD region for reuse as asphalt.

3.3.2 Integration of Comments

The Army evaluated in situ innovative technologies during conduct of the feasibility study for this site. Consideration was made regarding cost effectiveness, technical feasibility (effectiveness and implementability), and the ability for reuse of affected soil during the evaluation process. Excavation and asphalt incorporation were selected based on these criteria. The public's concern with offsite disposal is addressed by this technology, although excavation and hauling remain necessary components of the selected remedial action.

Table 3.1: Metals Above Background In Surface Soil - Building 1003 Area

	Concentration (μg/g [dry])									
	Certified Reporting Limits			Soil Type 312 and 313		All Soil Types				
Compound	CRL*	CRL (JS11) (1990-1991)	CRL (JS16) (1992-1993)	Number of Samples Above Median	Number of Samples Above Maximum	Number of Samples Above Median	Number of Samples Above Maximum	Frequency of Detects	Minimum	Maximum
Arsenic	0.25	---	---	19/19	16/19	19/19	0/19	19/19	4.57	10.2
Antimony	---	3.80	7.14	1/19	1/19	1/19	1/19	1/19	<3.80	10.3
Barium	---	29.6	5.20	19/19	8/19	3/19	0/19	19/19	125	410
Beryllium	---	1.86	0.500	0/19	0/19	0/19	0/19	0/19	<1.86	<1.86
Cadmium	---	3.05	0.700	0/19	0/19	0/19	0/19	0/19	<3.05	<3.05
Chromium	---	12.7	4.05	1/19	1/19	1/19	1/19	1/19	<12.7	27.6
Cobalt	---	15.0	1.42	NA	NA	NA	NA	NA	NA	NA
Copper	---	58.6	0.965	0/19	0/19	0/19	0/19	0/19	<58.6	<58.6
Lead	0.177	6.62	10.5	27/35	26/35	27/35	20/35	27/35	<6.62	175
Mercury	0.05	---	---	2/19	2/19	2/19	2/19	2/19	<0.05	0.092
Molybdenum	---	1.15	1.12	NA	NA	NA	NA	NA	NA	NA
Nickel	---	12.6	1.71	0/19	0/19	0/19	0/19	0/19	<12.6	<12.6
Selenium	0.25	---	---	0/19	0/19	0/19	0/19	0/19	<0.25	<0.25
Silver	---	2.50	0.589	0/19	0/19	0/19	0/19	0/19	<2.50	<2.50
Thallium	---	31.3	6.623	0/19	0/19	0/19	0/19	0/19	<31.3	<31.3
Vanadium	---	13.0	3.39	NA	NA	NA	NA	NA	NA	NA
Zinc	---	30.2	8.03	8/19	8/19	8/19	6/19	8/19	<30.2	228

μg/g Micrograms per gram

* Certified reporting limit (CRL) for analyses other than USAEC Methods JS11 and JS16.

Table 3.2: Metals Above Background in Subsurface Soil - Building 1003 Area

	Concentration (µg/g [dry])									
	Certified Reporting Limits			USCS Soil Type for Individual Sample		All USCS Soil Types				
Compound	CRL*	CRL (JS11) (1990-1991)	CRL (JS16) (1992-1993)	Number of Samples Above Median	Number of Samples Above Maximum	Number of Samples Above Median	Number of Samples Above Maximum	Frequency of Detects	Minimum	Maximum
Arsenic	0.25	---	---	45/89	4/89	50/89	4/89	89/89	1.29	41.0
Antimony	---	3.80	7.14	16/89	16/89	16/89	16/89	16/89	<3.80	14.2
Barium	---	29.6	5.20	54/89	10/89	62/89	0/89	79/89	<29.6	560
Beryllium	---	1.86	0.500	4/89	4/89	4/89	4/89	4/89	<1.86	3.90
Cadmium	---	3.05	0.700	0/89	0/89	0/89	0/89	0/89	<3.05	<3.05
Chromium	---	12.7	4.05	0/89	0/89	0/89	0/89	0/89	<12.7	<12.7
Cobalt	---	15.0	1.42	NA	NA	NA	NA	NA	NA	NA
Copper	---	58.6	0.965	0/89	0/89	0/89	0/89	0/89	<58.6	<58.6
Lead	0.177	6.62	10.5	22/89	22/89	22/89	22/89	22/135	<6.62	19.8
Mercury	0.05	---	---	1/89	1/89	1/89	1/89	1/89	<0.05	0.162
Molybdenum	---	1.15	1.12	NA	NA	NA	NA	NA	NA	NA
Nickel	---	12.6	1.71	0/89	0/89	0/89	0/89	0/89	<12.6	<12.6
Selenium	0.25	---	---	0/89	0/89	0/89	0/89	0/89	<0.25	<0.25
Silver	---	2.50	0.589	0/89	0/89	0/89	0/89	0/89	<2.50	<2.50
Thallium	---	31.3	6.623	3/89	3/89	3/89	3/89	3/89	<31.3	77.4
Vanadium	---	13.0	3.39	NA	NA	NA	NA	NA	NA	NA
Zinc	---	30.2	8.03	22/89	16/89	22/89	10/89	22/89	<30.2	141

µg/g	Micrograms per gram
USCS	Unified soil classification system

* Certified reporting limit (CRL) for analyses other than USAEC Methods JS11 and JS16.

Table 3.3: Summary of Compounds Detected in Groundwater - Building 1003 Area

	Concentrations in $\mu g/l$								
Analyte	State MCL	Federal MCL	CRL	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
BU1-01-MWA				4/24/91	7/20/91	2/23/92	4/23/92	10/16/93	1/18/94
Organic Compounds									
Methylene Chloride	NA	NA	2.3	ND	3.68	ND	ND	ND	ND
TCE	5	5	0.5	ND	ND	ND	ND	ND	1.4
bis(2-ethylhexyl)phthalate	4	6		ND	4.45	ND	ND	ND	ND
Metals[a]									
Barium	1,000	2,000	5	38.1	35.8	41.0	40.4	NA	NA
Copper	NA	1,000	8.09	9.57	ND	ND	ND	NA	NA
Lead	50	15	1.26	24.5	ND	ND	ND	ND	ND
Selenium	10	50	3.02	ND	16.6	16.7	18.4	NA	NA
Silver	50	100	0.25	0.745	ND	ND	ND	NA	NA
Nitrite, nitrate	45,000[b]	1,000[c]	10	NA	NA	NA	NA	NA	55,000
BU1-01-HP				-	-	-	-	-	8/30/93
Organic Compounds				NA	NA	NA	NA	NA	ND
Metals									
Lead	50	NA	1.26	NA	NA	NA	NA	NA	ND
BU1-02-HP				-	-	-	-	-	8/31/93
Organic Compounds				NA	NA	NA	NA	NA	ND
Metals									
Lead	50	NA	1.26	NA	NA	NA	NA	NA	ND
BU1-03-HP				-	-	-	-	-	8/24/93
Organic Compounds				NA	NA	NA	NA	NA	ND
Metals									
Lead	50	NA	1.26	NA	NA	NA	NA	NA	ND
BU1-04-HP				-	-	-	-	-	9/6/93
Organic Compounds									
Methyl ethyl ketone	NA	NA	6.4	NA	NA	NA	NA	NA	30.0
Metals									
Lead	50	NA	1.26	NA	NA	NA	NA	NA	ND

CRL	Certified reporting limit
MCL	Maximum contaminant level
MRL	Method reporting limit
NA	Not analyzed/not applicable
ND	Not detected
TCE	Trichloroethene
$\mu g/l$	Micrograms per liter

a. Metal concentrations detected in monitoring well BU1-01-MWA above SIAD background levels.
b. California MCL for nitrate
c. Federal MCL for nitrite as N. Federal MCL for nitrate as N = 10,000 $\mu g/l$

Table 3.4: Summary of Background Groundwater Samples for Sierra Army Depot

			DSB-04-MWA				BKG-01-MWA				BKG-02-MWA							
Compound	CRL (SS10)	CRL (others)	3/10/92	5/11/92	10/26/93	1/24/94	4/8/92	5/8/92	10/26/93	1/24/93	4/22/92	5/10/92	10/26/93	1/24/94	Frequency of Detects	Minimum	Maximum	Median
Arsenic	---	2.54	287	257	240	290	5.53	7.36	5.01*	4.37	6.40	8.42	5.54*	5.01	12/12	4.37‡	290	6.40*
Antimony	38.0	3.03	<38.0	<38.0	6.80#	<6.10	<38.0	<38.0	3.57#	9.29#	<38.0	<38.0	<3.03	12.6#	4/12	<3.03	12.6#	<38.0
Barium	5.00	---	21.4	14.2	14.4	14.4	23.6	24.8	28.9	26.1	15.6	16.4	16.3	15.8	12/12	14.2	28.9	16.3
Beryllium	5.00	---	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	0/12	<5.00	<5.00	<5.00
Cadmium	4.01	---	<4.01	<4.01	<4.01	<4.010	<4.01	<4.01	<4.01	<4.01	<4.01	<4.01	<4.01	<4.01	0/12	<4.01	<4.01	<4.01
Calcium	500	---	146000	203000	183000	128000	111000	115000	125000	108000	114000	122000	122000	117000	12/12	111000	203000	122000
Chromium	6.02	---	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	0/12	<6.02	<6.02	<6.02
Cobalt	25.0	---	NA	NA	<25.0	<25.0	NA	NA	<25.0	<25.0	NA	NA	<25.0	<25.0	0/6	<25.0	<25.0	<25.0
Copper	8.09	---	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	0/12	<8.09	<8.09	<8.09
Lead	18.6	1.26	<1.26	<1.26	<1.26	<1.26	1.84	<1.26	<1.26	<1.26	<1.26	<1.84	<1.26	<1.26	2/12	<1.26	1.84	<1.26
Mercury	---	0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	0/12	<0.243	<0.243	<0.243
Molybdenum	15.3	---	NA	NA	824	660	NA	NA	<15.3	<15.3	NA	NA	25.3	26.7	4/6	<15.3	824.000	25.3
Nickel	34.3	---	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	0/12	<34.3	<34.3	<34.3
Selenium	71.1	3.02	<12.0	<3.02	<6.00	<3.02	10.2	8.63	6.50	7.56	<3.02	<3.02	<3.02	<3.02	4/12	<3.02	10.2	<3.02
Silver	4.60	0.250	0.689	0.420	<4.60	<4.60	<0.250	<0.250	<4.60	<4.60	<0.250	<0.250	<4.60	4.60	2/12	<0.250	0.689	<4.60
Sodium	500	---	2180000	2640000	2360000	2300000	46200	46300	49700	48800	208000	213000	207000	210000	12/12	46200	2640000	208000
Thallium	---	6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	0/12	<6.99	<6.99	<6.99
Vanadium	11.0	---	NA	NA	22.7	36.3	NA	NA	12.2	<11.0	NA	NA	23.7	18.0	5/6	<11.0	36.3	18.0
Zinc	21.1	---	<21.1	<21.1	116	<21.1	<21.1	<21.1	105	<21.1	<21.1	<21.1	117	74.0	4/12	<21.1	117	<21.1

All groundwater samples were filtered prior to analysis

Concentrations are in micrograms per liter (μg/l)

CRL Certified reporting limit

* These concentrations are estimated due to the presence of arsenic in the filter blank associated with these samples at a concentration of 3.2 μg/l.
# These concentrations are qualified as non-detect due to the presence of antimony in the filter blanks associated with these samples at concentrations ranging from 7.7 μg/l to 8.8 μg/l.

Table 3.5: Summary of Multipathway Exposures at the Building 1003 Area

Exposure Scenario/Exposure Pathway	Hazard Index	Excess Lifetime Cancer Risk
Current Baseworker		
Soil exposure	0.035	1.6E-05
Current and Future Construction Worker		
Surface soil exposure	0.14	3.3E-06
Subsurface soil exposure	0.65	1.2E-05
Current Casual Visitor		
Surface soil exposure	0.011	2.0E-06
Hypothetical Future Adult Resident		
Soil exposure	0.067	3.6E-05
Groundwater exposure	4.3	2.3E-03
Hypothetical Future Child Resident		
Soil exposure	0.5	6.8E-05
Groundwater exposure	10	1.3E-03

Table 3.6: Applicable or Relevant and Appropriate Federal Requirements for Sierra Army Depot

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Action-Specific				
Occupational Safety and Health Act	29 USC §§ 651-678	Regulates worker health and safety	Applicable	Under 40 CFR § 300.38, requirements of the Act apply to all response activities under the NCP.
Department of Transportation Material Shipment Regulations	49 CFR 100-180	Regulates the packaging, labeling, and shipping of hazardous materials	Applicable	Department of Transportation requirements apply to all shipments of hazardous materials.

CFR	Code of Federal Regulations
NCP	National Contingency Plan
USC	United States Code

Table 3.7: Applicable or Relevant and Appropriate California Requirements for Sierra Army Depot

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Mulford-Carrell Air Resources Act	H & S Code, Div. 26, § 39000 et seq. CCR, Title 17, Part III, Chapter 1, § 60000 et seq.	Regulates both nonvehicular and vehicular sources of air contaminants in California. Defines relationships of the California Air Resources Board (ARB) and local or regional air pollution control districts (APCDs). Establishes emission limitations.	Applicable	The local APCD sets allowable emission limits. Emission limits will need to be established for emissions associated with specific remedial alternatives. SIAD is located in Lassen County. Applicable air quality regulations are specified in the Lassen County Air Pollution Control District's Air Pollution Regulations. The Lassen County APCD determines emission limits on a site-specific basis. CA Regulatory Agency: ARB; Lassen County APCD
Hazardous Waste Control Laws	H & S Code, Div. 20, Chapters 6.5 and 6.8, § 25100 et seq. CCR Title 22, Div. 4.5, Chapter 10, § 66001 et seq.	Regulations governing hazardous waste control; management and control of hazardous waste facilities; transportation; laboratories; classification of extremely hazardous, hazardous, and nonhazardous waste. Includes STLCs and TTLCs.	Applicable or relevant and appropriate	State hazardous waste control laws are considered applicable or relevant and appropriate operating standards for those alternatives involving treatment and disposal of hazardous wastes. CA Regulatory Agency: Department of Toxic Substances Control (DTSC).
Identification and Listing of Hazardous Waste (Hazardous Substance Act)	CCR, Title 22, Div. 4.5, Chapter 11, § 66261 et seq.	Definitions and characteristics of waste, hazardous waste, RCRA hazardous waste and special waste. Labeling requirements.	Applicable	This Act applies to ongoing operations of a facility that generates or manages hazardous waste. CA Regulatory Agency: DTSC
Health and Safety Standards for Management of Hazardous Waste	CCR, Title 22, Div. 4.5, Chapt. 14, Art. 16, §§ 66264.600-66264.603	Applies to owners and operators of facilities that treat, store or dispose of RCRA hazardous waste in miscellaneous units. Covers environmental performance standards, monitoring, inspections, and post-closure care.	Relevant and Appropriate	Some of the alternatives will utilize treatment systems that are considered miscellaneous units. CA Regulatory Agency: DTSC

Table 3.7: Applicable or Relevant and Appropriate California Requirements for Sierra Army Depot (continued)

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Health and Safety Standards for Management of Hazardous Waste (continued)	CCR, Title 22, Div. 4.5, Chapt. 14, Art. 9, §§ 66264.170-66264.178	Applies to owners and operators who store hazardous waste for more than 90 days in containers. Covers use and management of containers, containment, inspections, and closure.	Relevant and Appropriate	CA Regulatory Agency: DTSC

Table 3.8: Estimated Cost for Excavation and Offsite Asphalt Incorporation Building 1003 Area

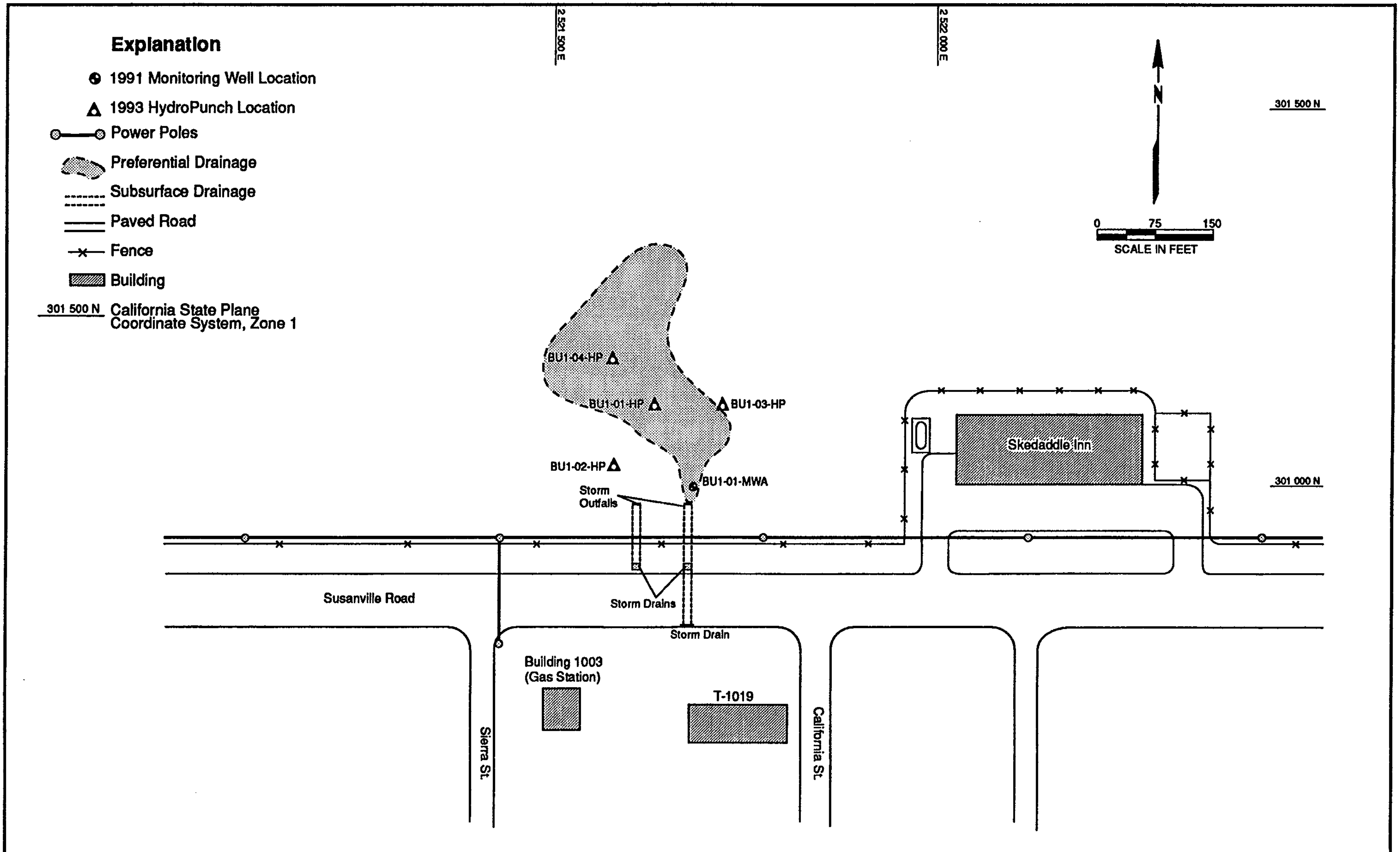
Item/Description	Unit	Unit Cost	Quantity	Subtotal[a]	Total
Soil Excavation					
Engineering Oversight[b]	Hour	$130	24	$3,100	
Health and Safety Plan	Lump sum	$5,000	1	$5,000	
Mobilization and Demobilization	Lump sum	$4,000	1	$4,000	
Site Clearing	Square foot	$0.20	1,400	$300	
Excavation[c]	Cubic yard	$15	170	$2,600	
Total					$15,000
Post Excavation Sampling[d]					
Sampling					
Personnel	Hour	$60	8	$500	
Sampling Equipment	Lump sum	$500	1	$500	
Analyses	Sample	$127	5	$635	
Total					$1,600
Disposal					
Transport to recycling facility in Doyle, California	Load of 23 tons	$115	10	$1,150	
Recycling Fee[e]	Ton	$45	220	$9,900	
Profiling Soil[e]	Sample	$1,220	1	$1,200	
Total					$12,300
Demobilization					
Imported Fill	Cubic yard	$17	170	$2,900	
Backfilling and compaction	Cubic yard	$11	170	$1,900	
Total					$4,800
Closure Report	Lump sum	$12,000	1	$12,000	
Total					$12,000
Capital Cost Subtotal					**$45,700**
Plan and Specification Preparation (7.5% of Capital Costs or $25,000, whichever is greater)					$25,000
Bid Preparation and Evaluation (2.5% of Capital Costs or $15,000, whichever is greater)					$15,000
Contingency (30% of Operating and Capital Costs)[f]					$13,700
Project Administration (15% of Operating and Capital Costs)[f]					$6,900
TOTAL COST OF REMEDIAL ALTERNATIVE[g]					**$106,000**

Table 3.8: Estimated Cost for Excavation and Offsite Asphalt Incorporation
Building 1003 Area
(continued)

STLC	Soluble threshold limit concentration
TPH	Total petroleum hydrocarbons
TTLC	Total threshold limit concentration
VOCs	Volatile organic compounds

a. Individual costs are rounded to the nearest one hundred dollars.
b. Two-person crew (one senior and one professional), 2 days, 12-hour days.
c. Excavation consists of three trenches: 20 feet x 30 feet x 1 foot, 20 feet x 20 feet x 1 foot, and 20 feet x 20 feet x 9 feet. It is assumed that shoring would not be required.
d. Assume five samples collected and analyzed for TPH (modified 8015).
e. Price quoted by Tahoe Asphalt Co., South Lake Tahoe, California. Actual fee for asphalt batch plant in Doyle, California, was not available. Soil profiling includes analyses for VOCs, TPH, TTLC metals, STLC lead, aquatic bioassay. One soil sample per 250 cubic yards is assumed.
f. For this alternative, it is assumed no operating costs are incurred after the removal action is implemented.
g. Total cost is rounded to nearest one thousand dollars.

SRA 1071.1 11/3/95 ECS



Modified from Montgomery Watson (1994)

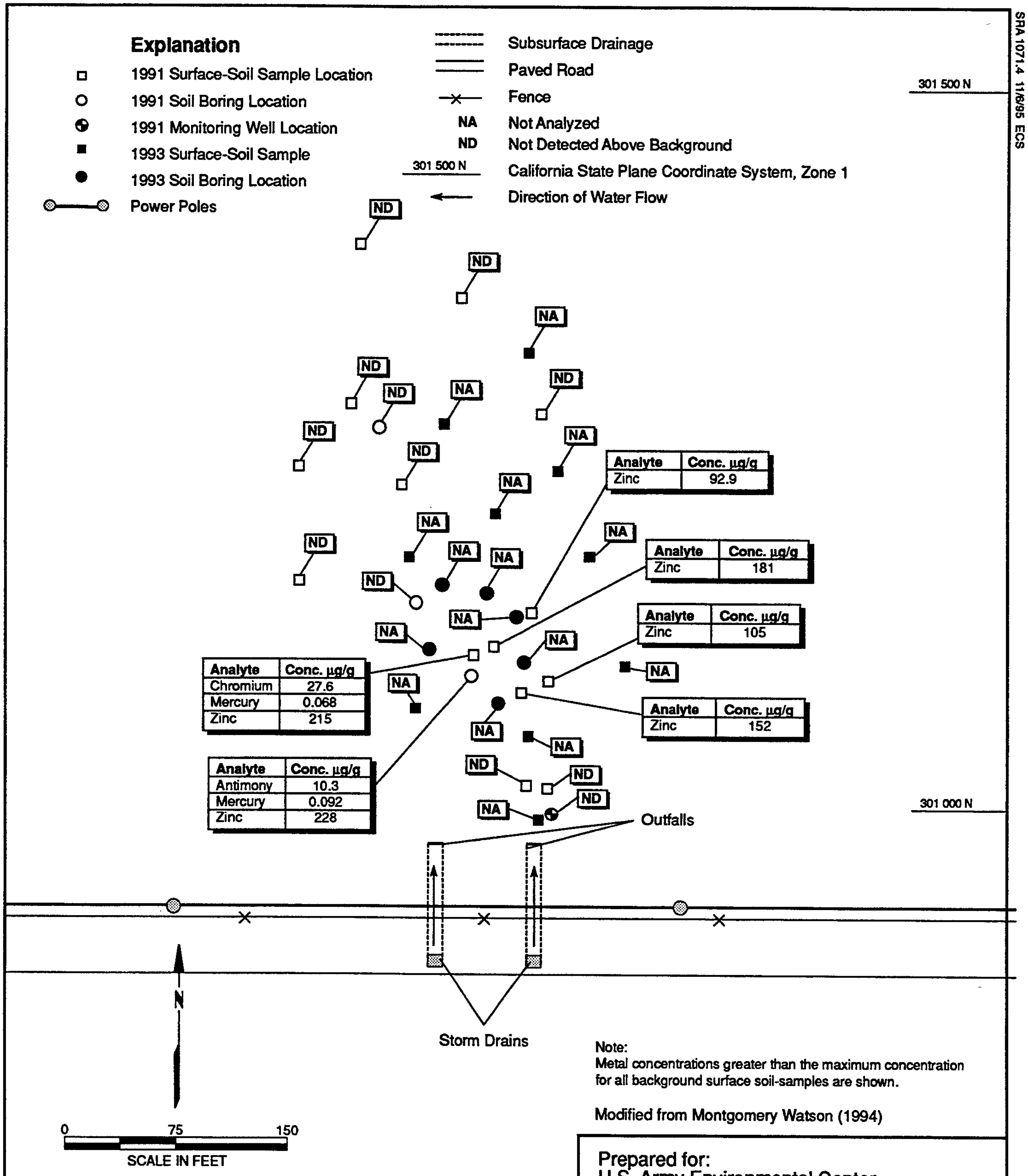
Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 3.1

Site Map
Building 1003 Area



Analyte	Conc. µg/g
Zinc	92.9

Analyte	Conc. µg/g
Zinc	181

Analyte	Conc. µg/g
Zinc	105

Analyte	Conc. µg/g
Chromium	27.6
Mercury	0.068
Zinc	215

Analyte	Conc. µg/g
Zinc	152

Analyte	Conc. µg/g
Antimony	10.3
Mercury	0.092
Zinc	228

Note:
Metal concentrations greater than the maximum concentration for all background surface soil-samples are shown.

Modified from Montgomery Watson (1994)

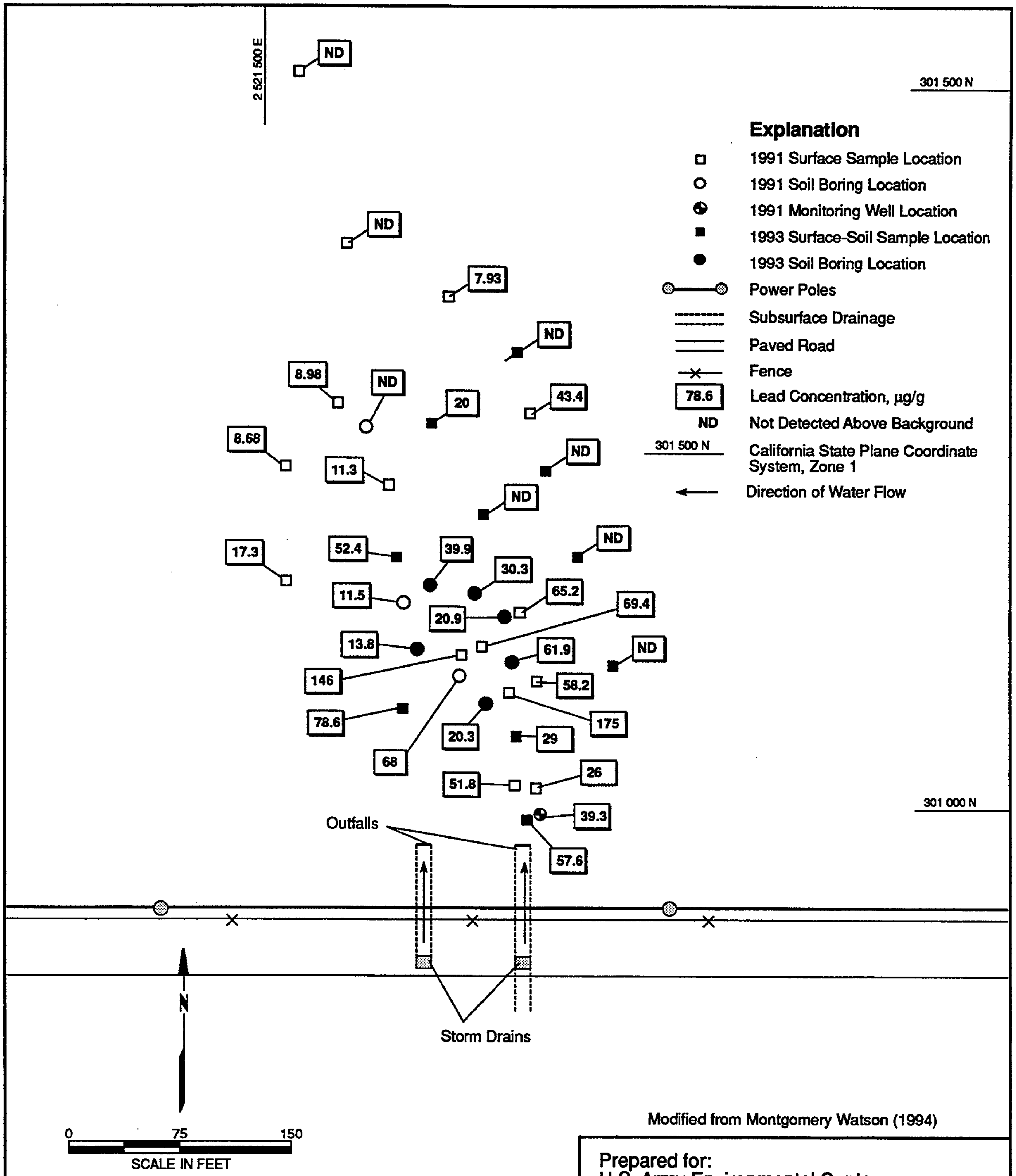
Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 3.2

Metal Concentrations Other Than Lead Above Background in Surface-Soil Samples Building 1003 Area



Modified from Montgomery Watson (1994)

SRA 1071.5 11/3/95 ECS

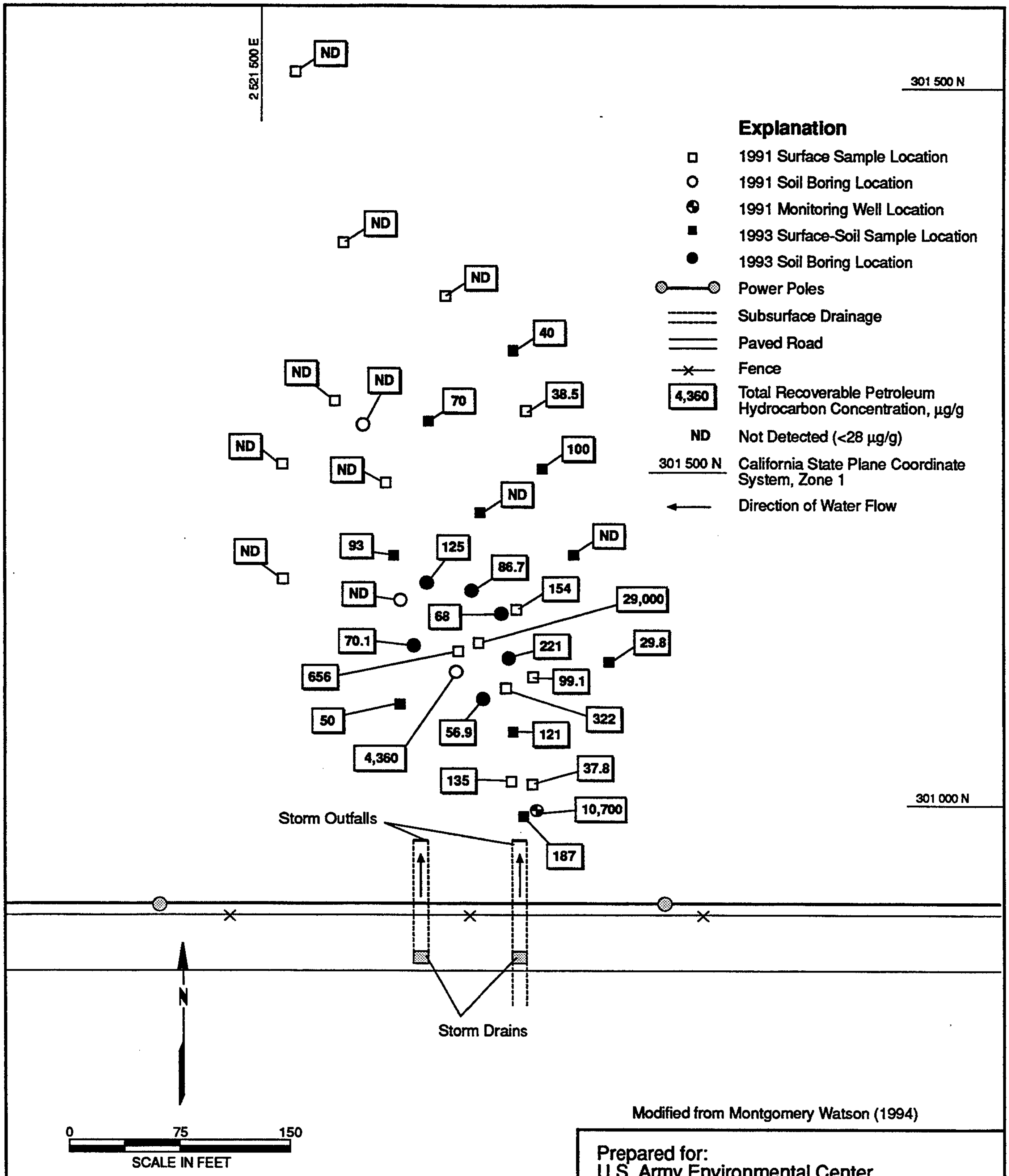
Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 3.3

Lead Concentrations in Surface-Soil Samples Building 1003 Area



Modified from Montgomery Watson (1994)

Harding Lawson Associates
Engineering and
Environmental Services

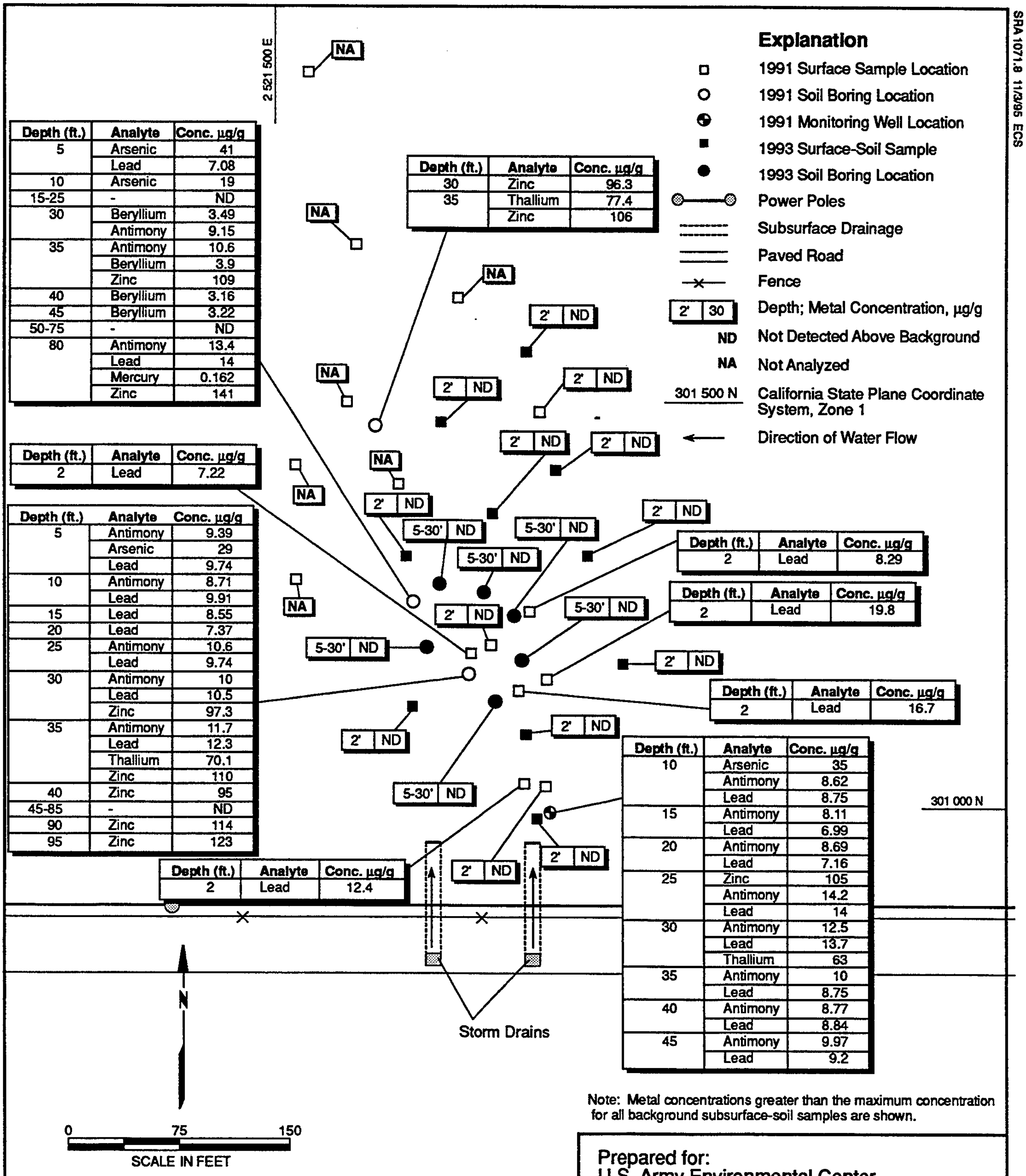
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 3.4

Total Recoverable Petroleum Hydrocarbon Concentrations in Surface-Soil Samples Building 1003 Area

SRA 1071.8 11/3/95 ECS



Depth (ft.)	Analyte	Conc. µg/g
5	Arsenic	41
	Lead	7.08
10	Arsenic	19
15-25	-	ND
30	Beryllium	3.49
	Antimony	9.15
35	Antimony	10.6
	Beryllium	3.9
	Zinc	109
40	Beryllium	3.16
45	Beryllium	3.22
50-75	-	ND
80	Antimony	13.4
	Lead	14
	Mercury	0.162
	Zinc	141

Depth (ft.)	Analyte	Conc. µg/g
30	Zinc	96.3
35	Thallium	77.4
	Zinc	106

Depth (ft.)	Analyte	Conc. µg/g
2	Lead	7.22

Depth (ft.)	Analyte	Conc. µg/g
5	Antimony	9.39
	Arsenic	29
	Lead	9.74
10	Antimony	8.71
	Lead	9.91
15	Lead	8.55
20	Lead	7.37
25	Antimony	10.6
	Lead	9.74
30	Antimony	10
	Lead	10.5
	Zinc	97.3
35	Antimony	11.7
	Lead	12.3
	Thallium	70.1
	Zinc	110
40	Zinc	95
45-85	-	ND
90	Zinc	114
95	Zinc	123

Depth (ft.)	Analyte	Conc. µg/g
2	Lead	8.29

Depth (ft.)	Analyte	Conc. µg/g
2	Lead	19.8

Depth (ft.)	Analyte	Conc. µg/g
2	Lead	16.7

Depth (ft.)	Analyte	Conc. µg/g
10	Arsenic	35
	Antimony	8.62
	Lead	8.75
15	Antimony	8.11
	Lead	6.99
20	Antimony	8.69
	Lead	7.16
25	Zinc	105
	Antimony	14.2
	Lead	14
30	Antimony	12.5
	Lead	13.7
	Thallium	63
35	Antimony	10
	Lead	8.75
40	Antimony	8.77
	Lead	8.84
45	Antimony	9.97
	Lead	9.2

Depth (ft.)	Analyte	Conc. µg/g
2	Lead	12.4

Note: Metal concentrations greater than the maximum concentration for all background subsurface-soil samples are shown.

Harding Lawson Associates
Engineering and
Environmental Services

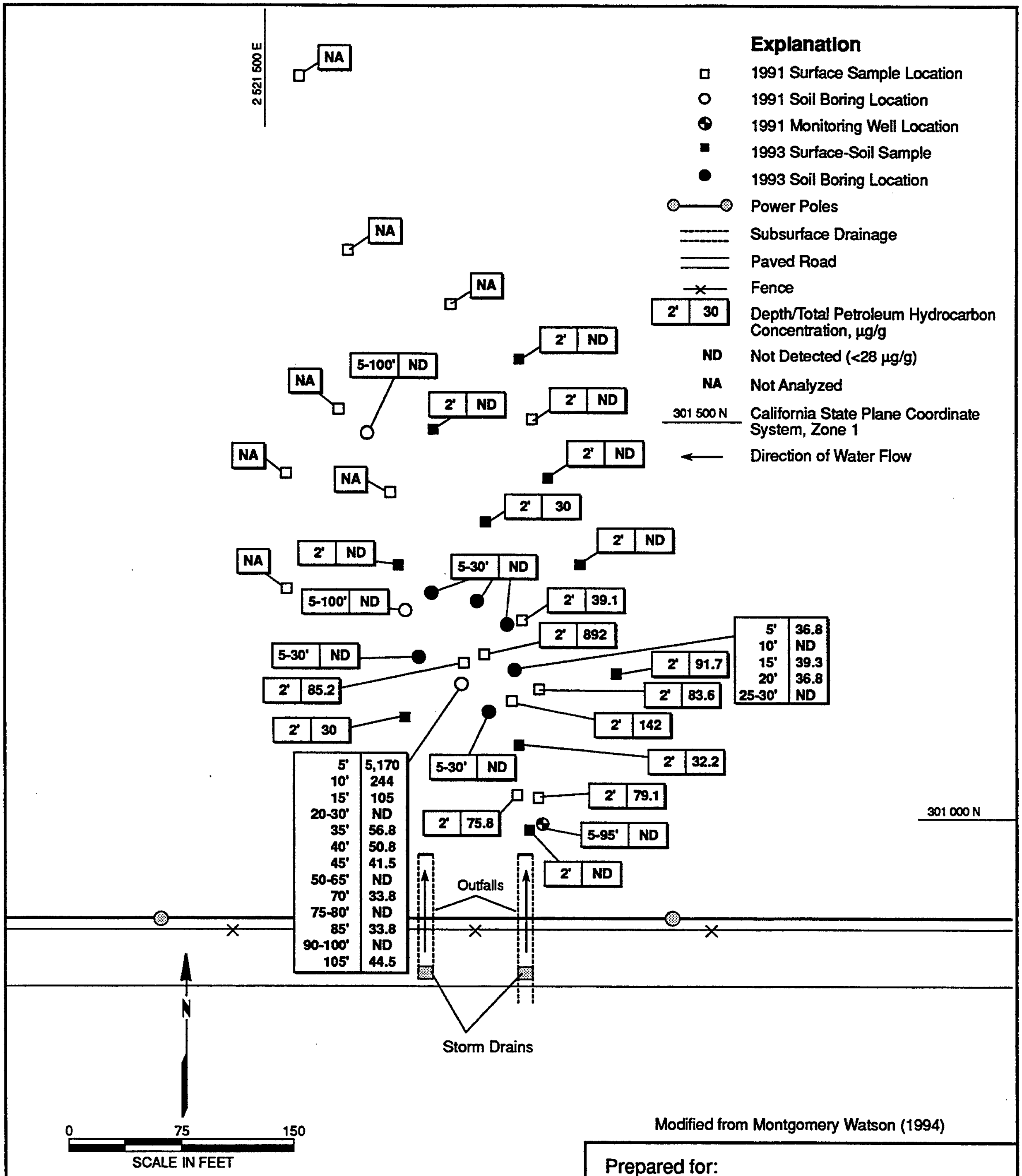
Modified from Montgomery Watson (1994)

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 3.5

Metal Concentrations Above Background in Subsurface-Soil Samples
Building 1003 Area



Modified from Montgomery Watson (1994)

SRA 1071.6 11/3/95 ECS

Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 3.6

Total Recoverable Petroleum Hydrocarbon Concentrations in Subsurface-Soil Samples Building 1003 Area

4.0 CHEMICAL BURIAL SITE

4.1 Declaration

This section provides the declaration portion of the ROD/RAP for the Chemical Burial Site.

4.1.1 Location

The Chemical Burial Site is located west of Main Magazine Road, within the southern portion of SIAD (Figure 1.1).

4.1.2 Assessment of the Site

The distribution and extent of contamination at the Chemical Burial Site was assessed based primarily on activities conducted and data obtained during the 1990 Phase I RI (JMM and E.C. Jordan, 1991). Groundwater sampling was conducted at the site during the 1991 Group II RI (JMM, 1992), 1992 Group I Follow-Up RI (Montgomery Watson, 1993), and 1993 Group I and II Follow-Up RI (Montgomery Watson, 1994). The results are summarized as follows:

- The potential source of contamination at the Chemical Burial Site was the previous burial of drums containing retrograde chemicals in a large trench at the site. In 1974, the drums were excavated and removed and the trench was backfilled. During excavation, all drums were observed to be intact.
- During geophysical investigations and test pit excavations conducted in 1990, no remaining buried drums or other containers were detected at the site.
- Very low levels of TCE were detected in soil gas in the southwestern and northeastern portions of the site. The low levels of TCE in soil gas in the southwest portion of the site may be related to sources in the northwest portion of the Abandoned Landfill.
- Low levels of pesticides and VOCs were detected in subsurface-soil samples. All inorganics detected in soil are interpreted to be naturally occurring.
- TCE was detected in the upgradient monitoring well at the site. No VOCs were detected downgradient of the Chemical Burial Site. The TCE in the upgradient well is interpreted to be part of a TCE plume originating to the south in the northwestern portion of the Abandoned Landfill. All inorganics detected in groundwater are interpreted to be naturally occurring. Based on the available soil and groundwater data, the Chemical Burial Site does not appear to be a source of groundwater contamination.

No human health or ecological risks associated with soil and groundwater exposure were identified at the Chemical Burial Site.

4.1.3 Description of the Selected Remedy

No further action is recommended for the Chemical Burial Site.

4.1.4 Statutory Determinations

Because no remedial actions are required at this site, no statutory determinations of remedial actions are necessary.

4.2 Decision Summary

This section provides the site-specific factors and analysis that were considered in the selection of the response action for the Chemical Burial Site.

4.2.1 Site Description

The Chemical Burial Site is a 100- by 600-foot area completely enclosed by the Construction Debris Landfill (Figure 4.1).

4.2.2 Site History and Enforcement Activities

The Chemical Burial Site was used from January 1971 to October 1972 for trench burial of retrograde drummed chemicals (Benioff, et al., 1988). In 1974, the drums were excavated and removed and the trench was backfilled (USATHAMA, 1979). Removal operations, conducted between March 4, 1974, and May 15, 1974, consisted of removing overburden using a dozer and scraper, excavating a trench to a depth of 12 feet, and removing the chemicals by hand (USAEHA, 1988). The chemicals were repackaged, overpacked into steel drums or containers, and transferred to the "K block" area. According to SIAD personnel, "K block" chemicals were either neutralized or removed by a commercial hauler in 1979 under a separate disposal contract. During excavation, all drums were observed to be intact (ESE, 1983). Based on this observation, the chemicals were believed to be completely contained within the drums and the area was believed to be uncontaminated (ESE, 1983).

Buried chemicals included pesticides (0.5 percent diazinon [1,000 liters (l)] and chlordane dust [4,500 kilograms (kg)]), toluene (365 l), xylene (235 l), paint (3,800 l), 1,1,1-trichloroethane (28 kg), and mercuric oxide (3 kg) (Benioff, et al., 1988).

4.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 4.3 of this ROD/RAP.

The public participation requirements of CERCLA § 113(K)(2)(B)(i-v) and § 117 and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site. The response action presented for this site in this ROD/RAP was selected in accordance with CERCLA, NCP, Chapter 6.8 of the California Health and Safety Code, and California Water Code. The basis for this decision is documented in the Administrative Record.

4.2.4 Scope and Role of Response Action

This ROD/RAP presents the final response action for the Chemical Burial Site. This site poses no potential threat to human health and the environment. The selected remedy is No Action. This will be the final action for the Chemical Burial Site.

4.2.5 Site Characteristics

The 1990 Phase I RI of the Chemical Burial Site was conducted to investigate the possibility of contamination resulting from trench burial of retrograde drummed chemicals (Benioff, et al., 1988). Potential soil and groundwater contamination was assessed based on a soil-gas survey, test pit sampling, subsurface-soil sampling, monitoring well installation, and groundwater sampling. Additional groundwater sampling was conducted at the site during the 1991 Group II RI, 1992 Group I Follow-Up RI, and 1993 Group I and II Follow-Up RI. An assessment of potential contamination at the site based on these data is provided in the following subsections.

4.2.5.1 Soil-Gas Survey

Soil-gas samples were collected and analyzed from 48 locations at the Chemical Burial Site to identify VOC soil sources. Target analytes were trichloroethane (TCA), TCE, tetrachloroethene (PCE), methylene chloride, chloroform, carbon tetrachloride, 1,2-DCA, benzene, ethylbenzene, toluene, and xylenes (BETX), and total hydrocarbons.

Low levels of TCE were detected in soil gas from the southwest portion of the Chemical Burial Site (Figure 4.2). The TCE detected in this area is believed to be the northeastern extension of the elevated TCE soil-gas concentrations associated with the northwestern portion of the Abandoned Landfill. Low levels of TCE were also detected in the northeastern portion of the Chemical Burial Site along Burning Ground Road (Figure 4.2). No other significant levels of VOCs were detected during the soil-gas survey at the Chemical Burial Site.

4.2.5.2 Test Pits

Three test pits were excavated to depths of 5 feet at the Chemical Burial Site (Figure 4.3) to search for possible buried drums. Three to 4 feet of fill material was uncovered in each test pit; the fill material consisted of clean sand that was similar in character to the native soil of the area. A small geophysical anomaly was uncovered in CCB-03-TP (Figure 4.3), and was found to be a piece of asphalt approximately 2 feet bgs. Buried drums were not found in the three test pits.

4.2.5.3 Soil

Three soil borings were drilled to the water table at this site (Figure 4.4). Soil samples were collected from each soil boring at the 5-foot interval to 50 feet and at the 10-foot interval from 50 feet to the water table. Samples were analyzed for extractable organic compounds (phenols, pesticides/polychlorinated biphenyls [PCBs], base neutral/acid extractable compounds [BNAs]), VOCs, and inorganics (priority pollutant metals and cyanide). The 5-foot sample from each boring was analyzed for dioxin/furans. Analytical results are discussed below.

Low levels of pesticides (chlordane, heptachlor, and heptachlor epoxide), and phenols were detected in subsurface soil (Figure 4.4). These compounds are not likely to be a source of groundwater contamination due to the low frequency of detection, depth to groundwater (approximately 80 to 90 feet bgs), and the low concentrations detected. The presence of phenols was not confirmed by gas chromatography/mass spectroscopy (GC/MS) analysis. This could be due to poor recoveries of phenols in the GC/MS extraction or to a positive interference in the spectrophotometric method.

Trace concentrations of toluene and trichlorofluoromethane were detected in near-surface and subsurface soil (Figure 4.5). As with the extractable organics detected in soil at this site, these VOCs are probably not a source of groundwater contamination.

No inorganic constituents were detected in soil above what are considered background soil levels at this site.

Dioxins were detected in two of the three soil samples analyzed for dioxin/furans. Total octachlorodibenzo-p-dioxin (TOCDD) was detected in CCB-02-SB and CCB-03-SB at 0.000062 $\mu g/g$ and 0.000064 $\mu g/g$, respectively.

4.2.5.4 Groundwater

Groundwater monitoring wells were installed at the Abandoned Landfill and Chemical Burial Site as part of the 1990 Phase I RI (Figure 4.6). Two wells (CCB-01-MWA and CCB-02-MWA) were installed specifically to monitor groundwater beneath the Chemical Burial Site. These wells were sampled and analyzed over two successive months during 1990 for extractable organics (phenols, SVOCs, pesticides/PCBs), VOCs, and inorganics (priority pollutant metals and cyanide). The wells were subsequently sampled during the 1991 Group II RI, 1992 Group I Follow-Up RI, and 1993 Group I and II Follow-Up RI. Results from this total of eight groundwater sampling rounds are summarized below.

TCE has been detected in monitoring well CCB-02-MWA at concentrations ranging from 4.7 to 12 μg/l. Because groundwater flow at the site is to the northeast, well CCB-02-MWA is in an upgradient location. The TCE detected in CCB-02-MWA is interpreted to be part of a TCE plume originating from the northwestern portion of the Abandoned Landfill to the south. Toluene was detected in two of eight sampling rounds in well CCB-01-MWA. No other VOCs or extractable organic compounds have been detected in well CCB-01-MWA, which is immediately north (downgradient) of the site. Based on these groundwater monitoring data, the Chemical Burial Site is not a source of VOCs or extractable organic compounds in groundwater.

All inorganic compound concentrations detected were below MCLs and interpreted to be naturally occurring.

4.2.6 Summary of Site Risks

This section summarizes the baseline risk assessment conducted for the Chemical Burial Site and Construction Debris Landfill during the 1990 Phase I RI. The Chemical Burial Site and Construction Debris Landfill were evaluated together in the baseline risk assessment due to their close proximity.

4.2.6.1 Compounds of Potential Concern

Chlordane, heptachlor, heptachlor epoxide, trichlorofluoromethane in subsurface soil, and TCE in groundwater were identified as COPCs for the Chemical Burial Site and Construction Debris Landfill in the 1990 Phase I RI Report (JMM and E.C. Jordan, 1991).

4.2.6.2 Contaminant Fate and Transport

This section describes the processes expected to control the fate and transport of chemicals identified as COPCs at the Chemical Burial Site/Construction Debris Landfill and the primary chemical and physical properties impacting those processes.

Chlordane, heptachlor, heptachlor epoxide, and trichlorofluoromethane have been identified as COPCs in near-surface and subsurface soil at the Chemical Burial Site/Construction Debris Landfill.

A potential route of migration for these chemicals is leaching from the soil to shallow groundwater. However, given the low frequency of detection, depth to groundwater (approximately 80 to 90 feet bgs), limited precipitation at the site, and the low concentrations detected, it is unlikely that the COPCs in near-surface and subsurface soil pose a threat to groundwater.

The pesticides probably present the greatest threat to potential environmental receptors due to their long biological half-life and their propensity for bioaccumulation. However, because these compounds were not detected in surface soil, they are not readily bioavailable.

4.2.6.3 Human Health Risks

The results of the human health risk assessment conducted for the Chemical Burial Site/Construction Debris Landfill are summarized in Table 4.1.

Soil

The ELCR and HI for current casual visitors are 2 x 10^{-8} and 0.0007, respectively (Table 4.1). The ELCR estimate is below the California benchmark of 1 x 10^{-6}. The HI is less than the benchmark of 1.

For future construction workers at the Chemical Burial Site/Construction Debris Landfill, the ELCR and HI are 5 x 10^{-8} and 0.04, respectively (Table 4.1). The ELCR estimate is below the California benchmark of 1 x 10^{-6}. The HI is less than the benchmark of 1.

Risks for hypothetical future adult residents at the Chemical Burial Site/Construction Debris Landfill were also estimated. The ELCR for a hypothetical future adult resident exposed to soil is 3 x 10^{-8}. The ELCR estimate is below the California benchmark of 1 x 10^{-6}. The HI was not calculated for the future resident exposed to soil.

Groundwater

Risks were estimated for hypothetical future residential use of groundwater even though potential future use of the shallow groundwater is highly unlikely. The ELCR and HI for a hypothetical future adult resident exposed to groundwater are 2×10^{-4} and 0.4, respectively. The HI is less than the benchmark of 1. The elevated ELCR is due to concentrations of TCE and naturally occurring levels of arsenic in groundwater. TCE was detected in monitoring well CCB-02-MWA, which is located upgradient of the Chemical Burial Site. Soil gas and groundwater monitoring data from the Abandoned Landfill suggest that well CCB-02-MWA may be within a TCE plume originating in the northwestern portion of the Abandoned Landfill (Figure 4.6).

4.2.6.4 Environmental Risks

A qualitative environmental assessment was performed for the Chemical Burial Site/Construction Debris Landfill (JMM and E.C. Jordan, 1991). The purpose of this assessment was to evaluate the potential for adverse effects to ecological receptors as a result of possible exposure to chemicals originating from these sites. Environmental assessment results indicate that low concentrations of pesticides and trichlorofluoromethane detected in near-surface and subsurface soil at these sites combined with the small size of the sites would not be expected to pose significant adverse effects to the environment.

4.2.7 Description of the No Action Alternative

Based on the results of the baseline risk assessment conducted for the Chemical Burial Site, there are no adverse impacts to human health or the environment from site-related activities. Thus, the No Action alternative is supported by the baseline risk assessment discussed in Section 4.2.6 and the Administrative Record.

4.2.8 Explanation of Significant Changes

The Proposed Plan for the nine sites was released to the public for comment on February 7, 1996. The preferred alternative identified for the Chemical Burial Site was No Action. Based on the absence of any new information or comments during the public comment period, no significant changes to the selected remedy for the Chemical Burial Site outlined in the Proposed Plan for Nine Sites were necessary.

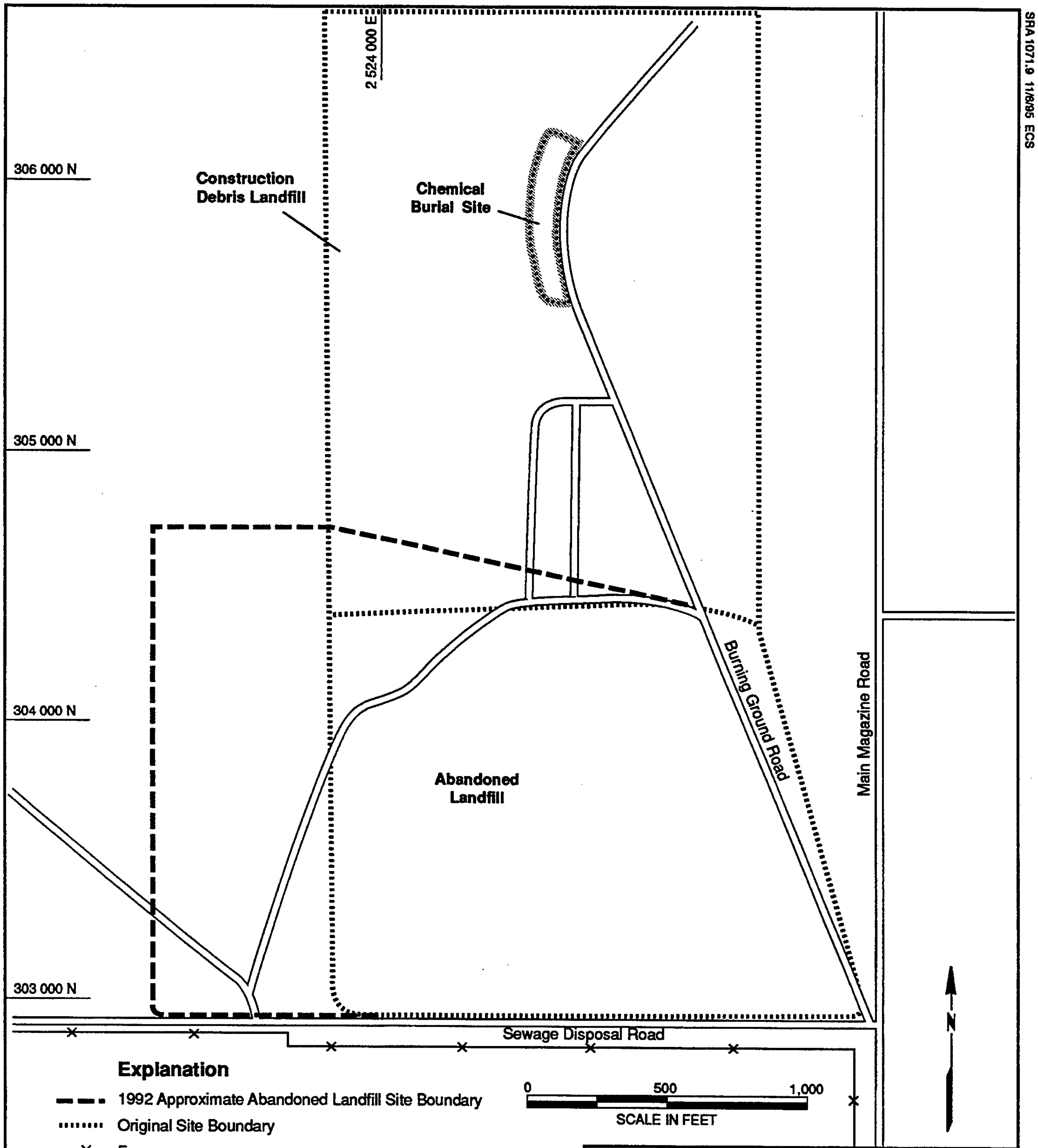
4.3 Responsiveness Summary

The public comment period for the Proposed Plan for Nine Sites at SIAD began on February 7, 1996, and extended through March 7, 1996. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. No oral comments were received regarding the Chemical Burial Site at the public meeting.

Table 4.1: Summary of Multipathway Exposures at the Chemical Burial Site and Construction Debris Landfill

Exposure Scenario/Exposure Pathway	Hazard Index	Excess Lifetime Cancer Risk
Current Casual Visitor		
Soil Exposure	0.0007	2E-08
Current and Future Construction Worker		
Soil Exposure	0.04	5E-08
Hypothetical Future Adult Resident		
Soil Exposure	N/C	3E-08
Groundwater Exposure	0.4	2E-04

N/C Not calculated



Modified from Montgomery Watson (1993)

Harding Lawson Associates
Engineering and
Environmental Services

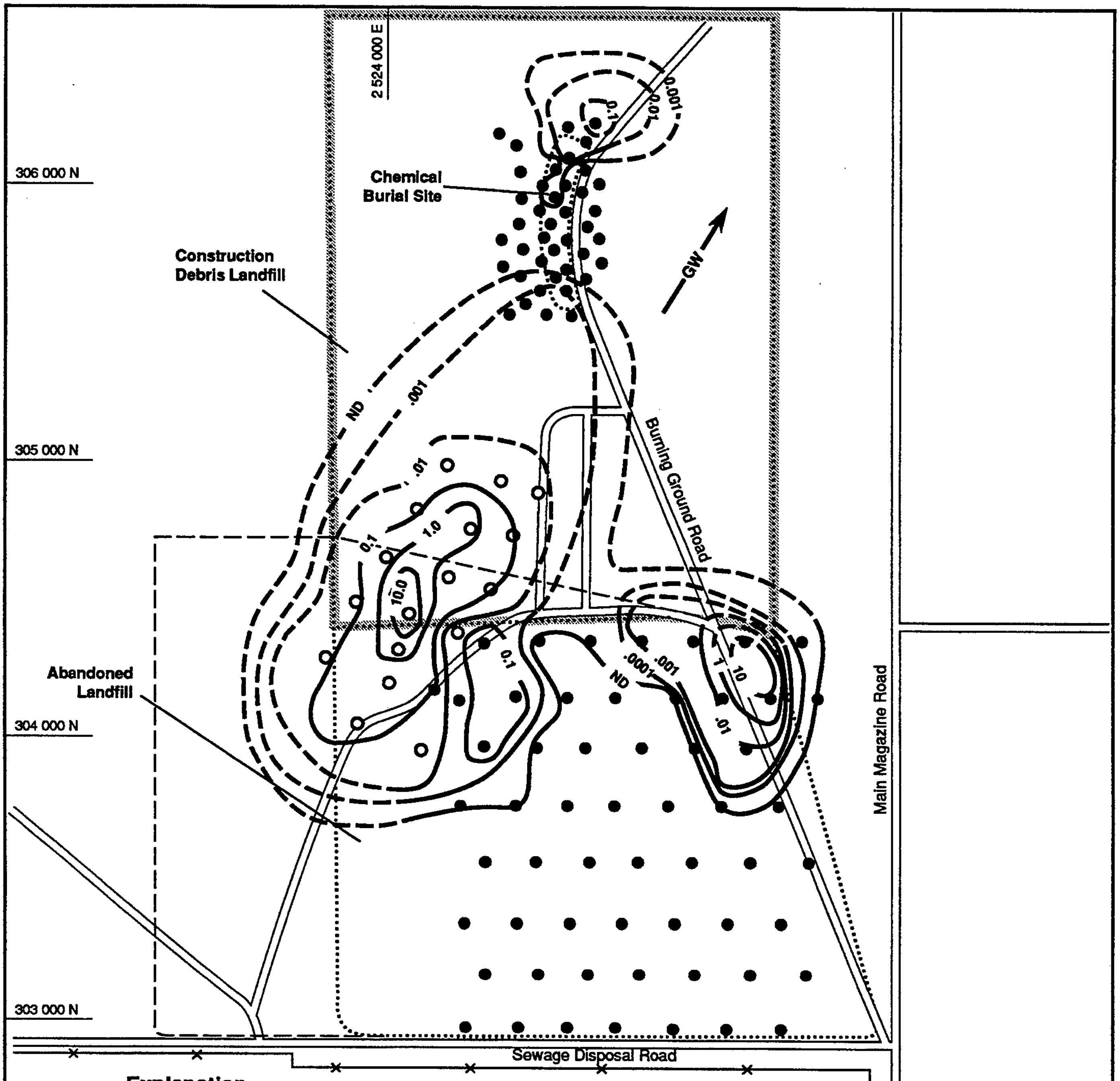
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 4.1

Location Map - Chemical Burial Site

SRA 1071.10 11/6/95 ECS



Explanation

- – – – 1992 Approximate Abandoned LandfillSite Boundary
- ······· Original Site Boundary
- –×– Fence
- ═ Road
- ● Approximate Unbiased Soil-Gas Location
- ○ Approximate Biased Soil-Gas Location
- ↗10↘ TCE Concentration Contour, µg/l
- ← GW – Direction of Groundwater Flow
- 305 000 N California State Plane Coordinate System, Zone 1

Modified from Montgomery Watson (1993)

N

0 250 500

SCALE IN FEET

HLA

Harding Lawson Associates

Engineering and
Environmental Services

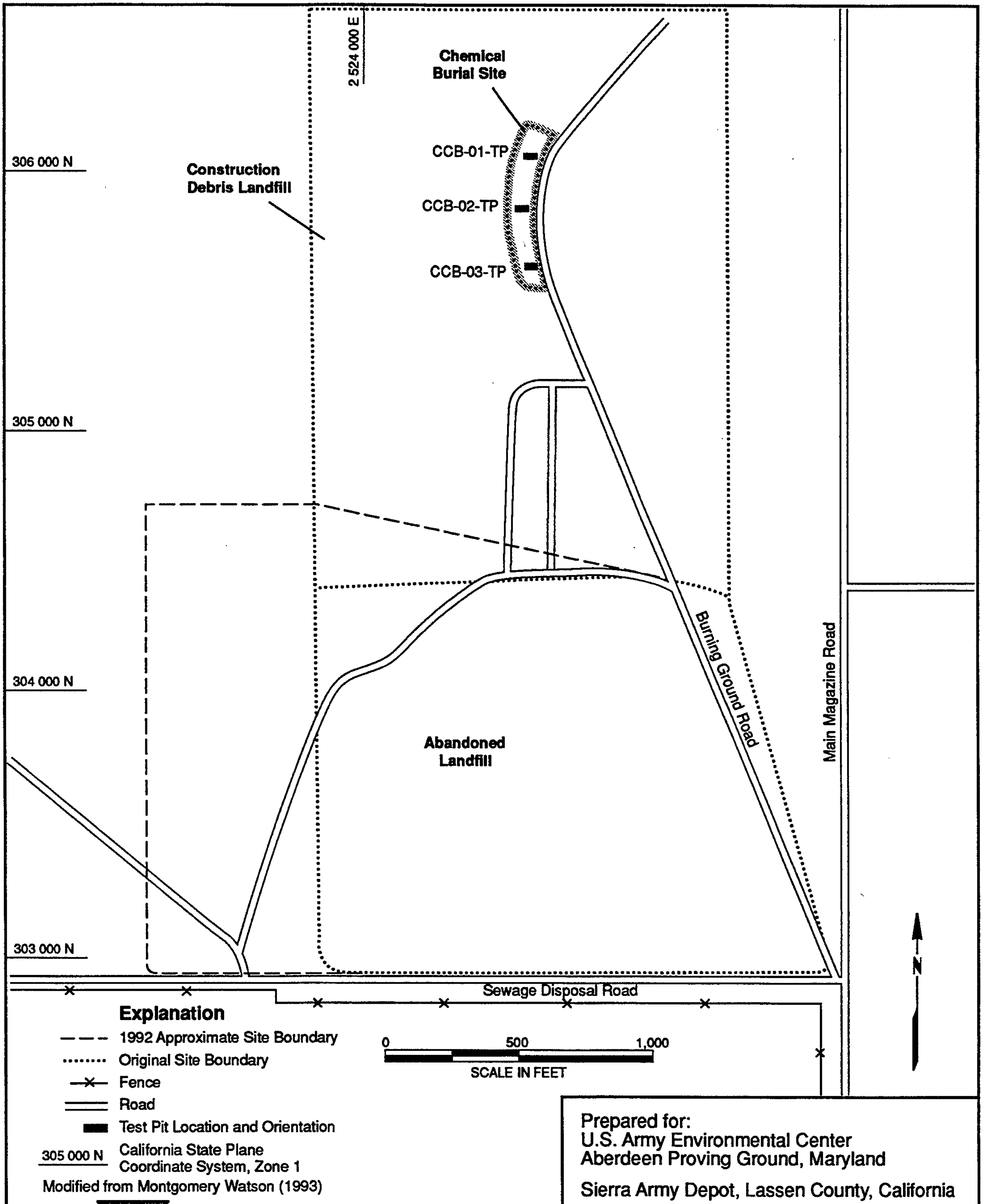
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 4.2

TCE Soil-Gas Plume - Chemical Burial Site/Construction Debris Landfill

SRA 1071.11 11/3/95 ECS



Modified from Montgomery Watson (1993)

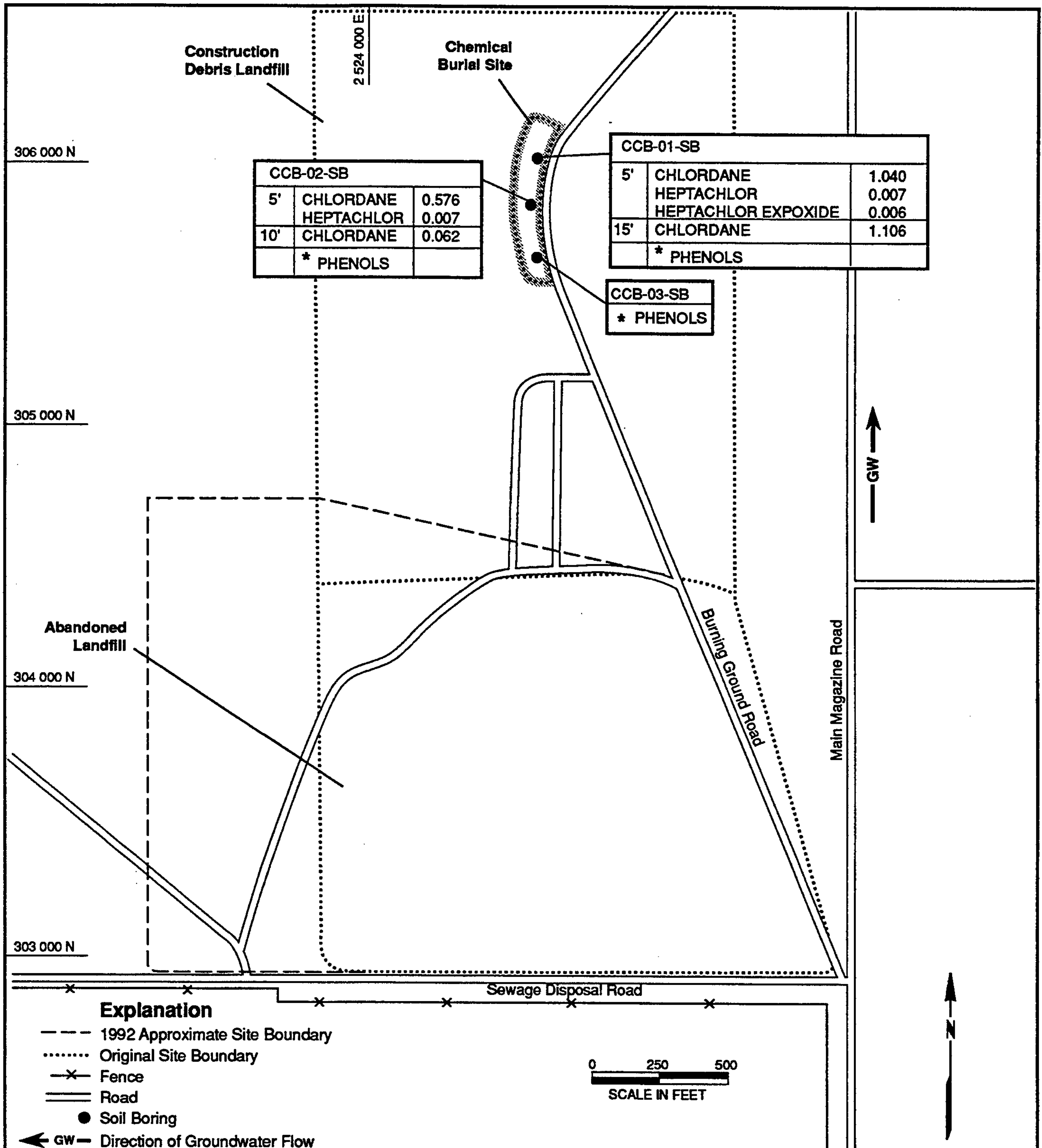
Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
Sierra Army Depot, Lassen County, California

Figure 4.3

Test Pit Locations - Chemical Burial Site

SRA 1071.12 11/3/95 ECS



CCB-02-SB		
5'	CHLORDANE HEPTACHLOR	0.576 0.007
10'	CHLORDANE	0.062
	* PHENOLS	

CCB-01-SB		
5'	CHLORDANE HEPTACHLOR HEPTACHLOR EXPOXIDE	1.040 0.007 0.006
15'	CHLORDANE	1.106
	* PHENOLS	

CCB-03-SB
* PHENOLS

Explanation

– – –	1992 Approximate Site Boundary
········	Original Site Boundary
–×–	Fence
═	Road
●	Soil Boring
← GW –	Direction of Groundwater Flow
*	Total phenols were detected at various depths but were not confirmed by GC/MS
305 000 N	California State Plane Coordinate System, Zone 1

Concentrations are in µg/g

Modified from Montgomery Watson (1993)

HLA

Harding Lawson Associates

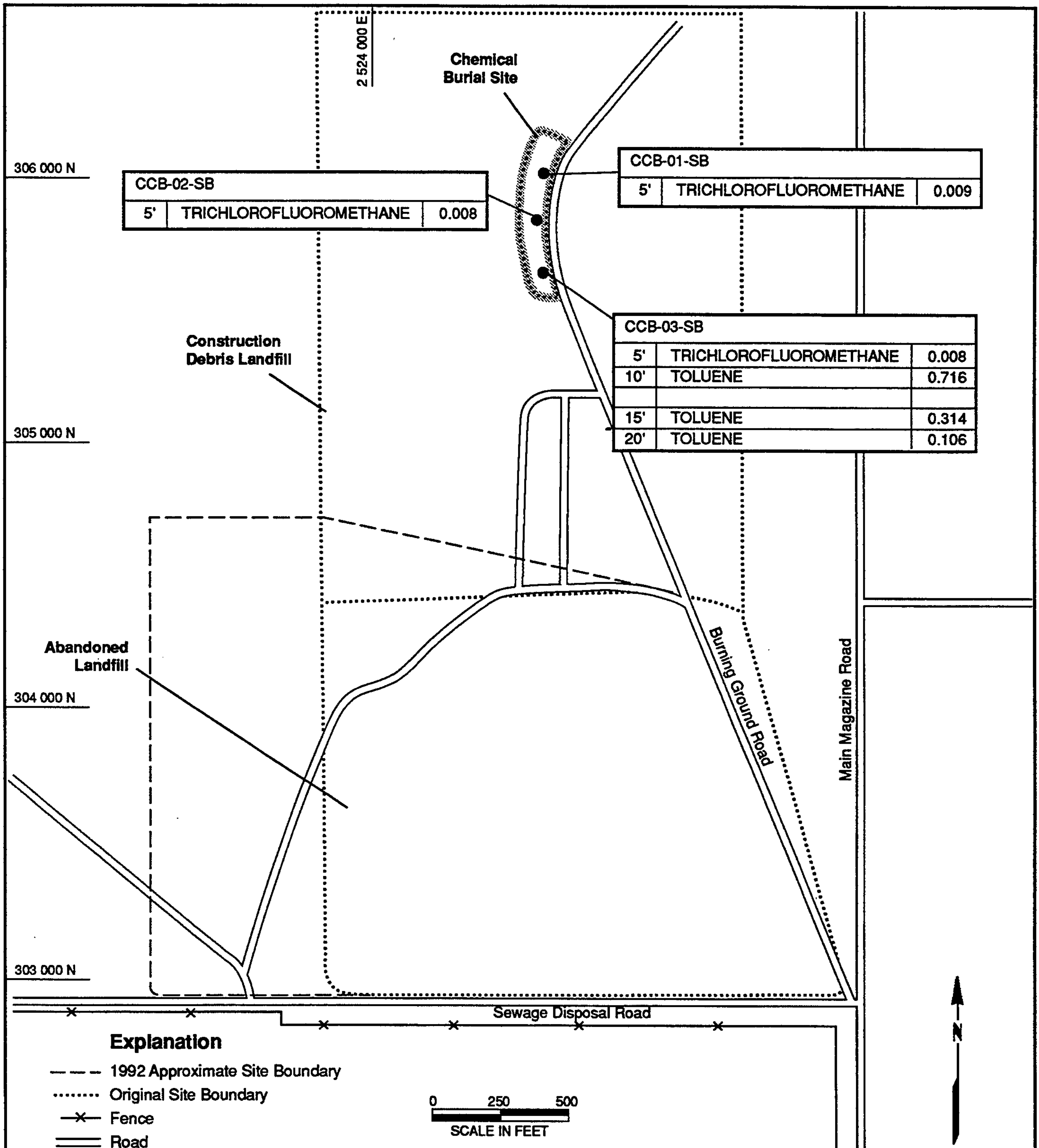
Engineering and Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 4.4

Extractable Organic Compound Concentrations from Soil Borings - Chemical Burial Site



CCB-01-SB		
5'	TRICHLOROFLUOROMETHANE	0.009

CCB-02-SB		
5'	TRICHLOROFLUOROMETHANE	0.008

CCB-03-SB		
5'	TRICHLOROFLUOROMETHANE	0.008
10'	TOLUENE	0.716
15'	TOLUENE	0.314
20'	TOLUENE	0.106

SRA 1071.13 11/3/95 ECS

Explanation

— — — 1992 Approximate Site Boundary
······· Original Site Boundary
—×— Fence
═ Road
● Soil Boring
305 000 N California State Plane Coordinate System, Zone 1
Concentrations are in μg/g
Modified from Montgomery Watson (1993)

HLA

Harding Lawson Associates
Engineering and
Environmental Services

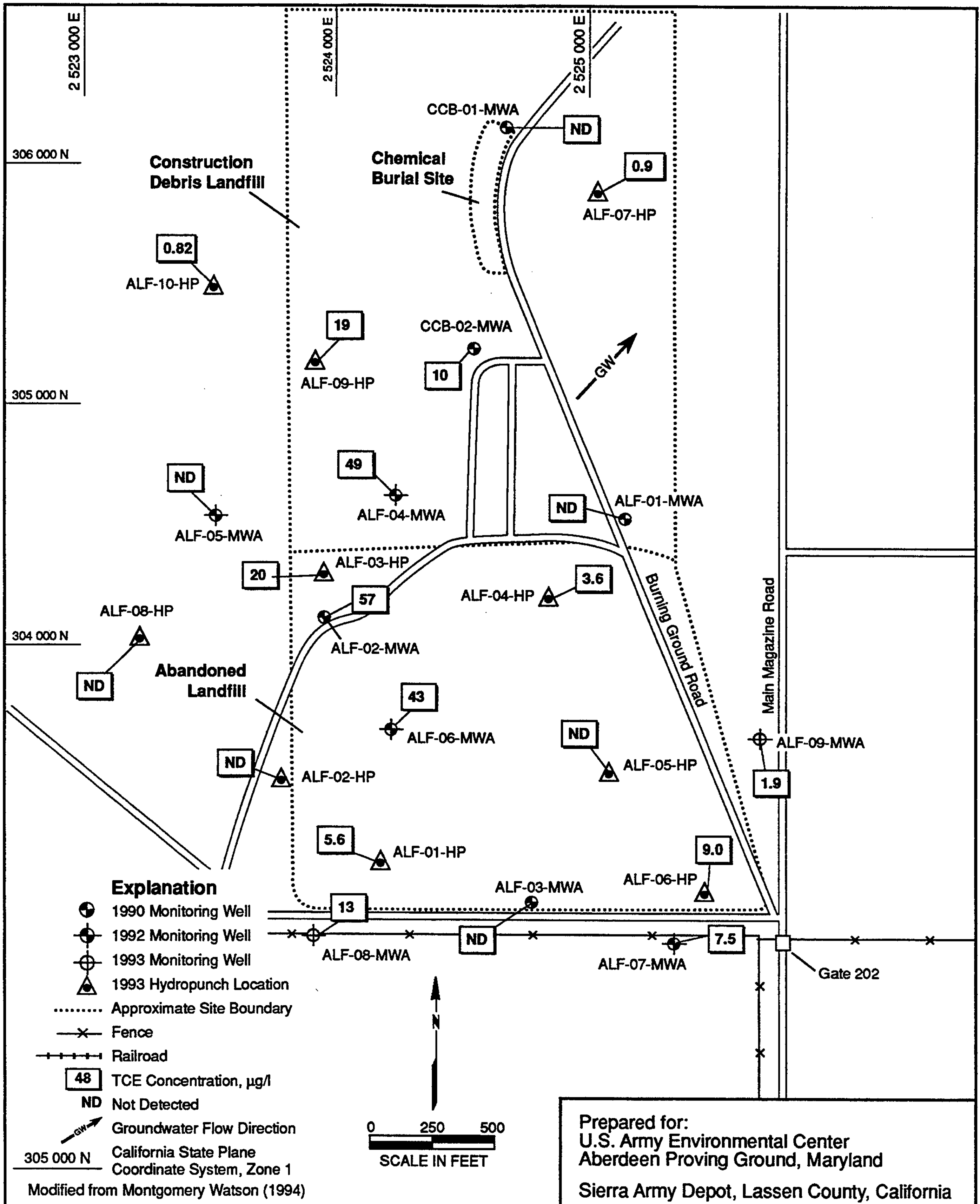
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 4.5

VOC Concentrations from Soil Borings - Chemical Burial Site

SRA 1071.14 11/8/95 ECS



Modified from Montgomery Watson (1994)

Harding Lawson Associates

Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 4.6

TCE Concentrations in Groundwater
January 1994 - Chemical Burial
Site/Construction Debris Landfill

5.0 CONSTRUCTION DEBRIS LANDFILL

5.1 Declaration

This section provides the declaration portion of the ROD/RAP for the Construction Debris Landfill.

5.1.1 Location

The Construction Debris Landfill is located east of Main Magazine Road, within the southern portion of SIAD (Figure 1.1).

5.1.2 Assessment of the Site

The distribution and extent of contamination at the Construction Debris Landfill was assessed based on activities conducted and data obtained during the 1990 Phase I Remedial Investigation (JMM and E.C. Jordan, 1991). Groundwater sampling was conducted at the site during the 1991 Group II RI (JMM, 1992), 1992 Group I Follow-Up RI (Montgomery Watson, 1993), and 1993 Group I and II Follow-Up RI (Montgomery Watson, 1994). The results are summarized as follows:

- The potential source of contamination at the Construction Debris Landfill was the disposal of inert construction debris and possibly hazardous materials.
- No drums or other containers that may have been buried were discovered from either geophysical investigations or test pit excavations.
- Low levels of TCE in soil gas were detected in the southern portion of this site and are apparently related to the TCE detected in soil gas at the Abandoned Landfill.
- Low levels of phenol and bis(2-ethylhexyl)phthalate were detected in subsurface-soil samples. All inorganics detected in soil are interpreted to be naturally occurring.
- TCE has been detected in groundwater within the southwestern portion of the Construction Debris Landfill. The TCE in the southwestern portion of the Construction Debris Landfill is interpreted to be part of a TCE plume originating in the northwestern portion of the Abandoned Landfill. All inorganics detected in groundwater are interpreted to be naturally occurring.

No human health or ecological risks associated with soil exposure were identified at the Construction Debris Landfill. Potentially unacceptable risks to human health were identified from the detected concentrations of TCE and naturally occurring levels of arsenic in groundwater. However, the TCE is believed to be part of a TCE plume originating from the Abandoned Landfill and thus is not associated with the Construction Debris Landfill.

5.1.3 Description of the Selected Remedy

No further action is recommended for the Construction Debris Landfill.

5.1.4 Statutory Determinations

Because no remedial actions are required at this site, no statutory determinations of remedial actions are necessary.

5.2 Decision Summary

This section provides the site-specific factors and analysis that were considered in the selection of the response action for the Construction Debris Landfill.

5.2.1 Site Description

The Construction Debris Landfill is a broad area that was used for dumping of concrete, asphalt, and construction rubble. The Construction Debris Landfill is nearly bisected by Burning Ground Road and is approximately 2,500 feet by 1,500 feet (Figure 5.1). The site was in operation from the early 1940s until closure in 1988 (USAEHA, 1988). The southern boundary of the Construction Debris Landfill overlaps the northern boundary of the Abandoned Landfill. The Chemical Burial Site is completely enclosed by the Construction Debris Landfill (Figure 5.1).

5.2.2 Site History and Enforcement Activities

The Construction Debris Landfill was in operation from the early 1940s until closure in 1988 (USAEHA, 1988). Some construction debris may have also been dumped within the Abandoned Landfill Area (Benioff, et al., 1988). The site reportedly was used only for the disposal of inert construction materials (ESE, 1983; USAEHA, 1988). The site was open to construction contractors working at SIAD for disposal of construction debris. Due to the uncontrolled nature of the site, there was the potential for disposal of hazardous materials. The site was used occasionally by base residents for disposal of household waste and appliances.

5.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 5.3 of this ROD/RAP.

The public participation requirements of CERCLA § 113(K)(2)(B)(i-v) and § 117 and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site. The response action presented for this site in this ROD/RAP was selected in accordance with CERCLA, NCP, Chapter 6.8 of the California Health and Safety Code, and California Water Code. The basis for this decision is documented in the Administrative Record.

5.2.4 Scope and Role of Response Action

This ROD/RAP presents the final response action for the Construction Debris Landfill. This site poses no potential threat to human health and the environment. The selected remedy is No Action. This will be the final action for the Construction Debris Landfill.

5.2.5 Site Characteristics

The 1990 Phase I RI of the Construction Debris Landfill was conducted to investigate the potential of contamination resulting from prior disposal activities. Potential soil and groundwater contamination was assessed based on a geophysical survey, soil-gas survey, test pit sampling, subsurface-soil sampling, monitoring well installation, and groundwater sampling. Additional groundwater sampling was conducted at the site during the 1991 Group II RI, 1992 Group I Follow-Up RI, and 1993 Group I and II Follow-Up RI.

5.2.5.1 Soil-Gas Survey

Soil-gas surveys were conducted at the Abandoned Landfill and Chemical Burial Site during the 1990 Phase I RI. The soil-gas survey at the Abandoned Landfill extended into the southwestern portion of the Construction Debris Landfill and the soil-gas survey at the Chemical Burial Site covered the central portion of the Construction Debris Landfill (Figure 4.2). Target analytes were TCA, TCE, PCE, methylene chloride, chloroform, carbon tetrachloride, 1,2-DCA, BETX, and total hydrocarbons.

Low levels of TCE were detected in two areas (Figure 4.2). The TCE soil-gas plume in the southwestern portion of the Construction Debris Landfill is believed to be related to burial trenches within the northwestern portion of the Abandoned Landfill. The low levels of TCE near the northern edge of the Chemical Burial Site may be due to a minor local source of VOCs in the soil (Figure 4.2). Based on the extremely low levels of TCE detected in soil gas within the Construction Debris Landfill, potential VOC soil contamination is not considered significant.

5.2.5.2 Test Pits

Three test pits were excavated in the southwestern portion of the Construction Debris Landfill to uncover and identify a geophysical anomaly discovered in this area (Figures 5.1 and 5.2). Excavation revealed 6 to 12 inches of burn material at the surface overlying native soil. No other buried debris was found. One soil boring, CCB-05-SB, was drilled and sampled in this area.

5.2.5.3 Soil

Two soil borings, CCB-04-MWA and CCB-05-MWA, were sampled from ground surface to the water table at this site (Figure 5.3). Soil samples were collected at the 5-foot interval to 50 feet and at the 10-foot interval from 50 feet to the water table. Soil samples were analyzed for extractable organic compounds (phenols, pesticides/PCBs, BNAs), VOCs, and inorganics (priority pollutant metals and cyanide). The 5-foot sample from each boring was analyzed for dioxin/furans.

Bis(2-ethylhexyl)phthalate was detected at a low level in one subsurface-soil sample at a depth of 35 feet bgs. Based on the isolated detection of bis(2-ethylhexyl)phthalate and the fact that the compound is a potential laboratory and sampling contaminant, the detection of bis(2-ethylhexyl)phthalate is not considered significant.

Total phenol was detected in CCB-04-SB (Figure 5.3). The presence of phenols was not confirmed by GC/MS analysis. This could be due to poor recoveries of phenols in the GC/MS extraction or to a positive interference in the spectrophotometric method.

No VOCs were detected in soil samples.

No inorganic constituents or metals were detected above what are considered background soil levels at this site.

Dioxins were detected in one of two soil samples collected for dioxin/furan analysis. TOCDD was detected at a concentration of 0.001 μg/g in the 5-foot sample collected from CCB-05-SB.

5.2.5.4 Groundwater

Four monitoring wells have been installed and two Hydropunch groundwater samples collected within the boundaries of the Construction Debris Landfill (Figure 4.6). Three of the monitoring wells have been sampled over eight rounds of sampling since 1990. The fourth well has been sampled over four rounds of sampling since installation in 1992. Based on the low levels and sporadic detection of these compounds, these detections of extractable organic compounds are not considered significant. The groundwater sampling results are summarized below.

Bis(2-ethylhexyl)phthalate has been detected sporadically at low levels in the wells, probably due to laboratory or sample contamination. Di-n-butyl phthalate and phenols were detected at low levels in the Hydropunch sample, ALF-07-HP. No other extractable organic compounds were identified above detection limits in the groundwater at this site.

TCE has been detected in the southwestern portion of the Construction Debris Landfill and Hydropunch sample ALF-07-HP in the central portion of the site (Figure 4.6). As discussed previously, the TCE is interpreted to be part of a TCE plume originating from the northwestern portion of the Abandoned Landfill to the south. Toluene and chloroform have been detected sporadically at low concentrations. No other VOCs have been detected in groundwater within the Construction Debris Landfill. The Construction Debris Landfill does not appear to be a significant source of VOCs in groundwater.

All inorganic contaminant concentrations detected in groundwater are below MCLs and are interpreted as naturally occurring.

5.2.6 Summary of Site Risks

This section summarizes the baseline risk assessment conducted for the Chemical Burial Site and Construction Debris Landfill during the 1990 Phase I RI. The Chemical Burial Site and Construction Debris Landfill were evaluated together in the baseline risk assessment due to their close proximity.

5.2.6.1 Compounds of Potential Concern

Chlordane, heptachlor, heptachlor epoxide, trichlorofluoromethane in subsurface soil, and TCE in groundwater were identified as COPCs for the Chemical Burial Site and Construction Debris Landfill in the 1990 Phase I RI Report (JMM and E.C. Jordan, 1991).

5.2.6.2 Contaminant Fate and Transport

This section describes the processes expected to control the fate and transport of chemicals identified as COPCs at the Chemical Burial Site/Construction Debris Landfill and the primary chemical and physical properties impacting those processes.

Chlordane, heptachlor, heptachlor epoxide, and trichlorofluoromethane have been identified as COPCs in near-surface and subsurface soil at the Chemical Burial Site/Construction Debris Landfill. A potential route of migration for these chemicals is leaching from the soil to shallow groundwater. However, given the low frequency of detection, depth to groundwater (approximately 80 to 90 feet bgs), limited precipitation at the site, and the low concentrations detected, it is unlikely that the COPCs in near-surface and subsurface soil pose a threat to groundwater.

The pesticides probably present the greatest threat to potential environmental receptors due to their long biological half-life and their propensity for bioaccumulation. However, because these compounds were not detected in surface soil, they are not readily bioavailable.

5.2.6.3 Human Health Risks

The results of the human health risk assessment conducted for the Chemical Burial Site/Construction Debris Landfill are summarized in Table 5.1.

Soil

The ELCR and HI for current casual visitors are 2×10^{-8} and 0.0007, respectively (Table 5.1). The ELCR estimate is below the California benchmark of 1×10^{-6}. The HI is less than the benchmark of 1.

For future construction workers at the Chemical Burial Site/Construction Debris Landfill, the ELCR and HI are 5×10^{-8} and 0.04, respectively (Table 5.1). The ELCR estimate is below the California benchmark of 1×10^{-6}. The HI is less than the benchmark of 1.

Risks for hypothetical future adult residents at the Chemical Burial Site/Construction Debris Landfill were also estimated. The ELCR for a hypothetical future adult resident exposed to soil is 3×10^{-8}. The ELCR estimate is below the California benchmark of 1×10^{-6}. The HI was not calculated for the future resident exposed to soil.

Groundwater

Risks were estimated for hypothetical future residential use of groundwater even though potential future use of the shallow groundwater is highly unlikely. The ELCR and HI for a hypothetical future adult resident exposed to groundwater are 2×10^{-4} and 0.4, respectively. The HI is less than the benchmark of 1. The elevated ELCR is due to concentrations of TCE and naturally occurring levels of arsenic in groundwater. TCE was detected in monitoring well CCB-02-MWA, which is located upgradient of the Chemical Burial Site. Soil gas and groundwater monitoring data from the Abandoned Landfill suggest that well CCB-02-MWA may be within a TCE plume originating in the northwestern portion of the Abandoned Landfill (Figure 4.6).

5.2.6.4 Environmental Risks

A qualitative environmental assessment was performed for the Chemical Burial Site/Construction Debris Landfill (JMM and E.C. Jordan, 1991). The purpose of this assessment was to evaluate the potential for adverse effects to ecological receptors as a result of possible exposure to chemicals originating from these sites. Environmental assessment results indicate that low concentrations of pesticides and trichlorofluoromethane detected in near-surface and subsurface soil at these sites combined with the small size of the sites would not be expected to pose significant adverse effects to the environment.

5.2.7 Description of the No Action Alternative

Based on the results of the baseline risk assessment conducted for the Construction Debris Landfill site, there are no adverse impacts to human health or the environment from site-related activities. Thus, the No Action alternative is supported by the baseline risk assessment discussed in Section 5.2.6 and the Administrative Record.

5.2.8 Explanation of Significant Changes

The Proposed Plan for the nine sites was released to the public for comment on February 7, 1996. The preferred alternative identified for the Construction Debris Landfill was No Action. Based on the absence of any new information or comments during the public comment period, no significant changes to the selected remedy for the Construction Debris Landfill outlined in the Proposed Plan for Nine Sites were necessary.

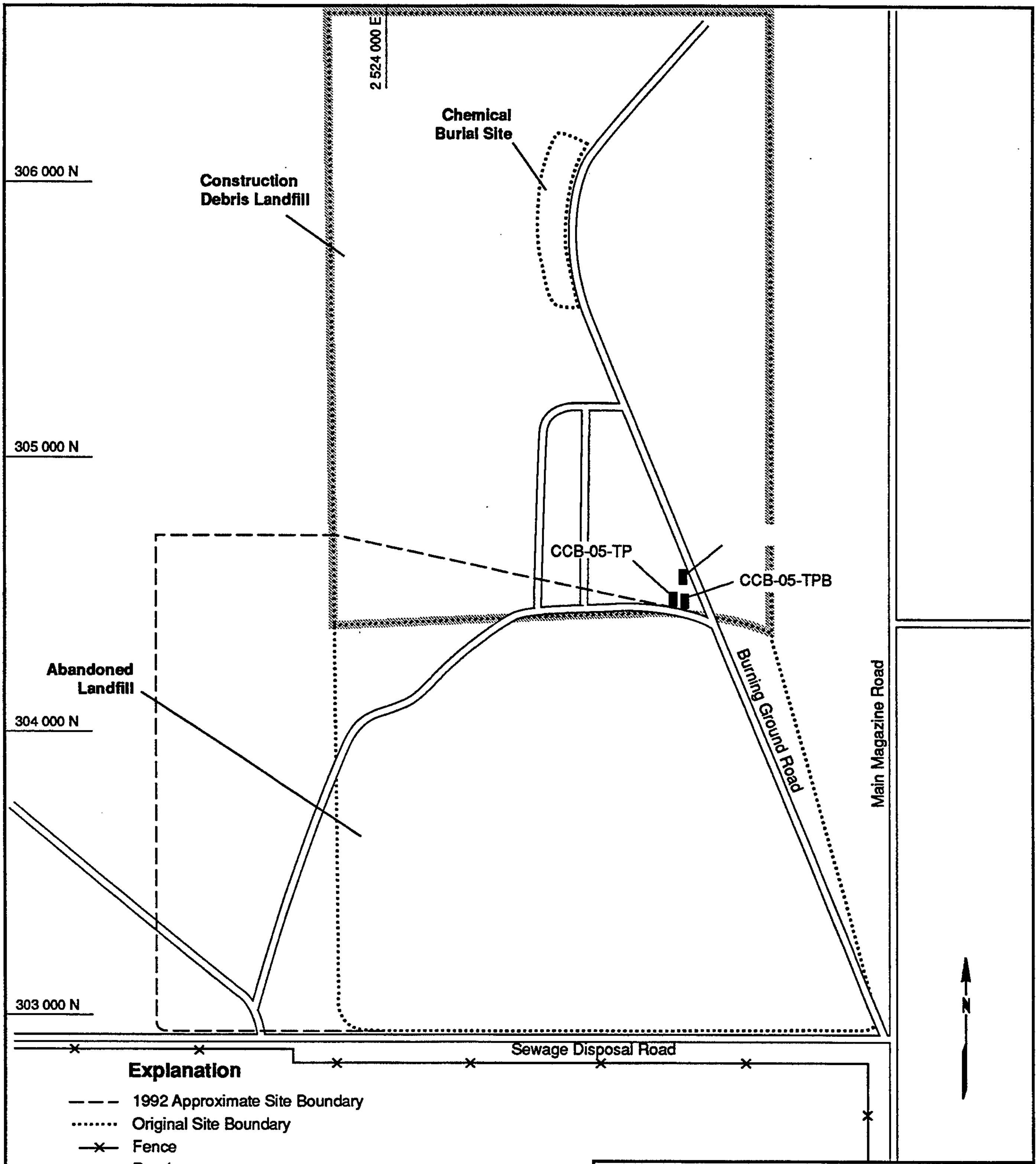
5.3 Responsiveness Summary

The public comment period for the Proposed Plan for Nine Sites at SIAD began on February 7, 1996, and extended through March 7, 1996. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. No oral comments were received regarding the Construction Debris Landfill at the public meeting.

Table 5.1: Summary of Multipathway Exposures at the Chemical Burial Site and Construction Debris Landfill

Exposure Scenario/Exposure Pathway	Hazard Index	Excess Lifetime Cancer Risk
Current Casual Visitor		
Soil Exposure	0.0007	2E-08
Current and Future Construction Worker		
Soil Exposure	0.04	5E-08
Hypothetical Future Adult Resident		
Soil Exposure	N/C	3E-08
Groundwater Exposure	0.4	2E-04

N/C Not calculated



Modified from J.M. Montgomery and E.C. Jordan (1991)

Harding Lawson Associates
Engineering and
Environmental Services

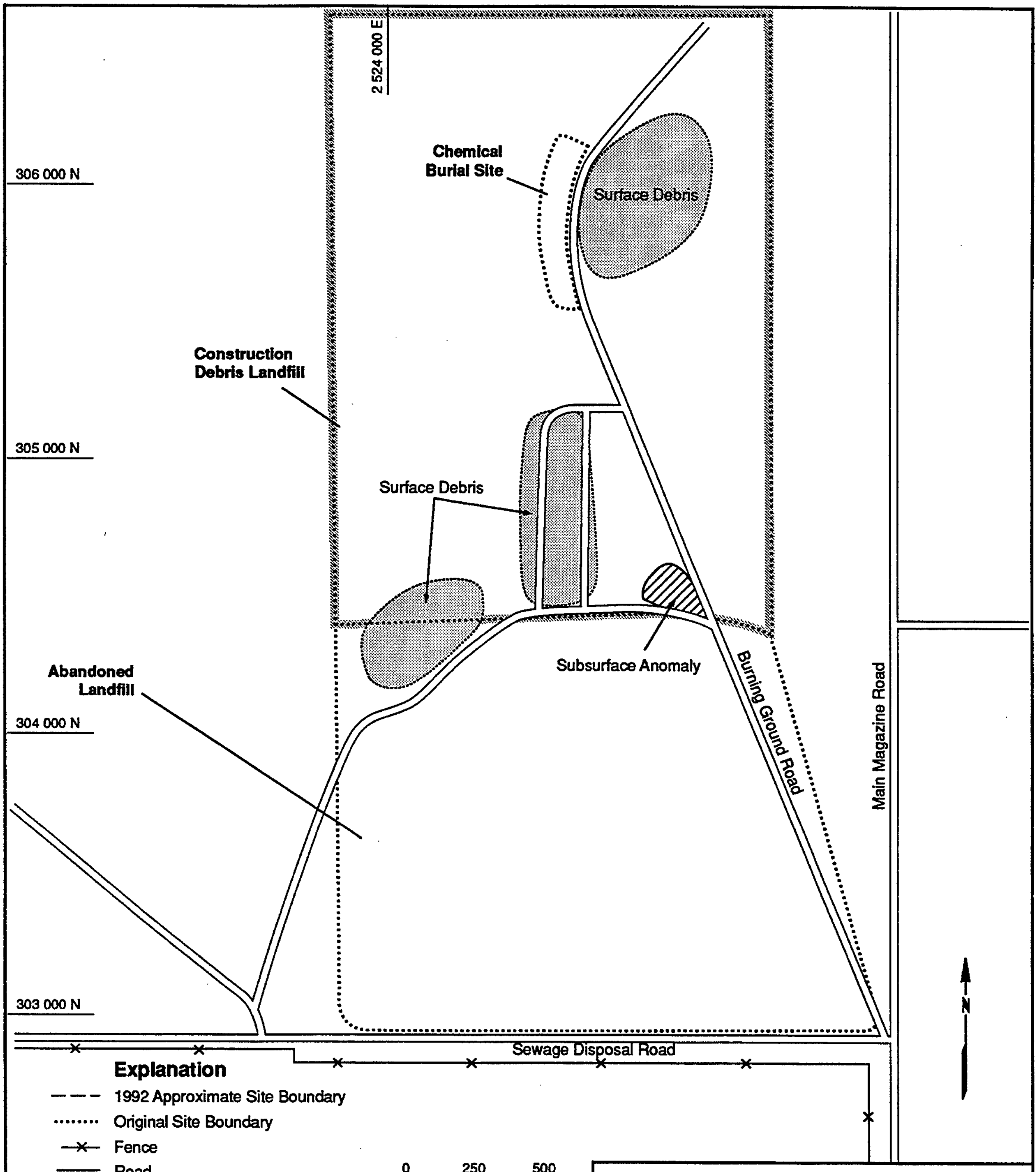
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 5.1

Site Map and Test Pit Locations - Construction Debris Landfill

SRA 1071.17 11/3/95 ECS



Modified from J.M. Montgomery and E.C. Jordan (1991)

Harding Lawson Associates
Engineering and
Environmental Services

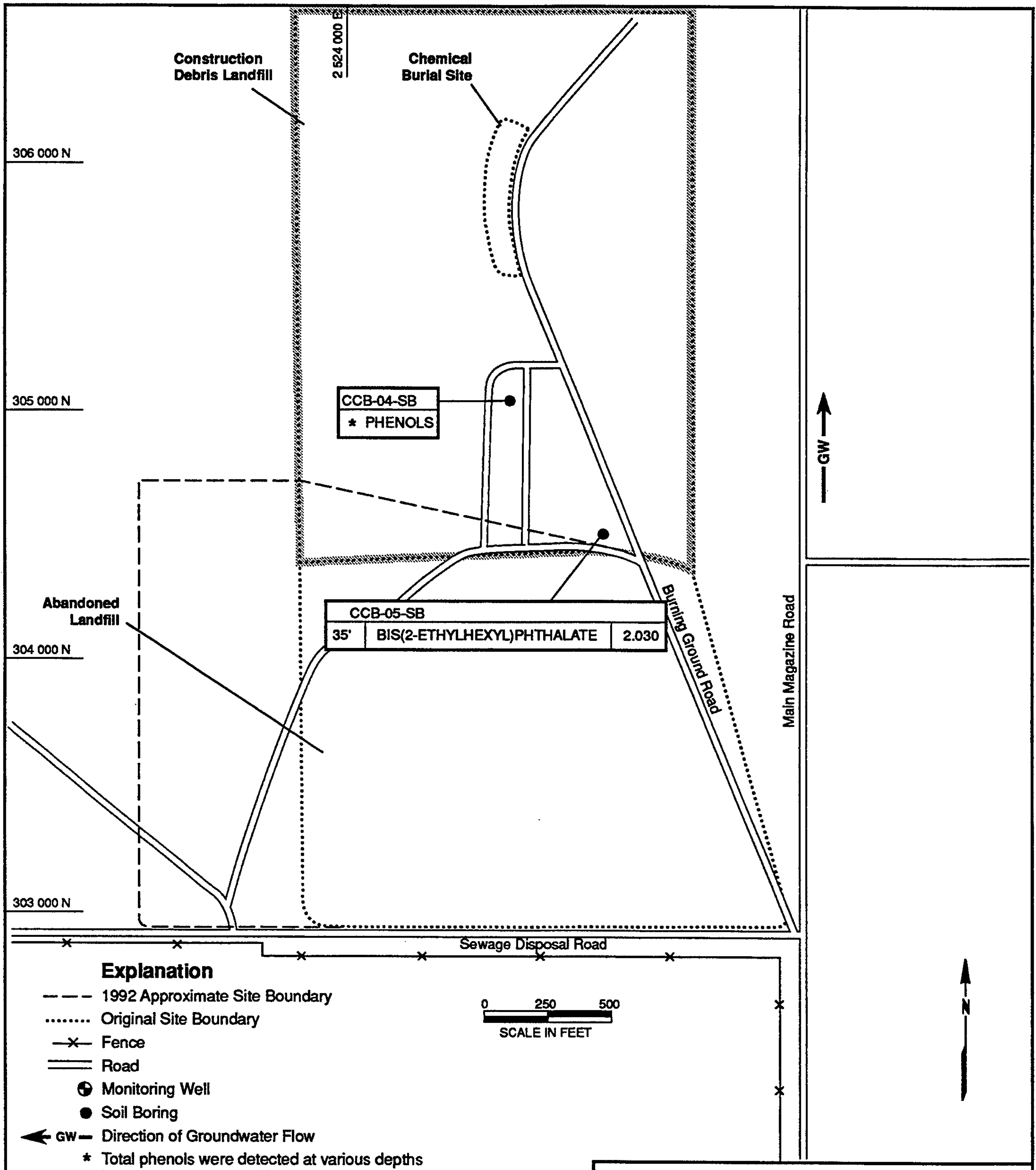
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 5.2

Geophysical Anomaly -
Construction Debris Landfill

SRA 1071.18 11/3/95 ECS



Explanation

— — —	1992 Approximate Site Boundary
········	Original Site Boundary
—×—	Fence
═══	Road
⊕	Monitoring Well
●	Soil Boring
◄ GW —	Direction of Groundwater Flow
*	Total phenols were detected at various depths but were not confirmed by GC/MS
305 000 N	California State Plane Coordinate System, Zone 1

Concentrations are in micrograms per gram (µg/g)

Modified from J.M. Montgomery and E.C. Jordan (1991)

HLA

Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 5.3

Extractable Organic Compound Concentrations from Soil Borings Construction Debris Landfill

6.0 EXISTING LANDFILL

6.1 Declaration

This section provides the declaration portion of the ROD/RAP for the Existing Landfill.

6.1.1 Location

The Existing Landfill is located in the southwest portion of the Main Depot, as shown in Figure 1.1.

6.1.2 Description of the Selected Remedy

The Existing Landfill is an active site and is regulated under waste discharge requirements set forth in the California Code of Regulations (CCR), Title 23, Division 3, Article 5, Chapter 15, and as a Subtitle D facility under RCRA. Therefore, no CERCLA action is recommended for the Existing Landfill under this ROD/RAP. When current operations cease at the Existing Landfill, it will be closed under the appropriate state and federal regulations.

6.1.3 Declaration Statement

The Existing Landfill will remain active and is regulated under CCR and RCRA guidelines. A closure/postclosure plan is in place. Any future need for corrective action will be evaluated at the time of site closure. No action is recommended in this ROD/RAP under the authority of CERCLA because the site is regulated separately under CCR and RCRA guidelines.

6.2 Decision Summary

This section provides the site-specific factors and analysis that were considered in the selection of the response action for the Existing Landfill.

6.2.1 Site Description

The Existing Landfill is located in the southwest portion of the Main Depot, west of Chewing Gum Road (Figure 6.1). The site is used for the disposal of nonhazardous and inert wastes from residential and commercial entities of SIAD. The Existing Landfill receives approximately 12,000 cubic yards of wastes per year. The remaining capacity for the Existing Landfill is estimated to be approximately 700,000 cubic yards.

6.2.2 Site History and Enforcement Activities

Pursuant to Article 3, Chapter 15 (CCR Title 23), the Existing Landfill is classified as a Class III Landfill for Nonhazardous Solid Waste. Pursuant to 40 CFR 258.2, the Existing Landfill is classified as an existing RCRA Subtitle D Municipal Solid Waste Landfill. Therefore, wastes that may be discharged legally to the Existing Landfill are classified as nonhazardous or inert solid wastes. The Existing Landfill is subject to the siting criteria and location restrictions prescribed under 40 CFR 258.10 through 258.16. No investigations have been conducted under the authority of CERCLA at this site.

6.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 6.3 of this ROD/RAP. The public participation requirements of CERCLA § 113(K)(2)(B)(i-v) and § 117, and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site.

6.2.4 Scope and Role of Response Action

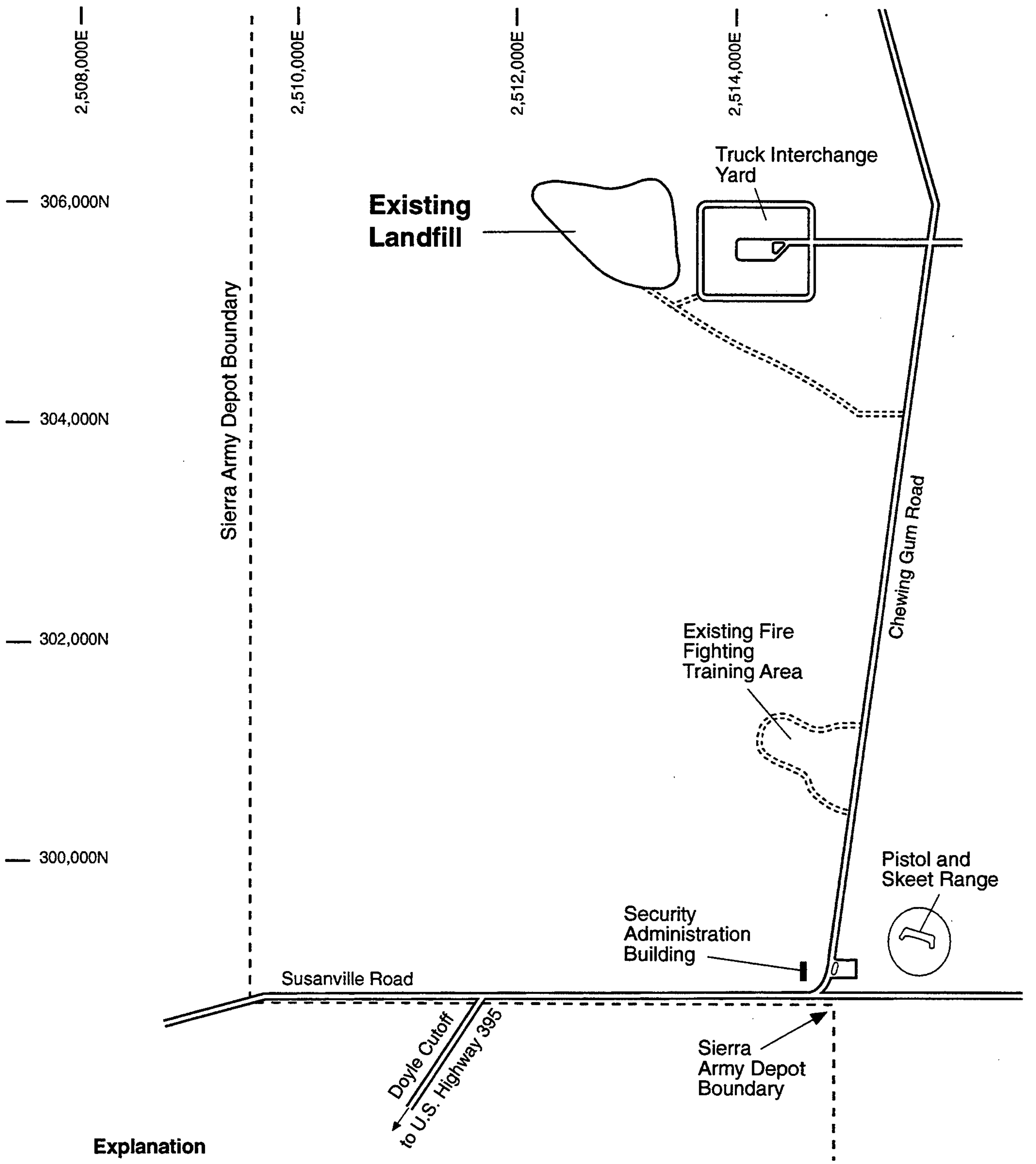
Any response action for the Existing Landfill will be undertaken according to the closure/postclosure plan already in place for the site.

6.2.5 Statutory Authority Finding

A decision on the need for remedial action at the Existing Landfill is not within the authority of CERCLA. The site is operated under CCR waste discharge requirements and RCRA Subtitle D and should be regulated accordingly.

6.3 Responsiveness Summary

The Proposed Plan for nine sites at SIAD was released to the public for comment on February 7, 1996; the public comment period extended through March 7, 1996. No CERCLA action is recommended for the existing Landfill under this ROD/RAP. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. No oral comments were received regarding the Existing Landfill at the public meeting. Based on the absence of any new information or comments during the public comment period, there are no changes to the recommended action for the Existing Landfill outlined in the Proposed Plan.



SRA 1075.3 3/5/96 NLM

Explanation

■	Building, permanent
═══	Pavement, roads and parking
= = = =	Unpaved road
- - - -	Sierra Army Depot boundary

Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 6.1

Location Map
Existing Landfill

7.0 EXISTING POPPING FURNACE

7.1 Declaration

This section provides the declaration portion of the ROD/RAP for the Existing Popping Furnace.

7.1.1 Location

The Existing Popping Furnace is located within the TNT Leaching Beds Area of SIAD (Figure 1.1).

7.1.2 Description of the Selected Remedy

Because this site will remain active and is regulated under RCRA guidelines, no CERCLA action is recommended for the Existing Popping Furnace under this ROD/RAP. When operations cease at the Existing Popping Furnace, it will be closed under the appropriate state and federal regulations.

7.1.3 Declaration Statement

The Existing Popping Furnace will remain active in the future and is regulated under RCRA. Therefore, decisions on the need for actions to provide adequate protection at the site will be made under the authority of RCRA. The future need for corrective action will be evaluated under RCRA at the time of site closure. No action is recommended in this ROD/RAP under the authority of CERCLA because the site is regulated under RCRA.

7.2 Decision Summary

This section provides the site-specific factors and analysis that were considered in the selection of the response action for the Existing Popping Furnace.

7.2.1 Site Description

The Existing Popping Furnace is located within Building 556 at the TNT Leaching Beds Area of SIAD (Figure 7.1). The site is used intermittently for the demilitarization of small arm munitions. This involves the burning of explosives and the separation and recovery of metals. Typical waste types incinerated in the furnace include bullets, fuses, primers, and detonators (JMM, 1987).

7.2.2 Site History and Enforcement Activities

The Existing Popping Furnace is operated under a RCRA Part B Permit and a permit from the Lassen County Air Pollution Control District. No investigations have been conducted under the authority of CERCLA at this site.

7.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 7.3 of this ROD/RAP. The public participation requirements of CERCLA § 113(K)(2)(B)(i-v) and § 117, and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site.

7.2.4 Scope and Role of Response Action

The final response action for the Existing Popping Furnace should be undertaken according to the regulations of RCRA at the time the site becomes inactive and undergoes closure.

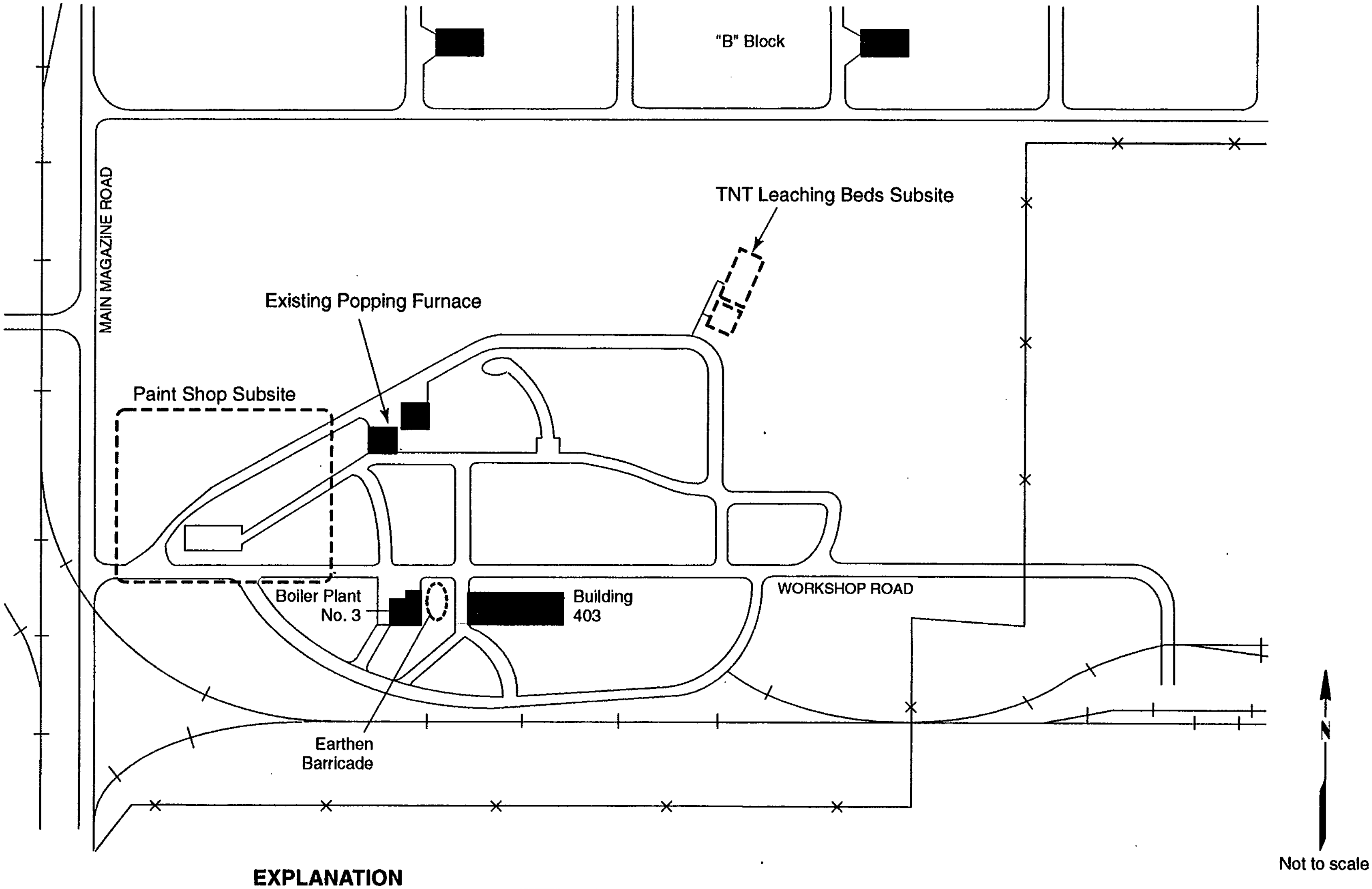
7.2.5 Statutory Authority Finding

A decision on the need for remedial action at the Existing Popping Furnace is not within the authority of CERCLA. The site is operated under the authority of RCRA and is regulated accordingly.

7.3 Responsiveness Summary

The Proposed Plan for nine sites at SIAD was released to the public for comment on February 7, 1996; the public comment period extended through March 7, 1996. No CERCLA action is recommended for the Existing Popping Furnace under this ROD/RAP. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. No oral comments were received regarding the Existing Popping Furnace at the public meeting. Based on the absence of any new information or comments during the public comment period, there are no changes to the recommended action for the Existing Popping Furnace outlined in the Proposed Plan.

SRA 1073.7a 03/01/96 ECS



EXPLANATION

- ✕—✕ Fence
- ┼┼┼┼ Railroad track
- ═ Roadway
- ■ Building

Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 7.1

Location Map
Existing Popping Furnace

8.0 LARGE SEWAGE TREATMENT PONDS

8.1 Declaration

The following section provides the declaration portion of the ROD/RAP for the Large Sewage Treatment Ponds.

8.1.1 Location

The Large Sewage Treatment Ponds are located in the south-central portion of the Main Depot, as shown in Figure 1.1. The site contains four unlined ponds that were used for the treatment of sewage from 1941 to 1971 (Figure 8.1).

8.1.2 Assessment of the Site

A contamination assessment of the Large Sewage Treatment Ponds was conducted during the Installation Restoration Program (IRP) Group III Remedial Investigation. The results of that assessment, presented in the Group III B Sites Final RI Report (HLA, 1994b), are summarized as follows:

- Aluminum, chromium, copper, iron, lead, magnesium, mercury, silver, thallium, vanadium, and zinc were detected sporadically in surface soil at concentrations greater than background concentrations. These metals may be associated with site activities.
- Pesticides and PCB-1260 were detected in surface-soil and subsurface-soil samples in low concentrations.
- Chromium, iron, vanadium, lead, mercury, and silver detected above the estimated background concentrations in subsurface soil.
- Nitrate plus nitrite was detected at concentrations in excess of 10 milligrams per kilogram (mg/kg) in subsurface soil collected from two soil boring locations.
- Groundwater samples collected from wells and piezometers downgradient of the site did not indicate that groundwater quality has been impacted.

A potentially unacceptable risk to human health from the detected concentrations of PCBs in surface soil was identified. The high end of the risk range (6×10^{-4}) is a risk estimate based on reasonable maximum exposure (RME) for hypothetical future receptors (residents). The lower range (2×10^{-4}), the "average" exposure scenario, is based upon the current receptor scenario. Although it is unlikely that the site will ever be zoned for residential use, the recommended action for the Large Sewage Treatment Ponds is excavation and offsite disposal of the PCB-contaminated soil.

8.1.3 Description of the Selected Remedy

The selected remedy involves the excavation of approximately 3,376 cubic yards of PCB-contaminated soil. Soil will be removed from the northern unlined pond and a soil pile adjacent to the southwest end of the two large ponds will be removed (Figure 8.2). The excavated soil will be transported to a licensed offsite landfill facility for disposal. Estimated capital costs are $1,081,000.

8.1.4 Statutory Determination

The selected remedy for the Large Sewage Treatment Ponds satisfies the statutory requirements of CERCLA § 121 and § 120(a)(4). The following mandates are satisfied:

- The selected remedy is protective of human health and the environment.
- The selected remedy complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action.
- The selected remedy is cost effective.
- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.
- The selected remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

8.2 Decision Summary

This section provides the site-specific factors and analyses that were considered in the selection of the response action for the Large Sewage Treatment Ponds.

8.2.1 Site Description

The site contains four unlined ponds that occupy an area approximately 600 feet by 600 feet square. Two polyethylene-lined ponds adjacent to the site occupy an area approximately 500 feet by 1,000 feet (Figure 8.1), which are not considered part of the Large Sewage Treatment Ponds site. A soil mound (Figure 8.2) near the lagoons and sump area was added to the site as a result of initial investigations.

8.2.2 Site History and Enforcement Activities

The unlined ponds were used for sewage treatment from 1941 to 1971. The polyethylene-lined ponds, constructed to replace the unlined ponds, have been in use from 1971 to the present (Benioff et al., 1988). However, the unlined ponds reportedly have received overflow from the lined ponds during wet times of the year (ESE, 1983). Based on field observations by HLA, release to only one of the unlined ponds has occurred as late as July 1994 (see Figure 8.2) whereas the other three of four unlined ponds are no longer used. The single unlined treatment pond that has recently been used was not part of the remedial investigation because of its "active" status.

The sewage treatment ponds receive primarily sanitary sewage, although small quantities of industrial wastes from wash sinks and shop floor drains are received occasionally (Benioff et al., 1988). Sewage treatment in the unlined ponds consisted of stabilization, evaporation, and percolation into the underlying soil. In the polyethylene-lined ponds, the treatment consists of stabilization and evaporation. When the polyethylene-lined ponds reached their capacity, excessive sanitary sewage was apparently discharged to the old unlined ponds via gravity flow through a piping system operated by a manual valve. The overflow sewage directed to the unlined ponds is subject to evaporation and percolation.

Investigations that have been conducted at the Large Sewage Treatment Ponds include the following:

- Group III Remedial Investigation, HLA, 1994
- Remedial Investigation Follow-on Well Installation and Groundwater Sampling, HLA, 1994 (Appendix V)
- Feasibility Study, HLA, 1995

The purpose of the Group III RI conducted by HLA was to ensure that potential environmental impacts associated with past and present waste management activities at the site were thoroughly investigated and, if necessary, remediated. The investigation was conducted in three stages and included surface-soil sampling, drilling and sampling of soil borings, and monitoring well installation and groundwater sampling. Stage 1 and Stage 2 sampling indicated a potential for surface soil to be contaminated with low concentrations of PCBs.

Stage 3 of monitoring well installation and groundwater sampling was conducted at the request of Cal-EPA. Stage 3 sampling confirmed that Army activities at the site had not adversely impacted groundwater quality. Results of the Stage 3 RI are presented in Appendix V of the Final Remedial Investigation for Sierra Army Depot - Group III B Sites (1994).

A FS report that includes the Large Sewage Treatment Ponds was prepared by HLA (1995). Surface soil and shallow soil were the medium of concern identified and addressed in the FS for this site.

No enforcement activity has been associated with the Large Sewage Treatment Ponds. The site is subject to the requirements and schedule outlined in the Federal Facilities Agreement (FFA) (State of California and U.S. Army, 1991).

8.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 8.3 of this ROD/RAP.

The public participation requirements of CERCLA § 113(k)(2)(B)(i-v) and § 117, and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site. The response action presented for this site in this ROD/RAP was selected in accordance with CERCLA, NCP, Chapter 6.8 of the California Health and Safety Code, and the California Water Code. The basis for this decision is documented in the Administrative Record.

8.2.4 Scope and Role of Response Action

This ROD addresses the PCB-contaminated soil in the northern unlined pond and at a soil pile adjacent to the southwest end of the two large ponds. This area of the site poses a potential threat to human health and the environment because of the risks from possible ingestion of the soil. The purpose of this response is to prevent current or future exposure to the PCB-contaminated soil. This will be the final response action for three of the four unlined Large Sewage Treatment Ponds.

8.2.5 Site Characteristics

Contamination at the Large Sewage Treatment Ponds was suspected because small quantities of industrial waste from wash sinks and shop floor drains are occasionally received and a groundwater mound was identified beneath the site. Potential contamination at the Large Sewage Treatment Ponds was evaluated on the basis of surface-soil, subsurface-soil, and groundwater analytical data. An assessment of potential contamination at the site based on these data is provided in the following subsections.

8.2.5.1 1994 Group III RI

Surface Soil

Potential surface-soil contamination at the Large Sewage Treatment Ponds was assessed on the basis of seven composite and five discrete surface-soil samples (Figure 8.2). The surface-soil samples were collected from a depth interval between the ground surface and 0.5-foot bgs. Each composite surface-soil sample represents a composite of 10 sampling locations. The five discrete surface-soil samples were obtained from soil boring locations. Surface-soil samples were analyzed for target compound list (TCL) semivolatiles, target analytes list (TAL) metals, nitrate plus nitrite-N, and pesticides/PCBs.

Table 8.1 summarizes the analytical results for TAL metals detected in the surface-soil samples at concentrations greater than background concentrations for soil Type 365 (Ardep sandy loam). The maximum exceedance concentration detected for chromium, copper, iron, lead, mercury, silver, thallium, vanadium, and zinc has the potential to be associated with site activities. The other analytes listed in Table 8.1 were detected sporadically at concentrations greater than the soil type-specific background concentrations but fall below either the facilitywide or western U.S. background concentrations presented. Figure 8.3 presents the locations and concentrations of inorganic analytes that are potentially associated with site activities detected above the soil type-specific and regional background concentrations.

In general, Samples STP-4-SB, STP-5-SB, and STP-7-SS contained the maximum or near maximum concentrations of chromium, copper, lead, mercury, silver and/or vanadium. These samples were collected in the area between the pump house and the sewage treatment ponds. The maximum or near maximum concentrations of mercury and zinc were detected in STP-1-SS, STP-2-SS, and STP-3-SB. These sample locations were all within the northernmost unlined sewage treatment pond. Lead was also detected in Sample STP-3-SB at a concentration that was significantly above the background concentration. Surface-soil Samples STP-5-SS and STP-6-SS contained the highest concentrations of thallium at 67.7 and 76.5 mg/kg, respectively. The highest concentration of iron (30,200 mg/kg) was detected in STP-1-SB. Samples STP-1-SB, STP-5-SS, and STP-6-SS are located within the southernmost unlined sewage treatment pond.

Nitrate plus nitrite-N was detected in the surface-soil samples collected at the Large Sewage Treatment Ponds. Surface-soil Samples STP-4-SB and STP-5-SB contained nitrate plus nitrite-N at concentrations of 180 and 45 mg/kg, respectively. As indicated in the SIAD Group III A Sites RI report (HLA, 1994), a concentration of nitrate plus nitrite-N exceeding 10 mg/kg could be related to a source of these compounds in the vicinity of the samples.

Figure 8.4 presents the locations and concentrations of the organic compounds detected in the surface-soil samples. The only TCL semivolatile organic compound detected above the certified reporting limit (CRL) in surface soil at the site was 1,4-dichlorobenzene. This compound was detected in one surface-soil sample, STP-7-SS, at a concentration of 0.58 mg/kg. This concentration is greater than the CRL value of 0.034 mg/kg for 1,4-dichlorobenzene.

Nine pesticides (2,2-bis[p-chlorophenyl]-1,1,1-trichloroethane[DDT]; 2,2-bis[p-chlorophenyl]-1,1-dichloroethene [DDE]; 2,2-bis[p-chlorophenyl]-1,1-dichloroethane[DDD]; dieldrin; endrin; heptachlor epoxide; beta-benzenehexachloride;alpha-chlordane; and gamma-chlordane) were detected in the surface-soil samples. Eight pesticides were detected in surface-soil Samples STP-4-SB and/or STP-5-SB. Sample STP-4-SB contained DDT, DDE, DDD, dieldrin, alpha-chlordane, and gamma-chlordane at reported detections of 0.068, 0.21, 3.1, 0.11, 0.1, and 0.12 mg/kg, respectively. DDT, DDE, DDD, endrin, beta-benzenehexachloride,alpha-chlordane, and gamma-chlordane were detected in soil sample STP-5-SB at 0.0232, 0.17, 0.33, 0.0147, 0.00844, 0.0406, and 0.084 mg/kg, respectively. Alpha-chlordane and gamma-chlordane were detected as a TIC of the pesticides analysis. Because alpha-chlordane and gamma-chlordane are TICs, there are no corresponding CRLs for these analytes.

Five pesticides were detected in the surface-soil samples collected at the Large Sewage Treatment Ponds using Method UB-LH17. Four of the pesticide compounds (DDT, DDE, DDD, and dieldrin) were detected in STP-2-SS, STP-3-SB, and STP-7-SS. The highest concentrations of DDT, DDE, DDD, and dieldrin detected in these samples were 0.0152, 0.013, 0.0915, and 0.0119 mg/kg, respectively. DDD was also detected in STP-1-SS, STP-2-SB, STP-3-SS, STP-4-SS (and its duplicate STP-4-SS-D) and STP-5-SS at concentrations ranging from 0.00556 to 0.0162 mg/kg. These detected concentrations were only slightly greater than DDD's CRL of 0.0027 mg/kg. Dieldrin was detected in Sample STP-1-SS at a concentration of 0.00413 mg/kg, slightly greater than the CRL for dieldrin of 0.0016 mg/kg. Heptachlor epoxide was detected only in surface-soil Sample STP-2-SB at a concentration of 0.00444 mg/kg, which was slightly greater than the CRL of 0.0013 mg/kg for heptachlor epoxide.

PCB-1260 was detected in surface-soil samples from STP-3-SB, STP-4-SB, STP-5-SB, and STP-7-SS (Table 8.3). The samples from STP-3-SB and STP-7-SS had PCB-1260 concentrations detected at 0.0576 and 0.0585 mg/kg, respectively. These concentrations are only slightly above the CRL of 0.0479 mg/kg. PCB-1260 was also detected in STP-4-SB and STP-5-SB at 1.4 and 0.248 mg/kg, respectively.

Subsurface Soil

Potential subsurface-soil contamination at the Large Sewage Treatment Ponds was assessed on the basis of 27 subsurface-soil samples collected from 5 soil borings (Figure 8.2). The samples were analyzed for TAL metals, TCL organics, pesticides/PCBs, and nitrate plus nitrite-N.

Table 8.2 summarizes the analytical results for metals detected in subsurface-soil samples at concentrations exceeding maximum soil type-specific background concentrations for subsurface soil. As indicated in Table 8.2, the concentration of five analytes in the subsurface soil exceeded background levels; however, most of these values were less than the facilitywide and regional background concentration. Figure 8.3 presents the locations and concentrations of inorganic analytes that are potentially associated with site activities detected above the soil type-specific and regional background concentrations.

Cobalt, iron, lead, mercury, silver, and zinc were detected at greater than soil type-specific and facilitywide background concentrations and are considered to be above natural conditions at this site. Cobalt, however, was detected at only slightly above the soil type-specific background concentration (15.5 mg/kg versus 15.0 mg/kg).

Subsurface-soil samples from STP-1-SB, STP-2-SB, STP-4-SB, and STP-5-SB contained nitrate plus nitrite-N concentrations greater than 10 mg/kg. Background SIAD subsurface-soil concentrations for nitrate plus nitrite-N are not available for comparison with the investigative samples. However, natural nitrate plus nitrite-N values in soil appeared to be typically less than 10 mg/kg. At Boring STP-1-SB, only one sample (a duplicate sample from a depth of 6 feet bgs) exceeded 10 mg/kg. This sample had a concentration of 10.2 mg/kg. Three subsurface-soil samples from STP-2-SB collected at 5.5, 10.5, and 15.5 bgs contained nitrate plus nitrite-N at concentrations (16.1, 38, and 12.9 mg/kg, respectively) that slightly exceeded 10 mg/kg. Deeper samples collected at STP-2-SB contained nitrate plus nitrite-N at concentrations less than 10 mg/kg. Three subsurface-soil samples from STP-4-SB contain nitrate plus nitrite-N at concentrations greater than 10 mg/kg. These samples were obtained at 3, 6, and 9 feet bgs and contained 180, 200, and 310 mg/kg, respectively, of nitrate plus nitrite-N. Three subsurface-soil samples from STP-5-SB at depths of 3, 4, and 6 feet bgs contained nitrate plus nitrite-N concentrations at levels greater than 10 mg/kg. The nitrate plus nitrite-N concentrations at 4 and 6 feet (16 and 58 mg/kg, respectively) were lower than the levels detected at 3 feet (220 mg/kg). These three subsurface-soil samples are considered likely to be above natural conditions at this site.

Figure 8.4 presents the locations and concentrations of the organic compounds detected in the subsurface-soil samples. Trichlorofluoromethane was the only TCL volatile organic compound detected in the subsurface-soil samples. A soil sample collected from STP-4-SB at a depth of 3 feet bgs and its duplicate sample collected at 3.5 feet bgs contained trichlorofluoromethane at concentrations of 0.0064 and 0.0057 mg/kg, respectively. These concentrations of trichlorofluoromethane are similar to or less than the CRL value of 0.0059 mg/kg. Because trichlorofluoromethane can be associated with a laboratory contaminant and because the concentrations of this compound are very low, the detected concentrations of trichlorofluoromethane in the above soil samples are considered to be laboratory contaminants and not associated with site conditions.

Seven pesticides were detected in the Large Sewage Treatment Ponds subsurface-soil samples collected at STP-4-SB and/or STP-5-SB. These pesticides included DDE, DDD, DDT, dieldrin, beta-benzenehexachloride, alpha-chlordane, and gamma-chlordane. DDE and DDD were detected in the soil samples from STP-4-SB at a depth of 3, 6 and 9 feet and in the soil Sample STP-5-SB collected at a depth of 3 feet. DDD was also detected in the soil sample collected from STP-5-SB at a depth of 4 feet. The DDE detected concentrations ranged from 0.0101 to 0.021 mg/kg and the DDD detected concentrations ranged from 0.0166 to 1.4 mg/kg in these samples.

DDT and dieldrin were detected in two soil samples collected at STP-4-SB, one sample at 6 feet and the other at 9 feet. DDT and dieldrin were detected at a concentration of 0.0178 mg/kg and 0.00958 mg/kg, respectively, in the shallower subsurface-soil sample that was collected at a depth of 6 feet. The other subsurface-soil sample obtained at a depth of 9 feet contained DDT and dieldrin at concentrations of 0.0276 and 0.0206 mg/kg, respectively. These detected concentrations of DDT and dieldrin were slightly greater than their respective CRLs of 0.00707 and 0.00629 mg/kg. Beta-benzenehexachloride was also detected in the soil samples collected at STP-4-SB from 6 and 9 feet. This analyte was detected at a concentration of 0.00307 and 0.01 mg/kg, respectively, which is slightly greater than the CRL of 0.00257 mg/kg.

The pesticides alpha-chlordane and gamma-chlordane were detected in two subsurface-soil samples, STP-4-SB at 6 feet and at 9 feet. These analytes were detected as TICs of the pesticides analysis using method ES-LH10 at concentrations ranging from 0.00932 to 0.044 mg/kg. Because alpha-chlordane and gamma-chlordane are TICs, there are no corresponding CRLs for these analytes.

PCB-1260 was detected in one subsurface-soil sample, STP-4-SB (9-foot sample) at a concentration of 0.262 mg/kg (Table 8.3). This concentration of PCB-1260 is only slightly greater than the corresponding CRL of 0.0804 mg/kg.

Groundwater

Potential contamination of groundwater at the Large Sewage Treatment Ponds was assessed on the basis of groundwater samples collected during Stage 1 and Stage 3 field activities.

Stage 1. Monitoring Well STP-2-MW was sampled during two rounds of sampling performed on September 16 and December 8, 1992. Samples were analyzed for TCL organics, TAL metals, nitrate plus nitrite-N, and macroparameters. TCL organics were not detected in the groundwater samples at concentrations above the CRL. The concentrations of barium, chromium, copper, and zinc were detected at levels above background groundwater concentrations as presented in Table 8.4.

Of the metal analytes detected in the groundwater samples collected from STP-2-MW at concentrations exceeding the background concentrations, barium, chromium, and copper were significantly lower than the corresponding MCL or proposed MCL. Zinc does not have a corresponding MCL or proposed MCL. Zinc was found to exceed the background concentrations at this sampling location during the first sampling period (September 16, 1992); however, the detected concentration of 80.8 μg/l was significantly below the secondary MCL drinking water standard of 5,000 μg/l. The detection of zinc in groundwater samples from this well during the second sampling period (December 8, 1992) was less than the reporting limit of 18 mg/kg.

The maximum concentration of nitrate plus nitrite-N detected in groundwater collected at this site was 2,900 μg/l (Table 8.4), which is lower than the drinking water MCL for nitrate plus nitrite-N of 10,000 μg/l.

As shown on Table 8.4, four pesticides were detected during the first sampling period including DDT, dieldrin, heptachlor epoxide, and isodrin. The concentrations of these analytes detected during the first sampling period ranged from 0.00298 to 0.019 μg/l, which were slightly above the corresponding CRLs. Isodrin was detected in the rinse blank associated with these samples at a concentration of 0.00406 μg/l. The detection of isodrin in the associated rinse blank may indicate a source of this compound that is not related to the investigative sample. These analytes were not detected during the second sampling period. Two pesticides (alpha-benzenehexachloride [BHC] and alpha-endosulfan/endosulfan I) were detected during the second sampling period. However, the analytical data for these analytes were flagged as being out of control but accepted because of high recoveries of control analytes. Control analytes are specified in USAEC and are introduced into the sample train by laboratory personnel to monitor analytical performance. The detected pesticide analytes are not likely associated with groundwater conditions at STP-2-MW because (1) the above pesticides were not consistently detected during both sampling periods, (2) isodrin was detected in an associated rinse blank, and (3) alpha-BHC and alpha-endosulfan/endosulfan I detections were flagged as being "out of control."

Stage 3. Potential contamination of groundwater at the Large Sewage Treatment Ponds area was further assessed during Stage 3 on the basis of groundwater samples collected from one monitoring well and six piezometers in November 1994 and February 1995. Figure 8.2 shows the locations of the monitoring well and piezometers where groundwater samples were collected at the Large Sewage Treatment Ponds. Samples were analyzed for nitrate plus nitrite-N, TCL organics, TAL metals, and macroparameters.

Table 8.4 provides a summary of the analytical results for inorganics detected in the Large Sewage Treatment Ponds groundwater samples at concentrations greater than Large Sewage Treatment Ponds background groundwater concentrations and facilitywide background groundwater. Table 8.3 also provides a summary of results for organic analytes detected in the Large Sewage Treatment Ponds groundwater samples. Available federal and California (state) MCLs are included in Table 8.3.

Several inorganic analytes present in the Large Sewage Treatment Ponds groundwater samples, including metals, cations, and anions, were detected at concentrations exceeding federal or state MCLs. Analyte concentrations exceeding federal or state MCLs are shown in bold type in Table 8.4. Analytes most commonly exceeding the respective MCLs were sulfate, total dissolved solids (TDS), nitrate/nitrite, and manganese. The sulfate and TDS detections are likely to be associated with naturally high salinity observed in groundwater collected from the SIAD site (HLA, 1994b). The observed sulfate concentrations in the Large Sewage Treatment Ponds groundwater samples were well below the maximum facilitywide 14,000,000 $\mu g/l$ background sulfate concentration. Nitrate/

nitrite was observed in samples collected from STP-3-PZ (57,000 µg/l), STP-4-PZ (23,000 µg/l), and STP-6-PZ (11,000 µg/l) during the November 1994 sample round and STP-3-PZ (36,000 µg/l), STP-4-PZ (34,000 µg/l), and STP-6-PZ (12,000 µg/l) during the February 1995 sample round. These analyte concentrations exceed the federal 10,000 µg/l limit for nitrate and one value slightly exceeds the 45,000 µg/l state limit. The use of this site for wastewater treatment in July 1994 may have contributed to elevated nitrate levels in groundwater through the biological conversion of ammonia to nitrate.

Manganese concentrations consistently exceeded the secondary federal and state MCL standard (50 µg/l) for manganese. However, these concentrations are believed to be representative of naturally occurring levels. HLA reviewed a USGS bulletin regarding development of mineral resources in the Skedaddle Mountains (USGS, 1988e) during research for background data. This USGS bulletin reported sediment samples from Skedaddle Mountain streambeds to have naturally occurring 2,000 mg/kg concentrations of manganese. Army activities that may have resulted in a discharge of manganese into these ponds have not been identified; however, a discharge of wastewater in July 1994 was reported. This discharge of highly organic carbon-enriched water may explain the increased manganese concentrations. Manganese exists in soil principally as manganese dioxide, which is insoluble in water containing carbon dioxide. Under reducing (anaerobic) conditions, the manganese in the dioxide form is reduced from an oxidation state of IV to II and solution occurs, as with ferric oxides (Sawyer and McCarty, 1978). Wastewater percolating into soil below the sewage treatment ponds may contain organic carbon. The biological conversion of the organic carbon may deplete available oxygen, increase carbon dioxide levels and increase solubility of the manganese present in the soil contributing to the elevated concentrations of manganese observed in groundwater collected during the November 1994 and February 1995 sampling events.

Organic analytes that were detected in the groundwater samples collected during the Stage 1 sampling rounds included the pesticides DDT, alpha- and delta-BHC, alpha-endosulfan, dieldrin, heptachlor epoxide, and isodrin. The concentrations of these compounds were less than 0.02 µg/l, with one exception for the unconfirmed detection of delta-BHC. Federal and state MCLs are available for heptachlor epoxide and chloroform as shown in Table 8.4. Heptachlor epoxide concentrations exceeded the state heptachlor epoxide MCL value for one Stage 1 sample. However, heptachlor epoxide and the other pesticides detected in the Stage 1 samples were not detected in Stage 3 samples collected during November 1994 and February 1995. Organic compounds detected in the groundwater samples collected in 1994 included chloroform in one groundwater sample (STP-2-MW). Chloroform was also detected in the associated rinse blank and was not detected during the February 1995 sampling event.

During the second round of Stage 3 sampling (February 1995) for piezometers STP-5-PZ and STP-6-PZ, TCE was reported at low concentrations (1.20 μg/l and 0.56 μg/l, respectively). (The certified reporting limit for TCE for these data is 0.50 μg/l.) The detection of TCE in groundwater is suspect because of (1) the spatial distribution of these detections, (2) the fact that sampling of these wells was conducted after sampling of wells with known concentrations of TCE, and (3) the fact that the sequence of sampling of wells at the site with the HLA Grundfos pump was STP-5-PZ, STP-6-PZ, and STP-8-PZ followed by the remaining piezometers and wells at this site.

HLA resampled the two piezometers, STP-5-PZ and STP-6-PZ, in April 1995 to verify the first or second round of Stage 3 analytical data. The analytical results of this resampling and analysis of groundwater from Piezometers STP-5-P2 and STP-6-P2 revealed no TCE in groundwater and verified the first round of Stage 3 VOC analytical data. These results support the conjecture that TCE was introduced into groundwater samples collected from Piezometers STP-5-P2 and STP-6-P2 during the February 1995 sample collection process and is not the result of groundwater contamination.

8.2.6 Summary of Site Risks

This section summarizes the baseline risk assessment conducted for the Large Sewage Treatment Ponds during the Group III B Sites RI.

8.2.6.1 Contaminant Fate and Transport

Fate and transport properties were evaluated for chemicals identified as COPCs at the Large Sewage Treatment Ponds in the Group III B Sites Final RI Report (HLA, 1994b). The purpose of evaluating fate and transport properties of COPCs was to assess the potential for these COPCs to migrate to other media or to human or ecological receptor locations (Figure 8.5).

COPCs identified in soil collected from the Large Sewage Treatment Ponds included metals, low-level pesticides, and PCBs. Chemical release and transport mechanisms considered for this site include (1) volatilization from soil to air, (2) dust entrainment, and (3) storm-water runoff.

Volatilization from soil to air is not expected for metals because metals are essentially nonvolatile. The pesticides and PCB-1260 detected in onsite soil are all chemicals with only moderate Henry's Law constants (Lyman et al., 1990) and high soil-water partition coefficients (K_{oc}) (Dragun, 1988). The combination of moderate Henry's Law constants with high K_{oc} values means that these organic chemicals are likely to bind tightly to organic matter in soil and will not volatilize.

The same properties that limit volatilization of metals, pesticides, and PCBs from soil also make them more likely to bind tightly to soil particles and potentially be released from the site as suspended dust particles in air.

Chemicals sorbed to soil particles may also be carried offsite by storm-water runoff. The runoff potential at the site is expected to be low, however, because of the greater infiltration rate associated with the high sand content of the soil at this location.

8.2.6.2 Human Health Evaluation

The results of the human health risk estimation for the Large Sewage Treatment Ponds are summarized in Table 8.5. Possible noncancer health effects and cancer risks were evaluated separately. For current onsite worker receptors, the maximum estimated HI of 2 indicated a slight chance that noncancer health effects (primarily associated with ingestion of and dermal contact with thallium in soil) may be of concern at this site. However, this estimate was based on RME exposure and, as such, probably overestimates the potential for adverse health effects in current workers. However, the maximum estimated HI of 10 for future hypothetical receptors indicates that noncancer health effects (again associated with ingestion of and dermal contact with thallium) may be of concern in the future if these unlikely exposure scenarios were to occur. However, the maximum detected concentration of thallium was 76.5 mg/kg; the EPA Region IV preliminary restoration goal for industrial soil is 120 mg/kg.

The cancer risk estimates ranged from 2×10^{-6} to 6×10^{-4} for current and hypothetical future receptors. The high end of this range was primarily associated with dermal contact and ingestion of PCB-1260 in soil by future hypothetical resident receptors. These risk estimates indicate that some potential cancer risks at the site are in the range of regulatory concern. However, the high end of this range (6×10^{-4}) is a risk estimate based on RME exposure. For more typical or "average" exposure, the risks presented in the Final Group III B Sites RI Report are in the lower range (2×10^{-6}). In addition, it is highly unlikely that the Large Sewage Treatment Pond area would ever be zoned for residential use even if the property were to be released to the public under base realignment.

8.2.6.3 Environmental Evaluation

A qualitative Environmental Evaluation (EE) was performed for SIAD. The purpose of the EE was to evaluate the potential for adverse effects to ecological receptors as a result of exposure to chemicals originating from chemical source areas. The potential for aluminum and thallium toxicity was indicated for the Townsend's ground squirrel, sage grouse, and the burrowing owl as a result of incidental ingestion at Large Sewage Treatment Ponds. Burrowing owls are known to inhabit the area adjacent to the southern border of the Large Sewage Treatment Ponds.

8.2.7 Description of Alternatives

Two alternatives were developed for the Large Sewage Treatment Ponds in the Group III B Sites Feasibility Study (HLA, 1995). The remedial alternatives identified include the following:

- Alternative 1: No Action
- Alternative 2: Excavation and Offsite Disposal, and limited followup groundwater monitoring

8.2.7.1 Alternative 1 - No Action

This alternative involves taking no action to treat, contain, or remove any of the PCB-contaminated soil from the site.

8.2.7.2 Alternative 2 - Excavation and Offsite Disposal

This alternative involves the excavation of approximately 3,400 cubic yards of PCB-contaminated soil. Soil will be removed from the northern unlined pond to a depth of 1 foot, and the soil pile adjacent to the southwest end of the two large ponds will be removed (Figure 8.2). The excavated soil will be transported to a licensed offsite landfill facility for disposal. Estimated capital cost for Alternative 2 is $1,081,000. Additional characterization of the extent of PCB-contaminated soil during removal in the northern unlined pond and the soil pile may reduce the volume to be excavated as well as the cost. After the removal action is completed, two semiannual rounds of groundwater sampling will be conducted at the existing site monitoring wells. A followup report will be submitted to the DTSC.

8.2.8 Summary of Comparative Analysis of Alternatives

Each of the remedial alternatives described in Section 8.2.7 has been assessed in accordance with the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988b). That guidance and the NCP provide for analysis of nine criteria when evaluating remedial alternatives. The criteria are as follows:

- Threshold Criteria
    - Overall protection of human health and the environment
    - Compliance with ARARs.
- Primary Balancing Criteria
    - Long-term effectiveness
    - Reduction of toxicity, mobility, and volume
    - Short-term effectiveness
    - Implementability
    - Cost
- Modifying Criteria
    - State acceptance
    - Community acceptance

Threshold criteria are requirements that each alternative must satisfy to be eligible for selection as the preferred alternative. Primary balancing criteria are used to weigh trade-offs among alternatives. Modifying criteria may be used to alter aspects of the preferred remedial alternative when preparing the Proposed Plan.

In the Group III B sites FS (HLA, 1995), the remedial alternatives were evaluated in terms of threshold and primary balancing criteria. Final evaluation of modifying criteria (state and community acceptance) was conducted after completion of the comment period on the final FS.

A brief description of each of the nine criteria is presented below.

- Overall Protection of Human Health and the Environment
  - How alternative provides human health and environmental protection
- Compliance with Applicable or Relevant and Appropriate Requirements
  - Compliance with Chemical-specific ARARs
  - Compliance with Action-specific ARARs
  - Compliance with Location-specific ARARs
  - Compliance with other criteria, advisories, and guidance
- Long-term Effectiveness and Permanence
  - Magnitude of residual risk
  - Adequacy and reliability of controls
- Reduction of Toxicity, Mobility, and Volume Through Treatment
  - Treatment process used and materials treated
  - Amount of hazardous materials destroyed or treated
  - Degree of expected reductions in toxicity, mobility, and volume
  - Degree to which treatment is irreversible
  - Type and quantity of residuals remaining after treatment
- Short-term Effectiveness
  - Protection of community during remedial actions
  - Protection of workers during remedial actions
  - Environmental impacts
  - Time until RAOs are achieved
- Implementability
  - Ability to construct and operate the technology
  - Reliability of the technology

  - Ease of undertaking additional remedial actions, if necessary
  - Ability to monitor effectiveness of remedy
  - Coordination with other agencies
  - Availability of offsite treatment, storage, and disposal services and capacity
  - Availability of necessary equipment and specialists
  - Availability of prospective technologies
- Cost
  - Capital costs
  - Operating and maintenance costs
  - Present-worth cost

8.2.8.1 Overall Protection of Human Health and the Environment

Alternative 1 (No Action) would not provide adequate protection to human health and the environment because of the risks posed by PCB-1260 in the site soil. Because Alternative 2 involves removing the soil and associated risks, it would achieve protection.

8.2.8.2 Compliance with Applicable or Relevant and Appropriate Requirements

The removal alternative (Alternative 2) will comply with ARARs whereas ARARs are not relevant to the No Action alternative (Alternative 1).

8.2.8.3 Long-term Effectiveness

Alternative 2 would provide the highest degree of long-term effectiveness and permanence by removing the soil and associated risks from the site.

8.2.8.4 Reduction of Toxicity, Mobility, or Volume

Only Alternative 2 would reduce the mobility of contaminants. Neither alternative would reduce the toxicity or volume of the contaminated soil.

8.2.8.5 Short-term Effectiveness

Alternative 2 would provide short-term effectiveness if risks posed by remediation activities were mitigated (i.e., dust control). Alternative 1 provides no short-term effectiveness.

8.2.8.6 Implementability

The No Action alternative (Alternative 1) would be inherently easy to implement; however, Alternative 2 is also relatively easy to implement and meets RAOs.

8.2.8.7 Cost

There are no costs for the No Action alternative (Alternative 1); Alternative 2 would cost approximately $1,081,000 to implement. Cost savings for Alternative 2 may be possible by further characterization of the soil to be excavated, thus possibly reducing the volume of soil to be removed.

8.2.9 Selected Remedy

The Army has selected Alternative 2, excavation and disposal, as the preferred remedy for the PCB contaminated soil at the Large Sewage Treatment Ponds. Based on the results presented in the RI/FS documents for the site, the State of California concurs with the selected remedy.

Alternative 2 will involve the excavation of 3,376 cubic yards of surface soil from the northern unlined pond and a soil mound adjacent to the west end of the large ponds. The excavated soil will be transported to a licensed offsite landfill facility to be selected during the remedial design phase.

The estimated capital cost for excavation and offsite disposal of 3,376 cubic yards of PCB-contaminated soil is $1,081,000. There will be no operation and maintenance costs. Table 8.6 presents a breakdown of the estimated capital costs for Alternative 2.

8.2.10 Statutory Determinations

The selected remedy satisfies statutory requirements of CERCLA § 121 and § 120(a)(4) such that the following mandates are satisfied:

- The selected remedy is protective of human health and the environment.
- The selected remedy complies with federal and state ARARs.
- The selected remedy is cost effective.
- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.
- The selected remedy satisfies the preference for treatment that reduces toxicity, mobility, and/or volume as a principal element.

8.2.10.1 Protection of Human Health and the Environment

The selected remedy protects human health and the environment through the excavation of PCB-contaminated soil and offsite disposal at a licensed landfill facility. Excavation and disposal will eliminate the threat of exposure to direct contact with or ingestion of contaminated soil. The current risk associated with these exposure pathways is 2×10^{-5}. By excavating the two areas of contaminated soil and disposing the soil offsite, the risk is removed. There are no short-term threats associated with the selected remedy that cannot be readily controlled. In addition, no adverse cross-media inputs are expected from the remedy.

8.2.10.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy of excavation and offsite disposal will comply with all applicable or relevant and appropriate chemical-, location- , and action-specific requirements. (A full discussion regarding SIAD ARARs is presented in Section 3.2.8.2 and are summarized in Tables 3.6 and 3.7.) The ARARs relevant to this site are presented below.

Chemical-specific ARARs

State or federal chemical-specific ARARs for constituents detected in soil at the Large Sewage Treatment Ponds have not been identified as a result of ARAR review.

Location-specific ARARs

State or federal location-specific ARARs for constituents detected in soil at the Large Sewage Treatment Ponds have not been identified as a result of ARAR review.

Action-specific ARARs

Chapter 10 of Title 22 CCR Division 4.5 (Chapter 10) contains regulations governing the management of hazardous waste. California's hazardous waste regulations are more stringent than the federal requirements in a number of ways.

Appendix X of Chapter 10 is a list of chemicals and materials that are presumed to be hazardous waste unless a generator can demonstrate that the material is not hazardous waste. Materials found on this list include PCBs, pesticides, and wastes containing these chemicals.

Disposal of PCB-contaminated soil from the Large Sewage Treatment Pond Area could trigger federal DOT material transportation requirements. DOT regulations are applicable to the shipment of media containing PCBs and other hazardous materials. DOT regulations are found in 40 CFR 100-180.

The excavation of PCB-contaminated soil and offsite disposal at a licensed facility may have to comply with the Chapter 10 hazardous waste requirements unless the generator can demonstrate that the PCB-contaminated soil is not hazardous. In addition, state and federal occupational health and safety regulations apply to the excavation and disposal of PCB-contaminated soil. These ARARs are found in Table 8.7.

Other criteria, Advisories, or Guidance to be Considered for This Remedial Action (TBCs)

None

8.2.10.3 Cost Effectiveness

The selected remedy is cost effective because it has been determined to provide overall effectiveness proportional to its costs. Estimated costs of the selected remedy are $1,081,800. Capital cost savings could be realized by including additional characterization of the soil to be excavated, thus possibly reducing the volume of soil to be removed. The selected remedy assures a much higher degree of certainty for risk reduction at the site than the No Action alternative.

8.2.10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the final source control at the Large Sewage Treatment Ponds. This selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; and short-term effectiveness, implementability, cost, and the statutory preference for treatment as a principal element and considers Cal-EPA and community acceptance.

The selected remedy offers a high degree of long-term effectiveness and permanence. It will significantly reduce the inherent hazards posed by the contaminated soil through excavation and offsite disposal such that any residual material that remains to be managed can be contained with a high degree of certainty over the long term. The selected remedy can be implemented quickly and with little difficulty and therefore is assessed to be the most appropriate solution for the contaminated soil at the Large Sewage Treatment Ponds. The impact on human health and the environment would be minimal if the public were allowed access to the site in the future.

8.2.10.5 Preference for Treatment as a Principle Element

The selected remedy addresses the principal threat posed by the site through excavation and offsite disposal at a licensed landfill facility. Therefore, the statutory preference for remedies that employ treatment as a principal element is not satisfied.

8.3 Responsiveness Summary

The public comment period for the Proposed Plan for Nine Sites at SIAD began on February 7, 1996, and extended through March 7, 1996. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. Oral comments were received for the Large Sewage Treatment Ponds at the public meeting.

8.3.1 Community Preferences

At the public hearing, Ms. Geralyn Smith questioned what "offsite disposal" was and expressed concern that it would be expensive. She wondered if the affected soil could be stored at SIAD, rather than be hauled to an offsite facility. Mr. John Harris, DTSC, noted that the soil must be stored at a permitted facility and that it would be cost- and time-prohibitive for SIAD to become a permitted facility of that type. Ms. Smith then asked if the Army had considered some of the new techniques, such as injecting foam into the soil. Ms. Anita Larson, HLA, noted that new and many other techniques had been evaluated during the feasibility study. Ms. Larson noted that the preferred alternative emerged based on cost effectiveness, implementability, and long-term effectiveness.
Ms. Larson noted that the Army intends to reuse the area in the near future and that that reuse was included during the evaluation phase of the feasibility study. Mr. Harry Kleiser, USAEC, noted that the USAEC is a leader in identifying new technologies for the Army and that they are required to use new technologies whenever it makes sense. Mr. Kleiser noted that in some situations, as at this site, a new technology is too expensive to justify its use. Mr. Wickham, Montgomery Watson, noted that

new alternatives were evaluated at this site, the Building 1003 Area (Section 3.0), and the Existing Fire-fighting Training Facility, whose record of decision was signed in 1993.

8.3.2 Integration of Comments

The Army evaluated in situ, innovative technologies during conduct of the feasibility study for this site. On the basis of cost effectiveness, long-term effectiveness, and implementability, excavation and removal of the affected soil to a permitted storage facility remain the preferred alternative.

The public's concern was incorporated into the re-evaluation that was conducted following the Public Hearing, and the alternative identified in the feasibility study and the Proposed Plan remains the preferred alternative for this site.

Table 8.1: Summary of Analyte Concentrations in Surface-Soil Samples That are Greater Than Background Concentrations - Large Sewage Treatment Ponds[a]

	Maximum[b] Background Concentration	Maximum[c] Background Concentration	STP-1-SB	STP-1-SS	STP-2-SB	STP-2-SS	STP-3-SB	STP-3-SB
Depth (feet):	0	0	0	0	0	0	0	0.5
Sample Date:	Not applicable	Not applicable	08/20/92	08/22/92	08/20/92	08/22/92	08/21/92	08/21/92
Soil Type:	310/312/313	365	365	365	365	365	365	365
Inorganic Analytes								
Aluminum	NA	6,710	23,900	9,520	19,900	9,410	12,400	NA
Arsenic	11.5	3.23	---	---	4.51[c]	---	---	NA
Barium	263	295	---	---	---	---	330	NA
Beryllium	1.86	1.86	---	---	---	---	---	NA
Cadmium	3.05	3.05	---	---	---	---	---	NA
Calcium	NA	34,300	---	---	---	---	60,000	NA
Chromium	12.7	12.7	13.9	---	---	---	---	NA
Copper	58.6	58.6	---	---	---	---	---	NA
Cyanide[d]	NA[d]	NA[d]	NA	<0.25	NA	<0.25	<0.25	NA
Iron	NA	8,440	30,200	12,300	25,900	12,200	13,800	NA
Lead	10.5	10.5	---	19.5	---	14.9	43	NA
Magnesium	NA	4,310	8,920	---	7,610	---	5,080	NA
Manganese	NA	455	---	---	---	---	462	NA
Mercury	0.0500	0.0500	---	0.238	0.0713	0.273	---	0.447
Nitrate, nitrite (nonspecific)[d]	NA	NA	23.8	8.76	9.56	7.89	2.17	NA
Potassium	NA	2,670	6,280	---	4,500	---	2,920	NA
Silver	2.50	2.50	---	8.27	---	5.63	8.56	NA
Sodium	NA	352	702	---	620	---	1,030	NA
Thallium	62.9	62.9	---	---	---	---	---	NA
Vanadium	33.8	41.0	60.7	---	60.7	---	---	NA
Zinc	34.6	30.2	64.4	121	46.1	113	133	NA

Table 8.1: Summary of Analyte Concentrations in Surface-Soil Samples That are Greater Than Background Concentrations - Large Sewage Treatment Ponds[a] (continued)

	STP-3-SS	STP-4-SB	STP-4-SS	STP-4-SB-D	STP-5-SB	STP-5-SS	STP-6-SS	STP-7-SS
Depth (feet):	0	0	0	0	0	0	0	0
Sample Date:	08/22/92	02/17/93	08/22/92	08/22/92	02/17/93	08/22/92	08/22/92	08/22/92
Soil Type:	365	365	365	365	312	365	365	312
Inorganic Analytes								
Aluminum	10,700	---	---	7,070	---	16,700	18,100	---
Arsenic	---	4.62	---	---	---	4.65	3.39	---
Barium	---	---	---	---	---	---	---	---
Beryllium	---	2.43	---	---	---	---	---	---
Cadmium	---	---	---	---	---	---	---	2.19
Calcium	---	---	---	---	---	---	---	---
Chromium	---	49.4	---	---	---	---	---	13.1
Copper	---	113	---	---	---	---	---	122
Cyanide[d]	<0.25	NA	<0.25	<0.25	NA	<0.25	<0.25	0.47
Iron	14,400	11,500	11,200	12,000	---	21,000	22,800	13,600[d]
Lead	---	297	11.5	---	37.7	---	---	---
Magnesium	5,040	---	---	---	---	8,170	8,630	---
Manganese	---	---	---	---	---	---	---	---
Mercury	0.16	0.661	0.16	0.14	0.867	0.0547	0.0563	0.656
Nitrate, nitrite (nonspecific)[d]	7.98	180	5.35	4.81	45	9.12	3.59	6.63
Potassium	2,910	2,800	---	---	---	5,070	5,820	---
Silver	---	21	4	2.42	4.7	---	---	22.3
Sodium	---	409	---	---	---	507	440	---
Thallium	---	---	---	---	---	67.7	76.5	---
Vanadium	---	440	---	---	---	57.2	63.3	---
Zinc	78.2	---	73.2	64.7	101	65.3	66.5	296

<	Less than certified reporting limits
---	Analyte not detected at levels exceeding background
NA	Not analyzed

a. Values are reported in milligrams per kilogram.
b. Maximum concentrations for background surface soil types 310, 312, and 313 taken from Table 5.3 of the Group III B Sites Final RI (HLA, 1994).
c. Maximum concentrations for background surface soil type 365 taken from Table 5.5 of the Group III B Sites Final RI (HLA, 1994).
d. Background concentrations were not available.

Table 8.2: Summary of Analyte Concentrations in Subsurface-Soil Samples That are Greater Than Background Concentrations - Large Sewage Treatment Ponds[a]

	Maximum Background Concentrations			STP-1-SB	STP-1-SB	STP-1-SB	STP-1-SB	STP-1-SB	STP-1-SB
Depth (feet):	**Not applicable**	**Not applicable**	**Not applicable**	**5.5**	**10.5**	**15.5**	**20.5**	**25.5**	**30.5**
Sample Date:	**Not applicable**	**Not applicable**	**Not applicable**	**08/20/92**	**08/20/92**	**08/20/92**	**08/20/92**	**08/20/92**	**08/20/92**
Soil Type:	**Sand[b]**	**Silt/clay[c]**	**Sand/silt/clay mix[d]**	**Sand**	**Sand**	**Sand**	**Sand**	**Sand**	**Sand**
Inorganic Analytes									
Aluminum	9,910	28,000	28,000	---	---	---	---	---	---
Cobalt	15.0	15.0	15.0	---	---	---	---	---	---
Iron	15,300	27,900	27,900	---	---	72,000	---	---	---
Lead	6.62	6.62	6.62	---	---	---	---	---	---
Mercury	0.0500	0.0500	0.0500	---	---	---	---	---	---
Nitrate, nitrite (nonspecific)	NA	NA	NA	9.03	6.12	2.37	2.58	1.34	5.57
Silver	2.50	2.50	2.50	---	---	---	---	---	---
Vanadium	52.7	130	130	---	---	203	---	---	---
Zinc	63.5	84.2	84.2	---	---	---	---	---	---

Table 8.2: Summary of Analyte Concentrations in Subsurface-Soil Samples That are Greater Than Background Concentrations - Large Sewage Treatment Ponds[a] (continued)

	STP-1-SB	STP-1-SB-D	STP-2-SB	STP-2-SB	STP-2-SB	STP-2-SB	STP-2-SB	STP-2-SB	STP-2-SB	STP-2-SB-D	STP-3-SB	STP-3-SB	STP-3-SB
Depth (feet):	**35.5**	**6**	**5.5**	**10.5**	**15.5**	**20.5**	**25.5**	**30.5**	**35.5**	**6**	**5.5**	**10.5**	**16**
Sample Date:	**08/20/92**	**08/20/92**	**08/20/92**	**08/20/92**	**08/20/92**	**08/20/92**	**08/20/92**	**08/20/92**	**08/20/92**	**08/20/92**	**08/21/92**	**08/21/92**	**08/21/92**
Soil Type:	**Sand**	**Sand**	**Sand**	**Sand**	**Silty sand**	**Sand**	**Sand**	**Sand and clayey sand**	**Sand**	**Sand**	**Silty sand**	**Sand**	**Sand**
Inorganic Analytes													
Aluminum	---	---	---	---	---	---	---	---	10,400	---	---	10,100	---
Cobalt	---	---	---	---	---	---	---	15.5	---	---	---	---	---
Iron	---	---	---	17,900	---	---	---	---	---	---	---	18,700	17,000
Lead	---	---	---	---	---	---	---	---	---	---	---	---	---
Mercury	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate, nitrite (nonspecific)	<1.00	10.2	16.1	38	12.9	1.44	<1.00	2.51	<1.00	10.7	9.1	4.92	6.52
Silver	---	---	---	---	---	---	---	---	---	---	---	---	---
Vanadium	---	---	---	---	---	---	---	---	---	---	---	---	---
Zinc	---	---	---	---	---	---	---	---	---	---	---	---	---

Table 8.2: Summary of Analyte Concentrations in Subsurface-Soil Samples That are Greater Than Background Concentrations - Large Sewage Treatment Ponds[a] (continued)

	STP-3-SB	STB-3-SB	STP-3-SB	STP-3-SB	STP-3-SB-D	STP-4-SB	STP-4-SB	STP-4-SB	STP-4-SB-D	STP-5-SB	STP-5-SB	STP-5-SB-D
Depth (feet):	**20.5**	**25.5**	**30.5**	**35.5**	**15.5**	**3**	**6**	**9**	**3.5**	**3**	**6**	**4**
Sample Date:	**08/21/92**	**08/21/93**	**08/21/92**	**08/21/93**	**08/21/92**	**02/17/93**	**02/17/93**	**02/17/93**	**02/17/93**	**02/17/93**	**03/02/93**	**02/17/93**
Soil Type:	**Sand**	**Sand**	**Sand and clay**	**Sand**	**Sand**	**Silty sand**	**Silty sand**	**Silty sand**	**Silty sand**	**Silty sand**	**Silty sand**	**Silty sand**
Inorganic Analytes												
Aluminum	---	---	---	---	12,800	---	---	---	---	---	---	---
Antimony	---	---	---	---	---	---	---	---	---	---	---	---
Cobalt	---	---	---	---	---	---	---	---	---	---	---	---
Iron	---	---	---	---	17,900	---	---	---	---	---	---	---
Lead	---	---	---	---	---	---	---	26.5	---	---	---	---
Mercury	---	---	---	---	---	---	---	0.32	---	---	---	467
Nitrate, nitrite (nonspecific)	1.39	<1.00	1.72	2.58	4.03	180	200	310	120	220	58	16
Silver	---	---	---	---	---	---	---	6.11	---	---	---	---
Vanadium	---	---	---	---	---	---	---	---	---	---	---	---
Zinc	---	---	---	---	---	---	---	167	---	84.8	---	---

< Less than certified reporting limit

--- Analytes not detected at levels exceeding background

a. Values are reported in milligrams per kilogram.

b. Maximum background concentrations for subsurface sandy soil taken from Table 5.8 of the Group III B Sites Final RI (HLA, 1994).

c. Maximum background concentrations for subsurface silt and clay soil taken from Table 5.9 of the Group III B Sites Final RI (HLA, 1994).

d. Maximum background concentrations for subsurface soil consisting of sand, silt, and clay taken from Table 5.7 of the Group III B Sites Final RI (HLA, 1994).

Table 8.3: Summary of Polychlorinated Biphenyl 1260 Detections in Surface and Subsurface Soils - Large Sewage Treatment Ponds[a]

Sample Location[b]	Depth	PCB Concentration[a]
Surface soil		
STP-3-SB		0.0576
STP-4-SB		1.4
STP-5-SB		0.248
STP-7-SS		0.0585
Subsurface soil		
STP-4-SB	9.0 feet	0.262

---

a. Values reported in milligrams per kilogram.
b. Refer to Figure 8.4.

Table 8.4: Summary of Analyte Concentrations in Groundwater - Large Sewage Treatment Ponds[a]

	Maximum Facilitywide Background Concentration	Maximum Local Background Concentration[b]	Primary Maximum Contaminant Level		Stage 1			
Sample Date			Federal	State	STP-2-MW 09/16/92	STP-2-MW-D 09/16/92	STP-2-MW 12/08/92	STP-2-MW-D 12/08/92
Inorganic Analytes								
Aluminum	141	NA	50-200[c]	1,000	186	159	--	--
Barium	74.1	24.8	2,000	1,000	68.5	72.2	92.8	97.2
Chloride	18,000,000	NA	250,000[c]	250,000[c]	180,000	180,000	341	334
Chromium (total)	9.62	6.02	100	50	22.4B	--	--	--
Copper	138	20.1	1,000[c]	1,000[c]	47.9B	40.7B	--	--
Iron	83.8	NA	300[c]	300[c]	118	231	--	--
Lead	6.3	1.84	15	50	--	--	--	--
Magnesium	471,000	NA	NA	NA	32,300	32,600	40,700	42,600
Manganese	66.5	NA	50[c]	50[c]	**90.7**	**91.3**	**64.7**	**66.2**
Nitrite, nitrate	NA	NA	10,000	45,000	2,900	2,900	2,000	2,000
Potassium	353,000	NA	NA	NA	20,600	20,500	24,700	26,000
Sulfate	14,000,000	NA	250,000[c]	250,000[c]	**400,000**	**400,000**	790	790
Total dissolved solids	NA	NA	500,000[c]	500,000[c]	**1,200,000**	**1,200,000**	**1,400,000**	**1,300,000**
Vanadium	969	NA	NA	NA	--	--	--	--
Zinc	28.7	28.7	5,000[c]	5,000[c]	55.9B	80.8B	--	--
Organic Analytes								
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	NA	NA	NA	NA	--	0.00298	--	--
alpha-Benzenehexachloride (alpha-BHC)	NA	NA	NA	NA	--	--	0.00442 C	--
alpha-Endosulfan	NA	NA	NA	NA	--	--	--	0.015
Caprolactum	NA	NA	NA	NA	--	--	--	--
Chloroform	NA	NA	100	100	--	--	--	--
delta-Benzenehexachloride (delta-BHC)	NA	NA	NA	NA	--	--	0.0492 U	0.0155
Dieldrin	NA	NA	NA	NA	0.0135	0.01	--	--
Heptachlor epoxide	NA	NA	0.2	0.01	**0.019[d]**	--	--	--
Hexadecanoic acid	NA	NA	NA	NA	--	--	--	--
Isodrin	NA	NA	NA	NA	0.00852	0.0116	--	0.0126
Trichloroethylene	NA	NA	5.0	5.0	---	---	---	---

Table 8.4: Summary of Analyte Concentrations in Groundwater - Large Sewage Treatment Ponds[a] (continued)

	Stage 3						
Sample Date	STP-2-MW 11/06/94	STP-2-MW-D 11/06/94	STP-2-MW 02/08/95	STP-3-PZ 11/04/94	STP-3-PZ 02/02/95	STP-4-PZ 11/03/94	STP-4-PZ 02/03/95
Inorganic Analytes							
Aluminum	--	--	--	--	--	--	**619**
Barium	46.5	47.2	53.1	65.9	99.8	53.1	59.1
Chloride	140,000	140,000	130,000	160,000	160,000	150,000	150,000
Chromium (total)	--	--	--	--	--	--	--
Copper	--	--	--	23.4	--	--	--
Iron	--	--	--	--	--	--	559
Lead	2.39	--	--	--	--	--	--
Magnesium	21,400	21,600	25,700	34,400	50,600	32,200	32,600
Manganese	13.8	13.8	**51.2**	**483**	**487**	**1,890**	**1,430**
Nitrite, nitrate	8,200	8,200	**21,000**	**57,000**	**36,000**	**23,000**	**34,000**
Potassium	18,600	19,000	18,500	17,900	19,900	22,400	--
Sulfate	240,000	240,000	**350,000**	**380,000**	**510,000**	**420,000**	**430,000**
Total dissolved solids	**1,000,000**	**1,020,000**	**1,200,000**	**14,500,000**[a]	--	--	--
Vanadium	30.3	32.4	29.7	19.4	**1,720,000**	**1,320,000**	**1,350,000**
Zinc	--	--	--	--	18.1	21.1	15.6
					--	--	--
Organic Analytes							
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	--	--	--	--			
Acetone	--	--	17.0	--	--	--	--
alpha-Benzenehexachloride (alpha-BHC)	--	--	--	--	--	--	--
alpha-Endosulfan	--	--	--	--	--	--	--
Caprolactum	90S	500S	--	--	5.00 S	--	10.0 S
Chloroform	--	--	--	--	--	--	--
delta-Benzenehexachloride (delta-BHC)	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--
Hexadecanoic acid	2.0S	--	--	--	--	--	--
Isodrin	--	--	--	--	--	--	--
Trichloroethylene	--	--	--	--	--	--	--

Table 8.4: Summary of Analyte Concentrations in Groundwater - Large Sewage Treatment Ponds[a] (continued)

	Stage 3								
Sample Date	STP-5-PZ 11/03/94	STP-5-PZ 02/02/95	STP-5-PZD 02/02/95	STP-6-PZ 11/02/94	STP-6-PZ 02/01/95	STP-7-PZ 11/02/94	STP-7-PZ 02/02/95	STP-8-PZ 11/04/94	STP-8-PZ 02/03/95
Inorganic Analytes									
Aluminum	--	--	--	--	--	--	--	--	--
Barium	37.5	38.2	36.5	28.3	32	29.4	32.7	--	41.6
Chloride	99,000	100,000	100,000	120,000	110,000	**880,000**	81,000	130,000	150,000
Chromium (total)	--	--	--	--	--	--	--	--	--
Copper	--	--	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--	--	51.3
Lead	--	--	--	--	--	--	--	--	--
Magnesium	23,400	25,900	25,300	29,000	28,600	46,200	45,600	31,300	35,000
Manganese	4.95	--	--	18.6	8.63	21.6	5.21	**406**	**407**
Nitrite, nitrate	8,100	8,400	8,400	**11,000**	**12,000**	5,300	6,000	7,900	**16,000**
Potassium	25,200	22,900	24,000	17,400	15,600	26,200	23,000	19,100	19,000
Sulfate	220,000	220,000	220,000	**260,000**	**260,000**	**380,000**	**340,000**	**280,000**	**310,000**
Total dissolved solids	**894,000**	**946,000**	**943,000**	**1,100,000**	**1,100,000**	**10,070,000**	**1,100,000**	**1,130,000**	**1,300,000**
Vanadium	20.5	16.0	16.1	--	--	--	--	20.5	--
Zinc	--	--	--	--	--	--	--	--	19.3
		--	--						
Organic Analytes									
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	--	--	--	--	--	--	--	--	--
alpha-Benzenehexachloride (alpha-BHC)	--	--	--	--	--	--	--	--	--
alpha-Endosulfan	--	--	--	--	--	--	--	--	--
Caprolactum	--	--	40 S	--	--	--	**4.8**	--	**5.2**
Chloroform	--	--	--	--	30.0 S	--	20.0 S	--	300 S
delta-Benzenehexachloride (delta-BHC)	--	--	--	--	--	1.0	0.75	--	--
Dieldrin	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--
Hexadecanoic acid	--	--	--	--	--	--	--	--	--
Isodrin	--	--	--	--	--	--	--	--	--
Trichloroethylene	--	1.20[d]	1.30[d]	--	--	--	--	--	--

Table 8.4: Summary of Analyte Concentrations in Groundwater - Large Sewage Treatment Ponds[a] (continued)

Analyte concentrations are micrograms per liter (μg/l).

Bold values exceed respective federal or state maximum contaminant level.

B	Analyte found in the method blank or quality control blank as well as the samples.
C	Analysis was confirmed.
D	Duplicate sample
NA	Not available
S	Non-target analyte analyzed for and detected
--	Analyte not detected, or concentration is less than the respective maximum local (STP) background concentration.
STP	Sewage treatment ponds
U	Analysis unconfirmed

a. Large sewage treatment ponds groundwater analyte concentrations that exceed the respective maximum local background concentration.
b. Taken from HLA, 1994.
c. Secondary maximum contaminant level
d. Confirmation of reported detection subject to additional sampling of wells conducted in April 1995. Trichloroethylene was not detected in groundwater samples collected in April 1995 from this piezometer.
e. Data processing error at laboratory identified during data package review; reported concentration should be reduced by an order of magnitude.

Table 8.5: Summary of Multipathway Exposures at the Large Sewage Treatment Ponds

	Hazard Index		Potential Upperbound Excess Cancer Risk	
Receptor Populations Exposure Pathways	**Average**	**RME**	**Average**	**RME**
Current Scenario				
Adult Workers (Onsite)				
Dermal Contact with Soil	9.77E-02	7.54E-01	8.77E-06	1.51E-04
Inhalation of Dust from Outdoor Air	N/A	N/A	9.71E-06	5.23E-05
Ingestion of Soil	3.02E-01	8.24E-01	1.66E-06	1.11E-05
Multipathway Exposures	4E-01	2E+00	2E-05	2E-04
Future Scenario				
Construction Workers (Onsite)				
Ingestion of Soil	8.91E-02	2.34E-01	4.55E-07	1.08E-06
Dermal Contact with Soil	1.88E-02	1.24E-01	4.89E-07	3.03E-06
Inhalation of Dust from Outdoor Air	N/A	N/A	9.22E-07	1.78E-06
Multipathway Exposures	1E-01	4E-01	2E-06	6E-06
Child/Adult Residents (Onsite)				
Ingestion of Soil	4.16E+00	1.13E+01	1.84E-05	5.12E-05
Dermal Contact with Soil	5.31E-01	3.14E+00	4.04E-05	4.10E-04
Inhalation of Dust from Outdoor Air	N/A	N/A	1.03E-05	4.64E-05
Inhalation of Dust from Indoor Air	N/A	N/A	3.16E-05	1.17E-04
Multipathway Exposures	5E+00	1E+01	1E-04	6E-04
Adult Residents (Onsite)				
Ingestion of Soil	7.72E-01	1.05E+00	4.29E-06	1.70E-05
Dermal Contact with Soil	1.24E-01	7.74E-01	1.11E-05	1.86E-04
Inhalation of Dust from Outdoor Air	N/A	N/A	5.23E-07	5.81E-06
Inhalation of Dust from Indoor Air	N/A	N/A	6.58E-06	4.79E-05
Multipathway Exposures	9E-01	2E+00	2E-05	3E-04

N/A	Not applicable
RME	Reasonable maximum exposure

Table 8.6: Order of Magnitude Cost Estimate - Excavation and Offsite Disposal Large Sewage Treatment Ponds

Cost Item	Quantity Units	Unit Cost ($)	Preliminary Estimated Total Cost
Preconstruction Activities			
a. Mobilization	1 LS	3,000	$3,000
Subtotal - Preconstruction Activities			$3,000
Sitework			
a. Excavation and loading	3,400 CY	10	$34,000
Subtotal - Sitework			$34,000
Offsite Disposal			
a. Transportation	3,400 CY	25	$ 85,000
b. Disposal fees (including taxes)	3,400 CY	225	765,000
c. Waste characterization	1 LS	4,000	4,000
Subtotal - Offsite Disposal			$854,000
Other Direct Costs			
a. Engineering design	1 LS	4,500	$4,500
b. Engineering services during construction	1 LS	6,000	6,000
Subtotal - Other Direct Costs			$10,500
Subtotal Capital Costs			$901,500
Contingency (20 percent)			$180,300
Total Preliminary Capital Costs			$1,081,800

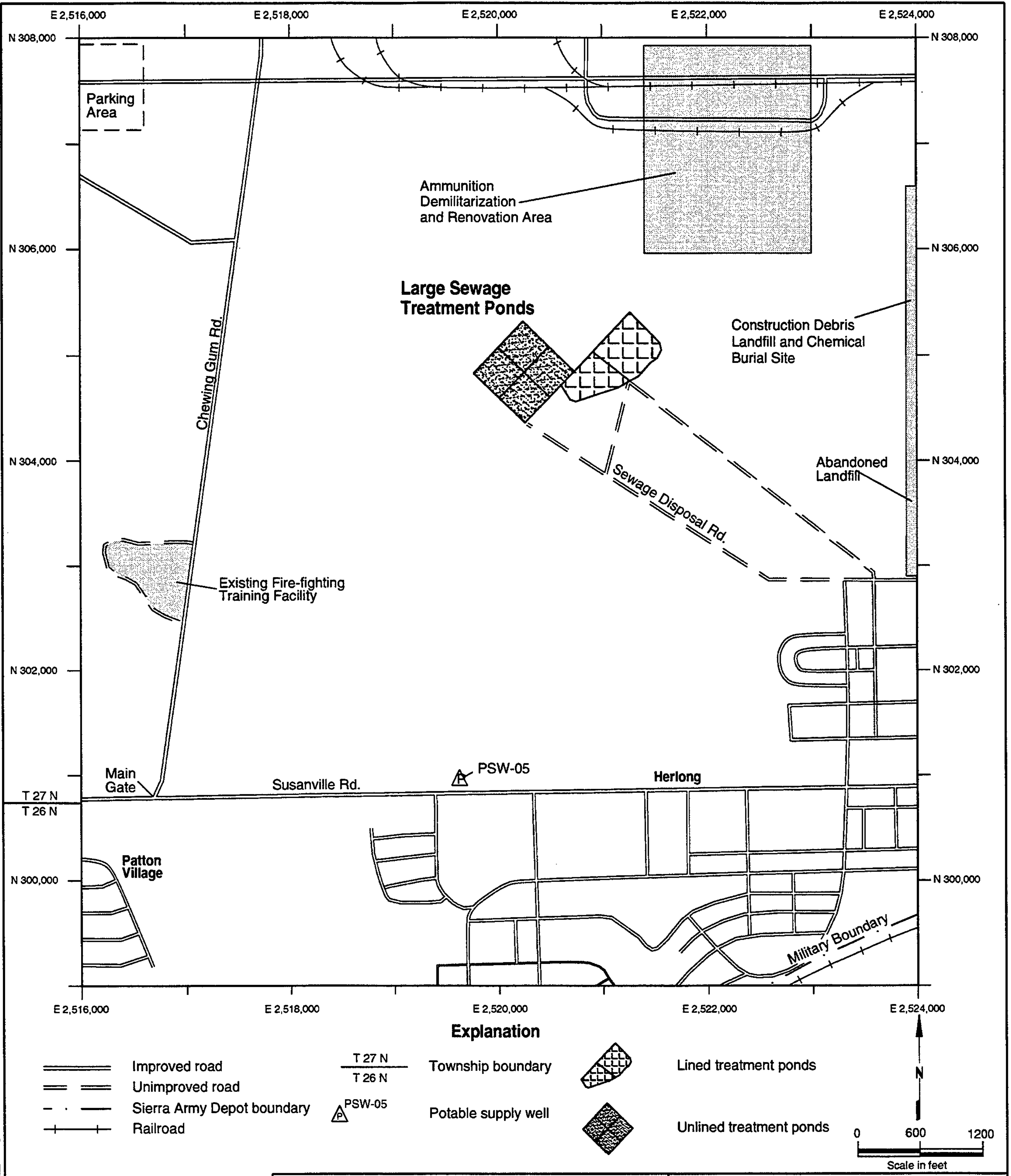
CY	Cubic yards
LS	Lump sum

Table 8.7: Applicable or Relevant and Appropriate Requirements for the Large Sewage Treatment Ponds

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Action-Specific				
Occupational Safety and Health Act	29 USC §§ 651-678	Regulates worker health and safety	Applicable	Under 40 CFR § 300.38, requirements of the Act apply to all response activities under the NCP.
Hazardous Waste Control Laws	H&S Code, Div. 2.0 Chapters 6.5 and 6.8 § 25100 et seq. CCR Title 22, Div. 4.5 Chapter 10, § 66001 et seq.	Regulations governing hazardous waste control; management and control of hazardous waste facilities; transportation; laboratories; classification of extremely hazardous, hazardous, and nonhazardous waste. Includes STLCs and TTLCs.	Applicable or relevant and appropriate	State hazardous waste control laws are considered applicable or relevant and appropriate operating standards for those alternatives involving treatment and disposal of hazardous waste.
Department of Transportation Material Shipment Regulations	49 CFR 100-180	Regulates the packaging, labeling, and shipping of hazardous materials	Applicable	Department of Transportation requirements apply to all shipments of hazardous materials.

CFR	Code of Federal Regulations
NCP	National Contingency Plan
STLC	Soluble threshold limit concentration
TTLC	Total threshold limit concentration
USC	United States Code

SIAD/12299605 2/1/95 LDZ



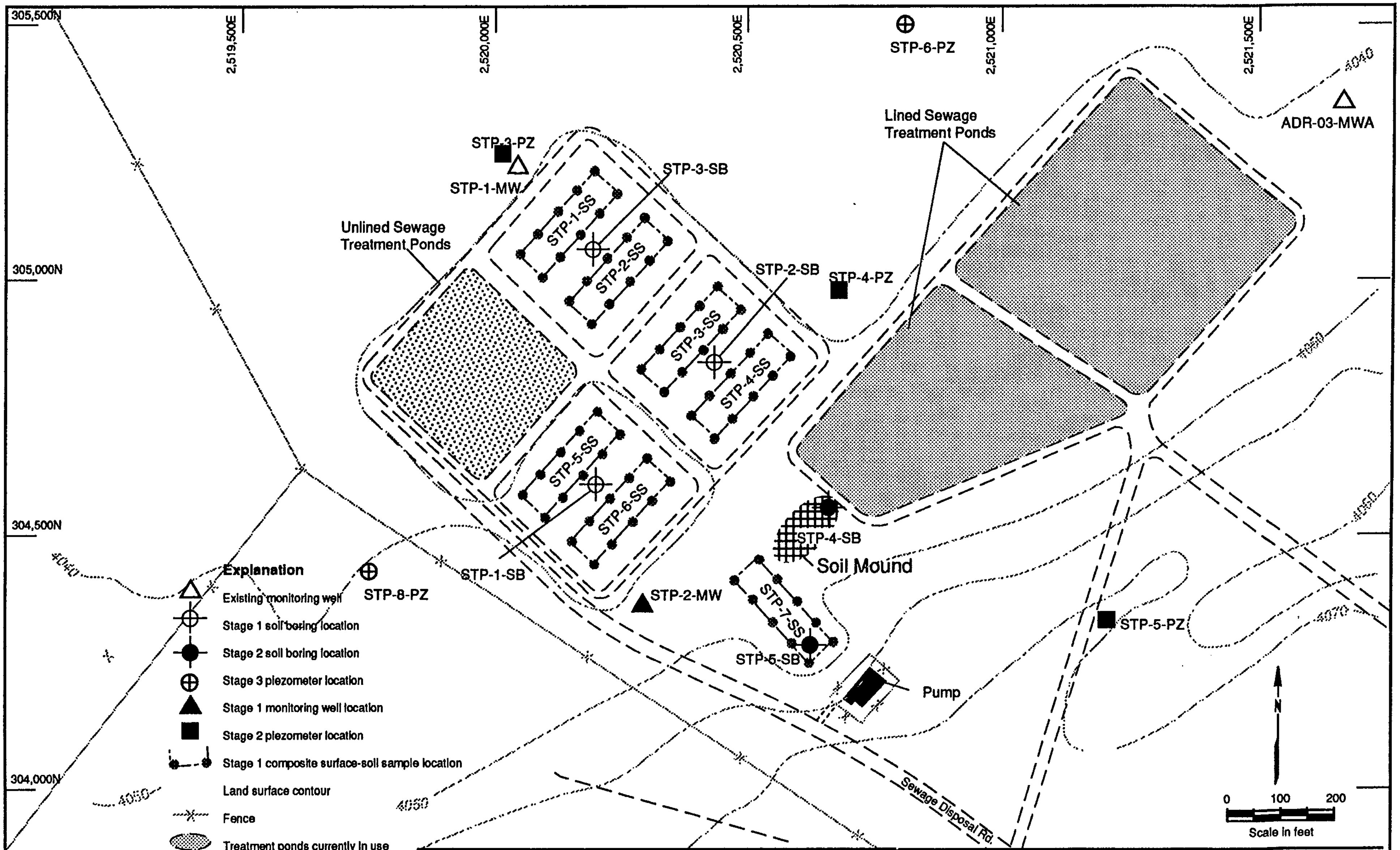
Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 8.1

Location Map-
Large Sewage Treatment Ponds



Harding Lawson Associates
Engineering and
Environmental Services

HLA

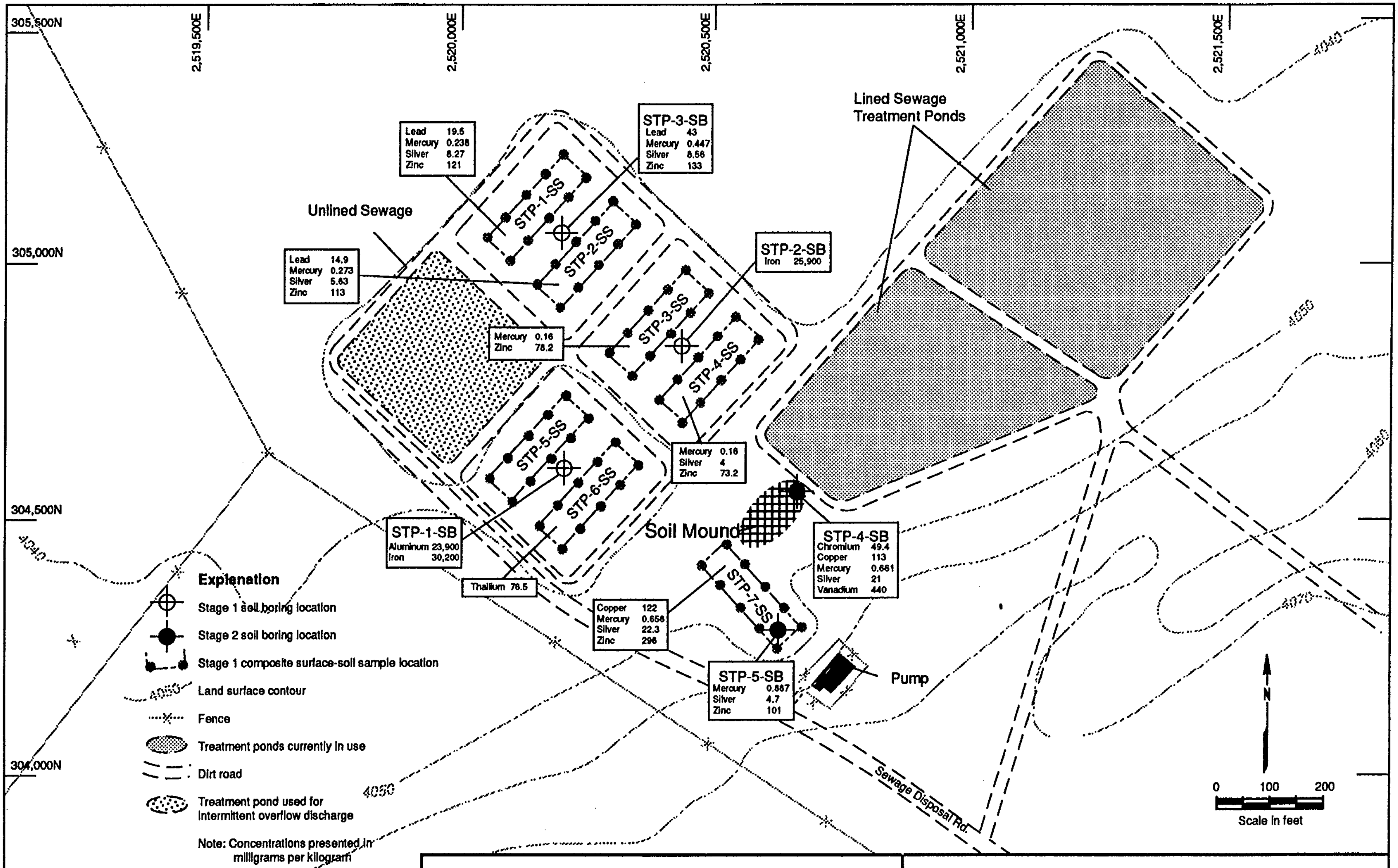
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 8.2

Surface-Soil, Soil Boring, Monitoring Well and Piezometer Locations - Large Sewage Treatment Ponds

SRA 1070.6a 02/01/96 ECS



Harding Lawson Associates
Engineering and Environmental Services

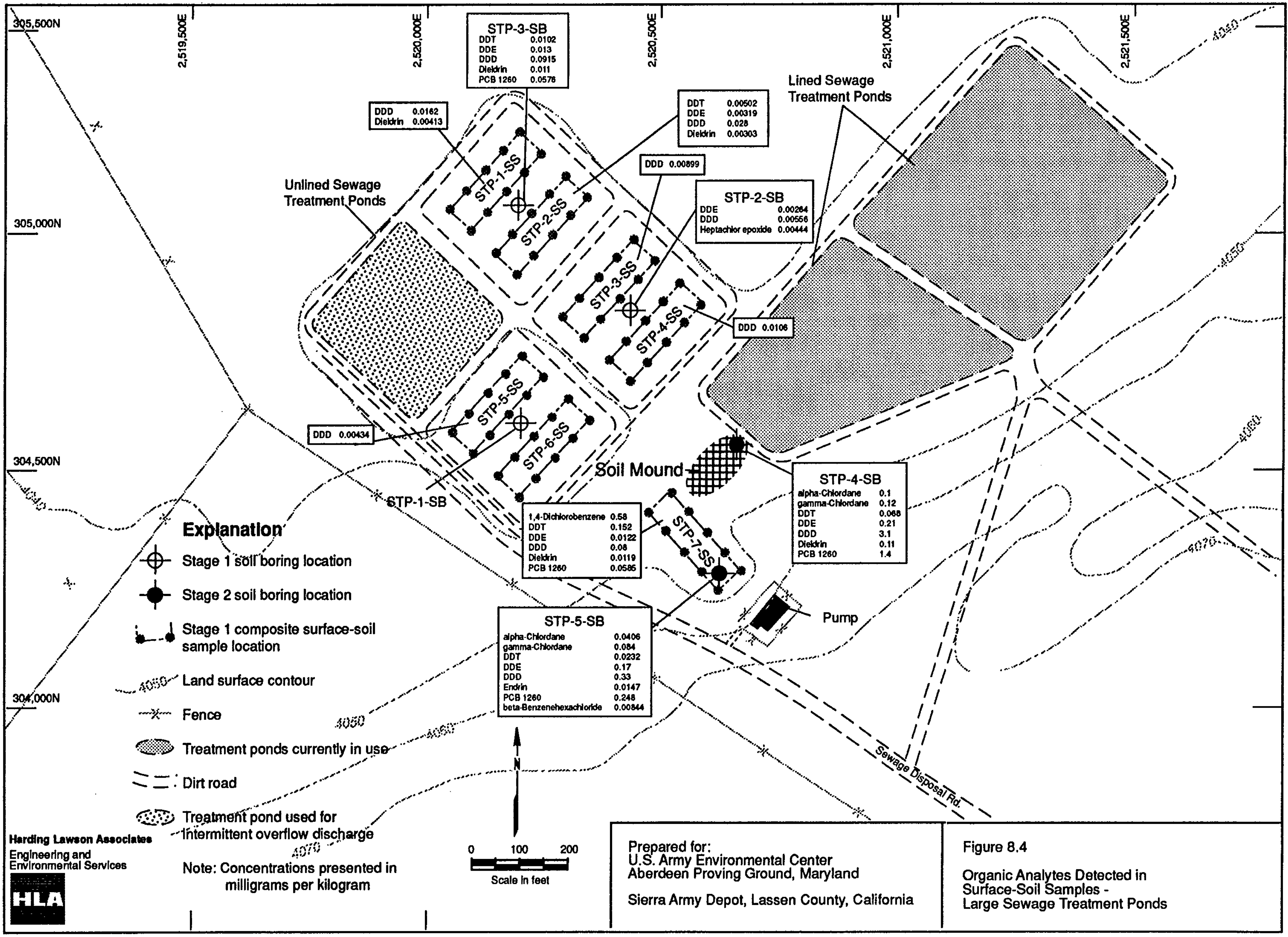
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 8.3

Inorganic Analytes Detected in Surface-Soil Samples That are Greater Than Soil-type Specific and Regional Background Concentrations - Large Sewage Treatment Ponds

SRA 1070.7a 02/01/96 ECS



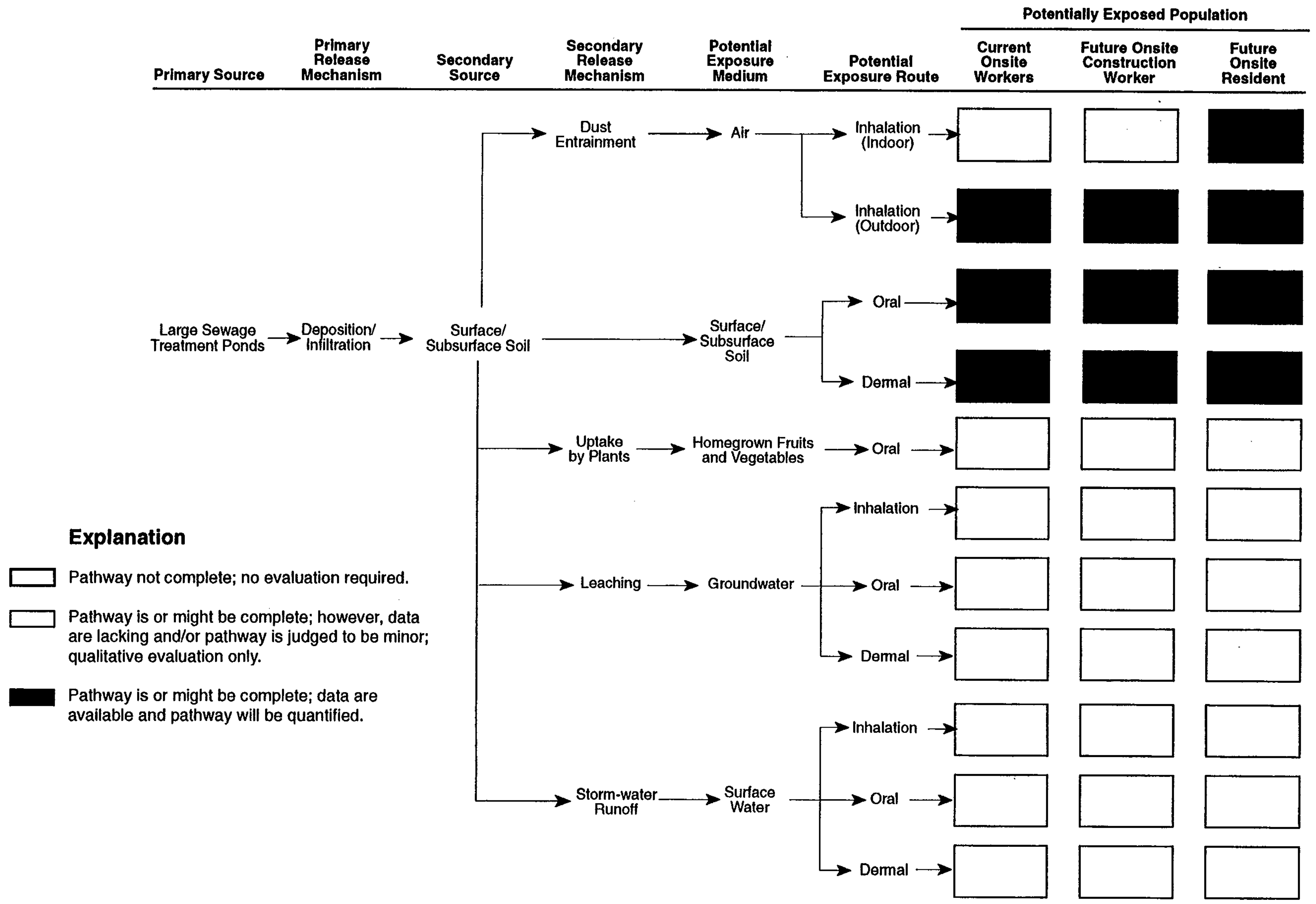
Note: Concentrations presented in milligrams per kilogram

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 8.4

Organic Analytes Detected in Surface-Soil Samples - Large Sewage Treatment Ponds



Harding Lawson Associates
Engineering and
Environmental Services
HLA

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 8.5

Conceptual Site Model -
Large Sewage Treatment Ponds

9.0 LOWER BURNING GROUND

9.1 Declaration

The following section provides the declaration portion of the ROD/RAP for the Lower Burning Ground.

9.1.1 Location

The Lower Burning Ground is located near the northeast corner of the Main Depot, as shown in Figure 1.1. The Lower Burning Ground was used for burning munitions and various pyrotechnics in pits and on the ground surface from approximately 1946 to 1974. The site encompasses a relatively large, irregularly shaped area that measures approximately 5,300 feet by 1,800 feet. The site includes a rectangular-shaped portion identified as Interim Burning Area A (Figure 9.1). Interim Burning Area A was used in 1960 and 1961, while the primary burning ground was being renovated, and may have been used as late as 1974 (USATHAMA, 1979).

9.1.2 Assessment of the Site

A contamination assessment of the Lower Burning Ground was conducted during the Group III RI. The results of that assessment, presented in the Group III B Sites Final RI Report (HLA, 1994b), are summarized as follows:

- Geophysical survey results indicated substantial amounts of buried metal.
- Unexploded ordnance (UXO) surveys indicated the presence of UXO across the site.
- Soil-gas survey results did not indicate potential sources of organic contamination at the site.
- Metal concentrations in surface-soil samples detected above background concentrations included aluminum, arsenic, cadmium, chromium, copper, lead, mercury, silver, sodium, thallium, and zinc. Heptachlor epoxide and 1,3,5-trinitrobenzene were detected in 1 of 10 surface-soil samples.
- Analytical results from groundwater sampling indicated very low-level detections of isodrin that are considered questionable.

A potential unacceptable risk to human health from the detected concentrations of arsenic and chromium in surface soil was identified in a residential exposure scenario during the baseline risk assessment. Arsenic concentrations at the Lower Burning Ground are below background levels and chromium concentrations are below preliminary remediation goals (PRGs). However, the presence of UXO at the site poses greater immediate health risks than metals in the soil. Access to this site is currently restricted to SIAD personnel, and fencing and warning signs are present to indicate the presence and danger of UXO. The presence of UXO resulting in site restrictions minimizes potential human exposure routes. Deed and further access restrictions will be placed on the Lower Burning Ground thus preventing the future establishment of residential development. Although these restrictions are not part of the CERCLA process, the restrictions will provide protection to human health from contaminants at the site by limiting onsite access. Therefore, no action is recommended at this site.

9.1.3 Description of the Selected Remedy

As discussed in the preceding section, no action is recommended for this site. Because UXO is present at the Lower Burning Ground, deed and access restrictions will be placed on the site. Access is already restricted and warning signs and fencing are in place to prevent exposure to UXO.

9.1.4 Statutory Determinations

Because no remedial actions are required at this site, no statutory determinations of remedial actions are necessary.

9.2 Decision Summary

This section provides an overview of the site-specific factors and analyses that were considered in the selection of the response action for the Lower Burning Ground.

9.2.1 Site Description

The Lower Burning Ground is generally free of vegetation. A greasewood and sagebrush brush line marks the eastern site boundary, and a gravel road marks the western site boundary. The terrain is flat, with the exception of several open pits and associated soil mounds in the northern area, and a relatively large elongated pit (200 feet long by 35 feet wide by 10 feet deep) in the central area. Alignments of shallow trenches approximately 1 to 2 feet deep were observed in the central area, and long paired alignments of gravel were observed in the northern area and in Interim Burning Area A during the RI field activities in 1992. Small metal debris, including spent ordnance casings, nails, bolts, straps, and hinges are scattered throughout the site. Metal signs noting "Flashed Scrap Metal Buried Here" are located in the western-central area.

9.2.2 Site History and Enforcement Activities

From 1946 to 1974, the Lower Burning Ground used for burning munitions and various pyrotechnics in pits and on the ground surface. Interim Burning Area A was used in 1960 and 1961, while the primary burning ground was being renovated, and may have been used as late as 1974 (USATHAMA, 1979).

A variety of materials have reportedly been disposed at the Lower Burning Ground. These materials include explosives; waste products generated during demilitarization operations including primers, charges, waste rags, paint sludge, and solvents; powder projectiles; and other munitions. In general, dumping was uncontrolled at the Lower Burning Ground; materials burned at Interim Burning Area A included projectiles containing TNT and composition B, a combination of TNT and cyclometrimethylenetrinitramine (RDX); trash contaminated by explosives; and fuses containing lead compounds.

Much of the burning and dumping at the Lower Burning Ground was reportedly performed in pits. Metal debris and scraps were removed periodically from the pits and sent to the Defense Property Disposal Office (DPDO) for disposal. The DPDO area is currently identified as the Defense Reutilization and Marketing Office (DRMO) trench area and is being investigated by Montgomery Watson as part of the SIAD Group I sites RI/FS. After removal of salvageable material, most of the pits were backfilled and covered (ESE, 1983).

Investigations that have been conducted at the Lower Burning Ground include the following:

- Soil contamination investigation at open-burning/open-detonation grounds, U.S. Army Environmental Hygiene Agency (USAEHA), 1985a
- Groundwater consultation, USAEHA, 1987
- Group III Remedial Investigation, HLA, 1994b
- Remedial Investigation follow-up groundwater sampling, HLA, 1994b
- Feasibility Study, HLA, 1995

In October 1984, USAEHA drilled and sampled five soil borings adjacent to a relatively large disposal trench in the central portion of the site. At the same time, five surface-soil samples were collected from the bottom of the trench. Each subsurface-soil sample was analyzed for metals and explosives, and two samples were analyzed for SVOCs. The explosives TNT and RDX were detected in one sample at very low concentrations. No SVOCs were detected. Metals detected in subsurface-soil samples included arsenic, barium, cadmium, chromium, lead, and mercury. Each surface-soil sample was analyzed for metals and explosives, and one sample was also analyzed for SVOCs and pesticides. No explosives, SVOCs, or pesticides were detected in surface-soil samples. Metals detected in surface-soil samples included barium, cadmium, chromium, copper, and lead.

USAEHA installed two monitoring wells, LBG-1-MW and LBG-2-MW, in August 1984 at locations upgradient (northeast) and downgradient (west) of the site. The wells were sampled in 1985, 1986, and 1987. Groundwater samples collected in August 1985 were analyzed for metals, purgeable organic compounds, and SVOCs. Groundwater samples collected in November 1986 and June 1987 were analyzed for metals, purgeable organic compounds, SVOCs, and explosives. Except for several sporadic, low-level detections of the common laboratory contaminants toluene and methylene chloride, no purgeable organic compounds, SVOCS, or explosives were detected. Metals detected in groundwater samples include arsenic, barium, boron, calcium, copper, magnesium, manganese, potassium, selenium, sodium, and zinc.

The purpose of the Group III RI conducted by HLA was to ensure that potential environmental impacts associated with past and present waste management activities at the site were thoroughly investigated and, if necessary, remediated. The investigation included a surface geophysics survey, soil-gas survey, an UXO survey, surface-soil sampling, drilling and sampling soil borings, and monitoring well installation and groundwater sampling. The surface geophysics survey indicated the presence of substantial amounts of buried metal and the results of the UXO survey indicated the presence of UXO across the site.

The follow-up groundwater sampling conducted by HLA was performed at the request of DTSC. The additional round of groundwater sampling confirmed that Army activities at the site had not adversely impacted groundwater quality. A letter report with an analysis of the results of the follow-up sampling is included in Appendix U of the Group III B Sites RI Report (HLA, 1994b).

A FS report for two Group III B sites was prepared by HLA (1996). Soil was the medium of concern identified and addressed in the FS.

No enforcement activity has been associated with the Lower Burning Ground. The site is subject to the requirements and schedules outlined in the FFA.

9.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 9.3 of this ROD/RAP.

The public participation requirements of CERCLA § 113(k)(2)(B)(i-v) and § 117 and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site. The response action presented for this site in this ROD/RAP was selected in accordance with CERCLA, NCP, Chapter 6.8 of the California Health and Safety Code, and the California Water Code. The basis for this decision is documented in the Administrative Record.

9.2.4 Scope and Role of Response Action

This ROD/RAP presents the final response action for the Lower Burning Ground. Although no further action is the recommended response action, deed and access restrictions will be placed on the site due to the presence of UXO.

9.2.5 Site Characteristics

Contamination at the Lower Burning Ground was suspected on the basis of past activities at this site that included burning munitions and various pyrotechnics in pits and on the ground surface and the reported dumping of waste products generated during demilitarization operations. Potential contamination at the Lower Burning Ground was evaluated on the basis of surface geophysical data, soil-gas data, surface- and subsurface-soil analytical data, and groundwater analytical data. An assessment of potential contamination at the site based on these data is provided in the following subsections.

9.2.5.1 USAEHA Investigations

Environmental investigations were performed by the USAEHA at the Lower Burning Ground from 1984 through 1987. These investigations included soil sampling in five borings, collecting five surface-soil samples, and installation and groundwater sampling from two monitoring wells. The results of these investigations were reported in USAEHA Report No. 37-26-0529-85 (1985a), USAEHA 1986 Report No. 38-26-503-86, and No. 38-26-0822-87 (1987). A summary of the results is also presented in Benioff et al. (1988) and the Final Group III B Sites RI Report (HLA, 1994b).

9.2.5.2 Group III Remedial Investigations

HLA performed remedial investigations at the lower Burning Ground under the Army's IRP. The IRP work conducted included the studies described below.

Surface Geophysics

Data assessed from the geophysical survey indicate three main areas of anomalous geophysical response characteristic of substantial amounts of buried metal (See Appendix B to HLA, 1994b; Figure B7). Six potential disposal cells were identified in the western area of the site (See Appendix B to HLA 1994b, Figure B8). In the southern portion of the Lower Burning Ground (Interim Area A), three separate anomalies spaced approximately 200 feet apart were identified. Two of these anomalies correspond to observed areas where the ground has cracked and subsided, suggesting the presence of backfilled trenches. The third main area of anomalous geophysical response corresponds with an approximately 100-foot by 100-foot notch in the brushline along the east edge of the site. This area is characterized by reworked surface soil and scattered surficial metal debris.

Soil Gas

Ninety-five soil-gas samples were collected across the Lower Burning Ground and analyzed for selected VOCs and total volatile hydrocarbons (TVHs). Due to the presence of UXO at the site, soil-gas samples were obtained from a depth of 2 feet bgs. A summary of the soil-gas analytical results is presented in Table 9.1. As indicated in this table, only two VOCs (TCA and TCE) and TVH were detected during the soil-gas survey performed at the Lower Burning Ground. The maximum soil-gas concentrations of TCA, TCE, and TVH were 0.003, 0.1, and 14 μg/l, respectively.

There are no laterally continuous patterns in the detections and concentrations of soil-gas analytes at the respective Lower Burning Ground soil-gas sample collection locations. Therefore, the detections and concentrations do not indicate significant subsurface soil or groundwater sources of volatile organic contamination. This assessment was supported by the analytical results of the Lower Burning Ground surface-soil and groundwater samples, as discussed below.

Surface Soil

Surface-soil contamination at the Lower Burning Ground was assessed on the basis of samples collected from the surface to 0.5-foot interval of 10 composite soil samples (Figure 9.1). Sample locations were selected in areas of highest potential impact from past site activities. Surface-soil samples were analyzed for TAL metals, explosives, TCL SVOCs, and pesticides/PCBs. Sample LBG-1-SS was also analyzed for TPH and dioxins/furans.

Table 9.2 summarizes the analytical results for metals detected in the surface-soil samples at concentrations greater than background concentrations for the soil types 325 (Epot very fine sandy loam) and 330 (Calneva silt loam). The following 16 analytes were detected at concentrations above the soil type-specific background concentration (excluding cyanide): aluminum, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, potassium, silver, thallium, vanadium, and zinc. These metals were detected at concentrations greater than soil type-specific and facilitywide maximum background concentrations and may be potentially associated with site activities. Barium, chromium, cobalt, iron, manganese, mercury, nickel, silver, vanadium, and zinc were detected at concentrations at the Lower Burning Ground below their maximum background detections of 1,499; 150; 30; 100,000; 2,000; 29.00; 50; 20; 700, and 150 mg/kg, respectively, found in the Skedaddle Mountains Wilderness Area. Cadmium, copper, lead, mercury, thallium, and zinc were detected at levels significantly above soil type-specific, facilitywide, and regional background concentrations. Figure 9.2 presents the values and locations of these inorganic analytes detected in surface-soil samples.

Samples LBG-1-SS, LBG-3-SS, LBG-7-SS, and LBG-8-SS contained the highest or highly elevated concentrations of cadmium, copper, lead, and zinc. The highest detected concentrations of cadmium, copper, lead, and zinc reported during this investigation at the Lower Burning Ground were 11.8, 1,500, 4,500, and 11,000 mg/kg. The maximum concentration of silver (3.66 mg/kg) was detected in LBG-3-SS. Sample LBG-8-SS contained maximum or near maximum concentrations of mercury, which was detected at 0.164 mg/kg, compared to the soil type-specific maximum background concentration of 0.05 mg/kg. Thallium and zinc were detected in LBG-2-SS at 143 and 161 mg/kg, respectively.

Samples LBG-4-SS and LBG-5-SS were both sampled in the northern portion of the Lower Burning Ground. Thallium was detected at 120 and 131 mg/kg, respectively. These concentrations are above the soil type-specific background concentration of 62.9 mg/kg. LBG-5-SS also contained cyanide at a concentration of 0.78 mg/kg, which is above the CRL of 0.25 mg/kg for cyanide. Cyanide was also detected in LBG-6-SS at a concentration of 0.26 mg/kg, which was only slightly above the CRL for cyanide. Sample LBG-6-SS was located approximately 400 feet southeast of LBG-5-SS. Background SIAD surface-soil concentrations for cyanide are not available for comparison to investigative samples. Because cyanide may be produced naturally via nitrate metabolism by microorganisms and because these detected values of cyanide are low and only slightly above their CRLs, the detected cyanide may be associated with the natural soil conditions at the Lower Burning Ground. However, cyanide could also be a by-product in the combustion of polymers.

In addition to cyanide, LBG-6-SS also contained cadmium and lead at concentrations of 3.65 and 24 mg/kg, respectively. Lead was also detected at concentrations of 14.2 and 19.5 mg/kg in soil Samples LBG-9-SS and LBG-10-SS, respectively. These samples were collected in Interim Burning Area A at the southern portion of the Lower Burning Ground. Because cadmium and lead were detected at significantly higher concentrations than background concentrations and in other samples collected from the Lower Burning Ground, it appears that the detected concentrations of lead in LBG-6-SS, LBG-9-SS, and LBG-10-SS and cadmium in LBG-6-SS are likely the result of site activities.

PCBs, TPH, and dioxin/furans were not detected in the surface-soil samples at concentrations above the CRL. The compound 1,3,5-trinitrobenzene was the only explosive detected in the surface-soil samples. This compound was detected in surface-soil sample LBG-5-SS at a concentration of 5.81 mg/kg. The only pesticide detected in the surface-soil samples from the Lower Burning Ground was heptachlor epoxide. This pesticide was detected in one surface-soil sample (LBG-5-SS) at a concentration of 0.00252 mg/kg, which is less than two times the CRL of 0.0013 mg/kg. The only TCL SVOC detected in the surface-soil samples at the site was di-N-butyl phthalate. This compound was detected in one surface-soil sample (LBG-7-SS) at a concentration of 1.4 mg/kg, which is only slightly above the CRL of 1.3 mg/kg. Figure 9.3 presents the locations and values of 1,3,5-trintrobenzene, heptachlor epoxide, and di-N-butyl phthalate detected in the surface-soil samples.

Groundwater

Potential contamination of groundwater at the Lower Burning Ground was assessed on the basis of groundwater collected from four monitoring wells (LBG-3-MW through LBG-6-MW) during two rounds of sampling (Figure 9.1). One groundwater sampling round was performed on September 17, 1992, and the other sampling round was performed December 8 through 9, 1992. Samples were analyzed for TCL organics, TAL metals, explosives, and macroparameters. A supplemental groundwater assessment was performed with a third round of sampling conducted at the request of DTSC. The third round of groundwater sampling was performed from May 31 through June 2, 1994. Samples were analyzed for TCL organics, TAL metals, explosives, and macroparameters.

Table 9.3 provides a summary of analytical results for organic analytes detected in groundwater samples. Table 9.3 also provides a summary of the analytical results for inorganic analytes detected in groundwater samples at concentrations greater than Lower Burning Ground background groundwater concentrations and summaries of the analyte concentrations representative of site and facility-wide background groundwater. Available federal and California (state) MCLs, as well as the CRLs for the analytical results, are included in Table 9.3.

Round 1 and 2. Acetone and methyl ethyl ketone (2-butanone) were the only two TCL organic volatile analytes detected above the CRLs. Acetone was detected in groundwater samples from

Well LBG-4-MW and methyl ethyl ketone was detected in samples from Wells LBG-3-MW and LBG-4-MW. Acetone was only detected in the groundwater sample collected from LBG-4-MW during the second round of groundwater sampling (December 9, 1992). The acetone concentration in this groundwater sample was 20 μg/l, slightly higher than the CRL of 8.0 μg/kg for acetone. Based on the following observations, the acetone detected in LBG-4-MW is likely not associated with site conditions because:

- Acetone was only detected in one of two sampling rounds.
- The concentration detected was near the CRL value.
- Acetone is a common laboratory contaminant.

Methyl ethyl ketone was detected in the groundwater samples collected from LBG-4-MW during the first (September 17, 1992) and the second (December 9, 1992) groundwater sampling rounds. The Methyl ethyl ketone concentrations in these samples were 159 and 71 μg/l, approximately 16 and 7 times the CRL concentration, respectively. Methyl ethyl ketone is a common laboratory contaminant and is likely associated with the laboratory. However, because methyl ethyl ketone was detected in both sampling rounds at concentrations significantly higher than the CRL concentration of 10.0 μg/l, the methyl ethyl ketone detected at LBG-4-MW may represent site conditions. Methyl ethyl ketone was also detected at a concentration of 64 μg/l in the duplicate sample collected from LBG-3-MW during the first groundwater sampling round. However, the corresponding investigative sample did not contain methyl ethyl ketone above the CRL. Methyl ethyl ketone was not detected in LBG-3-MW above the CRL concentration during the second round of groundwater sampling (December 8, 1992). The methyl ethyl ketone value detected in the duplicate sample for Well LBG-3-MW is not believed to be associated with groundwater conditions at LBG-3-MW because:

- The only detection of methyl ethyl ketone from groundwater samples obtained at Well LBG-3-MW was measured in the duplicate sample collected during the first groundwater sampling round.
- The subsequent sampling round did not detect methyl ethyl ketone above the CRL.
- Methyl ethyl ketone is a common laboratory contaminant.

Ten pesticides were detected above CRLs in the groundwater samples collected from Wells LBG-3-MW through LBG-6-MW during groundwater sampling Rounds 1 and 2. Most of these analytes were detected at concentrations slightly above their corresponding CRL except heptachlor, heptachlor epoxide, isodrin, and delta-benzenehexachloride. Heptachlor and heptachlor epoxide were detected at concentrations of 0.011 and 0.0406 μg/l, respectively, in the duplicate groundwater sample from LBG-3-MW during the first sampling round. Heptachlor epoxide was not detected above the CRL (0.0063 μg/l), and heptachlor was only detected at approximately 2 times the CRL (0.0025 μg/l) in the investigative sample collected from LBG-3-MW during the first groundwater sampling round. In addition, these analytes were not detected at concentrations greater than the corresponding CRL during the second groundwater sampling round. Therefore, the concentrations of heptachlor and heptachlor epoxide detected in the groundwater samples from the first round of groundwater sampling are not believed to be associated with site conditions.

Isodrin was detected at concentrations greater than between 2 and 10 times the CRL (0.0025 μg/l) in Wells LBG-4-MW and LBG-5-MW during sampling Rounds 1 and 2. In addition, isodrin was detected during the first round of groundwater sampling in LBG-6-MW at a concentration (0.0268 μg/l) 10 times greater than the CRL. Isodrin was detected in the rinsewater quality control (QC) sample collected during the first sampling round at a concentration of 0.00405 μg/l. Because isodrin was detected in the rinsewater sample collected during the first sampling round, the concentrations of isodrin detected in the samples could be attributed to the sampling or laboratory processing equipment. Isodrin detections from the second round of sampling were flagged to indicate higher than normal recoveries of associated control analysis. This flag implies that these investigative sample results may be overestimated. Additional follow-up groundwater sampling was then conducted to assess these earlier detections of isodrin. Isodrin was detected in a single groundwater sample (LBG-4-MW) but the result could not be confirmed by the laboratory. A duplicate analysis performed concurrently by a different laboratory did not detect isodrin in concentrations above the reporting limit (see page 9-14 of this document).

The pesticide delta-benzenehexachloride was detected during the second round of groundwater sampling at LBG-6-MW. This analyte was detected at a concentration of 0.0148 μg/l, approximately four times the CRL of 0.0034 μg/l. However, because this analyte was not detected during both sampling Rounds 1 and 2 and the detected concentration was only moderately above the CRL, this analyte is not believed to be representative of site conditions.

As shown in Table 9.3, five metals were sporadically detected in groundwater samples collected from Wells LBG-3-MW through LBG-6-MW at concentrations exceeding background concentrations. Table 9.5 summarizes the TCL metals that are greater than background concentrations. Sodium was consistently detected in Wells LBG-3-MW through LBG-6-MW at concentrations significantly higher than the background concentrations. However, similar levels of sodium were observed in other background groundwater samples (i.e., from BKG-3-HP). Because elevated concentrations of sodium occur throughout the SIAD region, the high concentrations of sodium are believed to be representative of site conditions.

In addition to elevated concentrations of sodium, the groundwater sample collected during the first sampling round (September 17, 1992) at Well LBG-3-MW also contained elevated concentrations of magnesium and potassium. However, these elevated concentrations of magnesium and potassium were not detected in the corresponding duplicate groundwater sample or in the groundwater sample from the second sampling round. Therefore, these elevated concentrations are not believed to be representative of groundwater conditions at LBG-3-MW.

Groundwater samples from Well LBG-5-MW contained arsenic at concentrations similar to the natural values of arsenic detected in other background well/borings to the west of LBG-5-MW. Because of this, the concentrations detected in samples from LBG-5-MW are likely associated with natural groundwater conditions within the region and not a result of site activities. The concentrations of vanadium detected in groundwater during the first and second groundwater sampling (1,090 and 1,920 μg/l) are significantly greater than the background concentration. Elevated concentrations of vanadium have not been detected in soil samples analyzed to date, and no known source of vanadium has been identified at the site. Therefore, it does not appear that the elevated concentrations of vanadium are associated with site activities.

Round 3 Follow-up. Acetone and methyl ethyl ketone (2-butanone) were detected in Round 1 and Round 2 groundwater samples; however, these compounds were not detected in Round 3 groundwater samples. Chloroform was detected in a groundwater sample collected from Monitoring Well LBG-5-MW and analyzed by Environmental Science and Engineering, Inc. (ESE), during the Round 3 sampling event; however, chloroform also was detected in the associated rinse blank sample. In addition, chloroform was not detected in the duplicate sample analyzed by DataChem. The presence of these VOCs in the Lower Burning Ground groundwater samples is not likely to be representative of site conditions because the acetone, 2-butanone, and chloroform were only detected sporadically in the groundwater samples, and these VOCs are common laboratory solvents and sample contaminants.

SVOCs were not detected in the Round 1 and Round 2 groundwater samples; however, three SVOCs were detected in the Round 3 groundwater samples. Two of the compounds, pentacosane and tetracosane, were detected in groundwater samples collected from Monitoring Wells LBG-3-MW, LBG-4-MW, and LBG-6-MW that were analyzed by ESE. These compounds are nontarget analytes and were tentatively identified by the laboratory. These compounds were not detected in the duplicate samples analyzed by DataChem. Because pentacosane and tetracosane are TICs and were not detected in the duplicate samples analyzed by DataChem, these compounds are not likely to be representative of site conditions.

The third compound, bis(2-ethylhexyl) phthalate, was detected in the Round 3 groundwater samples analyzed by ESE at concentrations that exceeded the respective federal and state MCLs. However, the compound was detected in the associated laboratory method blank and is likely to be a laboratory contaminant. In addition, the compound was not detected in the duplicate samples analyzed by DataChem. Therefore, the presence of this compound in groundwater samples is not likely to be the result of site-related activities or representative of site conditions. Because bis(2-ethylhexyl) phthalate is a target analyte and was detected in groundwater samples collected from each of the four monitoring wells sampled, bis(2-ethylhexyl) phthalate was included in a human health evaluation (HHE) and an environmental evaluation to provide evidence that it is not present at levels associated with adverse human health and ecological effects.

Pesticides were detected in one or more of the groundwater samples collected at the Lower Burning Ground; however, most of the pesticides were detected in Round 1 groundwater samples with fewer pesticides detected in the Round 2 and Round 3 groundwater samples. With one exception, the Round 3 follow-up groundwater samples did not contain detectable concentrations of pesticides. Isodrin was detected in a single groundwater sample collected from Monitoring Well LBG-4-MW on May 31, 1994. This result could not be confirmed. A duplicate analysis performed concurrently by a different laboratory did not detect isodrin in concentrations above the reporting limit. It is possible that laboratory contamination is responsible for the erratic nature of the detections. However, because isodrin and alpha-benzenehexachloride were detected in samples collected from more than one sampling round, these compounds were included in an HHE and an environmental evaluation to provide evidence that they are not present at levels associated with adverse human health and ecological effects (Appendix U of the Group III B Sites RI [HLA, 1994b]). Heptachlor and heptachlor epoxide also were included in the HHE and environmental evaluation because the concentration of these compounds in groundwater collected from Monitoring Well LBG-3-MW exceeded respective state MCLs; however, they were only detected in one round of analyses.

The explosive 1,3,5-trinitrobenzene was detected in Round 2 groundwater samples collected from Monitoring Wells LBG-3-MW and LBG-6-MW; however, these detections of 1,3,5-trinitrobenzene were not confirmed by the laboratory and 1,3,5-trinitrobenzene was not detected during the Round 1 or Round 3 groundwater sampling events. Therefore, the sporadic detections of 1,3,5-trinitrobenzene are not likely to be the result of site-related activity.

The cations magnesium, potassium, and sodium were detected in one or more of the Lower Burning Ground groundwater samples at concentrations that exceeded background concentrations. Sodium was detected in groundwater samples collected from Monitoring Wells LBG-3-MW through LBG-6-MW at concentrations significantly greater than the site background concentration, and in some samples, greater than the facilitywide background concentration. In addition to elevated concentrations of sodium, the groundwater samples collected from one or more of the monitoring wells contained elevated concentrations of magnesium and potassium. Although the concentrations of these cations occasionally exceeded site and facilitywide background values, activities associated with the Lower Burning Ground that could result in the raised concentrations of these cations have not been identified. However, similar levels of these cations were observed in other background samples (see Section 5.5 of the Final RI for SIAD Group III B Sites, [HLA, 1994b]) and the concentrations of these cations in the groundwater samples are not likely to be the result of site-related activity.

Metals, including arsenic, lead, iron, manganese, and vanadium, were detected in one or more of the groundwater samples at concentrations that exceeded site or facilitywide background concentrations. Groundwater samples collected at the Lower Burning Ground contained arsenic at concentrations that were greater than the values of arsenic detected in the site background well and exceed federal and state MCLs. However, the maximum concentration of arsenic detected in groundwater at the Lower Burning Ground is less than the concentration of arsenic detected in groundwater samples collected from facilitywide background monitoring wells. Thus, the concentrations of arsenic detected in samples collected from Monitoring Well LBG-5-MW are likely to be associated with natural groundwater conditions within the region and not associated with site activities. The concentrations of vanadium detected in groundwater collected from Monitoring Well LBG-5-MW during sampling Rounds 1, 2, and 3 are significantly greater than the site background concentrations. Elevated concentrations of vanadium have not been detected in soil samples analyzed to date and no known source of vanadium has been identified at the site. Therefore, it does not appear that the elevated concentrations of vanadium are associated with site activities. Iron, lead, and manganese were detected sporadically in groundwater collected from one or more of the monitoring wells and do not appear to be associated with site activities. Because of the relatively high concentrations of arsenic and vanadium detected in the groundwater samples, these metals were assessed in an environmental and human health evaluation (EHHE) (Appendix U of the Group III B Sites RI [HLA, 1994b]), which is summarized in the following section.

9.2.6 Summary of Site Risks

This section presents a review of the baseline risk assessment conducted for the Lower Burning Ground during the Group III B Sites RI/FS. Soil, including both surface and subsurface soil, is the only medium of concern at the site potentially requiring action, based on the results of the EHHE

(HLA, 1994b). Results of EHHEs for both soil and groundwater are presented in the following discussion.

9.2.6.1 Chemicals of Potential Concern

Soil

Surface soil consists of the soil or sediments from ground surface to 0.5 foot bgs and is the primary soil zone of concern. Subsurface soil at the Lower Burning Ground is of concern primarily because buried UXO is present.

The COPCs identified in the EHHE for the site surface soil were the following:

- 1,3,5-Trinitrobenzene
- Arsenic
- Beryllium
- Chromium (total)
- Lead
- Manganese
- Nickel
- Thallium

Groundwater

The COPCs identified in the EHHE for groundwater at the site consisted of:

- bis(2-ethylhexyl)phthalate
- Alpha-benzenehexachloride
- Heptachlor
- Heptachlor epoxide
- Isodrin
- Arsenic
- Vanadium

9.2.6.2 Contaminant Fate and Transport

The following is a discussion of contaminant fate and transport for the media of concern at the Lower Burning Ground soil.

Metals are not prone to volatilization; however, they may become entrained in air with dusts. The same is true for the one organic chemical present, 1,3,5-trinitrobenzene, which is typically classified as an SVOC. Even though 1,3,5-trinitrobenzene has a moderate water solubility (Merck, 1983; Ney, 1981) and only moderate soil sorption tendency (Spanggord et al., 1979; Kenaga and Goring, 1978; Dragun, 1988), entrainment with suspended dusts may be significant due to the infrequency of rain events at the site. Because all seven metals and the one organic COPC are found in surface soil, inhalation of entrained dusts by both current and future receptors may be an important exposure pathway.

The metal COPCs in surface soil will not tend to be mobilized by surface runoff in significant concentrations. As noted above, one organic COPC, 1,3,5-trinitrobenzene, has moderate water solubility and a moderate soil sorption tendency, and consequently may be prone to runoff. However, the low frequency of rainfall events combined with the relatively low surface-soil concentrations of 1,3,5-trinitrobenzene are expected to result in insignificant runoff potential. Additionally, the geographic relief of the Lower Burning Ground does not provide for surface runoff at this site.

9.2.6.3 Exposure Routes and Receptors

Soil

Many receptor populations and exposure pathways were evaluated for the site in the EHHE (HLA, 1994b), as shown in Figure 9.4. Several pathways identified in the EHHE were eliminated on the basis of the following considerations: (1) present land use and projected future land use, (2) low levels of risk as presented in Table 9.4, and (3) presence of UXO.

Present and projected future land use is a fundamental component when evaluating the relevance of potential exposure pathways. Land use assumptions provide the basis for identifying potential exposure pathways and developing the corresponding contaminant levels that are protective of human health and the environment. Future residential land use at SIAD is extremely unlikely; therefore, the residential exposure scenarios were not considered in developing RAOs for the FS. (Based on local city and county planning documents, including the Master Environmental Assessment for Lassen Southeast Planning Area [Lassen County Planning Department, June 1990]; the Wendel Area Plan and Environmental Impact Report [Resource Concepts, 1987]). Although SIAD has been targeted for realignment by the Base Closure and Realignment Committee (BRAC), transfer of this land to the public for residential use remains infeasible due to the buried UXO and deed restrictions attached to this site.

The NCP supports selection of a future land use other than residential occupancy before a ROD is developed. The NCP provides the following:

> The analysis for potential exposure under future land use conditions is used to provide decision-makers with an understanding of exposures that may potentially occur in the future. This analysis should include a qualitative assessment of the likelihood that the assumed future land use will occur. The reasonable maximum exposure estimate for future uses of the site will provide the basis for the development of protective exposure levels.
>
> In general, a baseline risk assessment will look at a future land use that is both reasonable, from land use development patterns, and may be associated with the highest (most significant) risk, in order to be protective. The assumption of residential land use is not a requirement of the program but rather is an assumption that may be made, based on conservative but realistic exposures. An assumption of future residential land use may not be justifiable if the probability that the site will support residential use in the future is small (55 Federal Regulations 8710).

The level of risk associated with a potential exposure pathway, as characterized in the EHHE, is a measure of the endangerment the potential exposure pathway may pose to receptors. It has been conservatively assumed that average conditions associated with potential exposure pathways that contribute excess cancer risks less than 1×10^{-6} and noncarcinogenic hazard quotients less than 1.0, as assessed by the EHHE (and in accordance with NCP), may be considered to be protective of human health.

The presence of UXO eliminates any potential onsite receptors and, therefore, eliminates any pathways associated with onsite chemical exposure. UXO presents a physical hazard, rather than a chemical hazard. As agreed to by the signatories of the FFA, access and land use restrictions shall be placed on this site due to the known presence of UXO.

Based on the three pathways eliminated above, the following receptor populations and exposure pathways were quantified in the EHHE.

Current Scenario

- Offsite Resident Farmer
  - Inhalation of dust from outdoor air
  - Inhalation of dust from indoor air

Future Scenario

- Onsite Construction Worker
  - Inhalation of dust from outdoor air
  - Ingestion of soil
  - Dermal contact with soil
- Onsite Resident
  - Inhalation of dust from outdoor air
  - Inhalation of dust from indoor air
  - Ingestion of soil
  - Dermal contact with soil

The results of the quantification of exposure pathways presented in the EHHE indicated the following:

- Noncarcinogenic health effects are not of concern for the current and future receptors evaluated. (An HI of less than 1.0 was estimated.) HIs greater than 1.0 were estimated for future receptors due primarily to ingestion of thallium in soil.

- Carcinogenic risk estimates for current receptors ranged from 6×10^{-6} to 4×10^{-5} for the average scenario and from 3×10^{-5} to 1×10^{-4} for the RME scenario. Carcinogenic risk estimates for future receptors ranged from 2×10^{-6} to 9×10^{-5} for the average scenario and from 3×10^{-6} to 3×10^{-4} for the RME scenario. Risks above EPA's acceptable range of 1×10^{-4} to 1×10^{-7} were due primarily to inhalation of chromium and arsenic.

- Estimated blood levels of lead were well below target levels, indicating an acceptable risk, for all current and future receptors evaluated.

Groundwater

The potential for exposure to groundwater is low because of its limited value as a source of water for domestic use. However, for this evaluation, human exposure to groundwater at the Lower Burning Ground was considered to be possible via the ingestion pathway.

Hypothetical receptors were identified as part of this HHE. The site is inactive with no regular or intermittent visits onsite by civilian or military workers, no residences onsite, and with controlled access. The human risk associated with a full-time resident using groundwater from the Lower Burning Ground for drinking and other domestic use was evaluated conservatively. The potentially complete exposure pathway is residential ingestion of the groundwater.

9.2.6.4 Human Health Risks

Soil

The results of the human health risk estimation for both current and future receptors are summarized in Table 9.4. For current receptors, all possible adverse noncancer health effects and cancer risks were below levels of regulatory concern. For hypothetical future residents, the maximum estimated HI of 30 indicates the possibility that adverse noncancer health effects (primarily associated with thallium [ingestion]) may be of concern at this site in the future. The cancer risk estimates for current and hypothetical future receptors ranged from 2×10^{-6} for the average scenario to 3×10^{-4} for the RME scenario. The high end of this range indicates that possible cancer risk exceeds the range of acceptable risk and was due primarily to inhalation of chromium in dust and ingestion of arsenic in soil for the future hypothetical composite child/adult resident receptor. However, it should be noted that the total chromium concentrations in soil were conservatively treated as hexavalent chromium, causing the risk estimates to be higher than actual conditions would warrant. In addition, the arsenic concentrations encountered in soil at the site are considered a natural condition, as discussed in Sections 5.2.4 and 5.3 of the Final Group III B Sites RI Report (HLA, 1994b).

Exposures to lead at the Lower Burning Ground were evaluated separately from exposures to the other COPCs. Modeling results indicated that adverse health effects from lead exposure are not expected for the current receptors, the offsite resident farmers. For hypothetical future residents, adverse health effects from lead exposure may be of concern for children (average and RME scenarios) and adults (RME scenario) if the postulated exposure conditions were to occur in the future. For hypothetical future construction workers, adverse health effects from lead exposure may also be of concern under the postulated RME conditions. However, significant adverse effects were associated only with future RME conditions that are hypothetical and conservative and unlikely to occur. Due to the presence of UXO at the site, it is highly unlikely that the Lower Burning Ground area would ever be zoned as residential. The potential physical hazards of UXO are more of a concern than the potential chemical hazards at the site.

Groundwater

A screening-level HHE of selected analytes detected in groundwater samples was performed to (1) provide an analysis of the maximum possible baseline risks potentially posed by chemicals in groundwater and (2) provide a basis for estimating levels of chemicals that can remain onsite and still be adequately protective of human health. This HHE was conducted with the knowledge that groundwater beneath the Lower Burning Ground is not potable and unlikely to be used domestically for reasons discussed in the Final RI for SIAD Group III B Sites (HLA, 1994b). These reasons include the following:

- The concentration of dissolved solids in groundwater samples exceeded federal MCLs of 500 milligrams per liter (mg/l) (EPA, 1993); therefore, groundwater at this site was not considered potable. However, it is recognized that the California Regional Water Quality Control Board has designated the entire Honey Lake Basin as a municipal drinking water source.
- Four PSWs are located near the southern boundary of the Main Depot supplying both the Depot and the adjacent town of Herlong; it was assumed that hypothetical future onsite residents at the site would receive domestic water supplies from these wells.
- A hydraulic connection is not known to exist between the aquifer sampled at the Lower Burning Ground and the aquifer that supplies the four PSWs (HLA, 1994b).

A toxicity assessment for the chemicals of potential concern was performed for the HHE. Toxicity values for each of the chemicals of potential concern were developed as described in Section 6.3 of the Final RI for SIAD Group III B Sites (HLA, 1994b). Specific California cancer potency factors were used where available. An EPA or California potency factor (or reference dose) is not available for isodrin. Therefore, isodrin was not included in the risk calculations.

Maximum concentrations for the chemicals of potential concern, as listed in Table 9.4, were used in the risk evaluation. EPA default exposure factors for a RME scenario were used (EPA, 1991). These factors are combined into an intake factor that, when multiplied by the groundwater concentration, results in an average daily intake for a specific chemical. These intake factors, along with the groundwater concentrations and the risk values, are provided in Table 9.5.

Screening-level human health risks for hypothetical residents using groundwater from the Lower Burning Ground were evaluated for adverse noncarcinogenic health effects and for carcinogenic risk. An HI was calculated to evaluate the potential for adverse noncarcinogenic health effects. The HI for the RME scenario is 163, of which 95 percent (an HI of 155) is contributed by the maximum concentration of arsenic. The majority of the remaining hazard index is contributed by vanadium, which has an individual hazard quotient of 7.8.

The RME carcinogenic risk estimate for a potential resident using groundwater is 3.5×10^{-2}. Arsenic contributes almost 100 percent of the estimated carcinogenic risk.

Background arsenic concentrations in SIAD are naturally high with a maximum detected background concentration of 5,300 μg/l. The maximum concentration detected in groundwater at the Lower Burning Ground and used in the risk estimation is 1,700 μg/l. The elevated risks associated with groundwater appear to reflect naturally occurring arsenic and are not site activities. The incremental site risks associated with arsenic are insignificant because the background and onsite levels are similar.

Isodrin is an isomer of aldrin. If aldrin is used as a surrogate for isodrin and a slope factor of 17 milligrams per kilogram body weight per day (mg/kg-day) is assumed for isodrin, the maximum concentration of 0.0000279 mg/l would be associated with an estimated risk of 5.5×10^{-6}. As with the compounds listed in Table 9.5, the estimated risk for isodrin is far exceeded by the risk associated with the arsenic groundwater concentrations.

9.2.6.5 Environmental Risks

A qualitative EE was performed for SIAD. The purpose of the EE was to evaluate the potential for adverse effects to ecological receptors as a result of possible exposure to chemicals originating from chemical source areas. The potential for aluminum and thallium toxicity was indicated for the Townsend's ground squirrel, sage grouse, and the burrowing owl as a result of incidental soil ingestion at the Lower Burning Ground. Conclusions regarding the potential for zinc toxicity to the sage grouse as a result of direct and indirect ingestion of soil at the Lower Burning Ground could not be made because insufficient avian toxicity data are available for zinc. It is not known whether the sage grouse, Townsend's ground squirrel, or the burrowing owl actually inhabit the 62-acre Lower Burning Ground, but because of the large acreage associated with the site, this possibility was not ruled out. The potential also exists for toxicity to Indian rice grass as a result of maximum concentrations of zinc present in soil at the site.

An EE of the groundwater at the Lower Burning Ground was not performed because the groundwater depth (in excess of 17 feet bgs) makes the groundwater inaccessible to biota that might frequent the site.

9.2.7 Description of the No Action Alternative

Based on the results of the baseline risk assessments performed during the RI/FS for the Lower Burning Ground, there is no adverse impact to human health or the environment from site-related activities. The only enhanced risks appear to be from naturally occurring levels of arsenic and thallium in the soil to a hypothetical future resident. Thus, the No Action alternative is supported by the baseline risk assessment discussed in Section 9.2.6 and the Administrative Record. Additionally, the presence of UXO at the site will prevent any future development of the site for residential use. The Lower Burning Ground is an isolated site in an inner secured area of SIAD and the solitary site access road is currently closed with a locked gate. The placement of deed and/or access restrictions on the site will restrict future use that could be harmful to human health.

9.2.8 Explanation of Significant Changes

The Proposed Plan for the nine sites was released to the public for comment on February 1, 1996. The preferred alternative identified for the Lower Burning Ground was No Action. Based on the absence of any new information or comments during the public comment period, no significant changes to the selected remedy for the Lower Burning Ground outlined in the Proposed Plan for Nine Sites were necessary.

9.3 Responsiveness Summary

The public comment period for the Proposed Plan for Nine Sites at SIAD began on February 7, 1996, and extended through March 7, 1996. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. No oral comments were received regarding the Lower Burning Ground at the public meeting.

Table 9.1: Summary of Soil-Gas Sampling Lower Burning Ground

Compound*	Number of Samples With Detections	Min Conc (µg/l)	Max Conc (µg/l)	Sample(s) With Max Conc
Methylene chloride	0	NA	NA	NA
Trichlorofluoromethane	0	NA	NA	NA
Chloroform	0	NA	NA	NA
1,2-Dichloroethene	0	NA	NA	NA
1,1,1-Trichloroethane	3	0.0009	0.003	LBG-11
Carbon tetrachloride	0	NA	NA	NA
Trichloroethene	1	NA	0.1	LBG-73
Tetrachloroethene	0	NA	NA	NA
Benzene	0	NA	NA	NA
Toluene	0	NA	NA	NA
Ethylbenzene	0	NA	NA	NA
Xylenes	0	NA	NA	NA
Total volatile hydrocarbons	6	0.4	14	LBG-75

Site identifications were labeled sequentially, total of 95 samples.

µg/l	Micrograms per liter
Conc	Concentration
Max	Maximum
Min	Minimum
NA	Not applicable

* Compounds are listed in elution order.

Table 9.2: Summary of Analyte Concentrations in Surface-Soil Samples That are Greater Than Background Concentrations - Lower Burning Ground[a]

	Minimum[b] Background Concentration	Maximum[b] Background Concentration	SIAD-wide Background Concentrations[c]	LBG-1-SS	LBG-1-SS-D	LGB-2-SS	LBG-3-SS
Depth (feet):	0	0	NS	0	0	0	0
Sample Date:	Not applicable	Not applicable	Not applicable	08/21/92	08/21/92	08/20/92	08/26/92
Soil Type:	325 and 330	325 and 330	NS	330	330	330	330
Inorganic Analytes							
Aluminum	12,100	29,200	1,780 to 29,200	51,200	37,900	25,900	41,700
Arsenic	0.500	4.63	0.500 to 18.0	---	---	5.46	6.06
Barium	223	609	41.4 to 630	---	---	---	---
Cadmium	0.589	3.05	0.589 to 3.05	4.32	4.45	---	11.8
Chromium	9.44	23.0	4.05 to 31.0	---	---	23.2	35.7
Cobalt	5.80	15.0	1.38 to 15.0	---	---	---	---
Copper	16.2	58.6	3.07 to 58.6	1,300	1,500	66.4	1,400
Cyanide	NA	NA	NA	<0.25	<0.25	<0.25	<0.25
Iron	12,600	29,200	3,330 to 29,200	31,400	30,300	33,300	40,300
Lead	0.170	10.5	0.170 to 10.5	130	89	---	400
Magnesium	7,780	15,000	1,400 to 26,600	---	---	---	15,700
Manganese	453	781	57.7 to 781	816	---	805	877
Mercury	0.0500	0.0500	0.0500	---	---	---	0.064
Nickel	8.20	21.6	0.24 to 22.4	---	---	---	24.4
Potassium	3,850	9,100	1,230 to 9,100	---	---	---	10,100
Silver	0.0250	2.50	0.250 to 2.50	---	---	---	3.66
Sodium	721	6,240	352 to 18,500	---	---	---	6,790
Thallium	6.62	62.9	6.38 to 62.9	---	---	143	---
Vanadium	30.1	63.0	9.76 to 130	65.3	---	66.1	---
Zinc	26.8	73.3	8.03 to 8.42	236	806	161	11,000

Table 9.2: Summary of Analyte Concentrations in Surface-Soil Samples That are Greater Than Background Concentrations - Lower Burning Ground[a] (Continued)

	LBG-4-SS	LGB-5-SS	LBG-6-SS	LBG-7-SS	LGB-8-SS	LGB-9-SS	LBG-10-SS
Depth (feet)	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Sample Date:	**08/20/92**	**08/20/92**	**08/26/92**	**08/26/92**	**08/21/92**	**08/21/92**	**08/21/92**
Soil Type	**330**	**330**	**330**	**330**	**330**	**330**	**330**
Inorganic Analytes							
Aluminum	28,700	29,600	33,200	44,400	32,600	61,400	41,000
Arsenic	---	---	---	---	14.8	5.91	---
Barium	---	---	---	---	---	654	---
Cadium	---	---	3.65	---	3.65	---	---
Chromium	---	---	---	---	---	30.8	23.6
Cobalt	---	---	---	---	---	21.4	16.7
Copper	---	---	---	476	386	70.7	---
Cyanide	<0.25	0.78	0.26	<0.25	<0.25	<0.25	<0.25
Iron	---	30,300	32,400	31,000	40,800	52,300	40,800
Lead	---	---	24	4,500	31	14.2	19.5
Magnesium	---	---	---	---	---	20,000	---
Manganese	864	819	879	795	---	846	869
Mercury	---	---	---	---	0.164	---	---
Nickel	---	---	---	---	---	28.4	22.4
Potassium	11,100	9,660	11,000	9,700	---	14,000	10,700
Silver	---	---	---	---	---	---	---
Sodium	---	---	---	---	8,860	7,700	---
Thallium	120	131	---	---	---	---	---
Vanadium	---	---	---	---	93.2	98.2	63.1
Zinc	---	80.2	108	169	1,700	99.4	120

Table 9.2: Summary of Analyte Concentrations in Surface-Soil Samples That are Greater Than Background Concentrations - Lower Burning Ground[a]
(Continued)

<	Less than certified reporting limits
---	Analyte not detected at levels exceeding background
NA	Not available
NS	Not specified

a. Values are reported in milligrams per kilogram.
b. Minimum and maximum concentrations for background surface-soil types 325 and 330 taken from Table 5.4 of the Group III B Sites RI Final Report (HLA, 1994).
c. Taken from Table 5.16 of the Group III B Sites RI Final Report (HLA, 1994).

Table 9.3: Summary of Analyte Concentrations in Groundwater - Lower Burning Ground^{a}

	Maximum LBG Background Concentration^{b}	Maximum Facilitywide Background Concentration^{b}	Primary Maximum Contaminant Level^{c}		Certified Reporting Limits		LBG-3-MW	LBG-3-MW	LBG-3-MW-(dup)	LBG-3-MW-(dup)	LBG-3-MW
			Federal	State							
Sample Date:	Not applicable	Not applicable	Not applicable		DataChem	ESE	09/17/92	12/08/92	09/17/92	12/08/92	06/02/94^{f}
Volatile Organic Compounds											
Acetone	NA	NA	N/L	N/L	8.0	13.0	<8.0	<8.0	<8.0	<8.0	<13.0
Methylene ketone/2-Butanone	NA	NA	N/L	N/L	10.0	3.6	<10.0	<10.0	64^{d}	<10.0	<6.4
Chloroform	NA	NA	100	N/L	1.0	0.500	<1.0	<1.0	<1.0	<1.0	<0.5
Semivolatile Organic Compounds											
bis(2-Ethylhexyl) phthalate	NA	NA	6.0	4.0	7.7	4.8	<7.7	<7.7	<7.7	<7.7	16
Pentacosane	NA	NA	N/L	N/L	N	N	ND	ND	ND	ND	20 S^{d}
Tetracosane	NA	NA	N/L	N/L	N	N	ND	ND	ND	ND	20 S^{d}
Pesticides/PCBs											
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane(ddt)	NA	NA	N/L	N/L	0.0025	0.034	<0.0025	<0.0025 H	<0.0025	<0.0025	<0.0340
2,2-bis(p-Chlorophenyl)-1,1-dichloroethene(dde)	NA	NA	N/L	N/L	0.0039	0.027	<0.0039	<0.0039 H	<0.0039	<0.0039	<0.0270
Aldrin	NA	NA	N/L	N/L	0.0074	0.091	<0.0074	<0.0074 H	<0.0074	<0.0074	<0.0918
Heptachlor	NA	NA	0.40	0.01	0.0025	0.042	0.0069	<0.0025 H	0.0110	<0.0025	<0.0423
Heptachlor epoxide	NA	NA	0.20	0.01	0.0063	0.024	<0.0063	<0.0063 H	0.0406	<0.0063	<0.0245
Isodrin	NA	NA	N/L	N/L	0.0025	0.056	<0.0025	0.0043 HU	<0.0025	<0.0025	<0.0562
Lindane	NA	NA	0.2	4.0	0.0025	0.051	<0.0025	<0.0025 H	<0.0025	<0.0025	<0.0507
alpha-Benzenehexachloride	NA	NA	N/L	N/L	0.0025	0.038	0.0042	<0.0025 H	0.0038 H	0.0031 H	<0.0385
alpha-Endosulfan/endosulfan I	NA	NA	N/L	N/L	0.0025	0.023	0.0067	<0.0025 H	<0.0025	<0.0025	<0.0230
delta-Benzenehexachloride	NA	NA	N/L	N/L	0.0034	0.029	<0.0034	<0.0034 H	<0.0034	<0.0034	<0.0293
Explosives											
1,3,5-Trinitrobenzene	NA	NA	N/L	N/L	0.210	0.449	<0.210	2.02 U	<0.210	<0.210	<0.449
Inorganic Analytes											
Arsenic	28.0	5,300	50	50	2.35	2.54	<74 K	<72 K	<12	<12	360^{d}
Iron	570	570	N/L	N/L	77.5	38.8	1,130^{d}	<77.5	731^{d}	<77.5	<38.8
Lead	5.0	6.30	15^{e}	50	4.47	1.26	<22 K	<22 JI	<22	<22	<2.5
Magnesium	513,000	513,000	N/L	N/L	135	500	2,600,000^{d}	630,000^{d}	670,000^{d}	640,000^{d}	475,000
Manganese	526	526	N/L	N/L	9.67	2.75	472	711^{d}	480	594^{d}	190
Potassium	240,000	353,000	N/L	N/L	1,240	375	1,200,000^{d}	350,000^{d}	410,000^{d}	370,000^{d}	341,000^{d}
Sodium	1,390,000	14,000,000	N/L	N/L	279	500	69,000,000^{d}	17,000,000^{d}	17,000,000^{d}	18,000,000^{d}	16,000,000^{d}
Vanadium	200	969	N/L	N/L	27.6	3.83	28.0	30.6	32.2	29.3	72.2

Table 9.3: Summary of Analyte Concentrations in Groundwater - Lower Burning Ground[a] (continued)

	LBG-4-MW	LBG-4-MW	LBG-4-MW	LBG-5-MW	LBG-5-MW	LBG-5-MW	LBG-5-MW-(dup)	LBG-6-MW	LBG-6-MW	LBG-6-MW
Sample Date:	**09/17/92**	**12/09/92**	**05/31/94^f**	**09/17/92**	**12/09/92**	**05/31/94^f**	**05/31/94^f**	**09/17/92**	**12/09/92**	**06/02/94^f**
Volatile Organic Compounds										
Acetone	<8.0	20	<13.0	<8.0	<8.0	<13.	<13.0	<8.0	<8.0	<13.0
Methylene ketone/2-Butanone	160^d	71	<6.4	<10.0	<10.0	<6.4	<6.4	<10.0	<10.0	<6.4
Chloroform	<1.0	<1.0	<0.5	<1.0	<1.0	0.68	<0.5	<1.0	<1.0	<0.5
Semivolatile Organic Compounds										
bis(2-Ethylhexyl) phthalate	<7.7	<7.7	**11**	<7.7	<7.7	**5.7**	**8.7**	<7.7	<7.7	**7.7**
Pentacosane	ND	ND	30 S	ND	ND	ND	ND	ND	ND	40 S
Tetracosane	ND	ND	20 S	ND	ND	ND	ND	ND	ND	40 S
Pesticides/PCBs										
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane(ddt)	<0.0025	0.0041 HU	<0.0340	<0.002	<0.0025 H	<0.0340	<0.0340	<0.0025	0.0032 HU	<0.034
2,2-bis(p-Chlorophenyl)-1,1-dichloroethene(dde)	0.0058	<0.0039 H	<0.027	<0.003	<0.0039 H	<0.00270	<0.0270	<0.0039	<0.0039 H	<0.027
Aldrin	0.0156	<0.0074 H	<0.918	0.013	<0.0074 H	<0.0918	<0.918	<0.0074	<0.0074 H	<0.0918
Heptachlor	<0.0025	<0.0025 H	<0.0423	0.0037	<0.0025 H	<0.0423	<0.0423	0.0043	<0.0025 H	<0.0423
Heptachlor epoxide	<0.0063	<0.0063 H	<0.0245	**0.0101**	<0.0063 H	<0.0245	<0.0245	<0.0063	<0.0063 H	<0.0245
Isodrin	0.0242	0.0109 HU	0.0036 U^g	0.0052	0.0279 HU	<0.0562	<0.0562	0.0268	<0.0025 H	<0.0562
Lindane	0.0059	<0.0025 H	<0.0507	0.0030	<0.0025 H	<0.0507	<0.0507	<0.0025	<0.0025 H	<0.0507
alpha-Benzenehexachloride	0.0047	<0.0025 H	<0.0385	0.0053	<0.0025 H	<0.0385	<0.0385	<0.0025	<0.0025 H	<0.0385
alpha-Endosulfan/endosulfan I	0.0059	<0.0025 H	<0.0230	0.0053	<0.0025 H	<0.0230	<0.0230	0.00427	<0.0025 H	<0.0230
delta-Benzenehexachloride	<0.0034	0.0037 HU	<0.0293	<0.003	<0.0034 H	<0.0293	<0.0293	<0.0034	0.0148 HU	<0.0293
Explosives										
1,3,5-Trinitrobenzene	<0.210	<0.210	<0.449	<0.210	<0.210	<0.449	<0.449	<0.210	0.349 U	<0.449
Inorganic Analytes										
Arsenic	**69^d**	49.6^d	**500^d**	<340 K	**390^d**	**1,700^d**	**1,700^d**	<37.0 K	<61 K	**280^d**
Iron	<77.5	<77.5	<38.8	790^d	<77.5	<38.	<38.8	429	<77.5	<38.8
Lead	<4.47	<4.47	2.98	<22 K	<22 JI	8.0^d	<2.5	<22 K	<22 JI	<2.5
Magnesium	310,000	188,000	84,900	280,000	480,000	330,000	336,000	670,000^d	930,000^d	760,000^d
Manganese	323	1,020^d	128	217	205	67.1	69.6	872^d	1,090^d	246
Potassium	<250,000	261,000^d	158,000	<250,000	490,000^d	412,000	407,000^d	<250,000	440,000^d	342,000^d
Sodium	15,000,000^d	9,800,000^d	7,300,000^d	13,000,000^d	20,000,000^d	16,000,000^d	17,000,000^d	15,000,-000^d	21,000,000^d	15,000,000^d
Vanadium	<27.6	<27.6	64.5	1,090^d	1,820^d	1,800^d	2,000^d	<27.6	<27.6	38.6

Table 9.3: Summary of Analyte Concentrations in Groundwater - Lower Burning Ground[a] (continued)

Values in bold exceed federal or state maximum contaminant levels.

Analytical results reported by DataChem except as indicated.

<	Less than certified reporting limit
DataChem	DataChem Laboratories, Inc.
dup	Duplicate analysis
ESE	Environmental Science and Engineering, Inc.
H	Out of control due to high quality control spike recoveries, but data accepted
I	Interferences in sample make quantitation and/or identification suspect
J	Value is estimated
K	Reported results are affected by interferences or high background
LBG	Lower Burning Ground
N/L	No maximum contaminant level for the respective analyte
N	Nontarget compound
NA	Background samples were not analyzed for organic compounds
NC	Non-USAEC performance demonstrated limit
ND	Non-target analyte was not detected
S	Tentatively identified compound
U	Analysis is unconfirmed

a. Values are reported in micrograms per liter.
b. Maximum concentrations for Lower Burning Ground and facilitywide background groundwater samples taken from Tables 5.13 and 5.15, respectively, of the Group III B Sites Final RI report.
d. Value exceeds concentrations representative of LBG background.
e. Treatment technique action level.
f. Analytical results reported by ESE.
g. Analytical results reported by DataChem.

Table 9.4: Summary of Multipathway Exposures at the Lower Burning Ground

Receptor Populations Exposure Pathways	Hazard Index Average	Hazard Index RME	Potential Upperbound Excess Cancer Risk Average	Potential Upperbound Excess Cancer Risk RME
Current Scenario				
Child/Adult Residents (Offsite)				
Inhalation of Dust from Outdoor Air	4.77E-02	8.89E-02	8.93E-06	2.96E-05
Inhalation of Dust from Indoor Air	1.55E-01	2.24E-01	2.76E-05	7.52E-05
Multipathway Exposures	2E-01	3E-01	4E-05	1E-04
Adult Residents (Offsite)				
Inhalation of Dust from Outdoor Air	2.20E-03	4.95E-03	4.56E-07	3.71E-06
Inhalation of Dust from Indoor Air	2.76E-02	4.11E-02	5.74E-06	3.08E-05
Multipathway Exposures	3E-02	5E-02	6E-06	3E-05
Future Scenario				
Construction Workers (Onsite)				
Ingestion of Soil	1.34E-01	3.87E-01	4.05E-07	1.00E-06
Dermal Contact with Soil	7.50E-03	6.80E-02	2.13E-08	1.62E-07
Inhalation of Dust from Outdoor Air	6.95E-02	9.07E-02	1.60E-06	2.29E-06
Multipathway Exposures	2E-01	5E-01	2E-06	3E-06
Child/Adult Residents (Onsite)				
Ingestion of Soil	6.84E+00	2.02E+01	1.82E-05	5.29E-05
Dermal Contact with Soil	6.73E-01	4.79E+00	1.77E-06	2.19E-05
Inhalation of Dust from Outdoor Air	9.53E-02	1.78E-01	1.79E-05	5.93E-05
Inhalation of Dust from Indoor Air	3.12E-01	4.47E-01	5.52E-05	1.51E-04
Multipathway Exposures	8E+00	3E+01	9E-05	3E-04
Adult Residents (Onsite)				
Ingestion of Soil	1.27E+00	1.87E+00	4.25E-06	1.75E-05
Dermal Contact with Soil	1.57E-01	1.18E+00	4.87E-07	9.97E-06
Inhalation of Dust from Outdoor Air	4.40E-03	9.93E-03	9.13E-07	7.41E-06
Inhalation of Dust from Indoor Air	5.53E-02	8.22E-02	1.15E-05	6.17E-05
Multipathway Exposures	1E+00	3E+00	2E-05	1E-04

RME Reasonable maximum exposure

Table 9.5: Risk Calculations Potential Adult Resident Ingestion of Groundwater - Reasonable Maximum Exposure Lower Burning Ground

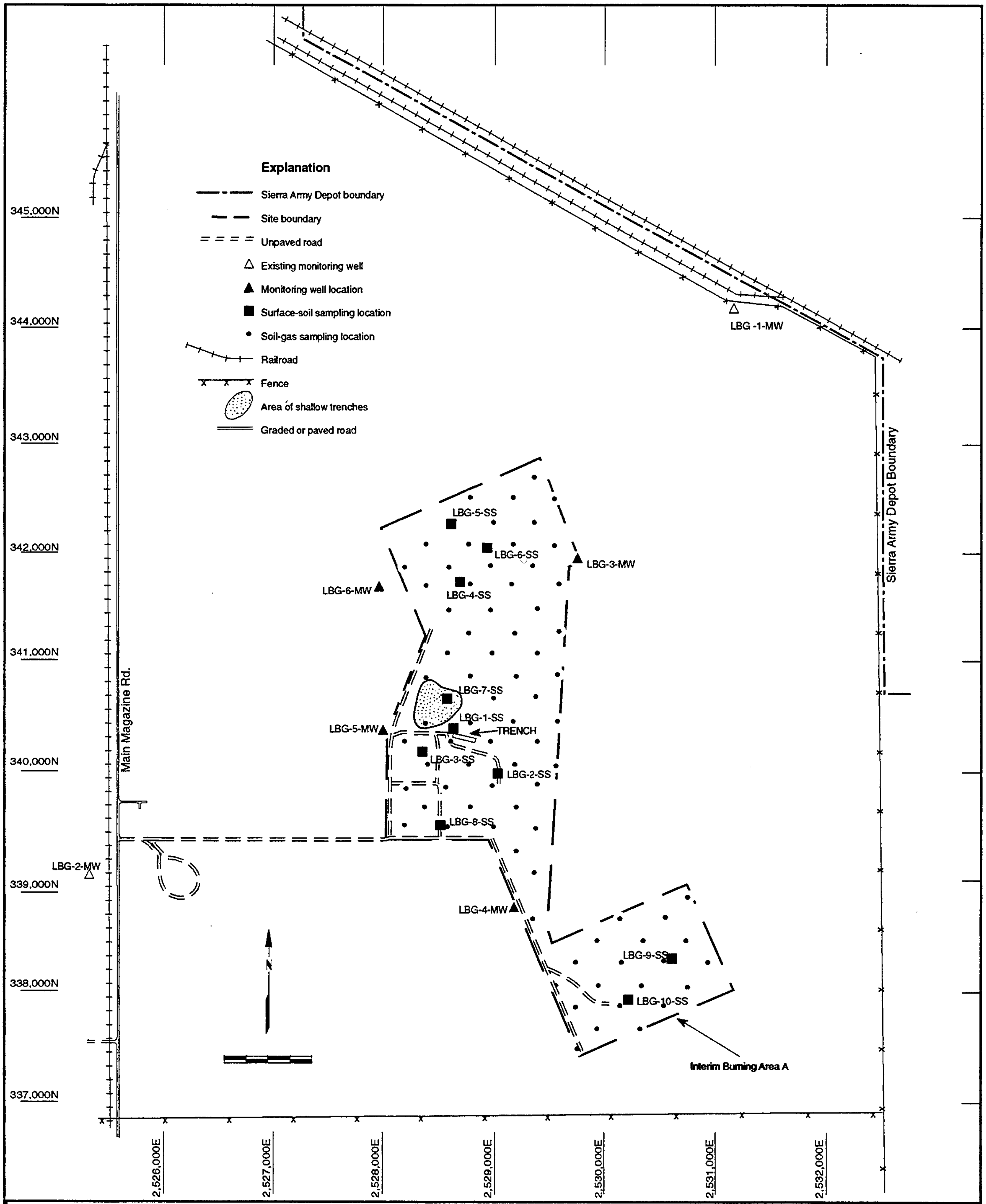
Carcinogenic Risk

Chemical	Chemical Concentration (mg/l)	Ingestion Intake Factor (l/kg-day)	Daily Intake (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Carcinogenic Risk	Percent of Total
Arsenic	1.70E+00	1.17E-02	2.00E-02	1.75E+00	3.49E-02	100.0
Bis-2(ethylhexyl)phthalate	1.60E-02	1.17E-02	1.88E-04	8.40E-03	1.58E-06	0.0
Heptachlor	2.12E-05	1.17E-02	2.49E-07	5.70E+00	1.42E-06	0.0
Heptachlor epoxide	4.06E-05	1.17E-02	4.77E-07	1.30E-01	6.20E-08	0.0
alpha-BHC, alpha-Lindane	1.93E-05	1.17E-02	2.27E-07	6.30E+00	1.43E-06	0.0
				Total Risk:	3.49E-02	

Hazard Index - Chronic

Chemical	Chemical Concentration (mg/l)	Ingestion Intake Factor (l/kg-day)	Daily Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Hazard Quotient	Percent of HI
Arsenic	1.70E+00	2.74E-02	4.66E-02	3.00E-04	1.55E+02	95.1
Bis-2(ethylhexyl)phthalate	1.60E-02	2.74E-02	4.38E-04	2.00E-02	2.19E-02	0.0
Heptachlor	2.12E-05	2.74E-02	5.81E-07	5.00E-04	1.16E-03	0.0
Heptachlor epoxide	4.06E-05	2.74E-02	1.11E-06	1.30E-05	8.56E-02	0.1
Vanadium	2.00E+00	2.74E-02	5.48E-02	7.00E-03	7.83E+00	4.8
				Hazard Index:	1.63E+02	

HI	Hazard index
l/kg-day	Liters per kilogram body weight day
mg/kg-day	Milligrams per kilogram body weight day
mg/l	Milligrams per liter
RfD	Reference dose

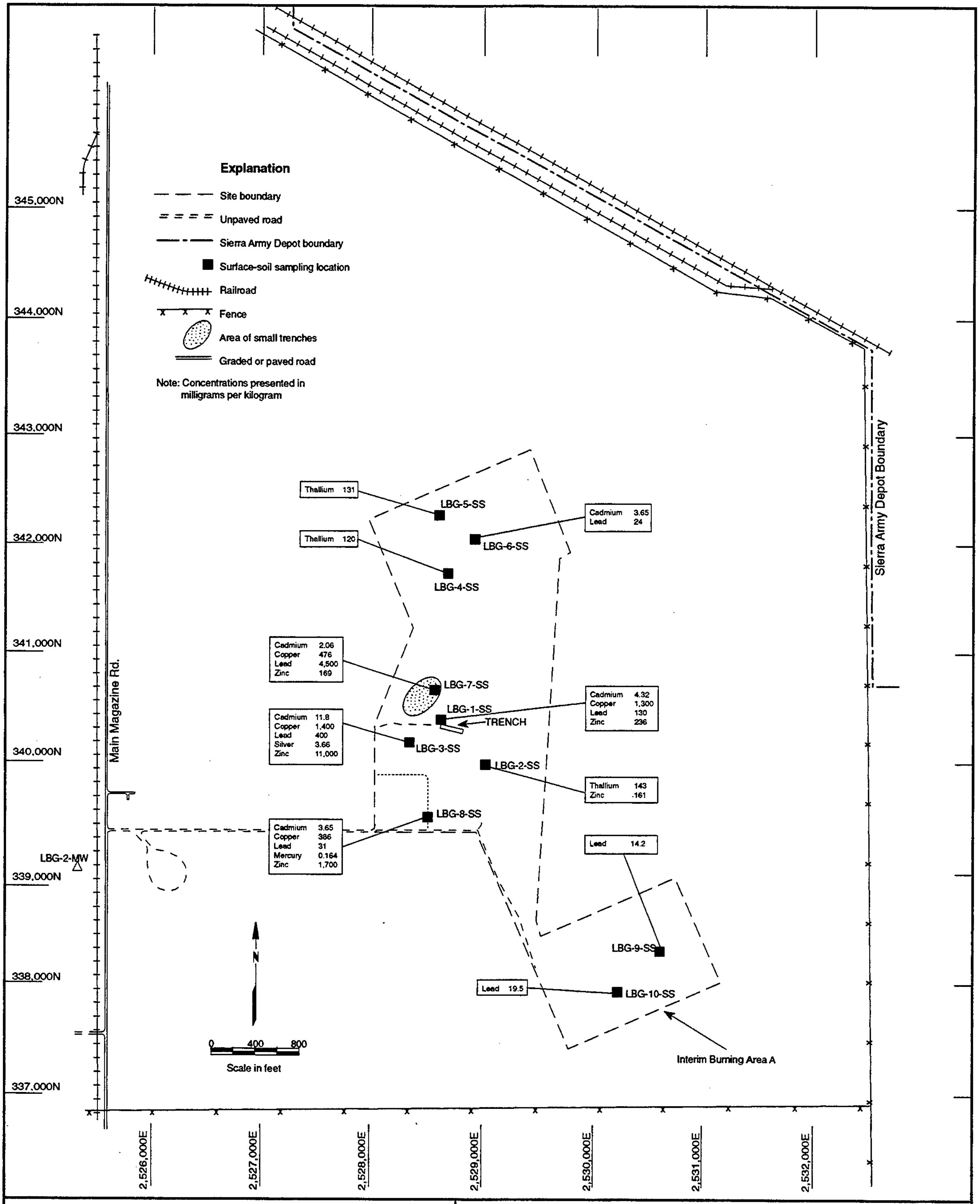


Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 9.1

Soil-Gas, Soil Boring, Surface-Soil, and
Monitoring Well Locations -
Lower Burning Ground



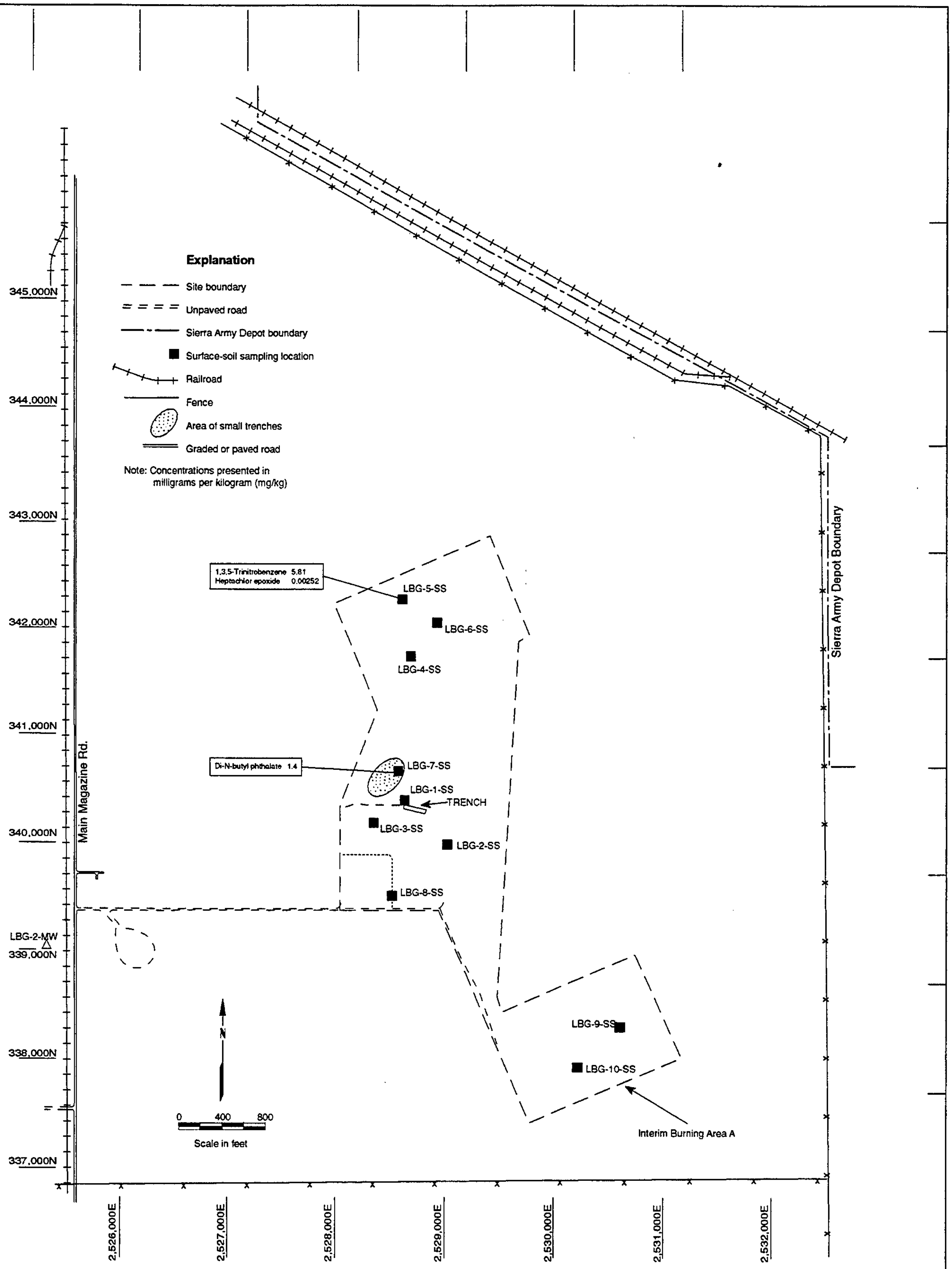
SRA 1070.11a 3/18/96 LAM

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 9.2

Inorganic Analytes Detected in Surface-Soil Samples that are Greater than Soil Type-specific and Regional Background Concentrations – Lower Burning Ground



SRA 1070.12a 02/01/96 ECS

Harding Lawson Associates
Engineering and Environmental Services

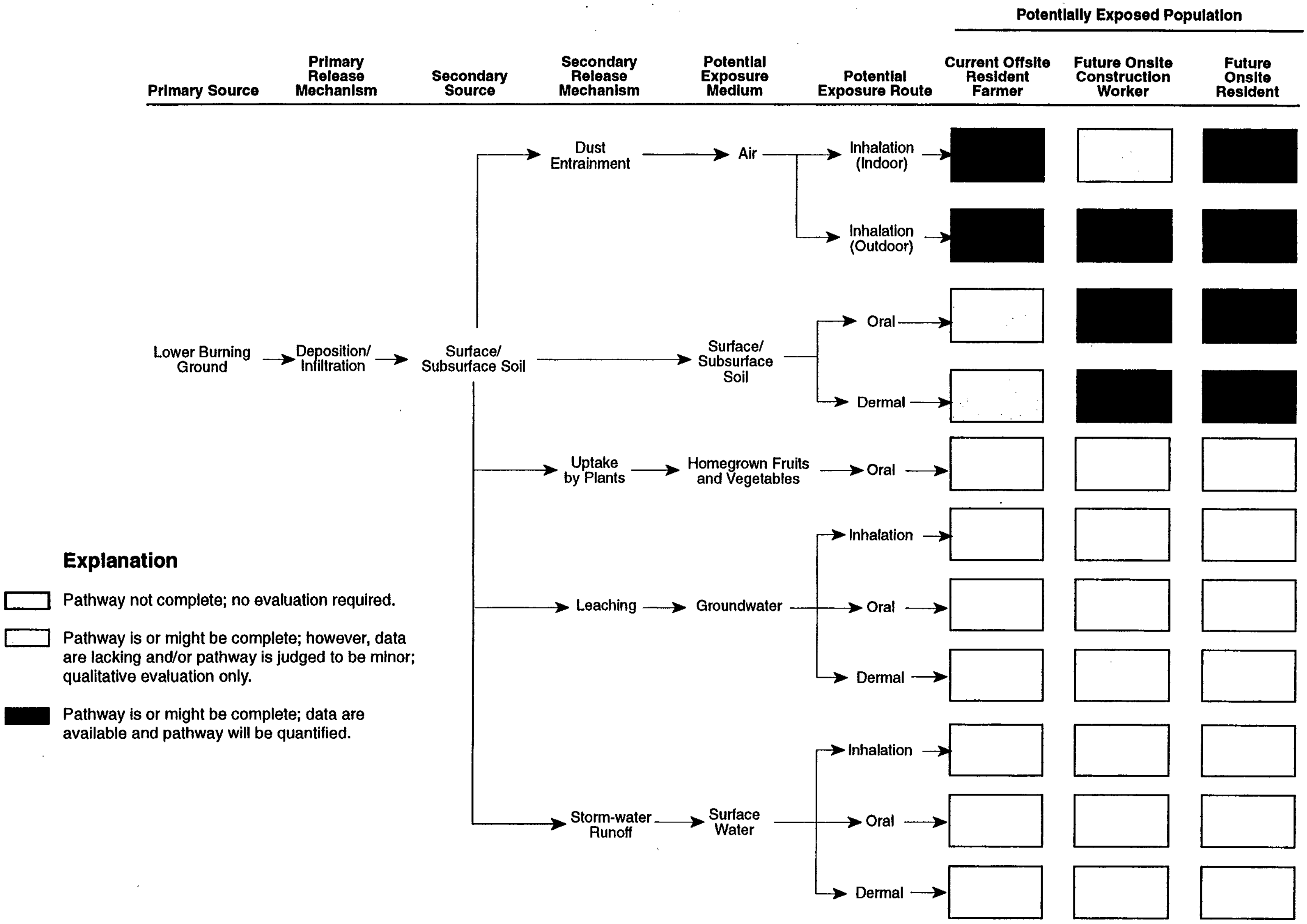
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 9.3

Organic Analytes Detected in Surface-Soil Samples - Lower Burning Ground

SRA 1070.13 02/01/96 ECS



Harding Lawson Associates
Engineering and
Environmental Services
HLA

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 9.4

Conceptual Site Model -
Lower Burning Ground

10.0 1960 DEMOLITION AREA

10.1 Declaration

This section provides the declaration portion of the ROD/RAP for the 1960 Demolition Area.

10.1.1 Location

The 1960 Demolition Area is located in the west-central portion of the Main Depot, as shown in Figure 1.1. The site was developed during 1960 when the Upper Burning Ground demolition area was closed for construction activities. The site consists of a large rectangular area measuring approximately 3,000 feet by 2,000 feet. Within the rectangular area are 24 relatively large, elongated surface depressions arranged in two rows, as shown in Figure 10.1.

10.1.2 Assessment of the Site

A contamination assessment of the 1960 Demolition Area was conducted during the Group III RI. The results of that assessment, presented in the Group III B Sites Final RI report (HLA, 1994b), are summarized as follows:

- Cobalt, copper, iron, nickel, and potassium were detected sporadically in surface soil at concentrations above background concentrations. The concentrations of these inorganic analytes probably represent natural conditions at this site.
- Cyclonite/hexahydro-1,3,5-trinitro-1,3,4-triazine (RDX) was the only explosive detected in surface soil. Its presence is likely the result of site activities.
- Three SVOCs (di-N-butyl phthalate, pyrene, and tetracosane) were detected in surface soil at concentrations just above their respective CRLs. Tetracosane was identified at very low concentrations but has no CRL. These compounds are not specifically known to have been used at the site; however, the presence of these compounds may be the result of site activities.
- Subsurface-soil sample metal concentrations detected above background levels include aluminum, cobalt, copper, manganese, nickel, and potassium.
- Groundwater samples collected from wells downgradient of the site did not indicate that groundwater quality has been impacted. Detections of antimony, lead, and nickel were below corresponding federal and/or state MCLs.

No potentially unacceptable risk to human health was identified. For current human receptors, noncarcinogenic health effects and cancer risks were below levels of regulatory concern. Ecological receptor risks include the potential for aluminum toxicity to the burrowing owl, sage grouse, and Townsend's ground squirrel as a result of soil ingestion.

Although the results of the RI indicate that no bombs remain onsite, the Army and Cal-EPA have agreed that site access shall be restricted because of the potential presence of UXO. Although these restrictions are not part of the CERCLA process, the restrictions will provide protection to human health from contaminants by limiting onsite access. On this basis, no action is recommended to achieve protection of human health and the environment.

10.1.3 Description of the Selected Remedy

As discussed in the preceding section, no action is recommended for this site. Because of the slight potential for UXO to be present at this site, deed and access restrictions will be placed on the site.

10.1.4 Statutory Determinations

No action is necessary to achieve protection of human health and the environment. None of the CERCLA § 121 statutory cleanup standards are triggered, and these requirements need not be addressed further in this ROD/RAP.

10.2 Decision Summary

This section provides the site-specific factors and analyses that were considered in the selection of No Action for the 1960 Demolition Area.

10.2.1 Site Description

The site consists of a large rectangular area measuring approximately 3,000 feet by 2,000 feet. Within the rectangular area are 24 relatively large, elongated surface depressions arranged in two rows, as shown in Figure 10.1. The largest depressions are located in the southern half of the site and are approximately 600 feet long, 100 feet wide, and 20 to 30 feet deep. The depressions have very steep-sided berms devoid of vegetation that are deeply incised by erosional gullies. The surface of the site consists of an abundance of scattered metal debris, especially in the southern half of the site. The debris includes jagged pieces of steel bomb fragments ranging in size from 1 inch to 1 foot or more in diameter. During the time that field activities were conducted at the site in June and July 1992, shallow standing water (groundwater) was present in several of the depressions.

10.2.2 Site History and Enforcement Activities

The site was developed during 1960 when the Upper Burning Ground demolition area was closed for construction activities. During 1960 and 1961, thirty-six 500-pound bombs were detonated at a rate of 12 times per day (432 bombs per day). Some of the metal fragments from this activity remain on the site surface today. CS tear gas grenades were also detonated at a rate of 200 to 248 pounds per day for a three-month period in 1961. During the 1970s, NIKE Hercules XM-30 motors were fired in silos on the site. The solid-based propellant used in the motors was burned in the silos during the firings. The NIKE motors were sent after the firings to the DPDO for salvage (ESE, 1983). The site is no longer in use for detonation of ordnance.

An Army explosive ordnance disposal (EOD) training area is located in the southern portion of the site. This area, which is south of the main bomb craters, contains concrete-lined silos placed at ground surface, scattered wooden crates, and bomb casings. The 1960 Demolition Area is currently used approximately five or six times a year as a training site for the Army EOD unit. The remainder of the time the site is unused.

Investigations that have been conducted at the 1960 Demolition Area include the Group III A Sites RI (HLA, 1994a).

The purpose of the Group III RI conducted by HLA was to ensure that potential environmental impacts associated with past activities at the site were thoroughly investigated and, if necessary, remediated. The investigation included the following:

- UXO clearance survey
- Surface geophysical survey
- Surface-soil sampling
- Subsurface-soil sampling
- Groundwater sampling

On the basis of the results of the RI contamination and risk assessments, an FS was not required for this site.

No enforcement activity has been associated with the 1960 Demolition Area. The site is subject to the requirements and schedule outlined in the FFA.

10.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 10.3 of this ROD/RAP.

The public participation requirements of CERCLA § 113(k)(2)(B)(i-v) and § 117 and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site. The response action presented for this site in this ROD/RAP was selected in accordance with CERCLA, NCP, Chapter 6.8 of the California Health and Safety Code, and the California Water Code. The basis for this decision is documented in the Administrative Record.

10.2.4 Scope and Role of Response Action

This site poses no potential threat to human health and the environment. The selected remedy is No Action. However, because of the potential for UXO to exist at the site, the Army and Cal-EPA have agreed to restrict site access by completing a perimeter fence at the site. This will be the final response action for the 1960 Demolition Area.

10.2.5 Site Characteristics

Investigation of the 1960 Demolition Area was initiated because of past uses of the site to destroy live ordnance. Potential contamination at the 1960 Demolition Area was evaluated to assess the impact of the site activities on soil and groundwater. An assessment of potential contamination at the site was based on surface geophysics, surface-soil, subsurface-soil, and groundwater analytical data.

10.2.5.1 1994 Group III RI

Geophysics

The assessment of data from the geophysical survey indicates that there were no anomalies indicating subsurface disposal at the 1960 Demolition Area. Metal debris appears to be present only on the ground surface or in the near surface. UXO surveys performed concurrently with the geophysics survey confirmed the absence of UXO. Generally, surficial metal debris, such as ejected bomb fragments, is more abundant in the southern half of the site.

Surface Soil

Potential surface-soil contamination at the 1960 Demolition Area was assessed on the basis of 16 composite and 4 discrete surface-soil samples (Figure 10.1). The surface-soil samples were collected from a depth interval between the surface and 0.5 foot bgs. Twelve of the 16 composite surface-soil samples were collected within the surface depressions (bomb craters) created by detonating bombs. The other four composite surface-soil samples were obtained along the perimeter of the bomb craters. The four discrete surface-soil samples were collected from soil boring locations within the bomb craters. The soil samples were analyzed for TAL metals, explosives, and TCL SVOCs (including orthochlorobenzaldehyde,a breakdown product of CS tear gas).

Table 10.1 summarizes the analytical results for TAL inorganic compounds detected in the surface-soil samples at concentrations greater than background concentrations for the soil types 325 (Epot very fine sandy loam) and 330 (Calneva silt loam). Thirteen analytes were sporadically detected at concentrations above the maximum background concentration. As shown in Table 10.2, with the exception of cobalt, copper, iron, nickel, and potassium, the maximum inorganic analytes detected at concentrations higher than the soil type-specific background concentrations fall below either western regional or SIAD facilitywide background concentrations. Cobalt was detected in 2 of 25 samples at levels exceeding background (16.4 and 18.7 mg/kg at DMA-3-SB and DMA-4-SB, respectively, versus the facilitywide maximum concentration of 15.5 mg/kg). Cobalt, however, has been detected in stream sediments in the Skeddadle Mountains Wilderness Area at concentrations as high as 30 mg/kg (Table 10.1). Maximum concentrations of copper were detected at the same surface-soil locations (DMA-3-SB and DMA-4-SB) at levels of 54.3 and 61.3 mg/kg, respectively, compared to the facility-wide maximum concentration of 58.6 mg/kg. Copper was detected in stream sediments in the Skedaddle Mountains Wilderness Area at concentrations as high as 300 mg/kg (Adrian, 1987; Table 10.1).

Maximum iron concentrations of 37,700 and 45,400 mg/kg are also associated with locations DMA-3-SB and DMA-4-SB. The facilitywide maximum background concentration for iron is 29,200 mg/kg. Iron has been detected at a maximum concentration of 100,000 mg/kg in the Skedaddle Mountains (Adrian, 1987; Table 10.1). The single detection of nickel exceeding background is at DMA-4-SB at a concentration of 25.7 mg/kg. This compares to the maximum facilitywide nickel concentration of 22.4 mg/kg and the range of 5 to 50 mg/kg detected in the Skedaddle Mountains (Adrian, 1987; Table 10.1). Potassium, an essential nutrient, also was detected at maximum concentrations of 9,940 and 11,300 mg/kg at DMA-3-SB and DMA-4-SB, respectively. The maximum facilitywide background concentration of potassium is 9,100 mg/kg.

Locations DMA-1-SB, DMA-2-SB, DMA-3-SB, and DMA-4-SB are at the bottom of the bomb craters and are subject to evaporation of groundwater. Because the groundwater level is near the surface soil at these locations, the concentration of these inorganic analytes may have been influenced by a process of upward capillary action and evaporation of groundwater (Brady, 1974). All other surface-soil locations are above the bomb crater depressions and contained inorganic compounds at levels within either the soil type- specific, facilitywide, or western regional background concentrations. For this reason, it is believed that the inorganic analytes represent natural conditions at this site.

Cyclonite/hexahydro-1,3,5-trinitro-1,3,4-triazine (RDX) was the only explosive detected in surface-soil samples. This analyte was detected in DMA-15-SS-D (the duplicate sample for DMA-15-SS) at a concentration of 1.64 mg/kg. The CRL for RDX was 0.587 mg/kg. Thus, the low concentration of RDX detected in DMA-15-SS-D was only slightly greater than the CRL. RDX was not detected above the CRL in the investigative sample DMA-15-SS. Therefore, the concentration of this compound was not reproducible. This is likely attributable to the physical limitations of collecting duplicate soil, which is a heterogeneous medium. Although RDX was not detected in the investigative soil sample DMA-15-SS and because the duplicate sample contained this compound above the CRL, RDX is considered to likely be present (in low concentrations near the CRL values) at the site. Explosives are known to have been detonated at this site, and therefore, the presence of this compound is likely a result of site activities.

Three semivolatiles (di-N-butyl phthalate, pyrene, and tetracosane) were detected in the 1960 Demolition Area surface-soil samples. Di-N-butyl phthalate was detected in DMA-6-SS and DMA-10-SS at concentrations of 1.3 and 2.7 mg/kg, respectively. The CRL for di-N-butyl phthalate was 1.3 mg/kg. Pyrene was detected in DMA-15-SS and its duplicate sample DMA-15-SS-D at low concentrations of 0.099 and 0.11 mg/kg, respectively. The CRL for pyrene was 0.033 mg/kg. Because the concentrations of pyrene in DMA-15-SS and DMA-15-SS-D are very similar, the value of pyrene detected in DMA-15-SS is considered to be reproducible. Tetracosane was detected as a TIC in DMA-14-SS and DMA-16-SS at concentrations of 0.36 and 0.46 mg/kg, respectively. Because tetracosane is a TIC, its identity was not confirmed, and there is no corresponding CRL for this analyte. Di-N-butyl phthalate and pyrene were considered to likely be present (in low concentrations near the CRL values) where they were detected within the site. These compounds are not specifically known to have been used or released at this site; however, the presence of these compounds may still be a result of site activities.

Subsurface Soil

Subsurface-soil contamination at the 1960 Demolition Area was assessed on the basis of 10 subsurface-soil samples collected from four soil borings (DMA-1-SB through DMA-4-SB) identified in Figure 10.1. The samples were analyzed for TAL metals and explosives. Explosives were not detected in the samples analyzed.

Table 10.2 summarizes the analytical results for TAL metals detected in subsurface-soil samples at concentrations exceeding background concentrations for subsurface soil. Each investigative sample was compared to the corresponding background concentration based on the soil type of the investigative sample. As indicated in Table 10.3, the concentration of several analytes (aluminum, cobalt, copper, manganese, nickel, and potassium) in the subsurface soil exceeded background levels.

Groundwater

Potential contamination of groundwater at the 1960 Demolition Area was assessed on the basis of two groundwater samples (DMA-1-HP and DMA-2-HP) collected from accumulated water in two shallow borings approximately 150 feet west (downgradient) of the 1960 Demolition Area site boundary. The groundwater samples were analyzed for TAL metals, hexavalent chromium, and macroparameters.

Sulfates were detected in the groundwater samples collected from DMA-1-HP and DMA-2-HP at concentrations of 2,700,000 to 8,300,000 μg/l, respectively. Sulfates were only analyzed in one background groundwater sample, BKG-3-HP, which had a detected sulfate concentration of 14,000,000 μg/l. Therefore, the concentrations of sulfates detected in the groundwater samples from DMA-1-HP and DMA-2-HP are considered to be within the natural range of sulfate concentrations in groundwater expected for this area. Although the CRLs for antimony, lead, and nickel exceeded the calculated background concentration, the detections were below the corresponding MCL (federal and/or state) or proposed MCL, as shown in Table 10.4.

10.2.6 Summary of Site Risks

This section presents a review of the baseline risk assessment conducted for the 1960 Demolition Area during the Group III B Sites RI. Soil, including both surface and subsurface soil, is the only medium of concern at the site based on the results of the EHHE (HLA, 1994b).

10.2.6.1 Chemicals of Potential Concern

The COPCs identified in the EHHE for the site surface and subsurface soil were the following:

- Arsenic
- Beryllium
- Chromium (total)
- Manganese
- Nickel
- Thallium

10.2.6.2 Contaminant Fate and Transport

Metals are not prone to volatilization; however, they may become entrained in air with dusts. Because all six metal COPCs are found in surface soil, inhalation of entrained dusts by both current and future receptors may be important. The metal COPCs in surface soil will not tend to be mobilized by surface runoff in significant concentrations. Additionally, the geographic relief of the 1960 Demolition Area does not provide for surface runoff from this site.

10.2.6.3 Exposure Routes and Receptors

Many receptor populations and exposure pathways were evaluated for the site in the EHHE (HLA, 1994b), as shown in Figure 10.2. Hypothetical receptors were identified on the basis of the chemicals detected at the site, current and future land uses, demographics of the area, and actual or possible activities of the population in question. Possible receptors considered in the analysis include current and future child and adult residents (both onsite and offsite), military and civilian workers, construction workers, and casual civilian visitors. Receptor populations selected for evaluation were considered to be hypothetical receptors whose inclusion in the risk analysis would provide estimates of potential upper-bound human health risks associated with exposure to the COPCs.

The following factors were considered in assessing whether current receptor populations would be evaluated for this site:

- The site is currently inactive (i.e., it has no current military uses), with no regular or intermittent visits onsite by military workers (Weis, oral commun., 1992).
- Military EOD personnel visit an area immediately south of the site boundary approximately eight times per year, for one working day per visit, to demonstrate equipment in a SIAD training program (Weis, pers. commun., 1993).
- There are no residences onsite.
- Honey Lake, located west of the site, historically occupies approximately 60,000 acres; however, only approximately 2,000 acres are currently covered by water. The nearest towns of Sage Flats and Herlong are located five to six miles southeast of the site.
- The site is within the fenced Depot boundary; access is controlled by routine base security measures, and the site is off limits to casual civilian visitors.

Based on these factors, offsite military workers were evaluated as a current receptor population. The following receptor populations are not present at the site and were, therefore, not evaluated in the HHE: current onsite workers, current child and adults residents (both onsite and offsite), current onsite construction workers, and current casual civilian visitors.

Possible future receptor populations at the 1960 Demolition Area were also considered, although residential development is very unlikely. Hypothetical future construction workers and hypothetical future onsite residents (both children and adults) were evaluated as receptor populations at this site.

Cal-EPA (1992) requested that a health risk assessment of hypothetical onsite resident scenarios be included in the HHE so that future determinations can be made regarding deed restrictions.

Therefore, the following receptor populations were evaluated for this site:

- Current offsite military workers
- Future onsite construction workers
- Future onsite residents (children and adults)

The future receptors are considered to be hypothetical individuals, assumed to be exposed to the COPCs via the conservative exposure assumptions used in this HHE. It is likely that receptors and actual exposure at the site in the future will be less than what is presented here. The following receptor populations and exposure pathways were quantified in the EHHE.

Current Scenario

- Offsite military worker
    - Inhalation of dust from outdoor air

Future Scenario

- Onsite Construction Worker
    - Inhalation of dust from outdoor air
    - Ingestion of soil
    - Dermal contact with soil
- Onsite Resident
    - Inhalation of dust from outdoor air
    - Inhalation of dust from indoor air
    - Ingestion of soil
    - Dermal contact with soil

The results of the quantification of exposure pathways presented in the EHHE indicated the following:

- Noncarcinogenic health effects are not of concern for the current and future receptors evaluated. (An HI of less than 1.0 was estimated.) HIs greater than one were estimated for future receptors due primarily to ingestion of thallium in soil.
- Carcinogenic risk estimates for the current offsite receptor were 4 x 10^{-6} for the average scenario and 2 x 10^{-5} for the RME scenario. Carcinogenic risk estimates for future individual receptors ranged from 2 x 10^{-6} to 5 x 10^{-5} for the average scenario and from 3 x 10^{-6} to 2 x 10^{-4} for the RME scenario. Risks above EPA's acceptable range of 1 x 10^{-4} to 1 x 10^{-7} were due primarily to inhalation of chromium and arsenic.

Figure 10.1 summarizes the exposure pathways and receptor populations for this site. Hypothetical average and RME exposures to these receptors via these exposure pathways were quantitatively estimated.

The pathways identified in the EHHE can be eliminated on the basis of the following considerations: (1) present land use and projected future land use, (2) low levels of risk as presented in Table 10.5, and (3) the physical hazard from the potential for the presence of UXO.

Present and projected future land use is a fundamental component when evaluating the relevance of potential exposure pathways. Land use assumptions provide the basis for identifying potential exposure pathways and developing the corresponding contaminant levels that are protective of human health and the environment. Future residential land use at SIAD is extremely unlikely. (Based on local city and county planning documents, including the Master Environmental Assessment for Lassen Southeast Planning Area [Lassen County Planning Department, June 1990]; the Wendel Area Plan and Environmental Impact Report [Resource Concepts, 1987]). Although SIAD has been targeted for realignment by the BRAC, transfer of this land to the public for residential use remains infeasible due to the potentially buried UXO and deed restrictions to be attached to this site.

10.2.6.4 Human Health Risks

The results of the human health risk estimation for both current and future receptors are summarized in Table 10.5. Possible noncancer health effects were evaluated separately. For current receptors, all possible adverse noncancer health effects were below levels of regulatory concern, and estimated cancer risks ranged from 4 x 10^{-6} to 2 x 10^{-5}. For hypothetical future receptors, the maximum estimated HI of 5 indicated that possible noncancer health effects (primarily associated with thallium ingestion) may be of concern at this site in the future. The cancer risk estimates ranged from

2×10^{-6} to 2×10^{-4}. The high end of this range is primarily associated with dust inhalation and ingestion of soil by hypothetical future composite child/adult resident receptors. The estimated risks were due primarily to chromium and arsenic. These estimates could indicate that possible cancer risk would be within the range of regulatory concern. However, the high end of this range (2×10^{-4}) is a risk estimate based on RME exposure. The chromium detected at this and other sites at SIAD was not speciated by the laboratory, being reported as "total chromium." For the purposes of this risk assessment, chromium was conservatively assumed to occur in the hexavalent form. However, chromium VI is not typically expected to persist in the environment because it tends to combine with organic compounds to form chromium III compounds, which are not carcinogenic. Moreover, chromium VI was not expected to be generated by the activities historically or currently conducted at SIAD. For these reasons, cancer risk estimates associated with dust inhalation, which were driven by chromium VI, are likely to be overestimated. Additionally, arsenic at this site is considered a natural condition.

10.2.6.5 Environmental Risks

A qualitative EE was performed for SIAD. The purpose of the EE was to evaluate the potential for adverse effects to ecological receptors as a result of possible exposure to chemicals originating from chemical source areas. Both direct and indirect routes of exposure were considered for five terrestrial indicator species at the 1960 Demolition Area. The one aquatic indicator species (mallard duck) was not evaluated at this site because aquatic receptors are not known to inhabit the site or nearby areas. The complete exposure pathways identified for the 1960 Demolition Area are discussed below and summarized in Table 10.6.

Plants may take up COPCs in surface and subsurface soil via their root systems if the roots are in direct contact with the chemicals and the chemicals are available for uptake. Plants may also take up soluble COPCs through the stomata or leaf cuticle after foliar deposition (Fergusson, 1990).

The most significant direct exposure pathway for herbivorous terrestrial animals (e.g., sage grouse and Townsend's ground squirrel) to chemicals in soil is through ingestion. The indirect exposure pathway of ingestion of soil while preening or grooming is expected to represent the main exposure route from dermally contacted chemicals. In addition, herbivorous terrestrial animals may possibly ingest seeds and other plant parts containing COPCs.

The two predatory indicator species, the burrowing owl and the kit fox, may also be directly exposed to chemicals in soil via ingestion. The burrowing owl may be exposed via soil ingestion while feeding or preparing and maintaining its nest. The kit fox may also be exposed while preparing and maintaining its den, as well as while foraging for the grubs and plants that comprise a small part of its diet. All indirect soil pathways (e.g., ingestion of plants) are considered to be complete for these two indicator species, except for ingestion of plants by the burrowing owl, which is strictly a carnivore.

The potential for aluminum and toxicity was indicated for the Townsend's ground squirrel, sage grouse, and the burrowing owl as a result of incidental soil ingestion at the 1960 Demolition Area. It is not known whether the sage grouse, Townsend's ground squirrel, or the burrowing owl actually inhabit the 138-acre 1960 Demolition Area, but because of the large acreage associated with the site, this possibility was not ruled out.

10.2.7 Description of the No Action Alternative

Based on the results of the baseline risk assessment performed during the RI for the 1960 Demolition Area, there is no adverse impact to human health or the environment from site-related activities. Thus, the No Action alternative is supported by the baseline risk assessment discussed in Section 10.2.6 and the Administrative Record. The 1960 Demolition Area is an isolated site in an inner secured area of SIAD. The placement of deed and/or access restrictions on the site due to the potential presence of UXO will ensure that there is no future use that will be harmful to human health.

10.2.8 Explanation of Significant Changes

The Proposed Plan for the nine sites was released to the public for comment on February 1, 1996. The preferred alternative identified for the 1960 Demolition Area was No Action. Based on the absence of any new information or comments during the public comment period, no significant changes to the selected remedy for the 1960 Demolition Area outlined in the Proposed Plan for Nine Sites were necessary.

10.3 Responsiveness Summary

The public comment period for the Proposed Plan for Nine Sites at SIAD began on February 7, 1996, and extended through March 7, 1996. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. No oral comments were received for the 1960 Demolition Area at the public meeting.

Table 10.1: Summary of Analyte Concentrations in Surface-Soil Samples That are Greater Than Background Concentrations - 1960 Demolition Area[a]

	Minimum[b] Background Concentration	Maximum[b] Background Concentration	DMA-1-SB	DMA-1-SS	DMA-2-SB	DMA-2-SS	DMA-2-SS-D	DMA-3-SB	DMA-3-SB-D	DMA-3-SS	DMA-4-SB	DMA-4-SB-D	DMA-4-SS
Depth (feet):	0	0	0	0	0	0	0	0	0	0	0	0	0
Sample Date:	Not applicable	Not applicable	08/17/92	08/17/92	08/18/92	08/18/92	08/18/92	08/19/92	08/19/92	08/18/92	08/19/92	08/19/92	08/18/92
Soil Type:	325 and 330	Not applicable	325	325	325	325	325	325	325	325	325	325	325
Inorganic Analytes													
Aluminum	12,100	29,200	---	---	---	---	---	33,600	31,000	---	53,200	---	---
Arsenic	0.500	4.63	---	---	6.7	---	---	14.9	NA	---	4.9	---	---
Chromium	9.44	23.0	---	---	---	---	---	23.2	---	---	28.8	---	---
Cobalt	5.80	15.0	---	---	---	---	---	16.4	---	---	18.7	---	---
Copper	16.2	58.6	41.3	---	41.6	---	---	54.3	48	---	61.3	---	---
Iron	12,600	29,200	---	---	30,000	---	---	37,700	34,500	---	45,400	---	---
Magnesium	7,780	15,000	---	---	---	---	---	17,800	16,200	---	19,400	---	---
Manganese	453	781	---	---	---	---	---	---	---	---	786	---	---
Nickel	8.20	21.6	---	---	---	---	---	---	---	---	25.7	---	---
Potassium	3,850	9,100	---	---	---	---	---	9,940	---	---	11,300	---	---
Sodium	721	6,240	8,500	---	8,730	---	---	8,710	8,800	---	8,140	---	8,140
Vanadium	30.1	63.0	---	---	---	---	---	87.7	73.5	---	101	---	---
Zinc	26.8	73.3	---	---	---	---	---	---	---	---	80	---	---

Table 10.1: Summary of Analyte Concentrations in Surface-Soil Samples That are Greater Than Background Concentrations - 1960 Demolition Area[a] (continued)

	DMA-5-SS	DMA-6-SS	DMA-7-SS	DMA-7-SS-D	DMA-8-SS	DMA-9-SS	DMA-10-SS	DMA-11-SS
Depth (feet):	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Sample Date:	**08/18/92**	**08/18/92**	**08/18/92**	**08/18/92**	**08/18/92**	**08/19/92**	**08/19/92**	**08/19/92**
Soil Type:	**325**	**325**	**325**	**325**	**325**	**325**	**325**	**325**
Inorganic Analytes:								
Aluminum	---	---	---	---	---	---	---	---
Arsenic	---	---	---	---	---	---	---	---
Chromium	---	---	---	---	---	---	---	---
Cobalt	---	---	---	---	---	---	---	---
Copper	---	---	---	---	---	---	---	---
Iron	---	---	---	---	---	---	---	---
Magnesium	---	---	---	---	---	---	---	---
Manganese	---	---	---	---	---	---	---	---
Nickel	---	---	---	---	---	---	---	---
Potassium	---	---	---	---	---	---	---	---
Sodium	---	---	---	---	---	---	---	---
Vanadium	---	---	---	---	---	---	---	---
Zinc	---	---	---	---	---	---	---	---

Table 10.1: Summary of Analyte Concentrations in Surface-Soil Samples That are Greater Than Background Concentrations - 1960 Demolition Area[a] (continued)

	DMA-12-SS	DMA-13-SS	DMA-14-SS	DMA-15-SS	DMA-15-SS-D	DMA-16-SS
Depth (feet):	**0**	**0**	**0**	**0**	**0**	**0**
Sample Date:	**08/17/92**	**03/17/93**	**03/03/93**	**03/03/93**	**03/03/93**	**03/17/93**
Soil Type:	**325**	**325**	**325**	**325**	**325**	**325**
Inorganic Analytes						
Aluminum	---	---	---	---	---	---
Arsenic	---	6.4	5.7	---	5.5	6.3
Chromium	---	---	---	---	---	---
Cobalt	---	---	---	---	---	---
Copper	---	---	---	---	---	---
Iron	---	---	---	---	---	---
Magnesium	---	---	---	---	---	---
Manganese	---	---	---	---	---	---
Nickel	---	---	---	---	---	---
Potassium	---	---	---	---	---	---
Sodium	---	7,010	8,200	---	---	7,010
Vanadium	---	---	76	---	---	---
Zinc	---	---	---	---	---	---

<	Less than certified reporting limits
---	Analyte not detected at levels exceeding background
NA	Not analyzed

a. Values are reported in milligrams per kilogram.

b. Minimum and maximum concentrations for background surface-soil types 325 and 330 taken from Table 5.4 of the Group III B Sites Final RI report (HLA, 1994b).

Table 10.2: Comparison of Maximum Analyte Detections in Surface Soil at the 1960 Demolition Area to Average Elemental Concentrations in Soil of the Western United States and Observed Concentrations at SIAD[a]

Analyte	Maximum Surface Soil Detection at the 1960 Demolition Area[b]	Mean[a,c]	Range of Detected Background Concentrations at SIAD[d]
Aluminum	53,200	74,000	1,780 to 29,200
Antimony	---	0.62	0.270 to 7.14
Arsenic	14.9	7.0	0.500 to 18.0
Barium	---	670	41.4 to 630
Beryllium	---	0.97	0.492 to 1.86
Cadmium	---	NA	0.589 to 3.05
Calcium	---	33,000	1,180 to 69,000
Chromium	28.8	56	4.05 to 31.0
Cobalt	18.7	9.0	1.38 to 15.0
Copper	61.3	27	3.70 to 58.6
Iron	45,400	26,000	3,330 to 29,200
Lead	---	20	0.170 to 10.5
Magnesium	19,400	NA	1,400 to 26,600
Manganese	786	480	57.7 to 781
Mercury	---	0.065	0.0500
Molybdenum	---	1.1	1.12 to 52.8
Nickel	2.57	19	0.240 to 22.4
Potassium	11,300	NA	1,230 to 9,100
Selenium	---	0.34	0.250
Silver	---	NA	0.250 to 2.50
Sodium	8,800	12,000	352 to 18,500
Thallium	---	NA	6.38 to 62.9
Vanadium	101	88	9.76 to 130
Zinc	80	65	8.03 to 84.2

All measurements are in milligrams per kilogram (mg/kg).

--- Analyte not detected at levels exceeding soil type-specific background.

a. Shacklette, H. T., and Boerngen, J.G., 1984, Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, U.S. Geological Survey Professional Paper 1270, 105 pp.
b. Taken from Table 5-17 of the Group III B Sites Final RI report (HLA, 1994b).
c. Mean is the estimated arithmetic mean for soil of the western United States.
d. Taken from Table 5.14 of the Group III B Sites Final RI report (HLA, 1994b).

Table 10.3: Summary of Analyte Concentrations in Subsurface-Soil Samples That are Greater Than Background Concentrations - 1960 Demolition Area[a]

	Maximum Background Concentration			DMA-1-SB	DMA-1-SB	DMA-2-SB
Depth (feet):	Not applicable	Not applicable	Not applicable	3.5	6.3	3.5
Sample Date:	Not applicable	Not applicable	Not applicable	08/17/92	08/17/92	08/18/92
Soil Type:	Sand[b]	Silt and clay[c]	Silty/clayey sand or sand and silt/clay[d]	Clay	Silty sand	Clay
Inorganic Analytes						
Aluminum	9,910	28,000	28,000	31,900	22,800	31,400
Chromium	12.7	31.0	31.0	---	---	---
Cobalt	15.0	15.0	15.0	15.8	---	15.5
Copper	58.6	58.6	58.6	---	---	---
Lead	6.62	6.62	6.62	6.9	---	---
Manganese	311	707	707	---	---	748
Nickel	12.6	22.4	22.4	---	---	---
Potassium	4,930	8,200	8,200	8,720	5,650	10,000

	DMA-2-SB-D	DMA-3-SB	DMA-3-SB	DMA-4-SB	DMA-4-SB	DMA-4-SB	DMA-4-SB
Depth (feet):	3	2	3.5	1	1.5	2	4
Sample Date:	08/18/92	08/19/92	08/19/92	08/19/92	08/19/92	08/19/92	08/19/92
Soil Type:	Silt and Clay	Silt	Silt and sand	Silt	Silt	Silt	Silt
Inorganic Analytes							
Aluminum	---	55,400	---	---	38,900	50,900	NA
Chromium	---	33.4	---	---	---	---	NA
Cobalt	---	20.1	---	---	16.5	18.9	NA
Copper	---	69.1	---	---	---	---	NA
Lead	---	10.8	---	---	8.19	9.5	15.1
Manganese	---	759	---	---	---	741	NA
Nickel	---	27.5	---	---	---	26.8	NA
Potassium	---	12,100	---	---	---	10,400	NA

Table 10.3: Summary of Analyte Concentrations in Subsurface-Soil Samples That are Greater Than Background Concentrations - 1960 Demolition Area[a]

(continued)

<	Less than certified reporting limits
---	Analyte not detected at levels exceeding background
NA	Not analyzed

a. Values are reported in milligrams per kilogram.
b. Maximum background concentrations for subsurface sandy soil taken from Table 5.8 of the Group III B Sites Final RI report (HLA, 1994b).
c. Maximum background concentrations for subsurface silt and clay soil taken from Table 5.7 of the Group III B Sites Final RI report (HLA, 1994b).
d. Maximum background concentrations for subsurface soil consisting of sand, silt, and clay taken from Table 5.9 of the Group III B Sites Final RI report (HLA, 1994b).

Table 10.4: Summary of Analyte Concentrations in Groundwater That are Greater Than Background Concentrations - 1960 Demolition Area[a]

	Maximum Background Concentration[b]	Primary Maximum Contaminant Level Federal	Primary Maximum Contaminant Level State	DMA-1-HP	DMA-1-HP-D	DMA-2-HP	DMA-2-HP	DMA-2-HP-D
Sample Date:	**Not applicable**	**Not applicable**		**3/17/93**	**3/17/93**	**3/04/93**	**3/17/93**	**3/04/93**
Inorganic Analytes:								
Antimony	112	6	N/L	<38.0	NA	<38.0	NA	<38.0
Lead	3.15	15[c]	50	<25	NA	-	NA	-
Nickel	17.2	100	N/L	<34.3	NA	<34.3	NA	<34.3

<	Less than certified reporting limit
-	Analytes not detected at levels exceeding background
N/L	No maximum contaminant level for the respective analyte
NA	Not analyzed
MCL	Maximum contaminant level

a. Values reported in micrograms per liter.

b. Maximum concentrations for background groundwater samples taken from Table 5.11 of the Group III B Sites Final RI report (HLA, 1994b); background wells for 1960 Demolition Area are Wells DSB-04-MW and BKG-03-HP.

c. Action level.

Table 10.5: Summary of Multipathway Exposures
1960 Demolition Area

Receptor Populations Exposure Pathways	Hazard Index Average	Hazard Index RME	Potential Upperbound Excess Cancer Risk Average	Potential Upperbound Excess Cancer Risk RME
Current Scenario				
Adult Workers (Offsite)				
Inhalation of Dust from Outdoor Air	2.25E-02	3.10E-02	4.47E-06	1.76E-05
Multipathway Exposures	2E-02	3E-02	4E-06	2E-05
Future Scenario				
Construction Workers (Onsite)				
Ingestion of Soil	5.48E-02	1.23E-01	3.34E-07	8.15E-07
Dermal Contact with Soil	2.84E-03	1.98E-02	1.72E-08	1.32E-07
Inhalation of Dust from Outdoor Air	5.16E-02	7.34E-02	1.51E-06	2.29E-06
Multipathway Exposures	1E-01	2E-01	2E-06	3E-06
Child/Adult Residents (Onsite)				
Ingestion of Soil	2.00E+00	4.22E+00	1.19E-05	3.34E-05
Dermal Contact with Soil	1.82E-01	9.03E-01	1.15E-06	1.39E-05
Inhalation of Dust from Outdoor Air	5.26E-02	1.02E-01	9.44E-06	3.11E-05
Inhalation of Dust from Indoor Air	1.72E-01	2.75E-01	2.91E-05	7.89E-05
Multipathway Exposures	2E+00	5E+00	5E-05	2E-04
Adult Residents (Onsite)				
Ingestion of Soil	3.71E-01	3.91E-01	2.78E-06	1.11E-05
Dermal Contact with Soil	4.25E-02	2.22E-01	3.18E-07	6.31E-06
Inhalation of Dust from Outdoor Air	2.42E-03	5.70E-03	4.81E-07	3.90E-06
Inhalation of Dust from Indoor Air	3.05E-02	4.73E-02	6.07E-06	3.23E-05
Multipathway Exposures	4E-01	7E-01	1E-05	5E-05

RME Reasonable maximum exposure

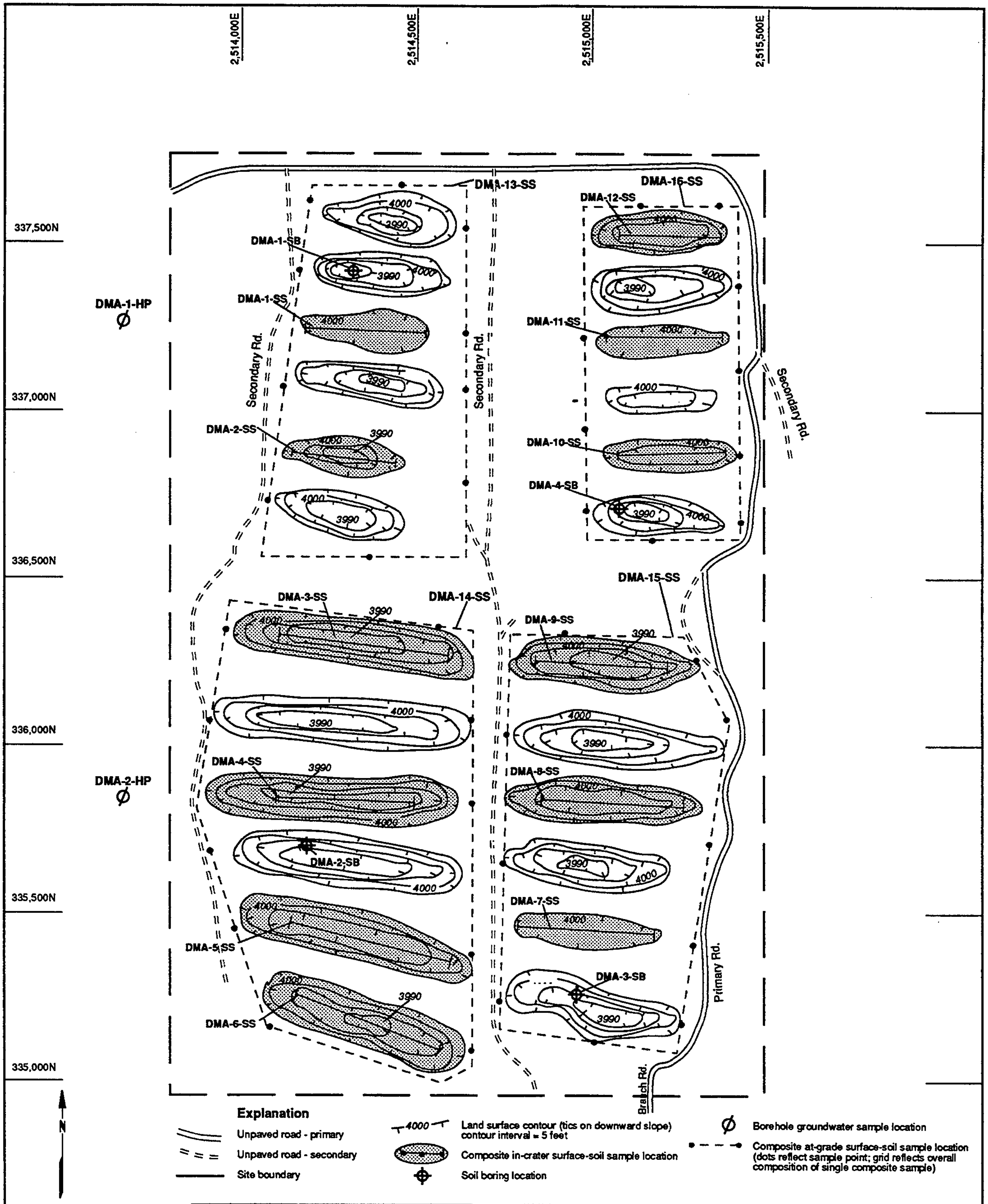
Table 10.6: Ecological Exposure Pathways Qualitatively Evaluated for the 1960 Demolition Area

	Potential Receptors#					
	Terrestrial					Aquatic
Possible Exposure Routes*	Indian Rice Grass	Sage Grouse	Townsend's Ground Squirrel	Burrowing Owl	Kit Fox	Mallard Duck
Soil						
Direct Pathways						
Uptake by plants	Y	---	---	---	---	---
Ingestion	---	Y	Y	Y	Y	---
Indirect Pathways						
Plant ingestion	---	Y	Y	N	Y	---
Ingestion during preening or grooming	---	Y	Y	Y	Y	---
Ingestion of herbivores by carnivores	---	---	---	Y	Y	---

--- Not applicable
N Exposure pathway was not evaluated in the ecological assessment because pathway was considered incomplete.
Y Exposure pathway was considered complete and was evaluated in the ecological assessment.

* Potential exposure routes considered for inclusion in the ecological assessment.
\# Potential receptors are representative indicator species possibly exposed to COPCs.

SRA 1070.16a 02/01/96 ECS



0 150 300
Scale in Feet

Harding Lawson Associates
Engineering and
Environmental Services

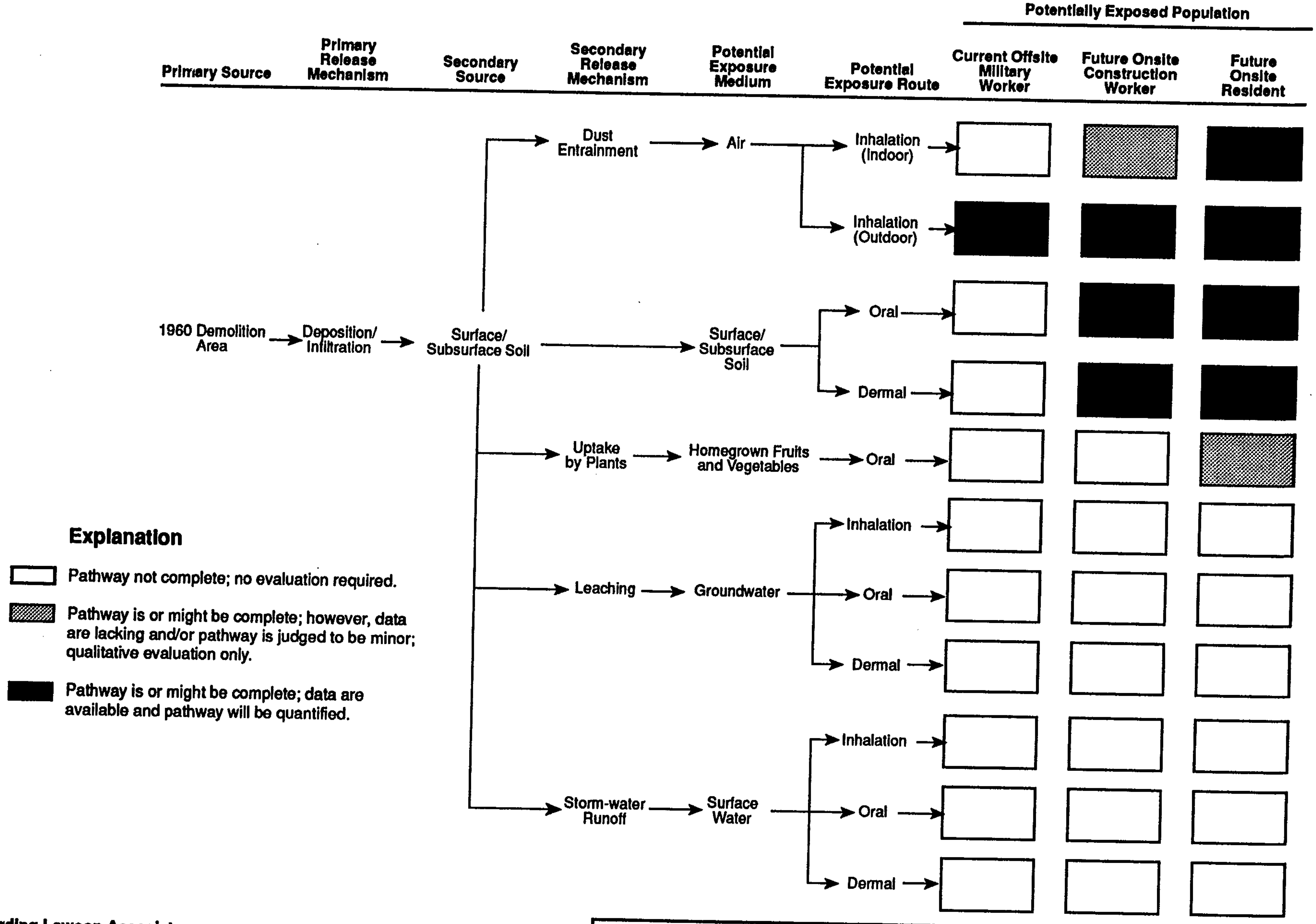
HLA

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 10.1

Surface-Soil, Soil Boring, and Borehole Groundwater Sample Locations - 1960 Demolition Area



Harding Lawson Associates
Engineering and
Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 10.2

Conceptual Site Model -
1960 Demolition Area

11.0 ACRONYMS

ADRA	Ammunition Demilitarization and Renovation Area
ARAR	Applicable or relevant and appropriate requirement
Army	U.S. Department of the Army
BETX	Benzene, ethylene, toluene, xylenes
bgs	Below ground surface
BHC	Alpha-benzenehexachloride
BNA	base/neutral/acid extractable compound
BRAC	Base Closure and Realignment Act
Cal-EPA	California Environmental Protection Agency
CCR	Code of California Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERFA	Community Environmental Response Facilitation Act
CFR	Code of Federal Regulations
cm/s	Centimeters per second
COPC	Compound of potential concern
CRL	Certified reporting limit
cy	Cubic yards
DDD	2,2-bis(p-Chlorophenyl)-1,1-dichloroethane
DDE	2,2-bis(p-Chlorophenyl)-1,1,1-dichloroethene
DDT	2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane
DPDO	Defense Property Disposal Office
DRMO	Defense Reutilization and Marketing Office
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
EE	Environmental Evaluation
EHHE	Environmental and Human Health Evaluation

ELCR	Excess lifetime cancer risk
EOD	Explosive and ordnance demolition
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
FFA	Federal Facility Site Remediation Agreement
FS	Feasibility Study
GC/MS	Gas chromatography/mass spectrometry
GPR	Ground penetrating radar
HHE	Human health evaluation
HI	Hazard index
HLA	Harding Lawson Associates
HPC	Heterotrophic plate count
HWM	Hazardous Waste Management
IRP	Installation Restoration Program
JMM	J.M. Montgomery Consulting Engineers, Inc.
kg	Kilogram
l	Liter
LBG	Lower Burning Ground
MCL	Maximum contaminant level
MEK	Methyl ethyl ketone
mg/l	Milligrams per liter
mg/kg-day	Milligrams per kilogram body weight per day
mg/kg	Milligrams per kilogram
MRL	Method reporting limit
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
PCBs	Polychlorinated biphenyls

PCE	Tetrachloroethene
PRG	Preliminary remediation goal
PSW	Potable supply well
QC	Quality control
RAOs	Remedial Action Objectives
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RDX	Cyclometrimethylenetrinitroamine
RI	Remedial Investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act of 1986
SIAD	Sierra Army Depot
STLC	Soluble threshold limit concentration
SVOC	Semivolatile organic compound
SWRCB	State Water Resources Control Board
TAL	Target analyte list
TBC	To be considered
TCA	Trichloroethane
TCE	Trichloroethylene
TCL	Target compound list
TDS	Total dissolved solid
TEPS	Total Environmental Program Support
TIC	Tentatively identified compound
TNT	Trinitrotoluene
TOCDD	Total octachlorodibenzo-p-dioxin

TPH	Total petroleum hydrocarbon
TRPH	Total recoverable petroleum hydrocarbons
TTLC	Total Threshold Limit Concentration
TVH	Total volatile hydrocarbon
USAEC	U.S. Army Environmental Center
USAEHA	U.S. Army Environmental Hygiene Agency
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UXO	Unexploded ordnance
VOC	Volatile organic compound
WDR	Waste discharge requirement
WET	Waste extraction test
°F	Degrees Fahrenheit
μg/l	Micrograms per liter
μg/g	Micrograms per gram

12.0 REFERENCES

Adrian, B.M., et al. 1987. Analytical results and sample locality map of stream sediment, heavy-mineral-concentration, rock, and water samples from the Skedaddle and Dry Valley Rim Wilderness Study Areas, Lassen County, California, and Washoe County, Nevada, U.S. Geological Survey Open-File Report 87-494.

Benioff, P.A., T. Filley, and S.Y. Tsai. 1988. *U.S. Army Toxic and Hazardous Materials Agency master environmental plan for the Sierra Army Depot*, October.

Brady, N.C. 1974. *The nature and properties of soils* (8th ed.). New York. MacMillan Publishing Co., Inc.

California Department of Water Resources. 1963. *Northeastern counties groundwater investigation*, Bulletin No. 98, February.

California Environmental Protection Agency. 1992. Comments regarding the Sierra Army Depot group III remedial investigation and feasibility study draft final technical plans. Department of Toxic Substance Controls, August 3.

Colberg, J. 1992. *Sierra Army Depot wildlife management plan*. Environmental Management Division, Herlong, California, November.

Dragun, J. 1988. *The soil chemistry of hazardous materials*. Silver Springs, Maryland. Hazardous Materials Control Research Institute.

Environmental Science and Engineering, Inc. 1983. *Reassessment of Sierra Army Depot, Herlong, California*, Report No. 149R. September.

Fergusson, J.E. 1990. The heavy elements, chemistry, environmental impact, and health effects. Pergamon Press.

Handman, E.H., C.J. Londquist, and D.K. Maurer. 1990. *Ground-water resources of Honey Lake Valley, Lassen County, California, and Washoe County, Nevada*. U.S. Geological Survey, Water Resources Investigations Report 90-4050.

Harding Lawson Associates. 1994a. *Final remedial investigation and environmental and human health evaluation for Sierra Army Depot - group III A sites, Lassen County, California*, June.

———. 1994b. *Final remedial investigation for Sierra Army Depot - group III B sites*, Lassen County, Calif. June.

———. 1996. *Final feasibility study for Sierra Army Depot group III B sites*, Lassen County, Calif. February.

James M. Montgomery Consulting Engineers, Inc. (JMM). 1992. *Final group II remedial investigation report*. Sierra Army Depot, July.

James M. Montgomery Consulting Engineers, Inc., and E.C. Jordan Company. 1991. *Sierra Army Depot phase I remedial investigation/feasibilitystudy, Lassen County, California, final remedial investigation, DAAA15-88-D-006, task order 3*. October.

James M. Montgomery Consulting Engineers, Inc. 1987. *Operation plan for deactivation furnace, Sierra Army Depot*, Herlong, California. December.

———. 1992. *Group II remedial investigation/feasibilitystudy, Sierra Army Depot, final remedial investigation report*. July.

Kenaga, E. and C. Goring. 1978. Relationship between water solubility, soil sorption, octanol/water partitioning, and bioconcentration of chemicals in biota. In *Proceedings of the ASTM Third Aquatic Toxicology Symposium*, New Orleans, Louisiana. Cited in USATHAMA, 1985.

Lassen County Planning Department. 1990. *Lassen southeast master environmental assessment.*

Lyman, W.J., W.F. Reahl, and D.H. Rosenblatt. 1990. *Handbook of chemical property estimation methods.* American Chemical Society, pub., Washington, D.C.

Merck and Company. 1983. Merck Index. M. Windholz, ed. Rahway, N.J. Merck and Co., Inc. Cited in USATHAMA, 1985 and EPA,1987a.

Montgomery Watson. 1993. *Final group I followup remedial investigation*, Sierra Army Depot. May.

———. 1994. *Draft final group I and II follow-up remedial investigation report*, Sierra Army Depot, Herlong, California. December.

———. 1996. *Draft focused feasibility study, building 1003 area*, Sierra Army Depot, Herlong, California. February.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 1990. Final Rule, 40 CFR Part 300, 55 Federal Register 46. March 8.

Ney, R.E. Jr. 1981. Fate, transport and prediction model applications to environmental pollutants. Spring Research Symposium, James Madison University, Harrisonburg, Virginia. April.

Resource Concepts, Inc. 1987. *Wendel area plan and environmental impact report.* Prepared for the Lassen County Planning Department, October.

Sawyer and McCarty. 1978. *Chemistry for sanitary engineers*, New York McGraw-Hill Book Company.

Spanggord, R.J., T. Mill, T.W. Chou, W.R. Mabey, J.H. Smith, and S. Lee. 1979. Environmental fate studies on certain munition wastewater constituents - literature review. U.S. Army Medical Research and Development Command, Contract DAMD17-78-C-8081. SRI International. Cited in USATHAMA, 1985.

State of California and U.S. Department of the Army. 1991. Sierra Army Depot Federal Facility Site Remediation Agreement. May.

Steinhart, P. 1990. *California's wild heritage - threatened and endangered animals in the Golden State.* Seattle. Craftsman Press.

U.S. Army Environmental Hygiene Agency (USAEHA). 1972. Solid Waste General Survey No. 26-005-73, Sierra Army Depot, Herlong, California. December 11 to 15.

———. 1985a. Hazardous Waste Study No. 37-26-0529-85, Phase 4 of AMC Open-Burning/Open-Detonation Grounds Evaluation, Investigation of Soil Contamination at the Open-Burning/Open-Detonation Grounds, Sierra Army Depot, Herlong, California, October 24 to 30, 1984, Aberdeen Proving Ground, Maryland. July 8.

———. 1985b. Geohydrologic Study No. 38-26-0503-86, Sierra Army Depot, Herlong California. August 12 to 29, Aberdeen Proving Ground, Maryland, April 9.

———. 1987. Ground-Water Consultation No. 38-26-0822-87, Results of Semiannual Sampling at the Lower Burning Ground, Sierra Army Depot, Herlong, California, November 12 to 25, 1986, and May 26 to June 6, 1987, Aberdeen Proving Ground, Maryland. October 7.

———. 1988. *Interim final report ground-water contamination survey no. 38-26-0864-88, evaluation of solid waste management units*, Sierra Army Depot, Herlong, California, October 5-9 1987. Aberdeen Proving Ground, Maryland. April.

U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). 1979. *Installation assessment of Sierra Army Depot.* Report No. 149. December.

U.S. Environmental Protection Agency. 1988a. *CERCLA compliance with other laws manual, part I.* EPA/G-89/006, OSWER Directive No. 9234.1-02, August.

———. 1988b. *Guidance for conducting remedial investigations and feasibility studies under CERCLA.* Interim Final, OWSER, EPA/540/G-89/004, October.

———. 1989a. *Guidance on preparing superfund decision documents.* Interim Final, EPA/540/G-89/007, OSWER, Directive No. 9355.3-02.

———. 1989b. *Risk assessment guidelines for Superfund, volume II, environmental evaluation manual.* Interim Final. EPA 540/1-89/001, March.

U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. 1991. *Risk assessment guidance for Superfund, volume 1, human health evaluation manual, supplemental guidance: "Standard default exposure factors".* OSWER 9285.6-03, March 25.

U.S. Environmental Protection Agency, Office of Health and Environmental Assessment. 1993. *Integrated risk information system (IRIS).* Maintained by the National Library of Medicine. Online database containing risk assessment information. Updated monthly.

U.S. Fish and Wildlife Service. 1989a. National wetlands inventory map, Doyle Northeast, California.

———. 1989b. National wetlands inventory map, Doyle Northwest, California.

———. 1989c. National wetlands inventory map, Wendel Southeast, California.

———. 1989d. National wetlands inventory map, Wendel Southwest, California.

U.S. Geological Survey. 1988a. Provisional edition, Calneva Lake, California, 7.5-minute quadrangle map.

———. 1988b. Provisional edition, Herlong, California, 7.5-minute quadrangle map.

———. 1988c. Provisional edition, Spencer Creek, California, 7.5-minute quadrangle map.

———. 1988d. Provisional edition, Wendel, California, 7.5-minute quadrangle map.

———. 1988e. *Mineral resources of Skedaddle Mountains wilderness study area,* Lassen County, California and Wahoe County, Nevada. USGS Bulletin 1706-C.