FEASIBILITY STUDY REPORT WITH ENGINEERING EVALUATION AND COST ANALYSIS ADDENDUM

FOR NON-TIME CRITICAL REMOVAL ACTION

OPERABLE UNIT NO. 3 FORMER NEBRASKA ORDNANCE PLANT MEAD, NEBRASKA

Department of the Army
U.S. Army Engineer District
Kansas City District
Corps of Engineers
Kansas City, Missouri

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URS

URS Greiner Woodward Clyde Federal Services, Inc.
10975 El Monte, Suite 100
Overland Park, Kansas 66211

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Engineering Evaluation/Cost Analysis Addendum to the Operable Unit 3 Feasibility Study

Former Nebraska Ordnance Plant

Introduction

This addendum designates the Operable Unit 3 (OU3) December 2000 Draft-Final Feasibility Study (FS) as the functional equivalent of the Engineering Evaluation/Cost Analysis (EE/CA), a required component of a Non-Time Critical Removal Action (NTCRA) under the Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Contingency Plan (NCP).

The December 2000 Draft-Final FS contains all the essential elements of the EE/CA reporting process including the identification of Removal Action Objections (RAO); Screening Criteria; and Removal Action Alternatives.

This EE/CA equivalent is intended to address only specific areas of OU3 which include the LL2 and LL4 Pant and Operations Area and the Potential Landfill Area.

Purpose

The purpose of this EE/CA Addendum shall provide a brief summary of information provided in the FS and identify the preferred alternative for the NTCRA.

Operable Unit 3 Summary

OU3 includes several miscellaneous waste disposal areas and other limited areas of environmental concern. A Remedial Investigation (RI) and Baseline Risk Assessment (BLRA) were conducted for several of these areas in OU3. Specific areas were identified by the OU3 threshold target of one (1) for Antimony. The Hazard Index (HI) exceedance was based upon the soil ingestion pathway. The EE/CA is specific to these areas:

- Load Line 2 Paint Operations Area
- Load Line 4 Paint Operations Area
- Potential Landfill Area

Antimony is the chemical contributing to the majority of the potential hazard at each exposure area. Soil ingestion is the exposure pathway contributing to majority of the hazard.

Removal Action Objective (RAO)

The contaminant of concern as identified in the OU3 BLRA is Antimony. The RAO for the OU3 EE/CA equivalent is defined as follows:

Minimize the potential for soil ingestion of antimony contaminated soils which would result in a Hazard Index greater than 1.

Screening Criteria

During the detailed analyses, each alternative was presented in sufficient detail so that its performance could be evaluated with respect to the following criteria:

- Overall protection of human health and the environment;
- Compliance with Applicable or Relevant and Appropriate Requirements;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume;
- Short-term effectiveness;
- Implementability; and
- Cost.

Removal Action Alternatives

Four (4) alternatives for OU3 were developed. The alternatives and their basic concepts are summarized below.

Alternative 1 – No Action**:** The No Action alternative consists only of environmental monitoring of the contaminated soil. This alternative is required by the NCP, in accordance with CERCLA, to provide a baseline for comparison with the other alternatives.

Alternative 2 – Capping: This alternative consists of installing a barrier (cap) over the contaminated soil and implementing land use restrictions. The cap, which can be made out of asphalt, concrete, or clay, or an engineered material (geosynthetics) will prevent human contact with the contaminated soil. Institutional controls such as land use restrictions may be appropriate for Alternative 2; however, the Army has no authority to place such controls on property which is in third party ownership. Land use restrictions, if employed, would prevent any land use that could compromise the integrity of the cap.

Alternative 3 – Excavation and Off-Site Disposal: This alternative allows for excavation of the contaminated soil and transportation of the soil to a permitted landfill. It is assumed that the excavated soil can be landfilled in an appropriate facility without treatment.

Alternative 4 – Capping at Load Lines 2 and 4 Paint Operations Areas and Excavation and Off-Site Disposal at the Potential Landfill Area: At the Load Line 2 Paint Operations Area the location of the preliminary soil remediation area is between the receiving and painting building and a driveway. At the Load Line 4 Paint Operations Area the location of the preliminary soil remediation area is adjacent to the receiving and painting building and a concrete pad. Due to the relatively small surface areas (approximately 8,300 square feet at Load Line 2, and 2,700 square feet at Load Line 4) and their location adjacent to the existing buildings, restricting the use of these areas will not impose a serious restriction on the use of the buildings and the adjacent surface areas. Capping will consist of installing a low permeability or impermeable barrier (cap) over the contaminated soil at the Load Lines 2 and 4 remediation areas, land use restrictions, and periodic inspection of the cap. The cap, which can be made of asphalt, concrete,

clay or similar engineered materials (geosynthestics) will prevent human contact with the contaminated soil. Institutional controls such as land use restrictions may be appropriate for Alternative 4; however, the Army has no authority to place such controls on property which is in third party ownership. Land use restrictions, if employed, would prevent any land use that could compromise the integrity of the cap.

At the Potential Landfill Area**,** there are no buildings or roadways near to the preliminary soil remediation area. At this location, the remedial alternative consists of excavating the contaminated soil and transporting it to a permitted landfill without treatment.

Recommended Removal Action Alternative

Based on the comparative analysis of the removal action alternatives against the screening criteria it is recommended that Alternative 3 – Excavation and Off Site Disposal be the preferred alternative for the NTCRA. The preferred alternative addresses the antimony contamination in the soils by excavating the antimony contaminated soils to a depth of approximately 1 feet at Load Line 2 and Load Line 4, and to 4 feet at the Potential Landfill Area. Based on reducing dermal exposure and soil ingestion of antimony containing soil, proposed excavation extent and depth will reduce the overall HI to less than one at these three areas. The contaminated soils shall be disposed at an appropriate landfill.

Alternative 3 is the preferred alternative as it successfully addresses all of the screening criteria:

- Overall protection of human health and the environment;
- Compliance with Applicable or Relevant and Appropriate Requirements;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume;
- Short-term effectiveness;
- Implementability; and
- Cost.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Tables

Drawings

TABLE OF CONTENTS

Attachments

Term	Definition
AME	Average Maximum Exposure
ARARs	Applicable or Relevant and Appropriate Requirements
ARDC	Agricultural Research and Development Center
bgs	Below Ground Surface
BRA	Baseline Risk Assessment
CENWK	U.S. Army Corps of Engineers, Missouri River Division - Kansas City District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CTE	Central Tendency Exposure
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
EPA	U.S. Environmental Protection Agency
EQ	Ecotox Quotient
ERA	Ecological Risk Assessment
FS	Feasibility Study
GRA	General Response Action
HI	Hazard Indice
IAG	Interagency Agreement
LPNNRD	Lower Platte North Natural Resources District
NDEQ	Nebraska Department of Environmental Quality
NOP	Nebraska Ordnance Plant
NPL	National Priorities List
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Act
OU	Operable Unit
PCOC	Potential Chemical of Concern
PRG	Preliminary Remediation Goal
RA	Remedial Action
RAO	Remedial Action Objective
RDX	Hexahydro-1,3,5-trintro-1,3,5-triazine
RCRA	Resources Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study

Term	Definition
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
Site	Former NOP
SVOC	Semi-Volatile Organic Compound
TCT	Twin Cities Testing Corporation
TNT	2, 4, 6-trinitrotoluene
USACE	U.S. Army Corps of Engineers
VOC	Volatile Organic Compound
µg/l	Micrograms per liter (ppb)
UNL	University of Nebraska, Lincoln
URSGWCFS	URS Greiner Woodward Clyde Federal Services (formerly WCFS)
W-C	Woodward-Clyde Consultants
WCFS	Woodward-Clyde Federal Services

A Remedial Investigation/Feasibility Study is being conducted at the former Nebraska Ordnance Plant (NOP) located one-half mile south of Mead, Nebraska. The investigation of the former NOP has been divided into three Operable Units (OU1, OU2, and OU3) under the Interagency Agreement dated January 30, 1992 between the U.S. Department of the Army, EPA Region VII, and the Nebraska Department of Environmental Quality (NDEQ). OU3 includes several waste disposal areas, landfills, underground storage tanks, buildings, streams, and other areas not evaluated under OU1 or OU2.

Based on the findings and conclusions from the OU3 Remedial Investigation (RI), the non-carcinogenic cumulative Hazard Index (HI) exceeded the threshold target of one at the Load Line 2 Paint Operations Area, the Load Line 4 Paint Operations Area, and at the Potential Landfill Area. Antimony is the chemical contributing the majority of the potential hazard at each exposure area. Soil ingestion is the exposure pathway contributing the majority of the hazard.

A Feasibility Study (FS) was conducted to address these areas of elevated concentrations of antimony in soil. The goal of the remedial action alternatives evaluated is to reduce HI to one or less at each exposure area. Based on this criterion, preliminary estimates indicate that antimony contamination has impacted a relatively small area with the total amount of soil impacted being less than 15,000 square feet and 1,000 cubic yards.

Detailed analyses of the following four alternatives for OU3 was designed to provide sufficient information concerning each potential remedial alternative for selecting an appropriate remedy for the Site:

Alternative 1 – No Action

Alternative 2 – Capping

Alternative 3 – Excavation and Off-Site Disposal (of the antimony contaminated soil)

Alternative 4 – Capping at Load Lines 2 and 4 Paint Operations Areas and Excavation and Off-Site Disposal at the Potential Landfill Area

During the detailed analyses, each alternative was presented in sufficient detail so that its performance could be evaluated with respect to the following seven criteria:

1. Overall protection of human health and the environment
2. Compliance with applicable or relevant and appropriate requirements
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost.

The former Nebraska Ordnance Plant (NOP) is located one-half mile south of Mead, Nebraska and 30 miles west of Omaha in Saunders County, Nebraska. The U.S. Army Corps of Engineers (USACE), Kansas City District (CENWK) is responsible for conducting environmental investigation and remediation activities at the former NOP (Site) under the Department of Defense (DoD) Defense Environmental Restoration Program (DERP).

A Remedial Investigation/Feasibility Study (RI/FS) is being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The Site was placed on the U.S. Environmental Protection Agency (EPA) National Priorities List (NPL) of Superfund sites in August 1990 due to identified groundwater contamination and the potential for risk to human health or the environment.

The investigation of the Site has been divided into three Operable Units (OU1, OU2, and OU3) under the Interagency Agreement (IAG) dated January 30, 1992 between the U.S. Department of the Army, EPA Region VII, and the Nebraska Department of Environmental Quality (NDEQ). OU1 includes explosives contaminated soils within the upper 4-feet. Incineration of the explosives contaminated soils for OU1 was completed in December 1997 in accordance with the OU1 Record of Decision (ROD) (USACE, 1995). OU2 includes groundwater as well as explosives-contaminated soil (exclusive of those addressed by OU1) which may be a contributing source of groundwater contamination**.** Ongoing OU2 activities include a groundwater removal action, construction activities in accordance with the OU2 ROD (Woodward-Clyde Consultants [W-C]), 1997), alternative water supply support, a groundwater circulation well pilot study, and continued groundwater monitoring. According to the IAG, OU3 includes the former NOP Landfill located near the former Sewage Treatment Plant as well as other potential waste disposal areas.

URS Greiner Woodward Clyde Federal Services (URSGWCFS), in conjunction with CENWK under Contract No. DACW 41-96-D-8014, is conducting the RI/FS for OU3. In May 1997, Woodward-Clyde Federal Services (WCFS) submitted the Draft Final OU3 Remedial Investigation (RI) Report (WCFS, 1997). The OU3 RI Report included results of an OU3 Phase I (conducted from January to April 1995) and Phase II (conducted in May and July 1996) RI. In February 2000, URSGWCFS submitted the Draft Final OU3 RI Addendum (URSGWCFS, 2000a), which included results of an OU3 Phase III RI (conducted from April to June 1999). The Draft Final OU3 Revised Baseline Risk Assessment (BRA) (URSGWCFS, 2000b), which included results from the OU3 Phase I, II, and III RIs, was submitted in February 2000. The OU3 RI, OU3 RI Addendum, and the OU3 BRA reports have been accepted as final primary documents, as defined by the IAG, thus completing the RI portion of the OU3 RI/FS.

1.1 PURPOSE OF REPORT

This document is the Feasibility Study (FS) report for OU3. This report has been prepared in conformance with CERCLA and its governing regulations, the National Oil and Hazardous Substances Contingency Plan (also referred to as the National Contingency Plan [NCP]), 40 CFR Part 300 (Federal Register, 1990). The scope of work for this FS is described in the Draft Final OU3 FS Work Plan (W-C, 1994).

The purpose of the FS is to develop and evaluate remedial action (RA) alternatives that address potential risks and comply with regulatory requirements. The FS process is based on technical, environmental, public health, and economic considerations so that an informed risk management decision can be made concerning selection of the most appropriate RA for a site.

1.2 BACKGROUND INFORMATION

The RI portion of the RI/FS serves for characterizing the nature and extent of contamination and developing necessary risk information to assist decision making at remedial sites. The following investigation areas were evaluated as part of OU3 RI activities:

- Load Line 1 Bomb Production Buildings*
- Load Line 2 Bomb Production Buildings*
- Load Line 3 Bomb Production Buildings*
- Load Line 4 Bomb Production Buildings*
- Load Line 1 Paint Operations Areas*
- Load Line 2 Paint Operations Areas*
- Load Line 3 Paint Operations Areas*
- Load Line 4 Paint Operations Areas*
- Former Raw Products Igloo Storage Areas
- Former Tetryl Pelleting Area
- North Burning Ground
- South Burning Ground
- Proving Grounds*
- Potential Landfill Area north of the Proving Grounds*
- Former NOP Landfill Area
- Potential Waste Disposal Area north of the former Nike Maintenance Area
- Potential Waste Disposal Area southwest of the former Bomb Booster Area
- Potential Waste Disposal Area at the former Ammonium Nitrate Plant
- Potential Waste Disposal Area at the former Atlas Missile Area
- Demolition Ground
- Detonation Craters
- Bermed Area southwest of Load Line 1
- Northeast Boundary Area*
- Former Ammonium Nitrate Plant

- Johnson and Clear Creeks*
- Silver Creek*
- Natural Resource District (NRD) Reservoir
- Underground storage tanks at the former Administration, Bomb Booster, and Atlas Missile Areas, and the former Air Force Communications Center
- Geophysical Anomaly at Load Line 3
- Site-Wide Potentially Hazardous Containerized Waste Surveys

As discussed in the OU3 Preliminary Data Package (W-C, 1996a), the OU3 RI Report and OU3 RI Addendum Report, a screening process was used to evaluate whether or not additional field activities were required and to determine if results indicated that any of the areas warranted further action. Soil, water, and sediment screening values were developed from multiple sources including EPA Water Quality Standards and Risk-Based Concentrations, soil cleanup goals established under OU1, and background/regional concentrations. Following this process, several OU3 investigation areas were identified as not requiring any further action under CERCLA. Those areas identified as requiring further action under OU3 (noted by * above) were evaluated in the OU3 BRA.

The non-carcinogenic cumulative Hazard Index (HI) exceeded the threshold target of one for the RME child resident scenario at the Load Line 2 Paint Operations Area, the Load Line 4 Paint Operations Area, and at the Potential Landfill Area. A HI greater than one indicates the potential for adverse health effects. Antimony is the chemical contributing the majority of the potential hazard at each exposure area. Soil ingestion was the exposure pathway contributing the majority of the hazard. As mentioned in Section 1.1, the RI for OU3 was completed with the acceptance of the OU3 RI, RI Addendum, and Revised BRA reports as final documents. Based on the findings and conclusions presented in each of these reports, the focus of the OU3 FS is to address isolated and contiguous areas of elevated concentrations of antimony in soil at the following OU3 exposure areas:

- Load Line 2 Paint Operations Area
- Load Line 4 Paint Operations Area
- Potential Landfill North of the Proving Grounds (Potential Landfill Area)

Background information on each of these exposure areas has been obtained from a number of reports and is summarized in the following sections.

1.2.1 Site Descriptions and Histories

During operations, the Site included 17,258 acres in Saunders County (**Drawing 1-1**). Currently, the University of Nebraska, Lincoln (UNL) - Agricultural Research and Development Center (ARDC), U.S. Army National Guard and Reserves, and various private interests own the land.

The principal operation at the Site was loading bombs in four separate load lines. This activity began in October 1942 and continued through August 1945 with the lines periodically deactivated and reactivated for operational changes. The operation of the lines was terminated in 1945 and reactivated in 1952 for use during the Korean conflict. In 1956, the Site was put on

standby notice. Starting in 1958 and continuing through 1971, much of the Site, including the load lines, was "excessed" and disposed or sold (Donohue, 1992).

- *Load Line 2 and 4 Paint Operations Areas*

There are three former paint operation buildings at Load Lines 2 and 4: the Receiving and Painting Building, Paint Storage and Mixing Building, and South Paint Storage Building (**Drawings 1-2** and **1-3**). The Receiving and Painting Building is located south of the Inert Storage Building. The Paint Storage and Mixing Building is located west of the Receiving and Painting Building. The South Paint Storage Building is located west of the Assembly, Pack, and Shipping Building.

- *Potential Landfill Area*

The Environmental Monitoring Systems Laboratory Report (EPA, 1987) identified a "potential landfill area" contiguous with the north side of the Proving Grounds and the northeast side of the North Burning Ground (**Drawing 1-4**). This same potential landfill area was identified in a 1949 aerial photo and covered approximately 10 acres. The Lower Platte North Natural Resource District (LPNNRD) Reservoir (NRD Reservoir) borders this area to the east. In a 1991 study conducted by Twin City Testing Corporation (TCT) (TCT, 1991) this area was specifically identified as a potential landfill area. The site is presently an untilled grassy area with no surface evidence of past disposal activities.

1.2.2 Nature and Extent of Contamination

- *Load Line 2 and 4 Paint Operations Areas*

During the OU3 Phase I RI at Load Line 2 and 4 Paint Operations Areas, soil samples were collected from 0- to 6-inches and a 1- to 2-foot below ground surface (bgs) and analyzed for metals. At Load Line 2, a total of 56 individual shallow soil samples were collected from 22 sampling locations (**Drawing 1-5**). At Load Line 4, a total of 58 individual shallow soil samples collected from 23 sampling locations (**Drawing 1-6**).

As discussed in the OU3 RI Report, elevated concentrations of metals in soil at the Load Line 2 and 4 Paint Operations Areas appear to be isolated occurrences with limited vertical and horizontal extent. At Load Line 2, the elevated concentrations of metals are predominantly in the 0- to 6-inch sampling interval at three contiguous sampling locations along the east side of the Receiving and Painting Building. At Load Line 4, one sampling location on the east side of the Receiving and Painting Building showed an elevated concentration of metals at this 0- to 6-inch sampling interval.

- *Potential Landfill Area*

During the Phase I RI, 16 soil samples were collected from 6 Potential Landfill Area sampling locations (**Drawing 1-7**) and analyzed for explosives, metals, volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). At each location, soil samples were

collected from 0- to 6-inches and 1 to 2 feet bgs. At two of the 6 sampling locations (PL-2 and PL-6) soil samples were also collected from 4 to 5 feet and from 9 to 10 bgs.

A Phase II RI was conducted to determine the horizontal extent of metals contamination in vicinity of the PL-1 sampling location. During the Phase II RI, 12 soil samples were collected at 3 new sampling locations (**Drawing 1-7**) and analyzed for explosives, metals, VOCs, and SVOCs. At each location, samples were collected from 0- to 6-inches, 1 to 2 feet, 4 to 5 feet and from 9 to 10 feet bgs. Samples were also collected at PL-1 from 4 to 5 feet and from 9 to 10 feet bgs to determine vertical extent of contamination.

A Phase III RI investigation was conducted at the Potential Landfill Area to evaluate the extent of explosives in soil. During the Phase III RI investigation, soil samples were collected from 35 test pits (PL-10 through PL-44) (**Drawing 1-7**) and analyzed for explosives. At each location, samples were collected from 0- to 6-inches, 1 to 2 feet, and 4 to 5 feet bgs. Depending on site-specific conditions (e.g., presence and depth of buried debris and/or results of High Explosives [2,4,6-Trinitrotoluene (TNT) or Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) only] field screening), additional soil samples were collected at greater depths.

As discussed in the OU3 RI Report and RI Addendum, elevated concentrations of metals in soil at the Potential Landfill Area appear to be of limited vertical (predominantly in the uppermost 2 feet) and associated with a single sampling location.

1.2.3 Contaminant Fate and Transport

Detailed discussions on contaminant fate and transport were presented in the OU3 RI Report. These discussions were based on the physical characteristics, contaminant source characteristics and the nature and extent of contamination at each OU3 exposure area. The metal antimony in soils at the site is the chemical contributing to the majority of the potential hazard.

Metals are strongly retained in soils by ion exchange and specific adsorption. Fundamentally, the most important physicochemical property governing the mobility of metals in soil is water solubility. The metal antimony is insoluble in water and the majority of common antimony compounds (i.e. salts) are either insoluble or have low solubility in water. As a result, antimony is expected to be relatively immobile and would move only if the soil itself were moved.

1.2.4 Baseline Risk Assessment

Under OU3, a BRA was conducted to specifically address potential human health effects and ecological effects associated with contaminated media at OU3 exposure areas not previously addressed under BRAs for OU1 and OU2. The OU3 BRA incorporated data collected as part of the Phase I, II, and III RI sampling activities.

In the Human Health Risk Assessment, the scenarios evaluated in the load line areas included residential (adult and child), trespasser/visitor (adult and juvenile), and on-site worker exposure to surface soil. Scenarios evaluated at the Potential Landfill Area included residential (adult and child) and trespasser (adult and juvenile) exposure to surface soil and construction worker exposure to both surface and subsurface soils. Potential health risks were evaluated quantitatively for ingestion and direct dermal contact for all receptors. In addition, residents (adults and children) were evaluated for potential exposure to explosives via a garden vegetable ingestion scenario for the Potential Landfill Area using bioaccumulation data developed by the

Army (USACE, 1997). Potential excess cancer risks and non-carcinogenic hazards were estimated for exposure to site-related chemicals using both a Reasonable Maximum Exposure (RME) and an Average Exposure (AE) approach. Risk assessment results are summarized in **Tables 2-1** through **2-7** for the exposure areas with potential risk.

The RME evaluation provides an estimate of potential upperbound risk among exposed individuals, and is commonly used as a basis for site remedial decisions. The AE evaluation, which is also termed the Central Tendency Exposure (CTE) evaluation, provides an estimate of more typical risks among exposed individuals. The AE evaluation has been included to provide site decision-makers with additional information that can be used in the remedial decision making process.

The non-carcinogenic cumulative Hazard Index (HI) exceeded the threshold target of one for the RME child resident scenario at the Load Line 2 Paint Operations Area, the Load Line 4 Paint Operations Area, and at the Potential Landfill Area. A HI greater than one indicates the potential for adverse health effects. Antimony is the chemical contributing the majority of the potential hazard at each exposure area. Soil ingestion was the exposure pathway contributing the majority of the hazard.

Potential excess cancer risks are within, or below, EPA risk range of 1×10^{-4} to 1×10^{-6} (i.e., 1 in 10,000 to 1 in 1,000,000) for all scenarios and areas evaluated.

An evaluation of the potential health risks to children associated with exposure to lead was conducted for all areas of concern. The results of this evaluation indicate that lead in Site soils is unlikely to pose a health hazard.

- *Ecological Risk Assessment*

A BRA, including a Site-wide Ecological Risk Assessment (ERA) was performed as part of the OU1 investigation (Rust, 1993). The scope of the OU1 BRA encompassed all of the terrestrial areas evaluated in OU3 and provided descriptions of habitats and receptor species, identified threatened or endangered species that could exist in the area, and evaluated potentially impacted ecological populations and communities. The OU1 BRA concluded that contaminants in Site soils would not pose a hazard to the environment. The results and conclusions of the OU1 BRA were incorporated into the OU3 investigation approach so that the focus of the OU3 ERA, as a part of the OU3 BRA, was on Site-related aquatic habitats.

Detected chemicals were conservatively screened against ecological benchmarks, background data, and other criteria to determine which chemicals should be retained for exposure assessment scenarios. No potential chemical of concern (PCOC) was selected for surface water samples because all detected chemicals were either unrelated to former NOP activities or did not exceed benchmark values. For the same reasons, all VOCs and explosives, and most metals and SVOCs detected in sediments were screened out at this step. Corresponding adverse effects from these chemicals to aquatic biota or wildlife on-site are unlikely.

The remaining sediment PCOCs (selenium, silver, and 4-methylphenol) were included in exposure assessment scenarios, which used Site-specific receptors, benchmarks, and assumptions to more accurately estimate receptors' exposure to chemicals. As discussed in the OU3 ERA, qualitative weight-of -evidence and semi-quantitative Ecotox Quotient (EQ) approaches found none of the sediment PCOCs presenting a hazard to aquatic and terrestrial receptors on the Site.

The potential for protected species or their habitats to occur at the Site was assessed as part of the OU3 RI. A document search for rare, threatened, or endangered species (plant or animal) found that two rare species (the brook stickleback [*Culaea inconstans*] and the plains topminnow [*Fundulus sciadicus*]) could potentially occur at the Site. The brook stickleback prefers clear, cool, heavily weeded, spring-fed ponds and streams. This type of habitat does not occur on the Site. The plains topminnow occurs in small to medium-sized, clear, sandy to rocky streams with rapid to moderate flow with pools and backwaters. A systematic habitat assessment for the plains topminnow was conducted in July 1996 as part of the OU3 RI on Johnson, Silver, and Clear Creeks. Based on the results of the habitat assessment, it was determined that habitat condition did not favor the plains topminnow.

Suitable habitat for the western prairie fringed orchid consists of undisturbed, dry-mesic and mesic upland prairies (Sheviak and Bowles, 1986). Suitable habitat for the American burying beetle seems to be largely restricted to areas most undisturbed by human influence. Habitats in Nebraska where these beetles have been recently found consist of grassland prairie, forest edge, and scrubland (Ratcliffe, 1996).

As part of the OU3 RI, a qualified biologist walked all three exposure areas to assess the suitability of the areas for threatened and endangered species habitat. All of these areas have had past soil disturbance associated with their previous land-use. Presently, these areas are fairly dry and consist of non-native grasses and forbs, which are periodically mowed. There are also buildings and daily operational activities still associated with Load Line 2 and 4. Due to the historical and present day land-uses and the present species composition of the three exposure areas, no suitable habitat for threatened and endangered species (i.e. western prairie fringed orchid and American burying beetle) was observed at any of the areas addressed in this FS.

- *Other Hazards*

Former uses of the Potential Landfill Area, North Burning Ground and Proving Grounds include disposal of construction debris and other wastes from the nearby University of Nebraska facility. In addition, several tons of Army explosives have been excavated and incinerated from the area, as well as very small amounts of incendiary devices and fuses. U.S. Army Engineering and Support Center, Huntsville, performed an Engineering Evaluation/Cost Analysis for ordnance and explosive removal and, based on site characterization efforts, proposed “no further action” for this area. Based on the foregoing, there might be uncertainties concerning non-COC wastes and other items.

2.1 INTRODUCTION

In this section, remedial technologies and process options are identified and screened based on site-specific information. This process involves the following steps.

- Develop Remedial Action Objectives (RAOs) that address site-specific contamination, contaminated media, and exposure pathways (Section 2.2).
- Identify contaminants of interest and areas and volumes of contamination (Section 2.2.1).
- Develop allowable exposure based on risk assessment (Section 2.2.2)
- Develop Preliminary Remediation Goals (PRGs) (Section 2.2.3)
- Develop General Response Actions (GRAs) to satisfy site-specific RAOs (Section 2.3).
- Identify and screen soil technologies and process options within GRAs (Section 2.4).
- Summarize the retained technologies and process options (Section 2.5).
- Assemble preliminary alternatives from retrained technologies (Section 3.0).

CERCLA, Section 121(d)(2)(A), specifies that Superfund RAs meet any Federal standards, requirements, criteria or limitations that are determined to be applicable or relevant and appropriate requirements (ARARs). Also included in CERCLA is the requirement that State ARARs must be met if they are more stringent than Federal requirements. ARARs are grouped into three categories as follows:

- Chemical-Specific ARARs: These are usually health or risk based numerical values or methodologies. The application of these numerical values establishes the acceptable amount or concentration of a chemical that may exist in a media or discharged to the environment.
- Action-Specific ARARs: These are usually technology or activity based requirements or limitations on actions taken with respect to hazardous waste.
- Location-Specific ARARs: These include restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations.

Chemical-specific ARARs are considered when developing RAOs and establishing PRGs. Action and location-specific ARARs are considered when identifying potential GRAs.

In addition to ARARs, other federal and state criteria, advisories, and guidance and local ordinances are considered, as appropriate, in the development of RA alternatives.

2.2 REMEDIAL ACTION OBJECTIVES

RAOs consist of medium-specific or operable unit-specific goals for protecting human health and the environment (EPA, 1988). The primary basis for developing the OU3 preliminary RAO is the OU3 BRA. Under OU3, the RAOs; specify:

- The contaminant(s) of interest
- Exposure route(s) and receptor(s)
- An acceptable contaminant level or range of levels for each exposure route (e.g., PRGs).

2.2.1 Contaminant of Interest

A contaminant of interest is a potentially toxic chemical that may have been released to the environment in significant quantities as a result of site-related activities. As discussed in Section 1.2.4, a BRA was conducted under OU3 to specifically addresses potential human health effects and ecological effects associated with contaminated media at OU3 exposure areas of concern. Data from samples collected during the OU3 RI Phase I, II, and III, and evaluated in the OU3 BRA, indicate that isolated and elevated antimony concentrations in soils from contiguous areas resulted in excessive non-cancer hazards at Load Line 2 and 4 Paint Operations Areas and the Potential Landfill Area.

2.2.2 Allowable Exposure Based on Risk Assessment

As mentioned in Section 1.2.4, a HI is used to assess non-cancer hazards. A HI greater than one is the level at which a potential hazard can occur. Therefore, an allowable exposure is a HI of one or less. Based on the results of the OU3 BRA, the non-carcinogenic cumulative HI was greater than one for the RME child resident scenario at the Load Line 2 Paint Operations Area, the Load Line 4 Paint Operations Area, and the Potential Landfill Area. As shown in **Table 2-8**, the total HI calculated under the child resident scenario for these three exposure areas ranged from 2.4 to 9.2.

2.2.3 Development of Remediation Goals

The goal of the remedial action is to reduce HI to one or less at Load Lines 2 and 4 Paint Operations Areas and the Potential Landfill Area. As shown in **Table 2-8**, antimony is the major contributor to HIs exceeding one. The HI values based on antimony alone range from 1.5 to 4.1, while the total HI values ranged from 2.0 to 4.2. As demonstrated in **Table 2-9,** excluding elevated concentrations of antimony reduces the total HI value to less than one at the three exposure areas. Therefore, reducing or otherwise eliminating the potential exposure to soils at locations that contribute to an exposure area HI greater than one is the remediation goal for OU3.

2.2.4 Preliminary OU3 Remedial Action Objective

Although no risk-based numerical value has been assigned to antimony under OU3, antimony is the major contributor to HI values above one. Therefore, concentrations of antimony which result in a HI value above one are the preliminary RAOs. Based on the contaminant of interest, the exposure route and receptor, and an acceptable contaminant level; the preliminary RAO for OU3 is defined as follows:

- Minimize non-cancer hazard to human health by minimizing the potential for exposure to soil that would result in a HI greater than one.

2.3 PRELIMINARY GENERAL RESPONSE ACTIONS

GRAs describe broad classes of actions that will satisfy the RAOs. GRAs must be defined for the medium in question, and if appropriate, for the extent (e.g., volume) of the problem.

The EPA Guidance (EPA, 1988) requires that a No Action Response Action be included in the FS to provide a baseline to characterize the effect on human health and the environment if no

specific action is taken. Further, the guidance recommends that at least one technology or process option be considered for each GRA, if applicable.

The U.S. Department of Army (USDA) (USDA, 1995) and CENWK (CENWK 1999) policy requires that Natural Attenuation be evaluated in the FS as a potential RA. Natural Attenuation is treated in a manner similar to a GRA. Natural Attenuation is introduced at this screening level because it can sometimes stand alone as an effective remedy to protect human health and the environment.

The following preliminary GRAs have been identified for the relatively small volumes of contaminated soil being considered under OU3.

- No Action (required by EPA guidance) – This GRA consists of leaving the Site "as is," with provisions only for monitoring the contamination. No active control or remediation would be included under this GRA.
- Institutional Controls – This GRA deters exposure to contaminated soil and may include, but is not limited to, access and land use restrictions.
- Natural Attenuation (required by USDA and CENWK policy) – Natural processes that may render the contaminant less toxic, reduce concentrations, reduce mobility, and/or alter bio-availability such that potential risks are reduced.
- Containment – This GRA involves physical isolation to limit contaminant mobility and/or water infiltration and prevents contact with the contaminated soil.
- Removal/Disposal – This involves the direct physical removal of the contaminated soil and transport to an off- or on-site disposal facility. Contaminants are relocated in such a way as to reduce their interaction with the public and the environment.
- Treatment – This consists of in-situ or ex-situ, on-site and/or off-site biological, physical, or chemical measures to reduce toxicity, mobility, and volume of the contaminated materials.

HIs were calculated to be greater than one at the Load Lines 2 and 4 Paint Operations Areas and the Potential Landfill Area (**Table 2-8**). Excluding elevated antimony results at three contiguous Load Line 2 Paint Operations Area sampling locations (P2A-003, P2A-004, and P2A-005), one Load Line 4 Paint Operations Area sampling location (P4A-001), and one Potential Landfill Area sampling location (PL-1), results in HIs of less than one at each exposure area (**Table 2-9**). Thus, the hazard posed by antimony will be reduced to an acceptable level by removing isolated areas of contamination. These specific antimony results excluded from the HI calculations are shown in **Table 2-9**, all of which present surface or near surface soil.

2.4 REMEDIATION AREAS

At each exposure area, the horizontal extent of remediation was extended to include locations of known antimony concentrations that, when included in the HI calculation, yields a HI of one or less or, in cases where no sample data exists, to the nearest physical boundary. A summary of the rationale used in defining the extent of remediation is provided in **Table 2-10**.

For vertical extent of remediation, sample depths yielding data that resulted in a HI calculation greater than one was 0 to 0.5 feet bgs at Load Lines 2 and 4 Paint Operation Areas and 1 to 2 feet bgs at the Potential Landfill Area. Below these depths, the next sample depth was at 1 to 2 feet

bgs at Load Lines 2 and 4 Paint Operation Areas and 4 to 5 feet bgs at the Potential Landfill Area. As a conservative approach, the vertical extent of remediation is extended to those depths at which the residual antimony levels would result in a HI value less than one when averaged across the exposure area. A summary of the rational used in defining the vertical extent of remediation is provided on in **Table 2-10**.

Remediation areas and volumes are listed in **Table 2-11** and displayed on **Drawings 2-1, 2-2,** and **2-3**. For all three exposure areas, the OU3 RI sampling results will be used in lieu of additional confirmation sampling. The following discussions summarize the rationale for establishing exposure area-specific remediation areas and volumes.

- *Load Line 2 Paint Operations Area*

For the Load Line 2 Paint Operations Area, elevated concentrations of antimony at sampling locations P2A-003, P2A-004, and P2A-005 contributed to an exposure area HI greater than one (**Drawing 2-1**). The remediation area is extended south of P2A-005 to include sampling location P2A-006, and north of P2A-003 to include sampling location P2A-001. Both sampling locations (P2A-001 and P2A-006) are included in the exposure area HI calculation yielding a HI of less than one. The remediation area is extended east of sampling locations P2A-003 and P2A-004; to the roadway and west of sampling locations P2A-003 and P2A-005; and to the Receiving and Painting Building Foundation. Thus, the east and west boundaries for excavation are determined by actual physical boundaries.

Sampling results are not available east of the Load Line 2 Paint Operations Area proposed remediation area. Therefore, additional soil samples will be collected to determine the concentrations of antimony just east of the easternmost remediation area boundary line. These concentrations will be compared to existing Load Line 2 Paint Operations Area data to verify that the HI is reduced sufficiently by remediating the area specified in the FS. These data will be reported prior to implementing the preferred remedial alternative at the site. The average antimony concentration corresponding to a HI of one, as established by the RI data, will be compared to the antimony concentrations obtained from the additional samples collected at Load Line 2. If the concentration of antimony detected in a new sample is less than the average at which the HI is less than one, then the remediation area will not change. If the concentration of any single new sample is not less than the average at which the HI is less than one, then the remediation area will be re-drawn to include that soil sampling location.

- *Load Line 4 Paint Operations Area*

For the Load Line 4 Paint Operations Area, elevated concentrations of antimony at sampling location P4A-001 contributed to an exposure area HI greater than one (**Drawing 2-2**). The remediation area is extended to the south of P4A-001 to include sampling location P4A-004, which is included in the HI calculation yielding an exposure area HI of less than one. The northernmost extent of remediation is to a concrete pad, which is the first physical boundary north of P4A-001. The westernmost extent of remediation is to the Receiving and Painting Building foundation, which is the first physical boundary west of P4A-001. The easternmost extent of remediation is along a north-south line that parallels sampling locations P4A-002 and P4A-003, which are included in the HI calculation yielding an exposure area HI of less than one.

- *Potential Landfill Area*

For the Potential Landfill Area, elevated concentrations of antimony at sampling location PL-1 contributed to an exposure area HI greater than one (**Drawing 2-3**). The remediation area is defined by PL-8 to the south, PL-7B to the west, PL-9 to the north, and PL-9B to the east. Data from all four of these sampling locations are included in the HI calculation yielding an exposure area HI of less than one.

2.5 IDENTIFICATION, EVALUATION, AND SCREENING OF PRELIMINARY REMEDIAL TECHNOLOGIES

2.5.1 Introduction

The methodology and criteria used in development of approaches to remediate contaminated medium follow EPA Guidance (EPA, 1988) for conducting feasibility studies. The guidance, when followed, is designed to assure objectivity in selecting appropriate, effective, implementable, and cost-effective remedies.

This analysis is directed exclusively to soils impacted by DoD-related activities at the former NOP. The areas and volumes of antimony-contaminated soil that exceed these goals were identified and discussed earlier in Sections 2.2.1 and 2.3. The goal of the remediation was identified in Section 2.2.3 and the GRAs was discussed in Section 2.3.

2.5.2 Identification of Preliminary Soil Remedial Technologies and Process Options

The FS process begins by assembling and identifying potentially applicable technologies. These technologies are then screened with respect to technical implementability. Within each category, process options are presented that generally represent possible technology options. Because the medium of concern addressed in this FS is limited to soil, the list of viable technologies is limited to those suitable for soils.

Preliminary technologies and process options were assembled after reviewing EPA guidance documents, EPA's ATTIC, CLU-IN, and REACHIT databases, the Federal Remediation Technologies Roundtable Database, pertinent journals/proceedings, and professional experience. These technologies were then described in terms of the process options that are representative of the range of processes within general technology types. The list of remedial technologies and their attendant process options were screened as to their technical implementability. Technologies meeting the criteria of the initial screening are presented in **Table 2-13**, including remedial technologies in all of the GRA categories; Institutional Control, Natural Attenuation, Containment, Removal and Disposal, and Treatment.

2.5.3 Evaluation and Screening of Preliminary Soil Remedial Technologies and Process Options

The process options identified in **Table 2-13** are further described to obtain enough base information on which to screen/evaluate each option for three criteria, namely, implementability, effectiveness, and cost. Technologies may be eliminated from further consideration if they do provide a cost–effective means to achieve the site RAOs.

The **Implementability** of each listed technology and process option is considered by answering fundamental questions of whether the approach may be deployed in the field. For a process option to pass this screening criterion, the answer to each of the following three questions must be affirmative:

- Physical Limitations – Are there any physical restrictions imposed by the project setting that would limit or prevent the application of the technology (i.e., soil type)?
- Availability of Resources – Are the equipment, manpower, and supplies available in reasonable proximity to the site and at the time proposed for the remediation? Can the requisite resources in supplies, labor, time, etc. be deployed or is the location itself suitable for deployment at the project setting?
- Disruption of Land Use - Does the current or reasonably anticipated future use of the land allow the deployment of the indicated technology?

This criterion is applied broadly, and a technology is only rejected in cases where it is functionally unable to be retained for further consideration.

Screening for **Effectiveness** evaluates the ability of each process option to achieve the RAOs. Process options that are capable of being implemented may not be suitable for other reasons. For a process option to meet this criterion, the answer to each of the following questions must be affirmative:

- Is the technology effective in reducing the volume, toxicity, mobility or concentration of the contaminants of concern?
- Is the type or concentration of contaminants suitable to the indicated technology?
- Are the resource requirements available and appropriate to permit the technology?

Screening for **Cost** uses published information, vendor-supplied data, and experience at similar sites to identify relative capital costs and financial requirements for operation and maintenance (O&M). Cost data used at this level of screening are qualitative only and are indicated in general terms as high, moderate, or low. Cost is generally used to reduce the number of options when comparable options remain. Consideration of the relevant cost of a technology should carefully take into account both capitol and O&M costs when screening a technology for possible elimination. **Table 2-14** shows the results of the process option screening/evaluation for the three criteria of implementability, effectiveness, and cost.

2.5.4 Summary of Retained Preliminary Technologies and Process Options

Only those technologies and process options retained after this second screening are considered for further development and evaluation. **Table 2-15** presents the outcome of the screening. Prior to disposal of the material in the Butler County Landfill, appropriate tests will be performed to confirm that the soil is not hazardous. The tests will be specified by the Butler County Landfill in accordance with their permit to accept special wastes, but will include, at a minimum, Toxicity Characteristic Leaching Procedure (TCLP) for metals and VOCs, flash point, and pH. When compared to the Site wide average background concentrations of metals in soils presented in OU3 RI, engineering judgment and experience with similarly contaminated soils suggest that the concentrations of antimony at the three exposures areas are not high enough to

fail the TCLP test. Therefore, the assumption was made that the soil will not be hazardous and will be eligible for disposal at the Butler County Landfill as a special waste.

3.1 INTRODUCTION

In this section, if it is still necessary to reduce the number of alternatives, the retained preliminary technologies and related process options summarized in Section 2.5.4 are screened to identify preliminary remedial alternatives to address contaminated soils under OU3. The criteria for screening alternatives, if necessary, as generally used for screening technology and process options in Section 2.0:

- **Effectiveness** addresses if an alternative provides short- and long-term protection of human-health and the environment and reduces toxicity, mobility, and volume.
- **Implementability** of an alternative must consider the technical and administrative feasibility of constructing, operating, and maintaining the alternative's remedial measures.
- **Cost**, as before, addresses both capital and O&M-related costs, but at this stage of screening, specific alternative estimates are generated and used for comparison.

3.2 ASSEMBLE PRELIMINARY ALTERNATIVES

Preliminary alternatives were assembled by combining different types of remedial technologies and/or process options in a manner that satisfies the preliminary RAOs for OU3. The following rationale was used in assembling the alternatives:

- The No Action alternative includes environmental monitoring of the chemical of interest (i.e. antimony) as identified in Section 2.2.1. The No Action alternative provides a baseline against which other alternatives may be compared.
- Based on preliminary estimates, antimony contamination has impacted a relatively small area and volume of soil (less than 15,000 square feet and 1,000 cubic yards).
- Except for the No Action alternative, alternatives which do not eliminate the toxicity, mobility, and volume of the contaminant, or take an extended period of time to do so, consider deed restriction or other deed notice or other institutional control in order to ensure that future users of the property are aware of existing hazards and do not adversely impact the remedy. In addition, EPA and NDEQ have suggested that a deed notice or deed restriction and fence might also be needed to address the uncertainties previously noted concerning unknown hazards associated with a landfill and anomalies in the Potential Landfill Area, North Burning Ground, and Proving Grounds (see "Other Hazards," page 1-6). However, the Army has no authority to place land use restrictions on property that is in third party ownership.
- All alternatives involving removal of the contaminated soil will also include disposal per applicable standards.

Four preliminary alternatives for OU3 were developed using this rationale. These preliminary alternatives are illustrated in **Table 3-1**. The preliminary alternatives and their basic concepts are summarized below.

Alternative 1 – No Action**:** The No Action alternative consists only of environmental monitoring of the contaminated soil. This alternative is required by the NCP, in accordance with CERCLA, to provide a baseline for comparison with the other alternatives.

Alternative 2 – Capping: This alternative consists of installing a barrier (cap) over the contaminated soil and implementing land use restrictions. The cap, which can be made out of asphalt, concrete, or clay, or an engineered material (geosynthetics) will prevent human contact with the contaminated soil. Institutional controls such as land use restrictions may be appropriate for Alternative 2; however, the Army has no authority to place such controls on property which is in third party ownership. Land use restrictions, if employed, would forbid any land use that could compromise the integrity of the cap.

Alternative 3 – Excavation and Off-Site Disposal: This alternative allows for excavation of the contaminated soil and transportation of the soil to a permitted landfill. It is assumed that the excavated soil can be landfilled in an appropriate facility without treatment.

Alternative 4 – Capping at Load Lines 2 and 4 Paint Operations Areas and Excavation and Off-Site Disposal at the Potential Landfill Area: At the Load Line 2 Paint Operations Area the location of the preliminary soil remediation area is between the receiving and painting building and a driveway (**Drawing 2-1**). At the Load Line 4 Paint Operations Area the location of the preliminary soil remediation area is adjacent to the receiving and painting building and a concrete pad (**Drawing 2-2**). Due to the relatively small surface areas (approximately 8,300 square feet at Load Line 2, and 2,700 square feet at Load Line 4) and their location adjacent to the existing buildings, restricting the use of these areas will not impose a serious restriction on the use of the buildings and the adjacent surface areas. Capping will consist of installing a low permeability or impermeable barrier (cap) over the contaminated soil at the Load Lines 2 and 4 remediation areas, land use restrictions, and periodic inspection of the cap. The cap, which can be made of asphalt, concrete, clay or similar engineered materials (geosynthestics) will prevent human contact with the contaminated soil. Institutional controls such as land use restrictions may be appropriate for Alternative 4; however, the Army has no authority to place such controls on property which is in third party ownership. Land use restrictions, if employed, would forbid any land use that could compromise the integrity of the cap.

At the Potential Landfill Area (**Drawing 2-3),** there are no buildings or roadways near to the preliminary soil remediation area. Restricting the use of the land by installing a cap would adversely impact future land use. At this location, the remedial alternative consists of excavating the contaminated soil and transporting it to a permitted landfill without treatment.

3.3 SCREEN PRELIMINARY ALTERNATIVES

Five preliminary remedial alternatives were assembled in Section 3.2. The three screening criteria of effectiveness, implementability and cost are applied to the preliminary remedial alternatives. The preliminary alternatives that are retained by the screening process will undergo a more thorough evaluation in the detailed analysis phase of the FS in Section 4.0. Following is a discussion of retaining or eliminating alternatives per each of the three screening criteria.

3.3.1 Effectiveness

Alternative 1 – No Action: The No Action Alternative does not provide an immediate or long-term reduction in human health hazard for existing or potential occupants of the site. Because this alternative does not meet the RAO it is not considered further in the screening analysis. However it is retained as a baseline for comparison of other alternatives.

Alternative 2 – Capping: Assuming adequate design and maintenance, capping will provide an immediate and effective reduction in human health hazard for existing or potential occupants by prohibiting contact with antimony-contaminated soil. Capping does not reduce the toxicity or volume of antimony in the soil. It may reduce mobility, limiting the potential for migration in the soil system.

Alternative 3 – Excavation and Off-Site Disposal: This alternative does provide immediate elimination of human health hazard by removing the antimony-contaminated soil from the Site and placing it in a controlled landfill.

Alternative 4 – Capping at Load lines 2 and 4 Paint Operations Areas and Excavation and Off-Site Disposal at the Potential Landfill Area: Alternative 4 is a combination of Alternatives 2 and 3 and has the same advantages, disadvantages, and effectiveness as discussed above.

3.3.2 Implementability

Alternative 1 – No Action: This alternative can easily be implemented because it requires no action other than environmental monitoring. It is retained as a baseline for comparison of other alternatives.

Alternative 2 – Capping: Because access to the site is readily obtainable and all supplies, material, and equipment can be transported to the site, Alternative 2 can be easily implemented. Readily available construction technology can be used.

Alternative 3 – Excavation and Off-Site Disposal: Like capping, this alternative can easily be implemented. To prevent emissions during off-Site transport, containers capable of being covered with sealed covers/lids can be used. On-site, the excavated soil can be placed in roll off boxes with sealed covers, or other similar containers. Excavation and Off-Site Disposal is implementable and local disposal facilities are available. For example, the Butler County Landfill, located near David City, NE, is permitted to accept special wastes. During a May 30, 2000 telephone conversation with a representative of the landfill (see **Attachment A**) it was indicated that the landfill could accept antimony-contaminated soil provided that the soil passed Resources Conservation and Recovery Act (RCRA) acceptance requirements and is granted a NDEQ Special Waste Permit. The excavated soil can be replaced with topsoil and seeded.

Alternative 4 – Capping at load Lines 2 and 4 and Excavation and Off-Site Disposal at the Potential Landfill Area: Alternative 4 is a combination of Alternatives 2 and 3. Based on the discussions in the preceding paragraphs, Alternative 4 is implementable.

3.3.3 Cost

Alternative 1 – No Action**:** This alternative has no capital cost and low O&M cost. The only cost required is periodic visual inspection for changes in land use and evidence of surface transport, including those attributed to wind and water erosion and burrowing animals.

Alternative 2 – Capping**:** Capping has low capital and O&M costs. A base layer for the cap would be placed over the remediation areas and then the cap constructed. A low permeable or impermeable cap (asphalt, concrete, etc) would be installed using readily available construction techniques. Environmental monitoring would consist only of periodic inspections of the cap.

Alternative 3 – Excavation and Off-Site Disposal**:** Excavation and Off-Site Disposal has low capital cost. Excavation can be accomplished using readily available construction equipment. Transportation to a disposal site can be accomplished in readily available transportation methods such as roll-off boxes transported by semi tractor-trailer trucks. Disposal costs can be accurately determined rates based established per/tonnage rates. Operating cost to monitor for fugitive dust emissions will be required during excavation. However, one major advantage of excavation and off-Site disposal is that once the contaminated soil is removed, no O&M at the site is required.

Alternative 4 – Capping at Load Lines 2 and 4 and Excavation and Off-Site Disposal at the Potential Landfill Area**:** Because this alternative is a combination of Alternatives 2 and 3, the cost assessment results in similar low capitol cost and O&M cost. Although O&M would not be required at the Potential Landfill Area, continued O&M would be required at the Load Lines 2 and 4 areas.

3.3.4 Summary of Retained Alternatives

The results of screening of remedial alternatives are contained in **Table 3-2**. Alternative 5 - Phytoremediation is rejected because of uncertainties in its effectiveness and implementability. Treatability studies would be necessary to establish parameters for design of this alternative. Because the other alternatives use readily available technologies, the time and expense to establish operating parameters for phytoremediation is not warranted. All of the other alternatives are retained for detailed analysis in Section 4.0.

4.1 INTRODUCTION

The detailed analysis of alternatives for the FS is designed to provide sufficient information concerning each potential remedial alternative for selecting an appropriate remedy for the Site. The analysis presented herein is in accordance with the procedure used to evaluate CERCLA sites. As such, the detailed analysis evaluates each alternative with respect to the nine criteria detailed in the RI/FS guidance (EPA, 1988) and the NCP. The detailed analysis concludes with a comparative analysis of the alternatives.

The evaluation criteria are discussed in Section 4.2. In Section 4.3, the remedial alternatives developed in Section 3.0 are fully described and analyzed using the nine evaluation criteria. Section 4.4 presents the comparative analysis of alternatives and the cost sensitivity analysis.

4.2 DESCRIPTION OF EVALUATION CRITERIA

During the detailed analyses, each alternative is presented in sufficient detail so that its performance can be evaluated with respect to the following seven criteria:

8. Overall protection of human health and the environment
9. Compliance with ARARs
10. Long-term effectiveness and permanence
11. Reduction of toxicity, mobility, or volume through treatment
12. Short-term effectiveness
13. Implementability
14. Cost.

There are no chemical-specific ARARs identified for this Site. For the remedial alternatives evaluated under OU3, the only action-specific ARAR is for regulating worker health and safety. Requirements for worker health and safety can be found in Occupational Safety and Health Act (OSHA) 20 USC Section 651-678. Although it is assumed that no hazardous waste will be encountered during OU3 remedial actions, any wastes considered as hazardous will be required to be handled in accordance with 40 CFR Part 261 of RCRA. 40 CFR Part 261 defines those solid wastes which are subject to regulation as hazardous wastes. Potential location-specific ARARs are shown in **Table 4-1**.

Following completion of the public comment period, two additional criteria; 1) state (support agency) acceptance, and 2) community acceptance, are evaluated, making a total of nine criteria.

The NCP suggests the separation of these nine criteria into three categories: 1) Threshold, 2) Balancing, and 3) Modifying. An alternative must meet the threshold criteria to be eligible for selection. The balancing criteria are then applied. These balancing criteria are the primary technical criteria upon which the detailed analysis is based. In the case of a CERCLA site, the modifying criteria do not impact the comparison of alternatives until the ROD for a site is prepared. At the time of the ROD, the modifying criteria can be used to adjust the components of a given alternative or change the preferred alternative.

The following paragraphs describe each of the three categories and associated criteria.

4.2.1 Threshold Criteria

Threshold criteria focus on how risks posed through each exposure pathway are reduced, controlled, or eliminated through institutional controls, engineering controls, or treatment. There are two threshold criteria: 1) overall protection of human health and the environment; and 2) compliance with ARARs. According to the RI/FS guidance (EPA, 1988), assessments against these criteria relate directly to statutory findings that must ultimately be made in the remedy selection. Therefore, these are categorized as threshold criteria that each alternative must meet.

The criterion of overall protection of human health and the environment assesses the adequacy of short-term and long-term protection from unacceptable risks associated with hazardous substances, pollutants, or contaminants at a site. Each risk and each pathway identified in the baseline risk assessment for a site must be addressed. An alternative that does not provide overall protection of human health and the environment cannot be considered for selection as the remedy for a site.

Assessing compliance with ARARs involves evaluating whether or not an alternative will meet all pertinent chemical-specific, location-specific, and action-specific ARARs.

4.2.2 Balancing Criteria

Balancing criteria are utilized to further evaluate the alternatives that satisfy the two threshold criteria. These balancing criteria include:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost

The criterion of long-term effectiveness and permanence involves the assessment of the ability of a remedial alternative to maintain protection of human health over time. The level of risk associated with residual contaminants left on the Site and the effectiveness of the reliability of controls used to manage untreated wastes are also considered and evaluated.

The detailed analysis will consider how treatment reduces the toxicity, mobility, or volume of the waste and, if possible, to what extent. Achievement of a 90 to 99 percent reduction in concentration or mobility of individual contaminants of concern is a goal stated in the RI/FS guidance (EPA, 1988). The degree to which the alternative is permanent is a consideration in the evaluation of the reduction of toxicity, mobility, and volume.

Short-term effectiveness addresses the impact to the community and workers during the implementation of the remedy and until remedial action objectives are met. Protecting human health and the environment during the remedy's implementation is the key goal of the short-term effectiveness criterion. Any risk resulting from the implementation of the remedial action will be assessed to evaluate short-term effectiveness.

Implementability refers to the technical and administrative feasibility of executing an alternative. Technical feasibility encompasses construction and operation considerations and the reliability of

the technology. Other considerations relative to the technical implementability of an alternative include the ease of undertaking additional remedial actions should they become necessary, the ability to monitor the effectiveness of the remedy, and the availability of prospective technologies not yet demonstrated. Included in the evaluation of technical implementability will be a determination of the availability of resources necessary to implement the alternative as well as the assessment of the capabilities of various vendors.

The ability to coordinate implementation of an alternative with other involved federal, state, or local authorities is the primary consideration in the assessment of administrative feasibility.

Estimates of the cost of implementing an alternative will include direct capital costs, indirect capital costs, and present worth of annual O&M costs. Direct capital items include equipment, land and site development, and buildings and utilities. Indirect capital costs include construction, engineering expenses, license or permit fees, start-up and shakedown costs, and contingency allowances. Operating labor, maintenance labor, energy, disposal of residues, purchased services such as sampling, administrative costs, insurance, taxes, maintenance reserve and contingency funds, rehabilitation r replacement, are typical elements of O&M cost estimates. As a final step, the present worth of all associated costs will be calculated so that the alternatives can be compared in today's dollars. The RI/FS guidance recommends a 30-year time frame for the development of present worth costs.

4.2.3 Modifying Criteria

The modifying criteria consist of community and state acceptance. These criteria will be evaluated in the ROD, following a review of the public comments received on the RI/FS reports and the Proposed Plan. State acceptance refers to whether the State agrees with the preferred alternative presented in the Proposed Plan.

4.3 INDIVIDUAL ANALYSIS OF ALTERNATIVES

In **Table 4-2**, each of the four retained alternatives is described and individually assessed against the nine criteria without considering the other alternatives. Results of this individual assessment are used for conducting a comparative analysis of the alternatives.

4.4 COMPARATIVE ANALYSIS OF ALTERNATIVES

The information presented in **Table 4-2** is used for comparative analysis. The purpose of this analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs the decision-maker must balance can be identified (EPA, 1988).

Because Alternative 4 is a combination of Alternatives 2 – Capping, and Alternative 3 – Excavation and Off-Site Disposal, discussions describing the strengths and weaknesses of Alternatives 2 and 3, unless specified, also apply to Alternative 4.

4.4.1 Overall Protection of Human Health and the Environment

The No Action Alternative does not comply with this threshold criterion, and therefore, is not eligible for selection. Alternative 2 is protective of human health and the environment because the cap will minimize the potential for human or animal contact with the antimony-contaminated

soil and limit infiltration that could carry contaminants through the soil to groundwater. The cap will also minimize the potential for migration of antimony-contaminated sediment via surface water, minimizing the potential for impacts to the environment.

Alternative 3 is protective of human health and the environment because the antimony-contaminated soil would be completely removed from the Site to a secure landfill. The secure landfill would have additional engineering controls to minimize the potential for impacts to human health and the environment. Alternative 4 includes capping and off-site disposal of antimony-contaminated soil and thus is protective of human health and the environment as described above for Alternative 2 (capping) and Alternative 3 (excavation and off-site disposal)

4.4.2 Compliance with ARARs

While Alternative 1, No Action, does not explicitly violate any ARARs, it also does not accomplish the remedial action objective of reducing the HI to less than one. Alternative 2, Capping, accomplishes the remedial action objective by removing the potential for exposure of humans to antimony-contaminated soil. The cap would be designed and constructed in accordance with location-specific ARARs such as Title 132, Chapter 3 (see **Table 4-1**). However, the portion of Title 132, Chapter 3, requiring a permanent notation on the deed to the disposal property cannot be implemented by the Army. The Army has no authority to place such controls on property that is in third property ownership. Excepting the deed notification requirement, Alternative 2 complies with ARARs. Alternative 3, Excavation and Off-Site Disposal will comply with Title 132, Chapter 13, because the soil will be tested for acceptance in accordance with the regulation prior to disposal in a landfill permitted to accept special waste. Alternative 4, Capping at Load Lines 2 and 4 and Excavation and Off-Site Disposal at the Potential Landfill Area, is a combination of Alternatives 2 and 3 and will similarly comply with ARARs.

4.4.3 Long-term Effectiveness and Permanence

Alternatives 3 and 4 involve at least partial excavation and off-site disposal of contaminated soil and thus offer a greater degree of permanence than Alternative 1, No Action, and Alternative 2, Capping. The long-term effectiveness of capping (Alternative 2 and part of Alternative 4) is dependent on the cap being maintained. Institutional controls may be appropriate for these alternatives; however, the Army has no authority to place such controls on property that is in third party ownership. Periodic inspection and repairs will be required to maintain the cap. Excavation and off-site disposal eliminates the potential hazard and, thus, the need for future monitoring.

4.4.4 Reduction of Toxicity, Mobility and Volume

Alternative 1 does not reduce toxicity, mobility, or volume. Alternative 2, Capping, reduces the mobility of antimony by minimizing infiltration and the potential for migration of the contamination to groundwater. Alternative 3, Excavation and Off-Site Disposal, reduces the mobility of the contaminated soil by moving it to a controlled landfill designed to limit the potential for contaminant migration. Alternative 4, Capping at Load Lines 2 and 4 and Excavation and Off-Site Disposal at the Potential Landfill Area, reduces mobility by limiting

infiltration at Load Lines 2 and 4 and by removing contaminated soil from the Potential Landfill Area to a controlled landfill.

4.4.5 Short-term Effectiveness

Both the capping and excavation and off-Site disposal alternatives are immediately effective at reducing risk. Since soil will not be disturbed, capping has a lesser potential for short-term dermal exposure to contamination by the onsite worker.

4.4.6 Implementability

Both capping and excavation and off-Site disposal are relatively simple to implement. Capping will require a greater amount of materials and services. The cap will provide a reliable technology as long as it is maintained. Excavation and off-Site disposal will require coordination with NDEQ to obtain a Special Waste Permit. Alternatives 2, 3, and 4, will each require coordination with ARDC.

4.4.7 Cost

Alternatives are evaluated in terms of estimated capital costs, annual O&M costs and total present worth costs (total of capital and present worth of O&M costs). Cost estimate details are contained in **Attachment A** which includes itemized cost spreadsheets for each alternative, discussion of assumptions used in developing the cost estimated and cost estimating references used. A detailed summary is contained in **Table A-1** of **Attachment A**. The following table summarizes the estimated base cost for each alternative, rounded to the nearest $1000.

Alternative	Capital Cost (x1000)	Present Worth O&M Cost (x1000)	Total Present Worth Cost (x1000)
1	$208	$23	$231
2	$278	$44	$322
3	$440	$0	$440
4	$401	$39	$439

EPA Guidance (EPA, 1988) specifies that a +50% to –30% range of cost be used for evaluating costs estimates. When this range is utilized, the alternative cost estimates overlap except for the no action alternative as shown in the following tabulation.

Total Present Worth Cost Range (x1000)				
Total Present Worth Cost	Alternative 1	Alternative 2	Alternative 3	Alternative 4
+ 50 %	$347	$483	$670	$659
Base Cost	$231	$322	$440	$439
- 30%	$162	$226	$308	$308

The fact that the +50% to –30% ranges overlap for Alternatives 2, 3 and 4 indicates that there is not a major cost discriminator between these alternatives.

For comparative purposes, in addition to present worth cost, the four alternatives are also evaluated in terms of non-discounted costs where the O&M present worth cost is replaced by annual O&M cost times the same number of years used in the present worth calculation. A detailed summary of non-discounted costs is contained in **Table A-2** of **Attachment A**. Following is the estimated non-discounted cost for each alternative, rounded to the nearest $1000.

Alternative	Capital Cost (x 1000)	Non-Discounted O&M Cost (x1000)	Total Non-Discounted Cost (x1000)
1	$208	$50	$258
2	$278	$109	$387
3	$440	$0	$440
4	$401	$94	$495

The following table summarizes the +50% to –30% cost range.

Total Non-Discounted Cost Range (x1000)				
Total Non-Discounted Cost	Alternative 1	Alternative 2	Alternative 3	Alternative 4
+50%	$388	$581	$660	$742
Base Cost	$258	$387	$440	$495
-30%	$181	$271	$308	$346

As is the case for present worth costs, with the exception of the No Action Alternative (Alternative 1) the alternative cost estimates overlap.

As discussed above, there are no major total present worth cost differences between Alternatives 3 and 4. However, when expressed as non-discounted, the ranking from lowest to highest cost total non-discounted cost is as follows:

- Alternative 1 – No Action
- Alternative 2 – Capping
- Alternative 3 - Excavation and Off-Site Disposal
- Alternative 4 – Capping at Load Lines 2 and 4 and Excavation and Off-Site Disposal for the Potential Landfill Area.

Cost sensitivity analysis may be used in the FS process where significant uncertainties exist such as uncertainty of the cost of innovative technologies, uncertainty concerning the volume of media to be remediated or uncertainty as to the length of time required for effective remediation.

A cost sensitivity analysis is not required for this FS because the remedial technologies use proven (capping, excavation and off-Site disposal) rather than innovative technologies. Costs for these technologies are available in published cost references (**Attachment A**). Also the maximum potential, surface area and volume of soil to be remediated is known (**Section 2.3, Table 2-12, Drawings 2-1, 2-2, 2-3**). The time for remediation is know because excavation and off-Site disposal is an immediate and permanent remediation and capping is in perpetuity and the FS guidance (EPA 1988) 30-year period for present worth calculations is used. Future changes in cost inflation, change in the discount rate, a different cap design and different laboratory analytical requirements may occur but these likely will fall within the +50% to –30% range.

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TABLE 2-1

NON-CARCINOGENIC AND CARCINOGENIC HEALTH HAZARDS ASSOCIATED WITH LOAD LINE 2 PAINT OPERATIONS AREA SURFACE SOIL (0-6 INCHES) FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

	AVERAGE EXPOSURE		RME	
	CANCER RISK	HAZARD INDEX	CANCER RISK	HAZARD INDEX
		ADULT RESIDENT		
SOIL INGESTION	1.05E-06	6.96E-02	1.89E-05	1.74E-01
SOIL DERMAL	8.49E-08	5.79E-03	9.90E-06	9.35E-02
TOTAL	1.13E-06	7.54E-02	2.88E-05	2.68E-01
		CHILD RESIDENT (0-6 YR OLD)		
SOIL INGESTION	6.53E-06	6.50E-01	1.51E-05	1.63E+00
SOIL DERMAL	2.44E-07	2.50E-02	3.28E-06	3.61E-01
TOTAL	6.78E-06	6.75E-01	1.84E-05	1.99E+00
		ADULT TRESPASSER/VISITOR		
SOIL INGESTION	3.60E-08	2.39E-03	1.30E-06	1.20E-02
SOIL DERMAL	2.91E-09	1.98E-04	6.79E-07	6.41E-03
TOTAL	3.89E-08	2.59E-03	1.98E-06	1.84E-02
		JUVENILE TRESPASSER/VISITOR (8-13 YR OLD)		
SOIL INGESTION	3.78E-08	4.52E-03	1.75E-07	2.26E-02
SOIL DERMAL	3.04E-09	3.72E-04	8.07E-08	1.07E-02
TOTAL	4.09E-08	4.89E-03	2.56E-07	3.33E-02
		ON-SITE WORKER		
SOIL INGESTION	1.67E-07	9.95E-03	2.41E-06	6.23E-02
SOIL DERMAL	6.73E-08	4.13E-03	2.53E-06	6.68E-02
TOTAL	2.34E-07	1.41E-02	4.94E-06	1.29E-01

Table 2-2

NON-CARCINOGENIC AND CARCINOGENIC HEALTH HAZARDS ASSOCIATED WITH LOAD LINE 2 PAINT OPERATIONS AREA SURFACE SOIL (0 - 2 FEET) FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

	AVERAGE EXPOSURE		RME	
	CANCER RISK	HAZARD INDEX	CANCER RISK	HAZARD INDEX
		ADULT RESIDENT		
SOIL INGESTION	1.14E-06	4.79E-02	1.89E-05	7.35E-02
SOIL DERMAL	9.25E-08	4.01E-03	9.90E-06	4.02E-02
TOTAL	1.24E-06	5.19E-02	2.88E-05	1.14E-01
		CHILD RESIDENT (0-6 YR OLD)		
SOIL INGESTION	7.12E-06	4.47E-01	1.51E-05	6.86E-01
SOIL DERMAL	2.66E-07	1.73E-02	3.28E-06	1.55E-01
TOTAL	7.39E-06	4.64E-01	1.84E-05	8.41E-01
		ADULT TRESPASSER/VISITOR		
SOIL INGESTION	3.93E-08	1.64E-03	1.30E-06	5.04E-03
SOIL DERMAL	3.17E-09	1.37E-04	6.79E-07	2.76E-03
TOTAL	4.24E-08	1.78E-03	1.98E-06	7.80E-03
		JUVENILE TRESPASSER/VISITOR (8-13 YR OLD)		
SOIL INGESTION	4.13E-08	3.11E-03	1.75E-07	9.54E-03
SOIL DERMAL	3.31E-09	2.58E-04	8.07E-08	4.59E-03
TOTAL	4.46E-08	3.36E-03	2.56E-07	1.41E-02
		ON-SITE WORKER		
SOIL INGESTION	1.82E-07	6.84E-03	2.41E-06	2.63E-02
SOIL DERMAL	7.34E-08	2.86E-03	2.53E-06	2.87E-02
TOTAL	2.55E-07	9.70E-03	4.94E-06	5.50E-02

Table 2-3

NON-CARCINOGENIC AND CARCINOGENIC HEALTH HAZARDS ASSOCIATED WITH LOAD LINE 4 PAINT OPERATIONS AREA SURFACE SOIL (0 - 6 INCHES) FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

	AVERAGE EXPOSURE		RME	
	CANCER RISK	HAZARD INDEX	CANCER RISK	HAZARD INDEX
		ADULT RESIDENT		
SOIL INGESTION	0.00E+00	2.59E-02	0.00E+00	3.69E-01
SOIL DERMAL	0.00E+00	2.09E-03	0.00E+00	1.93E-01
TOTAL	0.00E+00	2.80E-02	0.00E+00	5.62E-01
		CHILD RESIDENT (0-6 YR OLD)		
SOIL INGESTION	0.00E+00	2.42E-01	0.00E+00	3.44E+00
SOIL DERMAL	0.00E+00	9.04E-03	0.00E+00	7.46E-01
TOTAL	0.00E+00	2.51E-01	0.00E+00	4.19E+00
		ADULT TRESPASSER/VISITOR		
SOIL INGESTION	0.00E+00	8.89E-04	0.00E+00	2.53E-02
SOIL DERMAL	0.00E+00	7.18E-05	0.00E+00	1.32E-02
TOTAL	0.00E+00	9.61E-04	0.00E+00	3.85E-02
		JUVENILE TRESPASSER/VISITOR (8-13 YR OLD)		
SOIL INGESTION	0.00E+00	1.68E-03	0.00E+00	4.79E-02
SOIL DERMAL	0.00E+00	1.35E-04	0.00E+00	2.20E-02
TOTAL	0.00E+00	1.82E-03	0.00E+00	6.99E-02
		ON-SITE WORKER		
SOIL INGESTION	0.00E+00	3.70E-03	0.00E+00	1.32E-01
SOIL DERMAL	0.00E+00	1.50E-03	0.00E+00	1.38E-01
TOTAL	0.00E+00	5.20E-03	0.00E+00	2.70E-01

Table 2-4

NON-CARCINOGENIC AND CARCINOGENIC HEALTH HAZARDS ASSOCIATED WITH LOAD LINE 4 PAINT OPERATIONS AREA SURFACE SOIL (0 - 2 FEET) FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

	AVERAGE EXPOSURE		RME	
	CANCER RISK	HAZARD INDEX	CANCER RISK	HAZARD INDEX
		ADULT RESIDENT		
SOIL INGESTION	0.00E+00	1.59E-02	0.00E+00	5.68E-02
SOIL DERMAL	0.00E+00	1.28E-03	0.00E+00	2.97E-02
TOTAL	0.00E+00	1.71E-02	0.00E+00	8.65E-02
		CHILD RESIDENT (0-6 YR OLD)		
SOIL INGESTION	0.00E+00	1.48E-01	0.00E+00	5.30E-01
SOIL DERMAL	0.00E+00	5.54E-03	0.00E+00	1.15E-01
TOTAL	0.00E+00	1.54E-01	0.00E+00	6.45E-01
		ADULT TRESPASSER/VISITOR		
SOIL INGESTION	0.00E+00	5.44E-04	0.00E+00	3.89E-03
SOIL DERMAL	0.00E+00	4.40E-05	0.00E+00	2.04E-03
TOTAL	0.00E+00	5.88E-04	0.00E+00	5.93E-03
		JUVENILE TRESPASSER/VISITOR (8-13 YR OLD)		
SOIL INGESTION	0.00E+00	1.03E-03	0.00E+00	7.37E-03
SOIL DERMAL	0.00E+00	8.25E-05	0.00E+00	3.39E-03
TOTAL	0.00E+00	1.11E-03	0.00E+00	1.08E-02
		ON-SITE WORKER		
SOIL INGESTION	0.00E+00	2.27E-03	0.00E+00	2.03E-02
SOIL DERMAL	0.00E+00	9.16E-04	0.00E+00	2.12E-02
TOTAL	0.00E+00	3.18E-03	0.00E+00	4.15E-02

Table 2-5

NON-CARCINOGENIC AND CARCINOGENIC HEALTH HAZARDS ASSOCIATED WITH POTENTIAL LANDFILL AREA SURFACE SOIL (0 - 6 INCHES) FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

	AVERAGE EXPOSURE		RME	
	CANCER RISK	HAZARD INDEX	CANCER RISK	HAZARD INDEX
		ADULT RESIDENT		
SOIL INGESTION	7.00E-09	8.12E-03	1.09E-07	3.57E-02
SOIL DERMAL	5.66E-09	1.23E-03	5.70E-07	2.63E-02
VEGETABLE INGESTION	2.60E-07	1.56E-02	3.90E-06	2.52E-02
TOTAL	2.72E-07	2.50E-02	4.57E-06	8.72E-02
		CHILD RESIDENT (0-6 YR OLD)		
SOIL INGESTION	4.36E-08	7.58E-02	8.71E-08	3.33E-01
SOIL DERMAL	1.63E-08	5.32E-03	1.89E-07	1.02E-01
VEGETABLE INGESTION	1.96E-07	2.16E-02	3.51E-07	3.49E-02
TOTAL	2.56E-07	1.03E-01	6.26E-07	4.70E-01
		ADULT TRESPASSER/VISITOR		
SOIL INGESTION	2.40E-10	2.78E-04	7.47E-09	2.45E-03
SOIL DERMAL	1.94E-10	4.22E-05	3.91E-08	1.80E-03
TOTAL	4.34E-10	3.21E-04	4.65E-08	4.25E-03
		JUVENILE TRESPASSER/VISITOR (8-13 YR OLD)		
SOIL INGESTION	2.52E-10	5.27E-04	1.01E-09	4.63E-03
SOIL DERMAL	2.02E-10	7.93E-05	4.64E-09	3.00E-03
TOTAL	4.55E-10	6.06E-04	5.65E-09	7.63E-03

Table 2-6

NON-CARCINOGENIC AND CARCINOGENIC HEALTH HAZARDS ASSOCIATED WITH POTENTIAL LANDFILL AREA SURFACE SOIL (0 - 2 FEET) FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

	AVERAGE EXPOSURE		RME	
	CANCER RISK	HAZARD INDEX	CANCER RISK	HAZARD INDEX
		ADULT RESIDENT		
SOIL INGESTION	1.71E-08	2.36E-02	2.83E-07	1.93E-01
SOIL DERMAL	1.38E-08	3.79E-03	1.48E-06	1.26E-01
VEGETABLE INGESTION	1.83E-06	4.40E-02	2.65E-05	8.23E-02
TOTAL	1.86E-06	7.15E-02	2.83E-05	4.01E-01
		CHILD RESIDENT (0-6 YR OLD)		
SOIL INGESTION	1.07E-07	2.21E-01	2.26E-07	1.80E+00
SOIL DERMAL	3.98E-08	1.64E-02	4.90E-07	4.86E-01
VEGETABLE INGESTION	1.71E-06	6.13E-02	3.18E-06	1.15E-01
TOTAL	1.85E-06	2.98E-01	3.90E-06	2.40E+00
		ADULT TRESPASSER/VISITOR		
SOIL INGESTION	5.87E-10	8.11E-04	1.94E-08	1.32E-02
SOIL DERMAL	4.74E-10	1.30E-04	1.01E-07	8.63E-03
TOTAL	1.06E-09	9.41E-04	1.21E-07	2.19E-02
		JUVENILE TRESPASSER/VISITOR (8-13 YR OLD)		
SOIL INGESTION	6.17E-10	1.53E-03	2.62E-09	2.50E-02
SOIL DERMAL	4.95E-10	2.44E-04	1.20E-08	1.44E-02
TOTAL	1.11E-09	1.78E-03	1.47E-08	3.94E-02

Table 2-7

NON-CARCINOGENIC AND CARCINOGENIC HEALTH HAZARDS ASSOCIATED WITH POTENTIAL LANDFILL AREA SUBSURFACE SOILS FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

	AVERAGE EXPOSURE		RME	
	CANCER RISK	HAZARD INDEX	CANCER RISK	HAZARD INDEX
	CONSTRUCTION WORKER			
INGESTION	1.30E-10	2.53E-03	1.25E-08	3.90E-01
DERMAL	5.27E-10	3.30E-03	1.37E-08	7.20E-02
TOTAL	6.57E-10	5.83E-03	2.62E-08	4.62E-01

Note:

* All soils data were combined for evaluuating Construction Worker exposure.

TABLE 2-8
ANTIMONY-SPECIFIC CHILD RESIDENT SCENARIO HAZARD INDEX CALCULATION RESULTS

FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

OU3 Exposure Area	Depth Below Ground Surface (feet)	No. of Samples	Concentration Range for Antimony (mg/kg)	Reasonable Maximum Exposure for Antimony (mg/kg)	Antimony Hazard Index	Total Hazard Index
Load Line 2 Paint Operations Area	0 – 0.5	22	0.6 – 37.4*	37.4	1.5	2.0
Load Line 4 Paint Operations Area	0 – 0.5	18	0.71 – 171	106	4.1	4.2
Potential Landfill Area	0 – 2	16	0.5 – 81.8	46	2.0	2.4

Notes:

*Non-quantifiable estimated value of 250 mg/kg (one-half of the non-quantifiable estimated value of 501 mg/kg) is included in the calculation of exposure concentrations. The 501 mg/kg result was qualified as estimated (J) on account of spike recoveries being with range of 30 to 74 percent.

Hazard Index values are presented as two significant figures for illustration purposes. Hazard Index values are generally expressed as one significant figure.

Source: OU3 Draft Final Revised Baseline Risk Assessment (URSGWCFS, 2000b)

TABLE 2-9
SOIL SAMPLE LOCATIONS AND
CORRESPONDING ANTIMONY DATA REMOVED
TO ACHIEVE HI LESS THAN ONE
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

Area	No. of Soil Samples	Soil Sample Location*	Soil Sample No.*	Antimony Soil Concentration (mg/kg)	Sample Depth bgs (feet)	Estimated Exposure Point Concentration After Removal (mg/kg)	Estimated Residual Antimony Hazard Index After Removal
Load Line 2 Paint Operations Area	3	P2A-003 P2A-004 P2A-005	P2A-003-000 P2A-004-000 P2A-005-000	501** 44.2** 37.4	0-0.5 0-0.5 0-0.5	7.7	0.2
Load Line 4 Paint Operations Area	1	P4A-001	P4A-001-000	171	0-0.5	27.8	0.9
Potential Landfill Area	1	PLA-001	PLA-001-001	81.8	1-2	4.4	0.1

Notes:

*Soil samples were taken by hand auger and there are not separate soil boring numbers. The soil sample location is identified by six alpha/numeric characters/digits. The individual soil sample depth bgs and number are identified by three numeric digits following the soil sample location designation.

**Laboratory results could not be quantified and are reported as estimated values (J) on account of spike recoveries being with range of 30 to 74 percent.

TABLE 2-10

RATIONALE USED IN DEFINING THE HORIZONTAL EXTENT OF REMEDIATION FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

Extent	Load Line 2 Paint Operations Area	Load Line 4 Paint Operations Area	Potential Landfill Area
North	To sample location included in HI < 1 calculation	To physical boundary – concrete pad	To sample location included in HI < 1 calculation
South	To sample location included in HI < 1 calculation	To sample location included in HI < 1 calculation	To sample location included in HI < 1 calculation
East	To physical boundary – roadway	To sample location included in HI < 1 calculation	To sample location included in HI < 1 calculation
West	To physical boundary – building foundation	To physical boundary – building foundation	To sample location included in HI < 1 calculation

TABLE 2-11

RATIONAL USED IN DEFINING THE VERTICAL EXTENT OF REMEDIATION
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

Exposure Area	Maximum Sampling Interval At Which Antimony Contributed to HI > 1 (feet)	Minimum Sampling Interval At Which Antimony Did Not Contribute to HI > 1 (feet)	Depth of Remediation Excavation (feet)
Load Line 2 Paint Operations Area	0 - 0.5	1 - 2	1
Load Line 4 Paint Operations Area	0.0.5	1 - 2	1
Potential Landfill Area	0 – 2	4 – 5	4

TABLE 2-12

PRELIMINARY SOIL REMEDIATION AREAS AND VOLUMES
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

Location	Area of Excavation (square feet)	Depth of Excavation bgs (feet)	In Situ Volume (cubic yards)
Load Line 2 Paint Operations Area: (Drawing 2-1)	8,300	1	308
Load Line 4 Paint Operations Area: (Drawing 2-2)	2,700	1	100
Potential Landfill Area (Drawing 2-3)	3,800	4	563
Total	14,800		971

TABLE 2-13

PRELIMINARY REMEDIATION TECHNOLOGIES & PROCESS OPTIONS
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

General Response Actions	Remedial Technologies	Process Options
No Action	None	None
Institutional Controls	Property/Access Restrictions	Land Use/Deed Restrictions
Natural Attenuation	Natural Attenuation	Monitored Natural Attenuation
Containment	Capping	Asphalt, Concrete, or Clay
	Vertical/Horizontal Barriers	Liners, Grout Injection
	Surface Controls	Run-on/Runoff Diversion/Collection, Grading
Removal/Disposal	Excavation	Soil Excavation and Off-Site Disposal
		Soil Excavation and On-Site Disposal
Treatment	Biological In-Situ	Phytoremediation
	Biological Ex-Situ	Aerobic
		Anaerobic
	Physical/Chemical Ex-Situ	Chemical Reduction/Oxidation
		Chemical Extraction
		Electrokinetic Separation
		Solidification/ Stabilization
		Separation
		Soil Washing
		Soil Flushing
	Physical/Chemical In-Situ	Solidification/ Stabilization
		Soil Flushing

TABLE 2-14

PRELIMINARY REMEDIATION TECHNOLOGIES SCREENING
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

General Response Actions	Applicable Remedial Technology	Process Options	Description	Implementability	Effectiveness	Cost	Status
No Action	None	None	None	Institute a program of environmental monitoring.	No action taken.	No capital and low O&M costs.	Retain (required by NCP)
Institutional Controls	Property/Access Restrictions	Use/Deed Restrictions	Legal instrument attached to the land, forbidding access to surface soil contaminated areas or forbidding land uses exposing humans to contaminated soils or uses incompatible with remedial technologies.	May not be implementable since the land is owned by a third party.	Effective in limiting contact with contaminated soils. Does not reduce toxicity, mobility, or volume at the Site.	Primarily up-front legal fees.	Eliminate as a stand alone technology (implementability, effectiveness). Retain for use in conjunction with other remedial alternatives.
		Fencing and signage	Installation of a fence around the antimony-contaminated soil areas. Erect signs to explain the need for access control.	Implementable with cooperation of property owner.	Effective at limiting contact with contaminated soils. Does not reduce toxicity, mobility, or volume at the site.	Low capital and O&M costs.	Eliminate as a stand alone technology (effectiveness). Retain for use in conjunction with other remedial alternatives.
Natural Attenuation	Monitored Natural Attenuation	Monitored Natural Attenuation Processes	Refers to the practice of allowing natural processes, such as dilution, dispersion, volatilization, biodegradation, adsorption, and chemical reactions to reduce organic contaminant concentrations to acceptable levels.	Not implementable for soil contamination.	Effective primarily for organic compounds in groundwater. Not effective for antimony in soil.	Low capital cost and moderate O&M costs.	Eliminate (effectiveness, implementability)
Containment	Capping	Asphalt, Concrete, or Clay, or Engineered Materials	Installation of surface (or shallow) barrier of low permeable or impermeable material to prevent contact with contaminated soils and infiltration of precipitation or surface water through contaminated soils.	Technology is well developed and mature. Easily implemented at the Site to cover antimony-contaminated soils. Cooperation of third party landowner required.	Effective at restricting the potential for ingestion of antimony by humans at the Site. Does not reduce toxicity, mobility or volume at the Site, but minimizes the potential for migration.	Low capital and O&M costs.	Retain

TABLE 2-14

PRELIMINARY REMEDIATION TECHNOLOGIES SCREENING
(Continued)

General Response Actions	Applicable Remedial Technology	Process Options	Description	Implementability	Effectiveness	Cost	Status
Removal and Disposal	Excavation	Soil Excavation and Off-Site Disposal	Contaminated material is removed and transported to a permitted off-site disposal facility.	Easily implementable. Controlled landfill located within reasonable distance from the Site. Excavation can be accomplished even with the presence of existing buildings and surface features at Load Lines 2 and 4. Technology is well developed and mature. There may be fugitive emissions (dust) during operations. Contaminant type impacts disposal requirements.	Effective at restricting exposure pathways involving humans. Will eliminate the potential for migration of antimony from soil at the Site.	Low capital costs and no O&M costs based on contaminant, volume, and distance to disposal facility.	Retain
		Soil Excavation and On-Site Disposal	Contaminated material is removed and transported to a permitted on-site treatment and disposal facility.	Would require construction of an on-site landfill. Design, permitting, and construction process is necessarily complicated and thus may not be implementable for such a small volume of waste.	Effective at restricting exposure pathways involving humans. Reduces the mobility of the antimony-contamination.	High capital and O&M costs based on the contaminant volume. Not cost-effective for the volume involved.	Eliminate (implementability, cost)
Treatment	Biological In-Situ	Phytoremediation	Uses plants to remove, transfer, stabilize, and/or destroy contaminants in soil. Mechanisms include and phyto-extraction, degradation, and stabilization.	Requires treatability study. Requires cooperation and involvement of third party landowner. Requires post-planting care to ensure treatment.	Demonstrated to be effective for some metals in soil. There is a transfer of contaminants from one media to another requiring additional management of the plant structure. No data exist to show the technology is applicable for antimony.	Low capital and O&M costs.	Eliminate (implementability, effectiveness)
	Physical/Chemical Ex-Situ	Electrokinetic Separation	Removes metals and other contaminants from low permeability soils using electrochemical and electrokinetic processes to desorb and then remove metals and their polar organics.	Not implementable because site soils are not low permeability. In-situ method that would be difficult to conduct with continuing operations at the Site.	Not effective for the low levels of contamination at the Site. Could form undesirable products via oxygen/reduction reactions.	Moderate capital and high O&M costs. Not cost-effective for low volume involved.	Eliminate (implementability, effectiveness, cost)
		Chemical Reduction/ Oxidation	Oxidizing agents chemically convert hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert.	Requires treatability study for Site contamination. Technology has been demonstrated at full scale. Requires excavation of soil.	Not shown to be effective for low levels of antimony in soil. Used mostly for cyanide wastes.	Moderate capital and O&M costs. Not cost-effective for low volume involved.	Eliminate (effectiveness, cost)
		Chemical Extraction	Contaminated soil and the extractant are mixed, dissolving the contaminants. The extracted solution is placed in a separator, where the contaminants and extractant are separated for treatment and further use.	Fully developed technology with commercial scale units in operation. Acid is generally the extractant of choice for metals. Requires treatability study for Site contamination. Requires excavation of soil.	Not shown to be effective for low levels of antimony in soil. Transfers contaminants to acid which then needs to be disposed of or otherwise treated.	High capital and O&M costs.	Eliminate (effectiveness, cost)

TABLE 2-14

PRELIMINARY REMEDIATION TECHNOLOGIES SCREENING
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA
(Continued)

General Response Actions	Applicable Remedial Technology	Process Options	Description	Implementability	Effectiveness	Cost	Status
	Physical/Chemical Ex-Situ (Continued)	Solidification/ Stabilization	Contaminants are physically bound or enclosed within a stabilized mass (solidification) or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility. Includes innovative processes such as bituminization, emulsified asphalt, modified sulfur cement, polyethylene extrusion, pozzolan/ portland cement, soluble phosphates, and vitrification.	Less implementable than other technologies. Volume will increase. Treatability studies required. Requires design, permitting, and construction of an on-site repository following treatment. Off-site disposal would also be an option; however, treatment is added cost that is not needed for acceptance for off-site disposal.	Long-term effectiveness has not been demonstrated for many contaminants or process combinations.	Moderate capital and O&M costs.	Eliminate (implementability, effectiveness)
		Separation	Contaminants or contaminated solids are concentrated through physical (gravity and sieving) and chemical (magnetic) means or separated from the media that contains them.	Less implementable than other technologies for low level, non-heavy metal contamination. Requires excavation and disposal of separated material.	Not effective for the low concentrations of antimony found at the Site.	Moderate capital costs and high O&M costs.	Eliminate (implementability, effectiveness)
		Soil Washing	A water-based process for scrubbing soils to remove contaminants by dissolving/suspending them in wash solution (chemicals) or by concentrating them into a smaller volume via physical (gravity, sieving) processes.	Full-scale, well-developed technologies. Requires excavation of soil and disposal of washing fluid.	Not effective for low level inorganic contaminants such as antimony.	Moderate to high capital and O&M costs, depending on soil characteristics.	Eliminate (effectiveness)
	Physical/Chemical In-Situ	Solidification/ Stabilization	Contaminants are physically bound or enclosed within a stabilized mass (solidification) or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility. Includes auger/caisson, reagent/ injector, and vitrification systems. The first two are applicable to inorganics; vitrification applies to organics and inorganics.	Not implementable because future site usage may "weather" the materials reducing immobilization. Requires cooperation of third party landowner since solidified material may hinder future site use. Requires treatability studies	Effective at reducing the mobility of antimony at the Site. Not demonstrated to be effective for antimony-contaminated soil. Long-term effectiveness is less certain.	Moderate capital and O&M costs except for vitrification, which has higher associated cost.	Eliminate (implementability, effectiveness)
		Soil Flushing	Similar to soil washing except process is done without excavating soil. Water or water containing an additive to enhance contaminant solubility is applied to the soil or injected into the ground water to raise the water table into the contaminated zone. Contaminants are leached into the groundwater, which is then extracted and treated.	Little in the way of commercial applications. Potential for contaminants to move beyond the capture zone. Requires treatability studies to find appropriate soil flushing solution for antimony.	Transfers antimony to groundwater. Limitedly effective for low levels of localized antimony contamination in surficial soil. Extensive groundwater treatment system at site not designed for treating antimony.	Moderate capital costs and high O&M costs. Not cost-effective for volume involved.	Eliminate (implementability, effectiveness, cost)

TABLE 2-15

PRELIMINARY REMEDIATION TECHNOLOGIES SCREENING RESULTS
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

General Response Actions	Applicable Remedial Technology	Process Options	Description	Reason(s) for Retaining
No Action	None	None	None	Required by EPA guidance
Containment	Capping	Asphalt, Concrete, or Clay	Installation of surface (or shallow) zone of low permeable or impermeable material to prevent contact with contaminated soils or infiltration of precipitation or surface water through contaminated soils.	The cap would reduce or eliminate dermal contact with the contaminants. Land use restrictions to assure cap integrity may limit marketability but might be acceptable to current owners and some potential user/buyers (i.e., brownfields).
Removal/Disposal	Excavation	Soil Excavation and Off-Site Disposal	Contaminated material is removed and transported to a permitted off-Site disposal facility.	The contaminated soils would be removed from the Site and disposed off-Site at a permitted facility. This eliminates toxicity, mobility, and volume of contaminant of interest at the Site.

TABLE 3-1

PRELIMINARY REMEDIAL ALTERNATIVES
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

General Response Action	Alternative 1 No Action	Alternative 2 Capping	Alternative 3 Excavation and Off-Site Disposal	Alternative 4 Capping at Load Lines 2 and 4 and Excavation and Off-Site Disposal at the Potential Landfill Area
Environmental Monitoring	Included	Included	Not Included	Included
Institutional Controls	Not Included	Included	Not Included	Included
Soil Excavation	Not Included	Not Included	Included	Included
Treatment: In-Situ (Biological)	Not Included	Not Included	Not Included	Not Included
Off-Site Disposal	Not Included	Not Included	Included	Included

TABLE 3-2

PRELIMINARY REMEDIAL ALTERNATIVES SCREENING RESULTS
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

Alternative	Effectiveness	Implementability	Cost	Status
1 – No Action	Not effective. Retained for baseline comparison.	Can implement environmental monitoring program.	No capitol cost. Low O&M cost.	Retain
2 – Capping	Protective of human health by eliminating contact with contaminated soil.	Can implement capping using readily available technology.	Low capitol and O&M cost.	Retain
3 – Excavation and Off-Site Disposal	Protective of human health by removing contaminated soil.	Can implement excavation and off-Site disposal using readily available technology.	Low capitol cost. No O&M cost once contaminated soil removed.	Retain
4 – Capping at Load Lines 2 and 4 Paint Operations Area and Excavation and Off-Site Disposal At The Potential Landfill Area	Protective of human health by eliminating contact with the contaminated soil at Load Lines 2 and 4 and removing the contaminated soil at the Potential Landfill.	Can implement both capping and excavation and off-Site disposal using readily available technology.	Low capitol and O&M cost.	Retain

TABLE 4-1

MEAD OU3 POTENTIAL LOCATION-SPECIFIC ARARs
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

Standard, Requirement, Criterion, or Limitation	Citation	Description	Comment
Federal			
Flood Plain Management	Executive Order No. 11988 16 USC 661 et seq 40 CFR Part 6, Appendix A and 40 CFR 6.302	Action that will occur in a floodplain and relatively flat areas adjoining inland and coastal waters and other floodplain areas to avoid adverse effects.	Site is not located within a floodplain.
100-Year Floodplain Management	40 CFR 264.18(b)	RCRA treatment, storage, or disposal facility must be designed, constructed, operated, and maintained to avoid washout within 100-year floodplain.	Site is not located within a 100-year floodplain.
Protection of Wetlands	Executive Order No. 11990 40 CFR Part 6, Appendix A	Action involving construction of facilities or management of property in wetlands to avoid adverse effects, minimize potential harm, and preserve and enhance wetlands, to the extent possible.	May be relevant and appropriate for on-site remediations if wetlands are located near the Site.
Protection of Wetlands	CWA Section 404; 40 CFR Part 230 33 CFR Part 320-330	Action to prohibit discharge of dredged or fill materials into wetlands (as defined in USACE regulations) without permit.	No dredged or fill material will be discharged into a wetland.
Wilderness Act	16 USC 1311 et seq 50 CFR 53.1 et seq	Federally-owned area designated as wilderness area must be administered in such a manner that will leave it unimpaired as wilderness and preserve its wilderness.	No federally-owned wilderness area is located on-site or in the vicinity of the Site.
Wildlife Refuge	16 USC 668dd et seq 50 CFR Part 27	Only actions allowed under the provisions of 16 USC 668dd(c) may be undertaken in areas designed as part of National Wildlife Refuge System.	Site and immediate area do not contain areas designated as part of National Wildlife Refuge System.
Standards for Owners and Operators of hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264.18(a)	New RCRA treatment, storage, or disposal of hazardous waste prohibited within 61 meters of a fault displaced in Holocene time.	No treatment, storage, or disposal facilities located on-site will be within 61 meters of a Holocene-Age fault.

Standard, Requirement, Criterion, or Limitation	Citation	Description	Comment
Endangered Species Act	16 USC 1531 et seq 50 CFR Part 81 50 CFR Part 200 50 CFR Part 402	Action to conserve endangered species within critical habitats upon which endangered species depend, including consultation with the Department of Interior and the affected state.	Critical habitats for endangered species have not been identified at the Site.
Fish and Wildlife Coordination Act	16 USC 661 et seq 33 CFR Parts 320-330 40 CFR 6.302	Action to protect fish or wildlife for diversion, channeling, or other activity that modifies a stream or river and affects fish or wildlife.	No action at Site should modify a stream or river.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264.18(c)	Placement of non-containerized or bulk liquid RCRA hazardous waste prohibited within salt dome formation, underground mine, or cave.	None of the formations are present on or in the vicinity of the Site.
National Historic Preservation Act	16 USC Section 469 36 CFR Part 65	Action to recover and preserve artifacts in area where alteration of terrain threatens significant scientific, pre-historical, historical, or archaeological data.	From available information, Site contains no area which provides significant, prehistorical, historical, or archaeological data.
National Historic Preservation Act	16 USC 470 et seq 36 CFR Part 800 40 CFR Section 6.301	Action to preserve property in or eligible for National Register of Historic Places; planning of action to minimize harm to National Historic Landmarks.	No properties on the Site are eligible for National Register of Historic Places or are National Historic Landmarks.
State			
Flood Plain Management	Chapter 31 Article 10	Establishes the minimum standards for the alteration and management of floodplains.	Site is not located within a floodplain.
Flood Plain Rules	Title 258	Establishes the minimum standards for the alteration and management of floodplains.	Site is not located within a floodplain.
Rules Governing Flood Plain Management	Title 455	Establishes the minimum standards for the alteration and management of floodplains.	Site is not located within a floodplain.
Nebraska Hazardous Waste Rules	Title 128, Chapter 121	Adapts and incorporates all of Title 40 CFR Part 264 pertaining to standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.	Discussed in previous sections containing 40 CFR 264 standards, requirements, criteria, or limitations.

TABLE 4-1

MEAD OU3 POTENTIAL LOCATION-SPECIFIC ARARs
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA
(Continued)

Standard, Requirement, Criterion, or Limitation	Citation	Description	Comment
Nebraska Regulation of Disposal Sites Act	Section 19-4107	A disposal site shall be located at least 1,000 feet from the nearest edge of the right-of-way of any state, interstate, or federal highway unless the working area is screened so as not to be visible from such highway.	Might be relevant and appropriate for on-site disposal of solid waste.
Nebraska Solid Waste Rules	Title 132, Chapter 3, 005.03	Requires a permanent notation on the deed to the disposal property or some other permanent property record or instrument that is normally examined during a title search.	The Army may not be able to place permanent controls on property since it does not own the property where the antimony-contaminated soil is located.
Nebraska Solid Waste Rules	Title 132, Chapter 3, 005.9	Requires prior approval of the Nebraska Department of Environmental Quality to excavate, disturb the final cover, or remove any deposited materials.	Alternatives may involve capping antimony-contaminated soil.
Nebraska Solid Waste Rules	Title 132, Chapter 13	Describes the procedures to be followed when disposing of special wastes.	Antimony-contaminated soil may be disposed as part of the proposed remedy for the Site.

TABLE 4-2

COMPARATIVE ANALYSIS OF ALTERNATIVES
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA

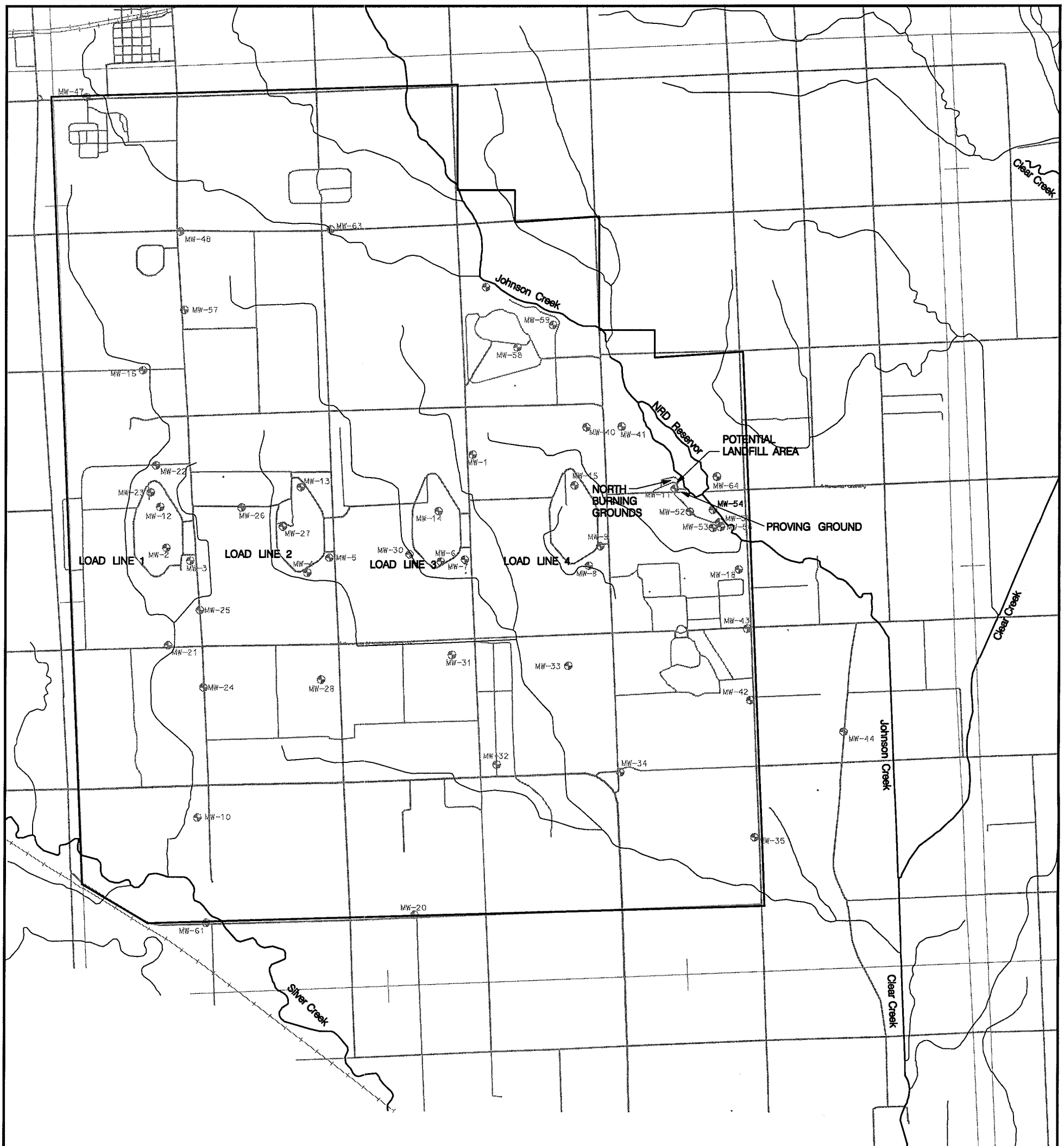
Criteria No.	Criteria Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4
		No Action	Capping	Excavation and Off-Site Disposal	Capping, Excavation, and Off-Site Disposal
1	Overall Protection of Human Health and the Environment				
	Soil ingestion by present and future populations	Not protective of human health or the environment.	Protects human health and the environment by minimizing the potential for ingestion of antimony-contaminated soil. Limits infiltration and potential for leaching to groundwater.	Removes antimony-contaminated soil to a controlled landfill.	Protects human health and the environment by minimizing the potential for ingestion of contaminated soil at Load Lines 2 and 4 and by removing antimony-contaminated soil at the Potential Landfill Area.
2	Compliance with ARARs				
	Chemical-Specific ARARs	There are no chemical-specific ARARs for antimony in soil.	There are no chemical-specific ARARs for antimony in soil.	There are no chemical-specific ARARs for antimony in soil.	There are no chemical-specific ARARs for antimony in soil.
	Action-Specific ARARs	There are no action-specific ARARs since no action will be taken under this alternative.	Can meet action-specific ARARs for worker protection during cap construction.	Can meet ARARs for worker protection during excavation.	Can meet action-specific ARARs for worker protection during remediation.
	Location-Specific ARARs	Would not meet any ARARs since there will be no action.	Can meet location-specific ARARs for notification of activities after cap is in place. Land use restrictions may not be enforceable.	Can meet location-specific ARARs for off-site disposal such as special waste requirements.	Can meet ARARs for notification of activities after cap is in place and for off-site disposal. Land use restrictions may not be enforceable.
3	Long-term Effectiveness and Permanence				
	Magnitude of Residual Risk	Contaminant has not been removed. Existing hazard will remain.	Hazard is reduced as long as cap is maintained. Antimony-contaminated soil remains at the site.	Hazard is eliminated through excavation and off-Site disposal of antimony-contaminated soil. There is no residual hazard after remediation.	Hazard is reduced at Load Lines 2 and 4 and eliminated at the Potential Landfill Area. Antimony-contaminated soil remains at Load Lines 2 and 4.
	Adequacy and Reliability of Controls	No controls over remaining contamination. No reliability.	Capping is an adequate control to prohibit soil ingestion. Inspection and maintenance of the cap is required to ensure reliability.	Excavation and off-Site disposal will eliminate the possibility of ingesting antimony-contaminated soil at the site.	Capping at Load Lines 2 and 4 is adequate and reliable if maintained properly. Excavation and off-site disposal are adequate and reliable for preventing ingestion of antimony-contaminated soil at the Site.
	Need for 5-Year Review	If no action is acceptable, then no 5-year review would be needed. However, the overall Mead Site may be the subject of a 5-year review. The antimony-contaminated areas can be included in the evaluation.	A 5-year review would be required for Alternative 2 to ensure that adequate protection of human health is maintained.	5-year review not required since waste would be removed completely from site. However, the overall Mead Site may be the subject of a 5-year review. The antimony-contaminated areas can be included in the evaluation.	A 5-year review would be required for Alternative 2 to ensure that adequate protection of human health is maintained. Also, the overall Mead Site may be the subject of a 5-year review.

Criteria No.	Criteria Description	Alternative 1 No Action	Alternative 2 Capping	Alternative 3 Excavation and Off-Site Disposal	Alternative 4 Capping, Excavation, and Off-Site Disposal
4	Reduction of Toxicity, Mobility or Volume				
	Treatment Process Used and Materials Treated	No treatment is included in the Alternative.	No treatment is included in the Alternative.	No treatment is included in the Alternative.	No treatment is included in the Alternative.
	Degree of Expected Reduction in Toxicity, Mobility or Volume	Alternative does not reduce toxicity, mobility, or volume.	Reduces mobility of antimony by minimizing infiltration.	Eliminates mobility of antimony at the Site by removing the contaminated soil to a controlled landfill.	Reduces mobility of antimony by minimizing infiltration at Load Lines 2 and 4 and by removing antimony-contaminated soil from the Potential Landfill Area.
5	Short-term Effectiveness				
	Protection of Community During Remedial Actions	No remedial action will take place so community is not endangered by the remediation.	Community will not be endangered during remediation because the antimony-contaminated soil will not be disturbed.	Alternative may increase dust production during soil excavation. Site is remote and impact to community is unlikely.	Community will be protected because no excavation will occur at Load Lines 2 and 4 and the Potential Landfill Area will take is located away from the community.
	Protection of Workers During Remedial Actions	No remedial action will take place so no workers will be impacted.	Personal Protective Equipment will be used by workers potentially coming into contact with antimony-contaminated soil.	Personal Protective Equipment will be used by workers potentially coming into contact with antimony-contaminated soil.	Personal Protective Equipment will be used by workers potentially coming into contact with antimony-contaminated soil.
	Environmental Impacts	The risk assessment did not indicate any potential for environmental impacts.	The risk assessment did not indicate any potential for environmental impacts.	The risk assessment did not indicate any potential for environmental impacts.	The risk assessment did not indite any potential for environmental impacts.
	Time Until Remedial Action Objective is Achieved	Remedial action objectives will not be achieved.	Cap installed in 3 months.	Contaminated soil excavated in 3 months.	Caps at Load Lines 2 and 4 will be installed in 3 months. Contaminated soil excavated from Potential Landfill Area and disposed off-site within 3 months.
6	Implementability				
	Ability to Construct and Operate the Technology	No technology to construct or operate.	Simple to operate and construct.	Simple to operate and construct.	Simple to operate and construct.
	Reliability of the Technology	No technology will be employed.	Reliable as long as cap is maintained.	Highly reliable.	Cap is reliable as long as properly maintained. Excavation and off-site disposal is highly reliable.
	Ease of Undertaking Additional Remedial Actions, if Necessary	Additional remedial actions could be easily undertaken if necessary.	Simple to extend limits of cap.	Simple to extend limits of excavation.	Simple to extend limits of cap or excavation if additional antimony-contaminated soil is identified.
6 (Cont.)	Ability to Monitor Effectiveness of Remedy	No remedy to monitor.	Simple visual inspection of cap.	None required.	Caps will be visually inspected at least annually. No monitoring will be necessary at the Potential Landfill Area after the antimony-contaminated soil is excavated and disposed off-site.

TABLE 4-2

COMPARATIVE ANALYSIS OF ALTERNATIVES
FORMER NEBRASKA ORDNANCE PLANT, MEAD, NEBRASKA
(Continued)

Criteria No.	Criteria Description	Alternative 1 No Action	Alternative 2 Capping	Alternative 3 Excavation and Off-Site Disposal	Alternative 4 Capping, Excavation, and Off-Site Disposal
	Ability to Obtain Approvals and Coordinate with Other Agencies	Institutional controls will need to be negotiated with the property owners. No other approvals or coordination required.	Simple to obtain approval of cap design.	Special Waste Permit required. Should be easy to obtain.	Approvals for design of caps and required special waste permit should be easily obtained..
	Availability of Services and Capabilities	Locally available.	Locally available.	Locally available.	Locally available.
	Availability of Necessary Materials, Equipment, and Specialists	No materials, equipment, or specialists required.	Locally available.	Locally available.	Locally available.
	Availability of Technologies	No technologies employed.	Readily available.	Readily available.	Readily available.
7	Costs				
	Capital Costs	$208,225	$278,335	$439,907	$400,937
	Operating and Maintenance Costs	$23,001	$43,895	$0	$38,544
	Present Worth Cost	$231,226	$322,230	$439,907	$439,481



INVESTIGATION AREA KEY:

- MW-29 Existing Groundwater Monitoring Well Cluster
- Former NOP Boundary
- Intermittent Drainages
- Streams

Revisions			
Symbol	Descriptions	Date	Approved

URS Greiner Woodward Clyde Federal Services
10975 El Monte, Suite 100
Overland Park, Kansas 66211

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: D.E.F.
Drawn by: R.A.D.
Checked by: L.A.T.
Submitted by: R.A.N.

U.S. Army Corps of Engineers

FEASIBILITY STUDY - OPERABLE UNIT 3
FMR. NEBRASKA ORDNANCE PLANT
MEAD, NEBRASKA

FORMER NOP SITE MAP

Scale: 1 IN - 4000 FT
Date: DECEMBER, 2000
Dwg. No.: 1-1
Sheet number: 1

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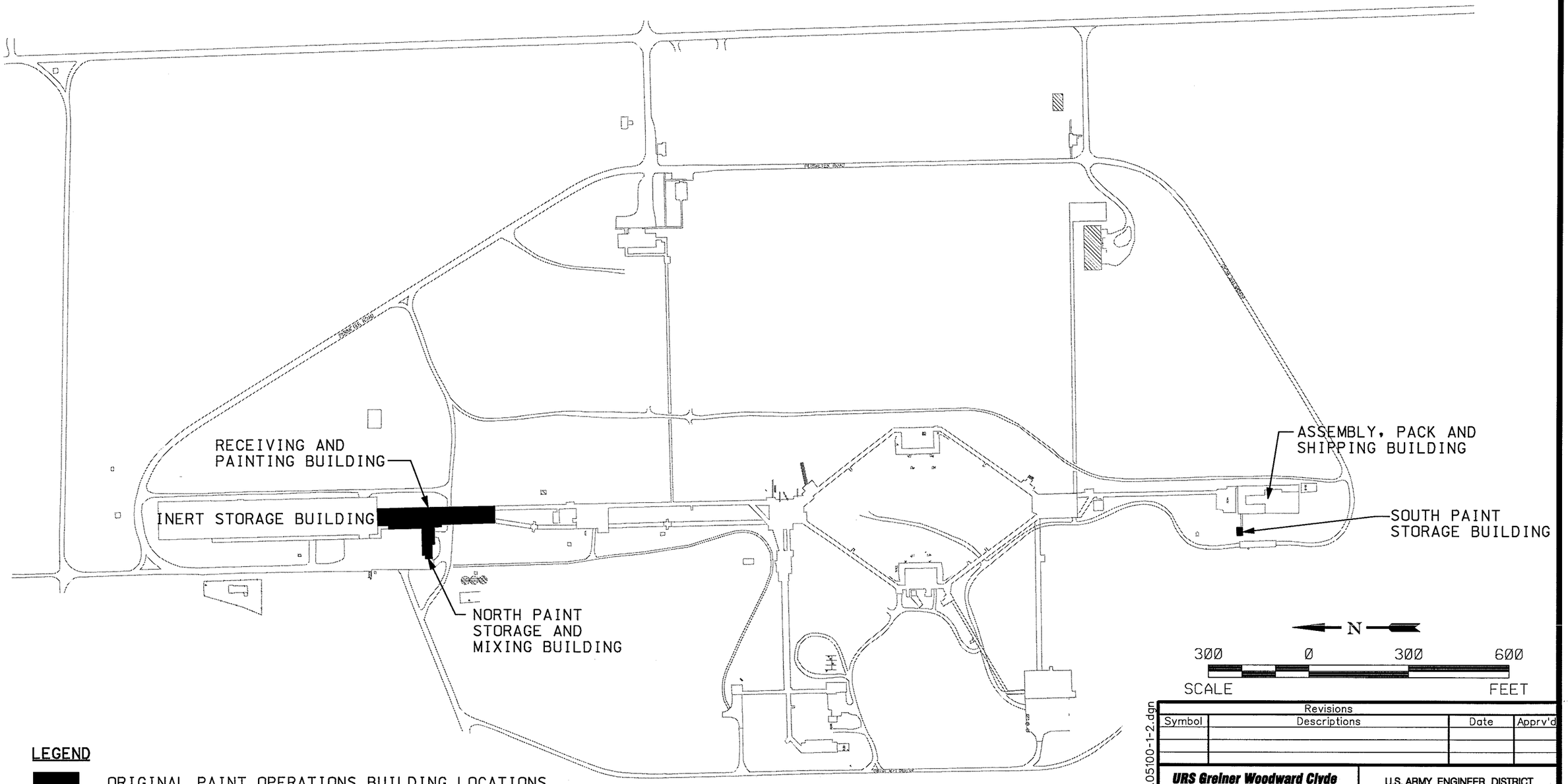

LEGEND

ORIGINAL PAINT OPERATIONS BUILDING LOCATIONS

NOTE:

THE SOUTH PAINT STORAGE BUILDING AT LOAD LINE 2 HAS BEEN DEMOLISHED.

SOURCE : DONOHUE, 1992B

Revisions			
Symbol	Descriptions	Date	Apprv'd

URS Greiner Woodward Clyde Federal Services
10975 El Monte, Suite 100
Overland Park, Kansas 66211

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: D.E.F.
Drawn by: R.A.D.
Checked by: L.A.T.
Submitted by: R.A.N.

U.S. Army Corps of Engineers

FEASIBILITY STUDY - OPERABLE UNIT 3
FMR. NEBRASKA ORDNANCE PLANT
MEAD, NE.

PAINT OPERATIONS AREAS AT LOAD LINE 2

Scale: 1 IN - 300 FEET
Date: DECEMBER, 2000
Dwg. No.: 1-2
Sheet number: 1

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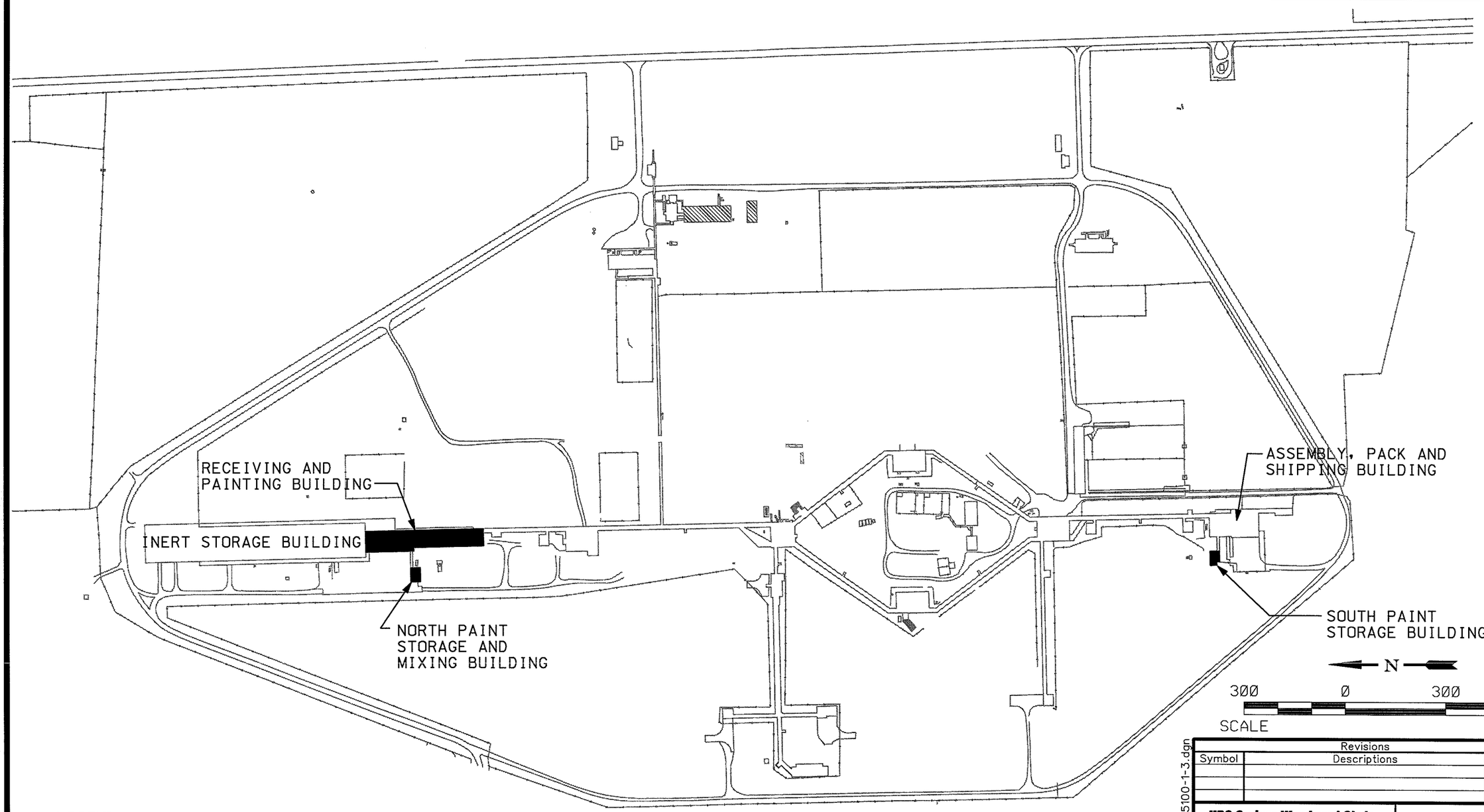


LEGEND

ORIGINAL PAINT OPERATIONS BUILDING LOCATIONS

SOURCE : DONOHUE, 1992B

06 DEC 2000 15:09:52
MCS FILE: J:\MEAD\K97209.00\05100-1-3.dgn

Revisions			
Symbol	Descriptions	Date	Apprv'd

URS Greiner Woodward Clyde Federal Services
10975 El Monte, Suite 100
Overland Park, Kansas 66211

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

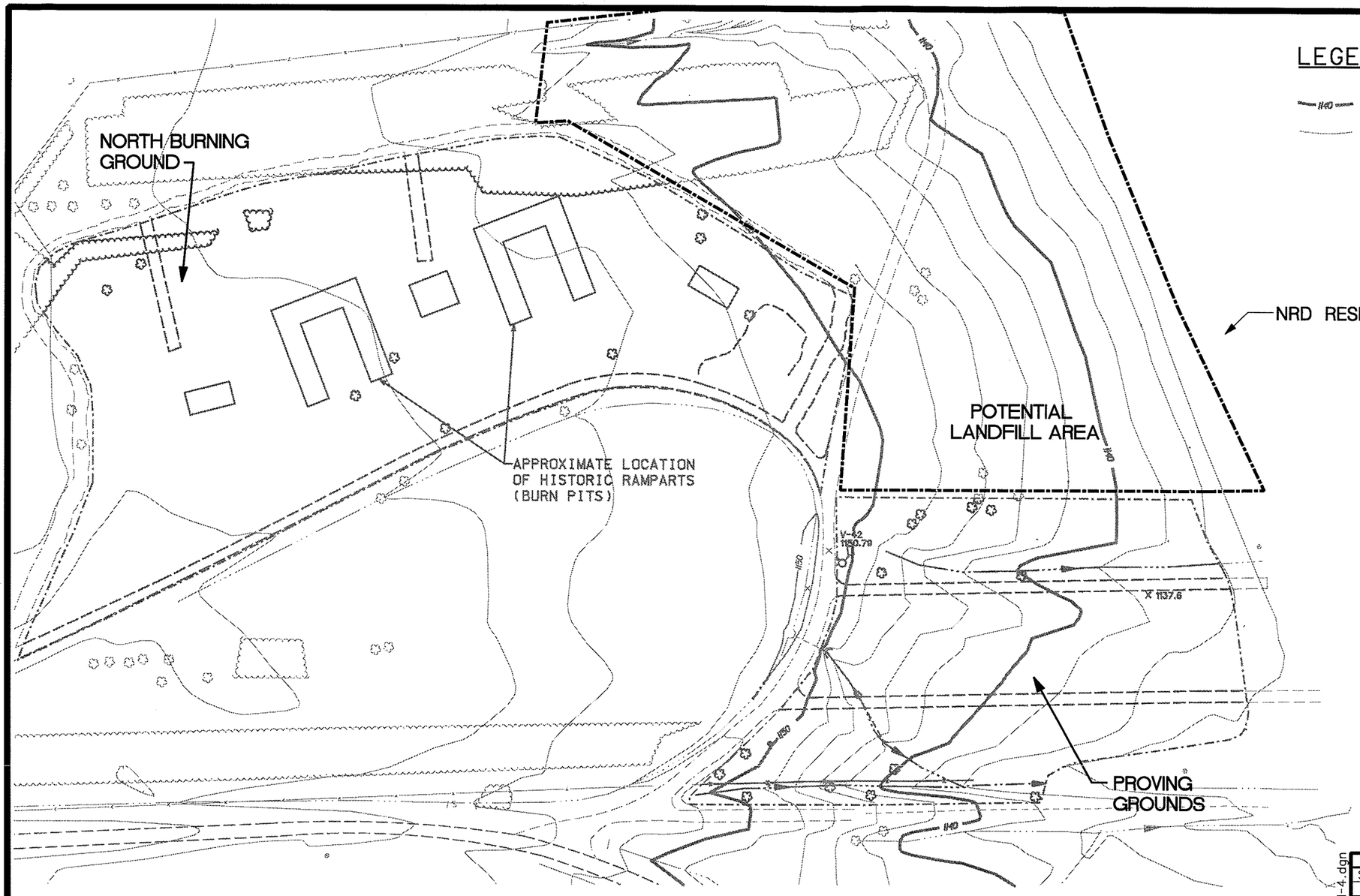
Designed by: D.E.F.
Drawn by: R.A.D.
Checked by: L.A.T.
Submitted by: R.A.N.

U.S. Army Corps of Engineers

FEASIBILITY STUDY - OPERABLE UNIT 3
FMR. NEBRASKA ORDNANCE PLANT
MEAD, NE.

PAINT OPERATIONS AREAS AT LOAD LINE 4

Scale: 1 IN - 300 FEET
Date: DECEMBER, 2000
Dwg. No.: 1-3
Sheet number: 1



LEGEND:

- 1140 — INDEX CONTOUR
- INTERMEDIATE CONTOUR

N

100 0 100 200

SCALE FEET

SOURCE: DONOHUE, 1992B

Revisions			
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10975 El Monte, Suite 100
Overland Park, Kansas 66211

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: D.E.F.
Drawn by: R.A.D.
Checked by: L.A.T.
Submitted by: R.A.N.

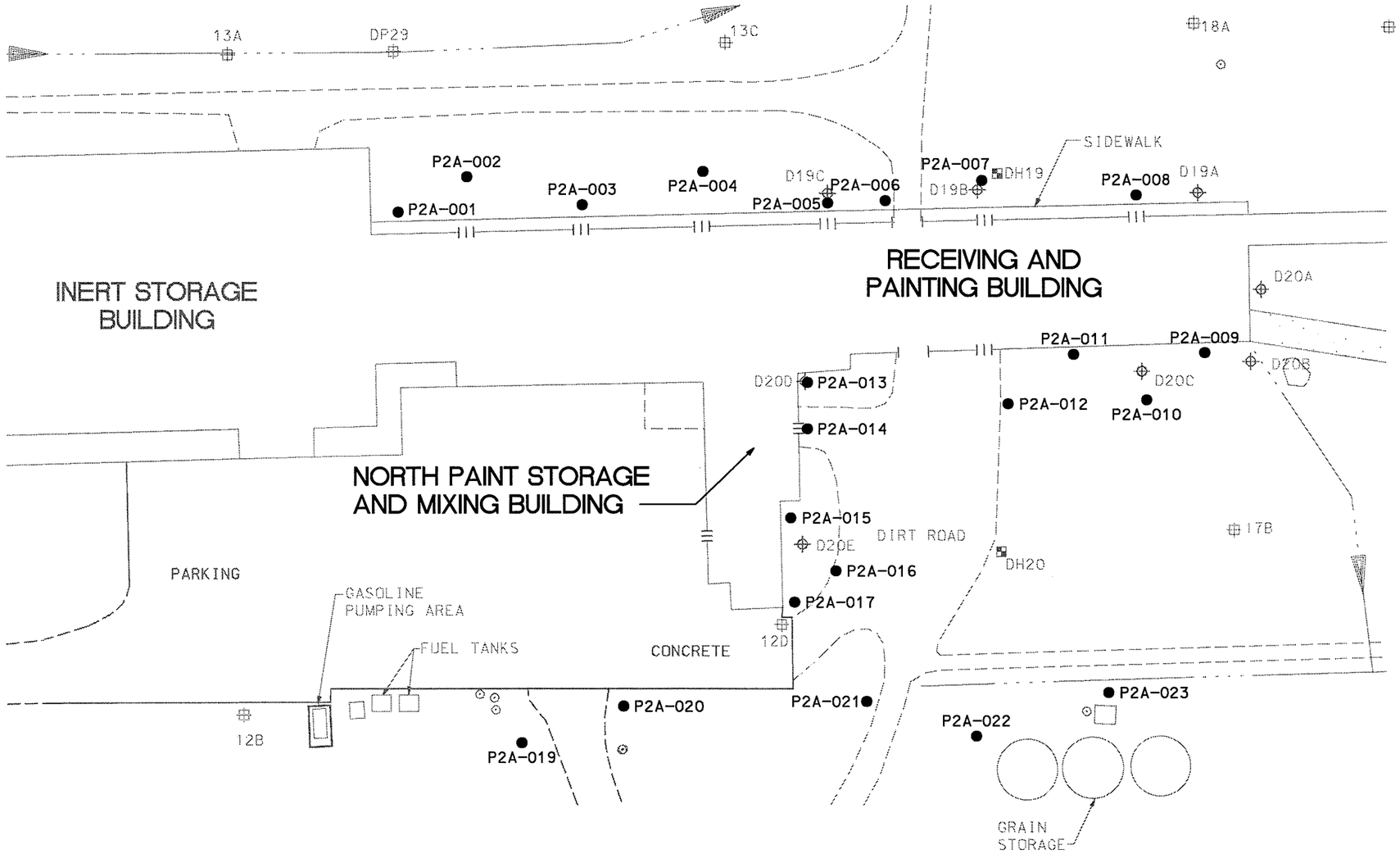
U.S. Army Corps of Engineers

FEASIBILITY STUDY - OPERABLE UNIT 3
FMR. NEBRASKA ORDNANCE PLANT
MEAD, NE.

POTENTIAL LANDFILL SITE MAP AREA

Scale: 1 IN = 100 FEET
Date: DECEMBER, 2000
Dwg. No.: 1-4
Sheet number: 1

06 DEC 2000 15:12:07 MCS FILE: J:\MEAD\K97209.00\05100-1-4.dgn



SOURCE : DONOHUE, 1992B

LEGEND:

● P2A-001	PHASE I RI SAMPLE LOCATION
▩ DH4	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (CONFIRMATION STUDY 1989)
⊕ D19C	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (OU1 RI 1991)
⊞ CP40	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (OU1 SUPPLEMENTAL RI/FS 1992)

NOTES:

1. SOIL SAMPLES WERE COLLECTED THE FOLLOWING DISTANCES FROM THE EXTERIOR WALLS OF THE RECEIVING AND PAINTING BUILDING:
   P2A-001 AT 6.5 FT, P2A-002 AT 20.0 FT,
   P2A-003 AT 7.5 FT, P2A-004 AT 20.0 FT,
   P2A-005 AT 7.0 FT, P2A-006 AT 7.0 FT,
   P2A-007 AT 20.0 FT, P2A-008 AT 7.0 FT,
   P2A-009 AT 2.0 FT, P2A-010 AT 20.0 FT,
   P2A-011 AT 1.0 FT, P2A-012 AT 20.0 FT,
   P2A-013 AT 2.0 FT
2. SOIL SAMPLES WERE COLLECTED THE FOLLOWING DISTANCES FROM THE EXTERIOR WALLS OF THE NORTH PAINT STORAGE AND MIXING BUILDING:
   P2A-015 AT 2.0 FT, P2A-016 AT 20.0 FT,
   P2A-017 AT 5.0 FT
3. SOIL SAMPLES WERE COLLECTED THE FOLLOWING DISTANCES FROM THE CONCRETE PAD WEST OF THE NORTH PAINT STORAGE AND MIXING BUILDING:
   P2A-018 AT 100.0 FT, P2A-019 AT 20.0 FT,
   P2A-020 AT 5 FT
4. SHALLOW SOIL SAMPLE P2A-014 NOT COLLECTED DUE TO CONCRETE PAD AT SAMPLING LOCATION.

N

50 0 50 100

SCALE FEET

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10975 El Monte, Suite 100
Overland Park, Kansas 66211

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: D.E.F.
Drawn by: R.A.D.
Checked by: L.A.T.
Submitted by: R.A.N.

U.S. Army Corps of Engineers

FEASIBILITY STUDY - OPERABLE UNIT 3
FMR. NEBRASKA ORDNANCE PLANT
MEAD, NE.

**LOAD LINE 2
RECEIVING AND PAINTING BUILDING / NORTH PAINT STORAGE AND MIXING BUILDING SAMPLING LOCATIONS**

Scale: 1 IN - 50 FEET
Date: DECEMBER, 2000
Dwg. No.: 1-5
Sheet number: 1

06 DEC 2000 15:13:00
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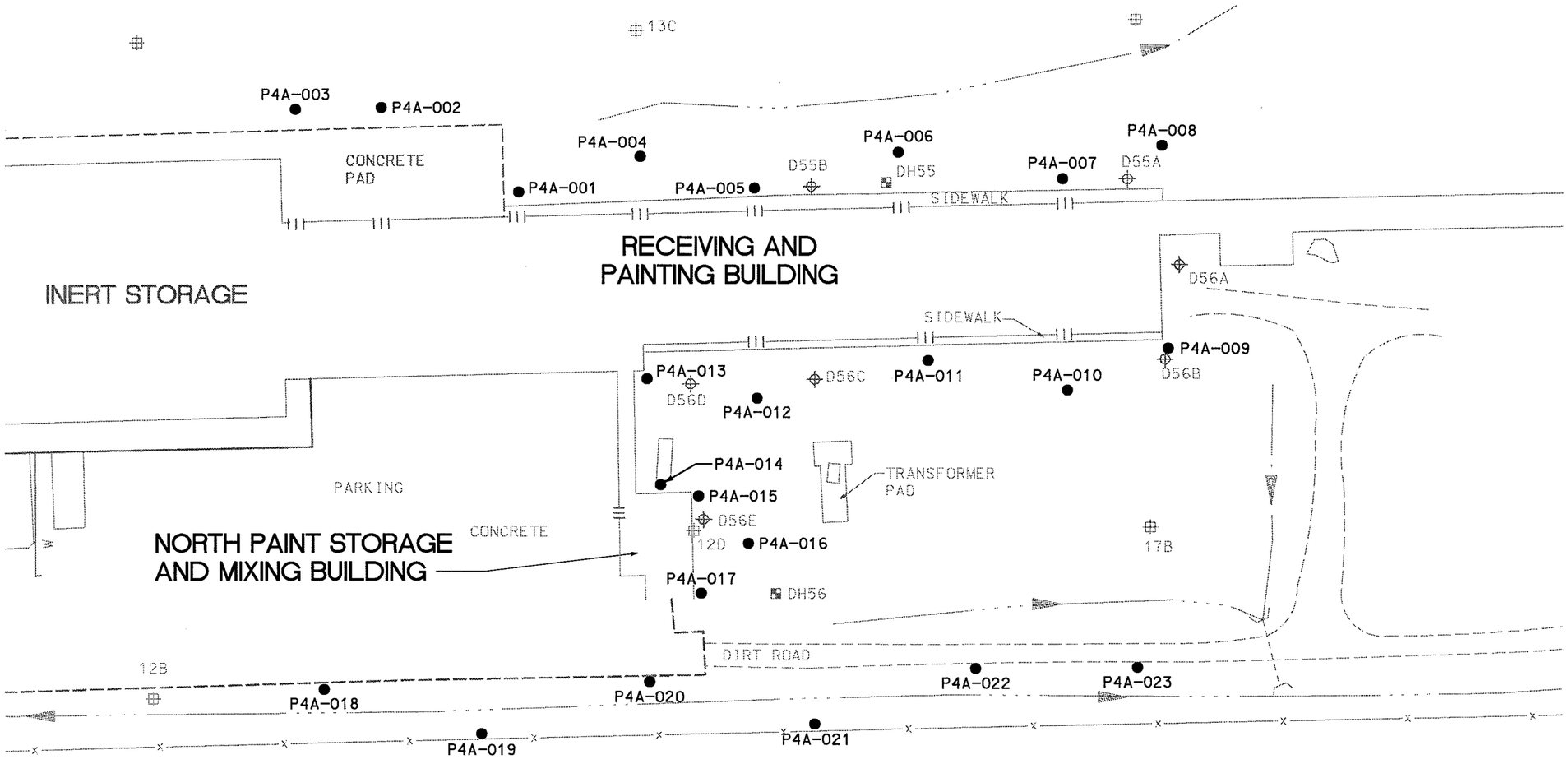

LEGEND:

● P4A-001	PHASE I RI SOIL SAMPLE LOCATION
■ DH56	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (OU1 RI 1991)
⊕ D56E	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (CONFIRMATION STUDY 1989)
⊞ 12B	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (OU1 SUPPLEMENTAL RI/FS 1992)

NOTES:

1. SOIL SAMPLES WERE COLLECTED THE FOLLOWING DISTANCES FROM THE EXTERIOR WALLS OF THE RECEIVING AND PAINTING BUILDING:
   P4A-001 AT 7.0 FT, P4A-002 AT 42.0 FT,
   P4A-003 AT 42.0 FT, P4A-004 AT 20.0 FT,
   P4A-005 AT 7.0 FT, P4A-006 AT 20.0 FT,
   P4A-007 AT 7.0 FT, P4A-008 AT 20.0 FT,
   P4A-009 AT 3.0 FT, P4A-010 AT 20.0 FT,
   P4A-011 AT 7.0 FT, P4A-012 AT 20.0 FT,
   P4A-013 AT 3.0 FT

2. SOIL SAMPLES WERE COLLECTED THE FOLLOWING DISTANCES FROM THE EXTERIOR WALLS OF THE NORTH PAINT STORAGE/MIXING BUILDING:
   P4A-014 AT 1.0 FT, P4A-015 AT 1.0 FT,
   P4A-016 AT 20.0 FT, P4A-017 AT 1.0 FT

3. SOIL SAMPLES WERE COLLECTED THE FOLLOWING DISTANCES WEST OF THE CONCRETE PAD AND OR DIRT ROAD WEST OF THE NORTH PAINT STORAGE/MIXING BUILDING:
   P4A-018 AT 1.0 FT, P4A-019 AT 20.0 FT,
   P4A-020 AT 1.0 FT, P4A-021 AT 20.0 FT,
   P4A-022 AT 1.0 FT, P4A-023 AT 1.0 FT

SOURCE : DONOHUE, 1992B

N

50 0 50 100

SCALE FEET

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10975 El Monte, Suite 100
Overland Park, Kansas 66211

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: D.E.F.
Drawn by: R.A.D.
Checked by: L.A.T.
Submitted by: R.A.N.

U.S. Army Corps of Engineers

FEASIBILITY STUDY - OPERABLE UNIT 3
FMR. NEBRASKA ORDNANCE PLANT
MEAD, NE.

**LOAD LINE 4
RECEIVING AND PAINTING BUILDING / NORTH PAINT STORAGE AND MIXING BUILDING SAMPLING LOCATIONS**

Scale: 1 IN = 50 FEET
Date: DECEMBER, 2000
Dwg. No.: 1-6
Sheet number: 1

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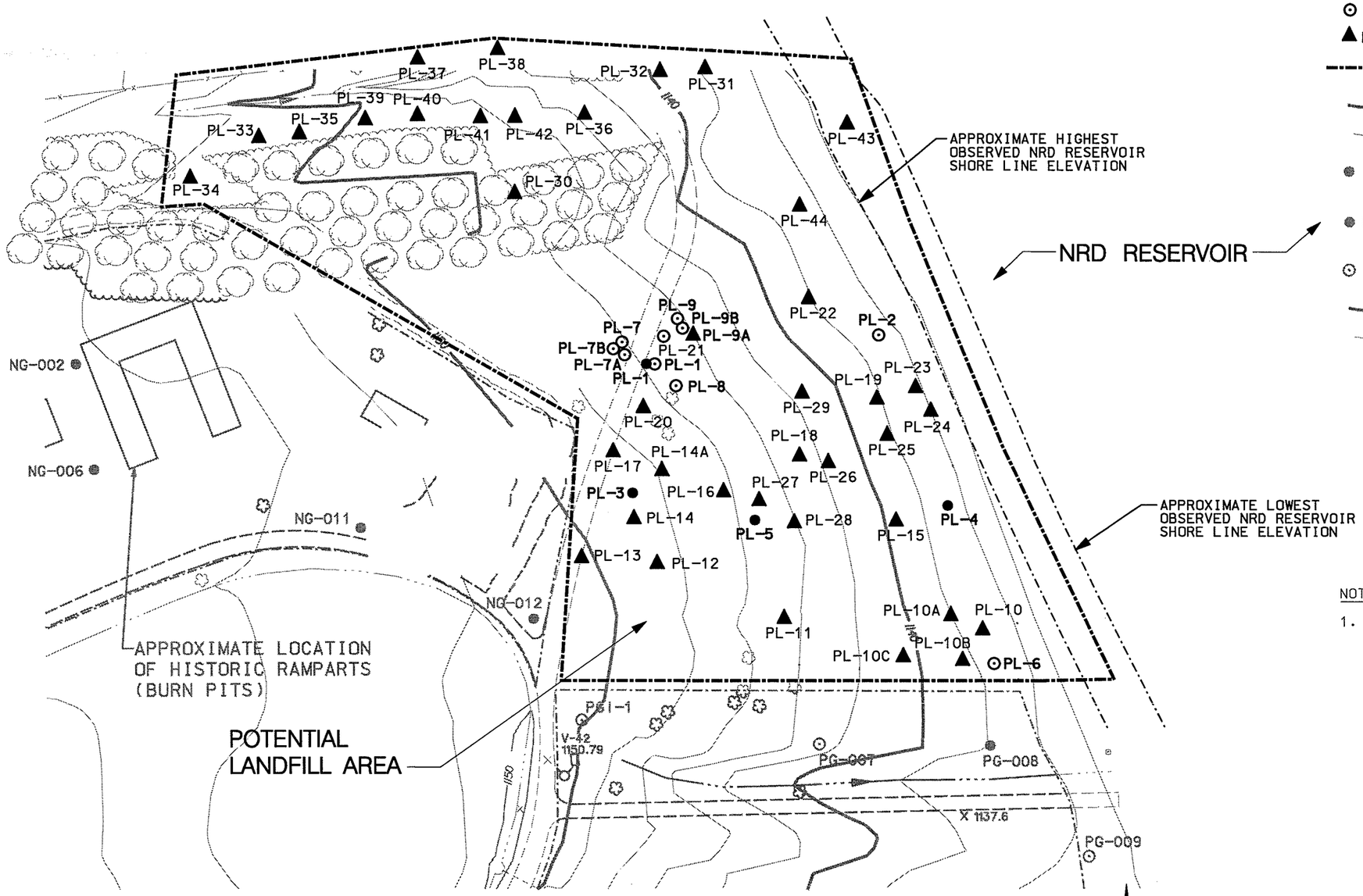

LEGEND:

● PL-5	PHASE I AND II SOIL SAMPLE LOCATION
⊙ PL-6	PHASE I AND II SOIL SAMPLE LOCATION
▲ PL-44	PHASE III SOIL SAMPLE LOCATION
	OU3 RI STUDY AREA BOUNDARIES
1140	INDEX CONTOUR
	INTERMEDIATE CONTOUR
● NG-006	NORTH BURNING GROUND PHASE I AND II SOIL SAMPLE LOCATION
● PG-008	PROVING GROUND PHASE I AND II SOIL SAMPLE LOCATION
⊙ PG-009	PROVING GROUND PHASE I AND II SOIL SAMPLE LOCATION
1140	INDEX CONTOUR
	INTERMEDIATE CONTOUR

NOTES:

1. ALL PREVIOUS SOIL INVESTIGATION SAMPLING LOCATIONS ARE PRESENTED IN APPENDIX A OF THE DRAFT FINAL SAMPLING AND ANALYSIS PLAN (WOODWARD CLYDE, 1999)

Revisions

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10975 El Monte, Suite 100
Overland Park, Kansas 66211

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: D.E.F.
Drawn by: R.A.D.
Checked by: L.A.T.
Submitted by: R.A.N.

U.S. Army Corps of Engineers

FEASIBILITY STUDY - OPERABLE UNIT 3
FMR. NEBRASKA ORDNANCE PLANT
MEAD, NE.

POTENTIAL LANDFILL AREA SAMPLING LOCATIONS

Scale: 1 IN = 80 FEET
Date: DECEMBER, 2000
Dwg. No.: 1-7
Sheet number: 1

06 DEC 2000 15:17:44
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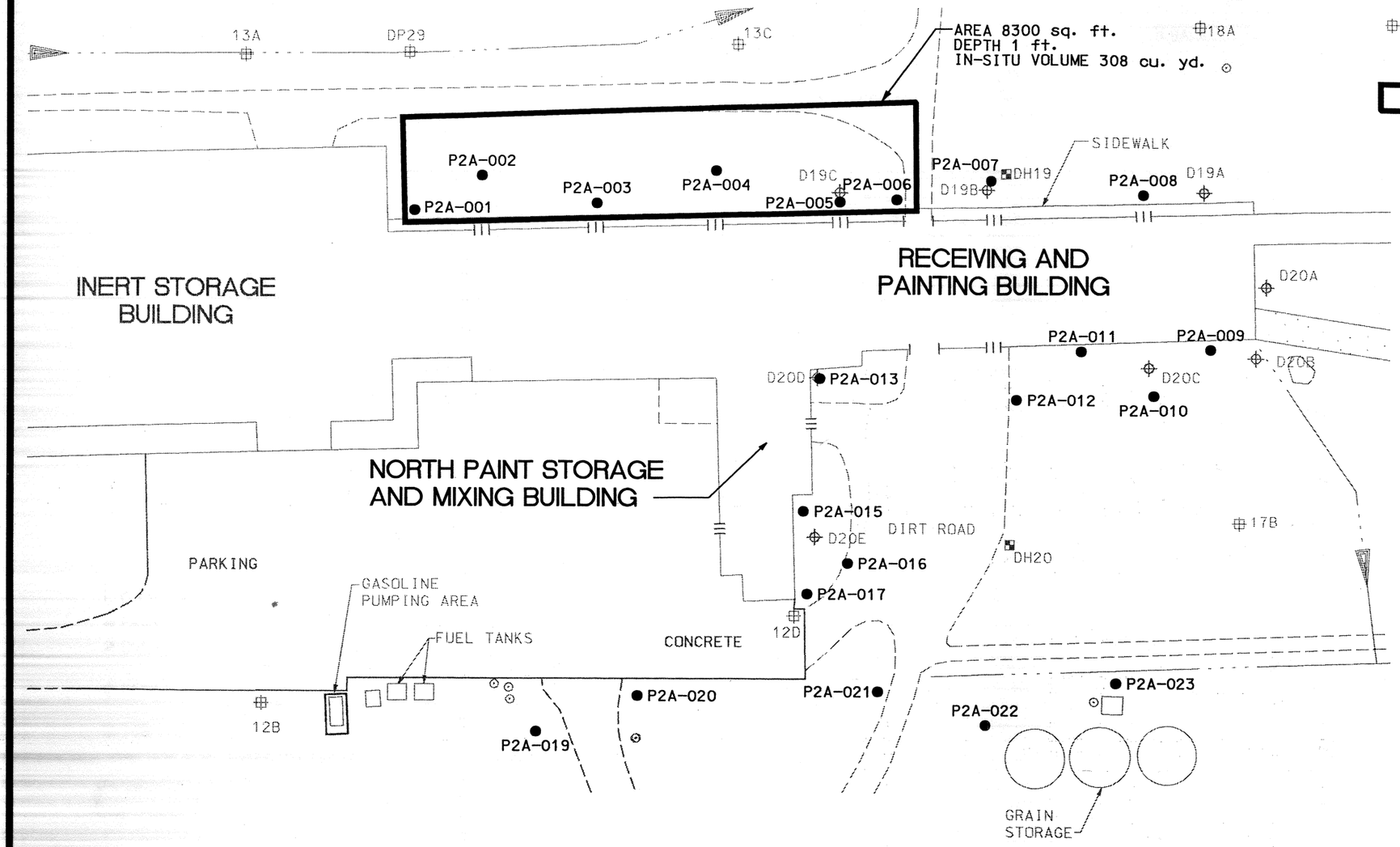

SOURCE : DONOHUE, 1992B

LEGEND:

● P2A-001	PHASE I RI SAMPLE LOCATION
▪ DH4	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (CONFIRMATION STUDY 1989)
⊕ D19C	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (OU1 RI 1991)
⊞ CP40	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (OU1 SUPPLEMENTAL RI/FS 1992)
▭	PRELIMINARY SOIL REMEDIATION AREA

NOTES:

1. SOIL SAMPLES WERE COLLECTED THE FOLLOWING DISTANCES FROM THE EXTERIOR WALLS OF THE RECEIVING AND PAINTING BUILDING:
   P2A-001 AT 6.5 FT, P2A-002 AT 20.0 FT,
   P2A-003 AT 7.5 FT, P2A-004 AT 20.0 FT,
   P2A-005 AT 7.0 FT, P2A-006 AT 7.0 FT,
   P2A-007 AT 20.0 FT, P2A-008 AT 7.0 FT,
   P2A-009 AT 2.0 FT, P2A-010 AT 20.0 FT,
   P2A-011 AT 1.0 FT, P2A-012 AT 20.0 FT,
   P2A-013 AT 2.0 FT
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   P2A-020 AT 5 FT
4. SHALLOW SOIL SAMPLE P2A-014 NOT COLLECTED DUE TO CONCRETE PAD AT SAMPLING LOCATION.

N

50 0 50 100

SCALE FEET

Revisions			
Symbol	Descriptions	Date	Apprv'd

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10975 ElMonte, Suite 100
Overland Park, Kansas 66211

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: D.E.F.
Drawn by: R.A.D.
Checked by: L.A.T.
Submitted by: R.A.N.

U.S. Army Corps of Engineers

FEASIBILITY STUDY - OPERABLE UNIT 3
FMR. NEBRASKA ORDNANCE PLANT
MEAD, NE.

LOAD LINE 2
RECEIVING AND PAINTING BUILDING / NORTH PAINT STORAGE AND MIXING BUILDING
PRELIMINARY REMEDIATION AREA AND VOLUME

Scale: 1 IN - 50 FEET
Date: DECEMBER, 2000
Dwg. No.: 2-1
Sheet number: 1

06 DEC 2000 15:18:14
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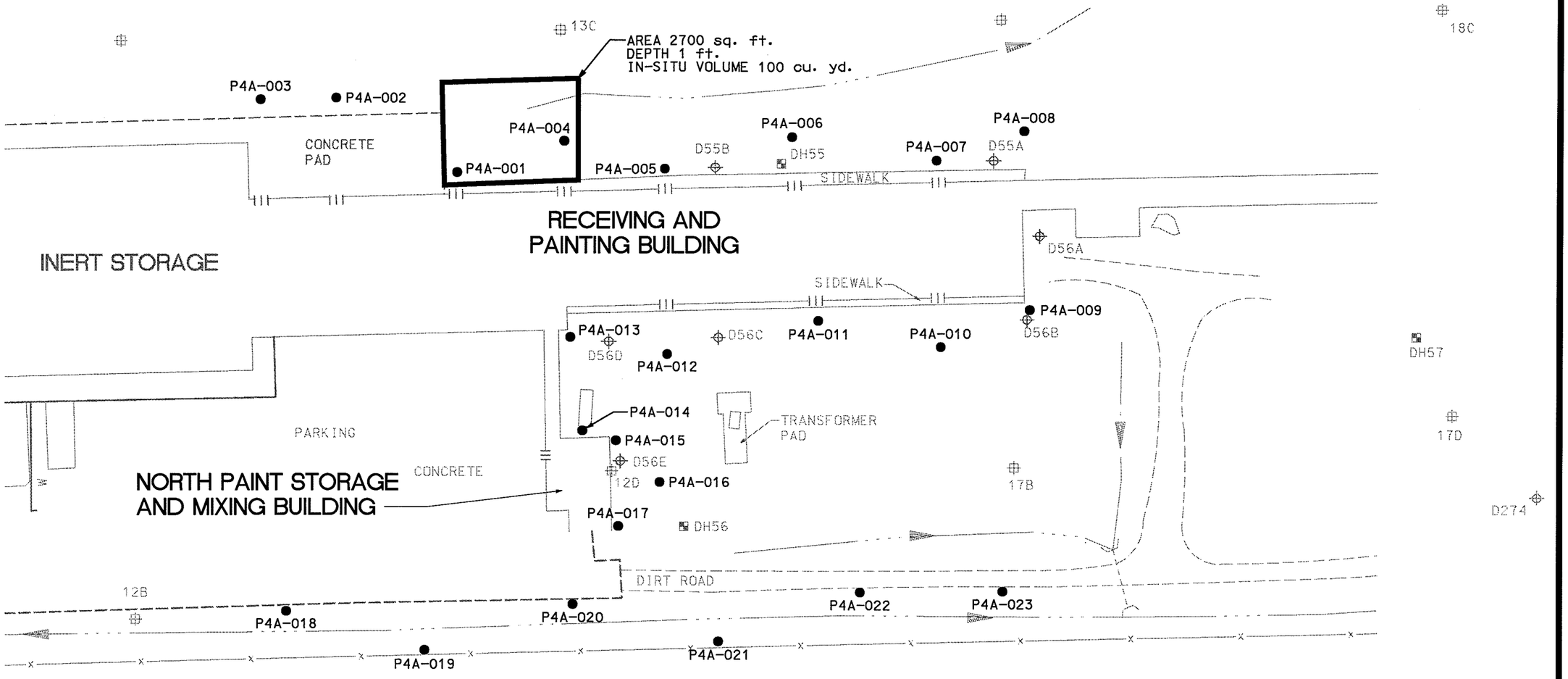

LEGEND:

● P4A-001	PHASE I RI SOIL SAMPLE LOCATION
▪ DH56	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (OU1 RI 1991)
⊕ D56E	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (CONFIRMATION STUDY 1989)
⊞ 12B	PREVIOUS INVESTIGATION SOIL SAMPLE LOCATION (OU1 SUPPLEMENTAL RI/FS 1992)
▭	PRELIMINARY SOIL REMEDIATION AREA

NOTES:

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   P4A-001 AT 7.0 FT, P4A-002 AT 42.0 FT,
   P4A-003 AT 42.0 FT, P4A-004 AT 20.0 FT,
   P4A-005 AT 7.0 FT, P4A-006 AT 20.0 FT,
   P4A-007 AT 7.0 FT, P4A-008 AT 20.0 FT,
   P4A-009 AT 3.0 FT, P4A-010 AT 20.0 FT,
   P4A-011 AT 7.0 FT, P4A-012 AT 20.0 FT,
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   P4A-020 AT 1.0 FT, P4A-021 AT 20.0 FT,
   P4A-022 AT 1.0 FT, P4A-023 AT 1.0 FT

SOURCE : DONOHUE, 1992B

N

50 0 50 100

SCALE FEET

Revisions			
Symbol	Descriptions	Date	Apprv'd

URS Greiner Woodward Clyde Federal Services
10975 El Monte, Suite 100
Overland Park, Kansas 66211

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: D.E.F.
Drawn by: R.A.D.
Checked by: L.A.T.
Submitted by: R.A.N.

U.S. Army Corps of Engineers

FEASIBILITY STUDY - OPERABLE UNIT 3
FMR. NEBRASKA ORDNANCE PLANT
MEAD, NE.

LOAD LINE 4
RECEIVING AND PAINTING BUILDING / NORTH PAINT STORAGE AND MIXING BUILDING
PRELIMINARY REMEDIATION AREA AND VOLUME

Scale: 1 IN - 50 FEET
Date: DECEMBER, 2000
Dwg. No.: 2-2
Sheet number: 1

06 DEC 2000 15:18:37
MCS FILE: J:\MEAD\K97209.00\05100-2-2.dgn

LEGEND:

- ● PL-5 — PHASE I AND II SOIL SAMPLE LOCATION
- ⊙ PL-6 — PHASE I AND II SOIL SAMPLE LOCATION
- ▲ PL-44 — PHASE III SOIL SAMPLE LOCATION
- OU3 RI STUDY AREA BOUNDARIES
- PRELIMINARY SOIL REMEDIATION AREA
- 1140 — INDEX CONTOUR
- INTERMEDIATE CONTOUR
- ● NG-006 — NORTH BURNING GROUND PHASE I AND II SHALLOW SOIL SAMPLE LOCATION
- ● PG-008 — PROVING GROUND PHASE I AND II SOIL SAMPLE LOCATION
- ⊙ PG-009 — PROVING GROUND PHASE I AND II SOIL SAMPLE LOCATION
- 1140 — INDEX CONTOUR
- INTERMEDIATE CONTOUR

PL-37 PL-38 PL-32 PL-31 PL-39 PL-40 PL-35 PL-33 PL-41 PL-42 PL-36 PL-34 PL-30 PL-43 PL-44 PL-22 PL-2 PL-23 PL-19 PL-29 PL-24 PL-18 PL-25 PL-26 PL-27 PL-28 PL-15 PL-4 PL-5 PL-3 PL-16 PL-14A PL-17 PL-14 PL-13 PL-12 PL-11 PL-10A PL-10 PL-10B PL-10C PL-6 PL-20 PL-9 PL-9B PL-9A PL-21 PL-7 PL-7B PL-7A PL-1 PL-8

AREA 3800 sq. ft.
DEPTH 4 ft.
IN-SITU VOLUME 563 cu. yd.

NRD RESERVOIR

APPROXIMATE HIGHEST OBSERVED NRD RESERVOIR SHORE LINE ELEVATION

APPROXIMATE LOWEST OBSERVED NRD RESERVOIR SHORE LINE ELEVATION

NG-002 NG-006 NG-011 NG-012

APPROXIMATE LOCATION OF HISTORIC RAMPARTS (BURN PITS)

POTENTIAL LANDFILL AREA

PG-1 PG-007 PG-008 PG-009

V-42 1150.79

X 1137.6

1140 1150

N

80 0 80 160
SCALE FEET

Revisions			
Symbol	Descriptions	Date	Apprv'd

URS Greiner Woodward Clyde Federal Services
10975 El Monte, Suite 100
Overland Park, Kansas 66211

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: D.E.F.
Drawn by: R.A.D.
Checked by: L.A.T.
Submitted by: R.A.N.

U.S. Army Corps of Engineers

FEASIBILITY STUDY - OPERABLE UNIT 3
FMR. NEBRASKA ORDNANCE PLANT
MEAD, NE.

POTENTIAL LANDFILL AREA PRELIMINARY REMEDIATION AREA AND VOLUME

Scale: 1 IN = 80 FEET
Date: DECEMBER, 2000
Dwg. No.: 2-3
Sheet number: 1

06 DEC 2000 15:19:07 MCS FILE: J:\MEAD\K97209.00\05100-2-3.dgn

Table A-4

COST ESTIMATE FOR ALTERNATIVE 1 - NO ACTION

Cost Item	Quantity	Unit	Unit Cost, $	Total Base Cost, $	Ref.
1. Capital Cost				$0	
1.1 Direct Capital Cost					
Fencing Around Burning/Proving Grounds					
8 ft. H, 6 ga wire, 2.5 inch line post, galv. steel	4500	Feet	$ 30.50	$ 137,250	5
3 inch diam corner post, galv. steel	20	Each	$ 106.00	$ 2,120	5
Double swing gates, 8 ft. H, 20 ft. opening	2	Each	$ 1,625.00	$ 3,250	5
Total Direct Capital Cost				$ 142,620	
1.2 Indirect Capital Cost					
Health & Safety - 8% of Direct Capital Cost	1	Lump Sum	11,410	$ 11,410	12
Legal & Administration - 5% of Direct Cost	1	Lump Sum	7,131	$ 7,131	6
Construction Related Services - 8% of Direct Cost (Administrative, Bonds & Insurance, Fees/Permits, etc.)	1	Lump Sum	11,410	$ 11,410	6
Contingency -25% of Direct Cost	1	Lump Sum	35,655	$ 35,655	12
Total Indirect Capital Cost				$ 65,605	
Total Capital Cost				**$ 208,225**	
2. Operations and Maintenance Cost					
Annual Site Inspection For Changes In Site Conditions (soil erosion, surrounding land use, etc.) Travel From Kansas City Or Equal					
Car Rental	2	Day	$ 48	$ 96	13
Per Diem - Full Day	1	Day	$ 85	$ 85	11
Per Diem - Half Day, No Lodging	1	Day	$ 30	$ 30	11
Travel & Inspection, Staff Scientist	16	Hour	$ 50	$ 800	6, 12
Photographs	1	Lump Sum	$ 20	$ 20	12
Management and Reporting, Senior Scientist	8	Hour	$ 80	$ 640	6, 12
Total Annual Site Inspection	9			$ 1,671	

Table A-4 (Continued)

Present Worth of Annual Operations and Maintenance Costs Time Period 30 years, Discount Rate 6%	$	23,001
Total Capital and Present Worth Costs	**$**	**231,226**

Summary of Estimated Costs

	+50% Range Base Cost, $	Base Cost, $	-30% Range Base Cost, $
1. Total Capital Cost	$ 312,338	$ 208,225	$ 145,758
2. Total Present Worth Annual Operation And Maintenance Cost	$ 34,502	$ 23,001	$ 16,101
3. Total Present Worth Cost, Alternative 1 - No Action (Total Capitol and Present Worth Annual Operations And Maintenance Cost)	**$ 346,839**	**$ 231,226**	**$ 161,858**

Table A-5

COST ESTIMATE FOR ALTERNATIVE 2 - CAPPING

Cost Item	Quantity	Unit	Unit Cost, $	Total Base Cost, $	Ref.
1. Capital Cost					
1.1 Direct Capital Cost					
Sampling & Analysis to Verify Remediation Area					
(3 samples east of easternmost remediation area boundary at Load Line 2 collected prior to final remedial design)					
Travel From Kansas City Or Equal					
Car Rental	2	Day	$ 48	$ 96	13
Mobilization/Demobilization To Site - Labor, Staff Scientist	12	Hour	$ 50	$ 600	6, 12
Sampling - Hand Auger, Staff Scientist	4	Hour	$ 50	$ 200	6, 12
Per Diem - Full Day	1	Day	$ 85	$ 85	11
Per Diem - Half Day, No Lodging	1	Day	$ 30	$ 30	11
Sample Containers & Shipping, Supplies, Personal Protective Equipment	1	Lump Sum	$ 50	$ 50	12
Sample Analysis For Antimony	3	Sample	$ 50	$ 150	7
Total Remediation Verification Sampling Direct Capital Cost				$ 1,211	
Cap, Safety Level C					
Base For Concrete Cap - Gravel 6 Inch Thickness	274	Cu. Yd.	$ 17.52	$ 4,800	5
Cap - Jointed Mesh Concrete Placed And Finished 4 Inch Thickness	1644	Sq. Yd.	$ 15.81	$ 25,992	6
Top Soil From Off-Site and Surface Grading Next to Cap For Surface Drainage Away From Cap	35	Cu. Yd.	$ 28.51	$ 998	6
Sodding Top Soil Placed Next to Cap	238	Sq. Yd.	$ 5.55	$ 1,321	5
Total Cap Direct Capital Cost				$ 33,111	
Fencing Around Burning/Proving Grounds					
8 ft. H, 6 ga wire, 2.5 inch line post, galv. steel	4500	Feet	$ 30.50	$ 137,250	5
3 inch diam corner post, galv. steel	20	Each	$ 106.00	$ 2,120	5
Double swing gates, 8 ft. H, 20 ft. opening	2	Each	$ 1,625.00	$ 3,250	5
Total Fencing Direct Capital Cost				$ 142,620	
Total Direct Capital Cost				$ 176,942	

Table A-5 (Continued)

1.2 Indirect Capital Cost						
Cap Final Design, Plans and Specifications	1	Lump Sum		10,000	$ 10,000	12
Design Plan	1	Lump Sum		10,000	$ 10,000	12
Health & Safety - 8% of Direct Capital Cost	1	Lump Sum		14,155	$ 14,155	12
Legal & Administration - 5% of Direct Cost	1	Lump Sum		8,847	$ 8,847	6
Construction Related Services - 8% of Direct Cost (Administrative, Bonds & Insurance, Fees/Permits, etc.)	1	Lump Sum		14,155	$ 14,155	6
Contingency -25% of Direct Cost	1	Lump Sum		44,235	$ 44,235	12
Total Indirect Capital Cost					$ 101,393	
Total Capital Cost					**$ 278,335**	
2. Operations and Maintenance Cost						
2.1 Cap Inspection Years 1 - 30						
Annual Cap Inspection For Cap Integrity						
Travel From Kansas City Or Equal						
Car Rental	2	Day	$	48	$ 96	13
Per Diem - Full Day	1	Day	$	85	$ 85	11
Per Diem - Half Day, No Lodging	1	Day	$	30	$ 30	11
Inspection - Staff Engineer	16	Hour	$	50	$ 800	6, 12
Photographs	1	Lump Sum	$	20	$ 20	12
Management & Reporting, Senior Engineer	8	Hour	$	80	$ 640	6, 12
Total Annual Cap Inspection					$ 1,671	
2.2 Annual Cost Years 6-30						
No maintenance on concrete cap for first 5 years. Then maintenance each year thereafter on 10% of cap area. (10% of 1644 Sq. Yd.)						12
Operations & Maintenance For Cap - Jointed Mesh Concrete	164	Sq. Yd.	$	14.40	$ 2,362	6, 12
Total Annual Cost Cap Maintenance					$ 2,362	
Present Worth Of Annual Operations And Maintenance Costs						
Time Period 30 years, Discount Rate 6%						
Years 1-30					$ 23,001	
Years 6-30					$ 20,894	

Table A-5 (Continued)

Total Present Worth Of Annual Operations And Maintenance Costs	**$**	**43,895**
Total Capital and Present Worth Costs	**$**	**322,230**

Table A-5 (Continued)

Summary of Estimated Costs

	+50% Range Base Cost, $	Base Cost, $	-30% Range Base Cost, $
1. Total Capital Cost	$ 417,503	$ 278,335	$ 194,835
2. Total Present Worth Annual Operation And Maintenance Cost	$ 65,843	$ 43,895	$ 30,727
3. Total Present Worth Cost - Alternative 2 - Capping (Total Capitol And Present Worth Annual Operations And Maintenance Cost)	$ 483,346	$ 322,230	$ 225,561

Table A-6

COST ESTIMATE FOR ALTERNATIVE 3 - EXCAVATION AND OFF-SITE DISPOSAL

Cost Item	Quantity	Unit		Unit Cost, $		Total Base Cost, $	Ref.
1. Capital Cost							
1.1 Direct Capital Cost							
Sampling & Analysis to Verify Remediation Area							
(3 samples east of easternmost remediation area boundary at Load Line 2 collected prior to final remedial design)							
Travel From Kansas City Or Equal							
Car Rental	2	Day	$	48	$	96	13
Mobilization/Demobilization To Site - Labor, Staff Scientist	12	Hour	$	50	$	600	6, 12
Sampling - Hand Auger, Staff Scientist	4	Hour	$	50	$	200	6, 12
Per Diem - Full Day	1	Day	$	85	$	85	11
Per Diem - Half Day, No Lodging	1	Day	$	30	$	30	11
Sample Containers & Shipping, Supplies, Personal Protective Equipment	1	Lump Sum	$	50	$	50	12
Sample Analysis For Antimony	3	Sample	$	50	$	150	7
Total Remediation Verification Sampling Direct Capital Cost					$	1,211	
Fencing Around Burning/Proving Grounds							
8 ft. H, 6 ga wire, 2.5 inch line post, galv. steel	4500	Feet	$	30.50	$	137,250	5
3 inch diam corner post, galv. steel	20	Each	$	106.00	$	2,120	6
Double swing gates, 8 ft. H, 20 ft. opening	2	Each	$	1,625.00	$	3,250	6
Total Fencing Direct Capital Cost					$	142,620	
Excavating And Hauling, Safety Level C							
Ordnance and Explosives Avoidance and Supervision	1	Lump Sum	$	3,000	$	3,000	12
Excavating To 4 Ft. Depth 1/2 Cu. Yd. Tractor/Loader Backhoe	971	Cu. Yd.	$	5.81	$	5,642	5
($4.65/Cu. Yd. + 25% for Safety Level C = $5.81/Cu. Yd.)							6
Transport To Butler County, NE Landfill - Roll-Off Boxes	1636	Ton	$	20.00	$	32,720	1
(971 Cu. Yd. @ 1.685 Ton/Cu. Yd. = 1636 Ton)							2
Disposal At Butler County Landfill, No Treatment	1636	Ton	$	36.25	$	59,305	1
Sampling & Analysis For Soil Toxicity Characterization For Landfill Acceptance							
(Sampling conducted Prior to Excavation)							
Travel From Kansas City Or Equal							
Car Rental	3	Day	$	48	$	144	13
Mobilization/Demobilization To Site - Labor, Staff Scientist	16	Hour	$	50	$	800	6, 12
Sampling - Hand Auger, Staff Scientist	8	Hour	$	50	$	400	6, 12

Table A-6 (Continued)

Per Diem - Full Day	2	Day	$ 85	$	170	11
Per Diem - Half Day, No Lodging	1	Day	$ 30	$	30	11
Sample Containers & Shipping, Supplies, Personal Protective Equipment	1	Lump Sum	$ 100	$	100	12
Sample Analysis For Soil Toxicity Characterization For Landfill Acceptance	9	Sample	$ 959	$	8,631	7
(3 samples per location x 3 locations of Load lines 2 & 4 & Potential Landfill)						12
Replace Excavated Soil With Backfill - Top Soil From Off-Site	1223	Cu. Yd.	$ 28.51	$	34,868	6
(Loose Soil AT 1.2 Ton/Cu. Yd. = 1223 Cu. Yd. To Be Compacted Into Excavation) (Includes soil cost, transportation, compaction & labor)						
Seeding - Vegetative Cover	1644	Sq. Yd.	$ 2.93	$	4,817	6
Total Excavation and Off-Site Disposal Direct Capital Cost				$	150,626	
Total Direct Capital Cost				$	294,457	
1.2 Indirect Capital Cost						
Design Plan	1	Lump Sum	10,000	$	10,000	12
Health & Safety - 8% of Direct Capital Cost	1	Lump Sum	23,557	$	23,557	12
Legal & Administration - 5% of Direct Cost	1	Lump Sum	14,723	$	14,723	6
Construction Related Services - 8% of Direct Cost (Administrative, Bonds & Insurance, Fees/Permits, etc.)	1	Lump Sum	23,557	$	23,557	6
Contingency -25% of Direct Cost	1	Lump Sum	73,614	$	73,614	12
Total Indirect Capital Cost				$	145,450	
Total Capital Cost				**$**	**439,907**	
2. Operations and Maintenance Cost					$0	
There is no annual Operations & Maintenance because all contaminated soil is removed from the site.						
Present Worth Of Annual Operations And Maintenance Costs					$0	
Total Capital and Present Worth Costs				**$**	**439,907**	

Table A-6 (Continued)

Summary of Estimated Costs

	+50% Range Base Cost, $	Base Cost, $	-30% Range Base Cost, $
1. Total Capital Cost	$ 659,861	$ 439,907	$ 307,935
2. Total Present Worth Annual Operation And Maintenance Cost	$0	$0	$0
3. Total Present Worth Cost - Alternative 3 - Excavation And Off-Site Disposal (Total Capitol And Present Worth Annual Operations And Maintenance Cost)	$ 659,861	$ 439,907	$ 307,935

Table A-7

COST ESTIMATE FOR ALTERNATIVE 4 - CAPPING FOR LOAD LINES 2 AND 4 PAINT OPERATIONS AREA AND EXCAVATION AND OFF-SITE DISPOSAL FOR POTENTIAL LANDFILL

Cost Item	Quantity	Unit	Unit Cost, $	Total Base Cost, $	Ref.
1. Capital Cost					
1.1 Direct Capital Cost					
(3 samples east of easternmost remediation area boundary at Load Line 2 collected prior to final remedial design)					
Travel From Kansas City Or Equal					
Car Rental	2	Day	$ 48	$ 96	13
Mobilization/Demobilization To Site - Labor, Staff Scientist	12	Hour	$ 50	$ 600	6, 12
Sampling - Hand Auger, Staff Scientist	4	Hour	$ 50	$ 200	6, 12
Per Diem - Full Day	1	Day	$ 85	$ 85	11
Per Diem - Half Day, No Lodging	1	Day	$ 30	$ 30	11
Sample Containers & Shipping, Supplies, Personal Protective Equipment	1	Lump Sum	$ 50	$ 50	12
Sample Analysis For Antimony	3	Sample	$ 50	$ 150	7
Total Remediation Verification Sampling Direct Capital Cost				$ 1,211	
Fencing Around Burning/Proving Gounds					
8 ft. H, 6 ga wire, 2.5 inch line post, galv. steel	4500	Feet	$ 30.50	$ 137,250	5
3 inch diam corner post, galv. steel	20	Each	$ 106.00	$ 2,120	6
Double swing gates, 8 ft. H, 20 ft. opening	2	Each	$ 1,625.00	$ 3,250	6
Total Fencing Direct Capital Cost				$ 142,620	
Cap Load Lines 2 & 4, Safety Level C					
Base For Concrete Cap - Gravel 6 Inch Thickness	204	Cu. Yd.	$ 17.52	$ 3,574	5
Cap - Jointed Mesh Concrete Placed And Finished 4 Inch Thickness	1222	Sq. Yd.	$ 15.81	$ 19,320	6
Top Soil From Off-Site and Surface Grading Next to Cap For Surface Drainage Away From Cap	26	Cu. Yd.	$ 28.51	$ 741	6
Sodding Top Soil Placed Next to Cap	176	Sq. Yd.	$ 5.55	$ 977	6
Total Cap Direct Capital Cost				$ 24,612	
Potential Landfill Excavation and Off-Site Disposal					
Ordnance and Explosives Avoidance and Supervision	1	Lump Sum	$ 3,000	$ 3,000	12
Excavating And Hauling Potential Landfill, Safety Level C					
Excavating To 4 Ft. Depth 1/2 Cu. Yd. Tractor/Loader Backhoe	563	Cu. Yd.	$ 5.81	$ 3,271	5

Table A-7 (Continued)

($4.65/Cu. Yd. + 25% for Safety Level C = $5.81/Cu. Yd.)						6
Transport To Butler County, NE Landfill - Roll-Off Boxes	949	Ton	$	20.00	$ 18,980	1
(971 Cu. Yd. @ 1.685 Ton/Cu. Yd. = 1636 Ton)						2
Disposal At Butler County Landfill, No Treatment	949	Ton	$	36.25	$ 34,401	1
Sampling & Analysis For Soil Toxicity Characterization For Landfill Acceptance						
(Sampling conducted Prior to Excavation)						
Travel From Kansas City Or Equal						
Car Rental	3	Day	$	48	$ 144	13
Mobilization/Demobilization To Site - Labor, Staff Scientist	16	Hour	$	50	$ 800	6, 12
Sampling - Hand Auger, Staff Scientist	8	Hour	$	50	$ 400	6, 12
Per Diem - Full Day	2	Day	$	85	$ 170	11
Per Diem - Half Day, No Lodging	1	Day	$	30	$ 30	11
Sample Containers & Shipping, Supplies, Personal Protective Equipment	1	Lump Sum	$	100	$ 100	12
Sample Analysis For Soil Toxicity Characterization For Landfill Acceptance	3	Sample	$	959	$ 2,877	7
(3 samples per one location of Potential Landfill)						12
Backfill And Seeding						
Replace Excavated Soil With Backfill - Top Soil From Off-Site	709	Cu. Yd.	$	28.51	$ 20,214	6
(Loose Soil AT 1.2 Ton/Cu. Yd. = 709 Cu. Yd. To Be Compacted						
Into Excavation) (Includes soil cost, transportation, compaction & labor)						
Seeding - Vegetative Cover	422	Sq. Yd.	$	2.93	$ 1,236	6
Total Excavation and Off-Site Disposal Direct Capital Cost					$ 85,623	
Total Alternative 4 Direct Capital Cost					$ 254,066	
1.2 Indirect Capital Cost						
Cap Final Design, Plans and Specifications	1	Lump Sum		10,000	$ 10,000	12
Cap Design Plan	1	Lump Sum		10,000	$ 10,000	12
Excavation Design Plan	1	Lump Sum		10,000	$ 10,000	12
Health & Safety - 8% of Direct Capital Cost	1	Lump Sum		20,325	$ 20,325	12
Legal & Administration - 5% of Direct Cost	1	Lump Sum		12,703	$ 12,703	6
Construction Related Services - 8% of Direct Cost	1	Lump Sum		20,325	$ 20,325	6
(Administrative, Bonds & Insurance, Fees/Permits, etc.)						
Contingency -25% of Direct Cost	1	Lump Sum		63,517	$ 63,517	12
Total Indirect Capital Cost					$ 146,870	

Table A-7 (Continued)

Total Capital Cost				**$**	**400,937**	
2. Operations and Maintenance Cost						
2.1 Cap Inspection Years 1 - 30						
Annual Cap Inspection For Cap Integrity						
Travel From Kansas City Or Equal						
Car Rental	2	Day	$ 48	$	96	13
Per Diem - Full Day	1	Day	$ 85	$	85	11
Per Diem - Half Day, No Lodging	1	Day	$ 30	$	30	11
Inspection - Staff Engineer	16	Hour	$ 50	$	800	6, 12
Photographs	1	Lump Sum	$ 20	$	20	12
Management & Reporting, Senior Engineer	8	Hour	$ 80	$	640	6, 12
Total Annual Cap Inspection				$	1,671	
2.2 Annual Cost Years 6-30						
No maintenance on concrete cap for first 5 years. Then maintenance each year thereafter on 10% of cap area. (10% of 1222 Sq. Yd.)						12
Operations & Maintenance For Cap - Jointed Mesh Concrete	122	Sq. Yd.	$ 14.40	$	1,757	6, 12
Total Annual Cost Cap Maintenance				$	1,757	
Present Worth Of Annual Operations And Maintenance Costs						
Time Period 30 years, Discount Rate 6%						
Years 1-30				$	23,001	
Years 6-30				$	15,543	
Total Present Worth Of Annual Operations And Maintenance Costs				**$**	**38,544**	
Total Capital and Present Worth Costs				**$**	**439,481**	

Table A-7 (Continued)

Summary of Estimated Costs

	+50% Range Base Cost, $	Base Cost, $	-30% Range Base Cost, $
1. Total Capital Cost	$ 601,405	$ 400,937	$ 280,656
2. Total Present Worth Annual Operation And Maintenance Cost	$ 57,816	$ 38,544	$ 26,981
3. Total Present Worth Cost - Alternative 4 - Capping At Load Lines 2 & 4 Paint Operations Area And Excavation And Off-Site Disposal At Potential Landfill (Total Capitol And Present Worth Annual Operations And Maintenance Cost)	$ 659,222	$ 439,481	$ 307,637

Excel PV

PV(rate,nper,pmt,fv,type)

PV = Present Value
rate = discount rate (.e. interest rate)
nper = total number of payment periods = number of years = 30
pmt = payment made each period
fv = future value = 0, omit in above formula
type = when payment are made. 0 = at end of period, 1 = at beginning of period.

In annuity function cash paid out is a negative number

Example:	Page 3-23	FS
rate	10%	6%
nper	31	31
pmt	-1	-1
fv	0	0
type	1	1
PV	(0.10,31,-1,0,1)	(0.06,31,-1,0,1)
Excel PV	$10.4269	$14.7648

Comparing to Page 3-23 of EPA 1987, the $10.4269 agrees with the 10.426 example.
Please Note: The 30 year period is actually 31 years in the Excel PV equation because the page 3-23 includes a first year + 30 years.

For a case where there are two periods, years 1 to 30 and 6 to 30, the 6 to 30 is calculated as 1 to 30 minus 1 to 5.

Example:	Page 3-23		
Period 1 to 30		Period 1 to 5	Period 6 to 30
rate	10%	10%	
nper	31	6	
pmt	-1	-1	
fv	0	0	
type	1	1	
PV	(0.10,31,-1,0,1)	(0.10,5,-1,0,1)	
Excel PV	$10.4269	$4.7908	$5.6361

FS			
Period 1 to 30		Period 1 to 5	Period 6 to 30
rate	6%	6%	
nper	31	6	
pmt	-1	-1	
fv	0	0	
type	1	1	
PV	(0.06,31,-1,0,1)	(0.06,5,-1,0,1)	
Excel PV	$14.7648	$5.2124	$9.5525

Table A-1

PRESENT WORTH COST SUMMARY OF ALTERNATIVES

Alternative		Capital Cost			Operations & Maintenance*			Total Present Worth
No.	Description	Direct	Indirect	Total	Year 1 - 30	Year 6 - 30	Present Worth	
1	**No Action**							
	+50% Base	$ 213,930	$ 98,408	$ 312,338	$ 2,507	$0	$ 34,502	$ 346,839
	Base Cost	$ 142,620	$ 65,605	$ 208,225	$ 1,671	$0	$ 23,001	$ 231,226
	-30% Base	$ 99,834	$ 45,924	$ 145,758	$ 1,170	$0	$ 16,101	$ 161,858
2	**Capping**							
	+50% Base	$ 265,413	$ 152,090	$ 417,503	$ 2,507	$ 3,542	$ 65,843	$ 483,346
	Base Cost	$ 176,942	$ 101,393	$ 278,335	$ 1,671	$ 2,362	$ 43,895	$ 322,230
	-30% Base	$ 123,859	$ 70,975	$ 194,835	$ 1,170	$ 1,653	$ 30,727	$ 225,561
3	**Excavation and Off-Site Disposal**							
	+50% Base	$ 441,686	$ 218,175	$ 659,861	$0	$0	$0	$ 659,861
	Base Cost	$ 294,457	$ 145,450	$ 439,907	$0	$0	$0	$ 439,907
	-30% Base	$ 206,120	$ 101,815	$ 307,935	$0	$0	$0	$ 307,935
4	**Capping At Load Lines 2 & 4 and Excavation & Off-Site Disposal At Potential Landfill**							
	+50% Base	$ 381,099	$ 220,306	$ 601,405	$ 2,507	$ 2,635	$ 57,816	$ 659,222
	Base Cost	$ 254,066	$ 146,870	$ 400,937	$ 1,671	$ 1,757	$ 38,544	$ 439,481
	-30% Base	$ 177,846	$ 102,809	$ 280,656	$ 1,170	$ 1,230	$ 26,981	$ 307,637

Note:

*Certain annual costs occur throughout the life of the alternative and are included in the row "Years 1-30". Other costs occur annually, but only after some period of time has passed. These annual costs are separated into the row "Years 6-30". Then the total present worth of these two sets of outflows is obtained by adding the present worth of Years 1-30 to the present worth of Years 6-30.

Table A-2

NON-DISCOUNTED COST SUMMARY OF ALTERNATIVES

Alternative		Capital Cost			Annual Operations & Maintenance*			Total
No.	Description	Direct	Indirect	Total	Year 1 - 30	Year 6 - 30	Non-Discounted 30-Year Cost	Non-Discounted 30-Year Cost
1	**No Action**							
	+50% Base	$ 213,930	$ 98,408	$ 312,338	$ 2,507	$ -	$ 75,195	$ 387,533
	Base Cost	$ 142,620	$ 65,605	$ 208,225	$ 1,671	$ -	$ 50,130	$ 258,355
	-30% Base	$ 99,834	$ 45,924	$ 145,758	$ 1,170	$ -	$ 35,091	$ 180,849
2	**Capping**							
	+50% Base	$ 265,413	$ 152,090	$ 417,503	$ 2,507	$ 3,542	$ 163,755	$ 581,258
	Base Cost	$ 176,942	$ 101,393	$ 278,335	$ 1,671	$ 2,362	$ 109,170	$ 387,505
	-30% Base	$ 123,859	$ 70,975	$ 194,835	$ 1,170	$ 1,653	$ 76,419	$ 271,254
3	**Excavation and Off-Site Disposal**							
	+50% Base	$ 441,686	$ 218,175	$ 659,861	$ -	$ -	$ -	$ 659,861
	Base Cost	$ 294,457	$ 145,450	$ 439,907	$ -	$ -	$ -	$ 439,907
	-30% Base	$ 206,120	$ 101,815	$ 307,935	$ -	$ -	$ -	$ 307,935
4	**Capping At Load Lines 2 & 4 and Excavation & Off-Site Disposal At Potential Landfill**							
	+50% Base	$ 381,099	$ 220,306	$ 601,405	$ 2,507	$ 2,635	$ 141,075	$ 742,480
	Base Cost	$ 254,066	$ 146,870	$ 400,937	$ 1,671	$ 1,757	$ 94,050	$ 494,987
	-30% Base	$ 177,846	$ 102,809	$ 280,656	$ 1,170	$ 1,230	$ 65,835	$ 346,491

Notes:

Non-discounted cost is the present cost of annual operations & maintenance times the same number of years used for present worth calculations.

*Certain annual costs occur throughout the life of the alternative and are included in the row "Years 1-30". Other costs occur annually, but only after some period of time has passed. These annual costs are separated into the row "Years 6-30". Then the total present worth of these two sets of outflows is obtained by adding the present worth of Years 1-30 to the present worth of Years 6-30.

Table A-3
Capping And Excavation: Areas, Volumes, Weights

Item	Units	Load Line 2 Paint Operations Area	Load Line 4 Paint Operations Area	Subtotal Load Line 2 & 4 Paint Operations Area	Potential Landfill Area	Total
Excavation						
Area	Sq. Ft.	8300	2700	11000	3800	14800
Area	Sq. Yd.	922	300	1222	422	1644
Depth	Ft.	1	1	2	4	
Volume	Cu. Ft.	8300	2700	11000	15200	26200
Volume	Cu. Yd.	308	100	408	563	971
Weight of Material In Natural Compacted State From Excavation[1] Earth Loam At 3370 Lb/Cu. Yd.	Ton	519	169	687	949	1636
Backfill						
Top Soil In Loose State From Off-Site At 26% Shrink[1] Due to Compaction	Cu. Yd.	388	126	514	709	1223
Gravel Base For Concrete Cap						
Thickness	Inch	6	6	6	6	6
Volume	Cu. Yd.	154	50	204	70	274
Surface Drainage Away From Cap Periphery (actual perimeter + 7Ft for corners)	Ln. Ft.	502	217	719	254	973
Slope Away From Cap At 10 In. Height By 20 Inch Wide (1:2 slope)						
Area In elevation	Sq. Ft.	0.7	0.7	0.7	0.7	0.7
Volume Placed At 26% Shrink[1] (area in elevation x perimeter) + 10% for potential additional grading	Cu. Yd.	18	8	26	9	35
Sodding						
Total Width of Slope Away From Cap In Plan View (rounded up to nearest Ft.)	Ft.	2	2	2	2	2
Total Area (width x perimeter + 10% for potential additional grading	Sq. Yd.	123	53	176	62	238

[1] Church, H.K. (Church). 1981. Excavation Handbook. McGraw Hill.

A1.0 COST SUMMARY

The summary of present worth estimated costs for all four alternatives is contained in **Table A-1**. The distribution of lowest to highest cost is:

Lowest to Highest Cost

Alternative 1 – No Action
Alternative 2 – Capping
Alternative 4 – Capping at Load Lines 2 and 4 and Excavation and Off-Site Disposal for the Potential Landfill Area
Alternative 3 – Excavation and Off-Site Disposal

Alternative 3 has the highest total present worth cost because of the highest indirect capital cost of any of the alternatives. One reason for the highest indirect cost is that in the cost estimate two design plans are required. All of these requirements are insensitive to area and volume of remediation.

The summary of non-discounted (O&M times the same number of years used for present worth calculations) estimated costs for all four alternatives is contained in **Table A-2**. The distribution of lowest to highest cost is:

Lowest to Highest Cost

Alternative 1 – No Action
Alternative 2 – Capping
Alternative 3 – Excavation and Off-Site Disposal
Alternative 4 – Capping at Load Lines 2 and 4 and Excavation and Off-Site Disposal for the Potential Landfill Area

A2.0 ASSUMPTIONS USED IN DEVELOPING COST ESTIMATES

A2.1 Remediation Time Period For Present Worth

EPA Guidance (EPA, 1987 and 1988) recommends that the time period be the actual estimated time for conducting the remedial action up to a maximum of 30 years. The 30-year maximum is specified because: "Remedial action alternatives requiring perpetual care should not be costed beyond 30 years for the purpose of feasibility analysis. The present worth costs beyond this period become negligible and have little impact on the total present worth of an alternative."

Alternative 3- Excavation and Off-Site Disposal has no present worth component because all of the contaminated soil is removed from the site. Because Alternative 1 – No Action, Alternative 2 – Capping, and the capping portion of Alternative 4- Capping at Load Lines 2 and 4 and Excavation and Off-Site Disposal do not remove any of the contaminated soil from the site, O&M functions of periodic monitoring and periodic cap inspection must continue in perpetuity.

For Alternatives 1 and 2 and the capping portion Alternative 4, a maximum of 30 years is assumed for costing purposes in accordance with EPA guidance. It must be kept in mind however that the O&M portion of the remediation is care in perpetuity.

A2.2 Discount Rate for Present Worth

EPA guidance (EPA, 1987) recommends using a discount rate "which represent the average rate of return on private investment." As of June 7, 2000 the U.S. Government 30-year Treasury Bond interest rate (Kansas City Star) was 6 percent (5.91 percent rounded to the nearest whole percent). This rate is used for calculation of Present Worth because the 30-year U.S. Treasury bond rate is a recognized published value used as one of the fundamental financial interest rates plus it meets the definition of a rate that a "private" investor can obtain.

A2.3 Excavation Area, Volume and Weight

The soil area and excavation volume is shown in **Table 2-4** and **Drawings 2-1, 2-2** and **2-3** in the body of the FS. For application of unit cost, conversion is made, where appropriate, to square yards, cubic yards, or tons. A shrink/swell factor of 26% is used to calculate the difference between the volume of soil in the natural compacted state and the loose condition outside the excavation. Results of these calculations are contained in **Table A-3**.

OSHA safety requirements for excavations (29CFR1926) apply to excavation that are 5-feet in depth or greater. Because the maximum depth of excavation is 4-feet, OSHA safety requirements for excavation side sloping and excavation do no apply. Estimated excavation volumes are based on the actual amount of soil to be remediated and no allowance is added for extra soil to be removed for excavation side sloping.

A2.4 Cap

The contaminated soil is to be left in place and the cap installed over the undisturbed soil. Therefore no excavation of soil is permitted. The assumed cap design is to place 6-inch thickness of gravel base over the soil followed by a 4-inch thick concrete cap. This results in a 10-inch increase in height from the existing ground surface to the top of the cap. To retain the gravel at the edge of the concrete and to allow for proper drainage away from cap, top soil at a 1:2 slope that is sodded is placed around the cap. Sodding is used instead of seeding so as to prevent soil erosion that could occur during period of heavy rain prior to any seeding becoming fully established. The amount for this edge around the cap is listed in **Table A-3**.

A2.5 Unit Costs

Unit costs are taken from the references as listed on the cost estimate spread sheets. Many of these unit costs are taken from either Means Environmental Remediation Cost Data (Means 2000b) or Means Building Construction Cost Data (Means 2000a). The Means Environmental Remediation Cost Data presents costs based on safety levels while the Means Building Construction Cost Data does not include allowance for various safety levels. For estimating purposes, environmental Safety Level C, which has an equipment productivity of 75% compared to environmental non-hazardous work, is applied to unit costs taken from Means Building Construction Cost Data. Percentages for Indirect Capitol Costs are taken from the ranges given in Means Environmental Remediation Cost Data.

A2.6 Off-Site Disposal

Alternative 3, and a portion of Alternative 4, is described in Sections 3 of the body of the FS as excavation and off-Site disposal. During a telephone conversation with the Butler County, NE Landfill, (Butler County Landfill, 2000) it was indicated that the landfill could accept and dispose of antimony contaminated soil without treatment provided soil analysis was below TCLP

acceptance levels, the soil was not ignitable, and NDEQ imposed no other restrictions. Analysis of soil samples taken from and near the excavation locations did not reveal any soil constituents that would lead to a concern for landfill acceptance. As a result, costs are for landfill disposal only and no costs for treatment are included.

A3.0 COST ESTIMATE FOR REMEDIAL ALTERNATIVES

Cost estimates for alternatives are contained in the following tables.

Table	Alternative
A-4	Alternative 1 – No Action
A-5	Alternative 2 – Capping
A-6	Alternative 3 – Excavation and Off-Site Disposal
A-7	Alternative 4 – Capping for Load Lines 2 & 4 and Excavation & Off-Site Disposal for the Potential Landfill Area

Cost estimate references are listed in Section B-4 of this attachment. They are numbered for convenience and the appropriate reference number included in **Tables A-4** through **A-7**.

A4.0 COST ESTIMATE REFERENCES

1. Butler County, NE, Landfill (Butler County Landfill). 2000. Telephone Conversation with Kelly Danielson. URS Greiner Woodward Clyde Federal Services. Overland Park, KS. May 30.

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