Feasibility Study
Residential Yard Soil

Omaha Lead Site
Omaha, Nebraska

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Prepared for:
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List of Acronyms

ARARs	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
DCHD	Douglas County Health Department
EBL	Elevated Blood Level
EPA	US Environmental Protection Agency
FS	Feasibility Study
HEPAVAC	High Efficiency Particulate Vacuum Cleaner
HHRA	Human Health Risk Assessment
IC	Institutional Control
IEUBK	Integrated Exposure Uptake Biokinetic Model
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NCP	National Oil & Hazardous Substances Contingency Plan
NDEQ	Nebraska Department of Environmental Quality
NERL	National Exposure Research Laboratory
OSWER	Office of Solid Waste and Emergency Response
O&M	Operation and Maintenance
ppm	parts per million
PRPs	Potentially Responsible Parties
RA	Risk Assessment
RAO	Remedial Action Objectives
RAPMA	Remedial Action Plan Monitoring Act
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
TAG	Technical Assistance Group
TBC	To Be Considered
TCLP	Toxic Characteristic Leachate Procedure
USC	United States Code
UTL	Upper Tolerance Limit
XRF	X-Ray Fluorescence Spectrograph
µg/dl	micrograms per deciliter

1.0 Introduction

This Feasibility Study (FS) for residential soils remediation at the Omaha Lead Site, Omaha, Nebraska, (the Site) has been prepared under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). This FS has been prepared to assist in the selection of a remedial action for cleanup of contaminated residential soils in the Site.

1.1 Purpose and Organization of the Report

The FS process is the procedure used to develop, evaluate, and select a remedial action. The FS report provides documentation for this process. The goals of this FS include the following:

- Providing a framework for evaluating and selecting technologies and remedial actions.
- Satisfying environmental review requirements for a remedial action.
- Complying with administrative record requirements for documentation of remedial action selection.

The purpose of the report is to present and evaluate the remedial alternatives that may be used to address the risks posed by the site. This FS, the remedial investigation, and the risk assessment form the basis from which a Proposed Plan will be developed. This FS does not propose a preferred remedial action. In the Proposed Plan, the U.S. Environmental Protection Agency (EPA) will indicate which type of cleanup action it prefers, and seek public input on what types of cleanup actions should take place. Once the public has had an opportunity to review and comment on the Proposed Plan, a record of decision (ROD) will be issued by the EPA selecting the remedial action.

In addition to this introduction, this report is organized into the following sections:

- Section 2 - Site Investigation
- Section 3 - Potential Applicable or Relevant and Appropriate Requirements
- Section 4 - Identification and Screening of Technologies
- Section 5 - Development of Alternatives

- Section 6 - Detailed Evaluation of Remedial Alternatives
- Section 7 - Comparative Analysis of Alternatives

1.2 Background Information

1.2.1 Site Location and Description

The site encompasses the eastern portion of the greater metropolitan area in Omaha, Nebraska. Sampling efforts for soil contamination resulted in the site being defined by the boundaries of Ames Avenue to the north, "L" Street to the south, 45th Street to the west, and the Missouri River to the east. The site consists of numerous child care facilities, residential properties, schools, and other residential type properties that have been contaminated as a result of air emissions from lead smelting and industrial operations. In addition, lead-based paint and leaded fuel emissions, which would be expected to be found in urban areas such as Omaha, may have contributed contamination to the soil. Land use within a 4-mile radius of the site area is residential, commercial, and industrial. The Omaha Lead Site includes only residential type properties and other areas where children may congregate; such as parks, schools, or child care facilities. The Site does not include commercial or industrial properties.

1.2.2 Operational History and Waste Characteristics

The ASARCO facility conducted lead refining operations from the early 1870s until 1997 The ASARCO facility was located on approximately 23 acres on the west bank of the Missouri River in downtown Omaha. The former lead refinery processed lead bullion containing recoverable amounts of metals, including gold, silver, antimony, and bismuth. The refinery process used the traditional pyrometallurgical process, including the addition of metallic and non-metallic compounds to molten lead and separation of the lead from the other metals and removing impurities. Refined lead and specialty metal by-products such as antimony-rich lead, bismuth, dore (silver-rich material), and antimony oxide were produced at the facility. The fully refined lead was formed into 100-pound castings or 1-ton blocks. The metal was then shipped to industries requiring lead to produce various products. During the operational period, lead, cadmium, zinc, and arsenic were emitted into the atmosphere through smoke stacks. The pollutants were transported downwind in various directions and deposited on the ground surface due to the combined process of turbulent diffusion and gravitational settling.

A secondary lead smelter was operated at 555 Farnam Street in Omaha from the early 1950s until closing in 1982. Aaron Ferer & Sons, Co. constructed this facility to smelt lead batteries and other scrap lead. The facility was sold to a predecessor of Gould National Batteries in 1963 that operated the facility until closing. Several other businesses in the Omaha area used lead in their manufacturing process. In 1998 the Omaha City Council solicited assistance from the EPA in addressing problems with lead contamination in the Omaha area. The EPA initiated the process to investigate the lead contamination in the area under the authority of CERCLA.

1.2.3 Nature and Extent of Contamination

Previous investigations have been conducted at the site since 1995. Several investigations were performed at the ASARCO facility. Groundwater and soils were characterized and a closure report was developed.

Surface soil samples were collected from 15,012 residential, EBL, and child care properties within the Omaha Lead site and analyzed for lead between March 1999 and January 2004. Jacobs Engineering conducted the sampling between March 1999 and July 2000, and since then the sampling has been conducted by BVSPC in a Remedial Investigation (RI) under the EPA Work Assignment No. 070-RICO-07ZY. The properties were relatively evenly distributed throughout the site and represent lead concentrations in surface soil in all areas of the site.

Previous studies have indicated that the highest lead concentrations were expected to be along the direction of prevailing wind. The RI results appear to support this assertion because most of the homes with soil-lead concentrations exceeding 400 ppm are clustered along the prevailing wind directions. Analysis results have been summarized in the RI report. An earlier investigation of subsurface soil-lead concentrations indicated that the lead has not generally migrated beyond the top 2-12 inches of soil. Conditions within the soil are not conducive to further migration.

1.2.4 Contaminant Fate and Transport

Early investigations at the Omaha Lead site found evidence of high lead concentrations in surface soils along the corridors of the prevailing wind currents that pass through downtown Omaha. At the same time, several industrial properties on the east side of downtown Omaha were being investigated as the sources of the contamination. The conclusions of these investigations demonstrated that the contamination was deposited from air currents transporting industrial emissions generated at the east edge of downtown, along the Missouri River and traveling outward. These potential sources have been closed and no other potential industrial sources of lead-contamination that would influence the entire site have been identified to date.

Investigations conducted at the site have studied potential migration of lead contamination from surface to subsurface soils. Investigations of soil chemistry and lead concentrations in subsurface soils at the site have indicated that the lead contamination at the site is concentrated in the top 2 to 12 inches of soil. Lead was detected in 511 surface samples where subsurface samples were collected at the same location. The number of samples in which lead was detected decreased at each downward interval. The average, maximum, and median lead concentrations also decreased as depth increased, indicating only minor migration downward from surface soils. These results led the EPA to discontinue depth sampling.

Additional migration of contaminants on the site may occur through wind, surface water erosion and human activity.

1.2.5 Baseline Risk Assessment

The Nebraska Department of Health and Human Services and the EPA, Region 7 developed a Human Health Risk Assessment (HHRA) concurrently with the Remedial Investigation Report. The HHRA evaluated the potential adverse health effects associated with exposure to metal contamination of residential soil. A total of ten metals, including lead, were identified as Contaminants of Potential Concern (COPCs). For lead, the Integrated Exposure Uptake Biokinetic (IEUBK) Model was used to predict a geometric mean blood-lead concentration for a hypothetical child of age 50 months at 12,366 residential properties, as well as the probability or chance that a given child might have a blood-lead concentration over 10 ug/dl. The model predicted there is a greater than a 5 percent chance of exceeding a blood-level of 10 ug/dl for young children residing at 4,279 of 12,366 homes evaluated on the site (34%). The HHRA results clearly indicate the risk to young children from lead is above the EPA's health protection goal at the Omaha Lead Superfund Site.

The HHRA also evaluated the potential risks from nine other metals found in surface soil. Incidental ingestion of soil was the only route of exposure quantified for residential children and adults, because dermal contact with soil and inhalation of soil/dust particles are insignificant in comparison. The HHRA evaluated the potential for adverse noncancer health effects by calculating Hazard Quotients (HQs) for individual chemicals and summing HQ values for all metals to yield a Hazard Index (HI) for each zip code area. The HQs were also summed by critical adverse effect or primary target organ used to derive the oral reference dose (RfD) to yield critical effect/target organ HIs. The risk assessment evaluated the potential for cancer health effects by calculating the excess individual lifetime cancer risk, which is the probability of an individual developing cancer over a 70-year lifetime as a result of exposure to the contaminant.

The cancer risk estimates range from 1.1E-05 to 1.1E-04 for child and adult residents across all zip code areas, which are entirely due to incidental ingestion of arsenic. These results are not outside of the EPA's target risk range of 10^{-6} to 10^{-4} for carcinogenic compounds. For adults, the hazard index was less than or equal to 1.0 in all zip codes evaluated, which indicates adverse noncarcinogenic effects are not anticipated. For a child resident, the potential for noncancer health effects was evaluated using both a subchronic and chronic RfD. The hazard indices are greater than 1.0 for all zip code areas, regardless of which toxicity value was used. However, arsenic is the only individual metal where HQs are greater than 1.0 when using a chronic RfD when the subchronic RfD is utilized, the arsenic HQs are all less than 1.0. The HIs were further segregated by critical effect or target organ which yielded HIs greater than 1.0 when the chronic arsenic RfD was used, but not when the subchronic value was utilized.

The EPA evaluated a number of factors in determining whether the potential for noncancer health effects in children warrant a remedial action. First of all, arsenic is the only individual contaminant where hazard quotients exceed 1.0. For the remaining COPCs, an examination of background data in soils indicates that concentrations found on-site were equal to or only slightly greater than naturally-occurring levels for several metals. Therefore, the resulting exposure and risk are in large part due to background levels found in the environment. It is also important to note that iron was also a significant contributor to HIs greater than one. However, the hazard quotients for iron may have been over-estimated by 10-fold because the RfD is based on an outdated provisional value that does not reflect the latest scientific data.

Another important issue to consider is that using the arsenic chronic RfD for children likely overestimates the risk of potential health impacts because chronic RfDs are derived so as to be protective for lifetime exposure and may not be applicable to much shorter exposure durations. In the case of arsenic, the subchronic RfD is based on actual exposure to humans for up to 10 years, including potentially sensitive subpopulations. This exposure duration is consistent with the time frame evaluated in the risk assessment for residential children. Last of all, there are adequate arsenic bioavailability data in the scientific literature for arsenic indicating the risks were likely overestimated by a least two-fold. While the HIs marginally exceed 1.0, the EPA believes the factors discussed above adequately demonstrate that the potential for noncancer health effects does not warrant taking remedial action to mitigate exposure.

Additional data analyses were conducted by the EPA's National Exposure Research Laboratory (NERL) and the University of Colorado's Laboratory for Environmental and Geological Studies (LEGS) to determine if arsenic found in surface soil is related to the lead that is widely found in the soil at the site. The NERL analyzed the site data and prepared a report titled, "Arsenic and Lead Contamination in Soil – Omaha, Nebraska" which describes the analyses performed on the data and the conclusions. The report concludes that soil samples with arsenic above 20 ppm are not correlated with the lead contamination, and high arsenic concentrations occasionally found in residential soils, are not related to lead contamination that is found in most residential yards. The NERL wrote a second report titled, "Spatial Distribution of Lead and Arsenic Contamination – Omaha, Nebraska" supplementing its earlier report with geo-spatial analyses of lead and arsenic data. This report concludes that arsenic found in surface soil does not have the same geo-spatial pattern as lead.

The LEGS also analyzed three soil samples from residential properties containing high arsenic concentrations. LEGS' analysis of the soil data from the site revealed that arsenic and lead concentrations are not correlated, which suggests the two metals are from different sources. Additionally, analysis of these samples indicated the arsenic is in a relatively pure form not related to smelter emissions.

2.0 Potential Applicable or Relevant and Appropriate Requirements

Pursuant to Section 121(d) of CERCLA, 42 United States Code (U.S.C.) § 9621(d), remedial actions shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and control of further release which, at a minimum, assures protection of human health and the environment. In addition, remedial actions shall, upon their completion, reach a level or standard of control for such hazardous substances, pollutants, or contaminants which at least attains legally applicable or relevant and appropriate federal standards, requirements, criteria, or limitations, or any promulgated standards, requirements, criteria, or limitations under a state environmental or facility siting law that is more stringent than any federal standard. These are termed as applicable or relevant and appropriate requirements (ARARs). In instances where the remedial actions do not achieve ARARs, the EPA must provide the basis for a waiver. An ARARs waiver is not contemplated for any of the alternatives evaluated in this FS.

Applicable requirements are those standards, requirements, criteria, or limitations promulgated under federal, state, or local law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those standards, requirements, criteria, or limitations promulgated under federal, state, or local law that address problems or situations similar to those encountered at the CERCLA site, and therefore, are well suited for that site. Although not legally applicable, these requirements may nonetheless be relevant and appropriate for a particular CERCLA site.

The EPA, Region 7 and the state of Nebraska determine which requirements are ARARs by considering the type of remedial actions contemplated, the hazardous substances present, the waste characteristics, the physical characteristics of the site, and other appropriate factors. Only the substantive portions of the requirements need to be followed for on-site actions; CERCLA procedural and administrative requirements require safeguards similar to those provided under other laws. Under Section 121(e) of CERCLA, 42 U.S.C. § 9621(e), and the National Oil and Hazardous Substances Contingency Plan (NCP), 40 Code of Federal Regulations (C.F.R.) § 300.400(e), federal state, and local permits are not required for the portions of CERCLA cleanups that are conducted entirely on-site, as long as the actions are selected and carried out in compliance with Section 121 of CERCLA.

There are three types of ARARs. The first type includes chemical-specific requirements. These ARARs set limits on concentrations of specific hazardous substances, pollutants, and contaminants in the environment. Examples of these types of ARARs are drinking water standards and ambient water quality criteria. Frequently, the chemical-specific ARARs constitute a basic level of protectiveness for certain hazardous substances. However, for some media, chemical-specific ARARs are not available.

A second type of ARAR includes location-specific requirements that set restrictions on certain types of activities such as those in wetlands, floodplains, and historic sites. Location specific ARARs generally apply to most alternatives under consideration because they are based on the location of the site.

The third type of ARAR includes action-specific requirements. These are technology-based restrictions that are triggered by the type of remedial action under consideration. Examples of action-specific ARARs are Resource Conservation and Recovery Act (RCRA) regulations for waste treatment, storage and disposal. Action-specific ARARs may vary depending on the remedial alternative under consideration. Potential federal and state action-specific ARARs are identified in Section 5 as each alternative is subjected to detailed analysis.

The potential federal and state chemical and location-specific ARARs for the Omaha Lead site FS, identified by the EPA, respectively, are presented in Tables 2-1 through 2-4. These tables cite the requirements identified, state whether the requirements are applicable or relevant and appropriate, or to be considered and summarize the substantive standards to be met. To be considered (TBC) criteria consist of advisories, criteria, or guidance that were developed by the EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. TBCs do not meet the definition of ARAR, but may be necessary to determine what is protective and are useful when ARARs are not available.

2.1 Potential Chemical-Specific ARARs

The potential chemical-specific ARARs identified for this site relate to protection of human health from exposure to residential yard soils because of the unacceptable risks associated with exposure of humans, particularly children under 7 years old, to contaminated yard soils. As discussed above, the principal contaminant is lead from smelter related operations.

Federal and Nebraska governments have not promulgated standards, requirements, criteria or limitations to control the level of hazardous substances, pollutants, or contaminants in the soil at residential yards. Therefore, the alternatives evaluated for this FS do not have chemical-specific ARARs for contaminated soils in residential yards. However, the risk assessment and other federal and state guidances are available to evaluate each alternative for its ability to achieve a basic level of protectiveness for hazardous substances in soil. These are listed in the tables under the category to be considered. Once contaminated soil has been removed from residential yards and disposed, the NDEQ Title 117 regulations, "Surface Water Quality Standards", would potentially establish effluent limits on the discharge of pollutants in storm water runoff from the soil disposal area. Tables 2-1 and 2-2 identify the potential federal and state chemical-specific ARARs for the Omaha Lead Site.

2.2 Potential Location-Specific ARARs

Physical characteristics of the site may influence the type and location of remedial responses considered for this FS. Potential federal and state location-specific ARARs, presented in Tables 2-3 and 2-4, relate to historic preservation, fish and wildlife coordination procedures, wetlands protection, flood plains protection, and work in navigable waters. Additionally, NDEQ siting statues and location restriction regulations in Title 128 "Nebraska Hazardous Wastes Regulations" and Title 132 "integrated Solid Waste Management Regulations" may be appropriate for consideration when siting the soil repository. The final determination of location-specific ARARs will depend upon detailed design and siting decisions made during remedial design.

2.3 Summary of ARARs

Contamination in the residential soils at the Omaha Lead site poses a potential threat to human health. CERCLA requires that any remedial action selected shall attain a degree of cleanup, which at a minimum assures protection of human health and the environment.

For this FS, the EPA and the NDEQ have determined that chemical specific ARARs are not available, but that the HHRA and the EPA and state guidances are to be used for the effectiveness evaluations of the remedial alternatives herein. Based on present knowledge, protection of human health can be provided by attaining the levels of protectiveness described in the HHRA. Public health action-specific ARARs related to remedial actions are identified and considered once the alternatives have been developed in Section 6.

Table 2-1
Potential Federal Chemical-Specific ARARs

	Citations	Prerequisite	Requirement
A. Applicable Requirements	None		
B. Relevant and Appropriate	None		
C. To Be Considered			
1. EPA Revised Interim Soil-lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities	Office of Solid Waste and Emergency Response (OSWER) Directive 9355.4-12, July 14, 1994	Establishes screening levels for lead in soil for residential land use, describes development of site-specific preliminary remediation goals, and describes a plan for soil-lead cleanup at CERCLA sites	This guidance recommends using the EPA Integrated Exposure Uptake Biokinetic Model (IEUBK) on a site-specific basis to assist in developing cleanup goals.
2. EPA Strategy for Reducing Lead Exposures	EPA, February 21, 1991	Presents a strategy to reduce lead exposure, particularly to young children.	The strategy was developed to reduce lead exposure to the greatest extent possible. Goals of the strategy are to 1) significantly reduce the incidence above 10 µg Pb/dL in children; and 2) reduce the amount of lead introduced into the environment.
3. Human Health Risk Assessment Report (HHRA)	"Area-Wide Human Health Risk Assessment for the Omaha Lead Site, Omaha, Nebraska" – prepared by NHHS, June 2004	Evaluates baseline health risk due to current site exposures and established contaminant levels in environmental media at the site for the protection of public health.	The risk assessment approach using this data should be used in determining cleanup levels because ARARs are not available for contaminants in soils.

Table 2-2
Potential State Chemical-Specific ARARs

	Citation	Prerequisite	Requirement
A. Applicable Requirements			
1. Nebraska Surface Water Quality Standards	Nebraska Department of Environmental Quality - TITLE 117	Regulates the discharge of constituents from any point source, including stormwater, to surface waters of the state. Provides for maintenance and protection of public health and aquatic life uses of surface water and groundwater.	Required for protection of wetlands, streams, lakes, and impounded waters from the runoff from toxic discharges.
B. Relevant and Appropriate Requirements	None		
C. To Be Considered			
1. Human Health Risk Assessment Report (HHRA)	"Area-Wide Human Health Risk Assessment for the Omaha Lead Site, Omaha, Nebraska" – prepared by NHHS, June 2004	Evaluates baseline health risk due to current site exposures and established contaminant levels in environmental media at the site for the protection of public health.	The risk assessment approach using this data should be used in determining cleanup levels because ARARs are not available for contaminants in soils.

Table 2-3
Potential Federal Location-Specific ARARs

	Citation	Prerequisite	Requirement
A. Applicable Requirements			
1. Historic project owned or controlled by a federal agency	National Historic Preservation Act: 16 U.S.C. 470, et.seq; 40 C.F.R. § 6.301; 36 C.F.R. Part 1.	Property within areas of the Site is included in or eligible for the National Register of Historic Places.	The remedial alternatives will be designed to minimize the effect on historic landmarks.
2. Site within an area where action may cause irreparable harm, loss, or destruction of artifacts.	Archeological and Historic Preservation Act; 16 U.S.C. 469, 40 C.F.R. 6.301.	Property within areas of the site contains historical and archaeological data.	The remedial alternative will be designed to minimize the effect on historical and archeological data.
3. Site located in area of critical habitat upon which endangered or threatened species depend.	Endangered Species Act of 1973, 16 U.S.C. 1531-1543; 50 C.F.R. Parts 17; 40 C.F.R. 6.302. Federal Migratory Bird Act; 16 U.S.C. 703-712.	Determination of the presence of endangered or threatened species.	The remedial alternatives will be designed to conserve endangered or threatened species and their habitat, including consultation with the Department of Interior if such areas are affected.
4. Site located within a floodplain soil.	Protection of Floodplains, Executive Order 11988; 40 C.F.R. Part 6.302, Appendix A.	Remedial action will take place within a 100-year floodplain.	The remedial action will be designed to avoid adversely impacting the floodplain in and around the soil repository to ensure that the action planning and budget reflects consideration of the flood hazards and floodplain management.
5. Wetlands located in and around the soil repository.	Protection of Wetlands; Executive Order 11990; 40 C.F.R. Part 6, Appendix A.	Remedial actions may affect wetlands.	The remedial action will be designed to avoid adversely impacting wetlands wherever possible including minimizing wetlands destruction and preserving wetland values.
6. Structures in waterways in and around the soil repository.	Rivers & Harbors Act, 33 C.F.R. Parts 320-330.	Placement of structures in waterways is restricted to preapproval of the U.S. Army Corps of Engineers.	The remedial action will comply with these requirements.
7. Waters in and around the removal repository.	Clean Water Act, (Section 404 Permits) Dredge or Fill Substantive Requirements, 33 U.S.C. Parts 1251-1376; 40 C.F.R. Parts 230,231.	Capping, dike stabilization construction of berms and levees, and disposal of contaminated soil, waste material or dredged material are examples of activities that may involve a discharge of dredge or fill material.	Four conditions must be satisfied before dredge and fill is an allowable alternative: 1. There must not be a practical alternative. 2. Discharge of dredged or fill material must not cause a violation of State water quality standards, violate applicable toxic effluent standards, jeopardize threatened or endangered species or injure a marine sanctuary. 3. No discharge shall be permitted that will cause or contribute to

Table 2-3, Continued
Potential Federal Location-Specific ARARs

	Citation	Prerequisite	Requirement
			significant degradation of the water. 4. Appropriate steps to minimize adverse effects must be taken. Determine long- and short-term effects on physical, chemical, and biological components of the aquatic ecosystem.
8. Area containing fish and wildlife habitat in and around the removal repository.	Fish and Wildlife Conservation Act of 1980, 16 U.S.C. Part 2901 et seq.; 50 C.F.R. Part 83 and 16 U.S.C. Part 661, et seq. Federal Migratory Bird Act, 16 U.S.C. Part 703.	Activity affecting wildlife and non-game fish.	Remedial action will conserve and promote conservation of non-game fish and wildlife and their habitats.
B. Relevant and Appropriate Requirements			
1. 100-year floodplain	Location Standard for Hazardous Waste Facilities- RCRA; 42 U.S.C. 6901; 40 C.F.R. 264.18(b).	RCRA hazardous waste treatment and disposal.	Facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout during any 100-year/24 hour flood.
C. To Be Considered	None		

Table 2-4
Potential State Location-Specific ARARs

	Citation	Prerequisite	Requirement
A. Applicable Requirements			
1. Solid waste management regulations	Nebraska Department of Environmental Quality – TITLE 132 – Integrated Solid Waste Management Regulations	Requires permits for proper identifications and disposal of solid waste in municipal solid waste disposal areas.	Requires specified procedures for the location, design, operation, and ground water monitoring, closure, disposal, post closure, and financial assurance for solid waste disposal facilities. Requires specific procedures for special waste management.
2. Siting Procedures and Policies	Nebraska State Statutes 13-1701 to 13-1714	Policies and procedures are required in order to get approval for a solid waste disposal.	Requires approvals by local jurisdictions prior to the development of a site as a solid waste disposal area.
3. Flood-plain Management Act	Nebraska State Statues 13-1001 to 31-1031 and Title 258	Policies and procedures for construction or disposal in flood plains	Governs certain activities occurring in flood plains
4. Nebraska Nongame and Endangered Species Act	Nebraska State Statues 37-801 to 37-811 and Title 163 Chapter 4, 012	Policies and procedures to ensure protection of Threatened and Endangered species	Requires consultation with Nebraska Game and Parks Commission regarding actions which may affect threatened or endangered species and their critical habitat
C. To Be Considered.			
1. Hazardous waste handling, transport and disposal regulations	Nebraska Department of Environmental Quality – TITLE 128 Nebraska Hazardous Waste Regulations	Requires operating permits for proper identifications, handling, transport, and disposal of hazardous materials.	Supplement the federal RCRA regulations and define state permitting requirements.
2. Siting Procedures and Policies	Nebraska State Statutes 81-1521.08 to 81-1521.23	Policies and procedures are required in order to get approval for a hazardous waste management facility.	Requires approvals by local jurisdictions prior to the development of a site as a hazardous waste management facility.

3.0 Identification and Screening of Technologies

In the Introduction section, the problem of residential yard soil contamination from lead refining/processing fallout in Omaha was discussed. The purpose of this section is to develop goals for the remedial action and to present remedial technologies that can be applied to residential soils to meet the goals. Section 4 discusses the remedial alternatives that have been assembled using these technologies.

3.1 Remedial Action Objectives

This section defines the goals of the remedial action, and identifies the remedial action objectives (RAOs) for residential soils at the Omaha Lead site. RAOs consist of quantitative goals for reducing human health and environmental risks and/or meeting established regulatory requirements at Superfund sites. Reviewing site characterization data, HHRA results, ARARs, and other relevant site information identifies RAOs.

Based on current site data and evaluations of potential risk, lead was identified as being a contaminant of concern and the primary cause of human health risk at the site is through direct ingestion.

One RAO has been developed for residential soils in Omaha:

- Reduce the risk of exposure of young children to lead such that an individual child, or group of similarly exposed children, have no greater than a 5 percent chance of having a blood-lead concentration exceeding 10 micrograms per deciliter (ug/dl).

3.2 Development of Action Levels

Lead was identified in the HHRA as the primary contaminant of concern. Using measured absolute bioavailability values for lead of 37 and 51 percent from a juvenile swine study, the EPA's IUEBK model predicts that young children (less than seven years old) residing at the site will have no greater than a 5 percent probability of having a blood-lead concentration of 10 ug/dl or greater at soil concentrations of 238 ppm to 329 ppm, respectively. Additional soil samples collected and analyzed for *in vitro* bioavailability support an average site-wide absolute bioavailability of approximately 40 percent. Assuming 40 percent bioavailablilty, the IEUBK model predicts there is no more than a 5 percent chance that a given child will exceed 10 ug/dl at a soil concentration of about 300 ppm.

Final cleanup levels for lead in residential soil at Superfund sites generally are based on the IEUBK model results and the nine criteria analysis per the NCP. It is generally accepted that the EPA regions can select a residential soil-lead cleanup level that is within the range of 400 ppm to 1,200 ppm and be protective of human health for long-term remedial actions. As described above, the IEUBK modeling results for the Omaha Lead site recommends a soil-lead concentration of about 300 ppm to reach the RAO that a child has a less than a 5 percent probability of having a blood-lead level exceeding 10 ug/dl. The IEUBK model input parameter that significantly influenced this recommended cleanup level is the relatively high bioavailability of the lead in the Omaha Lead site soils. The site-specific bioavailability parameter (approximately 40 percent) is based on both *in vivo* and numerous *in vitro* measurements and was used instead of the model default value (30 percent). The soil-to-dust ratio was another model-input parameter where site-specific data were collected to potentially adjust the model default value. The data collected for the analysis of the site-specific soil-to-dust ratio do not result in a strong enough relationship to adjust the default value in the model. A number of problems were identified with the collection of the data for the analysis of this parameter including access problems, time of year, and number and nature of properties used in the study and some concern was expressed regarding the design of the study. Default values were used for all other parameters in the model except for ambient air. It should be noted that the EPA performed a general analysis to compare modeled blood-lead predictions based on-site soil and dust concentrations with the corresponding existing blood-lead data in the community. There are many uncertainties associated with performing this type of blood-lead analyses, but the results indicated that the model did not significantly over or under predict the blood-lead levels in the areas sampled.

Based on the uncertainties in some parameters used in the IEUBK modeling effort, described in the HHRA, and a general analysis performed to compare model predictions based on-site soil concentrations with the existing blood-lead data in the community, the EPA is recommending a risk management cleanup level for lead in residential soils at the site of 400 ppm. This cleanup level is at the lower end of the 400 ppm to 1200 ppm range generally considered protective for residential cleanups. The cleanup of soils at or above 400 ppm combined with a variety of other risk reduction activities identified in the following sections are anticipated to reduce child blood-lead levels to meet the RAO and provide a protective remedy for the community. These additional activities might include health education involving blood-lead screening and in- home evaluations of potential sources of exposure for blood-lead elevations, cleaning home interiors, and addressing flaking exterior lead-based paint.

Although the IEUBK model identified a potential risk to young children at a soil-lead level in the range of 300 ppm, the EPA believes that the combination of site actions recommended in the alternatives in this document will be protective of human health. However, the EPA will use the large environmental and health data sets collected during the remedial action to further refine the Human Health Risk Assessment and address uncertainties noted in the document and to reassess the initial risk management decision to use a cleanup level of 400 ppm lead in residential soil. Additionally, at the completion of the comprehensive remedial action for the site, the EPA will sponsor a site-wide exposure study to assess whether the RAO(s) have been met and determine whether additional actions are required.

4.0 Identification of Applicable Technologies and Process Options

Remedial action technologies address exposure of residents to lead in soils by reducing the likelihood of metal ingestion. The purpose of this subsection is to screen technologies to be considered for remediation of metals in residential soils.

4.1 Institutional Controls

Control measures that are social in nature can be as effective as remedial technologies in preventing human exposure to metals. Therefore, institutional controls (IC), such as public health education and access restrictions, are included in this section along with technologies. ICs are being developed to reduce or prevent exposure to contamination in soil and dust and to protect the remedy where wastes are left in place. The specific ICs developed for the site will be documented as part of an Institutional Controls Implementation Plan.

4.1.1 Public Health Education

Public health education involves distribution of information about metal exposure to people in areas affected by metals in soils. Education can alert residents to the issues of exposure routes, sources of metals, people at risk, and preventative measures.

Educating citizens living in residences with metals in soils can be used as a supplemental action to reduce exposure and decrease risk. Education is appropriate because the primary exposure route is ingestion and is controllable. Specific education activities that may prove effective at reducing exposures include:

- Holding meetings with area physicians to inform local family practitioners
- Providing community education through meetings and literature
- Providing appropriate intervention when children are identified as having elevated blood-lead levels.

Education, especially if it is the primary means of reaching remediation goals, must be an ongoing process. The main limitation to public education is that educational programs require not only the cooperation of public health institutions, but public cooperation as well, to be successful. In addition, public concern and awareness tend to wane with time unless a continual mechanism of public education is in place, in perpetuity. Additionally, education activities, conducted over a long period of time, can become expensive. Typically, the EPA prefers that health education is not a stand-alone remedy, but is used only in conjunction with an engineered action as a supplemental activity. Health education activities are useful to help address initial site risks as the remedy is implemented, and then could be phased out as cleanup of the contamination is completed.

4.1.2 Access Restrictions

Access restrictions can prevent physical contact with contaminated soils using either physical barriers or legal restrictions, and may be appropriate for residential yards or the contaminated soil repositories if the soils are removed and disposed. General activities associated with these restrictions are:

- Physical access restrictions - Physical access restrictions may include fencing, no trespassing signs, or security guards. These types of controls are not appropriate for residential areas because it is impractical to restrict access to private yards.
- Legal access restrictions - Legal access restrictions include deed notices, zoning, and building restrictions. These types of restrictions may be appropriate for residential areas, when combined with engineered actions or technologies. Legal restrictions may be required to address contamination left on-site at the completion of the remedial action. These controls could include restrictions such as zoning or permit requirements for future construction to ensure that contaminated soil is properly addressed. The effectiveness of legal access restrictions is limited by enforcement of the specific control.

4.2 Excavation and Disposal

Excavation prevents human contact with soils through physical removal of soils for disposal. Residential soils can be either partially or totally removed. Soil excavation may be difficult and costly, particularly if yards are steeply sloped, or contain trees, shrubs, walkways, and driveways.

4.2.1 Partial Removal

Partial removal of soils refers to excavation of portions of yards containing concentrations of lead above the action level and leaving behind soils with concentrations of lead below the action level. Portions of a yard, but not the entire yard, may contain soil with lead above the action level. Partial removal of soils may be appropriate for these yards. The limitation of partial excavation is the need for extensive testing to carefully delineate the soils to be removed. However, the cost for testing may be offset by the lower removal, transportation, and disposal costs for smaller quantities of soil. All excavated soils require appropriate disposal.

4.2.2 Complete Removal

Complete removal is the excavation of soil to a predetermined depth for entire residential yards. Complete excavation may not be appropriate because soils containing low concentrations of lead with little associated risk are removed, along with soils containing higher concentrations. Excavation of entire yards may be necessary for yards contaminated from airborne sources, as lead is typically more evenly distributed in these yards. Complete yard soil removal may be most appropriate where the majority of the yards contain soil contamination above the action level, and eliminating the extensive sampling associated with partial removal reduces costs. The EPA has information for this site indicating that many of the residential yards with soil concentrations above the action level also have areas of their yard below the action level, meaning a complete removal may not be necessary. This technology is not considered further because of the much higher costs associated with complete removal.

4.2.3 Disposal

Disposal options must be considered with either partial or total excavation. The metals-contaminated soils removed from residential areas will require disposal in a secure facility. Several options exist for disposal of lead-contaminated soil from the Omaha site and are discussed in the following paragraphs.

A soil repository could be constructed on an existing area within the Superfund site. The repository, which would be covered or revegetated, would allow for disposal of soils in a controlled environment, minimizing transport of lead through contact with water. The primary limitation for this technology is land availability. Additionally, if the EPA constructed a discrete on-site repository for lead-contaminated soil disposal, the facility would require long-term operation and maintenance (O&M) by the state of Nebraska or through a permanent and enforceable agreement with the property owner.

Soils could also be disposed in off-site sanitary landfills as a special waste. The advantage of using existing landfills is the elimination of design and construction of a soil repository. The limitations of using an off-site disposal facility are possible regulatory constraints and cost. Costs for off-site disposal would be greater than on-site due to the extra transportation expense and tipping fees at the landfill. Another significant disadvantage to disposal in a sanitary landfill is the capacity space of the landfill used for the soil disposal. Additionally, the soils require testing, prior to disposal, using the toxicity characteristic leaching procedure (TCLP). If soils fail the TCLP test for lead, pretreatment would be required prior to disposal. Because of the potentially large quantities of soil to be generated from excavation activities, pretreatment of soil prior to disposal may be difficult to implement, as well as, cost prohibitive.

The soil excavated from the residential yards in Omaha potentially could be used as beneficial fill in a commercial land use project, if it can be demonstrated that there would be no unacceptable risk to human health or the environment. While the lead-contaminated soil presents a hazard to humans, especially children, in residential settings, no significant risks would be created in a commercial setting if the soil is properly placed and appropriate ICs are placed on the disposal property.

4.3 Capping Technologies

Capping prevents direct human contact with waste. The technologies used for capping include:

- Soil
- Geosynthetics
- Vegetation

Capping technologies could be used separately or in combination, in individual yards or in a central soil repository, or in other land use projects, to prevent human contact with metals in soil. Each of the capping technologies is described in the following subsections.

4.3.1 Soil Capping

Soil caps are constructed using either simple topsoil covers or low permeability clay layers to prevent human contact and transport of soils off site. Simple topsoil caps could be used directly in residential yards to cover contaminated soil with a protective layer, preventing human contact with the covered contamination. The advantage of topsoil capping is that contaminated soils remain in place, eliminating excavation, transport, and disposal problems. However, in-place capping would raise the yard level 6 to 12 inches, which create problems in correct contouring to existing driveways, walkways, and below grade window openings of homes. In large yards, capping could be used effectively in combination with excavation to achieve proper final grading of the yard around existing structures.

Low permeable clay caps, although not applicable for residential yards, may be used as final cover for soil disposal areas. These types of soil covers are typically used for preventing infiltration of water into a contaminated soil disposal pile to eliminate future metals migration from the pile.

4.3.2 Geosynthetics

Geosynthetics can consist of geotextile fabrics and geomembrane barriers. Geotextile fabrics are woven from synthetic material and made to withstand both chemical degradation and biodegradation. The fabric is laid over untreated or undisturbed soils, effectively separating them from clean fill material. In residential soils, geotextiles can be used as either a physical or visual barrier to separate the clean soil cover from underlying contaminated soil. The advantage of these barriers is that a resident digging in a remediated yard with contamination at depth would be notified of the contamination by the presence of the barrier.

Geomembrane barriers also have applicability as cover material over a soil disposal pile to prevent surface water infiltration and control surface migration of contaminants. These types of covers, however, are much more costly than soil covers.

4.3.3 Vegetation

Vegetative covers such as sod can prevent human contact with soils by creating a physical barrier. Roots from cover plants hold the soil in place, preventing erosion and off-site transport by surface runoff or wind. Vegetative covers may be appropriate alone for soils with low concentrations of metals. Vegetative covers may also be used in conjunction with clay caps, clean fill or geotextile fabrics. The advantage of a vegetative cover is that grass grows well in the Omaha area and, with proper maintenance, can be an effective barrier. The limitation of a vegetative cover is that routine maintenance (i.e., mowing, watering, and fertilizing) is necessary to maintain the cover. An additional disadvantage of a grass-only cover is that the protective layer is very thin, and without proper maintenance, the grass can die and contaminated soil can be readily re-exposed.

4.4 Stabilization

Stabilization refers to treatment of soils with chemical agents to either fix metals in place or form complexes that make metals less toxic. Two methods of stabilization appropriate for lead contamination are pozzolanic stabilization and phosphate addition. These technologies are both routinely used as treatment technologies. Each stabilization method is described in the following subsections.

4.4.1 Pozzolanic Stabilization

Pozzolanic stabilization of residential soils is the addition of a solidifying agent such as Portland cement or fly ash with soils to form a monolith, similar to concrete. The pozzolan is added in place by injection of a slurry mixture into the soil with auger mixing. The monolith would reduce leachability and mobility of metals in soils by reducing soil particle surface area and inhibit human contact by encapsulating soils. The advantage of pozzolanic stabilization is that treatment materials are inexpensive and readily available. The limitations with in-place pozzolanic stabilization include increased material volume, which would change the elevation of yards. Since paving yards is not generally acceptable to residents, this technology will not be further evaluated for application in residential yards.

4.4.2 Phosphate Stabilization

The formation of lead phosphates, such as pyromorphite, occurs naturally in the presence of sufficient concentrations of phosphate and lead. Lead phosphates are highly stable lead minerals that have been demonstrated to be less bioavailable due to their low solubility. Phosphate addition is a chemical stabilization procedure in which phosphate salts are added to soils either by solid or liquid addition and mixing. Phosphate ions combine with lead to form the less soluble lead phosphate complexes. Although the metals are not removed from the site, they become less bioavailable to humans since the lead that occurs in the soil as lead-phosphate is less likely to be absorbed by the body when ingested than in untreated soil. Phosphate stabilization is routinely used to treat metals in soil for disposal purposes. The technology is, however, new to treatment of soils for the reduction of human bioavailability where soil is left in place.

The transformation of lead carbonates (a more soluble and more bioavailable form of lead) to lead phosphates is dependent on the ability to distribute the phosphates in the soil. Solid or liquid phosphates could be applied by mixing (i.e. rototilling or discing) phosphates into the top 6 to 10 inches of soil. This method of application requires placement of new sod following the phosphate addition. Liquid spray or dry surface application could be easily implemented and would not require any soil removal or disturbance. However, its effectiveness would be limited by soil infiltration rates. Mixing technologies would be significantly more expensive than surface application. Multiple or seasonal phosphate additions may be necessary to control phosphate losses due to natural weathering or to enable surface applications to reach lower depths.

Advantages of phosphate addition are the ease of application and reduced volumes of soils requiring removal and disposal. Although recently completed bench-scale studies suggest that phosphate addition would effectively reduce bioavailability of lead in Omaha soils, additional treatability testing would be necessary to further evaluate the effectiveness, feasibility, and dosage requirements of this emerging technology.

4.5 Actions to Address Other Non-Soil Sources of Lead

The EPA is aware that lead in the environment at the Omaha Lead Site originates from many sources. In addition to the identified soil exposure pathway, which the above listed technologies will address, other important sources of lead exposure are interior and exterior lead-based paint, lead-contaminated interior dust, and to a much lesser extent, tap water. Generally, sources other than soil, exterior paint, interior dust, and tap water cannot be remediated by the EPA in the course of residential lead cleanups. CERCLA and the NCP limit Superfund authority to address interior lead-based paint. For example, CERCLA Section 104(a)(3)(B) limits the EPA's liability to respond to releases within residential structures as follows – Section 104(a)(3):

> "Limitations on Response. The President (EPA) shall not provide for removal or remedial action under this section in response to a release or threat of release…from products which are part of the structure of, and result in exposure within, residential buildings or business or community structures…"

The above cited section of CERCLA generally limits the EPA's authority to respond to lead-based paint inside a structure or house. However, the EPA has authority to conduct response actions addressing soils contaminated by a release of lead-contaminated paint chips from the exterior of homes to prevent recontamination of soils that have been remediated.

The Office of Solid Waste and Emergency Response (OSWER) policy recommends against using money from the Superfund Trust Fund to address interior lead-based paint exposures, and recommends that actions to address or abate interior lead-based paint risks be addressed by others such as HUD, local governments, health authorities, PRPs, private organizations, or individual homeowners. OSWER policy also recommends against using Superfund trust money to remove interior dust solely from lead-based paint or to replace lead plumbing within residential dwellings, and recommends that the regions seek partners to address these other lead exposure risks.

The EPA acknowledges the importance of addressing these other exposures in realizing an overall solution to the lead problems at residential Superfund sites. The EPA is prepared to partner with other organizations such as ATSDR, HUD, state environmental departments, state and local health departments, private organizations, PRPs, and individual residents and to participate in a comprehensive lead risk reduction strategy that addresses lead risks comprehensively. The EPA can provide assessments of these other lead hazards to homeowners as part of our investigation activities and can provide funds to support health education efforts to reduce the risk of lead exposure in general. It should be understood that OSWER policy directs that the EPA should not increase the risk-based soil cleanup levels as a result of the action taken to address these other sources of exposure.

While acknowledging the importance of addressing lead exposures from all sources and developing a comprehensive approach, the EPA can only recommend, as part of a preferred or selected remedy, those actions that the EPA has the authority and policy direction to address. The EPA will make a determination regarding the need to remediate residential soils. At properties where a soil cleanup action is conducted, the EPA can also perform an assessment and provide recommendations to address other sources of lead exposures. At residences where remediation of soils is performed the EPA remedy could also address:

- Addressing interior lead-contaminated dust through professional cleaning when it is not caused solely by deteriorating lead-based paint that exceeds the EPA and HUD standards
- Assessing the condition of, and removing exterior lead-based paint from homes where flaking lead-based paint may threaten the future protectiveness of a soil cleanup by re-contaminating the clean soil placed in the drip zone of the house
- Providing support to a health education program during cleanup actions.

4.6 Screening of Identified Technologies

This section screens the remedial technologies identified in Sections 4.1 through 4.4 for further consideration in developing comprehensive remedial actions to address site risks.

4.6.1 Institutional Controls

Public Health Education

Health education is readily implementable, and has been shown to reduce blood-lead concentrations in young children if efforts are aggressive and sustained. Health education will be retained for consideration in developing remedial alternatives to address site risks.

Access Restrictions

Physical restrictions, such as fencing, and legal restrictions such as deed notices, do not have applicability to existing residential homes. Physical restrictions are not practical to limit access of young children to contaminated soil in residential yards. Likewise, legal restrictions are neither easily implemented nor permanent for residential properties. Physical access restrictions will not be carried forward for consideration as part of an alternative to address the residential soil remediation for properties with existing homes.

Legal restrictions do have applicabilities for contaminated soil disposal sites and undeveloped residential properties, or properties where the current use may change from commercial/industrial to residential. Legal access restrictions will be carried forward for consideration in developing alternatives to address site risks for these types of properties.

4.6.2 Excavation and Disposal

Excavation and disposal of contaminated soil from residential yards is an accepted and highly utilized technology for addressing site risks. Excavation is easily implementable with readily available equipment. Several options have been identified for disposal of the excavated contaminated soil. This technology will be carried forward for consideration in developing remedial alternatives to address the site risks.

4.6.3 Capping Technologies

Capping of large residential yards with clean topsoil to reduce exposures to contamination is less costly than excavation and disposal and can be as protective in preventing exposure. Other types of capping, such as paving, are not practical for residential yard soil contamination. Capping with topsoil will be retained for consideration in developing remedial alternatives to address the site risks.

Geomembrane barriers and low permeable clay caps have applicability for cover material over the soil disposal pile to prevent surface water infiltration and controlling surface migration of contaminants. Geotextile fabrics can also be used as a physical barrier in residential yards to separate clean fill from contaminated soil at the bottom of excavations. These types of technologies will be retained for consideration during remedial alternative development, to address the soil disposal areas, and in some instances, in residential yards.

Vegetative covers are not considered protective when used alone in residential yards, and will not be retained for consideration in developing remedial alternatives for residential yards. Vegetative covers are applicable for use in capping excavated soil at disposal areas, and are retained for further consideration in those applications.

4.6.4 Stabilization

Pozzolonic stabilization is not an appropriate technology for residential soil in that it essentially turns the soil into a concrete mix. This technology will not be considered further. However, phosphate stabilization studies conducted by the EPA at other sites show promise for reducing the bioavailability of lead in soil such that levels of lead up to the effective treatment range can be treated and left in place as opposed to excavated and disposed or capped in place. A phosphate treatability study would be required at the site to assess the effectiveness of the stabilization of soils in Omaha. The treatability study would require formal peer review and public input prior to its implementation at the Omaha Lead Site. This technology will be retained for consideration in developing remedial alternatives to address site risks.

5.0 Development of Alternatives

This section documents the development of remedial alternatives for residential yard soils. Appropriate soil treatment and disposal technologies have been combined into four alternatives to address human exposure to residential soils at the Omaha Lead site. To avoid considering all possible combinations of technologies, criteria are applied to limit the number of alternatives to only the most effective and implementable. The criteria for combining technologies into alternatives are:

- Alternatives must address RAOs
- Alternatives must consist of unified groups of technologies
- Alternatives must represent the full range of possible remedies from No Action to Removal. Three removal alternatives, along with the No Action alternative are developed in this section to address residential yards.

As the alternatives have been developed they were screened, as appropriate, based on cost, implementability, and effectiveness in accordance with the NCP requirements.

The following general technologies identified in Section 3 have been retained for consideration in developing the remedial alternatives. Other technologies were eliminated as either not technically practical or cost effective for the Omaha site.

- Public Health Education
- Access Restrictions
- Excavation and Disposal
- Capping
- Phosphate Stabilization

5.1 Preliminary Remedial Alternatives

The following alternatives are based on the applicable technologies identified in Section 4 and were developed to most efficiently meet the RAOs and satisfy the ARARs. Also included for comparison is the No Action alternative. Additionally, the alternatives were developed to specifically address contamination resulting from industrial operations. Residential yards contaminated solely from other sources, such as lead-based paint, will not be addressed by these alternatives.

5.1.1 Alternative 1: No Action

The EPA is required by the NCP, 40 C.F.R. § 300.430(e)(6) to evaluate the no action alternative. The No Action Alternative may be appropriate at some sites where a removal action has already occurred that has reduced risks to human health and the environment. Although a time-critical removal action is occurring at the Site, residual risks to human health remain as documented in the HHRA. Under the No Action Alternative, the time-critical removals would cease. The concentrations of lead in residential yard soils remain at levels (i.e., lead concentrations greater than 400 ppm) that present a risk to human health, particularly for young children residing at the Site. The No Action Alternative is therefore not protective of human health and will not be considered further.

5.1.2 Alternative 2: Excavation with Health Education and Institutional Controls

Under this alternative, residential yard soils with at least one non-drip zone sample greater than 400 ppm lead will be excavated and disposed. Yards where only the drip zone soil exceeds 400 ppm lead would not be addressed under this action. A public health education program would be implemented to deal with the residual risk associated with soil contamination below 400 ppm and other non-soil sources of lead. An extensive sampling program would be required to identify residential yards that required excavation. The EPA estimates that approximately 16,000 residential yards contain soils that exceed 400 ppm lead. Excavated soil would be disposed either in an off-site constructed facility, used as beneficial fill in a commercial land use project, if appropriate, or transported to a sanitary landfill for disposal and used as daily cover. ICs would be developed for the soil disposal facility, and for non-residential lead-contaminated areas where land use changes to residential.

Excavation

This alternative involves the excavation and removal of soil, backfilling the excavation with clean soil, and restoring the grass lawn. Excavation of a yard would be triggered when the highest measured non-drip zone soil sample for the yard is greater than 400 ppm lead. Soil would be excavated using lightweight excavation equipment and hand tools in the portions of the yard where the surface soil exceeds 400 ppm lead. Excavation will continue until the lead concentration measured at the exposed surface of the excavation is less than 400 ppm in the initial foot or less than 1,200 ppm at depths greater than one foot. The ATSDR has provided the EPA with a health consultation (June 2, 2004), which states that soil-lead levels less than 1,200 ppm will not cause significant human health risk if covered with a minimum of 12 inches of clean soil. The excavation will cease at less than 12 inches if soil lead concentrations below 400 ppm are encountered within the initial foot of excavation. This FS assumes that approximately 16,000 homes have contamination over 400 ppm lead in soils and that each will require removal of approximately 60 cubic yards. A total of 960,000 cubic yards of soil would require excavation, replacement and disposal.

Clean fill and topsoil would be used to replace soil removed after excavation, returning the yard to its original elevation and grade. The EPA will avoid using soil from the Loess Hills as fill for the site. After the topsoil has been replaced, the yard would be hydro-seeded to restore the lawn. Hydro-seeding is preferred over sodding for its ease of initial maintenance and significant cost reduction over sodding. However, sod may be used in areas of yards with steep slopes that would be subject to erosion before the hydro-seed could become established.

Soil capping may be used as an acceptable alternative to, or in combination with, excavation to reduce cost in special cases such as large parks or schoolyards where placement of a cap would not create drainage problems. Capping in areas where surface soil-lead concentrations are greater than 400 ppm but less than 1,200 ppm would require a minimum of 12 inches of clean soil for the cap. Capping would not occur in areas where surface soils exceed 1,200 ppm lead.

Disposal

Three options are available to accommodate disposal of the excavated yard soils. The first option would be to simply haul the contaminated soil to an off-site sanitary landfill for use as daily cover and disposal. This option is currently being used for an on-going time-critical removal action at the site.

The second option would be to use the soil excavated from the residential yards as beneficial fill in the construction of a commercial or industrial facility. Lead-contaminated soils at the site are considered a risk to human health only in residential settings. Removed soils could be safely used in a commercial/industrial setting without creating a risk to human health. Constructed engineering features may also be necessary to protect human health and the environment. Long-term maintenance of any constructed engineering features would also be necessary. The EPA is currently discussing the use of excavated yard soil for beneficial fill with the city of Omaha Public Works Department for the construction of a new yard waste composting facility. The project could result in the use of up to 400,000 cubic yards of fill, and would be beneficial to the EPA, the state, and the city of Omaha.

Option three would consist of constructing an off-site repository on privately owned land. This alternative may be the most costly in that significant design and site preparation would be required for construction of the facility. This option would also be limited by the availability of land and willingness of landowners to maintain such a facility. A constructed off-site repository may be the preferred option should land belonging to a Responsible Party for the site be identified and the repository constructed and maintained by that Responsible Party.

Exterior Lead-Based Paint

In order to prevent the re-contamination of the clean soil placed in yards after excavation, flaking and deteriorating exterior lead based paint may be removed from homes prior to the soil excavation in the yards. Not all homes will require paint removal. Only those homes where lead-based paint is visibly flaking and deteriorating from 10 percent or more of the surface will be addressed. Paint would be removed primarily through power washing, although some minor scraping may occur in areas where damage from power washing would be expected. Paint removal activities will only occur at homes where soil cleanup actions are taken. Removal would follow the EPA and HUD guidelines and regulations.

The removal of exterior lead-based paint will be conducted on a voluntary basis. Homes where the EPA removes deteriorating lead-based paint will require repainting to avoid violation of city codes. The EPA will work with HUD, the city of Omaha, and other interested parties to develop a program to conduct the re-painting, or will otherwise arrange for the restoration repainting actions.

Interior Lead Dust

At homes where soil cleanup actions are conducted, interior dust will be sampled to assess indoor lead exposure. Homes that exceed the EPA and HUD standards will undergo a one-time cleaning. Interior cleaning would consist of extensive professional cleaning following the EPA and HUD guidelines. The interior cleaning will be conducted on a voluntary basis for willing homeowners, after the soil cleanup is completed in the yard.

Health Education

Due to the environmental problems of lead and other metals at the Omaha Lead Superfund Site, health education for the community and medical professionals in the area is needed to help reduce exposures that could potentially lead to adverse health effects. An active educational program would be conducted in cooperation with the EPA, the ATSDR, the NDEQ, and the Douglas County Health Department (DCHD) throughout the duration of the EPA remedial action. The following, although not an exhaustive list, indicate the types of education activities that may be conducted at the site. The education activities would be funded until the completion of the soil remediation activities.

- Physicians' education for diagnosis, treatment, and surveillance of lead exposure
- Prevention programs for Lamaze and pre-natal groups associated with local hospitals
- Extensive community-wide blood-lead monitoring
- In-home assessments for children identified with elevated blood-lead concentrations
- Distribution of prevention information and literature
- Development and implementation of prevention curriculum in schools
- Education of community groups such as Girl and Boy Scouts
- Provision of a High Efficiency Particulate Vacuum Cleaner (HEPAVAC) for interior cleaning
- Maintenance of a public database for homes where protective barriers are placed at depth as warning to underlying contamination

Equipment will be purchased for the enhancement of the environmental assessment capabilities and to assist in the removal of indoor contaminated dust. In order to perform adequate environmental assessments in the home, X-ray fluorescence (XRF) spectrophotometer equipment may be supplied if needed. Environmental specialists could use this equipment to identify possible sources of lead exposure in the home. Furthermore, HEPAVACs would be provided to allow properly-trained individuals to reduce the levels of lead dust in residences.

Institutional Controls

The EPA will work closely with the local governments to establish ICs to guide future development in lead-contaminated areas. This remedial alternative proposes to excavate soils with lead levels greater than 400 ppm only in existing residential yards. ICs are required, as part of this remedial alternative, to prevent future exposure of children to unacceptable levels of lead. New homes may be constructed in former non-residential areas where high lead levels in soil were not remediated and thus ICs are necessary. The ICs may include, depending on the authority of the city of Omaha and the desires of the community, such elements as zoning restrictions, long term zoning plans, special building codes and permits, health ordinances covering construction of residential homes, or deed notices. Additionally, the EPA will work with local governments to establish controls for the soil disposal areas, if necessary.

5.1.3 Alternative 3: Phosphate Stabilization and Excavation with Health Education and Institutional Controls

This alternative involves a combination of excavation and stabilization of residential yard soils and high child impact areas found to contain lead concentrations above 400 ppm. Phosphate stabilization would be conducted on soils with lead concentrations above 400 ppm but less than the level determined by treatability studies to be effectively stabilized. Residential yards above the affective stabilization level for lead would be excavated as described in Alternative 2. For alternative development and costing purposes in this FS, the upper bound that soil could be stabilized and left in place is assumed to be 800 ppm lead. The 800 ppm action is subject to change based on the final results of the ongoing phosphate treatability study. In addition, this alternative includes all other activities described in Alternative 2, including health education, ICs, exterior lead-based paint remediation, and interior cleaning. This alternative would require a phosphate stabilization treatability study to determine the treatment effectiveness and upper concentration levels before phosphate stabilization could be implemented. Additionally, extensive sampling to identify the residential properties exceeding action levels would be required. The EPA will seek peer review of the treatability study and the efficacy of using phosphate in Omaha and make the final treatability study report available for public review and comment. The final decision to proceed forward with phosphate stabilization of yards will be made by the EPA after assessing public comment on the study.

<u>Phosphate Stabilization</u>

Under this alternative, all residential yards and areas highly accessible to children (i.e., child care facilities, parks, and playgrounds) with lead concentrations exceeding 400 ppm, but less than 800 ppm (the assumed concentration for costing purposes only), would be treated with phosphate to reduce the bioavailability of metals in the soil, thereby controlling the health risk to children. This alternative would involve stabilizing metals in the soil by adding phosphate into the soil to a depth of 6 to 10 inches. It is anticipated that the phosphate, in the form of phosphoric acid, would be rototilled into the soil, and allowed to stabilize for a few days. Then lime would be added to the yard soil to raise the pH, and the lawn would be re-established. The stabilization action would be conducted on yards that exceed 400 ppm lead in the soils. Stabilization of a yard would be triggered when the highest recorded non-drip zone sample for the yard, is greater than 400 ppm lead, but less than the affective stabilization level (assumed to be 800 ppm for cost purposes.)

The EPA has not sampled or identified all residential yards that exceed 400 ppm lead. However, the EPA estimates that approximately 16,000 residential yards contain soils that exceed 400 ppm lead, but over 10,400 of these homes have concentrations less than 800 ppm. Additional sampling is required to define the extent of soil contamination exceeding 400 ppm

This alternative cannot be implemented until additional site-specific treatability tests are completed to assess the effectiveness of phosphate stabilization on reducing bioavailability. The treatability study would consist of an initial bench scale and bioavailability test to determine the effect that phosphate addition, under ideal laboratory conditions, has on soils at the site. The second part of the study, assuming initial findings are positive, would entail testing of field application methods and rates to lower the bioavailability of lead in the soil. Although site-specific treatability studies are necessary to determine the effect phosphate stabilization has on lowering the bioavailability of lead in on-site residential soils, studies conducted by the EPA at other residential lead sites indicate that phosphate stabilization is effective at lowering the toxicity of lead to young children. The final decision to proceed with phosphate stabilization of yards will be made by the EPA after peer review and assessment of the treatability study and public comments to the study. Additionally, the EPA, Region 7 will seek EPA Headquarters approval before implementing yard soil treatment.

A long-term monitoring program would be instituted to assess the effectiveness of phosphate stabilization. The program would include soil chemistry monitoring to assess the effects of natural weathering and the long-term stability of the lead-phosphate minerals formed during phosphate treatment. The 400-800 ppm range for phosphate treatment was chosen for cost estimating purposes only. The actual upper treatment limit will be determined during the treatability studies.

Excavation

As with Alternative 2, this alternative involves the excavation and removal of soil, backfilling the excavation with clean topsoil, and restoring the grass lawn. Excavation of a yard would be triggered when the highest measured non-drip zone soil sample for the yard is greater than 800 ppm lead. Soil would be excavated using lightweight excavation equipment and hand tools in the portions of the yard where the surface soil exceeds 400 ppm lead. For childcare facilities, residences that house children with elevated blood-lead levels, and high child impact areas, soil cleanup would be initiated if at least one non-drip zone sample exceeds 400 ppm lead. Excavation will continue until the lead concentration measured at the exposed surface of the excavation is less than 400 ppm in the initial foot, or less than 1,200 ppm at depths greater than one foot. The ATSDR has provided the EPA with a health consultation, which states that soil-lead levels less than 1,200 ppm will not cause significant human health risk if covered with a minimum of 12 inches of clean soil. The excavation will cease at less than 12 inches if soil lead concentrations below 400 ppm are encountered within the initial foot of excavation. The FS assumes that approximately 5,600 homes have contamination over 800 ppm lead in soils and that each will require removal of approximately 60 cubic yards. A total of 336,000 cubic yards of soil would require excavation, replacement, and disposal.

Clean fill and topsoil would be used to replace soil removed after excavation, returning the yard to its original elevation and grade. The EPA will avoid using soil from the loess hills as fill for the site. After the topsoil has been replaced, the yard would be hydro-seeded to restore the lawn. Hydro-seeding is preferred over sodding for its ease of initial maintenance and significant cost reduction over sodding. However, sod may be used in areas of yards with steep slopes that would be subject to erosion, before the hydro-seed could become established.

Soil capping may be used as an acceptable alternative to, or in combination with, excavation to reduce cost in special cases such as large parks or schoolyards where placement of a cap would not create drainage problems. Capping in areas where surface soil-lead concentrations are greater than 400 ppm but less than 1,200 ppm would require a minimum of 12 inches of clean soil for the cap. Capping would not occur in areas where surface soils exceed 1,200 ppm lead.

Disposal

Three options are available to accommodate disposal of the excavated yard soils. The first option would be to simply haul the contaminated soil to an off-site sanitary landfill for use as daily cover and disposal. This option is currently being used for an on-going time-critical removal action at the site.

The second option would be to use the soil excavated from the residential yards as beneficial fill in the construction of a commercial or industrial facility. Lead-contaminated soils at the site are considered a risk to human health only in residential settings. Removed soils could be safely used in a commercial/industrial setting without creating a risk to human health. Constructed engineering features may also be necessary to protect human health and the environment. Long-term maintenance of any constructed engineering features would also be necessary. The EPA is currently discussing the use of excavated yard soil for beneficial fill with the city of Omaha Public Works Department for the construction of a new yard waste composting facility. The project could result in the use of up to 400,000 cubic yards of fill, and would be beneficial to the EPA, the state, and the city of Omaha.

Option three would consist of constructing an off-site repository on privately owned land. This alternative may be the most costly in that significant design and site preparation would be required for construction of the facility. This option would also be limited by the availability of land and willingness of landowners to maintain such a facility. A constructed off-site repository may be the preferred option should land belonging to a Responsible Party for the site be identified and the repository constructed and maintained by that Responsible Party.

Exterior Lead-Based Paint

In order to prevent the re-contamination of the clean soil placed in yards after excavation, flaking and deteriorating exterior lead-based paint may be removed from homes prior to the soil excavation in the yards. Not all homes will require paint removal. Only those homes where lead-based paint is visibly flaking and deteriorating from 10 percent or more of the surface will be addressed. Paint would be removed primarily through power washing, although some minor scraping may occur in areas where damage from power washing would be expected. Paint removal activities will only occur at homes where soil cleanup actions are taken. Removal would follow the EPA and HUD guidelines and regulations.

The removal of exterior lead-based paint will be conducted on a voluntary basis. Homes where the EPA removes deteriorating lead-based paint will require repainting to avoid violation of city codes. The EPA will work with HUD, the city of Omaha, and other interested parties to try and develop a program to conduct the repainting or otherwise arrange for the restoration repainting actions.

Interior Lead Dust

At homes where soil cleanup actions are conducted, interior dust will be sampled to assess indoor lead exposure. Homes that exceed the EPA and HUD standards will undergo a one-time cleaning. Interior cleaning would consist of extensive professional cleaning following the EPA and HUD guidelines. The interior cleaning will be conducted on a voluntary basis for willing homeowners, after the soil cleanup is completed in the yard.

Health Education

Due to the environmental problems of lead and other metals at the Omaha Lead Superfund Site, health education for the community and medical professionals in the area is needed to help reduce exposures that could potentially lead to adverse health effects. An active educational program would be conducted in cooperation with the EPA, ATSDR, NDEQ and the DCHD throughout the duration of the EPA remedial action. The following, although not an exhaustive list, indicate the types of education activities that may be conducted at the site. The education activities will be funded until the completion of the soil remediation activities.

- Physicians' education for diagnosis, treatment, and surveillance of lead exposure
- Prevention programs for Lamaze and pre-natal groups associated with local hospitals
- Extensive community-wide blood-lead monitoring
- In-home assessments for children identified with elevated blood-lead concentrations
- Distribution of prevention information and literature
- Development and implementation of prevention curriculum in schools
- Education of community groups such as Girl and Boy Scouts
- Provision of a HEPAVAC for interior cleaning
- Maintenance of a public database for homes where protective barriers are placed at depth as warning to underlying contamination

Equipment will be purchased for the enhancement of the environmental assessment capabilities and to assist in the removal of indoor contaminated dust. In order to perform adequate environmental assessments in the home, XRF equipment may be supplied if needed. Environmental specialists could use this equipment to identify possible sources of lead exposure in the home. Furthermore, HEPAVACs would be provided to allow properly-trained individuals to reduce the levels of lead dust in residences.

Institutional Controls

The EPA will work closely with the local governments to establish ICs to guide future development in lead-contaminated areas. This remedial alternative proposes to excavate soils with lead levels greater than 800 ppm only in existing residential yards. ICs are required, as part of this remedial alternative, to prevent future exposure of children to unacceptable levels of lead. New homes may be constructed in former non-residential areas where high lead levels in soil were not remediated and thus ICs are necessary. The ICs may include, depending on the authority of the city of Omaha and the desires of the community, such elements as zoning restrictions, long term zoning plans, special building codes and permits, health ordinances covering construction of residential homes, or deed notices. Additionally, the EPA will work with local governments to establish controls for the soil disposal areas, if necessary.

5.1.4 Alternative 4: Interim Excavation with Treatability Study, Health Education, and Institutional Controls

Since Alternative 3, Phosphate Treatment with Excavation, is reliant on the outcome of a treatability study to determine the effectiveness of the phosphate treatment, this alternative was developed as an interim action to begin addressing the site risks while the studies are conducted. The EPA projects that the treatability study may take as long as three years or more to fully assess the effectiveness of treatment. This alternative is essentially the same as Alternative 3, but establishes 800 ppm lead in soil as an interim action level for excavation until the effectiveness of phosphate treatment of soils to protect human health can be established. As in Alternative 3, the 800 ppm action level was established since it is believed to be the upper bound that soil could be stabilized using phosphate treatment and left in place. The 800 ppm interim action level is subject to change based on the final results of the ongoing phosphate treatability study and a final action level will be selected in a future ROD. As part of this interim action, the EPA will continue to excavate soils exceeding 400 ppm lead at high child impact areas and homes where a child resides with an elevated blood-lead concentration.

Since human health risks are associated with soil-lead concentrations below 800 ppm, this alternative cannot be selected as the final action for the site, yet serves to initiate risk reduction actions at the higher contaminated properties until the phosphate treatability study can be completed to assess the effectiveness of that technology. This interim alternative would allow time to establish programs and partnerships with other agencies and organizations to assist in addressing the site risk from lead that EPA has limited or no authority to remediate. Under this interim alternative, the IC program described under Alternatives 2 and 3 may be initiated, but not required since a final alternative including the appropriate controls would be selected at a later date in a final ROD after reviewing public comment on a Proposed Plan describing this process. Additionally the EPA will use the environmental and health data collected during the interim remedial action to further refine the HHRA. The EPA will also address uncertainties noted in the document and reassess the initial risk management decision to use a cleanup level of 400 ppm lead in residential soil.

Excavation

Alternative 4 involves the excavation and removal of soil, backfilling the excavation with clean topsoil, and restoring the grass lawn. Excavation of a yard would be triggered when the highest measured non-drip zone soil sample for the yard is greater than 800 ppm lead. Soil would be excavated using lightweight excavation equipment and hand tools in the portions of the yard where the surface soil exceeds 400 ppm lead. For childcare facilities, residences that house children with EBLs, and high child impact areas, soil cleanup will be initiated if at least one non-drip zone sample exceeds 400 ppm lead. Excavation will continue until the lead concentration measured at the exposed surface of the excavation is less than 400 ppm in the initial foot, or less than 1,200 ppm at depths greater than one foot. The ATSDR has provided the EPA with a health consultation, which states that soil-lead levels less than 1,200 ppm will not cause significant human health risk if covered with a minimum of 12 inches of clean soil. The excavation will cease at less than 12 inches if soil lead concentrations below 400 ppm are encountered within the initial foot of excavation. The FS assumes that approximately 5,600 homes have contamination over 800 ppm lead in soils and that each will require removal of approximately 60 cubic yards. A total of 336,000 cubic yards of soil would require excavation, replacement, and disposal.

Clean fill and topsoil would be used to replace soil removed after excavation, returning the yard to its original elevation and grade. The EPA will avoid using soil from the loess hills as fill for the site. After the topsoil has been replaced, the yard would be hydro-seeded to restore the lawn. Hydro-seeding is preferred over sodding for its ease of initial maintenance and significant cost reduction over sodding. However, sod may be used in areas of yards with steep slopes that would be subject to erosion before the hydro-seed could become established.

Soil capping may be used as an acceptable alternative to, or in combination with, excavation to reduce cost in special cases such as large parks or schoolyards where placement of a cap would not create drainage problems. Capping in areas where surface soil-lead concentrations are greater than 400 ppm, but less than 1,200 ppm, would require a minimum of 12 inches of clean soil for the cap. Capping would not occur in areas where surface soils exceed 1,200 ppm lead.

Disposal

Three options are available to accommodate disposal of the excavated yard soils. The first option would be to simply haul the contaminated soil to an off-site sanitary landfill for use as daily cover and disposal. This option is currently being used for an on-going time-critical removal action at the site.

The second option would be to use the soil excavated from the residential yards as beneficial fill in the construction of a commercial or industrial facility. Lead-contaminated soils at the site are considered a risk to human health only in residential settings. Removed soils could be safely used in a commercial/industrial setting without creating a risk to human health. Constructed engineering features may also be necessary to protect human health and the environment. Long-term maintenance of any constructed engineering features would also be necessary. The EPA is currently discussing the use of excavated yard soil for beneficial fill with the city of Omaha Public Works Department for the construction of a new yard waste composting facility. The project could result in the use of up to 400,000 cubic yards of fill, and would be beneficial to the EPA, the state, and the city of Omaha.

Option three would consist of constructing an off-site repository on privately owned land. This alternative may be the most costly in that significant design and site preparation would be required for construction of the facility. This option would also be limited by the availability of land and willingness of landowners to maintain such a facility. A constructed off-site repository may be the preferred option should land belonging to a Responsible Party for the site be identified and the repository constructed and maintained by that Responsible Party.

Exterior Lead-Based Paint

In order to prevent the re-contamination of the clean soil placed in yards after excavation, flaking and deteriorating exterior lead based paint may be removed from homes prior to the soil excavation in the yards. Not all homes will require paint removal. Only those homes where lead-based paint is visibly flaking and deteriorating from 10 percent or more of the surface will be addressed. Paint would be removed primarily through power washing, although some minor scraping may occur in areas where damage from power washing would be expected. Paint removal activities will only occur at homes where soil cleanup actions are taken. Removal would follow the EPA and HUD guidelines and regulation.

The removal of exterior lead-based paint will be conducted on a voluntary basis. Homes where the EPA removes deteriorating lead-based paint will require repainting to avoid violation of city codes. The EPA will work with HUD, the city of Omaha, and other interested parties to try and develop a program to conduct the repainting or otherwise arrange for the restoration repainting actions.

Interior Lead Dust

At homes where soil cleanup actions are conducted, interior dust will be sampled to assess indoor lead exposure. Homes that exceed the EPA and HUD standards will undergo a one-time cleaning. Interior cleaning would consist of extensive professional cleaning following the EPA and HUD guidelines. The interior cleaning will be conducted on a voluntary basis for willing homeowners, after the soil cleanup is completed in the yard.

Phosphate Stabilization Treatability Study

The EPA is currently working to identify property meeting the required criteria for conducting a phosphate stabilization treatability study. Once suitable property has been identified, and access agreement issues are resolved, the study will be initiated. The EPA's experience with phosphate treatment studies at other sites indicates that the effect of phosphate addition to soil should be assessed for up to three years or more. Specific testing procedures and work plans to conduct the study are currently being developed by the EPA.

Health Education

Due to the environmental problems of lead and other metals at the Omaha Lead Superfund Site, health education for the community and medical professionals in the area is needed to help reduce exposures that could potentially lead to adverse health effects. An active educational program would be conducted in cooperation with the EPA, ATSDR, NDEQ and the DCHD throughout the duration of the EPA remedial action. The following, although not an exhaustive list, indicate the types of education activities that may be conducted at the site. The education activities will be funded until the completion of the soil remediation activities.

- Physicians' education for diagnosis, treatment, and surveillance of lead exposure
- Prevention programs for Lamaze and pre-natal groups associated with local hospitals
- Extensive community-wide blood-lead monitoring
- In-home assessments for children identified with elevated blood-lead concentrations
- Distribution of prevention information and literature
- Development and implementation of prevention curriculum in schools
- Education of community groups such as Girl and Boy Scouts
- Provision of a HEPAVAC for interior cleaning
- Maintenance of a public database for homes where protective barriers are placed at depth as warning to underlying contamination

Equipment will be purchased for the enhancement of the environmental assessment capabilities and to assist in the removal of indoor contaminated dust. In order to perform adequate environmental assessments in the home, XRF equipment may be supplied if needed. Environmental specialists could use this equipment to identify possible sources of lead exposure in the home. Furthermore, a HEPAVAC would be provided to allow properly-trained individuals to reduce the levels of lead dust in residences.

6.0 Detailed Evaluation of Remedial Alternatives

The NCP, 40 C.F.R. Section 300 et. seq., requires the EPA to evaluate selected remedial alternatives against nine criteria. A selected or preferred alternative should best satisfy all nine criteria before it can be implemented. The first step is to ensure that the selected remedy satisfies the threshold criteria. The two threshold criteria are overall protection of public health and the environment and compliance with the ARARs. In general, alternatives that do not satisfy these two criteria are rejected and not evaluated further. However, compliance with ARARs may be "waived" if site-specific circumstances warrant such a "waiver" as described in Section 300.430(f)(1)(ii)(C) of the NCP, 40 C.F.R. § 300.430(f)(1)(ii)(C). No ARAR waivers are contemplated for any of the alternatives evaluated in this FS.

The second step is to compare the selected remedy against a set of balancing criteria. The NCP establishes five balancing criteria, which include long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; implementability; short-term effectiveness; and cost. The third and final step is to evaluate the selected remedy on the basis of modifying criteria. The two modifying criteria are state and community acceptance. These final two criteria cannot be evaluated fully until the state and public have commented on the alternative and their comments have been analyzed.

6.1 Alternative Analysis Criteria

Each of the alternatives is subjected to nine evaluation criteria described in the NCP. The factors considered for each evaluation criterion and a brief description of each criterion follows:

6.1.1 Threshold Criteria

Overall Protection of Human Health and the Environment

This criterion provides a final check to assess whether each alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under the evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance With ARARs

This criterion is used to decide how each alternative meets applicable or relevant and appropriate federal and state requirements, as defined in CERCLA Section 121. Compliance is judged with respect to:

- chemical-specific ARARs
- action-specific ARARs
- location-specific ARARs
- appropriate criteria, advisories and guidance

Potential chemical- and location-specific ARARs are identified in Tables 2-1 through 2-4. Potential federal and state action-specific ARARs relating to the remedial alternatives are identified in Tables 6-1 and 6-2.

6.1.2 Balancing Criteria

Long-Term Effectiveness

This criterion addresses the results of a remedial action in terms of the risk remaining at the site after the response objectives have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The factors to be evaluated include:

- magnitude of risk remaining at the site after the remedial objectives are met,
- adequacy of controls, and
- reliability of controls (i.e., assessment of potential failure of the technical components.)

Short-Term Effectiveness

This criterion addresses the effects of the alternative during the construction and operation phase until the remedial actions have been completed and the selected level of protection has been achieved. Each alternative is evaluated with respect to:

- protection of community during remedial actions,
- protection of workers during remedial actions,
- time until remedial response objectives are achieved, and
- environmental impacts.

Table 6-1
Potential Federal Action-Specific ARARs

	Citation	Prerequisite	Requirement
A. Applicable Requirements			
1. Disposal of Solid Waste in a Permanent Repository and closure of the Repository.	Subtitle D of RCRA, Section 1008, Section 4001, et seq., 42 U.S.C. '6941, et seq.	State or Regional Solid Waste Plans and implementing federal and state regulations to control disposal of solid waste. The yard soils disposed in the repository may not exhibit the toxicity characteristic and therefore, are not hazardous waste. However, these soils may be solid waste.	Contaminated residential soils will be consolidated from yards throughout the site into a single location. The disposal of this waste material should be in accordance with regulated solid waste management practices.
2. Disposal of Hazardous Waste in the Permanent Repository and Designation as a Corrective Action Management Unit (CAMU).	Subtitle C of RCRA, Section 3001 et seq., 42 U.S.C. '6921, et seq. and implementing regulations at 40 C.F.R. Subpart S, Corrective action for solid waste management units and temporary units, 40 C.F.R. '264.522	RCRA defines CAMUs to be used in connection with implementing remedial measures for corrective action under RCRA or at Superfund sites. Generally, a CAMU is used for consolidation or placement of remediation wastes within the contaminated areas at the facility. Placement of wastes in a CAMU does not constitute land disposal of hazardous waste and does not constitute creation of a unit subject to minimum technology requirements.	The RCRA requirements of Subtitle C are not applicable to the disposal of residential yard soils in the repository. Residential yard soils contaminated from smelter fall out are not excluded from regulation under the RCRA exclusion for extraction, beneficiation and mineral processing. Therefore, yard soils exhibiting a RCRA toxicity characteristic would be regulated under Subtitle C of RCRA. However, because of the CAMU regulation, these residential soils are remediation wastes and may be disposed without triggering RCRA disposal requirements. The remedial action will comply with the requirements of the CAMU rule.
B. Relevant and Appropriate Requirements			
1. NPDES Storm Water Discharge for Permanent Repository.	40 C.F.R. Part 122, ' 122.26	Establishes permitting process and discharge regulations for storm water	Required management of repository where waste materials come into contact with storm water. Also required during construction of the repository.
2. Transportation of excavated soils.	DOT Hazardous Material Transportation Regulations, 49 C.F.R. Parts 107, 171-177	Regulates transportation of hazardous wastes.	Relevant and appropriate for the excavation alternative which would transport wastes on-site.
C. To Be Considered	None		

Table 6-2
Potential State Action-Specific ARARs

	Citation	Prerequisite	Requirement
A. Applicable Requirements			
1. Fugitive dust control measures to be utilized during excavation activities	Nebraska Department of Environmental Quality – TITLE 129 Air Quality Regulations, Chapter 32	Requires operating and construction permits to provide that reasonable measures be used to prevent particulate emissions from leaving the premises. Also, sets ambient air quality standards for a number of air constituents.	Recommend that excavation of yard soils or tilling of yards in treatment alternative be handled in such a manner as to control fugitive emissions, such as use of a water spray during excavation, tilling or transportation. May be used in monitoring ambient air quality during implementation for lead and other particulates.
2. Solid waste management regulations	Nebraska Department of Environmental Quality – TITLE 132 – Integrated Solid Waste Management Regulations	Requires permits for proper identifications and disposal of solid waste in municipal solid waste disposal areas.	Requires specified procedures for the location, design, operation, and ground water monitoring, closure, post closure, and financial assurance for solid waste disposal facilities. Requires specific procedures for special waste management.
3. Siting Procedures and Policies	Nebraska State Statutes 13-1701 to 13-1714	Policies and procedures are required in order to get approval for a solid waste disposal area.	Requires approvals by local jurisdictions prior to the development of a site as a solid waste disposal area.
B. Relevant and Appropriate Requirements			
1. Nebraska Surface Water Quality Standards	Nebraska Department of Environmental Quality - TITLE 117	Regulates the discharge of constituents from any point source, including stormwater, to surface waters of the state. Provides for maintenance and protection of public health and aquatic life uses of surface water and groundwater.	Required for protection of wetlands, streams, lakes, and impounded waters from the runoff from toxic discharges.
2. Rules and Regulations pertaining to the issuance of permits under the National Pollutant Discharge Elimination System	Nebraska Department of Environmental Quality - TITLE 119	Defines and issues permits for the discharge of constituents from any point source, including storm water, to surface waters of the state. Establishes development of an approved action plan and discharge regulations for storm water	Required for protection of wetlands, streams, lakes, and impounded waters from the runoff from toxic discharges. Required of management of repository where waste materials come into contact with storm water. Also required during construction of the repository. Monitoring program shall be implemented to ensure compliance with discharge regulations.
C. To Be Considered			
1. Hazardous waste handling, transport and disposal regulations	Nebraska Department of Environmental Quality – TITLE 128 Nebraska Hazardous Waste Regulations	Requires operating permits for proper identifications, handling, transport, and disposal of hazardous materials.	Supplement the federal RCRA regulations and define state permitting requirements.
2. Siting Procedures and Policies	Nebraska State Statutes 81-1521.08 to 81-1521.23	Policies and procedures are required in order to get approval for a hazardous waste management facility.	Requires approval by local jurisdictions prior to the development of a site as a hazardous waste management facility.

Reduction of Toxicity, Mobility, or Volume

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the contaminants. The factors to be evaluated include:

- treatment process and remedy,
- amount of hazardous material destroyed or treated,
- reduction in toxicity, mobility or volume of the contaminants,
- irreversibility of the treatment, and
- type and quantity of treatment residuals.

Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. Technical feasibility considers:

- the ability to construct technology,
- reliability of technology,
- ease of undertaking additional remedial actions if necessary,
- monitoring considerations,
- coordination with other agencies (e.g., state and local) to obtain permits or approvals for implementing remedial actions,
- availability of treatment, storage capacity, and disposal services,
- availability of necessary equipment and specialists, and
- availability of prospective technologies.

Cost

This criterion addresees the capital costs, annual operation and maintenance costs, and present worth analysis. Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs. Direct costs include expenditures for the equipment, labor and material necessary to perform remedial actions. Indirect costs include expenditures for engineering, financial and other services that are not part of actual installation activities but are required to complete the installation of remedial alternatives. Annual operation and maintenance costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action. A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the current year. This allows the cost of remedial action alternatives to be compared based on a single figure representing the amount of money that would be sufficient to cover all costs associated with the remedial action over its planned life. As suggested in the EPA's guidance, a discount rate of 5 percent will be applied.

6.1.3 Modifying Criteria

State Acceptance

This criterion evaluates the technical and administrative issues and concerns the state may have regarding each of the alternatives. The factors to be evaluated include those features of alternatives that the state supports, reservations of the state, and opposition of the state.

Community Acceptance

This criterion incorporates public concerns into the evaluation of the remedial alternatives. Typically, community acceptance cannot be determined during development of the FS. Evaluation of this criterion will be postponed until the FS and Proposed Plan have been released for review by the public. This criterion will then be addressed in the ROD and the responsiveness summary.

6.2 Alternative Analysis

The following sub-sections present the individual analyses of the alternatives against the nine criteria.

6.2.1 Alternative 1: No Action

Overall Protection of Human Health and the Environment

This alternative does not provide protection for the environment or residents in Omaha because no actions are taken to mitigate the exposure to lead-contaminated soil.

Compliance With ARARs

This alternative does not meet the preliminary cleanup criteria of the federal chemical-specific ARARs. The location-specific and action-specific ARARs are not applicable to this alternative.

Long-Term Effectiveness

This alternative provides no effectiveness for the protection of health and environment over the long term. The public is still exposed to elevated levels of lead.

Short-Term Effectiveness

No risk is imposed on the remedial action workers during the short term. The public and environment are still exposed to the same levels of lead.

Reduction of Toxicity, Mobility, or Volume

There is no reduction in the toxicity, mobility, or volume of contamination under the No Action alternative.

Implementability

This alternative does not require implementation.

Cost

There would be no costs associated with the No Action alternative.

State Acceptance

It is assumed that this alternative is not acceptable to the state.

Community Acceptance

The level of public awareness and involvement at the site indicates that this alternative is not acceptable to the community.

6.2.2 *Alternative 2: Excavation with Health Education and Institutional Controls*

Overall Protection of Human Health and the Environment

Exposure to lead-contaminated soil is a significant health risk posed by the site. Residential soils have been previously identified to be one of the primary contributors to risk associated with lead exposures. In order to reduce exposure to lead and the associated risks, the excavation alternative replaces lead-contaminated residential soils with clean soils, thereby breaking the exposure pathway between lead-contaminated soils and children.

Household dust has also been identified as a significant lead exposure pathway. Residential soils are a contaminant source to house dust. Thus, remediating residential soils would reduce a contamination pathway to home interiors. Interior dust above the action level will be cleaned in homes where soil is remediated. Additionally, the health education program includes the availability of a HEPAVAC and properly-trained individuals to operate the machine to reduce the levels of lead dust in homes upon request of residents in the affected areas.

Fugitive dust would need to be controlled and monitored concurrent with residential soils excavation and remediation to minimize soil recontamination. Control of fugitive dust during excavation would eliminate direct exposure to highly concentrated dusts and reduce accumulation of metals in homes.

The soil disposal area would be designed and engineered to protect human health and the environment, including ground water and surface water. With appropriate precautions taken during remedial design, there will be no unacceptable impact associated with implementation of this alternative.

The ICs program would ensure the maintenance of physical and institutional barriers that protect against exposure to contaminated soils. The long-term success of this alternative would be measured by the success of the ICs including the health education program, a program to control the future residential development of current non-residential property located in the fallout area of the former lead industries, and continued blood-lead monitoring.

This alternative would break the significant exposure pathways associated with contaminated residential soils. Once residential soils excavation, soil replacement, and revegetation is complete, the soils are properly disposed, and an effective IC program is implemented, risks associated with lead-contaminated residential soils will be controlled. Therefore, the excavation and replacement of contaminated soils is protective of human health and the environment.

Compliance With ARARs & Potential Action-Specific ARARs

The excavation alternative would comply with the chemical- and location-specific ARARs identified in Section 2 and detailed in Tables 2-1 through 2-4. As discussed previously, there are no promulgated laws or standards for lead-contaminated soil. However, a preliminary site-specific action level of 400 ppm for lead in soils has been proposed for the protection of human health at this site. This level was based on the guidance, criteria and advisories identified as potential chemical-specific ARARs, that are to be considered when evaluating remedial alternatives, and the nine NCP evaluation criteria.

The potential federal and state action-specific ARARs for the excavation alternative are identified in Tables 6-1 and 6-2. The excavation alternative would comply with action-specific ARARs. The principal action-specific ARARs for this alternative are the requirements for proper disposal of the excavated soils.

Long-Term Effectiveness

The residual risks (the risk remaining after implementation) would be significantly reduced under this alternative. Homes within the site with soil concentrations at or above 400 ppm lead in a non-foundation sample would have the contaminated soil removed and replaced with clean material. The removal of contaminated soil, replacement with clean backfill and revegetation, ensures that future potential for exposure will be significantly reduced.

The residual risks would be reduced for homes within the site with soil concentrations below 400 ppm lead through the implementation of health education programs, and ICs. Health education programs would be implemented by the local government, schools and health departments to educate residents about home gardening, interior house dust, proper hygiene and other health concerns for young children residing within the site.

The reliability of ICs is limited by the authority of the governing body that is responsible for enforcement of the control. The excavation alternative includes ICs for the development of non-remediated property located within the site. This program would be implemented to protect future residents from developing contaminated property by requiring remediation, as necessary, prior to development. It may require city or county zoning restrictions, long term zoning plans, special building codes or permits, or health ordinances covering construction of residential homes to be implemented. Therefore, the program effectiveness is limited by the adequacy and reliability of controls. The city of Omaha has authorities to enact and maintain the necessary controls.

Short-Term Effectiveness

This alternative is protective in the short term. Although lead-laden dust would be generated during excavation, dust suppression would be implemented for the protection of community and workers during the remedial action. The alternative would be lengthy to implement for all affected residences, requiring years to complete. However, the average length of time for excavation and backfilling at any one residence is about two days; therefore, the residential exposure to dust would be minimal.

A significant environmental aspect of this alternative could be the placement of the contaminated soils in a permanent repository. The repository would have no negative environmental impacts provided storm water controls and other design and engineering controls for a stable repository are achieved and maintained.

Reduction of Toxicity, Mobility, or Volume

This alternative would significantly reduce the mobility of the contaminants of concern by consolidation of the contaminated soils in a landfill or other disposal area. Although the exposure pathway would be eliminated or minimized, the toxicity and volume of the material would not be reduced. Proper construction of a soil repository and long-term maintenance are important components of this alternative that ensure a significant reduction of mobility.

Implementability

This alternative is readily implementable. Excavation methods, backfilling, and revegetation are typical engineering activities. Experience gained during previous EPA response actions has shown that this action is readily implementable. The IC component of this alternative for health education and the future residential construction controls program are implementable, but require cooperation and action by the local government entities.

Cost

This alternative is expected to have capital costs of $214.7 million, as shown on Table 6-3, based on the estimate of $11,000 per home for excavation, backfilling and lawn restoration. The overall cost includes $19.5 million for disposal of excavated soil in a constructed off-site repository, which is considered the most expensive option, although other less expensive options may be implemented.

Annual O&M costs for the soil disposal area are shown in Table 6-3. Health education costs were developed in Table 6-4 and appear as a line item in Table 6-3. The annual cost for providing the O&M program after year one is estimated to be approximately $25,000 with a present worth value of providing the service for the next 30 years at $384,375.

State Acceptance

State acceptance of the proposed alternative will be evaluated during the public comment period.

Community Acceptance

Community acceptance will be evaluated after the public comment period closes for the Proposed Plan and this FS.

6.2.3 Alternative 3: Phosphate Stabilization and Excavation with Health Education and Institutional Controls

Overall Protection of Human Health and the Environment

Excavation of soils with lead concentrations greater than 800 ppm (assumed for costing purposes) and treatment of soils with lead concentrations between 400 ppm and 800 ppm, would remove the primary threat to human health and the environment. The excavation will remove the potential for exposure to the most highly contaminated soils, and the phosphate treatment of moderately contaminated soils will convert the lead into a form that would be less bioavailable to humans. Phosphate stabilization has not been used on a full-scale basis to remediate lead-contaminated soils in place. The EPA has evidence from pilot studies on other sites indicating the addition of phosphate to soil is effective in reducing the bioavailability of the lead. A treatability study, using site soil, would be required to show that phosphate treatment would reduce the bioavailability of lead at the Omaha site to levels that are protective of human health and the environment before this alternative could be selected as the remedial action. The final

Table 6-3
Alternative 2 – Cost Analysis for Excavation with Health Education and Institutional Controls

WORK ITEM	QUANTITY	UNIT PRICE	TOTALCOST
RESIDENTIAL YARD EXCAVATION			
1. Mobilization		$50,000	$50,000
2. Property Access, Contaminant Assessment	16,000	$400	$6,400,000
3. Material Movement (excavation, transport, backfill)	16,000	$11,000	$176,000,000
4. Post Cleanup Reports	16,000	$100	$1,600,000
5. Exterior Lead-based Paint Removal	8,000	$500	$4,000,000
6. Interior Dust Cleaning	8,000	$500	$4,000,000
7. Health Education for duration of Remedial Action	1	$1,126,000	$1,126,000
8. Post Cleanup Exposure Study	1	$400,000	$400,000
Subtotal			$193,576,000
REPOSITORY *			
1. Design		$90,000	$90,000
2. Site preparation	60 acres	$4000/acre	$240,000
3. Material Placement	960,000 cy	$1.20	$1,152,000
4. Vegetative Cover	60 acres	$2000/acre	$120,000
Subtotal			$1,602,000
Contingencies (10% of subtotal)			$19,517,800
TOTAL CONSTRUCTION COSTS			$214,695,800
OPERATION AND MAINTENANCE			
1. O&M of Soil Repository			$5,000
2. Monitoring of Institutional Controls			$20,000
TOTAL ANNUAL O&M			$25,000
PRESENT WORTH VALUE TO PROVIDE O&M FOR YEARS 2 TO 30			$384,375

*Costs associated with the repository were assumed based on construction of a new off-site soil disposal area covering 60 acres and the disposal of 960,000 cubic yards of soil. Once placement of the soil is complete, the site would be graded to promote runoff, and then vegetated.

Table 6-4
Health Education

WORK ITEM	ESTIMATED COST
Initial Purchase of Equipment (XRF, HEPAVAC)	$50,000
ANNUAL HEALTH EDUCATION	
Annual maintenance of equipment	$2,200
Educational material	$16,000
Personnel and facility for blood-lead screening	$90,000
Professional education	$4,400
ANNUAL HEALTH EDUCATION COST	$112,600
TOTAL FOR FIRST YEAR	$162,600
TOTAL HE FOR 10 YEARS DURING REMEDIAL ACTIONS	$1,126,000

decision to proceed forward with phosphate stabilization of yards will be made by the EPA after assessing public comment on the study.

In order to reduce exposure to lead and the associated risks, the excavation portion of this alternative replaces lead-contaminated residential soils with clean soils, thereby breaking the exposure pathway between lead-contaminated soils and children.

Household dust has also been identified as a significant lead exposure pathway. Residential soils are a contaminant source for house dust. Thus, remediating residential soils would reduce a contamination pathway to home interiors. Interior dust above action levels will be cleaned in homes where soil is remediated. Additionally, the health education program includes the availability of a HEPAVAC and properly-trained individuals to operate the machine to reduce the levels of lead dust in homes upon request of residents in the effected areas.

Fugitive dust would need to be controlled and monitored concurrent with residential soils excavation and remediation to minimize soil recontamination. Control of fugitive dust during excavation would eliminate direct exposure to highly concentrated dusts and reduce accumulation of lead in homes.

The soil disposal area would be engineered and designed to protect human health and the environment, including groundwater and surface water. With appropriate precautions taken during remedial design, there will be no unacceptable impact associated with implementation of this alternative.

The IC program would ensure the maintenance of physical and institutional barriers that protect against exposure to contaminated soils. The long-term success of this alternative would be measured by the success of the ICs including the health education program, a program to control the future residential development of current non-residential property located in the fallout area of the former lead industries, and continued blood-lead monitoring.

This alternative would break the significant exposure pathways associated with contaminated residential soils. Once soil excavation, soil replacement, and revegetation is complete, the soils are properly disposed, and an effective IC program is implemented, risks associated with lead-contaminated residential soils will be controlled. Therefore, excavation and replacement of contaminated soils in conjunction with treatment is protective of human health and the environment.

Compliance With ARARs

Assuming the treatability study proves phosphate stabilization is effective, this alternative would comply with potential ARARs. This alternative would comply with the chemical and location-specific ARARs identified in Section 2 and detailed in Tables 2-1 through 2-4. As discussed previously, there are no promulgated laws or standards for lead-contaminated soil. However, a preliminary site-specific action level of 400 ppm for lead-contaminated soil has been proposed for the protection of human health at this site. This level was based on the guidance, criteria, and advisories identified as potential chemical-specific ARARs that are to be considered when evaluating remedial alternatives, and the nine NCP evaluation criteria.

The potential federal and state action-specific ARARs for this alternative are identified in Tables 6-1 and 6-2. The excavation portion of the alternative would comply with action-specific ARARs. The principal action-specific ARARs for this alternative are the requirements for the proper disposal of excavated soils.

Long-Term Effectiveness

The residual risks (the risk remaining after implementation) would be significantly reduced under the excavation portion of this alternative. Homes within the site with soil concentrations at or above 800 ppm lead in a non-foundation sample would have the contaminated soils exceeding 400 ppm removed and replaced with clean material (1,200 ppm at a depth of one foot or greater). The removal of contaminated soil, replacement with clean backfill and revegetation, ensures that potential for future exposure will be significantly reduced.

The EPA has data generated for other Superfund sites that indicate phosphate-treated soils remain stable. However, a treatability study and long-term monitoring would be required to demonstrate the long-term effectiveness of this alternative. This treatment method reduces the residual risks but still requires the implementation of ICs.

The residual risks would be reduced for homes within the site with soil concentrations below 400 ppm lead through the implementation of health education programs, and ICs. Health education programs would be implemented by the local government, schools and health departments to educate residents about home gardening, interior house dust, proper hygiene and other health concerns for young children residing within the site.

The reliability of ICs is limited by the authority of the governing body that is responsible for enforcement of the control. The excavation treatment alternative includes ICs for the development of non-remediated property located within the site. This program would be implemented to protect future residents from developing contaminated property by requiring remediation, as necessary, prior to development. It may require implementation of city or county zoning restrictions, long term zoning plans, special building codes or permits, or health ordinances covering construction of residential homes. Therefore, the program effectiveness is limited by the adequacy and reliability of controls. The city of Omaha has various authorities to enact and maintain the necessary controls.

Short-Term Effectiveness

This alternative is protective in the short term. Treatment methods (application technologies) are minimally invasive. Therefore, exposure to the residents, public, and remedial action workers to the lead contamination would be minimal. Fugitive dust control measures would be implemented during excavation or at other times the soil is disturbed. The residents' access to their yard would be restricted during phosphate application through fencing until the pH has been adjusted to safe levels.

The excavation portion of this alternative is protective in the short term. Although lead-laden dust would be generated during the excavation, dust suppression would be implemented for protection of community and workers during remedial action. The alternative would be lengthy to implement for all affected residences, requiring years to complete. However, the average length of time for excavation and backfilling at any one residence is about two days, while phosphate treatment may take a week; therefore, the residential exposure to dust for would be minimal.

A significant environmental aspect of this alternative could be the placement of the contaminated soils in a permanent repository. Provided storm water controls and other design and engineering controls for a stable repository are achieved and maintained. The repository would have no negative environmental impact.

Reduction of Toxicity, Mobility, or Volume

The treatment portion of this alternative, assuming treatability studies show phosphate stabilization would reduce the bioavailability of lead to acceptable health based levels, would reduce the toxicity and mobility of the contamination. The volume of the contamination would not be reduced. However, the amount of soil requiring excavation and disposal would be significantly reduced over Alternative 2.

The excavation portion of this alternative would significantly reduce the mobility of the contaminants of concern by consolidation of the contaminated soils in the landfill or other disposal area. Although the exposure pathway would be eliminated or minimized, the toxicity and volume of the material would not be reduced. Proper construction of a soil repository and long-term maintenance are important components of this alternative that ensure a significant reduction of mobility.

Implementability

This alternative is readily implementable. Phosphate application methods are relatively simple procedures using typical lawn or garden maintenance equipment. Excavation methods, backfilling, and revegetation are typical engineering activities. Experience gained during previous EPA response actions has shown that phosphate treatment is readily implementable. The IC component of this alternative for health education and the future residential contruction controls program are implementable, but require cooperation and action by the local government entities.

Cost

A treatability study would be required to assess phosphate application methods that effectively reduce the bioavailability of lead to acceptable health-based levels. The methods under consideration range from simply spreading phosphate fertilizer on the lawn by hand to rototilling the phosphate fertilizer into the top six to ten inches of the soil. Table 6-5 shows the costs associated with this alternative. The capitol costs estimated for the phosphate application is $44.5 million.

The excavation portion of this alternative is expected to have capital costs of $78.1 million, as shown on Table 6-5, based on the estimate of $11,000 per home for excavation, backfilling and lawn restoration. The overall cost included $619,200 for construction of the permanent repository.

The total capital cost for this alternative, including phosphate treatment and excavation, is expected to be $122.7 million.

Annual O&M costs for the phosphate-treated areas and soil repository are shown in Table 6-5. The annual cost for providing the O&M program is estimated to be approximately $75,000 with a present worth value of providing the service for the next 30 years at $1.1 million.

State Acceptance

State acceptance will be evaluated after the public comment period closes for the Proposed Plan and this FS.

Community Acceptance

Community acceptance will be evaluated after the public comment period closes for the Proposed Plan and this FS.

6.2.4 Alternative 4: Interim Excavation with Treatability Study, Health Education, and Institutional Controls

Overall Protection of Human Health and the Environment

Exposure to lead-contaminated soil is a significant health risk posed by the site. Residential soils have been previously identified to be one of the primary contributors to risk associated with lead exposures. In order to reduce exposure to lead and the associated risks, Alternative 4 replaces lead-contaminated residential soils with clean soils, thereby breaking the exposure pathway between lead-contaminated soils and children. Alternative 4 was developed as an interim action to address the higher levels of contaminated soils until the phosphate stabilization treatability study is complete and a final remedial action is selected for the site. This alternative proposes addressing only those yards with at least one non-drip zone sample exceeding 800 ppm lead. The actions conducted under this alternative allow for a final remedy to be selected to address lead-contaminated soils in yards at concentrations less than 800 ppm. This alternative would be protective for the residences where an action is

Table 6-5
Alternative 3 – Cost Analysis for Phosphate Stabilization and Excavation

WORK ITEM	QUANTITY	UNIT PRICE	TOTAL COST
1. Mobilization/Demobilization	1	$5,000	$5,000
2. Property Access and Sampling	13,000	$200	$2,600,000
3. Remedial Design	1	$50,000	$50,000
4. Phosphate Stabilization and lawn restoration	10,400	$3,000	$31,200,000
5. Exterior Lead-based Paint Removal	5,200	$500	$2,600,000
6. Interior Dust Cleaning	5,200	$500	$2,600,000
7. Post Cleanup Report	10,400	$100	$1,040,000
8. Post Cleanup Exposure Study	1	$400,000	$400,000
Subtotal			$40,495,000
Contingencies (10% of subtotal)			$4,049,500
TOTAL PHOSPHATE STABILIZATION			$44,544,500
RESIDENTIAL YARD EXCAVATION			
1. Mobilization		$50,000	$50,000
2. Property Access and Sampling	5,600	$400	$2,240,000
3. Yard Soil Excavation, Transport, and Backfill	5,600	$11,000	$61,600,000
4. Post Cleanup Reports	5,600	$400	$2,240,000
5. Exterior Lead-based Paint Removal	2,800	$500	$1,400,000
6. Interior Dust Cleaning	2,800	$500	$1,400,000
7. Health Education	1	$1,126,000	$1,126,000
Subtotal			$70,461,000
REPOSITORY			
1. Design		$90,000	$90,000
2. Site preparation	21 acres	$4000/acre	$84,000
3. Material Placement	336,000 cy	$1.20	$403,200
4. Vegetative Cover	21 acres	$2000/acre	$42,000
Subtotal			$619,200
Contingencies (10% of subtotals)			$7,108,020

Table 6-5, Continued
Alternative 3 – Cost Analysis for Phosphate Stabilization and Excavation

WORK ITEM	QUANTITY	UNIT PRICE	TOTAL COST
TOTAL EXCAVATION AND PHOSPHATE STABILIZATION			$122,732,720
ANNUAL OPERATION AND MAINTENANCE			
1. O&M of Soil Repository			$5,000
2. Soil Chemistry Monitoring	50 samples	$1000	$50,000
4. Monitoring of Institutional Controls			$20,000
TOTAL ANNUAL O&M			$75,000
PRESENT WORTH TO PROVIDE O&M FOR YEARS 2 TO 30			$1,152,900

taken, but would not be fully protective of people living in homes with yard soil lead levels between 800 ppm and 400 ppm lead. Therefore, this alternative would be protective if followed by subsequent actions for the lower-level contaminated yards.

Likewise, household dust has also been identified as a significant lead exposure pathway. Residential soils are a contaminant source to house dust. Thus, remediating residential soils would reduce a contamination pathway to home interiors. Interior dust above action levels will be cleaned in homes where soil is remediated. Additionally, the health education program includes the availability of a HEPAVAC and properly-trained individuals to operate the machine to reduce the levels of lead dust in homes upon request of residents in the effected areas.

Fugitive dust would need to be controlled and monitored concurrent with residential soils excavation and remediation to minimize soil recontamination. Control of fugitive dust during excavation would eliminate direct exposure to highly concentrated dusts and reduce accumulation of lead in homes.

The soil disposal area would be designed and engineered to protect human health and the environment, including groundwater and surface water. With appropriate precautions taken during remedial design, there will be no unacceptable impact associated with implementation of this alternative.

This alternative would break the significant exposure pathways associated with contaminated residential soils in yards with higher levels of lead contamination. Once soil excavation, soil replacement, and revegetation is complete, the soils are properly disposed, and an effective IC program is implemented, risks associated with lead-contaminated residential soils will be controlled. Therefore, this alternative is protective of human health and the environment if conducted as an interim action and followed by a final action at a later date.

<u>Compliance With ARARs & Potential Action-Specific ARARs</u>

Alternative 4 would comply with the chemical and location-specific ARARs identified in Section 2 and detailed in Tables 2-1 through 2-4. As discussed previously, there are no promulgated laws or standards for lead-contaminated soil. However, a preliminary site-specific action level of 400 ppm for lead-contaminated soil has been proposed for the protection of human health at this site. This level was based on the guidance, criteria, and advisories identified as potential chemical-specific ARARs that are to be considered when evaluating remedial alternatives, and the nine NCP evaluation criteria.

The potential federal and state action-specific ARARs for this alternative are identified in Tables 6-1 and 6-2. The excavation portion of this alternative would comply with action-specific ARARs. The principal action-specific ARARs for this alternative are the requirements for proper disposal of the excavated soils.

Long-Term Effectiveness

The residual risks (the risk remaining after implementation) would be significantly reduced under this alternative; however, the risk would still be unacceptable unless followed by a final action. Homes within the site with soil concentrations at or above 800 ppm lead in a non-foundation sample would have the contaminated soil removed. The removal of contaminated soil, and replacement with clean backfill and revegetation ensures that future potential for exposure will be significantly reduced.

The residual risks would be further reduced for homes within the site where soil removal is conducted through the implementation of interior dust cleaning, and health education programs. Health education programs would be implemented by the local government, schools and health departments to educate residents about home gardening, interior house dust, proper hygiene and other health concerns for young children residing within the site. The excavation alternative includes ICs for the development of non-remediated property located within the site. This program would be implemented to protect future residents from developing contaminated property by requiring remediation, as necessary, prior to development. It may require implementation of city or county zoning restrictions, long-term zoning plans, special building codes or permits, or health ordinances covering construction of residential homes. Therefore, the program effectiveness is limited by the adequacy and reliability of controls. The city of Omaha has various authorities to enact and maintain the necessary controls.

Short-Term Effectiveness

This alternative is protective in the short term. Although lead-laden dust would be generated during excavation, dust suppression would be implemented for the protection of community and workers during remedial action. The alternative would be lengthy to implement for all affected residences, requiring years to complete. However, the average length of time for excavation and backfilling at any one residence is about two days; therefore, the residential exposure to dust would be minimal.

A significant environmental aspect of this alternative could be the placement of the contaminated soils in a permanent repository. The repository would have no negative environmental impacts provided storm water controls and other design and engineering controls for a stable repository are achieved and maintained.

Reduction of Toxicity, Mobility, or Volume

This alternative would significantly reduce the mobility of the contaminants of concern by consolidation of the contaminated soils in a disposal area. Although the exposure pathway would be eliminated or minimized, the toxicity and volume of the material would not be reduced. Proper construction of a soil repository and long-term maintenance are important components of this alternative that ensure a significant reduction of mobility.

Implementability

This alternative is readily implementable. Excavation methods, backfilling, and revegetation are typical engineering activities. Experience gained during previous EPA response actions has shown that this action is readily implementable.

The IC component of this alternative for health education and the future residential construction controls program are implementable, but require cooperation and action by the local government entities.

Cost

This alternative is expected to have capital costs of $77.3 million, as shown on Table 6-6, based on the estimate of $11,000 per home for excavation, backfilling and lawn restoration. The overall cost includes disposal of excavated soil in a constructed off-site repository, which is considered the most expensive option, although other less expensive options may be implemented.

Since this alternative should only be selected as an interim action, no annual O&M costs are included. The O&M cost would be determined under the final remedy selected for the site. Health education costs were developed in Table 6-4 and are carried over into the cost information contained in Table 6-6.

State Acceptance

State acceptance of the proposed alternative will be evaluated during the public comment period.

Community Acceptance

Community acceptance will be evaluated after the public comment period closes for the Proposed Plan and this FS.

Table 6-6
Alternative 4 – Cost Analysis for Interim Excavation Action and Phosphate Treatment Study

PHOSPHATE STABILIZATION TREATABILITY STUDY	Quantity	Unit Price	Total Price
RESIDENTIAL YARD EXCAVATION			
1. Mobilization		$50,000	$50,000
2. Property Access and Sampling	5,600	$400	$2,240,000
3. Yard Soil Excavation, Transport, and Backfill	5,600	$11,000	$61,600,000
4. Post Cleanup Reports	5,600	$400	$2,240,000
5. Exterior Lead-based Paint Removal	2,800	$500	$1,400,000
6. Interior Dust Cleaning	2,800	$500	$1,400,000
7. Health Education for 3 years	1	$337,800	$232,800
Subtotal			$69,267,800
REPOSITORY			
1. Design		$90,000	$90,000
2. Site preparation	21 acres	$4000/acre	$84,000
3. Material Placement	336,000 cy	$1.20	$403,200
4. Vegetative Cover	21 acres	$2000/acre	$42,000
Subtotal			$619,200
Contingencies (10% of subtotals)			$7,033,700
TOTAL INTERIM ACTION COSTS			$77,370,700

7.0 Comparative Analysis of Alternatives

A comparative analysis of alternatives using each of the nine evaluation criteria, as required by federal regulation, is presented in this section. The purpose of this analysis is to identify the advantages and disadvantages of each alternative relative to the other alternatives. A separate comparison of the alternatives is presented under the heading of each criterion.

7.1 Protection of Human Health and the Environment

Protection of human health and the environment is addressed to varying degrees by the three action alternatives. The No Action Alternative would have no effect on the site. Therefore, it does not address any of the identified risks for human health.

Alternative 2 - Excavation, and Alternative 3 - Phosphate Treatment and Excavation, both provide protection of human health through reducing exposure to lead in contaminated soils. Alternative 3 provides protection through *in situ* treatment for soil levels between 400 ppm and 800 ppm by immobilizing lead and effectively reducing the bioavailability. However, this determination will have to be supported by laboratory bench scale data and a treatability study to determine if the treatment is effective at the site. Alternative 4 is protective for the residences where soil excavation and replacement is conducted, but must be followed by a final action to be fully protective. ICs would not be necessary except for future development in residential areas.

Alternatives 2, 3, and 4 provide protection by removing the contaminated soils from the exposure pathway and replacement with clean soil. The excavation activities address risk of exposure through direct contact with lead-contaminated soil. House dust exposure to lead would be reduced through interior cleaning. Future risk from residential development in contaminated areas is addressed through the implementation of ICs. Health education programs would provide further, ongoing risk reduction for Alternative 2, 3, and 4.

In general, permanence of the different alternatives is similar. Alternative 2 provides permanence through complete removal and containment of contaminated soils at or above 400 ppm lead concentrations. Alternative 3 provides permanence through immobilization of phosphate-treated contaminated soils and through both removal and replacement of excavated soils. Alternative 4 provides permanence for residential yards over 800 ppm lead through excavation and replacement of contaminated soils.

7.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Alternatives 2, 3, and 4 meet the federal and Nebraska ARARs. The No Action Alternative has no ARARs with which to comply. The detailed evaluation of Alternatives 2, 3, and 4 for achieving potential action-specific ARARs is discussed in Section 5. The identification of potential federal and state chemical- and location-specific ARARs is discussed in Section 2.

7.3 Long-Term Effectiveness

Alternative 3 effectively reduces risks through a combination of treatment and excavation, while Alternative 2 and 4 achieves risk reduction through excavation only. Both Alternatives 2 and 3 reduce risks for homes using effective engineering controls with soil concentrations of lead at or above 400 ppm. Alternative 4 only addresses residential yards with soil-lead over 800 ppm, and must be followed with a final action to address all long-term risks. Alternatives 2 and 3 also rely on the use of ICs and public education for controlling residual risks. The No Action alternative provides no effectiveness for the protection of public health and the environment over the long term.

While all action Alternatives involve the excavation and transport of contamination, Alternative 2 provides greater risks to residents and remediation workers due to the increased volume of material being transported during the remediation period only. Alternatives 2 and 3 rely on ICs to reduce risks from the soil repository and to control the risk associated with potential future development in residential areas. Alternative 4 relies upon ICs only to control risks associated with a soil repository.

7.4 Short-Term Effectiveness

Alternatives 2, 3, and 4 are similarly effective in the short-term for protection of the public and remedial action workers. Alternatives 2, 3, and 4 would require a similar length of time to implement at each residence. However, Alternative 2 would require more transportation of the contaminated soils to the repository, which would increase the risks to remedial action workers due to transportation incidents. Alternative 3 would present a greater risk to worker handling phosphoric acid during soil treatment activities. Alternative 4 would take the least amount of time to implement overall, but would be considered an interim action, and would require a follow-up final action to accomplish the required risk reduction. The No Action Alternative 1 imposes no risk on remedial action workers, but the public and environment would continue to be exposed to current lead levels.

7.5 Reduction of Toxicity, Mobility or Volume

The No Action Alternative would not reduce toxicity, mobility or volume of site contaminants. Alternative 2 would significantly reduce mobility for residences with soils at concentrations of 400 ppm lead or above through soil excavation and replacement. Alternative 3 would reduce mobility of contaminants through treatment of soils with lead concentrations between 400 ppm and 800 ppm lead, and through the removal and replacement of soils at concentrations of 800 ppm and above. Alternative 4 would significantly reduce mobility of contaminants in soils for those lead-contaminated properties at concentrations of 800 ppm and above through the removal and replacement of soils. Mobility of excavated materials placed in a soil repository is greatly reduced due to the engineering features designed to contain the contaminated soils.

7.6 Implementability

All alternatives are readily implementable. The extent or degree to which the remediation is applied does vary significantly between the three active remedial alternatives. Excavation is a proven and easily implemented technology. The treatment portion of Alternative 3 requires additional studies to prove the effectiveness of phosphate stabilization. All three action alternatives are technically feasible from an engineering perspective.

7.7 Cost

The present worth costs for Alternative 2 is estimated at $214 million. Alternative 3 is estimated at $122 million. Alternative 4 is estimated to cost $77 million. No costs are associated with the No Action, Alternative 1. The costs of the alternatives are listed in Tables 6-3 through 6-7.

7.8 State Acceptance

State acceptance on the alternatives will be evaluated after the public comment period closes for the Proposed Plan and this FS.

7.9 Community Acceptance

Community acceptance of the alternatives will be evaluated after the public comment period closes for the Proposed Plan and this FS.

8.0 References

1. Fact Sheet and Explanatory Statement provided by the Nebraska Department of Environmental Quality for the Omaha Lead site.

2. CERCLIS Site Information, CERCLIS Hazardous Waste Sites [electronic bulletin board], April 20, 2000 [cited August 21, 2000]. Available from epa.gov/superfund/sites/cursites /c3ne.htm; Internet.

3. U.S. Department of Commerce, Rainfall Frequency Atlas of the United States, Technical Paper Number 40, Washington, D.C.: GPO 1961.

4. Phase I Detailed Site Assessment for Groundwater at the ASARCO Omaha Plant, Omaha Nebraska. Prepared by Hydrometrics, Inc. for ASARCO Inc., March 1995.

5. Ken Brown, Director TSC, letter with attachment to Don Bahnke, Remedial Project Manager, U.S. EPA Region 7, September 20, 1999. Subject: Air Dispersion Modeling - ASARCO S.F. Site.

6. Don Bahnke, Remedial Project Manager, U.S. EPA Region 7, letter with attachment to Michael J. Sanderson, Director Superfund Division, August 2, 1999. Subject: Request for Removal Action, Twelve Month Exemption, and a Two Million Dollar Exemption at the Omaha Lead Site, Omaha, Nebraska and Council Bluffs, Iowa.

7. Ecological Risks Associated with Releases of ASARCO Omaha Refinery Groundwater into the Missouri River, Omaha, Nebraska. Prepared by Parametrix, Inc. for ASARCO Inc., November 29, 1995.

8. Soil and Groundwater Characterization for the ASARCO Omaha Plant, Omaha, Nebraska. Prepared by Hydrometrics Inc. for ASARCO, Inc., November 1995.

9. The Case of ASARCO, Incorporated, Consent Order of Stay, Before the Nebraska Department of Environmental Quality, January 13, 1997.

10. Joyce Tsuji, Director of Risk Assessment and Toxicology Services, letter with attachment to Dennis Heitmann, Nebraska Department of Environmental Quality, February 13, 1997. Subject: Risk Evaluation Report for the ASARCO Omaha Site.

11. Blood-lead Levels in Douglas County by Zip Codes, DCHD Facsimile Transmission, Kathy Leinenkugel Lead Program Coordinator, DCHD to Donald Bahnke, USEPA, February 2, 2001.

12. Douglas County Health Department, Douglas County Blood-lead Screening Results Exceed National Average, November 18, 1998.

13. Ken Brown, Director, TSC, letter with attachment to Don Bahnke, Remedial Project Manager, U.S. EPA Region 7, December 28, 1998. Subject: Contour Plots-ASARCO S.F. Site.

14. Background Summary Report, Omaha Lead Refining Site, Omaha, Douglas County, Nebraska. Prepared by Jacob Federal Operations for the Environmental Protection Agency, Region 7, January 27, 2000.

15. Don Bahnke, Federal Facilities/Special Emphasis Superfund Division U.S. EPA, Region 7, letter with attachment to Robert Little, Manager- Environmental Services ASARCO, Inc., April 5, 2000. Subject: Written consent for entry and access.

16. Trip Report, Omaha Lead Refining Site, Omaha, Douglas County, Nebraska, EPA Work Assignment No. 025-SISI-07ZY. Prepared by Jacobs Federal Operations for the United States Environmental Protection Agency, Region 7, May 31, 2000.

17. Gene Gunn, Chief Federal Facilities Superfund Division, letter with attachment to Michael Horn, July 10, 2000. Subject: Letter requesting the cooperation of Union Pacific Railroad Company to provide documents and information on the Omaha Lead Site.

18. Robert Litle, Owner of ASARCO, Inc., letter with attachment to Don Bahnke, Remedial Project Manager EPA Region 7, August 2, 2000. Subject: Omaha Lead Site.

19. Code of Federal Regulations Title 40: Protection of Environment, Chapter I, Subchapter J, Part 300 – National Oil and Hazardous Substances Pollution Contingency Plan. Available from epa.gov/docs/epacfr40/Chapt-I.info/subch-J.htm; Internet.

20. United States Environmental Protection Agency, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final,

October 1988. Available from epa.gov/superfund/guidance/remedy/crifs/ overview.htm; Internet.