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DOE/EA-0489, Rev. 1

Engineering Evaluation/Cost Analysis-Environmental Assessment for the Proposed Decontamination of Properties in the Vicinity of the Hazelwood Interim Storage Site, Hazelwood, Missouri

March 1992

U.S. Department of Energy
Oak Ridge Operations
Former Sites Restoration Division

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March 1992

prepared by

M.H. Picel, J.M. Peterson

Environmental Assessment and Information Sciences Division, Argonne National Laboratory

and M.J. Williams

Bechtel National, Inc., Oak Ridge, Tennessee

prepared for

U.S. Department of Energy, Oak Ridge Operations, Former Sites Restoration Division, Oak Ridge, Tennessee, under Contract W-31-109-Eng-38

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FOREWORD

The U.S. Department of Energy (DOE) has assumed responsibility for cleanup of the radioactively contaminated properties in Hazelwood and Berkeley under its Formerly Utilized Sites Remedial Action Program, one of two remedial action programs under the direction of the DOE Office of Environmental Restoration, Eastern Area Programs Division. The contamination, which is primarily confined to soil, potentially threatens human health and the environment because it is present in locations where public access is unrestricted. This contamination could also inadvertently be moved by property owners, creating additional hazards. To date, contaminated soil has been removed from some of the properties known to be contaminated. This material is currently being stored at the Hazelwood Interim Storage Site (HISS) pending the selection of a permanent remedy.

The DOE has conducted a comprehensive environmental review and analysis for the proposed management of contaminated material found on properties in the vicinity of HISS. The soil on these properties is radioactively contaminated (principally with thorium-230) above DOE guidelines established in DOE Order 5400.5. These properties became radioactively contaminated as a result of transportation and storage of various radioactive materials at nearby facilities, i.e., the St. Louis Airport Site (SLAPS) and HISS. In accordance with DOE policy, the environmental review and analysis performed by DOE integrated the values of the National Environmental Policy Act (NEPA) of 1969 (42 USC 4321 *et seq.*) and the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended. The resulting environmental review document is an engineering evaluation/cost analysis-environmental assessment (EE/CA-EA).

The DOE is currently preparing a comprehensive remedial investigation/feasibility study-environmental impact statement (RS/FS-EIS) for remedial action at several noncontiguous areas located in and near St. Louis, Missouri. The proposed action outlined in the EE/CA-EA is a component of a comprehensive cleanup strategy for the "St. Louis Site." The St. Louis Site consists of the St. Louis Downtown Site and vicinity properties; SLAPS and vicinity properties; and Latty Avenue Properties -- which consists of HISS, the Future Coatings site, and six vicinity properties along Latty Avenue. The draft RI/FS-EIS for the St. Louis Site is expected to be issued in 1994. The proposed action is to remove contaminated material from the SLAPS and Latty Avenue vicinity properties and place the material in storage at HISS; this action is being treated as an interim action in accordance with 40 CFR 1506.1. The proposed action will not limit the choice of reasonable alternatives or prejudice the ultimate decision for which the RI/FS-EIS is being prepared.

NOTATION

The following is a list of the acronyms, initialisms, and abbreviations (including units of measure) used in this document.

ACRONYMS, INITIALISMS, AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended
CFR	Code of Federal Regulations
CSR	Code of State Regulations
DOE	U.S. Department of Energy
EE/CA	engineering evaluation/cost analysis
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FUSRAP	Formerly Utilized Sites Remedial Action Program
HISS	Hazelwood Interim Storage Site
MSL	mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
RI	remedial investigation
ROD	record of decision
RSMo.	Revised Statutes of Missouri
SHPO	State Historic Preservation Office
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
TBC	to-be-considered (requirements)
USC	United States Code

UNITS OF MEASURE

°F	degrees Fahrenheit
°C	degrees Celsius
cm	centimeter(s)
ft	foot (feet)
ft^2	square foot (feet)
g	gram(s)
gpm	gallon(s) per minute
h	hour(s)
ha	hectare(s)
in.	inch(es)

lb	pound(s)
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
L	liter(s)
μCi	microcurie(s)
μR	microroentgen(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
MeV	million electron volt(s)
mi	mile(s)
mi^2	square mile(s)
min	minute(s)
mL	milliliter(s)
mph	mile(s) per hour
mrem	millirem(s)
pCi	picocurie(s)
ppm	part(s) per million
rem	roentgen-equivalent man
s	second(s)
WL	working level(s)
yd^3	cubic yard(s)
yr	year(s)

1 OVERVIEW AND SUMMARY

The U.S. Department of Energy (DOE), under its Formerly Utilized Sites Remedial Action Program (FUSRAP), is implementing a cleanup program for three groups of properties in the St. Louis, Missouri, area: (1) St. Louis Downtown Site (SLDS), (2) St. Louis Airport Site (SLAPS) and vicinity properties, and (3) Latty Avenue Properties, including the Hazelwood Interim Storage Site (HISS). The location of these properties is shown in Figure 1; they are referred to collectively as the St. Louis Site. None of the properties is owned by DOE, but each property contains radioactive residues from federal uranium-processing activities conducted at the SLDS during and after World War II.

This engineering evaluation/cost analysis-environmental assessment (EE/CA-EA) report has been prepared to support the interim cleanup measures for the contaminated properties in the Hazelwood and Berkeley, Missouri, area. The scope of the proposed action is to prepare additional interim storage capacity at the HISS and to remove contaminated soil from the SLAPS and Latty Avenue vicinity properties and transport this material to the HISS for interim storage. Information pertinent to the expansion of HISS storage capacity is discussed in Chapter 6 and Appendix A. The near-term cleanup measures that may be necessary at the vicinity properties are evaluated in the main body of this report.

This proposed action is a component of a comprehensive cleanup strategy for the St. Louis Site. Implementation of comprehensive cleanup measures will be preceded by completion of a remedial investigation/feasibility study-environmental impact statement (RI/FS-EIS) process. It is DOE's policy (DOE Order 5400.4) to integrate the values of the National Environmental Policy Act (NEPA) and the procedural and documentational requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The RI/FS-EIS process will conclude in the issuance of a record of decision that will identify the selected remedy for all contamination present at the St. Louis Site.

Because of the range of active land uses in the Hazelwood and Berkeley area and because of the extent of contamination on public and private properties, the potential exists for disturbance and spreading of soil contamination. Examples of near-term activities that could result in such disturbance include road improvements, private construction activities, and utility line installation and repair. The intent of the proposed action is to establish an interim storage facility and response process that would allow these types of activities to proceed while ensuring that appropriate environmental precautions are employed. Specifically, implementation of the proposed action would allow DOE to remove, transport, and safely store contaminated soils from properties where other activities (not involving DOE) are likely to result in either spreading contamination or otherwise complicating ultimate cleanup measures.

Some of the contaminated properties are located along roads previously used to transfer radioactive materials between facilities in this area; seven of these properties are currently being occupied as private residences. Although no significant near-term

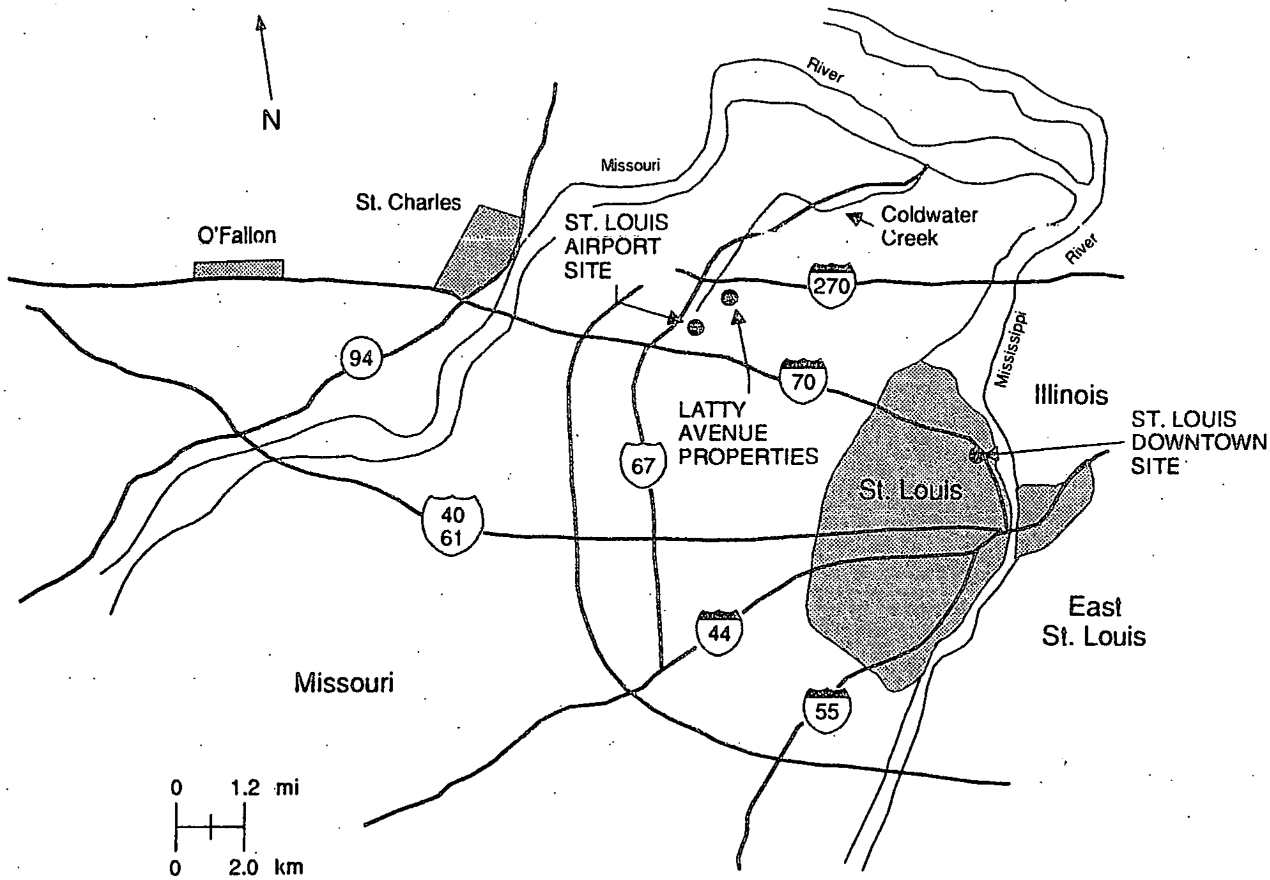

FIGURE 1 Location of FUSRAP Sites in the St. Louis, Missouri, Area

health threats are believed to be posed to occupants of these properties, DOE intends to expedite cleanup of the properties, i.e., prior to remediation of the entire St. Louis Site. Expediting cleanup of these residential properties will ensure minimizing exposure of residents to residual contamination and is consistent with the remedial action strategy currently being planned for the St. Louis Site.

The proposed removal action is expected to be implemented after appropriate regulatory agencies, local governmental officials, and interested members of the public have had sufficient opportunity to review and comment on the proposal. Preliminary discussion and coordination has taken place between DOE and the U.S. Environmental Protection Agency (EPA) Region VII, Missouri Department of Natural Resources, and U.S. Army Corps of Engineers. Because DOE cannot predict the extent of construction and other local activities that might occur in areas currently contaminated, it is not possible to estimate the volume of materials that would be transported to the HISS for storage as a result of the proposed action. However, no more than about 54,000 m^3 (70,000 yd^3) of additional material could be stored at the HISS. For comparative analysis of alternatives, a volume generation rate of 3,800 m^3 (5,000 yd^3) per year was assumed.

Ultimate disposal of the materials stored at the HISS will be coordinated with disposal of the remaining wastes present at SLAPS, the SLDS, and all associated vicinity properties. The DOE expects to propose comprehensive cleanup plans in calendar year 1994. Actual initiation of a final remedy may take as long as 2 years. At that time, transport of additional soils to the HISS for storage should not be necessary because a permanent waste management option will have been finalized.

The proposed removal action is consistent with CERCLA, which requires that interim actions contribute (to the extent practicable) to the efficient performance of any anticipated final remedy. In fact, failure to implement this interim action could make implementation of final cleanup measures more difficult because contamination might have spread as a result of land development activities and the total volume of soil requiring management would ultimately increase. The removal action would also satisfy the requirements for interim actions under NEPA while an EIS is in progress, as identified in Title 40, Code of Federal Regulations, Part 1506.1 (40 CFR 1506.1).

The analysis presented in this EE/CA-EA report demonstrates that the proposed action can be implemented in an environmentally acceptable manner. Although the HISS is located in the 100-year floodplain of Coldwater Creek, the site can be modified to control risks associated with local flooding of this creek. A floodplain assessment consistent with the requirements of Executive Order 11988 and 10 CFR Part 1022 is included in this document as Appendix A. No wetlands would be impacted by the proposed removal action.

In summary, the proposed removal action would address the goals of FUSRAP by reducing the further spread of radioactively contaminated soil in the Hazelwood and Berkeley area and by allowing implementation of near-term response measures for any contaminated properties warranting cleanup in advance of the comprehensive cleanup effort planned for the St. Louis Site. This proactive approach should expedite the future overall remedial action by reducing the ultimate volume of materials that must be excavated and disposed of, thereby reducing the overall cost of remediation. Additionally, consolidating these materials at the HISS would improve the local environment by reducing the risks associated with exposure to the materials.

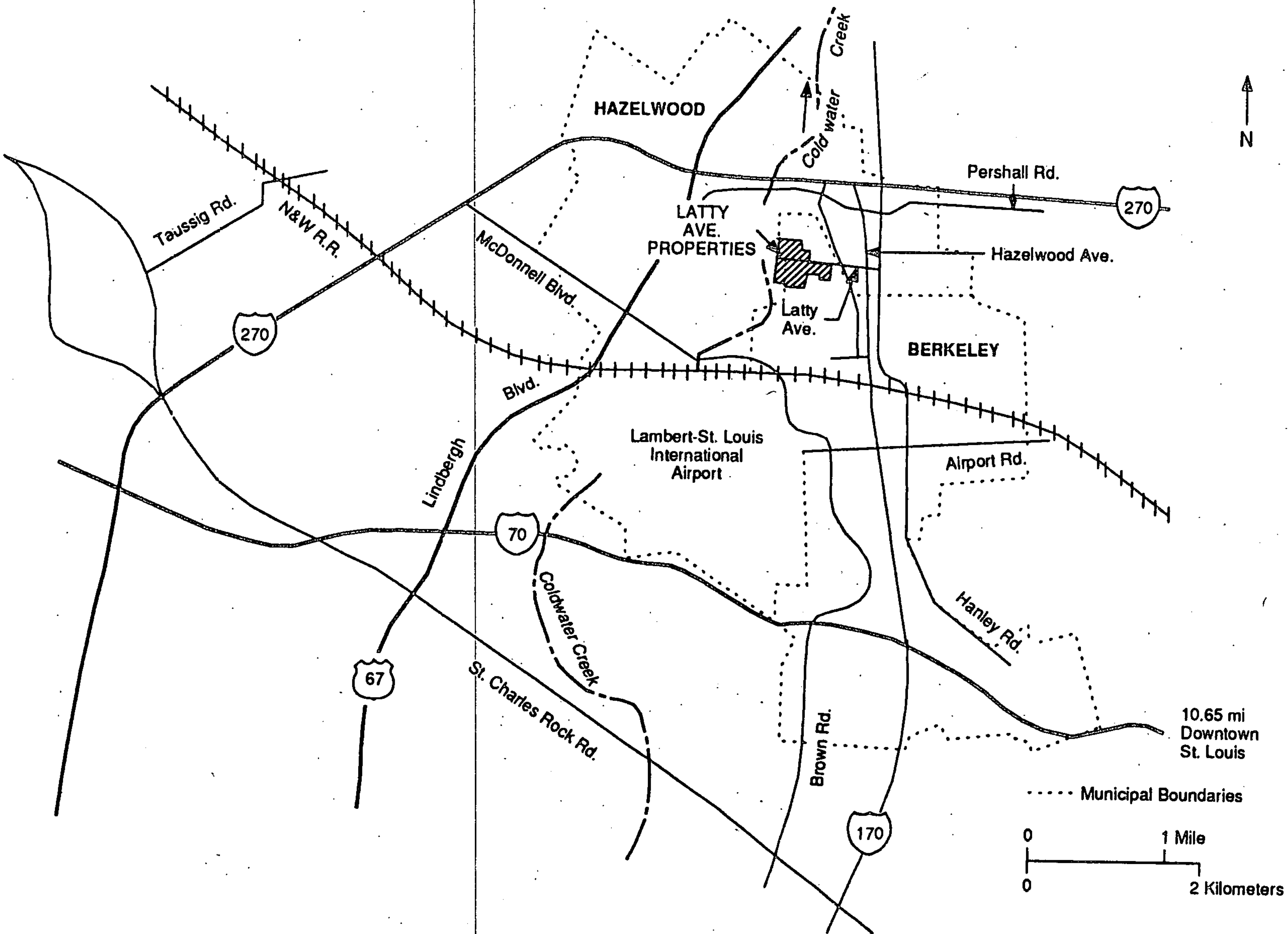

FIGURE 2 Location of the Latty Avenue Properties, Hazelwood, Missouri

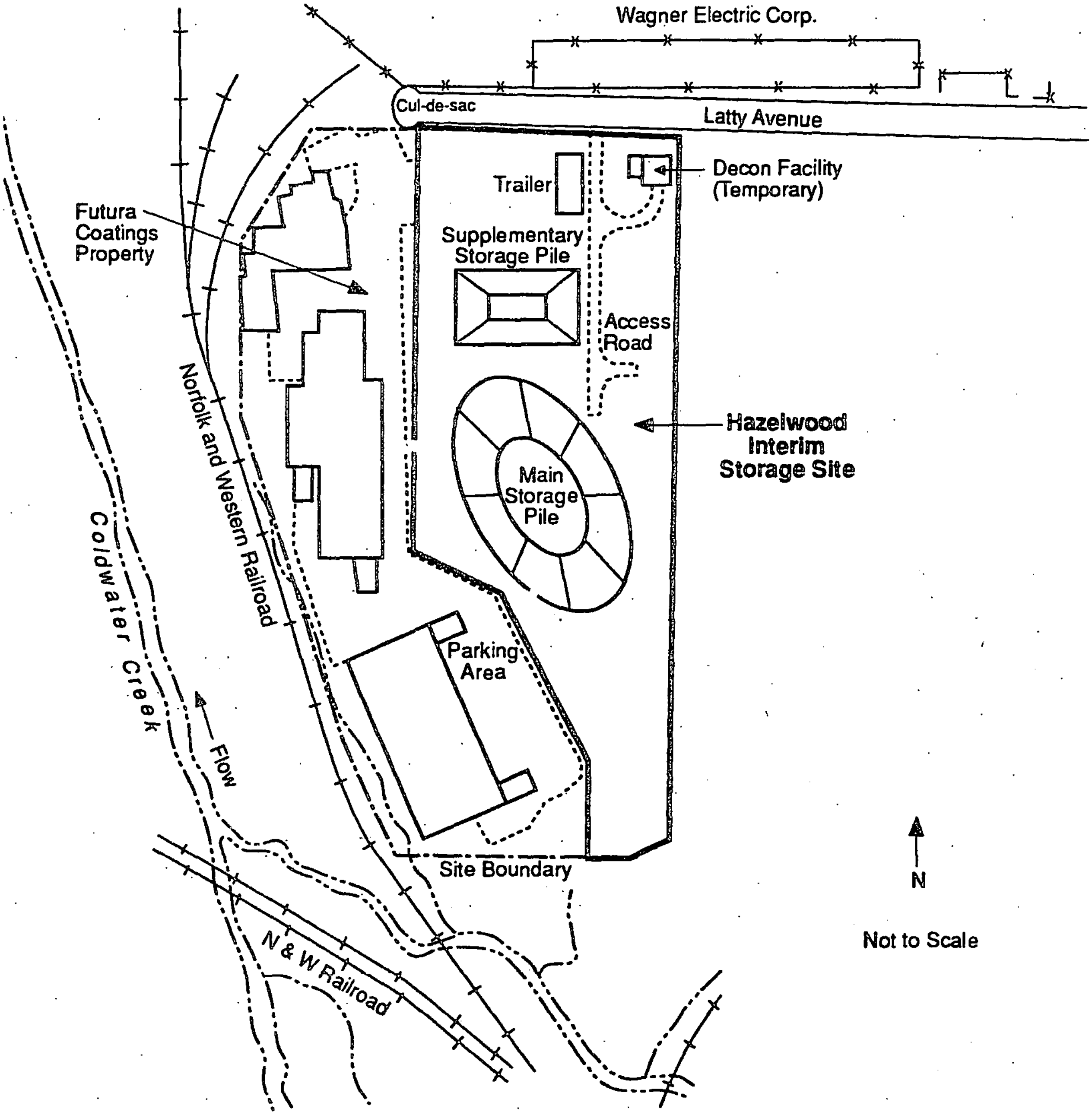

FIGURE 3 Layout of the Property at 9200 Latty Avenue (Source: Modified from Noey et al. 1987)

2 SITE CHARACTERIZATION

2.1 SITE DESCRIPTION

2.1.1 Setting

To date, 64 residential, commercial, and municipal properties in the vicinity of the HISS and SLAPS have been identified as radioactively contaminated (Bechtel National 1990a). This contamination resulted from transportation of contaminated materials in the area during the 1940s through the 1970s. These vicinity properties include the 6 Latty Avenue vicinity properties and 58 SLAPS vicinity properties; 7 of the SLAPS properties are residential.

HISS. The Latty Avenue Properties consist of the HISS, the Futura Coatings site, and six vicinity properties along Latty Avenue. The HISS and Futura Coatings sites are located at 9200 Latty Avenue in northern St. Louis County within the city limits of Hazelwood, Missouri. The property at 9200 Latty Avenue lies 3 km (2 mi) north of Lambert-St. Louis International Airport.

The 4.4-ha (11-acre) property at 9200 Latty Avenue is separated by a chain-link fence into (1) the western Futura Coatings section (2.2 ha [5.5 acres]), which contains a three-building complex, and (2) the eastern HISS section (2.2 ha [5.5 acres]), which contains a vehicle decontamination facility, an office trailer, and two covered surface storage piles of radioactive materials. The property at 9200 Latty Avenue is zoned for industrial use, and the nearby area is primarily industrial and commercial. The western property is currently owned by Jarboe Realty and Investment Company and is leased to Futura Coatings, Inc. The eastern property is also owned by Jarboe and is currently leased to DOE for use as a storage facility for low-level radioactively contaminated materials.

The topography of the HISS is generally flat, except for the two surface storage piles. The main storage pile is about 110 m (350 ft) long, 67 m (220 ft) wide, and 8 m (25 ft) high. The supplementary storage pile is about 52 m (170 ft) long, 27 m (90 ft) wide, and 5 m (17 ft) high. The total volume of stored material in these two piles is about 24,500 m^3 (32,000 yd^3). The ground surface slopes gently from these waste piles to the west and south toward Coldwater Creek; the ground elevation is about 157 m (514 ft) above mean sea level (MSL) near Latty Avenue and about 166 m (545 ft) above MSL at the top of the main storage pile. The 100-year flood level at the Norfolk and Western Railroad bridge across Coldwater Creek, just south of the Latty Avenue Properties, is about 159 m (520 ft) above MSL.

The area near HISS is primarily industrial and commercial. Most of the area along Latty Avenue lies within the northern section of the town of Berkeley, although the HISS is in the city of Hazelwood (Figure 2). The area is attractive for industrial development because of its proximity to the airport and to Lindbergh Avenue and Interstate 170 (an inner belt route), which is a major interchange of Interstate I-270. The

HISS and surrounding properties in both Hazelwood and Berkeley are zoned for industrial use. Some commercial operations are located about 0.3 km (0.2 mi) east of HISS on Latty Avenue. The nearest residential area is about 1 km (0.6 mi) east of the site. Located between about 1.2 km (0.75 mi) and 1.6 km (1 mi) of the HISS in Hazelwood and Berkeley are several high-density residential areas with single-family houses and apartment buildings. There are no churches, schools, hospitals, municipal buildings, or other community facilities adjacent to HISS (Argonne National Laboratory 1984). The populations of Hazelwood and Berkeley are 15,729 and 13,706, respectively (Nolan 1989). No wetlands are adjacent to or near the HISS. The closest wetland is a pond in St. Ferdinand Park, approximately 4.8 km (3 mi) downstream of the HISS along Coldwater Creek (St. Louis District Corps of Engineers 1987).

Vicinity Properties. Of the properties surveyed as a part of the radiological characterization conducted by DOE from 1988 through 1990, 64 were found to be radioactively contaminated in excess of DOE guidelines for residual contamination in soil (DOE Order 5400.5). Characterization data obtained from the vicinity properties indicated that thorium-230 is the primary contaminant.

The properties, which are owned by private individuals and a variety of businesses and industries, lie adjacent to the haul roads believed to have been used to transport radioactive materials between the properties comprising the St. Louis Site. The haul roads include Latty Avenue, McDonnell Boulevard, Hazelwood Avenue, Pershall Road, Eva Avenue, and Frost Avenue (Figure 4). These routes traverse Hazelwood, Berkeley, and St. Louis and are located near HISS and SLAPS. The remaining vicinity properties include (1) the Norfolk and Western Railroad properties, located adjacent to Coldwater Creek near the HISS and south of SLAPS between SLAPS and Banshee Road; (2) the Coldwater Creek vicinity properties, located along the creek between Byassee Drive and Pershall Road; (3) Banshee Road; (4) the ballfield north of SLAPS; and (5) the St. Louis Airport Authority property south of SLAPS.

2.1.2 Climate

The St. Louis metropolitan area has a modified four-season continental climate, i.e., the area does not have prolonged periods of extreme cold, extreme heat, or high humidity. To the south is warm, moist air from the Gulf of Mexico, and to the north is a region of cold air masses. Air masses from these sources alternately invade the St. Louis area, and the conflict along the frontal zones where they meet produces a variety of weather conditions. Winters are brisk but seldom severe; snowfall has averaged less than 50 cm (20 in.) per winter season since 1930. Temperatures remain as cold as 0°C (32°F) or lower for fewer than 20 to 25 days in most years. Summers are warm, with a maximum temperature of 32°C (90°F) or higher occurring an average of 35 to 40 days per year. Extremely hot days of 38°C (100°F) or more are expected no more often than about 5 days per year. Normal annual precipitation for the St. Louis area is about 90 cm (31 in.). Winds are predominantly from the south, with a mean speed of 15 km/h (9.5 mph) (Ford, Bacon & Davis Utah 1978).

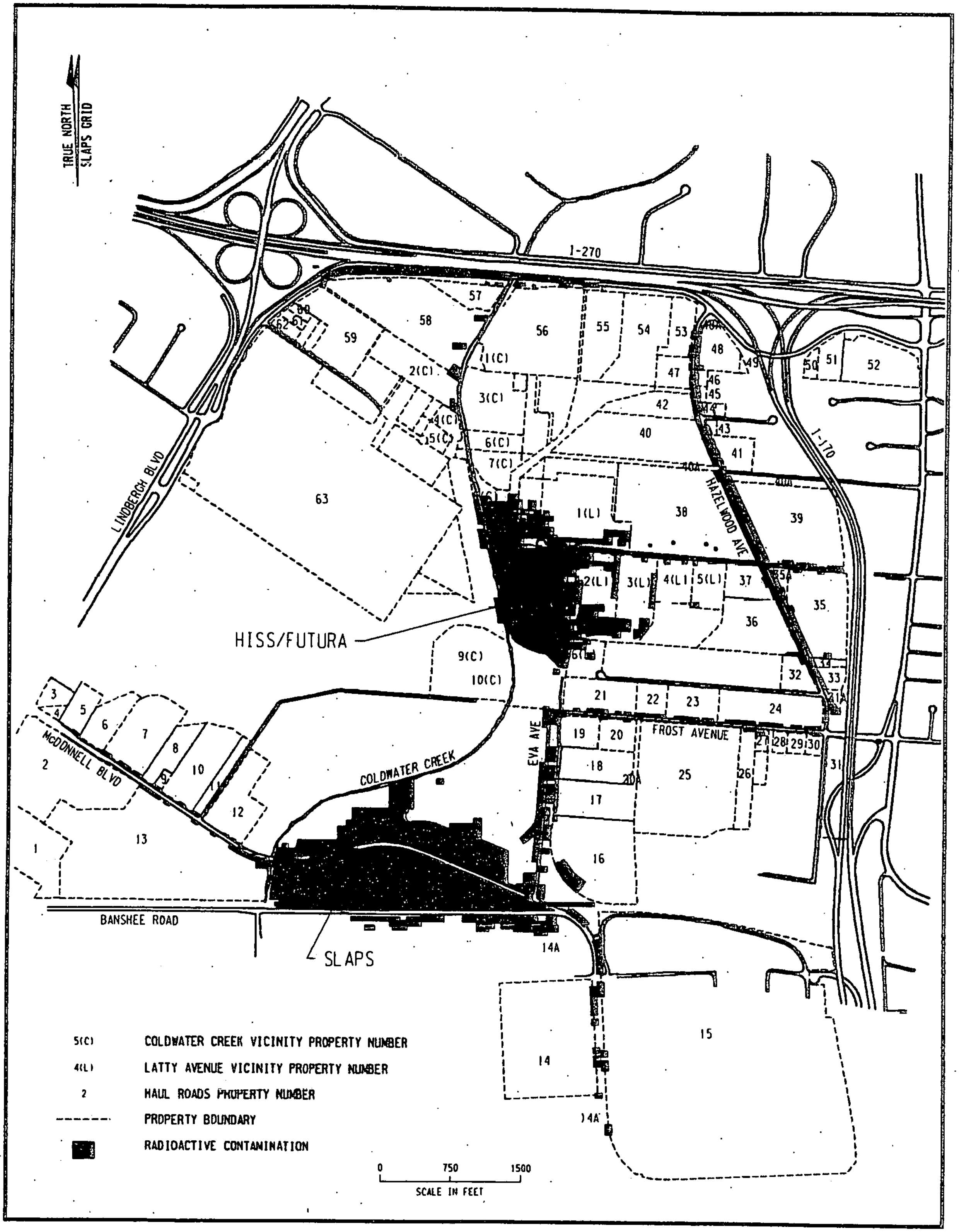

FIGURE 4 Location of the Vicinity Properties

2.1.3 Ecology

The HISS and the vicinity properties in Hazelwood and Berkeley are located within the northern oak-hickory forest subsection of the Prairie Parkland Province (Bailey 1978; Galvin 1979). Bottomlands of this subsection are flat and poorly drained, and the dense forested areas are dominated by oaks and hickories (Galvin 1979). However, because the vicinity properties are located within an urban setting with industrial development, little or no forest habitat is present except near Coldwater Creek and its unnamed tributary bordering the south side of the HISS.

The flora of the HISS and the vicinity properties is dominated by early successional species (e.g., grasses, aster, goldenrod, ragweed, dandelion, yarrow, thistle, and smartweed). Shrubs and small trees are also scattered in these areas. Typical early- to intermediate-stage successional trees and shrubs of Missouri floodplain forests include silver maple, eastern cottonwood, willow, hackberry, sycamore, elm, hawthorn, sumac, and box elder (Bragg and Tatschl 1977). Box elder predominates the lowland area near Coldwater Creek whereas a mixture of the above-mentioned species occurs along the tributary to Coldwater Creek.

The fauna of the area consists of species that have adapted to urban encroachment. Birds in the vicinity include house sparrow, red-winged blackbird, common crow, robin, mourning dove, cardinal, and starling. Mammals include Norway rat, raccoon, house mouse, eastern cottontail rabbit, opossum, prairie vole, white-footed mouse, short-tail shrew, and striped skunk. In addition, burrowing mammals -- such as woodchuck, plains pocket gopher, and eastern mole -- have ranges and habitats that coincide with the area.

Coldwater Creek is the major aquatic habitat within the vicinity. The substrate of the creek is predominantly silt and sand; water quality is governed by municipal and industrial drainage and discharges. Therefore, the biota of the creek is limited to pollution-tolerant organisms and to those species more tolerant of turbid and silty conditions. The invertebrate community consists of sludge worms (Tubificidae), blood worms and midge larvae (Chironomidae), and snails (Physa). Fish of Coldwater Creek include golden shiner, fathead minnow, and black bullhead. The main channel, upstream of the Lambert-St. Louis International Airport, is the least contaminated with domestic and industrial pollutants, and it supports the largest number of taxa (St. Louis District Corps of Engineers 1987). No listed species are likely to occur in the vicinity; this conclusion is based on habitat requirements of federally or Missouri-listed threatened and endangered species and on consultation with the U.S. Fish and Wildlife Service and the Missouri Department of Conservation.

2.1.4 Surface Water Hydrology

The Latty Avenue Properties are located within the Coldwater Creek drainage basin, about 61 m (200 ft) east of the creek (Figure 4). The creek is about 30 km (19 mi) long and drains a total area of about 118 km^2 (46 mi^2). At McDonnell Boulevard, about 1.6 km (1 mi) upstream of the HISS, Coldwater Creek has a drainage area of about 32 km^2 (12.3 mi^2). The creek originates about 9.2 km (5.7 mi) south of the site at a small spring-fed lake in Overland, Missouri; it flows by the site for about 2.6 km (1.6 mi) and joins the Missouri River after about 19 km (12 mi). Water flows off-site to the north into the Latty Avenue storm sewer system and to the south and southwest into an unnamed ditch, both of which drain into Coldwater Creek (Bechtel National 1990b). Coldwater Creek passes through culverts at Lambert-St. Louis International Airport, and its flow is influenced by storm-water runoff from the residential, commercial, industrial, and airport areas that are upstream.

More than 90% of the water used in St. Louis County comes from the Mississippi and Missouri rivers. The nearest potable surface water supply facilities are located at Central Plant and Howard Bend Plant on the Missouri River about 16 km (10 mi) west of the HISS, at Chain of Rocks Plant on the Mississippi River about 19 km (12 mi) east of the site, and at an intake point about 13 km (8 mi) downstream of the confluence of Coldwater Creek and the Missouri River. Coldwater Creek is not used for drinking water. The water quality of the creek is influenced by its setting in an industrial area; the pollutants of major concern are oil products transported into the stream by surface runoff, primarily from the airport (Argonne National Laboratory 1984).

2.1.5 Geology and Hydrogeology

The HISS and the vicinity properties in Hazelwood and Berkeley are located in the glaciated area of the Dissected Till Plains of eastern Missouri near the boundary with the Ozarks Province (Miller et al. 1974). The soils in this area consist of about 1 m (3 ft) of dark silt loam, and up to 3 m (10 ft) of eolian silty fine sands and clays (loess) that is underlain by 11 to 26 m (35 to 84 ft) of lacustrine sediments. Beneath the lacustrine sediments, the bedrock is composed of Pennsylvanian shales and sandstones and Mississippian limestone (Ford, Bacon & Davis Utah 1978).

Groundwater in this area is contained largely in unconsolidated deposits and to a much smaller extent in bedrock. The water from alluvial deposits is a calcium-magnesium-bicarbonate type, and softening is generally required. Alluvial deposits in the floodplains of the Missouri and Mississippi rivers can yield more than 126 L/s (2,000 gpm). The general direction of shallow groundwater flow in the vicinity of the HISS is west toward Coldwater Creek. The groundwater table varies seasonally. The water level at the HISS usually occurs about 6 m (20 ft) below the ground surface; during wet seasons, the water level is within 1.5 to 3 m (5 to 10 ft) of the surface (Argonne National Laboratory 1984; Ford, Bacon & Davis Utah 1978). Deeper groundwater in the bedrock is of very poor quality, containing dissolved solids at greater than 1,000 ppm. Yields from wells in bedrock about 1.6 km (1 mi) south of the HISS are very low, less than 25 L/min-m (2 gpm-ft) of drawdown. The groundwater in the vicinity of the HISS is not used for domestic purposes (Pais 1989).

2.2 SITE BACKGROUND

From 1942 through the late 1950s, several operations -- including the processing and production of various forms of uranium compounds and the machining and recovery of uranium metal -- were conducted at the facility now known as the St. Louis Downtown

Site. These activities were performed under contracts with the Manhattan Engineer District and the U.S. Atomic Energy Commission. At SLDS, which is now part of the St. Louis Site, thorium-230, uranium-238, and radium-226 have been identified as the primary radioactive contaminants (Bechtel National 1989b).

In 1946, the Manhattan Engineer District acquired SLAPS to store residues resulting from uranium processing at SLDS. Most of the wastes and residues were stored on open ground. Some contaminated materials and scrap were buried at the western end and in other parts of the site. From 1976 through 1978, Oak Ridge National Laboratory conducted a radiological investigation of SLAPS. The results of the study indicated elevated concentrations of uranium-238 and radium-226 (Oak Ridge National Laboratory 1979). In 1981, SLAPS was designated for remedial action under FUSRAP.

Continental Mining and Milling Company of Chicago, Illinois, purchased the wastes stored at SLAPS in 1966 and began to move them to 9200 Latty Avenue for storage. In 1967, the Commercial Discount Corporation of Chicago, Illinois, purchased the residues and, after drying, shipped much of the material to Canon City, Colorado. Cotter Corporation purchased the remaining residues at HISS in 1969, and dried and shipped additional material to Canon City during 1970. In 1973, the remaining material was shipped, undried, to Canon City, and the leached barium sulfate was mixed with 30 to 40 cm (12 to 18 in.) of topsoil and transported to a St. Louis County landfill. The U.S. Nuclear Regulatory Commission (NRC) was informed of this activity in early 1974.

In 1976, the NRC measured radiation levels and radionuclide concentrations in the soil at 9200 Latty Avenue. These measurements indicated that residual uranium and thorium concentrations and gamma exposure rates at the property exceeded existing guidelines for release without radiological restrictions. Radiological surveys conducted by Oak Ridge National Laboratory in 1977, prior to occupancy by the current owner, indicated surface contamination exceeding DOE guidelines (Leggett et al. 1977). Consequently, in 1979, the owner excavated approximately 10,000 m^3 (13,000 yd^3) from the western half of the property in an attempt to decontaminate that section prior to the construction of a manufacturing facility. The excavated material was stockpiled on the eastern portion of the property, the area now known as the HISS.

The 1984 Energy and Water Development Appropriations Act directed DOE to conduct a decontamination research and development project at four sites throughout the nation, one of which was the HISS. The results of surveys conducted to date demonstrate that the property at 9200 Latty Avenue (including the HISS) and surrounding vicinity properties exceed guidelines for residual radioactive material given in DOE Order 5400.5.

Remedial action activities at the HISS under FUSRAP were begun in 1984 by Bechtel National. These activities included clearing, cleanup, and excavation of the property at 9200 Latty Avenue and other nearby properties; fencing of HISS; and installation of environmental monitoring stations. This remedial action added about 11,000 m^3 (14,000 yd^3) of contaminated soil to the 10,000 m^3 (13,000 yd^3) of materials already in the storage pile.

Oak Ridge National Laboratory performed radiological surveys on and along Latty Avenue in 1981 and 1984. The 1984 survey identified thorium-230 as a major contaminant, with radium-226 and uranium-238 occurring in lesser amounts (Cottrell and Carrier 1986; Cottrell et al. 1986). Because of these results, DOE directed Bechtel to remediate areas of Latty Avenue to which contamination had spread, probably from utility line construction and flooding (Bechtel National 1985).

In 1985, DOE directed Oak Ridge National Laboratory to perform a radiological survey of the roads thought to have been used to transport contaminated materials to and from SLAPS and HISS. Gamma scans of roadsides detected exposure rates in excess of background due to elevated concentrations of radium-226 and uranium-238 in soil. However, thorium-230, an alpha emitter, was determined to be a primary radioactive contaminant in soil on the basis of its activity (Oak Ridge National Laboratory 1986). Parts of Hazelwood Avenue, Pershall Road, and McDonnell Boulevard were designated by DOE for remedial action in 1986.

In 1986, DOE directed Bechtel to provide radiological support to the cities of Berkeley and Hazelwood for a drainage/road improvement project. During that project, both thorium-230 and radium-226 were detected in excess of DOE remedial action guidelines, and about 3,500 m^3 (4,600 yd^3) of material was removed and placed in a supplemental storage pile at the HISS.

2.3 ANALYTICAL DATA

Radiological surveys were conducted by Bechtel National and its radiological subcontractor, ThermoAnalytical/Eberline, at HISS and the vicinity properties during 1986 through 1989. The purpose of the radiological surveys was to define the locations and boundaries of radioactive contamination and to provide data required to estimate the volume of contaminated materials. The radiological surveys indicated that thorium-230 is a contaminant at the SLAPS and HISS vicinity properties. Furthermore, a source term analysis performed by Bechtel National at SLAPS and HISS indicated that other radionuclides in the uranium-238, uranium-235, and thorium-232 decay series might be present (Liedle 1990).

The radiological hazards of the various radionuclides in the uranium-238 decay series can be determined from the activity concentrations of uranium-238, thorium-230, and radium-226. Activities of radionuclides from uranium-238 through uranium-234 can be assumed to be equal to that of uranium-238 because the activities of uranium-238 and uranium-234 are equal in nature and thorium-234 and protactinium-234 have short half-lives. Also, the activities of each individual radionuclide from radium-226 through lead-206 can be assumed to be equal to that of radium-226. The latter assumption is supported by measured concentrations of lead-210 reported in the source term analysis (Liedle 1990). Although the lead-210 concentrations are higher than those of radium-226 in some samples (by about a factor of 2), this has minimal impact on the dose calculation because the exposure routes of concern are inhalation and external gamma radiation (see Section 5.1.1).

The source term analysis indicated the presence of radionuclides in the uranium-235 series, principally protactinium-231 and actinium-227. For the analysis in this document, it was assumed that these two radionuclides and all subsequent decay products below actinium-227 down to lead-207 are in secular equilibrium, in which the activity of each radionuclide is equal to that of protactinium-231. This assumption is considered to be valid on the basis of the half-lives of the radionuclides (i.e., protactinium-231, 32,000 years; and actinium-227, 22 years) and the length of time since processing activities ceased (about 33 years). Because protactinium-231 and actinium-227 are assumed to be in secular equilibrium, it is not necessary to report both radionuclides in the risk calculation. Rather, the radiological hazards of actinium-227 are incorporated in the dose calculated for protactinium-231.

Although the concentrations of radionuclides in the thorium-232 decay series are slightly elevated above background values at the vicinity properties, preliminary calculations indicate that these radionuclides contribute less than 5% of the total dose and, hence, are not explicitly considered in the analysis presented in this report.

The results of the source term analysis confirmed that thorium-230 is a primary radioactive contaminant at HISS and SLAPS; the other radionuclides are present in significantly lower concentrations. The ratios of protactinium-231, radium-226, and uranium-238 to thorium-230 are conservatively determined to be about 2:100, 3:100, and 5:100, respectively. These ratios form the basis for the calculations presented in Section 5.1.1 of this report.

The procedures and types of measurements used at HISS and a summary of the survey results are briefly outlined in Section 2.3.1. The procedures and analytical results for the vicinity properties are discussed in Section 2.3.2. All field measurements and laboratory results represent gross readings; background values have not been subtracted. To establish background radiation levels and radionuclide concentrations in soil, measurements were made at three St. Louis locations. The average concentrations for the three locations (in pCi/g) were uranium-238, 1.1; thorium-230, 1.3; and radium-226, 0.9 (Bechtel National 1990a). Background concentrations of protactinium-231 and actinium-227 were not measured; however, based on a background concentration of 0.1 pCi/g determined for uranium-235, the background concentration of either protactinium-231 or actinium-227 can be assumed to be 0.1 pCi/g. The background concentration of thorium-232 in Missouri soils is about 1.0 pCi/g (Myrick et al. 1981).

2.3.1 Hazelwood Interim Storage Site

The radiological survey at the HISS consisted of establishing a reproducible grid, performing gamma radiation walkover surveys, taking near-surface gamma radiation measurements, and conducting subsurface soil investigations; soil samples were analyzed for uranium-238, radium-226, thorium-232, and thorium-230. A civil surveyor established a 15-m (50-ft) grid that spanned the entire site except for the two storage piles. The initial walkover gamma survey in the grid blocks was performed with an unshielded sodium-iodide, thallium-activated scintillation detector. Areas in which readings exceeded twice background levels were noted on a site drawing. Near-surface gamma radiation was measured 30 cm (12 in.) above the ground at 3.8-m (12.5-ft) intervals in the areas identified as contaminated on the basis of the walkover survey. Gamma exposure rates were measured at 1 m (3 ft) above the ground with a pressurized ionization chamber (PIC detector).

Subsurface investigations were conducted by drilling and/or hand augering holes at most of the 30-m (100-ft) grid intersections. The number and location of boreholes in each area were based on near-surface gamma measurements made in the respective area. Soil samples for thorium-230 analysis were collected in advance of an auger and sent for laboratory analysis because thorium-230 cannot be detected in situ. Gamma logging was conducted in each borehole; measurements were taken every 15 cm (6 in.) in order to obtain a profile of the depth of gamma-emitting radionuclides. The survey results for HISS are summarized in Table 1.

2.3.2 Vicinity Properties

A number of radiological investigations have been conducted on the vicinity properties associated with SLAPS and HISS. The range of thorium-230 contamination present at each property is summarized in Table 2. No walkover gamma scans or near-surface gamma radiation measurements were performed at the haul roads vicinity properties because thorium-230 (an alpha-emitting radionuclide) had already been identified as the major contaminant. However, walkover gamma scans will be performed prior to cleanup. With minor exceptions, the radiological investigation was conducted on each vicinity property by collecting soil samples in 0.3-m (1-ft) increments to a depth of 1 m (3 ft). Soil samples were collected at (1) the edge of the road at 15-m (50-ft) intervals, (2) 15 m (50 ft) from the road's edge at 15-m (50-ft) intervals, and (3) 46 m (150 ft) from the road's edge at 30-m (100-ft) intervals. The near-surface samples, i.e., those collected at a depth of 0 to 0.3 m (0 to 1 ft) from the edge of the road, were analyzed for thorium-230; the results of these analyses were used to determine whether to analyze successively deeper samples and/or samples collected farther back from the road's edge.

2.4 SITE CONDITIONS THAT JUSTIFY A REMOVAL ACTION

The threats posed by radioactive contamination at the vicinity properties are of a non-time-critical nature, i.e., no immediate risk to human health or the environment currently exists at these properties that would necessitate emergency cleanup within 6 months. However, the conditions do meet criteria listed in Section 300.415(b)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) for categorization of specific cleanup efforts as removal actions because there is "potential exposure to nearby populations, animals, or the food chain from hazardous substances or pollutants or contaminants." The conditions present at the SLAPS and HISS vicinity properties warrant selective interim remediation, as necessary, to prevent the inadvertent spread of contamination that could result from various non-DOE-initiated land development activities.

The results of sampling at the vicinity properties indicate that the primary contaminant is thorium-230. The guidelines for residual concentrations of thorium-230 in

TABLE 1 Summary of Soil Radiological Characteristics at the HISS

Measurement	Unit	Range	Average
Gamma radiation exposure rate	μR/h	13-55	24
General depth of radioactive contamination	ft	0-6	3
Radionuclide concentration[a]	pCi/g		
Radium-226		0.6-700	7.9
Thorium-230[b]		0.8-790	27.6
Thorium-232		0.4-5	1.5
Uranium-238		4-800	12.6

[a]Simple averages were used, and depth of contamination was disregarded.

[b]The maximum thorium-230 concentration at HISS is probably much greater than that indicated by the analytical results because only those samples not having elevated concentrations of gamma-emitting radionuclides were analyzed for thorium-230.

Source: Data from Bechtel National (1989a).

soil state that the concentrations shall not exceed 5 pCi/g averaged over the first 15 cm of soil below the surface; further, the concentration shall not exceed 15 pCi/g averaged over any 15-cm-thick soil layer below the surface layer. These guidelines represent allowable residual concentrations above background averaged across any 15-cm-thick layer to any depth and over any contiguous 100-m^2 surface area (DOE Order 5400.5). These guidelines were adapted by DOE from EPA guidelines and are based on a conservative (but plausible) use scenario for the contaminated areas. The average and range of thorium-230 concentrations at the SLAPS and Latty Avenue vicinity properties are given in Table 2; these data indicate that the radionuclides present at those vicinity properties exceed applicable DOE guidelines.

Potential radiological hazards from the contaminated soils are discussed in Section 5.1.1 of this report. To date, investigations have not identified evidence of other contaminated media (e.g., groundwaters, building surfaces, and surface waters) that warrant interim response actions.

TABLE 2 Concentrations of Thorium-230 on the SLAPS and Latty Avenue Vicinity Properties

Property	Thorium-230 (pCi/g) Average	Minimum	Maximum
SLAPS Vicinity Properties			
Banshee Road	1.5	0.4	34
Ditches to north and south	145	0.9	15,000
Airport Authority property	5.6	0.7	39
Ballfield	14.4	0.1	2,300
Haul roads properties			
Property 2	1.5	0.6	3.5
Property 3	1.3	0.6	2.4
Property 4	2.3	1.4	3.9
Property 5	4.5	1.1	14.0
Property 6	1.5	1.1	2.8
Property 7	5.5	0.6	32.0
Property 8	1.6	1.2	2.2
Property 9	5.5	0.5	12.0
Property 10	3.1	1.2	7.2
Property 11	6.3	0.8	18.0
Property 12	34.0	1.0	570.0
Property 13	34.0	0.7	370.0
Property 14	6.1	0.9	33.0
Property 14A	6.2	0.4	36.0
Property 15	12.7	0.6	460.0
Property 16	3.8	1.5	6.6
Property 16A	9.5	0.8	85.0
Property 17	1.3	0.9	1.4
Property 19 (residential)	2.6	0.7	11.0
Property 20 (residential)	3.1	0.7	8.4
Property 20A	1.6	0.6	2.6
Property 21	22.4	0.5	230.0
Property 22	15.2	0.6	110.0
Property 23	37.3	0.8	710.0
Property 24	26.2	0.4	710.0
Property 25	2.2	1.0	4.8
Property 26	3.0	1.4	6.9
Property 27	3.1	1.4	8.1
Property 28	2.9	0.5	4.6
Property 29	1.7	0.7	3.2
Property 30	3.4	1.0	8.8

TABLE 2 (Cont'd)

Property	Thorium-230 (pCi/g)		
	Average	Minimum	Maximum
SLAPS Vicinity Properties (Cont'd)			
Haul roads properties (Cont'd)			
Property 31	1.6	1.2	2.1
Property 31A	7.8	1.0	41.0
Property 32	39.4	0.3	540.0
Property 33 (residential)	27.6	1.1	170.0
Property 34 (residential)	17.9	1.3	140.0
Property 35	13.6	0.8	1,014.0
Property 36	19.0	1.2	210.0
Property 37	28.4	0.8	600.0
Property 38	20.6	0.5	1,200.0
Property 39	23.6	0.8	200.0
Property 40	15.4	0.5	110.0
Property 40A	2.5	1.9	3.8
Property 41 (residential)	5.2	0.8	53.0
Property 42	13.8	1.4	63.0
Property 43 (residential)	4.6	0.8	22.0
Property 44 (residential)	20.2	1.1	91.0
Property 45	5.2	1.0	21.0
Property 46	2.0	0.8	7.0
Property 47	12.3	0.9	110.0
Property 48	5.7	0.7	34.0
Property 48A	1.6	1.4	1.9
Property 49	1.1	0.8	1.5
Property 50	1.2	1.0	1.4
Property 51	1.3	1.0	1.7
Property 52	1.5	1.0	4.3
Property 53	3.7	0.8	21.0
Property 54	1.2	0.7	1.7
Property 55	1.6	1.3	2.3
Property 56	94.6	0.7	1,100.0
Property 57	4.8	1.3	19.0
Property 58	2.7	0.9	8.5
Property 59	1.7	1.3	2.2
Property 60	1.3	0.9	1.5
Property 61	1.3	0.8	1.7
Property 62	2.1	1.0	3.4
Property 63	2.4	1.0	10.0
Property 63A	3.6	0.6	200.0

TABLE 2 (Cont'd)

Property	Thorium-230 (pCi/g) Average	Minimum	Maximum
SLAPS Vicinity Properties (Cont'd)			
Norfolk and Western Railroad properties			
Adjacent to HISS	85.1	0.7	26,000
Adjacent to Hanley Road	2.1	0.8	6
South of SLAPS	22.7	1.5	170
Adjacent to Coldwater Creek	34.1	0.3	1,300
Coldwater Creek vicinity properties			
Property 1	8.9	1.4	38.0
Property 2	3.1	1.0	7.7
Property 3	9.8	0.8	79.0
Property 4	1.9	0.6	5.1
Property 5	13.0	0.7	61.0
Property 6	2.5	1.1	5.2
Property 7	1.9	0.9	3.7
Property 8	6.2	1.1	23.0
Property 9	2.6	1.0	6.5
Property 10	3.0	1.5	5.7
Latty Avenue Properties			
Property 1	34.8	0.7	810.0
Property 2	99.0	0.4	5,700.0
Property 3	3.6	0.2	31.0
Property 4	23.1	0.7	460.0
Property 5	2.5	0.6	12.0
Property 6	3.5	0.7	21.0

Source: Data from Bechtel National (1990a).

3 REMOVAL ACTION OBJECTIVES

The potential exists for disturbance and spreading of soil contamination on the uncontrolled public and private vicinity properties in the Hazelwood and Berkeley area because of the range of active land uses and the extent of contamination at the properties. Examples of near-term activities that could result in such disturbance include road improvements, private construction activities, and utility line installation and repair. The intent of the proposed action is to establish an interim storage facility and response process that would allow these types of activities to proceed while ensuring that appropriate environmental precautions are employed. Specifically, implementation of the proposed action would allow DOE to remove, transport, and safely store soils from properties where other activities (not involving DOE) are likely to result in either spreading contamination or otherwise complicating ultimate cleanup measures. This overall objective is defined in Sections 3.1 through 3.4 in terms of statutory limits, scope and purpose of the proposed action, schedule, and compliance with applicable or relevant and appropriate requirements (ARARs). This EE/CA-EA also addresses the potential impacts to human health and the environment associated with the proposed action.

3.1 STATUTORY LIMITS

Authority for responding to releases or threats of releases from a hazardous waste site is addressed in Section 104 of CERCLA. Executive Order 12580 delegates to DOE the authority for removal actions at DOE sites, whether or not the sites are on the National Priorities List. Under CERCLA Section 104(b), DOE is authorized to undertake such investigations, surveys, testing, or other data gathering deemed necessary to identify the existence, extent, and nature of the contaminants, including the extent of threats to human health and the environment. In addition, DOE is authorized to undertake planning, engineering, and other studies or investigations appropriate to directing response actions to prevent, limit, or mitigate the risk to human health and the environment.

3.2 SCOPE AND PURPOSE

The scope of the proposed removal action can be broadly defined as management of radioactively contaminated materials at the vicinity properties. The specific objectives of the proposed removal action are:

- Remediation of radioactively contaminated soil at vicinity properties to eliminate potential hazards to human health and the environment associated with this contamination,
- Minimization of potential health hazards to on-site personnel performing the removal action,

- Restoration of the affected vicinity properties according to agreements established with each property owner, and
- Certification of the properties for use without radiological restrictions.

The timely and complete removal of contaminated soil from these properties would contribute to the efficient performance of the remedial action being planned for the permanent disposition of materials currently located at the three areas comprising the St. Louis Site.

3.3 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The proposed response action at the HISS and vicinity properties would be carried out in accordance with all ARARs. *Applicable requirements* are those for which the jurisdictional prerequisites are specifically met by the proposed action or site circumstances. *Relevant and appropriate requirements* are those that address problems or situations sufficiently similar to those encountered at the site in question that their use is well suited to the particular site. A determination of applicability is made for the requirement as a whole, whereas a determination of relevance and appropriateness may be made for specific portions of a requirement. Any standard, requirement, criterion, or limitation under any federal or state environmental law or state facility siting law may be considered either applicable or relevant and appropriate to a specific action at a site.

Requirements that may be pertinent to the proposed action for the SLAPS and HISS vicinity properties are presented in Appendix B. The preliminary identification of potential ARARs for the proposed action is based on the nature of the contamination (primarily radioactively contaminated soils) and the locations of the properties.

In addition to ARARs, guidelines or standards that have not been promulgated may also have a direct bearing on the proposed action. These are identified as "to-be-considered (TBC)" requirements and include certain DOE guidelines. The DOE guidelines with which the proposed action will comply include limits for residual concentrations of radium and thorium in soil, which have been adopted from standards promulgated by EPA. The limits for these radionuclides are 5 pCi/g averaged over a 100-m^2 area for the surface 15 cm of soil and 15 pCi/g for each 15-cm increment below the surface (DOE Order 5400.5). Available data indicate that radionuclide concentrations present at the vicinity properties exceed these guidelines (see Table 2).

The DOE will comply with all pertinent environmental requirements to ensure the protection of human health and the environment during implementation of the proposed action. Appropriate standards from the Occupational Safety and Health Administration Act and other employee protection laws and guidelines will be followed to ensure worker protection during implementation.

4 REMOVAL ACTION TECHNOLOGIES

The following discussion summarizes the procedures and rationale for identifying alternative removal actions by considering the relevant technologies that may be implemented. This process is consistent with the NCP and with EPA guidance regarding removal actions. Because of the nature of the contamination at the vicinity properties, the number of practicable and suitable treatment technologies that can be applied is limited. The technologies considered in selecting removal action alternatives include those identified in the NCP. Additional technologies addressed in the following discussion are based on experience and information gained as a result of removal action planning and implementation at other FUSRAP sites.

4.1 TECHNOLOGIES POTENTIALLY APPLICABLE TO THE PROPOSED ACTION

The preliminary identification of technologies discussed in Sections 4.1.1 through 4.1.5 is not all-inclusive but provides a general overview of relevant technologies that could be applied to protect human health and the environment. These technologies were screened on the basis of site-specific conditions and the current understanding of contamination at the vicinity properties.

The objective of the removal action is to protect human health and the environment by altering the waste source (i.e., the radioactively hazardous constituents) or reducing the potential for human or environmental exposure. Response actions that are potentially applicable to the proposed action at the vicinity properties include access restrictions, waste removal, waste reprocessing/treatment, interim storage, and disposal.

4.1.1 Access Restrictions

Access restrictions involve the use of physical barriers and/or institutional controls to reduce the potential for exposure to contaminated materials. Physical barriers, such as fences or surface caps, are relatively easy to implement and can protect human health and the environment. Fences are generally not effective in controlling the source or migration of contaminated materials at the vicinity properties, and public concerns (e.g., inconvenience to property owners) could also result in difficulties regarding implementation. Therefore, fences as access restrictions at the vicinity properties are eliminated from further consideration. Capping (e.g., clay with vegetative cover or riprap, asphalt, or geosynthetic covers) can limit mobility and reduce the potential for exposure to contaminated materials. Therefore, capping as a physical barrier is considered applicable to the proposed action. Institutional controls are not generally effective for extended periods in preventing contact with the source of contaminants. Also, public concerns (e.g., inconvenience to property owners) could result in difficulties regarding their implementation.

4.1.2 Removal

The removal of contaminated materials may involve decontamination and excavation. These technologies are reliable, can be easily implemented with standard construction procedures and conventional equipment, and have been used extensively to control radioactive contamination similar to that associated with the vicinity properties. Because the scope of the proposed action at the vicinity properties is limited to the cleanup of contaminated soil, excavation is identified as the applicable removal technology.

4.1.3 Reprocessing/Treatment

Reprocessing/treatment includes a wide range of technologies, only a limited number of which can be implemented where radioactive contamination is present. Radioactive waste reprocessing/treatment technologies can be divided into two general categories:

- Those that remove the radioactive material from the waste matrix, and

- Those that change the form of the waste, thereby reducing its toxicity, mobility, or volume.

Extraction is a chemical treatment technology that may be considered for contaminated soil. Such a process can be used to separate radioactive contaminants from a waste matrix, and the liquid leachate can then be reprocessed to isolate the radioactive components. At the vicinity properties, the extraction of low levels of radioactive contaminants from large volumes of soil would involve significant cost, time, technical, and institutional factors.

Two classes of physical treatment technologies that may be considered for contaminated soil are in-situ vitrification and separation. However, the in-situ vitrification technology would not be suitable for use in an urban setting with its abundance of structures, vegetation, utilities, and roads adjacent to the contaminated areas. Another disadvantage is that the vitrified wastes are left in place. Several separation techniques have been identified for reducing the volume of contaminated soil and bulk waste materials by separating the radioactive constituents from the waste matrix. These techniques -- including sand sifting, paramagnetic separation, soil sorting, and selective mineral separation -- are developmental; their effectiveness and reliability for treatment of contaminated soil have not yet been demonstrated on a full-scale basis. Furthermore, use of these techniques would require additional costs for developing a central processing facility to treat the excavated wastes and for transporting the wastes to the processing facility.

The reprocessing/treatment of contaminated materials from the vicinity properties, by either chemical processing or physical treatment, is eliminated from further consideration on the basis of the factors discussed above that affect implementation. Most technologies identified as potentially applicable to this action have not yet been demonstrated on a full-scale basis, and the time required for their development is beyond the time frame under consideration. Furthermore, because the radioactive materials on the vicinity properties are present at low concentrations in a large volume of soil, separation by any developmental reprocessing or treatment technology would be difficult, time consuming, and costly.

4.1.4 Interim Storage

Interim storage involves the temporary placement of contaminated materials in a manner that protects human health and the environment. Interim storage can be achieved by placing the contaminated materials in an existing engineered facility or in a newly constructed facility. Because storage capacity can be made available at the HISS and because this facility meets all other requirements, temporary storage at the HISS is retained for further consideration. Interim storage at an alternate site is not practicable because of cost and time required for implementation. These considerations are discussed in Appendix A. Interim storage in a newly constructed facility is also eliminated from further consideration on the basis of cost and implementation time.

4.1.5 Disposal

Disposal involves the placement of contaminated materials in an engineered disposal facility, which reduces the mobility of the contamination and protects human health and the environment. The wastes may be permanently disposed of in one of three types of facilities: (1) a FUSRAP-exclusive facility, (2) a commercial facility, or (3) a government facility. Due to time constraints, cost, and origin of the FUSRAP wastes, permanent disposal is not a viable option at this time. A more detailed analysis of permanent disposal options is included in Appendix A.

4.1.6 Summary

The identification and preliminary screening of potential technologies for the proposed action at the vicinity properties are summarized in Table 3. Preliminary removal action alternatives are identified in Section 4.2.

4.2 IDENTIFICATION OF PRELIMINARY REMOVAL ACTION ALTERNATIVES

Alternatives for the proposed removal action were identified by consideration of applicable technologies in accordance with the criteria set forth in the NCP. The potential technologies described in Sections 4.1.1 through 4.1.5 and summarized in Table 3 were screened with regard to effectiveness, implementability, and cost on the basis of the characteristics of the vicinity properties and the waste materials at these properties. No treatment technology has yet been demonstrated -- in terms of effectiveness and reliability -- that would either eliminate the risks associated with radioactive contaminants or neutralize the radioactivity of the materials. Therefore,

TABLE 3 Summary of Response Action Technologies as Related to the Proposed Action at Contaminated Vicinity Properties

Technology	Evaluation Result	Comments
Access Restrictions		
Physical barriers		
Fences	Rejected	Not effective in controlling the source or migration of radioactive contaminants.
Capping	Retained	Can limit contaminant mobility and can mitigate potential exposures.
Institutional controls	Rejected	Prohibitively difficult to implement as an exclusive technology at the vicinity properties because of institutional issues.
Removal		
Excavation	Retained	Relatively straightforward to implement; allows use of the remediated area without radiological restrictions. Requires storage or disposal facility and access restrictions during excavation.
Decontamination	Rejected	Not relevant because no structures are involved in the proposed removal action for the vicinity properties.
Demolition	Rejected	Not relevant for contaminated soil.

TABLE 3 (Cont'd)

Technology	Evaluation Result	Comments
Reprocessing/Treatment		
Chemical treatment		
Leaching/extraction	Rejected	Not applicable because extraction of low levels of contaminants from relatively large volumes of soil would involve unacceptable cost, time, technical, and institutional factors.
Physical treatment		
In-Situ Vitrification	Rejected	Not applicable because implementation would involve unacceptable cost, time, technical, and institutional factors and because the overall objective of certifying the properties for use without radiological restrictions would not be met.
Sand sifting	Rejected	Not applicable because separation of low levels of contaminants from relatively large volumes of soil would involve unacceptable cost, time, technical, and institutional factors.
Paramagnetic separation, soil sorting, selective mineral separation	Rejected	Not applicable because separation of low levels of contaminants from relatively large volumes of soil would involve unacceptable cost, time, technical, and institutional factors.
Interim Storage		
Existing facility	Retained	Currently available at the HISS.
Newly engineered facility	Rejected	Not applicable because of cost and time required to site a new facility.

TABLE 3 (Cont'd)

Technology	Evaluation Result	Comments
Disposal		
Existing facility (government or commercial)	Rejected	Not applicable because of the time frame necessary to support the objectives of this action and because of prohibitive costs for transportation and disposal.
Newly constructed facility	Rejected	Not applicable because siting and construction of a new facility would take several years.

because of the nature of the contamination at the vicinity properties (i.e., low levels of contaminants in relatively large volumes of soil) and because of the unavailability of an acceptable technology (see Section 4.1.3), the treatment option was eliminated during preliminary screening. Hence, treatment technologies are not included as components of any of the proposed alternatives.

The preliminary screening of potentially applicable technologies, as summarized in Table 3, resulted in identification of the following technologies as potential components of removal action alternatives: access restrictions (capping), removal (excavation), and interim storage (existing facility). The screened technologies have been grouped into preliminary alternatives for the proposed action, as follows:

Alternative 1: No action;

Alternative 2: Access restrictions (capping); and

Alternative 3: Expedited removal (excavation) of the contaminated materials from the vicinity properties, with transport to and interim storage at the HISS. Includes temporary access restrictions during excavation and restoration activities.

5 ANALYSIS OF ALTERNATIVES

The proposed action is an interim action with regard to the overall remedial action planned for radioactively contaminated materials at the St. Louis Site. The purpose of this interim action is to improve near-term environmental and related health and safety conditions at the vicinity properties. The alternatives for the proposed action are evaluated in Section 5.1 for effectiveness in terms of their potential health impacts and potential environmental impacts. The alternatives are evaluated in Section 5.2 for implementability in terms of technical feasibility, availability, and administrative feasibility. The costs of implementing these alternatives are estimated in Section 5.3. The alternatives are compared in Section 5.4, and the preferred alternative is identified in Section 5.5.

5.1 EFFECTIVENESS

The effectiveness of an alternative is defined by its effectiveness in ensuring protection of and minimizing impacts to human health and the environment. Potential impacts of the three alternatives are addressed in Sections 5.1.1 and 5.1.2 and are summarized in Table 4.

5.1.1 Potential Health Impacts

Alternative 1, the no-action alternative, involves no change in current exposures to elevated levels of radioactivity in the environment. The no-action alternative does not allow for the control of contaminated materials in those instances where there is a high probability for the movement of contamination as a result of property development or improvements and repairs to community infrastructure. The inadvertent spread of contamination in these instances could increase the near-term risk to human health.

Alternative 2, use of access restrictions (capping), could limit contaminant mobility and could minimize exposure of the general public to radioactively contaminated materials at the vicinity properties. However, surface caps are not effective for extended periods of time, they can be inconvenient to property owners, and they require inspection and maintenance. Therefore, for Alternative 2, the potential health impacts associated with long-term exposure to radioactive contaminants at the vicinity properties would remain, and the objective of effectively protecting human health and the environment would not be achieved.

Under Alternative 3, the contaminated materials would be excavated from the vicinity properties and then transported to and stored at the nearby HISS. To assess the potential radiological impacts associated with Alternative 3, conservative estimates were calculated of radiation doses to both a member of the general public (i.e., a resident at a vicinity property or an employee at a nearby commercial or municipal property) and a removal action worker.

TABLE 4 Comparative Analysis of Removal Action Alternatives

Alternative	Effectiveness: Health Impacts	Effectiveness: Environmental Impacts	Implementability: Feasibility	Implementability: Availability	Implementability: Administrative Feasibility	Cost
1. No action	No change. Has potential for impacts due to disturbances by property owner or local utility company.	No direct impacts. Has potential for impacts due to natural forces or disturbances by property owner or local utility company.	Not applicable.	Not applicable.	Unacceptable. Does not achieve response objectives or satisfy state and local concerns.	No direct cost. Has potential for increased future cost due to invalidation of existing characterization data and migration of contamination resulting from disturbance of contaminated areas.
2. Access restrictions (capping)	Not effective for long term. Reduces potential for impacts due to natural forces or disturbances by property owner or local utility company.	No direct impacts. Reduces potential for impacts due to natural forces or disturbances by property owner or local utility company.	Technically feasible.	Available, but difficult to implement on private land.	Unacceptable. Only partially achieves response objectives and does not satisfy state and local concerns.	$125,000/yr for capping (estimate based on soil volume of 3,800 m^3 [5,000 yd^3] per year). Does not include long-term maintenance.
3. Expedited action (excavation and storage at HISS)	Minimal impacts that could be mitigated during remedial action. Eliminates long-term impacts at the vicinity properties.	Minimal impacts that could be mitigated during remedial action. Eliminates long-term impacts at the vicinity properties.	Technically feasible.	Available.	Acceptable. Achieves all response objectives and satisfies state and local concerns.	$2,350,000/yr (estimate based on soil volume of 3,800 m^3 [5,000 yd^3] per year). Does not include long-term maintenance or monitoring at the interim storage site.

General Public Radiation Dose and Health Risk. During excavation activities, a resident or employee at a nearby property could incur a radiation dose, primarily from inhalation of resuspended radionuclides. The dose from external gamma radiation would be much lower than that from airborne particulates because the external gamma exposure rate decreases rapidly with distance from the source. The doses incurred during transportation and storage of contaminated materials would be low because of the short transport distance and the controlled storage facility. The occurrence of any spillage during transport is expected to be minimal; also, because of the nature of the cargo (i.e., soil), any spillage could easily be picked up and reloaded onto the truck. Thus, the potential for radiation exposure of the general public resulting from spillage is minimal.

The inhalation dose to a member of the general public was estimated from the following radionuclide concentrations: 145 pCi/g for thorium-230, the highest average value measured in soil samples from any of the contaminated vicinity properties (see Table 2); 4.4 pCi/g for radium-226; 7.3 pCi/g for uranium-238; and 2.9 pCi/g for protactinium-231. The values for radium-226, uranium-238, and protactinium-231 were based on the measured concentration of thorium-230 (145 pCi/g) and ratios of the other three radionuclides to thorium-230 that were determined in the source term analysis (Section 2.3). The contaminated area was assumed to require 40 hours to clean up. It was also assumed that the impacted individual has a breathing rate of 1.2 m^3/h and is exposed to an airborne particulate concentration of 2×10^{-4} g/m^3. Dose conversion factors were obtained from Gilbert et al. (1989). The radiation dose to a resident or employee at a nearby property is estimated to be 0.69 mrem (Table 5). This dose is considerably below the basic annual dose limit of 100 mrem/yr given in DOE Order 5400.5 and would result in an incremental lifetime radiological risk of 4×10^{-7} (i.e., the risk of cancer induction over the remainder of this person's lifetime from the 40-hour radiation exposure during cleanup). For purposes of comparison, exposure to natural sources of radiation -- i.e., radon, terrestrial radiation, and cosmic rays -- results in an effective dose equivalent of about 300 mrem/yr (National Council on Radiation Protection and Measurements 1987), which corresponds to an annual radiological risk of about 2×10^{-4}.

Worker Radiation Dose and Health Risk. While conducting the removal action, a worker performing excavation, transportation, or unloading activities could incur a radiation dose. Assuming no use of respiratory protective equipment, the worker would incur doses primarily from inhalation of resuspended radionuclides and external gamma radiation. The inhalation dose was estimated by assuming that the worker would inhale contaminated dust having the same soil concentrations as those for the general public exposure assessment -- i.e., 145 pCi/g for thorium-230, 4.4 pCi/g for radium-226, 7.3 pCi/g for uranium-238, and 2.9 pCi/g for protactinium-231. An individual worker is assumed to spend 1,000 hours per year (number of hours estimated per construction season) in close proximity to these contaminated materials. The breathing rate, airborne particulate concentrations, and dose conversion factors were assumed to be the same as those for the general public dose calculation. The estimated dose to a removal action worker during one construction season is estimated to be 17 mrem/yr from inhalation and 9 mrem/yr from external gamma radiation (Table 5). Thus, the total radiation dose to a

TABLE 5 Estimated Radiation Doses and Resultant Health Risks to Hypothetical Receptors Resulting from a Single Construction Season

	Radiation Dose (mrem)			
Receptor	Inhalation of Resuspended Particulates	External Gamma	Total	Risk[a]
Member of the general public	0.69	–[b]	0.69	4×10^{-7}
Removal action worker	17	9[c]	26	2×10^{-5}

[a]Risk of cancer induction based on a risk factor of 6×10^{-7}/mrem (from information given in EPA [1989]).

[b]The external gamma pathway was not quantified because this exposure mechanism would be negligible for members of the general public.

[c]Dose estimate based on the assumption that a worker is standing on top of a large area of contaminated soil having a depth of 0.6 m (2 ft).

worker is estimated to be about 26 mrem/yr, which is considerably below the DOE occupational dose limit of 5,000 mrem/yr given in DOE Order 5480.11. This radiation dose would result in an incremental lifetime radiological risk of 2×10^{-5} (i.e., the risk of cancer induction over the remainder of the worker's lifetime from one construction season of radiation exposure).

An estimated 40 person-years of effort is projected to be required to decontaminate the vicinity properties and transport generated wastes to the HISS over a period of several years. The resultant dose to the entire work force is therefore estimated to be 1,040 person-mrem, and the incremental lifetime radiological risk to this work force is estimated to be 6×10^{-4}.

Discussion. Although the estimated doses to a member of the general public (i.e., resident or employee) and a removal action worker are considerably below DOE limits, they would be reduced even more by the implementation of mitigative measures during the removal action. These include employing good engineering practices (i.e., effective dust control during excavation) and establishing sound health physics and industrial hygiene procedures (e.g., effective monitoring and good housekeeping) in accordance with DOE's as low as reasonably achievable process.

Under Alternative 3, the radioactively contaminated materials resulting from cleanup of the vicinity properties would be placed at the HISS in accordance with ARARs and is therefore expected to ensure protection of human health and the environment. This site has been in use since 1979 for the storage of similar materials from earlier cleanup efforts, and DOE's continued monitoring of the environment in the vicinity of the HISS has shown that no negative impacts are associated with interim storage of the radioactive materials. After the contaminated materials from cleanup of the vicinity properties were placed into a new storage pile at the HISS, the pile would be covered with a synthetic membrane. The additional volume of radioactive materials stored at the HISS is expected to result in only a minimal increase in the potential dose to a nearby individual.

5.1.2 Potential Environmental Impacts

Soils and Water Resources. Alternatives 1 and 2 would not impact the soils of the vicinity properties because the soil would be undisturbed. However, for Alternative 1, the potential for contamination of surface water, groundwater, and other soils near the properties would continue as a result of radioactivity released from the vicinity properties through runoff and soil leaching. Alternative 2 would greatly reduce the potential for surface water and groundwater impacts as long as the integrity of the cap was maintained.

Alternative 3 is expected to reduce long-term potential impacts on water resources near the vicinity properties; however, some minor impacts on surface water and groundwater could occur during the excavation period. Disturbed areas would be susceptible to wind and water erosion and would potentially impact the quality of nearby water bodies (e.g., Coldwater Creek). Contamination of shallow groundwater might also occur due to higher rates of leaching under disturbed conditions. These temporary effects could be minimized by decreasing the area disturbed at any time during soil excavation operations and by employing good engineering practices (e.g., sediment barriers to minimize the amount of sediment leaving the work area and containment of surface runoff during storms). Further reduction of short-term impacts could be achieved if the removal action were followed by timely replacement of the excavated soil with uncontaminated topsoil and revegetation of the new soil cover.

Air Quality. Under Alternatives 1 and 2, private maintenance could disturb contaminated soils and raise dust, resulting in a potentially incremental impact on air quality due to the release of airborne contaminants from contaminated areas. Even though the potential releases are expected to be minimal and are not likely to result in significant exposure, they represent a continuing potential threat to nearby residents.

Resuspension/dispersal of contaminated dust during excavation under Alternative 3 could impact local air quality during the short term, but these impacts would be eliminated after the removal action were completed. The potential for dust generation while implementing the removal action would be minimized by limiting vehicular traffic and by implementing good engineering practices (e.g., wetting and/or covering exposed surfaces, as appropriate, during the action period). Monitors would be installed to determine airborne particulate concentrations so that compliance with pertinent requirements and protection of worker health and safety would be ensured.

Vegetation and Wildlife. Implementation of Alternative 1 would result in no physical alteration of existing habitats and associated biota. Implementation of Alternative 2 might result in minor alterations. However, under both Alternatives 1 and 2, the potential would continue for the spread of contamination into a larger area of the local environment due to resuspension and leaching. The potential for continued and increased exposure of local vegetation via uptake would remain.

Alternative 3 could impact biota as a result of disturbance and limited destruction of habitats during excavation and restoration activities. Animals inhabiting the vicinity properties and adjacent areas within auditory or visual detection of the excavation or waste transport operations might temporarily leave the area, having been disturbed or displaced. However, the vicinity properties do not provide substantial wildlife habitats because of low vegetative diversity, existence of buildings, and human disturbance. As a result, few animal species inhabit the vicinity properties. Vegetation on the contaminated areas of the vicinity properties would be destroyed during excavation activities; however, the existing plant species are neither unique nor restricted in distribution, and disturbed habitats could be readily revegetated. Thus, because the vicinity properties support only a few common species, the excavation of contaminated soil would have no significant deleterious effect on biota in the impacted area. Removal of the contaminated soil would, however, eliminate the existing potential for uncontrolled spread of contamination. No wetlands would be impacted as a result of adopting Alternative 3.

Threatened or endangered species should be unaffected by implementing any one of the alternatives because critical habitats for listed species are not present at the vicinity properties. In 1985, the U.S. Army Corps of Engineers requested that the Missouri Department of Conservation search available records in this regard. The search revealed no evidence for the existence of any sensitive species or communities in the area of the vicinity properties (St. Louis District Corps of Engineers 1987). Therefore, no impacts to threatened or endangered species are expected.

Cultural Resources. No archaeological sites or historic structures listed in the *National Register of Historic Places* would be affected by implementing any one of the alternatives. Because of the history of prior disturbance, it is unlikely that the potentially affected areas contain any previously unrecorded archaeological sites that meet eligibility criteria for the *National Register* (as defined in 36 CFR Part 60). The DOE will consult with the Missouri State Historic Preservation Office (SHPO) to establish whether additional inventory procedures (e.g., field surveys) would be necessary for compliance with the National Historic Preservation Act (following guidelines for consultation in 36 CFR Part 800). The SHPO is expected to determine that the proposed removal action would have no adverse effects on sites or structures eligible for the *National Register*.

5.2 IMPLEMENTABILITY

Implementability of an alternative is defined by its technical feasibility, availability, and administrative feasibility. The comparative analysis of the implementability of the three alternatives is discussed in Sections 5.2.1 through 5.2.3 and summarized in Table 4.

5.2.1 Technical Feasibility

Technical feasibility does not apply to Alternative 1, the no-action alternative, whereas the components of Alternatives 2 and 3 are technically feasible and have been implemented for similar actions. Access restrictions (capping) could reduce waste mobility and could limit human or animal contact with, and/or disturbance of, contaminated materials. Surface caps as access restrictions are technically feasible because they can be constructed using standard engineering practices and equipment. Excavation is technically feasible and would significantly reduce waste mobility subsequent to implementation. Its performance has been demonstrated during past removal actions at other vicinity properties. Monitoring and maintenance activities would not be required at the vicinity properties following excavation of the contaminated soils, and environmental conditions at the properties would not impede implementation of this option.

Interim storage is technically feasible and would reduce waste mobility. Its performance has been demonstrated by use of the HISS for storage of contaminated materials resulting from past removal actions. The useful life of the interim storage facility is sufficient for Alternative 3. Monitoring and maintenance of the performance and effectiveness of similar actions (in terms of protecting human health and the environment) have been conducted since DOE became responsible for the HISS and will be continued until the contaminated materials are transferred to a permanent disposal facility. The current monitoring system -- which consists of monitoring wells, gamma radiation monitors, and radon monitors around the site perimeter -- is sufficient to meet the objective of protecting human health and the environment.

5.2.2 Availability

All of the components required to implement either Alternative 2 or 3 are available, and availability does not apply to Alternative 1. However, it may be difficult to implement access restrictions on private land. Hence, Alternative 2 is less favorable than Alternative 3 with regard to availability.

5.2.3 Administrative Feasibility

Administrative feasibility considerations address the potential of a proposed action to achieve response objectives and to satisfy state and local concerns -- including permitting and interagency cooperation, public and occupational safety, transportation factors, impacts on land use and values, compliance with policies and requirements, and public acceptance. The NCP specifies that a formal community relations plan be developed to provide information to the public and to obtain public comment. A community relations plan is currently available for the FUSRAP sites in the St. Louis area.

The selection of Alternative 1 or 2 as a sole response could raise serious administrative feasibility concerns in terms of perceived health risks, reduced property values, and restricted land use. Because the affected owners/occupants want to have the contaminated materials removed from their properties, access restrictions -- in and of themselves -- is not considered an acceptable response.

Two specific issues could affect public reaction to cleanup of the vicinity properties as proposed under Alternative 3. The first issue is the perception that the HISS might become a permanent facility for waste storage. Congressional and programmatic directions are to consolidate all St. Louis FUSRAP wastes in one permanent disposal facility. The amount of land required for this far exceeds the size of the HISS. Hence, use of the HISS for permanent waste disposal is contrary to Congressional and programmatic direction and is not feasible. The second issue is the traffic and noise associated with excavation and transportation of the contaminated soils. Because the majority of properties in the vicinity of HISS are commercial or industrial, noise should not be a problem; also, any additional traffic would be minimal. In general, Alternative 3 is not expected to present significant administrative feasibility problems on the basis of both the strong desire of affected owners/occupants to have the contaminated materials removed from their properties and past experience with cleanup of other vicinity properties. To minimize such potential problems, all activities would be conducted in accordance with pertinent regulatory requirements, and excavation and property restoration would be conducted in accordance with the terms and conditions of the access agreements signed by each property owner.

Alternative 3 would probably have little if any negative impact on local land use or property values. If this alternative were selected, contaminated materials would be removed from the vicinity properties in the near term in a manner that would minimize potential administrative feasibility concerns. This removal action is expected to increase the marketability of the properties. In addition, the properties would be certified for use without radiological restrictions following implementation of Alternative 3. Interim storage at the HISS has been established pursuant to earlier remediation efforts, and additional administrative feasibility issues are not expected to result from the storage of an increased volume of contaminated materials at the site.

5.3 COST

Funds from DOE, not from EPA's Superfund, would be used to implement the proposed action at the vicinity properties; therefore, a detailed cost analysis is not included in this report. Because the proposed action would be completed within a few years, present value considerations would not appreciably impact cost estimates; therefore, they have not been used to compare cost estimates for the two action alternatives in this EE/CA. This consideration does not apply to Alternative 1, for which no costs would be incurred.

The estimated unit cost for implementing Alternative 2 (access restrictions -- i.e., capping contaminated areas) is $33/m^3 ($25/yd^3); thus, the annual cost of managing 3,800 m^3 (5,000 yd^3) of soil would be $125,000. This estimate includes costs for subcontracts, engineering, environmental health and safety support, procurement, office overhead, and contingencies. Alternative 2 would cost significantly less than Alternative 3 in the near term. The potential long-term costs associated with Alternative 2 could be substantially greater if failure to control the migration of contaminants resulted in their extension onto properties that are not currently contaminated. In addition, inspection and maintenance of the caps, although not significantly higher in the near term, could continue for an indeterminate period. For these reasons, the costs of Alternative 2 could potentially be quite high.

The cost estimate for Alternative 3 (excavation of soil from the vicinity properties with transport to the HISS for interim storage) includes the costs for subcontracts, engineering, environmental health and safety support, procurement, office overhead, and contingencies. For management of soil under Alternative 3, the estimated unit cost is $610/m^3 ($470/yd^3). This unit cost would apply to management of contaminated soil at all vicinity properties in the Hazelwood and Berkeley area as long as the destination of the excavated materials remained in the immediate area. Thus, the annual cost of managing 3,800 m^3 (5,000 yd^3) of soil would be $2,350,000. The cost benefit of Alternative 3 is associated with removal of contaminated materials from the vicinity properties, which limits the potential costs related to (1) cleanup of additional properties that become contaminated as a result of migration from adjacent contaminated properties and (2) potential long-term monitoring of the residential vicinity properties. Costs associated with interim storage are not expected to be significant because the HISS is currently being used for storage of contaminated materials and the incremental cost related to an increase in storage volume is expected to be small. Near-term costs associated with the excavation, transportation, and interim storage activities of Alternative 3 would exceed the near-term costs for Alternative 2. However, total costs could be less for Alternative 3 than Alternative 2 because of the timely removal of contaminated materials from the vicinity properties.

5.4 COMPARATIVE ANALYSIS OF REMOVAL ALTERNATIVES

Alternative 1 is not in compliance with ARARs because the concentrations of thorium-230 in soil exceed DOE guidelines for release of sites without radiological restrictions. This alternative does not allow for the control of contaminated materials and could contribute to the spread of contamination, especially in areas of property development and infrastructure improvement. It could impact property owners and communities who might not be able to implement development plans because of the presence of radioactive contamination. Hence, Alternative 1 is eliminated from further consideration.

Alternative 2 is technically feasible and would require only low near-term costs; however, it could lead to relatively high costs at a later date because of the potential for legal fees and property acquisitions as well as for a subsequent need to respond to a potential increased extent of contamination. Alternative 2 could confront major obstacles related to property values, perceived health risks, and DOE's responsibility to ensure protection of human health and the environment. Potential adverse environmental impacts include (1) the continued potential for contamination of surface waters and groundwaters through runoff and soil leaching and (2) the possible spread of contamination to a larger area -- through unauthorized disturbances (e.g., construction activities) and/or leaching -- with an increased potential for exposure of humans and local biota to radioactivity. Thus, Alternative 2 does not meet the stated objective of protecting human health and the environment.

Alternative 3 involves the use of technically feasible methods for the removal (i.e., excavation) of contaminated materials from the vicinity properties. Interim storage at the HISS is also technically feasible (the site is currently used to store materials from earlier remediation activities). Costs would be incurred in the near term for excavation and transport of the contaminated materials to the nearby storage facility. Additional costs associated with operation and maintenance of the storage facility are not expected to be significant (i.e., the incremental cost due to the additional volume of contaminated materials is expected to be negligible). Because the excavation and interim storage activities would be implemented in compliance with all ARARs (see Chapter 3 and Appendix B), these activities are not expected to confront significant institutional obstacles.

The potential environmental consequences associated with Alternative 3 include temporary disturbance of soils, potentially leading to (1) low-level contamination of surface waters and groundwaters in the near term, (2) temporary increases in airborne radioactive particulates, and (3) minor, near-term displacement and loss of vegetation and wildlife. Mitigative measures and good engineering practices would be implemented during the action period of Alternative 3 to minimize these potential impacts (see Chapter 6). The long-term environmental consequences associated with Alternative 3 would be beneficial because of the removal of the radioactive materials from the vicinity properties and the amelioration of potential risks to human health and the environment.

5.5 IDENTIFICATION OF PROPOSED ALTERNATIVE

The comparative analysis of removal action alternatives presented in Section 5.4 identified Alternative 3 as a technically feasible, timely, cost-effective alternative that is protective of human health and the environment and involves the least significant institutional concerns. The environmental consequences of removing the contaminated materials from the vicinity properties are minor relative to the potential adverse effects of continued exposure to and migration of radioactively contaminated soil that are associated with access restrictions (Alternative 2) or no action (Alternative 1). Therefore, the recommended response action for the vicinity properties is Alternative 3 -- excavation of the contaminated materials, with transport to and interim storage at the HISS.

6 PROPOSED ACTION

Under the proposed action, the contaminated soils at the vicinity properties would be excavated and transported to the HISS for interim storage. Prior to excavation, the HISS would be prepared to accommodate storage of the additional contaminated materials. The preparations would include refurbishing the existing vehicle decontamination facility (replacing, as necessary, the ballast and wind screen, as well as any piping). A haul road would be constructed from the site gate to a dumping ramp to allow the trucks to unload their cargo into an area that is below the level of the truck so the contaminated soil would not pile up against the wheels or exteriors of the truck beds. The road would be surfaced with clean gravel to keep the tires and exteriors of the trucks from becoming contaminated. The area designated for the new storage pile, which is south of the main storage pile (see Figure 3), would be prepared by removing and separately stockpiling the vegetation, grading the ground surface until level, packing and stabilizing the surface, and constructing drainage swales to control runon and runoff. A Hypalon liner would be placed on the prepared area to prevent contaminated leachate from percolating into the base soil.

The approximate boundaries of excavation on each property would be established from existing radiological data. The property owner's consent to remove the contaminated soil from the property would be secured through an access agreement defining DOE's responsibilities and liabilities with regard to cleanup. The contaminated areas would be excavated using conventional earth-moving equipment. During excavation, the soil would be kept moist to minimize generation and release of dust, and runon and runoff controls would be implemented at each excavation. The contaminated materials would be placed in dump trucks, and the exteriors of the trucks and the surrounding area would be shrouded with plastic sheeting to prevent the spread of contamination and to facilitate collection of any spilled soil.

The exteriors of the loaded trucks would be radiologically surveyed prior to leaving the affected property for the trip to HISS. Transportation routes would be established, with a maximum travel distance of 3.2 km (2 mi) one way. Because much of the contamination is immediately adjacent to public roads, traffic controls (e.g., flagpersons and temporary signs) would be used during remediation to protect both the work crews and passing motorists. An emergency response plan would be in place and would be coordinated with appropriate local fire and police departments. During all truck travel on public roads (loaded or return trips), truck beds would be covered by tarpaulins to contain the contaminated materials and avoid dust generation and release. The excavated materials are not considered to be radioactive for transportation purposes because the activity concentrations are below 2,000 pCi/g, the lower limit established by the U.S. Department of Transportation for defining radioactive materials.

After transport to the HISS, the contaminated materials would be unloaded from the trucks, placed on the new storage pile, and compacted using standard earth-moving equipment. The empty trucks would be driven to the decontamination facility where their exteriors would be surveyed and, if necessary, decontaminated. At the end of each day, the pile would be covered with a membrane, which would be anchored along the west side of the pile. A synthetic membrane with elastic properties and low moisture vapor transmission would be used (other criteria considered in selecting the membrane would be ultraviolet light stability, puncture resistance, insect and rodent resistance, and workability). Sandbags (with a minimum weight of 18 kg [40 lb] each) or other materials suitable for anchoring would be placed on top of the membrane at approximately 4.6-m (15-ft) centers each day. This cover system would prevent pile erosion from wind or rain and would also protect the pile against floodwaters from Coldwater Creek. The cover would be routinely inspected and repaired, as necessary, during the interim storage period. At the end of the construction season, the membrane would be trench-anchored along the remaining perimeter, and riprap would be placed around the base of the pile to an elevation 0.6 m (2 ft) above the level of the 100-year flood to mitigate the impact of a flood on the pile.

When necessary, the new pile would be merged with the existing main pile, and the resulting pile would be developed from the south end of the site in order to use the full capacity of the site. As each section of the pile was completed, riprap flood protection would be installed. Only the northern face of the pile would be uncovered during the construction season.

The environment at the vicinity properties and the HISS would be monitored during cleanup and during interim storage to ensure compliance with all pertinent requirements. Mitigative measures would be employed to reduce potential adverse environmental impacts (Table 6).

Soil samples would be collected from the excavated areas to determine that the residual radioactivity remaining in the soil was at acceptably low levels. Establishing that the samples meet the criteria for thorium-230 (the primary radioactive contaminant) would ensure that the concentrations of other radionuclides were at or near background levels. Selected samples would be analyzed for a broader spectrum of radionuclides that might be present at elevated concentrations to confirm that the approach is valid and protective of human health and the environment.

In general, results from confirmation samples can be obtained in 3 days for each 930 m^2 (10,000 ft^2) of excavation. Upon receipt of data confirming that all contaminated soil had been removed, the excavated area would be backfilled with clean fill. Local backfill sources would be reviewed and sampled, as required, to ensure that the fill did not pose a health threat. The area would be restored according to the agreement established with each property owner. Grass would be established, asphalt surfaces repaired, and fences replaced.

After the contaminated materials were moved from the HISS for permanent disposition, the affected areas at HISS would be restored to essentially original conditions (i.e., as they were prior to the storage of contaminated soils).

TABLE 6 Major Mitigative Measures for the Proposed Action

Mitigative Measure	Features
Dust control	Dust would be controlled by wetting down surfaces during all activities having the potential for generating significant quantities of airborne particulates. The exteriors of the trucks and surrounding areas would be shrouded with plastic sheeting during loading activities to prevent the spread of contamination. Truck beds would be covered with tarpaulins during transportation to contain contaminated materials.
Worker protection	An operational environmental safety and health plan would be developed for this action. Respiratory protective equipment would be used, as necessary, and radiation monitoring would be provided.
Environmental monitoring	Air would be monitored in the general work area and at the site perimeter to protect both workers and the general public. Appropriate responses, such as increasing engineering controls, would be taken if calculated exposure levels (based on measured contaminant levels) approached project administrative control limits. The interim storage site is currently monitored for gamma radiation levels and radon releases; groundwater is also monitored regularly. Contaminant releases to air and surface water off-site would be minimized by implementing appropriate engineering controls.
Interim storage	Contaminated materials would be placed in an engineered storage area that has a bottom liner and a cover. The environment in the area would be monitored.
Equipment inspection	Equipment used for excavation, transport, and unloading of contaminated materials would be routinely inspected during operations. Equipment would be decontaminated, if necessary, to prevent inadvertent spreading of contamination into uncontaminated areas.

TABLE 6 (Cont'd)

Mitigative Measure	Features
Runon and runoff controls	Water runon would be controlled by temporary berms or culverts. Migration of contaminated (and uncontaminated) sediment through runoff would be mitigated by sediment filters such as hay bales and siltation fences.
Access restrictions	Access to work areas would be restricted, and access to the storage area would continue to be restricted.

7 AGENCIES CONSULTED

The following federal, state, and local agencies were consulted during the preparation of this EE/CA-EA:

- Berkeley Public Works Department, Berkeley, Missouri
- Hazelwood Public Works Department, Hazelwood, Missouri
- Missouri Department of Natural Resources, Division of Environmental Quality, Jefferson City, Missouri
- St. Louis County Planning Department, St. Louis, Missouri
- U.S. Army Corps of Engineers, St. Louis District, St. Louis, Missouri
- U.S. Environmental Protection Agency, Region VII, Kansas City, Kansas

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APPENDIX A:

FLOODPLAIN ASSESSMENT FOR STORAGE OF ADDITIONAL CONTAMINATED MATERIALS AT THE HAZELWOOD INTERIM STORAGE SITE, HAZELWOOD, MISSOURI

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A.1 PROJECT DESCRIPTION

Properties in the vicinity of the St. Louis Airport Site, St. Louis County, Missouri, and the Hazelwood Interim Storage Site (HISS), Hazelwood, Missouri, are radioactively contaminated as a result of transportation of contaminated materials in the area during the 1940s through the 1970s. Because this contamination is on privately owned residential, commercial, and municipal properties, it is desirable to remove and transport it, where appropriate, to a controlled storage location as soon as possible. Options for storage locations, however, are currently limited; commercial radioactive waste sites are not a viable option because no facilities are currently available that can accept these wastes. Selection of a FUSRAP permanent waste disposal site for the St. Louis area is pending completion of a remedial investigation/feasibility study-environmental impact statement and issuance of the record of decision, a process that will take several years.

The U.S. Department of Energy (DOE) proposes to initiate a removal action at the contaminated private properties in the Hazelwood and Berkeley area to mitigate and possibly eliminate potential health hazards to current residents. For the near term, interim storage capacity is needed to accommodate the contaminated materials generated by the proposed cleanup of vicinity properties and by utility company excavations, road maintenance/improvement projects, and development of private property. Although the contaminated materials pose no immediate threat to human health and the environment, uncontrolled relocation and storage of contaminated soils will lead to further migration of contamination, resulting in the need to excavate an additional volume of soil for disposal. In addition, this migration of contamination could result in the invalidation of existing characterization data.

Under the proposed removal action at the affected vicinity properties, the contaminated soils would be excavated from the properties and then transported to and stored at the HISS, which is currently being used as an interim storage site and is centrally located to the contaminated properties. A factor that complicates the plan for the increased storage of contaminated soils at the HISS is that, with the exception of the two existing stockpiles, the majority of HISS is within the 100-year floodplain of Coldwater Creek. The extent of the 100-year floodplain is shown in Figure A.1. The two existing stockpiles have been flood-protected to an elevation of 0.6 m (2 ft) above the level of the 100-year flood by means of a synthetic membrane cover and riprap (see Figure A.2). (The riprap consists of crushed stone with a maximum particle size of at least 7.5 cm [3 in.] in diameter.)

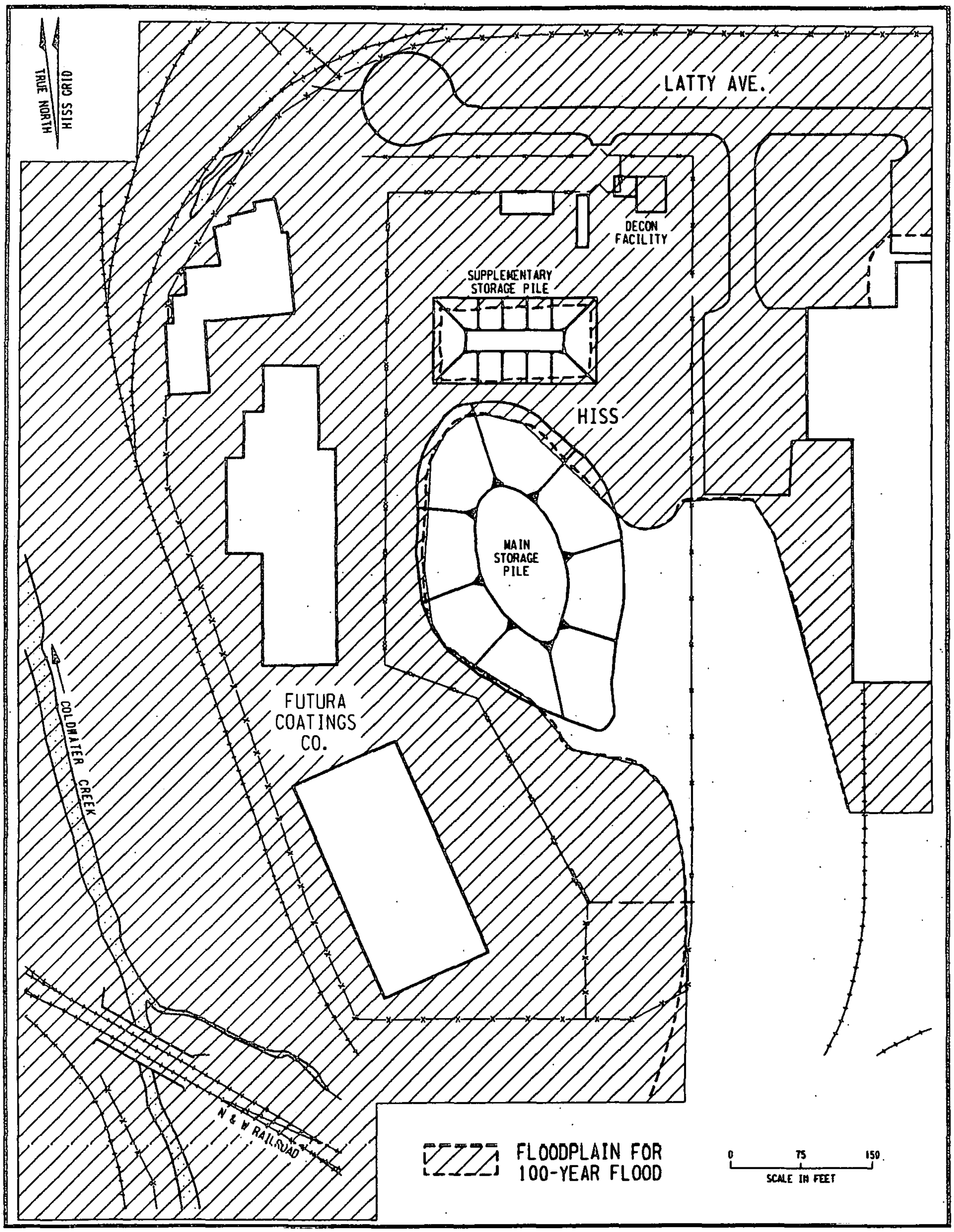

FIGURE A.1 Delineation of the 100-Year Floodplain at the HISS

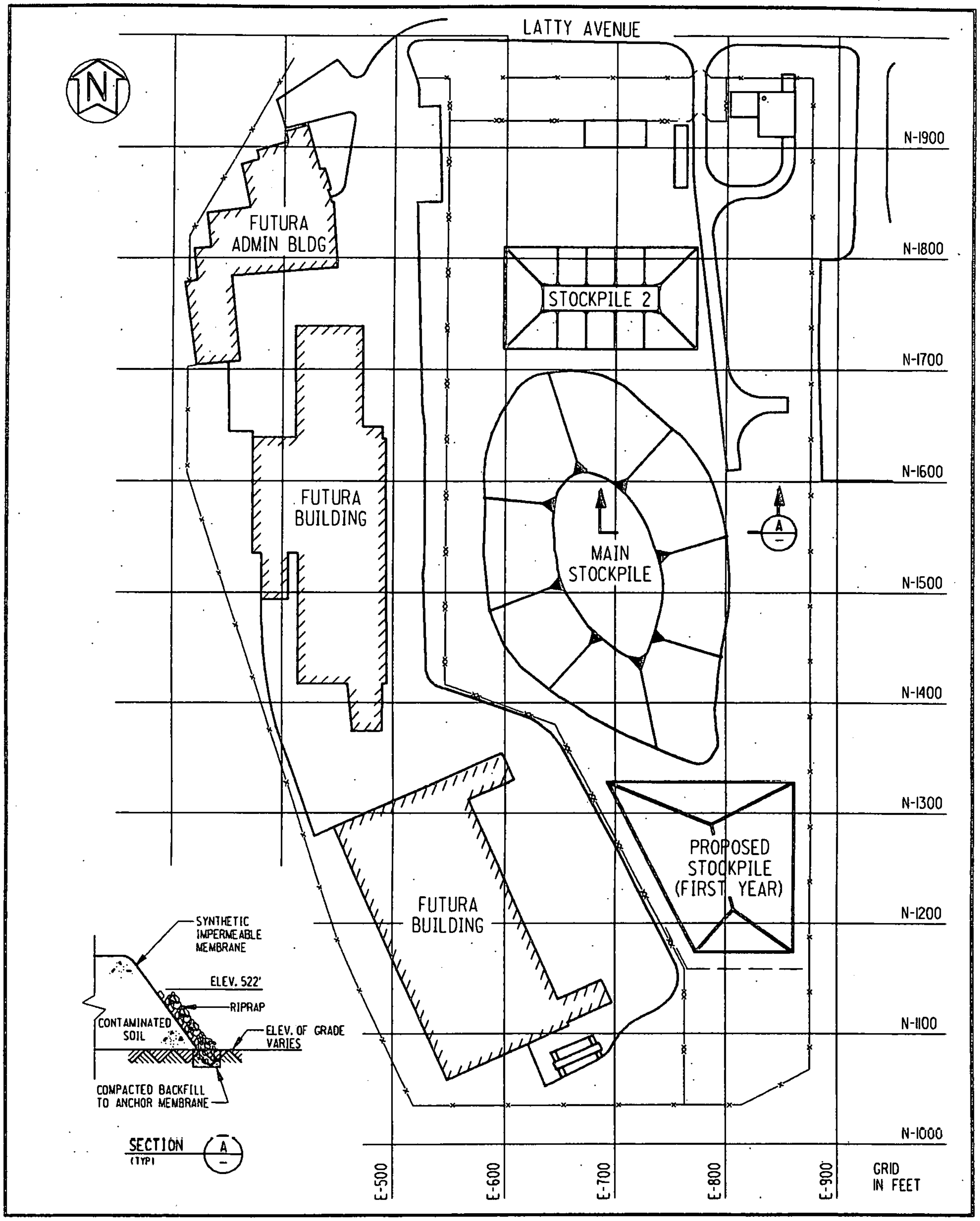

FIGURE A.2 Locations of Stockpiles at the HISS and Details of the Synthetic Membrane Cover and Riprap

Because the proposed action includes interim storage of additional contaminated materials at the HISS, the issue of flood mitigation/protection measures for these materials must be addressed. Notice of floodplain involvement and opportunity for public review and comment was published in the *Federal Register* on June 24, 1991 (56 FR 28750). Even though the proposed interim storage is not a critical action as defined in 10 CFR 1022.4(c), i.e., an activity for which even a slight chance of flooding would be too great (such as the storage of highly volatile, toxic, or water-reactive materials), precautionary measures would be taken. During the construction season, the portion of the stockpile where ongoing work was occurring would be covered daily with a synthetic membrane. The membrane would be anchored on one side of the pile and weighted at 4.6-m (15-ft) intervals. At the end of each construction season, or when a section of the pile had reached its capacity, the membrane would be anchored around the entire perimeter. Riprap would be added to a level of 0.6 m (2 ft) above the 100-year floodplain. These measures would produce a storage pile that complies with applicable or relevant and appropriate requirements at the federal, state, and local levels.

A.2 FLOODPLAIN EFFECTS

As the recurrence interval for the flood suggests, a 100-year flood is one that has a statistical probability of occurring once in 100 years, or a 1% chance of occurring in any given year during the interim period. The duration of high water during Coldwater Creek floods is less than 24 hours (St. Louis District Corps of Engineers 1987). The predominant soil type in the St. Louis area is a silty loess that has an erosion threshold of about 1.1 m/s (3.5 ft/s) water velocity when consolidated or vegetated (the storage piles at the HISS would be mechanically consolidated and the rest of the site vegetated). The average water velocity in the right overbank of the Coldwater Creek floodplain in the vicinity of the HISS is 0.91 m/s (3.0 ft/s) (Mills 1989). Although localized velocities could be higher, use of the membrane cover and riprap would minimize the potential for off-site transport of significant quantities of contaminated soil. In addition, the Futura site is surrounded by a 1.8-m (6-ft) chain-link fence and the HISS by a 1.2-m (4-ft) fence, which should prevent large flood debris from damaging the membrane. If the piles were not protected and the site did flood, the result would be redistribution of the contaminated materials to uncontrolled locations. Sediments in Coldwater Creek have been sampled downstream of the Missouri River, and the results indicate that radionuclide concentrations exceed guidelines in several places downstream of HISS. Because these materials pose no immediate health threat, the primary effects of redistribution would be the cost of reconsolidating materials and an increase in community concerns. With a membrane cover and riprap in place, the effects of a flood in terms of redistribution of contaminated materials would be minimized.

Concerns about floodplain effects relate primarily to displacement of floodplain storage volume. Because the interim storage of contaminated materials would not take place in the floodway, no significant impoundment, displacement, redirection, or other modification of floodwaters or floodplain storage volume would result. The storage action would take place beyond the floodway and within the 100-year floodplain areas -- which, by definition, could be completely obstructed without increasing the level of the 100-year flood by more than 0.3 m (1.0 ft) at any point. The portion of the 100-year floodplain storage volume that is within the HISS boundary is approximately 6,900 m^3 (9,000 yd^3). This is approximately 7.6% of the total 100-year floodplain storage volume of 91,000 m^3 (120,000 yd^3) for the reach of Coldwater Creek from stream mile 12.95 to 12.78 (which closely approximates the position and length of the site along the creek). Because of maintenance requirements, runoff controls, and maximum side slopes, the HISS can never be developed to the point where the entire on-site floodplain storage volume would be displaced by stockpiled waste. Consequently, the decrease in floodplain storage volume caused by additional waste storage at HISS would be considerably less than 7.6% of the floodplain storage volume in this area. Furthermore, the effects of developing the HISS would be distributed over a much longer reach of Coldwater Creek than the one immediately adjacent to the site because the floodplain extends upstream and downstream of HISS on both sides of the creek.

The flora in the vicinity of the HISS is dominated by early successional species (e.g., grasses, aster, goldenrod, ragweed, dandelion, smartweed, yarrow, and thistle). Shrubs and small trees are also scattered along the periphery of the site near Coldwater Creek, and the southern boundary is heavily forested (near the tributary to Coldwater Creek). Typical early- to intermediate-stage successional trees and shrubs common to floodplains occur in the area, including silver maple, eastern cottonwood, willow, hackberry, sycamore, elm, hawthorn, sumac, and box elder. Box elder predominates the lowland area near Coldwater Creek. The fauna of the area consists of species that have adapted to urban encroachment. Birds in the vicinity include house sparrow, red-winged blackbird, common crow, robin, mourning dove, and starling. Mammal species occurring in the site vicinity include Norway rat, raccoon, house mouse, eastern cottontail rabbit, opossum, prairie vole, white-footed mouse, short-tail shrew, and striped skunk. In addition, burrowing mammals -- such as woodchuck, plains pocket gopher, and eastern mole -- have ranges and habitats that coincide with the HISS. Based on habitat requirements of federally or Missouri-listed threatened and endangered species, no listed species are likely to occur in the vicinity.

Because the properties on all sides of the HISS and in the adjacent area have been industrially developed, the area is not likely to provide much refuge for wildlife now or in the future. No long-term impacts would occur because the proposed interim storage action involves only temporary encroachment on the floodplain and the area would be restored and released after removal of the contaminated materials to a permanent disposal facility. Following release, the site would probably be developed quickly because it is zoned industrial/commercial and the property owner wants to use the site to expand the manufacturing business located on the adjacent parcel at 9200 Latty Avenue.

A.3 ALTERNATIVES TO INTERIM STORAGE AT THE HISS

Alternatives to the proposed action of storing additional contaminated soil at the HISS include (1) interim storage at an alternate location that is not in a floodplain, (2) permanent disposal of the contaminated soil at an approved disposal site, and (3) no action. The analysis of alternatives presented in Sections A.3.1 through A.3.3 is based on the definition of practicable presented in 10 CFR Part 1022 for floodplain management, i.e., "practicable" is defined as capable of being accomplished within existing constraints. The test of what is practicable depends on the situation and includes consideration of many factors such as environment, cost, technology, and implementation time.

A.3.1 Alternative 1, Interim Storage at an Alternate Site

Interim storage at an alternate location outside a floodplain is not practicable because of the cost and time required for implementation. For purposes of analysis, an alternate site is assumed to be the same size as the HISS, about 2.2 ha (5.5 acres), but outside a floodplain. Two options for this alternative are a site in the vicinity of the HISS or a remote site. Although suitable property is available near the HISS, such property is scarce and valuable because of a high degree of commercial/industrial and residential development that has occurred in the area. A major aeronautical company owns or occupies 14 of the properties surveyed, a prominent regional grocery wholesaler owns 6, and other well-known corporations in the automotive, retail sales, and furniture business also own properties that were surveyed. Many of these and other property owners/occupants have plans for, or have already completed, facility expansions/improvements that impact contaminated areas. The HISS area has ready access to various transportation modes, including Lambert-St. Louis International Airport; Interstate Highways 70, 170, and 270; the Missouri and Mississippi rivers; and a well developed railroad network. In preparation for the recently completed lease of the HISS property, it was appraised at $455,000, or $207,000/ha ($82,700/acre); the cost of property anywhere within several miles of the HISS would be comparable. A remote alternate site (within 80 km [50 mi] of the HISS) would be less expensive to acquire, about $1,240 to $4,940/ha ($500 to $2,000/acre); however, increased costs would be incurred for transportation, about $13/m^3 ($10/yd^3) for a 160-km (100-mi) round trip. Furthermore, additional costs might be incurred to extend utilities to the site and to improve or repair roads.

For either option in Alternative 1, significant additional costs would be incurred to identify, prepare, generate environmental documentation for, and operate another interim storage site. Such costs would range from about $283,000 for a site near the HISS to $526,000 for a remote site. These cost estimates include screening for site selection, site characterization, preparation of appropriate environmental documentation, office trailer setup, decontamination facility construction, site grading and preparation, and installation of environmental monitoring wells. In addition, site operation costs for staff, maintenance and repair, and environmental monitoring would be duplicated because these costs would be incurred at HISS regardless of which option were selected.

Based on previous experience in siting a facility of this type, the time required to secure, prepare, and begin operating a site would be 2.5 to 3 years, which is only 1 to 1.5 years before the expected issuance of the record of decision for the St. Louis Site. In comparison, HISS could be prepared to receive additional contaminated soil in 1 month. The need for additional storage capacity becomes more apparent as property owners, utility companies, and municipalities plan (and, in some cases, proceed with) projects involving excavation in contaminated areas. The lack of a storage site is currently impeding property sales and leases, inhibiting infrastructure development and repair, and allowing contamination to be spread.

Further complicating the alternate site development process would be the negative aspect of occupying and potentially contaminating additional land. Use of the HISS, which is already extensively contaminated and is currently being used for storage of contaminated soil, means that no additional land would be potentially contaminated or precluded from revenue-generating use. Development of a second interim storage site might also create the perception of attempting to avoid a permanent solution to the contamination problem in St. Louis by creating a series of small sites designated as "interim" with the intent of leaving the contaminated soil there permanently.

The only significant advantage offered by an alternate site outside a floodplain would be elimination of the risk of detrimental impacts associated with flooding. This risk can be minimized at HISS by employing simple, proven engineering controls -- including installation of bottom and cover liners and installation of riprap around the base of the pile to provide protection against erosion. The resulting pile would conform to all applicable or relevant and appropriate requirements. In addition, the intrusion of an expanded HISS into the 100-year floodplain is temporary and reversible.

A.3.2 Alternative 2, Permanent Disposal

Permanent disposal is not practicable at this time because selection of the permanent disposal site for the St. Louis FUSRAP wastes will take several years. Operation of the FUSRAP disposal site is currently not scheduled to occur before the spring of 1997. Permanent disposal at an existing disposal site (e.g., DOE's Hanford Reservation near Richland, Washington) is not practicable because of the time required to implement this option and the prohibitive cost of transportation and disposal, about $2,250/m^3 ($1,720/yd^3), as well as the increased risk of accidents, exposures, and spills. In addition, no commercial radioactive waste disposal site currently holds a license that allows acceptance of such wastes. Hence, this alternative cannot be implemented in the near term.

A.3.3 Alternative 3, No Action

Taking no action would result in no additional impact to the 100-year floodplain of Coldwater Creek. However, delaying remedial action on selected properties would impede property sales and leases, inhibit infrastructure development and repair, and allow the spread of contamination.

A.3.4 Summary

In summary, interim storage of additional contaminated soil at the HISS is the preferred alternative for near-term management of the wastes based on implementability, public acceptability, and cost-effectiveness. Permanent disposal is either prohibitively costly or not possible within the time frame of this EE/CA-EA. Alternate storage sites present unacceptable costs and delays that are not commensurate with the risks associated with continued use of the HISS. Taking no action would potentially result in (1) increased costs for the ultimate management of the wastes as a result of the inadvertent spread of contamination and (2) negative impacts on community development. It is DOE policy that any activity in a floodplain must be conducted so as to avoid, to the extent possible, adverse impacts to the floodplain and to protect human health and the environment, as specified in 10 CFR Part 1022 and Executive Order 11988. The interim storage of materials at the HISS has been designed to minimize potential harm to or within the floodplain. Proper construction and maintenance procedures would be used to minimize potential impacts to the floodplain during the action period. Mitigative measures -- such such as covering the storage piles -- would be employed to reduce the risk of adverse environmental consequences (see also Chapter 6, Table 6). Following removal of the contaminated materials from the HISS to a permanent disposal facility, the affected areas at HISS would be restored to essentially original conditions (i.e., prior to deposition of contaminated residues).

A.4 LIST OF AGENCIES AND PERSONS CONSULTED

The following agencies were consulted with regard to this floodplain analysis: Missouri Department of Natural Resources; U.S. Army Corps of Engineers, St. Louis District; Federal Emergency Management Agency; and City of Hazelwood.

A.5 APPLICABLE FLOODPLAIN REGULATIONS

The following federal floodplain regulations are applicable to the proposed action: 10 CFR Part 1022, Compliance with Floodplain/Wetlands Environmental Review Requirements; and 44 CFR Part 9, Floodplain Management and Protection of Wetlands. Also applicable is a city of Hazelwood ordinance, Article XVII of Section 32.103, Floodways and Floodway Fringe Districts.

A.6 REFERENCES (APPENDIX A)

Mills, R., 1989, personal communication from R. Mills (Hydrologist, St. Louis District Corps of Engineers, St. Louis, Mo.) to J. Williams (Bechtel National, Inc., Oak Ridge, Tenn.), Aug. 2.

St. Louis District Corps of Engineers, 1987, *Coldwater Creek, Missouri, Feasibility Report and Environmental Impact Statement*, U.S. Army Corps of Engineers, St. Louis District, Lower Mississippi Valley Division, St. Louis, Mo., May (revised Dec.).

APPENDIX B:

REGULATORY REQUIREMENTS POTENTIALLY APPLICABLE TO THE PROPOSED ACTION

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REGULATORY REQUIREMENTS POTENTIALLY APPLICABLE TO THE PROPOSED ACTION

Potential requirements for a proposed action can be grouped into two general categories: (1) applicable or relevant and appropriate requirements (ARARs) and (2) "to-be-considered" (TBC) requirements. The first category consists of promulgated standards (e.g., public laws codified at the state or federal level) that may be applicable or relevant and appropriate to all or part of the proposed action. The second category consists of standards or guidelines that have been published but not promulgated and that may have specific bearing on all or part of the action, e.g., DOE Orders.

In addressing a requirement that may affect the proposed action, a determination is made regarding its relationship to (1) the location of the action, (2) the contaminants involved, and (3) the specific components of the action, e.g., factors associated with a certain technology. Any regulation, standard, requirement, criterion, or limitation under any federal or state environmental law or state facility siting law may be either *applicable* or *relevant and appropriate* to a response action, but not both. Only those state laws may become ARARs that are (1) promulgated, such that they are legally enforceable and generally applicable (i.e., consistently applied) and (2) more stringent than federal laws.

Applicable requirements are those that specifically address the circumstance(s) at the site, whereas relevant and appropriate requirements are those that address circumstances sufficiently similar that they are well suited to the site. That is, a potential ARAR is applicable if its prerequisites or regulated conditions are specifically met by the conditions of the proposed action (e.g., site location in a floodplain); if the conditions of a requirement are not specifically applicable, then a determination must be made as to whether they are sufficiently similar to be considered both relevant *and* appropriate (e.g., in terms of contaminant similarities and the nature and setting of the proposed action). This similarity is determined on the basis of best professional judgment, considering factors that include (1) the purpose of the requirement; (2) the medium, substance, action, type of place, and type and size of facility regulated; and (3) the use or potential use of affected resources, relative to the nature of these factors at the site.

Potential TBC requirements are typically considered only if no promulgated requirements exist that are either applicable or relevant and appropriate. Thus, TBC requirements are often considered secondary to ARARs. However, certain TBC requirements such as DOE Orders are developed on the basis of promulgated standards and can necessitate the same degree of compliance as ARARs. Because the removal action at the HISS and vicinity properties is being proposed by DOE, it will be conducted in accordance with DOE Orders irrespective of the "TBC" designation of these Orders under the formal ARAR process.

Activities at the HISS and vicinity properties will also be conducted in compliance with worker protection requirements, including those identified in the

Occupational Safety and Health Act and in a number of specific DOE Orders. Because these requirements address employee protection rather than environmental protection, they are not subject to consideration for attainment or waiver under the ARAR evaluation process. Rather, they are requirements with which the response actions must comply. Certain of these requirements are listed in this appendix for informational purposes (i.e., to identify worker protection requirements that will be met by the proposed action) rather than as an indication of a formal ARAR evaluation.

Potential location-specific, contaminant-specific, and action-specific ARARs and TBC requirements for the proposed removal action are identified and evaluated in Tables B.1, B.2, and B.3, respectively. The preliminary ARAR and TBC determinations for the listed requirements are also indicated in the tables. Because this appendix presents a comprehensive list of requirements with considerable overlap of regulated conditions, all determinations have been identified as "potentially" applicable, relevant and appropriate, or to be considered. These determinations will be finalized in consultation with the state of Missouri and EPA Region VII prior to implementing the proposed action. During finalization, the requirements identified as potentially applicable will be reviewed to confirm direct applicability; only one requirement will be finalized from among those that regulate the same conditions. For those identified as potentially relevant and appropriate and as TBC requirements, both the specific portion(s) of the requirements that have bearing on the proposed action and the manner in which compliance would be achieved will be finalized. After the finalization process, certain of the requirements will remain potentially an ARAR or a TBC requirement as the action proceeds, pending identification of the existence of their prerequisites or regulated conditions (e.g., the presence of cultural resources or threatened or endangered species in the affected areas). Because the scope of the proposed action does not include waste disposal, potential ARARs associated with disposal of radioactive, chemically hazardous, or uncontaminated material are not included in Table B.3.

In accordance with CERCLA, as amended, and the National Oil and Hazardous Substance Pollution Contingency Plan, an alternative that does not meet an ARAR may be selected if one of the following waiver conditions is met:

- The alternative is an interim measure and will become part of a total remedial action that will attain the requirement;

- Compliance with the requirement will result in greater risk to human health and the environment that other alternatives;

- Compliance with the requirement is technically impracticable from an engineering perspective;

- The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable ARAR through use of another method or approach;

- For state requirements, the state has not consistently applied the promulgated requirement (or demonstrated the intention to do so) in similar circumstances at other remedial actions within the state; or

- For Superfund-financed actions only, an alternative that attains the ARAR will not provide a balance between achieving protectiveness at the site and retaining sufficient funds for responses at other sites. (This condition is not relevant to the HISS and vicinity properties because Superfund money is not being used to finance the cleanup.)

The first waiver condition applies directly to the proposed removal action because this action is only part of the overall response action for the St. Louis Site.

TABLE B.1 Potential Location-Specific Requirements

Potential ARAR	Location	Requirement	Preliminary Determination	Remarks
Antiquity Act; Historic Sites Act (16 USC 431-433; 16 USC 461-467; 40 CFR 6.301(a))	Land	Cultural resources, such as historic buildings and sites and natural landmarks, must be preserved on federal land to avoid adverse impacts.	Potentially applicable	No adverse impacts to such resources are expected to result from the proposed action; however, if these resources were affected, the requirement would be applicable.
National Historic Preservation Act, as amended (16 USC 470 et seq.; 40 CFR 6.301(b); 36 CFR 800)	Land	The effect of any federally assisted undertaking must be taken into account for any district, site, building, structure, or object included in or eligible for the *National Register of Historic Places*.	Potentially applicable	No adverse impacts to such properties are expected to result from the proposed action; however, if these resources were affected, the requirement would be applicable.
Archeological and Historic Preservation Act (16 USC 469; 40 CFR 6.301(c); PL 93-291; 88 Stat. 174)	Land	Prehistorical, historical, and archeological data that might be destroyed as a result of a federal, federally assisted, or federally licensed activity or program must be preserved.	Potentially applicable	No destruction of such data is expected to result from the proposed action. The HISS and vicinity properties are in an area that has been considerably disturbed by past human activities; therefore, this area is not expected to contain any such data. However, if these data were affected, the requirement would be applicable.
Archeological Resources Protection Act (16 USC 470(a))	Land	A permit must be obtained if an action on public or Indian lands could impact archeological resources.	Potentially applicable	No impacts to archeological resources are expected to result from the proposed action. The HISS and vicinity properties are in an area that has been considerably disturbed by past human activities; therefore, this area is not expected to contain any such resources. However, if these resources were affected, the requirement would be applicable.
Protection and Enhancement of the Cultural Environment (Executive Order 11593; 40 CFR 6.301)	Land	Historic, architectural, archeological, and cultural resources must be preserved, restored, and maintained, and must be evaluated for inclusion in the *National Register*.	Potentially applicable	No impacts to such resources are expected to result from the proposed action. The HISS and vicinity properties are in an area that has been considerably disturbed by past human activities; therefore, this area is not expected to contain any such resources. However, if these resources were affected, the requirement would be applicable.
Endangered Species Act, as amended (16 USC 1531-1543; 50 CFR 17.402; 40 CFR 6.302(h))	Any	Federal agencies must ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify any critical habitat.	Potentially applicable	No critical habitat exists in the affected area, and no adverse impacts to threatened or endangered species are expected to result from the proposed action; however, if such species were affected, the requirement would be applicable.
Missouri Wildlife Code (1989) (RSMo. 252.240; 3 CSR 10-4.111), Endangered Species	Any	Endangered species, i.e., those designated by the Missouri Department of Conservation and the U.S. Department of the Interior as threatened or endangered (see 1978 Code, RSMo. 252.240) may not be pursued, taken, possessed, or killed.	Potentially applicable	No critical habitat exists in the affected area, and no adverse impacts to threatened or endangered species are expected to result from the proposed action. However, if such species were affected, the requirement would be applicable.

TABLE B.1 (Cont'd)

Potential ARAR	Location	Requirement	Preliminary Determination	Remarks
Missouri Wildlife Code (1989) (RSMo. 252.240; 3 CSR 10-4.110), General Prohibition; Applications	Any	Wildlife, including their homes and eggs, may not be taken or molested.	Potentially relevant and appropriate	No wildlife would be actively taken or molested as part of the proposed action. However, wildlife could be disturbed during implementation. Mitigative measures would be taken to minimize potential adverse impacts.
Missouri Wildlife Code (1989) (RSMo. 252.240; 3 CSR 10-4.115), Special Management Areas	Any	Wildlife may not be taken, pursued, or molested on any state or federal wildlife refuge or any wildlife management area, except under permitted conditions.	Potentially relevant and appropriate	No wildlife would be actively taken, pursued, or molested in any wildlife areas as part of the proposed action. However, wildlife could be disturbed during implementation. Mitigative measures would be taken to minimize potential adverse impacts.
Missouri Wildlife Code (1978) (RSMo. 252.040), Taking of Wildlife -- Rules and Regulations	Any	Wildlife may not be taken or pursued, except under permitted conditions.	Potentially relevant and appropriate	No wildlife would be actively taken or pursued as part of the proposed action. Mitigative measures would be taken to minimize potential environmental impacts, and these measures would serve to minimize impacts to wildlife.
Missouri Wildlife Code (1978) (RSMo. 252.240), Endangered species importation, transportation or sale, when prohibited -- how designated -- penalty	Any	The Missouri Department of Conservation must file with the state a list of animal species designated as endangered (for subsequent consideration of related requirements).	Potentially applicable	No critical habitat exists in the affected area, and no adverse impacts to threatened or endangered species are expected to result from the proposed action. However, if such species were affected, the requirement would be applicable.
Missouri Wildlife Code (1978) (RSMo.252.210), Contamination of streams	Stream	It is unlawful to put any deleterious substances into waters of the state in quantities sufficient to injure fish, except under precautionary measures approved by the commission.	Not an ARAR	No quantities of deleterious substances sufficient to injure fish would be discharged to surface water bodies (such as Coldwater Creek) as a result of this action.
Fish and Wildlife Coordination Act (14 USC 441-444; 40 CFR 4.302(a))	Any	Adequate protection of fish and wildlife resources is required when any federal department or agency proposes or authorizes any modification (e.g., diversion or channeling) of any stream or other water body or any modification of areas affecting any stream or other water body.	Potentially applicable	No modification of streams or stream areas is planned as part of the proposed action. If such modification were to occur, the pertinent requirements of this act would be followed during implementation of the proposed action.
Floodplain Management (Executive Order 11988; 40 CFR 6.302(b))	Flood-plain	Federal agencies must avoid, to the maximum extent possible, any adverse impacts associated with direct and indirect development of a floodplain.	Potentially applicable	The HISS is in the 100-year floodplain of Coldwater Creek. Mitigative measures would be taken to minimize potential adverse impacts.
Governor's Executive Order 82-19	Flood-plain	Potential effects of actions taken in a floodplain must be evaluated to avoid adverse impacts.	Potentially applicable	The HISS is in the 100-year floodplain of Coldwater Creek. Mitigative measures would be taken to minimize potential adverse impacts.
Protection of Wetlands (Executive Order 11990; 40 CFR 6.302(a))	Wetland	Federal agencies must avoid, to the extent possible, any adverse impacts associated with the destruction or loss of wetlands and the support of new construction in wetlands if a practicable alternative exists.	Not an ARAR	No wetland would be affected by the proposed action.

TABLE B.2 Potential Contaminant-Specific Requirements

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
Federal Water Pollution Control Act, Clean Water Act (33 USC 1251-1376); Water Quality Standards (40 CFR 131), National Pollutant Discharge Elimination System (40 CFR 122-125)	Any	Water	Permitting authority for surface water discharges is delegated to the states according to the National Pollutant Discharge Elimination System (NPDES) process.	Potentially applicable	Waste water resulting from the proposed action (e.g., wash water) will be managed in accordance with the NPDES process.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192)	Radium	Soil	The concentration of radium in soil averaged over an area of 100 m^2 shall not exceed the background level by more than 5 pCi/g in the top 15 cm of soil or 15 pCi/g in each 15-cm layer below the top layer.	Potentially relevant and appropriate	The HISS and vicinity properties are not mill tailings sites so these requirements are not applicable. However, they may be considered relevant and appropriate because of the contaminant similarity.
Radiation Protection of the Public and the Environment (DOE Order 5400.5)	Radium and thorium	Soil	Concentrations of radium-226, radium-228, thorium-230, and thorium-232 averaged over an area of 100 m^2 are 5 pCi/g in the top 15 cm of soil and 15 pCi/g in each 15-cm layer below the top layer. These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-230, and they assume secular equilibrium. If both thorium-230 and radium-226 or both thorium-232 and radium-228 are present and not in secular equilibrium, the appropriate guideline is applied as a limit for the radionuclide with the higher concentration.	To be considered	Although not promulgated standards, these constitute requirements for protection of the public with which the proposed action will comply.
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.040), Maximum Permissible Exposure Limits	Radiation	Air	For persons outside a controlled area, the maximum permissible whole-body dose due to sources in or migrating from the controlled area is limited to 2 mrem in any 1 hour, 0.1 rem in any 7 consecutive days, and 0.5 rem in any year. (Note: a controlled area is an area that requires control of access, occupancy, and working conditions for radiation protection purposes; 0.5 rem = 500 mrem.)	Potentially applicable	These requirements may be applicable to protection of the public during implementation of the proposed action.
Radiation Protection of the Public and the Environment (DOE Order 5400.5)	Radiation	Air	The basic dose limit for nonoccupationally exposed individuals is 100 mrem/yr above background, committed effective dose equivalent. Further, all radiation exposures must be reduced to levels as low as reasonably achievable.	To be considered	Although not promulgated standards, these requirements are derived from such standards and they constitute requirements for protection of the public with which the proposed action will comply.

TABLE B.2 (Cont'd)

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
National Emission Standards for Hazardous Air Pollutants (40 CFR 61), Subpart H, National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy (DOE) Facilities	Radionuclides other than radon-220 and radon-222	Air	Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public in any year an effective dose equivalent of 10 mrem/yr.	Potentially applicable	Because the HISS and vicinity properties do not strictly comprise a DOE facility, these requirements may not be strictly applicable. However, they are considered relevant and appropriate to protection of the public during implementation of the proposed action.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192)	Radon	Air	Releases of radon from tailings disposal piles must not exceed an average rate of 20 pCi/m^2-s or increase the annual average concentration in air outside the disposal site by more than 0.5 pCi/L.	Potentially relevant and appropriate	The HISS and vicinity properties are not mill tailings sites and disposal is beyond the scope of the proposed action, so these requirements are not applicable. However, they may be considered relevant and appropriate, e.g., for an outdoor storage facility, because of the contaminant similarity.
	Radon decay products	Air	The annual average (or equivalent) radon decay product concentration, including background, in any habitable building must not exceed 0.02 working level (WL) or a maximum of 0.03 WL -- where a WL is any combination of short-lived radon decay products in 1 liter of air, without regard to the degree of equilibrium, that will result in the emission of 1.3×10^5 MeV of alpha energy. (For radon-222 in equilibrium with its decay products, 1 WL = 100 pCi/L.)	Potentially relevant and appropriate	The HISS and vicinity properties are not mill tailings sites, so these requirements are not applicable. However, they may be considered relevant and appropriate because habitable buildings exist on several of the vicinity properties.
	External gamma radiation	Air	The level of external gamma radiation in any occupied or habitable building must not exceed the background level by more than 20 μR/h.	Potentially relevant and appropriate	The HISS and vicinity properties are not mill tailings sites, so these requirements are not applicable; however, they may be considered relevant and appropriate because habitable buildings exist on several of the properties.

TABLE B.2 (Cont'd)

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.040), Maximum Permissible Exposure Limits	Uranium, protactinium, thorium, actinium, radium, and radon	Air	The concentrations of radionuclides in air outside a controlled area (above natural background), averaged over any calendar quarter, should not exceed the following limits:	Potentially applicable	These requirements may be applicable to protection of the public during implementation of the proposed action.

Isotope	Solubility Class	Concentration (μCi/mL)
$U_{natural}$	Soluble	3×10^{-12}
	Insoluble	2×10^{-12}
Uranium-238	Soluble	3×10^{-12}
	Insoluble	5×10^{-12}
Uranium-235	Soluble	2×10^{-11}
	Insoluble	4×10^{-12}
Uranium-234	Soluble	2×10^{-11}
	Insoluble	4×10^{-12}
Protactinium-231	Soluble	4×10^{-14}
	Insoluble	4×10^{-12}
Thorium-232	Soluble	7×10^{-14}
	Insoluble	4×10^{-13}
Thorium-230	Soluble	8×10^{-14}
	Insoluble	3×10^{-13}
Actinium-227	Soluble	8×10^{-14}
	Insoluble	9×10^{-13}
Radium-228	Soluble	2×10^{-12}
	Insoluble	1×10^{-12}
Radium-226	Soluble	1×10^{-12}
	Insoluble	6×10^{-9}
Radon-222		1×10^{-9}
Radon-220		1×10^{-8}

TABLE B.2 (Cont'd)

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
Radiation Protection of the Public and the Environment (DOE Order 5400.5)	Uranium, protactinium, thorium, actinium, and radium	Air	Residual concentrations of radionuclides in air in uncontrolled areas are limited to the following. (For known mixtures of radionuclides, the sum of the ratios of the observed concentration of each radionuclide to its corresponding limit must not exceed 1.0.)	To be considered	Although not promulgated standards, these constitute requirements for protection of the public with which the proposed action will comply.

Isotope	Derived Concentration Guide[a] (μCi/mL) D	W	Y
Uranium-238	5×10^{-12}	2×10^{-12}	1×10^{-13}
Uranium-235	5×10^{-12}	2×10^{-12}	1×10^{-13}
Uranium-234	4×10^{-12}	2×10^{-12}	9×10^{-14}
Protactinium-231	-[b]	9×10^{-15}	1×10^{-14}
Thorium-232	-	7×10^{-15}	1×10^{-14}
Thorium-230	-	4×10^{-14}	5×10^{-14}
Actinium-227	2×10^{-15}	7×10^{-15}	1×10^{-14}
Radium-228	-	3×10^{-12}	-
Radium-226	-	1×10^{-12}	-

[a]D, W, and Y represent lung retention classes; removal half-times assigned to the compounds with classes D, W, and Y are 0.5, 50, and 500 days, respectively. Exposure conditions assume an inhalation rate of 8,400 m^3 of air per year (based on exposure over 24 hours per day, 365 days per year).

[b]A hyphen means no limit has been established.

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
	Radon-222	Air	The above-background concentration of radon-222 in air above an interim storage facility must not exceed 100 pCi/L at any point, an annual average of 30 pCi/L over the facility, or an annual average of 3 pCi/L at or above any location outside the site. (See also the discussion for DOE Order 5820.2A in Table B.3.)	To be considered	Although not promulgated standards, these constitute requirements for protection of the public with which the proposed action will comply.
	Radon-220 and radon-222	Air	The immersion derived concentration guide for both radon-220 and radon-222 in air in an uncontrolled area is 3 pCi/L.	To be considered	Although not promulgated standards, these constitute requirements for protection of the public with which the proposed action will comply.

TABLE B.2 (Cont'd)

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
Occupational Safety and Health Administration Standards; Occupational Health and Environmental Control (29 CFR 1910; 1910.96), Subpart G, Ionizing Radiation	Uranium, protactinium, thorium, actinium, radium, and radon	Air	Within a restricted area, airborne radioactive material (averaged over a 40-hour work week of seven consecutive days) should not exceed the following limits. (For hours of exposure less than or greater than 40, the limits are proportionately increased or decreased, respectively.)	Not an ARAR	These requirements are part of an employee protection law (rather than an environmental law) with which CERCLA response actions should comply; hence, they are not subject to the ARAR process. However, they constitute requirements for worker protection with which the proposed action will comply.

Isotope	Solubility Class	Concentration (μCi/mL)
$U_{natural}$	Soluble	1×10^{-10}
	Insoluble	1×10^{-10}
Uranium-238	Soluble	7×10^{-11}
	Insoluble	1×10^{-10}
Uranium-235	Soluble	5×10^{-10}
	Insoluble	1×10^{-10}
Uranium-234	Soluble	6×10^{-10}
	Insoluble	1×10^{-10}
Protactinium-231	Soluble	1×10^{-12}
	Insoluble	1×10^{-10}
Thorium-232	Soluble	3×10^{-11}
	Insoluble	3×10^{-11}
Thorium-230	Soluble	2×10^{-12}
	Insoluble	1×10^{-11}
Actinium-227	Soluble	2×10^{-12}
	Insoluble	3×10^{-11}
Radium-228	Soluble	7×10^{-11}
	Insoluble	4×10^{-11}
Radium-226	Soluble	3×10^{-11}
	Insoluble	5×10^{-11}
Radon-222[a]		3×10^{-8}
Radon-220		3×10^{-7}

[a]Limit is appropriate for radon-222 combined with its short-lived decay products and may be replaced by 1/3 WL; limit in restricted areas may be based on an annual average.

For mixtures of radionuclides, the sum of the ratios of the quantity present to the specific limit must not exceed 1. For uranium, chemical toxicity may be the limiting factor for soluble mixtures of uranium-238, uranium-235, and uranium-234 in air; if the percent by weight of uranium-235 is less than 5, the concentration limit for uranium is 0.007 mg/m^3 inhaled air.

TABLE B.2 (Cont'd)

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.040), Maximum Permissible Exposure Limits	Uranium, protactinium, thorium, actinium, radium, and radon	Air	Concentrations of radionuclides in air, averaged over any calendar quarter, should not exceed the following limits. (Limits apply to exposure in a controlled area and are based on a work week of 40 hours; for longer work weeks, the values must be adjusted downward.)	Not an ARAR	These requirements are part of an employee protection law (rather than an environmental law) with which CERCLA response actions should comply; hence, they are not subject to the ARAR process. However, they constitute requirements for worker protection with which the proposed action will comply.

Isotope	Solubility Class	Concentration (μCi/mL)
$U_{natural}$	Soluble	7×10^{-11}
	Insoluble	6×10^{-11}
Uranium-238	Soluble	7×10^{-11}
	Insoluble	1×10^{-10}
Uranium-235	Soluble	5×10^{-10}
	Insoluble	1×10^{-10}
Uranium-234	Soluble	6×10^{-10}
	Insoluble	1×10^{-10}
Protactinium-231	Soluble	1×10^{-12}
	Insoluble	1×10^{-10}
Thorium-232	Soluble	2×10^{-12}
	Insoluble	1×10^{-11}
Thorium-230	Soluble	2×10^{-12}
	Insoluble	1×10^{-11}
Actinium-227	Soluble	2×10^{-12}
	Insoluble	3×10^{-11}
Radium-228	Soluble	7×10^{-11}
	Insoluble	4×10^{-11}
Radium-226	Soluble	3×10^{-11}
	Insoluble	2×10^{-7}
Radon-222		3×10^{-8}
Radon-220		3×10^{-7}

TABLE B.2 (Cont'd)

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
Radiation Protection for Occupational Workers (DOE Order 5480.11)	Uranium, protactinium, thorium, actinium, radium, and radon	Air	Occupational exposure limits for specific radionuclides in air are as follows. (Values for radon isotopes assume 100% equilibrium with the short-lived decay products; these values may be replaced by 1 WL for radon-220 and 1/3 WL for radon-222.)	To be considered	Although not promulgated standards, these constitute requirements for worker protection with which the proposed action will comply.

Isotope	Derived Air Concentrations[a] (μCi/mL) D	W	Y
Uranium-238	6×10^{-10}	3×10^{-10}	2×10^{-11}
Uranium-235	6×10^{-10}	3×10^{-10}	2×10^{-11}
Uranium-234	5×10^{-10}	3×10^{-10}	2×10^{-11}
Protactinium-231	-[b]	7×10^{-13}	2×10^{-12}
Thorium-232	-	5×10^{-13}	1×10^{-12}
Thorium-230	-	3×10^{-12}	7×10^{-12}
Actinium-227	2×10^{-13}	7×10^{-13}	2×10^{-12}
Radium-228	-	5×10^{-10}	-
Radium-226	-	3×10^{-10}	-
Radon-222	3×10^{-8}	-	-
Radon-220	8×10^{-9}	-	-

[a] D, W, and Y represent lung retention classes; removal half-times assigned to the compounds with classes D, W, and Y are 0.5, 50, and 500 days, respectively. Exposure conditions assume an inhalation rate of 2,400 m^3 air per year (based on exposure over 40 hours per week, 50 weeks per year).

[b] A hyphen means no limit has been established.

TABLE B.2 (Cont'd)

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
Clean Air Act, as amended (42 USC 7401-7642); National Primary and Secondary Ambient Air Quality Standards (40 CFR 50)	Particulate matter	Air	For a major stationary source (see 40 CFR 52.2(b)(1)(i)(a)) that emits >250 tons/year of any regulated pollutant, particulate matter less than 10 μm in diameter (PM-10) should not exceed a 24-hour average concentration of 150 $\mu g/m^3$ or an annual arithmetic mean of 50 $\mu g/m^3$.	Not an ARAR	These requirements are national limitations on ambient concentrations and do not apply directly to source-specific emissions. However, they will be addressed in controlling emissions of particulates that could result from implementation of the proposed action.
Missouri Air Conservation Law; Public Health and Welfare (RSMo. Title 12, 643.055), Commission may adopt rules for compliance with federal law -- suspension, reinstatement	Any regulated under federal Clean Air Act	Air	Standards and guidelines promulgated to ensure that Missouri is in compliance with the Clean Air Act are not to be any stricter than those required under that act (see related discussion of 40 CFR 50).	Not an ARAR	These requirements are national limitations on ambient concentrations and do not apply directly to source-specific emissions. However, they will be addressed in controlling emissions of particulates that could result from implementation of the proposed action.
Missouri Air Quality Standards; Air Quality Standards, Definitions, Sampling and Reference Methods, and Air Pollution Control Regulations for the State of Missouri (10 CSR 10-6.010), Ambient Air Quality	Particulate matter (PM-10)	Air	Concentrations of PM-10 are limited to an annual arithmetic mean of 50 $\mu g/m^3$ and a 24-hour average of 150 $\mu g/m^3$.	Not an ARAR	These requirements are national limitations on ambient concentrations and do not apply directly to source-specific emissions. However, they will be addressed in controlling emissions of particulates that could result from implementation of the proposed action.
Missouri Air Pollution Control Regulations; Air Quality Standards and Air Pollution Control Regulations for the St. Louis Metropolitan Area (10 CSR 10-5.050), Restriction of Emission of Particulate Matter from Industrial Processes	Particulate matter	Air	Particulate matter from any industrial source may not exceed a concentration of 0.30 grain/ft^3 of exhaust gas; certain activities are exempted (e.g., grinding, crushing, and classifying operations at a rock quarry).	Not an ARAR	These requirements are neither applicable nor relevant and appropriate because no industrial processes are involved in the proposed action. However, they will be addressed in controlling emissions of particulates that could result from implementation of the proposed action.
Missouri Air Pollution Control Regulations; Air Quality Standards and Air Pollution Control Regulations for the St. Louis Metropolitan Area (10 CSR 10-5.090), Restriction of Emission of Visible Air Contaminants	Particulate matter	Air	Emissions of particulate matter (<25 lb/h) from any single source, not including uncombined water, may not be darker than the shade or density designated as No. 2 on the Ringelmann Chart, or 40% opacity.	Not an ARAR	These requirements are neither applicable nor relevant and appropriate because the site does not constitute an emission source per the regulatory definition. However, they will be addressed in controlling emissions of particulates that could result from implementation of the proposed action.

TABLE B.2 (Cont'd)

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
Missouri Air Pollution Control Regulations; Air Quality Standards and Air Pollution Control Regulations for the St. Louis Metropolitan Area (10 CSR 10-5.100), Preventing Particulate Matter from Becoming Airborne	Particulate matter	Air	No person may permit the handling, transport, or storage of any material in a way that allows unnecessary amounts of fugitive particulate matter to become airborne and that results in at least one complaint being filed. To prevent particulate matter from becoming airborne during construction, use, repair, or demolition of a road, driveway, or open area, the following measures may be required: paving or frequent cleaning of roads, applying dust-free surfaces or water, and planting and maintaining a vegetative ground cover. (Unpaved public roads in unincorporated areas that are in compliance with particulate matter standards are excluded.)	Potentially applicable	These requirements may be applicable to the control of particulate emissions that could result from implementation of the proposed action.
Missouri Air Pollution Control Regulations; Air Quality Standards and Air Pollution Control Regulations for the St. Louis Metropolitan Area (10 CSR 10-5.180), Emission of Visible Air Contaminants from Internal Combustion Engines	Particulate matter	Air	Visible air contaminants (other than uncombined water) may not be released from an internal combustion engine for more than 10 seconds at any one time.	Potentially applicable	These requirements may be applicable to particulates released from any internal combustion engines used during the proposed action.
Occupational Safety and Health Administration Standards; Occupational Health and Environmental Control (29 CFR 1910; 1910.95), Subpart G, Occupational Noise Exposure	Noise	Air	The permissible occupational exposure level for noise is 90 dBA (slow response) for an 8-hour day; with decreasing times of exposure, the levels increase to 115 dBA per 1/4-hour day.	Not an ARAR	These requirements are part of an employee protection law (rather than an environmental law) with which CERCLA response actions should comply; hence, they are not subject to the ARAR process. However, they constitute requirements for worker protection with which the proposed action will comply.

TABLE B.2 (Cont'd)

<table>
<tr><th>Potential ARAR</th><th>Contaminant</th><th>Medium</th><th>Requirement</th><th>Preliminary Determination</th><th>Remarks</th></tr>
<tr><td>Occupational Safety and Health Administration Standards; Occupational Health and Environmental Control (29 CFR 1910; 1910.96), Subpart G, Ionizing Radiation</td><td>Radiation</td><td>Any</td><td>The dose per calendar quarter resulting from exposure to radiation in a restricted area from sources in that area is limited to the following:<table><tr><th>Part of Body</th><th>Dose (rem)</th></tr><tr><td>Whole body: head and trunk; active blood-forming organs; lens of eye; or gonads</td><td>1 1/4</td></tr><tr><td>Hands and forearms; feet and ankles</td><td>18 3/4</td></tr><tr><td>Skin of whole body</td><td>7 1/2</td></tr></table>The occupational exposure of an individual younger than 18 is restricted to 10% of these limits; the whole-body dose to a worker may not exceed 3 rem in a calendar quarter, and when added to the cumulative occupational dose may not exceed 5(N-18) rem, where N is the age of the exposed individual.</td><td>Not an ARAR</td><td>These requirements are part of an employee protection law (rather than an environmental law) with which CERCLA response actions should comply; hence, they are not subject to the ARAR process. However, they constitute requirements for worker protection with which the proposed action will comply.</td></tr>
<tr><td>Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.040), Maximum Permissible Exposure Limits</td><td>Radiation</td><td>Any</td><td>Limits for occupational doses from ionizing radiation in a controlled area are as follows:<table><tr><th>Part of Body</th><th>Maximum Dose in Any Calendar Year (rem)</th><th>Maximum Dose in Any Calendar Quarter (rem)</th></tr><tr><td>Whole body: head and trunk; major portion of bone marrow; gonads; or lens of eye</td><td>5</td><td>3</td></tr><tr><td>Hands and forearms; feet and ankles</td><td>75</td><td>25</td></tr><tr><td>Skin of large body area</td><td>30</td><td>10</td></tr></table>Also, the whole-body dose added to the cumulative occupational dose must not exceed 5(N-18) rem, where N is the age of the exposed individual.</td><td>Not an ARAR</td><td>These requirements are part of an employee protection law (rather than an environmental law) with which CERCLA response actions should comply; hence, they are not subject to the ARAR process. However, they constitute requirements for worker protection with which the proposed action will comply.</td></tr>
</table>

TABLE B.2 (Cont'd)

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.050), Personnel Monitoring and Radiation Surveys	Radiation	Any	Personnel monitoring and radiation surveys are required for each worker for whom there is any reasonable possibility of receiving a weekly dose from all radiation exceeding 50 mrem, taking into consideration the use of protective gloves and radiation-limiting devices. An exemption from routine monitoring may be granted under certain conditions.	Not an ARAR	These requirements are part of an employee protection law (rather than an environmental law) with which CERCLA response actions should comply; hence, they are not subject to the ARAR process. However, they constitute requirements for worker protection with which the proposed action will comply.
Radiation Protection for Occupational Workers (DOE Order 5480.11)	Radiation	Any	The effective dose equivalent received by any member of the public entering a controlled area is limited to 100 mrem/yr. Limiting values for the assessed dose from exposure of workers to radiation are as follows. (These values represent maximum limits; it is DOE policy to maintain radiation exposures as far below these limits as is reasonably achievable.)	To be considered	Although not promulgated standards, these constitute requirements for protection from radionuclide emissions in a controlled area with which the proposed action will comply.

Radiation Effect	Annual Dose Equivalent (rem)
Stochastic effects	5[a]
Nonstochastic effects	
Lens of eye	15
Organ, extremity, or tissue including skin of whole body	50
Unborn child Entire gestation period	0.5

[a]Annual effective dose equivalent.

Potential ARAR	Contaminant	Medium	Requirement	Preliminary Determination	Remarks
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192)	Radiation	Any	Processing operations during and prior to the end of the closure period at a facility managing uranium by-product material should be conducted in a manner that provides reasonable assurance that the annual dose equivalent does not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public as a result of exposures to the planned discharge of radioactive material to the general environment (excluding radon-222 and its decay products).	Potentially relevant and appropriate	These requirements are not applicable because the proposed action does not constitute a processing operation nor does it include a planned discharge of radioactive material to the environment. However, these requirements may be considered relevant and appropriate to protection of the public during implementation of the proposed action.

TABLE B.3 Potential Action-Specific Requirements

Potential ARAR	Action	Requirement	Preliminary Determination	Remarks
Noise Control Act, as Amended; Noise Pollution and Abatement Act	Excavation and transport	The public must be protected from noises (e.g., that could result from excavation and transport activities) that jeopardize health or welfare.	Potentially applicable	Because equipment and vehicles would be involved in certain aspects of the proposec action (e.g., excavation and transport), all pertinent requirements of the act would be followed.
Occupational Safety and Health Administration Standards for Hazardous Waste Operations and Emergency Response (29 CFR 1910)	Waste management	General worker protection requirements are established, as are requirements for worker training and the development of an emergency response plan and a safety and health program for employees. In addition, procedures are established for hazardous waste operations -- including decontamination and drum/container handling (e.g., for radioactive waste).	Not an ARAR	These requirements are part of an employee protection law (rather than an environmental law) with which CERCLA response actions should comply; hence, they are not subject to the ARAR process. However, they constitute requirements for worker protection with which the proposed action will comply.
Radioactive Waste Management (DOE Order 5820.2A)	Waste management	External exposure to radioactive waste (including releases) should not result in an effective dose equivalent of >25 mrem/yr to any member of the public; releases to the atmosphere are to meet the requirements of 40 CFR 61 (see related discussion in Table B.2); and an environmental monitoring program must be implemented to address compliance with performance standards.	To be considered	Although not promulgated standards, these constitute requirements with which the proposed action will comply. An environmental monitoring program has been developed for implementation.
Radiation Protection of the Public and the Environment (DOE Order 5400.5)	Interim waste storage and management	The control and stabilization features of a storage facility should be designed to ensure an effective life of 50 years, with a minimum life of at least 25 years, to the extent reasonably achievable; site access controls should be designed to ensure an effective life of at least 25 years, to the extent reasonable; and periodic monitoring, shielding, access restrictions, and safety measures must be implemented to control the migration of radioactive material, as appropriate.	To be considered	Although not promulgated standards, these constitute requirements with which the storage of residues will comply.
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.070), Storage of Radioactive Materials	Storage of radioactive waste	Radioactive materials must be stored in a manner that will not result in the exposure of any person, during routine access to a controlled area, in excess of the limits identified in 19 CSR 20-10.040 (see related discussion in Table B.2); a facility used to store materials that may emit radioactive gases or airborne particulate matter must be vented to ensure that the concentration of such substances in the air does not constitute a radiation hazard; and provisions must be made to minimize the hazard to emergency workers in the event of a fire, earthquake, flood, or windstorm.	Potentially applicable	These requirements may be applicable to the storage of certain material resulting from the proposed action.

TABLE B.3 (Cont'd)

Potential ARAR	Action	Requirement	Preliminary Determination	Remarks
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.080), Control of Radioactive Contamination	Waste management	All work must be carried out under conditions that minimize the potential spread of radioactive material that could result in the exposure of any person above any limit specified in 19 CSR 20-10.040 (see related discussion in Table B.2). Clothing and other personal contamination should be monitored and removed according to procedures established by a qualified expert; any material contaminated to the degree that a person could be exposed to radiation above any limit specified in 19 CSR 20-10.040 should be retained on-site until it can be decontaminated or disposed of according to procedures established by a qualified expert.	Not an ARAR	These requirements are part of an employee protection law (rather than an environmental law) with which CERCLA response actions should comply; hence, they are not subject to the ARAR process. However, they constitute requirements for worker protection with which the proposed action will comply.

APPENDIX C:

ENGLISH/METRIC - METRIC/ENGLISH EQUIVALENTS

TABLE C.1 English/Metric Equivalents

Multiply	By	To obtain
acres	0.4047	hectares (ha)
cubic feet (ft^3)	0.02832	cubic meters (m^3)
cubic yards (yd^3)	0.7646	cubic meters (m^3)
degrees Fahrenheit (°F) - 32	0.5555	degrees Celsius (°C)
feet (ft)	0.3048	meters (m)
gallons (gal)	3.785	liters (L)
gallons (gal)	0.003785	cubic meters (m^3)
inches (in.)	2.540	centimeters (cm)
miles (mi)	1.609	kilometers (km)
pounds (lb)	0.4536	kilograms (kg)
short tons (tons)	907.2	kilograms (kg)
short tons (tons)	0.90718	metric tons (t)
square feet (ft^2)	0.09290	square meters (m^2)
square yards (yd^2)	0.8361	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)

TABLE C.2 Metric/English Equivalents

Multiply	By	To obtain
centimeters (cm)	0.3937	inches (in.)
cubic meters (m^3)	35.31	cubic feet (ft^3)
cubic meters (m^3)	1.308	cubic yards (yd^3)
cubic meters (m^3)	264.2	gallons (gal)
degrees Celsius (°C) + 17.78	1.8	degrees Fahrenheit (°F)
hectares (ha)	2.471	acres
kilograms (kg)	2.205	pounds (lb)
kilograms (kg)	0.001102	tons, short (t)
kilometers (km)	0.6214	miles (mi)
liters (L)	0.2642	gallons (gal)
meters (m)	3.281	feet (ft)
metric tons (t)	1.1023	short tons (tons)
square kilometers (km^2)	0.3861	square miles (mi^2)
square meters (m^2)	10.76	square feet (ft^2)
square meters (m^2)	1.196	square yards (yd^2)

FUSRAP Document Management System

Year	00
ID	3598
Further Info?	☐
Operating Unit	St. Louis Sites
Site	HISS
Area	hazelwood area
MARKS Number	FN:1110-1-8100g
Primary Document Type	Removal Response
Secondary Document Type	EE/CA
Subject or Title	EE/CA Environmental Assessment for the Proposed Decontamination of Properties in the Vicinity of the Hazelwood Interim Storage Site, Hazelwood, Missouri (DOE/EA-0489, Rev 1)
Author/Originator	M. H. Picel, J. M. Pete
Company	Argonne National Lab
Date	3/1/1992
Recipient (s)	
Company (-ies)	USDOE
Version	Final
Original's Location	Central Files
Document Format	paper
Confidential File?	☐
Comments	DOE/EA-0489,
SAIC number	
Bechtel ID	
ETL	2.16
Filed in Volume	2

Include in which AR(s)?

- ☑ North County
- ☐ Madison
- ☐ Downtown
- ☐ Iowa