RECORD OF DECISION: DOE/OR/21548-376

Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site

September 1993

U.S. Department of Energy
Oak Ridge Field Office
Weldon Spring Site Remedial Action Project

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September 1993

prepared by

U.S. Department of Energy, Oak Ridge Field Office, Weldon Spring Site Remedial Action Project

DECLARATION

SITE NAME AND LOCATION

Weldon Spring Site
St. Charles County, Missouri 63304

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the chemical plant area of the Weldon Spring site in St. Charles County, Missouri. This remedial action was selected in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), as amended, and to the extent practicable, the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP), 40 CFR Part 300.

In making this decision, it is the U.S. Department of Energy's (DOE's) policy to integrate *National Environmental Policy Act* (NEPA) values into the CERCLA remedial action process; however, it is not the intent of the DOE to make a statement on the legal applicability of the NEPA to CERCLA actions. This single document is intended to serve as the DOE's *Record of Decision* (ROD) under both the CERCLA and the NEPA.

The decision presented herein is based on the information available in the *Administrative Record* maintained in accordance with the CERCLA. The decision is also based on the issuance of the *Proposed Plan for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (DOE 1992a), holding a public meeting to receive comments on the *Proposed Plan*, and completion of the *Remedial Investigation/Feasiblity Study-Final Environmental Impact Statement* (RI/FS-Final EIS). In addition, the DOE has considered all comments received on the *Proposed Plan* and the RI/FS-Final EIS documents in the preparation of the ROD.

As the lead agency for the State of Missouri regarding the Weldon Spring Site Remedial Action Project, the Missouri Department of Natural Resources concurs that *Alternative 6a: Removal, Chemical Stabilization/Solidification and Disposal On Site* is the preferred remedy for the chemical plant area of the Weldon Spring site, and also concurs with applicable and/or relevant and appropriate requirements (ARARs) and waivers.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in the ROD, may present a threat to human health and the environment.

DESCRIPTION OF THE REMEDY

The chemical plant operable unit remedial action is the third of five major response actions planned for the chemical plant area. Previous response actions included a removal action involving the decontamination and dismantlement of site structures with short-term storage of the material on site until selection of a disposal option in this ROD and a removal action to treat impounded surface water. In addition, bulk waste material from the Weldon Spring Quarry is being placed in temporary storage on site until the selection of a disposal option.

This operable unit addresses the various sources of contamination at the chemical plant area including soils, sludge, sediment, and materials placed in short-term storage as a result of previous response actions.

This remedial action uses treatment to address the principal threat remaining at the site, (e.g., raffinate pit sludges and certain soil from the quarry). The major components of this remedy are:

- Dredge sludge from the raffinate pits, excavate sediment from Frog Pond and Ash Pond and three off-site lakes, and excavate soil from specific locations (including two former dump areas, locations adjacent to the chemical plant buildings on site, and 10 vicinity properties off site) using standard construction equipment and procedures.

- Remove material stored at the temporary facilities on site (including bulk waste excavated from the quarry, treatment residuals from the water treatment plants at the quarry and the chemical plant area, and building material from the chemical plant area) using standard construction equipment and procedures.

- Certain contaminated materials such as the raffinate pit sludges and portions of quarry soil will be treated on site by chemical stabilization/solidification.

Treated and untreated materials will be disposed of on site in a facility designed and constructed specifically for the Weldon Spring site wastes.

- Continued evaluation of vitrification as a contingency treatment option.

In reaching the decision to implement this remedial alternative, DOE evaluated three other alternatives in addition to no action. The other alternatives are: (1) Removal, Vitrification, and Disposal On-site; (2) Removal, Vitrification, and Disposal at the Envirocare Facility; and (3) Removal Vitrification, and Disposal at the Hanford Reservation Facility. A description of the alternatives is provided in the Decision Summary of the ROD (attached), and is available in the *Administrative Record.* CERCLA's nine criteria (two threshold, five primary balancing, and two modifying criteria) set out in the NCP were used to evaluate the alternatives. The selected remedy and the contingency treatment option represent the best balance of key factors with respect to these criteria and are the environmentally preferable alternatives.

Short-term effectiveness, implementability, and cost are the key factors for selection of the preferred alternative. The short-term effectiveness of the selected remedy is greater than for the two alternatives that involve transportation of the waste to off-site locations. The selected remedial action is the most implementable of all the alternatives evaluated in detail because the chemical stabilization/solidification technology has been utilized at other sites and would use readily available resources. Finally, the selected remedy is the most cost effective of those alternatives evaluated.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment; it complies with Federal and State of Missouri requirements that are legally applicable or relevant and appropriate to the remedial action, except as specifically waived pursuant to CERCLA, as set forth below, and is cost effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable, and satisfies the CERCLA statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

The following Federal and State of Missouri requirements are waived under this Record of Decision:

- 19 CSR 20-10.040 - State Rn-222 limit of 1 pCi/l above background in uncontrolled areas. CERCLA provision for waiver: Section 121(d)(4)(C).

- 40 CFR Part 268, Subpart E - Land Disposal Restrictions (LDR) storage limitations. CERCLA provision for waiver: Section 121(d)(4)(C).

- 40 CFR Part 268, Subpart C - LDR placement restrictions. CERCLA provision for waiver: Section 121(d)(4)(A).

- 10 CSR 25.5-262(2)(C)1 - packaging, marking, and labeling requirements. CERCLA provision for waiver: Section 121(d)(4)(A) and Section 121(d)(4)(B).

- 40 CFR 761.75(b)(3) - *Toxic Substance Control Act* (TSCA) requirements for bottom landfill liner. CERCLA provision for waiver: Section 121(d)(4)(D).

- 40 CFR 264.314(f) - restrictions regarding free liquids in CSS grout placed in the disposal facility for purposes of disposing of CSS treated wastes and to fill voids of dismantlement debris. CERCLA provisions for waiver: Section 121(d)(4)(B) and Section 121(d)(4)(D).

- 40 CFR Part 268.42, Subpart D - LDR treatment standards based upon use of a specified technology. CERCLA provision for waiver: Section 121(d)(4)(D).

- 40 CFR 61, Subpart M - National Emission Standards for Hazardous Air Pollutants (NESHAPs) requirements for asbestos storage. CERCLA provision for waiver: Section 121(d)(4)(B).

- 40 CFR 761.65(a) - TSCA requirement for PCB storage and disposal. CERCLA provision for waiver: Section 121(d)(4)(A).

Because both the selected and contingency remedies would result in hazardous substances remaining on site above health-based levels (within the engineered disposal facility), a review will be conducted within five years after this remedial action is complete in accordance with CERCLA to ensure that the remedy continues to provide adequate protection of human health and the environment.

All practicable means to avoid or minimize environmental harm from implementation of the selected remedy have been adopted. Excavation of contaminated soil in an area extending into the Schote Creek 100-year floodplain will be conducted using sediment controls to minimize off-site transport of contaminated materials and no net change in flood potential is expected due to these actions. A mitigation action plan will be prepared for dredging and excavation activities in areas considered to be wetlands to minimize adverse impacts. Final site layout and design will include all practicable means (e.g., sound engineering practices and proper construction practices) to minimize environmental impacts.

for:

Regional Administrator,
U.S. Environmental Protection Agency Region VII

9-28-93

Date

for TG

Assistant Secretary for Environmental Restoration
and Waste Management
U.S. Department of Energy

8/13/93

Date

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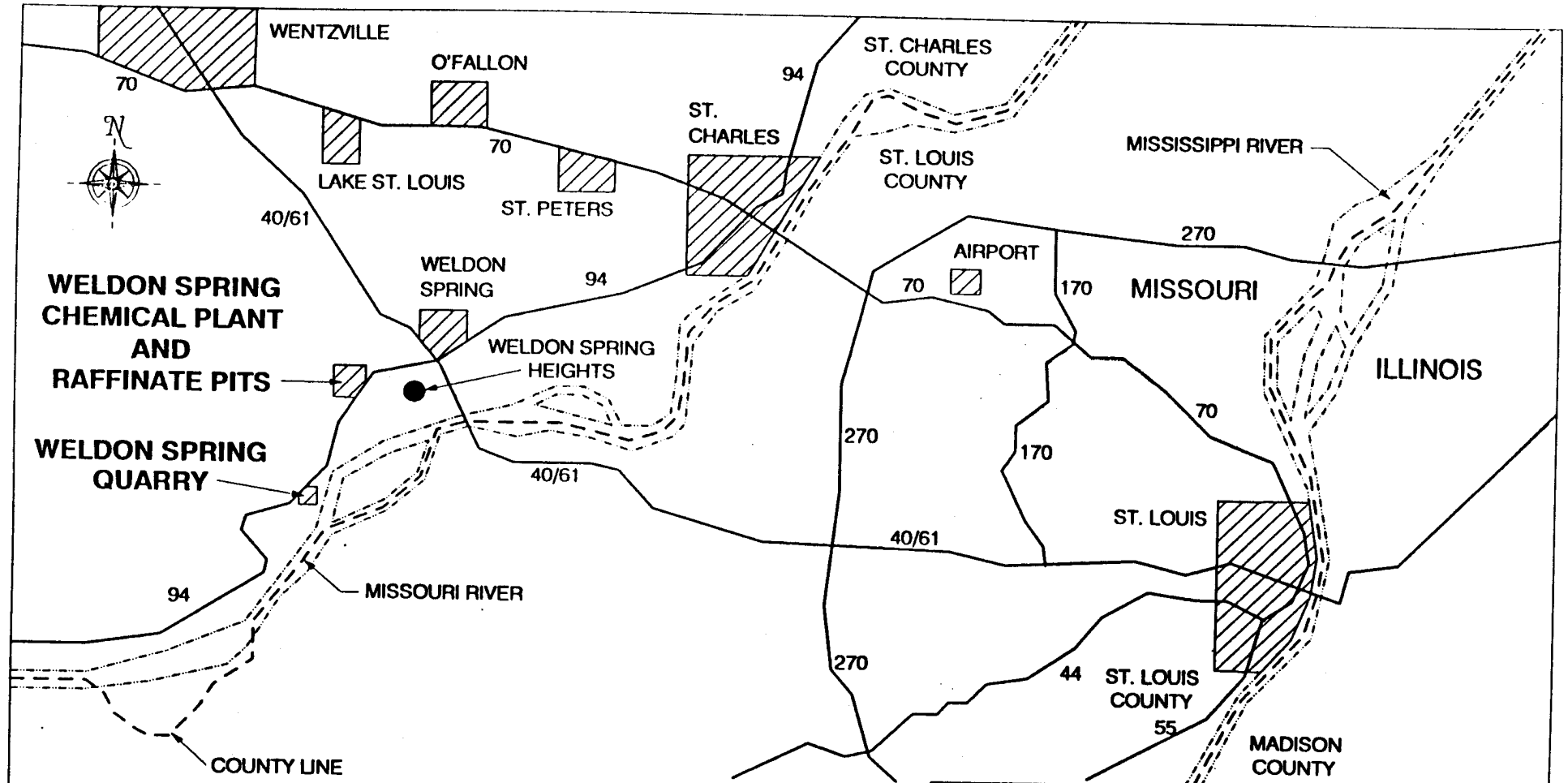
DECISION SUMMARY

1 SITE NAME, LOCATION, AND DESCRIPTION

The Weldon Spring site is located in St. Charles County, Missouri, about 48 km (30 mi) west of St. Louis (Figure 1-1). The site consists of two geographically distinct areas: the 88-ha (217-acre) chemical plant area, which is about 3.2 km (2 mi) southwest of the junction of Missouri (State) Route 94 and U.S. Route 40/61, and a 3.6-ha (9-acre) limestone quarry, which is about 6.4 km (4 mi) south-southwest of the chemical plant area. The chemical plant area and the quarry are accessible from State Route 94, and both are fenced and closed to the public. This remedial action addresses sources of contamination at the chemical plant area, hereafter referred to as "the site," and its vicinity. This action also represents the selected disposal option for contaminated bulk waste material from the quarry and vicinity areas.

The site was initially used by the Army during the 1940s to produce the explosives trinitrotoluene (TNT) and dinitrotoluene (DNT). After extensive demolition, decontamination, and regrading, the chemical plant was built by the U.S. Atomic Energy Commission (AEC, a predecessor of the U.S. Department of Energy [DOE]) to process uranium and thorium ore concentrates during the 1950s and 1960s. Radioactively and chemically contaminated waste was disposed of at the site during this period, and waste was disposed of in the quarry by both the Army and the AEC from the 1940s through the 1960s. Radioactive contaminants are primarily radionuclides of the natural uranium and Th-232 decay series; chemical contaminants include naturally occurring metals and inorganic anions, as well as organic compounds such as polychlorinated biphenyls (PCBs) and nitroaromatic compounds.

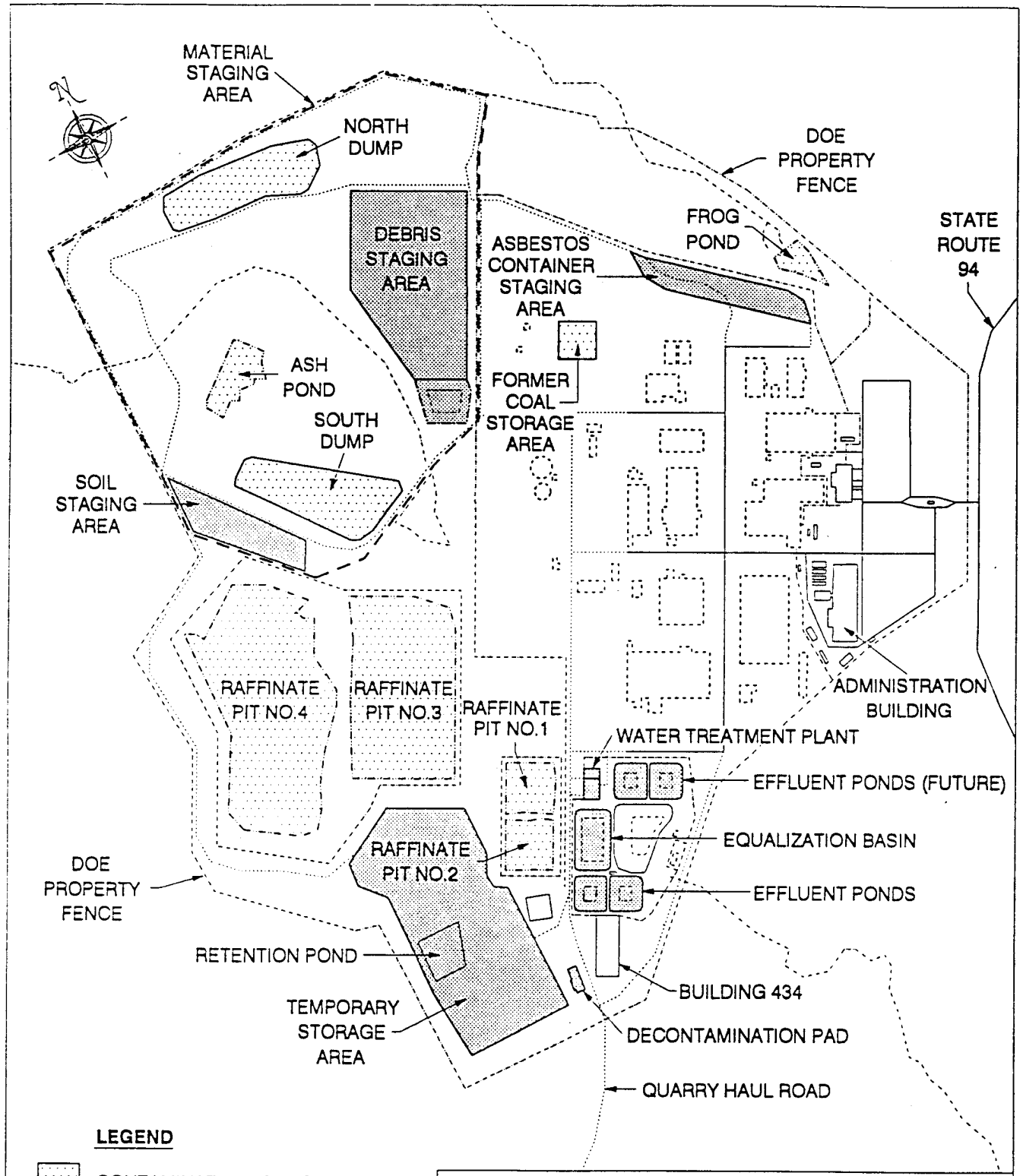
Site features include about 40 buildings (currently being dismantled), four raffinate pits, two ponds (Ash Pond and Frog Pond), and two former dump areas (north dump and south dump) (Figure 1-2). Most of the land surface around the buildings is paved or covered with gravel; the remainder of the site contains a variety of grasses and scattered small shrubs and trees. Much of the site is routinely mowed, and little undisturbed and/or natural habitat exists except in the northern quadrant. Soil in the two dump areas and at scattered locations throughout the chemical plant is radioactively contaminated; discrete locations also contain elevated concentrations of certain metals and a few organic compounds. Portions of the site are classified as prime farmland soil by the U.S. Soil Conservation Service on the basis of soil type, slope, and drainage.



LOCATION OF THE WELDON SPRING SITE

FIGURE 1-1

REPORT NO.:		EXHIBIT NO.: A/VP/013/0293	
ORIGINATOR: JAB	DRAWN BY: GLN	DATE: 8/27/93	



LEGEND

CONTAMINATED SOURCE AREAS

FACILITIES BEING CONSTRUCTED

STRUCTURES BEING DISMANTLED

0 500 1000 FT

0 152.4 304.8 M

SCALE

GENERAL LAYOUT OF THE CHEMICAL PLANT AREA

FIGURE 1-2

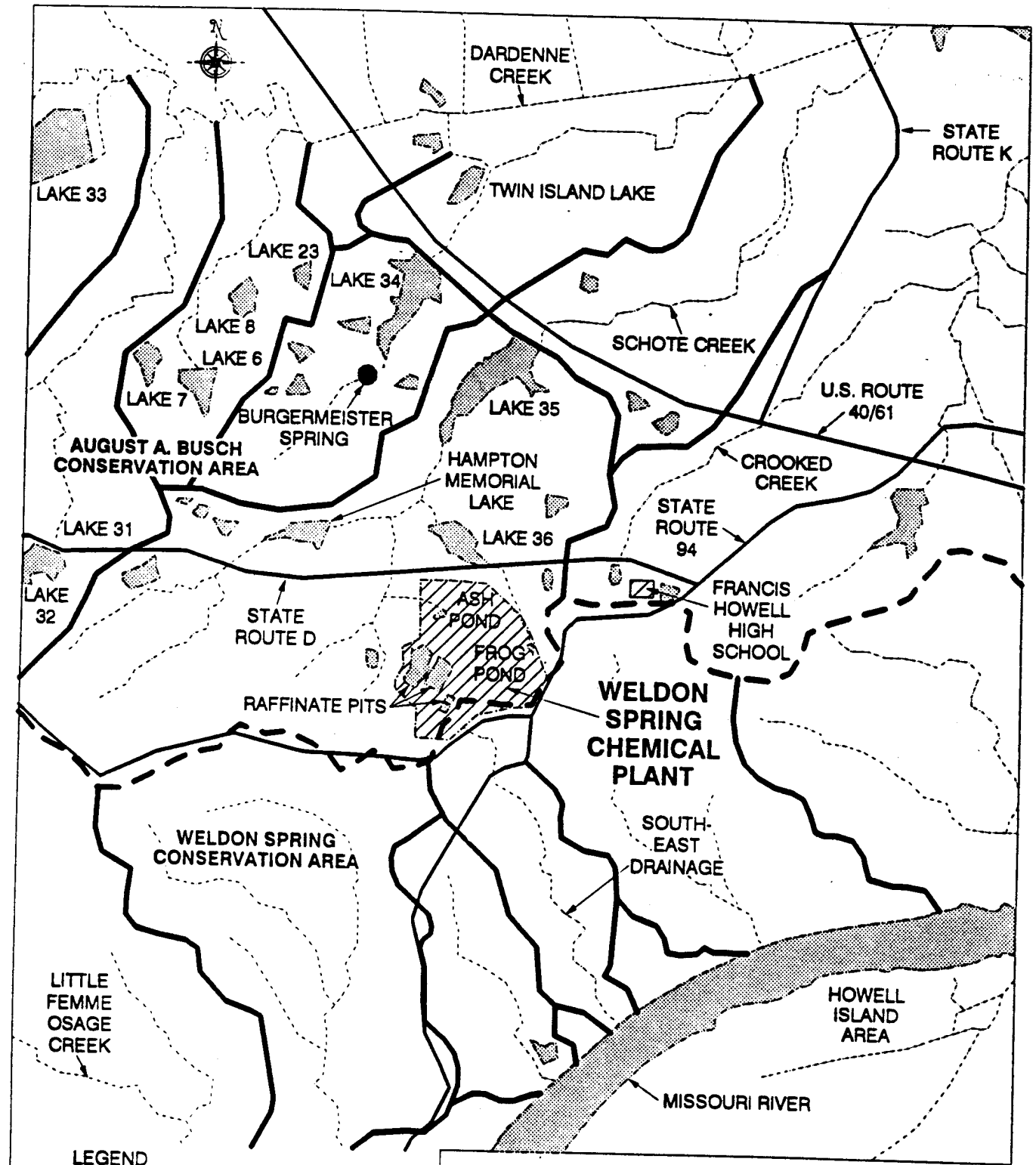
REPORT NO.:		EXHIBIT NO.:	A/CP/017/0293
ORIGINATOR: JAB	DRAWN BY: GLN	DATE: 2/93	

The raffinate pits cover about 10 ha (26 acres) in the southwestern portion of the site. They were excavated from existing soil during the operational period of the chemical plant to receive waste slurry from the processing operations. These pits constitute the most heavily contaminated area and contain about 150,000 m^3 (200,000 yd^3) of sludge and a combined average 216,000 m^3 (57,000,000 gal) of water. In addition, some drums and rubble from the Army's earlier decontamination activities at the chemical plant were disposed of primarily in the fourth pit.

Ash Pond covers about 4.5 ha (11 acres) in the northwestern portion of the site. This area received fly ash from the steam plant during the operational period. Frog Pond covers about 0.3 ha (0.7 acres) in the northeastern part of the site and served as a settling basin for flows from the pilot plant. The combined volume of surface water in these ponds averages about 8,700 m^3 (2,300,000 gal). The four pits and two ponds combined cover about 15 ha (38 acres) and are included on the Wetlands Inventory Map produced by the U.S. Department of the Interior.

The site is transected by a surface water divide (Figure 1-3), and the natural land surface is gently sloping. Surface runoff from the southern portion of the site flows south toward the Missouri River via a 2.4-km (1.5-mi) natural channel referred to as the Southeast Drainage; runoff from the remainder of the site flows north toward the Mississippi River. Soil in the Southeast Drainage is radioactively contaminated as a result of past discharges, and intermittent flows continue to carry contaminants off site from surface runoff down the channel. A small portion (about 0.5 ha [1.3 acres]) of the northern area of the site along the drainage leading off site from Ash Pond is within the 100-year floodplain of Schote Creek, a perennial stream west and north of the site. The affected area represents a very small fraction (<0.01%) of that floodplain. Contaminant levels in site runoff have recently decreased as a result of interim actions to divert surface flow around contaminated soil areas such as the south dump and to remove suspended solids using a siltation pond, straw, and vegetative cover.

The site is also situated atop a groundwater divide. Groundwater in the shallow Burlington Keokuk Limestone aquifer south of the divide flows toward the Missouri River, and groundwater north of the divide flows north toward the Mississippi River. Groundwater in this shallow aquifer beneath the site and the nearby area (e.g., the Army property) is contaminated with nitrates, sulfates, nitroaromatic compounds, some heavy metals, and uranium. No drinking-water wells are currently completed in this aquifer, either on site or in the immediate vicinity. The limited data available for the deep, productive St. Peter Sandstone indicate that groundwater in this aquifer is not contaminated.



LEGEND

- SURFACE WATER DIVIDE BETWEEN MISSISSIPPI RIVER AND MISSOURI RIVER
- CREEK OR SURFACE DRAINAGE
- CREEK OR SURFACE DRAINAGE
- POND OR LAKE

0 — 1 MI
0 — 1.6 KM
SCALE

SURFACE WATER DRAINAGES NEAR THE WSS

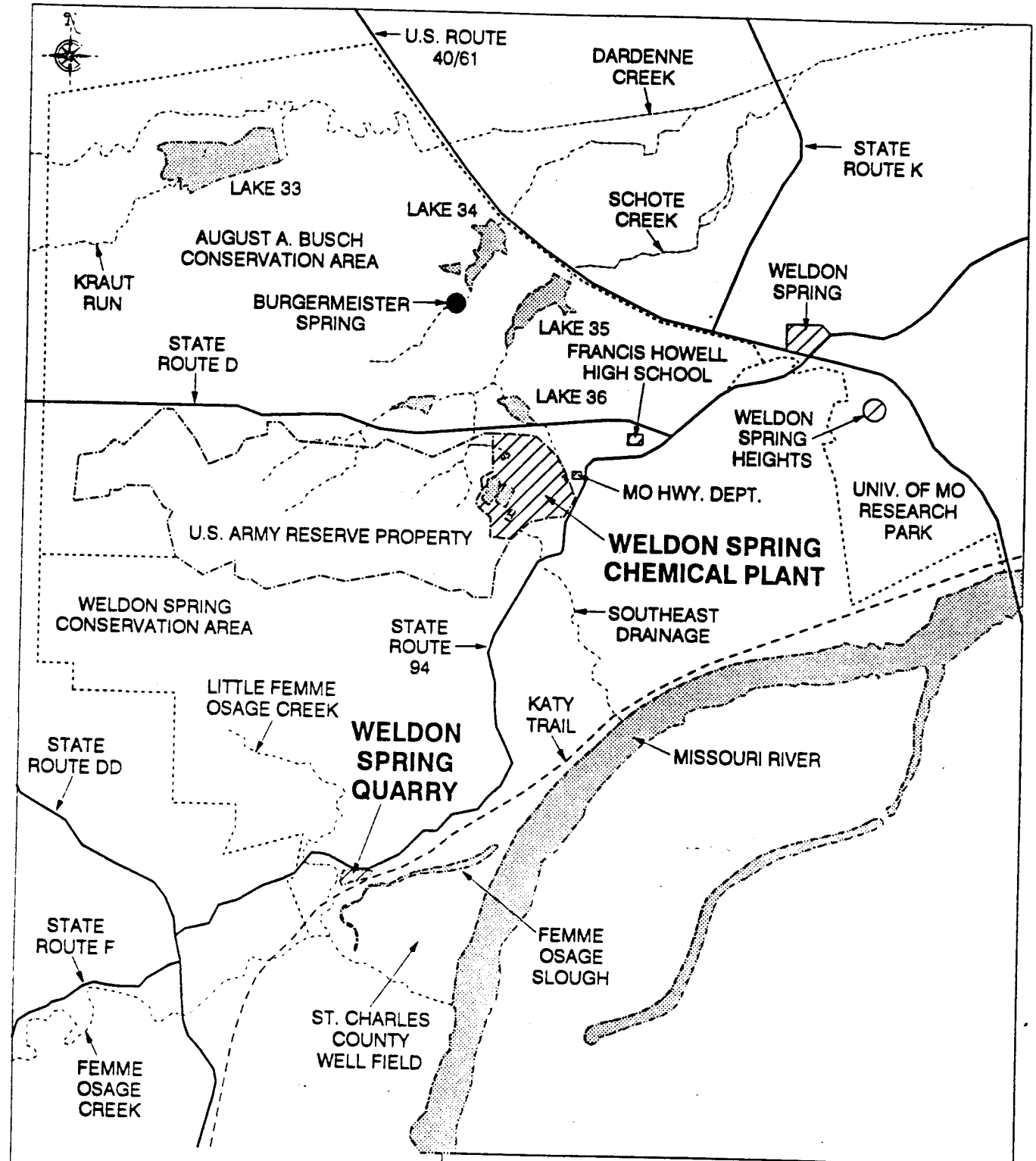
FIGURE 1-3

REPORT NO.:		EXHIBIT NO.:	A/VP/027/0393
ORIGINATOR: JAB	DRAWN BY: GLN	DATE: 8/9/93	

About 22 ha (55 acres) in the northern quadrant of the site have been relatively undisturbed and are essentially grassland/old-field habitat with some secondary forest growth. A wide variety of species occurs on site, especially in this northern portion. Deer, rabbits, raccoons, squirrels, turtles, frogs, wild turkeys, geese, and ducks have been observed. The site does not provide critical habitats for any Federal-listed threatened or endangered species, and no Federally listed species have been sighted in the chemical plant area. Two State-listed species, the pied-billed grebe (a State rare species) and the Swainson's hawk (a State endangered species) have been reported for the site, although there is no evidence that either species breeds on or uses the site year-round.

The site is bordered by the August A. Busch Conservation Area to the north, the Weldon Spring Conservation Area to the south and east, and the U.S. Army Reserve and National Guard Training Area to the west (Figure 1-4). The two wildlife areas are managed by the Missouri Department of Conservation and are open throughout the year for recreational uses; together, these areas receive about 1,200,000 visitors each year. Army reserve troops had previously used the Army property each year, primarily for weekend training exercises. This Army property and portions of the wildlife areas constitute the balance of the former ordnance works and are also listed on the National Priorities List (NPL). Soil at several small locations on the Army property and in the two wildlife areas contains generally low levels of radioactivity as a result of previous site activities. Three lakes in the Busch Conservation Area also contain low levels of radioactivity as a result of surface runoff. These lakes also show elevated levels of lead, barium, and arsenic, although there is no known source from the site.

A State of Missouri highway maintenance facility is located on State Route 94, just northeast of the site entry gate, and Francis Howell High School is located about 1 km (0.6 mi) east of the site (Figure 1-4). The maintenance facility employs nine staff and one mechanic. The school employs about 160 faculty and staff, and about 1,600 students currently attend. The two closest communities to the site are Weldon Spring and Weldon Spring Heights; they are located about 3.2 km (2 mi) east of the site and have a combined population of about 850. Three residences are located within this 3.2 km (2 mi) distance from the site, the closest of which is a trailer occupied by the janitor at the high school. The largest city in the county is St. Charles; it is located about 24 km (15 mi) northeast of the site and has a population of about 50,000.



SURFACE FEATURES NEAR THE WELDON SPRING SITE

FIGURE 1-4

REPORT NO.		EXHIBIT NO.	A/VP/014/0293
ORIGINATOR JAB	DRAWN BY: GLN	DATE 8/9/93	

2 SITE HISTORY

In April 1941, the U.S. Department of the Army acquired about 7,000 ha (17,000 acres) of land in St. Charles County, Missouri, to construct the Weldon Spring Ordnance Works — a production facility for trinitrotoluene (TNT) and dinitrotoluene (DNT) explosives. The facility began operations in 1941 and closed in 1946. By 1949, all but about 810 ha (2,000 acres) of the ordnance works property had been transferred to the State of Missouri and the University of Missouri for use as wildlife area and agricultural land. Except for several small parcels transferred to St. Charles County, the remaining property became the chemical plant area of the Weldon Spring site and the adjacent U.S. Army Reserve and National Guard Training Area.

In May 1955, the U.S. Atomic Energy Commission (AEC) acquired 83 ha (205 acres) of the property from the Army for construction of a uranium feed materials plant. An additional 6 ha (15 acres) was later transferred to the AEC for expansion of waste storage capacity; i.e., to construct the fourth raffinate pit. Considerable explosives decontamination and regrading activities were conducted prior to constructing the chemical plant. Uranium and thorium ore concentrates were processed at the plant from 1957 to 1966.

Plant operations generated several chemical and radioactive waste streams, including raffinates from the refinery operation and washed slag from the uranium recovery process. Waste slurries were piped to the raffinate pits, where the solids settled to the bottom and the supernatant liquids were decanted to the plant process sewer. This sewer drained off site to the Missouri River via the Southeast Drainage. Some solid waste was also disposed of on site during the plant's operational period. The quarry, which had been used by the Army since the early 1940s to dispose of chemically contaminated waste, was transferred to the AEC in July 1960. Radioactively contaminated wastes such as uranium and thorium residues, building rubble, and process equipment were disposed of in the quarry through 1969.

The Army reacquired the chemical plant property in 1967 and began decontamination and dismantling operations to prepare the facility for herbicide production. Much of the resultant debris was placed in the quarry; a small amount was also placed in the fourth raffinate pit. The project was canceled in 1969 prior to any production, and the plant has remained essentially unused and in caretaker status since that time. The Army returned the raffinate pits portion of the chemical plant area to the AEC in 1971 and the remainder of the property to the U.S. Department of Energy (DOE) in 1985. Prior to that transfer, the Army conducted building repair and additional decontamination activities in 1984. The DOE established a project office

at the site in 1986 to support cleanup activities, and several interim response actions have been developed and implemented since that time.

The U.S. Environmental Protection Agency (EPA) listed the quarry on the National Priorities List (NPL) in 1987, and the chemical plant area was added to this listing in 1989. The balance of the former Weldon Spring Ordnance Works property, which is adjacent to the DOE portion of the property and for which the Army has responsibility, was added to the NPL as a separate listing in 1990.

A *Record of Decision* was prepared for management of the Weldon Spring quarry bulk wastes in 1990. The selected remedy entailed removal of the bulk wastes from the quarry, transportation along a dedicated haul road to the chemical plant area, and interim storage in the temporary storage area south of the raffinate pits. This work is presently underway.

3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

A Remedial Investigation/Feasibility Study (RI/FS) process was conducted for the Weldon Spring site in accordance with the requirements of the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA), as amended, to document the proposed management of the chemical plant area as an operable unit for overall site remediation and to support the comprehensive disposal options for the entire cleanup. Documents developed during the RI/FS process included the *Remedial Investigation* (DOE 1992b), a *Baseline Assessment* (BA) (DOE 1992c), a *Feasibility Study* (DOE 1992d), and a *Proposed Plan* (PP) (DOE 1992a). These documents incorporate values of the *National Environmental Policy Act* (NEPA), and they represent a level of analysis consistent with an *Environmental Impact Statement* (EIS). Together, the RI, BA, FS, and PP are the required primary documents consistent with the provisions of the *First Amended Federal Facility Agreement* entered into between the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA). In accordance with Section 117 of the CERCLA, copies of these final documents were released to the public on November 20, 1992. A public notice announcing the availability of these documents and the date for the public hearing was published in the *St. Charles Journal* on November 22, 1992.

The RI, BA, FS, and PP, along with other documents in the *Administrative Record*, have been made available for public review in the public reading room at the Weldon Spring site. Copies have also been made available to the public in information repositories at Francis Howell High School and at three branches of the St. Charles City/County Library: Kathryn M. Linneman, Spencer Creek, and Kisker Road. A notice of availability of these documents was published in the *St. Charles Journal* and the St. Charles Section of the *St. Louis Post-Dispatch* on November 22, 1992. An informational bulletin was also prepared to summarize this proposed action and facilitate the community participation process.

A public comment period for this remedial action was held from November 20, 1992, through February 19, 1993. A public hearing was held on December 16, 1992, at The Columns in St. Charles, Missouri, as part of the public participation process. This public hearing was advertised in the newspaper announcements listed above. At this meeting, representatives from the DOE and the EPA Region VII received comments from the public about the site and the remedial alternatives under consideration. Transcripts of the public meeting are included as part of the *Administrative Record* for this operable unit remedial action. The *Administrative Record* includes the information used to support the selected remedy. All public comments were considered in the decision-making process for determining the selected remedy.

A report of this hearing was featured in the site's publication, *WSSRAP Update*, copies of which were distributed to about 70,000 residences in St. Charles County on February 7, 1993.

A detailed response to the comments received during the public comment period for this remedial action was developed as a separate document and may be found in the *Administrative Record* and the information repositories. A responsiveness summary that addresses the major issues raised during the public comment period is attached to this *Record of Decision*. This decision document presents the selected remedial action for managing the chemical plant area of the Weldon Spring site in accordance with the CERCLA, as amended, and to the extent practicable, the *National Contingency Plan* (NCP). The decision for this site is based on the *Administrative Record*.

4 SCOPE AND ROLE OF REMEDIAL ACTION

This proposed remedial action is the major component of overall site cleanup (Figure 4-1), and addresses comprehensive disposal decisions for the project. The primary focus of this action is contaminated material at the chemical plant area, including that generated as a result of previous response actions. However, the scope also includes the disposition of material that may be generated by upcoming actions (e.g., at the Southeast Drainage and the quarry). Although cleanup decisions for other components of site remediation are not included in the scope of this action, the contaminated material that could be generated by future response actions is being considered to facilitate an integrated disposal decision. The types of material that could result from future actions are the same as those being addressed in this action; i.e., soil, sediment, vegetation, and containerized process waste from the water treatment plants.

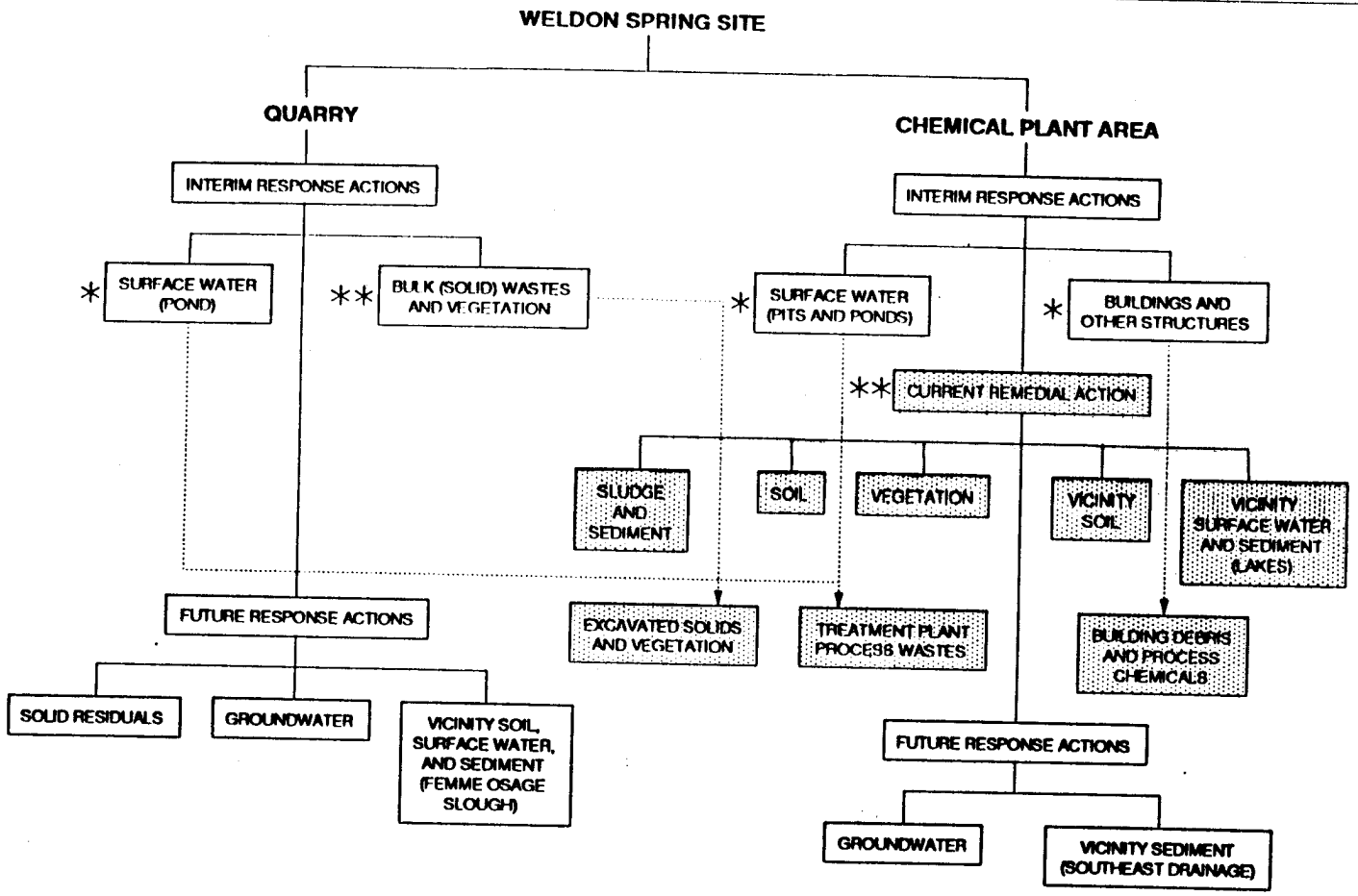
As used in this *Record of Decision* (ROD) and associated site documents, the use of the term "on site" refers to all areas, contaminated or otherwise, that exist within the physical boundaries of the Weldon Spring Chemical Plant (WSCP) and the Weldon Spring Quarry. The quarry and the chemical plant areas are reasonably close in proximity, and are compatible with regard to remediation approach. Therefore, they are considered one *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) site for purposes of this remedial action. "Off site" refers to those adjacent or nearby properties not located within the physical boundaries of the WSCP.

Several interim response actions have been selected for both the chemical plant area and the quarry and are currently being designed and/or implemented. The primary interim actions are summarized as follows:

- Excavation of solid wastes from the quarry, with transport to the chemical plant area for controlled storage in a temporary storage area (TSA) pending the disposal decision presented in this ROD.

- Removal and treatment of ponded water from the quarry, with transport of the treatment residuals to the chemical plant area for controlled storage as above.

- Removal and treatment of ponded water from surface water impoundments at the chemical plant area, with controlled storage of the treatment residuals as above.



NOTE : THE BOXES REPRESENT CONTAMINATED MEDIA ADDRESSED BY THE PROJECT'S CLEANUP ACTIONS FOR THE CHEMICAL PLANT AREA AND THE QUARRY, AND THEY ARE CONNECTED BY SOLID LINES TO THE APPROPIATE PHASE OF SITE CLEANUP. DASHED LINES IDENTIFY WASTE STORED AT THE CHEMICAL PLANT AREA AS A RESULT OF THE INTERIM ACTIONS. THE MEDIA FOR WHICH SPECIFIC TREATMENT AND DISPOSAL DECISIONS WILL BE MADE AS A PART OF THE CURRENT REMEDIAL ACTION ARE INDICATED BY SHADING.

* - REMOVAL ACTION

** - REMEDIAL ACTION

COMPONENTS OF SITE REMEDIATION

FIGURE 4-1

REPORT NO.:		EXHIBIT NO.:	A/PI/027/0293
ORIGINATOR: JAB	DRAWN BY: GLN	DATE: 8/9/93	

- Consolidation and containerization of abandoned chemicals and process wastes.

- Decontamination and dismantlement of site structures, with controlled storage in the material staging area (MSA) and/or the TSA as above.

These removal actions have been (and are being) conducted to respond to contaminant releases and to mitigate health and safety threats in accordance with CERCLA requirements. The actions have also been conducted in accordance with Council on Environmental Quality regulations for implementing the procedural provisions of the *National Environmental Policy Act* (NEPA).

The role of this proposed remedial action is to establish appropriate responses and final conditions for solid material at the chemical plant area and to identify an appropriate disposal decision for waste generated by project cleanup activities. The action addresses management of the following materials to minimize potential releases and related exposures:

- Sludge, sediment and soil from the raffinate pits and ponds; site-wide soil (e.g., from past dump and spill areas); and soil and sediment from vicinity properties.

- Structural debris in storage at the MSA.

- Solid material excavated from the quarry — including soil, sediment, process residues, rock, building rubble and equipment, and vegetation — and in storage at the TSA.

- Containerized wastes, including residuals generated by the two water treatment plants and in storage at Building 434, the TSA, or other engineered facilities.

Cleanup decisions for sediment and soil in the Southeast Drainage, groundwater beneath the chemical plant area, and material remaining at the quarry following bulk waste removal (including groundwater) are not included in the scope of the current remedial action. Separate environmental documentation will be prepared within the next several years to support cleanup decisions for those locations and media. These documents will be developed in consultation with the U.S. Environmental Protection Agency (EPA) Region VII and the State of Missouri.

5 SITE CHARACTERISTICS

The site has been extensively studied to determine the nature and extent of contamination in various media. These studies have produced thousands of data records for soil, surface water, sludge, sediment, and building material and other debris. Groundwater has also been sampled, and limited biota sampling has been conducted. This information has been used to identify areas and media for cleanup. The results of these studies are presented in the *Remedial Investigation for the Chemical Plant Area of the Weldon Spring Site* (RI) (DOE 1992b). A general description of the environmental setting at the Weldon Spring site is presented in Section 1, including a discussion of key source areas and general contaminant information.

The primary source areas and key contaminants that have been identified at the site are summarized in Table 5-1. The estimated areas and volumes of contaminated media addressed by the disposal decision under this action are summarized in Table 5-2. The concentration ranges of the major radioactive and chemical contaminants at the site are listed in Tables 5-3 and 5-4. A discussion on background levels of these contaminants is presented in Section 2 of the *Feasibility Study* (FS) (DOE 1992d).

The RI information was used to assess human health and ecological risks for the site to determine if adverse effects could result from possible exposures. Site characteristics were evaluated for this assessment in order to identify the primary mechanisms of contaminant release and pathways by which site contaminants could be transported to potential receptors (humans and biota). The primary mechanisms and transport pathways identified for the site are:

- Surface runoff from on-site areas to off-site drainage soil and surface water.
- Surface water loss to groundwater via losing streams off site.
- Groundwater discharge to surface water via gaining streams off site.
- Leaching from contaminated surface and/or subsurface soil, sediment, or sludge to groundwater.
- External gamma radiation from radioactively contaminated surfaces, including building material and soil.
- Atmospheric dispersion of radon from radium-contaminated soil.

TABLE 5-1 Sources of Contamination at the Weldon Spring Site

Area/Medium	Comments[a]
Primary On-Site Sources	
Raffinate pits	The four raffinate pits previously received process waste from the chemical plant and constitute the most heavily contaminated source area at the site.
Surface water	Although currently present in the pits, this water is targeted for removal and treatment under an interim action. Contaminants: uranium, radium, arsenic, manganese, selenium, cyanide, nitrate, and fluoride.
Sludge	Precipitates of waste slurries from uranium- and thorium-processing operations have settled to the bottom of each pit. Contaminants: uranium, thorium, radium, arsenic, molybdenum, vanadium, and sulfate.
Soil	Contamination in berms and beneath the pits is a result of contact with, and leaching from, the sludge and surface water. Characterization of this soil is limited because of difficulty in sampling under current conditions; additional characterization will be conducted as the surface water and sludge are removed. Contaminants: radionuclide and metal precipitates (see sludge), and nitrate.
Structural debris	A small amount of debris consisting of concrete, tanks, piping, drums, and structural material is present in Raffinate Pit 4. These materials were placed in Pit 4 during closure of the chemical plant when the Army began converting the plant for herbicide production. Contaminants: uranium, thorium, radium, PCBs, and metals.
Frog Pond	Frog Pond previously received flow from storm and sanitary sewers at the pilot chemical plant and currently receives overland flow from the northeastern portion of the site.
Surface water	Although currently present in the pond, this water is targeted for removal and treatment under an interim action. Contaminants: uranium and chloride.
Sediment	The sediment contains transported solids and precipitates from the surface water. Contaminant: uranium.
Soil	Soil around the pond could be contaminated as a result of leaching from the surface water and sediment. Contaminant: uranium.
Ash Pond	Ash Pond previously received fly ash slurry from the power plant and currently receives overland flow from the northwestern portion of the site. Soil and building debris from site removal actions are being stored here.
Surface water	Although currently present in the pond, this water is targeted for removal and treatment under an interim action. Contaminants: uranium and nitrate.
Sediment	The sediment contains transported solids and precipitates from the surface water. Contaminants: uranium and nitrate.
Soil	Soil around the pond is contaminated as a result of runoff from the South Dump. Contaminant: uranium.
Building debris	Debris resulting from site removal actions: Uranium and nonfriable asbestos.
Soil and building debris from site removal actions	Contaminants: uranium, thorium, and radium.

TABLE 5-1 Sources of Contamination at the Weldon Spring Site (Continued)

Area/Medium	Comments[a]
North dump and south dump	These dump areas were previously used to store and dispose of radioactive material.
Soil	Contaminants: uranium, thorium, and radium.
Metal building and equipment debris	Contaminants: uranium, thorium, and radium.
Material staging area (MSA)	The MSA is located in the northwestern portion of the site and provides a staging area for radiologically contaminated material resulting from dismantlement activities. The MSA includes a 3-ha (8-acre) gravel pad staging area with an engineered runoff collection system and retention pond.
Metal building and equipment debris	Contaminants: uranium, thorium, and radium.
Decontamination debris	Contaminants: uranium, thorium, and radium.
Temporary storage area (TSA)	The TSA is being constructed to store bulk quarry waste which will be excavated under an interim action.
Metal building and equipment debris	Contaminants: uranium, thorium, and radium.
Concrete building debris and rock	Contaminants: uranium, thorium, and radium.
Soil	Contaminants: uranium, thorium, radium, arsenic, lead, nickel, and selenium; also, in some spots, PCBs, polycyclic (or polynuclear) aromatic hydrocarbons (PAHs), and nitroaromatic compounds such as TNT, 2,4-DNT, 2,6-DNT, NB, and TNB.
Sludge and sediment	Contaminants: uranium, thorium, radium, arsenic, and 2,4-DNT.
Containerized process wastes from the two water treatment plants	Contaminants: uranium, thorium, radium, arsenic, fluoride, and nitroaromatic compounds.
Residual soil and sediment from the quarry area	This material could be temporarily stored at the TSA if it were determined to require removal. The contaminated material that could result from future actions will be addressed in separate environmental documentation supporting cleanup decisions for this location. Contaminants: same as the bulk waste soil and sediment.

TABLE 5-1 Sources of Contamination at the Weldon Spring Site (Continued)

Area/Medium	Comments[a]
Building 434	
Containerized chemicals	Building 434 was remodeled to use for storage of containerized material resulting from previous interim response actions. (As a contingency, this building might be used to store containerized process wastes from the water treatment plants.) Contaminants include nitric, sulfuric, and hydrofluoric acids; sodium hydroxide; PCBs; heavy metals; and paint solvents. Two tanks of tributyl phosphate have been drummed and transferred to Building 434.
Asbestos Storage Area	Containerized, bagged asbestos.
Scattered On-Site Sources	
Soil in areas adjacent to the chemical plant buildings	These areas were previously used to unload and store process material and to house electrical equipment. Contaminants: uranium, thorium, radium, sulfate, nitrate, PCBs, and PAHs.
Soil in areas adjacent to the raffinate pits	These areas were previously impacted by spills or overland flow. Contaminants: uranium, thorium, radium, fluoride, sulfate, and nitrate.
Vegetation	Vegetation could be contaminated as a result of biouptake.
Off-Site Sources	
Burgermeister Spring and Lakes 34, 35, and 36 in the Busch Wildlife Area	These areas are contaminated by surface runoff and groundwater discharge from contaminated areas on site.
Surface water	Contaminants: uranium and nitrate.
Sediment	Contaminant: uranium.
Soil at vicinity properties	These areas were previously impacted by transport and storage activities. Contaminants: uranium, thorium, and radium.

[a] Only primary contaminants are indicated in this table; additional in-place source area data are provided in the RI (DOE 1992c). Notation: TNB, 1,3,5-trinitrobenzene; 2,4-DNT, 2,4-dinitrotoluene; 2,6-DNT, 2,6-dinitrotoluene; TNT, 2,4,6-Trinitrotoluene; NB, nitrobenzene; PAHs, polycyclic aromatic hydrocarbons; PCBs, polychlorinated biphenyls.

TABLE 5-2 Estimated Areas and Volumes of Contaminated Media

Contaminated Media and Locations	Area (hectares)	Area (acres)	Volume (m^3)	Volume (yd^3)
Sludge				
Raffinate pits	10.4	25.8	168,212	220,000
Sediment				
Ash Pond	3.5	8.6	6,269	8,200
Frog Pond	0.7	1.9	5,352	7,000
TSA	0.4	1.0	3,134	4,100
Lakes 34, 35, and 36	45.7	113.0	15,292	20,000
Femme Osage Slough	1.4	3.5	61,550	80,500
Total sediment[a]	51.8	128.0	91,599	119,800[b]
Soil				
North Dump	0.8	1.9	5,810	7,600
South Dump	1.7	4.2	12,921	16,900
Other site-wide soil	8.1	20.0	65,296	85,400
TSA	0.8	2.0	39,759	52,000
Raffinate pits	10.4	25.8	117,366	153,500
Soil at subsurface piping	1.8	4.5	15,292	20,000
Off site (vicinity properties)	0.5	1.2	2,752	3,600
Total soil[a]	24.1	59.6	259,199	339,000
Structural material				
Concrete at TSA	0.9	2.3	23,090	30,200
Steel at TSA	0.3	0.8	8,028	10,500
Rubble/concrete at MSA	1.0	2.5	45,111	59,000
Steel at MSA	1.0	2.5	39,300	51,400
Debris at MSA	0.2	0.5	2,829	3,700
Asbestos	0.2	0.5	7,493	9,800
Building 434	0.2	0.5	3,823	5,000
Total structural material	3.9	9.6	129,676	169,600
Process chemicals				
Treatment plant process waste	0.2	0.5	2,752	3,600
Consolidated chemicals	0.2	0.5	275	360
Total process chemicals	0.4	1.0	3,027	3,960
Vegetation				
From quarry	0.2	0.4	4,969	6,500
From building demolition	0.04	0.1	573	750
From site-wide areas	1.5	3.8	17,891	23,400
Total vegetation	1.7	4.3	23,434	30,650
Total volume		[c]	675,141	883,000

[a] Volumes for sediment and soil are based on the ALARA goals shown in Tables 9-3 and 9-4.

[b] Total sediment material includes an engineering approximation of contaminated soil which may require removal as part of the quarry residuals operable unit.

[c] A value for total area would not be indicative of the total area impacted because some areas are counted more than once (e.g., the sludge and soil in the raffinate pits).

TABLE 5-3 Concentration Ranges of Radioactive Contaminants of Concern

Contaminant	On-Site Concentration Range[a]			Off-Site Concentration Range[b]	
	Soil (pCi/g)	Surface Water (pCi/l)	Raffinate Pit Sludge (pCi/g)	Surface Water (pCi/l)	Sediment (pCi/g)
Ac-227[c]	0.006-44	-[d]	2.8-990	-	-
Pb-210[c]	0.4-450	-	1.0-1,700	-	-
Pa-231[c]	0.01-87	-	3.6-1,200	-	-
Ra-226	0.4-450	3.4-130	1.0-1,700	ND[d]	0.7-220
Ra-228	0.4-150	1.5-25	4.0-1,400	ND	0.4-480
Rn-220[e]	-	-	-	-	-
Rn-222[f]	-	-	-	-	-
Th-230	0.3-97	1.4-760	8.0-34,000	1.0-8.0	1.5-10,000
Th-232[g]	0.4-150	0.2-7.6	3.0-1,400	ND	0.7-2.5
U-235[h]	0.01-110	1.3-60	0.2-78	0.09-27	0.02-33
U-238	0.3-2,300	28-1,300	4.9-1,700	2.0-590	0.5-720

(a) The concentration range is for detected values only; a single value is given if the contaminant was detected in only one sample. For surface water, combined values for the raffinate pits and NPDES sampling locations NP-0002, NP-0003, and NP-0004. For sludge, reported as wet weights (the sludge contains about 73% water by weight).

(b) The concentration range is for detected values only; a single value is given if the contaminant was detected in only one sample. Combined values for Lakes 34, 35, and 36; Burgermeister Spring; and the Southeast Drainage. For sediment, reported as dry weights.

(c) The concentrations of Ac-227, Pb-210, and Pa-231 for site soil and raffinate-pit sludge were determined from the radiological source term analysis.

(d) A hyphen indicates that the contaminant was not measured nor calculated from the radiological source term analysis; ND = not detected.

(e) Rn-220 is a contaminant of concern only for the chemical plant buildings.

(f) Rn-222 is a contaminant of concern for the chemical plant buildings and outdoor air. The concentration of Rn-222 and its short-lived decay products in outdoor air was calculated from the concentration of Ra-226 in soil.

(g) Consistent with the radiological source term analysis, Th-232 was assumed to be in secular equilibrium with Ra-228 for site soil.

(h) The ratio of U-238:U-235:U-234 in surface water, sludge, and sediment was assumed to be 1:0.046:1.

TABLE 5-4 Concentration Ranges of Chemical Contaminants of Concern

Contaminant	On-Site Concentration Range[a]			Off-Site Concentration Range[b]	
	Soil (mg/kg)	Surface Water (µg/l)	Raffinate Pit Sludge (mg/kg)	Surface Water (µg/l)	Sediment (mg/kg)
Metals					
Antimony	6.4-110	65-400	6.0-87	70-76	ND[c]
Arsenic	1.3-130	12-120	3.1-1,100	12-29	3.0-19
Barium	25-5,200	ND	20-7,700	78-110	100-330
Beryllium	0.51-5.5	7.0-9.0	0.59-25	ND	ND
Cadmium	0.51-11	37	0.94-14	ND	ND
Chromium III	2.0-280	28-170	4.5-150	13-23	6.3-23
Chromium VI	0.22-31	3.1-19	0.50-17	1.4-2.6	0.70-2.5
Cobalt	2.8-110	ND	5.1-44	ND	7.0-37
Copper	3.6-460	30-45	3.7-510	ND	5.0-170
Lead	1.3-1,900[d]	22-450	2.1-640	9.5-15	9.0-48
Lithium	5.3-71	61-4,500	5.0-120	ND	-[c]
Manganese	3.3-13,000	16-33	25-3,000	18-870	280-6,500
Mercury	0.11-2.1	0.29-0.36	0.10-15	0.35-1.3	ND
Molybdenum	4.1-120	690-4,100	16-1,600	22-42	-
Nickel	5.6-270	47-170	3.3-8,800	ND	8.0-66
Selenium	0.63-47	7.5-220	2.7-81	ND	ND
Silver	0.92-13	25-40	1.0-5.0	4.0-6.0	ND
Thallium	1.0-80	ND	1.1-58	33	ND
Uranium, total	0.9-6,900	4.4-5,200	15-5,100	6.0-1,800	1.6-2,200
Vanadium	7.2-330	90-2,100	26-8,700	ND	14-75
Zinc	6.1-1,100	26-60	7.9-1,600	21-78	24-220
Inorganic anions					
Fluoride	1.3-45	230-19,000	3.2-170	170-600	-
Nitrate	0.54-3,800	190-7,200,000	0.6-160,000	300-260,000	-
Nitrite	1.5-29	-	1.0-1,600	-	-
Asbestos[e]	ND	-	-	-	-
PAHs[f]					
Acenaphthene	1.9	-	ND	-	ND
Anthracene	3.4	-	ND	-	ND
Benz(a)anthracene	0.41-8.2	-	ND	-	ND
Benzo(b)fluoranthene	4.6	-	ND	-	ND
Benzo(k)fluoranthene	3.9	-	ND	-	ND
Benzo(g,h,i)perylene	2.1	-	ND	-	ND
Benzo(a)pyrene	5.1	-	ND	-	ND
Chrysene	0.39-8.0	-	ND	-	ND
Fluoranthene	0.58-11	-	ND	-	ND
Fluorene	1.6	-	ND	-	ND
Indeno(1,2,3-cd)pyrene	3.2	-	ND	-	ND
2-Methylnaphthalene	0.52-4.6	-	ND	-	ND
Naphthalene	1.8	-	ND	-	ND
Phenanthrene	0.42-11	-	ND	-	ND
Pyrene	0.35-19	-	ND	-	ND
PCBs	0.18-12	-	0.15-11	ND	0.2
Nitroaromatic compounds					

TABLE 5-4 Concentration Ranges of Chemical Contaminants of Concern (Continued)

Contaminant	On-Site Concentration Range			Off-Site Concentration Range	
	Soil (mg/kg)	Surface Water (µg/l)	Raffinate Pit Sludge (mg/kg)	Surface Water (µg/l)	Sediment (mg/kg)
DNB	1.0-3.8	ND	ND	0.18-0.81	ND
2,4-DNT	0.83-6.3	ND	ND	0.3-11	ND
2,6-DNT	1.6-3.5	ND	ND	0.19-18	ND
NB	1.6-3.8	ND	ND	0.87	ND
TNB	0.63-5.7	0.04-1.4	ND	0.02-0.84	ND
TNT	1.3-32[g]	0.80-7.5	ND	0.05-110	ND

(a) The concentration range is for detected values only; a single value is given if the contaminant was measured in only one sample. For surface water, the combined value for the raffinate pits and NPDES sampling locations NP-0002, NP-0003, and NP-0004. For sludge, reported as wet weights (the sludge contains about 73% water by weight).

(b) The concentration range is for detected values only; a single value is given if the contaminant was measured in only one sample. For surface water and sediment, the combined value for Lakes 34, 35, and 36; Burgermeister Spring; and the Southeast Drainage. For sediment, reported as dry weights.

(c) ND = not detected; a hyphen indicates that the contaminant was not assayed.

(d) One high sample was measured at 43,000 mg/kg.

(e) Asbestos is a contaminant of concern only for the chemical plant buildings.

(f) Although not technically considered PAHs, 2-methylnaphthalene and naphthalene are included in this category for presentational purposes.

(g) One high sample was measured at 650,000 mg/kg.

- Atmospheric dispersion of fugitive dust containing uranium, thorium, and radium.

In addition to areas of contamination on site, several off-site locations are contaminated as a result of releases that occurred during the operational period of the chemical plant (such as the release of raffinate pit surface water to the Southeast Drainage) in addition to ongoing releases (e.g., via surface runoff over contaminated soil and leaching of contaminants from the raffinate pits to groundwater). These off-site locations include Burgermeister Spring and three lakes in the Busch Conservation Area and 10 vicinity properties, one of which is the Southeast Drainage (which includes intermittent flow that is lost underground and reemerges downstream through a series of springs).

In order to develop specific cleanup decisions, a variety of information was used to estimate possible human health and ecological risks associated with the site. This information includes contaminant data from the extensive site characterization effort, fate and transport considerations, possible receptors, different types of exposures that could occur, and toxicological data developed by the U.S. Environmental Protection Agency (EPA) from the scientific literature. The risk estimates focus on the media and locations addressed by this remedial action. Section 6 discusses the receptors and routes of exposure, and also summarizes the risk assessment results.

Several key factors are relevant to the fate and transport of site contaminants and the potential for human and ecological exposures. First, certain interim actions at the site have not yet been completed — including dismantlement of all buildings and removal and treatment of water from the raffinate pits. (The latter is to be coordinated with raffinate sludge removal.) Therefore, although exposures to these areas are expected to be reduced within the next several years as these actions are implemented, related estimates (those health risk assessments performed for the building and raffinate-pit areas) were included in the *Baseline Assessment* (DOE 1992c) for the site. Second, surface water in the raffinate pits currently limits the emanation of radon, external gamma radiation and wind dispersion of the fine-grained sludge. If, in a future scenario, no site controls were in place and the surface water in the raffinate pits drained away (e.g., from a break in the dikes), air pathways could become an important exposure consideration for nearby individuals. Except in such a case, the air pathway does not play a role in contaminant transport because of the nature of surface features (including vegetation) and local meteorological conditions.

Local geology and geochemistry also play a role in contaminant transport. Solution features are present in the vicinity of the site, although the site itself is not considered to be

situated in an area of significant collapse potential. Site geology and surface water and groundwater flow were studied in coordination with the State of Missouri Department of Natural Resources, Division of Geology and Land Survey. This testing did not detect void space in the overburden or soil material, and voids in the limestone bedrock were few and small (with 90% of the void space within the upper 3 m [10 ft] of bedrock). No open subsurface networks were identified on site.

In addition, all surface water drainages on the chemical plant site are classified as gaining. Dye trace tests indicate that small voids do exist (e.g., in the weathered portion of the limestone bedrock), but results suggest that they are isolated. Thus, although contaminants that leach to groundwater (or are lost to the subsurface via nearby losing streams off site) could be further transported through solution channels rather than by diffuse flow, study results indicate that such transport at the site would be limited. In addition, clays in the overburden present low hydraulic conductivity and considerable attenuation capacity for contaminants that may leach from contaminated areas. (The site geology and flow characteristics continue to be evaluated in support of future documents and decisions for the groundwater operable unit. These documents will include an evaluation of potential exposure to groundwater.)

6 SUMMARY OF SITE RISKS

Potential human health effects associated with the chemical plant area of the Weldon Spring site and nearby off-site locations were assessed by estimating the radiological and chemical doses and associated health risks that could result from exposure to site contaminants. The assessment, which considered both current and future site conditions, is given in the *Baseline Assessment for the Chemical Plant Area of the Weldon Spring Site* (BA) (DOE 1992c) and in an updated rebaseline assessment in Appendix E of the *Feasibility Study for the Chemical Plant Area of the Weldon Spring Site* (FS) (DOE 1992d). Impacts to environmental resources are also addressed in the *Baseline Assessment*.

6.1 Contaminants of Concern

Radioactive and chemical contaminants and their concentrations in affected media are listed in Tables 5-3 and 5-4. The contaminants of concern for the human health assessment were identified from those detected in site soil, surface water, sediment, sludge, and buildings, and they represent the major chemical classes present at the site. These contaminants include radionuclides, metals, inorganic anions, nitroaromatic compounds, polycyclic (or polynuclear) aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and asbestos. Selection of the contaminants of concern was based on both the history of site operations and an evaluation of characterization data with respect to the distribution and concentration of contaminants in the various media at the site and the potential contribution of individual contaminants to overall health effects.

6.2 Exposure Assessment

6.2.1 Contaminant Fate and Transport

The fate and transport of contaminants released into the environment at the site were evaluated to determine potential exposure points. Human exposures evaluated were those resulting from potential contact with sources and affected media within the site boundary and contaminated media at off-site areas impacted by transport from the site.

The principal source areas and contaminated media identified at the site are (1) chemical plant buildings; (2) surface water and sludge at the four raffinate pits; (3) surface water and sediment at Frog Pond and Ash Pond (conservatively represented by the raffinate pits in this assessment because the contaminant levels are much higher in the pits); (4) contaminated soil

at the north dump, at the south dump, at the coal storage area, around certain chemical plant buildings, and at other scattered locations; (5) groundwater in the upper aquifer in the Burlington-Keokuk Limestone; and (6) containerized chemicals in storage in Building 434.

Off-site locations and media that have been impacted by contaminant transport from these source areas include surface water and sediment in the Southeast Drainage (Weldon Spring Wildlife Area) and in Burgermeister Spring and Lakes 34, 35, and 36 (Busch Conservation Area). Soil at discrete areas, referred to as soil vicinity properties, is also contaminated as a result of past operations (Table 5-1).

The major pathways that have resulted in contaminant transport to these off-site locations are surface water runoff, surface water loss to groundwater (via losing streams), groundwater discharge to surface water (via gaining streams), and leaching from surface and/or subsurface material to groundwater.

6.2.2 Exposure Scenarios

To address the changing site configurations, five assessments were conducted for the chemical plant area that considered time, institutional controls, and land use. A sixth assessment was conducted for the off-site areas impacted by site releases. The receptors, areas and media contacted, and routes of exposure evaluated for these assessments are summarized in Tables 6-1 and 6-2 and are described as follows.

For the first assessment, the site configuration as of early 1992 was evaluated to identify potential health effects under baseline conditions. These conditions include the presence of the raffinate pits and buildings but not the temporary facilities such as the temporary storage area (TSA), material staging area (MSA), and water treatment plant that will be completed to support interim actions. About 200 workers are currently on site, and public access is controlled by a perimeter fence and security guards. The potential on-site receptors identified for these conditions are a site maintenance worker and a trespasser. A swimmer was also evaluated to address the possibility that an intruder might swim in the raffinate pits.

The same baseline site configuration was evaluated for the second assessment as for the first assessment, but it was hypothetically assumed that U.S. Department of Energy (DOE) and other workers were no longer at the site and access was no longer controlled. This assessment permits an evaluation of long-term impacts that might occur in the absence of any further

TABLE 6-1 Scenario Descriptions for On-Site Receptors Under Current and Future Conditions

Site Conditions and Receptor	Description	On-Site Area	Medium	Routes of Exposure
Baseline site configuration, with access restrictions				
Maintenance Worker	An individual conducts routine maintenance activities eight hours a day, 200 days a year, for 10 years.	Site wide	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
Trespasser	An individual enters the site five times per year, one hour per visit, for 10 years.	Site wide	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
		Raffinate pits	Surface water	Ingestion.
			Sludge	External gamma irradiation, incidental ingestion.
		Buildings	Residues	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
Swimmer[a]	An individual swims in the raffinate pits for one hour, once per year, for 10 years.	Raffinate pits	Surface water	Incidental ingestion, dermal contact.
			Sludge	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
Recreational visitor	An individual visits the site 20 times per year, four hours per visit, for 30 years.	Site wide	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
		Raffinate pits	Surface water	Ingestion.
			Sludge	Incidental ingestion.
		Buildings	Residues	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.

TABLE 6-1 Scenario Descriptions for On-Site Receptors Under Current and Future Conditions (Continued)

Site Conditions and Receptor	Description	On-Site Area	Medium	Routes of Exposure
Sportsman	An individual hunts at the site 15 days per year, four hours per day, for 30 years.	Site wide	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
			Game	Ingestion.
Interim site configuration, with access restrictions				
Maintenance worker[b]	An individual conducts maintenance activities eight hours per day, 200 days per year, for 10 years.	Site wide	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
		TSA and MSA	Waste/debris	External gamma irradiation.
Trespasser	An individual enters the site five times per year, one hour per visit, for 10 years.	Site wide	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
Interim site configuration, with no access restrictions				
Recreational Visitor	An individual visits the site 20 times per year, four hours per visit, for 30 years.	Site wide	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
		Raffinate pits	Surface water	Ingestion.
			Sludge	Incidental ingestion.
		TSA and MSA	Waste/debris	External gamma irradiation.
Modified site configuration, with no access restrictions				
Recreational Visitor	An individual visits the site 20 times per year, four hours per visit, for 30 years.	Site wide	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.

TABLE 6-1 Scenario Descriptions for On-Site Receptors Under Current and Future Conditions (Continued)

Site Conditions and Receptor	Description	On-Site Area	Medium	Routes of Exposure
Ranger	An individual works outdoors and in an on-site ranger station eight hours per day, 250 days per year, for 25 years.	Site wide	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
Resident[c]	An individual lives in a house on site 24 hours per day, 350 days per year, for 30 years.	Site wide	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
Farmer[c]	An individual lives on a farm on site 24 hours per day, 350 days per year, for 30 years.	Ash Pond	Soil	External gamma irradiation, incidental ingestion, dermal contact.
			Air	Inhalation.
			Fruits, vegetables, beef, dairy products	Ingestion.

(a) Conditions for this receptor also represent those for a swimmer under the baseline configuration with no access restrictions.

(b) Exposures were assessed for a worker performing routine maintenance activities such as mowing and fence repair (as for the worker under the baseline configuration) and also for a worker performing maintenance activities at the TSA and MSA debris staging areas.

(c) Although ingestion of groundwater was evaluated for this receptor, the results are not included in this summary because of the preliminary nature of the assessment (see Appendix E, Section E.4).

TABLE 6-2 Scenario Descriptions for Off-Site Receptors Under Current and Future Conditions

Receptor	Description	Off-Site Area	Medium	Routes of Exposure
Recreational Visitor	An individual visits the off-site location 20 times per year, four hours per visit, for 30 years.	Vicinity properties[a]	Soil	External gamma irradiation, incidental ingestion.
		Southeast Drainage	Surface water	Ingestion.
			Sediment/soil	External gamma irradiation, incidental ingestion.
		Burgermeister Spring	Surface water	Ingestion.
		Lakes 34, 35 and 36	Surface water	Ingestion.
			Sediment/soil	External gamma irradiation, incidental ingestion, dermal contact.
Swimmer	An individual swims in Lake 34, 35, and 36 for one hour, once per year, for 10 years.	Lakes 34, 35 and 36	Surface water	Incidental ingestion, dermal contact.
			Sediment/soil	External gamma irradiation, incidental ingestion, dermal contact.
Sportsman	An individual fishes at Lakes 34, 35, and 36 seven days per year, four hours per day, for 30 years.	Lakes 34, 35 and 36	Surface water	Ingestion.
			Sediment/soil	External gamma irradiation, incidental ingestion, dermal contact.
			Fish	Ingestion.

[a] Soil vicinity properties except the Southeast Drainage, which is addressed separately.

cleanup. Under these conditions, land use on site was assumed to be recreational because the site is adjacent to two wildlife areas where recreational use is expected to continue into the reasonably foreseeable future. Consequently, a recreational visitor was identified as the future on-site receptor. To address possible exposures to contaminated game, a sportsman who was assumed to hunt on site was also evaluated. Because a sportsman might also fish at the off-site lakes, on-site and off-site exposures were combined for this receptor. Potential exposures were also assessed for an individual (youth) who was assumed to swim in the raffinate pits. The first and second assessments are presented in the BA (DOE 1992c).

For the third and fourth assessments, which are presented in Appendix E of the FS (DOE 1992d), the site configuration was assumed to reflect conditions associated with recent interim actions that are in various stages of planning and implementation. These actions include dismantling the chemical plant buildings and storing the material at the MSA, storing the bulk wastes excavated from the quarry at the TSA, and removing and treating water from the raffinate pits (Section 4). The purpose of these two assessments was to identify impacts that could occur if no further cleanup actions were taken at the site beyond those that have already been initiated, and assuming they are completed. These actions will result in interim or transitional site conditions because they represent only a partial completion of overall cleanup plans, pending implementation of the remedial actions identified in this *Record of Decision* (ROD).

Both short-term and long-term assessments were conducted for the interim site configuration. The short-term assessment evaluated possible health effects from the transitional site conditions for the reasonable scenario under which the DOE remains on site and existing institutional controls (e.g., access restrictions) are maintained; the maintenance worker and trespasser were the receptors evaluated. The long-term assessment of the interim site configuration evaluated exposures that could occur in the more extended future (e.g., after 100 years), hypothetically assuming that the DOE is no longer present and access to the site is unrestricted. Under these conditions, the most likely land use is recreational; therefore, the receptor evaluated was a recreational visitor.

The fifth assessment was conducted to focus the development of preliminary cleanup criteria for site soil. Soil is the only medium for which criteria were developed within the scope of the current remedial action because the other media have been addressed by interim actions. Therefore, a modified site configuration was evaluated by focusing on soil areas and not including the raffinate pits, buildings, and temporary facilities. For this assessment, which is presented in Appendix E of the FS (DOE 1992d), it was hypothetically assumed that the DOE

is no longer present, that access is unrestricted, and that land use in the area might change in the extended long term (e.g., after 100 to 200 years and beyond). Four receptors were evaluated for this long-term assessment of the modified site configuration: a recreational visitor, a ranger, a resident, and a farmer.

For the sixth assessment, off-site exposures were evaluated for a member of the general public at Burgermeister Spring; Lakes 34, 35, and 36; the Southeast Drainage; and specific soil vicinity properties. Although most of these areas are located in the Weldon Spring and Busch conservation areas, several vicinity properties are located on the adjacent Army land to which access is currently restricted. Recreational use of the conservation areas is expected to continue for the reasonably foreseeable future; hence, this assessment estimated exposures to the contaminated areas for a recreational visitor. (Ongoing and likely future exposures on the Army land would be bounded by those associated with recreational use because use of this land by Army personnel is less frequent. To be conservative, recreational use of those vicinity properties was evaluated for both the current and future assessments.) A swimmer was also evaluated for the off-site lakes.

Contaminant levels at the off-site locations are expected to remain the same or be somewhat lower in the future because interim actions are mitigating site releases. Therefore, one assessment was conducted for both current and future exposures that extend to 100 or 200 years and beyond. This assessment is presented in the BA (DOE 1992c).

Current data for the Southeast Drainage are limited, so exposures associated with this location will be reevaluated in greater detail within the next several years after more data become available. For the remaining vicinity properties, the results of the long-term assessment of the modified site configuration that considered nonrecreational land uses for on-site soil are incorporated into decisions for off-site soil. This addresses the possibility that local land use might change in the extended future.

6.2.3 Exposure Point Concentrations

Exposure point concentrations for the various media addressed in the exposure assessment were determined on the basis of data availability and the objective of the analysis. For the radioactive contaminants, not all contaminants of concern were directly measured. To address this issue, information from the radiological source term analysis for site soil and raffinate-pit sludge was used to infer concentrations of radionuclides not directly measured. Extensive data were available for soil, and contaminant heterogeneity was addressed by conducting both a site-

wide and a location-specific analysis for all receptors except the farmer. For the site-wide analysis, the 95% upper confidence limit of the arithmetic average (UL_{95}) value was used as the exposure point concentration for each contaminant. For the location-specific analysis, actual measurements from each sample location were used as the exposure point concentrations. For the farmer analysis, the 4-ha (10-acre) Ash Pond area was the basis for exposure point concentrations. It was recognized that a larger area is required to support a family farm, and this area was chosen because it is the most radioactively contaminated and contains most of the chemical contaminants of concern. The farmer-area approach consisted of two methods: for chemical contaminants, the UL_{95} of the arithmetic average from borehole measurements in the Ash Pond area was used; for radionuclides, the contour-weighted value was used. This value was determined using a statistical technique (kriging).

For the assessments evaluating current site conditions, exposure point concentrations for air were modeled from UL_{95} values for the southern portion of the site, which is considered the most likely source of fugitive dust under baseline conditions. This modeling approach was used because measurements are not available for all airborne contaminants. Under future conditions, where the site configuration has changed, exposure point concentrations for the recreational visitor, ranger, and resident were modeled from soil UL_{95} values for the entire site. For the farmer, exposure point concentrations were modeled from soil concentrations consistent with the other pathways. For sludge, sediment, and surface water, maximum concentrations were used as the exposure point concentrations (with one exception), because screening-level analyses were conducted for these media and certain limitations exist for the available data. The exception is uranium in surface water at the Southeast Drainage, in which water flows intermittently and measured concentrations vary widely over time with runoff conditions; half the maximum measured concentration was used to represent this exposure point concentration over the 30-year exposure period.

For radioactive contamination in the buildings, average concentrations from Building 403, a former process building that is heavily contaminated, were used to represent exposure point concentrations for all buildings. The UL_{95} value was used for residual PCB contamination from information for Building 408, and airborne concentrations of asbestos were determined from UL_{95} values for Building 201. Cleanup decisions have already been made for buildings and surface water, so results of these conservative analyses are considered as screening-level information.

On the basis of the types of contaminants present at the site (i.e., most are relatively immobile and resistant to biodegradation) and the implementation of release controls to prevent

further off-site releases, the contaminant levels at on-site and off-site areas are assumed to be similar to current conditions. Given that processing operations at the site ceased approximately 40 years ago, this is expected to be a reasonable but conservative assumption, with one exception. Ingrowth of Rn-222 from uranium would produce a peak concentration approximately 200,000 years in the future. This factor has been considered in the development of cleanup criteria. In general, other contaminant levels would be expected to decrease over time as a result of natural processes. Hence, the exposure point concentrations for the receptors evaluated under possible future site conditions were the same as those evaluated for current on-site receptors, and similarly, the exposure point concentrations for a future recreational visitor off site were assumed to be the same as those assessed for the current off-site recreational visitor. Because the exposure parameters for the off-site recreational visitor would also be the same under current and future conditions, only one assessment was conducted for this receptor.

6.3 Toxicity Assessment

Cancer and chemical toxicity are the two general health-effect end points from exposure to site contaminants. Cancer induction is the primary health effect associated with radionuclides at the site, and 17 of the chemical contaminants of concern are classified as potential carcinogens. Four of the 17 are classified as Group A carcinogens (arsenic, chromium VI, nickel, and asbestos), for which strong evidence exists for human carcinogenicity.

A number of toxic effects are linked with exposure to noncarcinogenic contaminants. Uranium is the most significant contributor to noncarcinogenic health effects associated with site soil, and the chemical toxicity associated with human exposure to uranium is kidney damage. The PCBs inside the chemical plant buildings, and at a few soil locations, also contribute significantly to potential chemical carcinogenicity and toxicity, which is characterized by skin effects and liver damage.

Potential carcinogenic risks from exposures to radiation were estimated using a two-phase evaluation. For the first phase, radiation doses were calculated for all relevant radionuclides and pathways using dose conversion factors (DCFs) based on dosimetry models developed by the International Commission on Radiation Protection. Radiological risks were calculated by multiplying the doses by a risk factor which represents an age-averaged lifetime excess cancer incidence per unit intake (and per unit external exposure). Three separate risk factors were used: (1) a risk factor of 3.5×10^{-4}/working-level month (WLM) was used for inhalation of Rn-222 and its short-lived decay products; (2) a risk factor of 1.2×10^{-4}/WLM was used for

inhalation of Rn-220 and its short-lived decay products; and (3) a risk factor of 6×10^{-7}/mrem was used for all other exposure routes.

The potential for carcinogenic and noncarcinogenic effects of human exposure to chemicals was quantified with slope factors and reference doses (RfDs). Cancer slope factors have been developed by the U.S. Environmental Protection Agency (EPA) for estimating incremental lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. The slope factors, which are expressed in units of $(mg/kg\text{-}d)^{-1}$, are multiplied by the estimated intake of a carcinogen, in mg/kg-d, to provide an upper-bound estimate of the incremental lifetime cancer risk. These risk estimates are considered to be conservative because the slope factors are derived as upper-bound estimates such that the true risk to humans is not likely to exceed the risk estimate and, in fact, may be lower. Slope factors are derived from the results of human epidemiological studies or chronic animal bioassays. Slope factors derived on the basis of animal studies are adjusted to account for extrapolation from animals to humans.

Reference doses have been developed by the EPA for indicating the potential for adverse health effects from exposure to chemicals inducing noncarcinogenic effects. The RfDs, which are expressed in units of mg/kg-d, are estimates of the lifetime daily exposure level for humans, including sensitive subpopulations, that are likely to be without an appreciable risk of adverse effects during a lifetime. The potential for adverse health effects is estimated by comparing contaminant intakes, in mg/kg-d, to the RfD. The RfDs are derived from the results of human epidemiological studies or animal studies, to which uncertainty factors have been applied. These uncertainty factors help ensure that the RfDs do not underestimate the potential for the occurrence of adverse noncarcinogenic effects.

The slope factors and RfDs are specific to the chemical, the route of exposure, and, for RfDs, the duration over which the exposure occurs. For all scenarios evaluated, the exposure duration exceeded a period of seven years; hence, chronic RfDs were applied to the assessment. The slope factors and RfDs used in the assessment are listed in Tables 6-3 and 6-4, respectively.

6.4 Summary of the Human Health Risk Characterization

Potential carcinogenic risks from radiological and chemical exposures were estimated for the human health assessment in terms of the increased probability that an exposed individual could develop cancer over the course of a lifetime. According to the NCP, an acceptable excess lifetime cancer risk to an individual from exposure to site contaminants is between 1×10^{-4} to

TABLE 6-3 Oral and Inhalation Slope Factors

Contaminant	Oral Slope Factor ([mg/kg-d]$^{-1}$)	Carcinogenic Weight-of-Evidence[a]
Metals		
Arsenic	1.8	A
Beryllium	4.3	B2
Lead	NA[b]	B2
Asbestos	NA	A
PAHs[c]	11.5	B2
PCBs	7.7	B2
Nitroaromatic compounds		
2,4-DNT	0.68[e]	B2
2,6-DNT	0.68[e]	B2
TNT	0.03	C

Contaminant	Inhalation Slope Factor ([mg/kg-d]$^{-1}$)	Carcinogenic Weight-of-Evidence[a]
Metals		
Arsenic	15	A
Beryllium	8.4	B2
Cadmium	6.1	B1
Chromium VI	41	A
Lead	NA	B2
Nickel	1.7	A
Asbestos	0.23[d]	A
PAHs[c, e]	6.1	B2
PCBs	NA	B2
Nitroaromatic compounds		
2,4-DNT	NA	B2
2,6-DNT	NA	B2
TNT	NA	C

(a) Carcinogenic weight-of-evidence is a qualitative designation for potential carcinogens: A, human carcinogen; B1 and B2, probable human carcinogen; C, possible human carcinogen.

(b) NA indicates not available.

(c) The carcinogenic PAHs detected at the Weldon Spring site are benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, and indeno(1,2,3-cd)pyrene.

(d) In units of (fibers/mL)$^{-1}$.

(e) Derived for 2,4-DNT and 2,6-DNT mixtures.

Sources: EPA (1991a) — asbestos, metals, nitroaromatic compounds, PCBs; (Appendix B) and EPA (1991b) — PAHs.

TABLE 6-4 Oral and Inhalation Reference Doses

Contaminant	Oral Reference Dose, Chronic (mg/kg-d)	Contaminant	Oral Reference Dose, Chronic (mg/kg-d)
Metals		Asbestos	NA
Antimony	4×10^{-4}		
Arsenic	3×10^{-4}	PAHs	
Barium	7×10^{-2}	Acenaphthene	6×10^{-2}
Beryllium	5×10^{-3}	Anthracene	3×10^{-1}
Cadmium (in water)	5×10^{-4}	Benz(a)anthracene[a]	3×10^{-2}
Cadmium (in food)	1×10^{-3}	Benzo(b)fluoranthene[a]	3×10^{-2}
Chromium III	1	Benzo(k)fluoranthene[a]	3×10^{-2}
Chromium VI	5×10^{-3}	Benzo(g,h,i)perylene[a]	3×10^{-2}
Cobalt	NA[b]	Benzo(a)pyrene[a]	3×10^{-2}
Copper[c]	4×10^{-2}	Chrysene[a]	3×10^{-2}
Lead	NA	Fluoranthene	4×10^{-2}
Lithium	2×10^{-2}	Fluorene	4×10^{-2}
Manganese	1×10^{-1}	Indeno(1,2,3-cd)pyrene[a]	3×10^{-2}
Mercury, inorganic	3×10^{-4}	2-Methylnaphthalene[d]	4×10^{-3}
Molybdenum	4×10^{-3}	Naphthalene	4×10^{-3}
Nickel	2×10^{-2}	Phenanthrene[a]	3×10^{-2}
Selenium	5×10^{-3}	Pyrene	3×10^{-2}
Silver	5×10^{-3}		
Thallium, soluble salts	7×10^{-5}	PCBs	1×10^{-4}
Uranium, soluble salts	3×10^{-3}		
Vanadium	7×10^{-3}	Nitroaromatic compounds	
Zinc	2×10^{-1}	DNB	1×10^{-4}
		2,4-DNT	2×10^{-4}
Inorganic anions		2,6-DNT	4×10^{-3}
Fluoride, soluble	6×10^{-2}	NB	5×10^{-4}
Nitrate	1.6	TNB	5×10^{-5}
Nitrite	1×10^{-1}	TNT	5×10^{-4}

Contaminant	Inhalation Reference Dose, Chronic (mg/kg-d)	Contaminant	Inhalation Reference Dose, Chronic (mg/kg-d)
Metals		Nitroaromatic compound	
Barium	1×10^{-4}	NB	6×10^{-4}
Cadmium[e]	2×10^{-4}		
Chromium III	6×10^{-7}		
Chromium VI	6×10^{-7}		
Manganese	1×10^{-4}		
Mercury	9×10^{-5}		

(a) In the absence of an RfD from Integrated Risk Information System or Health Effects Assessment Summary Tables, the RfD for pyrene was used for this compound.

(b) NA indicates not available.

(c) RfD calculated from the current drinking water standard of 1.3 mg/l.

(d) In the absence of an RfD from IRIS or HEAST, the RfD for naphthalene was used for this compound.

(e) RfD derived from a minimum risk level of 7×10^{-4} mg/m^3.

Sources: EPA (1991c) — barium (inhalation), chromium (inhalation), copper, mercury, molybdenum, NB (inhalation), thallium, vanadium, zinc; EPA (1991b) — antimony, arsenic, barium (oral), beryllium, cadmium (oral), chromium (oral), manganese, nickel, selenium, silver, thallium, uranium, fluoride, nitrate, nitrite, PAHs, DNB, NB (oral), TNB, TNT; Hurst (1990) — lithium; ATSDR (1989a) — cadmium (inhalation); ATSDR (1989b) — 2,4-DNT, 2,6-DNT; ATSDR (1989c) — PCBs.

1×10^{-6} — or 1 in 10,000 to 1 in 1 million (EPA 1990). This range is referred to as the target risk range in this discussion, and it provides a point of reference for the site-specific risks presented in the BA and FS. To put this range in the context of the background cancer rate, about one in three Americans will develop cancer from all sources, and it is estimated that 60% of cancers are fatal (American Cancer Society 1992). These estimates translate to a fatality cancer risk of about 2×10^{-1}, or 1 in 5. The individual lifetime risk of fatal cancer associated with background radiation, primarily from naturally occurring radon, is estimated to be about 1×10^{-2}, or 1 in 100 (EPA 1989b).

Radiological risks were calculated by multiplying the estimated radiological doses by specific risk factors to estimate the probability of cancer induction per unit dose. Chemical risks were calculated by multiplying the estimated average daily intake by the chemical-specific slope factors.

The potential for adverse effects other than cancer from exposure to a single contaminant was assessed by estimating the hazard quotient — the ratio of the daily intake (averaged over the exposure period) to the RfD. The individual hazard quotients determined for each contaminant and medium to which a given receptor may be exposed were then summed to determine the hazard index; a hazard index of less than 1 was considered to indicate a nonhazardous situation. Conversely, if the total hazard index was greater than 1, a potential concern may be indicated.

To determine whether cleanup is warranted at NPL sites, the EPA considers incremental risks relative to the target risk range of 1×10^{-6} to 1×10^{-4}, in combination with other site-specific factors (Appendix B). In the following summary of the risk results, estimates are presented as total risks unless otherwise specified. Potential incremental risks from exposures to site contaminants were assessed in developing cleanup criteria for site soil, which are discussed in Section 9 of this ROD.

The estimated risks and hazard indexes evaluated for exposures at the site under the baseline, interim, and modified future site configurations, as described in Section 6.2.2, are summarized in Tables 6-5 through 6-7. As appropriate to the site configuration and receptor, intakes and risks were estimated for exposures associated with (1) site-wide soil and air, (2) raffinate pit surface water and sludge, and (3) building air and residues. The significant findings of the risk assessment are summarized below and discussed with respect to their relationship to the need for remedial action; detailed discussions of the results of the risk characterization results are presented in the BA and in Section 1.6 and Appendix E of the FS.

For the baseline case, i.e., the current site configuration with continued access controls, the combined incremental risks from exposure to radioactive and chemical contaminants for the two hypothetical receptors evaluated — the maintenance worker and trespasser — exceed the upper end of the target range; i.e., the risks are greater than 1×10^{-4} (Table 6-5). Risks are also greater than the target range for the hypothetical recreational visitor under the modified (future) case, for which it is assumed, for purposes of analysis, that institutional controls are lost. The hazard index exceeds 1 for both the trespasser and recreational visitor. For the worker, inhalation of radon (estimated from conservative assumptions for radium in site soil) accounts for most of this risk. For the trespasser and recreational visitor, the elevated risks are associated with exposures at the raffinate pits and buildings; the hazard index above 1 is associated with exposures at the buildings.

The reasonable maximum exposure (RME) for the raffinate pits and buildings would be incurred by the trespasser under current conditions and by the recreational visitor under hypothetical future conditions. The risks from exposures at the raffinate pits result primarily from exposure to radioactive contamination in the sludge; for the buildings, the risks are from combined exposures to radon, dust, and residues for the radioactive contaminants and from exposures to residues (PCBs) for the chemical contaminants.

Decisions have already been made for interim actions at the site to dismantle the buildings and remove surface water from the pits. For the buildings, that action will effectively remove all potential risks currently associated with indoor exposures. For the raffinate pits, removal of surface water under the interim action and excavation, treatment, and placement of raffinate pit sludge in the disposal cell under the current remedial action (see Section 9.1) will

TABLE 6-5 Estimated Carcinogenic Risks for On-Site Receptors under the Baseline Configuration[a]

Area and Medium	Maintenance Worker		Trespasser[b]		Recreational Visitor[b]	
	Radiological	Chemical	Radiological	Chemical	Radiological	Chemical
Site-wide soil and air	5×10^{-4}	1×10^{-5}	2×10^{-6}	2×10^{-7}	6×10^{-5}	3×10^{-6}
Raffinate-pit surface water and sludge	NQ[c]	NQ	2×10^{-4}	9×10^{-6}	3×10^{-3}	1×10^{-4}
Building air and residues	NQ	NQ	1×10^{-4}	4×10^{-4}	1×10^{-3}	3×10^{-3}
Combined risk	5×10^{-4}	1×10^{-5}	9×10^{-5}	1×10^{-4}	1×10^{-3}	1×10^{-3}

(a) The maintenance worker and trespasser were evaluated for the baseline configuration under which existing site controls were assumed to be maintained; the recreational visitor was evaluated for the baseline configuration under which controls were assumed to no longer exist. The risk to the sportsman, which includes both on-site and off-site exposures, is given in the text.

(b) The individual risks correspond to the reasonable maximum exposures, which were estimated by assuming that the entire exposure occurs at the indicated area and medium. The combined risks correspond to exposures that were assumed to be equally distributed among site-wide soil and air, raffinate-pit surface water and sludge, and building air and residues. For a swimmer, the estimated radiological and chemical risks from exposures to raffinate-pit surface water and sludge and site-wide air are 2×10^{-4} and 5×10^{-6}.

(c) NQ indicates that the risk was not quantified for this receptor.

TABLE 6-6 Estimated Hazard Indexes for On-Site Receptors under the Baseline Configuration[a]

Area and Medium	Maintenance Worker	Trespasser[b]	Recreational Visitor[b]
Site-wide soil and air	0.5	0.005	0.03
Raffinate-pit surface water and sludge	NQ[c]	0.72	
Building air and residues	NQ	3	10
Combined hazard index	0.5	1	4

(a) The maintenance worker and trespasser were evaluated for the baseline configuration under which existing site controls were assumed to be maintained; the recreational visitor was evaluated for the baseline configuration under which controls were assumed to no longer exist. The hazard index for the sportsman, which includes both on-site and off-site exposures, is given in the text.

(b) The individual hazard indexes correspond to the reasonable maximum exposures, which were estimated by assuming that the entire exposure occurs at the indicated area and medium. The combined hazard index corresponds to exposures that were assumed to be equally distributed among site-wide soil and air, raffinate-pit surface water and sludge, and building air and residues. For a swimmer in the raffinate pits, the estimated hazard index is 0.02.

(c) NQ indicates that a hazard index was not quantified for the worker from those exposures.

TABLE 6-7 Estimated Carcinogenic Risks and Hazard Indexes for Exposures to Soil and Air under the Modified Site Configuration

Receptor	Carcinogenic Risk		Health Hazard Index for Noncarcinogenic Effects
	Radiological	Chemical	
Recreational visitor	6×10^{-5}	2×10^{-6}	0.02
Ranger			
Range[a]	6×10^{-4} - 1×10^{-2}	2×10^{-5}	0.3 - 0.5
Median	7×10^{-4}	2×10^{-5}	0.4
Resident			
Range	1×10^{-6} - 9×10^{-2}	3×10^{-6} - 6×10^{-4}	0.09 - 9
Median	2×10^{-4}	3×10^{-5}	0.6
Farmer[b]	1×10^{-2}	2×10^{-4}	11

(a) For chemical risks, because the variation is small and the results are rounded to one significant figure, the range and median are represented by the same value in this table.

(b) Results for the farmer include the contribution from ingesting food grown on contaminated soil. Considerable uncertainty is associated with the methodology used to estimate intakes for this pathway, and the chemical risk and hazard index estimated from a parallel analysis for a nearby background location are comparable to those estimated for the on-site farmer location. Excluding the contribution from this pathway, the estimated radiological and chemical risks for the farmer are 1×10^{-2} and 5×10^{-5}, and the hazard index is 2.

eliminate the associated risks. Cleanup criteria have not been specifically developed for the waste sludge; rather criteria developed for site soil (as addressed in the following discussions and in Section 9.2) will be applied to determine the extent of excavation required at the pits.

The risks and hazard indexes estimated for the four future land-use scenarios under the modified site configuration are summarized in Table 6-7. These analyses focused on exposures related to soil contaminants (i.e., incidental ingestion of soil and inhalation of soil-generated airborne contaminants), and the results shown in the tables represent the range of values estimated from data for several hundred individual locations across the site, as discussed in Section 6.2.3. For the ranger, resident, and farmer, the estimated radiological risks exceed the target risk range at most locations, primarily from inhalation of radon. The estimated chemical risks and hazard indexes for the resident each exceed the target levels (1×10^{-4} and 1, respectively) at 14 locations across the site. The potential noncarcinogenic effects are associated with incidental ingestion of soil, and the primary contributors are arsenic, PCBs, and uranium.

Future residential land use is considered to represent the RME scenario for the purpose of developing soil cleanup criteria protective of human health. Because the extent of exposure for a resident is greater than that associated with a worker (the RME scenario under current

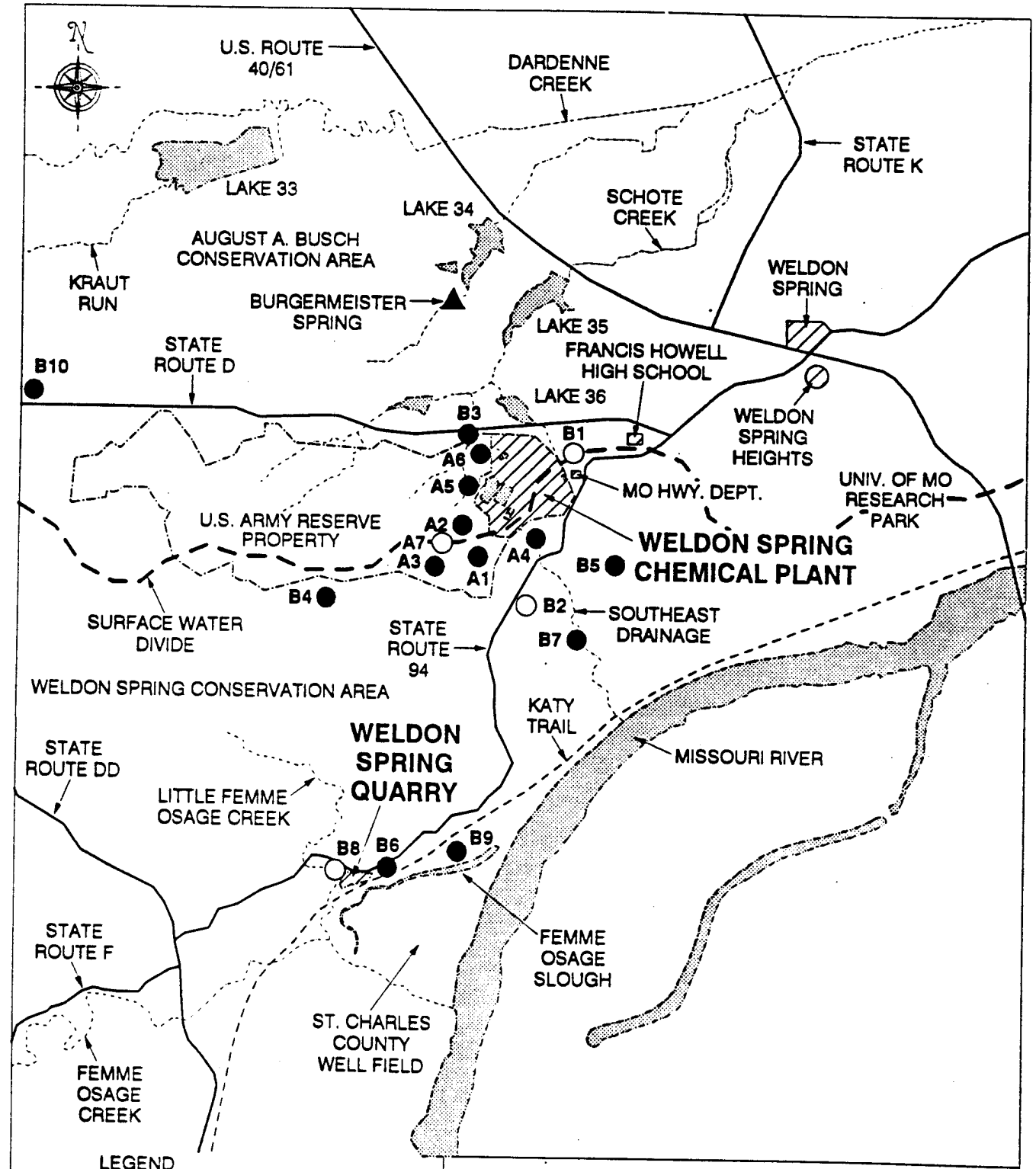
conditions), development of cleanup criteria on the basis of the more conservative residential scenario will also be protective of the worker. The development of cleanup criteria for site soil and the results of a "post-cleanup" assessment of residual risks for the RME and other scenarios are presented in Section 9.2.

For the off-site locations, exposures incurred by a recreational visitor represent the RME scenario. The hazard indexes for this receptor at these areas are less than 1, and the estimated risks are shown in Table 6-8. The radiological and chemical risks are less than 1×10^{-5} at Burgermeister Spring and Lakes 34, 35, and 36, and hence fall within the target risk range. The radiological risks for the soil vicinity properties are also within or below the target risk range except for vicinity property B4 (Figure 6-1). The risk estimated for repeated exposures at this remote location in the Weldon Spring Wildlife Area (now referred to as the Conservation Area) is 3×10^{-4}. The radiological risk estimated for similar exposures at the Southeast Drainage is 2×10^{-4}, which also exceeds the target range.

Except for the Southeast Drainage, the DOE is planning to clean up all vicinity properties for which it has responsibility as part of the current remedial action. The same criteria developed for on-site soil (see Section 9.2) will be used for these areas. Specific cleanup decisions for the Southeast Drainage, which currently receives contaminated runoff from the site, are not included in the scope of the current remedial action (see Section 4); these will be addressed in separate environmental documentation prepared during the next several years to support final decisions for that area.

6.5 Ecological Assessment

The Weldon Spring site is located adjacent to two State conservation areas and more than 200 species of plants and animals are expected to occur on site. Several State- and Federal-listed threatened and endangered species have been identified in this area. Studies to date have not reported these species at the site, although the pied-billed grebe, a State rare species, has been observed at the raffinate pits. Soil contaminants at certain discrete locations that present a potential impact to exposed biota include arsenic, cadmium, copper, lead, zinc, mercury, uranium, and selenium. Possible effects reported in scientific literature include decreased biomass and diversity.



LOCATION OF CONTAMINATED VICINITY PROPERTIES IN THE AREA OF THE WELDON SPRING SITE

FIGURE 6-1

REPORT NO.:		EXHIBIT NO.:	A/VP/015/0293
ORIGINATOR JAB	DRAWN BY: GLN	DATE 8/9/93	

TABLE 6-8 Estimated Carcinogenic Risks and Hazard Indexes for a Recreational Visitor at Off-Site Areas[a]

Area and Medium	Radiological Risk	Chemical Risk	Hazard Index
Lakes 34, 35, and 36 surface water and sediment	8×10^{-6}	5×10^{-6}	0.1
Burgermeister Spring surface water	4×10^{-6}	9×10^{-7}	0.04
Southeast Drainage surface water and sediment	2×10^{-4}	2×10^{-6}	0.2
Vicinity property soil	$6 \times 10^{-7} - 3 \times 10^{-4}$	NQ[b]	NQ

[a] The results shown in this table represent both current and future conditions (see text).

[b] NQ indicates that a carcinogenic risk or hazard index was not estimated for this location.

In off-site surface water, nitrate has been detected in the Southeast Drainage and Burgermeister Spring at levels that exceed water quality criteria. Thus, there is a potential for adverse impacts to off-site biota resulting from related exposure.

Certain contaminants in the raffinate-pit surface water exceed either water-quality criteria or concentrations reported in the scientific literature to adversely impact biota. For example, levels of beryllium, chromium, copper, lead, mercury, selenium, silver, uranium, and nitrate pose a potential hazard to aquatic and semiaquatic biota. Selenium is present at concentrations exceeding those shown to adversely affect waterfowl. Furthermore, because selenium bioconcentrates, it could pose a hazard to wildlife species higher in the food chain.

Ecological impacts could occur to on-site and off-site biota if exposure to contaminants were to continue. Implementing the preferred alternative, or one of the other active measures considered, would minimize the potential for such impacts.

6.6 Conclusion

In summary, actual or threatened releases from this site, if not addressed by implementing the response action selected in this ROD, may present a threat to human health and the environment. Irretrievable and irreversible commitments of resources involved in this project are detailed in Section 10.6 of this document.

TABLE 6-9 Description of Vicinity Properties in the Area of the Weldon Spring Site

Vicinity Property	*Description	Status
A1	Soil covered mound, 1.2 m wide ditch and drainage ditch flowing northwest.	Contaminated
A2	Rectangular area of soil, 21.4 m (70 ft.) by 79.3 m (260 ft) adjacent to railroad track.	Contaminated
A3	Wooden loading dock.	Contaminated
A4	Short segment of Southeast Drainage.	Contaminated
A5	Surface drainage ditch leading west from raffinate pits.	Contaminated
A6	Length of drainage ditch from Ash Pond 201 m (660 ft).	Contaminated
A7	Isolated area measuring 2.1 m (7 ft) by 1.5 m (5 ft).	Remediated
B1	Area of soil 167 m^2 (1800 ft^2).	Remediated
B2	Small piece of pipe near Highway 94.	Remediated
B3	Two small isolated areas of soil, 2.7 m (9 ft) by 2.4 m (8 ft) and 2.1 m (7 ft) by 1.8 m (6 ft).	Contaminated
B4	Mound of soil, miscellaneous wood, metal and other debris.	Contaminated
B5	Abandoned drums and adjacent soil.	Contaminated
B6	Isolated area of soil, 91 cm (3 ft) by 91 cm (3 ft).	Contaminated
B7	Southeast Drainage.	Contaminated
B8	Three isolated areas of soil, one measuring 61 cm (2 ft) by 91 cm (3 ft), two measuring 91 cm (3 ft) by 91 cm (3 ft).	Remediated
B9	Area of contaminated soil - will be fully characterized following quarry bulk waste removal.	Contaminated
B10	Isolated area of soil, estimated to be 0.15 m^3 (0.2 yd^3).	Contaminated

* A full description of each property and extent of contamination is found in the RI (DOE 1992b)

7 DESCRIPTION OF ALTERNATIVES

Alternative remedial actions for the site were developed as part of the *Feasibility Study* (FS) (DOE 1992d) by identifying remedial technologies and process options that are potentially applicable to the various contaminated media associated with the site. Potentially applicable technologies were incorporated into seven preliminary alternatives, and these alternatives were screened on the basis of effectiveness, implementability, and cost. From the screening analysis of the preliminary alternatives, the following final alternatives were retained for detailed evaluation:

- Alternative 1: No action.
- Alternative 6a: Removal, chemical stabilization/solidification, and disposal on site.
- Alternative 7a: Removal, vitrification, and disposal on site.
- Alternative 7b: Removal, vitrification, and disposal at the Envirocare facility.
- Alternative 7c: Removal, vitrification, and disposal at the Hanford Reservation facility.

These alternatives are described in Sections 7.1 through 7.5 on the basis of preliminary conceptual engineering information. The no-action alternative was retained for this evaluation in accordance with the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA), as amended, and *National Environmental Policy Act* (NEPA) processes to provide a baseline for comparison with the final action alternatives.

The technology process options discussed herein (e.g., for chemical stabilization/ solidification and vitrification) are considered representative of the general technologies that define the alternatives. The actual processes applied for site cleanup activities will be determined as part of the detailed design stage for this remedial action after the remedy is selected. Similarly, other representative components that have been evaluated for this analysis, such as the types of equipment and material and the treatment rates, will be specified as part of detailed design. The major regulatory requirements associated with each of these alternatives are discussed within the subsection for each alternative.

7.1 Alternative 1: No Action

The National Contingency Plan (NCP) requires that the "no-action" alternative be evaluated at every site to establish a baseline for comparison. Under Alternative 1, no further action would be taken at the site. Certain interim response actions for which decisions have already been finalized are assumed to be in effect, as follows: (1) the bulk waste excavated from the quarry would be in short-term storage at the temporary storage area (TSA); (2) the water treatment plants at the quarry and the chemical plant area would be operational; (3) the buildings and other structures would be dismantled, and the resulting material would be in short-term storage at the material staging area (MSA), debris staging area, and asbestos-container staging area; and (4) the containerized chemicals would remain in storage at Building 434. Contaminated soil, sludge, and sediment would remain in their current conditions, with continued potential for off-site releases during the short term and into the future. Site ownership, access restrictions, and monitoring would continue into the foreseeable future. Annual costs to maintain the site under this alternative are estimated to be approximately $1.2 million, with increases likely to address contamination that might be released in the absence of further source control or migration control measures.

Alternative 1 would not meet all applicable or relevant and appropriate requirements (ARARs).

7.2 Alternative 6a: Removal, Chemical Stabilization/Solidification and Disposal On Site

Under Alternative 6a, about 675,000 m^3 (883,000 yd^3) of contaminated sludge, soil, sediment, structural material, vegetation, and process waste from the two water treatment plants would be removed from the source areas and on-site storage areas. Approximately 342,000 m^3 (447,000 yd^3) of that material would be treated by chemical stabilization/solidification or volume reduction, as appropriate, and about 772,000 m^3 (1,010,000 yd^3) of treated and untreated material would be placed in an engineered disposal facility on site.

It is expected that the remedial action activities could be completed within about 10 years after the *Record of Decision* (ROD) for this action. For this and all other alternatives, substantial, continuous, physical on-site remedial action could commence within 15 months after signature of the chemical plant ROD. Remedial actions could include removal of foundations and contaminated soils to cleanup levels; construction of retention/detention basins; or treatment of wastes currently stored in Building 434. A 15 month schedule would not be sufficient time

in which to commence disposal cell construction, due to design and procurement requirements, nor could a treatment facility (for CSS or vitrification) be operational in this time frame, due to the necessity to perform additional treatment studies and pilot testing to implement full scale design and operation.

About one year would be required for pilot-scale testing; 3.5 to 4.5 years for design, construction, and start-up of the chemical stabilization/solidification (CSS) process plant; and 4.5 years for operating the CSS facility. Construction and operation of the disposal facility would require about 6.5 years. (Some of these activities would overlap.) Groundwater, surface water, and air would be monitored at the site and at specific off-site areas throughout the cleanup and maintenance period to facilitate protection of the general public and the environment. Because waste would remain on site under this alternative (in the disposal facility), the U.S. Department of Energy (DOE) would review the effectiveness of the remedy at least every five years following the mitigation of the remedial action in accordance with the provisions of Section 121(c) of CERCLA, as amended.

Treatment would be used as a principal element of the response, primarily to reduce the mobility of contaminants in raffinate-pit sludge, process waste, and certain soils. Standard equipment and readily available resources would be used to implement Alternative 6a, and the total cost is estimated to be about $157 million. The representative technical components of this alternative are described in the following paragraphs.

Standard construction equipment and procedures would be used to remove contaminated sludge and soil from the raffinate pits; sediment from ponds and lakes; solid material (including structural material and debris, process equipment, rock, vegetation, and soil) from the MSA and TSA; underground pipes; and soil from dump areas, scattered locations across the site, and vicinity properties. Good engineering practices and other mitigative measures would be applied to minimize potential releases; for example, the size of the area being disturbed would be minimized and erodible material would be misted with water during excavation and transport.

Sludge would be removed from the raffinate pits with a floating dredge and then pumped as a slurry to an adjacent treatment facility. (Although much of the surface water in these pits would have been previously removed and treated under a separate action, a small amount of water would be left in the pits to cover the sludge and prevent radon and particulate emissions.) After the sludge had been removed, the more highly contaminated soil forming the berms and pit bottoms would be removed with conventional earth-moving equipment (such as bulldozers and front-end loaders) and transported by truck to the treatment facility. Similar

equipment would be used to excavate sediment from other surface water impoundments after the water was removed and to excavate soil from across the site and vicinity properties. The excavated material not targeted for treatment would be transported by truck directly to the disposal facility.

Structural material, debris, and soil from the MSA and TSA would be removed and transported to the appropriate treatment facility or the disposal facility. In addition, a mobile chipper would be used intermittently to reduce the volume of woody material at the site; the resultant chips may be composted on site to reduce the waste volume. Containerized process chemicals stored in Building 434 would be either transported off site to a permitted incinerator or treated in the on-site sludge processing facility with stabilization or by chemical neutralization.

Excavated areas would be backfilled with clean soil material, regraded to natural contours matching the surrounding topography, and vegetated to support final site restoration. Much of the backfill could be obtained nearby; e.g., from a 81-ha (200-acre) parcel of land owned by the Missouri Department of Conservation located on State Route 94 across from Francis Howell High School. Additional fill such as gravel, sand, and topsoil may be obtained from local vendors.

Two new facilities would be constructed on site to support this alternative: one for CSS (the sludge processing facility) and another for physical treatment (the volume reduction facility). Each facility would be equipped with emission control systems to limit potential releases (e.g., a baghouse or high-efficiency particulate air [HEPA] filter system). A mulch pile would also be constructed on site to enhance the biodegradation of wooden debris and vegetation.

The volume of vegetation would be reduced and biodegradation facilitated by chipping vegetation in a mobile unit and then placing it in a composting facility (mulch pile) at the northern portion of the site. This pile would be maintained in an area of between 0.4 and 1.6 ha (1 and 4 acres) until material placement in the disposal cell could begin. The pile would be actively managed to enhance the biodegradation process, and this composting could result in a volume reduction of 80 to 90% (MKF and JEG 1992). The end product of the process would be placed in the on-site disposal cell. Materials such as railroad ties and utility poles would probably not be composted because they would have been treated with chemicals to inhibit biodegradation. These materials would be chipped and placed in the disposal cell.

The two criteria applied to determine what material will be treated by chemical stabilization/solidification are (1) whether treatment is needed to provide a structurally stable material, or (2) whether treatment is needed to eliminate the characteristic that would otherwise make the waste subject to the RCRA land disposal restrictions. Material expected to be treated includes the raffinate pit sludges (which are not structurally stable) and certain soil excavated from the quarry and in short-term storage at the TSA (which may be RCRA characteristic waste). Other material that may be treated includes process residuals from the water treatment plants and soil beneath the raffinate pits. Material treated by chemical stabilization/solidification would increase in volume by about 32%, and the overall volume for combined waste disposal would increase by about 12%. To minimize emissions during material transport to the sludge processing facility, the sludge would be pumped directly to the treatment facility as a slurry, and loose soil material would be wetted during transport over the short distances from the staging areas or pits.

The CSS treatment facility would be situated on approximately a 0.8 ha (2 acre) area located near the raffinate pits. Following dredging, settling, and thickening, the raffinate sludge would be conveyed to the CSS treatment plant by pumping or other continuous conveyance system. The thickened sludge would be placed in a storage tank and feed parameters (e.g., density and moisture content) checked before the sludge is metered into a mixing unit with binder agents. Binders that through bench scale testing have proven effective in immobilizing contaminants in the raffinate sludge and site and quarry soils are fly ash and Portland cement.

The CSS grout material resulting from the mixing of raffinate sludge and binder agents would be tested for quality control parameters and either be transported by truck to the disposal facility for grouting of voids in dismantlement debris or be further mixed with contaminated soils to produce a CSS soil-like product. These quality control parameters will be determined during pilot-scale testing of the CSS grout material. The batch material from the pilot scale program will be tested using the toxicity characteristic leaching procedure (TCLP). Results of TCLP testing will then be utilized to develop the quality control parameters for the grout material produced in the full-scale CSS facility. The mixing of CSS grout with soils would either be performed in the same mixer (e.g., high shear mixer) used to initially produce the CSS grout or, if necessary, another mixer (e.g., pug mill) which may be more suitable for producing a CSS soil-like material. This determination will be part of the CSS pilot testing program.

Other equipment components involved in the CSS treatment process such as tanks, pumps, compressors, valves, and piping for the preparation, storage, and conveyance of feed materials are readily available and widely used in the construction, mining, and hazardous waste

remediation industries. The operating parameters of the CSS treatment facility will be refined and the CSS grout and soil-like formulas optimized to meet performance and placement criteria during pilot testing.

Volume reduction operations would include the use of material-sizing equipment such as a shear, an impact crusher, a rotary shear shredder, and an in-drum compactor to treat structural material, rock, and containerized debris such as used personal protective equipment. The volume of material processed by these methods would be reduced from 10% to 50%, depending on the specific material type. A decontamination unit would also be provided to treat selected structural materials for which release and reuse is practicable. Such material could be treated with a wet or dry abrasive blast process; the equipment and facility would contain emission control systems. Any structural material determined to be unreleasable would be transported to the disposal facility.

Other facilities already present on site for interim actions would continue to be used for this remedial action, including the MSA, water treatment plant, and decontamination pad. Support facilities would also be maintained on site to provide electrical power, potable water, showers, portable sanitary facilities, offices for the construction management staff, and staging for excavation and construction activities. Most of these facilities are already in place, and they could be expanded to address incremental requirements associated with increased activity on site. Additional staging facilities would be constructed to support the heavy equipment needed for cleanup activities and to provide for stockpiling of material.

The various treatment and support facilities would be dismantled at the end of the remedial action period and either decontaminated for reuse (e.g., at another DOE facility) or, assuming reuse is not feasible or cost effective, treated by volume reduction and placed in the disposal facility. Following closure of the water treatment plant, a mobile water treatment unit may be utilized to support final site-closure activities.

An engineered disposal facility would be constructed at the chemical plant area within a specifically designated portion of the site that has undergone numerous subsurface investigations to confirm the suitability of the area for disposal of site wastes. The scope and range of the waste materials would cover an area of about 17 ha (42 acres) while the entire facility including the perimeter encapsulation dikes, would cover about 28 ha (70 acres). The design volume of material that would be placed in the cell is estimated to be about 1.1 million m^3 (1.5 million yd^3). This value includes incremental swell factors associated with excavation and treatment, and a contingency of about 10% to address the potential contribution

from subsurface and off-site material that has not yet been adequately characterized, including material that may be generated by future cleanup activities at the quarry and the Southeast Drainage.

The base of the disposal facility would consist of a double liner/leachate collection system. The lower leachate collection system would also serve as a leachate detection system and would facilitate the monitoring of cell performance during operation of the cell and the active leachate management period. The liners would be designed to minimize transport of any leachate from the contaminated material that would be contained in the cell. The multilayer cell cover would include an infiltration/radon attenuation barrier, a biointrusion layer, a frost protection layer, and an erosion protection layer. This cover would serve as a barrier to radon release and would protect against the potential effects of freeze-thaw cycles, intrusion by plant roots or burrowing animals, and erosion (including that associated with extreme precipitation events). The cell would be seismically engineered to withstand damage from potential earthquakes. The cell would be maintained and its performance would be monitored for the long term.

The cell would be constructed in stages to provide timely receiving capacity for waste generated by various concurrent cleanup activities (e.g., building dismantlement and volume reduction). This staged construction would minimize both the need for temporary storage and the potential for construction impacts by limiting the active work area. The cell would be maintained and its performance monitored for the long term, and its effectiveness would be reviewed every five years. The monitoring program would include visual inspection of the cell and regular testing of air, surface water, and groundwater. The surface water and groundwater monitoring program would comply with 40 CFR 264 Subpart F and 10 CSR 25-7.264(2)(f) as described in Section 10. This monitoring would be frequent (e.g., quarterly to annually) during the near term, and the frequency of monitoring would be evaluated within the five-year schedule, after the site entered long-term caretaker status and reduced, if appropriate.

Site-specific operational and contingency plans would be prepared to support the remedial action. These plans would specify (1) safe work practices, engineering controls, and worker protective equipment to reduce occupational exposures and/or contaminant releases; (2) monitoring techniques and frequencies; and (3) contingencies for a variety of possible occurrences (e.g., an accident, increased contaminant levels measured by monitoring systems, or an environmental disturbance such as a heavy rainstorm, tornado, or earthquake).

Under Alternative 6a, the DOE would continue to maintain custody of and accountability for the disposal area, but the remainder of the site could be released for other use. For example, the property outside the disposal location could be transferred back to the Army for incorporation into the adjacent Army Reserve Training Area, or it could be released for incorporation into the adjacent wildlife areas. Planning discussions would be held with parties interested in the future use of this property after the remedy is selected for the current remedial action. However, the final disposition of the site will not be determined until after the final remedy is selected for the chemical plant area; i.e., until after the decision is made for the groundwater operable unit within the next several years. Any institutional controls pertinent to the future use of this property, such as restrictions on the use of land or groundwater, would be identified at that time.

7.2.1 Applicable or Relevant and Appropriate Requirements

Federal and State environmental laws were evaluated for their applicability or relevance and appropriateness to the circumstances of the releases and threatened releases at the site. The applicable or relevant and appropriate requirements are discussed below.

Subtitle C of the *Resource Conservation and Recovery Act* (RCRA), as amended by the *Federal Facilities Compliance Act* (FFCA), regulates the generation, transportation, treatment, storage, and disposal of hazardous wastes as defined in 40 CFR 261. The determination on the applicability of RCRA Subtitle C requirements to the various response alternatives included an evaluation of whether any RCRA-listed or characteristic hazardous wastes were present at the site.

Based on current information (e.g., site records, the likely sources of contaminants), there are no known listed hazardous wastes present in any of the source areas on site. Three drums of containerized chemicals stored in Building 434 may be sufficiently similar to discarded commercial chemical products (listed wastes), which would make Subtitle C requirements relevant and appropriate to their management. However, it is not planned to manage these drums in the on-site treatment or disposal facilities. Further characterization of these drums is underway to assist in determining treatment/disposal options at a commercial facility. Pending a decision on treatment and disposal options for this waste, the drums are being stored on site in accordance with the RCRA.

A relatively small volume of materials fails the TCLP test and must be considered a characteristic hazardous waste. The management of these materials must comply with RCRA

(as amended by the FFCA) Subtitle C requirements, until they are treated to remove the characteristics and successfully test to be nonhazardous. The analysis of action-specific ARARs addressing relevant and appropriate RCRA hazardous waste rules is presented in Section 10.

Past bench scale tests have shown that the chemical stabilization/solidification product will pass the TCLP test and that decant or free liquid from the product would very likely also pass. Ongoing studies are being conducted to confirm that the free liquid will pass the TCLP test. This issue will also be addressed during CSS pilot scale testing. If needed, specialized addititives or reagents will be added to the CSS mixture to reduce any potential for the free liquid to fail the TCLP test. Although only small amounts of free liquid are expected to be generated from the CSS product, it will be managed through placement techniques as described in Section 10.2.3.4, Other Disposal Requirements.

All surface water discharges at the site are controlled through a surface water management program carried out in accordance with National Pollutant Discharge Elimination System (NPDES) permits issued under Section 402 of the *Clean Water Act* (CWA). Any changes in surface water discharges during construction of the disposal cell would be addressed through the NPDES permit.

The National Emission Standards for Hazardous Air Pollutants (NESHAP) are set forth under the *Clean Air Act* (CAA). The NESHAP standards have been set for those contaminants present in site wastes (i.e., radionuclides and asbestos) which may be released into the air during excavation/construction activities.

The following standards for radionuclides in 40 CFR 61 are applicable to remedial actions under consideration. Subpart H regulates emissions of radionuclides other than radon from DOE facilities. Emissions of these radionuclides to the ambient air shall not exceed amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem per year. Subpart H is applicable to the protection of the public during implementation of the remedial action as the Weldon Spring site is a DOE facility.

Subpart Q sets forth the standard for radon emissions. The standard states that no source at a DOE facility shall emit more than 20 pCi/m^2s of Rn-222 into the air as an average for the entire source. This standard is applicable at completion of the final remedial action as the Weldon Spring site is a DOE facility.

Regulation 40 CFR 61 Subpart T is considered relevant and appropriate to final site conditions because the site contains material sufficiently similar to uranium mill tailings. Subpart T states that Rn-222 emissions to ambient air from uranium mill tailings piles which are no longer operational should not exceed 20 pCi/m^2s.

The asbestos standard in 40 CFR 61 Subpart M requiring no visible emissions is considered to be applicable to some of the remedial actions under consideration. Various other requirements pertaining to asbestos abatement projects are promulgated in 40 CFR 61, Subpart M. These requirements address asbestos removal, demolition, and renovation operations. Because the Weldon Spring site remedial action includes asbestos abatement activities, these standards and requirements are applicable to the remedial alternatives under consideration. Removed asbestos is being stored on an interim basis pending final disposal. The NESHAP disposal requirements for asbestos are applicable at the time of final waste disposal.

Regulation 40 CFR 192.02(b), which addresses releases of radon from tailings disposal piles, is considered to be relevant and appropriate to those aspects of the remedial alternatives which involve waste disposal. At completion, the disposal facility will have to meet the Rn-222 flux standards specified in 40 CFR 192.02(b). This standard requires reasonable assurance that Rn-222 from residual radioactive material will not (1) exceed an average release rate of 20 pCi/m^2s, or (2) increase the annual average concentration of Rn-222 in air at or above any location outside the site perimeter by more than 0.5 pCi/l. This regulation is relevant and appropriate as the Weldon Spring waste is considered sufficiently similar to uranium mill tailings.

Subpart D of the Uranium Mill Tailings Remedial Action (UMTRA) regulations sets forth standards for the management of uranium by-product materials. Regulation 40 CFR 192.32(b) sets forth closure standards and is considered applicable to the remedial action at the Weldon Spring site, as the radioactively contaminated material has been classified as by-product material as defined in the *Atomic Energy Act*, as amended.

The State of Missouri has adopted the National Ambient Air Quality Standards (NAAQS) criteria specified in the CAA through the *State Implementation Plan* and has promulgated ambient concentration standards under 10 CSR 10-6.010. Implementation of some of the remedial alternatives could result in emissions of several of the criteria pollutants, including particulate matter (50 $\mu g/m^3$ annual average or 150 $\mu g/m^3$ over a 24-hour period) and lead (1.5 $\mu g/m^3$ quarterly average). Although ambient standards for these contaminants are not ARARs, the standards provide a sound technical basis for ensuring protection of public health

and welfare during implementation and will be considered for components of the remedial action involving potential air releases.

Particulate standards promulgated under 10 CSR 10-5.180 (Missouri Air Pollution Control Regulations) for internal combustion engines (no release for more than 10 seconds at one time) are applicable to particulate release from any internal combustion engines used during implementation of the action.

The Missouri Department of Health has issued standards for Protection Against Ionizing Radiation in 19 CSR 20, which include a Rn-222 concentration limit of 1 pCi/L above background (quarterly average) in uncontrolled areas. This requirement is applicable to protection of the public during remedial action activities. The remaining requirements are similar to those identified in the DOE Orders for radiation protection of individuals and the environment, and the remedial action will also comply with the applicable provisions of those Orders.

Missouri has adopted by reference the RCRA Subtitle C hazardous waste management regulations. These State requirements are the same as the Federal requirements (the State requirements are not more stringent), which are considered ARARs. However, Missouri has also adopted additional rules, which include landfill siting requirements, that are considered legally applicable to the disposal of hazardous waste in the State. These requirements are discussed separately, with the action-specific ARARs identified in Section 10.

Atomic Energy Act (AEA) requirements for DOE's radioactive waste management and radiation exposure standards are incorporated into DOE Orders developed under DOE's AEA authority. These Orders are generally consistent with, and typically include, equivalent technical Nuclear Regulatory Commission (NRC) requirements that are appropriate for DOE operations and waste management. DOE Order requirements are "to-be-considered" (TBC) requirements, which when included in a DOE CERCLA Record of Decision (ROD) are enforceable cleanup standards under the CERCLA. Limited sections of NRC requirements can be "Relevant and Appropriate" or TBC only when DOE Orders do not clearly address a specific condition or particulars of the site, and supplemental requirements from NRC requirements are needed to facilitate protection of human health and the environment.

Key environmental requirements promulgated by the NRC were assessed to determine their potential as relevant and appropriate or to-be-considered (TBC) requirements for the Weldon Spring Site Remedial Action Project. Radiation exposure standards are promulgated in

10 CFR 20. These standards are not applicable because they apply only to NRC licensees. Neither are these standards both relevant and appropriate based on the circumstances of the action relative to the type of facility for which similar, equally protective standards have been established in DOE Orders 5400.5, *Radiation Protection of the Public and the Environment*; and 5480.11, *Radiation Protection for Occupational Workers*, for radiation protection. The remedial action will be conducted in accordance with DOE Order 5400.5, Chapter II, "Requirements for Radiation Protection of the Public and the Environment" and Chapter III, "Derived Concentration Guides for Air and Water." The remedial action will also follow DOE Order 5480.11.

Standards published under 10 CFR 61 address the disposal of low-level radioactive waste. These requirements are not applicable because the definition of wastes covered under this part specifically excludes 11e(2) byproduct materials. Neither are the requirements of 10 CFR 61 both relevant and appropriate because the design standards address near-surface disposal, for which the disposal unit is typically a trench, and release for unrestricted use could be considered after 500 years on the basis of assumed radioactive decay and migration. These requirements are not technically appropriate to the long-lived, radon-generating, alpha-emitting materials present at the Weldon Spring site. The remedial action will be conducted in accordance with DOE Order 5820.2A, *Radioactive Waste Management*, Chapter III, "Management of Low-Level Waste" and Chapter IV, "Management of Waste Containing Byproduct Material and Naturally Occurring and Accelerator Produced Radioactive Material."

7.3 Alternative 7a: Removal, Vitrification, and Disposal On Site

Alternative 7a is similar to Alternative 6a except that vitrification would be the treatment method for the sludge, the more highly contaminated soil and sediment, and the containerized process waste. Under Alternative 7a, about 675,000 m^3 (883,000 yd^3) of contaminated sludge, soil, sediment, structural material, and water treatment plant process wastes would be removed from the source areas and on-site storage areas. About 342,000 m^3 (447,000 yd^3) of that material would be treated by vitrification or volume reduction, as appropriate, and about 522,000 m^3 (683,000 yd^3) of treated and untreated material would be placed in an engineered disposal facility on site.

It is projected that remedial action activities could be completed in 10 years following the ROD, if no difficulties were encountered during testing, start-up, or operation. It is estimated that 2.5 to three years are estimated to be required for bench-scale and pilot-scale testing; five to seven years for design, construction, and start-up of the vitrification facility; and

four years for operation. As construction and operation of the disposal facility would require about 6.5 years, some of these activities could overlap. However, the total time required for these activities could be longer because of the innovative nature of this technology. As in Alternative 6a, releases would be controlled with good engineering practices and mitigative measures, and monitoring would be conducted throughout the cleanup and maintenance period to address protection of the general public and the environment. Similarly, the DOE would review the effectiveness of the remedy every 5 years.

Treatment would be a principal element of Alternative 7a, and vitrification would reduce the toxicity of certain contaminants (e.g., nitrate and nitroaromatic compounds); the toxicity of radiation from the site waste would not be affected by vitrification (or any other treatment method). Vitrification would also reduce the mobility of contaminants in soil and sludge and the disposal volumes of these media; this treatment method would result in a volume reduction of about 68% for the treated material and an overall volume reduction of 24% for the combined waste. The volume of other material, such as structural debris and vegetation, would be reduced as described for Alternative 6a.

Standard equipment and readily available resources would be used for the excavation and nonthermal treatment operations. However, equipment and resources are not readily available for vitrification. Use of the vitrification technology for large-scale operations is innovative and would require further bench-scale and pilot-scale testing followed by engineering scale-up before implementation at the Weldon Spring site. The total cost of implementing Alternative 7a is estimated to be about $182 million. The representative technical components of removal and much of the treatment and disposal components are the same as described for Alternative 6a. Those components of Alternative 7a that differ from Alternative 6a are described in the following paragraphs.

The vitrification unit within the sludge processing facility would be expected to consist of two melters operating in parallel to provide system flexibility. The contaminated material that would be treated in these melters is the same material that would be chemically treated under Alternative 6a. Feed preparation (sludge dewatering and material sizing) would be required before vitrification. In addition, the sludge and soil would have to be mixed in an optimized blend ratio to produce a glassy product. The vitrification process would operate continuously (24 hours per day throughout the year), and would consume a considerable amount of energy.

The vitrified product would be irregularly shaped 0.32- to 0.64-cm (1/8- to 1/4-in.) pieces of glass-like fritted material; it would be collected in a hopper and transferred to bins for

truck transport directly to the disposal facility or to an adjacent staging area. Emissions from the vitrification process would be treated before release to the atmosphere. The specific off-gas treatment system would be developed following bench-scale and pilot-scale testing and optimization, but it would likely consist of a heat removal system, a primary quench scrubber, a submicron aerosol scrubber, a nitrogen oxide gas removal system, and a final filtration system, as required. Off-gas treatment requirements under this alternative would result in additional technical complexity, and delays could occur if inadequate controls were achieved during testing.

The location of the disposal area would be similar to that identified for Alternative 6a. However, for Alternative 7a, it was assumed that two cells could be constructed over the same general surface area. The first would be the same as that described for Alternative 6a, only smaller, and would receive all but the vitrified material. The design volume for nonvitrified material is about 591,000 m^3 (773,000 yd^3) with contingency. This disposal facility would cover about 12 ha (30 acres). A second cell could be constructed for the vitrified material, and it could have less stringent engineering controls if pilot testing demonstrated that the product would resist leaching. That is, although this cell would contain a cap similar to that described for Alternative 6a and a compacted natural clay liner, it would not include a leachate collection system because the material is expected to withstand leaching into the long term. The design volume of this cell is about 86,400 m^3 (113,000 yd^3) with contingency, and it would cover an area of about 5 ha (12 acres). The vitrified material would be cohesionless and would be placed in the cell in alternate layers with a binder such as clay to promote waste compaction and increase cell stability. The cell would be maintained and its performance monitored for the long term. As described for Alternative 6a, site-specific operational and contingency plans would be prepared to support the remedial action phase of this project, and institutional controls would be maintained for the long term.

On the basis of continuing engineering evaluations and pending further analyses to be developed during the detailed design phase, this approach might be modified to parallel the scenario described under Alternative 6a. The result would be a single disposal facility, designed to contain both the vitrified and untreated waste, which would incorporate the same features described under Alternative 6a. The major difference would be the smaller size of the cell because of volume reduction achieved during vitrification. The analyses for the representative case in the FS are expected to bound potential impacts that would be associated with cell operations (including construction, waste placement, and closure) under the modified approach if Alternative 7a were selected.

7.3.1 Applicable or Relevant and Appropriate Requirements

ARARs for this alternative are similar to the ones discussed for Alternative 6a. Additional emission standards for Alternative 7a are discussed below.

Regulation 40 CFR 266, Subpart H provides RCRA emissions standards for hazardous waste burned in boilers and industrial furnaces. This requirement is considered applicable to the vitrification alternative, as the fossil-fuel heated melter proposed for the vitrification facility is an industrial furnace that will process hazardous wastes. Part 266.104 states that the furnace must achieve a destruction and removal efficiency of 99.99% for each principal organic hazardous constituent. Concentrations of carbon monoxide (CO) in the off-gas must not exceed 100 ppmv (parts per million by volume) over a 60 minute moving average. Particulate emissions must not exceed 180 mg/dscm (dry standard cubic meter) or 0.008 gr/dscf (dry standard cubic foot) when corrected to 7% oxygen in the stack gas. In addition, Part 266.102 states that CO, oxygen, and possibly total hyrocarbons must be monitored continously at a point downstream of the combustion zone and prior to release into the atmosphere. The monitoring must conform with performance specifications found in Appendix IX of 40 CFR 266.

Regulation 10 CSR 10-5.030 limits particulate matter emissions from new indirect heating sources. Regulation 10 CSR 10-5.050 limits particulate matter from any industrial source to less than 0.030 grain/standard ft^3 of exhaust gas. Regulation 10 CSR 10-5.090 limits the opacity of the exit gas to 20%. The regulations are considered applicable to the vitrification process as the fossil-fuel heated melter is considered an industrial furnace which emits exit gases.

7.4 Alternative 7b: Removal, Vitrification, and Disposal at the Envirocare Facility

Alternative 7b is similar to Alternative 7a except that the treated and untreated material would be transported to the Envirocare facility near Clive, Utah, for disposal. It is expected that the removal and treatment activities at the Weldon Spring site could be completed within the same time frame as Alternative 7a; however, the environmental compliance process associated with obtaining the necessary license to dispose of the large volume of by-product material at the Envirocare facility could delay implementation of this alternative. Release controls and monitoring would also be the same as previously described. Under this alternative, the same material targeted for treatment under Alternative 7a would be vitrified at the Weldon Spring site before off-site transport for disposal. The total cost of implementing Alternative 7b is estimated to be about $351 million.

The Weldon Spring waste is classified as 11e(2) by-product material as defined in the *Atomic Energy Act*, as amended. The DOE can transfer this type of material only to organizations licensed to receive it by the U.S. Nuclear Regulatory Commission (NRC). This requirement would apply to the disposal of waste from the Weldon Spring site at the Envirocare site. The Envirocare site has been permitted by the State of Utah to accept mixed hazardous waste and naturally occurring radioactive material. However, a disposal facility is not currently available at the site to receive material from the Weldon Spring site (i.e., 11e(2) by-product material). Envirocare of Utah, Inc., has submitted an application to the NRC for a license to allow for disposal of 11e(2) by-product material, and the NRC is currently preparing an *Environmental Impact Statement* (EIS) to support the license application. Because of the nature of the regulatory compliance process associated with the proposed Envirocare facility, the Weldon Spring site cleanup might be delayed for several years under this alternative, depending on the length of time it takes the NRC and the Envirocare owners to complete the environmental review process.

The technologies and activities that would be used to construct, operate, and maintain a disposal facility for the Weldon Spring waste at the Envirocare site would most likely be similar to those identified for Alternative 7a. Although implementation of Alternative 7b would allow for release of the entire Weldon Spring site for future uses, the site will be evaluated every five years to evaluate the effectiveness of the cleanup. The long-term institutional controls appropriate for the Weldon Spring site would be determined on the basis of final site conditions, which will depend on the remedy selected for the groundwater operable unit, as described for Alternative 6a.

To support off-site disposal, the treatment facilities planned for the Weldon Spring site would have to be modified to include a staging area for loading the waste product into containers and onto trucks for off-site transport. These trucks would then transport contaminated material from the Weldon Spring site to a rail siding transfer station in Wentzville, Missouri, that would be either leased or newly constructed to support this action. About 38,600 trips would be required to transport the material to the siding over a combined one-way haul distance of 932,000 truck-km (579,000 truck-mi). The material would then be transferred to railcars for subsequent shipment along a commercial rail line to Clive, Utah. The transportation component of this alternative would probably extend over seven years. On the basis of an estimated 515 required train trips, Alternative 7b would involve transportation over about 1,240,000 rail-km (773,000 rail-mi).

Transport of waste for off-site disposal at the Envirocare facility would result in an increased risk of transportation accidents, with the potential for exposing workers and the general public to radioactive and chemically hazardous substances. On the basis of current statistics for highway and rail accident rates and the distance that would be traveled by transport vehicles, a total of about six transportation accidents would be expected to occur. About half of these would be truck accidents, largely as a result of truck transport of the waste to the rail siding transfer station in Wentzville. The remaining three transportation accidents would involve railcars transporting the waste to Clive. Based on statistics, no fatalities would be expected, although several injuries could occur as a result of these accidents.

7.4.1 Applicable or Relevant and Appropriate Requirements

Compliance with ARARs under Alternative 7b would be the same as for Alternative 7a. In addition, applicable requirements for transportation of radioactive and chemically hazardous material to the Envirocare facility would be met.

7.5 Alternative 7c: Removal, Vitrification, and Disposal at the Hanford Reservation Facility

Alternative 7c is similar to Alternative 7b except that the contaminated material would be transported to the Hanford Reservation facility near Richland, Washington, for disposal. Removal and treatment considerations would be the same as described for Alternative 7b, and the basic components of off-site disposal would be similar.

Under Alternative 7c, cleanup activities at the Weldon Spring site could be delayed many years because an appropriate disposal facility is not currently available at the Hanford facility to receive site waste and no such facility is planned. The technologies and activities that would be used to construct, operate, and maintain a disposal facility at the Hanford site would likely be similar to those identified for Alternative 7a. The total cost of implementing Alternative 7c is estimated to be about $304 million. This cost is based on an estimate of $130/m^3$ ($100/yd^3$) to dispose of the large volume of waste from the Weldon Spring site. The cost estimate for this alternative assumes that long-term monitoring and maintenance at the Hanford site would cost the same as at the Weldon Spring site. A detailed cost analysis would be performed to develop a firm price for disposal at the Hanford site, if this were a component of the remedy selected for the Weldon Spring site.

Transport of contaminated material to the Hanford site for disposal would involve the same considerations identified for Alternative 7b, but Alternative 7c would require transporting the material along a commercial rail line to Richland, Washington, and transferring it to a dedicated rail line for transport to the Hanford site. On the basis of an estimated 515 train trips, Alternative 7c would involve transportation over about 1.7 million rail-km (1.1 million rail-mi) during an estimated seven-year period. A total of about eight transportation accidents would be expected, three involving trucks and five involving railcars. (More railcar accidents are expected for Alternative 7c than 7b because of the longer transport distance.) Statistically, no fatalities would be expected, although several injuries could occur as a result of these accidents.

7.5.1 Applicable or Relevant and Appropriate Requirements

Compliance with ARARs under Alternative 7c would be the same as for Alternative 7a. In addition, applicable requirements for transportation of radioactive and chemically hazardous material to the Hanford Reservation facility would be met.

8 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The U.S. Environmental Protection Agency (EPA) has identified nine evaluation criteria against which final remedial action alternatives are to be evaluated. These criteria are derived from statutory requirements in Section 121 of the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA), as amended, as well as other additional technical and policy considerations that have proven to be important for selecting remedial alternatives. A balancing of these criteria is used to determine the most appropriate solution for the specific problems at each site. These statutory mandates, which any selected remedy must meet, include protection of human health and the environment, compliance with applicable or relevant and appropriate requirements (ARARs), cost effectiveness and use of a permanent solution and alternate treatment or resource recovery technologies to the maximum extent practicable. The nine criteria are:

1. *Overall protection of human health and the environment.* Addresses protection from unacceptable risks in both the short term and the long term by minimizing exposures.

2. *Compliance with ARARs.* Addresses compliance with Federal and State environmental requirements and State facility siting requirements, unless a waiver condition applies.

3. *Long-term effectiveness and permanence.* Addresses residual risks, focusing on the magnitude and nature of risks associated with untreated waste and/or treatment residuals. This criterion includes a consideration of the adequacy and reliability of any associated institutional or engineering controls, such as monitoring and maintenance requirements.

4. *Reduction of contaminant toxicity, mobility, or volume through treatment.* Addresses the degree to which treatment is used to address the principal hazards of the site; the amount of material treated; the magnitude, significance, and irreversibility of specific reductions; and the nature and quantity of treatment residuals.

5. *Short-term effectiveness.* Addresses the effect of implementing the alternative relative to potential risks to the general public during the action period, potential impacts to workers and the environment during the action period, the

effectiveness and reliability of mitigative measures, and the time required to achieve protection of workers and the environment.

6. *Implementability*. Addresses technical feasibility, including the availability and reliability of required resources (such as specific material and equipment, facility capacities, and availability of skilled workers); the ease of implementation; and the ability to monitor effectiveness. This criterion also addresses administrative feasibility, e.g., coordination with other agencies and the need for approvals or permits for off-site actions as appropriate to the alternative.

7. *Cost*. Addresses both capital costs and operation and maintenance costs, as well as the combined net present worth.

8. *State acceptance*. Addresses formal comments made by the State of Missouri on the consideration of alternatives and identification of the preferred alternative.

9. *Community acceptance*. Addresses the formal comments made by the community on the alternatives under consideration.

The first two criteria are considered threshold criteria and must be met by the final remedial action alternatives for a site (unless a waiver condition applies to the second criterion). The next five criteria are considered primary balancing criteria and are evaluated together to identify the advantages and disadvantages in terms of effectiveness and cost among the alternatives. The last two are considered modifying criteria and are evaluated after the *Remedial Investigation/Feasibility Study* (RI/FS) has been reviewed.

8.1 Threshold Criteria

8.1.1 Overall Protection of Human Health and the Environment

All of the final alternatives except Alternative 1 (no action) would provide overall protection for human health and the environment. This protection could not be ensured for the extended future, if no action were taken, because over time contaminants could migrate via groundwater to off-site receptors, resulting in possible impacts. For each of the action alternatives, human and environmental exposures would be reduced by removing the sources of

contamination, treating the waste that contributes to the principal hazards at the site, and managing low-risk contaminated materials not requiring treatment by permanently containing these untreated materials with the treated waste product in an engineered disposal facility designed to prevent the release of contaminants into the environment for at least 200 to 1,000 years.

8.1.2 Compliance with ARARs

Alternative 1 (no action) would not comply with all Federal and State ARARs.

Alternative 6a would meet all location, action, and contaminant-specific ARARs with the exceptions of:

- The State of Missouri's Rn-222 limit of 1 pCi/l above background in uncontrolled areas (19 CSR 20-10.040) may not be achieved during implementation: Absolute compliance with requirement during all phases of remedy implementation is technically impracticable from an engineering perspective (Section 121(d)(4)(C) of the CERCLA).

- Regulation 40 CFR 61, Subpart M presents National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements for asbestos handling. Due to technical impracticability and potential increased exposure to personnel, the small pieces of asbestos found in the quarry bulk wastes (smaller than 0.6 m x 0.6 m x 0.05 m [2 ft x 2 ft x 2 in.]) will not be segregated from the soils. As this material is moved from the temporary storage area (TSA), the NESHAPs requirements will be waived under Section 121(d)(4)(B) of the CERCLA.

- Regulation 40 CFR 268, Subpart E specifies the land disposal restrictions (LDRs). The LDRs prohibit the storage of restricted wastes unless storage is solely for the purpose of accumulating sufficient quantities of wastes to facilitate proper treatment, recovery, or disposal. The limitations on storage time are waived under Section 121(d)(4)(C) of the CERCLA.

- Regulation 40 CFR 268, Subpart C specifies LDR restrictions on hazardous waste placement. This requirement is waived under Section 121(d)(4)(A) of the CERCLA.

- Regulation 40 CFR 268, Subpart D specifies treatment standards which must be attained prior to land disposal of the hazardous waste. The treatment standard based upon use of a specified technology is waived under Section 121(d)(4)(D) of the CERCLA.

- Regulation 10 CSR 25.5-262(2)(C)1 sets forth the State regulation that hazardous wastes stored prior to off-site shipment shall comply with U.S. Department of Transportation (DOT) regulations regarding packaging, marking, and labeling. Meeting new packaging requirements for storage set forth in the DOT requirement HM-181 (in 49 CFR) could potentially result in unnecessary personnel exposure. Therefore, this requirement is waived under Section 121(d)(4)(A) and Section 121(d)(4)(B) of the CERCLA.

- Regulation 40 CFR 761.65(a) requires that any polychlorinated biphenyl (PCB) article or container be removed from storage and disposed of within one year from the date when it was first placed in storage. This requirement is waived under Section 121(d)(4)(A) of the CERCLA.

- Regulation 40 CFR 761.75(b)(3) of the Toxic Substance Control Act (TSCA) states that the bottom landfill liner system or natural in-place soil barrier shall be at least 17 m (50 ft) from the historical high-water table. This requirement is waived under Section 121(d)(4)(D) of the CERCLA.

- Regulation 40 CFR 264.314(f) sets forth restrictions on the placement of waste containing free liquids in a landfill. This requirement is waived in accordance with Section 121(d)(4)(B) and Section 121(d)(4)(D) of the CERCLA.

Alternative 7a would meet all location, action, and contaminant-specific ARARs.

The exceptions to this alternative meeting all ARARs, and waivers for these exceptions, are the same as those discussed under Alternative 6a. The waiver for 40 CFR 264.314(a), (b), (c), and (d) regarding placement of free liquids in a landfill is not applicable to Alternative 7a, as vitrification produces a glass-like product with no liquids.

Compliance with location, contaminant, and on-site action-specific requirements for Alternative 7b would be similar to that described for Alternative 7a. Applicable requirements

for transportation of radioactive and chemically hazardous material to the Envirocare facility would be met under this alternative.

Compliance with ARARs under Alternative 7c would be similar to that described for Alternative 7b.

8.2 Primary Balancing Criteria

8.2.1 Long-Term Effectiveness and Permanence

The long-term effectiveness of chemical stabilization/solidification generally is considered to be less than for vitrification (i.e., wastes that are vitrified could be expected to resist leaching for a longer time [thousands of years] compared with the chemically stabilized form [hundreds of years]. However, the uncertainties with regard to the performance and implementability of vitrification steered the decision toward a more demonstrated technology. In fact, it was this combination of performance uncertainty and potential for greater long-term effectiveness that led to the decision to further evaluate vitrification as a contingency treatment option in the selected remedy. The important point is that residual risks at the site would be reduced to near background levels regardless of which technology is used. The required monitoring and five-year reviews will provide an effective precaution against any future potential release going undetected and resulting in actual exposure. In addition, long-term effectiveness and permanence of the disposal facility is affected by the loss of institutional controls. The likelihood that institutional controls would be lost is the same for Alternatives 6a and 7a. However, continuation of institutional controls into the extended long term at a commercial facility (Alternative 7b) might be more difficult to ensure than at a Federally owned facility (Alternatives 6a, 7a, and 7c).

8.2.2 Reduction in Toxicity, Mobility, and Volume through Treatment

Greater reduction in toxicity, mobility, or volume through treatment would be achieved for Alternatives 7a, 7b, and 7c (vitrification), as compared with Alternative 6a, chemical stabilization/solidification (CSS). The volume of structural material, vegetation, and wooden debris would be similarly reduced under each alternative; however, for the sludge and soil that would be treated by vitrification, some contaminants (e.g., the limited organic compounds) would be destroyed, the others would be immobilized in a glass-like matrix, and the overall disposal volume would decrease by about 24%. Alternative 6a would also significantly reduce

contaminant mobility by incorporating contaminants into a cement-like matrix, but contaminant toxicity would not change and the overall waste disposal volume would increase by about 12%.

8.2.3 Short-Term Effectiveness

The short-term effectiveness of Alternatives 6a and 7a would be essentially the same. Potential short-term impact concerns from the implementation of Alternative 7b or 7c would be substantially greater than for Alternative 6a or 7a, due to the increased handling of waste material and the transportation of the waste to the off-site locations.

The two key differences among the final action alternatives are the treatment method and the disposal location (which includes a transportation component for the off-site disposal alternatives). Therefore, impacts to workers and the general public from removal activities during the remedial action period would be similar for each alternative because the same areas would be excavated or dredged. Incremental impacts to workers and the public from treatment activities could result from differences between the chemical treatment and vitrification operations, i.e., additional emissions are associated with vitrification, as compared with CSS, because contaminants would be released from the stack of the vitrification facility. However, these emissions are expected to be controlled by an extensive air pollution control system within the facility, so related impacts would be small to none.

Potential health impacts for members of the general public during the cleanup period would be below the EPA target limits for protecting human health for each of the action alternatives. Impacts would be relatively higher for Alternatives 7b and 7c than for Alternative 6a or 7a because of the increased likelihood of exposures and accidents during the waste handling and transportation activities for off-site disposal. The potential for risk to workers would be higher under the vitrification alternatives because this process would require more workers and additional accidents could result from the hazards of high operating temperatures and limited field experience.

Environmental impacts could potentially result from excavating and dredging contaminated material, constructing access roads, staging areas, and other support facilities; constructing and operating the disposal facility (either on site or off site); and excavating borrow soil from a location near the Weldon Spring site to provide backfill for the remediated areas on site and to construct the cell under Alternatives 6a and 7a. Additional impacts could be associated with activities at the rail siding in Wentzville and other transportation operations under Alternatives 7b and 7c. Except for the permanent loss of habitat at the disposal facility

area and possibly at the off-site borrow location (depending on the location selected during detailed design), any potential impact would be short term and likely could be mitigated by various standard practices, e.g., engineering controls to limit erosion and siltation. A mitigation action plan will be developed that will outline specific measures to be implemented for environmental controls or to address contingency response actions.

8.2.4 Implementability

The implementation of Alternative 6a would be the most straightforward of the final action alternatives because the chemical stabilization/solidification technology has been utilized at other sites and would use readily available resources. Implementation of chemical stabilization/solidification at the Weldon Spring site (testing, design, construction, and start-up) is estimated to require a maximum of five years. Implementation of Alternative 7a, 7b, or 7c would require further engineering scale-up of the vitrification system and application of that innovative technology to a large waste volume. Although the results of bench-scale testing have shown that the Weldon Spring wastes can be successfully vitrified, they also indicate the need for further testing to evaluate treatment of waste materials representing the extremes in chemical variability, and to test treatment equipment that would be similar in type and function to that required in full-scale operations. Implementation of vitrification at the Weldon Spring site (testing, design, construction, and start-up) is estimated to require about 7 years. However, there is greater uncertainty with this estimate due to the innovative nature of the technology. Alternative 7b or 7c would require coordination of licensing, regulatory compliance, and establishment of administrative procedures (as appropriate) in order to dispose of the Weldon Spring waste at either off-site facility.

Difficulty in implementing either Alternative 7b or 7c would include such factors as permitting of the facilities and transportation of the wastes to the off-site facilities. While the Envirocare facility is permitted to accept mixed hazardous waste and naturally occurring radioactive material, there is no permitted disposal facility currently on the site that may receive 11e(2) by-product material. Envirocare has submitted an application to the NRC for a license to dispose of 11e(2) by-product material. The Hanford facility (Alternative 7c) does not currently have an appropriate disposal facility to receive Weldon Spring site waste. Construction of such a disposal facility at Hanford could delay cleanup activities at the Weldon Spring site for several years.

Transportation concerns include constructing the necessary rail siding transfer station in Wentzville, Missouri, and the increased risk of transportation accidents.

8.2.5 Cost

Description of Alternatives	Approximate Costs (in millions)
Alternative 1: No Action	$1.2 (annual)
Alternative 6a: Removal, Chemical Stabilization/Solidification, and Disposal On Site	$157 (total)
Alternative 7a: Removal, Vitrification, and Disposal On Site	$182 (total)
Alternative 7b: Removal, Vitrification, and Disposal at Envirocare Site near Clive, Utah	$351 (total)
Alternative 7c: Removal, Vitrification, and Disposal at the Hanford Reservation Site near Richland, Washington	$304 (total)

8.3 Modifying Criteria

8.3.1 State Acceptance

The State of Missouri has requested that the DOE agree to certain stipulations as a condition for obtaining State concurrence. These stipulations are:

- No wastes from other sites shall be disposed of at the Weldon Spring site.
- An on-site disposal facility shall meet the substantive siting and design requirements of State and Federal hazardous waste laws and regulations.
- The selected remedial alternative shall be protective of human health and the environment.

- Cleanup procedures, design, and standards shall meet all State and Federal ARARs.

- Human radiation exposures must be reduced to a level that is as low as reasonably achievable (ALARA).

- The DOE shall commit to cleaning up the contaminated vicinity properties. These properties include several small locations on the adjacent Army area, August A. Busch Conservation Area, and Weldon Spring Conservation Area.

- Natural barriers and engineered materials, methods, and designs shall be used to the maximum extent possible in order to achieve a protective and permanent waste disposal solution, and institutional control measures shall be minimized.

- The U.S. Department of Energy (DOE) shall retain ownership and control of the disposal facility.

- The DOE shall commit to long-term monitoring and maintenance of the disposal facility.

8.3.2 Community Acceptance

In general, the comments received from the public indicate acceptance of Alternative 6a as a selected remedy for the Weldon Spring site. The main concerns that were raised involved a commitment by the DOE that the on-site disposal facility be used solely for Weldon Spring wastes, and that no off-site wastes be accepted for disposal on site. There were also concerns for safeguards to the Francis Howell High School population.

As stated in this Record of Decision (ROD), no off-site wastes will be accepted for disposal at the Weldon Spring site. In addition, measures taken to facilitate the safety of personnel at Francis Howell High School have been described in the *Remedial Investigation/ Feasibility Study-Final Environmental Impact Statement* (RI/FS-Final EIS) package.

9 SELECTED REMEDY

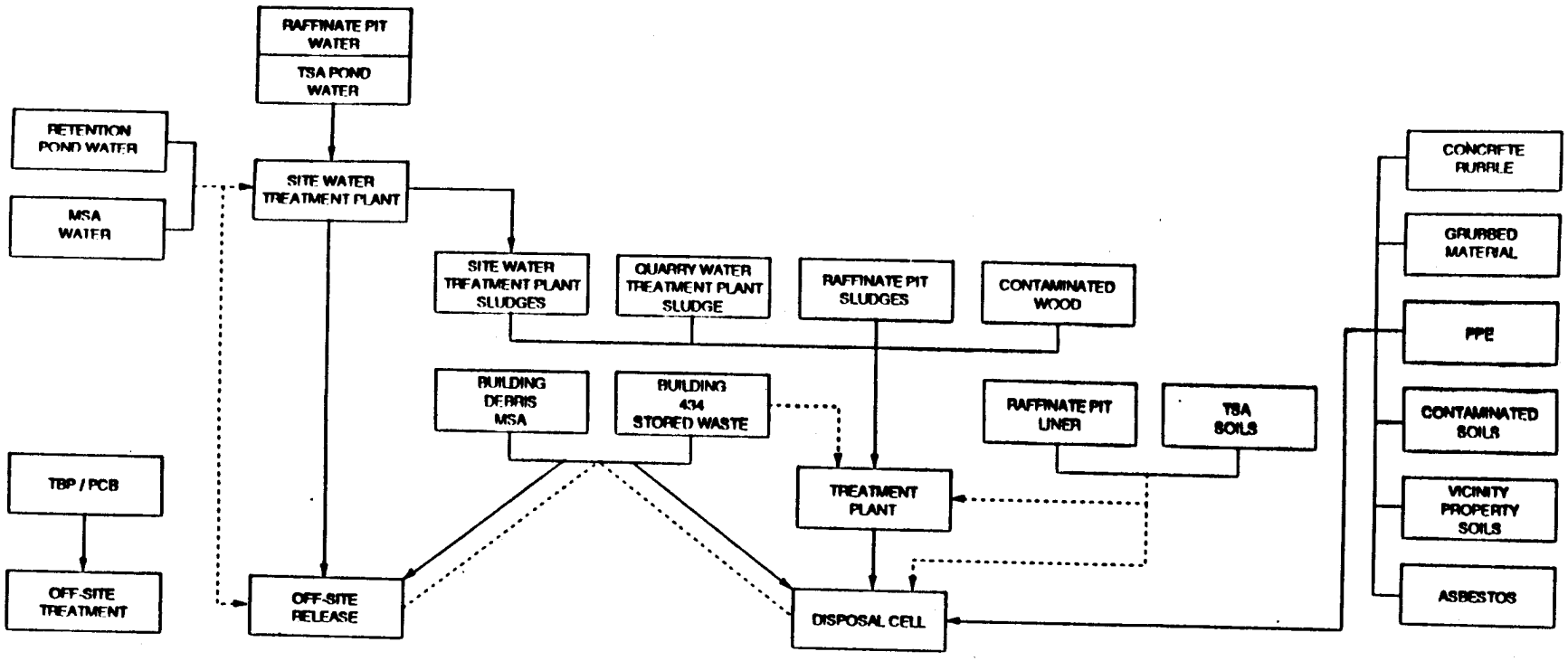
On the basis of the evaluation of final alternatives, Alternative 6a (removal, chemical stabilization/solidification, and disposal on site) has been identified as the selected remedy for remedial action at the chemical plant area of the Weldon Spring site. The key components of the remedy are described in Section 9.1, and the cleanup criteria developed for this remedy are presented in Section 9.2.

9.1 Key Components

Material will be removed from contaminated areas, treated as appropriate by chemical stabilization/solidification, and disposed of in an engineered disposal facility constructed on site (Figure 9-1). The treatment method specified in the selected remedy will substantially reduce the risks associated with those waste materials that represent the principal hazard at the site. This remedy will also provide for the safe management of less contaminated site wastes. This alternative will reduce risks and provide protection of human health and the environment in less time and at a lower cost than the other action alternatives. Chemical stabilization/solidification is an established technology that uses readily available resources and has been utilized at other sites, and disposal in an on-site engineered facility would also use readily available resources and standard technologies.

Chemical stabilization/solidification will be the treatment method used for contaminated sludge, certain quarry soil and sediment, and certain other contaminated soil from the site (such as soil taken from beneath the raffinate pits). Material treated by chemical stabilization/ solidification will undergo an increase in volume of about 32%. Volume reduction operations will be used to treat structural material, rock, and containerized debris (e.g., used personal protective equipment). The average volume of material processed by these methods will be reduced by between 10% and 50% depending upon the specific material type. Volume reduction operations will include a decontamination unit that can be used to treat selected structural materials for which release and reuse is practicable.

An engineered disposal facility will be constructed in the area of the chemical plant within a specifically designated portion of the site that has undergone numerous subsurface investigations to confirm the suitability of the area for disposal of site waste. The design volume of material that would be placed in the cell is estimated to be about 1.1 million m^3 (1.5 million yd^3). The base of the disposal facility will be designed to minimize the downward



- - - - - - - - - - - - - - - - - OPTIONS FOR REMEDIATION

WASTE MEDIA FLOWPATH

FIGURE 9-1

REPORT NO.:		EXHIBIT NO.:	A/PI/053/0393
ORIGINATOR: JAB	DRAWN BY: GLN	DATE: 3/93	

transport of any leachate from the contaminated material that will be contained in the cell. The long-term multilayer cell cover will serve as a barrier to infiltration and radon release and will protect against the potential effects of freeze-thaw cycles, intrusion by plant roots or burrowing animals, and erosion (including that associated with extreme precipitation events). In addition, the cell will be seismically engineered to withstand damage from potential earthquakes. The disposal facility will be maintained and its performance will be monitored for the long term.

Table 9-1 presents the estimated costs of the selected remedy. These costs are based on preliminary conceptual design information. Some changes may be made to the remedy as a result of the remedial design and construction processes. Such changes reflect modifications resulting from the engineering design process and could increase the cost estimates identified in this table.

Vitrification of the contaminated sludge, soil, and sediment (instead of chemical stabilization/solidification) is being retained as a contingency treatment option. Vitrification is being carried forward into the conceptual design phase so the effectiveness of this technology and the uncertainties associated with its implementability can continue to be evaluated. Estimated costs for this contingency remedy (Alternative 7a) are presented in Table 9-2.

If it becomes necessary to implement the contingency treatment option (vitrification and disposal on site) because chemical stabilization/solidification does not perform adequately during pilot-scale testing (i.e., if engineering limitations prevent treatment of the waste or if it is not possible to consistently produce a waste product which passes the toxicity characteristic leaching procedure [TCLP] test), an Explanation of Significant Differences from the selected action in this ROD will be developed in accordance with U.S. Environmental Protection Agency (EPA) guidance for post-ROD changes and this document will be made available to the public.

Since both chemical stabilization/solidification and vitrification processes involve the addition of soils, a practical approach is to use site soils with higher levels of radioactivity, such as those from Ash Pond and the north dump. These soils will be mixed preferentially with raffinate sludge and quarry bulk waste. If additional soil mixing material is needed, other site soils with still lower concentrations of radioactivity will be used preferentially over uncontaminated borrow soils.

TABLE 9-1 Cost Estimate for Alternative 6a

Activity	Estimated Cost (million $)
Removal	
Raffinate pits remediation	11.9
Chemical plant area preparation[c]	2.8
Building foundation and underground pipe removal[c]	5.9
Soil and sediment excavation	1.7
Building 434 waste removal[c]	0.6
Vicinity properties remediation[d]	
Army properties 1, 2, 3 and Busch properties 3, 4, 5[c]	0.4
Busch Lakes 34, 35, and 36[c]	0.4
Army properties 5 and 6[c]	0.3
Removal subtotal	24.0
Treatment	
Bench- and pilot-scale testing	2.1
Sludge processing facility construction	3.1
Sludge processing facility operations	14.7
Volume reduction facility construction[c]	2.9
Volume reduction facility operations[c]	2.5
Construction of second treatment train (distillation) of water treatment facility[c]	1.2
Water treatment plant operations	3.5
Treatment subtotal	30.0
Disposal	
Disposal facility construction material tests	0.9
Disposal facility construction	47.6
Disposal facility operations	7.2
Disposal subtotal	55.7
Other	
Material hauling	9.7
TSA operations[c]	2.0
MSA operations[c]	5.2
Decontamination station operations[c]	1.2
Facilities removal[c]	1.8
Site restoration	3.4
Long-term maintenance[e]	23.9
Other subtotal	47.2
Total	156.9
Present worth	78.5

(c) Items that are part of Alternative 6a and for which the cost estimate does not differ between this alternative and the contingency remedy (Alternative 7a).

(d) Includes both excavation and restoration costs.

(e) For a 30-year period; includes environmental monitoring.

TABLE 9-2 Cost Estimate for Alternative 7a

Activity	Estimated Cost (million $)
Removal	
Common removal costs (see Table 14)	10.4
Raffinate pits remediation	14.4
Soil and sediment excavation	1.7
Removal subtotal	26.5
Treatment	
Common treatment costs (see Table 14)	6.6
Bench- and pilot-scale testing	8.2
Sludge processing facility construction	25.6
Sludge processing facility operations	20.5
Water treatment plant operations	3.5
Treatment subtotal	64.4
Disposal	
Disposal facility construction material tests	0.9
Disposal facility construction	37.1
Disposal facility operations	6.7
Disposal subtotal	44.7
Other	
Common other costs (see Table 14)	10.2
Material hauling	9.3
Site restoration	3.4
Long-term maintenance[a]	23.9
Other subtotal	46.8
Total	182.4
Present worth	96.9

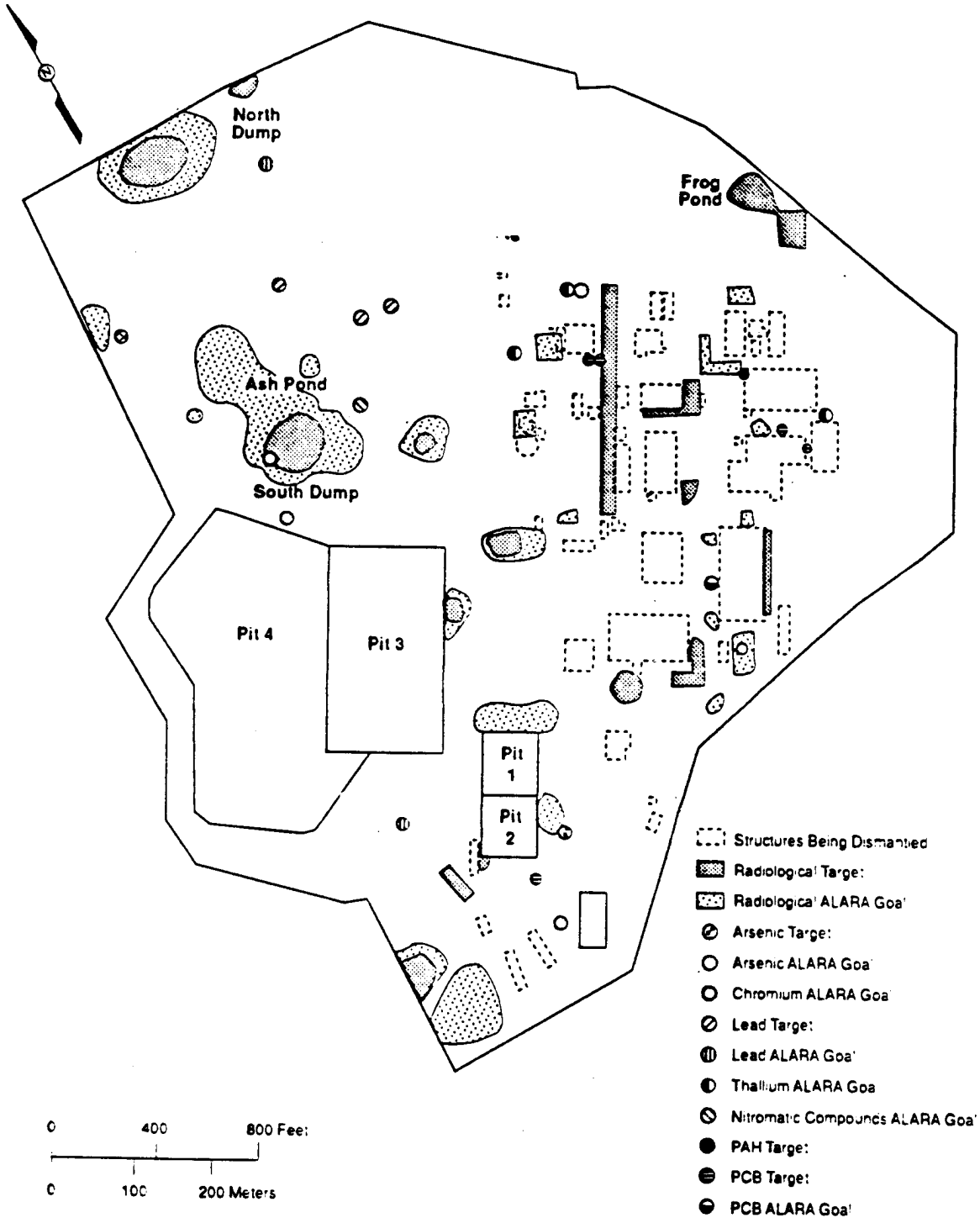
[a] For a 30-year period; includes environmental monitoring.

9.2 Cleanup Criteria

Interim actions have addressed cleanup criteria for surface water at the Weldon Spring site, and groundwater will be addressed as a separate operable unit in the future. Thus, soil is the focus of cleanup criteria for the current remedial action (as discussed in Section 2 of the FS). Cleanup criteria for the key contaminants in site soil were developed from available environmental regulations and guidelines in combination with the results of the site-specific risk assessments. As part of the latter, a site-specific analysis was conducted to address the reduction of residual risks to levels as low as reasonably achievable (ALARA), as described in Section 2 of the FS. For the purpose of developing these criteria from risk information, the RME was identified as the residential scenario described in Section 6.2.2, under which exposures to soil were evaluated for inhalation and incidental ingestion combined. In accordance with the NCP, the initial point of departure for the development of the cleanup criteria was an incremental risk level of 1×10^{-6} for carcinogens. A hazard index of 1 was the target for the noncarcinogens. However, for many of the contaminants at the Weldon Spring site, the point of departure for incremental risks could not reasonably serve as the endpoint for site cleanup criteria. That is, background concentrations of certain naturally occurring metals (including the radionuclides present at the site) correspond to risks more than 100 to 1,000 times greater than this level. Thus, it is very difficult to distinguish incremental contamination from variability in background concentrations that correspond to a fractional increment of 1×10^{-6}. For this reason, the site-specific risk assessments addressed reducing residual risks to ALARA levels, as described in Section 2 of the FS.

The soil areas identified for remediation on the basis of the risk-based criteria determined from these assessments are shown in Figure 9-2. Concentration-based criteria were also developed for each primary contaminant of concern to provide a means for ensuring that cleanup has been achieved, i.e., by verification sampling across the site. These criteria are listed in Tables 9-3 and 9-4 and represent the total concentrations (i.e., including background) above which site soil would be removed; the ALARA goals represent lower levels that the remedial action would aim to achieve during field excavation activities.

If soils with contaminant concentrations exceeding natural background are released off site, further risk assessments must be performed using parameters specific to the intended use or disposition of the soils. Concrete rubble will be treated like soil and will likewise not be released off site. The criteria contained in DOE Order 5400.5 will be used for materials (such



AREAS OF SOIL IDENTIFIED FOR REMEDIATION BASED ON CLEANUP CRITERIA

FIGURE 9-2

REPORT NO.: DOE/OR/21548-376	EXHIBIT NO.: A/CP/077/0893	
ORIGINATOR: JB	DRAWN BY: SRS	DATE: 8/23/93

TABLE 9-3 Estimated Radiological Risks for the Recreational Visitor, Ranger, and Resident Associated with the Soil Cleanup Criteria

Radionuclide/ Criterion[a]	Soil Concentration (pCi/g)[b]	Risk to Hypothetical Receptor		
		Recreational Visitor	Ranger	Resident
Ra-226				
Cleanup criteria	6.2	5×10^{-5}	8×10^{-4}	2×10^{-2}
ALARA goal	5	4×10^{-5}	6×10^{-4}	8×10^{-3}
Background	1.2	9×10^{-6}	2×10^{-4}	2×10^{-3}
Ra-228				
Cleanup criteria	6.2	2×10^{-5}	2×10^{-4}	1×10^{-3}
ALARA goal	5	1×10^{-5}	2×10^{-4}	8×10^{-4}
Background	1.2	3×10^{-6}	5×10^{-5}	2×10^{-4}
Th-230				
Cleanup criteria	6.2	3×10^{-7}	4×10^{-6}	8×10^{-6}
ALARA goal	5	2×10^{-7}	3×10^{-6}	6×10^{-6}
Background	1.2	6×10^{-8}	8×10^{-7}	2×10^{-6}
Th-232				
Cleanup criteria	6.2	2×10^{-6}	2×10^{-5}	4×10^{-5}
ALARA goal	5	1×10^{-6}	2×10^{-5}	3×10^{-5}
Background	1.2	3×10^{-7}	4×10^{-6}	7×10^{-6}
U-238				
Cleanup criteria	120	2×10^{-5}	2×10^{-4}	5×10^{-4}
ALARA goal	30	4×10^{-6}	5×10^{-5}	1×10^{-4}
Background	1.2	2×10^{-7}	3×10^{-6}	8×10^{-6}

(a) The radiological risks associated with all radionuclides in the U-238, U-235, and Th-232 decay series were included in the human health assessments. Cleanup criteria were developed for the five radionuclides listed in this table on the basis of a site-specific analysis of the relative concentrations of radionuclides present in site soil. The contributions of the other radionuclides in the three decay series are incorporated into the risk estimates reported for these five radionuclides, as described in Chapter 2 of the FS. Data for local background are presented for comparison; the background soil concentration of 1.2 pCi/g represents the average concentration measured for each of the listed radionuclides at off-site locations that have not been affected by site releases.

(b) The cleanup criteria for the individual radium and thorium isotopes represent the surface concentrations; the subsurface concentration is 16.2 pCi/g. The ALARA goal of 5 pCi/g applies to both surface and subsurface contamination. The listed cleanup criteria and ALARA goals for these individual isotopes include the background concentration of 1.2 pCi/g.

TABLE 9-4 Estimated Chemical Health Effects for the Recreational Visitor, Ranger, and Resident Associated with the Soil Cleanup Criteria

Chemical/ Criterion[b]	Soil Concentration (mg/kg)	Risk			Hazard Quotient[a]		
		Recreational Visitor	Ranger	Resident	Recreational Visitor	Ranger	Resident
Metals							
Arsenic							
Cleanup criterion	75	6×10^{-6}	7×10^{-5}	2×10^{-4}	0.02	0.3	0.9
ALARA goal	45	3×10^{-6}	3×10^{-5}	1×10^{-4}	0.01	0.2	0.5
Background	26	2×10^{-6}	2×10^{-5}	7×10^{-5}	0.008	0.1	0.3
Chromium (total)							
Cleanup criterion	110	NA[c]	NA	NA	0.03	0.6	1
ALARA goal	90	NA	NA	NA	0.02	0.4	0.8
Background	36	NA	NA	NA	0.01	0.1	0.3
Chromium (VI)							
Cleanup criterion	100	3×10^{-7}	6×10^{-6}	1×10^{-5}	0.03	0.6	1
ALARA goal	90	3×10^{-7}	5×10^{-6}	9×10^{-6}	0.02	0.4	0.8
Lead							
Cleanup criterion	450	–[d]	-	–	–	–	–
ALARA goal	240	-	-	-	–	–	–
Background	34	–	–	–	–	–	–
Thallium							
Cleanup criterion	20	NA	NA	NA	0.03	0.3	1
ALARA goal	16	NA	NA	NA	0.02	0.3	0.8
Background	16	NA	NA	NA	0.02	0.3	0.8
PAHs[e]							
Cleanup criterion	5.6	3×10^{-6}	3×10^{-5}	1×10^{-4}	0.00002	0.0002	0.0007
ALARA goal	0.44	2×10^{-7}	2×10^{-6}	8×10^{-6}	0.000001	0.00002	0.00005
PCBs[f]							
Cleanup criterion	8	2×10^{-6}	3×10^{-5}	1×10^{-4}	0.008	0.09	0.3
ALARA goal	0.65	2×10^{-7}	2×10^{-6}	8×10^{-6}	0.0006	0.008	0.02

TABLE 9-4 Estimated Chemical Health Effects for the Recreational Visitor, Ranger, and Resident Associated with the Soil Cleanup Criteria (Continued)

Chemical/ Criterion[b]	Soil Concentration (mg/kg)	Risk			Hazard Quotient[a]		
		Recreational Visitor	Ranger	Resident	Recreational Visitor	Ranger	Resident
Trinitrotoluene							
Cleanup criterion	140	2×10^{-7}	2×10^{-6}	7×10^{-6}	0.03	0.3	1
ALARA goal	14	2×10^{-8}	2×10^{-7}	7×10^{-7}	0.003	0.03	0.1

(a) The hazard quotient shown for each contaminant represents the sum of the contributions from inhalation and ingestion, as appropriate.

(b) The listed criteria and ALARA goals are for surface soil. Subsurface ALARA goals are the same as surface criteria (applied over a 10 ft depth). All values include background. Criteria for subsurface soil are 10 times the surface criteria. Data for local background are presented for comparison and to permit a determination of incremental risk for the listed criteria (for example, the incremental risk for the resident that corresponds to the arsenic cleanup target is 1×10^{-4}). For metals, the listed concentration represents the upper bound concentration (mean plus two standard deviations) measured at a nearby off-site area; no background concentration is listed for chromium (VI) because the soil samples were analyzed for total chromium (hexavalent chromium was assumed to be 10% of total chromium on the basis of limited site-specific data and general environmental data). No background concentration is listed for the organic compounds because they are not naturally present in soil. The cleanup criteria were determined from the site-specific risk assessment. Most ALARA goals are based on cleanup levels that had been proposed for soil in residential settings by the Missouri Department of Health in September 1992 but were subsequently withdrawn (a detailed description is presented in Section 2 of the FS document). Exceptions are chromium, arsenic, and thallium — for which the goals were determined from the site-specific risk assessment. For chromium, the concentrations in site soil are not expected to approach the State-proposed/withdrawn levels of 5,600 and 280 mg/kg for total and hexavalent chromium, respectively. The State-proposed/withdrawn levels for arsenic and thallium were 11 and 3.9 mg/kg, respectively, which are considerably below the local background concentrations.

(c) NA indicates that the entry is not applicable because the contaminant is not a carcinogen.

(d) A hyphen indicates that an EPA value is not available from which to quantify the risk or hazard quotient; instead the EPA has developed an uptake/biokinetic model for determining appropriate health-based levels. The cleanup criterion was determined by applying site-specific input to this EPA model; the ALARA goal was the State-proposed/withdrawn level for lead.

(e) The carcinogenic PAHs detected at the Weldon Spring site are benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, and indeno(1,2,3-cd)pyrene. The listed concentration represents the objective for each individual compound; where present together, the individual concentrations would be adjusted accordingly.

(f) Aroclor 1248, Aroclor 1254, and Aroclor 1260.

as metal scrap) with solid exterior surfaces. These criteria are compatible with standards used throughout the nuclear industry.

9.2.1 Radioactive Contaminants

Cleanup criteria for the radionuclides of concern at the Weldon Spring site — i.e., Ra-226, Ra-228, Th-230, Th-232, and U-238 — were determined from available standards and guidelines in combination with risk assessment information. These cleanup criteria address all radionuclides that may be present at the site, using results of a site-specific radionuclide source term analysis. The procedures used to develop these criteria are described in Section 2.2 and Section 2.4 of the FS. The criteria for Ra-226 and Ra-228 were adopted from EPA standards given in 40 CFR 192 that were determined to be relevant and appropriate to the conditions at the Weldon Spring site (see Section 10.2). Cleanup criteria for Th-230 and Th-232, which were adopted from DOE Order 5400.5, were included to protect from future exposures to Ra-226 and Ra-228 (and Rn-222 and Rn-220) as a result of radionuclide ingrowth. If both Th-230 and Ra-226, or both Th-232 and Ra-228, are present and not in secular equilibrium, the cleanup criteria apply for the radionuclide with the higher concentration. At locations where both Ra-226 and Ra-228 are present, the cleanup criteria of 5 pCi/g (above background) in the top 15 cm (6 in.) of soil, and 15 pCi/g (above background) in each 15-cm (6-in.) layer of soil more than 15 cm (6 in.) below the surface, applies to the sum of the concentrations of these two radionuclides. For U-238, no general standards are available. Hence, the cleanup criterion was developed on the basis of the site-specific risk assessment alone; this criterion is 120 pCi/g.

In accordance with the both the CERCLA process and DOE Order 5400.5, results of the site-specific risk assessment were then applied to determine the ALARA goals for each radionuclide. The ALARA goal represents the level that can reasonably be achieved during field implementation within existing constraints, as indicated by site-specific conditions. As discussed in Section 2 of the FS, the constraints for developing ALARA goals for radionuclides at the Weldon Spring site are the ability to measure the contaminants in the field, distinguish contamination from background, and verify that cleanup has been achieved. The ALARA goals for Ra-226, Ra-228, Th-230, and Th-232 at all depths are each 5 pCi/g, including background. As described above for the cleanup criteria, the ALARA goal for the radium isotopes applies to the sum of the concentrations of Ra-226 and Ra-228 at locations where both contaminants are present. For surface soil, the ALARA goal is 5 pCi/g combined, including background; for subsurface soil, the ALARA goal is 5 pCi/g combined, above background. The ALARA goal for U-238 at all depths is 30 pCi/g, including background.

9.2.2 Chemical Contaminants

The chemical contaminants of concern for which final cleanup criteria were developed are arsenic, chromium, lead, thallium, PAHs, PCBs, and TNT. Some ARAR and TBC information is available for lead and PCBs, and these standards and guidelines were used as the starting point to develop cleanup criteria, in combination with the site-specific risk assessments. For lead, the EPA has established interim guidance that considers the natural presence of lead in soil and recommends a cleanup level of 500 to 1000 mg/kg, as determined by site-specific conditions (EPA 1989a). The EPA has also developed an uptake/biokinetic model to estimate blood lead levels in children, who represent the most sensitive subpopulation for the residential scenario. The health-based criterion developed for lead on the basis of site-specific input to this model is 450 mg/kg.

For PCBs, regulations in the *Toxic Substances Control Act* that address cleanup of soil following a spill of PCB-contaminated material were considered relevant and appropriate to site conditions (see Section 10.2). The standard indicates that soil in areas of unrestricted access at which a spill occurs should be decontaminated to 10 mg/kg by weight, and this served as the starting point of the analysis. A health-based criterion of 8 mg/kg was determined on the basis of the risk assessment and other site-specific considerations, as discussed in Section 2.4.2.6 of the FS. ARARs are not currently available for the remaining chemical contaminants, so the cleanup criteria were developed solely on the basis of the site-specific risk assessments.

Cleanup criteria were developed for those contaminants at the Weldon Spring site that contribute significantly to site risks or hazard indexes on the basis of contaminant levels measured during extensive site characterization activities. Several nitroaromatic compounds — DNB, 2,4-DNT, 2,6-DNT, NB, TNB, and TNT — have been detected in site soil at a few discrete locations, but the results of the site-specific risk assessments indicate that the concentrations of these compounds are below levels of concern, except for TNT. For this reason, a final criterion has been developed only for TNT. For the remaining nitroaromatic compounds, the preliminary target levels presented in Section 2.5 of the FS will serve as the starting point for addressing these contaminants, if detected during field activities at levels higher than those currently identified in site characterization activities. Sampling during and after soil remediation will be conducted to ensure that residual risks associated with these compounds do not exceed the target range and that the hazard indexes are below 1 (see Section 4 of the *Proposed Plan* and Section 9.2.3 of this ROD).

Soil contamination at the Weldon Spring site is heterogeneous, i.e., contaminants are located in different combinations at different areas of the site. For the chemical contaminants, the areas that will be excavated were identified on the basis of actual measurements from the location-specific assessment and the results of the risk assessment (Figure 9-2). This risk-based approach allows the identification of areas for remediation resulting from the presence of multiple contaminants.

The concentration-based cleanup criteria were also developed from the site-specific risk assessment, considering information on the known patterns of contamination (Table 9-4). In general, the chemical contaminants contributing significantly to health effects near or above target levels are not present together; hence, additivity was generally not an issue in developing the cleanup criteria. The few areas at which multiple contaminants are present were identified for remediation on the basis of the location-specific risk assessment. However, to address the possibility that additional contaminant co-location may be found during field activities, lower ALARA goals were also established for all chemical contaminants. As indicated above, remediation of site soil will be designed to meet these ALARA goals. For lead, PAHs, PCBs, and TNT, the ALARA goals are the levels that had been proposed for statewide consideration by the Missouri Department of Health (1992) for soil in residential settings; the levels were withdrawn subsequent to the preparation of the FS. Many of these health-based levels were consistent with the ALARA process, so they have been retained. However, the draft State levels for arsenic and thallium were considerably below local background concentrations, and the levels for chromium were higher than those derived from the site-specific assessment. Hence, the draft State levels (subsequently withdrawn) were not adopted as ALARA goals for those three contaminants.

It is expected that contaminant levels remaining in soil across the site after remediation will range between the cleanup criteria and the ALARA goals, reaching the goals in most cases. Excavating soil to achieve these levels is expected to reduce risks to within or below the target risk range and to reduce hazard indexes below 1. Even lower criteria will be applied on a location-specific basis, if areas are identified during field work at which multiple contaminants are present. These criteria will be determined by combining the appropriate information from the target risk tables in Section 2.5 of the FS to ensure that health-protective concentrations have been achieved.

The cleanup criteria for chemical contaminants in subsurface soil at the site were addressed by separate analyses to ensure that levels remaining would be protective under future scenarios that could involve exposure to contaminants that are currently buried. For the purpose

of site cleanup, subsurface is defined as soil deeper than 15 cm (6 in.) below the surface. As discussed in Section 2.4.2 of the FS, the lower potential for exposures to subsurface material compared with surface material — i.e., from redistribution of this soil on the surface and leaching of contaminants to groundwater — resulted in the selection of subsurface criteria for chemicals that are 10 times the surface criteria. In no case will the subsurface residual levels exceed the subsurface cleanup criteria. The ALARA goals for subsurface soil are the same as the cleanup criteria for surface soil, averaged over a 3 m (10 ft) depth. The plans for site remediation will be designed to achieve subsurface ALARA goals. Thus, based on the known patterns and locations of contamination, subsurface cleanup is expected to attain the subsurface ALARA goals.

9.2.3 Post-Cleanup Assessment

Excavating soil to meet the cleanup targets for chemicals at the site would result in an incremental chemical risk at or below the EPA's target range for all scenarios, and the hazard index would be well below the level of concern. However, this is not the case for the radiological cleanup criteria, because incremental radiological risks exceed the target range at certain locations under a residential scenario. (The radiological risk at an uncontaminated area is about 3×10^{-3}, which indicates the difficulty in distinguishing an incremental risk of 1×10^{-4} from contamination versus natural variability.) Therefore, an additional "post-cleanup" assessment was conducted for the radionuclides. For this assessment, areas with soil concentrations that exceed the ALARA goals were assumed to be excavated and backfilled with uncontaminated soil from a nearby background area. The results of this evaluation were also used to assess compliance with environmental standards and guidelines.

Results indicate that the incremental radiological risk across the site for the resident, following soil excavation and backfill would range from 0 (i.e., background) to 6×10^{-3}, with a median of 8×10^{-6}. Locations where the risk would exceed 1×10^{-4} are generally those areas where the radium concentration in soil slightly exceeds the background concentration of 1.2 pCi/g; a small increment of 0.075 pCi/g corresponds to a risk of 1×10^{-4}. (This highlights the issue associated with meeting the EPA's target.) In addition, an annual dose of 25 mrem/yr above background could not be achieved for residential use at about 10% of the soil areas. The elevated risk estimates for those areas result almost entirely from exposures to the estimated levels of indoor radon, which would be generated by the residual radium in soil (entering through the basement or foundation slab). However, the target risk range was not specifically developed on the basis of exposures to radionuclides, and the EPA has separately identified an acceptable level for indoor radon of 4 pCi/L (EPA 1992a). The indoor radon concentrations

associated with the cleanup target and goal for radium are expected to be at or below this level at all site locations.

For outdoor air, the incremental radon concentration is estimated to be less than 0.1 pCi/L, and the annual dose from inhalation of airborne particulates generated from site soil is estimated to be less than 10 mrem/yr at all locations. Hence, standards for the radiological dose from exposure to outdoor air would be met by the cleanup targets for site soil. Potential leaching to groundwater, for radionuclides from soil, was also assessed for post-remedial action conditions to provide an initial indication of the potential impact to future receptors, in the event that groundwater in the shallow aquifer at the site was used for drinking. The results indicate that the proposed cleanup targets for soil are expected to be protective of groundwater. (This pathway will be evaluated further in the upcoming, final assessment of the chemical plant area.)

The incremental risk estimated for the ranger from sitewide exposures following remediation varies from 2×10^{-5} to 2×10^{-4}, with a median of 2×10^{-5}. The median and low end of the range are the same, because outdoor exposures from site-wide activities dominate the combined risk from indoor and outdoor exposures for this hypothetical receptor at most locations. For the recreational visitor, the incremental risk is estimated to be 7×10^{-6}. Thus, the incremental radiological risks associated with future recreational land use at the site are within the target range.

Following completion of site cleanup activities, an assessment of the residual risks based on actual site conditions, including measured concentrations of site contaminants, will be performed to determine the need for any future land use restrictions. This assessment will consider the presence of the on-site disposal cell, the buffer zone, the adjacent Army site, and any other relevant factors necessary to ensure that appropriate measures are taken to protect human health and the environment for the long term. The remedy selected in this ROD will be re-examined at least every five years to ensure that it is protective.

10 STATUTORY DETERMINATIONS

In accordance with the statutory requirements of Section 121 of the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA), as amended, remedial actions shall be selected that:

- Are protective of human health and the environment.
- Comply with applicable or relevant and appropriate requirements (ARARs).
- Are cost effective.
- Utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.
- Satisfy the preference for treatment which, as a principle element, reduces toxicity, mobility, or volume.

The manner in which the Weldon Spring Chemical Plant remedial action satisfies these five requirements is discussed in the following sections.

10.1 Protection of Human Health and the Environment

The selected remedy is protective of human health and the environment by (1) removing the sources of contamination, (2) treating the materials giving rise to the principal threats at the site to reduce contaminant mobility, and (3) containing treated and untreated materials in an engineered disposal facility designed to prevent migration of contaminants into the environment. The contingency remedy would also be protective of human health and the environment for the same reasons, with additional protection provided by treating contaminated materials to reduce toxicity and volume.

10.2 Compliance with Applicable or Relevant and Appropriate Requirements

Both the selected remedy and the contingency remedy will comply with ARARs, unless those requirements have been properly waived in accordance with CERCLA, and will be performed in accordance with all pertinent U.S. Department of Energy (DOE) Orders. The ARARs are presented below according to location-specific, contaminant-specific, and action-

specific requirements. Removal, treatment, transportation, and disposal of the contaminated material for both the selected remedy and the contingency remedy are on-site actions and must comply with the substantive requirements of Federal and State environmental laws that are ARARs.

ARAR waivers that are appropriate to this action are discussed in the following sections.

10.2.1 Location-Specific ARARs

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in a specific location. The analysis of location-specific ARARs included a review of the *Resource Conservation and Recovery Act* (RCRA), the Missouri Hazardous Waste Management Laws, the *Antiquities Act*, the *Historic Sites Act*, the *National Historic Preservation Act*, the *Archeological and Historic Preservation Act*, the *Archeological Resources Protection Act*, the *Endangered Species Act*, the Missouri Wildlife Code, the *Fish and Wildlife Coordination Act*, the *Clean Water Act* (CWA), and the *Farmland Protection Policy Act*.

Federal Executive Order 11988 and Missouri Governor's Executive Order 82-19 require that adverse impacts associated with activities in a floodplain be avoided to the maximum extent practicable. These requirements are considered applicable to the Weldon Spring remedial action. It is noted, however, that a portion of the Schote Creek 100-year floodplain extends onto the site in an area where excavation of contaminated soil is planned. The excavation of these materials will not increase the potential for off-site transport due to flooding; in fact, these remedial actions will result in the removal of these materials from within the 100-year floodplain.

No long-term impacts to flood storage capacity are anticipated from the remediation of the Ash Pond drainage and vicinity property A6. Potential short-term impacts, resulting primarily from vegetation clearing and excavation activities, would be mitigated by using good engineering practices and implementing the following mitigative measures: (1) erosion and sediment control measures, such as berms and silt fences, will be used during all excavation, fill, and contouring activities; contaminated soil and sediment will be excavated only when the Ash Pond drainage channel is dry; only clean fill will be used; excavated areas will be filled as soon as practicable after excavation and graded to original contours as much as possible; and revegetation activities will be implemented as soon as possible following recontouring of the refilled areas.

Executive Order 11990 requires Federal agencies to avoid, to the extent possible, any adverse impacts to wetland areas. This order is considered applicable since there are several areas on site (such as the pits) that are considered wetlands. There is no practicable alternative but to remove the contaminated material from these areas. The potential off-site soil borrow area also contains wetlands. Mitigative measures are being coordinated with the State of Missouri and will be defined in the mitigation action plan. A *Clean Water Act* Section 404 permit will be obtained from the U.S. Army Corps of Engineeers due to activities that may impact the wetland at the borrow area.

The DOE has initiated consultations with the U.S. Fish and Wildlife Service (FWS) regarding the need for mitigation of the on-site wetlands that would be lost as a result of remedial activities at the site. The FWS has recommended that the DOE consider wetland creation as a means of mitigating the wetlands loss. The DOE has initiated surveys of wetlands that could be affected by site activities to document their size, type, and biotic composition. Upon completion of these surveys and additional consultations with the FWS and the Missouri Department of Conservation, the DOE will develop a wetlands mitigation plan for the site that is expected to include wetlands creation. Mitigative measures will be taken at the off-site borrow area, such as contouring to ensure that downgradient wetlands are not indirectly impacted.

The *Farmland Protection Policy Act* (7 CFR 658; 40 CFR 6.302[c]) requires Federal agencies to assess the adverse impacts of Federal programs on farmland preservation and to consider alternative actions to lessen the adverse effects. This requirement is considered applicable for the potential off-site soil borrow area, as the borrow area has been classified as prime or unique farmland. A separate environmental assessment is planned for the borrow area to assess possible environmental impacts. Mitigation measures and restoration activities would be conducted at the off-site borrow area, as necessary, to minimize any adverse impacts to farmland.

Because the potential soil borrow area is off site, the requirements, including administrative requirements, of the following acts are applicable: the *Archaeological and Historic Preservation Act*, the *Archaeological Resources Protection Act*, and Section 404 of the *Clean Water Act*. The *Archaeological and Historic Preservation Act* requires that data recovery and preservation activities be conducted if prehistoric, historical, and archaeological data might be destroyed as a result of a Federal activity. A permit is required for excavation or removal of any archaeological resources on Federal lands under the *Archaeological Resources Protection Act*. Studies are being performed to determine if any archaeological sites or resources will be

affected in the borrow area, and whether any resources would be removed before soil is excavated. A permit would be obtained for removal of any archaeological resources in the borrow area.

Location standards are specified under RCRA (40 CFR 264.18) that address the siting of new hazardous waste treatment, storage, and disposal facilities. These requirements are considered to be applicable to the siting of the treatment facility (chemical stabilization/ solidification or vitrification), since the unit is expected to treat hazardous wastes. However, the treatment process will render the characteristic wastes nonhazardous; therefore, these standards are not applicable to the disposal facility. No listed wastes will be managed in the treatment system or the disposal facility. Certain of these requirements, as well as the companion requirements in the Missouri Hazardous Waste Management Laws, may be relevant and appropriate to the disposal facility as described below:

- Regulation 40 CFR 264.18(a) restricts locating hazardous waste management facilities within 200 ft of a fault that has been displaced in Holocene time. This requirement is intended to minimize the chances of a catastrophic failure resulting from an earthquake and is both relevant and appropriate to the disposal facility due to sufficient similarity of wastes and the purpose of the requirements.

- Regulation 40 CFR 264.18(b) restricts locating hazardous waste management facilities within a 100-year floodplain. This requirement is intended to prevent the spreading of contaminants during extreme flooding conditions and is both relevant and appropriate to the disposal facility due to sufficient similarity of wastes and the purpose of the requirements.

- Regulation 10 CSR 25-7.264(2)(N)1.A provides siting criteria for new hazardous waste landfills that identify a requirement for 9 m (30 ft) of soil or other material with a permeability of 1 x 10-7 cm/s or an equivalent protection based on at least 6 m (20 ft) of naturally occurring material for a landfill that receives only waste generated by its operator. Site characterization has demonstrated that present site conditions will meet the above criteria and it is, therefore, reasonable that such conditions be retained. An explanation is presented below on how this condition will be retained once the disposal cell is constructed.

The on-site disposal facility will be constructed and maintained to provide equivalent protection. Much of the site overburden has already been considerably disturbed as a result of

the extensive excavation, backfilling, and regrading activities that were conducted during plant construction many years ago. Thus, the existing overburden material, although naturally occurring, will not be the original, in-place material at the site. Therefore, the soil beneath the cell will be compacted to achieve a permeability at least as low a 1 x 10-7 cm/s over a depth of 6 m (20 ft). Compaction and permeability criteria are based on data collected during field permeability testing of in situ site soils using a two-stage borehole (TSB) procedure. As determined in the TSB testing, travel time and permittivity calculations were used to demonstrate that the soil units (Ferrelview Formation and clay till) comprising the foundation of the disposal facility will provide a level of protection superior to the State requirement 10 CSR 25-7.264(2)(N)1.A. The tests also determined that the soil units will satisfy the minimum soil performance requirement relative to the movement of hazardous constituents.

The intent of the overburden requirement is to provide a material that would retard contaminant migration so that groundwater would be protected from any impacts that could result from future leaching. The overburden soil, as explained above, will meet or exceed the permeability of 1 x 10-7. Other protective factors to groundwater include the cell components (i.e., the cover and liner) which will be engineered to limit infiltration and ensure that cell performance can be monitored, and post-closure monitoring which will detect any potential lapses in the integrity of the disposal cell facility.

- Regulation 10 CSR 25-7.264(2)(N)1.A(IV)(e) provides siting criteria for hazardous waste landfills which restrict locating new facilities in an area subject to catastrophic collapse. This requirement is intended to ensure long-term protection and is both relevant and appropriate to this action due to sufficient similarity of the regulated conditions. Previous studies have identified an area within the site boundary that complies with this standard. The cell will be located such that all waste materials are kept within that area. These studies are detailed in the *Site Suitability Data Report* (MKF and JEG 1991).

- Regulation 10 CSR 25-7.264(2)(N)2.D provides siting criteria for hazardous waste landfills which specify a 91 m (300 ft) buffer zone between the property line of the disposal facility and the actual landfill. The buffer zone provides an area which will be used only for monitoring and maintenance activities. This regulation is considered relevant and appropriate as discussed in Section 10.2.3.4.

In addition, Missouri Solid Waste Management Law 10 CSR 80-3.010(5)(C)(2) specifies a buffer zone of 50 ft (15 m) for landfills units. This regulation is considered relevant and appropriate as discussed in Section 10.2.3.4.

The proposed action will not impact historic, archeological, or cultural resources, sensitive ecosystems, or any threatened or endangered species.

As determined in the *Feasibility Study* (FS) (DOE 1992d), no other location-specific requirements were found to be either applicable or relevant and appropriate.

10.2.2 Contaminant-Specific ARARs

Contaminant-specific ARARs are health- or risk-based numerical values that establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the environment. Contaminant-specific ARARs were analyzed to identify each environmental law or regulation pertinent to the types of contaminants that will be encountered during the remedial action. This analysis included a review of the health and environmental protection standards for Uranium and Thorium Mill Tailings Actions (UMTRA), the *Resource Conservation and Recovery Act* (RCRA), the Missouri Radiation Regulations, the *National Emission Standards for Hazardous Air Pollutants* (NESHAP), the *Clean Air Act*, the Missouri Air Quality Standards, the Missouri Air Pollution Control Regulations, the *Toxic Substance Control Act* (TSCA), and the *Clean Water Act*. Several of the following standards were incorporated into the determination of cleanup criteria for contaminated soil at the Weldon Spring site (as explained in Section 2 of the FS).

NESHAP requirements for radionuclides (given in 40 CFR 61 Subparts H and Q) and asbestos (given in Subpart M) are applicable to the protection of the public during implementation of the remedial action. The NESHAP requirement for Rn-222 emissions (Subpart T) are relevant and appropriate as the site contains material sufficiently similar to uranium mill tailings, and the release requirements are well suited to final site conditions.

The NESHAP standards in 40 CFR 61 Subpart N set forth requirements for arsenic emissions. While this requirement is not considered a ARAR, because glass manufacturing is not part of the remedial action and commercial arsenic would not be used as a raw material, the requirement will be addressed in controlling emissions during implementation.

State air-quality standards found in 10 CSR 10-5.180, particulate standards for internal combustion engines, and 10 CSR 10-6.170, restriction of particulate matter to the ambient air are applicable to the implementation phase (including the excavation of borrow material) and will be met.

UMTRA 40 CFR 192.32(b)(1)(ii) addresses releases of radon from disposal areas after the closure period. These standards will be applicable after the bulk wastes have been placed in the disposal facility and the cover has been completed. At that time, the disposal area will meet the Rn-222 flux standards specified in 40 CFR 192.32(b)(1)(ii). These standards require reasonable assurance that Rn-222 releases will not exceed an average release rate of 20 pCi/m^2 sec.

Regulation 40 CFR 192, Subpart B addresses residual concentration levels of Ra-226 in soil. Residual levels should not exceed background 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, averaged over an area of 100 m^2. This standard applies to residual radium in soil at designated uranium processing sites. Because the Weldon Spring site is not a designated site, the standard is not applicable to this remedial action. However, it is relevant and appropriate because the contamination patterns at the Weldon Spring site are similar to those at the mill tailings sites. That is, there are no large volumes of subsurface radium-contaminated material with concentrations between 5 pCi/g and 15 pCi/g.

Regulation 40 CFR 192, Subpart E, specifies annual dose equivalent exposures to uranium and thorium by-product material as a result of planned discharges of radioactive material to the general environment. While the remedial action does not include a planned discharge of radioactive material, the requirements are relevant and appropriate to protection of the public during implementation of the action because the waste types are considered sufficiently similar. Subpart E also provides residual concentration limits for Ra-228 in soil. These levels, which are numerically identical to those given in Subpart B for Ra-226, are considered to be relevant and appropriate to site conditions for the same reasons as described above.

The State quarterly Rn-222 limit of 1 x 10^{-9} μCi/ml (1 pCi/l) above background in uncontrolled areas published in 19 CSR 20-10.040, *Missouri Radiation Regulations*, cannot be achieved during implementation of this action. It is possible that activities might result in temporary exceedances of the standard during the cleanup period. These activities are intermediate in nature, and are part of an overall remedial action that would attain compliance

with this standard upon completion. Protection will be achieved by limiting exposure to workers. Because compliance with the requirement during remedial implementation is technically impracticable, this standard is waived under the provisions of Section 121(d)(4)(C) of the CERCLA during implementation: compliance with such requirements is technically impracticable from an engineering perspective.

Regulation 19 CSR 20-10.040 also specifies maximum permissible exposure limits for persons outside a controlled area. This requirement is applicable to the protection of the public during the implementation phase and will be met.

Regulation 40 CFR 261 includes levels for identification of hazardous wastes which are subject to hazardous waste regulations. Regulation 40 CFR 268 outlines the treatment standards for wastes restricted from land disposal. These regulations are applicable to the identification and disposal of listed or characteristic hazardous wastes.

Regulation 40 CFR 761, Subpart G deals with spills of materials contaminated with greater than 50 ppm polychlorinated biphenyls (PCBs). The standard specifies a soil decontamination level of 10 ppm PCBs. While any spills at the site would have preceded the effective date of the regulations, the recommended level of 10 ppm by weight was considered in developing cleanup criteria for PCBs in site soil.

If the vitrification alternative were to be implemented, the following standards would also be relevant and appropriate. Missouri air quality standards (10 CSR 10-6.060) specify *de minimus* emission levels for specific pollutants that the vitrification system would have to meet. Regulation 10 CSR 10-5.030 places restrictions on emissions of particulate matter from fuel-burning equipment used for indirect heating. While such equipment would be used for direct heating of wastes in the vitrification system, this requirement would be relevant and appropriate based upon similarity of conditions.

10.2.3 Action-Specific ARARs

Action-specific ARARs are technology- or activity-based requirements or limitations on actions taken that are triggered by the particular remedial activities selected to accomplish the remedy. The analysis of action-specific ARARs addressed the following tasks for the selected remedy:

- *Storage.* Various contaminated materials are currently in storage at the chemical plant area as a result of interim response actions.

- *Excavation.* Removal of the contaminated sludge, soil, sediment, and vegetation from the chemical plant area and vicinity properties, and removal of the quarry bulk wastes and structural materials from the temporary storage areas at the chemical plant area.

- *Treatment.* Treatment of the raffinate-pit sludge and some soil and sediment by chemical stabilization/solidification and the structural materials by size/volume reduction.

- *Disposal.* Placement of all treated and untreated materials in an engineered disposal facility on site.

The analysis of action-specific ARARs for the contingency remedy addressed the same tasks, except that the treatment method for the sludge and soil was vitrification.

The ARARs for these activities are discussed in Sections 10.2.3.1 through 10.2.3.4.

10.2.3.1 Storage. As interim response actions prior to implementation of the final remedy, various wastes have been collected and placed in storage to prevent potential releases into the environment. Containerized chemical wastes (including PCB containerized waste) are stored in Building 434, and quarry bulk wastes will be stored at the TSA prior to placement in the on-site disposal facility. Building 434 contains approximately 2,500 drums of containerized wastes. It is estimated that 20% of the drums contain RCRA characteristic wastes, which includes approximately 190 drums of tributyl phosphate (TBP) waste. The TBP, which contains PCBs, mercury, uranium, and thorium, is being stored in Building 434 on an interim basis until proper treatment and disposal is determined. All RCRA and TSCA wastes are being stored in accordance with the RCRA and TSCA regulations (e.g., labeling, adequate roof and walls), with the exception of the storage limitation requirement discussed below. At the present time, no off-site treatment and disposal facilities have been identified that can or will accept the Weldon Spring site mixed waste. State and Federal ARARs that regulate the storage and management of these wastes are discussed below.

The facilities that manage or store RCRA wastes, or were designed to meet RCRA standards, will be closed in accordance with the substantive RCRA requirements (40 CFR 264,

Subpart G). The RCRA requirements are applicable to the following facilities as they are used to treat, store, or dispose of RCRA wastes or were designed in accordance with RCRA requirements and were constructed after 1980: the chemical plant and quarry water treatment plant equalization basins; the temporary storage area; Building 434; and the chemical stabilization/solidification facility.

The Land Disposal Restrictions (LDRs) specified under RCRA prohibit the storage of restricted wastes (40 CFR 268 Subpart E) unless storage is solely for the purpose of accumulating sufficient quantities of wastes to facilitate proper treatment, recovery, or disposal. The EPA has issued two guidance documents that address the application of the LDR storage prohibitions to cleanup actions:

- Overview of the RCRA LDRs, Office of Solid Waste and Emergency Response (OSWER) Directive 9347.3-01FS, July 1989.

- Guide to Management of Investigation-Derived Wastes, OSWER Publication 9345.3-03FS, April 1992.

Both documents recognize that LDR wastes may be generated during cleanup actions and stored pending selection and implementation of the final remedy, and state that such storage is allowable under the LDR storage prohibition. Therefore, the limitations on storage time are waived under the provisions of Section 121(d)(4)(C) of CERCLA: compliance with such requirements is technically impracticable from an engineering perspective.

Management of the quarry bulk wastes to be stored at the TSA is required to meet the NESHAP requirements for asbestos (40 CFR 61, Subpart M) as defined in the *Record of Decision* (ROD) for that action. During bulk waste removal, it is planned to place large asbestos-containing material (ACM) pieces (larger than 0.6 m x 0.6 m x 0.05 m [2 ft x 2 ft x 2 in.]) in appropriate bags and to place the bags in wind-tight, leak-tight metal boxes which will be transported to the asbestos storage area. Small pieces of asbestos, however, will be handled with the fine-grained soils. These small pieces that cannot practically be removed will be placed with the fine-grained soils at the TSA. This pile will be covered or sprayed with a foam to provide a wind-tight seal.

The smaller pieces that cannot be removed safely will not be segregated from the soil. Segregation is not technically feasible and could potentially increase exposure to personnel. Therefore, under this action, as this material is removed from the TSA, the NESHAP

requirements are waived under the provisions of Section 121(d)(4)(B) of CERCLA: compliance with the requirement will result in greater risk to human health and the environment than the action that is proposed.

In accordance with the Missouri State Code of Regulations 10 CSR 25.5-262(2)(C)1, hazardous wastes stored prior to off-site shipment shall be in compliance with the packaging, marking, and labeling requirements of the Department of Transportation (DOT) regulations delineated in 49 CFR during the entire on-site storage period. The wastes stored on site are packaged, labeled, and marked in accordance with the regulations effective at the time of containerization. Recently promulgated and future changes to the DOT regulations could greatly impact the operation of the on-site storage area by requiring a large quantity of containers to be repackaged (relabeling and remarking are administrative requirements). Continuing the efforts to maintain compliance with the transportation requirements for storage is not merited, primarily because these materials are not expected to be transported off site in the near term. Also, repackaging the waste in accordance with new DOT requirements (HM-181) could result in unnecessary personnel exposure. Prior to off-site shipment, the wastes will be re-packaged in accordance with applicable DOT requirements; therefore, the regulation 10 CSR 25.5-262(2)(C)1 is waived under provisions of Section 121(d)(4)(A) and Section 121(d)(4)(B) of CERCLA: the alternative is an interim measure and will become part of a total remedial action that will attain the applicable or relevant and appropriate Federal or State requirement and compliance with the requirement will result in greater risk to human health and the environment than the action that is proposed.

Regulation 40 CFR 761.65(a) requires that any PCB article or container be removed from storage and disposed of within one year from the date when it was first placed in storage. Under this action, PCB wastes will be stored in an adequate PCB storage facility (meeting the requirements of 40 CFR 761.65[b]) until final disposition of the PCB wastes can be accomplished. This requirement is waived under provisions of Section 121(d)(4)(A) of the CERCLA: this component is an interim measure and will become a part of a total remedial action that will attain the applicable or relevant and appropriate Federal or State requirement. This requirement could also be waived on the basis of impracticability since the PCB-contaminated waste is also radioactively contaminated and a disposal facility is not currently available for this type of waste.

10.2.3.2 Excavation. Excavation of contaminated areas will include removal of the contaminated sludge, soil, sediment, and vegetation from the chemical plant area and vicinity

properties, and removal of the quarry bulk wastes and structural materials from the TSA at the chemical plant area.

Although most of the raffinate pit sludge does not exhibit RCRA characteristics, certain isolated pockets of the raffinate pit sludge have failed the TCLP test. Since it does not appear to be feasible to excavate the sludge in a manner that would separate the RCRA pockets from the non-RCRA material, the raffinate pit sludge will be managed as a characteristic waste for treatment purposes. After the raffinate pit sludge is removed, the clay bottom and soils beneath will be excavated to the soil cleanup criteria defined in Section 9.2. If the clay bottom and soils are determined to be characteristic hazardous waste, they will be treated in the CSS treatment plant. Other soil, sediments, past dump and spill areas are not considered RCRA wastes. These areas will be excavated to the extent of contamination, verified "clean" based upon the cleanup criteria and backfilled with uncontaminated soils.

The LDRs (40 CFR 268 Subpart C) place specific restrictions (e.g., treatment of waste to concentration levels) on characteristic RCRA hazardous waste prior to its placement in land disposal units. Certain activities carried out under the remedial action may constitute placement; for example, placing sludge or sediment into a sedimentation tank and then redepositing the material back into the source area, or the movement of waste from one on-site area to another prior to treatment. These wastes will eventually be treated to the applicable specified treatment standards prior to placement in the disposal cell. Therefore, the LDRs are waived for these actions under the provisions of Section 121(d)(4)(A) of CERCLA; i.e., the alternative is an interim measure and will become part of a total remedial action that will attain the applicable or relevant Federal or State requirement.

10.2.3.3 Treatment. For the selected remedy, the hazardous waste treatment requirements specified in 40 CFR 264 and 10 CSR 25-7.264 are applicable. These include general facility standards, preparedness and prevention standards, and standards for closure upon completion of the remedial action. All treated material must pass the toxicity characteristic leachate procedure (TCLP) test which will ensure adequate treatment. In addition, 40 CFR 264, Subpart X requirements for miscellaneous units are also applicable.

The LDRs (40 CFR 268 Subpart D) specify treatment standards which must be attained before LDR wastes or treatment residuals may be land disposed. LDR wastes fall into one of two categories; those wastes subject to concentration-based treatment standards (described in 40 CFR 268.43), and those wastes subject to specific technology treatment standards (described in 40 CFR 268.42). Compliance with a concentration-based treatment standard requires only

that the treatment level be achieved. Once achieved, the waste may be land disposed. Most of the LDR wastes generated and stored at the Weldon Spring Site Remedial Action Project (WSSRAP) are subject to concentration-based treatment standards. These standards will be attained prior to land disposal.

The second type of treatment standard is based on the use of a specified technology. In these circumstances, a specific technology is required for the wastes, and as long as the wastes are treated by this technology, the treatment residuals are assumed to meet the treatment standards. Technologies other than those specified may be used to treat wastes subject to this type of treatment standard; however, it must be demonstrated to the appropriate regulatory agency that the alternative treatment method can achieve a measure of performance equivalent to that achievable by the specified technology. A limited amount of LDR wastes at the WSSRAP is subject to specified technology treatment standards. Given the limited national capacity for managing mixed waste, the specified technology may not be available.

A comprehensive site treatment plan as required by the *Federal Facilities Compliance Act* (FFCA), will be developed and implemented to evaluate and verify specified and alternative treatment technologies for the WSSRAP waste types. The plan will be consistent with the overall remedial action as controlled by the CERCLA process.

If it is determined that the specified technology treatment is not available for the LDR waste, the alternative treatment method would be implemented. In this case, the LDR treatment standard is waived under the provisions of CERCLA 121(d) (4) (D); however, the alternative must attain a standard of performance equivalent to that required under the specified technology treatment standard. The effectiveness of the alternative technologies will be demonstrated by TCLP assurance testing prior to disposal. WSSRAP waste types and specified and alternative treatment technologies as described in the LDR standards are listed below:

1. TYPE OF WASTE: D001-High Total Organic Carbon (TOC) Non-wastewater
   SPECIFIED TECHNOLOGY: Incineration, fuel substitution, or recovery
   ALTERNATIVE TECHNOLOGY: Oxidation

2. TYPE OF WASTE: California List-Liquid hazardous wastes containing greater than or equal to 50 ppm PCBs
   SPECIFIED TECHNOLOGY: Incineration in accordance with 40 CFR 761.70 or burning in a high efficiency boiler in accordance with 40 CFR 761.60
   ALTERNATIVE TECHNOLOGY: Oxidation followed by stabilization

3. TYPE OF WASTE: D008-Lead Batteries
   SPECIFIED TECHNOLOGY: Thermal recovery in a lead smelter
   ALTERNATIVE TECHNOLOGY: Stabilization

4. TYPE OF WASTE: D008-Radioactive Lead Solids
   SPECIFIED TECHNOLOGY: Macroencapsulation
   ALTERNATIVE TECHNOLOGY: Stabilization

5. TYPE OF WASTE: D009-Elemental Mercury Contaminated with Radioactive Materials
   SPECIFIED TECHNOLOGY: Amalgamation
   ALTERNATIVE TECHNOLOGY: Amalgamation followed by stabilization

The Best Demonstrated Available Technology (BDAT) for D008-non-wastewater wastes that are subject to a concentration-based treatment standard is stabilization.

Compliance with ARARs for the contingency (vitrification) remedy would be similar to that identified above, except that additional emission regulations requirements would be relevant and appropriate to the off gas from the vitrification facility. These requirements include Missouri air pollution control regulations for maximum allowable emissions of particulate matter from fuel-burning equipment used for indirect heating, restrictions for emissions of visible air contaminants, and restriction for emissions of particulate matter from industrial processes. State ambient air quality standards are also considered relevant and appropriate for Alternative 7a, insofar as the vitrification process would have a potential to emit pollutants above the *de minimus* emission levels specified in these regulations. Emission requirements for hazardous waste incineration under RCRA, as well as emission requirements for burning hazardous waste in boilers or industrial furnaces, are also relevant and appropriate for treatment of characteristic waste, because vitrification is considered similar to an industrial furnace (melting furnace). The substantive requirements will be met with emissions from the vitrification unit; however, actual permits are not required since this is an on-site CERCLA action.

10.2.3.4 Disposal. The primary environmental regulations that pertain to the design and operation of a newly constructed disposal facility are the *Solid Waste Disposal Act*, the RCRA, the TSCA, the Missouri hazardous and solid waste management laws, and the UMTRA. None of these regulations are applicable to the combination of wastes to be disposed of; however, aspects from each may be relevant and appropriate to activities included in the design,

TABLE 10-1 Disposal Facility Design ARARs

	Solid Waste Disposal Act (SWDA)	Resource Conservation and Recovery Act (RCRA)	Toxic Substances Control Act (TSCA)	Missouri Code of State Regulations Hazardous Waste	Missouri Code of State Regulations Solid Waste	Uranium Mill Tailings Radiation Control Act (UMTRCA)
Location		(a) 40 CFR 264.18(a) (a) 40 CFR 264.18(b)		(b) 10 CSR 25-7.264(2)(N)1.A(III)(a) (c) 10 CSR 25-7.264(2)(N)1.A(IV)(b) (c) 10 CSR 25-7.264(2)(N)1.A(IV)(c) (e) 10 CSR 25-7.264(2)(N)1.A(IV)(e)		
Buffer Zone				(e) 10 CSR 25-7.264(2)(N)2.D	(e) 10 CSR 80-3.010(5)(C)(2)	
Cover	(d) 40 CFR 241.209-1	(b) 40 CFR 264.310(a)			(d) 10 CSR 80-3.010(13)(A) (d) 10 CSR 80-3.010(13)(B)	(e) 40 CFR 192.32(b)(1)(ii)
Liners		(e) 40 CFR 264.301(c)(1)	(e) 40 CFR 761.75(b)(2)	(c) 10 CSR 25-7.264(2)(N)2.A	(c) 10 CSR 80-3.010(7)(B)1.(G)	

TABLE 10-1 Disposal Facility Design ARARs (Continued)

	Solid Waste Disposal Act (SWDA)	Resource Conservation and Recovery Act (RCRA)	Toxic Substances Control Act (TSCA)	Missouri Code of State Regulations Hazardous Waste	Missouri Code of State Regulations Solid Waste	Uranium Mill Tailings Radiation Control Act (UMTRCA)
Leachate Collection Systems	(a) 40 CFR 241.204-3(c)	(a) 40 CFR 264.301(c)(2) (a) 40 CFR 264.301(c)(3)	(a) 40 CFR 761.75(b)(7)	(b) 10 CSR 25-7.264(2)(N)2.A(I) (b) 10 CSR 25-7.264(2)(N)2.A(II) (b) 10 CSR 25-7.264(2)(N)2.A(III)	(c) 10 CSR 80-3.010(7)(B)1.(F)	
Groundwater Monitoring		(a) 40 CFR 264.310(b)(3) (a) 40 CFR 264 Subpart F	(a) 40 CFR 761.75(b)(6)(ii)	(a) 10 CSR 25-7.264(2)(f)	(b) 10 CSR 80-3.010(8)	
Post-Closure Monitoring and Maintenance		(a) 40 CFR 264.310 (a) 40 CFR 264.111 (a) 40 CFR 264.117		(c) 10 CSR 25-7.264(G)		(a) 40 CFR 192.32(b)(1) (a) 40 CFR 192.32(b)(1)(i)

(a) Relevant and appropriate due to purpose or actions regulated by the requirement.

(b) Relevant as requirement addresses a similar situation.

(c) Similar to or more stringent than Federal regulation.

(d) Neither relevant nor appropriate as requirement is less stringent than other requirements.

(e) Neither relevant nor appropriate due to hydrologic conditions of the site.

construction, and operation of the disposal facility. Table 10-1 shows the various requirements from each of these regulations and establishes whether it is relevant or appropriate and the rationale for the determination. Many requirements within the various regulations are similar or redundant and, in such an instance, the requirement that is considered more stringent is designated.

Although RCRA hazardous wastes regulations would be applicable to the excavation and treatment of hazardous wastes, the successful treatment to below RCRA characteristic levels would relieve these same wastes from any further jurisdiction as hazardous. While the RCRA requirements are not considered to be applicable to disposal operations, many are considered to be relevant and appropriate based primarily on the purpose of the requirements and the nature of the actions. The disposal facility shall comply with the substantive requirements of the TSCA with the exception of 40 CFR 761.75(b)(3). This requirement states the bottom landfill liner system or natural in-place soil barrier shall be at least 50 ft (17 m) from the historical high-water table. The volumes of TSCA wastes are expected to be limited, and any wastes containing greater than 50 ppm of PCBs will either be managed separately or the above requirement will be waived to allow disposal in the cell. This waiver is justified under the provisions of CERCLA 121(d)(4)(D), which states that the alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach. Consequently, the RCRA requirements and the UMTRA requirements, which regulate the disposal of low-level radioactive wastes, are the primary ARARs for cell construction and operation activities.

For purposes of analysis, the disposal requirements of these laws and their corresponding regulations can be grouped into the following categories: buffer-zone requirements, siting requirements, cover requirements, liner/leachate collection system requirements, and monitoring requirements.

As there are no buffer-zone requirements in the Federal regulations, the State of Missouri solid waste and hazardous waste regulations were reviewed for applicability or relevance and appropriateness to the on-site disposal facility. The Missouri solid waste regulation for a buffer zone (10 CSR 80-3.010[5][C][2]) requires a buffer zone of 15 m (50 ft) between the disposal facility and the property boundary. Given the nature of the site wastes, the need for monitoring and maintenance, and the impact on the integrity of the disposal facility, the Missouri solid waste requirement of a 15 m (50 ft) buffer zone is considered relevant and appropriate.

The Missouri hazardous waste regulation (10 CSR 25-7.264[2][N]2.D) specifies a 91 m (300 ft) buffer zone between the disposal facility and the property boundary. The Missouri Hazardous Waste requirement of a 91 m (300 ft) buffer zone is not applicable but is relevant and appropriate.

The intent of the buffer zone, in addition to ensuring that the public will not come in contact with the facility or its contents, is to allow adequate easement for operations, maintenance, and monitoring. Assuming a typical side slope of 3:1 for the covering of the waste cell, the buffer zone between the toe of the 3:1 dike (the area where the side slope meets the ground) and the property boundary will be at least 91 m (300 ft). However, for greater long-term integrity of the facility and enhancement of cell stability, additional clean-fill-dike material will be utilized at a flatter 5:1 slope. This extra clean-fill dike will not impinge on any operations, maintenance or monitoring of the disposal facility, and will provide better protection to the public.

In addition, in an effort to provide an additional safeguard, the DOE will attempt to acquire a small parcel of adjacent land from the Missouri Department of Conservation to extend the buffer zone to the degree practicable.

Siting. Siting criteria are discussed in the analysis of location-specific ARARs.

Cover. Requirements are specified in the various laws for disposal facility covers. As discussed above, the optimal cover, on the basis of the wastes to be disposed of, is a hybrid cover that consists of the major features of a RCRA cover plus the features of an UMTRA cover aimed at long-term control of radon. The UMTRA standard in 40 CFR 192.32(b)(1) refers to the RCRA closure standard in 40 CFR 264.111 for nonradiological hazards. The UMTRA requirements in 40 CFR Part 192, Subpart D (which limit releases of Rn-222 so as not to exceed 20 pCi/m^{2}s and which specify that the cover be effective for 1,000 years to the extent reasonably achievable, and in any case, for at least 200 years), are applicable because these requirements address by-product wastes as defined in the regulations. The RCRA design requirements in 40 CFR 264.310(a) are relevant and appropriate because they address similar actions.

Liner/Leachate Collection System. Design standards for liners and leachate collection systems are specified in the Missouri Code of State Regulations, the TSCA, and the RCRA; there are none in the UMTRA. Missouri solid waste regulations require at least 0.6 m (2 ft) of compacted soil with a hydraulic conductivity no greater than 10^{-6} cm/s. Both the Missouri hazardous waste regulations and the RCRA specify a double-liner, double-leachate collection

system for hazardous waste landfills. The TSCA requirements, which are broader and take into consideration the nature of the wastes and protectiveness of the overburden materials, require a liner consisting of 0.9 m (3 ft) of compacted soil with a permeability equal to or less than 1×10^{-7} cm/s, or a synthetic membrane liner. The TSCA also provides for three different leachate collection systems: (1) simple leachate collection, (2) compound leachate collection, and (3) suction lysimeters.

Each of these three laws contains elements that should be considered relevant and appropriate; consequently, a hybrid system was selected on the basis of the following considerations: (1) all wastes to be disposed of are solid, nonhazardous wastes that are expected to generate only minimal leachate; (2) the site is underlain by thick, unsaturated, low-permeability soils; and (3) it is prudent in the short term to remove precipitation, construction water, and transient drainage using a leachate collection system.

On the basis of the above, the hybrid system would consist of a single leachate collection system underlain by a composite liner. There are, however, other circumstances which affect the preferred design of the hybrid system by adding a secondary redundant liner and leachate collection system. These circumstances include site-specific considerations such as the presence of pre-existing groundwater contamination in the area. Although a single leachate collection and removal system could be designed to remove leachate and prevent migration through the liner, there is no way to ensure that 100% of the leachate will be collected. Considering that the redundant leachate collection and removal system can also serve as a leak detection system, this second system is desirable, since it could establish whether or not elevated contaminant levels in the groundwater can be attributed to cell failure.

Other considerations include the fact that RCRA wastes are present at the site. It is planned that all RCRA characteristic wastes will be treated to below RCRA standards, and listed wastes would be managed off site. However, utilizing a cell design which is consistent with RCRA (double liner/leachate collection and removal system) may provide flexibility for the potential situation where RCRA wastes would be placed in the cell. (If this were to happen, an Explanation of Significant Difference would be prepared in accordance with EPA guidance for post-ROD changes.)

For these reasons, the RCRA requirements for a double liner/leachate collection system are considered relevant and appropriate.

A response action plan will be developed during the remedial design phase, which will specify response actions that will occur if excessive quantities of leachate are observed (i.e., during monitoring/maintenance or repair of the cap). Active management of the leachate collection system will continue until such time as it is agreed by the DOE and the regulatory agencies that it is no longer required.

Borrow source area activities will consist of the excavation and transfer along a dedicated haul road of approximately 1.9 million m^3 (2.5 million yd^3) of clay material, which will be used for the construction of the disposal cell. Certain action-specific ARARs apply to these borrow source area activities. These ARARs contain administrative requirements that are applicable to the borrow area activity. Off-site actions must comply with all legally applicable requirements, both substantive and administrative.

The *Land Reclamation Act* (10 CSR 40-10.010) require obtaining a Land Reclamation Permit from the Land Reclamation Commission prior to surface mining of industrial minerals, including clay. However, a permit is not required of a governmental agency whose operations comply with the reclamation standards in RSMo. 444.774 and who registers with the Land Reclamation Commission prior to operations. The borrow area action will comply with the reclamation standards and will register with the commission.

The *Clean Water Act* requires a NPDES Permit for storm water discharges associated with industrial activities from construction sites involving the excavation or grading of five or more acres. This requirement is considered applicable to the borrow area because the extent of excavation at the borrow area is estimated at approximately 95 acres. Included as part of the permit process is a *Water Pollution Prevention Plan*, which will be prepared for the borrow area and which will include preventative measures for erosion control.

Monitoring and Maintenance. Requirements for post-closure monitoring and maintenance are specified in the RCRA and the UMTRA. The TSCA does not define specific post-closure requirements for a chemical waste landfill. Requirements under the RCRA specify a 30-year post-closure care period for maintenance of the cover, the leachate collection system, and the groundwater monitoring system. Groundwater monitoring requirements are set forth in the RCRA and the Missouri Code of State Regulations. The RCRA groundwater protection standard (40 CFR 264 Subpart F) sets forth general monitoring requirements. A groundwater monitoring program should provide representative samples of background water quality, as well as the quality of the groundwater passing the point of compliance. The sampling should allow for the detection of contaminant migration into the uppermost aquifer. State regulation

10 CSR 25-7.264(2)(f) sets forth surface water monitoring requirements to detect impacts from groundwater contamination. A sampling plan should provide representative background surface water quality (upgradient) samples as well as representative downgradient surface water quality samples. The initial values should be established for biological activity, chemical indicator parameters, and hazardous constituents by conducting quarterly sampling for one year. The surface water quality should be determined at least semiannually, and at those times when contaminant migration is greatest from the shallow groundwater to surface water. This monitoring should be conducted through the post-closure care period.

Post-closure standards under the UMTRA require the control of radiological hazards to (1) be effective for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years; and (2) limit releases of Rn-222 so as not to exceed an average release rate of 20 pCi/m^2s.

These UMTRA standards are relevant and appropriate because they address similar waste materials and a disposal scenario similar to the WSSRAP. The UMTRA requirements also directly reference the RCRA requirements of 40 CFR 264.111 with respect to the closure performance standard for nonradiological hazards. Therefore, 40 CFR 264.111 and 264.310 are also relevant and appropriate. Since the hazardous waste monitoring/maintenance requirements are more stringent than the solid waste requirements, the latter are not considered as ARARs.

Other Disposal Requirements. Other waste disposal issues include the restriction on the placement of waste containing free liquids in a landfill and a recommended minimum unconfined strength (UCS) for grout-like stabilized wastes. As required by 40 CFR 264.314 placement of wastes containing free liquids as defined by EPA Method 9095 (paint filter test) is restricted. Also, for grout-like materials resulting from the stabilization/solidification of wastes, a minimum UCS of 50 psi in place is recommended by EPA (EPA 1986 and EPA 1992b).

The free liquids restriction is not considered relevant with respect to CSS grout. Based on CSS testing of WSSRAP wastes, the free liquids restriction would likely prevent meeting waste placement objectives related to the proposed remedial action under Alternative 6a. Although the CSS grout resulting from the stabilization of raffinate sludge or contaminated soils may fail the paint filter test as a result of maintaining the needed fluidity for effective placement, long term benefits with respect to performance of the disposal facility would be realized.

First, the grout resulting from the treatment of raffinate sludge or more highly contaminated soils will be used to fill voids in the materials from the dismantlement of buildings and foundations. With hardening of the grout to a minimum UCS of 50 psi, the stability of placed waste will be increased and long-term subsidence of the cell cover will be minimized. Second, by filling voids of dismantlement debris with a treated waste, the overall size of the cell is reduced by making use of the void space.

To compensate for free liquids in the grout that allows the grout to flow into voids of dismantlement debris, grout placement techniques can be developed and specified so that free liquids are effectively removed by the leachate collection system. Grout placement techniques could include thin enough lifts of grouted debris which will promote drainage of liquids and temporary sumps for collection and removal of liquids from the cell. Such measures could be demonstrated so that the requirements of 40 CFR 264.314(f) are achieved.

The restriction of free liquids from materials placed in the disposal cell, as specified in 40 CFR 264.314(f), is therefore waived only with respect to grout used in filling voids of dismantlement debris. It will be determined during pilot-scale testing that any free liquids generated during solidification process will pass TCLP. The free liquids will be randomly tested during full scale operations to ensure that they pass TCLP. Also, all grout-like material will achieve a minimum UCS of 50 psi in place at 28 days as documented through bench and pilot scale testing. Placement methods (e.g., compaction) that minimize long-term subsidence of the cell cover will be used for non-grout materials.

10.3 Cost-Effectiveness

The selected remedy is estimated to cost about $157 million and is estimated to require about 10 years to complete. These figures, however, are based on preliminary conceptual design estimates and are likely to increase as engineering design is completed. The contingency treatment option is estimated to cost about $182 million and would also require about 10 years to complete. However, because the treatment technology employed in the contingency treatment option (vitrification) is an innovative technology, these estimates have greater uncertainty than those for the selected remedy; implementation of the contingency remedy is dependent upon the results of ongoing testing. The selected remedy is cost effective because it would achieve required objectives for the least cost and would use an established treatment technology. Thus, the potential for schedule delays and the resultant increased costs would be less for this remedy than for the other alternatives. The contingency treatment option would also be cost effective, assuming that results of ongoing and future bench-scale and pilot-scale testing demonstrate that

this option could be implemented at a cost and in a period of time comparable to that identified for the selected remedy. The increased cost of the vitrification technology would be somewhat offset by the increase in long-term protectiveness gained by the reduction in contaminant toxicity and volume.

Both the selected remedy and the contingency remedy would support comprehensive remediation of the Weldon Spring site by removal of the sources of contamination at the site and providing for disposal of all contaminated material generated from remediation of the site.

10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which the permanent solutions and treatment technologies can be utilized in a cost-effective manner. The selected remedy will result in the permanent removal of contaminated sludge, soil, sediment, and vegetation from the source areas and treatment of the material posing the principal threats to the maximum extent practicable. Of those alternatives that are protective of human health and the environment and that comply with ARARs, the selected remedy provides the best balance among the alternatives in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. The selected remedy also meets the statutory preference for treatment as a principal element, and meets State and community acceptance.

The selected remedy will significantly reduce the hazards posed by the contaminated media through stabilization/solidification of contaminants such that the treated product will significantly reduce contaminant mobility. The treated and untreated material will both be placed in an engineered disposal facility designed to contain the materials over the long term. Because the more highly contaminated material will be treated to reduce contaminant mobility, the impact on human health and the environment would be minimal if the containment system were to fail.

The contingency treatment option would also provide for significant reductions in risk. Vitrification would be expected to provide somewhat greater long-term effectiveness because organic contaminants and some inorganic contaminants would be destroyed, and the contaminants in the treated waste form would be more thoroughly immobilized. However, larger uncertainties are associated with the implementability of vitrification compared with chemical stabilization/ solidification, and thus could lead to project delays and increased costs. Vitrification is being

carried forward as a contingency treatment option so the effectiveness of this technology can continue to be evaluated in terms of current uncertainties associated with its implementability.

The selected remedy treats the material posing the principal threats at the site, achieving significant reduction in contaminant mobility. Chemical stabilization/solidification and disposal on site is more effective in the short term, requiring up to five years to implement the treatment operations and 10 years to complete remedial action at the site. In comparison, vitrification will require about seven years for implementation, provided engineering scale-up and design are not delayed because of the innovative nature of this technology. The off-site disposal alternatives could require significantly more time to implement due to the increased administrative requirements for transport and disposal of the wastes at the off-site facilities.

The off-site disposal alternatives do not offer an increase in effectiveness over the on-site disposal alternatives that can justify the greatly increased costs (two to 10 times the cost of the selected remedy). The long-term effectiveness of the off-site alternatives would be somewhat greater at the Weldon Spring site due to the removal of contaminated material from the site, and potential long-term impacts at the off-site locations would be less than those expected at the Weldon Spring site for on-site disposal, because of the arid climate and distance to potential receptors. However, short-term impacts would be greater due to the increased handling of contaminated materials and the transportation of those materials to the off-site locations. In addition, implementation of these alternatives would require coordination of licensing, permitting, regulatory compliance, and establishment of administrative procedures (as appropriate) in order to dispose of the Weldon Spring waste at either off-site facility.

The major balancing criteria that provide the basis for selection of the preferred alternative are short-term effectiveness, implementability, and cost. The selected remedy can be implemented more quickly, with less difficulty, and at less cost than the other alternatives and is therefore determined to be the most appropriate method. The contingency treatment option is being retained to facilitate implementation of an alternate treatment technology in the event that chemical stabilization/solidification does not perform adequately. Both technology types will be reevaluated against the balancing criteria during conceptual design and bench-scale and pilot-scale testing. If the contingency treatment option (vitrification and disposal on site) were selected pursuant to this continuing evaluation, an Explanation of Significant Differences from the selected remedy would be made available to the public, and public input would be solicited.

10.5 Preference for Treatment as a Principal Element

The selected remedy satisfies the preference for treatment as a principal element by treating the materials giving rise to the principal hazards at the site (the raffinate-pit sludge and the more highly contaminated fraction of soil, sand, and sediment) by chemical stabilization/ solidification. This treatment method will significantly reduce contaminant mobility. The contingency remedy would also satisfy the preference for treatment as a principal element by treating these same materials by vitrification. Vitrification would also significantly reduce contaminant mobility. In addition, vitrification would reduce contaminant toxicity by destruction of organic contaminants and some inorganic contaminants, and waste volume would be reduced through the elimination of water and void spaces during the melting process.

10.6 Irreversible and Irretrievable Commitment of Resources

Implementing the selected remedy will result in the permanent commitment of land at the Weldon Spring site for waste disposal. This commitment of land for the disposal facility is consistent with current land use at the site. The Weldon Spring site is a contaminated, inactive industrial complex under the custody of the DOE, and it contains waste pits from past disposal practices; it is adjacent to a similar contaminated site owned by the Army.

The disposal cell proper is expected to cover about 17 ha (42 acres), but the total amount of committed land would be larger (e.g., double the waste containment area) because a buffer zone will be established around the cell. No other area of the Weldon Spring site would sustain a long-term impact or injury as a result of this permanent remedy. Perpetual care will be taken of the committed land because the waste would retain its toxicity for thousands of years. For example, the cover will be visually inspected, groundwater will be monitored, and the effectiveness of the overall system at the Weldon Spring site will be reviewed at least every five years.

Consumptive use of geological resources (e.g., quarried rock, sand, and gravel) and petroleum products (e.g., diesel fuel and gasoline) will be required for the removal, construction, and disposal activities. Adequate supplies of these materials are readily available in the Weldon Spring area. The treatment process will also require the consumptive use of materials (including cement and fly ash) and energy. Cement and fly ash are readily available locally in the quantities required, and natural gas can be obtained from the local utility. Implementing the selected remedy is not constrained by the availability of resources or supplies beyond those currently available in the St. Louis area.

10.7 Significant Changes

The *Proposed Plan* for the Weldon Spring site was released for public comment in November 1992. The *Proposed Plan* identified Alternative 6a, Removal, Chemical Stabilization/ Solidification and Disposal On Site, as the preferred alternative. The DOE reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments, it was determined that no significant changes to the remedy, as it was originally identified in the *Proposed Plan*, were necessary.

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Federal Regulations

7 CFR 658	*USDA SCS Farmland Protection Policy*
10 CFR 20	*Standards for Protection Against Radiation*
29 CFR 1910	*OSHA Standards*
40 CFR 6	*Appendix A EPA Regulations for Implementing EO 11990 (Wetlands) and EO 11988 (Floodplains)*
40 CFR 61	*EPA NESHAPs National Emissions Radionuclides*
40 CFR 190	*Environmental Radiation Protection Standards for Nuclear Power Operations*
40 CFR 192	*UMTRA Standards*
40 CFR 241	*EPA Solid Waste Guidelines*
40 CFR 261	*EPA Identification and Listing of Hazardous Waste*
40 CFR 264	*EPA Standards for o/o of Hazardous Waste Treatment, Storage, and Disposal Facilities*
40 CFR 268	*EPA Land Disposal Restrictions*
40 CFR 300	*CEQ National Oil and Hazardous Substances Pollution Contingency Plan*
40 CFR 761	*EPA PCB Regulations*
40 CFR 763	*EPA TSCA Asbestos Regulations*
49 CFR 170-177	*Department of Transportation Hazardous Transportation Regulations*

DOE Orders

5480.11	*Radiation Protection for Occupational Workers*
5400.5	*Radiation Protection of the Public and the Environment*

Federal Executive Order

11988 *Floodplain Management*
11990 *Protection of Wetlands*

Missouri State Regulations

10 CSR 10-5.030	*Maximum Allowable Emission of Particulate Matter from Fuel Burning Equipment Used for Indirect Heating*
10 CSR 10-5.050	*Restriction of Emission of Particulate Matter from Industrial Processes*
10 CSR 10-5.090	*Restriction of Emission of Visible Air Contaminants*
10 CSR 10-5.180	*Emission of Visible Air Contaminants from Internal Combustion Engine*
10 CSR 10-6.010	*Ambient Air Quality Standards*
10 CSR 10-6.060	*Permits Required*
10 CSR 10-6.170	*Restriction of Particulate Matter to the Ambient Air Beyond the Premises of Origin*
10 CSR 25-7.264	*Missouri Hazardous Waste Treatment, Storage and Disposal Requirements*
19 CSR 20-10.040	*Missouri Radiation Regulations*

Missouri Register, September 1, 1992; Vol. 17, No. 17.
Missouri Register, November 2, 1992; Vol. 17, No. 21.

Other Orders

Missouri Governor's Executive Order 82-19 on Flood Plain Management

12 ACRONYMS

AEA	Atomic Energy Act
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirements
BA	baseline assessment
BDAT	best demonstrated available technology
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CSS	chemical stabilization/solidification
CWA	Clean Water Act
DAC	derived air concentration
DCF	dose conversion factor
DCG	derived concentration guideline
DNB	dinitrobenzene
DNT	dinitrotoluene
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ERDA	Energy Research and Development Adminstration
FS	feasibility study
LDR	Land Disposal Restrictions
MCL	maximum contaminant level
MCLG	maximum contaminant level goals
MSA	material staging area
NAAQS	National Ambient Air Quality Standards
NB	nitrobenzene
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclicpolynuclear) aromatic hydrocarbons

PCB	polychlorinated biphenyl
PP	Proposed Plan
RCRA	Resource Conservation Recovery Act
RfD	reference dose
RI	remedial investigation
RI/FS	Remedial Investigation/Feasibility Study
RI/FS-EIS	Remedial Investigation/Feasibility Study-Environmental Impact Statement
ROD	Record of Decision
SDWA	Safe Drinking Water Act
SWDA	Solid Waste Disposal Act
TCLP	toxicity characteristic leaching procedure
TNB	trinitrobenzene
TNT	trinitrotoluene
TSA	temporary storage area
TSCA	Toxic Substance Control Act
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978
WLM	working-level month

RESPONSIVENESS SUMMARY

The *Proposed Plan* and the *Remedial Investigation/Feasibility Study-Draft Environmental Impact Statement* (RI/FS-Draft EIS) for *Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (DOE 1992a, b, and d) were issued to the public on November 20, 1992. The U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) sponsored a public meeting on these documents and discussed the proposed action on December 16, 1992, at the Columns Banquet and Conference Center in St. Charles, Missouri; representatives from the State of Missouri were also in attendance. The DOE responded to oral comments made on the *Proposed Plan* and RI/FS-Draft EIS at this meeting, and those responses are included in the meeting transcript. The transcript is part of the *Administrative Record* for this remedial action, and it is on file at the information repositories for the Weldon Spring project. (The repositories are located in the project office reading room, at Francis Howell High School, and at several nearby libraries — as identified in Section 7 of the proposed plan for this action.)

At the public meeting, members of local labor unions made many additional statements and asked questions that were unrelated to the evaluations and conclusions presented in the *Proposed Plan* and RI/FS-Draft EIS. These comments generally related to the training qualifications of site workers, the use of nonunion labor for cleanup activities, and the procedures DOE follows to award and oversee contracts. Responses to most of these comments were provided orally at the public meeting and are included in the transcript. For those union issues not fully addressed at that meeting, a separate response report has been prepared (MKF and JEG 1993). That report is also available in the *Administrative Record* for this action.

The public comment period for the *Proposed Plan* and RI/FS-Draft EIS was initially scheduled to end on January 20, 1993. However, the period was extended 30 days pursuant to several requests from local citizens and community interest groups. Thus, the comment period formally ended on February 19, 1993. On March 19, 1993, the DOE met with a small group of individuals representing the St. Charles Countians Against Hazardous Waste who had submitted comment letters on the *Proposed Plan* and RI/FS-Draft EIS to the project office and/or presented comments orally at the formal public meeting. The purpose of this small meeting was to clarify those comments received within the formal comment period, and the intent was to allow responses developed by the DOE to address the underlying concerns of those commentors.

This responsiveness summary identifies the major issues raised in both the oral and written comments on the proposed action and provides the DOE's responses for those issues. For this summary, the page numbers of the transcript and/or the specific comment letters in which the issues were raised are identified in parentheses at the end of each issue (see Appendix B). The comment letters are referred to by an alphabetical identifier determined by the order in which they were received by the project office, except for an anonymous letter received at the public meeting (identified as Letter P). These letters are also part of the *Administrative Record* for this action.

In addition, each comment letter has been reproduced in a separate document (DOE 1993) to provide individual responses to written comments received on the RI/FS-Draft EIS. That document includes (1) copies of the comment letters and point-by-point responses; (2) copies of the comments submitted at the public meeting; and (3) copies of the letters received from the U.S. Department of Interior, Fish and Wildlife Service on the biological assessment that accompanied the RI/FS-Draft EIS. The separate document also includes a summary of the major issues raised in oral and written comments and the DOE's responses to those issues, similar to this responsiveness summary.

Issue 1

Comment. If the Weldon Spring site is used for waste disposal, it should be used solely to dispose of waste associated with cleanup of the Weldon Spring site. No additional waste should be brought to the site for treatment or disposal. *(Transcript pages 28, 29, 43, 44, 53, and 82; comment letters C and D.)*

Response. In response to community concerns such as this one, the DOE has committed that no other DOE waste would be brought to the site for treatment or disposal and intends to firmly abide by that commitment.

Issue 2

Comment. Any on-site disposal facility should essentially meet the substantive siting and design requirements of the State and Federal hazardous waste laws and regulations. Such a disposal facility should remain under the control and ownership of DOE. *(Transcript page 29.)*

Response. The on-site disposal facility will be sited and designed to achieve the substantive siting and design requirements, including equivalent performance standards, identified in applicable State and Federal hazardous waste laws and regulations. During the detailed engineering design phase for this facility, the DOE will coordinate with both the State of Missouri and EPA Region VII to see that such requirements are appropriately addressed. The disposal facility will remain under the control and ownership of DOE or any successor government agency.

Issue 3

Comment. Protective and permanent waste disposal should be achieved with natural barriers and engineered materials, methods, and designs to the maximum extent possible; reliance on institutional control measures should be kept to a minimum. *(Transcript page 30.)*

Response. The waste resulting from cleanup of the Weldon Spring site will be placed in an engineered containment facility using proven materials, methods, and designs. From the conceptual design for this facility, natural materials, including recompacted clay, will be used to construct the base because these materials have been shown to be very effective in similar facilities for radioactive and chemically hazardous wastes at other sites. In addition to these natural materials, synthetic materials such as flexible membrane liners will be used for certain components of the disposal facility, including the leachate collection and removal system. This engineered facility will include redundant containment features that will be the primary means for ensuring long-term protection of the general public and the environment. Although institutional controls will be employed to help facilitate protection during remedial action activities, reliance on such measures will be kept to a minimum following waste disposal.

Issue 4

Comment. The DOE should commit to an appropriate long-term monitoring and maintenance program to verify and maintain the performance of the on-site disposal facility. More details should be provided on the proposed long-term monitoring procedures for the disposal area. *(Transcript pages 30 and 36; comment letter H.)*

Response. The DOE is committed to performing long-term monitoring and maintenance of the disposal facility and surrounding area. The parameters and the frequency with which monitoring

and inspection will occur cannot be precisely defined at this stage of the remedial action process because detailed design activities can only be completed after this Record of Decision (ROD) has been signed. A long-term monitoring and maintenance plan that includes parameters and inspection frequency will be developed for the project after specific design information becomes available. In developing this plan, the DOE will consider the hydrologic and hydrogeologic conditions at the chemical plant area, will incorporate input received from the public, and will consult with EPA Region VII and the State of Missouri. It is expected that monitoring and maintenance inspections will occur at least annually. More frequent inspections (e.g., quarterly) will be conducted in the near term (e.g., over the first several years) to assess the performance of the containment system. Additional details on the monitoring and maintenance program that will be used at the site will be provided in the *Mitigation Action Plan*, which will be completed during the detailed design phase of this remedial action. The plan will be available in the information repositories for the project.

Issue 5

Comment. The waste resulting from cleanup of the Weldon Spring site should be transported to and disposed of at the Envirocare facility near Clive, Utah, because the geology at the site is not suitable to support a disposal facility; the geology in the area is porous, sinkholes are present nearby, and the possibility of an earthquake exists. In addition, disposal at the Envirocare facility could be less costly than estimated in the FS. Ideally, the more highly contaminated material should be vitrified and disposed of at a site that is geologically sound. *(Transcript pages 46, 47, and 52; comment letters F and L.)*

Response. The geology of the location considered for construction of an engineered disposal facility at the chemical plant area has been thoroughly investigated and has been determined to be suitable for such a facility, as discussed in the RI/FS-Draft EIS. Numerous geological studies have been conducted by the DOE in consultation with the State of Missouri, and no sinkholes have been identified in the study area. The results of these investigations have been reviewed by the State and EPA Region VII, and all parties agree that the disposal study area of the Weldon Spring site is acceptable for the construction of a facility to contain the waste resulting from site cleanup.

Issues associated with vitrifying the more highly contaminated material and with transporting all or a portion of the site waste to an off-site facility (such as the Envirocare facility near Clive, Utah) for disposal were evaluated in detail in the RI/FS-Draft EIS. The results of these analyses

indicated that the alternative selected as the remedy in this ROD — which incorporates source removal, treatment of the more highly contaminated material using a proven technology (chemical stabilization/solidification), and disposal in an on-site engineered facility — provides the best balance among the final action alternatives with respect to the prescribed evaluation criteria. Cost was not a major factor in this selection, so even if transportation costs or disposal fees were to change somewhat, the selected remedy would still be the preferable solution considering the other impacts associated with the off-site transportation and disposal of the large volume of waste from the Weldon Spring site. Most importantly, this remedy will protect human health and the environment and can be implemented in a straightforward manner.

Issue 6

Comment. The remedial action alternative selected for implementation should be protective of human health and the environment. Cleanup procedures, designs, and standards should meet all applicable or relevant and appropriate requirements of State and Federal environmental, health, and safety laws and regulations. *(Transcript page 29.)*

Response. The selected remedy will be implemented in a safe manner and will provide long-term protection of human health and the environment from contamination at the Weldon Spring site. The cleanup procedures, designs, and standards will meet all applicable or relevant and appropriate requirements except in specific cases where a waiver is appropriate to site conditions during cleanup. (For example, a waiver of the time limit for storing hazardous waste on-site is appropriate until the disposal facility is available.) These waivers and their justifications are discussed in Section 10 of this ROD.

Issue 7

Comment. The Francis Howell High School is located about 1 km (0.6 mi) east of the site, but the RI/FS-Draft EIS seems to minimize its closeness. Additionally, most citizens of St. Charles County live closer to the site than the city of St. Charles. Because the air pathway is the most direct means by which members of the general public could be impacted by cleanup activities, it is important that this pathway be analyzed in detail using the best information available. What

safeguards will be used to protect workers, the students and staff at the high school, and the community at large during remedial action activities? How can the safety of the general public be guaranteed? *(Transcript pages 38 and 42; comment letters C, I, N, and O.)*

Response. The closeness of the high school to the site is discussed in many sections of the RI/FS-EIS and is prominently identified in many figures. The DOE agrees that the air pathway is of primary concern during the cleanup period. For that reason, impacts that might result from contaminant releases were addressed in greater detail in the assessment of the cleanup period than were those associated with any other pathway. The fact that individuals live in unincorporated areas closer to the site than the city of St. Charles is also noted in text and presented in figures, and this was one of the main reasons that potential risks were estimated for the nearby population within 5 km (3 mi) of the site center; potential risks were also estimated for nearby residents and individuals at the high school (as discussed in Appendix F of the FS).

A comprehensive assessment of the material that could become airborne because of cleanup activities (including radon gas), the movement of airborne contaminants through the atmosphere to potential receptors nearby, and the types of control measures that could be applied to limit airborne releases were discussed extensively in Appendixes C and F of the FS. These analyses were performed using representative meteorological data for the site. The results were subsequently compared with those estimated using other meteorological data that were recently obtained by the project office. (Those data consisted of measurements for specific parameters collected from the on-site meteorological station over 10 months during 1992 and 1993 and mixing height data measured from Eureka, Missouri.) This comparison indicated that the results were essentially the same regardless of whether the representative or the slightly modified meteorological data set was used. These results provide additional support for the determination presented in the RI/FS-Draft EIS that remedial action at the Weldon Spring site can be safely performed such that members of the general public will be protected. These results also indicate that the DOE could reliably meet its commitment to conduct the cleanup with no measurable impact from site contaminants at the high school. The DOE will continue to consult with school administrators throughout the remedial action process so that they are kept fully informed of planned activities.

Cleanup activities at the site will be conducted in a manner that minimizes the release of contaminants to the environment, as discussed in the RI/FS-Draft EIS. The safety of the public, including students and staff at Francis Howell High School, will be facilitated by maintaining an extensive monitoring program in conjunction with operational contingency plans. These contingency plans will include the staged application of increasingly stringent operational

controls in the event that monitoring results identify any release situations that might affect workers or the general public as cleanup progresses. These controls include such measures as limiting or covering exposed areas and reducing dust and radon releases by applying water sprays. Additional details on the monitoring and operational contingency plans to be applied for this remedial action will be provided in the *Mitigation Action Plan*.

Issue 8

Comment. The *Atomic Energy Act* requires that human exposures to radiation be reduced to levels that are as low as reasonably achievable. The Weldon Spring project should be conducted with the design objective that no member of the general public would ever receive more than 25 mrem/year above background. If further dose reductions are reasonably possible, they should be pursued. *(Transcript page 29.)*

Response. Cleanup activities at the Weldon Spring site will be designed and conducted so that no member of the general public will receive a dose of 25 mrem/year above background level (doses estimated from conservative assumptions are well below this level). The DOE process whereby risks are reduced to levels as low as reasonably achievable (ALARA) will be applied during field activities. This ALARA process was also explicitly incorporated into the development of cleanup criteria for site soil so that future radiation doses are reduced to levels as far below applicable standards as reasonably achievable.

Following site cleanup, the dose level of 25 mrem/year will be met for all reasonably foreseeable exposures at the site, except possibly for exposures to indoor radon, if someone were to live at certain locations in the future. To put this issue in context, the annual dose from exposure to background levels of radon is estimated to be about 200 mrem/year, and these naturally occurring levels vary considerably. For this reason, the EPA has separately identified an acceptable radon concentration for indoor air, which is 4 pCi/L. The indoor radon concentrations estimated for those areas of the site at which the incremental dose to a future resident is estimated to be above the suggested 25 mrem/year level are projected to be below 4 pCi/L (and standard mitigative measures such as ventilation could be readily applied to further reduce radon exposures and related doses).

Issue 9

Comment. Soil cleanup levels should be conservatively developed so that individuals who may have unrestricted access to the site in the future will not be subjected to unacceptable risks. *(Comment letter K.)*

Response. The cleanup levels for contaminants in soil at the Weldon Spring site were developed in accordance with EPA guidance. These levels were conservatively developed by considering a residential scenario, to address the reasonable maximum exposures for a future individual with unrestricted access to the site. Per EPA guidance, the cleanup levels were determined by targeting an incremental risk range of 1 in 1 million (1×10^{-6}) to 1 in 10,000 (1×10^{-4}), with consideration of site-specific conditions. A key site-specific factor is the concentration of natural constituent in local soil, which will be used to backfill on-site areas from which contaminated soil is excavated during cleanup. That is, background concentrations of certain metals can correspond to estimated risks above the EPA's target range.

Therefore, given natural variability, it is difficult to distinguish an incremental risk associated with residual contamination at the upper end of the target range from the risk associated with natural concentrations, and this distinction is virtually impossible for the lower end of the target range. Further, replacing the excavated soil with uncontaminated local soil could result in actually increasing the risks at certain areas, depending on the specific levels of naturally occurring constituents in the backfill soil. For these reasons, the lower end of EPA's range could not serve as the endpoint for site cleanup criteria. The cleanup levels proposed for the site will be applied to areas released for other use and are expected to be protective of human health and the environment for all reasonably anticipated future uses.

Issue 10

Comment. The DOE should address chemical contamination at the vicinity properties. All contaminated vicinity properties should be cleaned up to allow for completely unrestricted use. *(Transcript pages 29 and 30; comment letter K.)*

Response. The DOE is responsible for properties on the adjacent Army site and in the surrounding State conservation area that were contaminated as a result of activities conducted by the DOE and its predecessor agency at the Weldon Spring site. These are termed vicinity properties and have been identified on the basis of their radioactive contamination; no DOE

vicinity property contains only chemical contaminants. The Army is responsible for properties on the Army site that are chemically contaminated by previous Army activities, and cleanup of those areas is currently being addressed by the Army under a separate RI/FS process. The DOE will continue to coordinate with the Army regarding cleanup of DOE vicinity properties on Army land.

As part of cleanup activities conducted pursuant to the remedy selected in this ROD, the DOE will remove radioactively contaminated soil from those vicinity properties. Excavating soil to remove the radioactive contamination will also result in the removal of any combined chemical contamination from these locations. The DOE is committed to cleaning up all radioactively contaminated vicinity properties to levels that will allow for unrestricted use. During soil cleanup activities in the Busch Conservation Area, which are addressed in this RI/FS-EIS, the DOE will also remove contaminated sediment from Lakes 34, 35, and 36 in conjunction with the draining of those lakes by the Missouri Department of Conservation (this draining has been planned as part of the State's routine sedimentation management program for the conservation area). Under existing conditions at the lakes, the estimated health risks associated with this contaminated sediment are well below the levels identified by the EPA as either of concern or warranting cleanup action. Nevertheless, the DOE is conducting this activity to address the possibility that sediment excavated from those lakes might subsequently be used as backfill material in a residential area.

Issue 11

Comment. The site risk assessments seem to focus almost exclusively on human health impacts. These assessments should consider all living organisms so as not to decrease biotic diversity or cause extinction of certain organisms. *(Comment letter N.)*

Response. The site risk assessments did examine potential ecological impacts that could result from the contamination present at the chemical plant and in affected areas nearby. An entire chapter (Section 7) of the baseline assessment (BA) and several appendixes were devoted to the assessment of ecological impacts that might occur in the absence of cleanup. Potential impacts to ecological resources from cleanup activities were assessed in the FS. These analyses were developed from current characterization data for the site in combination with available scientific information. No obvious adverse ecological impacts have been observed at the site or surrounding areas, except for circumstantial evidence (the paucity of biota) in the raffinate pits. However, adverse ecological impacts might occur if the site were not cleaned up and

contaminants remained in their current state, particularly at the raffinate pits, as discussed in the RI/FS-EIS. Possible impacts to the density and diversity of invertebrates at the site were also discussed. To address the long-term protection of ecological resources at the site, additional studies are under way and others are planned. As they become available, data from these studies will be incorporated into future documents prepared for the project.

Issue 12

Comment. The DOE should commit to follow-on studies of the groundwater contamination and, if necessary, undertake remedial action for groundwater after the sources of contamination are removed. *(Transcript page 30 and comment letter H.)*

Response. The DOE will continue to investigate groundwater at the chemical plant area. The groundwater response action has been separated from this action, as discussed in the RI/FS-EIS, because the comprehensive data needed to support a final decision for this medium are not yet available. The DOE will prepare a separate set of assessment documents focused specifically on groundwater at the chemical plant area. These documents will be developed in consultation with EPA Region VII and the State of Missouri, and they are expected to be issued to the public within the next several years. Comments received from the State, EPA Region VII, and the public on the proposal made in that future document package will be considered before a decision is made on the final response for groundwater.

Issue 13

Comment. The DOE should accelerate the process addressing contaminated groundwater at the quarry, including the Femme Osage Slough area. The quality of water in the St. Charles County well field is a chief concern for this project. *(Transcript page 53 and comment letter I.)*

Response. The DOE is committed to seeing that the county drinking water wells are not impacted by contaminants from the site. An extensive monitoring program is in place at the quarry and Femme Osage Slough areas to address this issue, and the process for seeing that groundwater contamination has been initiated. Focused characterization of the quarry and Femme Osage Slough area is expected to begin this year to support final remedial actions for that location.

Issue 14

Comment. Much of the cleanup work at the site is being performed by workers who do not reside in St. Charles County or the greater St. Louis metropolitan area. Many local laborers have been trained to perform remedial action work similar to that currently under way at the Weldon Spring site, and local unions provide a labor pool of qualified workers. The economic benefits associated with this project should be distributed to those most affected by the action. *(Transcript pages 40-41, 49-52, 54-62, 67, 77, and 79.)*

Response. The DOE recognizes that a large number of qualified workers are available locally to support cleanup activities such as those being conducted at the Weldon Spring site. Most of the site workers reside in St. Charles County or the greater St. Louis metropolitan area. Of the 256 full-time workers currently on-site in the project office building, all but five live within the St. Louis metropolitan area. Of the 158 craftspersons and laborers currently involved in site work — primarily in field activities to support interim actions (such as decontaminating and dismantling the chemical plant buildings) — 140 live in the area. All site workers are appropriately trained for the cleanup activities in which they are involved. In summary, the great majority of people involved in the on-site cleanup effort are local workers, they are qualified to conduct the work, and the economic benefits associated with this project are being distributed in the area. The employment of qualified local workers is expected to continue throughout the remedial action for which the current decision is being made.

Issue 15

Comment. The DOE should ensure that the funding for this project is maintained at a high level so the site is cleaned up expeditiously. The potential for future contaminant migration should be minimized. *(Transcript page 53 and comment letters H, I, and N.)*

Response. Maintaining an appropriate level of funding for expeditious cleanup of the Weldon Spring site is a high priority for the project. To date, cleanup activities have not been constrained by the availability of funds. Although the DOE anticipates project support to continue, the amount of funding available to the department is greatly affected by the annual budget established by the U.S. Congress.

The DOE is committed to cleaning up the site in a safe and environmentally sound manner and is moving forward with cleanup activities as quickly as possible. Numerous regulatory review

and engineering requirements must be met as part of the cleanup process before field activities can be implemented, and the extensive planning and development of detailed operational procedures is also involved. Focused cleanup activities have been expedited to reduce health and safety threats on-site and to limit contaminant migration. These interim actions include the treatment of surface water at both the quarry and chemical plant area, dismantlement of the chemical plant structures, and removal of bulk waste from the quarry — with maintenance of the resultant waste in controlled storage on site until the disposal facility is available. The major cleanup activities at the chemical plant area, which include the removal and treatment of sludge from the raffinate pits and disposal of all site waste, are expected to be initiated within the next few years following issuance of this ROD.

REFERENCES

MK-Ferguson Company and Jacobs Engineering Group, 1993. *Responses to Labor Issues Raised at the December 16, 1992, Public Meeting*. DOE/OR/21548-393. Prepared for U.S. Department of Energy, Oak Ridge Field Office, Weldon Spring Site Remedial Action Project, St. Charles, MO. June (Final).

U.S. Department of Energy, 1993. *Responses to Comments on the Remedial Investigation/Feasibility Study-Environmental Impact Statement for Remedial Action at the Chemical Plant Area of the Weldon Spring Site (November 1992)*. DOE/OR/21548-387. Prepared by Argonne National Laboratory, Environmental Assessment and Information Sciences Division, Argonne, IL, for U.S. Department of Energy, Oak Ridge Field Office, Weldon Spring Site Remedial Action Project. St. Charles, MO. June.

APPENDIX B

Comment Letters on the Draft Remedial Investigation/Feasibility Study-Environmental Impact Statement

Comment Letters on the Draft Remedial Investigation/Feasibility Study-Environmental Impact Statement

Letter	Commenter
A	Ken Gronewald, President of the St. Charles Countians Against Hazardous Waste Board of Directors, St. Charles, Missouri
B	Lois Pohl, Coordinator, Missouri Clearinghouse, State of Missouri, Office of Administration, Jefferson City, Missouri
C	John Jacobs, St. Charles, Missouri
D	Allan Wansing, Village Chairman, Weldon Spring Heights, Missouri
E	M. Vernice Santee, Environmental Review Section, Department of Ecology, State of Washingtion, Olympia, Washington
F	Mary A. Halliday, St. Charles Countians Against Hazardous Waste, St. Charles, Missouri
G	Gene Gunn, Chief, Environmental Review and Coordination Section, U.S. Environmental Protection Agency, Region VII, Kansas City, Kansas
H	Thomas Aley, Professional Hydrogeologist, Director, Ozark Underground Laboratory, Protem, Missouri
I	Daniel T. Brown, Associate Superintendent, Francis Howell School District, St. Charles, Missouri
J	D. Anne Martin, Chief, Hazardous Materials Division, Federal Emergency Management Agency, Washington, D.C.
K	Sally L. Shaver, Chief, Federal Programs Branch, Division of Health Assessment and Consultation, Agency for Toxic Substances and Disease Registry, Atlanta, Georgia
L	Charles A. Judd, Executive Vice President, Envirocare of Utah, Inc., Salt Lake City, Utah
M	George A. Farhner, St. Charles Countians Against Hazardous Waste Board of Directors, Project Manager for Technical Assitance Grant administered by EPA Region VII, St. Charles, Missouri
N	L. Rao Ayyagari, Ph.D., Professor of Biology, Lindenwood College, St. Charles, Missouri
O	William M. Vaughan, Ph.D., Environmental Solutions, St. Louis, Missouri
P	Unsigned letter submitted at the public meeting on December 16, 1992