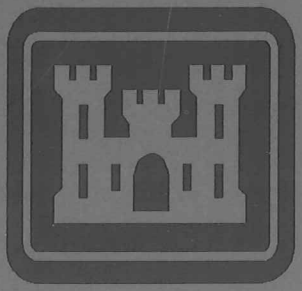
FINAL

RECORD OF DECISION FOR THE ST. LOUIS DOWNTOWN SITE

ST. LOUIS, MISSOURI

OCTOBER 1998



U. S. Army Corps of Engineers
St. Louis District Office
Formerly Utilized Sites Remedial Action Program

ROUTING AND TRANSMITTAL SLIP Date 11/2/98

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REMARKS

attached is a copy of the final signed/approved SLDS ROD. If you don't want it, please return it to me.

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Sharon

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This is an impressive bit of work — It shows a significant amount of understanding and detailed knowledge by the team participants.

FOR DP, DD, DX (CoE is auditing) there will be a graded test which counts 60% of your final on 7/11 ——

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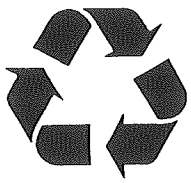
ST. LOUIS, MISSOURI

JULY 1998

prepared by
U.S. Army Corps of Engineers, St. Louis District Office, Formerly Utilized Sites Remedial Action Program

with technical assistance from
Science Applications International Corporation ESC-FUSRAP
under Contract No. DACA62-94-D-0029



I. DECLARATION FOR THE RECORD OF DECISION

Site Name and Location

St. Louis Downtown Site Accessible Soil/Ground Water Operable Unit
St. Louis Site
St. Louis, Missouri

Statement of Basis and Purpose

This document presents the selected remedial action for the cleanup of wastes related to Manhattan Engineering District/Atomic Energy Commission (MED/AEC) operations in accessible soils and ground water at the St. Louis Downtown Site (SLDS). Accessible soils are soils that are not beneath buildings or other permanent structures. The SLDS is one of a set of properties collectively referred to as the St. Louis site in St. Louis City and County, Missouri. The U.S. Environmental Protection Agency (EPA) has listed portions of the St. Louis site on the National Priorities List (NPL), but the SLDS is not included. The SLDS consists of property owned by Mallinckrodt, Inc. (Mallinckrodt Property), and vicinity properties (VPs). VPs are categorized as perimeter VPs, which are adjacent to the Mallinckrodt Property, as well as the utilities, roads, and railroads, which are located within the Mallinckrodt Property boundaries.

The selected alternative was developed in accordance with the Comprehensive Environmental, Response, Compensation, and Liabilities Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information available in the Administrative Record for the site.

This Record of Decision (ROD) is published by the U.S. Army Corps of Engineers (USACE) in consultation with the EPA. The Missouri Department of Natural Resources (MDNR) concurs in the selected remedy.

Assessment of the Site

Actual or threatened exposure to MED/AEC-related hazardous substances (primarily radioactivity) at the SLDS, if not addressed by implementing the response action selected in this ROD, may present a current or potential threat to public health, welfare, or the environment.

Description of the Selected Remedy

The selected remedy for this Operable Unit (OU), i.e., Alternative 6 of the Feasibility Study, Selective Excavation and Disposal, is the final remedial action for accessible soils at and ground water beneath the SLDS for MED/AEC-related hazardous substances. Portions of properties were previously cleaned under removal action authorities. Plant 10 (City Block 1201) was cleaned to composite criteria (ARAR based). The Mississippi River levee area was cleaned to risk-based levels

based upon recreational use. These cleaned areas do not present risks outside the acceptable risk range and no further remediation is required.

The main components of the selected remedial action include:

- Excavation and off-site disposal of approximately 65,000 cubic meters (85,000 cubic yards) (in-situ) contaminated soil, and

- No remedial action is required for ground water beneath the site. Perimeter monitoring of the ground water in the Mississippi River alluvial aquifer, designated as the hydrostratigraphic B Unit, will be performed and the need for ground water remediation will be evaluated as part of the periodic reviews performed for the site.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The selected remedy uses permanent solutions to the maximum extent practicable. Because no "principal threats" were identified for this Operable Unit and because the toxicity of radionuclides cannot be reduced through treatment, this operable unit's remedial action does not satisfy the statutory preference for treatment as a principal element. However, treatment is a conditional part of this remedy. Treatment technologies demonstrated to be cost-effective, may be added as an adjunct to excavation.

Because the selected remedy will result in hazardous substances remaining onsite, a review will be made of the adequacy of the selected remedial action no less often than every five years as required by Section 121(c) of CERCLA.

Russell L. Fuhrman
Major General, USA
Director of Civil Works

3 Aug 98
Date

Dennis Grams, P.E.
Regional Administrator
U.S. Environmental Protection Agency

Aug. 27, 98
Date

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LIST OF ACRONYMS

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liabilities Act
CFR	Code of Federal Regulations
COC	contaminant of concern
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FFA	Federal Facilities Agreement
FS	Feasibility Study
FUSRAP	Formerly Utilized Sites Remedial Action Program
HI	Hazard Index
MARSSIM	*Multi–Agency Radiation Survey and Site Investigation Manual*
MCL	Maximum contaminant limit
MDNR	Missouri Department of Natural Resources
MED	Manhattan Engineer District
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
SMCL	Secondary maximum contaminant level
TCLP	toxicity characteristic leaching procedure
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound
TBC	to be considered

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II. DECISION SUMMARY

1. SITE NAME, LOCATION, AND DESCRIPTION

1.1 PHYSICAL SITE LOCATION

The St. Louis Site is a set of properties grouped in two areas in St. Louis City and St. Louis County, Missouri (Figures 1-1 and 1-2). The St. Louis Downtown Site (SLDS) is the subject of this remedial action. The SLDS is located in an industrialized area on the eastern border of St. Louis, 90 m (300 ft) west of the Mississippi River and 18 kilometers (km) [11 miles (mi)] southeast of the Airport Area (Figure 1-3). The SLDS consists of the Mallinckrodt Chemical Works (Mallinckrodt Property), owned by Mallinckrodt, Inc. (Mallinckrodt), and VPs. The Mallinckrodt Property is bordered by a large metal recycling company (McKinley Iron Works) to the north; the Mississippi River, an abandoned food processing plant (PVO Foods), and City of St. Louis property to the east; a large lumber yard (Thomas and Proetz Lumber) to the south; and Broadway Street and small businesses to the west. Additionally, the Norfolk and Western Railroad; the Chicago, Burlington, and Quincy Railroad; and the St. Louis Terminal Railroad Association have active rail lines passing in a north/south direction through the Mallinckrodt Property. An earthen levee between the river and the SLDS protects the area from flood waters. These commercial and city-owned properties are collectively referred to as the SLDS VPs. Perimeter VPs include the City of St. Louis property, PVO Foods, McKinley Ironworks, and Thomas and Proetz Lumber Company. Manufacturing plants, support facilities, and administrative buildings cover a large portion of the site with the rest of the complex covered mostly with asphalt or concrete.

As a result of characterization of the soil, ground water, surface water, sediment, air, and structures associated with the SLDS, radiological contamination attributable to MED/AEC operations at Mallinckrodt was determined to be present in surface and subsurface soils. The principal risk concern is potential exposure to radiological contaminants of concern (COCs) attributable to MED/AEC operations at the site which include the thorium, actinium, and uranium decay series.

1.2 ENVIRONMENTAL SETTING

1.2.1 Land-use and Demography

1.2.1.1 Land-use

Land-use within a 1.6-km (1-mi) radius of the SLDS reflects a mixture of commercial, industrial, and residential uses. The majority of the SLDS is property owned by Mallinckrodt Inc., which has used the property for chemical manufacturing and related operations since 1867. Mallinckrodt currently maintains 24-hr security at the property and limits site access to employees, subcontracting employees, and authorized visitors. The SLDS is enclosed by a well-maintained security fence. Mallinckrodt's health and safety plans include measures intended to protect

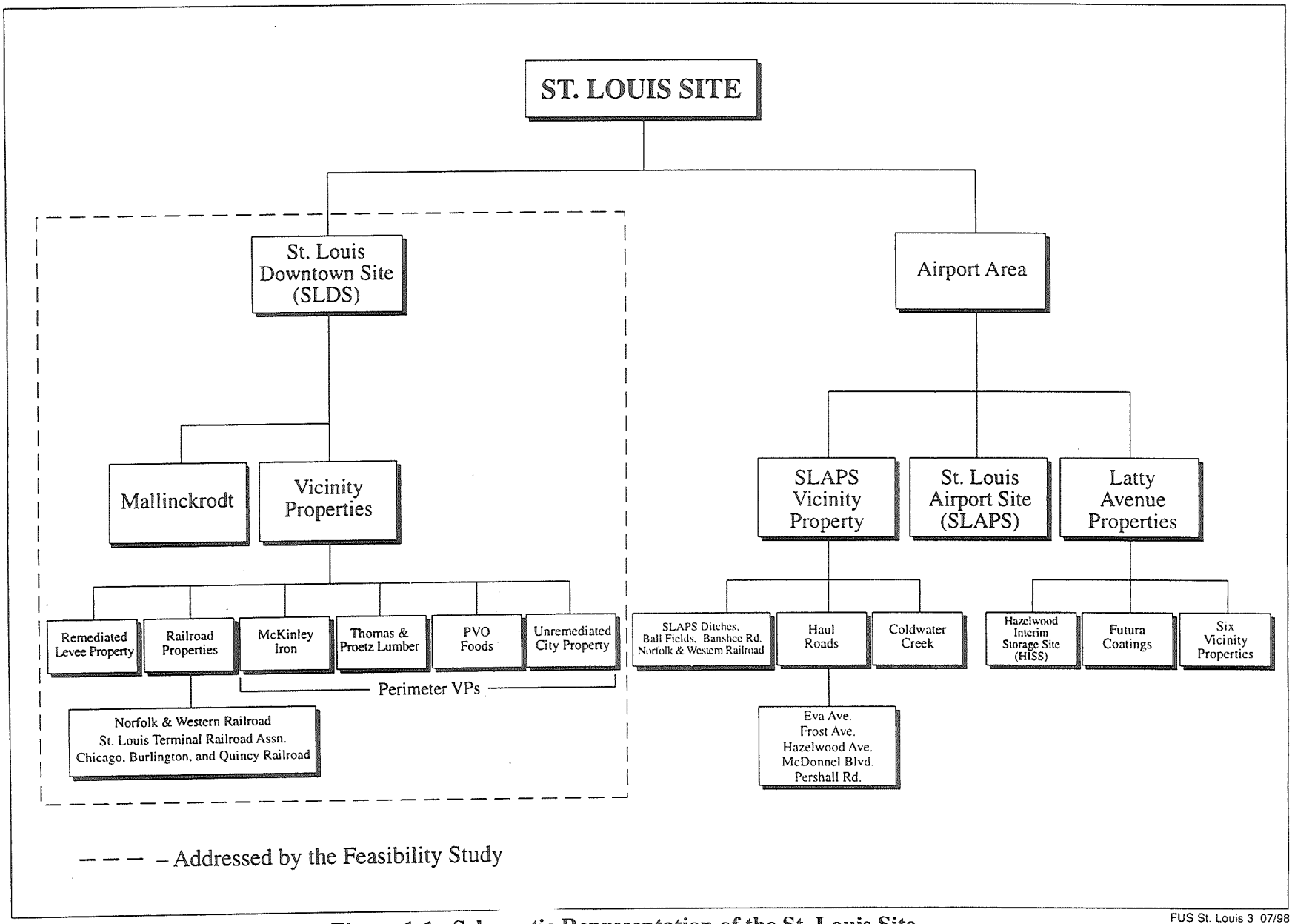
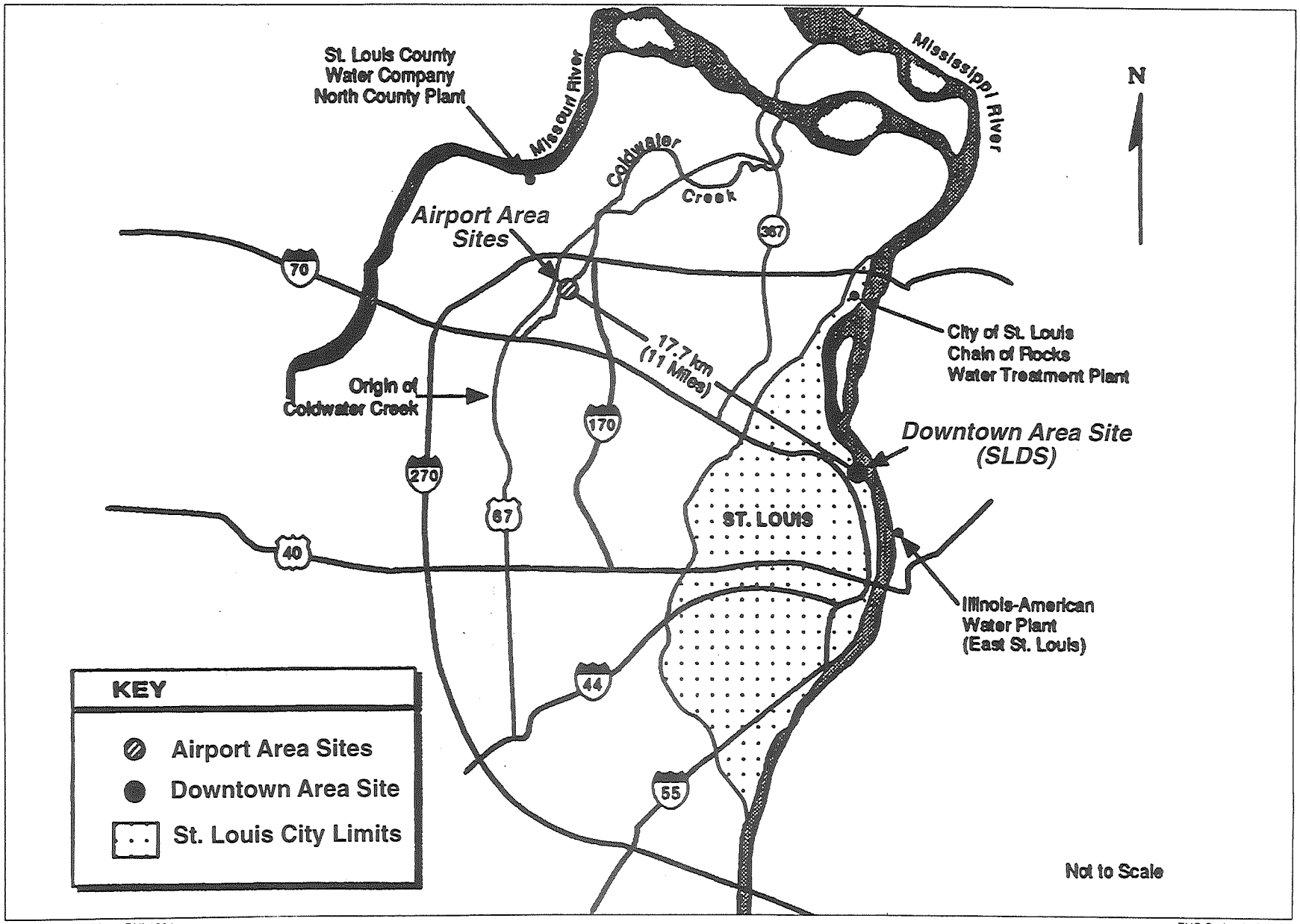


Figure 1-1. Schematic Representation of the St. Louis Site



Source: Modified from BNI 1991

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Figure 1-2. Locations of FUSRAP Properties in the St. Louis, Missouri Area

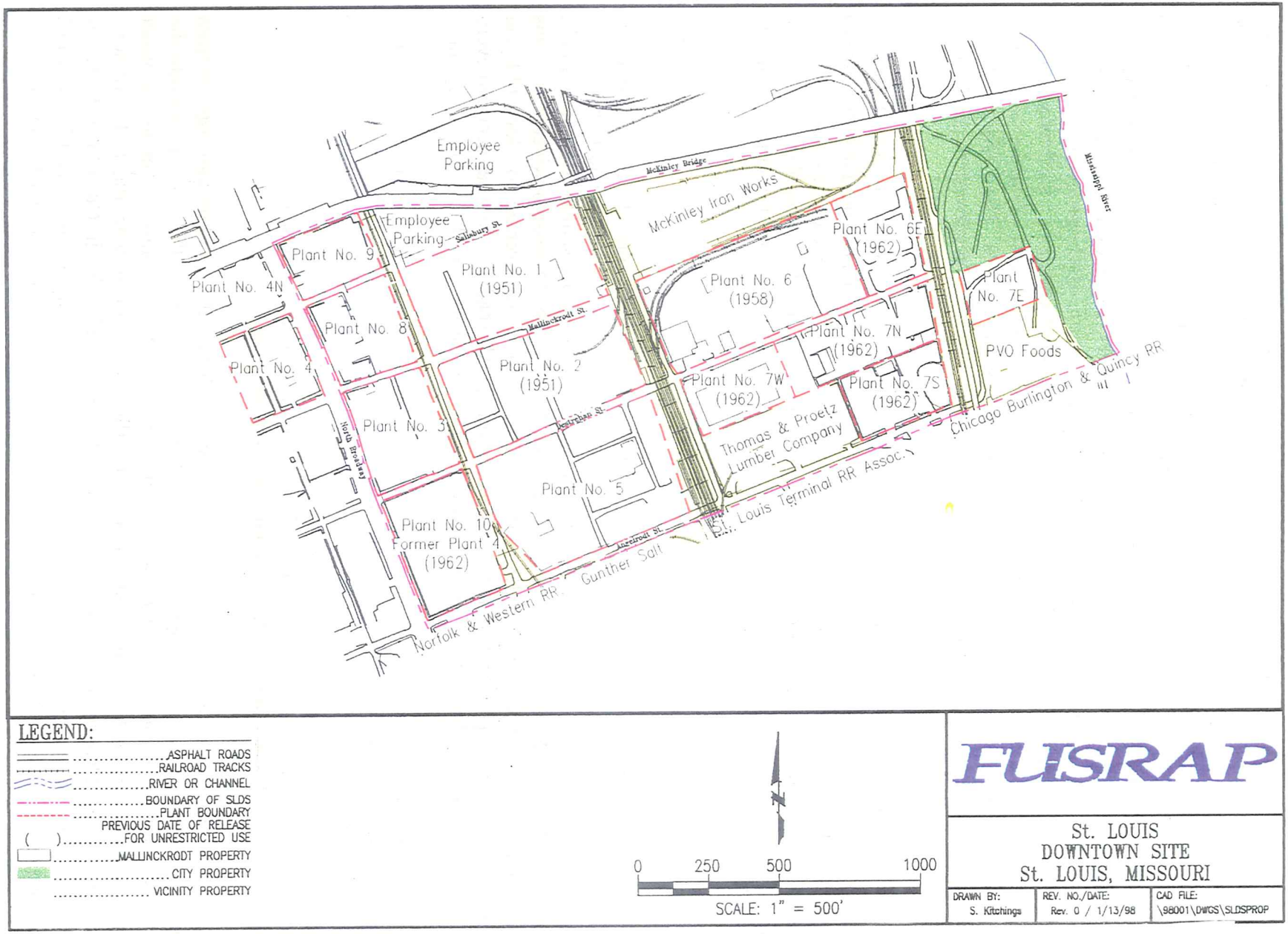


Figure 1-3. Plan View of the St. Louis Downtown Site

employees and visitors from excessive exposure to site contaminants. Zoning regulations prohibit new residences from being established in the area and state regulations require "a well shall be ...constructed ...exclude all known sources of contamination from the well, including sources of contamination from adjacent property" (10 CSR 23-3 010 (1) (A) (4). Two VPs, the McKinley Iron Company and the Thomas and Proetz Lumber Company, are used for commercial or industrial purposes. A third commercial operation, PVO Foods, has closed and the property has been abandoned. Three other VPs are the Chicago, Burlington, and Quincy Railroad; the Norfolk and Western Railroad; and the St. Louis Terminal Railroad Association, which transect the SLDS from north to south. These railroads are actively used as transportation corridors. A VP owned by the City of St. Louis is located between Mallinckrodt and the Mississippi River. With the exception of a recreational bike trail installed in 1997, the City Property is undeveloped. The closest residential dwelling is located on North Broadway, 60 m (200 ft) southwest of the southwestern corner of the SLDS.

The SLDS, as well as most properties east of Broadway and south of Merchants Bridge, has been used as an industrial area for well over a century. The area is currently zoned industrial, which does not allow residential land-use. Some uses allowed within this zone under conditional use permit are acid manufacture, petroleum refining, and stockyards. The long-term plans for this area are to retain the industrial uses, encourage the wholesale produce district, and phase out the remaining, marginal residential uses.

1.2.2 Topography, Drainage, and Surface Water

St. Louis is located in an area of gently rolling uplands which gradually flattens out to the north and east in Illinois. The hilly terrain is cut by several broad river valleys (up to 16 km [10 mi] wide) with steep bluffs. The Illinois and Mississippi Rivers join northwest of the City of St. Louis, to be joined by the Missouri and Meramec Rivers from the west. The Mississippi River at St. Louis has a drainage area of approximately 1.8×10^6 km^2 (700,000 mi^2). The average flow for a 114-year period is 5×10^6 m^3/s [177,000 cubic feet per second (cfs)]. Although flooding has occurred every month of the year, higher flows are usually associated with snow melt and heavy rains in spring.

The water quality of the Mississippi River in the St. Louis area is fair to good and generally meets the water quality standards set by the State of Missouri. Increased levels of polychlorinated biphenyls (PCBs) present downstream from St. Louis suggest that a significant source of PCBs is present in the St. Louis area. No PCBs have been found at the SLDS. The Mississippi, Missouri, and Meramec Rivers supply 97 percent of the 4.5 billion liters (1.2 billion gallons) per year of drinking and industrial water for the St. Louis metropolitan area.

The SLDS is on the western bank of the Mississippi River, 20 km (13 mi) downstream from the confluence of the Mississippi and Missouri Rivers. Runoff from the SLDS flows into the Mississippi River through an underground drainage system. All St. Louis-area municipal water intakes are located upstream of the SLDS except the Illinois-American Water Plant. The Illinois-American Water Plant supplies a small percentage of the water required by the City of East St. Louis, Illinois. The Illinois-American Water Plant intake is located approximately 12 km (8 mi) downstream of the SLDS on the opposite bank of the Mississippi River. The intake is sufficiently

far from any potential SLDS release points to preclude the possibility of intake of significant contamination from SLDS.

1.2.3 Geology/Soils

The geologic history of the St. Louis area is characterized by the cyclic deposition of 1,800 m (6,000 ft) of Paleozoic sandstones, shales, limestones, and dolomites. These layers thicken into the Illinois Basin to the east and toward the Ozark Dome to the southwest. They are nearly horizontal, dipping less than 1 degree to the northeast as a result of uplift of the Ozark Dome.

The stratigraphic section of interest for this site consists of the Pennsylvanian and Mississippian bedrock and the overlying Pleistocene and recent nonlithified sediments. The surficial sediments consist of sand, silt, and clay that typically range from less than 1.5 m (5 ft) to more than 30 m (100 ft) thick. These surficial deposits originated from multiple sources: glacial outwash consisting of mixtures of clay, silt, sand, and gravel; silts and clays deposited in glacial lakes; wind-deposited loess; and deposits from the Mississippi and Missouri rivers.

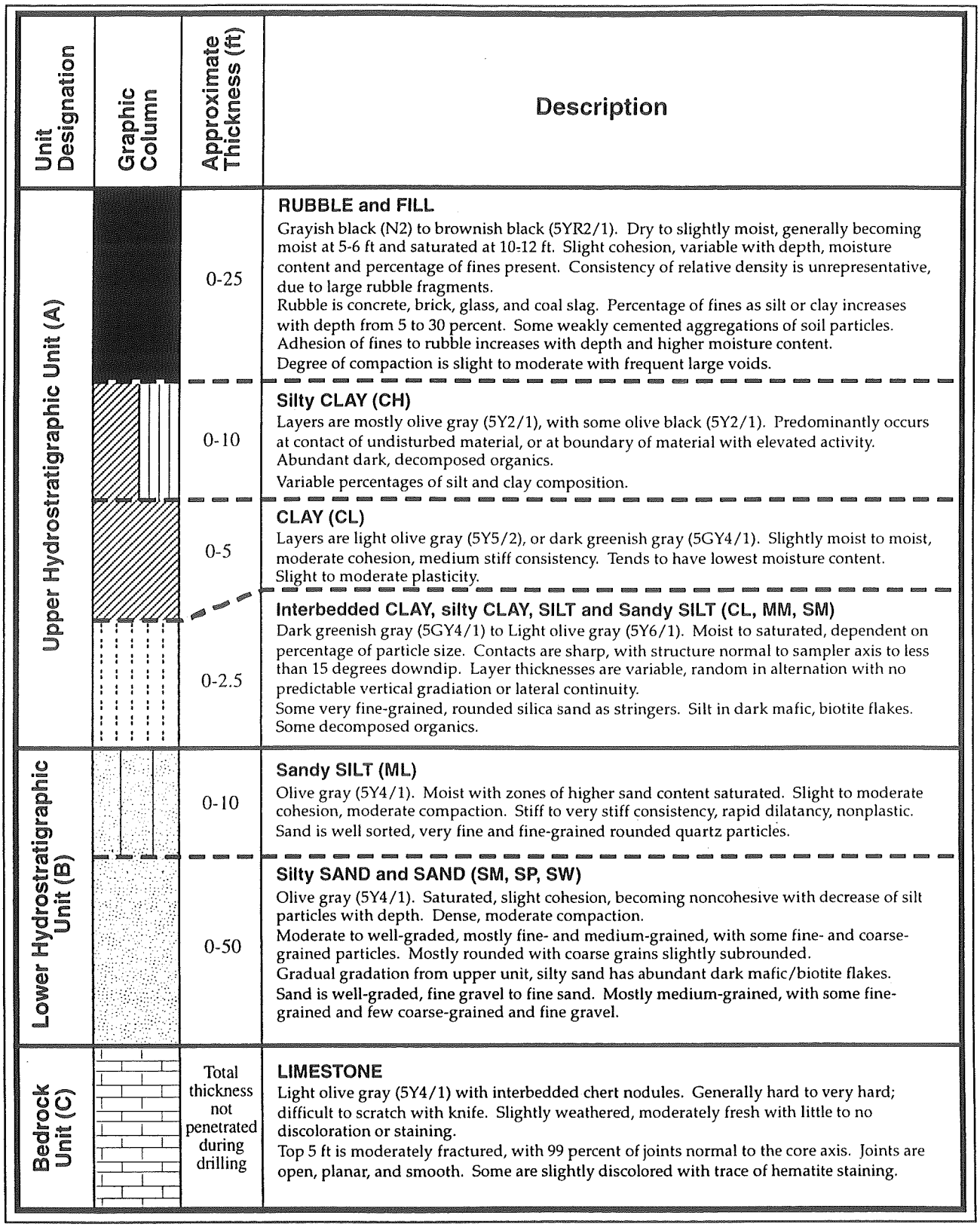
The SLDS stratigraphy (Figure 1-4) is characterized from surface to bedrock by a fill layer present over most of the property with an average thickness of 4 m (13 ft) and nonlithified alluvial deposits of stratified clays, silts, sands, and gravels which are located beneath the fill. Industrial fill has been placed on top of the original floodplain to depths of up to 9m (30 ft) as the area has been developed.

Limestone bedrock of Mississippian age underlies the unconsolidated sediments at a depth ranging from 6 m (19 ft) on the western side of the SLDS to 24 m (80 ft) near the Mississippi River.

1.2.4 Hydrogeology/Ground Water

Ground water at the SLDS is found within three horizons (or hydrostratigraphic units): the upper, nonlithified (soil) unit, referred to as the "A Unit;" the lower, nonlithified unit, referred to as either the Mississippi Alluvial Aquifer or the "B Unit;" and the bedrock (the lithified water-bearing unit), referred to as the "C unit" (Figure 1-4). The Mississippi Alluvial Aquifer is the principal aquifer in the St. Louis area, including the SLDS area. Aquifers in this region also exist in the bedrock formations underlying the alluvial deposits. Ground waters of the St. Louis area are generally of poor quality and do not meet drinking water standards without treatment. Expected future use of ground water at the SLDS is minimal, since the higher quality and large quantity of the Mississippi and Missouri Rivers is readily available.

The A Unit is heterogeneous and the youngest of the three hydrostratigraphic horizons. This young horizon overlies the B Unit on the east and bedrock on the west at the SLDS. The A Unit has the largest range of soil constituents and thus a great spread in hydraulic conductivities spatially. This uppermost unit does not have water levels or flow directly related to the river stage. The base of the A Unit consists of fine-grained deposits behind the Mississippi River's natural levee. The A Unit also had meandering creeks and swampy low topography prior to the introduction of fill material. In the 1800's the A Unit's surface was raised with the least expensive, most readily



Note: The codes in parentheses following lithologies are the Unified Soil Classification Systems codes.

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Source: Modified from BNI 1992

Figure 1-4. Generalized Stratigraphic Column for the SLDS

available fill materials: rubble and wood and coal combustion wastes, e.g., coal slag and cinders. The combustion products used for fill had inherently high metal concentrations. The infiltration and throughput of water in the A Unit is relatively minor, since the ground surface has large areas of buildings, road surfacing, and channeled surface water flow. This shallow unit is not a productive source of water due to poor yield and its multiple chemical constituents. The A Unit is not an aquifer and is not considered a potential source of drinking water because it has insufficient yield, poor natural water quality, and susceptibility to surface water contaminants of the industrial setting. The long-term industrial filling of the site and the present industrial setting also are factors in the consideration that the A Unit, the most shallow hydrostratigraphic horizon, is not a drinking water resource.

The B Unit thins westwardly on the rock surface until it becomes absent beneath the SLDS, being truncated by the rising bedrock and the A Unit (Figure 1-5). The B Unit may attain a thickness of 20 m (70 ft) to the east at the river. The ancestral Mississippi River deposited the B Unit's sediments after the river's greatest erosion of the bedrock floor. Unit B is a horizon of fining-upward, interfingered and crosscut sands and gravels with direct hydraulic connection to the Mississippi. The granular nature and association with the river allows the B Unit to have unique chemical and hydraulic character. The B Unit has high dissolved solids and metal concentrations (iron and manganese above their Secondary Maximum Contaminant Levels, SMCLs). The dissolved solids and metal content are naturally occurring. The aquifer's pressure and flow direction react to changing river stages. The source of the B Unit's ground water recharge at low river stages is upgradient flow from the bedrock unit and minor downward infiltration from the A Unit. Water at high river stages, or under heavy pumping loads, is predominantly from the Mississippi. Recharge from the B Unit aquifer is available at high volumetric rates. Extracted water from the B Unit would require treatment to reduce the natural total dissolved solid and metal content. The use of the B Unit for a drinking water resource is highly unlikely for several reasons: the industrial setting of the SLDS, the site's proximity to both the Mississippi and the city's drinking water supply, and the poor natural water quality of the B Unit. However, the B Unit does qualify as a potential source of drinking water under the "Guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy" (Final Draft, December, 1986).

The C unit surface slopes from the western uplands to the river. The limestone bedrock has nearly horizontal bedding, which slopes only a few degrees to the east. Solution channels and fractures dominate the water routes through the bedrock. Uplands recharge of the C unit flows downgradient to the river valley providing recharge to the B Unit, the Mississippi Alluvial Aquifer. The C unit would be an unlikely water supply source, as it is deeper and a less productive hydrostratigraphic unit.

1.2.5 Ecology

The St. Louis Downtown Site is located in the Oak-Hickory-Bluestem Parkland section of the Prairie Parkland Province. Topography is gently rolling with low bluffs north of the Missouri. Presettlement vegetation is characterized by deciduous woodlands intermixed with open prairie. Today, because of extensive industrialization, little presettlement vegetation exists in the area including the St. Louis Downtown Site.

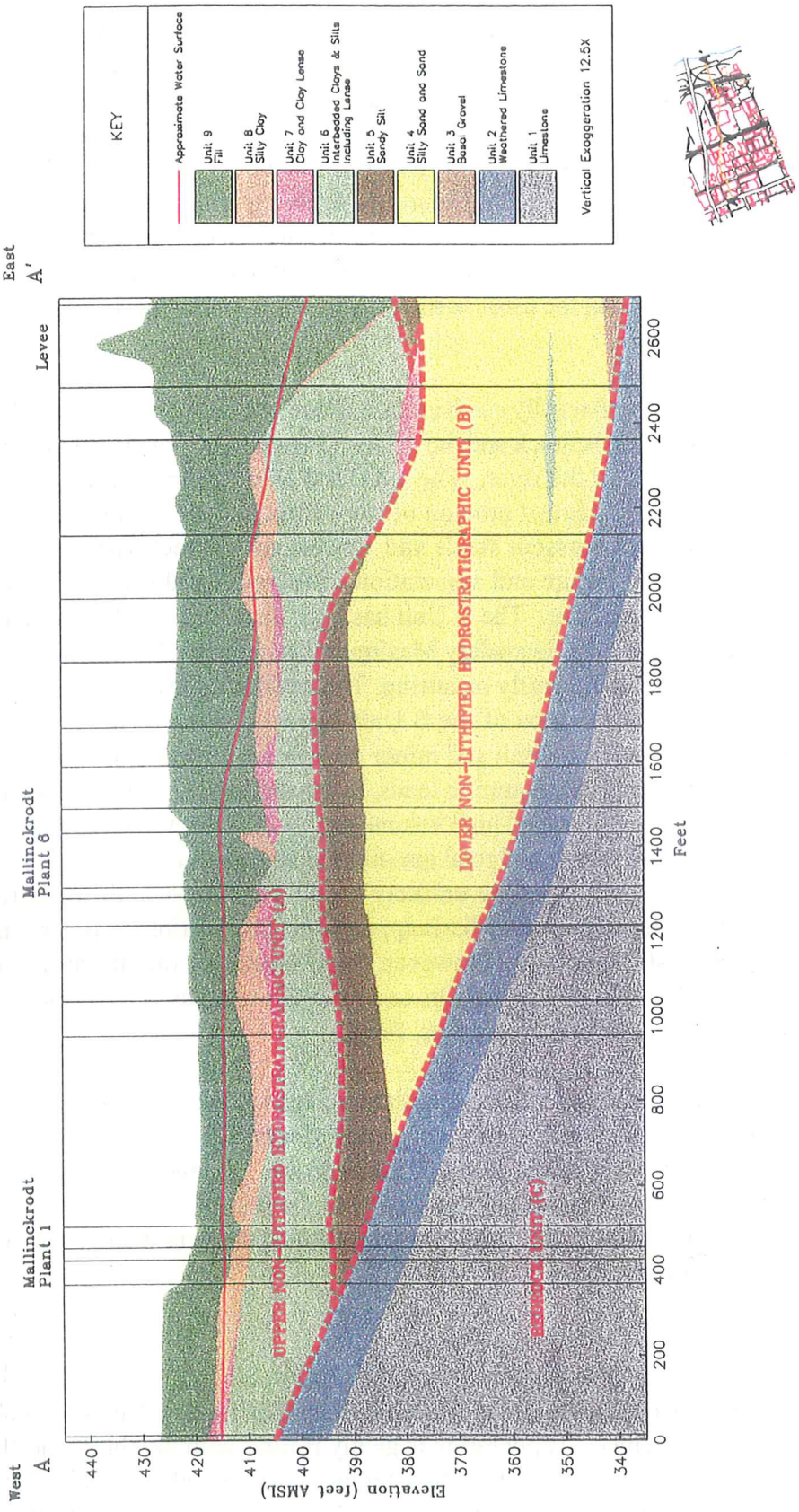

Figure 1-5. Hydrostratigraphic Units of the SLDS area

The SLDS is completely developed; therefore, almost no biological resources exist on or near the SLDS. This is related to several decades of highly urbanized land uses surrounding the site. The only animals observed at the SLDS during the site survey were insects (e.g., ants) and swifts (Chaetura pelagica), red-winged blackbirds (Agelaius tricolor), and pigeons (Columba livia) flying through the area. Small mammals, particularly house mice (Mus musculus) and rats (Ratus sp.) have habitat in the area.

1.2.6 Archaeological and Historical Sites

Two sites listed in the March 1992 edition of the National Register of Historic Places for the State of Missouri exist within a 1.6-km (1-mi) radius of the SLDS. The first site is the Bissell Street Water Tower, located approximately 1.3 km (0.8 mi) northeast of the SLDS. The second is the Murphy-Blair Historic District located 0.8 km (0.5 mi) from the SLDS.

SLDS does not contain any historic buildings. Available data indicate no archaeological sites in the area. Consultation with the State Historic Preservation Officer has been completed. However, no archaeological survey of the property itself has been conducted. The site is covered by a fill layer averaging 4 m (13 ft) which overlies alluvial deposits extending to 24.0 m (80 ft). The degree of disturbance beneath the fill layer is not presently known. The property is approximately 0.4 km (0.25 mi) from the former location of an American Indian mound group, the St. Louis Mounds.

2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

Mallinckrodt Inc., since 1867 at this facility, has used, blended, and/or manufactured chemicals, including organics (e.g., 1,2-dichloropropane, dichloromethane, phenol, zinc phenolsulfonate, toluene, hexane, dimethylaniline, chloroform, alcohols, propanediols, nitrobenzene, nitrophenols, xylenes, trichloroethene, hexachlorobutadiene, oxydianiline tars, stearates, biphenyls, acetonitrile), and inorganics (e.g., aluminum chloride, hydroxide salts, zinc, sulfuric acid, nitric acid, hydrochloric acid, chromium, sodium iodide, magnesium salts, palladium, bismuth oxychloride). A number of chemicals and compounds that have been associated with non-MED/AEC operations have been detected in soil and ground water. A levee/floodwall located to the east of the SLDS protects the area from flood waters.

Mallinckrodt Chemical Works, from 1942 until 1957, was contracted by MED and AEC to process uranium ore for the production of uranium metal. Residuals of the process, including spent pitchblende ore, process chemicals, and radium, thorium, and uranium, were inadvertently released from the Mallinckrodt Property and into the environment through handling and disposal practices. Residuals from the uranium process had elevated levels of radioactive radium, thorium, and uranium. From 1942 to 1945, Plants 1, 2, and 4 (now Plant 10) (Figure 1-3) were involved in the development of uranium-processing techniques, uranium compounds and metal production, and uranium metal recovery from residues and scrap. Uranium-bearing process residues from these operations were stored at the SLAPS and the Latty Avenue Properties from 1946 to 1966. Relocation and storage of these processed wastes at SLAPS and the Latty Avenue Properties resulted in the subsequent contamination of the SLAPS VPs. Mallinckrodt decontaminated Plants 1 and 2 from 1948 through 1950 to meet the AEC criteria then in effect, and the AEC released these plants for use without radiological restrictions in 1951.

Plant 6 produced uranium dioxide from pitchblende ore starting in 1946. During 1950 and 1951, Plant 10 was modified and used as a metallurgical pilot plant for processing uranium metal (until it was closed in 1956) and operations began at Plants 6E, 7, 7E, 7N, and 7S. AEC operations in Plant 6E ended in 1957. AEC managed decontamination efforts (removal of radiologically contaminated buildings, equipment, and soil disposed offsite) in Plants 10, 7, and 6E to meet AEC criteria in effect at that time and returned the plants to Mallinckrodt in 1962 for use without radiological restrictions. Since 1962, some buildings have been razed, and new buildings have been constructed at Plants 10 and 6. Except for Building 25, which will be addressed under a separate CERCLA action, the MED/AEC related buildings have recently been razed, making previously inaccessible contaminated soils available for cleanup.

Process, storm, and sanitary effluent from the SLDS was collected in a combined sewer system for discharge directly to the Mississippi River through a municipal outfall, before the Bissell Point Sewage Treatment Plant went on line in December 1970,. The Bissell Point Sewage Treatment Plant is approximately 1 mile north of the SLDS. After the Bissell Point Sewage Treatment Plant went on line, dry weather sewer flow was collected for treatment prior to release to the river. Mallinckrodt, Inc.'s discharge permit states that discharge of the wastewater shall not be at a rate that would cause the influent at Bissell Point to exceed the 1 Curie per year limit. In times of heavy

stormwater flow, when the capacity of the interceptor tunnel under the SLDS is exceeded, excess flow in the municipal sewer is discharged directly into the river.

A radiological survey conducted in 1977 at the SLDS found that alpha and beta-gamma contamination levels exceeded guidelines for release of the property for use without radiological restrictions (ORNL 1981). Elevated gamma radiation levels were measured at some outdoor locations and in some of the buildings formerly used to process uranium ore. Radium (Ra)-226 and uranium (U)-238 activities were found significantly above background in subsurface soil. Additionally, radon and radon daughter activities in two buildings exceeded guidelines for nonoccupational radiation exposure. In response to this survey, it was determined that further investigation was necessary to characterize the nature and extent of contamination, and possible remedial actions to mitigate threats to human health and the environment.

Four interim actions have been performed at SLDS. A summary of these actions is provided in Table 2-1. Actions taken at the site will be conducted under the Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP was executed by the U.S. Department of Energy (DOE) to identify and remediate or otherwise control sites where residual radioactivity remains from activities conducted while under contract to MED and AEC during the early years of the nation's atomic energy program or from commercial operations that Congress directed DOE to remediate and that DOE added to the FUSRAP sites. On 13 October 1997, the U.S. Congress transferred responsibility for FUSRAP from the U.S. Department of Energy (DOE) to the USACE through the 1998 Energy and Water Development Appropriations Act. In June 1990, EPA Region VII, and DOE entered into a CERCLA Section 120 Federal Facilities Agreement (FFA). In the FFA, DOE agreed to conduct response actions for the following materials:

- All wastes, including but not limited to radiologically contaminated wastes, resulting from or associated with MED/AEC uranium manufacturing or processing activities conducted at the SLDS.

- Other chemical or radiological wastes that have been mixed or commingled with wastes resulting from or associated with MED/AEC uranium manufacturing or processing activities conducted at the SLDS.

The ROD addresses contamination related to MED/AEC activities in accessible soils and ground water. SLDS Buildings 101 and 25 and St. Louis Site's currently inaccessible soils related to MED/AEC activities will be remediated under a future CERCLA action.

In addition, there are two other major environmental contaminant abatement efforts underway at the Mallinckrodt Property. Mallinckrodt, Inc. is pursuing a RCRA Part B permit for their entire facility and is also attempting to terminate their NRC license for the Columbium/Tantalum process conducted in the Plant 5 area. Columbite is the mineral name for (Fe, Mn)Nb_2O_6. Tantalite is the mineral name for (Fe, Mn)Ta_2O_6.

The USACE will continue to cooperate with the EPA, the State of Missouri and Mallinckrodt, Inc. to ensure that response actions are coordinated so that all site threats are addressed.

Table 2-1. Interim Actions at SLDS Since April 1994

Property	Activities	Volumes Remediated*	Authorizing Document
50 Series Buildings (Bldgs. 50, 51, 51A, 52, and 52A)	Decontamination, demolition, and crushing	1,000 yd^3 shipped off-site; 1,000 yd^3 of crushate stockpiled in a fenced area on Mallinckrodt Inc. property	DOE/OR/23701-02.2
Plant 6 and 7 Buildings (Bldgs. 100, 116, 116B, 117, 700, 704, 705, 706, 707, and 708)	Asbestos abatement, decontamination, demolition to floor elevation grade, crushing	2,673 yd^3 shipped off-site; 7,000 yd^3 of crushate stockpiled on the Mallinckrodt Inc. property, Lot 7E	DOE/OR/23701-02.2
Plant 10 area subsurface soil	Excavation	15,043 yd^3 shipped off-site	DOE/OR/23701-02.2
City Property (Riverfront Trail area)	Excavation	750 yd^3 shipped off-site	DOE/OR/23701-02.2

* These are the volumes shipped. They are greater than the in situ impacted volumes because they include any extra soil to assure removal and the bulking (volume increase) that results from excavation.

Source: DOE 1991. *Engineering Evaluation/Cost Analysis for Decontamination at the St. Louis Downtown Site*, St.Louis, MO, DOE/OR/23701-02.2, May.

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3. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Public input has been encouraged by both DOE and the USACE to ensure that the remedy selected for the SLDS meets the needs of the local community in addition to providing an effective solution to the problem.

The Administrative Record, which contains the documentation used to select the response action, is available at the following locations:

Government Information Section
St. Louis Public Library – Central Library
1301 Olive Street
St. Louis, MO 63101

USACE Public Information Center
9170 Latty Avenue
Hazelwood, MO 63134

DOE published a Notice of Intent in the Federal Register on January 9, 1992, to present pertinent background on the scope and content of the St. Louis site RI/FS. The comments, concerns, and written statements from a January 28, 1992 public scoping meeting held at Berkeley Senior High School, Berkeley, Missouri, were published in a Responsiveness Summary and made part of the St. Louis work plan for the RI/FS. In addition, the relevant comments from a December 6, 1990 scoping meeting on the programmatic environmental impact statement were also included in the work plan.

A copy of the Administrative Record File for actions at the SLDS has been maintained by the USACE and DOE at the Public Information Center and the St. Louis City Public Library and is updated quarterly. The community relations program interacts with the public through news releases, public meetings, availability sessions, site tours, public workshops, meetings with local officials and interest groups, and receiving and responding to public comments through correspondence and the information center. The documents describing the results of the integrated process for the St. Louis site have been made available to the public for review and comment at the information repositories noted above. The following documents were issued by USACE and DOE:

- The *Remedial Investigation for the St. Louis Site* (DOE 1994) and the *Remedial Investigation Addendum for the St. Louis Site* (DOE 1995) characterizes the nature and extent of contamination at the site.

- The *Baseline Risk Assessment for the Exposure to Contaminants at the St. Louis Site* (DOE 1993) evaluates the potential risk to human health and the environment from contaminants associated with the site in the absence of any remedial action.

- The *Feasibility Study for the St. Louis Downtown Site* (USACE 1998a) identifies, develops, and evaluates remedial action alternatives for the site based on the nature and extent of contamination documented in the RI.

- The *Proposed Plan for the St. Louis Downtown Site* (USACE 1998b) summarizes background information on the St. Louis site, describes the alternatives considered to clean up the site, presents the rationale for selection of the preferred remedy, and solicits public comment.

From September 1994 through December 1996, a task force known as the St. Louis Site Remediation Task Force studied all aspects of the St. Louis FUSRAP site and formally transmitted the results of their deliberations to the U.S. Department of Energy in the *St. Louis Site Remediation Task Force Report* (September 1996). Specific areas of focus included: 1) identification of alternative disposal sites, 2) health risks/cleanup standards, 3) development of local priorities with respect to cleanup of the site, 4) identification of remedial action alternatives, 5) a screening of technologies that may be applied at the site, and the 6) development of a communications and public awareness plan.

The task force was composed of members appointed by the city and county of St. Louis, adjacent communities, EPA, MDNR, concerned citizens, public utility and local business representatives, representatives of congressmen, and representatives of local environmental groups.

In their summary report, the following statement was provided in Section 4, titled Conclusions and Recommendations. "Further, the Task Force requests that remediation at the St. Louis Downtown site and the City Levee continue or begin with 'site specific' standards for industrial or recreational use, respectively."

The FS and Proposed Plan were released for public comment on April 8, 1998. The public was notified of the public comment period for the Proposed Plan through public mailings, notices in the regional metropolitan and rural newspapers, announcements on local radio stations, and notices delivered to residences in the nearby neighborhood.

The 30-day public comment period began on April 8, 1998. A public meeting was held on April 21, 1998 to provide information about the remedial alternatives and the opportunity to submit comments on the Proposed Plan. A Responsiveness Summary was prepared to address comments received during the public comment period. In general, public comments on the Proposed Plan rejected the USACE preferred alternative (Alternative 4) as too restrictive for property owners; a strong preference for Alternative 6 was expressed by the community. Based on community input and reevaluation of CERCLA cost and risk criteria, the USACE selected Alternative 6 for implementation at the site. The Responsiveness Summary is provided in Appendix A of this ROD.

4. SCOPE AND ROLE OF OPERABLE UNIT

This operable unit is the final remedial action for the accessible soil and ground water contaminated as the result of MED/AEC uranium manufacturing and processing activities at the St. Louis Downtown Site (SLDS). The subsequent response action includes remediation of the two remaining MED/AEC related buildings (buildings 25 and 101) and soil which is currently inaccessible because of the presence of the two buildings, active rail lines, roadways, and the levee. Previously cleaned up properties addressed under removal authority are described in Table 2-1 and include Plant 10 (City Block 1201) and the land east of the levee (DOE 1996, 1997). Remediation of these portions of the site is fully protective and thus they will not require further remediation.

Characterization activities at the SLDS have determined that contamination related to MED/AEC activities is present in the soils of Mallinckrodt, Inc. and VPs at levels that require remedial action. Much of the contamination detected resulted from MED/AEC activities while some of the contamination is the result of other industrial processes associated with Mallinckrodt operations and other nearby industries. Still other contaminants have leached from the coal slag and cinders used as fill in the area. As agreed to under the FFA, hazardous substances resulting from releases on the site during the Mallinckrodt operations for the MED/AEC are the subject of this response action. Contaminants resulting from other actions, or preexisting contaminants at the site are being addressed through actions being carried out by other authorities. This includes both radioactive and hazardous substances which are the responsibility of other parties. The other actions being carried out include termination of a Mallinckrodt NRC license for plant 5 and a RCRA action for the entire Mallinckrodt site. EPA, NRC, the State of Missouri and Mallinckrodt, Inc. are working together to assure that all remaining potential hazards at the site are addressed.

Inaccessible soils that contain MED/AEC contamination and associated buildings and structures are excluded from the scope of this ROD because they do not present a significant threat in their current configuration and because activities critical to the continued operation of the Mallinckrodt facility prevent excavation beneath the encumbrances (ie, roads, railroads, buildings 25 and 101, etc.). Contamination present within building 25 also does not present an excessive risk under its current configuration.

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5. SUMMARY OF SITE CHARACTERISTICS

A remedial investigation (RI) (DOE, 1994) was conducted in accordance with CERCLA to determine the nature and extent of contamination at SLDS relevant to this operable unit. Analytical results for radiological and chemical characterization surveys are summarized in the RI report (DOE 1994) and the RI Addendum (DOE 1995). Analyses performed during characterization included thorium (Th)-230, Th-232, radium (Ra)-226, uranium (U)-238, volatile organic compounds (VOCs), base neutral and acid extractable compounds, metals, Resource Conservation and Recovery Act (RCRA)-hazardous waste characteristics, pH, specific conductance, total organic halogens and total organic compounds. Characterization activities were performed at SLDS for soil, air, and ground water. In addition, above ground structures associated with MED/AEC processes were surveyed for fixed and transferable radiological contamination. The results of this investigation for the SLDS are summarized here.

Soil characterization results indicated that the areas associated with MED/AEC activities were principally contaminated with radionuclides. Metals and VOCs were also detected in those areas and across the site, but generally occur in limited pockets. The radiological contaminants associated with MED/AEC activities are readily identifiable because of the distinct suite of radionuclides used in the MED/AEC processes and the location where these contaminants were found. However, the source of the detected non-radionuclide contaminants is not as clear. The potential for non-MED/AEC process-related organic and inorganic releases from the Mallinckrodt Inc. facility and surrounding businesses is substantial given the nature and duration of industrial activities in the area. In addition, the non-MED/AEC columbium–tantalum processing activities and the coal combustion products used as fill in the area may have contributed radioactive contaminants as well as metals and polycyclic aromatic hydrocarbons (PAHs). There is no indication of use or generation of PAHs in MED/AEC processes or operations.

Radionuclide Distribution in Soil

The principal radioisotopes associated with the MED/AEC process at the SLDS are Ra-226, Ra-228, Th-230, Th-232, uranium (including U-238, U-235, and U-234) , and their respective radioactive decay products. Analytical results for radiological surveys at the VPs indicate that the primary radionuclide in soil is Th-230. Figures 5-1, 5-2 and 5-3 show the extent of Ra, Th, and U contamination associated with MED/AEC processes at the SLDS. Figures 5-4 , 5-5 and 5-6 illustrate the vertical profile of contaminants based on projections of the boring data. Most of the contamination is distributed near the surface, but does extend to significant depth (23 ft) at Plant 2. Also, inaccessible soils are found at 13 ft under the levee on property owned by City of St. Louis.

Distribution of Metals in Soil

Metals were found in radiologically contaminated soil, however for arsenic, the detection limit for the data collected during the RI exceeds the mean value for background samples collected in a subsequent investigation (SAIC 1998). All the sources of elevated metal concentrations are not defined. Geologic logging confirming anecdotal evidence indicates a probable source of elevated metal concentrations in soil is the coal combustion products used as fill throughout the property

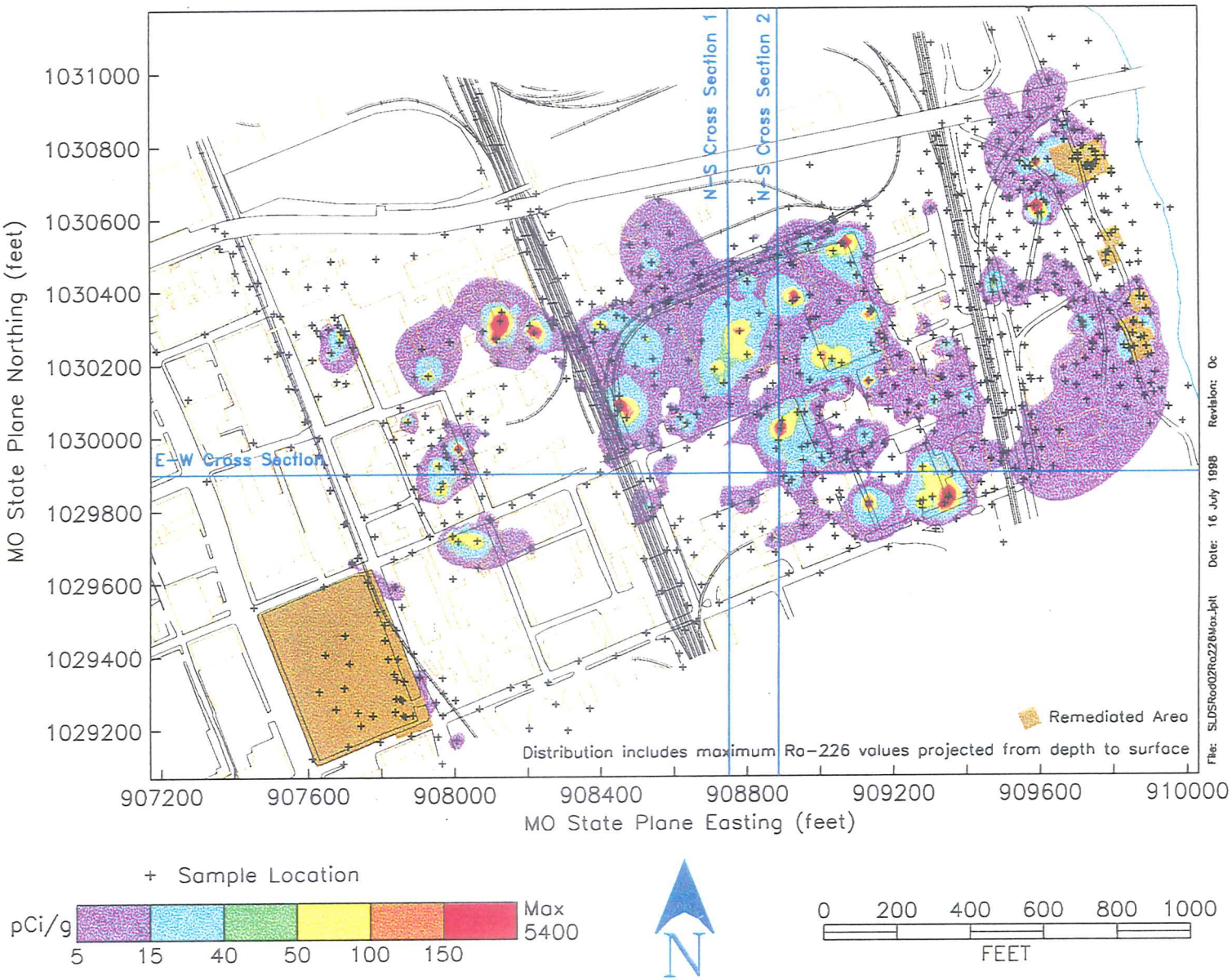

Figure 5-1. Extent of Ra-226 Contamination at SLDS

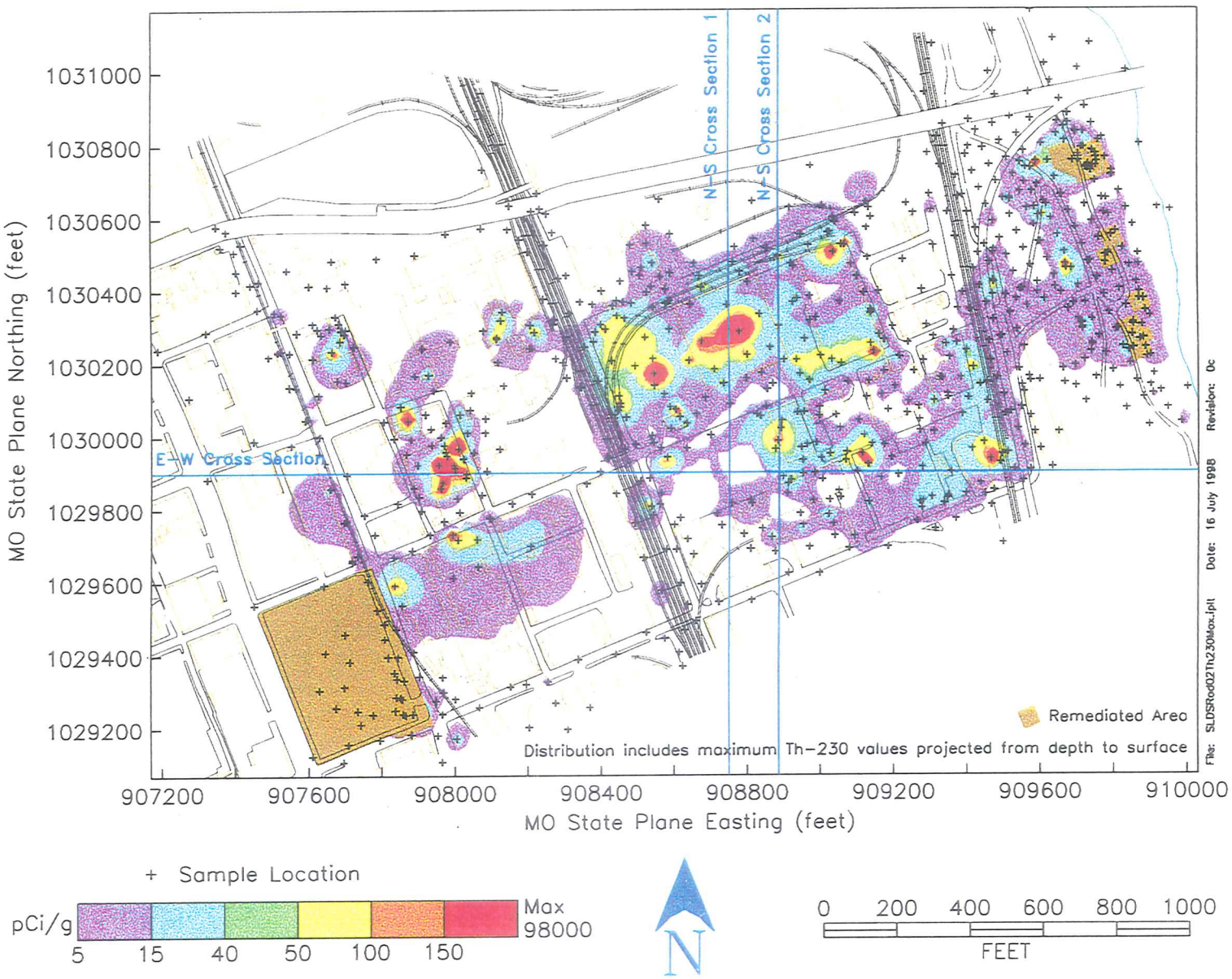

Figure 5-2. Extent of Th-230 Contamination at SLDS

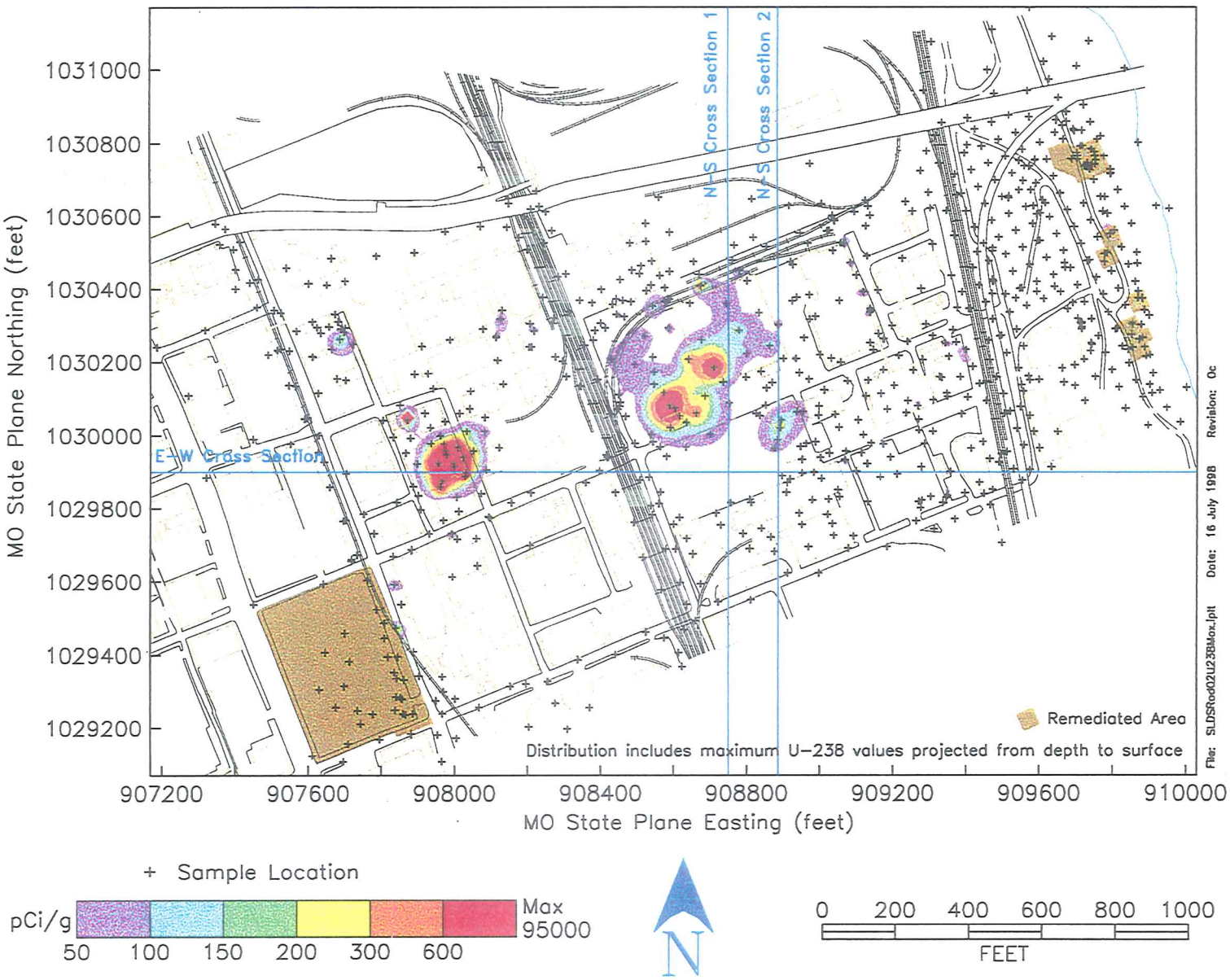

Figure 5-3. Extent of U-238 Contamination at SLDS

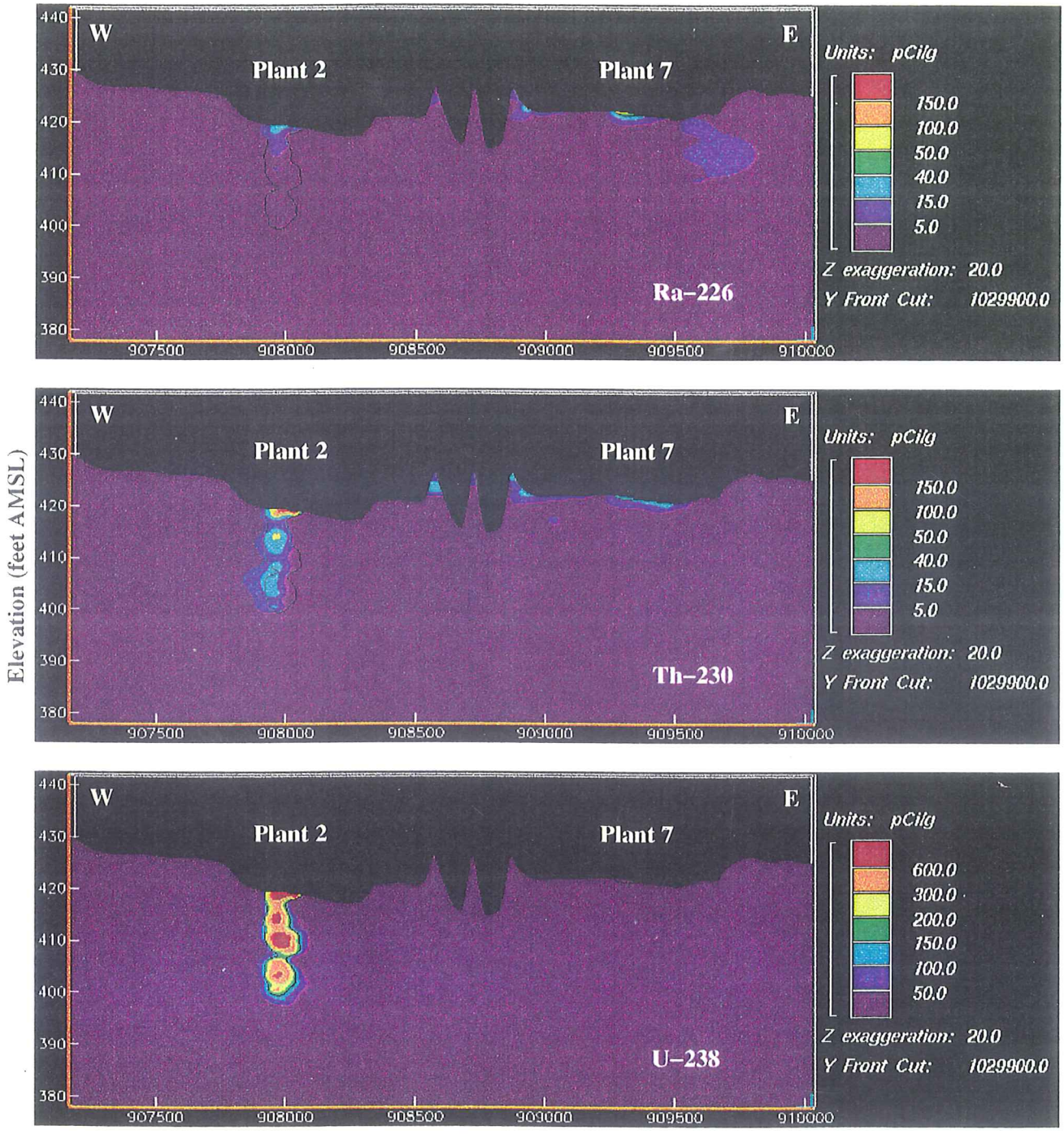

Figure 5-4. Vertical Extent of Contamination at SLDS (East-West Cross Section through Plant 7 and 2)

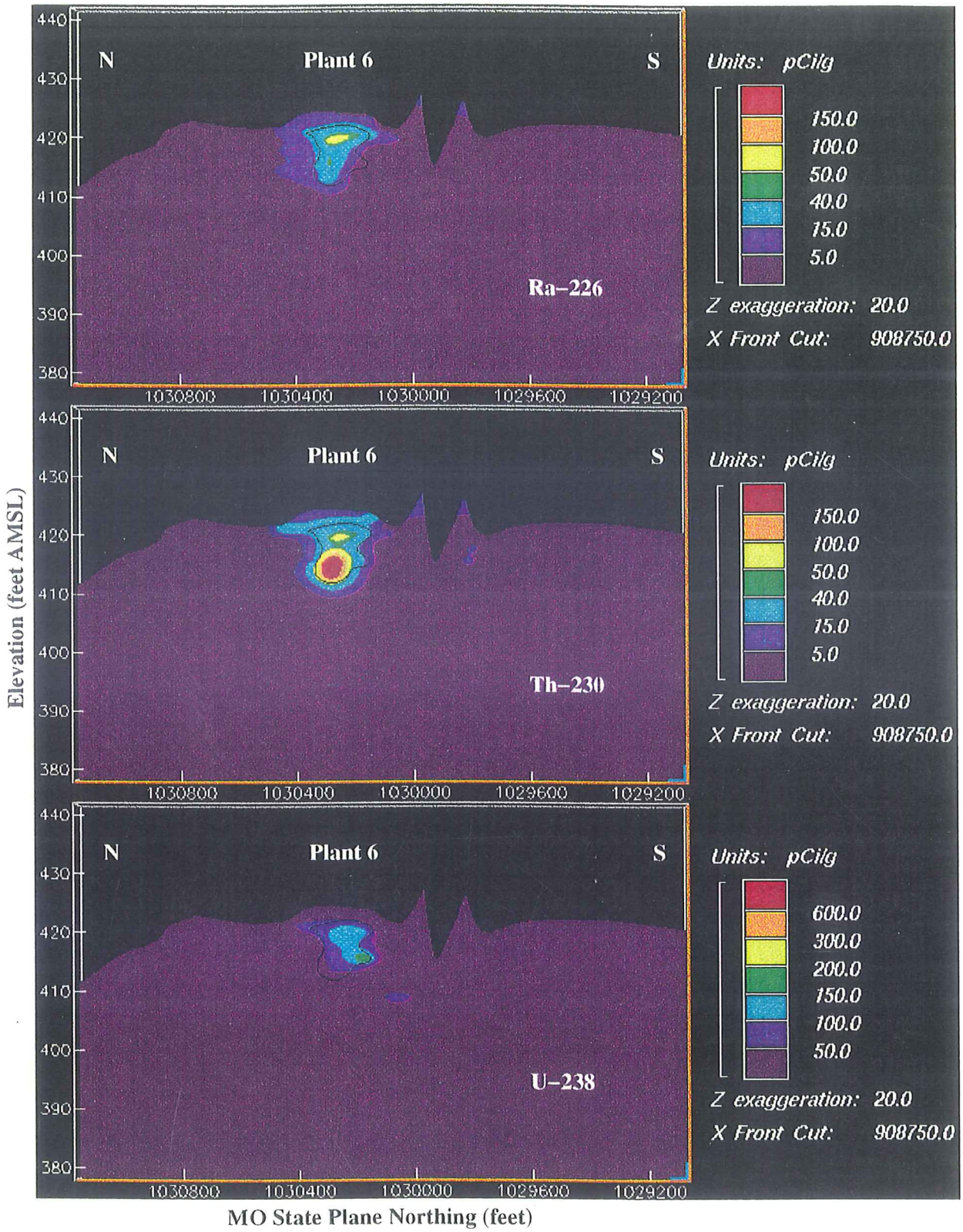

Figure 5-5. Vertical extent of contamination at SLDS North-South Cross Section through Plant 6

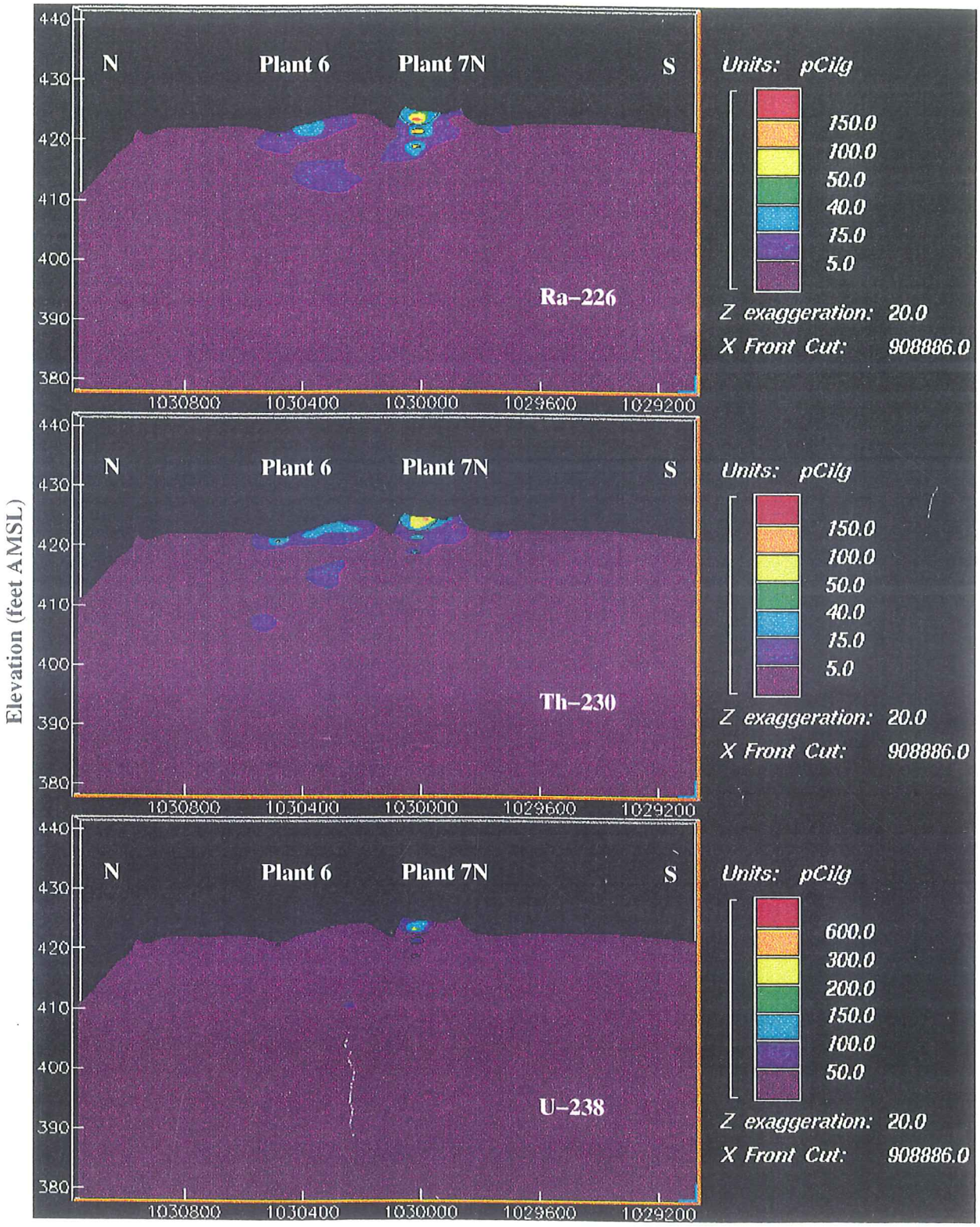

Figure 5-6. Vertical Extent of Contamination at SLDS (North-South Cross Section 2 through Plants 6 and 7

Production of Mallinckrodt products, and uranium processing activities may also have contributed. Based on ore assays, waste analyses, and risk assessment, the metals identified in the FS that may pose a risk and may have AEC/MED origins include arsenic, cadmium, copper, nickel, and uranium.

Table 5-1 summarizes the relevant metal and chemical data from the remedial investigation. Nickel was not detected in the 171 samples at values above average U.S. background (40 mg/kg). Copper was detected in 40 of 171 samples and ranged in concentration from 114 to 1120 mg/kg.

Arsenic was detected in 46 of 171 samples acquired from across the site. The detection limit for arsenic was relatively high, but it was sufficient to distinguish that arsenic is widely distributed, occurring both with other MED/AEC contaminants and randomly distributed across the site. Thirty background samples were collected near the SLDS and arsenic was detected in each in concentrations ranging from 4 to 27 mg/kg (SAIC 1998). While arsenic was identified as being present in the original uranium ore, no clear association could be discerned between the presence of arsenic and the location of MED/AEC radiological constituents. Figure 5-7 shows the distribution of arsenic.

There were 76 detections of cadmium in 171 samples. Soil concentrations ranged from less than 1 mg/kg to 44 mg/kg. As indicated in Figure 5-7, the distribution was both commingled with other MED/AEC contamination and random throughout SLDS independent of other MED/AEC contaminants. Cadmium was detected in 9 of 30 background samples with values up to 3.8 mg/kg (SAIC 1998).

Uranium is characterized based on both its chemical and radiological properties. Site characteristics are addressed as a radiological constituent.

Distribution of Organic Compounds in Soil

Organic compounds commonly found in industrial areas were detected in very low concentrations across the property; approximately two-thirds of these are PAHs. Base/neutral and acid extractables, identified as PAHs, were found in higher concentrations (ranging from 310 to 300,000 μg/kg) than were VOCs, but they are typically not very mobile in soil. No pattern of PAH distribution in soil was discernible across the site; these compounds are randomly distributed. In addition, no evidence has been found that any MED/AEC process used or generated PAHs. Data reviewed included all available information on site history and processes, and analysis of 30 off-site background samples (SAIC 1998). PAHs were detected in 25 of 30 background samples with concentrations to 14,000 μg/kg. Borings exhibiting the highest concentrations of PAHs were widely spaced across the site in Plants 1, 7W, and 10 (BNI 1990). PAHs are widespread in any urban area which has been subject to industrial development since the mid-1800s, and thus can not be attributed to a single process. The PAHs that occurred with the greatest frequency at the site are those associated with coal and coal combustion residues.

One of the last steps in the production of uranium metal at the Mallinckrodt facility was to cast the uranium into the form of hemispheres which resembled derbies. Therefore, the cast uranium hemispheres were known as uranium derbies, or derbies. A single reference from the late 1950's indicated that trichloroethene may have been used to clean uranium derbies (Harrington and Ruehle, 1959) which were produced in the Plant 6 area. No information was provided on the amount of TCE used or length of time over which it was used.

Table 5-1. Distribution of Potential Chemical COCs Detection

Analyte	Detections / # Samples	Minimum	Maximum	Average Detection
Plant 1				
Arsenic (mg/kg)	ND/1	ND	ND	ND
Cadmium (mg/kg)	1/1	16.1	16.1	16.1
Copper (mg/kg)	1/1	203	203	203
Nickel (mg/kg)	ND/1	ND	ND	ND
Plant 2				
Arsenic (mg/kg)	3/13	63.1	65.9	64.9
Cadmium (mg/kg)	5/13	0.97	1.9	1.15
Copper (mg/kg)	1/13	167	167	167
Nickel (mg/kg)	ND/13	ND	ND	ND
Plant 6a				
Arsenic (mg/kg)	ND/4	ND	ND	ND
Cadmium (mg/kg)	3/4	1.40	15.2	5.13
Copper (mg/kg)	2/4	101	113	107
Nickel (mg/kg)	ND/4	ND	ND	ND
Plant 6b				
Arsenic (mg/kg)	4/6	44.60	69.8	60.6
Cadmium (mg/kg)	2/6	3.60	5.5	2.3
Copper (mg/kg)	2/6	109	350	230
Nickel (mg/kg)	ND/6	ND	ND	ND
Plant 6c				
Arsenic (mg/kg)	1/1	84.4	84.4	84.4
Cadmium (mg/kg)	ND/1	ND	ND	1
Copper (mg/kg)	ND/1	ND	ND	ND
Nickel (mg/kg)	ND/1	ND	ND	ND

Table 5-1 Distribution of Potential Chemical COCs Detection (continued)

Analyte	Detections / # Samples	Minimum	Maximum	Average Detection
Plant 7				
Arsenic (mg/kg)	ND/4	ND	ND	ND
Cadmium (mg/kg)	3/4	1.7	3.6	2.47
Copper (mg/kg)	2/4	239	482	361
Nickel (mg/kg)	ND/4	ND	ND	ND
Remainder of Site				
Arsenic (mg/kg)	38/142	40.7	200	64
Cadmium (mg/kg)	62/142	0.95	44.1	2.25
Copper (mg/kg)	32/142	114	1120	289
Nickel (mg/kg)	ND/142	12.6	24.4	20.3

ND = Not Detected

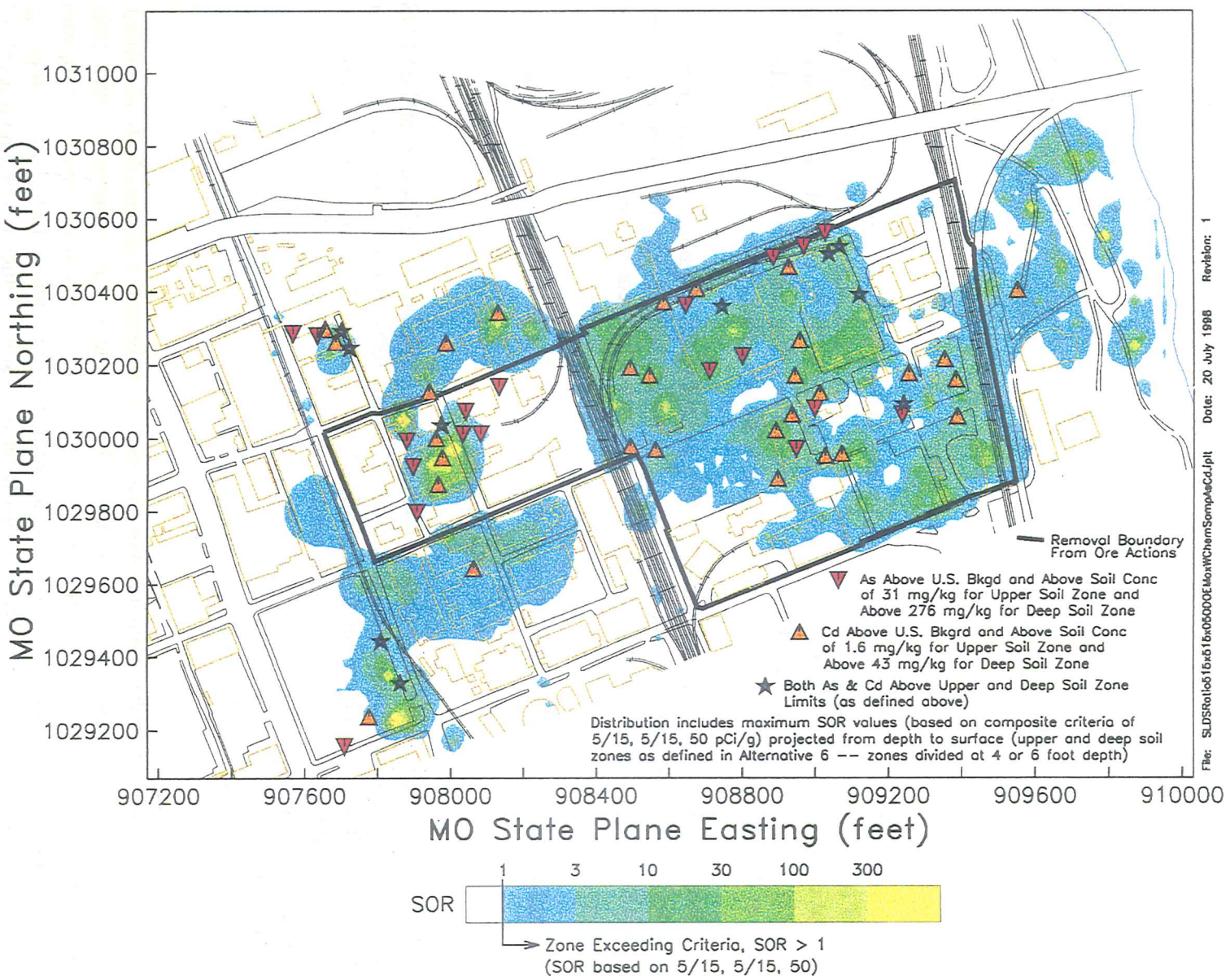

Figure 5-7. Distribution of Metal COCs at SLDS

At least forty-one samples for TCE were acquired from within or near where MED/AEC activities were known to have taken place. Eight detections of TCE were reported. While not as widespread as for cadmium or arsenic, the distribution was random. TCE was detected in 3 of 30 background samples (SAIC 1998).

Chemical sampling over the radiologically contaminated areas for spatial coverage of the site indicates the soil does not exhibit RCRA-hazardous waste characteristics for corrosivity, toxicity characteristic leaching procedure (TCLP), ignitability, or reactivity. In addition, no records or information were discovered that would indicate the environmental media contained any RCRA listed hazardous wastes.

Ground Water

Ground water has been impacted by processes conducted at this industrial location. A number of radiological, organic, and metal analytes were detected in the A Unit's ground water. Significant concentrations of uranium, 1,2-DCE, benzene, PCE, TCE, vinyl chloride, aluminum, arsenic, chloride, sulfate, iron, and manganese were detected in the A Unit. Other industrial activities at the site could have contributed any or all of these analytes.

Fewer analytes were detected in the B Unit's ground water. Significant concentrations of dichloromethane, hexachlorobenzene, 1,2-DCE, vinyl chloride, chloride, iron, and manganese were detected in the B Unit. Other industrial activities at the site could have contributed any or all of these analytes.

Section 6.1 discusses the COCs that are carried forward as part of this operable unit.

Sediments

Sediment samples taken from some of the manholes, catch basins, and sewers at the SLDS exhibited radioactive contamination exceeding composite guidelines. Some sections of these sewer lines are beneath buildings and are therefore considered inaccessible. Based on the observation that contamination levels decrease with increasing distance from the site, there is limited possibility that an accumulation of contaminated sediment of appreciable quantity exists offsite. With increasing development in the area and collection of wastewater for treatment, the water load on the system has increased. This has increased the likelihood that most of the loose deposits in the system have already been scoured away.

Some radiological contamination in Mississippi river sediments was tentatively identified. Sediment sampling was conducted in the Mississippi River along the City Property in 1987–1988 when the river water level was low. Results indicated the primary contaminants were Th-230, with activities ranging from 1 to 160 pCi/g, and Ra-226, with activities ranging from 6 to 1,100 pCi/g. Additional sampling conducted in 1992 to confirm earlier results yielded contaminant levels of <1 pCi/g for both Th-230 and Ra-226. It is suspected that periods of high water between 1988 and 1992 washed the contaminants in the sediment downstream.

6. SUMMARY OF SITE RISKS

A Baseline Risk Assessment (BRA) (DOE 1993) was conducted to evaluate potential risks to human health and the environment from the radioactive and non-radioactive contaminants at the site without regard to the source of contamination. In accordance with EPA guidance, both cancer and non-cancer toxic effects were evaluated for reasonable maximum exposures (RME). The assessment evaluated the potential risks that could develop without cleanup and assumes there are no protective controls in place, such as fencing to control access. In addition, possible effects on animal and plant species (ecological risk) were considered.

The purpose of the BRA is to determine the need for cleanup and to provide a baseline against which the remedial action alternatives are compared. The complete BRA report is available from the Administrative Record File for this site. A brief summary is provided here.

The BRA identified the routes by which people and the environment may be exposed to contaminants present at the SLDS. The SLDS has been industrial for over 100 years. The area is zoned "K" (unrestricted district) by the City of St. Louis. This category allows all uses except residential. Although there are residences near SLDS, the long-term plans for the area are to retain industrial uses, encourage the wholesale produce district, and phase out junk yards, truck storage lots, and the remaining residential uses. Based on past use, present zoning, and long-term planning, future use is most likely to remain industrial as well. Although future residential use is plausible, but unlikely, as a conservative measure the baseline risk assessment evaluated this scenario. Thus risks were calculated for current industrial and construction use and future residential use. In addition, recreational use of the City Property was evaluated. Pathways included external exposure to gamma radiation, particulate and radon inhalation, incidental soil ingestion, and dermal contact. In addition, for the future resident, ingestion of, inhalation of, and dermal contact with ground water were evaluated as well as ingestion of food from a garden grown in contaminated soil. It is the commercial/industrial scenario which is considered the reasonable future use upon which this remedial action is based. The results of the baseline risk assessment are summarized in Section 6.2.

Mathematical models were used to predict the possible effects on human health and the environment from exposure to radionuclides and chemicals for both present and future uses at the site. The results of the BRA were developed using the EPA required reasonable maximum exposure concentrations (representing the highest expected exposures) of the contaminants present at the site. The modeled risk estimates were then compared to an EPA-established "target risk range" for incremental cancer incidence (ie, the excess probability that an individual would develop cancer over a lifetime as a result of being exposed to the contamination at the site) to determine if remediation is warranted. A cancer risk greater than 10^{-4} or a hazard index (HI) greater than1.0 are generally considered unprotective and require action. HIs are calculated using reference doses and represent the possibility of developing non-cancer health effects. A hazard index of less than one indicates no adverse noncarcinogenic health effects are expected due to site contaminants.

The BRA used the available analytical data to characterize the risks associated with the SLDS. Data were obtained on organic and nonradioactive inorganic chemicals and radionuclides irrespective of whether they were associated with MED/AEC uranium activities. Limited ground-

water data for the SLDS were evaluated without regard to background levels in ground water; this may have resulted in the BRA analysis overestimating the number of site-related anthropogenic and naturally occurring contaminants of concern. Consequently, this could have resulted in elevated risk estimates.

6.1 CONTAMINANTS OF CONCERN

The principal risk concern at the SLDS is exposure to radioactivity. There are three decay series that must be considered; U-238, Th-232, and U-235 (ie, the uranium, thorium, and actinium decay series, respectively). Radiological COCs were derived from these decay series based on their presence on the site and associated risk. As there are many progeny within the decay series, EPA Slope Factors derived in accordance with Risk Assessment Guidance for Superfund include short-lived progeny as a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The slope factor is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen for radionuclides. The slope factors for radionuclides incorporate applicable radioactive decay and ingrowth of radioactive decay products.

Table 6-1 identifies the Preliminary Remediation Goals for potential non-radiological COCs developed specifically for the SLDS using EPA guidance. The FS identified four potential, non-radioactive COCs: arsenic, cadmium, copper, and nickel. Derivation of chemical COCs was accomplished by definition of the scope of MED/AEC actions at the SLDS including assessment of ore constituents and materials used in the processing of the ores to extract uranium. The concentration and distribution of potential COCs derived within the scope of the remediation were then compared to applicable CERCLA risk criteria based on the anticipated future industrial land use. Cadmium and arsenic were retained as COCs based on this process with emphasis on potential risk at the site. Additional evaluation eliminated nickel and copper as COCs as they are not of sufficient concentration, distribution, and toxicity to be considered COCs. Although TCE was not identified as a PCOC in the FS, the same rationale applies. Uranium, although addressed primarily due to its radiological characteristics, also presents chemical (heavy metal) risk to the kidneys and is retained as both a radiological and non-radiological COC.

Table 6-1. Risk-Based Soil Concentrations for Industrial/Construction Workers in the Workplace: St. Louis Downtown Site

Chemical	Risk-based soil concentrations (Cancer Risk/Hazard Quotient) (mg/kg)		
	10^{-6}/.1	10^{-5}/1	10^{-4}/3
Arsenic	0.69/5.7	6.9/57	69/171
*Cadmium	1.7	17	52
*Uranium	150	1,501	4,504

Concentrations shown here exceed those indicated in the FS due to FS use of an erroneous soil ingestion rate of 480 mg/day rather than the correct value of 136 mg/day. PRGs for carcinogens are the lower of carcinogenic and noncarcinogenic values based on either risk of 1E-6 or a HI of 1. Final soil cleanup levels are presented in Section 9, The Selected Remedy of this Record of Decision.
*Uranium and cadmium concentrations are for noncarcinogenic effects. Cadmium is not carcinogenic for oral or dermal exposures and inhalation would not result in risk above the NCP threshold for this site. Carcinogenic effects of uranium are addressed with radiological PRGs and cleanup levels.

In summary, this ROD addresses both chemical and radiological contaminants. Radiological COCs for the SLDS consist of U-238 and its daughters, especially Th-230 and Ra-226, U-235 and its decay products, including protactinium-231 and actinium-227, and Th-232 and its progeny. Chemical COCs are cadmium, uranium and arsenic. Other constituents were detected and are being addressed pursuant to other environmental remediation processes and/or efforts.

6.2 BASELINE RISK

Three exposure scenarios were evaluated using baseline data from the St. Louis Downtown Site and are summarized in Table 6-2 to demonstrate the need for action. Baseline is defined here as the site characteristics prior to remediation. The scenarios include a future resident (future plausible, but unlikely, potential receptor), a commercial/industrial worker (current and most likely future receptor), and a construction worker (plausible worker conducts infrequent deep soil excavations). It is the commercial/industrial scenario which is considered to be the reasonable maximum exposure. The commercial/industrial worker is a full-time on-site employee who periodically performs subsurface excavations. The construction worker is an individual who receives a one time exposure to deep materials. Table 6-2 summarizes risk calculations for each receptor. Results for the residential scenario include information from the BRA (DOE 1993) that represent exposure over the entire site. The residential scenario is provided for the purpose of comparison only because the selected remedy assumes that the site will remain an industrial facility under institutional control. Exposure pathways for the resident include external gamma, soil ingestion, dust inhalation, and ground water consumption. Results for the commercial/industrial and construction workers are taken from the FS and include the results from the highest risk estimates from an assessment of six exposure units. The BRA did contain an evaluation of potential risks to an industrial worker and a construction worker. This evaluation was updated in the FS using site-specific information that was not available during the BRA. Exposure pathways for the commercial/industrial and construction workers include external gamma, soil ingestion, and dust inhalation. Risk calculations assume reasonable maximum exposure conditions that tend to overestimate actual risk.

Table 6-2 lists the risks to potential receptors from the primary radiological and non-radiological MED/AEC related COCs including actinium- (Ac) 227, protactinium- (Pa) 231, Ra-226, Th-230, Th-232, U-238, arsenic, and cadmium (note that uranium is listed as a radionuclide and a chemical because it is both a carcinogenic and toxic hazard). Also listed are the pathways that create the largest hazard as measured by the hazard index.

Results indicate that the radiological constituents contribute the most significant risk to potential receptors at SLDS. In the unlikely event the site reverts to residential use, the total risk is estimated as approximately 2×10^{-2}. Assuming the site remains an industrial facility (the intended land use), a commercial/industrial worker could receive a lifetime risk of approximately 5×10^{-3} and a construction worker that digs into site soils could receive a lifetime risk of approximately 9×10^{-4} if existing worker protection programs are discontinued. All baseline risk estimates exceed the CERCLA target risk range of 10^{-4} to 10^{-6}. Results from hazard index estimates indicate that the target hazard index of 1.0 would be exceeded under the residential scenario (HI = 18) and commercial/industrial scenario (HI = 2.3).

Table 6-2. Baseline Risk at SLDS

Baseline Risk for Radionuclides by Exposure Scenario				
Analyte [a]	Primary Pathway [b]	Residential [c]	Commercial/Industrial [d]	Construction [d]
Ac-227	Inhalation	1×10^{-3}	1×10^{-4}	3×10^{-7}
Pa-231	Inhalation	3×10^{-4}	8×10^{-6}	3×10^{-8}
Ra-226	External gamma	1×10^{-2}	2×10^{-3}	3×10^{-6}
Th-230	Inhalation	1×10^{-4}	2×10^{-4}	2×10^{-7}
Th-232	External gamma	2×10^{-3}	1×10^{-4}	4×10^{-6}
U-238	Inhalation	1×10^{-3}	2×10^{-3}	9×10^{-4}
Total Risk from Radionuclides		2×10^{-2}	5×10^{-3}	9×10^{-4}
Baseline Risk and (Hazard Index) for Non-Radionuclides by Exposure Scenario [e]				
Arsenic	Ingestion	3×10^{-3} (12)	5×10^{-5} (0.3)	3×10^{-7} (<< 0.01)
Cadmium	Ingestion[f]	1×10^{-8} (0.3)	9×10^{-8} (0.005)	2×10^{-10} (<< 0.01)
Uranium	Ingestion	See above (6)	See above (2)	See above (0.01)
Total Carcinogenic Risk from Chemicals		3×10^{-3}	5×10^{-5}	3×10^{-7}
Total Hazard Index (HI)		(18)	(2.3)	(0.01)
Total Carcinogenic Risk from All Radiological and Non-Radiological Sources [g]				
Total Carcinogenic Risk		2×10^{-2}	5×10^{-3}	9×10^{-4}

[a] Includes relevant decay products and associated radionuclides. For example, Pb-210 is included with Ra-226; Ra-228 and Th-228 are included with Th-232; and U-234 and U-235 are included with U-238.
[b] Pathway resulting in largest contribution to risk or hazard index is listed. Pathways include direct gamma, soil ingestion, dust inhalation, and ground water ingestion (resident only).
[c] From the Baseline Risk Assessment (DOE 1993)
[d] From the St. Louis Downtown Site Feasibility Study (USACE 1998). The Baseline Risk Assessment also included industrial and construction scenarios. Those scenarios, however, were revised for the Feasibility Study to incorporate site-specific information not available at the time of the Baseline Risk Assessment. Six exposure units were evaluated in the Feasibility Study. The highest (most conservative) risk from those exposure units is listed for the commercial/industrial and construction workers.
[e] The hazard index is provided in parentheses (HI)
[f] Cancer risk for Cd from inhalation pathway only. The primary ingestion pathway is due to noncarcinogenic efforts.
[g] The total carcinogenic risk is provided here as per OSWER Guidance Directive 9400.4-18.

All risk estimates are rounded to one significant digit. Reported values may contain round-off error.

Ground water beneath the site is not currently used for any purpose and, after 45 years since uranium production ceased, does not contain hazardous levels of the COCs addressed in this ROD in the potentially usable B Unit.

The substantial variations in correlations between Ra-226 in soil and Rn-222 preclude accurate modeling of indoor radon in industrial structures especially if such structures do not have basements. No buildings currently exist within the OU. Actual radon concentration anticipated in structures to be built on site are currently indeterminate but could be significant. Radon concentrations must, therefore be measured in any such structure and the associated risk assessed individually based on such measurements after buildings they are constructed.

6.3 ECOLOGICAL RISK

An ecological risk assessment was conducted to evaluate potential effects from contamination at SLDS. Due to the urban environment, the SLDS has limited wildlife habitat and biotic diversity. The ecological assessment compared contaminant concentrations detected in various media (soil, sediment, and water) at the site with literature on contaminant toxicity to biota. This study indicated that only arsenic, thallium, and PAHs are at concentrations in soil that could potentially impact biota, and of these, only arsenic could be associated with uranium ores or uranium processing. Since habitats are unlikely even in the future, the ecological assessment concluded that the significance of the St. Louis site with regard to ecological resources is minimal, and that potential human health effects would determine the need and levels for cleanup (DOE 1993).

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7. DESCRIPTION OF ALTERNATIVES

A Feasibility Study was prepared to evaluate potential remedial action alternatives for the SLDS. Remedial alternatives were evaluated in accordance with the requirements of CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The evaluation of remedial action alternatives for the site included identifying remedial action objectives specific to the contaminated environmental media, identifying general response actions (GRAs) required to attain the remedial action objectives for the site, identifying and screening technologies and process options applicable to these GRAs, and evaluating the screened process options with regard to their effectiveness, implementability, and cost. The purpose of the final screening step was to develop a set of site-wide alternatives for detailed analysis.

Modeling indicates that loss of current controls would present an unacceptable risk to industrial/construction workers, although actual current risks at SLDS are protective for on-site industrial workers. The risks from MED/AEC contaminants, primarily radionuclides, must be addressed to eliminate direct contact of on-site industrial/construction workers with surficial contaminants, since risk could be expected to exceed CERCLA protectiveness criteria. Further, the residual site risk from the anticipated industrial land use, including excavation of soils in support of on-site construction and development, must be protective under CERCLA.

7.1 REMEDIAL ACTION OBJECTIVES

Remedial action objectives specify unit-specific contaminants, media of concern, potential exposure pathways, and remediation goals. Remedial action objectives are based on the nature and extent of contamination, threatened resources, and the potential for human and environmental exposure. Throughout the characterization process, preliminary remediation goals are modified as information concerning the unit and potential remedial technologies becomes available. Final remediation goals, which establish acceptable exposure levels protective of human health and the environment, are determined when the remedy is selected.

Media-specific remedial action objectives were developed for SLDS for soil and ground water. In general, mitigation of the exposure pathways of concern and compliance with ARARs provide a framework for media-specific remedial action objectives. Media-based remedial action objectives are discussed below. Potential environmental pathways warranting mitigative measures are:

- Direct contact with soils through ingestion and dermal contact,
- External gamma radiation from the surface soil (Risks are minimal for gamma radiation from subsurface soil containing radionuclides based on the shielding provided by clean surface soils.),
- Inhalation of fugitive dust and radon gas emissions from soils, and

- Ingestion of ground water. The risk from this exposure is remote since existing impacts do not affect usable ground water and migration to potentially usable ground water is not expected. Ground water is not currently used as a potential drinking water source, ground water is of poor quality, yields in the bedrock are poor, and the area has abundant surface water which makes future ground water use unlikely. This site is being remediated for industrial land use. Many of the anthropogenic compounds detected in the A Unit are not found in the B Unit suggesting little or no migration from the A Unit is occurring.

Soils at SLDS were characterized in the BRA as posing potentially unacceptable risks to human health and the environment due to the following MED/AEC related radiological COCs: Th-230, Th-232, Ra-226, Ra-228, U-235, U-238, and their respective radioactive decay products. Non-radiological COCs that may have been introduced by MED/AEC operations include arsenic and cadmium in uranium ore processing areas. The primary contribution to risk from uranium at this site results from its radioactivity. However, because uranium is a toxicant in addition to being a radionuclide, it is included in both the radiological and non-radiological categories. Remedial alternatives developed to address contamination in soils should consider elimination or mitigation of the exposure pathways listed above as well as compliance with guidelines (Table 7-1).

Table 7-1. Remedial Action Objectives for Remediation of the SLDS Operable Unit

Medium	Remedial Action Objective
Soil	Prevent exposures from surface residual contamination in soils greater than the criteria prescribed in 40 CFR Part 192
	Eliminate or minimize the potential for humans or biota to contact, ingest, or inhale soil containing COCs
	Eliminate or minimize volume, toxicity, and mobility of impacted soil
	Eliminate or minimize the potential for migration of radioactive materials offsite
	Comply with ARARs
	Eliminate or minimize potential exposure to external gamma radiation
Ground water	Remove sources of COCs in the A Unit
	Continue to maintain low concentrations of OU COCs in the B Unit

7.2 GENERAL RESPONSE ACTIONS (GRAs)

The toxicity of radionuclides cannot be reduced through treatment and treatment for stabilization and volume reduction purposes has not been found to be effective in this case. Therefore, GRAs considered for SLDS are limited to no action, institutional controls, containment, excavation and disposal. Excavation and disposal could be implemented based on unrestricted future land use or based on anticipated future industrial land use with numerous possible variations of each of these general approaches, predicated on CERCLA modifying criteria including community and

state participation. Each action may include several technology options. The GRAs are structured to achieve protectiveness for human health and the environment and applicable remedial action objectives.

Remedial action technologies that could be used to implement GRAs were identified and evaluated in detail in the Initial Screening of Alternatives (ISA) report for the St. Louis site (DOE 1992). The ISA, which is one of the St. Louis site's primary CERCLA documents, was prepared prior to the FS for the purpose of performing an initial screening of the available technologies for the contaminated media. In the ISA the universe of available technologies was narrowed to only those applicable to St. Louis site media, contaminant types and concentrations, and site-specific conditions. Chapter 2 of the ISA presents the remedial options considered along with a short description of the process option and evaluation of the available technologies effectiveness, implementability, and cost. Although not specifically called a technology, replacement of contaminated material with clean fill effectively blocks the gamma pathway. Fifteen to thirty centimeters (6 to 12 in.) of fill, reduces gamma radiation of the energies involved to essentially nondetectable levels. These factors are considered as follows:

- technologies are evaluated for effectiveness in terms of protecting human health and the environment in both the short-term and the long-term, and in reducing contaminant toxicity, mobility, and/or volume;

- technologies are evaluated for implementability in terms of technical feasibility, administrative feasibility, and resource availability; and,

- technologies are evaluated for cost in a comparative manner (ie, low, moderate, or high) for technologies of similar effectiveness or implementability.

The ISA document identifies potentially viable technologies and processes retained for consideration as components of the media-specific alternatives. Retained technologies are subsequently combined to form a broad range of alternatives for each medium. In the ISA, Chapter 3 identifies the alternatives that were considered for further evaluation during the FS development and screening of alternatives.

7.3 REMEDIAL ACTION ALTERNATIVES

Remedial action alternatives for the OU were evaluated using the criteria established under CERCLA to assure that the remedial action is protective of human health and the environment. Sitewide alternatives were developed to cover a wide range of options that address the source media of concern for the SLDS and provide overall protection of human health and the environment. A "no-action" alternative was evaluated in accordance with CERCLA to provide a baseline for comparison.

Given that excavation and remote disposal is generally the only viable option for the SLDS and that cleanup level is the only major variable left to evaluate, Alternatives 4, 5, and 6 below were developed essentially from the same general alternative, i.e., excavation and remote disposal. It was considered appropriate in this case to compare varying degrees of excavation.

Sitewide remedial action alternatives for the SLDS selected for detailed evaluation are:

- Alternative 1 – No Action
- Alternative 2 – Institutional Controls and Site Maintenance
- Alternative 3 – Consolidation and Capping
- Alternative 4 – Partial Excavation and Disposal
- Alternative 5 – Complete Excavation and Disposal
- Alternative 6 – Selective Excavation and Disposal

To make costs comparable across all alternatives, the cost of addressing inaccessible soils is included in the costs for Alternative 3, 4, and 6, although this in not actually a part of the scope.

All of the action alternatives are considered protective of ground water and include the implementation of a long-term ground-water monitoring program to demonstrate the effectiveness of the source removal action. Agreements with the state and local water authorities to restrict the installation of wells within a specified area could be used to control ground water use.

The sitewide remedial alternatives are described in detail in the FS, which is available in the Administrative Record File, and summarized in the following sections. The various components of the remedial action alternatives discussed here are considered representative of the general technologies that define the alternatives.

7.3.1 Alternative 1 – No Action

The no-action alternative was developed to provide a baseline for comparison with other alternatives in compliance with CERCLA requirements. This alternative consists of performing no remedial actions and maintaining a "status quo" at the site. Therefore, no soil would be removed. Buildings and structures would continue to be used and operated as is currently being done; and routine monitoring of air, buildings, ground water, and storm water, would continue. The NCP requires that a No Action alternative be included to serve as a basis for comparison with other alternatives.

Alternative 1 does not comply with ARARs. Residual radionuclide concentrations in soil would continue to exceed guidelines. No reduction of risk would be realized under the No Action alternative.

The present value for Alternative 1 would be approximately $22 million.

7.3.2 Alternative 2 – Institutional Controls and Site Maintenance

Under this alternative, institutional controls and site maintenance would be implemented to prevent significant exposure to site contamination. Institutional controls would include land-use restrictions, maintenance, and ground-water use restrictions through ground-water use advisories. Missouri regulation could be used to limit drilling wells for drinking water in areas of known contamination. Site maintenance would include surveillance of land, restricted ground-water use, environmental monitoring of affected media, and implementing minimal engineering controls such

as radon abatement. Site security, including fences and signs, is already maintained at most of the SLDS properties, including 24-hour security at the Mallinckrodt, Inc. Plant. Mallinckrodt's health and safety plan would continue to protect onsite employees. Barriers, such as fencing and posted signs, would be employed at other areas such as the city property and accessible areas of VPs.

The objective of environmental monitoring is to measure contaminant concentrations, location, and movement. The B Unit would be monitored for OU COCs. A long-term monitoring plan would be developed to measure the effectiveness of passive collection systems for newly constructed buildings.

This alternative would be protective of human health and the environment and comply with ARARs as long as institutional controls are maintained. The 30-year cost for Alternative 2 would be approximately $29 million.

7.3.3 Alternative 3 – Consolidation and Capping

Soil excavated to composite criteria (ARAR-based) as defined in Section 7.3.7 would be consolidated and covered with a low permeability cap at a suitable location onsite. The property associated with the consolidated pile would be acquired by the federal government. Either the city property or the area formerly occupied by the 50 series buildings at Plant 2 could be used. Plant 2 covers approximately 2 hectares (5 acres). To determine costs, it was assumed that the cap would be low permeability and consist of all-natural materials, no synthetic liners or other man-made materials.

The potential for subsidence over the proposed area to be capped would be evaluated during remedial design. Remedies to prevent uncontrolled subsidence would be employed as required to stabilize the cap area. Costs for these actions are included in the Alternative 3 cost analysis.

A long-term management plan would be developed to address notification requirements for property owners as well as monitoring and maintenance requirements into the future. This plan would include provisions addressing how property owners should contact the agency responsible for long-term control of impacted areas and how these areas will be reviewed, maintained, and monitored by the federal government after completion of Alternative 3.

The cap system reduces the potential for human exposure, for migration of contaminants into surface water and ground water, and for generation of fugitive dust. Capping is an effective means of preventing human exposure to underlying contaminated materials.

Alternative 3 would be protective of human health and the environment and comply with ARARs through use of institutional controls to restrict and regulate access to capped soils.

The 30-year cost for Alternative 3 would be approximately $100 million. This cost includes the inaccessible soil and building decontamination in order to provide comparability across the alternatives.

7.3.4 Alternative 4 – Partial Excavation and Disposal

This alternative includes excavation of accessible contaminated soil on the Mallinckrodt property to two feet and on VPs to depth based on the composite criteria (ARAR-based). Soils on the Mallinckrodt property from two feet to depth are excavated to site specific deep soil risk based removal criteria. (See Section 7.3.7.1 for derivation of criteria). Residual risk is assessed at each plant area under anticipated future industrial use of the property. This alternative assumes a periodic continuing government role to support disposal of soils exceeding the composite criteria (ARAR based) below 2 feet in depth that are brought to the surface by excavation pursuant to Mallinckrodt construction efforts on-site. It also assumes site institutional controls and development of a long-term agreement between Mallinckrodt and the government with respect to responsibilities for residual soil exceeding the composite criteria (ARAR based).

Alternative 4 would be protective of human health and the environment and meet ARARs through the use of institutional controls to restrict access to the subsurface.

The 30-year cost for alternative 4 would be approximately $92 million. As with Alternative 3, inaccessible soils and buildings 25 and 101 are included in the estimate. Alternative 4 may include substantial additional future costs to the government for disposal of soils above composite criteria (ARAR-based) which are excavated pursuant to construction activities on the Mallinckrodt property. Inability to accurately define long-term construction activities precludes inclusion of these potentially significant costs in the cost estimate.

7.3.5 Alternative 5 – Complete Excavation and Disposal

This alternative consists of excavation and off-site disposal of all accessible soils above the composite criteria (ARAR-based). Chemical COC's that are within the scope of the ROD are also remediated.

As with Alternatives 3 and 4, excavation of the source material would be protective of the ground water. A monitoring program for ground water will be established and enforced until discontinued pursuant to five-year CERCLA reviews. Agreements negotiated with the state and local water authorities to restrict the installation of wells within a specified area could be used to prevent unauthorized use of ground water.

Alternative 5 would be protective of human health and the environment and meets ARARs.

The 30-year costs for Alternative 5 would be approximately $140 million, including inaccessible soils and building decontamination.

7.3.6 Alternative 6 – Selective Excavation and Disposal

This alternative excavates soils to composite criteria (ARAR based) on perimeter VPs, and Mallinckrodt Plant 7. Plant 10 was previously protectively addressed pursuant to a removal action to the composite criteria (ARAR based). Within the remainder of the OU, this alternative excavates accessible soils on the Mallinckrodt property to composite criteria (ARAR based) in the top 4 or 6

feet and to depth to deep-soil criteria (risk based). (See Section 7.3.7.1, Derivation of soil criteria).

This alternative also includes levee property which was previously addressed to protective recreational use standards pursuant to a removal action and is not subject to further action under this ROD. Only approved off-site borrow would be used to fill in the excavation at the perimeter VPs and in the top 4 or 6 feet across the Mallinckrodt property. Material below the deep-soil criteria (risk-based) could be used as backfill at depths greater than the composite criteria (ARAR-based) concentration depth. Thus, below 4 or 6 feet, material below the deep-soil criteria (risk based) would be replaced with material less than the deep-soil criteria (risk based) provided it does not exhibit a hazardous characteristic. (Hazardous characteristic tests would be conducted on samples of potential backfill from each excavation.) Potential ground water degradation would be controlled by: removal of sources of soil contamination; implementing institutional controls, when applicable; and perimeter ground-water monitoring in the B Unit to assure post remediation compliance.

For Alternative 6, excavation to the most stringent criteria proceeds to a depth of 6 ft in areas of the Mallinckrodt portion of the site located west of the St. Louis Terminal RR Association tracks and at the former locations of Buildings 116 and 117; excavation to the composite criteria (ARAR based) occurs at other areas of the site to a depth of 4 ft except the Plant 7 area and vicinity properties where the composite criteria (ARAR-based) are applied to depth.

Alternative 6 is protective of human health and the environment and meets ARARs (see Section 10). This alternative focuses on minimizing the need for future studies, design, and remedial actions in addition to protection of human health and the environment relative to Alternative 4. Deeper excavation to the composite criteria (ARAR based) and use of off-site borrow as backfill above 4 to 6 foot depths reduces potential risk to personnel supporting ongoing and future excavation on the Mallinckrodt property and eliminates potential costs to the government for future disposal of contaminated soil generated during excavation in support of construction. As future construction activities cannot be fully defined, the anticipated future costs to the government associated with disposal of these soils cannot be fully assessed at the current time and are, therefore, excluded from cost analysis. The 30 year cost for Alternative 6 would be approximately $114 million, including the cost of excavation and disposal of inaccessible soils and the cost of building decontamination.

7.3.7 Derivation of Remediation Criteria

7.3.7.1 Radiological

40CFR192 and criteria contained therein for residual radium and thorium serves as an ARAR (see Section 10, ARAR analysis). As such, 5 pCi/g of radium or thorium is used as a standard for these radioisotopes in the top 15 cm (6 inches) and 15 pCi/g of radium or thorium is used in any subsequent 15 cm (6 inch) soil layer to 1.2 or 1.8 m (4 or 6 ft) for remediation of the site. Based on contaminant distribution in the subsurface, application of the 15 pCi/g standard is expected to result in residual concentrations that average below 5 pCi/g, but confirmation of remediation completion will be in accordance with the 5/15 ARAR or supplemental standards, as appropriate. In conjunction with the site-specific risk assessment for radium and thorium, USACE developed site-specific supplemental standards for U-238 which with Ra-226 and Th-230, represent the major radioisotopes of interest.

This remedy must also incorporate all radiological contaminants of concern in the OU. To assure that all potential radiological contaminants of concern are addressed, the BRA Investigation included all pertinent radionuclides. In particular, rather than assume that Pa -231 and Ac-227 were in secular equilibrium with their U-235 parent, direct measurements were made of Ac-227. That data was then compared to other radionuclides to enable derivation of a statistical relationships between Pa-231, Ac-227, and other radionuclides. Analyses of data supported use of a conservative 1:2.5 ratio for Ac-227 to Ra-226. This approach, together with factors that account for inclusion of appropriate daughter activity with the parent nuclide, assures that the risk assessment performed to develop this remedy incorporates applicable radionuclides and activity. Remediation cleanup levels are derived for the primary site contaminants Ra-226, Th-230, Ra-226, Th-232 and U-238 as remediation of these radioisotopes would assure that all radioactive contaminants are addressed concurrently.

Derivation of cleanup guidelines for U-238 pursuant to 40 CFR 192.21(h) necessitates determination of the site specific NCP point of departure remediation goal (See Table 7-2) The combined effects of a number of qualifying factors "including but not limited to exposure factors, uncertainty factors, and technical factors" are then addressed if required to move away from the remediation goal point of departure.

Table 7-2. Soil Preliminary Remediation Goals and Risk-Based Concentrations for Potential Radionuclides of Concern in SLDS Soils Based on a Long-Term Worker (Industrial/Construction) Scenario

Radionuclide	Cancer Risk			
	1×10^{-6} (PRG)	1×10^{-5}	1×10^{-4}	3×10^{-4} [a]
	PRG Concentration (pCi/g)			
Ac-227	0.2	2	21	64
Pa-231	0.2	2	22	65
Ra-226+D	<BKG	<BKG	4	11
Th-230	<BKG	<BKG	10	30
Th-232+D	<BKG	<BKG	3	7.6
U-235	0.8	8	80	239
U-238+D	2.6	26	262	787

Notes:

1. Exposure and intake parameters are based on references and Mallinckrodt site-specific assumptions as described in Appendix C of the Feasibility Study. The resultant concentrations are significantly more conservative than risk values derived using Risk Assessment Guidance for Superfund default values. For comparative purposes, concentrations calculated using RAGS equate to 99, 16, 47, 12 and 1200 pCi/g for Ac-227, Pa-231, Ra-226+D, Th-230, Th-232+D, and U-238+D respectively for the $3x10^{-4}$ risk level that EPA has determined equates to 15 mrem/y and is consistent with the high end of the acceptable risk range.
2. Calculations include contributions from decay and ingrowth of radioactive progeny to 1,000 yrs. The most limiting value for each decay chain is shown (ie, Th-232 includes the contributions from Ra-228, Th-228, and other progeny, and the PRG is based on the most limiting concentration in this decay series in the 1.000 year period).
3. <BKG indicates that the calculated PRG value is less than background for St. Louis site soils.

[a] EPA risk assessment guidance indicates that PRGs are typically for risks of 10^{-6}. However, OSWER Directive 9200.4-18 specifically indicates that 3×10^{-4} is considered consistent with the high end of the acceptable risk range.

D = daughters

Review of the point of departure (10^{-6}) remediation goal for U-238 (2.6 pCi/g) indicates that this value is within the range of site background concentrations (0.159 to 3.78 pCi/g for 32 sample detects). The point of departure concentration also presents significant issues with respect to implementability. To enable field measurement of U-238, preclude the cost for over excavation of clean soils, and facilitate statistical confirmation of the cleanup, the remediation goal was adjusted upward to 50 pCi/g. This guideline is protective in that it corresponds to a risk of less than 2×10^{-5} without regard to clean cover. This value is a valid, supportable remediation criterion for this site given that actual residual concentrations are generally substantially less than the applicable criterion, and is further appropriate given the need to minimize over excavation of soils and the associated costs.

As other nuclides are also present in most cases with U-238 it is necessary pursuant to 40 CFR 192.21 (h) to address the potential health effects of multiple contaminants. To concurrently address each of the major radionuclides of interest, a sum of the ratios calculation is applied as follows for Ra-226, Th-230 and U-238, the major radioisotopes of interest at this site:

$$\frac{\text{greater of Ra-226 or Th-230}}{5} + \frac{\text{greater of Ra-228 or Th-232}}{5} + \frac{\text{U-238}}{50} \text{ (all isotopes above background)} < 1$$

in the top 15 cm (6 in) or

$$\frac{\text{greater of Ra-226 or Th-230}}{15} + \frac{\text{greater of Ra-228 or Th-232}}{15} + \frac{\text{U-238}}{50} \text{ (all isotopes above background)} < 1$$

from the 6" to 4 or 6 feet. Taken together, these are called the composite criteria. Soil that meet the above criteria do not need to be removed.

This approach will result in excavation based on the primary isotope(s) of interest in each plant area and, given inclusion of U-238 and minimal quantities of Ra-228 and Th-232 on site, is fully protective and is expected to result in a more conservative remediation than the approach discussed in OSWER directives.

As previously noted, USACE also verified the appropriateness of the 5/15 pCi/g criterion for radium and thorium through a comprehensive review of residual contamination levels for Plant 10 (a portion of the SLDS previously remediated to the 5/15 criterion with a 50 pCi/g U-238 limit), and comparison of these results with EPA guidance. Table 7-3 presents the residual concentrations of radionuclides following the Plant 10 removal action.

Review of the data (which includes site background) clearly establishes that contaminant distribution in Plant 10 was such that remediation to criteria of 5/15 pCi/g for radium and thorium resulted in residual site, contamination below 5 pCi/g. Use of the 15 pCi/g subsurface standard is expected to result in a protective residual condition consistent with the land use at this site (USACE 1998a).

Table 7-3. Plant 10 Post Removal Summary Data

	Average (including background)	Std dev	Minimum	Maximum	Average Site Background
Ra-226 (pCi/g)	2.0	1.9	0.4	14	2.8
Th-230 (pCi/g)	4.9	3.0	1.4	26	1.9
U-238 (pCi/g)	20	35.1	0.8	290	1.4

*The standard deviation, minimum and maximum apply to the average residual concentration including background. Average site background is included for comparison (SAIC 1998). Data are rounded to two significant figures. Data were averaged over 100 square meters.
*The same uranium criteria as used in the current operable unit was used in the Plant 10 cleanup (50 pCi/g above background for U-238).

The composite criteria (ARAR based) were developed to address near-surface contaminated soils. The supplemental standards pursuant to 40CFR192.21 are invoked for contaminated soils at depths below two feet for Alternative 4 and below 4 or 6 feet for Alternative 6. Deep-soil criteria (risk-based) were derived to address deep soils which provide a more limited potential for exposure. Calculation of preliminary remediation goals for radium and thorium in deep soils under the industrial/construction worker scenario using 1×10^{-6} as the point of departure results in PRGs of less than 1 pCi/g. Development of a remediation design for cleanup levels in this range presents significant implementability and practicability problems, e.g. (1) cleanup goals are effectively indistinguishable from background (2) confirmation becomes statistically complex (3) inability to accurately measure main radionuclides of interest at concentrations approaching background will preclude field instruments.

Further, design and implementation factors systematically lead to over excavation and residual concentrations well below cleanup criteria (see confirmation results of Plant 10 cleanup). Development of the deep criteria accounts for predictable overexcavation by examining the risks posed by anticipated residual conditions (see Table 7-4). Application of criteria for radium and thorium of 50/100 pCi/g for deep soil will result in residual risks that are protective per the NCP risk range for all exposure units even under the hypothetical assumption that no cover is in place, and will minimize the amount of "clean" soil that will be excavated and transported offsite for disposal thereby improving cost-effectiveness. It will also comply with exposure criteria applicable in the event of loss of site controls.

Uranium cleanup guidelines were developed for deep soil, for soils two feet or more from the surface under alternative 4 and more than four or six feet under alternative 6, based on the anticipated continued industrial use of the sites. Use of the 10^{-6} remediation goal, point of departure of 2.6 pCi/g would present substantial implementability problems related to field measurement of concentrations approaching background, statistical comparison with background and costs of remediation associated with overexcavation of soils. A guideline of 150 pCi/g for U-238 represents

a mid-point (5.7×10^{-5}) between 10^{-5} and 10^{-4} based on the assumption of no clean cover. Use of 150 pCi/g as a remediation goal would, with the existence of clean cover, assure protectiveness

Table 7-4. Industrial/Construction Cancer Risk Assessment Results in the Top 6 ft of Soil by Cover Depth

Removal Option	Risk by Exposure Unit - No Cover					
Ra-226/Th-230/U-238 (pCi/g)	Plant 1	Plant 2	Plant 6a	Plant 6b	Plant 6c	Plant 7
A: No Removal	3.6×10^{-3}	1.5×10^{-2}	2.8×10^{-3}	1.7×10^{-3}	6.2×10^{-4}	1.1×10^{-2}
B: 200/400/600	3.3×10^{-3}	4.2×10^{-4}	5.2×10^{-4}	9.0×10^{-4}	3.0×10^{-4}	3.8×10^{-3}
C: 100/200/300	2.7×10^{-4}	3.0×10^{-4}	6.9×10^{-4}	6.4×10^{-4}	3.0×10^{-4}	1.1×10^{-3}
D: 50/100/150 (Alt 6)	2.7×10^{-4}	1.8×10^{-4}	2.1×10^{-4}	3.5×10^{-4}	3.0×10^{-4}	1.1×10^{-3}
E: 15/40/100	2.7×10^{-4}	1.8×10^{-4}	2.6×10^{-4}	3.9×10^{-4}	3.0×10^{-4}	2.3×10^{-4}
F: Composite Criteria (SOR > 1)	3.5×10^{-5}	1.7×10^{-4}	2.3×10^{-4}	3.1×10^{-4}	8.6×10^{-5}	2.3×10^{-4}
Removal Option	Risk Exposure Unit - 6-Inch Cover					
	Plant 1	Plant 2	Plant 6a	Plant 6b	Plant 6c	Plant 7
A: No Removal	5.4×10^{-4}	2.2×10^{-3}	4.0×10^{-4}	2.5×10^{-4}	9.5×10^{-5}	1.7×10^{-3}
B: 200/400/600	5.0×10^{-4}	5.1×10^{-5}	7.6×10^{-5}	1.4×10^{-4}	4.8×10^{-5}	5.8×10^{-4}
C: 100/200/300	3.8×10^{-5}	4.1×10^{-5}	1.0×10^{-4}	9.7×10^{-5}	4.8×10^{-5}	1.7×10^{-4}
D: 50/100/150 (Alt 6)	3.8×10^{-5}	2.5×10^{-5}	3.1×10^{-5}	5.3×10^{-5}	4.8×10^{-5}	1.7×10^{-4}
E: 15/40/100	3.8×10^{-5}	2.5×10^{-5}	4.0×10^{-5}	6.2×10^{-5}	4.8×10^{-5}	3.6×10^{-5}
F: Composite Criteria (SOR > 1)	5.1×10^{-6}	2.6×10^{-5}	3.4×10^{-5}	4.8×10^{-5}	1.3×10^{-5}	3.6×10^{-5}
Removal Option	Risk by Exposure Unit - 2-Ft Cover					
	Plant 1	Plant 2	Plant 6a	Plant 6b	Plant 6c	Plant 7
A: No Removal	1.8×10^{-6}	6.8×10^{-6}	1.3×10^{-6}	8.5×10^{-7}	3.3×10^{-7}	5.3×10^{-6}
B: 200/400/600	1.6×10^{-6}	1.8×10^{-7}	2.6×10^{-7}	4.6×10^{-7}	2.0×10^{-7}	1.9×10^{-6}
C: 100/200/300	1.2×10^{-7}	1.6×10^{-7}	3.5×10^{-7}	3.3×10^{-7}	2.0×10^{-7}	6.4×10^{-7}
D: 50/100/150 (Alt 6)	1.2×10^{-7}	9.7×10^{-8}	1.1×10^{-7}	2.0×10^{-7}	2.0×10^{-7}	6.4×10^{-7}
E: 15/40/100	1.2×10^{-7}	9.7×10^{-8}	1.5×10^{-7}	2.5×10^{-7}	2.0×10^{-7}	1.4×10^{-7}
F: Composite Criteria (SOR > 1)	1.6×10^{-8}	9.6×10^{-8}	1.2×10^{-7}	1.9×10^{-7}	4.6×10^{-8}	1.4×10^{-7}

approaching the point of departure, especially given comparison between remediation goals and post remediation concentration.

Derivation of remediation criteria for soils two feet or more below the surface are based on the sum of Ra-226, Th-230, and U-238 concentrations, the primary radionuclides of interest, using Table 7-4. It is immediately apparent from this table that protective remediation of Plant 7 due to risk associated with elevated Ra-226 concentration necessitates use of composite criteria (ARAR based) to depth. Such remediation assures protectiveness and compliance with standards applicable in the event of loss of site controls. Remediation criteria of 50/100/150 pCi/g was developed using the following sum of the ratios in consultation with stakeholders:

$$\frac{\text{Ra-226}}{50} + \frac{\text{Th-230}}{100} + \frac{\text{U-238}}{150} \text{ (all isotopes above background)} < 1$$

Soil that meets this standard does not need to be removed. It represents a movement away from the 10^{-6} point of departure for remediation goals to the range of 2.5×10^{-5} to 5.3×10^{-5} with a 6 inch cover depending on the plant area.

Giving consideration to applicable clean cover for Alternative 4, use of this criteria would assure protectiveness given consideration of chemical COCs. For Alternative 6, use of off-site borrow as backfill to 4 to 6 feet across the site would result in residual site risk of less than the CERCLA 10^{-6} point of departure.

To address comments that site-specifically derived remediation goals would be inclusive of background rather than exclusive of background as shown here, additional risk analysis shows that addition of background concentrations to the remediation goals would not alter any judgments regarding the protectiveness of this approach.

7.3.7.2 Derivation of Chemical Remediation Criteria

As a point of departure, preliminary remedial goals were developed for the reasonable maximum exposure identified in the Feasibility Study (FS) which was more recently developed than the Baseline Risk Assessment. PRGs were calculated for both carcinogenic risk at a lifetime cancer risk of 1×10^{-6} (1/1,000,000) and for noncarcinogenic toxic effects at a hazard quotient (HQ) of 1.0 Under the NCP, PRGs may be modified based upon the consideration of appropriate factors including, but not limited to, exposure factors, uncertainty factors, technical factors and other factors consistent with the five balancing criteria to determine final remedial goals, so long as the remedy would still be protective.

Arsenic in surface soil was retained as a chemical of concern because some of the onsite soil samples contained levels of arsenic above background as well as above risk-based screening benchmarks. The carcinogenic point of departure PRG was 0.69 mg/kg and the noncarcinogenic PRG was 15.8 mg/kg. The carcinogenic point of departure of 0.69 mg/kg was considered

unachievable. This concentration is an order of magnitude less than the average site background concentration of arsenic in surface soils (9 mg/kg). Cleaning up to 0.69 mg/kg is not achievable because many uncontaminated soils will contain more arsenic than this.

A final cleanup level of 60 mg/kg for arsenic in surface soil was determined based on considerations consistent with the five balancing criteria. This level is clearly distinguishable from background and the corresponding cancer risk of 9E-5 is within the protective risk range. Non-carcinogenic risk is also protective.

Cadmium in soil was retained as a chemical of concern because it was present onsite in concentrations above average site background (0.75 mg/kg), because some onsite concentrations exceeded risk-based screening levels, and because cadmium may have been present in some of the MED/AEC wastes.

Cadmium is not carcinogenic for oral or dermal exposures. The 10^{-6} inhalation pathway carcinogenic point of departure is reached at 5.4 mg/kg compared with an HQ = 1 concentration of 1.7 mg/kg. Consequently, 5.4 mg/kg is identified as the PRG for cadmium based on the more conservative value. This concentration was considered to be unachievable as it is within the range of measured background values. Therefore, the cadmium cleanup goal was adjusted to the concentration corresponding to a HQ of 1, yielding a revised surface soil cleanup level of 17 mg/kg which is also protective of cancer risk at 3.1E-6 which is well below 1E-4, the upper end of the NCP protective range. Using this value will assure that the residual soil concentrations of cadmium are well below 17 and that the residual combined cadmium and uranium concentrations will not exceed an HI of 1.0.

A similar rationale may be applied to metals in deep soil. Deep soil cleanup guidelines for arsenic, cadmium, and uranium are based on the anticipated continued industrial use of the site. For arsenic and cadmium, the deep-soil criteria were based on the construction worker who is exposed to deep soil as described in section 6.2. The non-carcinogenic effects of arsenic and cadmium presented greater threats than the carcinogenic effects to the construction worker. The deep-soil concentrations determined for a hazard index value equal to one were 2,760 and 430 mg/kg for arsenic and cadmium, respectively. Cleanup of uranium to 150 pCi/g will result in a non-carcinogenic HQ of less than 0.1. Therefore, addressing uranium as a radiological threat reduces the non-carcinogenic effects of uranium to negligible values. Since cadmium and arsenic do not affect the same organs, their respective cleanup criteria for deep soils were established separately and below the soil concentrations equivalent to HQs equal to one (i.e., 2,500 and 400 mg/kg for arsenic and cadmium, respectively).

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8. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The following discussion presents the advantages and disadvantages of the alternatives described in the preceding section in a comparative fashion, based on specific evaluation criteria prescribed under CERCLA. This information is used to select a preferred alternative for remediation of the SLDS.

Each of the remedial alternatives is evaluated using the nine criteria specified in the NCP. The criteria are derived from CERCLA Section 121. The criteria are:

- overall protection of human health and the environment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- short-term effectiveness;
- reduction of toxicity, mobility, or volume through treatment;
- implementability;
- cost;
- state or support agency acceptance; and
- community acceptance.

The first two criteria are threshold criteria which must be attained by the selected remedial action. The next five criteria are considered primary balancing criteria, which are considered together to identify significant tradeoffs and determine the optimal alternative among those having passed the threshold criteria. The final two criteria are modifying criteria which are evaluated following public comment on the RI/FS and Proposed Plan. Table 8-1 presents the evaluation of the remedial alternatives. Summaries of the comparative analysis are provided in this section.

8.1 THRESHOLD CRITERIA

Overall Protection of Human Health and the Environment. This criterion addresses whether an alternative provides adequate protection of human health and the environment, and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls. It also examines whether the alternative poses any unacceptable short-term or cross-media impacts.

Each of the alternatives except no-action (Alternative 1) is protective of human health and the environment. The degree of protection and permanence of the protectiveness is a function of whether and to what extent an alternative uses dedicated engineering containment, a removal strategy, or institutional control strategies. Alternative 1, with contaminated media left in place, is the least protective. Alternative 2, with contaminated media left in place, is more protective through the use of institutional controls and site maintenance. Alternative 3 confers more protection than Alternative 2 through consolidating the soils in a central location and reducing the opportunity for exposure. Alternative 4 confers more protection than Alternative 3 through removing the highest

Table 8-1. Summary of Comparative Analysis of Site-Wide Alternatives

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls/ Site Maintenance	Alternative 3 Consolidation and Capping	Alternative 4 Partial Excavation and Disposal	Alternative 5 Complete Excavation and Disposal	Alternative 6 -Selective Excavation and Disposal
Overall Protection						
• Human Health	Not Protective	Protective as long as proposed institutional controls are maintained	Similar to Alternative 2, but risk is less if institutional controls fail because contaminated area is consolidated.	Protective	Protective	Protective
• Ground water	Not Protective	Prevents consumption by land use restrictions, drilling restrictions, and monitoring	Similar to Alternative 2, but risk is less if institutional controls fail because contaminated area is consolidated.	Protective	Protective	Protective
• Environment	Not Protective	Protective	Protective	Protective	Protective	Protective
Compliance with ARARs	Not compliant for soils	Compliant as long as proposed institutional controls are maintained	Compliant; site-specific supplemental standards and institutional controls invoked for capped area. Backfill would need to pass hazardous characterization	Compliant; backfill would need to pass hazardous characterization	Compliant; backfill would need to pass hazardous characterization	Compliant; backfill would need to pass hazardous characterization
Long-term Effectiveness and Permanence						
• Magnitude of Remaining Risk	Same as BRA	Low as long as proposed institutional controls are maintained	Low as long as proposed institutional controls are maintained; lower than Alternative 2 if controls fail.	Low	Low	Low
• Adequacy of Controls	Existing site security would provide limited control over exposure	Adequate as long as proposed institutional controls are maintained	Good	Good	Excellent	Good

Table 8-1. Summary of Comparative Analysis of Site-Wide Alternatives (continued)

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls/ Site Maintenance	Alternative 3 Consolidation and Capping	Alternative 4 Partial Excavation and Disposal	Alternative 5 Complete Excavation and Disposal	Alternative 6 -Selective Excavation and Disposal
• Reliability of Controls	Limited by need for security	Reliable for security as long as institutional controls are maintained	Reliable for security as long as institutional controls are maintained. Better than Alternative 2 because area to be controlled is consolidated.	Reliable	Reliable	Reliable
• Long Term Management	Long-term management plan; environmental monitoring; site security	Long-term management plan; environmental monitoring; site security	Long-term management plan; environmental monitoring; site security	Long-term management plan; environmental monitoring; site security; radiological restrictions may be reduced following remedy selection for inaccessible soils and buildings 25 and 101.	Long-term management plan environmental monitoring; site security; only necessary until remedy for inaccessible soils and buildings25 and 101 is selected.	Long-term management plan; environmental monitoring; site security; radiological restrictions may be reduced following selection of remedy for inaccessible soils and buildings 25 and 101.
• Irreversible and Irretrievable Commitment of Resources	Restricted land use	Restricted land use	Restricted land use at capped area; fill material; petroleum	Restricted land use at disposal facility; restricted to confined industrial use; fill material; petroleum	Restricted land use at disposal facility; fill material; petroleum	Restricted land use at disposal facility; restricted to confined industrial use; fill material; petroleum
Reduction of Contaminant (overall)						
• Volume	None	None	None, however, treatment retained as a conditional part of the remedy	Onsite volume reduced with offsite disposal options; however, treatment retained as a conditional part of the remedy.	Onsite volume eliminated with offsite disposal options; however, treatment retained as a conditional part of the remedy.	Onsite volume reduced due to offsite disposal; however, treatment retained as a conditional part of the remedy.
• Toxicity	None	None	None	None	None	None
• Mobility	None	None	Reduced by the cap component of disposal	Reduced by removal component	Eliminated by removal component	Reduced by removal component

Table 8-1. Summary of Comparative Analysis of Site-Wide Alternatives (continued)

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls/ Site Maintenance	Alternative 3 Consolidation and Capping	Alternative 4 Partial Excavation and Disposal	Alternative 5 Complete Excavation and Disposal	Alternative 6 -Selective Excavation and Disposal
Short-term Effectiveness and Environmental Impacts						
• Protection of Community	No additional health effect	Protective with controls	Minimal short-term risk to community; protective with controls; long-term benefit	Minimal short-term risk to community; protective with controls; long-term benefit	Minimal short-term risk to community; protective with controls; long-term benefit	Minimal short-term risk to community; protective with controls; long-term benefit
• Protection of Workers	No additional health effect	Protective with controls	Short-term occupational risk to workers; protective with controls	Short-term occupational risk to workers; protective with controls	Short-term occupational risk to workers; protective with controls, which may be discontinued following removal of inaccessible soil.	Short-term, occupational risk to workers; protective with controls
• Environmental Impacts						
– Geology and Soils	Potential uncontrolled migration of contaminants	Potential uncontrolled migration of contaminants	Short-term soil disturbance during excavation; replacement of soil	Short-term soil disturbance during excavation; replacement of soil	Short-term soil disturbance during excavation; replacement of soil	Short-term, soil disturbance during excavation; replacement of soil
– Water Quality	No adverse effects beyond baseline conditions	No adverse effects beyond baseline conditions	Short-term minor impacts during excavation; short-term impact on surface water; long-term improvement in surface and ground water	Short-term minor impacts during excavation; short-term impact on surface water; long-term improvement in surface and ground water	Short-term minor impacts during excavation; short-term impact on surface water; long-term improvement in surface and ground water	Short-term minor impacts during excavation; short-term impact on surface water; long-term improvement in surface and ground water

Table 8-1. Summary of Comparative Analysis of Site-Wide Alternatives (continued)

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls/ Site Maintenance	Alternative 3 Consolidation and Capping	Alternative 4 Partial Excavation and Disposal	Alternative 5 Complete Excavation and Disposal	Alternative 6 -Selective Excavation and Disposal
– Biotic Resources						
Terrestrial biota	No adverse effect beyond baseline conditions	No adverse effect beyond baseline conditions	Temporary loss of habitat; long-term benefits due to removal of contaminant source; permanent loss of habitat for disposal location	Temporary loss of habitat; long-term benefits due to removal of contaminant source	Temporary loss of habitat; long-term benefits due to removal of contaminant source	Temporary loss of habitat; long-term benefits due to removal of contaminant source
Aquatic biota	No adverse effect beyond baseline conditions	No adverse effect beyond baseline conditions	Minimal adverse effect during excavation	Minimal adverse effect during excavation	Minimal adverse effect during excavation	Minimal adverse effect during excavation
– Threatened and Endangered Species	No impact	No impact	No impact	No impact	No impact	No impact
– Wetlands	No wetlands present	No wetlands present	No wetlands present	No wetlands present	No wetlands present	No wetlands present
– Floodplains	No impact	No impact	Potential impact over long-term if levee fails	No impact over long-term	No impact over long-term	No impact over long term
– Air Quality	No impact	Improvement with radon controls	Short-term increase in fugitive dust associated with remediation activities; improvement with radon controls	Short-term increase in fugitive dust associated with remediation activities; improvement with radon controls	Short-term increase in fugitive dust associated with remediation activities; improvement with radon controls	Short-term increase in fugitive dust associated with remediation activities; improvement with radon controls
• Archeological, Cultural, and Historical Resources	No impact	No impact	No impact	No impact	No impact	No impact
• Land Use and Recreational/Aesthetic Resources	Land use continues but future reuse is limited	Land use continues but future reuse is restricted by institutional controls	Restricted land use for inaccessible soils and capped area; restrictions on ground-water use; unrestricted land use for remediated areas	Restricted land use; restrictions on ground-water use and land use	Restricted land and ground-water use for inaccessible soils; unrestricted land use for remediated areas	Restricted land use; reduced restrictions compared to Alternative 4 due to greater depth of excavation; restrictions on ground-water use

Table 8-1. Summary of Comparative Analysis of Site-Wide Alternatives (continued)

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls/ Site Maintenance	Alternative 3 Consolidation and Capping	Alternative 4 Partial Excavation and Disposal	Alternative 5 Complete Excavation and Disposal	Alternative 6 -Selective Excavation and Disposal
• Socioeconomic and Institutional Issues – Community and Institutional Issues	Conflict with community. Inhibits land use.	Conflict with community. Inhibits land use.	Near term impact on community. Allows development outside of capped area. Impact on industrial properties.	Near term impact on community. Allows development to proceed. Impact on industrial properties.	Near term impact on community. Allows development to proceed. Impact on industrial properties until inaccessible soil remediated.	Near term impact on community. Allows development to proceed. Less impact on industrial properties than Alternative 4.
– Public Services	No impact on utilities. Low potential for impact on emergency response services.	No impact on utilities. Low potential for impact on emergency response services.	Low impact on utilities. Short-term potential impact on emergency response services.	Low impact on utilities. Short-term potential impact on emergency response services.	Low impact on utilities. Short-term potential impact on emergency response services.	Low impact on utilities. Short-term potential impact on emergency response services.
– Local Transportation Impacts	No impact	No impact	Minor local traffic volume increased and road deterioration during implementation	Moderate local traffic volume increased and road deterioration during implementation	Significant local traffic volume increased and road deterioration during implementation	Moderate local traffic volume increased and road deterioration during implementation
• Unavoidable Adverse Impacts	Potential risks to human health and the environment posed by site-related contaminants	All contaminants remain onsite requiring institutional controls	Potential short-term negative impact on surface water and air quality; short-term loss of habitats and animals; potential increase in noise annoyance, fugitive dust and traffic volume	Potential short-term negative impact on surface water and air quality; short-term loss of habitats and animals; potential increase in noise annoyance, fugitive dust and traffic volume	Potential short-term negative impact on surface water and air quality; short-term loss of habitats and animals; potential increase in noise annoyance, fugitive dust and traffic volume	Potential short-term negative impact on surface water and air quality; short-term loss of habitats and animals; potential increase in noise annoyance, fugitive dust and traffic volume
• Short-term Uses and Long-term Productivity	Short-term use remains; long-term productivity would decline with limited reuse of land	Short-term use remains; long-term productivity would decline with restricted reuse of land	Short-term use influenced by remedial activities; long-term productivity high for unrestricted areas; cap reduces long-term productivity by restricting future land use	Short-term use influenced by remedial activities; long-term productivity high for unrestricted areas; reduced long-term productivity by restricting future land use	Short-term use influenced by remedial activities; long-term productivity high for unrestricted areas; restricted at disposal facility	Short-term use influenced by remedial activities; long-term productivity high for unrestricted areas; long-term productivity enhanced over Alternative 4

Table 8-1. Summary of Comparative Analysis of Site-Wide Alternatives (continued)

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls/ Site Maintenance	Alternative 3 Consolidation and Capping	Alternative 4 Partial Excavation and Disposal	Alternative 5 Complete Excavation and Disposal	Alternative 6 -Selective Excavation and Disposal
• Cumulative Impacts	None	None	Ongoing activities at Mallinckrodt Inc. in relation to inaccessible soils. Loss of use of capped area.	Ongoing activities at Mallinckrodt Inc. in relation to inaccessible soils	Ongoing activities at Mallinckrodt Inc. in relation to inaccessible soils	Ongoing activities at Mallinckrodt Inc. in relation to inaccessible soils
IMPLEMENTABILITY						
• Technical Feasibility	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible
• Administrative Feasibility	Feasible	Feasible but requiring institutional controls such as rezoning and land use restrictions	Feasible but requires institutional controls such as rezoning, land purchases, land use restrictions.	Feasible but requires institutional controls such as rezoning and land use restrictions.	Feasible but requires institutional controls until remedy for inaccessible soils is selected.	Feasible but requires institutional controls such as rezoning and land use restrictions.
• Monitoring	Long-term onsite monitoring	Long-term onsite monitoring	Long-term onsite monitoring	Long-term monitoring at disposal facility and at locations of inaccessible soils	Long-term monitoring at disposal facility and at locations of inaccessible soils	Long-term monitoring at disposal facility and at locations of inaccessible soils
COST						
• Total Cost	$22 million	$29 million	$100 million	$92 million	$140 million (overburden reused)	$114 million (overburden to off-site disposal)

risk soil from the site. Alternative 6 confers more protection than Alternative 4 by removing contamination at lower concentrations to a greater depth than Alternative 4. Alternative 5 confers the most protection by removing the most contaminated soil from the site.

Alternatives 4 and 6 rely on continued institutional controls to maintain protectiveness. Alternative 3 would require permanent institutional controls for the capped area. Environmental monitoring and institutional controls are used in all alternatives to achieve protectiveness for the inaccessible soil and buildings 25 and 101 pending the selection of a remedy for these soils and buildings.

The no-action alternative cannot be implemented at the SLDS because it would not achieve the threshold criteria of being protective of human health and the environment as required by the NCP. It is included in the FS to provide a baseline case. Alternative 2 would use institutional controls to achieve overall protection of human health and the environment from soil and ground-water contamination. Alternatives 3, 4, 5, and 6 would use engineered and institutional controls to achieve overall protection of human health and the environment from soil and ground-water contamination.

Under Alternative 5, accessible contaminated materials will be ultimately excavated and disposed, with the result that institutional controls could be removed in the remediated areas. Alternatives 2, 3, 4, 5, and 6 will reduce the long-term risks associated with existing MED/AEC contamination to protective levels.

The transportation of the SLDS waste long distances from the site involves risk of injuries and fatalities that are much greater than any radiological cancer incidence resulting from these activities. The risk to the worker and the public from a transportation accident involving serious injury or fatality increases from Alternative 3, 4, 6 to 5 due to increasing excavated contaminated soil volume and necessary backfill volume. As the haul distances increase, the risk also increases.

Alternatives 3, 4, 5, and 6 would reduce contaminant mobility by capping or encapsulation as a component of disposal. Capping or encapsulation would prevent infiltration of precipitation through contaminated materials. Furthermore, capping or encapsulation would eliminate contaminant migration by means of wind erosion or surface runoff, and would prevent human exposure to the waste. Alternatives 3, 4, 5, and 6 provide the greatest degree of protection from residual risk because contaminated materials identified as posing potentially unacceptable risks to human health and the environment are removed from the site and permanently isolated in an engineered disposal facility. All current potential exposure pathways are eliminated by these alternatives.

Alternative 1 does not control ground-water use. Alternative 2 restricts the use of ground water through use of institutional controls. Alternatives 3, 4, 5, and 6 remove the source of potential future ground-water contamination from above and below the water table. Alternative 2 is more effective than Alternative 1 in controlling access to contamination. Alternatives 3, 4, 5, and 6 are as effective as Alternative 2 in controlling access to ground-water contamination and are more effective than Alternatives 1 and 2 at minimizing potential for future ground-water contamination and are comparable to each other in this regard.

Compliance with ARARs. This criterion addresses whether an alternative will meet all ARARs of Federal and state environmental laws, or provide justification for invoking a waiver. CERCLA Section 121(d) identifies specific circumstances under which an ARAR may be waived. However, no waivers would be required for remedial action alternatives discussed herein, except for the no-action alternative.

Alternative 1 would not comply with ARARs, since radionuclide concentrations in readily accessible soil would continue to exceed guidelines. Alternative 2 would meet ARARs through implementation of institutional controls. Alternatives 3, 4, 5 and 6 would comply with ARARs. Supplemental standards are applicable when it can be demonstrated that remedial action would cause environmental harm that is excessive compared to health benefits, where remedial action would pose a clear and present risk of injury to workers, or where cleanup costs are unusually high and contamination left in place presents no significant exposure hazard. Thus, Alternatives 3, 4, 5, and 6 would achieve ARARs with institutional controls being maintained for inaccessible soils at the site until a remedy is selected. Ground-water restrictions under institutional controls would cease in areas where the source term was remediated once protection of human health and the environment is demonstrated by risk assessment. Accordingly, these alternatives would comply with relevant standards for restoration of radiologically contaminated sites. Tables 10-1 and 10-2 contain a listing of ARARs.

8.2 PRIMARY BALANCING CRITERIA

Long-term Effectiveness and Permanence. This criterion addresses the magnitude of residual risk remaining at the conclusion of remedial activities, and the adequacy and reliability of controls established by a remedial action alternative to maintain reliable protection of human health and the environment over time, once cleanup goals have been attained.

Alternative 5 has the highest degree of long-term effectiveness and permanence because contaminated soils are excavated for permanent disposal at permitted offsite facilities. Alternative 6 has the second highest degree of long-term effectiveness and permanence because the criteria used for excavation below 4 to 6 feet depth are higher than Alternative 5. Alternative 4 is third because the higher concentration criteria begins at a depth of 2 feet. Alternatives 4, 5 and 6 rely more on engineering controls and less on institutional controls for isolating contamination from the environment. Alternatives 3, 4, 5, and 6 have a high degree of long-term effectiveness and permanence compared to Alternatives 1 and 2 in terms of residual risk because contaminated soils are either permanently disposed of onsite or are transported offsite for permanent disposal. The cap for onsite disposal under Alternative 3 provides isolation of contamination from the environment. Alternatives 3, 4 and 6 rely more on institutional controls and less on engineering controls, therefore making these alternatives less effective in the long-term than Alternative 5. Alternative 2 has only a moderate degree of long-term effectiveness and permanence compared to Alternative 1 due to the contaminated soils and building materials remaining onsite and the primary use of institutional controls. Alternative 1, No Action, has low long-term effectiveness and permanence.

Pursuant to SARA, a long-term management plan would be implemented, including reviews every five years for all alternatives because some radioactive contaminants (ie, soil and/or ground

water) would remain onsite. By using institutional controls and ground-water monitoring, Alternatives 2, 3, 4, 5 and 6 would achieve comparable long-term effectiveness and permanence for ground water.

Implementing Alternatives 2 or 3 would result in the permanent commitment of land for waste disposal. This commitment would occur throughout the SLDS for Alternative 2, and at Plant 2 or the City Property for Alternative 3.

The Alternative 3 onsite cap would cover most of the Plant 2 area. A portion of the perimeter would need to be used as a buffer zone and the sides of the cap would be sloped to promote drainage. No other area of the SLDS would sustain a long-term impact as a result of this cleanup action. Perpetual care would be needed for the committed land because the waste would retain its toxicity for thousands of years. Thus, the cap would need to be visually inspected, ground water would be monitored, and the effectiveness of the overall system would be reviewed every five years under Alternative 3.

Implementing any of the final action alternatives would not be constrained by the availability of resources or supplies beyond those currently available in the St. Louis area or expected to be available at the offsite disposal facilities. Consumptive use of geological resources (eg, quarried rock, sand, and gravel) and petroleum products (eg, diesel fuel and gasoline) would be required for the removal, construction, and disposal activities for Alternatives 3, 4, 5 and 6. Adequate supplies of these materials are readily available in the St. Louis area and would also be available in the area of the offsite disposal sites. Additional fuel use would result from offsite transport of the waste. However, adequate supplies are available without affecting local requirements for these products.

Reduction in Contaminant Volume, Toxicity, and Mobility through Treatment. This criterion addresses the statutory preference (CERCLA Section 121) for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element. This evaluation addresses the anticipated performance of the technologies that may be employed in achieving these treatment goals. It includes the amount of waste treated or destroyed; the reduction in toxicity, mobility, or volume; the irreversibility of the treatment process; and the type and quantity of residuals resulting from the treatment process.

At this time, treatment is a conditional component of all the retained remedial alternatives except Alternatives 1 and 2. Even though none of the alternatives offer reduction in contaminant volume, toxicity, or mobility through treatment, the addition of treatment (if warranted in the future) could be achieved as an adjunct to Alternatives 3, 4, 5 and 6.

Alternatives 3, 4, 5 and 6 would reduce contaminant mobility by disposal of the contaminated soils. The disposal of the soils under the cap in Alternative 3 would reduce the migration of contaminants by retarding infiltration into contaminated soil, by preventing fugitive dust emissions, and by isolating surface runoff from the contaminated media. Offsite disposal for Alternatives 4, 5 and 6 would reduce onsite contaminant volume because contaminated materials would be permanently disposed of offsite.

Short-Term Effectiveness. This criterion addresses the effects of an alternative during the construction and implementation phase until remedial action objectives are met, including the speed with which the remedy achieves protectiveness and the potential to create adverse impacts on human health and the environment during construction and implementation. Also included under this criterion are impacts to soil, water, biotic resources, air quality, socioeconomics, land-use, aesthetic/recreational resources, and cultural/historical resources.

An increase in the complexity of an alternative typically results in a decrease in short-term effectiveness because of increased waste handling and processing. Other than Alternative 1, Alternative 2 is the most effective in protecting the community and workers from short-term impacts and in achieving implementation because there is no handling nor removal of waste materials. Alternative 2 requires the shortest time to implement, followed by Alternative 3. Alternatives 4 and 6 would have significantly greater short-term impact than Alternatives 1, 2, or 3 because contaminated soils would be shipped offsite, constraining the excavation rate. Alternative 5 has the longest implementation time frame. Alternatives 2, 3, 4, 5 and 6 are comparable in short-term effectiveness of ground-water contamination control.

With respect to soil excavation, Alternative 3 has a higher degree of short-term effectiveness compared to the other excavation alternatives, because it requires the minimum amount of handling or movement of the contaminated soils among the action alternatives. Once the soils are removed and incorporated into the area to be capped, an initial layer of fill material is deposited on the contaminated materials. The initial layer of fill material would isolate the workers from the source material during remedial activities. Dust generated by the earth-moving aspects of the alternative would be controlled.

Alternatives 4, 5 and 6 offer a moderate degree of short-term effectiveness compared to Alternative 3 because they would require more time to implement than Alternative 3. The nonradiological occupational hazards increase significantly for Alternatives 4, 5, and 6. Fugitive dust generation and increased erosion and silt loading of surface waters are among the most significant concerns of Alternatives 4, 5 and 6.

Implementability. This criterion addresses the technical and administrative feasibility of implementing an alternative, and the availability of services and materials required during its implementation. This evaluation includes such items as the ability to construct and operate the technology; the reliability of the technology; the ease of undertaking additional remedial actions; the ability to obtain services, capacities, equipment, and personnel; the ability to monitor the performance and effectiveness of technologies; and the ability to obtain necessary approvals and coordinate with regulatory agencies and authorities.

The design, engineering, and administrative requirements of Alternatives 1 and 2 are essentially negligible. Materials required for the components of these alternatives are readily available. The remaining alternatives are technically and administratively feasible. The engineering, design, and administrative requirements increase with the complexity of the alternatives in the following order: 4, 5, 6 and 3. Alternative 3 has the greatest complexity because of the construction of the cap in addition to excavation. Except for Alternatives 1 and 2, Alternative 4 is the most amenable to timely implementation of an expedited remedial approach. It requires the least site

preparation, provides disposal (without construction of a disposal facility) of a smaller volume than Alternative 5 or 6, and involves the fewest logistical problems. Alternative 5 is the next best approach to implementing expedited soil removal. It is less implementable than Alternative 4 because of the increased volume. Volumes of soil under each alternative are given in Table 8-2. Alternatives 4 and 6 would require segregating soil below deep-soil criteria and returning this material to depth. Alternative 3 would remove the same volume of soil as Alternative 5, but the additional task of design and construction of the liner and cap would delay implementation of Alternative 3 relative to Alternatives 4, 5 and 6.

Materials and services for the removal of contamination and environmental monitoring activities for the various alternatives are readily available. The degree of difficulty in implementing alternatives increases with the amount and depth of contaminated soils to be excavated, the level of the design/transportation required to dispose of soils in accordance with regulations, and the time/coordination involved in completing the alternative. The degree of difficulty greatly increases when the excavation proceeds below the water table. This is due to the excavation of saturated materials requiring dewatering prior to disposal.

Cost. The comparative analysis of costs examines the differences in capital, operations and maintenance (O&M), and present-worth values. Costs for each alternative, itemization of individual components, and the sensitivity analysis for each alternative can be found in Appendix B of the FS. The total costs for the alternatives increase as follows: Alternatives 1, 2, 4, 3, 6 and 5. The total 30-year costs for the six alternatives are:

- Alternative 1 – No Action $22 million
- Alternative 2 – Institution Controls and Site Maintenance $29 million
- Alternative 3 – Consolidation and Capping $100 million
- Alternative 4 – Partial Excavation and Disposal $92 million
- Alternative 5 – Complete Excavation and Disposal $140 million
- Alternative 6 – Selective Excavation and Disposal $114 million

The differences in costs among alternatives are very significant and increase primarily with the amount of contaminated soil to be excavated. Alternatives 2 and 4 do not include long-term costs for management of residual contamination which are eliminated by Alternative 5 and addressed more comprehensively by Alternative 6.

8.3 MODIFYING CRITERIA

State and Community Acceptance. This criterion evaluates the technical and administrative issues and concerns the State and neighboring communities may have regarding each of the alternatives.

The St. Louis Site Remediation Task Force requested that remediation at the St. Louis Downtown Site and the City Levee continue or begin with 'site specific' standards for industrial or recreational use, respectively."

TABLE 8-2 St. Louis Downtown Site Volumes

(CY insitu)

Volume	Alt. 1 No Action	Alt. 2 Institutional Controls and Site Maintenance	Alt. 3 Excavation, Consolidation & Capping	Alt. 4 Partial Excavation & Disposal	Alt. 5 Complete Excavation & Disposal	Alt. 6 Selective Excavation & Disposal
Impacted Volume Excavated (Insitu)	0	0	87,900	44,900	87,900	57,983
Overburden and Overexcavation Volume Excavated (Insitu)	0	0	71,986	24,259	71,986	42,822
Total Volume Excavated (Insitu) including impacted material, overburden, and over-excavation (insitu)	0	0	159,886	69,159	159,886	100,805
Volume of Below Criteria Excavated Material used as Backfill	0	0	54,406	15,279	54,406	17,601**
Disposal Volume prior to application of 1.25 swell factor	0	0	0*	53,880	105,480	83,204
Final Disposal Volume	0	0	0*	67,350	131,850	104,005

* Table shows accessible volumes only. Inaccessible Soils will be disposed of as they become available in the future

** Alternative 6 below criteria overburden is used only as deep soils backfill with the balance sent to disposal.

A wide spectrum of stakeholders, including MDNR, local governments, federal agencies and lawmakers, citizen groups, and concerned citizens participated in the review of the proposed plan for SLDS during the 30-day comment period starting on April 8, 1998 and ending on May 8, 1998. A public meeting was held on April 21, 1998 to hear comments and answer questions regarding the SLDS' feasibility study and proposed plan.

State and public comments expressed concern over the protectiveness of Alternative 4 with respect to workers' health and the consequences of future liabilities Mallinckrodt, Inc. would have to negotiate as the result of handling and disposing of contaminated soils displaced during future construction and enhancement projects. Both state regulators and community stakeholders expressed overwhelming support for Alternative 6, particularly for the increased depth of remediation. It was asserted that the more extensive cleanup associated with Alternative 6 would not only provide greater protection of the worker, it would also allow Mallinckrodt the flexibility it needed to expand and grow, and be a valuable asset to the community without future remediation obstacles. Some support was also expressed for Alternative 5.

The Missouri Department of Natural Resources commented that:

"The State of Missouri prefers Alternative 6 as the remedy for cleaning up radioactive contamination at the St. Louis Downtown Site. We believe Selective Excavation and Disposal provides the best vehicle for attaining the objectives of the St. Louis Site Remediation Task Force. Only approved off-site borrow should be used to fill the excavations at the vicinity properties.

We do believe the remediation should clean up to industrial use criteria the Mallinckrodt site and 5/15 'any use' levels at any depth for the vicinity properties. We believe Alternative 6 can be accomplished in a manner that will leave property owners whole. Such will result in the best response to the federal nuclear weapons production legacy in this part of the community."

The community also expressed concern that Alternatives 4 and 6 did not address removal of all the contamination on Vicinity Properties to the stringent "composite" criteria, regardless of depth. The reviewers felt that the VP soils need to be remediated to levels which would allow for unrestricted land-use and soils that are inaccessible at the time of remediation should be managed with institutional controls until such time as the obstruction is removed. Once the obstruction is cleared the contaminated soil should be remediated.

Concerns were also expressed regarding contaminated soils remaining onsite under Alternative 3, which involved capping the soils. No State or public concerns were expressed regarding Alternatives 1 and 2. The Responsiveness Summary in Appendix A discusses and responds to individual comments received during the public meeting and throughout the comment period.

9. THE SELECTED REMEDY

EPA and the USACE have determined that Alternative 6 (Selective Excavation and Disposal) is the most appropriate remedy for this operable unit and ground water and accessible soil at SLDS based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives using the nine criteria, and extensive public participation and comment. This alternative, a refinement to Alternative 4, makes it unlikely that the federal government will have to manage and dispose of soil containing residual levels of radioactivity displaced by future industrial construction and maintenance projects at the SLDS. It also reduces the need for additional risk and fate and transport studies to demonstrate that the site remains protective.

Several areas of particularly elevated radioactivity exist within the OU, especially where uranium ore was digested and uranium was extracted. No treatment technology has been identified that could cost effectively reduce the mobility and toxicity of the radioactivity to acceptable risk levels, primarily because the toxicity of radionuclides cannot be reduced through treatment. Treatment is retained as a conditional part of the remedy. Treatment will be fully assessed during the design phase. If a treatment technology is identified to reduce the contaminant's volume, toxicity, or mobility and is demonstrated to be cost effective, it may be included as an adjunct to excavation. The volume and mobility of the contaminants are reduced without treatment by removing them and disposing offsite in an approved facility. The remedial action's excavation of soil also mitigates potential adverse health affects from the toxic and carcinogenic nature of the contaminants.

Approximately 77,000 m^3 (100,000 yd^3) of soil will be excavated under this remedy. This includes the excavation of overburden that must be removed in order to access subsurface pockets of contamination. Approximately 13,000 m^3 (17,000 yd^3) of this soil will be returned to depths below 1.2 or 1.8 m (4 or 6 ft) as backfill, because it does not exceed the deep-soil criteria (risk-based) or exhibit a hazardous characteristic. The remainder of excavated soil will be disposed offsite. Approved borrow obtained from an offsite location will be used to backfill excavations above 1.2 or 1.8 m (4 or 6 ft) to grade. [The estimated cost for the remedy for this operable unit is $114 million.]

Sources of soil contamination within the A Unit's ground water will be removed and water that must be managed as part of the excavation will be treated and disposed of appropriately. Ground water in the B Unit is not currently impacted by COCs identified in this remedy.

The goal of the ground-water portion of this remedy is to maintain protection of the potentially usable ground water (B unit) and establish the effectiveness of the source removal action in this regard. The strategy to accomplish this goal is to install and monitor perimeter wells on a long-term basis to demonstrate that there will be no significant impacts from COCs on the Mississippi Alluvial Aquifer (B Unit). Monitoring will be conducted during and after the source-term removal. If monitoring of the B Unit shows that the MED/AEC COCs have significantly exceeded MCLs or thresholds established in 40 CFR 192, a Ground-water Remedial Action Alternative Assessment (GRAAA) would be initiated. The GRAAA would model and resolve:

MED/AEC COC fate and transport, risk to the public and environment, practical and efficient technologies to reduce the COCs, the likely concentration to be removed, the likely concentration of the COC(s) remaining post-treatment, impact of Mississippi River flooding inflows to the B Unit, and a recommendation for action in the Mississippi Alluvial Aquifer, the B Unit. The outcome of the alternative assessment could lead to an action for ground-water improvement within the Mississippi Alluvial Aquifer. Regardless of whether the GRAAA is implemented, a ground-water monitoring plan will be developed as part of the remedial design to evaluate the impacts of the Remedial Action. The goal of the monitoring plan will be to assess the fate and transport of MED/AEC residual contaminants through and following the Remedial Action. A monitoring program for ground water will be established and enforced until discontinued pursuant to five year CERCLA review.

The estimated cost of this remedy is $114 million.

Cleanup levels

The purpose of this response action is to control risks posed by direct contact with soils and sediments and to maintain low concentrations of MED/AEC COCs in the B Unit's ground water. (The State of Missouri has designated the B Unit as a potential future public drinking water supply). The baseline risk established for this site indicates that existing conditions in this operable unit potentially pose an excess lifetime cancer risk to a commercial/industrial worker of 5×10^{-3} from direct contact with soil and sediments. There is not a plausible future pathway for ingestion of currently impacted ground water under the reasonable projected industrial land use, nor do COCs related to this operable unit currently exist at significant concentrations in the B Unit. The investigative limits when exceeded trigger the GRAAA are: 50 μg/L for arsenic, 5 μg/L for cadmium, or 20 μg/L for total uranium.

This remedy will address soil contaminated with radioactivity, arsenic, and cadmium related to MED/AEC uranium manufacturing and processing at SLDS. Contaminants mixed or commingled with these MED/AEC radiological COCs will be removed as a consequence of the remedial action to address these MED/AEC COCs.

Post-remedial risks for this remedy are presented in Table 9-1 for a commercial/industrial worker and for a construction worker. These scenarios represent the most likely future land use scenario: that SLDS will remain an industrial facility under institutional control. Risk estimates were calculated for the FS and are summarized here assuming that the preferred alternative (Alternative 6) has been implemented.

The commercial/industrial worker represents a full-time on-site worker that occasionally excavates into shallow site soils. This worker could be exposed to residual concentrations of radionuclides that remain under several feet of approved borrow (used as backfill after remedial actions) or soil near or at the surface that meet the criteria in 40 CFR 192. The construction worker is an individual that receives a one time exposure to deep materials. This worker could potentially be exposed to soil excavated to the 50/100/150 pCi/g criteria or to soil remediated to 40 CFR 192 criteria.

Table 9-1. Residual Risk at SLDS

Residual Risk for Radionuclides by Exposure Scenario					
Analyte [a]	Primary Pathway [b]	Commercial/Industrial [c]		Construction [c]	
		> 2-ft Cover	5/15 pCi/g	5/15 pCi/g	50/100/150 pCi/g
Ac-227	Inhalation	$< 10^{-6}$	$1x10^{-5}$	$< 10^{-6}$	$< 10^{-6}$
Pa-231	Inhalation	$< 10^{-6}$	$7x10^{-7}$	$< 10^{-6}$	$< 10^{-6}$
Ra-226	External gamma	$< 10^{-6}$	$2x10^{-4}$	$4x10^{-6}$	$4x10^{-6}$
Th-230	Inhalation	$< 10^{-6}$	$7x10^{-7}$	$< 10^{-6}$	$3x10^{-6}$
Th-232	External gamma	$< 10^{-6}$	$1x10^{-4}$	$2x10^{-6}$	$4x10^{-6}$
U-238	Inhalation	$< 10^{-6}$	$8x10^{-6}$	$< 10^{-6}$	$1x10^{-6}$
Total Risk from Radionuclides		$< 10^{-6}$	$3x10^{-4}$	$6x10^{-6}$	$1x10^{-5}$
Residual Risk and Hazard Index for Non-Radionuclides by Exposure Scenario [d]					
Arsenic	n/a [e]	n/a	n/a	n/a	n/a
Cadmium	n/a	n/a	n/a	n/a	n/a
Uranium	n/a	n/a	n/a	n/a	n/a

[a] Includes relevant decay products and associated radionuclides. That is, Pb-210 is include with Ra-226; Ra-228 and Th-228 are included with Th-232; and U-234 and U-235 are included with U-238.

[b] Pathway resulting in largest contribution to risk is listed. Pathways include direct gamma, soil ingestion, and dust inhalation.

[c] From the St. Louis Downtown Site Feasibility Study (USACE 1998). Six exposure units are evaluated in the Feasibility Study. The highest (most conservative) risk from those exposure units is listed. Because the selected alternative calls for the removal of soil to 4-6 ft depths with approved borrow used as backfill, the risks for assuming cover are presented. The residual risk for remediation to 5/15 pCi/g with no cover is also presented for comparison. A thicker cover (e.g., 4-6 ft) would result in reduced risk. It is assumed that the construction worker digs through any clean cover and could dig into deep materials that were remediated to the 50/100/150 pCi/g criterion.

[d] Because there is insufficient data to support reasonable assessment of risk from exposure to all MED/AEC related chemical, post-remedial risk and hazard index estimates are not provided. Prior to completion of remedial activities, sufficient new data will be collected to support post-remedial risk estimates including these chemicals.

[e] not applicable

All risk estimates are rounded to one significant digit. Reported values may contain round-off error.

Table 9-1 lists the risks subsequent to implementation of the selected remedy to potential receptors from the primary radiological MED/AEC related COCs including Ac-227, Pa-231, Ra-226, Th-230, Th-232, and U-238. Exposure pathways considered include direct gamma, soil ingestion, and dust inhalation. The pathway that resulted in the highest relative risk for each radionuclide is also listed.

Six exposure units were evaluated for OU. The two exposure units with the highest residual risk from radioactivity of 3×10^{-4} excess cancer incidents is reported in Table 9-1. These values correspond to the scenario for a commercial/industrial worker with the assumption that no protective cover is provided. The residual risk for the remaining 4 exposure units, using the same exposure assumptions, ranged between 1.8×10^{-4} and 2.7×10^{-4}. Since assumptions used to calculate residual risk are much more conservative than conditions required for remediation (no cover assumed as opposed to 4-5 feet depth of off-site borrow required), actual site risk would be lower than the calculated values.

A key component of this remedy, recommended by the community and other stakeholders, is that approved offsite borrow is to be used to backfill the excavations from grade to 1.2 or 1.8 m (4 or 6 ft). Greater use of offsite borrow and extending the depth of the composite criteria are the significant differences between Alternative 4 and the selected remedy. Alternative 6 was selected as the remedy primarily because it reduced the liability of the federal government from costs associated with managing and disposing of soil containing residual radioactivity displaced by future construction or maintenance projects. The use of this thickness of approved offsite borrow also has the benefit of reducing the post remedial risk to well below the 1×10^{-6} level for excess cancer incidences for the commercial/industrial worker. On the rare occasion that a construction worker works at depths greater than 1.2 or 1.8 m (4 or 6 ft), the excess lifetime cancer incidence risk of that worker would not exceed 1×10^{-5} for the highest risk exposure unit.

Insufficient data was available in some of the exposure units to support a reasonable assessment of risk from the chemical contaminants. The excess cancer incidence from arsenic will be reduced to 9×10^{-5} and cadmium will not exceed a hazard index of approximately 0.9 if it is assumed that the average concentration of arsenic and cadmium will simply meet the criteria established for this cleanup. The actual average concentrations remaining after excavation will be far below these values considering that 1.2 or 1.8 m (4 or 6 ft) of approved offsite borrow will be used to backfill the excavations.

Note that the exposure scenarios considered in this evaluation represent reasonable maximum exposure conditions that tend to overestimate actual risk.

The cleanup criteria for this operable unit apply to areas affected by the MED/AEC uranium manufacturing and processing activities and consist of the following components:

- Excavation of accessible soils according to the ARAR-based composite cleanup criteria of 5/15 pCi/g above background for Ra-226, Ra-228, Th-232, and Th-230, and 50 pCi/g above background for U-238 in the uppermost 1.2 or 1.8 m (4 or 6 ft) throughout the OU and at the Perimeter VPs (see section 1.1). See Section 10 for ARAR determination.

- On the portion of the Mallinckrodt property addressed in the OU, site-specific target removal levels of 50 pCi/g above background for Ra-226, 100 pCi/g above background for Th-230, and 150 pCi/g above background for U-238 (50-100-150 guidelines) will be used as the deep-soil cleanup guidelines below 1.2 m (4 ft) in most areas within the plant boundaries and below 1.8 m (6 ft) as described in Section 7.3.6.

- For arsenic and cadmium:

    1) within the upper 1.2 or 1.8 m (4 or 6 ft) of grade, soil concentrations of arsenic greater than 60 mg/kg and/or cadmium concentrations greater than 17 mg/kg will be removed, or

2) below 1.2 or 1.8 m (4 or 6 ft) of grade, soil concentrations of arsenic greater that 2500 mg/kg and/or cadmium are greater than 400 mg/kg will be removed;

- Remediation goals for radiological contaminants are applied to soil concentration above background consistent with the ARAR (40 CFR 192), from which they derive. However, addition of background concentrations to these goals would not alter any judgments regarding protectiveness. Remediation goals for non-radiological criteria are applied to soil concentrations including background consistent with the NCP.

- Compliance with soil contamination criteria will be verified by methods that are compatible with MARSSIM for soils being cleaned up in the OU effective with MARSSIM publication. (A representative number of samples obtained in the bottom of excavations will also be subjected to chemical analysis and comparison to chemical COCs criteria.);

- A post-remedial action risk assessment will be performed to describe the level of risk remaining from MED/AEC contaminants following completion of remedial activities;

- Final determinations as to whether institutional controls and use restrictions are necessary will be based on calculations of post remedial action risk derived from actual residual conditions. Five year reviews will be conducted per the NCP for residual conditions that are unsuitable for unrestricted use.

- Institutional controls may include land use restrictions for those areas having residual concentrations of contaminants unsuitable for unrestricted use. This determination will be made based on risk analysis of the actual post-remedial action conditions. Until a decision is developed to address the ultimate disposition of inaccessible soils, steps will be taken to control uses inconsistent with current uses and to learn of anticipated changes in conditions that might make these soils accessible or increase the potential for exposure. Periodic reviews with affected property owners will be conducted throughout the duration of active site remediation. For residual conditions requiring use restrictions after the period of active remediation, coordination with property owners and local land use planning authorities will be necessary to implement deed restrictions or other mechanisms to maintain industrial/commercial land use.

- A long-term ground-water monitoring strategy will be implemented to confirm expectations that significant impacts to the Mississippi Alluvial Aquifer (B unit) will not occur. Although ground water use in this area is not anticipated, agreements will be proposed to state and local water authorities to prevent well drilling, which may be impacted by the surficially contaminated A unit.

- Perimeter wells in the Mississippi Alluvial Aquifer will be monitored to determine if further action will be required with respect to ground water,

- Protactinium-231 (Pa-231) and actinium-227 (Ac-227) will be included in the analyses for the post-remedial action residual site risk; and

- Contaminated sediments in sewers and drains considered to be accessible will be remediated along with the soils.

During the remedial investigation of the SLDS, sediments containing radioactivity were found in a small area of the Mississippi River bed. A subsequent investigation could not re-locate radioactivity on the river bed. Presumably it was carried downstream during high flows. The location of the river bed where radiological contamination was detected during the remedial investigation will be revisited and characterized. If radiological contamination criteria established in this ROD are exceeded, the remediation of the river bed will be addressed under a subsequent response action . If no contamination is present above the composite criteria (ARAR based), the remedy will be considered the final remedy for this portion of the site.

Contamination present beneath the existing levee will be addressed in a subsequent response action. The exposure and land-use assumptions used to remediate the bicycle trail on the strip of land east of the levee and west of the Mississippi River, were different than the assumptions used in this ROD. The area standards, as part of interim actions preceding this ROD, were established after discussions with the St. Louis Site Remediation Task Force. No further action is necessary for this property, but it is to be included in the post remedial action risk assessment for the OU to determine whether restrictions will be required on this portion of the site.

No further action is required on City Block 1201 except to include it in the post-remedial action risk assessment to reconfirm the protectiveness of the removal action there.

Alternative 6 is selected as the preferred remedy for the SLDS. It is protective of human health and the environment, meets ARARs, and was developed to provide the best balance of effectiveness, cost, and implementability compared with the other alternatives considered. Additionally, it addresses more fully the CERCLA modifying criteria of "state and community acceptance."

All the proposed alternatives are protective of human health and the environment. Alternative 6 provides more protection than any of the others except for Alternative 5. Alternative 6 removes the contaminated soil to at least the 1.2 or 1.8 m (4 or 6 ft) depth. This depth is needed for protection of industrial workers during ongoing operations. Only Alternatives 3 and 5 remove deeper soil from the contaminated locations, however Alternative 3 consolidates the excavated material under an earthen cap located onsite. This cap would require maintenance and institutional controls to be effective.

Alternative 6 would comply with applicable and relevant requirements for permissible levels of residual contamination through a combination of excavation of the contaminated soil above the human health target risk range, removal of soil above 40 CFR Part 192 requirements within the depth of plausible intrusion, and institutional controls. Public doses would be less than 25 mrem/yr as required by 10 CFR 20 Subpart E. Residual risk would be within the CERCLA target risk range.

Institutional controls would ensure continued protectiveness through digging restrictions and adherence to federal and state worker safety regulations. Alternative 6 could readily be performed in accordance with specific ARARs.

The remedial action taken under Alternative 6 would provide a permanent and effective means of protecting the workers and the public from the residual MED/AEC contaminants in the soil. The alternative would permanently remove the significant contaminants in the upper 1.2 or 1.8 m (4 or 6 ft) of soil at the site. In addition to removal of contaminated soil, backfilling with 1.2 or 1.8 m (4 or 6 ft) of approved borrow will make exposure to the remaining contaminants unlikely. The backfill will also shield potential receptors from gamma emissions. Exposure to the material left below the 1.2 or 1.8 m (4 or 6 ft) boundary, as well as the contaminated soils that are inaccessible, would be managed by implementing institutional controls and a monitoring program.

Alternative 6 is readily implementable, as are all the alternatives evaluated. The components of the remedial action use well established site preparation, excavation, and disposal strategies used at other commercial and CERCLA sites. The occupational and radiological hazards associated with implementing the remedial action are easily mitigated through the use of protective equipment and the adherence to OSHA regulations and the approved health and safety plan. The institutional controls and monitoring programs can be implemented fairly quickly. The materials, as well as experienced labor resources needed to perform the remedy, are abundantly available. The necessary permits and municipal approvals are also obtainable with few delays. The overall time to implement Alternative 6 is not significantly different from the other excavation alternatives.

The cost of Alternative 6 is lower than Alternative 5, the most protective alternative. Although the cost for the rest of the alternatives are less than 6, they are not as effective in permanently protecting the current or future land-user. Alternative 3 is only effective as long as the cap is maintained and institutional controls are enforced. Alternative 4 would leave material exceeding free release criteria at depths below 0.6 m (2 ft) where it may be inadvertently disturbed during ordinary renovation and construction activities. In addition to increased risk and dose to the worker, such intrusions would result in unaccountable future liabilities for waste handling and disposal. Although Alternative 5 provides the most permanent and most effective protection of human health and environment, it is not cost effective. The cost benefit trade-off of complete removal to all depths, as in Alternative 5, is high since only the top 1.2 or 1.8 m (4 or 6 ft) of the soil has the potential for significant human exposure during the industrial life of the site. Alternative 6 would cost $22 million more than Alternative 4, but the reduction in dose, risk, and future liability would be substantial. In addition, implementation of Alternative 6 would reduce the probability of material being brought to the surface where it would impose an increased risk. Alternative 6 was the preferred remedy of the State of Missouri, Mallinckrodt, and the public though it provides protectiveness exceeding CERCLA requirements.

Based on the above discussions, Alternative 6 is believed to provide the best balance among the six alternatives with respect to the NCP evaluation criteria. Alternative 6 is protective of human health and the environment, compliant with ARARs, implementable, low risk and cost-effective.

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10. STATUTORY DETERMINATIONS

Section 121 of CERCLA requires that all remedial actions shall:

- be protective of human health and the environment
- attain legally applicable or relevant and appropriate standards, requirements, criteria, or limitations, unless such standard, requirement, criteria, or limitation is waived in accordance with Section 121(d)(4);
- be cost effective; and
- use permanent solutions and alternative treatment technologies to the maximum extent practicable.

The manner in which the selected remedy satisfies each of these requirements is discussed in the following sections.

10.1 PROTECTION OF HUMAN HEALTH AND ENVIRONMENT

Section 121(d)(1) of CERCLA requires remedial actions to attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and of control of further release that, at a minimum, assures protection of human health and the environment. The selected remedy for this operable unit at the SLDS will protect human health by reducing current and reasonably anticipated future risks to levels at or below CERCLA acceptable risk criteria. During remedial activities, institutional controls (e.g., access restrictions) and environmental monitoring and surveillance activities will be maintained to ensure protectiveness, so that no member of the public will receive radiation doses above guidelines from exposure to residual radioactive contaminants.

There are no short-term threats associated with the selected remedy that cannot be readily controlled and mitigated. In addition, no adverse cross-media impacts are expected from the remedy.

10.2 ATTAINMENT OF ARARS

Section 121(d)(1) of CERCLA requires that with respect to any hazardous substance, pollutant or contaminant that will remain onsite, remedial actions must, upon completion, achieve a level or standard of control which at least attains legally applicable or relevant and appropriate standards, requirements, criteria, or limitations under Federal environmental law or any promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law that is more stringent than any Federal standard, requirement, criteria, or limitation (applicable or relevant and appropriate requirements or ARARs), unless such standard, requirement, criteria, or limitation is waived in accordance with Section 121(d)(4). Applicable requirements are those requirements which specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at the site.

Relevant and appropriate requirements are those requirements which, while not applicable to a release, are relevant and appropriate to the circumstances of the release. Section 300.400(g)(2) of the NCP lists various factors to be considered in determining whether a requirement is relevant and appropriate. These factors include the purpose of the requirement compared to the purpose of the CERCLA action, the medium regulated or affected by the requirement compared to the medium contaminated or affected at the site, and the substances regulated compared to the substances found at the site.

ARARs have been classified into three types to simplify identification and compliance with environmental requirements: action-specific requirements, chemical-specific requirements, and location-specific requirements. Action-specific requirements are those with which design, performance, and other aspects of implementation of specific remedial activities must comply. Chemical-specific requirements are media-specific and health-based concentration limits (criteria) developed for site-specific levels of contaminants in specific media. Location-specific standards are based on the particular characteristics or locations of the site, such as the presence of wetlands, floodplains, or sensitive ecosystems or habitats, or places of historical or archaeological significance.

In addition to ARARs, other advisories, criteria, or guidance may be useful in developing CERCLA remedies. These "to be considered" (TBC) advisories, criteria, or guidance may be developed by EPA, other federal agencies or states. The TBCs are not ARARs and are not legally binding. Their use is at the discretion of the lead agency if they would be useful to implementation of the selected remedy.

USACE has determined that the following statute and regulations are ARARs, as that term is defined in CERCLA, for the cleanup of the contamination present at the SLDS. All Federal laws and regulations pertaining to NEPA are not included as ARARs as the USACE is following the CERCLA process which is the functional equivalent to NEPA.

Chemical Specific ARARs

The USACE identified no requirements directly applicable to the cleanup of MED/AEC-related radiological contaminants in accessible soils at the SLDS. Regulations promulgated pursuant to the Uranium Mill Tailings Radiation Control Act (UMTRCA) at 40 C.F.R. Part 192 Subpart B apply to the cleanup of land and buildings with residual radioactive materials at designated inactive uranium processing sites. Since the SLDS is not one of the designated processing sites, these regulations do not apply to the SLDS. However, based upon comparisons of the purpose of these regulations with the purpose of this operable unit, the medium involved, and the hazardous substances regulated, the USACE concludes the standards found in 40 C.F.R. § 192.12(a) for cleanup of radium-226 in soils are relevant and appropriate to the cleanup of (radium-226) accessible soils at the SLDS. The areas of the SLDS adjacent to the portions of the site where uranium ores were digested are similar to vicinity properties of mill tailings sites with respect to the general distribution of contamination and the mechanism(s) which resulted in distribution of the contamination. Radium-226 and uranium are the major contaminants under Plants 7 and 2,

respectively. Adjacent areas are similar to mill site vicinity properties in their proximity to uranium processing operations and associated migration of contamination from the uranium processing areas.

40 C.F.R. § 192.12(a) establishes cleanup standards for land, defined as "any surface or subsurface land that is not part of a disposal site and is not covered by an occupiable building. It provides that remedial actions shall be conducted so as to provide a reasonable assurance that the concentration of radium-226 in land averaged over any area of 100 square meters (m^2) shall not exceed the background level by more than 5 pCi/g averaged over the first 15 cm of soil below the surface and 15 pCi/g averaged over 15 cm thick layers of soil more than 15 cm below the surface.

In accordance with OSWER directive 9200.4-18 "Establishment of Cleanup levels for CERCLA Sites with Radioactive Contamination," the 5/15 pCi/g criteria for residual radium in soil are considered relevant and appropriate for SLDS. This site is sufficiently similar to Title I Sites under UMTRCA for the reasons stated above and in consideration of contaminant distribution. There is not a significant profile of contamination between 5 and 30 pCi/g in the subsurface and application of the 15 pCi/g subsurface criterion has resulted in a cleanup below 5 pCi/g. Site characterization data and general experience in excavation of these materials under previous removal actions, e.g., Plant 10, verify this result. Remediation of Plant 10 to the 15 pCi/g UMTRCA limit resulted in residual contamination below the 5 pCi/g. Similarity of the adjacent areas to mill site VPs when taken with the existing Plant 10 data (which achieved sub 5 pCi/g post remedial action soil concentrations for radium and thorium) supports the conclusion that UMTRCA VP criteria apply and that remediation to a design soil criteria of 15 pCi/g should assure protectiveness of the residual site.

40 C.F.R. § 192.21 provides for the establishment of supplemental standards in lieu of the standards in 40 C.F.R. § 192.12(a) under certain conditions. 40 C.F.R. § 192.21(c) provides for such supplemental standards when the estimated cost of cleaning up a vicinity site is unreasonably high in comparison to the long-term benefits, and the residual radioactive materials do not pose a clear present or future hazard. Remedial action is generally not necessary where residual radioactive materials have been placed semi-permanently in a location where site-specific factors limit their hazard and from which they are costly or difficult to remove, or where only minor quantities of residual radioactive materials are involved. Based on site-specific conditions at the SLDS, MED/AEC- related radiologically contaminated soils beneath 4 or 6 feet, depending upon the specific location on the Mallinckrodt property, satisfy the criteria for establishment of supplemental standards. Risk-based supplemental standards were developed as described in section 7.3.7.

40 C.F.R. § 192.02(a) provides that control of residual radioactive materials and constituents shall be designed to provide reasonable assurance that releases of radon-222 from residual radioactive material to the atmosphere will not exceed an average release rate of 20 pCi/m^2/second or increase the annual average concentration of radon-222 in the air at or above any location outside the disposal site by more than one-half pCi/l. These requirements are considered to be relevant and appropriate to cleanup of accessible soils at the SLDS.

Radon standards in Subpart B require that, in any occupied or habitable building, the objective of remedial action shall be to achieve an annual average radon decay product concentration (including background) not to exceed 0.02 working level. The remedy will satisfy this requirement for the units that are remediated. Radon in buildings 25 and 101 overlying inaccessible soil will be controlled through active and passive radon reduction measures until a remedy for the inaccessible soils unit is selected.

10 C.F.R. 20 Subpart E pertains to the decommissioning of NRC licensed facilities. It provides standards for determining the extent to which lands must be remediated before decommissioning of a site can be considered complete and the license terminated. These standards are: unrestricted use - 25 mrem/yr total effective dose equivalent (TEDE) and ALARA; restricted use - 25 mrem/yr TEDE 100 mrem/yr with loss of site controls and ALARA. These standards are applicable to any NRC-licensed materials commingled with MED/AEC-related wastes subject to this remedial action and are relevant and appropriate to any FUSRAP materials similar to licensable materials under the Atomic Energy Act.

Federal and state laws and regulations related to drinking water are not considered to be applicable or relevant and appropriate to currently impacted groundwater in Unit A beneath the SLDS. For the reasons summarized in Section 1.2.4, Unit A is not considered a potential source of drinking water. Use of the Mississippi River alluvial aquifer (Unit B) in this area is not likely; however, MCLs and the groundwater protection requirements found in 40 CFR Part 192, Subpart A, Table 1, are relevant and appropriate with regard to evaluation of the need for further study of groundwater in Unit B.

Action-Specific ARARs

UMTRCA, 42 U.S.C. 7901 et. seq., requires the control of residual radioactive material at processing and disposal sites in a safe and environmentally sound manner. This requirement is considered relevant and appropriate to the remedial action at the SLDS. The selected remedial action will provide for the removal of radiological contaminants to a level that protects the public health and the environment which meets this requirement.

Federal and solid and hazardous waste disposal laws and regulations are considered relevant and appropriate to any excavated materials that will be reused as fill materials on the site. A determination will be made as to whether excavated materials are a listed or characteristic RCRA hazardous waste before the excavated materials are used as onsite fill. The substantive requirements of the laws and regulations will be met for materials remaining at the site. State regulations regarding the disposal of radioactive materials in sanitary landfills are not considered to be applicable or relevant and appropriate.

State regulations pertaining to any state permits for onsite work, are not considered to be applicable or relevant and appropriate as CERCLA provides in Section 121 (e)(1), 42 U.S.C. 9621 (e)(1), that no federal, state, or local permits are required for the conduct of onsite response actions. Substantive requirements of such provisions will be implemented as appropriate.

Federal and State laws and regulations pertaining to Dredge or Fill requirements are not considered to be applicable or relevant and appropriate because no dredge or fill will be discharged into or removed from a wetland and/or waters of the United States as part of the remedial action.

Federal and State laws and regulations relating to drinking water are not considered ARARs because none of the A unit ground water is currently valuable as a drinking water source. Monitoring and assessment of the B unit ground water is addressed by the 40 CFR Subpart A, Table 1, as an ARAR.

State regulations pertaining to asbestos are not considered to be applicable or relevant and appropriate because the response action does not include the removal of buildings.

While Federal and State laws and regulations pertaining to Safety and Health Standards including, but not limited to OSHA, are not considered ARARs, per se, however, federal contractors are required to comply with applicable Safety and Health laws and regulations.

Location-Specific ARARs

Federal and State laws and regulations pertaining to the National Historic Preservation Act, State Historic Preservation Act, Archeological and Historical Preservation Act, and Native American Graves Protection and Repatriation Act are not considered to be applicable or relevant and appropriate.

Federal and state laws and regulations and Executive Orders pertaining to Floodplain Management and Protection are not considered to be applicable or relevant and appropriate because the site is not located on a floodplain, as defined by relevant regulations, 40 C.F.R. Part 6, Appendix A. The existence of a 500 year flood protection structure (the St. Louis floodwall) takes the SLDS out of the definition of a floodplain.

All Federal and State laws and regulations pertaining to Endangered Species are not included as ARARs in so far as available data indicates that there are no known endangered species or their habitats on the site.

Table 10-1 summarizes the chemical-specific ARARs appropriate for cleanup actions at the site. Table 10-2 summarizes the action-specific ARARs.

Table 10-1. Chemical Specific ARARS for the SLDS

Standard, Requirement, Criteria or Limitation	Citation	Description of Requirement	ARAR Status	Comment
Uranium Mill Tailings Radiation Control Act (UMTRCA) (October 1992): Cleanup of Radioactively Contaminated Land and Contaminated Buildings	40 C.F.R.192.12(a)	Residual radioactive material concentration of Ra-226 and Ra-228 in land averaged over any 100 m^2 area shall not exceed the background level by >5 pCi/g averaged over the first 15 cm of soil (6 inches) and 15 pCi/g averaged over 15 cm thick layers of soil >15 cm below the surface.	Relevant and Appropriate	This ARAR was used for to establish composite cleanup criteria for radium and thorium soils to a depth of 4-6 ft.
	40 C.F.R. 192.21 and 192.22	Supplemental Standards: Site-specific target removal levels of 50 pCi/g above background for Ra-226, 100 pCi/g above background for Th-230, and 150 pCi/g above background for U-238 (50-100-150 guidelines) will be used as the deep-soil cleanup guidelines below 1.2 m (4 ft) in most areas within the plant boundaries and below 1.8 m (6 ft) in areas delineated in Section 7.4.6.	Relevant and Appropriate	The provision allowing the development of supplemental standards under certain conditions was basis developing deep soil, i.e., greater than 4-6 ft., criteria.
	40 C.F.R. 192.02(b)(1)	Radon-222 releases not exceeding 20 pCi/m^3/sec. or 0.5 pCi/l in air above site	Relevant and Appropriate	
EPA Policy directives for radioactive contamination	OSWER Directive 9200.4-23	EPA policy for ARAR determination for radioactive sites.	TBC	These directives were consulted in developing radioactive cleanup criteria because of the similarly between these sites and the UMTRCA sites.
	OSWER Directive 9200.4-18	EPA policy on using 40 C.F.R. Part 192 for CERCLA cleanup criteria at radioactive sites, including radium and thorium.	TBC	
Uranium Mill Tailings Radiation Control Act	40 C.F.R. 192.40, 192.41	Criteria for sites where thorium ores were processed.	Relevant and Appropriate	This regulation was used in developing the thorium cleanup criteria.
Resource Conservation and Recovery Act	40 C.F.R. 257-272	Establishes accountability in handling hazardous waste from generation to disposal.	Relevant and Appropriate	Any excavated materials that remain on site will meet all hazardous waste requirements in addition to the radiological cleanup criteria.

Table 10-1. Chemical Specific ARARS for the SLDS (Continued)

Standard, Requirement, Criteria or Limitation	Citation	Description of Requirement	ARAR Status	Comment
NRC Radiological Criteria for License Termination	10 C.F.R. 20 Subpart E	This rule provides consistent standards to NRC licensees for determining the extent to which lands must be remediated before decommissioning of a site can be considered complete and the license terminated.	Applicable	These criteria would be applicable to any NRC-licensed materials commingled with MED/AEC-related wastes and are relevant and appropriate to materials similar to Atomic Energy Act licensable materials.

Table 10-2. Action Specific ARARS for the SLDS

Standard, Requirement, Criteria or Limitation	Citation	Description of Requirement	ARAR Status	Comment
General Pretreatment Regulation	10 CSR 20-6.100	Provides for procedures to prevent the introduction of pollutants into publicity-owned treatment works (POTWs).	Applicable	To the extent waters are encountered during cleanup, and disposal to a POTW is chosen, pretreatment requirements will be met.
Solid Waste Disposal Act, as amended; Identification and Listing of Hazardous Wastes	40 C.F.R. 260 and 261	Provides for identification and characterization of hazardous wastes.	Relevant and Appropriate	These requirements will be used only for purposes of analyzing suitability of excavated material for backfill onsite.
RCRA Land Disposal Restrictions	40 C.F.R. 268	Provides rule for treatment hazardous waste before landfilling.	Relevant and Appropriate	These are applicable only for purposes of analyzing suitability of excavated material for offsite disposal and for analyzing for backfill onsite.
Clean Water Act, National Pollutant Discharge Elimination System; Water Quality Standards	40 C.F.R. 122-125 10 CSR 20-7.031 (4) (I)	Provide for limitations on point source discharge to surface water.	Relevant and Appropriate	If a point source discharge is sued to dispose of waters encountered during cleanup, specific effluent limits will be established as part of work plans developed during remedial design or remedial action. However, a formal NPDES discharge permit will not be obtained.
Missouri General Pretreatment Regulation	10 CSR 20-6.100	Provides for procedures to prevent the introduction of pollutants into publicity-owned treatment work (POTWs).	Applicable	To the extent waters are encountered during cleanup, and disposal to a POTW is chosen, pretreatment requirements will be met.
Missouri Storm Water Regulations: Surface Runoff and Erosion Control; Missouri Storm Water Discharge Regulations	10 CSR 20-6.200 10 CSR 20-6.010(13)	Provides for the use of best management practices to control storm water, erosion control and sediment transport.	Relevant and Appropriate	To the extent storm waters are encountered during cleanup, they will be treated as required to meet substantive discharge criteria. Substantive surface control measures will be implemented as appropriate, although a state permit, per se, will not be obtained.
Standards for Construction, Monitoring and Plugging of Wells	10 CSR 23-3	Provides procedures for constructing, monitoring and plugging of wells.	Relevant and Appropriate	Ground water monitoring wells will be installed and operated consistent with substantive procedures, but permits will not be obtained.
Uranium Mill Tailings Radiation Control Act (UMTRCA) (October 1992)	40 C.F.R. 192.02 Table 1 to Subpart A	Table 1 describes maximum concentrations of constituents for ground water protection, including 0.05 and 0.01 mg/l arsenic and cadmium, and 5 pCi/l for radium-226 and radium-228 and 30 pCi/l for uranium-234 and uranium-238, respectively.	Relevant and Appropriate	Only Table 1 of this regulation is relevant and appropriate as it provides concentration limits that will trigger assessment of the B unit ground water if exceeded.

Table 10-2. Action Specific ARARS for the SLDS (Continued)

Standard, Requirement, Criteria or Limitation	Citation	Description of Requirement	ARAR Status	Comment
Clean Air Act, National Emission Standards for Radionuclide Facilities licensed by the NRC and Federal Facilities not covered by subpart H	40 C.F.R. Part 61 Subpart I	Emission levels shall not exceed an effective dose equivalent of 10 mrem/year	Relevant and Appropriate	These regulations are considered relevant and appropriate to the extent necessary to ensure emissions during construction activities meet regulatory limits.

10.3 COST EFFECTIVENESS

The selected remedy is the most cost-effective of the alternatives because it provides the best balance between cost and risk reduction. Alternative 6 successfully removes soils above cleanup criteria in current and potential future use areas, thus eliminating the most likely exposure pathways without unnecessary removal of soil. Additionally, the selected alternative will minimize liability associated with future remedial or protective actions necessary to accommodate future operational activities.

Total present worth cost for the selected alternative is estimated at $114 million. In consideration of these factors, the selected remedy provides the best overall effectiveness of all alternatives evaluated proportional to its cost. SLDS has been identified as a possible value engineering study area. Value engineering studies will be conducted as appropriate in order to maximize its cost effectiveness.

10.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedy for SLDS provides a permanent solution to contamination that currently exists on these properties. The selected remedy provides the best balance of trade-offs among the alternatives with respect to the evaluation criteria. The criteria that were most critical in the selection of Alternative 6 were cost effectiveness and overall protection of human health. Expenditures of large sums beyond that required by Alternative 6 would result in negligible reduction in dose.

The state, as well as the community, has expressed a strong preference for removal and out-of-state disposal. The selected remedy meets the statutory requirement to utilize permanent solutions and treatment technologies to the extent practicable. Treatment has not been demonstrated capable of achieving cleanup criteria for the SLDS soils. Soils in north St. Louis County have been tested using soil washing technologies. While high percent removal efficiencies were obtained, the composite criteria (ARAR based) could not be reached. Thus excavated soil, if treated, would still need to be disposed offsite following treatment. It is anticipated that sufficient backfill below deep-soil criteria (risk-based) will be obtained in the upper 4 or 6 feet to completely fill excavations to those depths without treatment.

11. EXPLANATION OF SIGNIFICANT CHANGES

The PP provided for involvement with the community through a document review process and a public comment period. A public meeting was advertised and held on April 21, 1998. Comments that were received during the 30-day public comment period are addressed in Appendix A of this Record of Decision.

Review of State and community comments indicates that all respondents preferred Alternative 6 in lieu of Alternative 4 as stated in the Proposed Plan. Stakeholders consisting of the State of Missouri, City of St. Louis, County of St. Louis and St. Louis Oversight Committee, and Mallinckrodt, Inc. were universally supportive of adoption of Alternative 6.

Upon further investigation it was determined that substantial additional costs would expect to be incurred by the government for Alternative 4 to support future monitoring and disposal considerations. Depending on the precise nature of Mallinckrodt construction activities, cost associated with excavation of contaminated soils and related studies may result in long-term costs for Alternative 4 which equal or exceed those of Alternative 6. This status, together with reduced operational impacts reduction in residual site risk, and consistent with state and community recommendations, Alternative 6 was selected. Residual site risks are substantially reduced for both an industrial/construction worker and for a utility worker due to the increased depth of excavation.

As a result of community comments, the remedy selected was changed to Alternative 6, Selective Excavation and Disposal. The preferred remedy in the initial draft Proposed Plan was Alternative 4. Based on public and stakeholder comments, Alternative 4 was not considered to be sufficiently protective considering the high possibility of construction activities intruding below a 2 foot depth interval. Additionally, concern was expressed regarding the open-ended liability for handling and disposal of wastes excavated from below 2 feet as a result of future activities. Alternative 6, as the preferred alternative, satisfactorily addresses these concerns and comments.

Therefore, Alternative 6 was selected pursuant to State and community comments to reduce future government costs for monitoring; impact and costs of disposal of contaminated soil carried to the surface by excavation activities; and operational impact on land owner's construction efforts. Use of Alternative 6 also substantially reduces residual site risks to construction/industrial workers on the site by minimizing exposure associated with soil excavation and overall access to radioactive material present in soil.

Building decontamination (buildings 25 and 101) will be included in a separate CERCLA action. This was done because, like the inaccessible soils, the building remediation would have to be deferred until the owner makes it available. The buildings and inaccessible soils will be managed through institutional controls until such time as they are otherwise addressed under a future CERCLA action. In addition, questions have arisen regarding whether contaminated buildings 25 and 101 may be addressed under CERCLA.

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12. RESPONSIVENESS SUMMARY

Numerous comments were received during the public comment period. In general these comments indicated overwhelming support by stakeholders for Alternative 6 instead of Alternative 4.

Many specific technical issues were also identified for consideration by USACE in developing the final remedial action design. The complete responsiveness summary to these comments is provided in Appendix A.

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APPENDIX A

DETAILED RESPONSES TO COMMENTS

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1.0 PUBLIC MEETING COMMENTS

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DETAILED RESPONSES TO COMMENTS

1.0 Public Meeting Comments

The 30-day comment period for the Proposed Plan for the St. Louis Downtown Site began on April 8, 1998 and ended on May 8, 1998. A public meeting was held on April 21, 1998 to hear comments and answer questions regarding the SLDS' Feasibility Study and Proposed Plan. The following comments were taken from the St. Louis Downtown Site Public Meeting transcript and paraphrased for continuity and clarity. Verbatim statements by meeting participants, as they appear in the transcript, are written in italic font.

Comment 1

Commentor: Mr. Bob Eck. Mr. Eck is the director of the Missouri Department of Natural Resources, St. Louis regional office. He is speaking on behalf of the Department Director, Steve Mahfood.

Comment: Mr. Eck stated the preference of the St. Louis Site Remediation Task Force for Alternative 6 and that all backfill should be from approved offsite borrow locations. Mr. Eck stated,

> *"The State of Missouri prefers Alternative 6 as the remedy for cleaning up radioactive contamination at the St. Louis Downtown Site. We believe Selective Excavation and Disposal provides the best vehicle for attaining the objectives of the St. Louis Site Remediation Task Force. Only approved off-site borrow should be used to fill the excavations at the vicinity properties.*
>
> *We do believe the remediation should clean up to industrial use criteria the Mallinckrodt site and 5/15 'any use' levels at any depth for the vicinity properties. We believe Alternative 6 can be accomplished in a manner that will leave property owners whole. Such will result in the best response to the federal nuclear weapons production legacy in this part of the community*

Mr. Eck also expressed his support for the use of institutional controls *"to ensure continued protection until a remedy for inaccessible soils is developed."*

Response: The USACE agrees to select Alternative 6 as the preferred remediation alternative, instead of Alternative 4. This will be reflected in the Record of Decision (ROD). This decision is largely due to the

overwhelming support for Alternative 6 by the public, Mallinckrodt, Inc. and local, state and federal government officials. Both alternatives are protective of the current and future worker and the environment. However, Alternative 6 reduces radionuclide levels further, thus providing additional protectiveness relative to Alternative 4. In addition, this alternative will reduce the need for future studies, designs, and remedial actions, thus avoiding future potential liability and costs to the federal government. Alternative 6 also allows Mallinckrodt, Inc. the freedom to grow and support the local community without future remediation liabilities.

As stated in the Proposed Plan and the Feasibility Study, Alternative 6 will continue to use soils from onsite removal activities as backfill, as long as the radiological contamination levels of the soil are less than ALARA criteria. This soil will only be used as backfill up to depths of 4 or 6 feet, depending on the excavation zone. Only approved borrow from offsite will be permitted to backfill areas at the vicinity properties and above 4 or 6 feet at SLDS. This approach is more cost effective than using offsite soil for all the backfill due to avoidance of disposal fees and minimizing transport costs for the new soil. Additionally, clean offsite backfill to depth will provide little or no substantial health benefits since the backfill areas in question extend deeper than areas projected to be disturbed by future activities.

In addition to choosing Alternative 6 for implementation, the USACE has revised Alternative 6 so the vicinity property soils will be remediated to levels equal to or less than the more stringent "composite" criteria regardless of depth. Inaccessible soils on the vicinity properties will be managed through institutional controls until a remedy is developed for the inaccessible soils operable unit. This rigorous level of remediation will allow unrestricted use of the accessible soils on the vicinity properties.

Comment 2

Commentor: Anna Ginzburg. Ms. Ginzburg represented the Mayor's Office of the City of St. Louis.

Comment: Ms. Ginzburg read a prepared statement from Mayor Harmon. The statement was principally in support of Alternative 6 and for the Mallinckrodt's "outstanding corporate citizenship". The statement opened,

"As Mayor of the City of St. Louis, I submit the following statement in response to the Army Corps of Engineers Proposed Plan for the downtown site dated April 1998. The Mallinckrodt site should be cleaned up to the standards laid out in Alternative 6 of the April 1998 Proposed Plan. This alternative is most consistent with the recommendations of the St. Louis Site Remediation Task Force which states that the Mallinckrodt properties should be cleaned up to a depth of 8 feet. Cleanup to the 4 and 6-foot levels stated in Alternative 6 will allow for the future development at the Mallinckrodt site."

The statement went on to praise Mallinckrodt as a "positive presence" by reading,

"The Mallinckrodt Corporation has displayed outstanding corporate citizenship throughout the entire cleanup and public input process. They have made major in-kind contributions of time, energy and resources moving the site cleanup forward significantly. The City of St. Louis values Mallinckrodt's commitment to the Near North Riverfront area and the other neighborhoods surrounding its facility.

The plan laid out in Alternative 6 will allow Mallinckrodt to undertake development and expansion that will help the company maintain and expand its positive presence. Supporting Mallinckrodt development plan is a top priority for the City of St. Louis."

The Mayor was critical of Alternative 4 because it "*does not take into account the long-term costs related to ongoing oversight and monitoring for the significant level of contamination that would remain.*" And, "*it is unfair to assume that Mallinckrodt Corporation will accept this burden indefinitely.*"

The Mayor's statement expressed concern for the contamination on the vicinity properties by stating,

"These vicinity properties include several small businesses, as well as property owned by the City of St. Louis. The City property is adjacent to the recently opened Riverfront Trail. It is essential that this property be cleaned up to standards for unrestricted use in the near future since it is likely to be frequented by families using the trail.

The cleanup of the businesses included in the vicinity properties must be closely coordinated with the business owners so that economic activity is not disrupted. The Army Corps of Engineers should begin negotiations with these businesses in order to develop a cleanup plan. Under no circumstances should the burden of cleanup costs or the responsibility for monitoring and oversight of continuing contamination fall on these businesses.

At a minimum, we need to clean up the vicinity properties to the same unrestricted use standards that the City, the County and the State want to see utilized at the Airport Site and adjacent properties in the much more affluent North County neighborhoods surrounding the Airport Site."

Response: Based on public comment, the USACE has selected Alternative 6 for implementation, rather than the initially proposed Alternative 4. The public and stakeholders expressed strong concern that Alternative 4 did not provide satisfactory protection of workers during Mallinckrodt, Inc. industrial activities. These parties also expressed concern that the residual contamination left in place below 2 feet represents an open-ended liability for Mallinkrodt, Inc. with respect to management of waste soils made available during future activities. It was noted by commentors that minimizing limitations so Mallinckrodt, Inc. can freely expand and renovate is of utmost importance to the community and the local economy. Selection of Alternative 6 as the preferred alternative provides an additional level of protectiveness relative to Alternative 4, and satisfactorily mitigates stakeholder concerns by reducing further the amount of residual radionuclide contamination and eliminating any future burden associated with Mallinckrodt, Inc. land-use. In addition, Alternative 6 will reduce the need for future studies, designs, and remedial actions, thus avoiding future potential liability and costs to the federal government.

In addition to selecting Alternative 6 for implementation, the USACE has revised Alternative 6 so the vicinity property soils are remediated to levels equal to or less than the more stringent "composite" criteria regardless of depth. Those inaccessible soils on the vicinity properties at the time of remediation will be managed through institutional controls until a remedy is developed. This rigorous level of remediation will allow unrestricted use of the accessible soils on the vicinity properties.

Comment 3

Commentor: Mr. Richard Cavannaugh. Mr. Cavannaugh is the Chair of the St. Louis FUSRAP Oversite Committee. He represented the St. Louis County and presented a Statement from the St. Louis County Executive, Buzz Westfall.

Comment: Before reading the county executive's statement, Mr. Cavanaugh gave a brief overview of the committee's purpose to collaboratively work with the City "*to provide oversight and assurance that standards are maintained on the cleanup*" on the Downtown site as well as the Airport Site and adjacent properties.

The Mr. Westfall's statement, read by Mr. Cavanaugh, expressed disagreement with the proposed alternative based on recommendations by the St. Louis Site Remediation Task Force and the long-term adverse economic impact Alternative 4 may have to Mallinckrodt Inc. and the region. Mr. Westfall's statement read,

> *"I* [Mr. Westfall] *must, however, disagree with the Corps of Engineers` current recommendation for Alternative 4 for cleanup of the St. Louis Downtown site. Alternative 4 would only provide a partial solution to the cleanup issue at the Mallinckrodt plant. Most importantly, the proposed plan for Alternative 4 is not consistent with the recommendations of the St. Louis Site Remediation Task Force. The Task Force recommendation--based on over three years of hard work and study by the Radioactive Waste Commissions of both St. Louis County and the City of St. Louis--clearly calls for the use of clean backfill at the St. Louis Downtown Site.*
>
> *The Mallinckrodt Corporation is a long standing and vital employer in the St. Louis region. Several other businesses operate in the nearby vicinity properties. The proposed Alternative 4 would result in radioactive contamination remaining in the ground on the north St. Louis site. The perceived short-term cost savings of Alternative 4 are overshadowed by the long-term economic benefits of complete remediation of the Downtown Site.*
>
> *It is the hope of the St. Louis community that Mallinckrodt will continue to operate a plant at the Downtown Site. Further, it's expected that Mallinckrodt will build future manufacturing facilities at that location. When such construction is contemplated, further radioactive waste remediation would be required prior to*

construction. Both the cost and time involved in such future remediation will functionally argue against Mallinckrodt's consideration of the north St. Louis site for future economic development."

Mr. Westfall's comments conclude with the recommendations of proceeding with Alternative 6 instead of Alternative 4. Alternative 6, according to Mr. Westfall's statement will *"assure complete remediation of the Mallinckrodt Site and will be a worthwhile investment in the future of a vibrant economy for our region. Any strategy short of the complete remediation outlined in Alternative 6 would be short sighted".*

Response: Please refer to the Responses associated with Comments 1 and 2, pertaining to the selection of Alternative 6 for implementation, based on public comment.

Comment 4

Commentor: Ms. Mimi Garstang. Ms. Garstang's comments were on behalf of State geologist Dr. James Williams.

Comment: Ms. Garstang began with a brief description of the site's groundwater system and its current use. Her principle concern was for the protection of the aquifer system potentially influenced by the site's contamination and that the selected remedy provide this protection. Ms. Garstang's statement read,

"You're probably all aware that the St. Louis Downtown Site is located on the Mississippi River flood plain. The facility is underlain by a major groundwater aquifer that extends from the northern reaches of the Mississippi River to the Gulf of Mexico. This aquifer supplies groundwater for private, public and commercial uses throughout much of its extent.

I [Dr. Williams] *recognize that the Mississippi River alluvial aquifer in the general vicinity of the St. Louis Downtown Site is not currently used for public water supply. However, the potential for such use cannot be discounted. The quantity as well as the quality of the water in this aquifer is adequate and suitable for many uses. Protection of the aquifer is essential given the volume and reliability of the water present.*

The close proximity of the Mississippi River means that there is a measurable influence by the river on the aquifer. The bedrock aquifer to the west influences the alluvium to a lesser amount. I [Dr. Williams] *realize that treatment of the water in this alluvium may be necessary prior to consumption. The extent of treatment may also be impacted by man-made influences on the aquifer. However, that does not allow for contamination risks to exist that knowingly would or could cause degradation of water quality beyond reasonable limits for standard treatment by the user.*

All remedial actions considered for the St. Louis Downtown Site should include efforts to eliminate the potential for radionuclides or other contaminants to adversely impact the alluvial aquifer usable as a water supply."

Response: Alternative 6, in addition to protecting the workers and providing flexibility for Mallinckrodt growth, also provides protection of groundwater by removing the majority of the source material responsible for deteriorating the water quality. A more aggressive treatment approach for meeting remedial objectives is not practical from a cost and technological standpoint because of the proximity to the Mississippi River, the nearest receptor, and the reduction of source material provided by the preferred alternative. Despite not being treated, residual contamination left by Alternative 6 does not pose a significant risk to water users since groundwater is not directly used as a water source and contaminants in the Upper Zone are not present in sufficient concentration to impact the quality of the Mississippi River.

Alternative 6, in addition to removing the majority of the source material, also provides for future assurances that the current non-use of regional groundwater continues. Alternative 6 regulates groundwater use through institutional controls that restrict groundwater usage until such time as the water no longer poses a threat. In addition to water-use restrictions, Alternative 6 also monitors the potential migration of the contaminants to determine the remedy's effectiveness and to provide a determination of water quality impacts.

Comment 5

Commentor: Ms. Sally Price. Ms. Price's comments were made on behalf of the St. Louis FUSRAP Oversight Committee, of which she is a member.

Comment: Ms. Price presented the opinion of the oversight committee that the preferred Alternative 4 should be switched to Alternative 6 based on the

increased protection to human health offered by 6, as well as Alternative 6 being *"more conducive to the continued long term growth and viability interests of Mallinckrodt Chemical Company"*. She stated,

> *"At the committee's last meeting this past Friday on April 17, 1998, they discussed the St. Louis Downtown Site Feasibility Study and Proposed Plan. As a result of the discussions, the committee unanimously approved a motion to support the Alternative 6 cleanup option offered in the report".*

Ms. Price closed her statement by emphasizing the importance of Mallinckrodt, Inc. and the vital economic base it provides the community as well as the North St. Louis area.

Response: Please refer to the Responses associated with Comments 1 and 2, pertaining to the selection of Alternative 6 for implementation, based on public comment.

Comment 6

Commentor: Ms. Rita Bleser. Ms. Bleser is the Vice Present and General Manager of Mallinckrodt, Inc. and Plant Manager of the St. Louis Plant.

Comment: Ms. Bleser opened with an overview of the Mallinckrodt company and its past growth and future upgrade plans. She emphasized Mallinckrodt growth and commitment to the FUSRAP Program by stating,

> *"Over the last 10 years Mallinckrodt has invested more than 200 million dollars in new manufacturing and support facilities in the St. Louis plant. Over the next 5 years Mallinckrodt hopes to continue investment in upgraded and new facilities at the plant. Mallinckrodt's interest in the continued development of the St. Louis plant makes it very concerned about the government cleanup of residual contamination under the FUSRAP program.*
>
> *Mallinckrodt has been an active partner in all FUSRAP activities. Employees serve on the Oversight Task Force, and we have committed staff and revenue to cleanup projects. To facilitate FUSRAP remedial activities, Mallinckrodt has relocated on-going operations, utility systems and demolished structures.*

Given our involvement in FUSRAP remedial activities and our continued desire to invest in and expand the St. Louis plant, we are concerned about the Corps stated preference for implementation of Alternative 4 of the plan. This alternative simply does not remove enough contaminated soil to ensure that future investment in the plant is financially justified.

The presence of contaminated soil in future construction zones will add costs, complexity and time to the construction of manufacturing and support facilities at the St. Louis plant. As a result, it may be more cost effective for Mallinckrodt to invest in facilities where such burdens do not exist."

Ms. Bleser expressed concern for the USACE's preferred Alternative 4 and recommended acceptance of Alternative 6. She stated,

"The Corps' preferred alternative is also not consistent with the recommendation of the St. Louis Site Remediation Task Force. In its September 1996 report this task force of community representatives recommended that soil contaminants be removed to a depth permitting general excavation for maintenance without concern.

Implementation of Alternative 4 would require that restrictions on future excavation be imposed according to the Corps' own risk analysis. Thus, the proposed plan does not excavate enough contaminated soil to avoid these restrictions and meet the task force recommendation. The Corps' plan also leaves its ownership of remaining contaminated materials unaddressed in this plan. Therefore, the cost of Alternative 4 is understated.

As the agency responsible for implementing the FUSRAP program, and as the successor to the Department of Energy, the Corps is obligated to remediate all MED - AEC related residues. Any left-behind contamination remains the responsibility of the Corps. As the Mallinckrodt facility and vicinity properties are further developed, soils left behind under Alternative 4 will be excavated by Mallinckrodt and other property owners and provided to the Corps for management and disposal. These administrative and disposal costs of the Corps are not included in the cost of Alternative 4. Most importantly, Alternative 4 does not minimize potential employee exposure. Remediation of more, not less, contaminated soils at this time lessens overall worker exposure.

...Implementation of Alternative 6 would remove contaminated soil to a depth of 6 feet and backfill the excavated site with clean fill. Therefore, contaminated soils likely to be encountered during routine maintenance and construction activity would be removed. This remediation alternative is consistent with Mallinckrodt needs, the task force recommendation, and minimizes long term worker exposure."

Response: Please refer to the Responses associated with Comments 1 and 2, pertaining to the selection of Alternative 6 for implementation, based on public comment.

Comment 7

Commentor: Father Richard Creason. Father Creason is the pastor of Holy Trinity Church.

Comment: Father Creason opened with a brief historical overview of his church. He emphasized how Mallinckrodt, Inc. is part of what makes a community. He states this support for Mallinckrodt, Inc.'s continued presence and Alternative 6 by stating,

"...I think we [Mallinckrodt and Holy Trinity Church] *both strive to be very responsible citizens in this community, to make a contribution to the improvement to a life and the well being of all who live here. And I think when you look at the elements that go to constitute a community, that it's employment and housing and education, and those things that people cherish in terms of a strong family life. I really would like to see Mallinckrodt stay here and continue to be that corporate citizen along with us.*

I think that the choice of level 6 or Alternative 6 for remediation would help them to redevelop that property and help to strengthen an otherwise fragile neighborhood. And so I think that that's my reason for saying that, and I hope you will give that due consideration."

Response Please refer to the Responses associated with Comments 1 and 2, pertaining to the selection of Alternative 6 for implementation, based on public comment.

Comment 8

Commentor: Mr. Tom Bratkowski. A resident of the Old North St. Louis neighborhood

Comment: Mr. Bratkowski stated he would favor removal of all radioactive waste and "*We need to remove any stigma associated the Manhattan project from north St. Louis.....We need to think in terms of rebuilding our community*". He stated,

> "*And the best way that can be achieved is not by doing the minimum but by doing the maximum, to reinsure that every effort is made to remove radioactive waste as deep and as far as possible. So I think this is an investment in the future. We can't think in terms of cheap dollars today and long term costs tomorrow if we ignore the opportunity to clean it up.*
>
> *So I would speak in terms of Alternative 6 if that means complete remediation of the sites as effectively as possible. If Alternative 5 is even better, even though there's a difference in terms of millions of dollars, I think that's money well spent, and I think face my children with that decision without any doubt in my mind that is money well spent.*"

After listening to other comments from the participants who supported Alternative 6 he asked the question, "*Does Alternative 5 mean that Mallinckrodt would go out of business or disappear*?"

It was explained to Mr. Bratkowski that Alternative 5 would not put Mallinckrodt out of business: that it simply provides an even greater measure of protection than Alternative 6.

Response: Please refer to the Responses associated with Comments 1 and 2, pertaining to the selection of Alternative 6 for implementation, based on public comment.

Alternative 5 would remove all the accessible contaminated soil whose concentration exceeds the most stringent cleanup criteria, the composite criteria. This approach is much more costly than Alternative 6 with little added benefit toward human health and the environment. The USACE and the majority of commentors agree that Alternative 6 has a more reasonable cost-to-benefit ratio than Alternative 5.

Comment 9

Commentor: Dr. Carol Prombo. Dr. Prombo has a Ph.D. in isotope geochemistry and is a citizen of St. Louis.

Comment: Dr. Prombo opened her remarks by listing her credentials as a scientist, teacher and a concerned citizen active in community affairs. She expressed support for funding the SLDS clean up effort, as well as other hazardous waste sites by saying,

> *"I look at all of the ways that we can spend our money as a society. I look at some of the lead contaminated sites. I look at piles of lead tailings that are not contained in anywhere near what the waste here is being controlled by. I look at the school system. And as I say, I strongly support a cleanup of all of the local radioactive waste sites.*
>
> *And I guess this is more of a comment --my next comment is more to our political leaders, because the laws that are being followed here are laws that are set by Congress, you know, by the Senate and the House of Representatives. And they are set in response to the public. Our public perception of the hazards from radioactive wastes is very high. We also have a number of other hazards locally where our perception is not as high where I would like to see an equivalent reduction of hazard."*

Dr. Prombo supported the need for cleanup action but expressed concern about the expense of the alternatives and about disposal of the excavated contaminated soil offsite by stating,

> *"...I am not in support of taking waste that was produced here and dumping it on people with less power. And if we look at states like Utah and Nevada and Arizona, they don't have as many people in the House of Representatives as we do here.*
>
> *I strongly support a cleanup that will reduce hazards to the people of St. Louis. I would like to see it done in a cost effective manner. I recently served on the NASA panel on the creation and planning team for extra terrestrial materials which oversees specifically the curation of our moon rocks. And NASA is switching from a philosophy of spending a lot of money on one mission to a faster, better, cheaper.*

And I hope that some day when it comes to our hazardous waste disposal we 'll go to a faster, better, cheaper approach. I just wish to say I strongly support the materials being cleaned up. It would seem that they could probably be done in a more cost effective manner and without dumping it on people that have less power than we do."

Later in the meeting Dr. Prombo made a comment that the SLDS "*is right in the thick of the liquefaction zone*". She went on to explain that the ground in the region would behave as a liquid during a moderate or larger earthquake, and the level of cleanup should be appropriate for these areas where residential use is not appropriate. She stated,

"And as far as a level to which one is going to clean up, going after every last atom of contamination--personally I don't think residential--expanding residential use in liquefaction areas makes good sense for personal safety of individuals. So as far as cleaning up to a level for industrial use, this sounds like a good use of resources. And not going to a more stringent residential standard for an area that's at a high risk for earthquake hazard".

In response to an individual's observation that no one has supported the USACE's recommendation for Alternative 4, Dr. Prombo stated she supported Alternative 4 because she wanted the "*cheaper*" cleanup.

Response: Alternative 4 would be the least expensive of the offsite disposal options, however, the majority of the comments received were in favor of Alternative 6. Alternative 6 is somewhat more costly than Alternative 4 but the stakeholders believe that the added costs are justified in order to provide additional protection to Mallinckrodt workers and eliminate future liabilities associated with residual contamination in soils. Please refer to the Responses associated with Comments 1 and 2.

Comment 10

Commentor: Mr. Doug Eller. Mr. Eller is a resident of the area, and is employed with Grace Hill Neighborhood Services.

Comment: Mr. Eller identified and supported Mallinckrodt as an "anchor" in the community and supported Alternative 6 by stating,

"I would like to say that we are also -- and I'm speaking for myself --I'm also in support of the alternate 6. We believe that it's important that we keep what few anchors that we have in our community here. Mallinckrodt is one of the few anchors as is Holy Trinity Church. There aren't very many left any more. We're trying to develop the Riverfront Trail to become an anchor in the community but it nowhere comes close to the impact that Mallinckrodt has had in the community here and continues to have. And we need to support that in any way possible. We want to make sure that it's economically feasible for them to remain here and that they can continue to be supportive.

They've done such things as employ people in the neighborhood. They sponsor, underwrite events within the community. They work at bringing people together and helping to problem solve when they're sometimes fragmented. And the list goes on to the point that it would be a grave loss to lose something as valuable as Mallinckrodt here.

So we want to --especially me -- want to make sure that we have this understood, that we support Alternative 6."

Mr. Eller also commented that the meeting was not well publicized in community and that the "didn't get any notification of meeting today except at the last minute". As a result he "observed not many residents were present at the meeting". He stated,

"And I know that our neighborhood is perhaps 75 or 80 percent African American. And I don't see very many African American faces here either as well as neighbors. So I think though that if you would have more people from the neighborhood here, they would also support the things that I'm saying. Because anybody coming in contact with Mallinckrodt has done so in a very positive way".

Mr. Eller questioned how the meeting was publicized to the local residents. Mr. Chris Haskell, the environmental public information specialist, responded by stating,

"The quick answer is we did the standard things, sent out press releases, notice in the paper. In fact, we're required to put notice, and we, in fact, did. And then also Anna from the Mayor's office, I thanked her for the suggestion of using a service that drops fliers around the community. I've never used that before and I'm

regretful to hear it didn't work. Sorry. We did contract with this firm and we'll look into whether or not they, in fact, dropped those fliers. 2,000 fliers were distributed. That's their minimum, in fact, and we put it together and got it to them. And thanks for the feedback".

We're required to put a so-called legal notice. That's with the fine print. It's hard to read, granted. Then there was also an advertisement too in the St. Louis Post-Dispatch. Plus other papers too but primarily we looked to the Post-Dispatch."

Mr. Eller responded to Mr. Haskell's answer by stating

"I just feel again if there would have been a better notification of the residents in the neighborhood - I know there's a lot of very involved people - that there would have been a better turnout tonight and you would have heard a lot more from the people that this is actually affecting. That's my only comment. I think fliers aren't a bad idea. I think it might have been a bad idea to hire whoever you hired to have done that".

Discussions continued about the limited degree of advance notice possible because of the "problems with date changes." Mr. Eller reiterated his concern about residents not being aware of the meeting by stating

"If it's important to hear the residents in this whole process I would recommend for the record that you hold another one with a better beginning than what happened tonight".

Response: Please refer to the Responses associated with Comments 1 and 2, pertaining to the selection of Alternative 6 for implementation, based on public comment.

Comment 11

Commentor: Mr. Frank Muehlheausler, Mr. Muehlheausler is the principal of the Clay School, the Clay Community Education Center.

Comment: Mr. Muehlheausler spoke of the contributions that Mallinckrodt, Inc. has made to his school, both with their financial gifts and the volunteer services of their employees. He described how his school had evolved

from one that was in trouble to a school the neighborhood is proud of. He credits Mallinckrodt for helping bring about the change by saying

> *"What I'm getting to is this, partnership has played a big role in changing the school culture. And to a certain extent this neighborhood culture. I've been here for 13 years and I live in the city. I've seen an evolution in this school because of partnerships like Mallinckrodt Chemical. They developed the CAP program which brings a lot of partners together from the community and we talk about issues.*
>
> *And I think that Mallinckrodt is very responsible. And that's what scares me. Because I see this whole issue of being one where Mallinckrodt has to be responsible to their business, they have to be responsible to their stockholders. And they will, I'm sure they will. Everything I know about these people from Mallinckrodt makes me believe that they are responsible.*
>
> *That if they can't develop that property the way they want to, they're going to be responsible for their stockholders and they're going to move some place else. And that scares me. Because if we lose Mallinckrodt we lose an anchor in this neighborhood just like Doug said. And an anchor that's been here for a long time*
>
> *I could go on and on about the involvement Mallinckrodt has had with not only this school but within the community. And it would be a loss, it would be a tremendous loss if they were to move.*
>
> *...But it's very important to us that Mallinckrodt remains in this community and that's why I'm saying No. 6 to keep Mallinckrodt here."*

Response: Please refer to the Responses associated with Comments 1 and 2, pertaining to the selection of Alternative 6 for implementation, based on public comment.

Comment 12

Commentor: Ms. Judice Green. Ms. Green is a resident of Hyde Park.

Comment: Mrs. Green stated her desires for the preferred alternative to be changed to Alternative 6 and questioned what effect the contamination may have had on the health of residents. She also expressed concern over the

publicity of the meeting, agreeing with earlier comments that another meeting should be held so those unaware of this meeting may have an opportunity to speak. She stated,

> *"And when I came in here I was quite taken because I wasn't expecting this. I didn't know what really to expect when I received a notice. And I didn't receive a notice until yesterday. So it didn't make it in this neighborhood until yesterday. And that was the 20th. Today is the 21st. So I really didn't get a chance to inform a lot of my neighbors. I don't know how many people I saw. I felt that there was interest, some serious interest. I needed to come out. If no one else came out then I needed to get the information to take back to my neighbors.*
>
> *I agree with this gentleman here who made a comment that another forum should be made available to people, for the residents. Like I said I didn't receive notice until yesterday. And I think that was very short. And it wasn't put in the community or any organizations like the Hyde Park Lions, through measures like that, for the information to be presented. I'm kind of - I'm sort of offended to a certain extent, you know, because I wasn't informed in time. But for my understanding since I've been here tonight I would be for the Alternative 6 for greater measures taken of cleaning up this contamination because I am greatly concerned because I have a daughter that I have raised in this area, and also I'm concerned about what are the effects this contamination has already had, if any. So that is also a question.*
>
> *And also I agree with the gentleman in that there should be an extended date if possible. That's my great concern. Because like I said, the meeting that - the means that you all have taken to give out this information, I'm disappointed, very disappointed."*

Response: Please refer to the Responses associated with Comments 1 and 2, pertaining to the selection of Alternative 6 for implementation, based on public comment.

The radiological contamination can only result in a health effect if an individual is exposed through direct contact with the material (ingestion or inhalation of the material) or spends an extended time in close proximity to the material (direct gamma exposure).

Because the MED/AEC materials are confined to the Mallinckrodt site and vicinity properties, and are generally not accessible to the general public, it is unlikely that exposure has occurred to member of the general public. Thus health effects to individuals living in the general area are not expected.

Comment 13

Commentor: Ms. Linda Ellenburg. Ms. Ellenburg is an employee of the Mallinckrodt, Inc. and a resident of the area.

Comment: Ms. Ellenburg expressed her support for the neighborhood and Mallinckrodt, Inc. In comment to the earlier statements pertaining to meeting pre-publicity, she indicated she had received notice of the meeting from a flyer sent to her home.

Response: No response statement is necessary.

Comment 14

Commentor: Ms. Debbie Eisenbraun. Ms. Eisenbraun is a resident of the Old North St. Louis.

Comment: Ms. Eisenbraun expressed her support for the complete cleanup associated with Alternative 5 and questioned the consequences of not cleaning it up. He stated,

> *"I know 15 years ago when my kids were young and they had detectable lead levels, the health department told us they weren't within a treatable range. But since then the kids who come up with that same level of lead are treatable. You know, the treatment range has changed.*
>
> *And I'm concerned about, similar to Tom Bratkowski, I'm concerned why not clean up at all. I mean what happens if in 5 or 10 years the problem, you know, range expands? Are we taking a risk of not cleaning it all up?"*

Response: Please refer to the Response associated with Comment 8, supporting Alternative 5 as the preferred alternative.

Comment 15

Commentor: Mr. Dennis Chambers. Mr. Chambers is a certified health physicist for the USACE.

Comment: Mr. Chambers responded to the concerns regarding risk by stating,

> *"With respect to the residual risk issues, the issues on the site, the allowable contamination going to be remaining there is being kept down to levels that are protective of the population, the workers there at the site as well as the environment.*
>
> *So we will minimize any effect on the personnel on site, let alone personnel off-site. And the levels are sufficiently low that they will meet the EPA risk criteria for the remediation and will be protective of the population."*

Response: Mr. Chambers comment was a response to an earlier comment. No additional comment is necessary.

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2.0 SPECIFIC RESPONSES TO WRITTEN COMMENTS FROM STAKEHOLDERS

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MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
Letter from Stephen Mahfood - Dept. of Natural Resources		The Missouri Department of Natural Resources has reviewed the Corps' Feasibility Study and Proposed Plan (FS/PP) which addresses removal of radioactive waste material at the St. Louis Downtown Site (SLDS) and associated vicinity properties. This letter summarizes our review and is intended to supplement the testimony we presented at the April 21, 1998, hearing. Please consider this letter part of the official hearing record. I applaud the Corps for moving forward with the cleanup of contamination from the nuclear weapons production era at SLDS. Based upon our experience, the key to a successful cleanup is community support and a remediation strategy founded on reasonably available scientific and technical knowledge. I urge the Corps to consider the following five issues in order to insure a successful cleanup at SLDS.	
		First, the vicinity properties need to be remediated to 5/15 pCi/g for Radium and Thorium combined, and 50 pCi/g for Uranium 238 to depth. This will insure that these properties are restored and economic hardships on the property owners are minimized.	The USACE agrees that the vicinity properties should be remediated using the 5/15 and 50 pCi/g criteria.
		Second, we strongly encourage the Corps to evaluate and implement measures to protect groundwater resources at SLDS. The department is unwilling to concede that groundwater in this area will never be used as a water supply. To do so would abdicate our responsibility to safeguard groundwater for future generations. Even though the groundwater is not currently used as a drinking water source, the studies we have seen to date do not eliminate the possibility that is could be used in the future if the radionuclides and other chemical contaminants from nuclear weapons production are removed. We recognize that the cleanup of contaminated soil may reduce the risk to groundwater. Therefore, if the Corp cannot reasonably address the groundwater issues without delaying this Record of Decision, groundwater should be the subject of a separate Record of Decision.	The USACE believes that the proposed remedy will prevent further degradiation of groundwater at SLDS, and provide for protection of human health and the environment.
		Third, we believe that the cleanup should address <u>all</u> chemical and radionuclide contamination that resulted from weapons production at this site. This includes Protactinium, Actinium, organic compounds and toxic metals. To do otherwise would not restore these properties to a useful condition. The FS/PP and supporting documents do not contain sufficient data for the department to determine whether the proposed cleanup will address all contaminants. We will need to work with Corps staff to answer these questions.	The USACE agrees that the cleanup should address chemical and radionuclide contamination that resulted from weapons production activities at this site. However, the USACE authority to remediate is limited to those areas and contaminants which can be specifically linked to MED/AEC activities.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
Letter (continued)		Fourth, we understand that the Corps is planning to issue a separate Record of Decision for the inaccessible soils in the vicinity properties. However, the department and the vicinity property owners need to be assured that human health and the environment will be protected until these soils can be fully remediated. We would also benefit from a more detailed description in the SLDS FS/PP regarding how the Corps intends to address the cleanup of inaccessible soils. Finally, it is very important for federal agencies to comply with state environmental requirements in conducting their cleanup activities. This allows the state to reassure Missouri citizens that the federal government is subject to the same environmental standards as they are. It appears that the list of state "Applicable or Relevant and Appropriate Requirements" (ARARs) identified in the FS/PP is a significantly shorter list than the Corps provided in previous draft documents. We will need to clarify with Corps staff whether some requirements have been inappropriately removed. I appreciate the Corps' assistance in expediting the cleanup of the St. Louis Downtown Site. I trust that you will find our comments useful in proceeding with a cleanup that the Corps, the department and the public can all support. Thank you for the opportunity to comment.	The USACE intends to develop institutional controls and a long term monitoring plan as part of the remedial design process. The FS was revised to reflect only those regulations and statutes that were "applicable" or "relevant and appropriate" for establishing a cleanup. The ARARs are modified from the FS/PP to add Action Specific ARARs on Table 7-2. Thank you for your comments and the support from your staff during development of the FS/PP.
1*		The FS/PP should clearly delineate the areas at the St. Louis Downtown Site (SLDS) which are covered by it. The St. Louis Task Force and MDNR have recommended the Vicinity Properties (VPs) be cleaned up to a 5/15 level at any depth.	Agree.
2		The FS/PP states that VPs will meet a dose limit of 15 mrem/yr. The Department requests that a site-specific, isotope-specific limit be used as the controlling metric, not a dose limit.	The FS/PP states that cleanup will result in conditions which satisfy CERCLA risk requirements. Isotope specific guidelines that will be used as controlling values for these guidelines are based on meeting the CERCLA risk guidance (i.e., 3×10^{-4} for a radiation site).
3*	4-25	States that only approved off-site borrow would be used to fill in the excavation done 4 or 6 feet across SLDS and the VPs. The FS/PP should include information on backfill for below 4 to 6 feet.	Below criteria soil will not be used as backfill at the VPs. Only approved borrow from offsite will be used at the VPs. At Mallinckrodt, material below the ALARA criteria could be used as backfill below 4 to 6 feet in depth.
4*		Currently the FS/PP for SLDS does not discuss water management. Water management issues, e.g., surface water and groundwater, must be included in any remedy for SLDS. The Department does not need to see all the detailed plans for water management in the FS/PP but some discussion by the USACE is necessary.	Some discussion is provided in the detailed analysis of alternatives under water quality/resources. Detailed plans for water management would be developed during design phase. Additional information on water management plans will be available in the remedial design documentation.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
5*		SLDS is located in an area that has been heavily industrialized for many years. However, continued degradation of groundwater is not justified on this basis. Although groundwater may not be currently used as a source for drinking water, its eventual use as a water source must be considered. The quantity of groundwater needed for a public water supply is available in the alluvial material in the vicinity of SLDS. The groundwater may not necessarily have been of potable quality prior to human impact. However, with standard treatment (such as softening, disinfection, and filtration), the alluvial groundwater must be considered a source of public drinking water and associated risks should be evaluated. Any remedial action objective considered for this site should include efforts to eliminate the potential for radionuclides or other contaminants to adversely impact the portions of the alluvium useable as a water supply. A groundwater monitoring system must be designed and a monitoring program implemented that ensures the detection of potential contaminant releases. It should also ensure that groundwater is evaluated on a regular basis to maintain representative, reproducible water quality information for each hydrologic unit.	Further measures will be taken to protect human health and the environment if MED/AEC contaminants are detected above MCLs and exceed site background. Additional monitoring wells will be installed during implementation of the remedial action. A groundwater monitoring system will be designed and a monitoring program implemented that ensures the detection of potential contaminant releases.
6		USACE needs to include a description in the FS/PP of how ground water and surface water treatment will be done for contaminated water encountered during remedial activities at SLDS.	Water Quality/Resources section in each excavation alternative acknowledges need for surface and groundwater management. Detailed description will be developed during design.
7	4-3, last ¶	The Department would disagree with much of this paragraph, specifically "Alluvial sediments beneath the site is not considered a potential source of drinking water due to its poor water quality." See statement 5 above.	See response to statement 5 above.
8	4-24	States that because SLDS is in an area expected to remain highly industrialized, agreements will be negotiated to restrict the installation of wells within specified areas to prevent unauthorized use of groundwater. The FS/PP should include a better description of the institutional controls to be used at SLDS, e.g. area of restriction, time, etc.	Specific details of institutional controls such as the area included would be developed during design. The time frame would be until MED/AEC COCs no longer present a hazard.
9		The aquifer below Mallinckrodt may not currently be used as a potable water source, but it must be looked at as a possible commercial usable water source. "Commercial" could also include a public water drinking system along with process water. See Statement 5 above.	See reply to statement 5 above.
10	5-16	The FS/PP should include a detailed map which shows the area to be affected by the well installation restriction. This makes the water unusable, which is in conflict with the desires of the Department. See Statement 5 above. The VP owners will be negatively affected by such a restriction, which is of grave concern to the Department.	Well restrictions could make provisions for requiring treatment to specific criteria if water is drawn. Criteria could be specified for both consumptive and non-consumptive use.
11*		The Department requests that off-site migration of contaminants in groundwater be addressed in this FS/PP and Record of Decision, or addressed as a separate operable unit.	Perimeter wells will be included in monitoring program.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
12		The FS/PP should contain information on further investigation and/or characterization of groundwater contamination at SLDS, specifically any groundwater monitoring which is to be done along with institutional controls.	Further investigation of groundwater contamination at SLDS is planned. This information will be provided to the MDNR as characterization plans are developed. Institutional controls plans will be developed during remedial design.
13*		It is unclear what designations or definitions are or will be given to contaminated groundwater that has migrated outside of the current FUSRAP area designations and is not co-located with current contaminants. The Feasibility Study unilaterally declares that these conditions do not exist. USACE is responsible for all contaminants that are associated with AEC/MED activities as stated in the Federal Facilities Agreement. The Department expects the USACE to remediate any area which has been affected by AEC/MED activities directly or by movement of contaminants through the air and/or surface/ground water. The FS/PP should document all investigation conducted by the U.S. Department of Energy or USACE to determine the nature and extent of contamination.	All investigations to date have been incorporated by reference in the FS/PP. Site background in the fill outside of the area that may have been impacted by AEC/MED activities will be determined in order to identify areas that may potentially have been impacted by chemical contaminants. However, because the chemicals that may have ~~been~~ derived from the ore may also have originated from the fill material or other industrial processes in the area, suspect chemical contaminants must have plumes that are associated with radiological AEC/MED contamination in at least part of its extent.
14		Under several of the remedial alternatives, groundwater contaminant sources may remain in place in the form of inaccessible soils. The FS/PP must demonstrate that any proposed remedial action scenarios will mitigate future groundwater contamination source areas where inaccessible soils remain in place.	The inaccessible soils will be addressed as a separate operable unit. Monitoring will continue in inaccessible soils areas to ensure groundwater remains unimpacted. Excavation of accessible soils will proceed as close to inaccessible areas as feasible including shoring around buildings rather than sloping the excavation.
15		It is unclear what the delineation is or will be between chemical and radiological groundwater contamination from Mallinckrodt activities and MED/AEC activities. The FS/PP must address issues which affect both Mallinckrodt and USACE and how they plan to work together to remediate the site.	The USACE will remediate MED/AEC wastes pursuant to the ROD. Once a given excavation is completed, Mallinckrodt will <u>be afforded</u> the opportunity to investigate and remediate non MED/AEC wastes. The USACE is willing to incorporate this planning into an memorandum of understanding (USACE excavtion closeout analyses will include other results on a cost-reimbursable basis if desired).
16		There is not enough data to indicate whether groundwater contamination has or has not been found outside of areas containing FUSRAP-contaminated soils. The FS/PP must address how data gaps will be handled and what affect they may have on a final remedy.	Groundwater monitoring will detect any FUSRAP materials that may have migrated out of FUSRAP areas. Removal of source material should prevent further degradation of groundwater.
17		Although it has not been demonstrated, institutional controls and/or usage restrictions for on-site groundwater usage may, indeed, be effective in mitigating on-site exposures to contaminated groundwater. However, these measures do not take off-site migrations or future off-site exposures into consideration. Nor do these measures take into account the potential for future off-site uses of groundwater that could influence groundwater flow at SLDS.	Institutional controls would include the VPs as well as Mallinckrodt. Because the VPs extend all the way to the river, there is no offsite migration of contaminants.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
18		The Department requests that groundwater monitoring not cease upon remediation of an area, as is suggested in the FS.	Monitoring would continue until it has demonstrated that source removal has adequately addressed groundwater contamination. Thereafter, there is no reason for the U.S. Government to continue to monitor.
19	4-18, 3rd ¶	Soil is listed as "high permeability" while the 4th ¶ lists soil as "low permeability." This inconsistency should be corrected.	Agree. The high permeability soils would refer to the lower unit and should have been specified as such. Low permeability in the next ¶ is referring to the upper unit soils.
20	4-5	"...potential for continued degradation of the groundwater quality is high..." While the statement may be correct, the USACE should avoid responsibility for continued degradation of any aquifer or river way in Missouri. An "applicable or relevant and appropriate requirement" which relates to this is Missouri's anti-degradation regulation (10 CAR 20-7.031(2)).	Most recent sampling of the Mississippi alluvial aquifer indicated non COCs above guidelines. Removal of source term will reduce the contaminant load to the aquifer. Perimeter monitoring will show any change of post-remediation COCs. Should monitoring indicate further risk-based degradation (although ~~the~~ USACE believes COC concentrations will reduce in time), additional appropriate action will be developed.
21		Groundwater flow directions have not been adequately characterized to determine whether groundwater is flowing away from SLDS. The FS/PP must provide a basic understanding of the nature and extent of contamination in all media.	Groundwater flow directions have been determined to be toward the Mississippi River in general. This river is undoubtedly the major influence for groundwater flow at the site and flow is generally toward the Mississippi River, although river stages complicate the lower unit groundwater flow direction. There is also a possibility that an old stream channel may complicate flow in the lower unit. The current site groundwater characterization and future monitoring should bring about a better understanding of flow directions.
22*		It should be noted that an assessment of Natural Resource damages may be considered based on impacts to the groundwater from MED/AEC activities.	Noted.
23	4-25	States that hazardous characteristic tests would be conducted on samples of potential backfill from each excavation. The use of below composite criteria and ALARA criteria soil as backfill must not have a negative effect on the RCRA corrective action site investigation. The limited hazardous characteristic testing may not adequately demonstrate that the proposed backfill material is appropriate for re-use. The Department requests that more complete sampling for chemicals be done on the possible backfill material to insure that it is appropriate for re-use.	Agree. However, we will require a list of chemicals to analyze.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
24*		The document states that background health effects (i.e., those associated with naturally occurring levels of the radionuclides and metals found at the site) influence the development of health-based cleanup criteria. This is true, but the placement of fill material on a site to make it suitable for industrial use does not qualify it as natural occurring condition. This is especially true if the fill material is composed of coal cinders, coal ash and other debris material. It is appropriate to take background samples which determine the naturally occurring levels of radionuclides and metals, but those samples should not be in an area impacted by fill material. Accurate and appropriate background samples should be taken for both groundwater and soil.	Lower aquifer background will be compared with upgradient water in the lower aquifer. The perched water in the upper hydrostratigraphic unit will be compared to fill background.
25		The residual risk assessment does not include the appropriate or requested exposure pathways. The Department has requested in the past that groundwater consumption be included as an exposure pathway in the residual risk assessment. The Department again makes this request that to include the groundwater consumption exposure pathway in the residual risk assessment.	It was USACEs understanding that the industrial exposure scenario was the appropriate scenario for developing cleanup guidelines. This scenario does not include consumption of groundwater, but does include inhalation of vapor and dermal exposures to contaminants in groundwater (as might be possible during a process water line break at an industrial facility). This understanding was reached during discussions with DOE and MDNR before transition of FUSRAP to USACE, and reconfirmed during subsequent meetings with USACE and MDNR.
26	§2.5	Preliminary Remediation Goals (PRG) should be developed for all chemical constituents listed on page 2-25, 2nd ¶. PRG's were developed only for "potential contaminants of concern" (PCOC) consisting of chemicals and metals associated with the MED/AEC process which have been detected at concentrations exceeding 1×10^{-6} industrial risk criteria. The results are from sampling for chemicals, done mainly from the Remedial Investigation. The Department requests that PRGs be prepared for the complete list of PCOC instead of basing the list on current data because it is so limited in nature. The Department requests that both PCOC and PRG be listed in the FS/PP.	The USACE is responsible for cleanup of contaminants related to MED/AEC activities. Thus PRGs have been established only for these PCOCs.
27		The composite criteria includes cleanup levels for Ra-226, Ra-228, Th-230, Th-232, and U-238. The ALARA criteria is based only on Ra-226, Th-230, and U-238. The FS/PP should explain how the cleanup criteria listed above will handle other radionuclides, i.e., Ac-227, Pa-231, U-234, Ra-228. The residual risk assessment groups Ra-226 with Ra-228, Th-230 and Th-232, and U-238 with U-234/U-235. The residual risk assessment approximates the amount of Ac/Pa on Ra-226 with the radionuclide ratio used in the BRA. The Department questions whether those ratios are appropriate. The FS/PP should justify the use of the existing multipliers in the residual risk assessment.	Other radionuclides are assumed to occur at a constant ratio with those for which measurements are available. The ratios used in the BRA have been the multipliers consistently used throughout the St. Louis site.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
28	4-19	USACE needs to also look at contaminants other than radiological, associated with MED/AEC activities at Mallinckrodt.	Given the K_D of metals that may have been associated with MED/AEC ores, it is expected that MED/AEC contaminants are co-located with radiological contaminants.
29	4-19	The FS/PP should address types of treatment, specifically any treatment of sludge.	Treatment of sludge would be identical to treatment of soils excavated from beneath the water table: dewater and dispose.
30	4-14	States that building materials which do not meet the surface criteria may, following crushing to a soil-like material, meet volumetric criteria and may then be used as backfill around the site. The Department does not consider dilution an acceptable treatment method.	Text also states "if regulatory approval can be obtained". It is not dilution to crush the materials and apply volumetric criteria rather than surface criteria. Dilution would involve the addition of clean material to increase the total mass relative to the mass of contaminants. Crushing the rubble does not add any new material to the total mass.
31*		The FS/PP states that monitoring will continue for as long as the media under the cap requires to protect human health and the environment. We assume the USACE means "indefinitely," since uranium's half-life is 4.5 billion years.	True. In 4.5 billion years the concentration of U-238 would be one-half what it is today. In 4.5 billion years the concentration of heavy metals will be unchanged if the site is left undisturbed. Five year reviews will be included in the remedy.
32*	2-41	Establishment of PRGs for chemicals includes the following exposure pathways: soil; soil ingestion; dermal contact with soil; inhalation of suspended particulate; groundwater; and, dermal contact with and inhalation of process water. USACE needs to include at a minimum the same groundwater exposure pathways in the radiological residual risk assessment as those used in the development of chemical PRGs.	The maximum radiological contamination in groundwater samples taken from the deep aquifer is about 10% of the proposed MCL for uranium.
33		PRGs for radiological constituents where included in the latest FS/PP for SLDS. The Department requests clarification and better documentation on the establishment of these PRGs.	PRGS were calculated using RAGS Part B guidance. A copy of the calculation package for the PRGs will be submitted for MDNR review.
34		The FS/PP should include a detailed description including maps showing the location where below composite criteria and ALARA backfill may be used at SLDS.	In Alternative 6, only approved borrow from offsite will be used as backfill at the VPs. Where excavations exceed 4-6 feet, soil below ALARA criteria could be used as backfill. Only approved offsite borrow would be used above the 4-6 foot depth.
35	Table 3-1	This table lists the isotopes covered by Uranium Mill Tailings Radiation Control Act (UMTRCA) regulations. UMTRCA covers Ra-226, Ra-228, Radon, and Uranium, but not Th-230 and Th-232 as currently listed in Table 3-1.	Table 3-1 referenced DOE Order 5400.5 as well as 40CFR192

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
36	3-19	The Sum of the Ratios (SOR) example does not include Ac, Pa, Ra-228, etc. Please explain why the SOR does not include the other radionuclide isotopes and how SOR is used during remedial activities.	The SOR uses the isotopes actually measured at the site. Other radionuclides were accounted for by assuming a constant ratio to the "indicator" isotopes. Concentrations used in the SOR equation were developed on the basis of dose assessments that accounted for all isotopes in the decay chain. The SOR will be used as a tool to help direct remediation activities. Post remedial action doses and risks will be calculated using actual sample data (including Ac-227 and Pa-231).
37	4-14	The FS/PP should provide a detailed list of what buildings or structures are left to be decontaminated at Mallinckrodt. Building materials which do not meet the surface criteria may (following crushing to a soil-like material) meet volumetric criteria and could be considered as backfill around the site, if regulatory approval could be obtained.	Building K has already been decontaminated and will be demolished. Building 30 was discovered to be contaminated during the RI, but subsequent renovations may have decreased surface contamination. There may be none left, or there may also be some as yet undiscovered surfaces in other buildings
38		The Department does not believe that dilution is an appropriate treatment method for either soil or groundwater. Therefore, we would disagree with a plan to allow groundwater flow through contaminated soil to the Mississippi River, simply because the large volume of water in the river dilutes the contaminants below detection levels or levels of concern.	The situation described is what is currently happening. The proposed remedial action would mitigate this situation and result in no further degradation of this system.
39		The USACE needs to document the contaminants of concern to be monitored with respect to radiological and chemical analyses.	COCs include U-238, U-235, Ra-226, Th-232, and decay progeny. Chemical COCs include Ni, Cu, Cd, U, and As.
40	Appendix C	The USACE should clearly document whether the concentrations in Table C-3 include other radionuclides.	For dose and risk calculations, all isotopes in the uranium series decay chain below U-238 are included as well as those in the actinium and thorium decay chains below U-235 and Th-232. Only the key indicator radionuclides are shown in the tables. However, the complete decay series for each indicator nuclide have been included in all calculations as documented in the ALARA analysis calculation package.
41		The USACE needs to clarify whether this FS/PP is intended to apply to radionuclides and chemicals both in soil and in groundwater. Please also explain how this FS/PP fits into the overall cleanup plans for the SLDS.	The remedy is intended to apply to MED/AEC radionuclides and to MED/AEC chemicals which are believed to be entirely co-located with the radionuclides in both soil and groundwater. Source removal is expected to remedy groundwater. Continued monitoring will verify success.
42		The PP deals only with radioactively contaminated soils. Chemical constituents associated with DOE's former processing activities should be addressed in the FS/PP.	

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
43		The subsurface in the FUSRAP areas has not been adequately characterized at this time with regard to the nature and extent of radiological and chemical contamination in soil and groundwater. Hence, this information will be needed in order to assure that potential contaminant exposure pathways and receptors can be identified to the extent necessary to support the soil clean-up levels, institutional controls and exposure assumptions presented in the PP.	The alternatives and their evaluation under the criteria for selection would not be likely to change if additional characterization data were available. Additional data would still not permit differentiation between site background and AEC/MED metals. The ALARA analysis was sufficiently conservative to ensure safe levels following cleanup even if the actual site mean is higher than currently believed.
44*	4-25	States that institutional controls would remain in place to insure continued protectiveness until a remedy for inaccessible soils is determined. The Department requests clarification that the inaccessible soil will be treated as a separate operable unit, and that the FS/PP for inaccessible soil will address how they will be handled by the federal agency in charge of long term operation and maintenance of the FUSRAP sites.	Inaccessible soils will be treated as a separate OU. Remedy documentation for the inaccessible soils will specify how they will be handled in terms of long-term O&M (if any).
45*	Appendix A	The FS needs to include a complete list of Applicable or Relevant and Appropriate Requirements (ARARs), along with a detailed analysis. The January 1998 version of the FS contained a more detailed list than the March 1998 version. A draft list of additional ARARs which were not included in the March 1998 version of the FS/PP have been attached with these technical comments. The detailed analysis should explain why an ARAR does or does not apply to SLDS.	The FS was revised to reflect only those regulations and statutes that were "applicable" or "relevant and appropriate" for establishing a cleanup under CERCLA.
46		SLDS is not an "official" NPL site under CERCLA. Therefore, the Department recommends that the USACE submit permit equivalent applications will allow the Department to establish ARARs for SLDS.	USACE is addressing SLDS as a CERCLA site via the NCP, as such all ARARs should be presented in the Record of Decision.
47	4-7	Disposal of waste at Mallinckrodt through excavation, consolidation and capping would not meet ARAR's for Missouri. (Solid Waste Regulations)	This is additional reason for selection of an alternative that features offsite disposal.
48		The FS/PP does not address protective measures for on-site workers, the public, and the environment during remediation activities at SLDS. The Department requests a general description of the protective measures to be implemented by the USACE or its contractors during the remediation activities.	Detailed health and safety procedures will be developed during design process and published in the site-specific Health and Safety Plan.
49		Clean-up criteria should be determined for groundwater below or down gradient of the site, which has been shown in previous assessments and reports to be contaminated.	PRGs were evaluated for chemicals in groundwater. However, the proposed remedy involves use of source removal to levels sufficient to prevent further degradation of groundwater due to MED/AEC contaminants of concern.
50*	5-34	USACE should clarify the use of the 30-year time frame and specify that it is only used for cost estimates, not for establishing a time period for walking away from the site.	Agree. The 30 yr. period is used as indicated. Long term monitoring and institutional controls would be developed based on conditions after remedial action.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
51	5-16	States that monitoring would include sampling to ensure that the remediation was adequate to protect human health and the environment as determined by risk assessment. The Record of Decision should document what will be monitored at SLDS.	ROD will include general description of contaminants to be monitored.
52		The USACE needs to clarify in the FS/PP how contaminant exposure pathway scenarios and concentration levels were derived when the site-specific residual risk assessment was performed based on the limited groundwater characterization at SLDS.	The groundwater pathway is a very minor exposure pathway in the industrial exposure scenario used to develop cleanup guidelines.
53	ES-3	Last paragraph needs appropriate spacing between words.	Agree.
54	4-9, Last ¶	Waste has already been shipped to Utah from SLAPS and North County Vicinity Properties so the requirements listed here have been addressed in the past.	True. Implementability should have taken into consideration that route planning and spill control plans have already been developed.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/07/98, MDNR Hazardous Waste Program			
Comment No.	**pp/§/¶**	**Comment**	**Response**
Letter from Cindy Kemper - Hazardous Waste Program		The Missouri Department of Natural Resources' Hazardous Waste Program is hereby transmitting to you a copy of a letter to Mallinckrodt, Inc. regarding corrective action being undertaken pursuant to the Missouri Hazardous Waste Management Facility Permit issued to Mallinckrodt on September 19, 1997. Several of the issues raised in this letter relate to the division of responsibility between Mallinckrodt and the U.S. Army Corps of Engineers for investigation and remediation of environmental contamination both inside and outside of FUSRAP areas at the Mallinckrodt facility. Inasmuch as the resolution of these issues bears directly on the site-specific corrective action requirements to which Mallinckrodt is subject, we are hereby requesting that the Corps formally respond to the issues raised in the enclosed letter as they may relate to the proposed Feasibility Study and Proposed Plan. Thank you for your consideration in this matter. If you have any questions concerning the enclosed letter, please do not hesitate to contact me or Richard A. Nussbaum, P. E., R. G., of my staff, at (573) 751-3553.	Many of the general issues raised in this letter from MDNR to Mallinckrodt (Attachment A-1) are similar to or the same issues raised by MDNR in the following detailed comments on SLDS FS/PP (e.g. use of site-specific risk assessment to develop cleanup guidelines, characterization and future use of groundwater, etc.) These issues are addressed in the responses to specific comments on the SLDS FS/PP.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (January 1998 Issue)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		Previous groundwater monitoring and sampling activities at the site have been infrequent and sporadic. A baseline groundwater characterization was conducted in late 1997 and early 1998 at SLDS. The purpose of the characterization was to collect current baseline water quality data from existing groundwater wells to use as a basis for evaluating future remedial actions at the site. The information provided in this groundwater characterization was to be used for determining the adequacy of subsequent sampling and monitoring activities and should be evaluated as the baseline in which future remedial activities will be judged. Future characterization activities should be linked to site specific remedial scenarios using the data collected from this sampling effort. Information presented in the FS is based on historic groundwater monitoring at SLDS. The Department has not had the opportunity to review the results of the baseline sampling and data collection or the information contained therein. Therefore, the following comments on groundwater should be considered preliminary until the characterization data has undergone full review. It is likely that review of the groundwater characterization will generate further comments on the FS.	As noted, additional groundwater characterization is planned, particularly with regard to non-radiological constituents. While the proposed remedy is not dependent on additional groundwater characterization, the results from the additional characterization will be used to help design suitable institutional controls and the long term monitoring program.
2*	ES-4	Table ES-1 states that none of the VP groundwater monitoring wells exceed applicable contaminant levels. Based on the information provided in this document, wells B16W06S and B16W06D are the only wells that can be identified within VP boundaries. The Department requests that a map be included in the FS/PP that identifies all the groundwater monitoring wells located within VP boundaries.	No additional wells are available. The final version of the FS and PP have been issued. No further revisions are planned. However, the map requested is available in the draft *Groundwater Characterization Report of 1997/1998 Baseline Data for the St. Louis Downtown Site.*
3	ES-8	The Alternative 4 description in Table ES-4 mentions disposing of soil at an on-site disposal cell at SLAPS. This disposal option is not advanced within the Feasibility Study. Furthermore, this disposal method is not presented in the Proposed Plan. If this soil disposal option is being retained for consideration, it should be specifically discussed as part of a Remedial Alternative for SLDS soils and included in the Alternative Analysis portions of the Feasibility Study. However, this option clearly would not meet several State laws and regulations, one of which prohibits locating a disposal facility in a flood plain.	This statement was in error. The final FS (April) has corrected this error.
4	ES-9, Line 32	The FS/PP should document all conclusions made within it. The Department requests more information to verify that contaminant leaching to groundwater is currently negligible.	Supporting evidence is available in the aforementioned Groundwater Characterization Report. Shallow wells in the upper hydrostratigraphic zone contain high levels of uranium while the five wells completed in the lower hydrostratigraphic zone had only 2 detections of uranium at 0.34 and 2 µg/L. The maximum detected value is 10% of the proposed MCL for uranium.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (January 1998 Issue) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
5	ES-9, Line 42	Alternative 4 does not propose the removal of inaccessible soils. Therefore, in locations where inaccessible soils will remain in place, the source for potential future groundwater contamination below the water table exists.	A remedy for inaccessible soils will be presented in future documentation. The volume of accessible soil is much greater than that of inaccessible soils, thus the problem will be greatly reduced pending a final decision for inaccessible soils. In addition to the smaller volume, much of the inaccessible soil is under buildings where infiltration of rainwater through contaminated material is intercepted by the structure.
6	2-11, Line 41	The hydraulic conductivity of the upper hydrostratigraphic unit is reported as 9.9×10^{-6} cm/sec. Limited geotechnical soil testing has been performed at this site. One variable-head permeability test was conducted within the upper hydrostratigraphic unit. Given the heterogeneous nature of the unit, one permeability measurement is not necessarily representative of the geologic characteristics of this unit. The hydraulic conductivity of this unit should be reported as a location-specific measurement, or an average hydraulic conductivity should be reported, based on information obtained from more than one permeability test.	Agree. This hydraulic conductivity value is a location-specific measurement.
7	2-13, Line 2	It is difficult to establish the relationship between the upper hydrostratigraphic unit and fluctuations in the Mississippi River stage. The hydrograph analysis that is presented in the Remedial Investigation Report takes into account only four wells open to the upper unit. The nearest of these wells is over one-half mile upgradient from the river. Given the hydrograph information, it is not obvious that water stages in the river significantly affect water levels measured in the four upper-unit wells. Furthermore, there is no information on how the river stage might affect the upper unit at locations closer to the river, since data from the upper-unit monitoring wells that are closer to the river were not used in the hydrograph analysis. That information, if available, may be used to establish the relationship and hydraulic connection between the two hydrostratigraphic units and the river.	Agree. The relationship between the Mississippi River and the upper unit have not been well defined. However, the relationship will be better defined during planned additional groundwater characterization efforts at SLDS.
8	2-13, Line 18	The document discusses two distinct alluvial hydrogeologic zones- an upper unit and a lower unit. It is reported that measured water levels in the two units can differ as much as 30 feet. Figure 2-5 shows monitoring well locations, water level measurements, and groundwater flow directions. However, this potentiometric surface map was constructed using water level measurements from both the upper and lower hydrostratigraphic units. This figure does not represent groundwater flow direction in either hydrostratigraphic unit. Furthermore, the difference in water level measurements is derived from shallow wells in the western portion of the site where the lower hydrostratigraphic unit is absent, and from deep wells near the river, where the lower hydrostratigraphic unit is the thickest. Potentiometric surface maps should be unique to the alluvial unit from which water levels were measured. Differences in water level measurements should be location comparative and site-wide. This information should appear in the FS as separate and distinct maps, and the text should contain a discussion about each hydrostratigraphic unit.	Agree. Figure 2-5 was deleted from the final FS published in April.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (January 1998 Issue) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
9	2-30, Line 5	The Department requests the USACE include information in the FS/PP as to where the trichloroethylene (TCE) was stored and used at SLDS.	Such information is not presently known. In the event such information is discovered during the RD/RA phase, it will be addressed.
10	2-34, Line 25	It has been determined that high water stages in the Mississippi River contributed to the mobilization of thorium and radium detected in the sediment. The Department requests that the movement of contamination and transport media be documented in the FS/PP, e.g., how sediments in the river became contaminated with Th-230 and Ra-226. Furthermore, it is unlikely that the periods of high water between 1988 and 1992 are the only instances where contaminants have been mobilized from the river sediment. Therefore, it is assumed that contaminants are migrating to the river sediments from an upgradient source and are periodically being mobilized by high water stages. The FS/PP should also document in detail all investigation conducted by the US Department of Energy or USACE on the nature and extent of contamination. (See Comment 11)	Detailed information on investigations on the nature and extent of contamination is contained in the RI and RI Addendum reports which are part of the Administrative Record. The FS only summarizes the information in these reports.
11	2-34, Line 25	The document states that high water in the Mississippi River mobilized the Ra-226 and Th-230 previously detected in the river sediments. The FS/PP should document whether the sediment contaminated with radionuclides was mobilized by high water and removed, or whether the radionuclides themselves were mobilized from the sediments. It should also explain how high water is expected to continue to mobilize the thorium and radium previously detected in the sediment. (See Comment 10)	Because of the low solubility of radium and thorium compounds it is likely that the contamination was transported along with the sediment. However, there is no way to prove this after the fact. Additional tests of chemical form of the radionuclides is planned as part of the SLDS characterization effort.
12	2-34, Line 32	The FS/PP must indicate in which groundwater wells were elevated metals detected to aid in understanding nature and extent of contamination. Levels of fluoride and VOCs, and corresponding groundwater wells, should be indicated as a map attachment in this document.	This information is available as part of the SLDS groundwater characterization report.
13*	2-36, Line 15	The possibility of an open jointed and leaking sewer creating an accumulation of contaminated sediment off-site does exist. Although sediments in the system have probably been scoured away, the sewers would have deposited contaminants in the soils around the lines, and contamination would not necessarily be found exclusively in those sediments remaining in the utilities.	No areas have been located in which this occurred. If such areas are discovered during remedial activities, they will be remediated. However, no further characterization is planned to locate these areas in advance.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (January 1998 Issue) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
14	2-39, Line 6	The permeability of the alluvial sediments is not known. Although the upper hydrostratigraphic unit likely exhibits lower permeability than the lower hydrostratigraphic unit, only one permeability test has been conducted within the upper hydrostratigraphic unit at this site. Three permeability tests have been conducted in the upper portion of bedrock. There have not been permeability tests done on the lower (likely more permeable) alluvial hydrostratigraphic unit. The statement that groundwater in the alluvial aquifer is controlled by low permeability materials is, therefore, misleading. (See Comment 6)	Agree. This sentence is poorly worded. This situation is appropriately worded for the upper unit.
15	2-41, Line 18	The statement that only limited groundwater data was available from SLDS during the Baseline Risk Assessment (BRA) suggests that new groundwater data has been provided since the BRA was developed. Any new residual risk assessment should be based on the most current data available. The Department requests to review any data that becomes available during the FUSRAP project.	A draft of the groundwater characterization report has been provided to the state. The data were not available in time to incorporate new risk calculations into the FS. The residual risk assessment conducted after remediation will incorporate the most current data available.
16	3-17, Line 16	The potential for future groundwater degradation due to the industrial future-use scenario does not preclude protection of groundwater as a resource. Numerous factors should be taken into account in determining which groundwater protection and remediation activities will be implemented at this site. These factors include the degree to which groundwater has suffered or will suffer degradation due to historic MED/AEC activities at this site.	Agree, however the proposed remedy will prevent further degradation by MED/AEC materials through source term removal.
17	3-17, Line 33	The document states: "If contaminants in groundwater reach the Mississippi River, they are below drinking water MCLs." The USACE will need to clarify the meaning of this assumption in the FS/PP. No modeling on the data has been presented which supports this statement.	The very low flow rate in the groundwater relative to the very high flow rate of the Mississippi will dilute contaminants in the groundwater to below detection limits.
18	4-3, Line 1	Again, this hydraulic conductivity information is the result of one permeability test in this unit. (See Comments 6 and 14)	Acknowledged.
19	4-3, Line 8	The text should be corrected to read "B16W07D." Well B16W017D does not exist.	Agree. The text should read "B16W07D".
20	4-3, Line 24	Very little information exists about the hydrologic properties of the alluvial sediments at SLDS. The USACE should document how the groundwater discharge was measured in the FS/PP. The documentation can include simply the reference of a standard method if documentation is available publicly.	Agree. A basic equation was used to determine approximate permeability and discharge rate in the RI. The method was not referenced. To check this result, a back-calculation was performed to determine the permeability factor used; permeability was determined to be within the published limits for this soil type.
21	4-3, Line 26	The statement that the saturated bedrock beneath the site has not been penetrated is not correct. The bedrock at the SLDS site has been penetrated with groundwater wells. Wells B16W01S and B16W04S are partially screened in the upper portion of the bedrock.	Agree. The April 1998 version of the FS was revised to state the saturated bedrock has not been penetrated more than 4m (13 ft) with a well.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (January 1998 Issue) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
22*	4-3, Line 35	The text suggests that, due to the large volume of the river relative to groundwater discharge, no impacts to the water quality of the Mississippi River can be expected. Although groundwater discharge to the river will effectively reduce contaminant concentrations, dilution is not considered a groundwater treatment alternative.	Agree.
23*	4-24, Line 10	The Department is unaware of any groundwater modeling of the St. Louis site. It may be appropriate that some type of groundwater model be developed for SLDS. Any groundwater model that is developed for SLDS should be reviewed by the Department.	The reference to groundwater modeling was deleted from the final revision issued in April.
24	5-17, Line 22	The USACE's proposed sampling and monitoring of groundwater should be presented in greater detail in the FS/PP.	Should Alternative 3 be selected, a long-term monitoring plan would be developed during the design phase.
25*	5-30, Line 32	The document states that annual monitoring would include ten groundwater samples. There are currently 17 groundwater monitoring wells at SLDS. Ten samples per year would not be considered an adequate monitoring program. Furthermore, the baseline groundwater characterization could present data that might be pertinent in determining sampling frequency and numbers of samples to be taken. There is also the possibility that additional groundwater monitoring wells will be required at SLDS or the VPs.	Deleted reference to the number of groundwater samples. Monitoring plan would be formulated during design.
26*	5-31, Line 5	This alternative does not take into account potential groundwater contamination from soils that are inaccessible and remain in place. The potential for contaminant migration into groundwater would exist until all access-restricted soils can be removed.	The final FS issued in April separates the inaccessible soils into a separate operable unit. Inaccessible soil locations would be assessed as part of the monitoring program until a remedy is selected. Surface water would be monitored as well.
27	5-42, Line 21	Alternative 5 states that the potential for contaminant infiltration leaching into groundwater would exist until all access-restricted soil is removed and that groundwater quality would eventually improve over baseline conditions. Alternative 4 should also discuss the effect on groundwater, where these conditions will remain a factor in potential future groundwater contamination at this site.	Inaccessible soils were removed from the scope of this FS.
28	5-53, Line 34	The document states that implementation of Alternative 4 would remove the source of potential future groundwater contaminants from below the water table. However, Alternative 4 leaves approximately 32,000 yd^3 of contaminated soil in place, which could function as a potential source of future groundwater contamination. This should be explained in the FS/PP with some detail.	The final version of the FS was issued in April. The soil left in place would be below the ALARA criteria. The soil removed would contain the highest concentrations of radionuclides and is therefore the most likely to contribute to groundwater contamination.
29	5-54, Line 46	Alternative 4 would not achieve the same groundwater protection as Alternatives 3 or 5. Alternative 4 leaves approximately 32,000 yd^3 of contaminated soil in place, which could function as a source of potential future groundwater contamination. The document should discuss this.	Acknowledged. Alternative 4 is less protective of groundwater than the other excavation alternatives.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (January 1998 Issue) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
30		The Missouri Department of Health (MDOH) offered assistance to SAIC in determining clean-up criteria for this site by offering information on current Risk Assessment Guidance for Superfund (RAGS) methodology, modifications, and accepted default values. To promote and expedite the determination of health protective clean-up criteria, MDOH also offers to answer any assessment questions SAIC may have during their in-house revision process.	We appreciate the efforts of MDOH and MDNR in reviewing the SLDS FS to help meet the tight FFA milestone schedule.
31		It is still unclear as to the target dose to be achieved at this site. As presented, there has been no agreement between using EPA's starting point of 15 mrem/yr and NRC's starting point of 25 mrem/yr. The "Concentrations Producing Target Limits for SLDS Radionuclides..." tables presented to our office, however, show comparisons to the NRC limit of 25 mrem/yr. Please include comparisons and subsequent clean-up criteria for the target dose of 15 mrem/yr.	The EPA target limit was set to 15 mrem/yr as a level that would fall in the 10^{-4} to 10^{-6} risk range considering only a generic conversion factor for gamma radiation. The site-specific ALARA analysis and exposure pathways found that reduction below 25 mrem/yr for the isotopes at SLDS reduced the incremental lifetime cancer risk to the 10^{-4} to 10^{-6} range for future industrial land use.
32		If pending documentation is determined to be correct, the approaches utilized in Attachment C, SLDS ALARA Analysis, appear to be protective of industrial exposure from radionuclides in the soils at this site. MDOH has yet to review the calculations and references on which the conclusions in this attachment were based. Final comments as to the protectiveness of the approach presented will be submitted after review of the documentation.	The complete ALARA analysis calculation package was submitted to MDNR in February, 1998
33		All Chemicals of Concern (COCs), excluding radiological aspects, should be assessed using RAGS, Part B, methodology. This would include determining a clean-up level for VOCs, SVOCs and inorganics. MDOH would request that uranium be included in the chemical toxicity analysis, as it has been found to have to have greater risk from toxicity than radioactivity in past assessments. The level determined should take into account the ingestion, inhalation and dermal contact pathways. This should be done for industrial exposure to surface soils and subsurface soils.	Agree. These methods have been incorporated for development of the PRG tables published in the April version of the FS.
34		Although presented in the review meeting as a risk driver, radon is not discussed in Attachment C. Discussion as to the reason for its exclusion and any plans to monitor radon levels should be included in the text.	Radon is regulated separately from other radionuclides. Outdoors, radon concentrations are negligible due to rapid dispersion into the atmosphere. Indoors, the concentration is dependent on ventilation of the structure. A section discussing potential indoor worker exposures to radon was added to the ALARA assessment in the April version of the FS.
35		Cleanup criteria should be determined for groundwater below or downgradient of the site, which has been shown in previous assessments and reports to be contaminated.	PRGS were evaluated for chemicals in groundwater. However, the proposed remedy involves source removal to levels sufficient to prevent further degradation of groundwater due to MED/AEC constituents.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (January 1998 Issue) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	pp/§/¶	Comment	Response
36		MDOH suggests utilizing the Jury model for determination of the volatilization factor. EPA Region VII is requesting that risk assessments and preliminary removal goal documents use this method. The use of this model in the next revision would expedite the review process. Complete inclusion of all exposure variables used, in addition to justification of the use of any non-default values, would assist the reader and prevent delays due to further revisions.	The Jury model pertains to soil to air transfers. Because the PCOCs at SLDS are metals and radionuclides (no volatile PCOCs), we only evaluated groundwater to air transfers in the development of PRGs.
37*		The hours worked per year by an industrial worker should be increased to 2125 in the determination of the Fraction of Time Outdoors variable.	Agree.
38	Appendix C	Ground water consumption was not used as a pathway in the residual risk assessment. The FS/PP should clarify why the groundwater consumption was not included in the residual risk assessment for radiological constituents.	Groundwater consumption was not included since residential exposures are not considered in the ALARA assessment. During previous discussions it was agreed that since SLDS has been an industrial site for over 100 years, and is likely to remain an industrial site for the foreseeable future, the industrial worker exposure scenario is appropriate for use in development of cleanup guidelines.
39	Appendix C	The Department requests that the location and time frame for the background sampling to determine the background levels for radionuclides which were used in the risk assessment be included in the FS/PP. (Ra-226 0.9 pCi/g, Th-230 1.5 pCi/g, Th-232 1.0 pCi/g, U-238 1.1 pCi/g) Background levels for groundwater also needs to be included in the FS/PP.	Background for soils was chosen to be consistent with the BRA. Groundwater background has not been determined.
40	Appendix C	The Department recommends that the multiplier for Ac-227 and Pa-231 used in the residual risk assessment be based on validated data for Ac-227 and Pa-231 from the SLAPS West End Excavation or results from Westlake Landfill Remedial Investigation. The multipliers used in the BRA can be used again if USACE verifies that the multiplier from the BRA is correct for the site with validated data. This work must be done before excavations are completed in order to avoid the possibility of going back to remove more soil after the project is complete because the data from the excavation used in the final residual risk assessment shows that the risk exceeds the appropriate risk levels ($<10^{-6}$).	During remediation samples will be analyzed for Ac-227 and Pa-231. Actual data not multipliers will be used to calculate post-remedial risk.
41		In the Summary of Radionuclides in Soils tables, exposure concentrations are presented. The actual sample results are not included, therefore, MDOH could not verify the accuracy of the standard deviation and subsequently, the exposure concentrations calculated.	UCL_{95} values are calculated according to RAGS guidance. Raw data tables may be provided if requested.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (January 1998 Issue) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
42		In the Summary of Radionuclides in Soils tables, several constituent concentrations could not be distributed due to low number of detects (footnote D). However, a 95% UCL seems to be presented for these constituents with the mentioned footnote. For example, in the Summary of Radionuclides in Soils (No Removal), the exposure concentrations for Th-232 and U-238 in Plant 1 Waste should be the maximum detected (6 pCi/g and 160 pCi/g, respectively) due to the low number of detects. In the Summary of Radionuclides in soils (SOR>1 Removed in Top 8 Feet and Labeled as Waste), the exposure concentrations for Th-232 and U-238 in Plant 1 Waste should be the maximum detected (6 pCi/g and 160 pCi/g, respectively) due to the low number of detects. The exposure concentration in Plant 2 After Removal for U-238 should be the maximum detected (35 pCi/g) due to the low number of detects. In the Summary of Radionuclides in Soils (SOR>1 Removed in Top 2 Feet with SOR>1 Removed and Labeled as Waste), the exposure concentrations for Th-230, Th-232 and U-238 in Plant 1 Waste should be the maximum detected (230 pCi/g, 6 pCi/g, and 160 pCi/g, respectively) due to the low number of detects. If these values are in error, please correct. If the values are correct, then the footnote should be omitted.	Exposure concentrations were estimated per RAGS guidance. This includes using reported values for all non-detects and using the smaller of the maximum value and the UCL_{95}. In the 6/160 example given, there are six results but only one detect for U-238 and three detects for Th-232. The UCL_{95} values were estimated using reported values (usually the detection limit). Because the estimated UCL_{95} was less than the max, the UCL_{95} was used.
43		In the Radionuclide Concentrations by Cleanup Option and Exposure Unit table, U-238 is listed as having an exposure concentration of 1.1 pCi/g at Plant 1 in the SOR>1 to 8 ft column, yet the Summary of Radionuclides in Soils (SOR>1 Removed in Top 8 Feet and Labeled as Waste) does not list the exposure concentration for U-238. The only value listed for U-238 at Plant 1 is 4.0 pCi/g for a mean concentration. Please explain.	The exposure concentration (RME) was determined by subtracting background from the UCL_{95} concentration. When there were no data to use in a UCL_{95} calculation, background was inserted as a place holder. Background was inserted so that once background was subtracted, a final concentration of zero, the actual value listed in the database, would be obtained.

MDNR COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY/PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (January 1998 Issue) (continued)

Comments received 05/07/98, MDNR * denotes major comments/key issues			
Comment No.	**pp/§/¶**	**Comment**	**Response**
44		In the Dose Estimates Tables, MDOH checked the accuracy of the calculations and found small inconsistencies in the values calculated. For example, in the Remove SOR>1 (top 8 ft), 6" Cover, Plant 1 table, the risk for Pa-231 should be 1.9×10^{-7} and the risk for Th-230 should be 1.5×10^{-6} for the Year 1000. This leads to a total risk at year 1000 of 4.8×10^{-6}, instead of the listed 5.1×10^{-6}. Although there were similar errors throughout these tables, the errors are not significant enough to warrant major concern. The 6" cover alternative risks in the 15/40/100, 50/100/150 and the 100/200/300 should be increased by 0.00001 to 3.0×10^{-4} and 4.3×10^{-4}, respectively, for Plant 2. The 6" Cover alternative risk in the 200/400/600 should be increased by 0.00001 to 2.7×10^{-4} for Plant 6A. The 6" Cover Alternative risk in the 15/40/100 should be increased by 0.00001 to 5.8×10^{-5} for Plant 6B. The No Cover alternative risk in the Remove SOR>1 should be increased by 0.00001 to 8.7×10^{-5} for Plant 6C. The No Cover alternative risk in the Remove SOR>1, 15/40/100, 50/100/150 and the 100/200/300 should be increased by 0.00001 to 2.3×10^{-4}, 2.3×10^{-4}, 9.6×10^{-4} and 9.6×10^{-4}, respectively, for Plant 7. The 6" Cover alternative risk in the Remove SOR>1 and the 15/40/100, 50/100/150 and the 100/200/3000 should be increased by 0.00001 to 3.5×10^{-5} and 3.5×10^{-5}, respectively, for Plant 7.	Small differences such as identified here may be attributable to a number of causes. New updated versions of RESRAD appear frequently. Different versions of the model may account for these differences, or small variations in input parameters. Dose to source and risk to source ratios were computed using RESRAD with estimated unit concentrations for each radionuclide. These values were then imported into a spreadsheet for subsequent concentration calculations. This approach vastly simplified the assessment. However, using spreadsheets to estimate dose and risk can introduce roundoff error that may not appear by using RESRAD exclusively. This error can be propagated through multiple calculations and result in slightly different answers. This is one reason that slight discrepancies have occurred. Please also note that the RESRAD output, on occasion, contains roundoff error such that the doses or risks from individual pathways do not sum to the total dose or risks. These sources of error are usually minor and, when considering the multiple levels of conservatism built into each modeled dose or risk, are insignificant.

COMMENTS AND RESPONSES ON
THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE
ST. LOUIS, MISSOURI (April 1998)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
General			
Mallincrokdt Letter		Mallinckrodt appreciates the opportunity to review the Feasibility Study and Proposed Plan for the St. Louis Downtown Site. Mallinckrodt commends the U.S. Army Corps of Engineers for its efforts in moving this project forward. Mallinckrodt, like the Corps, is looking forward to the timely completion of a practical remedial program which protects the public, current and future employees and property owners, and the environment while providing for continued operation, maintenance, and development of Mallinckrodt's manufacturing activities. As discussed in the attached, Mallinckrodt encourages the Corps to select and implement Alternative 6. Alternative No. 6 will remediate contamination to levels which are protective of human health and the environment. It will remove contaminated soils likely to be encountered during routine maintenance and construction activity and therefore will allow cost-effective operation, maintenance, and development of the facility by current or future property owners. It is therefore consistent with the St. Louis Site Remediation Task Force recommendations. As this alternative will provide clean borrow in future development areas, excavation for site maintenance and development may proceed with significantly lower risk of encountering contaminated soils. It has increased long term effectiveness and permanence than Alternatives 1-4. In addition, Mallinckrodt and Federal Government costs for the management and disposal of contaminated soil generated during facility maintenance and development will be greatly reduced when compared to all other alternatives except No. 5. Implementation of Alternative 6 is also endorsed by Federal, State, and local government representatives and officials as well community leaders and residents. Mallinckrodt will be pleased to review our comments with you and your staff and answer any questions you may have. Please contact Robert Boland at 314-654-6170 if you have any questions or comments.	After consideration of public comment, the USACE has selected Alternative 6 for implementation.

COMMENTS AND RESPONSES ON
THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE
ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
	Introduction	Mallinckrodt Inc. ("Mallinckrodt") recommends that Alternative No. 6 be selected as the preferred remedial action at the St. Louis Downtown Site (SLDS). It will impose less restrictive use-limitations on Mallinckrodt and future property owners. Alternative No. 6 will remediate contamination to levels which are protective of human health and the environment. It will remove contaminated soils likely to be encountered during routine maintenance and construction activity and therefore will allow cost-effective operation, maintenance, and development of the facility by current or future property owners. It is therefore consistent with the St. Louis Site Remediation Task Force recommendations. As this Alternative will provide clean borrow in future development areas, excavation for site maintenance and development may proceed with significantly lower risk of encountering contaminated soils. It has greater long term effectiveness and permanence than do Alternatives 1-4. In addition, Mallinckrodt and Federal Government costs for the management and disposal of contaminated soil generated during facility maintenance and development will be greatly reduced when compared to all other alternatives except No. 5. The following paragraphs provide general and specific comments on the Feasibility Study and Proposed Plan and support the selection and implementation of Alternative 6 by the Corps.	After consideration of public comment, the USACE has selected Alternative 6 for implementation.
2		**A. Mallinckrodt's Significant Investment in and Contribution to St. Louis** Mallinckrodt is a St. Louis-headquartered company with global operations. Mallinckrodt's economic presence in Missouri is significant and growing. Mallinckrodt's St. Louis area facilities have approximately 2200 employees with a total payroll of approximately $150 million. In 1997, Mallinckrodt paid a total of $6 million in state and local property, business, and income fees and taxes. Over the past 10 years, Mallinckrodt has installed $370 million in new manufacturing and support facilities in the St. Louis area. $200 million of this investment was at the St. Louis Plant. Employment at the St. Louis Plant has increased by 300 over this period. As a result of these St. Louis Plant investments, an estimated 450 jobs and an economic "output" benefit of $165 million were created in the local economy. Mallinckrodt[1] has shown a commitment to the City of St. Louis and the St. Louis area through continued investment and expansion at the St. Louis Plant. Our plant's location in North St. Louis helps stabilize this area. In addition, Mallinckrodt is an active corporate citizen in this neighborhood through its ongoing work with Grace Hill Settlement House, Hyde Park Neighbors, Clay Community Education Center, and The North Broadway Business Association.	The importance of Mallinckrodt's operation to the economic stability and development of the downtown area is recognized by the USACE.

[1] The St. Louis Plant and downtown vicinity properties contain approximately one third of the estimated total volume of St. Louis Site contaminated materials. Therefore, Mallinckrodt is a significant stakeholder in the St. Louis Site FUSRAP program.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
3		**B. Under FUSRAP and the Federal Facilities Agreement, the Corps Must Remediate All MED/AEC-Related Contamination.** As DOE's successor with responsibility for implementing the FUSRAP program, the Corps is obligated under FUSRAP and the Federal Facilities Agreement (FFA) to remediate all MED-AEC related residues - including both accessible and access-restricted materials. The presence of these contaminants hinders use and continued development of manufacturing operations at the St. Louis Plant. The Downtown site remediation plan must recognize that Mallinckrodt has an active manufacturing facility and that site operations will continue and expand after completion of the work. Remedial criteria and institutional controls which are appropriate for dormant land are not applicable and appropriate for this expanding industrial site. Alternative 4 does not adequately address the issues associated with an active plant site. To continue development, Mallinckrodt must be able to excavate for the construction of new facilities and for the maintenance of those that are now being operated without having each new construction or maintenance project, no matter how small, become a remediation project. Consistent with the United States' obligation to address all MED/AEC contamination under the FUSRAP program, several activities have recently been completed including: remediation of soils at City Block 1201, demolition of the 50 Series buildings, decontamination of surfaces in K building, and demolition of former uranium processing buildings in Plants 6 and 7. See FS at p. 2-47. To facilitate these FUSRAP remedial activities, Mallinckrodt has relocated ongoing operations, utility systems (gas, water, power), and demolished structures at a cost of approximately $7 million. Mallinckrodt anticipates working with the Corps to facilitate remedial activities in the future.	After consideration of public comment , the USACE has selected Alternative 6 for implementation. Alternative 6 reduces the need for future studies, designs, and remedial actions over Alternative 4. The USACE looks forward to maintaining a continued relationship with Mallinckrodt that supports the needs of all parties to maintain operations and provide cost-effective remediation.
4		**II. The Corps Should Select Remedial Alternative 6[2]** Mallinckrodt recommends that the Corps select Alternative 6. Implementation of Alternative 6 would remove contaminated soil to a depth of 4 to 6 feet and backfill the excavated site with clean fill. Contaminated soils likely to be encountered during routine maintenance and construction activity would be removed thereby eliminating a primary exposure risk which Alternative 4 fails to address. Alternative 6 is more consistent with CERCLA guidance than Alternative 4, is more protective of human health and the environment than Alternative 4, and minimizes long term worker exposure which is underestimated in the Corps' analysis of Alternative 4. In addition, Alternative 6 better addresses actual site conditions including Mallinckrodt's plans for future development and is consistent with the recommendation of the St. Louis Site Remediation Task force.	After consideration of public comment, the USACE has selected Alternative 6 for implementation.

[2] Since the FS and the Proposed Plan are based on the same analysis, Mallinckrodt's comments also apply to the Proposed Plan.

COMMENTS AND RESPONSES ON
THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE
ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt

Comment No.	pp/§/¶	Comment	Response
4 (continued)		In comparing Alternative 4 to Alternative 6, CERCLA requires the Corps to apply the following criteria: • Threshold Criteria – overall protection of human health and the environment; and – compliance with ARARs. • Balancing Criteria – long-term effectiveness and permanence; – reduction of volume, toxicity, and mobility through treatment; – short-term effectiveness; – implementability; and – cost. • Moifying Criteria – state acceptance; and – community acceptance.	
	page 5-2	As Alternative 6 includes excavation of contaminated soils which will be encountered during plant maintenance and development, it will be more protective of human health and the environment and will provide for more cost-effective operation, maintenance, and development of the site. It therefore better satisfies the Threshold Criteria objectives of protection of human health and the environment and of establishment of remedial criteria which are applicable, relevant, and appropriate for the continued use and development of an industrial facility. Alternative 6 also better satisfies the objectives of Balancing and Modifying Criteria than does Alternative 4. The removal of soils which will otherwise be disturbed by continued industrial activity at the facility will increase the long term effectiveness and permanence of the remedy when compared to that provided by Alternative 4. As Alternative 6 requires the establishment of fewer institutional controls and restrictions on site activities, it has increased implementability than Alternative 4. As described below, the long term costs of Alternative 6 are no greater, if not less, than those of Alternative 4. Lastly, implementation of Alternative 6 is supported by Federal, state, and local officials as well as local community residents. The following paragraphs further demonstrate that the required comparative analysis favors selection of Alternative 6.	After consideration of public comment, the USACE has selected Alternative 6 for implementation.

COMMENTS AND RESPONSES ON
THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE
ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
5		<u>A. Alternative 4 Poses More Risk than Alternative 6</u> The Corps' risk analysis shows that potential exposures to employees and construction workers may exceed Nuclear Regulatory Commission rules for site cleanup unless unrealistic restrictions on excavation (and hence future plant development) are imposed. These restrictions would include prohibitions on excavation at the St. Louis Plant. This is unreasonable at an active plant. Such restrictions on future excavation are not required by Alternative 6.	Future excavation activities would not be prohibited under Alternative 4, but would require implementation of safety measures to assure adequate worker protection. After consideration of public comment the USACE has selected Alternative 6 for implementation.
		The FS is in error when it fails to identify the exposure pathway of a construction/industrial worker digging in soil as important. Excavation for plant maintenance and development is a routine activity at the St. Louis Plant and represents the primary route of worker exposure, particularly for those alternatives, such as Alternative 4, which leave contaminated soils at depths of six feet or less. The baseline risk assessment (BRA) identified that potential health impacts at the St. Louis Plant are highest for the construction worker. In addition, the potential for adverse impacts on human health and the environment is increased since these future excavation projects will not be implemented as part of a single remedial effort as would occur under Alternative 6.	The FS ALARA assessment fully evaluated the construction/industrial worker under a variety of cleanup scenarios. The industrial/worker scenario was modeled as a worker who works at the site and digs into contaminated soil during a portion of the year. This worker scenario was based on site-specific information, including input from Mallinckrodt. Both dose and risk assessments are provided in Appendix C of the FS.
		To properly address this recognized risk to maintenance and construction workers, removal of MED/AEC contamination which restricts or impedes the current and future operation, maintenance, and development of the site must be included as a remedial objective and the effectiveness and implementability of a remedial alternative must be evaluated on the basis of how well the alternative accommodates current and future plant operations and development.	As stated in the FS, the distribution of radioactive contaminants at the SLDS is very similar to the distribution of contaminants at a typical UMTRCA site. The USACE did not intend this comparison to extend to work activities conducted at the SLDS. Per EPA's OSWER Directive No. 9200.4-18, "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination", cleanup of UMTRCA sites "is consistent with the minimally accepted dose limit of 15 mrem/yr effective dose equivalent (EDE) under a residential exposure scenario for Ra-226, Ra-228, and Th-232, and is much more stringent for all 4 radionuclides." After consideration of public comment, Alternative 6 has been selected for implementation.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
6		<u>B. Site Appropriate ARARs favor Alternative 6</u> The FS study (see, e.g., p. 3-20, Table 3-3) does not appropriately consider soil removal requirements associated with the future use of the property in establishing ARARs and remedial objectives, specifically the need to: • Provide for and allow future industrial use and development of the facility. • Minimize the administrative and financial burden of managing contaminated soils excavated during site maintenance and development. • Minimize the administrative and financial burden of managing radon exposure from access-restricted soils beneath existing and new site structures. In selecting ARARs and evaluating risks, the FS fails to recognize that site operations will continue and expand after completion of the work. The Corps mistakenly applied remedial criteria and institutional controls which are appropriate for unused land but which are not applicable and appropriate for this industrial site. Because the site is actively being developed, the ARARs must take into account excavation for the construction of new facilities and for the maintenance of those that are now being operated. Mallinckrodt believes that UMTRCA (40 CFR 192) is not appropriate for soils in an active facility. See FS at p. 3-20, Table 3-3. The Corps is simply wrong when it states that the St. Louis Plant is similar to "inactive" uranium processing sites where these standards apply. See FS at p.3-9. The St. Louis Plant is anything but inactive particularly when it comes to ongoing excavation activities for maintenance and construction. Hence, these standards are not appropriate for this site. Failure of the Corps to effectively address the management of soils containing above-background radioactivity which will be routinely excavated during ongoing plant maintenance and anticipated future development is a significant shortcoming of the FS. The Corps has not considered how effectively remediation alternatives allow continued operation, maintenance, and development of Mallinckrodt's manufacturing activities and facility, nor did the Corps consider the effectiveness of the Alternative for addressing the management and disposal of excavated soils during these activities. Since these points were not considered, the evaluation of Alternative 4 is incomplete. Alternative 4 would be very difficult to implement at an active site and impossible to implement cost-effectively at an expanding site.	Alternative 6 has been selected in response to public support.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
6 (continued)		Rather than addressing contaminated soils on a continuing and ongoing basis as the plant is maintained and developed, it is more reasonable and practical that the Corps remove all soils containing elevated radioactivity which will likely be encountered during plant maintenance and development at this time and in so doing minimize the burden and cost of management in the future. Mallinckrodt believes the use of clean cover as well as clean fill within the construction/excavation zone (depth of 4-6 feet, depending on location) will best minimize potential doses and risks to construction workers and workers or the public exposed to excavated soils, both on-site and off-site. Removal at this time will minimize the potential for mismanagement at some point in the future. Alternative 6 accomplishes this. In addition, both DOE and the St. Louis Site Remediation Task Force embraced this concept. Isolation from radioactive materials by providing clean fill in the excavation zone is the most practical and workable approach for remediation at the St. Louis Plant. If such isolation is not provided, the institutional controls envisioned by Alternative 4 will be violated and the Corps will be continually and repeatedly managing soils containing above-background radioactivity, or development at the plant could be severely curtailed. See page 4-9, paragraph 1. The plan does not identify elimination of the potential for direct contact when contaminated soil is brought to the surface by subsurface excavation and subsequently managed for disposal as a remedial objective. See Page 3-29, paragraph 4. This situation will occur whenever excavation is performed for facility maintenance or development. This pathway has the potential to expose excavation workers, Mallinckrodt employees and contractors working around the excavation area, and employees of waste transportation and disposal firms who handle the excavated materials. Failure of a remedial alternative to eliminate such exposures will increase the potential for worker exposure during facility maintenance and construction and reduce Mallinckrodt or future property owner's ability to cost-effectively operate, maintain, and expand the facility. Alternative 6 would excavate soil containing more than 5 pCi/g to 6 inches deep and subsoil containing more than 15 pCi/g to 6 feet deep in some areas and to 4 feet deep in other areas of the St. Louis Plant. Only approved (non-contaminated) earthen fill would be used to backfill. This remediation strategy would allow industrial use of the St. Louis Plant without prohibition against disturbing land shallower than 4 or 6 foot below grade. Restrictions when excavating deeper than 4 or 6 feet, restriction against ground water withdrawal, and provisions to manage excavation into currently inaccessible areas are expected and are acceptable to Mallinckrodt. To a depth of 4 or 6 feet, Alternative 6 would resolve the incompatibility between Alternative 4's proposed restriction against disturbing land at the St. Louis Plant and Mallinckrodt's need to maintain and change its operations. Alternative 6 also reduces the need for future radiation protection and contaminated soil disposal accompanying subsurface utility work, foundation construction, and grading on-site.	Approved earthen fill would be used to backfill to depths above 4 to 6 feet. Deeper excavations could be backfilled using material that is below ALARA.

COMMENTS AND RESPONSES ON
THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE
ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
6 (continued)		Moreover, under Alternative 4, there appears to be no safeguard during remediation against excavating radioactivity concentration in soil greater than remediation criteria, then mixing it to less than *composite* criterion, and depositing it back onto the site. Although that might be effective in reducing residual radioactivity concentration over larger area, it might be much less effective in reducing site-wide inventory of residual MED-AEC material. And the lower concentration, higher volume soil might still have to be dealt with in the future. Whereas Alternative 4 depends on restriction against disturbing the remediated site to meet ARAR, Alternative 6 is better able to meet ARAR for industrial use. Thus, Alternative 6 is the preferred alternative.	
7		**C. The Corps has Underestimated Alternative 4 Costs** The Corps has not considered all the costs associated with implementation of Alternative 4. As the Mallinckrodt facility and vicinity properties are developed, soils in the near-surface building zone will be excavated by property owners and provided to the Corps for management and disposal. In analyzing Alternative 4 in the FS, the Corps addressed neither Mallinckrodt's nor the Corps' administrative or remedial costs of managing these soils in the future. This soil removal will occur during utility maintenance and facility development (foundations, sewers, elevators, etc.). The actual costs for excavation and disposal of contaminated soil above free release criteria will be incrementally increased over those estimates for the planned remediation because of the smaller volumes handled and the cost and availability of support staff resources to plan, implement, and coordinate disposal activities. As a result, the purported savings recognized by leaving these contaminated soils in-place are exaggerated and, at best, temporary. The Corps implicitly recognized the future costs associated with Alternative 4 when, in analyzing Alternative 6, it said: "Alternative [6] focuses on reducing the need for future studies, designs, and remedial actions, in addition to protection of human health and the environment relative to Alternative 4." FS at p. 4-25. The Corps proposes to allow soils with concentrations 30 times higher than the appropriate limit to remain after excavation. See FS at p. 3-10, fn. c. This will result in increased exposures to maintenance and construction workers and increase the cost and complexity of management and disposal of excavated soil. As such, exposures and costs associated with those alternatives which leave contaminated soil in the construction zone are underestimated.	The USACE agrees that Alternative 6 will reduce the need for future studies, designs, and remedial actions for residual soils relative to Alternative 4. After consideration of public comment, the USACE has selected Alternative 6 for implementation.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
7 (continued)		To appreciate the substantial future costs of soil removal which the Corps ignored in evaluating Alternative 4, during the past three and one half years, Mallinckrodt has spent approximately $660,000 (roughly $190,000/yr) managing soil which contains MED/AEC residues. These soils were generated during routine operation and maintenance and by minor construction projects. DOE took possession of most of the soil and the Corps is obligated to take the remainder. Mallinckrodt estimates that it will generate approximately 340 cubic yards per year of soils containing MED-AEC contamination through future routine operation and maintenance activities, and spend approximately $195,000 per year for health-physics support and soil management and storage. The presence of radioactivity in soils also increases the cost and complexity of site construction. During a typical construction project, Mallinckrodt will incur approximately $150,000 in increased design, coordination, and contractor costs. Fifteen hundred to two thousand cubic yards of soil will be excavated during a typical major construction project such as installation of a new manufacturing or support structure. Based on recent experience, Mallinckrodt will spend approximately $400,000 per project to analyze, store, and deliver these soils to the Corps if construction is performed in an area containing FUSRAP contamination. Therefore, the presence of soil contamination increases the cost of major construction projects in areas containing FUSRAP contamination by approximately $554,000 each. Based on past history, Mallinckrodt assumed implementing eight development projects in areas containing MED-AEC contamination over the 30 year cost evaluation period. Over the 30 year period evaluated in the FS, Mallinckrodt will experience increased costs of approximately $10 million (1998 dollars) to manage the contaminated soils which will remain on site if Alternatives 1, 2, 3, or 4 are implemented by Corps. Over the same period, the Corps will spend approximately $11 million (1998 dollars) for the management, transportation, and disposal of these soils. These expenditures were not taken into account in evaluating Alternative 4. When these additional costs of future soil handling are taken into account, there is no cost justification for selecting Alternative 4 instead of Alternative 6.	
8		**D. Alternative 4 Would Limit Future Development of the Site to the Detriment of the Surrounding Community** The adverse impacts on the community, as well as Mallinckrodt, are not justified by the purported short term savings achieved by Alternative 4. Since 1980, City of St. Louis employment has declined in the services, manufacturing, and military industries. In contrast, during this period, Mallinckrodt employment increased by approximately 100. Further growth and the associated increased employment and community benefits are at risk if Mallinckrodt is unable to continue expansion in a cost-effective manner due to the presence of FUSRAP residues left behind by Alternative 4.	The importance of Mallinckrodt's operation to the economic stability and development of the downtown area is recognized by the USACE. After consideration of public comment, the USACE has selected Alternative 6 for implementation.

COMMENTS AND RESPONSES ON
THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE
ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
8 (continued)		Over the past ten years, Mallinckrodt has made capital investments of approximately $200 million for installation of new manufacturing facilities and upgrading of existing processes at the St. Louis Plant. Mallinckrodt has constructed state-of -the-art laboratory, maintenance, and warehouse facilities to support pharmaceutical manufacturing operations on previously remediated property. Mallinckrodt anticipates constructing new manufacturing facilities when other areas are fully remediated. Thus, continued remedial activities at the St. Louis Plant will provide immediate economic benefit to the St. Louis area. Over the next five years, Mallinckrodt anticipates a further capital investment of $120-150 million at the St. Louis Plant. Mallinckrodt hopes to install approximately $30 million of this new capital in areas remediated under FUSRAP. However, if Alternative 4 is selected, Mallinckrodt will be unable to construct new manufacturing facilities in these areas without encountering FUSRAP contamination. This creates a financial burden on development at the St. Louis Plant. Elimination of future Mallinckrodt costs and restrictions which would impede operation, maintenance, and future development of the site are best addressed by adopting Alternative 6 which provides for clean fill to depths ranging from four to six feet.	
9		**E. Alternative 6 is Preferred by Government and Community Leaders.** Alternative 4 is not consistent with the recommendations of the St. Louis Site Remediation Task Force. In its September 1996 report, this task force of community representatives recommended that soil contaminants be removed to a depth permitting general excavation for maintenance without concern. Because it includes removal of contaminated soils likely to be encountered during routine maintenance and construction activity, Alternative 6 is consistent with the Task Force recommendation. In addition to support by Mallinckrodt, implementation of Alternative 6 is supported by Missouri DNR, City of St. Louis Mayor Harmon, St. Louis County Executive Westfall, and the St. Louis Congressional delegation. Implementation of Alternative 6 is also supported by numerous community leaders and area residents, several of whom voiced their support at the public meeting held by the Corps at Clay School on April 21, 1998.	After consideration of public comment, the USACE has selected Alternative 6 for implementation.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
10		**F. Requirement for Long Term Commitment** The FS provides: "inaccessible soil will be addressed at a later date when an appropriate remedy that minimizes disruption of active facilities has been identified." FS at pp. 1-5; 4-1. However, the Feasibility Study and Proposed Plan fail to address how the Corps will take responsibility for the long term management of contaminated soils which are not removed by the cleanup. The Corps, DOE, or another Federal Government entity must establish a long term commitment to Mallinckrodt for management and disposal of residual materials if MED-AEC materials are left on site following remediation. In contrast to the Corps' inaccurate suggestion that there is uncertainty concerning the source of radionuclides at the St. Louis Plant (FS at ES-3), the MED/AEC operations caused by far the bulk of the radioactive materials processed at Mallinckrodt.[3] It would be inappropriate and inequitable to shift the burden of dealing with MED/AEC contamination to Mallinckrodt. The congressional intent of FUSRAP was to relieve property owners of this burden. Moreover, the United States is contractually obligated to Mallinckrodt to address all contamination related to MED/AEC uranium processing. Future responsibility must be acknowledged at this time to ensure that contaminated soils do not become a burden to future property owners or present a risk to human health and the environment when they are disturbed during future operation, maintenance, and development of the facility. Mallinckrodt believes that the FS must either address remediation of inaccessible soils which will occur at some point in the future, provide a long term commitment that the these soils will be addressed when they become accessible, or provide for remediation of these soils now with appropriate compensation to property owners for the disruptions caused by this remediation. Failure of the Corps to include these soils in the FS leaves their status and future remediation uncertain. In addition, the FS does not anticipate and address response actions for contaminated soils that are not now known but are discovered in the future. Mallinckrodt and future property owners must not be burdened with the administrative and financial costs of managing such contaminated materials in the future.	The USACE fully recognizes its responsibilities regarding MED/AEC contamination at Mallinckrodt, however this is not the only source of radioactive contamination at the facility. In clarifying the limits of the USACE's responsibility, there was no intent to reduce the U.S. Government's share of the obligation to remediate MED/AEC related contamination. Inaccessible soils will be addressed as a separate operable unit. Details regarding the management of these soils and the roles and responsibilities of the various parties will be included in subsequent CERCLA documentation.

[3] The Corps essentially concedes this fact in the FS stating: "the MED/AEC operation comprised most of the radioactive materials processed at Mallinckrodt." FS at p. .

COMMENTS AND RESPONSES ON
THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE
ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
11		**G. Corps Responsible for Chemical Contamination Resulting from Uranium Processing and For all Contamination Commingled with MED/AEC Residues** The FFA requires the Corps to remediate all waste, including but not limited to, radiologically contaminated waste, resulting from or associated with uranium manufacturing or processing activities conducted at the St. Louis Plant as well as other chemical or non-radiological waste which have become mixed or commingled with radiological contaminated waste resulting from or associated with uranium manufacturing or processing activities conducted at the St. Louis Plant. The FS expressly acknowledges the scope of the Corps' obligations when it cites the FFA as covering: • All wastes, including but not limited to radiologically contaminated wastes, resulting from or associated with uranium manufacturing or processing activities conducted at the St. Louis Plant. • Other chemical or radiological wastes that have been mixed or commingled with wastes resulting from or associated with uranium manufacturing or processing activities conducted at the St. Louis Plant. Areas of chemical contamination from MED/AEC activities are therefore also within the scope of the FFA and this remedial project. In evaluating the extent of chemical contamination for which the Corps is responsible, characterization activities did not attempt to identify all organic compounds used in uranium processing. See FS at p. 2-27, paragraph 4. Consequently, characterization studies completed to date may not have identified all of the compounds used in uranium processing which remain in the environment. In addition, the Corps is incorrect in stating that "No RCRA listed compounds were used..." The remedy that is implemented must account for all of the chemical contamination associated with MED/AEC operations. See FS at p. 2-33, paragraph 3. Acids (e.g., nitric) and organics (e.g., TCE) were used in uranium processing and are listed hazardous wastes. In fact, the FS lists numerous chemicals associated with uranium processing: chemicals associated with MED/AEC materials or processes include trichloroethylene (TCE), diethyl ether, inorganic compounds such as hydrofluoric, nitric, and sulfuric acids (Harrington and Ruehl, 1959), nitrates, calcium hydroxide, caustic soda, sodium bicarbonate and carbonate, anhydrous ammonia, graphite, and petroleum products. FS at p. 2-25.	USACE understands that it has responsibility for chemical contamination resulting from past uranium processing for MED/AEC. However, that does not make the USACE responsible for cleanup of all chemicals at the site that may have had some incidental use during uranium processing. This is a particular concern given the long history of the site as a chemical manufacturing facility. The context inwhich the statement was made was in considering PCOCs. A substance is RCRA hazardous if it either exhibits a hazardous characteristic or is a listed waste. A waste is a RCRA listed waste if it can be demonstrated that the waste derives from a source as specified in 40 CFR Part 261 Subpart D. None of the samples tested exhibited a characteristic, nor is the specific source of potentially hazardous constitutents known. Therefore, no RCRA listed and no RCRA characteristic wastes have been detected.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
12		**III. Conclusion** As stated above, Mallinckrodt recommends that Alternative No. 6 be selected as the preferred remedial action at the St. Louis Downtown Site (SLDS). It will impose less restrictive use-limitations on Mallinckrodt and future property owners. Alternative No. 6 will remediate contamination to levels which are protective of human health and the environment. It will remove contaminated soils likely to be encountered during routine maintenance and construction activity and therefore will allow cost-effective operation, maintenance, and development of the facility by current or future property owners. It is therefore consistent with the St. Louis Site Remediation Task Force recommendations. As this alternative will provide clean borrow in future development areas, excavation for site maintenance and development may proceed with significantly lower risk of encountering contaminated soils. It has greater long term effectiveness and permanence than do Alternatives 1-4. In addition, Mallinckrodt and Federal Government costs for the management and disposal of contaminated soil generated during facility maintenance and development will be greatly reduced when compared to all other alternatives except No. 5.	After consideration of public comment, the USACE has selected Alternative 6 for implementation.
13		**A. Inadequacy of Radon Analysis** Page 3-18, paragraph 2. This statement is incorrect. Radon emissions from materials beneath buildings 101 and K required installation of radon control measures to maintain concentrations at acceptable values. These soils also represent exposure risks when subsurface maintenance is performed. The Feasibility Study proposes, "... occupancy and use restrictions and engineered control measures would also be implemented for buildings where radon gas is a concern." [FS 5-32]. "... use of active and passive radon control systems and adherence to worker safety regulations will be used to maintain safe work levels for all SLDS employees." [FS 5-29] This, as well as routine monitoring for radon gas, are additional costs to Mallinckrodt which has not been identified.	Statement that inaccessible soils do not pose a current risk is not incorrect. Radon control measures are currently mitigating potential current risk. If subsurface maintenance is performed, these soils are no longer inaccessible. Radon monitoring costs are included in the cost estimates.

COMMENTS AND RESPONSES ON
THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE
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Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
13 (continued)		Industrial worker scenarios assumed a 2-foot thick zone of contamination. Yet a substantial fraction, perhaps the majority, of radon entering a building through its floor may originate deeper than 2 feet wherever cinder fill is relatively porous and dry. RESRAD models radon entry into a building by assuming diffusion from ground below and inflow of ventilation air from outside as the motives for entry. Although argumentative perhaps, the primary motive is apparently pressure differential between interior and exterior of the house near the ground floor caused by the chimney effect, wind, and atmospheric pressure drop that draws in soil gas.[4],[5] In view of this likely deficiency in RESRAD and RESRAD-BUILD models, the Corps should request ANL to re-examine the radon model in RESRAD and RESRAD-BUILD. The Corps should reconsider its estimation of potential radon exposure within a habitable building on land containing elevated Ra^{226}. If the Corps proposes to rely on the RESRAD model to predict indoor radon progeny concentration, it should address these concerns. The Corps should reconsider its estimation of potential radon exposure within a habitable building on land containing elevated Ra^{226} made using RESRAD or RESRAD-BUILD. The State of Missouri's prohibition on the placement of radioactive materials in landfills will increase the cost of disposal of soils containing <u>any</u> radioactivity above background levels. It was not considered a relevant and appropriate factor in evaluating the acceptability of remedial alternatives.	The contaminated zone is assumed to be 2 meters thick and not 2 feet, as indicated in the comment. Therefore, the source depth is probably less inadequate than thought by the commentor. "Less inadequate" is used here specifically because, as the commentor knows, the source of radon may be many meters away or may be limited to the top few inches of soil depending on the geology at the specified location. The current model assumes a conservative yet reasonable depth of contamination. An accurate model for predicting indoor radon concentrations has been quite elusive and is likely to be so for some time. If Argonne National Labs (ANL) comes up with a new model for predicting indoor radon, it will surely suffer the same scrutiny that their current model must endure. The current model is considering that the stack effect is typically a seasonal phenomenon and reverse stack effect conditions can apply (neither of which is necessarily a good thing).

[4] Nazaroff, W.M. "Entry by Pressure-driven Flow or Molecular Diffusion? A Reassessment of ^{222}Rn Concentrations Measured in an Energy-Efficient House." *Health Physics*. 55, no. 6. Pp1005-1008. Dec. 1988.

[5] Holub, R.F. "Reply to "Entry by Pressure-driven Flow or Molecular Diffusion?" *Health Physics*. 55, no. 6. Pp1009-1011. Dec. 1988.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (April 1998) (continued)

Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
14		**B. The Corps Is Correct in finding Groundwater Treatment Unnecessary** Mallinckrodt concurs with the Corps' assessment of the overall poor conditions of groundwater in the vicinity of the St. Louis Plant. See FS at pp. 2-36, ES-3, 2-11, 2-36, 2-39, 3-16, 4-3. Page 2-36, paragraph 2. Residents consuming groundwater from on-site wells and produce from home gardens is not a realistic future use scenario for SLDS. Residential use of the property is not a reasonable future use assumption and is therefore not a reasonable basis for evaluation of future exposures.	Agree.
15	2-3 and elsewhere	Uranium processing was not performed in plant 6E to our knowledge. Some portions of plant 6E may have been contaminated by migration of radionuclides into the area.	Thank you for this information.
16	2-25, ¶ 3	It is likely that the presence of coal slag and cinders in fill material has resulted in the presence of both inorganic and organic compounds in the environment (e.g., polycyclic aromatic hydrocarbons). PAHs are not believed to be from Mallinckrodt processing, but from the cinder fill material. Such fill material was used throughout the river front area to raise the grade elevation and allow development.	Agree. Additional background sampling in this fill material offsite is planned to enable establishment of the source of this contamination.
17	3-8, ¶ 5	Although the State of Missouri has not implemented regulations which address radioactive contamination in soil, it has issued regulations which effectively prohibit the landfill disposal of soils containing above-background concentrations of radioactivity. This effectively precludes the use of Missouri landfills for disposal of soils containing FUSRAP residues in any concentrations and creates a significant burden on property owners whenever soils are excavated for facility maintenance or expansion.	Agree.
18	Table 3-1	Soil Guidelines. The guidelines list is incomplete. It appears to provide only the guidelines in 40 CFR 192 and DOE Order 5400.5. Soil criteria for the full list of MED/AEC radionuclides to be addressed by the project and the impact of depth on criteria are not identified.	Table 3-1 addressed the primary radionuclides of concern for this site (Ra-226, Th-230 and U-238). Other radionuclides (e.g. Th-232 and Actinium series decay products) will be controlled by remediation of these primary radionuclides.
19	Table 3-1	External Gamma Radiation. 20 μR/hr is cited as a criterion in a habitable building. However, 7.5 μR/hr exposure rate times 2000 hr/yr occupancy would produce about 15 mrem/yr, absent any other exposure.	Agree. The 20 μR/hr limit would likely not be used as a guideline for areas with high occupancy.
20	3-10, Line 37	The DOE interpreted the equivalent of Table 3-1 to specify a surface release criterion of 5000 α(min 100 cm^2), ignoring the thorium criterion. How will the Corps interpret Table 3-1 surface criteria with the prospect that thorium is present? The proposed criteria do not seem to account for potential presence of thorium series radionuclides.	It has been our experience to date that thorium series (Th-232 + D) nuclides are a very small portion of the overall site radioactivity total. However, the values in Table 3-1 for thorium would be used in separate areas where thorium (particularly Th-230) was the dominant radionuclide.

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THE FEASIBILITY STUDY FOR THE ST. LOUIS DOWNTOWN SITE
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Comments received 05/8/98, Mallinckrodt			
Comment No.	**pp/§/¶**	**Comment**	**Response**
21	4-7, ¶ 6	The containment alternative is not acceptable to Mallinckrodt. Such an alternative would have significant impact on plant maintenance and development and would significantly reduce property values.	USACE has selected Alternative 6 for implementation.
22	5-51	Public Services. The statement that Alternative 4 has a low impact on utilities is not correct. Utilities exist in the soil horizons where residual contamination will remain.	The short duration of exposure to contaminants under a utility worker scenario effectively limits impacts to a utility worker. However, USACE has selected Alternative 6 after consideration of public comment.
23	5-57, ¶ 4; 4-10, ¶ 5	The use of Plant 2 as a location for fill or treatment processing facility is unacceptable to Mallinckrodt as this area is in the middle of the manufacturing facility. Moreover, as the Corps notes: "Consolidation at Plant 2 would have an impact on Mallinckrodt Inc.'s ability to expand its operations. This could result in reduced employment." FS at 5-23.	Alternative 6 has been selected for implementation.
24	5-9, ¶ 9	Alternative 2 - Institutional Controls And Site Maintenance is not acceptable to Mallinckrodt as it does not reduce employee exposures or impediments to facility maintenance and development.	Alternative 6 has been selected for implementation.
25	5-15, ¶ 3	Alternative 3 - Consolidation and Capping is not acceptable to Mallinckrodt as it does not reduce employee exposures or impediments to facility maintenance and development.	Alternative 6 has been selected for implementation.
26	5-15, ¶ 5	Mallinckrodt will not agree to consolidating and capping contaminated materials from property outside their boundaries.	Alternative 6 has been selected for implementation.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998)

Comments received 05/05/98, Michael Alesandrini			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		Several member companies of the St. Louis Regional Commerce & Growth Association have expressed a great deal of concern over the recently released Feasibility Study/Proposed Plan (FS/PP) with regard to the Corps' intentions to remediate the St. Louis FUSRAP. We are concerned because certain elements of the plan do not appear to be consistent with regional development goals.	Although regional development goals are not among the CERCLA evaluation criteria, these concerns may be considered under the CERCLA community acceptance criterion.
2		Under the previous plan, the contaminated sites were to be cleaned and made essentially available for redevelopment. The FS/PP does not provide for such treatment. Much of the property affected does have local market appeal. Responsible remediation planning would seek to take advantage of such favorable market conditions. It is not clear why the FS/PP not only fails to leverage said conditions, but also effectively removes these properties from the playing field in the immediate term—contaminated properties are at a distinct competitive disadvantage in the St. Louis area as available properties can be had readily which are not contaminated.	It is unclear what previous plan is being referenced. The Task Force Report recommended commercial and industrial use for Mallinckrodt, recreational for the Riverfront Trail, and unrestricted use for the VPs. The levels of cleanup proposed are consistent with these recommendations.
3		In addition to the plan's failure to envision new, short term growth on FUSRAP property, the plan clearly does not recognize the propensity, given historical tendencies, for near term expansion onto remediated parcels located on the Mallinckrodt facility.	These concerns have been addressed by the selection of Alternative 6 in the Record of Decision rather than Alternative 4 which was favored in the Proposed Plan. Implementation of Alternative 6 will increase the depth of complete remediation, providing additional protection against inadvertent intrusion.
4		The RCGA established a goal of generating 100,000 net new jobs by the year 2000. One of our most pressing economic development goals is therefore to foster expansion of existing operations and growth of new operations in the immediate term. Clearly, the FS/PP is inconsistent with that end. We would respectfully request, therefore, that you reconsider your strategy for remediation of the affected real estate.	In response to community concerns and other issues, USACE has changed its selection of alternatives from Alternative 4 to Alternative 6.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/06/98, Senator John Ashcroft			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		I have reviewed the Army Corps of Engineers' plans for remediation of the SLDS under FUSRAP. I commend the Corps for developing these assessments and plans under a challenging schedule. I look forward to the timely completion of the work and elimination of the burden that resides from early weapons production placed on property owners.	USACE appreciates your interest in this project.
2		While I believe cost should be one factor in deciding which plan should be implemented, it should not be the only factor. I encourage the Corps to select an alternative that will minimize the future administrative and financial burdens to property owners and minimize impediments to future development. Please choose an alternative that will best preserve and enhance the cost-effective development and expansion of SLDS properties and the resulting economic benefits that flow to the local and regional community.	Although development and expansion of SLDS properties and economic benefits to the community are not valid evaluation criteria under CERCLA, under Final Remedy Selection the law requires reassessment of the initial preferred alternative on the basis of new information or points of view expressed by the state and community. On the basis of concerns expressed by the community, USACE is selecting Alternative 6 in the Record of Decision.
3		I encourage the Corps to resolve the issue of continuing future responsibility for residues which are not removed under the current plan. Property owners must not bear a burden that is the government's responsibility, and it is appropriate and reasonable that the mechanism for establishing and guaranteeing such responsibility be established prior to issuance of the Record of Decision.	This concern will not be addressed prior to the issuance of the Record of Decision, especially for inaccessible soils. Inaccessible soils will be addressed as a separate operable unit in future documentation.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 04/29/98, William L. Clay			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		I have reviewed the Army Corps of Engineers' plans for remediation of the St. Louis Downtown Site (SLDS) under FUSRAP. I commend the Corps for the timely development of these assessments and plans. I look forward to the expedient completion of this cleanup project; it is time the St. Louis community is relieved of the burdens brought by early weapons production.	USACE appreciates your interest in this project.
2		I encourage the Corps to select and implement Site-Wide Alternative No. 6, Selective Excavation and Disposal. This alternative will minimize the future administrative and financial burdens to property owners and will minimize impediments to future development which would be created under Alternative 4. Although short-term cost to the federal government will be higher under Alternative 6, this plan will prevent the need to shift more than $10 million in costs for the management of soils not removed by Alternative 4 from FUSRAP to property owners. Alternative 6 will allow the most cost-effective development and expansion of SLDS properties while spurring economic benefits throughout the community. This alternative will also reduce the government's continuing obligation for the disposal of soils excavated by property owners.	USACE has selected Alternative 6 in the Record of Decision for this site because of the widespread public support for this alternative.
3		I encourage the Corps to resolve any question of future responsibility for residues which are not removed under the current plan. Property owners must not bear a burden that is the government's responsibility; it is both appropriate and reasonable that the mechanism for establishing and guaranteeing such responsibility be established prior to the issuance of the Record of Decision.	This concern cannot be addressed prior to the issuance of the Record of Decision, especially for inaccessible soils. Inaccessible soils will be addressed as a separate operable unit in future documentation.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/06/98, Congressman Jim Talent			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		Upon examining all of the proposed options for the remediation of the SLDS, I have decided to support Alternative 6, which provides for selective excavation and disposal. Under Alternative 6, all contaminated soils to a depth of 4–6 feet will be removed, and all excavated areas will be backfilled with clean soil. This recommendation is consistent with the recommendation of the St. Louis Site Remediation Task Force.	Agree. However, the plan is to use clean soil as backfill only in the top 4 to 6 feet. Below that depth, excavated materials below the ALARA criteria may be used as backfill.
2		I support Alternative 6 instead of the preferred alternative of the Corps of Engineers (Alternative 4) because: • Under Alternative 4, greater quantities of radioactive contamination will be left in the soil. This will inhibit further development at SLDS since the ongoing management of these soils, particularly during site development, is not addressed. Alternative 6 removes contaminated soil from most areas likely to be involved in future maintenance and development work. • Also, if one considers the costs of managing these soils over the long term, there is essentially very little, if any, difference between Alternatives 4 and 6, and Alternative 6 avoids shifting costs to property owners.	Agree.
3		In addition to selecting Alternative 6 for remediation at SLDS, I urge the Corps to resolve the issue of continuing future responsibility for contaminated soils and materials that will not be removed. Property owners should not be required to bear the burden that is the federal government's responsibility.	This issue must ultimately be resolved, but the resolution is not a part of this Record of Decision.
4		I would like to congratulate the St. Louis District Corps of Engineers for their commitment to cleaning up all the FUSRAP sites in the St. Louis area. In less than a year since the Corps took over the cleanup responsibilities for all FUSRAP sites, significant progress has been made in formulating a thorough and acceptable remedy for the St. Louis FUSRAP sites.	USACE appreciates your support.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/06/98, John Bratkowski			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		After consideration of the alternatives, the Old North St. Louis Restoration Group voted in favor of Alternative 5, the most complete cleanup. It was felt that the cost of complete cleanup was not that much greater than Alternatives 4 or 6 and that the nature of radioactive waste warranted complete cleanup. It was also noted that a natural disaster such as flooding or an earthquake in the immediate area could spread the radioactive contamination over a much wider location than the current site.	Alternative 5 is estimated to cost $48 Million dollars more than Alternative 4, about a 50% increase. USACE feels that is significantly greater cost. In response to community concerns, USACE is selecting Alternative 6 which is more protective than Alternative 4 at an increased cost of $22 Million. As demonstrated by the ALARA analysis in Appendix C of the FS, little reduction risk is achieved by more aggressive (and expensive) remediation than is proposed in Alternative 4. Alternative 6, by excavating to the most stringent criteria to depths of 4 to 6 feet, will further reduce the chance of inadvertent intrusion into contaminated materials and will also reduce the potential for spreading of contamination through flood or earthquake since the material will be greater depth than in Alternative 4.
2		The selection of Alternative 5 will not cause the elimination of the Mallinckrodt Company. So, an added benefit of this alternative is that is will not cause local economic disruption.	Alternative 6 also minimizes the potential economic consequences of post remedial conditions.
3		Regardless of any short-term economic impact, as neighborhood residents, we want the SLDS cleaned up completely, for once and for all. The cost of $140 million is reasonable considering that it will ensure the future viability of this important part of our urban environment.	Alternative 6 will meet these concerns through minimizing the opportunity for significant exposure to residual radioactive materials.
4		Our organization has voted unanimously to support Alternative 5. We would like our decision to be part of the public record and for our comments to be used in guiding the complete excavation with offsite disposal of all of the radioactive waste at the SLDS location.	Your comments are part of the public record as a result of inclusion in this Responsiveness Summary. However, based on other commentors, support for Alternative 6 appears to be more widespread in the community than support for Alternative 5.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/06/98, N.F. Brewer			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		RMI Environmental Services (RMIES) is a remediation company offering expertise and specialized technologies geared to individual site requirements. We are currently the prime contractor to DOE for remediation of a uranium extrusion plant in Ashtabula, Ohio. RMIES is also part of a joint venture team which demonstrated an effective soil treatment pilot plant at the Ashtabula site. Soil decontamination in the pilot scale plant was proven to be both fiscally and technically effective, and this success led the DOE to change the baseline remediation approach to include soil treatment. The change to soil treatment and the extraction of uranium from the soil is expected to provide a $20 million savings over standard soil transportation and disposal at Envirocare. A production scale soil treatment plant is under construction, and will begin operation this fall.	Alternative technologies which are viable and cost effective will be fully assessed and implemented at the SLDS as an integral part of remediation. Although such technologies have not been identified to date, additional investigations will be conducted as appropriate to minimize remediation costs.
2		The Feasibility Study for the SLDS states that soil treatment may be a viable alternative for the downtown site (page 3-31). Soil treatment removes contamination from the soil, substantially reduces the quantity of soil shipped offsite for disposal, and offers corresponding reductions in environmental impact and project costs. These potential benefits warrant an amendment to the Proposed Plan for the SLDS so that it will specifically call for the performance of a volume reduction via soil treatability study necessary to select and design an effective soil treatment process.	Soil treatment is a conditional component of any and all remedial alternatives and will be used as appropriate based on viability and cost effectiveness. (SLDS FS para. 5.3.4, pg. 5-58)

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/08/98, Rev. Richard Creason, Holy Trinity Church			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		Pursuant to the public meeting at Clay CEC on Tuesday, April 21, at which I made oral comments, I am now providing my opinion in writing concerning cleanup of the Mallinckrodt site. My opinion is not a scientific one, rather it is from a pastoral point of view. I hope that it will be given adequate consideration for it is a holistic view that is being offered.	USACE appreciates multiple perspectives on the issues involving SLDS remediation.
2		When I view the historical development of the Hyde Park community, I see it as always having been a working class community: factory workers, trades people, and shop keepers. This parish, founded in 1848, has been at the heart of this community seeking to connect family, faith, and human dignity. In any era, when people launch out on this path, three elements are important: 1) Where will I live? 2) Where will my children go to school? 3) Where will I shop for needed goods and services? Add on to that the larger questions of meaning: 1) Where will I find meaningful employment? 2)Where will faith and spirituality be nurtured, that is, will there be churches to serve a spectrum of belief? Now 150 years later, in the Hyde Park community, these concerns are even more critical: 1) 50% of households have an income below $15,000 per year (second lowest in St. Louis City); 2) the unemployment rate is 12.7%; 3) According to Project Respond research (1997), children in zip code 63107 are more at risk than any other neighborhood in the City of St. Louis; and 4) The dropout rate for St. Louis City Public Schools is almost 25%, the highest in the metropolitan area.	Noted.
3		Mallinckrodt, Inc., has been a corporate citizen in the Hyde Park community as well for over 100 years. I can only speak from a perspective of the last three years that I have been the pastor of Holy Trinity Church, but my experience is that Mallinckrodt has been very active in community affairs. Mallinckrodt is an anchor; if we were to lose this plant because of relocation, it would spell disaster for North St. Louis.	Noted.
3		Because Mallinckrodt is willing to stay in this community, the issue of remediation of hazardous soil at their plant site on North Broadway takes on greater importance in terms of future development. Having heard all of the proposed remedies at the public hearing, I want to reiterate my support for Alternative 6, that is to remove the contaminated soil and to replace the soil in the near surface of the building zone. This will allow Mallinckrodt to redevelop this site and enhance their investment.	USACE has selected Alternative 6 in the Record of Decision in response to community support for Alternative 6.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/08/98, Douglass Eller			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		I attended and testified at the Tuesday, April 21st, public hearing at Clay Elementary School. I work in the neighborhood with an environmental project developing the Riverfront Trail that runs between Mallinckrodt and the river. I am also active with neighborhood issues in Hyde Park and live on North 20th Street with my wife and two children. Our neighborhood has an annual income averaging $7000 per family. More than 60% of the community does not hold a high school degree. Little interest or caring exists for the neighborhood outside of its community borders. Very few "anchors" (neighborhood stabilizing forces) remain. And business anchors are even rarer. Mallinckrodt, Inc., has been a real strength to neighborhood improvements, particularly through the contribution of time and expertise by their staff. Mallinckrodt has brought area neighborhood organizations together, helped plan events, strategized with residents on political issues, supported small businesses, encouraged the recovery of chemically addicted parents, fostered solutions to environmental issues, employed area residents, and revealed its waste disposal practices in an open manner. The company has also invested funds to strengthen community efforts. Mallinckrodt is our business anchor that we cannot afford to lose.	Noted.
2		As I understand the issues, without the soil contamination removed to a specified level, Mallinckrodt cannot reinvest with new construction on those sites within its grounds. Our neighborhood must have Mallinckrodt remain a viable entity. My comments are in vigorous support of Alternative 6, as described in the Proposed Plan for the St. Louis Downtown Site.	USACE has selected Alternative 6 in the Record of Decision at this site in response to community concerns.
3		I feel that if more effective publicity was given within our neighborhood for the public meeting, a greater showing of support for Alternative 6 would have been demonstrated.	Noted.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/08/98, Melvia J. Forniss			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		Mallinckrodt Chemical Company has been very supportive of Grace Hill Family Center clients, staff, and the community. Mallinckrodt has made many contributions, donations, and volunteer time to families of the Family Center for over six years. Grace Hill Family Center recommends to the Army Corps of Engineers to select Alternative 6 so that Mallinckrodt Chemical can remain in our community. The Grace Hill Family Center is the only long-term residential treatment program in the State of Missouri providing services to pregnant and post-partum substance abusing women and their children. It is also currently the only treatment program of any kind on the north side of St. Louis. The Grace Hill Family Center opened on March 4, 1994. It has served 148 women and 174 children since it opened. Thirty-two babies have been born drug free since that time. This fact has saved the state and estimated $900,000 in neonatal medical costs to date. The Grace Hill Family Center is a comprehensive program which offers intensive substance abuse treatment, education, job training, and medical services in the frame of work of community based self help.	USACE has selected Alternative 6 in the Record of Decision for SLDS in response to community concerns.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/06/98, Hyde Park Eco-Justice Community			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		At a recent meeting of the Old North St. Louis Restoration Group, we learned of the effort being made to clean up the radioactive contamination at the Mallinckrodt Site. Because of our interest in ecology, we were encouraged to know that the Corps of Engineers was looking at this dangerous piece of property located so close to our neighborhood and trying to come up with some solutions. Of the six alternatives listed on the Proposed Plan, only Alternative 5 offers any real or permanent protection to the people who live nearby. To do anything short of complete excavation with offsite disposal makes no real sense. We would like to encourage you to choose Alternative 5 which would remove at least one of the many environmental health risks in this section of St. Louis.	An analysis to determine the risk from residual materials for various cleanup levels criteria was performed in order to determine the most cost effective cleanup criteria that would be protective of human health and the environment. The results of this analysis, which are published in Appendix C of the FS, indicate Alternative 4 provides the best balance between cost and risk. In response to public comments, USACE has selected Alternative 6 in this Record of Decision. Alternative 6 extends the depth of excavation for the most stringent criteria to a depth of 4 to 6 feet. This will offer both real and permanent protection to the residents of the community.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/08/98, Donovan Larson			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		Since the FUSRAP meeting this morning, certain residents of the neighborhood surrounding Mallinckrodt have contacted me and expressed unhappiness about their ability to comment on the SLDS FS/PP and associated decision. Perhaps an extension of the comment period would be reasonable to allow these unheard voices to be given a chance to comment.	The USACE followed applicable CERCLA guidance in notifying residents about the public meeting. We regret that not all residents received notification in time to attend the public meeting and comment on the FS/PP. However, overwhelming stakeholder response has caused USACE to reconsider selection of the preferred alternative.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/06/98, St. Louis Sites FUSRAP Oversight Committee			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		After reviewing the Feasibility Study and Proposed Plan submitted by the USACE for remediation under FUSRAP of the St. Louis Downtown Site, the St. Louis Sites FUSRAP Oversight Committee unanimously recommends that the USACE implement Alternative 6, Selective Excavation and Disposal, rather than Alternative 4 for remediation of SLDS. The SLSFOC believes that Alternative 6 is more protective of human health and will be more conducive to the continued long-term growth and operation of the Mallinckrodt St. Louis Plant.	Agree. USACE will select Alternative 6 in the Record of Decision in response to widespread community support.
2		The selection of Alternative 4 by the USACE is not consistent with the recommendations of the St. Louis Site Remediation Task Force. Alternative 6 appears to best meet the community's wishes as expressed in the SLSRTF final report submitted to DOE.	USACE believes both Alternatives 4 and 6 are consistent with the Task Force recommendations. However, Alternative 6 has been selected in response to these and other community comments.
3		It also appears that the USACE has not considered all the costs associated with implementation of Alternative 4. USACE has not included the cost of managing, excavation, handling, and disposal of near-surface soils that will be removed as a result of ongoing maintenance and/or development activities at the SLDS. Excavation of soils during maintenance and/or construction work in the 4–5 foot depths that remain under Alternative 4 could result in the unacceptable exposure of site employees or construction workers to residual radiological contamination. Additionally, the potential for adverse impacts on human health and the environment is increased as these smaller excavation projects will not be implemented as part of a single remedial effort.	These costs could not be predetermined because the volumes of these potential future excavations and the frequency of such intrusions could not be estimated with any degree of certainty. The FS does acknowledge the potential for these additional costs but does not attempt to quantify them.
4		The presence of radioactive contamination which will remain in place under USACE's Alternative 4 and resultant restrictions on development of that site will likely have a significant adverse impact on the future investments in the SLDS by Mallinckrodt. These future decisions on investments will also have an adverse economic and social affect on the community surrounding this site and the Metropolitan St. Louis area as a whole.	These effects do not fall within the evaluation criteria required by CERCLA. However, considerations of state and community points of view are required in the final remedy selection. In response to these community concerns USACE has selected Alternative 6.
5		The SLSFOC requests that the USACE revise its proposed plan to recommend the implementation of alternative 6 for remediation of the SLDS. Additionally, the SLSFOC reminds the USACE that the SLSRTF had recommended to the USDOE that the SLDS Vicinity Properties be cleaned up to standards that provide for unrestricted future use. The proposed plan should be modified to reflect the community's desire that vicinity properties, whether in North County or Downtown St. Louis, should be cleaned up to the same unrestricted standards.	The proposed plan will not be revised. The Record of Decision has selected Alternative 6 as the preferred alternative and provided reasons for changing from the Proposed Plan in the Explanation of Significant Differences Section. This section also specifies the more stringent standard for the vicinity properties.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/06/98, Nancy Weber			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		The proposed plan for the cleanup of the Mallinckrodt Plant is not consistent with the recommendations of the Remediation Task Force. The USACE has not considered all the costs associated with the implementation. Mallinckrodt is a viable and growing business in the St. Louis area and any plan that is recommended should have a positive impact on this facility and the surrounding area.	USACE has selected Alternative 6 for implementation instead of Alternative 4, which was identified as the preferred alternative in the proposed plan, due to community concerns such as are expressed by this comment.
2		Please consider alternative plans that would not have an adverse effect. The feasibility and proposed plans failed to address how the Corps or other government agencies would take responsibility for long-term management of contaminated soil which are not removed by the cleanup. Who will take future responsibility for this project?	
3		The presence of radioactive contamination which will remain in place under the recommendation will have significant impact on Mallickrodt and the surrounding areas. Please look to an alternative plan that would not have an adverse impact on this area.	

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/05/98, R.M. Wester & Associates			
Comment No.	**pp/§/¶**	**Comment**	**Response**
1		I have only recently received a fax copy of a letter dated April 8, 1998, well after the public meeting of April 21, 1998, which announces a distribution of the SLDS FS/PP via the Internet and availability of the document at several libraries for review. May I point out that none of these libraries are within easy access to those of us interested who reside in St. Charles County. I have requested a copy be sent to me via the U.S. Mail, and may I also request that I be maintained on file to receive any and all notices of meetings and document distribution in the future. I participated in all proceedings and served on subcommittees for the St. Louis Task Force for several years while the remediation programs were under the Department of Energy, and I feel that with the change in responsibility from DOE to the Corps of Engineers many of us who are interested have been lost and no longer kept abreast of your plans for remediating the various affected areas of our region.	USACE welcomes input from all interested citizens.
2		I understand that people and businesses in the region of the Downtown Site have voiced concerns about the overall approach, and that the approach in fact deviates significantly from that which was the desire of the participants of the original Task Force. If this is true, then I am very concerned because it would seem that the Corps of Engineers has taken several steps backwards. One of the last series of meetings that I attended included the presentation of a document which fully described the wishes of the local community to the responsible parties of the DOE.	We believe the approach taken at SLDS is consistent with that recommended by the Task Force.
3		It seems to me that the Corps of Engineers could begin making progress in remediating the sites much sooner, with cost-effective measures, by following the community guidance documents. After three years of tedious deliberation by the state and local governments, along with industry and affected private parties, the challenges were successfully overcome, and this document of recommendations represents the consensus of opinion which provided solutions to remediate these properties.	The alternative selected recognizes the predicted future use of the impacted properties recommended by the Task Force Report.
4		The National Research Council has recommended that the decision maker incorporate all relevant stakeholders in the decision-making process from the start. It is further recommended that an analytic-deliberative process be employed to deal with decisions that involve all stakeholders. The basic premise is that, by employing the analytic-deliberative process with the participation of the stakeholders, the decision-making process will be enhanced, and the previous failing and cause for mistrust will be overcome. This basically describes the process that the stakeholders went through to arrive at the unanimous decision for the directives issued in the report. I further recommend that the document submitted as the final report of the St. Louis Task Force be the beginning of your work, and the effort and time devoted to develop this report not be discarded or wasted.	We agree that incorporation of stakeholders needs is a relevant and necessary part of the process. On the basis of that, USACE has chosen Alternative 6 as the remedy to be implemented at SLDS.

COMMENTS AND RESPONSES ON THE FEASIBILITY STUDY AND PROPOSED PLAN FOR THE ST. LOUIS DOWNTOWN SITE ST. LOUIS, MISSOURI (May 1998) (continued)

Comments received 05/08/98 from Shannon D. Work - Givens, Funke & Work (Attorneys at Law)			
Comment No.	**pp/¶**	**Comment**	**Response**
Letter		I am Special Legal Counsel to the Spokane Tribe of Indians on various natural resource matters. You may recall that last month I submitted to you a letter similar to this concerning the St. Louis Airport Site and Hazelwood Interim Storage Site EE/CA documents. You may also recall I explained that one of the matters on which I work for the Tribe concerns an inactive uranium millsite located just off the Spokane Indian Reservation, but immediately adjacent to it and to an important Reservation waterway known as Chamokane Creek. Operated for decades by Dawn Mining Company, the millsite is known to contaminate both surface and ground waters, including waters to which the Tribe holds federally protected and adjudicated rights. See United States v. Anderson, 736 F. 2d 1358 (9th Cir. 1984). Under its off-reservation authority, the State of Washington in February 1995 licensed Dawn to convert a vast open impoundment at the site into a disposal cell for Atomic Energy Act 11e (2) byproduct material. Due to unresolved concerns for the health and safety of Reservation residents and visitors, as well as for Tribal trust resources, the Tribe has consistently opposed Dawn's waste and visitors, as well as for Tribal trust resources, the Tribe has consistently opposed Dawn's waste importation proposal. These comments are submitted on behalf of the Spokane Tribe regarding the USACE's Feasibility Study/Proposed Plan (FS/PP) Documents prepared in support of proposed actions to remove for off-site disposal radioactively contaminated soils from the St. Louis Downtown Site (SLDS). Although these documents do not appear to specifically describe the presence of 11.e(2) byproduct material, these comments are nonetheless submitted to raise issues of specific impacts to the Spokane Indian Reservation anticipated to be caused by alternatives which require off-site disposal, in the event removal of 11.e(2) byproduct material from the site is contemplated.	The USACE has not yet selected the disposal location for soils to be removed from SLDS. Only appropriately licensed or permitted facilities will be considered at the time of disposal. The disposal facility will be determined in accordance with all applicable laws and regulations including federal procurement laws and the EPA regulations on Federal use of offsite disposal facilities stated in the NCP, 40 CFR 300.440.

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ATTACHMENT A-1

MDNR Hazardous Waste Program Comments on Mallinckrodt's RCRA Facility Investigation Work Plan

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STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102-0176

May 7, 1998

CERTIFIED MAIL # Z 290 135 114
RETURN RECEIPT REQUESTED

Mr. Mark Puett
Mallinckrodt Chemical, Inc.
P.O. Box 5439
St. Louis, MO 63147

RE: RCRA Facility Investigation Work Plan, Newly-identified Solid Waste Management Units Report and Permit Appeal-related Comments for Mallinckrodt Chemical, Inc., St. Louis, Missouri, Permit #MOD096726484

Dear Mr Puett:

The Missouri Department of Natural Resources' (MDNR) Hazardous Waste Program (HWP) has completed review of the RCRA Facility Investigation (RFI) Work Plan dated January 16, 1998. The RFI Work Plan was submitted pursuant to Corrective Action Condition V. of Mallinckrodt's Missouri Hazardous Waste Management Facility Permit (hereafter referred to as the Part I Permit) dated September 19, 1997.

As you are aware, investigations performed pursuant to the RFI Work Plan must ultimately be sufficient to address the RFI objectives contained in Corrective Action Condition VI. of the Part I Permit. In general, the RFI Work Plan satisfactorily addresses the specific elements of investigation as they relate to individual Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) identified for further investigation in the Part I Permit. There are, however, a few exceptions. Comments concerning specific technical deficiencies in the RFI Work Plan and additional requirements related to the Newly-Identified SWMUs Report are provided below under the Technical Comments heading. Of greater concern is the broader conceptual approach to site investigation proposed in the RFI Work Plan. Comments concerning this approach are also provided below. Based on the HWP's review, Mallinckrodt's RFI Work Plan is hereby disapproved until all of the following RFI-related comments are satisfactorily addressed.

As part of the review of the RFI Work Plan, the HWP also reviewed Mallinckrodt's permit appeal letter of October 20, 1997, and the associated preliminary appeal resolution proposal dated January 14, 1998. The HWP felt this review was necessary inasmuch as resolution of the appeal may bear directly on the content of the RFI Work Plan. The HWP believes that the permit appeal may still be resolved via a permit modification; however, Mallinckrodt's proposed resolution must be rejected in its current form. Specific discussion of this topic can be found below under the Permit Appeal heading.

GENERAL COMMENTS

The HWP agrees that Mallinckrodt's screening evaluation may be limited to gathering only the information necessary to determine whether a release of hazardous waste and/or hazardous constituents has occurred at SWMUs 8, 14, 15, 20, and 27, and AOCs G and I. The RFI Work Plan must, however, acknowledge the need for further investigation, including a determination of the nature and extent of contamination at those SWMUs/AOCs demonstrating confirmed releases as a result of the screening evaluation. Mallinckrodt may wish to consider incorporation of a step-out contingency in the RFI Work Plan in the event that obvious contamination is identified in the field during the screening evaluation. This would provide Mallinckrodt with explicit flexibility, once the RFI Work Plan is approved, to make field decisions regarding additional investigation to determine the extent of any release(s) at the time they are discovered, thus minimizing the scope of further investigation required as part of implementation of a Phase II RFI Work Plan. The HWP encourages Mallinckrodt to consider establishing a step-out provision which relies on use of best professional judgement in the field to minimize the iterations necessary to complete all necessary site characterization. Once the RFI Work Plan is approved, the HWP must be consulted, if possible, prior to any significant deviations from the approved work plan. When contacted, the HWP will attempt to expedite any regulatory decisions at that time regarding additional field work proposed by Mallinckrodt.

Regardless of Mallinckrodt's initial investigation methodology, the HWP may determine that additional investigation is warranted based on the findings and/or quality of the data gathered during the SWMU/AOC screening evaluation. This must be acknowledged in the revised RFI Work Plan, including the specification that a Phase II RFI Work Plan and investigation performed thereunder may be required to satisfy the RFI objectives contained in Corrective Action Condition VI. of the Part I Permit.

TECHNICAL COMMENTS

Section 3.3.2, SWMU 14 and 15, page 3-4

This section indicates that in the absence of sensory evidence of contamination from the soil borings, the soil samples will be collected from a depth of five feet below ground surface at both boring locations. The HWP concurs with this approach for collecting soil samples at SWMU 14, only. Given the potential for release of contaminants at or below this depth at the SWMU 15 wastewater sump, the bottom of which is at a depth of 10 feet below ground surface, soil samples must be collected just below the level of the bottom of the wastewater sump even in the absence of sensory evidence. If evidence of a release(s) of hazardous waste or hazardous constituents is detected via field screening measurements (e.g., PID or FID readings), samples must be collected for laboratory analysis to confirm/deny the presence of a release. If the laboratory analyses confirm a release at any of the SWMUs/AOCs, additional soil and/or groundwater sampling will be required to define the vertical and horizontal extent of such contamination. As indicated above, Mallinckrodt may want to consider modifying the RFI Work Plan to specify a field contingency for further sampling in the event that obvious contamination is identified during the screening evaluation. The RFI Work Plan must, in any case, be revised to acknowledge the need for further investigation if a release(s) is discovered at the referenced SWMUs/AOCs.

Section 3.5, Data Evaluation Protocol, page 3-8

The last two sentences of this section propose an approach for identifying areas requiring further action by comparing analytical results to site-specific industrial risk-based screening levels without identifying those levels and explaining where such levels came from or how they will be derived. It matters not, as Mallinckrodt cannot predicate completion of site characterization on industrial risk-based screening levels. Characterization using such criteria will not meet the RFI objectives contained in Corrective Action Condition VI. of the Part I Permit.

During the corrective action investigation process, risk-based "point of departure" concentrations (e.g., EPA Region III risk-based concentrations, Missouri Department of Health's proposed Any-use Soil Levels (ASLs), Proposed Subpart S Action Levels, Superfund Soil Screening Levels (SSLs)) may have utility in defining contamination "hot-spots," indicating the need for immediate stabilization or interim measures, triggering further investigation efforts and/or suggesting the need for a Corrective Measures Study (CMS). These "point of departure" concentrations should not, however, be misconstrued as contamination extent investigation criteria or default clean-up levels. If Mallinckrodt desires to clean-up to industrial levels, justification in the

form of a site-specific risk assessment will be required to ensure protection of human health and the environment. This assessment must consider and address, among other things, the nature, extent and migration potential of any released contaminants; current and future land use; plausible contaminant exposure routes, exposure scenarios and contaminant receptors; potential off-site impacts; and long-term institutional and/or engineering controls. Hence, any site-specific risk assessment will have to be based on characterization of contaminant releases to levels which are sufficient to address these issues.

As indicated above, the HWP agrees that potentially applicable "point of departure" contaminant concentrations must be considered within the context of site characterization, but not in the manner described by Mallinckrodt. In the HWP's experience, site-specific risk assessments are often initiated during the RFI; however, the information necessary to identify actual/potential exposure pathways, concentrations and receptors is often not available until the RFI is complete or nearly so. The appropriate time to comprehensively address clean-up levels, which can be based on a site-specific risk assessment, is during the evaluation of corrective measures alternatives as part of the CMS. In order for this evaluation to be valid, the site has to have been adequately characterized as to the extent of contamination, thereby enabling identification of actual/potential contaminant exposure pathways, concentrations and receptors.

Section 3.3.6 AOC I, page 3-6

This section indicates that the Department of Energy/U.S. Army Corps of Engineers (DOE/USACE) has investigated groundwater at the facility pursuant to their FUSRAP obligations and that the need for groundwater corrective action measures at the facility will also be evaluated under FUSRAP. As discussed previously with Mallinckrodt and as referenced in other sections of this letter, the HWP is willing to accept DOE's/USACE's groundwater-related data in partial satisfaction of the corrective action requirements of the Part I Permit. It is Mallinckrodt's responsibility to ensure that this data is integrated into the RFI Report. Mere reference to this information is unacceptable. Mallinckrodt should also recognize that DOE's/USACE's groundwater-related data, while helpful, is not expected by itself to sufficiently address the RFI objectives of Corrective Action Condition VI. of the Part I Permit.

The HWP expects Mallinckrodt to take an active role in investigating the extent of groundwater contamination at the facility outside of the FUSRAP areas (including off-site if necessary). The HWP also expects Mallinckrodt to take an active role in investigating the extent of groundwater contamination within the FUSRAP areas to the extent that chemical or radiological contamination is present which cannot be attributed to DOE's historical activities and for which DOE/USACE ultimately assumes no responsibility.

At this point, it is unclear what the division of responsibility is or will be between Mallinckrodt and DOE/USACE for chemical and/or radiological contamination of groundwater both inside and outside the FUSRAP areas. Based on review of DOE's/USACE's preliminary Summary and Analysis of the 1997-1998 Baseline Groundwater Sampling Data for the St. Louis Downtown Site dated March 1998, it is evident that substantial releases of chemical and radiological contaminants to groundwater have occurred at the facility. It is also evident that additional investigation is warranted to characterize these releases and determine whether or not they pose an actual or potential threat to human health or the environment. The RFI Work Plan must acknowledge that the groundwater-related information generated by DOE/USACE as a function of their FUSRAP obligations may be insufficient to assess the presence/ absence and extent of release(s) of hazardous waste and hazardous constituents to the groundwater across the entire site. This information, at least with respect to the latest assessment, is limited to the FUSRAP areas. Again, this information may be used by Mallinckrodt for site characterization purposes and to focus any additional groundwater investigations consistent with Corrective Action Condition V.D. of the Part I Permit.

Based on review of the above-referenced DOE/USACE Summary Groundwater Report and considering the basic conceptual model of groundwater flow in similar alluvial systems, it appears that further investigation of the extent of groundwater contamination, both inside and outside of the FUSRAP areas, will be required. Inasmuch as the division of responsibility between Mallinckrodt and DOE/USACE for such investigation has not yet been fixed, the HWP is willing to defer Mallinckrodt's active investigation of the groundwater to Phase II of the RFI. The HWP would prefer that Mallinckrodt take an active role in groundwater investigation at this time including reconciliation of the division of responsibility with DOE/USACE leading to incorporation of provisions for such investigation in the revised RFI Work Plan. Mallinckrodt is advised that submission and implementation of a Phase II RFI Work Plan is a virtual certainty to the extent that Mallinckrodt chooses not to incorporate groundwater investigation provisions for non-FUSRAP areas into the revised RFI Work Plan.

To the extent that active groundwater investigation is proposed in the revised RFI Work Plan, the Health and Safety Plan contained in Volume III of the original RFI Work Plan must be revised to ensure that groundwater-related RFI activities including, but not limited to, monitoring well installation, development and sampling are conducted in a manner that is protective of human health and the environment.

Section 2.6, Potential exposure pathways and receptors, page 2-6

This section indicates that potential exposure pathways are incomplete because the ground surface at the facility is almost entirely covered by pavement/buildings and the industrialized setting does not provide habitat for living species. It would be much more appropriate to state that **exposure pathways are potentially incomplete** versus **potential exposure pathways are incomplete**. There is no technical foundation or substantive basis for the latter statement. Adequate site investigation, including determination of the nature, extent and rate of migration of released contaminants, is necessary to support any speculation that potential exposure pathways are incomplete. This is an integral part of any effort directed towards site-specific risk assessment to establish clean-up levels which are protective of human health and the environment. The HWP is aware of and has reviewed information regarding other sites in the St. Louis downtown area which, despite paving of the facility and current lack of groundwater use for drinking purposes, demonstrate significant potential for exposure to contaminants in soil and groundwater via plausible exposure pathways (e.g., subsurface utility excavations, contaminated groundwater and vapor seepage into sewers/subgrade structures and operation/maintenance of sewer pump stations and associated dewatering wells).

The HWP acknowledges that the Mallinckrodt facility is located in downtown St. Louis in an area that has been heavily industrialized for more than a century and as such is not in an environmentally "pristine" condition by any definition. Simply determining what a "naturally-occurring" condition is would be extremely difficult. However, to the extent that any release of hazardous waste and/or hazardous constituents poses an actual or potential threat to human health or the environment, it must be addressed by Mallinckrodt.

With respect to groundwater at the facility, Mallinckrodt is located on the Mississippi River floodplain. The facility is underlain by a major groundwater aquifer that extends from the northern reaches of the Mississippi River to the Gulf of Mexico. This aquifer supplies groundwater for private, public, and commercial uses throughout most of its extent. The HWP recognizes that the Mississippi River alluvial aquifer in the general vicinity of the facility is not currently used for public water supply. However, the potential for future use cannot be discounted. The quantity and general quality of the water in this aquifer is adequate and suitable for many uses. Protection of the aquifer is reasonable and must be considered given the volume and reliability of the water present. The HWP recognizes that treatment of water obtained from this alluvial aquifer may be necessary prior to consumption or other use. The extent of treatment required may be impacted by man-made influences on the aquifer. However, the fact that treatment may be necessary or that man-made impacts may have influenced the

aquifer does not justify ignoring contamination risks that would or could cause degradation of water quality beyond reasonable limits for standard treatment by a user. All investigations and corrective measures at the facility must include efforts to identify and mitigate, to the extent required for human health and environmental protection, contaminants released to the groundwater including consideration of the alluvial aquifer as a usable water supply.

Although groundwater may not be currently used as a source of drinking water, its potential use as a potable or industrial water source must be considered. The quantity of groundwater needed for public or industrial water supply is available in the alluvium at the facility. The alluvial groundwater may not be potable, but potential exposure to contaminated groundwater or contamination derived therefrom is still a real possibility. Mallinckrodt must demonstrate, through site-specific investigation, risk assessment, corrective measures and/or implementation of institutional/engineering controls, that the groundwater pathway is incomplete, the risks to human and environmental receptors are insignificant and/or that implementation of corrective measures will mitigate any significant human health and/or environmental risks that are identified.

Mallinckrodt's Assessment Report for Newly-Identified SWMUs at the Mallinckrodt St. Louis Facility dated January 20, 1998, confirms a release(s) of hazardous waste including hazardous constituents (i.e., volatile and semi-volatile organic compounds and metals) to the environment at the former tank car unloading area east of Building 63 (newly-identified SWMU 41). This confirmation is based on voluntary investigation conducted by Mallinckrodt in 1996. The HWP has determined that further investigation is warranted to define the nature and extent of releases at SWMU 41. The RFI Work Plan shall, therefore, be revised to address the nature and scope of investigation at SWMU 41.

PERMIT APPEAL

As to the language originally proposed in Mallinckrodt's October 20, 1997, appeal letter to resolve the issue of Mallinckrodt's versus DOE's (now including the USACE's) remediation responsibilities, this language is rejected, primarily due to use of the term "completion." Mallinckrodt would become responsible only "after completion by DOE of all remediation activities." There are no criteria to define what constitutes "completion," thus rendering this term highly subjective. There is also no discussion or acknowledgment of who would determine "completion" or how such a determination would be memorialized.

As to Mallinckrodt's appeal resolution follow-up letter of January 18, 1998, the flow chart attached to this letter does not accurately represent the HWP's vision of the corrective action process at the facility (refer to site characterization discussion under General

Comments above). Specifically, final corrective action chemical and/or radiological clean-up standards for contaminated environmental media cannot be established prior to addressing the RFI objectives (including characterization of the nature, extent, and rate of contaminant migration) contained in Corrective Action Condition VI. of the Part I Permit. During the corrective action investigation process, risk-based "point of departure" concentrations may be useful as discussed above, but should not be misconstrued as contamination extent investigation criteria or default clean-up levels. Again, if Mallinckrodt desires to clean-up to industrial levels, justification in the form of a site-specific risk assessment will be required to ensure protection of human health and the environment. This assessment must consider all relevant factors, including those outlined above.

In addition to the foregoing clean-up standards issue, the flow chart has a decision item entitled "Was there a SWMU in this area historically?" Whether there was or was not a SWMU in the area addressed by DOE/USACE is largely irrelevant from a corrective action standpoint. The Part I Permit can and does require corrective action for both SWMUs and AOCs. If a release of hazardous waste or hazardous constituents is evident, it does not matter where it came from, if such a release poses an actual or potential threat to human health or the environment.

The Permits Section understands that discussions are ongoing as to what, if any, responsibility DOE/USACE will have for sampling, analysis and/or remediation of chemical versus radiological contamination of environmental media in the FUSRAP areas. Conversely, the Permits Section understands that discussions are ongoing as to what, if any, responsibility Mallinckrodt will have for sampling, analysis and/or remediation of radiological versus chemical contamination in environmental media in the non-FUSRAP areas. Ultimately, it appears to be in Mallinckrodt's best interest to communicate with DOE/USACE to work these issues out since Mallinckrodt is liable pursuant to the Part I Permit for investigation and/or remediation of any and all releases of hazardous waste and hazardous constituents at the facility, including any which may have migrated off-site. It is Mallinckrodt's and DOE's/USACE's responsibility to discuss and come to terms as to which entity will take responsibility for chemical and/or radiological contamination in specific areas. This includes defining the transition point for these responsibilities. MDNR is not responsible for defining these responsibilities nor does MDNR anticipate being the mediator or arbitrator of any disputes between Mallinckrodt and DOE/USACE in this regard.

As stated herein and in past correspondence, MDNR agrees that there should be minimal, if any, duplicative regulatory effort in investigating and remediating the FUSRAP areas. MDNR reiterates its intention to allow DOE/USACE to discharge its investigation and remediation obligations as fully as possible pursuant to the FFA prior to requiring any additional corrective action by Mallinckrodt. However, MDNR retains

the ability under the Part I Permit to require Mallinckrodt to perform additional corrective action in the FUSRAP areas at any time for releases of hazardous waste and/or hazardous constituents as necessary to protect human health and the environment. MDNR would have no compelling reason for triggering such action on the part of Mallinckrodt as long as the DOE/USACE effort is sufficient to address substantive corrective action requirements and the investigation/remediation process under the FFA proceeds in a timely manner. MDNR cannot stress strongly enough that Mallinckrodt and DOE/USACE must communicate and work closely to develop criteria for the transition of environmental responsibilities in the FUSRAP areas and outside of those areas to the extent that contaminant migration has occurred which could be the responsibility of DOE/USACE.

In order to address the concerns expressed by Mallinckrodt in the Part I Permit appeal and to try and avoid regulatory gridlock, the MDNR hereby proposes modifying paragraph C. under Corrective Action Condition I. of the Part I Permit as follows:

> "The Permittee shall be responsible for working with the Department of Energy (DOE) and/or the U.S. Army Corps of Engineers (USACE) to define the environmental responsibilities of each agency at the facility including development of site investigation and remediation criteria. The Permittee shall be responsible for performing any necessary corrective action for any releases of hazardous waste, including hazardous constituents, to the environment attributable to SWMUs or AOCs at the facility which are not explicitly determined to be the responsibility of DOE/USACE pursuant to the Federal Facilities Agreement (FFA) between DOE and EPA dated June 26, 1990."
>
> "Further, the Department acknowledges that there should be minimal, if any, duplicative regulatory effort in investigating and remediating the FUSRAP areas. The Department intends to allow DOE/USACE to discharge its investigation and remediation obligations as fully as possible pursuant to the FFA prior to requiring any additional corrective action in the FUSRAP areas by Mallinckrodt. The Department would have no compelling reason for triggering early action in the FUSRAP areas on the part of Mallinckrodt as long as the DOE/USACE effort is sufficient to address substantive corrective action requirements and the investigation/remediation process under the FFA proceeds in a timely manner."

In closing, Mallinckrodt is hereby directed to submit a revised RFI Work Plan within 45 days of receipt of this letter to address the foregoing comments MDNR also requests that Mallinckrodt respond to the MDNR's modified permit language proposal within this time frame. If you have any questions concerning this letter, the appropriate response or wish to schedule a meeting to discuss the issues identified herein, please do not hesitate to contact Richard A. Nussbaum, P.E , R.G., or Fuad Marmash, of my staff, at (573) 751-3553.

Sincerely,

HAZARDOUS WASTE PROGRAM

Cindy Kemper
Director

CK:rnw

c: Ms. Shelley Woods, Attorney General's Office
Mr. Bob Geller, HWP-Federal Facilities
Mr. Scott Honig, HWP-Federal Facilities
Mr. Steve Poplawski, Bryan Cave
Ms. Mimi Garstang, MDNR-Division of Geology & Land Survey
Mr. Joe Gillman, MDNR-Division of Geology & Land Survey
Mr. Bob Boland, Mallinckrodt
Dr. Rob Mullins, USACE
Mr. Dan Wall, U.S. EPA Region VII

ATTACHMENT A-2

Comments from the Spokane Tribe Relating to Offsite Disposal of Contamination at the Dawn Mining Facility

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May 8, 1998

Dr. R.L. Mullins, Jr., PE, AICP
U.S. Army Corps of Engineers
St. Louis District
9170 Latty Avenue
Berkeley, MO 63134

Re: St. Louis Downtown Site Feasibility Study/Proposed Plan

Dear Dr. Mullins:

I am Special Legal Counsel to the Spokane Tribe of Indians on various natural resource matters. You may recall that last month I submitted to you a letter similar to this concerning the St. Louis Airport Site and Hazelwood Interim Storage Site EE/CA documents. You may also recall I explained that one of the matters on which I work for the Tribe concerns an inactive uranium millsite located just off the Spokane Indian Reservation, but immediately adjacent to it and to an important Reservation waterway known as Chamokane Creek. Operated for decades by Dawn Mining Company, the millsite is known to contaminate both surface and ground waters, including waters to which the Tribe holds federally protected and adjudicated rights. See *United States v. Anderson*, 736 F.2d 1358 (9th Cir. 1984). Under its off-reservation authority, the State of Washington in February 1995 licensed Dawn to convert a vast open impoundment at the site into a disposal cell for Atomic Energy Act 11.e(2) byproduct material. Due to unresolved concerns for the health and safety of Reservation residents and visitors, as well as for Tribal trust resources, the Tribe has consistently opposed Dawn's waste importation proposal.

These comments are submitted on behalf of the Spokane Tribe regarding the USACE's Feasibility Study/Proposed Plan (FS/PP) documents prepared in support of proposed actions to remove for off-site disposal radioactively contaminated soils from the St. Louis Downtown Site (SLDS). Although these documents do not appear to specifically describe the presence of 11.e(2) byproduct material, these comments are nonetheless submitted to raise issues of specific impacts to the Spokane Indian Reservation anticipated to be caused by alternatives which require off-site disposal, in the event removal of 11.e(2) byproduct material from the site is contemplated.

INTRODUCTION

An Executive Memorandum issued by President Clinton on April 29, 1994 implements four key guiding principles for federal actions affecting Indian tribes and tribal trust resources:

1) federal departments and agencies are to "operate[] within a government-to-government relationship with federally recognized tribal governments,"

2) federal departments and agencies "shall consult . . . with tribal governments prior to taking actions that affect federally recognized tribal governments,"

3) federal departments and agencies "shall assess the impact of Federal Government plans, projects, programs, and activities on tribal trust resources and assure that tribal government rights and concerns are considered during the development of such plans, projects, programs, and activities," and

4) federal departments and agencies "shall take appropriate steps to remove any procedural impediments to working directly and effectively with tribal governments on activities that affect the trust property and/or governmental rights of the tribes."

Presidential Memorandum, 59 Fed. Reg. 22951 (1994), *reprinted in* 25 USCA § 450 note. If disposal of 11.e(2) byproduct material from the SLDS at Dawn's site next to the Spokane Reservation is even a remote possibility, these principles have not been realized.

If such materials might be removed from the SLDS, the FS/PP documents are deficient because they do not discuss impacts specific to disposal at facilities licensed to receive such materials, particularly where tribes and their resources might be negatively impacted. At present, there are only three facilities in the United States licensed to receive 11.e(2) material for disposal: one was licensed in New Mexico last year by the Nuclear Regulatory Commission, another is located in Utah, and the third is Dawn's facility next to the Spokane Indian Reservation. To the Tribe's knowledge, the licenses at the Utah and New Mexico facilities are presently not under legal challenges, but Dawn's license is. Conceivably, however, administration of federal procurement and contracting laws may lead to an agreement by USACE to dispose 11.e(2) material at the Dawn facility despite the questionable legal status of the license.

RISK TO TRIBAL TRUST RESOURCES AND HUMAN HEALTH

The Tribe questions whether the SLDS and FS/PP alternatives contemplating off-site disposal can be found to be protective of human health and welfare and the environment when the potential impacts at the disposal end of the proposal are only briefly discussed. The Tribe is heavily dependent on the ground and surface waters of the Chamokane Creek Basin. See *United States v. Anderson*. In addition to supporting Reservation fish and wildlife, uses of this basin's waters include domestic, ranching, farming, and a Tribal fish hatchery. At present, the Dawn site is known to contaminate Chamokane Creek's surface water and an upper aquifer at the site. Tribal technical staff have determined it likely that the site also contaminates a deep aquifer from which drinking water is drawn. Further, the High Density Polyethylene liner in Dawn's disposal cell is only 30 mil, and is over 16 years old. The manufacturer's warranty for the liner expired more than one year ago. Similar concerns regarding this disposal cell's integrity have been raised by Department of Energy technical staff who should be consulted by USACE before determining to send any FUSRAP waste to eastern Washington. Beyond this, it is imperative that the Tribe be consulted with concerning any possible federal action which might threaten its Reservation, and that such consultation be conducted sufficiently early in the process that it will have a meaningful effect on the outcome. See *U.S. Army Corps of Engineers Tribal Policy Principles* (identifying as key principles Tribal Sovereignty, Trust Responsibility, Government to Government Relations, Pre-Decisional and Honest Consultation, Self-Reliance, and Natural and Cultural Resources).

In evaluating impacts related to the proposed removals, the FS/PP documents, in typical fashion, focus on the subject FUSRAP site under the rationale that "[t]he application of specific environmental regulations to activities being considered for off-site disposal facilities, such as disposal of waste at a commercial disposal facility, would be addressed by the respective owners/operators in the environmental compliance documents and activities for those facilities." Similarly, the Feasibility Study also states that "[e]xisting regulations for operation of disposal facilities would be protective of groundwater and surface water at the disposal facility." Such statements lead to the general conclusion that the off-site disposal alternatives are considered protective of human health. As discussed above, however, this conclusion when applied to Dawn's facility is highly suspect from a technical standpoint. Moreover, from a federal Indian policy standpoint, it is wholly unsupported since no effort has been made by USACE to "assess the impact of Federal Government plans, projects, programs, and activities on tribal trust resources and assure that tribal government rights and concerns are considered during the development of such plans, projects, programs and activities." See Presidential Memorandum dated April 29, 1994. See also, Civil Rights Act

of 1964, Title VI (42 USCA 2000d, et seq.) and related regulations. The reason the principles in the Presidential Memorandum exist is the federal trust responsibility to tribes and their resources, developed through more than 150 years of jurisprudence. States such as Washington have no such responsibility, and indeed throughout history have routinely taken strongly adverse positions to tribes as sovereigns. In fact, this responsibility can be neither delegated to states nor abdicated by the federal government. *Assiniboine and Sioux Tribes v. Bd. of Oil and Gas*, 792 F.2d 782 (9th Cir. 1986). Thus, when disposal of federal waste is considered for a state-licensed site like Dawn's it is incumbent upon the responsible federal agency as trustee to ensure no injury to affected tribes and their resources. While off-site disposal impacts are often not considered in environmental reviews for reclamation, they must be where federal trust duties have not been addressed in the process of licensing the disposal facility. And this must be accomplished before the federal action has proceeded down a path where federal procurement and contracting laws render it irreversible.

If Dawn's facility is a potential disposal site, the Spokane Tribe's "rights and concerns" must yet be considered. In the context of trust resources, those "rights and concerns" include the following. What are the impacts the DMC site and the additional FUSRAP waste will have on Reservation resources? Will the quality or quantity of these waters be impacted in any way by the proposed alternative? What impacts will result to Reservation fish and wildlife? To cultural resources? What socio-economic impacts will be felt by the Spokane Tribe due to the importation of radioactive waste for disposal next to its Reservation and adjacent to critical waters? What are the likely human health impacts if the FUSRAP waste in Dawn's impoundment contaminates the deep aquifer? What will be required as mitigation should this occur? Shouldn't the condition and integrity of the specific disposal cell at the facility be taken into account in order to complete this analysis? Have there been irreversible and irretrievable commitments of Tribal resources? How would a Tribal natural resource damage action under CERCLA for harm to Reservation resources affect the cost analyses contained in the SLDS and FS/PP documents? Does the federal government's trust responsibility over Tribal trust resources permit the disposal of FUSRAP materials at Dawn's site? These questions must be answered and a more meaningful opportunity for Tribal consultation presented before USACE commits to a course which may lead to further injury of Tribal trust resources.

TRAFFIC SAFETY RISKS TO TRIBE

The route selected by Dawn to transport its waste includes a narrow, winding and hilly highway which serves as the primary route for Tribal members and employees travelling to and from the Spokane Indian Reservation. The Tribe presently is contesting selection of this route, and has submitted to the State of Washington the enclosed document entitled "Traffic Safety Study, State Route 231, Reardan to Ford, Dawn Mining Mill Site Closure Proposal," which are formal comments prepared by a Tribal traffic safety consultant on a State conducted study, and which are to be considered as additional Tribal comments regarding the proposed actions at SLDS.

In general, the issues of trust responsibility raised in the above section concerning threats to human health and natural resources apply equally to the traffic threats Dawn's plan poses to Tribal membership. Although traffic and transportation impacts are considered in the FS/PP documents, the guiding principles of the 1994 Executive Memorandum are not satisfied. The Tribe must be consulted with on a government-to-government basis and impacts to the Tribe must be assessed prior to implementation of the plan.

In assessing these impacts, the following must be considered. According to Washington data, nearly one-half of the accidents studied along Dawn's route result in death or injury. Dawn's proposal will increase large truck traffic on State Route 231 by 400% to 600%. Large trucks, during the period in which the State's studies provide such statistics, represented nearly one-sixth of the accidents in this corridor. A particularly winding stretch of this route is in a canyon adjacent to a stream which flows onto the Spokane reservation, and represents an area in which nearly one-fourth of the accidents studied along Dawn's preferred route occurred. Spills of radioactive waste from accidents in either this canyon or at a dangerous bridge which crosses the Spokane River will result in contamination of critical Tribal waters and other resources. The terse statement in the FS/PP that "[a]dverse effects on surface water and groundwater related to transportation are unlikely except in the event of an accident" are far from satisfying. Beyond an assessment of these issues, the Tribe, consistent with the Presidential Memorandum and the United States' trust responsibility, is entitled to consultation.

THE PROPOSED ACTIONS AT SLAPS AND HISS RAISE ISSUES OF ENVIRONMENTAL JUSTICE

The need to examine the disposal end of the proposed actions at SLDS is important, not just to satisfy the guiding principles of the 1994 Presidential Memorandum, but also to satisfy the mandate of Executive Order 12898, dated February 11, 1994 (59 Fed. Reg. 7629 (1994), 60 Fed. Reg. 6381 (1995), *reprinted in* 42 USCA § 4321 note) and Title VI of the 1964 Civil Rights Act. The executive order requires agencies of the executive department to act consistent with the principle of environmental justice and the Civil Rights Act bars discrimination in federal programs and activities affecting human health and the environment. In other words, federal agencies must consider and address the disproportionate impact their actions have on minority and low income populations. Clearly, all impacts to the Spokane Tribe and its Reservation discussed above fall within this mandate. Federal agencies cannot escape applying this analysis to the disposal end of remediation actions where, as here, the licensing entity is not required to conduct a similar analysis. In this regard, environmental justice principles associated with the SLDS proposed plan — as it relates to Dawn's facility — must be satisfied in addition to meeting the government's trust obligations to the Spokane.

CONCLUSION

The Spokane Tribe appreciates the opportunity to submit these comments and the attached comments to the USACE. Please advise at the earliest opportunity whether the consultation sought in these comments can be arranged. Also, please keep me advised as to future developments on this and other FUSRAP projects which might affect my client's interests.

Sincerely,

SHANNON D. WORK
Attorney at Law

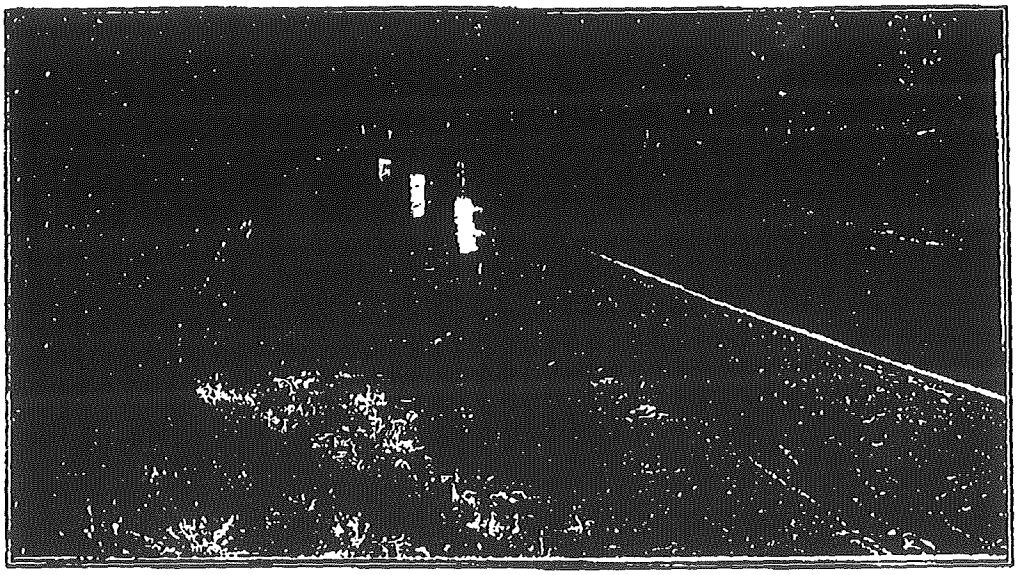
SDW.slr
enclosure

Traffic Safety Study

State Route 231

Reardan to Ford

Dawn Mining Mill Site Closure Proposal



January 1998

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Purpose of Report

In May of 1997, the Eastern Region of the Washington State Department of Transportation (WSDOT) completed a safety study entitled "SR 231 - Safety Study for the Closure of the Dawn Mining Mill Site". This study analyzed a number of roadway safety related items on SR 231 between the town of Reardan, WA and the access road to the Dawn Mining Company site just south of Ford, WA. Upon my review of this study I have found that although most roadway safety topics have been analyzed and discussed, the study basically serves as an analysis of existing conditions. The safety related impacts to SR 231 in view of the transport of hazardous and/or radioactive material with large, 5 axle vehicles on a consistent daily schedule for a long time period are not specifically discussed.

Enclosed in this report you will find my analysis and professional opinions specifically related to the transport of hazardous materials with large trucks on this section of SR 231. This analysis will be made with the existing roadway conditions as the foundation and the Dawn Mining Company (DMC) proposal built upon this foundation to give a better picture of the possible impacts to the safety of persons and the environment if DMC's proposal occurs.

Traffic Conditions - Existing and Proposed

This portion of the SR 231 corridor is the primary commuter route for Spokane Indian Reservation residents and Tribal employees traveling to and from the Spokane Indian Reservation. The SR 231 corridor is a rural two lane highway with reported 1996 traffic volumes of 1400 Average Daily Traffic (ADT) with 13.5% trucks just north of Reardan, 900 ADT with 11.6% trucks just south of the junction with SR 291, and 1100 ADT with 14.9% trucks just south of Ford. WSDOT reports that at the time of these counts (July 1996), approximately 1.4% of the total ADT consisted of large trucks, with large trucks defined as those having 5 axles or a length of at least 55 feet. Annual traffic growth rates of 4% to 5% are reported.

The current DMC proposal to import contaminated waste to its facility specifies 38 round trips per day, or an addition of 76 vehicles per day to the existing ADT. Table 1 outlines the impact to existing traffic conditions for total vehicle traffic, general truck traffic, and large truck traffic (5 axle or >55' in length) at the three locations on SR 231 where counts were taken in July of 1996. This table provides a framework for evaluating the increase in traffic safety concerns due to the DMC proposal. A traffic growth rate of 5% is used and 1999 is assumed to be the year contaminated material begins being imported to the DMC site.

Again, the assumptions made for Table 1 include an annual traffic growth rate of 5%, that the percentage of trucks in the traffic stream prior to the hauling of contaminated material to the DMC site remains constant, that the DMC proposal is implemented in 1999, and that large

trucks (5 axle or >55' length) are used to transport the contaminated material. All these assumptions are reasonable based on available information.

As seen in Table 1, overall traffic growth from 1996 to 1999 is a significant but modest 16%. The largest changes to the traffic stream due to the implementation of the DMC proposal involve trucks. The percentage increase in overall truck traffic ranges from 55% just north of Reardan to 86% just south of the SR 291 junction.

Table 1 - 1996 vs 1999 Average Daily Traffic, Average Daily Trucks, and Average Daily Large Trucks (5 axle or >55' length)

	SR 231 north of Reardan	SR 231 south of SR 291 Jct	SR 231 south of DMC access road
1996 ADT	1419	909	1130
1999 ADT	1643	1052	1308
% increase	16%	16%	16%
1996 Trucks	192	105	168
1999 Trucks	298	198	271
% increase	55%	86%	61%
1996 Large Trucks	20	13	15
1999 Large Trucks	99	91	93
% increase	395%	600%	520%

The percentage increase in large trucks is most significant and alarming. As seen in Table 1, the percentage increase in large trucks ranges from 395% just north of Reardan to 600% just south of the junction with SR 291.

The increase in regular and large truck traffic as outlined in Table 1 will serve as the basis for my analysis of roadway safety concerns based on the DMC proposal. It should be noted that the Dawn Mining Company estimates that approximately 25 million cubic feet of material will be hauled at 500 cubic feet per load. They state that this calls for 38 one way trips per day (76 two way trips), 260 days per year for five years. During recent safety mitigation discussions, Dawn Mining Company has stated a willingness to suspend hauling during times school buses pick up and drop off school children along SR 231. They further stated a willingness to suspend hauling during periods of poor weather and road conditions. If these mitigative

measures are invoked, it seems likely that the estimated number of trips per day would have to increase in order to end operations in five years, or if daily trips remain constant, hauling could extend into the sixth or seventh year. Either scenario would increase negative impacts.

Existing Lane and Overall Pavement Widths

The WSDOT safety study states that SR 231 "generally has adequate alignment with one, 11 foot lane in each direction and shoulders ranging from 2 to 4 foot in width". The surfacing requirements of the shoulder are not mentioned.

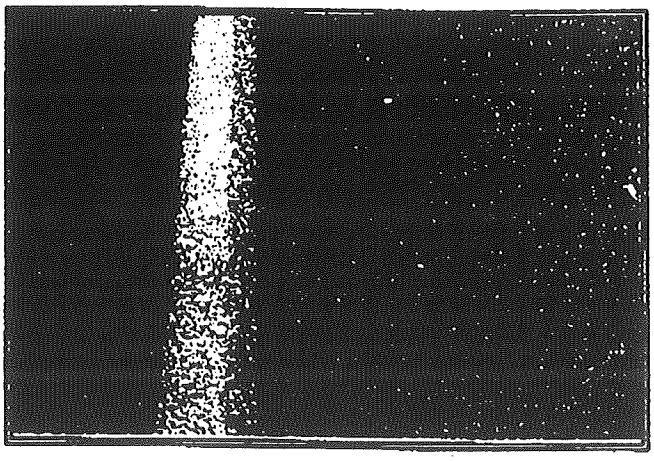

Figure 1 - Typical shoulder within SR 231 corridor

Any improvements made to the existing roadway would require an upgrade of existing lane and shoulder widths to a minimum of 12 foot and 3 foot, respectively (this assumes > 1000 ADT and > 10% trucks, both reasonable assumptions). The existing lane and shoulder widths do not meet those required of today's roadway project design standards. In other words, the increased lane and shoulder widths would be required of any roadway safety or capacity improvement projects as outlined in the Modified Design Standard requirements.

I am concerned about these lane and shoulder width issues with respect to the huge increase in large trucks proposed by the DMC. What concerns me more is that I disagree with the existing lane and shoulder width measurements reported in the WSDOT study. Table 2 below shows lane and shoulder width measurements taken at a number of locations within the corridor. It should be noted that in my opinion, the shoulders in this corridor need to be paved in order to be considered a shoulder due to the generally soft, sandy material found beyond the

edge of the pavement. Lane widths reported below are measured from the center of the centerline stripe to the center of the fogline, and shoulder widths are measured from the center of the fogline to the edge of the pavement. What is often overlooked is that effective lane widths are taken from the inside of the centerline stripe to the inside to the fogline, thus these effective lane widths are approximately 0.25 feet to 0.75 feet less than those shown in Table 2.

Table 2 - Existing lane and shoulder widths at selected locations

Location	Lane Width (ft)	Shoulder Width (ft)	Overall Pvmt Width (ft)
MP 34.4	10.75	1.25	24
MP 35.5	10.25	1.75	24
MP 36.7	10.5	2.5	26
MP 38.8	10.25	2.75	26
MP 40.7	10.25	1.75	24
MP 43.8	10.25	1.75	24
MP 44.7 (Spokane River Br.)	10.5	1.5	24
MP 46.4	10.25	1.25	23

As seen in Table 2, typical lane widths for the corridor are just over 10 feet, and typical shoulder widths are under 2 feet. Overall pavement width is typically 24 feet. These widths differ significantly from those reported by WSDOT, and differ even more from those required by the Modified Design Standard.

These travel lane and shoulder widths are of concern considering the proposed increase in large trucks by the DMC. Large trucks have difficulty remaining in their travel lane on straight sections of highway at these lane widths. In horizontal curves, particularly in those of 900 foot radius or less, it is unreasonable to expect that large trucks will always remain within their lane with these typical lane widths. The proposed increase in large trucks will negatively impact motorists who meet such trucks at highway speeds. In addition, the likelihood that two trucks will meet on a horizontal curve will significantly increase with the DMC proposal. This concern will be discussed in more detail in the next section.

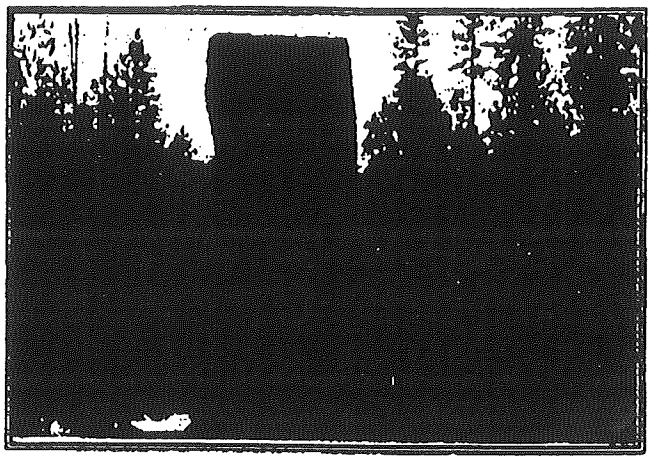

Figure 2 - Typical lane width

Horizontal Curves and Off-tracking

There are a number of horizontal curves of note within the corridor. Particularly noteworthy are horizontal curves of less than 900 foot radius. Horizontal curves with short radii present tracking concerns for large trucks on roadways with narrow lane and overall pavement widths such as SR 231. Due to the greater width and length of large vehicles, the wheel path can be wider than the lane of travel within the horizontal curve due to the rear wheels of the large vehicle tracking inside the front wheels. This is referred to as off-tracking.

The off-tracking phenomenon in curves with narrow roadway width conditions can cause the large vehicle to cross the centerline when negotiating the horizontal curve. This concern is often compounded by the fact that the forward sight line between the large vehicle and a vehicle approaching in the opposite direction is often limited by the horizontal curve itself.

I believe that off-tracking is of significant concern in this corridor, particularly if the current DMC proposal is implemented. Six main factors constitute the majority of my concern:

1) Overall lane and pavement widths are too narrow at certain horizontal curves within this corridor which will often result in large trucks off-tracking within these curves.

2) Sight distance is limited at certain horizontal curves, giving motorists less time to react to an approaching large vehicle that has crossed the centerline due to 1 above.

3) If the DMC proposal is implemented, there will be a 395% to 600% increase in large vehicles on SR 231, resulting in many more instances where large vehicles could cross the centerline at certain horizontal curves, particularly those listed in Table 3.

4) If the DMC proposal is implemented, there will be many more occurrences of two large vehicles approaching from opposite directions meeting within the smaller radius horizontal curve. Also of significant note is the increase in chance of a large vehicle and a school bus meeting per above, because it is unclear whether the DMC would cease operations only during normal morning and afternoon bus transport times or during all times of school bus operations (extracurricular).

5) There will be a significant increase in the chance that two large vehicles will meet while a pedestrian is standing or walking along the roadway or a cyclists is riding along the roadway if the DMC proposal is implemented. Should this happen in a roadway section with a steep embankment or guardrail, there could be no place for a pedestrian or cyclist to shy away from the roadway edge.

6) The huge increase in large vehicles will cause a proportionate increase in off-tracking in the small radius horizontal curves. This in turn will likely break down the shoulder areas adding to maintenance and safety concerns. The existing shoulders are typically narrow and soft beyond the pavement edge. If the shoulders lose width due to off-tracking, the concerns in the small radius curves will increase as the overall pavement width decreases.

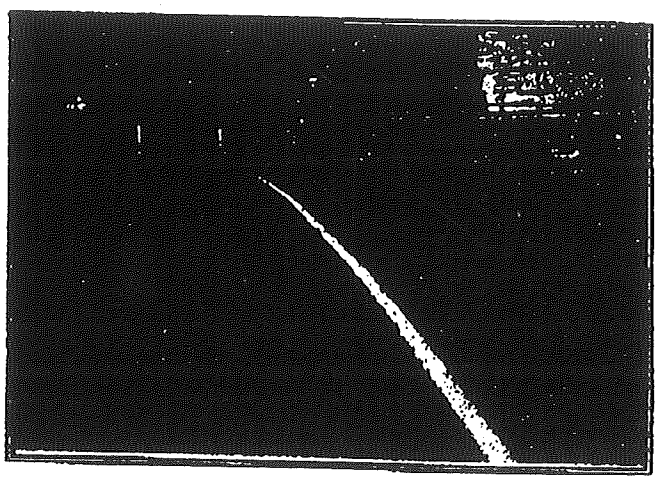

Figure 3 - Off-tracking in horizontal curve

In my opinion, the chance for a head on or run off the road collision at the less than 900 foot radius curves will significantly increase if the DMC proposal is implemented unless mitigative action is taken. The WSDOT safety report agrees that pavement widening is needed on certain curves due to large vehicle off-tracking.

The only fatality reported in this corridor by the WSDOT safety study appears to have occurred at the crest vertical/horizontal curve combination at MP 38.8. This was reported as a head on accident (two vehicles colliding head on from opposite directions). Because information on this accident is limited in the WSDOT study, further investigation into the specifics of this accident are needed, but it seems likely that the accident occurred in the horizontal curve. The probability of occurrence of this type of collision will increase if the DMC proposal is implemented and the <900 foot horizontal curves are not improved.

From my field review of the corridor, I am listing below in Table 3 a number of curves that I suspect to be less than 900 foot in radius. Horizontal and vertical stopping sight distance (SSD) measurements are also included at certain curves. It should be noted that Geometric Design of Highways and Streets by the American Association of State Highway and Transportation Officials (AASHTO) recommends 450 feet to 550 feet of stopping sight distance (SSD) for 55 mile per hour design speeds on level ground, and an additional 65 feet for 4% to 5% downgrades.

Table 3 - Horizontal curves suspected to have less than 900 foot radius

Location of Suspected <900' Radius Horizontal Curve	Lane Width (ft)	Overall Pavement Width (ft)	Horizontal Stopping Sight Dist. (ft)	Vertical Stopping Sight Dist. (ft)
MP 34.5 (rock cut)	10.5	24	--	--
* MP 35.5	10.25	24	--	--
* MP 36.7	10.5	26	430	--
MP 38.8	10.5	24	395	285
MP 43.8	--	24	--	--
MP 44.5	--	24	--	--
MP 44.8	--	24	--	--

* There are a series of curves from MP 35.5 to MP 37.0 that need to be further investigated.

The minimum lane width and minimum total roadway width for a 900 foot radius horizontal curve per the Modified Design Level is 11 feet and 26 feet, respectively. However, wider minimum lane widths and total pavement widths are required as the horizontal curve radius becomes less than 900 feet. For instance, a 500 foot radius horizontal curve requires a minimum 12 foot lane width and 28 foot total pavement width.

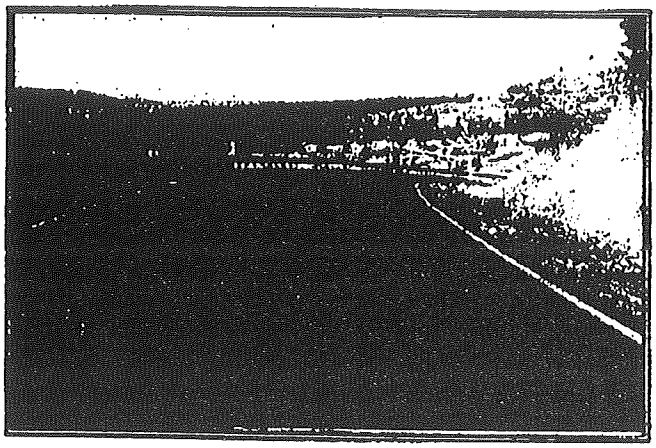

Figure 4 - Northbound at MP 38.8 - crest vertical & small radius horizontal curve combination

Before the current DMC proposal were to be implemented, I highly recommend that the exact radius of each suspect curve be determined and the curve widened to at least the minimum widths outlined in the Modified Design Level. Action should be taken to mitigate the large increase in likelihood of head on and run off the road collisions in these curve areas. Further shoulder widening should be considered beyond these minimums in areas where pedestrians are likely to be walking and no refuge area exists for their safety.

Existing Roadway Lighting

There is currently no roadway lighting along this corridor. Roadway lighting at selected locations, including the intersections of SR 231 at Little Falls Rd, SR 291, Corkscrew Canyon Rd, and the DMC access Rd, could help improve motorist safety during dark conditions. The WSDOT safety study specifically mentions that increasing driver awareness may help to reduce accidents at the Little Falls Rd intersection. Roadway lighting at this intersection would help better identify this intersection to motorists at night, dawn, and dusk.

Roadway lighting should certainly be included in any intersection improvement projects, including the addition of turn lanes on SR 231 at the DMC access Rd. Turn lanes require a driver decision approaching an intersection, and during darkness, dawn, or dusk, roadway lighting can help better define the lane choice decision faced by the motorist.

It should be noted that during late fall and early winter, dawn, dusk, and darkness extend into typical truck hauling hours and school bus pickup times. The use of roadway lighting at intersections and school bus pick up zones can help mitigate vehicle and pedestrian visibility concerns.

Little Falls Road Intersection

Of the twelve intersection collisions reported in the WSDOT safety study, eight occurred at the Little Falls Rd intersection. This constitutes 67% of all intersection collisions. Seven of these eight collisions were at right angle, indicating vehicles from Little Falls Rd turning into vehicles on SR 231.

Little Falls Rd via this intersection is a main access point to and from the state highway system and the Spokane Indian Reservation. The increase in large trucks proposed by the DMC will likely increase the severity of the angle accidents at this intersection due to the increased likelihood of any angle accident occurring involving a large truck on SR 231 (recall that general trucks will increase as much as 86% and large trucks will increase as much as 600% with the DMC proposal).

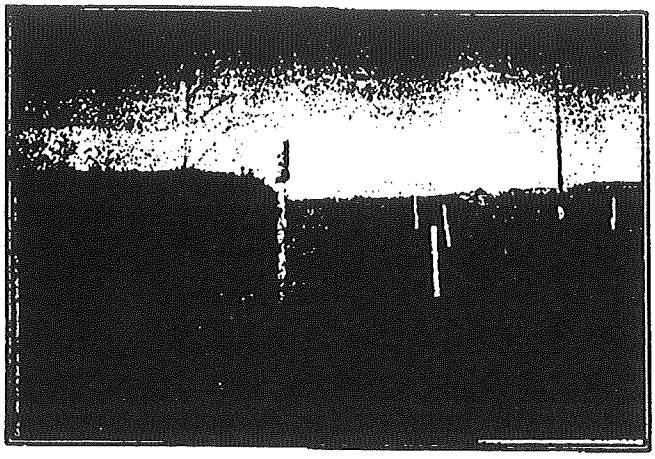

Figure 5 - West leg of Little Falls Rd & SR 231 intersection looking north

The WSDOT safety study states that increasing driver awareness at this intersection could lessen the possibility of accidents occurring.

To address collisions at this intersection, I recommend the following actions:

1) The installation of left turn channelization on SR 231 at the intersection. Although not readily warranted based on accident type, this improvement would do three things to decrease accident potential in my opinion. First, it would provide a refuge area on SR 231 for left turning vehicles from Little Falls Rd. Second, it would provide vehicles on SR 231 additional avoidance maneuver space. Third, it provides vehicles on SR 231 a visual queue that an intersection is approaching.

2) The installation of roadway lighting at the intersection. This improvement would also provide increased intersection awareness for vehicles on both SR 231 and on Little Falls Rd. Due to the lane choice decision, intersection lighting should be part of implementing recommendation 1 above.

3) Installation of highly reflective intersection warning signs on SR 231 in both directions approaching the intersection. Supplemental "Little Falls Rd" street names signs should be included as well. I recommend Diamond Grade VIP sheeting be used on these signs for enhanced nighttime performance.

4) The angle accidents should be studied to determine if any were caused due to vehicles on Little Falls Rd running the stop signs. If so, correctable measures in addition to roadway lighting could be implemented. Such measures include stop ahead signs, stop bars, and possibly a flashing beacon atop the stop signs.

School Bus Stops

School bus stops present a concern mainly due to the potential for conflict between the stopped school bus with its entering and/or existing school age passengers, and traffic on the highway. This concern is compounded by four main factors in highway situations. First, if there are a significant amount of trucks, especially large trucks, there can be increased likelihood for a collision because of the increased braking time that is required of such vehicles and their decreased maneuverability. Second, poor sight distance from highway traffic to the bus stop leaves less time for a motorist, especially the operator of a large vehicle, to react to the situation ahead. Third, the younger the child using the bus, the less capable the child is of dealing with the complexities of a highway school bus stop. Fourth, should buses pull over to allow vehicles to pass, large trucks will have difficulty accelerating to prevailing highway speeds, especially on grades, and a greater frequency of passing large trucks will occur.

As a pedestrian required to stand and walk aside highway traffic, school aged children are at significant risk as outlined above. In my opinion, elementary school children are at most risk. These young, inexperienced pedestrians have less experience in negotiating highway traffic. They are more apt to dart into traffic for no apparent reason. Until the age of approximately twelve, their depth perception and peripheral vision is not yet fully developed, leaving them less equipped to deal with bus stops beside high speed highways. Of course, as with most of the safety situations analyzed in view of a proposal like the DMC proposal, increasing truck traffic on the highway, particularly large truck traffic, increases the concern significantly due to vehicle size and width, increase in braking time, and decrease in maneuverability.

Per my field observations, school buses do regularly use SR 231 in this corridor. There are a number of "School Bus Stop Ahead" signs (S3-1) posted along the corridor. The presence of this type of signing alerts me to sight distance concerns between highway traffic and the bus stops. Per the Manual of Uniform Traffic Control Devices (MUTCD), which is the WSDOT standard for signing and striping roadways, this type of signing is intended for use where sight distance to the school bus stop is 500 feet or less, not just everywhere a school bus stop exists. For 55 mph, minimum stopping sight distance (SSD) requirements are 450 to 550 feet as reported by the American Association of State Highway and Transportation Officials (AASHTO). AASHTO also clearly states that these minimum SSD requirements are for passenger car operation and that "trucks as a whole, especially larger and heavier units, require longer stopping distance from a given speed than passenger vehicles do". Thus my concern over sight distance to these bus stop locations, particularly considering the DMC proposal.

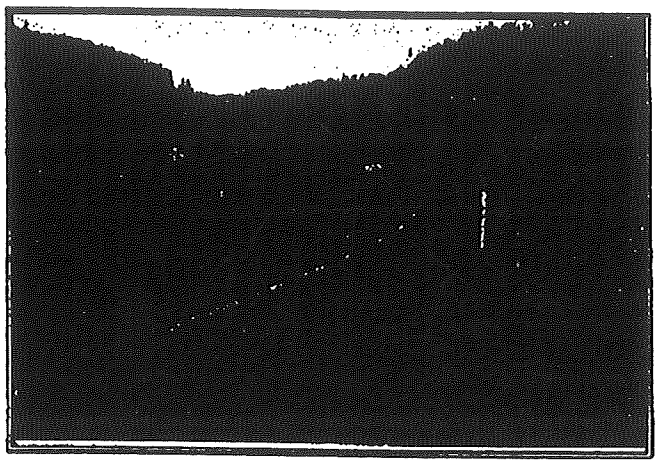

Figure 6 - School bus southbound at MP 38.8

If the current DMC proposal is implemented, I recommend three actions to address school bus stop concerns:

1) Construct bus pullouts at each bus stop location capable of removing the school bus from the highway completely.

2) Restrict the transport of hazardous materials during the school bus pickup and drop off times.

3) Review the location of bus stops and consider elimination or relocation of those located on upgrades or in areas of limited sight distance. Resulting pedestrian facility needs have to be considered for relocated stops.

A question may arise to the need for implementation of both recommendations one and two above. I feel that both should be implemented together as follows. First, it may be difficult to enforce the transport restriction during school bus pick up and drop off times. Thus, these restrictions may not always be observed. At the risk of making judgments without knowing the specifics on the contractor that will be transporting the hazardous materials, it has been my experience that in general, permit requirements for hauling are not always followed unless these requirements are strictly and regularly enforced. Second, school bus pick up and drop off times are not always restricted to the morning and afternoon. For instance, kindergarten classes are often half day and thus can have pick up and drop off around noon.

It has been reported to me that the current DMC proposal includes a provision for not transporting hazardous material during school bus pick up and drop off times. I highly recommend follow up on two issues prior to implementing this provision. First, have the local school districts provide a complete drop off and pick up schedule. Note the times outside the typical morning and afternoon routes. Will transport of hazardous materials be suspended during all times school buses use the highway? Last, design an enforcement plan including a schedule of penalties. Due to the lack of a weigh station on SR 231 within this corridor, enforcement could be difficult to implement. Suggestions for enforcement include regularly scheduled spot checks by the Washington State Patrol (WSP) or a commissioned private contractor.

Guardrail, Bridge Rail, and Clear Zone

Guardrail is a mitigative measure that can be employed to address hazards such as side slopes, fixed objects, and water in the event of a vehicle leaving the roadway. At bridges, bridge rail and bridge approach rail can be used to prevent errant vehicles from going over the side of the bridge structure, or striking the end of the structure. A clear zone is an unobstructed area beyond the edge of the roadway shoulder for the recovery of vehicles that leave the roadway.

My field investigation showed that there are many locations within this corridor where guardrail is warranted by current WSDOT standards, but no guardrail is provided. In addition, there are many existing locations of substandard guardrail including concrete post and post and cable types.

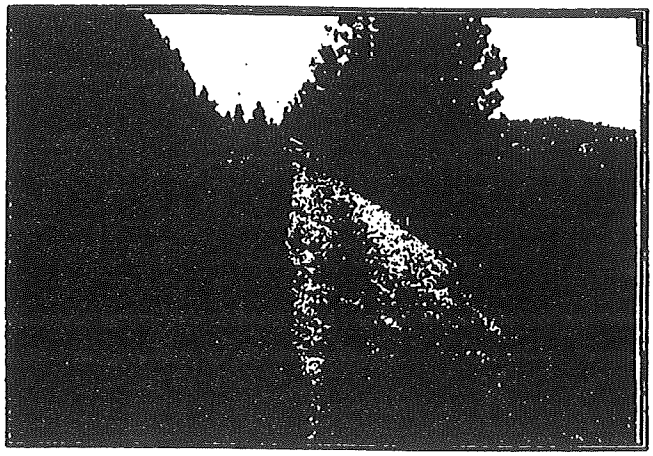

Figure 7 - High embankment without guardrail on the grade south of the Spokane River

The need and justification for mitigating the hazards presented by the existing side slope, water, and fixed object hazards along the SR 231 corridor in my opinion will increase if the current DMC proposal is implemented. More large trucks within the corridor will present increased opportunities for conflicts resulting in run off the road types of accidents as these trucks travel through and interact with other vehicles.

It is interesting to note that in the 52 non-intersection accidents reported in this corridor, it is likely that at least 43 involve vehicles leaving the roadway. If the two accidents that hit guardrail but did not break through are included, approximately 87 % of all non intersection accidents involve vehicles that either left the roadway or would have had guardrail not been present. It is my opinion that this percentage will likely remain the same if the DMC proposal is implemented, however the number of total accidents will likely increase. One can conclude from this accident data that vehicles leaving the road is a main concern and thus guardrail where warranted could be used to attempt to address this.

It should be noted that there are locations of water adjacent to the roadway in this corridor, as well as drainage and river crossings. It is reasonable to say that most of the streams and

drainage courses empty into the Spokane River, which forms the south border of most of the Spokane Indian Reservation. If a large truck transporting hazardous material were to leave the road and spill hazardous material into a stream or drainage course, the impact to the environment, particularly the Spokane River, could be significant. Again, barrier protection such as guardrail is one measure that can address this.

The WSDOT safety study states that further evaluation of approximately 15,000 feet of guardrail installation will be required if the ADT on SR 231 continues to grow. This statement likely reflects that for locations where guardrail is warranted for installation, it may not be recommended if the embankment is not high enough or steep enough for a given roadway ADT. This cost/benefit approach to installing guardrail does not appear to take into account the types of vehicles using the road, the likelihood that those vehicles may leave the roadway, roadway surface conditions (% time ice and snow on road), roadway grades, and perhaps most importantly in this case, the type of cargo being regularly transported on the road. Could the daily transport of hazardous material have an impact on the cost effectiveness of guardrail installation? I think so.

The WSDOT safety study also states that approximately 20,000 lineal feet of existing guardrail should be replaced to meet current standards. However, my field observations showed only about a quarter of this amount (4500 feet) of existing guardrail that needs upgrade. Thus accomplishing a total upgrade of existing guardrail to meet today's standards is not as overwhelming as may be initially reported by WSDOT.

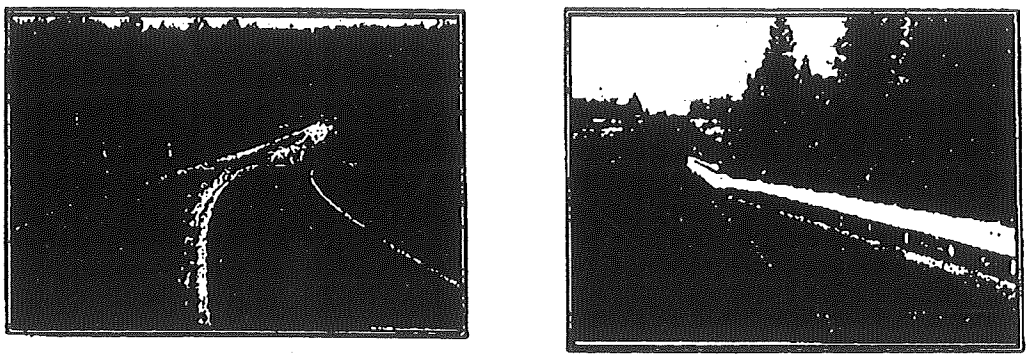

Figure 8 - Spokane River bridge rail that does not meet current WSDOT performance criteria (*left*), and an upgraded bridge approach (*right*)

At the Spokane River bridge, bridge rail and bridge end protection do not meet current standards. The installation of flared guardrail on the bridge approaches and thrie beam rail on the inside of the existing concrete bridge rail is recommended. These measures will help prevent vehicles, especially large trucks carrying hazardous material, from entering the Spokane River. Because of the possible terrible consequences of such an event to the motorist as well as the environment, the needed upgrades to the bridge rail and bridge end protection are highly recommended if the DMC proposal goes forward.

There are many locations adjacent to SR 231 where the clear zone area could be cleared of obstructions to improve safety. Areas with trees in the clear zone can be mitigated at a very reasonable cost. The rock cuts at MP 34.7 present a significant clear zone obstruction.

Drainage Crossings

The drainage crossing at MP 40.7 is of concern because at times the existing 24" diameter corrugated metal drain pipe is overwhelmed by storm water flow and siltation. This results in a flow of water over SR 231 and this presents a hazard to all vehicles on the highway. Large trucks transporting hazardous materials per the current DMC proposal may have difficulty negotiating the flooded roadway if the water over the roadway is not identified by the vehicle operator in time. Depending on the depth of water, this could cause the vehicle to lose control and overturn and/or leave the roadway. This presents the potential for hazardous material to enter the drainage stream and be carried to the Spokane River.

Due to the above mentioned concerns, I recommend that if the DMC proposal is implemented, the drainage crossing at MP 40.7 be improved so that water and mud flow across the highway is eliminated.

Grades

My field investigation revealed that there are a number of grades that would affect the speed of fully loaded large trucks on SR 231 within this corridor. However, three grades stand out as most significant due to their length. These three grades are shown in Table 4.

Of the three grades listed in Table 4, the last grade from MP 44.8 to MP 45.9 is of most concern to me if the current DMC proposal is implemented. The upgrade is in the northbound direction, which is the direction the large trucks transporting material to the DMC site will be fully loaded. In addition, this is the longest and steepest grade, with a maximum grade of approximately 7% at MP 45.7. Also, a major intersection with SR 291 is located within this grade.

Table 4 - Significant grades

Location of Grade	Length (miles)	Approx. Avg. Grade	Direction of Upgrade
MP 35.5 to MP 38.4	2.9	4.5%	Southbound
MP 43.6 to MP 44.5	0.9	5.5%	Southbound
MP 44.8 to MP 45.9	1.1	* 6%	Northbound

* Maximum grade of 7% at MP 45.7

Assuming the large trucks in the current DMC proposal begin this grade at MP 44.8 at the speed limit of 55 miles per hour, truck speed will steadily decrease to approximately 17 miles per hour at MP 45.4, and then decrease further to approximately 14 mph at the 7% grade at MP 45.7. These speeds will continue to the crest of the grade at MP 45.9. Heavy truck acceleration tables show that it can take just under 2 miles for these vehicle to reach the speed limit after the upgrade has ended (assuming flat road after the grade). This means these vehicles may not reach the speed limit again until approximately MP 47.8. It should be noted that it may be very difficult for large vehicles to actually begin this grade at the speed limit of 55 miles per hour as assumed above due to the horizontal curve at the beginning of the grade. If large vehicles actually begin the grade at a speed that is lower than the 55 miles per hour speed limit, the large vehicle will reach its lowest speed even sooner, increasing the time that it could delay the progress of the normal traffic stream.

I have two main concerns with this grade if many additional large trucks use it on a daily basis. First, the faster a heavy truck can travel at the beginning of the upgrade, the longer it can maintain its speed. Thus, there will be an incentive for truck operators to speed on the downgrade and horizontal curve approaching the Spokane River bridge in order to hit the beginning of the upgrade at as great of speed as possible. The horizontal curve just to the south of the Spokane River bridge is suspected to have less than a 900 foot radius, thus off-tracking in this curve is already of concern. Speeding through the curve compounds this concern. This of course will increase the accident potential northbound on SR 231 through the village and curve area south of the bridge, and on the approach to the bridge itself. Second, the huge speed differential between regular traffic on the grade and the large trucks destined for the DMC site will tend to cause motorist frustration and will encourage passing. This concern is magnified by the presence of no passing zones on the grade and at the intersection with SR 291.

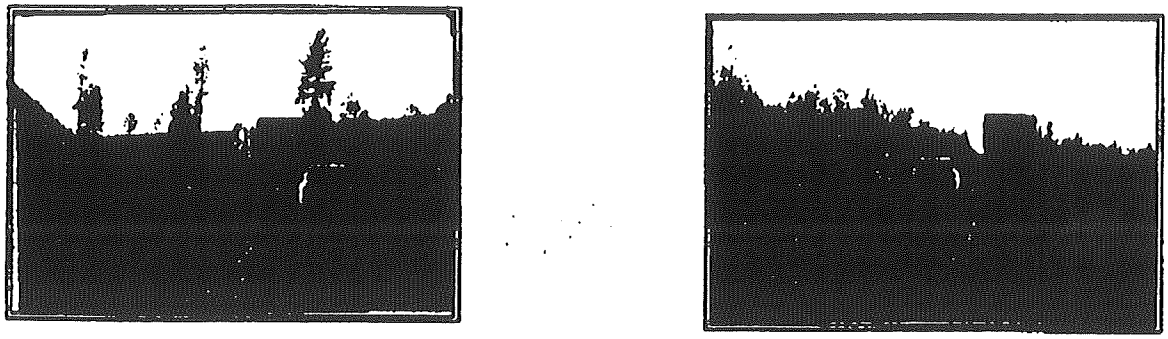

Figure 9 - Car closely following truck (*left*) then passing (*right*) on southbound grade south of the Spokane River

As shown in Table 5, this speed differential is estimated to be at least 41 mph at some points of the grade. The time differential between a passenger car and a large truck to negotiate the three miles that the large truck will be traveling at reduced speeds is approximately 142 seconds.

Table 5 - Large truck vs. passenger car on northbound grade north of the Spokane River

Location	Approx. Car Speed (mph)	Approx. Large Truck Speed (mph)	Approx. Speed Differential (mph)	Elapsed Time for Car Since Start of Grade (sec)	Elapsed Time for Large Truck Since Start of Grade (sec)
MP 44.8 (Start of Grade)	55	55	0	0	0
MP 45.0	55	40	15	13	15
MP 45.4	55	17	38	39	65
MP 45.7	55	14	41	59	135
MP 45.9	55	17	38	72	181
MP 46.3	55	42	13	98	230
MP 46.9	55	50	5	137	277
MP 47.8	55	55	0	196	338

There are many locations within the three grades listed in Table 5 that warrant guardrail installation. The proposed increase in large vehicles on these grades increases the justification and cost effectiveness of guardrail installation, particularly considering the high, steep embankments, and the significant amount of time ice and snow is on the road surface.

The Dawn Mining Company has stated they would suspend operations during inclement weather conditions, however, roadway surface conditions, not weather, is the main concern. Unfortunately, it is difficult to predict roadway surface conditions from forecasted weather. For example, during my field study on December 5th, 1997, conditions were cool and dry with clear skies and the high temperature in Reardan in the middle thirties. These are typical conditions for late fall and early spring. Frost was on the roadway during the morning hours with a considerable amount remaining throughout the day on the grade approaching and to the south of the Spokane River (MP 43.6 to MP 44.5). This downgrade is on a north facing slope and is shaded for most of the day. It had frost on the roadway surface the entire day I visited this corridor. I anticipate that this section of roadway with its nearly 6% grade for downhill trucks will have reduced traction roadway conditions with frost or snow for considerable amounts of time during late fall and winter. As previously mentioned, this section contains non standard barrier protection, an embankment of approximately 100 feet in height, and a horizontal curve of less than 900 foot radius just prior to the Spokane River bridge.

Trends

Based on accident information contained in the 1991 FEIS, 1994 FSEIS, and the 1997 WSDOT safety study, there is a trend of increasing accidents on SR 231 within the corridor between the years of 1983 and 1995. Average total yearly accidents within the corridor are as follows for the given time period: '83 to '86 = 7.8 accidents/year, '87 to '89 = 10 accidents/year, '90 to '92 = 10 accidents/year, '93 to '95 = 12.3 accidents/year. Based on the proceeding data, there has been a steady increase in accidents in the SR 231 corridor from the early eighties to the middle nineties. It is also seen that over half (52%) of the reported accidents in the WSDOT safety study involved injury or death, with a total of 58 injuries and one fatality occurring in the 60 accidents reported in the study. If the current DMC proposal is implemented, it is more likely that this trend of increasing accidents will continue.

The 1991 FEIS shows specific data on accidents involving large trucks. It is seen that between the years of 1983 and 1987, nine accidents involving large trucks occurred within the corridor. There were 39 total accidents during this time period, thus 23% of these accidents involved large trucks. Because the accident data reported in the 1997 WSDOT safety study did not include a key for the vehicle type code, it is difficult to readily determine the amount of large vehicles involved in the accidents reported in this study. However, it is very likely that whatever the percentage of accidents involving large trucks in the WSDOT safety study is, this percentage would significantly increase if the current DMC proposal is implemented.

Conclusion

This report and the engineering analysis contained herein is intended to serve as more than simply an analysis of existing roadway conditions within the SR 231 corridor between the towns of Reardan, WA and Ford, WA. Rather, this report is intended to analyze the safety related impacts to SR 231 with respect to the consistent transport of hazardous material with large trucks over a long period of time.

Based on my analysis, it is my opinion that if the current DMC proposal is implemented, roadway safety in a number areas will be negatively and significantly impacted. The 395% to 600% increase in large trucks will compound the safety concerns in a number of small (<900 foot) radius horizontal curves that have lane and shoulder widths that do not meet the Modified Design Level. The most significant of these concerns include large trucks off-tracking and crossing the roadway centerline. Existing lane and shoulder widths within the corridor were found to be significantly narrower than those reported in the WSDOT safety study, and the introduction of a 395% to 600% increase in the wide large vehicles is a concern considering the lane and shoulder widths found.

The impact to safety at school bus stops within the SR 231 corridor was also found to be significant, especially for elementary school students. These concerns are based on a number of factors, including the increased braking time required by large vehicles, especially at bus stops where braking sight distance between highway traffic and stopped buses is limited. Also of concern is introducing a significant increase in large trucks on the highway to young, inexperienced pedestrian school children, many of whom are at an age where depth perception and peripheral vision are not yet fully developed. Any proposal to restrict large trucks during school pick up and drop off times should be met with scrutiny as school children are often transported outside the normal morning and afternoon times and enforcement and implementation of such large truck transport restrictions can be difficult.

Mitigative measures that can be helpful in addressing "leave the highway" types of accidents are not present at many locations within the corridor. Field investigation showed that many locations within the corridor where these types of accidents are of concern could benefit from guardrail installation or hazard removal from clear zones. Approximately 87% of all non intersection accidents reported in the WSDOT safety study involve vehicles that either left the highway or likely would have had guardrail not been present. In addition, nearly a mile of existing guardrail within the corridor does not meet current WSDOT standards. Large trucks that in an accident could leave the roadway and spill their load of hazardous materials present a significant environmental concern as well, particularly if the spill occurs at the Spokane River or one of its tributaries.

The introduction of a huge increase in large trucks would significantly impact overall traffic operations on the many grades within the corridor, particularly the over mile long northbound grade situated just north of the Spokane River. There will be an incentive for the operators of large trucks to speed on the approaches to upgrades in order to maintain their speed for longer distances. The huge speed differential between the normal traffic stream and large trucks on significant upgrades will tend to increase motorist frustration and encourage passing although a significant amount of no passing zones are present of these grades. In addition, large trucks within the corridor will have to negotiate frost, ice, and snow roadway conditions for considerable amounts of time during the late fall and winter.

As outlined above, the DMC proposal will negatively impact roadway safety in a number of areas. As these negative impacts are realized, so typically are an increase in traffic accidents due to the increase likelihood for accidents these negative impacts create. I am of the opinion that the accident rate within the SR 231 corridor will increase if the current DMC proposal is implemented. I would also expect that due to the type of vehicle that would most significantly increase within the corridor, namely large trucks, the severity of accidents will also likely increase due to vehicle size and associated concerns such as increased linear momentum and braking time.

Since SR 231 is the primary commuter route for the Spokane Indian Reservation residents and Tribal employees, the Tribe will be particularly affected by the impacts of the current DMC proposal and the probable increase in total accidents and accident severity.