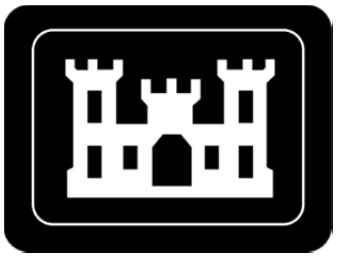
FINAL

RECORD OF DECISION FOR THE INACCESSIBLE SOIL OPERABLE UNIT ASSOCIATED WITH GROUP 1 PROPERTIES AT THE ST. LOUIS DOWNTOWN SITE

ST. LOUIS, MISSOURI

SEPTEMBER 29, 2014



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

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SEPTEMBER 29, 2014

prepared by

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

with assistance from

Leidos, formerly part of Science Applications International Corporation
Under Contract No. W912QR-12-D-0020

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LIST OF ACRONYMS AND ABBREVIATIONS

Both English and metric units are used in this report. The units used in a specific situation are based on common unit usage or regulatory language (e.g., depths are given in feet and meters, and areas are given in square feet and square meters). Acres are given for area when applicable.

1993 BRA	*Baseline Risk Assessment for Exposure to Contaminants at the St. Louis Site*
1998 FS	*Feasibility Study for the St. Louis Downtown Site*
1998 ROD	*Record of Decision for the St. Louis Downtown Site*
Ac	actinium
AEC	U.S. Atomic Energy Commission
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BNSF	Burlington Northern Santa Fe
BRA	baseline risk assessment
BV	background value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COPC	contaminant of potential concern
CSM	conceptual site model
DOE	U.S. Department of Energy
DT	downtown (vicinity property prefix designation)
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
EMDAR	Environmental Monitoring Data and Analysis Report
EPC	exposure point concentration
FFA	*Federal Facility Agreement in the Matter of: The United States Department of Energy, St. Louis and Hazelwood, Missouri*, Docket No. VII-90-F-0005
FS	feasibility study
FSSE	final status survey evaluation
ft	foot/feet
FUSRAP	Formerly Utilized Sites Remedial Action Program
GPS	global positioning system
GWS	gamma walkover survey
HHRA	human health risk assessment
HU	hydrostratigraphic unit
ISOU	inaccessible soil operable unit
m	meter
m^2	square meter
Mallinckrodt	Mallinckrodt LLC
MED	Manhattan Engineer District
MDNR	Missouri Department of Natural Resources
MSD	Metropolitan St. Louis Sewer District
NaI	sodium iodide
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFS	Norfolk Southern
NORM	naturally occurring radioactive material
NRHP	National Register of Historic Places

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

ORNL	Oak Ridge National Laboratory
OU	operable unit
Pa	protactinium
pCi/g	picocuries per gram
PDI	pre-design investigation
PP	*Proposed Plan for No Further Action for the Inaccessible Soil Operable Unit Associated with Group 1 Properties at the St. Louis Downtown Site*
PRAR	post-remedial action report
PRG	preliminary remediation goal
QCSR	Quality Control Summary Report
Ra	radium
RA	remedial action
RAGS Part A	*Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual, Part A*
RAGS Part F	*Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual: Part F, Supplemental Guidance for Inhalation Risk Assessment, Final*
RESRAD	RESidual RADioactivity (computer model)
RfD	reference dose
RG	remediation goal
RI	remedial investigation
RI/BRA Report	*Remedial Investigation and Baseline Risk Assessment Report for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site*
RI WP	*Remedial Investigation Work Plan of the Inaccessible Soil Operable Unit at the St. Louis Downtown Site*
RME	reasonable maximum exposure
ROD	record of decision
ROW	right-of-way
SAG	*Sampling and Analysis Guide for the St. Louis Site*
SARA	Superfund Amendments and Reauthorization Act
SF	slope factor
SLDS	St. Louis Downtown Site
SLERA	screening level ecological risk assessment
SLS	St. Louis Sites
SOR	sum of ratios
Th	thorium
TRRA	Terminal Railroad Association
U	uranium
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UUUE	unlimited use and unrestricted exposure
VP	vicinity property
yd^3	cubic yard

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1.0 DECLARATION FOR THE RECORD OF DECISION

1.1 SITE NAME AND LOCATION

St. Louis Downtown Site (SLDS)
St. Louis, Missouri
Inaccessible Soil Operable Unit (ISOU) associated with the Group 1 Properties
CERCLIS ID: MO980633176
Operable Unit (OU): 02

1.2 STATEMENT OF BASIS AND PURPOSE

This record of decision (ROD) presents the selected alternative for the ISOU media associated with selected properties listed in Section 1.3 (henceforth referred to as Group 1 Properties) at the Formerly Utilized Sites Remedial Action Program (FUSRAP) SLDS in St. Louis, Missouri. The selected alternative was chosen in accordance with the Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the information available in the Administrative Record located at the U.S. Army Corps of Engineers (USACE) St. Louis District FUSRAP Project Office, 8945 Latty Avenue, Berkeley, Missouri 63134, and at the St. Louis Public Library, Government Information Room, 1301 Olive Street, St. Louis, Missouri 63103.

This ROD is published by the USACE in coordination with the U.S. Environmental Protection Agency (USEPA) Region 7 and the Missouri Department of Natural Resources (MDNR). Under the FUSRAP, the USACE is authorized by the U.S. Congress as the lead agency performing the functions specified by Section 611(a) of Public Law 106-60.

Comments on the USACE 2014 *Proposed Plan for No Further Action for the Inaccessible Soil Operable Unit Associated with Group 1 Properties at the St. Louis Downtown Site* (PP) provided during the public comment period were evaluated and considered in selecting the final remedy.

1.3 DESCRIPTION OF THE SELECTED ALTERNATIVE

The selected alternative in this ROD establishes that No Further Action is required for ISOU media at the Group 1 Properties to be protective of human health and the environment. Because no remedial actions (RAs) are necessary for ISOU media at the Group 1 Properties, no remediation goals (RGs) have been established. The ISOU media addressed include inaccessible soil (i.e., soil located under buildings, railroads, roads, or other permanent structures, including the subsoil adjacent to the structure that cannot be disturbed without affecting the stability of the structure), soil adjacent to sewer lines, sediment inside of sewer lines, and soil on building/structural surfaces. The rationale for the selection of No Further Action for the Group 1 Properties is based on: (1) the determination that the property's inaccessible media was not impacted by Manhattan Engineer District/U.S. Atomic Energy Commission (MED/AEC) operations and, therefore, required no evaluations in the USACE 2012 *Remedial Investigation and Baseline Risk Assessment Report for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site* (RI/BRA Report), or (2) the determination of no complete exposure pathways and/or no unacceptable risks to human health and the environment based on the results of the BRA. No Further Action is the selected alternative for ISOU media at the Group 1 Properties relative only to past MED/AEC-related contamination and does not include potential contaminants from other possible sources within or around the SLDS.

The Group 1 Properties, which are listed as follows, are a subset of all the SLDS properties associated with the ISOU.

- Mallinckrodt Security Gate Number 49,
- Downtown (DT)-4 South,
- DT-8,
- DT-9 Levee,
- DT-15,
- DT-29,
- DT-34,
- the South of Angelrodt Property Group (i.e., DT-5, DT-13, DT-14, DT-16, DT-17, and DT-18), and
- West of Broadway Property Group (i.e., Plant 3, Plant 8, Plant 9, Plant 11, Mallinckrodt Parking Lots, DT-20, DT-21, DT-22, DT-23, DT-24, DT-25, DT-26, DT-27, DT-28, DT-30, DT-35, and DT-36).

The selected alternative of No Further Action is warranted for ISOU media at the Group 1 Properties, because the results of the RI/BRA Report have shown that any past release or threat of release of MED/AEC contamination does not pose a significant threat to human health or the environment. Therefore, implementation of remedial measures is not appropriate. Additionally, human health risks determined for ISOU media at each of the Group 1 Properties do not contribute to property-wide risks above background that exceed the USEPA's acceptable risk range, when combined with risks determined for accessible soil areas at the same properties.

1.4 STATUTORY DETERMINATIONS

The selected alternative for ISOU media at the Group 1 Properties is No Further Action. The USACE has determined that No Further Action is appropriate and protective of human health and the environment.

Because no further action is necessary to protect human health and the environment from the release or threat of release of MED/AEC contaminants, CERCLA Section 121 statutory determinations are not necessary for ISOU media at the Group 1 Properties of the SLDS, in accordance with USEPA's 1999 guidance titled *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents.* In addition, because this alternative will not result in a remediation being performed, five-year reviews will not be required.

1.5 AUTHORIZING SIGNATURE

29 SEP '14

Michael C. Wehr
Major General, USA
Commanding

Date

2.0 THE DECISION SUMMARY

2.1 SITE NAME AND LOCATION

The St. Louis Downtown Site (SLDS) is one of two separate geographical areas collectively referred to as the St. Louis Sites (SLS). These two areas are comprised of multiple properties and are located in two distinct areas: downtown St. Louis City and North St. Louis County (Figure 2-1). The SLDS encompasses the Accessible Soil and Ground-Water Operable Unit as well as the Inaccessible Soil Operable Unit (ISOU). The Group 1 Properties that are addressed in this record of decision (ROD) are a subset of the ISOU.

2.2 SITE DESCRIPTION

The SLDS is located in an industrial area in the eastern portion of the City of St. Louis, Missouri, just west of the Mississippi River, as shown on Figure 2-1. The SLDS consists of approximately 44.5 acres (180,000 square meters [m^2]) of land currently owned by Mallinckrodt LLC (Mallinckrodt) and more than 165 acres (670,000 m^2) of surrounding land owned by various private and government entities. The properties not owned by Mallinckrodt are referred to as vicinity properties (VPs). The VPs are identified using the prefix "DT" to represent the "downtown" site and are followed by a number for consistent identification regardless of changing property ownership (Figure 2-2).

The Mallinckrodt property encompasses an area of approximately 12 city blocks, roughly bound by the McKinley Bridge on the north, Angelrodt Street on the south, North Broadway on the west, and the Burlington Northern Santa Fe (BNSF) Railroad VP (DT-12) on the east (Figure 2-2). The Mallinckrodt property currently includes a chemical manufacturing plant, support facilities, and administrative buildings that cover a large portion of the property. The remainder of the complex is covered, mostly with asphalt or concrete pavement.

The SLDS VPs consist of 38 properties surrounding the Mallinckrodt property. Most of the VPs are small parcels of land owned by individuals conducting industrial; commercial; manufacturing; or retail businesses, including a lumber distributor, a scrap metal recycler, a bedding manufacturer, and a bank.

Various industrial and commercial processes have been conducted throughout the SLDS vicinity for more than 150 years. The area is primarily industrial with the exception of one mixed-use property (DT-22). While future residential use is prohibited by the City of St. Louis zoning ordinances regulating land use, the residential use was in place prior to the prohibition. The long-term plans for the area are to retain industrial uses; encourage a wholesale produce district; prohibit residential use; and phase out salvage yards, truck storage lots, and the remaining residential use. The City of St. Louis zoning ordinances regulating land use are presented in detail in Section 2.8.

Table 2-1 lists the properties included in the ISOU and indicates whether each ISOU property is subject to this ROD as a Group 1 Property for No Further Action.

Table 2-1. Summary of Group 1 Properties Associated with the Inaccessible Soil Operable Unit at the St. Louis Downtown Site

Property	Current Property Name	Group 1 Property	Comments
Mallinckrodt Plant Properties			
Plant 1	Mallinckrodt LLC		
Plant 2	Mallinckrodt LLC		
Plant 6	Mallinckrodt LLC		
Plant 7N	Mallinckrodt LLC		*a*
Plant 10 (Formerly Plant 4)	Mallinckrodt LLC		
Mallinckrodt Security Gate 49	Mallinckrodt LLC	✓	
Industrial/Commercial Vicinity Properties			
DT-1	Kiesel (formerly Archer Daniels Midland and PVO Foods)		*b*
DT-2	City Property		
DT-4 North	Gunther Salt North		
DT-4 South	Gunther Salt South	✓	*c*
DT-6	Heintz Steel and Manufacturing		
DT-7	Midwest Waste		*b*
DT-8	PSC Metals Inc.	✓	
DT-10	Thomas and Proetz Lumber Company		
DT-15	Metropolitan St. Louis Sewer District (MSD) Lift Station	✓	
DT-29	Midtown Garage	✓	
DT-34	Hjersted	✓	
DT-37	Lange-Stegmann		*b*
South of Angelrodt Property Group [d]			
DT-5	Ameren UE	✓	*c,d*
DT-13	Cash Scrap Metals	✓	*d*
DT-14	Cotto-Waxo	✓	*d*
DT-16	Star Bedding Company	✓	*d*
DT-17	Christiana Court LLC	✓	*d*
DT-18	City of St. Louis (formerly Curly Collins Recycling)	✓	*c,d*
West of Broadway Property Group [d]			
Plant 3	Mallinckrodt LLC	✓	*d*
Plant 8	Mallinckrodt LLC	✓	*d*
Plant 9	Mallinckrodt LLC	✓	*d*
Plant 11	Mallinckrodt LLC	✓	*d*
Parking Lots	Mallinckrodt LLC	✓	*d*
DT-20	Richey	✓	*d*
DT-21	Farve	✓	*c,d*
DT-22	Tobin Electric	✓	*c,d*
DT-23	Worth Industries	✓	*d*
DT-24	Bremen Bank	✓	*c,d*
DT-25	Eirten's Parlors	✓	*c,d*
DT-26	United Auto Workers Local 1887	✓	*c,d*

Table 2-1. Summary of Group 1 Properties Associated with the Inaccessible Soil Operable Unit at the St. Louis Downtown Site

Property	Current Property Name	Group 1 Property	Comments
West of Broadway Property Group [d] ***(Continued)***			
DT-27	Dillion	✓	*d*
DT-28	Challenge Enterprises	✓	*c,d*
DT-30	Zamzow Manufacturing	✓	*c,d*
DT-31	Porter Poultry		*b*
DT-32	Westerhide Tobacco		*b*
DT-35	Factory Tire Outlet	✓	*d*
DT-36	OJM Inc.	✓	*d*
Railroad Vicinity Properties			
DT-3	Norfolk Southern Railroad		
DT-9 Main Line	Terminal Railroad Association		
DT-9 Rail Yard	Terminal Railroad Association		
DT-9 Levee	Terminal Railroad Association	✓	
TRRA Soil Spoils Area	Terminal Railroad Association		
DT-12	Burlington Northern Santa Fe Railroad		
Roadway Vicinity Properties			
DT-11	McKinley Bridge (Jointly owned by the Missouri Department of Transportation and the Illinois Department of Transportation)		
DT-19	City of St. Louis-Owned Roads		
DT-33	Missouri Department of Transportation-Owned Roads		

[a] If inaccessible media are found containing Manhattan Engineer District/U.S. Atomic Energy Commission (MED/AEC) contamination, Plant 7W will be addressed with the Group 2 Properties.

[b] These properties are not included in the scope of the ISOU due to the absence of inaccessible soil areas and buildings/structures.

[c] Property's inaccessible media has been determined to be non-impacted during previous investigations.

[d] Property group was evaluated collectively in the remedial investigation (RI) nature and extent evaluation and in the baseline risk assessment (BRA). Therefore, although individual properties belonging to the group are indicated as being included in this ROD, it is the property group itself that is retained for this ROD.

Notes:

Check mark indicates that the property is a Group 1 Property included in this ROD.

The following subsections present individual property descriptions of the physical locations, features, and land use of the Group 1 Properties addressed by this ROD. The Group 1 Properties that are the subject of this ROD are presented in Figure 2-3. Only the inaccessible portions of each property, including the soil located under buildings, railroads, roads, or other permanent structures (including the subsoil adjacent to the structure that cannot be disturbed without affecting the stability of the structure); soil adjacent to sewer lines; sediment inside of sewer lines; and soil on building/structural surfaces are subject to this ROD and are shown in Figure 2-4.

2.2.1 Mallinckrodt Security Gate Number 49

The Mallinckrodt Security Gate Number 49 (henceforth referred to as Security Gate 49) is located east of Plant 10, just north of the intersection of the North Second Street corridor and Angelrodt Street. The triangular-shaped property has a frontage of approximately 60 feet (ft) (18.3 meters [m]) extending east to west along Angelrodt Street and spans approximately 250 ft (76.2 m) north to south along Plant 10.

A large area at Security Gate 49 consists of asphalt cover over North Second Street. A small building serves as a guard shack. The inaccessible areas at Security Gate 49 include the soil beneath the guard shack, the soil surrounding the guard shack that cannot be disturbed without affecting the stability of the structure, and the soil on the surface of the guard shack.

Current land use at Security Gate 49 is industrial.

2.2.2 DT-4 South – Gunther Salt

DT-4 South has an area of approximately 8.9 acres (36,017 m^2) and is one of two parcels (i.e., DT-4 North and DT-4 South) owned by the Gunther Salt Company. DT-4 South is bordered to the north by the former Buchanan Street corridor, to the east by the BNSF Railroad, to the south by Dock Street, and to the west by Hall Street.

DT-4 South contains a building used for the bulk storage and staging of salt and water-conditioning materials. The inaccessible areas at DT-4 South include the soil beneath the building, the soil surrounding the building that cannot be disturbed without affecting the stability of the structure, and the soil on the surface of the building.

Current land use at DT-4 South is commercial/industrial.

2.2.3 DT-8 – PSC Metals Inc.

DT-8 is generally bound by Bremen Avenue on the north, Mallinckrodt Street on the south, the St. Louis Flood Protection Levee System for the Mississippi River on the east, and North Second Street on the west. DT-8 consists of approximately 23.5 acres (95,100 m^2) owned by McKinley Iron Inc. DT-8 is comprised of seven tracts of property located within the general area.

A number of buildings are located within DT-8, including an administration building, warehouses, a shredder/welding shop, and a scale house. The inaccessible areas at DT-8 include the soil under six buildings and the railroad tracks, the soil surrounding the buildings and railroad that cannot be disturbed without affecting the stability of those structures, and the soil on the surfaces of the buildings.

Current land use at DT-8 is commercial/industrial.

2.2.4 DT-9 Levee – Terminal Railroad Association

The DT-9 Levee area is owned by the Terminal Railroad Association (TRRA). It consists of two undeveloped, non-contiguous parcels (i.e., a northern parcel and a southern parcel), which include a segment of the St. Louis Flood Protection Levee System for the Mississippi River. (The St. Louis Riverfront Trail, which runs along the DT-9 Levee property, is used for walking, jogging, and biking.) Both parcels are located west of the Mississippi River, while the northern DT-9 Levee parcel is located to the east of the DT-9 rail yard, and the southern parcel is located to the east of DT-8 and DT-34. In total, the DT-9 Levee area covers approximately 67 acres (273,078 m^2).

The inaccessible areas at the DT-9 Levee property (i.e., both north and south areas) are the area beneath the levee and the soil surrounding the levee that, if disturbed, would reasonably be expected to affect the stability of the levee. The DT-9 Levee area does not contain any buildings.

Current land use at the DT-9 levee is industrial and recreational.

2.2.5 DT-15 – Metropolitan St. Louis Sewer District Lift Station

DT-15 (the Metropolitan St. Louis Sewer District [MSD] Lift Station) is located in the northeastern portion of the SLDS. DT-15 is bound on the east by the City Property (DT-2), on the west by BNSF Railroad (DT-12), on the south by McKinley Bridge (DT-11), and on the north by DT-9. The DT-15 property covers approximately 2.3 acres (9,259 m^2).

DT-15 contains the Salisbury Pumping Station (which is part of the City of St. Louis Flood Protection System), a paved equipment yard, and part of the St. Louis Flood Protection Levee System for the Mississippi River. The DT-15 pumping station consists of a two-story brick structure and inlet chamber. Adjacent to the pumping station, to the south, is a paved equipment yard. The St. Louis Riverfront Trail, which runs along the levee, is used for walking, jogging, and biking. The remaining property area is covered with vegetation.

The inaccessible areas at DT-15 include soil beneath the levee and the pump house station, the soil surrounding the levee and the pump house station that cannot be disturbed without affecting the stability of those structures, and surfaces of the pump house station.

Current land use at DT-15 is industrial and recreational.

2.2.6 DT-29 – Midtown Garage

DT-29 is located at 3227 North Broadway Street and covers approximately 0.47 acres (1,900 m^2).

The property includes two adjoining buildings with a covered bay and a hoist along the western side of the property. More than 90 percent of the property is paved with asphalt, and the remainder, a 20-ft-by-80-ft (6.1-m-by-24.4-m) section on the north, is covered with gravel. Outdoor areas are used for parking and storage, and the property slopes gently from northwest to southeast.

The inaccessible areas at DT-29 include soil located beneath the buildings, the soil surrounding the buildings that cannot be disturbed without affecting the stability of the buildings, and the soil on the surfaces of the buildings.

Current land use at DT-29 is commercial/industrial.

2.2.7 DT-34 – Hjersted

DT-34 is located northeast of the Mallinckrodt facility in the northeastern corner of the SLDS. The property is bordered by Bremen Avenue to the north, an active rail line to the east, and DT-8 to the west and south.

DT-34 is occupied by numerous buildings and storage tanks that encompass approximately 0.32 acres (1,300 m^2) of the total property area of 3.7 acres (15,158 m^2). The remainder of the property is primarily covered by gravel, with some small areas of asphalt or concrete. Railroad tracks from the adjacent DT-8 extend into the property to the eastern edge.

The inaccessible areas at DT-34 include the soil beneath the buildings and railroad tracks, the soil surrounding the buildings and railroad tracks that cannot be disturbed without affecting the stability of those structures, and the soil on the surfaces of the buildings.

Current land use is commercial/industrial.

2.2.8 South of Angelrodt Property Group (DT-5, DT-13, DT-14, DT-16, DT-17, and DT-18)

The six South of Angelrodt Property Group VPs include properties owned by Ameren UE (DT-5), Cash Scrap Metals Company (DT-13), Cotto-Waxo Company (DT-14), Star Bedding Company (DT-16), Christiana Court LLC (DT-17), and City of St. Louis Land Reutilization Authority (formerly owned by Curley Collins Recycling) (DT-18). The properties lie south of Angelrodt Street, north of Dock Street, east of North Broadway, and west of a major railroad corridor.

These properties contain several buildings. Roads and railroads are not present on these properties. The inaccessible areas at the South of Angelrodt Property Group include soil located beneath the buildings, the soil surrounding the buildings that cannot be disturbed without affecting the stability of the buildings, and the soil on the surfaces of the buildings.

Current land use for these properties is commercial/industrial.

2.2.9 West of Broadway Property Group (DT-20, DT-21, DT-22, DT-23, DT-24, DT-25, DT-26, DT-27, DT-28, DT-30, DT-35, and DT-36, and Mallinckrodt Plants 3, 8, 9, and 11 and Parking Lots)

The 12 West of Broadway Property Group VPs are located generally south of McKinley Bridge, north of Dock Street, and between Ninth Street to the west and North Broadway to the east. Mallinckrodt Plants 3, 8, 9, and 11 and Parking Lots are bound on the north by the City of Venice VP (DT-11) and DT-8; on the east by DT-9, DT-8, and Mallinckrodt Plants 1 and 2; on the south by Mallinckrodt Plant 10; and on the west by North Broadway, as shown on Figure 2-3.

The inaccessible areas at the West of Broadway Property Group include soil located beneath the buildings, the soil surrounding the buildings that cannot be disturbed without affecting the stability of the buildings, and the soil on the surfaces of the buildings.

Current land use at these properties is commercial/industrial.

2.3 LEAD AND SUPPORT AGENCIES

The U.S. Environmental Protection Agency (USEPA) has listed portions of the SLS on the National Priorities List, but the SLDS is not included.

The U.S. Army Corps of Engineers (USACE), under the authority of the Formerly Utilized Sites Remedial Action Program (FUSRAP), is the lead agency performing the functions specified by Section 611(a) of Public Law 106-60. In June 1990, the *Federal Facility Agreement in the Matter of: The United States Department of Energy, St. Louis and Hazelwood, Missouri,* Docket No. VII-90-F-0005 (FFA) for the SLS was established between the U.S. Department of Energy (DOE) and USEPA Region 7. In 1997, Public Law 105-62 transferred responsibility for the execution of the FUSRAP from the DOE to the USACE under the Fiscal Year 1998 Energy and Water Development Appropriations Act. Consistent with this transfer, the USACE is conducting response actions at the SLDS under the legislative authority contained in the Energy and Water Development Appropriations Act for Fiscal Year 2000, Public Law 106-60, §611. This law establishes the authority of the USACE to conduct response actions for releases related to the nation's early atomic energy program as the lead federal agency, subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The USACE has been conducting investigations and response actions at the SLDS in coordination with the USEPA Region 7 and the Missouri Department of Natural Resources (MDNR).

2.4 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Since 1867, Mallinckrodt Inc. (now Mallinckrodt LLC) has used blended and/or manufactured chemicals at this facility, including organics and inorganics. From 1942 until 1957, Mallinckrodt Chemical Works (now Mallinckrodt LLC) was contracted by the Manhattan Engineer District/U.S. Atomic Energy Commission (MED/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. From 1942 to 1945, Plants 1, 2, and 4 (now Plant 10) (Figure 2-2) were involved in the development of uranium-processing techniques, uranium compounds and metal production, and uranium metal recovery from residues and scrap.

In 1974, the AEC established the FUSRAP for the cleanup of sites contaminated from past activities involving radioactive materials generated by MED/AEC activities. Because contamination related to MED/AEC activities was present at the SLDS at levels that required a response, the SLDS was designated for inclusion under the FUSRAP.

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. The radiological survey was conducted by the Oak Ridge National Laboratory (ORNL) and documented by the ORNL in a 1981 report titled *Radiological Survey of the Mallinckrodt Chemical Works, St. Louis, Missouri.* In response to this survey, it was determined that further investigation was necessary to characterize the nature and extent of contamination, and to evaluate possible remedial actions (RAs) to mitigate threats to human health and the environment.

In 1980, the U.S. Congress passed the CERCLA (Public Law 96-510), also known as "Superfund," which was created to remedy threats to human health and the environment from releases of hazardous wastes from various industries. In 1986, the CERCLA was reauthorized and amended by the Superfund Amendments and Reauthorization Act (SARA), requiring federal facilities to abide by the same CERCLA requirements. Response actions at FUSRAP Sites are subject to the administrative, procedural, and regulatory provisions of the CERCLA and the NCP.

The CERCLA process generally includes the investigation, evaluation, and documentation of the contaminants present at a site or portions of a site (the remedial investigation [RI]); an assessment of the potential risks to human health and the environment posed by those contaminants (the baseline risk assessment [BRA]); and, if necessary, assessment screening and detailed evaluation of potential remedial alternatives for reducing unacceptable risk (a feasibility study [FS]). However, because the ISOU media at the Group 1 Properties present no unacceptable risks to human health and the environment, development of an FS was not required. A proposed plan is developed to present the preferred alternative to the public and to receive public comments regarding the preferred alternative. Finally, after consideration of public comments, a remedial decision of a selected alternative is documented in a ROD.

In June 1990, an FFA for the SLS was established between the DOE and the USEPA Region 7. This agreement defined implementation and oversight roles for the signatories. This FFA stated that the DOE would conduct response actions at the SLS 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; and
- Other chemical or non-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 DOE managed the FUSRAP until October 1997, when responsibility for the execution of the program was transferred to the USACE under the Fiscal Year 1998 Energy and Water Appropriations Act. Subsequent legislation passed in 1999 made it clear that the USACE is the lead agency responsible for response actions at the SLDS. The DOE, beginning two years after closeout, shall be responsible for long term surveillance, operations and maintenance, including monitoring and enforcement of any institutional controls which have been imposed in a site or vicinity properties, and, upon closeout, shall accept the transfer of federally owned real property and interests therein, acquired by the USACE for FUSRAP execution.

In accordance with 40 *Code of Federal Regulations (CFR)* 300.430(a)(ii)(A), the CERCLA process may be completed in operable units (OUs) when phased analysis and response is necessary or appropriate given the size or complexity of the site or to expedite site cleanup. The ISOU is one of two OUs established to facilitate environmental investigations and remediation at the SLDS. The other OU, which is not subject to this ROD, is the Accessible Soil and Ground-Water OU. A separate *Record of Decision for the St. Louis Downtown Site* (henceforth referred to as the 1998 ROD), which was published by the USACE in consultation with the USEPA, was signed in 1998 (prior to the enactment of Public Law 106-60) by the USACE and the USEPA Region 7, to address MED/AEC-related contamination in accessible soil and ground water at the SLDS. Sections 2.4.1 and 2.4.2 describe the OUs and the respective histories of FUSRAP activities conducted in accordance with the CERCLA.

2.4.1 Accessible Soil and Ground-Water Operable Unit

Between 1989 and 1993, an RI and a BRA for the SLS were conducted and included the sampling of accessible and inaccessible soil, buildings, sewers, surface water, sediment, and ground water at both the North St. Louis County Sites and the SLDS. The *Baseline Risk Assessment for Exposure to Contaminants at the St. Louis Site* (henceforth referred to as the 1993 BRA), which was published by the DOE in 1993, calculated potential cancer risks in excess of the USEPA's CERCLA target cancer risk range of 1 in 1,000,000 to 1 in 10,000

(i.e., $1.0x10^{-6}$ to $1.0x10^{-4}$) under current industrial and future land use scenarios due to exposures to radiologically contaminated soil.

In 1991, the DOE's *Engineering Evaluation/Cost Analysis for Decontamination at the St. Louis Downtown Site* evaluated potential removal actions at the SLDS. In 1992, the *Action Memorandum for the Removal of Contaminated Materials at the St. Louis Downtown Site, St. Louis, Missouri,* was issued by the DOE to address four removal actions involving the demolition of several buildings at the Mallinckrodt plant area remaining from MED/AEC operations. When the *Feasibility Study for the St. Louis Downtown Site* (henceforth referred to as the 1998 FS) was published by the USACE in 1998, it stated that the inaccessible soil beneath buildings and other permanent structures would be addressed as a subsequent CERCLA action, because the inaccessible soil did not present a significant threat in its current configuration and "remediation of these soils at this time would result in severe economic dislocations and community disruptions."

Following the 1998 FS and subsequent identification of the preferred remedy by the USACE in the 1998 *Proposed Plan for the St. Louis Downtown Site,* the 1998 ROD was published by the USACE in consultation with the USEPA and with concurrence from the MDNR. The principal risk identified in the 1998 ROD was exposure to radioactivity remaining from past MED/AEC operations. The radiological contaminants of concern (COCs) (i.e., one or more contaminants found on, in, or under a property at a concentration that exceeds the applicable site condition standards for the property) defined by the 1998 ROD were actinium (Ac)-227, protactinium (Pa)-231, radium (Ra)-226, Ra-228, thorium (Th)-228, Th-230, Th-232, uranium (U)-235, and U-238. The metal COCs applicable for soil inside the uranium-ore processing area of the SLDS, as defined by the 1998 ROD, were identified as arsenic, cadmium, and uranium metal. In accordance with the CERCLA process, once COCs were identified, soil RGs were established as residual soil concentrations allowed to remain in place, following remediation that would pose no unacceptable risks to human health or the environment. Soil RGs for the radiological COCs identified in the 1998 ROD were consistent with applicable or relevant and appropriate requirements (ARARs) identified in accordance with the CERCLA. RGs for metal COCs were developed based on site-specific, risk-based values in accordance with the CERCLA.

The 1998 ROD defined RAs for accessible soil at the Mallinckrodt property and VPs. The 1998 ROD also established RAs for the ground water beneath the SLDS for MED/AEC-related hazardous substances, which include monitoring. Ground-water monitoring of the HU-B unit at the SLDS began in 1998 as part of the Environmental Monitoring Program required by the SLDS ROD. The 1998 ROD also stated that contaminated sediment in sewers and drains considered accessible would also be remediated.

Accessible soils are soils that are not beneath buildings or other permanent structures. The selected remedy for accessible soil was Alternative 6, "Selective Excavation and Disposal."

As stated in Section 9, "The Selected Remedy," of the 1998 ROD, accessible soil cleanup criteria for radiological contaminants within the OU are:

- "Excavation of accessible soils according to the ARAR-based composite cleanup criteria of 5/15 [picocuries per gram] (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 … 1.8 m (… 6 ft) throughout the OU and at the perimeter VPs…;" and,
- "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 … will be used as the deep-soil cleanup guidelines below … 1.8 m (… 6 ft)."

In March 2005, the *Memorandum for Record: Non-Significant Change to the Record of Decision for the St. Louis Downtown Site* was published by the USACE and provided specific clarifications regarding the delineation of the SLDS boundary. Additional VPs were determined to be impacted (i.e., potentially contaminated) by MED/AEC wastes from the SLDS. In addition, certain property boundaries and, in some cases the associated property owners, differed from those originally identified in the 1998 ROD.

2.4.1.1 Remedial Actions Pursuant to the 1998 Record of Decision at Group 1 Properties

In accordance with the 1998 ROD, RAs have been conducted at accessible soil areas of the Group 1 Properties at which MED/AEC-related contamination was detected above the 1998 ROD RGs. Final status survey evaluations (FSSEs) were developed to document that the accessible soil areas meet the cleanup standards of the 1998 ROD. The RA and/or compliance with 1998 ROD requirements for each of the Group 1 Properties are described in the following USACE post-remedial action report (PRAR)/FSSE and pre-design investigation (PDI) summary/FSSE documents and summarized in Table 2-2:

- Security Gate 49 – *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Northeast Corner of Plant 9 and Security Gate Number 49 Area,* Revision 0 (2010).
- DT-4 South (Gunther Salt) – *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Gunther Salt (DT-4),* Revision 0 (2012).
- DT-8 (PSC Metals Inc.) – *Post-Remedial Action Report and Final Status Survey Evaluation for Accessible Soils within the St. Louis Downtown Site Vicinity Property PSC Metals Inc. (DT-8),* Revision 0 (2013).
- DT-9 Levee (TRRA) – At this time, the document has not been finalized, as accessible portions of DT-9 (other than the levee) are still being investigated.
- DT-15 (MSD Lift Station) – *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Metropolitan St. Louis Sewer District Lift Station (DT-15),* Revision 0 (2012).
- DT-29 (Midtown Garage) – *Post-Remedial Action Report for the Accessible Soils within the St. Louis Downtown Site Midtown Garage Vicinity Property (DT-29),* Revision 0 (2005).
- DT-34 (Hjersted) – *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property DT-34,* Revision 0 (2012).
- South of Angelrodt Property Group (DT-5, DT-13, DT-14, DT-16, DT-17, and DT-18) – *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Properties DT-5, DT-13, DT-14, DT-16, and DT-18 and the Second Street Corridor, Revision 0* (2010) and *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Christiana Court, LLC (DT-17),* Revision 0 (2012).

- West of Broadway Property Group (DT-20, DT-21, DT-22, DT-23, DT-24, DT-25, DT-26, DT-27, DT-28, DT-30, DT-35, and DT-36, and Mallinckrodt Plants 3, 8, 9, and 11 and Parking Lots) – *Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Properties West of Broadway, Mallinckrodt Plants 3, 8, 9, 11, and Parking Lots*, Revision 0 (2006); *Pre-design Investigation and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Vicinity Properties DT-35 and DT-36* (2009)*; and Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Northeast Corner of Plant 9 and Security Gate Number 49 Area,* Revision 0 (2010a).

Table 2-2. Previous Actions at the Group 1 Properties

Property	Activities	Volumes Remediated [a]	Document
Security Gate 49	Soil excavation	16 cubic yards (yd^3) shipped off site	PRAR/FSSE (2010)
DT-4 South	Soil excavation	2,871 yd^3 shipped off site [b]	PRAR/FSSE (2012)
DT-8	Soil excavation	8,071 yd^3 shipped off site	PRAR/FSSE (2013)
DT-9 Levee	Soil excavation	Pending [c]	Pending [c]
DT-15	No RA required	0 yd^3	PDI/FSSE (2012)
DT-29	Soil excavation	51 yd^3 shipped off site	PRAR (2005)
DT-34	No RA required	0 yd^3	PDI/FSSE (2012)
South of Angelrodt Property Group	No RA required	0 yd^3	PDI/FSSE (2011)
DT-17 [d]	Soil excavation	47 in-situ yd^3 shipped off site	PRAR/FSSE (2012)
West of Broadway Property Group	No RA required	0 yd^3	FSSE (2006)
DT-35 and DT-36 [e]	No RA required	0 yd^3	PDI/FSSE (2009)
Plant 9	Soil excavation	6 yd^3 shipped off site	PRAR/FSSE (2010)

[a] Volumes presented are the volumes shipped for off-site disposal. These volumes are likely 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.

[b] The remediated volume shown for DT-4 is actually the sum of removal volumes for DT-4 North and DT-4 South, as presented in the *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Gunther Salt (DT-4)*. The remediated volume for DT-4 South was comprised of excavated areas along Buchanan Street and adjacent to DT-12 (BNSF Railroad). These excavated areas are indicated as survey units 2S and 3S, respectively, by USACE and represent a small fraction of the total remediated volume from both parcels.

[c] DT-9 Levee remediation and post-remediation evaluations are currently being documented as part of the DT-9 actions in a PRAR. This information will become available at a future date.

[d] Although evaluated in a separate PRAR/FSSE, DT-17 is part of the South of Angelrodt Property Group.

[e] Although evaluated in a separate PDI/FSSE, DT-35 and DT-36 are part of the West of Broadway Property Group.

2.4.2 Inaccessible Soil Operable Unit

The 1998 ROD addresses contamination related to MED/AEC activities in accessible soils and ground water. The 1998 ROD states that "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." As a result, the ISOU was established at the SLDS to address those media not covered under the Accessible Soil and Ground-Water OU that may have become contaminated as a result of the deposition or migration of MED/AEC-related contaminated media.

Generally, for all properties at the SLDS associated with the ISOU, the environmental media within the scope of the ISOU include:

- Soil that is inaccessible due to the presence of buildings and other permanent structures, including the subsoil adjacent to the structure of which a soil disruption (i.e., remediation) would reasonably be expected to affect the stability of the structure.

- Soil located under active railroads, including the supporting soil in the associated right-of-way (ROW).
- Soil located under roadways, including the supporting soil in the associated ROW. Roadways are defined as public and private streets. Inaccessible soil does not include soil beneath driveways, parking lots, or other paved surfaces located at plant or VP areas that were addressed as accessible soil areas.
- Soil on the exteriors and interiors of buildings and permanent structures (e.g., storage tanks, bridges, sheds, loading docks, utility poles, traffic signals, piping, rail tracks, and equipment boxes).
- Soil on sewers and sediment inside sewers not directly encountered within an excavation area during the RA conducted under the 1998 ROD.
- Soil adjacent to sewers located beneath buildings, permanent structures, railroads, and/or roads.

Prior to investigating MED/AEC-related contamination in ISOU media, the USACE developed the *Remedial Investigation Work Plan for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site* (RI WP). The RI WP was finalized in November 2009 after regulatory review by the USEPA and the MDNR. The RI WP presented the sampling protocol for the ISOU based on an evaluation of data from characterization studies of various media (e.g., soil, sediment, sewers, and buildings) conducted at the SLDS since 1977. These studies provided a detailed understanding of the environmental setting and the nature of contamination at the SLDS. In addition, the data collected from 1977 to 1993 were used as part of the 1993 BRA to evaluate the human health and ecological risks associated with the impacted media at the SLDS, including both inaccessible and accessible soil. The existing characterization data and the results of the 1993 BRA were used to streamline the data needs for the ISOU RI.

Sampling for the ISOU RI began in June 2009 and ended in August 2010, with the majority of work being completed between October 2009 and May 2010. The following RI field activities were conducted for the ISOU to evaluate the nature and extent of radionuclides and metals contamination within the ISOU:

- soil sampling of inaccessible soil beneath or immediately adjacent to buildings and other permanent structures (including the levee, railroads, and roadways);
- gamma walkover surveys (GWSs);
- radiological surveys of interior and exterior building surfaces and structural components;
- sewer sediment sampling of manholes and surface grates; and
- subsurface soil sampling adjacent to sewer lines.

Following the field and laboratory investigations, the results of the ISOU RI were reported in the *Remedial Investigation and Baseline Risk Assessment Report for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site* (RI/BRA Report), which was published as Final by the USACE on September 20, 2012. The purpose of the RI/BRA was to define the nature and extent of MED/AEC soil contamination present in the ISOU and to assess the associated risk to human health and the environment under the current and reasonable anticipated future land use for the SLDS. As part of the BRA, "property-wide" evaluations were performed to reflect that remediation had been conducted in accessible soil areas under the authority of the 1998 ROD and to reflect that, in reality, individuals move through all portions of each property. The results

of the ISOU RI relative to the characterization of the nature and extent of contamination and the BRA are summarized in this ROD in Sections 2.7.8 and 2.9, respectively.

The RI/BRA determination of no complete exposure pathways and/or no unacceptable risks to human health and the environment was used as a basis for the subsequent 2014 *Proposed Plan for No Further Action for the Inaccessible Soil Operable Unit Associated with the Group 1 Properties at the St. Louis Downtown Site* (PP) recommendation by the USACE of No Further Action for ISOU media at Group 1 Properties evaluated in the RI/BRA. Additionally, No Further Action was recommended in the PP for properties not evaluated in the RI/BRA because of the RI WP determination that ISOU media on the property were not impacted by past MED/AEC operations. The Group 1 Properties are included in this ROD as properties that clearly pose no unacceptable risks above background to human health and the environment, based on the findings and determinations made in both the RI WP and the RI/BRA. The remaining properties associated with the SLDS ISOU not included in this ROD as a Group 1 Property (henceforth referred to as "Group 2 Properties") are being separately evaluated following the CERCLA process. If no unacceptable risks are determined for any Group 2 Properties, those properties could also be recommended for No Further Action for ISOU media. Identification of individual SLDS properties with respect to specific operable units, as well as those included in this ROD, is presented in Table 2-3.

2.5 COMMUNITY PARTICIPATION

The community has been provided opportunities to be involved with the decision process regarding the selected alternative for the ISOU associated with the Group 1 Properties at the SLDS. The USACE maintains a website with current information about the status of the FUSRAP SLDS areas and historical documentation (www.mvs.usace.army.mil). The Administrative Record, which contains the documentation used to select the response action, is available at the following locations:

St. Louis Public Library
Government Information Room
1301 Olive Street
St. Louis, Missouri 63103

U.S. Army Corps of Engineers St. Louis District
FUSRAP Project Office
8945 Latty Avenue
Berkeley, Missouri 63134

The documents describing the results of the RI/BRA process at the ISOU and the subsequent determination of No Further Action for the Group 1 Properties were made available to the public for review and comment at the information repositories noted previously. The following documents were issued by the USACE:

- RI/BRA Report. This document, which was published by the USACE in 2012, describes the nature and extent of contamination of inaccessible soil, soil on buildings and structural surfaces, and sediment inside of sewer lines at all Mallinckrodt plant properties and VPs associated with the ISOU. This RI/BRA Report includes the BRA that evaluated the potential risk to human health and the environment from contaminants associated with prior MED/AEC activities at the SLDS.

Table 2-3. St. Louis Downtown Site Mallinckrodt Plant and Vicinity Property Operable Unit Matrix

Property	Current Property Name	Accessible Soil and Ground-Water Operable Unit	Inaccessible Soil Operable Unit		Comments
			Group 1 Property Included in this ROD for No Further Action for ISOU Media	Property Not Included in this ROD (Retained for Separate Evaluation for Further Action for ISOU Media)	
Mallinckrodt Plant Properties					
Plant 1	Mallinckrodt LLC	✓		✓	
Plant 2	Mallinckrodt LLC	✓		✓	
Plant 6	Mallinckrodt LLC	✓		✓	
Plant 7N	Mallinckrodt LLC	✓		✓	*a*
Plant 10 (Formerly Plant 4)	Mallinckrodt LLC	✓			
Security Gate 49	Mallinckrodt LLC	✓	✓		
Industrial/Commercial Vicinity Properties					
DT-2	City Property	✓		✓	
DT-4 North	Gunther Salt North	✓		✓	
DT-4 South	Gunther Salt South	✓	✓		*b*
DT-6	Heintz Steel and Manufacturing	✓		✓	
DT-8	PSC Metals Inc.	✓	✓		
DT-10	Thomas and Proetz Lumber Company	✓		✓	
DT-15	Metropolitan St. Louis Sewer District Lift Station	✓	✓		
DT-29	Midtown Garage	✓	✓		
DT-34	Hjersted	✓	✓		
South of Angelrodt Property Group					
DT-5	Ameren UE	✓	✓		*b,c*
DT-13	Cash Scrap Metals	✓	✓		*c*
DT-14	Cotto-Waxo	✓	✓		*c*
DT-16	Star Bedding Company	✓	✓		*c*
DT-17	Christiana Court LLC	✓	✓		*c*
DT-18	City of St. Louis (formerly Curly Collins Recycling)	✓	✓		*b,c*

Table 2-3. St. Louis Downtown Site Mallinckrodt Plant and Vicinity Property Operable Unit Matrix

Property	Current Property Name	Accessible Soil and Ground-Water Operable Unit	Inaccessible Soil Operable Unit		Comments
			Group 1 Property Included in this ROD for No Further Action for ISOU Media	Property Not Included in this ROD (Retained for Separate Evaluation for Further Action for ISOU Media)	
West of Broadway Property Group					
Plant 3	Mallinckrodt LLC	✓	✓		*c*
Plant 8	Mallinckrodt LLC	✓	✓		*c*
Plant 9	Mallinckrodt LLC	✓	✓		*c*
Plant 11	Mallinckrodt LLC	✓	✓		*c*
Parking Lots	Mallinckrodt LLC	✓	✓		*c*
DT-20	Richey	✓	✓		*c*
DT-21	Farve	✓	✓		*b,c*
DT-22	Tobin Electric	✓	✓		*b,c*
DT-23	Worth Industries	✓	✓		*c*
DT-24	Bremen Bank	✓	✓		*b,c*
DT-25	Eirten's Parlors	✓	✓		*b,c*
DT-26	United Auto Workers Local 1887	✓	✓		*b,c*
DT-27	Dillion	✓	✓		*c*
DT-28	Challenge Enterprises	✓	✓		*b,c*
DT-30	Zamzow Manufacturing	✓	✓		*b,c*
DT-35	Factory Tire Outlet	✓	✓		*c*
DT-36	OJM Inc.	✓	✓		*c*
Railroad Vicinity Properties					
DT-3	Norfolk Southern Railroad	✓		✓	
DT-9 Main Line	Terminal Railroad Association	✓		✓	
DT-9 Rail Yard	Terminal Railroad Association	✓		✓	
DT-9 Levee	Terminal Railroad Association	✓	✓		
TRRA Soil Spoils Area	Terminal Railroad Association	✓		✓	
DT-12	Burlington Northern Santa Fe Railroad	✓		✓	

Table 2-3. St. Louis Downtown Site Mallinckrodt Plant and Vicinity Property Operable Unit Matrix

Property	Current Property Name	Accessible Soil and Ground-Water Operable Unit	Inaccessible Soil Operable Unit		Comments
			Group 1 Property Included in this ROD for No Further Action for ISOU Media	Property Not Included in this ROD (Retained for Separate Evaluation for Further Action for ISOU Media)	
Roadway Vicinity Properties (Continued)					
DT-11	McKinley Bridge (Jointly owned by the Missouri Department of Transportation and the Illinois Department of Transportation)	✓		✓	
DT-19	City of St. Louis-Owned Roads	✓		✓	
DT-33	Missouri Department of Transportation-Owned Roads	✓		✓	

[a] If inaccessible media are found containing MED/AEC contamination, Plant 7W will be addressed with the Group 2 Properties.

[b] Property's inaccessible media has been determined to be non-impacted during previous investigations. Although no risk assessment was conducted for the property in the ISOU RI/BRA, the property is retained for inclusion as a Group 1 Property in the ROD for No Further Action.

[c] Property group was evaluated collectively in the RI nature and extent evaluation and in the BRA. Therefore, although individual properties belonging to the group are indicated as being included in this ROD, it is the property group itself that is retained for this ROD.

Notes:

Check mark indicates that the property is included in the OU category indicated by the column header and subheader.

- PP. This document, which was published by USACE in 2014, summarizes site and RI/BRA information regarding the SLDS, all properties associated with the ISOU, and the Group 1 Properties associated with the ISOU, and presents the rationale for determination of No Further Action for ISOU media at the Group 1 Properties as the preferred alternative. The USACE also solicited public comment regarding the preferred alternative presented in this PP.

The notice of availability for the RI/BRA Report, PP, and all other supporting documents was published in the *St. Louis Post-Dispatch* on January 12, 2014. A public comment period began on January 13, 2014. A public meeting was held on January 30, 2014, at Clay Elementary School in St. Louis, Missouri, to present the PP and the USACE's preferred remedy to interested members of the community. A transcript of the public meeting was prepared and is included as part of the Administrative Record. Responses to the comments received from the public are provided in the Responsiveness Summary included as Section 3.0 of this ROD.

2.6 SCOPE AND ROLE OF OPERABLE UNIT

This ROD completes the CERCLA process by establishing the selected alternative for ISOU media at the Group 1 Sites as No Further Action. This ROD has been prepared in accordance with the USEPA's 1999 guidance document titled *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents.*

This section is intended to discuss how the selected alternative of No Further Action for ISOU media associated with Group 1 Properties at the SLDS fits into the overall SLDS strategy. The selected alternative established by this ROD, when coupled with the other actions at the SLDS, will result in complete coverage of the Group 1 Properties with respect to addressing MED/AEC contamination.

As described previously in Section 2.4, the SLDS is divided into two OUs: (1) the Accessible Soil and Ground-Water OU and (2) the ISOU. The 1998 ROD addresses the Accessible Soils and Ground-Water OU, but does not address contamination in inaccessible areas. Inaccessible media were excluded from the scope of the 1998 ROD, because they did not present a significant threat in their current configuration, and because activities critical to the continued operation of the Mallinckrodt facility prevented excavation beneath permanent structures. These excluded media comprise the ISOU. In general, the permanent structures consisted of permanent buildings, structures, sewers, roads, and railroads.

To expedite and simplify the CERCLA planning process, the ISOU media are being addressed under multiple sets of CERCLA documents. This ROD establishes the Selected Alternative of No Further Action for the following Group 1 Properties, at which no unacceptable human health or environmental risks are posed by ISOU media: Security Gate 49, DT-4 South, DT-9 Levee, DT-15, DT-29, DT-34, the South of Angelrodt Property Group (i.e., DT-5, DT-13, DT-14, DT-16, DT-17, DT-18), and the West of Broadway Property Group (i.e., Plant 3, Plant 8, Plant 9, Plant 11, Mallinckrodt Parking Lots, DT-20, DT-21, DT-22, DT-23, DT-24, DT-25, DT-26, DT-27, DT-28, DT-30, DT-35, and DT-36). The remaining properties associated with the ISOU (i.e., those not addressed by this ROD) will be addressed in future CERCLA documents.

2.7 SITE CHARACTERISTICS

2.7.1 Topography, Drainage, and Surface Water

St. Louis is located in an area of gently rolling uplands that feature low hills and broad, shallow valleys that gradually flatten out to the north and east in Illinois. The hilly terrain is cut by several broad river valleys (up to 10 miles wide) with steep bluffs. The Illinois and Mississippi Rivers converge northwest of St. Louis and are joined downstream by the Missouri River from the west. Both the Mississippi and the Missouri Rivers have cut large valleys with wide floodplains. St. Louis is built on bluffs that rise above the western banks of the Mississippi River, 13 miles downstream of the Missouri River and Mississippi River confluence.

At the SLDS, surface elevations range from approximately 430 ft (131 m) above mean sea level (amsl) in the southwestern part of the site to 420 ft (128 m) amsl near the Mississippi River. The SLDS ground surface slopes at an average of 0.4 percent eastward toward the Mississippi River. An extensive levee system parallel to the Mississippi River has been constructed near the riverbank to protect the city from flooding. The top of the Mississippi River levee is approximately 438 ft (134 m) amsl and is designed to protect against a 500-year flood event. Surface drainage is directed through ditches and catchment basins into an extensive storm drainage system that discharges to a nearby MSD sewage treatment plant (i.e., the Bissell Plant). The surface water is treated at the plant prior to discharge to the Mississippi River. Much of the SLDS area is covered with concrete or asphalt, which interferes with natural surface-water runoff and ground-water recharge mechanisms, according to the 1993 BRA. No permanent surface-water bodies exist within the boundaries of the SLDS.

The Mississippi and Missouri Rivers are the major water supply sources for the St. Louis area. All of the St. Louis area municipal water intakes are located upstream of the SLDS except for the Illinois-American Water Plant, which 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 8 miles downstream of the SLDS on the opposite (east) bank of the Mississippi River.

2.7.2 Site Geology and Hydrogeology

A generalized stratigraphic column for the SLDS is shown on Figure 2-5. Surficial fill with an average thickness of 13 ft (4 m) is present over most of the property. The fill consists of brick; concrete; organic material; and coal slag with minor sand, coal ash, coal cinders, and silt. Underlying the fill, two depositional units are identified based on differences in their geologic properties: (1) an upper unit, consisting of clay and silty clay with interbedded clay, silt, and sandy silt, ranging in thickness from 10 to 17 ft (3 to 5 m); and (2) a lower unit comprised of sandy silt, silty sand, and gravelly sand deposits ranging in thickness from 0 to 60 ft (0 to 18 m).

The uppermost bedrock unit at the SLDS is the Mississippian-Age Ste. Genevieve Formation, which consists of moderately fractured limestone with some dolomite. The erosional surface of the bedrock dips eastward from a depth of approximately 19 ft (6 m) below ground surface (bgs) at the western edge of the SLDS to a depth of approximately 80 ft (24 m) bgs near the Mississippi River.

Ground water at the SLDS is found within the following three hydrostratigraphic units (HUs), in order of increasing depth (Figure 2-5):

- HU-A, which consists of fill and underlying fine-grained deposits (primarily silty clay, clay, and silt);

- HU-B, also referred to as the Mississippi Alluvial Aquifer, which predominantly consists of somewhat coarser-grained deposits (sandy silt, silty sand, sand, and gravelly sand); and
- HU-C, the limestone bedrock.

No known drinking water wells exist in the vicinity of the SLDS. City of St. Louis Ordinance 66777 explicitly forbids the installation of wells into the subsurface for the purposes of using the ground water as a potable water supply. The expected future use of SLDS ground water is not anticipated to change from its current use. The USACE continues to evaluate ground-water impacts at the SLDS under the 1998 ROD.

2.7.3 Ecological and Cultural Resources

The SLDS is located in the Oak-Hickory-Bluestem Parkland section of the Prairie Parkland Province. Pre-settlement vegetation is characterized by deciduous woodlands intermixed with open prairie. Today, the ecological resources at the SLDS are limited because of the site's location within an urban area of concentrated industrial and commercial developments. Site vegetation consists of a mixture of prairie species, disturbance-related aggressive species, and species typical to old fields, including wild carrot, aster, clover, dandelion, milkweed, ragweed, and various grasses, as reported in the 1993 BRA.

Vertebrate fauna of the St. Louis area consist of species that have adapted to urban encroachment, including mammals (e.g., mice, opossum, eastern cottontail rabbit, gray squirrel, and eastern mole), according to the 1993 BRA. Birds that inhabit the urban environment include the Canada goose, rock dove, mourning dove, American crow, American robin, and northern cardinal, per the 1993 BRA.

No wetlands occur within the SLDS boundaries, although according to the 2008 U.S. Fish and Wildlife Service's (USFWS's) National Wetlands Inventory, a portion of the area directly north of the McKinley Bridge and east of the St. Louis Flood Protection Levee System for the Mississippi River is classified as palustrine wetlands (i.e., non-tidal wetlands that are substantially covered with emergent vegetation), which are commonly found along the Mississippi River. Based on the "Environmental Assessment for Biota" presented in the 1993 BRA, and the conclusions of the screening level ecological risk assessment (SLERA) conducted as part of the RI/BRA, no potentially sensitive habitats for biota occur either on site or adjacent to the SLDS, as documented in the 1993 BRA and the RI/BRA Report.

Available data indicate no archaeological sites in the area. Consultation with the State Historic Preservation Officer was conducted during the 1998 ROD. According to the 1998 FS, due to the intensive industrial use of the site, it is unlikely that any significant archeological sites exist at the SLDS. Two sites listed in the March 1992 edition of the National Register of Historic Places (NRHP) for the State of Missouri exist within 1 mile of the SLDS. The first site is the Bissell Street Water Tower, located northwest of the SLDS; and the second site is the Murphy-Blair Historic District, located 0.5 mile southwest of the SLDS. Additionally, an official historic district (Hyde Park) is located west and northwest of the SLDS.

2.7.4 Conceptual Site Model

During the RI/BRA, a conceptual site model (CSM) was developed that identified complete and potentially significant pathways by which human and environmental receptors could be exposed to contaminants in ISOU media under industrial land use. The CSM assumes that current and future land use for the SLDS is industrial/commercial in an urban setting. The land use at some levee areas of the SLDS is considered recreational because of the presence of the St. Louis Riverfront Trail that

has been developed along the top of the levee. Under current land use, exposure pathways are evaluated assuming current physical configurations of contaminants existing in inaccessible soil areas (e.g., beneath or adjacent to buildings and structures), sediment inside of sewers and soil adjacent to sewers, and soil on building and structural surfaces. Under future land use, exposure pathways are evaluated assuming scenarios in which the inaccessible soil areas become accessible due to removal or gross degradation of ground cover (i.e., in the forms of buildings/structures, roadways, railroads, asphalt/concrete pavement, etc.). Complete and potentially significant exposure pathways are retained for further quantitative evaluations in the BRA. A complete exposure pathway is comprised of each of the following elements:

- a contaminant source,
- a release/transport mechanism,
- an exposure medium (or point) at which humans could contact the contaminated medium, and
- an exposure route.

Each of the previous elements of the CSM is presented schematically in Figure 2-6 for human and ecological receptors. Figure 2-6 also identifies the following types of potential exposure pathways assumed for both the current and reasonably anticipated future land use scenarios: (1) complete and potentially significant, (2) potentially complete but insignificant, and (3) incomplete.

The CSM (Figure 2-6) identifies main categories of potential sources of contamination and exposure as being inaccessible soil beneath ground cover, inaccessible soil with no ground cover, soil on building/structural surfaces, and sewers that may have received past MED/AEC-related discharges, the latter of which includes sediment inside of sewer lines and soil adjacent to sewer lines.

Release and environmental transport of contaminants away from a source can occur such that downgradient or downwind human and/or environmental receptors could also be adversely affected or contaminated. For all ISOU source media, the potentially significant transport pathways include air transport, subsurface water transport, and surface runoff transport.

As will be discussed in Sections 2.7.7 and 2.7.8, primary contaminants detected at the ISOU include radioactive isotopes of uranium, thorium, and radium. These contaminants were the focus of the RI conducted for inaccessible soil, soil on structural surfaces, sediment inside of sewer lines, and soil adjacent to sewer lines. Generally, the mobilities of these contaminants are greatly influenced by the chemical properties of the contaminants and the geochemical characteristics of the SLDS. Based on an evaluation of the chemical-specific properties of the contaminants and the geochemical characteristics of the ISOU, radium, thorium, and uranium isotopes are expected to persist in the environment, but are relatively immobile in environmental media. Additionally, the presence of various types of ground cover over most of the inaccessible soil areas minimizes the potential for environmental release and transport of these contaminants in the ISOU. Examples of ground cover at the ISOU that inhibit water infiltration to the subsurface include asphalt and concrete pavement, and building/structural surfaces (including roads and railroads).

If contaminant transport were to occur, this would typically result in increasing dilution, dispersion, and attenuation of contaminant concentrations with increasing distances away from the source. In other words, the effects of environmental transport would cause contaminant concentrations to decrease with increasing distances away from the source. Therefore, the BRA conservatively focused on estimating risks at the source, which are typically higher than those

estimated at downgradient or downwind locations. Additionally, risk estimates calculated at the source have less uncertainty than those estimated using environmental fate and transport modeling to determine risks at downgradient or downwind locations. This is because of the additional layers of uncertainty introduced by assumptions applied in modeling that are absent when estimating risks at the source.

Contamination in the ISOU source media may or may not be available for human and ecological exposures at the Group 1 Properties, depending on whether or not a physical barrier to exposure exists. At the SLDS, these physical barriers are present at inaccessible soil areas in the forms of various types of ground cover. These barriers minimize or prevent vertical migration to the water table. Generally, contaminants in inaccessible soil beneath impermeable ground cover that cannot migrate vertically to the water table because of reduced or no water infiltration will not be subject to subsequent horizontal transport in the water table. Barriers also minimize or eliminate release of contaminants to the air and transport to downwind areas. Therefore, the presence of ground cover minimizes or prevents contamination of areas located downgradient or downwind of the ISOU source media, as well as receptor exposures in those areas. However, once a barrier is removed, eroded, or damaged, contaminants in the exposure medium could become available for migration and exposure.

Exposures to humans and ecological receptors typically occur through similar routes. Under the industrial land use predominant at the SLDS, these exposure routes may include incidental ingestion of soil, dermal (skin) contact with soil, soil inhalation via windblown dusts, and external radiation.

Human receptors for evaluation in the BRA were identified in the CSM based on categories of land use considered at the SLDS Group 1 Properties (i.e., industrial, recreational, and hypothetical residential gardener land uses). Figure 2-6 presents these receptors as the following: industrial worker, construction worker, utility worker, building maintenance worker, sewer maintenance worker, sewer utility worker, recreational user of the St. Louis Riverfront Trail, and the hypothetical resident gardener (adult and child). Discussions of these receptors as they pertain to the Group 1 Properties are provided in Section 2.9.1.1.

2.7.5 Sampling Strategy for the Inaccessible Soil Operable Unit Remedial Investigation

ISOU RI sampling began in June 2009 and ended in August 2010, with the majority of work being completed between October 2009 and May 2010.

Some properties had no inaccessible media impacted by past MED/AEC operations at the SLDS. The basis for this identification of inaccessible media as non-impacted (i.e., no potential for MED/AEC contamination) is: (1) previous soil data indicated contamination levels were below background or the 1998 ROD RGs, or (2) the structure causing the soil to be inaccessible was constructed prior to MED/AEC processing operations. Because the properties' inaccessible media were determined to be non-impacted, the properties were not sampled during the ISOU RI. In addition, no existing data for the inaccessible media are available from previous investigations. Therefore, these properties were not evaluated in the ISOU RI/BRA. Properties with no impacted inaccessible media and no sample data, which are included in this ROD, include the following:

- DT-4 South,
- South of Angelrodt Properties DT-5 and DT-18, and
- West of Broadway Properties Mallinckrodt parking lots, DT-21, DT-22, DT-24, DT-25, DT-26, DT-28, and DT-30.

For the Group 1 Properties investigated and evaluated in the RI/BRA, the general strategy regarding the radiological survey and sampling activities conducted at the Group 1 Properties are listed as follows and are discussed in this section:

- inaccessible surface and subsurface soil sampling;
- radiological structure surveys; and
- sewer investigation.

Table 2-4 summarizes the ISOU RI characterization activities, by sample media, and the number of locations sampled at each of the Group 1 Properties.

2.7.5.1 Inaccessible Surface and Subsurface Soil Sampling

Soil sampling at the Group 1 Properties was conducted in the inaccessible soil areas to determine the nature and extent of radiological contamination. Soil investigations were conducted at systematic, biased, and/or random soil sampling locations in inaccessible areas. Soil investigations consisted of surface (typically below ground cover) and subsurface soil sampling. All soil samples were analyzed for radionuclides, while soil samples collected from some locations within the boundary of the former uranium-ore processing area were also analyzed for metals.

Inaccessible soil considered non-impacted by the USACE (per the RI WP) was not subjected to additional sampling. As such, no additional sampling for inaccessible soil was performed at DT-4 South, DT-29, the South of Angelrodt Property Group (DT-5, DT-13, DT-14, DT-16, and DT-18) or the West of Broadway Property Group (Plants 3, 8, 9, and 11 and the Mallinckrodt parking lots, DT-20, DT-23, DT-24, DT-27, DT-35, and DT-36).

2.7.5.2 Gamma Walkover Surveys

GWSs were conducted in indoor and outdoor areas that had the potential for MED/AEC-related radiological soil contamination. GWSs were conducted using a sodium-iodide (NaI) gamma scintillation detector coupled with a global positioning system (GPS) unit when possible in order to record both gamma radiation readings and geographic position data. GWSs were recorded manually at locations where GPS had limited effectiveness. Surveys were focused on inaccessible soil areas beneath buildings, permanent structures, railroads, and roadways; and the results were used to identify biased soil sample locations.

2.7.5.3 Radiological Structure Surveys

According to the RI WP, the ISOU RI survey activities for buildings were determined on a property-by-property basis using various information, including prior radiological survey data, construction date of the structure, use of the structure by the MED/AEC, proximity to accessible soil remediation activities, and distance from MED/AEC operational areas. Radiological surveys included scanning for total alpha and beta surface activity and obtaining fixed-point measurements for total alpha and beta surface activity using portable radiological survey equipment. Building and structure surfaces surveyed included roofs, exposed exterior and interior surfaces, air vents, vertical and horizontal piping, and piping supports. The scoping surveys were biased, focusing on areas that are prone to accumulate contamination (e.g., horizontal surfaces, depressions, cracked surfaces, rusted or unpainted surfaces, intake and exhaust vents).

Table 2-4. Remedial Investigation Characterization Activities by Sample Media and Number of Sampling Locations at Group 1 Properties

Property Area	Number of Inaccessible Soil Sampling Locations			Number of Building Surfaces Surveyed			Number of Sewer Sampling Locations
	Systematic or Random Sampling	Biased Soil Sampling	GWS at Building, Roadway, or Railroad	Interior	Exterior	Rooftop	Adjacent Soil Sampling
Security Gate 49	0	2	1	Non-impacted [a]			No sewers present
DT-4 South	Non-impacted [a]			Non-impacted [a]			Non-impacted [a]
DT-8	41	8	9	5	6	1	3
DT-9 Levee	5	1	1	No buildings; sewers addressed with property areas			
DT-15	4	0	1	Non-impacted [a]			Location identified with DT-8
DT-29	Non-impacted [a]			Non-impacted [a]			Non-impacted [a]
DT-34	Non-impacted [a]			Non-impacted [a]			Non-impacted [a]
South of Angelrodt Property Group	Non-impacted [a]			0	1	1	Non-impacted [a]
West of Broadway Property Group	0	2	0	0	12	9	Non-impacted [a]
Total Sample Locations	**50**	**13**	**12**	**5**	**19**	**11**	**3**

[a] The specific media (inaccessible soil, soil on buildings, or soil adjacent to sewer lines) at the property were previously determined to be non-impacted as documented in the RI WP; therefore, no RI sampling was conducted.

Based on the evaluation conducted in the RI WP, the buildings at the following Group 1 Properties were determined to be non-impacted: Security Gate 49, DT-4 South, DT-15, DT-29, and DT-34. Buildings determined to be non-impacted were not surveyed during the ISOU RI. Additionally, no buildings are present at DT-9 Levee.

2.7.5.4 Sewer Investigation

Soil and sediment samples associated with sewers were collected and analyzed to obtain sufficient and representative data to determine the extent of radiological and metals contamination associated with sewers. Specifically, two types of samples were collected:

- sediment samples from manholes and surface drains (grate inlets), and
- soil samples from areas adjacent to sewer lines.

The investigation included sewers that were used for MED/AEC operations, as well as sewers that could contain MED/AEC contamination due to receiving runoff from contaminated areas. Sediment samples were collected from manholes and surface drains, where there was sufficient sediment volume for a sample. At the Group 1 Properties, three sediment sample locations were proposed in the RI WP for sampling at DT-8. However, two of the locations could not be sampled due to lack of sediment. The third location that was planned for sediment sampling in the RI WP could not be located during the field investigation. Sediment sampling was also conducted in manholes located upstream (west) of the Mallinckrodt facility to provide a background dataset for determining site-specific sewer sediment background values. Soil samples adjacent to sewer lines were collected at representative sections of sewer pipe, as well as adjacent to areas of the pipe where leakage was suspected based on historical maps. Samples were collected approximately 2 ft (0.6 m) away from the sewer at intervals 2 ft (0.6 m) above the base of the sewer line; 0 to 2 ft (0 to 0.6 m) below the base of the sewer line; and 2 to 4 ft (0.6 to 1.2 m) below the base of the sewer. Soil samples collected adjacent to the sewer line at DT-8 were analyzed for metals and radionuclides.

2.7.5.5 Data Validation and Quality Assessment

Prior to preparing the RI/BRA, existing data were evaluated to determine whether they were of adequate quality for use in quantifying radiological risk and dose. Data judged to be of adequate quality were further reviewed to determine whether detection limits were sufficiently low for the intended risk assessment. Data quality is generally assured through the implementation of standard operating procedures during sample collection and sample analysis, quality control checks, and data review and validation.

Radiological data generated by the onsite USACE FUSRAP Laboratory and metals data generated by Test America Laboratory in St. Louis were validated at a rate of 5 percent in accordance with the USACE's 2000 *Sampling and Analysis Guide for the St. Louis Site* (SAG) and the RI WP. Data verification was performed on the remainder of all data that were not validated. Radiological split sample data generated by the offsite, third-party USACE QA laboratory (Test America in St. Louis) were verified before inclusion in the Quality Control Summary Report (QCSR) (Appendix B of the RI/BRA Report).

As discussed in the Data Quality Assessment Summary of the RI/BRA Report QCSR, all validated/verified data were determined to be usable, with data qualifications and reason codes being applied due to minor issues. Minor data issues resulted in the qualification of some detect and non-detect results as being estimated with appropriate USEPA qualification flags.

2.7.6 Known and Suspected Sources of Contamination

The known and suspected sources of radiological and metals contamination of ISOU media, which are the subject of this ROD, are the result of historical MED/AEC operations at the SLDS. From 1942 to 1957, under contract to the MED/AEC, Mallinckrodt processed uranium feed materials in support of the nation's early nuclear program. The work was conducted at Plants 1, 2, 6, 7, and 10 (formerly Plant 4) of the former Mallinckrodt Chemical Works (Figure 2-2). The MED/AEC work conducted by Mallinckrodt included the development of uranium-processing techniques and the production of uranium metal. The contractual work from 1942 to 1947 was carried out under the MED. In 1947, the contract was transferred to the newly formed AEC and remained under AEC until operations ceased at the SLDS in 1957, according to the ORNL's 1981 report, *Radiological Survey of Mallinckrodt Chemical Works, St. Louis, Missouri.*

Contamination of inaccessible soils (including soil adjacent to sewer lines) beneath buildings/structures constructed at the Group 1 Properties subsequent to past MED/AEC processes would have occurred prior to the construction of those features. Contamination of inaccessible soil beneath railroads and roadways likely resulted from spillage of ores and wastes during transport via trains or trucks. Contaminated soil on interior/exterior building and structural surfaces located at or downwind of the former processing areas could be the result of airborne fugitive dusts generated naturally by wind agitation of contaminated soil, or via manmade activities such as excavation and construction, demolition, and vehicular movements that have occurred over the years. Generally, according to the 1993 BRA, contamination of VPs associated with the ISOU likely resulted from movement of materials during underground utility, road, or other construction activities in the area and from spillage and fugitive dusts associated with truck or train transport — particularly on haul roads, railroads, and adjacent properties between the main processing sites and the storage sites.

Past MED/AEC waste flows from drainage lines originating from Plants 1 and 6 buildings in the former uranium processing area could potentially have resulted in sediment contamination inside of the sewer at DT-8. Cracks in that sewer line could then have allowed for the release of contaminants inside of the sewer to migrate into the adjacent soil outside of the sewer.

2.7.7 Types of Contaminants and Affected Media

The principal contaminants of ISOU media at the Group 1 Properties are radiological and decay-chain contaminants and metals associated with past MED/AEC uranium-ore processing activities that occurred at the Mallinckrodt plants. The ISOU contaminants at the SLDS are expected to be the same contaminants identified for the Accessible Soil and Ground-Water OU in the 1998 ROD. This expectation is based on knowledge of historical MED/AEC operations and the fact that releases from those operations and subsequent environmental migrations resulted in contamination of both accessible soil areas and ISOU media at the SLDS. Therefore, the following are primary radiological and decay chain contaminants that are included in this ROD: Ac-227, Pa-231, Ra-226, Ra-228, Th-228, Th-230, Th-232, U-235, and U-238.

Based on determinations made in the 1998 ROD, MED/AEC-related metals contamination of soil at the SLDS is limited to the former uranium-ore processing area. This is based on a detailed analysis conducted during the development of the 1998 ROD, in which it was determined that MED/AEC metals contamination at the SLDS is limited to the former uranium-ore processing area. Since none of the Group 1 Properties are in the former uranium-ore processing area, metal contaminants were not evaluated in inaccessible soil at the Group 1 Properties. However, metals associated with uranium ore (i.e., arsenic, cadmium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, thorium, uranium, vanadium, and zinc) were planned for investigation in the RI WP for

sediment inside of the sewer line at DT-8, as well as for soil adjacent to that sewer. This sewer, which runs along the southern side of Salisbury Street, is the only sewer at the Group 1 Properties investigated during the RI. Although MED/AEC-related activities were never conducted at DT-8, the sewer on this property may have been impacted by historical discharges from the Mallinckrodt facility (Plants 1 and 6) located upstream. None of the sewers at the other Group 1 Properties were impacted by historical discharges from the Mallinckrodt facility.

As previously stated, affected media being addressed as part of the scope of the ISOU include inaccessible soil (including soil adjacent to sewer lines), soil on building and structural surfaces, and sediment inside of sewer lines. These potentially affected media are also the subject of this ROD; however, as an unavoidable deviation from the RI WP, the sewer sediment at DT-8 could not be investigated. As discussed in Section 2.7.5, three sediment locations had been proposed in the RI WP for sampling at the DT-8 sewer, but during the RI, samplers found very little sediment at two of the locations, the amounts of which were determined to be insufficient for collection and analysis. No sediment could be collected from the third planned sampling location because access to the inside of the sewer line at that location could not be located.

2.7.8 Nature and Extent of Contamination

This section presents the results of the ISOU RI sampling, existing data from previous investigations, and relevant data collected as part of ongoing activities for soil addressed by the 1998 ROD used to define the nature and extent of contamination in ISOU media at the Group 1 Properties. For soil, this was done through comparisons of individual sample concentrations to health-conservative, risk-based preliminary remediation goals (PRGs) established by the USEPA for industrial land use (i.e., for inaccessible soil and soil adjacent to sewers) and for residential land use. Radiological PRGs were applied to inaccessible soil data comparisons, whereas both radiological and metal PRGs were applied to data comparisons for soil adjacent to the sewer at DT-8. SLDS-specific radiological PRGs were derived for comparisons with gross alpha measurements of soil on interior and exterior building/structural surfaces. Generally, all PRGs used are numerical values equivalent to the USEPA's lowest acceptable human health risk level and are health-conservative because they do not consider contributions from background. Comparisons of the risk-based PRGs for soil with SLDS soil background levels demonstrate the health-conservative nature of the PRGs in that the PRGs for Ra-226, Ra-228, and U-235 are less than corresponding SLDS background values (BVs) used for evaluations in the RI/BRA Report.

SLDS soil BVs were used in the RI/BRA to facilitate risk characterization efforts by providing a reference point for determining if risks calculated in the BRA at the Group 1 Properties are a result of historical MED/AEC releases or if they are due to releases from other anthropogenic activities. BVs were calculated from background soil data acquired for surface and subsurface soil samples collected from 12 locations within and around the SLDS study area. As such, the BVs represent conditions posed by the presence of the surficial fill underlying the SLDS, which consists of brick, concrete, organic material, and coal slag with minor sand, coal ash, coal cinders, and silt, all of which contribute background from naturally occurring radioactive materials. A generalized stratigraphic column for the surficial fill present at the SLDS is shown on Figure 2-5. BVs for some radionuclides at the SLDS may be influenced by the presence of mixed fill materials and other unknown materials from surrounding urbanized industrial sources. All risk-based PRGs and BVs are presented in tabular form and discussed in greater detail in the RI/BRA Report.

In addition to characterization of contaminant nature and extent, data comparisons with PRGs were used to identify contaminants from those listed in Section 2.7.7 that would be retained for quantitative risk evaluations in the BRA. In the RI/BRA, any contaminant detected in an ISOU

medium with at least one concentration exceeding the corresponding PRGs, across all of SLDS, was retained for quantitative risk evaluations in the BRA. These contaminants were identified in the RI/BRA as contaminants of potential concern (COPCs).

2.7.8.1 Inaccessible Soil

The evaluation of the nature and extent of contamination in inaccessible soil (including soil adjacent to sewer lines) included data collected from the ISOU RI sampling activities, inaccessible soil data collected from previous characterization activities, and relevant data collected at the SLDS as part of ongoing activities for soil addressed by the 1998 ROD. ISOU RI sampling was conducted in the inaccessible media as described in Section 2.7.5. Previous characterization activities included soil sampling at locations within the typical inaccessible soil area boundary (e.g., the building foundation and extending out 5 ft [1.5 m]). Data collected during pre-1990 investigations were used to identify potential areas for investigation in the RI WP, but were not included for the ISOU RI evaluation because they could not be replicated due to coordinate issues. Data from ongoing activities consist of samples of inaccessible media during accessible soil RAs. The pre-1990 investigations are documented by Bechtel National Institute in the following documents:

- *Preliminary Radiological Survey Report for the St. Louis Terminal Railroad Property in St. Louis, Missouri* (1989),
- *Preliminary Radiological Survey Report for the Chicago, Burlington, and Quincy Railroad Property in St. Louis, Missouri* (1989), and
- *Radiological, Chemical, and Hydrogeological Characterization Report for the St. Louis Downtown Site, St. Louis, Missouri* (1990).

Determination of the nature and extent of contamination of inaccessible soil at the Group 1 Properties was based on individual sample data comparisons with risk-based PRGs. Data comparisons considered both industrial and residential land use by utilizing USEPA-established PRGs for outdoor industrial worker and hypothetical future residential gardener receptor scenarios, respectively.

2.7.8.2 Soil on Building and Structural Surfaces

Radiological survey data collected during the ISOU RI were used to evaluate the nature and extent of soil contamination on building/structural surfaces.

The ISOU RI scoping surveys consisted of scanning for alpha and beta surface activity and fixed-point measurements for total alpha and beta activity in accordance with the RI WP. The buildings surveyed are shown on figures provided in Appendix E of the RI/BRA Report. The individual scoping survey results are presented in Appendix F of the RI/BRA Report. For soil on interior and exterior structural surfaces, site-specific, risk-based, industrial worker PRGs were derived by the USACE for comparison with gross alpha data.

2.7.8.3 Identification of Contaminants of Potential Concern for the Baseline Risk Assessment

Table 2-5 summarizes the results of data comparisons with industrial PRGs, residential PRGs, and the SLDS BVs for inaccessible soil at the Group 1 Properties, as well as for soil adjacent to the sewer line at DT-8. Some Group 1 Properties were determined to be non-impacted in the RI WP. However, at these properties, existing inaccessible soil data were evaluated against the risk-based PRGs as a conservative measure. Detailed, sample-specific data summaries are presented in Appendices E and J of the RI/BRA Report for inaccessible soil and soil adjacent to the sewer line at DT-8, respectively.

Table 2-5. Summary of Radiological Concentrations in Inaccessible Soil at Group 1 Properties [a]

Group 1 Property	Shallowest Depth Sampled (ft)	Deepest Depth Sampled (ft)	Ac-227											
			Average (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Total No. of Samples	No. of Detects	Industrial PRG (11.4 pCi/g)		Residential PRG (2.5 pCi/g)		BV (0.18 pCi/g)	
								No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of BV Exceedances [b]	Frequency of BV Exceedances (%)
Security Gate 49	0.0	6.0	0.12	-0.28	0.53	18	1	0	0%	0	0%	6	33%
DT-4 South	Non-Impacted		Non-Impacted										
DT-8	0.0	8.5	0.08	-0.29	1.21	322	5	0	0%	0	0%	67	21%
DT-8 (Soil Adjacent to Sewer Line)	17.5	32.5	-0.02	-0.35	0.25	10	0	0	0%	NA	NA	1	10%
DT-9 Levee	0.0	49.0	0.00	-0.37	0.41	131	1	0	0%	0	0%	10	8%
DT-15	8.0	50.0	0.02	-0.25	0.41	44	0	0	0%	0	0%	2	5%
DT-29	0.0	2.0	-0.04	-0.09	0.01	2	0	0	0%	0	0%	0	0%
DT-34	0.0	0.5	0.07	0.07	0.07	1	0	0	0%	0	0%	0	0%
South of Angelrodt Property Group [c]	0.0	3.5	0.08	-0.17	0.57	14	0	0	0%	0	0%	4	29%
West of Broadway Property Group [d]	0.0	6.0	0.05	-0.18	0.36	40	0	0	0%	0	0%	6	15%

Group 1 Property	Shallowest Depth Sampled (ft)	Deepest Depth Sampled (ft)	Pa-231											
			Average (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Total No. of Samples	No. of Detects	Industrial PRG (1.25 pCi/g)		Residential PRG (0.437 pCi/g)		BV (1.12 pCi/g)	
								No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of BV Exceedances [b]	Frequency of BV Exceedances (%)
Security Gate 49	0.0	6.0	-0.15	-1.56	0.51	18	0	0	0%	18	100%	0	0%
DT-4 South	Non-Impacted		Non-Impacted										
DT-8	0.0	8.5	0.02	-1.84	3.11	322	1	7	2%	37	11%	8	2%
DT-8 (Soil Adjacent to Sewer Line)	17.5	32.5	0.11	-0.41	0.92	10	0	0	0%	NA	NA	0	0%
DT-9 Levee	0.0	49.0	0.02	-0.96	0.97	131	0	0	0%	12	9%	0	0%
DT-15	8.0	50.0	0.07	-0.95	2.50	44	0	1	2%	7	16%	1	2%
DT-29	0.0	2.0	0.17	0.09	0.25	2	0	0	0%	0	0%	0	0%
DT-34	0.0	0.5	0.16	0.16	0.16	1	0	0	0%	0	0%	0	0%
South of Angelrodt Property Group [c]	0.0	3.5	0.13	-0.32	0.65	14	0	0	0%	2	14%	0	0%
West of Broadway Property Group [d]	0.0	6.0	0.12	-0.40	1.45	40	0	1	3%	3	8%	1	3%

Table 2-5. Summary of Radiological Concentrations in Inaccessible Soil at Group 1 Properties [a]

Group 1 Property	Shallowest Depth Sampled (ft)	Deepest Depth Sampled (ft)	Ra-226											
			Average (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Total No. of Samples	No. of Detects	Industrial PRG (0.0248 pCi/g)		Residential PRG (0.0121 pCi/g)		BV (3.04 pCi/g)	
								No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of BV Exceedances [b]	Frequency of BV Exceedances (%)
Security Gate 49	0.0	6.0	4.13	1.30	10.30	18	18	18	100%	18	100%	11	61%
DT-4 South	Non-Impacted		Non-Impacted										
DT-8	0.0	8.5	2.28	0.50	12.70	322	322	322	100%	322	100%	60	19%
DT-8 (Soil Adjacent to Sewer Line)	17.5	32.5	1.44	0.94	2.19	10	10	10	100%	NA	NA	0	0%
DT-9 Levee	0.0	49.0	1.40	0.65	3.48	131	131	131	100%	131	100%	2	2%
DT-15	8.0	50.0	1.90	1.02	7.21	44	44	44	100%	44	100%	6	14%
DT-29	0.0	2.0	1.11	1.08	1.13	2	2	2	100%	2	100%	0	0%
DT-34	0.0	0.5	2.37	2.37	2.37	1	1	1	100%	1	100%	0	0%
South of Angelrodt Property Group [c]	0.0	3.5	2.06	0.67	5.84	14	13	14	100%	14	100%	2	14%
West of Broadway Property Group [d]	0.0	6.0	1.92	0.91	4.70	40	40	40	100%	40	100%	6	15%

Group 1 Property	Shallowest Depth Sampled (ft)	Deepest Depth Sampled (ft)	Ra-228											
			Average (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Total No. of Samples	No. of Detects	Industrial PRG (0.0538 pCi/g)		Residential PRG (0.0292 pCi/g)		BV (1.00 pCi/g)	
								No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of BV Exceedances [b]	Frequency of BV Exceedances (%)
Security Gate 49	0.0	6.0	0.83	0.28	1.35	18	18	18	100%	18	100%	5	28%
DT-4 South	Non-Impacted		Non-Impacted										
DT-8	0.0	8.5	0.73	-0.02	2.44	322	312	321	100%	321	100%	46	14%
DT-8 (Soil Adjacent to Sewer Line)	17.5	32.5	0.89	0.44	1.20	10	10	10	100%	NA	NA	3	30%
DT-9 Levee	0.0	49.0	0.88	0.06	1.58	131	130	131	100%	131	100%	28	21%
DT-15	8.0	50.0	0.88	0.33	1.96	44	44	44	100%	44	100%	10	23%
DT-29	0.0	2.0	0.59	0.37	0.81	2	2	2	100%	2	100%	0	0%
DT-34	0.0	0.5	0.93	0.93	0.93	1	1	1	100%	1	100%	0	0%
South of Angelrodt Property Group [c]	0.0	3.5	0.70	0.13	1.35	14	14	14	100%	14	100%	3	21%
West of Broadway Property Group [d]	0.0	6.0	0.73	0.31	1.25	40	40	40	100%	40	100%	3	8%

Table 2-5. Summary of Radiological Concentrations in Inaccessible Soil at Group 1 Properties [a]

Group 1 Property	Shallowest Depth Sampled (ft)	Deepest Depth Sampled (ft)	Th-228											
			Average (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Total No. of Samples	No. of Detects	Industrial PRG (121 pCi/g)		Residential PRG (23.4 pCi/g)		BV (1.26 pCi/g)	
								No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of BV Exceedances [b]	Frequency of BV Exceedances (%)
Security Gate 49	0.0	6.0	1.13	0.38	2.16	18	18	0	0%	0	0%	6	33%
DT-4 South	Non-Impacted		Non-Impacted										
DT-8	0.0	8.5	0.93	-0.02	3.22	322	310	0	0%	0	0%	62	19%
DT-8 (Soil Adjacent to Sewer Line)	17.5	32.5	1.02	0.49	1.82	10	10	0	0%	NA	NA	3	30%
DT-9 Levee	0.0	49.0	1.09	0.02	1.97	131	130	0	0%	0	0%	43	33%
DT-15	8.0	50.0	1.13	0.45	2.02	44	44	0	0%	0	0%	14	32%
DT-29	0.0	2.0	1.09	0.49	1.68	2	2	0	0%	0	0%	1	50%
DT-34	0.0	0.5	0.71	0.71	0.71	1	1	0	0%	0	0%	0	0%
South of Angelrodt Property Group [c]	0.0	3.5	0.96	0.26	1.84	14	14	0	0%	0	0%	3	21%
West of Broadway Property Group [d]	0.0	6.0	1.02	0.34	1.96	40	40	0	0%	0	0%	7	18%

Group 1 Property	Shallowest Depth Sampled (ft)	Deepest Depth Sampled (ft)	Th-230											
			Average (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Total No. of Samples	No. of Detects	Industrial PRG (20 pCi/g)		Residential PRG (3.46 pCi/g)		BV (2.18 pCi/g)	
								No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of BV Exceedances [b]	Frequency of BV Exceedances (%)
Security Gate 49	0.0	6.0	3.82	1.26	9.01	18	18	0	0%	7	39%	14	78%
DT-4 South	Non-Impacted		Non-Impacted										
DT-8	0.0	8.5	1.57	-16.00	10.90	322	198	0	0%	47	15%	119	37%
DT-8 (Soil Adjacent to Sewer Line)	17.5	32.5	1.27	1.00	1.86	10	10	0	0%	NA	NA	0	0%
DT-9 Levee	0.0	49.0	1.45	0.50	4.76	131	131	0	0%	2	2%	10	8%
DT-15	8.0	50.0	1.97	0.95	7.80	44	44	0	0%	5	11%	9	20%
DT-29	0.0	2.0	1.18	0.91	1.45	2	2	0	0%	0	0%	0	0%
DT-34	0.0	0.5	2.86	2.86	2.86	1	1	0	0%	0	0%	1	100%
South of Angelrodt Property Group [c]	0.0	3.5	2.15	-0.06	4.99	14	13	0	0%	2	14%	5	36%
West of Broadway Property Group [d]	0.0	6.0	2.09	0.97	7.13	40	40	0	0%	3	8%	14	35%

Table 2-5. Summary of Radiological Concentrations in Inaccessible Soil at Group 1 Properties [a]

Group 1 Property	Shallowest Depth Sampled (ft)	Deepest Depth Sampled (ft)	Th-232											
			Average (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Total No. of Samples	No. of Detects	Industrial PRG (18.9 pCi/g)		Residential PRG (3.07 pCi/g)		BV (1.18 pCi/g)	
								No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of BV Exceedances [b]	Frequency of BV Exceedances (%)
Security Gate 49	0.0	6.0	0.96	0.30	1.73	18	18	0	0%	0	0%	4	22%
DT-4 South	Non-Impacted		Non-Impacted										
DT-8	0.0	8.5	0.78	-0.02	2.44	322	311	0	0%	0	0%	44	14%
DT-8 (Soil Adjacent to Sewer Line)	17.5	32.5	0.84	0.62	1.03	10	10	0	0%	NA	NA	0	0%
DT-9 Levee	0.0	49.0	0.98	0.09	1.81	131	127	0	0%	0	0%	32	24%
DT-15	8.0	50.0	0.99	0.24	2.32	44	44	0	0%	0	0%	11	25%
DT-29	0.0	2.0	0.78	0.50	1.05	2	2	0	0%	0	0%	0	0%
DT-34	0.0	0.5	1.46	1.46	1.46	1	1	0	0%	0	0%	1	100%
South of Angelrodt Property Group [c]	0.0	3.5	0.75	0.18	1.39	14	13	0	0%	0	0%	2	14%
West of Broadway Property Group [d]	0.0	6.0	0.82	0.37	1.43	40	40	0	0%	0	0%	2	5%

Group 1 Property	Shallowest Depth Sampled (ft)	Deepest Depth Sampled (ft)	U-235											
			Average (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Total No. of Samples	No. of Detects	Industrial PRG (34.5 pCi/g)		Residential PRG (3.95 pCi/g)		BV (0.1 pCi/g)	
								No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of BV Exceedances [b]	Frequency of BV Exceedances (%)
Security Gate 49	0.0	6.0	0.20	-0.05	0.68	18	2	0	0%	0	0%	11	61%
DT-4 South	Non-Impacted		Non-Impacted										
DT-8	0.0	8.5	0.14	-0.36	1.19	322	23	0	0%	0	0%	163	51%
DT-8 (Soil Adjacent to Sewer Line)	17.5	32.5	0.06	-0.18	0.28	10	0	0	0%	NA	NA	4	40%
DT-9 Levee	0.0	49.0	0.05	-0.34	0.46	131	0	0	0%	0	0%	39	30%
DT-15	8.0	50.0	0.09	-0.16	0.75	44	0	0	0%	0	0%	18	41%
DT-29	0.0	2.0	0.22	0.18	0.26	2	0	0	0%	0	0%	2	100%
DT-34	0.0	0.5	0.06	0.06	0.06	1	0	0	0%	0	0%	0	0%
South of Angelrodt Property Group [c]	0.0	3.5	0.14	-0.11	0.49	14	1	0	0%	0	0%	8	57%
West of Broadway Property Group [d]	0.0	6.0	0.09	-0.36	0.47	40	2	0	0%	0	0%	12	30%

Table 2-5. Summary of Radiological Concentrations in Inaccessible Soil at Group 1 Properties [a]

Group 1 Property	Shallowest Depth Sampled (ft)	Deepest Depth Sampled (ft)	U-238											
			Average (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Total No. of Samples	No. of Detects	Industrial PRG (1.65 pCi/g)		Residential PRG (0.696 pCi/g)		BV (1.67 pCi/g)	
								No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of PRG Exceedances [b]	Frequency of PRG Exceedances (%)	No. of BV Exceedances [b]	Frequency of BV Exceedances (%)
Security Gate 49	0.0	6.0	4.85	-0.87	10.90	18	15	17	94%	17	94%	17	94%
DT-4 South	Non-Impacted		Non-Impacted										
DT-8	0.0	8.5	2.58	-0.82	21.40	322	242	163	51%	285	89%	161	50%
DT-8 (Soil Adjacent to Sewer Line)	17.5	32.5	0.01	-4.71	1.65	10	3	0	0%	NA	NA	0	0%
DT-9 Levee	0.0	49.0	1.28	-2.30	3.88	131	89	33	25%	107	82%	33	25%
DT-15	8.0	50.0	1.51	0.13	4.99	44	36	12	27%	40	91%	12	27%
DT-29	0.0	2.0	1.36	0.96	1.76	2	2	1	50%	2	100%	1	50%
DT-34	0.0	0.5	1.87	1.87	1.87	1	1	1	100%	1	100%	1	100%
South of Angelrodt Property Group [c]	0.0	3.5	2.50	0.56	7.03	14	8	9	64%	12	86%	8	57%
West of Broadway Property Group [d]	0.0	6.0	2.09	0.75	8.24	40	39	21	53%	40	100%	19	48%

[a] Appendices E and J of the RI/BRA Report provide the analytical results for inaccessible soil samples at all properties and soil samples adjacent to the sewer line at DT-8, respectively, for each PCOC. The summary includes data collected during the ISOU RI and previous investigations from 1999 to 2010.

[b] Sample count includes detections and non-detects.

[c] Although inaccessible soil areas at the South of Angelrodt Property Group were determined to be non-impacted, per the RI WP, inaccessible soil data are available for the following VPs: DT-13, DT-14, DT-16, and DT-17. No inaccessible soil data were available for the following South of Angelrodt Properties: DT-5 and DT-18.

[d] Although inaccessible soil areas at the West of Broadway Property Group were determined to be non-impacted, per the RI WP, inaccessible soil data from the following properties were available: Plants 3, 8, 9, and 11, and DT-20, DT-23, DT-27, DT-35, and DT-36. No inaccessible soil data were available for the following properties for use in risk calculations: DT-21, DT-22, DT-24, DT-25, DT-26, DT-28, DT-30, and Mallinckrodt parking lots.

Table 2-6 shows gross alpha measurements were made on interior, exterior, and rooftop surfaces of buildings and structures at the following Group 1 Properties: DT-8, the South of Angelrodt Property Group (specifically, at DT-14), and the West of Broadway Property Group (specifically, at DT-21, DT-22, DT-24, DT-25, Plant 3, Plant 8, and Plant 9).

Table 2-6. Building Scoping Survey Summary at Group 1 Properties

Property Area	Associated Structure/Building	Appendix Figure in RI/BRA Report	Gross Alpha Results (dpm/100 cm^2)								
			Interior			Exterior			Rooftop		
			Number	Range	Average	Number	Range	Average	Number	Range	Average
Plant 3 [a]	Building 63	E-12	--	--	--	30	0-849	150	22	104-2,599	706
	Building 66	E-12	--	--	--	56	0-263	60	22	5-3,018	880
	Building 62	E-12	--	--	--	30	0-1,016	137	20	26-836	232
	Utility Measurements	E-12	NA	NA	NA	1	75-75	75	NA	NA	NA
Plant 8 [a]	Building 90	E-12	--	--	--	70	0-1,636	367	--	--	--
	Building 91	E-12	--	--	--	54	0-1,492	343	--	--	--
	Utility Measurements	E-12	NA	NA	NA	3	22-61	44	NA	NA	NA
Plant 9 [a]	Building 96	E-12	--	--	--	146	0-1,052	149	34	0-887	237
	Northeast Corner Building	E-12	--	--	--	5	24-67	44	--	--	--
	Building 90	E-12	--	--	--	70	0-1,636	367	--	--	--
DT-8	Warehouse	E-8	11	0-55	19	15	23-231	87	[b]	[b]	[b]
	Administration Building	E-8	[c]	[c]	[c]	66	0-743	133	16	106-2,128	1,194
	Building A	E-8	[b, c]	[b, c]	[b, c]	11	162-813	589	--	--	--
	Building B	E-8	10	0-51	8	10	0-137	66	--	--	--
	Building C	E-8	17	0-51	25	10	51-203	135	--	--	--
	Building D	E-8	7	0-40	26	12	10-981	497	--	--	--
DT-14 [d]	L-Shaped Building	E-13	--	--	--	99	**4-4,760** [e]	378	15	30-3,969 [f]	784
DT-21 [a]	Building	E-12	--	--	--	10	0-1,271	345	10	0-125	56
	Building	E-12	--	--	--	41	9-1,665	347	22	40-3,427 [f]	1,102
DT-22 [a]	Buildings	E-12	--	--	--	69	0-1,218	151	21	0-1,339	398
DT-24 [a]	Building	E-12	--	--	--	92	0-1,378	144	20	124-3,895 [f]	1,525
DT-25 [a]	Building	E-12	--	--	--	31	9-1,037	141	5	102-3,302 [f]	761

[a] West of Broadway Property.

[b] Modified from the RI WP based on field conditions.

[c] Interior inaccessible for survey.

[d] South of Angelrodt Property.

[e] Locations of measurement results greater than the screening level are shown in Appendix G of the RI/BRA Report.

[f] The level of radioactivity from naturally occurring radioactive material (NORM) present in clay/ceramic brick caps has not been subtracted from the reported results. For clay/ceramic brick caps at SLDS, this level was calculated to be 950 dpm/cm^2, per Section 2.2.2 of the RI/BRA Report. When naturally occurring radioactivity is subtracted, the rooftop measurement is below the PRG for exterior surfaces (3,200 dpm/100 cm^2).

Notes:

dpm/100 cm^2 – disintegrations per minute per 100 square centimeters

-- Sampling not proposed in the RI WP.

Bold values exceed the PRG in the RI/BRA (3,200 dpm/100 cm^2 for exterior structural surfaces).

Derivation of the structural surface PRGs is shown in Appendix S of the RI/BRA Report.

Based on the nature and extent evaluation conducted in the RI/BRA, radiological COPCs were conservatively identified for inaccessible soil, soil adjacent to sewers, and soil on structural surfaces in the Group 1 Properties, based on single, SLDS-wide exceedances of risk-based PRGs. The COPCs were retained for quantitative risk evaluations in the BRA. The lists of COPCs for each ISOU medium at the Group 1 Properties that were evaluated in the BRA are presented in Table 2-7.

Table 2-7. Contaminants of Potential Concern

Media	COPCs
Inaccessible Soil	Ac-227, Pa-231, Ra-226, Ra-228, Th-230, Th-232, U-235, U-238
Soil Adjacent to Sewers	Ac-227, Pa-231, Ra-226, Ra-228, Th-230, U-238
Soil on Structural Surfaces	Ac-227, Pa-231, Ra-226, Ra-228, Th-228, Th-230, Th-232, U-235, U-238

ISOU-wide metal COPCs determined for soil adjacent to sewers include arsenic, cadmium, and lead. Although only arsenic exceeded the industrial PRG in soil samples collected adjacent to the DT-8 sewer, all three metals were retained as COPCs for evaluation of the soil adjacent to the DT-8 sewer.

2.8 CURRENT AND POTENTIAL FUTURE LAND USES

Current land use of all Group 1 Properties of the SLDS is industrial/commercial. However, DT-9 Levee and DT-15 encompass portions of the St. Louis Flood Protection Levee System for the Mississippi River. The St. Louis Riverfront Trail runs along the top of the levee and is used recreationally for activities such as jogging, hiking, and bicycle riding. Therefore, current land use at DT-9 Levee and the levee portion of DT-15 also includes recreational use. The remaining non-levee portion of DT-9 Levee is considered industrial, because the property is owned by TRRA. The portion of DT-15 that is run as the Lift Station by the MSD is considered to be industrial in nature. Other than the levee/St. Louis Riverfront Trail portions of both properties and the lift station at MSD, both the DT-9 Levee and DT-15 properties are largely undeveloped and unfenced. Table 2-8 summarizes the current and expected future land uses of the Group 1 Properties.

Table 2-8. Current and Expected Future Land Uses for the Group 1 Properties

Group 1 Property	Land Use Patterns	
	Current	Future
Security Gate 49	Industrial/Commercial	Industrial/Commercial
DT-4 South		
DT-8		
DT-29		
DT-34		
West of Broadway Property Group		
South of Angelrodt Property Group		
DT-9 Levee	Industrial/Recreational	Industrial/Recreational
DT-15		

The Group 1 Properties of the SLDS are located in an urban industrial area in the northeastern section of the City of St. Louis. Manufacturing and support buildings cover a large portion of the site, and the remainder of the area is typically paved with asphalt or concrete. Three railroads cross, serve, or are adjacent to the SLDS: BNSF; Norfolk Southern (NFS); and TRRA. Active sewer lines that exist at most of the Group 1 Properties have never been impacted by past discharges of waste flows containing MED/AEC-related contamination from the Plant areas, except for sewer lines at

DT-8, which are included in the scope of this ROD. Land use within a 1-mile radius of the SLDS includes a mixture of commercial, industrial, and residential uses. According to the 2012 City of St. Louis Zoning Map, the SLDS properties are currently zoned as either "J Industrial District" or "K Unrestricted District." This industrial zone allows all uses except new or converted dwellings. Some uses allowed within this zone under conditional use permits are acid manufacture, petroleum refining, and stockyards. Descriptions of the "J Industrial District" and "K Unrestricted District," both of which prohibit new or converted residential dwellings, are provided in the St. Louis City Code Use Regulations, as follows, in Sections 26.56.020 and 26.60.020, respectively:

- *§26.56.020 (J Industrial District Use Regulations):*

  "The use regulations are the same as those in the I central business district, except that motor fuel pumping stations that meet the site requirements specified in Section 26.40.027 shall be permitted; carry-out restaurants that sell to customers who are in cars or who consume the sold products in cars parked on the carry-out restaurant premises, or sell products through a sales window, to customers who are in cars, for immediate consumption by the customer either on or off the premises that meet the site requirements specified in Section 26.40.026 (B)(1) or (2) as appropriate shall be permitted; and a building or premises may be used for an automobile body, fender repair shop, used car lot, or car leasing or rental lot; and provided further that no building shall be in any case hereinafter erected nor shall any existing building be converted, reconstructed or structurally altered for dwelling purposes except where forty percent (40%) or more of the frontage is occupied by dwellings."

- *§26.60.020 (K Unrestricted District Use Regulations):*

  "In the unrestricted district buildings and premises may be used for any purpose whatsoever not in conflict with any ordinance of the city regulating nuisances or Section 26.60.025, provided that motor fuel pumping stations shall meet the site requirements specified in Section 26.40.027 and carry-out restaurants that sell to customers in cars or who consume the sold products in cars parked on the carry-out restaurant premises, or sell products through a sales window, to customers who are in cars, for immediate consumption by the customer either on or off the premises shall meet the site requirements specified in Section 26.40.026 (B)(1) or (2) as appropriate. Provided, however, that no building shall be hereafter erected, nor shall any existing building be converted, reconstructed or structurally altered for dwelling purposes."

According to the 2012 City of St. Louis strategic land use map, which was adopted by the City of St. Louis' Planning Commission on January 5, 2005, all SLDS properties are listed as "Business and Industrial Preservation and Development Area" or "Business and Industrial Development Area." As stated previously, the SLDS properties are currently zoned for industrial uses, which do not allow new or converted dwellings (residential use). However, a resident is currently located on North Broadway (DT-22), approximately 200 ft (61 m) southwest of the Mallinckrodt Plant 10 property. This residential use is permitted to continue because it pre-dated the current City ordinances, but future residential use is prohibited.

Regarding expected future land uses of the SLDS, including the Group 1 Properties, the long-term plans for the area are to retain industrial uses, encourage a wholesale produce district, and phase out salvage yards, truck storage lots, and the remaining residential use. Future plans also include the continued maintenance of the St. Louis Flood Protection Levee System by the USACE, which is considered crucial for the protection of all infrastructure within the flood plain of the

Mississippi River. It is also expected that the levee areas encompassing the St. Louis Riverfront Trail will remain recreational for the foreseeable future.

2.9 SUMMARY OF SITE RISKS

This section provides (1) a brief summary of the relevant portions of the human health risk assessment (HHRA), (2) a brief summary of the SLERA, and (3) the basis for taking no action relative to ISOU media at the Group 1 Properties.

2.9.1 Human Health Risks

The HHRA estimates what risks ISOU media at the Group 1 Properties pose in the absence of any action, under current, future, and hypothetical future land use scenarios and provides the basis for taking no action relative to ISOU media at the Group 1 Properties.

The HHRA addresses risks to potential receptors evaluated under the aforementioned land use scenarios that were evaluated in the RI/BRA. The approach used for the HHRA is based on the USEPA's 1989 guidance in *Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual, Part A* (RAGS Part A).

Following identification of COPCs (Table 2-7) that was done as part of the evaluation of the nature and extent of contamination, the HHRA consists of four major components:

1. *Exposure Assessment:* Calculates exposure point concentrations (EPCs) and identifies actual or potential exposure pathways, the potentially exposed populations, and the extent of possible exposures;
2. *Toxicity Assessment:* Considers the types and magnitudes of adverse health effects associated with exposure to the COPCs;
3. *Risk Characterization:* Integrates COPC-specific information with the results of the exposure and toxicity assessments (including EPCs) to facilitate calculations of risks posed by COPCs to receptors identified at the Group 1 Properties; and
4. *Uncertainties Analysis:* Evaluates factors that contribute uncertainty to the risk calculations.

The details of the evaluations conducted as part of each of the above components, as well as the results, are presented in Appendix K of the RI/BRA Report.

2.9.1.1 Exposure Assessment

The purpose of the exposure assessment is to estimate the nature, extent, and magnitude of potential receptor exposures to COPCs present at or migrating from the site, considering both current and potential future land and resource use at the site. Components of the CSM (e.g., identification of potential receptors, exposure pathways, and exposure media) were used in performing the exposure assessment. The CSM for the Group 1 Properties is depicted on Figure 2-6.

Exposure scenarios are used to assess potential risk. Scenarios are developed by modeling the potential receptor's exposure given a specific concentration of the contaminant, the EPC, and specific exposure parameters (e.g., body surface area, duration on site, frequency of exposure, breathing rate, etc.) for each anticipated exposure pathway. EPCs were estimated for each type of ISOU medium at each Group 1 Property. In order to facilitate the calculation of the property-wide risk for each Group 1 Property (i.e., for combined inaccessible and accessible soil areas), EPCs were also calculated for accessible soil areas.

As indicated in the CSM, potentially exposed populations/receptors are industrial workers (SLDS/VP employees potentially exposed to inaccessible soil and interior building surfaces), construction workers (contractors potentially exposed to inaccessible soil), utility workers (utility employees/contractors potentially exposed to inaccessible soil), building maintenance workers (SLDS/VP industrial workers potentially exposed to soil on exterior structural surfaces), sewer maintenance workers (MSD workers potentially exposed to sediment inside of the DT-8 sewer), sewer utility workers (MSD workers potentially exposed to soil adjacent to the DT-8 sewer), recreational users of the St. Louis Riverfront Trail (potentially exposed to inaccessible soil beneath the levee at DT-9 Levee and DT-15), and hypothetical future resident gardeners (adults and children hypothetically exposed to inaccessible soil and fruits and vegetables homegrown in inaccessible soil areas). Exposure routes evaluated in the HHRA consisted of: dermal contact (only metals in soil adjacent to the DT-8 sewer), direct gamma (radiological only), soil/sediment ingestion, consumption of homegrown produce, and inhalation of fugitive dusts.

Exposures and subsequent risks to receptors were assessed using site-specific values for exposure parameters to the extent that such values were available, in conjunction with standard default values recommended by the USEPA's 1989 RAGS Part A, the USEPA's 2011 *Exposure Factors Handbook*, and the RESidual RADioactivity (RESRAD) computer model and RESRAD-BUILD default values. Both EPCs and input values for exposure parameters used to calculate risks are presented in Appendix K of the RI/BRA Report.

The exposure parameter values and EPCs used in the HHRA ensure that each of the evaluated receptor scenarios represent the USEPA's reasonable maximum exposure (RME) scenario. According to the USEPA's RAGS Part A, the RME is defined as the highest exposure that is reasonably expected to occur at a site, and is intended to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures. Where a population was exposed via more than one pathway, the combination of exposures across all pathways represented an RME. Each input value in the exposure assessment equations had a range of values, from which the value representing the RME was selected. The combination of all input values resulted in an estimate of RME for that exposure route, based on quantitative information, professional judgment, and site information. The overall risk to each receptor is the sum of the risks associated with all exposure routes summed.

At the Group 1 Properties, limiting RME receptor scenarios were identified for each ISOU medium as the decision basis for no action at the Group 1 Properties. These scenarios are considered limiting because they represent the highest rates of exposure assumed for the respective media. The limiting RME receptors are presented below by ISOU medium:

- Inaccessible Soil
  - Current Use – Industrial Worker
  - Future Use – Industrial Worker
  - Hypothetical Future Use – Resident Gardener
- Soil on Building/Structural Surfaces
  - Current Use – Building Maintenance Worker
  - Future Use – Building Maintenance Worker
- Soil Adjacent to the DT-8 Sewer
  - Current Use – Sewer Utility Worker
  - Future Use – Sewer Utility Worker

The limiting receptors are presented in the CSM (Figure 2-6), with the receptor column headers italicized in the figure. In the CSM, the building maintenance worker is covered under the current industrial worker receptor column.

Although the current and expected future land use of the SLDS is industrial/commercial with some recreational use, it has been indicated above that hypothetical future use was evaluated based on the resident gardener scenario. This scenario is considered hypothetical because it does not realistically reflect the current and expected land use of properties at the SLDS for the foreseeable future. The hypothetical resident gardener scenario was evaluated in the HHRA in response to stakeholder interest because it represents the highest soil exposure rates of all receptors evaluated in the HHRA. As such, presentation of the risk results for the hypothetical resident gardener in this ROD (i.e., in Section 2.9.1.3), further supports the selected alternative of No Further Action for ISOU media at the Group 1 Properties.

2.9.1.2 Toxicity Assessment

Health impacts from exposure to radiation and radionuclides are expressed as the risk of developing cancer and have been determined using the RESRAD computer code. Because radiological exposures may result in cancer, cancer risks from exposures to ISOU radiological COPCs have been estimated using the USEPA's slope factors (SFs) developed for inhalation, ingestion, and external radiation exposure routes. The radiological SFs specific to each exposure route are used to convert exposure to cancer risk.

The SFs for radionuclides are derived based on the following, as outlined in the USEPA's 1996 *Radiation Exposure and Risk Assessment Manual*:

- The radiological endpoint is morbidity.
- Radiological risk estimates are based primarily on human data.
- Radiological risk estimates are based on the central estimate of the mean.

Oral cancer SFs were used for estimating cancer risks for metals (i.e., in soil adjacent to the sewer at DT-8) that represent the 95 percent upper confidence limits (UCLs) of the probability of response per unit intake (by the oral route) over a lifetime. The USEPA's 2009 guidance for evaluating the inhalation exposure pathway (*Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual: Part F, Supplemental Guidance for Inhalation Risk Assessment, Final* [RAGS Part F]) recommends the use of inhalation unit risk values for calculating inhalation risks. Oral cancer SFs for metals are based on mathematical extrapolation from experimental animal data and epidemiological studies, when available. Because cancer SFs and unit risks are upper-bound estimates, actual cancer potencies of metal COPCs are likely lower than estimated, per the USEPA's 1989 RAGS Part A. Because there are no SFs specific to dermal exposure, the USEPA recommends that oral cancer SFs be adjusted to assess risks from dermal exposures. All oral and dermal cancer SFs and inhalation unit risks are presented and discussed in detail in Appendix K of the RI/BRA Report.

For calculating noncancer metal risks, which are referred to as hazard indices, oral reference doses and inhalation reference concentrations are used. The USEPA's 2009 RAGS Part F guidance for evaluating the inhalation exposure pathway recommends the use of inhalation reference concentrations for calculating inhalation hazard indices. The USEPA derives these toxicity values to protect sensitive populations, such as children, and has developed many chronic reference doses (RfDs) to evaluate long-term exposures (7 years to a lifetime) and a few subchronic RfDs to evaluate exposures of shorter duration (2 weeks to 7 years). Because there are no reference doses specific to dermal exposure, the USEPA recommends that oral reference doses be adjusted to assess hazard indices from dermal exposures. All oral and dermal cancer reference

doses and inhalation reference concentrations are presented and discussed in detail in Appendix K of the RI/BRA Report. Additionally, non-cancer hazard indices are determined for primary organs/systems affected by exposures metal COPCs. The target organs and critical effects associated with exposures to metal COPCs are presented in Appendix K of the RI/BRA Report.

Finally, lead is classified as a B2 carcinogen, and has known non-carcinogenic effects; however, no toxicity values have been established for lead. Therefore, risks associated with sewer utility worker exposures to lead in soil adjacent to the DT-8 sewer were estimated using the USEPA's Adult Lead Model. The model is a biokinetic model that assumes the worker to be a pregnant female, with the most sensitive receptor being the fetus. The adult lead model predicts the relative increase in blood lead concentrations in both the mother and fetus that might result from environmental exposures. Details regarding this model and its application for evaluating lead in ISOU media are provided in Appendix K of the RI/BRA Report.

2.9.1.3 Risk Characterization

A cancer risk is defined by the USEPA to be the "incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen." A cancer risk is expressed as the potential number of additional cancer cases estimated to occur above baseline within a given population (with baseline being the number of cases considered statistically normal for the population) over the course of a lifetime. The USEPA has established an acceptable (i.e., not to exceed) cancer risk range of $1x10^{-6}$ to $1x10^{-4}$. The minimum cancer risk or lower boundary of $1x10^{-6}$ is equal to the probability of the occurrence of one additional cancer case above the statistical baseline for a population of 1,000,000 people. The maximum acceptable cancer risk or upper boundary of $1x10^{-4}$ is equal to the probability of the occurrence of one additional cancer case above the statistical baseline for a population of 10,000 people. The upper boundary of the risk range is not a discrete line at $1x10^{-4}$. A specific risk estimate around $1x10^{-4}$ may be considered acceptable if justified based on site-specific reasons. Cancer risks below or within the acceptable risk range indicate little or no likelihood for the occurrence of adverse health effects. The cancer risks estimated for each evaluated property associated with the ISOU were compared to the acceptable risk range. In contrast, data from the American Cancer Society (http://www.cancer.org/cancer/cancerbasics/lifetime-probability-of-developing-or-dying-from-cancer) indicates that Americans have a 1 in 2 risk of developing cancer in their lifetime. This probability is orders of magnitude greater than the USEPA's acceptable cancer risk range and demonstrates the health-protective nature of the risk assessment process.

The potential for noncancer health effects resulting from exposures to individual metal COPCs in soil adjacent to the DT-8 sewer was evaluated by the calculation of a hazard index. A hazard index greater than 1.0 indicates a potential cause for concern for noncancer health effects.

Risks resulting from exposures to lead in soil adjacent to the DT-8 sewer, as calculated using the Adult Lead Model, were compared to the USEPA's benchmark of a 5 percent probability of exceeding a blood lead level of 10 micrograms per deciliter. Exceedance of this benchmark represents an unacceptable risk level due to exposures to lead.

Although the HHRA evaluated radiological cancer risks from exposures to MED/AEC-related contaminants, radiological risk can also come from naturally occurring radionuclides in the environment around the SLDS. Additionally, radionuclides can be present in the SLDS environment from manmade (anthropogenic) processes not related to past MED/AEC operations. Radiological cancer risks that exist as a result of naturally occurring and anthropogenic conditions are referred to as background radiological risk (or background risk). Although the scope of the RI/BRA is limited to determining property risks from MED/AEC-related contamination, site-specific background contributions to risk were also evaluated as part of the total risk estimated for each individual

property. Inclusion of site-specific background risk contributions in the risk assessment is consistent with the CERCLA process and is a recommended methodology for the purposes of risk characterization in the USEPA's 1989 RAGS Part A. This allows for a more complete characterization of overall risk at a site. However, as actions move beyond the risk assessment phase of the CERCLA process, risk contributions from background become more scrutinized when making determinations of the need for action versus No Further Action. This process of evaluating site-specific background has been implemented at the SLDS during all work completed under the authority of the 1998 ROD and has been instrumental in meeting the requirements of that ROD. Risks were estimated in the HHRA for exposures to ISOU media assumed applicable for each of the previously described receptor scenarios, at each of the Group 1 Properties.

For the purpose of supporting the risk characterizations of the Group 1 Properties relative to background conditions, the soil BVs were used as EPCs to calculate risk contributions from SLDS soil background and then compared with the property-specific risks. A property-specific soil risk less than the corresponding background risk indicates that all risk can be attributed to background. For a property-specific risk exceeding the background risk, the difference can be attributed to the MED/AEC-related risk above background.

All risks are summarized for all evaluated receptors in Tables 2-9 and 2-10 for soil and soil on buildings/structures, respectively). Sections 2.9.1.3.1 and 2.9.1.3.2 discuss the risks associated with inaccessible soil and soil on building/structural surfaces, respectively. Additionally, the RESRAD and RESRAD-BUILD models were used to estimate radiological cancer risks for each receptor, that represent the maximum total risks (i.e., summed over all radionuclides and pathways) estimated to occur over a 1,000-year evaluation period, in order to account for decay of parent radionuclides and the ingrowth of daughters over time.

2.9.1.3.1 Risks Associated with Soil

Table 2-9 shows three types of soil exposure scenarios were evaluated in the HHRA for each of the Group 1 Properties: property-wide soil, inaccessible soil, and inaccessible soil adjacent to sewer lines. Each of these is briefly described as follows.

- Risks due to property-wide exposures to soil were estimated for selected receptors (industrial workers, recreational users, and hypothetical residential gardeners) assumed to be the most frequently exposed individuals, under each of the evaluated land use types, and include combined risks estimated for both inaccessible soil and accessible soil areas at each property.
- Risks due to exposures to contaminants in only the inaccessible soil areas of each property were estimated for the construction worker and utility worker.
- Risks due to exposures to soil adjacent to sewer lines were estimated for sewer utility workers.

Of the receptors in the previous bullets, the summary of site risks due to inaccessible soil and soil adjacent to sewers will focus on the following receptors identified as the limiting RME receptors for this ROD: current industrial worker, hypothetical future resident gardener, and current/future sewer utility worker.

Property-wide soil risks were estimated for the current industrial worker and hypothetical future resident gardener at all properties, except for DT-4 South. No risks were estimated for the industrial worker and hypothetical future resident gardener at DT-4 South, because there were no inaccessible soil samples collected from that property. This is because the soil beneath the building is considered to be non-impacted. Therefore, no MED/AEC-related contamination is present and the associated

Table 2-9. Risk Summary for Soil at Group 1 St. Louis Downtown Site Properties

ISOU Medium:	Property-Wide Soil (Combined Inaccessible and Accessible Soil)												Inaccessible Soil						Inaccessible Soil Adjacent to Sewer Lines		
Receptor:	***Current Industrial Worker*** [a]			**Future Industrial Worker** [a]			**Recreational User**			***Hypothetical Resident Gardener***			**Construction Worker**			**Utility Worker**			***Sewer Utility Worker***		
Risk Results/ Comments:	**Property-Specific Risk** [b]	**Is Property-Specific Risk Below SLDS Background Risk? (Yes/No)** [c]	**Does Risk Due to MED/AEC-Related Contamination Exceed USEPA's Acceptable Risk Range? (Yes/No)** [d]	**Property-Specific Risk** [b]	**Is Property-Specific Risk Below SLDS Background Risk? (Yes/No)** [c]	**Does Risk Due to MED/AEC-Related Contamination Exceed USEPA's Acceptable Risk Range? (Yes/No)** [d]	**Property-Specific Risk** [b]	**Is Property-Specific Risk Below SLDS Background Risk? (Yes/No)** [c]	**Does Risk Due to MED/AEC-Related Contamination Exceed USEPA's Acceptable Risk Range? (Yes/No)** [d]	**Property-Specific Risk** [b]	**Is Property-Specific Risk Below SLDS Background Risk? (Yes/No)** [c]	**Does Risk Due to MED/AEC-Related Contamination Exceed USEPA's Acceptable Risk Range? (Yes/No)** [d]	**Property-Specific Risk** [b]	**Is Property-Specific Risk Below SLDS Background Risk? (Yes/No)** [c]	**Does Risk Due to MED/AEC-Related Contamination Exceed USEPA's Acceptable Risk Range? (Yes/No)** [d]	**Property-Specific Risk** [b]	**Is Property-Specific Risk Below SLDS Background Risk? (Yes/No)** [c]	**Does Risk Due to MED/AEC-Related Contamination Exceed USEPA's Acceptable Risk Range? (Yes/No)** [d]	**Property-Specific Risk** [b]	**Is Property-Specific Risk Below SLDS Background Risk? (Yes/No)** [c]	**Does Risk Due to MED/AEC-Related Contamination Exceed USEPA's Acceptable Risk Range? (Yes/No)** [d]
SLDS Background																					
SLDS Background	**$9.4x10^{-5}$**	**NA**	**NA**	**$1.8x10^{-4}$**	**NA**	**NA**	**$1.5x10^{-6}$**	**NA**	**NA**	**$7.9x10^{-4}$**	**NA**	**NA**	**$3.4x10^{-4}$**	**NA**	**NA**	**$3.7x10^{-7}$**	**NA**	**NA**	**$2.6x10^{-7}$**	**NA**	**NA**
Group 1 Properties																					
Security Gate 49	$1.5x10^{-4}$	No	No	$1.5x10^{-4}$	Yes	No	No Exposures	Yes	No	$6.1x10^{-4}$	Yes	No	$1.5x10^{-6}$	Yes	No	$1.7x10^{-7}$	Yes	No	No MED/AEC Sewer Lines	Yes	No
DT-4 South	ISOU Non-Impacted	Yes	No	ISOU Non-Impacted	Yes	No	ISOU Non-Impacted/No Exposures	Yes	No	ISOU Non-Impacted	Yes	No	ISOU Non-Impacted	Yes	No	ISOU Non-Impacted	Yes	No	No MED/AEC Sewer Lines	Yes	No
DT-8 [e]	$1.5x10^{-4}$	No	No	$1.7x10^{-4}$	Yes	No	No Exposures	Yes	No	$7.8x10^{-4}$	Yes	No	$2.8x10^{-6}$	Yes	No	$3.1x10^{-7}$	Yes	No	$2.0x10^{-7}$	Yes	No
DT-9 Levee	$1.1x10^{-4}$	No	No	$1.1x10^{-4}$	Yes	No	$1.9x10^{-6}$	No	No	$6.7x10^{-4}$	Yes	No	$2.1x10^{-6}$	Yes	No	$2.4x10^{-7}$	Yes	No	No MED/AEC Sewer Lines	Yes	No
DT-15	$4.4x10^{-5}$	Yes	No	$4.4x10^{-5}$	Yes	No	$7.2x10^{-7}$	Yes	No	$5.8x10^{-4}$	Yes	No	$2.7x10^{-6}$	Yes	No	$3.0x10^{-7}$	Yes	No	No MED/AEC Sewer Lines	Yes	No
DT-29	$1.3x10^{-4}$	No	No	$1.6x10^{-4}$	Yes	No	No Exposures	Yes	No	$7.0x10^{-4}$	Yes	No	$1.7x10^{-6}$	Yes	No	$1.9x10^{-7}$	Yes	No	No MED/AEC Sewer Lines	Yes	No
DT-34	$8.0x10^{-5}$	Yes	No	$1.3x10^{-4}$	Yes	No	No Exposures	Yes	No	$6.0x10^{-4}$	Yes	No	$3.1x10^{-6}$	Yes	No	$3.4x10^{-7}$	Yes	No	No MED/AEC Sewer Lines	Yes	No
South of Angelrodt Property Group [f]	$1.3x10^{-4}$	No	No	$1.5x10^{-4}$	Yes	No	No Exposures	Yes	No	$6.8x10^{-4}$	Yes	No	$3.0x10^{-6}$	Yes	No	$3.3x10^{-7}$	Yes	No	No MED/AEC Sewer Lines	Yes	No
West of Broadway Property Group [g]	$9.3x10^{-5}$	Yes	No	$1.4x10^{-4}$	Yes	No	No Exposures	Yes	No	$6.4x10^{-4}$	Yes	No	$2.5x10^{-6}$	Yes	No	$2.8x10^{-7}$	Yes	No	No MED/AEC Sewer Lines	Yes	No

[a] Cancer risks presented for a current industrial worker assumed the presence of existing ground cover, which acts as a barrier to direct radiological exposures to inaccessible soil. Cancer risks presented for future industrial worker exposures to inaccessible soil represent a worst case scenario for this receptor in which the absence of protective ground cover was assumed.

[b] The property-specific risk includes MED/AEC-related risk and background risk combined. All cancer risks presented are radiological. Metals risks were not calculated for any of the Group 1 Properties, except for soil adjacent to the sewer line at DT-8 (see footnote "e" below), because the properties are not located within the former uranium ore processing area. Also, the following qualifiers are presented when a property-specific cancer risk was not calculated:

- *ISOU Non-Impacted* - No risk calculations were necessary for DT-4 South in the ISOU RI because the ISOU portion of the property was previously determined to be non-impacted from past MED/AEC processes (according to the RI WP); therefore, no ISOU data were collected for performing a risk assessment. Also, accessible areas of contamination at DT-4 South have been remediated under the 1998 ROD. Therefore, there are no unacceptable risks from MED/AEC-related COCs at the property.
- *No Exposures* - Calculation of risk is not necessary for the receptor at the property because the receptor is not likely to be exposed to COCs at the property (i.e., no complete exposure pathways); therefore, there are no unacceptable risks from MED/AEC-related COCs at the property.
- *No MED/AEC Sewer Lines* - No sewer lines exist on the property that facilitated flow of MED/AEC-related COCs; therefore, there are no unacceptable risks from MED/AEC-related COCs in sewer sediment or soil adjacent to sewer lines at the property.

[c] A "Yes" response indicates that the calculated property-specific risk is indistinguishable from SLDS background. This is also true for properties for which risk is not calculated due to the following designations: *ISOU Non-Impacted, No Exposures, and No MED/AEC Sewer Lines.*

[d] A "No" response indicates that the calculated property-specific risk is either within or less than USEPA's acceptable risk range. This is also true for properties for which risk is not calculated due to the following designations: *ISOU Non-Impacted, No Exposures, and No MED/AEC Sewer Lines.*

[e] The risk presented for soil adjacent to the sewer line ($2.0x10^{0}$) represents the maximum risk calculated for three separate sampling locations (SLD124590, SLD124592, and SLD124594). The maximum risk presented is the radiological risk calculated for location SLD124590. The maximum metals risk calculated for the soil locations adjacent to the DT-8 sewer ($3.9x10^{-8}$) was calculated using the data from SLD124594. All radiological and metals risks are therefore below the USEPA's acceptable risk range.

[f] Although inaccessible soil areas at the South of Angelrodt Property Group were determined to be non-impacted in the RI WP based on the application of the screening levels used in that document, inaccessible soil data are available for the following VPs that were used in the ISOU RI/BRA risk calculations: DT-13, DT-14, DT-16, and DT-17. No inaccessible soil data were available for the following South of Angelrodt Properties: DT-5 and DT-18. Available data were later compared to more health-conservative USEPA-established PRGs in the RI/BRA, which resulted in PRG exceedances. Therefore, this property group was evaluated for risk in the RI/BRA, even though the property group was determined to be non-impacted in the RI WP.

[g] Although inaccessible soil areas at the West of Broadway Property Group were determined to be non-impacted in the RI WP based on the application of the screening levels used in that document, inaccessible soil data from the following properties were available and used in the RI/BRA risk calculations: Plants 3, 8, 9, and 11, and DT-20, DT-23, DT-27, DT-35, and DT-36. No inaccessible soil data were available for the following properties for use in risk calculations: DT-21, DT-22, DT-24, DT-25, DT-26, DT-28, and DT-30. Available data were later compared to more health-conservative USEPA-established PRGs in the RI/BRA, which resulted in PRG exceedances. Therefore, this property group was evaluated for risk in the RI/BRA, even though the property group was determined to be non-impacted in the RI WP.

Notes:

Receptor identifications in column headers presented in ***italicized font*** represent the limiting RME receptor scenarios for the corresponding ISOU medium.

NA - For the column with header reading "Is Property-Specific Risk SLDS Background Risk? (Yes/No)," SLDS background is not compared to itself; therefore, the comparison is not applicable (NA). For the column with the header reading "Does Risk Due to MED/AEC-related Contamination Exceed USEPA's Acceptable Risk Range? (Yes/No)," the comparison to the acceptable risk range is not applicable because by definition, SLDS background locations were selected in areas not impacted by past MED/AEC releases.

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Table 2-10. Risk Summary for Soil on Building/Structural Surfaces at Group 1 St. Louis Downtown Site Properties

ISOU Medium:	**Soil on Interior Building Surfaces**			**Soil on Exterior Building/ Structural Surfaces**		
Receptor:	**Industrial Worker**			***Building Maintenance Worker***		
Risk Results/ Comments:	**Property-Specific Risk** [a]	**Is Property-Specific Risk Below SLDS Background Risk? (Yes/No)** [b]	**Does Risk Due to MED/AEC-Related Contamination Exceed USEPA's Acceptable Risk Range? (Yes/No)** [c]	**Property-Specific Risk** [a]	**Is Property-Specific Risk Below SLDS Background Risk? (Yes/No)** [b]	**Does Risk Due to MED/AEC-Related Contamination Exceed USEPA's Acceptable Risk Range? (Yes/No)** [c]
SLDS Background						
SLDS Background	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Group 1 Properties						
Security Gate 49	Non-Impacted	NA	No	Non-Impacted	NA	No
DT-4 South	Non-Impacted	NA	No	Non-Impacted	NA	No
DT-8	Non-Impacted	NA	No	Non-Impacted	NA	No
DT-9 Levee	No Buildings	NA	No	No Buildings	NA	No
DT-15	Non-Impacted	NA	No	Non-Impacted	NA	No
DT-29	Non-Impacted	NA	No	Non-Impacted	NA	No
DT-34	Non-Impacted	NA	No	Non-Impacted	NA	No
South of Angelrodt Property Group [d]	Non-Impacted	NA	No	$1.6x10^{-7}$	NA	No
West of Broadway Property Group	Non-Impacted	NA	No	Non-Impacted	NA	No

[a] The property-specific risk includes MED/AEC-related risk across all building surfaces on the property. All risks presented are radiological. Also, the following qualifiers are presented when a property-specific risk was not calculated:

- *Non-Impacted* - No risk calculations were necessary in the ISOU RI because property was previously determined to be non-impacted from past MED/AEC processes; therefore, there are no unacceptable risks from MED/AEC-related COCs at the property.
- *No Buildings* - No buildings or structural surfaces associated with buildings exist at the property; therefore, there are no unacceptable risks from MED/AEC-related COCs from soil on building surfaces at the property.

[b] No SLDS background data are available for building/structural surfaces.

[c] A "No" response indicates that the calculated property-specific risk is either within or less than the USEPA's acceptable risk range. This is also true for properties for which risk is not calculated due to the following designations: *Non-Impacted* and *No Buildings.*

[d] DT-14 was the only South of Angelrodt property evaluated for risks associated with soil on interior and exterior building/structural surfaces.

Notes:

Receptor identifications in column headers presented in ***italicized font*** represent the limiting RME receptor scenarios for the corresponding ISOU medium.

NA - No background data were available for estimating risks due to background.

radiological cancer risk does not exceed the USEPA's acceptable risk range. The property-specific risks for the current industrial worker exceed the USEPA's acceptable risk range at all evaluated Group 1 Properties, except for DT-15, DT-34, and the West of Broadway Property Group. Property-specific risks for the hypothetical future resident gardener at all of the evaluated Group 1 Properties exceed the USEPA's acceptable risk range. Exceedances of the USEPA's acceptable risk range for these scenarios occur because the risk contributions from background are included. Because the SLDS background risks for the current industrial worker ($9.4x10^{-4}$) and hypothetical future resident gardener ($7.8x10^{-4}$) are greater than all of the property-specific risks for those receptors, the corresponding risks due to MED/AEC-related contamination for all properties are less than the USEPA's acceptable risk range.

Current/future sewer utility workers were considered for evaluations of risks due to exposures to inaccessible soil adjacent to sewer lines. This evaluation was only conducted for the sewer line associated with DT-8 for the reasons stated previously in Section 2.7.5. Sewer utility worker risks were calculated for three separate sewer soil locations at DT-8: SLD124590, SLD124592, and SLD124594. All risks are less than the corresponding SLDS background risks and the USEPA's acceptable risk range. Therefore, the risks due to MED/AEC-related contamination are less than the USEPA's acceptable risk range.

Although not presented in Table 2-9, cancer risks and hazard indices estimated for arsenic and cadmium, as well as risks estimated for lead in soil adjacent to the DT-8 sewer, were less than the USEPA's acceptable target criteria.

2.9.1.3.2 Risks Associated with Soil on Building/Structural Surfaces

For exposures to building/structural surfaces, the building maintenance worker was identified as the limiting RME receptor for exterior surfaces. No interior surfaces exceeded the PRG at the Group 1 Properties, so none were evaluated in the BRA. Table 2-10 shows that building maintenance worker risks due to soil on exterior building/structural surfaces were considered in the HHRA for each of the Group 1 Properties. As previously stated, no SLDS background data were collected for building/structural surfaces; therefore, no background risks were estimated for this ISOU medium. DT-9 Levee is the only property at which no buildings exist. Because no source medium and no exposure pathways exist at DT-9 Levee, the radiological cancer risks from building/structural surfaces do not exceed the USEPA's acceptable risk range at the DT-9 Levee. All existing surfaces at the remaining properties, except for an exterior surface at the South of Angelrodt Property Group (i.e., the horizontal beam between the L-shaped and Brick Buildings at DT-14) were determined to be non-impacted. The risk estimated for the exterior surface at the South of Angelrodt Property Group is less than the USEPA's acceptable risk range. The determination that building/structural surfaces at the remaining properties are non-impacted leads to the conclusion that no MED/AEC-related surface contamination exists; therefore, MED/AEC-related risk at those properties is less than the USEPA's acceptable risk range.

2.9.1.4 Uncertainties Analysis

A number of factors contribute uncertainty to the estimates of risk. These uncertainties are inherent to each of the main components of the risk assessment process and can impact the risk assessment by resulting in an overestimation or underestimation of risks. Uncertainties associated with the BRA and impacts to the risk calculations are briefly described in each of the following subsections. To summarize, most uncertainties assessed for the BRA tend to overestimate risks at the Group 1 Properties. More detailed information regarding each of the uncertainties is provided in the RI/BRA Report.

2.9.1.4.1 Uncertainties with Data Evaluation and Identification of Contaminants of Potential Concern

Sampling Strategy – To reduce uncertainties associated with characterizing SLDS ISOU media that could be impacted, either directly or indirectly, from past MED/AEC operations, a combination of systematic, biased, and/or random sampling strategies were employed. The objective of media characterization was to develop a health-conservative risk assessment that would not underestimate actual risks to potentially exposed populations. The sampling strategy employed during the ISOU RI likely contributed to the overestimation of risks.

Sample Coverage – Because of limited access to some ISOU media, contamination was characterized but not fully delineated in all cases. Although a health-conservative risk assessment is desired in the CERCLA process, a lack of sample coverage results in uncertainty by not adequately representing the probability of exposures as a receptor moves randomly about the property or exposure area. Although the impacts of this uncertainty are not measurable, application of the USEPA's 2002 guidance of applying the lesser of the 95 percent UCL and the maximum detected concentration for the EPC (according to *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites*) likely results in an overestimation of risks.

Analytical Data Quality – Some unavoidable uncertainty is associated with the contaminant concentrations detected and reported by the analytical laboratory. Data validation is used to provide the risk assessor with information as to the usability of each analytical result. The quality of all analytical data is not known to result in an overestimation or underestimation of risks at the Group 1 Properties.

Use of the 1998 ROD COCs as the Starting Point for the RI/BRA – The list of COPCs evaluated for the ISOU media is based on the list of radionuclides associated with past MED/AEC operations and on those constituents identified as COCs in the 1998 ROD. Therefore, risks calculated for the Group 1 Properties for ISOU media reflect the MED/AEC-related contamination that has been consistently characterized at the SLDS for years. The MED/AEC-related risks calculated for the Group 1 Properties are not likely to have been overestimated or underestimated.

Use of Risk-Based PRGs for Identifying COPCs – Risk-based PRGs for industrial and residential scenarios were used for comparisons with individual sample data to identify COPCs. Performing comparisons with individual sample results with PRGs, rather than comparisons with averaged concentrations, most likely result in more comprehensive lists of COPCs. Additionally, the fact that the PRGs do not consider background further enhances the list of COPCs. The methods used to identify COPCs tend to result in an overestimation of risks at the Group 1 Properties.

2.9.1.4.2 Uncertainties with Exposure Assessment

Determinations of the Sizes of Inaccessible Soil Exposure Areas – When performing calculations of inaccessible and accessible soil area fractions for each property with an existing PRAR/FSSE (i.e., for calculating area-weighted averages of combined inaccessible/accessible soil risks), the size of the accessible area used was the area established by the combined survey unit areas presented in the respective PRAR/FSSE. Because some survey units cross property boundaries, and may include samples outside of the property boundary, the size of the combined accessible area for the property could be overestimated. For properties without a PRAR/FSSE, accessible and inaccessible areas were both estimated, which could have led to the overestimation of either area. Therefore, the method of determining the sizes of the inaccessible and accessible areas of

each property could have resulted in an overestimation or underestimation of risks, depending on the property.

Uncertainties Associated with the EPCs – Analytical results are used to calculate a mean concentration and the 95 percent UCL on the mean concentration. The lesser of the maximum detected concentration or the 95 percent UCL was used as the EPC for the HHRA. For the datasets containing a small number of samples with high sample variability resulting in high standard deviations, the maximum detected concentration was used as the EPC, representing a worst-case scenario. Therefore, doses and risks generated for elevated measurement areas are likely to have been overestimated.

Exposure Assumptions – For each exposure pathway chosen for analysis in the HHRA, assumptions are made concerning the exposure parameters (e.g., amount of contaminated media a receptor can be exposed to and intake rates for different routes of exposure) and the routes of exposure. The assumptions used are based on the following:

- USEPA-approved default values published in guidance documents, which are generally upper-bound estimates of potentially exposed populations;
- RESRAD and RESRAD-BUILD model default values, which are assumed to be representative of potentially exposed populations; and
- professional judgment, which was applied when sufficient knowledge was available to allow for more realistic estimates of risk.

Collectively, the exposure assumptions used in the BRA were more likely to have resulted in an overestimation of risks than an underestimation of risks.

2.9.1.4.3 Uncertainties with Toxicity Assessment

Radiological Cancer Slope Factors for COPCs – Radiological cancer SFs have been developed primarily using data from groups, such as the Japanese atomic bomb survivors. These individuals received large doses of radiation over a short period of time. By contrast, potential receptors in this assessment receive relatively small radiological doses over a long period of time. In addition, the calculations of SFs are based on radium dial painter studies. The doses received from both the Japanese atomic bomb survivors and the radium dial painters were many orders of magnitude higher than those estimated for environmental levels. Therefore, the SFs used in the BRA are likely to overestimate risks at the Group 1 Properties.

2.9.1.4.4 Uncertainties with Risk Characterization

Use of SLDS Background Risks to Characterize Group 1 Properties – The determination of background at the SLDS may have been complicated by the presence of surficial fill consisting of brick, concrete, organic material, and coal slag with minor sand, coal ash, coal cinders, and silt that was used throughout the SLDS, all of which contribute background from naturally occurring radioactive materials. A generalized stratigraphic column for the surficial fill present at the SLDS is shown on Figure 2-5. BVs of some radionuclides at the SLDS may be influenced by the presence of mixed fill materials and other unknown materials from surrounding urbanized industrial sources. Comparisons of background risks that are greater than property-wide risks could result in characterizations that tend to underestimate property-wide risks.

Another uncertainty in the risk characterization of soil on building/structural surfaces is that no background levels were established for this evaluation. This is because typical gross alpha surface count rates for background are much lower than the typical count rates on surfaces at the

SLDS. Conversions to surface activity concentration units (e.g., pCi/g), would result in concentrations being much less than the PRGs. Therefore, background contributions have an insignificant impact on measurements made on surfaces and the associated risks. This is supported by the results of the risk characterization, which show that even with background contributions included, there are no unacceptable risks associated with soil on building/structural surfaces. Therefore, the absence of surface background information does not result in an overestimation or underestimation of the risk results for soil on building/structural surfaces.

Inability to Collect Sediment Samples from Inside of the DT-8 Sewer Line – As discussed in Section 2.7.5 (Sampling Strategy), the collection of three sediment samples from inside of the DT-8 sewer line (i.e., running along the south side of Salisbury Street) was planned in the RI WP. This sewer line was suspected of potentially having received past MED/AEC-related waste flows from the former uranium ore processing operations at Plants 1 and 6. DT-8 is the only Group 1 Property associated with a sewer line that could have received past MED/AEC-related waste flows from the plant areas. However, during the RI, the planned DT-8 sewer locations could not be sampled for sediment due to insufficient sediment for sampling and analysis at two locations and problems gaining access to the inside of the sewer at the third location. Therefore, sediment data for DT-8 could not be characterized during the RI. The lack of sediment data for the sewer line of DT-8 results in an underestimation of the overall risk estimated for this property.

Use of 95 Percent UCL-Based Soil Background Versus Mean Soil Background – During development of the PP, the USACE received regulator comments that raised concerns that calculating property-specific risks above mean background risk levels is a more health-conservative methodology than calculating property-specific risks above background risk levels based on the 95 percent UCL. To address to this uncertainty, the USACE wrote a Memorandum for Record in 2014 titled *Supplemental Resident Gardener Soil Risk Characterization of St. Louis Downtown Site (SLDS) Group 1 Properties, Associated with the Inaccessible Soil Operable Unit (ISOU), Using SLDS Background Risks Based on Mean Concentrations Versus Ninety-Five Percent Upper Confidence Limit (95% UCL) Concentrations.* The evaluation and calculations performed as part of this memorandum demonstrate that because only slight differences in mean versus 95 percent UCL BVs exist, the risk outcome of the HHRA would be similar if mean BVs were applied. This, in turn, indicates no impacts to the Group 1 Properties relative to the selected alternative of No Further Action.

2.9.2 Ecological Risks

The SLERA conducted as part of the RI/BRA agrees with the result of the ecological evaluation in the 1993 BRA, which determined that potential impacts to ecological receptors from accessible environmental media at the SLDS are likely to be insignificant. This is because the SLDS is a heavily urbanized area not suitable for habitation of sensitive and threatened and endangered species. In comparison to the accessible media evaluated in the 1993 BRA, the potential for impacts to ecological receptors from ISOU media evaluated in this SLERA is significantly less for the following reasons. First, based on the lack of suitable habitat, the potential for direct contact exposures to ISOU media is reduced for terrestrial or aquatic ecological receptors. Second, the presence of buildings and consolidated cover (e.g., asphalt and concrete pavement) over inaccessible soil acts as a physical barrier to direct contact exposures by terrestrial receptors. Third, the potential for subsurface migration from inaccessible soil to sensitive terrestrial or aquatic habitats (although no sensitive habitats have been found to exist, per the Ecological Checklist in

Appendix R of the RI/BRA Report) is not significant. Thus, conclusions indicate no complete or significant exposure pathways for ecological receptors at the ISOU.

Finally, RAs conducted at the SLDS under the 1998 ROD have reduced the likelihood that ISOU media will be impacted by accessible soil contamination. For the aforementioned reasons, contaminant screening was not conducted in the SLERA, and No Further Action was recommended from an ecological perspective. Therefore, the potential for significant ecological impacts to occur is small for any of the Group 1 Properties associated with ISOU media at the SLDS that were evaluated in the RI/BRA.

2.9.3 Basis for Action

The alternative of No Further Action has been selected in this ROD for ISOU media at the Group 1 Properties, because these media are protective of human health and the environment from past releases of MED/AEC-related contaminants into the environment at the SLDS.

2.10 DOCUMENTATION OF SIGNIFICANT CHANGES FROM THE PREFERRED ALTERNATIVE OF THE PROPOSED PLAN

The PP was released by the USACE for public comment on January 13, 2014. This document identified No Further Action as the preferred alternative for ISOU media at the SLDS Group 1 Properties. The USACE has reviewed all comments submitted during the public comment period. No significant changes to the alternative, as originally identified in the PP, were determined to be necessary or appropriate.

3.0 RESPONSIVENESS SUMMARY OF THE RECORD OF DECISION

3.1 OVERVIEW

This Responsiveness Summary has been prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [40 *Code of Federal Regulations (CFR)* § 300.430(f)]. This section provides the U.S. Army Corps of Engineers (USACE) responses to comments received on the 2014 *Proposed Plan for No Further Action for the Inaccessible Soil Operable Unit Associated with Group 1 Properties at the St. Louis Downtown Site* (PP) from the public and other stakeholders during the 30-day comment period. Based on the results of the remedial investigation/baseline risk assessment (RI/BRA), the preferred alternative for the inaccessible soil operable unit (ISOU) media at the Group 1 Properties is No Further Action, because action is not necessary for protection. Therefore, no feasibility study (FS) was prepared.

On January 13, 2014, the USACE released the PP for public review and comment. The PP discussed the USACE's preferred alternative of No Further Action for ISOU media at the Group 1 Properties of the St. Louis Downtown Site (SLDS). The public comment period was open from January 13 to February 13, 2014. The USACE held a public meeting on January 30, 2014, at Clay Elementary School in St. Louis, Missouri, to present the PP and the USACE's preferred remedy to interested members of the community, answer questions on the preferred remedy, and accept any comments provided by the public. To retain a record of these verbal comments, a court reporter was present to provide a transcript of the proceedings. A copy of the transcript of the public meeting is included in the Administrative Record. Comments received during the public comment period on the PP are summarized in Section 3.2.

3.2 SUMMARY OF COMMENTS RECEIVED AND AGENCY RESPONSES

Responses to verbal comments provided at the public meeting on January 30, 2014, are presented in Section 3.2.1. Written comments were received subsequent to the public meeting and are presented, along with the USACE's responses, in Section 3.2.2. Comments and responses are included in the Administrative Record for this record of decision (ROD).

3.2.1 Verbal Comments at Public Meeting (January 30, 2014)

There were two members of the public that chose to make verbal comments at the public meeting. One of the commenters who later submitted written comments requested a retraction of the earlier verbal comment. Therefore, the verbal comment is not included in this section; however, the written comments are addressed in Section 3.2.2.

3.2.1.1 Comments from Commenter 1: Susan Folle (Oversight Committee for the FUSRAP)

I have two questions is all. DT-22, the resident was grandfathered in, but future, future residential use is prohibited. I would like to know how that conclusion was reached. And there are long term plans that are to encourage a wholesale produce district. And I would like to know how safe that's going to be, beings that thorium is just a little bit of, little bitty critter. Another question real quick — it's dealing with Section 5.2.1.13. FUSRAP has decided that residences and gardens will not be constructed for the foreseeable future, and that existing buildings will be razed before construction. I would like to know what is the basis for this decision. That's it.

Response 1: The St. Louis Downtown Site (SLDS) properties are currently zoned by the City for industrial uses, which do not allow new or converted dwellings (residential use). Regarding the residential use question, land use within a 1-mile radius of the SLDS includes a mixture of commercial, industrial, and residential uses. According to the 2012 City of St. Louis Zoning Map, the SLDS properties are currently zoned as either "J Industrial District" or "K Unrestricted District." In addition, the City of St. Louis strategic land use map, which was adopted by the City of St. Louis' Planning Commission on January 5, 2005, all SLDS properties are listed as "Business and Industrial Preservation and Development Area" or "Business and Industrial Development Area." Descriptions of the "J Industrial District" and "K Unrestricted District," both of which prohibit new or converted residential dwellings, are provided in the St. Louis City Code Use Regulations, as follows, in Sections 26.56.020 and 26.60.020, respectively:

- *§26.56.020 (J Industrial District Use Regulations):*

  "The use regulations are the same as those in the I central business district, except that motor fuel pumping stations that meet the site requirements specified in Section 26.40.027 shall be permitted; carry-out restaurants that sell to customers who are in cars or who consume the sold products in cars parked on the carry-out restaurant premises, or sell products through a sales window, to customers who are in cars, for immediate consumption by the customer either on or off the premises that meet the site requirements specified in Section 26.40.026 (B)(1) or (2) as appropriate shall be permitted; and a building or premises may be used for an automobile body, fender repair shop, used car lot, or car leasing or rental lot; and provided further that no building shall be in any case hereinafter erected nor shall any existing building be converted, reconstructed or structurally altered for dwelling purposes except where forty percent (40%) or more of the frontage is occupied by dwellings."

- *§26.60.020 (K Unrestricted District Use Regulations):*

  "In the unrestricted district buildings and premises may be used for any purpose whatsoever not in conflict with any ordinance of the city regulating nuisances or Section 26.60.025, provided that motor fuel pumping stations shall meet the site requirements specified in Section 26.40.027 and carry-out restaurants that sell to customers in cars or who consume the sold products in cars parked on the carry-out restaurant premises, or sell products through a sales window, to customers who are in cars, for immediate consumption by the customer either on or off the premises shall meet the site requirements specified in Section 26.40.026 (B)(1) or (2) as appropriate. Provided, however, that no building shall be hereafter erected, nor shall any existing building be converted, reconstructed or structurally altered for dwelling purposes."

Regarding the wholesale produce district, produce being sold is not expected to be impacted by Manhattan Engineer District/U.S. Atomic Energy Commission (MED/AEC)-related contaminants in inaccessible soil operable unit (ISOU) media. This is mainly because the produce originates from areas outside of the SLDS, and perhaps from other parts of the country, and would be transported by truck or by rail to St. Louis. Therefore, it is unlikely that thorium, or any other MED/AEC-related contaminants, would be present in any produce.

The last question in the comment is referring to statements made in Section 5.2.1.1.3 of the *Proposed Plan for No Further Action for Group 1 Properties Associated with the Inaccessible Soil Operable Unit at the St. Louis Downtown Site* (PP) *("FUSRAP has decided that residences and gardens will not be constructed for the foreseeable future, and that existing buildings will be razed before construction. I would like to know what is the basis for this decision.").* The first

part of the parenthetical is likely referring to the following statement made in the cited section: *"Because current land use is predominantly industrial, and land use is expected to remain as such for the foreseeable future…."* This statement in the PP is consistent with the 2012 City of St. Louis Zoning and land use planning maps, which are cited in the first two paragraphs of this response.

As for buildings being razed, the PP states the following relative to the resident gardener: "Since all existing buildings are assumed to have been razed prior to land redevelopment, no resident gardener exposures were assumed to occur as a result of soil on building surfaces." This statement is not a Formerly Utilized Sites Remedial Action Program (FUSRAP) decision; rather, it is one of the assumptions necessary in developing the risk assessment. The risk assessment process relies on facts and data in order to develop exposure scenarios that are mathematically modeled to calculate risks. Often times site-specific facts and data are not available; therefore, reasonable assumptions must be made in the absence of actual information. The assumption that existing buildings would be razed to make way for a new residential development results in a health conservative exposure scenario for evaluation of a hypothetical resident gardener. This assumption is conservative because redevelopment, demolition, excavation, and construction activities would render currently inaccessible soil as being accessible for exposures to the hypothetical future resident gardener. This results in a "worst case" exposure scenario in comparison with another assumption that may consider a scenario in which the existing buildings are renovated for residential reuse. Building renovations would allow for existing buildings to remain in place, which in turn, would keep the soil beneath those buildings inaccessible to exposures.

3.2.2 Written Comments Received After the Public Meeting (January 30, 2014)

3.2.2.1 Comments from Commenter 2: Sandra Delcoure (from Letter to Sharon Cotner and Brenton Barkley of the USACE, Dated February 9, 2014)

After years on the FUSRAP Oversight Committee, a meeting and touring the SLDS property on Feb. 7, 2014, I agree with the Corps of Engineers Proposed (Inaccessible Property I) Plan for No Further Action in order to maintain protection of human health and the environment. I have not heard any objections to the Corps' work or plans over the years. My water company bills often include water quality standards being met in and around the city and county of St. Louis. St. Louis residents, MSD, City governments in the suburbs of St. Louis have never raised any criticism of the Corps' work. I have heard nothing but positive feedback for the Corps to continue its work on Coldwater Creek and in North County, St. Louis.

I hope the cleanup of the radioactive waste continues on Coldwater Creek to the highest and best cleanup standards possible. A special thank you to all those involved in the cleanup at SLDS and on Coldwater Creek.

Response 2: The comment is acknowledged.

3.2.2.2 Comments from Commenter 3: Beth Pross (from Letter to Steve Hamm of the USACE, Dated February 11, 2014)

Mr. Hamm,

I am writing in reference to the public comments about the *Proposed Plan for No Further Action for Group 1 Properties Associated with the Inaccessible Soil Operable Unit at the St. Louis Downtown Site.*

I am a member of the St. Louis FUSRAP Oversight Committee.

I appreciate the remediation efforts to date and also the opportunity to comment on this plan.

First I am requesting the retraction of my verbal comment from the public meeting on January 31, 2014.

My questions follow:

Will the Riverfront Trail, DT 15 and DT 9, be released as UUUE? This is significant as many people of all ages will likely access this trail on a regular basis. When will this section of the trail be re-opened?

How will ground water beneath ISOU properties be tested and/or processed to eliminate possible contamination? This is significant as current or future wells could be used for industrial use of non-potable water. For example, a business uses a well to supply water to clean trucks, other vehicles, or machines. Contaminated water could then be discharged into the environment.

Thank you for the tour of the SLDS and your time answering many of my questions prior to this letter.

Respectfully,

Beth Pross

Response 3: The verbal comment made during the public meeting has been retracted as requested by Ms. Pross.

The portions of the St. Louis Riverfront Trail at the Downtown [DT]-9 Levee and DT-15 associated with the Inaccessible Soil Operable Unit (ISOU) have been demonstrated in the remedial investigation/baseline risk assessment (RI/BRA) to meet the requirements for unlimited use and unrestricted exposure (UUUE), though the term mostly used for the St. Louis Downtown Site (SLDS) in past and present documents is "releasable for unrestricted use." Accessible soil portions of DT-15 have also been determined to meet the *Record of Decision for the St. Louis Downtown Site* (1998 ROD) requirements for unrestricted use, as documented in *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Metropolitan St. Louis Sewer District Lift Station (DT-15),* Revision 0. Accessible portions of DT-9 (other than the levee portion) are still being addressed under the 1998 ROD. Inaccessible portions of the DT-9 that do not include the levee portion (i.e., the main tracks, rail yard, and soil spoils area) will be addressed in future Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documentation for the SLDS ISOU Group 2 Properties.

Riverfront Trail has been rerouted through a marked detour during the City Property excavation. The trail will be reopened following the restoration of the City Property East of the Levee. No exact timeframe is currently available.

Ground water is outside of the scope of the ISOU, and consequently, is outside of the scope of this ROD. The selected remedy presented in the 1998 ROD encompasses all SLDS ground water, including ground water beneath the inaccessible soils. Ground water continues to be monitored under the authority of the 1998 ROD, and any decisions regarding the continued monitoring will be made within the framework of the Accessible Soil and Ground-Water Operable Unit (OU).

3.2.2.3 Comments from Commenter 4: Agnes C. Uhls (from Email to SLDS Project Manager, USACE FUSRAP, Dated February 13, 2014)

Because of the timing and length of the comment period, and my recent interest in the Downtown SDS site, these questions may already be answered in documents earlier in the FUSRAP process. I would appreciate any reference to tables or pages of documents in answering these questions, and a complete layperson answer be provided (as in SOR explanation).

Comment 4:

Where are the radon results and future predictions for equilibrium-seeking levels for the inaccessible sites? These results are referred to as below 40-*CFR* upper limits in surface soil only.

Response 4: Outdoor and indoor air radon monitoring is conducted semi-annually, and the results are published each year for the St. Louis Downtown Site (SLDS) in the St. Louis Downtown Site Annual Environmental Monitoring Data and Analysis Report (EMDAR). The calendar years are indicated as part of the document title for each EMDAR. Copies of the EMDARs can be found online at:

http://www.mvs.usace.army.mil/Missions/CentersofExpertise/FormerlyUtilizedSitesRemedialActionProgram.aspx

or are available for review at the Formerly Utilized Sites Remedial Action Program (FUSRAP) Project Office, located at 8945 Latty Avenue, Berkeley, Missouri 63134.

The radium (Ra)-226 data indicate that average soil concentrations at the Group 1 Properties are below 40 *Code of Federal Regulations (CFR)* 192 criteria that are protective of radon emissions into indoor air of habitable buildings. The highest average Ra-226 concentrations in soil were detected beneath Building 26 at Plant 1 and the south storage building of Downtown [DT]-4 North. Although these building are not on Group 1 Properties and not included in this record of decision (ROD), radon measurement results in these buildings indicate there are no unacceptable risk to human health. Because the monitored buildings are associated with higher Ra-226 levels in inaccessible soil than are found at the Group 1 Properties, and because the monitored radon concentrations in indoor air at the monitored buildings do not result in unacceptable health risks, it is concluded that there are no unacceptable human health risks associated with radon in indoor air at the Group 1 Properties. Therefore, no further action is necessary regarding radon in indoor air at the Group 1 Properties.

Comment 5:

What was the depth of testing of IS soils "adjacent to sewer lines," and "beneath or immediately adjacent to buildings and other permanent structures?" Are these soil depth test level results documented adequately to support possible future remediation?

Response 5: Sampling depths at inaccessible soil areas of the Group 1 Properties ranged from 0 to 50 feet (ft) (0 to 15 meters [m]) below ground surface (bgs), with the deepest soil samples having been collected beneath the levee at the Downtown [DT]-9 Levee and DT-15. For non-levee properties, sampling depths (excluding the soil adjacent to the sewer line at DT-8) ranged from 0 to 8.5 ft (0 to 2.3 m) bgs. Soil samples were collected adjacent to the sewer line at DT-8 at depths ranging from 17.5 to 32.5 ft (5.3 to 9.9 m) bgs. DT-8 is the only Group 1 Property from which soil samples were collected from locations adjacent to sewer lines. Detailed sample depth information for all inaccessible soil borehole locations, soil boreholes adjacent to sewer lines, and sediments inside of sewer lines, including those for the Group 1 Properties, is documented in Appendix A ("Soil Boring Logs and Sewer Sediment Manhole Logs") in the *Remedial*

Investigation and Baseline Risk Assessment Report for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site (RI/BRA Report).

Comment 6:

Explain if the contamination for IS from any soil level above or below 4-6 feet can migrate to the soil layers above it or lateral to it, and to accessible soils? Can construction activity adjacent to IS soil affect the contamination of adjacent soil? Has there been investigation into whether contaminant plume development has occurred or can occur at the accepted remediation levels that would impact IS released properties?

Response 6: The remedial investigation/baseline risk assessment (RI/BRA) has concluded that Manhattan Engineer District/U.S. Atomic Energy Commission (MED/AEC)-related contamination in inaccessible soil (including soil adjacent to sewer lines) and soil on buildings and structures at the Group 1 Properties does not pose unacceptable risk to human health or the environment. Therefore, there is not a migration concern at the inaccessible soil operable unit (ISOU) Group 1 Properties, because the contamination at all depths does not pose an unacceptable risk.

Further, construction activities at the ISOU Group 1 Properties would not cause an unacceptable risk, as shown by the results of risk assessment that assumed the material was at the surface with no cover material. The remaining properties at the St. Louis Downtown Site (SLDS) associated with the ISOU will be addressed through future Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documents, which will include a feasibility study (FS) to evaluate alternatives to address any risks identified in the RI/BRA, a proposed plan that will solicit public comment, and separate a ROD to document the selected remedy for those properties.

Contaminant plume development from ISOU media at the Group 1 Properties is not a concern for ground water. Ground-water contamination is being addressed under the 1998 ROD. It is important to note that, as stated earlier, the results of the RI/BRA indicate that there is no contamination in ISOU media at the Group 1 Properties that would pose an unacceptable risk to human health and the environment; therefore, the surrounding and underlying soil and ground water are protected without remedial action (RA). Migration of contamination onto the ISOU Group 1 Properties from other areas would not occur as the adjacent areas are accessible and being remediated to the 1998 ROD standards. In addition, protective measures are being utilized during RAs to suppress generation of airborne dust that would otherwise migrate to adjacent downwind areas.

Comment 7:

At what depth are the sewer lines which are determined to be in inaccessible soils for each property? If these sewers are within the depth of remediation under old building sites, why are they not being removed from the IS soils or at least restricted from MSD or St. Louis Water Dept. use? Will these sewer/utility access points be marked by permanent signage?

Response 7: The only Group 1 property that contains sewers used for Manhattan Engineer District/U.S. Atomic Energy Commission (MED/AEC) operations is Downtown [DT]-8. One of the DT-8 sewer lines that is the subject of the *Proposed Plan for No Further Action for Group 1 Properties Associated with the Inaccessible Soil Operable Unit at the St. Louis Downtown* Site (PP) and this record of decision (ROD) was a private, brick-lined sewer main into which MED/AEC wastewater generated from Plant 1 was discharged. Information regarding the sewer line at DT-8 was absent from the PP, though it is captured in this ROD (See Section 2.7.5.4,

summary of radiological concentrations detected in soil samples collected from locations adjacent to the DT-8 sewer in Table 2-5, the risk result for soil adjacent to the DT-8 sewer in Table 2-9, footnote "b" of Table 2-9, the fourth paragraph of Section 2.9.1.3.1, and Section 2.9.1.4.4 of this ROD).

The depth to the private sewer line is approximately 20 feet (ft) (6.1 meters [m]) below ground surface (bgs). This sewer is no longer in use, because it collapsed and was abandoned in the 1970s. Because the sewer line has been abandoned, it is highly unlikely that there would be sewer workers directly contacting that line. The risk assessment shows no MED/AEC-risk to the current or future sewer utility worker from exposures to soil adjacent to the DT-8 sewer line. Sediment could not be sampled from inside of this sewer. Three locations along the DT-8 portion of the sewer line were planned for sediment sampling in the *Remedial Investigation Work Plan for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site* (RI WP). However, during the remedial investigation (RI) field investigation, sediment samples could not be collected at any of the three planned locations. This is because of a lack of sediment encountered at two of the locations and the inability to locate the third sampling location because the point of access was either not visible (i.e., because it was covered with asphalt/concrete) or no longer exists. In addition to the private sewer, a portion of a 4.5-ft-diameter brick public sewer extends along former Salisbury Street beneath DT-8. The public sewer, which was constructed by the city of St. Louis sometime prior to 1927 and is still in operation, is several feet higher in elevation than the private sewer. The public sewer is currently owned and maintained by the Metropolitan St. Louis Sewer District (MSD). This portion of the public sewer was designated as unlikely impacted in the RI WP. Although this portion of the sewer received MED/AEC wastes from some of the buildings in Plant 6WH, it was not expected to exceed screening levels, because it is not in close vicinity to these areas. Aside from the three sewer locations planned for sediment sampling at DT-8, during the RI, 26 sediment samples were collected from within MED/AEC-related sewer lines throughout Plant 1, Plant 2, Plant 6, Plant 7, and DT-11 (none of which are Group 1 Properties), all of which received historical MED/AEC-related discharges. Each sample was evaluated individually for potential health risks, from radionuclides and metals, to a sewer maintenance worker. No unacceptable health risks were calculated for any of the sampled locations. Therefore, given this information, there are not likely to be any unacceptable risks associated with the sewer sediments at DT-8.

Comment 8:

The media story about a contaminated manhole in July 2012 revealed the presence of elevated radiation levels near the Salisbury Street levee wall (close to the Salisbury MSD station), however no test results have been released for this manhole. Will these be added to the RI, and the location of the manhole in question identified or marked?

Response 8: Activity measured in the referenced manhole was reported to be at a level of 2,600 disintegrations per minute per 100 square centimeters (dpm/100 cm^2), which is less than the American National Standards Institute standard (ANSI 13.12-1999 Table 1 – Acceptable Surface Contamination Levels – Group 2) limit for structural surfaces of 6,000 dpm/100 cm^2. Therefore, it is unnecessary to add this information to the *Remedial Investigation and Baseline Risk Assessment Report for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site* (RI/BRA Report) or identify/mark the manhole.

Comment 9:

Residential UUUE determinations. The ISOU BRA does not confirm UUUE requirements are met. In lieu of this it seems, the residential gardener scenario is used. However, this scenario

does not apply to all the ISOU Sites. In St. Louis the relationship to exposure among the population has been generally linked to childhood cancers, but not comprehensively studied for childhood cancers. In the Coldwater Creek investigation, recreational use of the creek was not initially considered. A BRA for childhood risk should be included in a residential scenario. There is no legal guarantee that all ISOU properties will be monitored or restricted to children and residential use, or that future St. Louis City property sales will not zone ISOU property residential for the next 1000 years. Can the BRA develop the residential child scenario? Can the residential gardener or at least residential scenario be done for all the ISOU properties? For employees of businesses at the site, are the scenarios accurately demonstrating their exposure time based on interview or is this hypothetical?

Response 9: Although separate evaluations of child receptors were not performed as part of the baseline risk assessment (BRA), the child receptor was incorporated into the determination of potential lifetime (70 years) cancer risks to a resident living at one Group 1 Property location for 30 years (starting from birth).

The hypothetical resident gardener scenario was applied to all Group 1 Properties associated with the Inaccessible Soil Operable Unit (ISOU), except for ISOU media at Downtown [DT]-4 South, which was determined to be non-impacted by Manhattan Engineer District/U.S. Atomic Energy Commission (MED/AEC)-contamination. Use or non-use of the residential scenarios for the remaining portions of properties associated with the ISOU will be further addressed in the appropriate documents for those properties, because they are not the subject of this *Proposed Plan for No Further Action for Group 1 Properties Associated with the Inaccessible Soil Operable Unit at the St. Louis Downtown Site* (PP) and record of decision (ROD).

Exposure assumptions specific to St. Louis Downtown Site (SLDS) employees are not based on interviews. Rather, conservative assumptions developed by U.S. Environmental Protection Agency (USEPA) guidance and SLDS-specific assumptions that have been agreed upon by the U.S. Army Corps of Engineers (USACE), Missouri Department of Natural Resources (MDNR), and USEPA were used in the BRA. These assumptions were designed to not underestimate risks to workers at the SLDS.

Comment 10:

Explain how the sum of ratios (SOR) is equivalent to the EPA 5/15 pCi/g remediation goal for radium, radon and thorium? Which law is being used to attain remediation goals? Is the SOR being used for SLDS ISOU consistent with residential use? Can the yearly dose in mrem be converted into pCi/g per year for layperson understanding?

Response 10: The sum of ratios (SOR) methodology is not applicable to the Group 1 Properties as the baseline risk assessment (BRA) concluded there was not a risk to human health or the environment and contaminants of concern (COCs) were not identified.

The SOR ensures that the sum of the concentration of radium, thorium and uranium do not exceed the 40 *Code of Federal Regulations (CFR)* 192 5/15 criteria. Both the site-measured concentrations and the 40 *CFR* 192 criteria are used in the calculation of the SOR, as shown in the equations following:

Surface Soil (top 6 inches [15 centimeters]):

$$\frac{\text{greater of Ra-226 or Th-230}}{5} + \frac{\text{greater of Ra-228 or Th-232}}{5} + \frac{\text{U-238}}{50} < 1.0$$

Subsurface Soil:

$$\frac{\text{greater of Ra-226 or Th-230}}{15} + \frac{\text{greater of Ra-228 or Th-232}}{15} + \frac{\text{U-238}}{50} < 1.0$$

An SOR of less than 1.0 indicates that the 40 *CFR* 192 criteria have been met. All isotope concentrations are those above background.

Comment 11:

Although this comment period addresses the inaccessible soils sites, some of these are sites where legal issues prevent remediation of what would otherwise be properties accessible to remediation. Given the unique contamination of this business and residential metropolitan area, what health studies of former and present residents and workers have been done, besides that for Mallinckrodt employees? Will mortality, disease and cancer data to study workers on the ISOU properties and surrounding North City residents be investigated to more accurately determine the BRA?

Response 11: The U.S. Army Corps of Engineers (USACE) is unaware of health studies of former and present residents and workers other than Mallinckrodt employees. It is not the role of the USACE to conduct health studies that are of an epidemiological nature. Under the Formerly Utilized Sites Remedial Action Program (FUSRAP), the USACE is authorized to characterize the nature and extent of Manhattan Engineer District/U.S. Atomic Energy Commission (MED/AEC)-related contamination present at the St. Louis Downtown Site (SLDS) properties and to remediate where it is determined necessary under the U.S. Environmental Protection Agency's (USEPA's) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidelines.

Comment 12:

What is the background radiation level (gamma) referred to in testing and remediation goals for SLDS ISOU? How and where was this background established for SLDS? Could this background level be altered in the future for the BRA?

Response 12: No remediation goals (RGs) have been determined for this record of decision (ROD), because no remediation is being conducted. The selected alternative for the Inaccessible Soil Operable Unit (ISOU) at the Group 1 Properties at the St. Louis Downtown Site (SLDS) is No Further Action.

Background radiation comes from many natural and man-made sources, particularly in urbanized industrial areas such as the SLDS. The U.S. Army Corps of Engineers (USACE) has investigated and studied radiological background levels associated with soil at the SLDS. In 1999, the USACE conducted a background study of the soil at the SLDS, which involved the collection of numerous samples from 12 locations in areas not impacted by Manhattan Engineer District/U.S. Atomic Energy Commission (MED/AEC)-related contaminants. The details of the background study and results are described and presented in the USACE's 1999 *Background Soils Characterization Report for the St. Louis Downtown Site*. This report is available for public review in the SLDS Administrative Record.

No anticipated scenario exists in which the background levels would be altered.

Comment 13:

Can the comment periods for the public be longer to allow access to the information needed to comment? Will USACE provide documents on a fast-track basis to those who are disabled or cannot gain internet access to documents for review?

Response 13: Yes. Upon timely request, and in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 30 *Code of Federal Regulations (CFR)* §300.430(f)(3), the comment period would have been extended for 30 days or more. However, no such request was received.

For the inaccessible soil operable unit (ISOU) Group 1 Properties, the U.S. Army Corps of Engineeers (USACE) closely adhered to the requirements of 40 CFR §300.430(f)(3) regarding community relations. For instance, the public was encouraged to participate in the decision-making process by providing comments on the *Proposed Plan for No Further Action for Group 1 Properties Associated with the Inaccessible Soil Operable Unit at the St. Louis Downtown Site* (PP) during the public comment period, from January 13, 2014, through February 13, 2014. A public meeting was held on January 30, 2014, to provide an opportunity for the public to learn more about the recommended plan for ISOU Group 1 Properties and to submit verbal and written comments. Information about the availability of the PP for the ISOU Group 1 Properties and the opportunity to provide comments during the comment period was announced in the *St. Louis Post Dispatch*, at the Oversight Committee meeting, and in the Formerly Utilized Sites Remedial Action Program (FUSRAP) Newsletter.

The U.S. Army Corps of Engineers (USACE) wishes to encourage public participation in the review process. To assist with this, the USACE will continue to include a notice of upcoming document reviews on the St. Louis District's website and in the FUSRAP newsletter. It will also work with local Oversight Committee members to publicize availability. Documents are immediately available on the district website and at the records repositories. Current plans also include furnishing documents to the St. Louis County Library as well.

Comment 14:

Are minority contract laws documented for the FUSRAP process, and where can this information be obtained?

Response 14: The Formerly Utilized Sites Remedial Action Program (FUSRAP) is obligated by law to follow the Federal Acquisition Regulations relating to any contracting activities. These regulations include the stipulations for contracting with small businesses and minority owned businesses. The Federal Acquisition Regulations can be found online at: www.acquisition.gov under the Policy and Regulations heading.

3.2.2.4 Additional Comments from Commenter 4: Agnes C. Uhls (from separate Email to SLDS Project Manager, USACE FUSRAP, Dated February 13, 2014)

Comment 15:

In Appendix H of the 2012 RI titled "Figures: Extent of Contamination for Radiological and Metals Sampling for Sewers," none of the test sample sites are actually on the Inaccessible Soils/No Further Action properties. These results are primarily for Plants 1 and 2 which border a portion of the ISOU Group 1 properties (Plants 3, 8, 9, 11, and the southern-most of the DT-8 properties). These results are either above-detect PRG, above–non-detect PRG, or below PRG. Please explain why no testing of the ISOU Group 1 properties' sewers is indicated on these maps.

Please explain how this can impact the recommendations and scenarios for public exposure contained in the BRA for these properties.

Response 15: Of all the sewers at the Group 1 Properties, only the sewers at Downtown [DT]-8, which runs along the southern side of Salisbury Street, were investigated during the inaccessible soil operable unit (ISOU) remedial investigation (RI). Although Manhattan Engineer District/U.S. Atomic Energy Commission (MED/AEC)-related activities were never conducted at DT-8, the sewer lines on this property were suspected of having been potentially impacted by historical discharges from the Mallinckrodt facility (Plants 1 and 6) located upstream. Information regarding the DT-8 sewer is absent from the *Proposed Plan for No Further Action for Group 1 Properties Associated with the Inaccessible Soil Operable Unit at the St. Louis Downtown* Site (PP), but is captured in this record of decision (ROD) (Please refer back to the Response to Comment 7). None of the sewers at the other Group 1 Properties were impacted by historical discharges from the Mallinckrodt facility; therefore, those sewers were not investigated. The results of the baseline risk assessment (BRA) for soil collected from locations adjacent to the DT-8 sewer, which are presented in Table 2-9 of this ROD, showed that there are no unacceptable risks associated with soil adjacent to the DT-8 sewers. Please refer back to Response 7 regarding sediment inside of the DT-8 sewer lines. Based on the finding of no unacceptable risks calculated for soil adjacent to the DT-8 sewer lines, as well as the finding of no unacceptable risks calculated for individual sewer sediment samples collected from throughout Plant 1, Plant 2, Plant 6, Plant 7, and DT-11, there is no impact to the recommendations and scenarios for public exposure contained in the BRA for the Group 1 Properties.

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FIGURES

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Path: U:\GPS\SLDS\Inaccessible Areas\Projects\ISOU Group 1 ROD\Rev 0\Figure 2-1 Location Map of the St.mxd

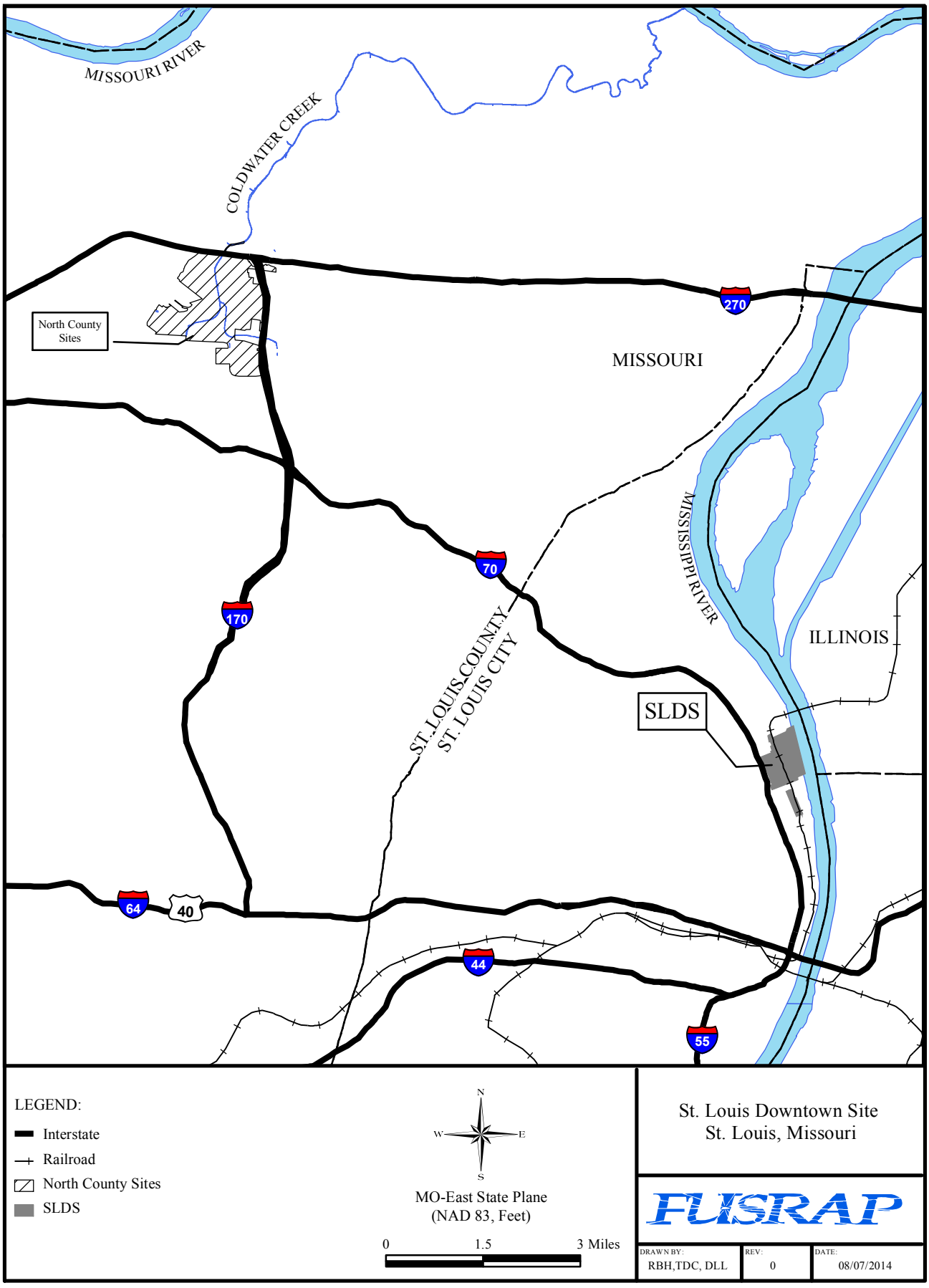


Figure 2-1. Location Map of the St. Louis Sites

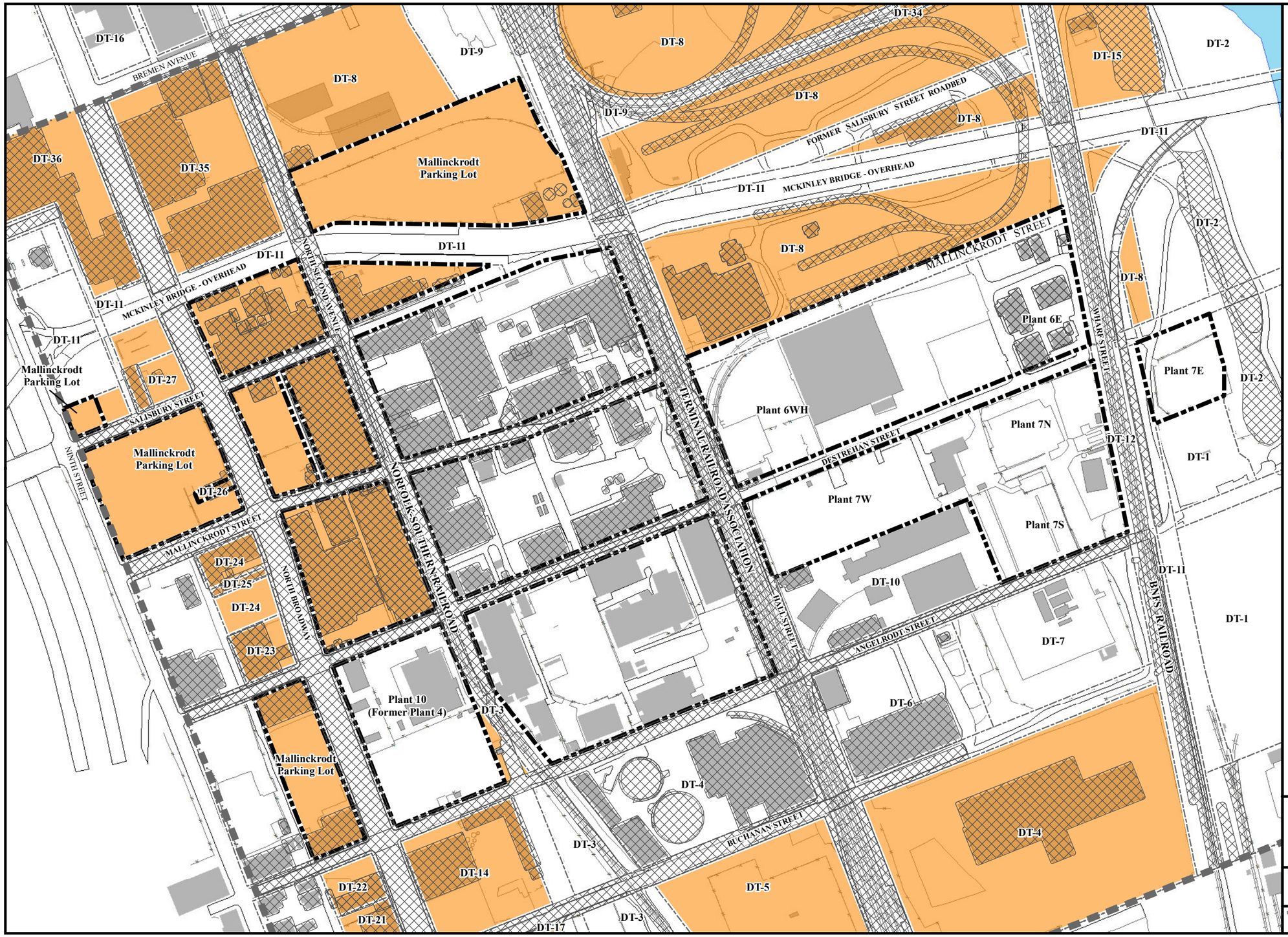
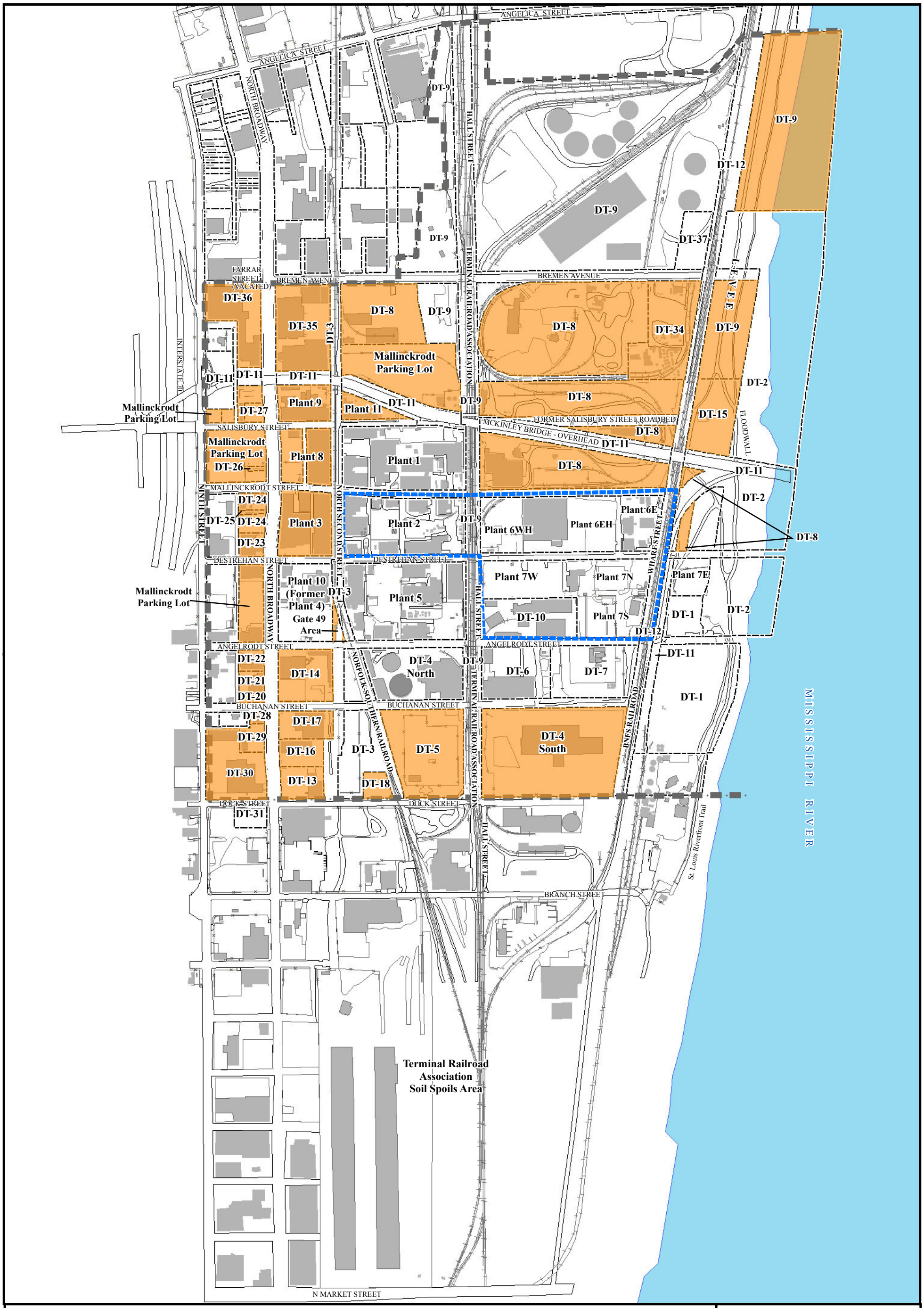


Figure 2-2. Mallinckrodt Plant Designations

Path: U:\GPS\SLDS\Inaccessible Areas\Projects\ISOU Group 1 ROD\Rev 0\Figure 2-3 Selected Properties Recommended for No Further Action.mxd



LEGEND

- Property Boundary
- Uranium-Ore Processing Areas as Defined by the 1998 ROD
- SLDS Boundary
- Building or Tank
- River/Stream
- Fence
- Railroad
- No Further Action Properties

MO-East State Plane
(NAD 83, Feet)

0 250 500 1,000 Feet

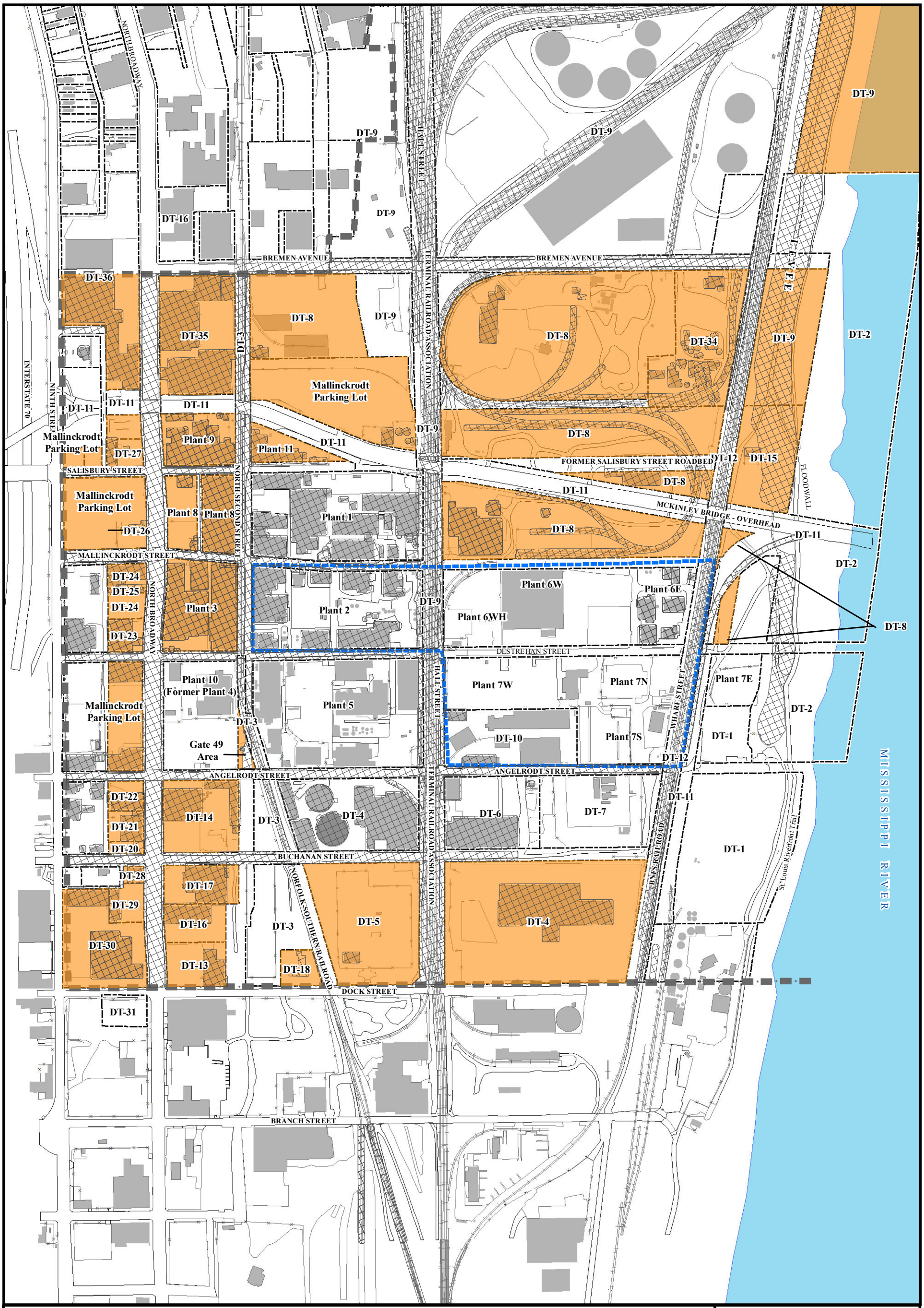
St. Louis Downtown Site (SLDS)
St. Louis, Missouri

FUSRAP

DRAWN BY:	REV:	DATE:
KLP, DJH, DLL	0	08/07/2014

Figure 2-3. Group 1 Properties Recommended for No Further Action

Path: U:\GPS\SLDS\Inaccessible Areas\Projects\ISOU Group 1 ROD\Rev 0\Figure 2-4 Inaccessible Areas within selected properties.mxd



LEGEND

- Inaccessible Areas
- Property Boundary
- Uranium-Ore Processing Areas as Defined by the 1998 ROD
- SLDS Boundary
- Building or Tank
- River/Stream
- Fence
- Railroad
- No Further Action Properties

MO-East State Plane
(NAD 83, Feet)

0 187.5 375 750 Feet

St. Louis Downtown Site (SLDS)
St. Louis, Missouri

FUSRAP

DRAWN BY:	REV:	DATE:
KLP, DJH, DLL	0	08/07/2014

Figure 2-4. Inaccessible Areas within Group 1 Properties

Unit Designation	Approximate Thickness (ft)	Description
Upper Hydrostratigraphic Unit (HU-A)	0-25	**FILL** Grayish black (N2) to brownish black (5YR2/1). Dry to slightly moist, generally becoming moist at 5 to 6 ft and saturated at 10 to12 ft. Slight cohesion, variable with depth, moisture content and percentage of fines present. Consistency of relative density is unrepresentative due to large rubble fragments. Rubble is concrete, brick, glass, and coal slag. Percentage of fines as silt or clay increases with depth from 5 to 30%. Some weakly cemented aggregations of soil particles. Adhesion of fines to rubble increases with depth and higher moisture content. Degree of compaction is slight to moderate with frequent large voids.
	0-10	**Silty CLAY (CH)** Layers are mostly olive gray (5Y2/1) with some olive black (5Y2/1). Predominantly occurs at contact of undisturbed material or at boundary of material with elevated activity. Abundant dark, decomposed organics. Variable percentages of silt and clay composition.
	0-5	**CLAY (CL)** Layers are light olive gray (5Y5/2) or dark greenish gray (5GY4/1). Slightly moist to moist, moderate cohesion, medium stiff consistency. Tends to have lowest moisture content. Slight to moderate plasticity.
	0-2.5	**Interbedded CLAY, silty CLAY, SILT and Sandy SILT (CL, ML, SM)** Dark greenish gray (5GY4/1) to light olive gray (5Y6/1). Moist to saturated, dependent on percentage of particle size. Contacts are sharp, with structure normal to sampler axis to less than 15 degrees downdip. Layer thicknesses are variable, random in alternation, with no predictable vertical gradiation or lateral continuity. Some very fine-grained, rounded silica sand as stringers. Silt in dark mafic, biotite flakes. Some decomposed organics.
Lower Hydrostratigraphic Unit (HU-B)	0-10	**Sandy SILT (ML)** Olive gray (5Y4/1). Moist with zones of higher sand content saturated. Slight to moderate cohesion, moderate compaction. Stiff to very stiff consistency, rapid dilatancy, nonplastic. Sand is well sorted, very fine, and fine-grained rounded quartz particles.
	0-50	**Silty SAND and SAND (SM, SP, SW)** Olive gray (5Y4/1). Saturated, slight cohesion, becoming noncohesive with decrease of silt particles with depth. Dense, moderate compaction. Moderate to well-graded, mostly fine- and medium-grained with some fine- and coarse-grained particles. Mostly rounded with coarse grains slightly subrounded. Gradual gradation from upper unit, silty sand has abundant dark mafic/biotite flakes. Sand is well-graded, fine gravel to fine sand. Mostly medium-grained, with some fine-grained and few coarse-grained and fine gravel.
Limestone Bedrock Unit (HU-C)	Total thickness not penetrated during drilling	**LIMESTONE** Light olive gray (5Y4/1) with interbedded chert nodules. Generally hard to very hard; difficult to scratch with knife. Slightly weathered, moderately fresh with little to no discoloration or staining. Top 5 ft is moderately fractured with 99% of joints normal to the core axis. Joints are open, planar, and smooth. Some are slightly discolored with trace of hematite staining.

Source: Modified from BNI 1994.

Note: The codes in parentheses following lithologies are the Unified Soil Classification System (USCS) codes.

The codes in parentheses following the colors represent chroma, hue, and value from the Munsell soil color charts.

NOT TO SCALE

FUSRAP

St. Louis Downtown Site
St. Louis, Missouri

DRAWN BY:	REV. NO./DATE:	CAD FILE:
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Figure 2-5. Generalized Stratigraphic Column for the SLDS

Source (Radiological Contaminants at Group 1 Properties)	Release/ Transport Mechanism	Exposure Medium/ Secondary Source	Release/ Transport Mechanism	Exposure Medium	Exposure Routes	Potential Human Receptors							Ecological Receptors [a]	
						Current Industrial Worker	Future Industrial Worker	Current/Future Construction Worker	Current/Future Utility Worker	*Current/Future Sewer Maintenance Worker at DT-8*	Current/Future Recreational User (St. Louis Riding Trail)	*Hypothetical Resident Gardener*	Aquatic	Terrestrial
Inaccessible Soil Beneath Ground Cover [b]					External Radiation	❷					❷			❶
					Ingestion									❶
	Particulate Emissions	Air			Dust Inhalation									❶
	Rn-222 Emissions				Rn-222 Inhalation [h]									❶
	Infiltration/ Percolation	Ground Water [c]			External Radiation									
					Ingestion									
	Surface Runoff	Surface Water/ Sediment in Mississippi River			External Radiation								❶	❶
					Ingestion								❶	❶
Inaccessible Soil with No Ground Cover [d]					External Radiation		❷	❷	❷			❷		❶
					Ingestion		❷	❷	❷			❷		❶
	Particulate Emissions	Air			Dust Inhalation		❷	❷	❷			❷		❶
	Rn-222 Emissions				Rn-222 Inhalation [h]	❶	❶	❶	❶	❶		❶		❶
	Infiltration/ Percolation	Ground Water [c]			External Radiation			❶	❶					
					Ingestion			❶	❶					
	Surface Runoff	Surface Water/ Sediment in Mississippi River			External Radiation								❶	❶
					Ingestion								❶	❶
	Biological Uptake	Fruits & Vegetables			Homegrown Produce Consumption							❷		
Soil on Structural Surfaces [e]					External Radiation	❷	❷	❶						
					Ingestion	❷	❷	❶						
	Dust Emissions From Renovation/ Construction	Air			Dust Inhalation	❷	❷	❶						
	Oxidized Particulates from Metal Surfaces				External Radiation								❶	❶
					Ingestion								❶	❶
	Surface Runoff	Surface Water/ Sediment/Biota in Mississippi River												
Sewers (Sediment) [f]					External Radiation				❶					
					Ingestion				❶					
	Particulate Emissions	Air			Dust Inhalation				❶	❶				
	Leakage from Sewer Line	Inaccessible Soil Adjacent to Sewer Lines [g]			External Radiation				❷	❶				
					Ingestion				❷	❶				
			Particulate Emissions	Air	Dust Inhalation				❷	❶				
			Infiltration/ Percolation	Ground Water [c]	External Radiation				❶	❶				
					Ingestion				❶	❶				
			Surface Water/ Sediment in Mississippi River		External Radiation									
					Ingestion									

Notes

KEY:

Receptors presented in ***italics*** are the limiting RME receptors for this ROD.

Incomplete exposure pathway. Pathway was not evaluated in the BRA.

❶ Pathway is potentially complete, but is considered unlikely, insignificant, out of scope for the ISOU, or no data could be collected. Therefore, the pathway was not quantitatively evaluated in the BRA.

❷ Potentially complete and significant exposure pathway. Pathway is evaluated in the BRA.

NOTES:

[a] Ecological receptors include animals and plants.

[b] SLDS-wide and property-specific inaccessible soil beneath ground cover was evaluated under the current industrial land use scenario.

[c] There are no complete or significant human or ecological exposure pathways for ground water.

[d] SLDS-wide and property-specific inaccessible soil with no ground cover was evaluated under the future industrial worker, current/future construction worker, utility worker, and hypothetical resident gardener scenarios.

[e] Includes interior and exterior surfaces containing radiologically contaminated soil. Industrial worker exposures are assumed for interior surfaces, and exposures to industrial workers performing maintenance are assumed for exterior surfaces and roofs. Industrial workers are assumed to be exposed 2,000 hours per year for 25 years. Industrial maintenance workers are assumed to be exposed 80 hours per year for 1 year.

[f] The only sewer considered to be a potential source at the Group 1 Properties is located at DT-8. Although the collection of sediment samples from three locations at the DT-8 sewer was planned in the RI WP, no samples could be collected during the RI. This is because of insufficient amounts of sediment (i.e, for sampling and analysis) were present at two locations and the inability to find access to the third sampling location. Because no sediment data are available for the DT-8 sewer, the status of the sediment exposure pathways for sewer utility workers, via ingestion, external radiation and inhalation is presented as being "1" potentially complete without data.

[g] Although no contamination was identified in sewer sediment, soil adjacent to sewer lines was sampled during the RI to check for possible contamination from sewer leaks.

[h] Only Rn-222 emissions from inaccessible soil to indoor air are considered for occupied or habitable buildings. Indoor air monitoring results available from two buildings not associated with the Group 1 Properties (Building 26 at Plant 1 and the South Storage Building at DT-4 North), beneath which the highest average concentrations of Ra-226 have been detected, have shown no signification levels of Rn-222.

Figure 2-6. Human Health and Ecological Conceptual Site Model for St. Louis Downtown Site Group 1 Properties, Inaccessible Soil Operable Unit