REVISION 0

FIVE-YEAR REVIEW REPORT

FOURTH FIVE-YEAR REVIEW REPORT FOR FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM (FUSRAP) ST. LOUIS SITES

ST. LOUIS, MISSOURI

AUGUST 17, 2020

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

10-50% Recycled Fiber

REVISION 0

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AUGUST 17, 2020

prepared by:

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

with assistance from:

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ACRONYMS AND ABBREVIATIONS

2005 NSC	*Memorandum for Record: Non-Significant Change to the Record of Decision for the St. Louis Downtown Site*
6EH	6 East Half
6WH	6 West Half
7E	7 East
7N	7 North
7S	7 South
7W	7 West
Ac	actinium
AEC	U.S. Atomic Energy Commission
amsl	above mean sea level
ANL	Argonne National Laboratory
ARAR	applicable or relevant and appropriate requirement
ATD	alpha track detector
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BMP	best management practice
BNI	Bechtel National, Inc.
BNSF	Burlington Northern Santa Fe
BRA	baseline risk assessment
CalEPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CIP	*Community Involvement Plan for the St. Louis FUSRAP Sites*
CNS	central nervous system
COC	contaminant of concern
CR	cancer risk
CSR	*Code of State Regulations*
CSF	cancer slope factor
CSFd	dermal cancer slope factor
CSFi	inhalation cancer slope factor
CSF_o	oral cancer slope factor
CWC	Coldwater Creek
CWC-94, CWC-96, CWC-98, and Industrial Lane PDIR-FSSE	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-94, CWC-96, CWC-98, and Industrial Lane, St. Louis, Missouri*
CY	calendar year
DCAL	dose and risk calculation (software)
DCF	dose conversion factor
DHSS	Department of Health and Senior Services
DOE	U.S. Department of Energy
DT	Downtown

ACRONYMS AND ABBREVIATIONS (Continued)

DT-2 WOL/DT-11 PRAR-FSSE	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Vicinity Properties City Property (DT-2) West of the Levee and City of Venice (DT 11) (Partial)*, *St. Louis, Missouri*
DT-10 PRAR-FSSE	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Thomas and Proetz Lumber Company (DT-10)*
ED	exposure duration
EDE	effective dose equivalent
EE/CA	engineering evaluation/cost analysis
ELAP	Environmental Laboratory Accreditation Program
EMDAR	Environmental Monitoring Data and Analysis Report
EOL	east of the levee
EPC	exposure point concentration
FFA	Federal Facility Agreement
FGR-11	*Federal Guidance Report No. 11: Limiting Values of Radionuclide Intake And Air Concentration and Dose Conversion Factors For Inhalation, Submersion, And Ingestion*
FGR-12	*Federal Guidance Report No. 12: External Exposure to Radionuclides in Air, Water, and Soil*
FGR-13	*Federal Guidance Report No. 13: Cancer Risk Coefficients for Environmental Exposure to Radionuclides*
FGR-15	*Federal Guidance Report No. 15: External Exposure to Radionuclides in Air, Water and Soil*
First Five-Year Review Report	*Five-Year Review Report: Initial Five-Year Review Report for Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites*
Fourth Five-Year Review Report	*Five-Year Review: Fourth Five-Year Review Report for Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites*
FSS	final status survey
FSSE	final status survey evaluation
FUSRAP	Formerly Utilized Sites Remedial Action Program
Futura	Futura Coatings Company
FY	fiscal year
GIFREHC	General Investment Funds Real Estate Holding Company
GRAAA	ground-water remedial action alternative assessment
GSN	Gunther Salt North
GSS	Gunther Salt South
GWS	gamma walkover survey
HEAST	*Health Effects Assessment Summary Tables*
HI	hazard index
HISS	Hazelwood Interim Storage Site
HISS EA EE/CA	*Engineering Evaluation/Cost Analysis – Environmental Assessment for the Proposed Decontamination of Properties in the Vicinity of the Hazelwood Interim Storage Site, Hazelwood, Missouri*

ACRONYMS AND ABBREVIATIONS (Continued)

HISS EE/CA	*Engineering Evaluation/Cost Analysis (EE/CA) for the Hazelwood Interim Storage Site (HISS)*
HR	hazard ratio
HU	hydrostratigraphic unit
HZ	hydrostratigraphic zone
I	Interstate
IA	investigation area
ICRP	International Commission on Radiological Protection
IL	investigative limit
ISOU	Inaccessible Soil Operable Unit
IRIS	Integrated Risk Information System
IT	IT Corporation
IUR	inhalation unit risk
LM	Legacy Management
LUC	land use control
Mallinckrodt	Mallinckrodt LLC
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual*
MB	mass-balance
McDonnell Boulevard	James S McDonnell Boulevard
MCL	maximum contaminant level
MDNR	Missouri Department of Natural Resources
MED	Manhattan Engineer District
MoDOT	Missouri Department of Transportation
MOU	Memorandum of Understanding
MSD	Metropolitan St. Louis Sewer District
NC	North St. Louis County Sites
NC FS	*Feasibility Study for the St. Louis North County Site*
NC PP	*Proposed Plan for the St. Louis North County Site*
NC ROD	*Record of Decision for the North St. Louis County Sites*
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NORM	naturally occurring radioactive materials
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NTP	National Toxicology Program
O&M	operations and maintenance
OPP	Office of Pesticide Programs
ORNL	Oak Ridge National Laboratory
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
Pa	protactinium
Pb	lead
PDI	pre-design investigation
PDIR	pre-design investigation report
PEF	particulate emission factor
POTW	publicly owned treatment work

ACRONYMS AND ABBREVIATIONS (Continued)

PR	public relations
PRAR	post-remedial action report
PVC	polyvinyl chloride
Q&A	question and answer
Ra	radium
RAGS Part A	*Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)*
RAGS Part E	*Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Assessment)*
RAGS Part F	*Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)*
RAIS	Risk Assessment Information System
RAO	remedial action objective
RAS	remedial action summary
RAWD	remedial action work description
RAWP	remedial action work plan
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RESRAD	RESidual RADioactivity (computer model)
RfC	reference concentration
RfD	reference dose
RfD_d	dermal reference dose
RfD_i	inhalation reference dose
RfD_o	oral reference dose
RFI	Resource Conservation and Recovery Act Facility Investigation
RG	remediation goal
RI	remedial investigation
Rn	radon
ROD	record of decision
ROE	right of entry
ROW	right-of-way
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act of 1986
Second Five-Year Review Report	*Five-Year Review: Second Five-Year Review Report for Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites*
SLAPS	St. Louis Airport Site
SLAPS Interim Action EE/CA	*St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA)*
SLDS	St. Louis Downtown Site
SLDS EE/CA	*Engineering Evaluation/Cost Analysis for Decontamination of the St. Louis Downtown Site*
SLDS ROD	*Record of Decision for the St. Louis Downtown Site*
SLS	St. Louis Sites

ACRONYMS AND ABBREVIATIONS (Continued)

SLS RI Report	*Remedial Investigation Report for the St. Louis Site*
SLS RI Addendum	*Remedial Investigation Addendum for the St. Louis Site*
SOR	sum of ratios
SOR_N	net sum of ratios
SSLF	Soil Storage and Loadout Facility
SU	survey unit
TBC	To Be Considered
TEDE	total effective dose equivalent
Th	thorium
Third Five-Year Review Report	*Five-Year Review Report: Third Five-Year Review Report for Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites*
TLD	thermoluminescent dosimeter
TRRA	Terminal Railroad Association
U	uranium
UCL_{95}	95 percent upper confidence limit
UMTRCA	Uranium Mill Tailings Radiation Control Act
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UUUE	unlimited use and unrestricted exposure
VP	vicinity property
VP-53 PRAR-FSSE	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property 53*
WOL	west of levee
WQC	water quality criteria

UNIT 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 areas are given in square meters). Units included in the following list are not defined at first use in this report.

ºF	degrees Fahrenheit
µCi/mL	microcurie(s) per milliliter
µg/dL	microgram(s) per deciliter
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter
Bq	becquerel
Ci	curie(s)
cm	centimeter(s)
cm^2	square centimeter(s)
cm^3/g	cubic centimeter(s) per gram
dpm	disintegration(s) per minute
ft	foot/feet
ft^2	square foot/feet
g	gram(s)
g/cm^3	gram(s) per cubic centimeter
g/m^3	gram(s) per cubic meter
kg	kilogram(s)
kg/m^3	kilogram(s) per cubic meter
L	liter(s)
L/kg	liter(s) per kilogram
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
m^3/kg	cubic meter(s) per kilogram
m^3-year/kg-day	cubic meter-year per kilogram-day
mg	milligram(s)
mg/cm^2	milligram(s) per square centimeter
mg-day/kg-year	milligram-day per kilogram-year
mg/kg	milligram(s) per kilogram
mg/kg-day	milligram(s) per kilogram body weight per day
mg/m^3	milligram(s) per cubic meter
mrem	millirem
mrem/pCi	millirem per picocurie
mSv	millisievert(s)
pCi	picocurie(s)
pCi/g	picocurie(s) per gram
pCi/L	picocurie(s) per liter
pCi/m^2	picocurie(s) per square meter(s)
ppb	part(s) per billion
Sv	sievert(s)
WL	working level
yd^3	cubic yard

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EXECUTIVE SUMMARY

This five-year review was performed by the U.S. Army Corps of Engineers (USACE), St. Louis District, to evaluate the implementation, performance, and protectiveness of the response actions conducted at the Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites (SLS). The SLS have areas of contamination as a result of the historic Manhattan Engineer District (MED)/Atomic Energy Commission (AEC) operations at the Mallinckrodt LLC (Mallinckrodt) property and/or subsequent transportation, storage, or migration of MED/AEC-related residues. SLS include the following two locations:

(1) The St. Louis Downtown Site (SLDS), comprised of the Mallinckrodt property and the 40 surrounding vicinity properties (VPs). This site is located near the Mississippi River, north of downtown St. Louis, Missouri. The SLDS is not listed on the National Priorities List (NPL).

(2) The North St. Louis County Sites comprise an NPL site that is located near St. Louis Lambert International Airport in St. Louis County, Missouri, and includes the following properties:

- the Latty Avenue Properties, including the Hazelwood Interim Storage Site (HISS), Futura Coatings Company (Futura), and 10 VPs;
- the St. Louis Airport Site (SLAPS); and
- SLAPS VPs, consisting of the properties between SLAPS, HISS, Coldwater Creek (CWC), and the properties along CWC.

SLAPS, HISS, and Futura were placed on the NPL in 1989 (CERCLIS Identification Number MOD980633176).

In 1974, the AEC established 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 SLS at levels that required a response, SLS was designated for inclusion under FUSRAP. Until 1997, the Department of Energy (DOE) led the cleanup of SLS as part of its responsibility for the cleanup of FUSRAP sites. In 1997, Public Law 105-62 transferred responsibility for the execution of FUSRAP from DOE to USACE under the Fiscal Year 1998 Energy and Water Development Appropriations Act. Consistent with this transfer, USACE is conducting response actions at SLS 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 USACE, as the lead federal agency, to conduct response actions for releases related to the nation's early atomic energy program, subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). USACE has been conducting investigations and response actions at SLS in coordination with the U.S. Environmental Protection Agency (USEPA) Region 7 and the Missouri Department of Natural Resources (MDNR).

ST. LOUIS DOWNTOWN SITE

SLDS comprises a 182,108-m^2 (45-acre) chemical manufacturing complex owned by Mallinckrodt and 40 adjacent VPs located in an industrialized area approximately 2 miles north of the St. Louis downtown area. From 1942 until 1957, Mallinckrodt Chemical Works (now Mallinckrodt LLC [Mallinckrodt]) was contracted by the 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.

SLDS has been separated into two Operable Units (OUs): (1) the SLDS Accessible Soil and Ground-Water OU and (2) the SLDS Inaccessible Soil Operable Unit (ISOU). The SLDS Accessible Soil and Ground-Water OU consists of the accessible soil and ground water contaminated as the result of MED/AEC uranium processing activities at the Mallinckrodt plant. The media that comprises the ISOU (i.e., inaccessible soil, soil adjacent to sewer lines, sediment inside the sewer lines, and soil on building/structural surfaces) are being addressed under separate, ongoing CERCLA actions and are outside the scope of this five-year review. This five-year review report addresses only the SLDS Accessible Soil and Ground-Water OU.

The accessible soil and ground-water OU at SLDS is being addressed by USACE consistent with the final remedy presented in the *Record of Decision for the St. Louis Downtown Site* (SLDS ROD) (USACE 1998a). The radiological contaminants of concern (COCs) for the accessible soil and ground-water OU identified in the SLDS ROD include 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 chemical COCs include arsenic and cadmium.

The SLDS ROD identifies the following general components of the remedy:

- Excavation and off-site disposal of accessible soil containing radiological and chemical contamination resulting from MED/AEC processing activities, and
- No remedial action is required for ground water beneath the site. Perimeter monitoring of the ground water in the Mississippi River alluvial aquifer, designated as the hydrostratigraphic B Unit, will be performed and the need for ground-water remediation will be evaluated as part of the periodic reviews performed for the site.

Table ES-1 summarizes the remedial activities conducted at the SLDS properties during this Five-Year Review period.

Table ES-1. Summary of Remedial Activities Conducted at SLDS During This Five-Year Review Period (January 2014 through December 2018)

Location	Property	Start	Complete	Volume Removed (yd^3)
DT-2	City Property VP: East of the Levee (EOL)[a]			
	Areas 3, 4, 5, 7 and 9[b]	January 2011	February 2015	30,589
	Kiesel Riverfront Property	January 2011	January 2015	267
	Area 8[b]	August 2012	Ongoing	*
Mallinckrodt	Plant 6EH: Remediation conducted concurrently with Building 101 remediation at Plant 6 West Half (6WH)	December 2012	September 2017	20,632[a]
Mallinckrodt	Plant 6WH: Remediation associated with Building 101	November 2012	Ongoing	61,616[c]
NA	Kiesel Hall Street Properties	May 2013	October 2014	10,503
Mallinckrodt	Destrehan Street-East and Plant 7W North Areas	June 2016	Ongoing	25,624[c]
Mallinckrodt	Destrehan Street -West	August 2016	February 2017	815
Mallinckrodt	Plant 1: Stage 1 remediation of Former Building 17 Area	June 2017	August 2018	2,300[c]
DT-6	Heintz Steel and Manufacturing VP: Remediation associated with storage building	August 2018	September 2018	40

Table ES-1. Summary of Remedial Activities Conducted at SLDS During This Five-Year Review Period (January 2014 through December 2018) (Continued)

Location	Property	Start	Complete	Volume Removed (yd^3)
DT-4	GSN – Dome 2 Area	November 2018	Ongoing	*

[a] The volume removed for the Plant 6EH includes radiologically contaminated soil removed during the 2000 to 2003 remedial action, the 2007 to 2008 remedial action, and the additional excavation required during the remediation of the adjacent Plant 6WH Building 101 and Destrehan Street - East areas.

[b] Area 3, Area 7, and Area 9 are located near the bank of the Mississippi River. Area 4 and Area 5 are both situated on the east side of the levee and are located between Area 3 and the 15-inch and 30-inch sewers. Area 8 is near the shoreline of the Mississippi River and is situated due east and slightly downstream of the 15-inch and 30-inch sewer outlets.

[c] Additional remediation activities are planned for these properties, so the associated soil volumes shown do not necessarily represent final volumes removed. Rather, for these properties, the volumes presented represent the amount of soil removed between the "Start" and "Complete" dates shown.

Notes:

This table includes only those properties for which remedial actions were conducted during this five-year review period (January 1, 2014, through December 31, 2018). It does not include completed properties for which remedial actions were not required. The post-remedial action report (PRAR)-final status survey evaluations (FSSEs) for the remediated properties are listed in Section 2.4.2.2, Table 5, of this report.

* Final volume removed is not available because the remedial action is ongoing and/or the PRAR-FSSE for this area is not yet completed.

NA - Not Applicable

Since the issuance of the SLDS ROD, USEPA has implemented updates to exposure assumptions, toxicity criteria, and USEPA's risk assessment guidance/methodologies. Based on the updates, the remediation goals (RGs) still meet the remedial action objectives (RAOs). The findings of the health protectiveness evaluation performed for the technical assessment demonstrate that the remedy at SLDS is still protective of human health and protective of the environment.

Based on the technical evaluation, no natural or manmade changes to the physical or biological characteristics of SLDS that would impact protectiveness of the remedy have occurred. Mallinckrodt currently maintains 24-hour security at the Mallinckrodt property and limits site access to employees, subcontract employees, and authorized visitors. The Mallinckrodt property is enclosed by a well-maintained and patrolled security fence. SLDS is currently zoned industrial, which does not allow for the construction or renovation of buildings for residential purposes. No significant changes in land use are expected. No information is known that could call into question the human health or environmental protectiveness of the remedy.

The remedy at SLDS is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.

NORTH ST. LOUIS COUNTY SITES

The North St. Louis County Sites include the Latty Avenue Properties, SLAPS and SLAPS VPs. These properties are located within the City of Hazelwood and the City of Berkeley, and include the airport property owned by the City of St. Louis. The SLAPS VPs consist of the properties between SLAPS and HISS, along CWC, and the open fields immediately north of SLAPS (the former Ballfields area). The Latty Avenue Properties include HISS, Futura, and the ten Latty Avenue VPs (VP-01(L) through 06(L) and 40A (partial), and Parcel 10K5300870, 10K530076, and 10K530065).

In 1946, the MED/AEC acquired the 89,031-m^2 (22-acre) tract of land now known as SLAPS. From 1946 until 1967, this property was used to store residues and scrap resulting from uranium processing at SLDS. In 1966, the uranium-bearing residues were purchased and removed from

SLAPS. Residues were placed in storage at a property on Latty Avenue (now known as HISS and Futura). Over time, soils and sediments at the VPs were contaminated by residues originating from residue hauling activities or from water and wind erosion from other sites. In October 1989, USEPA placed three of the North St. Louis County Sites properties (SLAPS, HISS, and Futura) on the National Priorities List (NPL) (CERCLIS No. MOD980633176).

The *Record of Decision for the North St. Louis County Sites* (NC ROD) (USACE 2005a) was issued on September 2, 2005. The selected remedy presented in the NC ROD requires the excavation and disposal of radiological and chemical contamination in accessible soil resulting from MED/AEC processing activities. The other components of the selected remedy include the following:

- Implement use restrictions at areas under roads, active rail lines, and other permanent structures at which the residual condition is not consistent with unlimited use and unrestricted exposure (UUUE);
- Dredge contaminated sediments from CWC to RGs that support UUUE;
- Monitor ground water long-term in selected areas in which soils contaminated above RGs are left in place or in which contaminated ground water has the potential to degrade adjacent ground-water or surface-water systems.

The North St. Louis County Site is currently being addressed by USACE consistent with the final remedy presented in the NC ROD (USACE 2005a). The radiological COCs for soil include: Ac-227, Pa-231, Ra-226, Ra-228, Th-228, Th-230, Th-232, U-235, and U-238. The metal COCs include antimony, arsenic, barium, cadmium, chromium, molybdenum, nickel, selenium, thallium, and vanadium. Metal COCs are only applicable at SLAPS IAs 1 through 13, HISS, Futura, VP2L and 10K530087.

During the period of this review, USACE sampled CWC banks, sediment, and adjacent properties within the 10-year floodplain, working downstream (north) from the historical source areas. Pre-design investigation (PDI) sampling, and delineation and bounding sampling is ongoing south of St. Denis Bridge to determine the extent and depth of the contamination at areas in the creek and adjacent properties where initial sampling identified the presence of contamination. This sampling will be used to help develop the remedial design (RD) for these areas. PDI sampling is ongoing for the next segment of CWC north of St. Denis Bridge.

Table ES-2 summarizes the remedial activities conducted at the North St. Louis County Sites during this Five-Year Review period.

Table ES-2. Summary of Remedial Activities Conducted at the North St. Louis County Sites During This Five-Year Review Period (January 2014 through December 2018)

Area	Designation	Start	Complete	Volume Removed (yd^3)
Latty Avenue Properties	VP-04(L)[a]	April 2015	May 2015	3
	Futura – Ameren Poles Area	December 2018	Ongoing	88[b]
SLAPS and SLAPS VPs	VP-57 and VP-58	April 2014	Ongoing	10,273[b]
	Pershall Road – South Ditch	June 2014	July 2015	58
	St. Cin Park (CWC-56)	July 2015	July 2016	3,088
	Duchesne Park	February 2016	May 2017	6,371
	Palm Drive (CWC-65 through 82) and Chez Paree (CWC-83-92)	February 2017	February 2019	6,157[b]
	IA-09 Ballfields, Phase 2B[a]and Phase 3	April 2018	Ongoing	16,012[b]

Table ES-2. Summary of Remedial Activities Conducted at the North St. Louis County Sites During This Five-Year Review Period (January 2014 through December 2018) (Continued)

Area	Designation	Start	Complete	Volume Removed (yd^3)
SLAPS and SLAPS VPs (Continued)	Eva Avenue-North	October 2018	Ongoing	731[b]

[a] Remedial actions were also conducted over portions of these properties prior to this review period (i.e., prior to January 2014).

[b] Final volume removed is not available because the remedial action is ongoing and/or the PRAR-FSSE for this area is not yet completed. The associated soil volumes shown do not necessarily represent final volumes removed.

Notes:

Table includes only those properties for which remedial actions were conducted during this five-year review period (January 1, 2014, through December 31, 2018). It does not include completed properties for which remedial actions were not required. The PRARs for the remediated properties are listed in Table 30.

NA – Not Applicable

Since the issuance of the NC ROD in 2005, USEPA has implemented updates to exposure assumptions, toxicity criteria, and USEPA's risk assessment guidance/methodologies. Based on the updates, the RGs still meet the RAOs. The findings of the health protectiveness evaluation performed for the technical assessment demonstrate that the remedy at the North St. Louis County Sites is still protective of human health and protective of the environment.

The remedy at the North St. Louis County Sites is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have addressed all exposure pathways that could result in unacceptable risks in these areas.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Formerly Utilized Sites Remedial Action Program (FUSRAP) – St. Louis Sites (SLS)		
EPA ID: MOD980633176		
Region: 7	**State:** MO	**City/County:** St. Louis

SITE STATUS	
NPL Status: Final North St. Louis County Sites consisting of St. Louis Airport Sites (SLAPS), Hazelwood Interim Storage Site (HISS), and Futura Coatings Company (Futura) and the SLAPS Vicinity Properties (VPs)	
Multiple OUs? Not Yet No	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** U.S. Army Corps of Engineers (USACE)
Author affiliation: USACE, St. Louis District
Review period: August 18, 2015 through May 8, 2020
Date of site inspection: July 31, 2019
Type of review: Statutory
Review number: 4 (Fourth)
Triggering action date: 08/17/2015
Due date *(five years after triggering action date)*: 08/17/2020

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
None

FIVE-YEAR REVIEW SUMMARY FORM (Continued)

Other Finding and Recommendations Identified in the Five-Year Review:				
OU(s): SLDS Accessible Soil and Ground-Water Operable Unit (OU)	**Category:** Monitoring			
	Observation: Concentrations of Arsenic and Total U have exceeded the Investigation Levels (IL): Ground-water monitoring results indicate that total uranium (U) and arsenic concentrations are exceeding the ILs in HU-B ground water, also known as the Mississippi Alluvial Aquifer. The ILs are 50 µg/L for arsenic and 20 µg/L for U. Continue to monitor HU-B to monitor the effectiveness of the source removal action and to help ensure that the SLDS ROD RAOs are achieved. Complete the remediation of potential sources beneath the Building 101 area in Plant 6WH to address areas of soil contamination at formerly inaccessible and continuing source areas.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	USACE	USEPA	12/31/2022
OU(s): North St. Louis County Sites	**Category:** Monitoring			
	Observation: Total U concentrations in a shallow ground-water monitoring well exceed the *Record of Decision for the North St. Louis County Sites* (NC ROD) monitoring guideline at SLAPS: Ground-water monitoring results indicate that total U consistently exceeds the 30 µg/L monitoring guideline established in the NC ROD in shallow (HZ-A) ground-water monitoring well PW46, located at the western edge of SLAPS. At this time, monitoring of surface water and sediments in CWC indicate that significant transport of total U from HZ-A into CWC is not occurring. Continue to monitor PW46 and CWC to verify that total U transport via shallow ground water does not impact CWC.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	USACE	USEPA	12/31/2022

FIVE-YEAR REVIEW SUMMARY FORM (Continued)

Protectiveness Statement(s)		
Operable Unit: SLDS Accessible Soil and Ground-Water OU	*Protectiveness Determination:* Will be Protective	*Addendum Due Date (if applicable):*
Protectiveness Statement: The remedy at SLDS is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.		
Operable Unit: North St. Louis County Sites	*Protectiveness Determination:* Will be Protective	*Addendum Due Date (if applicable):*
Protectiveness Statement: The remedy at the North St. Louis County Sites is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.		

STATEMENT OF PROTECTIVENESS

Protectiveness Statement (St. Louis Downtown Site)

The remedy at SLDS is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.

Protectiveness Statement (North St. Louis County Sites)

The remedy at the North St. Louis County Sites is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.

For the U.S. Army:

Kevin R Golinghorst 17 Aug 2020

Signature Date

Kevin R. Golinghorst
Colonel, U.S. Army
District Commander

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1.0 INTRODUCTION

The purpose of this five-year review is to evaluate the implementation and performance of the remedy for the Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites (SLS) in order to determine if the remedy is and will be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review Reports. In addition, Five-Year Review Reports identify issues found during the review, if any, and recommendations to address them. This five-year review is required because concentrations of hazardous substances, pollutants, or contaminants at SLS do not meet the criteria for unlimited use and unrestricted exposure (UUUE).

This review was conducted pursuant to Section 121 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

SLS is composed of two locations designated as the St. Louis Downtown Site (SLDS) (non-National Priorities List [NPL] site) and the North St. Louis County Sites (NPL site) (Figure 1). In October 1989, three of the North St. Louis County Site properties were placed on the NPL (CERCLIS No. MOD980633176), pursuant to Section 105 of CERCLA. The NCP, at 40 *Code of Federal Regulations (CFR)* §300.430(f)(4)(ii), states the following.

> If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

The U.S. Army Corps of Engineers (USACE), St. Louis District, conducted a five-year review of the remedy for SLS in accordance with the U.S. Environmental Protection Agency's (USEPA's) *Comprehensive Five-Year Review Guidance* (USEPA 2001). The review was conducted from June 10, 2019, to January 20, 2020. The results of the CERCLA five-year review are documented in this report; Section 2 presents the five-year review results for SLDS and Section 3 presents the five-year review results for the North St. Louis County Sites.

This is the fourth five-year review conducted for SLS. The USEPA's *Comprehensive Five-Year Review Guidance* recommends that subsequent five-year review reports be prepared within 5 years of the signature date of the previous review (USEPA 2001). The triggering date for this review is the signature date of the *Five-Year Review Report: Third Five-Year Review Report for Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites* (Third Five-Year Review Report) (USACE 2015a), which is August 17, 2015. The due date for the fourth five-year review is August 17, 2020.

1.1 REGULATORY BACKGROUND

FUSRAP was initiated by the U.S. Atomic Energy Commission (AEC) in 1974 to identify, remediate, or otherwise control sites at which residual radioactivity remained from operations conducted for the Manhattan Engineer District (MED). FUSRAP continued under the successor agencies to the AEC until 1997, when the U.S. Congress transferred responsibility for management of FUSRAP from the U.S. Department of Energy (DOE) to USACE.

The remedial actions at SLS are being conducted under FUSRAP and are implemented per the requirements set forth in two Records of Decision (RODs): the *Record of Decision for the St. Louis*

Downtown Site (SLDS ROD) (USACE 1998a) and the *Record of Decision for the North St. Louis County Sites* (NC ROD) (USACE 2005a).

SLDS, consisting of a chemical manufacturing complex owned by Mallinckrodt LLC (Mallinckrodt) and 40 adjacent vicinity properties (VPs), has been separated into two Operable Units (OUs): (1) the SLDS Accessible Soil and Ground-Water OU and (2) the SLDS Inaccessible Soil Operable Unit (ISOU). The SLDS Accessible Soil and Ground-Water OU consists of the accessible soil and ground water contaminated as the result of MED/AEC uranium processing activities at the Mallinckrodt plant. This five-year review report addresses only the SLDS Accessible Soil and Ground-Water OU and the North St. Louis County Sites.

The SLDS ISOU was excluded from the scope of the SLDS ROD (USACE 1998a) because the inaccessible soil did not present a significant threat in its current configuration and because activities critical to the continued operation of Mallinckrodt prevented excavation beneath the encumbrances (e.g., roads, active railroads, buildings, and other permanent structures). Because land use on the Mallinckrodt property and the SLDS VPs has remained the same since the SLDS ROD (USACE 1998a) was signed, these determinations hold true today. The SLDS ISOU is therefore outside the scope of this five-year review. USACE has developed the *Record of Decision for the Inaccessible Soil Operable Unit Associated with Group 1 Properties at the St. Louis Downtown Site* (USACE 2014a), in coordination with USEPA Region 7 and with concurrence from the Missouri Department of Natural Resources (MDNR). The remaining properties in the ISOU (i.e., Group 2) are currently being evaluated and will be addressed under a future CERCLA action.

This five year review also addresses the North St. Louis County Sites. Prior to the NC ROD signature date (September 2, 2005), response actions at the North St. Louis County Sites were conducted as removal actions under engineering evaluations/cost analyses (EE/CAs). After September 2, 2005, the effective date of the NC ROD, a remedial action was initiated. The media addressed by the NC ROD are contaminated soil, sediment, surface water, ground water, and structures at the North St. Louis County Sites. The remedial action at the North St. Louis County Sites is currently ongoing.

1.2 ORGANIZATION OF THIS FIVE-YEAR REVIEW REPORT

This Five-Year Review Report is organized into Sections 1.0 through 4.0 and Appendices A through E.

Section 1.0 Contains a brief overview of and regulatory background for FUSRAP, SLS, and this five-year review.

Section 2.0 Contains the methods, findings, and conclusions of the CERCLA five-year review for contaminated soil at SLDS, as well as issues (if any) found during the review and recommendations to address them.

Section 3.0 Contains the methods, findings, and conclusions of the CERCLA five-year review for the North St. Louis County Sites, as well as issues (if any) found during the review and recommendations to address them.

Section 4.0 Lists the references and resource materials used in the development and preparation of this Five-Year Review Report for SLS.

Figures Contains the figures referenced in Sections 1.0 through 3.0. These figures depict the location of SLDS and the North St. Louis County Sites, and the specifics (e.g., properties, stratigraphy, remediated areas, monitoring locations, and monitoring data trends) relevant to each location.

Appendix A	Contains details of site inspections performed to determine the effectiveness of the remedy at SLDS and the North St. Louis County Sites as part of this five-year review.
Appendix B	Contains a list of individuals (name and affiliation) interviewed for this five-year review and a record of each interview.
Appendix C	Contains an analysis of applicable or relevant and appropriate requirements (ARARs).
Appendix D	Contains evaluations of *Federal Guidance Report No. 15: External Exposure to Radionuclides in Air, Water and Soil* (FGR-15) updated dose conversion factors for external radiation exposure pathways.
Appendix E	Contains detailed descriptions of remedial actions taken during this review period.

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2.0 ST. LOUIS DOWNTOWN SITE

2.1 INTRODUCTION

SLDS is a non-NPL site; however, a five-year review is required by statute at SLDS because the remedy selected will leave hazardous substances beyond levels that support UUUE (CERCLA §121(c)). The methods, findings, and conclusions of the CERCLA five-year review for contaminated soil at SLDS are documented in this section of the report. In addition, this section identifies issues found during the review and recommendations to address them.

2.2 SITE CHRONOLOGY

A summary of the chronology of events for SLDS is presented in Table 1. The SLDS VPs are identified using the prefix of "DT" to represent the "downtown" site, followed by a number.

Table 1. Chronology of Events for SLDS

SLS Events	Date
FUSRAP created.	March 1974
DOE submitted the *Remedial Investigation Report for the St. Louis Site* (SLS RI Report) (DOE 1994).	1994
DOE submitted the *Remedial Investigation Addendum for the St. Louis Site* (SLS RI Addendum) (DOE 1995a).	September 1995
The U.S. Congress transferred responsibility for administration and execution of cleanup at eligible FUSRAP areas from DOE to USACE.	October 13, 1997
First Five-Year Review Report for SLS was signed (USACE 2004a).	September 28, 2004
Second Five-Year Review Report for SLS was signed (USACE 2010a).	September 28, 2010
USACE issued the *Community Involvement Plan for the St. Louis FUSRAP Sites* (CIP) (USACE 2015b).	May 2015
Third Five-Year Review Report for SLS was signed (USACE 2015a).	August 17, 2015
SLDS Events	**Date**
Mallinckrodt Chemical Works performed work under contract to the MED/AEC.	1942 – 1957
Mallinckrodt Plants 1 and 2: Decontaminated to meet AEC criteria then in effect.	1948 – 1950
Plants 1 and 2: AEC released for use without radiological restrictions.	1951
AEC managed decontamination efforts in Mallinckrodt Plants 10, 7, and 6 East (6E) to meet criteria then in effect; plants returned to Mallinckrodt for use without radiological restrictions.	1962
Radiological survey conducted by Oak Ridge National Laboratory (ORNL) found alpha and radiological levels in excess of the criteria for unrestricted use of the property (ORNL 1981).	1977
DOE issued the *Engineering Evaluation/Cost Analysis for Decontamination of the St. Louis Downtown Site* (SLDS EE/CA) (DOE 1991).	May 1991
Interim action at Mallinckrodt 50 Series Buildings: decontamination, demolition, and crushing pursuant to the SLDS EE/CA.	1996
Interim action at Mallinckrodt Plants 6 and 7: decontamination, asbestos abatement, demolition to floor elevation grade, and crushing, pursuant to the SLDS EE/CA.	1997
Interim action at Mallinckrodt Plant 10 area: subsurface soil excavation and off-site shipment pursuant to the SLDS EE/CA.	1997
Interim action at City Property VP (DT-2) St. Louis Riverfront Trail area: excavation and off-site shipment pursuant to the SLDS EE/CA.	1997
Feasibility Study for the St. Louis Downtown Site (USACE 1998b) issued.	June 1998
The SLDS ROD was signed by the U.S. Army Director of Civil Works and by the Regional Administrator of USEPA Region 7 (USACE 1998a).	August 1998
USACE commenced field operations at SLDS.	September 8, 1998
City Property VP (DT-2): remedial action initiated and completed in the central and southern portions of DT-2 located west of the levee (WOL).	1998 – 1999
Mallinckrodt Plant 2: remedial action initiated and completed[a].	1998 – 2000
Remedial Action Work Plan, FUSRAP St. Louis Downtown Site, St. Louis, Missouri, Revision 1 (IT 1999) issued.	December 1999
Mallinckrodt Plant 1: remedial action initiated and completed.	2000 – 2003

Table 1. Chronology of Events for SLDS (Continued)

SLDS Events (Continued)	Date
Mallinckrodt Plant 6E: remedial action initiated and completed.	2000 – 2002
Mallinckrodt Plant 6 East Half (6EH): remedial action initiated and completed with exception of Building 101 Area.	2000-2013
Midwest Waste VP (DT-7): remedial action initiated and completed.	2001 – 2003
Heintz Steel and Manufacturing VP (DT-6): remedial action initiated and completed[b].	2003 – 2004
Phase 1 Ground-Water Remedial Action Alternative Assessment (GRAAA) at SLDS (USACE 2003a) issued.	June 2003
Thomas and Proetz Lumber Company VP (DT-10): remedial action initiated and completed.	2003 – 2006
Mallinckrodt Plant 7 East (7E): remedial action initiated and completed.	July – September 2003
City of Venice, Illinois, VP (DT-11): remedial action initiated and completed.	2003 – 2004
Mallinckrodt Plant 6 West Half (6WH): remedial action initiated and completed with exception of Building 101 Area.	2004 - 2013
Midtown Garage VP (DT-29): remedial action initiated and completed.	October 2004
Mallinckrodt Plant 7 North (7N): remedial action initiated and completed.	2005, 2010 – 2011
Mallinckrodt Plant 7 South (7S): remedial action initiated and completed.	2005 – 2007, 2010
Memorandum for Record: Non-Significant Change to the Record of Decision for the St. Louis Downtown Site (2005 NSC) issued (USACE 2005b).	March 2005
Gunther Salt VP (DT-4): remedial action initiated and completed[c].	2006 – 2007
Mallinckrodt Plant 9 and Security Gate Number 49 Area: remedial action initiated and completed.	July – August 2006
PSC Metals, Inc. VP (DT-8): remedial action initiated and completed.	2006 – 2008
Christiana Court VP (DT-17): remedial action initiated and completed.	August 2007
Norfolk Southern Railroad VP (DT-3): remedial action initiated and completed.	October – November 2007
Terminal Railroad Association (TRRA) Soil Spoils Area: remedial action initiated and completed.	August – September 2008
TRRA VP (DT-9): remedial action initiated and completed.	February – June 2009
City Property VP (DT-2): remedial action initiated and completed in the Phase I portion of DT-2 located WOL.	2009 – 2012
Burlington Northern Santa Fe (BNSF) Railroad VP (DT-12): remedial action initiated and completed.	2010 – 2011
Kiesel Riverfront Property: remedial action initiated and completed.	January 2011– January 2015
City Property VP (DT-2): remedial action initiated and ongoing in the Phase 2 portion of DT-2 located east of the levee (EOL).	2011 – present
Mallinckrodt Plant 7 West (7W): Initiated and completed excavation of contaminated soils beneath and adjacent to the 700 Pad and a rail spur.	2011 – 2012
Mallinckrodt Plant 6WH: initiated and completed demolition of Building 101. Remedial action beneath and adjacent to Building 101 initiated and ongoing.	2012 – present
Mallinckrodt Plant 6EH: remedial action adjacent to Building 101 initiated and completed.	2012 – 2017
Kiesel Hall Street Properties: remedial action initiated and completed.	2013 – 2014
Destrehan Street – East: remedial action initiated and ongoing.	2016 – present
Destrehan Street – West: remedial action initiated and completed.	2016 – 2017
Mallinckrodt Plant 7W North Area: remedial action initiated and ongoing.	2016 – present
Mallinckrodt Plant 1 Former Building 17 Area: remedial action initiated and completed.	2017 – 2018
Heintz Steel (DT-6) Storage Building: remedial action initiated and completed.	August – September 2018

[a] Additional remedial activities were conducted at Plant 2 in calendar year (CY) 2011 in order to address contamination in a formerly inaccessible area located north of the main excavation and contamination associated with sewer lines.

[b] Additional remedial activities were conducted at DT-6 in CY 2009 in order to address contamination associated with the storage building.

[c] Additional excavation was conducted along the eastern edge of Gunther Salt South (GSS), adjacent to DT-12, in CY 2010.

Note:

Shaded properties are those for which remedial actions were conducted during this five-year review period (January 2014 through December 2018).

2.3 BACKGROUND

The locations of the Mallinckrodt plants and VPs that comprise SLDS are shown on Figure 2 and are listed in Table 2.

The SLDS VPs consist of 37 numbered properties and three unnumbered properties that have potential contamination as a result of the historic MED/AEC operations at the Mallinckrodt property and/or subsequent transportation, storage, or migration of MED/AEC-related residues. The VPs are identified using the prefix of "DT" to represent the "downtown" site and are followed by a number for consistent identification regardless of changing property ownership (e.g., DT-1). It should be noted that as new data were obtained and new civil land survey information became available during the ongoing pre-design investigation (PDI) efforts, the size, designation, and number of VPs has increased subsequent to signature of the SLDS ROD (USACE 1998a). In March 2005, USACE issued the *Memorandum for Record: Non-Significant Change to the Record of Decision for the St. Louis Downtown Site* (2005 NSC) (USACE 2005b). The memorandum clarified and amended the boundaries of SLDS to include additional areas to the north, south, and west of the site. The property boundaries shown on Figure 2 reflect the current understanding of the SLDS property boundaries.

Table 2. SLDS Properties

Property	ID	City Block/Tract Number and/or Address
Mallinckrodt (Mallinckrodt property)	N/A	Multiple
Kiesel (formerly Archer Daniels Midland [ADM] and PVO Foods) VP	DT-1	2543; 2544
City Property VP	DT-2	Multiple
Norfolk Southern Railroad VP	DT-3	1198; 1200; 1201
Gunther Salt VP Gunther Salt South (GSS) Gunther Salt North (GSN)	DT-4	1198-E; 101 Buchanan Street
AmerenUE VP	DT-5	660-W
Heintz Steel and Manufacturing[a] VP	DT-6	2541; 2542; 3300 Hall Street
Midwest Waste VP (currently owned by Longview of St. Louis, Inc.)	DT-7	2543
PSC Metals, Inc. (formerly McKinley Iron) VP	DT-8	Multiple; 3620 Hall Street
TRRA VP	DT-9	2520
Thomas and Proetz Lumber Company VP	DT-10	2540; 3400 Hall Street
City of Venice, Illinois (formerly McKinley Bridge), VP (currently owned by the Illinois Department of Transportation and the Missouri Department of Transportation [MoDOT])	DT-11	2536; 2540; 2541
BNSF Railroad VP	DT-12	2526; 2540; 2541
Cash's Scrap Metal VP (currently owned by MW Recycling Inc.)	DT-13	308-W; 201-205 Dock
Cotto-Waxo Company VP (currently owned by PTG Investments, LLC)	DT-14	1197; 3301 - 3327 N. Second Street
Metropolitan St. Louis Sewer District (MSD) Lift Station	DT-15	2536; 2526; 3525 N. Wharf and 1 E. Salisbury
Star Bedding Company VP (currently owned by Rutzgroup, LLC)	DT-16	308-W; 3228 N. Broadway
Christiana Court, LLC VP (currently owned by Rutzgroup, LLC)	DT-17	308-W; 3240 N. Broadway
Curley Collins Recycling (currently owned by the City of St. Louis)	DT-18	308-E; 121 Dock
City of St. Louis Streets	DT-19	Multiple
Richey VP (currently owned by S. Markovic)	DT-20	1196; 3301 N. Broadway
Favre VP (currently owned by Bad Influence, Inc.)	DT-21	1196; 3319 N. Broadway
Tobin Electric VP (currently owned by Pringle, Patra P TRS)	DT-22	1196; 3321 N. Broadway
InterChem VP (currently owned by Pringle, Patra P TRS)	DT-23	1205; 3501 N. Broadway
Midwest BankCenter (formerly Bremen Bank) VP	DT-24	1205; 3529 N. Broadway

Table 2. SLDS Properties (Continued)

Property	ID	City Block/Tract Number and/or Address
Eirten's Parlors (O.T. Hodges) VP	DT-25	1205; 3500 N. 9th
United Auto Workers Local 1887 VP	DT-26	1214; 3607 N. Broadway
Dillon VP	DT-27	1217; 3707 - 9 N. Broadway
Challenge Enterprise VP (currently owned by Paul W. Mitchell)	DT-28	2545; 816 Buchanan
Midtown Garage VP (currently owned by RGM-STL LLC)	DT-29	2545; 309-W; 3227 N. Broadway
Zamzow Manufacturing VP	DT-30	2545; 3234 N. 9th
Porter Poultry VP (currently owned by MW Recycling, LLC)	DT-31	309-W; 3123 N. Broadway
Westerheide Tobacco Store (purchased by Mallinckrodt)	DT-32	1213
MoDOT	DT-33	1204/1215
Hjersted VP (currently owned by Kemira Water Solutions, Inc.	DT-34	2526; 10 Bremen
Commercial Wholesale Tire Distribution Company VP (currently owned by Performance Food Group, Inc.)	DT-35	1932; 3812 N. Broadway
OJM, Inc. VP	DT-36	1217 and 1931; 3801 - 3903 N Broadway
Lange-Stegmann VP (currently owned by Oakley St. Louis, Inc.)	DT-37	2520; 11 Bremen
TRRA Soil Spoils Area (owned by TRRA, Norfolk Southern, and BNSF)	N/A	664-W; 50 Branch; 2901 Hall; 3001 Hall; 21-99 North Market
Kiesel Hall Street Properties[b]	N/A	661-E; 3130 Hall, 13 Branch
Kiesel Riverfront Property[c]	N/A	2541; 3301 N. Wharf

[a] The property was owned and operated by the Heintz Steel and Manufacturing Company until December 3, 2018, at which time it was sold to Maxim Construction, Inc.

[b] Includes portions of the adjacent Gunther Salt and St. Louis City VPs.

[c] Includes a portion of the City of St. Louis VP.

Note:
N/A – Not Applicable

2.3.1 Physical Characteristics

SLDS is located in an industrialized area approximately 2 miles north of the St. Louis downtown area. SLDS is situated within the floodplain adjacent to the western bank of the Mississippi River and is separated from the river by the St. Louis Flood Protection system (a combination of manmade levees and floodwall structures). The local topography of the site is generally flat. Surface drainage is directed through ditches and catchment basins into an extensive storm drainage system that discharges to a nearby sewage treatment plant.

2.3.2 Land and Resource Use

SLDS is comprised of a 182,108-m^2 (45-acre) chemical manufacturing complex, owned by Mallinckrodt, and 40 VPs. Mallinckrodt has used the property for chemical manufacturing and related operations since 1867. Mallinckrodt currently maintains 24-hour security at the property and limits site access to employees, subcontract employees, and authorized visitors. Mallinckrodt property is enclosed by a well-maintained and patrolled security fence.

The VPs encompass more than 667,731 m^2 (165 acres) of land surrounding the Mallinckrodt property. The land uses at the SLDS VPs are varied and include active businesses (e.g., lumber yard, metal salvage, and steel fabrication), inactive/abandoned businesses, railroad lines, bridge structures (the McKinley Bridge), a portion of the earthen levee and concrete floodwall that protects the St. Louis area from Mississippi River floodwaters, and a recreational bike trail adjacent to the Mississippi River. Current zoning restrictions generally limit SLDS to commercial/industrial land uses, and do not allow the construction or renovation of buildings for residential purposes. The long-term plans for the SLDS area are to retain the industrial uses; encourage the wholesale produce district; and phase out the remaining, marginal residential uses.

The Mississippi Alluvial Aquifer is a principal aquifer in the St. Louis area, including at SLDS. It is currently not used as a source of drinking water. The future use of ground water at SLDS is not expected to change from current use for several reasons: ground water is of poor quality, yields in the bedrock are poor, and the area has abundant surface water, which makes future ground-water use unlikely.

2.3.3 History of Contamination

Contamination at SLS originated at the Mallinckrodt property. Mallinckrodt was contracted by the MED/AEC, from 1942 to 1957, to process uranium ore for the production of uranium metal. From 1942 to 1945, Plants 1, 2, and 4 (where Plant 10 is now located) were involved in the development of uranium-processing techniques, uranium compounds and metal production, and uranium metal recovery from residues and scrap.

Plant 6 produced uranium dioxide from pitchblende ore starting in 1946. During 1950 and 1951, Plant 4 was modified and used as a metallurgical pilot plant for processing uranium metal. Plant 4 continued to operate until 1956, when it was closed and operations began at Plants 6 and 7. MED/AEC operations in Plant 6 ended in 1957. 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.

The radiological contamination in soil on the VPs may be attributed to inadvertent releases of radionuclides to the environment during the MED/AEC uranium processing operations or operations unique to the VP itself (e.g., various types of naturally occurring radioactive materials [NORM] were handled and stored on some VPs). Buildings and/or other structures on the VPs may also have been affected by the inadvertent release of radionuclides during the MED/AEC operations. The AEC managed decontamination efforts (removal and offsite disposal of radiologically contaminated buildings, equipment, and soil) in Plants 4, 7, and 6 to meet AEC criteria and returned the plants to Mallinckrodt in 1962 for use without radiological restrictions.

A radiological survey conducted at SLDS in 1977 found radiological contamination that exceeded existing guidelines. Elevated gamma radiation levels were measured at outdoor locations and within some of the historical processing buildings. Additionally, radium (Ra)-226 and uranium (U)-238 concentrations in certain soil samples significantly exceeded background concentrations. In response to this survey, it was determined that further investigation of the site was necessary to characterize the nature and extent of the contamination. In 1990, USEPA Region 7 and DOE established schedules and deliverables for the CERCLA process at SLS. In 1994, DOE submitted the *Remedial Investigation Report for the St. Louis Site* (SLS RI Report) (DOE 1994).

2.3.4 Initial Response

Four interim actions were performed by DOE at SLDS prior to signing of the SLDS ROD. The first interim action consisted of the decontamination, demolition, and crushing of the 50 Series Buildings (Buildings 50, 51, 51A, 52, and 52A). In this action, 1,000 yd^3 of contaminated material were shipped offsite, and 1,000 yd^3 of crushed concrete (crushate) were generated. In the second interim action, asbestos abatement, decontamination, demolition to floor elevation, grading, and crushing operations were conducted at Plants 6 and 7 (Buildings 100, 116, 116B, 117, 700, 704, 705, 706, 707, and 708). In this interim action, 2,673 yd^3 of contaminated material were shipped offsite and 7,000 yd^3 of crushate were generated. The third interim action consisted of contaminated soil excavation at Plant 4 (currently Plant 10). A total of 15,043 yd^3 of contaminated material were shipped offsite. In the fourth interim action, 750 yd^3 of contaminated material were excavated from the St. Louis Riverfront Trail area and shipped offsite.

2.3.5 Basis for Taking Action

Radiological and non-radiological contamination related to MED/AEC activities is present in accessible soil and ground water at SLDS. USACE determined, based on the results of the baseline risk assessment, that a remedial action was required at SLDS, because the contamination poses a current or potential threat to human health or the environment. Contaminants include arsenic, cadmium, and radionuclides in the uranium, thorium, and actinium series. Potential exposure pathways evaluated in the baseline risk assessment include direct contact with soil through ingestion and dermal contact, external gamma radiation from soil, inhalation of fugitive dust and radon gas emissions from soil, and ingestion of ground water.

2.4 REMEDIAL ACTION

The remedial action for the SLDS Accessible soil and Ground-Water OU presented in the SLDS ROD (USACE 1998a) will be protective of human health and the environment upon attainment of the cleanup goals; will meet ARARs; and was developed to provide the best balance of effectiveness, cost, and implementability.

2.4.1 Remedy Selection

2.4.1.1 Remedial Action Objectives

The remedial action objectives (RAOs) for the SLDS Accessible Soil and Ground-Water OU, as set forth in the SLDS ROD (USACE 1998a), are the following:

Soil

- prevent exposures from surface residual contamination in soil at concentrations greater than the criteria prescribed in 40 *CFR* 192;
- eliminate or minimize the potential for humans or biota to contact, ingest, or inhale soil containing contaminants of concern (COCs);
- eliminate or minimize volume, toxicity, and mobility of affected soil;
- eliminate or minimize the potential for migration of radioactive materials offsite;
- comply with ARARs; and
- eliminate or minimize potential exposure to external gamma radiation.

Ground Water

- remove sources of COCs in the A Unit (hydrostratigraphic unit [HU]-A); and
- continue to maintain low concentrations of the soil COCs in the B Unit (HU-B).

For soil, remediation goals (RGs) for radiological contaminants are applied to concentrations exceeding background, consistent with the ARAR (40 *CFR* 192) from which they derive. Background values were determined using 32 soil samples collected from non-impacted areas near SLDS. The mean background concentrations for the SLDS soil COCs are: 0.14 pCi/g actinium (Ac)-227; 0.90 pCi/g protactinium (Pa)-231; 2.78 pCi/g Ra-226; 0.95 pCi/g Ra-228; 1.16 pCi/g thorium (Th)-228; 1.94 pCi/g Th-230; 1.09 pCi/g Th-232; 0.08 pCi/g U-235; and 1.44 pCi/g U-238. The surface and subsurface soil RGs prescribed in 40 *CFR* 192, Subpart B, for Ra-226 are 5 and 15 pCi/g, respectively, as an areal average concentration exceeding background in the top 6-inch layer and in subsequent 6-inch layers, respectively. USEPA's guidance documents for the cleanup of CERCLA sites using 40 *CFR* 192 as an ARAR set forth USEPA's expectation that remediation of subsurface soil contamination will, in practice, achieve the surface cleanup criterion of 5 pCi/g for Ra-226. Results of excavations performed at SLDS indicate that residual concentrations of radium generally average less than the 5 pCi/g surface criteria and generally do not significantly exceed background. The results also demonstrate that implementation of the subsurface remediation criterion of 15 pCi/g for Ra-226 results in actual average residual concentrations of Ra-226 significantly less than 5 pCi/g.

The Th-230 surface and subsurface RGs established in the SLDS ROD are also consistent with a residual Ra-226 concentration of 5 pCi/g. Constraining the concentration of Th-230 in surface and subsurface soils to 15 pCi/g, along with the use of the unity rule, assures that the concentration of Ra-226 does not exceed 5 pCi/g during the 1,000-year time period. Based on post-remediation data from various properties at SLDS, these RGs achieve doses that are less than 12 mrem per year in practice. In addition, risk assessments performed to date have determined that the RGs would achieve protectiveness to levels within the CERCLA risk range and below a hazard index (HI) of 1.

Supplemental standards for soil at depth were developed pursuant to 40 *CFR* 192.21. Supplemental standard soil RGs are appropriate in accordance with criteria specified in 40 *CFR* 192.21(c), which states that supplemental standards may be applied under circumstances in which removal would result in excessive remedial action costs relative to the long-term benefits and the residual radioactive materials do not pose a clear present or future hazard, given the configuration and appropriate institutional controls. For accessible deep subsurface soil (deeper than 4 or 6 ft below ground surface [bgs]) at the Mallinckrodt portion of SLDS, excavation is conducted to risk-based RGs of 50 pCi/g for Ra-226, 100 pCi/g for Th-230, and 150 pCi/g for U-238. Deep soil has a more limited potential for exposure than surface soil or shallow soil. The risk-based deep soil RGs are protective at SLDS under industrial use conditions, with land use restrictions to ensure that future residential use is precluded at the site.

Section 2.6.4.1 summarizes the results of the final status surveys (FSSs) at the SLDS areas completed prior to the end of this five-year review period. As demonstrated in Section 2.6.4.1, the results of the FSSs confirm that the requirements of 40 *CFR* 192, Subpart B, have been met.

2.4.1.2 Remedy Components

The major components of the remedial action presented in the SLDS ROD include the following:

- excavation of accessible soil to composite criteria (ARAR-based) on perimeter VPs and Mallinckrodt Plant 7;
- excavation of accessible soil on the Mallinckrodt property (except Plant 7) to composite criteria (ARAR-based) in the top 4 or 6 ft and to depth to deep-soil criteria (risk-based);
- control of potential ground-water degradation by removal of sources of soil contamination;
- removal, treatment, and disposal of ground water from excavations within the A Unit (HU-A);
- implementation of institutional controls, when applicable; and
- perimeter ground-water monitoring in the B Unit (HU-B) to assure post-remediation compliance.

Final determinations as to whether institutional controls are necessary at the remediated areas will be based on calculations of post-remedial action risk derived from actual residual conditions. Residual dose and risk assessments are performed using three different receptor scenarios (on-site residential receptor, utility worker, and industrial/construction worker) as the potential receptors for the site. Although not required by the SLDS ROD, the resident receptor is evaluated for informational purposes. The potential exposure pathways are direct contact, ingestion, inhalation of dust, and external gamma. In addition to these pathways, the resident is evaluated for home-grown produce consumption. USEPA generally defines the CERCLA target risk range as 1×10^{-6} to 1×10^{-4}.

2.4.2 Remedy Implementation

As part of the remedial action implementation for SLDS, PDIs were conducted on the various SLDS properties to obtain the information necessary to develop the remedial design (RD) documents. Common to remedial action implementation at each Mallinckrodt property or VP is the coordination with the property owner; establishment of a central support facility, water treatment facility, and soil storage and loadout facility (SSLF); implementation of air monitoring, access controls, and security measures; and sequencing of excavation, confirmation, and FSS activities. Support facilities include personnel and equipment decontamination facilities. The central support facility is located at the Midwest Waste VP (DT-7). The water treatment plants are located in the northwest corner of Plant 6 West Half (6WH) and at the Plant 7 South (7S) support compound. All potentially contaminated water is processed through the waste-water treatment plants, and the treated water is discharged to the Metropolitan St. Louis Sewer District (MSD) sewer line in accordance with the MSD authorization letter dated October 30, 1998 (MSD 1998). The authorization was revised in a July 23, 2001, MSD authorization letter (MSD 2001a) and amended in an October 13, 2004, MSD letter (MSD 2004). The authorization has been extended through the issuance of letters dated June 19, 2006; May 22, 2008; May 10, 2010; May 24, 2012; June 23, 2014; July 18, 2016; and June 11, 2018 (MSD 2006a, 2008a, 2010a, 2012a, 2014a, 2016a, 2018a). The discharge is directed to the Bissell Point Treatment Plant through underground mains. Each discharge is monitored, and the results are reported to MSD.

One soil storage and railroad car loading facility is currently established at SLDS. The Plant 6WH SSLF is located in the former rail spur area at the northern end of Plant 6WH. Once loaded into the railcars, the excavated material is covered and sent out of state for disposal. Material is disposed, depending on the concentration of the contamination, at US Ecology Idaho, Inc. in Grand View, Idaho, or US Ecology Michigan, Inc. in Belleville, Michigan, and at EnergySolutions (formerly Envirocare) in Utah. US Ecology Idaho and US Ecology Michigan are Resource Conservation and Recovery Act (RCRA) Subtitle C disposal facilities permitted to accept wastes containing low-activity or exempt radioactive wastes. EnergySolutions is a low-level radioactive waste disposal facility.

Excavation perimeter air monitoring is conducted during excavation activities and consists of both real-time (continuous readout) and time-integrated monitoring. Real-time monitoring is conducted for lower exposure limit, oxygen level, particulates, and organic compounds. Time-integrated monitoring consists of mid-volume and low-volume samplers for total alpha and total beta measurements. Indoor and outdoor air radon monitoring is conducted to determine whether radon releases are occurring.

The remediation activities planned for each property are described in a remedial action work description (RAWD). A RD is developed for each property based on the results of the PDI and existing site conditions. Accessible soil that has concentrations of COCs exceeding the RGs is excavated in accordance with the RD and transported by truck to the soil loadout area. The contaminated soil is then either loaded directly into railcars or stockpiled for future loadout and transportation for final disposal at an out-of-state facility. Gamma walkover surveys (GWSs) and soil sampling are performed to guide excavation (by identifying locations of contaminated soil) and to identify when the RGs have been met. If the analytical results from samples collected from the excavated areas indicate that the RGs have not been met, then additional excavation, GWSs, and re-sampling, if required, are performed. This sequence is repeated until the concentration-based RGs are met.

The primary means of access control is provided by security fencing surrounding each excavation area. Prior to the commencement of work, temporary chain-link fences, gates, and/or other barriers are installed around the remediation work area. Additional safety fencing is also installed at specific excavation locations as determined by site conditions. All non-remediation pedestrian traffic is excluded from construction zones. Access exclusion is established through the use of temporary chain-link fences, barricades, orange construction fencing, and/or radiation rope. Appropriate warning signs are posted on or adjacent to contaminated areas.

Once informational sampling demonstrates that the contamination has been removed, FSS confirmation sampling is conducted. The FSS is conducted by an independent contractor. USACE evaluates the results to ensure that the residual concentrations in the excavation meet the SLDS ROD (USACE 1998a) RGs and the excavation can be backfilled. Following the completion of backfilling, the excavated areas are regraded, compacted, and resurfaced with the same type of material initially present (e.g., asphalt, concrete, gravel). Following resurfacing, a topographic survey of the excavation areas is completed to document backfill volumes and final conditions.

Post-remedial action reports (PRARs) are prepared to document the series of response actions performed and the final status survey evaluations (FSSEs) conducted at each remediated property. As part of this documentation, post-remedial action risk assessments are performed to describe the level of residual risk from COC concentrations remaining following completion of remedial activities.

Remediation is ongoing at SLDS. A summary of the remedial activities conducted at SLDS through December 2018 is presented in Table 3 in chronological order. Shaded properties are those for which remedial activities were conducted during this five-year review period (January 2014 through December 2018).

Table 3. Summary of Remedial Activities Conducted at SLDS

Location	Property	Start	Complete	Volume Removed (yd^3)
Mallinckrodt	Plant 2[a]	October 1998	August 2000	9,659
DT-2	City Property VP[b]			
	WOL	October 1998	March 2012	7,400[c]
	EOL, Areas 3, 4, 5, 7 and 9	January 2011	February 2015	30,589[c]
	Kiesel Riverfront Property	January 2011	January 2015	267
	EOL, Area 8	August 2012	Present	*[c]
Mallinckrodt	Plant 1	July 2000	September 2003	2,410
	Stage 1 remediation of Former Building 17 Area[b]	June 2017	August 2018	2,300
Mallinckrodt	Plants 6EH and 6E	December 2000	July 2008	
	Additional remediation in Plant 6EH conducted concurrently with Building 101 remediation at Plant 6WH	November 2012	Sept 2017	20,362[g]
DT-7	Midwest Waste VP	May 2001	January 2003	3,910
DT-6	Heintz Steel and Manufacturing VP	April 2003	March 2004	1,660
	Remediation associated with storage building	December 2009	December 2009	150
	Additional remediation associated with storage building	August 2018	September 2018	40
DT-10	Thomas and Proetz Lumber Company VP	June 2003	June 2006	1,995
Mallinckrodt	Plant 7E	July 2003	September 2003	1,775

Table 3. Summary of Remedial Activities Conducted at SLDS (Continued)

Location	Property	Start	Complete	Volume Removed (yd^3)
DT-11	City of Venice, Illinois (formerly McKinley Bridge), VP (currently owned by the Illinois Department of Transportation and MoDOT)	October 2003	January 2004	2,834
Mallinckrodt	Plant 6WH[b]			
	Phase 1	June 2004	December 2004	3,513
	Phases 2A (Rail Spur Area) and 2C (North of Building 101)	2005	2007	*
	Phase 2B	March 2008	November 2010	30,300
	Remediation associated with Building 101	November 2012	Present	61,616[b]
DT-29	Midtown Garage VP	October 2004	October 2004	51
Mallinckrodt	Plant 7N	February 2005	August 2006	14,324
	Plant 7N (Hazardous Waste Storage Area Footprint, Survey Unit [SU]-9)	November 2010	July 2011	2,240
Mallinckrodt	Plant 7S	February 2005	March 2007	3,630
	Additional remediation of small area in Plant 7S conducted during remediation of DT-12	July 2010	November 2010	150
DT-4	Gunther Salt VP			
	GSS[d]	April 2006	December 2011	426
	GSN	October 2006	August 2007	2,445
	GSN – Remediation outside Dome 2	November 2018	Present	*
Mallinckrodt	Plant 9 and Security Gate Number 49 Area	July 2006	August 2006	22
DT-8	PSC Metals, Inc. VP	September 2006	March 2008	8,071
DT-17	Christiana Court, LLC VP	August 2007	August 2007	47
DT-3	Norfolk Southern Railroad VP	October 2007	November 2007	243
NA	TRRA Soil Spoils Area	August 2008	August 2008	147
DT-9	TRRA VP	February 2009	June 2009	2,440
DT-12	BNSF Railroad VP	May 2010	September 2011	2,290[e]
Mallinckrodt	Plant 7W – 700 Pad	April 2011	May 2012	10,150
	Additional remediation in Plant 7W North Area conducted concurrently with Destrehan Street-East	June 2016	Present	25,624[f]
NA	Kiesel Hall Street Properties	May 2013	October 2014	10,503
Mallinckrodt	Destrehan Street - East	June 2016	Present	25,624[b,f]
	Destrehan Street -West	August 2016	February 2017	815

[a] Additional remedial activities were conducted at Plant 2 in CY 2011 in order to address contamination in a formerly inaccessible area located north of the main excavation and some contamination associated with sewer lines.

[b] Additional remediation activities are planned for these properties, so the associated soil volumes shown do not necessarily represent final volumes removed. Rather, for these properties, the volumes presented represent the amount of soil removed between the "Start" and "Complete" dates shown.

[c] Volume for DT-2 WOL includes soils excavated from a portion of DT-11. Remediation of DT-2 EOL Area 8 is ongoing. Area 3, Area 7, and Area 9 are located near the bank of the Mississippi River. Area 4 and Area 5 are both situated on the east side of the levee and are located between Area 3 and the 15-inch and 30-inch sewers. Area 8 is near the shoreline of the Mississippi River and is situated due east and slightly downstream of the 15-inch and 30-inch sewer outlets.

[d] Remediation was initially conducted at GSS between April and July 2006 (382 yd^3). Additional remediation was conducted at GSS between May 2010 and December 2011 to address a contaminated area located along the eastern property line adjacent to DT-12 (44 yd^3 [33.6 m^3]).

[e] Volume removed for DT-12 also includes a small portion of the adjacent Plant 7S and Plant 7N properties, as well as a portion of the Destrehan Street right-of-way (ROW).

[f] The volume removed for the Plant 7W North Area is included in the volume removed shown for Destrehan Street – East.

[g] The volume removed for the Plant 6EH includes radiologically contaminated soil removed during the 2000 to 2003 remedial action, the 2007 to 2008 remedial action, and the additional excavation required during the remediation of the adjacent Plant 6WH Building 101 and Destrehan Street - East areas.

Notes:

Shaded properties are those for which remedial actions were conducted during this five-year review period (January 2014 through December 2018). This table does not include completed properties for which remedial actions were not required.

* Final volume removed is not available because the remedial action is ongoing and/or the PRAR-FSSE for this area is not yet completed.

NA – Not Applicable

Those areas for which remedial actions were completed prior to the beginning of the fourth five-year review period (i.e., pre-January 2014) are discussed in the Second and Third Five-Year Review Reports (USACE 2010a and 2015a) and are thus not further addressed in this five-year review report. Areas where remedial activities were conducted during the fourth five-year review period (January 2014 through December 2018) are presented in the following section, chronologically by start date.

2.4.2.1 Remedial Actions Conducted During Fourth Five-Year Review Period

Remedial actions were performed at the properties shaded in Table 3. Detailed Descriptions of the remedial actions for each property are contained in Appendix E.

2.4.2.2 Status of Remedy Implementation

Remedial action at the SLDS is ongoing. The remediation status of the SLDS properties at the end of the review period is shown on Figure 3. The completed properties at SLDS that did not require remediation are listed in Table 4. Properties for which remediation has been completed and final PDI-FSSEs or PRAR-FSSEs have been issued are listed in Table 5.

Table 4. Completed Properties at SLDS Not Requiring Remediation

Location	Documentation of FSSE Results
DT-1	*Final Status Survey Evaluation for the St. Louis Downtown Site Archer Daniels Midland Vicinity Property (DT-1),* St. Louis, Missouri, June 2002 (USACE 2002a).
Mallinckrodt Plants 3, 8, 9, 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,* St. Louis, Missouri, May 25, 2006 (USACE 2006a).
West of Broadway VPs[a]: DT-20, DT-21, DT-22, DT-23, DT-24, DT-25, DT-26, DT-27, DT-28, DT-30, and DT-36	*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,* St. Louis, Missouri, May 25, 2006 (USACE 2006a).
DT-35 and DT-36[b]	*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,* St. Louis, Missouri, April 3, 2009 (USACE 2009b).
South of Angelrodt Properties: DT-5, DT-13, DT-14, DT-16, DT-18, and Second Street Corridor	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Accessible Soils within the St. Louis Downtown Site Vicinity Properties DT-5, DT-13, DT-14, DT-16, DT-18, and the Second Street Corridor,* St. Louis, Missouri, October 25, 2010 (USACE 2010b).
DT-15	*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),* St. Louis, Missouri, August 27, 2012 (USACE 2012a).
DT-34	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property DT-34,* St. Louis, Missouri, September 21, 2012 (USACE 2012b).
DT-37	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the St. Louis Downtown Site Vicinity Property Lange-Stegmann (DT-37),* St. Louis, Missouri, September 23, 2013 (USACE 2013b).
DT-31	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Vicinity Property DT-31, St. Louis, Missouri*, September 13, 2015 (USACE 2017b);

[a] DT-29 is included in the West of Broadway VPs. A small area on DT-29 was remediated in October 2004.

[b] DT-36 is included in the West of Broadway VPs.

Note:

Completed properties are those for which remedial actions were not required and the FSSE was completed prior to the end of this five-year review period (December 2018). Shaded properties are those for which the FSS was completed during this five-year review period (January 2014 through December 2018).

Table 5. List of Remedy Completion Documents for SLDS

Property	Document
City-Owned VP	*Post-Remedial Action Report for the St. Louis Downtown Site City-Owned Vicinity Property,* September 1999 (USACE 1999a).
Plant 2	*Post-Remedial Action Report for the Accessible Soils within the Downtown Site Plant 2 Property*, January 2002 (USACE 2002b).
Plant 1	*Post-Remedial Action Report for the Accessible Soils within the St. Louis Downtown Site Plant 1 Property,* September 10, 2004 (USACE 2004b).
City of Venice, Illinois, VP (DT-11)	*Post-Remedial Action Report for the Soils Within the St. Louis Downtown Site City of Venice, Illinois Property (DT-11),* September 2005 (USACE 2005d).
Heintz Steel and Manufacturing and Midwest Waste VPs (DT-6 and DT-7)	*Post-Remedial Action Report for the Accessible Soils Within the St. Louis Downtown Site, Heintz Steel and Manufacturing Vicinity Property (DT-6) and Midwest Waste Vicinity Property (DT-7),* September 22, 2005 (USACE 2005c).
Midtown Garage VP (DT-29)	*Post-Remedial Action Report for the Accessible Soils within the St. Louis Downtown Site Midtown Garage Vicinity Property (DT-29),* October 18, 2005 (USACE 2005f).
Thomas and Proetz Lumber Company VP (DT-10)	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Thomas and Proetz Lumber Company (DT-10*), July 12, 2010 (USACE 2010c).
Plant 9 and Security Gate Number 49 Area	*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,* November 2, 2010 (USACE 2010d).
Christiana Court VP (DT-17)	*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),* May 18, 2012 (USACE 2012c).
City Property VP (DT-2)	*Updated Remedial Action Summary for Phase 1 Portion of City Property (DT-2) West of Mississippi River Flood Protection Levee, FUSRAP St. Louis Downtown Site,* June 19, 2012 (USACE 2012d).
Gunther Salt VP (DT-4)	*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),* September 14, 2012 (USACE 2012e).
PSC Metals VP (DT-8)	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Vicinity Property PSC Metals, Inc. (DT-8),* July 15, 2013 (USACE 2013c).
TRRA Soil Spoils Area	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Vicinity Property Terminal Railroad Association Soil Spoils Area,* September 10, 2013 (USACE 2013d).
Norfolk Southern Railroad VP (DT-3)	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Vicinity Property Norfolk Southern Railroad (DT-3),* September 23, 2013 (USACE 2013e).
BNSF Railroad VP (DT-12)	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Burlington Northern Santa Fe Railroad (DT-12),* August 19, 2014 (USACE 2014c).
TRRA VP (DT-9)	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Terminal Railroad Association (DT-9), St. Louis, Missouri,* March 3, 2015 (USACE 2015d).
Kiesel Hall Street Properties	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the Kiesel Hall Street Properties, St. Louis, Missouri,* August 27, 2015 (USACE 2015c).
Kiesel Riverfront Property	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Kiesel Riverfront Property, St. Louis, Missouri,* March 2, 2016 (USACE 2016a)
Plant 6E	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 6 East Property, St. Louis, Missouri*, September 26, 2016 (USACE 2016b)
Plant 7E	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 7 East Property, St. Louis, Missouri*, September 27, 2016 (USACE 2016c)

Table 5. List of Remedy Completion Documents for SLDS (Continued)

Property	Document
Plant 7N and Plant 7S	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 7 North and Plant 7 South Properties, St. Louis, Missouri,* September 27, 2017 (USACE 2017c)
City Property VP (DT-2) and City of Venice VP (DT 11)	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Vicinity Properties City Property (DT-2) West of the Levee and City of Venice (DT 11) (Partial), St. Louis, Missouri,* August 20, 2018 (USACE 2018a)
Plant 6EH	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 6 East Half, St. Louis, Missouri,* September 27, 2018 (USACE 2018b)
Destrehan Street - West	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Destrehan Street (West) Property, St. Louis, Missouri,* September 27, 2018 (USACE 2018c)
Plant 1 Former Building 17 Area	*Post-Remedial Action Report and Final Status Survey Evaluation Addendum for the Accessible Soil Within the St. Louis Downtown Site Plant 1 Former Building 17 Area, St. Louis, Missouri,* September 25, 2019 (USACE 2019a)

Note:

Shaded properties are those for which remedial activities were completed during this five-year review period and for which a final PRAR-FSSE has been issued.

FSSs compatible with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (DOD 2000) are performed subsequent to remediation at SLDS. These surveys document achievement of RGs. Results of FSSs are documented in PRARs for properties requiring remediation and in FSSE reports for those properties not requiring remedial action. Each of these reports includes a summary of the detailed documentation that confirms that the areas involved achieve RGs. This documentation specifically includes residual concentrations of COCs (e.g., exposure point concentrations [EPCs]) and assessment of residual site risks to confirm protectiveness.

As noted previously, authority under the SLDS ROD (USACE 1998a) for the remediation of MED/AEC-related wastes is limited to those wastes in accessible soil and ground water. The SLDS ROD defines accessible soil as soil that is not beneath buildings or other permanent structures. Soil that is inaccessible due to the presence of buildings, active roads, active rail lines, and the levee is specifically excluded from remediation. In the areas where the soil is inaccessible due to the presence of structures, the soil will remain in place until the soil becomes accessible. The determination of whether an area is accessible or inaccessible is made on a case-by-case basis by applying the SLDS ROD definition of accessible soil. Because the determination of whether soil is accessible is directly related to the permanent nature of structures built upon soil, USACE has concluded that areas surrounding buildings or other permanent structures where the volume of soil underlying the areas is required for structural stability of the adjacent building or other permanent structures are also inaccessible. Each area excluded from remediation as inaccessible is documented in the appropriate PRAR-FSSE and will be included in the final site closeout report.

The SLDS remedy also includes implementation of a long-term, ground-water monitoring strategy for the Mississippi Alluvial Aquifer (HU-B). If long-term monitoring of HU-B shows that COCs are significantly exceeding the SLDS-ROD-specified investigative limits (ILs) or the thresholds established in 40 *CFR* 192, then a ground-water remedial action alternative assessment (GRAAA) is to be initiated. The SLDS-ROD-specified ILs for each of the ground-water COCs are 50 µg/L for arsenic, 5 µg/L for cadmium, and 20 µg/L for total U. Samples from three HU-B monitoring wells exceeded the ILs for one or more of the COCs established in the SLDS ROD. Phase 1 of the GRAAA was initiated in 2001 in response to significant exceedances of the total U IL in DW19 for an extended period (USACE 2003a). Phase 1 of the GRAAA summarized the ground-water sampling data and recommended further investigation of HU-B. Phase 1 identified potential sources of the elevated COC concentrations detected in HU-B ground water, such as contaminated soil located beneath Building 101 at Plant 6WH. Phase 2 of the GRAAA will be developed following completion of remedial activities at Plant 6WH to assess the fate and transport of MED/AEC residual contaminants in ground water at SLDS.

In order for the remedy to be protective in the long term, land use controls (LUCs) (institutional controls and/or engineering controls) are required to maintain protectiveness under a commercial/industrial land use scenario. Table 6 summarizes the planned and existing LUCs that are relevant to SLDS.

Table 6. Summary of Planned and/or Implemented LUCs for SLDS

Media	LUCs Needed	LUCs Called for in Decision Documents	Impacted Parcel	LUC Objective	Institutional Control or Engineering Control Instrument
Soil	Yes	Engineering Controls: Access Controls	Mallinckrodt Facility	Restrict access to portions of the Mallinckrodt Facility.	**Current:** security fence and site security.
			Inaccessible Areas at SLDS	Prevent or restrict access to inaccessible soil.	**Current:** Addressed by a separate OU (ISOU). **Planned:** If LUCs are deemed necessary for inaccessible areas, formal documentation placing restrictions on intrusive activities for inaccessible areas will be developed for the ISOU.
	Yes	Land Use Restrictions: Administrative Controls	Mallinckrodt Facility	Prevent or restrict intrusive activities (excavation, utility work, drilling, construction) in areas with inaccessible soil.	**Current:** Mallinckrodt procedures (work permits, safety procedures, etc.). **Planned:** Formal documentation placing restrictions on intrusive activities for inaccessible areas will be developed for the ISOU.
Ground water	Yes	Governmental Control: Land Use Restriction	Entire Site	Prevent or restrict exposures to contaminated ground water.	**Current:** St. Louis City Ordinance 66777 prevents the use or attempted use of ground water as a potable water supply, and the drilling and installation of wells for the purpose of using the ground water as a potable water supply. Ground-water LUCs were retained and confirmed as a current restriction.

Current zoning restrictions generally limit SLDS to commercial/industrial land uses, with a recreational bike trail adjacent to the Mississippi River. The closest residential dwelling is located approximately 200 ft southwest of the southwestern corner of the SLDS boundary specified in the SLDS ROD. Zoning regulations prohibit new residences from being established in the area. Along with the zoning restrictions, a City of St. Louis ordinance is in place to prohibit the installation of water wells within 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 (City of St. Louis 2005). This land use restriction prevents potential exposures to contaminated ground water at SLDS.

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

USACE is responsible for implementing, maintaining, reporting on, and enforcing the institutional controls until 2 years after site closeout. At that time, these responsibilities will be transferred to DOE as agreed to under the Memorandum of Understanding (MOU), dated March 17, 1999 (DOE and USACE 1999).

2.4.3 System Operations/Operation and Maintenance

No operations and maintenance (O&M) activities have taken place at the SLDS. No O&M documents are required for the SLDS.

2.5 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

This is the fourth five-year review for SLDS. The last five-year review (the Third Five-Year Review Report) was completed and signed in August 2015. The protectiveness statements, and the status of the recommendations and follow-up actions for SLDS from the Third Five-Year Review Report (USACE 2015a) are presented as follows.

Protectiveness Statement from the Last Five-Year Review

Pursuant to USEPA guidance, USACE, in coordination with USEPA, has completed the third five-year review for the St. Louis FUSRAP Sites. The five-year review is required because hazardous substances, pollutants, or contaminants remain at the site in concentrations that do not allow for unrestricted use. This review evaluates the protectiveness of the SLDS Accessible Soil and Ground-Water OU remedy.

The remedial action of the SLDS Accessible Soil and Ground-Water OU is under construction and is not yet completed. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.

The review indicates that while conditions at the SLDS Accessible Soil and Ground-Water OU may be protective, conditions could be improved with relatively minor effort, consistent with the recommendations in this review, to ensure the safety and health of SLDS workers and other potential exposure groups. Therefore, the remedy at the SLDS Accessible Soil and Ground-Water OU is expected to be protective of human health and the environment upon completion. Table 7 shows the status of recommendations and follow-up actions from the third five-year review.

Table 7. Status of Recommendations and Follow-up Actions from Third Five-Year Review

Third Five-Year Review Finding	Progress Since the Third Five-Year Review
Concentrations of Arsenic and Total U have exceeded the IL	Progress has been made since the third five-year review in remediating potential source areas beneath Building 101 in Plant 6WH. The total U concentrations in DW19 are lower during this five-year review period than they were during the previous five-year review period. This decrease is likely due to the excavation of potential contaminant sources beneath the Building 101 area. However, total U and arsenic concentrations in HU-B ground water continue to exceed the ILs. Monitoring of the Mississippi Alluvial Aquifer (HU-B) will continue.

2.6 FIVE-YEAR REVIEW PROCESS

2.6.1 Administrative Components of the Five-Year Review Process

The five-year review process included notifying regulatory agencies, the community, and other interested parties of the start of the five-year review; establishing the five-year review team in consultation with USEPA and MDNR; reviewing relevant documents and data pertaining to the remedial actions conducted over the past 5 years; conducting site inspections; conducting site interviews; and developing/reviewing this Fourth Five-Year Review Report. Each of these elements is discussed in the following sections.

Specific individuals forming the five-year review team are listed in Table 8.

Table 8. Identification of Five-Year Review Team Members

Name	Agency, Office	Title, Role
Rita Alexander	MDNR	Florissant Field Services Manager, Regulatory Oversight
Jill Bennett	DOE/Navarro Research & Engineering	Environmental Scientist, Site Inspection
Daniel Carey	MDNR	FUSRAP North St. Louis County and SLDS Project Coordinator (Florissant Field Office), Regulatory Oversight
Kevin Harris	Leidos	Environmental Engineer, Consultant, Co-author
Jessica Kidwell	USEPA, Region 7	Geologist, Agency Oversight
Tom Mahler	USEPA, Region 7	Engineer, Remedial Project Manager, Agency Oversight
Phil Moser	USACE, St. Louis District	FUSRAP SLDS Project Manager, Lead Agency
Jeffrey Murl	DOE, Office of Legacy Management (LM)	LM Site Manager, Site Inspection
Rebecca Roberts	DOE/Navarro Research & Engineering	FUSRAP Project Manager, Site Inspection
Kelly Schumacher	USEPA, Region 7	Toxicologist, Agency Oversight
Jo Anne Wade	USACE, St. Louis District	FUSRAP North St. Louis County Sites Project Manager, Lead Agency, Author

2.6.2 Community Notification and Involvement

The *Community Involvement Plan for the St. Louis FUSRAP Sites* (CIP) (USACE 2015b) provides a framework for making information concerning the remediation activities at SLDS fully and readily available to nearby communities. It facilitates community involvement activities to address community needs and concerns that arise during remediation activities and during the decision-making process.

An initial public notice concerning the upcoming fourth five-year review was presented in the Winter 2018 *FUSRAP Update: The St. Louis Sites* newsletter issued to the site mailing list. More detailed information concerning the review, as well as a request for community input, were presented in the Winter 2019 newsletter. When the review is completed, a public notice will be published to announce completion of the Fourth Five-Year Review Report.

The final Fourth Five-Year Review Report will be available on the following FUSRAP webpage:

- https://www.mvs.usace.army.mil/Missions/Centers-of-Expertise/Formerly-Utilized-Sites-Remedial-Action-Program/ under the link “Five-Year Review.”

2.6.3 Document Review

The documents used in this Fourth Five-Year Review Report are listed in Section 4. For this review, site-related documents included the following:

- Basis for response action documents, to identify the components of the remedies, the basis for action, the RAOs, and clean-up levels (i.e., SLDS ROD, EE/CA, Action Memoranda, prior Five-Year Review Reports),
- Implementation documents, to furnish information about design assumptions and documentation of the response actions at the sites (i.e., PDI, FSSE),
- Response action evaluation documents, to provide information that can be used to determine whether the response action continues to operate and function as designed (i.e., PRAR, Remedial Action Summary [RAS], FSSE, SLDS Environmental Monitoring and Data Analysis Report [EMDAR]),
- Legal documentation outlining the responsibility for the administration and execution of FUSRAP for SLS (i.e., MOU, Federal Facility Agreement [FFA]) and
- Community involvement documentation (i.e., CIP, newsletters).

2.6.4 Data Review and Evaluation

The data review and evaluation component of this five-year review consisted of examining the soil verification sampling data and the environmental monitoring data collected as part of remedial action conducted at SLDS. The soil data include post-excavation (verification) soil sampling data for properties where remedial actions were completed during this review period. The environmental monitoring program for SLDS includes the preparation of an annual EMDAR that consolidates and evaluates the environmental monitoring data over a single CY. This review is based on data presented in the CY 2014, CY 2015, CY 2016, CY 2017, and CY 2018 SLDS EMDARs (USACE 2015e, 2016d, 2017d, 2018d, and 2019b). The SLDS EMDARs assess compliance with ARARs and form the basis for assessing the status of residual contaminants and the potential for contaminant migration.

The following types of data were reviewed:

- Soil verification data
- Radiological monitoring data
- Ground-water data
- Excavation-water discharge monitoring data.

All samples collected during environmental monitoring activities were analyzed by USACE-approved subcontractor laboratories. Radiological samples were analyzed at the Environmental Laboratory Accreditation Program (ELAP)-accredited USACE St. Louis District FUSRAP Radioanalytical Laboratory, and all radiological QA splits and non-radiological samples were analyzed at a Test America laboratory, demonstrating adherence to the requirements of the *Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (DOD, v.5.1 and DOE, v.3.1 2017).

2.6.4.1 Soil Sampling Program

FSS verification and PDI sampling has been conducted at properties at which removal actions and/or remedial actions have taken place. Table 9 summarizes actions completed at SLDS during this five-year review period.

Table 9. SLDS Soil Sampling Program Completed Actions (January 2014 through December 2018)

Site	Location	Document	Completed Action	Radiological COCs		Metal COCs
				Maximum Residual Dose[a] (mrem/year)	Maximum Residual Risk[a] (unitless)	Two-Tiered Toxicity Assessment[b]
SLDS	DT-31 Porter Poultry VP	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Vicinity Property DT-31, St. Louis, Missouri,* September 13, 2017 (USACE 2017b).	No remedial action was required. Residual radioactivity in the accessible areas on both properties meets the requirements of the SLDS ROD. The accessible soil meets the criteria for unrestricted use.	0.2	4E-06	NA
SLDS	DT-2 City Property WOL, and DT-11 City of Venice (Partial)	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Vicinity Properties City Property (DT-2) West of the Levee and City of Venice (DT 11) (Partial), St. Louis, Missouri,* June 22, 2018 (USACE 2018a).	Residual radioactivity in the accessible areas on DT-2 WOL and DT-11 (partial) meets the requirements of the SLDS ROD. The accessible soil meets the criteria for unrestricted use. Volume Removed: 7,400 yd^3	9	2E-04[c]	NA
SLDS	Plant 6EH Building 101 Area	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 6 East Half, St. Louis, Missouri,* September 27, 2018 (USACE 2018b).	Residual radioactivity in the accessible areas on Plant 6EH in the Building 101 Area meets the requirements of the SLDS ROD. The accessible soil meets the criteria for unrestricted use for radioactivity. For non-radiological COCs, the accessible soil meets SLDS ROD criteria. Volume Removed: 20, 632 yd^3	3	7E-05	All Tier 1 hazard ratios (HRs) less than 1.0.
SLDS	Kiesel Hall Street Properties	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the Kiesel Hall Street Properties, St. Louis, Missouri,* August 27, 2015 (USACE 2015c).	Residual radioactivity in the accessible areas within the Kiesel Hall Street Properties meets the requirements of the SLDS ROD. The accessible soil meets the criteria for unrestricted use. Volume Removed: 10,503 yd^3	2	3E-05	NA
SLDS	Destrehan Street - West	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Destrehan Street (West) Property, St. Louis, Missouri,* September 27, 2018 (USACE 2018c).	Residual radioactivity in accessible soil on Destrehan Street (West) meets the requirements of the SLDS ROD. The accessible soil meets the criteria for unrestricted use. Volume Removed: 815 yd^3	0.3	6E-06	NA

Table 9. SLDS Soil Sampling Program Completed Actions (January 2014 through December 2018) (Continued)

Site	Location	Document	Completed Action	Radiological COCs		Metal COCs
				Maximum Residual Dose[a] (mrem/year)	Maximum Residual Risk[a] (unitless)	Two-Tiered Toxicity Assessment[b]
SLDS	Mallinckrodt Plant 1 Former Building 17 Area	*Post-Remedial Action Report and Final Status Survey Evaluation Addendum for the Accessible Soil Within the St. Louis Downtown Site Plant 1 Former Building 17 Area, St. Louis, Missouri,* September 25, 2019 (USACE 2019a).	Residual radioactivity in the accessible areas of the Plant 1 Former Building 17 Area meets the requirements of the SLDS ROD. The accessible soil meets the criteria for unrestricted use. Volume Removed: 2,300 yd^3	5	1E-04	NA
SLDS	DT-12	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Vicinity Property Burlington Northern Santa Fe Railroad (DT-12), St. Louis, Missouri,* August 19, 2014 (USACE 2014c).	Residual radioactivity in the accessible areas on DT-12 meets the requirements of the SLDS ROD. The accessible soil meets the criteria for unrestricted use. Volume Removed: 2,290 yd^3	5	1E-04	NA
SLDS	DT-9	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Vicinity Property Terminal Railroad Association (DT-9), St. Louis, Missouri,* March 3, 2015 (USACE 2015d).	Residual radioactivity in the accessible areas within the DT-9 TRRA VP meets the requirements of the SLDS ROD. The accessible soil meets the criteria for unrestricted use. Volume Removed: 2,440 yd^3	1	2E-05	NA
SLDS	Kiesel Riverfront Property	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Kiesel Riverfront Property, St. Louis, Missouri,* March 2, 2016 (USACE 2016a).	Performed final inspection of excavated and restored area at the Kiesel Riverfront Property portion of Area 9 (SU-2B). Volume Removed: 267 yd^3	9	2E-04	NA
SLDS	Plant 6E	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Plant 6 East Property, St. Louis, Missouri,* September 26, 2016 (USACE 2016b).	Residual radioactivity in the accessible areas on Plant 6E meets the requirements of the SLDS ROD. The accessible soil meets the criteria for unrestricted use for radioactivity. For non-radiological COCs, the accessible soil meets SLDS ROD criteria. Volume Removed: 11 yd^3	0.3	6E-04	All Tier 1 HRs less than 1.0.

Table 9. SLDS Soil Sampling Program Completed Actions (January 2014 through December 2018) (Continued)

Site	Location	Document	Completed Action	Radiological COCs		Metal COCs
				Maximum Residual Dose[a] (mrem/year)	Maximum Residual Risk[a] (unitless)	Two-Tiered Toxicity Assessment[b]
SLDS	Plants 7N and 7S	*Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 7 North and Plant 7 South Properties, St. Louis, Missouri,* September 27, 2017 (USACE 2017c).	Performed final inspection of excavated and restored areas in Plants 7N and 7S (excluding the trailer drop lot). Residual radioactivity in the accessible areas on Plants 7N and 7S meets the requirements of the SLDS ROD. The accessible soil meets the criteria for unrestricted use for radioactivity. For non-radiological COCs, the accessible soil meets SLDS ROD criteria. Volume Removed: 20,850 yd^3	11	2E-04[c]	All Tier 1 HRs less than 1.0.

[a] Maximum residual doses and risks were determined using the RESidual RADioactivity (RESRAD) (computer model) and represent the maximum total doses and risks above background, summed over all radiological COCs, estimated to occur over a 1,000-year period at the property for the evaluated receptor scenario. COC-specific EPCs were calculated across all accessible soil areas at each property as the lesser of the 95 percent upper confidence limit (UCL_{95}) or the maximum detected concentration above background for residual soil (including accessible soil not requiring remediation). Modeled receptor scenarios at DT-9 and DT-12 included the industrial worker, utility worker, and resident gardener. The modeled receptors for the remaining properties/documents included the industrial worker, utility worker, resident gardener, suburban resident, and recreational user/trespasser.

[b] A two-tiered toxicity assessment is performed as part of the PRAR or pre-design investigation report (PDIR) to calculate non-cancer HRs and/or target organ HIs for metal COCs based primarily on EPC comparisons with the soil RGs. A Tier 1 toxicity assessment result stating "All Tier 1 HRs less than 1.0" indicates that the ratio of the EPC to the RG is less than 1.0 for all metal COCs, and that SLDS ROD requirements are met. During the toxicity assessment, if at least one HR exceeds 1.0, then target organ HIs are calculated for the metal COCs as part of the Tier 2 toxicity assessment. If the HIs calculated for all COCs are less than the USEPA's acceptable limit of 1, then "All Tier 2 target organ HIs less than 1" is indicated and the SLDS ROD requirements are met.

[c] The maximum dose and risk values presented for accessible soil at DT-2 WOL and DT-11 (partial), as well as at Plants 7N and 7S, estimated over a 1,000-year period, without ground cover in place, are for a resident gardener receptor. The maximum dose for this scenario is less than the target dose of 25 mrem per year, while the maximum risk exceeds the target risk range of 1E-06 to 1E-04. The highest residual radiological dose and risk calculated for accessible soil with ground cover (i.e., soil backfill) in place (i.e., under current configurations) is 5 mrem per year and 1E-04, respectively. Although USEPA defines the CERCLA target risk range as 1E-06 to 1E-04, USEPA's Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-18, *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination* (USEPA 1997) states "A specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions." In accordance with OSWER 9200.4-18 (USEPA 1997), if a dose assessment is conducted at a site, a risk level of 3E-04 "…is consistent with levels generally considered protective in other governmental actions, particularly regulations and guidance developed by [the US]EPA in other radiation control programs." Therefore, post-remedy conditions meet the requirements of the SLDS ROD, as well as the criteria for unrestricted use.

Note:

NA – indicates soil samples were not analyzed for metals.

2.6.4.2 Radiological Monitoring Data

Site radiological monitoring consisted of collecting gamma radiation, airborne particulate radionuclide, and outdoor and indoor airborne radon data. The data were used to evaluate the compliance status of each site with ARARs, to evaluate trends, and to assess protectiveness of the remedy. The background locations for gamma radiation, radon, and particulate air monitoring at SLS are shown on Figure 4. The gamma radiation, radon, and particulate air monitoring locations at SLDS are shown on Figure 5.

According to the respective SLDS EMDARs, radiological air monitoring was conducted as shown in the following list, during each CY.

- CY 2014 – DT-2, Kiesel Hall Street, Plant 6, and Plant 6 Loadout;
- CY 2015 – Plant 6, and Plant 6 Loadout;
- CY 2016 – Plant 6, Plant 7, and Plant 6 Loadout;
- CY 2017 – Destrehan Street, Plant 1 Building 17, and Plant 6 Loadout; and
- CY 2018 – Heintz Steel, Destrehan Street/Plant 6WH/Plant 7, Plant 1 Building 17, Gunther Salt, and Plant 6 Loadout.

Radiological Monitoring Standards

Title 40 CFR *192.02(b)(2)*

Outdoor airborne radon was compared to the regulatory criterion of 0.5 pCi/L average annual concentration above background, as listed in 40 *CFR* 192.02(b)(2).

Title 40 CFR *61*

Airborne particulate radionuclide data from the site were used to calculate the effective dose equivalent (EDE) to a critical receptor. The National Emission Standards for Hazardous Air Pollutant (NESHAP) standard of EDE to a critical receptor from radionuclide emissions is 10 mrem per year, as stated in 40 *CFR* 61, Subpart I *(National Emission Standards for Emissions of Radionuclides Other Than Radon From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered By Subpart H)*.

Title 40 CFR *192.12(b)*

Indoor airborne radon in affected buildings was compared to the regulatory criterion of 0.02 WL (objective) and 0.03 WL (limit) listed in 40 *CFR* 192.12(b).

Gamma Radiation Monitoring

Gamma radiation was measured using thermoluminescent dosimeters (TLDs). TLDs at SLDS were located at four areas (DA-1, DA-2, DA-3, and DA-6) between the work areas and public areas; the results for the TLD located closest to the hypothetical receptor are used for dose estimates for that receptor. At each monitoring station, the TLDs were placed approximately 3 ft above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at SLDS at four locations during CY 2014 through CY 2018.

Gamma Radiation Monitoring Program Results

The gamma radiation data collected from each location during CY 2014 to CY 2018 were corrected for background, shelter absorption, and fade, and were normalized to exactly 1 year to calculate an annual dose. The corrected annual gamma radiation monitoring results are presented in Table 10.

Table 10. External Gamma Radiation Monitoring Results at SLDS

Monitoring Location	Monitoring Station[a]	CY 2014 TLD Data	CY 2015 TLD Data	CY 2016 TLD Data	CY 2017 TLD Data	CY 2018 TLD Data
		(mrem/year)				
SLDS	DA-1	0	1	0	0	0
	DA-2	0.2	2	0.5	0	0
	DA-3	0	0	2	0.2	0
	DA-6	2	0	3	1.3	1.3

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the SLDS EMDARs (USACE 2015e, 2016d, 2017d, 2018d, and 2019b)..

Gamma Radiation Data Analysis

Gamma radiation data from SLDS were used to calculate an average dose rate to a hypothetically maximally exposed individual. A summary of calculated gamma radiation dose rates is presented in Table 11.

Table 11. External Gamma Dose Rate at SLDS

CY	Maximum Average Gamma Dose Rate above Background[a]	Annual Gamma Dose Rate
	(mrem/hour)	(mrem/year)
2014	<0.1	0
2015	<0.1	<0.1
2016	<0.1	<0.1
2017	<0.1	0
2018	<0.1	0

[a] Calculated by dividing the maximum annual gamma radiation result in Table 10 by 8,760 hours, the number of hours in a year, for each location.

Note: Assumptions used in calculating these doses to the hypothetical public receptor are described in the SLDS EMDARs (USACE 2015e, 2016d, 2017d, 2018d, and 2019b).

Gamma Radiation Trend Analysis

The annual dose to a member of the public from gamma radiation at SLDS had negligible variance from year to year. There is no trend for the CY 2014 to CY 2018 time period.

Airborne Particulate Monitoring

Airborne radioactive particulates result from radioactive material in soil (or other sources) that becomes suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 ft above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in µCi/mL.

Perimeter air sampling for radiological particulates was not conducted at SLDS during CY 2014 to CY 2018 due to the insignificant potential for material to become airborne at the site. Particulate air monitors were located at excavation and loadout perimeter locations on SLDS. Air particulate samples are collected during active excavation and waste loadout at SLDS and analyzed at the USACE St. Louis FUSRAP laboratory.

Airborne Particulate Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual to airborne particulates. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table 12.

Table 12. Airborne Particulate Monitoring at SLDS

CY	Average Annual Gross Alpha Concentration[a] (µCi/mL)	Average Annual Gross Beta Concentration[a] (µCi/mL)	Annual Airborne Particulate Dose Rate (mrem/year)
2014	4.34E-15	2.23E-14	<0.1
2015	3.85E-15	2.44E-14	<0.1
2016	4.51E-15	3.16E-14	<0.1
2017	4.84E-15	2.80E-14	<0.1
2018	4.23E-15	2.73E-14	0.2

[a] Average annual concentrations are determined using data from all applicable SLDS properties.

Airborne Particulate Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 *CFR* 61 standard of 10 mrem per year. A comparison of the EDE due to airborne particulate radionuclides at SLDS and the regulatory limits is presented in Table 13.

Table 13. Airborne Particulate Dose Rate at SLDS

CY	Annual Airborne Particulates Dose Rate (mrem/year)	40 *CFR* 61 Standard (10 mrem/year)
2014	<0.1	10
2015	<0.1	10
2016	<0.1	10
2017	<0.1	10
2018	0.2	10

As shown in Table 13, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 *CFR* 61 standard of 10 mrem per year during CY 2014 to CY 2018.

Airborne Particulate Trend Analysis

The annual dose to a member of the public from airborne particulate radionuclides at SLDS was significantly less than the 40 *CFR* 61 standard and did not vary significantly from year to year. There is no trend over the CY 2014 to CY 2018 time period.

Radon Monitoring

Outdoor airborne radon monitoring was performed at SLDS using alpha track detectors (ATDs) to measure radon emissions. Outdoor radon monitoring was performed at SLDS at four locations (DA-1, DA-2, DA-3, and DA-6) during CY 2014 through CY 2018, with the outdoor ATDs collocated with the TLDs used to monitor gamma radiation at the site. The ATDs were collected semiannually. Recorded outdoor airborne radon concentrations were used to calculate a site annual average concentration to compare to the ARAR value of 0.5 pCi/L average annual concentration above background, as listed in 40 *CFR* 192.02(b).

Indoor airborne radon monitoring was performed during CY 2014 through CY 2018 at two SLDS buildings (Building 26 in Plant 1 and the South Storage Building at GSN (DT-4 North). One ATD was placed in each building at a height of 4 ft (to approximate breathing zone conditions) to measure radon concentrations. The ATDs were located in areas that represent the highest likely exposure from indoor radon.

The average soil concentrations of Ra-226 and Th-230 above background were evaluated for all structures located within the ISOU at SLDS where at least one Ra-226 or Th-230 soil sample result was greater than the surface soil criteria of 5 pCi/g and 14 pCi/g, respectively. Only four structures had average soil concentrations of Ra-226 and Th-230 above background that exceeded the surface soil criteria of 5 pCi/g and 14 pCi/g, respectively. These structures were Building 26 in Plant 1, and the two Salt Storage Domes and the South Storage Building at GSN. The two Salt Storage Domes at GSN were deemed to be not habitable or occupied.

The average soil concentrations of Ra-226 and Th-230 above background detected beneath the footprint of Building 26 are 64 pCi/g and 8.2 pCi/g, respectively. The average soil concentration of Ra-226 above background detected beneath the footprint of the GSN South Storage Building is 13 pCi/g, while the average Th-230 concentration is less than background. ATD locations for monitoring indoor airborne radon concentrations were selected with consideration given to known Ra-226 concentrations under Building 26 and the GSN South Storage Building, and to occupancy times at any one location within each building.

Annual average indoor radon data in each applicable building (including background) were compared to the 40 *CFR* 192.12(b) ARAR values of 0.02 WL (objective) and 0.03 WL (limit). In accordance with 40 *CFR* 192.12(b), reasonable effort shall be made to achieve, in each habitable or occupied building, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL. In any case, the radon decay product concentration shall not exceed 0.03 WL. Background indoor radon monitors were not necessary, because the regulatory standard of 0.02 WL includes background. Indoor ATDs were collected approximately every 6 months and sent to an off-site laboratory for analysis.

Outdoor Airborne Radon Monitoring Program Results

The outdoor airborne radon data collected from each location during CY 2014 to CY 2018 were corrected for background and were normalized to exactly 1 year to compare to the limit of 0.5 pCi/L greater than background from 40 *CFR* 192.02(b). The calculated annual outdoor radon monitoring results are presented in Table 14.

Table 14. Outdoor Airborne Radon Monitoring at SLDS

Monitoring Location	Monitoring Station[a]	CY 2014 Radon Data	CY 2015 Radon Data	CY 2016 Radon Data	CY 2017 Radon Data	CY 2018 Radon Data
		(pCi/L)				
SLDS	DA-1	0	0	0	0	0
	DA-2	0	0	0	0	0.1
	DA-3	0	0	0	0	0
	DA-6	0	0	0	0.15	0
	Average	0	0	0	<0.1	<0.1

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the SLDS EMDARs (USACE 2015e, 2016d, 2017d, 2018d, and 2019b)..

Note: Background concentrations used in calculating these doses to the hypothetical public receptor are described in the SLDS EMDARs (USACE 2015e, 2016d, 2017d, 2018d, and 2019b).

Trend Analysis of Outdoor Airborne Radon

The annual outdoor airborne radon concentrations at SLDS were less than the 40 *CFR* 192.02(b) limit, with negligible variance from year to year. There is no trend for the CY 2014 to CY 2018 time period. The average annual concentration of radon remained approximately the same for the period.

Indoor Airborne Radon Monitoring Program Results

The indoor airborne radon data collected from each location during each sampling event from CY 2014 to CY 2018 (background included) were normalized to exactly 1 year to calculate radon WLs. The measured semiannual radon concentrations are presented in Table 15.

Table 15. Summary of Annual Indoor Airborne Radon (Rn-222) Data at SLDS

Monitoring Location	Monitoring Station	Average Annual Indoor Radon Concentration									
		CY 2014		CY 2015		CY 2016		CY 2017		CY 2018	
		Annual Average (pCi/L)[a]	WL[b]	Annual Average (pCi/L)[a]	WL[b]	Annual Average (pCi/L)[a]	WL[b]	Annual Average (pCi/L)[a]	WL[b]	Annual Average (pCi/L)[a]	WL[b]
Plant 1, Building 26	DI-1	0.2	0.001	0.2	0.001	0.85	0.003	1.05	0.004	0.4	0.002
GSN South Storage Building	DI-2	0.75	0.003	0.85	0.003	0.9	0.004	1.15	0.005	1.1	0.004

[a] Results reported from vendor for two periods are averaged to estimate an annual average radon concentration (pCi/L). A result of 5 pCi/L is equivalent to 0.02 WL and a result of 7.5 pCi/L is equivalent to 0.03 WL for comparison of indoor concentrations to the indoor objective and limit.

[b] The average annual WL is calculated by dividing the average pCi/L by 100 pCi/L per WL and multiplying by 0.4 (the indoor radon equilibrium factor [ICRP 2008]. The average annual WL should be less than 0.02 and shall be less than 0.03 WL (40 *CFR* 192.12(b)).

Trend Analysis of Indoor Airborne Radon

The annual indoor airborne radon WLs at Plant 1, Building 26, and the GSN South Storage Building were significantly less than the 40 *CFR* 192 limit from CY 2014 through CY 2018, and showed only slight variation from year to year.

2.6.4.3 Ground-Water Data

Ground water at SLDS is found within three HUs: the upper HU-A unit, which consists of fill overlying clay and silt; the lower Mississippi Alluvial Aquifer, referred to as HU-B; and the limestone bedrock, referred to as HU-C. A generalized stratigraphic column and a geologic cross-section for SLDS are shown on Figures 6 and 7, respectively.

Ground-water monitoring is conducted to meet the following objectives:

- identify potential impacts to ground-water quality resulting from removal actions and remedial actions;
- obtain requisite data to evaluate response action performance; and
- ensure compliance with the SLDS ROD (USACE 1998a) requirements.

Ground-water sampling was conducted at SLDS during the period of this review at 14 monitoring wells (4 HU-A and 10 HU-B wells) (Figure 8). In addition, ground-water levels were measured on a quarterly basis at these wells. The water level measurements confirm that ground-water flow direction and gradient in HU-B are strongly influenced by river stage. The ground-water flow is generally toward the Mississippi River, except during periods of high river stage.

The ground-water samples were analyzed for two metal COCs (arsenic and cadmium) and seven radionuclide COCs (Ra-226, Th-228, Th-230, Th-232, U-234, U-235, and U-238). Total U values were calculated from isotopic concentrations in pCi/L and converted to µg/L using radionuclide-specific activities.

The HU-B ground-water results are compared to the following SLDS ROD ground-water criteria (USACE 1998a):

1. The ILs: 50 µg/L arsenic, 5 µg/L cadmium, and 20 µg/L total U; and
2. The concentration limits from the Uranium Mill Tailings Radiation Control Act regulations listed in 40 *CFR* 192.02, Table 1 to Subpart A: 5 pCi/L combined Ra-226 and Ra-228.

Because HU-A is not considered a potential source of drinking water, the SLDS ROD did not establish ground-water criteria for HU-A ground water.

The results of ground-water monitoring at SLDS are evaluated in the annual SLDS EMDARs. The following section provides a summary of the results of the ground-water sampling conducted at SLDS during the period of this review, based on the data presented in the CY 2014 through CY 2018 SLDS EMDARs (USACE 2015e, 2016d, 2017d, 2018d, and 2019b). The results of ground-water sampling conducted at SLDS during this review period are summarized in Table 16.

Table 16. Summary of Ground-Water Monitoring Results for COCs at SLDS (CY 2014 through CY 2018)

Unit	Monitoring Well	Arsenic (µg/L)		Cadmium (µg/L)		Ra-226 (pCi/L)		Th-228 (pCi/L)		Th-230 (pCi/L)		Total U[a] (µg/L)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
HU-A	B16W06S	110	260	ND	1.6	ND	1.09	ND	ND	ND	0.41	ND	1.5
	B16W08S	ND	ND	ND	0.38	ND	ND	ND	ND	0.34	0.50	8.1	10.6
	B16W12S	ND	1.7	0.98	1	ND	ND	ND	ND	ND	0.37	6.2	14.3
	DW21	81	140	ND	22	ND	ND	ND	ND	ND	0.48	ND	0.4
HU-B	B16W06D	ND	2	ND	ND	ND	2.35	ND	ND	ND	ND	ND	1.9
	B16W07D	29	40	0.29	*6.6*	ND	ND	ND	ND	ND	ND	ND	3.8
	B16W08D	20	30	0.64	0.66	ND	ND	ND	0.62	ND	0.37	2	2
	B16W09D	9.1	37	0.2	0.53	ND	1.76	ND	0.40	0.56	0.82	ND	2.6
	DW14	***100***	***130***	0.46	*6.7*	ND	1.94	ND	1.07	ND	0.47	ND	2.2
	DW15	ND	*53*	2.5	***34***	ND	1.49	ND	ND	ND	ND	1.5	1.9
	DW16	15	***230***	0.19	1.8	ND	2.33	ND	0.55	ND	0.46	2.4	3.9
	DW17[b]	11	11	***73***	***73***	***3.77***	***3.77***	***1.95***	***1.95***	3.9	3.9	14	14
	DW18	***60***	***120***	ND	0.57	ND	0.93	ND	0.15	ND	0.35	U	1.2
	DW19[c]	9	18	***13***	***15***	ND	ND	0.40	0.55	ND	ND	***43.3***	***54.8***

[a] Total U values were calculated from isotopic concentrations in pCi/L and converted to µg/L using radionuclide-specific activities.

[b] DW17 is a flush-mount well located in a topographically low-lying area. After September 2014, sampling was terminated when it was determined that sediment was infiltrating the well via surface water runoff. Sampling will be resumed after the well is converted to an above-ground (stickup) well and redeveloped. The well modifications were completed during the fourth quarter of CY 2019.

[c] On August 3, 2016, DW19 was plugged and abandoned so that remediation activities could be conducted in that area Results for DW19 presented in this table are based on the two samples collected from DW19 during this review period. In March 2019, after the remedial activities were completed, DW19RD was installed.

Notes:

Exceedances of the ground-water criteria in HU-B ground water are shown in ***bold italics***. There are no ground-water criteria for HU-A ground water. The SLDS ROD criteria are: 50 µg/L arsenic, 5 µg/L cadmium, 20 µg/L total U and 5 pCi/L combined Ra-226 and Ra-228. Ra-228 assumed to be in equilibrium with Th-228.

Values in *italics* represent results that do not exceed ILs when the range of associated measurement error is taken into account.

Th-232 is not shown because it was not detected in SLDS ground water during the CY 2014 through CY 2018 period.

ND – Nondetect. The detection limits were 4 µg/L for arsenic and 0.2 µg/L for cadmium.

The results indicate that arsenic, cadmium, and total U have been detected at levels exceeding the ILs in multiple samples collected from the following HU-B wells:

- Arsenic in DW14, DW16, and DW18 exceeded the IL of 50 µg/L;
- Cadmium in DW15 and DW19 exceeded the IL of 5 µg/L; and
- Total U in DW19 exceeded the IL of 20 µg/L.

In addition, cadmium results slightly exceeded the IL in the HU-B wells B16W07D and DW14 for a single sampling event conducted during the period of this review. A single cadmium exceedance was also detected in DW17 (73 µg/L in the September 2014 sample), but this exceedance is possibly due to sediment that had accumulated in this flush-mount well as a result of surface water infiltration.

As part of this five-year review, an evaluation of concentration trends has been conducted for the COCs detected at concentrations exceeding SLDS ROD ground-water criteria in HU-B to support evaluation of the effectiveness of the remedial action. In addition, an evaluation of concentration trends has been conducted for select COCs detected in HU-A ground water to assure protectiveness of the final remedy and to verify that ground-water conditions are not degrading. Mann-Kendall Trend Tests were performed to evaluate the concentration trends using the available data for unfiltered ground-water samples collected during the period from January 2000 through December 2018. The use of data collected prior to the start of this review period (i.e., prior to January 2014) is necessary in order to have sufficient data to conduct statistical trend analysis for those wells that are sampled less than annually.

For the HU-A wells, the Mann-Kendall Trend Test was conducted for COCs for which these conditions were met: (1) the COC was detected at least twice during the period of this review (January 2014 through December 2018) at elevated concentrations (relative to other HU-A wells); (2) sufficient sampling results were available (i.e., at least six) for the period between January 2000 through December 2018; and (3) the detection frequency was greater than 50 percent. The following COCs were detected in HU-A wells at SLDS during the period of this review and met the data requirements:

- Arsenic: B16W06S and DW21
- Total U: B16W08S and B16W12S

For the HU-B wells, the Mann-Kendall Trend Test was conducted for COCs for which these conditions were met: (1) the COC was detected at concentrations exceeding the IL at least twice during the period of this review; (2) sufficient sampling results were available (i.e., at least six) for the period between January 2000 through December 2018; and (3) the detection frequency was greater than 50 percent. The following COCs exceeded their ILs in HU-B wells at SLDS during the period of this review and met the data requirements:

- Arsenic: DW14, DW16, and DW18
- Total U: DW19

In addition, the Mann-Kendall Trend Test was performed for two HU-B wells (DW15 and DW19) that exceeded the cadmium IL at SLDS during the period of this review, but did not meet the data requirement of a detection frequency greater than 50 percent for the January 2000 through December 2018 period. In this case, the database was restricted to the September 2002 through December 2018 period in order to meet the detection frequency requirement while still retaining a sufficient number of samples to conduct the Mann-Kendall Trend Test. Results of the Mann-Kendall Trend Tests are summarized in Table 17.

Table 17. Results of Mann-Kendall Trend Test for SLDS Ground Water

Analyte	HU	Station	N[a]	DF[b]	S[c]	Trend[d]
Arsenic	HU-A	B16W06S	21	100%	4	No Trend
		DW21	26	100%	-135	Downward Trend
	HU-B	DW14	22	100%	-101	Downward Trend
		DW16	21	86%	97	Upward Trend
		DW18	27	100%	216	Upward Trend
Cadmium	HU-B	DW15	17	65%	62	Upward Trend
		DW19	12	50%	49	Upward Trend
Total U	HU-A	B16W08S	11	73%	25	Upward Trend
		B16W12S	17	100%	36	No Trend
	HU-B	DW19	25	100%	-56	No Trend

[a] N is the number of unfiltered ground-water sample results for a particular analyte at the well for the period between January 2000 and December 2018. For DW15 and DW19 cadmium results, the database was restricted to the September 2002 through December 2018 period in order to meet the 50 percent detection frequency requirement for performing the Mann-Kendall Trend Test.

[b] DF = Detection Frequency (percent)

[c] S = the Mann-Kendall S-Statistic

[d] One-tailed Mann-Kendall Trend Tests were performed at a 95 percent level of confidence. For non-radiological data, non-detected results were replaced with 0.5 of the detection limit.

The arsenic concentration trends for two HU-A wells (B16W06S and DW21) and three HU-B wells (DW14, DW16, and DW18) were evaluated using the Mann-Kendall Trend Test. The Mann-Kendall Trend Test indicated a decreasing trend in arsenic concentrations for the HU-A well DW21. Based on the results of the Mann-Kendall trend analyses conducted for HU-B ground water, two wells (DW16 and DW18) exhibit statistically significant upward trends in arsenic concentrations and one well (DW14) exhibits a statistically significant downward trend. Figure 9 presents the time-versus-concentration plots for arsenic in HU-A well DW21 and the three HU-B wells (DW14, DW16, and DW18).

For cadmium, two HU-B wells (DW15 and DW19) were evaluated using the Mann-Kendall Trend Test. Based on the results of the Mann-Kendall trend analyses, both wells exhibit statistically significant upward trends in cadmium concentrations. Figure 9 presents the time-versus-concentration plots for cadmium in DW15 and DW19.

Total U trends were evaluated for two HU-A wells (B16W08S and B16W12s) and one HU-B well (DW19) using the Mann-Kendall Trend Test. The Mann-Kendall trend analyses indicate a statistically significant upward trend in total U concentrations in B16W08S. There are no statistically significant concentration trends for total U in the HU-B well, DW19. Figure 9 presents the time-versus-concentration plots for total U in B16W08S and DW19.

2.6.4.4 Excavation-Water Discharge Monitoring at SLDS

This section provides a description of the excavation-water monitoring activities conducted at SLDS during this five-year review period. The monitoring results obtained from these activities are presented and compared with their respective permit or permit-equivalent requirements. The purpose of excavation-water discharge sampling at SLDS is to monitor compliance with the established discharge requirements. These requirements are established by the following: MSD discharge authorization letters dated 1998, 2001, 2004, 2006, 2008, 2010, 2012, 2014, 2016, and 2018 for SLDS (MSD 1998, 2001a, 2004, 2006a, 2008a, 2010a, 2012a, 2014a, 2016a, 2018a).

Precipitation runoff and ground-water infiltration that collect in excavation areas of SLDS are treated and discharged to the Bissell Point Sewage Treatment Plant under an authorization letter issued by MSD. MSD establishes a maximum volume of excavation water allowed to be discharged in a 24-hour period, and requires that USACE show compliance of the treated excavation water with applicable standards and limits before MSD will allow the discharge. Excavation water is discharged to MSD sewer inlets located at SLDS. A summary of the excavation-water discharges from SLDS for this five-year review period is presented in Table 18.

Table 18. Summary of Excavation-Water Discharges at SLDS

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Activity Discharged (Ci)	Total Volume Discharged (gallons)
2014	No Exceedance	No Exceedance	No Exceedance	No Exceedance	Th – 2.8E-05 U – 6.3E-04 Ra – 1.3E-05	2,188,720
2015	No Exceedance	No Exceedance	No Exceedance	No Exceedance	Th – 3.4E-05 U – 4.1E-03 Ra – 2.0E-05	2,964,362
2016	No Exceedance	No Exceedance	No Exceedance	No Exceedance	Th – 2.5E-05 U – 1.5E-03 Ra – 2.4E-05	4,742,100
2017	No Exceedance	No Exceedance	No Exceedance	No Exceedance	Th – 2.5E-05 U – 1.9E-04 Ra – 1.0E-05	1,962,146
2018	No Exceedance	No Exceedance	No Exceedance	No Exceedance	Th – 1.4E-05 U – 2.0E-04 Ra – 1.6E-05	2,440,251

2.7 SITE INSPECTION

A site inspection was conducted at SLDS on July 31, 2019. The site inspection participants are identified in Table 8. The purpose of the inspection was to visually assess the implementation and effectiveness of the remedial actions conducted at SLDS. Those agencies participating in the inspection included USACE (St. Louis District), USEPA, MDNR, and DOE. A Site Inspection Checklist was completed for each inspection (see Appendix A). The checklist focuses on the implementation of the remedy, adequacy of O&M, early indicators of potential remedy problems, and opportunities for optimization.

No issues were identified as part of the site inspection. The general site conditions were good, and the areas are well maintained. Site access appeared to be sufficiently restricted where necessary. Fences, gates, and signage were in good condition. Ground-water monitoring wells were observed to be secure and well maintained. No equipment was observed to be in disrepair during the inspections. No additional tasks or opportunities for optimization were identified during the inspection. No potential land use changes that would lessen the effectiveness of the selected remedy for the sites have occurred or are planned to occur.

2.8 INTERVIEWS

Interviews were conducted between July and September, 2019. Interview candidates were identified from a variety of organizations and groups familiar with the remediation being conducted at SLDS under FUSRAP. Not all of those invited to participate chose to do so. Respondents included key site and contractor personnel involved in remediation projects at SLDS; local residents and business owners; and local, state, and federal government agency representatives.

A complete list of interview questions and responses are provided on the individual interview record forms included in Appendix B, along with a list of the respondents. A summary of the interview results follows.

In general, the respondents expressed a positive overall impression of the project. They stated that they believed that the project is being done in an effective and thorough manner. They also commended several individual members of the FUSRAP team for being very responsive, professional, and respectful when addressing community concerns and when working with other government agencies. While noting that the sampling and remediation activities have caused some disruptions in the use of local roads, parks, and trails, they acknowledged that FUSRAP was coordinating their activities with property/business owners and local agencies to ensure the operations had minimal impacts. A few respondents expressed concern that the pace of the work was being slowed by funding limitations.

Respondents generally reported feeling well informed of the site activities and progress. Respondents noted good communication between members of the FUSRAP team and the community, and indicated the information provided by the newsletters, website, and meetings has kept them well informed of the site activities and progress. However, three respondents expressed that while the FUSRAP public relations (PR) representatives had done a great job in the past, the FUSRAP PR manager in CY 2018 was less responsive and less open with the community.

The majority of the respondents concerns were regarding the North St. Louis County portion of the SLS. Those concerns are discussed in further detail in Section 3.8, which is specific to North St. Louis County.

2.9 TECHNICAL ASSESSMENT

2.9.1 QUESTION A: Is the remedy functioning as intended by the decision documents?

Yes.

Although the remedial action at SLDS is under construction and is not yet completed, the remedy is expected to function as intended by the decision documents. Based upon a review of the documents, ARARs, exposure assumptions, and the results of the site inspections, it has been determined that the actions taken to date have been implemented as intended by the SLDS ROD.

2.9.1.1 Remedial Action Performance

The excavation and off-site disposal of soil with COC concentrations exceeding the SLDS ROD RGs is being performed as prescribed in the SLDS ROD. During this fourth five-year review period, remedial and/or FSS actions have been completed (including verification documentation) at the following nine SLDS properties in accordance with the SLDS ROD: DT-31, DT-2/DT-11 (Partial), Plant 6EH Building 101 Area, Kiesel Hall Street Properties, Kiesel Riverfront Property, Destrehan Street West, Mallinckrodt Plant 1 Former Building 17 Area, and Plants 7 North (7N) and 7S. Collectively, response actions at these properties (excluding DT-31) have resulted in the removal and offsite disposal of 41,650 in situ yd^3 of soil exceeding SLDS ROD RGs. The remediation of accessible soil contaminated by MED/AEC operations has achieved acceptable risks for the exposure scenarios applicable to industrial use as specified by the SLDS ROD.

2.9.1.2 Systems Operations/Operations and Maintenance

No O&M documents are required for SLDS.

2.9.1.3 Implementation of Institutional Controls and Other Measures

In areas where contamination will remain (i.e., in inaccessible soil areas), the existing institutional controls prevent or restrict access to inaccessible soil. The need for any additional institutional controls will be evaluated under the scope of the SLDS ISOU.

2.9.2 QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Yes.

The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid. The information presented in the following subsections summarizes the rationale and evaluations that form the basis of this response.

2.9.2.1 Changes in Standards and To Be Considered

Chemical-specific and action-specific ARARs and To Be Considered (TBCs) were identified in the SLDS ROD (USACE 1998a) and are presented in Appendix C, Attachment C-1. No location-specific ARARs were identified in the SLDS ROD. Attachment C-1 in Appendix C presents lists and analyses of chemical-specific and action-specific ARARs in Tables C-1-1 and C-1-2, respectively, relative to the current remedy that is ongoing at the SLDS accessible soil and groundwater OU. Both tables show that no changes or updates have occurred to any of the ARARs or TBCs identified in the SLDS ROD, and the ARARs and TBCs identified in the SLDS ROD remain valid. Therefore, implementing the remedy and achieving the SLDS ROD RGs, which are based on the chemical- and action-specific ARARs, will be protective.

2.9.2.2 Changes in Exposure Pathways, Exposure Assumptions, and Risk Assessment Methods

Since issuance of the Third Five-Year Review Report, no changes have occurred in the exposure pathways, exposure assumptions, or risk assessment methods that are used in calculating pre- and post-remediation human health risk and dose to receptors for the purpose of determining compliance of the remedy with the requirements of the SLDS ROD. Since the third five-year review, Argonne National Laboratory (ANL) released the current RESidual RADioactivity (RESRAD) model version, RESRAD-ONSITE Version 7.2, on July 20, 2016. The updates within this version include improved computational time and options to select between the radionuclide decay chain databases based on International Commission on Radiological Protection (ICRP)-38, *Radionuclide Transformations – Energy and Intensity of Emissions* (ICRP 1983), versus ICRP-107, *Nuclear Decay Data for Dosimetric Calculations* (ICRP 2008). ICRP-107 contains a revised database of nuclear decay data (energies and intensities of emitted radiations, physical half-lives, and decay models) for 1,252 naturally occurring and manmade radionuclides, and supersedes the previous database, ICRP-38, which was published in 1983. As indicated in the Third Five-Year Review Report (USACE 2015a), USACE has applied the ICRP-107 database since the release of RESRAD Version 7.0. Therefore, since there have been no changes in user-defined or model default exposure pathways, assumptions, or calculation methods applied in the model, there are no differences in the risks and doses produced by either model version when applying the ICRP-107 decay chain. Therefore, the remedy remains health-protective.

2.9.2.3 Changes in Toxicity or Contaminant Characteristics

No changes have occurred in the characteristics of the radiological or metal COCs identified for SLDS. The Third Five-Year Review Report (USACE 2015a) describes, in detail, changes in cancer slope factors (CSFs) for radiological and metal COCs, dose conversion factors (DCFs) for radiological COCs, and noncarcinogenic toxicity criteria for metal COCs that had occurred between the signing of the SLDS ROD and the issuance of the Third Five-Year Review Report. For the radiological COCs, CSFs and DCFs updates were based on the Oak Ridge National Laboratory (ORNL) document titled *Calculation of Slope Factors and Dose Coefficients* (ORNL 2014). The new factors were calculated by ORNL using dose and risk calculation (DCAL) software in the manner of *Federal Guidance Report No. 12: External Exposure to Radionuclides in Air, Water, and Soil* (FGR-12) (USEPA 1993) and *Federal Guidance Report No. 13: Cancer Risk Coefficients for Environmental Exposure to Radionuclides* (FGR-13) (USEPA 1999), and were based on the ICRP-107 decay chain database. These updates are available in the DCFPAK 3.02 library program, which is integrated with both the RESRAD Version 7.0 and RESRAD-ONSITE Version 7.2 models. DCFPAK 3.02 allows the user to select from 14 different DCF and CSF libraries. Based on an evaluation of the CSFs and DCFs conducted over the range of age groups in Appendix F, Attachment F-1, of the Third Five-Year Review Report (USACE 2015a), USACE determined that future residual risk and dose assessments would be conducted using the DCFPAK 3.02 (adult) CSFs and DCFs. Consequently, this library has continued to be applied in the RESRAD-ONSITE Version 7.2 model for evaluations of SLDS properties since the third five-year review. Further evaluations in the Third Five-Year Review Report (USACE 2015a), using radiological data from previously remediated sites considered to be complete, in conjunction with the CSFs and DCFs in the DCFPAK 3.02 (Adult) library, USACE determined that the remedy being implemented at SLDS is expected to remain protective of human health and the environment upon completion.

Sections 2.9.2.3.1 and 2.9.2.3.2 below discuss changes in toxicity criteria for radiological and metal COCs, respectively.

2.9.2.3.1 Changes in Radiological Cancer Slope Factors and Dose Conversion Factors

Since the release of RESRAD Version 7.0, updated internal and external exposure DCFs and CSFs published in the Calculation of Slope Factors and Dose Coefficients (ORNL 2014) have been incorporated into the DCFPAK 3.02 library program (with the exception of the soil ingestion CSFs) that is integrated into both the RESRAD Version 7.0 and RESRAD-ONSITE Version 7.2 models. However, a more recent update of external exposure DCFs was published in 2019 by USEPA in FGR-15 (USEPA 2019a). In addition to providing updated external exposure DCFs, FGR-15 expands upon FGR-12 by providing age-specific DCFs for external exposures to radionuclides in air, water, and soil. FGR-12 external DCFs were used in dose assessments performed using the earlier versions of the RESRAD model for SLDS properties prior to the Third Five-Year Review Report (USACE 2015a).

Risk and dose assessments of accessible soil areas at SLDS properties completed within this Fourth Five-Year Review period, as well as prior five-year review periods, incorporate analysis of external radiation exposures from soil through application of CSFs and DCFs based on infinite depth (i.e., also referred to as infinite volume). CSFs and DCFs for external radiation exposures to soil are available from ORNL (ORNL 2014) and FGR-15 (USEPA 2019a), with the latter being applicable only to DCFs, for the following depths: ground plane, 1 cm, 5 cm, 15 cm, and infinite depth (or soil volume). Infinite depth values have been applied in RESRAD calculations for SLDS properties because a contaminated zone thickness of 2 m, which has been used based on the characterized vertical extent of contamination, is typically assumed.

In order to assess potential impacts of the updated FGR-15 DCFs on the health-protectiveness of remedy verifications completed during this five-year review period, two evaluations have been conducted. First, an analysis comparing DCFPAK 3.02 (Adult) library external radiation (infinite depth) morbidity DCFs for SLDS radiological COCs (not including decay progeny) versus corresponding FGR-15 (Adult) values was performed. Given the differences noted between the two sets of DCFs, a second set of evaluations were performed. This involved recalculations of external radiation and maximum total effective doses (i.e., occurring over a 1,000-year period of evaluation) for one SLDS property included in this five-year review, as well as for one SLDS property included in past five-year reviews, using FGR-15 external radiation DCFs for infinite volume. SLDS properties associated with the highest maximum total doses were selected for recalculations of external radiation dose and maximum total dose. For this Five-Year Review period, the highest maximum total dose at SLDS (9.4 mrem per year) was estimated for resident gardener exposures to accessible soil (without ground cover/backfill) at the DT-2 (City Property) located west of the levee (WOL) and DT-11 (City of Venice) (Partial) area (USACE 2018a). Of the SLDS properties with verifications completed prior to this Fourth Five-Year Review Report for which no further removal actions have been conducted, the most elevated maximum total dose (6.2 mrem per year) was estimated for resident gardener exposures to accessible soil at DT-10 (Thomas and Proetz Lumber Company) (USACE 2010c). Verification of remedial actions at DT-10 were completed and documented within the Third Five-Year Review Report (USACE 2015a).

The details of the aforementioned external radiation DCF evaluations are discussed in Appendix D. The results of both evaluations (i.e., comparisons of external radiation DCFs and dose recalculations) demonstrate that the remedy being applied at SLDS remains health-protective.

USEPA has not issued new FGRs pertaining to publication of updated radiological CSFs. Because no changes or updates to radiological CSFs have occurred since the third Five-Year Review, no further review is needed.

2.9.2.3.2 Changes in Toxicity Criteria for Metal COCs

The following USEPA hierarchy of sources of chemical toxicity data (USEPA 2003) have been reviewed for updates relative to the SLDS metal COCs:

- Tier 1 Source – Integrated Risk Information System (USEPA 2019b)
- Tier 2 Source – USEPA Provisional Peer-Reviewed Toxicity Values
- Tier 3 Sources – Other peer-reviewed federal and state toxicity values, as cited in the USEPA's online Regional Screening Levels (RSL) tables (USEPA 2019c) and the ORNL's online Risk Assessment Information System (ORNL 2019)
    - Agency for Toxic Substances and Disease Registry
    - California EPA (CalEPA) toxicity database (CalEPA 2019)

Because no changes or updates to carcinogenic and noncarcinogenic toxicity criteria used to evaluate SLDS metal COCs have occurred since the Third Five-Year Review, no further review is needed.

2.9.3 QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No.

Other than remedial activities having been conducted, no natural or manmade changes to the physical or biological characteristics of SLDS have occurred that would impact current or expected land use patterns, or that would change human or ecological exposure conditions. Therefore, no new information has come to light that could call into question the protectiveness of the remedy at SLDS.

On June 17, 2019, SLDS ground-water monitoring well DW14 was observed to be discharging ground water on to the ground surface. DW14 is a 2-inch polyvinyl chloride (PVC) flush mount well with a total depth of 40.0 feet. This well has a screening interval from 26.6 feet to 36.6 feet in the lower HU, referred to as HU-B or the Mississippi Alluvial Aquifer. This aquifer is hydraulically connected to the Mississippi River, which was experiencing major flood conditions at the time (approximately 42 feet gage height on June 17, 2019). Therefore, the ground water discharging at DW14 was attributed to the major flood conditions of the Mississippi River. Due to the short duration of the flooding event and addition of a temporary riser to the well, the conditions did not have an impact on the protectiveness of the remedy.

2.9.4 Technical Assessment Summary

During this Fourth Five-Year Review period, remedial and/or FSS actions have been completed (including verification documentation) at the following nine SLDS properties in accordance with the SLDS ROD:

- DT-31,
- DT-2/DT-11 (Partial),
- Plant 6EH Building 101 Area,
- Kiesel Hall Street Properties,
- Kiesel Riverfront Property,
- Destrehan Street West,
- Mallinckrodt Plant 1 Former Building 17 Area,
- Plant 7N, and
- Plant 7S.

These have resulted in the removal and offsite disposal of 41,650 in situ yd^3 of soil exceeding SLDS ROD RGs. The FSSEs performed verify that the accessible soil areas of these properties meet RGs and health protection requirements that are consistent with current and expected future land use of SLDS, as established by the SLDS ROD. In response to Question A, based upon a review of the applicable verification documentation and the results of the site inspections, it has been determined that the actions taken to date have been implemented as intended by the SLDS ROD.

In addition to the FSSEs, risk and dose assessments were conducted; these assessments incorporated the latest and best data and information available relative to physical and contaminant site characteristics, ARARs, risk and dose assessment methodology, exposure pathways and assumptions, and radiological and chemical toxicity characteristics.

Since completion of the Third Five-Year Review Report, there has been an update to the RESRAD model version (i.e., RESRAD Version 7.0 update to RESRAD-ONSITE Version 7.2 on July 20, 2016). This update has been identified and is evaluated as part of this Fourth Five-Year Review Report relative to potential impacts on remedy health protection. No changes or updates have occurred relative to standards and TBCs, exposure pathways, exposure assumptions, radiological CSFs, or chemical toxicity criteria. Based on the responses to Question B and the health-protectiveness evaluations pertaining to each of the identified changes/updates/issue, the remedy remains health-protective.

Finally, other than remedial activities having been conducted, no natural or manmade changes to the physical or biological characteristics of SLDS have occurred that would impact current or expected land use patterns, or that would change human or ecological exposure conditions.

Therefore, in response to Question C, no new information has come to light that could call into question the protectiveness of the remedy at SLDS.

2.10 ISSUES

No issues affecting the protectiveness of the remedy have been identified for SLDS.

2.11 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 19. Recommendations and Follow-up Actions

Observation	Recommendations/Follow-up Actions	Party Responsible	Affects Protectiveness? (Y/N)	
			Current	Future
Concentrations of Arsenic and Total U have exceeded the IL.	Continue to monitor HU-B to monitor the effectiveness of the source removal action and to help ensure that the SLDS ROD RAOs are achieved. Complete the remediation of potential sources beneath the Building 101 area in Plant 6WH to address areas of soil contamination at formerly inaccessible and continuing source areas.	USACE	N	N

2.12 PROTECTIVENESS STATEMENT

The remedy at SLDS is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.

2.13 NEXT FIVE-YEAR REVIEW

The next five-year review is scheduled for completion no later than 5 years from the signature date of this report (anticipated to be August 2025).

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3.0 NORTH ST. LOUIS COUNTY SITES

3.1 INTRODUCTION

The North St. Louis County Sites comprise an NPL site that includes the St. Louis Airport Site (SLAPS), SLAPS VPs, Hazelwood Interim Storage Site (HISS), Futura Coatings Company (Futura) and the Latty Avenue VPs. SLAPS, HISS, and Futura were placed on the NPL in 1989 (CERCLIS Identification Number MOD980633167). The methods, findings, and conclusions of the CERCLA five-year review for the North St. Louis County Sites are documented in this section of the report. In addition, this section identifies issues found during the review and recommendations to address them.

3.2 SITE CHRONOLOGY

A summary of the chronology of events for the North St. Louis County Sites is presented in Table 20. The shaded events are applicable to this five-year review period.

Table 20. Chronology of Events for the North St. Louis County Sites

SLS Events	Date
FUSRAP created.	March 1974
DOE submitted the SLS RI Report (DOE 1994)	1994
DOE submitted the SLS RI Addendum (DOE 1995a)	September 1995
The U.S. Congress transferred responsibility for administration and execution of cleanup at eligible FUSRAP areas from DOE to USACE.	October 13, 1997
First Five-Year Review Report for SLS was signed (USACE 2004a).	September 28, 2004
Second Five-Year Review Report for SLS was signed (USACE 2010a).	September 28, 2010
USACE issued the CIP (USACE 2015b)	May 2015
Third Five-Year Review Report for SLS was signed (USACE 2015a)	August 17, 2015
North St. Louis County Site Events	**Date**
St. Louis Airport Site (SLAPS): Acquired by MED/AEC to store uranium-bearing residues and scrap from SLDS	1946
Continental Mining and Milling Company of Chicago, Illinois, purchased and began moving wastes from SLAPS to the Hazelwood Interim Storage Site (HISS)	1966
HISS: Used to store radioactive material purchased from the AEC prior to shipment to Colorado	1966 – 1973
SLAPS: Ownership transferred from MED/AEC to St. Louis Airport Authority	1973
HISS: Radiological surveys conducted by the U.S. Nuclear Regulatory Commission (NRC) indicated the presence of residual uranium and thorium concentrations in the soil above guidelines for unrestricted use of land areas	1976
SLAPS: DOE performed a radiological survey and found elevated radionuclide levels onsite and north of the site in ditches north and south of James S McDonnell Boulevard (McDonnell Boulevard)	1976 and 1978
HISS: Contaminated soil from the adjacent Futura Coatings Company (Futura) parcel stockpiled on HISS in support of construction of a manufacturing facility	1979
HISS: DOE performed response actions, including clearing, excavating, and stockpiling contaminated soil from excavation of the property at 9200 Latty Avenue (Futura)	1984
HISS: Supplemental pile is created as the result of DOE radiological monitoring support of Latty Avenue drainage and street improvements	1986
NPL: USEPA placed SLAPS, HISS, and Futura on the NPL	October 4, 1989
DOE issued *Engineering Evaluation/Cost Analysis – Environmental Assessment for the Proposed Decontamination of Properties in the Vicinity of the Hazelwood Interim Storage Site, Hazelwood, Missouri*, Revision 1 (HISS EA EE/CA) (DOE 1992)	March 1992
DOE issued *St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA),* Final (SLAPS Interim Action EE/CA) (DOE 1997a)	September 1997

Table 20. Chronology of Events for the North St. Louis County Sites (Continued)

North St. Louis County Sites Events (Continued)	Date
Removal action at SLAPS: West End – excavation and removal of contaminated soil east of Coldwater Creek (CWC) bank gabion wall on SLAPS pursuant to the SLAPS Interim Action EE/CA	1997
USACE issued *Engineering Evaluation/Cost Analysis (EE/CA) for the Hazelwood Interim Storage Site (HISS),* Final (HISS EE/CA) (USACE 1998c)	October 1998
SLAPS VP: VP-56 removal action completed	1998
SLAPS: Construction of a loadout facility and a 1,200-ft rail spur	1998
SLAPS VPs: St. Denis Street Bridge replacement support, Florissant, Missouri	1998
SLAPS: North Ditch Removal Action and Sedimentation Basin Installation	1998 – 1999
Latty Avenue Properties: Rail spur constructed at HISS	1998 – 1999
USACE issued *Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum*, Final (SLAPS EE/CA and Action Memorandum) (USACE 1999b)	March 1999
SLAPS: East End, East End Extension and ROW Work Areas – removal action initiated and completed	1999 – 2001
SLAPS VPs: Removal action conducted in the North Ditch area between McDonnell Boulevard and the former Ballfield area	1999
SLAPS: East End and ROW Work Areas – removal action initiated and completed	1999 – 2001
SLAPS: *Site Wide Removal Action Work Plan, FUSRAP St. Louis Airport Site, St. Louis, Missouri,* Revision 0 Addendum 1 (Stone & Webster 2000), issued	March 2000
SLAPS: Radium Pits Work Area removal action initiated and completed	2000
SLAPS VP: VP-38 removal action initiated and partially completed	2000
Latty Avenue Properties: HISS and Futura stockpiled material removed and shipped out of state to disposal facilities	2000 – 2001
Latty Avenue Properties: VP-02(L) Building Roof remediation initiated and completed	2001 - 2002
SLAPS VP: VP-24 removal action initiated and completed	May 2002
SLAPS: Phase 1 Work Area – removal action initiated and completed	2001 – 2003
SLAPS: Phases 2 and 3 Work Area – removal action initiated and completed	2002 – 2005
Feasibility Study for the St. Louis North County Site (NC FS) (USACE 2003b) and *Proposed Plan for the St. Louis North County Site* (NC PP) (USACE 2003c) issued	May 2003
SLAPS: Phase 5 Work Area removal action initiated and completed	2003 – 2005
SLAPS VP: VP-10 removal action conducted	October – November 2003
SLAPS: Phase 6 (EE/CA) Work Area removal action initiated and completed	2004 – 2005
SLAPS: Phase 4 Work Area removal action initiated and completed	2004
SLAPS VP: VP-13 removal action conducted	June – July 2004
SLAPS VPs: VP-04(C) and VP-05(C) removal action conducted	2004
NC ROD (USACE 2005a) signed by the Commander of the Mississippi Valley Division, USACE; and by the Director of the Superfund Division, USEPA Region 7	August 3 and September 2, 2005
SLAPS removal action (EE/CA) completed	September 2005
SLAPS: Phase 6 (NC ROD) Work Area remedial action initiated and completed	2005 – 2007
Latty Avenue Properties: VP-01(L) and Parcel 10K530087 remedial action initiated and completed, with the exception of the interior of buildings at VP-01(L)	2007 – 2008
Latty Avenue Properties: VP-40A East remedial action initiated and partially completed	2007 – 2011
SLAPS VP: VP-08(C) remedial action initiated and completed	June – October 2007
SLAPS VP: IA-12 remedial action initiated and completed	2007 – 2008
Latty Avenue Properties: HISS/Futura remedial action initiated and completed	2008 – 2013
SLAPS VP: IA-13 remedial action initiated and completed	June – September 2008
Latty Avenue Properties: VP-04(L) and VP-05(L) remedial action initiated and completed	February – March 2008
SLAPS VPs: VP-08 and VP-09 remedial action initiated and completed	June 2008
SLAPS VP: VP-38 remedial action initiated and partially completed	February 2009

Table 20. Chronology of Events for the North St. Louis County Sites (Continued)

North St. Louis County Sites Events (Continued)	Date
Hazelwood Avenue, Hazelwood Avenue ROW, and SLAPS VPs along Hazelwood Avenue (VPs 32, 35, 35A, 36, 39, 40, 42, and 47): remedial action initiated and completed	2009 – 2010
Latty Avenue Properties: VP-02(L) remedial action initiated and completed	2009 – 2011
SLAPS VP: VP-54 remedial action initiated and completed	March – June 2010
SLAPS VP: VP-63 remedial action initiated and completed	March – June 2010
SLAPS VP: VP-55 remedial action initiated and completed	April – July 2010
SLAPS VP: VP-53 remedial action initiated and completed	April – August 2010
SLAPS VPs: VP-05 and VP-06 remedial action initiated and completed	May – August 2010
SLAPS VP: VP-12 remedial action initiated and completed	2010 – 2011
SLAPS VP: McDonnell Boulevard East Section (b) ROW remedial action initiated and completed	2010 – 2011
SLAPS VP: VP-31A remedial action initiated and completed	February – May 2011
SLAPS VP: Ballfields VP (IA-09): Phase I remedial action initiated and completed	2011 – 2012
SLAPS VP: Ballfields VP (IA-09): Phase 2 and Phase 2B (partial) remedial action initiated and completed	2012 – 2013
SLAPS VP: VP-16 remedial action initiated and completed	2013
Latty Avenue Properties: VP-01(L) interior of buildings remedial action initiated and completed	March – August 2013
SLAPS VP: Banshee Road remedial action initiated and completed	September – October 2013
SLAPS VP: VP-57 and VP-58 remedial action initiated and completed	2014-2015
SLAPS VP: Pershall Road (South Ditch) remedial action initiated and completed	2014-2015
Current *FUSRAP Remedial Design/Remedial Action Work Plan for the FUSRAP North St. Louis County Sites,* Revision 0 (USACE 2015f)	March 2015
Latty Avenue VPs: VP-04(L) additional remedial action initiated and completed.	April 2015
SLAPS VP: St. Cin Park (CWC-56) remedial action initiated and completed	2015-2016
SLAPS VP: Duchesne Park (CWC-93 [Partial], CWC-95 [Partial] and CWC-97 [Partial]) remedial action initiated and completed	2016-2017
SLAPS VP: Palm Drive and Chez Paree Properties (CWC-83 through CWC-92 and Chez Vant Court) remedial action initiated and completed	2017-2019
SLAPS VP: Eva Avenue remedial action initiated and ongoing	October 2018-present
SLAPS VP: Ballfields VP (IA-09): Phase 2B remedial action initiated and ongoing	November 2018 – present

Note:
Shaded properties are those for which remedial actions were conducted during this five-year review period (January 2014 through December 2018).

3.3 BACKGROUND

The North St. Louis County Sites are located in St. Louis County, Missouri, throughout an area immediately north of St. Louis Lambert International Airport and approximately 11 miles northwest of SLDS. The general location of the North St. Louis County Sites is shown on Figure 10. The North St. Louis County Sites are composed of the following properties:

- the Latty Avenue Properties, which include the HISS, Futura, and ten VPs;
- SLAPS; and
- SLAPS VPs, consisting of the properties between SLAPS, HISS, Coldwater Creek (CWC), and the properties along CWC.

These properties are located within the City of Hazelwood and the City of Berkeley, and include the airport property owned by the City of St. Louis. The SLAPS VPs consist of the properties between SLAPS and HISS, along CWC, and the open fields immediately north of SLAPS (the former Ballfields area). The Latty Avenue Properties include HISS, Futura, and the Latty Avenue VPs 01(L) through 06(L) and 40A (partial), Parcels 10K530087, 10K530076 and 10K530065. The individual VPs are shown on Figures 10 and 11 and are listed in Tables 21, 22, and 23. The VPs are listed according to their associated USACE property designation number (e.g., VP-24).

Table 21. North St. Louis County Site Properties – SLAPS VPs

Site Location	VP Number	County Locator Number and Address
SLAPS VPs	01	10L220921 and 10L220912 5800 and 5862 N. Lindbergh Boulevard Hazelwood, Missouri
SLAPS VPs	02	10L240143, 10L240152, 10L330150, 10L240161, and 10L330161 5896 N. Lindbergh Boulevard and 280, 150, 158, and 140 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	03	10L330123 5900 N. Lindbergh Boulevard Hazelwood, Missouri
SLAPS VPs	04 and 05	10L330114 183 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	06	10L330040 163 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	07	10L330031 153 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	N/A	11L630022
SLAPS VPs	08	10L330022 143 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	09	10L330073 141 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	10 and 11	10L340151 133 McDonnell Boulevard Hazelwood, Missouri 63042
SLAPS VPs	12	10L340142 123 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	13 and IA-11	10L310031 5290 Banshee Road and 142 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	N/A	St. Louis Lambert International Airport Wells
SLAPS VPs	N/A	St. Louis Lambert International Airport, NE Corner of Airport Airfield
SLAPS VPs	N/A (St. Louis Co. Department of Highways and Traffic)	McDonnell Boulevard from Lindbergh to ~2,500 ft (~762 m) south of Banshee
SLAPS VPs	N/A	Railway ROW in and around SLAPS, the Latty Avenue Properties, SLAPS VPs, and County Parcel ID No. 10K520143

Table 21. North St. Louis County Site Properties – SLAPS VPs (Continued)

Site Location	VP Number	County Locator Number and Address
SLAPS VPs	14	11K510035 6367 McDonnell Boulevard Berkeley, Missouri 63042
SLAPS VPs	15	11K520056 8905 Airport Road Berkeley, Missouri 63134
SLAPS VPs	IA-09 (Ballfields) and IA-10	10K110021 and 10K130014 McDonnell Boulevard and Eva Avenue Berkeley, Missouri 63134
SLAPS VPs	16	10K210064 6685 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	17	10K210053 6709 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	18	10K230051 6745 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	19	10K230031 9080 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	20A	No parcel number 9060 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	20	10K230040 9040 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	21	10K230073 9043 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	22	10K240106 9015 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	23	10K240094 8921 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	24	10K330360, 10K240225, and 10K240216 8801, 8875, and 8893 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	25	10K210031 and 10K220195 8900 and 9060 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	26	10K240207 and 10K220184 8870 Frost Avenue and 6745 Romiss Court Berkeley, Missouri 63134
SLAPS VPs	27	10K330030 8854 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	28	10K330351 8838 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	29	10K330223 8822 Frost Avenue Berkeley, Missouri 63134

Table 21. North St. Louis County Site Properties – SLAPS VPs (Continued)

Site Location	VP Number	County Locator Number and Address
SLAPS VPs	30	10K330232 8810 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	31 (MoDOT)	Locator Number not available. SE Corner Jonas Place and Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	31A	10K330342 and 10K330250 6822 and 6824 Hazelwood Avenue Berkeley, Missouri 63134
SLAPS VPs	32	10K330241 8801 Seeger Ind. Drive Berkeley, Missouri 63134
SLAPS VPs	33	10K330333 6826 Hazelwood Avenue Berkeley, Missouri 63134
SLAPS VPs	34	10K330324 6830 Hazelwood Avenue Berkeley, Missouri 63134
SLAPS VPs	35 and 35A	10K610178 6850 Hazelwood Avenue Berkeley, Missouri 63134
SLAPS VPs	36	10K520198 and 10K520202 6821 Hazelwood Avenue Berkeley, Missouri 63134
SLAPS VPs	37	10K520066 6891 Hazelwood Avenue Berkeley, Missouri 63134
SLAPS VPs	38	10K540097 7101 Hazelwood Avenue Berkeley, Missouri 63042
SLAPS VPs	39	10K630363 7100 Hazelwood Avenue Berkeley, Missouri 63042
SLAPS VPs	40	09K220140 7275 Hazelwood Avenue Hazelwood, Missouri 63042
SLAPS VPs	41	10K540031 8827 Nyflot Avenue St. Louis, Missouri 63140
SLAPS VPs	42	09K220041 7301 Hazelwood Avenue Hazelwood, MO 63042
SLAPS VPs	43	10K540075 8834 Heather Lane, Suite A Hazelwood, Missouri 63042
SLAPS VPs	44	09K220030 8841 Heather Lane Hazelwood, Missouri 63042
SLAPS VPs	45	09K220216 (part of) 8864 Hazelwood Tech Court Hazelwood, Missouri 63042
SLAPS VPs	46	09K220074 7314 Hazelwood Avenue Hazelwood, Missouri 63042

Table 21. North St. Louis County Site Properties – SLAPS VPs (Continued)

Site Location	VP Number	County Locator Number and Address
SLAPS VPs	47	09K220085 7351 Hazelwood Avenue Hazelwood, Missouri 63042
SLAPS VPs	48 and 48A	09K220315 and 09K220326 7320 and 7328 Hazelwood Avenue Hazelwood, Missouri 63042
SLAPS VPs	49	09K310207 (part of) 8800 Hazelwood Tech Court Hazelwood, Missouri 63042
SLAPS VPs	50 and 51	09K310197 8784 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	52	09K324497 and 09K3244868780 8700 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	53	09K220162 8830 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	54	09K220205 8840 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	55	09K210217 and 09K210228 8900 and 8880 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	56	09K210239, 09K230161, 09K230172, and 09K230183 8950, 8970, 8940, and 8930 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	57	09K140026 9044 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	58	09K140015 9050 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	59	09K110304 9124 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	N/A (MoDOT)	Location number not available. Pershall Road from east of Lindbergh Boulevard to just west of Hazelwood Avenue
SLAPS VPs	60 and 61	09K130115 9144 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	62	09K130038 9150 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	63	10K430053, 10K420043, and 10K420054 6250, 6252, and 6248 N. Lindbergh Boulevard Hazelwood, Missouri 63042
SLAPS VPs	VP Number not assigned (City of Florissant)	County Bridge No. 14650211

Note:

In addition to the properties listed in this table, additional properties for which VP numbers were not assigned (i.e., parcels associated with Ford Lane, Seeger Industrial Drive, Polson Lane, Romiss Court, Jonas Place, Heather Lane, Interstate (I)-170 ROW, and Byassee Drive) are included in the SLAPS VPs.

Table 22. North St. Louis County Site Properties – SLAPS VPs: CWC

Site Location	VP Number	County Locator Number and Address
CWC	01(C)	09K210064 8950 Pershall Road Hazelwood, Missouri 63042
CWC	02(C)	N/A (Norfolk Southern Railroad)
CWC	03(C)	09K120040 7225 Polson Lane Hazelwood, MO 63042
CWC	04(C)	09K120127 95 Ford Lane Hazelwood, MO 63042
CWC	05(C)	09K120116 93 Ford Lane Hazelwood, MO 63042
CWC	06(C)	10K440113 and 10K440104 7203 and 7201 Polson Lane Hazelwood, MO 63042
CWC	07(C)	10K440096 7207 Polson Lane Hazelwood, MO 63042
CWC	08(C)	10K440074 7213 Polson Lane Hazelwood, MO 63042
CWC	09(C) and 10(C)	10K420032 105 Byassee Drive Hazelwood, MO 63042
CWC	VP Number Not Assigned[1]	07J520900

[1] CWC property numbers are assigned as the PDIs advance down CWC toward the Missouri River. As properties are cleared or remediated, they will be included in future reviews.

Table 23. North St. Louis County Site Properties – Latty Avenue Properties

Site Location	VP Number	County Locator Number and Address
Latty Avenue VP	01(L)	10K530098 9151 Latty Avenue Berkeley, Missouri 63134
Latty Avenue VP	Parcel 10K530065	10K530065 9205 Latty Avenue Berkeley, Missouri 63134
Latty Avenue VP	Parcel 10K530076	10K530076 9205 Latty Avenue Berkeley, Missouri 63134
Latty Avenue VP	Parcel 10K530087	10K530087 9205 Latty Avenue Berkeley, Missouri 63134
Latty Avenue VP	02(L)	10K510012 9150 Latty Avenue Hazelwood, Missouri 63134
Latty Avenue VP	03(L)	10K520022 9060 Latty Avenue Berkeley, Missouri 63134
Latty Avenue VP	04(L)	10K520220 8966 Latty Avenue Berkeley, Missouri 63134
Latty Avenue VP	05(L)	10K520211 8942 Latty Avenue Berkeley, Missouri 63134

Table 23. North St. Louis County Site Properties – Latty Avenue Properties (Continued)

Site Location	VP Number	County Locator Number and Address
Latty Avenue VP	06(L)	10K510067 8999 Seeger Ind. Drive Berkeley, Missouri 63134
Latty Avenue VP	40A (Partial)	10L340041
HISS/Futura	Futura	10K510023 9200 Latty Avenue Berkeley, Missouri 63134
HISS/Futura	HISS	10K510090 9170 Latty Avenue Berkeley, Missouri 63134

3.3.1 Physical Characteristics

SLAPS covers 89,031 m^2 (22 acres) bounded by James S McDonnell Boulevard (McDonnell Boulevard) to the north, CWC to the west, and Norfolk Southern Railroad tracks to the south. A 1,000-ft-long railroad spur, constructed in 1998, parallels and connects to these tracks. The local topography of SLAPS is relatively flat. Surface drainage from SLAPS is directed through four drainage ditches that ultimately discharge to CWC. The local terrain of the remainder of the North St. Louis County Sites (i.e., Latty Avenue Properties and the SLAPS VPs) is generally flat with surface runoff toward CWC, either directly or via intermittent tributaries.

3.3.2 Land and Resource Use

SLAPS

The response actions are completed at The SLAPS. Soil exceeding the NC ROD RGs has been removed and the excavations backfilled and covered. Currently, some temporary buildings and other structures, including office space, a laboratory, a railspur, and loadout pad, are located at the SLAPS to facilitate remedial activities at other properties at the North St. Louis County Sites. The SLAPS loadout facility will be removed when it is no longer needed to support North St. Louis County remedial activities. Once removed, the area underneath will undergo verification to confirm that the area still meets RGs. No permanent structures are located at the SLAPS.

SLAPS VPs

The SLAPS VPs consist of more than 146 properties between the SLAPS and the HISS, as well as railroad lines, the open field area immediately north of the SLAPS (the former Ballfields area), and CWC. The NC ROD originally identified 78 named properties, but there are additional unnamed properties within the NC ROD boundary that are considered un-impacted. The former Ballfields area is covered with grass and is not used, except for one portion occupied by the City of Berkeley Shooting Range and Mulch Storage Area.

Latty Avenue Properties

The Latty Avenue Properties consist of commercial, industrial, and warehouse facilities, and buildings with adjoining paved and turfed areas. The most notable of these are the HISS and Futura properties. Stockpiled material was removed from HISS and shipped to an out-of-state disposal facility during the initial five-year review period. The Futura portion of the site consists of a manufacturing facility, consisting of four buildings, surrounded by paved and turfed areas. The parcel is surrounded by a fence and is bounded on the west by railroad tracks.

Coldwater Creek

Coldwater Creek is classified as a Class C waterway (periodic no-flow conditions) designated for livestock and aquatic life use, from Lindbergh Boulevard to the Missouri River. The portion of

CWC from Banshee Road to the Missouri River is designated as a SLAPS VP in the NC ROD. In addition to CWC itself, the USACE is addressing adjacent properties within the 10-year floodplain, because the same mechanism for contamination to have reached CWC and been deposited within its banks could also have resulted in such deposition outside the banks, especially at low-lying areas within the 10-year floodplain. Because the NC ROD remedy is based on the suburban resident scenario, the NC ROD remedy is applicable to the 10-year floodplain.

3.3.3 History of Contamination

In 1946, the MED/AEC acquired the 89,031-m^2 (22-acre) tract of land now known as SLAPS to store residues and scrap resulting from uranium processing at SLDS. Several wastes and by-products, including radium-bearing residues, raffinate cake, barium sulfate cake, and C-liner slag, were transported to SLAPS for storage. The MED/AEC ultimately obtained the title to SLAPS by condemnation proceedings on January 3, 1947. By 1960, approximately 50,000 empty drums and 3,500 tons of contaminated steel and alloy scrap were stored at SLAPS.

Continental Mining and Milling Company of Chicago purchased uranium-bearing residues from MED and removed them from SLAPS in 1966. The company placed the residues in storage at a property on Latty Avenue (now known as HISS and Futura) under an AEC license. In January 1967, the Commercial Discount Corporation of Chicago, Illinois, purchased the residues. Much of the material was dried and shipped to Canon City, Colorado. The material remaining at the Latty Avenue storage site was sold to Cotter Corporation in December 1969. From August through November 1970, Cotter Corporation dried some of the remaining residues and shipped them to its mill in Canon City. Over time, soils and sediments at the VPs were contaminated by residues originating from residue hauling activities or from water and wind erosion from other sites.

In 1979, the owner of the Futura property excavated approximately 13,000 yd^3 of soil and debris from the western portion of the property prior to constructing a manufacturing facility. This excavated material was placed at the eastern end of HISS in a storage pile, subsequently referred to as the Main Pile.

With regard to the Latty Avenue Properties, DOE supported construction activities at Futura in 1984. These activities resulted in the generation of approximately 14,000 yd^3 of contaminated soil that was added to the Main Pile at HISS. In 1986, DOE provided radiological support to the cities of Hazelwood and Berkeley for a drainage and road improvement project along Latty Avenue. This project generated another approximately 4,600 yd^3 of contaminated material that was placed in a storage pile at HISS. This storage pile later became known as the Supplemental Pile.

In 1996, General Investment Funds Real Estate Holding Company (GIFREHC), in consultation with DOE, made commercial parking and drainage improvements on the property, resulted in the creation of two contaminated soil piles on VP-02(L). These piles were known as East Piles 1 and 2. A high-density polyethylene liner was placed over the material in both piles, followed by "clean" soil and a vegetative cover. In addition, two small piles, referred to as Spoil Piles A and B (contaminated soil and debris), were generated during construction of the railroad spur on HISS in early 1999. Spoil Piles A and B were covered with synthetic liners.

The original sources of contamination for CWC and the adjacent properties were the storage of materials at SLAPS, the stockpiling and processing of materials at HISS and Futura, and the transport of the material by truck from SLAPS to HISS and Futura. Therefore, unnamed properties adjacent to the haul roads were included for investigation to verify they were not impacted

Low levels of contamination have been found in the creek sediment, banks and adjacent properties including residential, recreational and commercial areas north of Dunn Road adjacent to CWC.

The USACE started sampling CWC and adjacent properties north of Dunn Road within the 10-year floodplain. Sampling revealed contamination in the creek corridor and adjacent properties. The adjacent properties are sampled within the 10-year floodplain of CWC. Sampling will proceed beyond the 10-year floodplain when necessary if contamination is found beyond this area. Contamination to date has been found in two parks and six residential areas. The USACE completed remedial activities in the parks and residential properties.

3.3.4 Initial Response

Several removal actions were performed by DOE and USACE at the North St. Louis County Sites prior to the signing of the NC ROD in September 2005. At SLAPS, the first removal action was conducted by DOE in the spring of 1985. To mitigate gully erosion that had occurred in the western portion of SLAPS along the bank of CWC, a gabion retaining wall was constructed along the bank.

USACE conducted a second removal action at SLAPS in the fall of 1997 to address contamination in an area immediately east of the gabion wall. Approximately 5,100 in situ yd^3 of contaminated material were removed under this action and transported offsite pursuant to the *St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA)* (SLAPS Interim Action EE/CA) (DOE 1997a) and the *SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material* (DOE 1997b).

Removal actions have also been conducted at several of the SLAPS VPs and Latty Avenue Properties pursuant to the *Engineering Evaluation/Cost Analysis – Environmental Assessment for the Proposed Decontamination of Properties in the Vicinity of the Hazelwood Interim Storage Site, Hazelwood, Missouri* (HISS EA EE/CA) (DOE 1992), and the *St. Louis Site – Action Memorandum for Vicinity Property Cleanups* (DOE 1995b).

3.3.5 Basis for Taking Action

Characterization activities at the North St. Louis County Sites have been used to determine that contamination related to MED/AEC activities is present in the surface and subsurface soil and requires remedial action.

Radiological and metals contamination related to MED/AEC activities is present in environmental media at the site. USACE determined, based on the results of the baseline risk assessment, that the contamination poses a current or potential threat to human health and the environment at the North St. Louis County Sites. Affected media at the North St. Louis County Sites are soil, sediment, shallow ground water, surface water, and soils adhered to the surface(s) of buildings and structures. Exposure pathways include dermal contact (non-radionuclides only), direct gamma (radionuclides only), soil/sediment ingestion, and dust inhalation. Ground water is not considered a complete exposure pathway, because the potentially usable ground-water unit (deep ground water in the Mississippian Limestone aquifer designated as hydrostratigraphic zone [HZ]-E) is not contaminated. The shallow ground water is not potable and there are St. Louis County well restrictions that prevent digging a drinking water well in the shallow aquifer. Drinking water in the St. Louis area is obtained from surface water (i.e. Mississippi, Meramec, and Missouri Rivers).

3.4 REMEDIAL ACTIONS

The remedial action for the North St. Louis County Sites presented in the NC ROD (USACE 2005a) will be protective of human health and the environment upon attainment of the cleanup goals; will meet ARARs; and was developed to provide the best balance of effectiveness, cost, and implementability.

3.4.1 Remedy Selection

3.4.1.1 Remedial Action Objectives

The RAOs for the North St. Louis County Sites, as set forth in the NC ROD (USACE 2005a), are to:

1. Prevent exposure to contaminated soil at concentrations which exceed chemical-specific ARARs or which result in an excess lifetime CR greater than the acceptable risk range (greater than one in ten thousand) or which result in a HI greater than 1. The potential exposure pathways are direct contact, ingestion, inhalation of dust, and external gamma.
2. Prevent exposure to contaminated structural surfaces at concentrations which result in an excess lifetime CR greater than the acceptable risk range. Buildings and structures are contaminated primarily as a result of contaminated soils adhering to or becoming embedded in surfaces. The potential exposure pathways are external gamma, ingestion, and inhalation.
3. Prevent exposure to contaminated sediments in CWC at concentrations which result in an excess lifetime CR greater than the acceptable risk range. The potential exposure pathways are direct contact, ingestion, and external gamma.
4. Remove the potential for ongoing migration of soil contaminants to the shallow ground-water system and CWC. Accomplishing this objective would also preclude the potential for future impacts to the deep ground-water systems (HZ-C, HZ-D, and the usable ground-water resource HZ-E).

The RGs for the radiological and non-radiological COCs at the North St. Louis County Sites, as set forth in the NC ROD (USACE 2005a), are presented in Table 24. The principal COCs are radionuclides associated with the residues from MED/AEC processes. Further discussion of the RGs for the radiological COCs is provided in this section.

Table 24. Remediation Goals for the North St. Louis County Sites

Media	SLAPS (Includes IA-01 to IA-07)		Latty Avenue Properties		SLAPS VPs (excluding CWC below mean water gradient)		CWC (below mean water gradient)	
	COC	RG	COC	RG	COC	RG	COC	RG
Surface Soil (less than or equal to 6 inches)	***Non-Radiological (mg/kg)***							
	Antimony	15	Antimony*	15	Antimony**	15	NA	
	Arsenic	36	Arsenic*	36	Arsenic**	36		
	Barium	2,800	Barium*	2,800	Barium**	2,800		
	Cadmium	12	Cadmium*	12	Cadmium**	12		
	Chromium	350	Molybdenum*	1,000	Chromium**	350		
	Molybdenum	1,000	Nickel*	1,500	Molybdenum**	1,000		
	Nickel	1,500	Selenium*	300	Nickel**	1,500		
	Selenium	300	Thallium*	25	Selenium**	300		
	Thallium	25	Vanadium*	112	Thallium**	25		
	Uranium	150			Uranium**	150		
	Vanadium	112			Vanadium**	112		
	Radiological (pCi/g)							
	Ra-226[a]	5	Ra-226[a]	5	Ra-226[a]	5	NA	
	Th-230[b]	14	Th-230[b]	14	Th-230[b]	14		
	U-238[c]	50	U-238[c]	50	U-238[c]	50		

Table 24. Remediation Goals for the North St. Louis County Sites (Continued)

Media	SLAPS (Includes IA-01 to IA-07)		Latty Avenue Properties		SLAPS VPs (excluding CWC below mean water gradient)		CWC (below mean water gradient)	
	COC	RG	COC	RG	COC	RG	COC	RG
Subsurface Soil (greater than 6 inches)	*Non-Radiological (mg/kg)*							
	Antimony	25	Antimony*	25	Antimony**	25	NA	
	Arsenic	40	Arsenic*	40	Arsenic**	40		
	Thallium	30	Thallium*	30	Thallium**	30		
	Uranium	150			Uranium**	150		
	Radiological (pCi/g)							
	Ra-226[a]	15	Ra-226[a]	15	Ra-226[a]	15	NA	
	Th-230[b]	15	Th-230[b]	15	Th-230[b]	15		
	U-238[c]	50	U-238[c]	50	U-238[c]	50		
Soil on Structures (e.g., Buildings)	*Radiological (dpm/100 cm²)*							
	Ac-227	400	Ac-227	400	Ac-227	400	NA	
	Pa-231	1,400	Pa-231	1,400	Pa-231	1,400		
	Ra-226	15,000	Ra-226	15,000	Ra-226	15,000		
	Ra-228	7,700	Ra-228	7,700	Ra-228	7,700		
	Th-228	4,400	Th-228	4,400	Th-228	4,400		
	Th-230	6,900	Th-230	6,900	Th-230	6,900		
	Th-232	1,300	Th-232	1,300	Th-232	1,300		
	U-234	17,000	U-234	17,000	U-234	17,000		
	U-235	16,000	U-235	16,000	U-235	16,000		
	U-238	19,000	U-238	19,000	U-238	19,000		
Sediment	*Radiological (pCi/g)*							
	NA		NA		NA		Ra-226[a]	15
							Th-230[b]	43
							U-238[c]	150
Ground Water	None		None		None		NA	
Surface Water	NA		NA		NA		None	
Inaccessible Areas	External Gamma	20 uR/hr	External Gamma	20 uR/hr	External Gamma	20 uR/hr	External Gamma	

[a] Lead (Pb)-210 is assumed to be present in equilibrium with Ra-226.
[b] Th-232 is co-located with Th-230 and is present at relatively low concentrations. Remediation of Th-230 will effectively remove Th-232 from the soils.
[c] U-238 was used as a surrogate for Ac-227, Pa-231, U-234, and U-235.
Notes:
* Applies only to HISS, Futura, VP-02(L), and Parcel 10K530087. Does not apply to Latty Avenue VPs 01(L), 03(L), 04(L), 05(L), and 06(L).
** Applies only to IA-08 through IA-13.
NA – Not Applicable

For ground water, the NC ROD identifies two types of monitoring guidelines: (1) response-action monitoring guidelines and (2) a total-U monitoring guideline (which is used for both response-action and long-term monitoring).

Response-action monitoring is conducted to assure that the remedial action does not significantly degrade ground-water conditions. A significantly degraded ground-water condition requires all of the following:

- that soil COC concentrations have statistically increased in ground water (relative to the well's historic data and accounting for uncertainty) for more than a 12-month period. Significantly increased concentrations are defined as doubling of an individual COC concentration above the UCL_{95} of the mean (based on the historical concentration before remedial action) for a period of 12 months;
- that the degraded well is close enough to impact CWC; and
- that a significant degrading of CWC surface water is anticipated.

Long-term monitoring of ground water (HZ-A only) will be conducted for inaccessible areas where contaminants remain at levels exceeding the RGs (e.g., at the Futura buildings and McDonnell Boulevard) to assure protectiveness of the final remedy and to verify that ground-water conditions do not degrade. If ground-water monitoring indicates the presence of soil COCs at significantly increased concentrations and total U concentrations significantly exceeding 30 µg/L, and it is determined that significant degrading of CWC surface water may occur, an evaluation of potential response actions would be conducted.

Use restrictions and LUCs will be maintained until the concentrations of hazardous substances in the soil are at levels that support UUUE. The areas requiring use restrictions and LUCs are limited to the areas described as "inaccessible," meaning that the areas are located under roads, active rail lines, and other permanent structures.

USACE is responsible for implementing, maintaining, reporting on, and enforcing the institutional controls until 2 years after site closeout in accordance with USEPA guidance on closeout procedures for NPL sites. At that time, these responsibilities will be transferred to DOE as agreed to under the MOU (DOE and USACE 1999).

3.4.1.2 Remedy Components

The main components of the selected remedy, as set forth in the NC ROD (USACE 2005a), include:

- Excavate all accessible contaminated soils to RGs that support UUUE and dispose off-site at a permitted facility;
- Impose use restrictions at areas under roads, active rail lines, and other permanent structures where the residual condition is not consistent with UUUE;
- Dredge contaminated sediments from CWC to RGs that support UUUE;
- Remove contaminated soils from the surfaces of buildings and structures as necessary to achieve RGs that support UUUE, or remove the contaminated structures themselves and dispose off-site at a permitted facility;
- Monitor ground water and surface water during the soil remediation period to ensure water quality is unimpacted and identify any areas where ground water may be significantly degraded; and,
- Monitor ground water long-term in selected areas where soils contaminated in excess of the RGs are left in place or where contaminated ground water has the potential to degrade adjacent ground-water or surface-water systems.

3.4.2 Remedy Implementation

As previously noted, prior to the NC ROD signature date, response actions at the North St. Louis County Sites were conducted as removal actions under the EE/CAs and action memoranda. From October 2005 to December 2013, a CERCLA remedial action was conducted at the North St. Louis County Sites in accordance with the NC ROD. The remedial action is ongoing at the North St. Louis County Sites.

The remediation activities planned for each property are described in a RD/Remedial Action Work Plan (RAWP) and in a series of RD/RAWDs. For the North St. Louis County Sites, the RAWPs include the *Remedial Design/Remedial Action Work Plan for the FUSRAP North St. Louis County Sites (USACE 2015f)* and the *Remedial Action Work Plan Coldwater Creek Properties, FUSRAP North St. Louis County Sites*) (USACE 2014d).

A summary of the remedial activities conducted at the North St. Louis County Sites through December 2018 is presented in Table 25 (Latty Avenue Properties) and Table 26 (SLAPS and SLAPS VPs) in chronological order. Shaded properties are those for which remedial activities were conducted during this five-year review period (January 2014 through December 2018).

Table 25. Summary of Response Actions Conducted at the Latty Avenue Properties

Designation	Start	Complete	Volume Removed (in situ yd^3)
HISS Removal Action (Stockpile Removal)	November 1999	October 2001	39,485
VP-02(L)	March 2000	August 2011	15,434
VP-01(L) and Parcel 10K530087	January 2007	January 2008	11,017
VP-40A (partial)	March 2007	November 2011	29,714
HISS Remedial Action (In Situ Soil)	January 2008	October 2011	53,800
VP-04(L) and VP-05(L)	February 2008	March 2008	3
	April 2015	April 2015	3
Futura			
Futura (Soil)	January 2008	October 2011	20,950
Futura (Buildings)	April 2012	January 2013	103,560[a]
Futura (Ameren Poles)	December 2018	Ongoing	88
VPs 03(L) through 06(L)	February 2008	March 2008	3
VP-01(L) Interior of Buildings	March 2013	August 2013	83

[a] Waste materials and construction debris (including pavement, utilities, and miscellaneous debris).

Note:

Shaded properties are those for which remedial actions were conducted during this five-year review period (January 2014 through December 2018).

Table 26. Summary of Response Actions Conducted at SLAP and SLAPS VP

Designation	Start	Complete	Volume Removed (in situ yd^3)
SLAPS	September 1998	January 2007	420,538
CWC VP - St. Denis Bridge Area Utility Support	November 1998	November 1998	193[a,b]
IA-12	June 1999	July 2008	16,719
VP-38 (partial)[c]	November 1999	June 2000	4,620 (Removal Action)
	February 2009	May 2009	1,440 (Remedial Action)
VP-24 (Removal Action)	May 2002	May 2002	95
VP-04(C) and VP-05(C) (partial)[c]	March 2004	July 2004	71[b]
McDonnell Boulevard ROW Adjacent to VP-13	June 2004	July 2004	1,296
IA-09 Ballfields (Phases 1, 2, and 2B partial)	September 2005	September 2005	730[c]
VP-08(C) (partial)[c]	June 2007	October 2007	4,892 (Eastern Portion of Property)
IA-13	June 2008	September 2008	2,802
VP-08 and VP-09	June 2008	June 2008	252
Hazelwood Avenue VPs[d]	May 2009	March 2010	943
VP-63	March 2010	April 2010	70
VP-54	March 2010	April 2010	65
VP-55	April 2010	April 2010	228
VP-53	April 2010	June 2010	104
VP-05 and VP-06	May 2010	August 2010	42
VPs 10, 11, and 12	June 2010	May 2011	2,720[e]
IA-10 and CWC Area North of McDonnell Boulevard	2011[f]	Present	*
McDonnell Boulevard East Section (b) ROW	September 2010	March 2011	434
VP-31A	February 2011	May 2011	34
IA-09 Ballfields (Phases 1, 2, and 2B partial)[c]	November 2011	November 2013	10,587

Table 26. Summary of Response Actions Conducted at the SLAP and SLAPS VPs (Continued)

Designation	Start	Complete	Volume Removed (in situ yd^3)
Frost Avenue ROW Adjacent to VP-21	January 9, 2012	January 26, 2012	26 (soil); 33 (waste and construction debris)
VP-16	May 2013	June 2013	68[g]
Norfolk Southern/Eva Loadout Facility[c]	May 2013	Present	*
Banshee Road	September 2013	September 2013	1
VP-57 and VP-58	June 2014	Present	10,273*[c]
Pershall Road – South Ditch	June 2014	July 2015	58
St. Cin Park (CWC-56)	July 2015	July 2016	3,088
Duchesne Park	February 2016	May 2017	6,371
Palm Drive and Chez Paree	February 2017	February 2019	6,157
IA-09 Ballfields (Phase 2B)	April 2018	Present	16,012*
Eva Avenue North	October 2018	Present	731[b]

[a] Excavation was conducted in conjunction with replacement of the St. Denis Street Bridge.

[b] Excavation was conducted in conjunction with utility work.

[c] Remediation is not complete. Additional sampling is planned for these properties.

[d] Hazelwood Avenue VPs include Hazelwood Avenue, the Hazelwood Avenue ROW (partial) and VPs 32, 35, 35A, 36, 39, 40, 42, and 47.

[e] Soil volume represents the in-situ volume removed from VP-12 during this review period. An additional 35 in situ yd^3 (26.8 m^3) of contaminated materials were removed from VP-10 between October 30 and November 14, 2003.

[f] Additional remediation was conducted in 2011 in the CWC Area North of McDonnell Boulevard during remediation of an adjacent property, VP-12.

[g] Soil volume represents combined quantities from both VP-16 and an adjacent portion of the Norfolk Southern/Eva Loadout Facility.

Notes:

This table does not include completed properties for which remedial actions were not required.

Shaded properties are those for which remedial actions were conducted during this five-year review period (January 2014 through December 2018).

* Final volume removed is not available because the remedial action is ongoing.

Those areas for which remedial actions were completed prior to the fourth five-year review period (i.e., pre-January 2014) are discussed in the Second and Third Five-Year Review Reports (USACE 2010a and 2015a) and are thus not further addressed in this Fourth Five-Year Review Report. Areas of the North St. Louis County Sites where remedial activities were conducted during the fourth five-year review period (January 2014 through December 2018) are presented in the following section.

3.4.2.1 Remedial Actions Conducted During Fourth Five-Year Review Period

This section provides a summary of the remedial actions implemented at the North St. Louis County Sites during this five-year review period. Detailed descriptions of the remedial actions taken are included in Appendix E.

3.4.2.2 Status of Remedy Implementation

The remedial action at the North St. Louis County Sites is ongoing. The remediation status of the North St. Louis County Site properties at the end of the review period is shown on Figure 12. Un-named vicinity properties at the North St. Louis County Sites that the FS and ROD considered un-impacted are listed in Table 27. These properties were sampled and investigated to verify no contamination existed on the property. A PDIR-FSSE was issued for each of these properties.

Properties where remediation was completed and final PRAR-FSSEs issued are listed in Table 28.

Table 27. North St. Louis County Sites: Completed Properties Not Requiring Remediation

Designation	Documentation of FSSE Results
VP-27	*Final Status Survey Evaluation for the SLAPS Vicinity Property 27,* St. Louis, Missouri, March 30, 2006 (USACE 2006b).
VPs 21, 22, 23, 24, 26, 28, 29, 30, and 31	*Pre-Design Investigation and Final Status Survey Evaluation for the SLAPS Vicinity Properties 21, 22, 23, 24, 26, 28, 29, 30, and 31, North St. Louis County Sites,* St. Louis, Missouri, May 7, 2008 (USACE 2008b).
VPs 17, 18, 19, 20, 20A, and 25	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the SLAPS Vicinity Properties 17, 18, 19, 20, 20A, and 25,* St. Louis, Missouri, August 12, 2009 (USACE 2009c).
VPs 41, 43, 44, 45, 46, 48, 48A, 49, 50, 51, and 52	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the SLAPS Vicinity Properties 41, 43, 44, 45, 46, 48, 48A, 49, 50, 51 and 52,* St. Louis, Missouri, September 18, 2009 (USACE 2009d).
VPs 33, 34, and 37	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the SLAPS Vicinity Properties 33, 34, and 37,* St. Louis, Missouri, September 23, 2010 (USACE 2010e).
VP-03 and VP-04	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 03 and 04,* St. Louis, Missouri, June 24, 2011 (USACE 2011b).
VP-40A (partial)[a]	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Property 40A (Partial),* St. Louis, Missouri, August 13, 2013 (USACE 2013f).
VP-09(C) and VP-10(C)	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 09(C), 10(C), and the Road Right-of-Way (partial),* St. Louis, Missouri, September 18, 2013 (USACE 2013g).
VPs 60, 61, and 62, and Parcels 09K130104A and 09K130104B	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 60, 61, and 62 and Parcels 09K130104A and 09K130104B,* St. Louis, Missouri, July 30, 2013 (USACE 2013h).
VPs 01, 02, 07, 13, 14, 15, and IA-11(partial)	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 01, 02, 07, 13, 14, 15, and Investigation Area 11 (partial).* St. Louis, Missouri, September 3, 2014 (USACE 2014f).
Byassee Drive and Adjacent Properties	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Byassee Drive and Adjacent Properties, St. Louis, Missouri,* February 20, 2015 (USACE 2015h).
VP-59	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for St. Louis Airport Site Vicinity Property 59, St. Louis, Missouri*, July 22, 2016 (USACE 2016f).
VPs Seeger-5 and Seeger-6	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Seeger-5 and Seeger-6, St. Louis, Missouri,* September 15, 2016 (USACE 2016g).
VP-06C	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for St. Louis Airport Site Vicinity Property 06(C), St. Louis, Missouri*, September 15, 2016 (USACE 2016h).
CWC-1, CWC-4 through CWC-8, CWC-13 through CWC-28, CWC-156, and Willow Lane	*Pre-Design Investigation Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-1, CWC-4 through CWC-8, CWC-13 through CWC-28, CWC-156, and Willow Lane, St. Louis, Missouri*, June 19, 2017 (USACE 2017f).
CWC-34 through CWC-44, CWC-46 through CWC-51, CWC-53 through CWC-55, CWC-56 (partial), CWC-59 through CWC-64, Foxtree Drive, Alma Drive, and St. Cin Lane	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-34 through CWC-44, CWC-46 through CWC-51, CWC-53 through CWC-55, CWC-56 (partial), CWC-59 through CWC-64, Foxtree Drive, Alma Drive, and St. Cin Lane, St. Louis, Missouri*, October 9, 2017 (USACE 2017e).

Table 27. North St. Louis County Sites: Completed Properties Not Requiring Remediation (Continued)

Designation	Documentation of FSSE Results
Ford-1, Ford-2, Ford-3, Ford-4, Ford-5, Ford-6, Ford-7, Ford-8, and Ford-9.	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Ford-1, Ford-2, Ford-3, Ford-4, Ford-5, Ford-6, Ford-7, Ford-8, and Ford-9*, June 7, 2018 (USACE 2018h).
CWC 65-82, CWC-56 Partial, and Palm Drive	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC) Floodplain Properties CWC 65-82, CWC-56 Partial and Palm Drive*, September 13, 2018 (USACE 2018g).
CWC-94, CWC-96, CWC-98, and Industrial Lane.	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-94, CWC-96, CWC-98, and Industrial Lane, St. Louis, Missouri,* May 1, 2019 (USACE 2019d).
Seeger-1, Seeger-2, Seeger-3, Seeger-4, Romiss Court, and Jonas Place	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Seeger-1, Seeger-2, Seeger-3, Seeger-4, Romiss Court, and Jonas Place, St. Louis, Missouri,* May 9, 2019 (USACE 2019e).
Polson-1, Polson-2, Polson-3, Polson-4, Polson-5, Polson-6, Polson-7, Polson-8, North I-170 ROW, and Heather Lane	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Polson-1, Polson-2, Polson-3, Polson-4, Polson-5, Polson-6, Polson-7, Polson-8, North Interstate 170 Right-of-Way, and Heather Lane, St. Louis, Missouri*, June 11, 2019 (USACE 2019f).

[a] Additional evaluation and remediation activities are planned for VP-40A.

Note:

Completed properties are those for which remedial actions were not required and the FSSE was completed prior to the end of this five-year review period (December 2018). Shaded properties are those for which the final PDI-FSSE report was completed during this five-year review period (January 2014 through December 2018).

Table 28. List of Response Action Evaluation Documents for the North St. Louis County Sites

Property	Document
SLAPS VPs: St. Denis Bridge Area	*Post-Remedial Action Report for the St. Denis Bridge Area*, July 1999 (USACE 1999c).
SLAPS VPs: VP-38	*Vicinity Property 38 Removal Action Summary, Berkeley, Missouri*, April 9, 2001 (USACE 2001).
Latty Avenue Properties: VP-02(L) Building Roof	*VP-2(L) Building Roof Remediation Final Status Survey Evaluation Report,* August 31, 2005 (USACE 2005f).
SLAPS: IA-01 through IA-08, South Ditch, IA-11 and IA-12 (partial), and CWC west of IA-01.	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site, Includes Investigation Areas 01 through 07, Investigation Area 08: South Ditch, Parts of Investigation Areas 11 and 12, and Coldwater Creek: West of IA-01,* May 14, 2009 (USACE 2009e).
Latty Avenue Properties: VP-01(L) and Parcel 10K53008	*Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Vicinity Properties 01(L) and Parcel 10K530087,* May 28, 2010 (USACE 2010f).
SLAPS VPs: Hazelwood Avenue plus adjacent ROW (Partial) and VP-32, VP-35, VP-35A, VP-36, VP-39, VP-40, VP-42, and VP-47	*Post-Remedial Action Report and Final Status Survey Evaluation for Hazelwood Avenue, the Right-of-Way Adjacent to Hazelwood Avenue (Partial) and St. Louis Airport Site Vicinity Properties 32, 35, 35A, 36, 39, 40, 42 and 47,* September 28, 2010 (USACE 2010g).
SLAPS VPs: VP-05 and VP-06	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 05 and 06,* August 3, 2011 (USACE 2011c).
SLAPS VPs: VP-08 and VP-09	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 08 and 09,* August 3, 2011 (USACE 2011d).

Table 28. List of Response Action Evaluation Documents for the North St. Louis County Sites (Continued)

Property	Document
SLAPS VPs: VP-53	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property 53,* August 15, 2011 (USACE 2011e).
SLAPS VPs: VP-63	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property 63,* September 8, 2011 (USACE 2011f).
SLAPS VPs: VP-54	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property 54,* December 12, 2011 (USACE 2011g).
SLAPS VPs: VP-55	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property 55,* December 12, 2011 (USACE 2011h).
Latty Avenue Properties: VP-03(L) -06(L)	*Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Vicinity Properties 03(L), 04(L), 05(L), and 06(L),* September 27, 2012 (USACE 2012f).
Latty Avenue Properties: VP-02(L)	*Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Vicinity Property 02(L),* December 21, 2012 (USACE 2012g).
SLAPS VPs: Frost Avenue ROW	*Remedial Action Summary for the Frost Avenue Right-of-Way, FUSRAP North St. Louis County Sites,* January 30, 2013 (USACE 2013i).
SLAPS VPs: VP-10, VP-11, and VP-12	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 10, 11, and 12,* September 5, 2013 (USACE 2013j).
SLAPS VPs: VP-31A	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property 31A,* September 18, 2013 (USACE 2013k).
Latty Avenue Properties: HISS	*Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Vicinity Property Hazelwood Interim Storage Site,* September 25, 2013 (USACE 2013l).
SLAPS VPs: IA-13	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property Investigation Area 13 Airport Authority,* September 27, 2013 (USACE 2013m).
SLAPS VPs: IA-13 Airport Authority and Banshee Road	*Remedial Action Summary for the Abandoned Culvert Pipe at the St. Louis Airport Site Vicinity Property Investigation Area-13: Airport Authority and Banshee Road,* December 19, 2013 (USACE 2013n).
SLAPS VPs: VP-16	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property 16, St. Louis, Missouri*. July 9, 2014 (USACE 2014g).
Latty Avenue Properties: Futura	*Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Property Futura, St. Louis, Missouri*, September 4, 2014 (USACE 2014e).
Latty Avenue Properties: VP-01(L) and Parcel 10K53087	*Addendum to the Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Vicinity Properties 01(L) and Parcel 10K530087 (including Parcels 10K530065 and 10K530076), St. Louis, Missouri*, December 19, 2014 (USACE 2014h).
SLAPS VPs: Banshee Road	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property Banshee Road, St. Louis, Missouri,* February 20, 2015 (USACE 2015i).
SLAPS VPs: IA-12	*Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property Investigation Area 12 (Partial), St. Louis, Missouri*, September 28, 2016 (USACE 2016i).
SLAPS VPs: St. Cin Park	*Post-Remedial Action Report and Final Status Survey Evaluation for the Coldwater Creek (CWC)-Floodplain Property CWC-56 (Partial)*, August 1, 2018 (USACE 2018e).

Note:

Shaded properties are those for which remedial activities were completed during this five-year review period (January 2014 through December 2018) and for which the final PRAR-FSSE was issued.

The NC ROD (USACE 2005) requires use restrictions for areas at the North St. Louis County Sites in which contamination remains at levels above the RGs that allow for unrestricted land use. The *Institutional Controls Implementation Plan for the North St. Louis County Sites* (USACE 2015j) provides guidance for the implementation and maintenance of institutional controls. The types of legal and administrative mechanisms that currently serve as institutional controls for inaccessible soil at the North St. Louis County Sites are summarized in Table 29. Existing regulations that function as controls include the governmental controls currently imposed by the Missouri Well Construction Rules in 10 *Code of State Regulations (CSR)* 23. These regulations identify requirements related to the construction, repair, maintenance, and plugging of water supply wells and monitoring wells, and the licensing of well drillers. The MDNR Division of Environmental Quality administers and enforces the well construction rules and certifies that wells meet the minimum standards. The restrictions imposed by these regulations minimize the potential for human exposure to site contaminants in ground water.

Table 29. Summary of LUCs for the North St. Louis County Sites

Media	LUCs Needed	LUCs Called for in Decision Documents	Impacted Parcel	LUC Objective	LUC Instrument
Soil	Yes	Proprietary Control: Road Easements	Roads: • Latty Avenue • Eva Avenue • Frost Avenue • McDonnell Boulevard	These controls involve land-use restrictions to limit use of roads as transportation/utility corridors, thereby preventing access to underlying soil containing residual contamination.	**Current:** The municipality is responsible for the road easements. USACE works with MODOT and the local municipalities to ensure than when road work is planned, the USACE is notified. (Utility Support Policy)
	Yes	Proprietary Control: Railroad Easements	Rail lines on the following properties: • VP-40A • IA-12 • Norfolk Southern • VP-02(C) • VP-04(C)	These controls involve land-use restrictions to limit use of railroads as transportation/utility corridors, thereby preventing access to underlying soil containing residual contamination.	**Current:** Norfolk Southern Railway is responsible for the railroad easements. The rail road is also included in the Utility Support Policy to prevent exposure of rail road workers.
	Yes	Governmental Control	Buildings at Futura	Restricts land use: Any use not shown as a use permitted by right or as a Special Land Use Permit, or expressly permitted only as a Planned District, is specifically prohibited.	**Current:** Zoning Restrictions specified in Chapter 405, Appendix A Table "Use Regulations" in the Municipal Code of the City of Hazelwood. USACE works with the property owner to ensure no work is being done on the property unless USACE is notified (Utility Support Policy).

USACE is responsible for verifying that necessary controls are in place until 2 years after site closeout in accordance with USEPA guidance on closeout procedures for NPL sites. At that time, these responsibilities will be transferred to DOE as agreed to under the MOU (DOE and USACE 1999).

3.4.3 System Operations/Operation and Maintenance

No O&M activities have taken place at the North St. Louis County Sites. No O&M documents have been required for the North St. Louis County Sites.

3.5 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

This is the Fourth Five-Year Review for the North St. Louis County Sites. The last five-year review (the Third Five-Year Review Report) was completed and signed in August 2015. The protectiveness statements and the status of the recommendations and follow-up actions for the North St. Louis County Sites from the Third Five-Year Review Report (USACE 2015a) are presented as follows.

Protectiveness Statement from the Last Five-Year Review

Pursuant to USEPA guidance, USACE, in coordination with USEPA, has completed the third five-year review for the St. Louis FUSRAP Sites. The five-year review is required because hazardous substances, pollutants, or contaminants remain at the site in concentrations that do not allow for UUUE. This review evaluates the protectiveness of the North St. Louis County Sites OU remedy.

The remedial action at the North St. Louis County Sites OU is under construction and is not yet completed. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.

The remedy at the North St. Louis County Sites OU is expected to be protective of human health and the environment upon completion. Table 30 shows the status of recommendations and follow-up actions from the third five-year review.

Table 30. Status of Recommendations and Follow-up Actions from Third Five-Year Review

Third Five-Year Review Finding	Progress Since the Third Five-Year Review
Total U concentrations detected in a shallow ground-water monitoring well at SLAPS exceed the NC ROD monitoring guideline of 30 µg/L.	The concentrations of total U detected in monitoring well PW46 did not meet the ROD definition of a significant exceedance, however, follow-up actions were taken. These actions included the continued monitoring of ground water, surface water, and sediment to ensure that the elevated total U concentrations in shallow ground water do not impact CWC. In addition, recommendations and follow-up actions included evaluation of the condition of monitoring well PW46 to determine if well decommissioning and replacement is necessary. In April 2016, a downhole video inspection was conducted at PW46, a PVC well, to determine if well damage, sediment accumulation, or other downhole problems could be factors contributing to the total U exceedances in this well. Because the results of the video surveys were not conclusive regarding the effects of downhole conditions on the total U concentrations, immediate well decommissioning and replacement was not recommended. USACE has continued to monitor PW46 (and CWC) to verify that total U transport via shallow ground water does not impact CWC surface water. The decommissioning and replacement of PW46 may be reconsidered at a later date based on results of future sampling.

The concentrations of total U detected in monitoring well PW46 did not meet the NC ROD definition of a significantly increased concentration;[1] however, follow-up actions were taken, including the continued monitoring of this well on a quarterly basis.

3.6 FIVE-YEAR REVIEW PROCESS

3.6.1 Administrative Components of the Five-Year Review Process

The five-year review process included notifying regulatory agencies, the community, and other interested parties of the start of the five-year review; establishing the five-year review team in consultation with USEPA and MDNR; reviewing relevant documents and data pertaining to the remedial actions conducted over the past 5 years; conducting site inspections; conducting site interviews; and developing/reviewing this Fourth Five-Year Review Report. Each of these elements is discussed in the following sections.

Specific individuals forming the five-year review team are listed in Table 31.

Table 31. Identification of Five-Year Review Team Members

Name	Agency, Office	Title, Role
Rita Alexander	MDNR	Florissant Field Services Manager, Regulatory Oversight
Jill Bennett	DOE/Navarro Research & Engineering	Environmental Scientist, Site Inspection
Daniel Carey	MDNR	FUSRAP North St. Louis County and SLDS Project Coordinator (Florissant Field Office), Regulatory Oversight
Kevin Harris	Leidos	Environmental Engineer, Consultant, co-author
Jessica Kidwell	USEPA, Region 7	Geologist, Agency Oversight
Tom Mahler	USEPA, Region 7	Engineer, Remedial Project Manager, Agency Oversight
Phil Moser	USACE, St. Louis District	FUSRAP SLDS Project Manager, Lead Agency
Jeffrey Murl	DOE, Office of Legacy Management (LM)	LM Site Manager, Site Inspection
Rebecca Roberts	DOE/Navarro Research & Engineering	FUSRAP Project Manager, Site Inspection
Kelly Schumacher	USEPA, Region 7	Toxicologist, Agency Oversight
Jo Anne Wade	USACE, St. Louis District	FUSRAP North St. Louis County Sites Project Manager, Lead Agency, Author

3.6.2 Community Notification and Involvement

The CIP (USACE 2015b) provides a framework for making information concerning the remediation activities at the North St. Louis County Sites fully and readily available to nearby communities. It facilitates community involvement activities to address community needs and concerns that arise during remediation activities and during the decision-making process.

An initial public notice concerning the upcoming Fourth Five-year review was presented in the Winter 2018 *FUSRAP Update: The St. Louis Sites* newsletter issued to the site mailing list. More detailed information concerning the review, as well as a request for community input, were presented in the Winter 2019 newsletter. When the review is completed, a public notice will be published to announce completion of the Fourth Five-Year Review Report.

The final Fourth Five-Year Review Report will be available at the FUSRAP webpage:

- https://www.mvs.usace.army.mil/Missions/Centers-of-Expertise/Formerly-Utilized-Sites-Remedial-Action-Program/ under the link "Five-Year Review."

[1] Significantly increased concentrations are defined as doubling of an individual COC concentration above the upper confidence level of the mean (based on the historical concentration before remedial activity) for a period of 12 months.

3.6.3 Document Review

The documents used in this Fourth Five-Year Review Report are listed in Section 4. For this review, site-related documents included:

- Basis for response action documents, to identify the components of the remedies, the basis for action, the RAOs, and clean-up levels (i.e., NC ROD, EE/CA, Action Memoranda, prior Five-Year Review Reports, the NC FS),
- Implementation documents, to furnish information about design assumptions and documentation of the response actions at the sites (i.e., PDI, FSSE),
- Response action evaluation documents, to provide information that can be used to determine whether the response action continues to operate and function as designed (i.e., PRAR, RAS, FSSE, NC EMDAR),
- Legal documentation outlining the responsibility for the administration and execution of FUSRAP for SLS (i.e., MOU, FFA) and
- Community involvement documentation (i.e., CIP, newsletters).

3.6.4 Data Review and Evaluation

The data review and evaluation component of this five-year review consisted of examining the soil verification sampling data and the environmental monitoring data collected as part of remedial action conducted at the North St. Louis County Sites. The soil data include post-excavation (verification) soil sampling data for properties where remedial actions were completed during this review period. The environmental monitoring program for the North St. Louis County Sites includes the preparation of an annual EMDAR that consolidates and evaluates the environmental monitoring data over a single CY. This review is based on data presented in the CY 2014, CY 2015, CY 2016, CY 2017, and CY 2018 NC EMDARs (USACE 2015k, 2016j, 2017g, 2018i, and 2019g). The NC EMDARs assess compliance with ARARs and form the basis for assessing the status of residual contaminants and the potential for contaminant migration. The following types of data were reviewed:

- Soil verification data
- Radiological monitoring data
- Ground-water monitoring data
- Surface-water and sediment data
- Storm-water and excavation-water discharge monitoring data.

All samples collected during environmental monitoring activities were analyzed by USACE-approved subcontractor laboratories. Radiological samples were analyzed at the ELAP-accredited USACE St. Louis FUSRAP laboratory, and all radiological QA splits and non-radiological samples were analyzed at a Test America laboratory, demonstrating adherence to the requirements of the *Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (DOD v.3.1 and DOE v.5.1, 2017).

3.6.4.1 Soil Sampling Program

FSS verification and PDI sampling has been conducted at properties at which removal actions and/or remedial actions have taken place. Table 32 summarizes actions completed at North St. Louis County Sites during this five-year review period.

Table 32. North St. Louis County Sites Soil Sampling Program Completed Actions (January 2014 through December 2018)

Site	Location	Document	Completed Action	Radiological COCs[a]	
				Maximum Residual Dose[b] (mrem/year)	Maximum Residual Risk[b] (unitless)
North St. Louis County Sites	VPs 01, 02, 07, 13, 14, 15, and IA-11 (partial)	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 01, 02, 07, 13, 14, 15, and Investigation Area 11 (partial), St. Louis, Missouri,* September 3, 2014 (USACE 2014f).	No remedial action required. The soil on VPs 01, 02, 07, 13, 14, 15, and IA-11 (partial) meets the criteria for UUUE in accordance with the NC ROD.	2	2E-05
North St. Louis County Sites	Byassee Drive and Adjacent Properties	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Byassee Drive and Adjacent Properties, St. Louis, Missouri,* February 20, 2015 (USACE 2015h).	No remedial action required. The soil on Parcels 10K130050, 10K130061, 10K410033, 10K410132, and 10K420021; the Road ROW (partial); and Byassee Drive meets the criteria for UUUE in accordance with the NC ROD.	2	2E-05
North St. Louis County Sites	VP-59	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for St. Louis Airport Site Vicinity Property 59, St. Louis, Missouri,* July 22, 2016 (USACE 2016f).	No remedial action required. The soil on VP-59 meets the criteria for UUUE in accordance with the NC ROD.	1	9E-06
North St. Louis County Sites	VPs Seeger-5 and Seeger-6	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Seeger-5 and Seeger-6, St. Louis, Missouri,* September 15, 2016 (USACE 2016g).	No remedial action required. The soil on Seeger-5 and Seeger-6 meets the criteria for UUUE in accordance with the NC ROD.	0.4	6E-06
North St. Louis County Sites	VP-06C	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for St. Louis Airport Site Vicinity Property 06(C). St. Louis, Missouri,* September 15, 2016 USACE 2016h).	No remedial action required. The soil and structures on VP-06(C) meet the criteria for UUUE in accordance with the NC ROD.	1.1	2E-05
North St. Louis County Sites	CWC 1, CWC 4-8, CWC 13-28, CWC 156, and Willow Lane	*Pre-Design Investigation Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-1, CWC-4 through CWC-8, CWC-13 through CWC-28, CWC-156, and Willow Lane, St. Louis, Missouri,* June 19, 2017 (USACE 2017f).	No remedial action required. The soil on CWC-floodplain properties CWC-1, CWC-4 through CWC-8, CWC-13 through CWC-28, CWC-156, and Willow Lane meets the criteria for UUUE in accordance with the NC ROD.	1	3E-05

Table 32. North St. Louis County Sites Soil Sampling Program Completed Actions (January 2014 through December 2018) (Continued)

Site	Location	Document	Completed Action	Radiological COCs[a] Maximum Residual Dose[b] (mrem/year)	Radiological COCs[a] Maximum Residual Risk[b] (unitless)
North St. Louis County Sites	CWC 34-44, CWC 46-51, CWC 53-55, CWC-56 (partial), CWC 59-64, Foxtree Drive, Alma Drive, and St. Cin Lane	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-34 through CWC-44, CWC-46 through CWC-51, CWC-53 through CWC-55, CWC-56 (partial), CWC-59 through CWC-64, Foxtree Drive, Alma Drive, and St. Cin Lane, St. Louis, Missouri,* October 9, 2017 (USACE 2017e).	No remedial action required. The soil and structures on CWC-floodplain properties CWC-34 through CWC-44, CWC-46 through CWC-51, CWC-53 through CWC-55, CWC-56 (partial), CWC-59 through CWC-64, Foxtree Drive, Alma Drive, and St. Cin Lane meets the criteria for UUUE in accordance with the NC ROD.	2	3E-05
North St. Louis County Sites	Ford-1, Ford-2, Ford-3, Ford-4, Ford-5, Ford-6, Ford-7, Ford-8, and Ford-9	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Ford-1, Ford-2, Ford-3, Ford-4, Ford-5, Ford-6, Ford-7, Ford-8, and Ford-9,* June 7, 2018 (USACE 2018h).	No remedial action required. The soil and structures on Ford-1 through Ford-9 meet the criteria for UUUE in accordance with the NC ROD.	1	5E-06
North St. Louis County Sites	CWC 65-82, CWC-56 Partial, and Palm Drive	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC 65-82, CWC-56 Partial and Palm Drive,* September 13, 2018 (USACE 2018g).	No remedial action required. The soil and structures on CWC-floodplain properties CWC-65 through CWC-82, CWC-56 (partial), and Palm Drive meets the criteria for UUUE in accordance with the NC ROD.	2	3E-05
North St. Louis County Sites	CWC-94, CWC-96, CWC-98, and Industrial Lane	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-94, CWC-96, CWC-98, and Industrial Lane. St. Louis, Missouri,* May 1, 2019 (USACE 2019d).	No remedial action required. The soil on CWC-floodplain properties CWC-94, CWC-96, CWC-98, and Industrial Lane meets the criteria for UUUE in accordance with the NC ROD.	3	5E-05
North St. Louis County Sites	Seeger-1, Seeger-2, Seeger-3, Seeger-4, Romiss Court, and Jonas Place	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Seeger-1, Seeger-2, Seeger-3, Seeger-4, Romiss Court, and Jonas Place. St. Louis, Missouri,* May 9, 2019 (USACE 2019e).	No remedial action required. The soil and non-impacted structures on Seeger-1, Seeger-2, Seeger-3, Seeger-4, Romiss Court, and Jonas Place meet the criteria for UUUE in accordance with the NC ROD.	1	2E-05

Table 32. North St. Louis County Sites Soil Sampling Program Completed Actions (January 2014 through December 2018) (Continued)

Site	Location	Document	Completed Action	Radiological COCs[a]	
				Maximum Residual Dose[b] (mrem/year)	Maximum Residual Risk[b] (unitless)
North St. Louis County Sites	Polson-1, Polson-2, Polson-3, Polson-4, Polson-5, Polson-6, Polson-7, Polson-8, North I-170 ROW, and Heather Lane	*Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Polson-1, Polson-2, Polson-3, Polson-4, Polson-5, Polson-6, Polson-7, Polson-8, North Interstate 170 Right-of-Way, and Heather Lane. St. Louis, Missouri*, June 11, 2019 (USACE 2019f).	No remedial action required. The soil on Polson-1 through Polson-8, the North I-170 ROW, and Heather Lane meets the criteria for UUUE in accordance with the NC ROD.	2	3E-05
North St. Louis County Sites	St. Cin Park	*Post-Remedial Action Report and Final Status Survey Evaluation for the Coldwater Creek (CWC)-Floodplain Property CWC-56 (Partial),* August 1, 2018 (USACE 2018e).	Soil remedial actions were performed. The residual radioactivity in soil and on structures at CWC-56 (partial) meets the criteria for UUUE in accordance with the NC ROD. Volume Removed: 3,088 yd^3	1	2E-05

[a] Only radiological COCs were evaluated as part of pre-design and post-remedy verifications during this five-year review period. Therefore, the results of two-tiered toxicity assessments typically performed for metal COCs are not applicable to this review, so none are presented.

[b] Maximum residual doses and risks were determined using RESRAD and represent the maximum total doses and risks above background, summed over all radiological COCs, estimated to occur over a 1,000-year period at the property for the evaluated receptor scenario. COC-specific EPCs were calculated across all accessible soil areas at each property as the lesser of the UCL_{95} or the maximum detected concentration above background for residual soil (including accessible soil not requiring remediation). Modeled receptor scenarios at SLS include the current and future industrial worker, utility worker, construction worker, maintenance worker, recreational user/trespasser (ages 6 to 14 years old), and the on-site resident, as applicable. Residential receptors evaluated include a suburban resident and resident gardener, as specified in the NC ROD and for informational purposes, respectively.

Note:

NA – Soil samples were not analyzed for metals.

3.6.4.2 Radiological Monitoring

Radiological monitoring is used to evaluate the compliance status of each site with ARARs, to evaluate trends, and to assess protectiveness of the remedy, as appropriate. The background locations for gamma radiation, radon, and particulate air monitoring at SLS are shown on Figure 4. The gamma radiation, radon, and particulate air monitoring locations at HISS and at SLAPS are shown on Figures 13 and 14, respectively.

LATTY AVENUE PROPERTIES

Radiological monitoring at the Latty Avenue Properties consists of collecting gamma radiation, airborne particulate radionuclide, and outdoor and indoor radon data. According to the respective NC EMDARs, radiological air monitoring was conducted at the Latty Avenue Properties as shown in the following list, by CY.

- CY 2014 – Futura;
- CY 2015 – Futura, and VP-04(L);
- CY 2016 – Futura;
- CY 2017 – VP-40A; and
- CY 2018 – Futura.

Radiological Monitoring Standards

<u>*Title 40* CFR *Part 192.12(b)*</u>

Indoor airborne radon in affected buildings was compared to the regulatory criterion of 0.02 WL (objective) and 0.03 WL (limit) listed in 40 *CFR* 192.12(b).

<u>*Title 40* CFR *Part 61.102(a)*</u>

Airborne particulate radionuclide data from the site were used to calculate the EDE to a critical receptor. The NESHAP standard of EDE to a critical receptor from radionuclide emissions is 10 mrem per year, as stated in 40 *CFR* 61.102(a).

Emissions of radionuclides to the ambient air shall not exceed those amounts that would cause any member of the public to receive in any year an EDE of 10 mrem per year during cleanup activities.

<u>*Title 10* CFR *40, Appendix A, Criterion 6(6)*</u>

Byproduct material containing concentrations of radionuclides other than radium in soil, and surface activity on remaining structures, must not result in a total effective dose equivalent (TEDE) exceeding the dose from cleanup of radium-contaminated soil to the above standard (benchmark dose), and must be at levels which are as low as is reasonably achievable. Page 3-16 of the NC ROD establishes that the benchmark dose is 19 mrem per year and that in practice the final conditions achieve doses less than 15 mrem per year.

<u>*Title 40* CFR *Part 192.02(b)*</u>

The release of Ra-222 from residual radioactive material to the atmosphere will not exceed an average release rate of 20 pCi/m^2 per second nor increase the annual average concentration of Ra-222 in the air at or above any location outside the disposal site by more than 0.5 pCi/L.

Gamma Radiation Monitoring

Gamma radiation was measured using TLDs. Because cleanup activities at HISS and Futura were initially completed in CY 2013, external gamma radiation exposure from the Latty Avenue

Properties was considered negligible. Therefore, environmental TLD monitoring was not conducted at the Latty Avenue Properties from CY 2014 to CY 2016. Additional sampling along the rail line (VP-40A), along with the subsequent dose and risk assessment, indicated that additional monitoring, per the NC ROD, was necessary to verify the remedy is protective. Therefore, two new radiological monitoring stations were added to monitor gamma radiation on VP-40A in CY 2017. Environmental TLD monitoring for Latty Avenue Properties was only conducted at VP-40A in CY 2017 and CY 2018.

TLDs were located at two locations along the railroad tracks on VP-40A. At each monitoring station, the TLDs were placed approximately 3 ft above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. However, because monitoring stations at FA-2 and FA-3 were not set up until the third quarter of CY 2017, results from last 2 quarters of CY 2017 were assumed to be equal to the first two quarters for the purposes of assessing annual exposure.

Gamma Radiation Monitoring Program Results

The gamma radiation data collected from each location during CY 2014 to CY 2018 were corrected for background, shelter absorption, and fade, and were normalized to exactly 1 year to calculate an annual dose. The corrected annual gamma radiation results are presented in Table 33.

Table 33. External Gamma Radiation Monitoring at VP-40A

Monitoring Location	Monitoring Station	CY 2017 TLD Data	CY 2018 TLD Data
		(mrem/year)	
VP-40A	FA-2	10.1	11
	FA-3	0.2	0

Gamma Radiation Data Analysis

Gamma radiation data from HISS were used to calculate an average dose rate to a hypothetically maximally exposed individual. A summary of the calculated gamma radiation dose rates is presented in Table 34.

Table 34. External Gamma Dose Rate at HISS

CY	Maximum Average Gamma Dose Rate above Background[a]	Annual Gamma Dose Rate
	(mrem/hour)	
2014	---	---
2015	---	---
2016	---	---
2017	<0.1	<0.1
2018	<0.1	<0.1

[a] Calculated by dividing the maximum annual gamma radiation result in Table 33 by 8,760 hours, the number of hours in a year, for each location.

Note:

--- indicates sampling not conducted.

Trend Analysis of Gamma Radiation Data

The annual dose to a member of the public from gamma radiation at the Latty Avenue Properties had negligible variance from year to year.

Airborne Particulate Monitoring

At Latty Avenue Properties, air sampling for radionuclide particulates was conducted at the perimeter of each active excavation and loadout area during CY 2015 and CY 2018. During 2015, material was excavated at VP-2(L) and in 2018, impacted material surrounding a utility pole was excavated. No excavation or loadout activities occurred at the Latty Avenue Properties in CY 2014, CY 2016, or CY 2017. Therefore, radioactive particulate emissions were considered negligible, and air sampling for particulate radionuclides was not required during this period.

Airborne radioactive particulates result from radioactive material in soil (or other sources) that becomes suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 ft above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in µCi/mL.

Airborne Particulate Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table 35.

Table 35. Airborne Particulate Monitoring at the Latty Avenue Properties

CY	Average Annual Gross Alpha Concentration[a]	Average Annual Gross Beta Concentration[a]	Annual Airborne Particulate Dose Rate
	(µCi/mL)		(mrem/year)
2014	---	---	---
2015	0	1.49E-14	<0.1
2016	---	---	---
2017	---	---	---
2018	1.35E-15	4.78E-14	<0.1

[a] Average annual concentrations are determined using data from all applicable Latty Avenue Properties.

Note:

--- indicates sampling not conducted.

Airborne Particulate Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 *CFR* 61.102(a) standard of 10 mrem per year. A comparison of the EDE (due to airborne particulate radionuclides at HISS) and the regulatory limits is presented in Table 36. As shown in Table 36, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 *CFR* 61.102(a) standard of 10 mrem per year during CY 2014 to CY 2018.

Table 36. Airborne Particulate Dose Rate at the Latty Avenue Properties

CY	Annual Airborne Particulate Dose Rate	40 *CFR* 61.102(a) Standard
	(mrem/year)	
2014	---	10
2015	<0.1	10
2016	---	10
2017	---	10
2018	<0.1	10

Note: --- indicates sampling not conducted.

Trend Analysis of Airborne Particulate Data

The annual dose to a member of the public from airborne particulate radionuclides at the Latty Avenue Properties was significantly less than the 40 *CFR* 61.102(a) standard for all years, with a negligible variance from year to year.

Radon Monitoring

Because cleanup activities at HISS and Futura were initially completed in CY 2013, outdoor exposure to Rn-222 from the Latty Avenue Properties was considered negligible from CY 2014 to CY 2016. Therefore, outdoor environmental Rn-222 monitoring was not conducted at the Latty Avenue Properties during this period.

Additional sampling along the rail line (VP-40A), along with the subsequent dose and risk assessment, indicated that additional monitoring, per the ROD, to verify the remedy is protective. Therefore, three new radiological monitoring stations were added to monitor outdoor exposure to Rn-222 on VP-40A in CY 2017. Outdoor exposure to Rn-222 from Latty Avenue Properties other than VP-40A is considered negligible. Therefore, outdoor environmental Rn-222 monitoring for the Latty Avenue Properties was only conducted at VP-40A in CY 2017 and CY 2018. For the Latty Avenue Properties, outdoor airborne radon monitoring was performed using ATDs placed along the railroad tracks on VP-40A. The ATDs were collected semiannually.

Indoor airborne radon monitoring was performed at Futura buildings, due to contamination above the RGs being present beneath the buildings. The monitoring was conducted using ATDs placed at several locations in each of three Futura buildings at a height of 4 ft (to approximate breathing zone conditions) during CY 2014 through CY 2018. The ATDs were collected semiannually. The indoor airborne radon results (including background) in each building were evaluated based on the 0.02 WL (objective) and 0.03 WL (limit) criteria contained in 40 *CFR* 192.12(b).

<u>Outdoor Airborne Radon Monitoring Program Results</u>

The outdoor airborne radon data collected from each location during CY 2017 through CY 2018 were corrected for background and were normalized to exactly 1 year to compare to the limit of 0.5 pCi/L greater than background from 40 *CFR* 192.02(b). The calculated annual outdoor radon monitoring results are presented in Table 37.

Table 37. Outdoor Airborne Radon Monitoring at HISS

MonitoringLocation	Monitoring Station	CY 2017 Radon Data	CY 2018 Radon Data
		(pCi/L)	
VP-40A	FA-1	0.0	0.05
	FA-2	0.1	0.15
	FA-3	0.0	0.15
	Average	<0.1	0.1

<u>Trend Analysis of Outdoor Airborne Radon Data</u>

With data points from only 2 years, a trend cannot be established.

<u>Indoor Airborne Radon Monitoring Program Results</u>

The indoor airborne radon data collected from each location at Futura during CY 2014 through CY 2018 (including background) were normalized to exactly 1 year to calculate an annual dose. The calculated annual indoor airborne radon monitoring results are presented in Table 38.

Table 38. Indoor Airborne Radon Monitoring at Futura

Monitoring Location	Monitoring Station	CY 2014 ATD Data[a]	CY 2015 ATD Data[a]	CY 2016 ATD Data[a]	CY 2017 ATD Data[a]	CY 2018 ATD Data[a]
		(pCi/L)				
North Building	HF-1	1.3	1.25	1.65	1.95	2.45
	HF-2	4.35	4.8	5.05	6.1	6.3
	HF-3	0.3	0.3	0.3	0.6	0.5
Middle Building	HF-4	0.8	0.7	0.6	0.85	0.95
	HF-5	0.45	0.5	0.75	0.95	0.8
	HF-6	0.5	0.4	0.6	0.9	0.95
	HF-7	0.8	0.6	0.85	1.15	1.3
South Building	HF-8	0.55	0.7	0.5	0.9	1.1
	HF-9	0.55	0.55	0.5	1	1.15
	HF-10	0.5	0.7	0.45	0.95	1.25

[a] Results reported from vendor for two periods are averaged to estimate an annual average radon concentration (pCi/L). A result of 5 pCi/L is equivalent to 0.02 WL and a result of 7.5 pCi/L is equivalent to 0.03 WL for comparison of indoor concentrations to the indoor objective and limit.

Indoor Airborne Radon Data Analysis

Indoor airborne radon data from Futura were used to calculate an average annual concentration in each affected building. Another calculation was performed to convert the average concentration to a WL value for comparison to the ARAR WL values of 0.02 (objective) and 0.03 (limit), as listed in 40 *CFR* 192.12(b). A summary of the indoor airborne radon concentrations and calculated WLs is presented in Table 39.

Table 39. Indoor Airborne Radon Concentrations and Working Levels at Futura

Monitoring Period	Average ATD Data[a]			Average WL[b]				
	North Building	Middle Building	South Building	North Building	Middle Building	South Building	40 *CFR* 192.12(b) Objective	40 *CFR* 192.12(b) Limit
	(pCi/L)			(WL)				
CY 2014	1.98	0.64	0.53	0.008	0.003	0.002	0.02	0.03
CY 2015	2.12	0.55	0.65	0.008	0.002	0.003	0.02	0.03
CY 2016	2.33	0.7	0.48	0.009	0.003	0.002	0.02	0.03
CY 2017	2.9	1	1	0.012	0.004	0.004	0.02	0.03
CY 2018	3.1	1	1.2	0.012	0.004	0.005	0.02	0.03

[a] Average ATD data were determined by averaging monitoring station concentrations (pCi/L) presented in Table 38 for each building.

[b] The average annual WL is calculated by dividing the average pCi/L by 100 pCi/L per WL and multiplying by 0.4 (the indoor radon equilibrium factor [ICRP 2008]).

As shown in Table 39, the average annual WL calculated for each monitored Futura building during CY 2014 to CY 2018 was less than the 40 *CFR* 192.12(b) value of 0.02 WL.

Trend Analysis of Indoor Airborne Radon Data

The annual indoor airborne radon WLs calculated for all of the investigated Futura buildings were below the 40 *CFR* 192 limit.

SLAPS AND SLAPS VP

Radiological monitoring at SLAPS and SLAPS VPs consisted of collecting gamma radiation, airborne particulate radionuclide, and outdoor airborne radon data. According to the respective NC EMDARs, radiological air monitoring was conducted as shown in the following list, during each CY.

- CY 2014 – Ballfields, VP-57 and VP-58, Pershall Road South Ditch, and SLAPS Loadout;
- CY 2015 – CWC Corridor, VP-57 and VP-58, Pershall Road South Ditch, St. Cin Park, IA-10, and SLAPS Loadout;
- CY 2016 – Duchesne Park, St. Cin Park, and SLAPS Loadout;
- CY 2017 – Duchesne Park, Palm Drive Properties and Chez Paree, Ballfields, and SLAPS Loadout; and
- CY 2018 – Eva Avenue, Ballfields, Chez Paree, and SLAPS Loadout.

Applicable Standards

Title 40 CFR *61.102(a)*

Airborne particulate radionuclide data from the site were used to calculate the EDE to a critical receptor. The NESHAP standard of EDE to a critical receptor from radionuclide emissions is 10 mrem per year, as stated in 40 *CFR* 61.102(a).

Title 40 CFR *192.12(b)*

Indoor airborne radon in affected buildings was compared to the regulatory criterion of 0.02 WL (objective) and 0.03 WL (limit) listed in 40 *CFR* 192.12(b).

Title 40 CFR *Part 61.102(a)*

Emissions of radionuclides to the ambient air shall not exceed those amounts that would cause any member of the public to receive in any year an EDE of 10 mrem per year during cleanup activities.

Title 10 CFR *40, Appendix A, Criterion 6(6)*

Byproduct material containing concentrations of radionuclides other than radium in soil, and surface activity on remaining structures, must not result in a TEDE exceeding the dose from cleanup of radium contaminated soil to the above standard (benchmark dose), and must be at levels which are as low as is reasonably achievable. Page 3-16 of the NC ROD establishes that the benchmark dose is 19 mrem per year and that in practice the final conditions achieve doses less than 15 mrem per year.

Title 40 CFR *Part 192.02(b)*

The release of Ra-222 from residual radioactive material to the atmosphere will not exceed an average release rate of 20 pCi/m^2 per second nor increase the annual average concentration of Ra-222 in the air at or above any location outside the disposal site by more than 0.5 pCi/L.

Gamma Radiation Monitoring

Gamma radiation was measured using TLDs. TLDs at SLAPS Loadout area were located at the site perimeter. At each monitoring station, the TLDs were placed approximately 3 ft above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at SLAPS at four locations during CY 2014 through CY 2018. Gamma radiation monitoring was not conducted at SLAPS VPs.

Gamma Radiation Monitoring Program Results

The gamma radiation data collected from each location during CY 2014 to CY 2018 were corrected for background, shelter absorption, and fade, and were normalized to exactly 1 year for the purpose of comparison to an annual dose. The calculated annual gamma radiation results are presented in Table 40.

Table 40. External Gamma Radiation Monitoring at SLAPS

Monitoring Location	Monitoring Station	CY 2014 TLD Data	CY 2015 TLD Data	CY 2016 TLD Data	CY 2017 TLD Data	CY 2018 TLD Data
		(mrem/year)				
SLAPS	PA-1	0.6	1.9	0.2	2.9	1.2
	PA-2	12.2	15.1	13.8	17.6	14.6
	PA-3	1.2	3.6	3.6	3.8	3.4
	PA-4	10.6	23.9	25.1	20.7	22.8

Gamma Radiation Data Analysis

Gamma radiation data from SLAPS were used to calculate an average dose rate to a hypothetically maximally exposed individual, with the results presented in Table 41.

Table 41. External Gamma Dose Rates at SLAPS

CY	Maximum Average Gamma Dose Rate above Background[a] (mrem/hour)	Annual Gamma Dose Rate (mrem/year)
2014	<0.1	<0.1
2015	<0.1	<0.1
2016	<0.1	<0.1
2017	<0.1	<0.1
2018	<0.1	<0.1

[a] Calculated by dividing the maximum annual gamma radiation result in Table 40 by 8,760 hours, the number of hours in a year, for each location.

Trend Analysis of Gamma Radiation Data

The annual dose to a member of the public from gamma radiation at SLAPS had negligible variance from year to year.

Airborne Particulate Monitoring

During CY 2014 through CY 2018, air sampling for particulate radionuclides was conducted at each active excavation and loadout area at SLAPS and SLAPS VPs. Air particulate samples were generally collected weekly at SLAPS and SLAPS VPs and analyzed at the USACE St. Louis FUSRAP laboratory.

Airborne Particulate Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table 42.

Table 42. Airborne Particulate Monitoring at SLAPS/SLAPS VPs

CY	Average Annual Gross Alpha Concentration[a]	Average Annual Gross Beta Concentration[a]	Annual Dose
	(µCi/mL)		(mrem/year)
2014	3.10E-15	2.78E-14	<0.1
2015	8.38E-15	3.62E-14	<0.1
2016	4.10E-15	4.07E-14	<0.1
2017	4.69E-15	2.99E-14	<0.1
2018	3.27E-15	3.48E-14	<0.1

[a] Average annual concentrations are determined using data from all applicable SLAPS properties/SLAPS VPs.

Airborne Particulate Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 *CFR* 61 standard of 10 mrem per year. A comparison of the EDE due to airborne particulate radionuclides at the SLAPS load-out area and SLAPS VPs to the regulatory standards is presented in Table 43.

Table 43. Airborne Particulate Dose Rates at SLAPS/SLAPS VPs

CY	Annual Airborne Particulate Dose Rate (mrem/year)	40 *CFR* 61.102(a) Standard (10 mrem/year)
2014	<0.1	10
2015	<0.1	10
2016	<0.1	10
2017	<0.1	10
2018	<0.1	10

As shown in Table 43, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 *CFR* 61 standard of 10 mrem per year from CY 2014 to CY 2018.

Trend Analysis of Airborne Particulate Data

The annual dose to a member of the public from airborne particulate radionuclides at the SLAPS load-out area was below the 40 *CFR* 61.102(a) standard for all years and is negligible.

Radon Monitoring

Outdoor airborne radon monitoring was performed at SLAPS using ATDs to measure radon emissions. The ATDs were collocated with the TLDs at the site. The ATDs were collected semiannually. Outdoor airborne radon monitoring was performed at four SLAPS locations during CY 2014 through CY 2018.

Outdoor Airborne Radon Monitoring Program Results

The outdoor airborne radon data collected from each location during CY 2014 to CY 2018 were corrected for background and were normalized to exactly 1 year to compare to the limit of 0.5 pCi/L greater than background from 40 *CFR* 192.02(b). The calculated annual outdoor radon monitoring results are presented in Table 44.

Table 44. Outdoor Airborne Radon Monitoring at SLAPS

Monitoring Location	Monitoring Station	CY 2014 Radon Data	CY 2015 Radon Data	CY 2016 Radon Data	CY 2017 Radon Data	CY 2018 Radon Data
		(pCi/L)				
SLAPS	PA-1	0	0.05	0.05	0	0
	PA-2	0	0	0	0.05	0
	PA-3	0	0	0	0	0
	PA-4	0.5	0.1	0	0.05	0
	Average	0.13	0.04	0.01	0.03	0.00

Trend Analysis of Outdoor Airborne Radon Data

For CY 2014 through CY 2018, the average annual outdoor airborne radon concentrations at SLAPS did not increase more than 0.5 pCi/L greater than background (40 *CFR* 192.02(b)), with limited variance from year to year.

3.6.4.3 Ground-Water Monitoring Data

Five HZs (HZ-A through HZ-E) are present at the North St. Louis County Sites. These HZs are identified in the conceptual model of ground-water flow shown on Figure 15. The upper ground-water zone is comprised of HZ-A (consisting of fill, loess, and silty clay) and HZ-B (a clay-rich layer). The lower ground-water zone is comprised of HZ-C (consisting of silty clay and clayey to sandy gravel), HZ-D (a shale unit), and HZ-E (the Mississippian Limestone). HZ-E is the protected aquifer for the North St. Louis County Sites. The stratigraphy beneath HISS is similar to that found at SLAPS, with the exception that the shale unit (HZ-D) encountered at SLAPS is absent at HISS. The upper and lower ground-water zones are distinct ground-water systems with limited hydraulic connection. The ground-water flow direction in the upper zone (HZ-A) is toward CWC at the Latty Avenue Properties, and at SLAPS and SLAPS VPs. The flow direction in the lower zone (HZ-C) does not appear to be influenced by CWC and is generally east or northeast beneath the Latty Avenue Properties, and SLAPS and SLAPS VPs. A generalized stratigraphic column and two geologic cross-sections for SLAPS are shown on Figures 16 through 18.

A relatively impermeable clay aquitard (HZ-B) separates HZ-A from the remaining underlying HZs at SLAPS and HISS. The presence of this aquitard, along with available analytical data, indicates there is little to no hydraulic connection between ground water in HZ-A and the lower HZs at SLAPS. This interpretation of negligible communication between HZ-A and the lower HZs is supported by anion and cation compositions of ground-water samples, differing piezometric surfaces, and tritium data. Additionally, the available ground-water monitoring data indicate localized effects on ground water in HZ-A and an absence of these effects in lower HZ ground water (USACE 2003b). The total dissolved solids values in HZ-A ground water, combined with poor water extraction rates due to low hydraulic conductivities (on the order of 10^{-6} to 10^{-8} cm per second), provide confirmation that HZ-A does not produce water in sufficient quantities to fit the definition of an aquifer or to serve as a drinking-water supply. Furthermore, the low yields of ground water in HZ-A neither contribute an important part of the base flow to CWC nor contribute to contaminant levels above water quality standards in creek surface water.

Ground-water monitoring is conducted at the North St. Louis County Sites to meet several general objectives. These objectives are to:

- identify potential impacts to ground-water quality resulting from removal actions and remedial actions;
- obtain requisite data to evaluate response action performance; and
- ensure compliance with the NC ROD (USACE 2005a) requirements.

During the period of this review (CY 2014 through CY 2018), 27 ground-water monitoring wells were sampled at the North St. Louis County Sites. Ground water samples were analyzed for the soil COCs identified in the NC ROD (i.e., antimony, arsenic, barium, cadmium, chromium, molybdenum, nickel, selenium, thallium, total U, vanadium, Ra-226, Ra-228, Th-228, Th-230, Th-232, U-234, U-235, and U-238). Total U values were calculated from isotopic concentrations in pCi/L and converted to µg/L using radionuclide-specific activities.

The ground-water monitoring data at the North St. Louis County Sites are currently evaluated against the requirements for ground-water monitoring identified in the NC ROD (USACE 2005a). The NC ROD identifies two types of monitoring guidelines: (1) response-action monitoring guidelines and (2) a total U monitoring guideline (which is used for both response-action and long-term monitoring). The NC ROD guidelines for response-action monitoring are well-specific guidelines that are equal to two times the UCL_{95}, based on historical concentrations of the analyte in a particular well before remedial actions were initiated under the NC ROD. The total U monitoring guideline, used for both remedial actions were initiated under the NC ROD. The total U monitoring guideline, used for both response-action and long-term monitoring, is defined in the NC ROD as 30 µg/L (USACE 2005a). A full list of the well-specific monitoring guidelines for the North St. Louis County Sites is presented in Appendix F of the CY 2018 NC EMDAR (USACE 2019g). The evaluation of the ground-water sampling results for CY 2014 through CY 2018 is based on comparisons to these NC ROD monitoring guidelines.

As part of this five-year review, ground-water data are evaluated to determine if any sustained COC concentrations are above the ground-water monitoring guidelines. In addition, an evaluation of concentration trends, using the Mann-Kendall Trend Test, is conducted for soil COCs detected at concentrations exceeding NC ROD ground-water guidelines to assess whether concentrations of the COCs are increasing (upward trending) or decreasing (downward trending) over time.

Ground-water monitoring would continue until determined to be no longer required as part of the five-year review process. Long-term monitoring may be discontinued when the contamination has low impact (i.e., the mean (temporal) total-uranium concentration is below 30 µg/L). Monitoring that has not met the assurance level of low impact will be continued subject to five-year reviews. Long-term surface-water monitoring of Coldwater Creek would only be required to appraise potential impacts from significantly degraded ground-water conditions. The decision to continue or cease monitoring of HZ-A ground water will be based upon COC concentrations in HZ-A ground water, the well's position at the site, and the anticipated rate of COC delivery to Coldwater Creek.

The following section provides a summary of the results of the ground-water sampling conducted at the North St. Louis County Sites during the period of this review, based on the data presented in the CY 2014 through CY 2018 NC EMDARS (USACE 2015k, 2016j, 2017g, 2018i, and 2019g). The ground-water results are discussed first for the Latty Avenue Properties and then for SLAPS and SLAPS VPs.

LATTY AVENUE PROPERTIES

Ground-water sampling was conducted at eight monitoring wells at HISS during the period of this review. The ground-water monitoring wells at the Latty Avenue Properties are located on or immediately adjacent to HISS and Futura (Figure 19). With the exception of monitoring well HW23, which is screened in HZ-C, all of the monitoring wells at HISS are screened in HZ-A.

The results of ground-water sampling conducted at HISS during this review period are summarized in Table 45 (radiological analytes) and Table 46 (inorganic analytes). The results indicate that three radiological soil COCs (U-234, U-238, and total U) were detected at concentrations in excess of the NC ROD guidelines in HZ-A ground water during the period of this review. The concentrations of U-234 and U-238 exceeded the NC ROD guidelines in HISS-10 during the first-quarter sampling event conducted in CY 2014, but have not exceeded the ground-water guidelines since that sampling event. Total U concentrations exceeded the ground-water guideline of 30 µg/L in one HZ-A well (HISS-01) during the period of this review. The total U concentrations have not exceeded the total U guideline since CY 2014.

Table 45. Summary of Ground-Water Monitoring Results for the Radiological Soil COCs Detected at HISS (CY 2014 through CY 2018)

HZ	Monitoring Well	Ra-226		Th-228		Th-230		U-234		U-235		U-238		Total U	
		(pCi/L)												(µg/L)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
HZ-A	HISS-01	ND	1.21	ND	ND	ND	0.41	6.39	10	ND	0.83	7.91	10.8	24.4	***32.5***
	HISS-06A	ND	ND	ND	ND	ND	0.75	2.37	3.28	ND	ND	2.36	2.86	7.1	8.6
	HISS-10	ND	ND	ND	ND	ND	0.46	4.84	***10***	ND	0.62	4.14	***8.41***	12.4	25.4
	HISS-11A	ND	1.49	ND	0.39	ND	ND	1.23	1.8	ND	ND	1.49	2.04	4.5	6.1
	HISS-17S	ND	0.98	ND	ND	0.39	0.47	0.53	0.82	ND	ND	0.41	0.44	1.2	1.3
	HISS-19S	1.33	1.42	ND	ND	0.21	0.70	0.47	0.83	ND	ND	0.27	0.96	0.8	2.9
	HW22	ND	1.5	ND	ND	ND	0.6	5.08	7.22	ND	0.62	3.56	4.65	10.7	14.0
HZ-C	HW23	ND	1.82	ND	ND	ND	0.49	ND	ND	ND	ND	ND	0.80	ND	2.4

Notes:

One soil COC, Th-232, is not shown because it was not detected in HISS ground water during the CY 2014 – CY 2018 period.

Exceedances of the ground-water guidelines are shown in ***bold italics***.

ND – Nondetect

Table 46. Summary of Ground-Water Monitoring Results for the Inorganic Soil COCs Detected at HISS (CY 2014 through CY 2018)

HZ	Monitoring Well	Antimony		Arsenic		Barium		Cadmium		Chromium		Molybdenum		Nickel		Selenium		Thallium		Vanadium	
		(µg/L)																			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
HZ-A	HISS-06A	ND	ND	ND	ND	78	93	ND	0.58	ND	ND	ND	3.7	ND	7.5	300	370	ND	ND	ND	2.8
	HISS-10	ND	ND	ND	ND	79	130	0.16	1.1	ND	ND	***18***	***40***	ND	3.8	ND	***69***	ND	ND	ND	ND
	HISS-11A	ND	ND	ND	ND	120	160	ND	1.5	ND	ND	2.9	***5***	ND	11	28	43	ND	ND	ND	2.4
	HISS-17S	ND	ND	ND	ND	53	60	0.22	0.29	ND	ND	10	11	2	2.5	9.3	21	ND	ND	ND	ND
	HISS-19S	ND	ND	260	350	590	640	0.83	1.9	ND	1.9	8.1	9.9	3.7	5.8	ND	ND	ND	ND	ND	ND
	HW22	ND	1.7	ND	ND	160	210	ND	0.43	ND	ND	ND	ND	ND	1.3	1.7	6.9	ND	ND	ND	3.3
HZ-C	HW23	ND	ND	140	230	390	540	ND	0.56	ND	ND	6.2	8.2	2	6.3	ND	ND	ND	0.55	ND	***7.1***

Notes:

Exceedances of the ground-water guidelines are shown in ***bold italics***. The NC ROD guidelines are well-specific and equate to two times the UCL_{95}, based on historical (pre-NC ROD) concentrations in the well.

ND – Nondetect

In addition, two inorganic soil COCs (molybdenum and selenium) were detected at concentrations in excess of the NC ROD guidelines in HZ-A ground water at the Latty Avenue Properties. Molybdenum concentrations detected in HZ-A Well HISS-10 consistently exceeded the NC ROD guideline, and concentrations detected in HZ-A well HISS-11A exceeded the NC ROD guideline once, during the sampling event conducted in CY 2018. However, molybdenum concentrations in HISS-11A do not exceed the NC ROD guideline when measurement error is taken into account. Selenium was detected in HISS-10 at concentrations exceeding the NC ROD guideline during the CY 2018 third and fourth quarter sampling events.

Concentrations of all soil COCs (inorganic and radiological) were less than the NC ROD ground-water guidelines in CY 2014 through CY 2018 ground-water samples from the HZ-C well HW23 when the range of measurement error was taken into account.

As part of this five-year review, and to support evaluation of the effectiveness of the remedial action, an evaluation of concentration trends has been conducted for the soil COCs detected in ground water at concentrations exceeding the NC ROD ground-water guidelines. Trend Tests were performed using the available data for unfiltered ground-water samples collected at the Latty Avenue Properties during the period from January 2000 through December 2018 to evaluate the concentration trends. The use of data collected prior to the start of this review period (i.e., prior to January 2014) is necessary in order to have sufficient data to conduct statistical trend analyses for those wells that are sampled less than annually.

The Mann-Kendall Trend Test was conducted for those analytes for which these conditions were met: (1) the analyte was detected at concentrations exceeding NC ROD ground-water guidelines at least once during the period of this review (January 2014 through December 2018); (2) sufficient sampling results were available (i.e., at least six) for the period between January 2000 through December 2018; and (3) the detection frequency was greater than 50 percent. The following soil COCs were detected in HZ-A wells at the Latty Avenue Properties during the period of this review and met the data requirements:

- Molybdenum: HISS-10
- Selenium: HISS-10
- U-234: HISS-10
- U-238: HISS-10
- Total U: HISS-01

For molybdenum and selenium in HISS-10, the dataset was restricted to the time period of CY 2002 through CY 2018 to meet requirement that the dataset have a detection frequency greater than 50 percent. Results of the Trend Tests are summarized in Table 47.

No soil COCs detected in the HZ-C well HW23 at the Latty Avenue Properties during the period of this review met the data requirements. Although one inorganic analyte, vanadium, exceeded the NC ROD guideline in one sample from HW23 during the period of this review, it did not meet the data requirement that the dataset have a detection frequency greater than 50 percent.

Based on the results of the analyses conducted for HZ-A ground water, one HZ-A well (HISS-01) exhibits a statistically significant upward trend in total U concentrations for the CY 2000 through CY 2018 dataset. However, based on the time-versus-concentration plot shown on Figure 20, the total U concentrations have been decreasing since May 2005, and have not exceeded the total U guideline of 30 µg/L since CY 2014. In addition, one well (HISS-10) exhibits statistically significant upward trends in molybdenum, U-234, and U-238 concentrations. As shown on the time-versus-concentration plots for U-234 and U-238 in HISS-10 (Figure 20), the U-234 and

U-238 concentrations have not exceeded the ground-water guidelines since CY 2014. No trend was identified for selenium in HISS-10.

Table 47. Results of the Mann-Kendall Trend Test for Analytes with Concentrations Exceeding the NC ROD Guidelines in HZ-A Ground Water at the Latty Avenue Properties

Analyte	Station	N[a]	DF[b]	S[c]	Trend[d]
Molybdenum	HISS-10	16	75%	72	Upward Trend
Selenium	HISS-10	16	69%	0	No Trend
U-234	HISS-10	15	100%	62	Upward Trend
U-238	HISS-10	15	80%	62	Upward Trend
Total U	HISS-01	33	100%	118	Upward Trend

[a] N is the number of unfiltered ground-water sample results for a particular analyte at the well for the period between January 2000 and December 2018. For molybdenum and selenium in HISS-10, the dataset was restricted to January of 2002 to December of 2018 to meet the Mann-Kendall Trend Test requirement that the dataset have a detection frequency greater than 50 percent.

[b] DF = Detection Frequency (percent)

[c] S = the Mann-Kendall S-Statistic

[d] One-tailed Mann-Kendall Trend Tests were performed at a 95 percent level of confidence. For non-radiological data, non-detected results were replaced with 0.5 of the detection limit.

In summary, results of the trend analyses indicate four statistically significant upward trends in HZ-A ground water: molybdenum, U-234, and U-238 concentrations in HISS-10 and total U concentrations in HISS-01. However, three of these analytes (U-234, U238, and total U) have not exceeded guidelines since CY 2014. Molybdenum has consistently exceeded its guideline since CY 2006. Based on the evaluation of CWC surface water data, presented in Section 3.6.4.4, a significant degradation of CWC surface water has not occurred. Therefore, there is currently no finding of significantly degraded ground-water conditions in HZ-A ground water. Based on the continued exceedances, ground-water monitoring will continue subject to subsequent CERCLA five-year reviews.

SLAPS AND SLAPS VPs

Ground-water sampling was conducted at SLAPS and SLAPS VPs at 19 monitoring wells during the period of this review. The current well network for SLAPS and SLAPS VPs is shown on Figure 21. Fourteen (14) wells are screened exclusively across the shallow zone (HZ-A). Four (4) wells are screened exclusively across the lower zone (HZ-C, HZ-D, and/or HZ-E). The remaining well (PW36) is screened across both HZ-B and HZ-C.

The results of ground-water sampling conducted at SLAPS and SLAPS VPs during this review period are summarized in Table 48 (radiological analytes) and Table 49 (inorganic analytes). The results indicate that two radiological soil COCs (U-238 and total U) were detected at concentrations in excess of the NC ROD guidelines in HZ-A ground water during the period of this review. The concentrations of U-238 and total U exceeded the NC ROD guidelines in B53W13S during the CY 2014 first- and third-quarter sampling events, but have not exceeded the guidelines since those sampling events. In addition, total U consistently exceeds the 30 µg/L monitoring guideline in shallow (HZ-A) ground-water samples from PW46.

Concentrations of six inorganic soil COCs (i.e., barium, cadmium, chromium, molybdenum, nickel, and vanadium) exceeded the NC ROD ground-water guidelines in samples collected from the upper ground-water zone from CY 2014 through CY 2018. However, the cadmium and vanadium concentrations did not exceed the NC ROD guidelines if the associated measurement errors are taken into account.

Table 48. Summary of Ground-Water Monitoring Results for the Radiological Soil COCs Detected at SLAPS and SLAPS VPs (CY 2014 through CY 2018)

HZ	Monitoring Well	Ra-226		Th-228		Th-230		U-234		U-235		U-238		Total U	
		(pCi/L)												(µg/L)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
HZ-A	B53W01S	ND	ND	ND	0.34	ND	ND	ND	0.26	ND	ND	ND	0.37	ND	1.1
	B53W06S	ND	ND	ND	ND	ND	0.39	5.56	10.30	ND	0.62	4.28	8.86	13.0	26.6
	B53W07S	ND	ND	ND	ND	0.51	0.52	3.97	4.16	ND	ND	2.75	3.21	8.3	9.6
	B53W09S	ND	1.21	ND	ND	ND	0.96	1.41	2.73	ND	ND	1.17	2.86	3.5	8.7
	B53W13S	ND	0.72	ND	0.44	ND	1.00	9.34	11.90	ND	0.61	7.63	***11.40***	23.1	***34.2***
	B53W17S	ND	ND	ND	ND	ND	0.39	1.35	1.56	ND	ND	1.37	1.80	4.2	5.5
	B53W18S	ND	0.63	ND	ND	ND	0.74	1.19	1.51	ND	ND	1.50	1.54	4.5	4.6
	B53W19S	ND	ND	ND	ND	ND	0.49	0.70	0.75	ND	ND	ND	0.61	0.4	1.8
	MW31-98	ND	ND	ND	ND	ND	0.36	2.85	4.01	ND	ND	2.43	4.14	7.3	12.5
	MW32-98	ND	ND	ND	ND	ND	0.40	ND	0.90	ND	ND	0.48	0.60	1.4	1.8
	PW43	ND	1.87	ND	ND	ND	0.53	2.74	4.04	ND	ND	2.50	3.21	3.0	3.2
	PW44	ND	ND	ND	ND	ND	ND	0.69	1.59	ND	ND	0.38	1.44	0.4	1.4
	PW45	ND	ND	ND	ND	ND	0.32	2.82	4.06	ND	ND	2.37	3.36	2.4	3.4
	PW46	ND	1.15	ND	ND	ND	1.36	156	587	8.88	42.4	159	602	***896***	***1,810***
HZ-B, HZ-C, HZ-D, and/or HZ-E	B53W01D	ND	ND	ND	ND	ND	0.44	ND	ND	ND	ND	ND	ND	ND	ND
	B53W07D	ND	ND	ND	ND	ND	0.30	ND	ND	ND	ND	ND	ND	ND	ND
	PW35	2.98	4.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	PW36	1.43	1.72	ND	ND	ND	0.49	ND	ND	ND	ND	ND	ND	ND	ND
	PW42	ND	ND	ND	ND	ND	0.49	ND	0.30	ND	ND	ND	ND	ND	0.7

Notes:

One soil COC, Th-232, is not shown because it was not detected in ground water at SLAPS or SLAPS VPs during the CY 2014 – CY 2018 period.

Exceedances of the ground-water guidelines are shown in ***bold italics***. The total U guideline is 30 µg/L. The remaining NC ROD guidelines are well-specific and equate to two times the UCL_{95}, based on historical (pre-NC ROD) concentrations of the analyte in the particular well.

ND – Nondetect

Table 49. Summary of Ground-Water Monitoring Results for the Inorganic Soil COCs Detected at SLAPS and SLAPS VPs (CY 2014 through CY 2018)

HZ	Monitoring Well	Arsenic		Barium		Cadmium		Chromium		Molybdenum		Nickel		Selenium		Thallium		Vanadium	
		(µg/L)																	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
HZ-A	B53W01S	ND	110	86	***500***	ND	0.8	ND	ND	ND	2.3	ND	15	ND	ND	ND	ND	ND	ND
	B53W06S	ND	1.9	48	110	0.92	11	ND	17	5.3	12	4.6	***27***	2.5	59	ND	0.67	ND	6.6
	B53W07S	ND	ND	160	190	ND	0.13	1.8	4.2	1.3	1.7	1.5	1.7	3.5	4.6	ND	ND	ND	ND
	B53W09S	ND	ND	270	430	0.36	1.8	5.2	***200***	ND	6.9	14	***460***	ND	12	ND	0.83	ND	ND
	B53W13S	ND	ND	280	***550***	ND	1.6	ND	***31***	ND	2.8	49	***230***	81	130	ND	1.2	ND	ND
	B53W17S	ND	ND	230	260	ND	0.27	ND	*8.9*	ND	1.2	ND	2.9	80	94	ND	ND	ND	ND
	B53W18S	ND	1.6	440	620	0.25	1.7	47	***380***	22	***59***	470	***1,500***	ND	ND	ND	1.6	ND	3.9
	B53W19S	ND	3.4	210	***670***	0.45	*2.1*	100	***370***	23	***180***	380	***2,900***	ND	1.7	ND	0.84	ND	3.7
	MW31-98	ND	ND	360	410	0.13	0.32	ND	1.4	1.3	2.3	1.3	2.4	11	44	ND	ND	ND	2.5
	MW32-98	ND	ND	93	140	0.15	0.88	ND	ND	ND	ND	ND	0.59	ND	ND	ND	ND	ND	ND
	PW43	ND	6.3	160	220	0.19	0.89	ND	ND	ND	3.1	2.2	***18***	ND	1.8	ND	ND	ND	*4.4*
	PW44	ND	1.4	69	99	0.86	0.94	ND	ND	ND	2	ND	1.5	ND	ND	ND	ND	ND	ND
	PW45	ND	ND	72	90	0.11	0.27	ND	ND	39	100	3.4	7.7	22	23	ND	ND	ND	ND
	PW46	ND	1.6	45	83	ND	1.2	ND	ND	ND	ND	ND	1.4	8	44	ND	ND	ND	ND
HZ-C, HZ-D, and/or HZ-E	B53W01D	97	100	460	490	0.3	5.7	ND	*8.5*	ND	1.4	2.1	9.8	ND	ND	ND	ND	ND	5.5
	B53W07D	81	110	340	400	ND	1.2	ND	*8.1*	ND	2.8	7.3	*14*	ND	ND	ND	ND	ND	7.5
	PW35	29	36	2000	3000	0.52	*3.6*	ND	5.6	3.7	5.1	ND	6.4	ND	ND	ND	ND	ND	6
	PW36	120	120	450	450	ND	0.43	ND	1.2	ND	1.7	0.83	4.3	ND	ND	ND	ND	ND	ND
	PW42	ND	140	92	340	ND	0.36	ND	ND	ND	ND	ND	0.84	ND	1.8	ND	ND	ND	ND

Notes:

One soil COC, antimony, is not shown because it was not detected in ground water at SLAPS or SLAPS VPs during the CY 2014 – CY 2018 period.

Exceedances of the ground-water guidelines are shown in ***bold italics***. The NC ROD guidelines are well-specific and equate to two times the UCL_{95}, based on historical (pre-NC ROD) concentrations of the analyte in the particular well.

Values in *italics* represent results that do not exceed the ground-water guidelines when the range of associated measurement error is taken into account.

ND – Nondetect

Barium was detected at concentrations in excess of the NC ROD guidelines in three HZ-A wells (B53W01S, B53W13S, and B53W19S) during the period of this review (CY 2014 through CY 2018). Barium concentrations exceeded the NC ROD guideline of 390 µg/L in the CY 2017 second quarter sample from B53W01S (500 µg/L), but the guideline was not exceeded during subsequent sampling events. Barium concentrations exceeded the NC ROD guidelines (510 µg/L for B53W13S and 510 µg/L for B53W19S) in the CY 2016 first quarter sample from B53W13S (550 µg/L) and the CY 2014 third quarter and CY 2015 first quarter samples from B53W19S (670 µg/L and 640 µg/L, respectively).

Results of the sampling conducted during this review period indicate that three stainless steel wells (B53W13S, B53W18S and B53W19S) had consistently elevated concentrations of the metals chromium, nickel, and/or molybdenum. High-volume purging was conducted at these wells in December 2014 to determine if the elevated metal concentrations were the result of sediment in the wells. The purging did not result in substantially improved well conditions in B53W13S or B53W18S, and resulted in only a temporary decrease in some of the metal concentrations in B53W19S. Downhole video inspections of these wells were conducted in April 2016 to investigate if well corrosion could be causing the elevated metal concentrations. Two downhole video surveys were conducted in each well, one with a standard camera lens and one with a fisheye lens. The downhole video inspection results indicated that two of the stainless steel wells (B53W18S and B53W19S) had evidence of corrosion (severe staining, encrustations) of their well screens. The other stainless steel well (B53W13S) had evidence of corrosion in the steel casing at depths above the well screen. All three stainless steel wells, but particularly B53W18S and B53W19S, had large amounts of suspended sediment. Because well conditions (high particulates, possible corrosion) could be affecting the analytical results in these wells, sampling was discontinued in these wells after the CY 2016 first quarter sampling event. Decommissioning and possible replacement of B53W13S, B53W18S, and B53W19S is planned.

Chromium and/or nickel concentrations also exceeded the NC ROD guidelines in B53W09S (chromium and nickel), B53W06S (nickel), and PW43 (nickel) during the period of this review. However, the concentrations of nickel and chromium in B53W09S and nickel in PW43 were below the NC ROD guidelines in the last sampling events conducted at these wells in CY 2018. Chromium was detected at concentrations in excess of the NC ROD guideline (16 µg/L) in the CY 2018 fourth quarter sample from B53W06S (27 µg/L); chromium had not been detected at levels exceeding the guideline in any previous samples from B53W06S. Chromium concentrations also exceeded the NC ROD guideline in B53W17S (8.9 µg/L); however, the guideline is not exceeded (7.0 µg/L) if the associated measurement error is taken into account.

Concentrations of all radiological soil COCs were below the NC ROD ground-water guidelines in CY 2014 through CY 2018 ground-water samples from the lower ground-water zone (HZ-C and/or HZ-E). Concentrations of three inorganic soil COCs exceeded the NC ROD ground-water guidelines in samples collected from the lower ground-water zone from CY 2014 through CY 2018: cadmium in PW35, chromium in B53W01D and B53W07D, and nickel in B53W07D. However, these COCs do not exceed the ground-water guidelines when the range of associated measurement error is taken into account.

As part of this five-year review, and to support evaluation of the effectiveness of the remedial action, an evaluation of concentration trends has been conducted for the soil COCs detected in ground water at concentrations exceeding the NC ROD ground-water guidelines. Mann-Kendall Trend Tests were performed using the available data for unfiltered ground-water samples collected at SLAPS and SLAPS VPs during the period from January 2000 through December 2018 to evaluate the concentration trends. The use of data collected prior to the start of this review period (i.e., prior to January 2014) is necessary in order to have sufficient data to conduct statistical trend analyses for those wells that are sampled less than annually.

The Mann-Kendall Trend Test was conducted for those analytes for which these conditions were met: (1) the analyte was detected at concentrations exceeding NC ROD ground-water guidelines at least once during the period of this review (January 2014 through December 2018); (2) sufficient sampling results were available (i.e., at least six) for the period between January 2000 through December 2018; and (3) the detection frequency was greater than 50 percent. The following soil COCs were detected in HZ-A wells at SLAPS and SLAPS VPs during the period of this review and met the data requirements:

- Barium: B53W01S, B53W13S, and B53W19S
- Chromium: B53W09S, B53W13S, B53W18S, and B53W19S
- Molybdenum: B53W18S and B53W19S
- Nickel: B53W06S, B53W09S, B53W13S, B53W18S, B53W19S, and PW43
- Total U: B53W13S and PW46

U-238 in B53W13S also met the data requirements. However, because the total U values are calculated using the U-238 value, the trend in the U-238 value is the same as the total U trend result. Therefore, it was unnecessary to perform a separate trend analysis for U-238 in B53W13S. The Mann-Kendall Trend Test was not conducted for the lower ground-water zone at SLAPS and SLAPS VPs, because during the period of this review no soil COCs were detected in the lower ground-water zone at levels exceeding NC ROD guidelines when the range of associated measurement error is taken into account. Results of the Trend Tests are summarized in Table 50.

Table 50. Results of Mann-Kendall Trend Test for Analytes with Concentrations Exceeding NC ROD Guidelines in HZ-A Ground Water at SLAPS and SLAPS VPs

Analyte	Station	N[a]	DF[b]	S[c]	Trend[d]
Barium	B53W01S	15	100%	-30	No Trend
	B53W13S	26	100%	177	Upward Trend
	B53W19S	17	100%	14	No Trend
Chromium	B53W09S	29	83%	218	Upward Trend
	B53W13S	26	77%	104	Upward Trend
	B53W18S	22	82%	163	Upward Trend
	B53W19S	18	94%	41	No Trend
Molybdenum	B53W18S	22	82%	140	Upward Trend
	B53W19S	18	83%	26	No Trend
Nickel	B53W06S	22	77%	126	Upward Trend
	B53W09S	29	86%	196	Upward Trend
	B53W13S	26	85%	107	Upward Trend
	B53W18S	22	100%	122	Upward Trend
	B53W19S	18	89%	34	No Trend
	PW43	24	54%	109	Upward Trend
Total U	B53W13S	23	100%	153	Upward Trend
	PW46	19	100%	-19	No Trend

[a] N is the number of unfiltered ground-water sample results for a particular analyte at the well for the period between January 2000 and December 2018.

[b] DF = Detection Frequency (percent)

[c] S = the Mann-Kendall S-Statistic

[d] One-tailed Mann-Kendall Trend Tests were performed at a 95 percent level of confidence. For non-radiological data, non-detected results were replaced with 0.5 of the detection limit.

Two wells with evidence of corrosion and suspended sediment, B53W13S and B53W18S, were found to have statistically significant increasing trends in barium, chromium, nickel, and/or molybdenum. These wells are planned for future decommissioning and possible replacement. Results also indicate statistically significant increasing trends for chromium concentrations in B53W09S and for nickel concentrations in B53W06S, B53W09S, and PW43. Based on time-versus-concentration plots shown on Figure 22, the chromium and nickel concentrations in B53W09S and nickel concentrations in PW43 did not exceed NC ROD guidelines in the most recent CY 2018 samples. A statistically significant upward trend in total U concentrations was identified for B53W13S.

No statistically significant trend was identified for total U in PW46. Total U has consistently exceeded its 30 µg/L guideline since installation of the well in CY 2006. Based on the time-versus-concentration plot shown on Figure 22, total U concentrations at PW46 vary considerably, likely due to seasonal conditions, but appear to be gradually decreasing over time.

In summary, results of the trend analysis indicate 11 statistically significant upward trends in HZ-A ground water at SLAPS and SLAPS VPs: nickel in B53W06S; chromium and nickel in B53W09S; barium, chromium, nickel, and total U in B53W13S; chromium, molybdenum, and nickel in B53W18S; and nickel in PW43. As noted previously, the exceedances in two of these wells (B53W13S and B53W18S) are likely due to corrosion and suspended sediment. For three of the four remaining trends (chromium and nickel in B53W09S, and nickel in PW43), the concentrations did not exceed NC ROD guidelines in the most recent sampling event. Nickel concentrations in B53W06S exceeded the NC ROD guideline in a single sample (CY 2018). Total U concentrations continue to exceed the 30 µg/L guideline in PW46. Based on the evaluation of CWC surface water data, presented in Section 3.6.4.4, a significant degradation of CWC surface water has not occurred. Semiannual monitoring of surface water and sediments in CWC indicate that significant transport of total U and inorganic soil COCs from HZ-A into CWC is not occurring. Therefore, there is currently no finding of significantly degraded ground-water conditions in HZ-A ground water at SLAPS or SLAPS VPs. Based on the continued exceedances, ground-water monitoring will continue subject to subsequent CERCLA five-year reviews.

3.6.4.4 Surface-Water and Sediment Sampling

The environmental monitoring plan for CWC evaluates the physical, radiological, and chemical parameters present in CWC's surface water and sediment. The radiological and chemical parameters to be monitored are based on annual environmental monitoring implementation plans and are not necessarily FUSRAP COCs. The monitoring programs are conducted at CWC as a part of SLS to meet several objectives. These objectives are:

- assess the quality of surface water and sediment in CWC;
- compare the sampling results of the COCs to the RGs for sediment in the NC ROD; and
- evaluate/determine whether runoff from SLAPS, HISS and their VPs due to remedial actions is affecting the quality of surface water and sediment in CWC.

Sampling of CWC's surface water and sediment was conducted semiannually at six monitoring stations (C002 through C007) until October 2014, when two additional monitoring stations (C008 and C009) were established and sampled. Following that, sampling of CWC's surface water and sediment has been conducted semiannually at eight monitoring stations (C002 through C009).

Monitoring Program Results

The evaluation results for the surface water and sediment sampling data for CWC from CY 2014 through CY 2018 are presented in the following section. The sampling locations along CWC are shown on maps included in the annual NC EMDARs. Monitoring parameters included field measurements (temperature, pH, specific conductance, oxidation reduction potential, and dissolved oxygen), radiological analytes (Ra-226, Ra-228, Th-228, Th-230, Th-232, U-234, U-235, and U-238) and non-radiological analytes (antimony, arsenic, barium, cadmium, chromium, molybdenum, nickel, selenium, thallium, and vanadium).

Surface water and sediment data collected from CWC are evaluated relative to historical sample results obtained at each station. In addition, prior to approval of the NC ROD in September 2005, data collected from CWC surface water and sediment were compared to the North St. Louis County Sites background concentrations. The Water Quality Criteria (WQC) in 10 *CSR* 20-7.031, Table A, Classifications I, II and V, were used if no background value existed for a given constituent. The background values and WQC are referred to as the pre-NC ROD evaluation criteria.

For CY 2014 through CY 2018, the surface-water and sediment data were evaluated using the criteria specified in the NC ROD (USACE 2005a). The NC ROD states that the Drinking Water Standard of 30 µg/L for total U may be used as a monitoring guide for surface water. The NC ROD also established data RGs for Ra-226, Th-230, and U-238 in sediment. These RGs are used in evaluating CWC sediment for CY 2014 through CY 2018. A trend analysis was also performed for each station to determine the effects of the remedial action on surface water and sediment in CWC.

Calendar Year 2014 CWC Sampling

Two sampling events were conducted for both surface water and sediment during CY 2014. Six monitoring stations (C002 – C007) were sampled during the first semiannual event of CY 2014. Due to remedial action adjacent to CWC near station C007, the farthest downstream station, two new monitoring stations (C008 and C009) were established in October 2014. These stations were first sampled during the second semiannual event of CY 2014, increasing the number of monitoring stations sampled to eight.

All sediment monitoring required through implementation of the *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2014* was conducted as planned during CY 2014 (USACE 2013o). The sediment data collected in CY 2014 were compared to the NC ROD RGs (USACE 2005a). The evaluation of the monitoring data demonstrates that all applicable ARARs have been met.

Calendar Year 2015 CWC Sampling

Two sampling events were conducted for both surface water and sediment at all eight monitoring stations during CY 2015. Surface-water results for U-234, U-235, and U-238 (reported in pCi/L) were converted to µg/L and compared to the 30 µg/L guideline for total U described in the NC ROD. The total U concentrations in surface water were less than the 30 µg/L guideline.

All sediment monitoring required through implementation of the *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2015* was conducted as planned during CY 2015 (USACE 2014i). The sediment data collected in CY 2015 were compared to the NC ROD RGs (USACE 2005a). The evaluation of the monitoring data demonstrates that all applicable ARARs have been met.

Calendar Year 2016 CWC Sampling

Two sampling events were conducted for both surface water and sediment at all eight monitoring stations during CY 2016. Surface-water results for U-234, U-235, and U-238 (reported in pCi/L) were converted to µg/L and compared to the 30 µg/L guideline for total U described in the NC ROD. The total U concentrations in surface water were less than the 30 µg/L guideline.

All sediment monitoring required through implementation of the *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2016* was conducted as planned during CY 2016 (USACE 2016k). The sediment data collected in CY 2016 were compared to the NC ROD RGs (USACE 2005a). The evaluation of the monitoring data demonstrates that all applicable ARARs have been met.

Calendar Year 2017 CWC Sampling

Two sampling events were conducted for both surface water and sediment at all eight monitoring stations during CY 2017. Surface-water results for U-234, U-235, and U-238 (reported in pCi/L) were converted to µg/L and compared to the 30 µg/L guideline for total U described in the NC ROD. The total U concentrations in surface water were less than the 30 µg/L guideline.

All sediment monitoring required through implementation of the *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2017* was conducted as planned during CY 2017 (USACE 2016l). The sediment data collected in CY 2017 were compared to the NC ROD RGs (USACE 2005a). The evaluation of the monitoring data demonstrates that all applicable ARARs have been met.

Calendar Year 2018 CWC Sampling

Two sampling events were conducted for both surface water and sediment at all eight monitoring stations during CY 2018. Surface-water results for U-234, U-235, and U-238 (reported in pCi/L) were converted to µg/L and compared to the 30 µg/L guideline for total U described in the NC ROD. The total U concentrations in surface water were less than the 30 µg/L guideline.

All sediment monitoring required through implementation of the *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2018* was conducted as planned during CY 2018 (USACE 2017h). The sediment data collected in CY 2018 were compared to the NC ROD RGs (USACE 2005a). The evaluation of the monitoring data demonstrates that all applicable ARARs have been met.

Trend Analysis

Figure 23 represents the concentration trend analysis for different radionuclides in surface water and sediment. The concentrations of Ra-226, Th-230, Th-232, and total U at each monitoring station were graphed for the CY 2014 through CY 2018 period. The COC concentrations in surface water are scaled by the primary *y*-axis to the left of the plot area. Concentrations in sediment are scaled by the secondary *y*-axis to the right of the plot area.

Figure 23 shows that Ra-226, Th-230, and Th-232 concentrations in surface water have been relatively stable (flat) and generally varying within a small range (±2 pCi/L) at all eight stations over the CY 2014 through CY 2018 period. Total U concentrations in surface water were also relatively stable (flat) and generally varied within a small range (±2 µg/L) at all eight stations. An exception to the stable (flat) trend is the increase in total U concentrations observed for the first (March) sampling event at C003 in CY 2016. However, the increased total U concentrations were brief and significantly less than the NC ROD monitoring guideline. The concentrations of total U in surface-water samples from CWC have not exceeded the NC ROD monitoring guideline (30 µg/L) during the CY 2014 through CY 2018 period.

Based on the graphs on Figure 23, the Ra-226 concentrations in sediment have been relatively stable over the CY 2014 through CY 2018 period. The Ra-226 concentrations in sediment samples from CWC have not exceeded the RG (15 pCi/g) during the CY 2014 through CY 2018 period, with concentrations remaining significantly less than the NC ROD monitoring guideline.

A temporary increase in the Th-230 concentration in sediment occurred at C007 during the second (October) sampling event in CY 2014 and at C006 during the first (March) sampling event in CY 2017. However, these values did not exceed the RG. It should be noted that the scale of the *y*-axis on the Th-230 graph for Station C006 and Station C007 differs from the scale of the *y*-axis on the other Th-230 graphs on Figure 23. These axes have been increased in scale in order to show the higher Th-230 values for October 2014 at C007 and March 2017 at C006. In general, the Th-230 concentrations in sediment are slightly greater at station C007 with respect to other stations during the CY 2014 through CY 2018 period. The concentrations of Th-230 in sediment samples from CWC have not exceeded the RG (43 pCi/g) during the CY 2014 through CY 2018 period.

Total U concentrations in sediment are relatively stable (flat) and consistent at all eight stations over the CY 2014 through CY 2018 period. A few exceptions to the stable (flat) trend are the increase in total U concentrations observed for the second (October) sampling event in CY 2016 and the first (March) sampling event in CY 2017 at C002. However, concentrations of total U in sediment samples from CWC have not exceeded the NC ROD monitoring guideline (30 µg/L) during the CY 2014 through CY 2018 period. Additionally, the concentrations of U-238 in sediment samples from CWC have not exceeded the RG (150 pCi/g) during the CY 2014 through CY 2018 period.

In addition to the trend analysis, the concentration trends in surface water and sediment were compared to determine if a correlation exists between the concentrations of Ra-226, Th-230, Th-232, and total U in surface water and the concentrations of the same COCs in sediment at each sampling location. When two parameters (e.g., a COC concentration in surface water and the same COC concentration in sediment at a particular location) vary together, a correlation is assumed to exist between the two parameters. Based on the graphs on Figure 23, the localized and temporary changes in the concentrations of each COC over time in surface-water samples differ from the localized and temporary changes in COC concentrations in sediment samples. However, the Ra-226, Th-230, Th-232, and total U concentrations in surface-water and sediment samples over the CY 2014 to CY 2018 period are generally stable (flat) and consistent at all the monitoring stations, with a few minor exceptions as discussed previously. Based on Figure 23, a significant correlation between Ra-226, Th-230, Th-232, and total U concentrations in surface-water and sediment is not evident at any of the monitoring stations.

In summary, during the period of this review (January 2014 through December 2018), no exceedances of the total U monitoring guideline for surface water in CWC or of the NC ROD RGs for sediment occurred. The evaluation of the surface-water and sediment data indicates that the quality of the surface water and sediment in CWC has not been impacted by runoff from the remedial actions at the North St. Louis County Sites.

3.6.4.5 Storm-Water and Excavation Water Monitoring

This section provides a description of the excavation-water and storm-water monitoring activities conducted at the North St. Louis County Sites during this five-year review period. The monitoring results obtained from these activities are presented and compared with their respective permit or permit-equivalent requirements. The purpose of excavation-water and storm-water discharge sampling at the North St. Louis County Sites is to monitor compliance with the established discharge requirements. These requirements are established by the following: MDNR National Pollutant Discharge Elimination System (NPDES)-equivalent document dated October 2, 1998 (MDNR 1998); and MSD discharge authorization letters dated 2001, 2005, 2006, 2008, 2010, 2012, 2014, 2016, and 2018 for SLAPS (MSD 2001b, 2005, 2006b, 2008b, 2010b, 2012b, 2014b, 2016b, 2018b).

Excavation-Water Discharge Monitoring at the North St. Louis County Sites

On July 23, 2001, MSD responded to a request by USACE to discharge treated excavation water, following biodenitrification, to an MSD sanitary sewer located onsite by issuing a conditional approval for discharge of treated excavation water that resulted from USACE response actions at SLAPS. Two (2)-year permit extensions were granted in 2006, 2008, 2010, 2012, 2014, 2016, and 2018, with the current extension remaining in effect until July 23, 2020. The primary condition of the approval was that a treatment system be installed, maintained, and operated to produce an effluent meeting the standards contained in the following: MSD ordinances 8472, 10177, and 10082 (MSD 1991, 1994, and 1997); 10 *CFR* 20; and 19 *CSR* 20-10.

MSD limits the annual allocation for radioactivity from SLAPS to the MSD CWC treatment plant, establishes the maximum volume of excavation water allowed to be discharged in a 24-hour period, and requires that USACE show compliance of the treated excavation water with applicable standards and limits before MSD will allow the discharge. Also, as part of revising the discharge limits, a request for a selenium variance was approved on February 10, 2005 (MSD 2005). The selenium variance allows the use of a mass limit rather than a concentration limit.

On May 24, 2012, the MSD responded with approval to a request by USACE to review and remove the requirement to analyze for barium, lead, and selenium after the first two batches from new investigation areas (MSD 2012b).

No remediation-related discharge of excavation water occurred at the North St. Louis County Sites during the following period: CY 2017 (third quarter).

A summary of the excavation-water discharges from the North St. Louis County Sites for this five-year review period is presented in Table 51.

Table 51. Summary of Excavation-Water Discharges at the North St. Louis County Sites

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Activity Discharged (Ci)	Total Volume Discharged (gallons)
2014	No Exceedance	No Exceedance	No Exceedance	No Exceedance	Th – 7.2E-06 U – 3.6E-05 Ra – 6.3E-06	1,261,406
2015	No Exceedance	No Exceedance	No Exceedance	No Exceedance	Th – 1.5E-05 U – 4.4E-05 Ra – 6.9E-06	1,852,244
2016	No Exceedance	No Exceedance	No Exceedance	No Exceedance	Th – 6.3E-06 U – 1.6E-05 Ra – 4.4E-06	1,269,793
2017	No Exceedance	No Exceedance	No Discharge	No Exceedance	Th –6.7E-06 U – 4.6E-06 Ra – 3.2E-06	999,126
2018	No Exceedance	No Exceedance	No Exceedance	No Exceedance	Th – 7.3E-06 U – 6.1E-06 Ra – 4.4E-06	1,090, 492

USACE owns the USACE St. Louis FUSRAP laboratory located at 8945 Latty Avenue in Hazelwood, Missouri. The laboratory operates in accordance with an MSD special discharge permit. The laboratory waste water is discharged to the MSD sewer system at Manhole 10K2-075S in accordance with the MSD discharge authorization letter dated February 7, 2018 (MSD 2018c). The MSD special discharge approval requires compliance with applicable discharge regulations (Ordinance 8472) (MSD 1991).

Although many of the parameters are found above laboratory method detection limits, no discharge limits or criteria regulate these parameters; the parameters are monitored for permit renewal purposes and submitted to MSD for approval. The permit was successfully renewed every year of this five-year review period (CY 2014 through CY 2018).

Storm-Water Monitoring at the Latty Avenue Properties

Historical monitoring of storm-water discharges at HISS involved storm-water discharge sampling at three outfalls (HN01, HN02, and HN03) under the MDNR NPDES operating permit MO-0111252. This permit for HISS was terminated per letter from USACE to Mr. Phillip A. Schroeder, MDNR Permit Chief, dated November 18, 2003 (USACE 2003d).

Starting in April of CY 2007, un-named moving pumping outfalls were utilized during excavation activities at the North St. Louis County Sites for the management of storm water with regard to sediment control and pumped excavation water. The moving outfalls were necessary to pump excess excavation water to CWC. The excavation water was pumped to CWC in accordance with agreements made during a March 12, 2007, meeting with Mr. Tom Siegel, MDNR, and as described in a subsequent April 20, 2007, letter from USACE (USACE 2007). The excavation-water sampling is being conducted to verify compliance with the NPDES permit-equivalent requirements. The parameters for the un-named outfalls follow the same NPDES parameters as PN02.

No outfalls were utilized or sampled at the Latty Avenue Properties from CY 2014 through CY 2018.

Storm-Water Discharge Monitoring at SLAPS

Historical monitoring of storm-water discharges at SLAPS involved semiannual sampling of the effluent from two outfalls. The first of the SLAPS historical outfalls (STW-001) was located at the northwest entrance to the site, and the second historical outfall (STW-002) was located in the southwest corner of the site.

In an NPDES-equivalent document dated October 2, 1998, MDNR established storm-water discharge requirements for three outfalls at SLAPS in conjunction with the proposed construction of the sedimentation basin. These three storm-water discharge outfalls at SLAPS replaced the historical outfalls and were designated as Outfall PN01, Outfall PN02, and Outfall PN03. Outfall PN01 is located at the termination of the drainage feature that conveys storm water along the south side of McDonnell Boulevard to CWC. Outfall PN01 actually consists of two separate outfalls. Outfall PN01a is the discharge point for the sedimentation basin, and Outfall PN01b is the discharge point for the emergency spillway. Outfall PN01b is located near historical Outfall STW-001. In May 2008, USACE notified MDNR that the monitoring of Outfall PN01 was terminated due to the completion of remedial actions at SLAPS (USACE 2008c).

Outfall PN02 is located at the termination of a drainage feature that conveys storm water along the north side of McDonnell Boulevard to CWC. On February 19, 2002, MDNR issued a letter to USACE conditionally agreeing with a request to reduce the sampling frequency at PN02 to once per year, effective February 2002 until the drainage area becomes affected by soil disturbance such as excavation (MDNR 2002). On November 26, 2013, the sampling frequency at PN02 returned to monthly due to the remedial activities at the Ballfields (IA-09). Sampling frequency at PN02 was again reduced to annually on June 17, 2014, when remedial activities at the Ballfields (IA-09) were discontinued. USACE again increased the sampling frequency at PN02 from annually (MDNR 2002) to monthly as of August 30, 2017, because remediation resumed at IA-09 (Ballfields). Sampling frequency at PN02 was again temporary reduced to annually on October 31, 2017, when remediation was discontinued at IA-09 (Ballfields). On December 4, 2017, USACE notified MDNR that the sampling frequency at PN02 was increased from annually (MDNR 2002) to monthly because remediation resumed at IA-09 (Ballfields). Sampling frequency at PN02 was temporarily reduced to annually on February 8, 2018, when remediation was discontinued at IA-09 (Ballfields). On April 19, 2018, USACE notified MDNR that the sampling frequency at PN02 was increased from annually (MDNR 2002) to monthly because remediation resumed at IA-09 (Ballfields). Outfall PN03 was discontinued as a sampling location in accordance with a letter from MDNR dated February 19, 2002 (MDNR 2002).

As previously described, starting in April of CY 2007, un-named moving pumping outfalls were utilized during excavation activities at the North St. Louis County Sites for the management of storm water with regard to sediment control and pumped excavation water. The moving outfalls were necessary to pump excess excavation water to CWC. The excavation water was pumped to CWC in accordance with agreements made during a March 12, 2007, meeting with Mr. Tom Siegel, MDNR, and as described in a subsequent April 20, 2007, letter from USACE (USACE 2007). The excavation-water sampling is being conducted to verify compliance with the NPDES permit-equivalent requirements. The parameters for the un-named outfalls follow the same NPDES parameters as PN02.

During CY 2014, storm-water monitoring was conducted at Outfall PN02. One un-named moving pumping outfall was utilized during excavation activities at VP-57 and VP-58, and the Pershall Road South Ditch. All NPDES permit-specific sample results from SLAPS were in compliance with NPDES permit-equivalent requirements.

In CY 2015, storm-water monitoring was conducted at Outfall PN02. Two un-named moving pumping outfalls were utilized during excavation activities at VP-57 and VP-58, the Pershall Road South Ditch, and St. Cin Park. All NPDES permit-specific sample results from SLAPS were in compliance with NPDES permit-equivalent requirements.

During CY 2016, storm-water monitoring was conducted at Outfall PN02. One un-named moving pumping outfall was utilized during excavation activities at Duchesne Park. All NPDES permit-specific sample results from SLAPS were in compliance with NPDES permit-equivalent requirements.

During CY 2017, storm-water monitoring was conducted at Outfall PN02. Two un-named moving pumping outfalls were utilized during excavation activities at Duchesne Park and the Palm Drive Properties. All NPDES permit-specific sample results from SLAPS were in compliance with NPDES permit-equivalent requirements.

During CY 2018, storm-water monitoring was conducted at Outfall PN02. All NPDES permit-specific sample results from SLAPS were in compliance with NPDES permit-equivalent requirements.

3.7 SITE INSPECTION

A site inspection was conducted at the North St. Louis County Sites on July 31, 2019. The site inspection participants were a subset of the Five-Year review team and are identified in Table 31. The purpose of the inspection was to visually assess the implementation and effectiveness of the remedial actions conducted at the North St. Louis County Sites. Those offices participating in the inspection included USACE (St. Louis District), USEPA, MDNR, and DOE. A Site Inspection Checklist was completed for each inspection (see Appendix A). The checklist focuses on the implementation of the remedy, adequacy of O&M, early indicators of potential remedy problems, and opportunities for optimization.

No issues were identified as part of the site inspection. The general site conditions were good, and the areas are well maintained. Site access appeared to be sufficiently restricted where necessary. Fences, gates, and signage were in good condition. No equipment was observed to be in disrepair during the inspections. Ground-water monitoring wells were observed to be secure and well maintained. No additional tasks or opportunities for optimization were identified during the inspection. No potential land use changes that would lessen the effectiveness of the selected remedy for the sites have occurred or are planned to occur.

3.8 INTERVIEWS

Interviews were conducted between July and September, 2019. Interview candidates were identified from a variety of organizations and groups familiar with the remediation being conducted at the North St. Louis County Sites under FUSRAP. Not all of those invited to participate chose to do so. Respondents included key site and contractor personnel involved in remediation projects at the North St. Louis County Sites; local residents and business owners; several members of citizen interest groups (e.g., the "Coldwater Creek – Just the Facts Please" public group); and local, state, and federal government agency representatives.

A complete list of interview questions and responses are provided on the individual interview record forms included in Appendix B, along with a list of the respondents. A summary of the interview results follows.

In general, the respondents expressed a positive overall impression of the project. They stated that they believed that the project is being done in an effective and thorough manner. They also commended several individual members of the FUSRAP team for being very responsive, professional, and respectful when addressing community concerns and when working with other government agencies. While noting that the sampling and remediation activities have caused some disruptions in the use of local roads, parks, and trails, they acknowledged that FUSRAP was coordinating their activities with property/business owners and local agencies to ensure the operations had minimal impacts. A few respondents expressed concern that the pace of the work was being slowed by funding limitations.

Respondents generally reported feeling well informed of the site activities and progress. Respondents noted good communication between members of the FUSRAP team and the community, and indicated the information provided by the newsletters, website, and meetings has kept them well informed of the site activities and progress. However, three respondents expressed that while the FUSRAP PR representatives had done a great job in the past, the FUSRAP PR manager in CY 2018 was less responsive and less open with the community.

Several respondents identified some areas for improvement with respect to public outreach. One respondent proposed specific improvements to the public meetings, such as clearly limiting the scope of the meetings to prevent getting off-topic; using less technical jargon to help increase the audience's level of understanding; and defining some basic rules of conduct to help prevent and/or swiftly address arguments and emotional outbursts. Another respondent recommended adding more effective online communication with residents (e.g., a monthly question and answer [Q&A] post on the USACE Facebook page, and making it easier to sign up for the newsletter online). Another respondent suggested USACE conduct more frequent meetings and try to increase public attendance through area mailings or email.

One respondent would like FUSRAP to provide more information about the soil testing activities to help residents understand the process. That respondent suggested providing the information about the status of the soil sampling and remediation in a visual format, such as a color-coded map, so residents could more easily understand how the sampling and remediation process will affect their neighborhoods.

Respondents expressed some specific concerns about the effects of site operations on the surrounding community. In particular, many indicated a concern with the potential long-term health effects of radiological contamination exposure for those who grew up around or currently live in the area around CWC. In addition, some respondents pointed out that there are psychological impacts to the residents from the cleanup activities (i.e., the fear of health effects to residents) as well as concerns about the potential economic impacts (i.e., lowered property values). One respondent expressed awareness of public concerns over potential impacts to the surrounding community as a result of the transport of excavated materials through the community. The respondent suggested more community outreach be conducted to educate the public about the safety measures taken during the transport of wastes and their disposition at the disposal site. DOE expressed a concern that future property owners might not be fully informed of site conditions because the FSS information is not being recorded by local government agencies. DOE recommended that USACE should make efforts to record the FSS for each parcel with the appropriate city/county agency to ensure this information is tied to the property deed.

An Agency for Toxic Substances and Disease Registry (ATSDR) representative, as well as several members of the community, provided recommendations for additional sampling for CWC areas.

3.9 TECHNICAL ASSESSMENT

3.9.1 QUESTION A: Is the remedy functioning as intended by the decision documents?

Yes.

Although the remedial action at the North St. Louis County Sites is ongoing, the remedy is expected to function as intended by the decision documents. Based upon a review of the documents, ARARs, exposure assumptions, and the results of the site inspections, it has been determined that the actions taken to date have been implemented as intended by the NC ROD.

3.9.1.1 Remedial Action Performance

The excavation and off-site disposal of soil with COC concentrations exceeding the NC ROD RGs is being performed as prescribed in the NC ROD. The remediation of accessible soil contaminated by MED/AEC operations has achieved acceptable risks for the exposure scenarios applicable to suburban resident use as specified by the NC ROD.

Sampling of CWC's surface water and sediment was conducted semiannually at six monitoring stations (C002 through C007) until October 2014, when two additional monitoring stations (C008 and C009) were established and sampled. Following that, sampling of CWC's surface water and sediment has been conducted semiannually at eight monitoring stations (C002 through C009). The evaluation of the surface-water and sediment data indicates that the quality of the surface water and sediment in CWC has not been impacted by runoff from the remedial actions at the North St. Louis County Sites.

3.9.1.2 Systems Operations/Operations and Maintenance

No O&M activities have taken place at the North St. Louis County Sites. No O&M documents have been required for the North St. Louis County Sites.

3.9.1.3 Implementation of Institutional Controls and Other Measures

In areas where contamination will remain (i.e., in inaccessible soil areas), temporary institutional controls are in place to address any remaining health risks to ensure that residual COC concentrations that exceed the RGs do not pose an unacceptable risk. Permanent land use controls will be implemented at areas under roads, active rail lines, and other permanent structures at which the residual condition is not consistent with RGs.

3.9.2 QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Yes.

The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid, and any changes in these values have no impact on health-protectiveness. The information presented in the following subsections summarizes the rationale and evaluations that form the basis of this response.

3.9.2.1 Changes in Standards and To Be Considered

Chemical-specific and action-specific ARARs were identified in the NC ROD (USACE 2005a) and are presented in Appendix C, Attachment C-2. No location-specific ARARs were identified in the NC ROD. Tables C-2-1 and C-2-2 in Attachment C-2 present lists and analyses of chemical-specific and action-specific ARARs, respectively, relative to the current remedy that is ongoing at the North St. Louis County Sites. Table C-2-1 shows that no changes or updates have occurred to any of the chemical-specific ARARs identified in the NC ROD, and all chemical-specific ARARs identified in the NC ROD remain valid.

Table C-2-1 shows that only Missouri Title 10 *CSR* 23, an action-specific ARAR identified in the NC ROD has been changed or updated. The following ARARs were based on Missouri Title 10 (Department of Natural Resources) *CSR* Division 23, Chapter 4, *Monitoring Well Construction Code*, the following requirements were identified as being applicable to the selected remedy: 10 *CSR* 23-4.030 through 10 *CSR* 23-4.080. Since the issuance of the NC ROD, the following requirements have been rescinded: 10 *CSR* 23-4.030, *Location of Wells* (Rescinded 2/28/2019); 10 *CSR* 23-4.040, *Drilling Methods for Monitoring Wells* (Rescinded 7/30/2011); and 10 *CSR* 23-4.070, *Monitoring Well Development* (Rescinded 7/30/2011). The remaining requirements (10 *CSR* 23-4.050, *General Protection of Groundwater Quality and Resources;* 10 *CSR* 23-4.060, *Construction Standards for Monitoring Wells;* and 10 *CSR* 23-4.080, *Plugging of Monitoring Wells*) have not been rescinded and are still considered to be applicable.

Based on the evaluations in Attachment C-2, all chemical- and action-specific ARARs and TBCs remain health-protective.

3.9.2.2 Changes in Exposure Pathways, Exposure Assumptions and Risk Assessment Methods

Since issuance of the Third Five-Year Review Report, no changes have occurred in the exposure pathways, exposure assumptions, or risk assessment methods that are used in calculating pre- and post-remediation human health risk and dose to receptors for the purpose of determining compliance of the remedy with the requirements of the NC ROD. Since the Third Five-Year Review, ANL released the current RESRAD model version, RESRAD-ONSITE Version 7.2, on July 20, 2016. The updates within this version include options to select between the radionuclide decay chain databases based on ICRP-38 (ICRP 1983) versus ICRP-107 (ICRP 2008). ICRP-107 contains a revised database of nuclear decay data (energies and intensities of emitted radiations, physical half-lives, and decay models) for 1,252 naturally occurring and manmade radionuclides, and supersedes the previous database, ICRP-38, which was published in 1983. As indicated in the Third Five-Year Review Report (USACE 2015a), USACE has applied the ICRP-107 database since the release of RESRAD Version 7.0. Therefore, since there have been no changes in user-defined or model default exposure pathways, assumptions, or calculation methods applied in the model, there are no differences in the risks and doses produced by either model version when applying the ICRP-107 decay chain. Therefore, the remedy remains health-protective.

3.9.2.3 Changes in Toxicity or Contaminant Characteristics

No changes have occurred in the characteristics of the radiological or metal COCs identified for the North St. Louis County Sites. The Third Five-Year Review Report (USACE 2015a) describes, in detail, changes in CSFs for radiological and metal COCs, DCFs for radiological COCs, and noncarcinogenic toxicity criteria for metal COCs that had occurred between the signing of the NC ROD and issuance of the Third Five-Year Review Report. For the radiological COCs, CSFs and DCFs updates were based on *Calculation of Slope Factors and Dose Coefficients* (ORNL 2014). The new factors were calculated by ORNL using DCAL software in the manner of FGR-12 (USEPA 1993) and FGR-13 (USEPA 1999) and were based on the ICRP-107 decay chain database. These updates are available in the DCFPAK 3.02 library program, which is integrated with both the RESRAD Version 7.0 and RESRAD-ONSITE Version 7.2 models. DCFPAK 3.02 allows the user to select from 14 different DCF and CSF libraries. Based on an evaluation of the CSFs and DCFs conducted over the range of age groups in Appendix F, Attachment F-1, of the Third Five-Year Review Report (USACE 2015a), USACE determined that future residual risk and dose assessments would be conducted using the DCFPAK 3.02 (adult) CSFs and DCFs. Consequently, this library has continued to be applied in the RESRAD-ONSITE Version 7.2 model for evaluations of the North St. Louis County Sites since the third five-year review. Further evaluations in the Third Five-Year Review Report (USACE 2015a), using radiological data from previously remediated sites considered to be complete, in conjunction with the CSFs and DCFs in the DCFPAK 3.02 (Adult) library, USACE determined that the remedy being implemented at the North St. Louis County Sites is expected to remain protective of human health and the environment upon completion.

Sections 3.9.2.3.1 and 3.9.2.3.2 below discuss changes in toxicity criteria for radiological and metal COCs, respectively.

3.9.2.3.1 Changes in Radiological Cancer Slope Factors and Dose Conversion Factors

Since the release of RESRAD Version 7.0, updated internal and external exposure DCFs and CSFs published in the *Calculation of Slope Factors and Dose Coefficients* (ORNL 2014) have been incorporated into the DCFPAK 3.02 library program (with the exception of the soil ingestion CSFs) that is integrated into both the RESRAD Version 7.0 and RESRAD-ONSITE Version 7.2 models. However, a more recent update of external exposure DCFs was published in 2019 by USEPA in FGR-15 (USEPA 2019a). In addition to providing updated external exposure DCFs, FGR-15 expands upon FGR-12 by providing age-specific DCFs for external exposures to radionuclides in air, water, and soil. FGR-12 external DCFs were used in dose assessments performed using the earlier versions of the RESRAD model for the North St. Louis County Sites prior to the Third Five-Year Review Report (USACE 2015a).

Risk and dose assessments of accessible soil areas at the North St. Louis County Sites completed within this Fourth Five-Year Review period, as well as prior Five-Year Review periods, incorporate analysis of external radiation exposures from soil through application of CSFs and DCFs based on infinite depth (i.e., also referred to as infinite volume). CSFs and DCFs for external radiation exposures to soil are available from ORNL (ORNL 2014) and FGR-15 (USEPA 2019a), with the latter being applicable only to DCFs, for the following depths: ground plane, 1 cm, 5 cm, 15 cm, and infinite depth (or soil volume). Infinite depth values have been applied in RESRAD calculations for North St. Louis County Sites because a contaminated zone thickness of 0.3 m, which is representative of the vertical extent of contamination typically evaluated in PDIR-FSSEs and PRAR-FSSEs for Class 2 areas and in post-remedy Class 1 areas. Therefore, the use of infinite depth DCFs are considered applicable in RESRAD calculations for the North St. Louis County Sites.

In order to assess potential impacts of the updated FGR-15 DCFs on the health-protectiveness of remedy verifications completed during this five-year review period, two evaluations have been conducted. First, an analysis comparing DCFPAK 3.02 (Adult) library external radiation (infinite depth) morbidity DCFs for North St. Louis County Sites radiological COCs (not including decay progeny) versus corresponding FGR-15 (Adult) values was performed. Given the differences noted between the two sets of DCFs, a second set of evaluations were performed. This involved recalculations of external radiation and maximum total effective doses (i.e., occurring over a 1,000-year period of evaluation) for one North St. Louis County Sites property included in this Five-Year Review, as well as for one North St. Louis County Sites property included in past five-year reviews, using FGR-15 external radiation DCFs for infinite volume. North St. Louis County Sites properties associated with the highest maximum total doses were selected for recalculations of external radiation dose and maximum total dose. For this Five-Year Review period, the highest maximum total dose at the North St. Louis County Sites (2.8 mrem per year) was estimated for resident gardener exposures to accessible soil (without ground cover/backfill) at CWC properties CWC-94, CWC-96, CWC-98, and Industrial Lane (USACE 2019d). Of the North St. Louis County Sites with verifications completed prior to this Fourth Five-Year Review Report for which no further removal actions have been conducted, the most elevated maximum total dose (4.6 mrem per year) was estimated for resident gardener exposures to accessible soil at VP- 53 (USACE 2011e). Verification of remedial actions at VP-53 were completed and documented within the Third Five-Year Review Report (USACE 2015a).

The details of the aforementioned external radiation DCF evaluations are discussed in Appendix D. The results of both evaluations (i.e., comparisons of external radiation DCFs and dose recalculations) demonstrate that the remedy being applied at the North St. Louis County Sites remains health-protective.

USEPA has not issued new FGRs pertaining to publication of updated radiological CSFs. Because no changes or updates to radiological CSFs have occurred since the Third Five-Year review, no further review is needed.

3.9.2.3.2 Changes in Radiological Cancer Slope Factors

USEPA has not issued new FGRs pertaining to publication of updated radiological CSFs. Because no changes or updates to radiological CSFs have occurred since the third five-year review, no further review is needed.

3.9.2.3.3 Changes in Toxicity Criteria for Metal COCs

The following USEPA hierarchy of sources of chemical toxicity data (USEPA 2003) have been reviewed for updates relative to the North St. Louis County Sites metal COCs:

- Tier 1 Source – Integrated Risk Information System (USEPA 2019b)
- Tier 2 Source – USEPA Provisional Peer-Reviewed Toxicity Values

- Tier 3 Sources – Other peer-reviewed federal and state toxicity values, as cited in the USEPA's online RSL tables (USEPA 2019c) and the ORNL's online Risk Assessment Information System (ORNL 2019)
  - Agency for Toxic Substances and Disease Registry
  - CalEPA toxicity database (CalEPA 2019)

Because no changes or updates to carcinogenic and non-carcinogenic toxicity criteria used to evaluate North St. Louis County Sites metal COCs have occurred since the Third Five-Year Review, no further review is needed.

3.9.3 QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No.

Other than remedial activities having been conducted, no natural or manmade changes to the physical or biological characteristics of the North St. Louis County Sites have occurred that would impact current or expected land use patterns, or that would change human or ecological exposure conditions. Therefore, no new information has come to light that could call into question the protectiveness of the remedy at the North St. Louis County Sites.

3.9.4 Technical Assessment Summary

Thirteen (13) PDIR-FSSE documents that cover numerous North St. Louis County Site properties have been completed during this Fourth Five-Year Review period. Active remediation and a PRAR-FSSE was conducted for one property, St. Cin Park (CWC-56). The FSSEs performed for all 13 properties verify that soil and structures meet RGs and health protection requirements that are consistent with current and expected future land use of the North St. Louis County Sites, as established by the NC ROD. In response to Question A, based upon a review of the applicable verification documentation and the results of the site inspections, it has been determined that the actions taken to date have been implemented as intended by the NC ROD.

In addition to the FSSEs, risk and dose assessments were conducted; these assessments incorporated the latest and best data and information available relative to physical and contaminant site characteristics, ARARs, risk and dose assessment methodology, exposure pathways and assumptions, and radiological and chemical toxicity characteristics.

Since completion of the Third Five-Year Review Report, there has been an update to the RESRAD model version (i.e., RESRAD Version 7.0 update to RESRAD-ONSITE Version 7.2 on July 20, 2016). This update has been identified and is evaluated as part of this Fourth Five-Year Review Report relative to potential impacts on remedy health protection. No changes or updates have occurred relative to standards and TBCs, exposure pathways, exposure assumptions, radiological CSFs, or chemical toxicity criteria. Based on the responses to Question B and the health-protectiveness evaluations pertaining to each of the identified changes/updates/issue, the remedy remains health-protective.

Finally, other than remedial activities having been conducted, no natural or manmade changes to the physical or biological characteristics of the North St. Louis County Sites have occurred that would impact current or expected land use patterns, or that would change human or ecological exposure conditions. Therefore, in response to Question C, no new information has come to light that could call into question the protectiveness of the remedy at the North St. Louis County Sites.

3.10 ISSUES

No issues affecting the protectiveness of the remedy have been identified for the North St. Louis County Sites.

3.11 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 52. Recommendations and Follow-up Actions

Observation	Recommendations/Follow-up Actions	Party Responsible	Affects Protectiveness? (Y/N)	
			Current	Future
Ground-water monitoring results indicate that total U concentrations in the shallow (HZ-A) ground-water monitoring well PW46, located at the western edge of SLAPS, consistently exceed the 30 µg/L monitoring guideline established in the NC ROD.	Continue monitoring ground water, surface water, and sediment to ensure that the elevated total U concentrations in shallow ground water do not impact CWC. Evaluate the condition of monitoring well PW46 located at the western edge of SLAPS to determine if well decommissioning and replacement is necessary.	USACE	N	N
Indoor radon monitoring location HF-2 has a trend of exceeding 0.02 WL, but is less than 0.03 WL (40 *CFR* 192.12(b)).	Continue monitoring radon and review the monitoring location for representativeness of breathing air for workers over the course of a year.	USACE	N	N
The external gamma radiation at SLAPS monitoring location exceeds 19 mrem/year (10 *CFR* 40, Appendix A, Criterion 6(6)).	Continue monitoring radon and review the monitoring location for representativeness of public access to this location.	USACE	N	N

3.12 PROTECTIVENESS STATEMENT

The remedy at the North St. Louis County Sites is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have addressed all exposure pathways that could result in unacceptable risks in these areas.

3.13 NEXT FIVE-YEAR REVIEW

The next five-year review is scheduled for completion no later than 5 years from the signature date of this report (anticipated to be August 2025).

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4.0 REFERENCES

40 *CFR* 300, 2000, *Code of Federal Regulations,* Title 40, "Protection of Environment," Part 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Office of the Federal Register.

42 USC § 9601 et seq., 1980. "Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA/Superfund)." *United States Code.* December 11.

BNI 1996. Bechtel National, Inc. *Groundwater Contaminant Migration Modeling for the St. Louis Airport Site.* August.

CalEPA 2019. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA). "Online Risk Assessment Chemical Database." https://oehha.ca.gov/chemicals.

City of St. Louis 2005. City Ordinance 66777, effective August 2005.

DOD 2000. U.S. Department of Defense, U.S. Department of Energy, U.S. Environmental Protection Agency, and U.S. Nuclear Regulatory Commission. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).* NUREG 1575. USEPA 402-R-97-016. August.

DOD and DOE 2017. U.S. Department of Defense and U.S. Department of Energy. *Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories*. DOD Quality Systems Manual Version 5.1 and DOE Quality Systems for Analytical Services Version 3.1. 2017.

DOE 1991. U.S. Department of Energy. *Engineering Evaluation/Cost Analysis for Decontamination at the St. Louis Downtown Site.* St. Louis, Missouri. DOE/OR/23701-02.2. May.

DOE 1992. U.S. Department of Energy. *Engineering Evaluation/Cost Analysis – Environmental Assessment for the Proposed Decontamination of Properties in the Vicinity of the Hazelwood Interim Storage Site, Hazelwood, Missouri.* DOE/EA-0489. Revision 1. March.

DOE 1994. U.S. Department of Energy, Oak Ridge Operations Office. *Remedial Investigation Report for the St. Louis Site, St. Louis, Missouri.* DOE/OR/21949-280. January.

DOE 1995a. U.S. Department of Energy. *Remedial Investigation Addendum for the St. Louis Site.* St. Louis, Missouri. DOE/OR-21950-132. September.

DOE 1995b. U.S. Department of Energy. *St. Louis Site – Action Memorandum for Vicinity Property Cleanups.* Memorandum from L.K. Price (OR-FSRD) to File, CCN 130703. June 2.

DOE 1997a. U.S. Department of Energy. *St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA).* St. Louis, Missouri. DOE/OR/21950-1026. Final. September.

DOE 1997b. U.S. Department of Energy. *SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material.* Memorandum from Steve McCracken (St. Louis Site Manager) to File. September 17.

DOE and USACE 1999. U.S. Department of Energy and U.S. Army Corps of Engineers. *Memorandum of Understanding between the U.S. Department of Energy and the U.S. Army Corps of Engineers Regarding Program Administration and Execution of the Formerly Utilized Sites Remedial Action Program (FUSRAP).* March.

ICRP 1983. International Commission on Radiological Protection. *Annals of the ICRP, Publication 38, Radionuclide Transformations – Energy and Intensity of Emissions.*

ICRP 2008. International Commission on Radiological Protection. *Annals of the ICRP, Publication 107, Nuclear Decay Data for Dosimetric Calculations.*

IT 1999. IT Corporation. *Remedial Action Work Plan, FUSRAP St. Louis Downtown Site, St. Louis, Missouri.* Revision 1. December.

MDNR 1998. Missouri Department of Natural Resources. Letter dated October 2, 1998. From Philip A. Schroeder, Permit Section Chief, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: St. Louis Airport Site (SLAPS), St. Louis, Missouri.

MDNR 2002. Missouri Department of Natural Resources. Letter dated February 19, 2002. From Matthew Sikes to Sharon Cotner, USACE FUSRAP Project Manager. Subject: Reduce Sampling at SLAPS Outfall 0002.

MSD 1991. Metropolitan St. Louis Sewer District. Ordinance No. 8472. Adopted August 14.

MSD 1994. Metropolitan St. Louis Sewer District. Ordinance No. 10177. Adopted November 9.

MSD 1997. Metropolitan St. Louis Sewer District. Ordinance No. 10082. Adopted May 8.

MSD 1998. Metropolitan St. Louis Sewer District. Letter dated October 30, 1998. From Bruce H. Litzsinger, Civil Engineer, to Ken Axetel, International Technology Corporation.

MSD 2001a. Metropolitan St. Louis Sewer District. Letter dated July 23, 2001. From Bruce H. Litzsinger, Civil Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: St. Louis Downtown Site. File: IU – Mallinckrodt 21120596-00.

MSD 2001b. Metropolitan St. Louis Sewer District. Letter dated July 23, 2001. From Bruce H. Litzsinger, Civil Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: St. Louis Airport Site, File: SD – St. Louis Airport FUSRAP Site, 110 McDonnell.

MSD 2004. Metropolitan St. Louis Sewer District. Letter dated October 13, 2004. From Roland A. Biehl, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. File: IU – Mallinckrodt 21120596-00.

MSD 2005. Metropolitan St. Louis Sewer District. Letter dated February 10, 2005. From Roland A. Biehl, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager.

MSD 2006a. Metropolitan St. Louis Sewer District. Letter dated June 19, 2006. From Roland A. Biehl, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Downtown Site, File: IU-Mallinckrodt 2112059600, SP809.

MSD 2006b. Metropolitan St. Louis Sewer District. Letter dated June 19, 2006. From Roland A. Biehl, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Airport Site, Special Discharge Permit Extension.

MSD 2008a. Metropolitan St. Louis Sewer District. Letter dated May 22, 2008. From Steven M. Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Downtown Site, File: IU-Mallinckrodt 2112059600, SP809.

MSD 2008b. Metropolitan St. Louis Sewer District. Letter dated May 22, 2008. From Steve Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Airport Site, File: SD, St. Louis Airport FUSRAP Site, 9012138501.

MSD 2010a. Metropolitan St. Louis Sewer District. Letter dated May 10, 2010. From Steven M. Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Downtown Site, File: IU-Mallinckrodt 2112059600, SP809.

MSD 2010b. Metropolitan St. Louis Sewer District. Letter dated May 10, 2010. From Steve Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Airport Site, File: SD, St. Louis Airport FUSRAP Site, 9012138501, SP801.

MSD 2012a. Metropolitan St. Louis Sewer District. Letter dated May 24, 2012. From Steven M. Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Downtown Site, File: IU-Mallinckrodt 2112059600, SP801.

MSD 2012b. Metropolitan St. Louis Sewer District. Letter dated May 24, 2012. From Steve Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Airport Site, File: SD, St. Louis Airport FUSRAP Site, 9012138501, SP801.

MSD 2014a. Metropolitan St. Louis Sewer District. Letter dated June 23, 2014. From Steven M. Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Downtown Site, File: IU-Mallinckrodt 1011728100, SP809.

MSD 2014b. Metropolitan St. Louis Sewer District. Letter dated June 23, 2014. From Steve Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Airport Site, File: SD, St. Louis Airport FUSRAP Site, 9012138501, SP801.

MSD 2016a. Metropolitan St. Louis Sewer District. Letter dated July 18, 2016. From Steven M. Grace, Environmental Assistant Engineer, to Bruce Munholand, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Downtown Site, File: IU-Mallinckrodt 1011728100, SP809.

MSD 2016b. Metropolitan St. Louis Sewer District. Letter dated June 18, 2016. From Steve Grace, Environmental Assistant Engineer, to Bruce Munholand, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Airport Site, File: SD, St. Louis Airport FUSRAP Site, 9012138501, SP801.

MSD 2018a. Metropolitan St. Louis Sewer District. Letter dated June 11, 2018. From Steven M. Grace, Environmental Assistant Engineer, to Bruce Munholand, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Downtown Site, File: IU-Mallinckrodt 1011728100, SP809.

MSD 2018b. Metropolitan St. Louis Sewer District. Letter dated June 11, 2018. From Steve Grace, Environmental Assistant Engineer, to Bruce Munholand, USACE FUSRAP Project Manager. Subject: FUSRAP St. Louis Airport Site, File: SD, St. Louis Airport FUSRAP Site, 9012138501, SP801.

MSD 2018c. Metropolitan St. Louis Sewer District. Letter dated February 7, 2018. From Steve Grace, Environmental Assistant Engineer, to Bruce Munholand, USACE FUSRAP Project Manager. Subject: SD, Hazelwood Interim Storage Site, SOUR057900, 8945 Latty Avenue, Berkeley, Missouri.

ORNL 1981. Oak Ridge National Laboratory. *Radiological Survey of Mallinckrodt Chemical Works, St. Louis, Missouri.* December.

ORNL 2014. Oak Ridge National Laboratory. Center for Radiation Protection Knowledge. *Calculation of Slope Factors and Dose Coefficients.* September.

Stone & Webster 2000. *Site Wide Removal Action Work Plan, FUSRAP St. Louis Airport Site.* St. Louis, Missouri. Revision 0 Addendum 1. March 3.

USACE 1998a. U.S. Army Corps of Engineers. *Record of Decision for the St. Louis Downtown Site.* St. Louis, Missouri. Final. October.

USACE 1998b. U.S. Army Corps of Engineers. *Feasibility Study for the St. Louis Downtown Site.* St. Louis, Missouri. Final. April.

USACE 1998c. U.S. Army Corps of Engineers. *Engineering Evaluation/Cost Analysis (EE/CA) for the Hazelwood Interim Storage Site (HISS).* St. Louis, Missouri. Final. October.

USACE 1999a. U.S. Army Corps of Engineers. *Post-Remedial Action Report for the St. Louis Downtown Site City-Owned Vicinity Property.* St. Louis, Missouri. Final. September.

USACE 1999b. U.S. Army Corps of Engineers. *Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum.* St. Louis, Missouri. Final. March.

USACE 1999c. U.S. Army Corps of Engineers. *Post-Remedial Action Report for the St. Denis Bridge Area.* St. Louis, Missouri. Final. July.

USACE 2001. U.S. Army Corps of Engineers. *Vicinity Property 38 Removal Action Summary.* Revision 3. Final. April 9.

USACE 2002a. U.S. Army Corps of Engineers. *Final Status Survey Evaluation for the St. Louis Downtown Site Archer Daniels Midland Vicinity Property (DT-1).* St. Louis, Missouri. Revision 0. June.

USACE 2002b. U.S. Army Corps of Engineers. *Post-Remedial Action Report for the Accessible Soils Within the St. Louis Downtown Site Plant 2 Property*. St. Louis, Missouri. Revision 0. January.

USACE 2003a. U.S. Army Corps of Engineers. *Phase 1 Ground-Water Remedial Action Alternative Assessment (GRAAA) at SLDS.* St. Louis, Missouri. Final. June 30.

USACE 2003b. U.S. Army Corps of Engineers. *Feasibility Study for the St. Louis North County Site.* St. Louis, Missouri. Final. May 1.

USACE 2003c. U.S. Army Corps of Engineers. *Proposed Plan for the St. Louis North County Site*. St. Louis, Missouri. Final. May 1.

USACE 2003d. U.S. Army Corps of Engineers. Letter dated November 18. From Sharon Cotner, USACE FUSRAP Project Manager, to Phillip A. Schroeder, Permit Section Chief, MDNR.

USACE 2004a. U.S. Army Corps of Engineers. *Five-Year Review Report: Initial Five-Year Review Report for Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites.* St. Louis, Missouri. Final. August 23.

USACE 2004b. U.S. Army Corps of Engineers. *Post-Remedial Action Report for the Accessible Soils within the St. Louis Downtown Site Plant 1 Property.* St. Louis, Missouri. Revision 0. September 10.

USACE 2005a. U.S. Army Corps of Engineers. *Record of Decision for the North St. Louis County Sites.* St. Louis, Missouri. Final. September 2.

USACE 2005b. U.S. Army Corps of Engineers. *Memorandum for Record: Non-Significant Change to the Record of Decision for the St. Louis Downtown Site*. March 31.

USACE 2005c. U.S. Army Corps of Engineers. *Post-Remedial Action Report for the Accessible Soils Within the St. Louis Downtown Site, Heintz Steel and Manufacturing Vicinity Property (DT-6) and Midwest Waste Vicinity Property (DT-7)*. St. Louis, Missouri. Revision 0. September 22.

USACE 2005d. U.S. Army Corps of Engineers. *Post-Remedial Action Report for the Soils Within the St. Louis Downtown Site City of Venice, Illinois Property (DT-11).* St. Louis, Missouri. Revision 0. September 22.

USACE 2005e. U.S. Army Corps of Engineers. *Post-Remedial Action Report for the Accessible Soils within the St. Louis Downtown Site Midtown Garage Vicinity Property (DT-29).* St. Louis, Missouri. Revision 0. October 18.

USACE 2005f. U.S. Army Corps of Engineers. *VP-2(L) Building Roof Remediation Final Status Survey Evaluation Report.* St. Louis, Missouri. Revision 0. August 31.

USACE 2006a. U.S. Army Corps of Engineers. *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.* St. Louis, Missouri. Revision 0. May 25.

USACE 2006b. U.S. Army Corps of Engineers. *Final Status Survey Evaluation for the SLAPS Vicinity Property 27.* St. Louis, Missouri. Revision 0. March 30.

USACE 2007. U.S. Army Corps of Engineers. Letter dated April 20, 2007. From Sharon Cotner, USACE FUSRAP Project Manager, to Thomas Siegel, Permit and Engineering Chief, MDNR. Subject: Sediment Control and Pumped Excavation Water Outfall Vicinity Properties 08(c) and 40A.

USACE 2008a. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report, Investigation Area (IA)-09: Ballfields, IA-08: North Ditch, IA-09: North Ditch, and Ballfields: North of IA-09, North St. Louis County Sites.* St. Louis, Missouri. Revision 0. October 23.

USACE 2008b. U.S. Army Corps of Engineers. *Pre-Design Investigation and Final Status Survey Evaluation for the SLAPS Vicinity Properties 21, 22, 23, 24, 26, 28, 29, 30 and 31, North St. Louis County Sites.* St. Louis, Missouri. Revision 0. May 7.

USACE 2008c. U.S. Army Corps of Engineers. Letter dated May 6, 2008. From Sharon Cotner, USACE FUSRAP Project Manager, to Kurt Riebeling, MDNR Water Pollution Control Program. Subject: Termination of Sampling at Outfall 001.

USACE 2009a. U.S. Army Corps of Engineers. *Pre-Design Investigation Data Summary Report, City Property Vicinity Property (DT-2), FUSRAP St. Louis Downtown Site.* St. Louis, Missouri. Revision 0. May 6.

USACE 2009b. U.S. Army Corps of Engineers. *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.* St. Louis, Missouri. Revision 0. April 3.

USACE 2009c. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the SLAPS Vicinity Properties 17, 18, 19, 20, 20A, and 25.* St. Louis, Missouri. Revision 0. August 12.

USACE 2009d. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the SLAPS Vicinity Properties 41, 43, 44, 45, 46, 48, 48A, 49, 50, 51 and 52.* St. Louis, Missouri. Revision 0. September 18.

USACE 2009e. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site, Includes Investigation Areas 01 through 07, Investigation Area 08: South Ditch, Parts of Investigation Areas 11 and 12, and Coldwater Creek: West of IA-01.* St. Louis, Missouri. Revision 0. May 14.

USACE 2010a. U.S. Army Corps of Engineers. *Five-Year Review: Second Five-Year Review Report for Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites.* St. Louis, Missouri. Final. September 22.

USACE 2010b. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Accessible Soils within the St. Louis Downtown Site Vicinity Properties DT-5, DT-13, DT-14, DT-16, DT-18, and the Second Street Corridor*. St. Louis, Missouri. Revision 0. October 25.

USACE 2010c. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Vicinity Property Thomas and Proetz Lumber Company (DT-10).* St. Louis, Missouri. Revision 0. July 12.

USACE 2010d. U.S. Army Corps of Engineers. *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*. St. Louis, Missouri. Revision 0. November 2.

USACE 2010e. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the SLAPS Vicinity Properties 33, 34, and 37.* St. Louis, Missouri. Revision 0. September 23.

USACE 2010f. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Vicinity Properties 01(L) and Parcel 10K530087.* St. Louis, Missouri. Revision 0. May 28.

USACE 2010g. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for Hazelwood Avenue, the Right-of-Way Adjacent to Hazelwood Avenue (Partial) and St. Louis Airport Site Vicinity Properties 32, 35, 35A, 36, 39, 40, 42 and 47.* St. Louis, Missouri. Revision 0. September 28.

USACE 2011a. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Data Report for Eva Road Vicinity Property.* St. Louis, Missouri. Revision 0. November 22.

USACE 2011b. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 03 and 04.* St. Louis, Missouri. Revision 0. June 24.

USACE 2011c. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 05 and 06.* St. Louis, Missouri. Revision 0. August 3.

USACE 2011d. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 08 and 09.* St. Louis, Missouri. Revision 0. August 3.

USACE 2011e. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for St. Louis Airport Site Vicinity Property 53.* St. Louis, Missouri. Revision 0. August 15.

USACE 2011f. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for St. Louis Airport Site Vicinity Property 63.* St. Louis, Missouri. Revision 0. September 8.

USACE 2011g. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for St. Louis Airport Site Vicinity Property 54.* St. Louis, Missouri. Revision 0. December 12.

USACE 2011h. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for St. Louis Airport Site Vicinity Property 55.* St. Louis, Missouri. Revision 0. December 12.

USACE 2012a. U.S. Army Corps of Engineers. *Updated Remedial Action Summary for Phase 1 Portion of City Property (DT-2) West of Mississippi River Flood Protection Levee, FUSRAP St. Louis Downtown Site.* St. Louis, Missouri. June 19.

USACE 2012b. U.S. Army Corps of Engineers. *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).* St. Louis, Missouri. Revision 0. August 27.

USACE 2012c. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property DT-34.* St. Louis, Missouri. Revision 0. September 21.

USACE 2012d. U.S. Army Corps of Engineers. *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).* St. Louis, Missouri. Revision 0. May 18.

USACE 2012e. U.S. Army Corps of Engineers. *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).* St. Louis, Missouri. Revision 0. September 14.

USACE 2012f. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Vicinity Properties 03(L), 04(L), 05(L) and 06(L).* St. Louis, Missouri. Revision 0. September 27.

USACE 2012g. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Vicinity Property 02(L).* St. Louis, Missouri. Revision 0. December 21.

USACE 2013a. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report, Kiesel Hall Street Property, FUSRAP St. Louis Downtown Site.* St. Louis, Missouri. Revision 0. March 14.

USACE 2013b. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Lange-Stegmann (DT-37).* St. Louis, Missouri. Revision 0. September 23.

USACE 2013c. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Vicinity Property PSC Metals, Inc. (DT-8).* St. Louis, Missouri. Revision 0. July 15.

USACE 2013d. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Vicinity Property Terminal Railroad Association Soil Spoils Area.* St. Louis, Missouri. Revision 0. September 10.

USACE 2013e. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Vicinity Property Norfolk Southern Railroad (DT-3*). St. Louis, Missouri. Revision 0. September 23.

USACE 2013f. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Property 40A (Partial)*. St. Louis, Missouri. Revision 0. August 13.

USACE 2013g. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 09(C), 10(C), and the Road Right-of-Way (Partial).* St. Louis, Missouri. Revision 0. September 18.

USACE 2013h. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 60, 61, and 62 and Parcels 09K130104A and 09K130104B.* St. Louis, Missouri. Revision 0. July 30.

USACE 2013i. U.S. Army Corps of Engineers. *Remedial Action Summary for the Frost Avenue Right-of-Way, FUSRAP North St. Louis County Sites.* St. Louis, Missouri. Final. January 30.

USACE 2013j. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 10, 11, and 12.* St. Louis, Missouri. Revision 0. September 5.

USACE 2013k. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property 31A.* St. Louis, Missouri. Revision 0. September 18.

USACE 2013l. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Vicinity Property Hazelwood Interim Storage Site.* St. Louis, Missouri. Revision 0. September 25.

USACE 2013m. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property Investigation Area 13 Airport Authority.* St. Louis, Missouri. Revision 0. September 27.

USACE 2013n. U.S. Army Corps of Engineers. *Remedial Action Summary for the Abandoned Culvert Pipe at the St. Louis Airport Site Vicinity Property Investigation Area-13: Airport Authority and Banshee Road.* St. Louis, Missouri. Revision 0. December 19.

USACE 2013o. U.S. Army Corps of Engineers. *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2014.* St. Louis, Missouri. Revision 0. December 27.

USACE 2014a. U.S. Army Corps of Engineers. *Record of Decision for the Inaccessible Soil Operable Unit Associated with Group 1 Properties at the St. Louis Downtown Site.* St. Louis, Missouri. Revision 0. September 29.

USACE 2014b. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report Destrehan Street - East, FUSRAP St. Louis Downtown Site, St. Louis, Missouri.* Revision 0. August 11.

USACE 2014c. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Burlington Northern Santa Fe Railroad (DT-12).* St. Louis, Missouri. Revision 0. August 19.

USACE 2014d. U.S. Army Corps of Engineers. *Remedial Action Work Plan Coldwater Creek Properties, FUSRAP North St. Louis County Sites, St. Louis, Missouri.* Revision 0. September 17.

USACE 2014e. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Property Futura.* St. Louis, Missouri. Revision 0. September 4.

USACE 2014f. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Properties 01, 02, 07, 13, 14, 15, and Investigation Area 11 (Partial).* St. Louis, Missouri. Revision 0. September 3.

USACE 2014g. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Vicinity Property 16.* St. Louis, Missouri. Revision 0. July 9.

USACE 2014h. U.S. Army Corps of Engineers. *Addendum to the Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Vicinity Properties 01(L) and Parcel 10K530087 (including Parcels 10K530065 and 10K530076).* St. Louis, Missouri. Revision 0. December 19.

USACE 2014i. U.S. Army Corps of Engineers. *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2015.* St. Louis, Missouri. Revision 0. December 23.

USACE 2015a. U.S. Army Corps of Engineers. *Five-Year Review Report: Third Five-Year Review Report for Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites.* St. Louis, Missouri. Revision 0. July 31.

USACE 2015b. U.S. Army Corps of Engineers. *Community Involvement Plan for the St. Louis FUSRAP Sites.* St. Louis, Missouri. Revision 0. May.

USACE 2015c. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the Kiesel Hall Street Properties.* St. Louis, Missouri. Revision 0. August 27.

USACE 2015d. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Terminal Railroad Association (DT-9).* St. Louis, Missouri. Revision 0. March 3.

USACE 2015e. U.S. Army Corps of Engineers. *St. Louis Downtown Site Annual Environmental Monitoring Data and Analysis Report For Calendar Year 2014.* St. Louis, Missouri. Revision 0. June 30.

USACE 2015f. U.S. Army Corps of Engineers. *Remedial Design/Remedial Action Work Plan for the FUSRAP North St. Louis County Sites, St. Louis, Missouri.* March 30.

USACE 2015g. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report for St. Cin Park, the Archdiocese of St. Louis Property, and Duchesne Park, St. Louis, Missouri.* Revision 0. June 24.

USACE 2015h. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Byassee Drive and Adjacent Properties.* St. Louis, Missouri. Revision 0. February 20.

USACE 2015i. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property Banshee Road.* St. Louis, Missouri. Revision 0. February 20.

USACE 2015j. U.S. Army Corps of Engineers. *Institutional Controls Implementation Plan for the North St. Louis County Sites.* St. Louis, Missouri. Final. August 13.

USACE 2015k. U.S. Army Corps of Engineers. *North St. Louis County Sites Annual Environmental Monitoring Data and Analysis Report for Calendar Year 2014.* St. Louis, Missouri. Revision 0. June 30.

USACE 2016a. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils Within the St. Louis Downtown Site Kiesel Riverfront Property.* St. Louis, Missouri. Revision 0. March 2.

USACE 2016b. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 6 East Property.* St. Louis, Missouri. Revision 0. September 26.

USACE 2016c. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 7 East Property.* St. Louis, Missouri. Revision 0. September 27.

USACE 2016d. U.S. Army Corps of Engineers. *St. Louis Downtown Site Annual Environmental Monitoring Data and Analysis Report for CY 2015.* St. Louis, Missouri. Revision 0. June 21.

USACE 2016e. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report Palm Drive Properties, FUSRAP North St. Louis County Sites, St. Louis, Missouri,* July 18.

USACE 2016f. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for St. Louis Airport Site Vicinity Property 59.* St. Louis, Missouri. Revision 0. July 22.

USACE 2016g. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Seeger-5 and Seeger-6, St. Louis, Missouri.* Revision 0. September 15.

USACE 2016h. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for St. Louis Airport Site Vicinity Property 06(C)*. St. Louis, Missouri. Revision 0. September 15.

USACE 2016i. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property Investigation Area 12 (Partial).* St. Louis, Missouri. Revision 0. September 28.

USACE 2016j. U.S. Army Corps of Engineers. *North St. Louis County Sites Annual Environmental Monitoring Data and Analysis Report for CY 2015.* St. Louis, Missouri. Revision 0. June 21.

USACE 2016k. U.S. Army Corps of Engineers. *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2016.* St. Louis, Missouri. Revision 0. January 29.

USACE 2016l. U.S. Army Corps of Engineers. *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2017.* St. Louis, Missouri. Revision 0. December 29.

USACE 2017a. U.S. Army Corps of Engineers. *Remedial Design/Remedial Action Work Description Mallinckrodt Plant 1 Former Building 17 Area, Supplement No. 1 to the Remedial Action Work Plan for Selective Remediation at the St. Louis Downtown Site, FUSRAP St. Louis Downtown Site, St. Louis, Missouri.* Revision 0. April 11.

USACE 2017b. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Vicinity Property DT-31.* St. Louis, Missouri. Revision 0. September 13.

USACE 2017c. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 7 North and Plant 7 South Properties.* St. Louis, Missouri. Revision 0. September 27.

USACE 2017d. U.S. Army Corps of Engineers. *St. Louis Downtown Site Annual Environmental Monitoring Data and Analysis Report for CY 2016.* St. Louis, Missouri. Revision 0. July 21.

USACE 2017e. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-34 through CWC-44, CWC-46 through CWC-51, CWC-53 through CWC-55, CWC-56 (partial), CWC-59 through CWC-64, Foxtree Drive, Alma Drive, and St. Cin Lane.* St. Louis, Missouri. Revision 0. October 9.

USACE 2017f. U.S. Army Corps of Engineers. *Pre-Design Investigation Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-1, CWC 4 through CWC 8, CWC 13 through CWC 28, CWC 156, and Willow Lane.* St. Louis, Missouri. Revision 0. June 19.

USACE 2017g. U.S. Army Corps of Engineers. *North St. Louis County Sites Annual Environmental Monitoring Data and Analysis Report for CY 2016.* St. Louis, Missouri. Revision 0. July 21.

USACE 2017h. U.S. Army Corps of Engineers. *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2018.* St. Louis, Missouri. Revision 0. December 15.

USACE 2018a. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Vicinity Properties City Property (DT-2) West of the Levee and City of Venice (DT 11) (Partial)*. St. Louis, Missouri. Revision 1. August 20.

USACE 2018b. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 6 East Half.* St. Louis, Missouri. Revision 0. September 27.

USACE 2018c. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Destrehan Street (West) Property.* St. Louis, Missouri. Revision 0. September 27.

USACE 2018d. U.S. Army Corps of Engineers. *St. Louis Downtown Site Annual Environmental Monitoring Data and Analysis Report for CY 2017*. St. Louis, Missouri. Revision 0. June 21.

USACE 2018e. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for the Coldwater Creek (CWC)-Floodplain Property CWC-56 (Partial).* St. Louis, Missouri. Revision 0. August 1.

USACE 2018f. U.S. Army Corps of Engineers. *Remedial Action Summary for the St. Louis Airport Site Vicinity Property Duchesne Park, St. Louis, Missouri.* Revision 0. May 14.

USACE 2018g. U.S. Army Corps of Engineers *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC) Floodplain Properties CWC-65 through CWC-82, CWC-56 (Partial) and Palm Drive.* St. Louis, Missouri. Revision 0. September 13.

USACE 2018h. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Ford-1, Ford-2, Ford-3, Ford-4, Ford-5, Ford-6, Ford-7, Ford-8, and Ford-9.* St. Louis, Missouri. Revision 0. June 7.

USACE 2018i. U.S. Army Corps of Engineers *North St. Louis County Sites Annual Environmental Monitoring Data and Analysis Report for CY 2017.* St. Louis, Missouri. Revision 0. June 21.

USACE 2019a. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation Addendum for the Accessible Soil Within the St. Louis Downtown Site Plant 1 Former Building 17 Area.* St. Louis, Missouri. Revision 0. September 25.

USACE 2019b. U.S. Army Corps of Engineers. *St. Louis Downtown Site Annual Environmental Monitoring Data and Analysis Report for CY 2018.* St. Louis, Missouri. Revision 0. June 14.

USACE 2019c. U.S. Army Corps of Engineers. *Post-Remedial Action Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties, CWC-83 through CWC-92 and Chez Vant Court.* St. Louis, Missouri. Revision 0. September 26.

USACE 2019d. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-94, CWC-96, CWC-98, and Industrial Lane.* St. Louis, Missouri. Revision 0. May 1.

USACE 2019e. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Seeger-1, Seeger-2, Seeger-3, Seeger-4, Romiss Court, and Jonas Place*. St. Louis, Missouri. Revision 0. May 9.

USACE 2019f. U.S. Army Corps of Engineers. *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Vicinity Properties Polson-1, Polson-2, Polson-3, Polson-4, Polson-5, Polson-6, Polson-7, Polson-8, North Interstate 170 Right-of-Way, and Heather Lane.* St. Louis, Missouri. Revision 0. June 11.

USACE 2019g. U.S. Army Corps of Engineers. *North St. Louis County Sites Annual Environmental Monitoring Data and Analysis Report for CY 2018.* St. Louis, Missouri. Revision 0. June 14.

USEPA 1988. U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, D.C. *Federal Guidance Report No. 11: Limiting Values of Radionuclide Intake And Air Concentration and Dose Conversion Factors For Inhalation, Submersion, And Ingestion.* EPA-520/1-88-020. September.

USEPA 1993. U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, D.C. *Federal Guidance Report No. 12: External Exposure to Radionuclides in Air, Water, and Soil.* EPA-402-R-93-081. September.

USEPA 1997. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination.* Memorandum OSWER 9200.4-18. August 22, 1997.

USEPA 1999. U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, D.C. *Federal Guidance Report No. 13: Cancer Risk Coefficients for Environmental Exposure to Radionuclides.* EPA 402-R-99-001. September.

USEPA 2001. U.S. Environmental Protection Agency. *Comprehensive Five-Year Review Guidance.* OSWER No. 9355.7-03B-P, EPA-540-R-01-007. June.

USEPA 2003. U.S. Environmental Protection Agency. *Human Health Toxicity Values in Superfund Risk Assessments,* Office of Solid Waste and Emergency Response, Washington, D.C., OSWER Directive 9285.7-53. December 5, 2003.

USEPA 2019a. U.S. Environmental Protection Agency. *Federal Guidance Report No. 15: External Exposure to Radionuclides in Air, Water and Soil.* Oak Ridge National Laboratory, Oak Ridge, Tennessee and Office of Radiation and Indoor Air, Washington, D.C. EPA 402-R-19-002. Revised August.

USEPA 2019b. U.S. Environmental Protection Agency. Integrated Risk Information System. https://www.epa.gov/iris. Accessed November 2019.

USEPA 2019c. U.S. Environmental Protection Agency. *Regional Screening Levels*, "RSL Tables." https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables. November. Accessed November 2019.

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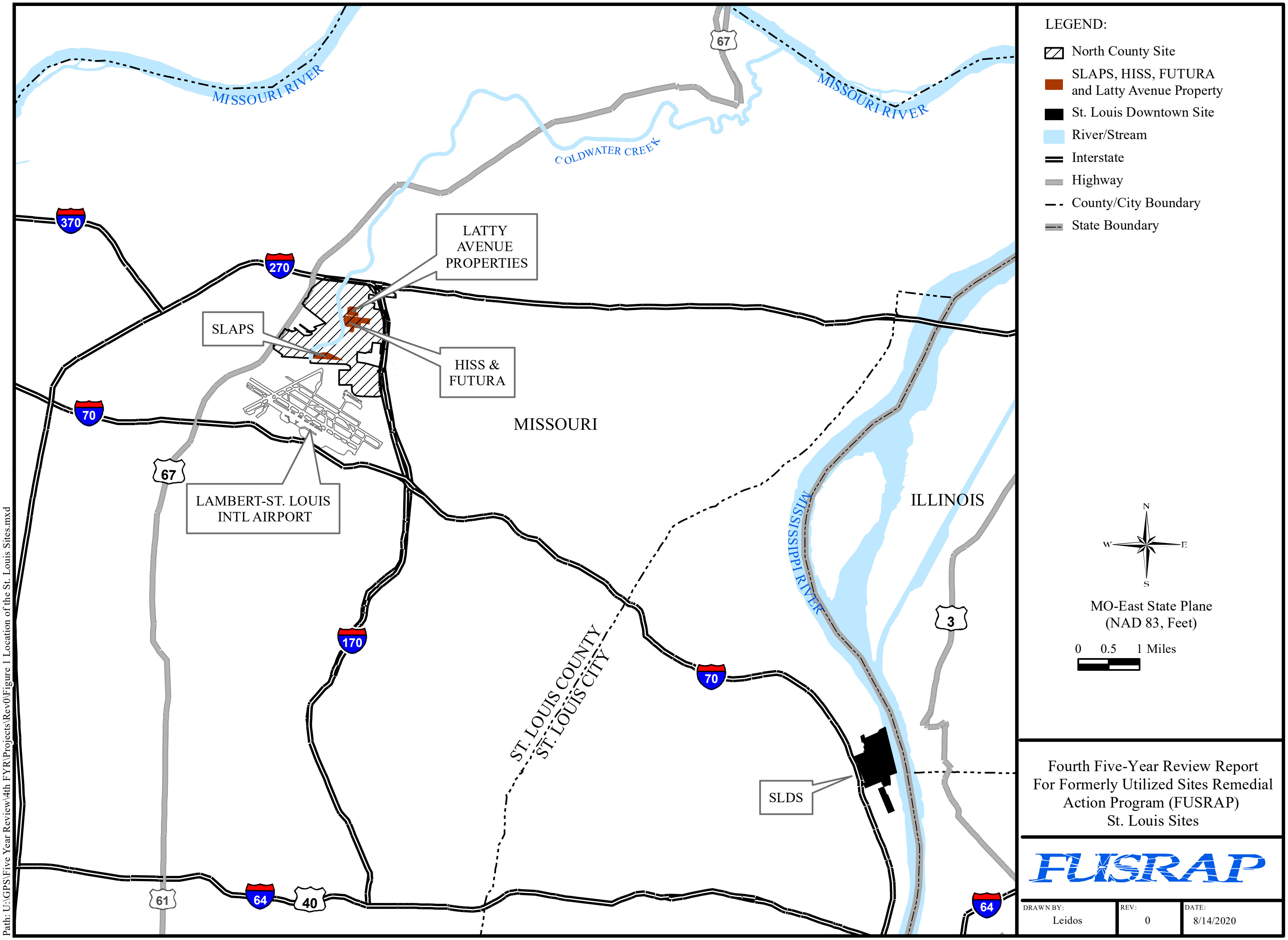

Path: U:\GPS\Five Year Review\4th FYR\Projects\Rev0\Figure 1 Location of the St. Louis Sites.mxd

Figure 1. Location of the St. Louis Sites

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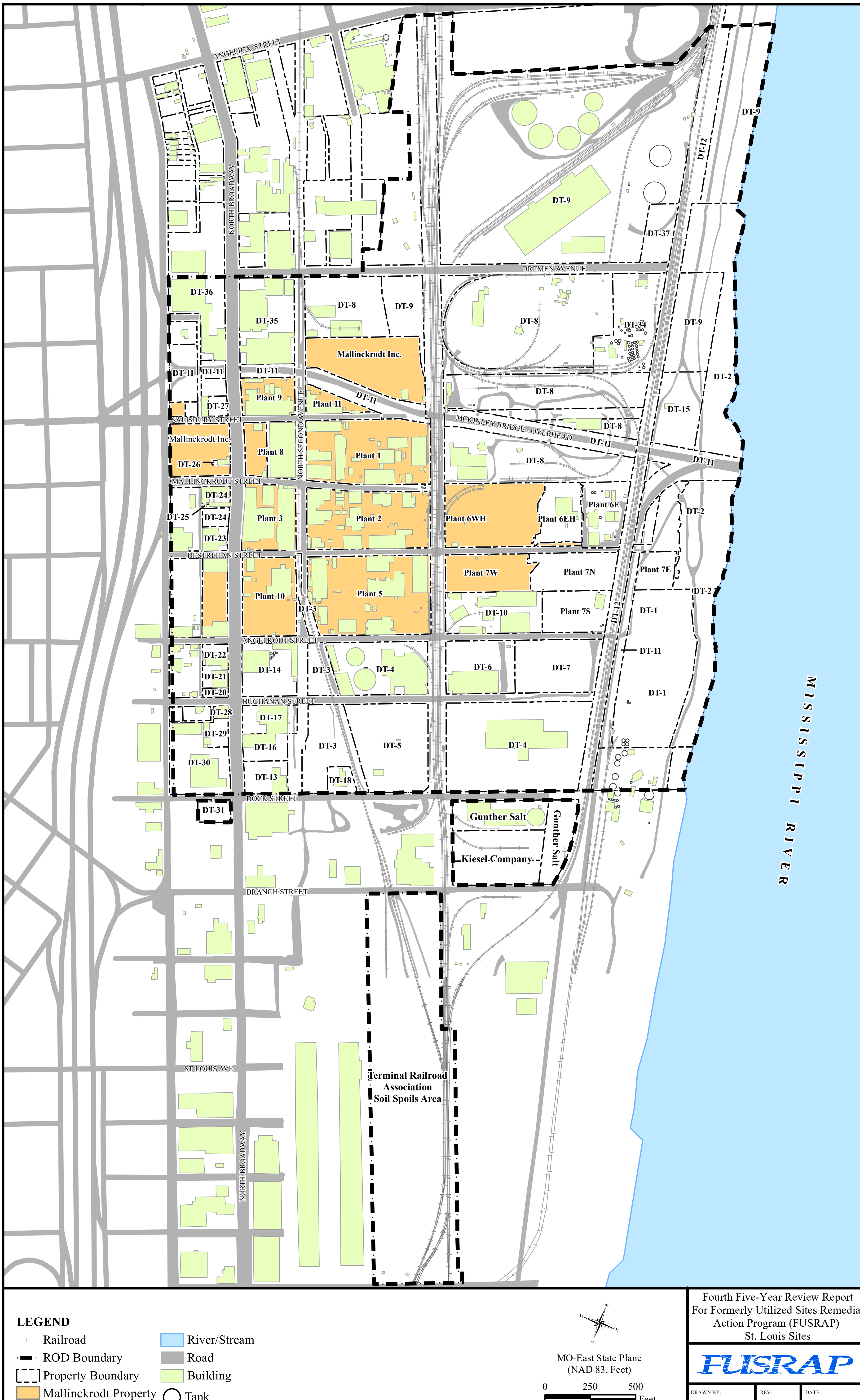

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Figure 2. Plan View of SLDS

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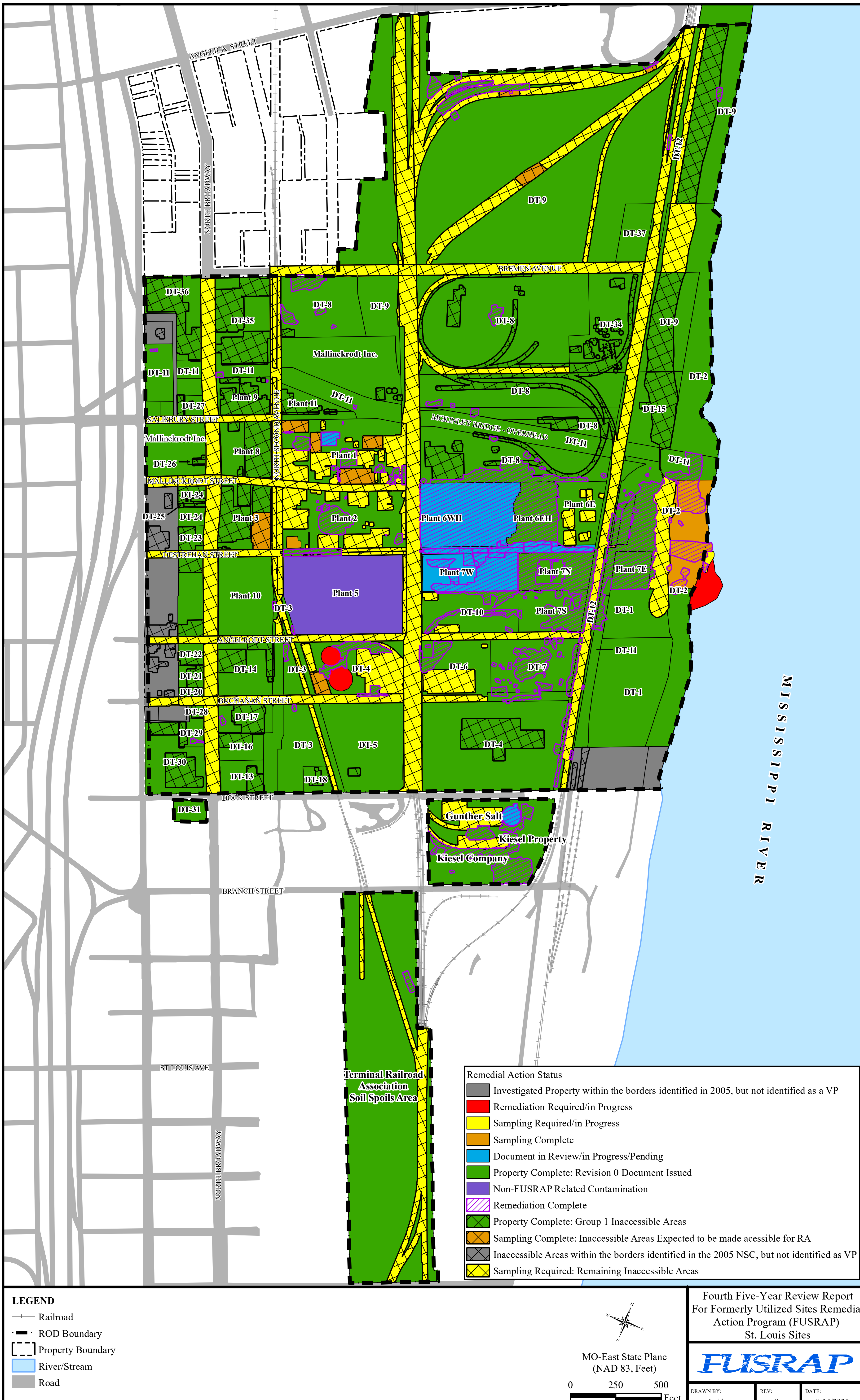

Figure 3. Remediation Status of SLDS

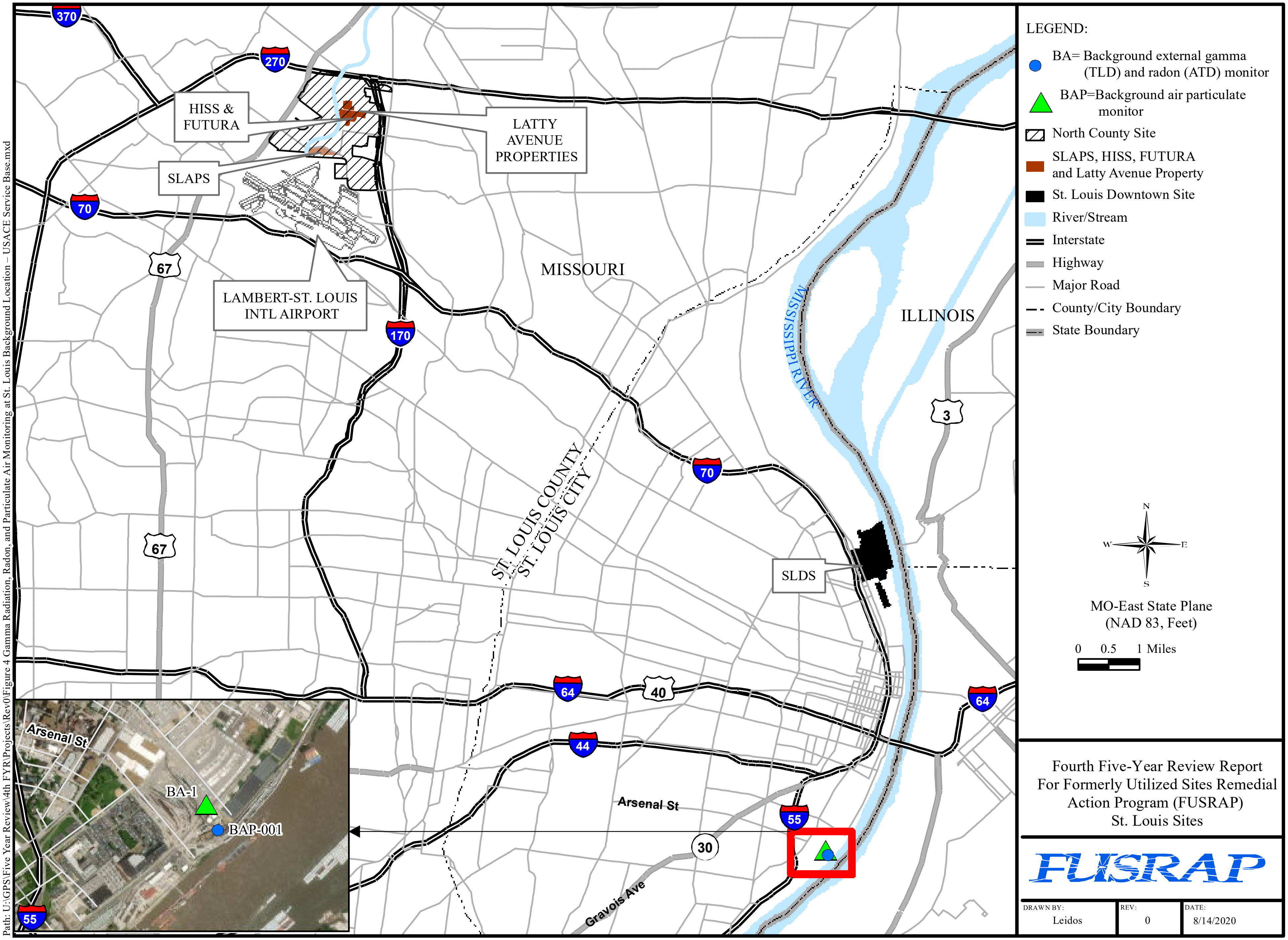

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Figure 4. Gamma Radiation, Radon, and Particulate Air Monitoring at St. Louis Background Location – USACE Service Base

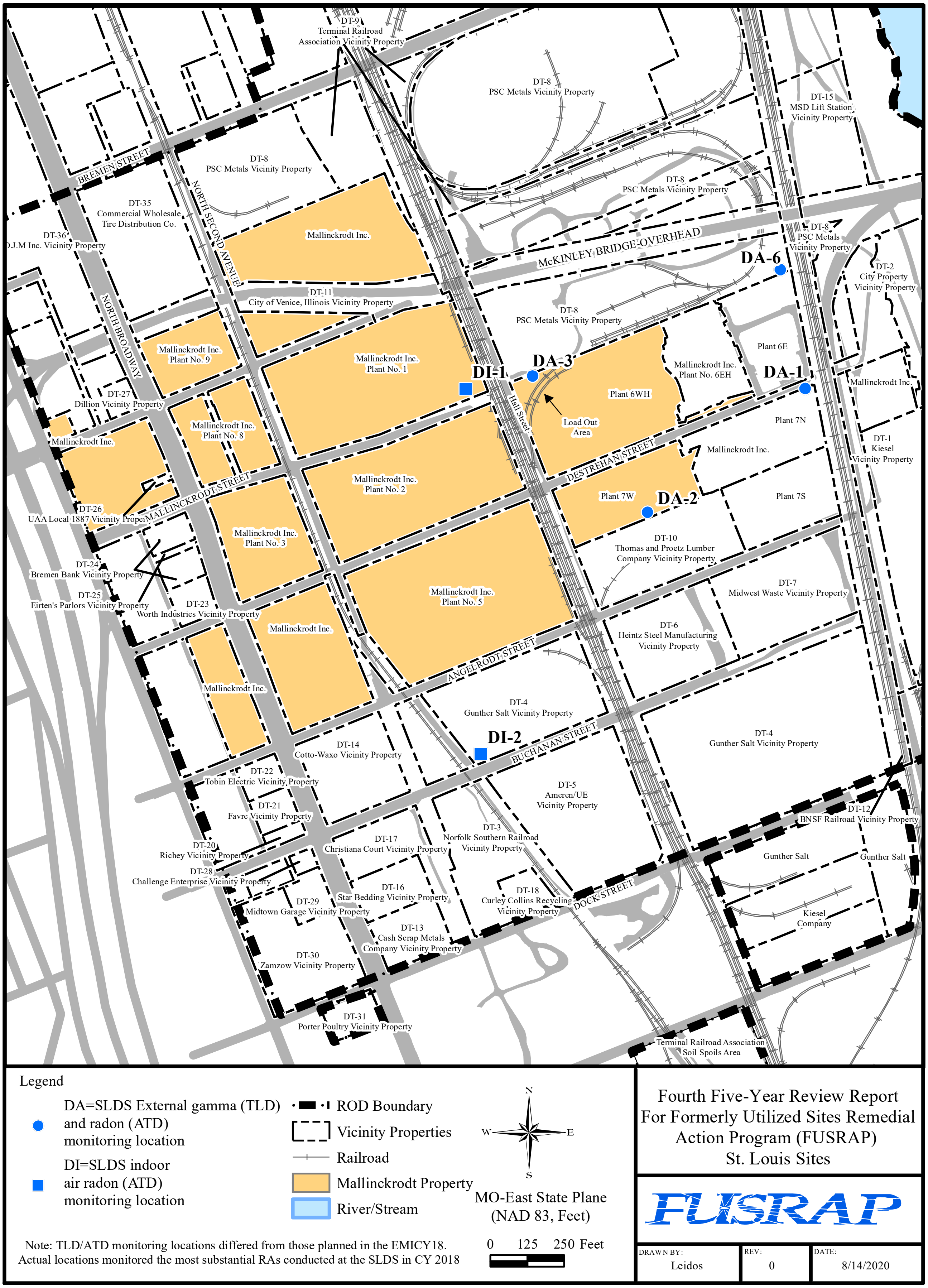

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Figure 5. Gamma Radiation, Radon, and Particulate Air Monitoring Locations at SLDS

Unit Designation	Approximate Thickness (ft)	Description
Upper Hydrostratigraphic Unit (HU-A)	0-25	**RUBBLE and FILL** Grayish black (N2) to brownish black (5YR2/1). Dry to slightly moist, generally becoming moist at 5-6 ft and saturated at 10-12 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 percent. 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 gradation 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 percent 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 THE SLS RI REPORT (DOE 1994).

NOTE: THE CODES IN PARENTHESES FOLLOWING THE 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.

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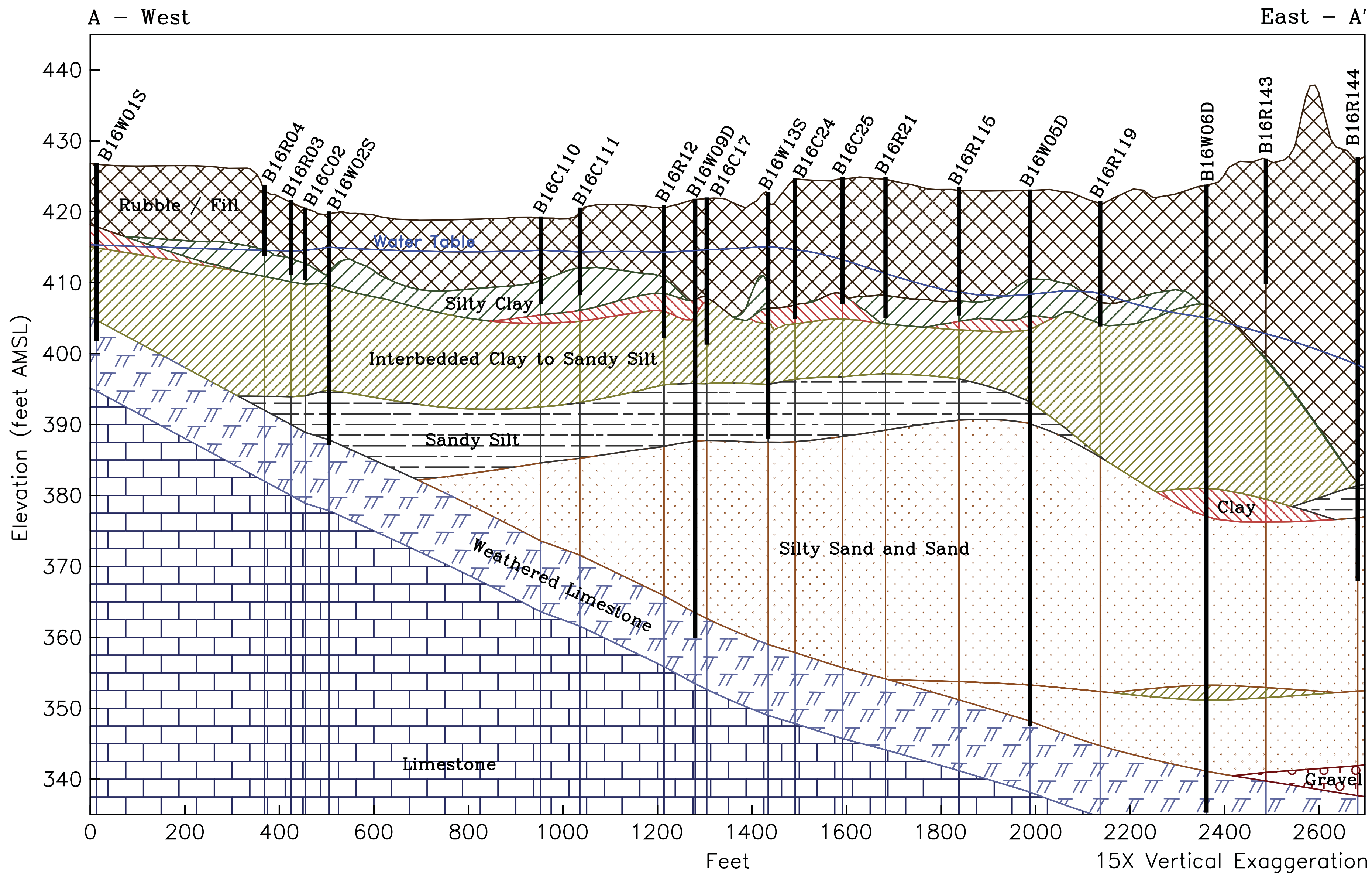
Figure 6. Generalized Stratigraphic Column for SLDS



Geologic data used in the cross-section collected prior to 1998.

Cross-Section Location Map

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Figure 7. SLDS Geologic Cross-Section A-A'

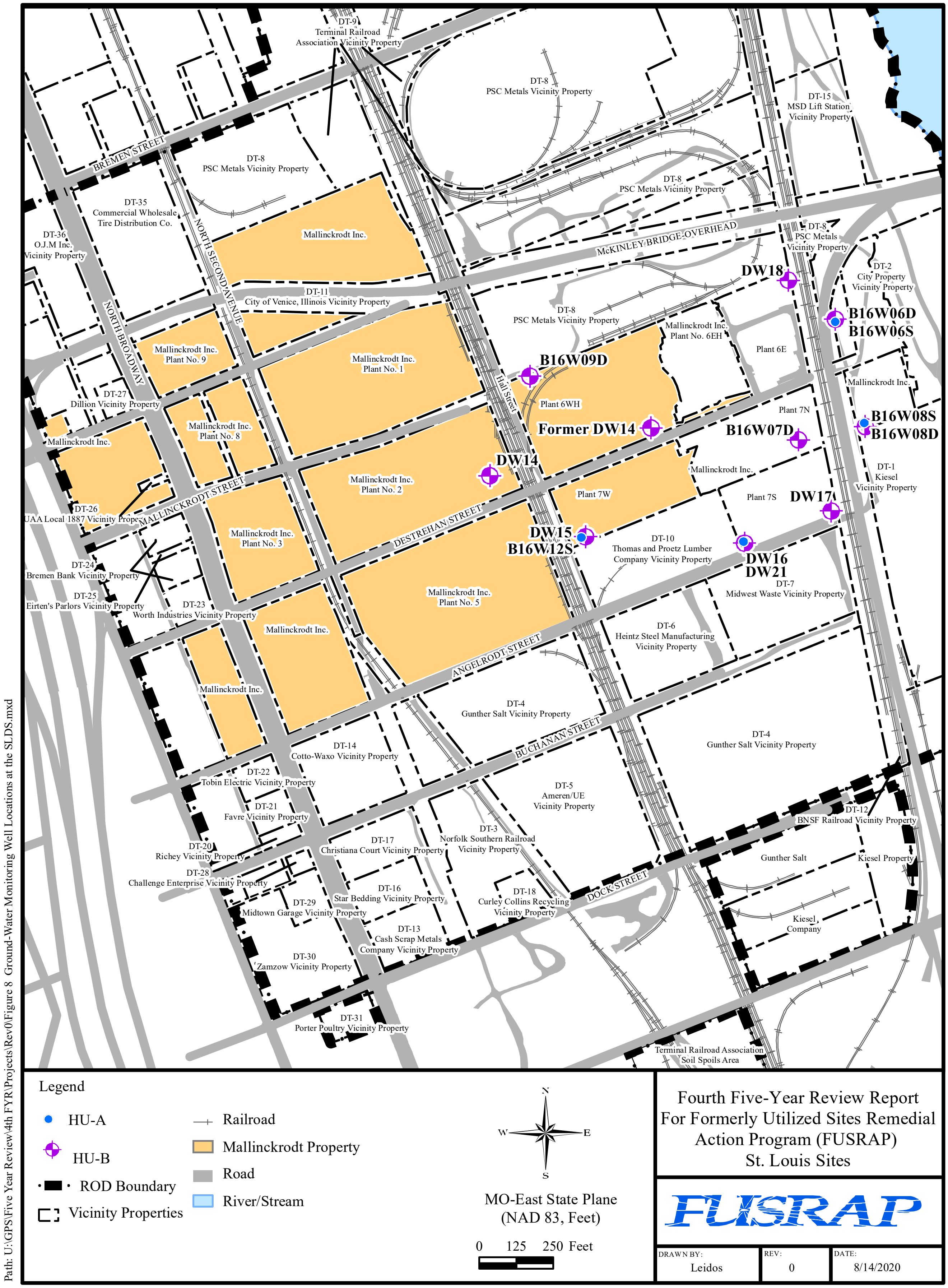
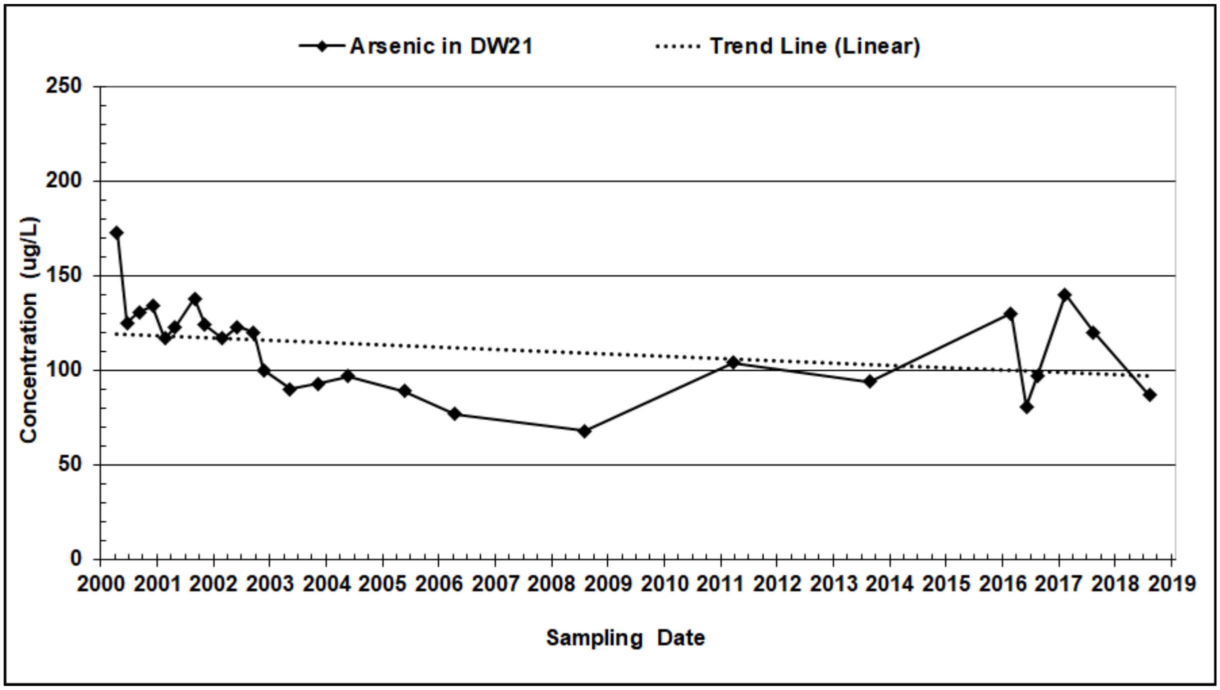
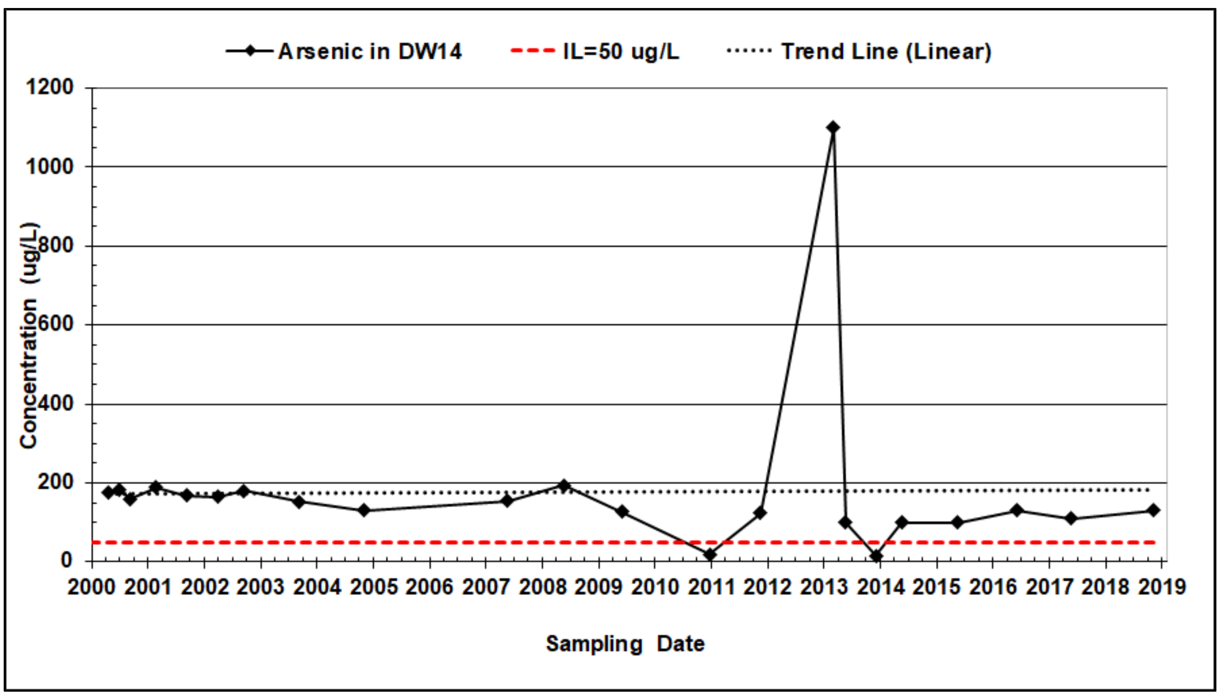


Figure 8. Ground-Water Monitoring Well Locations at SLDS

Arsenic Concentrations

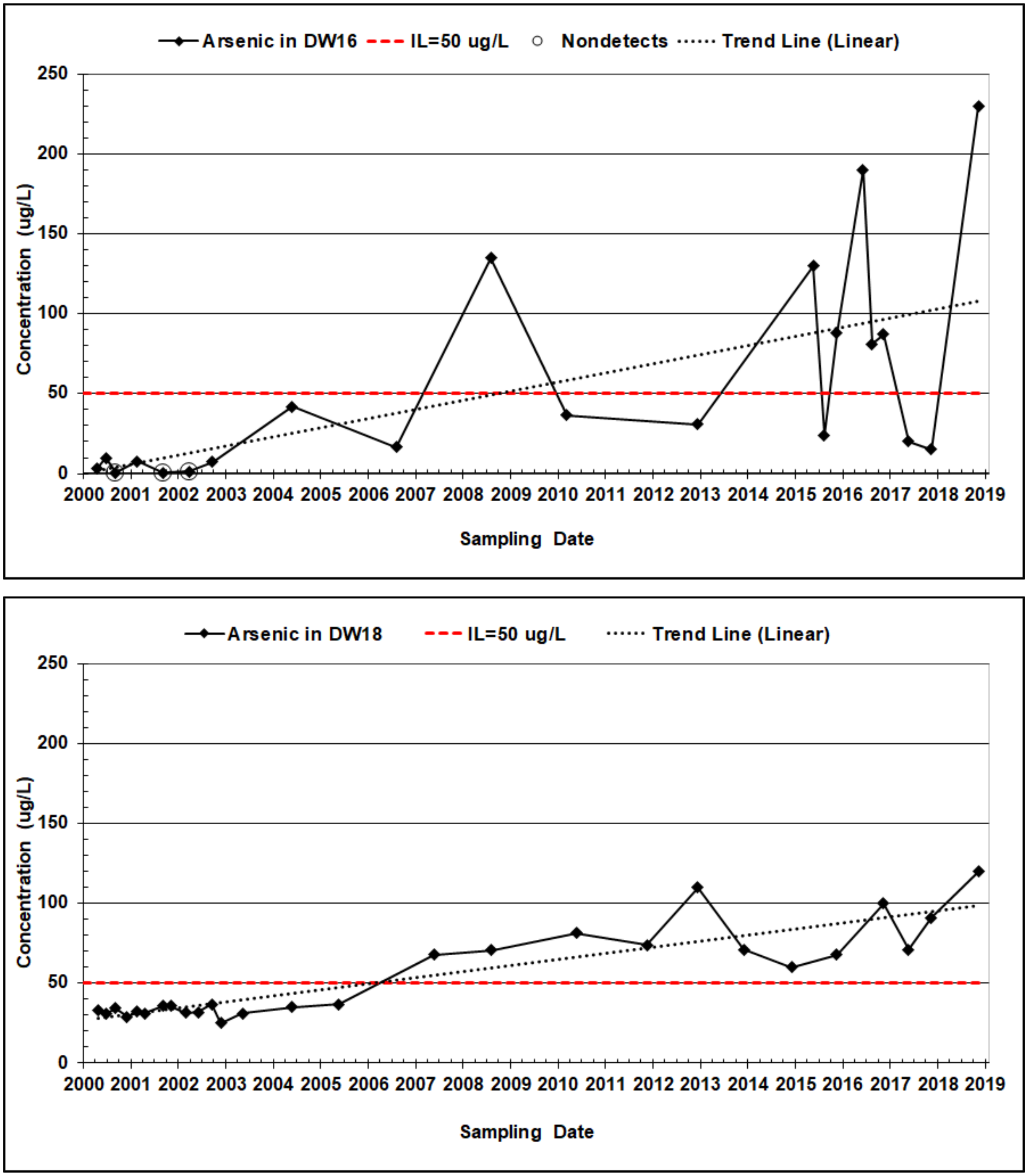




Notes:
The ILs are shown only for HU-B wells. No SLDS ROD ground-water criteria exist for HU-A wells.
DW19 was plugged and abandoned on August 3, 2016. Replacement wells were installed in March 2019.

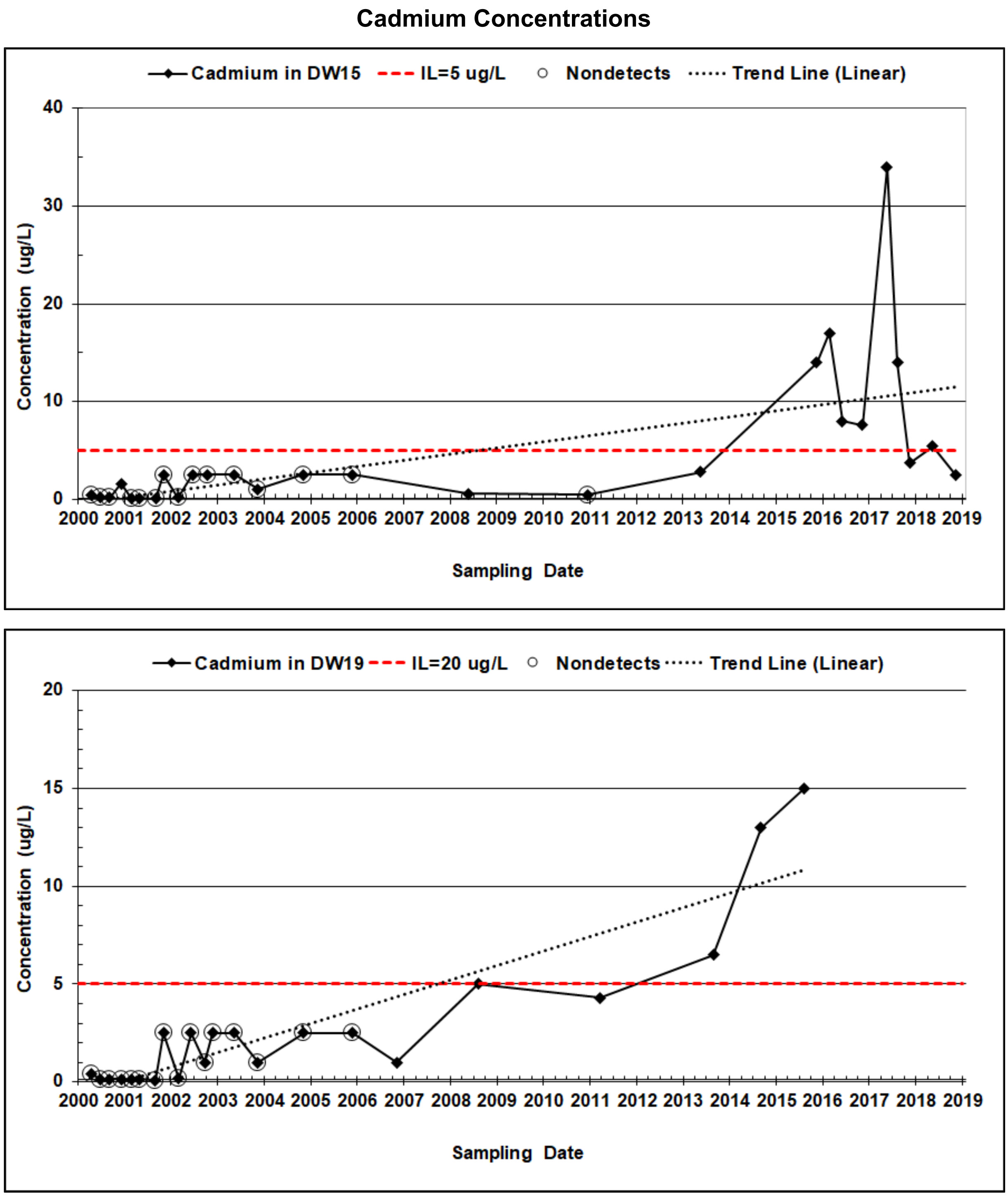
Figure 9. Concentration Trends in SLDS Ground Water

Arsenic Concentrations (Continued)



Notes:
The ILs are shown only for HU-B wells. No SLDS ROD ground-water criteria exist for HU-A wells.
DW19 was plugged and abandoned on August 3, 2016. Replacement wells were installed in March 2019.

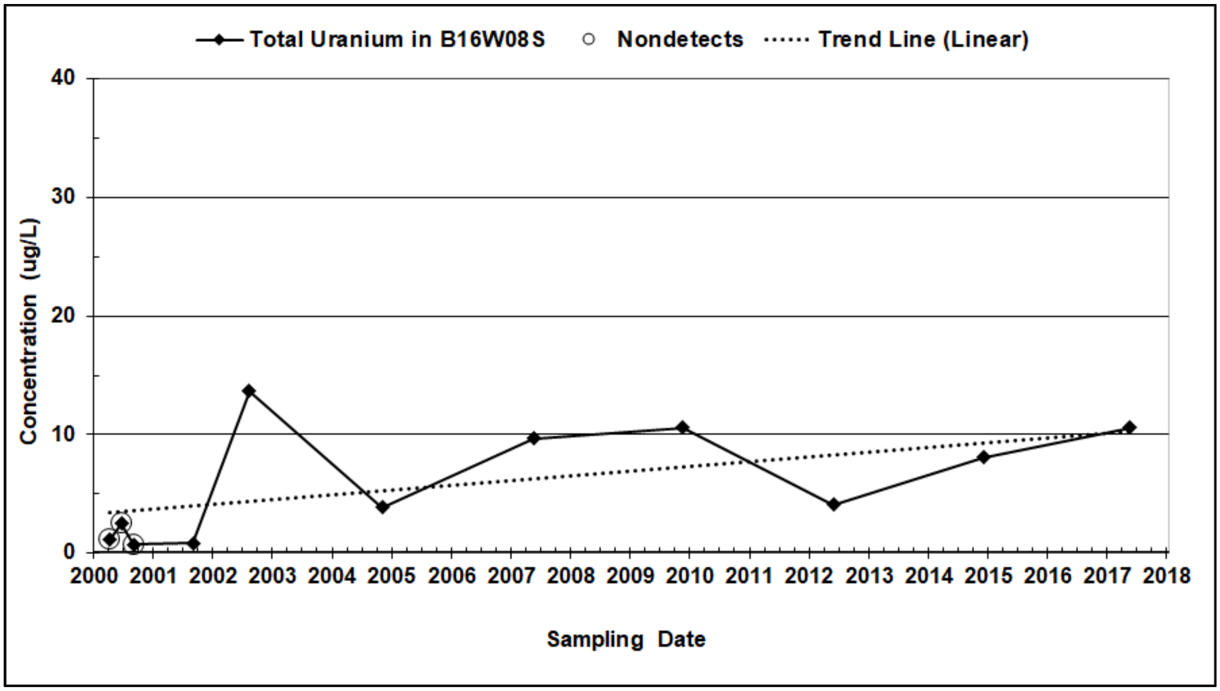
Figure 9. Concentration Trends in SLDS Ground Water (Continued)

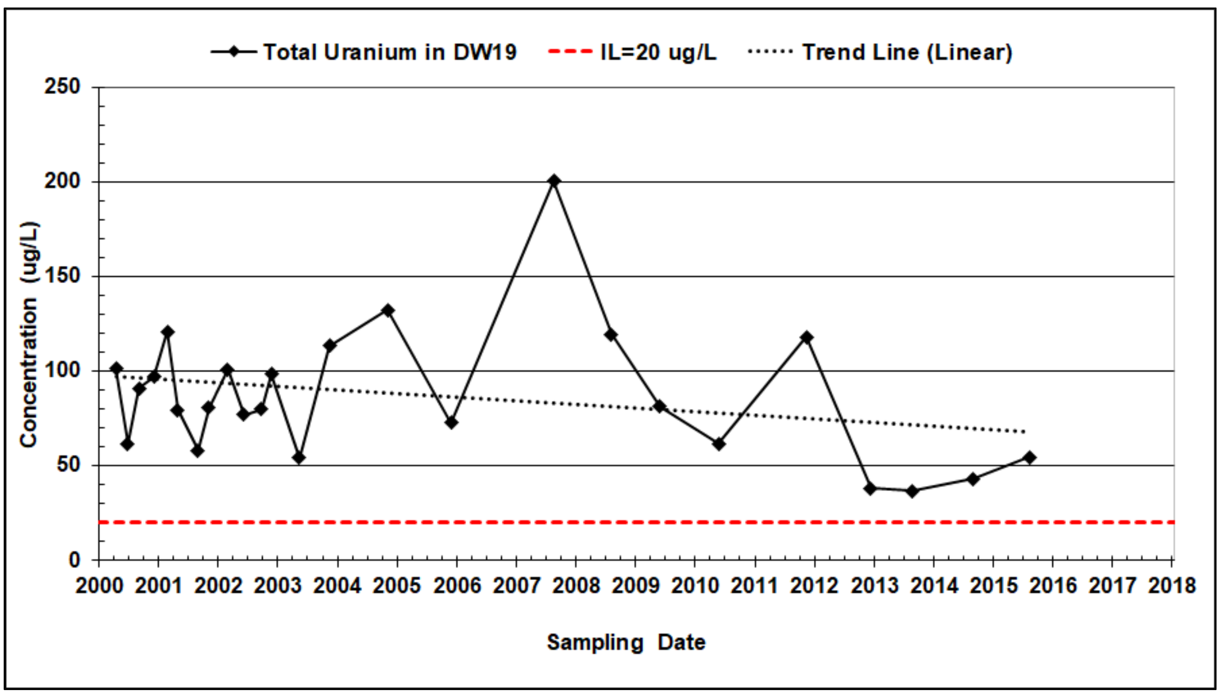


Notes:
The ILs are shown only for HU-B wells. No SLDS ROD ground-water criteria exist for HU-A wells.
DW19 was plugged and abandoned on August 3, 2016. Replacement wells were installed in March 2019.

Figure 9. Concentration Trends in SLDS Ground Water (Continued)

Total Uranium Concentrations





Notes:
The ILs are shown only for HU-B wells. No SLDS ROD ground-water criteria exist for HU-A wells.
DW19 was plugged and abandoned on August 3, 2016. Replacement wells were installed in March 2019.

Figure 9. Concentration Trends in SLDS Ground Water (Continued)

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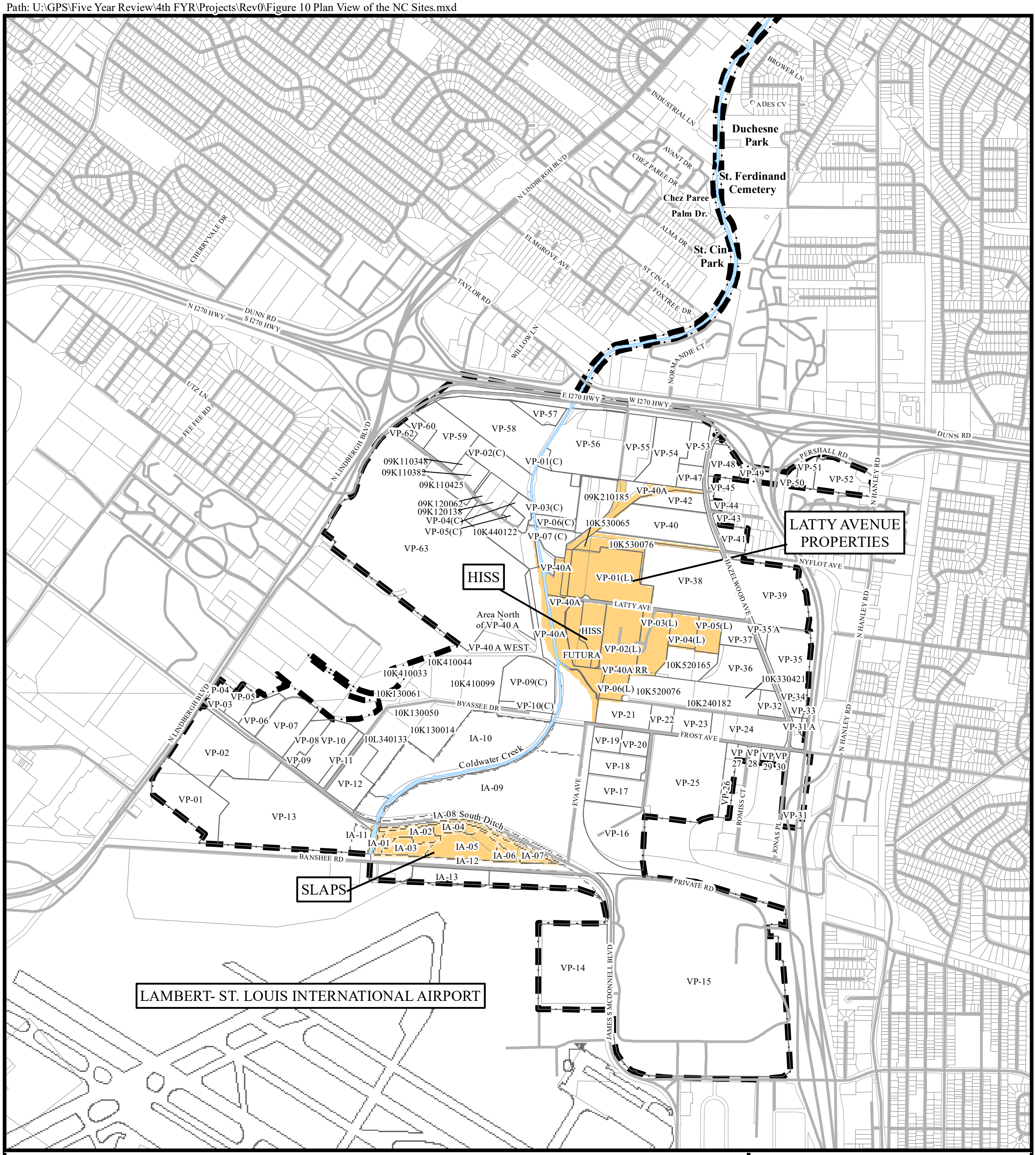

LEGEND:

- General Location of SLAPS and Latty Avenue Properties
- Road
- Airfield
- Investigation Areas
- Parcel Boundary
- River/Stream
- ROD Boundary

N
W E
S

MO-East State Plane
(NAD 83, Feet)

0 1,000 2,000 Feet

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Figure 10. Plan View of the NC Sites

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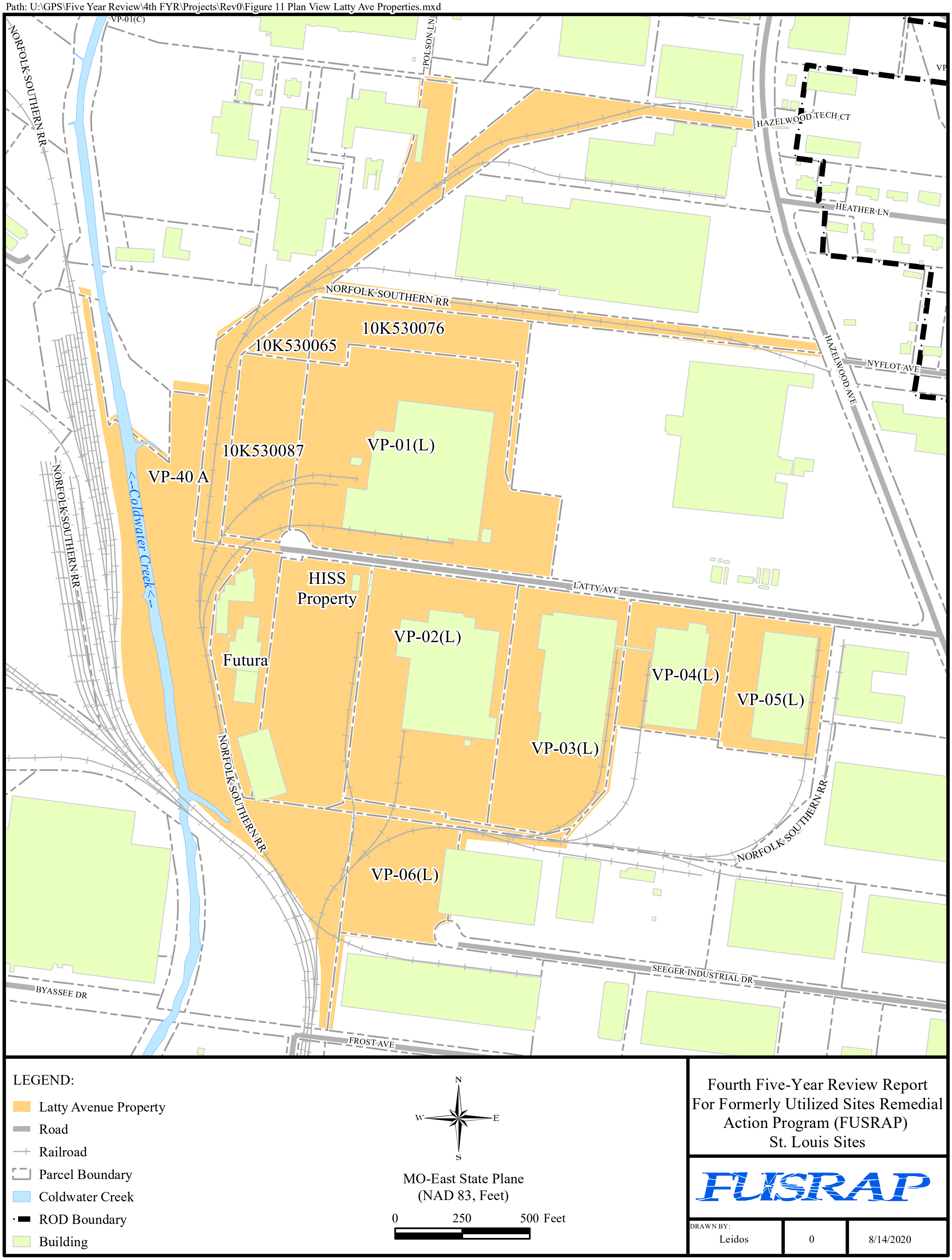

Figure 11. Plan View of the Latty Avenue Properties

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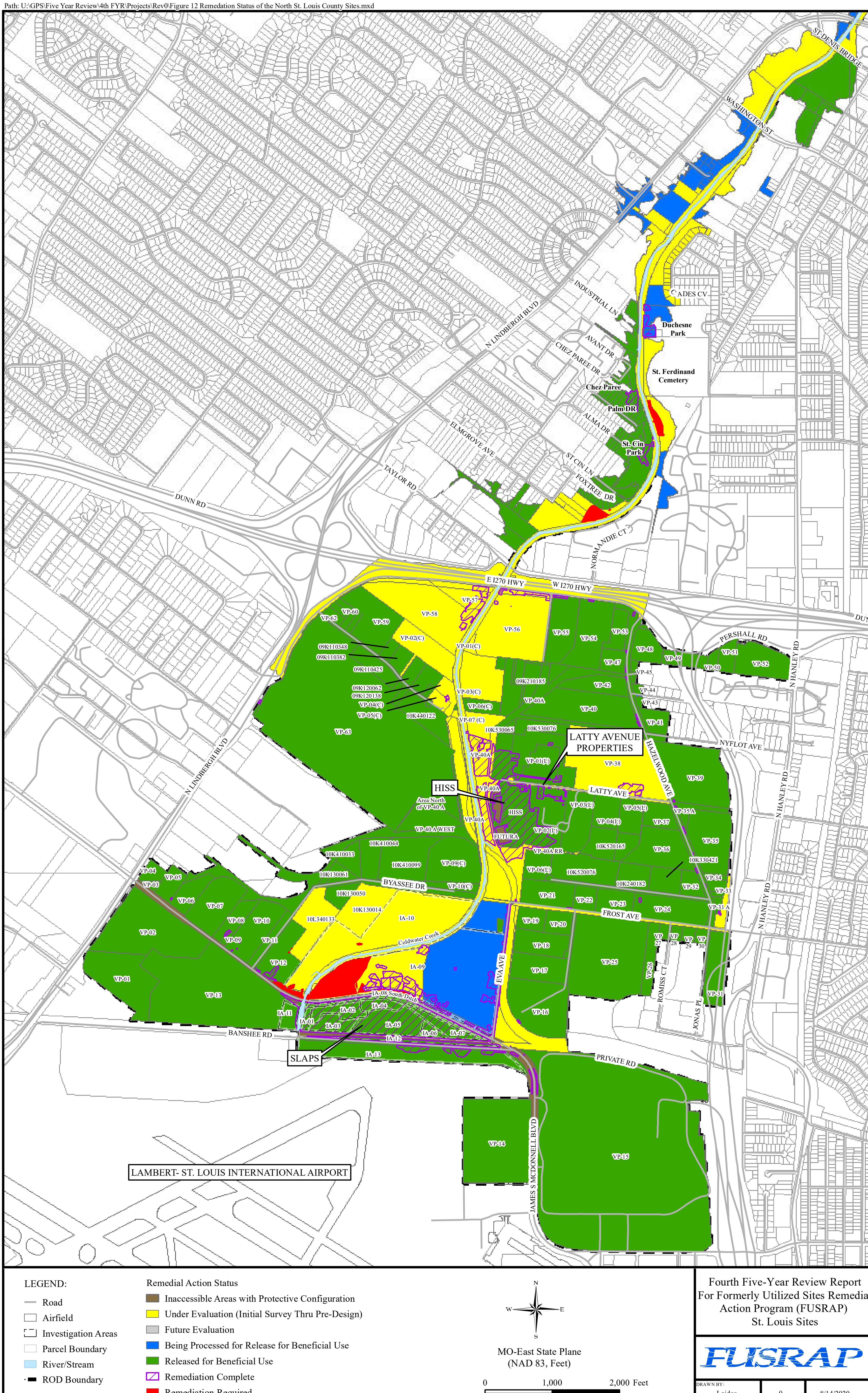

Figure 12. Remedation Status of the North St. Louis County Sites

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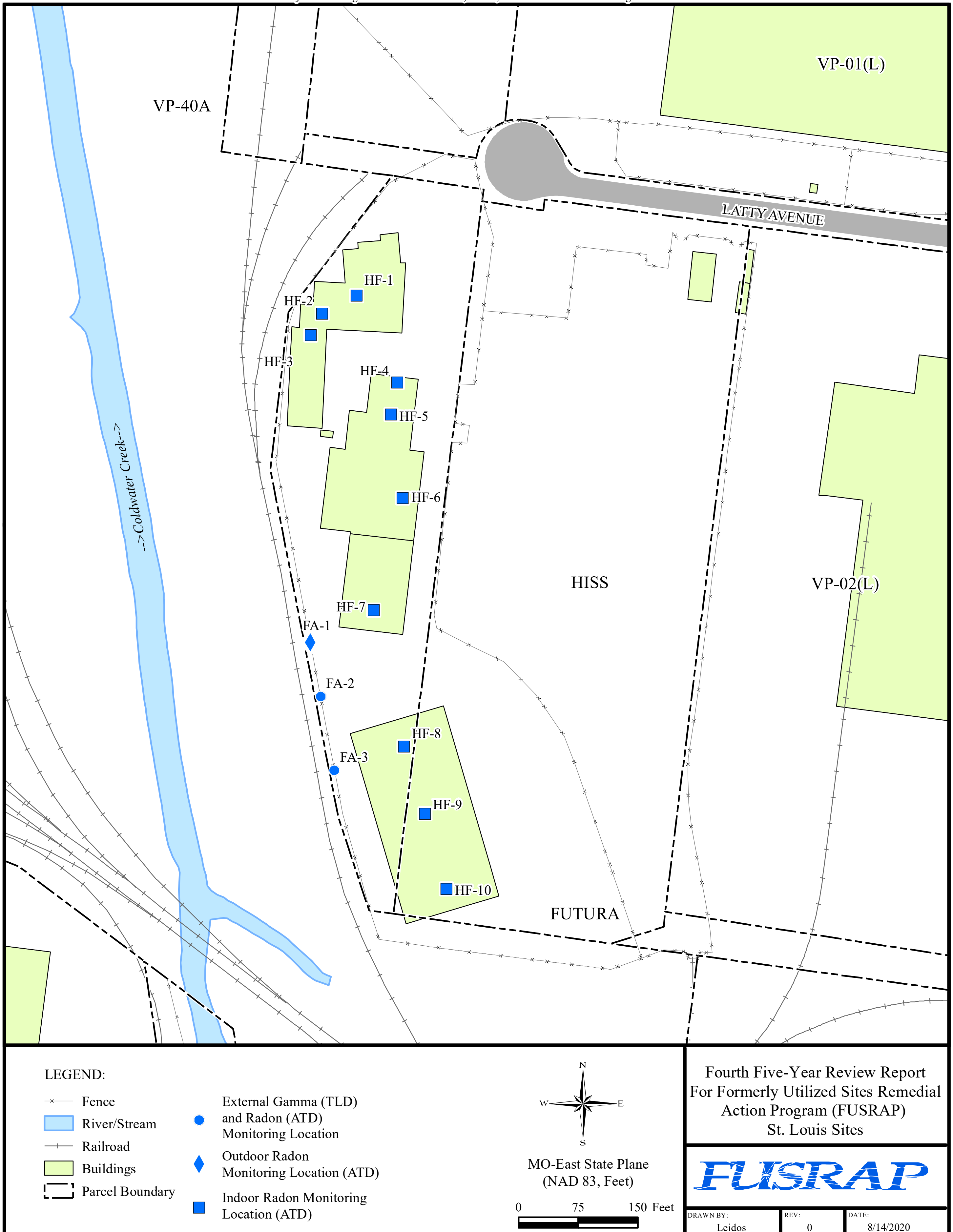

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Figure 13. Gamma Radiation, Radon, and Particulate Air Monitoring Locations at HISS

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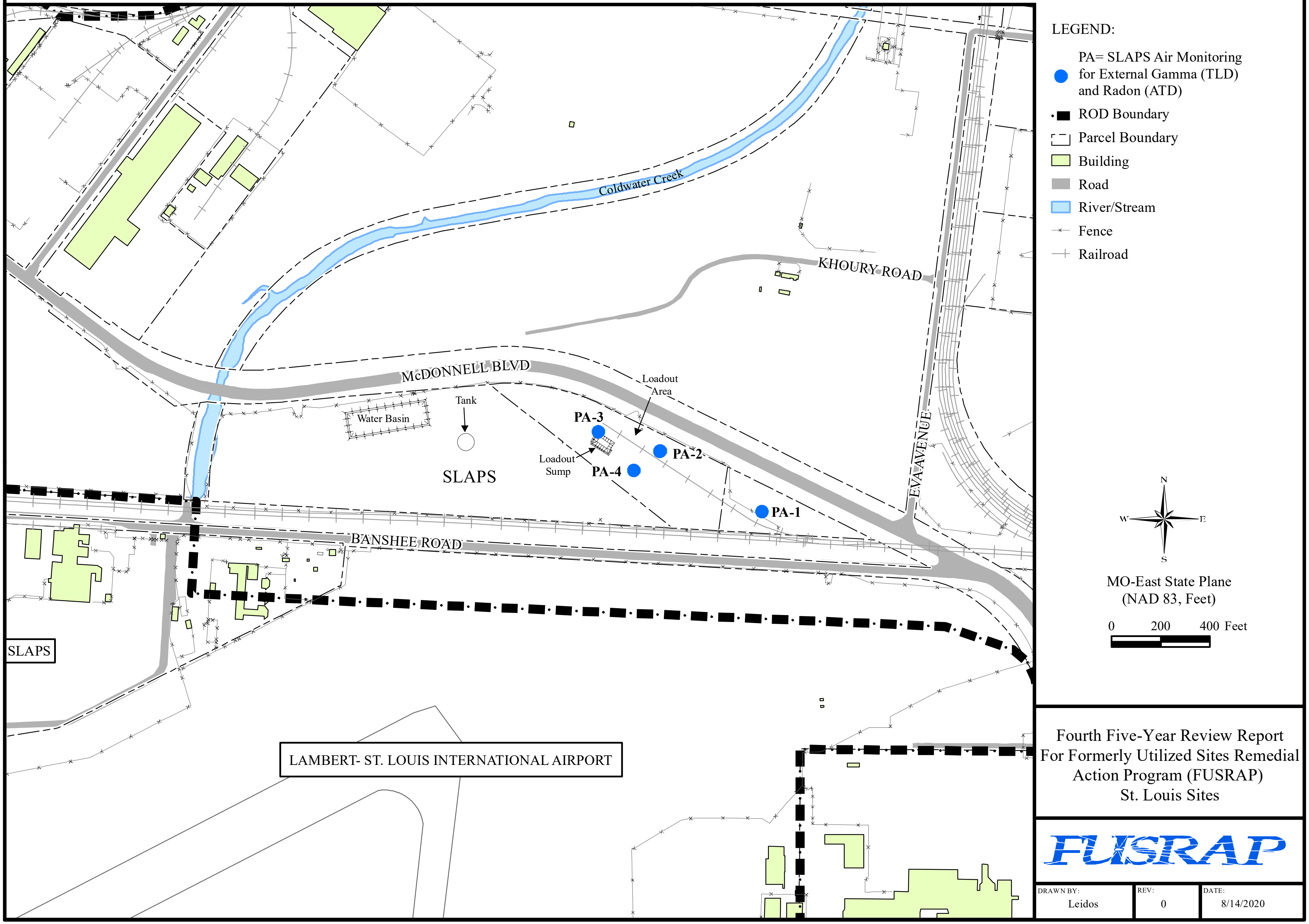

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Figure 14. Gamma Radiation, Radon, and Particulate Air Monitoring Locations at SLAPS

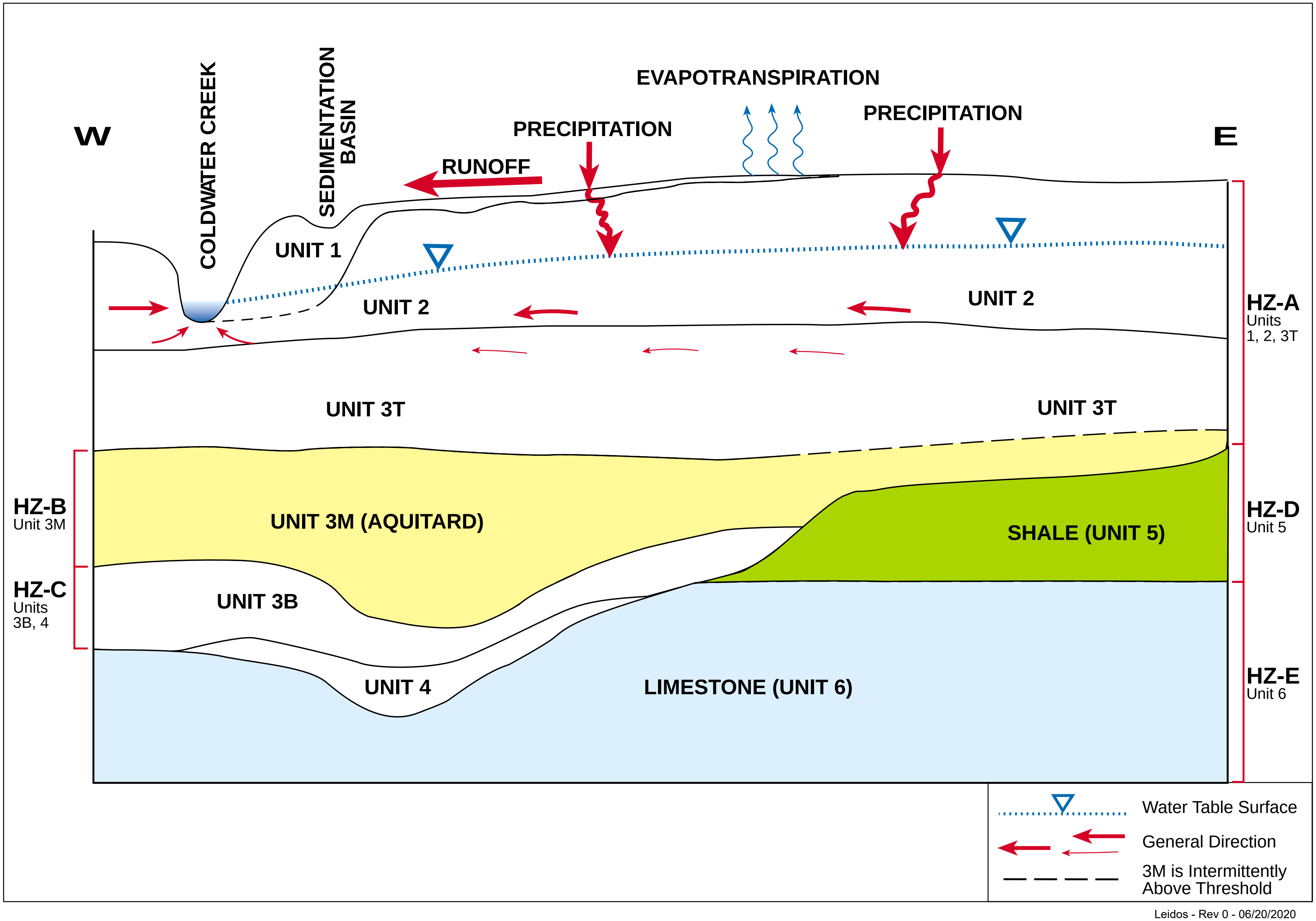

Figure 15. Conceptual Model of Ground-Water Flow at SLAPS Showing Stratigraphic Units and Hydrostratigraphic Zones

Zone	Period	Epoch	Stratigraphy	Thickness (ft.)	Description
Hydrostratigraphic zone (HZ)-A	Quaternary	Holocene	FILL/TOPSOIL	0-14	**UNIT 1** Fill - Sand, silt, clay, concrete, rubble. Topsoil - Organic silts, clayey silts, wood, fine sand.
		Pleistocene	LOESS (CLAYEY SILT)	11-32	**UNIT 2** Clayey silts, fine sands, commonly mottled with iron oxide staining. Scattered roots and organic material, and a few fossils.
			GLACIOLACUSTRINE SERIES: SILTY CLAY	19-75 (3) 9-27 (3T)	**UNIT 3** Silty clay with scattered organic blebs and peat stringers. Moderate plasticity. Moist to saturated (3T).
Hydrostratigraphic zone (HZ)-B			VARVED CLAY	0-8	Alternating layers of dark and light clay as much as 1/16 inch thick (3M).
			CLAY	0-26	Dense, stiff, moist, highly plastic clay (3M).
Hydrostratigraphic zone (HZ)-C			SILTY CLAY	10-29	Similar to upper silty clay. Probable unconformable contact with highly plastic clay (3B).
			BASAL CLAYEY AND SANDY GRAVEL	0-6	**UNIT 4** Glacial clayey gravels, sands, and sandy gravels. Mostly chert.
Hydrostratigraphic zone (HZ)-D	Pennsylvanian		CHEROKEE (?) GROUP (UNDIFFERENTIATED)	0-35	**UNIT 5** BEDROCK: Interbedded silty clay/shale, lignite/coal, sandstone, and siltstone. Erosionally truncated by glaciolacustrine sequences. (Absent at HISS).
Hydrostratigraphic zone (HZ)-E	Mississippian		STE. GENEVIEVE ST. LOUIS LIMESTONES	10+	**UNIT 6** BEDROCK: Hard, white to olive, well cemented, sandy limestone with interbedded shale laminations.

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Figure 16. Generalized Stratigraphic Column for the North St. Louis County Sites

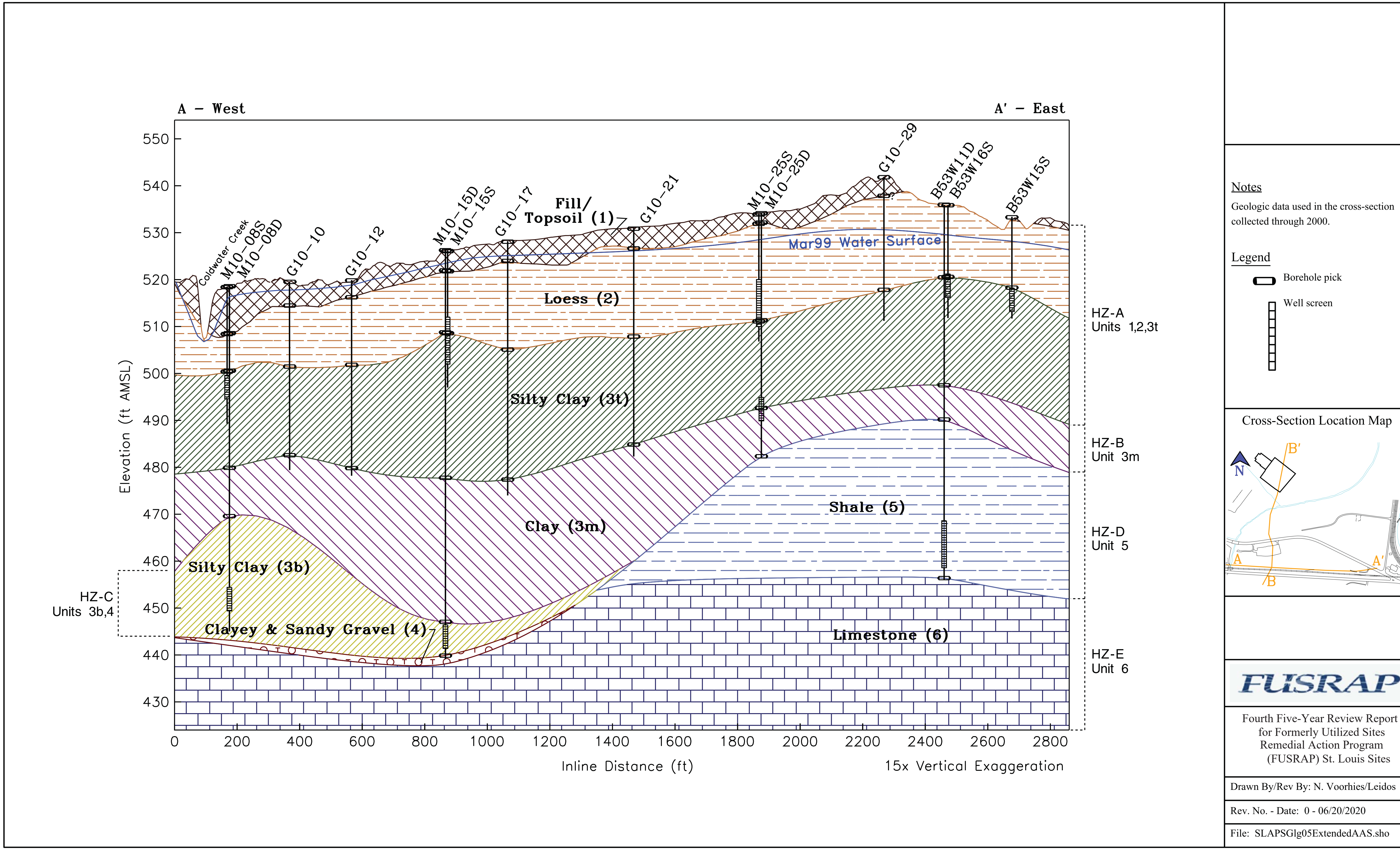
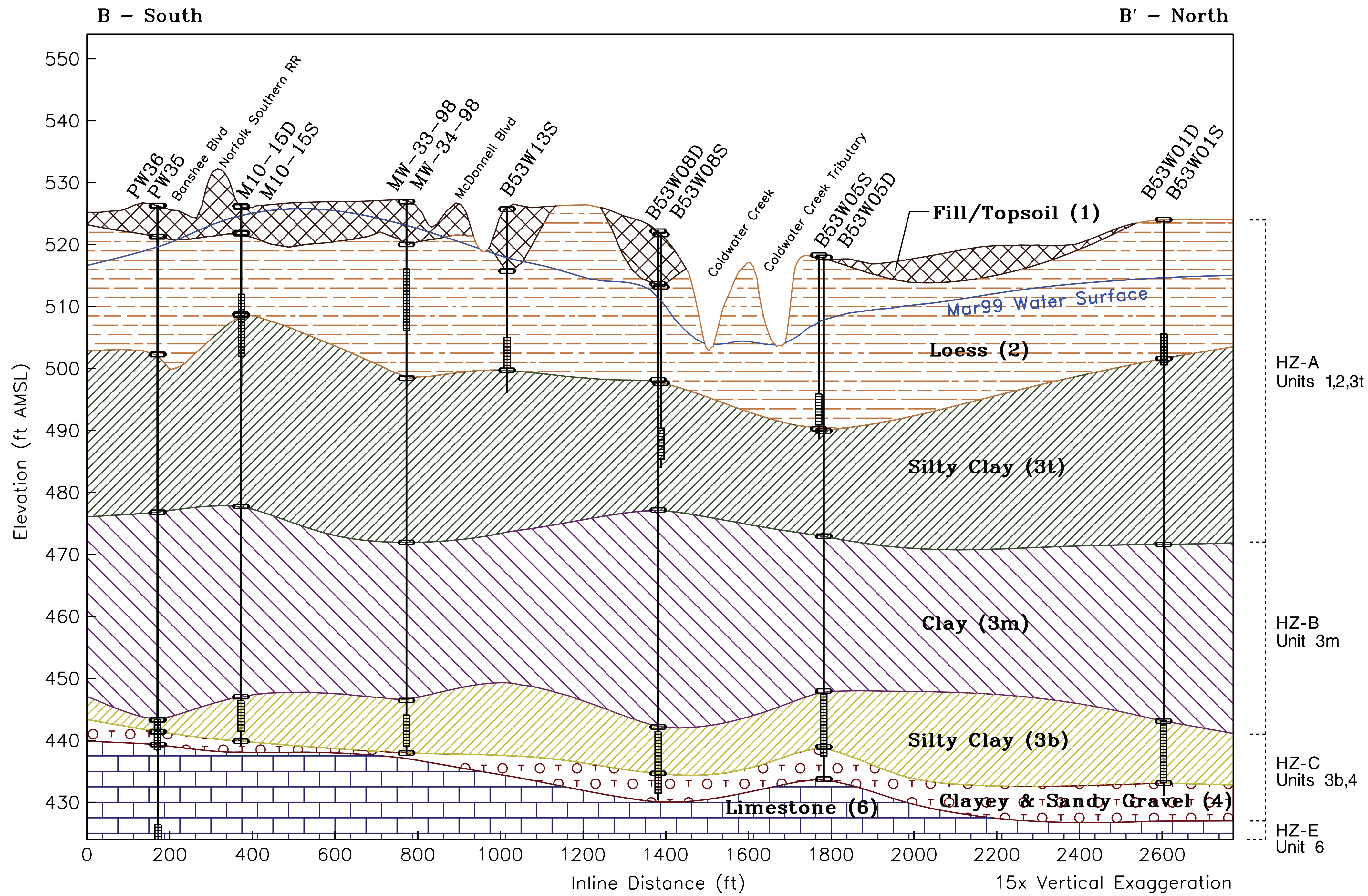


Figure 17. Geologic Cross-Section A-A' at SLAPS



Notes

Geologic data used in the cross-section collected through 2000.

Legend

Borehole pick

Well screen

Cross-Section Location Map

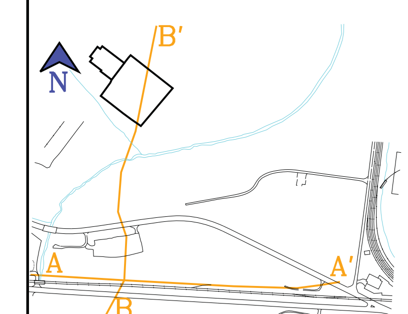


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Figure 18. Geologic Cross-Section B-B' at SLAPS and SLAPS VPs

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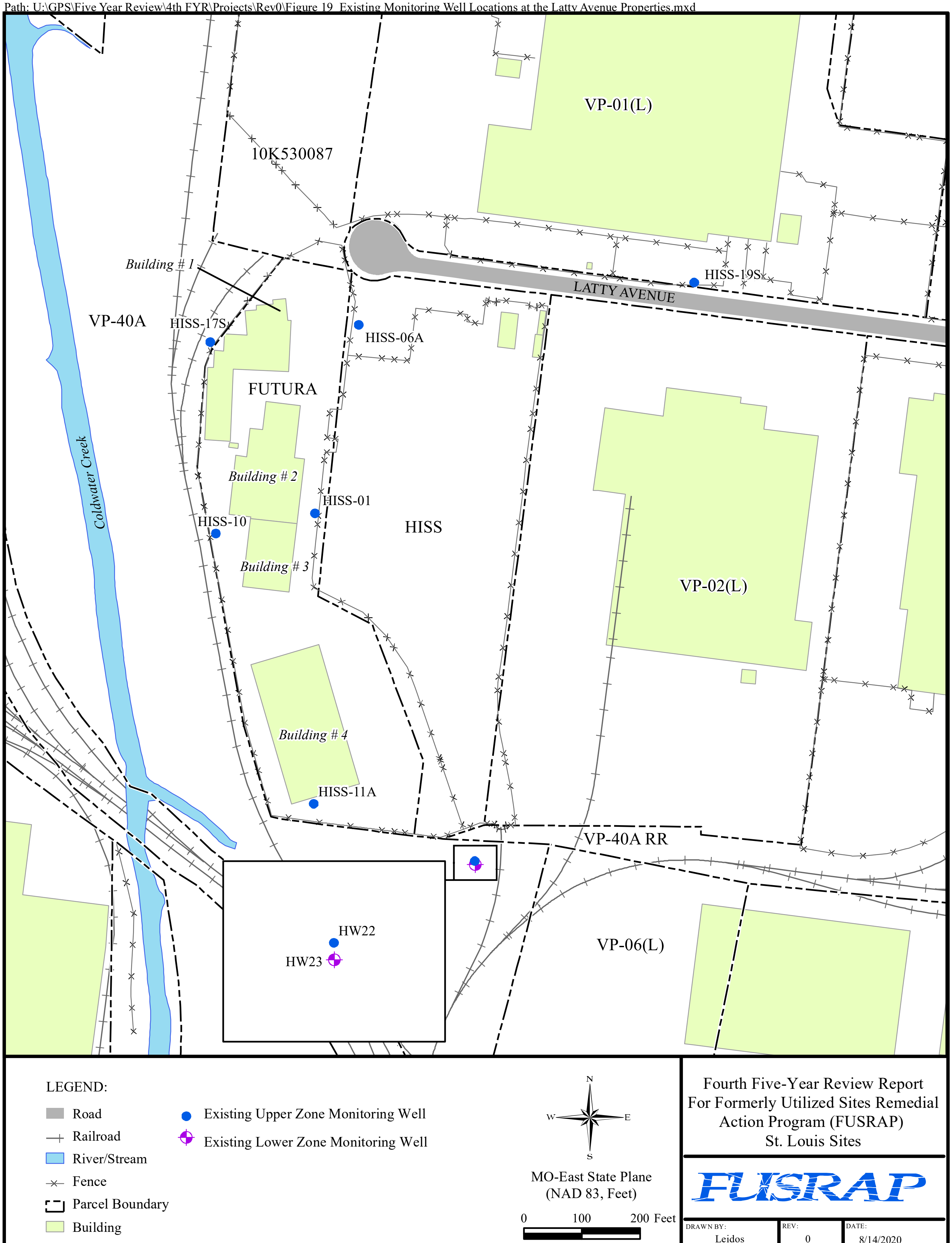

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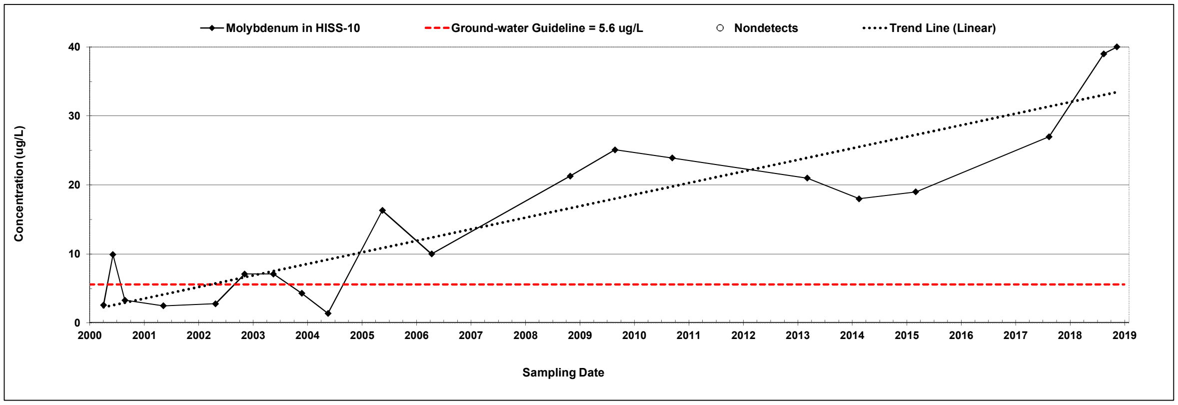
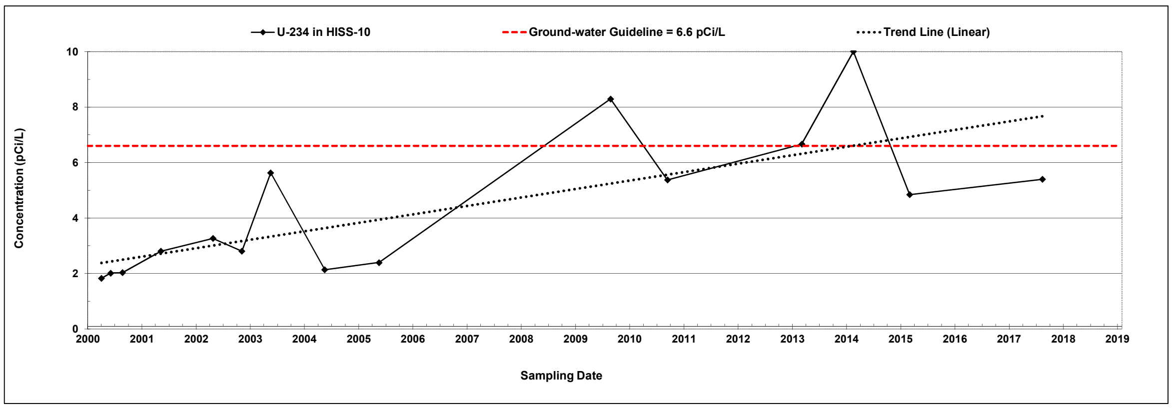
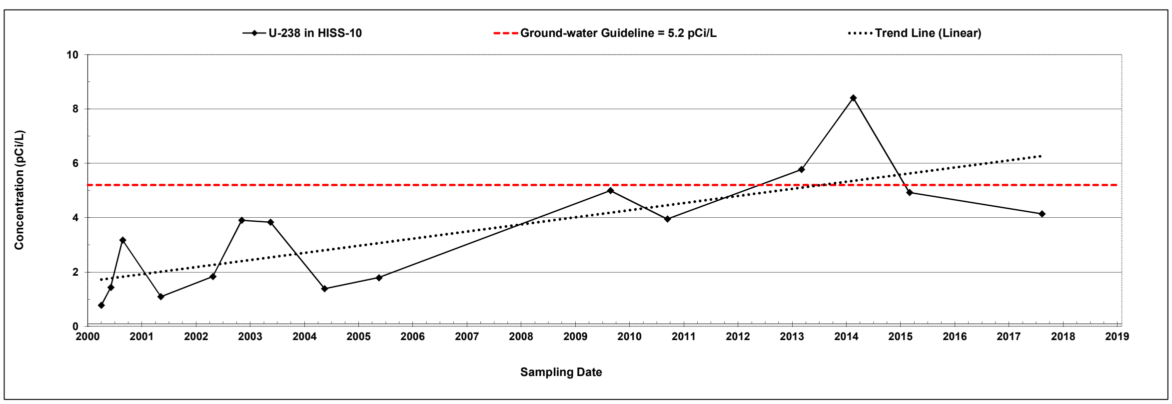
Figure 19. Ground-Water Monitoring Well Locations at the Latty Avenue Properties







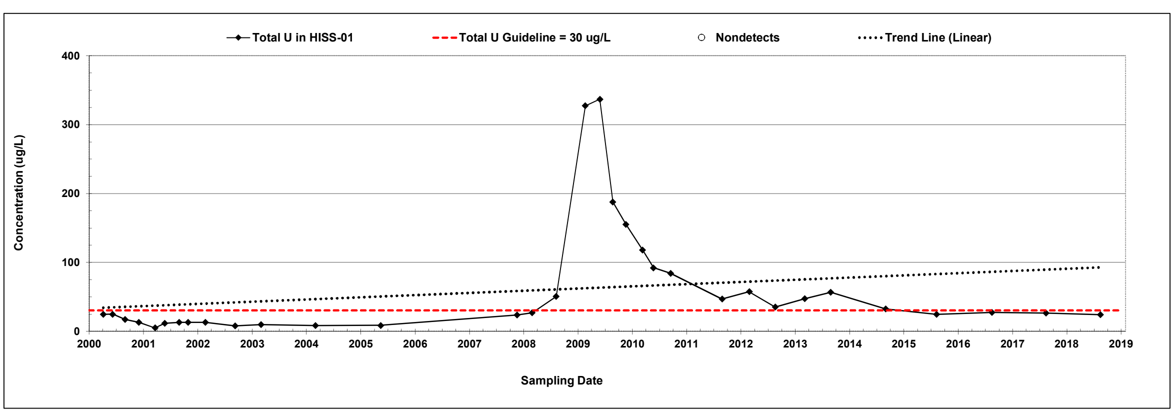
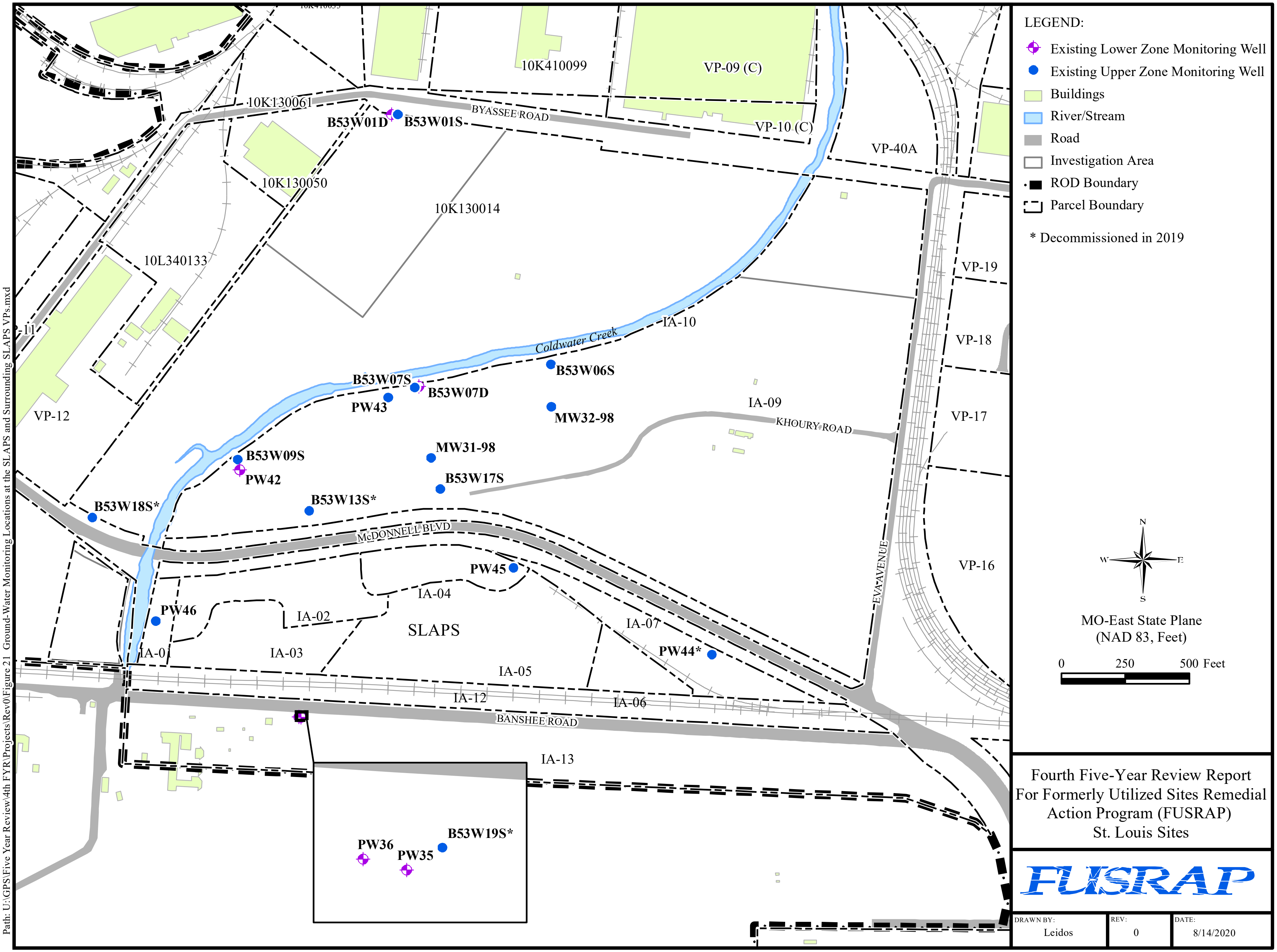
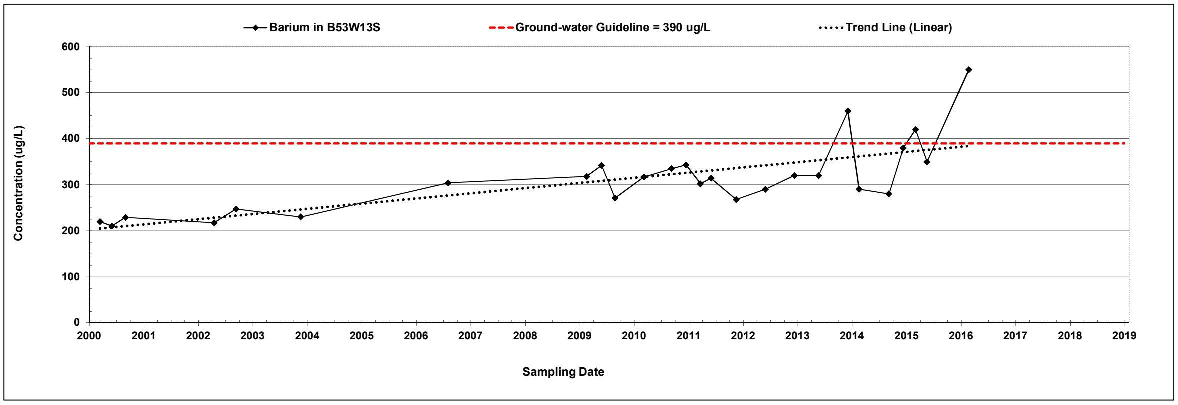


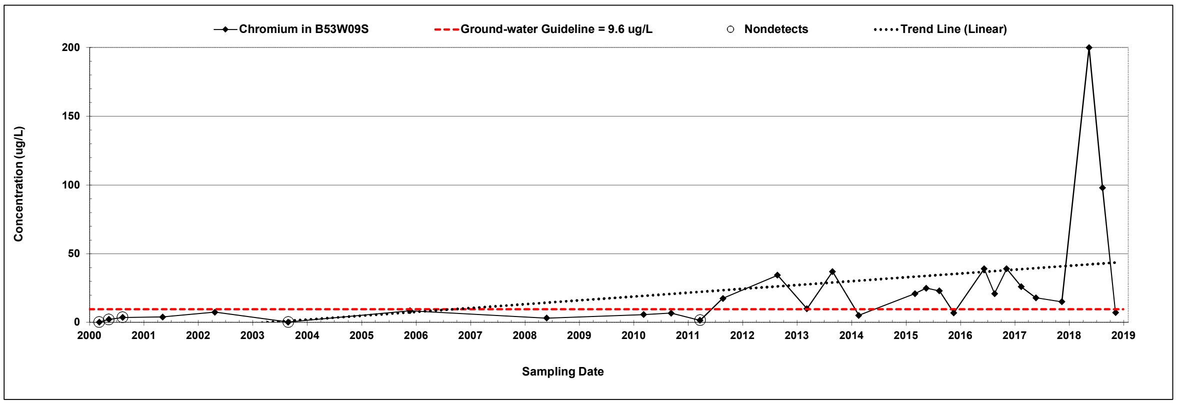
Figure 20. Concentration Trends in Ground Water at the Latty Avenue Properties

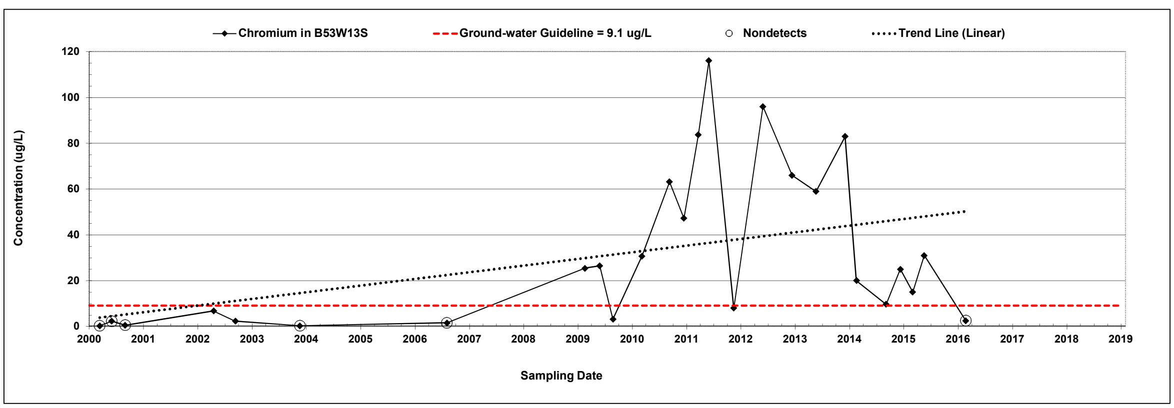


Path: U:\GPS\Five Year Review\4th FYR\Projects\Rev0\Figure 21 Ground-Water Monitoring Locations at the SLAPS and Surrounding SLAPS VPs.mxd

Figure 21. Ground-Water Monitoring Well Locations at the SLAPS and Surrounding SLAPS VPs







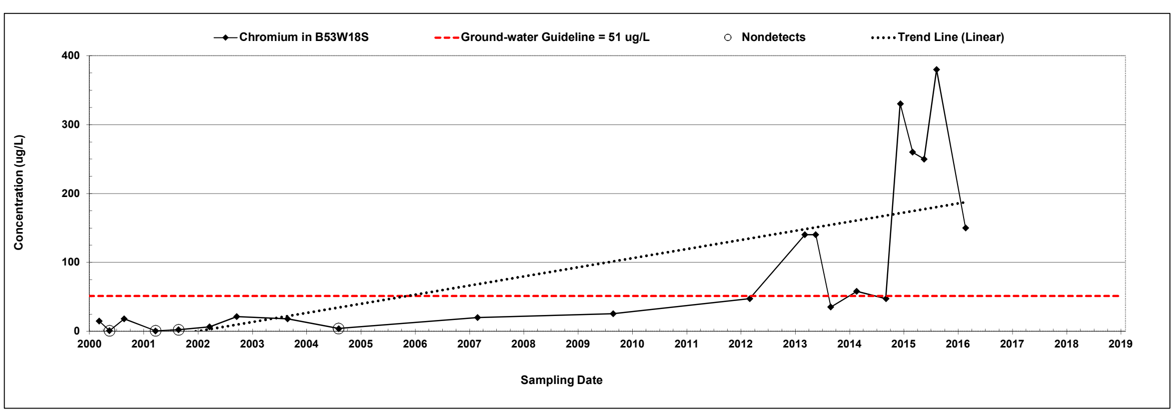
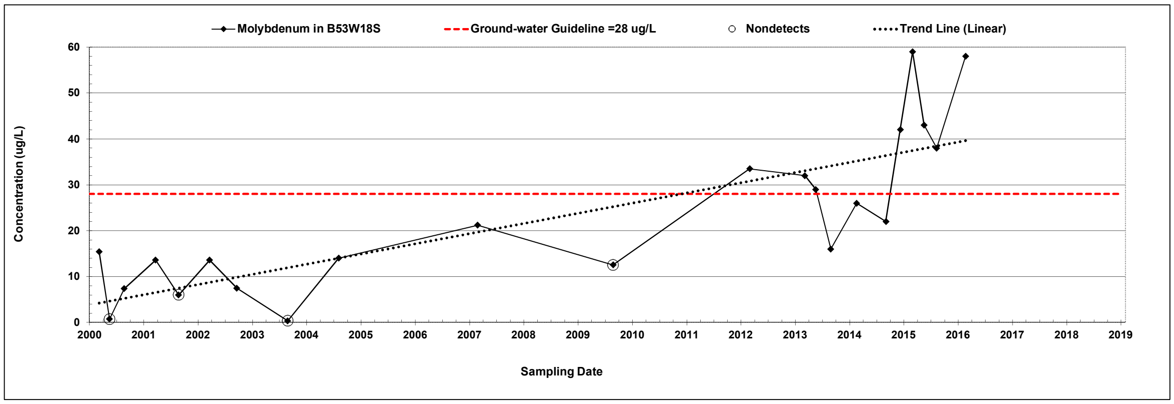
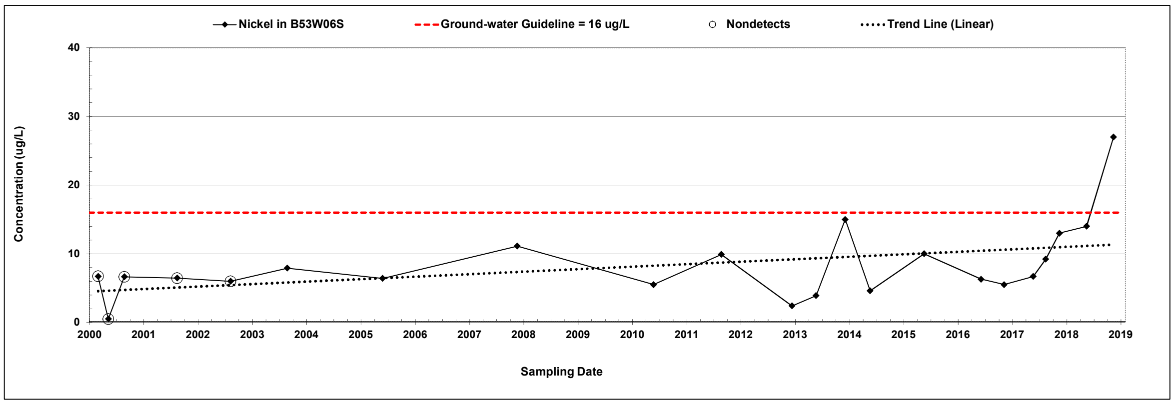
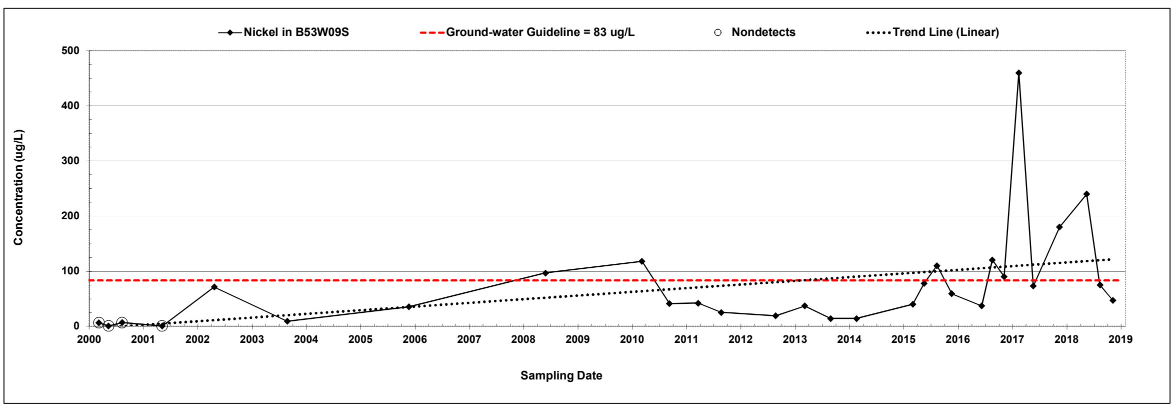


Figure 22. Concentration Trends in Ground Water at SLAPS and SLAPS VPs







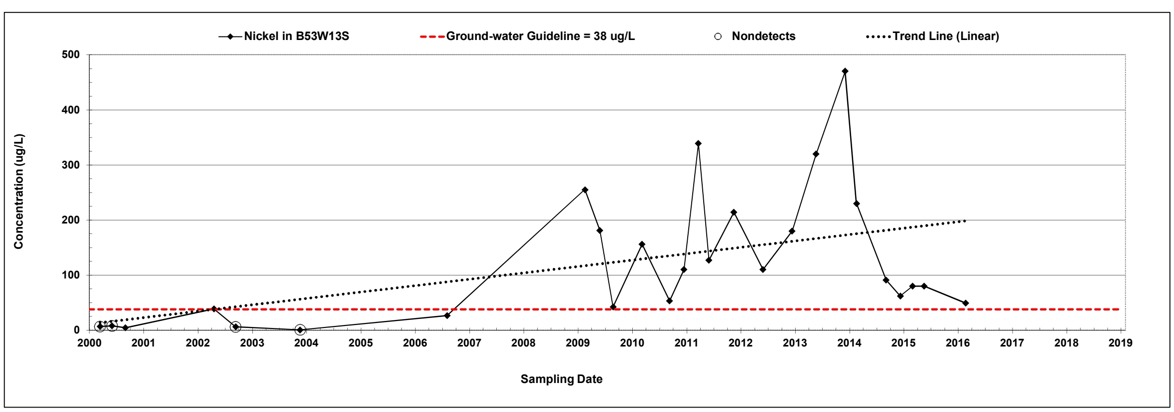
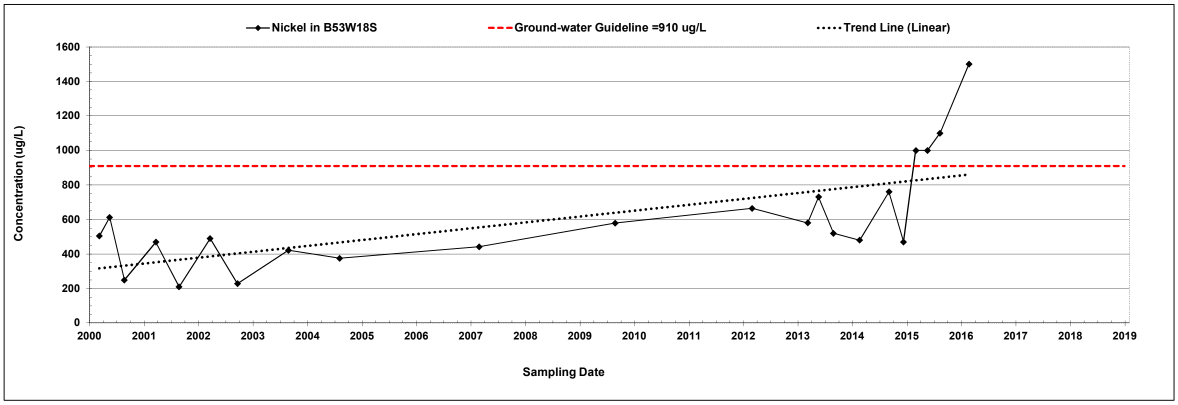
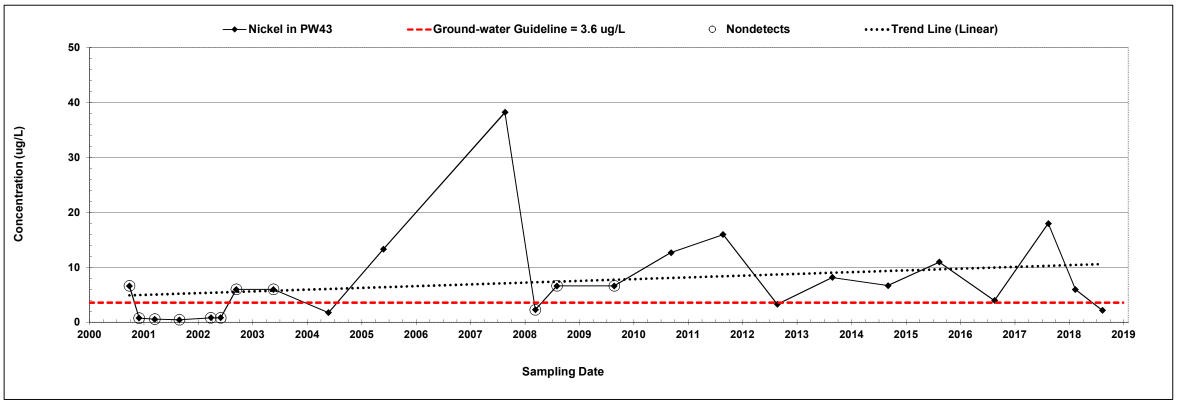
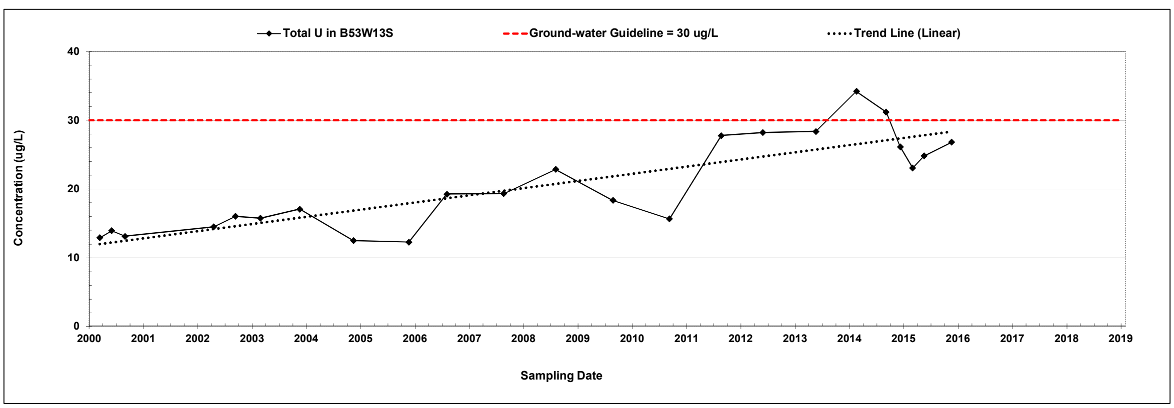


Figure 22. Concentration Trends in Ground Water at SLAPS and SLAPS VPs (Continued)







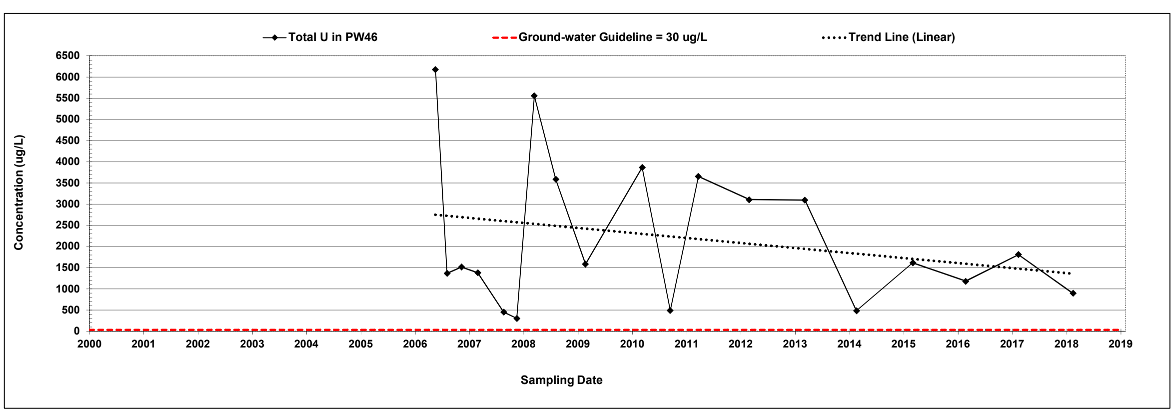


Figure 22. Concentration Trends in Ground Water at SLAPS and SLAPS VPs (Continued)

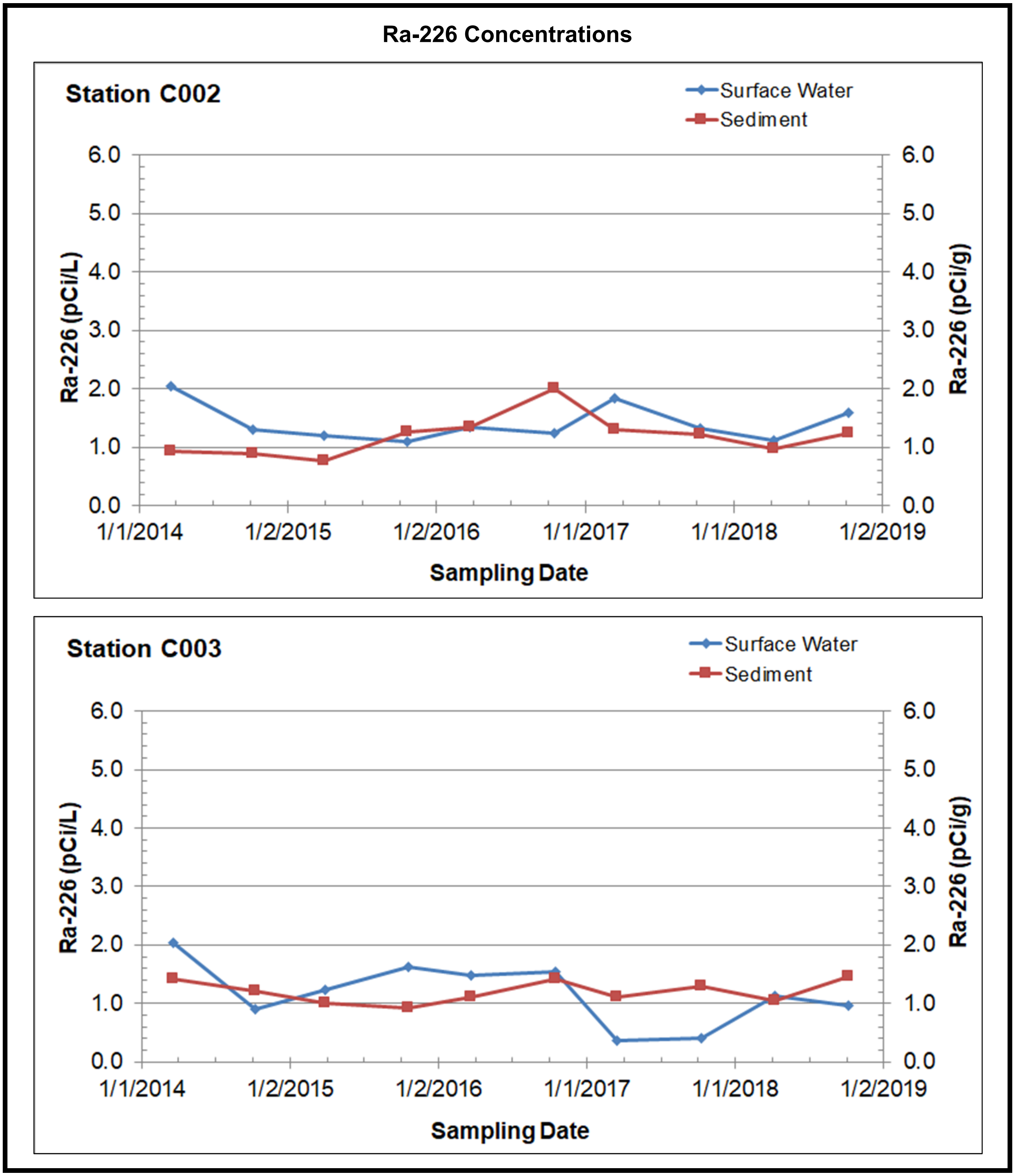


Figure 23. Comparison of Concentration Trends for Surface Water and Sediment in CWC

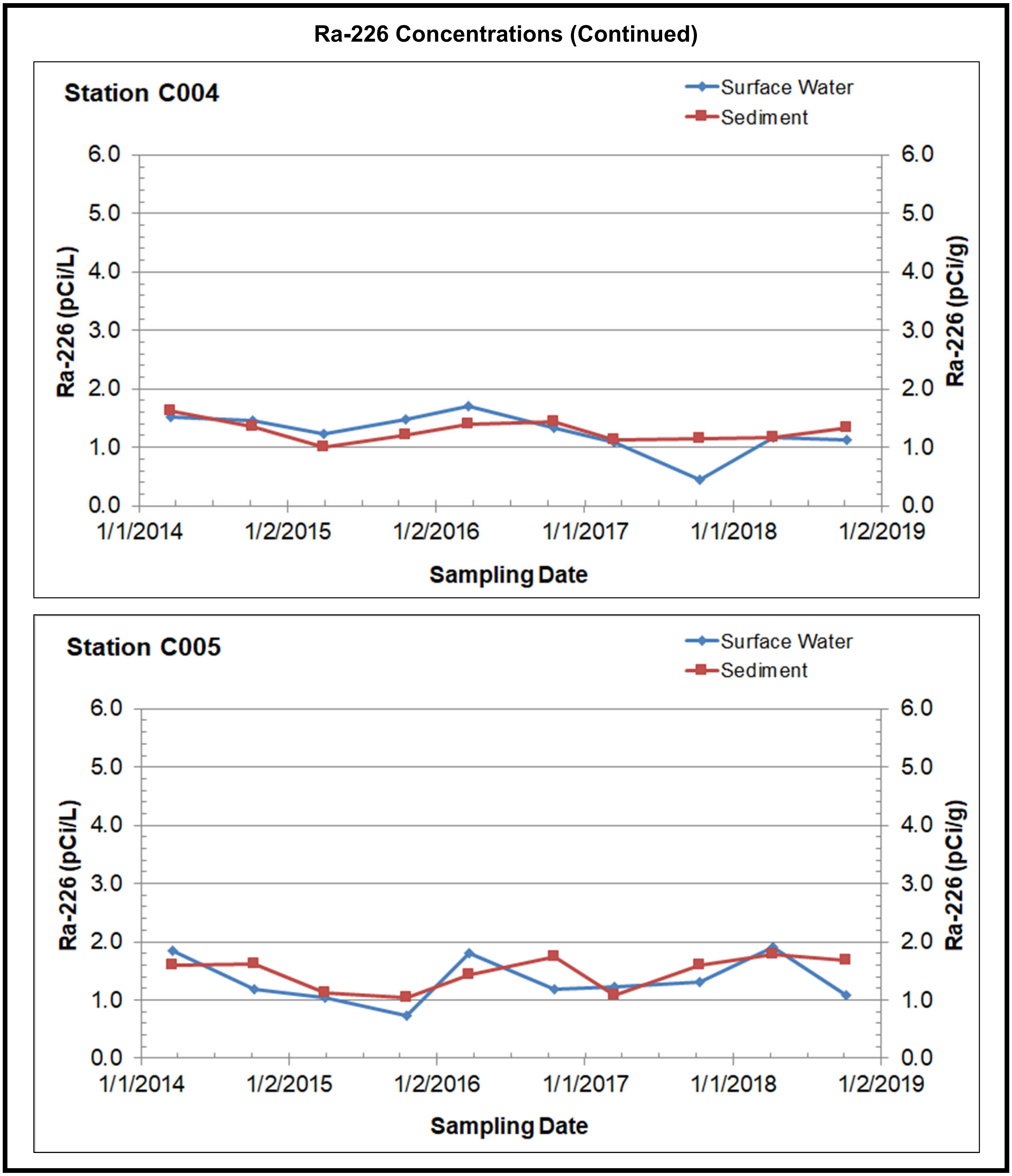
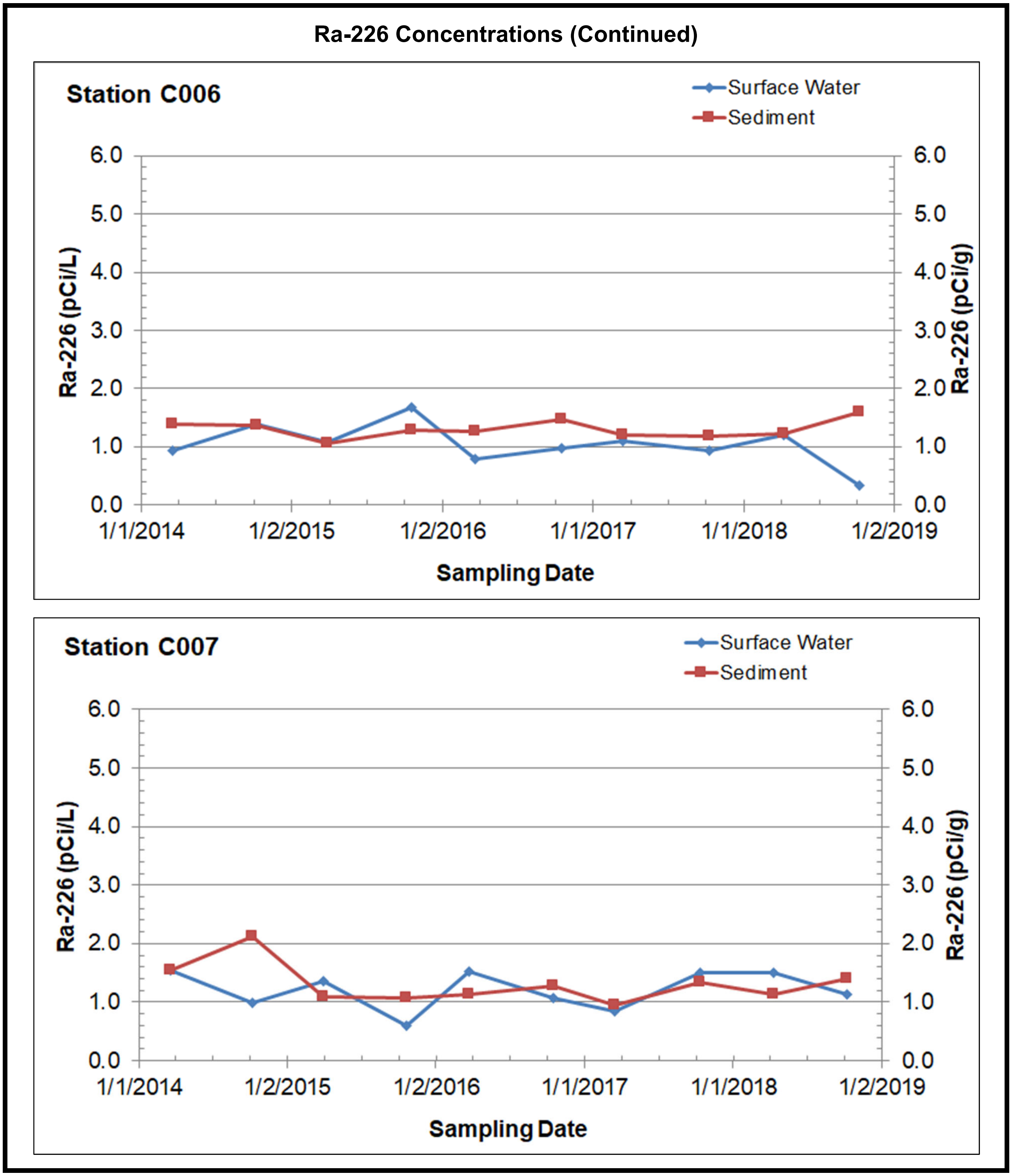


Figure 23. Comparison of Concentration Trends for Surface Water and Sediment in CWC (Continued)



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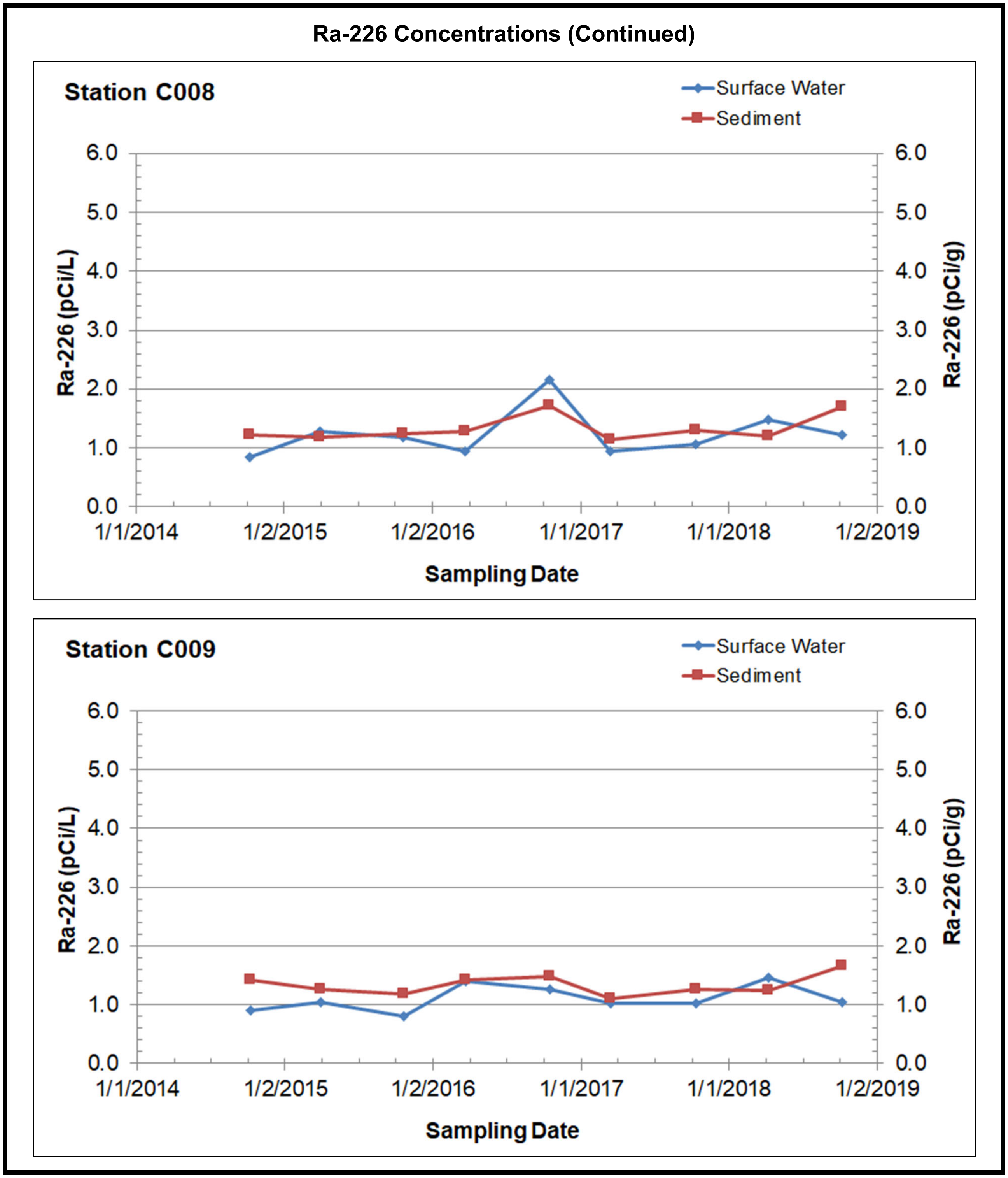

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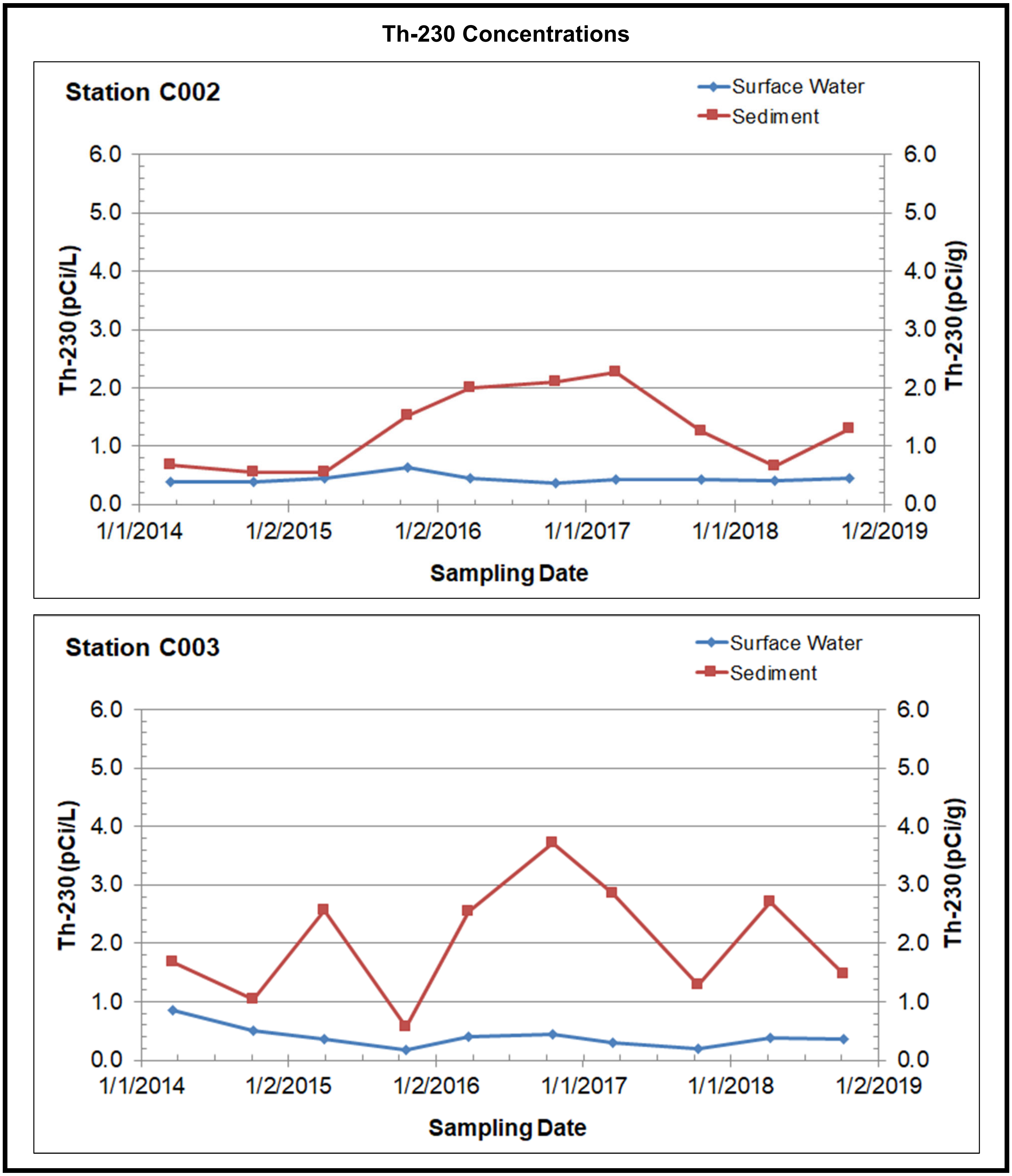

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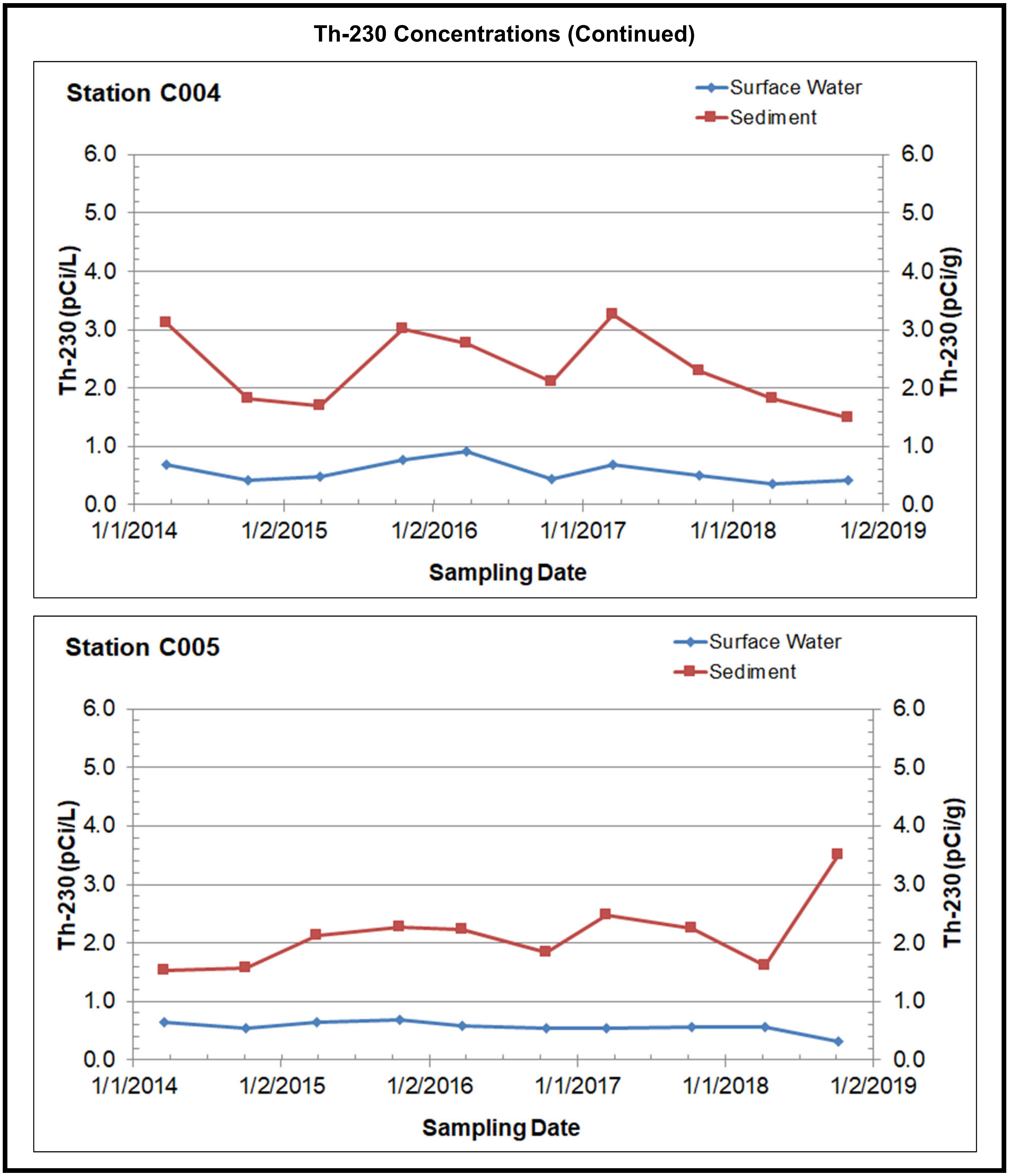

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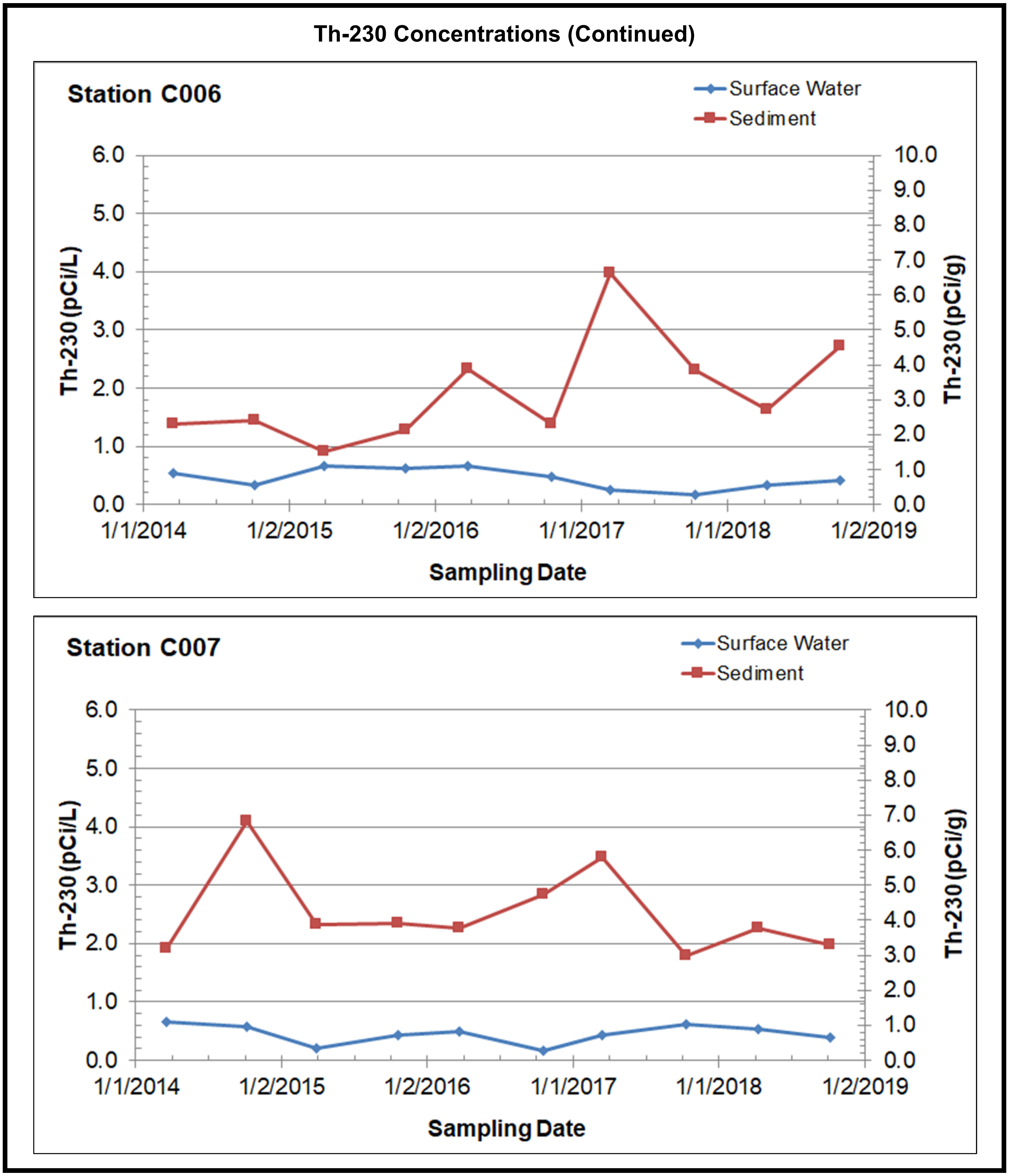

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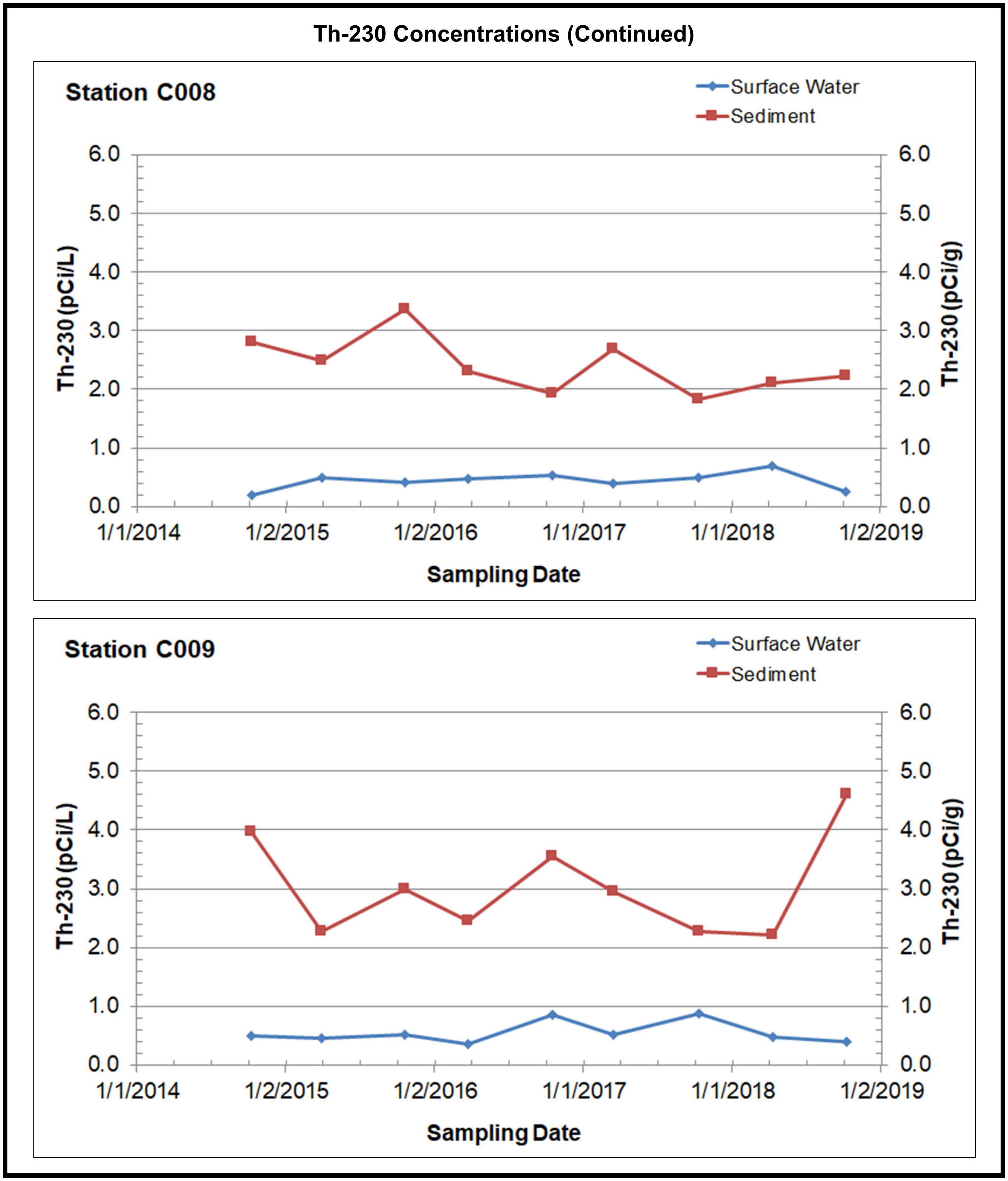

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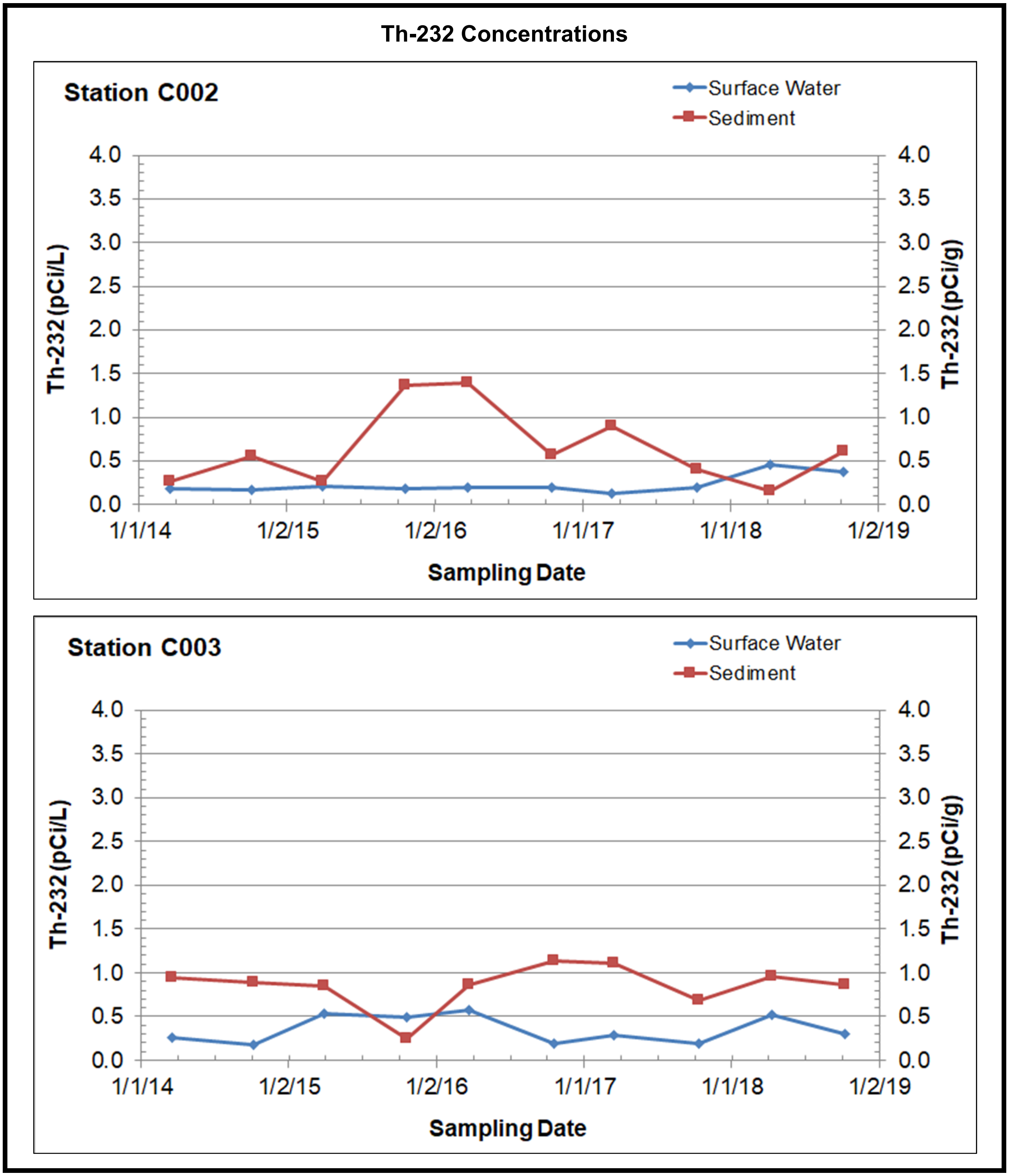

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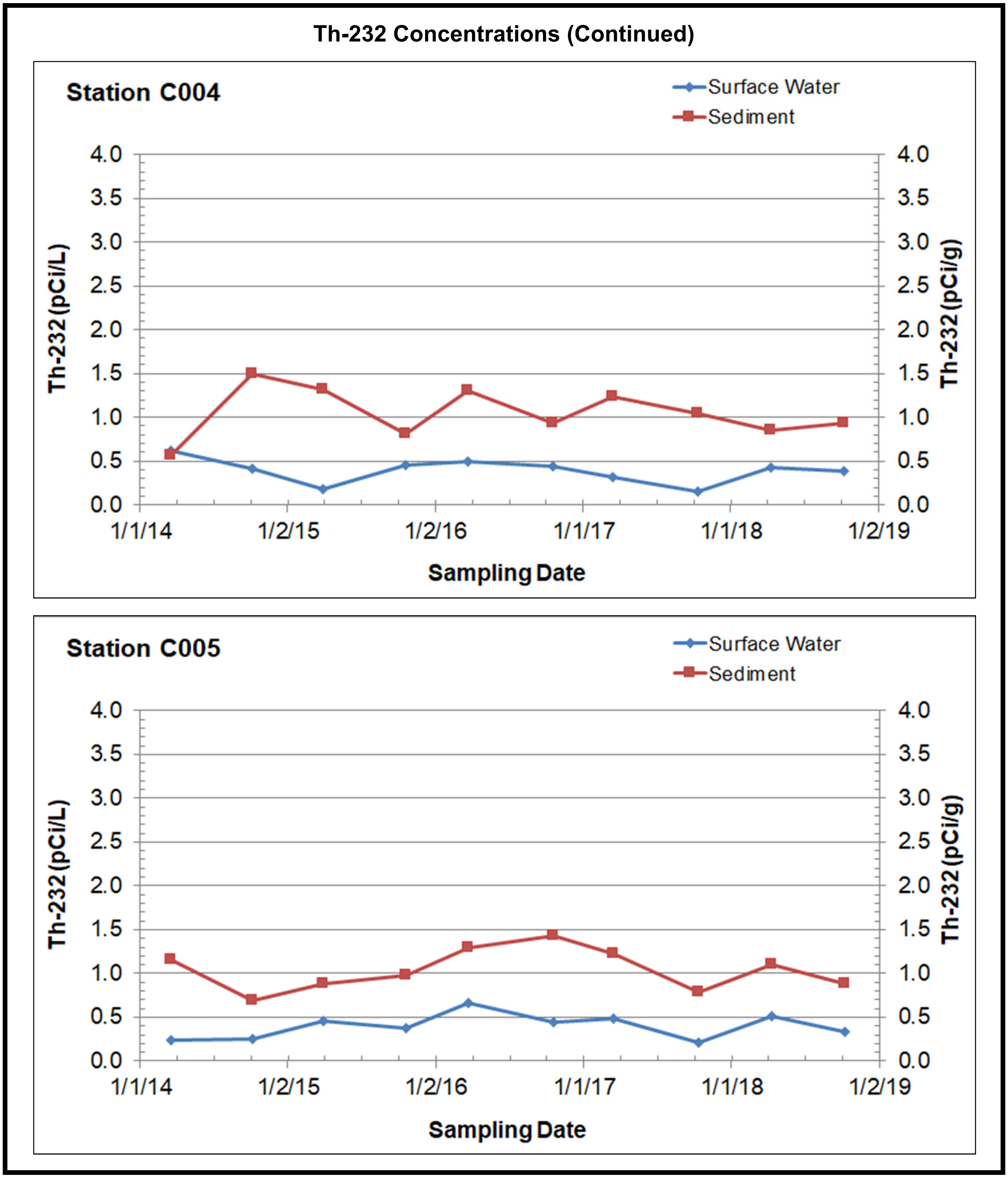

Figure 23. Comparison of Concentration Trends for Surface Water and Sediment in CWC (Continued)

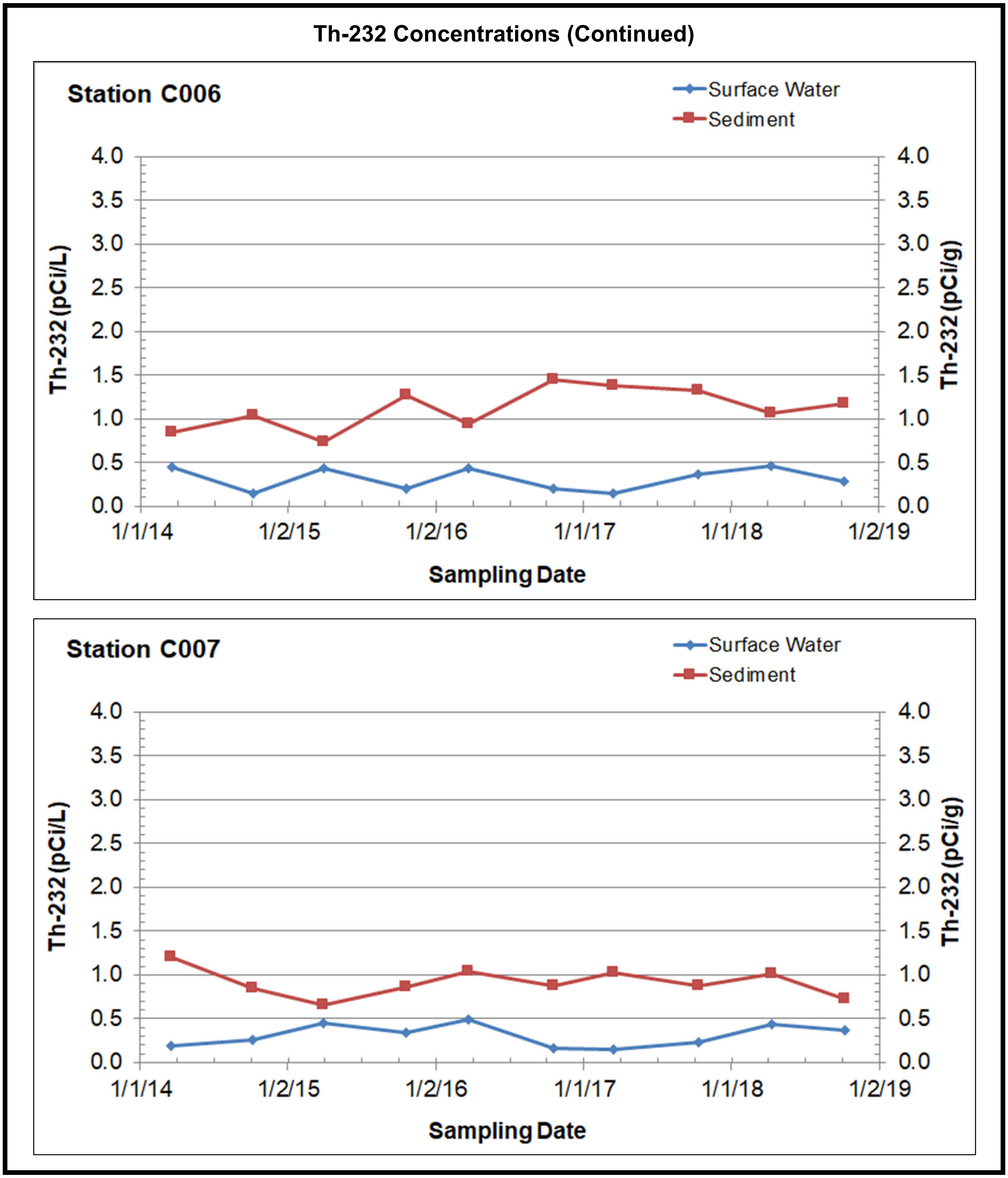

Figure 23. Comparison of Concentration Trends for Surface Water and Sediment in CWC (Continued)

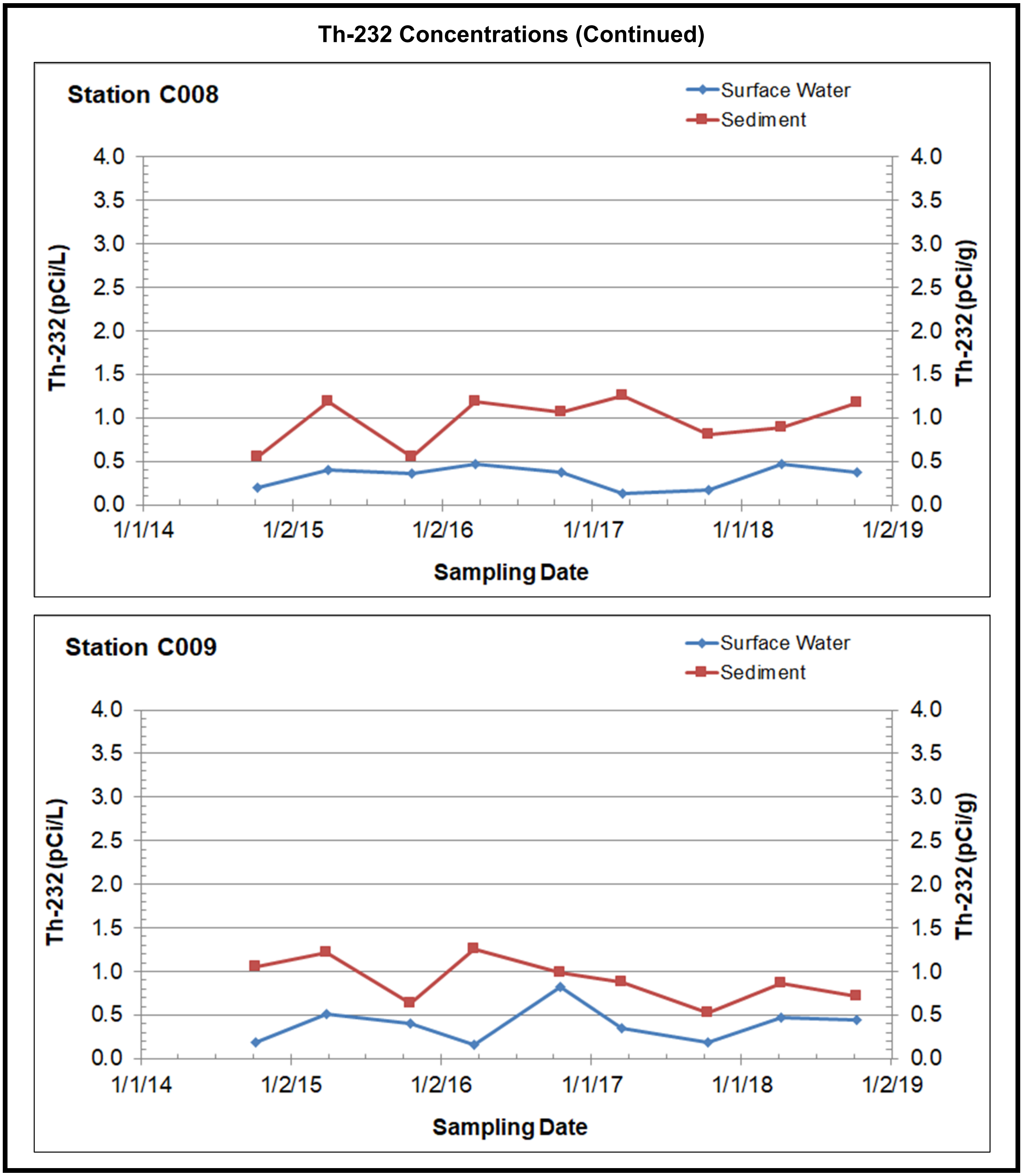

Figure 23. Comparison of Concentration Trends for Surface Water and Sediment in CWC (Continued)

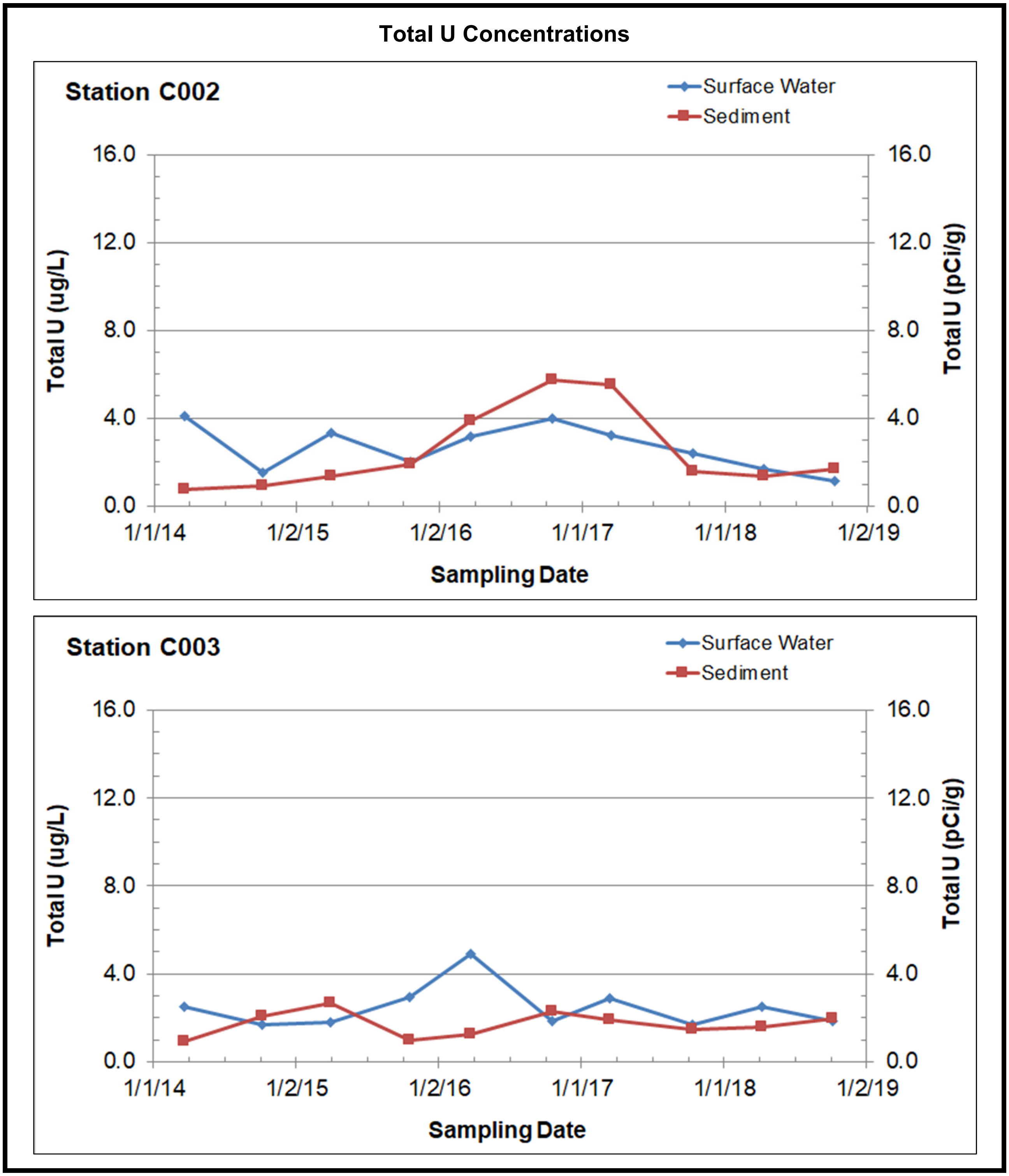

Figure 23. Comparison of Concentration Trends for Surface Water and Sediment in CWC (Continued)

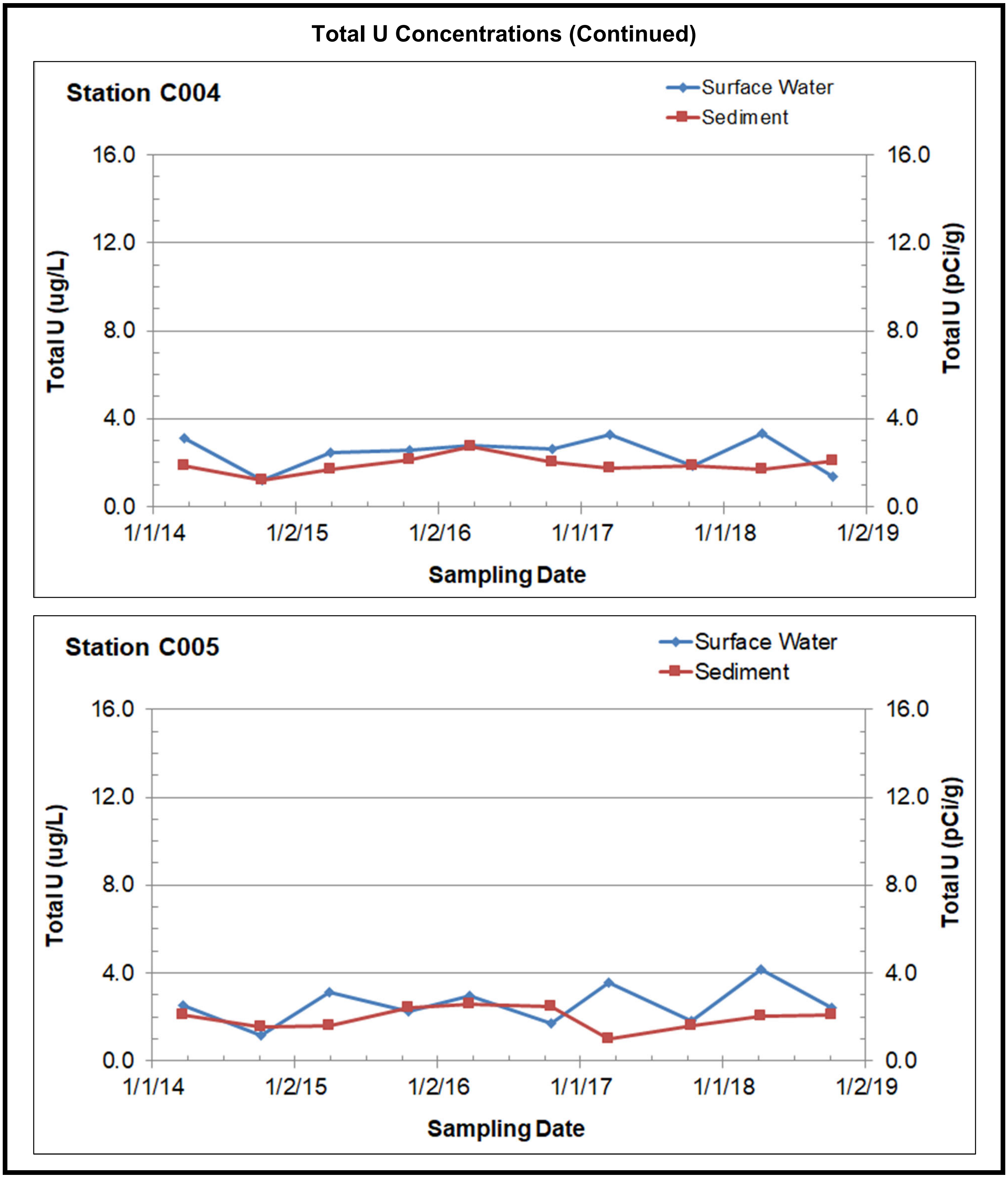

Figure 23. Comparison of Concentration Trends for Surface Water and Sediment in CWC (Continued)

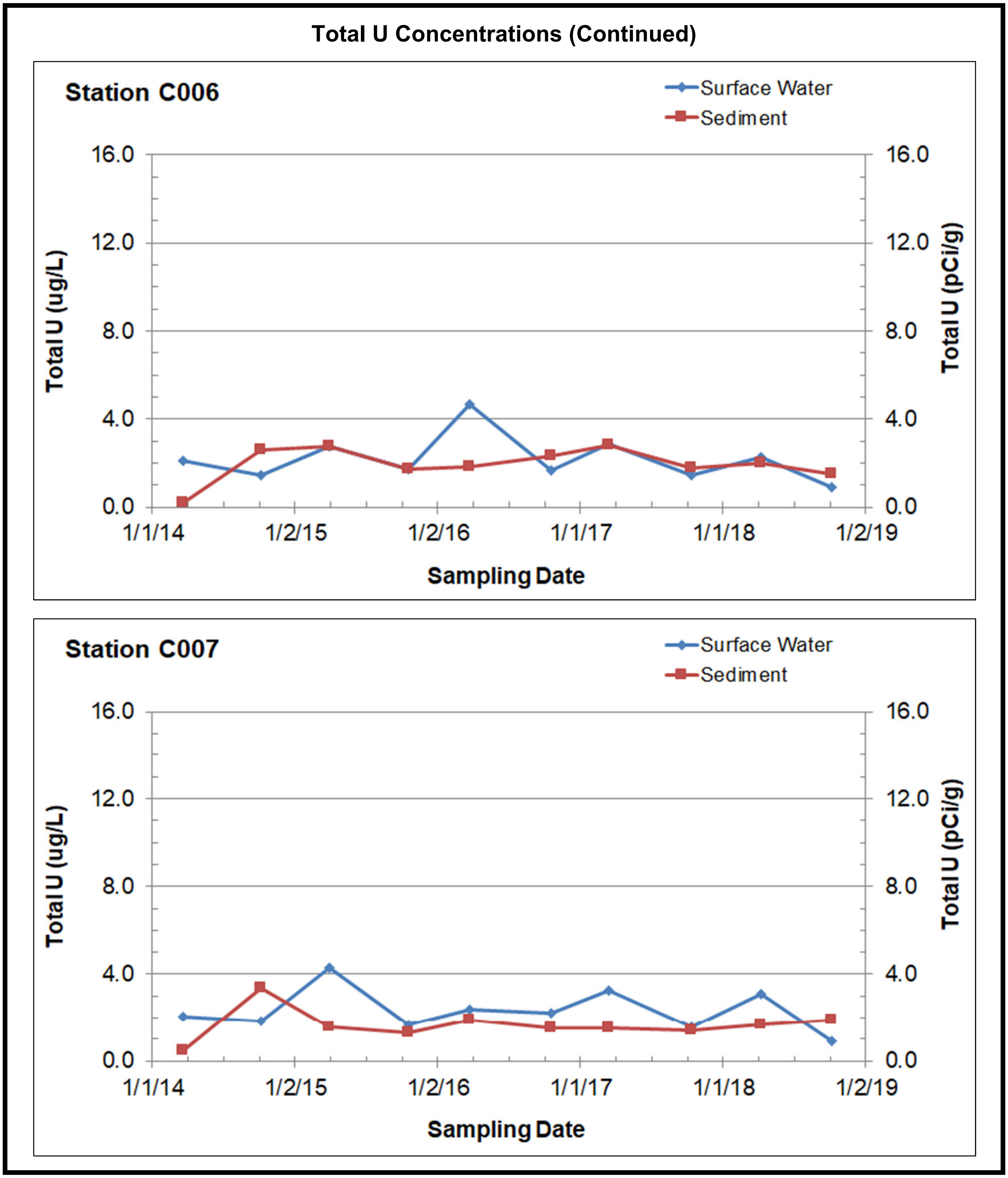

Figure 23. Comparison of Concentration Trends for Surface Water and Sediment in CWC (Continued)

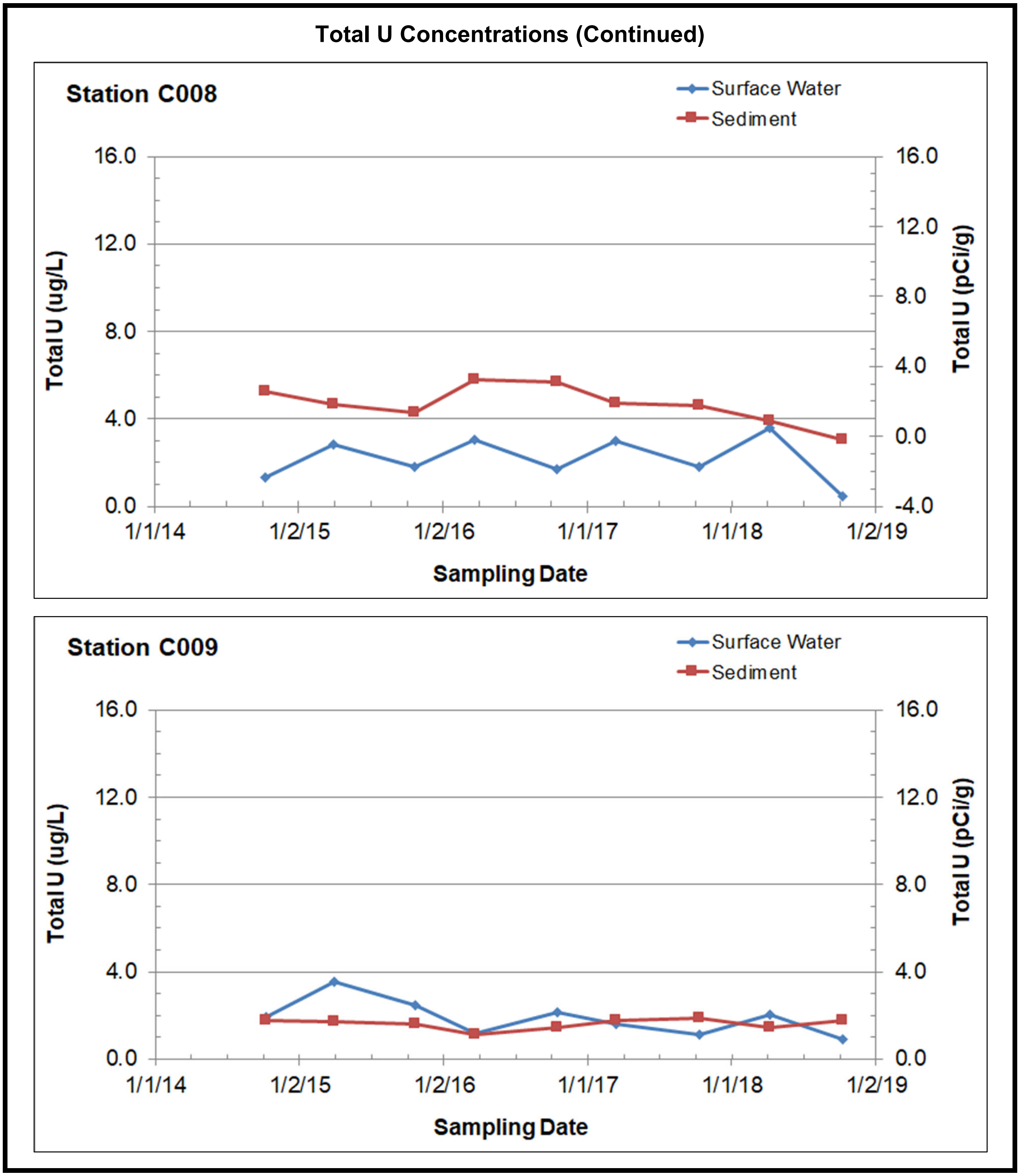

Figure 23. Comparison of Concentration Trends for Surface Water and Sediment in CWC (Continued)

APPENDIX A

FIVE-YEAR REVIEW SITE INSPECTIONS

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Attachment A-1

U.S. Environmental Protection Agency Site Inspections

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Exhibit A-1-1

U.S. Environmental Protection Agency
Site Inspections for the North St. Louis County Sites

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St. Louis FUSRAP
North County Site
Five-Year Review Site Inspection Checklist
EPA Region 7

Five-Year Review Site Inspection Checklist

Purpose of the Checklist

The site inspection checklist provides a useful method for collecting important information during the site inspection portion of the five-year review. The checklist serves as a reminder of what information should to be gathered and provides the means of checking off information obtained and reviewed, or information not available or applicable. The checklist is divided into sections as follows:

I. Site Information
II. Interviews
III. On-site Documents & Records Verified
IV. O&M Costs
V. Access and Institutional Controls
VI. General Site Conditions
VII. Landfill Covers
VIII. Vertical Barrier Walls
IX. Groundwater/Surface Water Remedies
X. Other Remedies
XI. Overall Observations

Some data and information identified in the checklist may or may not be available at the site depending on how the site is managed. Sampling results, costs, and maintenance reports may be kept on site or may be kept in the offices of the contractor or at State offices. In cases where the information is not kept at the site, the item should not be checked as "not applicable," but rather it should be obtained from the office or agency where it is maintained. If this is known in advance, it may be possible to obtain the information before the site inspection.

This checklist was developed by EPA and the U.S. Army Corps of Engineers (USACE). It focuses on the two most common types of remedies that are subject to five-year reviews: landfill covers, and groundwater pump and treat remedies. Sections of the checklist are also provided for some other remedies. The sections on general site conditions would be applicable to a wider variety of remedies. The checklist should be modified to suit your needs when inspecting other types of remedies, as appropriate.

The checklist may be completed and attached to the Five-Year Review report to document site status. Please note that the checklist is not meant to be completely definitive or restrictive; additional information may be supplemented if the reviewer deems necessary. Also note that actual site conditions should be documented with photographs whenever possible.

Using the Checklist for Types of Remedies

The checklist has sections designed to capture information concerning the main types of remedies which are found at sites requiring five-year reviews. These remedies are landfill covers (Section VII of the checklist) and groundwater and surface water remedies (Section IX of the checklist). The primary elements and appurtenances for these remedies are listed in sections which can be checked off as the facility is inspected. The opportunity is also provided to note site conditions, write comments on the facilities, and attach any additional pertinent information. If a site includes remedies beyond these, such as soil vapor extraction or soil landfarming, the information should be gathered in a similar manner and attached to the checklist.

Considering Operation and Maintenance Costs

Unexpectedly widely varying or unexpectedly high O&M costs may be early indicators of remedy problems. For this reason, it is important to obtain a record of the original O&M cost estimate and of annual O&M costs during the years for which costs incurred are available. Section IV of the checklist provides a place for documenting annual costs and for commenting on unanticipated or unusually high O&M costs. A more detailed categorization of costs may be attached to the checklist if available. Examples of categories of O&M costs are listed below.

<u>Operating Labor</u> - This includes all wages, salaries, training, overhead, and fringe benefits associated with the labor needed for operation of the facilities and equipment associated with the remedial actions.

<u>Maintenance Equipment and Materials</u> - This includes the costs for equipment, parts, and other materials required to perform routine maintenance of facilities and equipment associated with a remedial action.

<u>Maintenance Labor</u> - This includes the costs for labor required to perform routine maintenance of facilities and for equipment associated with a remedial action.

<u>Auxiliary Materials and Energy</u> - This includes items such as chemicals and utilities which can include electricity, telephone, natural gas, water, and fuel. Auxiliary materials include other expendable materials such as chemicals used during plant operations.

<u>Purchased Services</u> - This includes items such as sampling costs, laboratory fees, and other professional services for which the need can be predicted.

<u>Administrative Costs</u> - This includes all costs associated with administration of O&M not included under other categories, such as labor overhead.

Insurance, Taxes and Licenses - This includes items such as liability and sudden and accidental insurance, real estate taxes on purchased land or right-of-way, licensing fees for certain technologies, and permit renewal and reporting costs.

Other Costs - This includes all other items which do not fit into any of the above categories.

Please note that "O&M" is referred to throughout this checklist. At sites where Long-Term Response Actions are in progress, O&M activities may be referred to as "system operations" since these sites are not considered to be in the O&M phase while being remediated under the Superfund program.

Five-Year Review Site Inspection Checklist

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: North County Site	**Date of inspection: July 31, 2019**
Location and Region: St. Louis, MO - EPA Region 7	**EPA ID:**
Agency, office, or company leading the five-year review: USACE	**Weather/temperature: Sunny/typical summer temperatures**

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment ☐ Monitored natural attenuation
☒ Access controls ☐ Groundwater containment
☒ Institutional controls ☐ Vertical barrier walls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other Removal and off-site disposal of accessible contaminated soils soil and sediment to RGs that support UUUE, impose use restrictions at areas with contaminated soils that are inaccessible, and monitor ground water and surface water.

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply) - **Not conducted during the inspection.**

1. **O&M site manager**
2. **O&M staff**
3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.)
4. **Other interviews** (optional)

All interviews have been or will be conducted by either USACE or MDNR and included in the 5 year review.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED

IV. O&M COSTS ☒ **N/A**

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A
Remarks It is unclear which portions of the Site may require fencing as part of the final remedy. However, fencing in place to manage access to portions of the Site undergoing active remediation/construction appeared to be effective and secured.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks_Similar to fencing, it is unclear which portions of the Site require signs or other security measures as part of the final remedy. Security measures in place to manage the RA operations appear to be effective and in good condition. Further, areas of known contamination yet to be remediated, such as sediments within Coldwater Creek or along the banks of the creek were also observed during the inspection. Based on the inspection and review of documents describing prior design investigation activities performed on these areas, it appears that the contaminated material is present in the subsurface and, if undisturbed, would not result in unacceptable exposures to the public. However, further evaluation of interim measures to prevent these areas from being disturbed by the general public, including signage, should be presented in the forthcoming five-year review.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented	☐ Yes	☒ No	☐ N/A
Site conditions imply ICs not being fully enforced	☐ Yes	☒ No	☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ____**(Unclear)**_
Frequency ____
Responsible party/agency ____
Contact ____ ____ ____ ____
Name Title Date Phone no.

Reporting is up-to-date	☐ Yes	☐ No	☐ N/A
Reports are verified by the lead agency	☐ Yes	☐ No	☐ N/A
Specific requirements in deed or decision documents have been met	☐ Yes	☐ No	☒ N/A
Violations have been reported	☐ Yes	☐ No	☒ N/A

Other problems or suggestions: ☐ Report attached
Several, but not all, of the inaccessible soil areas (e.g., contaminated soils underneath roads, railroads, and permanent structures) were observed during the inspection. It appeared that site conditions associated with these specific inaccessible areas were currently preventing release of contaminated media and otherwise would not result in unacceptable exposures from the contaminated materials as long as the overlying structure was not impacted. In addition, properties undergoing further investigation and remediation were also visited. EPA was also able to review an example letter provided to a private property owner whose property was undergoing these activities. It appeared, based on the inspection and other documentation described above, that interim IC's have been effective at preventing unacceptable exposures to properties owners whose properties were undergoing active remediation. EPA notes that additional information is expected to be included in the 5YR providing further documentation of interim measures implemented until formal institutional controls are implemented.

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☒ N/A
Remarks_This determination could not be made because formal IC's have not been implemented at the time of the inspection.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks____

2. **Land use changes on site** ☒ N/A
Remarks_No obvious signs of recent land use changes were observed on-site during the inspection.

3. **Land use changes off site** ☒ N/A
Remarks_ No obvious signs of recent land use changes were observed off-site during the inspection.

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☐ Roads adequate ☒ N/A
Remarks___

B. Other Site Conditions

Remarks _Infrastructure in place to support the RA operations appeared to be effective and in good condition.

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ NA

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☒ N/A
Remarks___

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks_NA

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks_NA

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps, and Electrical**
☐ Good condition ☐ Needs Maintenance
Remarks_Not part of a final remedy; however, the general location of water treatment/collection systems used to support active RA operations appeared to be functioning as intended and in good condition.

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks_Not observed during the inspection.

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks_Not observed during the inspection.

C. Treatment System ☐ Applicable ☒ N/A

D. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining
Remarks Monitoring data was not reviewed during the Site Inspection. EPA will review and consider groundwater and surface water monitoring data in the forthcoming five-year review.

D. Monitored Natural Attenuation ☒ N/A

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

N/A

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The remedy construction appears to be proceeding in accordance with the ROD.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Specific review and observation of long-term monitoring activities were not conducted during the Site Inspection.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.
No issues were observed during the inspection.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.
No opportunities for optimization were evident during the inspection.

Exhibit A-1-2

U.S. Environmental Protection Agency
Site Inspections for the St. Louis Downtown Sites

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St. Louis FUSRAP
St. Louis Downtown Site
Five-Year Review Site Inspection Checklist
EPA Region 7

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Please note that "O&M" is referred to throughout this checklist. At sites where Long-Term Response Actions are in progress, O&M activities may be referred to as "system operations" since these sites are not considered to be in the O&M phase while being remediated under the Superfund program.

Five-Year Review Site Inspection Checklist

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: St. Louis Downtown Site	**Date of inspection: July 31, 2019**
Location and Region: St. Louis, MO - EPA Region 7	**EPA ID:**
Agency, office, or company leading the five-year review: USACE	**Weather/temperature: Sunny/typical summer temperatures**
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ☐ Monitored natural attenuation ☒ Access controls ☐ Groundwater containment ☒ Institutional controls ☐ Vertical barrier walls ☐ Groundwater pump and treatment ☐ Surface water collection and treatment ☒ Other Removal and off-site disposal of contaminated soil/sediment RGs, groundwater monitoring, and institutional controls such as land use restrictions for those areas having residual concentrations of contaminants unsuitable for unrestricted use.	
Attachments: ☐ Inspection team roster attached ☐ Site map attached	
II. INTERVIEWS (Check all that apply) - **Not conducted during the inspection.**	
1. **O&M site manager**	
2. **O&M staff**	
3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.)	
4. **Other interviews** (optional)	
All interviews have been or will be conducted by either USACE or MDNR and included in the 5 year review.	
III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)	
IV. O&M COSTS ☒ **N/A**	
V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A	
A. Fencing	
1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A Remarks It is unclear which portions of the Site require fencing as part of the remedy. However, fencing in place to manage access to portions of the Site undergoing active remediation/construction appeared to be effective and secured.	
B. Other Access Restrictions	

1.	**Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks Similar to fencing, it is unclear which portions of the Site require signs or other security measures as part of the remedy. Security measures in place to manage the RA operations appeared to be effective and in good condition.	
C. Institutional Controls (ICs)		
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented **(Unclear)** ☐ Yes ☐ No ☐ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A Type of monitoring (*e.g.*, self-reporting, drive by) **(Unclear)** Frequency ____ Responsible party/agency ____ Contact ____ Name ____ Title ____ Date ____ Phone no. Reporting is up-to-date ☐ Yes ☐ No ☐ N/A Reports are verified by the lead agency ☐ Yes ☐ No ☐ N/A Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☒ N/A Violations have been reported ☐ Yes ☐ No ☒ N/A Other problems or suggestions: ☐ Report attached It is unclear which portions of the Site may require an IC to be implemented. The ROD states "Institutional controls may include land use restrictions for those areas having residual concentrations of contaminants unsuitable for unrestricted use. This determination will be made based on risk analysis of the actual post-remedial action conditions. Until a decision is developed to address the ultimate disposition of inaccessible soils, steps will be taken to control uses inconsistent with current uses and to learn of anticipated changes in conditions that might make these soils accessible or increase the potential for exposure." (page 67 of the 1998 SLDS ROD) The inspection did not include a review and discussion of any portions of the Site that may require land use restrictions or other interim measures discussed in the ROD.	
2.	**Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks This determination could not be made during the inspection.	
D. General		
1.	**Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident Remarks ____	
2.	**Land use changes on site** ☒ N/A Remarks No obvious signs of recent land use changes were observed on-site during the inspection.	
3.	**Land use changes off site** ☒ N/A Remarks No obvious signs of recent land use changes were observed off-site during the inspection.	
VI. GENERAL SITE CONDITIONS		
A. Roads ☐ Applicable ☒ N/A		

1.	**Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks Some roads used to access the Site were in need of repair but were still passible by standard on-road vehicles and did not otherwise appear to effect the on-going remedial action.
B. Other Site Conditions	
	Remarks Infrastructure in place to support the RA operations appeared to be effective and in good condition.
VII. LANDFILL COVERS ☐ Applicable ☒ N/A	
VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ NA	
IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** ☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☒ N/A Remarks
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks NA
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks NA
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A	
1.	**Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks Not part of a final remedy, however, the general location of water treatment/collection systems used to support active RA operations appeared to be functioning as intended and in good condition.
2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks Not Observed during the inspection.
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks Not observed during the inspection.
C. Treatment System ☐ Applicable ☒ N/A	
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

Remarks__Monitoring data was not reviewed during the Site Inspection. EPA will review and consider groundwater and surface water monitoring data in the forthcoming five-year review.

D. Monitored Natural Attenuation ☒ N/A

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

N/A

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Construction of the remedy described in the 1998 ROD for the accessible soil operable unit of the St. Louis Downtown Site, including the removal of contaminated soils in excess of site-specific cleanup levels, monitoring of groundwater, and institutional controls is on-going. EPA believes that upon completion, the remedy will achieve the remedial action objectives also described in the ROD. EPA notes however that Phase 1 of the ground-water remedial action alternative assessment (GRAAA) was initiated in 2001 in response to significant exceedances of the total U IL in DW19 for an extended period. Further, the Phase 1 (assessment) of the GRAAA was completed in 2003 and determined that Phase 2 (investigation) was necessary. This phase GRAAA should be completed as soon as possible so that Phase 3 (Feasibility) can begin and ultimately to ensure the long-term protection of any potential drinking water sources of groundwater (HU-B unit).

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.
_N/A____

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.
No issues were observed during the inspection.

D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. _No opportunities for optimization were evident during the inspection.

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Attachment A-2

U.S. Department of Energy Site Inspections

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USACE FIVE-YEAR REVIEW SITE INSPECTION COMMENTS FROM THE U.S. DEPARTMENT OF ENERGY/NAVARRO, DATED JULY 31, 2019

ST. LOUIS DOWNTOWN SITE – IMPLEMENTATION OF REMEDY

The remedy at SLDS is to excavate and dispose of accessible soil containing contamination exceeding the ROD RGs at the site.

- USACE is implementing the remedy with the future in mind. They are using their engineering expertise to perform excavation in areas that were previously thought to be inaccessible. This shows forward thinking and high quality communication with property owners to identify opportunities to lower the government’s liability and long term costs.
- It appears that USACE takes extreme care to minimize the spread of contamination. The following observations were made at the excavation area at SLDS.
    - Radiological ropes and signage were used to prevent unintentional access to potentially contaminated areas.
    - Plastic sheeting was used under the truck tires in the area where the excavator and truck were working.
    - The entire swing radius of the excavator was roped off.
    - Worker air monitoring was being performed.
    - Instrument calibrations were up to date.
- Routine air monitoring is being performed at the site and the results are documented in an annual report that is posted to the USACE public website. This ensures transparency and accountability to the project stakeholders.
- USACE actively implements lessons learned and best practices from previous salt dome excavations to minimize costs, improve efficiency and safety of the Salt Dome #3 excavation (specifically the application of the “pie” segment approach).

NORTH ST. LOUIS COUNTY SITES – IMPLEMENTATION OF REMEDY

The remedy at the North St. Louis County Sites is to excavate and dispose of accessible soil containing contamination exceeding the ROD RGs at the site.

- USACE appears to take extreme care to minimize the spread of contamination. The following observations were made at the excavation area and while observing the sampling event at the North St. Louis County Sites.
    - Radiological ropes and signage were used to prevent unintentional access to potentially contaminated areas.
    - Upon completion of loading the truck with potentially contaminated soil, the truck was equipped with a cover to prevent spillage as the soil was transported to the loadout area.
    - Active water spraying being used for dust suppression.
    - Worker air monitoring was being performed.
    - The workers performing the sampling were thorough and knowledgeable about the sampling procedures.

- Routine air monitoring is being performed at the site and the results are documented in an annual report that is posted to the USACE public website. This ensures transparency and accountability to the project stakeholders.

Attachment A-3

Missouri Department of Natural Resources Site Inspections

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Exhibit A-3-1

Missouri Department of Natural Resources
Site Inspections for the North St. Louis County Sites

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Five-Year Review Site Inspection Checklist for: **FUSRAP North County Sites**
Completed by: **Rita Alexander, MoDNR ERP FFS**

For the SLS, the remedial actions either on-going, have met UUUE for a property, or have met UUUE for accessible soil with Institutional Controls proposed for completion of the remedy. There are currently no properties where O&M is being performed or scheduled to be performed.

The Checklist has been modified to focus on items related to SLS sites.

Five-Year Review Site Inspection Checklist (Template)

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. **SITE INFORMATION**	
Site name: ***FUSRAP North County Sites***	**Date of inspection:** ***July 31, 2019***
Location and Region: ***North St. Louis County, MO***	EPA ID:
Agency, office, or company leading the five-year review: ***USACE***	**Weather/temperature:** ***Sunny in the 80s***
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ☒ Access controls ☒ Institutional controls ☐ Groundwater pump and treatment ☒ Surface water collection and treatment ☒ Other: *Excavation and removal of contaminated soil and other materials with shipment offsite to permitted facilities. Site activities concurrent with excavation include surface water management and air monitoring to confirm that best management practices are followed. Groundwater monitoring also conducted, but not part of remedy.*	☐ Monitored natural attenuation ☐ Groundwater containment ☐ Vertical barrier walls
Attachments: ☒ Inspection team roster attached	☒ Site map attached
II. **INTERVIEWS** (Check all that apply)	
1. **O&M site manager** ______ ______ ______ Name Title Date Interviewed ☐ at site ☐ at office ☐by phone Phone no. Problems, suggestions; ☐ Report attached ______	
2. **O&M staff** ______ ______ Name Title Date Interviewed ☐ at site ☐ at office ☐ by phone Phone no. ______ Problems, suggestions; ☐ Report attached ______	

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ____________________
Contact ______________________________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____________________

Agency ____________________
Contact ______________________________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____________________

Agency ____________________
Contact ______________________________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____________________

Agency ____________________
Contact ______________________________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____________________

4. **Other interviews** (optional) ☐ Report attached.

NA, interviews were or will be done after the 5 year review inspections date.

III. **ON-SITE DOCUMENTS & RECORDS VERIFIED**

IV. O&M COSTS ☐Not Applicable

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐N/A
Remarks *No damage to fencing was observed*

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐N/A
Remarks: *Appropriate signage and security measures were observed.*

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐Yes ☒No ☐N/A
Site conditions imply ICs not being fully enforced ☐Yes ☒No ☐N/A

Type of monitoring (*e.g.*, self-reporting, drive by)
Frequency
Responsible party/agency
Contact
Name Title Date Phone no.

Reporting is up-to-date ☐Yes ☐No ☒N/A
Reports are verified by the lead agency ☐Yes ☐No ☒N/A

Specific requirements in deed or decision documents have been met ☐Yes ☐No ☒N/A
Violations have been reported ☐Yes ☐No ☒N/A
Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☒N/A
Remarks: *Current site conditions did not indicate any problems.*

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks

2. **Land use changes on site** ☒NA
Remarks *None observed*

3. **Land use changes off site** ☒NA
Remarks *None observed*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐N/A

1. **Roads damaged** ☐ Location shown on site map ☒Roads adequate ☐NA
Remarks *USACE-constructed access roads were observed to be in good condition.*

B. Other Site Conditions

Remarks *All general site conditions appeared to be well maintained. Water treatment system, stockpile and Loadout Area, air monitoring and ventilation, and structural monitors were all observed during the inspection and appeared to be in good condition and functioning as intended.*

VII. LANDFILL COVERS ☐ Applicable ☒ NA

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ NA

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☐ Good condition ☐All required wells properly operating ☐Needs Maintenance ☒NA
Remarks

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks *NA*

3. **Spare Parts and Equipment**
☐Readily available ☐Good condition ☐Requires upgrade ☐Needs to be provided
Remarks *NA*

B. Surface Water Collection Structures, Pumps, and Pipelines ☒ Applicable ☐N/A

1. **Collection Structures, Pumps, and Electrical**
☒ Good condition ☐Needs Maintenance
Remarks: *General location of water treatment system used to treat surface water was observed onsite. Equipment appeared to be in good condition and performing its intended function*

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks: *Although specific equipment was not inspected, these systems overall appeared to be in good condition and performing their intended functions.*

3. **Spare Parts and Equipment**
☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks: *The condition and functionality of specific equipment was not observed. Although it is presumed that spare parts and equipment are readily available to insure adequate surface water management, this may need additional documentation.*

C. Treatment System ☐ Applicable ☒ N/A

D. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests: *NA, continued monitoring to determine this is warranted.*
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks: *Monitoring wells were observed to be secure and well maintained. Groundwater is being monitoring, but groundwater remedy is not natural attenuation.*

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

NA

Five-Year Review Site Inspection Checklist for: **FUSRAP North County Sites**
Completed by: **Rita Alexander, MoDNR ERP FFS**
July 31, 2019

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.)

The remedy for North County FUSRAP (removal of contaminated soil and other materials to achieve UUUE with ICs required for areas with inaccessible contamination that do not meet UUUE) appears to be functioning as intended.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

NA

C. **Early Indicators of Potential Remedy Problems**

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

NA. No issues were observed during the inspection.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Moving the lab and USACE offices from Latty Avenue to the SLAPS location, underway at the time of this inspection, was discussed as providing numerous opportunities for optimization.

For the SLS, the remedial actions either on-going, have met UUUE for a property, or have met UUUE for accessible soil with Institutional Controls proposed for completion of the remedy. There are currently no properties where O&M is being performed or scheduled to be performed.

The Checklist has been modified to focus on items related to SLS sites.

Five-Year Review Site Inspection Checklist (Template)

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. **SITE INFORMATION**

Site name: FUSRAP North County Sites	**Date of inspection: July 31, 2019**
Location and Region: North St. Louis County, MO	EPA ID:
Agency, office, or company leading the five-year review: USACE	**Weather/temperature: Sunny in the 80s**

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment
☒ Access controls
☒ Institutional controls
☐ Groundwater pump and treatment
☒ Surface water collection and treatment
☒ Other Excavation of contaminated soil and other materials, removal of soil and other materials to facilities permitted to receive them, surface water management at areas under active excavation, air monitoring at active areas with contaminated materials for confirmation that best management practices are successful, and groundwater monitoring.

☐ Monitored natural attenuation
☐ Groundwater containment
☐ Vertical barrier walls

Attachments: ☒ Inspection team roster attached ☒ Site map attached

II. **INTERVIEWS** (Check all that apply)

1. **O&M site manager** NA

Name	Title	Date
NA		

Interviewed ☐ at site ☐ at office ☐by phone Phone no.
Problems, suggestions; ☐ Report attached

2. **O&M staff**

Name	Title	Date

Interviewed ☐ at site ☐ at office ☐ by phone Phone no.
Problems, suggestions; ☐ Report attached

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ______________________

Contact ______________________

Name Title Date Phone no.

Problems; suggestions; ☐ Report attached

Agency ______________________

Contact ______________________

Name Title Date Phone no.

Problems; suggestions; ☐ Report attached

Agency ______________________

Contact ______________________

Name Title Date Phone no.

Problems; suggestions; ☐ Report attached

Agency ______________________

Contact ______________________

Name Title Date Phone no.

Problems; suggestions; ☐ Report attached

4. **Other interviews** (optional) ☒ Report attached.

NA, interviews were or will be done after the 5 year review inspections date.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED

IV. O&M COSTS ☒ Not Applicable

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A
Remarks No damage to fencing was observed.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks: Appropriate signage and security measures were observed.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by)
Frequency
Responsible party/agency
Contact
Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ☒ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☒ N/A
Violations have been reported ☐ Yes ☐ No ☒ N/A
Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks: Current site conditions did not indicate any problems. DNR reviewed letters to homeowners and other USACE documents prior to the inspections which gives some confidence in the adequacy of interim ICs and notification of identified contamination.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks

2. **Land use changes on site** ☒NA
Remarks None observed.

3. **Land use changes off site** ☒NA
Remarks None observed.

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐N/A

1. **Roads damaged** ☐ Location shown on site map ☒Roads adequate ☐NA
Remarks USACE-constructed access roads were in good condition. City roads were in adequate condition.

B. Other Site Conditions

Remarks The general site conditions appeared to be well-maintained.
(Water treatment system, stockpile and loadout Area, air monitoring and ventilation, surface water management from areas where contaminated materials were stored or were being excavated, and structural monitors were observed during the inspection. They were all functioning as intended and appeared to be in good condition.)

VII. LANDFILL COVERS ☐ Applicable ☒ NA

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ NA

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☒ Good condition ☐All required wells properly operating ☐Needs Maintenance ☐NA
Remarks: Monitoring wells were observed during the inspection and appeared to be in good condition.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks NA

3. **Spare Parts and Equipment**
☐Readily available ☐Good condition ☐Requires upgrade ☐Needs to be provided
Remarks NA

B. Surface Water Collection Structures, Pumps, and Pipelines ☒ Applicable ☐N/A

1. **Collection Structures, Pumps, and Electrical**
☒ Good condition ☐Needs Maintenance
Remarks: General location of water treatment system used to treat surface water was observed onsite. Equipment appeared to be in good condition and performing its intended function.

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐Needs Maintenance
Remarks: Although specific equipment was not inspected, these systems overall appeared to be in good condition and performing their intended functions.

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☒ Needs to be provided
Remarks: The condition and functionality of specific equipment was not observed, although we presume spare parts and equipment for surface water management and control that may be needed are readily available this may need additional documentation.

C. Treatment System ☐ Applicable ☒N/A

D. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests: NA, continued monitoring is warranted as per ROD requirements.
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ All required wells located ☐ Needs Maintenance ☐N/A
Remarks: Monitoring wells were observed to be secure and well maintained. Groundwater is being monitoring, but groundwater remedy is not natural attenuation.

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction. NA

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.)

The remedy for North County FUSRAP, removal of contaminated soil and other materials to achieve UUUE with ICs required for areas with inaccessible contamination that do not meet UUUE appears to be functioning as intended.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

NA

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

No issues were observed during the inspection.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

No additional tasks or opportunities for optimization were identified during the inspection. Movement of the lab and USACE offices to SLAPS (where North County FUSRAP's primary remediation contractor has their offices) which was underway at the time of this inspection was discussed as providing numerous optimization opportunities.

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Exhibit A-3-2

Missouri Department of Natural Resources
Site Inspections for the St. Louis Downtown Sites

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Five-Year Review Site Inspection Checklist for: **FUSRAP SLDS Site**
Completed by: **Rita Alexander, MoDNR ERP FFS**

For the SLS, the remedial actions either on-going, have met UUUE for a property, or have met UUUE for accessible soil with Institutional Controls proposed for completion of the remedy. There are currently no properties where O&M is being performed or scheduled to be performed.

The Checklist has been modified to focus on items related to SLS sites.

Five-Year Review Site Inspection Checklist (Template)

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. **SITE INFORMATION**	
Site name: *FUSRAP SLDS*	**Date of inspection:** *July 31, 2019*
Location and Region: *St. Louis, MO*	EPA ID:
Agency, office, or company leading the five-year review: *USACE*	**Weather/temperature:** *Sunny in the 80s*

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment
☒ Access controls
☒ Institutional controls
☐ Groundwater pump and treatment
☒ Surface water collection and treatment
☐ Monitored natural attenuation
☐ Groundwater containment
☐ Vertical barrier walls
☒ Other: *Excavation and removal of contaminated soil and other materials with shipment offsite to permitted facilities. Site activities concurrent with excavation include surface water management and air monitoring to confirm that best management practices are followed. Groundwater monitoring is also being conducted.*

Attachments: ☒ Inspection team roster attached ☒ Site map attached

II. **INTERVIEWS** (Check all that apply)

1. **O&M site manager** ____________ ____________ ____________
Name Title Date
Interviewed ☐ at site ☐ at office ☐by phone Phone no.
Problems, suggestions; ☐ Report attached ____________

2. **O&M staff** ____________ ____________
Name Title Date
Interviewed ☐ at site ☐ at office ☐ by phone Phone no. ________
Problems, suggestions; ☐ Report attached ____________

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ______________
Contact ______________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________

Agency ______________
Contact ______________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________

Agency ______________
Contact ______________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________

Agency ______________
Contact ______________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________

4. **Other interviews** (optional) ☐ Report attached.

NA, interviews were or will be done after the 5 year review inspections date.

Five-Year Review Site Inspection Checklist for: **FUSRAP SLDS Site**
Completed by: **Rita Alexander, MoDNR ERP FFS**
July 31, 2019

III. **ON-SITE DOCUMENTS & RECORDS VERIFIED**

IV. O&M COSTS ☐**Not Applicable**

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐N/A
Remarks *No damage to fencing was observed*

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐N/A
Remarks: *Appropriate signage and security measures were observed.*

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented	☐Yes	☒No	☐N/A
Site conditions imply ICs not being fully enforced	☐Yes	☒No	☐N/A

Type of monitoring (*e.g.*, self-reporting, drive by)
Frequency
Responsible party/agency
Contact
Name Title Date Phone no.

Reporting is up-to-date	☐Yes	☐No	☒N/A
Reports are verified by the lead agency	☐Yes	☐No	☒N/A
Specific requirements in deed or decision documents have been met	☐Yes	☐No	☒N/A
Violations have been reported	☐Yes	☐No	☒N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☒N/A
Remarks: *Current site conditions did not indicate any problems.*

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks

2. **Land use changes on site** ☒NA
Remarks *None observed*

3. **Land use changes off site** ☒NA
Remarks *None observed*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐N/A

1. **Roads damaged** ☐ Location shown on site map ☒Roads adequate ☐NA
Remarks *USACE-constructed access roads were observed to be in good condition. City roads were in adequate condition.*

B. Other Site Conditions

Remarks *The general site conditions appeared to be well-maintained. The following items were observed to be functioning as intended and appeared to be in good condition: Water treatment system, stockpile and Loadout Area, air monitoring and ventilation, surface water management from areas where contaminated materials were stored or were being excavated, and structural monitors were observed during the inspection.*

VII. LANDFILL COVERS ☐ Applicable ☒ NA

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ NA

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☐ Good condition ☐All required wells properly operating ☐Needs Maintenance ☒NA
Remarks

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks *NA*

3. **Spare Parts and Equipment**
☐Readily available ☐Good condition ☐Requires upgrade ☐Needs to be provided
Remarks *NA*

B. Surface Water Collection Structures, Pumps, and Pipelines ☒ Applicable ☐N/A

1. **Collection Structures, Pumps, and Electrical**
☒ Good condition ☐Needs Maintenance
Remarks: *General location of water treatment system used to treat surface water was observed onsite. Equipment appeared to be in good condition and performing its intended function*

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐Needs Maintenance
Remarks: *Although specific equipment was not inspected, these systems overall appeared to be in good condition and performing their intended functions.*

3. **Spare Parts and Equipment**
☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks: *The condition and functionality of specific equipment was not observed. Although it is presumed that spare parts and equipment are readily available to insure adequate surface water management, additional documentation may be needed.*

C. Treatment System ☐ Applicable ☒N/A

D. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests: *NA, continued monitoring to determine this is warranted per the ROD requirements.*
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ All required wells located ☐ Needs Maintenance ☐N/A
Remarks: *Monitoring wells were observed to be secure and well maintained. Groundwater is being monitoring, but groundwater remedy is not natural attenuation and has not yet been determined.*

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

NA

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.)

The remedy for the FUSRAP SLDS Site which includes:

- *removal of contaminated soil and other materials to achieve UUUE*
- *future determinations required for areas with inaccessible contamination that do not meet UUUE and*
- *interim ICs in these areas until these determinations are made*

appears to be functioning as intended.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

NA

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

NA. No issues were observed during the inspection.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

No additional tasks or opportunities for optimization were identified during the inspection at SLDS.

For the SLS, the remedial actions either on-going, have met UUUE for a property, or have met UUUE for accessible soil with Institutional Controls proposed for completion of the remedy. There are currently no properties where O&M is being performed or scheduled to be performed.

The Checklist has been modified to focus on items related to SLS sites.

Five-Year Review Site Inspection Checklist (Template)

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. **SITE INFORMATION**	
Site name: FUSRAP SLDS	**Date of inspection: July 31, 2019**
Location and Region: St. Louis, MO	EPA ID:
Agency, office, or company leading the five-year review: USACE	**Weather/temperature: Sunny in the 80s**
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ☒ Access controls ☒ Institutional controls ☐ Groundwater pump and treatment ☒ Surface water collection and treatment ☒ Other Excavation of contaminated soil and other materials, removal of soil and other materials to facilities permitted to receive them, surface water management at areas under active excavation, air monitoring at active areas with contaminated materials for confirmation that best management practices are successful, and groundwater monitoring.	☐ Monitored natural attenuation ☐ Groundwater containment ☐ Vertical barrier walls
Attachments: ☒ Inspection team roster attached	☒ Site map attached

II. **INTERVIEWS** (Check all that apply)
1. **O&M site manager** ______ Name ______ Title ______ Date Interviewed ☐ at site ☐ at office ☐by phone Phone no. ______ Problems, suggestions; ☐ Report attached ______
2. **O&M staff** ______ Name ______ Title ______ Date Interviewed ☐ at site ☐ at office ☐ by phone Phone no. ______ Problems, suggestions; ☐ Report attached ______

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ______________________
Contact ______________________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached

Agency ______________________
Contact ______________________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached

Agency ______________________
Contact ______________________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached

Agency ______________________
Contact ______________________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached

4. **Other interviews** (optional)☐ Report attached.

NA, interviews were or will be done after the 5 year review inspections date.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED

IV. O&M COSTS ☐ Not Applicable

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A
Remarks No damage to fencing was observed.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks: Appropriate signage and security measures were observed.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented	☐ Yes	☒ No	☐ N/A
Site conditions imply ICs not being fully enforced	☐ Yes	☒ No	☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by)
Frequency
Responsible party/agency
Contact

Name Title Date Phone no.

Reporting is up-to-date	☐ Yes	☐ No	☒ N/A
Reports are verified by the lead agency	☐ Yes	☐ No	☒ N/A
Specific requirements in deed or decision documents have been met	☐ Yes	☐ No	☒ N/A
Violations have been reported	☐ Yes	☐ No	☒ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☒ N/A
Remarks: Current site conditions did not indicate any problems.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks

2. **Land use changes on site** ☒NA
Remarks None observed

3. **Land use changes off site** ☒NA
Remarks None observed

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐N/A

1. **Roads damaged** ☐ Location shown on site map ☒Roads adequate ☐NA
Remarks USACE-constructed roads were in good condition. City roads were in adequate condition.

B. Other Site Conditions

Remarks The general site conditions appeared to be well-maintained.
(Water treatment system, stockpile and loadout Area, air monitoring and ventilation, surface water management from areas where contaminated materials were stored or were being excavated, and structural monitors were observed during the inspection. They were all functioning as intended and appeared to be in good condition.)

VII. LANDFILL COVERS ☐ Applicable ☒ NA

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ NA

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☐N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☐N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☐ Good condition ☐All required wells properly operating ☐Needs Maintenance ☒NA
Remarks

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks NA

3. **Spare Parts and Equipment**
☐Readily available ☐Good condition ☐Requires upgrade ☐Needs to be provided
Remarks NA

B. Surface Water Collection Structures, Pumps, and Pipelines ☒ Applicable ☐N/A

1. **Collection Structures, Pumps, and Electrical**
☒ Good condition ☐Needs Maintenance
Remarks: General location of water treatment system used to treat surface water was observed onsite. Equipment appeared to be in good condition and performing its intended function.

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks: Although specific equipment was not inspected, these systems overall appeared to be in good condition and performing their intended functions.

3. **Spare Parts and Equipment**
☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks: The condition and functionality of specific equipment was not observed, although we presume spare parts and equipment for surface water management and control that may be needed are readily available this may need additional documentation.

C. Treatment System ☐ Applicable ☒ N/A

D. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests: NA, continued monitoring is warranted as per ROD requirements.
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks: Monitoring wells were observed to be secure and well maintained. Groundwater is being monitoring, but groundwater remedy is not natural attenuation and has not yet been determined.

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction. NA

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.)

The remedies established for SLDS FUSRAP, including the removal of contaminated soil and other materials to achieve UUUE with future determinations required for areas with inaccessible contamination that do not meet UUUE and interim ICs in these areas until these determinations are made appears to be functioning as intended.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

NA

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

No issues were observed during the inspection.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

No additional tasks or opportunities for optimization were identified during the inspection. Movement of the lab and USACE project management offices to SLAPS in North County which was underway at the time of this inspection was discussed as providing numerous optimization opportunities.

APPENDIX B

FIVE-YEAR REVIEW INTERVIEWS

(On the CD-ROM on the Back Cover of this Report)

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LIST OF INTERVIEWEES

Property Owner/Citizen #1

Property Owner/Citizen #2

Carrie Dickhans (Representative, St. Louis County Department of Public Health)

Nora Estopare (Representative, MSD)

Erin Evans (ATSDR)

Dan Fuehn (Ameren)

Ben Grossman (Great Rivers Greenway)

Property Owner/Citizen #3

Jeffrey Murl (DOE)

Mark Nankivil (St. Louis Water Division)

Rebecca Roberts (Navarro/DOE contractor)

Property Owner/Citizen #4

Property Owner/Citizen #5

Property Owner/Citizen #6

Matt Zimmerman (Manager, City of Hazelwood)

Property Owner/Citizen #7

Citizen #8

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Property Owner/Citizen #1

Five Year Review Questions

Property Owners/Citizens
How are you familiar with the St. Louis FUSRAP sites?
1 I am part of the coldwater creek group

What is your overall impression of the project?
2 thorough and complete

What contacts have you had with representatives from FUSRAP?
Were they responsive to your concerns?
3 have not had any contact or reason to communicate with.
But everyone has always been very respectful when together in meetings.

Do you have any current concerns about the site?
If so, what are they?
4 when the community sees workers out taking soil samples causes concern
And of course rumors because they're not familiar or understand what is
Going on. Many are uninformed and this causes rumors and social media
Negative Discussion.

What effects of the site operations had on your business/property?
5 fortunately there has been no affect for me or my business, although
My business is retired since 2011. The fear of the unknown and not
Being informed could have an adverse affect.

Do you think site operations have had an effect on the community?
If so, what are they?
6. Yes there is fear in the community primarily because of lack of knowledge
And not understanding in simple terms. Everyone jumps to conclusions
And always assumes the worst. In general the community is very simple minded
And public updates/town hall meetings, with a simple explanation would be
Beneficial. Possibly area mailings of such a meeting would be a benefit.
Inviting the public would be proactive.

Are you aware of the community concerns regarding site operations and administration?
If so, please provide details.
7 when the community sees soil testing in the process it is easy for the community
To make assumptions. Most of which are negative caused from fear of the
Unknown/lack of knowledge. Typically the only avenue is social media if they
are face book familiar. These discussions become very negative and Foster
Uneducated rumors. These discussions are sporadic and not routine.

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings?
8 yes I attend

5YRR Questionnaires Page 1

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings?
9 the general public are not engineers or educated environmentalists. It is like speaking with
A medical professor and hard to understand in a simple mind what is going on at some of
The public meetings. For the most part people have simple questions, such as,
"does this affect me", which I understand is a hard question to address, but it is valid.
While I understand the government wants to do everything top notch and professional
Some presentations give the interpretation of bureaucracy and the runaround. Presenters
Need to speak at the audience level of understanding.

Do you feel that FUSRAP has reached out to inform the community regarding the project operations?
10 NO I do not, I believe more communication needs to be done at possibly in a direct way.
I receive information because I'm signed up e-mail wise. The majority is not. Possibly consider
More public meetings and direct mail.

Do you feel well informed about FUSRAP?
11 I do because I take an interest in what is going on and engage in involvement.

Do you have any suggestions for how information concerning the sites should be distributed to the community?
12 as stated above, email is not for everyone, at it takes an invitation by mail to get people
Engaged to become more educated.

Do you have any comments, suggestions, or recommendations regarding the site's operations or management?
13 I understand public meetings of such a sensitive nature can be difficult to manage.
A strong Sargent of arms, and consistency during a meeting can achieve this.
A printed copy of the meetings rules needs to be handed to everyone coming in the door,
The rules do not need to be lengthy and in bullet points of the structure and courtesy.
Information should be given in understandable terms.
Audience questions should be addressed publicly if able quickly and simply.
Arguments debates and emotions should swiftly be addressed, in order to keep the meeting moving.
I understand managing a potentially unruly crowd is difficult, that is cause by emotions.
The meeting needs to be very clear, this discussion is on coldwater creek, no other project.
It means to be stated on the rules sheet, this is coldwater creek discussion-no other.
If an attempt is made to discuss another project, it should he be voice this is not part of tonight's discussion.
I realize I am making suggestions regarding a public meeting and not site operations.
I do not have anything to offer regarding operations or management of the site. Just public meetings.

Property Owner/Citizen #2

Five Year Review Questions

Property Owners/Citizens

How are you familiar with the St. Louis FUSRAP sites?

> I became aware of the project in 2011 after my Son was diagnosed with PMP Cancer in 2011

What is your overall impression of the project?

> The work FUSRAP is doing is preforming is very positive. But, it should have never been necessary in the first place.

What contacts have you had with representatives from FUSRAP? Were they responsive to your concerns?

> I have had contact with Management of FUSRAP since 2013 as a member of the FUSRAP Oversite committee. Everyone has been very open and as direct as they could be.

Do you have any current concerns about the site? If so, what are they?

> Not the sites in general, but the soil that has been removed over the years and has been deposited outside the cleanup sites.

What effects of the site operations had on your business/property?

> STL North County is the wasteland of St. Louis because of the dumping and lower income comunities. Property values are lower than other sections of the region because of these practices. Noo one will admit this to be fact vut, we all know it is true.

Do you think site operations have had an effect on the community? If so, what are they?

> YES!! See the answer to the 5th question.

Are you aware of the community concerns regarding site operations and administration? If so, please provide details.

> I think most are concerned more ablout property values, exposure, and health issues. Coldwater Creek just the facts Please, has documented higher cancer rate than the national adverages. The ATSDR has reviewed our findings and will not confirm them but, they do not denight them.

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings?

> Yes, I do not have any suggestions.

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings?

> I would like to see you address the health aspect but it would only create panic. It is also not your responceability.

Do you feel that FUSRAP has reached out to inform the community regarding the project operations?

> Yes!! And you are doing a good job of it.

Do you feel well informed about FUSRAP?

> Yes

Do you have any suggestions for how information concerning the sites should be distributed to the community?

> I cannot think of anything that you are not doing.

Do you have any comments, suggestions, or recommendations regarding the site's operations or management?

> NIO

Carrie Dickhans (Representative, St. Louis County Department of Public Health)

Five Year Review Questions

State and Local Governments:
Carrie Dickhans, Director
Division of Environmental Services St. Louis County Department of Public Health

How are you familiar with the St. Louis FUSRAP sites?

Relatively familiar

What is your overall impression of the project?

A significant project that is being done in an effective manner.

What contacts have you had with representatives from FUSRAP?

Community information meetings with the USACE. County DPH meetings with the USACE.

What are your current concerns about the site?

Disruptions to the residents during investigation and remediation activities. Potential long term health impacts for those with continued long-term exposure.

If applicable, what effects have site operations had on property owned by your organization?

Do you think site operations have had an effect on the community? If so, what are they?

Traffic disruptions, economic impact, lowered property values. In addition, there is a certain level of psychological impact evident with this type of remediation due to fear of health effects.

Have there been routine communications or activities conducted by your office at the FUSRAP site (site visits, inspections, reporting activities, etc.)?
If so, please give purpose and results.

We have not routinely conducted any inspections or had contact onsite with the remediation team.

Have there been any complaints, or other incidents related to the site requiring a response by your office? If so, please give details.

Not within the past 5 years since I have been in my current role with the department.

Do you currently have any unaddressed comments, suggestions, or recommendations regarding the site's management and operations?

More frequent informational meetings with the community and with County DPH officials would be helpful.

Nora Estopare (MSD)

Five Year Review Questions

Property Owners/Citizens

How are you familiar with the St. Louis FUSRAP sites?

MSD is familiar with the St. Louis FUSRAP sites through communication with the USACE. The SLAPS and SLDS sites are marked in our GIS system to alert MSD staff to contact the FUSRAP remedial managers when work activities need to be conducted within these boundaries.

What is your overall impression of the project?

The remedial approach is sound and has been well executed. The project has been complicated by Coldwater Creek contamination that has been carried out of the creek and deposited in surrounding areas during flooding events.

What contacts have you had with representatives from FUSRAP? Were they responsive to your concerns?

MSD has ongoing contact with the FUSRAP remedial managers under the terms of the Utility Support Agreement. FUSRAP representatives are responsive to MSD's requests for support.

Do you have any current concerns about the site? If so, what are they?

There are no current concerns about the site.

What effects of the site operations had on your business/property?

Extra steps are necessary for completing MSD work activities in the FUSRAP site boundaries.

Do you think site operations have had an effect on the community?

If so, what are they?

Yes, the same effect that any construction project would have. Additionally, site operations have caused community concern for radiological contamination exposure.

Are you aware of the community concerns regarding site operations and administration?

If so, please provide details.

MSD is aware of the community concerns that are covered in news reports.

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings?

MSD receives the FUSRAP newsletter.

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings?

Do you feel that FUSRAP has reached out to inform the community regarding the project operations?

> Ample information is available on the St. Louis Sites FUSRAP website, but MSD is uncertain to what extent additional efforts have been made by FUSRAP to inform the community regarding project operations.

Do you feel well informed about FUSRAP?

> Yes, MSD has ongoing contact with the FUSRAP remedial managers under the terms of the Utility Support Agreement.

Do you have any suggestions for how information concerning the sites should be distributed to the community?

> No suggestions

Do you have any comments, suggestions, or recommendations regarding the site's operations or management?

> No suggestions

Erin Evans (ATSDR)

Five Year Review Questions

How are you familiar with the St. Louis FUSRAP sites?

> ATSDR performed a public health assessment on the St. Louis Airport Site/ Hazelwood Interim Storage Site/ Futura NPL site in 1994. ATSDR became re-engaged in approximately 2015 at the request of the community. In 2019, ATSDR released the final version of another public health assessment focusing on recreational and residential exposures along Coldwater Creek.

What is your overall impression of the project?

> ATSDR supports FUSRAP's continued investigation and cleanup of areas potentially affected by historical activities at the site, especially Coldwater Creek.

What contacts have you had with representatives from FUSRAP?

> ATSDR regional staff participate in regular meetings with FUSRAP staff related to North County FUSRAP sites. FUSRAP staff provided data, site information to ATSDR regional and headquarters staff for ATSDR's latest activities, and took ATSDR staff on a site visit.

What are your current concerns about the site?

> No data exist to characterize many miles of Coldwater Creek and its floodplain downstream from the historical former waste sites. ATSDR supports timely investigation and cleanup, if necessary, of these areas.

If applicable, what effects have site operations had on property owned by your organization?

> Not applicable. ATSDR owns no property in the area.

Do you think site operations have had an effect on the community? If so, what are they?

> Frequent, long-term exposure to site contaminants in recreational and residential areas along the creek may have increased the risk of certain types of cancer, especially in the past. Perception of continued risk adds stress and fear; this is why ATSDR supports timely investigation, cleanup, and communication of site findings to the community.

Have there been routine communications or activities conducted by your office at the FUSRAP site (site visits, inspections, reporting activities, etc.)? If so, please give purpose and results.

> ATSDR regional staff participate in FUSRAP regulator calls and public meetings, as requested. ATSDR regional and headquarters staff participated in multiple non-routine public meetings and site visits during development and release of the 2019 public health assessment.

Have there been any complaints, or other incidents related to the site requiring a response by your office? If so, please give details.

ATSDR's recent public health assessment related to Coldwater Creek was initiated in response to concerns raised by the community. ATSDR received numerous public comments on the 2018 draft public health assessment which are published in the final report.

Do you currently have any unaddressed comments, suggestions, or recommendations regarding the site's management and operations?

ATSDR recommends that FUSRAP continue investigating and cleaning up Coldwater Creek sediments and floodplain soils to meet regulatory goals. To increase knowledge about contaminant distribution and allay community concerns, ATSDR recommends future sampling include

- areas reported to have received soil or sediment moved from the Coldwater Creek floodplain (such as fill used in construction)
- areas with possible soil or sediment deposited by flooding of major residential tributaries to Coldwater Creek
- indoor dust in homes where yards have been cleaned up or require cleanup
- sediment or soil remaining in basements that were directly flooded by Coldwater Creek in the past

ATSDR also recommends that authorities install signs to inform residents and visitors of potential exposure risks in areas around Coldwater Creek not yet investigated or remediated and that public health agencies continue to evaluate, to the extent possible, community concerns about exposure and educate the community about radiological exposures and health. We recognize all these recommendations may not be within FUSRAP authority.

Dan Fuehn (Ameren)

Five Year Review Questions

Property Owners/Citizens

How are you familiar with the St. Louis FUSRAP sites? I had 3 projects in 10 years

What is your overall impression of the project? Seems organized

What contacts have you had with representatives from FUSRAP? Kurtis and George
Were they responsive to your concerns? Yes

Do you have any current concerns about the site? no
If so, what are they?

What effects of the site operations had on your business/property?none

Do you think site operations have had an effect on the community?I don't know
If so, what are they?

Are you aware of the community concerns regarding site operations and administration?
If so, please provide details.no

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings?no

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings?no

Do you feel that FUSRAP has reached out to inform the community regarding the project operations?
I don't know

Do you feel well informed about FUSRAP? somewhat

Do you have any suggestions for how information concerning the sites should be distributed to the community?no

Do you have any comments, suggestions, or recommendations regarding the site's operations or management?no

Ben Grossman (Great Rivers Greenway)

Five Year Review Questions

State and Local Governments

How are you familiar with the St. Louis FUSRAP sites?

Familiar with the project site, but not with details of the project itself. Cleanup site is adjacent to the Mississippi Greenway: Riverfront Trail in which our organization is not the direct maintenance partner (St. Louis City is) but we do supplement maintenance of the facility.

What is your overall impression of the project?

Project had an impact on our trail as there was a detour for some time, today the project has no impact on our operation.

What contacts have you had with representatives from FUSRAP?

At the end of the project we had contact with representatives, when coordinating the removal of the detour barriers.

What are your current concerns about the site?

We have no concerns about the site, however we have no information or data as to potential risks associated with the site. We only know what we know.

If applicable, what effects have site operations had on property owned by your organization?

The cleanup/mitigation efforts caused a re-route of our trail system so users were temporarily detoured around the work area.

Do you think site operations have had an effect on the community? If so, what are they?

We are not aware of any impacts to the community.

Have there been routine communications or activities conducted by your office at the FUSRAP site (site visits, inspections, reporting activities, etc.)?
If so, please give purpose and results.

Routing visual inspections by park operations, not exclusive to the site but the 13 miles of trail along the riverfront in general.

Have there been any complaints, or other incidents related to the site requiring a response by your office? If so, please give details.

No.

Do you currently have any unaddressed comments, suggestions, or recommendations regarding the site's management and operations?
No.

Property Owner/Citizen #3

Five Year Review Questions

Property Owners/Citizens

How are you familiar with the St. Louis FUSRAP sites? Yes – been aware for multiple decades

What is your overall impression of the project? My impression of the action taken on our HISS site has been completed with excellent communication, organization, with a good contracting firm and with a clear schedule with timely updates.

What contacts have you had with representatives from FUSRAP?

1) Josephine Wade COE
2) Tony Bryant – Shaw / APTIM

Were they responsive to your concerns?

Yes – Both responded all our past calls or emails. Very impressed working with Tony over the last ~10 years during the clean up process. Very accommodating to make sure that clean up process did not negatively impact the functions of our business.

Do you have any current concerns about the site? Some
If so, what are they? What do we as a property owner to with the remaining contamination that is under the buildings and around the perimeter of the building footings. We can probably never sell the property in the future. When we sell or wind down our businesses in the next 5-10 years – what do we do with the property.

What effects of the site operations had on your business/property? Our entire property was cleaned up over a 2+ year period of time. Our entire parking lot and trucking lanes were affected at some point. However, Shaw did a good job of accommodating our business and providing alternative options that kept things working. So while the clean up was definitely disruptive, the process was workable

Do you think site operations have had an effect on the community? Since our property is somewhat isolated, I am not sure how much the community is aware of our property and the process.
If so, what are they?

Are you aware of the community concerns regarding site operations and administration? No
If so, please provide details.

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings? We no longer get the Newsletter I guess since our property has been cleaned up, but we received it for years prior to that. I was very informative (even though we already had the notebooks outlining the plans and schedules.)

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings? Nothing specific, it has been at least 2-4 years since we received the last newsletter.

Do you feel that FUSRAP has reached out to inform the community regarding the project operations? Yes – between meetings and the newsletter and website – I think things were publicized adequately

Do you feel well informed about FUSRAP? I did during our clean up process

Do you have any suggestions for how information concerning the sites should be distributed to the community? I am not up to date with the present methods that currently being done. Are email campaigns being done?

Do you have any comments, suggestions, or recommendations regarding the site's operations or management? Keep up the present process – they were working during our process.

Jeffrey Murl (DOE)

Five Year Review Questions

How are you familiar with the St. Louis FUSRAP sites?

I have been with DOE for 3 years and directly involved with St Louis Sites for 8 months. I have reviewed our historical documents and participated in site visits, annual meetings, and bimonthly calls.

What is your overall impression of the project?

I am impressed by the overall coordination between the USACE and property owners. This has led to opportunities to cleanup previously inaccessible soils and ultimately lowering the government's liabilities and long term costs. This also results in less effort for DOE to maintain the final remedy once the sites transfer, including less chance of having the USACE return to the site many years after transfer if inaccessible soils are exposed.

What contacts have you had with representatives from FUSRAP?

I have routine contact with FUSRAP representatives from site visits, annual meetings, and bimonthly calls. I feel like I can ask questions any time and get a prompt response.

What are your current concerns about the site?

DOE-LM is concerned that status of the FUSRAP cleanup is not being documented within city/county databases, i.e., the final status survey for each parcel is not recorded with the property deed. This would ensure property owners are informed about FUSRAP activities on the property regardless of future ownership. It would extinguish potential tort claims against the government by documenting UU/UE or LUC restrictions as private property owners sell and/or subdivide a property in the future.

If applicable, what effects have site operations had on property owned by your organization?

N/A

Do you think site operations have had an effect on the community? If so, what are they?

USACE coordinates activities with property owners and local governments to ensure that site operations have minimal effects. Without such communication, I can envision mass hysteria from owners not understanding the true risks.

Have there been routine communications or activities conducted by your office at the FUSRAP site (site visits, inspections, reporting activities, etc.)? If so, please give purpose and results.

DOE LM routinely participated in site visits, annual meetings, and bimonthly calls.

Have there been any complaints, or other incidents related to the site requiring a response by your office? If so, please give details.

No

Do you currently have any unaddressed comments, suggestions, or recommendations regarding the site's management and operations?

> USACE should investigate recording the final status survey for each parcel with the city/county so that it runs with the property deed.

Mark Nankivil (St. Louis Water Division)

Five Year Review Questions

Property Owners/Citizens

How are you familiar with the St. Louis FUSRAP sites?

Our only location which we have had involvement in is the Mallinckrodt/Tyco site, specifically Destrehan Street from Hall to the east. WE had earlier involvement along Angelrodt but I beleive that was previous to this 5 year review.

What is your overall impression of the project?

Our involvement has been pretty basic and straightforward. The contractors and those overseeing the work have been professional and easy to work with.

What contacts have you had with representatives from FUSRAP?
Were they responsive to your concerns?

Our interaction has been at planning sessions prior to work being done and has been professional and quite satisfactory. Good people to work with.

Do you have any current concerns about the site?
If so, what are they?

None.

What effects of the site operations had on your business/property?
Nothing directly on a day to day basis. Long term issues regarding our underground facilities in the site are being addressed by the work that is ongoing.

Do you think site operations have had an effect on the community?
If so, what are they?

This is a rather isolated site/location and well away from residential housing. Other than with Mallinkckrodt/Tyco employees and operations, any impact should be minimal to nonexistent.

Are you aware of the community concerns regarding site operationsand administration?
If so, please provide details.

I am not directly aware of any community concerns.

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings?

I have not.

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings?

None.

Do you feel that FUSRAP has reached out to inform the community regarding the project operations?

Don't have any opinion or input on this.

Do you feel well informed about FUSRAP?

I do when it concerns Water Division facilities in the site.

Do you have any suggestions for how information concerning the sites should be distributed to the community?

None.

Do you have any comments, suggestions, or recommendations regarding the site's operationsor management?

Rebecca Roberts (Navarro/DOE contractor)

Five Year Review Questions

How are you familiar with the St. Louis FUSRAP sites?

> I have worked on FUSRAP for approximately 15 years, nearly 10 of those were with the USACE verification contractor. Now, as a contractor for the Department of Energy (DOE) Office of Legacy Management (LM), our team will be responsible for the long-term stewardship of the St. Louis FUSRAP sites they transfer from USACE to LM.

What is your overall impression of the project?

> The project managers at USACE have increased coordination with property owners and local government agencies to perform additional remediation and/or investigation as required to ensure that the amount of inaccessible soils remaining in place will be minimized prior to transfer to LM. These efforts show commitment to completion of the project with dedication to protection of human health and the environment.

What contacts have you had with representatives from FUSRAP?

> As a contractor for LM, we have routine contact with FUSRAP representatives. The USACE FUSRAP program and project managers have been responsive to questions posed to them about the sites as well as to allowing LM representatives visit the sites as requested.

What are your current concerns about the site?

> As the long-term steward of the FUSRAP sites, LM is concerned that status of the FUSRAP cleanup is not being documented within city/county databases, i.e., the final status survey for each parcel is not recorded with the property deed. This would ensure future property owners are not only informed about FUSRAP but also understand if there are any limitations to the use of their property.

If applicable, what effects have site operations had on property owned by your organization?

> N/A

Do you think site operations have had an effect on the community? If so, what are they?

> USACE coordinates activities with property owners and local governments to ensure that site operations have minimal effects.

Have there been routine communications or activities conducted by your office at the FUSRAP site (site visits, inspections, reporting activities, etc.)? If so, please give purpose and results.

> LM routinely communicates with the USACE, attends USACE FUSRAP public meetings and performs annual site visits.

Have there been any complaints, or other incidents related to the site requiring a response by your office? If so, please give details.

No

Do you currently have any unaddressed comments, suggestions, or recommendations regarding the site's management and operations?

USACE should investigate recording the final status survey for each parcel with the city/county so that it runs with the property.

Property Owner/Citizen #4

Five Year Review Questions

Property Owners/Citizens

How are you familiar with the St. Louis FUSRAP sites?

Highly familiar with the St. Louis Airport site. Others a passing interest.

What is your overall impression of the project?

Professionally run; capable staff; project absolutely essential to public perception of health and safety

What contacts have you had with representatives from FUSRAP? Were they responsive to your concerns?

Interaction occurs near annually or more depending on need. FUSRAP reps have always been responsive to concerns. They display a willingness to find compromise on issues, but always remain focused on the program objective.

Do you have any current concerns about the site? If so, what are they?

None

What effects of the site operations had on your business/property?

No impact on aviation activity. Loss of potential revenue generation, but viewed as inconsequential when compared to value provided the general public.

Do you think site operations have had an effect on the community? If so, what are they?

Positive effect: the program is a clear display of commitment to public health and welfare.

Negative effect: a stigma – if the government allowed radioactive contamination to be readily scattered in the St. Louis region, what else awaits to be discovered.

Are you aware of the community concerns regarding site operations and administration?

If so, please provide details.

- Long term community health risks due to prolonged exposure
- Safety/security of contaminated product during transport to SLAPS
- Future funding commitment for program completion

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings?

Newsletter received. Attendance at public meetings is nominal.

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings?

> Discussion of safety features during product transport. Discussion about disposition of product at the disposal site.

Do you feel that FUSRAP has reached out to inform the community regarding the project operations?

> The community involvement plan identifies fifteen (15) action activities that are in effect. The USACE convenes biannual public meetings/biannual newsletters/routine web site updates. The program is achieving outreach.

Do you feel well informed about FUSRAP?

> There is sufficient information available to make rational judgements and decisions.

Do you have any suggestions for how information concerning the sites should be distributed to the community?

> None

Do you have any comments, suggestions, or recommendations regarding the site's operations or management?

> None

Property Owner/Citizen #5

Five Year Review Questions

Property Owners/Citizens

How are you familiar with the St. Louis FUSRAP sites?

Founding member of the Coldwater Creek Group

What is your overall impression of the project?

Very pleased with the cleanup activities

What contacts have you had with representatives from FUSRAP?

Close contact through email and phone with Jo Anne Wade, Bruce Munholand over the past several years. Brief phone conversation with Scott Ross once.

Were they responsive to your concerns?

Bruce and Jo Anne have always been very responsive and helpful. However, we are very disappointed in the lack of communication from Scott Ross, and the disregard for several concerns that we brought forth to him as a group.

Do you have any current concerns about the site?

Yes

If so, what are they?

Biggest concern is lack of testing in the tributaries, which we believe may have been contaminated from past flooding. We fear that contamination may now be "land locked in several of these tributaries due to past MSD projects.

What effects of the site operations had on your business/property?

None

Do you think site operations have had an effect on the community? If so, what are they?

I believe that remediation is having an overall positive effect on the community

Are you aware of the community concerns regarding site operations and administration?

Yes

If so, please provide details.

Many residents do not understand the construction / testing process or that annual testing is limited based on project funding. As a group, we have tried to help educate the community, with some progress… unfortunately, there are many who are unwilling to listen to factual information

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings?

> Yes, both when I can make it into town.

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings?

> The biggest question we get from folks regarding FUSRAP are requests for updates on testing. Many folks only skim the newsletter, at best. It might be helpful to include a visual color coded picture of remediation activities along the creek in the newsletter or website that categorizes the various stages of the project (completed, current remediation, future remediation). It doesn't have to be too detailed, just something simple … such as an AutoCAD layer over an imported map of the creek

Do you feel that FUSRAP has reached out to inform the community regarding the project operations?

> I believe that FUSRAP does their best to inform the community during their semi-annual meetings. But beyond that, there has not been much community outreach. Given the volatile/ emotional nature of the topic, and the incidents with public officials at past meetings, I believe that this is an acceptable public response. It would be nice to see an improved open line of communication between FUSRAP public relations and the oversight committee. I am not sure how frequently FUSRAP meets with city officials, but hopefully they receive a regular face to face update on ongoing activities.

Do you feel well informed about FUSRAP?

> Yes

Do you have any suggestions for how information concerning the sites should be distributed to the community?

> It is not easy to sign up for the newsletter. Is there a way to incorporate a form on your homepage where community members can sign up? Perhaps a monthly Q&A post on the Army Corps of Engineers facebook page? One comment we often receive from our community members when we direct them to your site is that they are not receiving call backs for their concerns. I imagine that there are times when FUSRAP receives a high volume of calls (especially after any news/ press releases)… this may be alleviated through more effective online communication with residents.

Do you have any comments, suggestions, or recommendations regarding the site's operations or management?

> I think that overall, FUSRAP is doing a great job! Thank you for all that you have done to improve the overall wellbeing of the community. I would really like to see testing of some of the main tributaries and potentially a few areas where we know the creek was rerouted during subdivision construction and creek sediment was used in landscaping (ie., Wedgewood, Shoveltown, and Paddock Estates)

Property Owner/Citizen #6

Five Year Review Questions

Property Owners/Citizens

How are you familiar with the St. Louis FUSRAP sites?

I lived for 27 years in the SLAPS/HISS/Coldwater Creek/North County area, and am very familiar with the FUSRAP activity pertaining to this vicinity.

What is your overall impression of the project?

Overall, I am very satisfied with the level of scientific methodology/support and the FUSRAP North County STL team members themselves. I am pleased they take time to listen to community concerns and patiently answer questions. They return phone calls, emails, etc., and are easy to converse with about both technical and human-impact issues concerning the project.

What contacts have you had with representatives from FUSRAP? Were they responsive to your concerns?

I have spoken frequently with JoAnne Wade, Bruce Munholand, Angela Bonstead, former public relations personnel Amanda Kruse and Mike Petersen, and Jonathan Rankins. Yes, all individuals listed above were very responsive to my concerns and I commend them for a job very well done. Unfortunately, I did not experience the same professionalism from Scott Ross in public relations and was quite disappointed in his lack of communication and respect to the affected SLAPS/HISS/Coldwater Creek community.

Do you have any current concerns about the site? If so, what are they?

Yes, I have remaining concerns (but am thrilled with FUSRAP listening and acting on other concerns I raised with Sharon Cotner *(former FUSRAP North County sites Project Manager)* in 2012/2013 before FUSRAP planned to extensively test north of Highway 270). Remaining big concerns:

(1) Despite what the Coldwater Creek watershed historical flooding data suggests (unsure of the former flood source data at this moment), myself and thousands of other present and former community members clearly remember creek flooding events where the creek flowed "backward" up several tributaries and flowed up into hundreds (or more) of local residential basements. In addition, during these flooding events water flooded external properties of some homes. (Some homes had both external and internal flooding, other homes had <u>only</u> internal basement flooding from the then-connected sewer and Coldwater Creek system which <u>was later corrected with a federal multi-several hundred-million-dollar project authorized by U.S. Congress pushed by Lacey Clay Sr. in the 1990s.</u> Note USACE did not participate in this project despite requests for their expertise due to their concern about the presence of radionuclides due to the nuclear weapons waste). These properties are not currently planned for contaminants of concern testing to

my knowledge. Please know we citizens have located numerous news articles and photos in old community newspapers supporting our reporting of the creek's extensive flooding. FUSRAP should consider the 50-year flood plain data instead of the 10-year flood plain data. The failure to consider the height of flooding history (before the above-referenced project occurred and corrected the flooding problems in order for the more recent flooding to not be as extensive) is extremely concerning to community members, as this extensive flooding occurred during the period of higher risk of possible exposure to contaminants of concern as found by the ATSDR in their Public Health Assessment finalized in 2018.

(2) We have federal US Govt satellite photos of the area from 1958 onward. One can easily see the massive amount of soil movement in the areas contiguous to the original creek path throughout the period of highest risk for possible exposure to contaminants of concern as recently reported by the ATSDR's Public Health Assessment finalized in 2018. Former builders and developers in the area report they filled dump trucks of the soil/sediment of Coldwater Creek (when the contaminants were flowing freely) as it was believed to be very fertile soil…and they deposited this soil to backfill homes in a few Florissant and Hazelwood subdivisions as well as other specified locations. Why is FUSRAP not testing these areas when the builder has specifically described where he knew the contaminated soil was moved to (unbeknownst at that time to contain anything dangerous)?

(3) The St. Louis Metropolitan Sewer District (MSD) was heavily involved in the Flooding Control project beginning in the 1990s mentioned above authorized by U.S. Congress as during the period of highest possibility of inhalation of contaminants of concern (per ATSDR) the sewer system was interlaced with Coldwater Creek. In looking at satellite images from the U.S. Govt immediately before and after the project, one can see the extensive movement and removal of large areas of soil/sediment in the creek, the creek banks, and creek contiguous properties. Metropolitan Sewer District oversaw much of this work with soil we know contained the contaminants of concern (per the Bruce Drive report and 1987/88 thorium 230 elevated report along the entire corridor of Coldwater Creek…citizens have copies of these reports). This quasi-governmental organization has failed to comply with FUSRAP requests for information. FUSRAP thus is unable to locate where these thousands of contaminated soil tons were moved during this project (FUSRAP did not opt to participate in due to their radionuclide presence concerns). It is my firm opinion this issue be elevated in order for MSD to comply and properly provide any records on this soil movement, especially as the ATSDR has reported the increased likelihood of developing cancer from exposure to the contaminants of concern in their PHA finalized in 2018.

What effects of the site operations had on your business/property?

None

Do you think site operations have had an effect on the community?

Yes

If so, what are they?

> Some people were dubious of the operations due to the nature of what was allowed to occur in this community (regarding contaminants of concern) from 1947 until remediation began in the late 1990s. At this time, it seems most residents realize the remediation is a positive boost to their area (but only if the contaminants of concern are tracked down and removed from unaddressed areas in the Original Record of Decision workplan and scope….created before all of the flooding, soil movement, and creek/sewer reconfiguration projects were fully known and/or considered in the testing methodology).

Are you aware of the community concerns regarding site operations and administration? If so, please provide details.

> No concerns to my knowledge at this moment. I have asked many questions over the years (I am a former auditor), and am very satisfied with the site operations.

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings?

> Yes-both.

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings?

> Please continue to provide detailed information on recent testing, recent remediation efforts in process, recent remediation efforts completed, etc.

Do you feel that FUSRAP has reached out to inform the community regarding the project operations?

> Yes; however, I am disappointed media and local municipalities have not taken a more active role in communicating to the community when FUSRAP meetings take place, etc.

Do you feel well informed about FUSRAP?

> Yes.

Do you have any suggestions for how information concerning the sites should be distributed to the community?

> I am certain this is a sensitive topic due to budgetary constraints. Perhaps social media announcements (where comments are disabled), pamphlets for distribution at city offices, local announcement boards at places like Panera, and distribution to local houses of worship for inclusion in their weekly community bulletins to their members, and emails sent to all of the email addresses gathered over the years at meetings, etc.

Do you have any comments, suggestions, or recommendations regarding the site's operations or management?

> I commend the dedicated FUSRAP employees I mentioned earlier. They carry out their mission and tasks well, and have built a level of trust with myself and many in the community who have had a difficult walk with health issues and deaths of loved ones

possibly linked to the contaminants of concern exposure mentioned by the ATSDR in their finalized Public Health Assessment related to the materials FUSRAP is removing and areas being remediated. Very impressed with these individuals…I heartily thank them and wish them well for their service and devotion to this most important project!

Matt Zimmerman (Manager, City of Hazelwood)

Five Year Review Questions

How are you familiar with the St. Louis FUSRAP sites?

Somewhat in Hazelwood. Very little in other communities.

What is your overall impression of the project?

It is a critically needed project to clean up dangerous soil and water in North County. I believe the Corp is taking all of the proper testing and remediation efforts as required.

What contacts have you had with representatives from FUSRAP?

I have met with the project coordinators, including Joann Wade, Jacob Prebianca, and Bruce Munholand. City staff, including myself, has met with the public affairs program managers, including Andrea Wales, to host community outreach and informational meetings. I have met with the Colonel for the St. Louis District at the informational meetings.

What are your current concerns about the site?

There are still hotspots in Hazelwood that I would like to see cleaned up. Also, the creek bed and sides are still not remediated.

If applicable, what effects have site operations had on property owned by your organization?

One City park had to be closed for several months. Several City streets were impacted by trucks removing material. But overall the impact has been minimal.

Do you think site operations have had an effect on the community? If so, what are they?

Some homes were affected on Palm Dr. as backyards were remediated. The City fully closed one park during remediation. Otherwise, the biggest impact was psychological as many residents expressed concerns about the impact of the radioactive materials on their health as well as the safety of the remediation plans. I am glad the ATSFD started attending meetings to discuss long-term health impacts from the original storage of radioactive materials. That seemed to help address a lot of the concerns.

Have there been routine communications or activities conducted by your office at the FUSRAP site (site visits, inspections, reporting activities, etc.)?

If so, please give purpose and results.

City crews inspected the restoration of grounds following completion of the remediation. The City was pleased with the restoration efforts.

Have there been any complaints, or other incidents related to the site requiring a response by your office? If so, please give details.

Residents on the east side of Coldwater Creek were blocked from crossing the bridge over the creek and into St. Cin Park during remediation. This caused a hardship as residents had to walk up to an extra mile during the closure. Also, the concerns expressed by residents as described in Question 6, which had a significant impact on the City's response during remediation. Otherwise, no other complaints or concerns were expressed.

Do you currently have any unaddressed comments, suggestions, or recommendations regarding the site's management and operations?

No.

Property Owner/Citizen #7

Five Year Review Questions

Property Owners/Citizens

How are you familiar with the St. Louis FUSRAP sites?

> I am quite familiar with the FUSRAP sites since I followed the FUSRAP efforts as a representative of the St. Louis County Public Health Department for ~18 years prior to my retirement in 2016.

What is your overall impression of the project?

> The main drawback to progress seems to continually be funding.

What contacts have you had with representatives from FUSRAP? Were they responsive to your concerns?

> In the 'early years', I regularly attended the FUSRAP Oversight Committee meetings and staff were responsive and transparent. Since 2016, I haven't kept up with the project.

Do you have any current concerns about the site? If so, what are they?

> My only concern was (is) the lack of funding which has delayed project completion.

What effects of the site operations had on your business/property?

> N/A

Do you think site operations have had an effect on the community? If so, what are they?

> Community members seem to be greatly concerned about exposure during their youth while growing up around (and playing in) Coldwater Creek. I believe that FUSRAP is trying to address those concerns in the only way that FUSRAP can – by characterizing and delineating the extent of contamination at this time and remediating it.

Are you aware of the community concerns regarding site operations and administration? If so, please provide details.

> See response to 6th question above.

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings?

> I receive (and read) the FUSRAP Newsletter but I no longer attend Public Meetings.

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings?

> Not at this time.

Do you feel that FUSRAP has reached out to inform the community regarding the project operations?

> I can't speak about current efforts but I do believe that FUSRAP did inform the community when I was more involved.

Do you feel well informed about FUSRAP?

> I believe that I am (was) informed as much as I could have been.

Do you have any suggestions for how information concerning the sites should be distributed to the community?

> No further suggestions.

Do you have any comments, suggestions, or recommendations regarding the site's operations or management?

> Not at this time.

Citizen #8

Five Year Review Questions

Property Owners/Citizens

How are you familiar with the St. Louis FUSRAP sites?

As a former resident, I grew up along Coldwater Creek. I became aware of the FUSRAP sites in 2011.

What is your overall impression of the project?

I have many mixed feelings on the project. While I am thankful for clean up activities, I wish the project could move faster.

What contacts have you had with representatives from FUSRAP? Were they responsive to your concerns?

I have had many contacts with FUSRAP representatives through the years. In the beginning of my involvement (2011) FUSRAP, as well as other agencies, were not very responsive. This changed over time when contamination was found in residential areas. FUSRAP became much more responsive to community concerns when it was discovered contamination was present in residential areas and the clean up program was expanded to include the entire length of the creek. Over the past year or so; however, there has been some changing of the guard and communication between FUSRAP and the community has not been as open as it has been in the past; specifically with the FUSRAP PR department. Thankfully, there are other FUSRAP team members I can call that are very responsive to community questions/concerns.

Do you have any current concerns about the site? If so, what are they?

My main concern at this time is testing of the tributaries of Coldwater Creek. Unlike the main channel that washes out to the river, the tributaries dead end. I believe there is potential for contamination to be present in the tributaries and I would like the tributaries to be tested. I am hopeful that funding will become available to expand testing to tributaries in the future.

What effects of the site operations had on your business/property?

As a former resident that grew up along Coldwater Creek and spent much of my childhood playing in the creek; effects are more health related than business/property related.

Do you think site operations have had an effect on the community? If so, what are they?

Effects of the site for people who lived/grew up here during time of maximum exposure are immense. The exposure to nuclear weapons waste that sat out in the open next to the creek for decades has impacted the health of generations of community members. Countless loved ones have been taken from their friends and family too soon. I believe current site operations, although necessary, do have an impact on the community.

When people in the community have lost so much, it's not a very comforting sight when we see you all in your moon suits.

Are you aware of the community concerns regarding site operations and administration? If so, please provide details.

Yes. I am an admin for the Facebook group Coldwater Creek Just the Facts. Many community concerns are posted daily to our facebook.

Do you receive the FUSRAP Newsletter or attend any of the Public Meetings?

Yes.

Is there any information or topics you think would be helpful to cover in the newsletter or at the public meetings?

I know this has been covered several times but I think it is important to regularly cover the soil testing/grid sampling process. Outsiders and "independent scientists" have descended upon the community offering such things as sticking as geiger counter in people's soil for the low price of $1200. Unfortunately, as with any tragedy, there are people looking to take advantage of others in this situation. I believe if people understand the process they are less likely to be taken advantage of by outsiders looking to make a buck.

Do you feel that FUSRAP has reached out to inform the community regarding the project operations?

For several years FUSRAP has reached out to inform the community and it has been satisfactory. When Mike Petersen and Amanda Kruse were with the FUSRAP St. Louis office, communication between FUSRAP and the community was at a very high point. It actually exceeded my expectations. Since their departure, communication has come to a screeching halt. About a year ago, a FUSRAP representative took part in a stunt, in which there was a lot of Creek community bashing. It was unwarranted, unprofessional and so far removed from the level of service I have come to expect from USACE. Unfortunately, I believe the relationship with this particular department of FUSRAP is beyond repair in its current state. I am hopeful this can be rectified in the future.

Do you feel well informed about FUSRAP?

Yes.

Do you have any suggestions for how information concerning the sites should be distributed to the community?

I am not sure if there is anything beyond distributing newsletters, keeping the website up-to-date and holding regular meetings that can be done.

Do you have any comments, suggestions, or recommendations regarding the site's operations or management?

Please find a way to test the tributaries.

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APPENDIX C

ANALYSIS OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

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Attachment C-1

Analysis of Applicable or Relevant and Appropriate Requirements for the Remedy Implemented at the St. Louis Downtown Site Under FUSRAP, St. Louis, Missouri

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Table C-1-1. Analysis of Chemical-Specific ARARs for the Remedy Implemented at the St. Louis Downtown Site Under FUSRAP, St. Louis, Missouri

ARAR	Citation	Specific Requirements	ARAR Status		Comment
			SLDS ROD	Current	
Uranium Mill Tailings Radiation Control Act (UMTRCA) (October 1992): Cleanup of Radioactively Contaminated Land and Contaminated Buildings	40 *CFR* 192.12(a)	Residual radioactive material concentration of Ra-226 and Ra-228 in land averaged over any 100 m^2 area shall not exceed the background level by >5 pCi/g averaged over the first 0.5 ft of soil and 15 pCi/g averaged over 0.5-ft-thick layers of soil >0.5 ft below the surface.	Relevant and Appropriate	Relevant and Appropriate	This ARAR was used for to establish composite cleanup criteria for radium and thorium soils to a depth of 4 to 6 ft.
	40 *CFR* 192.21 and 192.22	Supplemental Standards: Site-specific target removal levels of 50 pCi/g above background for Ra-226, 100 pCi/g above background for Th-230, and 150 pCi/g above background for U-238 (50-100-150 guidelines) will be used as the deep-soil cleanup guidelines below 4 ft in most areas within the plant boundaries and below 6 ft in areas delineated in Section 7.4.6.	Relevant and Appropriate	Relevant and Appropriate	The provision allowing the development of supplemental standards under certain conditions was basis developing deep soil, i.e., greater than 4 to 6 ft, criteria.
	40 *CFR* 192.02(b)(1)	Radon-222 releases not exceeding 20 pCi/m^3/sec or 0.5 pCi/L in air above site.	Relevant and Appropriate	Relevant and Appropriate	Outdoor radon monitoring using alpha track detectors is conducted approximately every 6 months at SLDS to demonstrate compliance with the 0.5 pCi/L ARAR.

Table C-1-1. Analysis of Chemical-Specific ARARs for the Remedy Implemented at the St. Louis Downtown Site Under FUSRAP, St. Louis, Missouri

ARAR	Citation	Specific Requirements	ARAR Status		Comment
			SLDS ROD	Current	
USEPA Policy directives for radioactive contamination	OSWER Directive 9200.4-23	USEPA policy for ARAR determination for radioactive sites.	TBC	TBC	These directives were consulted in developing radioactive cleanup criteria because of the similarly between these sites and the UMTRCA sites. These USEPA OWSER directives are still considered TBCs.
	OSWER Directive 9200.4-18	USEPA policy on using 40 *CFR* Part 192 for CERCLA cleanup criteria at radioactive sites, including radium and thorium.	TBC	TBC	
UMTRCA	40 *CFR* 192.40, 192.41	Criteria for sites where thorium ores were processed.	Relevant and Appropriate	Relevant and Appropriate	This regulation was used in developing the thorium cleanup criteria that are still valid.
RCRA	40 *CFR* 257-272	Establishes accountability in handling hazardous waste from generation to disposal.	Relevant and Appropriate	Relevant and Appropriate	Any excavated materials that remain on site will meet all hazardous waste requirements in addition to the radiological cleanup criteria.
NRC Radiological Criteria for License Termination	10 *CFR* 20 Subpart E	This rule provides consistent standards to NRC licensees for determining the extent to which lands must be remediated before decommissioning of a site can be considered complete and the license terminated.	Applicable	Applicable	These criteria would be applicable to any NRC-licensed materials commingled with MED/AEC-related wastes and are relevant and appropriate to materials similar to Atomic Energy Act licensable materials.

Table C-1-2. Analysis of Action-Specific ARARs for the Remedy Implemented at the St. Louis Downtown Site Under FUSRAP, St. Louis, Missouri

ARAR	Citation	Specific Requirements	ARAR Status		Comment
			SLDS ROD	Current	
General Pretreatment Regulation	10 *CSR* 20-6.100	Provides for procedures to prevent the introduction of pollutants into publicly owned treatment works (POTWs).	Applicable	Applicable	To the extent waters are encountered during cleanup, and disposal to a POTW is chosen, pretreatment requirements will be met.
Solid Waste Disposal Act, as amended; Identification and Listing of Hazardous Wastes	40 *CFR* 260 and 261	Provides for identification and characterization of hazardous wastes.	Relevant and Appropriate	Relevant and Appropriate	These requirements will be used only for purposes of analyzing suitability of excavated material for backfill onsite.
RCRA Land Disposal Restrictions	40 *CFR* 268	Provides rule for treatment hazardous waste before landfilling.	Relevant and Appropriate	Relevant and Appropriate	These are applicable only for purposes of analyzing suitability of excavated material for offsite disposal and for analyzing for backfill onsite.
Clean Water Act, NPDES; Water Quality Standards	40 *CFR* 122-125 10 *CSR* 20-7.031 (4) (I)	Provide for limitations on point source discharge to surface water.	Relevant and Appropriate	Relevant and Appropriate	If a point source discharge is used to dispose of waters encountered during cleanup, specific effluent limits will be established as part of work plans developed during remedial design or remedial action. However, a formal NPDES discharge permit will not be obtained.
Missouri General Pretreatment Regulation	10 *CSR* 20-6.100	Provides for procedures to prevent the introduction of pollutants into POTWs.	Applicable	Applicable	Excavation-water effluent from SLDS is discharged to a combined (sanitary and storm) MSD sewer inlets located at SLDS and must be compliant with MSD discharge-limit-based criteria.
Missouri Storm Water Regulations: Surface Runoff and Erosion Control; Missouri Storm Water Discharge Regulations	10 *CSR* 20-6.200 10 *CSR* 20-6.010(13)	Provides for the use of best management practices to control storm water, erosion control and sediment transport.	Relevant and Appropriate	Relevant and Appropriate	To the extent storm waters are encountered during cleanup, they will be treated as required to meet substantive discharge criteria. Substantive surface control measures will be implemented as appropriate, although a state permit, per se, will not be obtained.

Table C-1-2. Analysis of Action-Specific ARARs for the Remedy Implemented at the St. Louis Downtown Site Under FUSRAP, St. Louis, Missouri

ARAR	Citation	Specific Requirements	ARAR Status		Comment
			SLDS ROD	Current	
Standards for Construction, Monitoring and Plugging of Wells	10 *CSR* 23-3	Provides procedures for constructing, monitoring and plugging of wells.	Relevant and Appropriate	Relevant and Appropriate	Ground water monitoring wells will be installed and operated consistent with substantive procedures, but permits will not be obtained.
UMTRCA (October 1992)	40 *CFR* 192.02 Table 1 to Subpart A	Table 1 describes maximum concentrations of constituents for ground water protection, including 0.05 and 0.01 mg/L arsenic and cadmium, and 5 pCi/L for Ra-226 and Ra-228 and 30 pCi/L for U-234 and U-238, respectively.	Relevant and Appropriate	Relevant and Appropriate	These requirements remain relevant and appropriate for the protection of ground water at SLDS.
Clean Air Act, National Emission Standards for Radionuclide Facilities licensed by the NRC and Federal Facilities not covered by Subpart H	40 *CFR* Part 61 Subpart I	Emission levels shall not exceed an effective dose equivalent of 10 mrem/year.	Relevant and Appropriate	Relevant and Appropriate	Compliance of effective dose equivalents from radionuclide emissions with this ARAR is checked in EMDARs per NESHAP.

Attachment C-2

Analysis of Applicable or Relevant and Appropriate Requirements for the Remedy Implemented at the North St. Louis County Sites Under FUSRAP, St. Louis, Missouri

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Table C-2-1. Analysis of Chemical-Specific ARARs for the Remedy Implemented at the North St. Louis County Sites Under FUSRAP, St. Louis, Missouri

ARAR	Citation	Specific Requirements	ARAR Status		Comment
			NC ROD	Current	
40 *CFR* Part 192, Subpart A: UMTRCA, Standards for Control of Residual Radioactive Materials from Inactive Uranium Processing Sites	40 *CFR* 192.02 (a)	The standards in 192.02 (a) requires that control of residual radioactive materials will "be effective for up to 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years..." The 1,000-year time period specified in 192.02(a) is relevant and appropriate for the development of soil RGs.	Relevant and Appropriate	Relevant and Appropriate	The RG for Th-230 accounts for ingrowth of Ra-226 over 1,000 years and remains relevant and appropriate.
40 *CFR* Part 192, Subpart B: UMTRCA, Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites	40 *CFR* 192.12 (a), (b)	*192.12 (a)* specifies that Ra-226 concentrations shall not exceed 5 pCi/g above background in the top 0.5 ft and 15 pCi/g above background in lower 0.5-ft layers averaged over 100-m^2 areas.	Relevant and Appropriate	Relevant and Appropriate	The standards for residual Ra-226 remain relevant and appropriate for all accessible soils.
		192.12 (b) specifies limitations for gamma radiation and radon level in occupied or habitable buildings.	Relevant and Appropriate	Relevant and Appropriate	The gamma and radon limitations remain relevant and appropriate to occupied buildings (i.e., Futura buildings).

Table C-2-1. Analysis of Chemical-Specific ARARs for the Remedy Implemented at the North St. Louis County Sites Under FUSRAP, St. Louis, Missouri

ARAR	Citation	Specific Requirements	ARAR Status		Comment
			NC ROD	Current	
40 *CFR* Part 192, Subpart C: UMTRCA, Implementation	40 *CFR* 192.20 (a) (1,3); (b) (1, 2, 3);192.21 (a-f, h); 192.22 (a-c)	Subpart C allows the use of supplemental standards for establishing alternate limits in lieu of the standards of Subparts A or B if it is determined that circumstances set forth in 40 *CFR* 192.21 exist. Supplemental standards for subsurface soil used with institutional controls are appropriate under the circumstance set forth in 40 *CFR* 192.21 (c) which allows the use of supplemental standards if "the estimated cost of remedial action to satisfy § 192.12(a) is unreasonably high relative to the long-term benefits, and the residual radioactive materials do not pose a clear present or future hazard."	Relevant and Appropriate	Relevant and Appropriate	Supplemental standards remain relevant and appropriate to inaccessible soil areas and the current concentrations still constitute appropriate alternate limits.

Table C-2-1. Analysis of Chemical-Specific ARARs for the Remedy Implemented at the North St. Louis County Sites Under FUSRAP, St. Louis, Missouri

ARAR	Citation	Specific Requirements	ARAR Status		Comment
			NC ROD	Current	
10 *CFR* 40 Appendix A Criterion 6(6) Criteria for Disposal of Wastes from Processing Source Material	10 *CFR* 40 Appendix A Criterion 6(6)	Criterion 6(6) requires that byproduct material containing concentrations of radionuclides other than radium in soil, and surface activity on remaining structures, must not result in a TEDE exceeding the dose from cleanup of radium contaminated soil to the above standard (benchmark dose), and must be at levels which are as low as is reasonably achievable. If more than one residual radionuclide is present in the same 100-square-meter area, the sum of the ratios for each radionuclide of concentration present to the concentration limit will not exceed "1" (unity). Provides basis for the derivation of RGs for radionuclides other than Ra-226.	Relevant and Appropriate	Relevant and Appropriate	Criterion 6(6) remain relevant and appropriate to structures and accessible soils. This approach was used to derive soil RGs for radionuclides other than Ra-226 and DCLGs for structures and is still applied as a RG.

Table C-2-2. Analysis of Action-Specific ARARs for the Remedy Implemented at the North St. Louis County Sites Under FUSRAP, St. Louis, Missouri

ARAR	Citation	Specific Requirements	ARAR Status: NC ROD	ARAR Status: Current	Comment
40 *CFR* Part 122, Clean Water Act – NPDES	40 *CFR 1* 22 Subpart C:δ122.41(d, e) δ122.44(a, d, e, i)	Establishes limits for discharge of pollutants into waters of the state. Any water discharged from a point source into waters of the state must meet any limits that would have been established in the NPDES permit. The substantive requirements in the NPDES permit equivalent for SLAPS, dated 10/2/1998, are ARAR for the North St. Louis County Sites. The effluent limits (daily maximum and monthly average concentrations) addressing site COCs for the North St. Louis County Sites are: 100 µg/L total recoverable arsenic 94 µg/L total recoverable cadmium 280 µg/L total recoverable chromium.	Relevant and Appropriate	Relevant and Appropriate	Relevant and appropriate to onsite discharges. Will comply with substantive requirements.
40 *CFR* Part 61, Subpart I: National Emission Standards for Radionuclide Emissions from Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered by Subpart H	40 *CFR* 61.102(a)	Emissions of radionuclides to the ambient air shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/year.	Relevant and Appropriate	Relevant and Appropriate	Relevant and appropriate during cleanup activities. The requirement is not ARAR for airborne emissions from residual contamination after cleanup.

Table C-2-2. Analysis of Action-Specific ARARs for the Remedy Implemented at the North St. Louis County Sites Under FUSRAP, St. Louis, Missouri

ARAR	Citation	Specific Requirements	ARAR Status		Comment
			NC ROD	Current	
10 *CSR* Division 23, Chapter 4: Monitoring Well Construction Code	10 *CSR* 23-4.030 through 10 *CSR* 23-4.080	Identifies substantive requirements related to the construction, operation, maintenance, and plugging of monitoring wells.	Applicable	Only 10 *CSR* 23-4.050, -4.060, and -4.080 are Still Applicable	Since the NC ROD, the following sections have been rescinded: 10 *CSR* 23-4.030 - Location of Wells (Rescinded 2/28/2019); 10 *CSR* 23-4.040 - Drilling Methods for Monitoring Wells (Rescinded 7/30/2011); and 10 *CSR* 23-4.070 - Monitoring Well Development (Rescinded 7/30/2011).

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APPENDIX D

EVALUATIONS OF U.S. ENVIRONMENTAL PROTECTION AGENCY-UPDATED SOIL EXTERNAL DOSE CONVERSION FACTORS ON HEALTH-PROTECTIVENESS OF THE REMEDY

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EVALUATIONS OF U.S. ENVIRONMENTAL PROTECTION AGENCY-UPDATED SOIL EXTERNAL DOSE CONVERSION FACTORS ON HEALTH-PROTECTIVENESS OF THE REMEDY

Since the release of RESRAD Version 7.0, updated internal and external exposure DCFs and CSFs published in the *Calculation of Slope Factors and Dose Coefficients* (ORNL 2014) have been incorporated into the DCFPAK 3.02 library program (with the exception of the soil ingestion CSFs) that is integrated into both the RESRAD Version 7.0 and RESRAD-ONSITE Version 7.2 models. However, a more recent update of external exposure DCFs was published by USEPA in FGR-15 (USEPA 2019a). In addition to providing updated external exposure DCFs, FGR-15 expands upon FGR-12 by providing age-specific DCFs for external exposures to radionuclides in air, water, and soil. FGR-12 external DCFs were used in dose assessments performed with earlier versions of the RESRAD model for SLDS and North St. Louis County Sites properties prior to the Third Five-Year Review Report (USACE 2015a).

Dose assessments of accessible soil areas at SLDS and North St. Louis County Sites properties completed within this fourth five-year review period, as well as within prior five-year review periods, incorporate analysis of external radiation exposures from soil through application of DCFs based on infinite depth (i.e., also referred to as infinite volume). DCFs for external radiation exposures to soil are available from ORNL (ORNL 2014) and FGR-15 (USEPA 2019a), with the latter document being applicable only to external radiation DCFs. DCFs for internal exposures are not included in FGR-15. Both documents provide external radiation DCFs for the following depths: ground plane, 1 cm, 5 cm, 15 cm, and infinite depth (or soil volume). Currently, RESRAD calculations for both the SLDS and North St. Louis County Sites properties assume a contaminated zone thickness of 0.3 m, which is representative of the vertical extent of contamination typically evaluated in PDIR-FSSEs and PRAR-FSSEs for Class 2 areas and in post-remedy Class 1 areas. Therefore, the use of infinite depth DCFs are considered applicable in RESRAD calculations for both the SLDS and North St. Louis County Sites properties.

This appendix to the Fourth Five-Year Review presents evaluations that have been conducted to assess potential impacts of the updated FGR-15 DCFs for external radiation pathways on the health-protectiveness of remedy verifications completed for the SLS during this and past five-year review periods. To assess potential impacts of the updated FGR-15 DCFs on the health-protectiveness of remedy verifications completed during this five-year review period, an analysis comparing DCFPAK 3.02 (Adult) library external radiation (infinite depth) morbidity DCFs (ORNL 2014) for SLDS radiological parent COCs and progeny radionuclides versus corresponding FGR-15 (Adult) values is presented in Attachment D-1, Table D-1-1. The column to the right of the ORNL DCFs column quantifies the comparisons as ratios of the FGR-15 DCFs to the current 2014 ORNL DCFs. The comparisons show that the DCFs for most of the parent COCs closely approximate each other (i.e., within 5 percent), based on the following ratios: Pa-231 (0.99), Ra-226 (1.01), Th-228 (1.03), Th-230 (1.05), U-234 (1.02), U-235 (1.01), and U-238 (1.00). However, ratios greater than 1.05 are noted for the following COCs, indicating that the DCFPAK 3.02 DCFs are less protective than corresponding FGR-15 DCFs: Ac-227 (1.66), lead (Pb)-210 (1.12), Ra-228 (2.09), and Th-232 (1.07). This raises the uncertainty that DCFs currently being used from the DCFPAK 3.02 library for the external radiation pathway could be resulting in total doses that are potentially underestimated relative to total doses that would otherwise result from application of the FGR-15 DCF updates.

To evaluate the impact that application of FGR-15 external radiation DCFs would have on the protectiveness of the remedy at both SLDS and North St. Louis County Sites properties, a modified

DCF library was created in the RESRAD-ONSITE 7.2 model that includes FGR-15 DCFs (infinite depth, adult age grouping) for all SLS radiological parent COCs and progeny radionuclides. Two properties were selected from SLDS and North St. Louis County Sites properties each, which exhibited the highest doses calculated in the respective PDIR-FSSEs or PRAR-FSSEs. For SLDS and North St. Louis County Sites each, one property was selected from this five-year review period and one was selected from past five-year reviews.

Dose assessments that were conducted for properties just prior to the release of the 2014 ORNL DCFs (i.e., properties not covered within the current five-year review period) incorporated USEPA's external radiation DCFs from FGR-12 (USEPA 1993). Therefore, in addition to comparisons between FGR-15 and 2014 ORNL external radiation DCFs, Table D-1-1 presents comparisons between FGR-15 and FGR-12 external radiation DCFs, for informational purposes.

The following two sections include discussion of the dose evaluations conducted, using the RESRAD-ONSITE model, to determine potential impacts to health-protectiveness of the remedy if FGR-15 external radiation DCFs were applied to dose assessments conducted for SLDS and North St. Louis County Sites properties associated with the current and past five-year review periods. However, because FGR-12 external radiation DCFs are no longer available in the RESRAD-ONSITE model DCF library, the dose modeling of all exposure pathways at the two properties selected from past five-year review periods have been updated with the 2014 ORNL DCFs as a starting point for the evaluations of those properties. Evaluations of past properties compare dose results determined using the FGR-15 external radiation DCFs with the dose results determined using (1) 2014 ORNL DCFs for all exposure pathways, and (2) dose results documented in the actual PRAR-FSSEs or PDIR-FSSEs that incorporated the FGR-12 DCFs. All RESRAD-ONSITE model outputs for the evaluations discussed in the following sections are presented in Attachment D-2 of this document, with the outputs for SLDS properties presented in Exhibit D-2-1 and those for the North St. Louis County Sites properties presented in Exhibit D-2-2.

EVALUATIONS OF USEPA-UPDATED EXTERNAL DOSE CONVERSION FACTORS ON HEALTH-PROTECTIVENESS OF THE REMEDY AT ST. LOUIS DOWNTOWN SITE PROPERTIES

For this five-year review period, the highest maximum total dose at SLDS (9.4 mrem per year) was estimated for resident gardener exposures to accessible soil (without ground cover/backfill) at the DT-2 (City Property) WOL and DT-11 (City of Venice) (partial) area (USACE 2018a). Attachment D-1, Table D-1-2, contains evaluation of the uncertainty posed by application of FGR-15 DCFs on the PRAR-FSSE maximum total dose estimated over a 1,000-year period of evaluation. Exhibit D-2-1 contains the RESRAD-ONSITE output for the dose calculations to which FGR-15 DCFs were applied to the external radiation exposure pathway, and 2014 ORNL DCFs were applied to all remaining pathways. The original model output used to calculate dose results for the PRAR-FSSE are included in Attachment A-9-2 of that *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Vicinity Properties City Property (DT-2) West of the Levee and City of Venice (DT 11) (Partial), St. Louis, Missouri* (DT-2 WOL/DT-11 PRAR-FSSE) (USACE 2018a). As shown in Table D-1-2, application of the FGR-15 external radiation (adult) DCFs for infinite depth would result in a maximum total dose of 10 mrem per year, which represents an increase of approximately 6 percent over the maximum total dose of 9.4 mrem per year reported in the DT-2 WOL/DT-11 PRAR-FSSE (USACE 2018a). The increased maximum total dose of 10 mrem per year is less than the 25 mrem per year dose limit. Therefore, the remedy is still health-protective for SLDS properties completed within this fourth five-year review period.

Of the SLDS properties with verifications completed prior to this Fourth Five-Year Review Report, the most elevated maximum total dose (7 mrem per year) was reported for DT-6 (Heintz Steel and Manufacturing) and DT-7 (Midwest Waste) (USACE 2005c). However, a soil removal that was conducted inside of the DT-6 storage building in 2018 is likely to have reduced the total dose; however, this will be determined in a future PRAR-FSSE. The SLDS property with the next highest reported dose (6.2 mrem per year) is DT-10 (Thomas and Proetz Lumber Company) (USACE 2010c). This dose, which was calculated using the FGR-12 external radiation DCFs, represents the maximum total dose calculated for a resident gardener (with no ground cover) at DT-10. Verification of remedial actions at DT-10 were completed and documented in the Third Five-Year Review Report (USACE 2015a). In the *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Vicinity Property Thomas and Proetz Lumber Company (DT-10)* (DT-10 PRAR-FSSE) (USACE 2010c), doses resulting from internal and external exposures were evaluated using FGR-11 (USEPA 1988) and FGR-12 DCFs, respectively. As shown in Table D-1-3, the doses reported in the DT-10 PRAR-FSSE have been reassessed using the 2014 ORNL internal and external DCFs and the updated FGR-15 external radiation DCFs. Soil EPCs presented in the dose assessment (Attachment A-9 of the DT-10 PRAR-FSSE) (USACE 2010c) were used in the analysis. The two RESRAD-ONSITE output reports contained in Exhibit D-2-1 showing the dose calculations for DT-10 are based on (1) the use of 2014 ORNL DCFs for all exposure pathways, and (2) the application of FGR-15 DCFs for the external radiation pathway and 2014 ORNL DCFs for all remaining internal exposure pathways. As shown in Table D-1-3, the recalculated maximum total dose for DT-10 using 2014 ORNL DCFs for all pathways is 5.7 mrem per year, which represents an 8 percent decrease from the maximum total dose originally estimated for DT-10 in the DT-10 PRAR-FSSE (USACE 2010c). The combined application of the 2014 ORNL internal DCFs and FGR-15 external radiation DCFs results in a dose of 6.2 mrem per year, which represents an 8 percent increase over the maximum total dose from that which was estimated using 2014 ORNL DCFs for all pathways, and a 0 percent change from the maximum total dose originally estimated for DT-10 in the DT-10 PRAR-FSSE (USACE 2010c). Therefore, the remedy is still health-protective for SLDS properties completed within past five-year review periods.

EVALUATIONS OF USEPA-UPDATED EXTERNAL DOSE CONVERSION FACTORS ON HEALTH-PROTECTIVENESS OF THE REMEDY AT NORTH ST. LOUIS COUNTY PROPERTIES

For this five-year review period, the highest maximum total dose at the North St. Louis County Sites (2.8 mrem per year) was estimated for resident gardener exposures to soil (without ground cover/backfill) at CWC-floodplain properties CWC-94, CWC-96, CWC-98, and Industrial Lane (USACE 2019d). Attachment D-1, Table D-1-4, contains evaluation of the potential impact on the maximum total dose estimated over a 1,000-year period of evaluation in the *Pre-Design Investigation Summary Report and Final Status Survey Evaluation for Coldwater Creek (CWC)-Floodplain Properties CWC-94, CWC-96, CWC-98, and Industrial Lane, St. Louis, Missouri* (CWC-94, CWC-96, CWC-98, and Industrial Lane PDIR-FSSE) (USACE 2019d), from application of FGR-15 DCFs. As shown in Table D-1-4, application of the FGR-15 external radiation (adult) DCFs for infinite depth would result in the same maximum total dose of 2.8 mrem per year, which is less than the 19 mrem per year dose limit. Therefore, the remedy is still health-protective for North St. Louis County Sites properties completed within this fourth five-year review period.

Of the North St. Louis County Site properties with verifications completed prior to this Fourth Five-Year Review Report, the most elevated maximum total dose in accessible soil areas (4.6 mrem per year) was reported for VP-53, the verifications of which were completed and documented in the Third Five-Year Review Report (USACE 2015a). This dose was calculated for a suburban resident (non-gardener), with no ground cover assumed, using the FGR-12 external radiation DCFs in the *Post-Remedial Action Report and Final Status Survey Evaluation for the St. Louis Airport Site Vicinity Property 53* (VP-53 PRAR-FSSE) (USACE 2011e). In the VP-53 PRAR-FSSE, doses resulting from internal and external exposures were evaluated using FGR-11 and FGR-12 DCFs, respectively. As shown in Attachment D-1, Table D-1-5, the doses reported in the VP-53 PRAR-FSSE have been reassessed using the 2014 ORNL internal and external DCFs and the updated FGR-15 external radiation DCFs. Soil EPCs presented in the original dose assessment (Attachment A-9 of the VP-53 PRAR-FSSE) were used in this analysis. Additionally, although the suburban resident was evaluated in the VP-53 PRAR-FSSE, the more health-conservative resident gardener has been evaluated in this dose assessment. The two RESRAD-ONSITE output reports contained in Exhibit D-2-2 showing the dose calculations for VP-53 are based on (1) the use of 2014 ORNL DCFs for all exposure pathways, and (2) the application of FGR-15 DCFs for the external radiation pathway and 2014 ORNL DCFs for all remaining internal exposure pathways. As shown in Table D-1-5, the recalculated maximum total dose for VP-53 using 2014 ORNL DCFs for all pathways is 4.4 mrem per year, which represents a 4 percent decrease from the maximum total dose originally reported for VP-53 (4.6 mrem per year) in the VP-53 PRAR-FSSE (USACE 2011e). However, the combined application of the 2014 ORNL internal DCFs and FGR-15 external radiation DCFs results in a maximum total dose of 4.7 mrem per year, which represents a 5 percent increase over the maximum total dose estimated using 2014 ORNL DCFs for all pathways, and a 2 percent increase over the maximum total dose originally estimated for VP-53 in the VP-53 PRAR-FSSE (USACE 2011e). Based on the result of this evaluation, the remedy being applied at the North St. Louis County Sites remains health-protective.

Attachment D-1

Differences in Dose Assessment Results for Select St. Louis Site Properties Based on Applications of Currently Used Versus U.S. Environmental Protection Agency-Updated Soil External Dose Conversion Factors

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Table D-1-1. Comparisons of External Radiation Dose Conversion Factors (Infinite Volume) for St. Louis FUSRAP Radiological COCs Plus Progeny Radionuclides in Soil from FGR-15, 2014 ORNL, and FGR-12

Parent Isotope (COC)	Parent and Progeny Isotope(s)	FGR-15 Morbidity DCFs (USEPA 2019a) (mrem/year)/(pCi/g)[a,b,c]	2014 ORNL Morbidity DCFs (ORNL 2014)[a]		FGR-12 DCFs (USEPA 1993)[a,b]	
			DCF (mrem/year)/(pCi/g)	Ratio of FGR-15 DCF to 2014 ORNL DCF[d]	DCF (mrem/year)/(pCi/g)	Ratio of FGR-15 DCF to FGR-12 DCF[d]
Ac-227	Ac-227	4.33E-04	2.62E-04	1.66	4.95E-04	0.88
	Th-227	5.60E-01	5.64E-01	0.99	5.21E-01	1.08
	Fr-223	2.86E-01	1.76E-01	1.62	1.98E-01	1.44
	Ra-223	5.83E-01	5.79E-01	1.01	6.03E-01	0.97
	Rn-219	2.93E-01	2.97E-01	0.99	3.08E-01	0.95
	At-219	0.00E+00	0.00E+00	NA	NA	NA
	Bi-215	1.59E+00	1.37E+00	1.16	NA	NA
	Po-215	9.34E-04	9.45E-04	0.99	1.02E-03	0.92
	Pb-211	5.15E-01	3.68E-01	1.40	3.06E-01	1.68
	Bi-211	2.37E-01	2.41E-01	0.98	2.56E-01	0.93
	Tl-207	1.92E-01	2.39E-02	8.05	1.98E-02	9.72
	Po-211	4.67E-02	4.71E-02	0.99	4.76E-02	0.98
Pa-231	Pa-231	1.59E-01	1.61E-01	0.99	1.90E-01	0.83
	Ac-227	4.33E-04	2.62E-04	1.66	4.95E-04	0.88
	Th-227	5.60E-01	5.64E-01	0.99	5.21E-01	1.08
	Fr-223	2.86E-01	1.76E-01	1.62	1.98E-01	1.44
	Ra-223	5.83E-01	5.79E-01	1.01	6.03E-01	0.97
	Rn-219	2.93E-01	2.97E-01	0.99	3.08E-01	0.95
	At-219	0.00E+00	0.00E+00	NA	NA	NA
	Bi-215	1.59E+00	1.37E+00	1.16	NA	NA
	Po-215	9.34E-04	9.45E-04	0.99	1.02E-03	0.92
	Pb-211	5.15E-01	3.68E-01	1.40	3.06E-01	1.68
	Bi-211	2.37E-01	2.41E-01	0.98	2.56E-01	0.93
	Tl-207	1.92E-01	2.39E-02	8.05	1.98E-02	9.72
	Po-211	4.67E-02	4.71E-02	0.99	4.76E-02	0.98

Table D-1-1. Comparisons of External Radiation Dose Conversion Factors (Infinite Volume) for St. Louis FUSRAP Radiological COCs Plus Progeny Radionuclides in Soil from FGR-15, 2014 ORNL, and FGR-12

Parent Isotope (COC)	Parent and Progeny Isotope(s)	FGR-15 Morbidity DCFs (USEPA 2019a) (mrem/year)/(pCi/g)[a,b,c]	2014 ORNL Morbidity DCFs (ORNL 2014)[a]		FGR-12 DCFs (USEPA 1993)[a,b]	
			DCF (mrem/year)/(pCi/g)	Ratio of FGR-15 DCF to 2014 ORNL DCF[d]	DCF (mrem/year)/(pCi/g)	Ratio of FGR-15 DCF to FGR-12 DCF[d]
Pb-210	Pb-210	2.35E-03	2.09E-03	1.12	2.45E-03	0.96
	Bi-210	1.28E-01	5.47E-03	23.48	3.60E-03	35.65
	Hg-206	7.30E-01	6.13E-01	1.19	NA	NA
Ra-226	Ra-226	3.21E-02	3.18E-02	1.01	3.17E-02	1.01
	Rn-222	2.11E-03	2.13E-03	0.99	2.35E-03	0.90
	Po-218	2.26E-06	9.23E-09	244.75	5.64E-05	0.04
	Pb-214	1.30E+00	1.26E+00	1.03	1.34E+00	0.97
	At-218	5.26E-04	5.57E-05	9.45	5.84E-03	0.09
	Bi-214	9.37E+00	9.13E+00	1.03	9.80E+00	0.96
	Rn-218	4.20E-03	4.26E-03	0.99	4.54E-03	0.93
	Po-214	4.78E-04	4.80E-04	1.00	5.13E-04	0.93
	Tl-210	1.73E+01	1.68E+01	1.03	NA	NA
Ra-228	Ra-228	1.37E-04	6.58E-05	2.09	NA	NA
	Ac-228	5.15E+00	5.04E+00	1.02	5.97E+00	0.86
Th-228	Th-228	7.43E-03	7.25E-03	1.03	7.93E-03	0.94
Th-230	Th-230	1.16E-03	1.11E-03	1.05	1.21E-03	0.96
Th-232	Th-232	5.12E-04	4.78E-04	1.07	5.21E-04	0.98
	Ra-228	1.37E-04	6.58E-05	2.09	NA	NA
	Ac-228	5.15E+00	5.04E+00	1.02	5.97E+00	0.86
	Th-228	7.43E-03	7.25E-03	1.03	7.93E-03	0.94
	Ra-224	4.91E-02	4.95E-02	0.99	5.12E-02	0.96
	Rn-220	3.44E-03	3.47E-03	0.99	2.30E-03	1.50
	Po-216	8.81E-05	8.87E-05	0.99	1.04E-04	0.85
	Pb-212	6.50E-01	6.31E-01	1.03	7.04E-01	0.92
	Bi-212	8.16E-01	6.26E-01	1.30	1.17E+00	0.70
	Po-212	0.00E+00	0.00E+00	NA	0.00E+00	NA
	Tl-208	2.20E+01	2.17E+01	1.02	2.30E+01	0.96

Table D-1-1. Comparisons of External Radiation Dose Conversion Factors (Infinite Volume) for St. Louis FUSRAP Radiological COCs Plus Progeny Radionuclides in Soil from FGR-15, 2014 ORNL, and FGR-12

Parent Isotope (COC)	Parent and Progeny Isotope(s)	FGR-15 Morbidity DCFs (USEPA 2019a) (mrem/year)/(pCi/g)[a,b,c]	2014 ORNL Morbidity DCFs (ORNL 2014)[a]		FGR-12 DCFs (USEPA 1993)[a,b]	
			DCF (mrem/year)/(pCi/g)	Ratio of FGR-15 DCF to 2014 ORNL DCF[d]	DCF (mrem/year)/(pCi/g)	Ratio of FGR-15 DCF to FGR-12 DCF[d]
U-234	U-234	3.51E-04	3.46E-04	1.02	4.01E-04	0.87
U-235	U-235	7.06E-01	7.01E-01	1.01	7.21E-01	0.98
	Th-231	4.69E-02	3.25E-02	1.44	3.64E-02	1.29
U-238	U-238	1.72E-04	1.71E-04	1.00	1.03E-04	1.67
	Th-234	2.99E-02	2.32E-02	1.29	2.41E-02	1.24
	Pa-234m	4.46E-01	1.26E-01	3.54	8.96E-02	4.98
	Pa-234	8.29E+00	8.28E+00	1.00	1.15E+01	0.72

[a] The exteral radiation DCFs presented from each of the three sources (i.e., USEPA 2019a, ORNL 2014, and USEPA 1993) are for infinite volume. The external radiation DCFs obtained from FGR-15 are for the Adult age grouping, for consistency with the DCFPAK3.02 libary applied in dose assessments conducted for the St. Louis FUSRAP Sites using the RESRAD-ONITE Model Version 7.2, since the Third Five-Year Review Report (USACE 2015a).

[b] For presentation in this table, the external radiation DCFs in FGR-15 and FGR-12 were converted from (Sv per second)/(Bq/m^3) to (mrem per year)/(pCi/g). For this conversion, a soil density of 1,600 kg/m^3 is assumed (USEPA 2019a and USEPA 1993, respectively).

[c] DCFs for the Adult age grouping are applied for external (infinite depth) exposures because SLDS land use is commerical/industrial.

[d] A ratio greater than 1.0 indicates that the FGR-15 DCF is greater than the 2014 ORNL DCF or FGR-12 DCF (whichever is applicable), indicating that the FGR-15 DCF is greater than (i.e., more health protective than) the corresponding 2014 ORNL DCF or FGR-12 DCF. A ratio less than 1.0 indicates that the FGR-15 DCF is less than the 2014 ORNL DCF or FGR-12 DCF (whichever is applicable), indicating that the FGR-15 DCF is less than (i.e., less health protective than) the corresponding 2014 ORNL DCF or FGR-12 DCF.

Notes:

NA - Not available.

Table D-1-2. Analysis of Impacts on Maximum Total Dose Calculations for Accessible Soil at DT-2 West of Levee from Use of FGR-15 External Radiation (Infinite Depth) DCFs (Adult), St. Louis Downtown Site, St. Louis, Missouri

Parent COC (Including Decay Chain Progenies)	COC-Specific, Pathway-Specific, and Total Doses (mrem/year) for Resident Gardener Soil Exposures at DT-2 West of Levee at Time of Maximum Total Dose (i.e., at 1,000 years)[a]							
	PRAR-FSSE External Dose (USACE 2018a)[b]	External Radiation Dose Based on FGR-15 [Adult] DCFs (USEPA 2019a)[c]	PRAR-FSSE Dust Inhalation Dose (USACE 2018a)[b]	PRAR-FSSE Plant Ingestion Dose (USACE 2018a)[b]	PRAR-FSSE Soil Ingestion Dose (USACE 2018a)[b]	PRAR-FSSE Total Dose (USACE 2018a)[b]	Total Dose (Based on FGR-15 [Adult] DCFs)[d]	Percent Change in Total Dose Based on FGR-15 Relative to PRAR-FSSE Total Dose
Ac-227	2.1E-16	2.4E-16	2.2E-19	1.9E-17	1.0E-17	2.4E-16	2.7E-16	13%
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA
Pb-210	6.7E-18	1.1E-16	1.1E-19	2.9E-15	3.9E-16	3.2E-15	3.4E-15	3%
Ra-226	1.4E-01	1.5E-01	3.4E-06	7.3E-02	7.2E-03	2.2E-01	2.3E-01	2%
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA
Th-230	5.2E+00	5.4E+00	2.4E-03	2.6E+00	3.4E-01	8.2E+00	8.4E+00	2%
Th-232	5.0E-01	5.1E-01	7.5E-05	1.7E-01	8.9E-03	6.8E-01	7.0E-01	2%
U-234	2.5E-02	2.6E-02	1.3E-04	3.3E-02	1.3E-02	7.1E-02	7.2E-02	1%
U-235	5.1E-02	5.3E-02	1.3E-05	2.7E-03	9.9E-04	5.4E-02	5.6E-02	3%
U-238	1.6E-01	4.8E-01	9.9E-05	2.0E-02	1.1E-02	1.9E-01	5.1E-01	168%
Total Dose (mrem/year) =	6.1E+00	6.6E+00	2.7E-03	2.9E+00	3.8E-01	9.4E+00	1.0E+01	6%

[a] The impact of applying the FGR-15 external radiation (infinite depth) DCFs (USEPA 2019a) on the maximum total dose was analyzed for a resident gardener at DT-2 WOL accessible soil area of SLDS because this scenario produced the highest maximum total dose of all SLDS properties completed within the fourth five-year review period. The table contains COC-specific, pathway-specific, and total doses presented in Attachment A-9-2 of the DT-2 WOL/DT-11 PRAR-FSSE (USACE 2018a),which represent the time of the maximum total dose over the 1,000-year period of evaluation, based on the DCFPAK 3.02 DCFs published by ORNL (ORNL 2014), along with the total dose calculated when the FGR-15 external radiation (infinite depth) DCFs are applied.

[b] Pathway dose was reported in the DT-2 WOL/DT-11 PRAR-FSSE (USACE 2018a). The total dose reported in the DT-2 WOL/DT-11 PRAR-FSSE is calculated as the sum of the pathway doses presented in this table from the DT-2 WOL/DT-11 PRAR-FSSE.

[c] The FGR-15-based external radiation dose (infinite depth) pathway was calculated for each COC by application of a modified DCF library in the RESRAD-ONSITE model Version 7.2 that includes FGR-15 external radiation DCFs (infinite depth, adult) for parent COCs and progeny radionuclides. (See Table D-1-1.)

[d] The total dose based on FGR-15 DCFs is calculated as the sum of the pathway doses presented in this table from the DT-2 WOL/DT-11 PRAR-FSSE (USACE 2018a) for dust inhalation, plant ingestion, soil ingestion, plus the FGR-15-based external radiation dose (i.e., based on application of the FGR-15 [Adult] DCFs).

Note:

NA - Not available.

Table D-1-3. Analysis of Impacts on Maximum Total Dose Calculations for Accessible Soil at DT-10 from Use of FGR-15 External Radiation (Infinite Depth) DCFs (Adult), St. Louis Downtown Site, St. Louis, Missouri

Parent COC (Including Decay Chain Progenies)	COC-Specific, Pathway-Specific, and Total Doses (mrem/year) for Resident Gardener Soil Exposures at DT-10 at Time of Maximum Total Dose (i.e., at 1,000 Years)[a]							
	External Dose Based on 2014 ORNL DCFs (ORNL 2014)[b]	Predicted External Dose (Based on FGR-15 [Adult] DCFs [USEPA 2019a])[c]	Dust Inhalation Dose Based on 2014 ORNL DCFs (ORNL 2014)[b]	Plant Ingestion Dose Based on 2014 ORNL DCFs (ORNL 2014)[b]	Soil Ingestion Dose Based on 2014 ORNL DCFs (ORNL 2014)[b]	Total Dose Based on 2014 ORNL DCFs (ORNL 2014)[b]	Total Dose (Based on FGR-15 [Adult] DCFs)[d]	Percent Change in Total Dose Based on FGR-15 Relative to Total Dose Based on 2014 ORNL
Ac-227	2.4E-16	2.7E-16	2.5E-19	2.1E-17	1.2E-17	2.7E-16	3.1E-16	13%
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA
Pb-210	2.5E-17	4.3E-16	4.1E-19	1.1E-14	1.5E-15	1.2E-14	1.3E-14	3%
Ra-226	5.4E-01	5.6E-01	1.3E-05	2.7E-01	2.7E-02	8.3E-01	8.6E-01	3%
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA
Th-230	2.8E+00	2.9E+00	1.3E-03	1.4E+00	1.8E-01	4.4E+00	4.5E+00	2%
Th-232	1.4E-01	1.5E-01	2.1E-05	4.9E-02	2.5E-03	1.9E-01	2.0E-01	2%
U-234	2.5E-02	2.5E-02	1.3E-04	3.3E-02	1.3E-02	7.0E-02	7.1E-02	1%
U-235	4.5E-02	4.6E-02	1.2E-05	2.4E-03	8.8E-04	4.8E-02	5.0E-02	3%
U-238	1.6E-01	4.7E-01	9.8E-05	2.0E-02	1.1E-02	1.9E-01	5.1E-01	168%
Total Dose (mrem/year) =	3.7E+00	4.2E+00	1.5E-03	1.8E+00	2.4E-01	5.7E+00	6.2E+00	8%

[a] The impact of applying the FGR-15 external radiation (infinite depth) adult DCFs (USEPA 2019a) on the maximum total dose is analyzed for a resident gardener at the DT-10 accessible soil area of SLDS because this scenario produced the highest maximum total dose of all SLDS properties completed within past five-year review periods (i.e., the first, second, and third five-year review periods). The table contains COC-specific, pathway-specific, and total doses that represent the time of the maximum total dose over the 1,000-year period of evaluation, based on the DCFPAK 3.02 DCFs published by ORNL (ORNL 2014), along with the predicted external radiation doses and the total dose calculated when the FGR-15 external radiation (infinite depth) DCFs are applied.

[b] The pathway dose is recalculated (i.e., updated) from the DT-10 PRAR-FSSE (USACE 2010c) using the 2014 ORNL DCFs (i.e., as available in the DCFPAK 3.02 model library) (ORNL 2014). The total dose is the sum of the individual recalculated pathway doses.

[c] The FGR-15-based external radiation dose (infinite depth) pathway was calculated for each COC by application of a modified DCF library in the RESRAD-ONSITE model Version 7.2 that includes FGR-15 external radiation DCFs (infinite depth, adult) for parent COCs and progeny radionuclides. (See Table D-1-1.)

[d] The total dose based on FGR-15 DCFs is calculated as the sum of the pathway doses presented in this table from the DT-10 PRAR-FSSE (USACE 2010c) for dust inhalation, plant ingestion, soil ingestion, plus the FGR-15-based external radiation dose (i.e., based on application of the FGR-15 [Adult] DCFs).

Note:

NA - Not available.

Table D-1-4. Analysis of Impacts on Maximum Total Dose Calculations for Accessible Soil at CWC-Floodplain Properties CWC-94, CWC-96, CWC-98, and Industrial Lane from Use of FGR-15 External Radiation (Infinite Depth) DCFs (Adult), North St. Louis County, St. Louis, Missouri

Parent COC (Including Decay Chain Progenies)	COC-Specific, Pathway-Specific, and Total Doses (mrem/year) for Resident Gardener Soil Exposures at CWC-94, CWC-96, CWC-98, and Industrial Lane at Time of Maximum Total Dose (i.e., at 0 Years)[a]							
	External Dose (USACE 2019d)[b]	External Radiation Dose Based on FGR-15 [Adult] DCFs (USEPA 2019a)[c]	Dust Inhalation Dose (USACE 2019d)[b]	Plant Ingestion Dose (USACE 2019d)[b]	Soil Ingestion Dose (USACE 2019d)[b]	Total Dose (USACE 2019d)[b]	Total Dose (Based on FGR-15 [Adult] DCFs)[d]	Percent Change in Total Dose Based on FGR-15 Relative to PDIR-FSSE Total Dose
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA
Pa-231	1.1E-02	1.1E-02	4.1E-03	2.4E-02	9.7E-03	4.8E-02	4.8E-02	0.3%
Pb-210	9.9E-05	1.7E-03	4.1E-05	2.2E-02	8.9E-03	3.1E-02	3.2E-02	5%
Ra-226	1.8E+00	1.9E+00	5.6E-04	1.8E-01	2.0E-02	2.0E+00	2.1E+00	2%
Ra-228	7.8E-02	8.0E-02	9.2E-05	3.1E-02	3.2E-03	1.1E-01	1.1E-01	2%
Th-228	4.1E-01	4.2E-01	6.5E-04	6.0E-04	2.4E-03	4.1E-01	4.2E-01	3%
Th-230	2.9E-03	3.0E-03	2.9E-02	1.7E-02	6.9E-02	1.2E-01	1.2E-01	0%
Th-232	6.7E-03	6.9E-03	7.1E-04	3.1E-03	1.9E-03	1.2E-02	1.3E-02	1%
U-234	3.5E-06	3.6E-06	2.9E-05	1.1E-04	1.7E-04	3.2E-04	3.2E-04	0%
U-235	1.2E-02	1.2E-02	4.4E-05	1.7E-04	2.8E-04	1.2E-02	1.3E-02	3%
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA
Total Dose (mrem/year) =	2.3E+00	2.4E+00	3.5E-02	2.8E-01	1.2E-01	2.8E+00	2.8E+00	2%

[a] The impact of applying the FGR-15 external radiation (infinite depth) DCFs (USEPA 2019a) on the maximum total dose was analyzed for a resident gardener at CWC-94, CWC-96, CWC-98, and Industrial Lane because this scenario produced the highest maximum total dose of all the North St. Louis County Sites completed within the fourth five-year review period. The table contains COC-specific, pathway-specific, and total doses presented in Attachment L-2 of the CWC-94, CWC-96, CWC-98, and Industrial Lane PDIR-FSSE (USACE 2019d), that represent the time of the maximum total dose over the 1,000-year period of evaluation, based on the DCFPAK 3.02 DCFs published by ORNL (ORNL 2014), along with the total dose calculated when the FGR-15 external radiation (infinite depth) DCFs are applied.

[b] Pathway dose was reported in the CWC-94, CWC-96, CWC-98, and Industrial Lane PDIR-FSSE (USACE 2019d). The total dose reported in the CWC-94, CWC-96, CWC-98, and Industrial Lane PDIR-FSSE is calculated as the sum of the pathway doses presented in this table from the CWC-94, CWC-96, CWC-98, and Industrial Lane PDIR-FSSE.

[c] The FGR-15-based external radiation dose (infinite depth) pathway was calculated for each COC by application of a modified DCF library in the RESRAD-ONSITE model Version 7.2 that includes FGR-15 external radiation DCFs (infinite depth, adult) for parent COCs and progeny radionuclides. (See Table D-1-1.)

[d] The total dose based on FGR-15 DCFs is calculated as the sum of the pathway doses presented in this table from the CWC-94, CWC-96, CWC-98, and Industrial Lane PDIR-FSSE (USACE 2019d) for dust inhalation, plant ingestion, soil ingestion, plus the FGR-15-based external radiation dose (i.e., based on application of the FGR-15 [Adult] DCFs).

Note:

NA - Not available.

Table D-1-5. Analysis of Impacts on Maximum Total Dose Calculations for Accessible Soil at VP-53 from Use of the USEPA FGR-15 External Radiation (Infinite Depth) DCFs (Adult), North St. Louis County, St. Louis, Missouri

Parent COC (Including Decay Chain Progenies)	COC-Specific, Pathway-Specific, and Total Doses (mrem/year) for Onsite Resident (Non-Gardener) Soil Exposures at VP-53 at Time of Maximum Total Dose (i.e., at 0 Years)[a]							
	External Dose Based on 2014 ORNL DCFs (ORNL 2014)[b]	Predicted External Dose (Based on FGR-15 [Adult] DCFs [USEPA 2019a])[c]	Dust Inhalation Dose Based on 2014 ORNL DCFs (ORNL 2014)[b]	Plant Ingestion Dose Based on 2014 ORNL DCFs (ORNL 2014)[b]	Soil Ingestion Dose Based on 2014 ORNL DCFs (ORNL 2014)[b]	Total Dose Based on 2014 ORNL DCFs (ORNL 2014)[b]	Total Dose (Based on FGR-15 [Adult] DCFs)[d]	Percent Change in Total Dose Based on FGR-15 Relative to Total Dose Based on 2014 ORNL
Ac-227	6.8E-01	7.8E-01	1.9E-02	1.2E-01	5.2E-02	8.7E-01	9.7E-01	12%
Pa-231	1.5E-02	1.5E-02	5.9E-03	1.2E-01	1.4E-02	1.6E-01	1.6E-01	0%
Pb-210	7.5E-05	1.3E-03	3.2E-05	6.0E-02	6.7E-03	6.7E-02	6.8E-02	2%
Ra-226	1.2E+00	1.3E+00	3.8E-04	4.6E-01	1.4E-02	1.7E+00	1.7E+00	2%
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA
Th-228	1.5E+00	1.5E+00	2.4E-03	8.0E-03	8.8E-03	1.5E+00	1.6E+00	4%
Th-230	2.2E-03	2.3E-03	2.2E-02	4.8E-02	5.3E-02	1.3E-01	1.3E-01	0.1%
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA
U-234	2.3E-06	2.4E-06	2.0E-05	2.6E-04	1.2E-04	4.0E-04	4.0E-04	0.01%
U-235	2.4E-03	2.5E-03	9.0E-06	1.3E-04	5.5E-05	2.6E-03	2.7E-03	3%
U-238	2.2E-02	6.6E-02	3.6E-04	5.4E-03	2.4E-03	3.0E-02	7.4E-02	147%
Total Dose (mrem/year) =	3.4E+00	3.7E+00	5.0E-02	8.2E-01	1.5E-01	4.4E+00	4.7E+00	5%

[a] The impact of applying the FGR-15 external radiation (infinite depth) adult DCFs (USEPA 2019a) on the maximum total dose is analyzed for a resident gardener at VP-53 because the onsite resident scenario (i.e., non-gardener) produced the highest maximum total dose of all the NC sites completed within past five-year review periods (i.e., the first, second, and third five-year review periods). The table contains COC-specific, pathway-specific, and total doses that represent the time of the maximum total dose over the 1,000-year period of evaluation, based on the DCFPAK 3.02 DCFs published by ORNL (ORNL 2014), along with the total dose calculated when the FGR-15 external radiation (infinite depth) DCFs are applied.

[b] The pathway dose is recalculated (i.e., updated) from the VP-53 PRAR-FSSE (USACE 2011e) using the 2014 ORNL DCFs (i.e., as available in the DCFPAK 3.02 model library). The total dose is the sum of the individual recalculated pathway doses.

[c] The FGR-15-based external radiation dose (infinite depth) pathway was calculated for each COC by application of a modified DCF library in the RESRAD-ONSITE model Version 7.2 that includes FGR-15 external radiation DCFs (infinite depth, adult) for parent COCs and progeny radionuclides. (See Table D-1-1.)

[d] The total dose based on FGR-15 DCFs is calculated as the sum of the pathway doses presented in this table from the VP-53 PRAR-FSSE (USACE 2011e) for dust inhalation, plant ingestion, soil ingestion, plus the FGR-15-based external radiation dose (i.e., based on application of the FGR-15 [Adult] DCFs).

Note:

NA - Not available.

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Attachment D-2

Supporting RESRAD-ONSITE Version 7.2 Model Outputs for Attachment D-1 Evaluations

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Exhibit D-2-1

RESRAD-ONSITE Dose Output Summary Reports for the Residential Gardener Scenario at St. Louis Downtown Site Vicinity Properties DT-2 (City Property) West of the Levee and DT-11 (City of Venice) (Partial) and for the Residential Gardener Scenario with Accessible Soil at St. Louis Downtown Site Vicinity Property DT-10 (Thomas and Proetz Lumber Company)

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DT-2 WOL/DT-11 Resident Gardener with FGR-15 External DCFs (Infinite Volume, Adult)
RESRAD Dose Summary

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-227 (Source: FGR-15_STL COCs)	4.330E-04	2.615E-04	DCF1(1)
A-1	Ac-228 (Source: FGR-15_STL COCs)	5.150E+00	5.044E+00	DCF1(2)
A-1	At-218 (Source: FGR-15_STL COCs)	5.260E-04	5.567E-05	DCF1(3)
A-1	At-219 (Source: FGR-15_STL COCs)	0.000E+00	0.000E+00	DCF1(4)
A-1	Bi-210 (Source: FGR-15_STL COCs)	1.280E-01	5.474E-03	DCF1(5)
A-1	Bi-211 (Source: FGR-15_STL COCs)	2.370E-01	2.410E-01	DCF1(6)
A-1	Bi-212 (Source: FGR-15_STL COCs)	8.160E-01	6.259E-01	DCF1(7)
A-1	Bi-214 (Source: FGR-15_STL COCs)	9.370E+00	9.136E+00	DCF1(8)
A-1	Bi-215 (Source: FGR-15_STL COCs)	1.590E+00	1.369E+00	DCF1(9)
A-1	Fr-223 (Source: FGR-15_STL COCs)	2.860E-01	1.758E-01	DCF1(10)
A-1	Hg-206 (Source: FGR-15_STL COCs)	7.300E-01	6.128E-01	DCF1(11)
A-1	Pa-231 (Source: FGR-15_STL COCs)	1.590E-01	1.609E-01	DCF1(12)
A-1	Pa-234 (Source: FGR-15_STL COCs)	8.290E+00	8.276E+00	DCF1(13)
A-1	Pa-234m (Source: FGR-15_STL COCs)	4.460E-01	1.257E-01	DCF1(14)
A-1	Pb-210 (Source: FGR-15_STL COCs)	2.350E-03	2.092E-03	DCF1(15)
A-1	Pb-211 (Source: FGR-15_STL COCs)	5.150E-01	3.680E-01	DCF1(16)
A-1	Pb-212 (Source: FGR-15_STL COCs)	6.500E-01	6.315E-01	DCF1(17)
A-1	Pb-214 (Source: FGR-15_STL COCs)	1.300E+00	1.257E+00	DCF1(18)
A-1	Po-210 (Source: DCFPAK3.02)	5.641E-05	5.641E-05	DCF1(19)
A-1	Po-211 (Source: FGR-15_STL COCs)	4.670E-02	4.708E-02	DCF1(20)
A-1	Po-212 (Source: FGR-15_STL COCs)	0.000E+00	0.000E+00	DCF1(21)
A-1	Po-214 (Source: FGR-15_STL COCs)	4.780E-04	4.801E-04	DCF1(22)
A-1	Po-215 (Source: FGR-15_STL COCs)	9.340E-04	9.453E-04	DCF1(23)
A-1	Po-216 (Source: FGR-15_STL COCs)	8.810E-05	8.874E-05	DCF1(24)
A-1	Po-218 (Source: FGR-15_STL COCs)	2.260E-06	9.229E-09	DCF1(25)
A-1	Ra-223 (Source: FGR-15_STL COCs)	5.830E-01	5.791E-01	DCF1(26)
A-1	Ra-224 (Source: FGR-15_STL COCs)	4.910E-02	4.951E-02	DCF1(27)
A-1	Ra-226 (Source: FGR-15_STL COCs)	3.210E-02	3.176E-02	DCF1(28)
A-1	Ra-228 (Source: FGR-15_STL COCs)	1.370E-04	6.576E-05	DCF1(29)
A-1	Rn-218 (Source: FGR-15_STL COCs)	4.200E-03	4.260E-03	DCF1(30)
A-1	Rn-219 (Source: FGR-15_STL COCs)	2.930E-01	2.970E-01	DCF1(31)
A-1	Rn-220 (Source: FGR-15_STL COCs)	3.440E-03	3.475E-03	DCF1(32)
A-1	Rn-222 (Source: FGR-15_STL COCs)	2.110E-03	2.130E-03	DCF1(33)
A-1	Th-227 (Source: FGR-15_STL COCs)	5.600E-01	5.642E-01	DCF1(34)
A-1	Th-228 (Source: FGR-15_STL COCs)	7.430E-03	7.249E-03	DCF1(35)
A-1	Th-230 (Source: FGR-15_STL COCs)	1.160E-03	1.106E-03	DCF1(36)
A-1	Th-231 (Source: FGR-15_STL COCs)	4.690E-02	3.251E-02	DCF1(37)
A-1	Th-232 (Source: FGR-15_STL COCs)	5.120E-04	4.783E-04	DCF1(38)
A-1	Th-234 (Source: FGR-15_STL COCs)	2.990E-02	2.317E-02	DCF1(39)
A-1	Tl-206 (Source: DCFPAK3.02)	1.278E-02	1.278E-02	DCF1(40)
A-1	Tl-207 (Source: FGR-15_STL COCs)	1.920E-01	2.391E-02	DCF1(41)

A-1	Tl-208 (Source: FGR-15_STL COCs)	2.200E+01	2.167E+01	DCF1(42)
A-1	Tl-210 (Source: FGR-15_STL COCs)	1.730E+01	1.678E+01	DCF1(43)
A-1	U-234 (Source: FGR-15_STL COCs)	3.510E-04	3.456E-04	DCF1(44)
A-1	U-235 (Source: FGR-15_STL COCs)	7.060E-01	7.006E-01	DCF1(45)
A-1	U-238 (Source: FGR-15_STL COCs)	1.720E-04	1.713E-04	DCF1(46)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.459E-01	5.760E-01	DCF2(1)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

0

Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	Pa-231	8.505E-01	8.505E-01	DCF2(2)
B-1	Pb-210+D	3.708E-02	2.077E-02	DCF2(3)
B-1	Ra-226+D	3.528E-02	3.517E-02	DCF2(4)
B-1	Ra-228+D	5.943E-02	5.938E-02	DCF2(5)
B-1	Th-228+D	1.600E-01	1.468E-01	DCF2(6)
B-1	Th-230	3.759E-01	3.759E-01	DCF2(7)
B-1	Th-232	4.070E-01	4.070E-01	DCF2(8)
B-1	U-234	3.479E-02	3.479E-02	DCF2(9)
B-1	U-235+D	3.132E-02	3.132E-02	DCF2(10)
B-1	U-238	2.973E-02	2.973E-02	DCF2(11)
B-1	U-238+D	2.976E-02	2.973E-02	DCF2(12)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.607E-03	1.191E-03	DCF3(1)
D-1	Pa-231	1.772E-03	1.772E-03	DCF3(2)
D-1	Pb-210+D	7.057E-03	2.575E-03	DCF3(3)
D-1	Ra-226+D	1.037E-03	1.036E-03	DCF3(4)
D-1	Ra-228+D	2.577E-03	2.575E-03	DCF3(5)
D-1	Th-228+D	5.286E-04	2.664E-04	DCF3(6)
D-1	Th-230	7.918E-04	7.918E-04	DCF3(7)
D-1	Th-232	8.547E-04	8.547E-04	DCF3(8)
D-1	U-234	1.831E-04	1.831E-04	DCF3(9)
D-1	U-235+D	1.740E-04	1.728E-04	DCF3(10)
D-1	U-238	1.650E-04	1.650E-04	DCF3(11)
D-1	U-238+D	1.776E-04	1.650E-04	DCF3(12)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)

D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(5,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(7,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(7,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(7,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(10,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(11,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(11,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(11,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(12,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(12,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(12,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(5,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)

D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(7,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(7,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(8,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(11,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(12,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(12,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.038E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ac-227	8.000E-02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Pb-210	9.000E-02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Ra-226	7.000E-02	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Ra-228	1.000E-02	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Th-228	1.100E-01	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Th-230	3.530E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): Th-232	7.000E-02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-234	3.950E+00	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g): U-235	2.600E-01	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): U-238	3.950E+00	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L): Ac-227	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Ra-228	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(11)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.280E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	6.000E-05	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.200E-01	4.000E-01	---	TPCZ

R013	Contaminated zone field capacity	3.600E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	3.048E+00	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	1.040E+01	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	4.170E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	9.200E-01	1.000E+00	---	PRECIP

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	8.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.772E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.584E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(4)

R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.113E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.113E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.990E-07	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.990E-07	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.990E-07	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for U-238				

R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	5.900E-06	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	5.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.550E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	7.990E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)

R018	Fruits, vegetables and grain consumption (kg/yr)	4.270E+01	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	4.660E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	4.380E+01	3.650E+01	---	SOIL

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL

C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active

4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions

Area:	10381.00 square meters
Thickness:	2.00 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Ac-227	8.000E-02
Pb-210	9.000E-02
Ra-226	7.000E-02
Ra-228	1.000E-02
Th-228	1.100E-01
Th-230	3.530E+00
Th-232	7.000E-02
U-234	3.950E+00
U-235	2.600E-01
U-238	3.950E+00

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.641E+00	2.565E+00	2.517E+00	2.666E+00	2.984E+00	3.679E+00	5.571E+00	9.950E+00
M(t):	1.056E-01	1.026E-01	1.007E-01	1.067E-01	1.194E-01	1.472E-01	2.228E-01	3.980E-01

0Maximum TDOSE(t): 9.950E+00 mrem/yr at t = 1.000E+03 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	9.535E-02	0.0361	8.697E-05	0.0000	0.000E+00	0.0000	7.484E-03	0.0028	0.000E+00	0.0000	0.000E+00	0.0000	4.068E-03	0.0015
Pb-210	5.886E-03	0.0022	5.623E-06	0.0000	0.000E+00	0.0000	1.481E-01	0.0561	0.000E+00	0.0000	0.000E+00	0.0000	2.012E-02	0.0076
Ra-226	3.802E-01	0.1440	4.294E-06	0.0000	0.000E+00	0.0000	7.085E-02	0.0268	0.000E+00	0.0000	0.000E+00	0.0000	2.581E-03	0.0010
Ra-228	3.186E-02	0.0121	1.382E-06	0.0000	0.000E+00	0.0000	2.306E-02	0.0087	0.000E+00	0.0000	0.000E+00	0.0000	8.075E-04	0.0003
Th-228	4.414E-01	0.1671	2.527E-05	0.0000	0.000E+00	0.0000	1.156E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	1.570E-03	0.0006
Th-230	6.275E-03	0.0024	2.271E-03	0.0009	0.000E+00	0.0000	6.695E-02	0.0254	0.000E+00	0.0000	0.000E+00	0.0000	9.000E-02	0.0341
Th-232	1.271E-02	0.0048	4.930E-05	0.0000	0.000E+00	0.0000	1.074E-02	0.0041	0.000E+00	0.0000	0.000E+00	0.0000	2.270E-03	0.0009
U-234	7.451E-04	0.0003	2.351E-04	0.0001	0.000E+00	0.0000	4.282E-02	0.0162	0.000E+00	0.0000	0.000E+00	0.0000	2.328E-02	0.0088
U-235	1.006E-01	0.0381	1.394E-05	0.0000	0.000E+00	0.0000	2.679E-03	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	1.456E-03	0.0006
U-238	9.790E-01	0.3707	2.011E-04	0.0001	0.000E+00	0.0000	4.152E-02	0.0157	0.000E+00	0.0000	0.000E+00	0.0000	2.257E-02	0.0085
Total	2.054E+00	0.7778	2.894E-03	0.0011	0.000E+00	0.0000	4.153E-01	0.1573	0.000E+00	0.0000	0.000E+00	0.0000	1.687E-01	0.0639

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.070E-01	0.0405
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.741E-01	0.0659
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.537E-01	0.1718
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.573E-02	0.0211
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.441E-01	0.1682
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.655E-01	0.0627
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.578E-02	0.0098
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.708E-02	0.0254
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.048E-01	0.0397
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.043E+00	0.3950
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.641E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	9.220E-02	0.0360	8.410E-05	0.0000	0.000E+00	0.0000	7.237E-03	0.0028	0.000E+00	0.0000	0.000E+00	0.0000	3.934E-03	0.0015
Pb-210	5.703E-03	0.0022	5.448E-06	0.0000	0.000E+00	0.0000	1.435E-01	0.0559	0.000E+00	0.0000	0.000E+00	0.0000	1.950E-02	0.0076
Ra-226	3.800E-01	0.1482	4.424E-06	0.0000	0.000E+00	0.0000	7.438E-02	0.0290	0.000E+00	0.0000	0.000E+00	0.0000	3.059E-03	0.0012
Ra-228	3.968E-02	0.0155	1.880E-06	0.0000	0.000E+00	0.0000	2.046E-02	0.0080	0.000E+00	0.0000	0.000E+00	0.0000	7.561E-04	0.0003
Th-228	3.071E-01	0.1198	1.759E-05	0.0000	0.000E+00	0.0000	8.041E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	1.092E-03	0.0004
Th-230	1.458E-02	0.0057	2.271E-03	0.0009	0.000E+00	0.0000	6.853E-02	0.0267	0.000E+00	0.0000	0.000E+00	0.0000	9.006E-02	0.0351
Th-232	4.327E-02	0.0169	5.070E-05	0.0000	0.000E+00	0.0000	2.899E-02	0.0113	0.000E+00	0.0000	0.000E+00	0.0000	2.930E-03	0.0011
U-234	7.447E-04	0.0003	2.350E-04	0.0001	0.000E+00	0.0000	4.279E-02	0.0167	0.000E+00	0.0000	0.000E+00	0.0000	2.326E-02	0.0091
U-235	1.006E-01	0.0392	1.394E-05	0.0000	0.000E+00	0.0000	2.680E-03	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	1.455E-03	0.0006
U-238	9.783E-01	0.3815	2.010E-04	0.0001	0.000E+00	0.0000	4.149E-02	0.0162	0.000E+00	0.0000	0.000E+00	0.0000	2.255E-02	0.0088
Total	1.962E+00	0.7651	2.885E-03	0.0011	0.000E+00	0.0000	4.308E-01	0.1680	0.000E+00	0.0000	0.000E+00	0.0000	1.686E-01	0.0657

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Dependent Pathways
0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.035E-01	0.0403
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.687E-01	0.0658
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.575E-01	0.1784
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.090E-02	0.0237
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.091E-01	0.1205
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.754E-01	0.0684
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.524E-02	0.0293
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.704E-02	0.0261
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.047E-01	0.0408
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.043E+00	0.4065
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.565E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	8.620E-02	0.0342	7.863E-05	0.0000	0.000E+00	0.0000	6.767E-03	0.0027	0.000E+00	0.0000	0.000E+00	0.0000	3.678E-03	0.0015
Pb-210	5.354E-03	0.0021	5.115E-06	0.0000	0.000E+00	0.0000	1.347E-01	0.0535	0.000E+00	0.0000	0.000E+00	0.0000	1.831E-02	0.0073
Ra-226	3.796E-01	0.1508	4.672E-06	0.0000	0.000E+00	0.0000	8.099E-02	0.0322	0.000E+00	0.0000	0.000E+00	0.0000	3.970E-03	0.0016
Ra-228	4.375E-02	0.0174	2.198E-06	0.0000	0.000E+00	0.0000	1.610E-02	0.0064	0.000E+00	0.0000	0.000E+00	0.0000	6.384E-04	0.0003
Th-228	1.487E-01	0.0591	8.516E-06	0.0000	0.000E+00	0.0000	3.894E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	5.290E-04	0.0002
Th-230	3.117E-02	0.0124	2.271E-03	0.0009	0.000E+00	0.0000	7.193E-02	0.0286	0.000E+00	0.0000	0.000E+00	0.0000	9.021E-02	0.0358
Th-232	1.153E-01	0.0458	5.423E-05	0.0000	0.000E+00	0.0000	5.969E-02	0.0237	0.000E+00	0.0000	0.000E+00	0.0000	4.108E-03	0.0016
U-234	7.441E-04	0.0003	2.347E-04	0.0001	0.000E+00	0.0000	4.273E-02	0.0170	0.000E+00	0.0000	0.000E+00	0.0000	2.323E-02	0.0092
U-235	1.004E-01	0.0399	1.393E-05	0.0000	0.000E+00	0.0000	2.681E-03	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	1.454E-03	0.0006
U-238	9.769E-01	0.3881	2.007E-04	0.0001	0.000E+00	0.0000	4.143E-02	0.0165	0.000E+00	0.0000	0.000E+00	0.0000	2.252E-02	0.0089
Total	1.888E+00	0.7501	2.874E-03	0.0011	0.000E+00	0.0000	4.574E-01	0.1817	0.000E+00	0.0000	0.000E+00	0.0000	1.686E-01	0.0670

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Dependent Pathways
0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.673E-02	0.0384
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.583E-01	0.0629
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.645E-01	0.1846
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.049E-02	0.0240
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.497E-01	0.0595
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.956E-01	0.0777
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.791E-01	0.0712
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.695E-02	0.0266
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.046E-01	0.0416
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.041E+00	0.4136
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.517E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	6.813E-02	0.0256	6.215E-05	0.0000	0.000E+00	0.0000	5.348E-03	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	2.907E-03	0.0011
Pb-210	4.292E-03	0.0016	4.100E-06	0.0000	0.000E+00	0.0000	1.080E-01	0.0405	0.000E+00	0.0000	0.000E+00	0.0000	1.467E-02	0.0055
Ra-226	3.779E-01	0.1417	5.419E-06	0.0000	0.000E+00	0.0000	1.009E-01	0.0379	0.000E+00	0.0000	0.000E+00	0.0000	6.727E-03	0.0025
Ra-228	2.584E-02	0.0097	1.348E-06	0.0000	0.000E+00	0.0000	6.916E-03	0.0026	0.000E+00	0.0000	0.000E+00	0.0000	2.988E-04	0.0001
Th-228	1.175E-02	0.0044	6.729E-07	0.0000	0.000E+00	0.0000	3.076E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.179E-05	0.0000
Th-230	8.909E-02	0.0334	2.272E-03	0.0009	0.000E+00	0.0000	8.589E-02	0.0322	0.000E+00	0.0000	0.000E+00	0.0000	9.103E-02	0.0341
Th-232	3.269E-01	0.1226	6.513E-05	0.0000	0.000E+00	0.0000	1.239E-01	0.0465	0.000E+00	0.0000	0.000E+00	0.0000	6.784E-03	0.0025
U-234	7.447E-04	0.0003	2.337E-04	0.0001	0.000E+00	0.0000	4.253E-02	0.0159	0.000E+00	0.0000	0.000E+00	0.0000	2.312E-02	0.0087
U-235	9.995E-02	0.0375	1.393E-05	0.0000	0.000E+00	0.0000	2.684E-03	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	1.449E-03	0.0005
U-238	9.720E-01	0.3646	1.997E-04	0.0001	0.000E+00	0.0000	4.122E-02	0.0155	0.000E+00	0.0000	0.000E+00	0.0000	2.241E-02	0.0084
Total	1.977E+00	0.7413	2.858E-03	0.0011	0.000E+00	0.0000	5.174E-01	0.1941	0.000E+00	0.0000	0.000E+00	0.0000	1.694E-01	0.0635

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.645E-02	0.0287
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.269E-01	0.0476
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.855E-01	0.1821
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.306E-02	0.0124
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.182E-02	0.0044
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.683E-01	0.1006
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.577E-01	0.1716
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.663E-02	0.0250
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.041E-01	0.0390
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.036E+00	0.3885
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.666E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	3.479E-02	0.0117	3.173E-05	0.0000	0.000E+00	0.0000	2.731E-03	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	1.484E-03	0.0005
Pb-210	2.282E-03	0.0008	2.180E-06	0.0000	0.000E+00	0.0000	5.741E-02	0.0192	0.000E+00	0.0000	0.000E+00	0.0000	7.803E-03	0.0026
Ra-226	3.723E-01	0.1248	6.778E-06	0.0000	0.000E+00	0.0000	1.375E-01	0.0461	0.000E+00	0.0000	0.000E+00	0.0000	1.183E-02	0.0040
Ra-228	2.437E-03	0.0008	1.278E-07	0.0000	0.000E+00	0.0000	6.147E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	2.704E-05	0.0000
Th-228	8.328E-06	0.0000	4.769E-10	0.0000	0.000E+00	0.0000	2.180E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.962E-08	0.0000
Th-230	2.530E-01	0.0848	2.274E-03	0.0008	0.000E+00	0.0000	1.389E-01	0.0465	0.000E+00	0.0000	0.000E+00	0.0000	9.519E-02	0.0319
Th-232	4.975E-01	0.1667	7.406E-05	0.0000	0.000E+00	0.0000	1.679E-01	0.0562	0.000E+00	0.0000	0.000E+00	0.0000	8.704E-03	0.0029
U-234	7.691E-04	0.0003	2.308E-04	0.0001	0.000E+00	0.0000	4.194E-02	0.0141	0.000E+00	0.0000	0.000E+00	0.0000	2.281E-02	0.0076
U-235	9.860E-02	0.0330	1.394E-05	0.0000	0.000E+00	0.0000	2.696E-03	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	1.437E-03	0.0005
U-238	9.582E-01	0.3211	1.969E-04	0.0001	0.000E+00	0.0000	4.064E-02	0.0136	0.000E+00	0.0000	0.000E+00	0.0000	2.209E-02	0.0074
Total	2.220E+00	0.7438	2.831E-03	0.0009	0.000E+00	0.0000	5.903E-01	0.1978	0.000E+00	0.0000	0.000E+00	0.0000	1.714E-01	0.0574

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.904E-02	0.0131
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.750E-02	0.0226
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.217E-01	0.1748
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.079E-03	0.0010
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.380E-06	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.893E-01	0.1640
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.741E-01	0.2259
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.575E-02	0.0220
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.027E-01	0.0344
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.021E+00	0.3422
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.984E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0
Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	3.309E-03	0.0009	3.018E-06	0.0000	0.000E+00	0.0000	2.598E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	1.412E-04	0.0000
Pb-210	2.502E-04	0.0001	2.390E-07	0.0000	0.000E+00	0.0000	6.293E-03	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	8.554E-04	0.0002
Ra-226	3.500E-01	0.0951	7.773E-06	0.0000	0.000E+00	0.0000	1.663E-01	0.0452	0.000E+00	0.0000	0.000E+00	0.0000	1.618E-02	0.0044
Ra-228	5.090E-07	0.0000	2.670E-11	0.0000	0.000E+00	0.0000	1.283E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.647E-09	0.0000
Th-228	7.893E-17	0.0000	4.520E-21	0.0000	0.000E+00	0.0000	2.067E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.807E-19	0.0000
Th-230	8.052E-01	0.2189	2.284E-03	0.0006	0.000E+00	0.0000	3.815E-01	0.1037	0.000E+00	0.0000	0.000E+00	0.0000	1.180E-01	0.0321
Th-232	5.145E-01	0.1398	7.495E-05	0.0000	0.000E+00	0.0000	1.721E-01	0.0468	0.000E+00	0.0000	0.000E+00	0.0000	8.892E-03	0.0024
U-234	1.107E-03	0.0003	2.211E-04	0.0001	0.000E+00	0.0000	4.007E-02	0.0109	0.000E+00	0.0000	0.000E+00	0.0000	2.177E-02	0.0059
U-235	9.418E-02	0.0256	1.411E-05	0.0000	0.000E+00	0.0000	2.743E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	1.403E-03	0.0004
U-238	9.115E-01	0.2478	1.873E-04	0.0001	0.000E+00	0.0000	3.867E-02	0.0105	0.000E+00	0.0000	0.000E+00	0.0000	2.102E-02	0.0057
Total	2.680E+00	0.7285	2.793E-03	0.0008	0.000E+00	0.0000	8.080E-01	0.2196	0.000E+00	0.0000	0.000E+00	0.0000	1.882E-01	0.0512

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0
Water Dependent Pathways
0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.713E-03	0.0010
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.399E-03	0.0020
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.325E-01	0.1447
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.430E-07	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.942E-17	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.307E+00	0.3552
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.956E-01	0.1891
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.317E-02	0.0172
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.834E-02	0.0267
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.713E-01	0.2640
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.679E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	3.986E-06	0.0000	3.636E-09	0.0000	0.000E+00	0.0000	3.129E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.701E-07	0.0000
Pb-210	4.521E-07	0.0000	4.318E-10	0.0000	0.000E+00	0.0000	1.137E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.545E-06	0.0000
Ra-226	2.899E-01	0.0520	6.591E-06	0.0000	0.000E+00	0.0000	1.418E-01	0.0255	0.000E+00	0.0000	0.000E+00	0.0000	1.396E-02	0.0025
Ra-228	1.555E-17	0.0000	8.157E-22	0.0000	0.000E+00	0.0000	3.921E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.725E-19	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	2.196E+00	0.3942	2.311E-03	0.0004	0.000E+00	0.0000	1.059E+00	0.1900	0.000E+00	0.0000	0.000E+00	0.0000	1.843E-01	0.0331
Th-232	5.144E-01	0.0923	7.494E-05	0.0000	0.000E+00	0.0000	1.721E-01	0.0309	0.000E+00	0.0000	0.000E+00	0.0000	8.891E-03	0.0016
U-234	3.910E-03	0.0007	1.960E-04	0.0000	0.000E+00	0.0000	3.613E-02	0.0065	0.000E+00	0.0000	0.000E+00	0.0000	1.915E-02	0.0034
U-235	8.274E-02	0.0149	1.446E-05	0.0000	0.000E+00	0.0000	2.830E-03	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	1.311E-03	0.0002
U-238	7.901E-01	0.1418	1.625E-04	0.0000	0.000E+00	0.0000	3.354E-02	0.0060	0.000E+00	0.0000	0.000E+00	0.0000	1.823E-02	0.0033
Total	3.877E+00	0.6960	2.766E-03	0.0005	0.000E+00	0.0000	1.445E+00	0.2594	0.000E+00	0.0000	0.000E+00	0.0000	2.459E-01	0.0441

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.473E-06	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.337E-05	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.457E-01	0.0800
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.964E-17	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.442E+00	0.6178
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.955E-01	0.1248
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.938E-02	0.0107
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.689E-02	0.0156
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.420E-01	0.1511
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.571E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	2.418E-16	0.0000	2.205E-19	0.0000	0.000E+00	0.0000	1.898E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.031E-17	0.0000
Pb-210	1.133E-16	0.0000	1.083E-19	0.0000	0.000E+00	0.0000	2.850E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.874E-16	0.0000
Ra-226	1.497E-01	0.0150	3.403E-06	0.0000	0.000E+00	0.0000	7.321E-02	0.0074	0.000E+00	0.0000	0.000E+00	0.0000	7.207E-03	0.0007
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	5.413E+00	0.5440	2.369E-03	0.0002	0.000E+00	0.0000	2.632E+00	0.2645	0.000E+00	0.0000	0.000E+00	0.0000	3.387E-01	0.0340
Th-232	5.142E-01	0.0517	7.491E-05	0.0000	0.000E+00	0.0000	1.720E-01	0.0173	0.000E+00	0.0000	0.000E+00	0.0000	8.888E-03	0.0009
U-234	2.567E-02	0.0026	1.319E-04	0.0000	0.000E+00	0.0000	3.317E-02	0.0033	0.000E+00	0.0000	0.000E+00	0.0000	1.316E-02	0.0013
U-235	5.250E-02	0.0053	1.346E-05	0.0000	0.000E+00	0.0000	2.668E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	9.937E-04	0.0001
U-238	4.791E-01	0.0481	9.876E-05	0.0000	0.000E+00	0.0000	2.039E-02	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	1.108E-02	0.0011
Total	6.634E+00	0.6667	2.691E-03	0.0003	0.000E+00	0.0000	2.934E+00	0.2948	0.000E+00	0.0000	0.000E+00	0.0000	3.800E-01	0.0382

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.713E-16	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.351E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.301E-01	0.0231
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.386E+00	0.8428
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.952E-01	0.0699
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.214E-02	0.0072
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.617E-02	0.0056
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.106E-01	0.0513
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.950E+00	1.0000

0*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227+D	Ac-227+D	1.000E+00	1.337E+00	1.293E+00	1.209E+00	9.556E-01	4.879E-01	4.641E-02	5.591E-05	3.391E-15
0Pb-210+D	Pb-210+D	1.000E+00	1.934E+00	1.874E+00	1.759E+00	1.410E+00	7.500E-01	8.221E-02	1.485E-04	3.724E-14
0Ra-226+D	Ra-226+D	1.000E+00	6.446E+00	6.440E+00	6.428E+00	6.386E+00	6.266E+00	5.865E+00	4.856E+00	2.507E+00
Ra-226+D	Pb-210+D	1.000E+00	3.500E-02	9.518E-02	2.083E-01	5.507E-01	1.187E+00	1.742E+00	1.512E+00	7.804E-01
Ra-226+D	ΣDSR(j)		6.481E+00	6.535E+00	6.636E+00	6.936E+00	7.453E+00	7.607E+00	6.367E+00	3.287E+00
0Ra-228+D	Ra-228+D	1.000E+00	4.823E+00	4.273E+00	3.354E+00	1.437E+00	1.277E-01	2.666E-05	8.143E-16	0.000E+00
Ra-228+D	Th-228+D	1.000E+00	7.498E-01	1.817E+00	2.695E+00	1.869E+00	1.802E-01	3.765E-05	1.150E-15	0.000E+00
Ra-228+D	ΣDSR(j)		5.573E+00	6.090E+00	6.049E+00	3.306E+00	3.079E-01	6.431E-05	1.964E-15	0.000E+00
0Th-228+D	Th-228+D	1.000E+00	4.038E+00	2.810E+00	1.361E+00	1.075E-01	7.618E-05	7.220E-16	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+00	4.549E-02	4.549E-02	4.549E-02	4.549E-02	4.548E-02	4.545E-02	4.536E-02	4.505E-02
Th-230	Ra-226+D	1.000E+00	1.384E-03	4.173E-03	9.748E-03	2.917E-02	8.397E-02	2.677E-01	7.298E-01	1.798E+00
Th-230	Pb-210+D	1.000E+00	5.463E-06	3.391E-05	1.659E-04	1.337E-03	9.167E-03	5.706E-02	1.998E-01	5.326E-01
Th-230	ΣDSR(j)		4.688E-02	4.970E-02	5.541E-02	7.600E-02	1.386E-01	3.702E-01	9.750E-01	2.376E+00
0Th-232	Th-232	1.000E+00	4.874E-02	4.874E-02	4.874E-02	4.874E-02	4.874E-02	4.873E-02	4.873E-02	4.871E-02
Th-232	Ra-228+D	1.000E+00	2.880E-01	8.341E-01	1.749E+00	3.658E+00	4.962E+00	5.089E+00	5.088E+00	5.086E+00
Th-232	Th-228+D	1.000E+00	3.147E-02	1.920E-01	7.611E-01	2.832E+00	4.620E+00	4.799E+00	4.799E+00	4.797E+00
Th-232	ΣDSR(j)		3.682E-01	1.075E+00	2.559E+00	6.538E+00	9.631E+00	9.937E+00	9.936E+00	9.931E+00
0U-234	U-234	1.000E+00	1.698E-02	1.697E-02	1.695E-02	1.686E-02	1.662E-02	1.581E-02	1.369E-02	8.287E-03
U-234	Th-230	1.000E+00	2.168E-07	6.361E-07	1.471E-06	4.385E-06	1.263E-05	4.055E-05	1.129E-04	2.970E-04
U-234	Ra-226+D	1.000E+00	4.218E-09	2.975E-08	1.577E-07	1.408E-06	1.175E-05	1.227E-04	9.828E-04	7.514E-03
U-234	Pb-210+D	1.000E+00	1.329E-11	1.746E-10	1.861E-09	4.457E-08	9.213E-07	2.099E-05	2.444E-04	2.164E-03
U-234	ΣDSR(j)		1.698E-02	1.697E-02	1.695E-02	1.687E-02	1.665E-02	1.599E-02	1.503E-02	1.826E-02
0U-235+D	U-235+D	1.000E+00	4.031E-01	4.028E-01	4.022E-01	4.002E-01	3.945E-01	3.753E-01	3.253E-01	1.972E-01
U-235+D	Pa-231	1.000E+00	5.719E-06	1.751E-05	4.110E-05	1.231E-04	3.530E-04	1.106E-03	2.861E-03	5.734E-03
U-235+D	Ac-227+D	1.000E+00	1.544E-07	1.059E-06	5.445E-06	4.491E-05	3.066E-04	1.845E-03	6.053E-03	1.308E-02
U-235+D	ΣDSR(j)		4.031E-01	4.028E-01	4.022E-01	4.004E-01	3.952E-01	3.782E-01	3.342E-01	2.161E-01
0U-238	U-238	5.450E-07	8.294E-09	8.288E-09	8.277E-09	8.235E-09	8.118E-09	7.722E-09	6.694E-09	4.059E-09
0U-238+D	U-238+D	1.000E+00	2.641E-01	2.639E-01	2.636E-01	2.622E-01	2.585E-01	2.459E-01	2.132E-01	1.292E-01
U-238+D	U-234	1.000E+00	2.397E-08	7.187E-08	1.675E-07	4.999E-07	1.431E-06	4.486E-06	1.162E-05	2.344E-05
U-238+D	Th-230	1.000E+00	2.089E-13	1.415E-12	7.359E-12	6.509E-11	5.422E-10	5.687E-09	4.622E-08	3.707E-07
U-238+D	Ra-226+D	1.000E+00	2.963E-15	4.487E-14	5.255E-13	1.392E-11	3.367E-10	1.156E-08	2.745E-07	6.751E-06
U-238+D	Pb-210+D	1.000E+00	7.865E-18	2.115E-16	4.813E-15	3.389E-13	2.075E-11	1.662E-09	6.255E-08	1.889E-06
U-238+D	ΣDSR(j)		2.641E-01	2.639E-01	2.636E-01	2.622E-01	2.585E-01	2.459E-01	2.132E-01	1.293E-01

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	1.869E+01	1.933E+01	2.068E+01	2.616E+01	5.124E+01	5.386E+02	4.472E+05	*7.232E+13
Pb-210	1.293E+01	1.334E+01	1.421E+01	1.773E+01	3.334E+01	3.041E+02	1.683E+05	*7.632E+13
Ra-226	3.857E+00	3.825E+00	3.767E+00	3.604E+00	3.355E+00	3.286E+00	3.926E+00	7.606E+00
Ra-228	4.486E+00	4.105E+00	4.133E+00	7.562E+00	8.121E+01	3.888E+05	*2.726E+14	*2.726E+14
Th-228	6.192E+00	8.898E+00	1.838E+01	2.326E+02	3.282E+05	*8.201E+14	*8.201E+14	*8.201E+14
Th-230	5.332E+02	5.030E+02	4.512E+02	3.289E+02	1.804E+02	6.753E+01	2.564E+01	1.052E+01
Th-232	6.789E+01	2.326E+01	9.770E+00	3.824E+00	2.596E+00	2.516E+00	2.516E+00	2.517E+00
U-234	1.472E+03	1.473E+03	1.475E+03	1.482E+03	1.502E+03	1.563E+03	1.663E+03	1.369E+03
U-235	6.202E+01	6.207E+01	6.215E+01	6.244E+01	6.326E+01	6.610E+01	7.481E+01	1.157E+02
U-238	9.465E+01	9.472E+01	9.486E+01	9.533E+01	9.670E+01	1.017E+02	1.173E+02	1.934E+02

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 1.000E+03 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ac-227	8.000E-02	0.000E+00	1.337E+00	1.869E+01	3.391E-15	*7.232E+13
Pb-210	9.000E-02	0.000E+00	1.934E+00	1.293E+01	3.724E-14	*7.632E+13
Ra-226	7.000E-02	67.0 ± 0.1	7.697E+00	3.248E+00	3.287E+00	7.606E+00
Ra-228	1.000E-02	1.841 ± 0.004	6.201E+00	4.032E+00	0.000E+00	*2.726E+14
Th-228	1.100E-01	0.000E+00	4.038E+00	6.192E+00	0.000E+00	*8.201E+14
Th-230	3.530E+00	1.000E+03	2.376E+00	1.052E+01	2.376E+00	1.052E+01
Th-232	7.000E-02	101.8 ± 0.2	9.937E+00	2.516E+00	9.931E+00	2.517E+00
U-234	3.950E+00	1.000E+03	1.826E-02	1.369E+03	1.826E-02	1.369E+03
U-235	2.600E-01	0.000E+00	4.031E-01	6.202E+01	2.161E-01	1.157E+02
U-238	3.950E+00	0.000E+00	2.641E-01	9.465E+01	1.293E-01	1.934E+02

*At specific activity limit

Summary : DT-2 W of the Levee, DT-11 (Partial) - Res. Gardener, FGR15, Five Year Review
File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\DT-2 DT-11 RESIDENT GARDENER_FGR15.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	Ac-227	1.000E+00	1.070E-01	1.035E-01	9.673E-02	7.645E-02	3.904E-02	3.713E-03	4.473E-06	2.713E-16
Ac-227	U-235	1.000E+00	4.015E-08	2.753E-07	1.416E-06	1.168E-05	7.972E-05	4.797E-04	1.574E-03	3.402E-03
Ac-227	ΣDOSE(j)		1.070E-01	1.035E-01	9.673E-02	7.646E-02	3.912E-02	4.193E-03	1.578E-03	3.402E-03
0Pb-210	Pb-210	1.000E+00	1.741E-01	1.687E-01	1.583E-01	1.269E-01	6.750E-02	7.399E-03	1.337E-05	3.351E-15
Pb-210	Ra-226	1.000E+00	2.450E-03	6.662E-03	1.458E-02	3.855E-02	8.306E-02	1.220E-01	1.058E-01	5.463E-02
Pb-210	Th-230	1.000E+00	1.928E-05	1.197E-04	5.857E-04	4.718E-03	3.236E-02	2.014E-01	7.054E-01	1.880E+00
Pb-210	U-234	1.000E+00	5.248E-11	6.897E-10	7.350E-09	1.760E-07	3.639E-06	8.291E-05	9.654E-04	8.548E-03
Pb-210	U-238	1.000E+00	3.107E-17	8.356E-16	1.901E-14	1.339E-12	8.195E-11	6.563E-09	2.471E-07	7.461E-06
Pb-210	ΣDOSE(j)		1.765E-01	1.754E-01	1.735E-01	1.702E-01	1.829E-01	3.309E-01	8.122E-01	1.943E+00
0Ra-226	Ra-226	1.000E+00	4.512E-01	4.508E-01	4.500E-01	4.470E-01	4.386E-01	4.106E-01	3.399E-01	1.755E-01
Ra-226	Th-230	1.000E+00	4.886E-03	1.473E-02	3.441E-02	1.030E-01	2.964E-01	9.451E-01	2.576E+00	6.347E+00
Ra-226	U-234	1.000E+00	1.666E-08	1.175E-07	6.227E-07	5.560E-06	4.639E-05	4.846E-04	3.882E-03	2.968E-02
Ra-226	U-238	1.000E+00	1.170E-14	1.772E-13	2.076E-12	5.498E-11	1.330E-09	4.565E-08	1.084E-06	2.667E-05
Ra-226	ΣDOSE(j)		4.561E-01	4.655E-01	4.844E-01	5.500E-01	7.351E-01	1.356E+00	2.920E+00	6.552E+00
0Ra-228	Ra-228	1.000E+00	4.823E-02	4.273E-02	3.354E-02	1.437E-02	1.277E-03	2.666E-07	8.143E-18	0.000E+00
Ra-228	Th-232	1.000E+00	2.016E-02	5.839E-02	1.224E-01	2.560E-01	3.473E-01	3.562E-01	3.562E-01	3.560E-01
Ra-228	ΣDOSE(j)		6.839E-02	1.011E-01	1.560E-01	2.704E-01	3.486E-01	3.562E-01	3.562E-01	3.560E-01
0Th-228	Ra-228	1.000E+00	7.498E-03	1.817E-02	2.695E-02	1.869E-02	1.802E-03	3.765E-07	1.150E-17	0.000E+00
Th-228	Th-228	1.000E+00	4.441E-01	3.091E-01	1.497E-01	1.182E-02	8.380E-06	7.942E-17	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	2.203E-03	1.344E-02	5.328E-02	1.982E-01	3.234E-01	3.360E-01	3.359E-01	3.358E-01
Th-228	ΣDOSE(j)		4.538E-01	3.407E-01	2.299E-01	2.287E-01	3.252E-01	3.360E-01	3.359E-01	3.358E-01
0Th-230	Th-230	1.000E+00	1.606E-01	1.606E-01	1.606E-01	1.606E-01	1.605E-01	1.604E-01	1.601E-01	1.590E-01
Th-230	U-234	1.000E+00	8.564E-07	2.513E-06	5.811E-06	1.732E-05	4.988E-05	1.602E-04	4.460E-04	1.173E-03
Th-230	U-238	1.000E+00	8.250E-13	5.588E-12	2.907E-11	2.571E-10	2.142E-09	2.246E-08	1.826E-07	1.464E-06
Th-230	ΣDOSE(j)		1.606E-01	1.606E-01	1.606E-01	1.606E-01	1.606E-01	1.606E-01	1.606E-01	1.602E-01
0Th-232	Th-232	1.000E+00	3.412E-03	3.412E-03	3.412E-03	3.412E-03	3.411E-03	3.411E-03	3.411E-03	3.409E-03
0U-234	U-234	1.000E+00	6.708E-02	6.703E-02	6.694E-02	6.660E-02	6.565E-02	6.244E-02	5.409E-02	3.273E-02
U-234	U-238	1.000E+00	9.469E-08	2.839E-07	6.615E-07	1.975E-06	5.654E-06	1.772E-05	4.591E-05	9.260E-05
U-234	ΣDOSE(j)		6.708E-02	6.704E-02	6.694E-02	6.661E-02	6.566E-02	6.246E-02	5.414E-02	3.283E-02
0U-235	U-235	1.000E+00	1.048E-01	1.047E-01	1.046E-01	1.041E-01	1.026E-01	9.757E-02	8.457E-02	5.128E-02
0Pa-231	U-235	1.000E+00	1.487E-06	4.552E-06	1.069E-05	3.202E-05	9.178E-05	2.876E-04	7.439E-04	1.491E-03
0U-238	U-238	5.450E-07	3.276E-08	3.274E-08	3.269E-08	3.253E-08	3.207E-08	3.050E-08	2.644E-08	1.603E-08
U-238	U-238	1.000E+00	1.043E+00	1.043E+00	1.041E+00	1.036E+00	1.021E+00	9.713E-01	8.420E-01	5.105E-01
U-238	ΣDOSE(j)		1.043E+00	1.043E+00	1.041E+00	1.036E+00	1.021E+00	9.713E-01	8.420E-01	5.105E-01

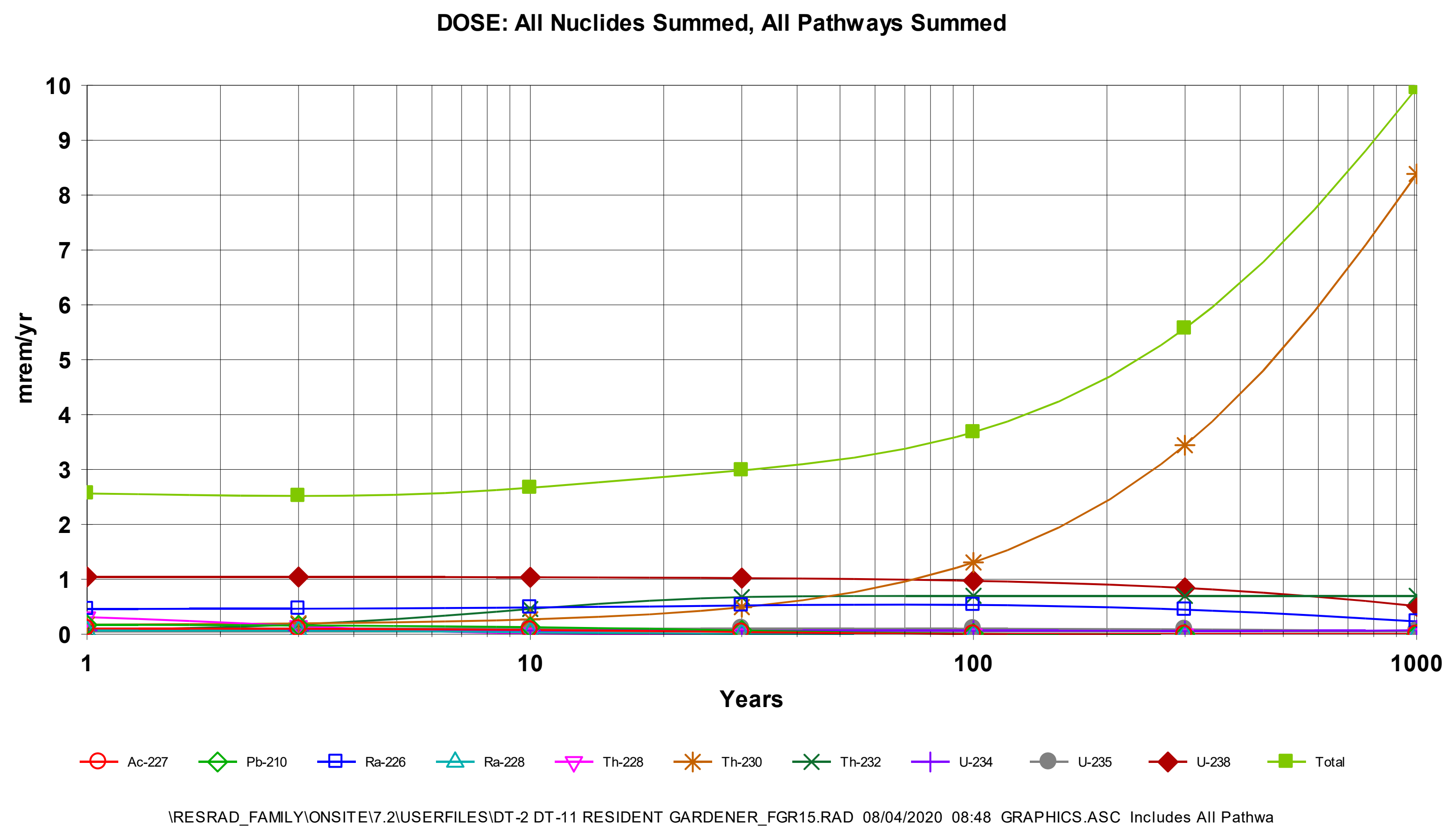
THF(i) is the thread fraction of the parent nuclide.

1RESRAD-ONSITE, Version 7.2   T½ Limit = 180 days   08/04/2020 08:48 Page 24
Summary : DT-2 W of the Levee, DT-11 (Partial) - Res. Gardener, FGR15, Five Year Review
File   : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\DT-2 DT-11 RESIDENT GARDENER_FGR15.RAD

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	Ac-227	1.000E+00	8.000E-02	7.736E-02	7.233E-02	5.717E-02	2.919E-02	2.776E-03	3.344E-06	2.028E-16
Ac-227	U-235	1.000E+00	0.000E+00	8.655E-08	7.612E-07	7.814E-06	5.696E-05	3.503E-04	1.155E-03	2.500E-03
Ac-227	ΣS(j):		8.000E-02	7.736E-02	7.233E-02	5.717E-02	2.925E-02	3.127E-03	1.158E-03	2.500E-03
0Pb-210	Pb-210	1.000E+00	9.000E-02	8.720E-02	8.186E-02	6.563E-02	3.490E-02	3.826E-03	6.912E-06	1.733E-15
Pb-210	Ra-226	1.000E+00	0.000E+00	2.150E-03	6.247E-03	1.865E-02	4.169E-02	6.188E-02	5.373E-02	2.774E-02
Pb-210	Th-230	1.000E+00	0.000E+00	2.362E-05	2.080E-04	2.148E-03	1.588E-02	1.014E-01	3.573E-01	9.538E-01
Pb-210	U-234	1.000E+00	0.000E+00	8.121E-11	2.157E-09	7.548E-08	1.750E-06	4.148E-05	4.880E-04	4.334E-03
Pb-210	U-238	1.000E+00	0.000E+00	5.741E-17	4.588E-15	5.407E-13	3.860E-11	3.263E-09	1.246E-07	3.781E-06
Pb-210	ΣS(j):		9.000E-02	8.938E-02	8.832E-02	8.642E-02	9.247E-02	1.672E-01	4.115E-01	9.859E-01
0Ra-226	Ra-226	1.000E+00	7.000E-02	6.993E-02	6.980E-02	6.934E-02	6.804E-02	6.369E-02	5.273E-02	2.722E-02
Ra-226	Th-230	1.000E+00	0.000E+00	1.529E-03	4.581E-03	1.522E-02	4.523E-02	1.459E-01	3.989E-01	9.839E-01
Ra-226	U-234	1.000E+00	0.000E+00	7.863E-09	7.069E-08	7.824E-07	6.964E-06	7.443E-05	6.001E-04	4.599E-03
Ra-226	U-238	1.000E+00	0.000E+00	7.400E-15	1.996E-13	7.360E-12	1.964E-10	6.976E-09	1.673E-07	4.130E-06
Ra-226	ΣS(j):		7.000E-02	7.146E-02	7.438E-02	8.456E-02	1.133E-01	2.096E-01	4.522E-01	1.016E+00
0Ra-228	Ra-228	1.000E+00	1.000E-02	8.860E-03	6.955E-03	2.980E-03	2.647E-04	5.527E-08	1.688E-18	0.000E+00
Ra-228	Th-232	1.000E+00	0.000E+00	7.948E-03	2.123E-02	4.893E-02	6.786E-02	6.970E-02	6.969E-02	6.966E-02
Ra-228	ΣS(j):		1.000E-02	1.681E-02	2.818E-02	5.191E-02	6.812E-02	6.970E-02	6.969E-02	6.966E-02
0Th-228	Ra-228	1.000E+00	0.000E+00	2.854E-03	5.382E-03	4.074E-03	3.971E-04	8.297E-08	2.535E-18	0.000E+00
Th-228	Th-228	1.000E+00	1.100E-01	7.655E-02	3.707E-02	2.928E-03	2.075E-06	1.967E-17	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	0.000E+00	1.306E-03	8.703E-03	3.945E-02	6.693E-02	6.970E-02	6.969E-02	6.966E-02
Th-228	ΣS(j):		1.100E-01	8.070E-02	5.115E-02	4.645E-02	6.733E-02	6.970E-02	6.969E-02	6.966E-02
0Th-230	Th-230	1.000E+00	3.530E+00	3.530E+00	3.530E+00	3.530E+00	3.529E+00	3.527E+00	3.520E+00	3.496E+00
Th-230	U-234	1.000E+00	0.000E+00	3.631E-05	1.088E-04	3.619E-04	1.078E-03	3.503E-03	9.789E-03	2.578E-02
Th-230	U-238	1.000E+00	0.000E+00	5.125E-11	4.608E-10	5.103E-09	4.549E-08	4.888E-07	4.000E-06	3.216E-05
Th-230	ΣS(j):		3.530E+00	3.530E+00	3.530E+00	3.530E+00	3.530E+00	3.530E+00	3.529E+00	3.521E+00
0Th-232	Th-232	1.000E+00	7.000E-02	7.000E-02	7.000E-02	7.000E-02	7.000E-02	7.000E-02	6.999E-02	6.996E-02
0U-234	U-234	1.000E+00	3.950E+00	3.947E+00	3.942E+00	3.922E+00	3.866E+00	3.677E+00	3.185E+00	1.927E+00
U-234	U-238	1.000E+00	0.000E+00	1.114E-05	3.339E-05	1.107E-04	3.275E-04	1.038E-03	2.699E-03	5.450E-03
U-234	ΣS(j):		3.950E+00	3.947E+00	3.942E+00	3.922E+00	3.866E+00	3.678E+00	3.188E+00	1.933E+00
0U-235	U-235	1.000E+00	2.600E-01	2.598E-01	2.594E-01	2.581E-01	2.545E-01	2.421E-01	2.098E-01	1.272E-01
0Pa-231	U-235	1.000E+00	0.000E+00	5.497E-06	1.647E-05	5.461E-05	1.615E-04	5.116E-04	1.328E-03	2.664E-03
0U-238	U-238	5.450E-07	2.153E-06	2.151E-06	2.148E-06	2.137E-06	2.107E-06	2.004E-06	1.737E-06	1.053E-06
U-238	U-238	1.000E+00	3.950E+00	3.947E+00	3.942E+00	3.922E+00	3.866E+00	3.678E+00	3.188E+00	1.933E+00
U-238	ΣS(j):		3.950E+00	3.947E+00	3.942E+00	3.922E+00	3.866E+00	3.678E+00	3.188E+00	1.933E+00

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time =   2.95 seconds



Note: The data line for each radionuclide includes dose contributions from that radionuclide's decay progeny (e.g., the Th-230 data line includes the dose contribution from Ra-226 that results from the radioactive decay of Th-230; the Ra-226 data line does not include the Ra-226 resulting from Th-230 decay).

DT-2 WOL/DT-11 Resident Gardener with FGR-15 External DCFs (Infinite Volume, Adult)
RESRAD Dose Summary

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-227 (Source: FGR-15_STL COCs)	4.330E-04	2.615E-04	DCF1(1)
A-1	Ac-228 (Source: FGR-15_STL COCs)	5.150E+00	5.044E+00	DCF1(2)
A-1	At-218 (Source: FGR-15_STL COCs)	5.260E-04	5.567E-05	DCF1(3)
A-1	At-219 (Source: FGR-15_STL COCs)	0.000E+00	0.000E+00	DCF1(4)
A-1	Bi-210 (Source: FGR-15_STL COCs)	1.280E-01	5.474E-03	DCF1(5)
A-1	Bi-211 (Source: FGR-15_STL COCs)	2.370E-01	2.410E-01	DCF1(6)
A-1	Bi-212 (Source: FGR-15_STL COCs)	8.160E-01	6.259E-01	DCF1(7)
A-1	Bi-214 (Source: FGR-15_STL COCs)	9.370E+00	9.136E+00	DCF1(8)
A-1	Bi-215 (Source: FGR-15_STL COCs)	1.590E+00	1.369E+00	DCF1(9)
A-1	Fr-223 (Source: FGR-15_STL COCs)	2.860E-01	1.758E-01	DCF1(10)
A-1	Hg-206 (Source: FGR-15_STL COCs)	7.300E-01	6.128E-01	DCF1(11)
A-1	Pa-231 (Source: FGR-15_STL COCs)	1.590E-01	1.609E-01	DCF1(12)
A-1	Pa-234 (Source: FGR-15_STL COCs)	8.290E+00	8.276E+00	DCF1(13)
A-1	Pa-234m (Source: FGR-15_STL COCs)	4.460E-01	1.257E-01	DCF1(14)
A-1	Pb-210 (Source: FGR-15_STL COCs)	2.350E-03	2.092E-03	DCF1(15)
A-1	Pb-211 (Source: FGR-15_STL COCs)	5.150E-01	3.680E-01	DCF1(16)
A-1	Pb-212 (Source: FGR-15_STL COCs)	6.500E-01	6.315E-01	DCF1(17)
A-1	Pb-214 (Source: FGR-15_STL COCs)	1.300E+00	1.257E+00	DCF1(18)
A-1	Po-210 (Source: DCFPAK3.02)	5.641E-05	5.641E-05	DCF1(19)
A-1	Po-211 (Source: FGR-15_STL COCs)	4.670E-02	4.708E-02	DCF1(20)
A-1	Po-212 (Source: FGR-15_STL COCs)	0.000E+00	0.000E+00	DCF1(21)
A-1	Po-214 (Source: FGR-15_STL COCs)	4.780E-04	4.801E-04	DCF1(22)
A-1	Po-215 (Source: FGR-15_STL COCs)	9.340E-04	9.453E-04	DCF1(23)
A-1	Po-216 (Source: FGR-15_STL COCs)	8.810E-05	8.874E-05	DCF1(24)
A-1	Po-218 (Source: FGR-15_STL COCs)	2.260E-06	9.229E-09	DCF1(25)
A-1	Ra-223 (Source: FGR-15_STL COCs)	5.830E-01	5.791E-01	DCF1(26)
A-1	Ra-224 (Source: FGR-15_STL COCs)	4.910E-02	4.951E-02	DCF1(27)
A-1	Ra-226 (Source: FGR-15_STL COCs)	3.210E-02	3.176E-02	DCF1(28)
A-1	Ra-228 (Source: FGR-15_STL COCs)	1.370E-04	6.576E-05	DCF1(29)
A-1	Rn-218 (Source: FGR-15_STL COCs)	4.200E-03	4.260E-03	DCF1(30)
A-1	Rn-219 (Source: FGR-15_STL COCs)	2.930E-01	2.970E-01	DCF1(31)
A-1	Rn-220 (Source: FGR-15_STL COCs)	3.440E-03	3.475E-03	DCF1(32)
A-1	Rn-222 (Source: FGR-15_STL COCs)	2.110E-03	2.130E-03	DCF1(33)
A-1	Th-227 (Source: FGR-15_STL COCs)	5.600E-01	5.642E-01	DCF1(34)
A-1	Th-228 (Source: FGR-15_STL COCs)	7.430E-03	7.249E-03	DCF1(35)
A-1	Th-230 (Source: FGR-15_STL COCs)	1.160E-03	1.106E-03	DCF1(36)
A-1	Th-231 (Source: FGR-15_STL COCs)	4.690E-02	3.251E-02	DCF1(37)
A-1	Th-232 (Source: FGR-15_STL COCs)	5.120E-04	4.783E-04	DCF1(38)
A-1	Th-234 (Source: FGR-15_STL COCs)	2.990E-02	2.317E-02	DCF1(39)
A-1	Tl-206 (Source: DCFPAK3.02)	1.278E-02	1.278E-02	DCF1(40)

A-1	Tl-207 (Source: FGR-15_STL COCs)	1.920E-01	2.391E-02	DCF1(41)
A-1	Tl-208 (Source: FGR-15_STL COCs)	2.200E+01	2.167E+01	DCF1(42)
A-1	Tl-210 (Source: FGR-15_STL COCs)	1.730E+01	1.678E+01	DCF1(43)
A-1	U-234 (Source: FGR-15_STL COCs)	3.510E-04	3.456E-04	DCF1(44)
A-1	U-235 (Source: FGR-15_STL COCs)	7.060E-01	7.006E-01	DCF1(45)
A-1	U-238 (Source: FGR-15_STL COCs)	1.720E-04	1.713E-04	DCF1(46)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.459E-01	5.760E-01	DCF2(1)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	Pa-231	8.505E-01	8.505E-01	DCF2(2)
B-1	Pb-210+D	3.708E-02	2.077E-02	DCF2(3)
B-1	Ra-226+D	3.528E-02	3.517E-02	DCF2(4)
B-1	Ra-228+D	5.943E-02	5.938E-02	DCF2(5)
B-1	Th-228+D	1.600E-01	1.468E-01	DCF2(6)
B-1	Th-230	3.759E-01	3.759E-01	DCF2(7)
B-1	Th-232	4.070E-01	4.070E-01	DCF2(8)
B-1	U-234	3.479E-02	3.479E-02	DCF2(9)
B-1	U-235+D	3.132E-02	3.132E-02	DCF2(10)
B-1	U-238	2.973E-02	2.973E-02	DCF2(11)
B-1	U-238+D	2.976E-02	2.973E-02	DCF2(12)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.607E-03	1.191E-03	DCF3(1)
D-1	Pa-231	1.772E-03	1.772E-03	DCF3(2)
D-1	Pb-210+D	7.057E-03	2.575E-03	DCF3(3)
D-1	Ra-226+D	1.037E-03	1.036E-03	DCF3(4)
D-1	Ra-228+D	2.577E-03	2.575E-03	DCF3(5)
D-1	Th-228+D	5.286E-04	2.664E-04	DCF3(6)
D-1	Th-230	7.918E-04	7.918E-04	DCF3(7)
D-1	Th-232	8.547E-04	8.547E-04	DCF3(8)
D-1	U-234	1.831E-04	1.831E-04	DCF3(9)
D-1	U-235+D	1.740E-04	1.728E-04	DCF3(10)
D-1	U-238	1.650E-04	1.650E-04	DCF3(11)
D-1	U-238+D	1.776E-04	1.650E-04	DCF3(12)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)

D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(5,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(7,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(7,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(7,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(10,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(11,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(11,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(11,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(12,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(12,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(12,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(5,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(6,1)

D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(7,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(7,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(8,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(11,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(12,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(12,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.129E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ac-227	9.000E-02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Pb-210	3.400E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Ra-226	2.600E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Ra-228	2.000E-02	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Th-228	7.000E-02	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Th-230	1.890E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): Th-232	2.000E-02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-234	3.910E+00	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g): U-235	2.300E-01	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): U-238	3.910E+00	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L): Ac-227	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Ra-228	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(11)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.280E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	6.000E-05	1.000E-03	---	VCZ

R013	Contaminated zone total porosity	4.200E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	3.600E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	3.048E+00	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	1.040E+01	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	4.170E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	9.200E-01	1.000E+00	---	PRECIP

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	8.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.772E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.584E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Ra-226				

R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.113E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.113E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.990E-07	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.990E-07	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.990E-07	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)

R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	5.900E-06	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	5.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.550E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	7.990E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)

R018	Fruits, vegetables and grain consumption (kg/yr)	4.270E+01	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	4.660E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	4.380E+01	3.650E+01	---	SOIL

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ

C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5

Site-Specific Parameter Summary (continued)

0

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active

3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : DT-10 Accessible Soil - Res. Gardener, FGR15, Five Year Review
File   : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\DT-10 ACC RES GARDENER_FGR-15.RAD

Contaminated Zone Dimensions

Area:	11292.00 square meters
Thickness:	2.00 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Ac-227	9.000E-02
Pb-210	3.400E-01
Ra-226	2.600E-01
Ra-228	2.000E-02
Th-228	7.000E-02
Th-230	1.890E+00
Th-232	2.000E-02
U-234	3.910E+00
U-235	2.300E-01
U-238	3.910E+00

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.147E+00	4.080E+00	3.996E+00	3.903E+00	3.866E+00	4.022E+00	4.669E+00	6.173E+00
M(t):	1.659E-01	1.632E-01	1.598E-01	1.561E-01	1.547E-01	1.609E-01	1.868E-01	2.469E-01

0Maximum TDOSE(t): 6.173E+00 mrem/yr   at t = 1.000E+03 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	1.074E-01	0.0259	9.872E-05	0.0000	0.000E+00	0.0000	8.420E-03	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	4.577E-03	0.0011
Pb-210	2.226E-02	0.0054	2.143E-05	0.0000	0.000E+00	0.0000	5.593E-01	0.1349	0.000E+00	0.0000	0.000E+00	0.0000	7.603E-02	0.0183
Ra-226	1.413E+00	0.3408	1.609E-05	0.0000	0.000E+00	0.0000	2.632E-01	0.0635	0.000E+00	0.0000	0.000E+00	0.0000	9.586E-03	0.0023
Ra-228	6.378E-02	0.0154	2.789E-06	0.0000	0.000E+00	0.0000	4.611E-02	0.0111	0.000E+00	0.0000	0.000E+00	0.0000	1.615E-03	0.0004
Th-228	2.811E-01	0.0678	1.623E-05	0.0000	0.000E+00	0.0000	7.354E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	9.990E-04	0.0002
Th-230	3.362E-03	0.0008	1.227E-03	0.0003	0.000E+00	0.0000	3.585E-02	0.0086	0.000E+00	0.0000	0.000E+00	0.0000	4.818E-02	0.0116
Th-232	3.636E-03	0.0009	1.421E-05	0.0000	0.000E+00	0.0000	3.070E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	6.485E-04	0.0002
U-234	7.376E-04	0.0002	2.348E-04	0.0001	0.000E+00	0.0000	4.239E-02	0.0102	0.000E+00	0.0000	0.000E+00	0.0000	2.304E-02	0.0056
U-235	8.910E-02	0.0215	1.244E-05	0.0000	0.000E+00	0.0000	2.370E-03	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	1.288E-03	0.0003
U-238	9.699E-01	0.2339	2.009E-04	0.0000	0.000E+00	0.0000	4.110E-02	0.0099	0.000E+00	0.0000	0.000E+00	0.0000	2.234E-02	0.0054
Total	2.955E+00	0.7124	1.845E-03	0.0004	0.000E+00	0.0000	1.003E+00	0.2417	0.000E+00	0.0000	0.000E+00	0.0000	1.883E-01	0.0454

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.205E-01	0.0290
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.576E-01	0.1586
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.686E+00	0.4066
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.115E-01	0.0269
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.829E-01	0.0682
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.862E-02	0.0214
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.368E-03	0.0018
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.641E-02	0.0160
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.277E-02	0.0224
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.034E+00	0.2492
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.147E+00	1.0000

0*Sum of all water independent and dependent pathways.

Summary : DT-10 Accessible Soil - Res. Gardener, FGR15, Five Year Review
File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\DT-10 ACC RES GARDENER_FGR-15.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	1.038E-01	0.0254	9.546E-05	0.0000	0.000E+00	0.0000	8.142E-03	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	4.425E-03	0.0011
Pb-210	2.156E-02	0.0053	2.077E-05	0.0000	0.000E+00	0.0000	5.420E-01	0.1328	0.000E+00	0.0000	0.000E+00	0.0000	7.366E-02	0.0181
Ra-226	1.413E+00	0.3462	1.658E-05	0.0000	0.000E+00	0.0000	2.763E-01	0.0677	0.000E+00	0.0000	0.000E+00	0.0000	1.136E-02	0.0028
Ra-228	7.943E-02	0.0195	3.794E-06	0.0000	0.000E+00	0.0000	4.093E-02	0.0100	0.000E+00	0.0000	0.000E+00	0.0000	1.512E-03	0.0004
Th-228	1.956E-01	0.0479	1.129E-05	0.0000	0.000E+00	0.0000	5.117E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	6.952E-04	0.0002
Th-230	7.812E-03	0.0019	1.227E-03	0.0003	0.000E+00	0.0000	3.669E-02	0.0090	0.000E+00	0.0000	0.000E+00	0.0000	4.822E-02	0.0118
Th-232	1.238E-02	0.0030	1.461E-05	0.0000	0.000E+00	0.0000	8.282E-03	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	8.372E-04	0.0002
U-234	7.372E-04	0.0002	2.347E-04	0.0001	0.000E+00	0.0000	4.236E-02	0.0104	0.000E+00	0.0000	0.000E+00	0.0000	2.303E-02	0.0056
U-235	8.904E-02	0.0218	1.244E-05	0.0000	0.000E+00	0.0000	2.371E-03	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	1.287E-03	0.0003
U-238	9.692E-01	0.2376	2.007E-04	0.0000	0.000E+00	0.0000	4.107E-02	0.0101	0.000E+00	0.0000	0.000E+00	0.0000	2.232E-02	0.0055
Total	2.892E+00	0.7089	1.837E-03	0.0005	0.000E+00	0.0000	9.986E-01	0.2447	0.000E+00	0.0000	0.000E+00	0.0000	1.874E-01	0.0459

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.165E-01	0.0285
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.372E-01	0.1562
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.700E+00	0.4167
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.219E-01	0.0299
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.968E-01	0.0482
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.395E-02	0.0230
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.151E-02	0.0053
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.636E-02	0.0163
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.271E-02	0.0227
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.033E+00	0.2531
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.080E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	9.706E-02	0.0243	8.925E-05	0.0000	0.000E+00	0.0000	7.612E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	4.138E-03	0.0010
Pb-210	2.024E-02	0.0051	1.950E-05	0.0000	0.000E+00	0.0000	5.088E-01	0.1273	0.000E+00	0.0000	0.000E+00	0.0000	6.915E-02	0.0173
Ra-226	1.411E+00	0.3531	1.751E-05	0.0000	0.000E+00	0.0000	3.008E-01	0.0753	0.000E+00	0.0000	0.000E+00	0.0000	1.475E-02	0.0037
Ra-228	8.758E-02	0.0219	4.435E-06	0.0000	0.000E+00	0.0000	3.219E-02	0.0081	0.000E+00	0.0000	0.000E+00	0.0000	1.277E-03	0.0003
Th-228	9.472E-02	0.0237	5.468E-06	0.0000	0.000E+00	0.0000	2.478E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	3.366E-04	0.0001
Th-230	1.670E-02	0.0042	1.227E-03	0.0003	0.000E+00	0.0000	3.851E-02	0.0096	0.000E+00	0.0000	0.000E+00	0.0000	4.830E-02	0.0121
Th-232	3.296E-02	0.0082	1.563E-05	0.0000	0.000E+00	0.0000	1.706E-02	0.0043	0.000E+00	0.0000	0.000E+00	0.0000	1.174E-03	0.0003
U-234	7.366E-04	0.0002	2.344E-04	0.0001	0.000E+00	0.0000	4.230E-02	0.0106	0.000E+00	0.0000	0.000E+00	0.0000	2.300E-02	0.0058
U-235	8.891E-02	0.0222	1.244E-05	0.0000	0.000E+00	0.0000	2.371E-03	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	1.286E-03	0.0003
U-238	9.679E-01	0.2422	2.004E-04	0.0001	0.000E+00	0.0000	4.101E-02	0.0103	0.000E+00	0.0000	0.000E+00	0.0000	2.229E-02	0.0056
Total	2.818E+00	0.7051	1.826E-03	0.0005	0.000E+00	0.0000	9.909E-01	0.2480	0.000E+00	0.0000	0.000E+00	0.0000	1.857E-01	0.0465

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.089E-01	0.0273
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.982E-01	0.1497
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.727E+00	0.4321
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.211E-01	0.0303
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.531E-02	0.0239
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.047E-01	0.0262
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.121E-02	0.0128
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.627E-02	0.0166
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.258E-02	0.0232
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.031E+00	0.2581
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.996E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0
Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	7.672E-02	0.0197	7.054E-05	0.0000	0.000E+00	0.0000	6.017E-03	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	3.270E-03	0.0008
Pb-210	1.623E-02	0.0042	1.563E-05	0.0000	0.000E+00	0.0000	4.079E-01	0.1045	0.000E+00	0.0000	0.000E+00	0.0000	5.544E-02	0.0142
Ra-226	1.405E+00	0.3599	2.031E-05	0.0000	0.000E+00	0.0000	3.749E-01	0.0960	0.000E+00	0.0000	0.000E+00	0.0000	2.498E-02	0.0064
Ra-228	5.173E-02	0.0133	2.720E-06	0.0000	0.000E+00	0.0000	1.383E-02	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	5.976E-04	0.0002
Th-228	7.484E-03	0.0019	4.320E-07	0.0000	0.000E+00	0.0000	1.958E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.659E-05	0.0000
Th-230	4.774E-02	0.0122	1.227E-03	0.0003	0.000E+00	0.0000	4.599E-02	0.0118	0.000E+00	0.0000	0.000E+00	0.0000	4.874E-02	0.0125
Th-232	9.348E-02	0.0240	1.877E-05	0.0000	0.000E+00	0.0000	3.540E-02	0.0091	0.000E+00	0.0000	0.000E+00	0.0000	1.938E-03	0.0005
U-234	7.372E-04	0.0002	2.334E-04	0.0001	0.000E+00	0.0000	4.210E-02	0.0108	0.000E+00	0.0000	0.000E+00	0.0000	2.289E-02	0.0059
U-235	8.848E-02	0.0227	1.243E-05	0.0000	0.000E+00	0.0000	2.374E-03	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	1.282E-03	0.0003
U-238	9.630E-01	0.2468	1.994E-04	0.0001	0.000E+00	0.0000	4.081E-02	0.0105	0.000E+00	0.0000	0.000E+00	0.0000	2.218E-02	0.0057
Total	2.750E+00	0.7047	1.801E-03	0.0005	0.000E+00	0.0000	9.693E-01	0.2484	0.000E+00	0.0000	0.000E+00	0.0000	1.813E-01	0.0465

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0
Water Dependent Pathways
0

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.607E-02	0.0221
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.796E-01	0.1229
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.805E+00	0.4624
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.616E-02	0.0170
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.531E-03	0.0019
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.437E-01	0.0368
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.308E-01	0.0335
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.595E-02	0.0169
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.215E-02	0.0236
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.026E+00	0.2629
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.903E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

0
Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	3.917E-02	0.0101	3.602E-05	0.0000	0.000E+00	0.0000	3.072E-03	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	1.670E-03	0.0004
Pb-210	8.630E-03	0.0022	8.310E-06	0.0000	0.000E+00	0.0000	2.169E-01	0.0561	0.000E+00	0.0000	0.000E+00	0.0000	2.948E-02	0.0076
Ra-226	1.384E+00	0.3580	2.540E-05	0.0000	0.000E+00	0.0000	5.107E-01	0.1321	0.000E+00	0.0000	0.000E+00	0.0000	4.394E-02	0.0114
Ra-228	4.877E-03	0.0013	2.579E-07	0.0000	0.000E+00	0.0000	1.229E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	5.408E-05	0.0000
Th-228	5.304E-06	0.0000	3.062E-10	0.0000	0.000E+00	0.0000	1.388E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.885E-08	0.0000
Th-230	1.356E-01	0.0351	1.229E-03	0.0003	0.000E+00	0.0000	7.435E-02	0.0192	0.000E+00	0.0000	0.000E+00	0.0000	5.096E-02	0.0132
Th-232	1.423E-01	0.0368	2.135E-05	0.0000	0.000E+00	0.0000	4.796E-02	0.0124	0.000E+00	0.0000	0.000E+00	0.0000	2.487E-03	0.0006
U-234	7.614E-04	0.0002	2.305E-04	0.0001	0.000E+00	0.0000	4.152E-02	0.0107	0.000E+00	0.0000	0.000E+00	0.0000	2.258E-02	0.0058
U-235	8.729E-02	0.0226	1.244E-05	0.0000	0.000E+00	0.0000	2.385E-03	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	1.272E-03	0.0003
U-238	9.494E-01	0.2455	1.966E-04	0.0001	0.000E+00	0.0000	4.023E-02	0.0104	0.000E+00	0.0000	0.000E+00	0.0000	2.187E-02	0.0057
Total	2.752E+00	0.7118	1.760E-03	0.0005	0.000E+00	0.0000	9.384E-01	0.2427	0.000E+00	0.0000	0.000E+00	0.0000	1.743E-01	0.0451

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

0
Water Dependent Pathways

0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.395E-02	0.0114
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.550E-01	0.0659
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.939E+00	0.5014
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.161E-03	0.0016
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.337E-06	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.621E-01	0.0678
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.927E-01	0.0498
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.509E-02	0.0168
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.096E-02	0.0235
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.012E+00	0.2616
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.866E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	3.726E-03	0.0009	3.426E-06	0.0000	0.000E+00	0.0000	2.922E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	1.588E-04	0.0000
Pb-210	9.460E-04	0.0002	9.110E-07	0.0000	0.000E+00	0.0000	2.378E-02	0.0059	0.000E+00	0.0000	0.000E+00	0.0000	3.232E-03	0.0008
Ra-226	1.301E+00	0.3235	2.913E-05	0.0000	0.000E+00	0.0000	6.177E-01	0.1536	0.000E+00	0.0000	0.000E+00	0.0000	6.011E-02	0.0149
Ra-228	1.019E-06	0.0000	5.388E-11	0.0000	0.000E+00	0.0000	2.567E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.129E-08	0.0000
Th-228	5.027E-17	0.0000	2.902E-21	0.0000	0.000E+00	0.0000	1.315E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.786E-19	0.0000
Th-230	4.315E-01	0.1073	1.234E-03	0.0003	0.000E+00	0.0000	2.043E-01	0.0508	0.000E+00	0.0000	0.000E+00	0.0000	6.316E-02	0.0157
Th-232	1.471E-01	0.0366	2.160E-05	0.0000	0.000E+00	0.0000	4.918E-02	0.0122	0.000E+00	0.0000	0.000E+00	0.0000	2.541E-03	0.0006
U-234	1.096E-03	0.0003	2.208E-04	0.0001	0.000E+00	0.0000	3.966E-02	0.0099	0.000E+00	0.0000	0.000E+00	0.0000	2.155E-02	0.0054
U-235	8.337E-02	0.0207	1.259E-05	0.0000	0.000E+00	0.0000	2.427E-03	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	1.241E-03	0.0003
U-238	9.030E-01	0.2245	1.871E-04	0.0000	0.000E+00	0.0000	3.827E-02	0.0095	0.000E+00	0.0000	0.000E+00	0.0000	2.081E-02	0.0052
Total	2.872E+00	0.7140	1.710E-03	0.0004	0.000E+00	0.0000	9.756E-01	0.2426	0.000E+00	0.0000	0.000E+00	0.0000	1.728E-01	0.0430

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.181E-03	0.0010
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.795E-02	0.0070
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.979E+00	0.4920
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.287E-06	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.058E-17	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.001E-01	0.1741
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.989E-01	0.0494
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.253E-02	0.0155
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.705E-02	0.0216
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.623E-01	0.2393
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.022E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	4.488E-06	0.0000	4.127E-09	0.0000	0.000E+00	0.0000	3.520E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.913E-07	0.0000
Pb-210	1.709E-06	0.0000	1.646E-09	0.0000	0.000E+00	0.0000	4.296E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.839E-06	0.0000
Ra-226	1.078E+00	0.2308	2.470E-05	0.0000	0.000E+00	0.0000	5.267E-01	0.1128	0.000E+00	0.0000	0.000E+00	0.0000	5.185E-02	0.0111
Ra-228	3.113E-17	0.0000	1.646E-21	0.0000	0.000E+00	0.0000	7.841E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.450E-19	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	1.177E+00	0.2521	1.249E-03	0.0003	0.000E+00	0.0000	5.668E-01	0.1214	0.000E+00	0.0000	0.000E+00	0.0000	9.869E-02	0.0211
Th-232	1.471E-01	0.0315	2.160E-05	0.0000	0.000E+00	0.0000	4.917E-02	0.0105	0.000E+00	0.0000	0.000E+00	0.0000	2.540E-03	0.0005
U-234	3.873E-03	0.0008	1.957E-04	0.0000	0.000E+00	0.0000	3.576E-02	0.0077	0.000E+00	0.0000	0.000E+00	0.0000	1.896E-02	0.0041
U-235	7.324E-02	0.0157	1.290E-05	0.0000	0.000E+00	0.0000	2.503E-03	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	1.159E-03	0.0002
U-238	7.828E-01	0.1677	1.623E-04	0.0000	0.000E+00	0.0000	3.320E-02	0.0071	0.000E+00	0.0000	0.000E+00	0.0000	1.804E-02	0.0039
Total	3.262E+00	0.6986	1.666E-03	0.0004	0.000E+00	0.0000	1.214E+00	0.2601	0.000E+00	0.0000	0.000E+00	0.0000	1.912E-01	0.0410

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

0 Water Dependent Pathways

Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.036E-06	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.050E-05	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.656E+00	0.3548
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.931E-17	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.844E+00	0.3949
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.988E-01	0.0426
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.879E-02	0.0126
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.692E-02	0.0165
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.342E-01	0.1787
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.669E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

0
Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	2.722E-16	0.0000	2.503E-19	0.0000	0.000E+00	0.0000	2.135E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.160E-17	0.0000
Pb-210	4.285E-16	0.0000	4.126E-19	0.0000	0.000E+00	0.0000	1.077E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.464E-15	0.0000
Ra-226	5.564E-01	0.0901	1.275E-05	0.0000	0.000E+00	0.0000	2.719E-01	0.0440	0.000E+00	0.0000	0.000E+00	0.0000	2.677E-02	0.0043
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	2.901E+00	0.4699	1.280E-03	0.0002	0.000E+00	0.0000	1.409E+00	0.2283	0.000E+00	0.0000	0.000E+00	0.0000	1.813E-01	0.0294
Th-232	1.470E-01	0.0238	2.159E-05	0.0000	0.000E+00	0.0000	4.915E-02	0.0080	0.000E+00	0.0000	0.000E+00	0.0000	2.539E-03	0.0004
U-234	2.543E-02	0.0041	1.317E-04	0.0000	0.000E+00	0.0000	3.284E-02	0.0053	0.000E+00	0.0000	0.000E+00	0.0000	1.302E-02	0.0021
U-235	4.648E-02	0.0075	1.201E-05	0.0000	0.000E+00	0.0000	2.360E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	8.791E-04	0.0001
U-238	4.746E-01	0.0769	9.864E-05	0.0000	0.000E+00	0.0000	2.018E-02	0.0033	0.000E+00	0.0000	0.000E+00	0.0000	1.097E-02	0.0018
Total	4.151E+00	0.6723	1.556E-03	0.0003	0.000E+00	0.0000	1.786E+00	0.2893	0.000E+00	0.0000	0.000E+00	0.0000	2.355E-01	0.0381

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

0
Water Dependent Pathways

0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.054E-16	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.266E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.551E-01	0.1385
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.492E+00	0.7277
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.988E-01	0.0322
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.143E-02	0.0116
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.973E-02	0.0081
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.059E-01	0.0819
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.173E+00	1.0000

0*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227+D	Ac-227+D	1.000E+00	1.338E+00	1.294E+00	1.210E+00	9.564E-01	4.883E-01	4.645E-02	5.595E-05	3.393E-15
0Pb-210+D	Pb-210+D	1.000E+00	1.934E+00	1.874E+00	1.759E+00	1.410E+00	7.500E-01	8.222E-02	1.485E-04	3.724E-14
0Ra-226+D	Ra-226+D	1.000E+00	6.451E+00	6.444E+00	6.432E+00	6.390E+00	6.270E+00	5.869E+00	4.859E+00	2.508E+00
Ra-226+D	Pb-210+D	1.000E+00	3.500E-02	9.518E-02	2.083E-01	5.507E-01	1.187E+00	1.742E+00	1.512E+00	7.805E-01
Ra-226+D	ΣDSR(j)		6.486E+00	6.540E+00	6.641E+00	6.941E+00	7.457E+00	7.612E+00	6.371E+00	3.289E+00
0Ra-228+D	Ra-228+D	1.000E+00	4.825E+00	4.275E+00	3.356E+00	1.438E+00	1.277E-01	2.667E-05	8.146E-16	0.000E+00
Ra-228+D	Th-228+D	1.000E+00	7.504E-01	1.819E+00	2.697E+00	1.870E+00	1.803E-01	3.768E-05	1.151E-15	0.000E+00
Ra-228+D	ΣDSR(j)		5.575E+00	6.094E+00	6.053E+00	3.308E+00	3.081E-01	6.435E-05	1.966E-15	0.000E+00
0Th-228+D	Th-228+D	1.000E+00	4.041E+00	2.812E+00	1.362E+00	1.076E-01	7.625E-05	7.226E-16	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+00	4.550E-02	4.550E-02	4.550E-02	4.549E-02	4.549E-02	4.545E-02	4.537E-02	4.506E-02
Th-230	Ra-226+D	1.000E+00	1.385E-03	4.176E-03	9.754E-03	2.919E-02	8.403E-02	2.679E-01	7.303E-01	1.799E+00
Th-230	Pb-210+D	1.000E+00	5.463E-06	3.391E-05	1.659E-04	1.337E-03	9.167E-03	5.706E-02	1.998E-01	5.326E-01
Th-230	ΣDSR(j)		4.689E-02	4.971E-02	5.542E-02	7.603E-02	1.387E-01	3.704E-01	9.755E-01	2.377E+00
0Th-232	Th-232	1.000E+00	4.874E-02	4.874E-02	4.874E-02	4.874E-02	4.874E-02	4.874E-02	4.873E-02	4.871E-02
Th-232	Ra-228+D	1.000E+00	2.882E-01	8.345E-01	1.750E+00	3.659E+00	4.964E+00	5.091E+00	5.090E+00	5.088E+00
Th-232	Th-228+D	1.000E+00	3.149E-02	1.922E-01	7.617E-01	2.834E+00	4.624E+00	4.803E+00	4.803E+00	4.801E+00
Th-232	ΣDSR(j)		3.684E-01	1.075E+00	2.560E+00	6.542E+00	9.637E+00	9.943E+00	9.942E+00	9.938E+00
0U-234	U-234	1.000E+00	1.698E-02	1.697E-02	1.695E-02	1.686E-02	1.662E-02	1.581E-02	1.369E-02	8.287E-03
U-234	Th-230	1.000E+00	2.168E-07	6.362E-07	1.471E-06	4.385E-06	1.263E-05	4.056E-05	1.129E-04	2.970E-04
U-234	Ra-226+D	1.000E+00	4.221E-09	2.977E-08	1.578E-07	1.409E-06	1.175E-05	1.228E-04	9.835E-04	7.519E-03
U-234	Pb-210+D	1.000E+00	1.329E-11	1.746E-10	1.861E-09	4.457E-08	9.214E-07	2.099E-05	2.444E-04	2.164E-03
U-234	ΣDSR(j)		1.698E-02	1.697E-02	1.695E-02	1.687E-02	1.665E-02	1.599E-02	1.504E-02	1.827E-02
0U-235+D	U-235+D	1.000E+00	4.034E-01	4.031E-01	4.025E-01	4.005E-01	3.948E-01	3.755E-01	3.255E-01	1.974E-01
U-235+D	Pa-231	1.000E+00	5.720E-06	1.751E-05	4.111E-05	1.232E-04	3.530E-04	1.106E-03	2.861E-03	5.734E-03
U-235+D	Ac-227+D	1.000E+00	1.545E-07	1.060E-06	5.449E-06	4.494E-05	3.068E-04	1.846E-03	6.057E-03	1.309E-02
U-235+D	ΣDSR(j)		4.034E-01	4.031E-01	4.025E-01	4.007E-01	3.955E-01	3.785E-01	3.344E-01	2.162E-01
0U-238	U-238	5.450E-07	8.295E-09	8.289E-09	8.277E-09	8.236E-09	8.119E-09	7.722E-09	6.694E-09	4.059E-09
0U-238+D	U-238+D	1.000E+00	2.643E-01	2.642E-01	2.638E-01	2.625E-01	2.587E-01	2.461E-01	2.133E-01	1.294E-01
U-238+D	U-234	1.000E+00	2.397E-08	7.187E-08	1.675E-07	4.999E-07	1.431E-06	4.486E-06	1.162E-05	2.344E-05
U-238+D	Th-230	1.000E+00	2.089E-13	1.415E-12	7.360E-12	6.510E-11	5.423E-10	5.687E-09	4.623E-08	3.708E-07
U-238+D	Ra-226+D	1.000E+00	2.965E-15	4.490E-14	5.259E-13	1.393E-11	3.370E-10	1.157E-08	2.747E-07	6.755E-06
U-238+D	Pb-210+D	1.000E+00	7.865E-18	2.116E-16	4.813E-15	3.389E-13	2.075E-11	1.662E-09	6.255E-08	1.889E-06
U-238+D	ΣDSR(j)		2.643E-01	2.642E-01	2.638E-01	2.625E-01	2.587E-01	2.461E-01	2.133E-01	1.294E-01

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	1.868E+01	1.932E+01	2.066E+01	2.614E+01	5.120E+01	5.382E+02	4.468E+05	*7.232E+13
Pb-210	1.292E+01	1.334E+01	1.421E+01	1.772E+01	3.333E+01	3.041E+02	1.683E+05	*7.632E+13
Ra-226	3.855E+00	3.823E+00	3.765E+00	3.602E+00	3.353E+00	3.284E+00	3.924E+00	7.602E+00
Ra-228	4.484E+00	4.103E+00	4.130E+00	7.557E+00	8.115E+01	3.885E+05	*2.726E+14	*2.726E+14
Th-228	6.187E+00	8.891E+00	1.836E+01	2.324E+02	3.279E+05	*8.201E+14	*8.201E+14	*8.201E+14
Th-230	5.332E+02	5.029E+02	4.511E+02	3.288E+02	1.803E+02	6.749E+01	2.563E+01	1.052E+01
Th-232	6.786E+01	2.325E+01	9.764E+00	3.821E+00	2.594E+00	2.514E+00	2.515E+00	2.516E+00
U-234	1.472E+03	1.473E+03	1.475E+03	1.482E+03	1.502E+03	1.563E+03	1.663E+03	1.369E+03
U-235	6.198E+01	6.202E+01	6.211E+01	6.240E+01	6.322E+01	6.605E+01	7.475E+01	1.156E+02
U-238	9.458E+01	9.464E+01	9.478E+01	9.525E+01	9.662E+01	1.016E+02	1.172E+02	1.932E+02

*At specific activity limit
0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 1.000E+03 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ac-227	9.000E-02	0.000E+00	1.338E+00	1.868E+01	3.393E-15	*7.232E+13
Pb-210	3.400E-01	0.000E+00	1.934E+00	1.292E+01	3.724E-14	*7.632E+13
Ra-226	2.600E-01	67.1 ± 0.1	7.701E+00	3.246E+00	3.289E+00	7.602E+00
Ra-228	2.000E-02	1.841 ± 0.004	6.205E+00	4.029E+00	0.000E+00	*2.726E+14
Th-228	7.000E-02	0.000E+00	4.041E+00	6.187E+00	0.000E+00	*8.201E+14
Th-230	1.890E+00	1.000E+03	2.377E+00	1.052E+01	2.377E+00	1.052E+01
Th-232	2.000E-02	103.1 ± 0.2	9.943E+00	2.514E+00	9.938E+00	2.516E+00
U-234	3.910E+00	1.000E+03	1.827E-02	1.369E+03	1.827E-02	1.369E+03
U-235	2.300E-01	0.000E+00	4.034E-01	6.198E+01	2.162E-01	1.156E+02
U-238	3.910E+00	0.000E+00	2.643E-01	9.458E+01	1.294E-01	1.932E+02

*At specific activity limit

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

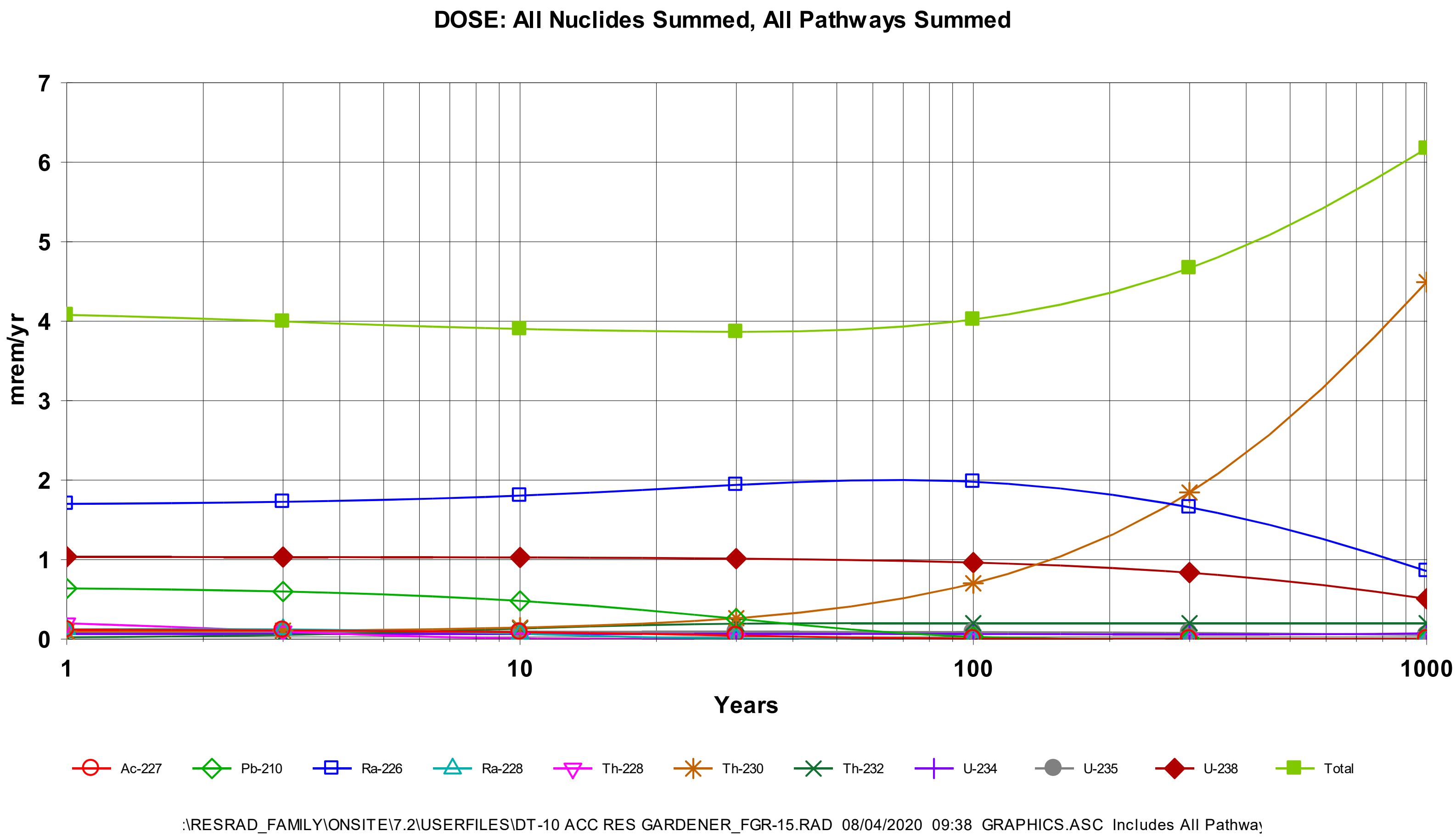
0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	Ac-227	1.000E+00	1.205E-01	1.165E-01	1.089E-01	8.607E-02	4.395E-02	4.181E-03	5.036E-06	3.054E-16
Ac-227	U-235	1.000E+00	3.554E-08	2.437E-07	1.253E-06	1.034E-05	7.057E-05	4.247E-04	1.393E-03	3.012E-03
Ac-227	ΣDOSE(j)		1.205E-01	1.165E-01	1.089E-01	8.608E-02	4.402E-02	4.605E-03	1.398E-03	3.012E-03
0Pb-210	Pb-210	1.000E+00	6.576E-01	6.372E-01	5.982E-01	4.796E-01	2.550E-01	2.795E-02	5.050E-05	1.266E-14
Pb-210	Ra-226	1.000E+00	9.099E-03	2.475E-02	5.416E-02	1.432E-01	3.085E-01	4.530E-01	3.930E-01	2.029E-01
Pb-210	Th-230	1.000E+00	1.033E-05	6.409E-05	3.136E-04	2.526E-03	1.733E-02	1.078E-01	3.777E-01	1.007E+00
Pb-210	U-234	1.000E+00	5.195E-11	6.827E-10	7.275E-09	1.743E-07	3.603E-06	8.207E-05	9.557E-04	8.462E-03
Pb-210	U-238	1.000E+00	3.075E-17	8.272E-16	1.882E-14	1.325E-12	8.112E-11	6.497E-09	2.446E-07	7.386E-06
Pb-210	ΣDOSE(j)		6.668E-01	6.620E-01	6.527E-01	6.253E-01	5.809E-01	5.889E-01	7.717E-01	1.218E+00
0Ra-226	Ra-226	1.000E+00	1.677E+00	1.676E+00	1.672E+00	1.661E+00	1.630E+00	1.526E+00	1.263E+00	6.522E-01
Ra-226	Th-230	1.000E+00	2.618E-03	7.893E-03	1.844E-02	5.518E-02	1.588E-01	5.063E-01	1.380E+00	3.401E+00
Ra-226	U-234	1.000E+00	1.650E-08	1.164E-07	6.168E-07	5.508E-06	4.596E-05	4.800E-04	3.845E-03	2.940E-02
Ra-226	U-238	1.000E+00	1.159E-14	1.755E-13	2.056E-12	5.446E-11	1.318E-09	4.522E-08	1.074E-06	2.641E-05
Ra-226	ΣDOSE(j)		1.680E+00	1.683E+00	1.691E+00	1.717E+00	1.789E+00	2.033E+00	2.647E+00	4.082E+00
0Ra-228	Ra-228	1.000E+00	9.650E-02	8.550E-02	6.711E-02	2.876E-02	2.554E-03	5.334E-07	1.629E-17	0.000E+00
Ra-228	Th-232	1.000E+00	5.763E-03	1.669E-02	3.500E-02	7.319E-02	9.928E-02	1.018E-01	1.018E-01	1.018E-01
Ra-228	ΣDOSE(j)		1.023E-01	1.022E-01	1.021E-01	1.019E-01	1.018E-01	1.018E-01	1.018E-01	1.018E-01
0Th-228	Ra-228	1.000E+00	1.501E-02	3.638E-02	5.395E-02	3.741E-02	3.607E-03	7.536E-07	2.302E-17	0.000E+00
Th-228	Th-228	1.000E+00	2.829E-01	1.968E-01	9.531E-02	7.531E-03	5.337E-06	5.058E-17	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	6.298E-04	3.843E-03	1.523E-02	5.668E-02	9.248E-02	9.606E-02	9.605E-02	9.601E-02
Th-228	ΣDOSE(j)		2.985E-01	2.371E-01	1.645E-01	1.016E-01	9.609E-02	9.607E-02	9.605E-02	9.601E-02
0Th-230	Th-230	1.000E+00	8.599E-02	8.599E-02	8.599E-02	8.598E-02	8.597E-02	8.591E-02	8.574E-02	8.515E-02
Th-230	U-234	1.000E+00	8.478E-07	2.488E-06	5.753E-06	1.715E-05	4.938E-05	1.586E-04	4.416E-04	1.161E-03
Th-230	U-238	1.000E+00	8.167E-13	5.532E-12	2.878E-11	2.546E-10	2.120E-09	2.224E-08	1.807E-07	1.450E-06
Th-230	ΣDOSE(j)		8.599E-02	8.599E-02	8.600E-02	8.600E-02	8.602E-02	8.607E-02	8.618E-02	8.632E-02
0Th-232	Th-232	1.000E+00	9.748E-04	9.748E-04	9.748E-04	9.748E-04	9.748E-04	9.748E-04	9.747E-04	9.743E-04
0U-234	U-234	1.000E+00	6.641E-02	6.636E-02	6.626E-02	6.593E-02	6.499E-02	6.181E-02	5.355E-02	3.240E-02
U-234	U-238	1.000E+00	9.373E-08	2.810E-07	6.548E-07	1.955E-06	5.597E-06	1.754E-05	4.545E-05	9.166E-05
U-234	ΣDOSE(j)		6.641E-02	6.636E-02	6.626E-02	6.593E-02	6.500E-02	6.183E-02	5.359E-02	3.249E-02
0U-235	U-235	1.000E+00	9.277E-02	9.271E-02	9.257E-02	9.211E-02	9.080E-02	8.637E-02	7.487E-02	4.540E-02
0Pa-231	U-235	1.000E+00	1.316E-06	4.027E-06	9.455E-06	2.833E-05	8.120E-05	2.544E-04	6.581E-04	1.319E-03
0U-238	U-238	5.450E-07	3.243E-08	3.241E-08	3.236E-08	3.220E-08	3.174E-08	3.019E-08	2.617E-08	1.587E-08
U-238	U-238	1.000E+00	1.034E+00	1.033E+00	1.031E+00	1.026E+00	1.012E+00	9.623E-01	8.341E-01	5.058E-01
U-238	ΣDOSE(j)		1.034E+00	1.033E+00	1.031E+00	1.026E+00	1.012E+00	9.623E-01	8.341E-01	5.058E-01

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	Ac-227	1.000E+00	9.000E-02	8.703E-02	8.137E-02	6.431E-02	3.284E-02	3.124E-03	3.762E-06	2.282E-16
Ac-227	U-235	1.000E+00	0.000E+00	7.657E-08	6.733E-07	6.913E-06	5.038E-05	3.099E-04	1.022E-03	2.212E-03
Ac-227	ΣS(j):		9.000E-02	8.703E-02	8.137E-02	6.432E-02	3.289E-02	3.433E-03	1.026E-03	2.212E-03
0Pb-210	Pb-210	1.000E+00	3.400E-01	3.294E-01	3.093E-01	2.479E-01	1.318E-01	1.445E-02	2.611E-05	6.545E-15
Pb-210	Ra-226	1.000E+00	0.000E+00	7.987E-03	2.320E-02	6.927E-02	1.548E-01	2.298E-01	1.996E-01	1.030E-01
Pb-210	Th-230	1.000E+00	0.000E+00	1.264E-05	1.114E-04	1.150E-03	8.504E-03	5.430E-02	1.913E-01	5.107E-01
Pb-210	U-234	1.000E+00	0.000E+00	8.038E-11	2.135E-09	7.472E-08	1.732E-06	4.106E-05	4.831E-04	4.290E-03
Pb-210	U-238	1.000E+00	0.000E+00	5.683E-17	4.541E-15	5.352E-13	3.821E-11	3.230E-09	1.234E-07	3.743E-06
Pb-210	ΣS(j):		3.400E-01	3.374E-01	3.326E-01	3.183E-01	2.952E-01	2.986E-01	3.914E-01	6.180E-01
0Ra-226	Ra-226	1.000E+00	2.600E-01	2.598E-01	2.593E-01	2.576E-01	2.527E-01	2.366E-01	1.958E-01	1.011E-01
Ra-226	Th-230	1.000E+00	0.000E+00	8.184E-04	2.453E-03	8.149E-03	2.422E-02	7.809E-02	2.136E-01	5.268E-01
Ra-226	U-234	1.000E+00	0.000E+00	7.784E-09	6.997E-08	7.745E-07	6.893E-06	7.367E-05	5.941E-04	4.552E-03
Ra-226	U-238	1.000E+00	0.000E+00	7.325E-15	1.975E-13	7.286E-12	1.944E-10	6.906E-09	1.656E-07	4.088E-06
Ra-226	ΣS(j):		2.600E-01	2.606E-01	2.617E-01	2.657E-01	2.770E-01	3.147E-01	4.100E-01	6.324E-01
0Ra-228	Ra-228	1.000E+00	2.000E-02	1.772E-02	1.391E-02	5.960E-03	5.294E-04	1.105E-07	3.377E-18	0.000E+00
Ra-228	Th-232	1.000E+00	0.000E+00	2.271E-03	6.065E-03	1.398E-02	1.939E-02	1.991E-02	1.991E-02	1.990E-02
Ra-228	ΣS(j):		2.000E-02	1.999E-02	1.997E-02	1.994E-02	1.992E-02	1.991E-02	1.991E-02	1.990E-02
0Th-228	Ra-228	1.000E+00	0.000E+00	5.708E-03	1.076E-02	8.148E-03	7.941E-04	1.659E-07	5.069E-18	0.000E+00
Th-228	Th-228	1.000E+00	7.000E-02	4.871E-02	2.359E-02	1.864E-03	1.321E-06	1.252E-17	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	0.000E+00	3.731E-04	2.487E-03	1.127E-02	1.912E-02	1.991E-02	1.991E-02	1.990E-02
Th-228	ΣS(j):		7.000E-02	5.479E-02	3.684E-02	2.128E-02	1.992E-02	1.991E-02	1.991E-02	1.990E-02
0Th-230	Th-230	1.000E+00	1.890E+00	1.890E+00	1.890E+00	1.890E+00	1.889E+00	1.888E+00	1.884E+00	1.872E+00
Th-230	U-234	1.000E+00	0.000E+00	3.594E-05	1.077E-04	3.582E-04	1.067E-03	3.468E-03	9.690E-03	2.552E-02
Th-230	U-238	1.000E+00	0.000E+00	5.073E-11	4.561E-10	5.051E-09	4.503E-08	4.838E-07	3.960E-06	3.184E-05
Th-230	ΣS(j):		1.890E+00	1.890E+00	1.890E+00	1.890E+00	1.891E+00	1.892E+00	1.894E+00	1.897E+00
0Th-232	Th-232	1.000E+00	2.000E-02	2.000E-02	2.000E-02	2.000E-02	2.000E-02	2.000E-02	2.000E-02	1.999E-02
0U-234	U-234	1.000E+00	3.910E+00	3.907E+00	3.902E+00	3.882E+00	3.827E+00	3.639E+00	3.153E+00	1.908E+00
U-234	U-238	1.000E+00	0.000E+00	1.103E-05	3.305E-05	1.096E-04	3.241E-04	1.028E-03	2.672E-03	5.394E-03
U-234	ΣS(j):		3.910E+00	3.907E+00	3.902E+00	3.882E+00	3.827E+00	3.640E+00	3.155E+00	1.913E+00
0U-235	U-235	1.000E+00	2.300E-01	2.298E-01	2.295E-01	2.284E-01	2.251E-01	2.141E-01	1.856E-01	1.125E-01
0Pa-231	U-235	1.000E+00	0.000E+00	4.863E-06	1.457E-05	4.831E-05	1.429E-04	4.526E-04	1.174E-03	2.356E-03
0U-238	U-238	5.450E-07	2.131E-06	2.129E-06	2.126E-06	2.116E-06	2.086E-06	1.984E-06	1.720E-06	1.043E-06
U-238	U-238	1.000E+00	3.910E+00	3.907E+00	3.902E+00	3.882E+00	3.827E+00	3.640E+00	3.155E+00	1.913E+00
U-238	ΣS(j):		3.910E+00	3.907E+00	3.902E+00	3.882E+00	3.827E+00	3.640E+00	3.155E+00	1.913E+00

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time = 3.20 seconds



Note: The data line for each radionuclide includes dose contributions from that radionuclide's decay progeny (e.g., the Th-230 data line includes the dose contribution from Ra-226 that results from the radioactive decay of Th-230; the Ra-226 data line does not include the Ra-226 resulting from Th-230 decay).

DT-10 Resident Gardener with 2014 ORNL DCFs
RESRAD Dose Summary

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-227 (Source: DCFPAK3.02)	2.615E-04	2.615E-04	DCF1(1)
A-1	Ac-228 (Source: DCFPAK3.02)	5.044E+00	5.044E+00	DCF1(2)
A-1	At-218 (Source: DCFPAK3.02)	5.567E-05	5.567E-05	DCF1(3)
A-1	At-219 (Source: DCFPAK3.02)	0.000E+00	0.000E+00	DCF1(4)
A-1	Bi-210 (Source: DCFPAK3.02)	5.473E-03	5.473E-03	DCF1(5)
A-1	Bi-211 (Source: DCFPAK3.02)	2.410E-01	2.410E-01	DCF1(6)
A-1	Bi-212 (Source: DCFPAK3.02)	6.258E-01	6.258E-01	DCF1(7)
A-1	Bi-214 (Source: DCFPAK3.02)	9.135E+00	9.135E+00	DCF1(8)
A-1	Bi-215 (Source: DCFPAK3.02)	1.369E+00	1.369E+00	DCF1(9)
A-1	Fr-223 (Source: DCFPAK3.02)	1.758E-01	1.758E-01	DCF1(10)
A-1	Hg-206 (Source: DCFPAK3.02)	6.127E-01	6.127E-01	DCF1(11)
A-1	Pa-231 (Source: DCFPAK3.02)	1.608E-01	1.608E-01	DCF1(12)
A-1	Pa-234 (Source: DCFPAK3.02)	8.275E+00	8.275E+00	DCF1(13)
A-1	Pa-234m (Source: DCFPAK3.02)	1.257E-01	1.257E-01	DCF1(14)
A-1	Pb-210 (Source: DCFPAK3.02)	2.092E-03	2.092E-03	DCF1(15)
A-1	Pb-211 (Source: DCFPAK3.02)	3.680E-01	3.680E-01	DCF1(16)
A-1	Pb-212 (Source: DCFPAK3.02)	6.314E-01	6.314E-01	DCF1(17)
A-1	Pb-214 (Source: DCFPAK3.02)	1.257E+00	1.257E+00	DCF1(18)
A-1	Po-210 (Source: DCFPAK3.02)	5.641E-05	5.641E-05	DCF1(19)
A-1	Po-211 (Source: DCFPAK3.02)	4.707E-02	4.707E-02	DCF1(20)
A-1	Po-212 (Source: DCFPAK3.02)	0.000E+00	0.000E+00	DCF1(21)
A-1	Po-214 (Source: DCFPAK3.02)	4.801E-04	4.801E-04	DCF1(22)
A-1	Po-215 (Source: DCFPAK3.02)	9.452E-04	9.452E-04	DCF1(23)
A-1	Po-216 (Source: DCFPAK3.02)	8.873E-05	8.873E-05	DCF1(24)
A-1	Po-218 (Source: DCFPAK3.02)	9.228E-09	9.228E-09	DCF1(25)
A-1	Ra-223 (Source: DCFPAK3.02)	5.791E-01	5.791E-01	DCF1(26)
A-1	Ra-224 (Source: DCFPAK3.02)	4.950E-02	4.950E-02	DCF1(27)
A-1	Ra-226 (Source: DCFPAK3.02)	3.176E-02	3.176E-02	DCF1(28)
A-1	Ra-228 (Source: DCFPAK3.02)	6.575E-05	6.575E-05	DCF1(29)
A-1	Rn-218 (Source: DCFPAK3.02)	4.259E-03	4.259E-03	DCF1(30)
A-1	Rn-219 (Source: DCFPAK3.02)	2.970E-01	2.970E-01	DCF1(31)
A-1	Rn-220 (Source: DCFPAK3.02)	3.474E-03	3.474E-03	DCF1(32)
A-1	Rn-222 (Source: DCFPAK3.02)	2.130E-03	2.130E-03	DCF1(33)
A-1	Th-227 (Source: DCFPAK3.02)	5.641E-01	5.641E-01	DCF1(34)
A-1	Th-228 (Source: DCFPAK3.02)	7.248E-03	7.248E-03	DCF1(35)
A-1	Th-230 (Source: DCFPAK3.02)	1.106E-03	1.106E-03	DCF1(36)
A-1	Th-231 (Source: DCFPAK3.02)	3.250E-02	3.250E-02	DCF1(37)
A-1	Th-232 (Source: DCFPAK3.02)	4.782E-04	4.782E-04	DCF1(38)
A-1	Th-234 (Source: DCFPAK3.02)	2.316E-02	2.316E-02	DCF1(39)
A-1	Tl-206 (Source: DCFPAK3.02)	1.278E-02	1.278E-02	DCF1(40)

A-1	Tl-207 (Source: DCFPAK3.02)	2.391E-02	2.391E-02	DCF1(41)
A-1	Tl-208 (Source: DCFPAK3.02)	2.167E+01	2.167E+01	DCF1(42)
A-1	Tl-210 (Source: DCFPAK3.02)	1.677E+01	1.677E+01	DCF1(43)
A-1	U-234 (Source: DCFPAK3.02)	3.456E-04	3.456E-04	DCF1(44)
A-1	U-235 (Source: DCFPAK3.02)	7.005E-01	7.005E-01	DCF1(45)
A-1	U-238 (Source: DCFPAK3.02)	1.713E-04	1.713E-04	DCF1(46)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.459E-01	5.760E-01	DCF2(1)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: DCFPAK3.02 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	Pa-231	8.505E-01	8.505E-01	DCF2(2)
B-1	Pb-210+D	3.708E-02	2.077E-02	DCF2(3)
B-1	Ra-226+D	3.528E-02	3.517E-02	DCF2(4)
B-1	Ra-228+D	5.943E-02	5.938E-02	DCF2(5)
B-1	Th-228+D	1.600E-01	1.468E-01	DCF2(6)
B-1	Th-230	3.759E-01	3.759E-01	DCF2(7)
B-1	Th-232	4.070E-01	4.070E-01	DCF2(8)
B-1	U-234	3.479E-02	3.479E-02	DCF2(9)
B-1	U-235+D	3.132E-02	3.132E-02	DCF2(10)
B-1	U-238	2.973E-02	2.973E-02	DCF2(11)
B-1	U-238+D	2.976E-02	2.973E-02	DCF2(12)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.607E-03	1.191E-03	DCF3(1)
D-1	Pa-231	1.772E-03	1.772E-03	DCF3(2)
D-1	Pb-210+D	7.057E-03	2.575E-03	DCF3(3)
D-1	Ra-226+D	1.037E-03	1.036E-03	DCF3(4)
D-1	Ra-228+D	2.577E-03	2.575E-03	DCF3(5)
D-1	Th-228+D	5.286E-04	2.664E-04	DCF3(6)
D-1	Th-230	7.918E-04	7.918E-04	DCF3(7)
D-1	Th-232	8.547E-04	8.547E-04	DCF3(8)
D-1	U-234	1.831E-04	1.831E-04	DCF3(9)
D-1	U-235+D	1.740E-04	1.728E-04	DCF3(10)
D-1	U-238	1.650E-04	1.650E-04	DCF3(11)
D-1	U-238+D	1.776E-04	1.650E-04	DCF3(12)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)

D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(5,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(7,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(7,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(7,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(10,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(11,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(11,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(11,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(12,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(12,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(12,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(5,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(6,1)

D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(7,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(7,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(8,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(11,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(12,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(12,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.129E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ac-227	9.000E-02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Pb-210	3.400E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Ra-226	2.600E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Ra-228	2.000E-02	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Th-228	7.000E-02	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Th-230	1.890E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): Th-232	2.000E-02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-234	3.910E+00	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g): U-235	2.300E-01	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): U-238	3.910E+00	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L): Ac-227	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Ra-228	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(11)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.280E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	6.000E-05	1.000E-03	---	VCZ

R013	Contaminated zone total porosity	4.200E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	3.600E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	3.048E+00	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	1.040E+01	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	4.170E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	9.200E-01	1.000E+00	---	PRECIP

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	8.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.772E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.584E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Ra-226				

R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.113E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.113E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.990E-07	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.990E-07	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.990E-07	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)

R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.147E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	5.900E-06	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	5.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.550E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	7.990E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)

R018	Fruits, vegetables and grain consumption (kg/yr)	4.270E+01	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	4.660E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	4.380E+01	3.650E+01	---	SOIL

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ

C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active

3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : DT-10 Accessible Soil - Res. Gardener, ORNL, Five Year Review
File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\DT-10 ACC RES GARDENER_ORNL.RAD

Contaminated Zone Dimensions

Area:	11292.00 square meters
Thickness:	2.00 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Ac-227	9.000E-02
Pb-210	3.400E-01
Ra-226	2.600E-01
Ra-228	2.000E-02
Th-228	7.000E-02
Th-230	1.890E+00
Th-232	2.000E-02
U-234	3.910E+00
U-235	2.300E-01
U-238	3.910E+00

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	3.414E+00	3.350E+00	3.271E+00	3.185E+00	3.163E+00	3.349E+00	4.057E+00	5.722E+00
M(t):	1.366E-01	1.340E-01	1.308E-01	1.274E-01	1.265E-01	1.339E-01	1.623E-01	2.289E-01

0Maximum TDOSE(t): 5.722E+00 mrem/yr at t = 1.000E+03 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	9.359E-02	0.0274	9.872E-05	0.0000	0.000E+00	0.0000	8.420E-03	0.0025	0.000E+00	0.0000	0.000E+00	0.0000	4.577E-03	0.0013
Pb-210	1.320E-03	0.0004	2.143E-05	0.0000	0.000E+00	0.0000	5.593E-01	0.1638	0.000E+00	0.0000	0.000E+00	0.0000	7.603E-02	0.0223
Ra-226	1.376E+00	0.4032	1.609E-05	0.0000	0.000E+00	0.0000	2.632E-01	0.0771	0.000E+00	0.0000	0.000E+00	0.0000	9.586E-03	0.0028
Ra-228	6.226E-02	0.0182	2.789E-06	0.0000	0.000E+00	0.0000	4.611E-02	0.0135	0.000E+00	0.0000	0.000E+00	0.0000	1.615E-03	0.0005
Th-228	2.714E-01	0.0795	1.623E-05	0.0000	0.000E+00	0.0000	7.354E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	9.990E-04	0.0003
Th-230	3.251E-03	0.0010	1.227E-03	0.0004	0.000E+00	0.0000	3.585E-02	0.0105	0.000E+00	0.0000	0.000E+00	0.0000	4.818E-02	0.0141
Th-232	3.552E-03	0.0010	1.421E-05	0.0000	0.000E+00	0.0000	3.070E-03	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	6.485E-04	0.0002
U-234	7.262E-04	0.0002	2.348E-04	0.0001	0.000E+00	0.0000	4.239E-02	0.0124	0.000E+00	0.0000	0.000E+00	0.0000	2.304E-02	0.0067
U-235	8.667E-02	0.0254	1.244E-05	0.0000	0.000E+00	0.0000	2.370E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	1.288E-03	0.0004
U-238	3.223E-01	0.0944	2.009E-04	0.0001	0.000E+00	0.0000	4.110E-02	0.0120	0.000E+00	0.0000	0.000E+00	0.0000	2.234E-02	0.0065
Total	2.222E+00	0.6507	1.845E-03	0.0005	0.000E+00	0.0000	1.003E+00	0.2936	0.000E+00	0.0000	0.000E+00	0.0000	1.883E-01	0.0552

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

0 Water Dependent Pathways

0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.067E-01	0.0312
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.367E-01	0.1865
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.649E+00	0.4830
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.100E-01	0.0322
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.731E-01	0.0800
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.851E-02	0.0259
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.284E-03	0.0021
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.640E-02	0.0194
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.034E-02	0.0265
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.860E-01	0.1130
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.414E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	9.049E-02	0.0270	9.546E-05	0.0000	0.000E+00	0.0000	8.142E-03	0.0024	0.000E+00	0.0000	0.000E+00	0.0000	4.425E-03	0.0013
Pb-210	1.279E-03	0.0004	2.077E-05	0.0000	0.000E+00	0.0000	5.420E-01	0.1618	0.000E+00	0.0000	0.000E+00	0.0000	7.366E-02	0.0220
Ra-226	1.375E+00	0.4105	1.658E-05	0.0000	0.000E+00	0.0000	2.763E-01	0.0825	0.000E+00	0.0000	0.000E+00	0.0000	1.136E-02	0.0034
Ra-228	7.729E-02	0.0231	3.794E-06	0.0000	0.000E+00	0.0000	4.093E-02	0.0122	0.000E+00	0.0000	0.000E+00	0.0000	1.512E-03	0.0005
Th-228	1.888E-01	0.0564	1.129E-05	0.0000	0.000E+00	0.0000	5.117E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	6.952E-04	0.0002
Th-230	7.584E-03	0.0023	1.227E-03	0.0004	0.000E+00	0.0000	3.669E-02	0.0110	0.000E+00	0.0000	0.000E+00	0.0000	4.822E-02	0.0144
Th-232	1.207E-02	0.0036	1.461E-05	0.0000	0.000E+00	0.0000	8.282E-03	0.0025	0.000E+00	0.0000	0.000E+00	0.0000	8.372E-04	0.0002
U-234	7.258E-04	0.0002	2.347E-04	0.0001	0.000E+00	0.0000	4.236E-02	0.0126	0.000E+00	0.0000	0.000E+00	0.0000	2.303E-02	0.0069
U-235	8.661E-02	0.0259	1.244E-05	0.0000	0.000E+00	0.0000	2.371E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	1.287E-03	0.0004
U-238	3.221E-01	0.0961	2.007E-04	0.0001	0.000E+00	0.0000	4.107E-02	0.0123	0.000E+00	0.0000	0.000E+00	0.0000	2.232E-02	0.0067
Total	2.162E+00	0.6454	1.837E-03	0.0005	0.000E+00	0.0000	9.986E-01	0.2981	0.000E+00	0.0000	0.000E+00	0.0000	1.874E-01	0.0559

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.032E-01	0.0308
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.169E-01	0.1842
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.663E+00	0.4964
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.197E-01	0.0357
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.901E-01	0.0567
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.372E-02	0.0280
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.120E-02	0.0063
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.635E-02	0.0198
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.028E-02	0.0269
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.857E-01	0.1151
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.350E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	8.461E-02	0.0259	8.925E-05	0.0000	0.000E+00	0.0000	7.612E-03	0.0023	0.000E+00	0.0000	0.000E+00	0.0000	4.138E-03	0.0013
Pb-210	1.200E-03	0.0004	1.950E-05	0.0000	0.000E+00	0.0000	5.088E-01	0.1556	0.000E+00	0.0000	0.000E+00	0.0000	6.915E-02	0.0211
Ra-226	1.373E+00	0.4197	1.751E-05	0.0000	0.000E+00	0.0000	3.008E-01	0.0920	0.000E+00	0.0000	0.000E+00	0.0000	1.475E-02	0.0045
Ra-228	8.503E-02	0.0260	4.435E-06	0.0000	0.000E+00	0.0000	3.219E-02	0.0098	0.000E+00	0.0000	0.000E+00	0.0000	1.277E-03	0.0004
Th-228	9.144E-02	0.0280	5.468E-06	0.0000	0.000E+00	0.0000	2.478E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	3.366E-04	0.0001
Th-230	1.624E-02	0.0050	1.227E-03	0.0004	0.000E+00	0.0000	3.851E-02	0.0118	0.000E+00	0.0000	0.000E+00	0.0000	4.830E-02	0.0148
Th-232	3.207E-02	0.0098	1.563E-05	0.0000	0.000E+00	0.0000	1.706E-02	0.0052	0.000E+00	0.0000	0.000E+00	0.0000	1.174E-03	0.0004
U-234	7.252E-04	0.0002	2.344E-04	0.0001	0.000E+00	0.0000	4.230E-02	0.0129	0.000E+00	0.0000	0.000E+00	0.0000	2.300E-02	0.0070
U-235	8.649E-02	0.0264	1.244E-05	0.0000	0.000E+00	0.0000	2.371E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	1.286E-03	0.0004
U-238	3.216E-01	0.0983	2.004E-04	0.0001	0.000E+00	0.0000	4.101E-02	0.0125	0.000E+00	0.0000	0.000E+00	0.0000	2.229E-02	0.0068
Total	2.092E+00	0.6397	1.826E-03	0.0006	0.000E+00	0.0000	9.909E-01	0.3030	0.000E+00	0.0000	0.000E+00	0.0000	1.857E-01	0.0568

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Dependent Pathways
0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.645E-02	0.0295
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.792E-01	0.1771
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.688E+00	0.5162
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.185E-01	0.0362
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.203E-02	0.0281
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.043E-01	0.0319
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.032E-02	0.0154
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.626E-02	0.0203
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.016E-02	0.0276
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.851E-01	0.1178
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.271E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	6.687E-02	0.0210	7.054E-05	0.0000	0.000E+00	0.0000	6.017E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	3.270E-03	0.0010
Pb-210	9.623E-04	0.0003	1.563E-05	0.0000	0.000E+00	0.0000	4.079E-01	0.1280	0.000E+00	0.0000	0.000E+00	0.0000	5.544E-02	0.0174
Ra-226	1.364E+00	0.4281	2.031E-05	0.0000	0.000E+00	0.0000	3.749E-01	0.1177	0.000E+00	0.0000	0.000E+00	0.0000	2.498E-02	0.0078
Ra-228	5.014E-02	0.0157	2.720E-06	0.0000	0.000E+00	0.0000	1.383E-02	0.0043	0.000E+00	0.0000	0.000E+00	0.0000	5.976E-04	0.0002
Th-228	7.225E-03	0.0023	4.320E-07	0.0000	0.000E+00	0.0000	1.958E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.659E-05	0.0000
Th-230	4.640E-02	0.0146	1.227E-03	0.0004	0.000E+00	0.0000	4.599E-02	0.0144	0.000E+00	0.0000	0.000E+00	0.0000	4.874E-02	0.0153
Th-232	9.077E-02	0.0285	1.877E-05	0.0000	0.000E+00	0.0000	3.540E-02	0.0111	0.000E+00	0.0000	0.000E+00	0.0000	1.938E-03	0.0006
U-234	7.258E-04	0.0002	2.334E-04	0.0001	0.000E+00	0.0000	4.210E-02	0.0132	0.000E+00	0.0000	0.000E+00	0.0000	2.289E-02	0.0072
U-235	8.607E-02	0.0270	1.243E-05	0.0000	0.000E+00	0.0000	2.374E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	1.282E-03	0.0004
U-238	3.200E-01	0.1005	1.994E-04	0.0001	0.000E+00	0.0000	4.081E-02	0.0128	0.000E+00	0.0000	0.000E+00	0.0000	2.218E-02	0.0070
Total	2.033E+00	0.6382	1.801E-03	0.0006	0.000E+00	0.0000	9.693E-01	0.3043	0.000E+00	0.0000	0.000E+00	0.0000	1.813E-01	0.0569

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.623E-02	0.0239
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.643E-01	0.1458
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.764E+00	0.5537
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.458E-02	0.0203
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.271E-03	0.0023
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.423E-01	0.0447
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.281E-01	0.0402
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.594E-02	0.0207
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.973E-02	0.0282
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.832E-01	0.1203
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.185E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	3.415E-02	0.0108	3.602E-05	0.0000	0.000E+00	0.0000	3.072E-03	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	1.670E-03	0.0005
Pb-210	5.117E-04	0.0002	8.310E-06	0.0000	0.000E+00	0.0000	2.169E-01	0.0686	0.000E+00	0.0000	0.000E+00	0.0000	2.948E-02	0.0093
Ra-226	1.339E+00	0.4232	2.540E-05	0.0000	0.000E+00	0.0000	5.107E-01	0.1615	0.000E+00	0.0000	0.000E+00	0.0000	4.394E-02	0.0139
Ra-228	4.727E-03	0.0015	2.579E-07	0.0000	0.000E+00	0.0000	1.229E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	5.408E-05	0.0000
Th-228	5.120E-06	0.0000	3.062E-10	0.0000	0.000E+00	0.0000	1.388E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.885E-08	0.0000
Th-230	1.315E-01	0.0416	1.229E-03	0.0004	0.000E+00	0.0000	7.435E-02	0.0235	0.000E+00	0.0000	0.000E+00	0.0000	5.096E-02	0.0161
Th-232	1.380E-01	0.0436	2.135E-05	0.0000	0.000E+00	0.0000	4.796E-02	0.0152	0.000E+00	0.0000	0.000E+00	0.0000	2.487E-03	0.0008
U-234	7.491E-04	0.0002	2.305E-04	0.0001	0.000E+00	0.0000	4.152E-02	0.0131	0.000E+00	0.0000	0.000E+00	0.0000	2.258E-02	0.0071
U-235	8.490E-02	0.0268	1.244E-05	0.0000	0.000E+00	0.0000	2.385E-03	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	1.272E-03	0.0004
U-238	3.155E-01	0.0997	1.966E-04	0.0001	0.000E+00	0.0000	4.023E-02	0.0127	0.000E+00	0.0000	0.000E+00	0.0000	2.187E-02	0.0069
Total	2.049E+00	0.6477	1.760E-03	0.0006	0.000E+00	0.0000	9.384E-01	0.2967	0.000E+00	0.0000	0.000E+00	0.0000	1.743E-01	0.0551

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Dependent Pathways
0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.892E-02	0.0123
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.469E-01	0.0780
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.893E+00	0.5986
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.010E-03	0.0019
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.153E-06	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.580E-01	0.0816
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.885E-01	0.0596
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.508E-02	0.0206
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.857E-02	0.0280
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.778E-01	0.1194
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.163E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	3.248E-03	0.0010	3.426E-06	0.0000	0.000E+00	0.0000	2.922E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	1.588E-04	0.0000
Pb-210	5.609E-05	0.0000	9.110E-07	0.0000	0.000E+00	0.0000	2.378E-02	0.0071	0.000E+00	0.0000	0.000E+00	0.0000	3.232E-03	0.0010
Ra-226	1.253E+00	0.3743	2.913E-05	0.0000	0.000E+00	0.0000	6.177E-01	0.1845	0.000E+00	0.0000	0.000E+00	0.0000	6.011E-02	0.0180
Ra-228	9.874E-07	0.0000	5.388E-11	0.0000	0.000E+00	0.0000	2.567E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.129E-08	0.0000
Th-228	4.853E-17	0.0000	2.902E-21	0.0000	0.000E+00	0.0000	1.315E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.786E-19	0.0000
Th-230	4.169E-01	0.1245	1.234E-03	0.0004	0.000E+00	0.0000	2.043E-01	0.0610	0.000E+00	0.0000	0.000E+00	0.0000	6.316E-02	0.0189
Th-232	1.427E-01	0.0426	2.160E-05	0.0000	0.000E+00	0.0000	4.918E-02	0.0147	0.000E+00	0.0000	0.000E+00	0.0000	2.541E-03	0.0008
U-234	1.072E-03	0.0003	2.208E-04	0.0001	0.000E+00	0.0000	3.966E-02	0.0118	0.000E+00	0.0000	0.000E+00	0.0000	2.155E-02	0.0064
U-235	8.106E-02	0.0242	1.259E-05	0.0000	0.000E+00	0.0000	2.427E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	1.241E-03	0.0004
U-238	3.001E-01	0.0896	1.871E-04	0.0001	0.000E+00	0.0000	3.827E-02	0.0114	0.000E+00	0.0000	0.000E+00	0.0000	2.081E-02	0.0062
Total	2.198E+00	0.6565	1.710E-03	0.0005	0.000E+00	0.0000	9.756E-01	0.2914	0.000E+00	0.0000	0.000E+00	0.0000	1.728E-01	0.0516

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

0 Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.702E-03	0.0011
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.706E-02	0.0081
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.931E+00	0.5767
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.255E-06	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.884E-17	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.855E-01	0.2047
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.945E-01	0.0581
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.250E-02	0.0187
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.474E-02	0.0253
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.594E-01	0.1073
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.349E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	3.912E-06	0.0000	4.127E-09	0.0000	0.000E+00	0.0000	3.520E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.913E-07	0.0000
Pb-210	1.013E-07	0.0000	1.646E-09	0.0000	0.000E+00	0.0000	4.296E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.839E-06	0.0000
Ra-226	1.038E+00	0.2557	2.470E-05	0.0000	0.000E+00	0.0000	5.267E-01	0.1298	0.000E+00	0.0000	0.000E+00	0.0000	5.185E-02	0.0128
Ra-228	3.016E-17	0.0000	1.646E-21	0.0000	0.000E+00	0.0000	7.841E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.450E-19	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	1.135E+00	0.2797	1.249E-03	0.0003	0.000E+00	0.0000	5.668E-01	0.1397	0.000E+00	0.0000	0.000E+00	0.0000	9.869E-02	0.0243
Th-232	1.427E-01	0.0352	2.160E-05	0.0000	0.000E+00	0.0000	4.917E-02	0.0121	0.000E+00	0.0000	0.000E+00	0.0000	2.540E-03	0.0006
U-234	3.749E-03	0.0009	1.957E-04	0.0000	0.000E+00	0.0000	3.576E-02	0.0088	0.000E+00	0.0000	0.000E+00	0.0000	1.896E-02	0.0047
U-235	7.112E-02	0.0175	1.290E-05	0.0000	0.000E+00	0.0000	2.503E-03	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	1.159E-03	0.0003
U-238	2.601E-01	0.0641	1.623E-04	0.0000	0.000E+00	0.0000	3.320E-02	0.0082	0.000E+00	0.0000	0.000E+00	0.0000	1.804E-02	0.0044
Total	2.650E+00	0.6532	1.666E-03	0.0004	0.000E+00	0.0000	1.214E+00	0.2993	0.000E+00	0.0000	0.000E+00	0.0000	1.912E-01	0.0471

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.460E-06	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.890E-05	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.616E+00	0.3984
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.835E-17	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.801E+00	0.4440
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.945E-01	0.0479
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.866E-02	0.0145
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.480E-02	0.0184
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.115E-01	0.0768
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.057E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	2.373E-16	0.0000	2.503E-19	0.0000	0.000E+00	0.0000	2.135E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.160E-17	0.0000
Pb-210	2.541E-17	0.0000	4.126E-19	0.0000	0.000E+00	0.0000	1.077E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.464E-15	0.0000
Ra-226	5.356E-01	0.0936	1.275E-05	0.0000	0.000E+00	0.0000	2.719E-01	0.0475	0.000E+00	0.0000	0.000E+00	0.0000	2.677E-02	0.0047
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	2.794E+00	0.4883	1.280E-03	0.0002	0.000E+00	0.0000	1.409E+00	0.2463	0.000E+00	0.0000	0.000E+00	0.0000	1.813E-01	0.0317
Th-232	1.427E-01	0.0249	2.159E-05	0.0000	0.000E+00	0.0000	4.915E-02	0.0086	0.000E+00	0.0000	0.000E+00	0.0000	2.539E-03	0.0004
U-234	2.451E-02	0.0043	1.317E-04	0.0000	0.000E+00	0.0000	3.284E-02	0.0057	0.000E+00	0.0000	0.000E+00	0.0000	1.302E-02	0.0023
U-235	4.494E-02	0.0079	1.201E-05	0.0000	0.000E+00	0.0000	2.360E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	8.791E-04	0.0002
U-238	1.578E-01	0.0276	9.864E-05	0.0000	0.000E+00	0.0000	2.018E-02	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	1.097E-02	0.0019
Total	3.700E+00	0.6465	1.556E-03	0.0003	0.000E+00	0.0000	1.786E+00	0.3121	0.000E+00	0.0000	0.000E+00	0.0000	2.355E-01	0.0412

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 Water Dependent Pathways
0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.705E-16	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.226E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.344E-01	0.1458
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.386E+00	0.7665
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.944E-01	0.0340
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.051E-02	0.0123
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.820E-02	0.0084
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.890E-01	0.0330
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.722E+00	1.0000

0*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227+D	Ac-227+D	1.000E+00	1.185E+00	1.146E+00	1.072E+00	8.470E-01	4.325E-01	4.114E-02	4.955E-05	3.005E-15
0Pb-210+D	Pb-210+D	1.000E+00	1.873E+00	1.814E+00	1.703E+00	1.366E+00	7.261E-01	7.960E-02	1.438E-04	3.605E-14
0Ra-226+D	Ra-226+D	1.000E+00	6.309E+00	6.303E+00	6.291E+00	6.250E+00	6.133E+00	5.741E+00	4.752E+00	2.453E+00
Ra-226+D	Pb-210+D	1.000E+00	3.403E-02	9.232E-02	2.018E-01	5.334E-01	1.149E+00	1.687E+00	1.464E+00	7.557E-01
Ra-226+D	ΣDSR(j)		6.343E+00	6.396E+00	6.493E+00	6.783E+00	7.282E+00	7.428E+00	6.216E+00	3.209E+00
0Ra-228+D	Ra-228+D	1.000E+00	4.775E+00	4.230E+00	3.321E+00	1.423E+00	1.264E-01	2.639E-05	8.061E-16	0.000E+00
Ra-228+D	Th-228+D	1.000E+00	7.247E-01	1.756E+00	2.605E+00	1.806E+00	1.741E-01	3.638E-05	1.111E-15	0.000E+00
Ra-228+D	ΣDSR(j)		5.499E+00	5.987E+00	5.925E+00	3.229E+00	3.005E-01	6.277E-05	1.918E-15	0.000E+00
0Th-228+D	Th-228+D	1.000E+00	3.902E+00	2.715E+00	1.315E+00	1.039E-01	7.362E-05	6.978E-16	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+00	4.547E-02	4.547E-02	4.547E-02	4.547E-02	4.546E-02	4.543E-02	4.534E-02	4.503E-02
Th-230	Ra-226+D	1.000E+00	1.354E-03	4.084E-03	9.540E-03	2.855E-02	8.219E-02	2.620E-01	7.143E-01	1.760E+00
Th-230	Pb-210+D	1.000E+00	5.323E-06	3.294E-05	1.609E-04	1.295E-03	8.877E-03	5.525E-02	1.935E-01	5.157E-01
Th-230	ΣDSR(j)		4.683E-02	4.959E-02	5.517E-02	7.532E-02	1.365E-01	3.627E-01	9.531E-01	2.321E+00
0Th-232	Th-232	1.000E+00	4.872E-02	4.872E-02	4.872E-02	4.872E-02	4.872E-02	4.872E-02	4.872E-02	4.870E-02
Th-232	Ra-228+D	1.000E+00	2.851E-01	8.257E-01	1.732E+00	3.621E+00	4.912E+00	5.038E+00	5.037E+00	5.035E+00
Th-232	Th-228+D	1.000E+00	3.042E-02	1.856E-01	7.356E-01	2.737E+00	4.465E+00	4.638E+00	4.638E+00	4.636E+00
Th-232	ΣDSR(j)		3.642E-01	1.060E+00	2.516E+00	6.406E+00	9.426E+00	9.725E+00	9.723E+00	9.719E+00
0U-234	U-234	1.000E+00	1.698E-02	1.697E-02	1.694E-02	1.686E-02	1.662E-02	1.580E-02	1.369E-02	8.286E-03
U-234	Th-230	1.000E+00	2.167E-07	6.358E-07	1.471E-06	4.383E-06	1.262E-05	4.053E-05	1.129E-04	2.969E-04
U-234	Ra-226+D	1.000E+00	4.127E-09	2.911E-08	1.543E-07	1.378E-06	1.150E-05	1.201E-04	9.619E-04	7.354E-03
U-234	Pb-210+D	1.000E+00	1.297E-11	1.698E-10	1.806E-09	4.319E-08	8.923E-07	2.033E-05	2.367E-04	2.095E-03
U-234	ΣDSR(j)		1.698E-02	1.697E-02	1.695E-02	1.687E-02	1.664E-02	1.599E-02	1.500E-02	1.803E-02
0U-235+D	U-235+D	1.000E+00	3.928E-01	3.925E-01	3.919E-01	3.900E-01	3.845E-01	3.657E-01	3.170E-01	1.922E-01
U-235+D	Pa-231	1.000E+00	5.730E-06	1.754E-05	4.118E-05	1.234E-04	3.536E-04	1.108E-03	2.866E-03	5.744E-03
U-235+D	Ac-227+D	1.000E+00	1.372E-07	9.395E-07	4.829E-06	3.981E-05	2.718E-04	1.635E-03	5.365E-03	1.160E-02
U-235+D	ΣDSR(j)		3.928E-01	3.925E-01	3.920E-01	3.902E-01	3.851E-01	3.684E-01	3.252E-01	2.095E-01
0U-238	U-238	5.450E-07	8.294E-09	8.288E-09	8.277E-09	8.235E-09	8.118E-09	7.722E-09	6.694E-09	4.059E-09
0U-238+D	U-238+D	1.000E+00	9.871E-02	9.864E-02	9.850E-02	9.801E-02	9.662E-02	9.190E-02	7.966E-02	4.830E-02
U-238+D	U-234	1.000E+00	2.397E-08	7.186E-08	1.674E-07	4.998E-07	1.431E-06	4.485E-06	1.162E-05	2.344E-05
U-238+D	Th-230	1.000E+00	2.088E-13	1.414E-12	7.356E-12	6.506E-11	5.419E-10	5.684E-09	4.620E-08	3.705E-07
U-238+D	Ra-226+D	1.000E+00	2.899E-15	4.390E-14	5.143E-13	1.362E-11	3.296E-10	1.131E-08	2.687E-07	6.607E-06
U-238+D	Pb-210+D	1.000E+00	7.683E-18	2.059E-16	4.674E-15	3.285E-13	2.010E-11	1.609E-09	6.057E-08	1.829E-06
U-238+D	ΣDSR(j)		9.871E-02	9.864E-02	9.850E-02	9.801E-02	9.662E-02	9.191E-02	7.967E-02	4.834E-02

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	2.109E+01	2.181E+01	2.333E+01	2.952E+01	5.781E+01	6.077E+02	5.045E+05	*7.232E+13
Pb-210	1.335E+01	1.378E+01	1.468E+01	1.831E+01	3.443E+01	3.141E+02	1.738E+05	*7.632E+13
Ra-226	3.941E+00	3.909E+00	3.850E+00	3.686E+00	3.433E+00	3.366E+00	4.022E+00	7.790E+00
Ra-228	4.546E+00	4.176E+00	4.219E+00	7.743E+00	8.319E+01	3.983E+05	*2.726E+14	*2.726E+14
Th-228	6.407E+00	9.208E+00	1.901E+01	2.407E+02	3.396E+05	*8.201E+14	*8.201E+14	*8.201E+14
Th-230	5.338E+02	5.042E+02	4.531E+02	3.319E+02	1.831E+02	6.893E+01	2.623E+01	1.077E+01
Th-232	6.864E+01	2.358E+01	9.937E+00	3.902E+00	2.652E+00	2.571E+00	2.571E+00	2.572E+00
U-234	1.472E+03	1.473E+03	1.475E+03	1.482E+03	1.502E+03	1.564E+03	1.666E+03	1.386E+03
U-235	6.365E+01	6.369E+01	6.378E+01	6.408E+01	6.492E+01	6.785E+01	7.687E+01	1.193E+02
U-238	2.533E+02	2.534E+02	2.538E+02	2.551E+02	2.587E+02	2.720E+02	3.138E+02	5.172E+02

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 1.000E+03 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ac-227	9.000E-02	0.000E+00	1.185E+00	2.109E+01	3.005E-15	*7.232E+13
Pb-210	3.400E-01	0.000E+00	1.873E+00	1.335E+01	3.605E-14	*7.632E+13
Ra-226	2.600E-01	66.8 ± 0.1	7.516E+00	3.326E+00	3.209E+00	7.790E+00
Ra-228	2.000E-02	1.799 ± 0.004	6.084E+00	4.109E+00	0.000E+00	*2.726E+14
Th-228	7.000E-02	0.000E+00	3.902E+00	6.407E+00	0.000E+00	*8.201E+14
Th-230	1.890E+00	1.000E+03	2.321E+00	1.077E+01	2.321E+00	1.077E+01
Th-232	2.000E-02	102.6 ± 0.2	9.725E+00	2.571E+00	9.719E+00	2.572E+00
U-234	3.910E+00	1.000E+03	1.803E-02	1.386E+03	1.803E-02	1.386E+03
U-235	2.300E-01	0.000E+00	3.928E-01	6.365E+01	2.095E-01	1.193E+02
U-238	3.910E+00	0.000E+00	9.871E-02	2.533E+02	4.834E-02	5.172E+02

*At specific activity limit

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	Ac-227	1.000E+00	1.067E-01	1.032E-01	9.645E-02	7.623E-02	3.892E-02	3.702E-03	4.460E-06	2.705E-16
Ac-227	U-235	1.000E+00	3.156E-08	2.161E-07	1.111E-06	9.157E-06	6.251E-05	3.761E-04	1.234E-03	2.667E-03
Ac-227	ΣDOSE(j)		1.067E-01	1.032E-01	9.645E-02	7.624E-02	3.899E-02	4.079E-03	1.238E-03	2.667E-03
0Pb-210	Pb-210	1.000E+00	6.367E-01	6.169E-01	5.792E-01	4.643E-01	2.469E-01	2.706E-02	4.890E-05	1.226E-14
Pb-210	Ra-226	1.000E+00	8.848E-03	2.400E-02	5.248E-02	1.387E-01	2.988E-01	4.386E-01	3.806E-01	1.965E-01
Pb-210	Th-230	1.000E+00	1.006E-05	6.226E-05	3.041E-04	2.447E-03	1.678E-02	1.044E-01	3.657E-01	9.747E-01
Pb-210	U-234	1.000E+00	5.069E-11	6.640E-10	7.060E-09	1.689E-07	3.489E-06	7.947E-05	9.254E-04	8.193E-03
Pb-210	U-238	1.000E+00	3.004E-17	8.052E-16	1.828E-14	1.284E-12	7.857E-11	6.292E-09	2.368E-07	7.151E-06
Pb-210	ΣDOSE(j)		6.456E-01	6.410E-01	6.319E-01	6.054E-01	5.624E-01	5.702E-01	7.472E-01	1.179E+00
0Ra-226	Ra-226	1.000E+00	1.640E+00	1.639E+00	1.636E+00	1.625E+00	1.595E+00	1.493E+00	1.236E+00	6.379E-01
Ra-226	Th-230	1.000E+00	2.560E-03	7.719E-03	1.803E-02	5.397E-02	1.553E-01	4.952E-01	1.350E+00	3.326E+00
Ra-226	U-234	1.000E+00	1.614E-08	1.138E-07	6.033E-07	5.387E-06	4.495E-05	4.695E-04	3.761E-03	2.876E-02
Ra-226	U-238	1.000E+00	1.133E-14	1.717E-13	2.011E-12	5.326E-11	1.289E-09	4.423E-08	1.050E-06	2.583E-05
Ra-226	ΣDOSE(j)		1.643E+00	1.647E+00	1.654E+00	1.679E+00	1.750E+00	1.988E+00	2.589E+00	3.993E+00
0Ra-228	Ra-228	1.000E+00	9.549E-02	8.460E-02	6.641E-02	2.846E-02	2.528E-03	5.278E-07	1.612E-17	0.000E+00
Ra-228	Th-232	1.000E+00	5.701E-03	1.651E-02	3.463E-02	7.242E-02	9.824E-02	1.008E-01	1.007E-01	1.007E-01
Ra-228	ΣDOSE(j)		1.012E-01	1.011E-01	1.010E-01	1.009E-01	1.008E-01	1.008E-01	1.007E-01	1.007E-01
0Th-228	Ra-228	1.000E+00	1.449E-02	3.513E-02	5.209E-02	3.612E-02	3.483E-03	7.277E-07	2.223E-17	0.000E+00
Th-228	Th-228	1.000E+00	2.731E-01	1.901E-01	9.203E-02	7.271E-03	5.153E-06	4.884E-17	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	6.084E-04	3.712E-03	1.471E-02	5.473E-02	8.930E-02	9.276E-02	9.275E-02	9.271E-02
Th-228	ΣDOSE(j)		2.882E-01	2.289E-01	1.588E-01	9.812E-02	9.278E-02	9.276E-02	9.275E-02	9.271E-02
0Th-230	Th-230	1.000E+00	8.594E-02	8.594E-02	8.594E-02	8.593E-02	8.591E-02	8.586E-02	8.569E-02	8.510E-02
Th-230	U-234	1.000E+00	8.473E-07	2.486E-06	5.750E-06	1.714E-05	4.935E-05	1.585E-04	4.413E-04	1.161E-03
Th-230	U-238	1.000E+00	8.163E-13	5.528E-12	2.876E-11	2.544E-10	2.119E-09	2.222E-08	1.806E-07	1.449E-06
Th-230	ΣDOSE(j)		8.594E-02	8.594E-02	8.594E-02	8.595E-02	8.596E-02	8.601E-02	8.613E-02	8.626E-02
0Th-232	Th-232	1.000E+00	9.745E-04	9.745E-04	9.745E-04	9.745E-04	9.745E-04	9.744E-04	9.743E-04	9.739E-04
0U-234	U-234	1.000E+00	6.639E-02	6.635E-02	6.625E-02	6.592E-02	6.498E-02	6.180E-02	5.354E-02	3.240E-02
U-234	U-238	1.000E+00	9.372E-08	2.810E-07	6.547E-07	1.954E-06	5.596E-06	1.754E-05	4.544E-05	9.165E-05
U-234	ΣDOSE(j)		6.639E-02	6.635E-02	6.625E-02	6.592E-02	6.499E-02	6.181E-02	5.358E-02	3.249E-02
0U-235	U-235	1.000E+00	9.034E-02	9.028E-02	9.015E-02	8.970E-02	8.842E-02	8.411E-02	7.291E-02	4.421E-02
0Pa-231	U-235	1.000E+00	1.318E-06	4.034E-06	9.471E-06	2.837E-05	8.133E-05	2.548E-04	6.592E-04	1.321E-03
0U-238	U-238	5.450E-07	3.243E-08	3.241E-08	3.236E-08	3.220E-08	3.174E-08	3.019E-08	2.617E-08	1.587E-08
U-238	U-238	1.000E+00	3.860E-01	3.857E-01	3.851E-01	3.832E-01	3.778E-01	3.593E-01	3.115E-01	1.889E-01
U-238	ΣDOSE(j)		3.860E-01	3.857E-01	3.851E-01	3.832E-01	3.778E-01	3.593E-01	3.115E-01	1.889E-01

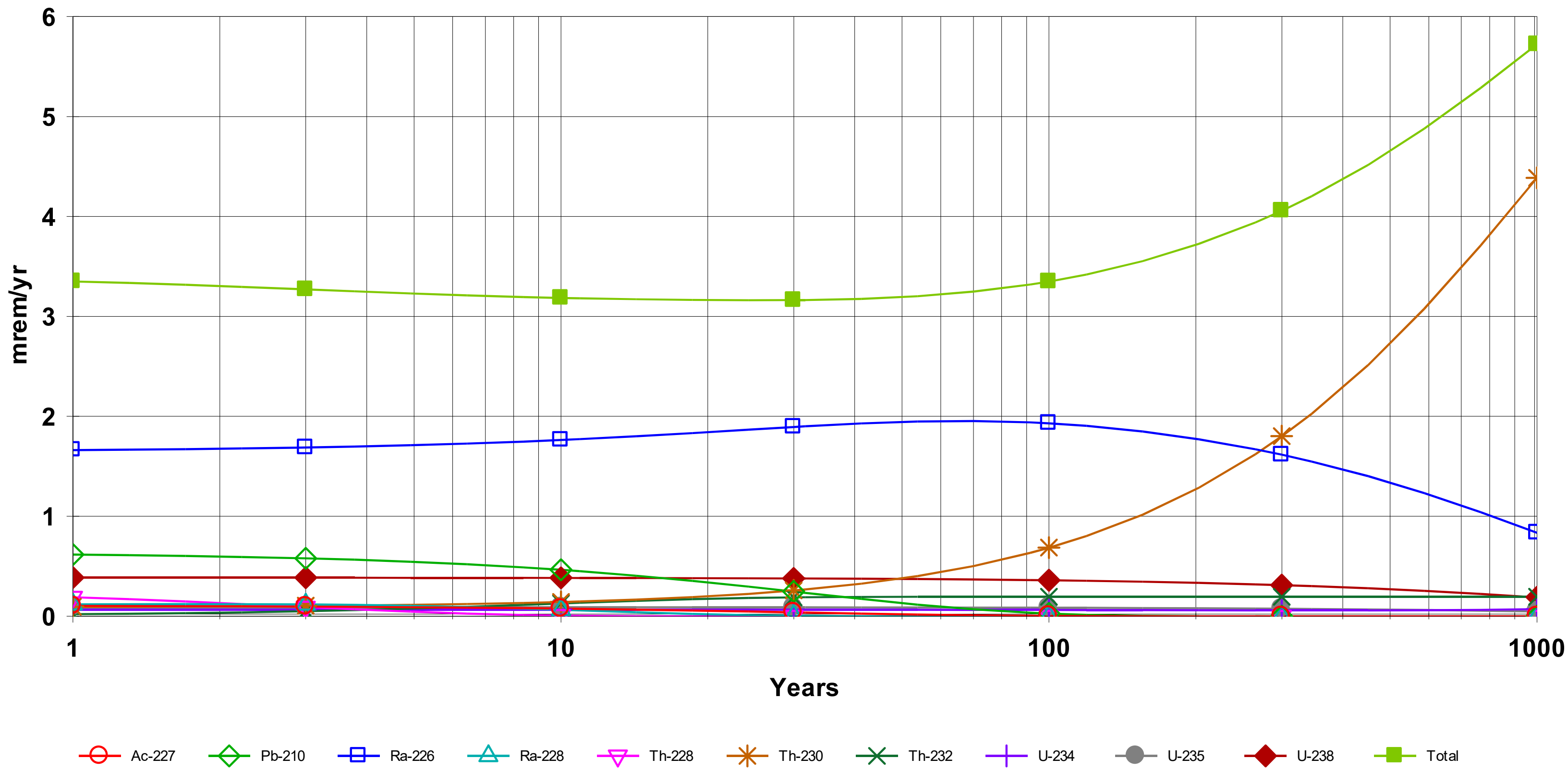
THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	Ac-227	1.000E+00	9.000E-02	8.703E-02	8.137E-02	6.431E-02	3.284E-02	3.124E-03	3.762E-06	2.282E-16
Ac-227	U-235	1.000E+00	0.000E+00	7.657E-08	6.733E-07	6.913E-06	5.038E-05	3.099E-04	1.022E-03	2.212E-03
Ac-227	ΣS(j):		9.000E-02	8.703E-02	8.137E-02	6.432E-02	3.289E-02	3.433E-03	1.026E-03	2.212E-03
0Pb-210	Pb-210	1.000E+00	3.400E-01	3.294E-01	3.093E-01	2.479E-01	1.318E-01	1.445E-02	2.611E-05	6.545E-15
Pb-210	Ra-226	1.000E+00	0.000E+00	7.987E-03	2.320E-02	6.927E-02	1.548E-01	2.298E-01	1.996E-01	1.030E-01
Pb-210	Th-230	1.000E+00	0.000E+00	1.264E-05	1.114E-04	1.150E-03	8.504E-03	5.430E-02	1.913E-01	5.107E-01
Pb-210	U-234	1.000E+00	0.000E+00	8.038E-11	2.135E-09	7.472E-08	1.732E-06	4.106E-05	4.831E-04	4.290E-03
Pb-210	U-238	1.000E+00	0.000E+00	5.683E-17	4.541E-15	5.352E-13	3.821E-11	3.230E-09	1.234E-07	3.743E-06
Pb-210	ΣS(j):		3.400E-01	3.374E-01	3.326E-01	3.183E-01	2.952E-01	2.986E-01	3.914E-01	6.180E-01
0Ra-226	Ra-226	1.000E+00	2.600E-01	2.598E-01	2.593E-01	2.576E-01	2.527E-01	2.366E-01	1.958E-01	1.011E-01
Ra-226	Th-230	1.000E+00	0.000E+00	8.184E-04	2.453E-03	8.149E-03	2.422E-02	7.809E-02	2.136E-01	5.268E-01
Ra-226	U-234	1.000E+00	0.000E+00	7.784E-09	6.997E-08	7.745E-07	6.893E-06	7.367E-05	5.941E-04	4.552E-03
Ra-226	U-238	1.000E+00	0.000E+00	7.325E-15	1.975E-13	7.286E-12	1.944E-10	6.906E-09	1.656E-07	4.088E-06
Ra-226	ΣS(j):		2.600E-01	2.606E-01	2.617E-01	2.657E-01	2.770E-01	3.147E-01	4.100E-01	6.324E-01
0Ra-228	Ra-228	1.000E+00	2.000E-02	1.772E-02	1.391E-02	5.960E-03	5.294E-04	1.105E-07	3.377E-18	0.000E+00
Ra-228	Th-232	1.000E+00	0.000E+00	2.271E-03	6.065E-03	1.398E-02	1.939E-02	1.991E-02	1.991E-02	1.990E-02
Ra-228	ΣS(j):		2.000E-02	1.999E-02	1.997E-02	1.994E-02	1.992E-02	1.991E-02	1.991E-02	1.990E-02
0Th-228	Ra-228	1.000E+00	0.000E+00	5.708E-03	1.076E-02	8.148E-03	7.941E-04	1.659E-07	5.069E-18	0.000E+00
Th-228	Th-228	1.000E+00	7.000E-02	4.871E-02	2.359E-02	1.864E-03	1.321E-06	1.252E-17	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	0.000E+00	3.731E-04	2.487E-03	1.127E-02	1.912E-02	1.991E-02	1.991E-02	1.990E-02
Th-228	ΣS(j):		7.000E-02	5.479E-02	3.684E-02	2.128E-02	1.992E-02	1.991E-02	1.991E-02	1.990E-02
0Th-230	Th-230	1.000E+00	1.890E+00	1.890E+00	1.890E+00	1.890E+00	1.889E+00	1.888E+00	1.884E+00	1.872E+00
Th-230	U-234	1.000E+00	0.000E+00	3.594E-05	1.077E-04	3.582E-04	1.067E-03	3.468E-03	9.690E-03	2.552E-02
Th-230	U-238	1.000E+00	0.000E+00	5.073E-11	4.561E-10	5.051E-09	4.503E-08	4.838E-07	3.960E-06	3.184E-05
Th-230	ΣS(j):		1.890E+00	1.890E+00	1.890E+00	1.890E+00	1.891E+00	1.892E+00	1.894E+00	1.897E+00
0Th-232	Th-232	1.000E+00	2.000E-02	2.000E-02	2.000E-02	2.000E-02	2.000E-02	2.000E-02	2.000E-02	1.999E-02
0U-234	U-234	1.000E+00	3.910E+00	3.907E+00	3.902E+00	3.882E+00	3.827E+00	3.639E+00	3.153E+00	1.908E+00
U-234	U-238	1.000E+00	0.000E+00	1.103E-05	3.305E-05	1.096E-04	3.241E-04	1.028E-03	2.672E-03	5.394E-03
U-234	ΣS(j):		3.910E+00	3.907E+00	3.902E+00	3.882E+00	3.827E+00	3.640E+00	3.155E+00	1.913E+00
0U-235	U-235	1.000E+00	2.300E-01	2.298E-01	2.295E-01	2.284E-01	2.251E-01	2.141E-01	1.856E-01	1.125E-01
0Pa-231	U-235	1.000E+00	0.000E+00	4.863E-06	1.457E-05	4.831E-05	1.429E-04	4.526E-04	1.174E-03	2.356E-03
0U-238	U-238	5.450E-07	2.131E-06	2.129E-06	2.126E-06	2.116E-06	2.086E-06	1.984E-06	1.720E-06	1.043E-06
U-238	U-238	1.000E+00	3.910E+00	3.907E+00	3.902E+00	3.882E+00	3.827E+00	3.640E+00	3.155E+00	1.913E+00
U-238	ΣS(j):		3.910E+00	3.907E+00	3.902E+00	3.882E+00	3.827E+00	3.640E+00	3.155E+00	1.913E+00

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time = 3.00 seconds

DOSE: All Nuclides Summed, All Pathways Summed



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Note: The data line for each radionuclide includes dose contributions from that radionuclide's decay progeny (e.g., the Th-230 data line includes the dose contribution from Ra-226 that results from the radioactive decay of Th-230; the Ra-226 data line does not include the Ra-226 resulting from Th-230 decay).

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Exhibit D-2-2

RESRAD-ONSITE Dose Output Summary Reports for the Residential Gardener Scenario at North St. Louis County Vicinity Property 53 and Coldwater Creek-Floodplain Properties CWC-94, CWC-96, and CWC- 98, and Industrial Lane

(On the CD-ROM on the Back Cover of this Report)

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CWC-94, CWC-96, CWC-98, and Industrial Lane Resident Gardener with FGR-15 External DCFs
(Infinite Volume, Adult)
RESRAD Dose Summary

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

0

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-227 (Source: FGR-15_STL COCs)	4.330E-04	2.615E-04	DCF1(1)
A-1	Ac-228 (Source: FGR-15_STL COCs)	5.150E+00	5.044E+00	DCF1(2)
A-1	At-218 (Source: FGR-15_STL COCs)	5.260E-04	5.567E-05	DCF1(3)
A-1	At-219 (Source: FGR-15_STL COCs)	0.000E+00	0.000E+00	DCF1(4)
A-1	Bi-210 (Source: FGR-15_STL COCs)	1.280E-01	5.474E-03	DCF1(5)
A-1	Bi-211 (Source: FGR-15_STL COCs)	2.370E-01	2.410E-01	DCF1(6)
A-1	Bi-212 (Source: FGR-15_STL COCs)	8.160E-01	6.259E-01	DCF1(7)
A-1	Bi-214 (Source: FGR-15_STL COCs)	9.370E+00	9.136E+00	DCF1(8)
A-1	Bi-215 (Source: FGR-15_STL COCs)	1.590E+00	1.369E+00	DCF1(9)
A-1	Fr-223 (Source: FGR-15_STL COCs)	2.860E-01	1.758E-01	DCF1(10)
A-1	Hg-206 (Source: FGR-15_STL COCs)	7.300E-01	6.128E-01	DCF1(11)
A-1	Pa-231 (Source: FGR-15_STL COCs)	1.590E-01	1.609E-01	DCF1(12)
A-1	Pb-210 (Source: FGR-15_STL COCs)	2.350E-03	2.092E-03	DCF1(13)
A-1	Pb-211 (Source: FGR-15_STL COCs)	5.150E-01	3.680E-01	DCF1(14)
A-1	Pb-212 (Source: FGR-15_STL COCs)	6.500E-01	6.315E-01	DCF1(15)
A-1	Pb-214 (Source: FGR-15_STL COCs)	1.300E+00	1.257E+00	DCF1(16)
A-1	Po-210 (Source: DCFPAK3.02)	5.641E-05	5.641E-05	DCF1(17)
A-1	Po-211 (Source: FGR-15_STL COCs)	4.670E-02	4.708E-02	DCF1(18)
A-1	Po-212 (Source: FGR-15_STL COCs)	0.000E+00	0.000E+00	DCF1(19)
A-1	Po-214 (Source: FGR-15_STL COCs)	4.780E-04	4.801E-04	DCF1(20)
A-1	Po-215 (Source: FGR-15_STL COCs)	9.340E-04	9.453E-04	DCF1(21)
A-1	Po-216 (Source: FGR-15_STL COCs)	8.810E-05	8.874E-05	DCF1(22)
A-1	Po-218 (Source: FGR-15_STL COCs)	2.260E-06	9.229E-09	DCF1(23)
A-1	Ra-223 (Source: FGR-15_STL COCs)	5.830E-01	5.791E-01	DCF1(24)
A-1	Ra-224 (Source: FGR-15_STL COCs)	4.910E-02	4.951E-02	DCF1(25)
A-1	Ra-226 (Source: FGR-15_STL COCs)	3.210E-02	3.176E-02	DCF1(26)
A-1	Ra-228 (Source: FGR-15_STL COCs)	1.370E-04	6.576E-05	DCF1(27)
A-1	Rn-218 (Source: FGR-15_STL COCs)	4.200E-03	4.260E-03	DCF1(28)
A-1	Rn-219 (Source: FGR-15_STL COCs)	2.930E-01	2.970E-01	DCF1(29)
A-1	Rn-220 (Source: FGR-15_STL COCs)	3.440E-03	3.475E-03	DCF1(30)
A-1	Rn-222 (Source: FGR-15_STL COCs)	2.110E-03	2.130E-03	DCF1(31)
A-1	Th-227 (Source: FGR-15_STL COCs)	5.600E-01	5.642E-01	DCF1(32)
A-1	Th-228 (Source: FGR-15_STL COCs)	7.430E-03	7.249E-03	DCF1(33)
A-1	Th-230 (Source: FGR-15_STL COCs)	1.160E-03	1.106E-03	DCF1(34)
A-1	Th-231 (Source: FGR-15_STL COCs)	4.690E-02	3.251E-02	DCF1(35)
A-1	Th-232 (Source: FGR-15_STL COCs)	5.120E-04	4.783E-04	DCF1(36)
A-1	Tl-206 (Source: DCFPAK3.02)	1.278E-02	1.278E-02	DCF1(37)
A-1	Tl-207 (Source: FGR-15_STL COCs)	1.920E-01	2.391E-02	DCF1(38)
A-1	Tl-208 (Source: FGR-15_STL COCs)	2.200E+01	2.167E+01	DCF1(39)
A-1	Tl-210 (Source: FGR-15_STL COCs)	1.730E+01	1.678E+01	DCF1(40)
A-1	U-234 (Source: FGR-15_STL COCs)	3.510E-04	3.456E-04	DCF1(41)

A-1	U-235 (Source: FGR-15_STL COCs)	7.060E-01	7.006E-01	DCF1(42)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.459E-01	5.760E-01	DCF2(1)
B-1	Pa-231	8.505E-01	8.505E-01	DCF2(2)
B-1	Pb-210+D	3.708E-02	2.077E-02	DCF2(3)
B-1	Ra-226+D	3.528E-02	3.517E-02	DCF2(4)
B-1	Ra-228+D	5.943E-02	5.938E-02	DCF2(5)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

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Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	Th-228+D	1.600E-01	1.468E-01	DCF2(6)
B-1	Th-230	3.759E-01	3.759E-01	DCF2(7)
B-1	Th-232	4.070E-01	4.070E-01	DCF2(8)
B-1	U-234	3.479E-02	3.479E-02	DCF2(9)
B-1	U-235+D	3.132E-02	3.132E-02	DCF2(10)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.607E-03	1.191E-03	DCF3(1)
D-1	Pa-231	1.772E-03	1.772E-03	DCF3(2)
D-1	Pb-210+D	7.057E-03	2.575E-03	DCF3(3)
D-1	Ra-226+D	1.037E-03	1.036E-03	DCF3(4)
D-1	Ra-228+D	2.577E-03	2.575E-03	DCF3(5)
D-1	Th-228+D	5.286E-04	2.664E-04	DCF3(6)
D-1	Th-230	7.918E-04	7.918E-04	DCF3(7)
D-1	Th-232	8.547E-04	8.547E-04	DCF3(8)
D-1	U-234	1.831E-04	1.831E-04	DCF3(9)
D-1	U-235+D	1.740E-04	1.728E-04	DCF3(10)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(5,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)

D-34					
D-34	Th-230	, plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(7,1)
D-34	Th-230	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(7,2)
D-34	Th-230	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(7,3)
D-34					
D-34	Th-232	, plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Th-232	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Th-232	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(10,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(5,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(7,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(7,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(8,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.218E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	3.000E-01	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.900E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Pa-231	1.700E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Pb-210	4.000E-02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Ra-226	5.500E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Ra-228	4.000E-02	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Th-228	1.700E-01	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Th-230	2.690E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): Th-232	6.000E-02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-234	3.000E-02	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g): U-235	5.000E-02	0.000E+00	---	S1(10)
R012	Concentration in groundwater (pCi/L): Pa-231	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Ra-228	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(10)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	6.000E-05	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ

R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.109E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(4)

R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.582E-02	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.582E-02	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.852E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.852E-05	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.852E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Ac-227				

R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.497E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	4.836E+03	8.400E+03	---	INHALR

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	4.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.550E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	7.990E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	4.270E+01	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	4.660E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	4.380E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI

R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				

STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Summary : CWC-94, 96, 98, Industrial Ln- Res. Gardener, FGR15, Five Year Review
File   : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\CWC-94 96 98 GARDENER_FGR15.RAD

Contaminated Zone Dimensions

Area:	12182.00 square meters
Thickness:	0.30 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Pa-231	1.700E-01
Pb-210	4.000E-02
Ra-226	5.500E-01
Ra-228	4.000E-02
Th-228	1.700E-01
Th-230	2.690E+00
Th-232	6.000E-02
U-234	3.000E-02
U-235	5.000E-02

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.900E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.830E+00	2.723E+00	2.589E+00	2.400E+00	2.041E+00	1.172E+00	7.316E-01	7.262E-01
M(t):	1.490E-01	1.433E-01	1.362E-01	1.263E-01	1.074E-01	6.169E-02	3.851E-02	3.822E-02

0Maximum TDOSE(t): 2.830E+00 mrem/yr   at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Pa-231	1.082E-02	0.0038	4.133E-03	0.0015	0.000E+00	0.0000	2.364E-02	0.0084	0.000E+00	0.0000	0.000E+00	0.0000	9.726E-03	0.0034
Pb-210	1.684E-03	0.0006	4.148E-05	0.0000	0.000E+00	0.0000	2.183E-02	0.0077	0.000E+00	0.0000	0.000E+00	0.0000	8.897E-03	0.0031
Ra-226	1.863E+00	0.6582	5.587E-04	0.0002	0.000E+00	0.0000	1.842E-01	0.0651	0.000E+00	0.0000	0.000E+00	0.0000	2.012E-02	0.0071
Ra-228	7.992E-02	0.0282	9.163E-05	0.0000	0.000E+00	0.0000	3.052E-02	0.0108	0.000E+00	0.0000	0.000E+00	0.0000	3.206E-03	0.0011
Th-228	4.210E-01	0.1488	6.518E-04	0.0002	0.000E+00	0.0000	5.972E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	2.426E-03	0.0009
Th-230	3.013E-03	0.0011	2.888E-02	0.0102	0.000E+00	0.0000	1.706E-02	0.0060	0.000E+00	0.0000	0.000E+00	0.0000	6.858E-02	0.0242
Th-232	6.861E-03	0.0024	7.052E-04	0.0002	0.000E+00	0.0000	3.058E-03	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	1.944E-03	0.0007
U-234	3.557E-06	0.0000	2.949E-05	0.0000	0.000E+00	0.0000	1.075E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.749E-04	0.0001
U-235	1.231E-02	0.0043	4.425E-05	0.0000	0.000E+00	0.0000	1.702E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	2.770E-04	0.0001
Total	2.399E+00	0.8475	3.514E-02	0.0124	0.000E+00	0.0000	2.812E-01	0.0994	0.000E+00	0.0000	0.000E+00	0.0000	1.154E-01	0.0408

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Dependent Pathways
0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.832E-02	0.0171
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.245E-02	0.0115
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.068E+00	0.7306
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.137E-01	0.0402
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.247E-01	0.1501
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.175E-01	0.0415
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.257E-02	0.0044
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.154E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.280E-02	0.0045
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.830E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Pa-231	1.441E-02	0.0053	4.133E-03	0.0015	0.000E+00	0.0000	2.328E-02	0.0085	0.000E+00	0.0000	0.000E+00	0.0000	9.767E-03	0.0036
Pb-210	1.614E-03	0.0006	3.977E-05	0.0000	0.000E+00	0.0000	2.092E-02	0.0077	0.000E+00	0.0000	0.000E+00	0.0000	8.528E-03	0.0031
Ra-226	1.834E+00	0.6733	5.670E-04	0.0002	0.000E+00	0.0000	1.905E-01	0.0699	0.000E+00	0.0000	0.000E+00	0.0000	2.351E-02	0.0086
Ra-228	9.778E-02	0.0359	1.234E-04	0.0000	0.000E+00	0.0000	2.668E-02	0.0098	0.000E+00	0.0000	0.000E+00	0.0000	2.959E-03	0.0011
Th-228	2.930E-01	0.1076	4.536E-04	0.0002	0.000E+00	0.0000	4.155E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	1.688E-03	0.0006
Th-230	6.930E-03	0.0025	2.888E-02	0.0106	0.000E+00	0.0000	1.745E-02	0.0064	0.000E+00	0.0000	0.000E+00	0.0000	6.862E-02	0.0252
Th-232	2.313E-02	0.0085	7.249E-04	0.0003	0.000E+00	0.0000	8.193E-03	0.0030	0.000E+00	0.0000	0.000E+00	0.0000	2.502E-03	0.0009
U-234	3.480E-06	0.0000	2.884E-05	0.0000	0.000E+00	0.0000	1.051E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.711E-04	0.0001
U-235	1.204E-02	0.0044	4.331E-05	0.0000	0.000E+00	0.0000	1.667E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	2.710E-04	0.0001
Total	2.283E+00	0.8382	3.500E-02	0.0129	0.000E+00	0.0000	2.877E-01	0.1056	0.000E+00	0.0000	0.000E+00	0.0000	1.180E-01	0.0433

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.159E-02	0.0189
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.111E-02	0.0114
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.048E+00	0.7521
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.275E-01	0.0468
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.955E-01	0.1085
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.219E-01	0.0448
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.455E-02	0.0127
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.085E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.252E-02	0.0046
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.723E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Pa-231	2.043E-02	0.0079	4.111E-03	0.0016	0.000E+00	0.0000	2.253E-02	0.0087	0.000E+00	0.0000	0.000E+00	0.0000	9.785E-03	0.0038
Pb-210	1.483E-03	0.0006	3.654E-05	0.0000	0.000E+00	0.0000	1.922E-02	0.0074	0.000E+00	0.0000	0.000E+00	0.0000	7.836E-03	0.0030
Ra-226	1.776E+00	0.6862	5.811E-04	0.0002	0.000E+00	0.0000	2.013E-01	0.0777	0.000E+00	0.0000	0.000E+00	0.0000	2.966E-02	0.0115
Ra-228	1.050E-01	0.0406	1.413E-04	0.0001	0.000E+00	0.0000	2.035E-02	0.0079	0.000E+00	0.0000	0.000E+00	0.0000	2.429E-03	0.0009
Th-228	1.419E-01	0.0548	2.196E-04	0.0001	0.000E+00	0.0000	2.011E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	8.174E-04	0.0003
Th-230	1.458E-02	0.0056	2.888E-02	0.0112	0.000E+00	0.0000	1.827E-02	0.0071	0.000E+00	0.0000	0.000E+00	0.0000	6.873E-02	0.0266
Th-232	6.063E-02	0.0234	7.741E-04	0.0003	0.000E+00	0.0000	1.664E-02	0.0064	0.000E+00	0.0000	0.000E+00	0.0000	3.476E-03	0.0013
U-234	3.331E-06	0.0000	2.760E-05	0.0000	0.000E+00	0.0000	1.005E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.637E-04	0.0001
U-235	1.152E-02	0.0045	4.149E-05	0.0000	0.000E+00	0.0000	1.597E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	2.594E-04	0.0001
Total	2.132E+00	0.8236	3.482E-02	0.0135	0.000E+00	0.0000	2.987E-01	0.1154	0.000E+00	0.0000	0.000E+00	0.0000	1.232E-01	0.0476

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.686E-02	0.0220
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.857E-02	0.0110
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.008E+00	0.7756
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.280E-01	0.0494
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.431E-01	0.0553
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.305E-01	0.0504
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.152E-02	0.0315
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.952E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.198E-02	0.0046
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.589E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0
Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Pa-231	3.251E-02	0.0135	3.876E-03	0.0016	0.000E+00	0.0000	1.988E-02	0.0083	0.000E+00	0.0000	0.000E+00	0.0000	9.376E-03	0.0039
Pb-210	1.103E-03	0.0005	2.717E-05	0.0000	0.000E+00	0.0000	1.427E-02	0.0059	0.000E+00	0.0000	0.000E+00	0.0000	5.827E-03	0.0024
Ra-226	1.589E+00	0.6620	6.081E-04	0.0003	0.000E+00	0.0000	2.264E-01	0.0943	0.000E+00	0.0000	0.000E+00	0.0000	4.568E-02	0.0190
Ra-228	5.680E-02	0.0237	7.974E-05	0.0000	0.000E+00	0.0000	7.845E-03	0.0033	0.000E+00	0.0000	0.000E+00	0.0000	1.029E-03	0.0004
Th-228	1.120E-02	0.0047	1.735E-05	0.0000	0.000E+00	0.0000	1.586E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.458E-05	0.0000
Th-230	3.950E-02	0.0165	2.889E-02	0.0120	0.000E+00	0.0000	2.143E-02	0.0089	0.000E+00	0.0000	0.000E+00	0.0000	6.929E-02	0.0289
Th-232	1.653E-01	0.0689	9.187E-04	0.0004	0.000E+00	0.0000	3.321E-02	0.0138	0.000E+00	0.0000	0.000E+00	0.0000	5.566E-03	0.0023
U-234	2.872E-06	0.0000	2.366E-05	0.0000	0.000E+00	0.0000	8.598E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.403E-04	0.0001
U-235	9.868E-03	0.0041	3.569E-05	0.0000	0.000E+00	0.0000	1.374E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	2.226E-04	0.0001
Total	1.905E+00	0.7938	3.447E-02	0.0144	0.000E+00	0.0000	3.233E-01	0.1347	0.000E+00	0.0000	0.000E+00	0.0000	1.372E-01	0.0572

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0
Water Dependent Pathways
0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.564E-02	0.0274
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.123E-02	0.0088
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.861E+00	0.7756
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.575E-02	0.0274
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.130E-02	0.0047
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.591E-01	0.0663
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.050E-01	0.0854
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.528E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.026E-02	0.0043
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.400E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Pa-231	3.309E-02	0.0162	2.778E-03	0.0014	0.000E+00	0.0000	1.321E-02	0.0065	0.000E+00	0.0000	0.000E+00	0.0000	6.832E-03	0.0033
Pb-210	4.733E-04	0.0002	1.166E-05	0.0000	0.000E+00	0.0000	6.098E-03	0.0030	0.000E+00	0.0000	0.000E+00	0.0000	2.500E-03	0.0012
Ra-226	1.153E+00	0.5649	5.707E-04	0.0003	0.000E+00	0.0000	2.316E-01	0.1135	0.000E+00	0.0000	0.000E+00	0.0000	6.117E-02	0.0300
Ra-228	3.986E-03	0.0020	5.637E-06	0.0000	0.000E+00	0.0000	5.113E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	6.888E-05	0.0000
Th-228	7.935E-06	0.0000	1.229E-08	0.0000	0.000E+00	0.0000	1.119E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.575E-08	0.0000
Th-230	9.704E-02	0.0476	2.890E-02	0.0142	0.000E+00	0.0000	3.127E-02	0.0153	0.000E+00	0.0000	0.000E+00	0.0000	7.163E-02	0.0351
Th-232	2.387E-01	0.1170	1.022E-03	0.0005	0.000E+00	0.0000	4.275E-02	0.0210	0.000E+00	0.0000	0.000E+00	0.0000	6.857E-03	0.0034
U-234	1.964E-06	0.0000	1.525E-05	0.0000	0.000E+00	0.0000	5.506E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.021E-05	0.0000
U-235	6.343E-03	0.0031	2.326E-05	0.0000	0.000E+00	0.0000	8.954E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.438E-04	0.0001
Total	1.532E+00	0.7509	3.332E-02	0.0163	0.000E+00	0.0000	3.256E-01	0.1596	0.000E+00	0.0000	0.000E+00	0.0000	1.493E-01	0.0732

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.591E-02	0.0274
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.084E-03	0.0045
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.446E+00	0.7087
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.571E-03	0.0022
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.004E-06	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.288E-01	0.1121
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.893E-01	0.1418
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.625E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.599E-03	0.0032
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.041E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	7.989E-03	0.0068	6.124E-04	0.0005	0.000E+00	0.0000	2.802E-03	0.0024	0.000E+00	0.0000	0.000E+00	0.0000	1.514E-03	0.0013
Pb-210	2.449E-05	0.0000	6.031E-07	0.0000	0.000E+00	0.0000	3.110E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	1.293E-04	0.0001
Ra-226	3.711E-01	0.3166	2.345E-04	0.0002	0.000E+00	0.0000	9.980E-02	0.0851	0.000E+00	0.0000	0.000E+00	0.0000	3.067E-02	0.0262
Ra-228	2.847E-07	0.0000	4.033E-10	0.0000	0.000E+00	0.0000	3.603E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.925E-09	0.0000
Th-228	7.498E-17	0.0000	1.164E-19	0.0000	0.000E+00	0.0000	1.045E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.331E-19	0.0000
Th-230	1.989E-01	0.1697	2.890E-02	0.0247	0.000E+00	0.0000	5.504E-02	0.0470	0.000E+00	0.0000	0.000E+00	0.0000	7.859E-02	0.0671
Th-232	2.433E-01	0.2076	1.028E-03	0.0009	0.000E+00	0.0000	4.276E-02	0.0365	0.000E+00	0.0000	0.000E+00	0.0000	6.940E-03	0.0059
U-234	1.036E-06	0.0000	3.344E-06	0.0000	0.000E+00	0.0000	1.170E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.944E-05	0.0000
U-235	1.351E-03	0.0012	5.207E-06	0.0000	0.000E+00	0.0000	1.997E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.121E-05	0.0000
Total	8.226E-01	0.7019	3.078E-02	0.0263	0.000E+00	0.0000	2.007E-01	0.1713	0.000E+00	0.0000	0.000E+00	0.0000	1.179E-01	0.1006

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.292E-02	0.0110
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.655E-04	0.0004
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.018E-01	0.4281
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.261E-07	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.564E-17	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.615E-01	0.3084
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.940E-01	0.2509
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.553E-05	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.408E-03	0.0012
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.172E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Pa-231	9.529E-05	0.0001	7.301E-06	0.0000	0.000E+00	0.0000	3.204E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.805E-05	0.0000
Pb-210	5.180E-09	0.0000	1.275E-10	0.0000	0.000E+00	0.0000	6.305E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.733E-08	0.0000
Ra-226	1.433E-02	0.0196	9.461E-06	0.0000	0.000E+00	0.0000	3.895E-03	0.0053	0.000E+00	0.0000	0.000E+00	0.0000	1.270E-03	0.0017
Ra-228	4.048E-19	0.0000	5.761E-22	0.0000	0.000E+00	0.0000	4.937E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.036E-21	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	2.433E-01	0.3325	2.877E-02	0.0393	0.000E+00	0.0000	6.481E-02	0.0886	0.000E+00	0.0000	0.000E+00	0.0000	8.215E-02	0.1123
Th-232	2.414E-01	0.3299	1.024E-03	0.0014	0.000E+00	0.0000	4.086E-02	0.0559	0.000E+00	0.0000	0.000E+00	0.0000	6.914E-03	0.0095
U-234	1.113E-06	0.0000	1.719E-07	0.0000	0.000E+00	0.0000	4.276E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.079E-07	0.0000
U-235	1.629E-05	0.0000	7.143E-08	0.0000	0.000E+00	0.0000	2.693E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.960E-07	0.0000
Total	4.991E-01	0.6821	2.981E-02	0.0407	0.000E+00	0.0000	1.096E-01	0.1498	0.000E+00	0.0000	0.000E+00	0.0000	9.035E-02	0.1235

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.777E-03	0.0038	0.000E+00	0.0000	0.000E+00	0.0000	2.930E-03	0.0040
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.569E-08	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.950E-02	0.0267
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.618E-19	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.190E-01	0.5727
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.902E-01	0.3966
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.321E-06	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.126E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.116E-05	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.781E-03	0.0038	0.000E+00	0.0000	0.000E+00	0.0000	7.316E-01	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0
Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	1.753E-11	0.0000	1.349E-12	0.0000	0.000E+00	0.0000	5.039E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.335E-12	0.0000
Pb-210	7.122E-22	0.0000	1.749E-23	0.0000	0.000E+00	0.0000	7.364E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.751E-21	0.0000
Ra-226	1.605E-07	0.0000	1.080E-10	0.0000	0.000E+00	0.0000	3.786E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.450E-08	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	2.359E-01	0.3248	2.822E-02	0.0389	0.000E+00	0.0000	5.454E-02	0.0751	0.000E+00	0.0000	0.000E+00	0.0000	8.073E-02	0.1112
Th-232	2.331E-01	0.3210	1.011E-03	0.0014	0.000E+00	0.0000	3.433E-02	0.0473	0.000E+00	0.0000	0.000E+00	0.0000	6.825E-03	0.0094
U-234	1.094E-06	0.0000	1.309E-07	0.0000	0.000E+00	0.0000	2.530E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.746E-07	0.0000
U-235	3.130E-12	0.0000	1.932E-14	0.0000	0.000E+00	0.0000	6.510E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.890E-14	0.0000
Total	4.690E-01	0.6458	2.923E-02	0.0403	0.000E+00	0.0000	8.887E-02	0.1224	0.000E+00	0.0000	0.000E+00	0.0000	8.756E-02	0.1206

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0
Water Dependent Pathways
0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.247E-02	0.0172	0.000E+00	0.0000	0.000E+00	0.0000	1.247E-02	0.0172
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.759E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.760E-17	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.050E-02	0.0282	0.000E+00	0.0000	0.000E+00	0.0000	2.050E-02	0.0282
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.831E-02	0.0252	0.000E+00	0.0000	0.000E+00	0.0000	4.177E-01	0.5752
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.752E-01	0.3790
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.491E-05	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	7.676E-05	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.926E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	1.926E-04	0.0003
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.155E-02	0.0710	0.000E+00	0.0000	0.000E+00	0.0000	7.262E-01	1.0000

0*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pa-231	Pa-231	1.000E+00	2.706E-01	2.647E-01	2.532E-01	2.167E-01	1.388E-01	2.925E-02	3.413E-04	2.311E-02
Pa-231	Ac-227+D	1.000E+00	1.362E-02	3.878E-02	8.131E-02	1.695E-01	1.900E-01	4.674E-02	1.689E-02	5.025E-02
Pa-231	ΣDSR(j)		2.843E-01	3.035E-01	3.345E-01	3.861E-01	3.289E-01	7.598E-02	1.724E-02	7.336E-02
0Pb-210+D	Pb-210+D	1.000E+00	8.113E-01	7.776E-01	7.143E-01	5.307E-01	2.271E-01	1.164E-02	2.392E-06	1.190E-15
0Ra-226+D	Ra-226+D	1.000E+00	3.746E+00	3.685E+00	3.567E+00	3.183E+00	2.298E+00	7.347E-01	2.825E-02	6.424E-03
Ra-226+D	Pb-210+D	1.000E+00	1.422E-02	3.885E-02	8.339E-02	2.016E-01	3.313E-01	1.776E-01	7.211E-03	3.084E-02
Ra-226+D	ΣDSR(j)		3.760E+00	3.724E+00	3.651E+00	3.384E+00	2.629E+00	9.123E-01	3.546E-02	3.727E-02
0Ra-228+D	Ra-228+D	1.000E+00	2.383E+00	2.079E+00	1.583E+00	6.090E-01	3.977E-02	2.828E-06	3.981E-18	0.000E+00
Ra-228+D	Th-228+D	1.000E+00	4.602E-01	1.109E+00	1.616E+00	1.035E+00	7.452E-02	5.323E-06	7.564E-18	0.000E+00
Ra-228+D	ΣDSR(j)		2.844E+00	3.189E+00	3.199E+00	1.644E+00	1.143E-01	8.152E-06	1.155E-17	0.000E+00
0Th-228+D	Th-228+D	1.000E+00	2.498E+00	1.738E+00	8.417E-01	6.648E-02	4.708E-05	4.449E-16	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+00	4.288E-02	4.288E-02	4.287E-02	4.286E-02	4.281E-02	4.264E-02	4.215E-02	4.049E-02
Th-230	Ra-226+D	1.000E+00	8.095E-04	2.418E-03	5.559E-03	1.578E-02	3.928E-02	8.058E-02	9.821E-02	9.539E-02
Th-230	Pb-210+D	1.000E+00	2.195E-06	1.380E-05	6.714E-05	5.125E-04	2.981E-03	1.115E-02	1.540E-02	1.940E-02
Th-230	ΣDSR(j)		4.369E-02	4.531E-02	4.850E-02	5.915E-02	8.507E-02	1.344E-01	1.558E-01	1.553E-01
0Th-232	Th-232	1.000E+00	4.608E-02	4.608E-02	4.608E-02	4.606E-02	4.602E-02	4.586E-02	4.543E-02	4.391E-02
Th-232	Ra-228+D	1.000E+00	1.441E-01	4.122E-01	8.508E-01	1.710E+00	2.210E+00	2.231E+00	2.190E+00	2.042E+00
Th-232	Th-228+D	1.000E+00	1.930E-02	1.176E-01	4.617E-01	1.660E+00	2.566E+00	2.624E+00	2.601E+00	2.502E+00
Th-232	ΣDSR(j)		2.095E-01	5.758E-01	1.359E+00	3.417E+00	4.822E+00	4.901E+00	4.836E+00	4.587E+00
0U-234	U-234	1.000E+00	1.051E-02	1.028E-02	9.837E-03	8.421E-03	5.402E-03	1.142E-03	1.347E-05	2.428E-03
U-234	Th-230	1.000E+00	1.982E-07	5.843E-07	1.330E-06	3.695E-06	8.735E-06	1.582E-05	1.751E-05	1.690E-05
U-234	Ra-226+D	1.000E+00	2.463E-09	1.713E-08	8.851E-08	7.256E-07	4.779E-06	2.347E-05	4.014E-05	5.182E-05
U-234	Pb-210+D	1.000E+00	5.273E-12	7.012E-11	7.408E-10	1.648E-08	2.702E-07	2.838E-06	6.233E-06	6.236E-05
U-234	ΣDSR(j)		1.051E-02	1.028E-02	9.838E-03	8.426E-03	5.416E-03	1.184E-03	7.736E-05	2.559E-03
0U-235+D	U-235+D	1.000E+00	2.560E-01	2.504E-01	2.396E-01	2.052E-01	1.318E-01	2.801E-02	3.351E-04	2.313E-03
U-235+D	Pa-231	1.000E+00	2.788E-06	8.316E-06	1.867E-05	4.807E-05	8.958E-05	6.224E-05	2.177E-06	4.944E-04
U-235+D	Ac-227+D	1.000E+00	9.674E-08	6.488E-07	3.146E-06	2.096E-05	8.031E-05	8.432E-05	8.589E-05	1.045E-03
U-235+D	ΣDSR(j)		2.560E-01	2.504E-01	2.396E-01	2.053E-01	1.320E-01	2.815E-02	4.231E-04	3.852E-03

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.900E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pa-231	6.684E+01	6.261E+01	5.680E+01	4.921E+01	5.777E+01	2.501E+02	1.102E+03	2.590E+02
Pb-210	2.342E+01	2.443E+01	2.660E+01	3.580E+01	8.367E+01	1.633E+03	7.942E+06	*7.632E+13
Ra-226	5.053E+00	5.102E+00	5.205E+00	5.614E+00	7.227E+00	2.083E+01	5.358E+02	5.098E+02
Ra-228	6.682E+00	5.959E+00	5.939E+00	1.156E+01	1.663E+02	2.331E+06	*2.726E+14	*2.726E+14
Th-228	7.605E+00	1.093E+01	2.257E+01	2.858E+02	4.036E+05	*8.201E+14	*8.201E+14	*8.201E+14
Th-230	4.349E+02	4.193E+02	3.917E+02	3.212E+02	2.233E+02	1.414E+02	1.220E+02	1.224E+02
Th-232	9.071E+01	3.300E+01	1.398E+01	5.561E+00	3.941E+00	3.877E+00	3.929E+00	4.142E+00
U-234	1.807E+03	1.847E+03	1.931E+03	2.255E+03	3.508E+03	1.604E+04	2.456E+05	7.425E+03
U-235	7.421E+01	7.587E+01	7.930E+01	9.256E+01	1.440E+02	6.749E+02	4.490E+04	4.932E+03

*At specific activity limit
0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Pa-231	1.700E-01	13.04 ± 0.03	3.900E-01	4.872E+01	2.843E-01	6.684E+01
Pb-210	4.000E-02	0.000E+00	8.113E-01	2.342E+01	8.113E-01	2.342E+01
Ra-226	5.500E-01	0.000E+00	3.760E+00	5.053E+00	3.760E+00	5.053E+00
Ra-228	4.000E-02	1.952 ± 0.004	3.274E+00	5.803E+00	2.844E+00	6.682E+00
Th-228	1.700E-01	0.000E+00	2.498E+00	7.605E+00	2.498E+00	7.605E+00
Th-230	2.690E+00	318.8 ± 0.6	1.558E-01	1.220E+02	4.369E-02	4.349E+02
Th-232	6.000E-02	57.8 ± 0.1	4.912E+00	3.868E+00	2.095E-01	9.071E+01
U-234	3.000E-02	0.000E+00	1.051E-02	1.807E+03	1.051E-02	1.807E+03
U-235	5.000E-02	0.000E+00	2.560E-01	7.421E+01	2.560E-01	7.421E+01

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

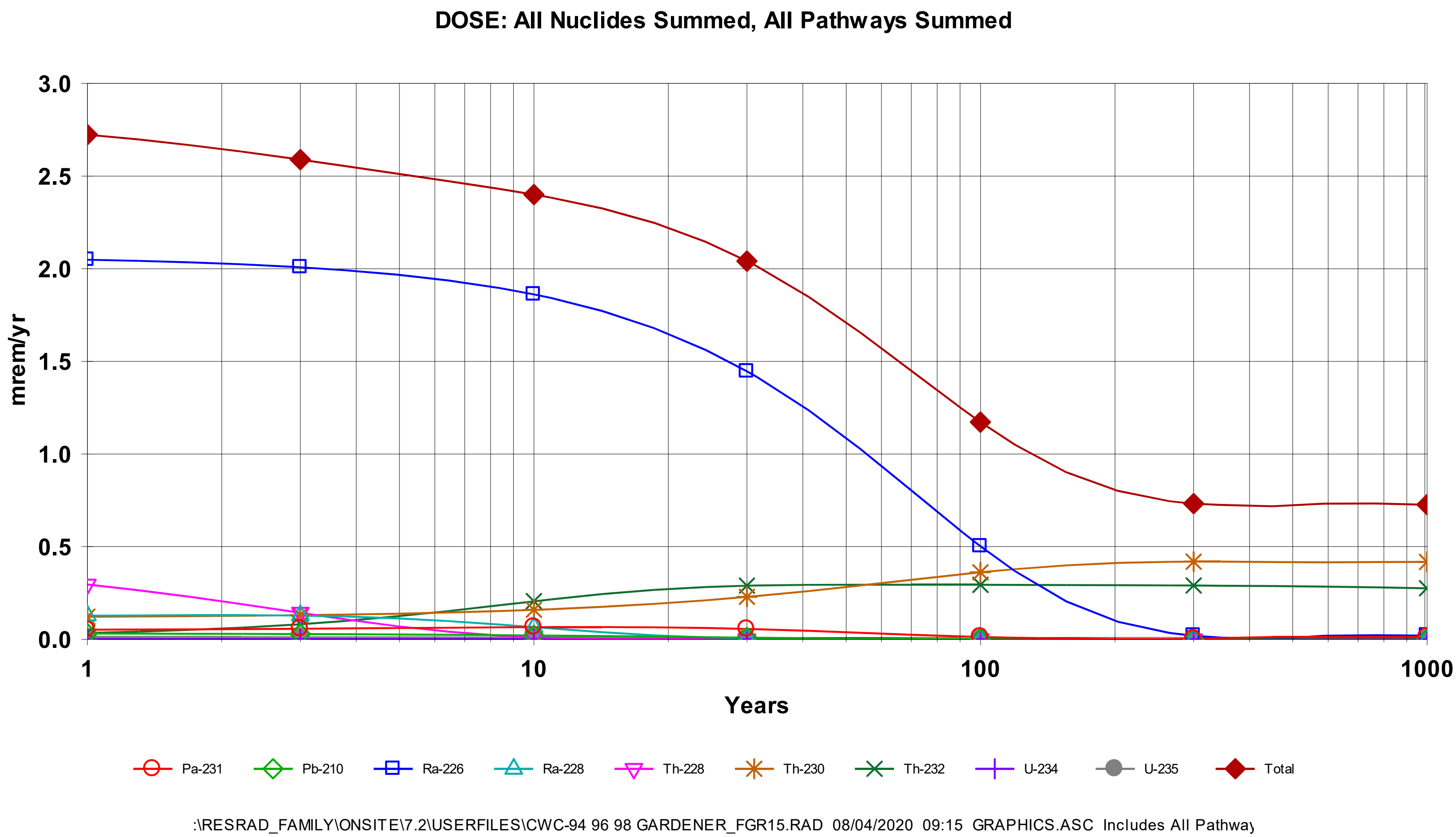
0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pa-231	Pa-231	1.000E+00	4.601E-02	4.500E-02	4.304E-02	3.683E-02	2.360E-02	4.972E-03	5.802E-05	3.928E-03
Pa-231	U-235	1.000E+00	1.394E-07	4.158E-07	9.334E-07	2.404E-06	4.479E-06	3.112E-06	1.088E-07	2.472E-05
Pa-231	ΣDOSE(j)		4.601E-02	4.500E-02	4.304E-02	3.684E-02	2.361E-02	4.975E-03	5.813E-05	3.953E-03
0Ac-227	Pa-231	1.000E+00	2.315E-03	6.592E-03	1.382E-02	2.881E-02	3.231E-02	7.946E-03	2.872E-03	8.542E-03
Ac-227	U-235	1.000E+00	4.837E-09	3.244E-08	1.573E-07	1.048E-06	4.015E-06	4.216E-06	4.295E-06	5.223E-05
Ac-227	ΣDOSE(j)		2.315E-03	6.592E-03	1.382E-02	2.881E-02	3.231E-02	7.950E-03	2.876E-03	8.594E-03
0Pb-210	Pb-210	1.000E+00	3.245E-02	3.111E-02	2.857E-02	2.123E-02	9.084E-03	4.655E-04	9.569E-08	4.760E-17
Pb-210	Ra-226	1.000E+00	7.823E-03	2.137E-02	4.586E-02	1.109E-01	1.822E-01	9.769E-02	3.966E-03	1.696E-02
Pb-210	Th-230	1.000E+00	5.906E-06	3.713E-05	1.806E-04	1.379E-03	8.019E-03	2.998E-02	4.142E-02	5.218E-02
Pb-210	U-234	1.000E+00	1.582E-13	2.104E-12	2.222E-11	4.944E-10	8.106E-09	8.514E-08	1.870E-07	1.871E-06
Pb-210	ΣDOSE(j)		4.028E-02	5.251E-02	7.462E-02	1.335E-01	1.993E-01	1.281E-01	4.538E-02	6.914E-02
0Ra-226	Ra-226	1.000E+00	2.060E+00	2.027E+00	1.962E+00	1.751E+00	1.264E+00	4.041E-01	1.554E-02	3.533E-03
Ra-226	Th-230	1.000E+00	2.177E-03	6.505E-03	1.495E-02	4.244E-02	1.057E-01	2.168E-01	2.642E-01	2.566E-01
Ra-226	U-234	1.000E+00	7.388E-11	5.139E-10	2.655E-09	2.177E-08	1.434E-07	7.042E-07	1.204E-06	1.555E-06
Ra-226	ΣDOSE(j)		2.062E+00	2.033E+00	1.977E+00	1.793E+00	1.369E+00	6.208E-01	2.797E-01	2.601E-01
0Ra-228	Ra-228	1.000E+00	9.534E-02	8.318E-02	6.331E-02	2.436E-02	1.591E-03	1.131E-07	1.593E-19	0.000E+00
Ra-228	Th-232	1.000E+00	8.645E-03	2.473E-02	5.105E-02	1.026E-01	1.326E-01	1.338E-01	1.314E-01	1.225E-01
Ra-228	ΣDOSE(j)		1.040E-01	1.079E-01	1.144E-01	1.270E-01	1.342E-01	1.338E-01	1.314E-01	1.225E-01
0Th-228	Ra-228	1.000E+00	1.841E-02	4.436E-02	6.465E-02	4.139E-02	2.981E-03	2.129E-07	3.026E-19	0.000E+00
Th-228	Th-228	1.000E+00	4.247E-01	2.955E-01	1.431E-01	1.130E-02	8.004E-06	7.564E-17	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	1.158E-03	7.053E-03	2.770E-02	9.963E-02	1.540E-01	1.574E-01	1.560E-01	1.501E-01
Th-228	ΣDOSE(j)		4.443E-01	3.470E-01	2.354E-01	1.523E-01	1.569E-01	1.574E-01	1.560E-01	1.501E-01
0Th-230	Th-230	1.000E+00	1.154E-01	1.153E-01	1.153E-01	1.153E-01	1.152E-01	1.147E-01	1.134E-01	1.089E-01
Th-230	U-234	1.000E+00	5.947E-09	1.753E-08	3.991E-08	1.108E-07	2.621E-07	4.745E-07	5.254E-07	5.069E-07
Th-230	ΣDOSE(j)		1.154E-01	1.153E-01	1.153E-01	1.153E-01	1.152E-01	1.147E-01	1.134E-01	1.089E-01
0Th-232	Th-232	1.000E+00	2.765E-03	2.765E-03	2.765E-03	2.764E-03	2.761E-03	2.752E-03	2.726E-03	2.635E-03
0U-234	U-234	1.000E+00	3.154E-04	3.085E-04	2.951E-04	2.526E-04	1.621E-04	3.426E-05	4.042E-07	7.283E-05
0U-235	U-235	1.000E+00	1.280E-02	1.252E-02	1.198E-02	1.026E-02	6.591E-03	1.400E-03	1.675E-05	1.157E-04

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pa-231	Pa-231	1.000E+00	1.700E-01	1.663E-01	1.591E-01	1.362E-01	8.747E-02	1.856E-02	2.212E-04	4.087E-11
Pa-231	U-235	1.000E+00	0.000E+00	1.035E-06	2.970E-06	8.478E-06	1.634E-05	1.156E-05	4.142E-07	2.570E-13
Pa-231	ΣS(j):		1.700E-01	1.663E-01	1.591E-01	1.362E-01	8.749E-02	1.857E-02	2.216E-04	4.113E-11
0Ac-227	Pa-231	1.000E+00	0.000E+00	5.126E-03	1.381E-02	3.194E-02	3.688E-02	9.124E-03	1.089E-04	2.012E-11
Ac-227	U-235	1.000E+00	0.000E+00	1.612E-08	1.331E-07	1.100E-06	4.493E-06	4.813E-06	1.934E-07	1.246E-13
Ac-227	ΣS(j):		0.000E+00	5.126E-03	1.381E-02	3.194E-02	3.689E-02	9.129E-03	1.091E-04	2.025E-11
0Pb-210	Pb-210	1.000E+00	4.000E-02	3.834E-02	3.523E-02	2.620E-02	1.124E-02	5.815E-04	1.229E-07	1.686E-20
Pb-210	Ra-226	1.000E+00	0.000E+00	1.668E-02	4.720E-02	1.285E-01	2.195E-01	1.201E-01	5.019E-03	5.732E-08
Pb-210	Th-230	1.000E+00	0.000E+00	1.784E-05	1.545E-04	1.502E-03	9.422E-03	3.642E-02	5.193E-02	5.157E-02
Pb-210	U-234	1.000E+00	0.000E+00	6.095E-13	1.581E-11	5.094E-10	9.354E-09	1.030E-07	2.344E-07	2.393E-07
Pb-210	ΣS(j):		4.000E-02	5.504E-02	8.258E-02	1.562E-01	2.402E-01	1.571E-01	5.695E-02	5.157E-02
0Ra-226	Ra-226	1.000E+00	5.500E-01	5.411E-01	5.238E-01	4.675E-01	3.377E-01	1.082E-01	4.189E-03	4.783E-08
Ra-226	Th-230	1.000E+00	0.000E+00	1.156E-03	3.412E-03	1.075E-02	2.765E-02	5.748E-02	7.066E-02	6.984E-02
Ra-226	U-234	1.000E+00	0.000E+00	5.899E-11	5.176E-10	5.263E-09	3.699E-08	1.862E-07	3.220E-07	3.240E-07
Ra-226	ΣS(j):		5.500E-01	5.423E-01	5.272E-01	4.782E-01	3.654E-01	1.657E-01	7.485E-02	6.984E-02
0Ra-228	Ra-228	1.000E+00	4.000E-02	3.490E-02	2.657E-02	1.023E-02	6.688E-04	4.781E-08	6.829E-20	0.000E+00
Ra-228	Th-232	1.000E+00	0.000E+00	6.761E-03	1.781E-02	3.947E-02	5.213E-02	5.295E-02	5.275E-02	5.207E-02
Ra-228	ΣS(j):		4.000E-02	4.166E-02	4.438E-02	4.970E-02	5.280E-02	5.295E-02	5.275E-02	5.207E-02
0Th-228	Ra-228	1.000E+00	0.000E+00	1.133E-02	2.098E-02	1.469E-02	1.071E-03	7.662E-08	1.095E-19	0.000E+00
Th-228	Th-228	1.000E+00	1.700E-01	1.183E-01	5.728E-02	4.525E-03	3.206E-06	3.035E-17	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	0.000E+00	1.113E-03	7.344E-03	3.215E-02	5.159E-02	5.295E-02	5.275E-02	5.207E-02
Th-228	ΣS(j):		1.700E-01	1.307E-01	8.561E-02	5.136E-02	5.267E-02	5.295E-02	5.275E-02	5.207E-02
0Th-230	Th-230	1.000E+00	2.690E+00	2.690E+00	2.690E+00	2.689E+00	2.688E+00	2.683E+00	2.668E+00	2.616E+00
Th-230	U-234	1.000E+00	0.000E+00	2.728E-07	8.007E-07	2.474E-06	6.045E-06	1.108E-05	1.236E-05	1.214E-05
Th-230	ΣS(j):		2.690E+00	2.690E+00	2.690E+00	2.689E+00	2.688E+00	2.683E+00	2.668E+00	2.616E+00
0Th-232	Th-232	1.000E+00	6.000E-02	6.000E-02	6.000E-02	5.999E-02	5.997E-02	5.989E-02	5.967E-02	5.890E-02
0U-234	U-234	1.000E+00	3.000E-02	2.934E-02	2.807E-02	2.404E-02	1.545E-02	3.281E-03	3.925E-05	7.346E-12
0U-235	U-235	1.000E+00	5.000E-02	4.891E-02	4.679E-02	4.007E-02	2.574E-02	5.470E-03	6.547E-05	1.228E-11

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time = 3.21 seconds



Note: The data line for each radionuclide includes dose contributions from that radionuclide's decay progeny (e.g., the Th-230 data line includes the dose contribution from Ra-226 that results from the radioactive decay of Th-230; the Ra-226 data line does not include the Ra-226 resulting from Th-230 decay).

VP-53 Resident Gardener with FGR-15 External DCFs (Infinite Volume, Adult)
RESRAD Dose Summary

Summary : VP-53 - Res. Gardener, FGR15, Five Year Review
File   : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\VP-53 RES GARDENER_FGR15.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

0

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-227 (Source: FGR-15_STL COCs)	4.330E-04	2.615E-04	DCF1(1)
A-1	At-218 (Source: FGR-15_STL COCs)	5.260E-04	5.567E-05	DCF1(2)
A-1	At-219 (Source: FGR-15_STL COCs)	0.000E+00	0.000E+00	DCF1(3)
A-1	Bi-210 (Source: FGR-15_STL COCs)	1.280E-01	5.474E-03	DCF1(4)
A-1	Bi-211 (Source: FGR-15_STL COCs)	2.370E-01	2.410E-01	DCF1(5)
A-1	Bi-212 (Source: FGR-15_STL COCs)	8.160E-01	6.259E-01	DCF1(6)
A-1	Bi-214 (Source: FGR-15_STL COCs)	9.370E+00	9.136E+00	DCF1(7)
A-1	Bi-215 (Source: FGR-15_STL COCs)	1.590E+00	1.369E+00	DCF1(8)
A-1	Fr-223 (Source: FGR-15_STL COCs)	2.860E-01	1.758E-01	DCF1(9)
A-1	Hg-206 (Source: FGR-15_STL COCs)	7.300E-01	6.128E-01	DCF1(10)
A-1	Pa-231 (Source: FGR-15_STL COCs)	1.590E-01	1.609E-01	DCF1(11)
A-1	Pa-234 (Source: FGR-15_STL COCs)	8.290E+00	8.276E+00	DCF1(12)
A-1	Pa-234m (Source: FGR-15_STL COCs)	4.460E-01	1.257E-01	DCF1(13)
A-1	Pb-210 (Source: FGR-15_STL COCs)	2.350E-03	2.092E-03	DCF1(14)
A-1	Pb-211 (Source: FGR-15_STL COCs)	5.150E-01	3.680E-01	DCF1(15)
A-1	Pb-212 (Source: FGR-15_STL COCs)	6.500E-01	6.315E-01	DCF1(16)
A-1	Pb-214 (Source: FGR-15_STL COCs)	1.300E+00	1.257E+00	DCF1(17)
A-1	Po-210 (Source: DCFPAK3.02)	5.641E-05	5.641E-05	DCF1(18)
A-1	Po-211 (Source: FGR-15_STL COCs)	4.670E-02	4.708E-02	DCF1(19)
A-1	Po-212 (Source: FGR-15_STL COCs)	0.000E+00	0.000E+00	DCF1(20)
A-1	Po-214 (Source: FGR-15_STL COCs)	4.780E-04	4.801E-04	DCF1(21)
A-1	Po-215 (Source: FGR-15_STL COCs)	9.340E-04	9.453E-04	DCF1(22)
A-1	Po-216 (Source: FGR-15_STL COCs)	8.810E-05	8.874E-05	DCF1(23)
A-1	Po-218 (Source: FGR-15_STL COCs)	2.260E-06	9.229E-09	DCF1(24)
A-1	Ra-223 (Source: FGR-15_STL COCs)	5.830E-01	5.791E-01	DCF1(25)
A-1	Ra-224 (Source: FGR-15_STL COCs)	4.910E-02	4.951E-02	DCF1(26)
A-1	Ra-226 (Source: FGR-15_STL COCs)	3.210E-02	3.176E-02	DCF1(27)
A-1	Rn-218 (Source: FGR-15_STL COCs)	4.200E-03	4.260E-03	DCF1(28)
A-1	Rn-219 (Source: FGR-15_STL COCs)	2.930E-01	2.970E-01	DCF1(29)
A-1	Rn-220 (Source: FGR-15_STL COCs)	3.440E-03	3.475E-03	DCF1(30)
A-1	Rn-222 (Source: FGR-15_STL COCs)	2.110E-03	2.130E-03	DCF1(31)
A-1	Th-227 (Source: FGR-15_STL COCs)	5.600E-01	5.642E-01	DCF1(32)
A-1	Th-228 (Source: FGR-15_STL COCs)	7.430E-03	7.249E-03	DCF1(33)
A-1	Th-230 (Source: FGR-15_STL COCs)	1.160E-03	1.106E-03	DCF1(34)
A-1	Th-231 (Source: FGR-15_STL COCs)	4.690E-02	3.251E-02	DCF1(35)
A-1	Th-234 (Source: FGR-15_STL COCs)	2.990E-02	2.317E-02	DCF1(36)
A-1	Tl-206 (Source: DCFPAK3.02)	1.278E-02	1.278E-02	DCF1(37)
A-1	Tl-207 (Source: FGR-15_STL COCs)	1.920E-01	2.391E-02	DCF1(38)
A-1	Tl-208 (Source: FGR-15_STL COCs)	2.200E+01	2.167E+01	DCF1(39)
A-1	Tl-210 (Source: FGR-15_STL COCs)	1.730E+01	1.678E+01	DCF1(40)

A-1	U-234 (Source: FGR-15_STL COCs)	3.510E-04	3.456E-04	DCF1(41)
A-1	U-235 (Source: FGR-15_STL COCs)	7.060E-01	7.006E-01	DCF1(42)
A-1	U-238 (Source: FGR-15_STL COCs)	1.720E-04	1.713E-04	DCF1(43)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.459E-01	5.760E-01	DCF2(1)
B-1	Pa-231	8.505E-01	8.505E-01	DCF2(2)
B-1	Pb-210+D	3.708E-02	2.077E-02	DCF2(3)
B-1	Ra-226+D	3.528E-02	3.517E-02	DCF2(4)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	Th-228+D	1.600E-01	1.468E-01	DCF2(5)
B-1	Th-230	3.759E-01	3.759E-01	DCF2(6)
B-1	U-234	3.479E-02	3.479E-02	DCF2(7)
B-1	U-235+D	3.132E-02	3.132E-02	DCF2(8)
B-1	U-238	2.973E-02	2.973E-02	DCF2(9)
B-1	U-238+D	2.976E-02	2.973E-02	DCF2(10)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.607E-03	1.191E-03	DCF3(1)
D-1	Pa-231	1.772E-03	1.772E-03	DCF3(2)
D-1	Pb-210+D	7.057E-03	2.575E-03	DCF3(3)
D-1	Ra-226+D	1.037E-03	1.036E-03	DCF3(4)
D-1	Th-228+D	5.286E-04	2.664E-04	DCF3(5)
D-1	Th-230	7.918E-04	7.918E-04	DCF3(6)
D-1	U-234	1.831E-04	1.831E-04	DCF3(7)
D-1	U-235+D	1.740E-04	1.728E-04	DCF3(8)
D-1	U-238	1.650E-04	1.650E-04	DCF3(9)
D-1	U-238+D	1.776E-04	1.650E-04	DCF3(10)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)

D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR-15_STL COCs Plus DCFPAK3.02 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(10,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(5,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(5,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(10,1)

D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.400E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	3.000E-01	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.900E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ac-227	1.050E+00	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Pa-231	2.400E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Pb-210	3.000E-02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Ra-226	3.700E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Th-228	6.200E-01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Th-230	2.060E+00	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): U-234	2.000E-02	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-235	1.000E-02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-238	4.200E-01	0.000E+00	---	S1(9)
R012	Concentration in groundwater (pCi/L): Ac-227	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Pa-231	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(9)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	6.000E-05	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ

R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.497E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)

R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.109E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.582E-02	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.852E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.852E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)

R017	Inhalation rate (m**3/yr)	4.836E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	4.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.550E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	7.990E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	4.380E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT

R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)

STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Summary : VP-53 - Res. Gardener, FGR15, Five Year Review

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\VP-53 RES GARDENER_FGR15.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	13998.00 square meters	Ac-227	1.050E+00
Thickness:	0.30 meters	Pa-231	2.400E-01
Cover Depth:	0.00 meters	Pb-210	3.000E-02
		Ra-226	3.700E-01
		Th-228	6.200E-01
		Th-230	2.060E+00
		U-234	2.000E-02
		U-235	1.000E-02
		U-238	4.200E-01

0

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 1.900E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.681E+00	4.127E+00	3.423E+00	2.550E+00	1.889E+00	9.457E-01	4.884E-01	5.804E-01
M(t):	2.464E-01	2.172E-01	1.802E-01	1.342E-01	9.944E-02	4.977E-02	2.570E-02	3.055E-02

0Maximum TDOSE(t): 4.681E+00 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	7.843E-01	0.1676	1.882E-02	0.0040	0.000E+00	0.0000	1.175E-01	0.0251	0.000E+00	0.0000	0.000E+00	0.0000	5.201E-02	0.0111
Pa-231	1.530E-02	0.0033	5.918E-03	0.0013	0.000E+00	0.0000	1.226E-01	0.0262	0.000E+00	0.0000	0.000E+00	0.0000	1.373E-02	0.0029
Pb-210	1.264E-03	0.0003	3.156E-05	0.0000	0.000E+00	0.0000	6.015E-02	0.0129	0.000E+00	0.0000	0.000E+00	0.0000	6.673E-03	0.0014
Ra-226	1.255E+00	0.2680	3.812E-04	0.0001	0.000E+00	0.0000	4.554E-01	0.0973	0.000E+00	0.0000	0.000E+00	0.0000	1.354E-02	0.0029
Th-228	1.537E+00	0.3284	2.411E-03	0.0005	0.000E+00	0.0000	8.001E-03	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	8.848E-03	0.0019
Th-230	2.310E-03	0.0005	2.243E-02	0.0048	0.000E+00	0.0000	4.799E-02	0.0103	0.000E+00	0.0000	0.000E+00	0.0000	5.252E-02	0.0112
U-234	2.372E-06	0.0000	1.994E-05	0.0000	0.000E+00	0.0000	2.632E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	1.166E-04	0.0000
U-235	2.464E-03	0.0005	8.977E-06	0.0000	0.000E+00	0.0000	1.251E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.541E-05	0.0000
U-238	6.594E-02	0.0141	3.581E-04	0.0001	0.000E+00	0.0000	5.359E-03	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	2.374E-03	0.0005
Total	3.663E+00	0.7826	5.038E-02	0.0108	0.000E+00	0.0000	8.174E-01	0.1746	0.000E+00	0.0000	0.000E+00	0.0000	1.499E-01	0.0320

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.727E-01	0.2078
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.576E-01	0.0337
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.812E-02	0.0146
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.724E+00	0.3683
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.556E+00	0.3325
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.253E-01	0.0268
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.021E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.654E-03	0.0006
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.404E-02	0.0158
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.681E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	7.191E-01	0.1742	1.725E-02	0.0042	0.000E+00	0.0000	1.077E-01	0.0261	0.000E+00	0.0000	0.000E+00	0.0000	4.768E-02	0.0116
Pa-231	2.037E-02	0.0049	5.918E-03	0.0014	0.000E+00	0.0000	1.207E-01	0.0293	0.000E+00	0.0000	0.000E+00	0.0000	1.379E-02	0.0033
Pb-210	1.212E-03	0.0003	3.025E-05	0.0000	0.000E+00	0.0000	5.765E-02	0.0140	0.000E+00	0.0000	0.000E+00	0.0000	6.396E-03	0.0015
Ra-226	1.235E+00	0.2992	3.869E-04	0.0001	0.000E+00	0.0000	4.708E-01	0.1141	0.000E+00	0.0000	0.000E+00	0.0000	1.581E-02	0.0038
Th-228	1.070E+00	0.2591	1.678E-03	0.0004	0.000E+00	0.0000	5.566E-03	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	6.157E-03	0.0015
Th-230	5.312E-03	0.0013	2.243E-02	0.0054	0.000E+00	0.0000	4.909E-02	0.0119	0.000E+00	0.0000	0.000E+00	0.0000	5.255E-02	0.0127
U-234	2.320E-06	0.0000	1.950E-05	0.0000	0.000E+00	0.0000	2.574E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	1.141E-04	0.0000
U-235	2.410E-03	0.0006	8.786E-06	0.0000	0.000E+00	0.0000	1.225E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.421E-05	0.0000
U-238	6.450E-02	0.0156	3.503E-04	0.0001	0.000E+00	0.0000	5.241E-03	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	2.322E-03	0.0006
Total	3.117E+00	0.7552	4.808E-02	0.0116	0.000E+00	0.0000	8.173E-01	0.1980	0.000E+00	0.0000	0.000E+00	0.0000	1.449E-01	0.0351

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.918E-01	0.2161
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.608E-01	0.0390
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.529E-02	0.0158
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.722E+00	0.4172
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.083E+00	0.2624
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.294E-01	0.0313
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.933E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.596E-03	0.0006
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.241E-02	0.0175
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.127E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	6.045E-01	0.1766	1.450E-02	0.0042	0.000E+00	0.0000	9.053E-02	0.0264	0.000E+00	0.0000	0.000E+00	0.0000	4.008E-02	0.0117
Pa-231	2.888E-02	0.0084	5.887E-03	0.0017	0.000E+00	0.0000	1.169E-01	0.0341	0.000E+00	0.0000	0.000E+00	0.0000	1.381E-02	0.0040
Pb-210	1.114E-03	0.0003	2.780E-05	0.0000	0.000E+00	0.0000	5.295E-02	0.0155	0.000E+00	0.0000	0.000E+00	0.0000	5.877E-03	0.0017
Ra-226	1.196E+00	0.3494	3.965E-04	0.0001	0.000E+00	0.0000	4.975E-01	0.1453	0.000E+00	0.0000	0.000E+00	0.0000	1.995E-02	0.0058
Th-228	5.179E-01	0.1513	8.124E-04	0.0002	0.000E+00	0.0000	2.694E-03	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	2.981E-03	0.0009
Th-230	1.117E-02	0.0033	2.244E-02	0.0066	0.000E+00	0.0000	5.140E-02	0.0150	0.000E+00	0.0000	0.000E+00	0.0000	5.264E-02	0.0154
U-234	2.221E-06	0.0000	1.866E-05	0.0000	0.000E+00	0.0000	2.462E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	1.091E-04	0.0000
U-235	2.306E-03	0.0007	8.416E-06	0.0000	0.000E+00	0.0000	1.173E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.188E-05	0.0000
U-238	6.171E-02	0.0180	3.351E-04	0.0001	0.000E+00	0.0000	5.012E-03	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	2.222E-03	0.0006
Total	2.424E+00	0.7080	4.443E-02	0.0130	0.000E+00	0.0000	8.173E-01	0.2388	0.000E+00	0.0000	0.000E+00	0.0000	1.377E-01	0.0402

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.496E-01	0.2190
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.655E-01	0.0483
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.997E-02	0.0175
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.714E+00	0.5007
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.243E-01	0.1532
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.376E-01	0.0402
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.762E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.484E-03	0.0007
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.928E-02	0.0202
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.423E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	3.292E-01	0.1291	7.900E-03	0.0031	0.000E+00	0.0000	4.924E-02	0.0193	0.000E+00	0.0000	0.000E+00	0.0000	2.183E-02	0.0086
Pa-231	4.594E-02	0.0180	5.550E-03	0.0022	0.000E+00	0.0000	1.031E-01	0.0404	0.000E+00	0.0000	0.000E+00	0.0000	1.324E-02	0.0052
Pb-210	8.282E-04	0.0003	2.067E-05	0.0000	0.000E+00	0.0000	3.932E-02	0.0154	0.000E+00	0.0000	0.000E+00	0.0000	4.371E-03	0.0017
Ra-226	1.070E+00	0.4195	4.150E-04	0.0002	0.000E+00	0.0000	5.596E-01	0.2194	0.000E+00	0.0000	0.000E+00	0.0000	3.073E-02	0.0120
Th-228	4.090E-02	0.0160	6.418E-05	0.0000	0.000E+00	0.0000	2.125E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	2.355E-04	0.0001
Th-230	3.028E-02	0.0119	2.244E-02	0.0088	0.000E+00	0.0000	6.030E-02	0.0236	0.000E+00	0.0000	0.000E+00	0.0000	5.306E-02	0.0208
U-234	1.914E-06	0.0000	1.600E-05	0.0000	0.000E+00	0.0000	2.106E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	9.351E-05	0.0000
U-235	1.975E-03	0.0008	7.241E-06	0.0000	0.000E+00	0.0000	1.010E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.452E-05	0.0000
U-238	5.285E-02	0.0207	2.870E-04	0.0001	0.000E+00	0.0000	4.287E-03	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	1.903E-03	0.0007
Total	1.572E+00	0.6163	3.670E-02	0.0144	0.000E+00	0.0000	8.164E-01	0.3201	0.000E+00	0.0000	0.000E+00	0.0000	1.255E-01	0.0492

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.082E-01	0.1601
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.679E-01	0.0658
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.454E-02	0.0175
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.661E+00	0.6511
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.142E-02	0.0162
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.661E-01	0.0651
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.220E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.128E-03	0.0008
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.933E-02	0.0233
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.550E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	5.801E-02	0.0307	1.392E-03	0.0007	0.000E+00	0.0000	8.642E-03	0.0046	0.000E+00	0.0000	0.000E+00	0.0000	3.847E-03	0.0020
Pa-231	4.676E-02	0.0247	3.978E-03	0.0021	0.000E+00	0.0000	6.852E-02	0.0363	0.000E+00	0.0000	0.000E+00	0.0000	9.644E-03	0.0051
Pb-210	3.553E-04	0.0002	8.868E-06	0.0000	0.000E+00	0.0000	1.680E-02	0.0089	0.000E+00	0.0000	0.000E+00	0.0000	1.875E-03	0.0010
Ra-226	7.762E-01	0.4108	3.894E-04	0.0002	0.000E+00	0.0000	5.725E-01	0.3030	0.000E+00	0.0000	0.000E+00	0.0000	4.115E-02	0.0218
Th-228	2.897E-05	0.0000	4.547E-08	0.0000	0.000E+00	0.0000	1.500E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.669E-07	0.0000
Th-230	7.439E-02	0.0394	2.245E-02	0.0119	0.000E+00	0.0000	8.797E-02	0.0466	0.000E+00	0.0000	0.000E+00	0.0000	5.485E-02	0.0290
U-234	1.309E-06	0.0000	1.031E-05	0.0000	0.000E+00	0.0000	1.348E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	6.014E-05	0.0000
U-235	1.270E-03	0.0007	4.719E-06	0.0000	0.000E+00	0.0000	6.579E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.876E-05	0.0000
U-238	3.395E-02	0.0180	1.844E-04	0.0001	0.000E+00	0.0000	2.743E-03	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	1.223E-03	0.0006
Total	9.910E-01	0.5245	2.841E-02	0.0150	0.000E+00	0.0000	7.574E-01	0.4009	0.000E+00	0.0000	0.000E+00	0.0000	1.127E-01	0.0596

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

0 Water Dependent Pathways

0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.189E-02	0.0381
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.289E-01	0.0682
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.904E-02	0.0101
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.390E+00	0.7358
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.933E-05	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.397E-01	0.1268
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.066E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.369E-03	0.0007
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.810E-02	0.0202
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.889E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	1.332E-04	0.0001	3.197E-06	0.0000	0.000E+00	0.0000	1.957E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.835E-06	0.0000
Pa-231	1.129E-02	0.0119	8.769E-04	0.0009	0.000E+00	0.0000	1.453E-02	0.0154	0.000E+00	0.0000	0.000E+00	0.0000	2.137E-03	0.0023
Pb-210	1.839E-05	0.0000	4.588E-07	0.0000	0.000E+00	0.0000	8.570E-04	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	9.700E-05	0.0001
Ra-226	2.499E-01	0.2642	1.600E-04	0.0002	0.000E+00	0.0000	2.467E-01	0.2608	0.000E+00	0.0000	0.000E+00	0.0000	2.064E-02	0.0218
Th-228	2.737E-16	0.0000	4.304E-19	0.0000	0.000E+00	0.0000	1.400E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.579E-18	0.0000
Th-230	1.525E-01	0.1612	2.245E-02	0.0237	0.000E+00	0.0000	1.548E-01	0.1637	0.000E+00	0.0000	0.000E+00	0.0000	6.019E-02	0.0636
U-234	6.908E-07	0.0000	2.261E-06	0.0000	0.000E+00	0.0000	2.867E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.296E-05	0.0000
U-235	2.705E-04	0.0003	1.056E-06	0.0000	0.000E+00	0.0000	1.468E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.241E-06	0.0000
U-238	7.210E-03	0.0076	3.919E-05	0.0000	0.000E+00	0.0000	5.748E-04	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	2.598E-04	0.0003
Total	4.213E-01	0.4455	2.353E-02	0.0249	0.000E+00	0.0000	4.175E-01	0.4415	0.000E+00	0.0000	0.000E+00	0.0000	8.334E-02	0.0881

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Dependent Pathways

Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.648E-04	0.0002
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.884E-02	0.0305
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.729E-04	0.0010
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.173E-01	0.5470
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.771E-16	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.900E-01	0.4124
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.458E-05	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.925E-04	0.0003
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.083E-03	0.0085
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.457E-01	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	3.843E-12	0.0000	9.227E-14	0.0000	0.000E+00	0.0000	5.417E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.550E-13	0.0000
Pa-231	1.347E-04	0.0003	1.045E-05	0.0000	0.000E+00	0.0000	1.662E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	2.548E-05	0.0001
Pb-210	3.889E-09	0.0000	9.696E-11	0.0000	0.000E+00	0.0000	1.737E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.050E-08	0.0000
Ra-226	9.648E-03	0.0198	6.455E-06	0.0000	0.000E+00	0.0000	9.628E-03	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	8.541E-04	0.0017
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	1.865E-01	0.3818	2.235E-02	0.0458	0.000E+00	0.0000	1.824E-01	0.3734	0.000E+00	0.0000	0.000E+00	0.0000	6.291E-02	0.1288
U-234	7.430E-07	0.0000	1.162E-07	0.0000	0.000E+00	0.0000	1.047E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.053E-07	0.0000
U-235	3.262E-06	0.0000	1.449E-08	0.0000	0.000E+00	0.0000	1.979E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.920E-08	0.0000
U-238	8.615E-05	0.0002	4.696E-07	0.0000	0.000E+00	0.0000	6.604E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.112E-06	0.0000
Total	1.963E-01	0.4020	2.236E-02	0.0458	0.000E+00	0.0000	1.922E-01	0.3935	0.000E+00	0.0000	0.000E+00	0.0000	6.379E-02	0.1306

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.367E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.367E-05	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.369E-02	0.0280	0.000E+00	0.0000	0.000E+00	0.0000	1.403E-02	0.0287
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.982E-07	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.014E-02	0.0412
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.541E-01	0.9298
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.312E-06	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.881E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.435E-06	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.633E-05	0.0002
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.371E-02	0.0281	0.000E+00	0.0000	0.000E+00	0.0000	4.884E-01	1.0000

0*Sum of all water independent and dependent pathways.

Summary : VP-53 - Res. Gardener, FGR15, Five Year Review
File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\VP-53 RES GARDENER_FGR15.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	2.477E-11	0.0000	1.932E-12	0.0000	0.000E+00	0.0000	2.614E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.708E-12	0.0000
Pb-210	5.346E-22	0.0000	1.330E-23	0.0000	0.000E+00	0.0000	2.029E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.813E-21	0.0000
Ra-226	1.081E-07	0.0000	7.371E-11	0.0000	0.000E+00	0.0000	9.357E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.753E-09	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	1.808E-01	0.3115	2.192E-02	0.0378	0.000E+00	0.0000	1.534E-01	0.2644	0.000E+00	0.0000	0.000E+00	0.0000	6.182E-02	0.1065
U-234	7.303E-07	0.0000	8.853E-08	0.0000	0.000E+00	0.0000	6.198E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.497E-07	0.0000
U-235	6.266E-13	0.0000	3.918E-15	0.0000	0.000E+00	0.0000	4.784E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.778E-14	0.0000
U-238	1.975E-09	0.0000	2.376E-10	0.0000	0.000E+00	0.0000	1.664E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.705E-10	0.0000
Total	1.808E-01	0.3115	2.192E-02	0.0378	0.000E+00	0.0000	1.534E-01	0.2644	0.000E+00	0.0000	0.000E+00	0.0000	6.182E-02	0.1065

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.509E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.509E-28	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.148E-02	0.1059	0.000E+00	0.0000	0.000E+00	0.0000	6.148E-02	0.1059
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.247E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.247E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.816E-02	0.0830	0.000E+00	0.0000	0.000E+00	0.0000	4.816E-02	0.0830
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.898E-02	0.0844	0.000E+00	0.0000	0.000E+00	0.0000	4.670E-01	0.8046
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.744E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	1.761E-04	0.0003
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.345E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	1.345E-04	0.0002
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.472E-03	0.0060	0.000E+00	0.0000	0.000E+00	0.0000	3.472E-03	0.0060
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.624E-01	0.2798	0.000E+00	0.0000	0.000E+00	0.0000	5.804E-01	1.0000

0*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227+D	Ac-227+D	1.000E+00	9.263E-01	8.493E-01	7.139E-01	3.888E-01	6.847E-02	1.570E-04	1.301E-05	2.389E-28
0Pa-231	Pa-231	1.000E+00	6.414E-01	6.273E-01	5.999E-01	5.132E-01	3.285E-01	6.891E-02	7.948E-04	8.070E-02
Pa-231	Ac-227+D	1.000E+00	1.518E-02	4.284E-02	8.951E-02	1.862E-01	2.087E-01	5.125E-02	5.765E-02	1.755E-01
Pa-231	ΣDSR(j)		6.565E-01	6.701E-01	6.894E-01	6.994E-01	5.371E-01	1.202E-01	5.845E-02	2.562E-01
0Pb-210+D	Pb-210+D	1.000E+00	2.271E+00	2.176E+00	1.999E+00	1.485E+00	6.348E-01	3.243E-02	6.607E-06	4.156E-15
0Ra-226+D	Ra-226+D	1.000E+00	4.618E+00	4.543E+00	4.397E+00	3.923E+00	2.830E+00	9.028E-01	3.449E-02	2.244E-02
Ra-226+D	Pb-210+D	1.000E+00	4.126E-02	1.104E-01	2.350E-01	5.654E-01	9.272E-01	4.953E-01	1.993E-02	1.077E-01
Ra-226+D	ΣDSR(j)		4.659E+00	4.654E+00	4.632E+00	4.488E+00	3.757E+00	1.398E+00	5.442E-02	1.302E-01
0Th-228+D	Th-228+D	1.000E+00	2.510E+00	1.747E+00	8.457E-01	6.680E-02	4.730E-05	4.470E-16	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+00	5.981E-02	5.980E-02	5.979E-02	5.975E-02	5.962E-02	5.918E-02	5.795E-02	5.371E-02
Th-230	Ra-226+D	1.000E+00	9.876E-04	2.969E-03	6.841E-03	1.943E-02	4.837E-02	9.902E-02	1.199E-01	1.166E-01
Th-230	Pb-210+D	1.000E+00	6.479E-06	3.970E-05	1.904E-04	1.441E-03	8.350E-03	3.110E-02	4.257E-02	5.634E-02
Th-230	ΣDSR(j)		6.080E-02	6.281E-02	6.682E-02	8.062E-02	1.163E-01	1.893E-01	2.204E-01	2.267E-01
0U-234	U-234	1.000E+00	2.011E-02	1.966E-02	1.881E-02	1.609E-02	1.031E-02	2.170E-03	2.527E-05	8.478E-03
U-234	Th-230	1.000E+00	2.824E-07	8.217E-07	1.862E-06	5.157E-06	1.217E-05	2.195E-05	2.408E-05	2.252E-05
U-234	Ra-226+D	1.000E+00	2.984E-09	2.096E-08	1.087E-07	8.932E-07	5.883E-06	2.884E-05	4.901E-05	9.093E-05
U-234	Pb-210+D	1.000E+00	1.575E-11	2.036E-10	2.112E-09	4.644E-08	7.574E-07	7.920E-06	1.723E-05	2.130E-04
U-234	ΣDSR(j)		2.011E-02	1.967E-02	1.881E-02	1.610E-02	1.033E-02	2.229E-03	1.156E-04	8.804E-03
0U-235+D	U-235+D	1.000E+00	2.654E-01	2.596E-01	2.483E-01	2.127E-01	1.366E-01	2.901E-02	3.466E-04	8.078E-03
U-235+D	Pa-231	1.000E+00	6.516E-06	1.960E-05	4.414E-05	1.138E-04	2.119E-04	1.467E-04	5.069E-06	1.727E-03
U-235+D	Ac-227+D	1.000E+00	1.089E-07	7.206E-07	3.472E-06	2.305E-05	8.820E-05	9.247E-05	2.918E-04	3.648E-03
U-235+D	ΣDSR(j)		2.654E-01	2.596E-01	2.484E-01	2.128E-01	1.369E-01	2.925E-02	6.435E-04	1.345E-02
0U-238	U-238	5.450E-07	9.821E-09	9.605E-09	9.187E-09	7.861E-09	5.037E-09	1.060E-09	1.235E-11	4.175E-09
0U-238+D	U-238+D	1.000E+00	1.763E-01	1.724E-01	1.649E-01	1.413E-01	9.071E-02	1.925E-02	2.293E-04	8.242E-03
U-238+D	U-234	1.000E+00	2.828E-08	8.318E-08	1.858E-07	4.771E-07	8.879E-07	6.159E-07	2.145E-08	2.398E-05
U-238+D	Th-230	1.000E+00	2.708E-13	1.814E-12	9.189E-12	7.366E-11	4.658E-10	2.047E-09	3.049E-09	3.211E-09
U-238+D	Ra-226+D	1.000E+00	2.084E-15	3.140E-14	3.590E-13	8.615E-12	1.569E-10	2.104E-09	5.993E-09	5.804E-08
U-238+D	Pb-210+D	1.000E+00	9.318E-18	2.462E-16	5.431E-15	3.461E-13	1.605E-11	5.042E-10	2.068E-09	2.274E-07
U-238+D	ΣDSR(j)		1.763E-01	1.724E-01	1.649E-01	1.413E-01	9.071E-02	1.925E-02	2.294E-04	8.267E-03

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.900E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	2.051E+01	2.237E+01	2.661E+01	4.887E+01	2.775E+02	1.210E+05	1.460E+06	*7.232E+13
Pa-231	2.894E+01	2.835E+01	2.756E+01	2.717E+01	3.537E+01	1.581E+02	3.251E+02	7.417E+01
Pb-210	8.367E+00	8.730E+00	9.504E+00	1.280E+01	2.993E+01	5.859E+02	2.876E+06	*7.632E+13
Ra-226	4.078E+00	4.083E+00	4.102E+00	4.234E+00	5.057E+00	1.359E+01	3.491E+02	1.460E+02
Th-228	7.569E+00	1.088E+01	2.247E+01	2.844E+02	4.017E+05	*8.201E+14	*8.201E+14	*8.201E+14
Th-230	3.125E+02	3.025E+02	2.843E+02	2.357E+02	1.633E+02	1.004E+02	8.620E+01	8.382E+01
U-234	9.450E+02	9.662E+02	1.010E+03	1.180E+03	1.839E+03	8.524E+03	1.644E+05	2.158E+03
U-235	7.159E+01	7.319E+01	7.650E+01	8.928E+01	1.388E+02	6.496E+02	2.953E+04	1.412E+03
U-238	1.078E+02	1.102E+02	1.152E+02	1.345E+02	2.095E+02	9.872E+02	8.284E+04	2.298E+03

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ac-227	1.050E+00	0.000E+00	9.263E-01	2.051E+01	9.263E-01	2.051E+01
Pa-231	2.400E-01	7.28 ± 0.01	7.040E-01	2.699E+01	6.565E-01	2.894E+01
Pb-210	3.000E-02	0.000E+00	2.271E+00	8.367E+00	2.271E+00	8.367E+00
Ra-226	3.700E-01	0.000E+00	4.659E+00	4.078E+00	4.659E+00	4.078E+00
Th-228	6.200E-01	0.000E+00	2.510E+00	7.569E+00	2.510E+00	7.569E+00
Th-230	2.060E+00	1.000E+03	2.267E-01	8.382E+01	6.080E-02	3.125E+02
U-234	2.000E-02	0.000E+00	2.011E-02	9.450E+02	2.011E-02	9.450E+02
U-235	1.000E-02	0.000E+00	2.654E-01	7.159E+01	2.654E-01	7.159E+01
U-238	4.200E-01	0.000E+00	1.763E-01	1.078E+02	1.763E-01	1.078E+02

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	Ac-227	1.000E+00	9.727E-01	8.918E-01	7.496E-01	4.082E-01	7.189E-02	1.648E-04	1.367E-05	2.509E-28
Ac-227	Pa-231	1.000E+00	3.644E-03	1.028E-02	2.148E-02	4.469E-02	5.008E-02	1.230E-02	1.384E-02	4.211E-02
Ac-227	U-235	1.000E+00	1.089E-09	7.206E-09	3.472E-08	2.305E-07	8.820E-07	9.247E-07	2.918E-06	3.648E-05
Ac-227	ΣDOSE(j)		9.763E-01	9.021E-01	7.711E-01	4.529E-01	1.220E-01	1.247E-02	1.385E-02	4.215E-02
0Pa-231	Pa-231	1.000E+00	1.539E-01	1.505E-01	1.440E-01	1.232E-01	7.883E-02	1.654E-02	1.907E-04	1.937E-02
Pa-231	U-235	1.000E+00	6.516E-08	1.960E-07	4.414E-07	1.138E-06	2.119E-06	1.467E-06	5.069E-08	1.727E-05
Pa-231	ΣDOSE(j)		1.539E-01	1.505E-01	1.440E-01	1.232E-01	7.884E-02	1.654E-02	1.908E-04	1.939E-02
0Pb-210	Pb-210	1.000E+00	6.812E-02	6.529E-02	5.997E-02	4.454E-02	1.904E-02	9.729E-04	1.982E-07	1.247E-16
Pb-210	Ra-226	1.000E+00	1.527E-02	4.085E-02	8.694E-02	2.092E-01	3.431E-01	1.833E-01	7.374E-03	3.986E-02
Pb-210	Th-230	1.000E+00	1.335E-05	8.178E-05	3.922E-04	2.968E-03	1.720E-02	6.406E-02	8.769E-02	1.161E-01
Pb-210	U-234	1.000E+00	3.149E-13	4.072E-12	4.225E-11	9.287E-10	1.515E-08	1.584E-07	3.447E-07	4.261E-06
Pb-210	U-238	1.000E+00	3.914E-18	1.034E-16	2.281E-15	1.453E-13	6.742E-12	2.118E-10	8.687E-10	9.550E-08
Pb-210	ΣDOSE(j)		8.340E-02	1.062E-01	1.473E-01	2.567E-01	3.793E-01	2.483E-01	9.507E-02	1.559E-01
0Ra-226	Ra-226	1.000E+00	1.709E+00	1.681E+00	1.627E+00	1.451E+00	1.047E+00	3.341E-01	1.276E-02	8.303E-03
Ra-226	Th-230	1.000E+00	2.034E-03	6.116E-03	1.409E-02	4.003E-02	9.964E-02	2.040E-01	2.470E-01	2.403E-01
Ra-226	U-234	1.000E+00	5.968E-11	4.191E-10	2.175E-09	1.786E-08	1.177E-07	5.769E-07	9.802E-07	1.819E-06
Ra-226	U-238	1.000E+00	8.752E-16	1.319E-14	1.508E-13	3.618E-12	6.589E-11	8.836E-10	2.517E-09	2.437E-08
Ra-226	ΣDOSE(j)		1.711E+00	1.687E+00	1.641E+00	1.491E+00	1.147E+00	5.380E-01	2.598E-01	2.486E-01
0Th-228	Th-228	1.000E+00	1.556E+00	1.083E+00	5.243E-01	4.142E-02	2.933E-05	2.771E-16	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+00	1.232E-01	1.232E-01	1.232E-01	1.231E-01	1.228E-01	1.219E-01	1.194E-01	1.106E-01
Th-230	U-234	1.000E+00	5.649E-09	1.643E-08	3.723E-08	1.031E-07	2.434E-07	4.391E-07	4.815E-07	4.503E-07
Th-230	U-238	1.000E+00	1.137E-13	7.621E-13	3.859E-12	3.094E-11	1.957E-10	8.597E-10	1.281E-09	1.349E-09
Th-230	ΣDOSE(j)		1.232E-01	1.232E-01	1.232E-01	1.231E-01	1.228E-01	1.219E-01	1.194E-01	1.106E-01
0U-234	U-234	1.000E+00	4.021E-04	3.933E-04	3.762E-04	3.219E-04	2.062E-04	4.341E-05	5.055E-07	1.696E-04
U-234	U-238	1.000E+00	1.188E-08	3.494E-08	7.802E-08	2.004E-07	3.729E-07	2.587E-07	9.009E-09	1.007E-05
U-234	ΣDOSE(j)		4.021E-04	3.933E-04	3.762E-04	3.221E-04	2.066E-04	4.367E-05	5.145E-07	1.796E-04
0U-235	U-235	1.000E+00	2.654E-03	2.596E-03	2.483E-03	2.127E-03	1.366E-03	2.901E-04	3.466E-06	8.078E-05
0U-238	U-238	5.450E-07	4.125E-09	4.034E-09	3.858E-09	3.302E-09	2.115E-09	4.453E-10	5.188E-12	1.753E-09
U-238	U-238	1.000E+00	7.404E-02	7.241E-02	6.928E-02	5.933E-02	3.810E-02	8.083E-03	9.632E-05	3.462E-03
U-238	ΣDOSE(j)		7.404E-02	7.241E-02	6.928E-02	5.933E-02	3.810E-02	8.083E-03	9.632E-05	3.462E-03

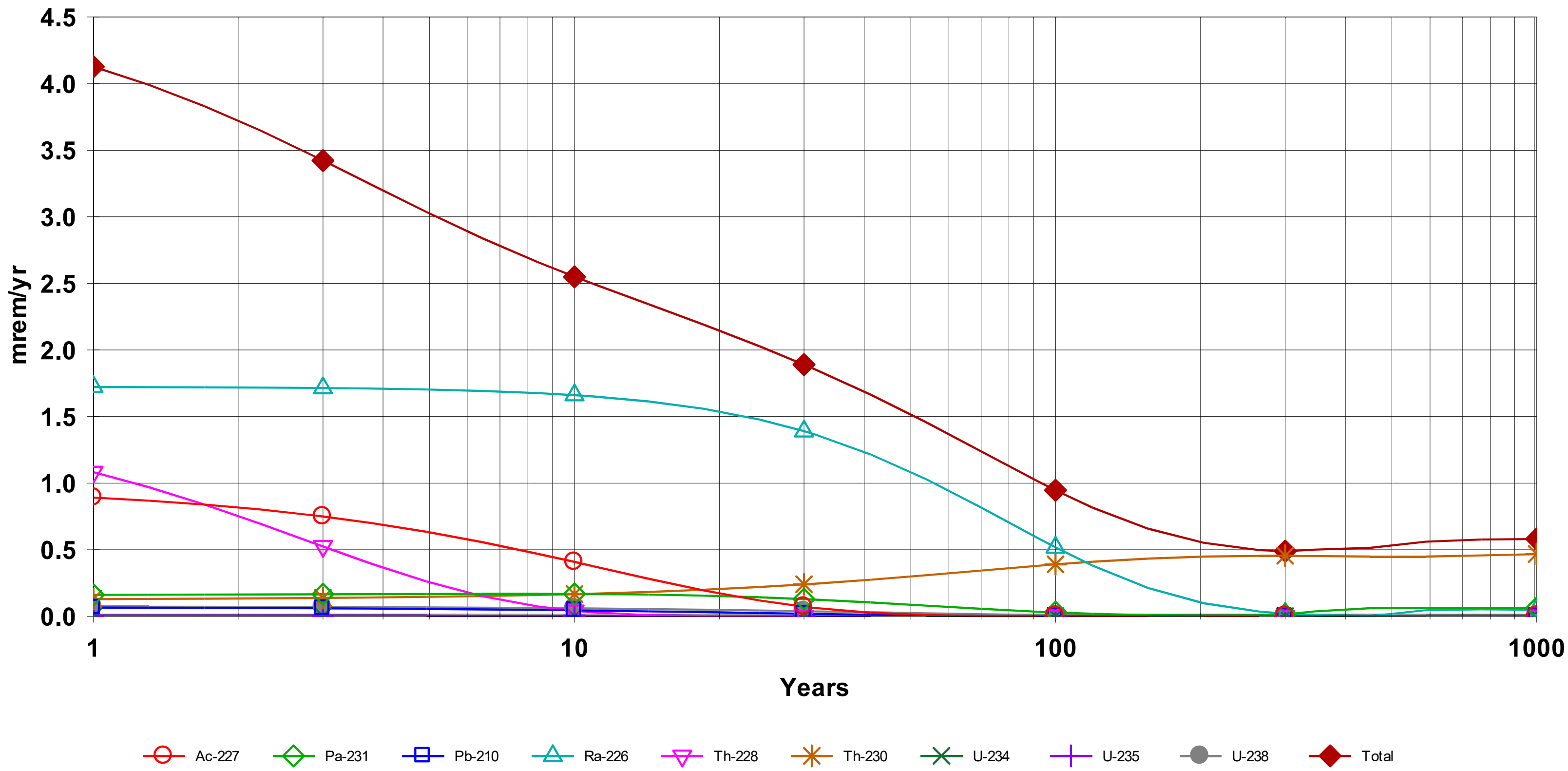
THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	Ac-227	1.000E+00	1.050E+00	9.627E-01	8.093E-01	4.408E-01	7.767E-02	1.784E-04	5.148E-12	2.102E-38
Ac-227	Pa-231	1.000E+00	0.000E+00	7.237E-03	1.950E-02	4.509E-02	5.207E-02	1.288E-02	1.538E-04	2.841E-11
Ac-227	U-235	1.000E+00	0.000E+00	3.224E-09	2.662E-08	2.200E-07	8.985E-07	9.626E-07	3.868E-08	2.492E-14
Ac-227	ΣS(j):		1.050E+00	9.699E-01	8.288E-01	4.859E-01	1.297E-01	1.306E-02	1.538E-04	2.844E-11
0Pa-231	Pa-231	1.000E+00	2.400E-01	2.347E-01	2.246E-01	1.923E-01	1.235E-01	2.620E-02	3.122E-04	5.770E-11
Pa-231	U-235	1.000E+00	0.000E+00	2.070E-07	5.940E-07	1.696E-06	3.267E-06	2.312E-06	8.284E-08	5.141E-14
Pa-231	ΣS(j):		2.400E-01	2.347E-01	2.246E-01	1.923E-01	1.235E-01	2.620E-02	3.123E-04	5.775E-11
0Pb-210	Pb-210	1.000E+00	3.000E-02	2.876E-02	2.642E-02	1.965E-02	8.431E-03	4.361E-04	9.217E-08	1.265E-20
Pb-210	Ra-226	1.000E+00	0.000E+00	1.122E-02	3.175E-02	8.644E-02	1.477E-01	8.080E-02	3.376E-03	3.856E-08
Pb-210	Th-230	1.000E+00	0.000E+00	1.366E-05	1.183E-04	1.150E-03	7.216E-03	2.789E-02	3.977E-02	3.949E-02
Pb-210	U-234	1.000E+00	0.000E+00	4.063E-13	1.054E-11	3.396E-10	6.236E-09	6.868E-08	1.563E-07	1.595E-07
Pb-210	U-238	1.000E+00	0.000E+00	6.020E-18	4.681E-16	5.011E-14	2.723E-12	9.137E-11	3.936E-10	4.280E-10
Pb-210	ΣS(j):		3.000E-02	3.999E-02	5.829E-02	1.072E-01	1.633E-01	1.091E-01	4.314E-02	3.949E-02
0Ra-226	Ra-226	1.000E+00	3.700E-01	3.640E-01	3.524E-01	3.145E-01	2.272E-01	7.280E-02	2.818E-03	3.217E-08
Ra-226	Th-230	1.000E+00	0.000E+00	8.852E-04	2.613E-03	8.235E-03	2.118E-02	4.401E-02	5.411E-02	5.348E-02
Ra-226	U-234	1.000E+00	0.000E+00	3.933E-11	3.450E-10	3.509E-09	2.466E-08	1.241E-07	2.147E-07	2.160E-07
Ra-226	U-238	1.000E+00	0.000E+00	7.755E-16	2.032E-14	6.773E-13	1.360E-11	1.895E-10	5.512E-10	5.796E-10
Ra-226	ΣS(j):		3.700E-01	3.649E-01	3.550E-01	3.227E-01	2.484E-01	1.168E-01	5.693E-02	5.348E-02
0Th-228	Th-228	1.000E+00	6.200E-01	4.314E-01	2.089E-01	1.650E-02	1.169E-05	1.107E-16	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+00	2.060E+00	2.060E+00	2.060E+00	2.059E+00	2.058E+00	2.054E+00	2.043E+00	2.004E+00
Th-230	U-234	1.000E+00	0.000E+00	1.819E-07	5.338E-07	1.650E-06	4.030E-06	7.388E-06	8.241E-06	8.093E-06
Th-230	U-238	1.000E+00	0.000E+00	5.372E-12	4.695E-11	4.710E-10	3.191E-09	1.442E-08	2.192E-08	2.171E-08
Th-230	ΣS(j):		2.060E+00	2.060E+00	2.060E+00	2.059E+00	2.058E+00	2.054E+00	2.043E+00	2.004E+00
0U-234	U-234	1.000E+00	2.000E-02	1.956E-02	1.872E-02	1.603E-02	1.030E-02	2.187E-03	2.616E-05	4.897E-12
U-234	U-238	1.000E+00	0.000E+00	1.160E-06	3.329E-06	9.504E-06	1.832E-05	1.297E-05	4.656E-07	2.908E-13
U-234	ΣS(j):		2.000E-02	1.956E-02	1.872E-02	1.604E-02	1.031E-02	2.200E-03	2.663E-05	5.188E-12
0U-235	U-235	1.000E+00	1.000E-02	9.781E-03	9.358E-03	8.015E-03	5.149E-03	1.094E-03	1.309E-05	2.455E-12
0U-238	U-238	5.450E-07	2.289E-07	2.239E-07	2.142E-07	1.835E-07	1.179E-07	2.504E-08	2.997E-10	5.621E-17
U-238	U-238	1.000E+00	4.200E-01	4.108E-01	3.930E-01	3.366E-01	2.162E-01	4.595E-02	5.499E-04	1.031E-10
U-238	ΣS(j):		4.200E-01	4.108E-01	3.930E-01	3.366E-01	2.162E-01	4.595E-02	5.499E-04	1.031E-10

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time = 4.31 seconds

DOSE: All Nuclides Summed, All Pathways Summed



:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\VP-53 RES GARDENER_FGR15.RAD 08/04/2020 16:17 GRAPHICS.ASC Includes All Pathway

Note: The data line for each radionuclide includes dose contributions from that radionuclide's decay progeny (e.g., the Th-230 data line includes the dose contribution from Ra-226 that results from the radioactive decay of Th-230; the Ra-226 data line does not include the Ra-226 resulting from Th-230 decay).

VP-53 Resident Gardener with 2014 ORNL DCFs
RESRAD Dose Summary

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: DCFPAK3.02 (Adult)

0

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-227 (Source: DCFPAK3.02)	2.615E-04	2.615E-04	DCF1(1)
A-1	At-218 (Source: DCFPAK3.02)	5.567E-05	5.567E-05	DCF1(2)
A-1	At-219 (Source: DCFPAK3.02)	0.000E+00	0.000E+00	DCF1(3)
A-1	Bi-210 (Source: DCFPAK3.02)	5.473E-03	5.473E-03	DCF1(4)
A-1	Bi-211 (Source: DCFPAK3.02)	2.410E-01	2.410E-01	DCF1(5)
A-1	Bi-212 (Source: DCFPAK3.02)	6.258E-01	6.258E-01	DCF1(6)
A-1	Bi-214 (Source: DCFPAK3.02)	9.135E+00	9.135E+00	DCF1(7)
A-1	Bi-215 (Source: DCFPAK3.02)	1.369E+00	1.369E+00	DCF1(8)
A-1	Fr-223 (Source: DCFPAK3.02)	1.758E-01	1.758E-01	DCF1(9)
A-1	Hg-206 (Source: DCFPAK3.02)	6.127E-01	6.127E-01	DCF1(10)
A-1	Pa-231 (Source: DCFPAK3.02)	1.608E-01	1.608E-01	DCF1(11)
A-1	Pa-234 (Source: DCFPAK3.02)	8.275E+00	8.275E+00	DCF1(12)
A-1	Pa-234m (Source: DCFPAK3.02)	1.257E-01	1.257E-01	DCF1(13)
A-1	Pb-210 (Source: DCFPAK3.02)	2.092E-03	2.092E-03	DCF1(14)
A-1	Pb-211 (Source: DCFPAK3.02)	3.680E-01	3.680E-01	DCF1(15)
A-1	Pb-212 (Source: DCFPAK3.02)	6.314E-01	6.314E-01	DCF1(16)
A-1	Pb-214 (Source: DCFPAK3.02)	1.257E+00	1.257E+00	DCF1(17)
A-1	Po-210 (Source: DCFPAK3.02)	5.641E-05	5.641E-05	DCF1(18)
A-1	Po-211 (Source: DCFPAK3.02)	4.707E-02	4.707E-02	DCF1(19)
A-1	Po-212 (Source: DCFPAK3.02)	0.000E+00	0.000E+00	DCF1(20)
A-1	Po-214 (Source: DCFPAK3.02)	4.801E-04	4.801E-04	DCF1(21)
A-1	Po-215 (Source: DCFPAK3.02)	9.452E-04	9.452E-04	DCF1(22)
A-1	Po-216 (Source: DCFPAK3.02)	8.873E-05	8.873E-05	DCF1(23)
A-1	Po-218 (Source: DCFPAK3.02)	9.228E-09	9.228E-09	DCF1(24)
A-1	Ra-223 (Source: DCFPAK3.02)	5.791E-01	5.791E-01	DCF1(25)
A-1	Ra-224 (Source: DCFPAK3.02)	4.950E-02	4.950E-02	DCF1(26)
A-1	Ra-226 (Source: DCFPAK3.02)	3.176E-02	3.176E-02	DCF1(27)
A-1	Rn-218 (Source: DCFPAK3.02)	4.259E-03	4.259E-03	DCF1(28)
A-1	Rn-219 (Source: DCFPAK3.02)	2.970E-01	2.970E-01	DCF1(29)
A-1	Rn-220 (Source: DCFPAK3.02)	3.474E-03	3.474E-03	DCF1(30)
A-1	Rn-222 (Source: DCFPAK3.02)	2.130E-03	2.130E-03	DCF1(31)
A-1	Th-227 (Source: DCFPAK3.02)	5.641E-01	5.641E-01	DCF1(32)
A-1	Th-228 (Source: DCFPAK3.02)	7.248E-03	7.248E-03	DCF1(33)
A-1	Th-230 (Source: DCFPAK3.02)	1.106E-03	1.106E-03	DCF1(34)
A-1	Th-231 (Source: DCFPAK3.02)	3.250E-02	3.250E-02	DCF1(35)
A-1	Th-234 (Source: DCFPAK3.02)	2.316E-02	2.316E-02	DCF1(36)
A-1	Tl-206 (Source: DCFPAK3.02)	1.278E-02	1.278E-02	DCF1(37)
A-1	Tl-207 (Source: DCFPAK3.02)	2.391E-02	2.391E-02	DCF1(38)
A-1	Tl-208 (Source: DCFPAK3.02)	2.167E+01	2.167E+01	DCF1(39)
A-1	Tl-210 (Source: DCFPAK3.02)	1.677E+01	1.677E+01	DCF1(40)

A-1	U-234 (Source: DCFPAK3.02)	3.456E-04	3.456E-04	DCF1(41)
A-1	U-235 (Source: DCFPAK3.02)	7.005E-01	7.005E-01	DCF1(42)
A-1	U-238 (Source: DCFPAK3.02)	1.713E-04	1.713E-04	DCF1(43)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.459E-01	5.760E-01	DCF2(1)
B-1	Pa-231	8.505E-01	8.505E-01	DCF2(2)
B-1	Pb-210+D	3.708E-02	2.077E-02	DCF2(3)
B-1	Ra-226+D	3.528E-02	3.517E-02	DCF2(4)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	Th-228+D	1.600E-01	1.468E-01	DCF2(5)
B-1	Th-230	3.759E-01	3.759E-01	DCF2(6)
B-1	U-234	3.479E-02	3.479E-02	DCF2(7)
B-1	U-235+D	3.132E-02	3.132E-02	DCF2(8)
B-1	U-238	2.973E-02	2.973E-02	DCF2(9)
B-1	U-238+D	2.976E-02	2.973E-02	DCF2(10)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.607E-03	1.191E-03	DCF3(1)
D-1	Pa-231	1.772E-03	1.772E-03	DCF3(2)
D-1	Pb-210+D	7.057E-03	2.575E-03	DCF3(3)
D-1	Ra-226+D	1.037E-03	1.036E-03	DCF3(4)
D-1	Th-228+D	5.286E-04	2.664E-04	DCF3(5)
D-1	Th-230	7.918E-04	7.918E-04	DCF3(6)
D-1	U-234	1.831E-04	1.831E-04	DCF3(7)
D-1	U-235+D	1.740E-04	1.728E-04	DCF3(8)
D-1	U-238	1.650E-04	1.650E-04	DCF3(9)
D-1	U-238+D	1.776E-04	1.650E-04	DCF3(10)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)

D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: DCFPAK3.02 (Adult)

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(10,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(5,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(5,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(10,1)

D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.400E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	3.000E-01	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.900E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ac-227	1.050E+00	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Pa-231	2.400E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Pb-210	3.000E-02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Ra-226	3.700E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Th-228	6.200E-01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Th-230	2.060E+00	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): U-234	2.000E-02	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-235	1.000E-02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-238	4.200E-01	0.000E+00	---	S1(9)
R012	Concentration in groundwater (pCi/L): Ac-227	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Pa-231	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(9)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	6.000E-05	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ

R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.497E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)

R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.109E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.582E-02	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.852E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.852E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.213E-02	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)

R017	Inhalation rate (m**3/yr)	4.836E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	4.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.550E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	7.990E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	4.380E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT

R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)

STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Summary : VP-53 - Res. Gardener, ORNL DCFs, Five Year Review
File   : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\VP-53 RES GARDENER_ORNL.RAD

Contaminated Zone Dimensions

Area:	13998.00 square meters
Thickness:	0.30 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Ac-227	1.050E+00
Pa-231	2.400E-01
Pb-210	3.000E-02
Ra-226	3.700E-01
Th-228	6.200E-01
Th-230	2.060E+00
U-234	2.000E-02
U-235	1.000E-02
U-238	4.200E-01

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.900E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.447E+00	3.919E+00	3.250E+00	2.434E+00	1.826E+00	9.248E-01	4.815E-01	5.741E-01
M(t):	2.341E-01	2.063E-01	1.710E-01	1.281E-01	9.608E-02	4.867E-02	2.534E-02	3.022E-02

0Maximum TDOSE(t): 4.447E+00 mrem/yr   at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	6.835E-01	0.1537	1.882E-02	0.0042	0.000E+00	0.0000	1.175E-01	0.0264	0.000E+00	0.0000	0.000E+00	0.0000	5.201E-02	0.0117
Pa-231	1.507E-02	0.0034	5.918E-03	0.0013	0.000E+00	0.0000	1.226E-01	0.0276	0.000E+00	0.0000	0.000E+00	0.0000	1.373E-02	0.0031
Pb-210	7.457E-05	0.0000	3.156E-05	0.0000	0.000E+00	0.0000	6.015E-02	0.0135	0.000E+00	0.0000	0.000E+00	0.0000	6.673E-03	0.0015
Ra-226	1.222E+00	0.2747	3.812E-04	0.0001	0.000E+00	0.0000	4.554E-01	0.1024	0.000E+00	0.0000	0.000E+00	0.0000	1.354E-02	0.0030
Th-228	1.483E+00	0.3334	2.411E-03	0.0005	0.000E+00	0.0000	8.001E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	8.848E-03	0.0020
Th-230	2.233E-03	0.0005	2.243E-02	0.0050	0.000E+00	0.0000	4.799E-02	0.0108	0.000E+00	0.0000	0.000E+00	0.0000	5.252E-02	0.0118
U-234	2.335E-06	0.0000	1.994E-05	0.0000	0.000E+00	0.0000	2.632E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	1.166E-04	0.0000
U-235	2.398E-03	0.0005	8.977E-06	0.0000	0.000E+00	0.0000	1.251E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.541E-05	0.0000
U-238	2.190E-02	0.0049	3.581E-04	0.0001	0.000E+00	0.0000	5.359E-03	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	2.374E-03	0.0005
Total	3.430E+00	0.7712	5.038E-02	0.0113	0.000E+00	0.0000	8.174E-01	0.1838	0.000E+00	0.0000	0.000E+00	0.0000	1.499E-01	0.0337

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.719E-01	0.1960
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.573E-01	0.0354
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.693E-02	0.0150
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.691E+00	0.3802
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.502E+00	0.3378
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.252E-01	0.0281
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.021E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.587E-03	0.0006
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.999E-02	0.0067
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.447E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	6.267E-01	0.1599	1.725E-02	0.0044	0.000E+00	0.0000	1.077E-01	0.0275	0.000E+00	0.0000	0.000E+00	0.0000	4.768E-02	0.0122
Pa-231	1.945E-02	0.0050	5.918E-03	0.0015	0.000E+00	0.0000	1.207E-01	0.0308	0.000E+00	0.0000	0.000E+00	0.0000	1.379E-02	0.0035
Pb-210	7.148E-05	0.0000	3.025E-05	0.0000	0.000E+00	0.0000	5.765E-02	0.0147	0.000E+00	0.0000	0.000E+00	0.0000	6.396E-03	0.0016
Ra-226	1.202E+00	0.3067	3.869E-04	0.0001	0.000E+00	0.0000	4.708E-01	0.1201	0.000E+00	0.0000	0.000E+00	0.0000	1.581E-02	0.0040
Th-228	1.032E+00	0.2633	1.678E-03	0.0004	0.000E+00	0.0000	5.566E-03	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	6.157E-03	0.0016
Th-230	5.156E-03	0.0013	2.243E-02	0.0057	0.000E+00	0.0000	4.909E-02	0.0125	0.000E+00	0.0000	0.000E+00	0.0000	5.255E-02	0.0134
U-234	2.284E-06	0.0000	1.950E-05	0.0000	0.000E+00	0.0000	2.574E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	1.141E-04	0.0000
U-235	2.345E-03	0.0006	8.786E-06	0.0000	0.000E+00	0.0000	1.225E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.421E-05	0.0000
U-238	2.142E-02	0.0055	3.503E-04	0.0001	0.000E+00	0.0000	5.241E-03	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	2.322E-03	0.0006
Total	2.909E+00	0.7422	4.808E-02	0.0123	0.000E+00	0.0000	8.173E-01	0.2085	0.000E+00	0.0000	0.000E+00	0.0000	1.449E-01	0.0370

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Dependent Pathways
0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.994E-01	0.2040
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.599E-01	0.0408
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.415E-02	0.0164
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.689E+00	0.4310
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.045E+00	0.2667
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.292E-01	0.0330
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.933E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.531E-03	0.0006
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.934E-02	0.0075
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.919E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0
Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	5.268E-01	0.1621	1.450E-02	0.0045	0.000E+00	0.0000	9.053E-02	0.0279	0.000E+00	0.0000	0.000E+00	0.0000	4.008E-02	0.0123
Pa-231	2.679E-02	0.0082	5.887E-03	0.0018	0.000E+00	0.0000	1.169E-01	0.0360	0.000E+00	0.0000	0.000E+00	0.0000	1.381E-02	0.0043
Pb-210	6.568E-05	0.0000	2.780E-05	0.0000	0.000E+00	0.0000	5.295E-02	0.0163	0.000E+00	0.0000	0.000E+00	0.0000	5.877E-03	0.0018
Ra-226	1.164E+00	0.3580	3.965E-04	0.0001	0.000E+00	0.0000	4.975E-01	0.1531	0.000E+00	0.0000	0.000E+00	0.0000	1.995E-02	0.0061
Th-228	4.996E-01	0.1537	8.124E-04	0.0002	0.000E+00	0.0000	2.694E-03	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	2.981E-03	0.0009
Th-230	1.086E-02	0.0033	2.244E-02	0.0069	0.000E+00	0.0000	5.140E-02	0.0158	0.000E+00	0.0000	0.000E+00	0.0000	5.264E-02	0.0162
U-234	2.187E-06	0.0000	1.866E-05	0.0000	0.000E+00	0.0000	2.462E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	1.091E-04	0.0000
U-235	2.244E-03	0.0007	8.416E-06	0.0000	0.000E+00	0.0000	1.173E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.188E-05	0.0000
U-238	2.050E-02	0.0063	3.351E-04	0.0001	0.000E+00	0.0000	5.012E-03	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	2.222E-03	0.0007
Total	2.250E+00	0.6925	4.443E-02	0.0137	0.000E+00	0.0000	8.173E-01	0.2515	0.000E+00	0.0000	0.000E+00	0.0000	1.377E-01	0.0424

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0
Water Dependent Pathways
0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.719E-01	0.2068
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.634E-01	0.0503
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.892E-02	0.0181
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.681E+00	0.5174
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.061E-01	0.1557
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.373E-01	0.0423
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.762E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.421E-03	0.0007
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.806E-02	0.0086
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.250E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	2.869E-01	0.1179	7.900E-03	0.0032	0.000E+00	0.0000	4.924E-02	0.0202	0.000E+00	0.0000	0.000E+00	0.0000	2.183E-02	0.0090
Pa-231	4.143E-02	0.0170	5.550E-03	0.0023	0.000E+00	0.0000	1.031E-01	0.0424	0.000E+00	0.0000	0.000E+00	0.0000	1.324E-02	0.0054
Pb-210	4.885E-05	0.0000	2.067E-05	0.0000	0.000E+00	0.0000	3.932E-02	0.0162	0.000E+00	0.0000	0.000E+00	0.0000	4.371E-03	0.0018
Ra-226	1.038E+00	0.4267	4.150E-04	0.0002	0.000E+00	0.0000	5.596E-01	0.2299	0.000E+00	0.0000	0.000E+00	0.0000	3.073E-02	0.0126
Th-228	3.946E-02	0.0162	6.418E-05	0.0000	0.000E+00	0.0000	2.125E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	2.355E-04	0.0001
Th-230	2.942E-02	0.0121	2.244E-02	0.0092	0.000E+00	0.0000	6.030E-02	0.0248	0.000E+00	0.0000	0.000E+00	0.0000	5.306E-02	0.0218
U-234	1.885E-06	0.0000	1.600E-05	0.0000	0.000E+00	0.0000	2.106E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	9.351E-05	0.0000
U-235	1.922E-03	0.0008	7.241E-06	0.0000	0.000E+00	0.0000	1.010E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.452E-05	0.0000
U-238	1.755E-02	0.0072	2.870E-04	0.0001	0.000E+00	0.0000	4.287E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	1.903E-03	0.0008
Total	1.455E+00	0.5979	3.670E-02	0.0151	0.000E+00	0.0000	8.164E-01	0.3354	0.000E+00	0.0000	0.000E+00	0.0000	1.255E-01	0.0516

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.659E-01	0.1503
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.633E-01	0.0671
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.376E-02	0.0180
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.629E+00	0.6694
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.997E-02	0.0164
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.652E-01	0.0679
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.220E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.075E-03	0.0009
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.403E-02	0.0099
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.434E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	5.056E-02	0.0277	1.392E-03	0.0008	0.000E+00	0.0000	8.642E-03	0.0047	0.000E+00	0.0000	0.000E+00	0.0000	3.847E-03	0.0021
Pa-231	4.165E-02	0.0228	3.978E-03	0.0022	0.000E+00	0.0000	6.852E-02	0.0375	0.000E+00	0.0000	0.000E+00	0.0000	9.644E-03	0.0053
Pb-210	2.096E-05	0.0000	8.868E-06	0.0000	0.000E+00	0.0000	1.680E-02	0.0092	0.000E+00	0.0000	0.000E+00	0.0000	1.875E-03	0.0010
Ra-226	7.502E-01	0.4109	3.894E-04	0.0002	0.000E+00	0.0000	5.725E-01	0.3136	0.000E+00	0.0000	0.000E+00	0.0000	4.115E-02	0.0225
Th-228	2.794E-05	0.0000	4.547E-08	0.0000	0.000E+00	0.0000	1.500E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.669E-07	0.0000
Th-230	7.214E-02	0.0395	2.245E-02	0.0123	0.000E+00	0.0000	8.797E-02	0.0482	0.000E+00	0.0000	0.000E+00	0.0000	5.485E-02	0.0300
U-234	1.288E-06	0.0000	1.031E-05	0.0000	0.000E+00	0.0000	1.348E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	6.014E-05	0.0000
U-235	1.235E-03	0.0007	4.719E-06	0.0000	0.000E+00	0.0000	6.579E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.876E-05	0.0000
U-238	1.128E-02	0.0062	1.844E-04	0.0001	0.000E+00	0.0000	2.743E-03	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	1.223E-03	0.0007
Total	9.271E-01	0.5078	2.841E-02	0.0156	0.000E+00	0.0000	7.574E-01	0.4149	0.000E+00	0.0000	0.000E+00	0.0000	1.127E-01	0.0617

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.444E-02	0.0353
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.238E-01	0.0678
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.871E-02	0.0102
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.364E+00	0.7473
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.831E-05	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.374E-01	0.1301
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.066E-04	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.335E-03	0.0007
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.543E-02	0.0084
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.826E+00	1.0000

0*Sum of all water independent and dependent pathways.

Summary : VP-53 - Res. Gardener, ORNL DCFs, Five Year Review
File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\VP-53 RES GARDENER_ORNL.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ac-227	1.161E-04	0.0001	3.197E-06	0.0000	0.000E+00	0.0000	1.957E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.835E-06	0.0000
Pa-231	1.003E-02	0.0108	8.769E-04	0.0009	0.000E+00	0.0000	1.453E-02	0.0157	0.000E+00	0.0000	0.000E+00	0.0000	2.137E-03	0.0023
Pb-210	1.084E-06	0.0000	4.588E-07	0.0000	0.000E+00	0.0000	8.570E-04	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	9.700E-05	0.0001
Ra-226	2.402E-01	0.2597	1.600E-04	0.0002	0.000E+00	0.0000	2.467E-01	0.2667	0.000E+00	0.0000	0.000E+00	0.0000	2.064E-02	0.0223
Th-228	2.641E-16	0.0000	4.304E-19	0.0000	0.000E+00	0.0000	1.400E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.579E-18	0.0000
Th-230	1.474E-01	0.1594	2.245E-02	0.0243	0.000E+00	0.0000	1.548E-01	0.1674	0.000E+00	0.0000	0.000E+00	0.0000	6.019E-02	0.0651
U-234	6.728E-07	0.0000	2.261E-06	0.0000	0.000E+00	0.0000	2.867E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.296E-05	0.0000
U-235	2.631E-04	0.0003	1.056E-06	0.0000	0.000E+00	0.0000	1.468E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.241E-06	0.0000
U-238	2.395E-03	0.0026	3.919E-05	0.0000	0.000E+00	0.0000	5.748E-04	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	2.598E-04	0.0003
Total	4.004E-01	0.4329	2.353E-02	0.0254	0.000E+00	0.0000	4.175E-01	0.4515	0.000E+00	0.0000	0.000E+00	0.0000	8.334E-02	0.0901

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.477E-04	0.0002
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.758E-02	0.0298
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.556E-04	0.0010
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.077E-01	0.5489
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.675E-16	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.849E-01	0.4162
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.456E-05	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.851E-04	0.0003
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.268E-03	0.0035
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.248E-01	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	3.349E-12	0.0000	9.227E-14	0.0000	0.000E+00	0.0000	5.417E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.550E-13	0.0000
Pa-231	1.196E-04	0.0002	1.045E-05	0.0000	0.000E+00	0.0000	1.662E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	2.548E-05	0.0001
Pb-210	2.293E-10	0.0000	9.696E-11	0.0000	0.000E+00	0.0000	1.737E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.050E-08	0.0000
Ra-226	9.265E-03	0.0192	6.455E-06	0.0000	0.000E+00	0.0000	9.628E-03	0.0200	0.000E+00	0.0000	0.000E+00	0.0000	8.541E-04	0.0018
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	1.800E-01	0.3739	2.235E-02	0.0464	0.000E+00	0.0000	1.824E-01	0.3788	0.000E+00	0.0000	0.000E+00	0.0000	6.291E-02	0.1307
U-234	7.175E-07	0.0000	1.162E-07	0.0000	0.000E+00	0.0000	1.047E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.053E-07	0.0000
U-235	3.171E-06	0.0000	1.449E-08	0.0000	0.000E+00	0.0000	1.979E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.920E-08	0.0000
U-238	2.862E-05	0.0001	4.696E-07	0.0000	0.000E+00	0.0000	6.604E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.112E-06	0.0000
Total	1.894E-01	0.3935	2.236E-02	0.0464	0.000E+00	0.0000	1.922E-01	0.3991	0.000E+00	0.0000	0.000E+00	0.0000	6.379E-02	0.1325

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Dependent Pathways
0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.367E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.367E-05	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.369E-02	0.0284	0.000E+00	0.0000	0.000E+00	0.0000	1.401E-02	0.0291
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.946E-07	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.975E-02	0.0410
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.476E-01	0.9297
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.286E-06	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.881E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.344E-06	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.880E-05	0.0001
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.371E-02	0.0285	0.000E+00	0.0000	0.000E+00	0.0000	4.815E-01	1.0000

0*Sum of all water independent and dependent pathways.

Summary : VP-53 - Res. Gardener, ORNL DCFs, Five Year Review
File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\VP-53 RES GARDENER_ORNL.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0
Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	2.201E-11	0.0000	1.932E-12	0.0000	0.000E+00	0.0000	2.614E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.708E-12	0.0000
Pb-210	3.150E-23	0.0000	1.330E-23	0.0000	0.000E+00	0.0000	2.029E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.813E-21	0.0000
Ra-226	1.037E-07	0.0000	7.371E-11	0.0000	0.000E+00	0.0000	9.357E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.753E-09	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	1.745E-01	0.3040	2.192E-02	0.0382	0.000E+00	0.0000	1.534E-01	0.2673	0.000E+00	0.0000	0.000E+00	0.0000	6.182E-02	0.1077
U-234	7.049E-07	0.0000	8.853E-08	0.0000	0.000E+00	0.0000	6.198E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.497E-07	0.0000
U-235	6.078E-13	0.0000	3.918E-15	0.0000	0.000E+00	0.0000	4.784E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.778E-14	0.0000
U-238	1.896E-09	0.0000	2.376E-10	0.0000	0.000E+00	0.0000	1.664E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.705E-10	0.0000
Total	1.745E-01	0.3040	2.192E-02	0.0382	0.000E+00	0.0000	1.534E-01	0.2673	0.000E+00	0.0000	0.000E+00	0.0000	6.182E-02	0.1077

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0
Water Dependent Pathways
0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.509E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.509E-28	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.148E-02	0.1071	0.000E+00	0.0000	0.000E+00	0.0000	6.148E-02	0.1071
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.247E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.247E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.816E-02	0.0839	0.000E+00	0.0000	0.000E+00	0.0000	4.816E-02	0.0839
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.898E-02	0.0853	0.000E+00	0.0000	0.000E+00	0.0000	4.607E-01	0.8024
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.744E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	1.761E-04	0.0003
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.345E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	1.345E-04	0.0002
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.472E-03	0.0060	0.000E+00	0.0000	0.000E+00	0.0000	3.472E-03	0.0060
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.624E-01	0.2829	0.000E+00	0.0000	0.000E+00	0.0000	5.741E-01	1.0000

0*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227+D	Ac-227+D	1.000E+00	8.304E-01	7.613E-01	6.400E-01	3.485E-01	6.137E-02	1.407E-04	1.301E-05	2.389E-28
0Pa-231	Pa-231	1.000E+00	6.419E-01	6.278E-01	6.004E-01	5.136E-01	3.288E-01	6.897E-02	7.955E-04	8.070E-02
Pa-231	Ac-227+D	1.000E+00	1.364E-02	3.844E-02	8.027E-02	1.669E-01	1.870E-01	4.593E-02	5.759E-02	1.755E-01
Pa-231	ΣDSR(j)		6.556E-01	6.663E-01	6.807E-01	6.806E-01	5.158E-01	1.149E-01	5.838E-02	2.562E-01
0Pb-210+D	Pb-210+D	1.000E+00	2.231E+00	2.138E+00	1.964E+00	1.459E+00	6.236E-01	3.185E-02	6.485E-06	4.156E-15
0Ra-226+D	Ra-226+D	1.000E+00	4.530E+00	4.456E+00	4.313E+00	3.848E+00	2.776E+00	8.855E-01	3.382E-02	2.244E-02
Ra-226+D	Pb-210+D	1.000E+00	4.064E-02	1.086E-01	2.310E-01	5.556E-01	9.110E-01	4.865E-01	1.956E-02	1.077E-01
Ra-226+D	ΣDSR(j)		4.570E+00	4.565E+00	4.544E+00	4.403E+00	3.687E+00	1.372E+00	5.339E-02	1.302E-01
0Th-228+D	Th-228+D	1.000E+00	2.423E+00	1.686E+00	8.163E-01	6.447E-02	4.566E-05	4.314E-16	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+00	5.979E-02	5.978E-02	5.977E-02	5.973E-02	5.960E-02	5.917E-02	5.793E-02	5.369E-02
Th-230	Ra-226+D	1.000E+00	9.684E-04	2.912E-03	6.710E-03	1.906E-02	4.744E-02	9.712E-02	1.176E-01	1.144E-01
Th-230	Pb-210+D	1.000E+00	6.389E-06	3.908E-05	1.872E-04	1.416E-03	8.205E-03	3.055E-02	4.179E-02	5.556E-02
Th-230	ΣDSR(j)		6.076E-02	6.273E-02	6.667E-02	8.021E-02	1.152E-01	1.868E-01	2.173E-01	2.236E-01
0U-234	U-234	1.000E+00	2.010E-02	1.966E-02	1.881E-02	1.609E-02	1.031E-02	2.170E-03	2.527E-05	8.478E-03
U-234	Th-230	1.000E+00	2.824E-07	8.215E-07	1.861E-06	5.155E-06	1.217E-05	2.195E-05	2.407E-05	2.251E-05
U-234	Ra-226+D	1.000E+00	2.926E-09	2.055E-08	1.066E-07	8.761E-07	5.771E-06	2.829E-05	4.806E-05	8.999E-05
U-234	Pb-210+D	1.000E+00	1.554E-11	2.006E-10	2.078E-09	4.565E-08	7.443E-07	7.780E-06	1.692E-05	2.127E-04
U-234	ΣDSR(j)		2.010E-02	1.966E-02	1.881E-02	1.610E-02	1.033E-02	2.228E-03	1.143E-04	8.803E-03
0U-235+D	U-235+D	1.000E+00	2.587E-01	2.530E-01	2.421E-01	2.073E-01	1.332E-01	2.828E-02	3.379E-04	8.078E-03
U-235+D	Pa-231	1.000E+00	6.522E-06	1.962E-05	4.418E-05	1.139E-04	2.121E-04	1.468E-04	5.074E-06	1.727E-03
U-235+D	Ac-227+D	1.000E+00	9.797E-08	6.471E-07	3.115E-06	2.067E-05	7.907E-05	8.288E-05	2.914E-04	3.648E-03
U-235+D	ΣDSR(j)		2.587E-01	2.531E-01	2.421E-01	2.075E-01	1.335E-01	2.851E-02	6.344E-04	1.345E-02
0U-238	U-238	5.450E-07	9.820E-09	9.605E-09	9.187E-09	7.861E-09	5.037E-09	1.060E-09	1.235E-11	4.175E-09
0U-238+D	U-238+D	1.000E+00	7.141E-02	6.985E-02	6.682E-02	5.722E-02	3.673E-02	7.781E-03	9.236E-05	8.242E-03
U-238+D	U-234	1.000E+00	2.828E-08	8.317E-08	1.857E-07	4.770E-07	8.879E-07	6.159E-07	2.145E-08	2.398E-05
U-238+D	Th-230	1.000E+00	2.707E-13	1.814E-12	9.186E-12	7.364E-11	4.657E-10	2.046E-09	3.048E-09	3.210E-09
U-238+D	Ra-226+D	1.000E+00	2.043E-15	3.079E-14	3.521E-13	8.450E-12	1.539E-10	2.063E-09	5.877E-09	5.792E-08
U-238+D	Pb-210+D	1.000E+00	9.202E-18	2.426E-16	5.345E-15	3.402E-13	1.578E-11	4.953E-10	2.030E-09	2.273E-07
U-238+D	ΣDSR(j)		7.141E-02	6.985E-02	6.682E-02	5.722E-02	3.673E-02	7.782E-03	9.239E-05	8.267E-03

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.900E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	2.288E+01	2.496E+01	2.969E+01	5.452E+01	3.096E+02	1.351E+05	1.460E+06	*7.232E+13
Pa-231	2.898E+01	2.852E+01	2.791E+01	2.792E+01	3.684E+01	1.653E+02	3.254E+02	7.417E+01
Pb-210	8.516E+00	8.885E+00	9.673E+00	1.302E+01	3.047E+01	5.965E+02	2.930E+06	*7.632E+13
Ra-226	4.157E+00	4.162E+00	4.181E+00	4.315E+00	5.153E+00	1.385E+01	3.559E+02	1.460E+02
Th-228	7.842E+00	1.127E+01	2.328E+01	2.947E+02	4.162E+05	*8.201E+14	*8.201E+14	*8.201E+14
Th-230	3.127E+02	3.029E+02	2.850E+02	2.369E+02	1.649E+02	1.017E+02	8.744E+01	8.496E+01
U-234	9.451E+02	9.662E+02	1.010E+03	1.180E+03	1.839E+03	8.527E+03	1.662E+05	2.158E+03
U-235	7.344E+01	7.508E+01	7.847E+01	9.158E+01	1.424E+02	6.665E+02	2.995E+04	1.412E+03
U-238	2.661E+02	2.720E+02	2.843E+02	3.321E+02	5.173E+02	2.442E+03	2.057E+05	2.298E+03

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ac-227	1.050E+00	0.000E+00	8.304E-01	2.288E+01	8.304E-01	2.288E+01
Pa-231	2.400E-01	6.26 ± 0.01	6.887E-01	2.759E+01	6.556E-01	2.898E+01
Pb-210	3.000E-02	0.000E+00	2.231E+00	8.516E+00	2.231E+00	8.516E+00
Ra-226	3.700E-01	0.000E+00	4.570E+00	4.157E+00	4.570E+00	4.157E+00
Th-228	6.200E-01	0.000E+00	2.423E+00	7.842E+00	2.423E+00	7.842E+00
Th-230	2.060E+00	1.000E+03	2.236E-01	8.496E+01	6.076E-02	3.127E+02
U-234	2.000E-02	0.000E+00	2.010E-02	9.451E+02	2.010E-02	9.451E+02
U-235	1.000E-02	0.000E+00	2.587E-01	7.344E+01	2.587E-01	7.344E+01
U-238	4.200E-01	0.000E+00	7.141E-02	2.661E+02	7.141E-02	2.661E+02

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

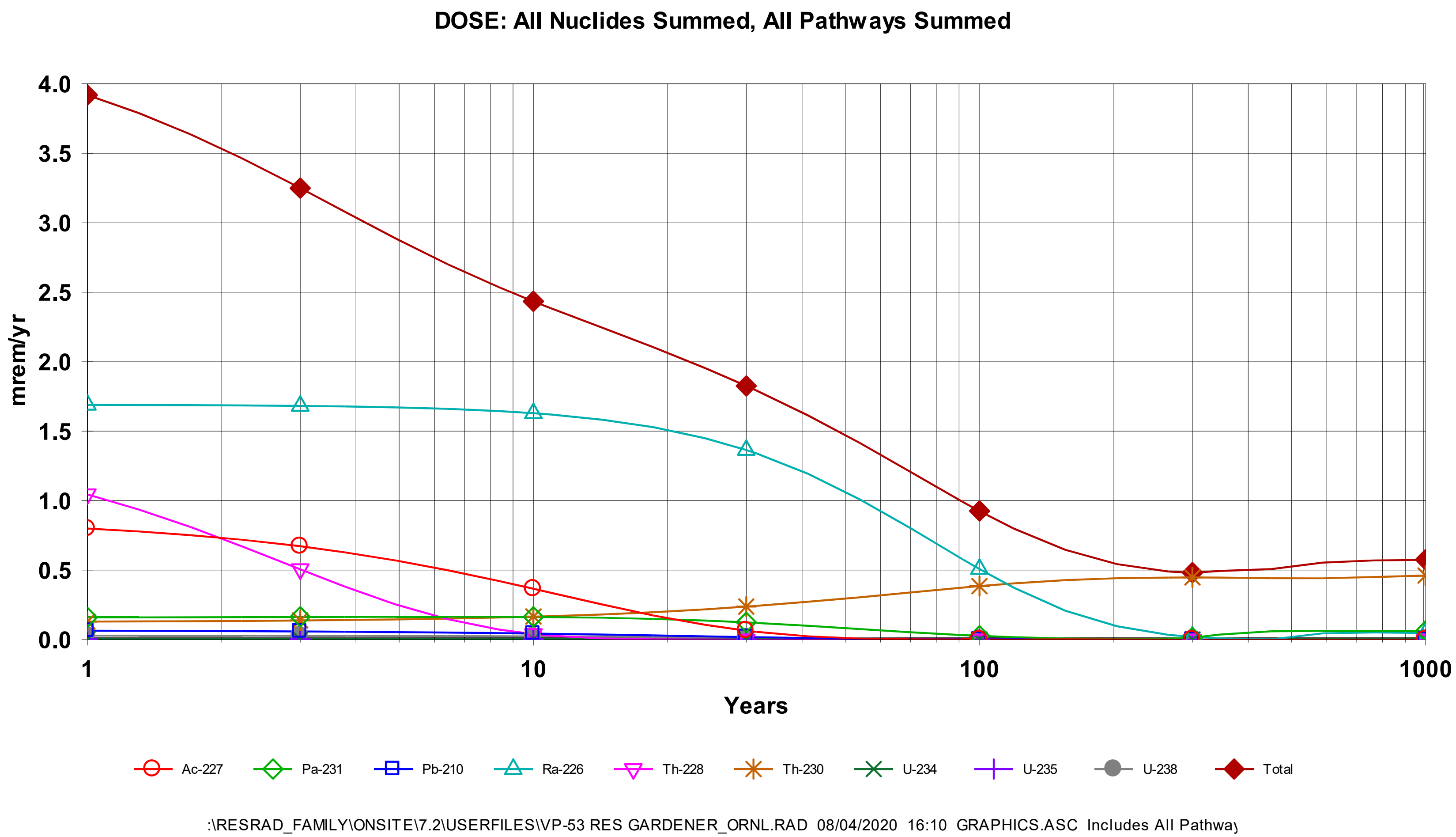
0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	Ac-227	1.000E+00	8.719E-01	7.994E-01	6.719E-01	3.659E-01	6.444E-02	1.477E-04	1.367E-05	2.509E-28
Ac-227	Pa-231	1.000E+00	3.274E-03	9.225E-03	1.926E-02	4.007E-02	4.489E-02	1.102E-02	1.382E-02	4.211E-02
Ac-227	U-235	1.000E+00	9.797E-10	6.471E-09	3.115E-08	2.067E-07	7.907E-07	8.288E-07	2.914E-06	3.648E-05
Ac-227	ΣDOSE(j)		8.751E-01	8.086E-01	6.912E-01	4.060E-01	1.093E-01	1.117E-02	1.384E-02	4.215E-02
0Pa-231	Pa-231	1.000E+00	1.541E-01	1.507E-01	1.441E-01	1.233E-01	7.891E-02	1.655E-02	1.909E-04	1.937E-02
Pa-231	U-235	1.000E+00	6.522E-08	1.962E-07	4.418E-07	1.139E-06	2.121E-06	1.468E-06	5.074E-08	1.727E-05
Pa-231	ΣDOSE(j)		1.541E-01	1.507E-01	1.441E-01	1.233E-01	7.891E-02	1.656E-02	1.910E-04	1.939E-02
0Pb-210	Pb-210	1.000E+00	6.693E-02	6.415E-02	5.892E-02	4.376E-02	1.871E-02	9.556E-04	1.946E-07	1.247E-16
Pb-210	Ra-226	1.000E+00	1.504E-02	4.018E-02	8.546E-02	2.056E-01	3.371E-01	1.800E-01	7.238E-03	3.986E-02
Pb-210	Th-230	1.000E+00	1.316E-05	8.051E-05	3.857E-04	2.917E-03	1.690E-02	6.293E-02	8.608E-02	1.144E-01
Pb-210	U-234	1.000E+00	3.108E-13	4.011E-12	4.156E-11	9.129E-10	1.489E-08	1.556E-07	3.383E-07	4.254E-06
Pb-210	U-238	1.000E+00	3.865E-18	1.019E-16	2.245E-15	1.429E-13	6.626E-12	2.080E-10	8.527E-10	9.548E-08
Pb-210	ΣDOSE(j)		8.198E-02	1.044E-01	1.448E-01	2.523E-01	3.727E-01	2.439E-01	9.332E-02	1.543E-01
0Ra-226	Ra-226	1.000E+00	1.676E+00	1.649E+00	1.596E+00	1.424E+00	1.027E+00	3.276E-01	1.251E-02	8.303E-03
Ra-226	Th-230	1.000E+00	1.995E-03	5.999E-03	1.382E-02	3.927E-02	9.773E-02	2.001E-01	2.422E-01	2.356E-01
Ra-226	U-234	1.000E+00	5.851E-11	4.110E-10	2.133E-09	1.752E-08	1.154E-07	5.658E-07	9.612E-07	1.800E-06
Ra-226	U-238	1.000E+00	8.579E-16	1.293E-14	1.479E-13	3.549E-12	6.462E-11	8.666E-10	2.468E-09	2.432E-08
Ra-226	ΣDOSE(j)		1.678E+00	1.655E+00	1.610E+00	1.463E+00	1.125E+00	5.277E-01	2.547E-01	2.439E-01
0Th-228	Th-228	1.000E+00	1.502E+00	1.045E+00	5.061E-01	3.997E-02	2.831E-05	2.675E-16	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+00	1.232E-01	1.232E-01	1.231E-01	1.230E-01	1.228E-01	1.219E-01	1.193E-01	1.106E-01
Th-230	U-234	1.000E+00	5.647E-09	1.643E-08	3.722E-08	1.031E-07	2.433E-07	4.389E-07	4.814E-07	4.502E-07
Th-230	U-238	1.000E+00	1.137E-13	7.619E-13	3.858E-12	3.093E-11	1.956E-10	8.594E-10	1.280E-09	1.348E-09
Th-230	ΣDOSE(j)		1.232E-01	1.232E-01	1.231E-01	1.230E-01	1.228E-01	1.219E-01	1.193E-01	1.106E-01
0U-234	U-234	1.000E+00	4.021E-04	3.933E-04	3.761E-04	3.219E-04	2.062E-04	4.340E-05	5.054E-07	1.696E-04
U-234	U-238	1.000E+00	1.188E-08	3.493E-08	7.801E-08	2.003E-07	3.729E-07	2.587E-07	9.009E-09	1.007E-05
U-234	ΣDOSE(j)		4.021E-04	3.933E-04	3.762E-04	3.221E-04	2.066E-04	4.366E-05	5.144E-07	1.796E-04
0U-235	U-235	1.000E+00	2.587E-03	2.530E-03	2.421E-03	2.073E-03	1.332E-03	2.828E-04	3.379E-06	8.078E-05
0U-238	U-238	5.450E-07	4.125E-09	4.034E-09	3.858E-09	3.302E-09	2.115E-09	4.453E-10	5.188E-12	1.753E-09
U-238	U-238	1.000E+00	2.999E-02	2.934E-02	2.806E-02	2.403E-02	1.542E-02	3.268E-03	3.879E-05	3.462E-03
U-238	ΣDOSE(j)		2.999E-02	2.934E-02	2.806E-02	2.403E-02	1.542E-02	3.268E-03	3.879E-05	3.462E-03

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	Ac-227	1.000E+00	1.050E+00	9.627E-01	8.093E-01	4.408E-01	7.767E-02	1.784E-04	5.148E-12	2.102E-38
Ac-227	Pa-231	1.000E+00	0.000E+00	7.237E-03	1.950E-02	4.509E-02	5.207E-02	1.288E-02	1.538E-04	2.841E-11
Ac-227	U-235	1.000E+00	0.000E+00	3.224E-09	2.662E-08	2.200E-07	8.985E-07	9.626E-07	3.868E-08	2.492E-14
Ac-227	ΣS(j):		1.050E+00	9.699E-01	8.288E-01	4.859E-01	1.297E-01	1.306E-02	1.538E-04	2.844E-11
0Pa-231	Pa-231	1.000E+00	2.400E-01	2.347E-01	2.246E-01	1.923E-01	1.235E-01	2.620E-02	3.122E-04	5.770E-11
Pa-231	U-235	1.000E+00	0.000E+00	2.070E-07	5.940E-07	1.696E-06	3.267E-06	2.312E-06	8.284E-08	5.141E-14
Pa-231	ΣS(j):		2.400E-01	2.347E-01	2.246E-01	1.923E-01	1.235E-01	2.620E-02	3.123E-04	5.775E-11
0Pb-210	Pb-210	1.000E+00	3.000E-02	2.876E-02	2.642E-02	1.965E-02	8.431E-03	4.361E-04	9.217E-08	1.265E-20
Pb-210	Ra-226	1.000E+00	0.000E+00	1.122E-02	3.175E-02	8.644E-02	1.477E-01	8.080E-02	3.376E-03	3.856E-08
Pb-210	Th-230	1.000E+00	0.000E+00	1.366E-05	1.183E-04	1.150E-03	7.216E-03	2.789E-02	3.977E-02	3.949E-02
Pb-210	U-234	1.000E+00	0.000E+00	4.063E-13	1.054E-11	3.396E-10	6.236E-09	6.868E-08	1.563E-07	1.595E-07
Pb-210	U-238	1.000E+00	0.000E+00	6.020E-18	4.681E-16	5.011E-14	2.723E-12	9.137E-11	3.936E-10	4.280E-10
Pb-210	ΣS(j):		3.000E-02	3.999E-02	5.829E-02	1.072E-01	1.633E-01	1.091E-01	4.314E-02	3.949E-02
0Ra-226	Ra-226	1.000E+00	3.700E-01	3.640E-01	3.524E-01	3.145E-01	2.272E-01	7.280E-02	2.818E-03	3.217E-08
Ra-226	Th-230	1.000E+00	0.000E+00	8.852E-04	2.613E-03	8.235E-03	2.118E-02	4.401E-02	5.411E-02	5.348E-02
Ra-226	U-234	1.000E+00	0.000E+00	3.933E-11	3.450E-10	3.509E-09	2.466E-08	1.241E-07	2.147E-07	2.160E-07
Ra-226	U-238	1.000E+00	0.000E+00	7.755E-16	2.032E-14	6.773E-13	1.360E-11	1.895E-10	5.512E-10	5.796E-10
Ra-226	ΣS(j):		3.700E-01	3.649E-01	3.550E-01	3.227E-01	2.484E-01	1.168E-01	5.693E-02	5.348E-02
0Th-228	Th-228	1.000E+00	6.200E-01	4.314E-01	2.089E-01	1.650E-02	1.169E-05	1.107E-16	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+00	2.060E+00	2.060E+00	2.060E+00	2.059E+00	2.058E+00	2.054E+00	2.043E+00	2.004E+00
Th-230	U-234	1.000E+00	0.000E+00	1.819E-07	5.338E-07	1.650E-06	4.030E-06	7.388E-06	8.241E-06	8.093E-06
Th-230	U-238	1.000E+00	0.000E+00	5.372E-12	4.695E-11	4.710E-10	3.191E-09	1.442E-08	2.192E-08	2.171E-08
Th-230	ΣS(j):		2.060E+00	2.060E+00	2.060E+00	2.059E+00	2.058E+00	2.054E+00	2.043E+00	2.004E+00
0U-234	U-234	1.000E+00	2.000E-02	1.956E-02	1.872E-02	1.603E-02	1.030E-02	2.187E-03	2.616E-05	4.897E-12
U-234	U-238	1.000E+00	0.000E+00	1.160E-06	3.329E-06	9.504E-06	1.832E-05	1.297E-05	4.656E-07	2.908E-13
U-234	ΣS(j):		2.000E-02	1.956E-02	1.872E-02	1.604E-02	1.031E-02	2.200E-03	2.663E-05	5.188E-12
0U-235	U-235	1.000E+00	1.000E-02	9.781E-03	9.358E-03	8.015E-03	5.149E-03	1.094E-03	1.309E-05	2.455E-12
0U-238	U-238	5.450E-07	2.289E-07	2.239E-07	2.142E-07	1.835E-07	1.179E-07	2.504E-08	2.997E-10	5.621E-17
U-238	U-238	1.000E+00	4.200E-01	4.108E-01	3.930E-01	3.366E-01	2.162E-01	4.595E-02	5.499E-04	1.031E-10
U-238	ΣS(j):		4.200E-01	4.108E-01	3.930E-01	3.366E-01	2.162E-01	4.595E-02	5.499E-04	1.031E-10

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time =   3.98 seconds



Note: The data line for each radionuclide includes dose contributions from that radionuclide's decay progeny (e.g., the Th-230 data line includes the dose contribution from Ra-226 that results from the radioactive decay of Th-230; the Ra-226 data line does not include the Ra-226 resulting from Th-230 decay).

APPENDIX E

DETAILED DESCRIPTION OF REMEDIAL ACTIONS TAKEN DURING THIS REVIEW PERIOD

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DETAILED DESCRIPTION OF REMEDIAL ACTIONS TAKEN DURING THE REVIEW PERIOD

ST LOUIS DOWNTOWN SITE

City Property Vicinity Property (DT-2) East of the Levee and Kiesel Riverfront Property

The City Property VP (DT-2) is located east of the Mallinckrodt facility between the Burlington Northern Santa Fe (BNSF) Railroad (DT-12) and the Mississippi River. Remediation of the portions of DT-2 located WOL was completed prior to this five-year review period and is summarized in the Third Five Year Review Report (USACE 2015a). Results of the FSSE for the remedial action at DT-2 WOL are documented in the *Post-Remedial Action Report for the St. Louis Downtown Site City-Owned Vicinity Property* (USACE 1999a) and in the DT-2 WOL/DT-11 PRAR-FSSE (USACE 2018a).

The remaining portion of DT-2 consists of the EOL portion. Remediation of DT-2 EOL was initiated during this five-year review period. Nine radiological contamination areas (Areas 1 through 5 and Areas 7 through 10) were identified at DT-2 EOL based on the results of the PDI. The results of the DT-2 PDI are presented in the *Pre-Design Investigation Data Summary Report City Property Vicinity Property (DT-2), FUSRAP St. Louis Downtown Site, St. Louis, Missouri* (USACE 2009a).

Six areas in the EOL portion of DT-2 (Areas 3, 4, 5, 7, 8, and 9) were found to exceed the SLDS ROD RGs. Remediation and restoration activities at Areas 4, 5, and 9 were performed between January and April 2011. The excavation activities resulted in the removal of approximately 800 in situ yd^3 of contaminated soils from these three areas. Remediation and restoration activities were conducted on Area 3 of DT-2 Phase 2 EOL between February and November 2011. The remediation of this area included excavation depths extending to approximately 22 ft for the removal of approximately 7,900 in situ yd^3 of contaminated soils.

In October 2011, remediation began at the two final excavation areas, Area 7 and Area 8, of DT-2 Phase 2, EOL, along the abandoned portion of the Destrehan Street sewer. More than 200 linear feet of sheet pile shoring had been previously installed along the eastern side of the levee toe to facilitate remediation of the area. Excavation adjacent to the sheet pile wall was required to remove contaminated soil around the abandoned MSD sewers. Between October 2011 and February 2015, remediation of Area 7 resulted in the removal of 21,926 in situ yd^3 of contaminated soil. The remediation of Area 7 included excavation depths extending to 36 ft and affected an area of 47,664 ft^2. Remediation of Area 8 is ongoing. Restoration activities at DT-2 EOL included the replacement of approximately 430 ft of asphalt pavement for the St. Louis Riverfront Trail, revegetation of approximately 57,000 ft^2 of river bank area, and restoration of approximately 24,000 ft^2 of rip rap slope protection.

The remediation of DT-2 EOL included a portion of the adjacent Kiesel Riverfront Property. The Kiesel Riverfront Property is primarily comprised of the property immediately adjacent to the Mississippi River, along with portions of parcels owned by the Kiesel Company and the City of St. Louis. Between January and March, 2011, approximately 267 in situ yd^3 of contaminated soil were excavated from the Kiesel Riverfront Property. To access underlying soil, approximately 30 linear ft of the St. Louis Riverfront Trail pavement was removed. The excavation was backfilled, and the pavement was restored. The final inspection was conducted during this review period, in January 2015. Results of the FSSE are documented in the *Post-Remedial Action Report* *and Final Status Survey Evaluation for the Accessible Soils within the St. Louis Downtown Site Kiesel Riverfront Property* (USACE 2016a).

Remediation activities for portions of DT-2 EOL are ongoing. Upon completion of the remediation, a PRAR-FSSE will be developed and will be submitted to MDNR and USEPA for review and comment prior to finalization.

Plant 6 East Half Building 101 Area

Remediation of the majority of Plant 6EH was completed prior to this five-year review period. The prior excavations at Plant 6EH were conducted from December 2000 until July 2003 and from May 2007 until May 2008, and are documented in the *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 6 East Half* (USACE 2018b). The results are also summarized in the Third Five-Year Review Report (USACE 2015a).

During the period of this review, additional remediation of the Plant 6EH area was required as part of the remedial action of the adjacent Plant 6WH Building 101 Area when contamination was identified above SLDS ROD RGs at depths greater than previously excavated. As a result, the excavation along the east side of Plant 6WH Building 101 extended into previously remediated portions of Plant 6EH. Similarly, the Destrehan Street - East remedial action resulted in extension into Plant 6EH survey units (SUs) adjacent to Destrehan Street. The remedial actions associated with Building 101 on Plant 6WH and with Destrehan Street-East were conducted from November 2012 through September 2017. In total, 20,632 in-situ yd^3 of radiologically contaminated soil were removed from Plant 6EH during the 2000 to 2003 remedial action, the 2007 to 2008 remedial action, and the additional excavation required during the remediation of the adjacent Plant 6WH Building 101 and Destrehan Street - East areas. Final inspections will be performed after the Destrehan Street pavement is replaced. The remedial actions associated with Building 101 on Plant 6WH and with Destrehan Street-East will be documented in future PRAR-FSSE documents.

Plant 6 West Half Building 101 Area

The remediation at Plant 6WH is being conducted in phases. Phase 1 and Phase 2 were completed prior to the period of this review. The demolition of Building 101, Mallinckrodt's former Bulk Shipping Center, located in Plant 6WH, was also conducted prior to this review, from May to October 2012. These activities are summarized in the Third Five-Year Review Report (USACE 2015a).

Excavation activities within the footprint of the former Building 101 were completed in January 2017. A small area associated with Building 101 located along the western edge of Plant 6EH was remediated concurrently with the area at Plant 6WH. USACE has removed 61,616 yd^3 of contaminated soils and has backfilled much of the eastern and northern portions of the Building 101 area. Backfill activities in the remaining excavation areas at Plant 6WH are ongoing. Final restoration and grading of the remediated area has not yet been conducted, in order to accommodate the remediation of the adjacent portions of Destrehan Street and Plant 7W. Upon completion of the remediation, a PRAR-FSSE for the accessible soil at Plant 6WH will be developed and will be submitted as part of the PRAR-FSSE for Plant 6WH to MDNR and USEPA for review and comment prior to finalization.

Kiesel Hall Street Properties

The Kiesel Hall Street Properties consist of four contiguous parcels located between Dock Street to the north, Branch Street to the south, BNSF Railroad lines to the east, and TRRA property and Hall Street to the west. The four parcels include the Kiesel Property located at 3130 Hall Street; the Kiesel Property located at 13 Branch Street; and the Gunther Salt Properties located at 44 Dock Street and 5 Branch Street.

A PDI for the Kiesel Hall Street Properties was conducted in September and October 2012 (USACE 2013a). The remediation of the Kiesel Hall Street Properties was conducted from May 27, 2013, to October 27, 2014. Approximately 79,780 ft^2 of ground surface area were affected, to a maximum depth of 15 ft, by the remediation activities. Approximately 10,500 in situ yd^3 of radiologically contaminated soil was excavated from the Kiesel Hall Street Properties. The majority of the excavations were located on the south side of the rail spur on the Kiesel Properties, between the Gunther Salt building and Kiesel concrete pad, areas adjacent to the salt dome, and a large area in the southeast corner of the Kiesel Hall Street Properties. Other small, localized excavations were located on the Kiesel Properties and St. Louis City Property.

Upon completion of excavation activities, an FSS was performed. Results of the FSSE are documented in the *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soils within the Kiesel Hall Street Properties* (USACE 2015c). The FSS results demonstrate that the accessible soils on the Kiesel Hall Street Properties meet the criteria for unrestricted use in accordance with the SLDS ROD.

Destrehan Street – East and Plant 7W-North Area

The Destrehan Street – East area encompasses the section of Destrehan Street between the eastern property line of Hall Street and the western property line of the BNSF Railroad VP (DT-12). Remedial activities were conducted for approximately 450 ft of the 24-ft wide roadway area, and for additional areas adjacent to Destrehan Street at Plant 7W (the Plant 7W-North Area). Soil beneath Destrehan Street had been identified as inaccessible soil and so had been excluded from the scope of the SLDS ROD. Remediation of this area was initiated under the SLDS ROD when the area was made accessible.

A PDI of Destrehan Street – East was completed in May 2011 (USACE 2014b). Remediation of this area began in June 2016 and is ongoing. Remediation progressed in four linear segments from east to west. In addition to the excavation activities, required relocations/modifications of existing utilities, street restoration activities, and the removal of the Destrehan Street Security Guard Station and the abandoned Electric Substation Building were conducted.

By the end of 2018, excavation of the first three linear sections was complete. Excavation of the last remaining linear section included demolition and removal of portions of the inactive concrete sedimentation structures. In addition, guided excavation within Plant 7W resulted in the removal of a portion of the 27-inch diameter underground sewer. Pavement and drainage structures will be installed when all four areas are completed. Final restoration of the Destrehan Street-East/Plant 7W-North area will include the replacement of active underground utilities as well as replacement of the paved street and adjacent street lights to pre-construction conditions. By the end of this review period (December 2018), approximately 25,600 yd^3 of contaminated material had been removed. Upon completion of the remediation, a PRAR-FSSE will be developed and will be submitted to MDNR and USEPA for review and comment prior to finalization.

Destrehan Street – West

The Destrehan Street – West area coincides with the 100 block of Destrehan Street (vacated), and is bounded by the western boundary of North Second Street and the eastern boundary of the TRRA rail line. Remediation of Destrehan Street – West included the contaminated soil underlying the paved street, as well as an alley in Plant 2 located adjacent to Destrehan Street. Remediation of this area was conducted as part of utility work in an area previously considered inaccessible.

In 2015, at Mallinckrodt's request, USACE provided utility support for water-line repair and street pavement replacement work on Destrehan Street – West. To access the subsurface utility, Mallinckrodt was responsible for pavement removal and soil excavation. The USACE agreed to dispose of MED/AEC contaminated material, specifically, the top 2 ft of material and any deeper material that was determined to have MED/AEC contamination. None of the removed concrete slabs were found to have MED/AEC contamination. Excavation through restoration of Destrehan Street – West occurred from August 2016 to June 2017. The utility support activity resulted in one SU with a ground surface area of 13,702 ft^2, an excavated soil volume of 814.5 in situ yd^3, and a maximum excavation depth of approximately 2 ft. The excavation encompassed nearly all of Destrehan Street – West. Upon completion of excavation activities, an FSS was performed. The results of the FSS confirm that the RGs were met. Additional details regarding the excavation and results of the FSSE are discussed in the *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Destrehan Street (West) Property* (USACE 2018c).

Mallinckrodt Plant 1 Former Building 17 Area

The Plant 1 Former Building 17 Area is a formerly inaccessible area of approximately 783 m^2 (0.2 acres) located near the center of Plant 1. It includes the footprint of former Building 17 as well as the footprints of former Buildings 16 and 16A, which were attached to former Building 17. The remedial action addressing accessible soil at Plant 1 was completed in 2003 (USACE 2004b). The Former Building 17 Area was not included in this remedial action, because inaccessible soil that contains MED/AEC contamination and associated buildings and structures were excluded from the scope of the SLDS ROD.

In June 2016, the Former Building 17 Area became accessible when Mallinckrodt demolished Building 17 to make room for the expansion of an adjacent building. A PDI of the newly accessible soil within the Plant 1 Former Building 17 Area was completed in December 2016. The PDI data resulted in identification of radiological contamination on the north and west sides of the Plant 1 Former Building 17 Area, and on an adjacent area to the west, where a sewer line is located. Of the 25 PDI soil sample locations, 10 had analytical results that did not meet the SLDS ROD RGs. The PDI data are contained in Appendix A of the *Remedial Design/Remedial Action Work Description Mallinckrodt Plant 1 Former Building 17 Area, Supplement No. 1 to the Remedial Action Work Plan for Selective Remediation at the St. Louis Downtown Site, FUSRAP St. Louis Downtown Site, St. Louis, Missouri* (USACE 2017a).

Remediation activities for the Former Building 17 Area were conducted between April 24, 2017, and August 6, 2018. The remedial action approach for the Plant 1 Former Building 17 Area was divided into two stages in order to minimize disruption of Mallinckrodt's daily activities. Stage 1 addressed a portion of the Plant 1 Former Building 17 Area located east of the Plant 1 sewer bypass system, and covered a surface area of 672 m^2 (0.17 acres). The Stage 1 remediation activities included excavation of soil to a maximum excavation depth of approximately 12 ft and the removal of approximately 100 linear feet of a previously collapsed portion of the Plant 1 sewer. The Stage 1 remedial action resulted in the removal of approximately 2,300 in situ yd^3 of soil and sewer lines. The

FSS analytical data confirm that no accessible soil that exceeds the RGs has been left in place on the Plant 1 Former Building 17 Area. Additional details regarding the excavation and results of the FSSE are discussed in the *Post-Remedial Action Report and Final Status Survey Evaluation Addendum for the Accessible Soil Within the St. Louis Downtown Site Plant 1 Former Building 17 Area* (USACE 2019a).

The Stage 2 remedial action has not yet been initiated. Remediation of the Stage 2 area will be addressed during future remediation activities at adjacent Plant 1 areas, as Mallinckrodt makes the areas accessible for remediation.

Heintz Steel and Manufacturing VP (DT-6) Storage Building

The Heintz Steel and Manufacturing VP (DT-6) is located south and east of the main Mallinckrodt property and is bordered on the north by Angelrodt Street, on the south by Buchanan Street, on the east by DT-7 and on the west by Hall Street. Remediation of portions of DT-6 was completed prior to this five-year review period. The remedial action for accessible soil at DT-6 was conducted between April 21, 2003 and March 1, 2004 (USACE 2005c). Additional remediation was conducted during 2009, when USACE removed 155 in-situ yd^3 of radiologically contaminated soil during utility support work at the Heintz Steel and Manufacturing VP Storage Building, a 5,530-ft^2, single story, masonry-block building located in the northwest corner of the DT-6 property.

The remediation activities conducted at the DT-6 Storage Building during this five-year review period began on August 21, 2018, and were completed on September 27, 2018. The area remediated was previously considered inaccessible as defined by the SLDS ROD (USACE 1998a) but was later deemed accessible per discussions between the property owner and USACE. The 2018 remedial action included the removal of the concrete floor and excavation of radiologically contaminated soil beneath the concrete floor slab within the building's central drive area, and adjacent to the building's interior columns. During the 2018 remedial action, 344 ft^2 of surface area were affected and approximately 40 in situ yd^3 of radiologically contaminated soil were removed from the DT-6 Storage Building. A PRAR-FSSE is currently being developed for the DT-6 Storage Building remedial action and will be submitted to MDNR and USEPA for review and comment prior to finalization.

Gunther Salt North (DT-4)

GSN (DT-4) includes approximately 3.5 acres and is bordered to the north by Angelrodt Street, to the east by Hall Street, to the south by Buchanan Street, and to the west by the Norfolk Southern Railroad. Remediation of a portion of the GSN Property (DT-4) was initiated on November 28, 2018, to address contamination in and around the previously inaccessible salt-storage domes. Excavation activities at Dome 2 and Dome 3 are ongoing.

ST. LOUIS NORTH COUNTY SITES

Latty Avenue Properties

Remedial actions were performed at the following Latty Avenue Properties during the period of this review: VP-04(L) and Futura (Ameren Poles Area).

VP-04(L)

VP-04(L) is located on the south side of Latty Avenue. A remedial action was conducted on VP-04(L) prior to the period of this five-year review (in CY 2008), resulting in the removal of three (3) in situ yd^3 of contaminated materials from VP-04(L) (USACE 2012f).

In March 2014, during utility support activities conducted along Latty Avenue, a small area of radiological contamination was identified in the ROW along VP-04(L). Soil sampling data collected in March 2014 for the utility support activities and in CY 2015 to support the Latty Avenue PDI were used to define the boundaries of the contamination. In April 2015, hand excavation was conducted at VP-04(L), resulting in the removal of 3 in situ yd^3 from VP-04(L).

Futura (Ameren Poles Area)

Futura occupies approximately 22,700 m^2 (5.6 acres) and is located at 9200 Latty Avenue in Hazelwood, Missouri. Prior to the period of this review, a remedial action to address accessible soil at Futura was conducted between January 2008 and March 2011, resulting in the removal of approximately 20,950 in situ yd^3 of contaminated soil. Decontamination of select portions of the Futura Buildings 2/3 and 4 was performed between April 2012 and January 2013. These activities are documented in the *Post-Remedial Action Report and Final Status Survey Evaluation for the Latty Avenue Property Futura* (USACE 2014e). Upon completion of this remedial action, several inaccessible areas with residual contamination in excess of the NC ROD RGs remained, including the inaccessible soil around and beneath three buildings, the transportation corridor of the Norfolk Southern Railroad rail lines (mostly located on the adjacent property west of Building 2/3), and inaccessible soil surrounding two Ameren UE utility poles on the northeast end of the site.

In December 2018, remediation was initiated to remove contaminated materials under the two Ameren UE utility poles on Futura. Approximately 530 ft^2 of ground surface area were affected, to a maximum depth of approximately 7 ft, by the remediation activities. The remedial action was completed in December 2018 and resulted in the removal of 88 in situ yd^3 from the Ameren Poles Area. The remaining inaccessible areas at Futura will require further removals or LUCs to achieve the objectives of the NC ROD.

SLAPS and SLAPS VPs

Remedial actions were performed at the following areas at SLAPS and SLAPS VPs during the period of this five-year review: VP-57 and VP-58, and Pershall Road (South Ditch); St. Cin Park; Duchesne Park; the Palm Drive and Chez Paree Properties; IA-09 (Ballfields); and Eva Avenue-North.

VP-57 and VP-58, and Pershall Road (South Ditch)

VP-57 and VP-58, and Pershall Road (South Ditch) are located directly south of Pershall Road and west of CWC, in the City of Hazelwood, Missouri. To provide MSD with the necessary utility support for the construction of a wet-weather storage tank facility on the eastern portion of VPs 57 and 58, and Pershall Road (South Ditch), USACE sampled and remediated approximately 28,330 m^2 (7 acres) along the Pershall Road South Ditch, and eastern portions of VPs 57 and 58. Remediation was conducted between June 2014 and July 2015, resulting in the removal of approximately 10,270 in situ yd^3 of contaminated soil. Additional remedial activities will be required to support the MSD construction along the west bank of CWC adjacent to VPs 57 and 58.

St. Cin Park (CWC-56)

St. Cin Park (CWC-56) is owned by the City of Hazelwood, Missouri, and is operated as a municipal public park. It is approximately 52,609 m^2 (13 acres) in size and is located at 135 St. Cin Lane. The portion of St. Cin Park addressed by the remedial action conducted during this review period encompasses approximately 25,461 m^2 (6.3 acres) and is limited to only the 10-year floodplain area of CWC within St. Cin Park. The 10-year floodplain area of CWC within St. Cin Park consists mainly of grass-covered areas and trees, but also includes a basketball court and walkway areas. The remaining portions of the park are excluded.

A PDI for St. Cin Park was conducted in 2014 and is documented in the *Pre-Design Investigation Report for St. Cin Park, the Archdiocese of St. Louis Property, and Duchesne Park* (USACE 2015g). The analytical results of the PDI sampling indicated 12 soil sample locations in the central portion of St. Cin Park with net sum of ratios (SOR_N) values greater than 1.0.

The remediation of St. Cin Park was conducted from July 1, 2015, to July 13, 2016. The remedial action for St. Cin Park is documented in the *Post-Remedial Action Report and Final Status Survey Evaluation for the Coldwater Creek (CWC)-Floodplain Property CWC-56 (Partial)* (USACE 2018e). During the removal and restoration activities, portions of the park were closed to the public to minimize the risks associated with heavy equipment at a construction site. During the early period of remedial action, only the northern portion of St. Cin Park in the vicinity of the excavations and haul road were isolated and closed to the public. After members of the public expressed concern to the City of Hazelwood during public meetings, the City of Hazelwood subsequently decided to close the entire park to public access for the duration of the remedial action up to the beginning of restoration activities.

Asphalt pavement was encountered during the remedial action, resulting in the removal of a basketball court and portions of a paved walkway. This pavement was restored upon completion of the remedial action. In addition, the remediation required the removal of 13 large trees (excluding stumps). Trees were not replaced per agreement between USACE and the City of Hazelwood. Previously vegetated areas affected by the remedial action were restored with grass vegetative cover.

Approximately 24,918 ft^2 of ground surface area were affected, to a maximum depth of approximately 7 ft, by the remediation activities. Approximately 3,088 yd^3 of radiologically contaminated soil was excavated from St. Cin Park. Upon completion of excavation activities, an FSS was performed. The FSS results demonstrate that the accessible soils at St. Cin Park meet the criteria for unrestricted use in accordance with the NC ROD (USACE 2018e).

Duchesne Park [CWC-93 (Partial), CWC-95 (Partial) and CWC-97 (Partial)]

Duchesne Park is a lightly used public recreational park located approximately 1 mile north of Interstate (I)-270 between CWC and Graham Road, in Florissant, Missouri. Duchesne Park encompasses approximately 15,783 m^2 (3.9 acres) and consists of the CWC-floodplain properties designated as CWC-93 (partial), CWC-95 (partial), and CWC-97 (partial). CWC-93 and CWC-95 are owned by Catholic Cemeteries of the Archdiocese of St. Louis, and CWC-97 is owned by the City of Florissant. The park primarily consists of grass-covered areas and a few trees. A portion of Duchesne Park is located in the CWC 10-year floodplain.

A PDI for these properties was initiated in 2014. Results indicated that four soil sample locations on the northwest corner of Duchesne Park, and one sample location on the southwest corner of Duchesne Park exceeded NC ROD RGs. The delineation of these areas are described in the *Pre-Design Investigation Summary Report for St. Cin Park, the Archdiocese of St. Louis Property, and Duchesne Park* (USACE 2015g).

The remediation activities at Duchesne Park were conducted from February 17, 2016, through May 24, 2017. The remedial action conducted on Duchesne Park resulted in the removal of 6,371 yd^3 of soil. The remedial action conducted on Duchesne Park is documented in the *Remedial Action Summary for the St. Louis Airport Site Vicinity Property Duchesne Park* (USACE 2018f).

Palm Drive and Chez Paree Properties (CWC-83 through CWC-92 and Chez Vant Court)

The CWC-floodplain properties CWC-83 though CWC-92 and Chez Vant Court are located approximately 0.5 mile north of I-270, between Lindbergh Boulevard and CWC in Hazelwood, Missouri. CWC-85 through CWC-90 are single-family residential properties along Palm Drive. CWC-91, CWC-92, and Chez Vant Court comprise an apartment complex located on Avant Drive and Chez Vant Court. The area consists of residential properties with landscaped yards (i.e., vegetation, trees, and grass). Structures within the 10-year floodplain include private residences, outbuildings, driveways, walkways, recreational facilities (i.e., clubhouse, pool, patio, courts), and the street named Chez Vant Court. The remedial action conducted during this five-year review period was conducted at the Palm Drive Properties (CWC-85 through CWC-88) and the Chez Paree Properties (CWC-91 and CWC-92). No remedial action was required at CWC-83, CWC-84, CWC-89, CWC-90, or the street (i.e., Palm Drive) (USACE 2018g).

A PDI for these properties, conducted between July 2015 and September 2017, identified areas where soil sample results exceeded NC ROD RGs. Based upon the PDI results, the areas of contamination appeared to be approximately 4,815 m^2 in size and to extend from 1 to 6 ft bgs. The PDI results are reported in the *Pre-Design Investigation Summary Report, Palm Drive Properties, FUSRAP North St. Louis County Sites, St. Louis, Missouri* (USACE 2016e).

The remediation activities at CWC-85 through CWC-88, CWC-91, and CWC-92 were conducted from February 17, 2017, through February 5, 2019. Approximately 6,157 in situ yd^3 of contaminated soil were removed. Remediation activities involved a combined ground surface area of approximately 5,375 m^2 and a maximum excavation depth of approximately 6 ft. The area of contaminated soil was primarily associated with a ditch that had existed prior to development of the land for residential use. Buried debris, including apparent remnants of former manhole structures and playground equipment, was encountered and was included with project waste. Upon completion of excavation activities, an FSS was performed. The FSS results demonstrate that the accessible soils on these properties meet the criteria for unrestricted use in accordance with the NC ROD. The remedial action for these properties is documented in the *Post-Remedial Action Report and Final Status Survey Evaluation for the Coldwater Creek (CWC)-Floodplain Properties CWC-83 Through CWC-92 and Chez Vant Court* (USACE 2019c).

IA-09 (Ballfields)

The IA-09 Ballfields area consists of approximately 242,811 m^2 (60 acres) of land located north of St. Louis Lambert International Airport and adjacent to SLAPS. The area is bordered to the south by McDonnell Boulevard, to the north by CWC and Frost Avenue, and to the east by Eva Avenue. The property is currently unused. No traces of the former baseball fields remain, with the exception of a small building and pad located in the former center of the four fields on the eastern half of the property.

Remediation of the Ballfields area is being completed in three phases, moving from east (upgradient) to west (downgradient). The Phase 1 area, located at the eastern end of the Ballfields area, was remediated between November 2011 and July 2012, prior to the period of this five-year review. The Phase 2 area is situated on the central drainage area of the IA-09 Ballfields, IA-08 North Ditch, and IA-09 North Ditch Properties, and the Phase 2B area is located adjacent to the west side of the initial Phase 2 area and comprised of the IA-09 Ballfields (western portion), IA-08 North Ditch (western portion), and IA-09 North Ditch (western portion). Remediation of the Phase 2 and Phase 2B areas was also completed prior to the period of this five-year review (i.e., prior to January 2014). Remediation of Phase 2 and Phase 2B (partial) was initiated in June 2012 and was completed in November 2013.

A PDI soil boring and sampling program was performed periodically between 2005 and 2008 over the Ballfields area and adjoining properties (USACE 2008a). An additional PDI that focused on the Ballfields Phase 2 area was conducted in CY 2011 and CY 2012. Evaluation of the PDI data indicated the presence of three discrete areas within the Ballfields Phase 2B area that contained concentrations of radiological COCs exceeding the NC ROD RGs.

During the period of this fourth five-year review, remediation was conducted for the remaining portions of the Phase 2B area. Remediation was initiated in April 2018 and is ongoing. To date, 16,012 in situ yd^3 of contaminated material have been removed. Phase 3 was not initiated until CY 2019; therefore, Phase 3 will be addressed in the next five-year review.

Eva Avenue (North)

Eva Avenue is an active roadway located along the eastern boundary of the Ballfields (IA-09), between McDonnell Boulevard and Frost Avenue. A PDI for Eva Avenue was conducted in March 2011. Five areas requiring remediation were identified, including one area at the northern end of Eva Avenue, southwest of its intersection with Frost Avenue (USACE 2011a). Previous remedial activities along Eva Avenue include the remedial action conducted in 2013 to address contamination at the Norfolk Southern Railroad/Eva Loadout Facility, located in the northwest corner of the intersection of Eva Avenue and McDonnell Boulevard.

In October 2018, Phase 1 of a remedial action was initiated along Eva Avenue (North) to support road improvements. Remediation activities involved a combined ground surface area of approximately 784 m^2 and a maximum excavation depth of approximately 5 ft. Approximately 730 in situ yd^3 of contaminated material were removed. Remediation activities are ongoing to address additional areas along Eva Avenue where road improvements are required.

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